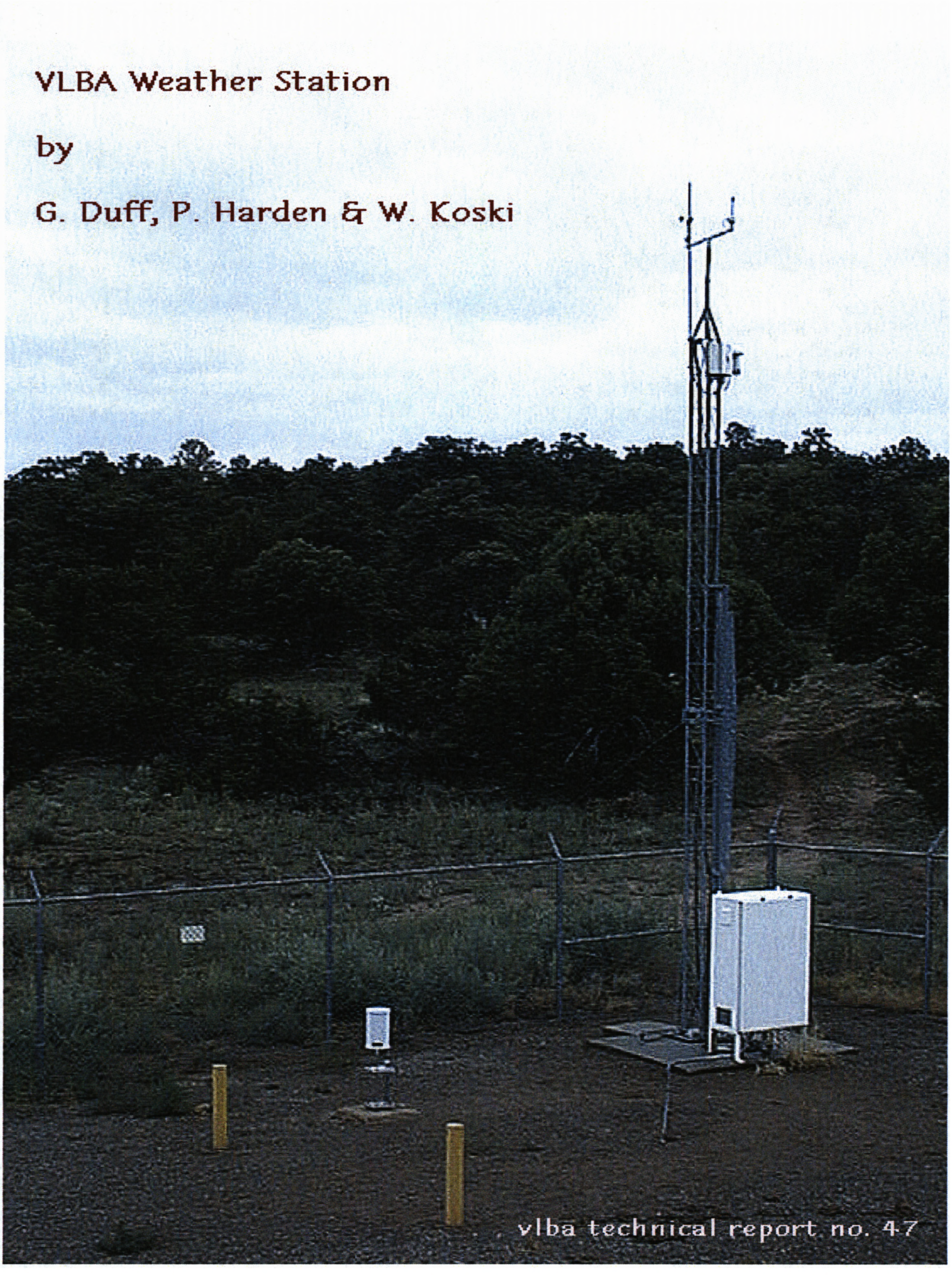
VLBA Weather Station

by

G. Duff, P. Harden & W. Koski



vlba technical report no. 47

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Introduction

This manual describes the VLBA Weather Station, an instrument to measure and record atmospheric conditions at each VLBA antenna site. The weather station is multi-component, and includes devices for measuring the ambient temperature, dew point, wind speed, wind direction, atmospheric pressure, and rainfall. The sensors are electrical devices that respond to atmospheric changes, thus generating scaled analog signals that are converted into digital form for ease of data communication and event recording via a time serial Monitor and Control Bus.

Manual Overview

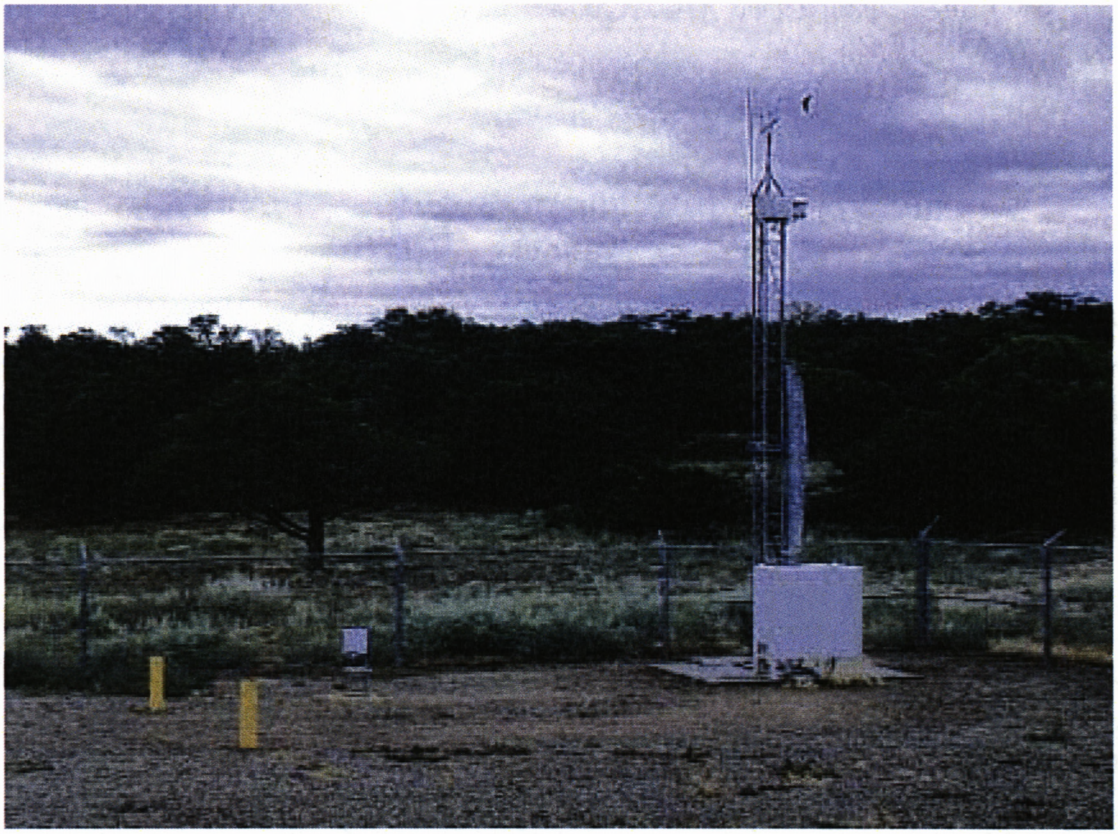
This manual provides functional descriptions of the weather station, each sensor, and panel mount assemblies inside the electronics enclosure. Descriptions of any additional hardware assemblies are included. The sensors and the panel mount assemblies are explained in detail in each sub-section in the theory of operation. Schematics, wiring diagrams, cable interconnections, enclosures, tower, and panel mounting information for the weather station are also in this manual. The appendices are the product manuals for the TSL Model 1063 Hygrothermometer, the Qualimetrics sensors and instrumentation, the A.I.R. barometer, the power supply, and the box heater. Also included is an appendix for the schematics and drawings referred to in the text portion of this manual.

VLBA Weather Station Overview

Each weather station has a 10m tower for mounting the TSL Hygrothermometer, wind speed and wind direction sensors. A hank-crank winch allows for lowering and raising the tower when sensor replacement or maintenance is necessary. A lightning rod, ground strap and copper rod are used in concert for a low resistance path to ground in the event of lightning strikes.

The bulk of the electronics are housed in a NEMA 4 standard type enclosure placed next to the tower for convenient cable interconnection. The various signal processing and conditioning circuit boards, terminal strips, power distribution, surge protection, heater, and barometer are panel mounted within the enclosure. Situated near the enclosure is the rain gauge. The tower, electronics enclosure, and rain gauge are mounted on a level concrete slab adjacent to each antenna.

Plate 1 illustrates the VLBA Weather Station tower & sensors, electronics enclosure and rain gauge.



Monitor and Control functions are routed through a VLBA Standard Interface Board and interfaces to the VLBA Telescope Monitor and Control System. It is panel mounted inside the enclosure. The Standard Interface Board functions as a serial-parallel converter to interface the Monitor and Control Bus to the devices that are to be controlled or monitored. Through this system weather conditions can be monitored remotely in real-time as long as there is power at the VLBA antenna site and the main commercial communication link is operative.

Fiber optic cable is used for the communication link from the electronics enclosure to the station control building. This was the preferred method chosen to isolate the weather station from the control building in case of lightning strikes to the 10m tower.

Figure 1 is the VLBA Weather Station Control Drawing, C55006Y001. It is a generalized drawing that exemplifies the general layout, construction, and components of the weather station at a VLBA antenna site.

VLBA Weather Station Functional Description

The purpose of the VLBA Weather Station is to measure atmospheric conditions at each VLBA antenna site, and is a system level component of the VLBA Telescope Monitor and Control System. The weather station does several important tasks necessary for observational data, operational status and safety at each antenna.

Measurements of the ambient temperature, dew point, and barometric pressure are used to calculate the amount of water vapor in the lower atmosphere. Corrections can then be made for pointing the antenna with respect to the position of the observed radio source. Additionally, any rapid changes, for example a large drop in the barometric pressure can indicate an approaching storm condition. The barometer can also be used as an indicator for any variance in altitude at site locations.

For safety there are three wind speed sensors at each VLBA antenna site. One is on the 10m tower and is the weather-recording instrument. Although not part of the weather station, the other two are mounted on opposite sides of the antenna dish. This redundancy is in case the position of the antenna blocks the weather tower from the wind, and provides a reliable method for determining when to stow and avoid climbing the antenna. The M106 Wind Speed Interface Module combines the wind status from all three sensors into a single condition for stowing the antenna. Harm to an antenna or personnel can occur in high wind conditions, and it is important to stay clear and stow the antenna before winds exceed the boundaries of safety.

Knowing the direction of the prevailing wind is important, especially during hurricane season in the Caribbean. By anticipating the direction a weather phenomenon or a fire is headed, preventive steps can be taken to protect equipment and personnel. Furthermore, wind loads are capable of increasing motor currents, and changing the position of the antenna in accordance to wind direction can prevent excessive current flow in the drive motors.

Measuring the amount of rainfall or snow accumulated at an antenna is useful to the observational log entry for interpreting data, and to indicate to VLBA Operations if there are conditions preventing site accessibility. In addition, snow loading can produce undue stress on the mechanical structures in the antenna dish, but the antenna dish may be pointed toward the sun to hasten the melting process of snow or ice. Also, prolonged

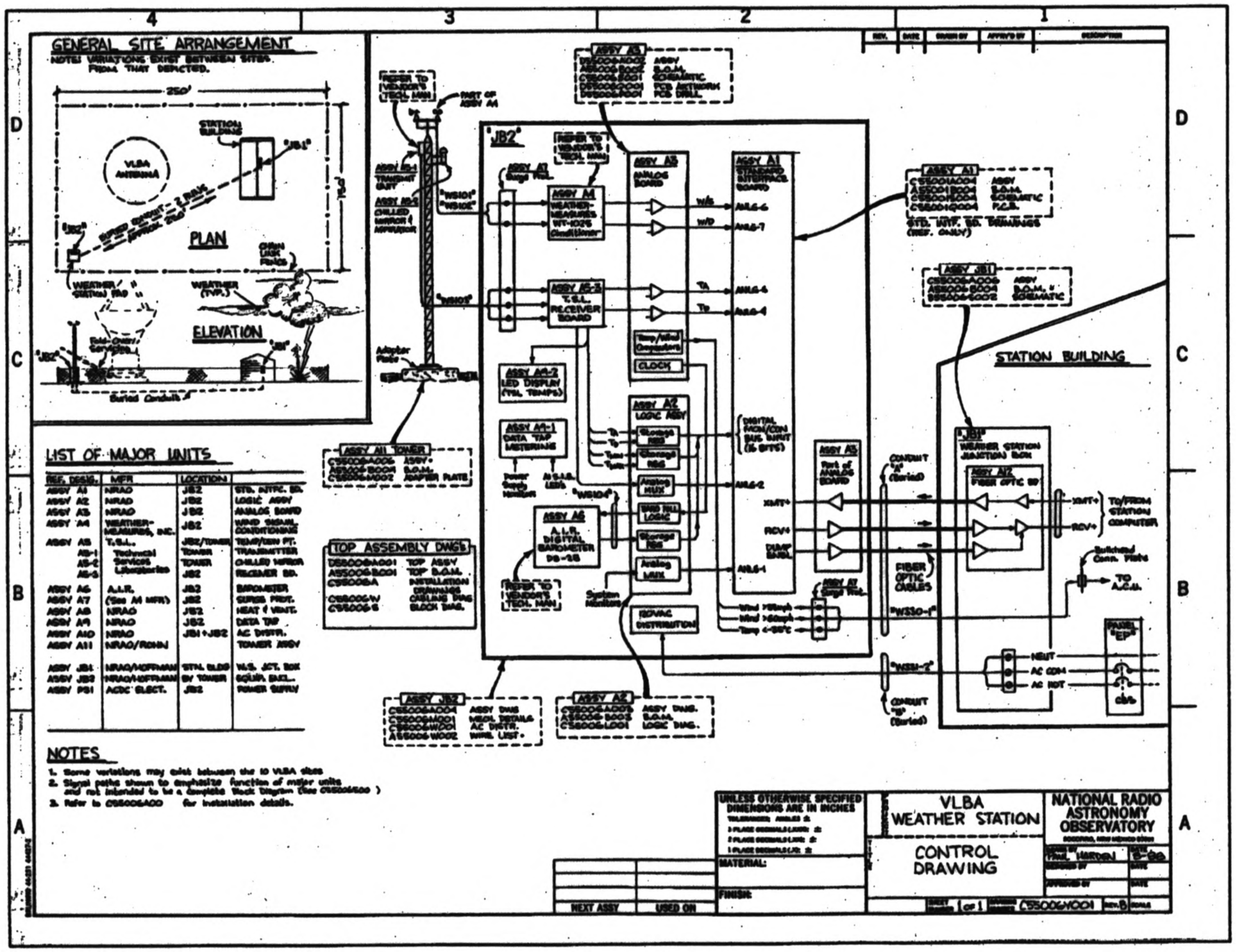


Figure 1 VLBA Weather Station Control Drawing, C55006Y001

periods of heavy rain or snow usually makes apparent any leaks, and moisture can find its way into almost anything dubbed critical to antenna operation.

Sensor Descriptions

TSL Model 1063 Hygrothermometer and Aspirator Assemblies

The TSL Model 1063 Hygrothermometer and Aspirator assemblies are the components used to measure the ambient and dew point temperatures, and shall be affectionately referred to as the TSL for convenience from this point forthwith.

In reality, the TSL is comprised of transducers, monitor and control circuitry, and power supply electronics. The ambient temperature is measured directly. The dew point temperature sensor utilizes a closed-loop servo-system that controls a chilled mirror to obtain the dew point measurement. Data is exchanged via the TSL transmit and receive boards through a serial communication cable running from the enclosure mounted on the tower to the electronics enclosure.

The ambient temperature and dew point sensors are located in the aspirator assembly. The aspirator assembly forces a uniform flow of air past the sensors and protects the dew point sensor assembly from the elements. It helps to eliminate any pressure gradients, moisture and contaminates from accumulating inside of the aspirator housing. Those conditions would interfere with dew point sensor accuracy.

A cable interconnection between the aspirator assembly and the TSL enclosure is the link between the sensors, the monitor and control circuitry, and the power supply.

Figure 2 is the VLBA Weather Station Temp/Dew Point Functional Loop Diagram, A55006W008. It is a generalized drawing that shows the various interconnections of the TSL, and Figure 3 is the Dew Point and Ambient Temperature Block Diagram.

Barometer

The barometer for the weather station is the Atmospheric Instrumentation Research (A.I.R.) Model AIR-DB-2AX. This instrument is a microprocessor controlled digital pressure transducer, and measures the atmospheric pressure in millibars.

The barometer is inside the electronics enclosure, and is connected to the digital electronics via a serial communication cable. The electronics inside the barometer are in a sealed weather resistant black anodized aluminum cover. Outside air is filtered to the barometer via a tube.

Figure 4 is the VLBA Weather Station Barometer Functional Loop Diagram, A55006W007. It is a generalized drawing that shows the various interconnections of the barometer, and Figure 5 is the Barometer Block Diagram.

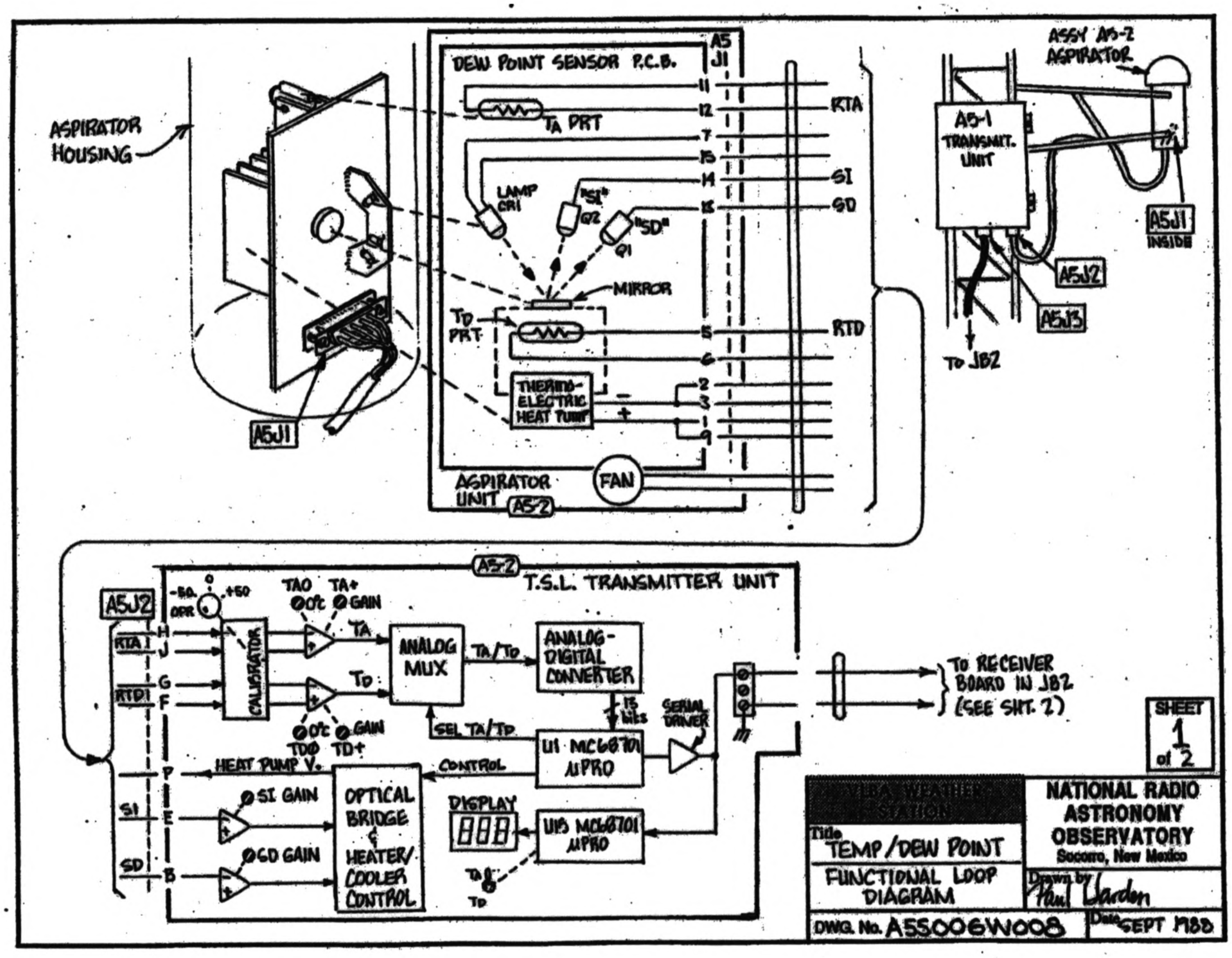


Figure 2 VLBA Weather Station Temp/Dew Point Functional Loop, A5506W008

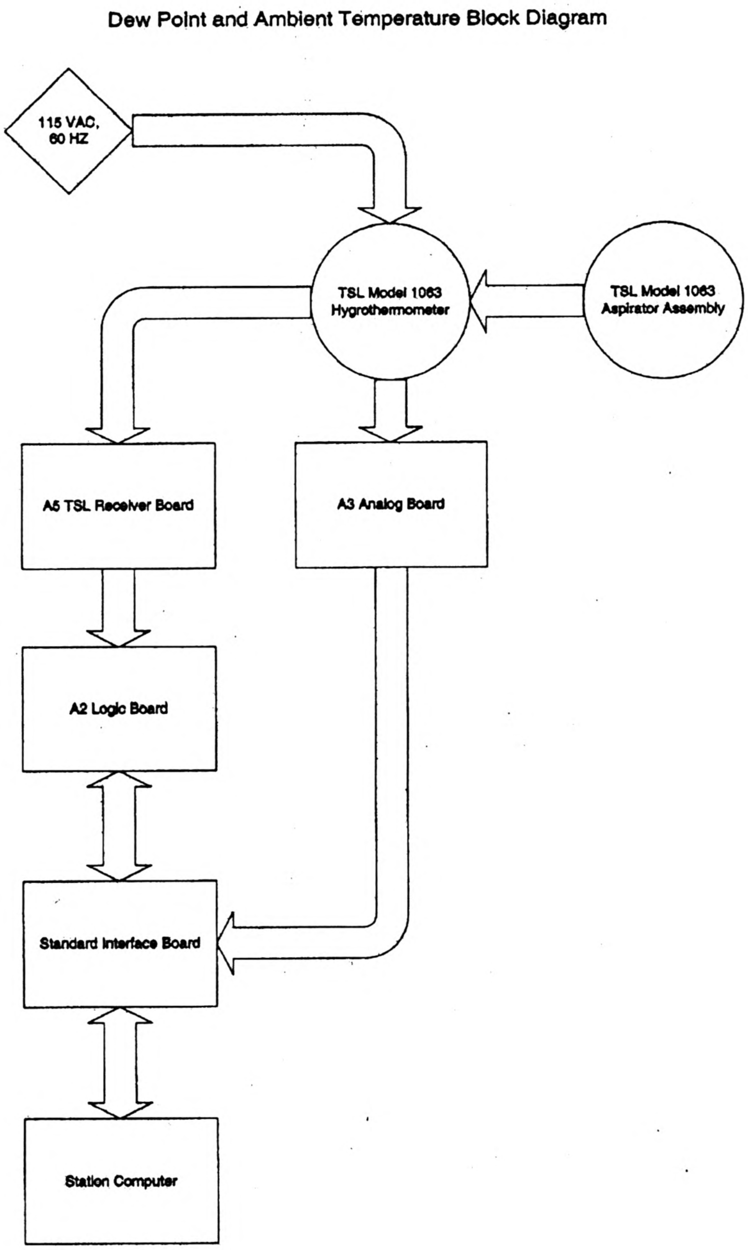


Figure 3 Dew Point and Ambient Temperature Block Diagram

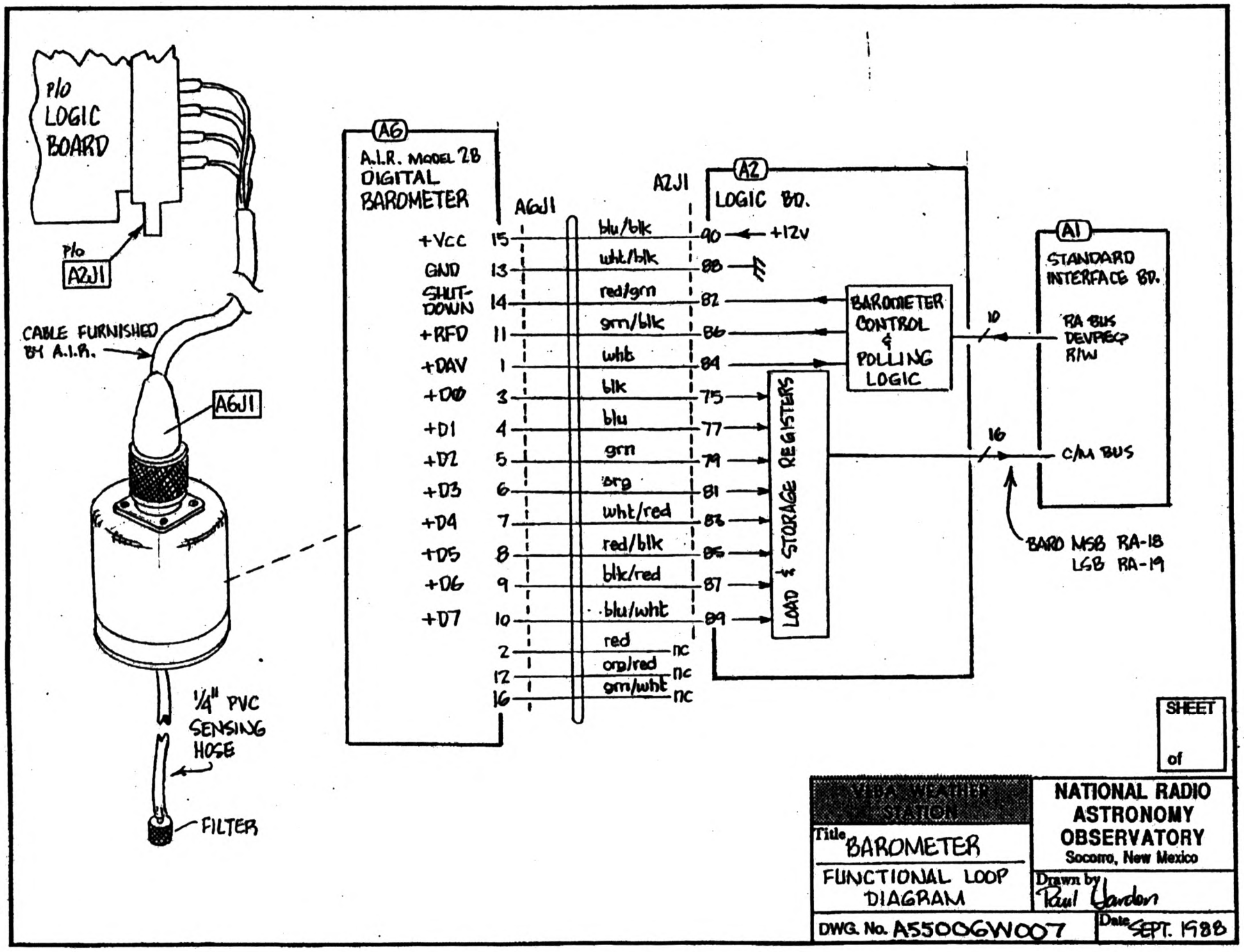
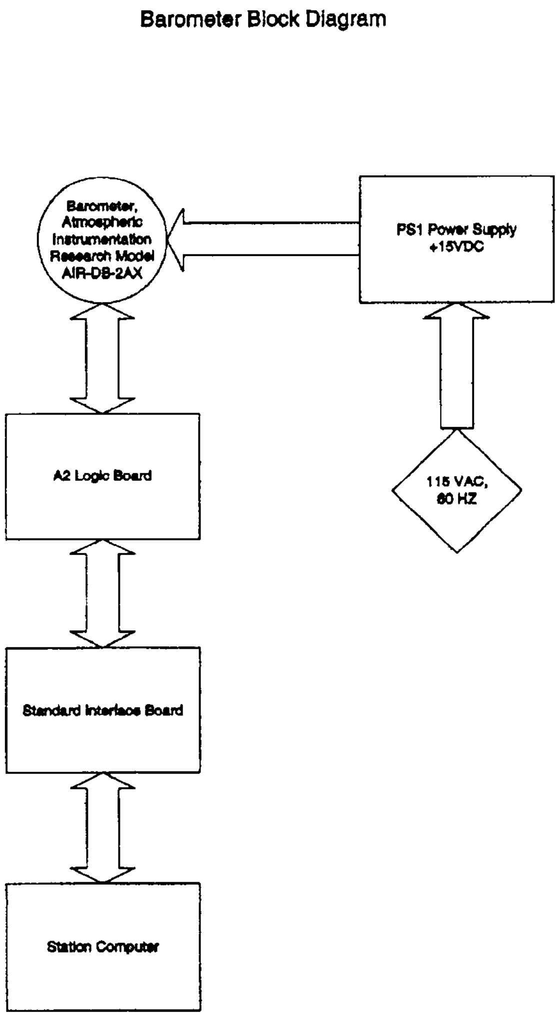


Figure 4 VLBA Weather Station Barometer Functional Loop Diagram, A55006W007



Barometer Block Diagram

Figure 5 Barometer Block Diagram

Plate 2 illustrates the barometer.

Wind Speed Sensor

Each wind speed sensor is a Qualimetrics Model 2030. The sensor is a 3-cup anemometer, and is designed to measure low wind speeds.

The construction of the unit is stainless steel and anodized aluminum to resist corrosive environmental conditions. The interconnection is made with a quick release waterproof connector and a two twisted-pair shielded cable from the sensor to the electronics enclosure.

Wind Direction Sensor

The wind direction sensor is a Qualimetrics Model 2020. This is designed for high reliability and a low threshold wind direction response.

Construction is similar to the wind speed sensor, with the exception of the vane itself. It has a reinforced, lightweight foam tail with a butyrate skin and a stainless steel counterweight. Interconnection is through a quick release waterproof connector and a three-wire shielded cable from the sensor to the electronics enclosure.

Figure 6 & 7 are the VLBA Weather Station Wind Speed & Wind Direction Functional Loop Diagrams, A55006W005 & A55006W006 respectively. They are generalized drawings that show the various interconnections to both the sensors, and Figure 8 is the Wind Speed and Wind Direction Block Diagram.

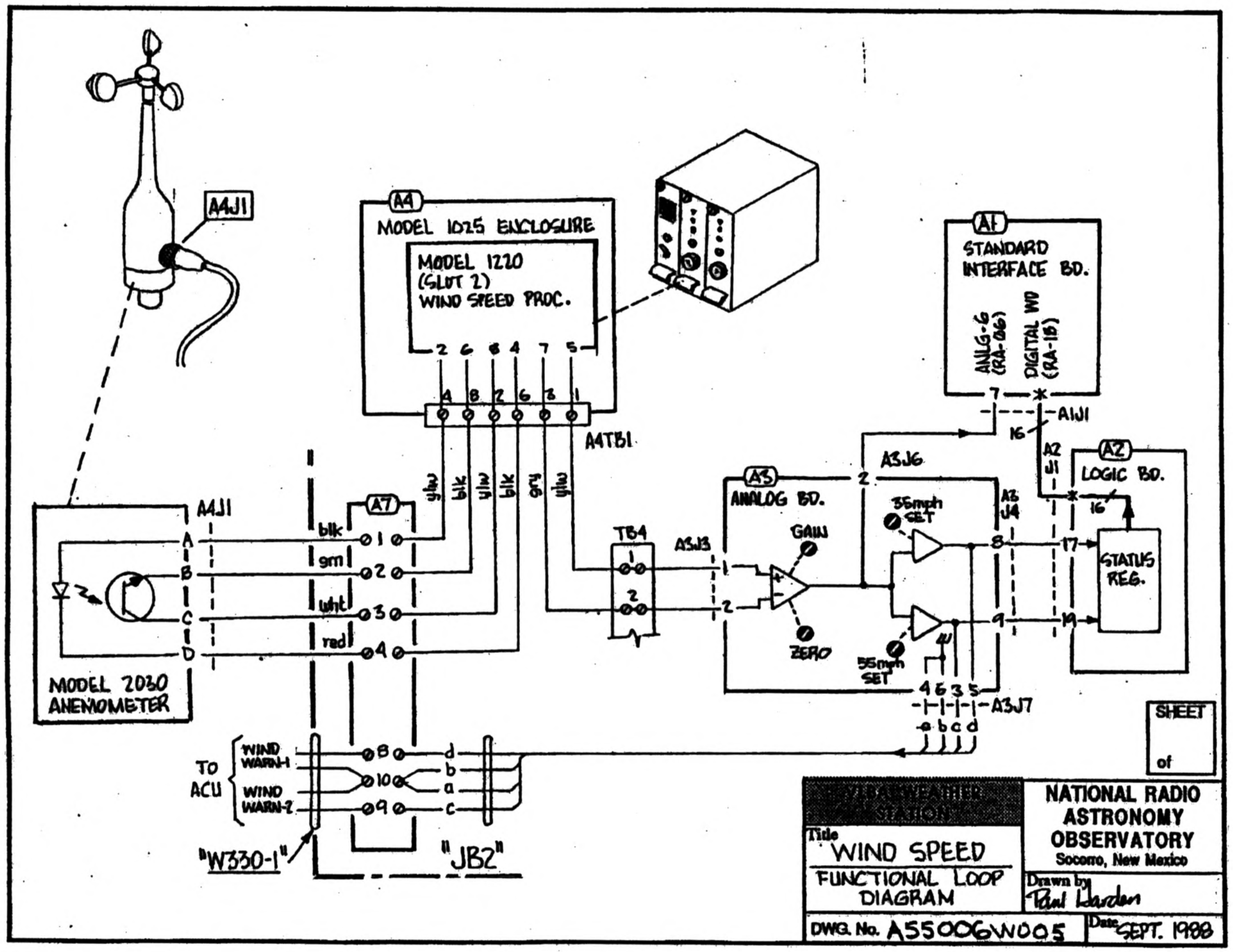


Figure 6 VLBA Weather Station Wind Speed Functional Loop Diagram, A55006W005

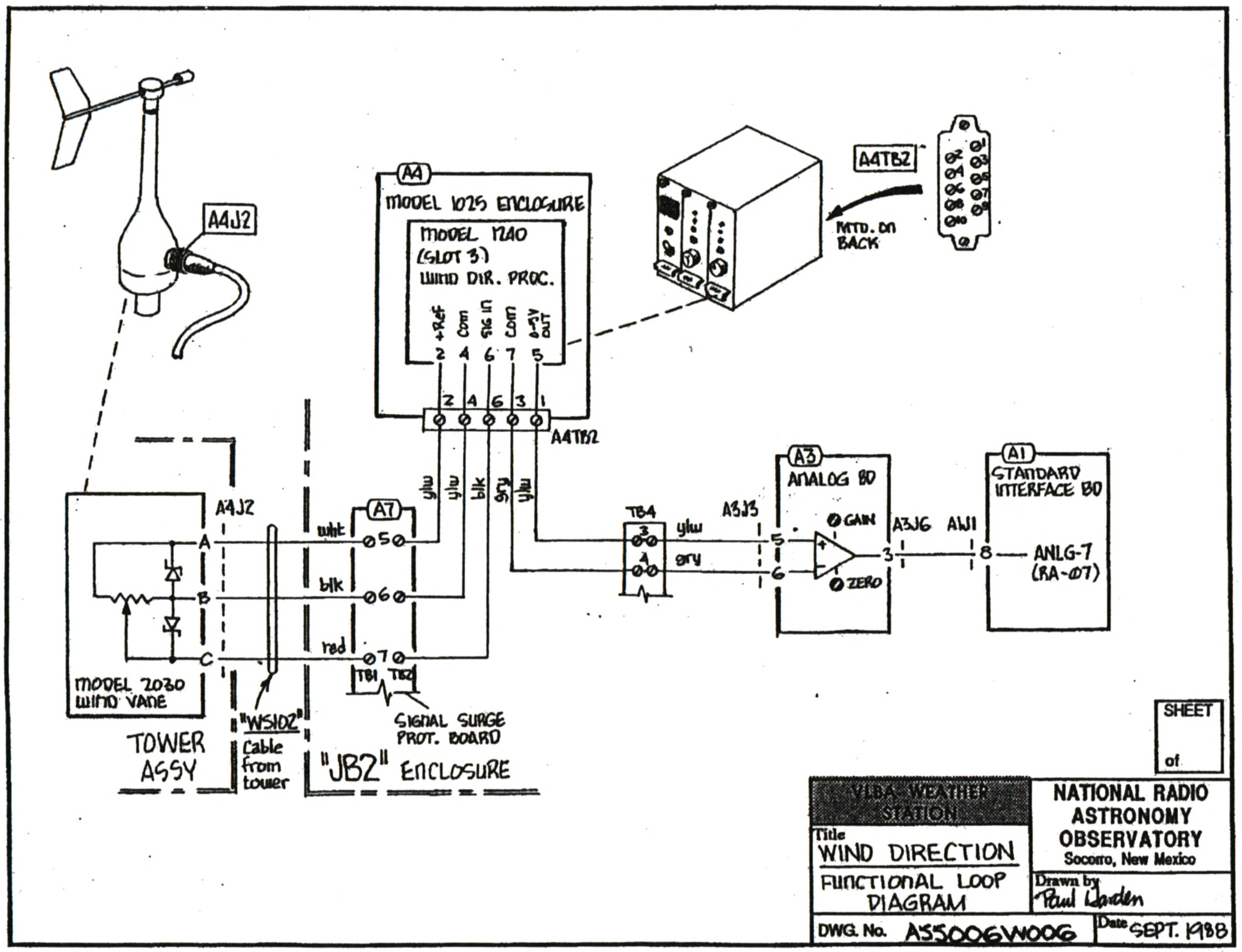
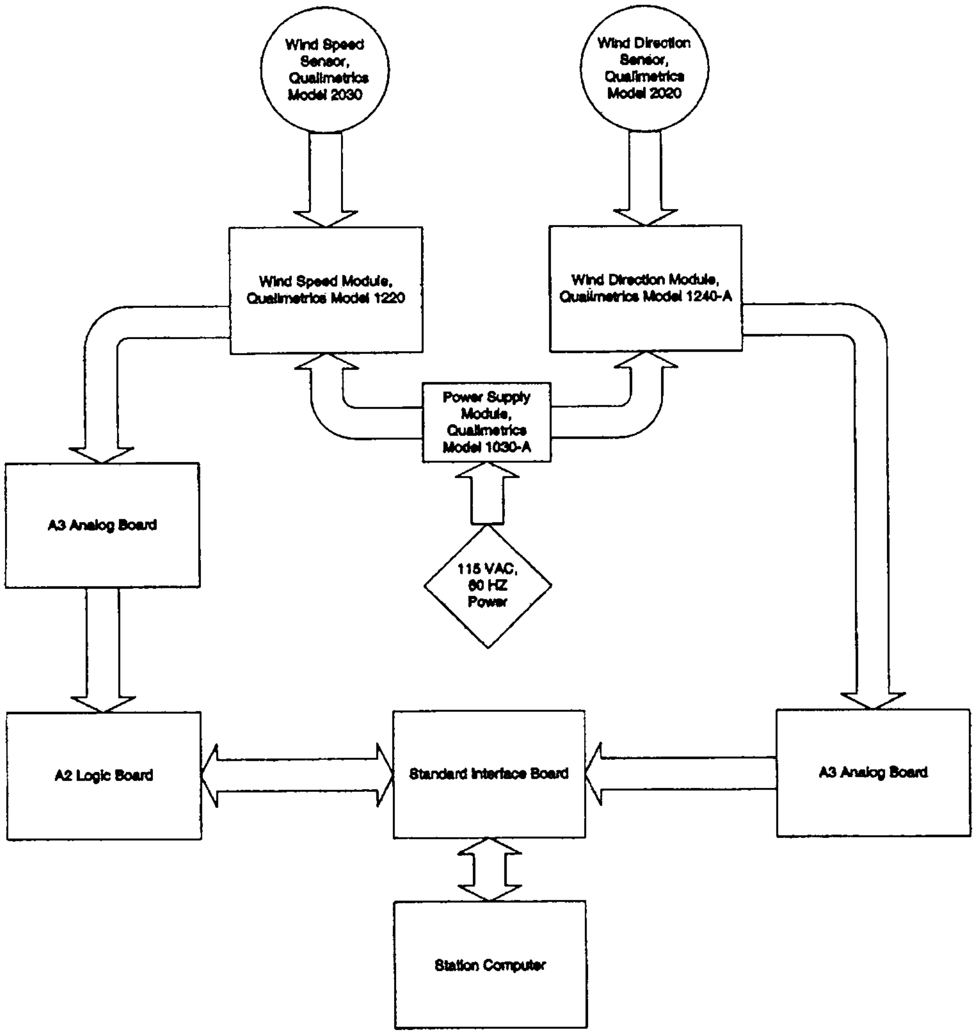


Figure 7 VLBA Weather Station Wind Direction Functional Loop, A55006W006

Plate 3 illustrates the TSL, the wind speed sensor and the wind direction sensor.



Windspeed and Wind Direction Block Diagram

Figure 8 Wind Speed and Wind Direction Block Diagram

Rain Gauge

Precipitation in the form of rain or snow is measured with the Qualimetrics Model 6021-B Electrically Heated Rain and Snow Gauge. These gauges are designed for corrosion resistance, and have a built-in level for proper installation.

This gauge has a tipping bucket with a switch closure. Each tip is equivalent to 0.1mm of depth measured over the surface area of the collection funnel. The gauge can be heated for site locations that usually receive snowfall.

Figure 9 is the Rain Gauge Block Diagram, however refer to Appendix 2 for further information and specification for the rain gauge.

Plate 4 illustrates the rain gauge and its mounting assembly.

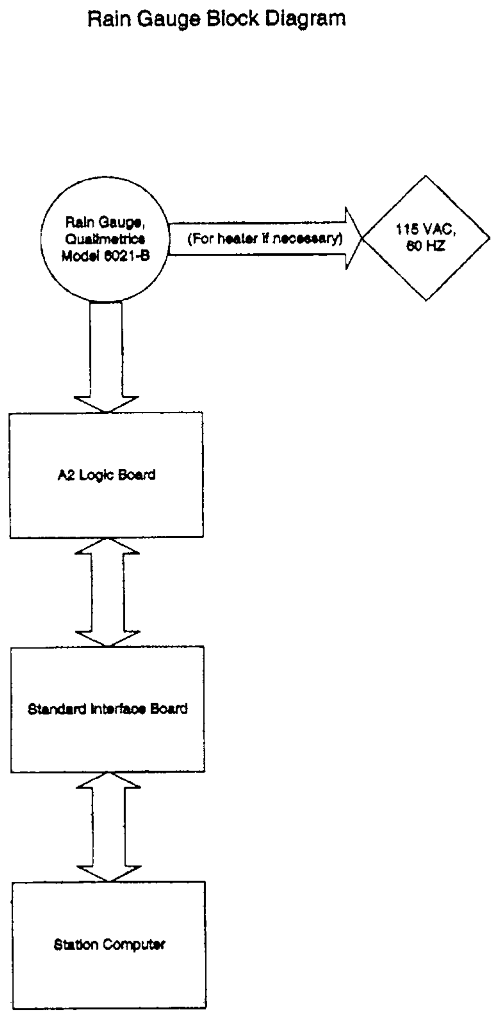
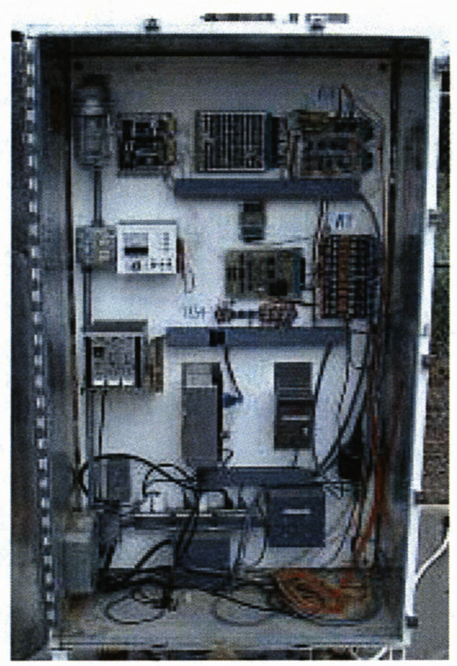


Figure 9 Rain Gauge Block Diagram

Panel Mount Assembly Descriptions

Plate 5 illustrates the panel mount assembly and associated components inside the electronics enclosure.



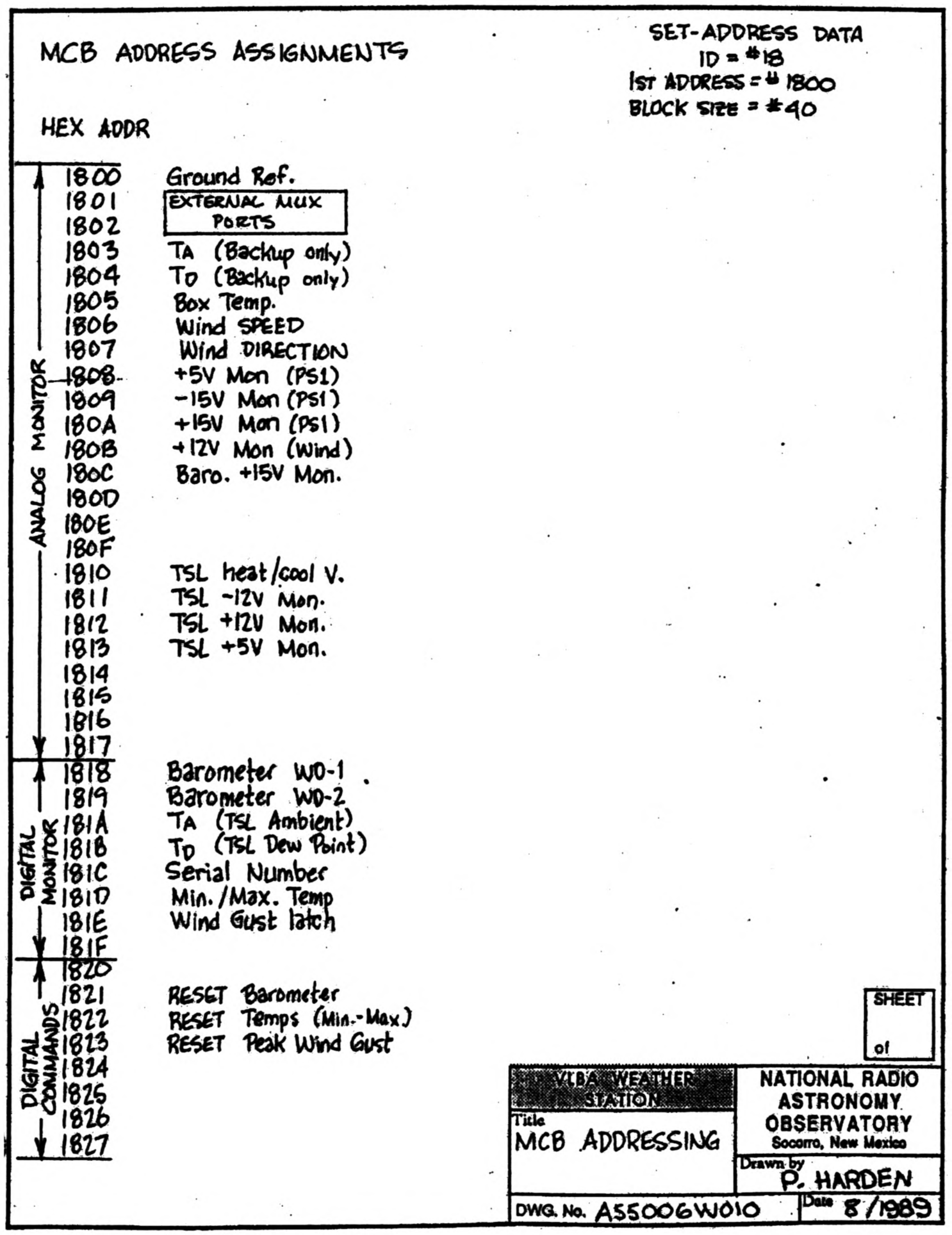
A1 Standard Interface Board

The Standard Interface Board is a 6" x 6" x ¾" PC board appropriate for installation in an NRAO module, and is the heart of the communications link from each weather station via a time-serial Monitor and Control Bus. It is the general-purpose monitor and control interface in the VLBA Telescope Monitor and Control System.

The Standard Interface Board sends or receives data from the A2 Logic Board and the A3 Analog Board. The A2 Logic Board implements the command and monitor data functions, device address and decode. The analog signals come from the A3 Analog Board, and are converted to digital form by the Standard Interface Board.

Interconnection between the electronics enclosure to the control building is through a set of fiber optic cables, consequently reducing the risk of damage in the event of lightning strikes or an external electrical source introduced on or near the weather station. Stow signals to the ACU in the antenna pedestal room from the A3 Analog Board is via twisted pair cable.

Figure 10 is the VLBA Weather Station MCB Addressing, A55006W010. It shows the MCB address assignments for the various monitor and control functions of the weather station.



MCB ADDRESS ASSIGNMENTS

SET-ADDRESS DATA
ID = #18
1st ADDRESS = # 1800
BLOCK SIZE = #40

	HEX ADDR	
ANALOG MONITOR	1800	Ground Ref.
	1801	EXTERNAL MUX PORTS
	1802	
	1803	TA (Backup only)
	1804	TD (Backup only)
	1805	Box Temp.
	1806	Wind SPEED
	1807	Wind DIRECTION
	1808	+5V Mon (PS1)
	1809	-15V Mon (PS1)
	180A	+15V Mon (PS1)
	180B	+12V Mon (Wind)
	180C	Baro. +15V Mon.
	180D	
	180E	
	180F	
	1810	TSL heat/cool V.
	1811	TSL -12V Mon.
	1812	TSL +12V Mon.
	1813	TSL +5V Mon.
	1814	
	1815	
	1816	
	1817	
DIGITAL MONITOR	1818	Barometer WD-1
	1819	Barometer WD-2
	181A	TA (TSL Ambient)
	181B	TD (TSL Dew Point)
	181C	Serial Number
	181D	Min./Max. Temp
	181E	Wind Gust latch
	181F	
DIGITAL COMMANDS	1820	
	1821	RESET Barometer
	1822	RESET Temps (Min.-Max.)
	1823	RESET Peak Wind Gust
	1824	
	1825	
	1826	
	1827	

SHEET
of

VLBA WEATHER STATION
Title
MCB ADDRESSING

NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

Drawn by
P. HARDEN

DWG. No. A55006W010
Date 8/1989

Figure 10 VLBA Weather Station MCB Addressing, A55006W010

A2 Logic Board

The A2 Logic Board is a 6" x 7" wire-wrap board with a 100-pin edge connector. The logic board stores and distributes the digital information furnished from the sensors and their component parts to the Standard Interface Board when requested. It performs a variety of functions including address decoding, digital command and monitor decoding, as well as analog multiplexing to the A/D converter on the Standard Interface Board.

Detailed schematic drawings for the A2 Logic Board are in the theory of operation portion of this manual.

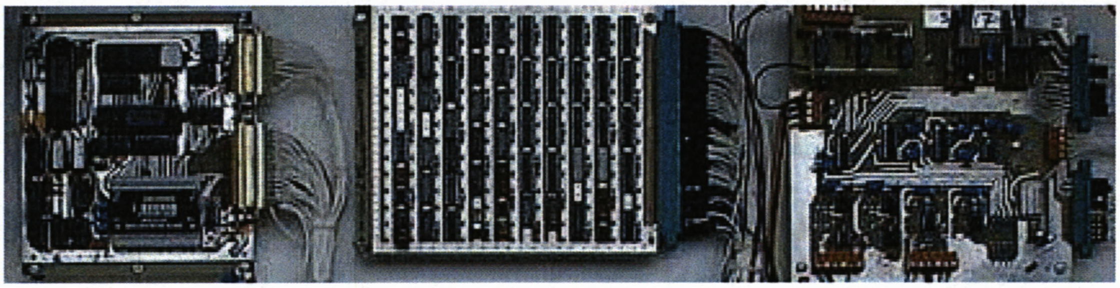
A3 Analog Board

The A3 Analog Board is a 6¾" x 7" PC board with two edge connectors, and an interface to the fiber optic link. It supplies signal conditioning for the ambient and dew point temperatures measured directly from the 10m tower. This is for detecting and setting a low temperature warning for the antenna ACU.

Conditioning for the wind direction and wind speed is provided, as well as warning levels for excessive wind velocities. There is also circuitry for setting the box hot and cold conditions, which turns on either the box fan or heater for moderating the enclosure temperatures.

Likewise, the detailed schematic drawings for the A3 Analog Board are in the theory of operation portion of this manual.

Plate 6 illustrates the Standard Interface Board, the A2 Logic Board and the A3 Analog Board.



A4 Wind Signal Processors

The outputs from the wind speed and wind direction sensors require a bit of signal conditioning. The Wind Signal Processors are a conditioning system that provides for sensor load matching, sensor electrical isolation, as well as calibration and amplification of the sensor signals.

The Wind Signal Processors are housed in a single Signal Conditioning Module File, Qualimetrics Model 1023. It accepts a power supply module and two signal conditioning modules. Input and output signal lines to the modules are on terminal connector blocks located at the rear of the file.

Refer to Appendix 2 for detailed schematics of the wind speed and wind direction sensors and signal conditioning electronics.

Plate 7 illustrates the Wind Signal Processors.

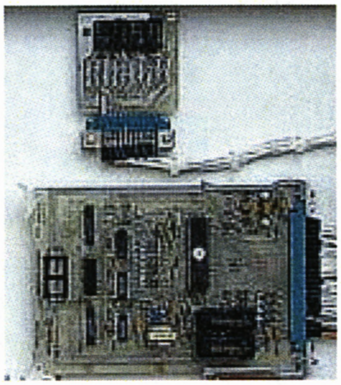
A5 TSL Receiver Board

The A5 TSL Receiver Board is a 5" x 7" PC board with an edge connector. It receives a serial data stream from the TSL located on the 10m-weather tower.

The recorded ambient and dew point temperatures, along with the minimum and maximum temperatures are passed to the A2 Logic Board where they are loaded into data registers and readied for transfer to the Standard Interface Board.

The detailed schematics for the A5 Receiver Board are in the theory of operation portion of this manual.

Plate 8 illustrates the TSL receiver board and display card.



A6 A.I.R. Digital Barometer

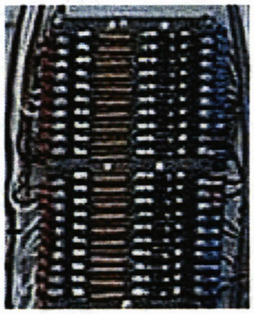
As described in the Sensor Descriptions above, the barometer for the weather station is the Atmospheric Instrumentation Research (A.I.R.) Model AIR-DB-2AX, a microprocessor controlled digital pressure transducer. It measures the atmospheric pressure in millibars.

Refer to Appendix 3 for the detailed schematics and addressing information for the A.I.R. barometer.

A7 Signal Protection Board

The A7 Signal Protection Board is assembled onto a single 5" x 9" PC board, Qualimetrics Model 10643. It bestows protection against surge currents created by lightning or electrical sources external to the meteorological instrumentation, thereby guarding the delicate circuitry located within the electronics enclosure. The circuit board contains components and terminals for 20 input signal lines.

Plate 9 illustrates the A7 Signal Protection Board



Surge protection is offered by self-quenching gas tube arrestors that feature rapid transient response and can withstand high follow currents. A resistor and inductor are used in conjunction with the spark-gap tube and a dual zener diode helps to slow and extinguish surge currents that are below the ionization threshold of the gas tube.

Refer to Appendix 2 for the detailed information of the signal protection board.

A8 Box Heater

The Box Heater for the electronics enclosure is a thermostatically controlled fan-driven unit, and is adjustable from 0°F to 100°F. It is a Hoffman Model A-DAH1001FT. The dimensions are 10½" x 3" x 4", and the housing is anodized aluminum.

The fan draws cool air from the bottom of the enclosure and passes the air over the thermostat and heating elements before being released into the enclosure space. This unit helps maintain stable temperatures inside the enclosure, improving the reliability of the electronics within.

Figure 11 is the VLBA Weather Station “JB2” Temperature Control Circuits Functional Diagram, A55006W009. It is a generalized drawing that shows interconnections for the fan and heater circuits in the electronics enclosure. Also refer to Appendix 5 for more information on the box heater.

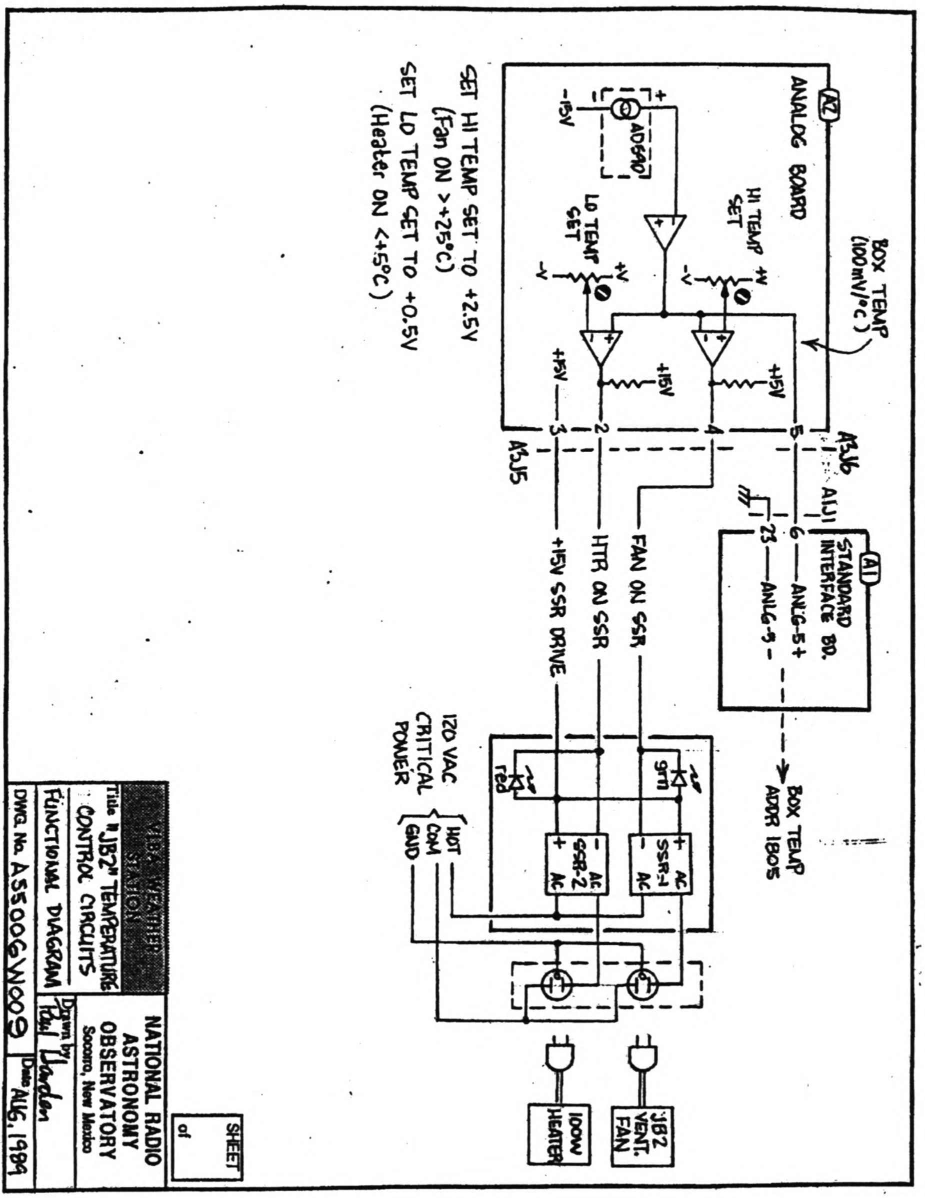


Figure 11 VLBA Weather Station “JB2” Temperature Control Circuits, A55006W009

Plate 10 illustrates the Box Heater.

A9 Data Display Units

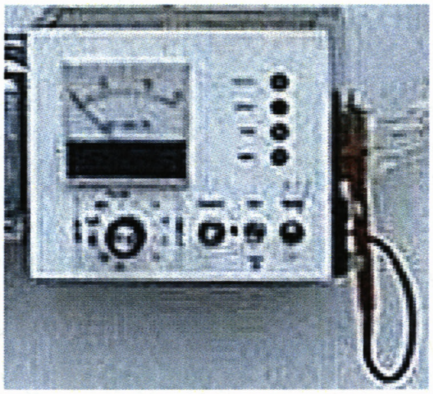
The A9 Data Display Units are used to display the ambient and dew point temperatures, the wind speed, the wind direction, as well as +5 VDC. They also monitor the high and low temperatures.

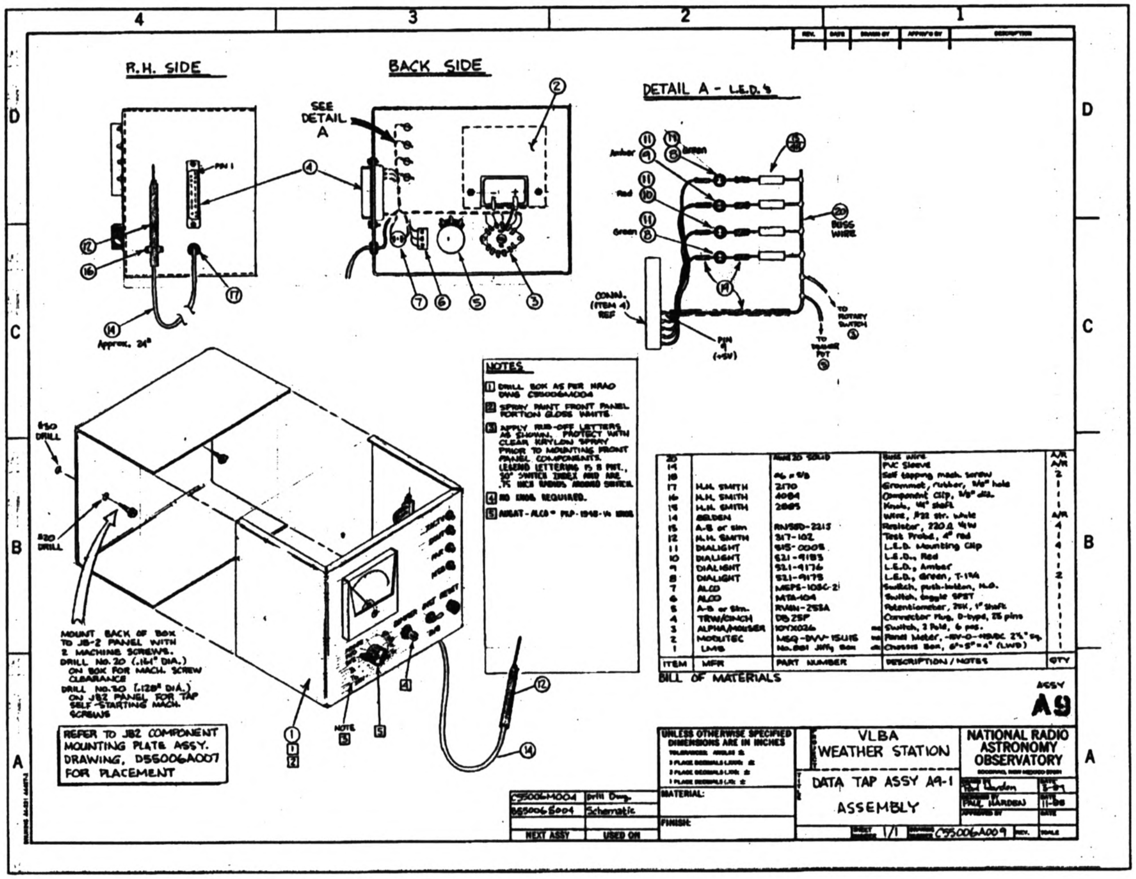
The A9-1 is 6" x 5" x 4" panel mounted chassis that has data transmit LED's that verify data flow from the electronics enclosure via the Monitor and Control Bus.

Interconnection is made to the A9-1 with a 25-pin D-type connector, and the A9-2 is a 3" x 3" PC board with an edge connector. It is a TSL Display Unit PCB, Model 1063-301.

Figure 12 is the VLBA Weather Station Data Tap Ass'y A9-1 Assembly, C55006A009. It is a schematic, assembly drawing and material list for this unit.

Plate 11 illustrates the Data Display Unit.





MOUNT BACK OF BOX TO JB-2 PANEL WITH 2 MACHINE SCREWS.
DRILL No. 20 (.161" DIA.) ON BOX FOR MACH. SCREW CLEARANCE
DRILL No. 30 (.128" DIA.) ON JB2 PANEL FOR TAP SELF-STARTING MACH. SCREWS

REFER TO JB2 COMPONENT MOUNTING PLATE ASSY. DRAWING, D55006A007 FOR PLACEMENT

NOTES

1. DRILL BOX AS PER NRAO DWG C55006M004
2. SPRAY PAINT FRONT PANEL PORTION GLOSS WHITE.
3. APPLY RUB-OFF LETTERS AS SHOWN. PROTECT WITH CLEAR KRYLON SPRAY PRIOR TO MOUNTING FRONT PANEL COMPONENTS. LEGEND LETTERING IS 8 PNT., 30° SWITCH INDEX AND ARE .75 INCH RADIUS AROUND SWITCH
4. NO KNOB REQUIRED.
5. AUGAT-ALCO PKP-1948-¼ KNOB

ITEM	MFR	PART NUMBER	DESCRIPTION / NOTES	QTY
20		AWG 20 SOLID	Buss wire	A/R
19			PVC Sleeve	A/R
18		#6 x 3/8	Self tapping mach. screw	2
17	H.H. SMITH	2170	Grommet, rubber, 1/4" hole	1
16	H.H. SMITH	4084	Component clip, 1/2" dia.	1
15	H.H. SMITH	2885	Knob, 1/4" shaft	1
14	BELDEN		Wire, #22 str. white	A/R
13	A-B or sim	RN55D-2215	Resistor, 220Ω ¼W	4
12	H.H. SMITH	317-102	Test Probe, 4" red	1
11	DIALIGHT	515-0005	L.E.D. Mounting Clip	4
10	DIALIGHT	521-9183	L.E.D., Red	1
9	DIALIGHT	521-9176	L.E.D., Amber	1
8	DIALIGHT	521-9175	L.E.D., Green, T-1¾	2
7	ALCO	MSPS-103C-2	Switch, push-button, N.O.	1
6	ALCO	MTA-104	Switch, toggle SPST	1
5	A-B or Sim.	RV4N-253A	Potentiometer, 25K, 1" shaft	1
4	TRW/CINCH	DB25P	Connector Plug, D-type, 25 pins	1
3	ALPHA/MOUSER	10YX026	Switch, 2 Pole, 6 pos.	1
2	MODUTEC	MSQ-DVV-15U15	Panel Meter, -15V-0-+15VDC 2½" sq.	1
1	LMB	No.881 Jiffy Box	Chassis Box, 6"x5"x4" (LWD)	1

BILL OF MATERIALS

ASSY A9

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

MATERIAL:

FINISH:

NEXT ASSY	USED ON
C55006M004	Drill Dwg.
B55006S004	Schematic

VLBA WEATHER STATION

DATA TAP ASSY A9-1 ASSEMBLY

NATIONAL RADIO ASTRONOMY OBSERVATORY

DRAWN BY Paul Harden DATE 5-89
DESIGNED BY PAUL HARDEN DATE 11-88
APPROVED BY DATE
SHEET NUMBER 1/1 DRAWING NUMBER C55006A009 REV. SCALE

Figure 12 VLBA Weather Station Data Tap Ass'y A9-1 Assembly, C55006A009

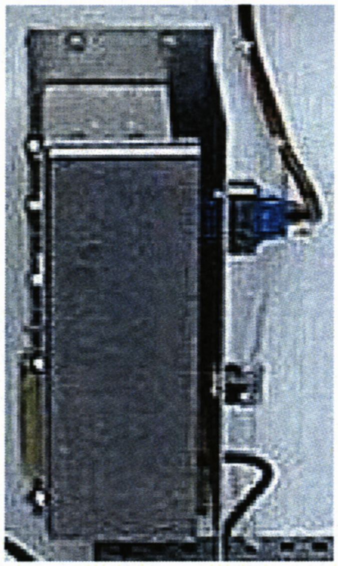
PS1 Power Supply

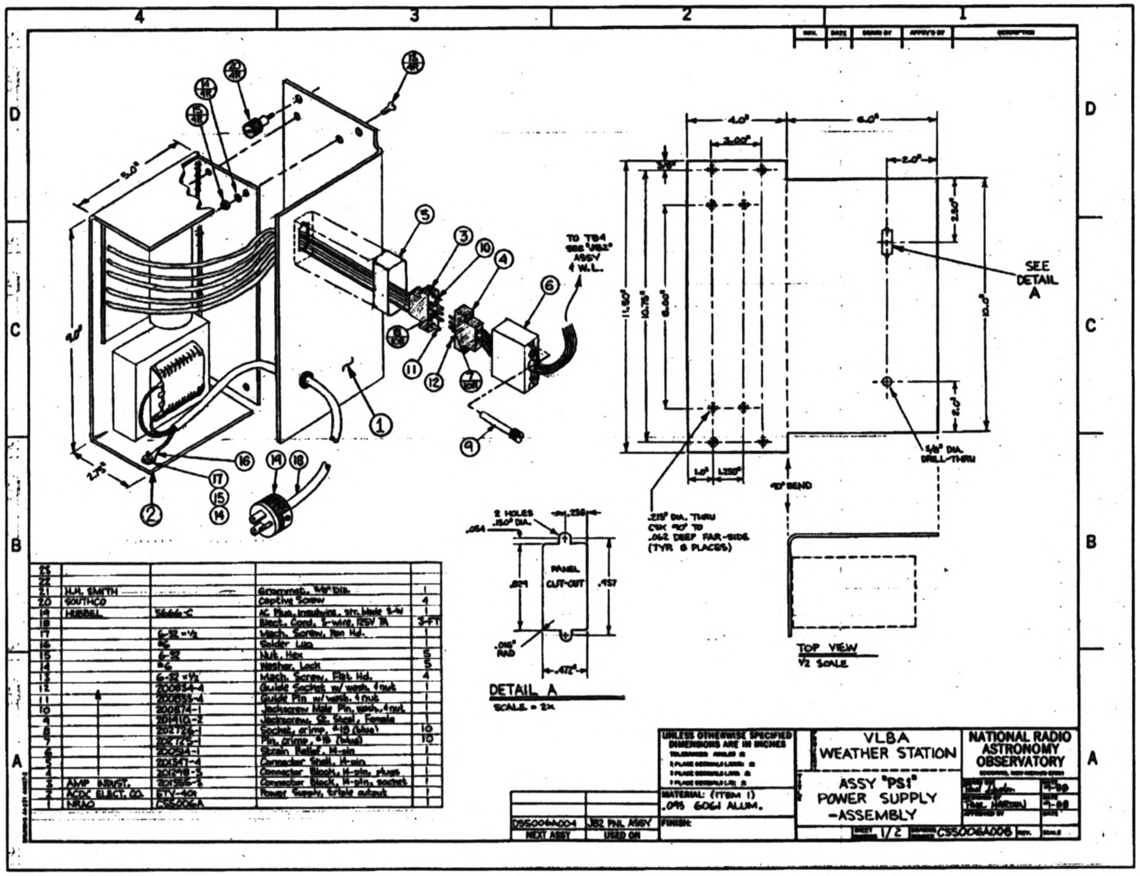
The Power Supply is mounted on an aluminum-mounting bracket equipped with four captive screws for easy installation and removal on the panel inside the electronics enclosure. The power supply is ACDC Electronics Co., Model ETV-401 triple output DC. It requires 115 VAC power input.

The output voltages supplied are +5 VDC, as well as ±15 VDC. They are connected to the power bus terminal strip via a 14-pin AMP connector plug and socket arrangement, and the power supply is fused on the input side with a 2A, 250V fuse.

Figure 13 is the VLBA Weather Station Assy "PS1" Power Supply Assembly, C55006A006. It is a schematic, assembly drawing and material list for this unit. Appendix 4 contains more information regarding this unit as well.

Plate 12 illustrates the PS1 Power Supply.





23				
22				
21	H.H. SMITH		Grommet, 5/8" Dia.	1
20	SOUTHCO		Captive Screw	4
19	HUBBEL	5666-C	AC Plug, insulwire, str. blade 3-W	1
18			Elect. Cond, 3-wire, 125V 7A	3-FT
17		6-32 x 1/2	Mach. Screw, Pan Hd.	1
16		#6	Solder Lug	1
15		6-32	Nut, Hex	5
14		#6	Washer, Lock	5
13		6-32 x 1/2	Mach. Screw, Flat Hd.	4
12		200834-4	Guide Socket w/ wash. & nut	1
11		200833-4	Guide Pin w/ wash. & nut	1
10		200874-1	Jackscrew Male Pin, wash., & nut	1
9		201410-2	Jackscrew, St. Steel, Female	1
8		202726-1	Socket, crimp, #18 (blue)	10
7		202725-1	Pin, crimp, #18 (blue)	10
6		200514-1	Strain Relief, 14-pin	1
5		201347-4	Connector Shell, 14-pin	1
4		201298-3	Connector Block, 14-pin, plugs	1
3	AMP INDUST.	201355-3	Connector Block, 14-pin, socket	1
2	ACDC ELECT. CO.	ETV-401	Power Supply, triple output	1
1	NRAO	C55006A		

Figure 13 VLBA Weather Station Ass'y "PS1" Power Supply Assembly, C55006A006-1

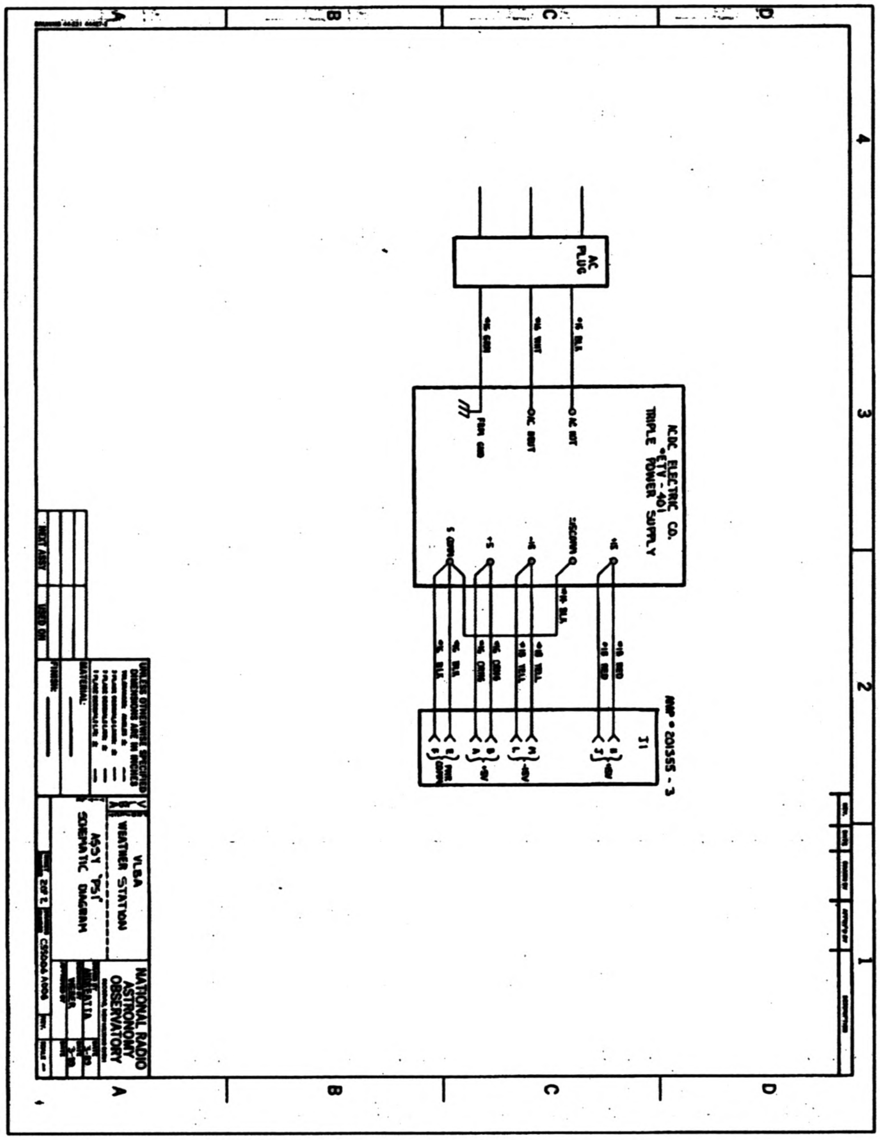


Figure 13 VLBA Weather Station Ass'y "PS1" Power Supply Assembly, C55006A006-2

Additional Hardware Descriptions

AC Power Distribution Assembly

Power for the weather station is 115 VAC single-phase power. There are no circuit breakers or exposed 115 VAC inside the weather station electronics enclosure, however the enclosure is equipped with an AC disconnect switch to shut off all power in the weather station. A single circuit breaker in the control building provides protection. Dedicated AC receptacles inside the electronics enclosure supply interconnection points for various instruments and power supplies. A utility light, switch and power receptacle is furnished inside the electronics enclosure as well.

Plate 13 illustrates the AC Power Distribution Assembly.

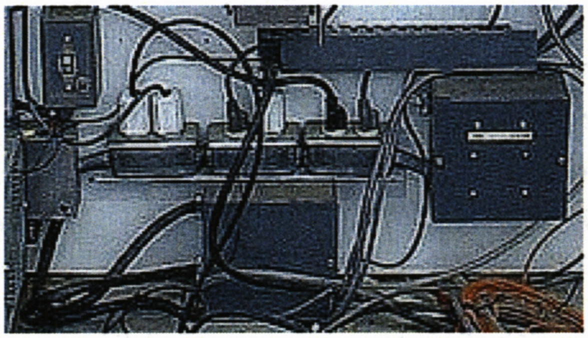


Plate 14 illustrates the utility light, switch and power receptacle.

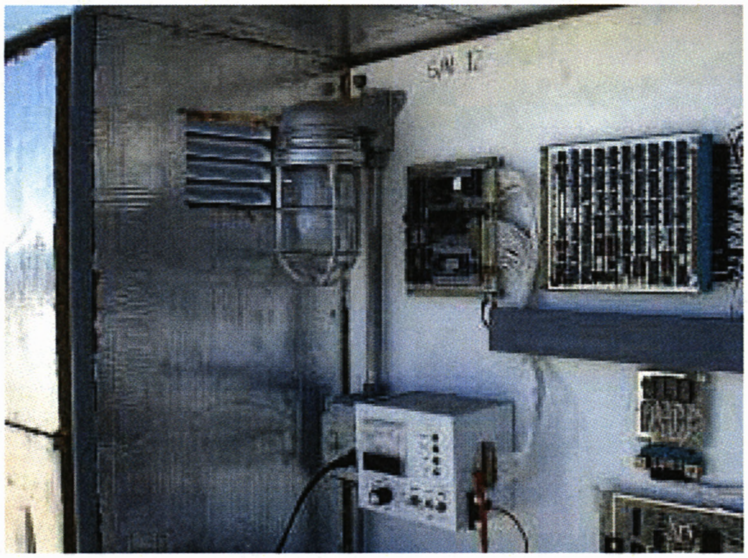


Figure 14 is the VLBA Weather Station "JB2" Equip Enclosure 120VAC Distribution Wiring Diagram, C55006W001. It is a drawing that shows the interconnections for the AC power at the electronics enclosure.

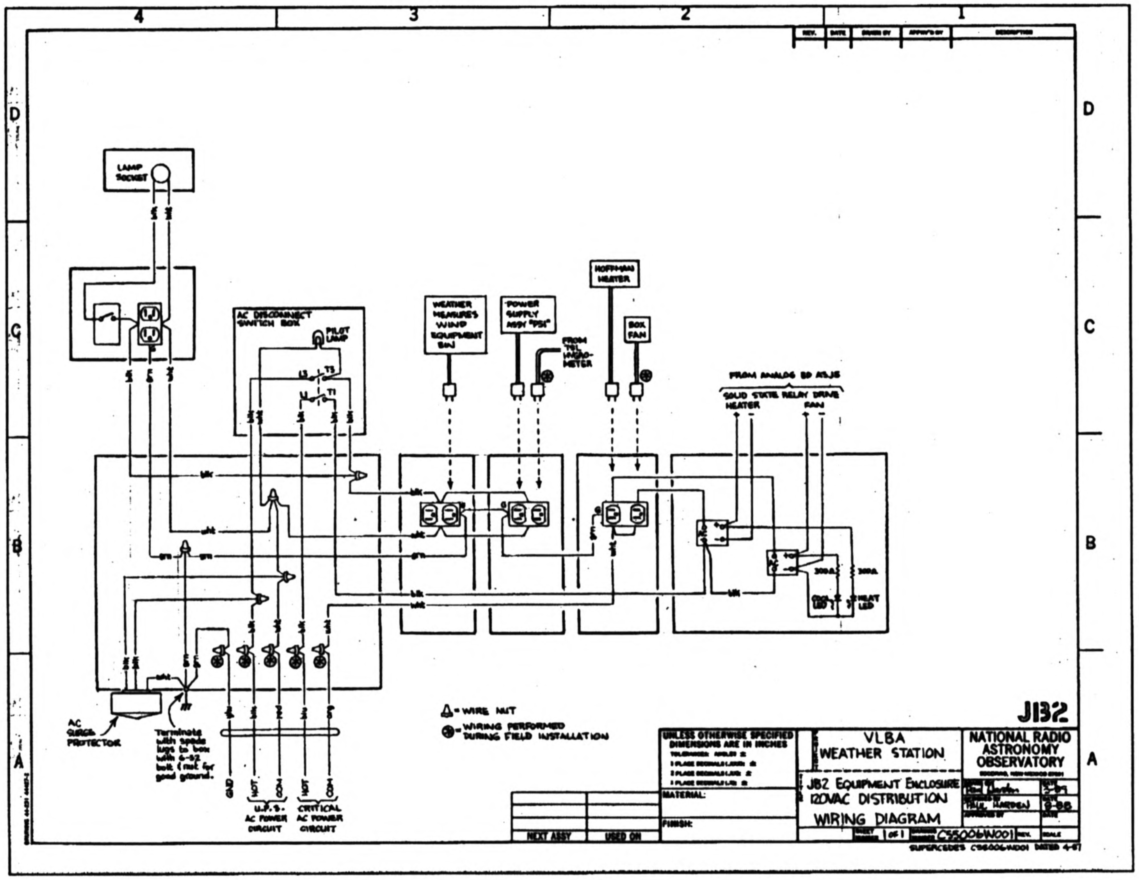
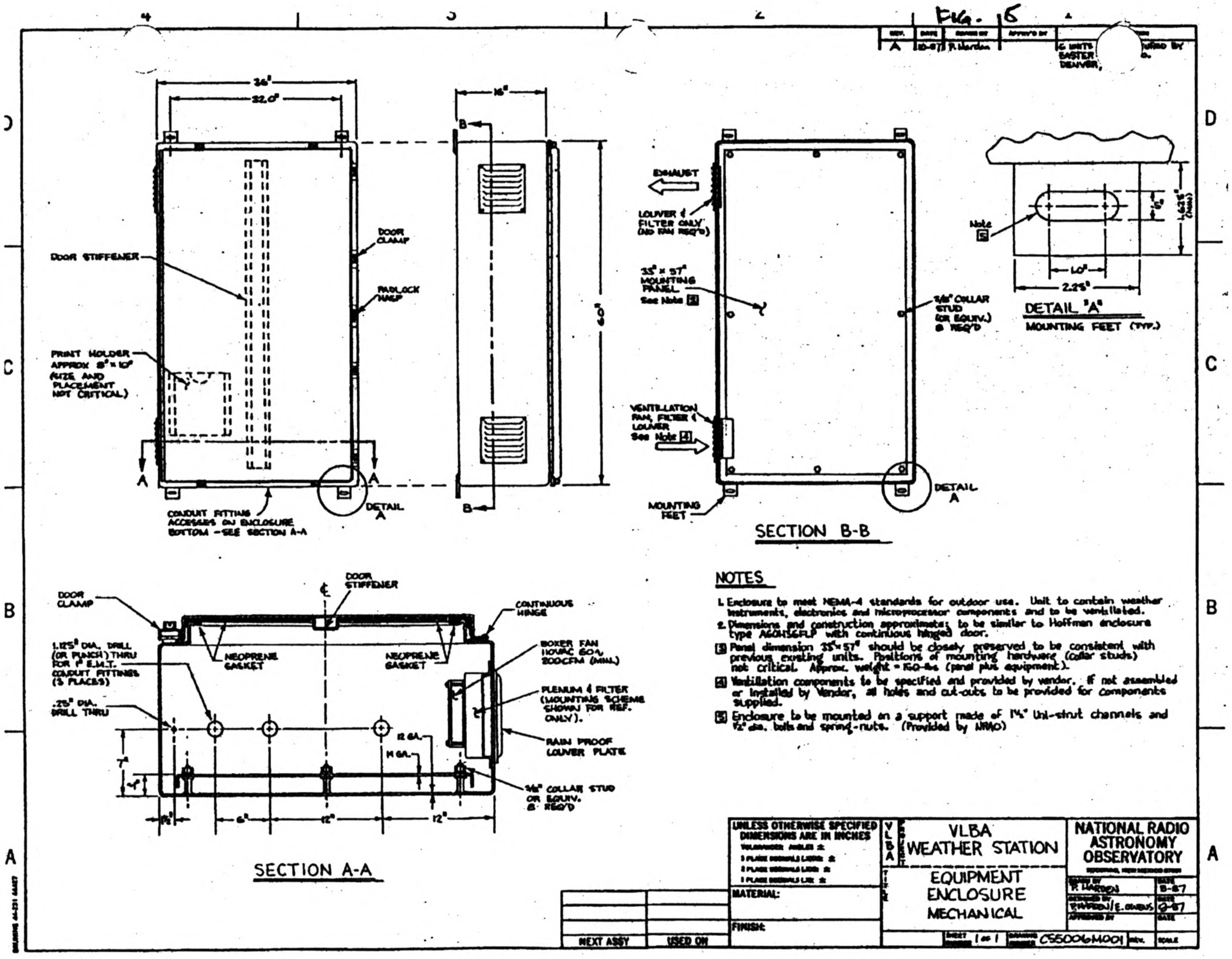


Figure 14 VLBA Weather Station "JB2" Equip Enclosure 120VAC, C55006W001

Enclosure Assembly

The electronics enclosure is similar to Hoffman enclosure type A60H36FLP with a continuous hinged door. This enclosure meets NEMA-4 standards for outdoor use. Outer dimensions are 60" x 36" x 16" for the enclosure. The mounting panel dimensions are 57" x 35". There are ventilation openings located on the enclosure, both equipped with a louver and filter to help keep out contaminants or foreign matter. The lower opening has the ventilation fan mounted therein. Some enclosures have rigid insulation in the interior to help minimize temperature extremes.

Figure 15 is the VLBA Weather Station Equipment Enclosure Mechanical Drawing, C55006M001. It is the mechanical drawing for the enclosure. Figure 16 is the VLBA Weather Station "JB2" Component Mounting Plate Assembly, D55006A007. It is the assembly, layout and part list for the panel mounted assemblies inside the electronics enclosure.



NOTES

1. Enclosure to meet NEMA-4 standards for outdoor use. Unit to contain weather instruments, electronics and microprocessor components and to be ventilated.
2. Dimensions and construction approximate; to be similar to Hoffman enclosure type A60H36FLP with continuous hinged door.
3. Panel dimension 35"×57" should be closely preserved to be consistent with previous existing units. Positions of mounting hardware (collar studs) not critical. Approx. weight = 150 lbs (panel plus equipment).
4. Ventillation components to be specified and provided by vendor. If not assembled or installed by Vendor, all holes and cut-outs to be provided for components supplied.
5. Enclosure to be mounted on a support made of 1⅝" Uni-strut channels and ½" dia. bolts and spring-nuts. (Provided by NRAO)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
1 PLACE DECIMALS ±
MATERIAL:
FINISH:

VLBA WEATHER STATION
EQUIPMENT ENCLOSURE MECHANICAL

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO

DRAWN BY P. HARDEN DATE 8-87
DESIGNED BY P. HARDEN / E. OWENS DATE 9-87
APPROVED BY DATE
SHEET NUMBER 1 of 1
DRAWING NUMBER C55006M001
REV.
SCALE

Figure 15 VLBA Weather Station Equipment Enclosure, C55006M001

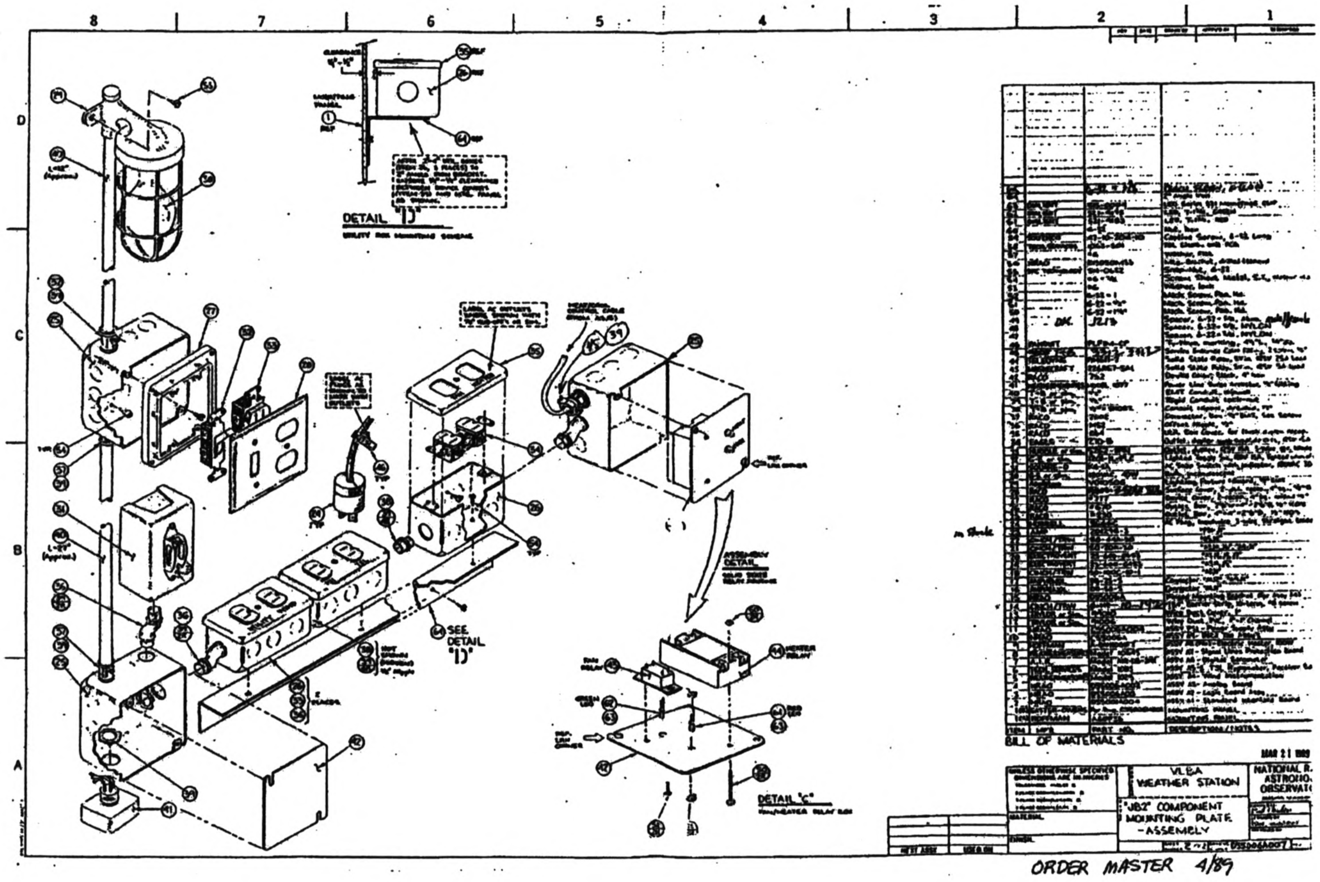


Figure 16 VLBA Weather Station "JB2" Component Mounting Plate, D55006A007-1

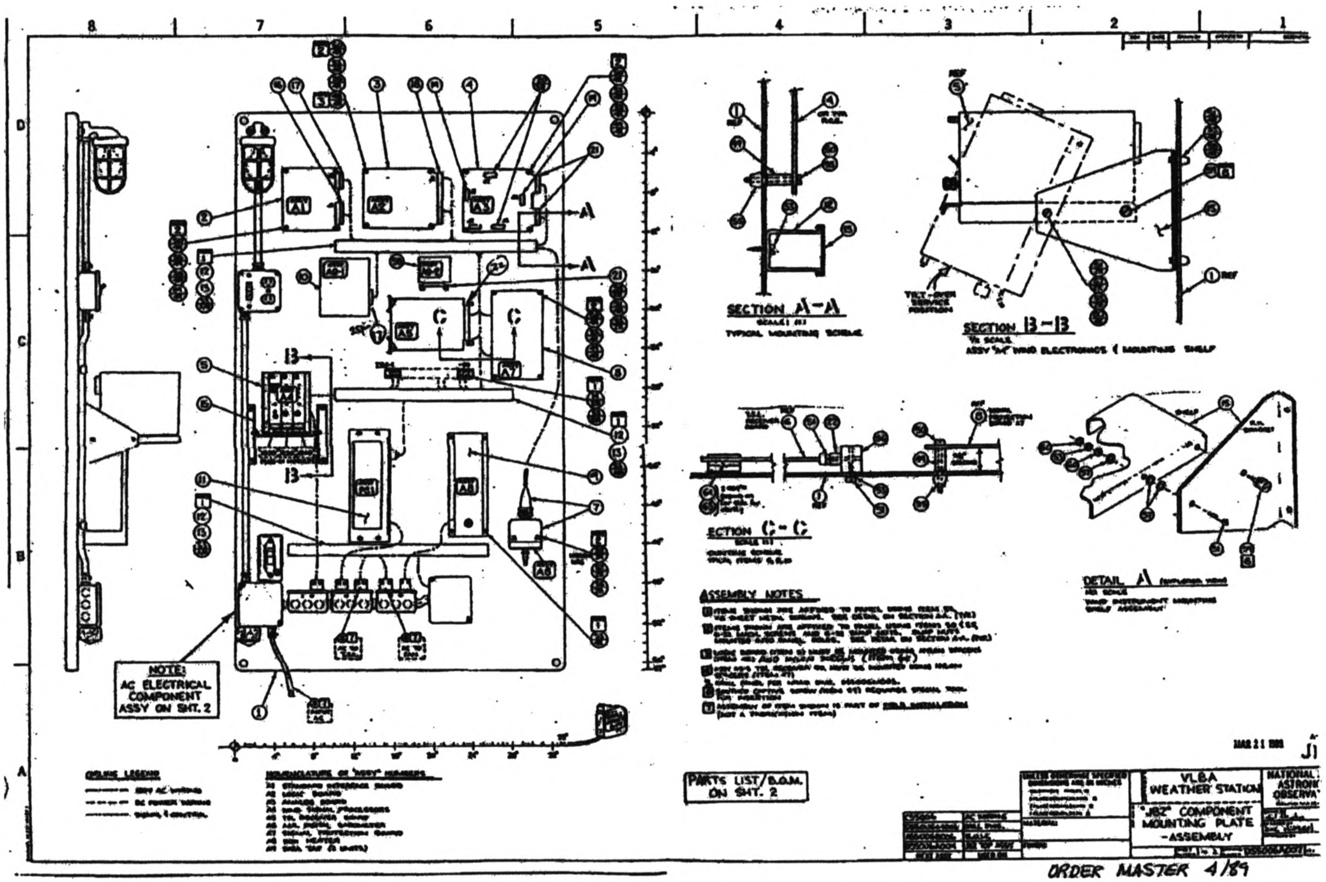


Figure 16 VLBA Weather Station “JB2” Component Mounting Plate, D55006A007-2

Fan Assembly

The fan assembly is a 115 VAC 60 HZ boxer fan mounted with a bracket in proximity to the lower ventilation opening on the enclosure. The airflow from the fan is 200-CFM minimum.

There are no drawings for the fan assembly, however Plate 15 illustrates the fan assembly inside of the electronics enclosure.

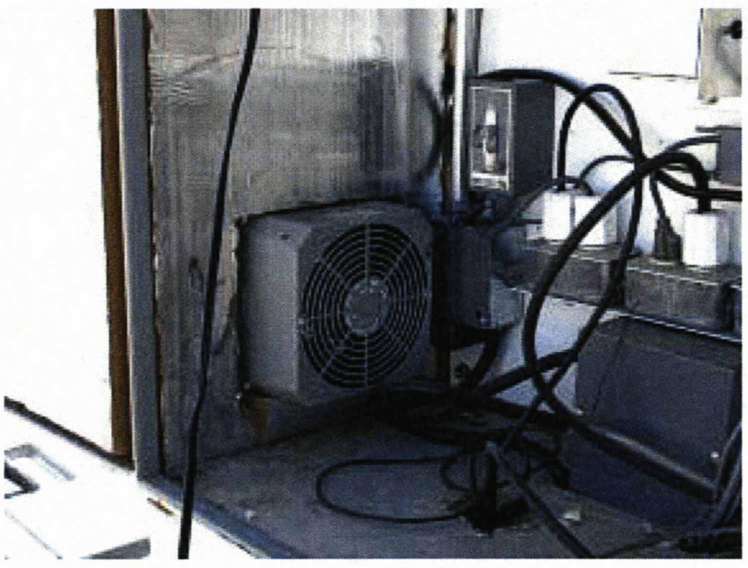


Plate 16 illustrates the ventilation opening on the enclosure.

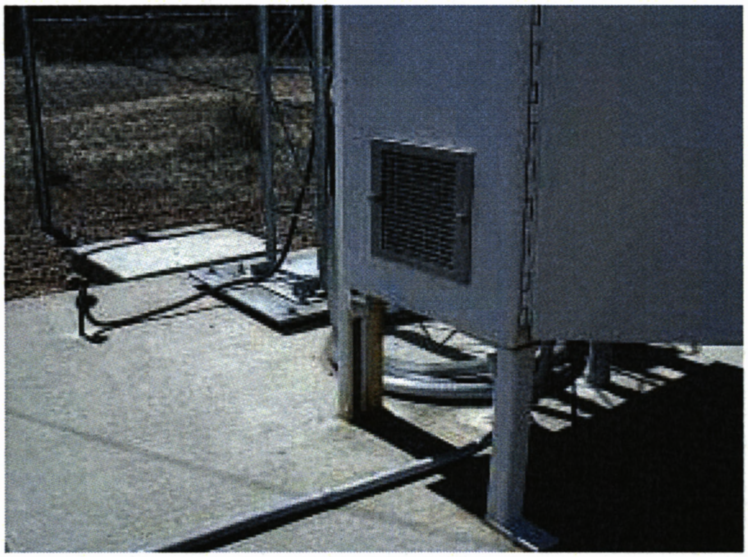
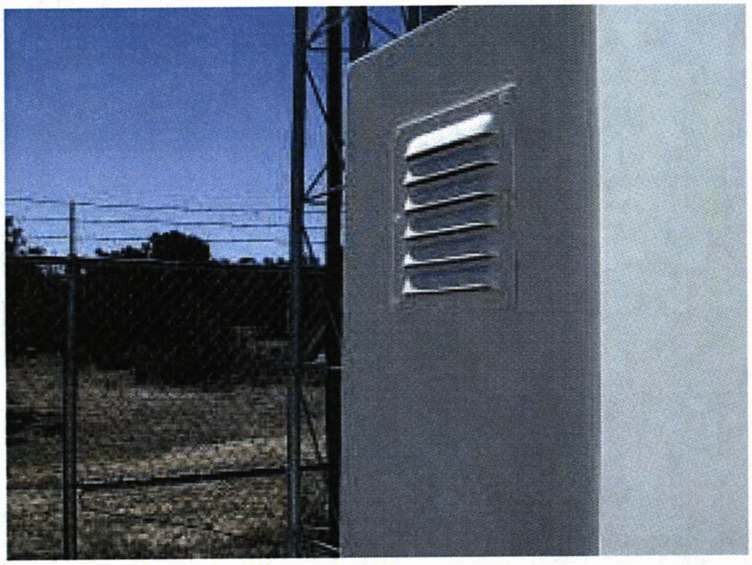


Plate 17 shows the upper ventilation opening.



Miscellaneous Assembly

The 10m tower for the weather station is a Rohn Model 25G fold-over tower, and has a base mount adapter plate ensconced firmly into a concrete pad. There is a hand-crank to raise and lower the tower for servicing the instruments mounted atop the tower

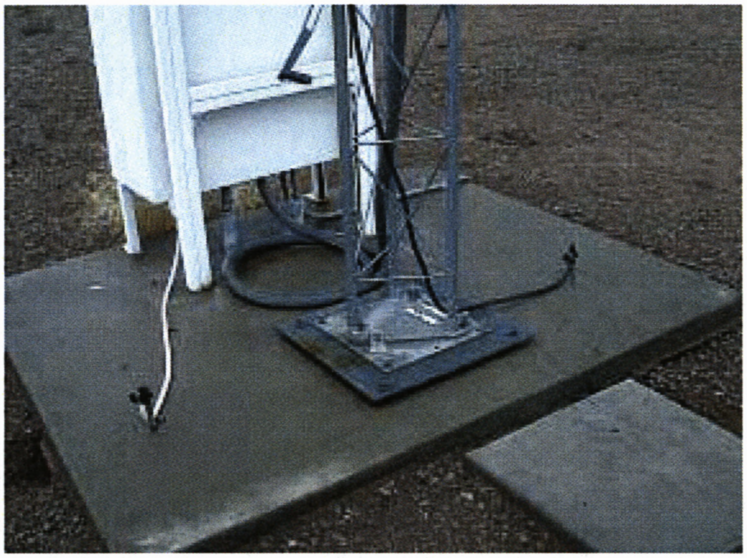
Plate 18 illustrates the hand crank mounted on the tower.

A cross-arm for mounting the wind direction and wind speed sensors is the Qualimetrics Model 2023, and mates with the mast on the tower. The tower lightning rod ground and electronics enclosure ground cables are cad-welded to the ground rods. Tower guy wires are also grounded.

Plate 19 shows guy wire and turnbuckle hardware.

Figure 17 is the VLBA Weather Station Site Installation Drawings, C55006A008. It shows the tower installation and electronics enclosure. Figure 18 is the VLBA Weather Station Rohn Tower Adapter Plate, C55006M002. It is the adapter plate for the tower.

Plate 20 illustrates the concrete pad, adapter plate and grounding for the tower.



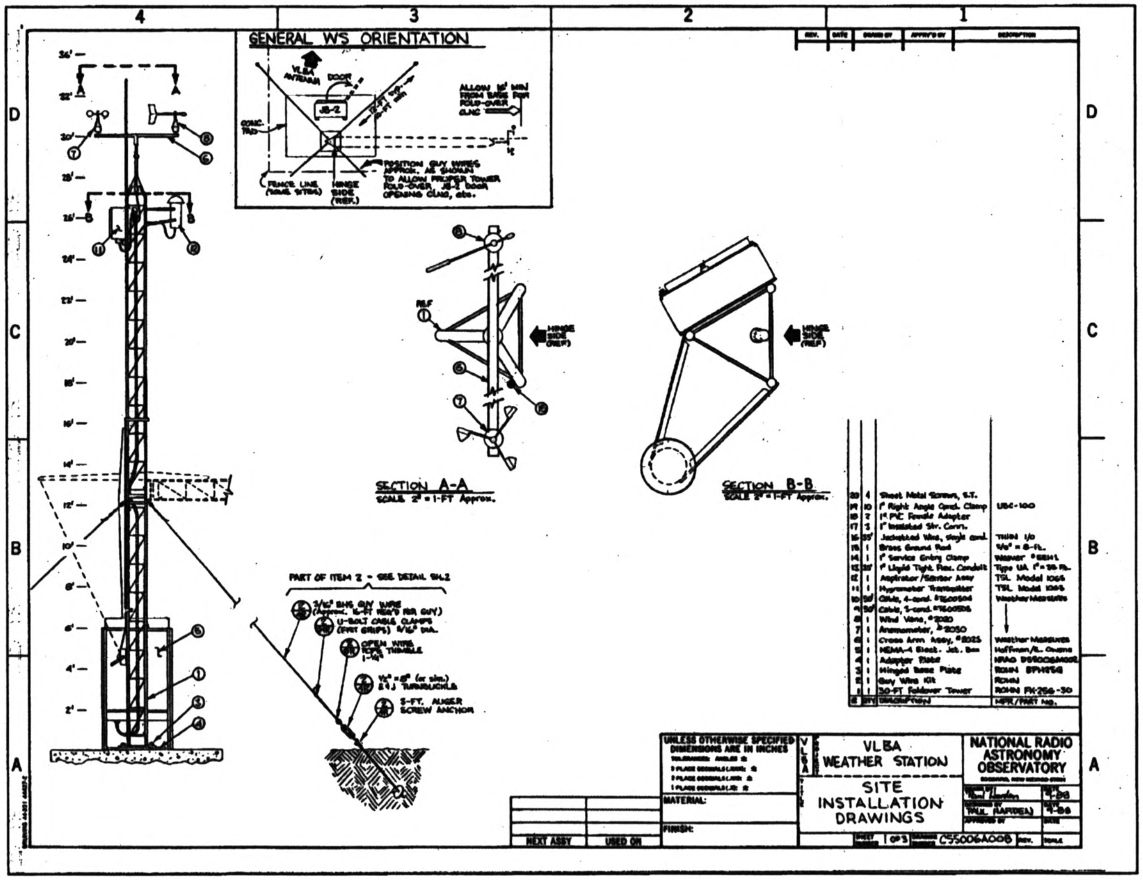
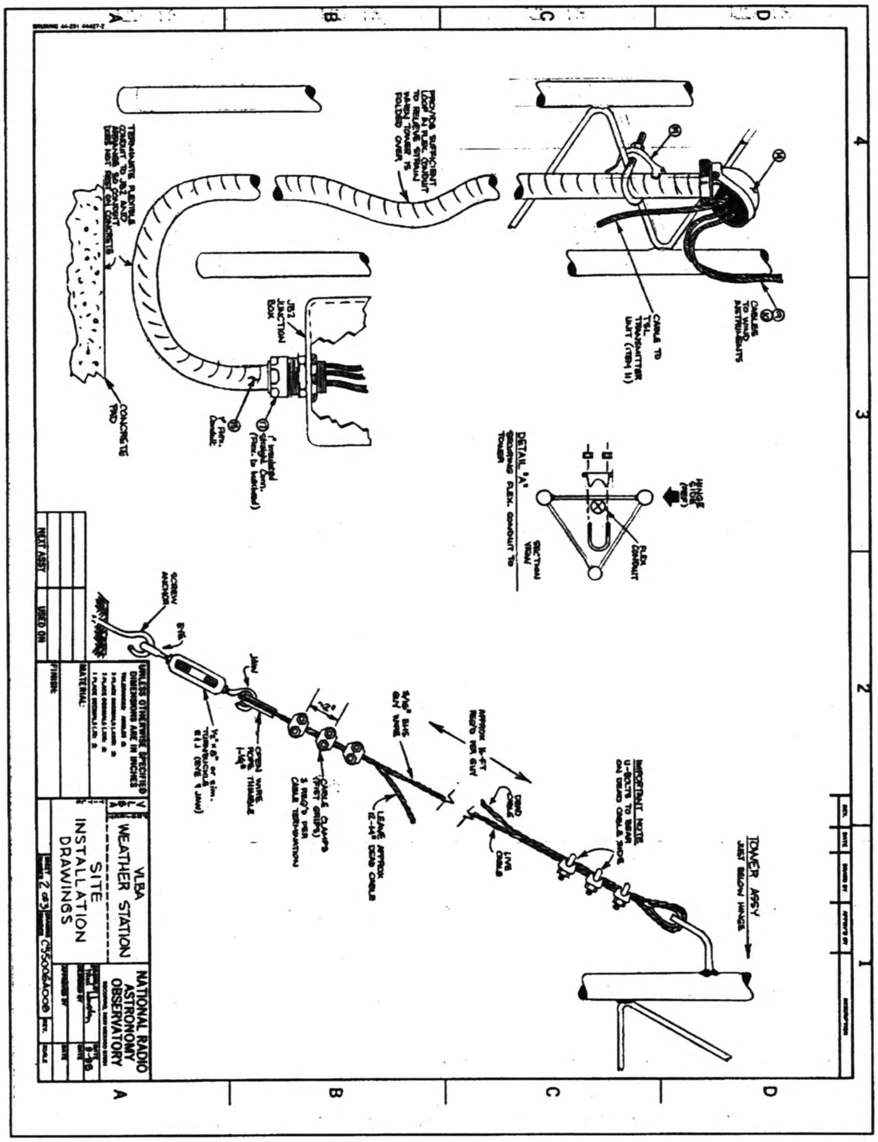


Figure 17 VLBA Weather Station Site Installation Drawings, C55006A008-1



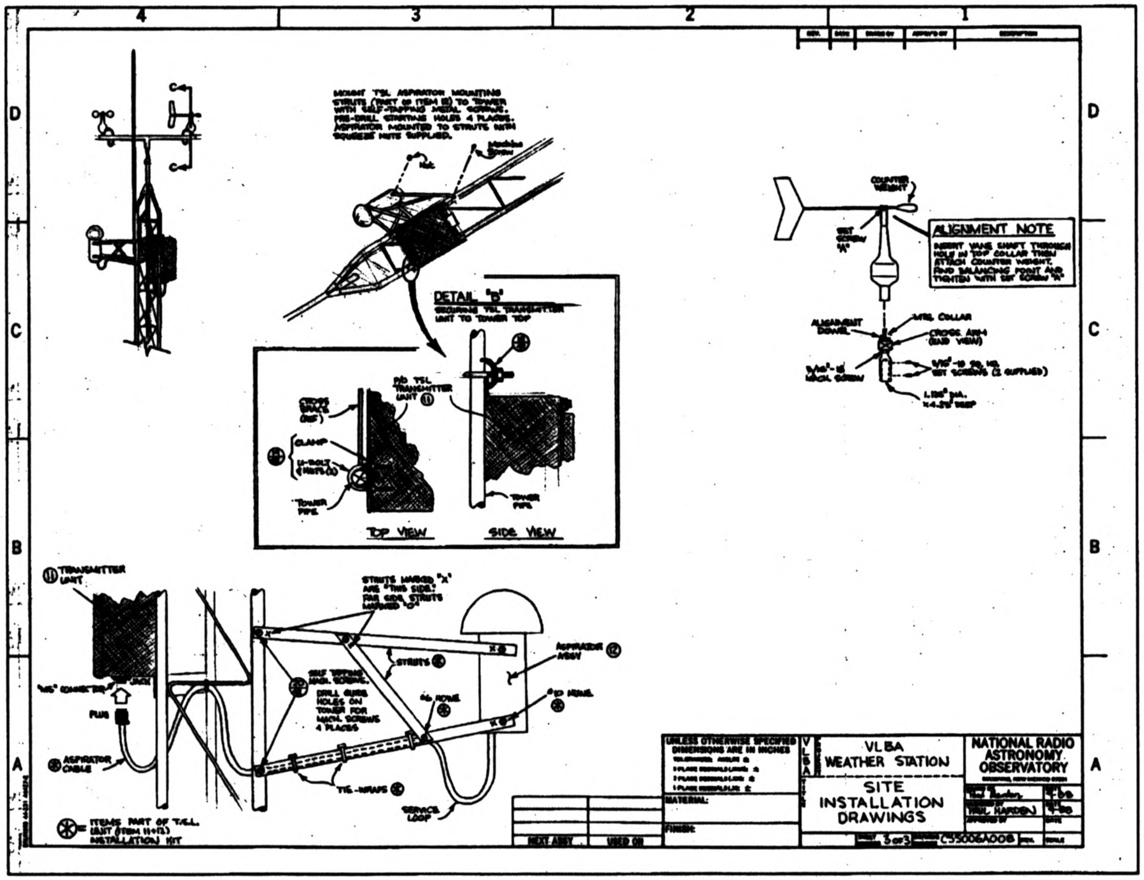


Figure 17 VLBA Weather Station Site Installation Drawings, C55006A008-3

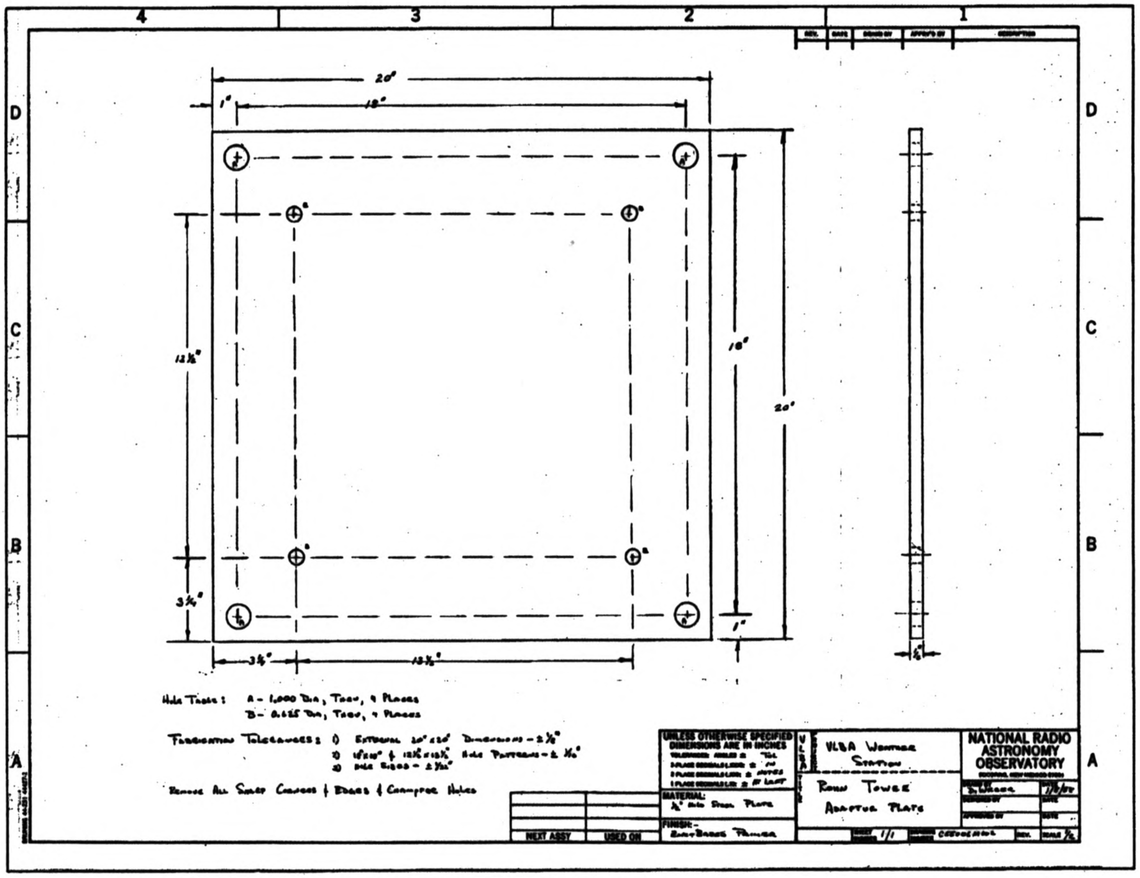


Figure 18 VLBA Weather Station Rohn Tower Adapter Plate, C55006M002

Theory of Operation

TSL Model 1063 Hygrothermometer

This section was excerpted directly from the manual for the TSL. The comprehensive manual is in Appendix 1 of this manual. The TSL has several separate functional areas, including the thermal control loop, temperature measurement, data management, analog to digital conversion, data multiplexing, data transmission, data receiving, data processing, and data display.

Figure 19 is the VLBA Weather Station TSL Transmitter Card Schematic Diagram, C55006S010. It is the detailed electronic schematic for the TSL, and should be referred to for troubleshooting and analysis purposes.

First the thermal control loop is considered. Figure 3-1 in Appendix 1 graphically illustrates the elements of the feedback loop that maintains the mirror at the dew point temperature. This is the heart of the TSL.

A beam of light from a small LED, CR1, is directed at the surface of a mirror at an angle of 45 degrees. Two phototransistors, Q1 & Q2, are mounted to receive the reflected light as shown. Q1, the "direct" sensor, is placed so that it receives light when the mirror is clear. Q2, the "indirect" sensor, is located so that it is sensitive to light that is scattered when the mirror is clouded with visible condensation. As the amount of cloudiness of the mirror surface increases, Q1 receives less light and Q2 receives more light.

The feedback loop is closed by condensation forming on the mirror. This occurs from cooling provided by the thermal module. When the unit is first turned on, the mirror is clear and photosensor Q1 receives directly reflected light, and Q2 receives no scattered light. This condition causes a large negative unbalanced signal at the output of U6B, causing a heavy current to flow through the thermal module in the cooling direction. The unbalanced condition remains, typically for about one minute, until the mirror surface temperature has reached the dew point temperature. At the dew point, the output of Q1 decreases and the output of Q2 increases because of the visible effect of condensation on the mirror. The system now stabilizes at the dew point temperature, maintaining just enough cooling effect to keep the signal levels from Q1 and Q2 in balance, with U6B and the power amplifier supplying just enough cooling current to maintain the mirror temperature at the dew point. If the dew point of the air should change, or if the circuit should be disturbed by noise, the loop makes the necessary corrections to re-stabilize at the dew point. The system is designed for continuous operation.

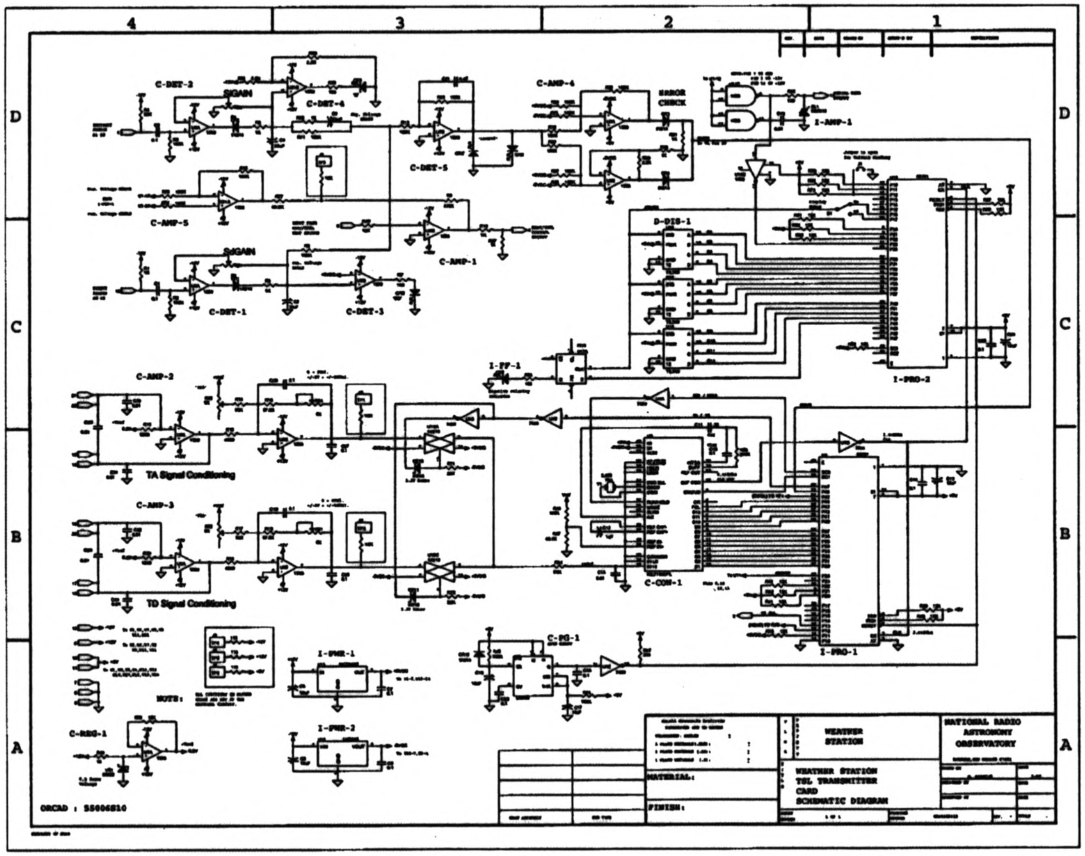


Figure 19 VLBA Weather Station TSL Transmitter Card Schematic, C55006S010

Following Q1 & Q2 are a set of identical signal amplifier-detectors, U5A & U6A, that drive a differential control amplifier, U6B. The output of this hi-gain amplifier is negative when the mirror is clear, and positive when the mirror is heavily clouded, because of the positive difference between the outputs of Q1 & Q2. The output of U6B, through a power amplifier drives the mirror-cooling module, U1. This device is an electronic heat pump, operating much like a thermocouple in reverse. With a DC voltage applied across the terminals, the module produces a temperature difference between its upper and lower surfaces. Depending on the polarity of the applied voltage, the thermal module can heat or cool.

The simplified circuitry described above is the core of the hygrothermometer. All that remains to make this a useful instrument is a means of measuring and displaying the mirror temperature.

Two temperatures are measured, the ambient (Ta) and the dew point (Td). The measurement circuits for the two channels are identical. Figure 3-2 in Appendix 1 illustrates all the circuitry involved in producing two output DC voltage levels which precisely represent Ta and Td. The basic sensor for temperature measurement is a platinum wire resistor called an RTD, for Resistance-Temperature Device. This sensor is encased in a ceramic cylinder, about 1/8 inches in diameter and ¾ inches long. At a temperature of 0°C, the RTD has an electrical resistance of exactly 100 ohms. The resistance varies linearly with temperature, at a rate of .392 percent per degree C.

In our application, a constant DC current of 5 mA flows through the RTD, and the resulting voltage drop across the sensor is used as the temperature signal. In the Ta channel, amplifier U8A is used as the constant 5-mA source through the RTD. The RTD in this example would be located in the stream of air entering the aspirator unit, so that it would assume the temperature of the ambient air. U8B is used as a scaling and offset adjustment amplifier, setting the output voltage level at a convenient value.

Two DC currents feed the node of U8A, a 5 mA reference input from a 6.2 volt reference voltage source through a precise 1240 Ω resistor, and a feedback current of opposite polarity equal to U8A output voltage through the RTD. By standard operational amplifier analysis, one can see that the feedback loop will force the feedback current to be equal to the 5-mA input current. Since the node of the op-amp, pin 1, is at virtually zero, the U8A output voltage must be equal to .01 x R1 volts. This would give us an output voltage equal to -.5 volt DC at 0°C, -0.4 volts an output voltage equal to -.5 volt DC at 0°C, -0.4 volts at -50°C, and -.6 volts at +50°C. These values could be used directly for measurement and display purposes, however, they are amplified, inverted and offset by U8B to a more convenient scale. U8B is a conventional inverting op-amp with a gain factor of 20 by virtue of the ratio of the feedback resistance, R34 and R16, and the input resistor, R15. The gain, or scale factor, is slightly adjustable by varying the setting of R34. This is used as a calibration adjustment. The input offset value (-0.5 volt at 0°C) is cancelled out by the signal through R35 and R14. Potentiometer R35 is adjusted to bring the output of U8B to zero at 0°C. At the output of U8B, the signal level vs. temperature relationship is 25°/volt, with 0 volts representing 0°C. A temperature of plus or minus 50°C would be represented by plus or minus 2 volts DC at the output.

The dew point temperature measurement channel is identical in all respects, except that the dew point RTD is physically located inside the body of the mirror, so that it assumes the temperature of the mirror, which is constantly held at the dew point temperature.

In a simpler hygrothermometer system, the outputs of U8 and U9 could be connected to a pair of voltmeters and the system would be complete. The Model 1063 has been designed for capability of displaying the outputs at a great distance from the sensors, so a means of transmitting the outputs must be provided which is insensitive to the effects of line length, noise and other sources of errors.

In addition to transmitting the two analog temperature signals to remote indicators, certain other operations are performed on the data. Among these are detection and storage of maximum and minimum temperature values and averaging the data to eliminate short-term variations. Because of the complexity of circuits that would be required for these operations, microprocessors are used for all of the necessary data manipulations. In the transmitter unit, the two analog signals, Ta and Td, are converted to binary digital words and fed to the input of a microprocessor (MPU). This MPU is used only as a formatting device, converting the input data into a serial format suitable for transmission over long distance telephone equipment. In our case, the data is transmitted from the top of the 10m tower to the electronics enclosure. In the receive unit, another similar MPU receives the data words and performs all of the necessary arithmetic operations and re-formats the data for output display on numeric panel indicators. As an incidental function, the MPU's also perform data quality checks as a safeguard against effects of detectable errors, noise and component failures.

A single analog to digital converter (A/D), type 7109, is used for the Ta and Td data, so a means must be included for time-sharing or multiplexing the converter input. The multiplex gates and A/D converter connections are shown in Figure 3-3 in Appendix 1.

Two CMOS gates are used to selectively connect Ta and Td to the input to the converter. The gates are, in effect, series switches, each controlled by a select line. When the control line to a gate is in the low (0) state, the gate has an effective resistance of hundreds of megohms to the signal. When the control line is high (+5v), the gate presents a resistance of about 50Ω, connecting the signal to the converter. The two gate outputs are tied together, and their control inputs are complementary, so that at any given time only one of the two inputs is connected to the converter.

Operation of the converter is automatic, as described by the 7109 data sheet. When the RUN/HOLD line from the MPU to the converter is in the RUN condition, the analog input controls the generation of a parallel 12-bit binary representation of the input quantity. The 11 data bits and polarity bits are hard wired to appropriate inputs of the MPU.

Conversion requires about 30 milliseconds, depending on the data value. To prevent data transfer to the MPU occurring during the conversion time, a STATUS line from the converter is used as a signal to indicate to the MPU that data is stable and available after each conversion. When the STATUS line is high, the MPU may request new data values. Likewise, after the MPU has processed an input data word, it raises the RUN/HOLD line to signal the converter that a new conversion may begin. This exchange of control signals is called a "handshake" process.

After the MPU has processed an input sample, it reverses the state of the multiplex control line to the analog gates. If the data sample had been Ta, the next condition of the control line would be to enable the Td gate, and vice versa.

In the MPU, the data words Ta and Td are temporarily stored and formatted into a low-speed serial output train. A 1488 RS232 line driver is used to buffer the MPU output signal for transmission. Transmission is by way of a 600 baud Manchester code, suitable for conventional telephone-grade circuits. The data is otherwise unchanged by the transmitter data handling circuits.

Figure 20 is the VLBA Weather Station Receiver PCB Logic Diagram, C55006L002. It is the detailed electronic schematic for the TSL receiver, and should be referred to for troubleshooting and analysis purposes.

In the receive unit, the serial data stream is buffered by a type RS232 1489 line receiver and fed directly to the serial input data port of the MPU. Although data flows continuously into the MPU at a rate of 2.5 complete frames/second, the MPU uses the input data only once per 37.5 seconds. When the MPU begins its input process, it examines the Ta and Td values. If Ta or Td is more than 2 degrees different from the presently displayed value, the data is considered to be faulty, and the sample is discarded, and the next sample is tested. This process is repeated for three trials. At the fourth trial, the data is accepted unconditionally. This tends to screen out errors that may be caused by momentary signal transients or transmission line faults. The data that is accepted is stored in the MPU memory. Figure 3-4 in Appendix 1 illustrates the flow of data in the receiver unit.

All of the data processing described so far has served only to enable the transmission of the raw data, unchanged, to the receiving display unit. Before the Ta and Td values are displayed, certain manipulations and calculations must be made. These are all performed by the MPU in the receive unit.

The received data, after the input screening for obvious errors, is stored in memory. This process occurs at 37.5-second intervals. Memory space is reserved for 8 complete samples of Ta and Td, representing 5 minutes of climate conditions. The 8 sample values are added and divided by 8 to yield a 5-minute average value of Ta and a 5-minute average of Td. The average values are updated at each 37.5-second input sampling and stored in memory.

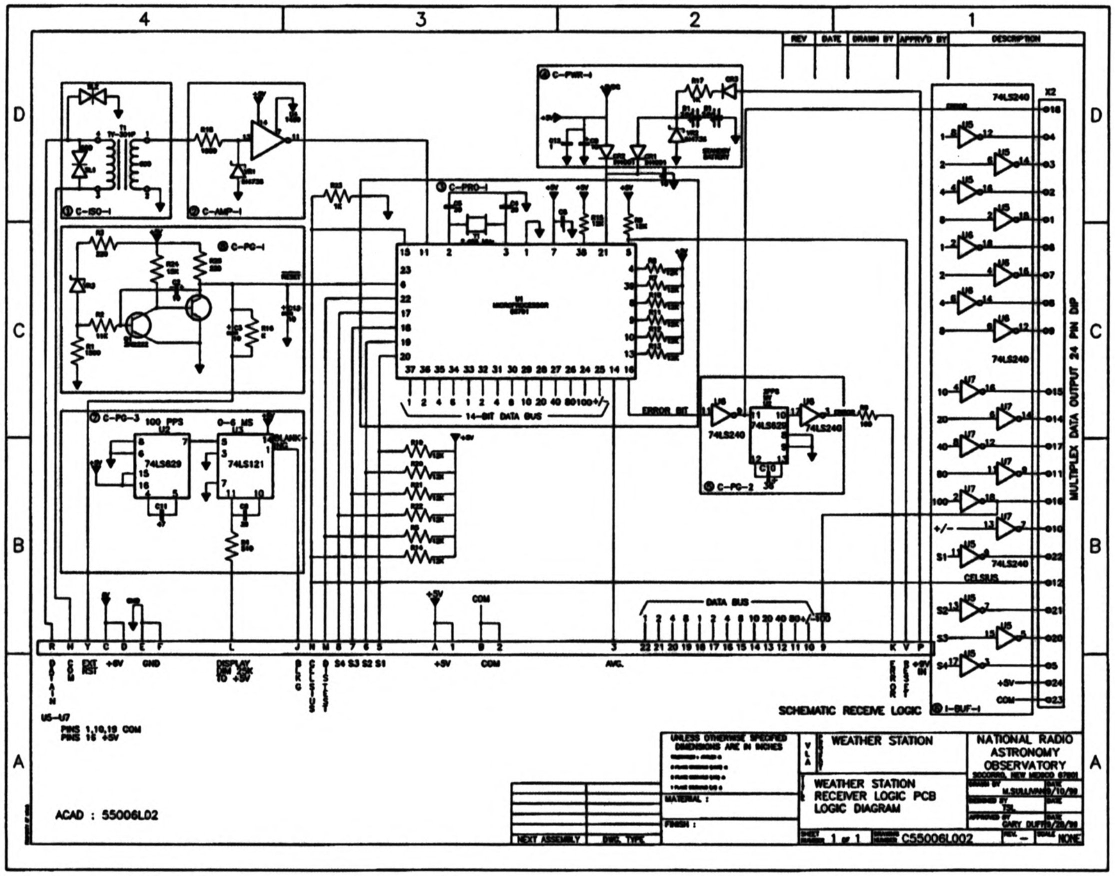


Figure 20 VLBA Weather Station Receiver PCB Logic Diagram, C55006L002

At each updating, the value of average Ta is examined and compared against a stored maximum and minimum value. If the average Ta is greater than Tmax or less than Tmin, the max or min value is changed accordingly. Tmax and Tmin are maintained continuously, and are re-started by way of a reset command.

To prepare the output data words for display, the 11-bit binary numbers in storage are converted to Binary Coded Decimal (BCD) format. This is done by a subroutine in the MPU program. All of the output data are brought out of the MPU on 14 lines, coded as tenths, units, tens, and hundreds of degrees and a polarity bit.

The display module in the electronics enclosure contains storage latches to sample and store the data as it is strobed in. The latch modules, type MC14511, also contain seven-segment decoder-drivers that directly drive the incandescent segments of the decimal display.

Wind Speed Sensor

The wind speed sensor is a Qualimetrics Model 2030 anemometer. It uses three cups, and utilizes a photon-coupled chopper to produce a pulse output with frequency proportional to wind speed. The threshold of this anemometer is 0.5 miles/hour. The complete assembly, with exception of the photon coupled chopper, is manufactured from stainless steel. It is connected with cabling with a quick release waterproof connector. This anemometer is used in conjunction with signal conditioning modules that provide an analog signal output proportional to the wind speed.

The photon-coupled chopper consists of two parts. A light emitting diode in combination with a light sensitive transistor is mounted directly to the anemometer connector. A slotted wheel connected to the anemometer shaft interrupts the light beam between the light emitting diode and the photon transistor. This interruption of light causes a change in the transistor collector to emitter current. The changes in current are amplified and conditioned in the signal conditioning modules to provide an analog signal proportional to frequency.

Wind Direction Sensor

The wind direction sensor is a Qualimetrics Model 2020 vane. It is an analog output wind vane, and is equipped with a structural plastic tail with a durable aluminum filled plastic coating. The vane body is a precision-machined aluminum housing with a clear anodized finish. Stainless steel shafts bearings and fittings are used throughout. A precision potentiometer is coupled to the vane shaft to provide an analog output proportional to wind direction. An airfoil style counter-weight provides precision balance of the tail assembly upon the shaft. A quick release waterproof connector is provided for cable terminations.

Changes in the wind direction are sensed mechanically by a balanced vane assembly. The mechanical motion is transformed into an electrical signal through a shaft that couples the vane to a potentiometer.

The potentiometer used in the wind vane has a long electrical angle and is a make-before-break 5000Ω resistive element. The actual element is a wire wound device to help increase the life of the sensor.

Protective zener diodes are attached across the excitation lead and the wiper lead to the common lead. The diodes help quench transients induced by external sources.

The potentiometer is excited by a +5 VDC regulated source. A 2500Ω resistor is placed in series with the +5 VDC source to protect the source when the make-before-break contact occurs and to protect the potentiometer element against a dead short in the +5 VDC power source. The voltage generated at the potentiometer wiper varies from 0 to 3.333 VDC as a direct function of the wind direction variations.

Rain Gauge

The rain gauge is a Qualimetrics Model 6021-B Electrically Heated Rain and Snow Gauge. It is a tipping bucket rain gauge. Rain enters the gage through a large funnel, the rim of which is protected by a metal ring to prevent distortion. Collected water passes through a debris-filtering screen and is funneled into one of two tipping buckets inside the gage. The bucket tips when a given amount of water has been collected, the amount is determined by gauge calibration.

When precipitation occurs in a frozen form, it is necessary for the heater to be used. Each gauge includes 4 separate heaters. A NiChrome wire heater wraps around the collection funnel to melt the precipitation for measurement. A second NiChrome wire heater warms the internal components and the gage base to prevent re-freezing of the water inside the gage. Additionally, a cartridge heater is plugged into each of the gauge drain tubes so that the measured precipitation passes out of the gauge freely without freezing on contact with the cold outside air. Thermostats control the funnel and the base heaters; the drain tube heaters are continuous duty. Either 115 or 230 VAC can be used as input power.

As the bucket tips, it causes a 0.1-second switch closure. The tip also brings a second bucket into position under the funnel, ready to fill and repeat the cycle. After the rainwater is measured, it drains out through tubes in the base of the gage. The drain holes are cover by screens to prevent insect entry.

The rain gauge is calibrated to a resolution of 0.1mm. As the bucket tips, it causes a magnet to pass over a mercury-wetted reed switch, closing the switch momentarily. Measurement accuracy is 0.5% at a precipitation rate of 0.5 inches per hour.

A1 Standard Interface Board (SIB)

This is a brief overview from VLBA Technical Report No. 12, VLBA Standard Interface Board Manual. For a comprehensive, detailed discussion of the Standard Interface Board, please refer to this manual.

Figure 21 is the VLBA Standard Interface Board Model D Schematic, C55001S004. This is a detailed electronic schematic for the SIB. Refer to this drawing for troubleshooting and analysis purposes.

The Standard Interface Board is used as a general-purpose monitor and control interface in the VLBA Telescope Monitor and Control System. The VLBA Station Computer is the system Controller in this system. The Controller communicates with Standard Interface Boards installed in the system components. The communication path is a two-pair, party line, time-serial Monitor and Control Bus. The Controller (the computer) outputs time-serial, simplex mode messages to the system devices via the Command (XMT) bus. XMT bus messages are either control messages or monitor requests. Monitor request messages return communication status information or monitor data messages to the controller. The VLBA Monitor and Control Bus (XMT and RCV) conforms to the EIA RS-485 signal specification. The XMT and RCV bus message formats and protocol are described by specification A55001N001 (section 6 in VLBA Technical Report No. 12).

The Standard Interface Board is typically a modular component of a device and functions as a serial-parallel converter to interface the Monitor and Control Bus to the devices that are to be controlled or monitored. Some devices are modules, such as a receiver control unit or an IF processor; other devices are subsystems, such as the weather station for example. In this case, the use of the Standard Interface in monitor and control interfacing is very simple; the chief differences between applications are the character and volume of control or monitor operations be performed.

Because analog signal multiplexing and A/D conversion are frequently required, the Standard Interface Board contains an optional analog multiplexer-A/D converter. The converter is integrated into the logic of the interface so that it may be easily applied to analog signal monitoring applications. Additional analog multiplexers installed in the device circuitry may extend the analog multiplexing capacity of the interface.

The Standard Interface Board is always used in conjunction with digital circuitry, in this case the A2 Logic Board, that implements the device address, command and monitor data functions.

The SIB is an address-restricted implementation of specification A55001N002-A (also section 6 in VLBA Technical Report No. 12). The board device address capability is 256 command and 256 data channels. In addition there are 16 interface internal command and 16 interface internal data addresses. The message format specifications (cited above) do not define the maximum size of an interface address block; it could be any size within the specified address range. The interface board specification is both a functional and physical specification in that it defines the functional properties, physical size, and I/O connector types and pin assignments.

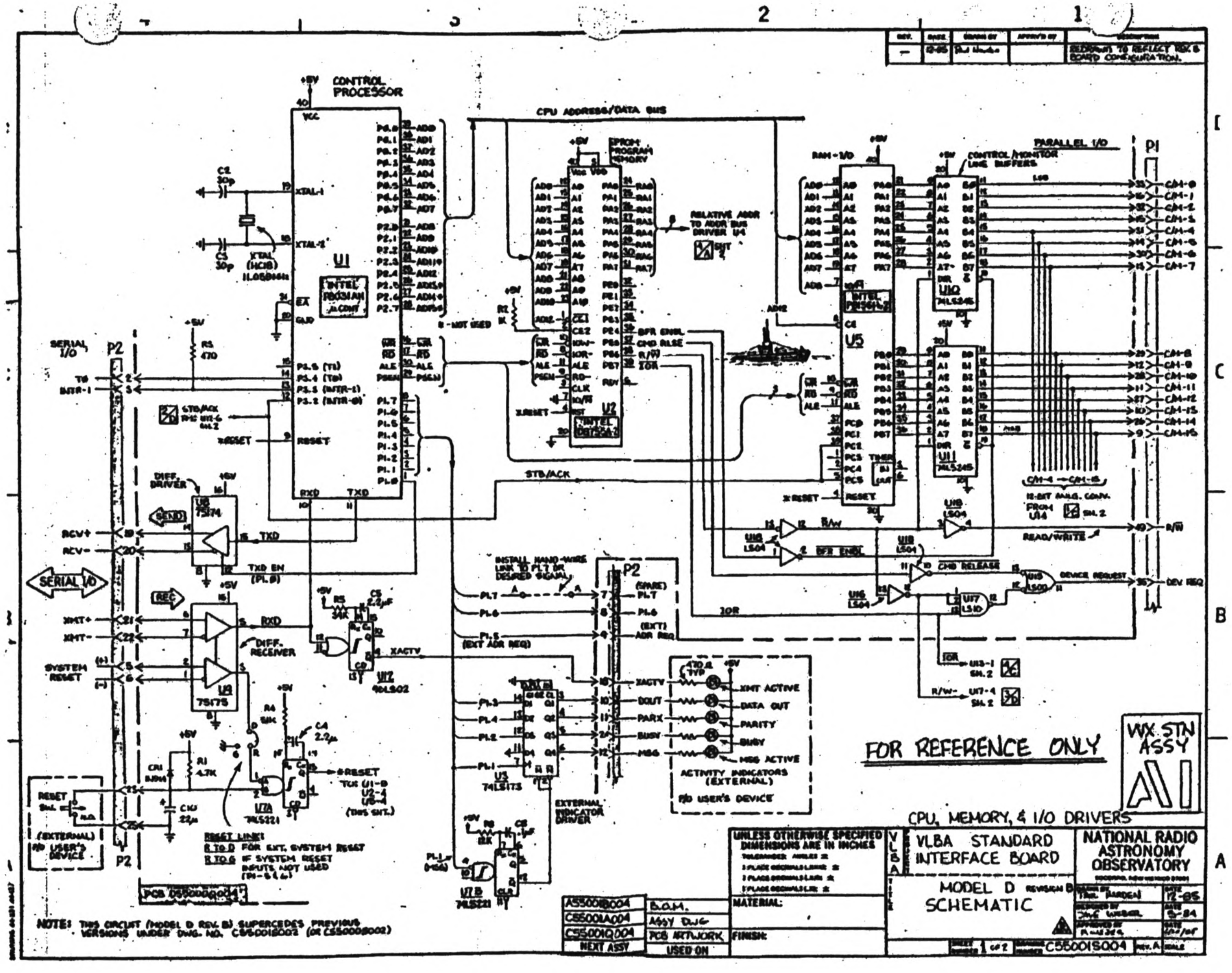


Figure 21 Standard Interface Board Model D Schematic, C55001S004-1

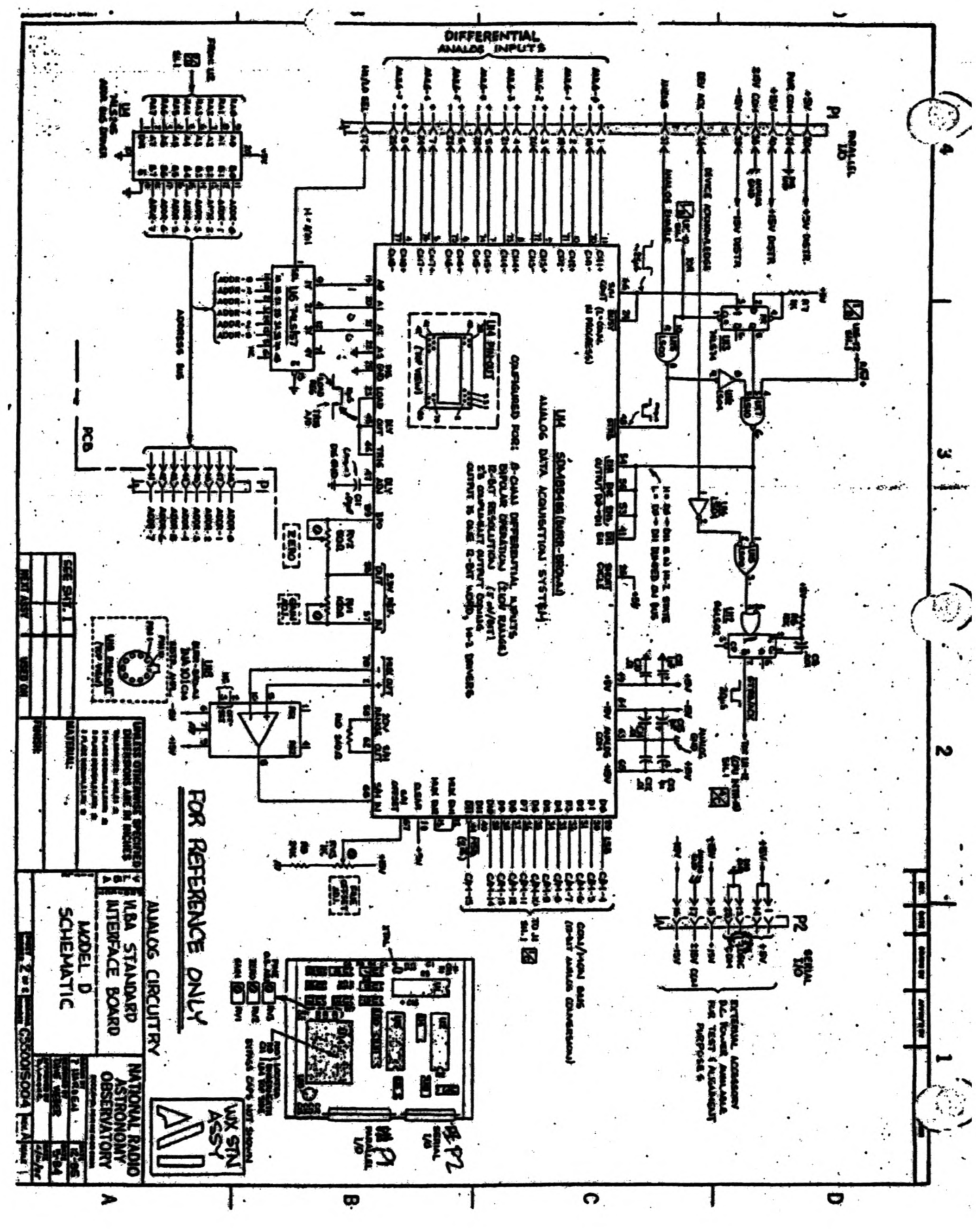


Figure 21 VLBA Standard Interface Board Model D Schematic, C55001S004-2

A2 Logic Board

The A2 Logic Board is a 6" x 7" wire-wrap board with a 100-pin edge connector. The logic board stores and distributes the digital information furnished from the sensors and their component parts to the Standard Interface Board when requested. It decodes the address, handles digital command & monitor data, and performs some analog multiplexing for the analog 1 and analog 2 lines to the A/D converter on the Standard Interface Board. The logic board also initiates control and handshake functions to receive digital information from the barometer.

Figure 22 is the VLBA Weather Station A2 Logic Board Schematic, C55006S006. Refer to this drawing for troubleshooting and analysis purposes.

There are three decode functions for the A2 Logic Board. They are the digital command decode, monitor data decode and the relative address block decode. Relative address blocks are hexadecimal in format, and are listed as such in VLBA Technical Report No. 5, List of Current Monitor and Control Points. The logic for each is a 74LS138 three-line to eight-line decoder. This logic decodes one of eight lines dependent on conditions at the three binary select inputs and the three enable inputs.

U30 decodes the relative address lines A3-A7 with device request, this decoder produces five blocks of relative address enables which are 0-7, 8-0F, 10-17, 18-1F, and 20-27. The first three blocks 0-7, 8-0F, and 10-17 are used for the analog monitors. Block 10-17 is used to enable the digital monitors via U26. Block 20-27 is used to enable digital commands via U25.

Address lines A0-A2 are the binary select inputs to the digital command decoder and monitor decoder on pins 1, 2 & 3 of U25 & U26 in order to select one of 8 functions within a block.

Pin 6 of U25 is pulled high so that pins 4 & 5 will enable U25. U25 will only be enabled if block 32-39 is active (pin 11 of U30) and R/W is set to write mode (low). The outputs from the digital command decoder are reset lines for the TSL (RA22), the peak windspeed latches (RA23) pin 1 of U23 & U24, and the rain-gauge binary counters (RA24) pins 2 & 12 of U39 & U40.

The TSL reset line goes to the A5 TSL Receiver Board, it resets the TSL min/max temperature to the current temperature. The wind speed reset activates the latch reset on pin 1 of U23 & U24, and resets the peak wind gust reading to zero. The rain-gauge reset activates the binary counter reset on pins 2 & 12 of U39 & U40, and resets the rain-gauge counters to zero.

The enable inputs to the monitor decoder is R/W at pin 6 of U26, and block 18-1F decodes from pin 12 of U30 relative address block decoder to pins 4 & 5 of U26. U26 will only be enabled if block 18-1F is active and R/W is set to the read mode (HIGH).

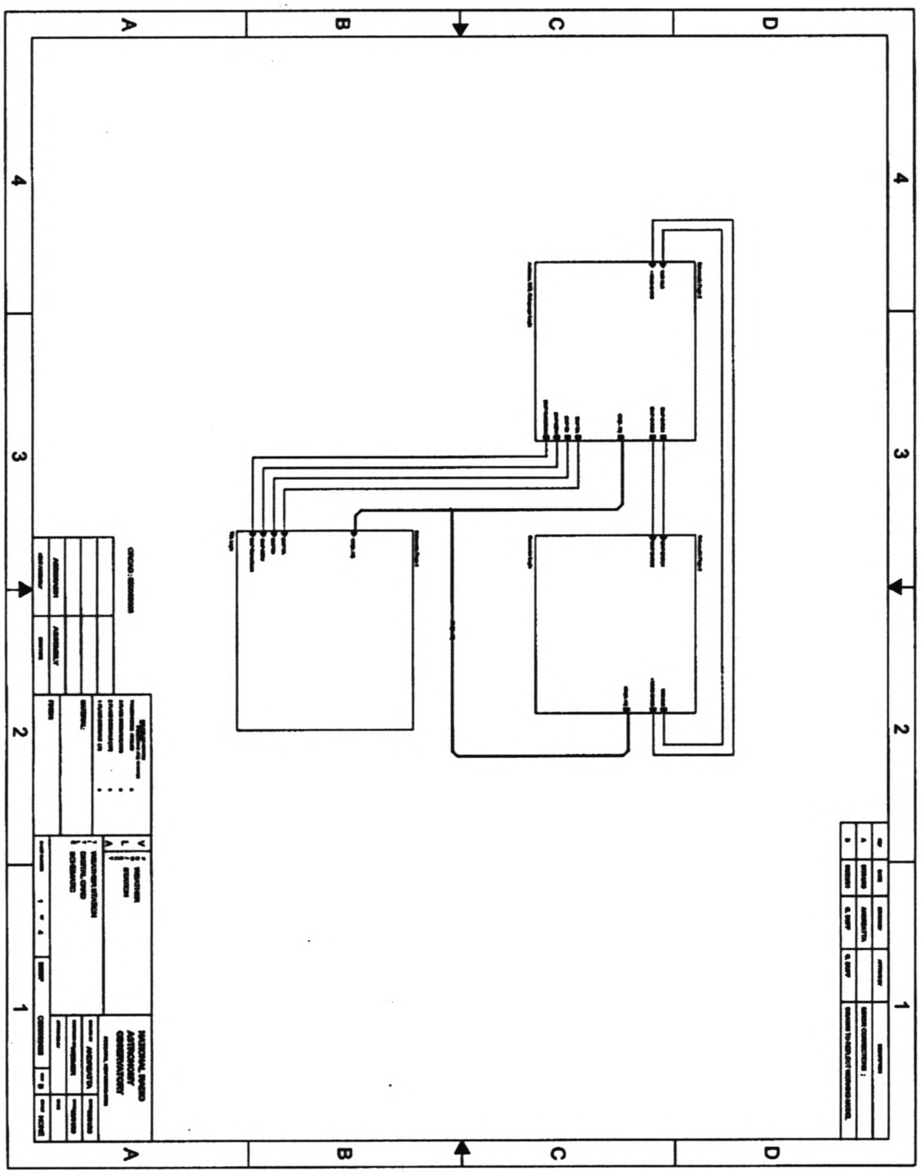


Figure 22 VLBA Weather Station A2 Logic Board Schematic, C55006S006-1

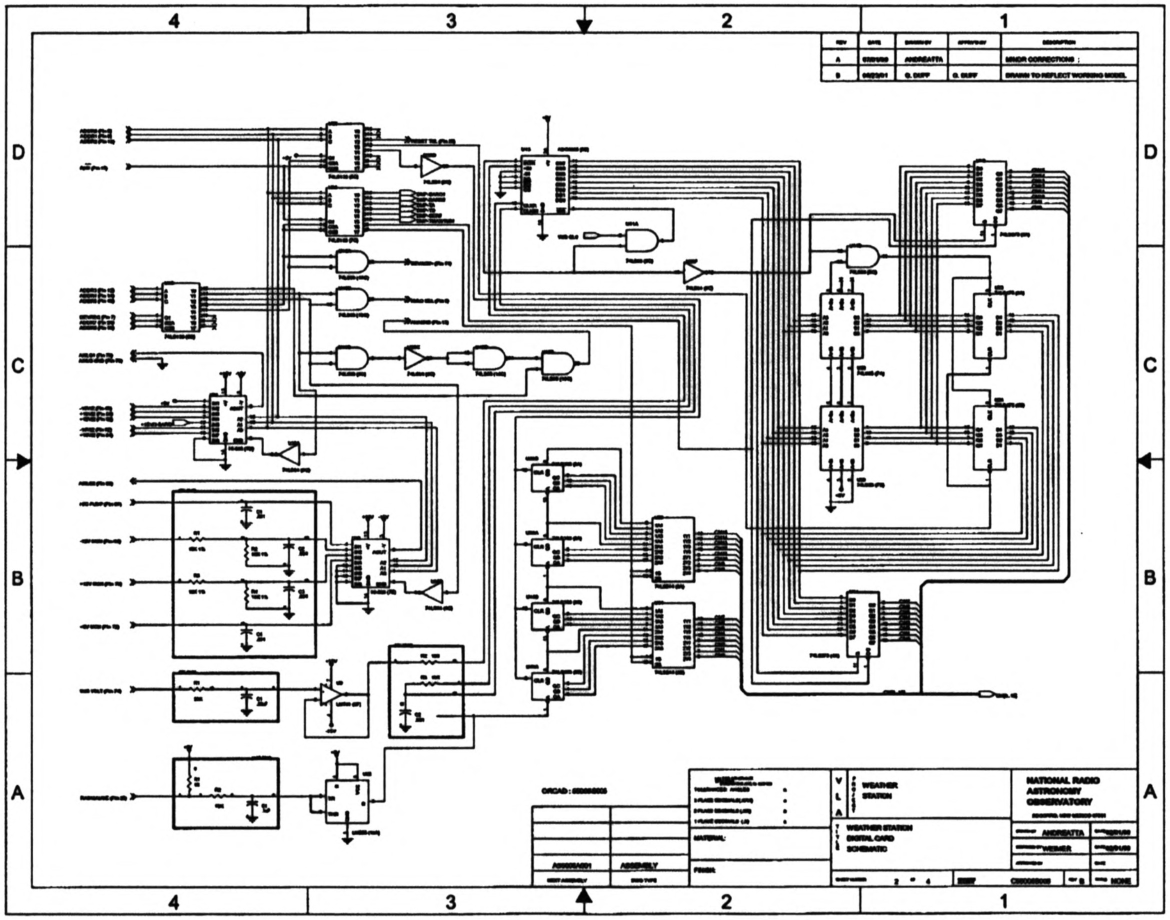


Figure 22 VLBA Weather Station A2 Logic Board Schematic, C55006S006-2

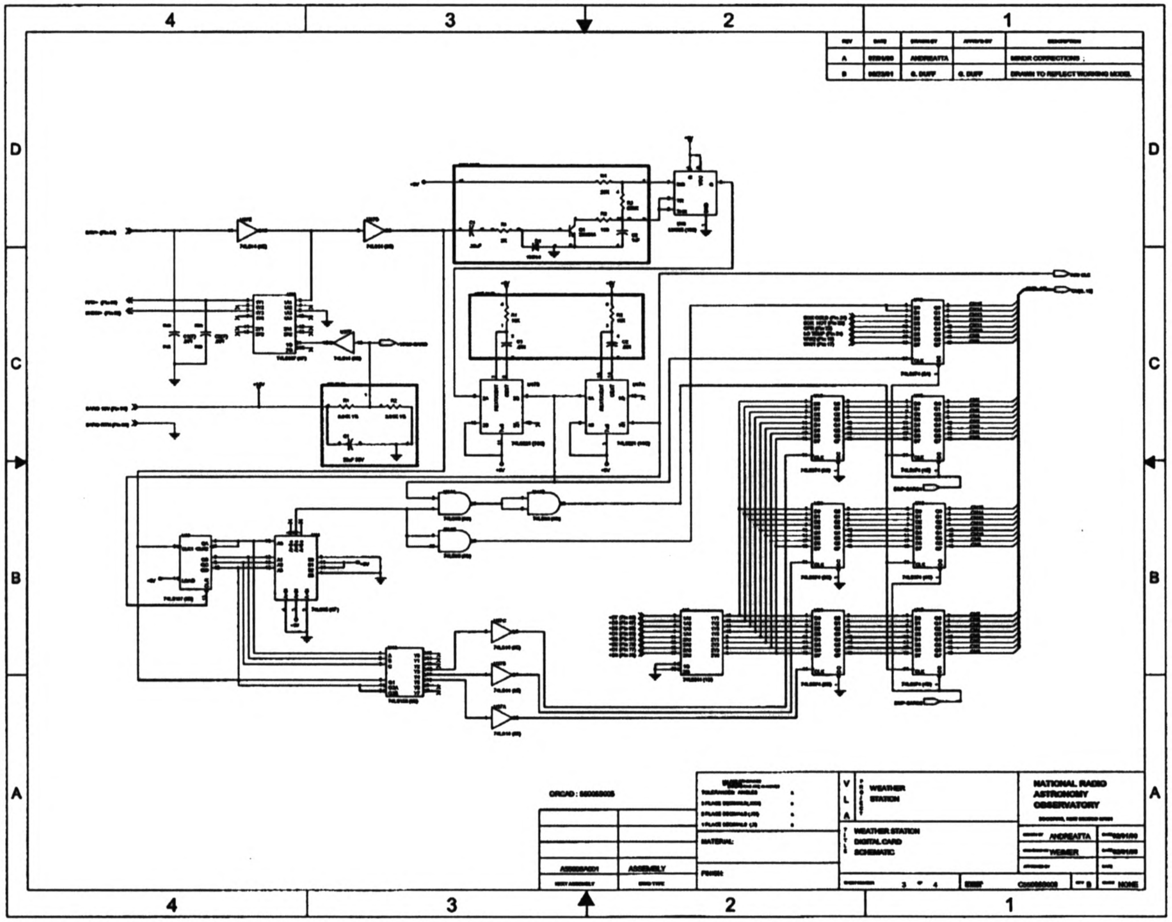


Figure 22 VLBA Weather Station A2 Logic Board Schematic, C55006S006-3

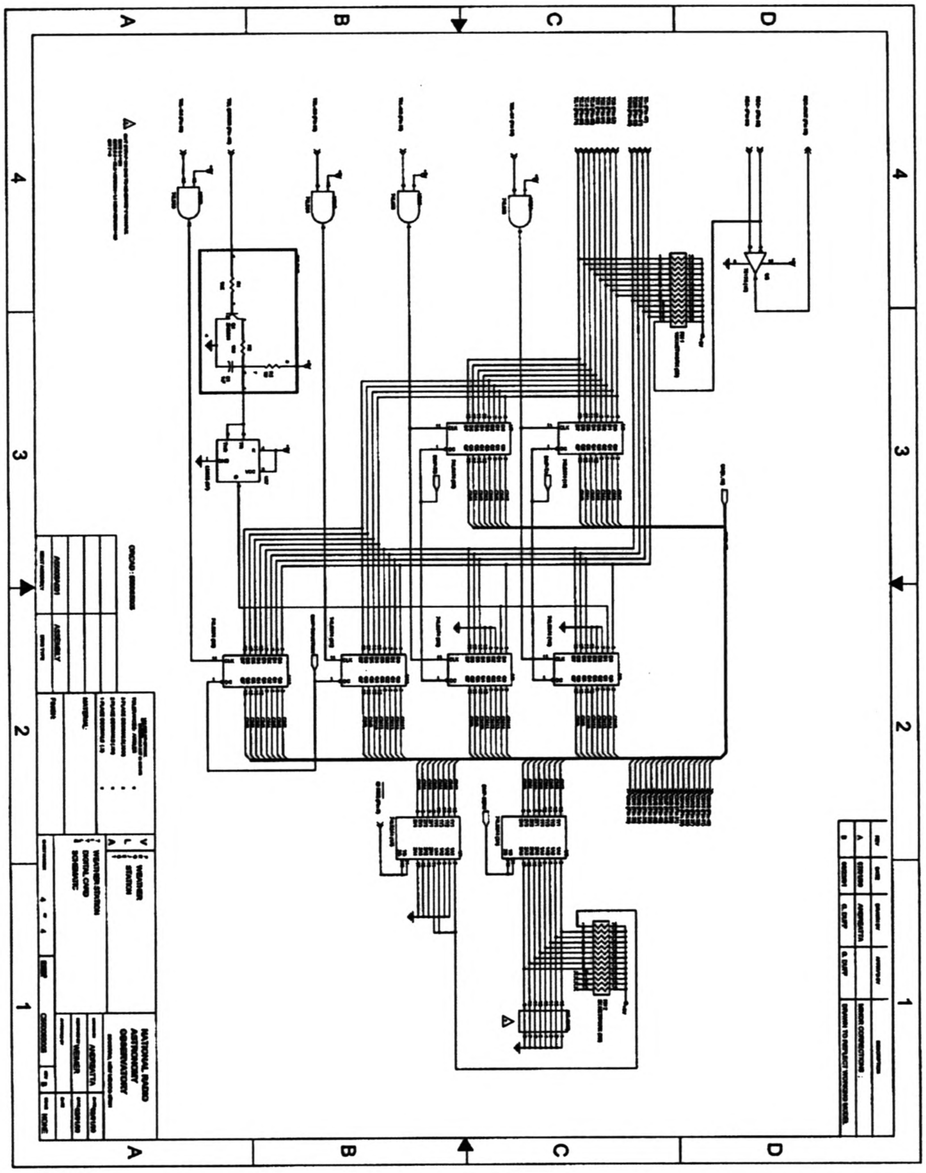


Figure 22 VLBA Weather Station A2 Logic Board Schematic, C55006S006-4

The outputs from the monitor decoder are tri-state output enable lines to the latches for the barometer (RA18) pin 1 of U16 & U17 and (RA19) pin 1 of U15 & U18. For the ambient temp/dew point (RA1A, RA1B), it is pin 1 of U2 & U3. For the minimum and maximum temperature (RA1D) pin 1 of U11 & U12, the serial number (RA1C) pins 1 & 19 of U6, the wind speed (RA1E) pin 1 of U10 & U14, and the rain-gauge (RA1F) pins 1 & 19 of U33 & U34.

The monitor data for the barometer also includes status information for box temperature hot (fan turned on), cold (heater turned on), a low temperature warning for antenna stow, excessive wind warnings, and barometer error. With the exception of the barometer error, all status information comes from the A3 Analog Board. These inputs are pins 7,8,13,14,17 & 18 on U18. Barometer errors are reported on pins 3 & 4 of U18.

The handshake and control for the barometer is a two-line function used to synchronize transfers between the barometer and the A2 logic board. The A2 logic board controls the RFD+ (ready for data) signal and the barometer controls the DAV+ (data valid) signal. The RFD+ is active high, generated from pin 3 of U38 to the barometer. Consequently, after the barometer has completed a measurement averaging cycle it tests the RFD+ signal for the active state, and upon detecting the RFD+ signal, it begins the data transfer sequence.

The barometer monitor data is input in from the barometer through U4, a 74LS244 octal buffer and clocked into 74LS374 latches U19, U20 and U21 to store the data as 3 eight-bit words.

Each +DAV trailing edge will clock pin 8 of U36 until states 3, 4 & 5 are presented to U43 while it is enabled during +DAV. States 0, 1 & 2 are disregarded, however only states 3, 4 & 5 will clock the data into U19, U20 & U21 respectively by the rising edge of +DAV.

U48 is a 555 timer running as an astable oscillator with ~70% positive duty cycle, with a frequency of ~1.14 Hz. The first +DAV pulse, consequently providing the bias voltage for Q1 on header 10G-DH8 triggers it high. This forces the threshold voltage on pin 6 of U48 below the normal 1/3Vcc condition that allows the 555 to free run at ~50% positive duty cycle. The net effect is that it takes a longer period of time to charge capacitor C2 to above the 1/3Vcc and then to the 2/3Vcc condition, thus stretching the output of U48 to around 700ms. This is adequate enough time to load the data into U19, U20 & U21, which is clocked by the +DAV pulse.

The barometer takes 10 measurements per second and averages the result, which in turn is available at D0-D7 every second. The 555 timer gives the loading process plenty of time (555 frequency ~1.14 Hz) for the data cycle to complete one measurement process.

When U36 reaches state 6, the magnitude comparator U44 recognizes this condition and outputs the high state, which in turn supplies the status bits for the barometer, in this case 0's on pins 3 & 4 of U18. This is of course when the electronics are working properly, and the barometer is dutifully reporting atmospheric pressure.

When the output of the 555 timer is high, likewise the input pin 9 of U47B is high as well. The negative going transition from high to low on pin 9 of U47B as qualified from the 555 timer duty cycle supplies the high clock pulse to parallel load the data into U15, U16 & U17. This also forces pin 4 of U47A to output a low, which in turn clears the state machine U36, and be ready to start again with the next measurement.

If for any reason +DAV is unavailable or any other malfunction in the circuitry, the state machine U36 and its cohort U44 will be unable to identify the subsequent state 6. The result is a low condition on pin 6 of U44, which sets the status bits to 1's on pins 3 & 4 of U18. This is identified as an error condition in the software program, thus the data will be disregarded.

Likewise, if there is no positive going transition from pin 5 of U47B, there can be no new data parallel loaded into U15, U16 & U17. Visually on the overlay screen this would appear as an unchanging barometric pressure reading.

The SHDN+ (shutdown) feature for the barometer is not used in this application, however the input is grounded through pins 6 & 7 of U38 to prevent any capacitively coupled signals from activating the SHDN+ pin on the barometer.

The monitor data for the ambient and dew point temperatures are input from the A5 TSL Receiver Board, and is three binary coded decimal (BCD) values. The input signals are pulled-up via a 10KΩ-resistor network RN1. The logic board uses bits TC 0.1 through TC 40 on bits 0-10 of the storage registers for the BCD values, with TC – on bit 15 to indicate the sign of the value (±). Bits 11-13 are unused, and bit 14 indicates an error. Bits 0-7 measure tenths and ones, but bits 8-10 measure tens. It's important to remember that the values are BCD in format.

74LS374 registers U2 & U3 are loaded with the ambient temperature, while U7 & U8 are loaded with the dew-point temperature. There are two clocks generated at the A5 TSL Receiver Board, TSL S1 for the ambient temperature and TSL S2 for the dew point temperature. The ambient temperature gets clocked on pins 11 of U2 & U3. The dew point temperature is clocked on pins 11 of U7 & U8. The current latched values are transferred to the SIB when requested.

The technique is repeated for the minimum and maximum ambient temperatures, however only the sign, the tens, and ones are loaded into the registers. The tenths values are ignored. The storage registers for the minimum and maximum temperatures are U11 & U12 respectively. There are two clocks from the A5 TSL Receiver Board, TSL S4 for minimum temperature and TSL S3 for maximum temperature. Minimum temperature is clocked on pin 11 of U11, and maximum temperature is clocked on pin 11 of U12. The current latched values are transferred to the SIB when requested.

The serial number identifying the location of the weather station is generated on the logic board. DH2-4E is an eight-pin header wired to reflect the serial number of the station. A cut link on DH2-4E indicates a high value, while a closed link is a low value. The inputs are pulled up via a 10kΩ-resistor network. The ID (weather station in hex = 18) is hard-wired on board. This information is passed through 74LS244 buffer/drivers U1 and U6 to the SIB when requested for ID and serial number respectively.

The monitor data for the wind speed/wind gust is routed through a buffer U2F, a 741 Op-amp non-inverting buffer to the ADC0805 Vin+ on pin 6 of U13. The analog-digital converter has eight bits of resolution with an on-chip clock generator. The outputs of the ADC are used for current values for wind speed, and for peak wind gust values. Bits 0-7 are used for the current wind speed and bits 8-15 are used for the peak wind gust. Four-bit magnitude comparators 74LS85 U28 & U29 compare the current peak wind gust values with the previous latched values in 74LS175 U23 & U24 to determine which one is the highest value, thereby providing a current peak wind gust value to 74LS373 latch U10. The information is transferred to the SIB when requested.

The rainfall gauge monitor data is derived from a switch closure in the rainfall gauge and a high-low signal is thus generated through a voltage divider RC network on the logic board to provide stable trigger mechanism for the clock element for the binary counter. A 555 timer U22 provides a positive de-bounced clock when the contact closure in the rainfall gauge is made, initiating a binary count for the cascaded counters 74LS393 U39 & U40. The current counter values are passed through 74LS244 U33 & U34 to the SIB when requested. Each count is equal to 0.1mm precipitation measured over the collection surface area.

The output lines from the relative address block decoder Y0-Y2 pins 13,14 & 15 of U30 are used for ANAENB for the SIB, which specifies the analog monitor data to be sampled. In this case, relative addresses RA00-RA17. These monitor points include all analog portions of the weather station. Y1-Y2 pins 13 & 14 of U6D are used for HI/LO SEL for the SIB and for this application both the on-board and device multiplexers are used. This allows for the relative addresses to be RA08-RA17, which in fact are the monitor data inputs to the logic board analog multiplexers HI-508 U31 & U32. Y3-Y4 pins 11 & 12 of U30 are used for the DEVACK+ for the SIB, which signals that the device has accepted command data or has written monitor data on the data bus. This includes commands and monitor data for relative addresses RA18-RA27.

The analog multiplexing on the logic board sends analog signals for ANLG1 and ANLG2 U31 & U32 going to the SIB. There are two eight-channel multiplexers on the logic board, each a HI-508. The decode address lines are A0-A2, pins 1,15 & 16 on U31 & U32.

Analog multiplexer U31 is associated with ANLG1 to the SIB. This multiplexer selects voltage monitor points coming from the A3 Analog Board. The voltage monitor points are –15V/2, +15V/2, +12V/2, +15V/3, -10V/2, +10V/2, +5V, and GND. The pins corresponding to the inputs are pins 5,6,7,12,11,10,4, & 9 on U31. The enable input to this multiplexer is from Y1 pin 14 of U30 on the relative address block decoder. The enable input on the multiplexer is pin 2 of U31.

Analog multiplexer U32 is associated with ANLG2 to the SIB. This multiplexer selects voltage monitor points coming from the TSL transmit card. The voltage monitor points are the heat/cool pump for the chilled mirror, -12V, +12V, +5V, and GND. They monitor power and the control voltages heating and cooling the chilled mirror in the dew point sensor assembly. The pins corresponding to the inputs are pins 4,5,6,7,9,10,11 & 12 on U32. The enable input to this multiplexer is from Y2 pin 13 of U30 on the relative address block decoder. The enable input on the multiplexer is pin 2 of U32.

A3 Analog Board

The A3 Analog Board provides for signal conditioning from the sensors in preparation for the analog to digital conversion process on the Standard Interface Board. Voltage references is used on this board for indications setting the alarm trip conditions for low temperatures and two high wind-speeds to the antenna control unit (ACU). There is also voltage reference to detect electronic enclosure hot or cold conditions, which provides for either turning on the box fan or heater depending on which condition is present.

Figure 23 is the VLBA Weather Station A3 Conditioner Board Schematic, D55006S005. Refer to this drawing for troubleshooting and analysis purposes.

The fiber optic transmit and receive devices are included on this board assembly, however the digital transmit and receive signals are routed directly to the Standard Interface Board. Fiber optics is to provide for isolation between the weather station and control building to prevent damage from occurring due to lightning either at the tower or the control building.

There is also a small relay board sub-assembly mounted on the A3 Analog Board. This board is to provide some isolation between the weather station and the ACU located in the pedestal room of the antenna. The alarm trip levels should de-activate the small relays and remove the illumination of the LEDs on the circuit board as a convenient means of adjustment and testing during preventive maintenance procedures.

The fiber optics is mounted on small sub-assembly boards and includes TTL driver or receiver devices. The transmit line is routed from the Standard Interface Board to a Hewlett-Packard HFBR-1404 fiber optic transmitter via a 75451 driver. The 75451 driver is used for adequate TTL levels from the SIB to the transmitter.

The receive line is routed to the SIB from a Hewlett-Packard HFBR-2402 fiber optic receiver via a 75452 receiver chip. The 75452 receiver is used for beefing up the TTL receive levels from the receiver to the SIB.

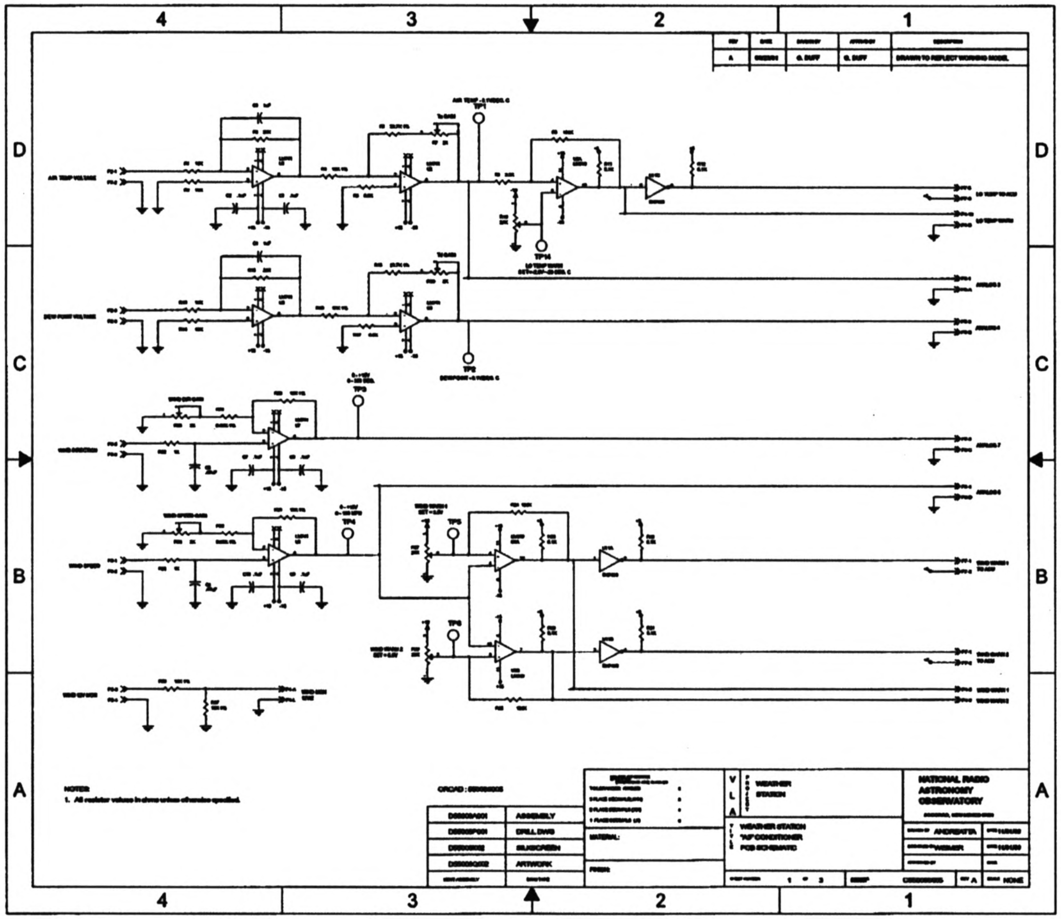


Figure 23 VLBA Weather Station A3 Conditioner Board Schematic, D55006S005-1

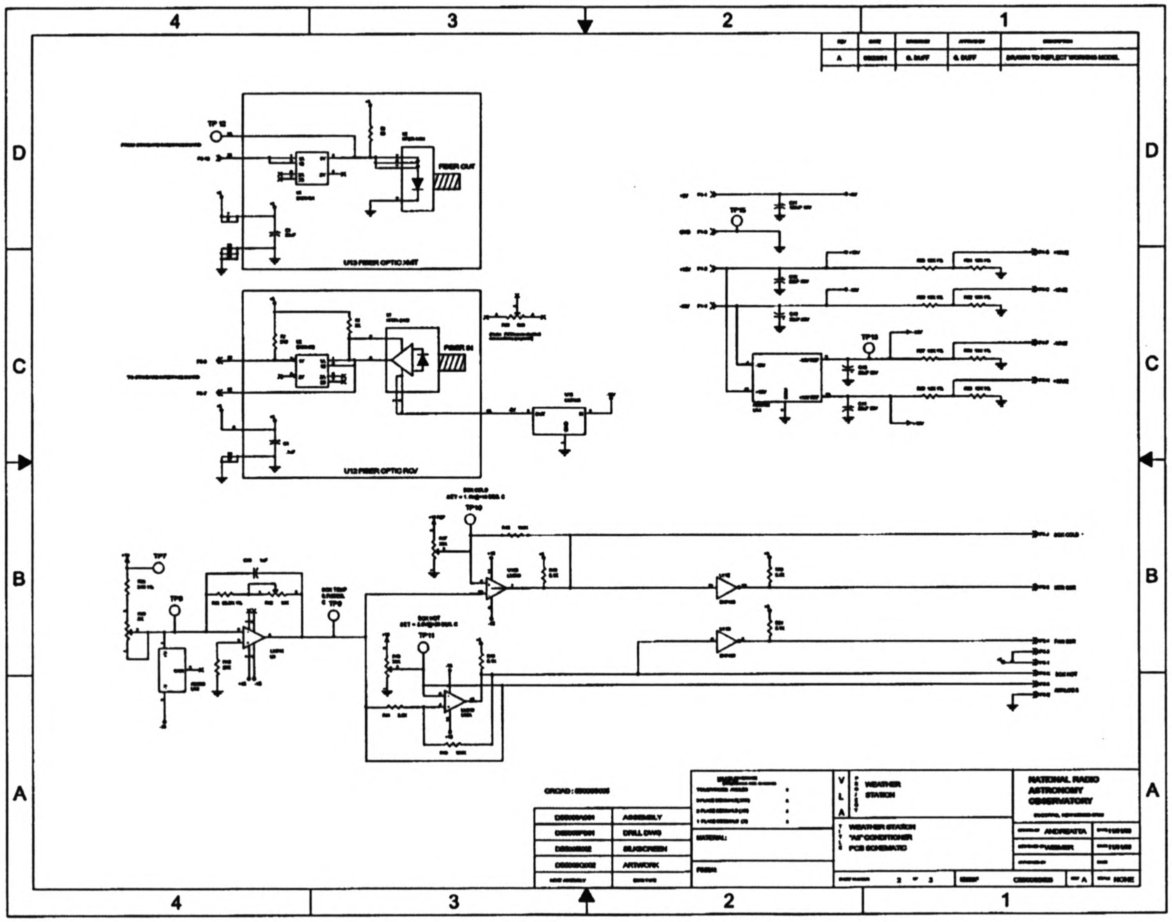


Figure 23 VLBA Weather Station A3 Conditioner Board Schematic, D55006005-2

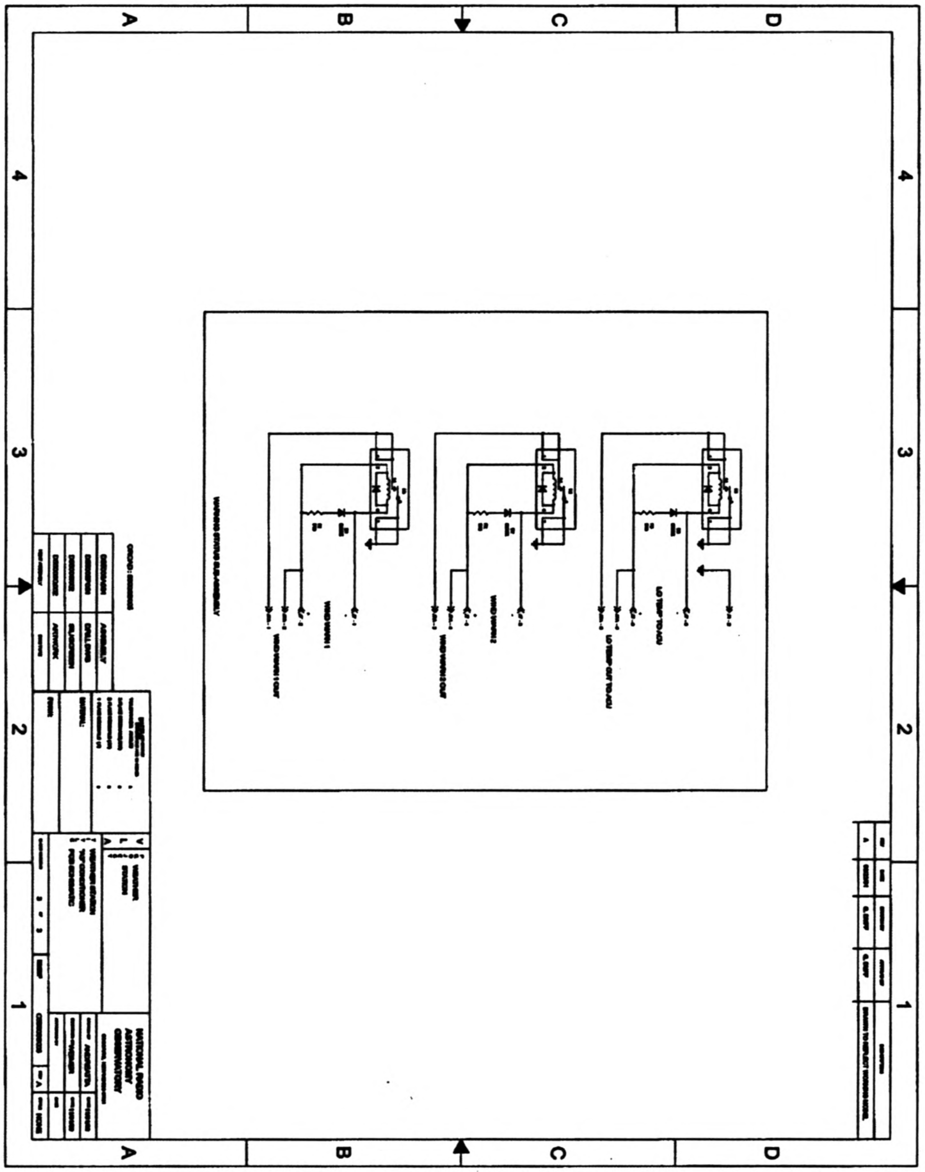


Figure 23 VLBA Weather Station A3 Conditioner Board Schematic, D55006S005-3

The relay sub-assembly provides a switch opening to the ACU when the set trip levels are activated. The outputs of the respective alarm circuits de-energize the coil, which in turn opens the continuity path to the ACU. This is the stimulus to initiate the antenna stow conditions in the ACU.

This sub-assembly is equipped with LEDs to indicate when the trip levels have been exceeded and the relay contacts have been opened. This is useful when the preventive maintenance schedule requires board alignment procedures.

The input lines for the alarm circuitry for the analog board typically is routed into op-amp circuitry that 1) provide a good signal to noise ratio, 2) amplification, and 3) trip level thresholds for the alarm conditions.

When the signals first are received on the board, only the rise in signal is desirable. Unwanted, noise or transient induced variations could produce a false alarm if a good common-mode rejection circuit was not in use in the first stage. After this stage, an amplified signal is desirable for use as an input to the comparator stage. The amplifier is nice for good isolation as well, it has a high input impedance with a low output impedance. Finally, a comparator with adjustable trip points referenced from a convenient, precision voltage source to produce the on/off conditions necessary for stowing the antenna.

The box cold/hot is similar, with the addition for a current source from the AD590. This device is a temperature-sensing device that produces changes in output current proportional to variation in temperature. This output must be converted into a voltage output, which in turn then produces the on/off condition for either heating or cooling the electronics enclosure.

The remaining circuitry on the analog board is passive, and provides for voltage monitoring points.

A4 Wind Signal Processing

This section is excerpted directly from the Qualimetrics manual in Appendix 2 of this manual. There are three modules associated with the wind signal processing for our application in the weather station. One is a power supply module, and the other two are signal-conditioning modules. These are housed in a Qualimetrics Model 1023 Module File. A series of printed circuit board edge connectors are located inside the card file to bus all common signals and power supply voltages from the power supply module to all other modules. A power cord on the back panel provides 115/230 VAC, 50/60 Hz to the power supply module.

Refer to Appendix 2 for drawings and schematics for the A4 signal conditioning electronics.

First, quick overviews of the module file. With exception of the power supply, all modules have two connectors. The top connector provides input/output connection to sensors and data acquisition equipment. The bottom connector provides common busing of power and control lines from each module to the power supply. The power supply connector, besides providing the above lines, also connects the power source with the circuit board. Refer to Figure x for a schematic of the module file. The safety ground wire of the AC power cord is tied to chassis ground. The system common is a floating signal and should not be tied to chassis ground. A chassis ground screw terminal is located below each terminal block to be used to ground shielded cables.

A Qualimetrics Model 1030-A Power Supply Module is designed to provide power for the signal conditioning modules. It provides ±12 VDC regulated power to the power bus in the module file.

The power supply requires either 115 or 220 VAC. Conversion from one to the other is accomplished by changing jumper wires on the printed circuit board. It is used with systems that do not require RF suppression filters.

AC power is input on the printed circuit connector pins 1 & 3. The neutral side of the line voltage ties directly to the primary winding of the transformer. The hot side is connected to fuse F1 on the front panel. Fuse F1 is connected to the power switch and then terminates at transformer T1. Jumpers W1 & W2 are installed for 115 VAC. VLBA antenna sites utilize the 115 VAC as the AC power source.

The secondary windings of T1 are rated at 12 VAC @ 500 mA. These feed a full-wave bridge rectifier CR5. The DC voltage obtained at the full-wave bridge is filtered by capacitors C8 & C4 and is applied to input terminals of ICU1 and ICU2. These IC's are three-lead voltage regulators rated at 12 VDC.

Capacitors C1 & C2 are used to improve transient response of the circuit. Diodes CR2, CR4, CR1 and CR3 are used to keep reverse currents from entering opposite power sources. Varistors V1 & V2 are transient protectors for the power supply bus. The green front panel indicator, DS1, connected across the negative power supply, illuminates when AC power is applied.

The black test point on all modules is system common. The brown test point is –12 VDC supply while the red test point is +12 VDC supply.

The ±12 VDC bus leaves the power supply card on pins 12-14 and is bused to all other modules through printed circuit connectors.

The wind speed module is a Qualimetrics Model 1220. The wind speed module provides a linear DC signal output proportional to wind speed over the 100-mph range. The module has a reference voltage for sensor excitation and/or scaling reference supply. An LED indicator is mounted on the front panel and it will illuminate when the module is in either LOW or HIGH calibration. A rotary switch selects either the OPERATE, LOW calibration, or HIGH calibration mode of operation, however calibration for these modules is performed at the DCS lab in Socorro, NM.

The input to the wind speed module is a pulsed square wave, and is generated by the wind speed anemometer. The input signal at pin 8 enters the switching network, S301 and jumper JW301. From there, it enters the non-inverting input of IC301. This op-amp performs several important tasks. First, through resistor R308 it references the output level to a slightly positive value (+2.5 VDC). Since the positive supply is 5 VDC and the gain of the amplifier is ~ 4.5, the output signal is clipped at approximately 5 VDC.

The output of IC301 goes through current limiting resistor, R310, and the low state is held at ~ system common level by the input diode clamp of IC302. R311 is a pull-up resistor for unused inputs of IC302, a Schmidt trigger. The Schmidt trigger defines the on and off times more precisely for triggering the one-shot, IC303.

Capacitor C302, diode CR303 and resistors R312 & R313 make up a differentiator circuit to trigger the one-shot on the falling edge. R312 & R313 set the low state level while CR303 sets the high state level.

IC303 is a timer used as a one-shot with resistor R315 and capacitor C304 as its timing elements. The time constant for the circuit is found from the formula:

$$
\begin{aligned}
T &\approx 1.1\ RC \\
&\approx 1.1\ (75K)\ (.01\mu F) \\
&\approx 825\ \mu S
\end{aligned}
$$

An 825 µS pulse width signal is generated by IC303 with voltage amplitude of 5.0 VDC. Resistor R314 loads the circuit enough to insure stability over the entire frequency range.

IC304 integrates the area under each pulse entering its input and provides a proportional DC output level. Resistors R318 & R319 are used as a gain doubling circuit for wind speed range select.

IC304 signal output is inverted by IC305. The gain of this circuit is set so that the value at the violet test point varies approximately 0 to –5.5 VDC.

The input to IC201 is derived from IC305 pin 6 and can be measured at the violet test point. This voltage is summed with the zero adjust voltage and enters IC201 pin 2, the inverting input. CR201 & CR202 regulate the voltage across potentiometer VR202 to stabilize its value. Potentiometer VR202 is used to zero both outputs. IC201 has a variable gain due to potentiometer VR201 that is used to obtain the full-scale value at output 1. After output 1 is set, potentiometer VR203 is adjusted for full-scale reading of output 2.

Voltage regulator, IC101, obtains its power from the +12 VDC bus referenced to common. IC101 is a three-lead positive voltage regulator fixed at 5 VDC.

To calibrate the circuit, a free running oscillator is designed for the HI calibration position of the mode switch. Capacitor C301 and resistors R304 & R305 determine this frequency which is ~ 470 Hz.

The wind direction module is a Qualimetrics Model 1240-A. It has a reference voltage for sensor excitation and/or scaling reference supply. An indicator is mounted on the front panel and will illuminate when the module is in either LOW or HIGH calibration or HIGH calibration mode of operation. Front panel controls are available for adjusting the low and high span points for both outputs.

The signal from the wind vane is fed through two stages of amplification before entering the output stage. A small filter capacitor on the input line removes external noise. The wind direction module provides linear signal output over the 360° range.

The sensor is connected to the module with a three-conductor cable. The white conductor terminates sensor pin A to wind direction module pin 2, and supplies the excitation voltage to the potentiometer. R302 is used for short circuit protection. The black lead connects pin B of the sensor to pin 4 of the module and represents system common. The red lead is the potentiometer wiper output and connects pin C of the sensor to pin 6 of the module.

The signal passes through the mode switch and jumper JW301 and enters pin 3 of U301. The mode switch substitutes the zero and full scales values of the sensor in the LOW and HIGH calibration positions, respectively. Buffer amplifier, U301, provides an impedance match between sensor and electronics. This amplifier has unity gain.

The output of U301 enters the inverting input of U302. This second amplifier has a gain of approximately –2. This gain is selected to provide a 0 to –5.5 VDC signal to U201 pin 2 and this voltage can be measured at the violet test point. The input voltage at U201 pin 2 is summed with the zero-adjust voltage and is applied to the inverting amplifier input. CR201 & CR202 regulate the voltage across potentiometer R202 to stabilize its value. Potentiometer R202 is used to zero both outputs. U201 has a variable gain due to potentiometer R201 that is used to obtain the full-scale at output 1. After signal output 1 is set, potentiometer R203 is adjusted for full-scale reading of signal output 2.

Voltage regulator, U101, obtains its power from the +12 VDC bus and is referenced to common. U101 is a three-lead positive regulator fixed at 5 VDC.

Relay K301 is a printed circuit board assembly with two each DPDT relays in it. The K301A section is used to remotely switch from the sensor to the LOW calibration position. The K301B section along with the K301A section is used to switch from the LOW to HIGH calibration position.

A5 TSL Receiver Board

A substantial portion of the receiver board has been discussed above in the TSL Model 1063 Hygrothermometer theory of operation. This section is additional information regarding the receive board function in the weather station.

Figure 20 is the VLBA Weather Station Receiver PCB Logic Diagram, C55006L002. Refer to this schematic for troubleshooting and analysis purposes.

The receiver board performs the data display function for the TSL. It receives the transmitted serial binary multiplexed ambient temperature (Ta) and dew point temperature (Td) data streams and converts the data into format suitable to be sent to the A2 Logic Board. The data can then be sent via the Standard Interface Board to the central computer as monitor data when requested.

Arithmetic manipulations are performed on the data, including 5-minute averaging of Ta and Td, and recording maximum and minimum Ta. Data quality checks are performed, and the four data outputs, Ta, Td, Tmax, and Tmin can be utilized as monitor data for the weather station.

The data processor on the receiver board is a type 68701 single-chip microprocessor. It performs virtually all of the timing and logical functions of the receiver. Data is brought through a line receiver amplifier to the serial input port of the processor. Under control of the resident program, the processor gathers, computes, and stores the pertinent data. Output from the processor is on a 13-bit parallel bus that is time-multiplexed to Ta, Td, Tmax, and Tmin. As each of the data words is on the bus, a unique strobe pulse is generated, one for each of the four outputs.

When the error flag bit is received from the transmitter, or when certain other error conditions are detected by the receive logic, the error output level goes high. This indicates an unusual condition with the TSL.

The Tmax and Tmin values can be reset to the present values by sending a command via the monitor and control bus from the central computer.

In the event of a momentary or prolonged power failure, the critical part of the data processor memory remains active, powered by a small battery located on the receive board. This battery is trickle-charged during normal operation, and has enough capacity to protect to memory for approximately 10 hours. Memory protection retains Tmax, Tmin, and the averaged values of Ta and Td.

A6 A.I.R. Digital Barometer

The Barometer is an Atmospheric Instrumentation Research (A.I.R.) Model AIR-DB-2AX. It is a microprocessor controlled digital pressure transducer, and measures the atmospheric pressure in millibars. The range of this instrument is from 800 to 1060 mb. Accuracy is ±0.5 mb.

Refer to Appendix 3 for drawings and schematics for the barometer.

It measures pressure 10 times per second, averages the measurement, and makes it available in digital format. It is housed in a sealed aluminum case, uses a stable capacitance type pressure sensor, and has microcomputer control. The analog electronics and sensor are computer calibrated together for full range accuracy. The calibration data is stored in ROM memory.

The data is transferred from the barometer to the A2 logic board on a parallel 8-line input. The data is binary coded format and is transferred 8 bits at a time. A two-line handshake is used to synchronize transfers between the barometer and the A2 logic board. The A2 logic board controls the RFD+ (ready for data) signal and the barometer controls the DAV+ (data valid) signal.

On board the barometer, the logic sequence goes something like this: 1) wait for RFD+ to become asserted, 2) write data byte, 3) assert DAV+, 4) wait for RFD+ to become negated, and 5) negate DAV+. Likewise, a complementary logic sequence on the A2 logic board is reflected as: 1) assert RFD+, 2) wait for DAV+ to become asserted, 3) read data byte, 4) negate RFD+, and 5) wait for DAV+ to become negated.

When the barometer completes a measurement averaging cycle it tests the RFD+ signal. If RFD+ is negated, it starts another measurement cycle and the data is lost. If RFD+ is asserted it starts a data transfer sequence. Once a transfer is begun it must be completed before the barometer begins another measurement. If there is an interruption in the handshaking, the barometer will stop.

A7 Signal Protection Board

The surge protection is provided by gas tube arrestors which are self quenching and feature extremely fast response to transients, and the ability to withstand high follow currents.

Refer to Appendix 2 for drawings and schematics for the A7 board.

Each gas tube arrestor has two metal electrodes forming a discharge gap characterized as an open circuit under normal conditions. The arrestor represents only a very small capacitance and no resistance to the circuit it protects.

When a surge occurs and exceeds the breakdown voltage of the arrestor, the internal gap becomes highly ionized, conducting currents within fractions of a microsecond. The arrestor is then virtually a short circuit until the voltage returns to normal. Ionization and de-ionization happen extremely fast due to the type of gas in the tube and the physical configuration employed in the design.

The resistor and inductor are used in conjunction with the spark-gap tube and the dual zener diodes act to slow and quench surge currents that occur below the ionization threshold of the spark-gap tube.

A8 Box Heater

The box heater is a Hoffman D-AH1001A, a 100-watt electric heater. This heater has an adjustable thermostat with a range from 0°F to 100°F (-18°C to 38°C). The fan in the unit draws the cool air from the bottom of the enclosure and passes this air across the thermostat and heating elements before being released into the electronics enclosure.

There are no schematics for the box heater.

A9 Data Display Units

There are four temperature values that can be displayed inside the electronics enclosure. Rotating the switch on the A9 display unit box changes the display value. The values are the average ambient temperature (Ta), the average dew-point temperature (Td), the maximum ambient temperature (Tmax), and the minimum ambient temperature (Tmin). The max and min temperatures are from a 24-hour interval. The temperatures are displayed in degrees Celsius.

Refer to Appendix 1 for drawings and schematics for the A9 display unit.

The temperatures are decimal numbers, however for this data to be displayed, 11-bit binary numbers from the TSL receive card have to be converted to a BCD format. This is done by a subroutine in the MPU program on the TSL receive card. All of the output data is brought out of the MPU on 14 lines, coded as tenths, units, tens, and hundreds of degrees and a polarity bit. The data is then multiplexed to read out Ta, Td, Tmax and Tmin.

The data lines are distributed to the panel display, along with a strobe input. This allows for the display to sample the data lines when the data is valid and selected by the switch for the display.

The individual display module contains storage latches to sample and hold the data as it is strobed in. The latch modules, MC14511 contain seven-segment decoder-drivers that directly drive the incandescent segments of the decimal displays.

There is also a toggle switch for selecting the instantaneous or average values for the temperatures. Normal operation for the weather station is in the average position. If the switch is left in the instantaneous position, the error flag is set and VLBA operations will assume there is a problem with the TSL.

There is a control for the illumination of the incandescent display. Rotating the knob will increase or decrease the display brightness.

PS1 Power Supply

The power supply is regulated providing +5V, and ±15V outputs. The DC input voltage has a range of 85-132 volts AC @ 47-440 Hz. This power supply is rated at 62% minimum efficiency. There is overload protection, an automatic electronic current limiting circuit with automatic recovery limits short circuit output current to a safe preset value, thus protecting load and power supply when direct shorts occur. Sustained short circuit operation for more than 30 seconds may cause power supply damage. Internal failure is fuse protected.

The input fuse is a 2A slo-blo in the AC input line to protect the input wiring to the power supply. Overload of power supply does not cause the fuse to fail. This supply is convection cooled, so no external fans are required, and is supposed to provide continuous output voltage from 0°C to +60°C.

Appendix 5 has minimal illustrations for this power supply.

VLBA Technical Report 47

VLBA Weather Station

Appendix 1

IM-1063-2

INSTRUCTION MANUAL

for the

HYGROTHERMOMETER

Model 1063

TECHNICAL SERVICES LABORATORY

Fort Walton Beach, Florida

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TABLE OF CONTENTS, Continued

LIST OF ILLUSTRATIONS

TABLE OF CONTENTS, Continued

FOREWORD

The following is a listing of the major sections found in this manual, followed by a brief description of each:

General Information

This section contains a list of equipment supplied with the system, equipment required for operation but not supplied with the system, equipment reference data, warranty information, and a general description of how the system works.

Operation

This section directs the operator in the use of the 1063 system. Turn-on procedures are explained as are methods of verifying the accuracy of display information.

Theory of Operation

This section explains how physical stimuli are measured electrically to determine the dew point and ambient temperatures. It gives a description of all hardware elements in the system.

Scheduled Maintenance

A periodic maintenance table is located in this section, as are all procedures necessary to perform routine, scheduled maintenance.

LIST OF TABLES

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this manual. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components with the equipment energized. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to charges retained by capacitors. To avoid injury, always remove power and discharge and ground a circuit before touching it.

RESUSCITATION

Personnel working with high voltages should be familiar with modern methods of resuscitation.

FIRST AID

Seek medical help immediately after injury. Any injury, however slight, should be treated.

TEST EQUIPMENT

Make certain test equipment is calibrated within required dates and is in good operating condition. If a test meter must be held, ground the case of the meter before starting measurement; do not touch live equipment or personnel working on live equipment while holding a test meter. Some types of measuring devices should not be grounded; these devices should not be held when taking measurements.

WARNINGS

A WARNING appears for an operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury to or death of personnel.

CAUTION

A CAUTION appears for an operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to or destruction of the equipment.

Installation

This section supplies information needed to prepare the system site, a list of tools needed for installation, installation procedures, and checkout procedures needed to ensure system accuracy.

Functional Information

This section contains functional diagrams which permit maintenance personnel to isolate a fault to a given hardware unit/assembly.

Schematics, Wiring

Complete schematics with explanatory text are given for each assembly and subassembly. Wiring diagrams for the three main units of the system are also included in this section.

Repair Notes

Repair instructions, with pictorial guides, are given for all routine repair, replacement, and service operations.

Appendices

Integrated circuit data, a software listing, and a comprehensive parts list are found in this section. An appendix is also included which covers all details pertinent to the optional Autobalance module.

SECTION 1.

GENERAL INFORMATION

1-1. INTRODUCTION

This manual is intended for use by on-site technical personnel as a guide to installation, operation, and preventive & corrective maintenance of the Model 1063 Hygrothermometer.

1-1.1 Scope

This manual provides all information necessary to operate and maintain the Model 1063 Hygrothermometer.

1-1.2 Applicability

This manual is applicable to the Model 1063, manufactured by Technical Services Laboratory, and to subassemblies of this model.

1-1.3 Warranty

Each system, including all parts, spare parts, and non-repairable subassemblies, shall be individually guaranteed against any noncompliance with this specification for a period of 180 calendar days after final customer acceptance of that system. Should any noncompliancy develop within the guarantee period, the noncompliant part(s) shall be replaced with compliant part(s) by the Contractor f.o.b. point of installation without expense to the customer.

All replaced parts, spare parts, equipment, and non-repairable subassemblies shall be covered under the provisions of this guarantee for a minimum of 30 calendar days in addition to the original guarantee period after receipt of that item by the customer at the point of installation.

1-2 EQUIPMENT DESCRIPTION

The Model 1063 Hygrothermometer System is a climatic thermometer and dew point indicator developed by Technical Services Laboratory. It was initially developed as Model H083 for the National Weather Service and meets all of the requirements of NWS Specification #H083, dated 2/25/81. The system indicates dew-point and ambient temperatures in the range of -60 to +60 Degrees Celsius. Ambient temperature measurement accuracy is 0.5°RMS throughout the range. Dew point accuracy is 0.5°RMS above 0 . Below 0 , dew point accuracy varies with decreasing temperature, to a worst case of approximately 2°RMS. Resolution of display is 0.1 Degree Celsius. The dew point instrument channel is calibrated to read dew point, not frost point, below 0°C.

The system consists of three component units, shown in Figure 1-1: an aspirator, transmitter, and a display unit. The aspirator is mounted outdoors in a location where it may sample the local atmosphere with a minimum of distractive influences such as ground water, vegetation, etc. The transmitter is located within 5 feet of the aspirator, and is designed to be weatherproof. A telephone line connects the transmitter to the remote display unit. The display unit may be located as much as two miles away from the aspirator and transmitter without the need for special signal handling equipment, and is designed for an indoor environment. Certain installations may be equipped only with the Aspirator and Transmitter Units; these sites will use their own data processing system in lieu of the Model 1063 Display Unit.

There are many ways in which dew point measurements can be made. The classic method is by using a "sling psychrometer" which consists simply of a dry- and wet-bulb thermometer pair which the operator slings over his head for a minute or so, to make wet and dry bulb temperature readings. He then converts the data by reference to a standard chart to determine dew point. This method, although cumbersome, is still the standard backup for most electronic systems.

Other more direct methods of measuring dew point include lithium chloride dew cells, and nuclear detector cells. All of the aforementioned methods have a common drawback, however; they measure dew point in an indirect manner. They all enable the operator to compute dew point in terms of side effects such as air moisture content, electrical conductivity, relative humidity, etc.

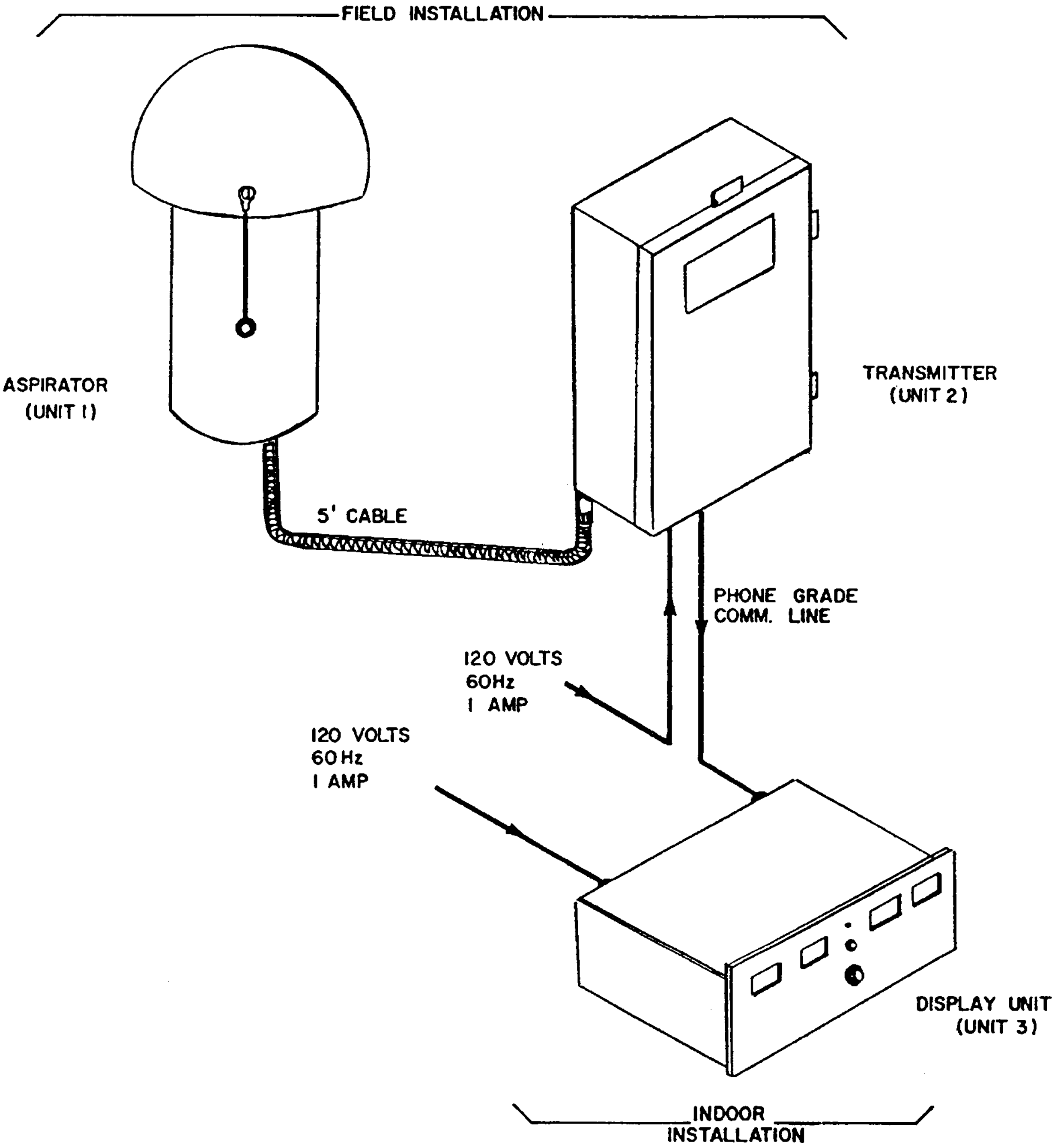


FIGURE 1-1
RELATIONSHIP OF UNITS

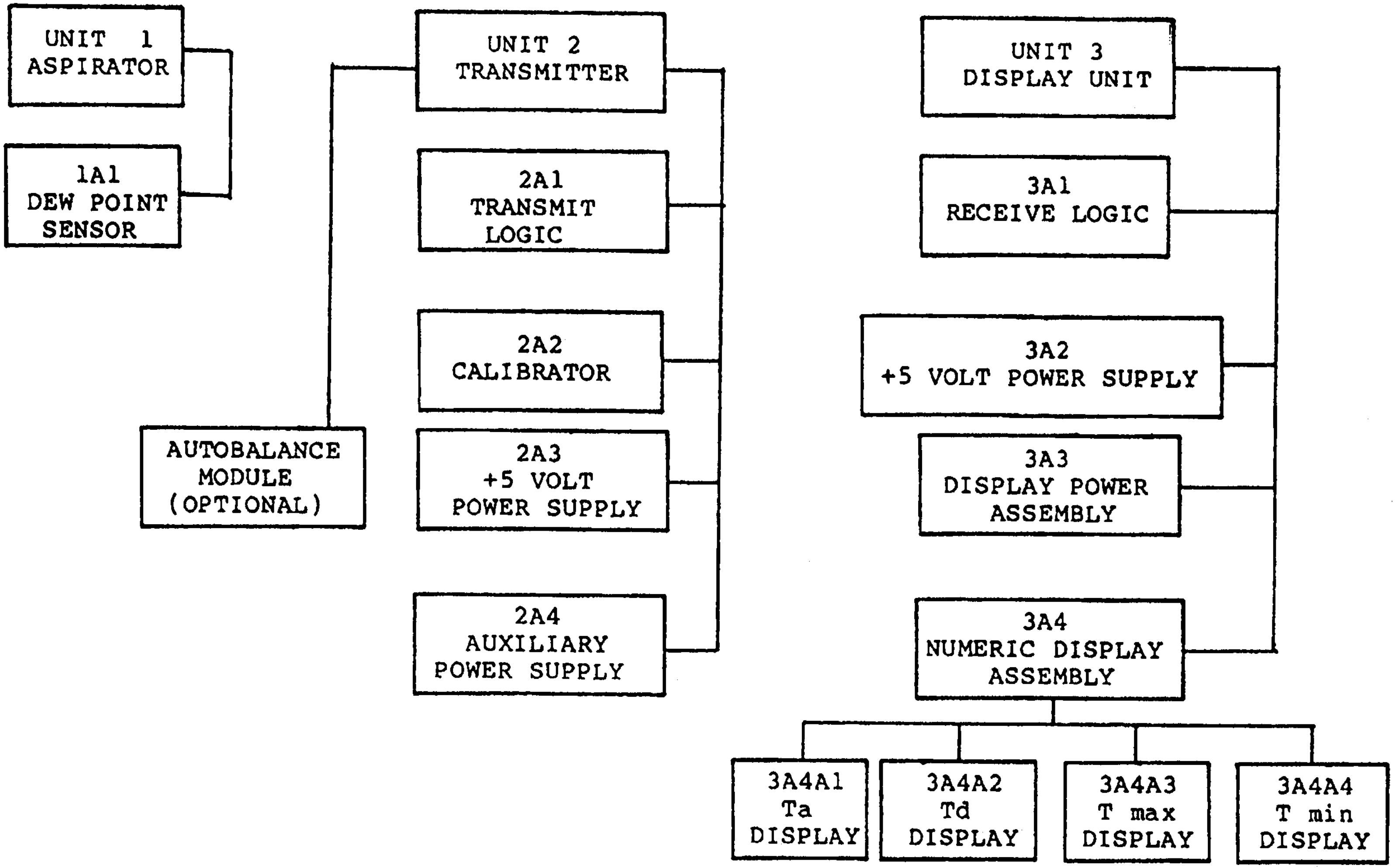


FIGURE 1-2

MODEL 1063 HYGROTHERMOMETER
FAMILY TREE

The chilled mirror hygrothermometer method as used in the Model 1063 system and many other dew point indicators is unique in that it measures dew point directly, in accordance with the basic definition of dew point. By definition, the dew point of a sample of air is the temperature to which the air must be lowered to make the vapor become just visible by condensation. In the chilled mirror system, a mirror is held at the temperature at which a fine film of condensate is present on the surface without increasing or decreasing in thickness. With a mirror maintained at precisely this temperature, it is a simple matter to read the mirror surface temperature and display that temperature as the dew point.

Internal circuits of the Model 1063 include a means of refrigerating a small mirror, and by way of an optical feedback loop, maintaining the mirror at exactly the temperature at which the mirror surface is slightly clouded with condensed water vapor from the sampled air. A precision thermal sensor imbedded in the mirror provides the basis for making the temperature measurement. A similar thermal sensor located in the surrounding air indicates the ambient temperature.

1-3 RELATIONSHIP OF UNITS

Figure 1-1 shows the physical relationships of the three main hardware units of the 1063. Figure 1-2 shows the systematic relationship of all components.

1-4 REFERENCE DATA

Table 1-1 supplies reference data for the three main hardware units of the 1063.

1-5 EQUIPMENT SUPPLIED

Table 1-2 lists the equipment supplied with a typical 1063 system.

1-6 EQUIPMENT REQUIRED, NOT SUPPLIED

Table 1-3 lists the equipment that is required to install and maintain the 1063, but not supplied with a typical system.

1. ASPIRATOR/SENSOR UNIT

Power:	120 V, 60 Hz, 0.2 amp. Supplied by Transmitter
Environment	
Temperature:	-50° C to +70° C.
Relative Humidity:	5% to 100%
Wind:	0 to 50 knots
Ice Loading:	To 1 inch Note: Ice coat or snow cap may affect accuracy, but equipment will return to normal operation after removal of ice/snow.
Accuracy:	
Ambient temperature:	+/- 0.5° C RMS, -50° C to +50° C
Dew point:	Variable with conditions below 0°,2° RMS worst case. 0.5° C, above 0°
Sensitivity:	0.1° C

2. TRANSMITTER UNIT

Signal type:	RS-232
Frequency:	600 baud
Output Load:	600 ohms
Sample rate:	2.5 per second
Power:	120 V, 60 Hz, 1.0 amperes, nominal
Environment:	Same as for Aspirator Unit

3. DISPLAY UNIT

Digital display:	
Character height:	0.5 in.
Character width:	0.25 in.
Viewing angle:	45° or more from a perpendicular to the face
Power:	120 V, 60 Hz, 1.0 ampere nominal
Environment:	
Temperature:	+10° C to +50° C
Relative Humidity:	10% to 80%

Table 1-1

SYSTEM REFERENCE DATA

Quantity	Unit Name	Weight and Dimensions (Uncrated)
1	Aspirator Unit	14" L 8" W 8" D 6 Lbs.
1	Transmitter Unit	19" L 14" W 6" D 28 Lbs.
1	Display Unit	19" L 6" W 15" D 14 Lbs.
1	Mounting Kit, Manual, Accessories (Boxed)	25" L 14" W 6" D 22 Lbs.

Table 1-2

EQUIPMENT SUPPLIED WITH SYSTEM

CATEGORY	RECOMMENDED EQUIPMENT
POWER CABLE	PER INSTALLATION SPECS
COMMUNICATION CABLES	PER INSTALLATION SPECS
MOUNTING POLE	PER INSTALLATION SPECS
DIGITAL VOLT-OHMETER	SIMPSON 465 OR EQUAL
OSCILLOSCOPE	TEKTRONIX T922 OR EQUAL

<u>TABLE 1-3</u>

<u>EQUIPMENT REQUIRED, NOT SUPPLIED</u>

SECTION 2

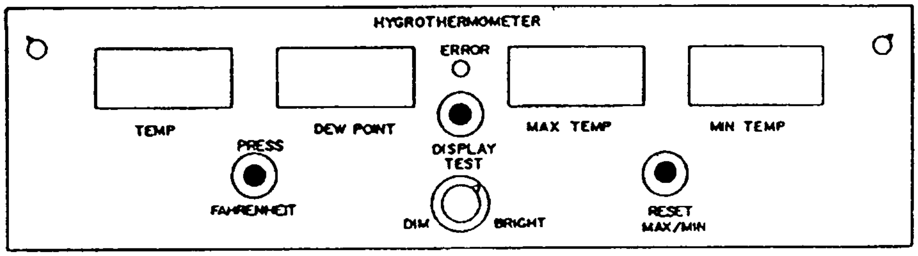
OPERATION

2-1. INTRODUCTION

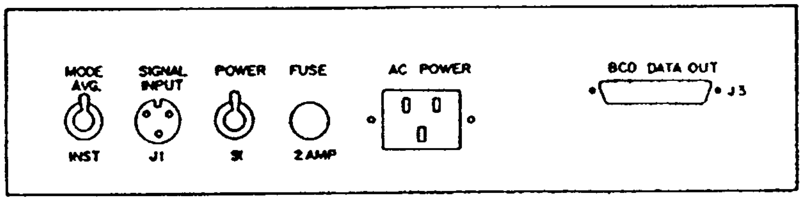
This section provides the operator of the 1063 Hygrothermometer System with all information needed to use the system successfully under all conditions.

2-2. OPERATORS DATA TABLE

The operators data table, Table 2-1, lists all switches and indicators that appear on the Display unit, shown in Figure 2-1. The table describes each item and lists its usual status or position when the unit is operating normally.



FRONT PANEL



REAR PANEL

FIGURE 2-1
DISPLAY UNIT PANELS

CONTROL OR INDICATOR	DESCRIPTION	NORMAL OPERATING STATUS
AC Power On-Off	Energizes Display Panel only.	ON position
Display Test Switch	When depressed, all light segments of the four digital displays (Td, Ta, Tmax, & Tmin) should indicate -188.n and Error Light should blink.	Out position (Relaxed)
Dimmer Control	Allows operator to select desired display brightness. Full clockwise position produces full brightness.	As desired
Max/Min Reset Switch	When pushed simultaneously with Fahrenheit Display Switch, resets Tmax and Tmin displays.	Out position (Relaxed)
Ta Display	Four-digit numeric display with negative (-) or positive (blank) sign indicates present ambient temperature through the range of -79.9 to +79.9 C., or, with Fahrenheit Display Switch depressed, indicates -188 to +188 F.	Data indication
Tmax Display	Four-digit numeric display with negative (-) or positive (blank) sign indicates most positive Ta displayed since last "reset".	Data indication
Tmin Display	Four-digit numeric display with negative (-) or positive (blank) sign indicates most negative Ta displayed since last "reset".	Data indication
Td Display	Four-digit numeric display with negative (-) or positive (blank) sign indicates present dew point temperature through range of -79.9 to +79.9 C or, with Fahrenheit Display Switch depressed, indicates -188 to +188 F.	Data indication
Error Light	Indicator light blinks when one of the following errors occurs: 1. Signal is not present. 2. Error is detected in transmitter. 3. Data is suspected to be in error.	Light is out
Fahrenheit Display Switch	When depressed, all four displays indicate present data in Fahrenheit temperatures instead of Celsius temperatures.	Out position (Relaxed)
Display Mode Switch (REAR PANEL)	In the normal (AVERAGE) position, displayed data is averaged over a 5-minute period. In the INST (INSTANTANEOUS) positon, data is displayed instantaneously as received and Tmax, Tmin displays do not function. This switch is used for test purposes only.	Up position (AVERAGE)

Table 2-1.

OPERATOR'S DATA TABLE

2-3. OPERATING PROCEDURES

The following procedures allow the operator to safely energize the Display unit, utilize displayed data, and turn off the unit when necessary.

a. Safety Precautions

WARNING

> There are no operator-serviceable components in the 1063 System. High voltages are present inside the equipment with the main power switch the ON position, and under certain conditions may also exist when the switch is OFF.

b. OPERATOR TURN-ON

The system is designed for continuous operation and will normally remain on at all times, except for maintenance or repairs.

The system is placed in operation by turning on the main power switch on the rear panel of the Display Unit. The data displays will begin updating at 18.75 second intervals and the Error Light will flash for approximately five minutes while the data averages build up. If the Error Light blinks for more than 5 minutes, a technician should be called to ensure that the Transmitter power switch has been turned on or to perform corrective maintenance.

c. MODES OF OPERATION

The Display unit has two distinct modes of operation, Averaging and Instantaneous, selected by a switch on the rear panel. The Average position is to be used under all normal circumstances, the Inst position only for test purposes. In the Inst position, the data averaging and Tmax/Tmin maintenance programs are bypassed and the data is displayed continuously as received. As a warning to the operator, the Error light flashes at all times when the system is in the Instantaneous mode.

The temperature displays normally read out in degrees Celsius; however, when the Fahrenheit pushbutton is depressed, all four temperature readouts display Fahrenheit. When the switch is released, all displays revert to the Celsius mode.

d. OPERATOR TURN-OFF

The Display unit is shut down by turning off the main power switch located on the rear panel. The Display unit is normally left energized for continuous operation unless maintenance is to be performed.

2-4. TURN-ON/CHECK-OUT PROCEDURES

Immediately after energizing the Display unit, the operator should depress the Display Test Switch to ensure the operation of the Display modules. With the switch depressed, all four Display modules should indicate -188.8 and the Error Light should flash. If any of the modules does not indicate -188.8 or the Error Light does not flash, a technician should be called.

Operator's only other indication of unsatisfactory performance will be the illumination of the Error Light. If this occurs, the Operator should call a technician to thoroughly inspect the system. If the Error Light does not light, it can be assumed that any data displayed is reliable because of the system's own error detection capability.

To initiate Max/Min temperature recording, the system must be reset. This is done by depressing the Max/Min Reset switch and the Fahrenheit display switch simultaneously. The Tmax and Tmin displays will then assume the current value of Ta, and will track Tmax and Tmin as temperature changes.

Operation of the Display unit after start-up is fully automatic. In the event of AC power failure, a standby battery in the Display unit will maintain the stored values of Ta, Td, Tmax, and Tmin for up to approximately 10 hours although the displays will not be lighted. Initial charging time for the battery is approximately 10 hours of normal operation.

2-5. OPERATOR'S MAINTENANCE ACTIONS AND SCHEDULES

No maintenance tasks are intended to be performed by the operator. Periodic maintenance or corrective maintenance must be performed by a trained technician.

SECTION 3

THEORY OF OPERATION

3-1. INTRODUCTION

This section gives a detailed explanation of how the 1063 Hygrothermometer System converts physical stimuli (Temperature, Dew Point) as received in the Aspirator Unit into usable data for the operator presented on the Display Unit.

Description of the system operation is broken into several separate functional areas. All of the descriptive data given in this section is pertinent and accurate, although the circuit descriptions have been simplified to show only the basic functional elements. For a detailed treatment of circuit operation, the reader is directed to Sections 6 and 7, in which the circuits are analyzed down to the lowest component level.

3-2. THERMAL CONTROL LOOP

Figure 3-1 describes the elements of the feedback loop which maintains the mirror at the dew point temperature.

A light beam from a small LED, CR1, is directed at the surface of a mirror at an angle of 45 degrees. Two phototransistors, Q1 and Q2, are mounted to receive the reflected light as shown. Q1, the "direct" sensor, is placed so that it receives a high degree of light when the mirror is clear. Q2, the "indirect" sensor, is located so that it is sensitive to light which is scattered when the mirror is clouded with visible condensation. As the degree of cloudiness of the mirror surface increases, Q1 tends to receive less light and Q2 tends to receive more light.

Following Q1 and Q2 are a pair of identical signal amplifier-detectors, U5A and U6A, which drive a differential control amplifier, U6B. The output of this high-gain amplifier is negative when the mirror is clear, and positive when the mirror is heavily clouded, because of the positive difference between the outputs of Q1 and Q2.

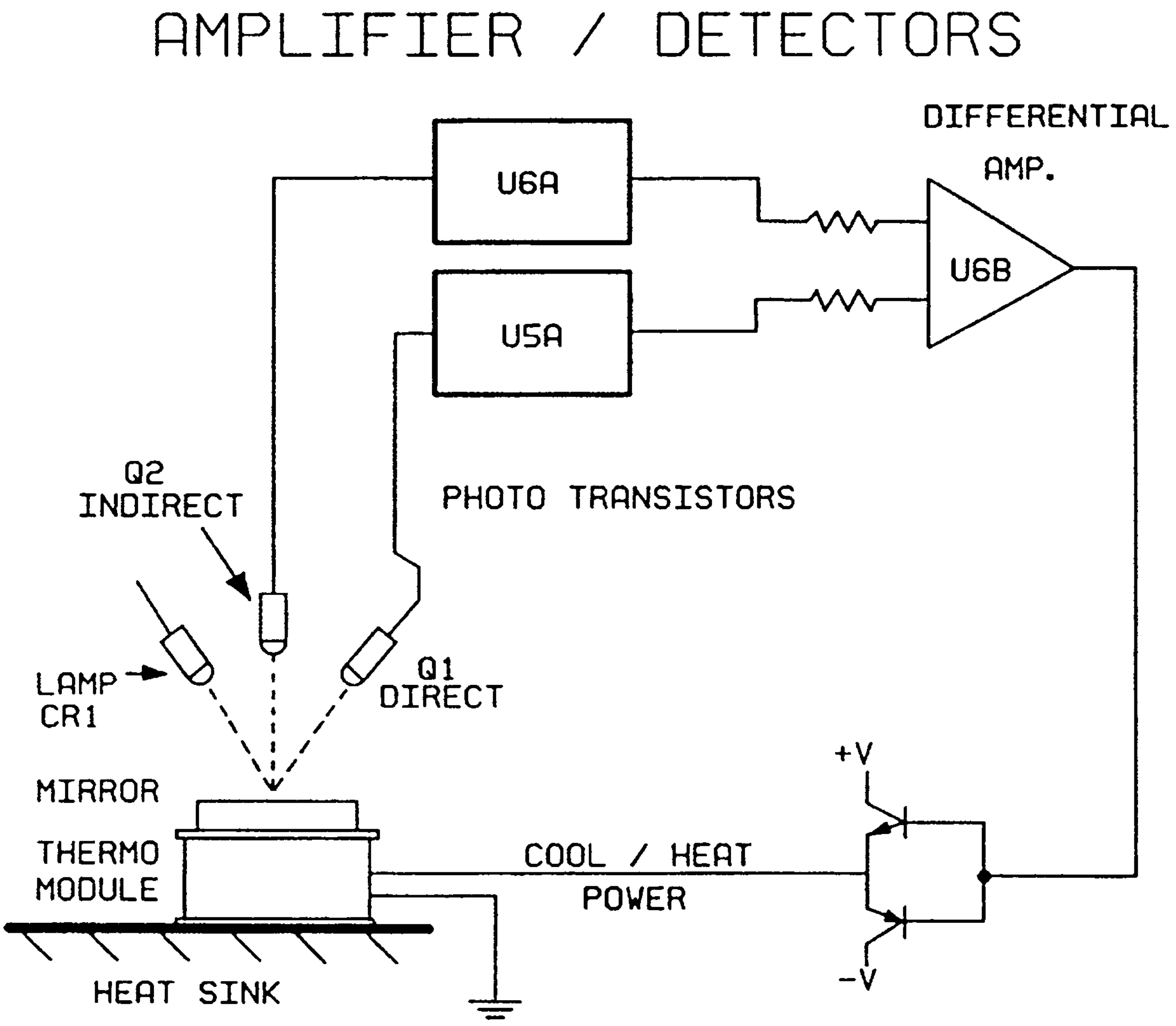


FIGURE 3-1

THERMAL CONTROL LOOP

The output of U6B, through a power amplifier, drives the mirror cooling module, U1. This device is an electronic heat pump, operating much like a thermocouple in reverse. With a DC voltage applied across the terminals, the module produces a temperature difference between its upper and lower surfaces. Depending on the polarity of the applied voltage, the thermal module can produce heating or cooling effect.

The feedback loop is effectively closed by the physical phenomenon of formation of condensate on the mirror as the mirror is cooled by the thermal module. When the unit is first turned on, the mirror is clear and photosensor Q1 receives a high level of directly reflected light, and Q2 receives no scattered light. This condition causes a large negative unbalance signal at the output of U6B, causing a heavy current to flow through the thermal module in the cooling direction. The unbalanced condition remains, typically for about one minute, until the mirror surface temperature has reached the dew point temperature. At the dew point, the output of Q1 decreases and the output of Q2 increases because of the visible effect of condensation on the mirror. The system now stabilizes at the dew point temperature, maintaining just enough cooling effect to keep the signal levels from Q1 and Q2 in balance, with U6B and the power amplifier supplying just enough cooling current to maintain the mirror temperature at the dew point. If the dew point of the air should change, or if the circuit should be disturbed by noise, the loop makes the necessary corrections to re-stabilize at the dew point. The system is designed for continuous operation.

The simplified circuitry described by Figure 3-1 is the heart of the hygrothermometer. All that remains to make this a useful instrument is a means of measuring and displaying the mirror temperature.

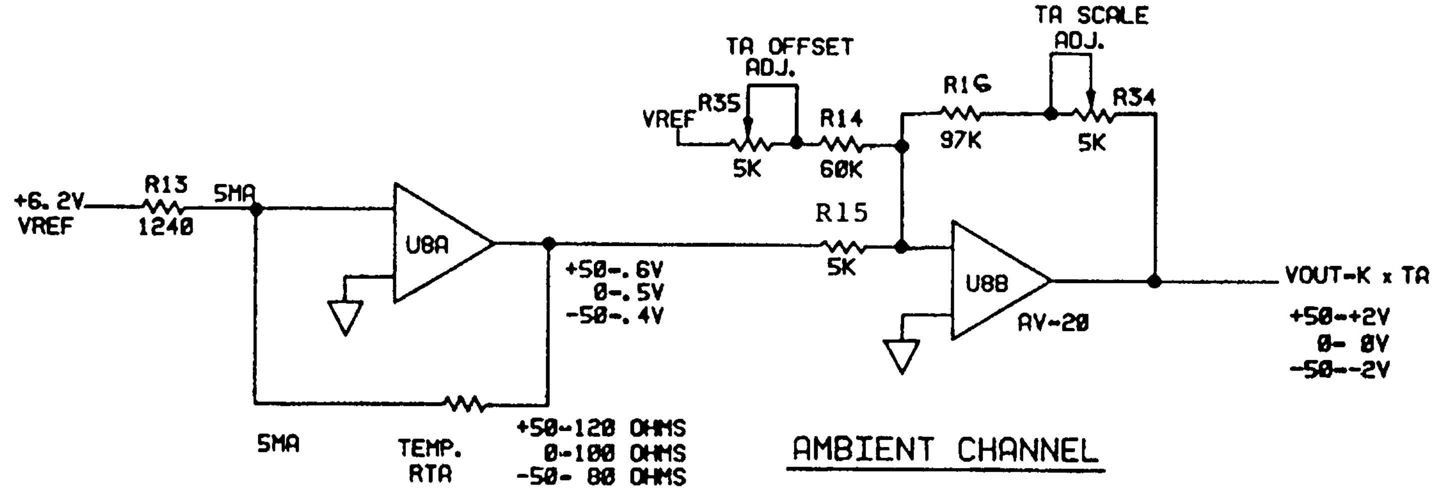
3-3. TEMPERATURE MEASUREMENT

In the Model 1063, two temperatures are measured and remotely displayed, ambient (Ta) and dew point (Td). The measurement circuits for the two channels are identical.

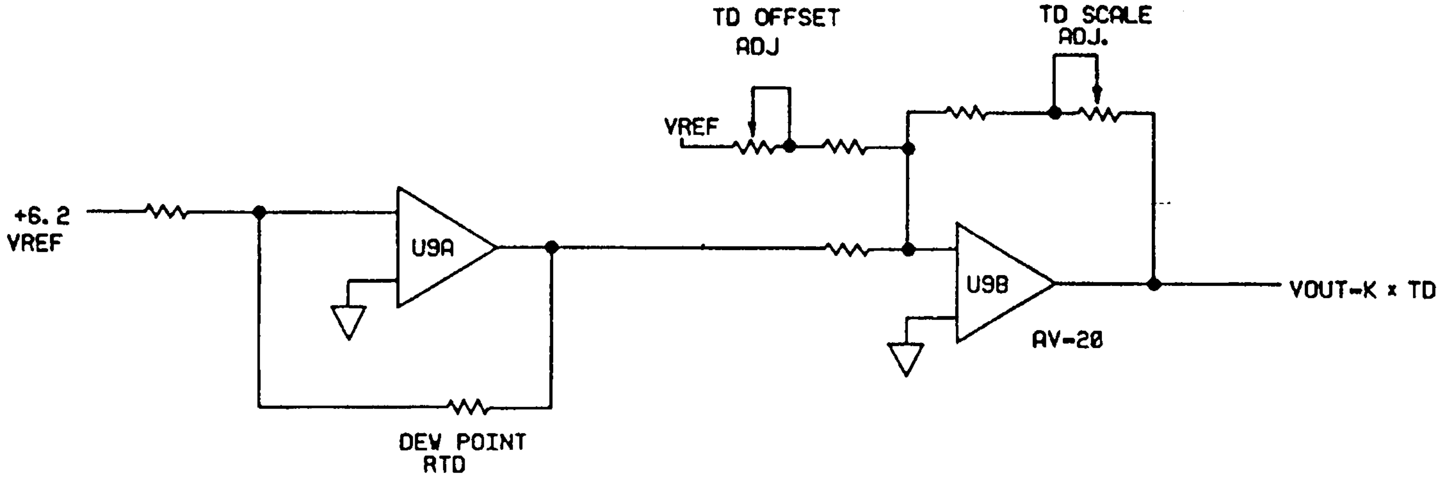
Figure 3-2 illustrates all of the circuitry involved in producing two output DC voltage levels which precisely represent Ta and Td. The basic sensor for temperature measurement is a platinum wire resistor called an RTD, for Resistance-Temperature Device. This sensor is encased in a ceramic cylinder, about 1/8 inch in diameter and 3/4 inch long. At a temperature of 0°C, the RTD has an electrical resistance of exactly 100 ohms. The resistance varies linearly with temperature, at a rate of .392 percent per degree C.

In our application, a constant DC current of 5 milliamperes flows through the RTD, and the resulting voltage drop across the sensor is used as the temperature signal. In the Ta channel of Figure 3-2, amplifier U8A is used as the constant 5 milliampere source through the RTD. The RTD in this example would be located in the stream of air entering the aspirator unit, so that it would assume the temperature of the ambient air. U8B is used as a scaling and offset adjustment amplifier, setting the output voltage level at a convenient value.

Two DC currents feed the node of U8A, a 5 ma reference input from a 6.2 volt reference voltage source through a precise 1240 ohm resistor, and a feedback current of opposite polarity equal to U8A output voltage through the RTD. By standard operational amplifier analysis, one can see that the feedback loop will force the feedback current to be equal to the 5 ma input current. Since the node of the op-amp, pin 1, is at virtually zero, the U8A output voltage must be equal to .01 x R1 volts. This would give us an output voltage equal to -.5 volt DC at 0° C, -0.4 volts at -50°C, and -.6 volts at +50°C. These values could be used directly for measurement and display purposes, however, they are amplified, inverted and offset by U8B to a more convenient scale. U8B is a conventional inverting op-amp with a gain factor of 20X by virtue of the ratio of the feedback resistance, R34 and R16, and the input resistor, R15. The gain, or scale factor, is slightly adjustable by varying the setting of R34. This is used as a calibration adjustment. The input offset value (-0.5 volt at 0°C) is cancelled out by the signal through R35 and R14. Potentiometer R35 is adjusted to bring the output of U8B to zero at 0° C. At the output of U8B, the signal level vs temperature relationship is 25 degrees per volt, with 0 volts representing 0 degrees C. A temperature of plus or minus 50 degrees C would be represented by plus or minus 2 volts DC at the output.



AMBIENT CHANNEL



DEW-POINT CHANNEL

FIGURE 3-2

TEMPERATURE MEASUREMENTS

The dew point temperature measurement channel is identical in all respects, except that the dew point RTD is physically located inside the body of the mirror, so that it assumes the temperature of the mirror, which is constantly held at the dew point temperature.

In a simpler hygrothermometer system, the outputs of U8 and U9 could be connected to a pair of voltmeters and the system would be complete. The Model 1063 has been designed for capability of displaying the outputs at a great distance from the sensors, so a means of transmitting the outputs must be provided which is insensitive to the effects of line length, noise and other sources of errors.

3-4. DATA MANAGEMENT

In addition to simply transmitting the two analog temperature signals to remote indicators, certain other operations are performed on the data. Among these are detection and storage of maximum and minimum temperature values and averaging the data to eliminate short-term variations. Because of the complexity of circuits which would be required for these operations, microprocessors have been used for all of the necessary data manipulations. In the transmitter unit, the two analog signals, Ta and Td, are converted to binary digital words and fed to the input of a microprocessor (MPU). This MPU is used only as a formatting device, converting the input data into a serial format suitable for transmission over long distance telephone equipment. In the display unit, another similar MPU receives the data words and performs all of the necessary arithmetic operations and re-formats the data for output display on numeric panel indicators. As an incidental function, the MPU's also perform data quality checks as a safeguard against effects of detectable errors, noise, and component failures.

3-5. ANALOG-TO-DIGITAL CONVERSION

A single A-to-D converter, type 7109,is used for the Ta and Td data, so a means must be included for time-sharing or multiplexing the converter input. The multiplex gates and the A-to-D converter connections are shown on Figure 3-3.

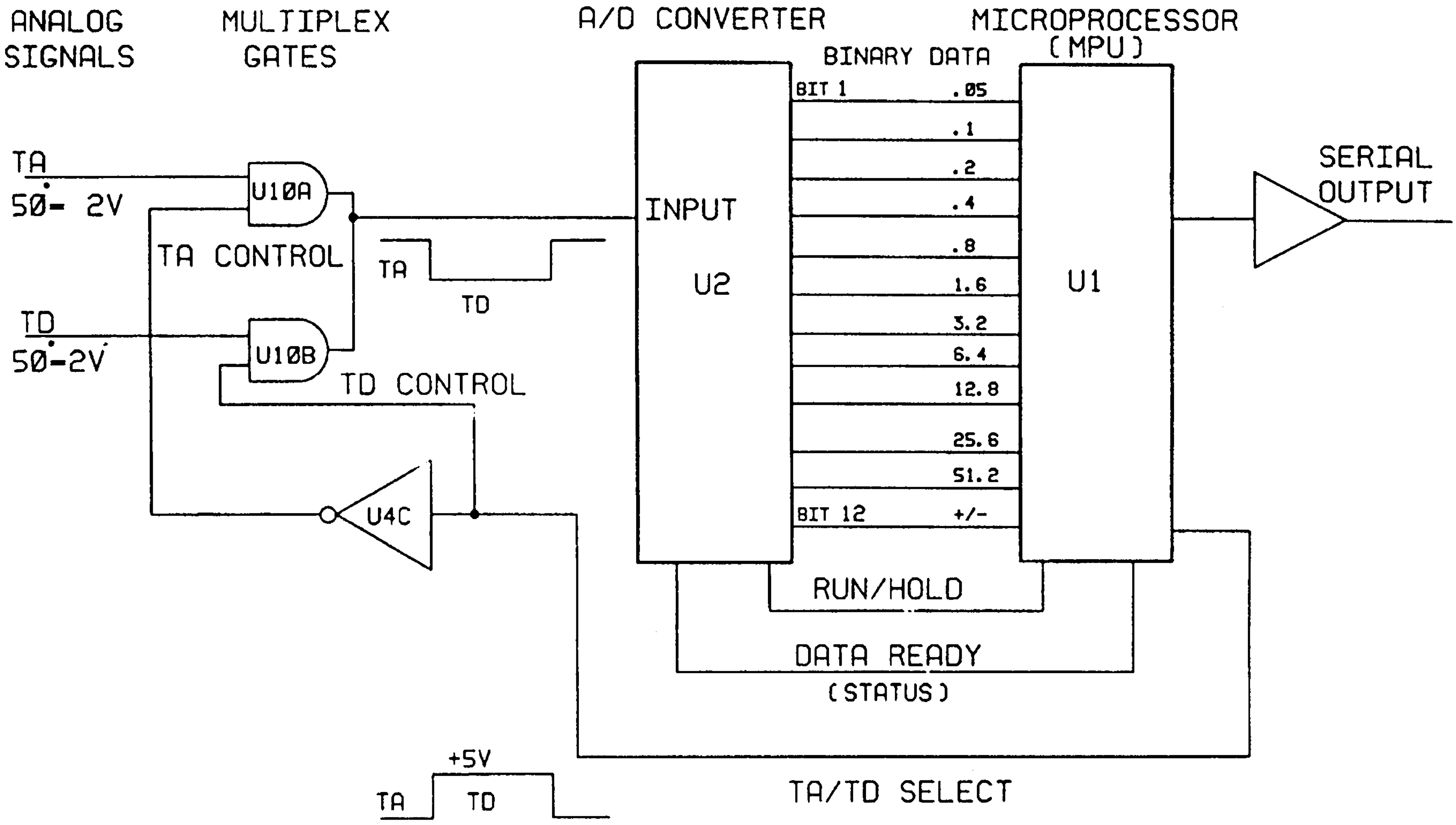


FIGURE 3-3
ANALOG-TO-DIGITAL CONVERSION

3-6. DATA MULTIPLEX

Two CMOS gates are used to selectively connect Ta and Td to the input to the converter. The gates are, in effect, series switches, each controlled by a select line. When the control line to a gate is in the low (0) state, the gate has an effective resistance of hundreds of megohms to the signal. When the control line is high(+5v), the gate presents a resistance of about 50 ohms, connecting the signal to the converter. The two gate outputs are tied together, and their control inputs are complementary, so that at any given time one of the two inputs is connected to the converter.

Operation of the converter is automatic, as described by the 7109 data sheet. When the RUN/HOLD line from the MPU to the converter is in the RUN condition, the analog input controls the generation of a parallel 12-bit binary representation of the input quantity, with an additional bit indicating the polarity of the input. The 11 most significant bits and the polarity bit are hard wired to appropriate inputs of the MPU.

Conversion requires about 30 milliseconds, depending on the data value. To prevent data transfer to the MPU occuring during the conversion time, a STATUS line from the converter is used as a signal to indicate to the MPU that data is stable and available after each conversion. When the STATUS line is high, the MPU may request new data values. Likewise, after the MPU has processed an input data word, it raises the RUN/HOLD line to signal the converter that a new conversion may begin. This exchange of control signals is called a "handshake" process.

After the MPU has processed an input sample, it reverses the state of the multiplex control line to the analog gates. If the data sample had been Ta, the next condition of the control line would be to enable the Td gate, and vice versa.

3-7. DATA TRANSMISSION

In the MPU, the data words Ta and Td are temporarily stored and formatted into a low-speed serial output train. A 1488 line driver amplifier is used to buffer the MPU output signal for transmission. Transmission is by way of a 600 Baud Manchester code, suitable for conventional telephone-grade circuits. The data is otherwise unchanged by the transmitter data handling circuits.

3-8. DATA RECEIVER

In the display unit, the serial data stream is buffered by a type 1489 line amplifier and fed directly to the serial input data port of the MPU. Although data flows continuously into the MPU at a rate of 2.5 complete frames per second, the MPU uses the input data only once per 37.5 seconds. When the MPU begins its input process, it examines the Ta and Td values. If Ta or Td is more than 2 degrees different from the presently displayed value, the data is considered to be faulty, and the sample is discarded, and the next sample is tested. This process is repeated for three trials. At the fourth trial, the data is accepted unconditionally. This tends to screen out errors which may be caused by momentary signal transients, or transmission line faults. The data which is accepted is stored in the MPU memory. Figure 3-4 illustrates the flow of data in the Display Unit.

3-9. DATA PROCESSING

All of the data processing described so far has served only to enable the transmission of the raw data, unchanged, to the receiving display unit. Before the Ta and Td values are displayed, certain manipulations and calculations must be made. These are all performed by the MPU in the display unit.

The received data, after the input screening for obvious errors, is stored in memory. This process occurs at 37.5-second intervals. Memory space is reserved for 8 whole samples of Ta and Td, representing 5 minutes of climate conditions. The 8 sample values are added and divided by 8 to yield a 5-minute average value of Ta and a 5-minute average of Td. The average values are updated at each 37.5-second input sampling and stored in memory.

At each updating, the value of average Ta is examined and compared against a stored maximum and minimum value. If the average Ta is greater than Tmax or less than Tmin, the max or min value is changed accordingly. Tmax and Tmin are maintained continuously, and are re-started only by way of the manual reset switch.

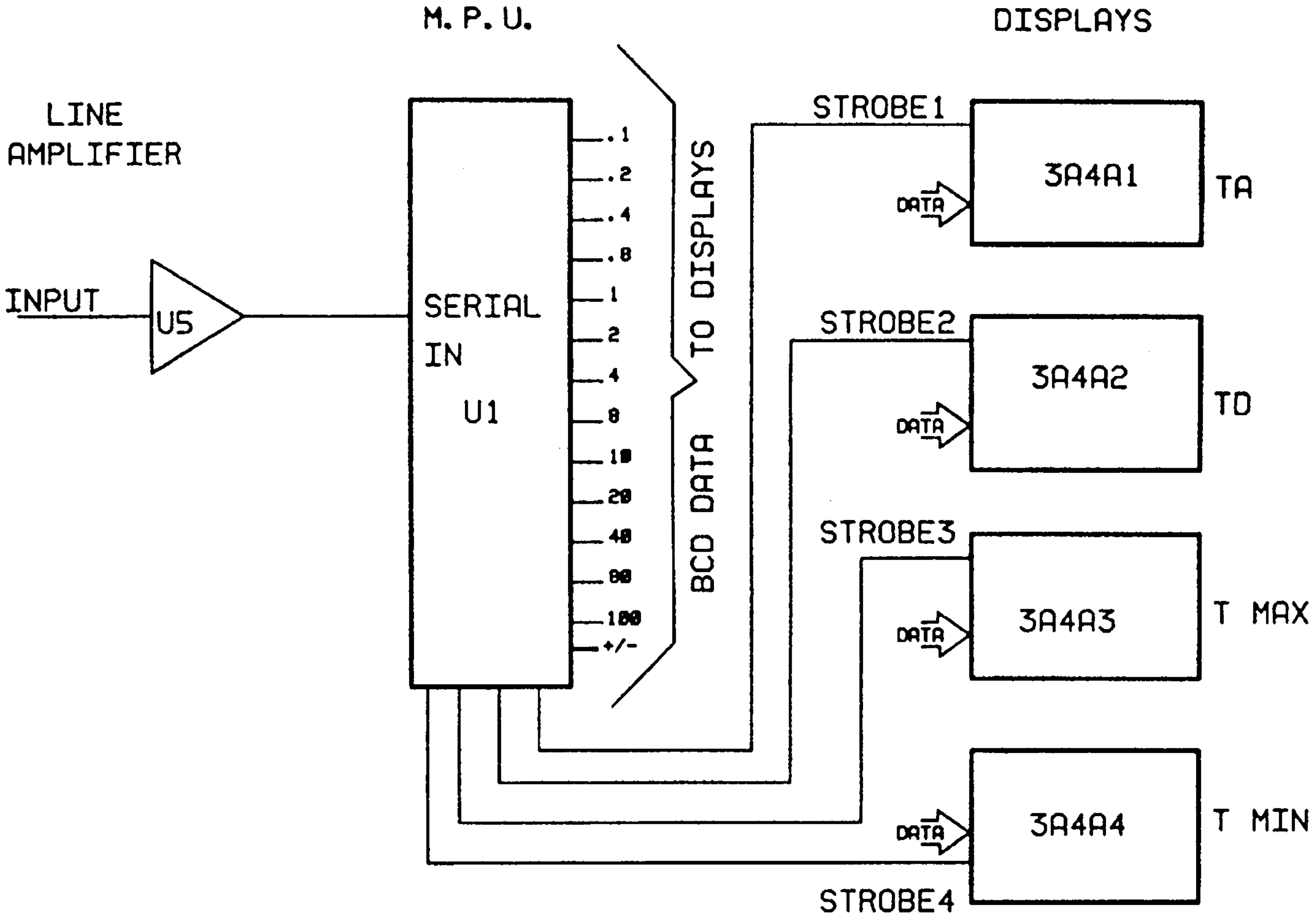


FIGURE 3-4

OUTPUT DISPLAY

3-10. DATA DISPLAY

The four temperature values, Average Ta, Average Td, Ta max and Ta min, are continuously displayed as decimal numbers on the front panel. To prepare the output data words for display, the 11-bit binary numbers in storage must be converted to Binary-Coded-Decimal format. This is done by a subroutine in the MPU program. All of the output data are brought out of the MPU on 14 lines, coded as tenths, units, tens, and hundreds of degrees and a polarity bit. Data on the lines is multiplexed to read out Ta, Td, Tmax and Tmin in that order. The data lines are distributed to all of the panel displays, and a unique strobe input, (S1-S4), is provided to each display so that each display may sample the data lines at the instant when the data is valid for that display.

The individual display modules, 3A4A1 - 3A4A4, on the panel contain storage latches to sample and store the data as it is strobed in. The latch modules, type MC14511, also contain seven-segment decoder-drivers which directly drive the incandescent segments of the decimal displays.

Data is displayed in degrees Celsius or in degrees Fahrenheit, depending on the logic state (1 or 0) of a control line to the microprocessor. This line may be switched by way of a front panel control for F or C selection.

SECTION 4

SCHEDULED MAINTENANCE

4-1. INTRODUCTION

This section furnishes the technician with all information necessary to perform periodic maintenance that will keep the system operating properly. The system is designed in such a manner that scheduled maintenance actions consist mainly of routine housekeeping chores.

4-2. SCHEDULED MAINTENANCE ACTION INDEX

Period	Maintenance Action	Reference
Daily	Operate Display Test switches	4-4. a.
Twice monthly	Check Aspirator Unit air passages	4-3. b.
	Check Aspirator Unit mirror and clean if necessary	4-3. b.
	Optic Loop Adjustments (Sensor Gain Adjustments)	4-3. b.
Semi-annually	Instrument Calibration	4-4. b.

4-3. PREVENTIVE MAINTENANCE PROCEDURES

a. Safety Precautions

Operating personnel must at all times observe all safety regulations.

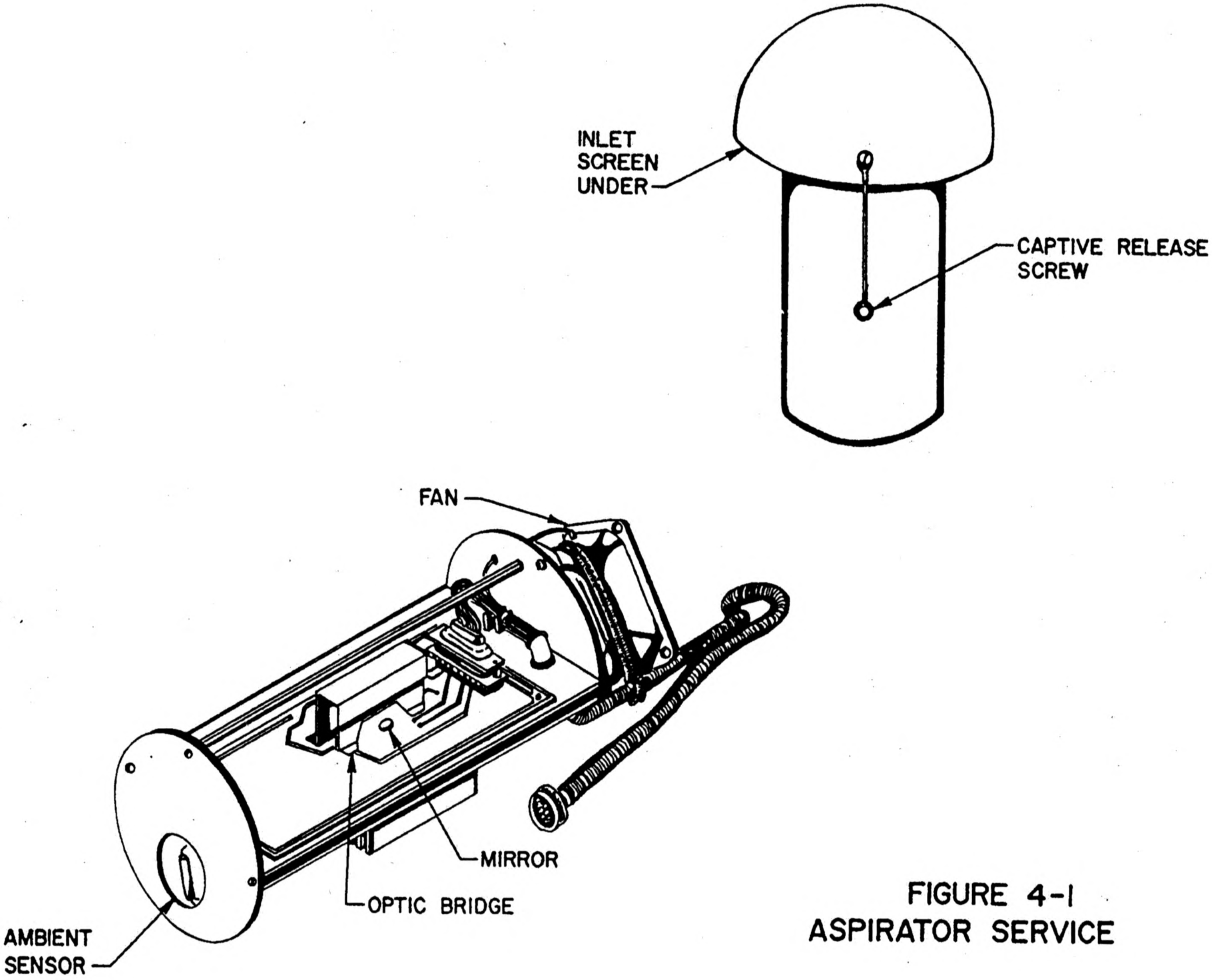


FIGURE 4-1
ASPIRATOR SERVICE

b. Aspirator Unit Maintenance

Because of the continuous flow of outside air through the Aspirator Unit, the optic bridge mirror will gradually acquire a film of contamination which, if not removed, will impair performance of the system. Periodically, the mirror surface must be examined and cleaned. This operation should be performed at least twice monthly at first, then more or less frequently as demanded by local climate conditions. Also, the air passages of the unit may accumulate obstructions such as leaves, insects, and dust, and should be wiped or blown clear during the mirror cleaning procedure.

To service the mirror, turn off the Transmitter Unit main power. Remove the sensor assembly from the Aspirator Unit by removing the captive screw on the side of the unit (Fig. 4-1). With the screw removed, the entire sensor assembly slides downward out of its shield.

NOTE

> If the system is equipped with an Autobalance unit, refer to Appendix D for adjustment procedure. The Autobalance dial must be set to 000 before proceeding.

Referring to Figure 4-1, examine the mirror surface, which should be clean and bright. If any degree of dirt or film is evident, spray the surface with an inert aerosol cleaner, such as FREON. Allow the mirror to air-dry and re-examine for contamination. If necessary, apply more solvent spray. Only if absolutely necessary to remove heavy contamination should the surface of the mirror be wiped. If it is necessary, wipe the surface lightly with a clean cotton swab wetted with FREON.

Replace the sensor assembly in the shell and restore system power.

After replacing the sensor assembly in the Aspirator shell, the technician must perform the optic loop adjustments as follows (Refer to Figure 4-2, Optic Loop Adjustments):

1. Direct Sensor Gain Adjustment

Open Transmitter Unit cover. Switch the Monitor Display Switch (S1) to the Td position. Observe Td on the Monitor Display. Depress the TEST switch to the HEAT position. Td should increase at a rate of about 1 degree per second.

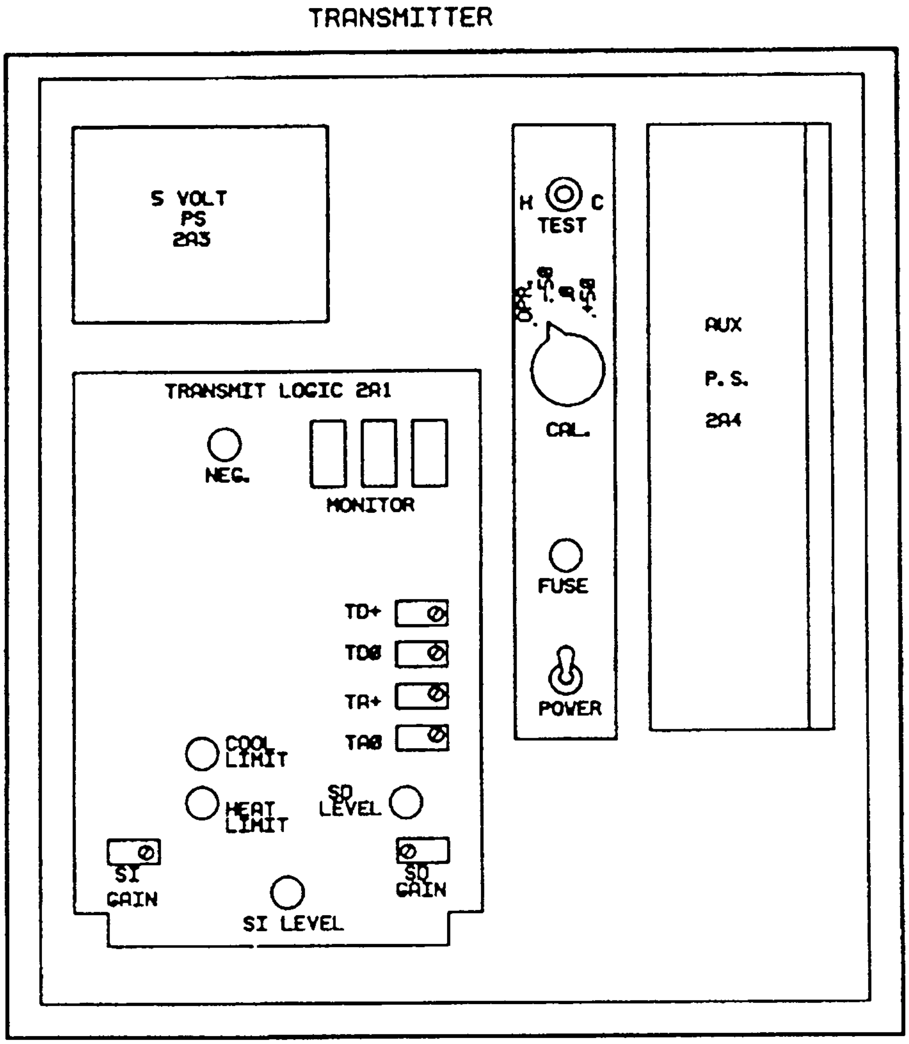


FIGURE 4-2

OPTIC LOOP ADJUSTMENTS

Keep the TEST switch depressed until Td is at least 20° above Ta. At some point during this increase, the direct sensor (Sd) LED (CR5) should light. Release TEST switch. Turn the Sd Gain Adjustment (R21) counter-clockwise until CR5 is off. Turn R21 clockwise until light just illuminates (threshold level).

2. Indirect Sensor Gain Adjustment

When TEST switch is released, the Td indication should descend at about 1°per second. Adjust the indirect sensor (Si) Gain Adjustment (R22) clockwise until the Si LED (CR9) comes on, then back off until the LED just goes out. Note that this adjustment must be completed while Td is still above Td, assuring that the mirror is still dry. Recheck and repeat if necessary.

After the system has stabilized, the Si LED (CR9) should be on, the LIMIT LED's should be off, and the Sd LED (CR5) should be off.

4-4. SCHEDULED PERFORMANCE TESTS

a. Display Test Switch (Display Unit Front Panel)

Leave Display Unit on. Depress the Display Test Switch. All light segments of the four digital displays (Td, Ta, Tmax, and Tmin) should indicate -188.8 and the Error Lamp should blink. If not, consult Section 8, Repair Notes.

b. Instrument Calibration (Transmitter Unit)

With transmitter turned on, turn the Calibrate switch to 0. Observe Monitor Ta and Td readings. Adjust the TA0 Trimpot (R14) and the TD0 Trimpot (R15) for a 32.0+/-0.2 indication on the respective displays. This represents 0° Celsius.

Turn the Calibrate switch to +50. Observe Monitor Ta and Td readings. Adjust the Ta+ Trimpot (R16) and Td+ Trimpot (R17) for a 22.0+/-0.2 reading, representing +50° C (the hundreds digit is not active in the Monitor display. Turn the Calibrate switch back to 0 and verify that Ta and Td remain at 32.0.

Turn the Calibrate switch to -50. Verify that the display indicates -58 +/- .5 for Ta and -67.7 +/- 0.5 for Td.

SECTION 5

INSTALLATION

5-1. INTRODUCTION

This section supplies the installation technician or team with all information needed for installing the 1063 Hygrothermometer System. Included in this section are installation drawings, site selection requirements, packing and unpacking and preservation instructions, input data requirements, actual installation procedures, and installation checkout procedures.

5-2. INSTALLATION DRAWINGS

The following drawings should be consulted during the installation phase:

a. Pictorial system diagram (Figure 1-1)
b. Mounting Plan (Figure 5-1)
c. Interconnecting wiring & cabling diagram (Figure 5-2)
d. Summary list of all installation material requirements
e. Input & output reference data

5-3. SITE INFORMATION

a. Aspirator and Transmitter Units

The Aspirator Unit is mounted approximately 5' above ground in any location that can provide unobstructed air flow through the sensor assembly. The ideal location is as far removed from standing water and vegetation as is possible due to their effect on the dew point temperature. It is assumed that the 1063 will be installed at existing station sites, which already have a concrete pad and standpipe (mounting pipe). The 1063 may be mounted at sites with threaded or unthreaded standpipes. The Aspirator Unit is physically attached to the Transmitter Unit by struts as shown in Figure 5-1 and electrically connected by a 5' cable. The cable has been pre-wired with a quick-disconnect plug. The Transmitter is equipped with a flange for mounting to the standpipe.

b. Display Unit

The Display unit is mounted on slides in a standard 19 inch equipment cabinet at the operator's station.

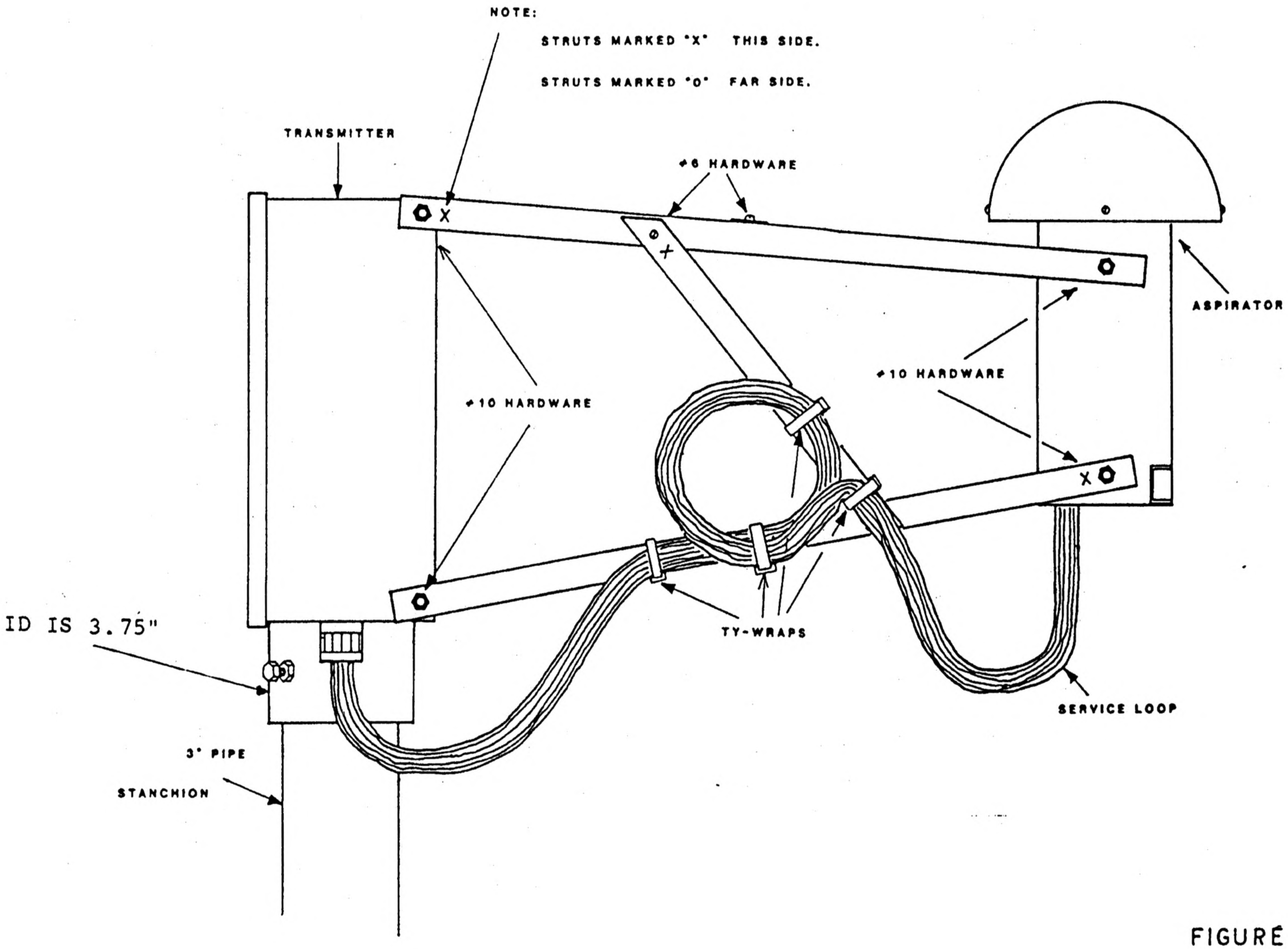
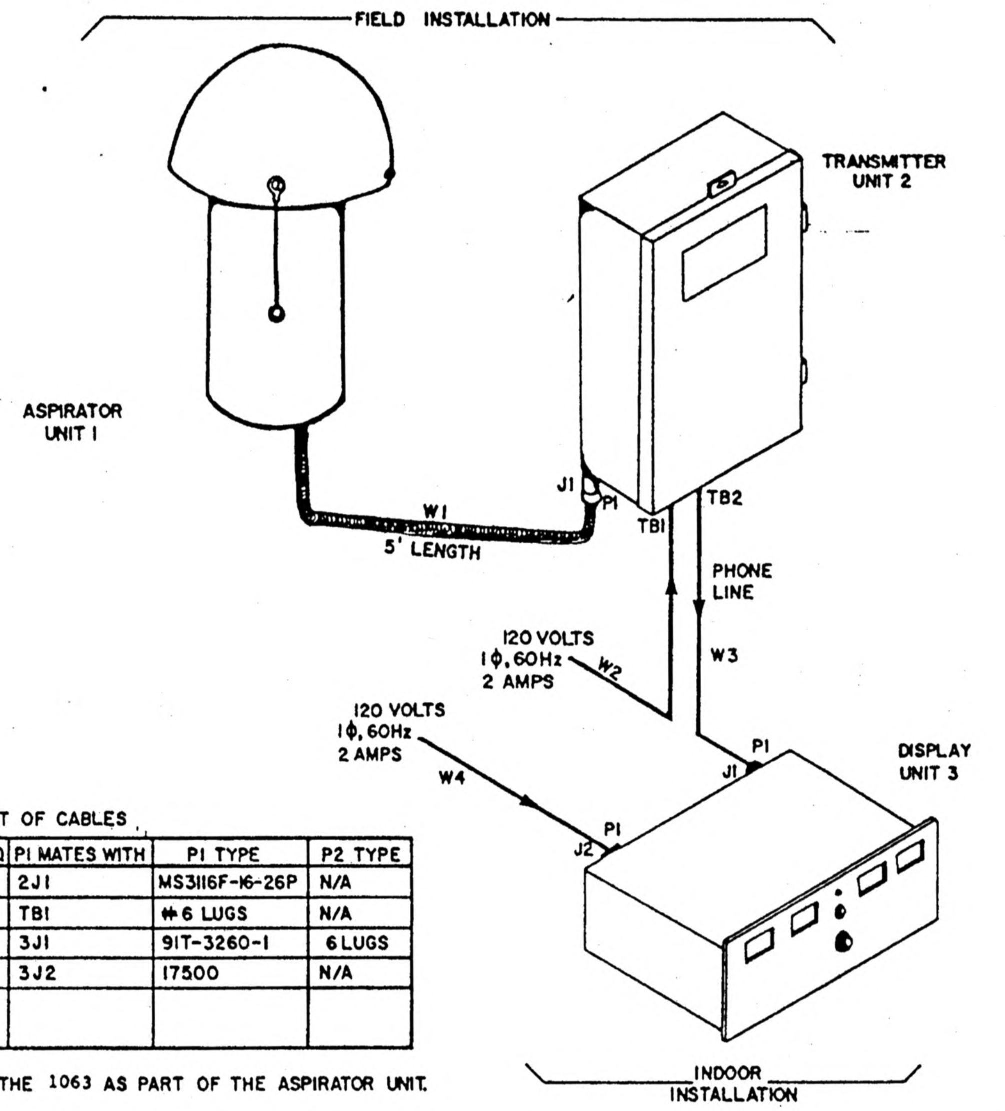


FIGURE 5-1
MOUNTING PLAN



LIST OF CABLES

CABLE	TYPE	ACTIVE COND.	P1 MATES WITH	P1 TYPE	P2 TYPE
W1	#8774	14 & SHLD.	2J1	MS3116F-16-26P	N/A
W2	SJ-14	2 & GND	TB1	#6 LUGS	N/A
W3	22GA. PR	2	3J1	91T-3260-1	6 LUGS
W4	17500	2 & GND	3J2	17500	N/A

NOTE: W1 IS FURNISHED WITH THE 1063 AS PART OF THE ASPIRATOR UNIT.

FIGURE 5-2
INTERCONNECTING CABLE DIAGRAM

5-4. REFERENCE PUBLICATIONS

This manual is the only reference manual necessary for installation of the 1063.

5-5. MATERIALS REQUIRED FOR INSTALLATION

The following materials are needed for installation:

Wiring & cabling - All power input and communication wiring must be fabricated by the installer, with the exception of the control cable which connects the Aspirator and Transmitter Units. However, mating connectors are furnished with the equipment. The minimum recommended wiring standards are as follows:

1. Transmitter Unit: AC power: 2 - 18 AWG with ground.
   Signal output: 22 AWG twisted pair.

2. Display Unit: AC power: 2 - 18 AWG with ground.
   Signal input: 22 AWG twisted pair.

Connections to the environment-proof enclosure of the Transmitter Unit are made through the mounting pipe at the bottom of the enclosure.

5-6. UNPACKING AND REPACKING

The 1063 system is ready for installation when removed from the shipping cartons. The shipping cartons and protective cushioning may be saved for repacking as required.

5-7. POWER REQUIREMENTS

The following electrical inputs are required for proper installation and operation of the system:

a. Aspirator Unit - Power supplied by Transmitter Unit.

b. Transmitter Unit - 120 V/60 Hz, approx. 1 ampere.

c. Display Unit - 120 V/60 Hz, single phase, approx. 1 ampere.

5-8. INSTALLATION PROCEDURES

a. Aspirator Unit

The Aspirator is supported by angle struts as shown by the Mounting Plan, Figure 5-1. The Aspirator is attached to the Transmitter prior to mounting on the standpipe.

b. Transmitter Unit

Mount the Transmitter Unit as shown by Figure 5-1. Make AC power and communication line connections through the mounting pipe at the bottom of the enclosure before tightening flange screws. Figure 5-2 indicates all necessary electrical connections. Connect the Aspirator Unit cable to receptacle J1.

c. Display Unit

The signal input and AC power cables may be plugged into the rear of the Display Unit after it is installed in the cabinet. The unit is installed by placing it on the slide rollers and pushing it into the cabinet until the slide assembly locks. The chassis assembly is retained by front panel locks.

5-9. INSTALLATION CHECKOUT

The following installation checkout procedure is used to ensure all units have been properly installed and the system is working reliably.

5-9.1 Phase 1

Installation inspection and pre-power procedures.

Verify the following:

a. That all units of the system are installed correctly and that all cabling interconnections conform to Fig. 5-2.

b. That the Calibration switch on the Transmitter Unit is in the OPER position.

c. That all test equipment listed in Section 1 of the manual is available at the site, is operating satisfactorily, and has been calibrated.

d. That there are no obstructions impeding air flow into the aspirator. Normal air flow is into the dome and downward through the Aspirator.

e. That there is access to the equipment for maintenance, especially clearance for opening the cover door on the Transmitter Unit.

5-9.2 Phase 2

Initial turn-on & preliminary test.

Energize the Transmitter Unit and the Display Unit. The Monitor Indicator inside the Transmitter and the Display Unit indicators should illuminate immediately. If the lights do not illuminate or if they light momentarily and go out, check the fuses on both the Transmitter and the Display.

5-9.3 Phase 3

Installation verification test.

Display Unit Test

a. Turn off Transmitter Unit. Leave Display Unit on. Depress the Display Test Switch. All light segments of the four digital displays (Td, Ta, Tmax, & Tmin) should indicate -188.8 and the Error Light should flash.

b. Rotate the Dimmer Control and verify that the display intensity varies from very dim to maximum brightness.

c. Use a voltmeter to test internal voltage at the 5 V Test Point (3A2-6). Meter should indicate 5 V +/-.5 V.

Transmitter Unit Test

a. Ensure that Transmitter is OFF. Remove the aspirator from its shell as detailed in 4-3. Examine the mirror and clean if necessary per 4-3.b. Replace aspirator in shell. Energize Transmitter. By listening to the aspirator, verify that the fan is operating.

b. After 2-3 minutes stabilization time, measure the three main DC power levels, +5V, +12V, -12V, at the appropriate test points. These are 2A3-10, -6, and -12 respectively. All should be within +/-.5 V of the nominal voltages.

c. Optic Loop Adjustments

NOTE: If the unit is equipped with the optional "Autobalance" module (10-turn dial next to the Heat/Cool switch), turn the dial counter-clockwise to 000, then proceed.

1. Direct Sensor Gain Adjustment

Observe Ta and Td on the monitor display in the transmitter. Move the Monitor Display Switch to the Td position. Place the TEST switch in the HEAT position. Td should increase at a rate of about 1 degree per second. Keep the TEST switch depressed until Td is about 20° above Ta. At some point during this increase, the direct sensor (Sd) LED (CR5) should light. Release the TEST switch and turn the Sd gain trimpot (R21) counter-clockwise until the LED is off. Turn R21 clockwise until the LED just illuminates (threshold level).

2. Indirect Sensor Gain Adjustment

After TEST switch is released, adjust the indirect sensor (Si) gain trimpot (R22). Si gain may be increased until the Si LED (CR9) comes on, then carefully decreased until the LED just goes off. After the system stabilizes at dew point, the Si LED (CR9) will be on, and the Sd LED (CR5) should be off. Note that Sd and Si gain adjustments must be finished before the system has chilled the mirror down to or below the dew point, to assure that the adjustments are made in the clear mirror condition.

d. Instrument Calibration

NOTE: The monitor display on the Transmit Logic card may read in degrees Fahrenheit or Celsius, depending on whether the F jumper near the top edge of the card is installed. If the jumper is installed, the 0, -50, and +50 degree calibration values are -58 Ta, -67.7 Td, 32 and 22 (for 122).

With transmitter on, turn the Calibrate Switch to 0. Observe Monitor Ta and Td readings. Adjust the TA0 Trimpot (R35) and the TD0 Trimpot (R52) for a 0 +/- 0.1 degree indication on the respective displays.

Turn the Calibrate Switch to +50. Observe Monitor Ta and Td readings. Adjust the Ta+ Trimpot (R34) and Td+ Trimpot (R51) for a 50.0 +/- 0.1 indication. Turn the Calibration Switch back to 0 and verify that Ta and Td remain at 0.

Turn the Calibrate Switch to -50. Verify that the Monitor Ta display shows -50 +/- 0.3, and that the Monitor Td display shows -55.4. The displays read different values because Td is calibrated for dew point, not frost point.

Turn the Calibrate Switch to OPER. Leave Power switch on. Close transmitter unit cover.

Transmitter/Display Tests

The following tests require one technician to monitor the Transmitter Unit and one technician or operator to monitor the Display Unit.

a. Error Light - With Transmitter Power switch remaining on, energize the Display Unit. Disconnect input signal cable (P1) on rear of Display Unit. Error Light should flash continuously. Ta, Td, Tmax, and Tmin readings should remain the same as before disconnecting P1. Re-connect the input signal cable. Hold the Transmitter Test switch in the Heat position. The Error light should flash. When the Calibrate switch is placed in the 00, +50, or -50 positions, the Error Light should flash periodically until the displayed Ta and Td values are within 2 degrees of the test value. With the Display Unit rear panel Data Test switch in the INST position, the Error light should flash continuously.

b. Tmax and Tmin - With both units operating and stabilized, reset Tmax and Tmin by depressing the RESET switch and the FAHRENHEIT display switch simultaneously. Tmax and Tmin should both indicate the same as Ta, +/- 0.2. At the transmitter, set the Calibrate switch to +50 and wait six minutes, then turn the Calibrate switch to -50 and wait six minutes. Turn the Calibrate switch to OPERATE. The Tmax and Tmin displays at the Display Panel should indicate +50 +/-0.3 and -50 +/-0.5 respectively. Reset Tmax/Tmin. The Tmax and Tmin displays should indicate the same as Ta, +/- 0.2.

SECTION 6

FUNCTIONAL DIAGRAMS

GENERAL:

Functional structure of the Model 1063 is described by the following diagrams. On the first diagram, the Overall Function, operation of the system is described in 5 interrelated sections. In the subsequent diagrams, each of the five sections is further broken down for analysis. Note that the groupings do not represent physical (hardware) packages, but are arranged to give a clear picture of the functional relationship of all of the parts of the system.

OVERALL FUNCTION DIAGRAM KEYED TEXT

① SENSING FUNCTION

Sensing Function consists of all circuits necessary to provide a pair of electrical signals (resistance values Rta and Rtd) which represent Ambient Temperature, Ta, and Dew Point Temperature, Td. Components of the Sensing Function are located in the Aspirator Unit and in the Transmitter Unit. Physical measurement of dew point is made by way of a chilled mirror optical system.

② ANALOG SIGNAL CONDITIONING

This functional group receives the two resistance values representing ambient temperature and dewpoint temperature, and converts the values into a pair of DC voltage levels, Vta and Vtd, which are proportional to the two temperatures of interest. Included in the signal path is a calibrator which provides a convenient means of checking and adjusting the calibration of the system. Following the conversion to DC analog signals is a multiplex gate which allows the two channels of data to share a single output line for data transmission.

③ DATA TRANSMISSION

The multiplexed analog representation of ambient temperature (Ta) and dewpoint temperature (Td) is processed into a parallel binary digital data format, still multiplexed alternately as Ta and Td. This data is presented to a parallel input port of a data processor which performs all of the necessary storage and formatting to convert the data into a serial stream suitable for transmission over a telephone-quality line. The data stream is transmitted at a 600 Baud rate, 2.5 frames of data per second. Each frame of data transmits Ta and Td values. For use in servicing the equipment, a data receiver and numeric data display are included in the data transmitter package. By switch selection, the user may select Ta or Td presented as a decimal numeric display.

④ DISPLAY FUNCTION

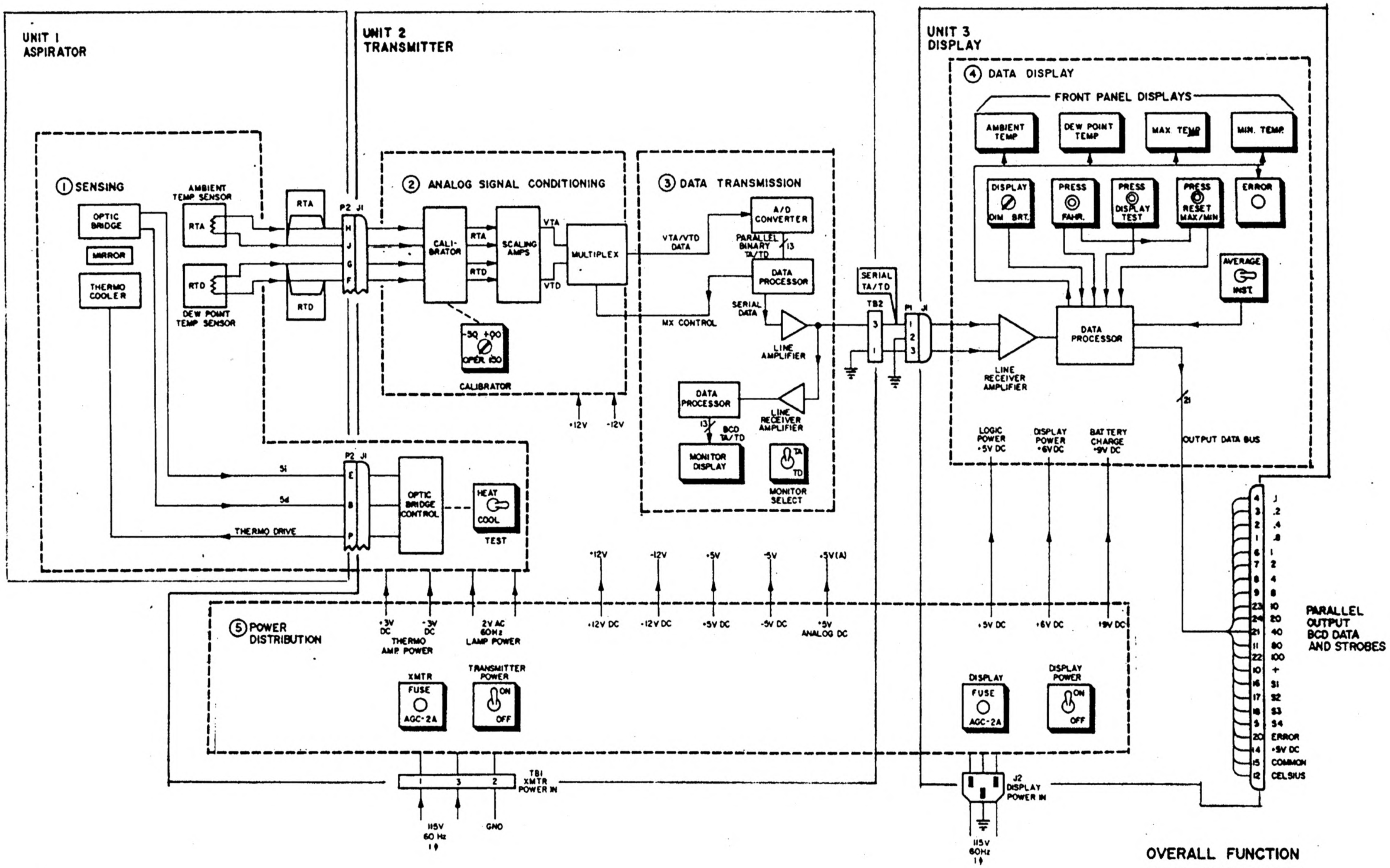
The serial data stream is received from the data transmitter and converted into a parallel format suitable for output display. Also included in the Display Function are arithmetic processes which average the Ta and Td data, and maintain current values of maximum and minimum values of Ta. Ta, Td, Tmax, and Tmin are continuously displayed on the front panel of the Display Unit. All of the data are also buffered and brought to a rear panel connector.

⑤ POWER DISTRIBUTION

The Power Distribution function includes all of the necessary circuits to provide and distribute AC and DC power levels to the components of the hygrothermometer. Using independent 115 volt, single phase, 60 Hz inputs at the Transmitter and Display units, voltages are developed and regulated as required. Input to the Aspirator, Unit 1, is furnished by cable from the Transmitter, Unit 2.

NOTE

The Model 1063 is designed as a Celsius indicating instrument, with provision for displaying Fahrenheit by depressing a momentary switch on the Display Unit panel. Some 1063 instruments, as an option, read Fahrenheit, and the switch provides a Celsius readout. The only difference is the sense of the switch and the legend on the front panel.



OVERALL FUNCTION
HYGROTHERMOMETER

SENSING FUNCTION KEYED TEXT

① OPTIC BRIDGE

The Dew Point Sensor assembly, 1A1, includes the sensing elements for both dew point and ambient temperature measurements. Dew point measurement is made by the Optic Bridge in the Aspirator Unit, in which a mirror surface is cooled and held at exactly the temperature at which a fine film of condensate forms and is maintained. The Optic Bridge includes a thermoelectric heat pump, U1, which is electrically controlled by the Optic Control portion of the Transmit Logic PC assembly in the Transmitter Unit. A platinum temperature sensing resistor, RT2, in the mirror block assumes a resistance value exactly proportional to the mirror temperature. This resistance value is used as the basis for the Td data value.

The Optic Bridge includes an infra-red LED, CR1, which illuminates a mirror block, and two photosensitive transistors, Q1 and Q2, which sense the direct and scattered reflection from the mirror. When the mirror is not cool enough, the direct reflection (Sd) is high and the indirect reflection (Si) is low. If the mirror surface is too cool, the opposite situation exists. The phototransistor output signals, Sd and Si, serve as inputs to the Optic Control section of the sensing function, which maintains balance between Sd and Si, holding the mirror at exactly the dewpoint temperature. Input to the bridge lamp is a 60 Hz voltage, so that Sd and Si are AC signals.

② OPTIC BRIDGE CONTROL

In the Transmit Logic PC assembly of the Transmitter Unit, the Optic Bridge Control section receives the Direct and Indirect optical signals, detects them, and amplifies the difference between the amplitudes of the Sd and Si DC levels. The difference signal, amplified by U6B, is fed to the Thermo Power amplifier, Q1 and Q2 of the Auxiliary Power Supply in the Transmitter Unit. The Thermo Power amplifier produces a DC output varying between + and - 3 volts DC to drive the thermoelectric heat pump, U1, in the Optic Bridge assembly in the aspirator. The polarity of the power output produces heating or cooling of the mirror to tend to make the Si and Sd signals equal.

③ Sd LEVEL INDICATOR

For use in adjusting the optic control system, Light Emitting Diode CR5 indicates when the direct light signal, Sd, is at its proper level. Sd amplifier gain is adjusted to produce +5 volts DC in the clear mirror condition. When the Sd level is at +5 volts DC or slightly higher, threshold amplifier U5B saturates positive, lighting CR5.

④ HEAT/COOL TEST SWITCH

Also for use in testing and adjusting the equipment, the technician is provided with a switch, by which he can introduce a DC unbalance in the optic control loop, causing the mirror to heat or to cool.

⑤ HEAT/COOL LIMIT DETECTOR

Normally, when the optic control loop is functioning, feedback amplifier U6B maintains a moderate output level, providing the necessary DC level to maintain the mirror at the dew point temperature. In this normal condition, the voltage at the input node of U6B is virtually zero. If the loop should fail to maintain balance because of mirror condition or component failure, U6B will assume a saturated condition, and its node voltage will increase to a relatively high value. The node voltage is monitored by high-gain amplifier U7B, driving indicator LED's CR6 and CR7. If the U6B node voltage becomes excessive in the positive or negative direction, one of the LED's will indicate the abnormal condition. The output of U7B is also used as an error input to the data transmitter, so that the malfunction can be displayed remotely.

⑥ TEMPERATURE SENSING

Two identical platinum temperature sensors, RT1 and RT2, are located in the Dew Point Sensor assembly. RT2 is mounted in the body of the mirror and assumes the temperature of the mirror which is at the dew point. RT1 is mounted directly in the incoming airstream of the aspirator and assumes the ambient air temperature. The resistance values of RT1 and RT2 are exactly proportional to their temperatures. These resistance values are used as the basis of measurement of Ta and Td.

⑦ ASPIRATION

For the ambient and dew point sensors to function properly, an ample supply of air must be furnished. The aspirator fan, 1B1, provides a stream of air for the Ta sensor and for exhausting the heat generated by the thermoelectric cooler.

⑧ Si LEVEL INDICATOR

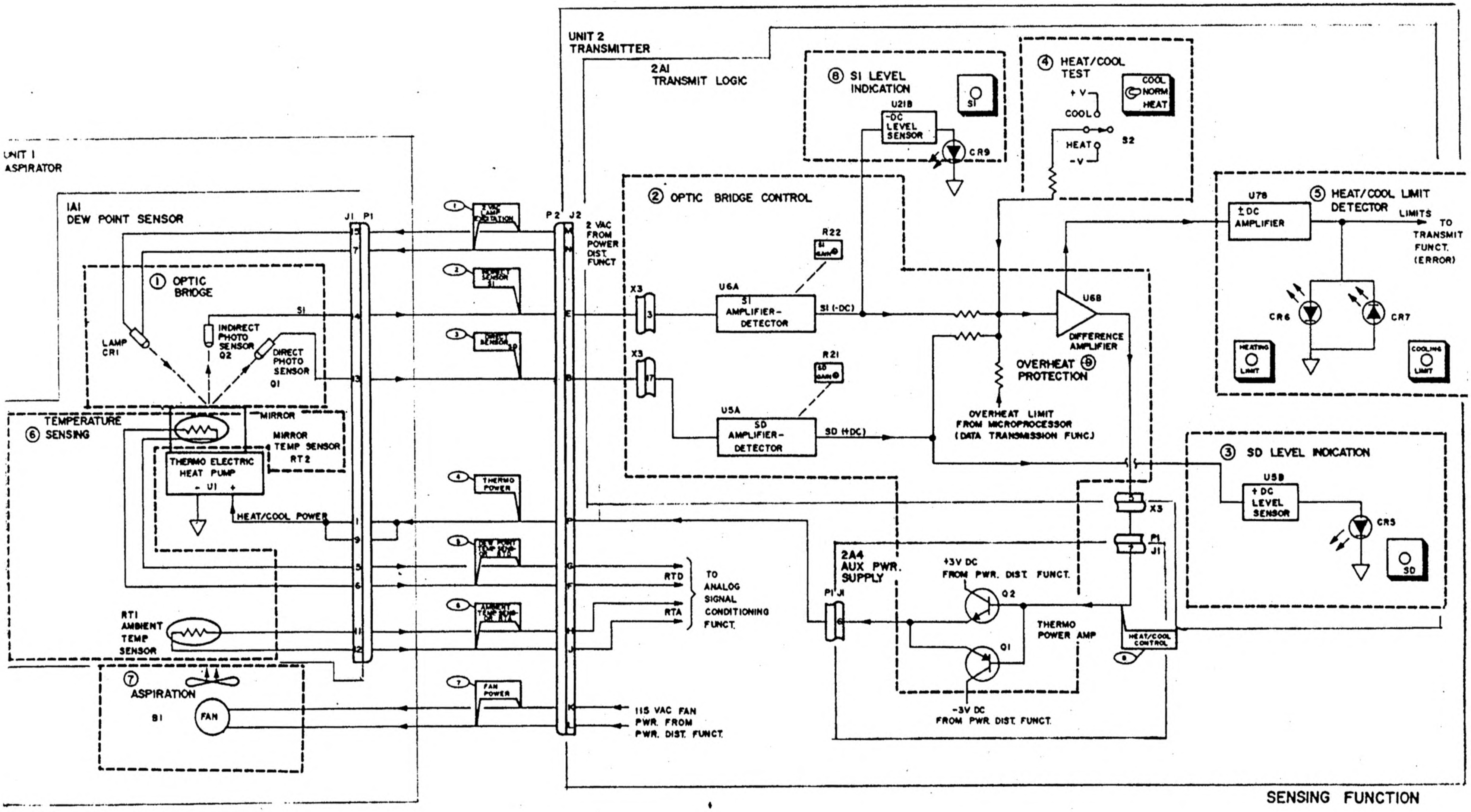
Threshold amplifier U21B detects when the Si level is at -3 volts DC, lighting LED CR9. This is used as an aid in adjusting Si gain.

⑨ OVERHEAT PROTECTION

If a Td or Ta temperature value greater than +65 degrees C is sensed by the microprocessor, the overheat protect line is raised from its normal zero level to +5 volts DC. This signal, injected to the node of the differential amplifier, produces full cooling effect. Presence of the overheat protect signal can indicate a runaway Td heating condition, dirty mirror, or component failure.

⑩ AUTOBALANCE INPUT

Some installations are equipped with an optional Autobalance module. This module feeds a DC bias to the Optic Bridge control amplifier to compensate for the effect of long-term contamination of the mirror. The Autobalance circuit is described in Appendix D.



SENSING FUNCTION

ANALOG SIGNAL CONDITIONING FUNCTION KEYED TEXT

GENERAL

Analog Signal Conditioning receives the resistance values representing Ta and Td and transforms those values into a multiplexed DC representation of the data values, Ta and Td.

① INPUT AMPLIFIERS

Operational amplifier U9A is driven by a precise 6.2 volt DC reference through input resistor R20. The dewpoint sensor resistance, Rtdp, is used as the feedback resistor for U9A, making the DC output of U9A exactly proportional to Rtdp; hence, U9A output voltage is an exact measure of the dewpoint temperature.

Operational amplifier U8A performs the same function in the ambient temperature channel.

② SCALING AMPLIFIERS

Amplifier U9B in the dewpoint channel provides gain and eliminates the zero offset level, yielding an output at a more convenient level for processing. At the output of U9B, zero voltage represents 0 degrees Celsius and +/- 2 volts DC represents +/- 50 degrees. Adjustments are provided for a small degree of offset trimming at zero and gain trimming at +50 degrees. These adjustments are normally made in conjunction with the use of the Calibrator.

Amplifier U8B performs identical scaling and offset correction functions in the ambient channel.

③ MULTIPLEXER

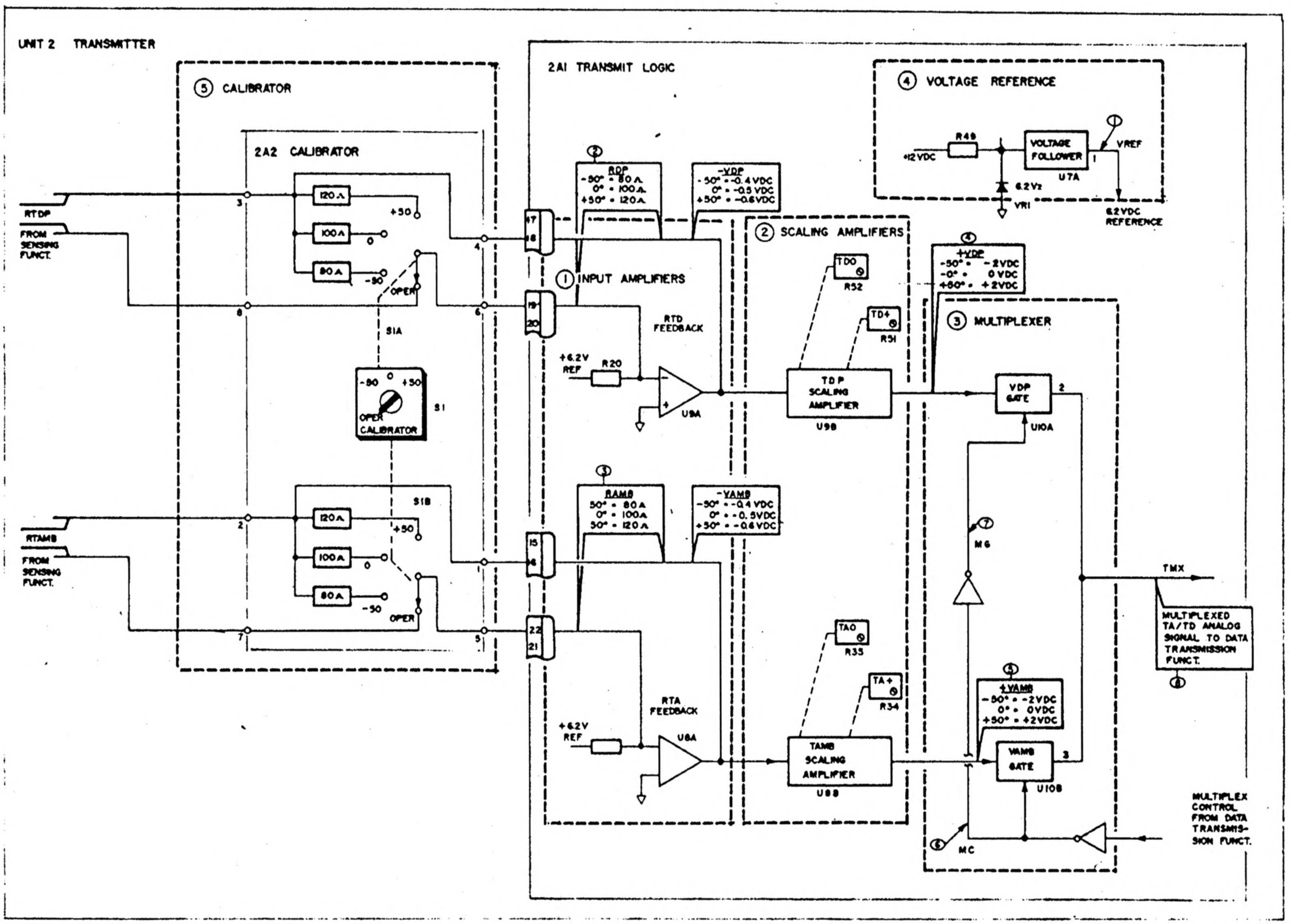
The DC analog voltages, Vdp and Vamb, are each brought to the input of a pair of gates, U10A and U10B. These gates, when disabled, present a series resistance on the order of 100 megohms, and when enabled present about 50 ohms to the signal path. The Vdp and Vamb gates are alternately switched on and off by a control input from the data transmitter at a rate of 5 cycles per second. The gates, their outputs tied together, alternately connect Vdp and Vamb to the output line.

④ VOLTAGE REFERENCE

A stable Zener reference diode, VR1, provides an input to voltage-follower amplifier U7A. This 6.2 volt reference is used by the data amplifiers and also as a reference in the data transmitter.

⑤ CALIBRATOR

For use in checking operation of the system and also as an internal calibration standard, the Calibrator switch 2A2S1 permits the operator to substitute precision fixed resistors in place of the ambient and dewpoint temperature sensors. Three standard resistor values are included in each channel, providing simulated inputs at zero and +/- 50 degrees Celsius.



ANALOG SIGNAL CONDITIONING
FUNCTION

DATA TRANSMISSION FUNCTION KEYED TEXT

GENERAL

Data Transmission receives multiplexed Vamb and Vdp DC analog signals from Analog Signal Condtioning and converts the data to a serial digital stream suitable for transmission to the remote display unit.

① A/D CONVERTER

A single-chip analog-to-digital converter, U2, converts the input Ta/Td signal to a parallel straight binary output data bus. On the bus are 12 data bits and a sign bit. The converter is fully automatic, working in synchronism with the Data Processor. The output data bus handles the parallel Ta and Td data alternately.

② DATA PROCESSOR

A single-chip microprocessor, type 68701, performs all of the timing and control functions of clocking the A/D converter through its cycle, and takes in the parallel binary data from the A/D converter. Under control of its resident program, the processor formats the data into a 600 Baud serial data stream. The processor also receives an Error indicator bit and includes it in the output format. The output serial signal is brought through a line driver, U11, to the transmitter output terminal.

Synchronism between the A/D converter and the data processor is controlled by "handshake" lines. A Status line from the A/D indicates to the processor when conversion is in process, and an output line from the processor to the Run/Hold input of the A/D signals the A/D that the processor is ready to receive new data.

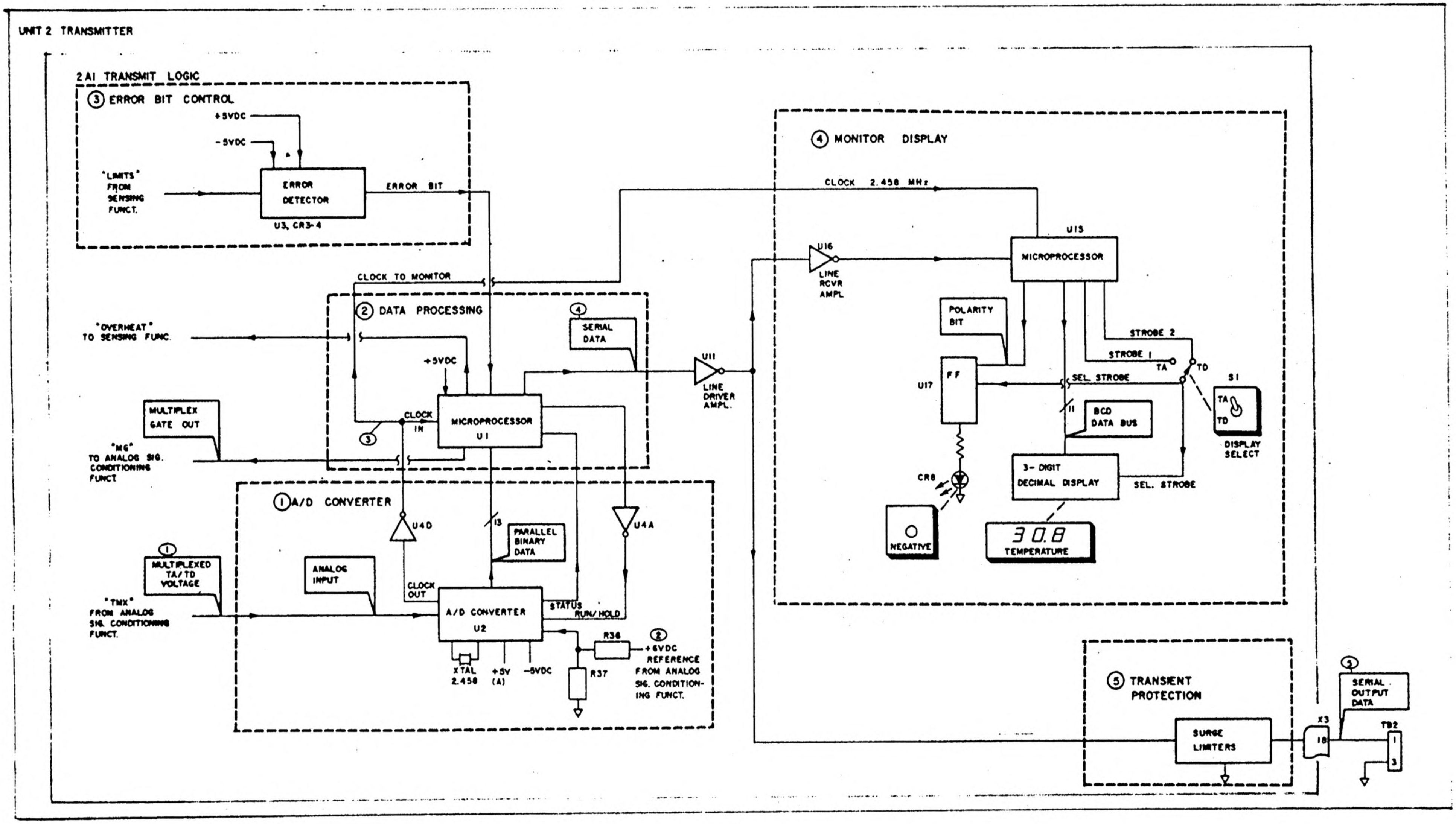
③ ERROR BIT CONTROL

The Limit sensing circuit in the Optic Control circuit, normally a zero level, is summed with the +5 and -5 volt DC supply levels. Under normal conditions, the summation voltage is zero, or very close to zero. In the event of a failure in the optic control, or if a power supply line should fail, an unbalance will exist,positive or negative, in the summation level. The unbalance is amplified by U3A and U3B. Whether the unbalance is positive or negative, the result will be a positive output of the OR circuit of CR3 and CR4. This positive level is brought to an input of the Data Processor as the Error bit input.

Also, internal to the microprocessor, the digitized values of Ta and Td are checked continuously. If either value exceeds +65 degrees C, the Error flag is set, indicating the presence of an overheat condition or a component failure.

④ MONITOR DISPLAY

Built in as a part of the Transmit Logic PC assembly is a data receiver which serves as an aid in servicing the system. This circuit, the Monitor Display, contains all of the elements of a data display system, operating independently of the transmitter circuits. The transmitter output is connected through a line receiver amplifier, U16, into a separate Type 68701 microprocessor, U15, programmed to convert the data stream into parallel Binary Coded Decimal form suitable to drive numeric digital displays. A three-digit display is mounted on the Transmit Logic PC assembly, and reads out the current value of Ta or Td, selected by a toggle switch, S1, on the card. The Monitor microprocessor shares the common 2.458 Mhz clock which serves the A/D converter and the transmitter data processor.



DATA TRANSMISSION FUNCTION

DATA DISPLAY FUNCTION KEYED TEXT

GENERAL

The Data Display Function is the output portion of the system. It receives the transmitted serial binary multiplexed Ta and Td data stream and converts the data into format suitable for panel display. Arithmetic manipulations are performed on the data, including 5-minute averaging of Ta and Td, and recording maximum and minimum Ta. Data quality checks are performed, and the four data outputs, Ta, Td, Tmax, Tmin, are displayed on the front panel.

① DATA PROCESSOR

A Type 68701 single-chip microprocessor performs virtually all of the timing and logical functions of the receiver. Data is brought through a line receiver amplifier to the serial input port of the processor. Under control of the resident program, the processor gathers, computes, and stores the pertinent data. Output from the processor is on a 13-bit parallel bus which is time-multiplexed to Ta, Td, Tmax, and Tmin. As each of the data words is on the bus, a unique strobe pulse is generated, one for each of the four outputs. The data bus and the pertinent strobe are connected to each of the output display subassemblies on the panel. Output data is normally presented in degrees Celsius.

② NUMERIC DISPLAY

The Display assembly, 3A4, located behind the Display Unit front panel contains four identical 4-digit numeric plug-in display modules, for Ta, Tdp, Tmax, and Tmin. Each module consists of 5 latch/decoder/driver IC's and four incandescent decimal display elements. The drivers are connected to the common data bus, and are sampled by strobe lines, S1-S4. Each strobe line controls one of the four displays. Once each 37.5 seconds, all four display modules are updated.

③ ERROR INDICATION

When the error flag bit is received from the transmitter, or when certain other error conditions are detected by the receive logic, the Error output level goes high. This turns on a 2 pulse-per-second multivibrator, U2B,which flashes an Error LED indicator on the front panel.

④ DISPLAY BRIGHTNESS CONTROL

Built into each of the latch/decoder/drivers in the display modules is a blanking input. The blanking control line is driven by 100 pulse-per-second multivibrator U2A through one-shot U3 with controllable output pulse width. When the blanking line is up, the displays operate at full intensity; when the line is at zero, the displays are off. The positive pulse width of the blanking control line is controlled by the Display Dimmer control on the front panel, so that the average voltage on the pulsed line governs the apparent intensity of the displays.

⑤ FAHRENHEIT DISPLAY SELECTOR

The system output display is normally in degrees Celsius. At any time the operator may select Fahrenheit display by depressing the Fahrenheit Display pushbutton on the front panel. The button is momentary-action, so that the displays automatically revert to Celsius when the button is released. All four of the displayed values, Ta, Td, Tmax, Tmin, are affected by the Fahrenheit display selection. The conversion to Fahrenheit is controlled by software resident in the processor. The output BCD data is also affected by the Fahrenheit Display selector.

⑥ MAX/MIN RESET

The Tmax and Tmin displays may be reset to the present value by depressing the momentary Reset switch. To guard against accidental resetting, the Reset switch is connected in series with a pole of the Fahrenheit switch, so that both the Fahrenheit and the Reset switch must be pushed simultaneously to reset the Max/Min display.

⑦ DISPLAY TEST SWITCH

As a test of all the segments of the displays, depressing the momentary Display Test Switch causes all of the displays to indicate -188.8 degrees. In Display Test, the Error indicator is also caused to flash.

⑧ MEMORY PROTECTION

In the event of a momentary or prolonged power failure, the critical part of the data processor memory remains active, powered by a small battery located on the Receive Logic PC assembly. This battery is trickle-charged during normal operation, and has enough capacity to protect the memory for approximately 10 hours. Memory protection retains Tmax, Tmin, and the averaged values of Ta and Td.

⑨ OUTPUT DATA BUS

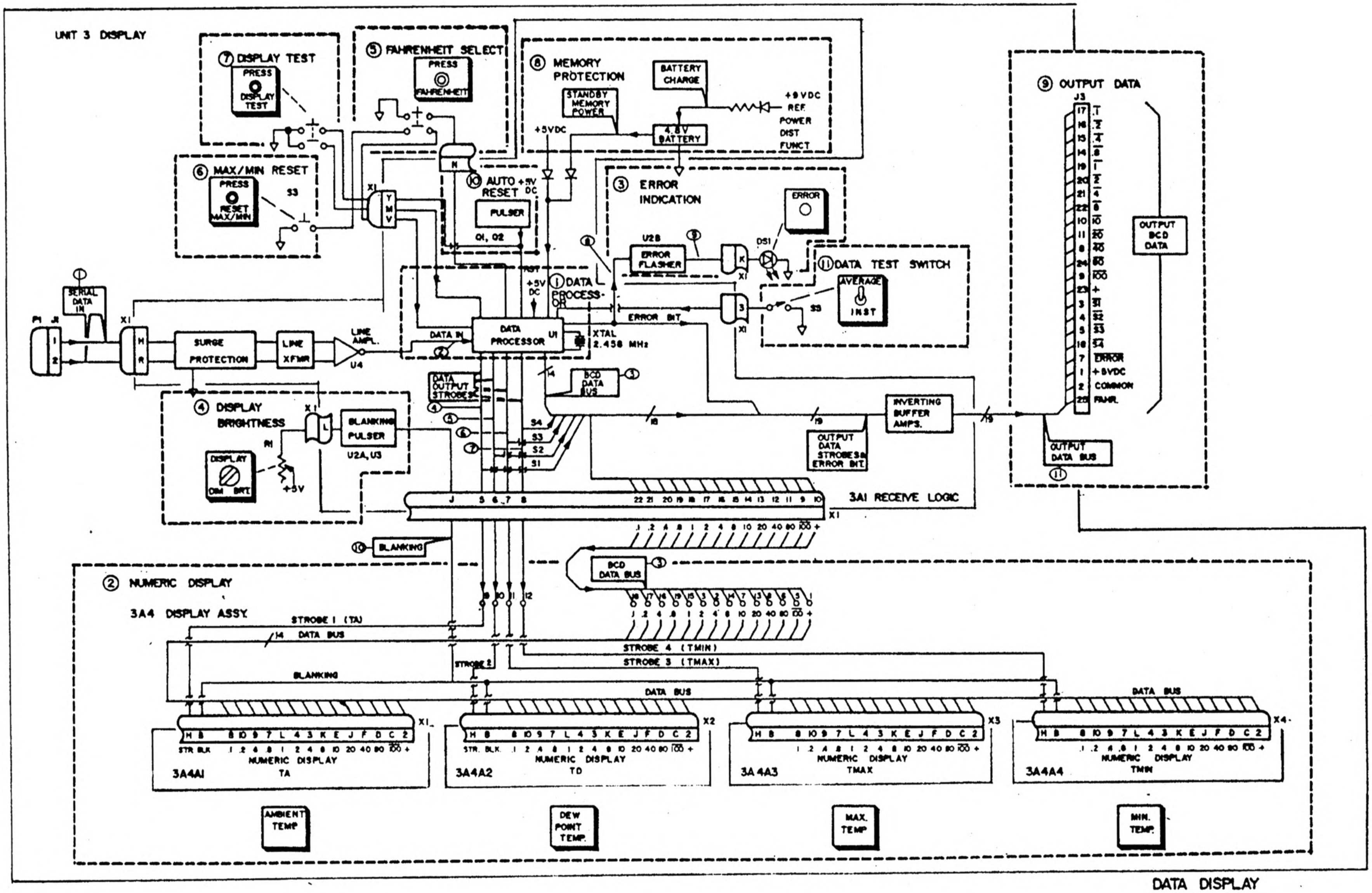
The multiplexed BCD data bus, which includes Ta, Td, Tmax, and Tmin data in sequence is buffered and brought to J3 on the rear panel of the Display Unit. Also brought out for external use are the data strobe lines, S1-S4, the Error bit, the +5 volt DC supply line, common line, and the Fahrenheit/Celsius select status.

⑩ AUTO RESET

Q1 and Q2, with their associated circuitry, form a level-sensitive one-shot multivibrator. If the +5 volt DC line drops below 4 volts, when power is removed or is about to fail, the circuit holds U1 pin 6 low, resetting the computer in an orderly manner. This reset does not affect the stored, protected data. Display Test also triggers the Reset circuit.

⑪ DATA TEST SWITCH

Toggle switch S5, mounted on the rear panel of the display unit, permits the operator or technician to operate the display unit in the Monitor mode. The switch positions are labeled INST (Instantaneous) and AVERAGING. Normally, the averaging mode is used. When the switch is in the INST position, Ta and Td data values are displayed immediately as received, and are not subjected to the 5-minute averaging program. Also, in this mode, the Tmax and Tmin displays are not operative. Since the instantaneous mode is for test purposes only, and should never be used in normal operation, the error light is flashed at all times when the test switch is in the INST position.



DATA DISPLAY FUNCTION

POWER DISTRIBUTION FUNCTION KEYED TEXT

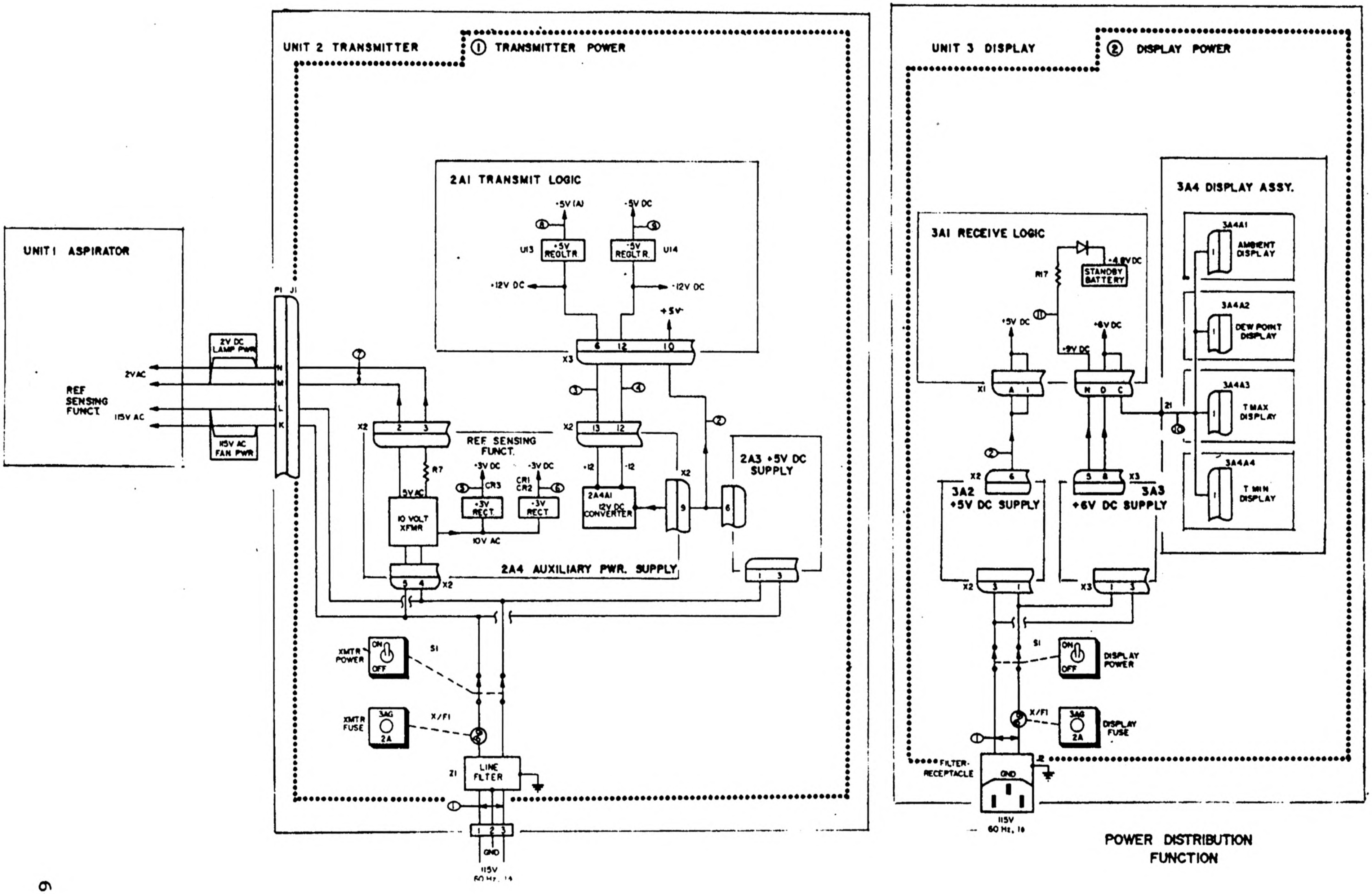
① TRANSMITTER POWER

All power for the Aspirator, Unit 1, and the Transmitter, Unit 2, is derived from a single-phase 115 volt, 60 Hz input line into the transmitter enclosure. The Aspirator receives its power from the transmitter by way of an interconnecting cable.

The transmitter includes a regulated +5 volt DC logic power supply, 2A3, and the Auxiliary Power Supply, 2A4. The Auxiliary Power Supply includes a DC-to-DC converter, 2A4A1, which converts +5 volts to regulated + and - 12 volts DC for the analog amplifiers. Also included in the Auxiliary Power Supply are power transformer T1 and the + and - 3 volt rectifiers which provide unregulated DC power for the thermo power amplifier. T1 also furnishes 5 volts AC excitation for the Optic Bridge illuminator LED.

② DISPLAY POWER

A separate 115 volt input line provides power to the remote display unit. The display unit includes a +5 volt DC regulated supply, identical to that used in the transmitter, and a +6 volt unregulated DC supply which provides power for the numeric displays. The +6 volt supply also furnishes an unregulated +9 volt line which supplies charging current for the display standby battery.



POWER DISTRIBUTION FUNCTION

SECTION 7

SCHEMATIC DIAGRAMS

In this section, schematic diagrams of all component subassemblies are given, with an analysis of each circuit section. Wiring diagrams of the three major units of the system are also included in this section.

ASPIRATOR UNIT KEYED TEXT

GENERAL

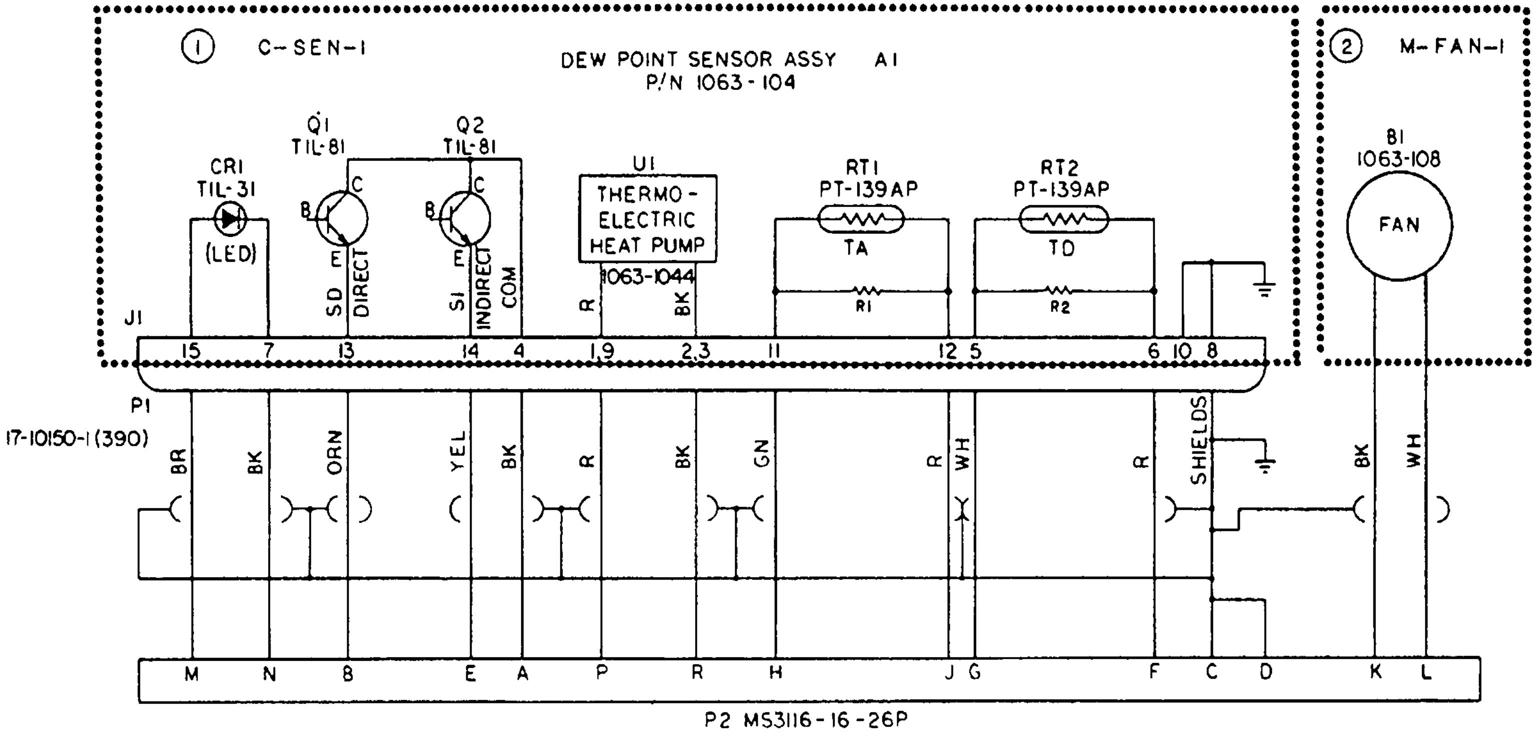
The Aspirator Unit is co-located outdoors with the Transmitter Unit, and receives its power from the Transmitter. Sampling of the ambient and dewpoint temperatures is controlled by the Aspirator.

① C-SEN-1

The Dew Point Sensor assembly is a line-replaceable unit, containing all of the sensing elements for dew point and ambient temperature measurement. It is physically constructed on a printed circuit board, connected by plug to the aspirator wiring. Inputs to the sensor are lamp power and thermoelectric drive power. Outputs consist of two resistance values, representing ambient temperature (Ta) and dew point temperature (Tdp), and two optic sensor output signals, Si and Sd, for controlling the mirror temperature.

② M-FAN-1

An axial blower, B1, supplies air flow through the aspirator unit to provide for atmospheric sampling and also to furnish cooling air for the thermoelectric element heat sink in the Dew Point Sensor assembly.



SCHEMATIC DIAGRAM
ASPIRATOR UNIT

TRANSMITTER UNIT KEYED TEXT

GENERAL

The Transmitter Unit is co-located outdoors with the Aspirator Unit. Input to the Transmitter unit is 115 Volts AC. Output is a serial data stream to the remote Display Unit. A short interconnecting cable to the Aspirator connects aspirator power and signals.

① N-FL-1

A packaged filter assembly provides isolation against power line interference in both directions, and protection against short (microseconds) voltage transients.

② C-PWR-1

Power switch S1 and fuse X/F1 (2 amperes) control the AC input to the Transmitter and Aspirator Units. The fuse is accessible when the Transmitter door is open.

③ C-PS-1

The 5 volt DC power supply provides regulated +5 volts DC. It is rated at a load of 1.5 amperes.

④ C-PS-2

The Auxiliary Power Supply assembly, a line-replaceable unit, contains a DC-to-DC converter which receives +5 volts DC and converts to + and - 12 volts DC. The Auxiliary Power Supply also houses the power amplifier which drives the thermoelectric heater/cooler in the dew point sensor. The + and - 12 volt outputs are each rated at 0.1 ampere.

⑤ N-CAL-1

The Calibrator is an assembly of precision resistors and a double-pole four-position switch. It substitutes fixed resistance values in place of the resistive temperature sensors for checking accuracy of the instrument circuits.

⑥ C-LOG-1

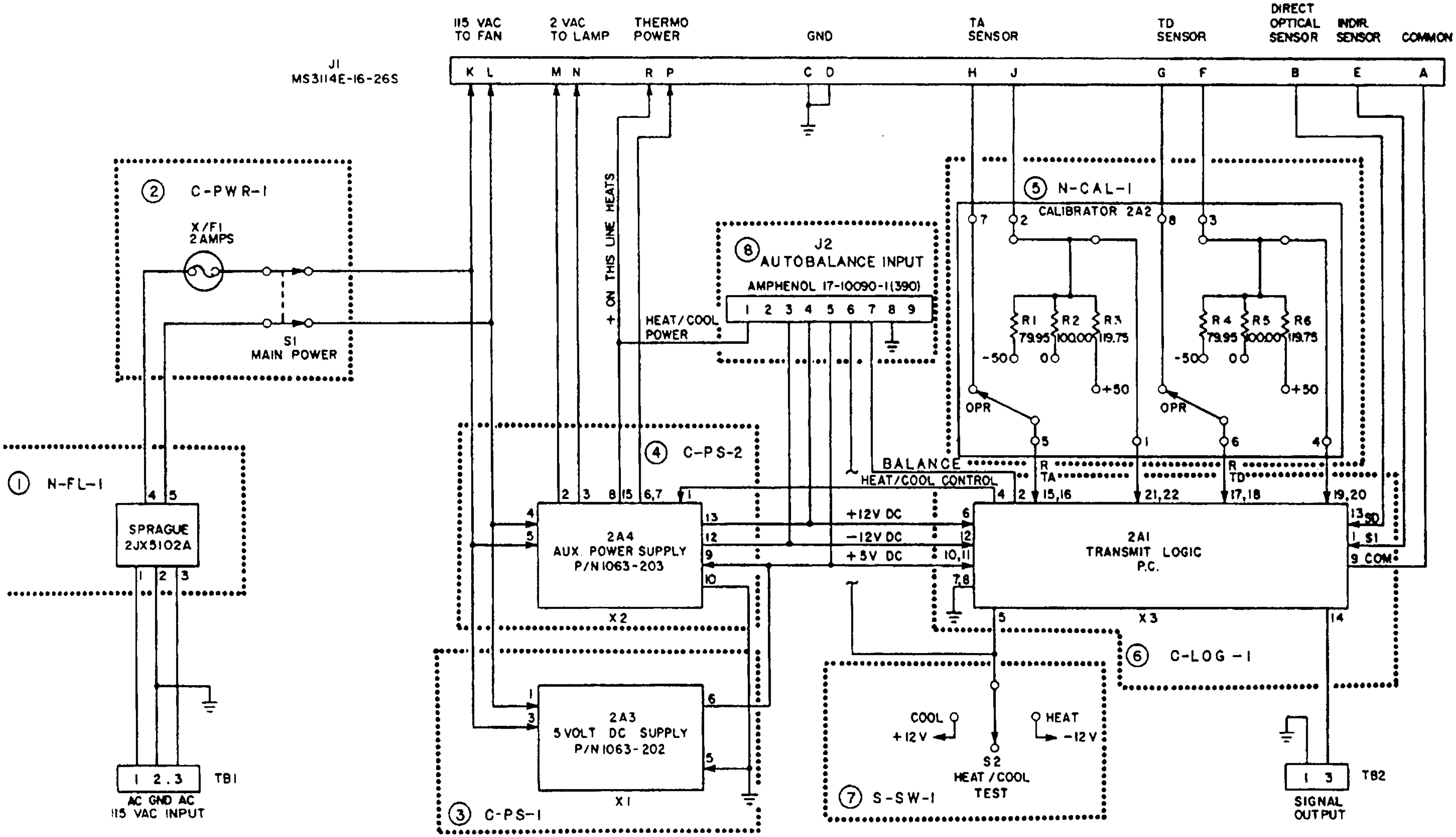
The Transmit Logic assembly is a plug-in printed circuit assembly which contains all of the logic and control circuits necessary for controlling temperature sensing, data formatting and data transmission. The output of the Transmit logic is connected directly to the output transmission line. Also included in the assembly is a numeric display monitoring the transmitted data.

⑦ S-SW-1

S2, a momentary toggle switch, enables a technician to force the dew point mirror to a high or low temperature for testing purposes. When the switch is released, it assumes the normal operating position, and control of the mirror temperature returns to the automatic system.

⑧ AUTOBALANCE INPUT

All connections, signal and power, to the optional Autobalance module are made by way of J2. See Appendix D for Autobalance circuit details.



SCHEMATIC DIAGRAM
TRANSMITTER UNIT

DISPLAY UNIT KEYED TEXT

GENERAL

The Display Unit is designed for indoor installation at the operator's working location. It receives a serial data transmission from the Transmitter/Aspirator via phone line, and presents numeric front panel displays of Ambient Temp, Dew Point Temp, Tmax and Tmin. Certain arithmetic functions are performed on the data before the data is displayed. The Display Unit also controls an output BCD data bus which may be used for external data processes.

① N-FL-1

A packaged line filter, physically a part of the AC input connector J2, provides isolation against power line interference and short (microseconds) duration transients.

② C-PWR-1

Main power switch S1 and the 2 ampere line fuse X/F1 control input AC power. Both are located on the rear panel of the unit.

③ C-PWR-2

The Display Power Supply furnishes regulated +6 volts DC as main power to the display modules on the front panel. The supply is rated at 4 amperes output. A separate output, 9 volts DC unregulated, furnishes battery charging power to the memory protection battery in the Receive Logic assembly.

④ C-PWR-3

A 5 volt DC regulated power supply furnishes logic power where needed in the Display Unit. This power supply is identical to and interchangeable with the 5 volt DC supply used in the Transmitter Unit.

⑤ C-LOG-1

The Receive Logic assembly, a plug-in printed circuit card, contains all of the logic circuitry which controls the Display Unit.

⑥ C-DIS-1

The Display subassembly consists of a "motherboard" with 4 identical numeric display modules plugged into sockets. The subassembly is located just behind the front panel. A common BCD display data bus is connected among the display modules, multiplexing data for the four displayed values. A unique strobe line is connected to each of the four modules, so that each module reads the data only when its own data value is on the bus.

⑦ S-SW-1

The Data Test switch, S5, is located on the rear panel, and is used only for test purposes. When the switch is in the INST (instantaneous) position, Ta and Tdp values are displayed as received from the transmitter. When the switch is the normal AVERAGE position, the data values are averaged and screened for errors before they are displayed. In the INST mode, the Tmax and Tmin displays are not updated.

⑧ S-SW-2

S3, the Max/Min Reset switch, when depressed momentarily, resets the Tmax and Tmin displays to the present value of Ta. To guard against accidental operation of reset, the switch is connected in series with a pole of the Fahrenheit display switch, S2, requiring that the Fahrenheit switch must be pressed simultaneously with the Reset switch.

⑨ S-SW-3

S4, the Display Test switch, when depressed, causes all numeric displays to read -188.8 to verify that all segments of the displays are functioning. This action also causes the Error indicator to flash.

⑩ S-SW-4

When S2, the Fahrenheit Display switch is depressed, all four data displays read out in degrees Fahrenheit, instead of Celsius. The output BCD data is also presented in degrees Fahrenheit.

⑪ R-RES-1

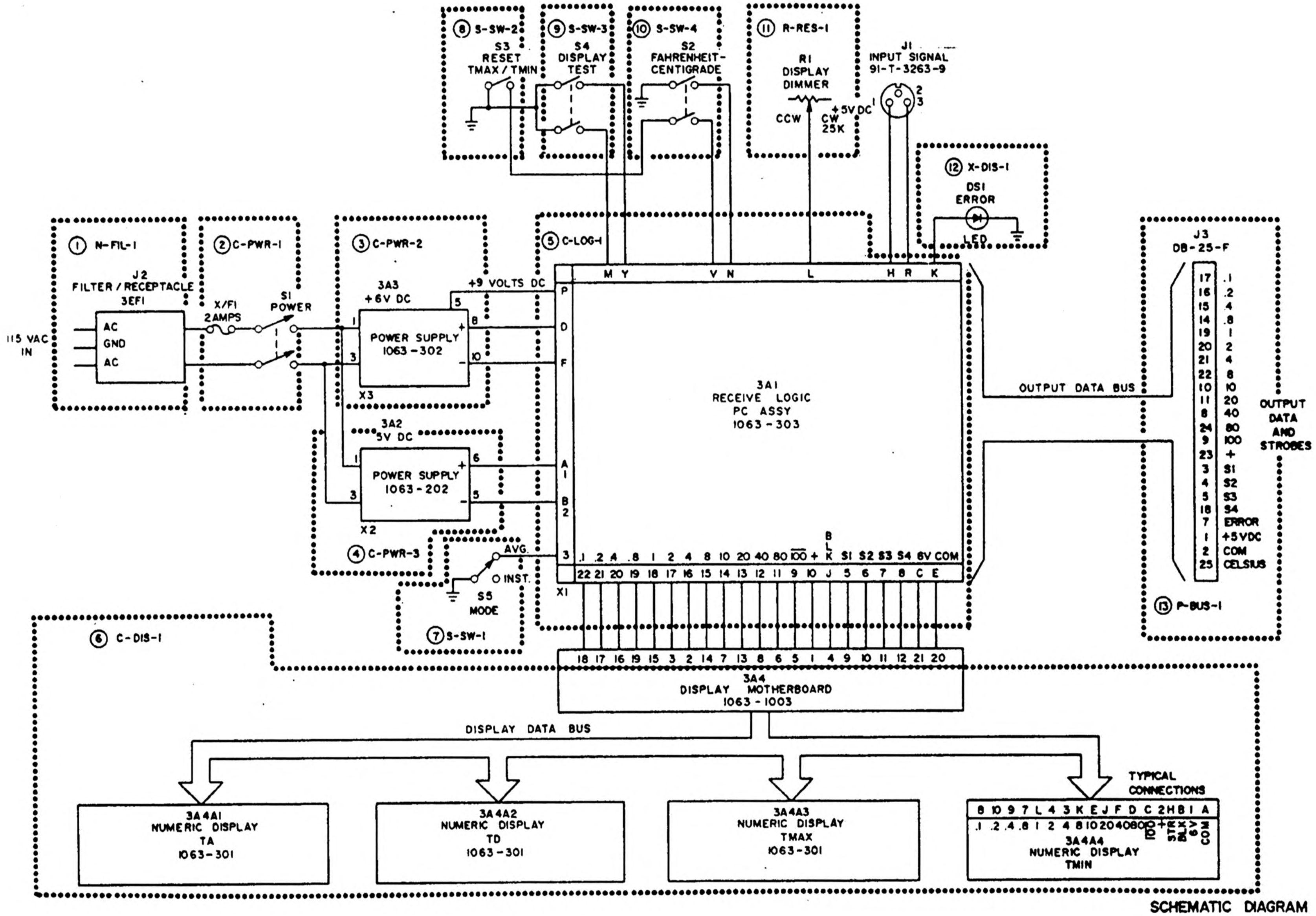
Potentiometer R1, Display Dimmer, controls brightness of the numeric displays.

⑫ X-DIS-1

DS1, Error Indicator, indicates the presence of various error conditions which may be detected in the data. In the case of a sustained error condition, DS1 flashes at a rate of about 2 pulses per second. DS1 also flashes constantly when the test switch, S-SW-1, is in the Instantaneous position.

⑬ B-BUS-1

Mounted on the rear panel is a 25-pin D-style connector which brings out the BCD multiplexed data bus, all strobe lines, the Error bit, a +5 volt DC and common line and a Celsius/Fahrenheit select status line. The output lines are buffered for loading by external equipment, and to prevent external shorts from ffecting the internally distributed data.



SCHEMATIC DIAGRAM
DISPLAY UNIT

AUXILIARY POWER SUPPLY KEYED TEXT

GENERAL

The Auxiliary Power Supply is a line replaceable unit, plug-connected inside the Transmitter Unit. It includes a +5 volt to +/- 12 volt DC converter, and a power amplifier for the mirror heater/cooler.

① C-PWR-1

Transformer T1, CR1-CR2, and C1-C2 are connected as a full-wave -5 volt DC unregulated power supply. This -5 volt DC level serves as the power source for mirror cooling.

② X-RCT-1

CR3 is a half-wave rectifier providing unfiltered +DC power for mirror heating. The power is pulsating DC with a peak level of approximately +7 volts.

③ Q-AMP-1

Power transistors Q1 and Q2 form a complementary PNP-NPN power amplifier furnishing DC current as required by the mirror heater/cooler element. Each of the transistors is a Darlington type, so that a very high current gain is obtained, matching the extremely low resistance of the thermoelectric module. The PNP transistor, Q1, controls negative output for cooling, and the NPN transistor, Q2, controls positive output for heating. Voltage gain of the amplifier is about 0.6.

④ C-OSC-1

Q1, Q2, and toroidal transformer T1, are connected as a square-wave oscillator operating at approximately 10 KHz. This circuit uses +5 volts DC input and produces a 36 volt square wave output.

⑤ C-RCT-1

CR1-CR4 form a full-wave bridge rectifier, yielding + and - 18 volts DC. The outputs are filtered by C2 and C3.

⑥ I-REG-1

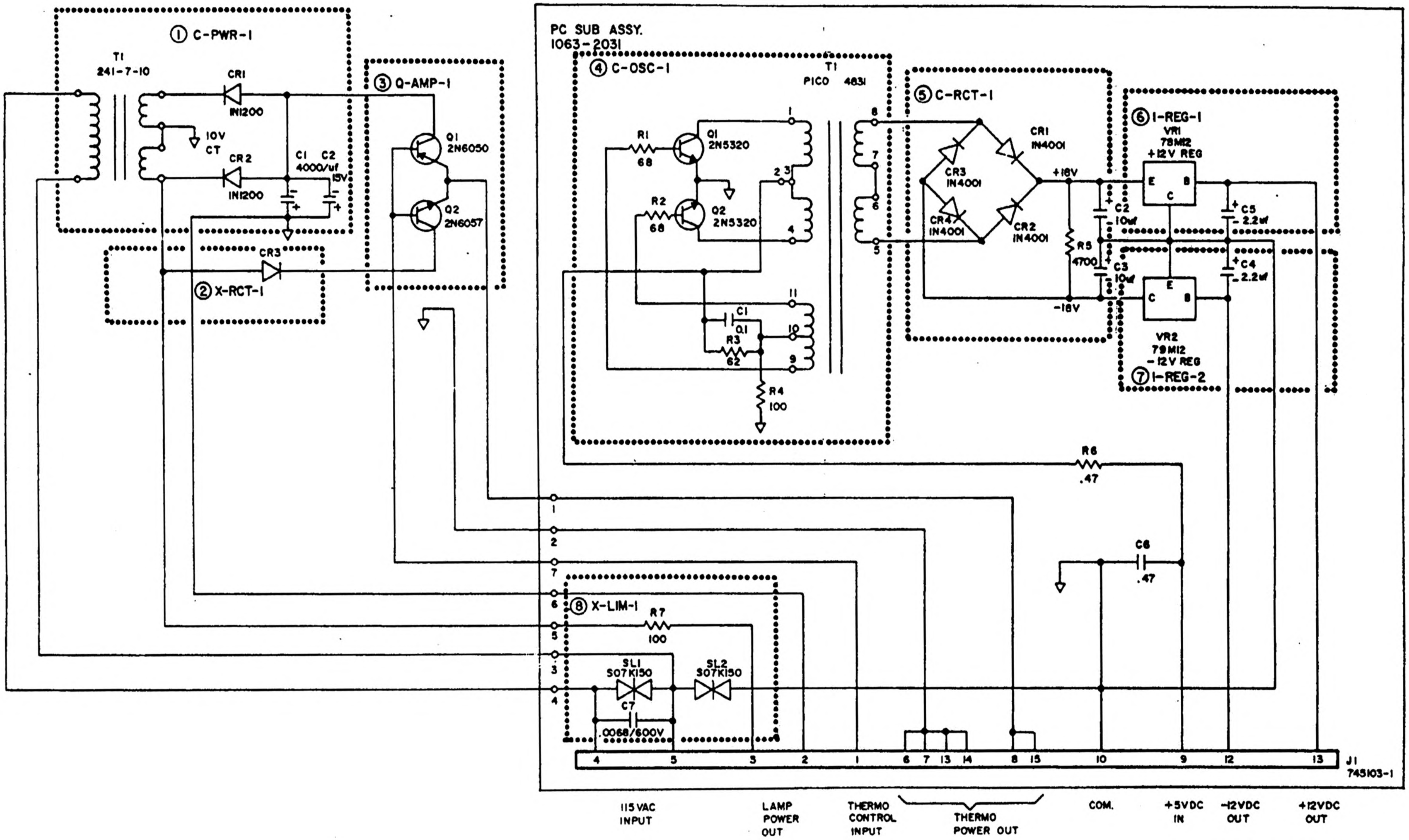
VR1 receives +18 volts and provides a regulated +12 volt DC output, filtered by C5.

⑦ I-REG-2

VR2 receives -18 volts and provides a regulated -12 volt DC output, filtered by C4.

⑧ X-LIM-1

Surge limiters SL1 and SL2 protect the system against short (microseconds) duration line transients. SL1 absorbs transients between the lines; SL2 absorbs transients from line to ground.



SCHEMATIC DIAGRAM
AUXILIARY POWER SUPPLY

NUMERIC DISPLAY KEYED TEXT

GENERAL

The Numeric Display module is a plug-in printed circuit assembly which decodes a 13-bit parallel BCD data bus and presents a 3 1/2 digit decimal numeric display. In addition to decoding, driving and displaying the data value, the card includes +/- indication, data storage, and blanking.

① C-DIS-1

The digital display elements are Type FFD-41 incandescent 7-segment units. They are plug-in replaceable. Bar segments are physically arranged as shown by the segment plan. Each segment is driven by an individual logic line at a level of 0 or +6 volts DC, from its decoder-driver output. U4 is located at the right-hand side of the array, indicating tenths of a degree.

② C-DIS-2

U3 operates identically to U4, described above, and it indicates units. The decimal point input, pin 8, is permanently connected to +6 volts, fixing the decimal point permanently at the right side of the units display.

③ C-DIS-3

U2 operates identically to U4, indicating tens.

④ C-DIS-4

On U5, the hundreds digit, only the segments necessary for displaying a "1" and a "-" are connected. When elements b and c are energized, a "1" is displayed, representing 100, and when element g is lit, the center bar is lit, indicating the negative sign. In its application in the 1063, data values never exceed 199, so that the other conditions of the hundreds digit need not be activated.

⑤ I-DEC-1

A Motorola 14511 CMOS latch/decoder/driver IC is used to drive the displays. U9 BCD inputs, pins 7, 1, 2, and 6 are connected to the data bus tenths data lines. Pin 5 is the latch enable, or strobe input.

When the strobe line, normally at high level, goes to 0 momentarily and is returned to 1, the values on the data lines at the time of the transition trailing edge are stored in the latches of the 14511. The latch outputs are internally connected to 7-bar encoders which drive the appropriate outputs to the display.

A blanking input, pin 4, is used to enable the output power to the display. This input is pulse-width modulated to vary the average on/off time of the power, resulting in variable average display dimming.

⑥ I-DEC-2

U8 functions identically to U9, using the "units" BCD data lines and driving the units display. The strobe line is common to all decoders.

⑦ I-DEC-3

U7 functions identically to U9, using the "tens" data and driving the tens display.

⑧ I-DEC-4

U6 is connected to respond to the inverse of the 100 data line. When 100 is to be displayed, the input line is 0. This is decoded as 8 input to 14511. Since only segments b and c are used, the digit "8" looks like a "1". When the input line is up, indicating that the hundreds digit is not to be displayed, the input is decoded as value 12, since input pins 2 and 6 are up, representing 8 + 4. The value 12 is decoded as an illegal state by the 14511, and the output is automatically blanked, and the hundreds display is blanked out.

⑨ I-DEC-5

U5 is connected only to segment g of the hundreds display. When the sign input is 0, U5 decodes a 0 value, and bar g is not energized. When the sign bit is 1, U5 decodes a 2 value which lights the center bar, producing the effect of negative (-) sign on the hundreds display. The negative sign and the 1 display can exist at the same time, indicating -1, representing -100.

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DISPLAY POWER SUPPLY KEYED TEXT

GENERAL

The Display Power Supply furnishes regulated 6.8 volts DC with an output capacity of 3 amperes. This power is used only by the Numeric Display modules. An auxiliary output, 9 volts DC unregulated, is used as a trickle-charging source to the standby battery in the Receive Logic card.

① X-LIM-1

SL1 and SL2 are MOV surge limiters, providing protection against input line surges and transients. Maximum amplitude of transients is limited to about 200 volts. C3 filters out high-frequency line noise.

② C-PWR-1

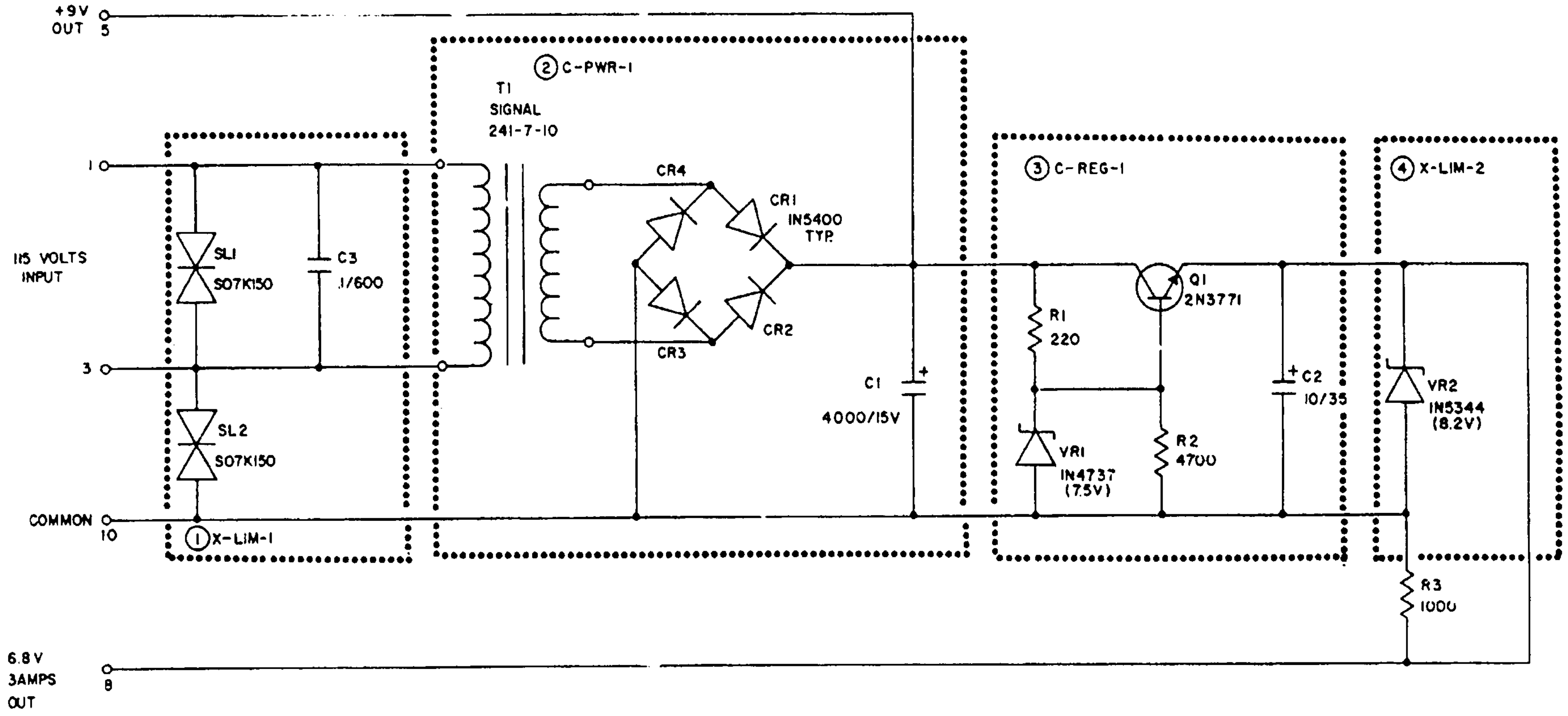
Transformer T1, rectifier bridge CR1-CR4, and C1 comprise a 9 volt DC power supply.

③ C-REG-1

Reference diode VR1 establishes a 7.5 volt DC level at the base of high-gain power transistor Q1. The output of Q1, regulated by its low output impedance, is at a level of 6.8 volts DC. C2 provides additional filtering.

④ X-LIM-2

VR2, a power zener diode, acts as an output voltage limiter in the event of failure of Q1, holding the output voltage below about 8.0 volts.



SCHEMATIC
DISPLAY POWER SUPPLY

5 VOLT POWER SUPPLY KEYED TEXT

GENERAL

The 5 volt Power Supply receives 115 volts AC input and delivers regulated +5 volts DC with an output capacity of 1.5 amperes. Two identical and interchangeable 5 volt supplies are used in the system, one in the Transmitter unit and one in the Display unit.

① C-PWR-1

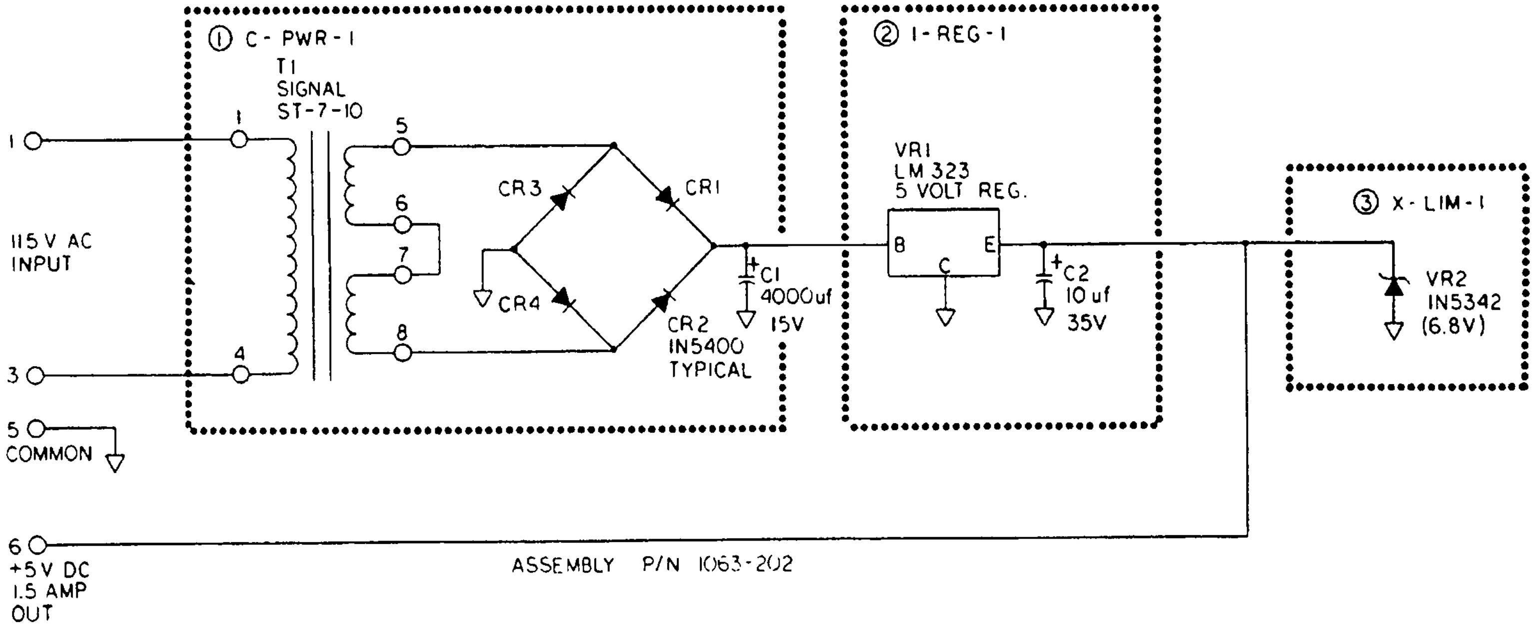
T1, rectifier bridge CR1-CR4 and C1 comprise an unregulated +8 volt power supply.

② I-REG-1

VR1, an LM-323 integrated circuit, regulates the +8 volt level to +5 volts DC output. C2 provides additional filtering.

③ X-LIM-1

VR2, a power zener diode, limits the output of the power supply to about 7 volts in the event of failure of VR1.



SCHEMATIC DIAGRAM
5 VOLT POWER SUPPLY

TRANSMIT LOGIC KEYED TEXT

GENERAL

The Transmit Logic card is the main logic controller for the Transmitter Unit. Its circuits control mirror heating and cooling to maintain dew point temperature at the mirror surface, and it processes the Ta and Tdp resistance sensor values into a serial digital data stream for transmission to a remote receiver. The card also contains a simple data receiver and local numeric data display for use in servicing the equipment.

① C-DET-1

U5A and CR1 are connected as an "ideal diode" detector circuit. The direct sensor signal is coupled through C1 to the non-inverting input of U5A. U5A output is rectified positive by CR1, charging C2 to the average value of Sd. The detected level on C2 is fed back to U5A inverting input through R21. Gain of the detector is adjusted by the setting of R21. Typical operating level of C2 voltage is +4 volts DC.

② C-DET-2

U6A, CR2 and C4 function essentially the same as U5A, negatively detecting the indirect sensor (Si) signal amplitude. R22 serves as the stage gain adjustment. Typical operating level on C4 is -4 volts DC.

③ C-AMP-1

The positive Sd level and the negative Si level are summed through 100K resistors into the inverting input of U6B. U6B output, representing heat/cool control, is brought out to the thermo power amplifier in the Auxiliary Power Supply. If the mirror surface is too warm, making Sd too high and Si too low, U6B output tends to go negative, producing more cooling power, and vice versa if Si is too high and Sd too low. R65 and C5 across the Si input resistor improve response and stability of the control loop. Special inputs controlled by the microprocessor are also brought into the loop by way of R77. These inputs are described under C-AMP-5.

④ C-DET-3

U5B is a threshold amplifier. If its input, pin 5, is at less than +5 volts DC, its output is at negative saturation. If its input is greater than +5 volts, the output is at positive saturation, lighting LED CR5. CR5 serves as an adjustment level indicator for Sd gain.

⑤ C-DET-4

U21B operates much the same as U5B, using the negative Si signal as its input. If Si is more positive than -3 volts, LED CR9 is off. When Si is more negative than -3 volts, CR9 is lit, indicating an adjustment level for Si gain.

⑥ C-DET-5

During normal operation, the node, pin 6, of control amplifier U6B, is at virtually zero because of its feedback. If the control loop should open for any reason and U6B goes to saturation, the node voltage will rise to a relatively high voltage. This voltage is monitored by U7B. Normally U7B output is close to zero, but when U6B saturates, U7B output will rise positive or negative, lighting either CR6 or CR7, indicating a fault condition.

⑦ C-AMP-2

U8A is a feedback amplifier which uses the ambient temperature sensing element as its feedback resistor, so that U8A output DC varies precisely with Ta. At 0 degrees, the sensor resistance is 100 ohms, and U8A output is -0.5 volts. In the scaling amplifier U8B, an offset correction is introduced through R14, making U8B output zero at zero degrees. Feedback of U8B, through R16, has been selected so that 50 degrees is represented by exactly 2 volts. Trimpots R35 and R34 provide a means of making minor adjustments in the offset and gain values for instrument calibration.

⑧ C-AMP-3

The dew point instrument voltage channel, U9A-U9B, is identical to U8A-U8B, using the dew point sensor resistance as the controlling element.

⑨ C-MUX-1

U10A and U10B are sections of a CMOS analog gate. U10A controls the Ta voltage; U10B controls the Td voltage. The gates are alternately opened and closed by a Ta/Td selector line from the microprocessor. When the control line to a gate section is high, the signal is passed through. When the control line is low, the signal is blocked by the gate. Using alternate control lines and tying the two gate outputs together results in an output signal which is at the Ta DC level for 200 milliseconds, then at Td DC for 200 milliseconds, continuously alternating.

⑩ C-CON-1

U2 is a CMOS Analog-to-Digital converter, using the Ta/Td multiplexed signal as its input. Output of the converter is a 12-bit straight binary representation of the input levels, with an additional bit for the polarity. The converter works in conjunction with the microprocessor, U1, exchanging control and timing signals. U2 is a Type 7109 chip, operating on the dual-slope integration principle. Output scaling and the essential accuracy of conversion are determined mainly by R53, C10, and the reference voltage applied through a divider to pin 36. The "Status" output tells the microprocessor when a conversion is complete. The 2.458 MHz crystal clock signal generated by the converter is also used by the microprocessor.

⑪ I-PRO-1

Parallel-to-serial data conversion and output signal timing and formatting are controlled by U1, a Motorola Type 68701 microprocessor. This 8-bit processor contains a 128 byte RAM and 2048 bytes of erasable and programmable ROM. Although the processor is pre-programmed, it is removable and may be re-programmed or modified. Three 68701 processors are used in the 1063 system, two in the Transmit Logic and one in the Receive Logic assemblies. All of the 68701's are programmed identically and are interchangeable. Ground connections on pins 13 and/or 14 determine which section of the program will be used in each part of the system.

Pins 13 and 14 are inputs to the microprocessor, and during the start-up part of the program, the processor scans the condition of pins 13 and 14. Depending on the combination of grounds or opens (logic 1 or 0) on the two pins, the program is directed to the "transmit", "monitor", or "display" section of the resident program.

The 12-bit binary data and sign bit are tied to input ports of U1 and the data is input when the program calls it up. The Ta and Td data words are alternately processed and brought out as a serial 600 Baud bit stream, still in straight binary code. The transmission signal is formatted as a Manchester code, in which the signal line is toggled at a 600 pulse-per-second rate, and logic 1's are indicated by a transition at the half-period point. At the receiving end, the detector is insensitive to signal polarity and does not require a separate clock input.

The data stream also includes various formatting and check bits used internally by the processor. As the processor alternately processes Ta and Td, it toggles the Ta/Td select line which controls the multiplex gates.

An error bit, indicating the presence of certain fault conditions in the transmitter, is included in the output data for use by the remote display unit.

Complete details of the microprocessor software are given in Appendix B to this manual.

⑫ C-AMP-4

U3A and U3B monitor the dew point "limit" signal line which indicates faulty operation of the mirror control loop. This signal, which may be positive or negative, is brought to the inverting input of U3A and the non-inverting input of U3B. The two amplifier outputs are positive-OR'ed through CR3-CR4 as the error bit input to the microprocessor. Also summed into U3A and U3B inputs are the +5 volt (A) and the -5 volt DC supply lines. Since the + and - 5 volt DC lines are equal and opposite, they cancel out in the summation, but in the event of a failure or change in level of one of the lines, the error input balance is upset and the error bit line is raised.

⑬ I-AMP-1

A Type 1488 level converting line driver is used as the transmission line driver to the remote displays. Output binary levels are balanced at approximately +/- 6 volts with respect to ground. R66, C16, and surge limiter SL1 protect the line amplifier against transient spikes from the transmission line.

⑭ C-PG-1

U12, a Type 555 timer IC, is connected as a monostable (one-shot) multivibrator. Its input control point, pin 2, is connected to the +5 volt DC logic power line. When the +5 volt line is low, or during a negative-going transient on the line, the timer produces a positive-going pulse output at pin 3. This pulse is inverted by U4E and fed to the reset input of microprocessors U1 and U15. This insures that the processors are reset when power is first applied, and that they are also reset if power fails momentarily.

⑮ C-REG-1

Reference diode VR1, driven by +12 volts DC through R49, establishes a stable 6.2 volt reference level for use by the Ta and Td signal amplifiers and the A-to-D converter. The 6.2 volt level is buffered by U7A in the non-inverting voltage follower configuration.

⑯ I-PWR-1

Using the +12 volt DC line as input, U13 provides a regulated +5 volt line for critical analog circuits. This line is referred to as +5 volts (A).

⑰ I-PWR-2

Using -12 volts DC as input, U14 provides a -5 volt DC line for use by the multiplex gates and the A-to-D converter.

⑱ I-AMP-2

U16, a line receiver identical to that used in the remote display, samples the output data line, providing the input signal for the monitor display in the transmitter.

⑲ I-PRO-2

A Type 68701 microprocessor, identical to U1, receives the output data stream and performs all of the necessary processing and conversion to drive the local 3-digit Ta or Td monitor display.

This processor, U15, uses the 2.458 MHz clock signal generated by the A-to-D converter. Output of U15 is a 12-bit BCD data bus, a sign bit and two strobe lines, S1 and S2, for selection of Ta or Td display.

⑳ D-DIS-1

A 3-digit numeric display is mounted on the PC assembly for use in servicing. The display elements, U18, U19, U20, are plug-in and interchangeable. They are dot-matrix decimal displays and include storage registers, storing and displaying the data value on the lines at the instant of the trailing edge of the strobe pulse. Display selection of Ta or Td is made by selecting Strobe 1 or Strobe 2 by way of switch S1. Solder jumper J1 determines whether the monitor indicates Fahrenheit or Celsius. With J1 installed, the indication is Fahrenheit.

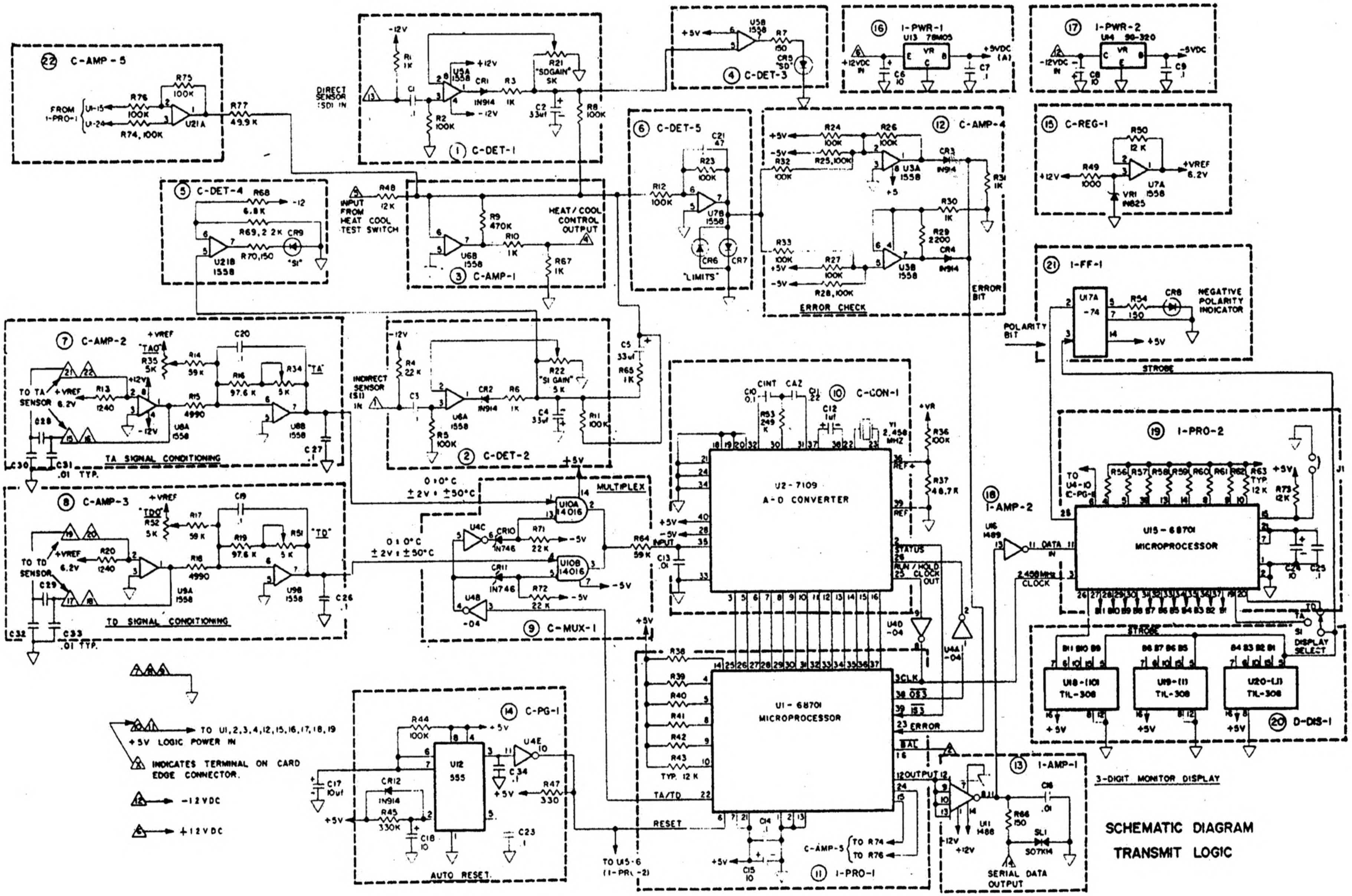
㉑ I-FF-1

Negative polarity is displayed by LED CR8, controlled by flip-flop U17A. The sign bit is connected to the flip-flop data input and the selected Ta or Td strobe is the clocking input.

㉒ C-AMP-5

Control of the dew point mirror temperature is independent of the microprocessor, with two exceptions: In the event of the mirror overheating because of a system failure, the microprocessor senses when the mirror temperature (Td) is 65 degrees C or greater. In this condition, pin 24 of the microprocessor is set high. This signal, through U21B, applies full cooling signal to the heat/cool control amplifier U6B.

Also, during the automatic 24-hour mirror drying cycle, the microprocessor sets up pin 15, causing full heat control signal to be applied. Both of the microprocessor-controlled signals are brought through U21B and R77.



SCHEMATIC DIAGRAM
TRANSMIT LOGIC

RECEIVE LOGIC KEYED TEXT

GENERAL

The Receive Logic PC assembly is the logical controller for the Display Unit. It receives the serial data stream from the transmitter, converts the data to a parallel format, translates the binary data to BCD for display, and performs various arithmetic functions on the data. These functions include 5-minute data averaging, error checking, suppression of leading zeros, and Celsius-to-Fahrenheit display conversion when requested. Output of the assembly is a BCD data bus for distribution to the display modules, a BCD data bus buffered for external use, and strobe lines for separating data words from the multiplexed data output.

① C-ISO-1

T1 is a 900 to 600 ohm line transformer which converts the balanced input signal to a single-ended input to the input amplifier. Surge limiters SL1 and SL2 provide protection against high voltage transients which may be received on the incoming phone line.

② C-AMP-1

U4 is a standard data line receiver IC which converts the bipolar input signal to TTL logic levels. VR1, a 6.8 volt zener diode, provides additional protection against input transients.

③ C-PRO-1

U1, a Motorola Type 68701 microprocessor, is identical to those used in the transmitter. The processors are socket mounted and are interchangeable. U1 contains a 128 byte RAM and an on-board 2048 byte ROM. All of the necessary programs for transmit, monitor, and display are written into each processor. Ground connections on pins 13 and/or 14 serve as control inputs, determining which of the three internal programs is to be used. In the Receive Logic application, during the start-up sequence, the processor scans the inputs on pins 13 and 14 and sees a 1 on 13 and a 0 on 14, and automatically goes to the display section of the resident program. The 68701 is erasable and may be re-programmed.

U1 contains an internal clock, controlled by 2.458 MHz crystal Y1. Output data is in the form of a parallel BCD bus of 15 bits (3 1/2 digits and sign), multiplexed to read Ta, Td, Tmax, and Tmin. Four data strobe signals, S1-S4, are timed for separating the data for external storage.

An Error Flag bit is brought out for the display unit Error light. This bit indicates presence of various faults which may be detected in the transmitter; it also indicates errors which may have occurred in the data transmission process, or data values which fall outside arbitrary limits in the program.

Certain functions of the program are controlled by grounding appropriate input lines to the processor. This includes the Display Test, in which the processor is programmed to write -188.8 to all displays, the Fahrenheit mode, in which the display data is converted to degrees Fahrenheit, and the Average/Instantaneous mode selection. When the Instantaneous mode is used (for test purposes only), the processor uses the "monitor" portion of the program.

Complete details of the operating software and operation of the microprocessor are given in an appendix to this manual.

④ C-PWR-1

A portion of the RAM which contains data that must be preserved through power failures is powered by way of + 5 volts DC on U1 pin 21. Main 5 volt power to U1 comes in through pin 7. In the event of loss of system power, U1-21 receives standby power from a 4.8 volt battery B1, protecting the RAM data for as long as 11 hours. B1 is maintained under continuous trickle charge of about 4 milliamperes by the 9 volt supply through CR3 and R17.

⑤ C-PG-2

When the Error bit output is high, astable multivibrator U2B is enabled, generating a 2-PPS square wave. The square wave, through inverter U6H, drives the Error lamp on the display unit front panel.

⑥ I-BUF-1

A bank of inverters with high drive capacity brings out the BCD data bus, all strobes and the error bit to a connector on the display unit rear panel for external use.

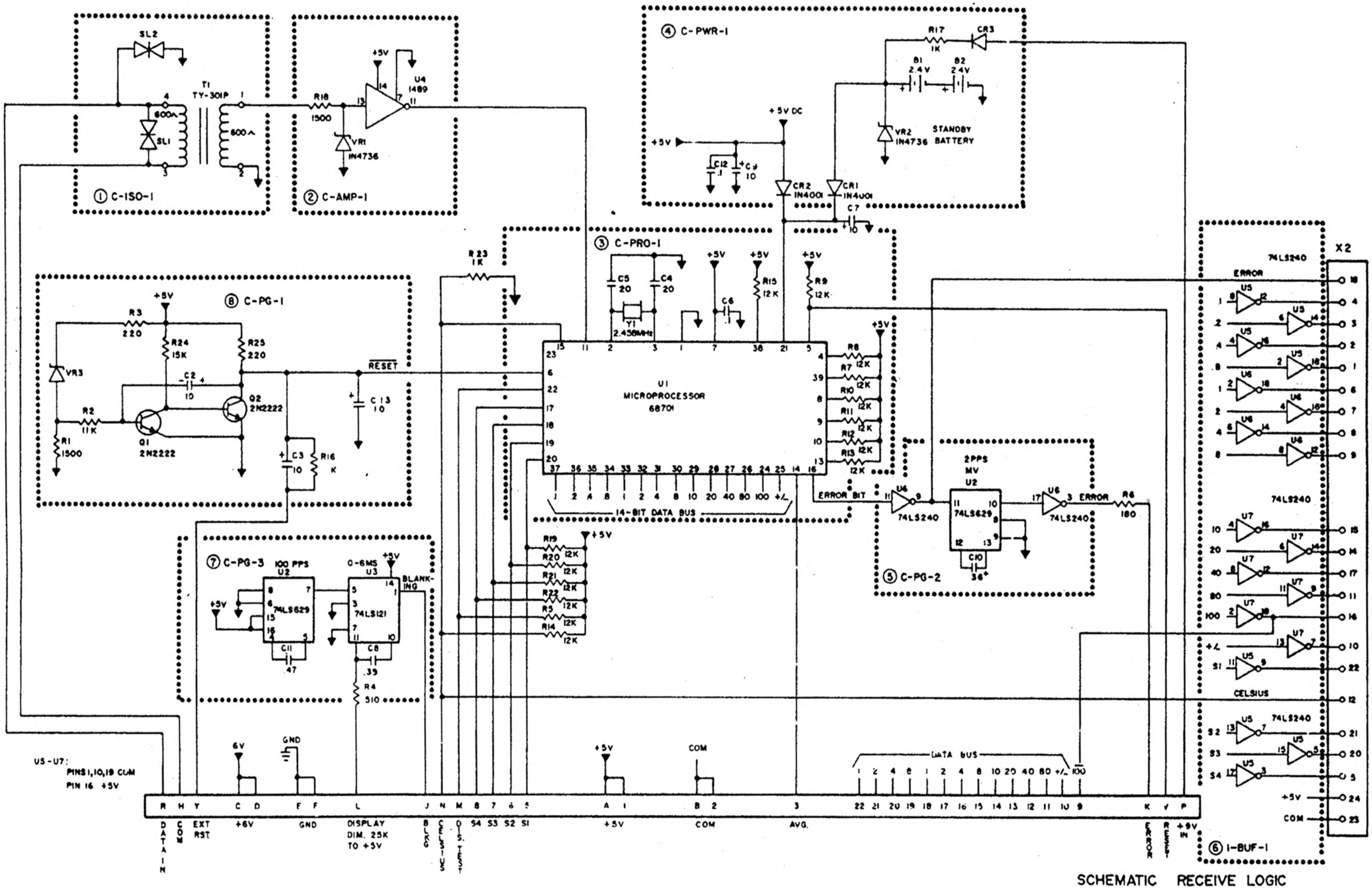
⑦ C-PG-3

U2B is a 100 PPS free-running multivibrator driving one-shot U3. The active time of U3 is variable, controlled by the value of the Display Dimmer control on the display unit front panel. U3 output is a train of positive pulses at 100 PPS with a positive pulse duration variable from 0 to 7 milliseconds. This signal is used as the blanking input to the Numeric Display modules. When the dimmer control is in the "dim" position, U3 output is zero with very narrow positive pulses and the displays are not visibly lighted. When the control is near the "bright" end, U3 output is high about 70 per cent of the time, and the displays are brightly illuminated.

⑧ C-PG-1

When power fails, critical data is protected by the standby battery. This, however, does not guarantee that the processor goes down in an orderly manner, and there is the possibility that the RAM data may be erased in the last few cycles of operation. To guarantee an orderly shut down, the processor must be placed in the Reset condition before power goes off. Q1 and Q2 are a level-sensitive one-shot which monitors the +5 volt DC supply line. Sensed by VR3, if the nominal + 5 volt level drops below + 4 volts as power begins to fail, the one-shot holds the Reset input, U1 pin 6, at zero for a few milliseconds.

The Reset condition does not affect the protected data. The Reset line is also momentarily brought down each time the Display Test switch on the front panel is depressed, as a means of re-starting the processor in the event of spontaneous failure of the processor.



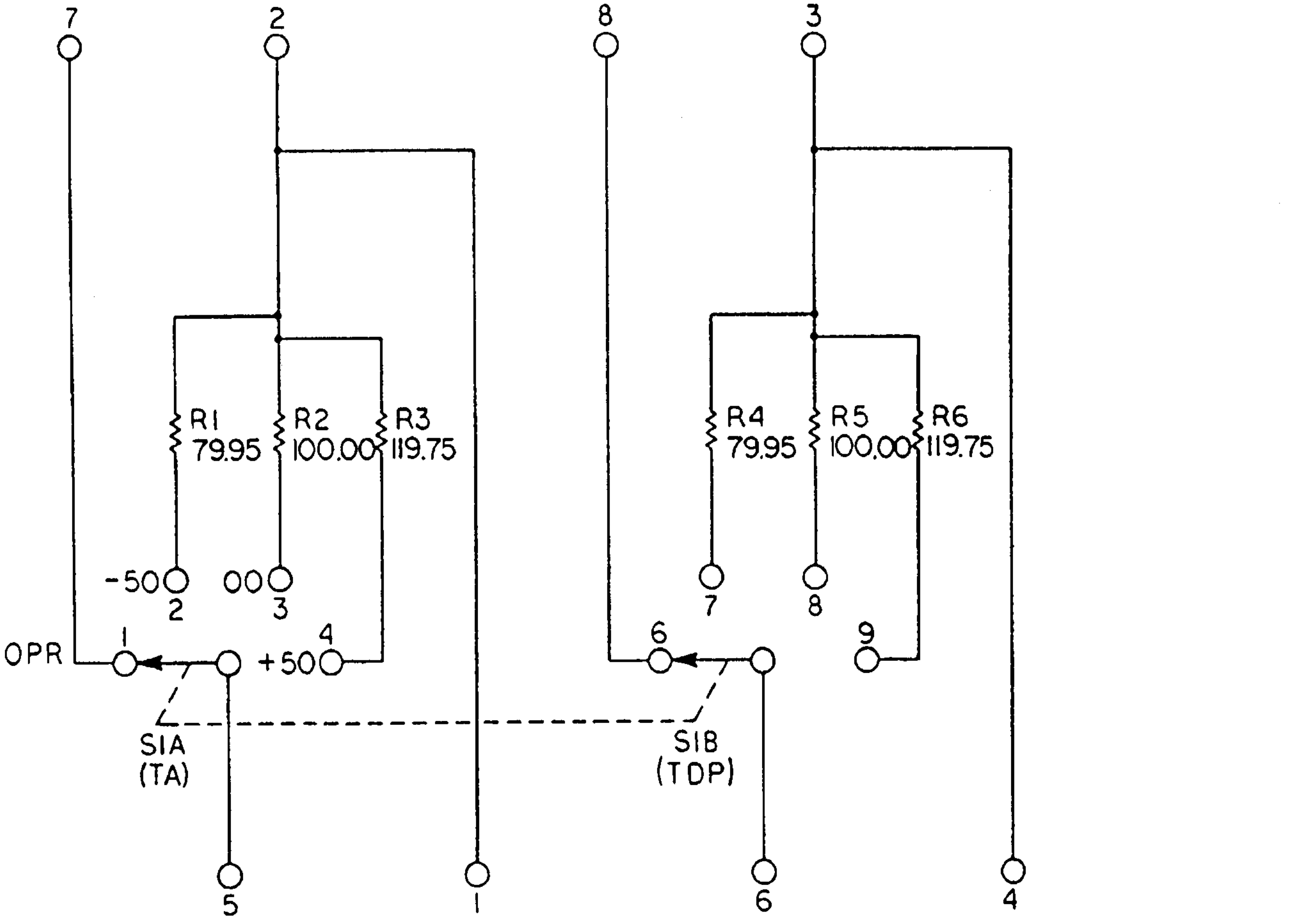
SCHEMATIC RECEIVE LOGIC

CALIBRATOR KEYED TEXT

GENERAL

The Calibrator subassembly of the Transmitter Unit consists of a double-pole, four position switch and a set of ultra-precise resistors. It enables a technician to substitute standard resistance values in place of the ambient and dew point sensing resistors to test and/or adjust instrument accuracy.

When the calibrator switch is in its normal (Operate) position, the standard resistors are out of the circuit. When in the 00 position, 100.0 ohm resistors are substituted for the sensors. In the - 50 position, 79.95 ohm resistors are substituted, and in the + 50 position, 119.75 ohm resistors are substituted. These values represent exactly the resistance which would be presented by the sensors at the test temperatures.



RESISTOR VALUES ARE IN OHMS.
R1-R6 ARE ±.02%

SCHEMATIC DIAGRAM
CALIBRATOR

DEW POINT SENSOR KEYED TEXT

GENERAL

The Dew Point Sensor subassembly in the Aspirator Unit includes all of the active elements of the Aspirator Unit except for the air blower.

① X-LED-1

CR1 is an infrared light-emitting-diode (LED). Its output wavelength is approximately matched to the response peak of the sensor phototransistors. The output of CR1 is directed at a mirror surface at an angle of 45 degrees.

② Q-SEN-1

Q1 is an NPN silicon phototransistor. It is aligned so that it receives the directly reflected rays from illumunator CR1. Its output is called Sd.

③ Q-SEN-2

Q2 is identical to Q1, but aligned perpendicular to the mirror surface, so that it is sensitive to the light rays which are scattered when the mirror surface is clouded or frosted. Its output is called Si.

④ U-THM-1

U1 is a thermoelectric heat pump which cools or heats the mirror block. When positive current flows through U1, the mirror heats; when negative current flows through U1, the mirror cools. Maximum current is approximately 4 amperes DC.

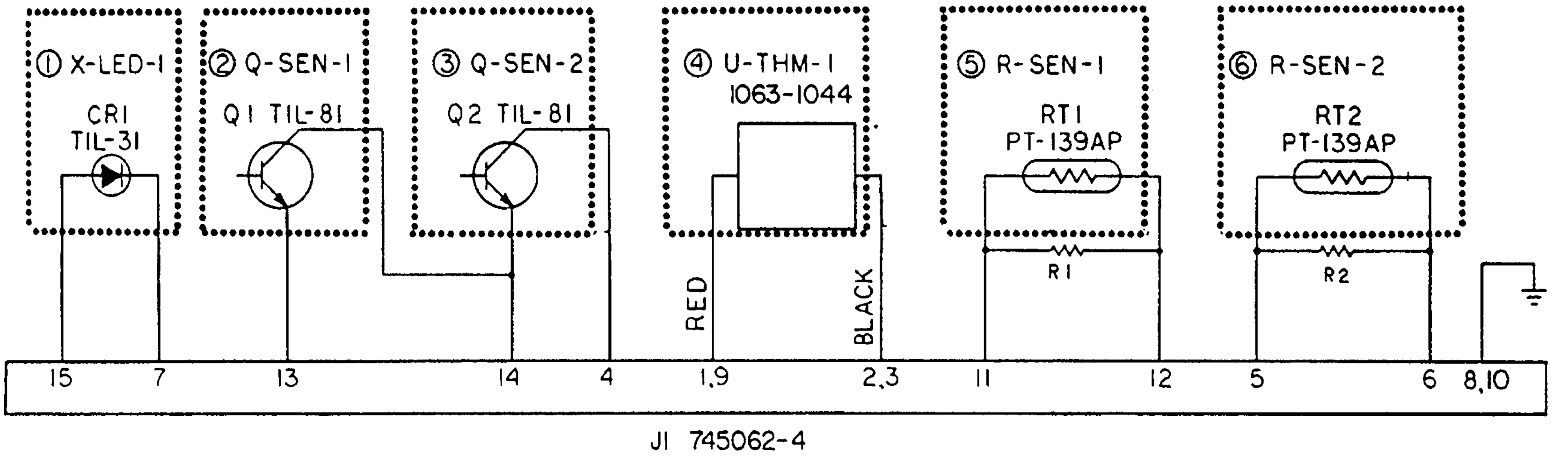
⑤ R-SEN-1

RT1 is a platinum wire-wound resistive temperature sensor. Its resistance at 0 degrees C is exactly 100 ohms. RT1 has a stable coefficient of resistance vs. temperature of 0.4 ohms per degree C. It is mounted directly in the path of the air drawn into the Aspirator, and its resistance is used for measuring ambient temperature. Its resistance value is called Rta.

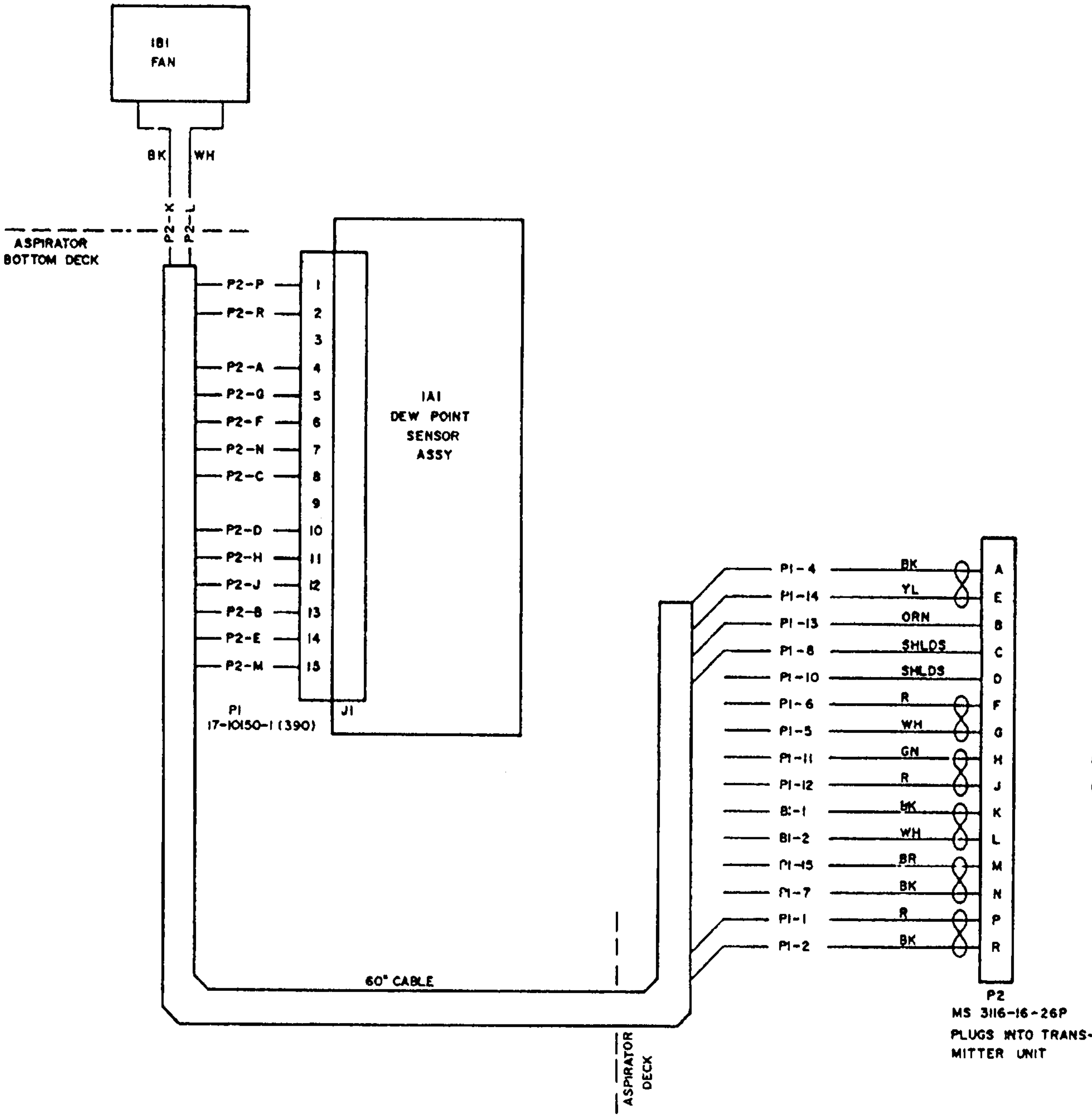
⑥ R-SEN-2

RT2 is identical to RT1, but it is mounted inside the mirror body, so that the resistance of RT2 is a measure of the mirror temperature. The resistance value is called Rtd.

NOTE: R1 AND R2 ARE FACTORY SELECTED
NOM. VALUE 47K, 5%, 1/4 WATT



SCHEMATIC DIAGRAM
DEW POINT SENSOR

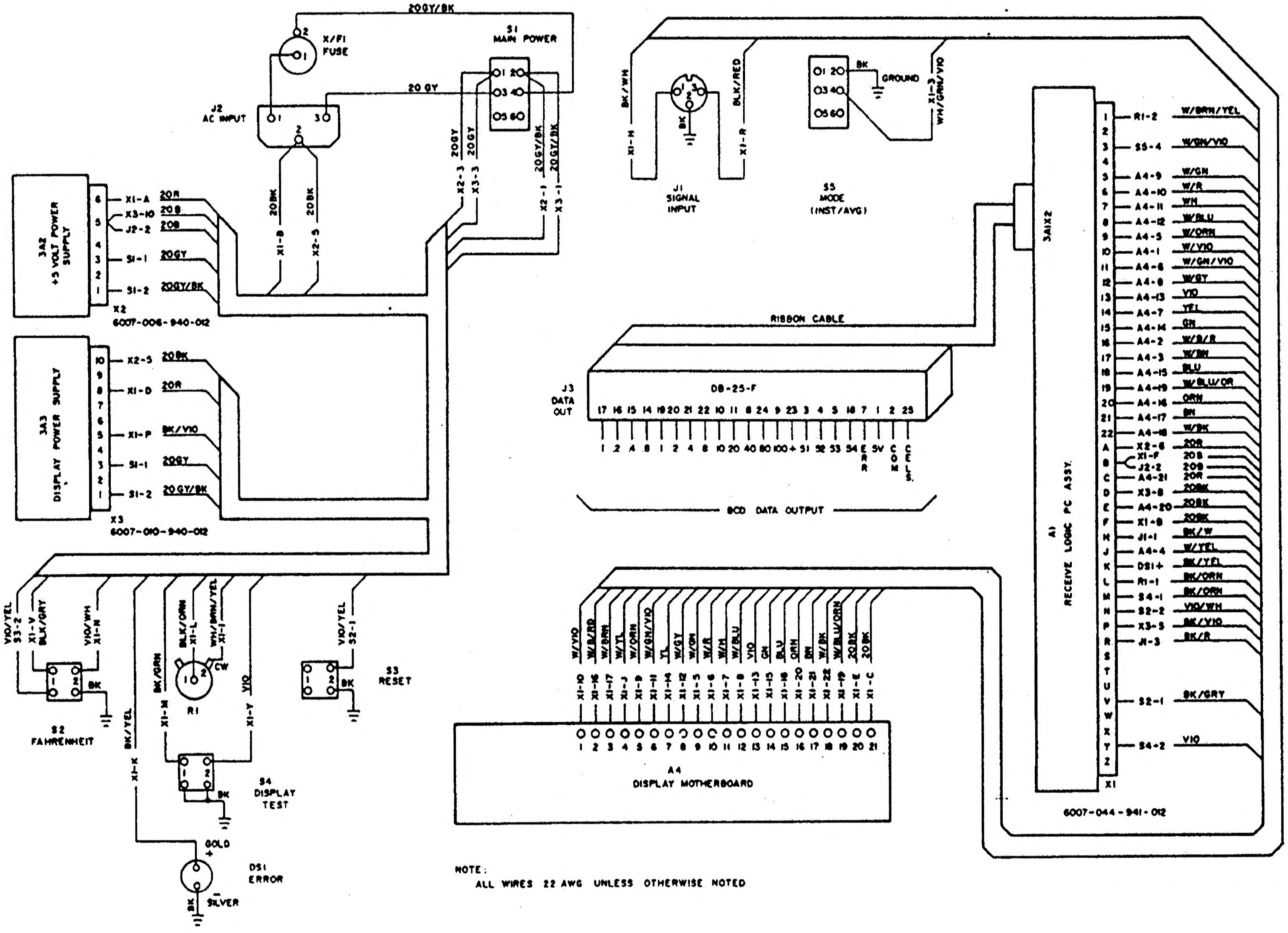


NOTES

∞ DENOTES TWISTED, SHIELDED, PAIR

ALL CONDUCTORS ARE AWG 22

WIRING DIAGRAM
ASPIRATOR



NOTE:
ALL WIRES 22 AWG UNLESS OTHERWISE NOTED

WIRING DIAGRAM
DISPLAY UNIT

SECTION 8

REPAIR NOTES

REPAIR NOTES

DISPLAY UNIT

GENERAL

Most of the repair tasks listed below may be made while the Display Unit is in place in its cabinet installation. Access to the chassis components and behind the panels is made by unlatching the chassis retainers at the upper corners of the front panel. The chassis slides out, and may be tilted downward. Removal of the top cover screws allows the cover to be removed, exposing all internal components. If the unit is to be removed from the rack, disconnect the input signal cable, P1, and pull out the AC power line connector, and slide the unit out to its limits. Depressing the buttons on the slide assembly disengages the slide stops and the unit may be pulled out of the rack.

1. RECEIVE LOGIC PC ASSY. (3A1)

REMOVAL

Turn off power. Disconnect the BCD output cable which plugs into the top of the PC assembly, by pulling it straight up from the DIP socket. Using the card ejection ears, slide the card in its guides out of its socket and slide it out.

REPLACEMENT

Slide the card into place in its guides, and seat it firmly in its socket by depressing the ejection ears. Carefully plug the BCD output ribbon cable into its DIP socket on the replacement card. Check operation of the display unit per the Support Volume, Section 5-9.3.

2. + 5 VOLT DC POWER SUPPLY (3A2)

REMOVAL

Turn off power. Remove the four mounting screws which secure the power supply card to the chassis. Lift the supply straight up, disconnecting receptacle 3X2.

REPLACEMENT

Install the new supply by way of its four mounting screws. Re-connect 3X2. Test the display unit per the Support Volume, Section 5-9.3.

3. DISPLAY POWER SUPPLY (3A3)

REMOVAL

Turn off power. Remove the four mounting screws which secure the supply to the chassis. Lift the supply straight up, disconnecting receptacle 3X3.

REPLACEMENT

Install the new supply by way of its four mounting screws. Re-connect 3X3. Test the display unit per Section 5-9.3.

4. NUMERIC DISPLAYS (3A4A1 - 3A4A4)

REMOVAL

Remove the two 4-40 nuts and nylon washers which connect the display module to the front panel bezel. Pull the bezel away from the front panel, taking care not to lose the two black plastic spacers on the bezel screws. Push the display module back slightly, away from the front panel, and lift the module out of its socket.

REPLACEMENT

Plug the replacement module into its socket. Insert the bezel from the front, through the panel, guiding the two screws through the matching holes in the module. The black spacers must be between the panel and the module. Install the nylon flat washers and the mounting nuts loosely. Turn the two spacers so that their feet point outward, clamping on the sides of the panel cutout. Tighten the nuts only enough to secure the assembly. Test operation of the display unit per the Support Volume, Section 5-9.3.

5. DISPLAY MOTHERBOARD (3A4)

REMOVAL

Turn power off. Remove the four numeric display modules. Unsolder the 21 wires which connect the assembly to the main wiring harness. Remove the six screws which secure 3A4 to the chassis floor. Lift the assembly straight up and out.

REPLACEMENT

Trim, dress and tin all of the 21 connection wires. Re-solder, using the display wiring diagram as a guide. Re-install the motherboard by way of its six mounting screws. Re-install the four numeric display modules. Test operation of the display unit per the Suppor Volume, Section 5-9.3.

6. FRONT PANEL COMPONENTS (3S2-3S4, 3R1, 3DS1)

REMOVAL

Turn power off. Unsolder the component and remove by carefully loosening the mounting nut on the panel.

REPLACEMENT

Re-install the component by way of its mounting nut. Trim, dress, and tin the leads and re-solder. Test operation of the display unit per the Support Volume, Section 5-9.3.

7. REAR PANEL COMPONENTS (3S1, 3S5, 3J1, 3J2, 3XF1, 3J3)

REMOVAL

Turn power off. Unsolder leads. Remove component by way of its mounting nut or screws.

REPLACEMENT

Re-install the component by way of its mounting hardware. Trim, dress and tin leads and re-solder, using the display unit wiring diagram as a guide. Test operation of the display unit per the Support Volume, Section 5-9.3.

APPENDIX D

AUTOBALANCE MODULE

GENERAL

To decrease the required mirror maintenance effort, an automatic optic balancing system has been added to the Model H083. Once per day this device causes the mirror to be heated until dry, and adjusts a bias applied to the optic bridge circuit to compensate for accumulated dirt and other visible contamination of the mirror surface. The maintenance time cycle, as before, is determined mainly by the amount of contaminant in the local air, but can be improved by a factor of at least two by way of the autobalance system.

As the mirror accumulates surface contamination, it appears to the optic detectors to be cloudy as if it were too heavily coated with moisture. The mirror temperature control circuit reacts by applying heat, or less cooling, to the mirror. Ultimately, if the mirror becomes sufficiently clouded with dirt, the control loop will become ineffective, or will constantly apply heat to the mirror in an attempt to "dry" it.

The autobalance circuit, once per day, forces the mirror temperature upward to dry the mirror, then releases the optic loop to seek the dew point. As the system seeks dew point from a dry mirror condition, it should be applying a relatively large cooling signal. During the first 15 seconds after heating is turned off, the heat/cool control signal is monitored and an external bias voltage is adjusted to bring the cooling signal up to the correct level. This bias voltage is stored and remains as a fixed input to the control system, until it is automatically readjusted the next day.

OPERATION

Although the Autobalance is fully automatic in its operation, the system user must observe certain precautions in its use. Adjustments of optic sensor amplifier gains (Si and Sd) may be made only when the mirror is clean and dry, and with the Autobalance dial manually set to 000. If the gain settings are adjusted with the dial positioned above 000, the system may become inoperative. In routine maintenance, procedures are as follows:

Periodically examine the mirror condition and check the Autobalance dial position. A period of two weeks is suggested at first, and this may be extended to several months in unusually clean atmosphere. As the mirror becomes visibly contaminated, the dial position will assume a higher value each day, and the dial reading may be taken as a rough indication of mirror condition. When the dial indication has reached 250, the mirror should be cleaned. The system will function up to an indication of about 500, but with impaired response.

After cleaning the mirror, manually turn the dial back to 000.

Readjust Si and Sd gain trimmers according to standard procedure: Using the Heat/Cool test switch, heat the mirror until Td reads at least 30 degrees above ambient, to assure that the mirror is dry. Release the Heat switch and, as the system drives downward toward dew point, adjust Sd gain until the Sd indicator light just comes on. Adjust the Si gain trimmer CW until the Si light comes on, then back off until the Si light just goes out. Be sure that the adjustments are completed before the system has reached dew point. If necessary, reheat the mirror and re-check the adjustments.

After these adjustments have been made, the system will track dew point, and the Autobalance will be inactive until its clock turns on the active cycle.

CIRCUIT DESCRIPTION

Referring to the Transmit Logic PC Schematic, page 2-19, mirror heating/cooling power is controlled by the output of U6B. One of the inputs to U6B is from the Heat/Cool test switch by way of pin 5 of the card socket and through R48. Pin 5 is also connected to the Autobalance connector, pin 6, as shown on the Transmit Unit Schematic, page 2-11. A positive DC voltage applied to that point will cause the mirror to cool.

Referring now to the Autobalance schematic, a motor-driven potentiometer, R7, controls the output voltage from the Autobalance module. This voltage, 0 to +5 volts DC, is connected through R8 to pin 5 of the Transmit Logic PC.

Once per day, just after the mirror has been heated dry for 5 minutes, the heating signal is removed and the "Balance" input to the Autobalance module, pin 7, is switched to 0 volts.. This enables analog switch, U2, completing the circuit from the drive motor return, M2, to ground. With the gate enabled, the motor will drive at a speed and direction determined by the output level and polarity of amplifier U1.

U1, a high-gain operational amplifier, receives as its inputs a fixed positive voltage through R5, and the negative heat/cool control signal through R1, R2, and R3. U1 drives the motor in the proper direction to adjust the potentiometer output to make the heat/cool signal equal to approximately -1.8 volts DC. At this level, the two inputs to U1 are in balance and the motor stops. The whole active part of the balance cycle takes 15 seconds, which is adequate time for the potentiometer position to stabilize. At the end of the 15 second period, the balance logic level switches up to +5 volts DC, and the motor is disabled. With the motor de-energized by the open analog gate, the output DC voltage from the potentiometer remains as a constant correction to the heat/cool circuit, furnishing the proper level of bias in a cooling direction to cancel the effect of visible contamination on the mirror.

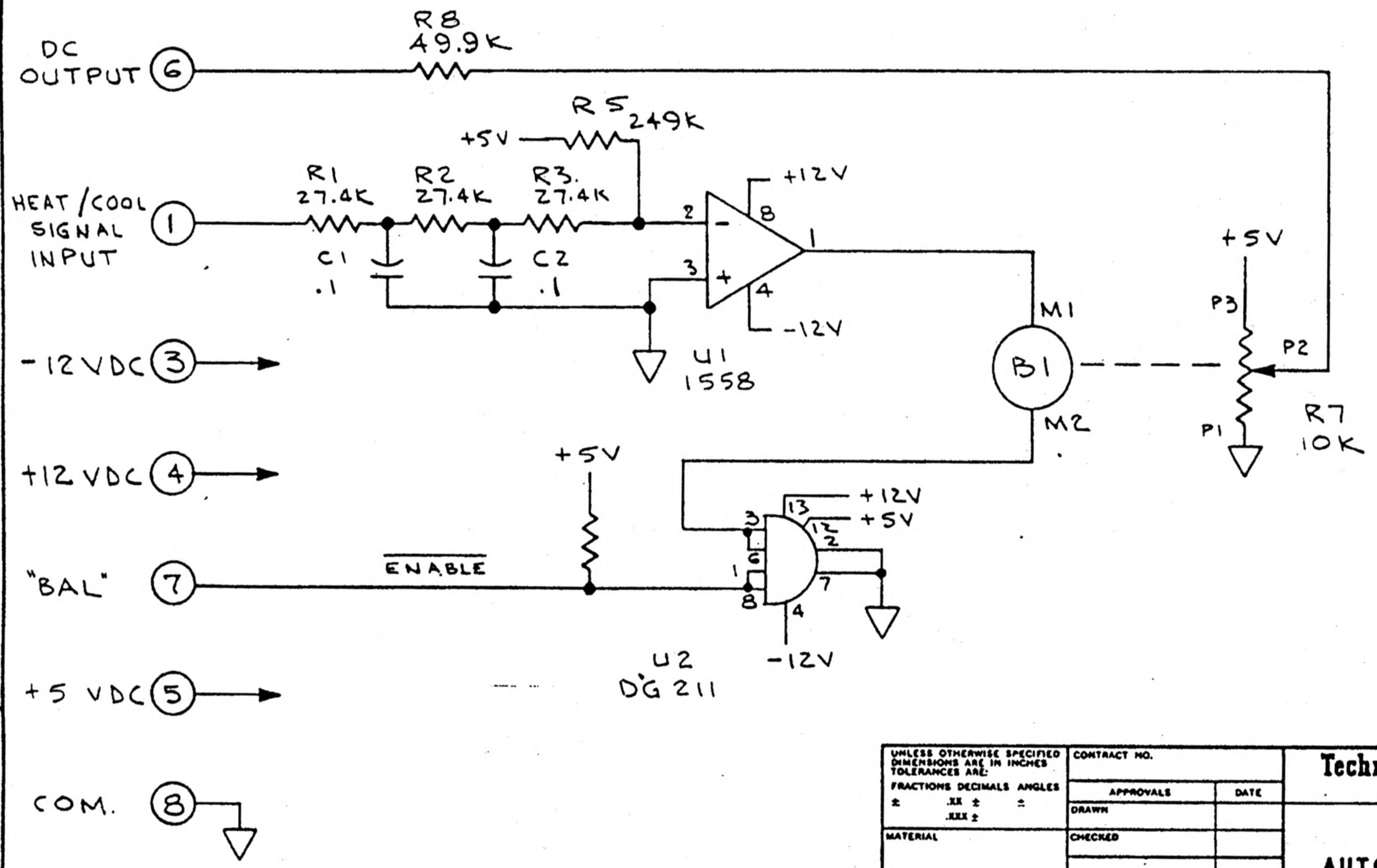
TIMING

Control of the daily cycle has been programmed into the main microprocessor in the Transmit Logic PC. Referring to the program listing, Appendix B, this is a part of the 24-hour clock routine at program location $F8AB. The heating and balancing actions occur at a time count just less than 24:00:00 hours. The clock is preset to 1200 by any interruption of transmitter main power. To set the heating/balancing action to a convenient time, simply turn off the transmitter AC power momentarily, 12 hours before the desired time. For example, if the transmitter power is interrupted for a few seconds at noon, the Autobalance system will be set to make its interruption of the dew point tracking at midnight. It will continue to operate each day at midnight until the next interruption of transmitter power, whether the interruption is accidentional or intentional, at which time the action will be resumed 12 hours after the last power interruption.

AUTOBALANCE TEST

The Autobalance may be initiated for observation by carefully momentarily grounding the Non-maskable Interrupt (NMI) input to the microprocessor, U1. Using a grounded lead, touch pin 4 of U1. Do not connect to pin 4 first and then ground the lead, as the antenna effect of the flying lead will probably stall the microprocessor, requiring a re-start by momentary interruption of power. Ten seconds after the NMI input has been grounded, the mirror temperature will begin to rise rapidly, as indicated by the dewpoint temperature readout. Mirror heating will last exactly 5 minutes, at which time the servo potentiometer will be enabled and the potentiometer dial will indicate any change of potentiometer position. After 15 seconds, the motor will be disabled, and the system will seek the dew point. During the entire cycle of 5 minutes and 15 seconds, plus an additional 8 minutes for restabilization, the error bit is activated in the transmitted data, so that the elevated dew point data will not be mistaken for valid data by the remote display unit.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	CONTRACT NO.	
	APPROVALS	DATE
	DRAWN	
MATERIAL	CHECKED	
FINISH		
DO NOT SCALE DRAWING		

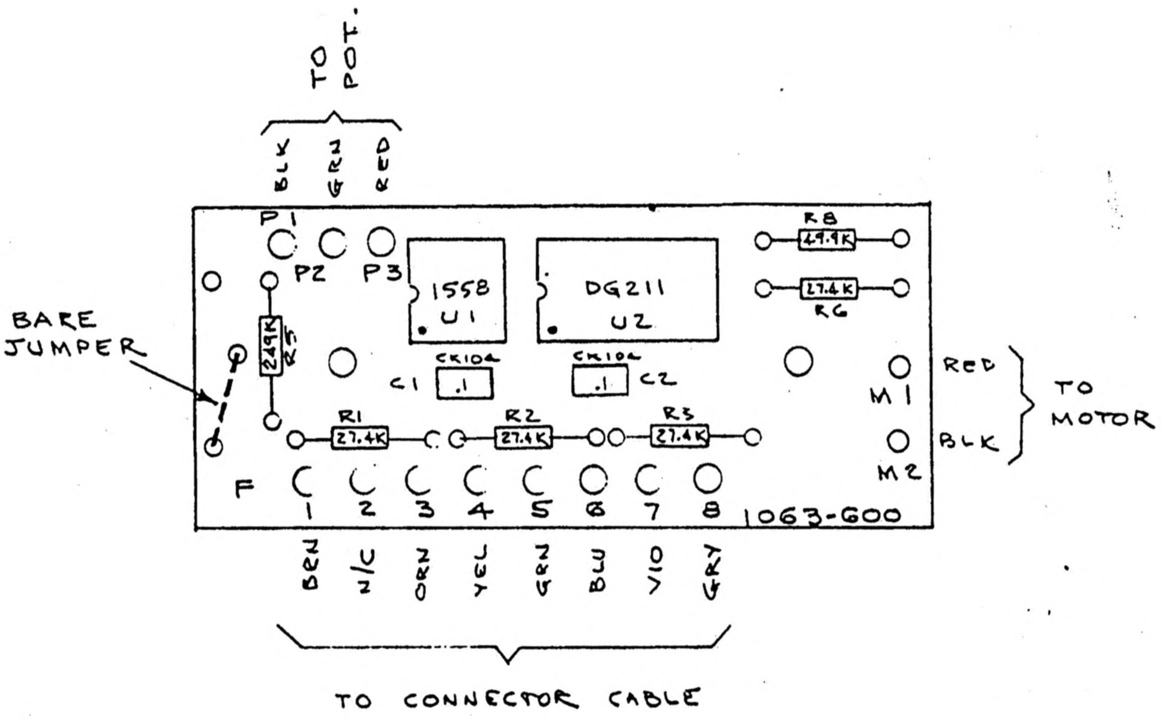
Technical Services Laboratory, Inc.
FORT WALTON BEACH, FLORIDA

SCHEMATIC

AUTOBALANCE MODULE

SIZE	CODE IDENT NO.	DRAWING NO.
B		1063-602

SCALE		SHEET	OF



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ±.5° 3 PLACE DEC. ±.005 2 PLACE DEC. ±.02	ENGINEERING DIVISION SILVER SPRING, MD. 20910	U. S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE
MATERIAL	PREPARED CHECKED DESIGN APPROVED BY APPROVED BY	COMPONENT LAYOUT AUTOBALANCE
		SIZE · DATE · DRAWING NO. 1063-601
		SCALE · SHEET · FILE

PARTS LIST

AUTOBALANCE MODULE 1063-600

ITEM	REF	QTY.	PART NAME	PART NO.	MFR.
1	E1	1	MOTOR-POT, 10K, 10-TURN,	MC20-1	E.T.I.
2	P1	1	PLUG, 9-PIN "D"	17-20090-1(390)	AMPHENOL
3	U1	1	IC, DUAL OP-AMP	MC1558	MOTOROLA
4	U2	1	IC, ANALOG GATE	DG211	SILICONIX
5	R1-R3,R6	4	RESISTOR, FILM, 27.4K, 1%	RN55-	
6	R4		NOT USED		
7	R5	1	RESISTOR, FILM, 249K, 1%	RN55-	
8	R7	1	POTENTIOMETER, 10K, 10 TURN	P/O E1	
9	R8	1	RESISTOR, FILM, 49.9K, 1%	RN55-	
10	C1,C2	2	CAPACITOR, CERAMIC, .1, 50V	CK05BX104K	

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VLBA Weather Station

Appendix 2

GENERAL SYSTEM INFORMATION

TABLE OF CONTENTS

GENERAL SYSTEM INFORMATION

1.0 INTRODUCTION

1.1 Qualimetrics, Inc., is a manufacturer and distributor of electronic, electro-mechanical, and mechanical meteorological instruments and systems. As a manufacturer, Qualimetrics Inc. is able to furnish components, sensors, signal conditioning, data acquisition, cabling, towers, conduit, lightning protection, hardware, software, systems engineering, and customer service. Off-the-shelf products as well as full turn-key systems are available to suit the varied needs of customers. Turn-key systems include project management, complete shop testing, calibration, installation, on-site supervision, and initial start-up. In addition, Qualimetrics Inc, offers in-house and on-site training of customer personnel for more advanced systems.

1.2 The two divisions of Qualimetrics, Inc, WeatherMeasure and Weathertronics, have combined many years of practical experience to produce well designed instruments and systems. The latest innovations in electronic technology are continually being incorporated into existing designs to improve product performance and reliability. The combined product lines of the two divisions allows Qualimetrics, Inc., to offer a wide range in systems designs. Above all Qualimetrics, Inc., is continually improving and expanding its ability to respond to the needs and demands of customers for after-sale problems and replacement parts and customer service.

1.3 The main concept behind the electronic meteorological systems and instrumentation is the modular structure. The modular design concept allows expansion or reduction of existing systems to meet continually changing requirements without having to discard or redesign major system components. The modular concept also provides for more rapid customer service without loss of the full system by allowing the defective module or sensor/module pair to be taken out of service while the rest of the systems stays online.

2.0 SENSORS

2.1 Qualimetrics produces and selects other manufacturers sensors to withstand severe environments while providing the required accuracies and performance specifications. Sensor designs are continually reviewed and improved as new technological advances are developed in order to provide customers with the best possible systems response.

2.2 Sensors are designed for use as individual instruments or with other sensors in large systems. Most sensors use cables and connectors for the transmission of sensor electrical outputs. Sensor cable terminations are accomplished by using environmental connectors to prevent moisture from degrading signal transmission and to prevent component failures due to corrosion. Cables can be ordered with the sensors or can be supplied by the customer. Standard cables supplied by Qualimetrics Inc, have a PVC jacket with an overall foil shield and drain wire. The individual wires are stranded, 20 AWG, with PVC insulation. The cables are multiple conductor style cables with color coded wires. Twisted-pair cables are sometimes provided in applications where externally induced noise is a critical factor.

2.3 Sensor accessories are available to provide full support for field use of the equipment. Accessories can include cable, mounting adapters, hardware, calibration devices, enclosures, towers, and much more. Accessories are usually unique to each sensor type to help eliminate unnecessary errors during calibration and installation. Most accessories are listed in the Qualimetrics, Inc, catalog and in some instrument instruction manuals.

3.0 SIGNAL CONDITIONING

3.1 The majority of the sensors used to gather meteorological data produce outputs which are as varied as the parameters being measured. In order to produce homogenous signals which can easily be connected into data acquisition systems, Qualimetrics provides modular signal conditioning. The modular signal conditioning systems provide sensor load matching, sensor electrical isolation, as well as calibration and amplification of the sensor signal. Signal conditioning modules allow an unlimited arrangement in the types of sensors used in a system. Most often the modules are arranged to correspond to the configuration of the instruments on the tower in descending order from the top of the tower.

3.2 Qualimetrics currently provides 2 styles of signal conditioning modules, an analog output version (formerly the Weathertronics design) and an analog output plus data acquisition output version (formerly the WeatherMeasure design). The analog output only style of modules operates with module files Models 1005, 1018 and 1023 and provides standard outputs of 0-5 VDC and 0-10 mVDC. The analog output plus data acquisition output style of modules operates with module files Models 1000 and 1001. It must be noted that the two styles of modules are not interchangeable and must be used with the appropriate module files for which they have been designed.

3.3 The analog output only modules are designed to provide a low cost, easy-to-use modular data system with analog outputs for use with analog dials, panel meters, strip chart recorders or customer furnished computer systems requiring 0-5 VDC input signals. The analog/digital modules are designed for use with the Model 1120 Data Acquisition System manufactured by Qualimetrics. The analog/digital modules feature programmable addressing and automatic remote calibration for use with the Model 1120 system. The modules are a little more expensive than the analog only modules and provide 3 standard outputs of 0-5 VDC, 0-1 VDC and 0-1 mADC. Both styles of modular systems have a wide range of applications and include special output modules. It is recommended that the customer discuss any further changes with the Qualimetrics Customer Service Department or Applications Engineering Department prior to making the change in order to obtain the maximum advantage of the existing system.

4.0 DATA ACQUISITION

4.1 Data Acquisition Systems include any number of devices that collect and/or display data gathered by sensors. Qualimetrics provides data acquisition systems that can include analog dials, digital panel meters, strip chart recorders, solid state recorders, digital data loggers, and data transmission systems.

4.2 Indicating systems are available to display real time data for public information systems, such as radio and television broadcasts, or to assist in process control in industrial facilities. Indicators are provided in modular form, 6-inch analog dials, or digital panel meters. The type of display used should be selected to best suit the application.

4.3 Recording systems are available to provide historical data for profile generation or for legal protection of industrial processing where pollutants are harmful. Strip chart recorders are often useful as back-up data acquisition systems where more than 90% of data retention is required by law. Recorder styles are available in single pen, dual side-by-side pen, multiple dotting type or solid state electronic versions.

4.4 Digital data acquisition systems provided by Qualimetrics can consist of programmable data loggers, magnetic tape or disk recording systems, digital printers and data transmission systems. These systems are used to take the sensor or module signals and create or manipulate the data, generate reports, and interface the sensors to other computer equipment. Typical data acquisition equipment can include 9 track magnetic tape recorders, line printers, RS232-C interfaces, teletype printers, telephone modems, and mass storage systems. Data logging collection can be accomplished in either of two ways: 1) gather the raw data continuously or at intervals; 2) record the data and store the records for future processing. Micro processor based systems can control the data collection as well perform on-site data reduction, units conversion, and perform additional calculations such as time averaging, minimum/maximum values and standard deviations.

5.0 OTHER SYSTEM COMPONENTS

5.1 Qualimetrics, Inc., specializes in providing complete turn-key systems for customers on a world wide basis. These turn-key systems can include major items such as towers, portable shelters, conduit, fencing, emergency power systems, civil works, and on-site training. In addition, two full sets of system documentation are included in the purchase price with additional sets of manuals available at an additional cost. System manuals include instruction manuals for each sensor and module, calibration data sheets, system interconnecting wiring diagrams, and installation assembly drawings for all major components. System manuals are shipped with the equipment unless special instructions are given. System manuals are enclosed in Qualimetrics 3-ring binders to protect the documents.

MANUAL
FOR
SIGNAL CONDITIONING MODULE FILE
MODEL 1018
1023

TABLE OF CONTENTS

MANUAL NO: 1018-001
DATE: AUGUST 1985
ECN: 2409

SIGNAL CONDITIONING MODULE FILE
MODEL 1018
1023

1.0 INTRODUCTION

1.1 The Models 1018 and 1023 Signal Conditioning Module Files are designed for table top mounting. The Model 1023 will accept a power supply module and two signal conditioning modules while the Model 1018 will accept a power supply module and five signal conditioning modules. The overall dimensions of the Model 1023 are 5.25"H x 5.40"W x 9.0"D (133 mm x 137 mm x 229 mm). The Model 1018 differs only in the width which is 9.75" (248 mm). Input and output signals lines to the modules are available on terminal connector blocks located at the rear of the file. A series of printed circuit board edge connectors are located inside the card file to bus all common signals and power supply voltages from the power supply module to all other modules. An 8-pin terminal block is located on the back panel to connect two 12 VDC batteries (± 12 VDC required) to the power supply. A six foot (180 cm) power cord on the back panel provides 115/230 VAC, 50/60 Hz to the power supply module.

1.2 The module file has a brushed aluminum finish with black grained inserts. The signal conditioning modules have a brushed aluminum finish with black lettering.

2.0 SPECIFICATIONS

2.1 Number of module positions:
Model 1023.. 3
Model 1018.. 6
Number of signal conditioning module positions:
Model 1023.. 2
Model 1018.. 5
Type of termination.......................terminal block, connectorless
Power cord length........................... 6' (180 cm)
Mounting..................................Table top
Finish................................Brushed aluminum
Power........................... 115/230 VAC, 50/60 Hz or ±12 VDC
Size: Model 1023.................. 5.25"H x 5.40"W x 9.0"D (133 mm x 137 mm x 229 mm)
Model 1018.................5.25"H x 9.75"W x 9.0"D (133 mm x 248 mm x 229 mm)
Weight/Shipping.............. 4 lbs/8 lbs (1.8 kg/3.6 kg)

3.0 INSTALLATION

3.1 This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 Both the Model 1018 and 1023 Module Files can be mounted on a shelf or table top. All cabling is terminated at the rear of the file. All switches and calibration adjustments are accessible at the front panel or top of each module. Voltage measurements must be made either at the rear panel or at the top edge test points of each module. In order to use the top edge test points, use an extender card Model 1605. Otherwise, the top cover must be removed to access the test points. Remove only the black plastic cover.

3.3 Caution must be taken to prevent connecting the module file to an incorrect operating voltage. Power Supply Model 1030-A will accept 115 VAC. Power Supply Model 1030-B will accept 220 VAC. The serial tag with the module model number is located behind the module panel. Remove the module and inspect the serial tag for the model number.

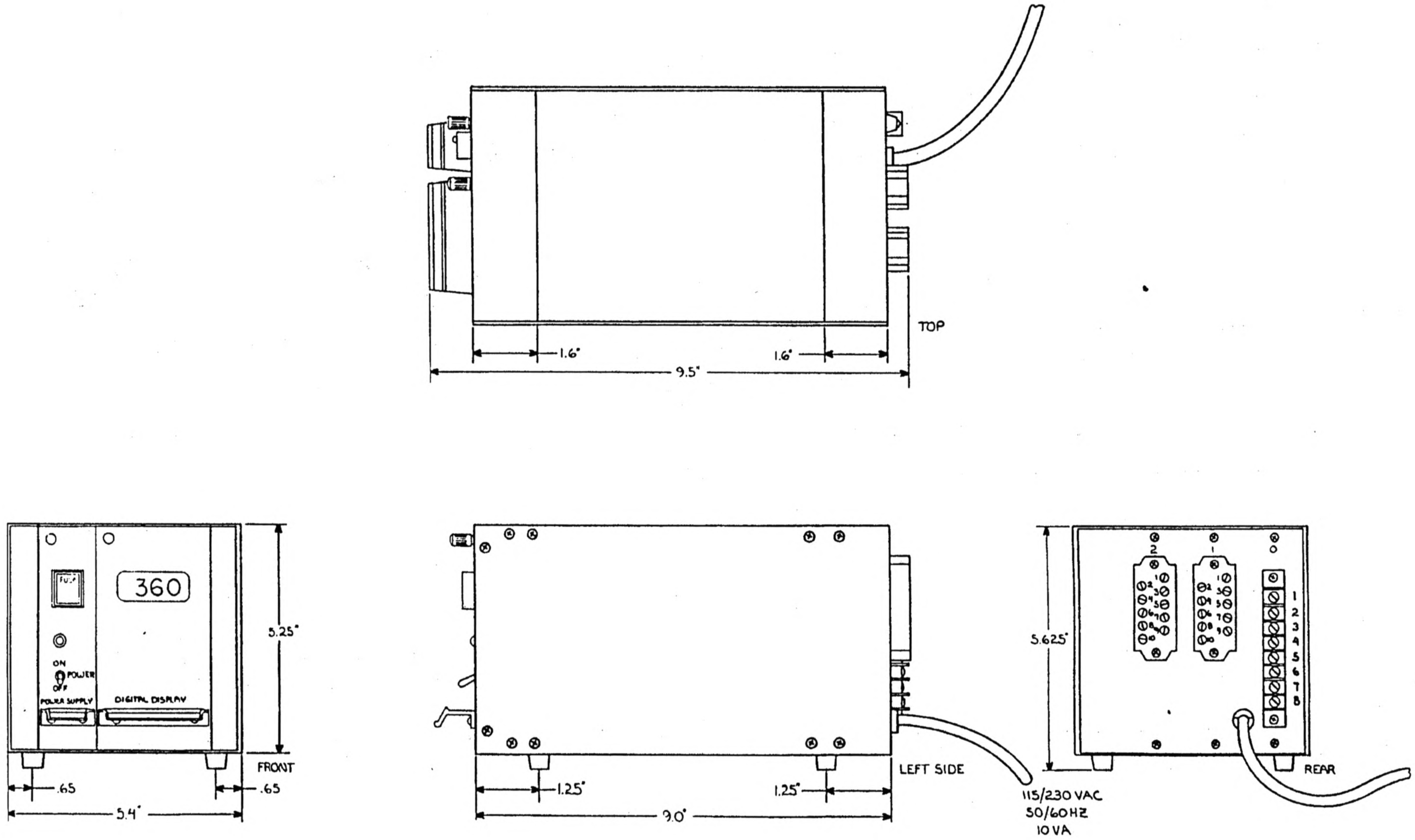
CAUTION

The Power Supply Module and Power Supply Card Extender have 115/230 VAC present on them. Use extreme caution while servicing or installing this equipment.

3.4 Before turning power on, each module should be installed into its position and the correct input and output cables attached to the terminal block. Refer to the system wiring diagram for module position designations for each module file. The interconnecting tables at the end of this section are included in the manuals for each type of module being used to indicate cable terminations. Figure 3.1 displays a typical form used for module designations. The table in Figure 3.2 is a typical interconnecting wiring list. Module positions are shown as the system has been constructed and tested at the factory and are not restricted should the user require changes to the system.

3.5 To connect battery leads to terminal block zero use .300" wide spade lugs.

3.6 To connect input/output wires to terminal blocks 1 through 11, turn the recessed screws counter-clockwise until the screw is flush with the edge of the terminal block. Strip each wire approximately 1/4", insert into funnel opening and tighten the screw. These terminal blocks are designed



POS	PARAMETER	MODEL	OUTPUT 1 RANGE		OUTPUT 2 RANGE	
			ENGR UNITS	ELECTRICAL	ENGR UNITS	ELECTRICAL
0	POWER SUPPLY	1030-A	—	—	—	—
1	DIGITAL DISPLAY	1991	—	—	—	—
2	↓ ↓	↓	—	—	—	—

TYPICAL VIEW

FIG 3.1

ITEM	PART NO.	SUFFIX	QTY.	UNIT	DESCRIPTION	REFERENCE NO.

BILL OF MATERIALS

WEATHERtronics
2777 Del Monte St.
West Sacramento, CA 95691
Telephone (916) 371-2000

NEXT ASSY | REV. | DATE

DO NOT SCALE DRAWING

TITLE SIGNAL CONDITIONING MODULE FILE

MOD 1023

SCALE 1/2

DRAWN BY GT

RELEASE DATE 9-30-81

DOCUMENT NO. 1023-03-C

SHEET 1 OF 1

SENSOR	CABLE	JUNCTION BOX	CABLE	MODULE	CABLE	OUTPUT DEVICE
MODEL	SIZE	MODEL	SIZE	MODEL	SIZE	MODEL
PIN	COLOR	TERMINAL	COLOR	TERMINAL 2		
				4		
				6		
				8		
				1		
				3		
				5		
				7		

NOTES:

QUALIMETRICS INC.
3213 Orange Grove Avenue
North Highlands, Ca. 95660
(916)481-7565

INTERCONNECTION TABLE

MODULE MODEL ____________ MODULE FILE ____________ POSITION ____________

FIG 3.2

for wire sizes 22 to 12 AWG, solid or stranded. It is not necessary to tin stranded wire.

4.0 CIRCUIT DESCRIPTION

4.1 The Model 1018 and 1023 Module Files are made to accept any WEATHERtronics signal conditioning modules. With the exception of the power supply, all modules have two connectors. The top connector provides input/output connection to sensors and data acquisition equipment. The bottom connector provides common busing of power and control lines from each module to the power supply. The power supply connector, besides providing the above lines, also connects the power source with the circuit board. Refer to Drawing Number 1018-004 for a schematic of the module file. The neutral wire of the AC power cord is tied to chassis ground. The system common is a floating signal and should not be tied to chassis ground. A chassis ground screw terminal is located below each terminal block to be used to ground shielded cables, if required.

5.0 CALIBRATION

5.1 The Model 1018 and 1023 Signal Conditioning Module Files do not require any external calibration.

5.2 Calibration adjustments are located on the front panel and the top edge of each module. If card extenders are required, use them to calibrate and troubleshoot each module. NOTE: The power supply module has its own Card Extender Model 1606. Please observe caution described in Step 3.3.

6.0 MAINTENANCE

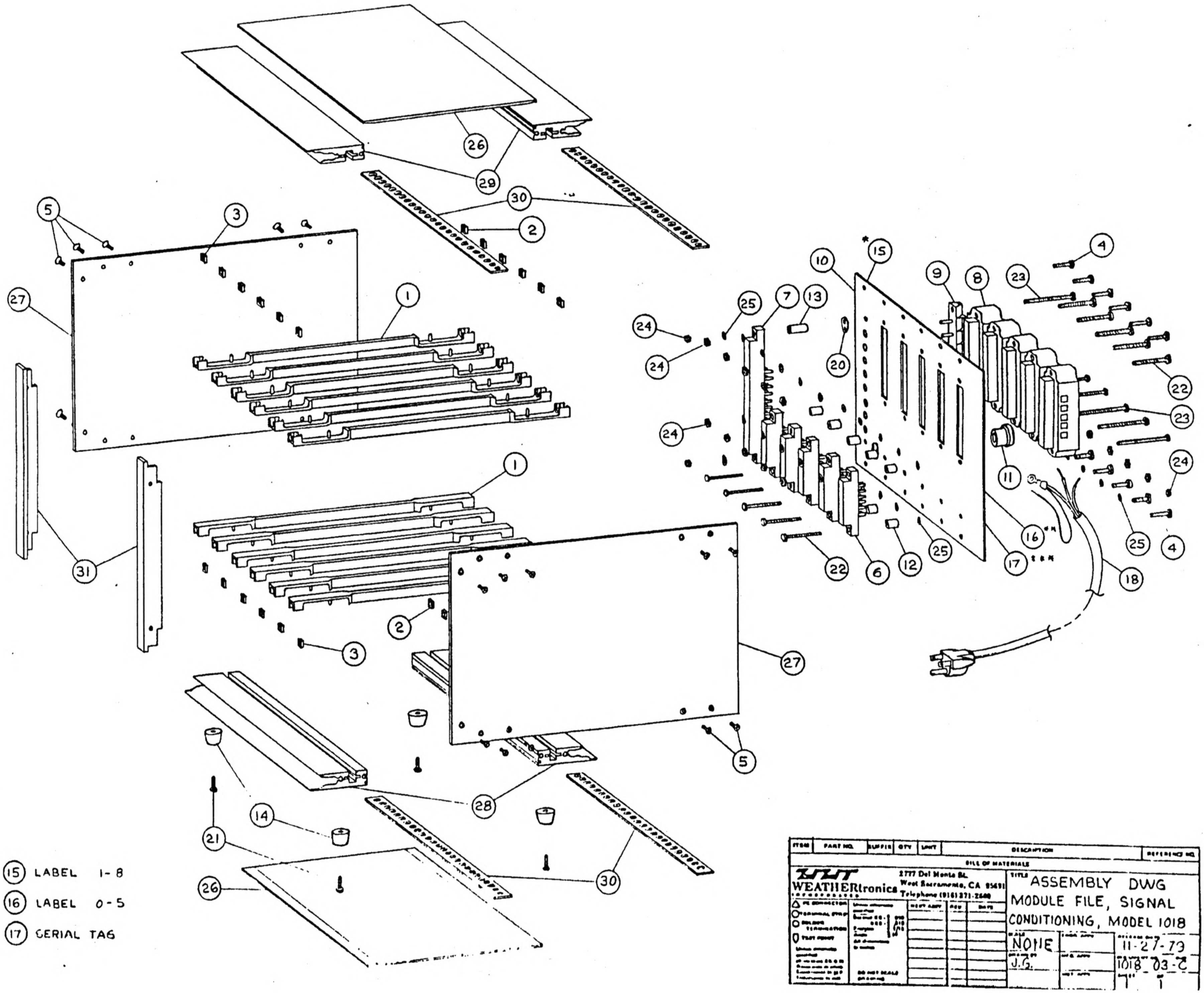
6.1 Maintenance is primarily limited to the power cord and/or breakage of any of the terminal strips or printed circuit connectors. For safety and maximum accuracy, replace any parts that are damaged.

7.0 SCHEMATIC AND PARTS LIST

7.1 The following pages include schematics, assembly drawings, and parts list for this instrument. Please note that the parts lists are arranged in assembly/subassembly form. Each subassembly is on its own page. Subassemblies and parts are listed in the smallest economical size available from Qualimetrics.

8.0 WARRANTY

8.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others, may cancel warranty.



* ⑮ LABEL 1-8

* * ⑯ LABEL 0-5

* * * ⑰ SERIAL TAG

ITEM	PART NO.	SUFFIX	QTY	UNIT	DESCRIPTION	REFERENCE NO.

BILL OF MATERIALS

WEATHERtronics
INCORPORATED
2777 Del Monte St.
West Sacramento, CA 95691
Telephone (916) 371-2600

DO NOT SCALE DRAWING

TITLE ASSEMBLY DWG
MODULE FILE, SIGNAL
CONDITIONING, MODEL 1018

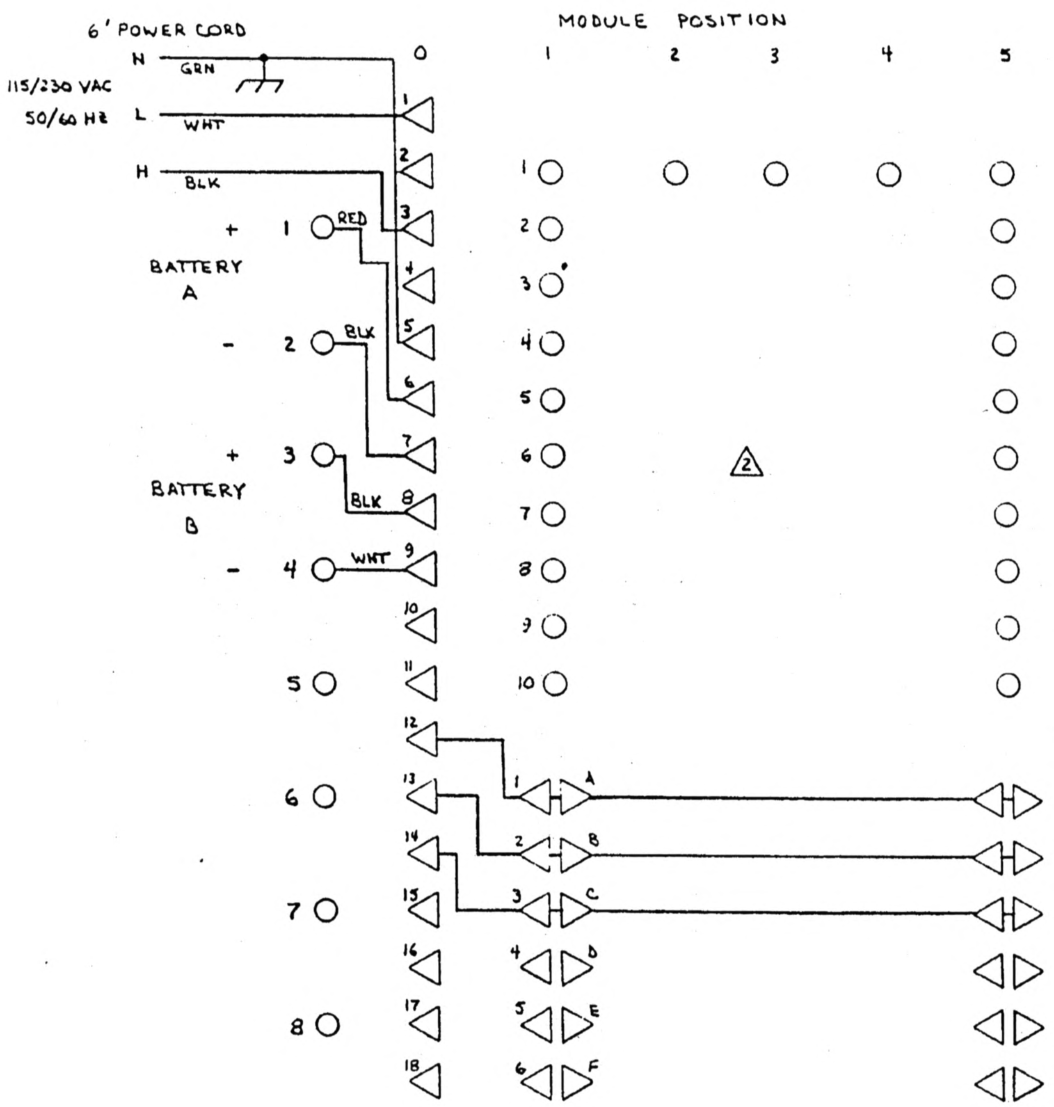
SCALE NONE

DRAWN BY J.G.

11-27-79

1018 03-C

"I" 1



1. MODULE POSITION 0 FOR POWER SUPPLY ONLY. MODULE POSITIONS 1 TO 5 FOR ANY COMBINATION OF SYSTEM MODULES.

2. ALL SYSTEM MODULE POSITIONS WIRED IDENTICAL.

3. MODEL 1023 HAS 3 POSITIONS. MODEL 1018 HAS 6 POSITIONS.

—▷ PC CONNECTOR

—○ TERMINAL BLOCK

REV	ECN	DATED	QTY	NEXT ASM

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ± .005 XX= ± .010 FRACTIONS= ± .02
ANGLES ± ½° CONCENTRICITY= .003 TIR

MATL

FINISH

ENGR | DT
APPRO | DT

WeatherMeasure
WEATHERtronics

NOMENCLATURE SCHEMATIC
MODULE FILE
MODEL 1018 & 1023

MOD USAGE | SHEET 1 OF 1

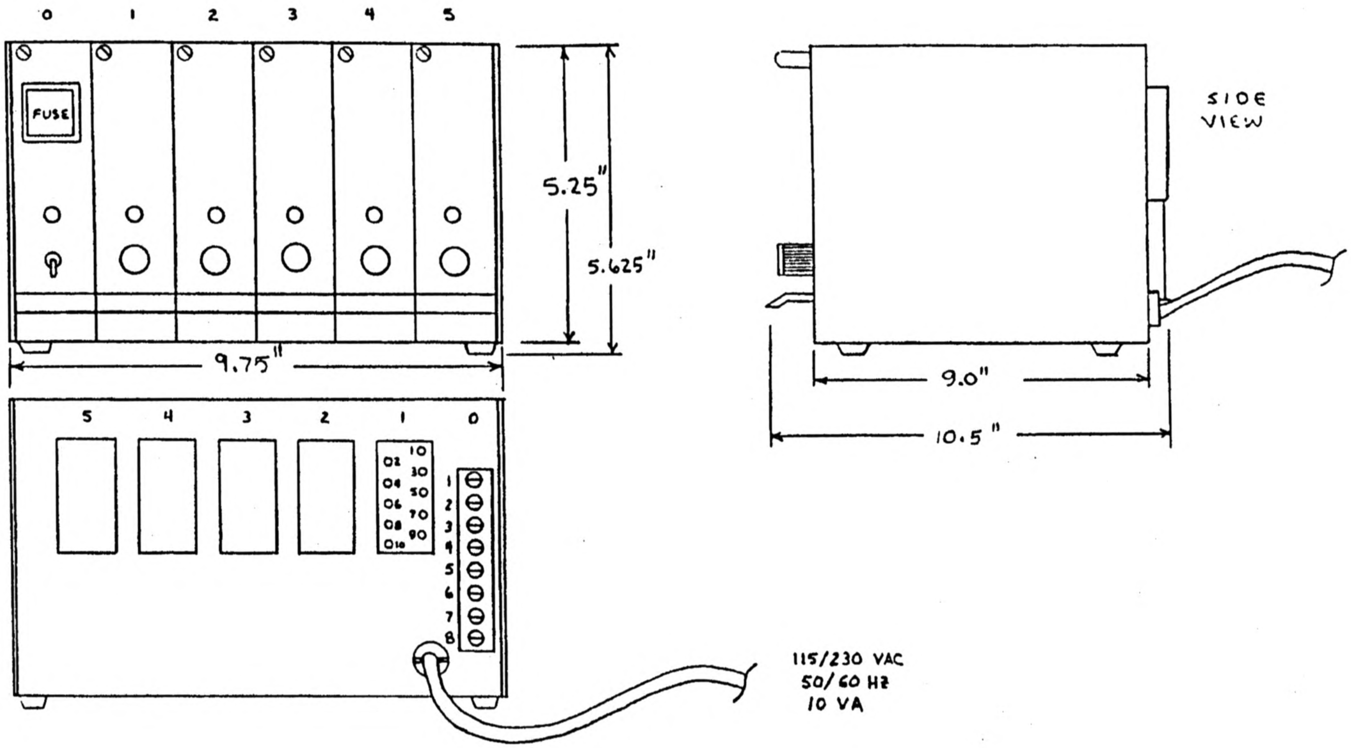
BY WSH
DT 9/20/77
SCALE Ø
DWG NO 1018-004

FRONT VIEW

OVERALL SIZE

MODEL 1018 5.25"H x 9.75"W x 10"D

BACK VIEW



POS	PARAMETER	MODEL	OUTPUT 1 RANGE		OUTPUT 2 RANGE	
			ENGR UNITS	ELECTRICAL	ENGR UNITS	ELECTRICAL
0	POWER SUPPLY	1030-A	—	—	—	—
1						
2						
3						
4						
5						

REV	ECN	DATED	QTY	NEXT ASM

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ± .005 XX= ± .010 FRACTIONS= ± .02
ANGLES ± ½° CONCENTRICITY= .003 TIR

MATL

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ENGR DT

APPRD DT

WeatherMeasure
WEATHERtronics

NOMENCLATURE SIGNAL CONDITIONING
MODULE FILE
MODEL 1018

MOD USAGE

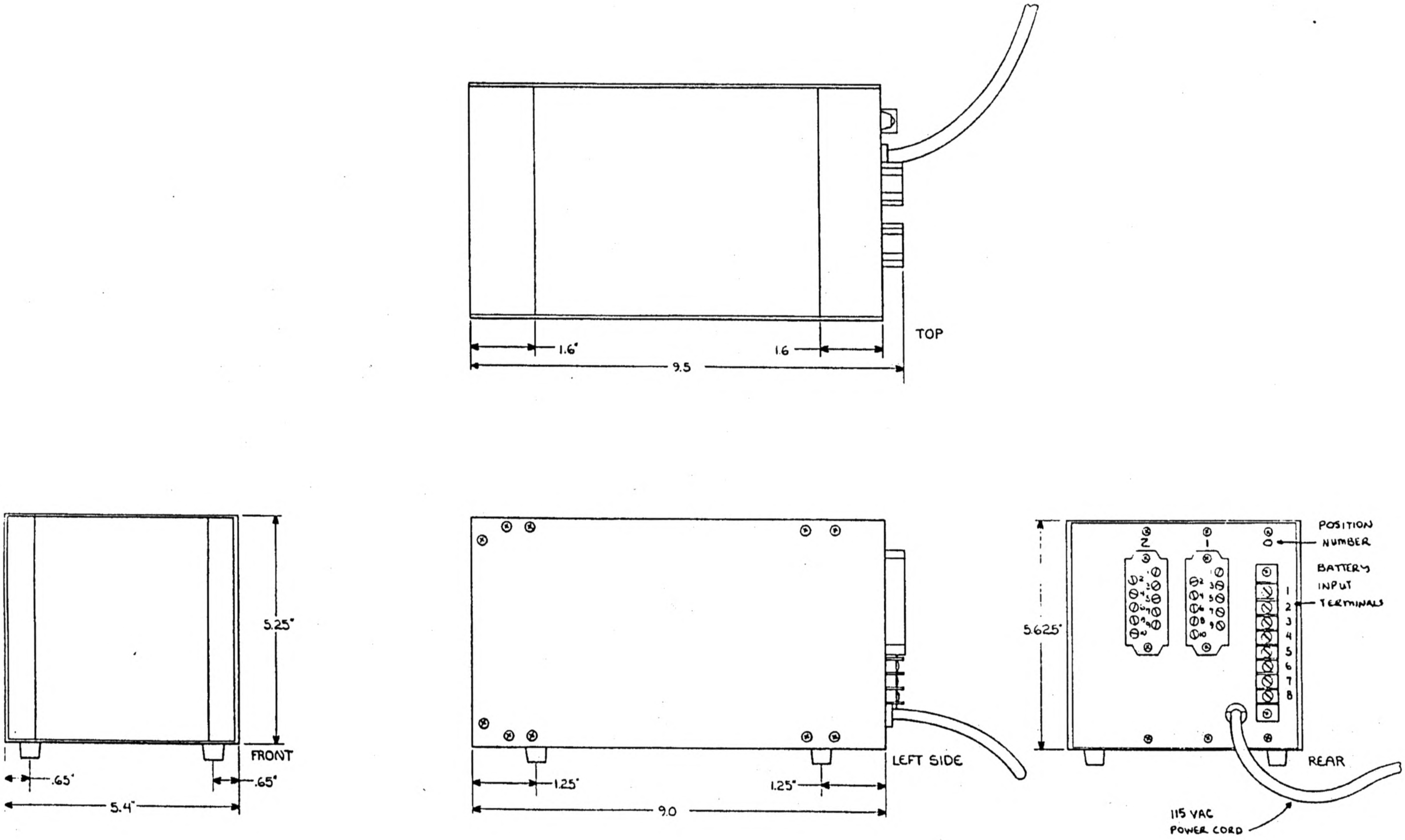
SHEET 1 OF 1

BY WSH

DT 07/7/77

SCALE Ø

DWG NO 1018-005



POS	PARAMETER	MODEL	OUTPUT 1 RANGE		OUTPUT 2 RANGE	
			ENGR. UNITS	ELECTRICAL	ENGR. UNITS	ELECTRICAL
0	POWER SUPPLY	1030-A				
1						
2						

ITEM	PART NO.	SUFFIX	QTY.	UNIT	DESCRIPTION	REFERENCE NO.

BILL OF MATERIALS

WEATHERtronics
INCORPORATED
2777 Del Monte St.
West Sacramento, CA 95691
Telephone (916) 371-2660

TITLE SIGNAL CONDITIONING MODULE FILE

MOD 1023

SCALE 1/2

DRAWN BY C.T

DRAWING NO. 1023 05-0

SHEET 1 OF 1

DO NOT SCALE DRAWING

MANUAL
FOR
CROSSARM
MODEL 2023

TABLE OF CONTENTS

MANUAL NO: 2023-001
DATE: APRIL 1987
ECN: 2599

CROSSARM
MODEL 2023

1.0 INTRODUCTION

1.1 The Micro Response Wind Sensors and new style Low Threshold Wind Sensors are designed for use as sets of wind speed and wind direction sensors. In order to properly install the sensors as a set, the Crossarm Model 2023 is recommended.

1.2 The Crossarm provides a stable, easy-to-use mounting for the wind sensors. Mounting pins with orientation pins allow easy removal and reinstallation of the sensor without loss of orientation. This is especially important when servicing wind direction sensors.

1.3 The simple design and construction of the Crossarm facilitates the handling and installation of the Crossarm and the wind sensors. All sensor wiring and cable connections are external to the Crossarm, eliminating wiring problems and simplifying troubleshooting.

2.0 SPECIFICATIONS

Size	48"W x 6"H x 1" Dia. (1219 x 152 x 25 mm)
Mounting	1 inch O.D. pipe or tubing
Material	Aluminum
Weight/Shipping	3.5 lbs/5 lbs (1.6 kg/2.3 kg)

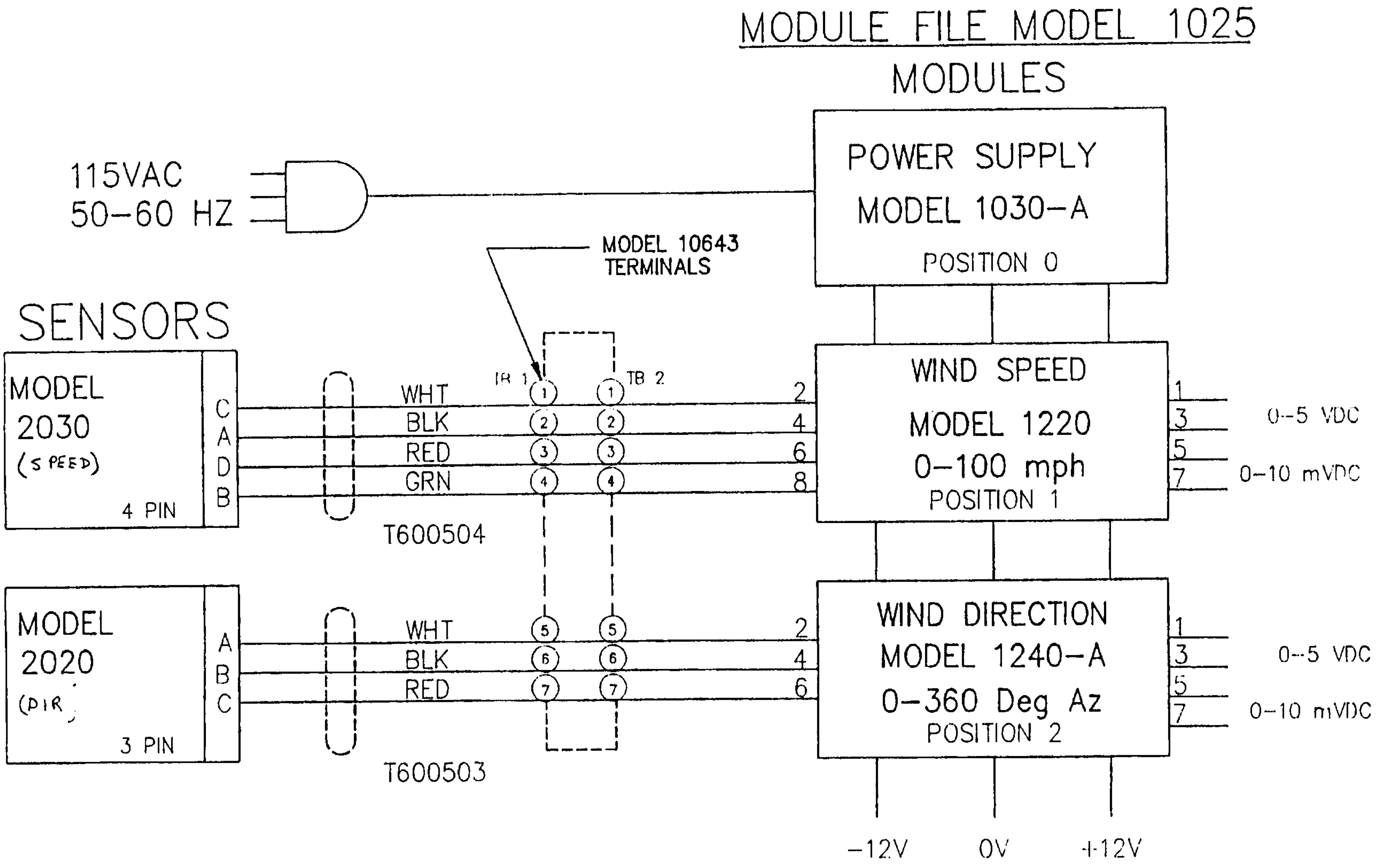
3.0 INSTALLATION

3.1 This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 The Crossarm is designed to be mounted onto a pipe mast or a boom nipple with an outside diameter of 1.0 inches. Two square head set screws fasten the Crossarm to the mast.

3.3 Install the Crossarm. Place the arms so that there is sufficient clearance from all guy wires, cables, etc. that are attached to the mast.

3.4 The mounting pin on each end of the Crossarm has a dowel pin on the side. The dowel pin fits into a guide hole



QUALIMETRICS, Inc.

TITLE SCHEMATIC WIND SYSTEM

JOB NO. J53797 | NATIONAL RADIO ASTRONOMY OBSERVATORY

DATE 6-26-89 | SHEET 1 OF 1

drilled into the base extension of each sensor. On the wind vane, the hole for the dowel pin is on the same side as, and is aligned with, the North mark. The Crossarm can be installed with both mounting pins oriented toward North to allow mounting of the wind vane on either end. The mounting pins are secured by a 5/16 diameter bolt. Lock washers help prevent the pins from turning. These bolts may be loosened and left loose until the vane is installed and precisely oriented towards North. Be sure to securely fasten all Crossarm hardware before leaving the equipment.

3.5 With the mounting pin bolt loosened, the mounting pin will rotate when the sensor body is turned. In this way, whenever the wind vane sensor is aligned to North, the mounting pin is also aligned to North and will remain aligned after the bolt is securely fastened. The wind vane can then be removed and replaced without loss of orientation. Loosening the square head set screws will cause loss of orientation of the crossarm to North. These set screws should only be loosened for removal of the crossarm.

3.6 REMEMBER, it is not necessary to loosen the crossarm mounting pins when removing the sensors for repair or replacement. Loosen only the allen head screws on the sensor base to remove the sensor from the crossarm.

4.0 MAINTENANCE

4.1 No maintenance is required of the Crossarm other than routine checks for excessive corrosion or general inspection.

4.2 Occasional lubrication of the set screws and bolt threads may be required in order to remove the Crossarm or to re-orient the sensors after the system has been in service for some time. Use a silicon compound for lubrication.

4.3 Bee wax is recommended as a lubricant for the mounting pins to allow for easy installation and removal of the sensors from the crossarm.

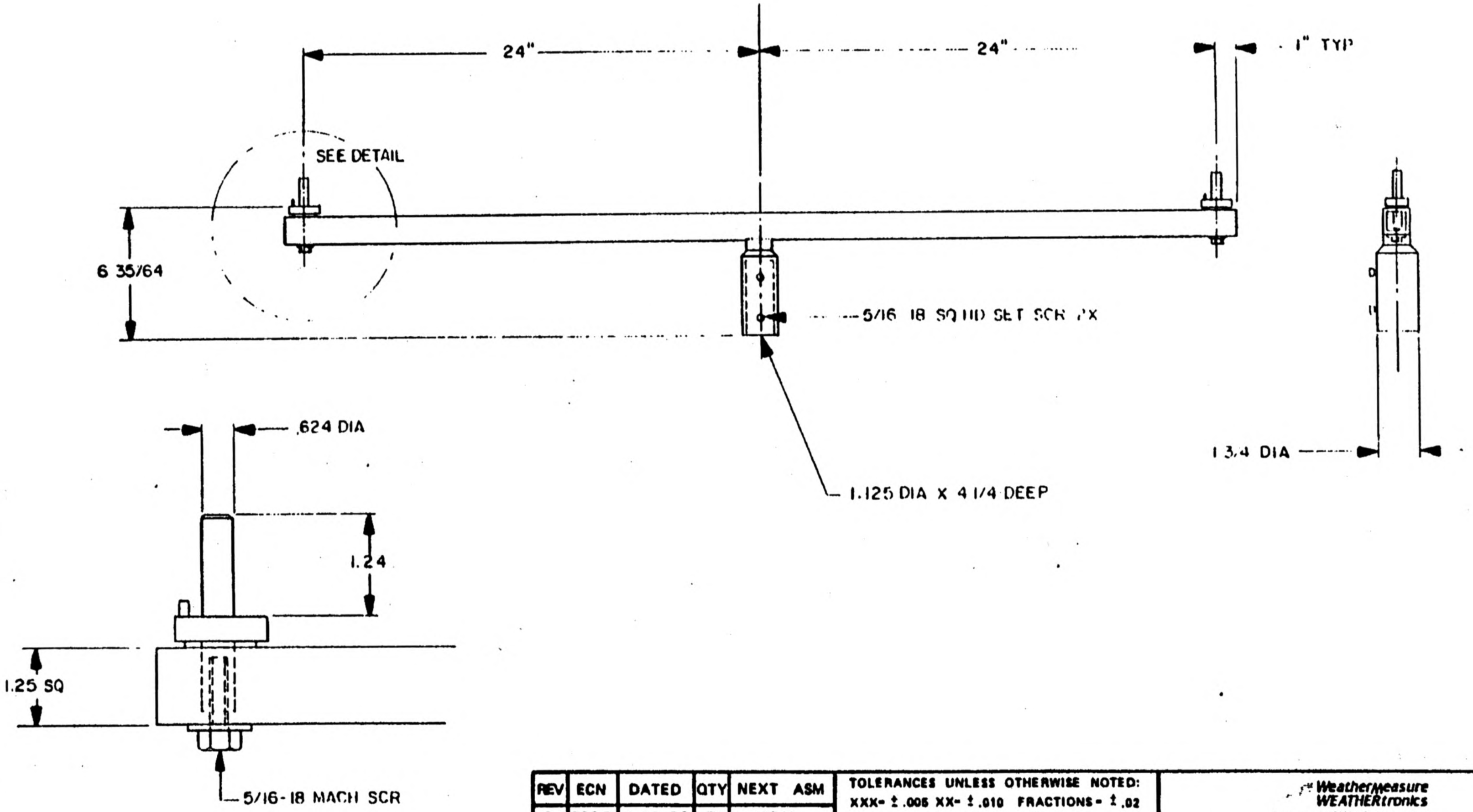
5.0 DRAWINGS AND PARTS LIST

5.1 The following pages include assembly drawings and parts lists. Parts lists are arranged in assembly/subassembly form. All subassemblies are listed on separate pages. parts are listed in the smallest size available.

6.0 WARRANTY

6.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others, may cancel warranty.

DWG NO. 2023-005



REV	ECN	DATED	QTY	NEXT ASM
B	2599	8-22-86	END ITEM	

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ±.005 XX= ±.010 FRACTIONS= ±.02
ANGLES ± ½° CONCENTRICITY=.003 TIR

WeatherMeasure WEATHERtronics
Division of QUALIMETRICS Inc

B

MATL
ALUMINUM

FINISH
WHITE PAINT & CLEAR ANODIZE

NOMENCLATURE
MODEL 2023 CROSSARM
OUTLINE DWG

ENGR		DT	
APPRO		DT 8-26-86	

MOD. USAGE 2023

SHEET 1 OF 1

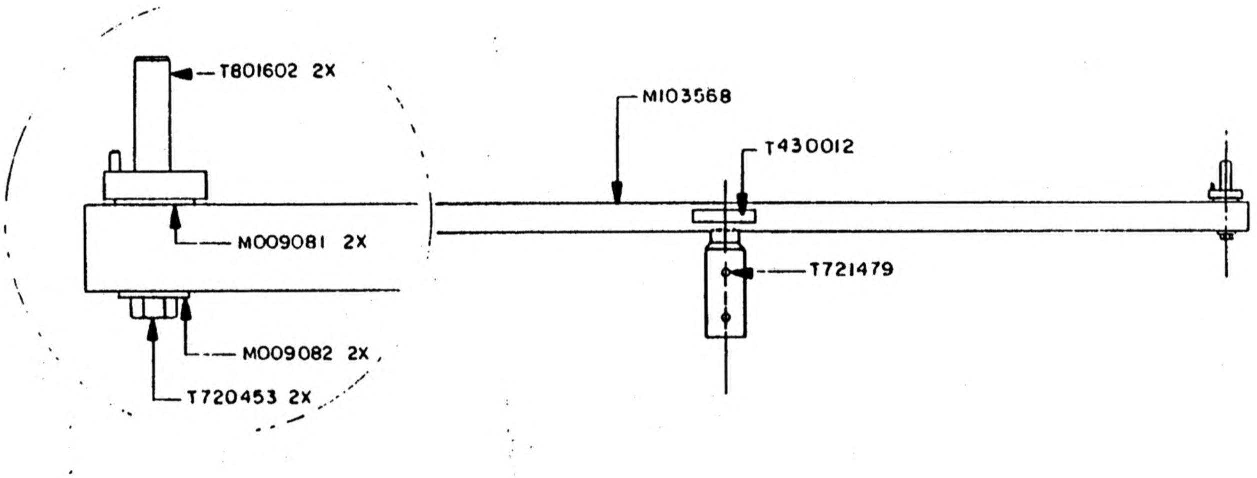
BY GEARHEART

DT 25 AUG 86

SCALE 1/5

DWG. NO. 2023-005

DWG. NO 2023-0[illegible]



REV	ECN	DATED	QTY	NEXT ASM
B	2599	8 22-86	END ITEM	

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ±.005 XX= ±.010 FRACTIONS = ±.02
ANGLES ± ½° CONCENTRICITY= .003 TIR

MATL
SEE BILL OF MATERIAL

FINISH
AS ISSUED

ENGR		**DT**	
APPRO		**DT**	8-26-86

WeatherMeasure
WEATHERtronics
[illegible]

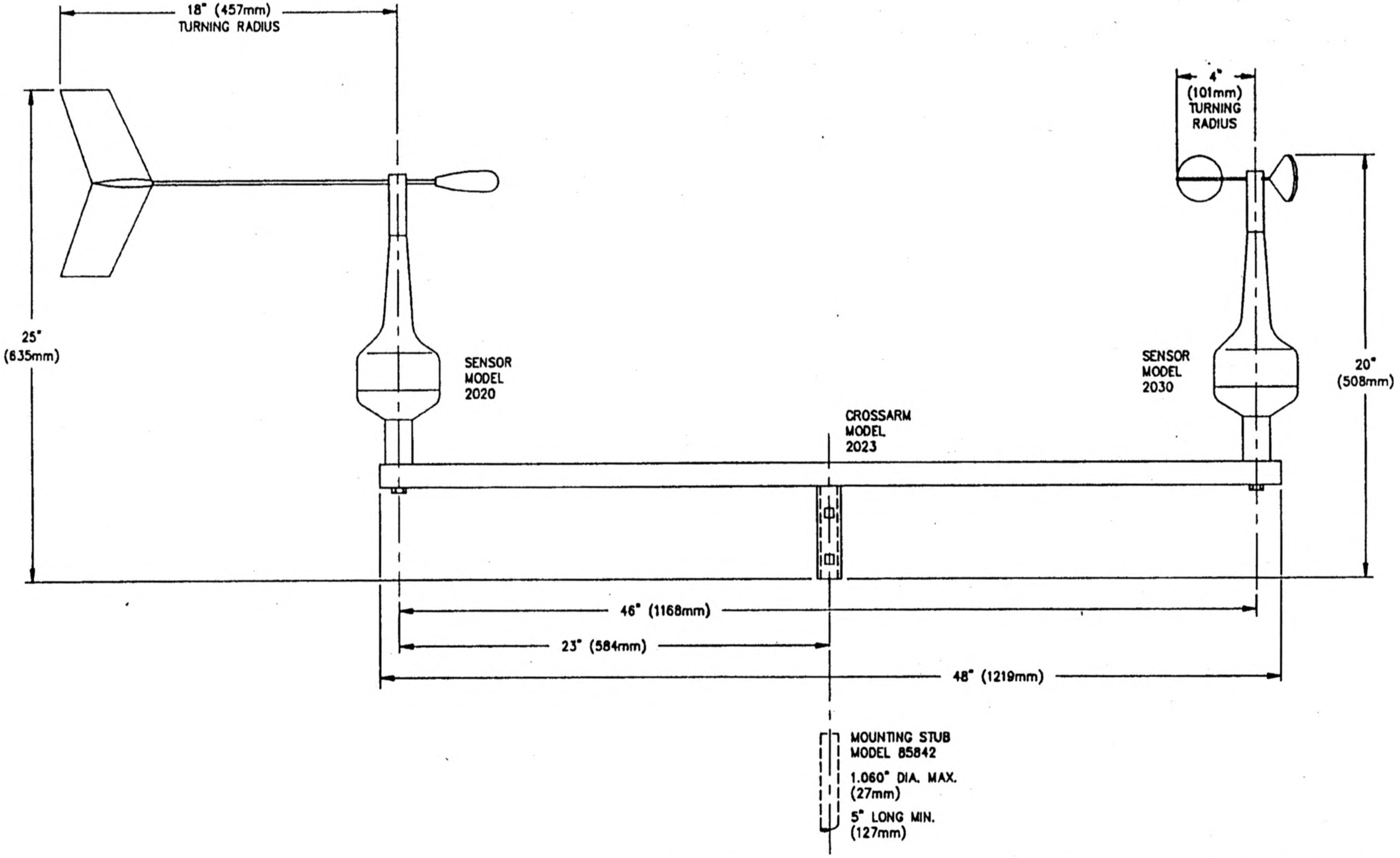
B

NOMENCLATURE
CROSSARM ASSY, MOD 20[illegible]

MOD. USAGE 2023
SHEET 1 **OF** 1

BY GEARHEART	**SCALE** 1/5	**DWG NO.** 2023-0[illegible]
DT 22 AUG 86		

DWG. NO. 2023-025



	REV	ECN	DATED	QTY	NEXT ASSY
	A		5/78		
	B	2599	4/87		
REDRAWN	C	2669	6/87		

TOLERANCES UNLESS OTHERWISE NOTED
XXX=±.005 XX=±.010 FRACTIONS=±.02
ANGLES ±1/2° CONCENTRICITY=.003 TIR

MATL

FINISH

ENGR RJ DT 7/7/87

APPROVED DT

WeatherMeasure
WEATHERtronics
Division of QUALIMETRICS, Inc

C

TITLE OUTLINE DRAWING,
MICRO-RESPONSE WIND SYSTEM

MOD. USAGE

SHEET 1 OF 1

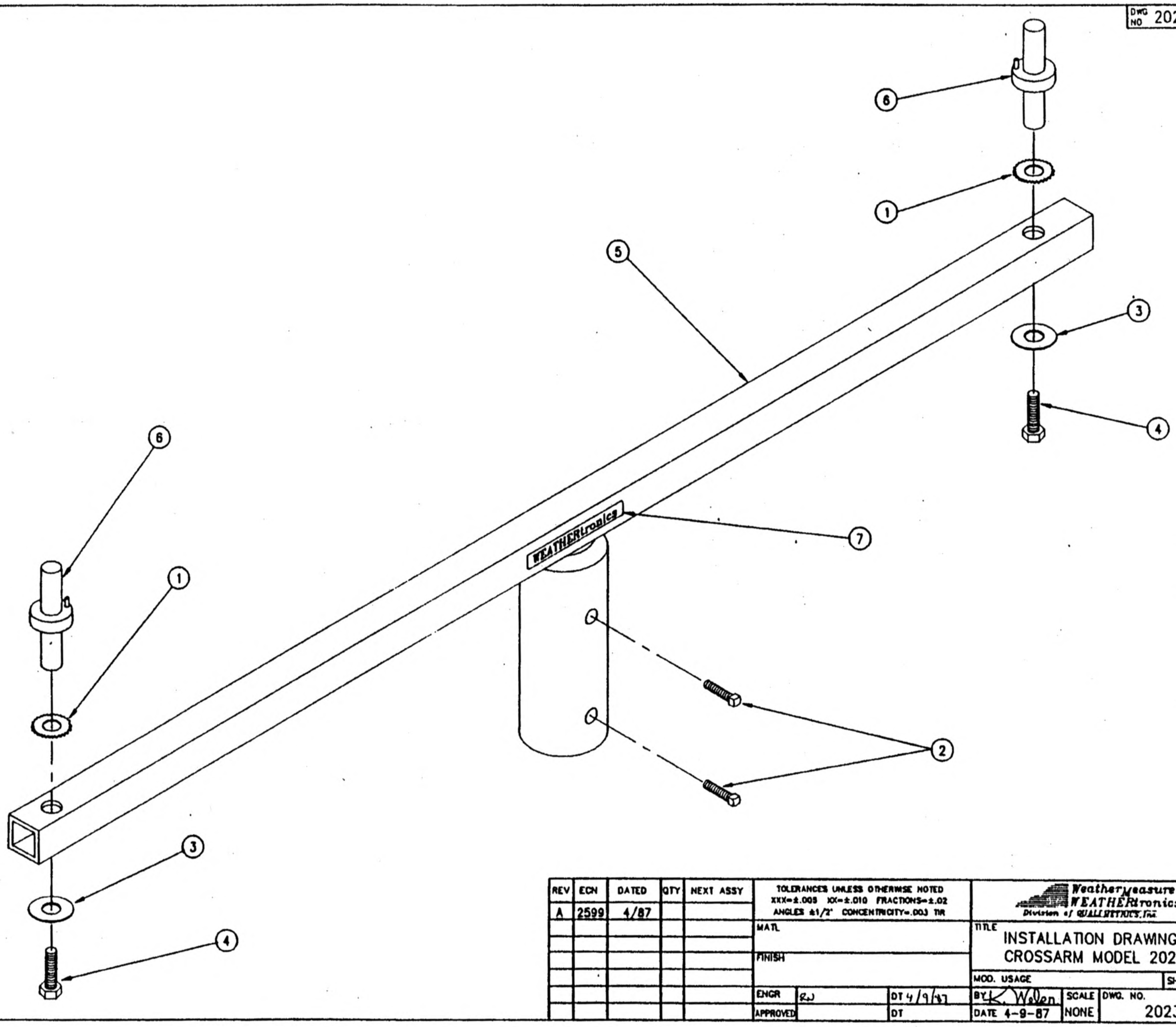
BY K. Weller

DATE 6-30-87

SCALE

DWG. NO. 2023-025

DWG NO 2023-007



REV	ECN	DATED	QTY	NEXT ASSY
A	2599	4/87		

TOLERANCES UNLESS OTHERWISE NOTED
XXX=±.005 XX=±.010 FRACTIONS=±.02
ANGLES ±1/2° CONCENTRICITY=.003 TIR

MAT'L

FINISH

ENGR RJ DT 4/9/87
APPROVED DT

WeatherMeasure
WEATHERtronics
Division of QUALIMETRICS, Inc.

C

TITLE
INSTALLATION DRAWING,
CROSSARM MODEL 2023

MOD. USAGE
SHEET 1 OF 1

BY K. Welen
DATE 4-9-87
SCALE NONE
DWG. NO. 2023-007

MANUAL
FOR
WIND DIRECTION MODULE
360°
MODEL 1240-A
1241-A

TABLE OF CONTENTS

MANUAL NO: 1240-A01
DATE: FEB 1985
ECN: 2305
FOR SERIAL NO: 292+

COLOR	DESIGNATION
Blk	System common
Brn	12 VDC bus
Red	+12 VDC bus
Org	Output 2
Yel	Input signal
Grn	Not used
Blu	Output 1
Vio	Inverted signal
Gry	U301 output
Wht	Reference voltage
Blk/Wht	Not used
Brn/Wht	Not used

TEST POINT DESIGNATIONS
Figure 1.1

WIND DIRECTION MODULE
360°
MODEL 1240-A
1241-A

1.0 INTRODUCTION

1.1 Qualimetrics has designed all system modules to be as identical as possible. Each module has a reference voltage for sensor excitation and/or scaling reference supply. An indicator is mounted on the front panel and will illuminate when the module is in either LOW or HIGH calibration. A rotary switch selects either the OPERATE, LOW calibration or HIGH calibration mode of operation. Front panel controls are available for adjusting the low and high span points for both outputs. Standard outputs are 0-5 VDC at output 1 and 0-10 mVDC at output 2.

1.2 Remote calibration can be added as an option to all modules. It is used by a data acquisition system to interrogate each module for LOW and HIGH calibration values and uses these values to adjust the conversion formula if the circuits drifts off the calibration points.

1.3 Circuit reference designations are standardized for all modules. The power supply uses 1XX designations, the final output stage uses 2XX references. Parts common to all modules use the same reference designation. For example, K301, the relay used for remote calibration, carries that designation in all modules. It operation is identical in all modules. As shown in Figure 1.1 many test points are identical for all systems, e.g. the black test point is system common on every module.

1.4 The final output stage (after the violet test point) is identical for every module, simplifying troubleshooting and calibration procedures.Any output devices sees identical circuitry as it scans each channel.

1.5 The Model 1240-A Wind Direction Module is designed to accept any potentiometric wind direction sensor by Qualimetrics. The signal is fed through two stages of amplification, before entering the output stage. A small filter capacitor on the input line removes external noise. The wind direction module provides linear signal output over the 360° range.

1.6 The standard 360° wind direction module is Model 1240-A. If the remote calibration option is desired, the Model is 1241-A.

2.0 SPECIFICATIONS

2.1	Input range	0-360°, 0-5 VDC
	Linearity	Less than 0.1%
	Standard outputs	0-5 VDC; 0-10 mVDC
	Power requirements	12V at 30 mA; +12V at 25 mA
	Size	5.25"H x 1.4"W x 7.0"D (133 x 36 x 178 mm)
	Weight/Shipping	0.4 lbs/1.5 lbs (0.2 kg/0/.7 kg)

3.0 INSTALLATION

3.1 This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 Be sure the module file power supply is off before inserting the wind direction module. Connect cables as shown in Figure 3.1. Set mode switch to LOW calibration position and turn system power on. Follow procedure in calibration section for initial scaling. Return mode switch to OPERATE position to read sensor measurements.

4.0 THEORY OF OPERATION

4.1 The following sections describe the operation of the Wind Direction Module. Use Drawing No. 1240-A04 as a reference while reading the text.

4.2 The sensor is connected to the module with a three conductor cable. The white conductor terminates sensor pin A to wind direction module pin 2, and supplies the excitation voltage to the potentiometer. R302 is used for short circuit protection. The black lead connects pin B of the sensor to pin 4 of the module and represents system common. The red lead is the potentiometer wiper output and connects pin C of the sensor to pin 6 of the module.

4.3 The signal passes through the mode switch and the remote calibration relay (Model 1241-A only) or Jumper JW301 and enters pin 3 of U301. The mode switch substitutes the zero and full scale values of the sensor in the LOW and HIGH calibration positions, respectively. Buffer amplifier, U301, provides an impedance match between sensor and electronics. This amplifier has unity gain.

4.4 The output of U301 enters the inverting input of U302. This second amplifier has a gain of approximately minus 2. This gain is selected to provide a 0 to -5.5 VDC signal to

U201 pin 2 and this voltage can be measured at the violet test point.

4.5 The input voltage at U201 pin 2 is summed with the zero adjust voltage and is applied to the inverting amplifier input. CR201 and CR202 regulate the voltage across potentiometer R202 to stabilize its value. potentiometer R202 is used to zero both outputs. U201 has a variable gain due to potentiometer R201 which is used to obtain the full scale at output 1. After signal output 1 is set, potentiometer R203 is adjusted for full scale reading of signal output 2.

4.6 Voltage regulator, U101, obtain its power from the +12 VDC bus and is referenced to common. U101 is a three lead positive regulator fixed at 5 VDC.

4.7 Relay, K301, is a printed circuit board assembly with two each DPDT relays in it. The K301A section is used to remotely switch from the sensor to the LOW calibration position. The K301B section along with the K301A section is used to switch from the LOW to HIGH calibration position.

5.0 CALIBRATION

5.1 Calibrate the wind direction sensor using the procedure specified in its manual before calibrating this module.

5.2 The Wind Direction Module has a mode switch to simplify scaling of the module. In the LOW calibration position the input to amplifier U301 is brought to the common side of the sensor. This represents zero degrees or the low scaling point. In the HIGH calibration position the input is brought to the positive reference value of the sensor representing 360°.

5.3 Monitor the Blue (+) and Black (-) test points and place the mode switch to the LO CAL position.

Adjust potentiometer R202 (SIGNAL OUT 1, LO) for 0.00 VDC.

5.5 Place the mode switch to the HI CAL position and adjust potentiometer R201 (SIGNAL 1 OUT, HI) for 5.00 VDC.

5.6 Monitor the Orange (+) and Black (-) test points and adjust R203 (SIGNAL OUT 2, HI) for 0.010 VDC.

5.7 Place the mode switch to the OPR (operate) position and verify correct sensor and module operation.

5.8 Repeat Steps 5.3 to 5.7 until no further adjustments are necessary.

5.9 Upon successful completion of the calibration procedure, turn the mode switch to OPR and place the unit into service.

6.0 MAINTENANCE

6.1 Qualimetrics has conservatively designed all modules in this system. Maintenance should be limited to periodic calibration checks and procedures as described in Section 5.0.

6.2 If a failure does occur use the Schematic Drawing No. 1240-A04, and Section 4.0 of this manual to isolate the problem. Qualimetrics Customer Service is available to help with troubleshooting.

6.3 If it is imperative that the system be operational immediately, it is recommended that a spare module be kept with the system.

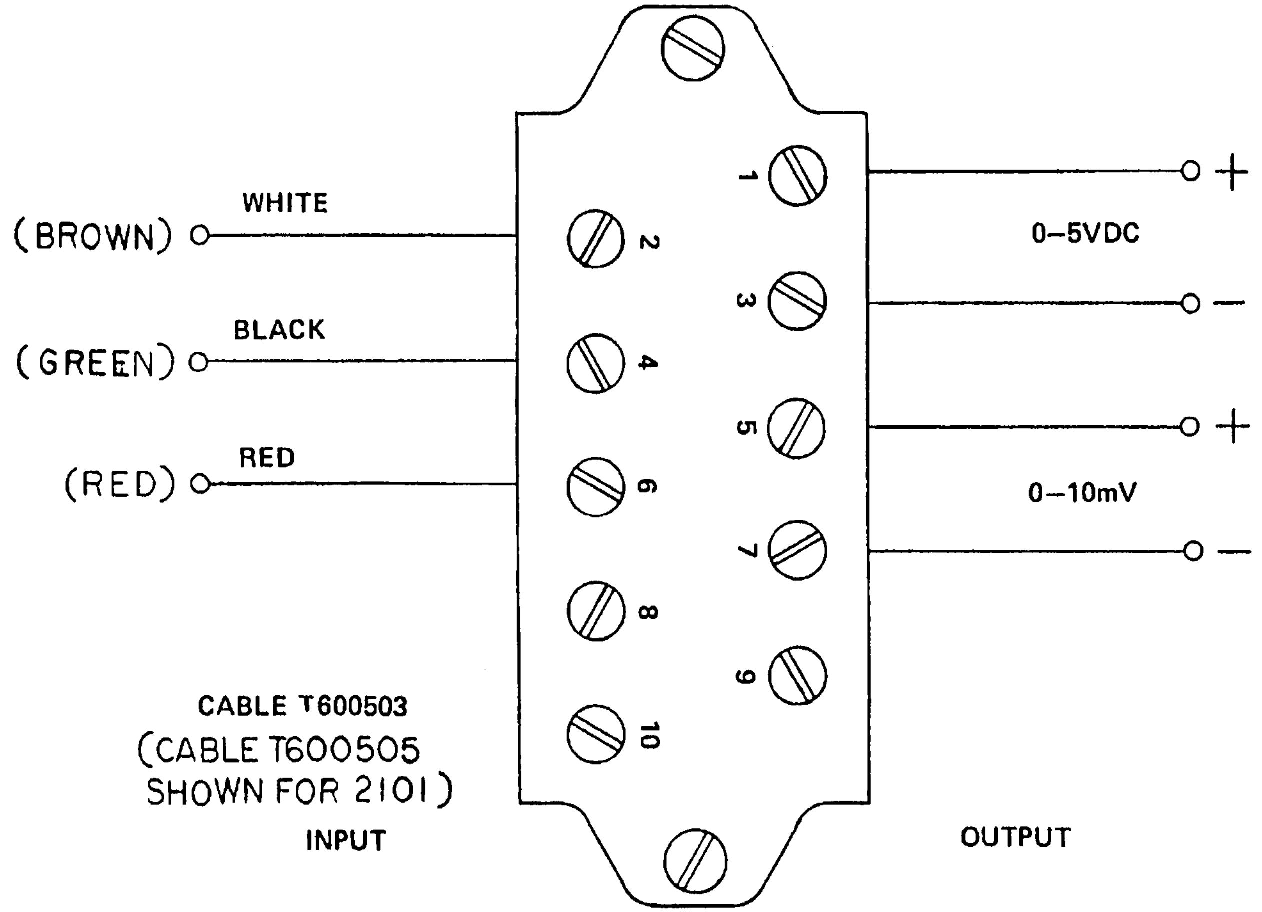
7.0 SCHEMATIC & PARTS LIST

7.1 The following pages include schematics, assembly drawings, and parts list for this instrument. Please note that the parts lists are arranged in assembly/subassembly form. Each subassembly is on its own page. Subassemblies and parts are listed in the smallest economical size available from Qualimetrics.

8.0 WARRANTY

8.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others, may cancel warranty.

DWG. NO. 1240 A25



REV	ECN	DATED	QTY	NEXT ASM
A	2305	2-85		

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ± .005 XX= ± .010 FRACTIONS = ± .02
ANGLES ± ½° CONCENTRICITY= .003 TIR

MATL

FINISH

ENGR		DT	
APPRO		DT	

QUALIMETRICS, Inc.

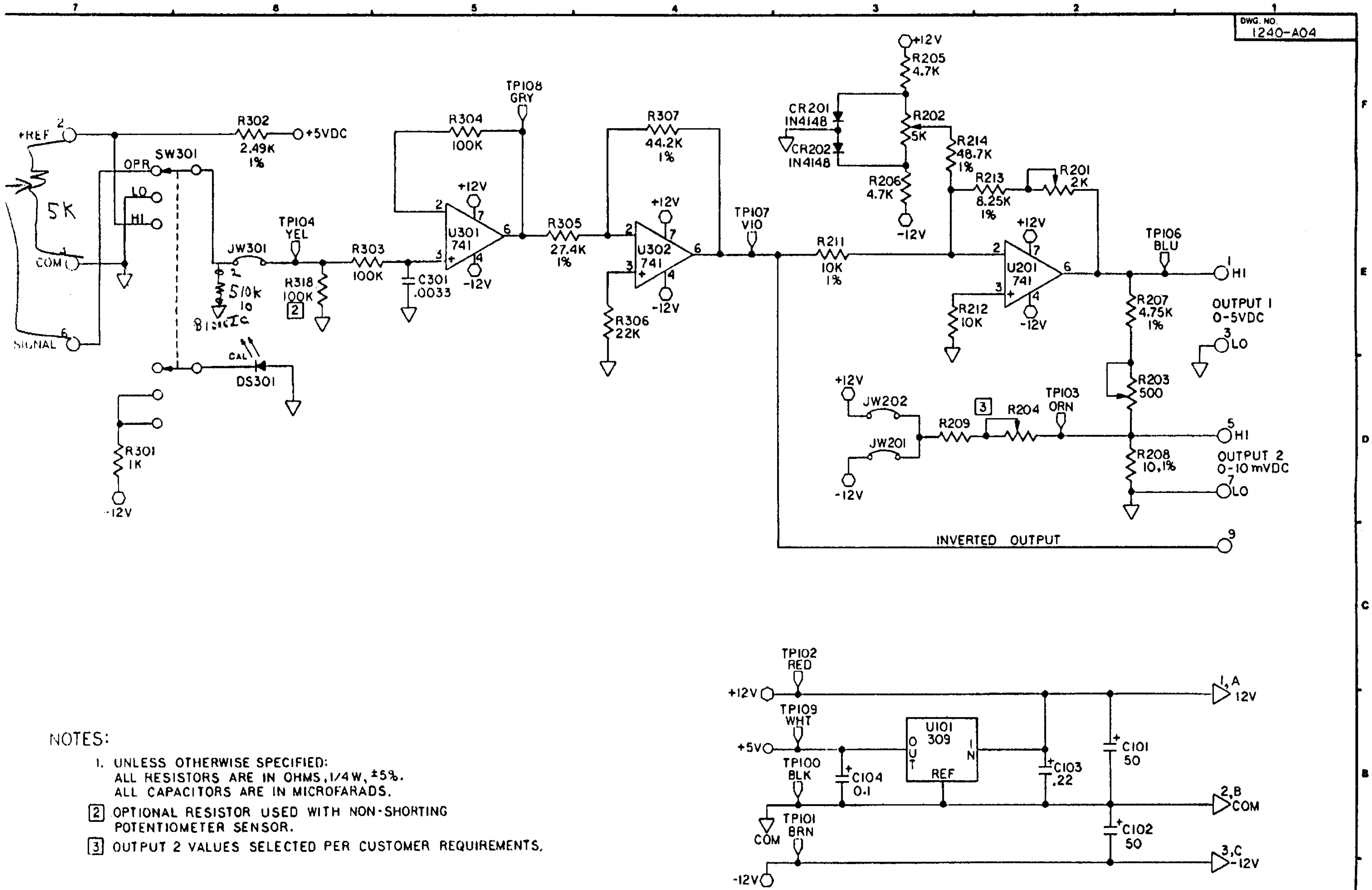
WEATHERMEASURE / WEATHERTRONICS
Instruments and Systems Division
3213 Orange Grove Avenue
Sacramento, California 95660 U S A

NOMENCLATURE SIGNAL CONDITIONING
MODULE FILE TERMINAL BLOCK

MOD. USAGE 1240-A

SHEET 1 OF 1

BY GT	SCALE	DWG NO.	
DT 3-11-83	0	1240-A25	A



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
   ALL CAPACITORS ARE IN MICROFARADS.

[2] OPTIONAL RESISTOR USED WITH NON-SHORTING POTENTIOMETER SENSOR.

[3] OUTPUT 2 VALUES SELECTED PER CUSTOMER REQUIREMENTS.

REV	ECN	DATED	QTY	NEXT ASM
A		4/80		
B	2214	9/14/84		
C	2305	2/85		
D	2409	2/18/86		

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ±.005 XX= ±.010 FRACTIONS= ±.02
ANGLES ± ½° CONCENTRICITY= .003 TIR

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Weathermeasure WEATHERtronics
Division of QUALIMETRICS, Inc

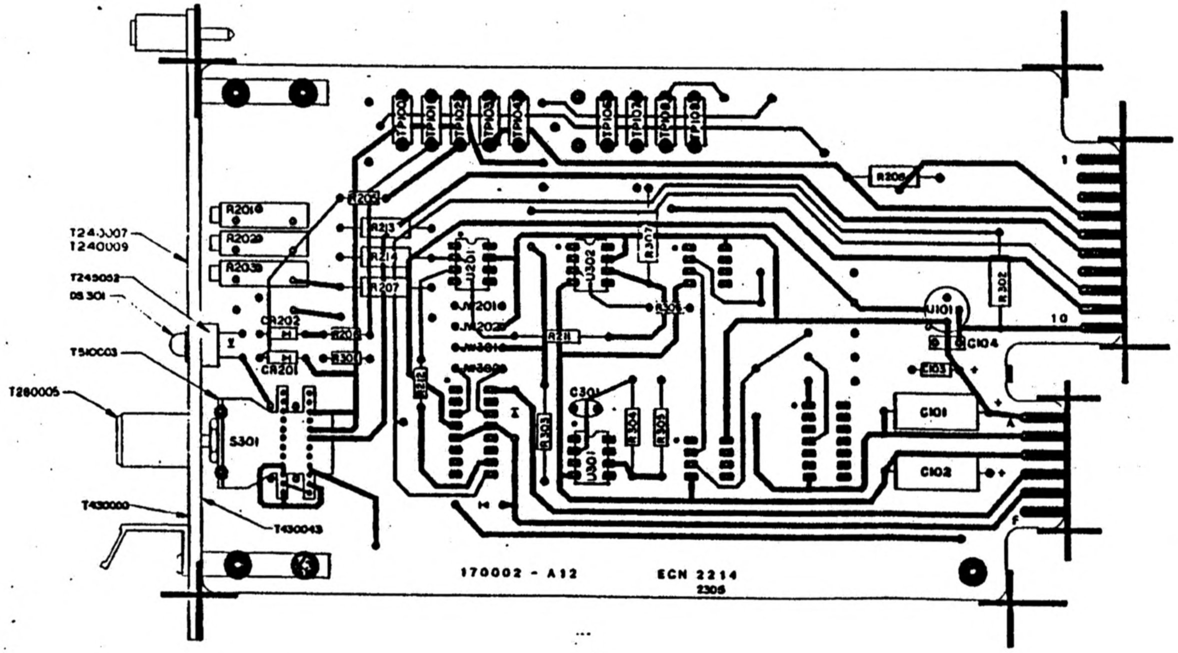
C

NOMENCLATURE SCHEMATIC
WIND DIRECTION
360 DEG MODEL 1240-A

MOD. USAGE
SHEET 1 OF 1

BY K. WEBER
DT 2/18/86
SCALE Ø
DWG.NO. 1240-A04

1240-A03



REV	ECN	DATED	QTY	NEXT ASSY
A	2214	7-4-84		
B	2302	2-85		

[illegible]

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QUALIMETRICS Inc.

NOMENCLATURE

PCB ASSEMBLY : 1240-A
WIND DIRECTION 360 DEGREES

MOD. USAGE

SHEET 1 OF 1

SCALE

DWG NO 1240-A03

D

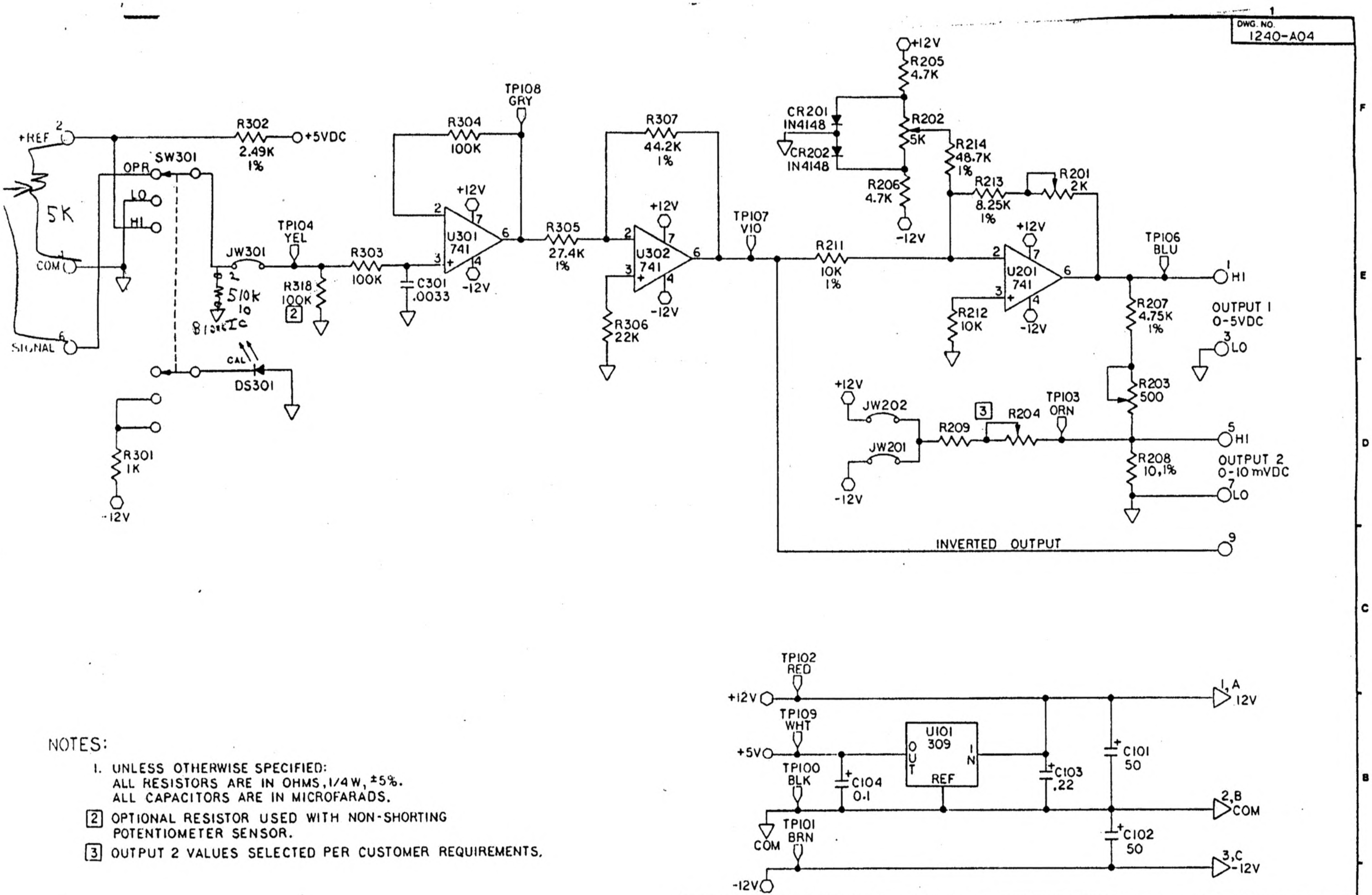
SENSOR	CABLE	JUNCTION BOX	CABLE	MODULE	CABLE	OUTPUT DEVICE
MODEL 2030	SIZE 4 cond/20AWG	MODEL	SIZE	MODEL 1220	SIZE 2 cond/18AWG	MODEL
PIN C	COLOR WHT	TERMINAL	COLOR	TERMINAL 2		
A	BLK			4		
D	RED			6		
B	GRN			8		
				1	COLOR WHT	TERMINAL
				3	BLK	
				5		
				7		

NOTES: Wind Speed - Cup Anemometer

INTERCONNECTION TABLE

MODULE MODEL 1220 ______ MODULE FILE ______ POSITION ______

Figure 3.1



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4 W, ±5%.
   ALL CAPACITORS ARE IN MICROFARADS.

[2] OPTIONAL RESISTOR USED WITH NON-SHORTING POTENTIOMETER SENSOR.

[3] OUTPUT 2 VALUES SELECTED PER CUSTOMER REQUIREMENTS.

REV	ECN	DATED	QTY	NEXT ASM
A		4/80		
B	2214	9/14/84		
C	2305	2/85		
D	2409	2/18/86		

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ±.006 XX= ±.010 FRACTIONS = ±.02
ANGLES ± ½° CONCENTRICITY=.003 TIR

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C

NOMENCLATURE SCHEMATIC
WIND DIRECTION
360 DEG MODEL 1240-A

MOD. USAGE

SHEET 1 OF 1

BY K. WEBER

SCALE

DWG.NO.

MANUAL FOR
WIND SPEED MODULE
PULSE INPUT

MODELS 1220
1222

TABLE OF CONTENTS

MANUAL NO. 1220-001
ECN: 2798
DATE: MARCH, 1988

WIND SPEED MODULE
PULSE INPUT
MODELS 1220
1222

1.0 INTRODUCTION

1.1 Model 1220 Wind Speed Module is designed to accept any wind speed sensor that generates a pulse or sinusoidal wave form. The wind speed module provides a linear DC signal output proportional to wind speed over the 100 mph range.

1.2 The Standard Wind Speed Module with pulse input is Model 1220. Model 1222 is a dual range module for wind speed with a front panel switch to select either the HI range or the LO range.

1.3 Qualimetrics, Inc. has designed all system modules to be as identical as possible. Each module has a reference voltage for sensor excitation and/or scaling reference supply. An LED indicator is mounted on the front panel and it will illuminate when the module is in either LOW or HIGH calibration. A rotary switch selects either the OPERATE, LOW calibration, or HIGH calibration mode of operation. Front panel controls are available for adjusting the low and high span points for both outputs. Standard outputs are 0-5 VDC at output 1 and 0-10 mVDC at output 2.

1.4 Circuit component reference designations are standardized for all modules. The power supply uses 1XX designations, the final output stage uses 2XX, and the remainder of the circuitry uses 3XX reference. Parts common to all modules use the same reference designation. As shown in Figure 1.1, many test points are identical for all systems, e.g., the black test point is system common on every module.

1.5 The final output stage (after the violet test point) is identical for every module, to simplify troubleshooting and calibration procedures. Any output device sees identical circuitry as it scans each channel.

COLOR	DESIGNATION
Blk	System common
Brn	-12 VDC bus
Red	+12 VDC Bus
Org	Output 2
Yel	Input signal
Grn	Oscillator output
Blu	Output 1
Vio	Inverted signal
Gry	Schmidt trigger input
Wht	Reference Voltage
Blk/Wht	One shot output
Brn/Wht	Schmidt trigger output

TEST POINT DESIGNATIONS

FIGURE 1.1

2.0 SPECIFICATIONS

2.1

Input range	0-100 mph
Frequency response	0-1100 Hz
Linearity	Less than 0.1%
Standard outputs	0-5 VDC; 0-10 mVDC
Power requirements	+12 V at 25 mA; -12 V at 20 mA
Size	5.25" H x 1.4" W x 7.0" D (133 x 36 x 178 mm)
Weight/Shipping	0.4 lbs./1.5 lbs. (0.2 kg./0.7 kg.)

3.0 INSTALLATION

3.1 This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 Be sure that the module file power supply is off before inserting the wind speed module. Connect cables as shown in Figure 3.1. Set the mode switch to LOW calibration position and turn system power on. Follow procedures in calibration section for initial scaling. Place the mode switch into the OPERATE position to read sensor measurements.

4.0 CIRCUIT DESCRIPTION

4.1 Refer to Drawing No. 1220-004 while reading the following text.

4.2 The Model 1220 Wind Speed Module can accept two types of input, a square wave or sinusoidal wave form.

4.3 As an example, the Model 2030 Micro Response Anemometer generates a pulsed square wave output signal. Model 1220 pins 4 and 6 provide an excitation voltage to the light emitting diode (LED) in the sensor. Pin 2 is a reference supply for the light sensitive transistor while pin 8 is the pulsed signal returning from the sensor.

4.4 If a sinusoidal input device is used the signal will enter on pin 8 and be referenced to system common, pin 4.

4.5 The input signal at pin 8 enters the switching network, S301, and jumper JW301, and then the signal enters the non-inverting input of IC301. This operational amplifier performs several important tasks. First, through resistor R308 it references the output level to a slightly ~~negative~~ value (+2.5 VDC). Since the positive supply is 5 VDC and the gain of the amplifier is approximately 4.5, the output signal is clipped at approximately ~~3.5~~ 5V VDC.

Positive —

?

4.6 The output of IC301 goes through current limiting resistor, R310, and the low state is held at approximately system common level by the input circuitry of IC302. R311 is a pull-up resistor for unused inputs of IC302, a Schmidt trigger. The Schmidt trigger defines the on and off times more precisely for triggering the one-shot, IC303.

diode clamp

1014 HZ=100mph
→ 986 µS

4.7 Capacitor C302, diode CR303 and resistors R312 and R313 make up a differentiator circuit to trigger the one-shot on the falling edge. R312 and R313 set the low state level while CR303 sets the high state level.

4.8 IC303 is a timer used as a one-shot with resistor R315 and capacitor C304 as its timing elements. The time constant for the circuit is found from the formula

$$\begin{aligned} T &= 1.1\ RC \\ &= 1.1\ (75\ K)\ (.01\ \mu) \\ &= \underline{825}\ \mu\ S \end{aligned}$$

An 825 micro second pulse width signal is generated by IC303 with voltage amplitude of 5.0 VDC. Resistor R314 loads the circuit enough to insure a stable amplitude over the entire frequency range.

4.9 IC304 integrates the area under each pulse entering its input and provides a proportional DC output level. Resistors R318 and R319 are used as a gain doubling circuit for wind speed range select.

4.10 IC304 signal output is inverted by IC305. The gain of this circuit is set so that the value at the violet test point varies approximately 0 to -5.5 VDC.

4.11 The input to IC201 is derived from IC305 pin 6 and can be measured at the violet test point. This voltage is summed with the zero adjust voltage and enters IC201 pin 2, the inverting input. CR201 and CR202 regulate the voltage across potentiometer VR202 to stabilize its value. Potentiometer VR202 is used to zero both outputs. IC201 has a variable gain due to potentiometer VR201 which is used to obtain the full scale value at output 1. After output 1 is set, potentiometer VR203 is adjusted for full scale reading of output 2.

4.12 Voltage regulator, IC101, obtains its power from the +12 VDC bus referenced to common. IC 101 is a three lead positive voltage regulator fixed at 5 VDC.

4.13 To calibrate the circuit, a free running oscillator is designed for the HI calibration position of the mode switch. Capacitor C301 and resistors R304 and R305 determine this frequency which is approximately 470 Hz.

5.0 CALIBRATION

5.1 Refer to the calibration curve of the wind speed sensor before calibrating the module. Calibration of the sensor should always precede calibration of the module. The calibration sheet specifies that 1800 rpm is proportional to a particular wind speed and is equal to a specific frequency. Full scale range of the Model 2030 sensor is 100 mph. Therefore, from the following formula we can determine the scaling value of the HI calibration oscillator.

$$V \text{ mph} = \frac{F \text{ Hz}}{10.19} + 0.52$$

where F Hz is the specified frequency out of the oscillator. See Figure 5.1 for a sample calculation.

5.2 To calibrate the module, monitor the Blk/Wht (+) and the Black (-) test points with a frequency counter or with an oscilloscope. Place the mode switch to the HI CAL position and measure the frequency. Substitute the measured value into the formula of Step 5.1.

5.3 Monitor with a volt meter the Blue (+) and Black (-) test points. Place the optional HI/LO Range switch to the HI position. Place the mode switch to the LO CAL position. Adjust potentiometer VR202 (Signal Out 1, LO) for 0.000 VDC.

5.4 Place the mode switch to the HI CAL position. Adjust potentiometer VR201 (Signal Out 1, HI) for the appropriate voltage corresponding to the value from Step 5.2. Use the formula

$$V \text{ out} = \frac{5.0 \text{ VDC}}{\text{Range}} \times V \text{ mph}$$

where 5.0 VDC equals the full scale voltage output at the Blue test point, and Range equals the full scale range of the sensor.

$$V_{mph} = \frac{F_{in}}{10.19} + 0.52$$

$$= \frac{470\ Hz}{10.19} + 0.52$$

$$= 46.12 + 0.52$$

$$= 46.64\ mph$$

Where F_{in} is the input frequency in Hertz

10.19 is the Cup Anemometer constant

0.52 is the threshold constant

and V_{mph} is the velocity in miles per hour

SAMPLE CALCULATION
INPUT FREQUENCY vs. WIND SPEED
Figure 5.1

5.5 Monitor the Orange (+) and Black (-) test points. Adjust potentiometer VR203 (Signal Out 2, Hi) for a value equal to 0.002 times the value of Step 5.4.

5.6 Set the optional HI/LO Range switch to LO and verify correct circuit operation.

5.7 Monitor the Blue (+) and Black (-) test points, and set the mode switch to the OPR (operate) position.

5.8 Connect the wind speed sensor to the module and drive the sensor shaft with a synchronous motor at one of the rpm levels listed on the sensor data sheet.

5.9 Verify that the module output corresponds to the velocity indicated by Step 5.8.

5.10 Repeat Sections 5.2 through 5.9 until the calculated values are obtained at the Blue and Orange test points.

5.11 Should the module fail to calibrate and operate as described above notify Qualimetrics, Inc. for immediate assistance.

5.12 Upon successful completion of the calibration procedure, turn the mode switch to the OPR position and place the unit into service.

6.0 MAINTENANCE

6.1 Qualimetrics, Inc. has conservatively designed all modules in this system. Maintenance should be limited to periodic calibration checks and procedures as described in Section 5.0.

6.2 If a failure does occur use the schematic, Drawing 1220-004 and Section 4.0 of this manual to isolate the problem. Qualimetrics, Inc. Customer Service

6.3 If it is imperative that the system be operational immediately it is recommended that a spare module be kept with the system.

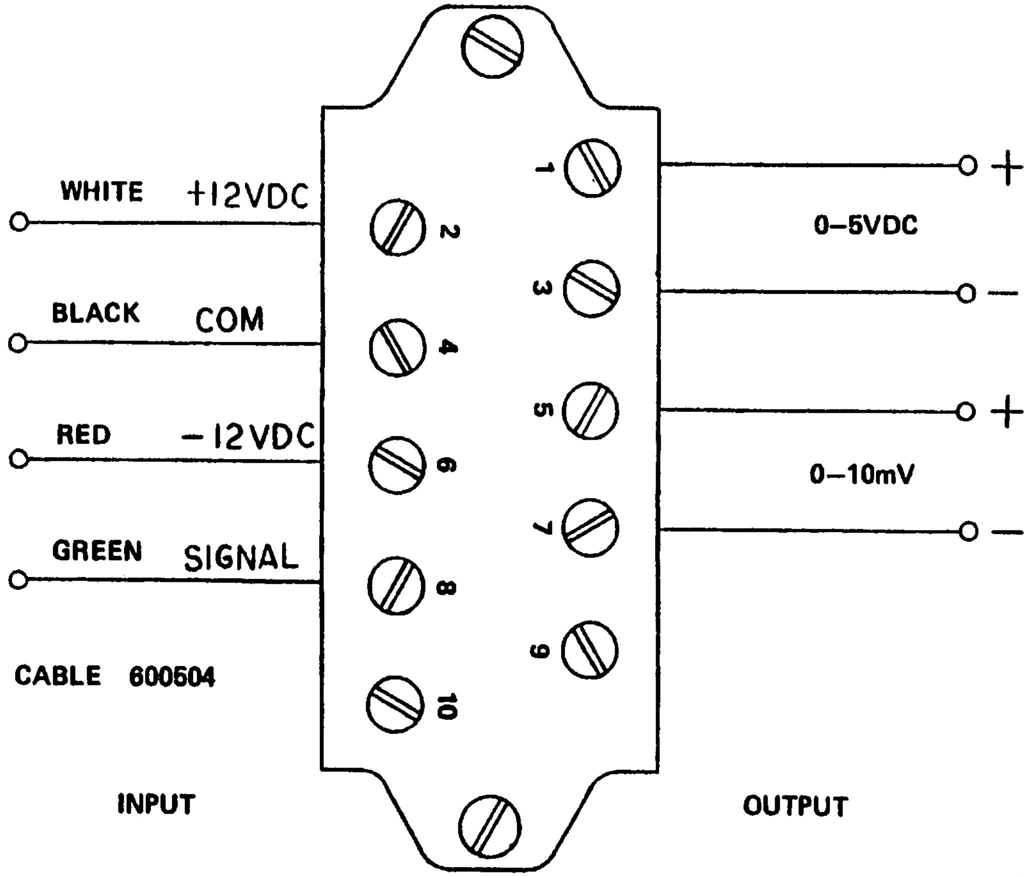
7.0 SCHEMATIC AND PARTS LIST

7.1 The following pages include schematics, assembly drawings, and parts lists for this instrument. Please note that the parts lists are arranged in assembly/subassembly form. Each subassembly is on its own page. Subassemblies and parts are listed in the smallest economical size available from Qualimetrics, Inc.

8.0 WARRANTY

8.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics, Inc. will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others may cancel warranty.

DWG. NO. 1220-025



REV	ECN	DATED	QTY	NEXT ASM
A	—	3/83		
B	2826	6/88		RN 6/88

TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ± .005 XX= ± .010 FRACTIONS = ± .02
ANGLES ± ½° CONCENTRICITY= .003 TIR

MATL

FINISH

ENGR RN DT 3/11/83
APPRO DT

QUALIMETRICS, Inc.

WEATHERMEASURE / WEATHERTRONICS
Instruments and Systems Division
3213 Orange Grove Avenue
Sacramento California 95660 U S A

NOMENCLATURE SIGNAL CONDITIONING MODULE FILE TERMINAL BLOCK

MOD. USAGE 1220 MODULE

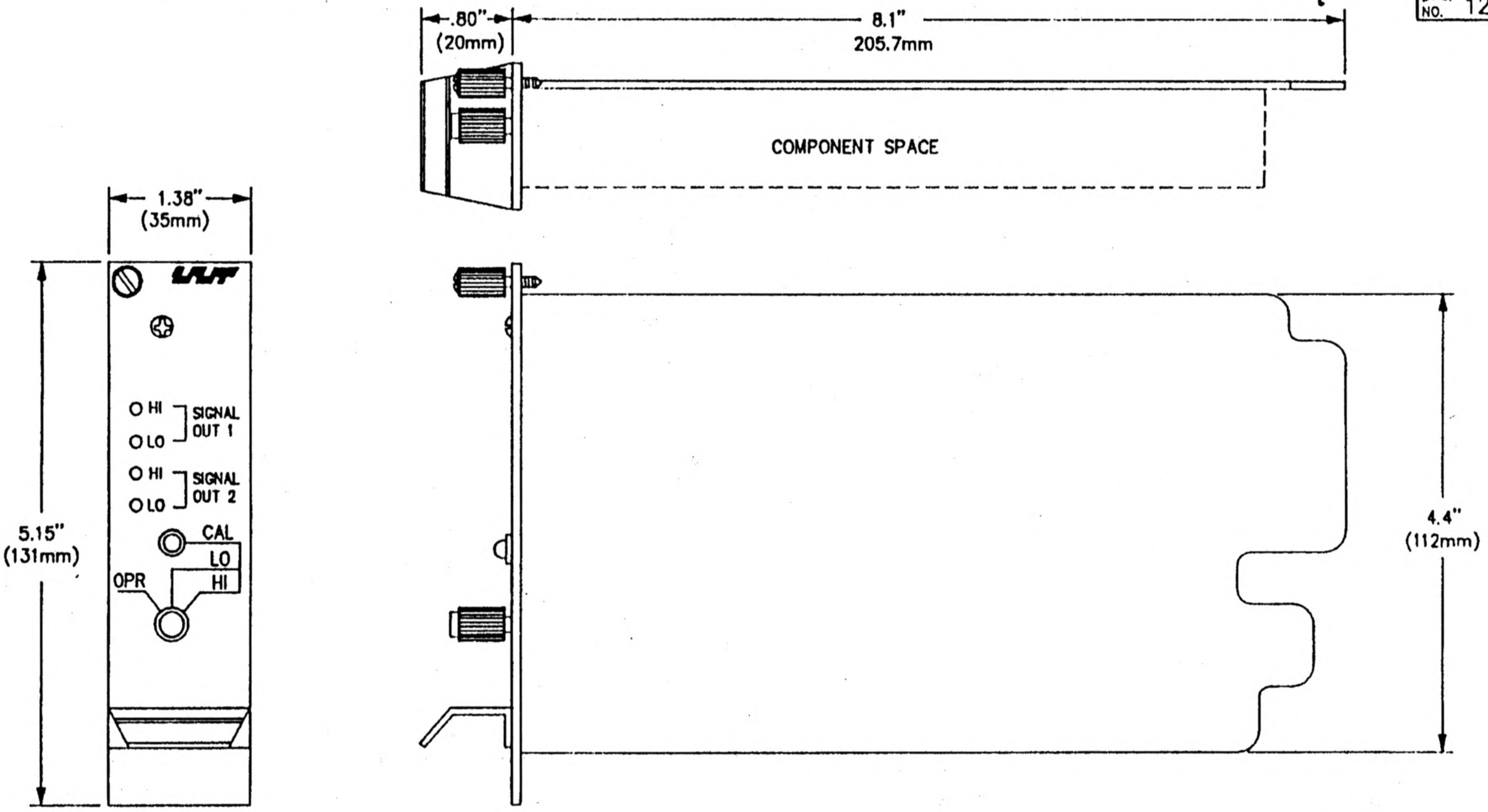
SHEET 1 OF 1

BY GT
DT 3 11 83

SCALE 0

DWG NO. 1220-025 A

DWG. NO. 1200-005



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TOLERANCES UNLESS OTHERWISE NOTED
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ANGLES ±1/2° CONCENTRICITY=.003 TIR

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ENGR	RW	DT	5/25/88
APPROVED		DT	

WeatherMeasure
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Division of QUALIMETRICS, Inc.

B

TITLE OUTLINE DRAWING,
SIGNAL CONDITIONING MODULE
MODELS 1200 THROUGH 1700

MOD. USAGE 1200 – 1700

SHEET 1 OF 1

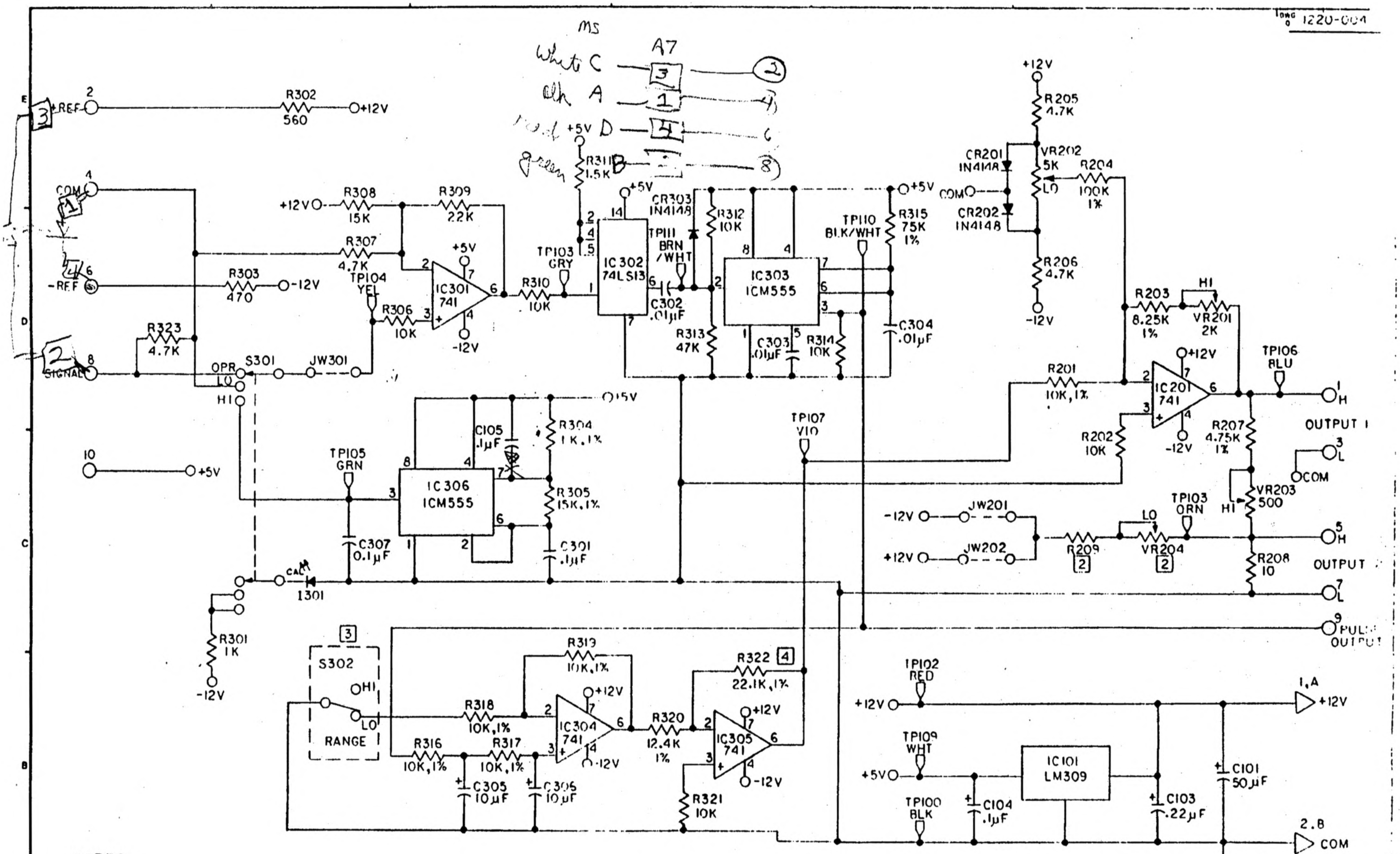
BY K. Weler

DATE 5-24-88

SCALE 1/1

DWG NO 1200-005

DWG NO 1220-004



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, 1/4 W, ±5%.
2. OUTPUT 2 VALUES SELECTED PER CUSTOMER REQUIREMENTS.
3. ADD S302 AND R318 FOR DUAL RANGE OPTION.
4. R322 MAY VARY SLIGHTLY DUE TO REFERENCE VOLTAGE.

	REV	ECN	DATED	QTY	NEXT ASM
	U		6-80		
REDRAWN	E	2409	11/6/85		

TOLERANCES UNLESS OTHERWISE NOTED: XXX= ±.005 XX= ±.010 FRACTIONS= ±.02 ANGLES ± ½° CONCENTRICITY=.003 TIR

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ENGR DT

APPRO DT 4-85

QUALIMETRICS, Inc.

NOMENCLATURE SCHEMATIC
WIND SPEED, PULSE INPUT MODULE

MOD USAGE

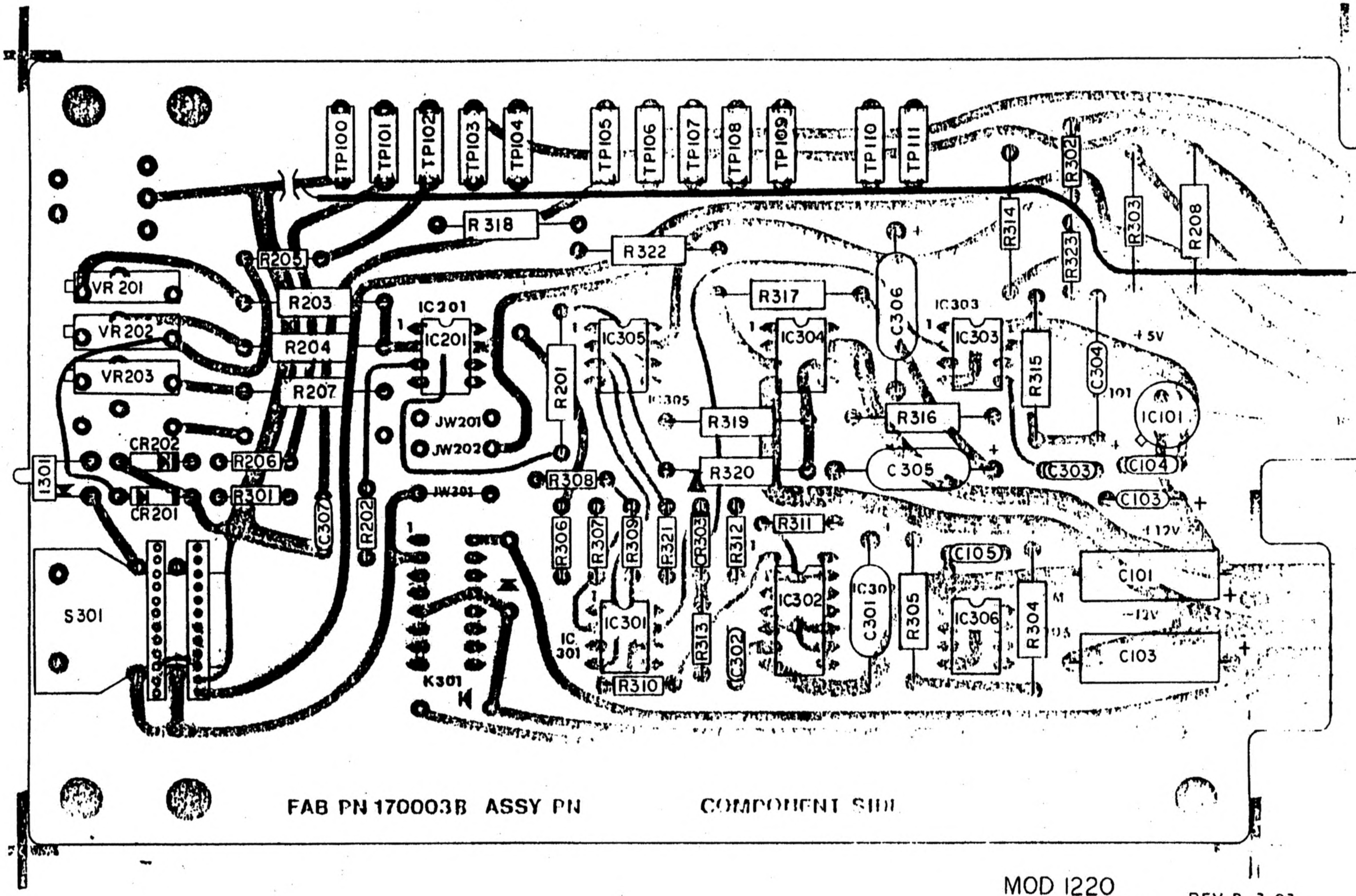
SHEET 1 OF 1

BY K. WEBER

DT 11/6/85

SCALE

DWG NO 1220-004 C



MOD 1220
WIND SPEED
1220-03-C

REV B 3-83

MANUAL
FOR
MICRO RESPONSE VANE
MODEL 2020

TABLE OF CONTENTS

MANUAL NO: 2020-001
DATE: AUGUST 1988
ECN: 2826

MICRO RESPONSE VANE
MODEL 2020

1.0 INTRODUCTION

1.1 The Model 2020 Micro Response Vane is a highly responsive analog output wind vane. The vane is equipped with a structural plastic tail with a durable aluminum filled plastic coating. The vane body is a precision machined aluminum housing with a clear anodized finish. Stainless steel shafts, bearings and fittings are used throughout. A precision potentiometer is coupled to the vane shaft to provide an analog output proportional to wind direction. An airfoil style counter-weight provides precision balance of the tail assembly upon the shaft. A quick release waterproof connector is provided for cable terminations.

1.2 The base of the sensor has a mounting collar which fits onto the Model 20231 Mast Adapter or the Model 2023 Crossarm. The 20231 Mast Adapter is for mounting a single sensor onto a pipe stub or mast with a 1.0 inch outside diameter. The 2023 crossarm provides mounting for a 2020 with an anemometer such as Model 2030 at the same elevation on a pipe stub or a mast with a 1.0 inch outside diameter.

2.0 SPECIFICATIONS

2.1

Sensor type	Rotating vane
Transducer	Potentiometer, 5000 ohm, make-before-break single wiper, continuous turning
Threshold	0.5 mph
Dead band	1.0° at 0°
Resolution	Less than 1.0°
Distance constant	3.5' (1.07 m)
Damping ratio	0.4
Potentiometer linearity	0.5%
Bearing	Sealed stainless steel with synthetic lubricant
Turning radius	18" (457 mm)
Operating temperature range	-15 to 55°C
Body size	12"H x 2-3/4" dia (305 mm H x 70 mm dia)
Weight/Shipping	2.5 lbs/7.0 lbs (1.13 kg/3.18 kg)
Mounting	Direct to crossarm or with adapter to 1" (25.4 mm) O.D. mast

3.0 INSTALLATION

3.1 This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 The Model 2020 Micro Response Vane is shipped complete with a tail assembly, counter-weight and mating electrical connector. The mating connector will be attached to the cable if cable was included with the order. The vane will mount directly onto the Model 2023 Crossarm Assembly. An accessory Model 20231 Mast Adapter may be ordered to allow the vane to be mounted onto a 1" O.D. mast.

3.3 Assembly: With exception of installing the tail and counter-weight, the Model 2020 Micro Response Vane is completely assembled and ready for mounting. The tail and counter-weight are installed as described in Steps 3.4 to 3.7.

3.4 The counter-weight is generally shipped unattached and is located inside the packing carton of the 2020 housing. The vane tail is packed inside a folded cardboard container taped onto the side of the 2020 carton.

3.5 Slide the vane tail shaft into the vane hub, entering the hub at the side opposite the scribe mark. Do not tighten the set screw on the hub at this time.

3.6 Install the counter-weight, making certain the vane tail shaft is fully engaged. Tighten the counter-weight set screw.

3.7 Hold the vane in a horizontal position and slide the tail shaft through the hub until the counter-weight exactly balances the tail weight and the vane does not turn when placed in any horizontal position. When balance is achieved tighten the hub set screw making certain the tail is aligned with the axis of the vane. This procedure must be performed in an area free of drafts and air currents.

3.8 Definition: Wind direction is defined as the direction of the source of the wind flow and measured in degrees from true North in a clockwise increasing angle. Example: A West wind or a 270° wind originates or comes from the West and is moving in an Eastward direction.

3.9 Site Selection: Location of the sensor is critical for accurate wind measurements. The standard exposure of an anemometer or vane over open, level terrain is 10 meters above the ground. Open, level terrain is defined as level ground with no obstruction within 300m. In locations where obstructions are not large and are distributed more or less evenly (i.e., residential), the sensor can be placed at an effective height of h + 10 meters, where h is the approximate height (in meters) of the various obstacles. As a common example, in a location where trees and buildings reach to about 5 meters high, the sensors must be placed on a 15 meter mast to avoid erroneous results.

3.10 In areas where large obstructions do exist within 300 meters of the sensor, the following table can be used to calculate the proper height of the sensor (h is the height of the obstruction).

Distance of obstruction	Minimum height above ground level of anemometers
h	1.75h to 2.25h
5h	1.67h
10h	1.50h
20h	1.25h
25h	1.13h
30h	h

TABLE 3.1

Thus if there is a building 10 meters high and 50 meters away, the anemometer should be at least 16.7 meters above the ground; but if the same building is 200 meters away the sensor could be lowered to 12.5 meters.

3.11 When the sensor is mounted on a building, the building itself disturbs the wind flow and must be taken into account before installation. For large buildings (i.e., excluding such things as lighthouses, and skyscrapers), the sensor must be mounted as far away from the building edge as possible and at a height at least 3/4 the height of the building. Thus with a large building 28 meters high, a roof top tower at least 21 meters should be used for mounting.

3.12 Mounting: Model 2020 Micro Response Vane mounts directly onto the Model 2023 Crossarm without any additional accessories. The crossarm is generally used to mount one each Model 2020 Vane and one each Model 2030 Micro Response Anemometer. If the Model 2020 Vane is to be mounted separately, a Model 20231 Mast Adapter should be ordered as an accessory. This mast adapter will accept a mast with an outside diameter of 25 mm (1") or 3/4" schedule 40 pipe.

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[1] Handbook of Meteorological Instruments, 2nd Edition. Measurement of Surface Wind, Volume. London, HMSO: 1881

3.13 Orientation: The Model 2020 Micro Response Vane must be correctly oriented as to direction. The axis of the vane should be as close to vertical as possible. The vane may be correctly oriented as to direction (azimuth) as described in Sections 3.14 to 3.18.

3.14 The crossarm and/or mast should be locked into the operating position. To aid in sensor orientation, crossarm can be positioned in a North-South direction using the two mounting pins as targets.

3.15 The vane should be positioned onto the mast adapter with the dowel pin aligned with the mating hole in the vane housing. Once alignment is properly attained the housing will set onto the adapter. The crossarm has an identical dowell pin arrangement.

3.16 Tighten the clamp screw at the base of the vane. Align the scribe mark on the body with the scribe mark on the hub by rotating the hub and tail assembly. Hold the two marks in alignment. An easy way to accomplish this task is to use Model 1249-A Wind Direction Calibrator.

3.17 Loosen the clamp cap screw at the end of the crossarm to allow the vane and pin to turn as a unit. On the mast adapter, loosen the mast set screws.

3.18 Using a reference point, and a transit or compass, rotate the vane body until the vane counter-weight points to true North. Tighten the cap screw on the crossarm clamp or the set screws on the mast adapter. Remove the calibrator from the vane hub and body to allow free rotation of the tail. This completes the orientation.

3.19 When removing the vane assembly do not disturb the position of the pin on the crossarm or in the case of the mast adapter, the position of the adapter. The orientation will be maintained and the vanes may be replaced or reinstalled without repeating the orientation.

3.20 Install a three wire No. 20 AWG cable in the mating connector using care in the soldering and cable dress. Replace the connector back shell forming a waterproof assembly. The connector is a quick release type and only requires a quarter turn of the nut to lock in place. Do not tighten with a wrench. Connections are as shown in Drawing 2020-004. If cable is ordered with the sensor, the connector will be attached at the factory. To order cable specify Part Number T600503.

4.0 THEORY OF OPERATION

4.1 Changes in the wind direction are sensed mechanically by a balanced vane assembly. The mechanical motion is transformed into an electrical signal through a shaft which couples the vane to a potentiometer.

4.2 The potentiometer used in Model 2020 has a long electrical angle and is a make-before-break 5000 ohm resistive element. The actual element is a wire wound device to help increase the life of the sensor.

4.3 Protective zener diodes are attached across the excitation lead and the wiper lead to the common lead. The diodes help quench transients induced by external sources.

4.4 The potentiometer is excited by a +5 VDC regulated source. A 2500 ohm resistor is placed in series with the +5 VDC source to protect the source when the make-before-break contact occurs and to protect the potentiometer element against a dead short in the +5 VDC power source. The voltage generated at the potentiometer wiper varies from 0 to 3.333 VDC as a direct function of the wind direction variations.

not in our module

4.5 The make-before-break feature of the potentiometer is used in conjunction with electronic circuitry to create a 0-540 degree system. An additional 180 degrees is added electrically by the circuit to prevent painting of strip chart recorders.

5.0 CALIBRATION

5.1 Refer to the appropriate signal conditioning manual for system calibration instructions.

5.2 Check the Model 2020 sensor for correct operation prior to making any adjustments to the system electronics.

5.3 To check the operation, use a voltmeter or multimeter and measure across the potentiometer. USE CAUTION. Set to measure 1 k ohms minimum. Observe polarity of the test leads. The zener diodes will give faulty readings if the test lead polarities are reversed. Using the sensor cable supplied by Qualimetrics, place the (+) test probe onto the red wire and the (-) test probe onto the black wire. The indication will be an increasing voltage or resistance for a clockwise motion of the vane as viewed from directly above the shaft cap.

5.4 Measuring across the white (+) wire and black (-) wire will give the total resistance of the potentiometer. The value should be 5000 ohms plus or minus 5%. A more accurate measurement is obtained across the red (+) and black (-) wires while rotating the vane slowly to its maximum position just before the make-before-break point. Several readings should be made using this second method, with an average value made from the readings.

5.5 Alignment of the potentiometer with the North alignment marks on the sensor housing is accomplished by monitoring the sensor as describe in Step 5.4 and rotating the potentiometer body.

5.6 To rotate the potentiometer body loosen the 2 clamping screws on the potentiometer mounting plate.

5.7 While holding the North alignment marks stationary and in line with each other, rotate the potentiometer body until the signal output reads either 5k ohms or zero ohms (3.333 VDC or zero VDC).

5.8 Tighten the clamping screws and remeasure the output to check for changes during tightening of the screws. Repeat Step 5.7 if necessary.

5.9 Verify sensor operation prior to reinstalling the sensor. Always verify sensor operation after each realignment and especially after any service requiring disassembly of the housing.

6.0 MAINTENANCE

6.1 Periodic maintenance must be performed on the sensor to prevent severe corrosion build-up and to check the bearings and sensor operation.

6.2 The vane shaft coupled to the potentiometer should turn freely at all times. Rough motion indicates worn bearings either in the potentiometer or in the sensor body. Determine which bearings are faulty by decoupling the potentiometer from the main shaft.

6.3 Replace bearings as required. The potentiometer is not serviceable and must be replaced if bearings are faulty or if the resistive element is worn.

6.4 Disassembly of the sensor housing is relatively simple. Refer to assembly drawing 2020-003 for parts identification.

6.5 The potentiometer must be unsoldered from the housing connector before it can be removed from the housing. The potentiometer is accessed by removing 3 screws from the base of the housing and removing the base from the housing.

6.6 Two screws with flat washers secure the potentiometer into place inside the housing. Remove the mounting screws and gently lower the potentiometer and shaft.

The main sensor shaft is held in place by the potentiometer. The two parts are fastened together at the shafts by a spring pin.

6.8 The sensor cap is secured to the flat of the shaft by an allen-head set screw.

6.9 Since corrosion is the main problem associated with wind sensors, apply a thick coating of silicon lubricant to the connector shell after the connector is attached and in place. Also use a non-corrosive lubricant such as bee wax on all screws and fasteners whenever disassembly of the sensor is required. The use of these lubricants will make servicing of the sensor easier and will prevent seizure of the fastening hardware. It is also advisable to apply lubricant to the mounting adapter surfaces prior to final sensor installation. A commercial grade lubricant recommended for use is DOOR-EASE and is available at hardware and automotive stores.

6.10 Use great care in disassembly and reassembly of the sensor. Never use excessive force to make parts fit together. Over tightening of fasteners will either break the fastener or damage the machined threads of the sensor. Refer to Step 5.5 after reassembly of the sensor is complete.

6.11 Any difficulties encountered during servicing that are not correctable by the user should be referred to the Qualimetrics Customer Service Department.

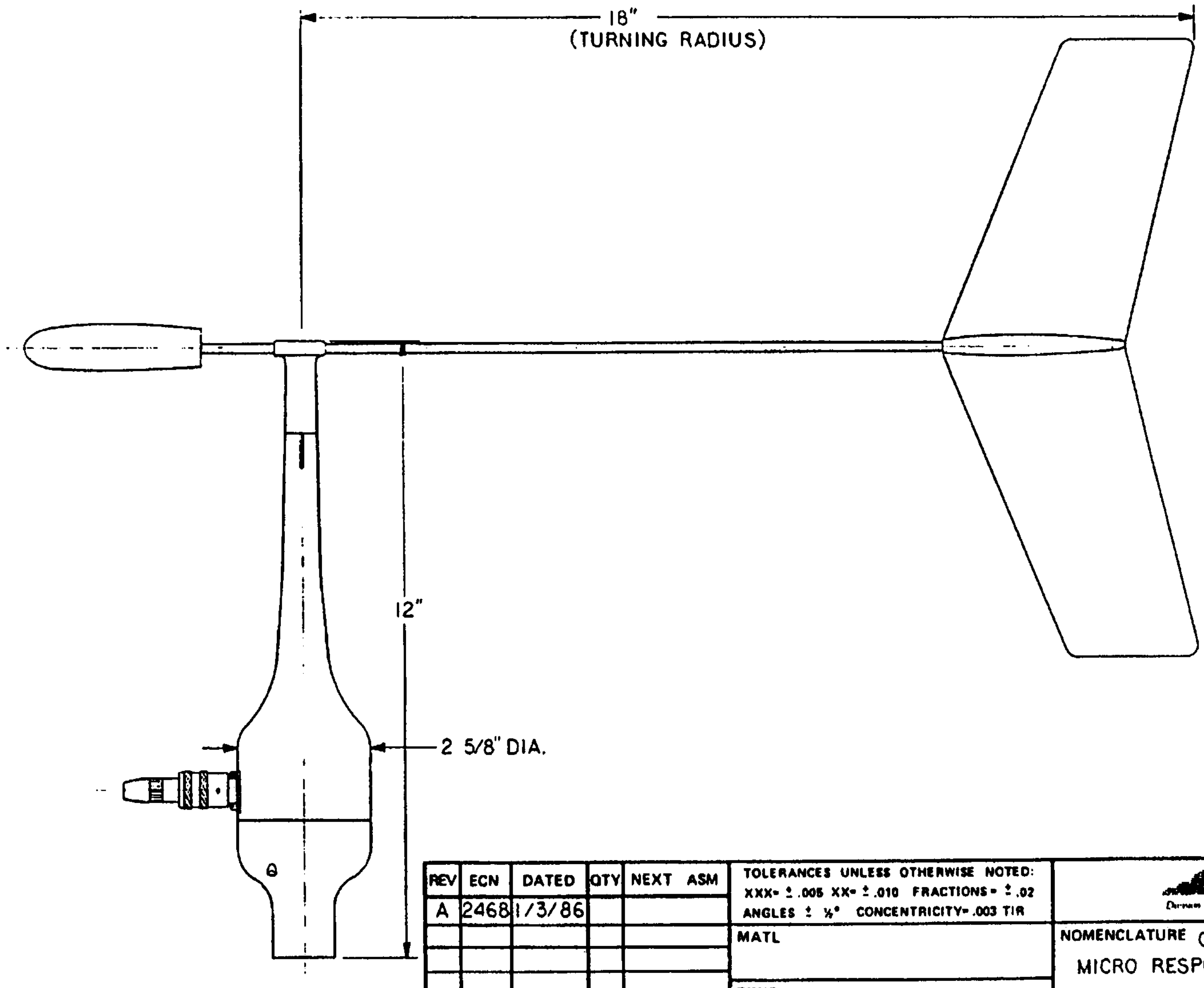
7.0 SCHEMATIC & PARTS LIST

7.1 The following pages include schematics, assembly drawings, and parts list for this instrument. Please note that the parts lists are arranged in assembly/sub-assembly form. Each sub-assembly is on its own page. Sub-assemblies and parts are listed in the smallest economical size available from Qualimetrics.

8.0 WARRANTY

8.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others, may cancel warranty.

DWG. NO. 2020-005



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TOLERANCES UNLESS OTHERWISE NOTED:
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ANGLES ± ½° CONCENTRICITY= .003 TIR

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ENGR G.J. DT 1/3/86
APPRO G.J. DT 1/3/86

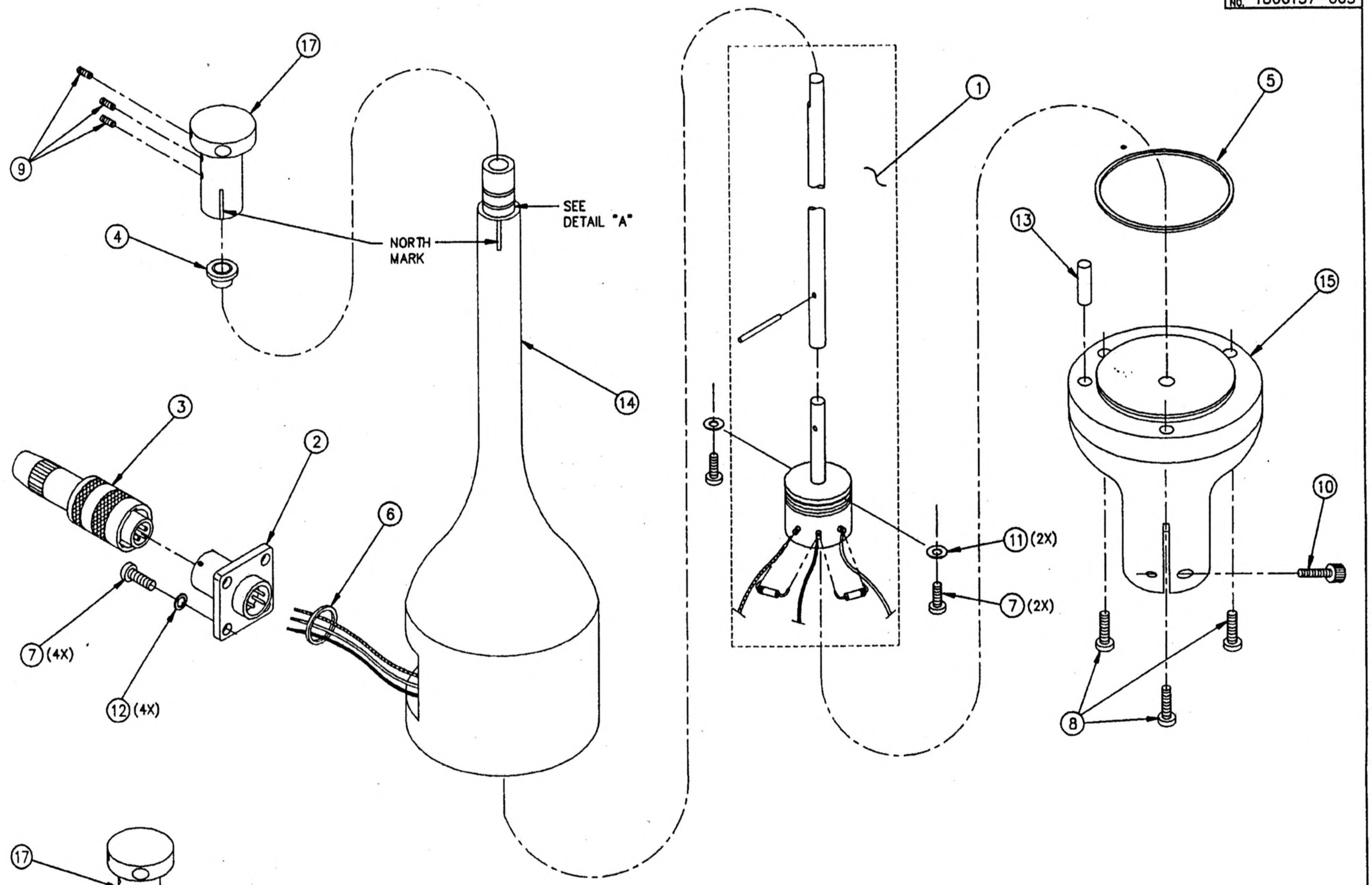
WeatherMeasure WEATHERtronics
Division of QUALIMETRICS

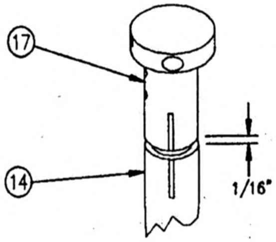
B

NOMENCLATURE OUTLINE DRAWING
MICRO RESPONSE VANE

MOD. USAGE 2020
SHEET 1 OF 1
BY K. WEBER
DT 1/3/86
SCALE 1/2
DWG. NO. 2020-005

DWG. NO. T800137-003





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B		5/82		
C		1/83		
D	2744	7/87		

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ANGLES ±1/2° CONCENTRICITY=.003 TIR

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C

TITLE ASSEMBLY,
MICRO RESPONSE VANE
SENSOR BODY

MOD. USAGE

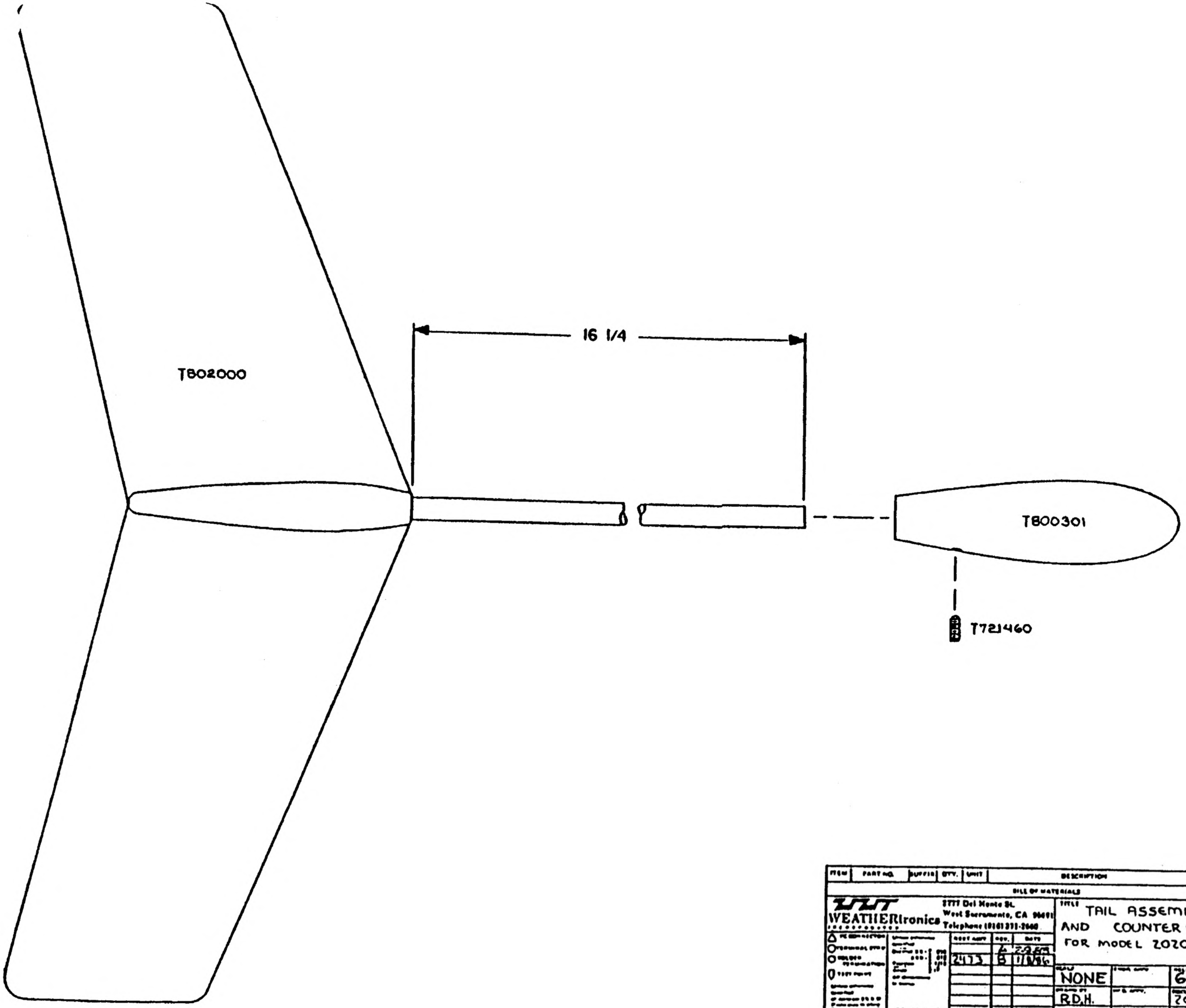
SHEET 1 OF 1

BY K. Weber

DATE 7-7-87

SCALE NONE

DWG. NO. T800137-003



ITEM	PART NO.	SUFFIX	QTY.	UNIT	DESCRIPTION	REFERENCE NO.

BILL OF MATERIALS

WEATHERtronics
2777 Del Monte St.
West Sacramento, CA 95691
Telephone (916) 371-2660

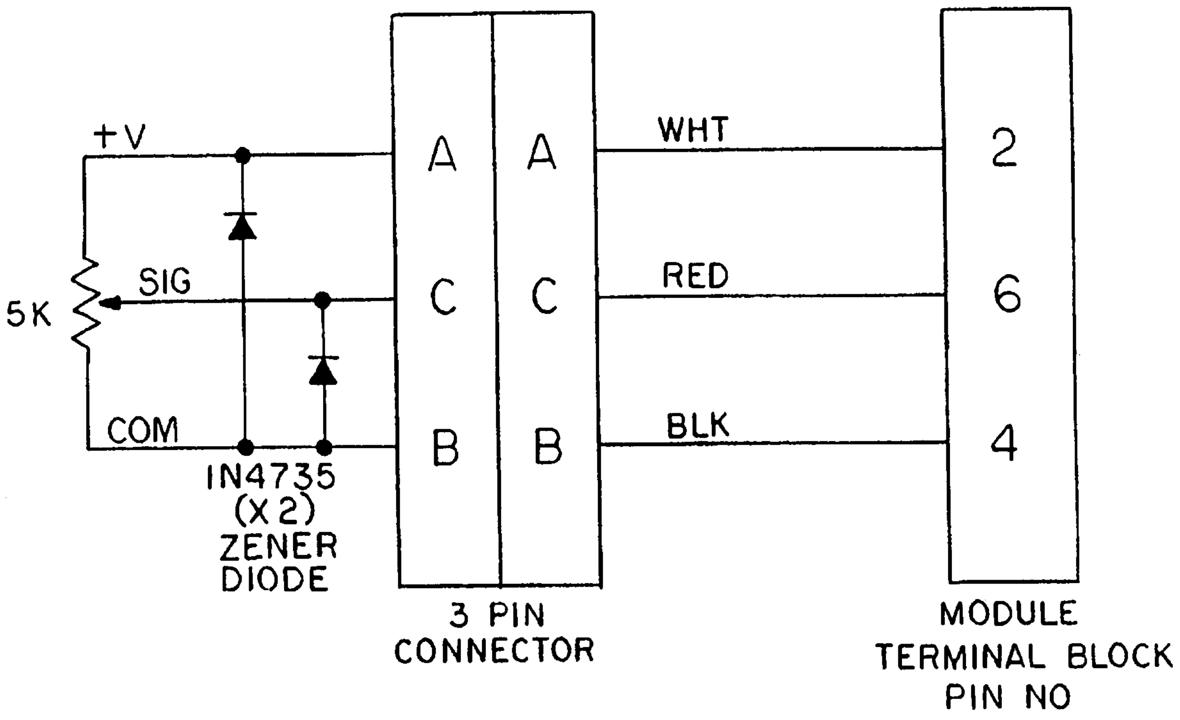
ECO NO.	REV.	DATE
	A	2-2-83
2473	B	1/8/86

TITLE TAIL ASSEMBLY
AND COUNTER WEIGHT
FOR MODEL 2020

SCALE NONE
DRAWN BY R.D.H.
DRAWING DATE 6-20-77
DRAWING NO. 2020-075 REV. C
SHEET 1 OF 1

DO NOT SCALE DRAWING

DWG. NO. 2020-004



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TOLERANCES UNLESS OTHERWISE NOTED:
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ANGLES ± ½° CONCENTRICITY= .003 TIR

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QUALIMETRICS, Inc.
WEATHERMEASURE / WEATHERTRONICS
Instruments and Systems Division
3213 Orange Grove Avenue
Sacramento California 95660 U S A

NOMENCLATURE SCHEMATIC
MICRORESPONSE VANE

MOD. USAGE 2020
SHEET 1 OF 1

BY GT
DT 3-16-83
SCALE 0
DWG NO. 2020-004
A

MANUAL
FOR
MICRO RESPONSE ANEMOMETER
MODEL 2030

TABLE OF CONTENTS

MANUAL NO: 2030-001
DATE: AUGUST 1985
ECN: 2409

MICRO RESPONSE ANEMOMETER
MODEL 2030

30 pulse/revolution

1.0 INTRODUCTION

1.1 The Model 2030 Micro Response Anemometer is a highly responsive three cup anemometer which utilizes a photon coupled chopper to produce a pulse output with frequency proportional to wind speed. The threshold of this anemometer is 0.5 miles per hour. The entire anemometer assembly with exception of the photon coupled chopper is made from stainless steel or anodized aluminum. A quick release waterproof connector is provided. The Model 2030 Anemometer is normally used in conjunction with the Model 1220 and 1280 Wind Speed Signal Conditioning Modules. The module provides an analog signal output proportional to wind speed.

2.0 SPECIFICATIONS

2.1

Threshold	0.5 mph
Accuracy	±.15 mph up to 25 mph 1% above 25 mph
Distant constant	5 feet
Range	0-100 mph or 0-45 m/s
Cup material	0.004" stainless steel
Turning radius	3.8"
Body size	12"H x 2-3/4" dia. (305 mm H x 70 mm dia.)
Weight/Shipping	2.5 lbs/7 lbs (1.1 kg/3.2 kg)
Mounting	Direct to crossarm or with adapter to 1" (25.4 mm) O.D. mast
Photon chopper current	20 mA

3.0 INSTALLATION

3.1 This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 Assembly: With exception of installing the cup assembly, the Model 2030 Micro Response Anemometer is ready for mounting. Install the cup assembly as described in Sections 3.3 to 3.5.

3.3 Loosen the two No. 6 Allen set screws and slide the cup assembly over the anemometer shaft. Be certain that the flat on the shaft faces towards the set screw position.

3.4 The cup assembly hub should slide down over the shaft and body and seat the shaft ring. When correctly in place there should be about a 0.050 inch clearance between the skirt of the hub and the shoulder of the body. Tighten both set screws.

3.5 Spin the cup assembly by hand to assure smooth operation. The cup wheel should coast to a smooth stop.

3.6 Site Selection: Location of the sensor is critical for accurate wind measurements. The standard exposure of an anemometer or vane over open, level terrain is 10 meters above the ground. Open, level terrain is defined as level ground with no obstruction within 300 m. In locations where obstructions are not large (e.g., residential) and are distributed more or less evenly, the sensor can be placed at an effective height of h + 10 meters, where h is the approximate height (in meters) of the various obstacles. As an example, in a location where trees and buildings reach to about 5 meters high, the sensors must be placed on a 15 meter mast to avoid erroneous results.

3.7 In areas where large obstructions do exist within 300 meters of the sensor, the following table can be used to calculate the proper height of the sensor (h is the height of the obstruction).

Distance of obstruction	Minimum height above ground level of anemometers
h	1.75h to 2.25h
5h	1.67h
10h	1.50h
20h	1.25h
25h	1.13h
30h	h

TABLE 3.1[1]

[1] Handbook of Meteorological Instruments, 2nd Edition. Measurement of Surface Wind, Volume 4. London, HMSO: 1981

Thus if there is a building 10 meters high and 50 meters away, the anemometer should be at least 16.7 meters above the ground; but if the same building is 200 meters away the sensor could be lowered to 12.5 meters.

3.8 When the sensor is mounted on a building, the building itself disturbs the wind flow and must be taken into account before installation. For large buildings, except things such as lighthouses, and skyscrapers, the sensor must be mounted as far away from the building edge as possible and at a height at least 3/4 the height of the building. Thus with a large building 28 meters high, a roof top tower at least 21 meters should be used for mounting.

3.9 The Model 2030 Micro Response Anemometer mounts directly to the Model 2023 Crossarm without any additional accessories. The crossarm is generally used to mount one each Model 2030 Anemometer and one each Model 2020 Vane to form a wind speed and direction measuring set. If the Model 2030 Anemometer is to be mounted separately, a Model 20231 Mast Adapter should be ordered as an accessory. Both the Model 2023 Crossarm and the Model 20231 Mast Adapter will mount onto a mast with an outside diameter of 1" (25.4 mm) or 3/4" schedule 40 pipe. Set screws are provided to fasten the adapter to the mast. The lower part of the anemometer body will slip over the pin on the crossarm or the mast adapter. With the anemometer in place, tighten all mounting screws. The anemometer should be mounted with its axis as close to vertical as possible to provide for best measurement of horizontal wind movement. If it becomes necessary to remove the sensor from the mounting adapter or crossarm, loosen only the screw on the sensor base. Do not remove the mounting pin from the crossarm or the mast adapter from the mast. Reinstallation of the sensor is facilitated in this procedure.

3.10 Install a four wire 20 AWG cable into the mating connector using care in soldering and cable dressing. Replace the connector back shell forming a waterproof assembly. The connector is a quick release type and requires only a quarter turn of the nut to lock in place. Do not tighten with a wrench. Connections are a shown in Figure 3.1.

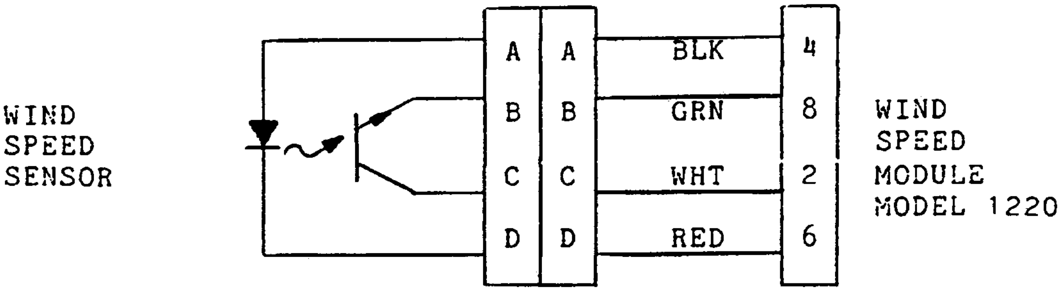


FIGURE 3.1

4.0 CIRCUIT DESCRIPTION

4.1 The photon coupled chopper consists of two parts. A light emitting diode in combination with a light sensitive transistor is mounted directly to the anemometer connector. A slotted wheel connected to the anemometer shaft interrupts the light beam between the light emitting diode and the photon transistor. This interruption of light causes a change in the transistor collector to emitter current.

ANEMOMETER MODEL 2030

FREQ. (HZ.)	SHAFT SPEED REV/MIN	WIND SPEED mph	WIND SPEED m/s
25	50	3.0	1.33
30	60	3.5	1.55
60	120	6.4	2.9
150	300	15.24	6.8
450	900	44.7	20.0
504	1008	50.0	22.4
750	1500	74.1	33.1
900	1800	88.8	39.7
1014	2027	100.0	44.7
1021	2042	100.7	45.0
1135	2270	111.9	50.0
912	1824	90.0	

CALIBRATION TABLE
FIGURE 5.1

These changes in current are amplified and conditioned in the Model 1220 Wind Speed Signal Conditioning Module to provide an analog output signal proportional to frequency.

5.0 CALIBRATION

5.1 The slotted wheel has 30 slots giving thirty electrical pulses per revolution. The output frequency of the anemometer may be determined by the following equation:

$$F_{HZ} = 10.19\ (V\ mph - 0.52).$$

where F_{HZ} is the frequency in Hertz and V_{mph} is the velocity in miles/hour.

5.2 Calibration data in Figure 5.1 has been developed from operating the anemometer in a wind tunnel equipped with NBS traceable measuring instruments.

5.3 The Model 1220 Wind Speed Signal Conditioning Module is equipped with a calibration feature consisting of a constant frequency oscillator and a switch to apply the oscillator to the signal conditioning circuitry. This feature allows the operator to quickly set up the output signals for zero and full scale values. Refer to the manual for the Model 1220 for additional information.

5.4 To verify the calibration of the anemometer, rotate the anemometer shaft at one of the known rpm values shown in Figure 5.1 and measure the sensor output with a frequency counter or oscilloscope. If module Model 1220 is part of the system, place the module into the OPERATE mode and measure the frequency between the BLK/WHT and the BLK test points (TP110 and TP100). The measured frequency should equal the value indicated in the calibration table.

6.0 MAINTENANCE

6.1 Periodically the anemometer bearings should be inspected for wear. The bearings are sealed and protected to prevent dirt and moisture from entering. With time the seals will no longer prevent dirt from entering the bearing race and the bearings may fail. The bearings may be replaced in the field or the anemometer may be returned to Qualimetrics for servicing.

6.2 Since corrosion is the main problem associated with wind sensors, apply a thick coating of silicon lubricant to the connector shell after the connector is attached and in place. Also use a non-corrosive lubricant such as bee wax on all screws and fasteners whenever disassembly of the sensor is required. The use of these lubricants will make servicing of the sensor easier and will prevent seizure of the fastening hardware. It is also advisable to apply lubricant to the mounting adapter surfaces prior to final sensor installation. A commercial grade lubricant recommended for use is DOOR-EASE and is available at hardware and automotive stores.

6.3 Follow Sections 6.4 to 6.12 to replace the bearings in the field.

6.4 Remove the cup wheel.

6.5 Remove the electrical receptacle-photon coupled chopper by removing four each 4-40 screws and sliding out the entire unit.

6.6 Remove the lower body section by removing three each 6-32 screws.

6.7 Remove the E-clip from the shaft at the top of the unit and slide the entire shaft down out of the unit taking care not to bend the shaft.

6.8 Lift out the upper bearing by working a knife edge under the flanged outside race.

6.9 Using a rod of about 1/4" diameter passed down from the top, carefully knock out the lower bearing.

6.10 Clean all parts. Install new bearings. Press in place by applying pressure only to the outer race. The bearing could be damaged by pressing against the inner race.

6.11 Re-assemble all parts in the reverse order of disassembly. Check for free and smooth rotation of the shaft before and after installing the cup wheel. The receptacle-photon coupled chopper assembly should be installed with the large connector key toward the top of the unit. Wipe clean the lens areas of the chopper with a soft cloth prior to assembly.

6.12 Should any problem occur with the photon coupled chopper the entire connector-chopper assembly should be ordered and replaced. Check for proper excitation current polarity and also photo transistor circuit polarity prior to connection of power to the new assembly.

6.13 Use great care in disassembly and reassembly of the sensor. Never use excessive force to make parts fit together. Over tightening of fasteners will either break the fastener or damage the machined threads of the sensor.

6.14 Any difficulties encountered during servicing that are not correctable by the user should be referred to the Qualimetrics Customer Service Department.

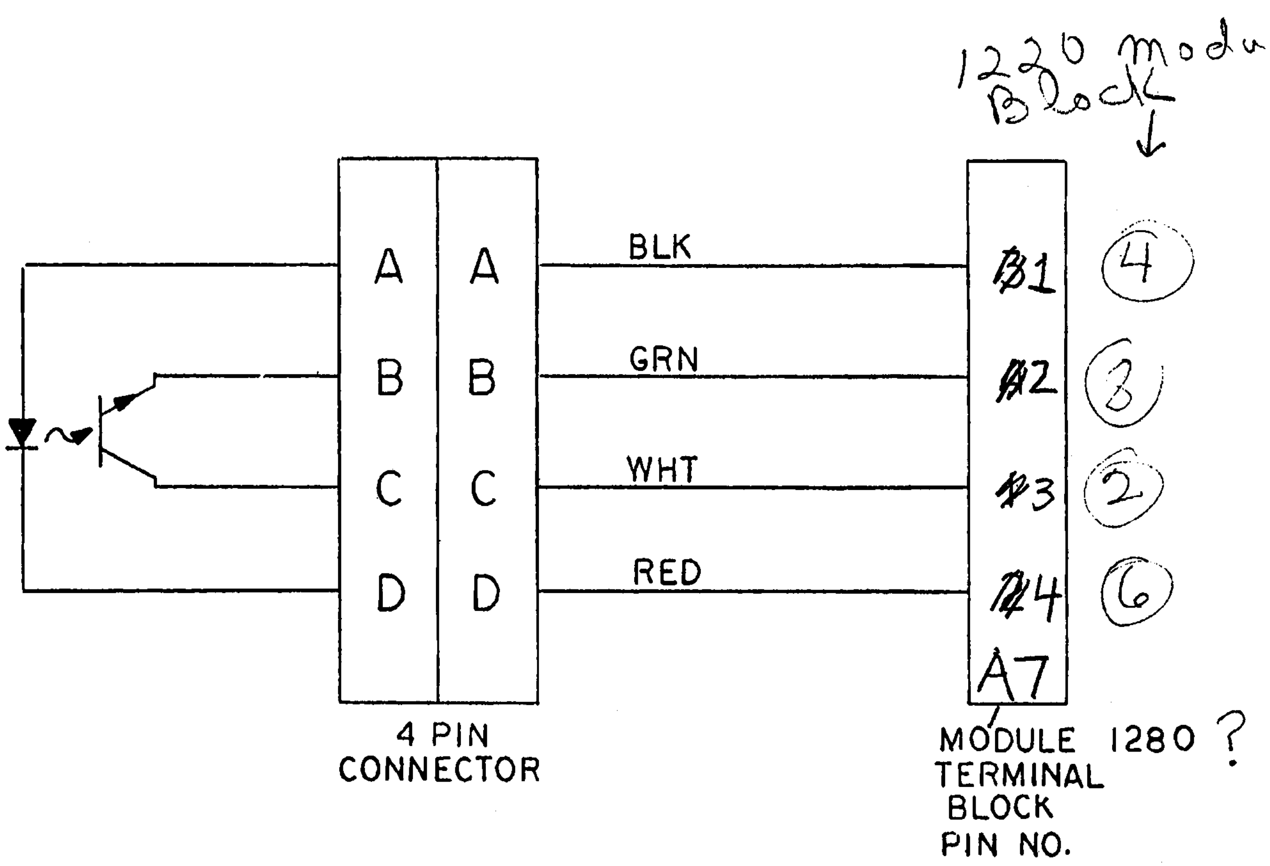
7.0 SCHEMATIC AND PARTS LIST

7.1 The following pages include schematics, assembly drawings, and parts list for this instrument. Please note that the parts lists are arranged in assembly/subassembly form. Each subassembly is on its own page. Subassemblies and parts are listed in the smallest economical size available from Qualimetrics.

8.0 WARRANTY

8.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others, may cancel warranty.

DWG. NO. 2030 04



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TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ± .005 XX= ± .010 FRACTIONS = ± .02
ANGLES ± ½° CONCENTRICITY= .003 TIR

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QUALIMETRICS, Inc.

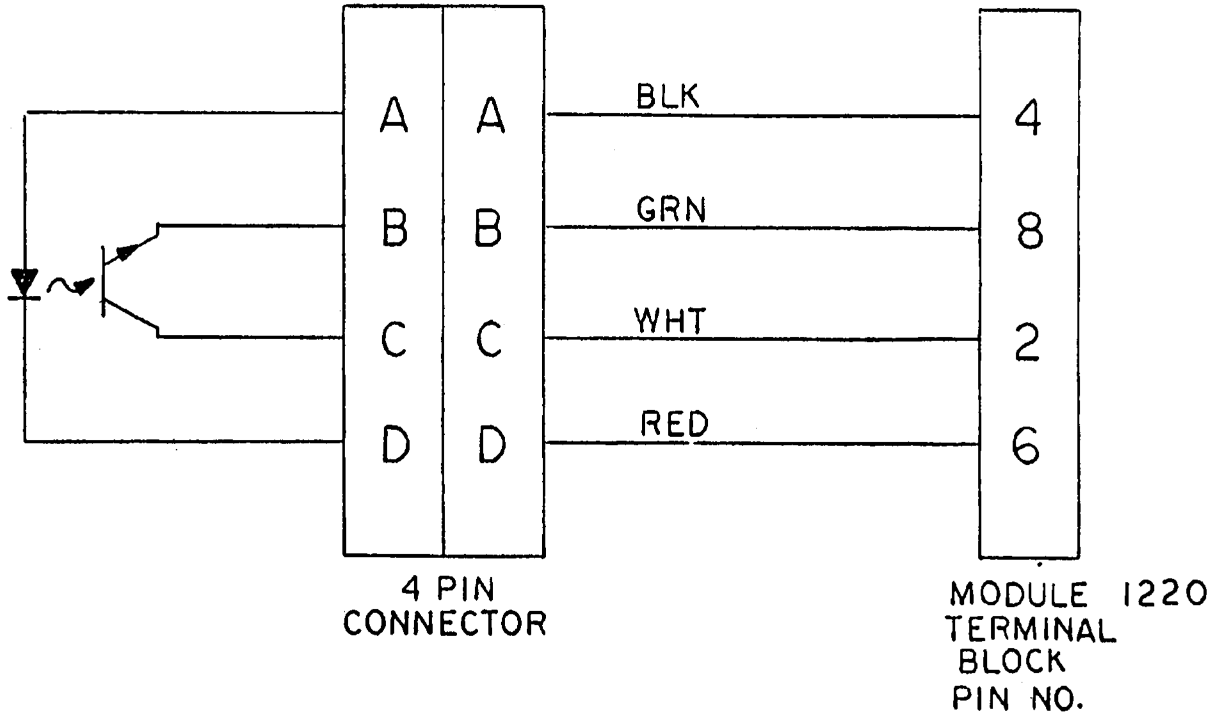
WEATHERMEASURE / WEATHERTRONICS
Instruments and Systems Division
3213 Orange Grove Avenue
Sacramento, California 95660 U.S.A.

NOMENCLATURE SCHEMATIC
MICRO RESPONSE ANEMOMETER
PHOTON CHOPPER ASSEMBLY

MOD. USAGE 2030
SHEET 2 OF 2

BY GT
DT 3-17-83
SCALE 0
DWG NO. 2030-04 A

DWG. NO. 2030 04



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Instruments and Systems Division
3213 Orange Grove Avenue
Sacramento, California 95660 U S A

NOMENCLATURE SCHEMATIC
MICRO RESPONSE ANEMOMETER
PHOTON CHOPPER ASSEMBLY

MOD. USAGE 2030

SHEET 1 OF 2

BY GT

DT 3-17-83

SCALE 0

DWG NO. 2030-04

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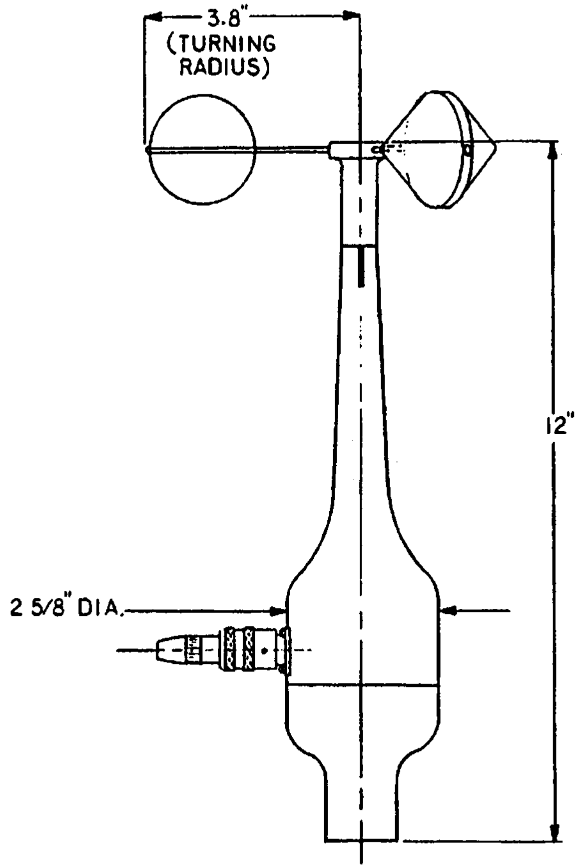
DWG. NO. 2030-005



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TOLERANCES UNLESS OTHERWISE NOTED:
XXX= ± .005 XX= ± .010 FRACTIONS = ± .02
ANGLES ± ½° CONCENTRICITY= .003 TIR

MATL

FINISH

ENGR R.J DT 1/3/86
APPRO RJ DT 1/3/86

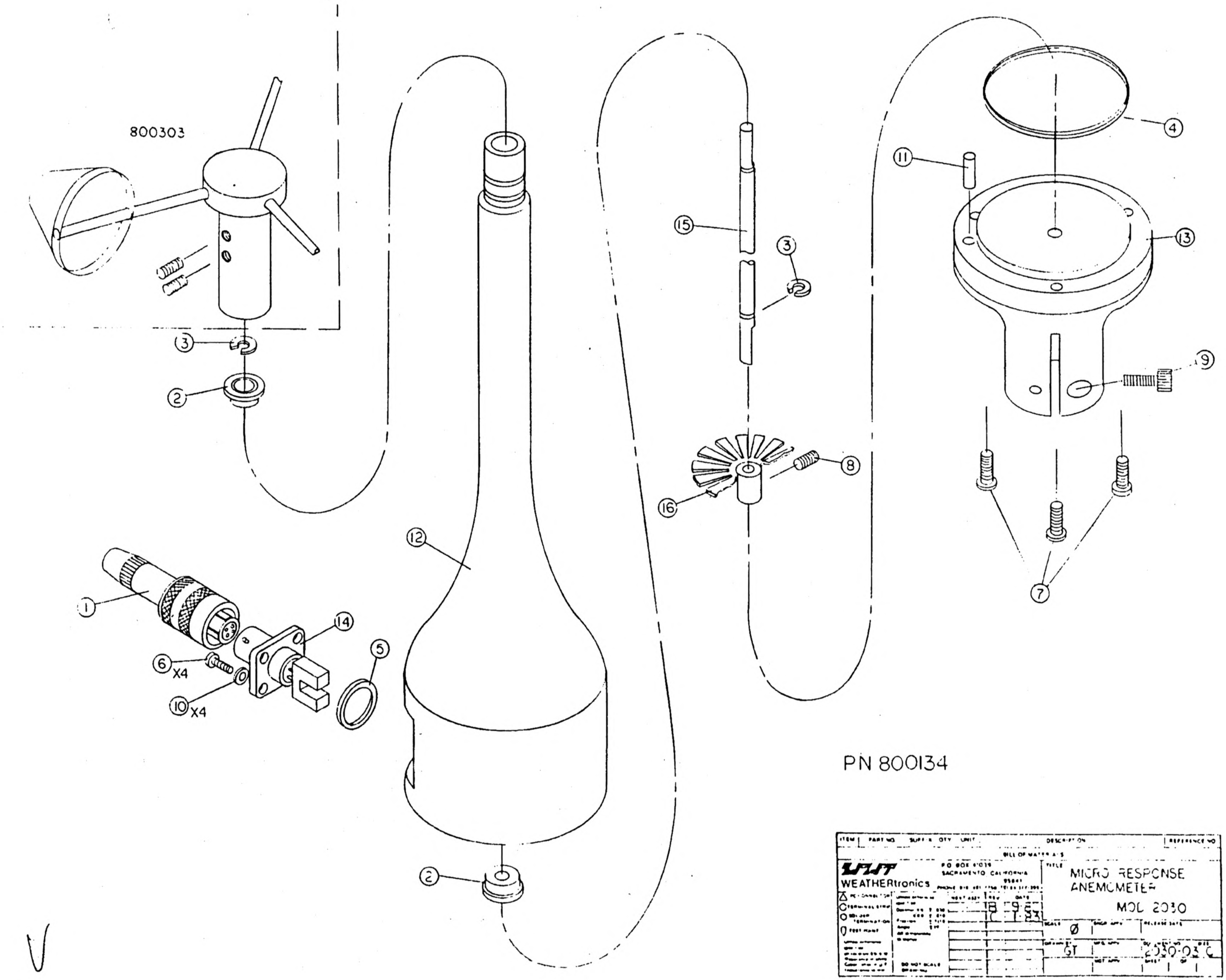
WeatherMeasure
WEATHERtronics

B

NOMENCLATURE OUTLINE DRAWING
MICRO RESPONSE ANEMOMETER

MOD. USAGE 2030
SHEET 1 OF 1

BY K. WEBER
DT 1/3/86
SCALE 1/2
DWG. NO. 2030-005



PN 800134

ITEM | PART NO | SUFFIX | QTY | UNIT | DESCRIPTION | REFERENCE NO

BILL OF MATERIALS

WEATHERtronics

P O BOX 41039
SACRAMENTO CALIFORNIA
95841

DO NOT SCALE DRAWING

REV | DATE
B | 9-8?
C | 1-83

TITLE
MICRO RESPONSE
ANEMOMETER
MOD 2030

SCALE Ø

DRAWN BY GT

DWG NO 2030-03 C

MANUAL
FOR
SIGNAL LINES SURGE PROTECTION
PRINTED CIRCUIT BOARD
MODEL 10643

TABLE OF CONTENTS

MANUAL NO: 10643-001
DATE: JUNE 1986
ECN: 2575

SIGNAL LINES SURGE PROTECTION
PRINTED CIRCUIT BOARD
MODEL 10643

1.0 INTRODUCTION

1.1 The Signal Lines Surge Protection is assembled onto a single printed circuit board, Model 10643. The assembly provides protection against surge currents created by lightning or nearby electrical sources external to the meteorological instrumentation. The circuit board contains components and terminals for 20 input signal lines.

1.2 The Model 10643 has been designed for use inside Qualimetrics, Inc. junction boxes where the meteorological instruments are mounted onto a tower or mast with the junction box installed at the tower base. The junction box, grounding cable, ground rods, clamps and interconnecting wiring are all ordered separately or are included in other products such as the junction box assembly Model 1078-A.

1.3 Two terminal strips with 20 terminals each provide positions for the termination of the sensors and the modules. The sensor cables are wired into the terminal marked TB1 and the modules or data collection system cables are connected into terminal block 2, TB2. The individual wires from each cable are separated and connected to the terminal blocks, one wire per terminal. As an example, the Wind Speed Sensor Model 2030 requires a 4-wire cable to transmit the sensor signal and provide power to the sensor. To connect the 2030 cable to the Model 10643, terminals 1, 2, 3, and 4 would be used and the white wire would be connected to terminal 1, the black wire to terminal 2, the red wire to terminal 3, and the green wire to terminal 4. Similarly a separate 4 wire cable would be used to connect to terminals 1, 2, 3 and 4 on terminal block 2 to transmit the signal from the 10643 to the data collection equipment. For large systems, a single, multiple conductor cable such as T600225 (25 wires) is recommended for connecting the 10643 to the data collection equipment to simplify system wiring and to make cabling through conduit much easier.

2.0 SPECIFICATIONS

2.1	Static DC breakdown E_{BD}	145 V ±20%
	Surge sparkover voltage, E_L at 5 KVμS	580 V
	Rated discharge current I_{RS} 6 x 20 to 10 x 20 μS Wave	5 KA

Maximum follow current	30 amperes peak
Rated AC discharge current	5 amperes rms
Insulation resistance	
R_{Ka} at 100 VDC	Greater than 10^9 ohms
Capacitance	Less than 2.5 pf
Maximum DC holdover voltage E_{HO}	100 volts
Spark Arrestor Size	0.25" thick x 0.35" dia. with 2" leads (6 x 9 x 50 mm leads)
Number of sensor lines:	
Model 10643	20 maximum

3.0 INSTALLATION

3.1 This instrument is thoroughly assembled and inspected at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify Qualimetrics, Inc.

3.2 The Model 10643 is ready to be installed into a junction box as it is received from the factory. If a junction box such as Model 1064 is included in the system, the 10643 will be factory installed into the junction box prior to shipment to the customer.

3.3 The Model 10643 must be mounted away from any metallic surfaces. The use of standoffs approximately 1 inch long is recommended for correct spacing. Portions of the board are wired to earth ground, however, the connecting circuits up to these components must not be grounded or loss of signal will occur.

3.4 Prior to attaching the signal cables, connect the ground plane of the 10643 to a ground rod. Use #4 or #6 AWG copper wire and connect to earth ground in the shortest most direct manner available. Avoid sharp bends, twists, and kinks in the ground wire. The ground plane is the silvered portion of the board between TB1 and TB2. Use the large bolt hole and attach a #4 ground lug to the board in order to attach the cable.

3.5 Attach the sensor signal lines to TB1. For best results and ease in system troubleshooting, connect the sensor wires in the order of their connection to the signal conditioning modules. Similarly, attach the cables to the signal conditioning to TB2.

3.6 Any terminals used with relative humidity probes such as Model 5120-B must have the 10643 resistor shorted by a jumper wire on each of the sensor wires. Humidity probes such as Model 5120 must have the resistor and the inductor shorted by jumper wires.

4.0 THEORY OF OPERATION

4.1 The Model 10643 is an improved version of previously constructed signal lines surge arrestor assemblies. The use of a printed circuit style assembly reduces the space requirements of the assembly as well as improves the grounding of the components to the ground plane.

4.2 The surge protection is provided by gas tube arrestors which are self quenching and feature extremely fast response to transients, and the ability to withstand high follow currents.

4.3 Each gas tube arrestor has two metal electrodes forming a discharge gap characterized as an open circuit under normal conditions. The arrestor represents only a very small capacitance and no resistance to the circuit it protects.

4.4 When a surge occurs and exceeds the breakdown voltage of the arrestor, the internal gap becomes intensively ionized, conducting currents within fractions of a microsecond. The arrestor is then virtually a short circuit until the voltage returns to normal. Ionization and deionization occur extremely fast due to the type of gas in the tube and the physical configuration employed in the design.

4.5 The resistor and inductor used in conjunction with the spark-gap tube and the dual zener diodes act to slow and quench surge currents, especially those that are below the ionization threshold of the spark-gap tube.

4.6 Refer to drawing 10643-004 for the assembly and schematic views of the Model 10643.

5.0 CALIBRATION

5.1 Calibration of the Model 10643 is not required.

6.0 MAINTENANCE

6.1 The Model 10643 should have regularly performed inspections of the terminals to insure good mechanical connection, especially in locations where the junction box is subject to frequent or severe vibrations which can occur on tower mounted instruments.

6.2 Inspection of the 10643 should also be performed to locate and correct any corrosion that may occur due to moisture or chemical action.

6.3 Any severely corroded or damaged components must be replaced immediately.

6.4 The spark gap arrestors will not give any indication should there be a failure in the open state. A spark gap or zener diode pair which fails in the closed or shorted states will be noticeable due to the loss of signal at the data collection instruments.

6.5 Notify Qualimetrics, Inc. for replacement or repair of any damaged or failed components. Should there be a requirement for immediate resumption of system operation following a component failure, Qualimetrics, Inc., recommends that a spare Model 10643 be purchased and stored at the system site.

7.0 SCHEMATIC AND PARTS LIST

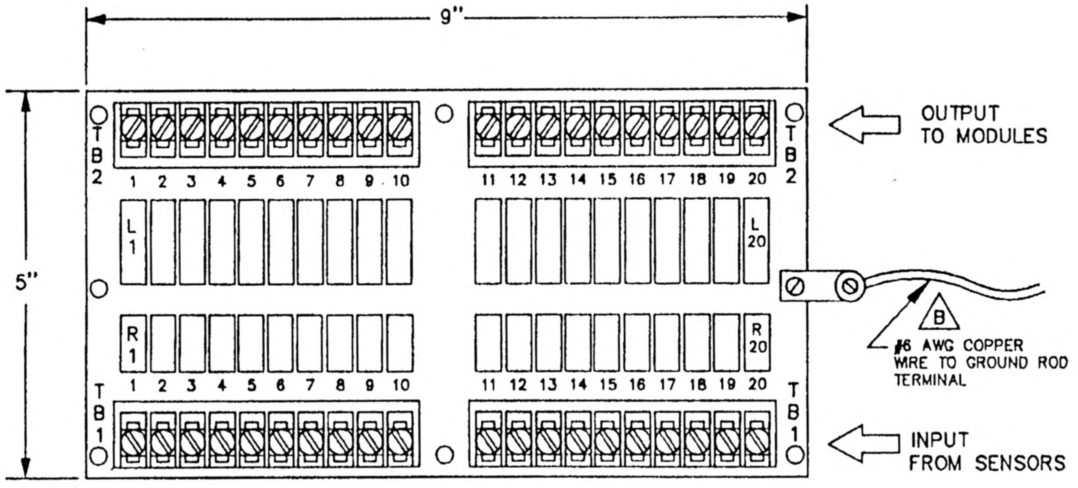
7.1 The following pages include schematics, assembly drawings, and parts list for this instrument. Please note that the parts lists are arranged in assembly/subassembly form. Each subassembly is on its own page. Subassemblies and parts are listed in the smallest economical size available from Qualimetrics.

8.0 WARRANTY

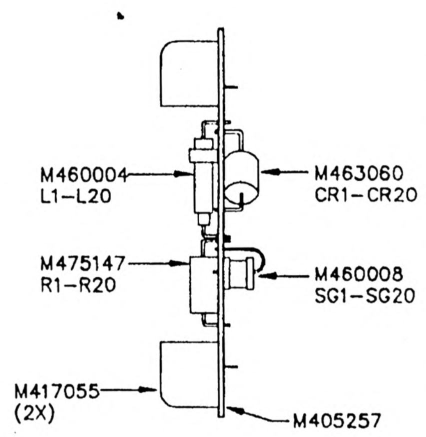
8.1 All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, upon written notice and return of the instrument freight prepaid, Qualimetrics will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, and modified or altered by others, may cancel warranty.

8.2 Due to the nature of lightning and the internal properties of the lightning arrestor, Qualimetrics Inc. does not provide a warranty for the arrestor. All other products used in Models 1078-A are covered by Step 8.1.

DWG. NO. 10643-004



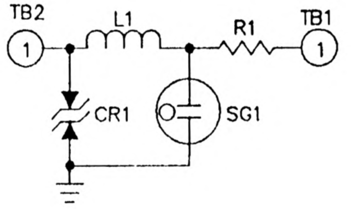
STANDARD



NOTES:

1. SOME COMPONENT POSITIONS MAY BE UNFILLED OR CONTAIN JUMPER WIRES.
2. TERMINALS RESERVED FOR R.H. PROBE ARE:

STANDARD LOAD



REV	ECN	DATED	QTY	NEXT ASSY
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B	2655	2/87		
C	2826	6/88		

TOLERANCES UNLESS OTHERWISE NOTED
XXX=±.005 XX=±.010 FRACTIONS=±.02
ANGLES ±1/2° CONCENTRICITY=.003 TIR

MATL

FINISH

ENGR RJ DT 6/88

APPROVED DT

WeatherMeasure
WEATHERtronics
Division of QUALIMETRICS, Inc.

B

TITLE SCHEMATIC, SENSOR PROTECTION

MOD. USAGE

SHEET 1 OF 1

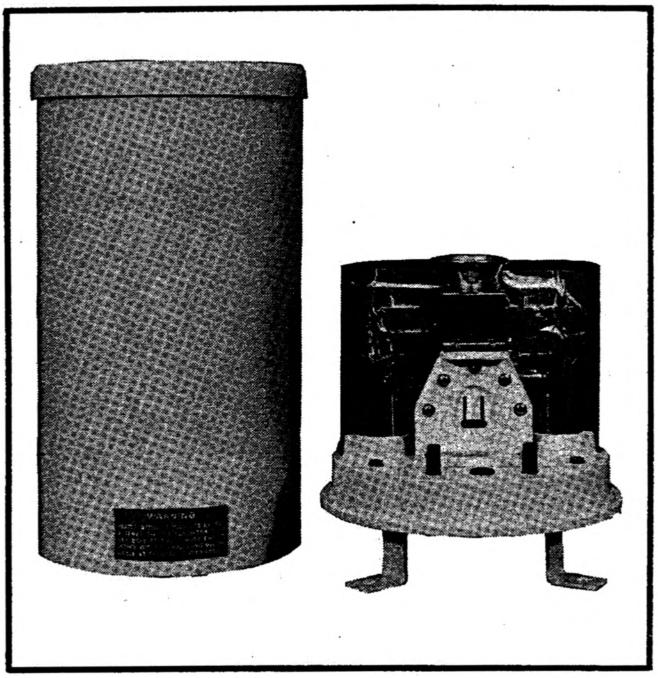
BY K. Weler

DATE 2-5-87

SCALE NONE

DWG. NO. 10643-004

ELECTRICALLY HEATED RAIN AND SNOW GAGE



For areas where precipitation occurs in a frozen form, electrically heated rain and snow gages are available. Each gage includes 4 separate heaters. A NiChrome wire heater wraps around the collection funnel to melt the precipitation for measurement. A second NiChrome wire heater warms the internal components and the gage base to prevent refreezing of the water inside the gage. In addition, a cartridge heater is plugged into each of the gage drain tubes so that the measured precipitation passes out of the gage freely without freezing on contact with the cold outside air. The funnel and the base heaters are controlled by thermostats; the drain tube heaters are continuous duty. Either 115 VAC or 230 VAC may be used as input power.

Two types of electric snow gages are available. The 6021 Series gages feature an 8-inch-diameter collection funnel, while funnel of the 6028 Series gages is 12 inches in diameter. The larger orifice provides the maximum sampling area, resulting in improved catch.

The melted precipitation is funneled into one of two tipping buckets inside the gage. The bucket tips when a given amount of water has been collected. The 6021 gages may be calibrated to a resolution of either 0.01 inch or 0.1 mm. The 6028 gages feature a resolution of 0.01 inch or 0.25 mm. As the bucket tips, it causes a magnet to pass over a mercury-wetted reed switch, closing the switch momentarily. Measurement accuracy is 0.5% at a precipitation rate of 0.5 inch per hour.

These gages are designed for many years of accurate, trouble-free operation. They are constructed entirely of corrosion-resistant materials including aluminum, nickel-plated brass, and stainless steel. A built-in level and predrilled feet aid in proper installation.

SPECIFICATIONS

Sensor type	Tipping bucket
Output	0.1-second switch closure
Switch	Form A reed, mercury-wetted
Sensitivity:	
Models 6021-A, -C	1 tip per 0.01"
Models 6021-B, -D	1 tip per 0.1 mm
Models 6028-A, -C	1 tip per 0.01"
Models 6028-B, -D	1 tip per 0.25 mm
Accuracy	0.5% at 0.5"/hr.
Capacity	Unlimited
Collector orifice:	
6021 Series	8.214" dia. (208 mm)
6028 Series	12" dia. (305 mm)
Heaters:	
Funnel	NiChrome wire in foil, 500 W, thermostatically controlled
Base	NiChrome wire in foil, 150 W, thermostatically controlled
Drain tubes	2, cartridge, 20 W ea., continuous duty
Thermostat setpoint:	
Funnel heater	Approximately 52°F (11°C)
Base heater	Approximately 42°F (6°C)
Operating temperature range	-13 to 104°F (-25 to 40°C)
Input voltage:	
Models 6021-A, -B	115 VAC, 60 Hz
Models 6021-C, -D	230 VAC, 50 Hz
Models 6028-A, -B	115 VAC, 60 Hz
Models 6028-C, -D	230 VAC, 50 Hz
Size:	
6021 Series	8.25" dia. × 17.5" H (210 × 445 mm)
6028 Series	12.5" dia. × 18" H (318 × 457 mm)
Weight/shipping:	
6021 Series	8 lbs./15 lbs. (3.6 kg/6.8 kg)
6028 Series	16 lbs./30 lbs. (7.3 kg/13.6 kg)

ORDERING INFORMATION

Model	
6021-A	**Electrically Heated Rain and Snow Gage,** 0.01"/tip, 115 VAC; less power cable
6021-B	**Electrically Heated Rain and Snow Gage,** 0.1 mm/tip, 115 VAC; less power cable
6021-C	**Electrically Heated Rain and Snow Gage,** 0.01"/tip, 230 VAC; less power cable
6021-D	**Electrically Heated Rain and Snow Gage,** 0.1 mm/tip, 230 VAC; less power cable
6028-A	**Electrically Heated 12" Rain and Snow Gage,** 0.01"/tip, 115 VAC; less power cable
6028-B	**Electrically Heated 12" Rain and Snow Gage,** 0.25 mm/tip, 115 VAC; less power cable
6028-C	**Electrically Heated 12" Rain and Snow Gage,** 0.01"/tip, 230 VAC; less power cable
6028-D	**Electrically Heated 12" Rain and Snow Gage,** 0.25 mm/tip, 230 VAC; less power cable
6410	**Precipitation Gage Wind Screen**
60211	**Heater Kit Option,** to convert 6011 Series gage to 6021 Series; 115 VAC input; less power cable
60212	**Same as 60211** except 230 VAC input
T600502	**2-conductor, 20 AWG shielded cable** to connect rain gage to output device
T600723	**Power cable,** 3-conductor, 16 AWG
NOTE:	*The 6021-A was formerly known as Model P511-A in the WeatherMeasure line.*

VLBA Technical Report 47

VLBA Weather Station

Appendix 3

INTELLISENSOR
Digital Barometer/Altimeter
User Manual.

Model AIR-DB series

Atmospheric Instrumentation Research, Inc.
1880 S. Flatiron Court
Boulder, Colorado 80301
303-443-7187

Version 2.2

Atmospheric Instrumentation Research, Inc.
1880 S. Flatiron Court
Boulder, Colorado 80301

Printed in USA

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INTRODUCTION

The INTELLISENSOR™ Digital Barometer/Altimeter measures pressure 10 times per second and makes it available in digital format to a terminal or computing device. The barometer can output pressure, altitude or altimeter setting. Altitude is computed from the pressure based on the U.S. standard atmosphere. Altimeter setting is computed from the pressure and a fixed specified altitude. Groups of readings can be averaged before transmission. Data are available on a serial port in ASCII coded format or on an 8 bit parallel port in either ASCII or binary coded format. Modes of operation are selected by jumpers inside the barometer.

The barometer is housed in a sealed aluminum case, uses a stable capacitance type pressure sensor, and has microcomputer control. Voltage requirements are +8 to +16 volts DC for LSTTL output. Use with RS-232C requires +11 to +16 volts DC and -11 to -16 volts DC. The analog electronics and sensor are computer calibrated together for full range accuracy. Calibration data is stored in ROM memory to assure data integrity and reliability. As shipped from the factory the instrument is configured as a barometer with 1200 baud RS-232C serial output, 10 readings averaged, and pressure units of millibars.

Included with the INTELLISENSOR Digital Barometer/Altimeter are:

- * Mounting bracket
- * Cable with connector
- * Manual
- * Calibration data sheet

This manual tells you how to use your digital barometer. Chapter 1 discusses the power requirements and communication interface. Chapter 2 explains the modes of operation and how to select them. Chapter 3 discusses the output data formats and how to read the data. Chapter 4 discusses the mechanical mounting and pressure line connections.

1. POWER AND COMMUNICATION INTERFACE

This section explains how to connect the hardware interface cable to provide power and to transfer data to an external device. Signal names are in capital letters and preceeded by a "+" or "-". A "+" means the signal is asserted or active when the voltage is at the more positive level. A "-" means the signal is asserted or active when the voltage is at the more negative level. For example, +DAV (parallel data valid) is asserted by +5v and negated by 0v. The RS-232C signal -DTR is asserted by -12v and negated by +12v. See Appendix D "Digital Board Schematic" for the barometer's interface electronics. Appendix F "Digital Barometer External Cable Diagram" contains connector pin assignments and wire colors.

1.1 CONNECTING POWER

The barometer must be powered from a dc power supply; either a battery or an ac/dc converter which meets the requirements listed in Table 1.1. These specifications apply at 22 degrees C and are average values which may vary by +-20%. At higher temperatures the current increases slightly and at lower temperatures it decreases slightly. The positive supply should have less than 100 mv of noise and ripple and the negative supply less than 500 mv of noise and ripple.

data interface	shutdown	voltage range	current
RS-232C serial	negated	+11 to +16 v	14.5 ma
		-11 to -16 v	8.5 ma
RS-232C serial	asserted	+11 to +16 v	8.5 ma
		-11 to -16 v	8.5 ma
LSTTL serial	negated	+8 to +16 v	6.3 ma
	asserted	+8 to +16 v	10.0 ua
LSTTL parallel	negated	+8 to +16 v	6.3 ma
	asserted	+8 to +16 v	10.0 ua

TABLE 1.1 POWER REQUIREMENTS

Apply power to the barometer's IO connector as follows.

- \+ voltage to pin 15
- \- voltage to pin 16
- ground to pin 13

1.2 USING THE POWER SHUTDOWN

You may use the logic level power shutdown feature to conserve power in battery applications. The barometer is turned off by asserting the +SHUTDOWN (pin 14) with a voltage greater than +1.4 volts but less than the voltage of the external positive supply. This signal can be driven by a LSTTL gate, a port bit on a CMOS or NMOS microcomputer, or by a microprocessor interface chip. It is turned on by negating the +SHUTDOWN with a voltage less than 0.8 volts. The barometer restarts just as though power had been applied.

This feature provides a convenient means of turning off the barometer in remote low power applications. For example, in a remote weather buoy application the external microcomputer turns on the barometer once every 10 minutes for 10 seconds to read the average of 100 readings. This reduces current by a factor of 10/600 to save battery power. If the power shutdown feature is not used then pin 14 may be left floating with no wire connected to it. If a wire is connected such as in the AIR supplied cable, it should be grounded to prevent stray capacitively coupled signals from asserting the +SHUTDOWN pin.

1.3 CONNECTING THE SERIAL INTERFACE

The serial port is used to interface the barometer to a serial device like a printer, a CRT terminal, or a data acquisition computer. Serial signals are available in both RS-232C and LSTTL voltage levels. The RS-232C Transmit Data signal is named -RSTXD and the RS-232C Data Terminal Ready is named -RSDTR. The LSTTL Transmit Data signal is named +LSTXD and the LSTTL Data Terminal Ready is named -LSDTR. The +LSTXD signal is capable of driving one TTL load. Voltage level specifications and pin numbers for the serial lines are given in Table 1.2. The protocol for each transmitted serial character is: one start bit, eight data bits, no parity and two stop bits.

If the external device is not ready to accept data when an average of measurements is completed then the barometer erases that measurement and goes on to make the next. Data will not be available again until another average is complete. For a successful data transfer to occur, the -RSDTR (-LSDTR) signal must be asserted at the time the barometer is ready to start transmitting a reading. The -RSDTR (-LSDTR) signal can be negated between characters to slow down transmission. Once transmission is begun, all characters must be sent before the barometer will begin the next measurement cycle.

If a Data Terminal Ready signal is not available from the external device, then -LSDTR pin 11 should be connected to ground to enable transmission. If both -RSDTR and -LSDTR are left unconnected, no data will be transmitted.

Note that the barometer is considered to be "Data Communication Equipment" (DCE) according to the EIA RS-232C specification because the data is originating at the barometer. Your device which is accepting data from the barometer is "Data Terminal Equipment" (DTE).

	Serial Transmitted Data	
	RS-232C	LSTTL
meaning	-RSTXD pin 2 voltage range	+LSTXD pin 1 voltage range
negated (logic 0)	+3v to +15v	0v to +.8v
asserted (logic 1)	-3v to -15v	2.4v to 5v
	Serial Data Terminal Ready	
	RS-232C	LSTTL
meaning	-RSDTR pin 12 voltage range	-LSDTR pin 11 voltage range
negated (not rdy)	+3v to +15v	2.4v to 5v
asserted (ready)	-3v to -15v	0v to +.8v

TABLE 1.2 SERIAL INTERFACE SPECIFICATIONS

CHOOSING BETWEEN LSTTL AND RS-232C SERIAL OUTPUT

When interfacing to an existing device with a RS-232C port the decision is simple, use the RS-232C levels. The only disadvantage is the higher power consumption, especially if the +shutdown signal is used. To obtain the RS-232C level output the two jumpers in the upper right of the digital pc board must be in place to enable the RS-232C level driver chip.

The LSTTL levels are more economically interfaced to and require less power, much less when the shutdown feature is used. You can only use LSTTL when the cable to the external device is less than a few feet. The actual distance depends upon the type of cable and baud rate. The LSTTL serial signals interface directly with common UART chips like the Motorola MC6850 ACIA.

1.4 CONNECTING THE PARALLEL INTERFACE

The parallel port is used to interface the barometer to an 8 line input port of a data acquisition computer. The data may be in ASCII or binary coded format and is transferred 8 bits at a time.

A two line handshake is used to synchronize transfers between the barometer and external device. The external device controls the +RFD (ready for data) signal and the barometer controls the +DAV (data valid) signal. The barometer writes the data on the 8 lines +D0, +D1, ... +D7. These 9 parallel output lines are each capable of driving 1 TTL load and should be connected to high impedance inputs. The +RFD signal can be driven by a LSTTL gate, a port on a CMOS or NMOS microcomputer or by a microprocessor interface chip. Table 1.3 shows the voltage levels for these interface lines.

Figure 1.1 shows the parallel transfer handshake sequence. It can be implemented in either hardware or software. The logic sequence used by the barometer for parallel transfers is:

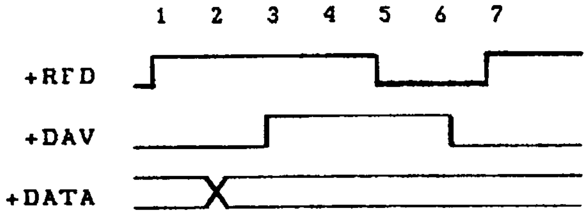
```
Do for each byte
    Wait for +RFD to become asserted.
    Put out data byte.
    Assert +DAV.
    Wait for +RFD to become negated.
    Negate +DAV.
End do
```

The complimentary logic sequence for the external device is:

```
Do for each byte
    Assert +RFD
    Wait for +DAV to become asserted
    Read one 8 bit byte
    Negate +RFD
    Wait for +DAV to become negated
End do
```

When the barometer finishes a measurement averaging cycle it tests the +RFD signal. If +RFD is negated, it begins another measurement cycle and the data is lost. If +RFD is asserted it begins a parallel data transfer sequence. Once a transfer is begun it must be completed before the barometer will begin another measurement. If the external device expects fewer bytes than the barometer sends and quits performing the handshake, the barometer will hang up.

Appendix D "Digital Board Schematic" shows the parallel interface electronics. The parallel signals are connected to the Motorola MC146805E2 microcomputer's parallel port pins. These pins, PA0 thru PA7 and PB0 thru PB7, are software programmable as either inputs or outputs. PA6 is an output and drives +DAV. PA7 is an input and receives +RFD. PB0 thru PB7 are outputs and drive +D0 thru +D7.



1 computer asserts +RFD
2 barom writes data byte
3 barom asserts +DAV
4 computer reads data byte
5 computer negates +RFD
6 barom negates +DAV
7 computer asserts +RFD

FIGURE 1.1 PARALLEL HANDSHAKE SEQUENCE

signal	meaning	voltage range
+DAV	negated (data not valid) asserted (data vaid)	0v to +.8v 2.4v to 5v
+RFD	negated (not ready for data) asserted (ready for data)	0v to +.8v 2.4v to 5v
+DATA	negated (logic 0) asserted (logic 1)	0v to +.8v 2.4v to 5v

TABLE 1.3 PARALLEL SIGNAL VOLTAGE LEVELS

1.5 PROTECTION FROM ABNORMAL VOLTAGES

Protect the barometer from abnormal voltages such as power surges and over/under voltages which might cause CMOS latch up or chip destruction. For example, you can protect the sensitive CMOS circuitry of the barometer from power line transients which might be passed through the external power supply with transient supressors attached to the power lines and to the serial and parallel data lines. The line of General Semiconductor Industries Inc. TransZorbs might be used to accomplish this kind of transient protection. These devices also supress some transients from near by lightning strikes.

You should also take precautions to avoid CMOS latch up of the chips on board the barometer or CMOS chips in external interface devices. Avoid applying voltages to the input lines, -LSDTR (+RFD), which are above +5.5 v or below -0.5 v. The output lines +D0, +D1, ... +D7, +DAV and +LSTXD should be connected only to high impedance inputs to avoid damage or latch up. The proper power up sequence is to make all signal inputs between -0.5v and +0.5v. About 400 milliseconds after power is applied, normal logic level signals may be applied. This also applies when negating the +SHUTDOWN with power already applied.

In some interfacing cases you may want to insert resistors in the signal lines between the barometer and the external device to minimize current which might be sourced to the barometer if the external signals can not be lowered to 0 volts when power is shut off. These resistors will prevent CMOS latch up of the chips in the barometer but their values must be low enough to prevent distortion of the data which is transferred from the barometer.

CMOS LATCH UP SUMMARY

To avoid CMOS latch up on power up, make certain that the voltage on each interface signal pin is between -0.5v and +0.5v with respect to ground.

For more information on interfacing to CMOS devices and a treatment of the latch up problem refer to the COS/MOS Integrated Circuits Manual by RCA, CMS-272.

2. SELECTING A MODE OF OPERATION

The barometer may operate in one of 4 modes. The mode is determined at power up by the jumpers inside the aluminum housing. After you position the jumpers, you must turn the barometer off and then on to enter the new mode. The following list summarizes each mode.

1) Barometer mode

In this mode the instrument operates as a pressure transducer and provides pressure readings. You may select the units of pressure, the number of measurements to average, and either serial or parallel data outputs. Tables 2.1 and 2.2 show the available jumper options.

2) Altimeter mode

In this mode the instrument operates as a pressure altimeter and provides pressure altitude or pressure altitude and pressure. You may select the units of altitude and pressure, the number of measurements to average, and either serial or parallel data outputs. Tables 2.3 and 2.4 show the available jumper options.

3) Altimeter setting mode

In this mode the instrument operates to provide altimeter setting. The indicated altimeter setting is accurate when the barometer is operated at a specific elevation above sea level. This elevation is specified at the time of order and is stored in the instrument during the calibration procedure. If no elevation was specified then 0 is assumed and the altimeter setting is accurate only at sea level. The units of altimeter setting are always in(Hg). You may select the number of measurements to average, and either serial or parallel data outputs. The pressure reading in in(Hg) follows each altimeter setting reading. Tables 2.5 and 2.6 show the available jumper options.

4) Test mode

The test mode is used for calibration and troubleshooting. You may select an ASCII coded serial output of raw data, raw data accompanied by the computed pressure, serial number identification information, or a digital test mode for troubleshooting. Table 2.7 shows the available jumper options.

2.1 GENERAL INFORMATION ABOUT THE MODES

The available pressure units are millibars, inches of Hg, millimeters of Hg, and PSIA. Pressure altitude is in either feet or meters. Altimeter setting is always inches of Hg.

The number of measurements averaged can be 1, 10, 100 or 1000. At approximately 10 measurements per second, data is output about every .1, 1, 10 or 100 seconds. The measurement time varies slightly with pressure and temperature.

Serial Data is transmitted at 110, 300, 1200 or 9600 baud, with either RS-232C or LSTTL voltage levels. All data are transmitted as ASCII strings suitable for use with a printer or computer. Numbers are converted to ASCII decimal and the most significant digit sent first. The string includes an embedded decimal point and terminates with carraige return and line feed <cr><lf>. The external device controls the DTR (Data Terminal Ready) signal to enable or disable the transfer of characters.

Parallel data tansmission requires an interactive handshake from an external device. The external device controls the RFD (ready for data) line and the barometer controls the DAV (data valid) line. Data are transmitted as either ASCII strings or as binary numbers. The ASCII strings have the same format as with serial transmission. Numbers are converted to ASCII decimal and the most significant digit sent first. The string includes an embedded decimal point and terminates with carraige return and line feed <cr><lf>.

The parallel binary format is a 24 bit integer transmitted as three bytes with the most significant byte sent first. The floating point number in the barometer is scaled by powers of ten to preserve decimal place accuracy and converted to a 24 bit integer.

2.2 SETTING THE MODE JUMPERS

The options jumpers are located inside the aluminum cover on the top printed circuit board. First remove power to the barometer. Now remove the 4 socket head screws on the side of the cylindrical aluminum cover. Then carefully pull the housing until it slides over the O-ring gasket. A slight twisting and pulling motion works best. There is a cable from the housing to the printed circuit board so don't twist more than about 20 degrees. Lift the housing off and to one side being careful not to stress the cable or short the electronics. Now hold the instrument with the jumper block nearest you so that you can read the label "AIR Inc." at the bottom of the PC board. Jumper #0 is at the right and jumper #7 is at the left. You select a jumper value of 1 by connecting an upper pair of pins with a jumper and a 0 by connecting a lower pair of pins. All 8 jumpers must be installed for reliable operation.

Two more jumpers are just above the ribbon cable connector. They must be in place for RS-232C serial data formats. When RS-232C is not in use, they may be removed to reduce power requirements. Figure 2.1 shows the location of all jumpers.

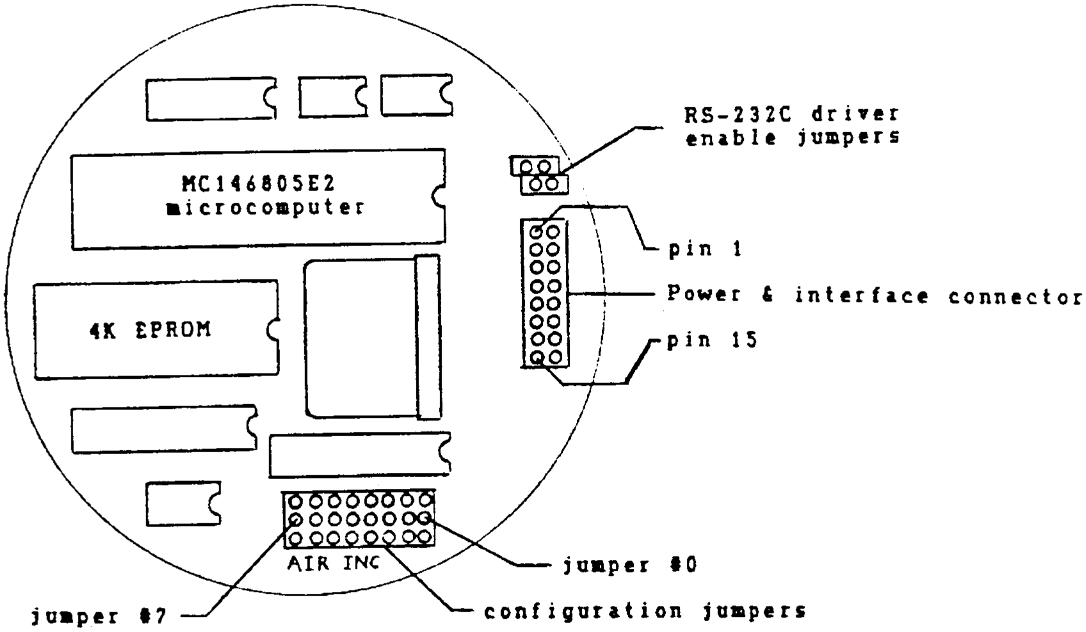


FIGURE 2.1 LOCATION OF JUMPERS ON DIGITAL BOARD

The following tables show you how to specify the modes and options with the jumpers. The abbreviations used are:

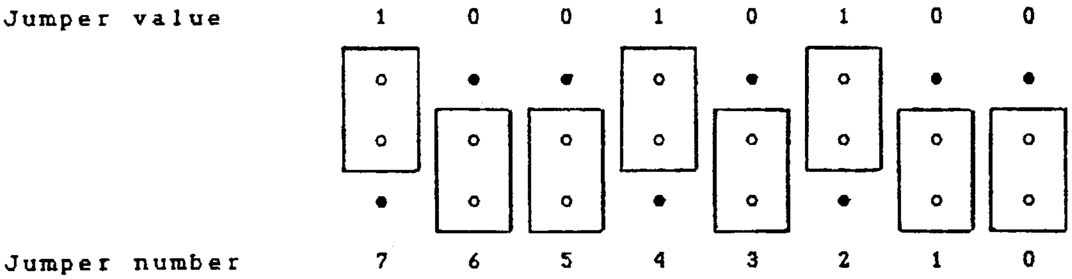
b = binary/ASCII coded parallel output
n = number of measurements to average
r = baud rate
t = test to run
u = units of output
* = don't care, jumper must be installed

2.3 BAROMETER MODE WITH SERIAL OUTPUT

Jumper #		7 6	5 4	3 2	1 0
Jumper use		units	baud rate	number average	serial barom
Serial Barometer		u u	r r	n n	0 0
Number of measurements averaged	1	u u	r r	0 0	0 0
	10	u u	r r	0 1	0 0
	100	u u	r r	1 0	0 0
	1000	u u	r r	1 1	0 0
Serial output baud rate	9600	u u	0 0	n n	0 0
	1200	u u	0 1	n n	0 0
	300	u u	1 0	n n	0 0
	110	u u	1 1	n n	0 0
Units of output	mb	0 0	r r	n n	0 0
	in(Hg)	0 1	r r	n n	0 0
	mm(Hg)	1 0	r r	n n	0 0
	PSIA	1 1	r r	n n	0 0

TABLE 2.1 SERIAL BAROMETER JUMPER CONFIGURATIONS

The following example selects barometer mode with serial output (jumpers 0 & 1), 1200 baud (jumpers 4 & 5), average 10 measurements (jumpers 2 & 3), and pressure units of mm(Hg) (jumpers 6 & 7).



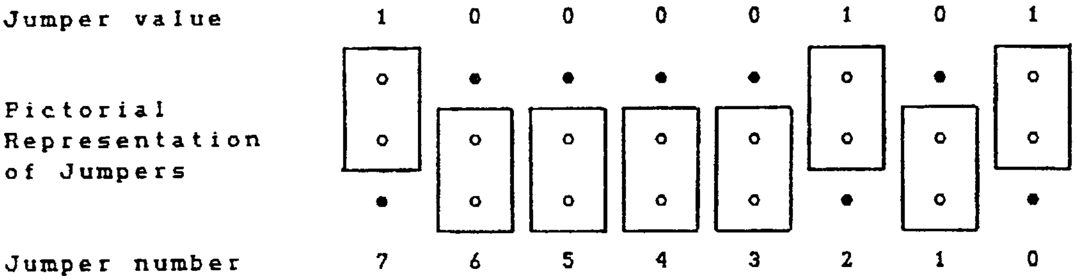
The two jumpers just above the ribbon cable connector must be in place for RS-232C serial data outputs.

2.4 BAROMETER MODE WITH PARALLEL OUTPUT

Jumper #	7	6	5	4	3	2	1	0
Jumper use	units		par bar	binry ASCII	number average		parallel barom	
Parallel Barometer	u	u	0	b	n	n	0	1
Number of 1	u	u	0	b	0	0	0	1
measurements 10	u	u	0	b	0	1	0	1
averaged 100	u	u	0	b	1	0	0	1
1000	u	u	0	b	1	1	0	1
ASCII coded output	u	u	0	0	n	n	0	1
Binary coded output	u	u	0	1	n	n	0	1
Units of mb	0	0	0	b	n	n	0	1
output in(Hg)	0	1	0	b	n	n	0	1
mm(Hg)	1	0	0	b	n	n	0	1
PSIA	1	1	0	b	n	n	0	1

Table 2.2 PARALLEL BAROMETER JUMPER CONFIGURATIONS

The following example selects barometer mode with parallel output (jumpers 0, 1 & 5); ASCII coded output (jumper 4); average 10 measurements (jumpers 2 & 3); and pressure units of mm(Hg) (jumpers 6 & 7).

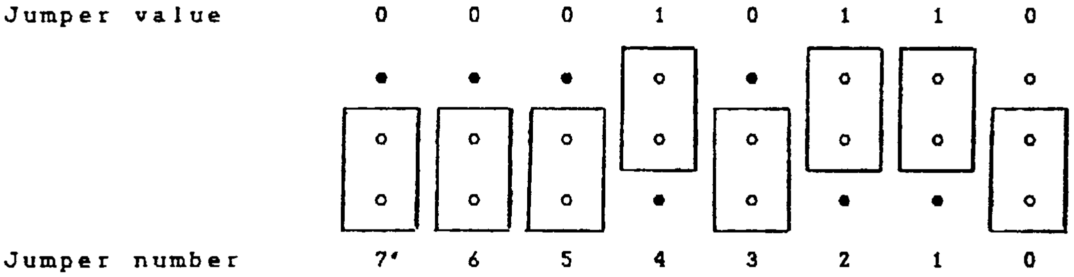


2.5 PRESSURE ALTIMETER MODE WITH SERIAL OUTPUT

Jumper #		7	6	5	4	3	2	1	0
Jumper use		units		baud rate		number average		serial altimetr	
Serial Altimeter		u	u	r	r	n	n	1	0
Number of	1	u	u	r	r	0	0	1	0
measurements	10	u	u	r	r	0	1	1	0
averaged	100	u	u	r	r	1	0	1	0
	1000	u	u	r	r	1	1	1	0
Serial	9600	u	u	0	0	n	n	1	0
output	1200	u	u	0	1	n	n	1	0
baud rate	300	u	u	1	0	n	n	1	0
	110	u	u	1	1	n	n	1	0
Units of	ft	0	0	r	r	n	n	1	0
output	m	0	1	r	r	n	n	1	0
	ft/in(Hg)	1	0	r	r	n	n	1	0
	m/mb	1	1	r	r	n	n	1	0

Table 2.3 SERIAL ALTIMETER JUMPER CONFIGURATIONS

The following example selects altimeter mode with serial output (jumpers 0 & 1), average 10 measurements (jumpers 2 & 3), 1200 baud (jumpers 4 & 5), and altitude units of feet (jumpers 6 & 7).



The two jumpers just above the ribbon cable connector must be in place for RS-232C serial data outputs.

2.6 PRESSURE ALTIMETER MODE WITH PARALLEL OUTPUT

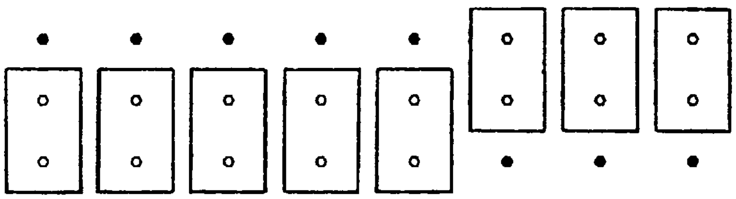
Jumper #	7	6	5	4	3	2	1	0
Jumper use	units		par alt	binry ASCII	number average		parallel altim	
Parallel Altimeter	u	u	0	b	n	n	1	1
Number of 1	u	u	0	b	0	0	1	1
measurements 10	u	u	0	b	0	1	1	1
averaged 100	u	u	0	b	1	0	1	1
1000	u	u	0	b	1	1	1	1
ASCII coded output	u	u	0	0	n	n	1	1
Binary coded output	u	u	0	1	n	n	1	1
Units of ft	0	0	0	b	n	n	1	1
output m	0	1	0	b	n	n	1	1
ft/in(Hg)	1	0	0	b	n	n	1	1
m/mb	1	1	0	b	n	n	1	1

TABLE 2.4 PARALLEL ALTIMETER JUMPER CONFIGURATIONS

The following example selects altimeter mode with parallel output (jumpers 0, 1 & 5), average 10 measurements (jumpers 2 & 3), ASCII coding (jumper 4), and altitude units of feet (jumpers 6 & 7).

Jumper value 0 0 0 0 0 1 1 1

Pictorial representation of jumpers.



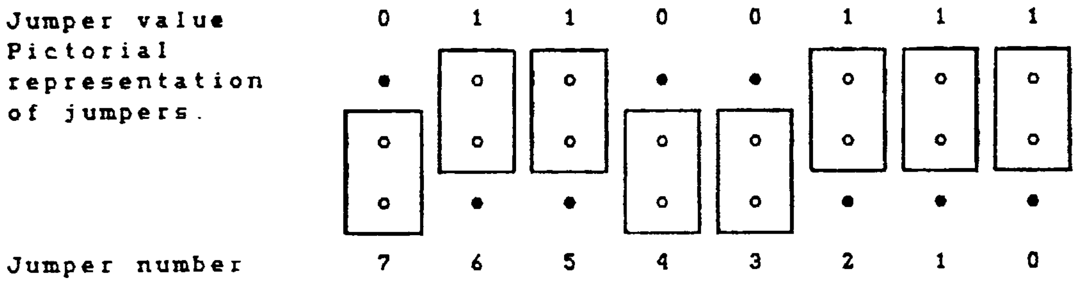
Jumper number 7 6 5 4 3 2 1 0

2.7 ALTIMETER SETTING MODE WITH SERIAL OUTPUT

Jumper # Jumper use		7 6 baud rate	5 4 serial alt set	3 2 number average	1 0 altimetr setting
Serial altimeter setting		r r	1 0	n n	1 1
Number of measurements averaged	1	r r	1 0	0 0	1 1
	10	r r	1 0	0 1	1 1
	100	r r	1 0	1 0	1 1
	1000	r r	1 0	1 1	1 1
Serial output baud rate	9600	0 0	1 0	n n	1 1
	1200	0 1	1 0	n n	1 1
	300	1 0	1 0	n n	1 1
	110	1 1	1 0	n n	1 1

TABLE 2.5 SERIAL ALTIMETER SETTING JUMPER CONFIGURATIONS

The following example selects altimeter setting mode with serial output (jumpers 0, 1, 4 & 5), average 10 measurements (jumpers 2 & 3), 1200 baud (jumpers 6 & 7). The units are always in(Hg).



The altitude of the site where the instrument is to be used has been entered at the factory during the custom calibration procedure.

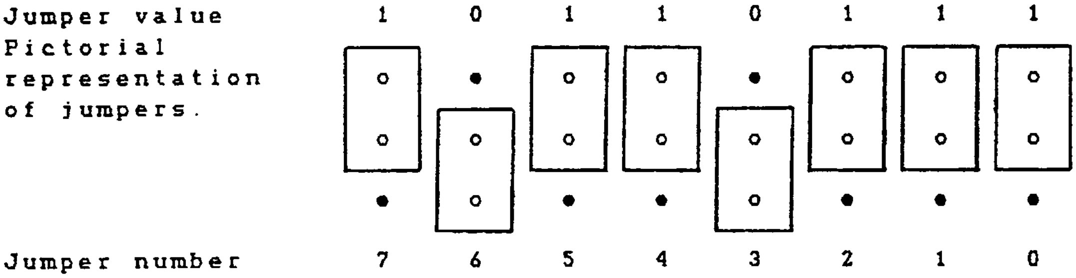
The two jumpers just above the ribbon cable connector must be in place for RS-232C serial data outputs.

2.8 ALTIMETER SETTING MODE WITH PARALLEL OUTPUT

Jumper # Jumper use	7 6 don't care	5 4 parallel alt set	3 2 number average	1 0 parallel alt set
Parallel altimeter setting	* *	1 1	n n	1 1
Number of measurements averaged 1	* *	1 1	0 0	1 1
10	* *	1 1	0 1	1 1
100	* *	1 1	1 0	1 1
1000	* *	1 1	1 1	1 1

TABLE 2.6 PARALLEL ALTIMETER JUMPER CONFIGURATIONS

The following example selects altimeter setting mode with parallel output (jumpers 0, 1, 4 & 5), and average 10 measurements (jumpers 2 & 3). The units are always in(Hg) and the output format is always ASCII coded decimal. Note that even though jumpers 6 and 7 are "don't cares" they must still be in place.



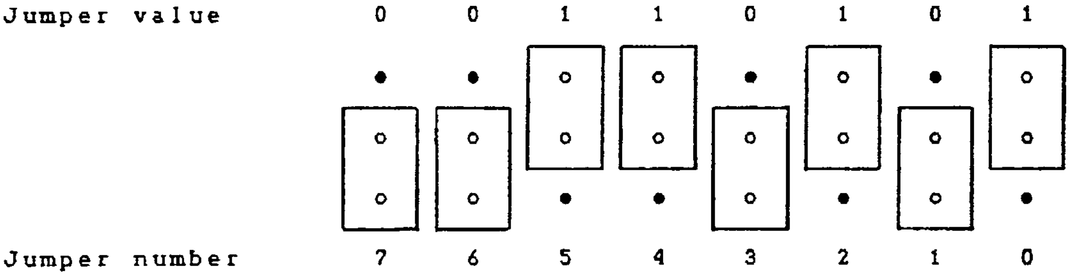
The altitude of the site where the instrument is to be used has been entered at the factory during the custom calibration procedure.

2.9 TEST MODE WITH SERIAL OUTPUT

Jumper # Jumper use	7 6 baud rate	5 4 test mode	3 2 number average	1 0 test mode
Test mode	r r	1 1	t t	0 1
Raw data/pressure	r r	1 1	0 0	0 1
Serial ID test	r r	1 1	0 1	0 1
Signature analys	r r	1 1	1 0	0 1
Raw data	r r	1 1	1 1	0 1
Serial 9600	0 0	1 1	t t	0 1
output 1200	0 1	1 1	t t	0 1
baud rate 300	1 0	1 1	t t	0 1
110	1 1	1 1	t t	0 1

TABLE 2.7 SERIAL TEST JUMPER CONFIGURATIONS

The following example selects the serial test mode (jumpers 0, 1, 4 & 5), identification test (jumpers 2 & 3), 9600 baud (jumpers 6 & 7).



The two jumpers just above the ribbon cable connector must be in place for RS-232C serial data outputs.

The test mode is used to service the barometer at the factory or in the field. There are tests for the serial output, for the analog circuitry, for factory calibration and for signature analysis. A description of the four tests follows.

1) Serial ID test - This test is used to identify the instrument and to test the serial output independently of the other circuitry. The first number is the calibration code consisting of the year, month, day, hour and test position of last calibration. Next is a hardware serial number, the software revision date, and the altitude in feet of the site for which the altimeter setting mode is set. A sample output is:
8401271701 00013 02/27/84 Alt=5280.

2) Raw data and pressure in mb - This test is used to verify that the front end analog circuits are working properly. The serial output consists of four raw counts used to calculate pressure followed by the calculated pressure in millibars. A sample output is:

```
*63319.  44408.  47570.  28063. 838.09
```

The first number is the high reference and should be the largest. It is insensitive to temperature and pressure. The second number is sensitive to pressure. Increase pressure to increase the number or decrease pressure to decrease the number. The third number is sensitive to temperature. Increase temperature to decrease the number or decrease temperature to increase the number. The fourth number is the low reference and should be the smallest. It is insensitive to temperature and pressure. The last number is the pressure computed from the previous 4 numbers and the calibration coeficients stored in ROM.

3) Raw data - This test is used for factory calibration. It is the same as test 1 without the pressure output. A sample output is:

```
*63319.  44408.  47570.  28063.
```

4) SA test - The signature analysis test is used by an electronics technician to locate faults in a defective barometer. By using this test and a digital signature analyzer, the technician may isolate and replace bad integrated circuits.

3. READING DATA FROM THE BAROMETER

3.1 MEASUREMENT AND DATA TRANSFER CYCLE

Refer to Figure 3.1 "Barometer Sequence of Operation" as you read this section. At power up, the barometer reads the configuration jumpers and initializes the hardware. It then enters the measurement and data transfer cycle. The specified number of measurements are made and summed. This takes from approximately 0.1 to 100 seconds depending on the number. Next it computes the average pressure and, if required, the altitude or altimeter setting. Appendix C "Computational Procedures", contains the relevant formulas. Finally it converts to the proper units and output format to complete the measurement part.

If the external device is not ready then another measurement cycle begins and the data is lost. If the external device is ready then the first byte or character is output. The transfer continues until all bytes or characters are output. Another cycle then begins.

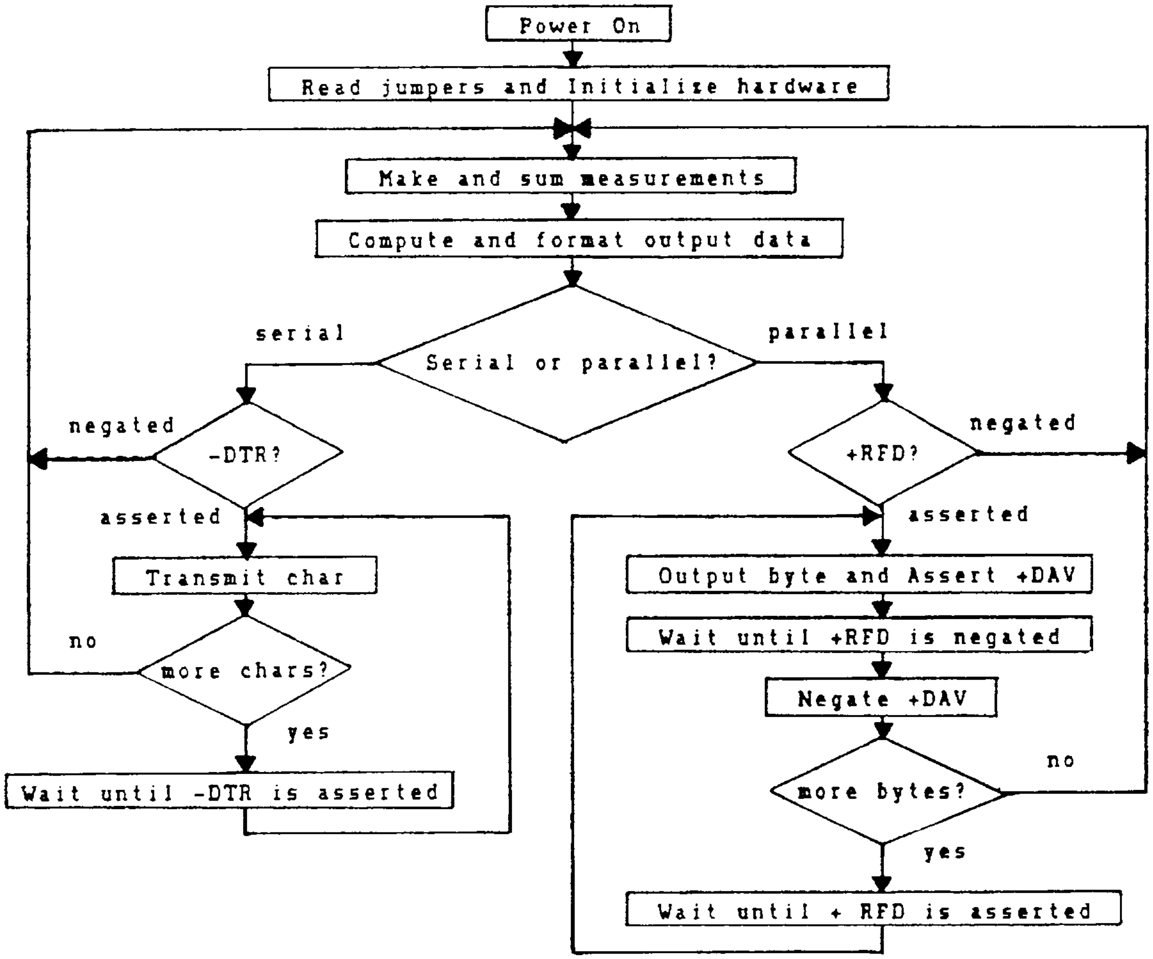


FIGURE 3.1 BAROMETER SEQUENCE OF OPERATIONS

3.2 ASCII CODED FORMATS

All ASCII formated numbers in the barometer, altimeter and altimeter setting modes are right justified in a 7 character field with an embedded decimal point. The numbers in the test mode are left justified in a variable width field with an embedded decimal point. The symbols <cr> and <lf> denote a carraige return and linefeed. The # symbol represents a leading blank or a digit.

The external computer should read characters until it detects a <lf>. The output formats are shown in Table 3.1.

BAROMETER MODE

units	output format	sample output
mb	####.##<cr><lf>	1013.25<cr><lf>
in(Hg)	###.###<cr><lf>	29.921<cr><lf>
mm(Hg)	####.##<cr><lf>	760.04<cr><lf>
PSIA	##.####<cr><lf>	16.6921<cr><lf>

ALTIMETER MODE

units	output format	sample output
ft	######.<cr><lf>	5139.<cr><lf>
m	#####.#<cr><lf>	1566.4<cr><lf>
ft/in(Hg)	######. ###.###<cr><lf>	5139. 25.057<cr><lf>
m/mb	#####.# ####.##<cr><lf>	1566.4 848.52<cr><lf>

ALTIMETER SETTING MODE

units	in(Hg)
output format	P=###.### AS=###.###<cr><lf>
sample output	P= 21.114 AS= 21.114<cr><lf>

TEST MODE

test	output format
Serial ID	YYMMDDhhcc sssss MM/DD/YY ALT=#####.<cr><lf>
Raw data	*#####. #####. #####. #####.<cr><lf>
Raw data w P	*#####. #####. #####. #####. ####.##<cr><lf>
Signature	no serial output
	sample output
Serial ID	8404211302 00013 04/13/84 ALT=0.<cr><lf>
Raw data	*63287. 44387. 47595. 28044.<cr><lf>
Raw data w	*63287. 44387. 47595. 28044. 864.78<cr><lf>
Signature	no serial output

TABLE 3.1 ASCII CODED OUTPUT DATA FORMATS

3.3 BINARY CODED FORMATS

The parallel binary format is a 24 bit integer transmitted as three bytes with the most significant byte sent first. The floating point number in the barometer is scaled by powers of ten to preserve decimal place accuracy and converted to a 24 bit integer. For example, the reading of 987.35 mb would be transmitted as a binary representation of the decimal number 987350. In binary the 3 bytes are 00001111 00010000 11010110. Those modes such as altimeter setting which transmit two numbers will send two 24 bit integers as 6 bytes.

The external computer must read the number of bytes as specified in Table 3.3. Each byte must be acknowledged by the external device before the barometer transmits the next. Table 3.2 shows the scale factor used for the various units of output. One possible formula for reconstruction of the floating point representation is:

F = ((B1 * 256.0 + B2) * 256.0 + B1) / SF

where F = floating point representation
B1 = most significant binary byte
B2 = next most significant binary byte
B3 = least significant binary byte
SF = scale factor from Table 3.2

UNITS	SCALE FACTOR	UNITS	SCALE FACTOR
mb	1000.0	ft	10.0
in(Hg)	10000.0	m	100.0
mm(Hg)	1000.0		
PSIA	100000.0		

TABLE 3.2 PARALLEL BINARY SCALE FACTORS

		BAROMETER MODE		
units	internal value	number of bytes	sample output in decimal	sample output in hexadecimal
mb	1013.250	3	1013250	0F 76 02
in(Hg)	29.9214	3	299214	04 90 CE
mm(Hg)	760.043	3	760043	0B 98 EB
PSIA	16.69128	3	1669218	19 78 62
		ALTIMETER MODE		
units	internal values	# of bytes	sample output in decimal	sample output in hexadecimal
ft	5139.3	3	51393	00 C8 C1
m	1566.42	3	156642	02 63 E2
ft/inHg	5139.3 25.0576	6	51393 250576	00 C8 C1 03 D2 D0
m/mb	1566.41 848.529	6	156641 848529	02 63 E2 0C F2 91

TABLE 3.3 PARALLEL DATA FORMATS

4. INSTALLATION

4.1 MECHANICAL CONNECTIONS

The barometer is supplied with mounting hardware which may be attached at either of two locations on the body. The orientation of the barometer is not important. Care should be taken that the barometer is not mounted to a significant heat source or sink which might produce large thermal gradients. A difference in temperature between the pressure sensor and temperature sensor causes an error in pressure of approxiametely 0.1 mb per degree centigrade. The standard pressure port consists of a 3/16" OD x 1/8" ID x 5/8" long NPT brass fitting for use with 3/16" I.D. flexible tubing.

4.2 ENVIRONMENTAL CONSIDERATIONS

Moisture should not be allowed to condense on the pressure sensor or accumulate within the sensor chamber. Condensation can be avoided by keeping the barometer above the dewpoint or by using a dessicant to dry the sample air.

Each barometer is calibrated over a specific range of pressure and temperature, and may not be accurate outside that range. The sensor is designed for use at pressures between 0 and 38.4 in(Hg) or 1300 mb. Higher pressures may permanently change the sensor thus altering the accuracy.

APPENDIX A. QUICK REFERENCE SHEET

	Jumper #	7	6	5	4	3	2	1	0
Barometer mode with serial output		u	u	r	r	n	n	0	0
Barometer mode with parallel output		u	u	0	b	n	n	0	1
Altimeter mode with serial output		u	u	r	r	n	n	1	0
Altimeter mode with parallel output		u	u	0	b	n	n	1	1
Altimeter setting mode with serial output		r	r	1	0	n	n	1	1
Altimeter setting mode with parallel output		*	*	1	1	n	n	1	1
Test mode with serial output		r	r	1	1	t	t	0	1
Units of output - Barometer modes	mb	0	0	-	-	-	-	-	-
	in(Hg)	0	1	-	-	-	-	-	-
	mm(Hg)	1	0	-	-	-	-	-	-
	PSIA	1	1	-	-	-	-	-	-
Units of output - Altimeter modes	ft	0	0	-	-	-	-	-	-
	m	0	1	-	-	-	-	-	-
	ft/in(Hg)	1	0	-	-	-	-	-	-
	m/mb	1	1	-	-	-	-	-	-
Number of measurements averaged - All modes	1	-	-	-	-	0	0	-	-
	10	-	-	-	-	0	1	-	-
	100	-	-	-	-	1	0	-	-
	1000	-	-	-	-	1	1	-	-
Serial output baud rate - Barometer mode and Altimeter mode	9600	-	-	0	0	-	-	-	-
	1200	-	-	0	1	-	-	-	-
	300	-	-	1	0	-	-	-	-
	110	-	-	1	1	-	-	-	-
Serial output baud rate - Altimeter setting mode and Test mode	9600	0	0	-	-	-	-	-	-
	1200	0	1	-	-	-	-	-	-
	300	1	0	-	-	-	-	-	-
	110	1	1	-	-	-	-	-	-
Parallel output data format - All modes	ASCII	-	-	-	0	-	-	-	-
	Binary	-	-	-	1	-	-	-	-
Test mode tests -	Raw data/press (mb)	-	-	-	-	0	0	-	-
	Serial ID test	-	-	-	-	0	1	-	-
	SA test	-	-	-	-	1	0	-	-
	Raw data	-	-	-	-	1	1	-	-

Key to table abbreviations -

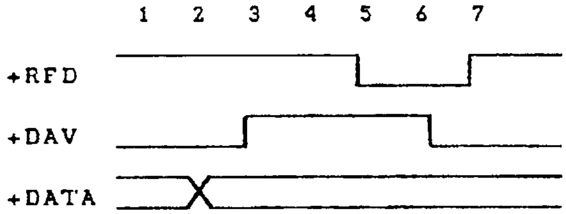
r = Serial output baud rate.
n = Number of measurements to be averaged.
b = Format of parallel output - binary/ASCII coded.
u = Units of output.
* = Don't care - jumpers must be in place however.
t = Test type.

MODE SELECTION JUMPERS

QUICK REFERENCE SHEET

pin	wire color	serial data use	parallel data use	signal dir
1	WHT	+LSTXD	+DAV	out
2	RED	-RSTXD	nc	out
3	BLK	nc	+D0	out
4	BLU	nc	+D1	out
5	GRN	nc	+D2	out
6	ORG	nc	+D3	out
7	WHT/RED	nc	+D4	out
8	RED/BLK	nc	+D5	out
9	BLK/RED	nc	+D6	out
10	BLU/WHT	nc	+D7	out
11	GRN/BLK	-LSDTR	+RFD	in
12	ORG/RED	-RSDTR	nc	in
13	WHT/GRY	GROUND	GROUND	
14	RED/GRN	+SHUTDOWN	+SHUTDOWN	in
15	BLU/BLK	+8 TO +16	+8 to +16	
16	GRN/WHT	-8 TO -16	nc	

CABLE AND CONNECTOR PIN ASSIGNMENTS



1 computer asserts +RFD
2 barom writes data
3 barom asserts +DAV
4 computer reads data
5 computer negates +RFD
6 barom negates +DAV
7 computer asserts +RFD

PARALLEL TIMING DIAGRAM

BAROMETER MODE

units	output format
mb	####.##<cr><lf>
in(Hg)	###.###<cr><lf>
mm(Hg)	####.##<cr><lf>
PSIA	##.####<cr><lf>

ALTIMETER MODE

units	output format
ft	######.<cr><lf>
m	#####.#<cr><lf>
ft/in(Hg)	######. ###.###<cr><lf>
m/mb	#####.# ####.##<cr><lf>

ALTIMETER SETTING MODE

units	output format
in(Hg)	P=###.### AS=###.###<cr><lf>

TEST MODE

test	output format
Serial ID	cccccccccc sssss vv/vv/vv ALT=######.<cr><lf>
Raw data	*######. #####. #####. #####.<cr><lf>
Raw data & P	*######. #####. #####. #####. ####.##<cr><lf>
SA	no serial output

OUTPUT DATA FORMATS

APPENDIX B. SPECIFICATIONS

GENERAL SPECIFICATIONS

Pressure Resolution: 0.01 mb (0.001 in Hg)
Altitude Resolution: 0.1 m (1 ft)
Max. Operating Pressure: 1300 mb (38.4 in Hg)
Operating Modes: Barometer, Altimeter
Altimeter Setting, Test
Selectable Data Units: Pressure - mb, in Hg, mm Hg, psia
Altitude - feet, meters
Altimeter Setting - in Hg
Sampling Rate (max): 10/second
Selectable Averaging: 1, 10, 100, 1000 samples/average
Selectable Interfaces: RS-232C or LSTTL Serial
(110, 300, 1200, 9600 baud)
Parallel (8-bit with handshaking)
Data Format: Serial ASCII, Parallel ASCII or binary
Power Requirements: RS-232C +11 to +16 & -11 to -16 vdc
14.5 ma (oper), 8.5 ma (stdby)
LSTTL Serial or parallel +8 to +16 vdc
6.3 ma (oper), 10 ua (stdby)
Connector: AMP CPC 207292-1
Size: Length - 3.5 in (8.9 cm)
Diameter - 3.5 in (8.9 cm)
Weight: 20.5 oz (0.58 kg)
Finish: Black Anodized Aluminum

APPENDIX C. COMPUTATIONAL PROCEDURES

The indicated pressure output by the barometer is derived from four seperate internal measurements of capacitance. Two measurements sense pressure and temperature. The other two compensate for drift in the analog electronics. These four measurements are used as independent variables in a pressure transfer function. The coefficients of the transfer function are unique for each barometer and are determined by calibration. They are stored in the ROM of the microcomputer. The microcomputer executes floating point routines to evaluate the transfer function, convert to the selected units and compute altitude or altimeter setting.

The indicated altitude is based on the U.S. Standard Atmosphere, 1976. In this model of the atmosphere, altitude is a function of pressure alone. The equation for altitude is:

$$H = 44330.77 * (1.0 - (P / 1013.25) ** .19026)$$

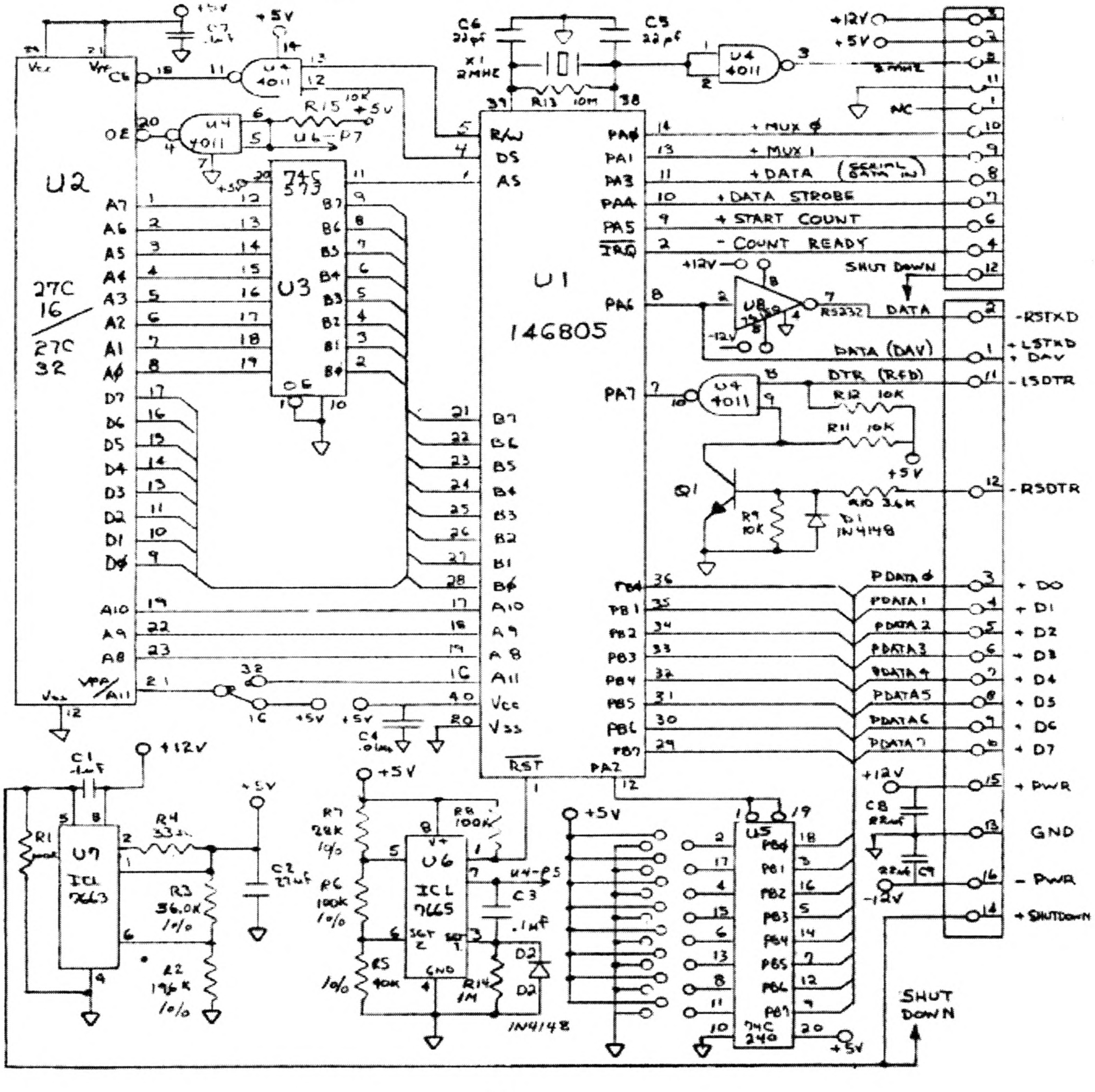
where H = altitude in meters
P = pressure in millibars

The indicated altimeter setting is also based on the U.S. Standard Atmosphere, 1976. The equation for altimeter setting is:

$$A.S. = 0.02953 * \exp(\mathrm{Ln}(P) - \mathrm{Ln}(1.0 - EL / 44330.77) / 0.19026)$$

where P = pressure in millibars
EL = elevation in meters stored in ROM during calibration
A.S. = altimeter setting in(Hg)

APPENDIX D. DIGITAL BOARD SCHEMATIC



APPENDIX E. DIGITAL BAROMETER INTERNAL CABLE DIAGRAM

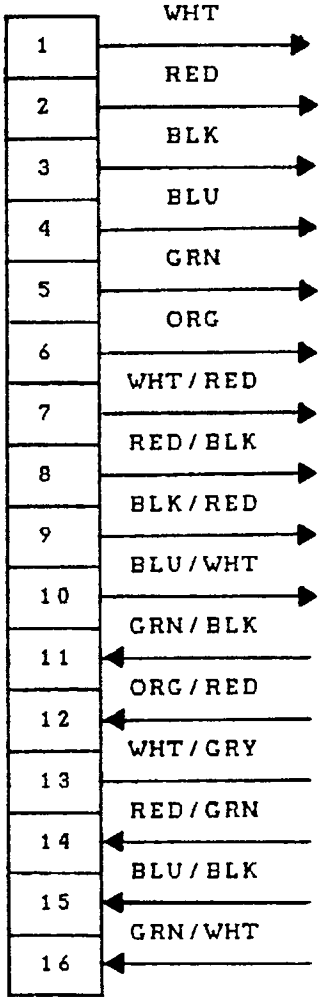
AMP pin	wire color	MOLEX pin	serial output use	parallel output use	signal dir
1	BRN-1	1	+LSTXD	+DAV	out
2	RED-1	2	-RSTXD	nc	out
3	ORG-1	3	nc	+D0	out
4	YEL-1	4	nc	+D1	out
5	GRN-1	5	nc	+D2	out
6	BLU-1	6	nc	+D3	out
7	VIO-1	7	nc	+D4	out
8	GRA-1	8	nc	+D5	out
9	WHT-1	9	nc	+D6	out
10	BLK-1	10	nc	+D7	out
11	BRN-2	11	-LSDTR	+RFD	in
12	RED-2	12	-RSDTR	nc	in
13	ORG-2	13	GROUND	GROUND	
14	YEL-2	14	+SHUTDOWN	+SHUTDOWN	in
15	GRN-2	15	+8 TO +16v	+8 to +16v	
16	BLU-2	16	-8 TO -16v	nc	

AMP CPC
206404-1
Male
Connector

MOLEX
15-25-1561
Female
Connector

5 inch x 16 conductor
ribbon cable

APPENDIX F. DIGITAL BAROMETER EXTERNAL CABLE DIAGRAM



pin	wire color	serial output use	parallel output use	signal dir
1	WHT	+LSTXD	+DAV	out
2	RED	-RSTXD	nc	out
3	BLK	nc	+D0	out
4	BLU	nc	+D1	out
5	GRN	nc	+D2	out
6	ORG	nc	+D3	out
7	WHT/RED	nc	+D4	out
8	RED/BLK	nc	+D5	out
9	BLK/RED	nc	+D6	out
10	BLU/WHT	nc	+D7	out
11	GRN/BLK	-LSDTR	+RFD	in
12	ORG/RED	-RSDTR	nc	in
13	WHT/GRY	GROUND	GROUND	
14	RED/GRN	+SHUTDOWN	+SHUTDOWN	in
15	BLU/BLK	+8 TO +16v	+8 to +16v	
16	GRN/WHT	-8 TO -16v	nc	

AMP CPC 207292-1
Female Connector

7 foot x 16 conductor cable

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VLBA Weather Station

Appendix 4

INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LVT-40 SERIES

DC OUTPUT — Voltage regulated for line and load. For voltage and current ratings see table I below.

TABLE I

MODEL	MAIN OUTPUT			2ND OUTPUT			3RD OUTPUT		
	VTGE RANGE (ADJ)	AMPS @ AMB. TEMP.		VTGE (NON-ADJ)	AMPS @ AMB. TEMP.		VTGE (NON-ADJ)	AMPS @ AMB. TEMP.	
		50°C	60°C		50°C	60°C		50°C	60°C
LVT-40-144B	+5V ±1%	2.0	1.0	+15 ±5%	0.3	0.15	-15 ±5%	0.2	0.1
LVT-40-133B	+5V ±1%	2.0	1.0	+12 ±5%	0.3	0.15	-12 ±5%	0.2	0.1
LVT-40-131B	+5V ±1%	2.0	1.0	+12 ±5%	0.3	0.15	-5 ±5%	0.2	0.1

Current range must be chosen to suit the appropriate ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation (line)	0.4% for input variations from 85-132 VAC or 132-85 volts AC, all outputs.
Regulation (load).	2% for load variations from no-load to full-load or full-load to no-load.
Ripple and Noise	150 mV peak-to-peak for 5V outputs; 300 mV peak-to-peak for 12V and 15V outputs; 15 m V rms for all outputs.
Temperature Coefficient	0.02%/°C for main output; 0.03%/°C for 2nd and 3rd outputs.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off or power failure.

AC INPUT — 85-132 volts AC at 47-440 Hz. Input power 25 watts maximum.* Ratings apply for 47-440 Hz input.
*With output loaded to full current rating and input voltage 132 volts AC at 60 Hz.

DC INPUT — 110-175 volts DC.

EFFICIENCY — 62% minimum.

OVERLOAD PROTECTION — Automatic electronic current limiting circuit with automatic recovery limits short circuit output current to a safe preset value, protecting load and power supply when direct shorts occur. Sustained short circuit operation for more than 30 seconds may cause power supply damage. Internal failure protection provided by fuse.

HOLD-UP TIME — Output will remain within regulation limits for at least 16.0 msec after loss of AC power at full-load with nominal output voltage and 85 VAC input at 60 Hz.

INPUT FUSE — Fuse F1, 2A Slo-Blo, in AC input line protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

INPUT AND OUTPUT CONNECTIONS — Molex type 5289-4A connector contains all terminals for AC input and ground, Molex type 5287-5A connector contains all terminals for DC output. AC input terminals are marked H and N for hot side and neutral respectively.

COOLING — Convection cooled; no external blowers required.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0° to +60°C with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE — -30°C to +85°C.

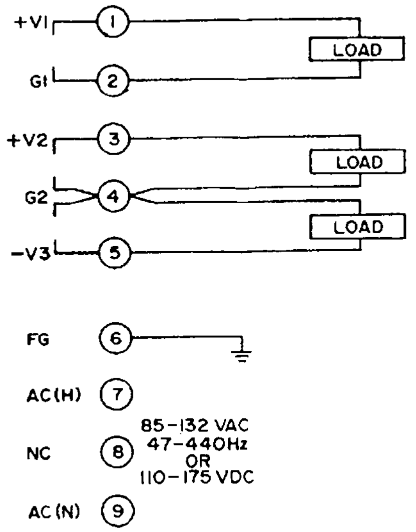
WARRANTY — 90 day warranty from date of shipment . . . . materials and labor.

OUTPUT STATUS INDICATOR — L.E.D. light indicates presence of voltage on the main output terminals.

PHYSICAL DATA

Size	3-13/16 x 1-3/8" x 4-31/64"
Weight	0.84 lbs. net; 1.0 lb. shipping
Finish	NICKEL PLATE, FED. STD. 595 No. 26081

MOUNTING — Two surfaces with threaded mounting holes can be utilized for mounting this unit. Air circulation is required when unit is mounted in confined area.



DC Output Connection Diagram

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VLBA Weather Station

Appendix 5

Hoffman
A Pentair Company

iHELPS On-Line Catalog System
PRODUCT DISPLAY

Home

Browse Product Families

Select Product

Bill of Materials

Modification Services

Technical Information

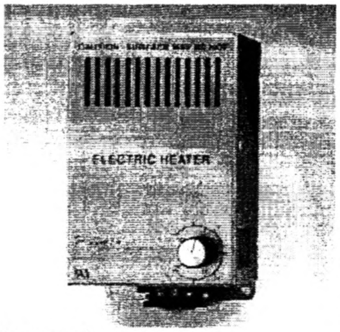
On-Line Help

Standard Terms and Conditions

Sales Channel Tools

Price List

General Accessories, Thermal Management Products, Heaters, Electric Heaters



Legend

- Application
- Construction
- Finish
- Notes
- Selection
- Standards
- Selection and Sizing
- Download Hoffman Thermal Management Selection Software
- More Thermal Management Products

Catalog No.	UPC/EDP No.	Bulletin	Description	Material	Footnotes	Weight	List Price
D-AH1001A	70530	D85	Heater 100 Watts, 115 Volt			2.50	$212.80
D-AH1002A	70540	D85	Heater 100 Watts, 230 Volt			2.50	$212.80
D-AH2001A	70550	D85	Heater 200 Watts, 115 Volt			2.50	$252.70
D-AH2002A	70560	D85	Heater 200 Watts, 230 Volt			2.50	$252.70
D-AH4001B	70570	D85	Heater 400 Watts, 115 Volt			3.00	$292.50
D-AH4002B	70580	D85	Heater 400 Watts, 230 Volt			3.00	$292.50
D-AH8001B	70590	D85	Heater 800 Watts, 115 Volt			3.00	$332.40
D-AH8002B	70600	D85	Heater 800 Watts, 230 Volt			3.00	$332.40

Application

Designed to protect sensitive mechanical, electrical, and electronic equipment from the harmful effects of condensation, corrosion, and low temperatures. Thermostatically controlled fan-driven heater units maintain a stable temperature within enclosures so critical components can perform more reliably over a longer period of time.

Construction

- Attractive and durable housing is anodized aluminum
- Thermostat, standard on all units, is adjustable from 0°F to 100°F (-18°C to

38°C)

- Fan draws cool air from the bottom of the enclosure and passes this air across the thermostat and heating elements before being released into enclosure cavity
- Heated air is discharged through the top of the heater unit
- Four 10-32 x self-tapping screws are included with each heater
- Ball bearing fan runs continuously for even temperature distribution
- Terminal block has three 6-32 screw terminals with barriers labeled for power and ground connections

Finish

Anodized aluminum.

Notes

Installation

Hoffman electric heaters should be centered as low as possible on an interior enclosure panel. This permits the unit to heat the cool air located at the bottom of the enclosure. For maximum efficiency, the heater should be mounted in a vertical position with the terminal block to the bottom and the air outlet openings at the top. However, the unit will also effectively distribute heat if turned 90 degrees with the terminal block out the bottom and the air outlet at the side. Although enclosure panels are preferable, heaters may be installed on any flat sheet metal surface. Do not install heaters on wood panels.

Heat sensitive components should not be placed near the heater discharge area since this air can be quite warm. The clearance range defines the space that must be kept free of these components for proper and safe operation of the heater.

Selection

Example

Which electric heater would most efficiently maintain a 60°F temperature in an uninsulated 24x24x10 enclosure that is exposed to a temperature not less than 30°F?

Step 1

Calculate the total enclosure surface area.

Area (sq. ft.) = 2(AxB)+(AxC)+(BxC) ÷144, where "A", "B", "C" are the dimensions of the enclosure.

In our example,

Area = 2(24x24)+(24x10)+(24x10)÷144

Step 2

Using the graphs, draw a vertical line through the enclosure surface area and determine the temperature rise given by each heater.

For enclosures exposed to windy conditions, heaters should be oversized by approximately 50%.

Step 3

Select the electric heater that achieves the desired temperature rise. In our example, the desired temperature rise is 30°F (60°F - 30°F). The 200 watt heater should be selected since its temperature rise (35°F) exceeds the requirement.

Standards

UL Component Recognized

CSA Listed

VLBA Technical Report 47

VLBA Weather Station

Appendix 6

REVISIONS

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
A	3-89	P. Harden		ADDED DATA TAP ASSY "A9" AND "PS1-J1"

CONTENTS

CONNECTOR	SHEET
A1J1	2
A1J2	3
A2J1	4,5
A3J1	6
A3J2	6
A3J3	6
A3J4	7
A3J5	6
A3J6	7
A3J7	6
A5J1	8

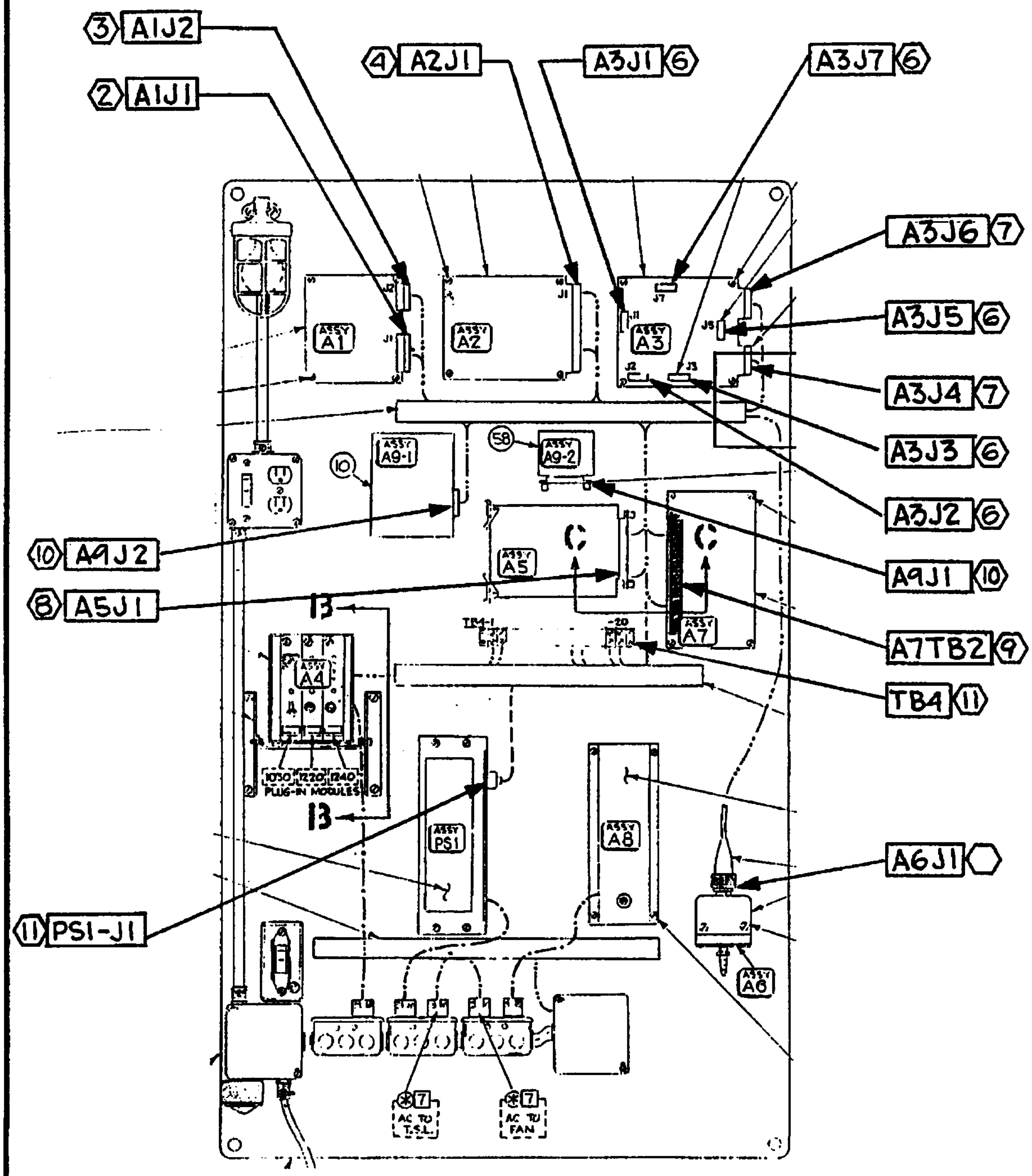
CONNECTOR	SHEET
A7TB1	9
A7TB2	9
A9J1	10
A9J2	10
PS1-J1	11
TB4	11

DRAWN BY Paul Harden	DATE JULY 1988
DESIGNED BY	DATE
APPROVED BY	DATE

D55006A007	JB2 MTG PLATE ASSY
NEXT ASSY	USED ON

NATIONAL RADIO ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

PROJECT VLBA WEATHER STATION
TITLE "JB2"
WIRE LIST
DWG NO. A55006W002 SHEET 1 OF 12



Wire List
Sheet #
Connector #
6 A3J1

SHEET
1
of

VLBA WEATHER STATION

Title "JB2"
WIRE LIST

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
Socorro, New Mexico

Drawn by Paul Harden 3-89

DWG. No. A55006W002

Date JULY 1988

VLBA WEATHER STATION | 2-88 PMH FILE: WL/A1 | **WIRE LIST**

REV. 7-88
3-89

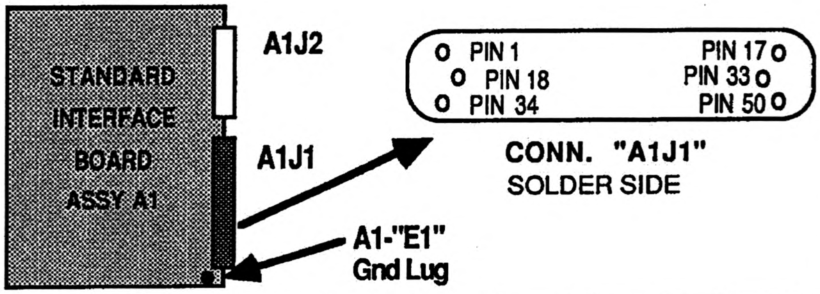
A1	A1J1	
ANLG0+	1	A1-E1 GND LUG
ANLG1+	2	A2J1-76
ANLG2+	3	A2J1-80
ANLG3+	4	A3J6-1
ANLG4+	5	A3J6-5
ANLG5+	6	A3J6-4
ANLG6+	7	A3J6-2
ANLG7+	8	A3J6-3
CM15	9	A2J1-43
CM13	10	A2J1-39
CM11	11	A2J1-35
CM9	12	A2J1-31
CM7	13	A2J1-44
CM5	14	A2J1-40
CM3	15	A2J1-36
CM1	16	A2J1-32
HI/LO SEL	17	A2J1-5
ANLG0-	18	
ANLG1-	19	A2J1-78
ANLG2-	20	
ANLG3-	21	
ANLG4-	22	
ANLG5-	23	
ANLG6-	24	
ANLG7-	25	

STANDARD INTERFACE BOARD

A1	A1J1		
CM14	26		A2J1-41
CM12	27		A2J1-37
CM10	28		A2J1-33
CM8	29		A2J1-29
CM6	30		A2J1-42
CM4	31		A2J1-38
CM2	32		A2J1-34
CM0	33		A2J1-30
PWR COM	34	#18 blk	TB4-18
DEVREQ	35		A2J1-7
DEVACK	36		A2J1-11
ANENB	37		A2J1-13
+/-15V COM	38	#18 blk	TB4-18
-15VDC	39	#18 ylw	TB4-14
+15VDC	40	#18 red	TB4-16
ADDR7	41		A2J1-20
ADDR6	42		A2J1-18
ADDR5	43		A2J1-16
ADDR4	44		A2J1-14
ADDR3	45		A2J1-12
ADDR2	46		A2J1-10
ADDR1	47		A2J1-8
ADDR0	48		A2J1-6
R/W	49		A2J1-15
+5VDC	50	#18 org	TB4-12

STANDARD INTERFACE BOARD

U/D
3-89
9-89



CONN. "A1J1"
SOLDER SIDE

WIRE LIST

Conn. "A1P1/J1"
Standard Interface
Board

A55006W002 | **SHEET** 2

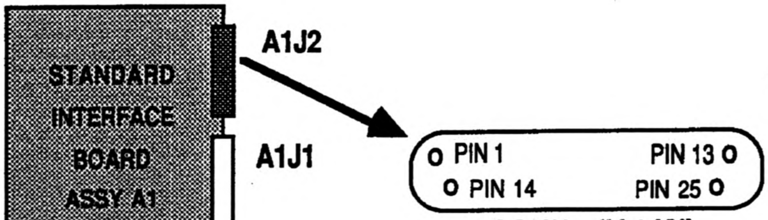
VLBA WEATHER STATION | 2-88 PMH FILE: WL/A1 | **WIRE LIST**

REV. 7-88
3-89

A1 **A1J2**

+5VDC	1	NC
T0	2	NC
INTR-1	3	NC
	4	NC
EXTRST+	5	NC
EXTRST-	6	NC
TX ENBL	7	NC
P1.6	8	NC
ID REQ-	9	A2J1-9
DOUT-	10	A9J2-12
PARX-	11	A9J2-11
MSG-	12	A9J2-10
GND	13	A9J2-14
+5VDC	14	A9J2-9
+15VDC	15	NC
-15VDC	16	NC
ANLG GND	17	NC
XACTV+	18	A9J2-13
RCV+	19	A2J1-93
RCV-	20	A2J1-95
XMT+	21	A3J6-8
XMT-	22	A3J6-7
RST SW-	23	NC
BUSY-	24	NC
SW GND	25	NC

STANDARD INTERFACE BOARD



CONN. "A1J2"
SOLDER SIDE

WIRE LIST

Conn. "A1P2/J2"

Standard Interface Board

A55006W002 | **SHEET** 3

VLBA WEATHER STATION | 2-88 PMH FILE: WL/A2 | **WIRE LIST**

REV. 7-88
3-89

A2 **A2J1**

LOGIC COM	1	NC
LOGIC COM	3	NC
HI/LO SEL	5	A1J1-17
DEV REQ	7	A1J1-35
ID REQ	9	A1J2-9
DEVACK	11	A1J1-36
ANENB	13	A1J1-37
R/W	15	A1J1-49
WIND WARN 1	17	A3J4-8
WIND WARN 2	19	A3J4-9
LO TEMP WARN	21	A3J4-10
OPR/CAL	23	A3J4-D
-10V/2 MON	25	A3J4-F
+10V/2 MON	27	A3J4-H
CM8	29	A1J1-29
CM9	31	A1J1-12
CM10	33	A1J1-28
CM11	35	A1J1-11
CM12	37	A1J1-27
CM13	39	A1J1-10
CM14	41	A1J1-26
CM15	43	A1J1-9
TSL ERR	45	A5J1-K
TSL TC-	47	A5J1-10
GND	49	NC

LOGIC ASSY

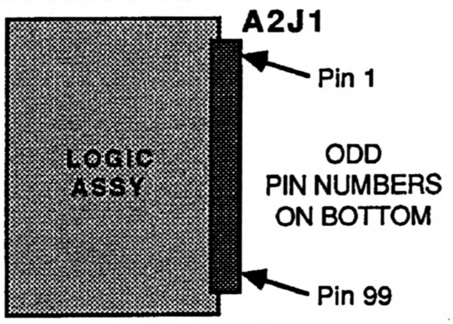
A2 **A2J1**

TSL TEMP/DP INPUTS

TC40	51		A5J1-12
TC20	53		A5J1-13
TC10	55		A5J1-14
TC8	57		A5J1-15
TC4	59		A5J1-16
TC2	61		A5J1-17
TC1	63		A5J1-18
TC.8	65		A5J1-19
TC.4	67		A5J1-20
TC.2	69		A5J1-21
TC.1	71		A5J1-22
GND	73		A5J1-B
+D0	75	blk	A6J1-3
+D1	77	blu	A6J1-4
+D2	79	grn	A6J1-5
+D3	81	org	A6J1-6
+D4	83	wht/red	A6J1-7
+D5	85	red/blk	A6J1-8
+D6	87	blk/red	A6J1-9
+D7	89	blu/wht	A6J1-10
+15V	91	#18 red	TB4-16
RCV+	93		A1J2-19
RCV-	95		A1J2-20
PWR GND	97		
PWR GND	99	#18 blk	TB4-19

TO BAROMETER

LOGIC ASSY



WIRE LIST

Conn. "A1P1/J1"
LOGIC ASSEMBLY
BOARD

A55006W002 | SHEET 4

VLBA WEATHER STATION | 2-88 PMH FILE: WL/A2-2 | **WIRE LIST**

REV 7-88
3-89

A2 — **A2J1**

+5VDC IN	2	NC
+5VDC IN	4	NC
ADDR0	6	A1J1-48
ADDR1	8	A1J1-47
ADDR2	10	A1J1-46
ADDR3	12	A1J1-45
ADDR4	14	A1J1-44
ADDR5	16	A1J1-43
ADDR6	18	A1J1-42
ADDR7	20	A1J1-41
BOX HOT	22	A3J4-K
BOX COLD	24	A3J4-J
TSL RESET	26	A5J1-V
	28	NC
CM0	30	A1J1-33
CM1	32	A1J1-16
CM2	34	A1J1-32
CM3	36	A1J1-15
CM4	38	A1J1-31
CM5	40	A1J1-14
CM6	42	A1J1-30
CM7	44	A1J1-13
	46	NC
-15V/2 MON	48	A3J4-B
+15V/2 MON	50	A3J4-C

LOGIC ASSY

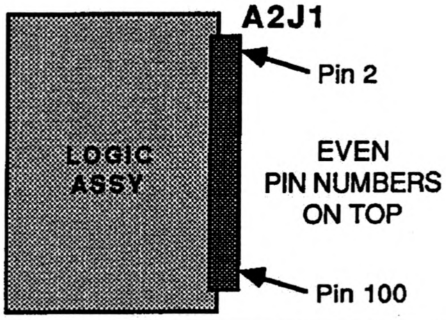
A2 — **A2J1**

+12V WIND MON	52		A3J4-A
TSL S1	54		A5J1-5
TSL S2	56		A5J1-6
TSL S3	58		A5J1-7
TSL S4	60		A5J1-8
CLK+ IN	62		A3J4-7
	64		NC
TSL PUMP V	66		A7TB2-13
TSL -12V MON	68		A7TB2-16
TSL +12V MON	70		A7TB2-15
TSL +5V MON	72		A7TB2-14
W/S INPUT	74		TB4-1
ANLG-1 IN	76		A1J1-2
ANLG GND	78		A1J1-19
ANLG-2 IN	80		A1J1-3
+SHUTDN	82	red/grn	A6J1-14
+DAV	84	wht	A6J1-1
+RFD	86	grn/blk	A6J1-11
BARO RET	88	wht/blk	A6J1-13
BARO +12V	90	blu/blk	A6J1-15
	92		TB4-14
	94		NC
RCV+ OUT	96		A3J6-10
+5VDC	98		TB4-12
+5VDC	100		NC

TO/FM BAROMETER

P/O CABLE TO BAROMETER

LOGIC ASSY



WIRE LIST

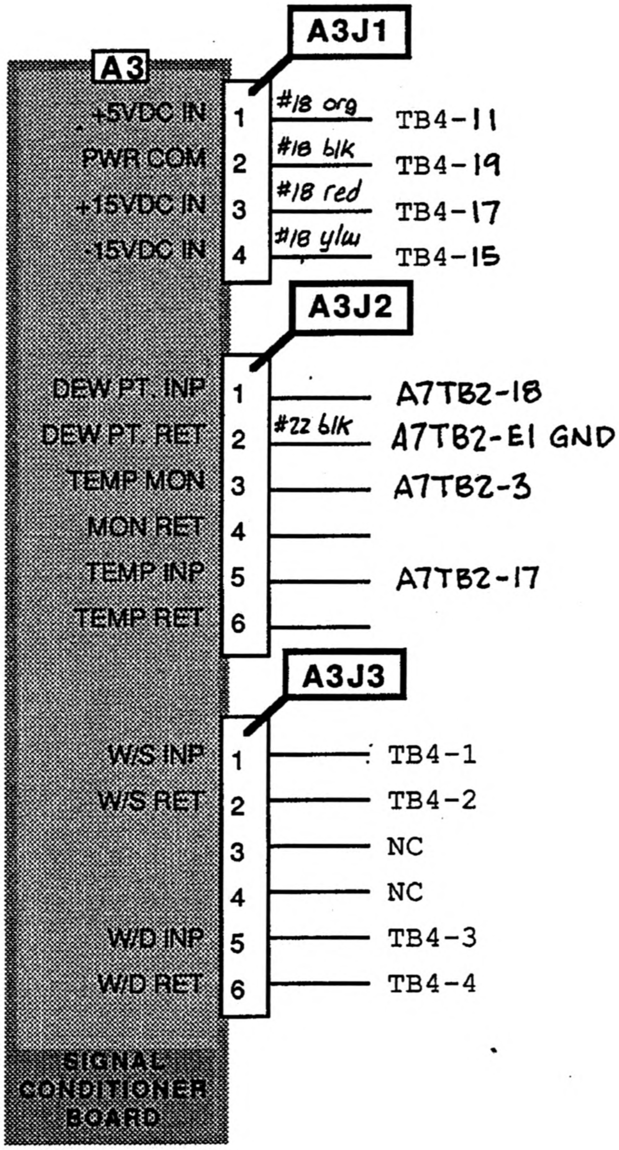
Conn. "A2P1/J1"

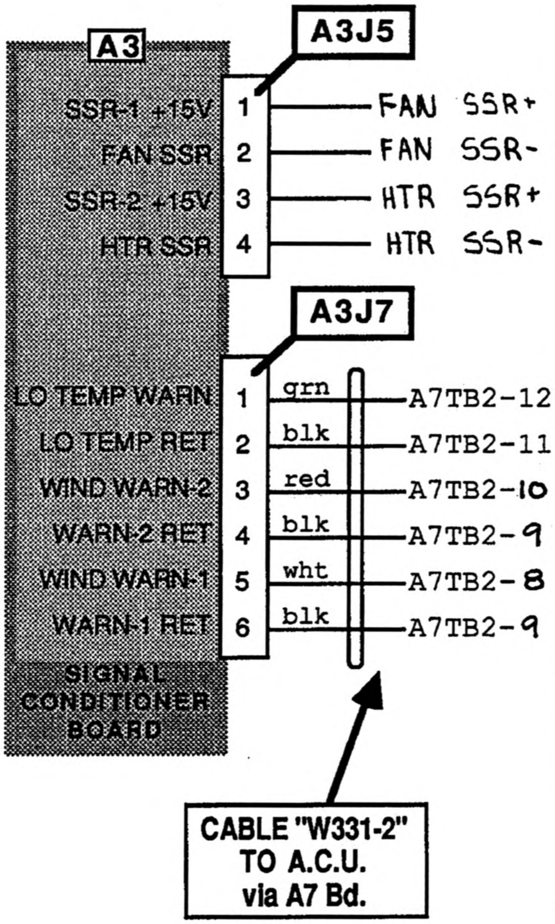
Logic Assembly
Board

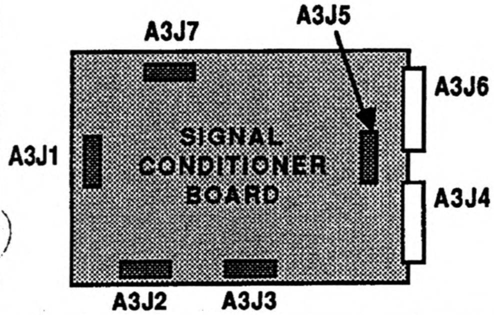
A55006W002 | SHEET 5

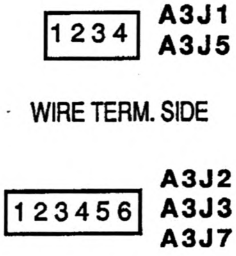
VLBA WEATHER STATION | 2-88 PMH FILE:WL/A3 | **WIRE LIST**

REV. 7-88
3-89









WIRE LIST

A3J1, J2, J3, J5, J7

Signal Conditioner Board

A55006W002 | SHEET 6

VLBA WEATHER STATION | 2-88 PMH FILE: WL/A3-2 | **WIRE LIST**

REV. 7-88
3-89

A3 **A3J4**

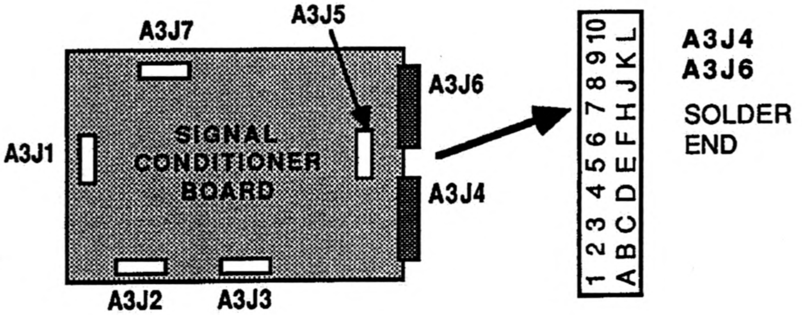
	1	
	2	
	3	
	4	
	5	
	6	
CLK OUT+	7	A2J1-62
WIND WARN-1	8	A2J1-17
WIND WARN-2	9	A2J1-19
LO TEMP WARN	10	A2J1-21
+24V/4 MON	A	A2J1-52
-15V/2 M ON	B	A2J1-48
+15V/2 MON	C	A2J1-50
	D	A2J1-23
	E	
-10V/2 MON	F	A2J1-25
+10V/2 MON	H	A2J1-27
BOX COLD	J	A2J1-24
BOX HOT	K	A2J1-22
GND	L	

SIGNAL CONDITIONER BOARD

A3 **A3J6**

TEMP OUT	1	A1J1-4 (ANLG-3)
DEW PT.	2	A1J1-7 (ANLG-6)
WIND DIR	3	A1J1-8 (ANLG-7)
WIND SPD	4	A1J1-6 (ANLG-5)
BOX TEMP	5	A1J1-5 (ANLG-4)
	6	
XMT-	7	A1J2-22
XMT+	8	A1J2-21
MCB DUMP	9	NC
RCV+	10	A2J1-96
PIN 1 RET	A	
PIN 2 RET	B	
PIN 3 RET	C	
PIN 4 RET	D	
PIN 5 RET	E	
	F	
	H	
	J	
	K	
	L	

SIGNAL CONDITIONER BOARD



WIRE LIST

A3J4/P4 & A3J6/P6

Signal Conditioner Board

A55006W002 | SHEET 7

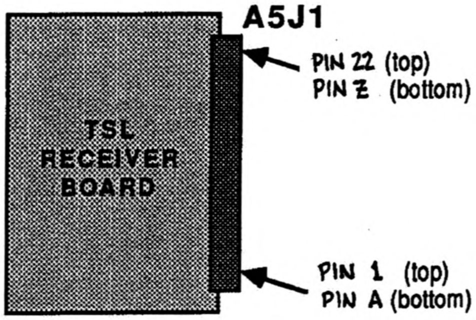
VLBA WEATHER STATION | 2-88 PMH FILE: WL A5-A7 | **WIRE LIST**

REV. 7-88
3-89

A5	A5J1		
+5V LOGIC IN	1	#18 org	TB4-13
PWR COM	2	#18 blk	TB4-20
INST/AVG SW	3		A9J2-6
	4		NC
S1	5		A2J1-54/A9J2-1
S2	6		A2J1-56/A9J2-2
S3	7		A2J1-58/A9J2-3
S4	8		A2J1-60/A9J2-4
TC100	9		A9J1-C
TC-	10		A2J1-47/A9J1-2
TC80	11		NC
TC40	12		A2J1-51/A9J1-F
TC20	13		A2J1-53/A9J1-J
TC10	14		A2J1-55/A9J1-E
TC8	15		A2J1-57/A9J1-K
TC4	16		A2J1-59/A9J1-3
TC2	17		A2J1-61/A9J1-4
TC1	18		A2J1-63/A9J1-L
TC0.8	19		A2J1-65/A9J1-7
TC0.4	20		A2J1-67/A9J1-9
TC0.2	21		A2J1-69/A9J1-10
TC0.1	22		A2J1-71/A9J1-8
TSL RECEIVER BD			

A5	A5J1		
+5V LOGIC IN	A	#18 org	A9J1-1
PWR COM	B	#18 blk	A2J1-73 +A9J1-A
	C		NC
	D		NC
+6V IN	E		NC
+6V COM	F		NC
SERIAL DATA -	H		A7TB2-19
BLANKING	J		A9J1-B
ERROR	K		A2J1-45
DIMMER V.	L		A9J2-7
DISPLAY TEST	M		NC
DEG C/F SEL	N		NC
+9V BATT CHG	P		TB4-10
SERIAL DATA +	R		A7TB2-20
	S		
	T		
	U		
CPU RESET	V		A2J1-26
	W		
	X		
POR RESET	Y		
	Z		
TSL RECEIVER BD			

ASSY A9 is the T.S.L. Temperature LED Display Board

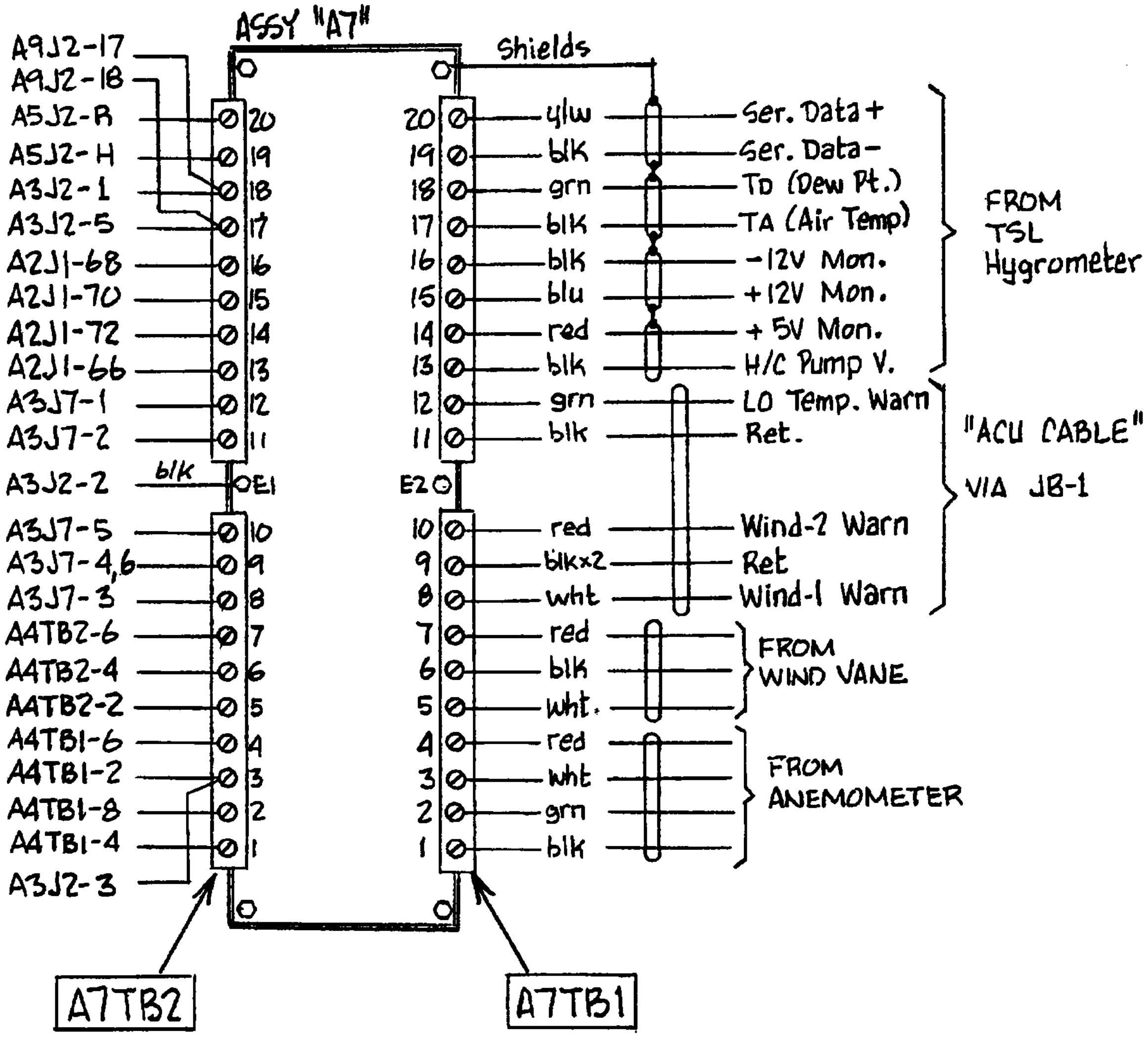


WIRE LIST

Conn. "A5P1/J1"

T.S.L. Receiver Board

A55006W002 | SHEET 8



SHEET 9 of

VLBA WEATHER STATION

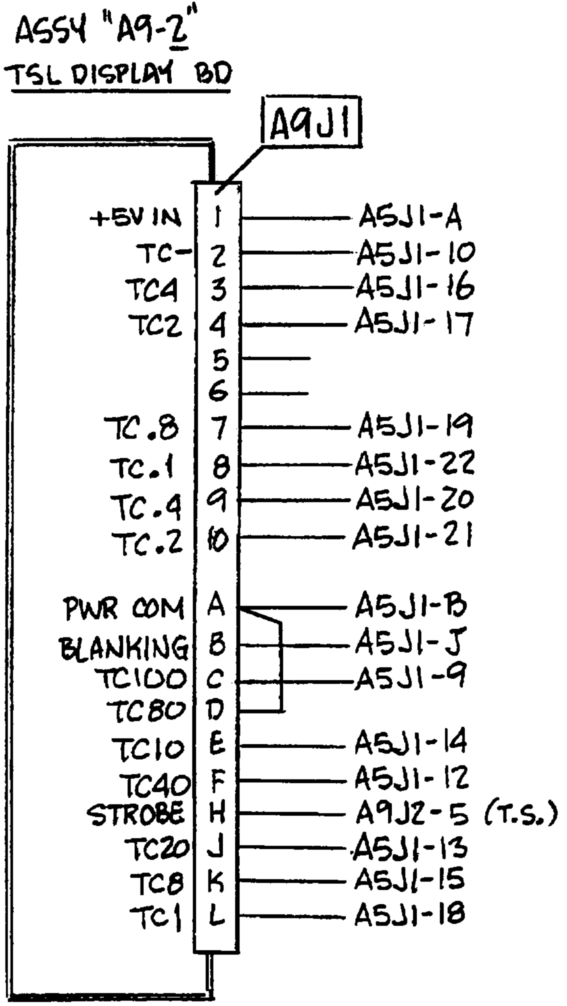
Title "A7TB1" & "A7TB2" SIGNAL PROTECTION BOARD

NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

Drawn by Paul Harden

DWG. No. A55006W002

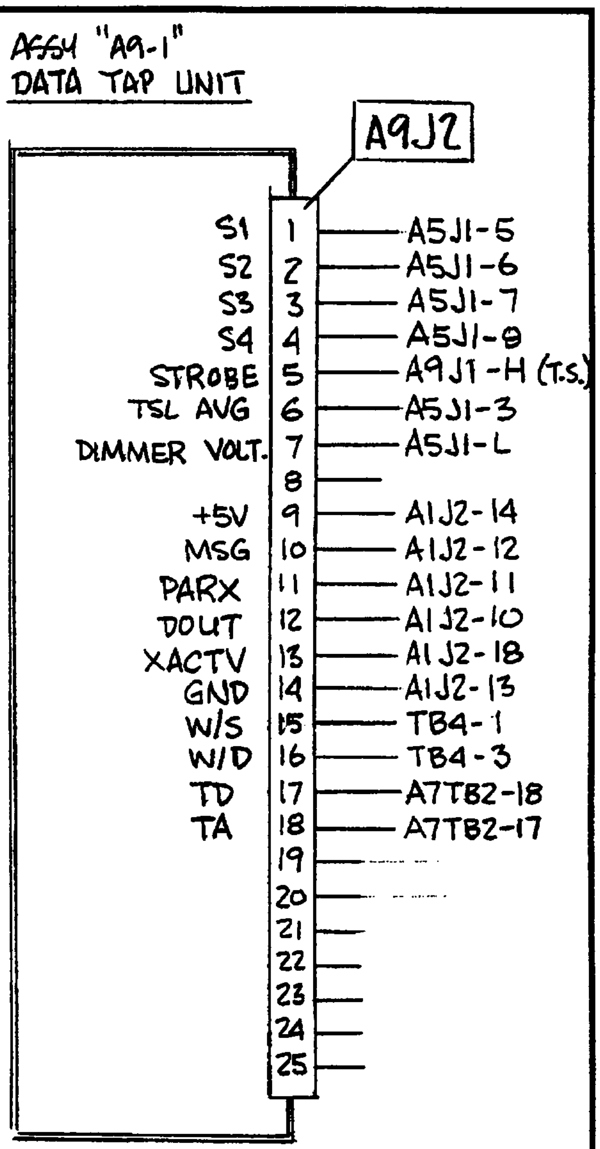
Date 3-12-89



ASSY "A9-2"
TSL DISPLAY BD

A9J1

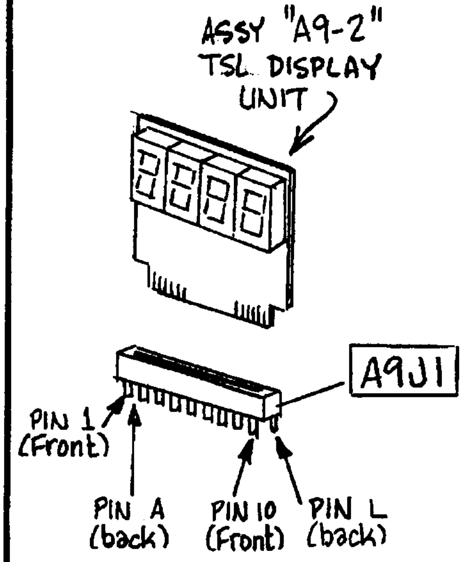
+5V IN	1	A5J1-A
TC-	2	A5J1-10
TC4	3	A5J1-16
TC2	4	A5J1-17
	5	
	6	
TC.8	7	A5J1-19
TC.1	8	A5J1-22
TC.4	9	A5J1-20
TC.2	10	A5J1-21
PWR COM	A	A5J1-B
BLANKING	B	A5J1-J
TC100	C	A5J1-9
TC80	D	
TC10	E	A5J1-14
TC40	F	A5J1-12
STROBE	H	A9J2-5 (T.S.)
TC20	J	A5J1-13
TC8	K	A5J1-15
TC1	L	A5J1-18

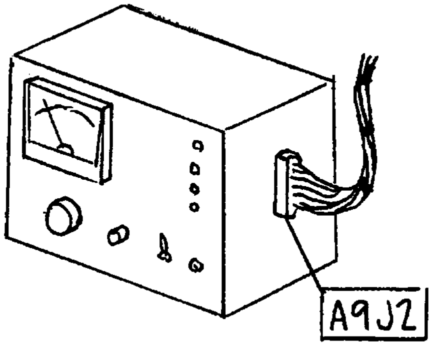


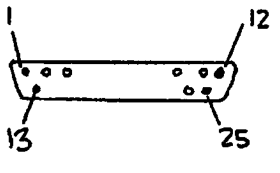
ASSY "A9-1"
DATA TAP UNIT

A9J2

S1	1	A5J1-5
S2	2	A5J1-6
S3	3	A5J1-7
S4	4	A5J1-8
STROBE	5	A9J1-H (T.S.)
TSL AVG	6	A5J1-3
DIMMER VOLT.	7	A5J1-L
	8	
+5V	9	A1J2-14
MSG	10	A1J2-12
PARX	11	A1J2-11
DOUT	12	A1J2-10
XACTV	13	A1J2-18
GND	14	A1J2-13
W/S	15	TB4-1
W/D	16	TB4-3
TD	17	A7TB2-18
TA	18	A7TB2-17
	19	
	20	
	21	
	22	
	23	
	24	
	25	







SHEET 10 of

VLBA WEATHER STATION

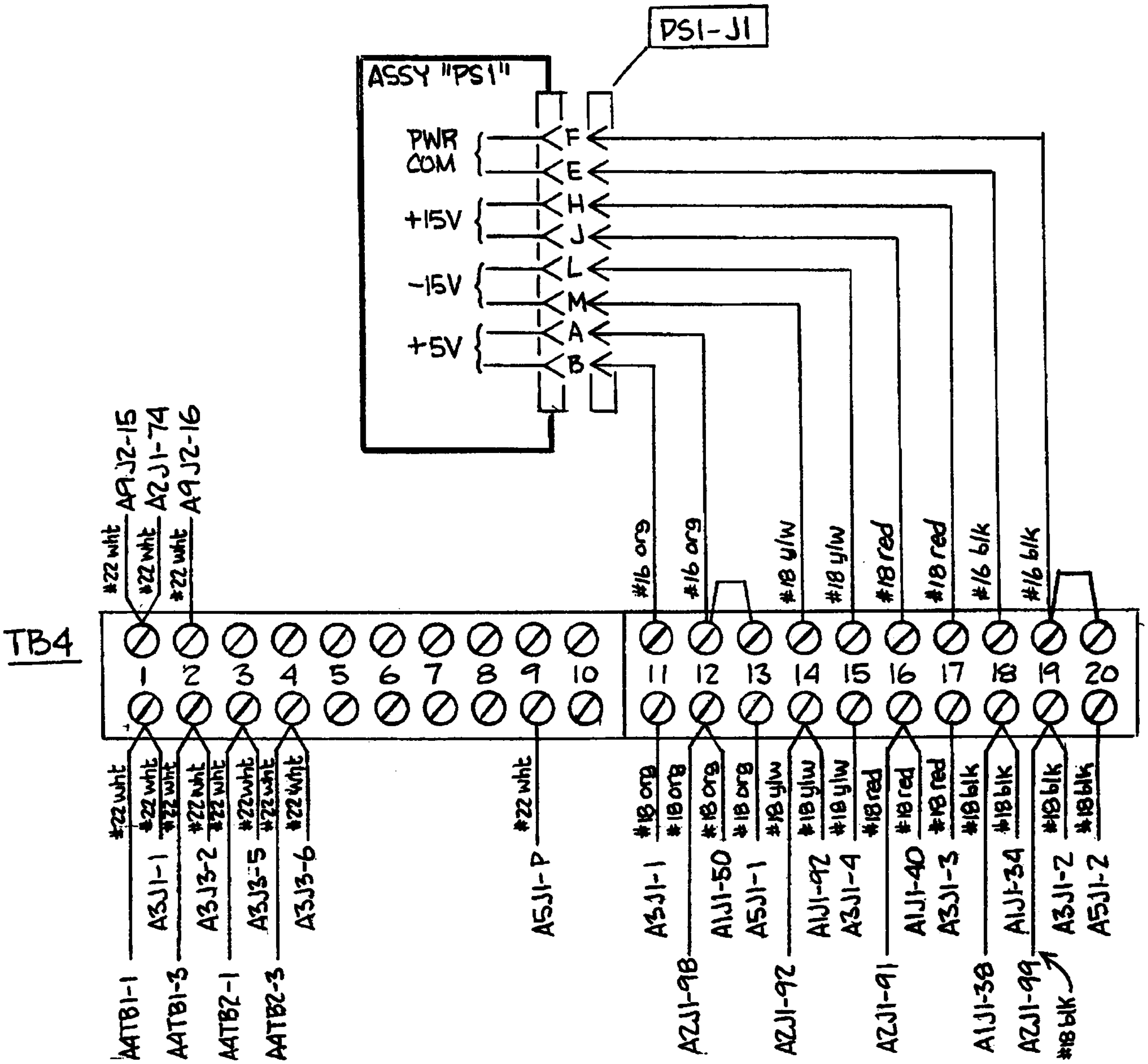
Title CONN. "A9J1" & "A9J2"
DATA TAP/DISPLAY ASSY

NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

Drawn by Paul Harden

DWG. No. A55006W002

Date 3-12-89



APPROX. LENGTHS

TB4	TO PS1-J1	26"
TB4	TO A1J1	4 feet
TB4	TO A2J1	3 feet
TB4	TO A3J1	3 feet

SHEET 11 of

VLBA WEATHER STATION

Title
"TB4" & "PS1-J1"
POWER SUPPLY AND
TERMINAL STRIP

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
Socorro, New Mexico

Drawn by PAUL HARDEN

DWG. No. A55006W002

Date 3-12-89

VLBA Technical Report 47

VLBA Weather Station

Appendix 7

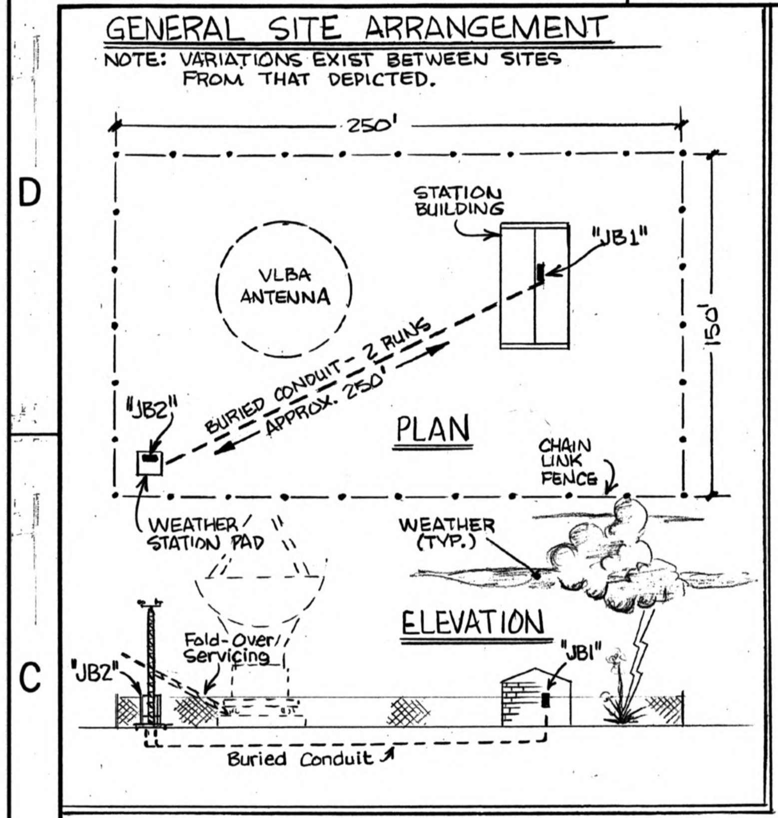
4 3 2 1

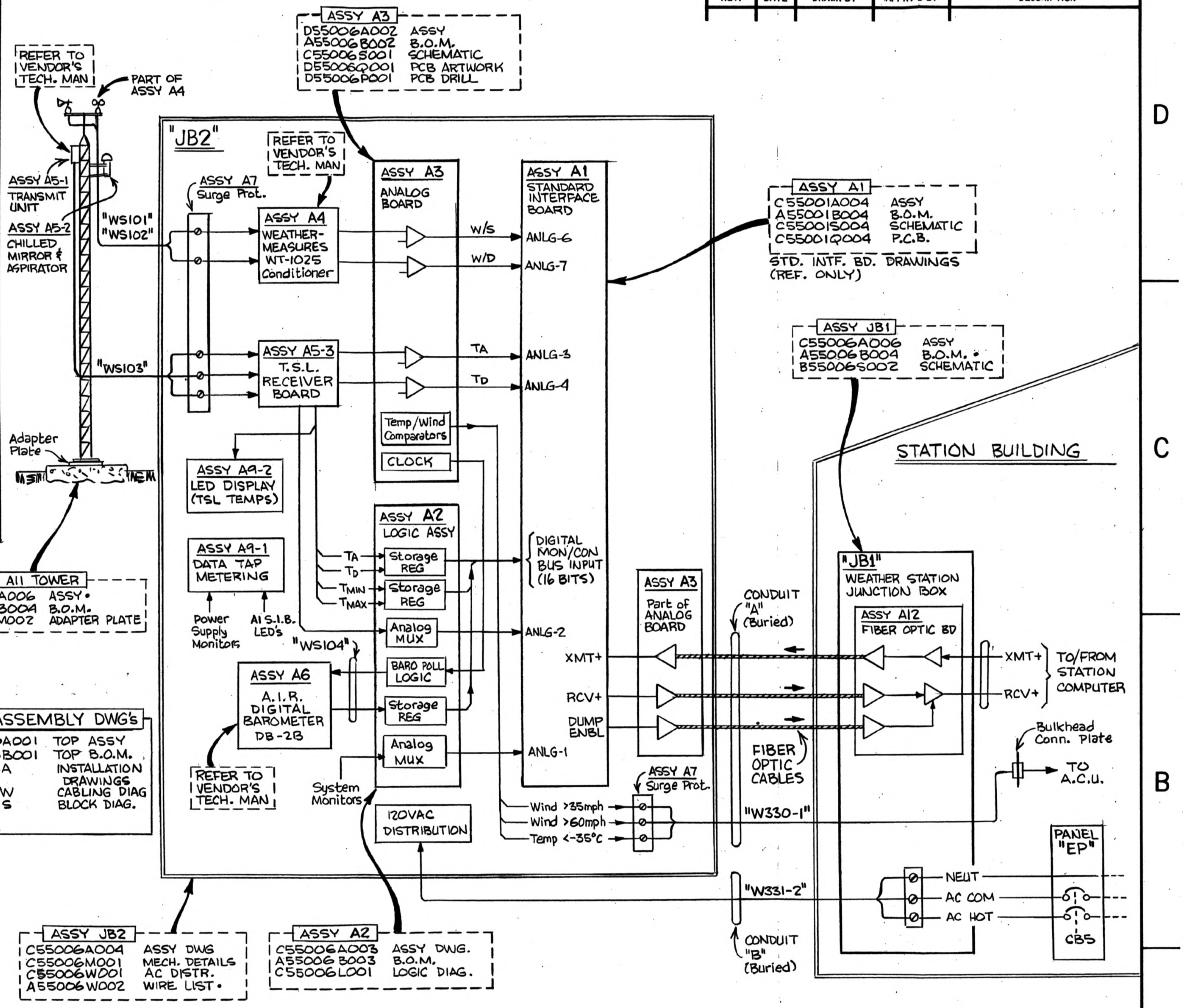
D

REV.	DATE	DRAWN BY	APPR'V'D BY	DESCRIPTION

GENERAL SITE ARRANGEMENT

NOTE: VARIATIONS EXIST BETWEEN SITES FROM THAT DEPICTED.





ASSY A11 TOWER
C55006A006 ASSY.
A55006B004 B.O.M.
C55006M002 ADAPTER PLATE

TOP ASSEMBLY DWG's
D55006A001 TOP ASSY
A55006B001 TOP B.O.M.
C55006A INSTALLATION DRAWINGS
C55006W CABLING DIAG
C55006S BLOCK DIAG.

C

LIST OF MAJOR UNITS

REF. DESIG.	MFR	LOCATION	
ASSY A1	NRAO	JB2	STD. INTFC. BD.
ASSY A2	NRAO	JB2	LOGIC ASSY
ASSY A3	NRAO	JB2	ANALOG BOARD
ASSY A4	WEATHER-MEASURES, INC.	JB2	WIND SIGNAL CONDITIONING
ASSY A5	T.S.L.	JB2/TOWER	TEMP/DEW PT.
A5-1	Technical Services Laboratories	TOWER	TRANSMITTER
A5-2		TOWER	CHILLED MIRROR
A5-3		JB2	RECEIVER BD.
ASSY A6	A.I.R.	JB2	BAROMETER
ASSY A7	(See A4 MFR)	JB2	SURGE PROT.
ASSY A8	NRAO	JB2	HEAT & VENT.
ASSY A9	NRAO	JB2	DATA TAP
ASSY A10	NRAO	JB1+JB2	AC DISTR.
ASSY A11	NRAO/ROHN		TOWER ASSY
ASSY JB1	NRAO/HOFFMAN	STN. BLDG	W.S. JCT. BOX
ASSY JB2	NRAO/HOFFMAN	BY TOWER	EQUIP. ENCL.
ASSY PS1	ACDC ELECT.	JB2	POWER SUPPLY

B

NOTES

1. Some variations may exist between the 10 VLBA sites
2. Signal paths shown to emphasize function of major units and not intended to be a complete Block Diagram (See C55006S00)
3. Refer to C55006A00 for Installation details.

A

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±
MATERIAL:
FINISH:

NEXT ASSY | USED ON

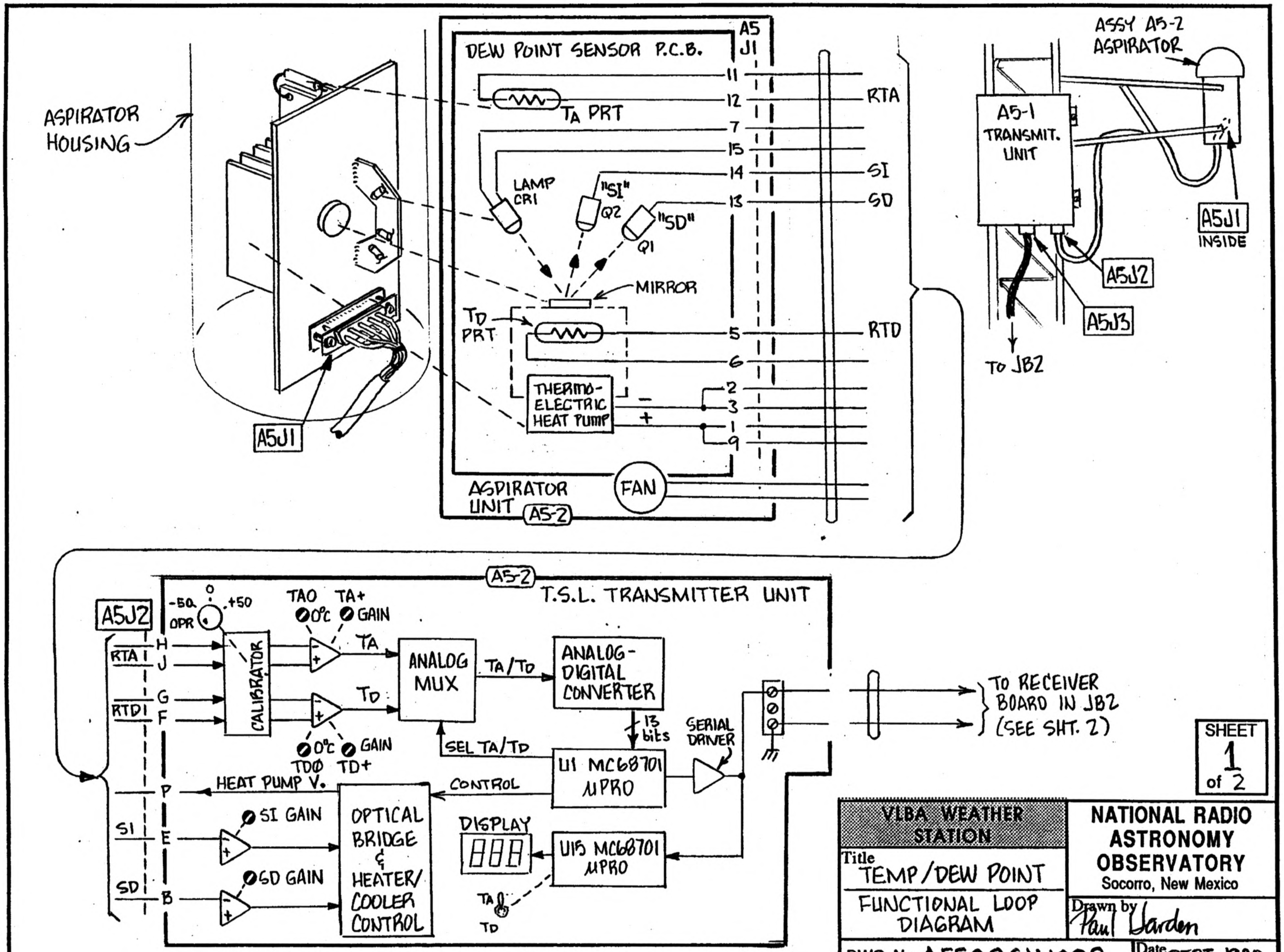
PROJECT VLBA WEATHER STATION
TITLE CONTROL DRAWING

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY PAUL HARDEN DATE 8-88
DESIGNED BY DATE
APPROVED BY DATE

SHEET NUMBER 1 OF 1 DRAWING NUMBER C55006Y001 REV. B SCALE

BRUNING 44-231 44427-2



SHEET 1 of 2

VLBA WEATHER STATION

Title TEMP/DEW POINT FUNCTIONAL LOOP DIAGRAM

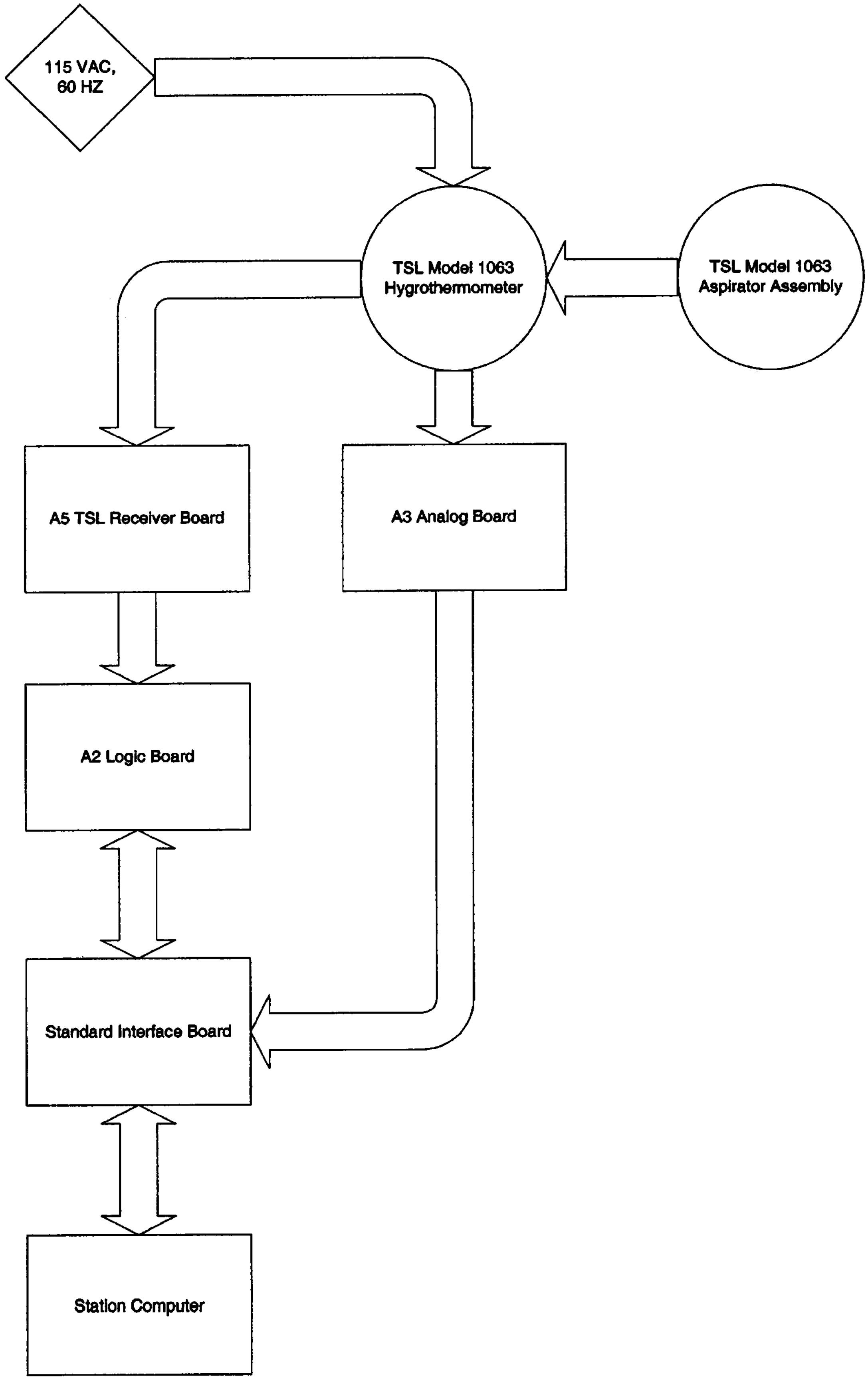
NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

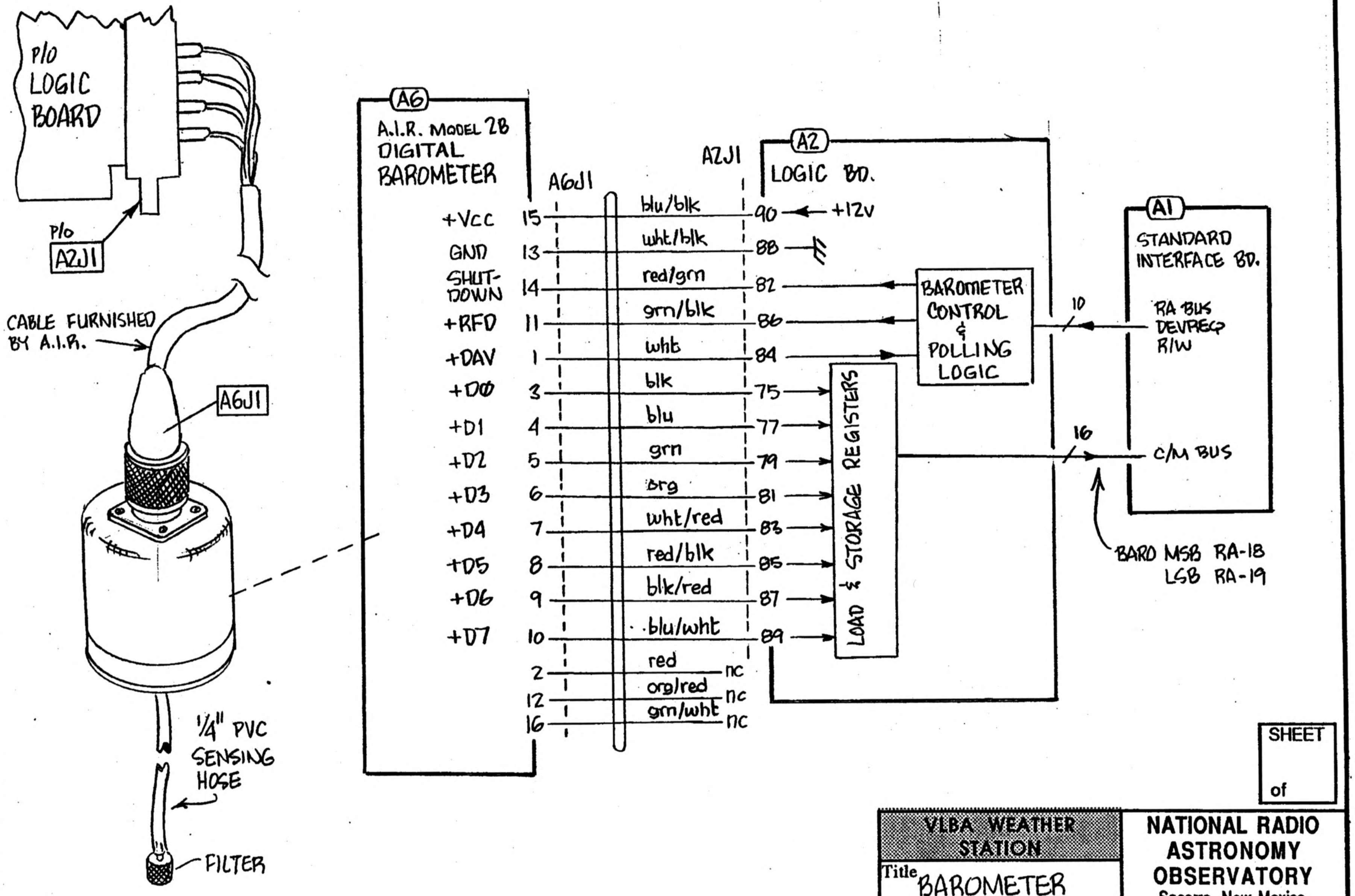
Drawn by Paul Harden

DWG. No. A55006W008

Date SEPT 1988

Dew Point and Ambient Temperature Block Diagram





SHEET

of

VLBA WEATHER STATION

Title BAROMETER

FUNCTIONAL LOOP DIAGRAM

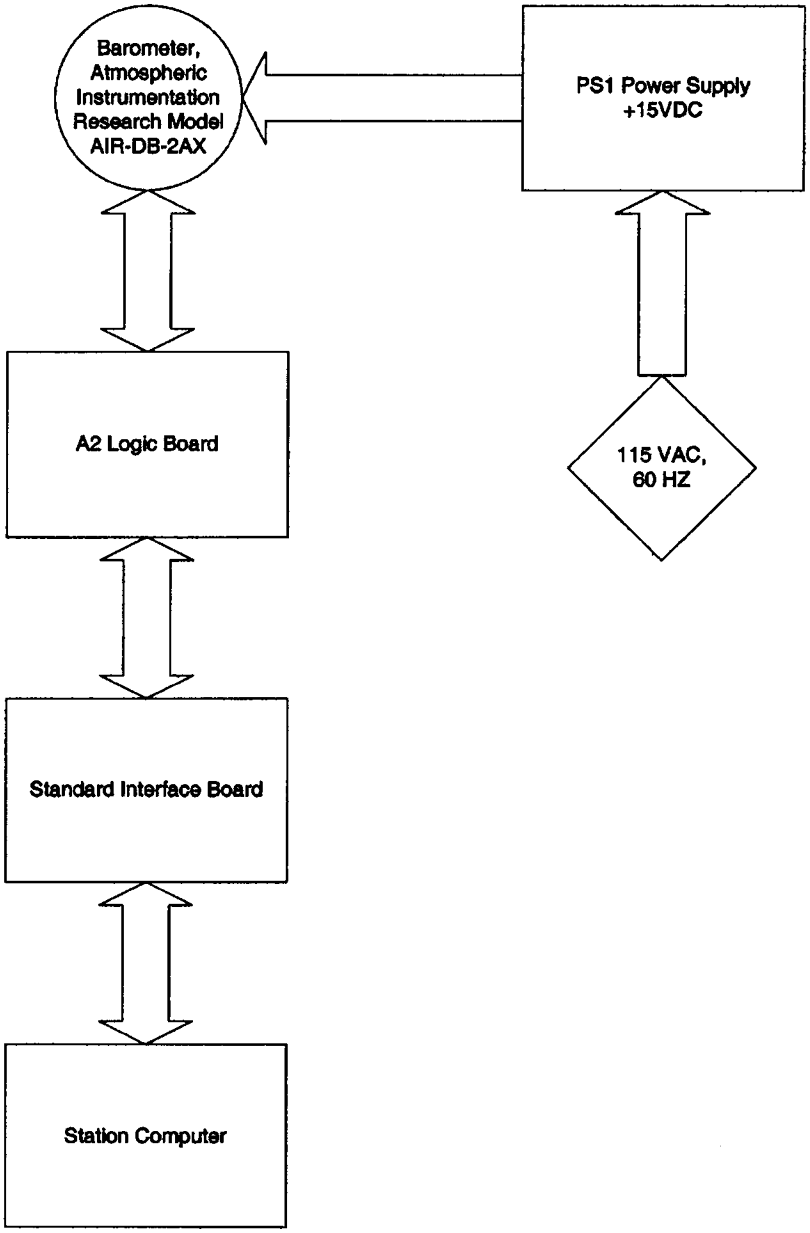
NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

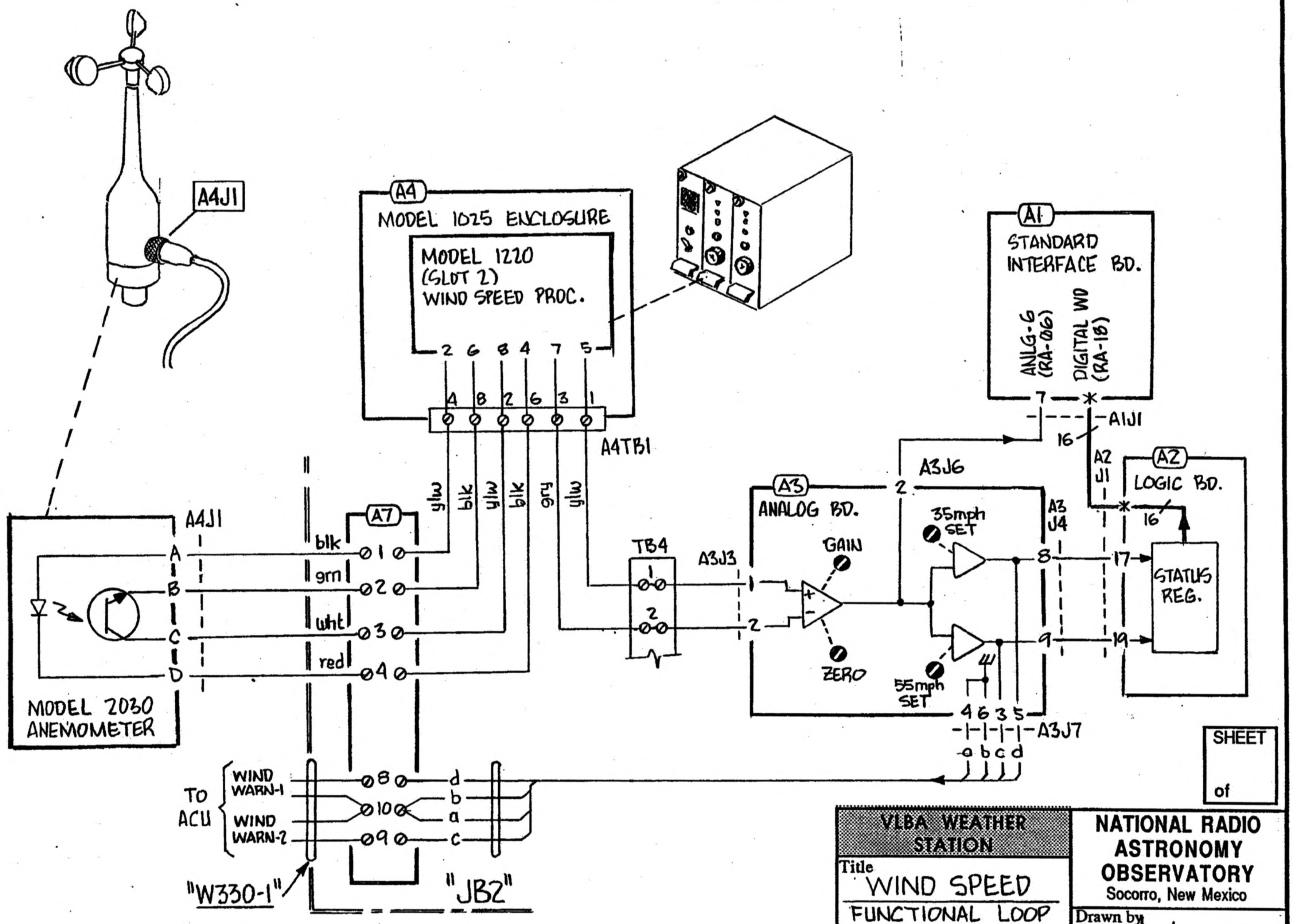
Drawn by Paul Harden

DWG. No. A55006W007

Date SEPT. 1988

Barometer Block Diagram





SHEET

of

VLBA WEATHER STATION

Title WIND SPEED

FUNCTIONAL LOOP DIAGRAM

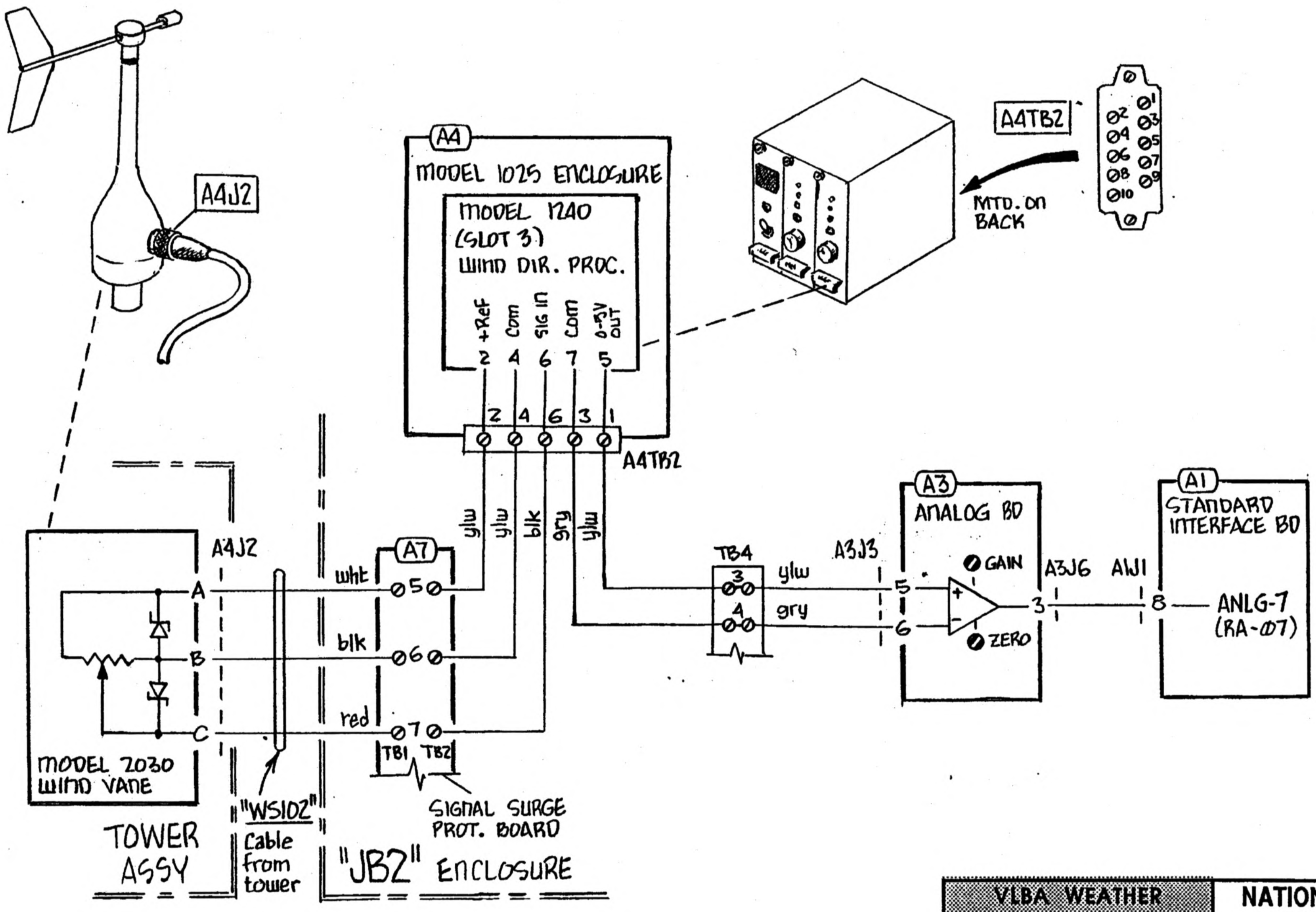
NATIONAL RADIO ASTRONOMY OBSERVATORY

Socorro, New Mexico

Drawn by Paul Harden

DWG. No. A55006W005

Date SEPT. 1988



SHEET

of

VLBA WEATHER STATION

Title
WIND DIRECTION
FUNCTIONAL LOOP
DIAGRAM

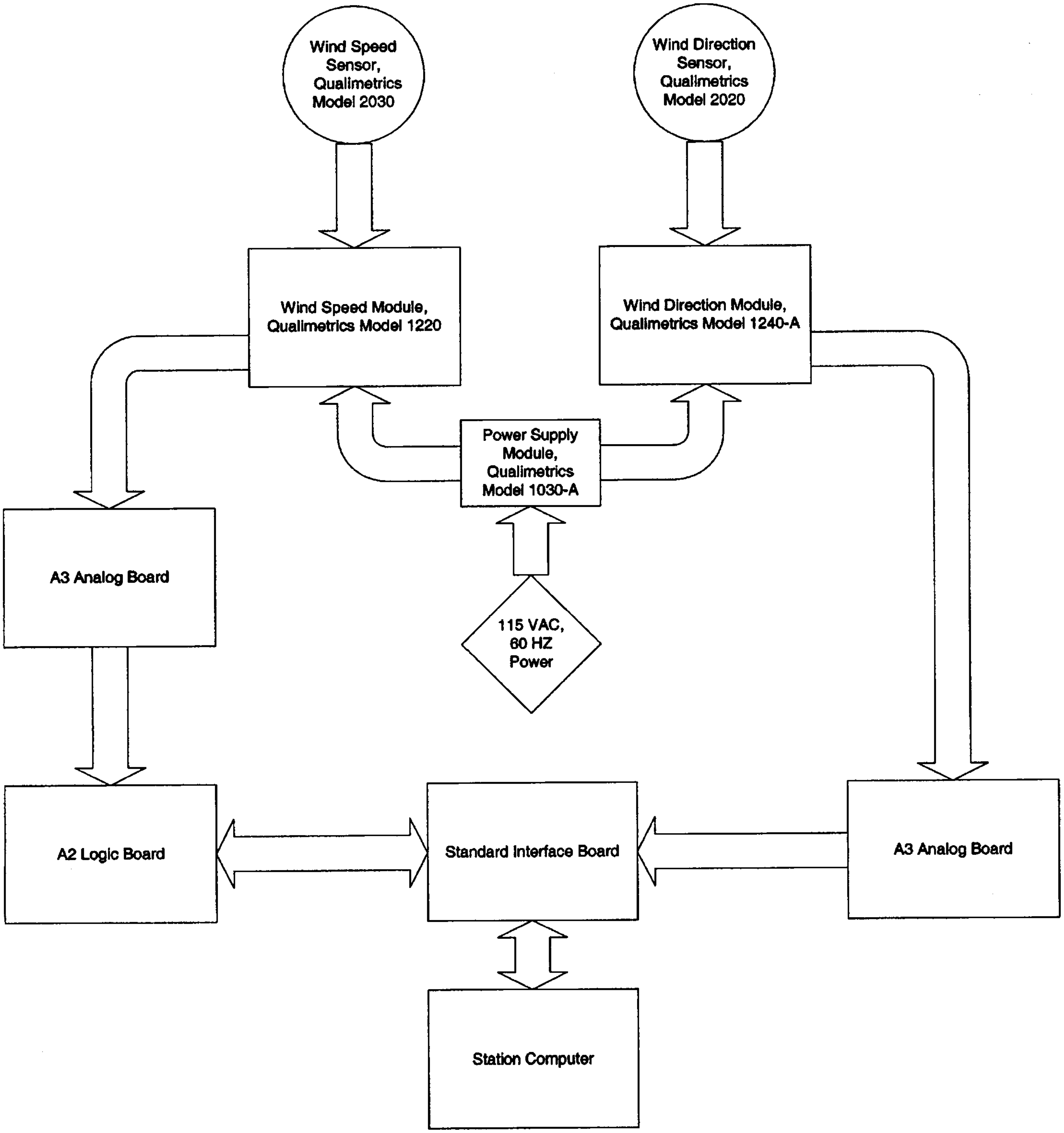
NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

Drawn by
Paul Harden

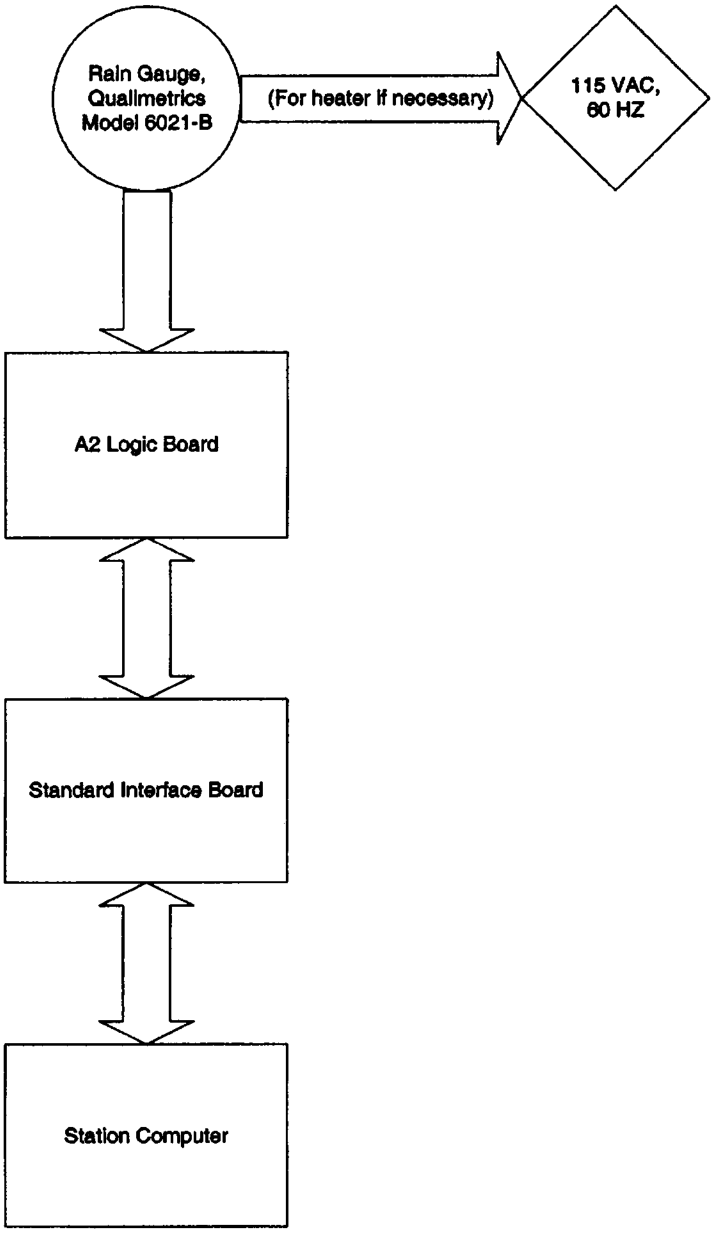
DWG. No. A55006W006

Date SEPT. 1988

Windspeed and Wind Direction Block Diagram



Rain Gauge Block Diagram



MCB ADDRESS ASSIGNMENTS

SET-ADDRESS DATA
ID = #18
1ST ADDRESS = # 1800
BLOCK SIZE = #40

	HEX ADDR	
ANALOG MONITOR	1800	Ground Ref.
	1801	EXTERNAL MUX PORTS
	1802	
	1803	TA (Backup only)
	1804	TD (Backup only)
	1805	Box Temp.
	1806	Wind SPEED
	1807	Wind DIRECTION
	1808	+5V Mon (PS1)
	1809	−15V Mon (PS1)
	180A	+15V Mon (PS1)
	180B	+12V Mon (Wind)
	180C	Baro. +15V Mon.
	180D	
	180E	
	180F	
	1810	TSL heat/cool V.
	1811	TSL −12V Mon.
	1812	TSL +12V Mon.
	1813	TSL +5V Mon.
	1814	
	1815	
	1816	
	1817	
DIGITAL MONITOR	1818	Barometer WD-1
	1819	Barometer WD-2
	181A	TA (TSL Ambient)
	181B	TD (TSL Dew Point)
	181C	Serial Number
	181D	Min./Max. Temp
	181E	Wind Gust latch
	181F	
DIGITAL COMMANDS	1820	
	1821	RESET Barometer
	1822	RESET Temps (Min.-Max.)
	1823	RESET Peak Wind Gust
	1824	
	1825	
	1826	
	1827	

SHEET
of

VLBA WEATHER STATION

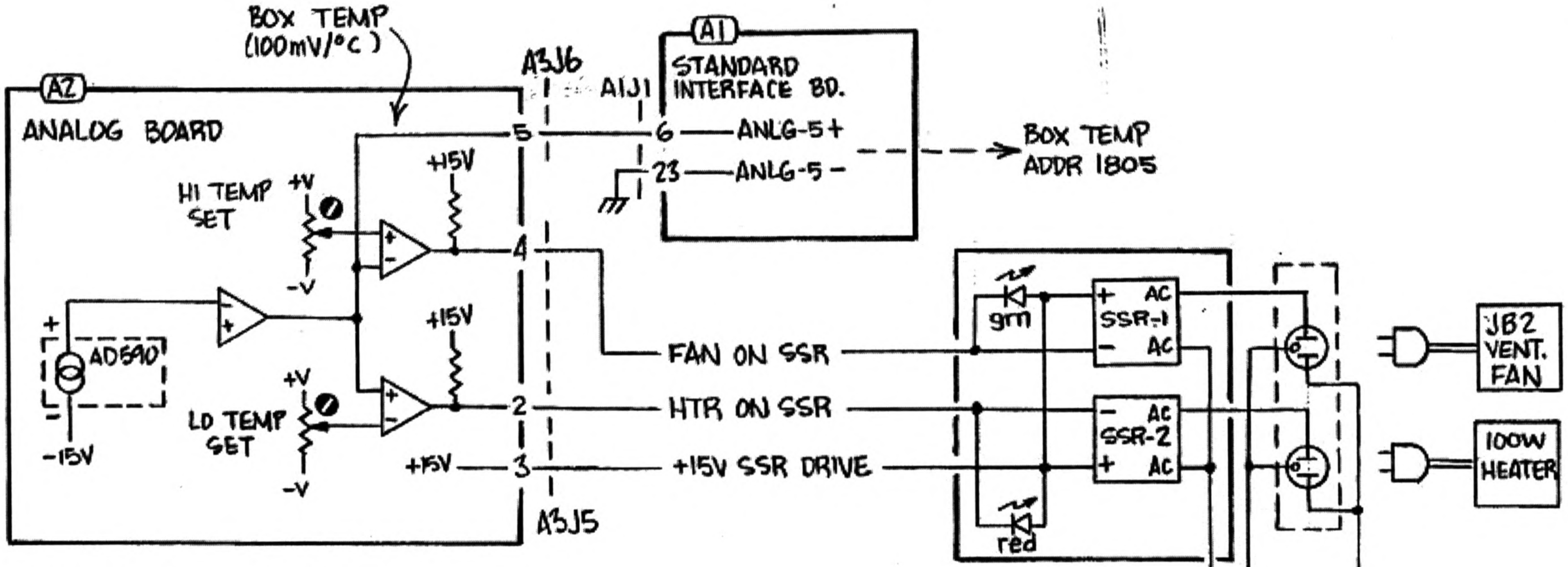
Title
MCB ADDRESSING

NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

Drawn by P. HARDEN

DWG. No. A5500GW010

Date 8/1989



SET HI TEMP SET TO +2.5V
(Fan ON >+25°C)

SET LO TEMP SET TO +0.5V
(Heater ON <+5°C)

120 VAC CRITICAL POWER { HOT
COM
GND

SHEET
of

VLBA WEATHER STATION

Title "JB2" TEMPERATURE CONTROL CIRCUITS

FUNCTIONAL DIAGRAM

NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

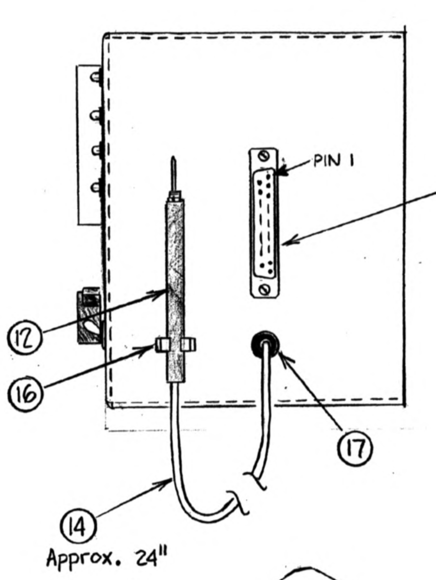
Drawn by Paul Harden

DWG. No. A55006W009

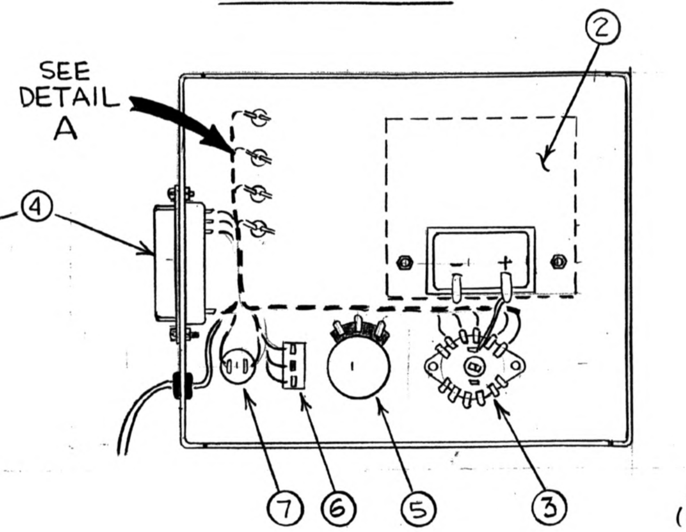
Date AUG. 1989

REV.	DATE	DRAWN BY	APPR'V'D BY	DESCRIPTION

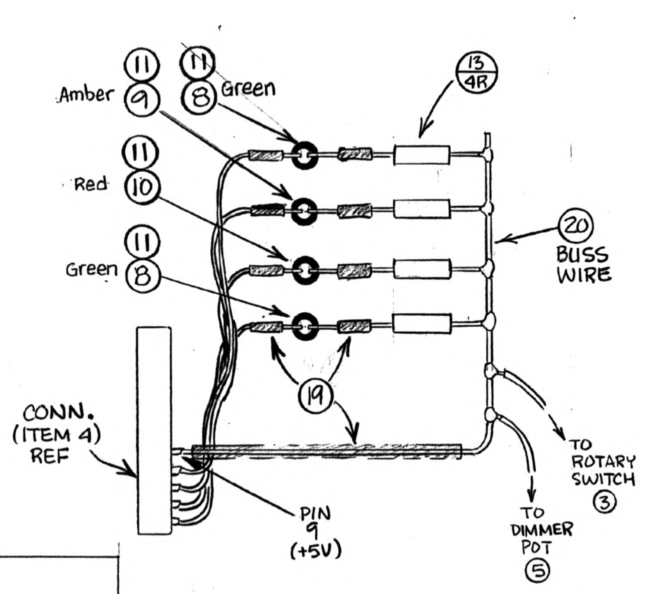
R.H. SIDE

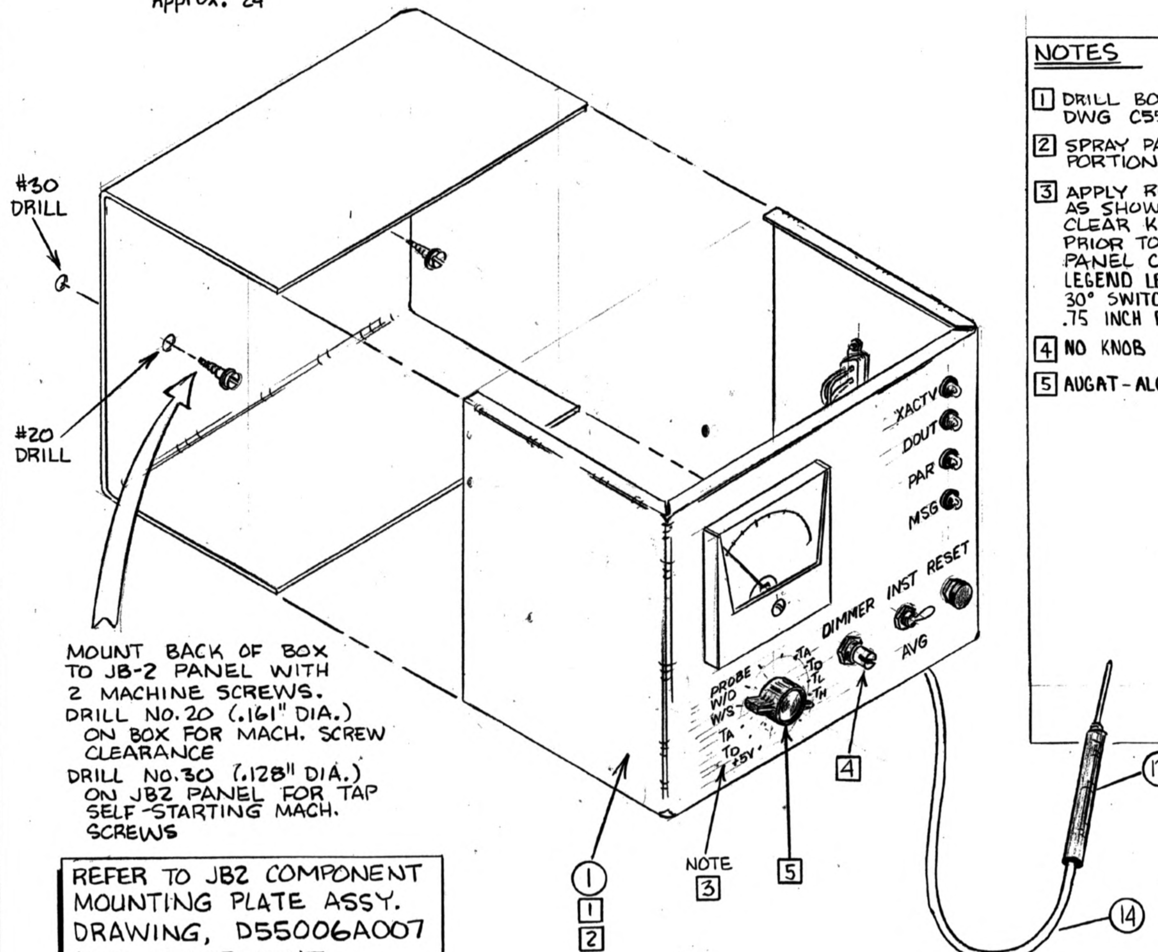


BACK SIDE



DETAIL A - L.E.D.'s





MOUNT BACK OF BOX TO JB-2 PANEL WITH 2 MACHINE SCREWS.
DRILL NO. 20 (.161" DIA.) ON BOX FOR MACH. SCREW CLEARANCE
DRILL NO. 30 (.128" DIA.) ON JB2 PANEL FOR TAP SELF-STARTING MACH. SCREWS

REFER TO JB2 COMPONENT MOUNTING PLATE ASSY. DRAWING, D55006A007 FOR PLACEMENT

NOTES

1. DRILL BOX AS PER NRAO DWG C55006M004
2. SPRAY PAINT FRONT PANEL PORTION GLOSS WHITE.
3. APPLY RUB-OFF LETTERS AS SHOWN. PROTECT WITH CLEAR KRYLON SPRAY PRIOR TO MOUNTING FRONT PANEL COMPONENTS. LEGEND LETTERING IS 8 PNT., 30° SWITCH INDEX AND ARE .75 INCH RADIUS AROUND SWITCH.
4. NO KNOB REQUIRED.
5. AUGAT-ALCO # PKP-1948-1/4 KNOB

ITEM	MFR	PART NUMBER	DESCRIPTION / NOTES	QTY
20		AWG20 SOLID	Buss Wire	A/R
19			PVC Sleeve	A/R
18		#6 × 5/8	Self tapping mach. screw	2
17	H.H. SMITH	2170	Grommet, rubber, 3/8" hole	1
16	H.H. SMITH	4084	Component Clip, 3/8" dia.	1
15	H.H. SMITH	2885	Knob, 1/4" shaft	1
14	BELDEN		Wire, #22 str. white	A/R
13	A-B or sim	RN55D-221J	Resistor, 220Ω 1/4W	4
12	H.H. SMITH	317-102	Test Probe, 4" red	1
11	DIALIGHT	515-0005	L.E.D. Mounting Clip	4
10	DIALIGHT	521-9183	L.E.D., Red	1
9	DIALIGHT	521-9176	L.E.D., Amber	1
8	DIALIGHT	521-9175	L.E.D., Green, T-1 3/4	2
7	ALCO	MSPS-103C-2	Switch, push-button, N.O.	1
6	ALCO	MTA-104	Switch, toggle SPST	1
5	A-B or Sim.	RV4N-253A	Potentiometer, 25K, 1" Shaft	1
4	TRW/CINCH	DB25P	Connector Plug, D-type, 25 pins	1
3	ALPHA/MOUSER	10YX026 me	Switch, 2 Pole, 6 pos.	1
2	MODUTEC	MSQ-DVV-15U15 me	Panel Meter, -15V-0-+15VDC 2½" sq.	1
1	LMB	No.881 Jiffy Box dk	Chassis Box, 6"×5"×4" (LWD)	1

BILL OF MATERIALS

ASSY
A9

NEXT ASSY	USED ON
C55006M004	Drill Dwg.
B55006S004	Schematic

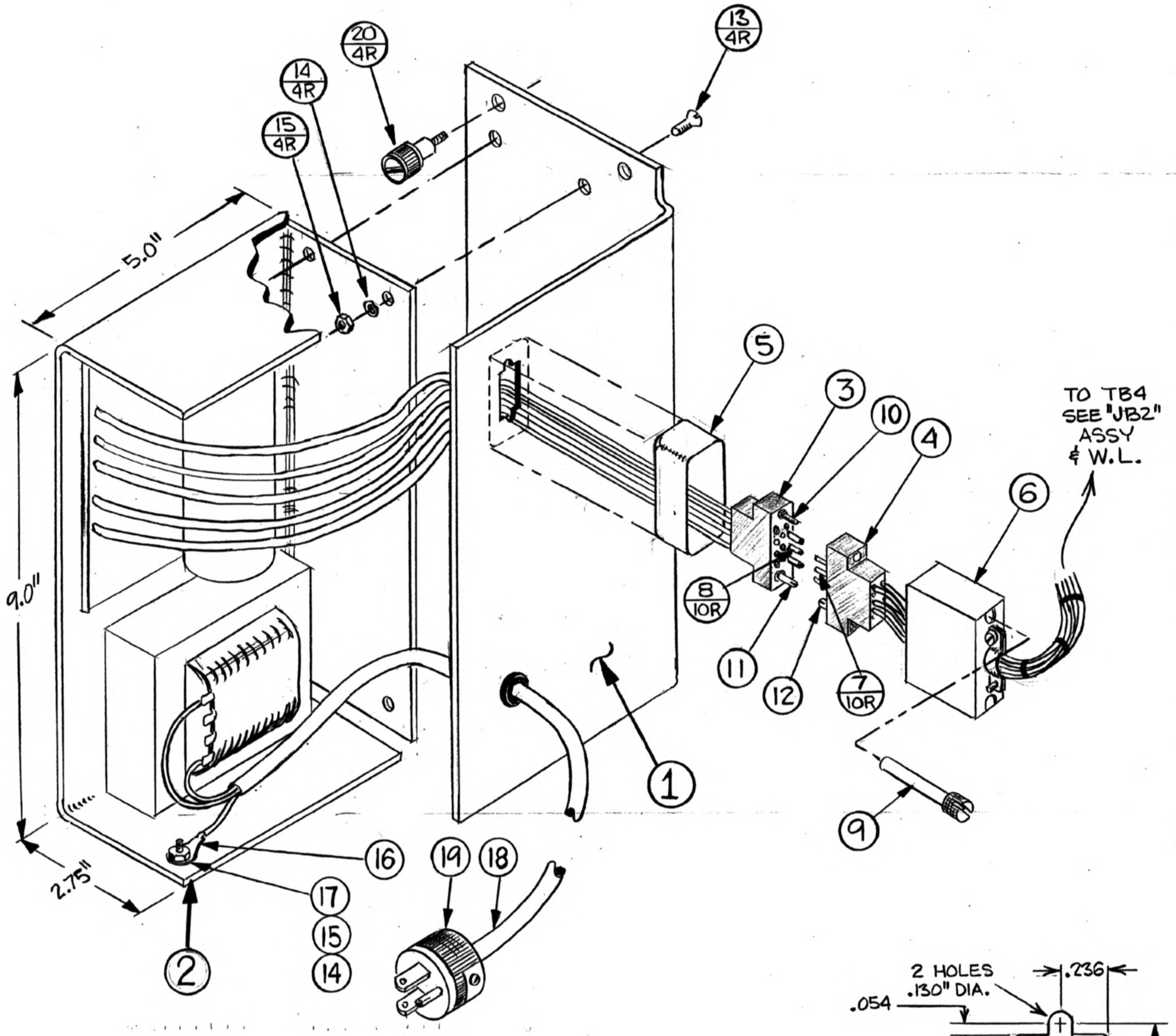
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±
MATERIAL:
FINISH:

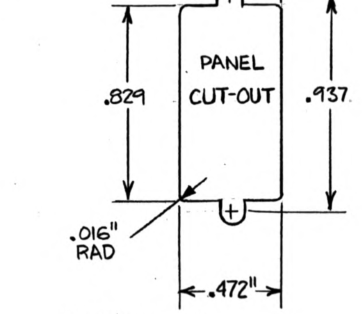
PROJECT VLBA WEATHER STATION
TITLE DATA TAP ASSY A9-1 ASSEMBLY

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY Paul Harden DATE 3-89
DESIGNED BY PAUL HARDEN DATE 11-88
APPROVED BY DATE
SHEET NUMBER 1/1 DRAWING NUMBER C55006A009 REV. SCALE

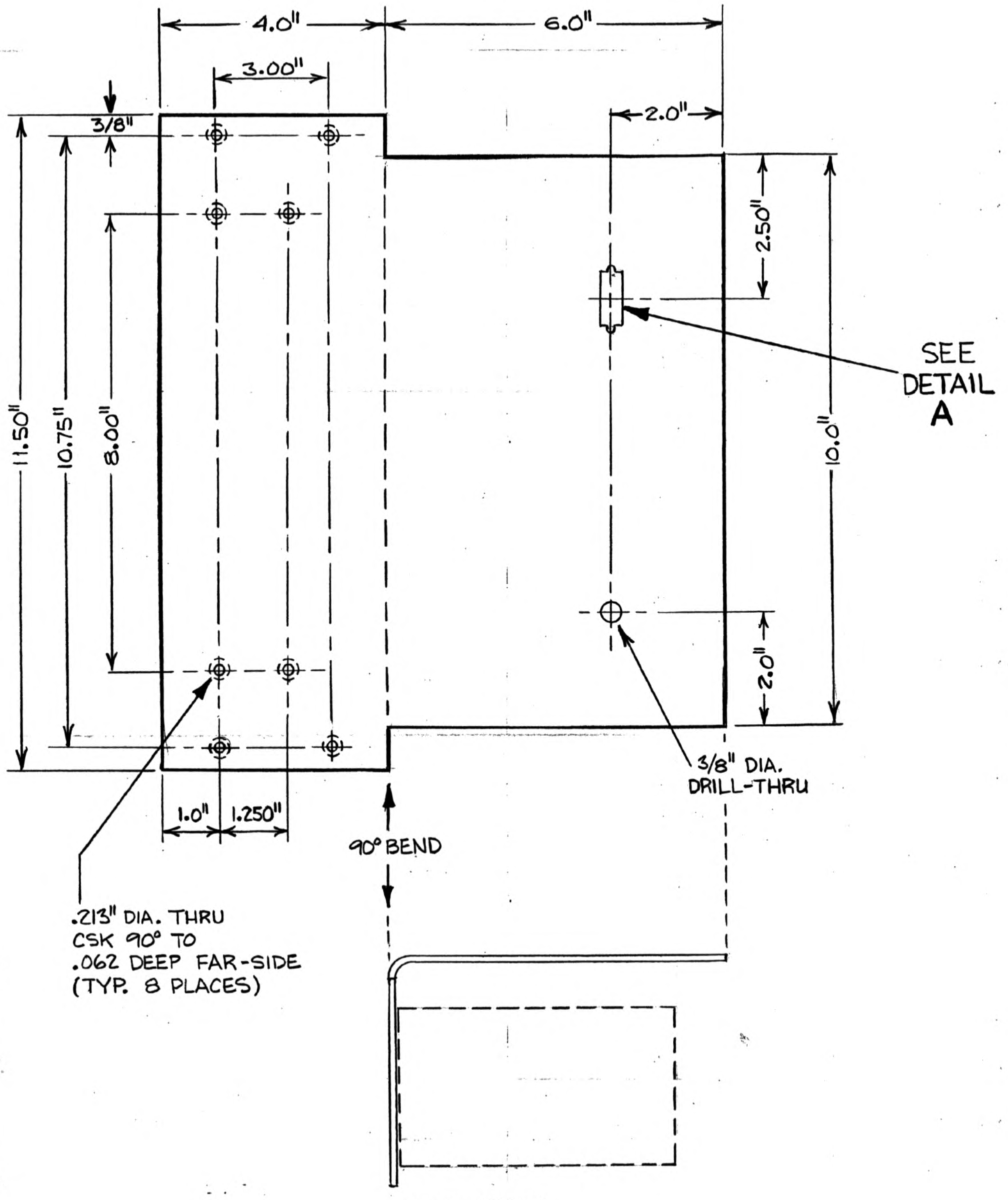
REV.	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION





DETAIL A

SCALE = 2X



TOP VIEW

1/2 SCALE

23				
22				
21	H.H. SMITH		Grommet, 3/8" Dia.	1
20	SOUTHCO		Captive Screw	4
19	HUBBEL	5666-C	AC Plug, Insulwire, str. blade 3-W	1
18			Elect. Cord, 3-wire, 125V 7A	3-FT
17		6-32 ×1/2	Mach. Screw, Pan Hd.	1
16		#6	Solder Lug	1
15		6-32	Nut, Hex	5
14		#6	Washer, Lock	5
13		6-32 ×1/2	Mach. Screw, Flat Hd.	4
12	↑	200834-4	Guide Socket w/ wash. & nut	1
11		200833-4	Guide Pin w/ wash. & nut	1
10		200874-1	Jackscrew Male Pin, wash., & nut	1
9		201910.-2	Jackscrew, St. Steel, Female	1
8		202726-1	Socket, crimp, #18 (blue)	10
7		202725-1	Pin, crimp, #18 (blue)	10
6		200514-1	Strain Relief, 14-pin	1
5		201347-4	Connector Shell, 14-pin	1
4		201298-3	Connector Block, 14-pin, plugs	1
3	AMP INDUST.	201355-3	Connector Block, 14-pin, socket	1
2	ACDC ELECT. CO.	ETV-401	Power Supply, triple output	1
1	NRAO	C55006A		1

D55006A004	JB2 PNL ASSY
NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±

MATERIAL: (ITEM 1)
.093 6061 ALUM.

FINISH:

PROJECT
VLBA
WEATHER STATION

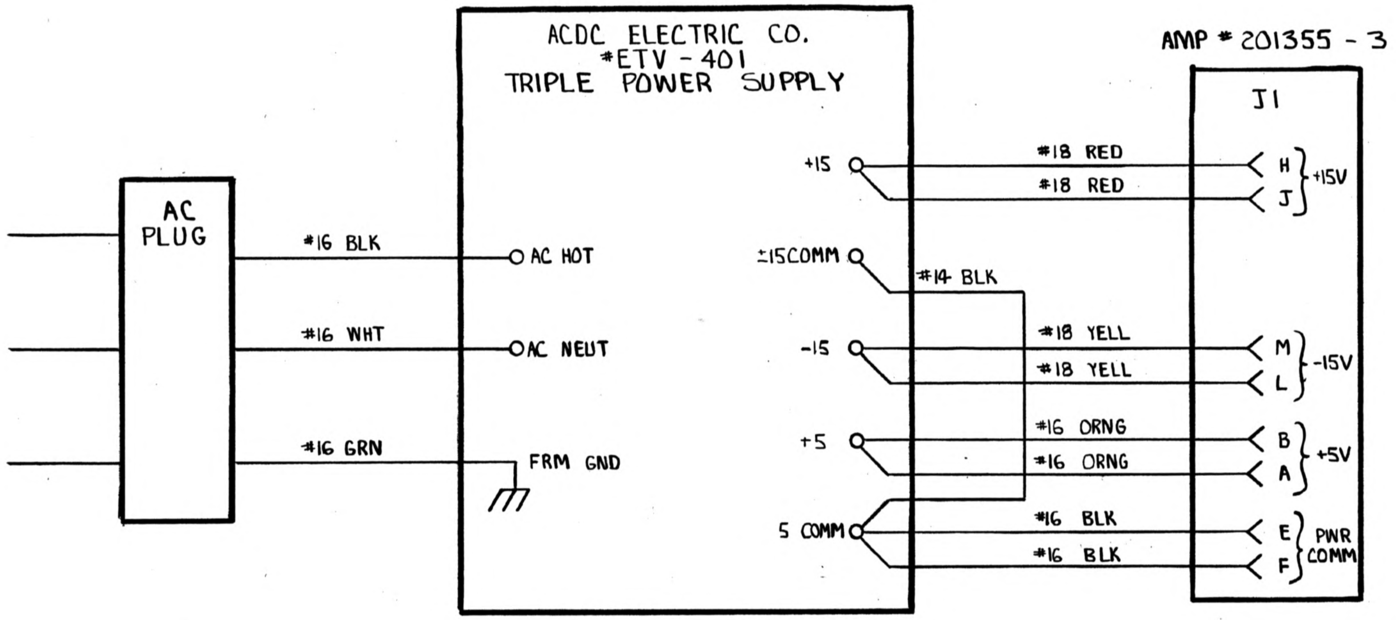
TITLE
ASSY "PS1"
POWER SUPPLY
-ASSEMBLY

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY Paul Harden DATE 9-88
DESIGNED BY PAUL HARDEN DATE 9-88
APPROVED BY DATE

SHEET NUMBER 1/2
DRAWING NUMBER C55006A006
REV.
SCALE

REV.	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION



NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ± ___
3 PLACE DECIMALS (.XXX): ± ___
2 PLACE DECIMALS (.XX): ± ___
1 PLACE DECIMALS (.X): ± ___
MATERIAL: ___
FINISH: ___

PROJECT: VLBA
VLBA
WEATHER STATION

TITLE:
ASSY "PS1"
SCHEMATIC DIAGRAM

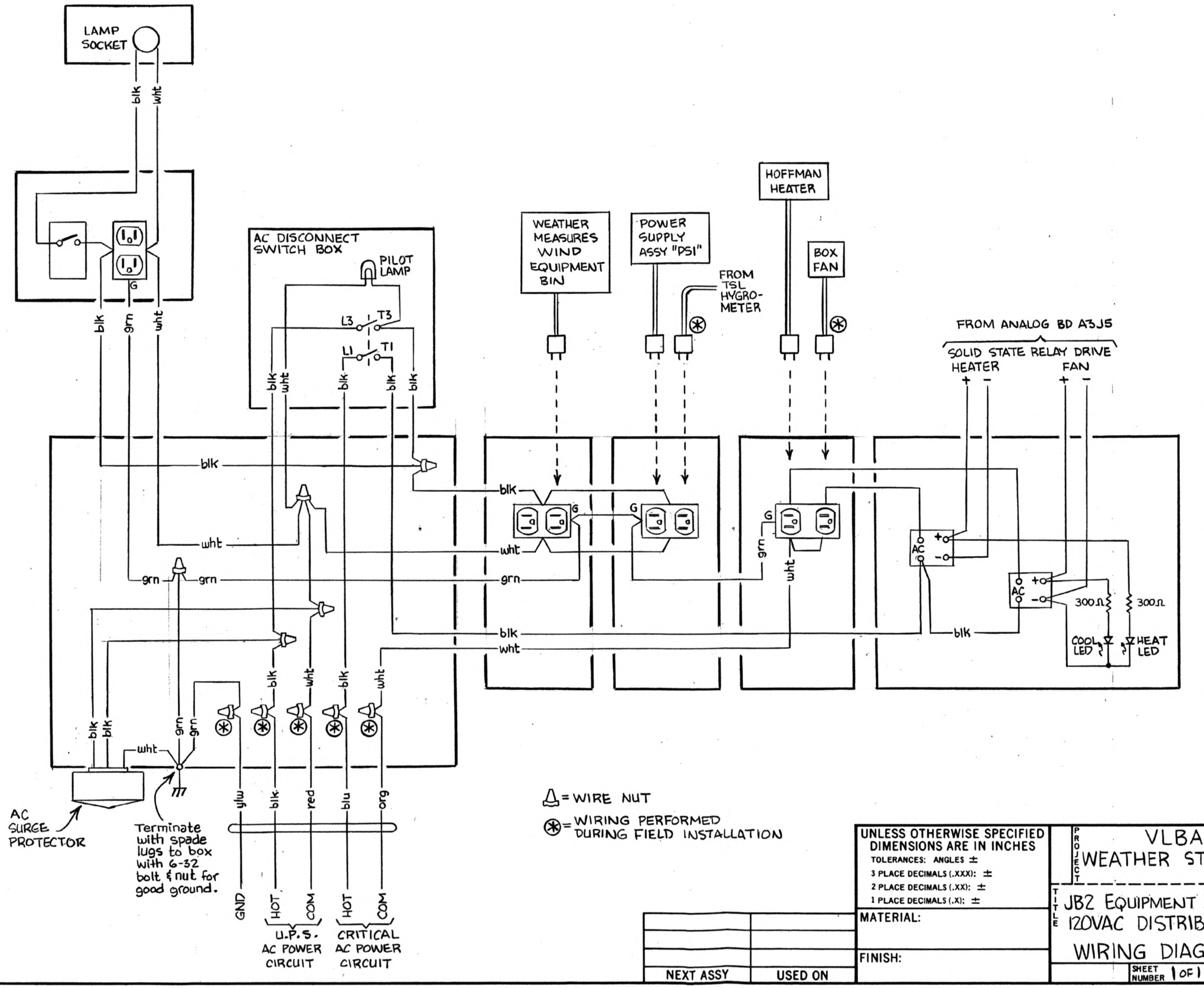
NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA — DATE 3-89
DESIGNED BY WEBER — DATE 3-89
APPROVED BY — DATE

SHEET NUMBER 2OF 2
DRAWING NUMBER C55006A006
REV.
SCALE —

BRUNING 44-231 44427-2

REV.	DATE	DRAWN BY	APPR'V'D BY	DESCRIPTION



JB2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±
MATERIAL:
FINISH:

NEXT ASSY	USED ON

PROJECT VLBA WEATHER STATION

TITLE JB2 EQUIPMENT ENCLOSURE 120VAC DISTRIBUTION WIRING DIAGRAM

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

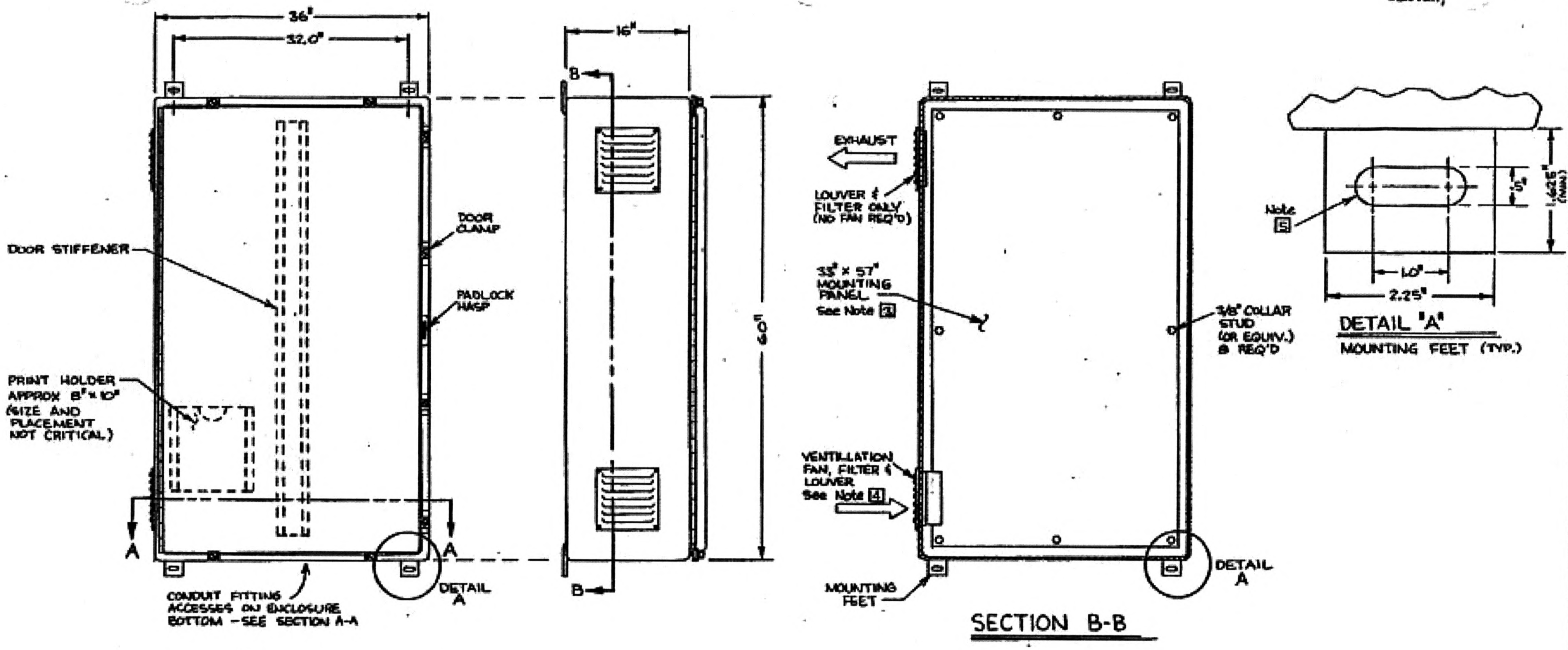
DRAWN BY Paul Harden	DATE 3-89
DESIGNED BY PAUL HARDEN	DATE 8-88
APPROVED BY	DATE

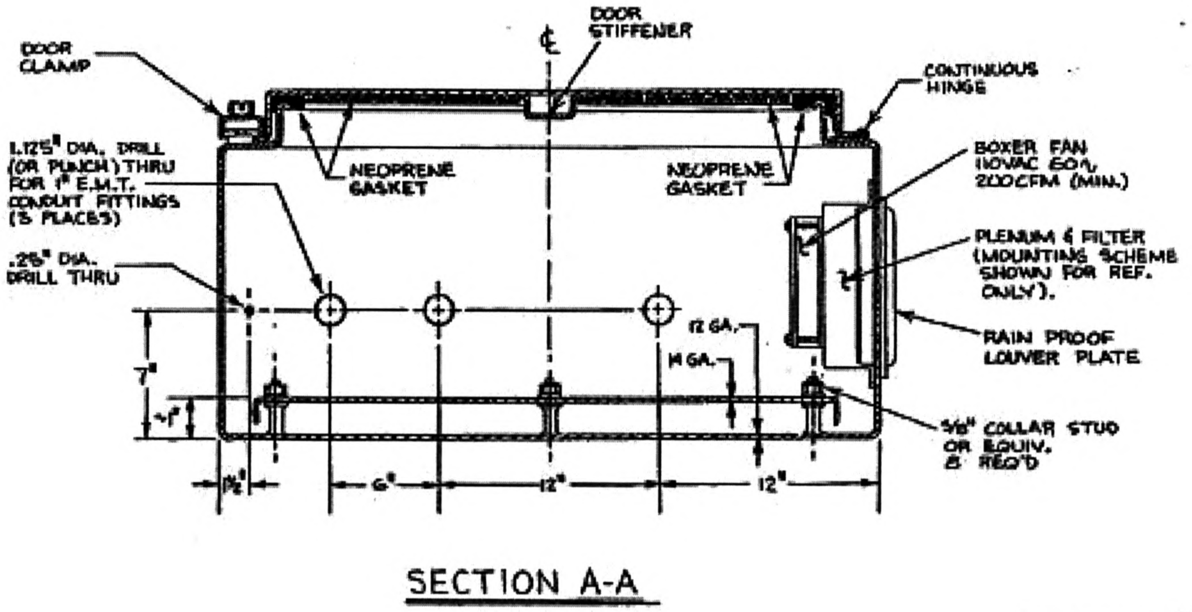
SHEET NUMBER 1 OF 1 DRAWING NUMBER C55006W001 REV. SCALE

SUPERCEDES C55006W001 DATED 4-87

FIG. 15

REV.	DATE	DRAWN BY	APPR'D BY	TION
A	10-87	P. Harden		6 UNITS URED BY EASTER O. DENVER,





NOTES

1. Enclosure to meet NEMA-4 standards for outdoor use. Unit to contain weather instruments, electronics and microprocessor components and to be ventilated.
2. Dimensions and construction approximate; to be similar to Hoffman enclosure type A60H36FLP with continuous hinged door.

☐3 Panel dimension 35"×57" should be closely preserved to be consistent with previous existing units. Positions of mounting hardware (collar studs) not critical. Approx. weight = 160 lbs (panel plus equipment).

☐4 Ventillation components to be specified and provided by vendor. If not assembled or installed by Vendor, all holes and cut-outs to be provided for components supplied.

☐5 Enclosure to be mounted on a support made of 1⅝" Uni-strut channels and ½" dia. bolts and spring-nuts. (Provided by NRAO)

NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±

MATERIAL:

FINISH:

PROJECT: VLBA

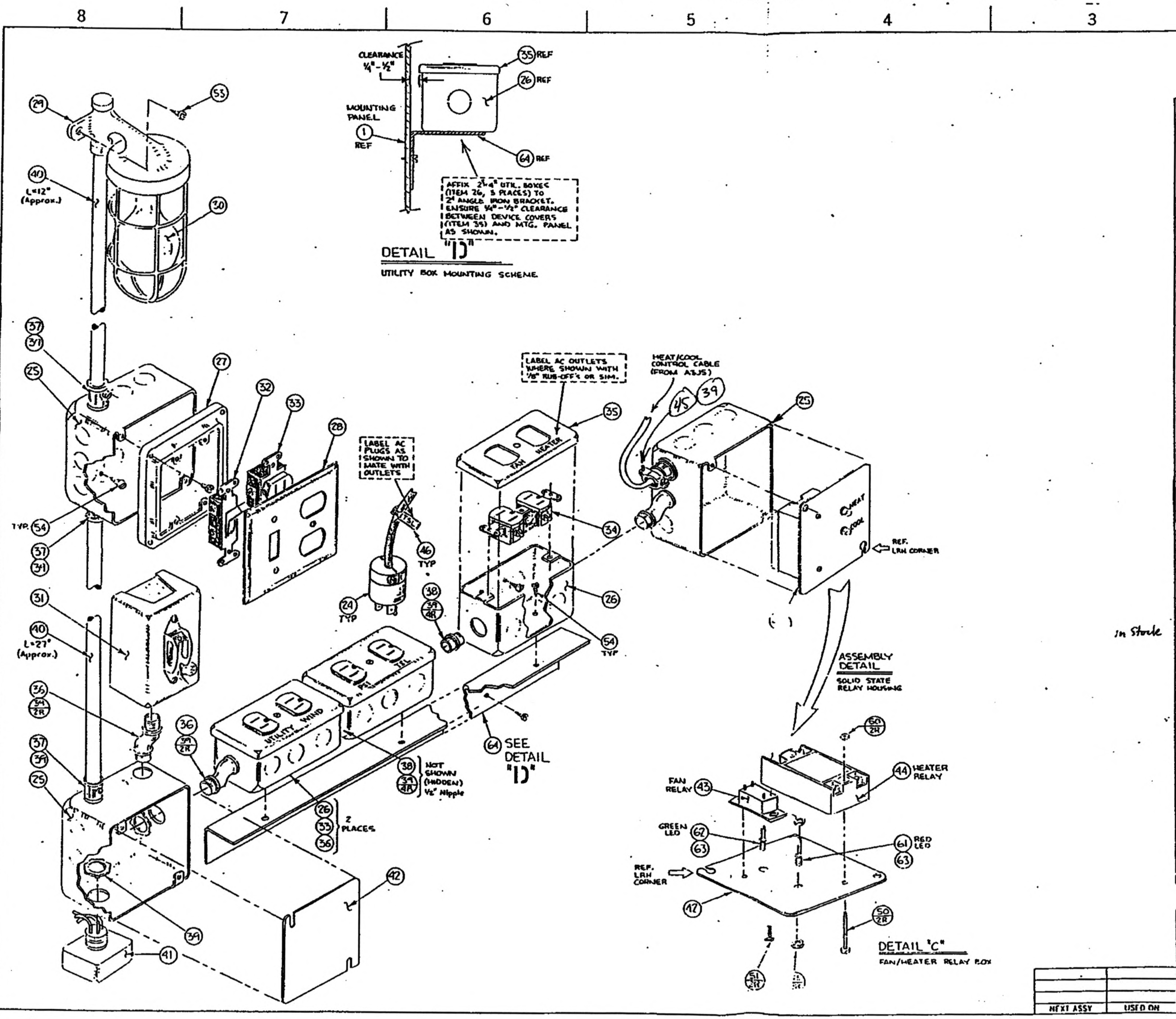
VLBA
WEATHER STATION

TITLE:
EQUIPMENT
ENCLOSURE
MECHANICAL

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY P. HARDEN	DATE 8-87
DESIGNED BY P. HARDEN/E. OSABUS	DATE 8-87
APPROVED BY	DATE

SHEET NUMBER 1 of 1 | DRAWING NUMBER C55006M001 | REV. | SCALE



In Stock

65		6-32 × 7/8	MACH. SCREW, NYLON
64			2" Angle Iron
63	DIALIGHT	515-0004	LED Series 521 MOUNTING CLIP
62	DIALIGHT	521-9175	LED, T-1¾, GREEN
61	DIALIGHT	521-9193	LED, T-1¾, RED
60		6-32	Nut, hex
59	SOUTHCO	47-10-204-10	Captive Screw, 6-32 Long
58	TECH. SERVICES	1063-301	TSL Display Unit PCB
57		#6	Washer, Flat
56	NRAO	B1305OM35	Mtg. Bracket, drilled & tapped
55	SFC TECHNOLOGY	SN-0632	Snap-Nut, 6-32
54		#6 × ⅜	Screw, Sheet Metal, S.T., washer hd
53		#6	Washer, lock
52		6-32 × 1	Mach. Screw, Pan. Hd.
51		6-32 × ½"	Mach. Screw, Pan. Hd.
50		6-32 × 1¼"	Mach. Screw, Pan. Hd.
49	DK.	J213	Spacer, 6-32 × ⅝, Alum. male/female
48			Spacer, 6-32 × ⅝, NYLON
47			Spacer, 6-32 × ⅜, NYLON
46	PANDUIT	PLF1M-CP	Ty-Wrap, marking, 4½"L, ¼" dia.
45	~~RACO~~ T+B	~~3312~~ 3311	Service Entrance Cable Fitting, 2 screw, ½"
44	TELEDYNE	PAN611-7	Solid State Relay, 5V in, 125V 25A load
43	MAGNECRAFT	226RE7-5A1	Solid State Relay, 5V in, 125V 5A load
42	RACO	752	Device Cover, Blank, 4" box
41	WEATHERMEASURES	MODEL 1077	Power Line Surge Arrestor, ½" fitting
40	T+B or sim.	½"	EMT Conduit, thinwall
39	T+B or sim.	½"	Rigid Conduit Lock-nut
38	T+B or sim.	½" × SHORT.	Conduit Nipple, threaded, ½"
37	RACO	2602	Connector, Box-½" EMT, Set Screw
36	RACO	1452	Offset Nipple, ½"
35	RACO	864	Util. Box Cover, for flush duplex recep.
34	EAGLE	270-B	Outlet, duplex with separate ckts, 125V 15A
33	HUBBLE or sim.	5262-BRN	Outlet, duplex, 125V 15A, 3-wire str. blade
32	G-E or sim.	1201-1L-PLC	Lighted Toggle Sw., 120V 15A, lighted when o
31	SQUARE-D	KG-1A	AC Snap Switch with indicator, 120VAC 30
30	G-E or sim.	120VAC, 40W	Bulb, incandescent
29	Appleton	VD1050G	Lighting Fixture & Guard, ½" EMT
28	RACO	[illegible]	Surface Cover, 2-otl. recep., 4" sq., ½" D
27	RACO	#777	Device Cover, 2-recep., 4" sq. raised ¼"
26	RACO	#670	Outlet Box, 2⅛"W × 4" × 2⅛"D, ½" KO's
25	RACO	#230	Outlet Box, 4" × 4" × 2⅛"D, ½" KO'S
24	HUBBELL	5666C	AC Plug, Insulwire 3-wire Straight Blade
23	AMP	201298-3	"PS1-J1"
22	CINCH/TRW	50-44A-30	"A5J4"
21	CINCH/TRW	50-20A-30	"A3J4, J6", "A4-J1"
20	ELECTROVERT	25-600-0653	"A3J2, J3, J7"
19	ELECTROVERT	25-600-0453	"A3J1, J5"
18	CINCH/TRW	50-100C-10-1	"A2J1"
17	AMPHENOL	DB-25-S	Connector "A1J2", "A9J1"
16	AMPHENOL	DD-50-S	Connector "A1J1"
15	NRAO	D55006A	Hinged Mounting Bracket (for Assy A4)
14	CINCH/TRW	~~8-142~~ 10-142	"TB4" Barrier Strip, 10-term. #8 screw
13	TAYLOR or Sim.	99010	Wire Duct Cover, 1"
12	TAYLOR or Sim.	91006	Wire Duct, PVC, 1" × 1" Channel
11	NRAO	C55006A004	ASSY PS1 - Power Supply Assy
10	NRAO	C55006A	ASSY A9 - Data Tap Assy's
9	HOFFMAN	A-DAH1001FT	ASSY A8 (P10) - Electric Heater, 100W
8	WEATHERMEASURES	Model 10643	ASSY A7 - Signal Lines Protection Board
7	A.I.R.	Model AIR-DB-2AX	ASSY A6 - Digital Barometer
6	TECH. SERVICES	Model 1083	ASSY A5-3 TSL Hygrometer, Receiver Bd
5	WEATHERMEASURES	Model 1025	ASSY A4 - Wind Instrumentation
4	NRAO	D55006A002	ASSY A3 - Analog Board
3	NRAO	D55006A00	ASSY A2 - Logic Board Assy
2	NRAO	D55001A004	ASSY A1 - Standard Interface Board
1(B)	EASTER-OWENS	Per Dwg. C55006M001	MOUNTING PANEL
1(A)	HOFFMAN	A60P36	MOUNTING PANEL
ITEM	MFR	PART NO.	DESCRIPTION / NOTES

BILL OF MATERIALS

MAR 2 1 1983

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ANGLES ±
3 PLACE DECIMALS (.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL

FINISH:

NEXT ASSY | USED ON

VLBA
WEATHER STATION

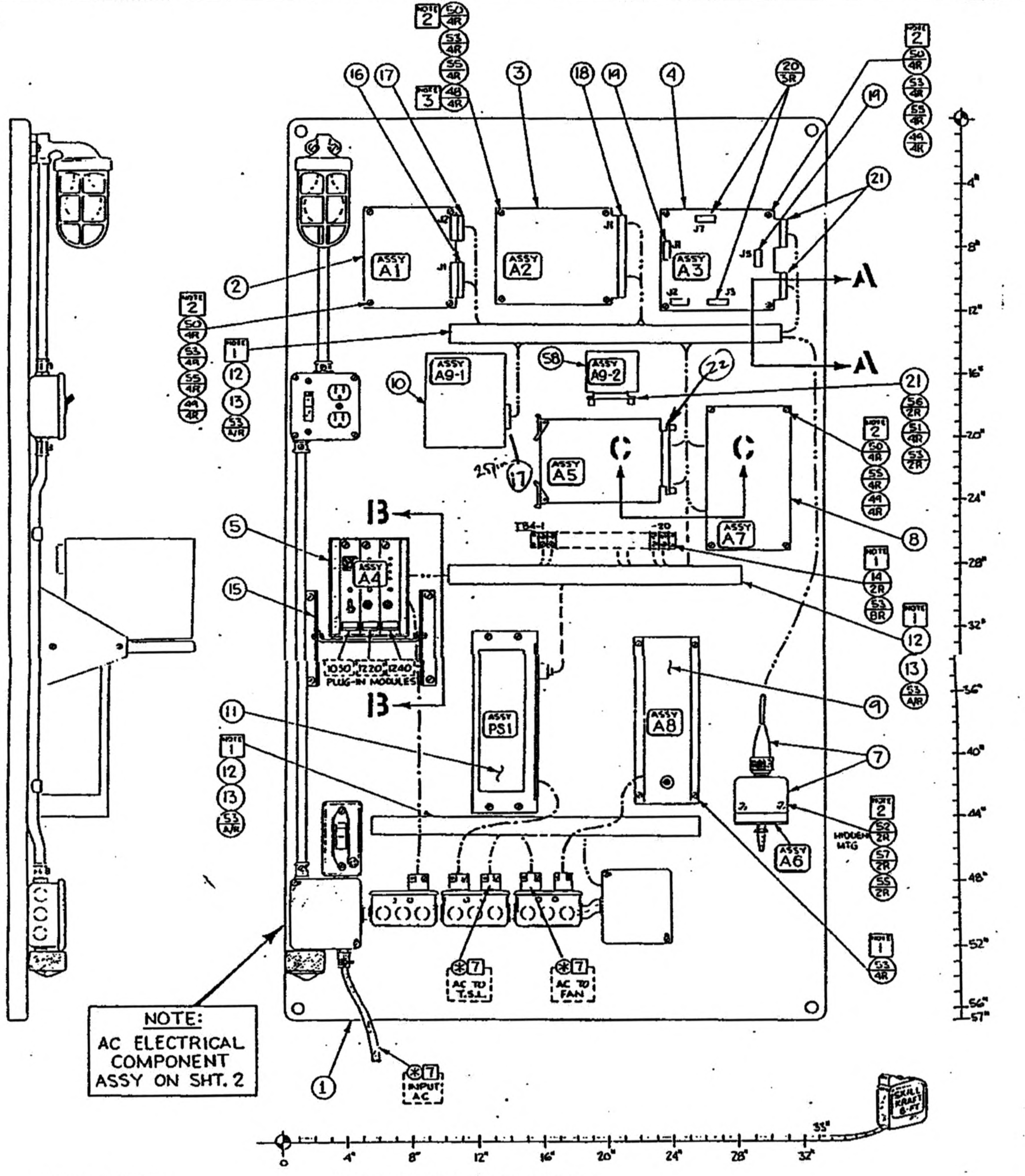
"JB2" COMPONENT
MOUNTING PLATE
-ASSEMBLY

NATIONAL R
ASTRONO
OBSERVAT

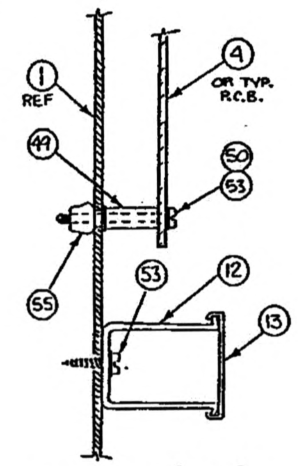
SHEET 2 of 2

D55006A007

ORDER MASTER 4/89

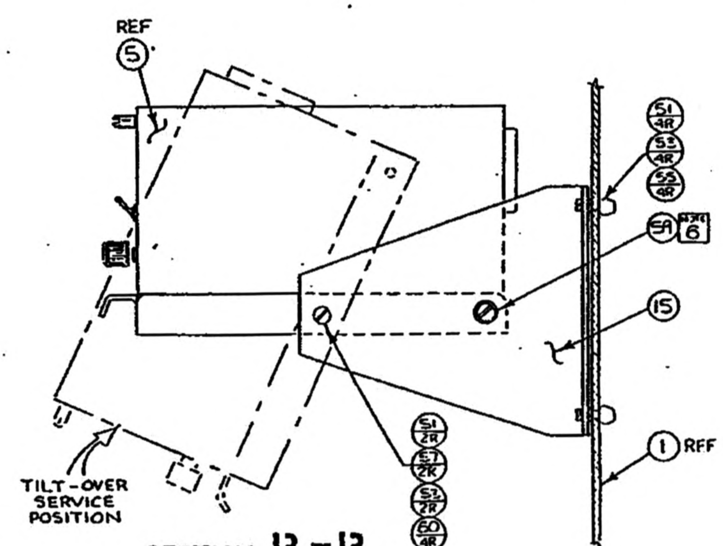


NOTE:
AC ELECTRICAL
COMPONENT
ASSY ON SHT. 2



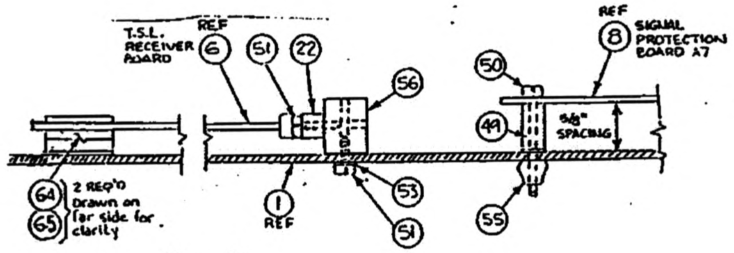
SECTION A-A

SCALE: 1:1
TYPICAL MOUNTING SCHEME



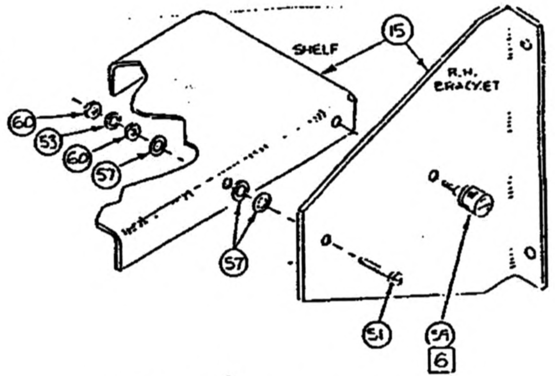
SECTION B-B

1/2 SCALE
ASSY "A4" WIND ELECTRONICS & MOUNTING SHELF



ECTION C - C

SCALE 1:1
OUNTING SCHEME
YPICAL ITEMS 6,8,10



DETAIL A (EXPLODED VIEW)

NO SCALE
WIND INSTRUMENT MOUNTING
SHELF ASSEMBLY

ASSEMBLY NOTES

1. ITEMS SHOWN ARE AFFIXED TO PANEL USING ITEM 53, #6 SHEET METAL SCREWS. SEE DETAIL ON SECTION A-A. (TYP.)
2. ITEMS SHOWN ARE AFFIXED TO PANEL USING ITEMS 50 & 55, 6-32 MACH. SCREWS AND 6-32 SNAP NUTS. SNAP NUTS MOUNTED INTO PANEL HOLES. SEE DETAIL ON SECTION A-A. (TYP.)
3. LOGIC BOARD (ITEM 3) MUST BE MOUNTED USING NYLON SPACERS (ITEM 48) AND NYLON SCREWS (ITEM 65)
4. ASSY A9-6 TSL RECEIVER BD. MUST BE MOUNTED USING NYLON SPACERS (ITEM 47)
5. DRILL PANEL PER NRAO DWG. D55006M003.
6. SOUTHCO CAPTIVE SCREW (ITEM 59) REQUIRES SPECIAL TOOL FOR INSERTION
7. ASSEMBLY OF ITEM SHOWN IS PART OF FIELD INSTALLATION (NOT A FABRICATION ITEM)

CABLING LEGEND

—·—·—	120V AC WIRING
– – – –	DC POWER WIRING
—··—··—	SIGNAL & CONTROL

NOMENCLATURE OF "ASSY" NUMBERS

A1	STANDARD INTERFACE BOARD
A2	LOGIC BOARD
A3	ANALOG BOARD
A4	WIND SIGNAL PROCESSORS
A5	TSL RECEIVER BOARD
A6	A.I.R. DIGITAL BAROMETER
A7	SIGNAL PROTECTION BOARD
A8	BOX HEATER
A9	DATA TAP (2 UNITS)

PARTS LIST/B.O.M.
ON SHT. 2

MAR 2 1 1989

NEXT ASSY	USED ON
C55006	AC WIRING
D55006M003	DRILL DWG.
A55006B006	B.O.M.
D55006A004	JB2 TOP ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ANGLES ±
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
1 PLACE DECIMALS ±

MATERIAL:

FINISH:

VLBA
WEATHER STATION

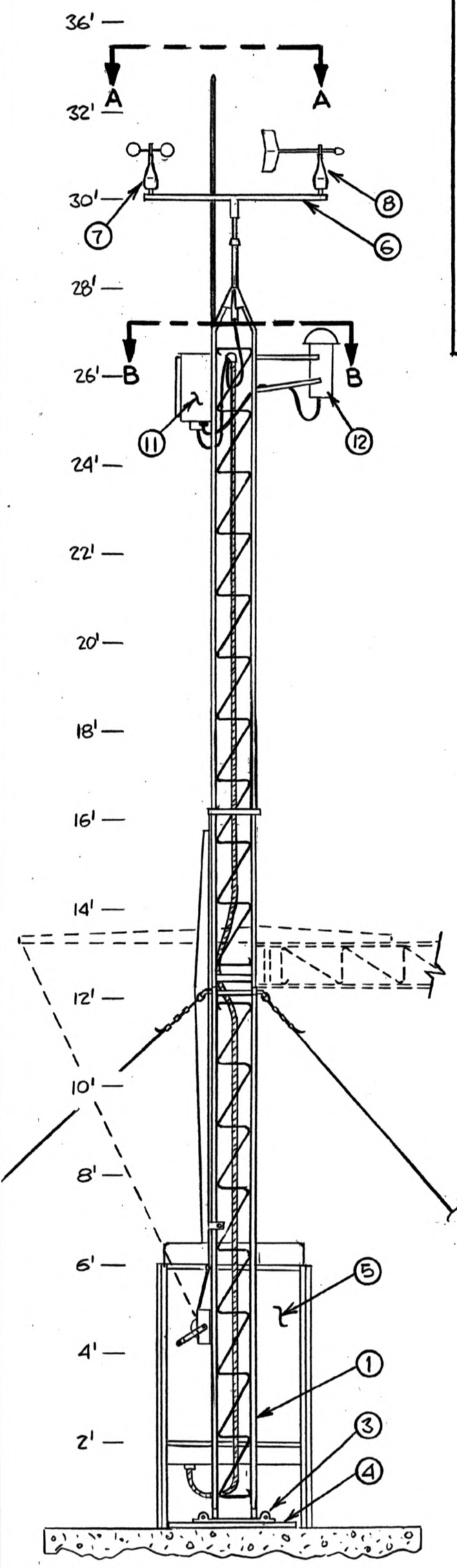
"JB2" COMPONENT
MOUNTING PLATE
-ASSEMBLY

NATIONAL
ASTRON
OBSERVA

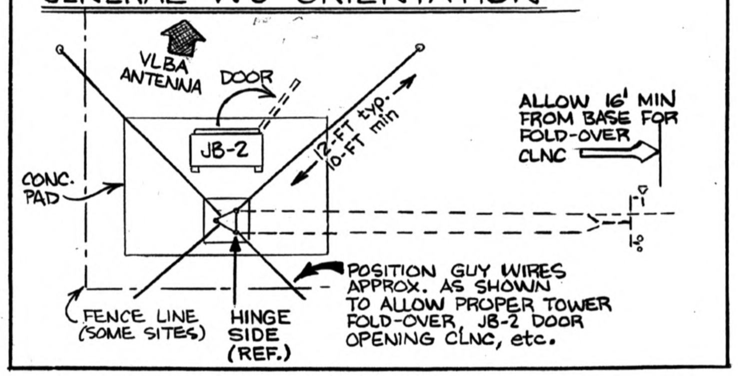
SHEET 1 OF 2
DRAWING NUMBER D55006A007

ORDER MASTER 4/89

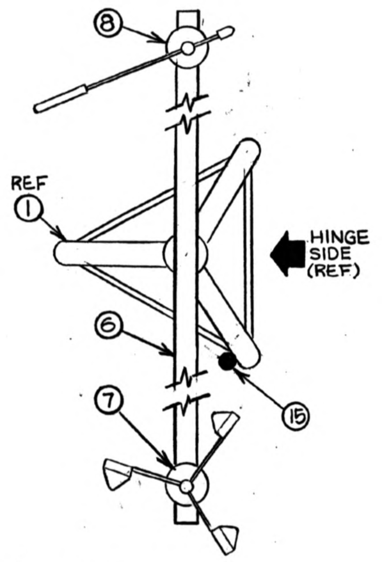
REV.	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION



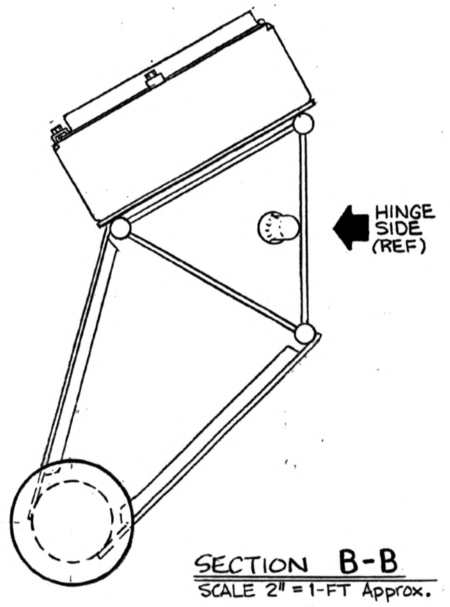
GENERAL WS ORIENTATION



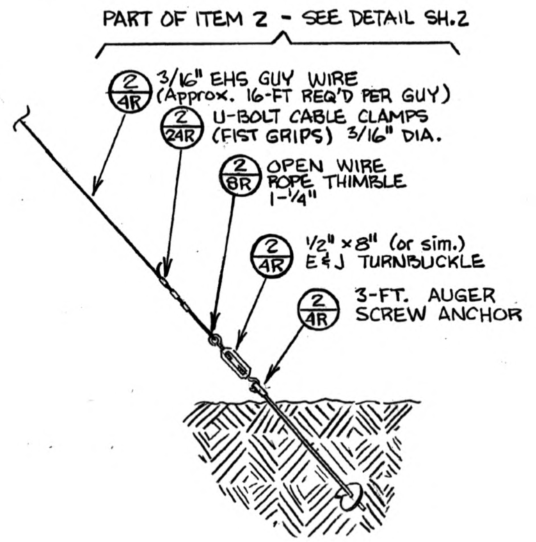
POSITION GUY WIRES APPROX. AS SHOWN TO ALLOW PROPER TOWER FOLD-OVER, JB-2 DOOR OPENING CLNC, etc.



SECTION A-A
SCALE 2" = 1-FT Approx.



SECTION B-B
SCALE 2" = 1-FT Approx.



PART OF ITEM 2 - SEE DETAIL SH.2

$\frac{2}{4R}$ 3/16" EHS GUY WIRE (Approx. 16-FT REQ'D PER GUY)

$\frac{2}{24R}$ U-BOLT CABLE CLAMPS (FIST GRIPS) 3/16" DIA.

$\frac{2}{8R}$ OPEN WIRE ROPE THIMBLE 1-1/4"

$\frac{2}{4R}$ 1/2" × 8" (or sim.) E&J TURNBUCKLE

$\frac{2}{4R}$ 3-FT. AUGER SCREW ANCHOR

#	QTY	DESCRIPTION	MFR/PART NO.
20	4	Sheet Metal Screws, S.T.	
19	10	1" Right Angle Cond. Clamp	UBC-100
18	2	1" PVC Female Adapter	
17	3	1" Insulated Str. Conn.	
16	35'	Jacketted Wire, single cond.	THHN 1/0
15	1	Brass Ground Rod	5/8" × 8-Ft.
14	1	1" Service Entry Clamp	Weaver #EEH1
13	35'	1" Liquid Tight Flex. Conduit	Type UA 1" × 35 Ft.
12	1	Aspirator/Sensor Assy	TSL Model 1063
11	1	Hygrometer Transmitter	TSL Model 1063
10	50'	Cable, 4-cond. #T600504	Weather Measures
9	50'	Cable, 3-cond. #T600503	↓
8	1	Wind Vane, #2020	
7	1	Anemometer, #2030	
6	1	Cross Arm Assy, #2023	Weather Measures
5	1	NEMA-4 Elect. Jct. Box	Hoffman/E. Owens
4	1	Adapter Plate	NRAO D55006M002
3	1	Hinged Base Plate	ROHN BPH25G
2	1	Guy Wire Kit	ROHN
1	1	30-FT Foldover Tower	ROHN FK-25G-30

NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±

MATERIAL:

FINISH:

VLBA PROJECT: VLBA WEATHER STATION

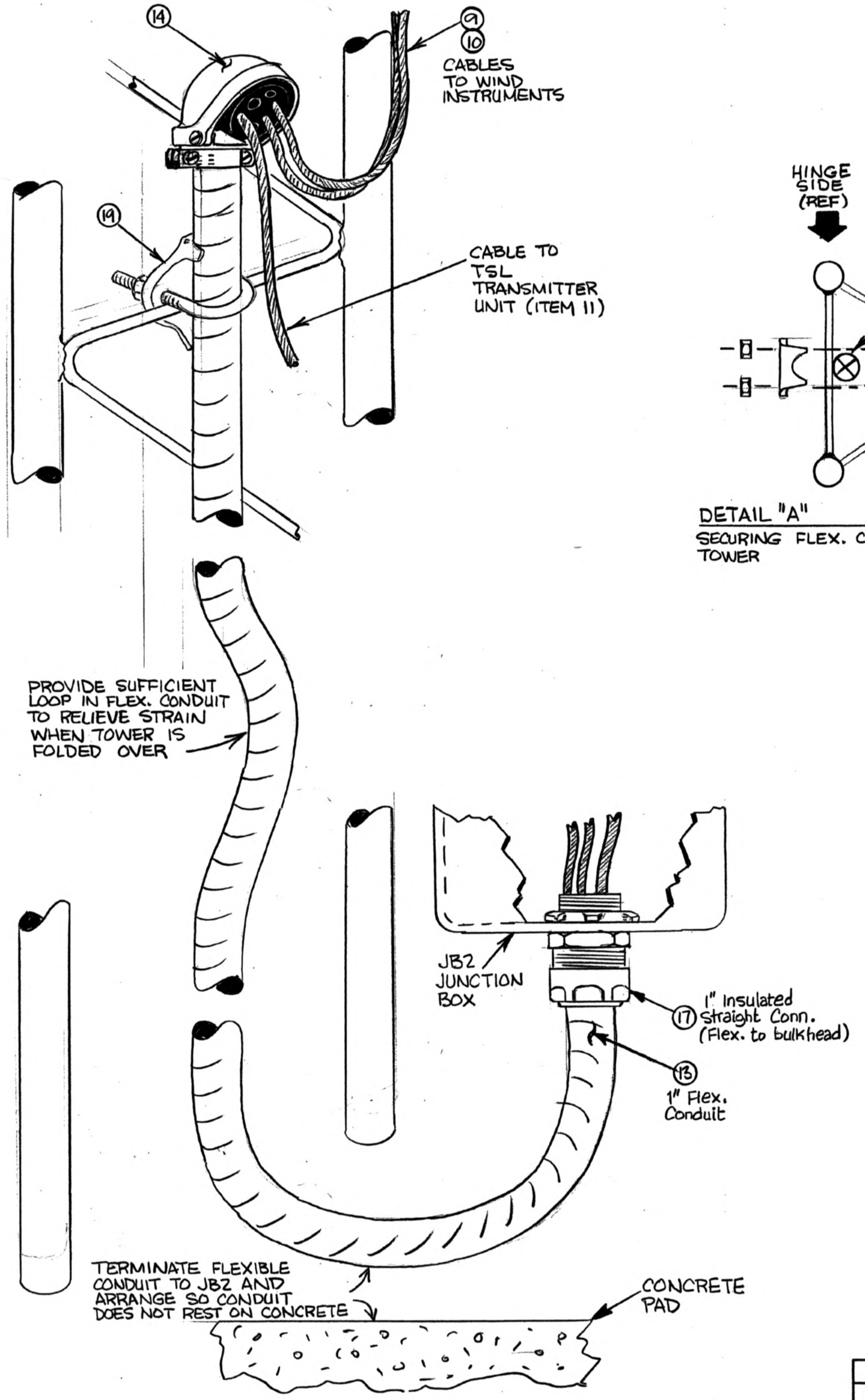
TITLE: SITE INSTALLATION DRAWINGS

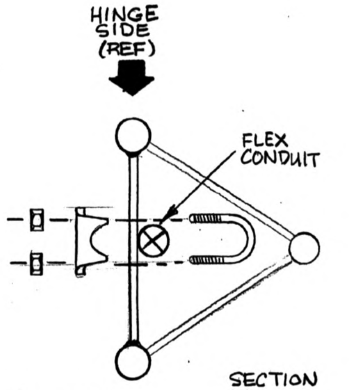
NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY Paul Harden — DATE 9-88
DESIGNED BY PAUL HARDEN — DATE 9-88
APPROVED BY — DATE

SHEET NUMBER 1 OF 3
DRAWING NUMBER C55006A008
REV.
SCALE

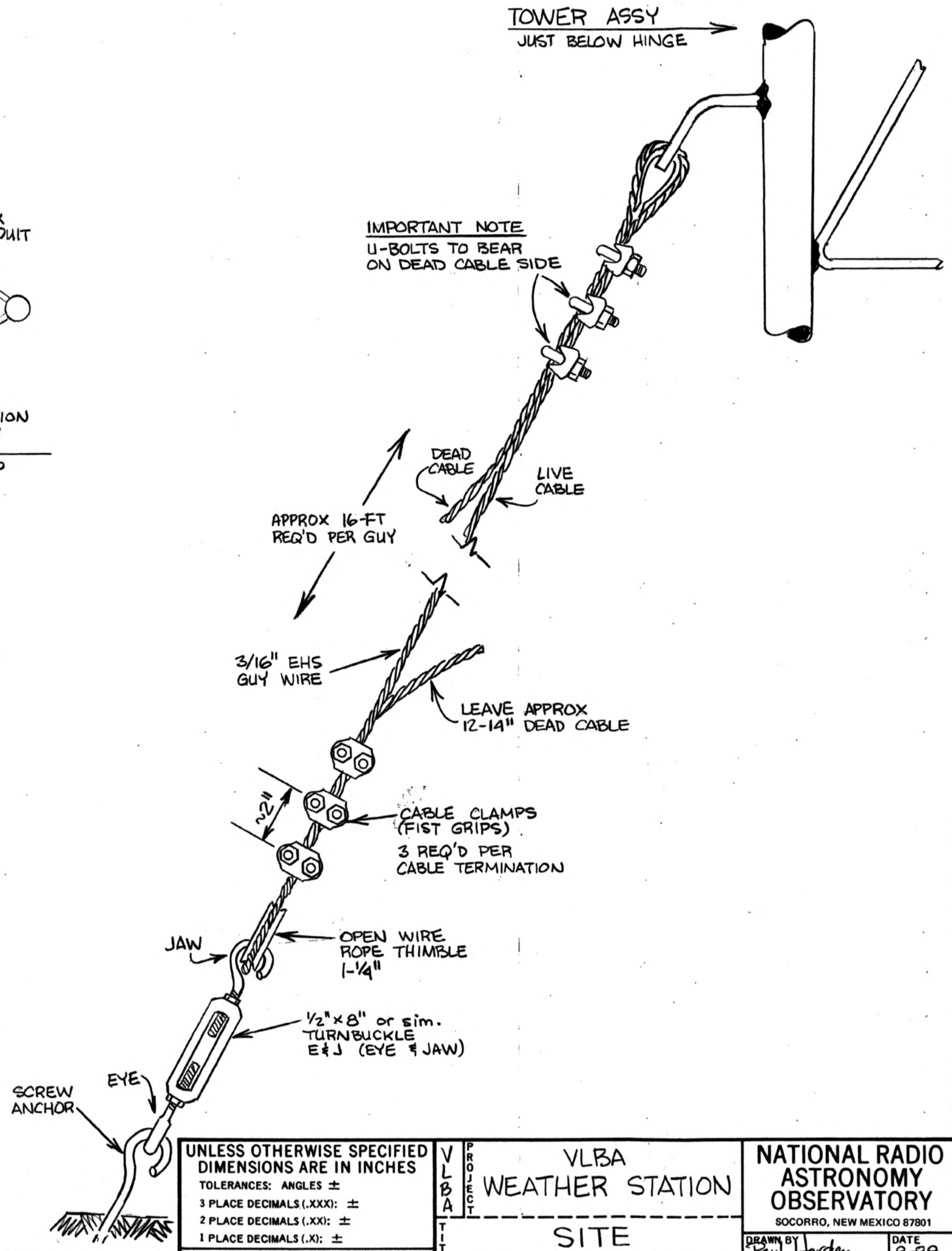
REV.	DATE	DRAWN BY	APPR'D BY	DESCRIPTION





DETAIL "A"

SECURING FLEX. CONDUIT TO TOWER



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±

MATERIAL:

FINISH:

NEXT ASSY	USED ON

VLBA PROJECT: VLBA WEATHER STATION

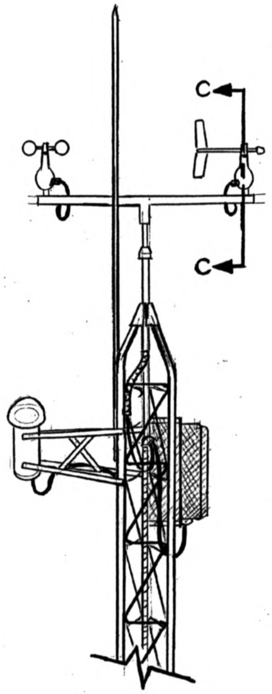
TITLE: SITE INSTALLATION DRAWINGS

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

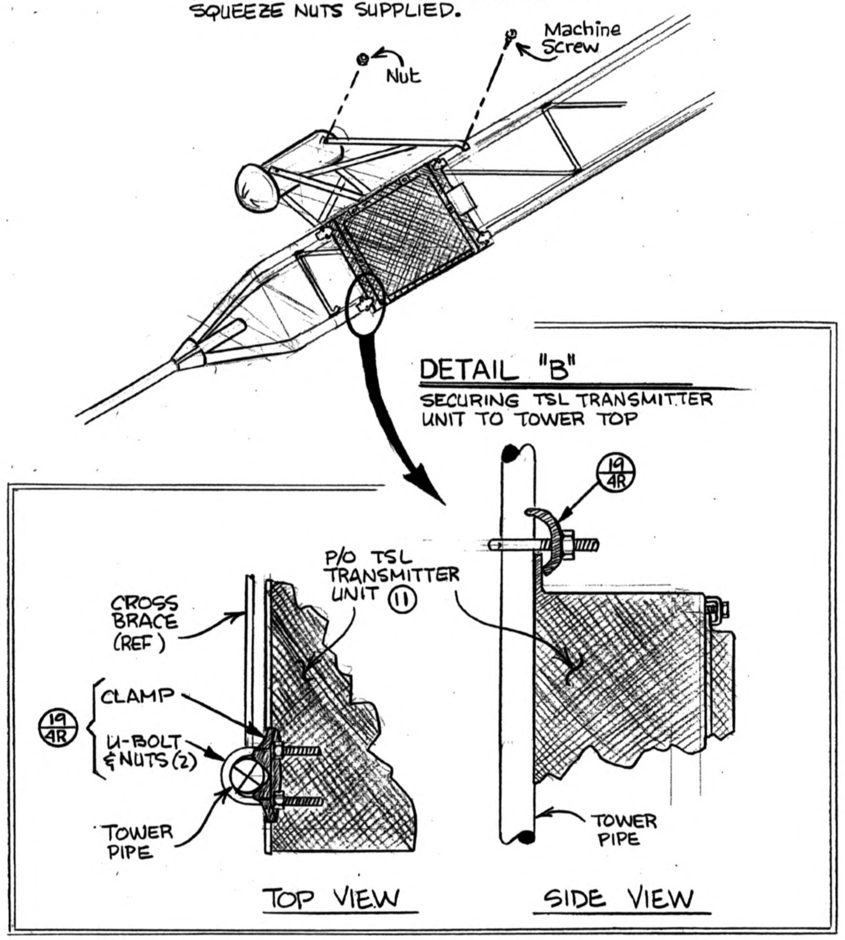
DRAWN BY Paul Harden DATE 8-88
DESIGNED BY DATE
APPROVED BY DATE

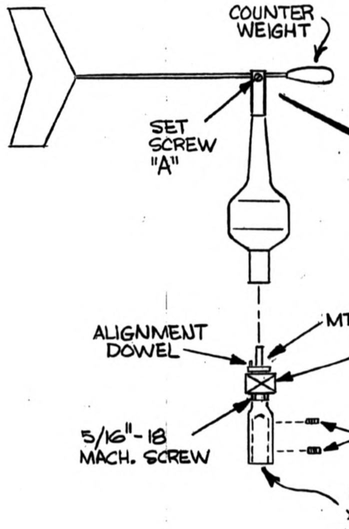
SHEET NUMBER 2 OF 3 DRAWING NUMBER C55006A008 REV. SCALE

REV.	DATE	DRAWN BY	APPR'V'D BY	DESCRIPTION



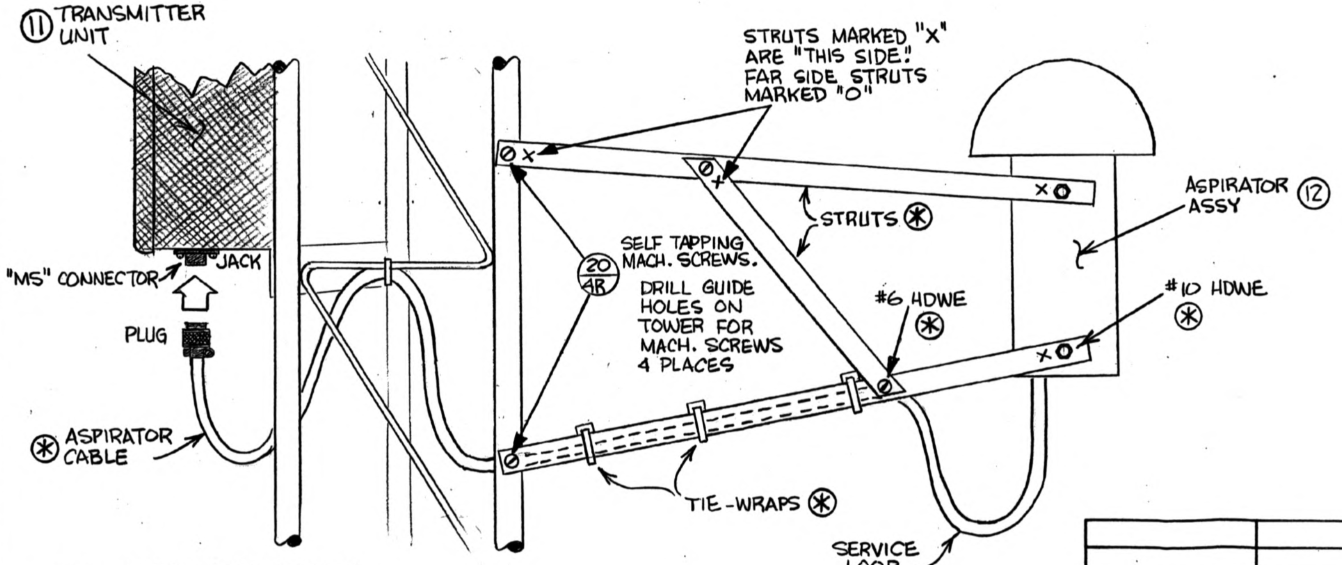
MOUNT TSL ASPIRATOR MOUNTING STRUTS (PART OF ITEM 12) TO TOWER WITH SELF-TAPPING METAL SCREWS. PRE-DRILL STARTING HOLES 4 PLACES. ASPIRATOR MOUNTED TO STRUTS WITH SQUEEZE NUTS SUPPLIED.





ALIGNMENT NOTE

INSERT VANE SHAFT THROUGH HOLE IN TOP COLLAR THEN ATTACH COUNTER WEIGHT. FIND BALANCING POINT AND TIGHTEN WITH SET SCREW "A"



⊛ = ITEMS PART OF T.S.L. UNIT (ITEM 11+12) INSTALLATION KIT

NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±

MATERIAL:

FINISH:

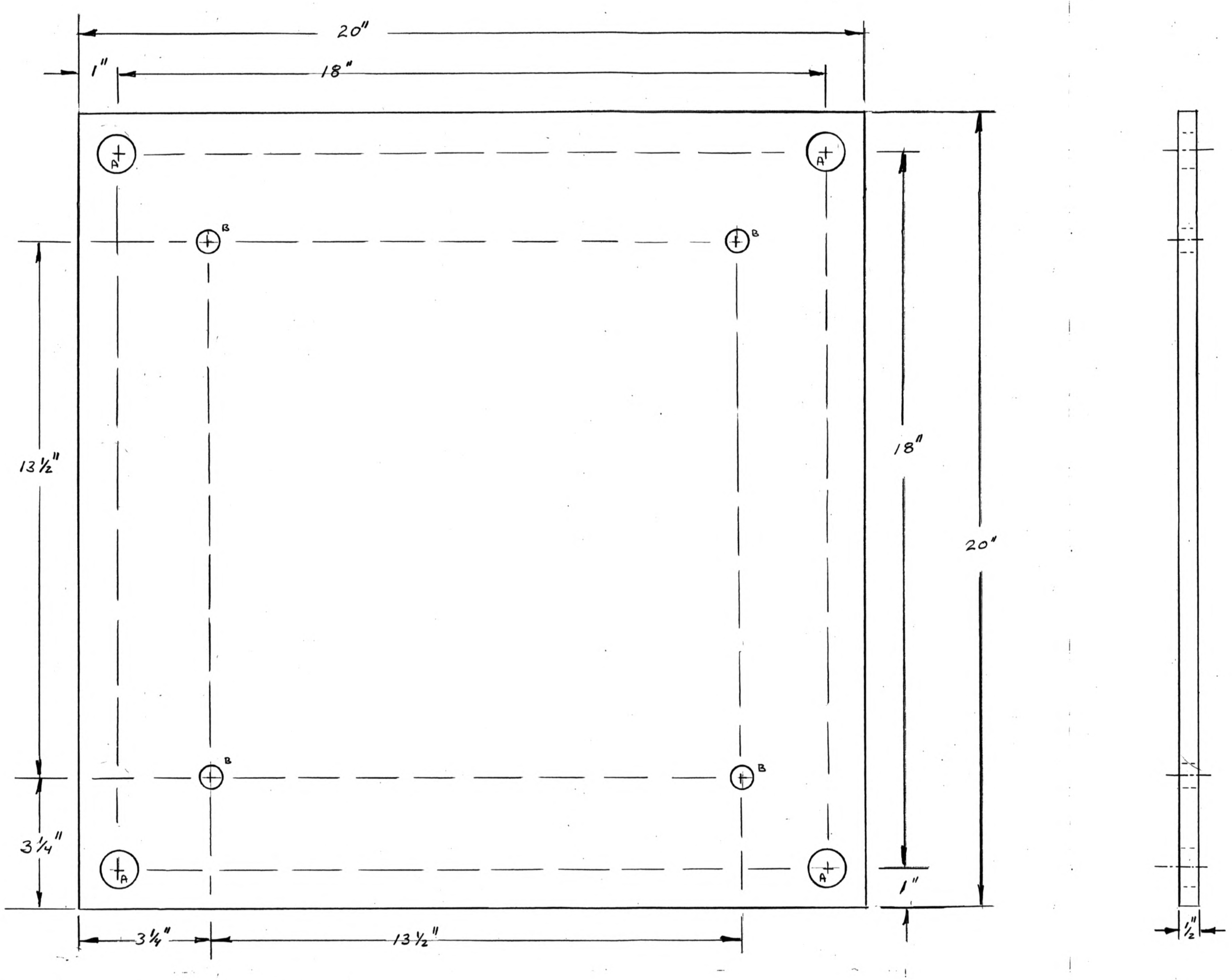
VLBA PROJECT: VLBA WEATHER STATION
TITLE: SITE INSTALLATION DRAWINGS

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY Paul Harden DATE 9-88
DESIGNED BY PAUL HARDEN DATE 9-88
APPROVED BY DATE

SHEET NUMBER 3 OF 3 DRAWING NUMBER C55006A008 REV. SCALE

REV.	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION



Hole Table: A – 1.000 Dia, Thru, 4 Places
B – 0.625 Dia, Thru, 4 Places

Fabrication Tolerances:
1) External 20"x20" Dimensions – ± ⅛"
2) 18"x18" & 13½"x13½" Hole Patterns – ± 1/16"
3) Hole Sizes – ± 1/32"

Remove All Sharp Corners & Edges & Champfer Holes

NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ± Tol
3 PLACE DECIMALS (.XXX): ± in
2 PLACE DECIMALS (.XX): ± Notes
1 PLACE DECIMALS (.X): ± At Left

MATERIAL:
½" Mild Steel Plate

FINISH: –
Zinc-Based Primer

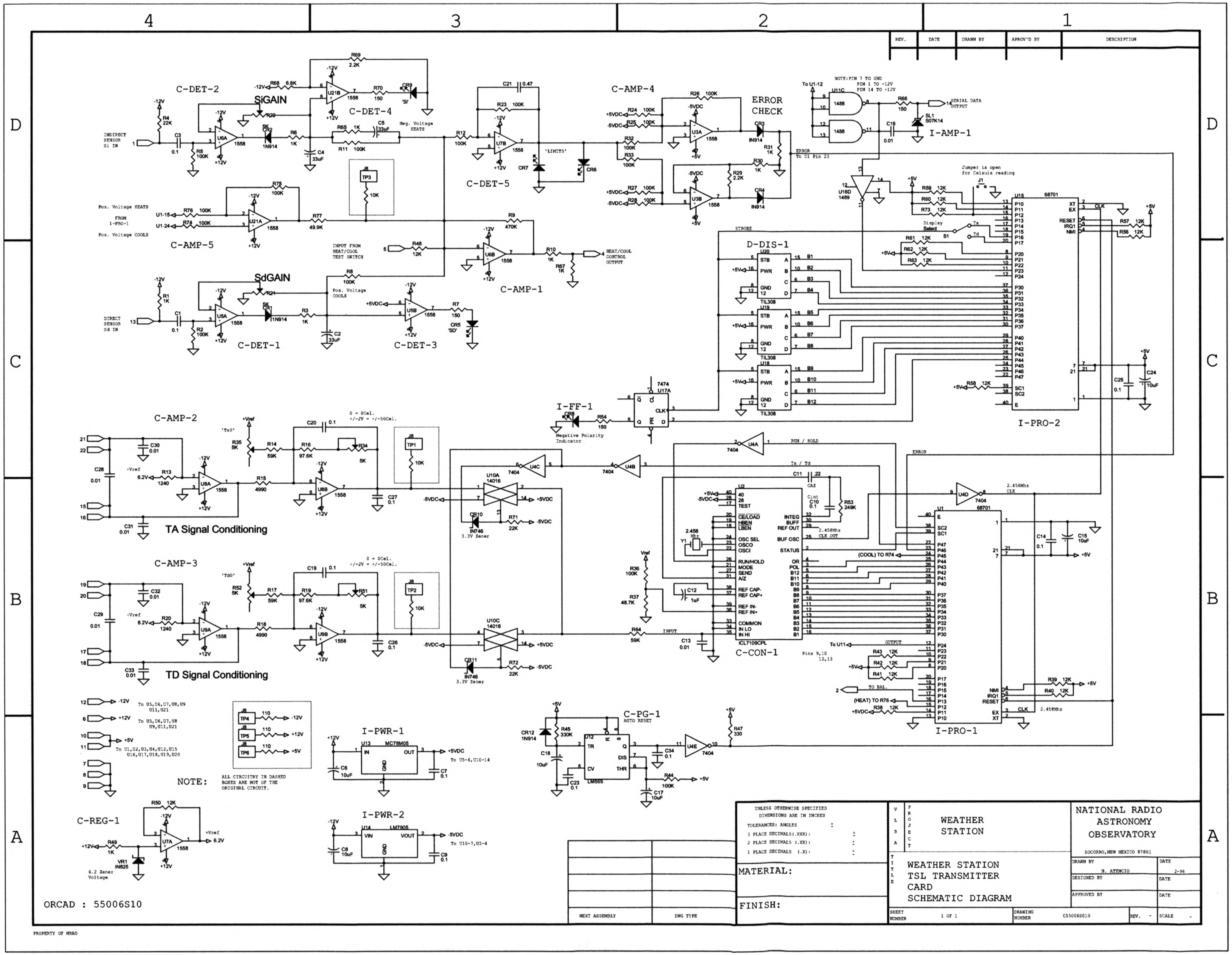
VLBA PROJECT: VLBA Weather Station

TITLE: Rohn Tower Adaptor Plate

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY D. Weber	DATE 1/8/88
DESIGNED BY	DATE
APPROVED BY	DATE

SHEET NUMBER 1/1
DRAWING NUMBER C55006M002
REV.
SCALE ½



NOTE: ALL CIRCUITRY IN DASHED BOXES ARE NOT OF THE ORIGINAL CIRCUIT.

ORCAD : 55006S10

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES

TOLERANCES: ANGLES ±

3 PLACE DECIMALS(.XXX): ±

2 PLACE DECIMALS (.XX): ±

1 PLACE DECIMALS (.X): ±

MATERIAL:

FINISH:

NEXT ASSEMBLY

DWG TYPE

VLBA PROJECT: WEATHER STATION

TITLE: WEATHER STATION
TSL TRANSMITTER
CARD
SCHEMATIC DIAGRAM

NATIONAL RADIO
ASTRONOMY
OBSERVATORY

SOCORRO,NEW MEXICO 87801

DRAWN BY N. ATENCIO	DATE 2-96
DESIGNED BY	DATE
APPROVED BY	DATE

SHEET NUMBER 1 OF 1

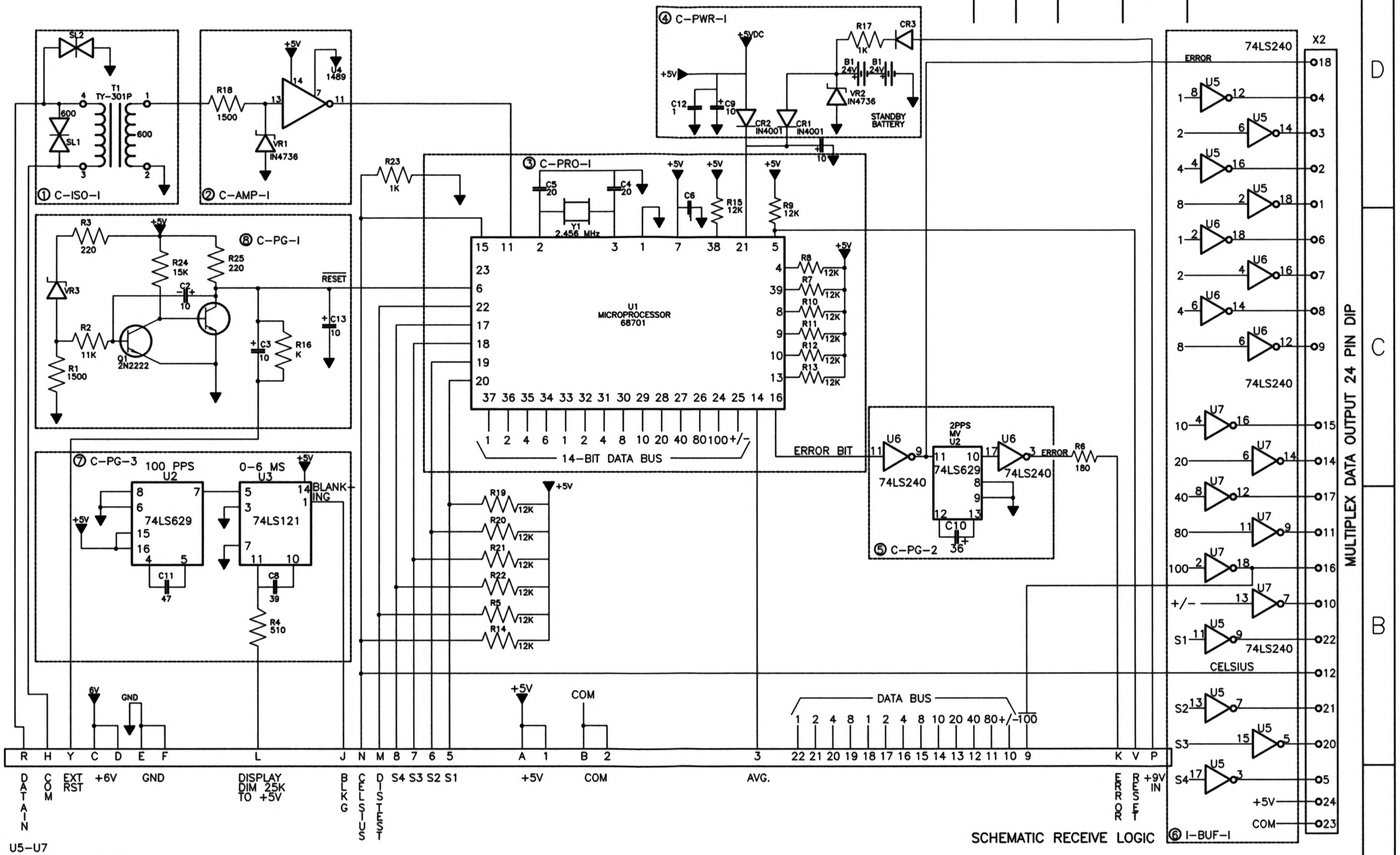
DRAWING NUMBER C55006S010

REV. -

SCALE -

PROPERTY OF NRAO

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION



SCHEMATIC RECEIVE LOGIC

U5–U7
PINS 1,10,19 COM
PINS 16 +5V

ACAD : 55006L02

PROPERTY OF NRAO

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES : ANGLES ±
3 PLACE DECIMALS (.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±
MATERIAL :
FINISH :

NEXT ASSEMBLY
DWG. TYPE

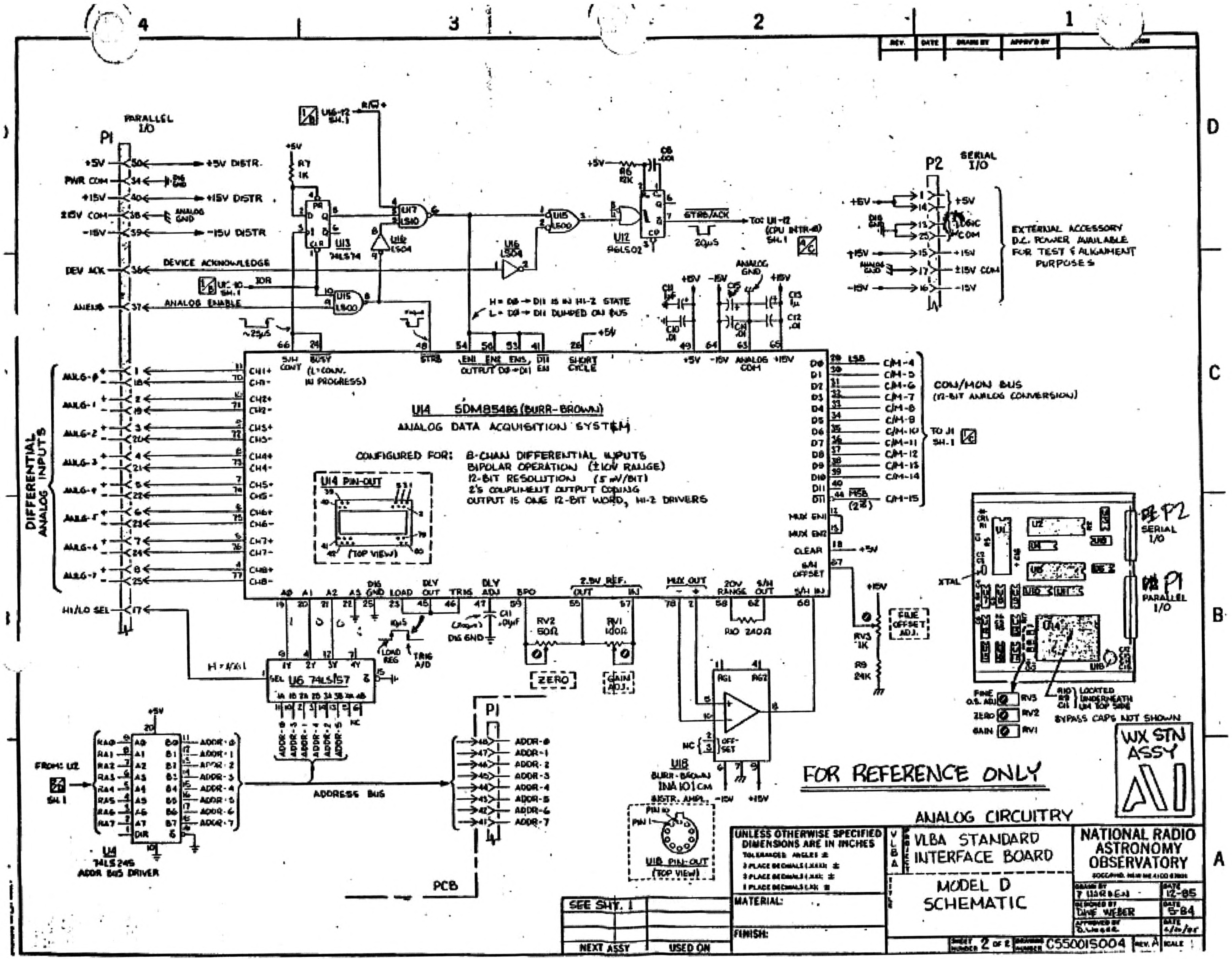
VLA
PROJECT WEATHER STATION

TITLE WEATHER STATION
RECEIVER LOGIC PCB
LOGIC DIAGRAM

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY M.SULLIVAN DATE 9/10/99
DESIGNED BY TSL DATE
APPROVED BY GARY DUFF DATE 9/28/99

SHEET NUMBER 1 OF 1
DRAWING NUMBER C55006L002
REV. —
SCALE NONE



FOR REFERENCE ONLY

ANALOG CIRCUITRY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

SEE SHT. 1

NEXT ASSY | USED ON

VLBA

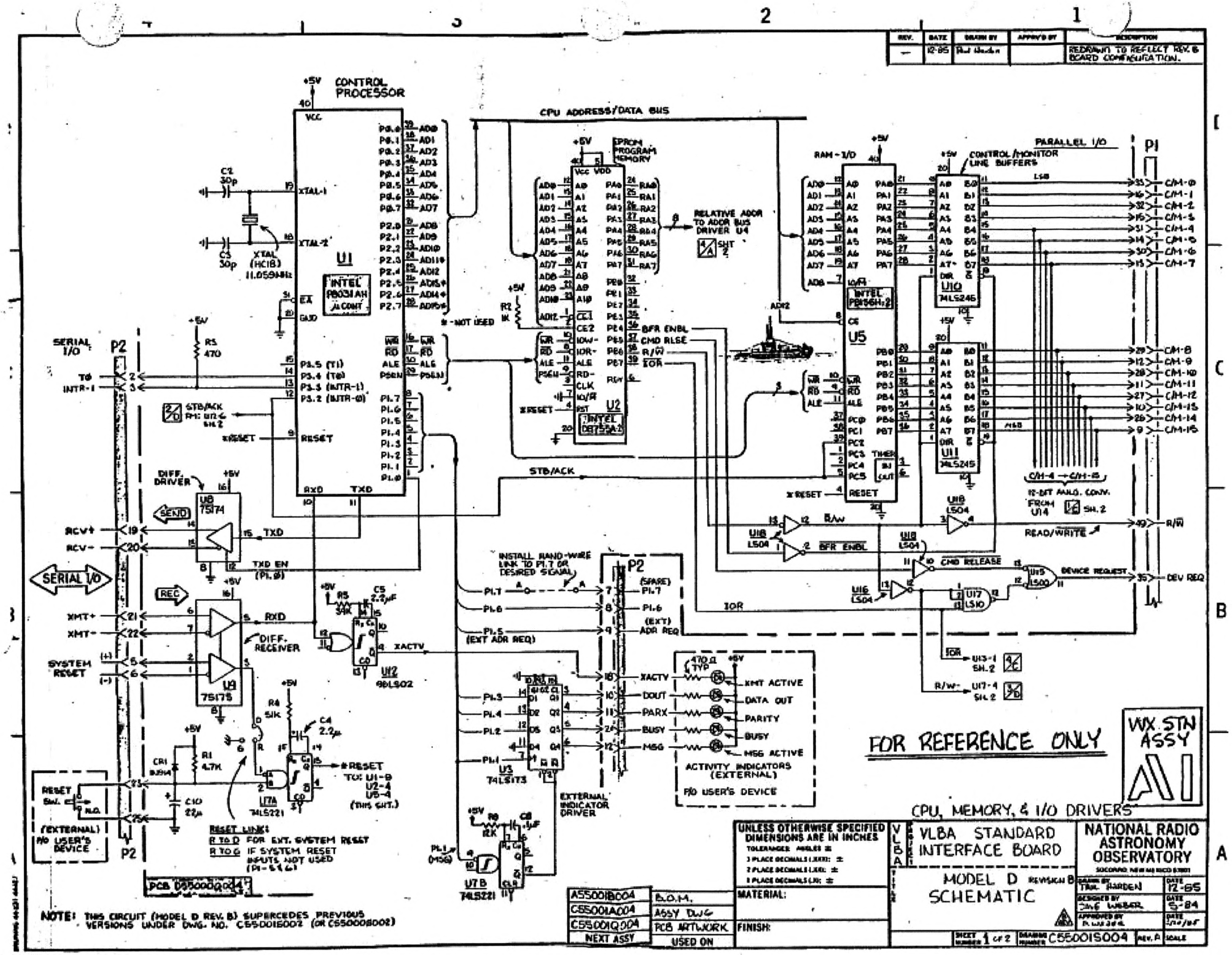
VLBA STANDARD
INTERFACE BOARD

MODEL D
SCHEMATIC

NATIONAL RADIO
ASTRONOMY
OBSERVATORY

DRAWN BY T. HARDEN — DATE 12-85
DESIGNED BY DAVE WEBER — DATE 5-84
APPROVED BY — DATE

SHEET NUMBER 2 OF 2 DRAWING NUMBER C55001S004 REV. A SCALE



REV.	DATE	DRAWN BY	APPR'D BY	DESCRIPTION
—	12-85	Paul Harden		REDRAWN TO REFLECT REV. B BOARD CONFIGURATION.

NOTE: THIS CIRCUIT (MODEL D REV. B) SUPERCEDES PREVIOUS VERSIONS UNDER DWG. NO. C55001S002 (OR C55000S002)

CPU, MEMORY, & I/O DRIVERS

NEXT ASSY	USED ON
A55001B004	B.O.M.
C55001A004	ASSY DWG
C55001Q004	PCB ARTWORK

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±

MATERIAL:

FINISH:

VLBA

VLBA STANDARD INTERFACE BOARD

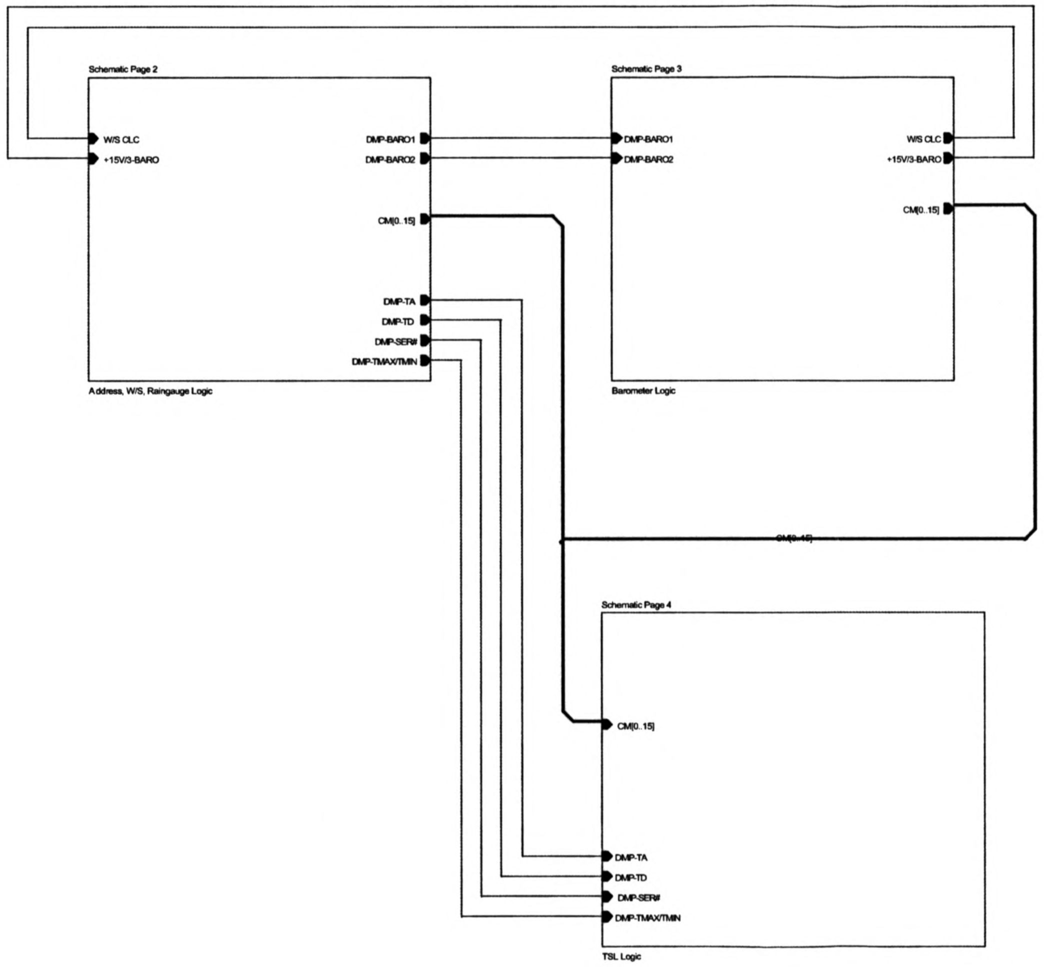
MODEL D REVISION B
SCHEMATIC

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY: PAUL HARDEN DATE: 12-85
DESIGNED BY: DAVE WEBER DATE: 5-84
APPROVED BY: DATE:

SHEET NUMBER 1 OF 2
DRAWING NUMBER C55001S004
REV. A
SCALE

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
A	07/01/90	ANDREATTA		MINOR CORRECTIONS ;
B	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



ORCAD : 55006S006

A55006A001	ASSEMBLY
NEXT ASSEMBLY	DWG TYPE

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS(.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA
PROJECT WEATHER STATION

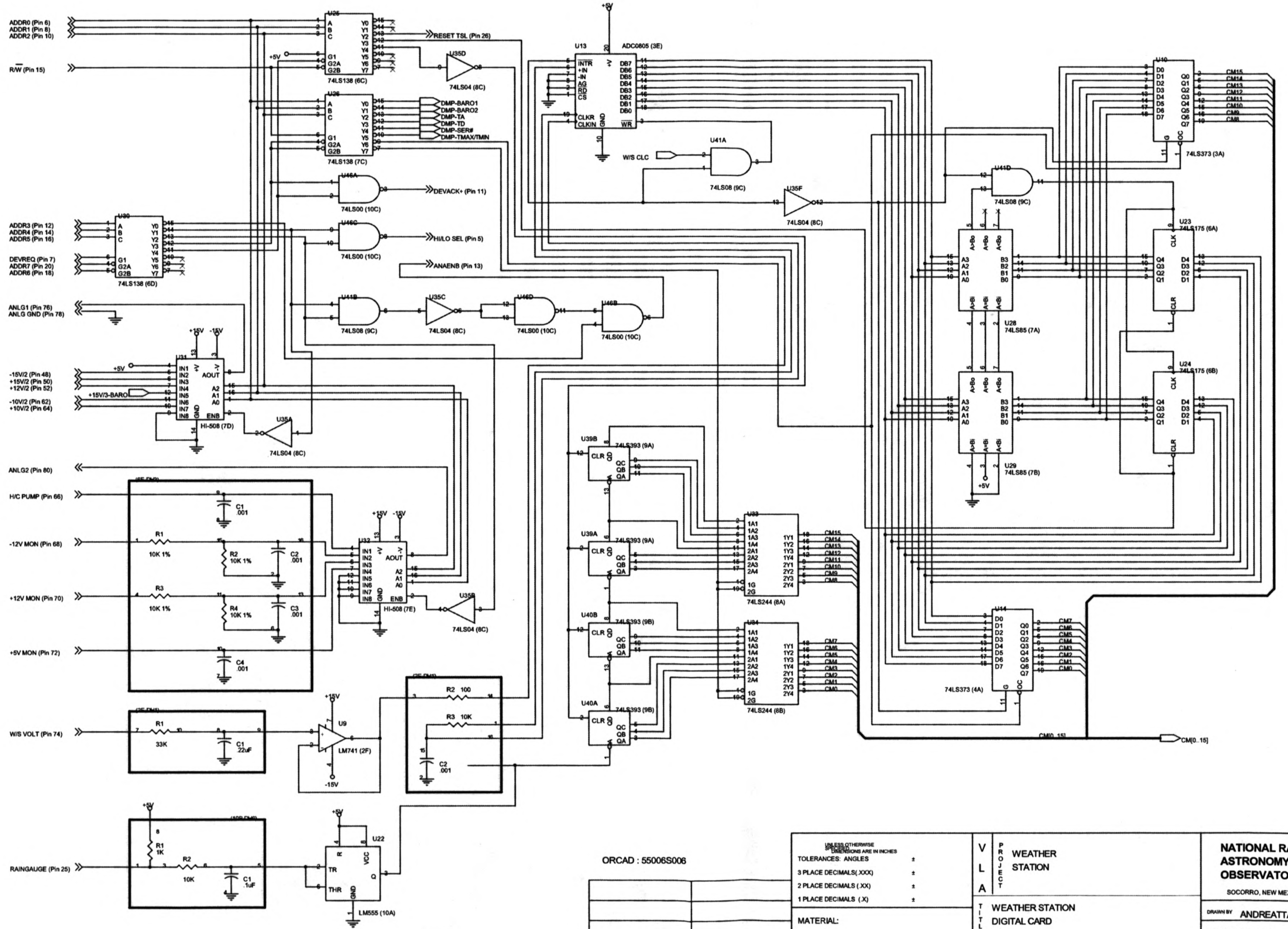
TITLE WEATHER STATION
DIGITAL CARD
SCHEMATIC

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA DATE 02/01/90
DESIGNED BY WEIMER DATE 02/01/90
APPROVED BY DATE

SHEET NUMBER 1 OF 4 DRAWING NUMBER C55006S006 REV B SCALE NONE

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
A	07/01/90	ANDREATTA		MINOR CORRECTIONS ;
B	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



ORCAD : 55006S006

A55006A001 | ASSEMBLY
NEXT ASSEMBLY | DWG TYPE

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS(.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA
PROJECT WEATHER STATION

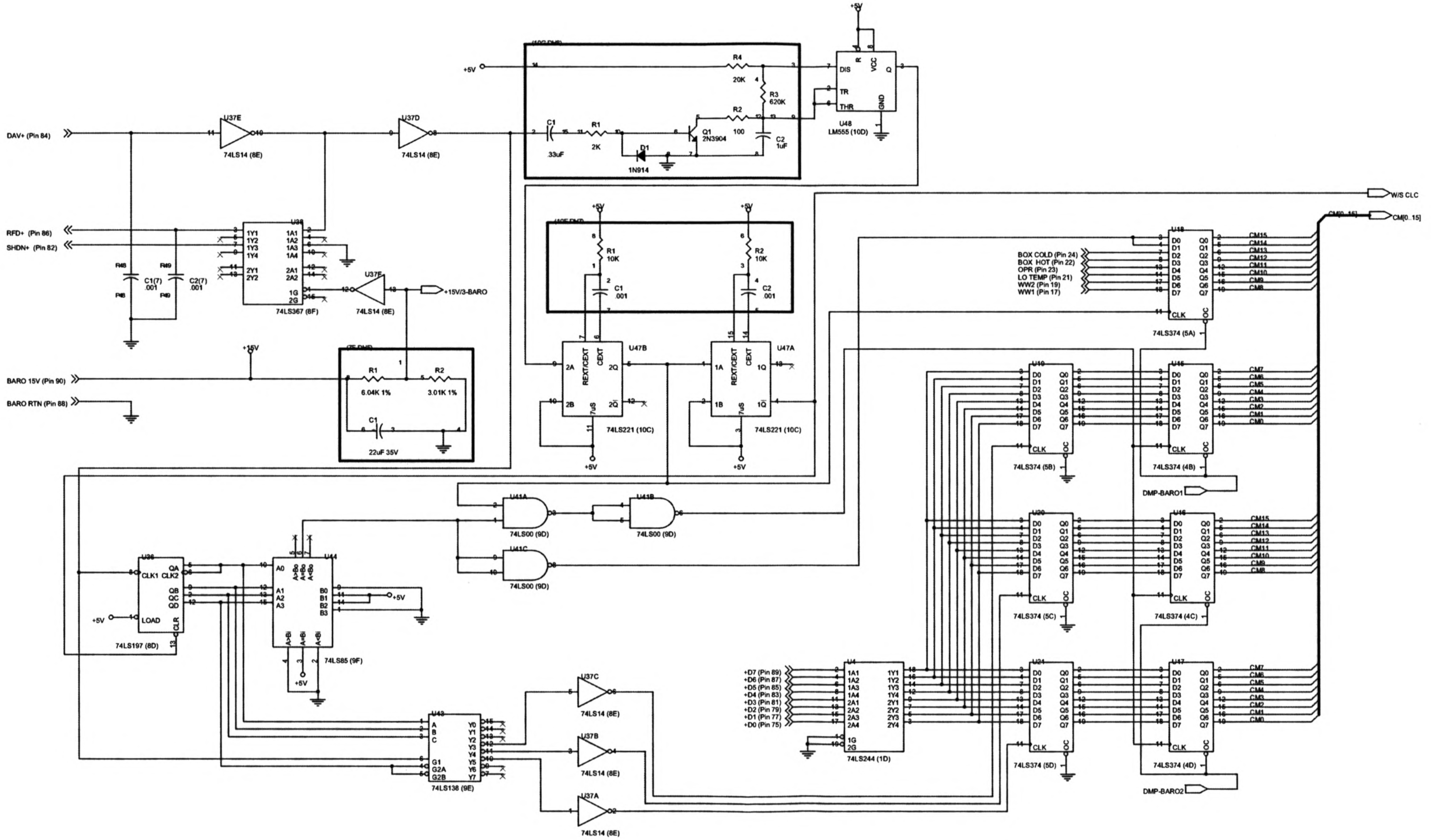
TITLE WEATHER STATION
DIGITAL CARD
SCHEMATIC

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA | DATE 02/01/90
DESIGNED BY WEIMER | DATE 02/01/90
APPROVED BY | DATE

SHEET NUMBER 2 OF 4
DRAWING NUMBER C55006S006
REV B
SCALE NONE

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
A	07/01/90	ANDREATTA		MINOR CORRECTIONS ;
B	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



ORCAD : 55006S006

A55006A001	ASSEMBLY
NEXT ASSEMBLY	DWG TYPE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS(.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA

PROJECT WEATHER STATION

TITLE WEATHER STATION DIGITAL CARD SCHEMATIC

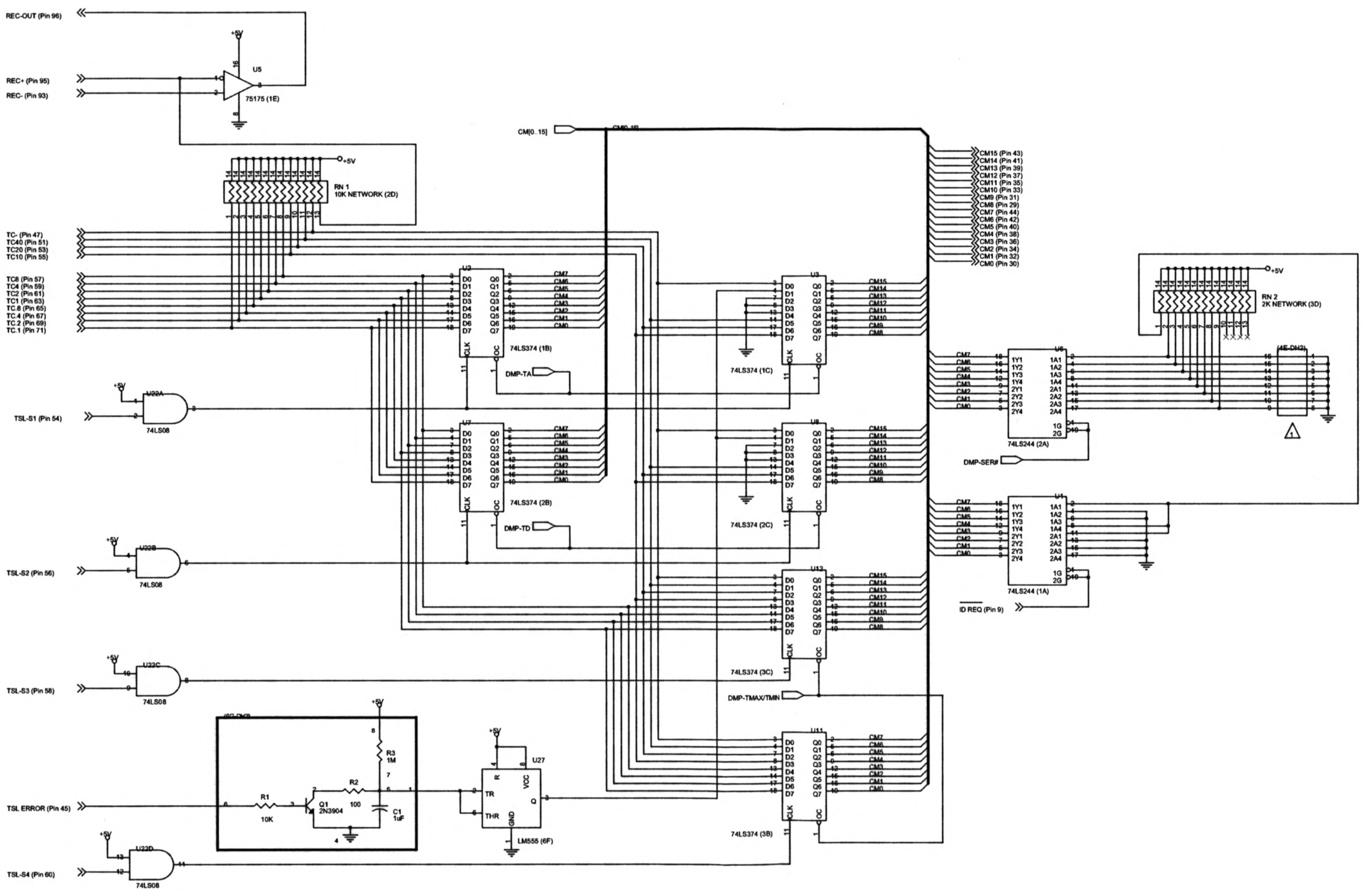
NATIONAL RADIO ASTRONOMY OBSERVATORY

SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA DATE 02/01/90
DESIGNED BY WEIMER DATE 02/01/90
APPROVED BY DATE

SHEET NUMBER 3 OF 4
DRAWING NUMBER C55006S006
REV B
SCALE NONE

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
A	07/01/90	ANDREATTA		MINOR CORRECTIONS ;
B	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



1 CUT STRAP ON DH3 TO GENERATE "1" ON INPUT.
BITS 0-4 = SN
BITS 5-6 = OLD VERSION = 1,1 NEW VERSION = 0,0
BIT 7 = 0

ORCAD : 55006S006

NEXT ASSEMBLY	DWG TYPE
A55006A001	ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS(.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA
PROJECT WEATHER STATION

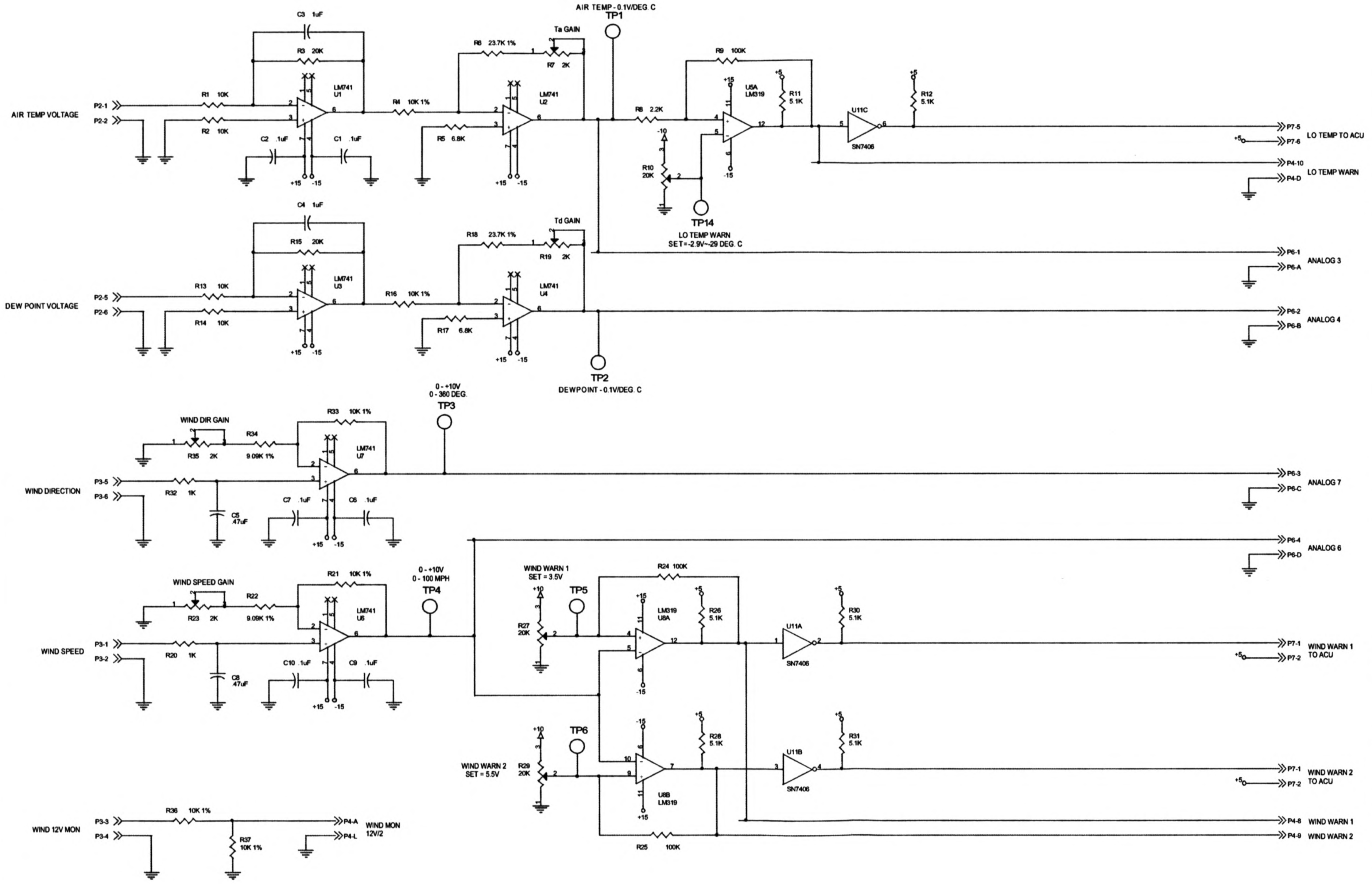
TITLE WEATHER STATION
DIGITAL CARD
SCHEMATIC

NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA DATE 02/01/90
DESIGNED BY WEIMER DATE 02/01/90
APPROVED BY DATE

SHEET NUMBER 4 OF 4
DRAWING NUMBER C55006S006
REV B
SCALE NONE

REV	DATE	DRAWN BY	APPRVD BY	DESCRIPTION
A	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



NOTES:

1. All resistor values in ohms unless otherwise specified.

ORCAD : 55006S005

D55006A001	ASSEMBLY
D55006P001	DRILL DWG
D55006I002	SILKSCREEN
D55006Q002	ARTWORK
NEXT ASSEMBLY	DWG TYPE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES: ANGLES ±

3 PLACE DECIMALS(.XXX) ±

2 PLACE DECIMALS (.XX) ±

1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA

PROJECT WEATHER STATION

TITLE WEATHER STATION "A3" CONDITIONER PCB SCHEMATIC

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

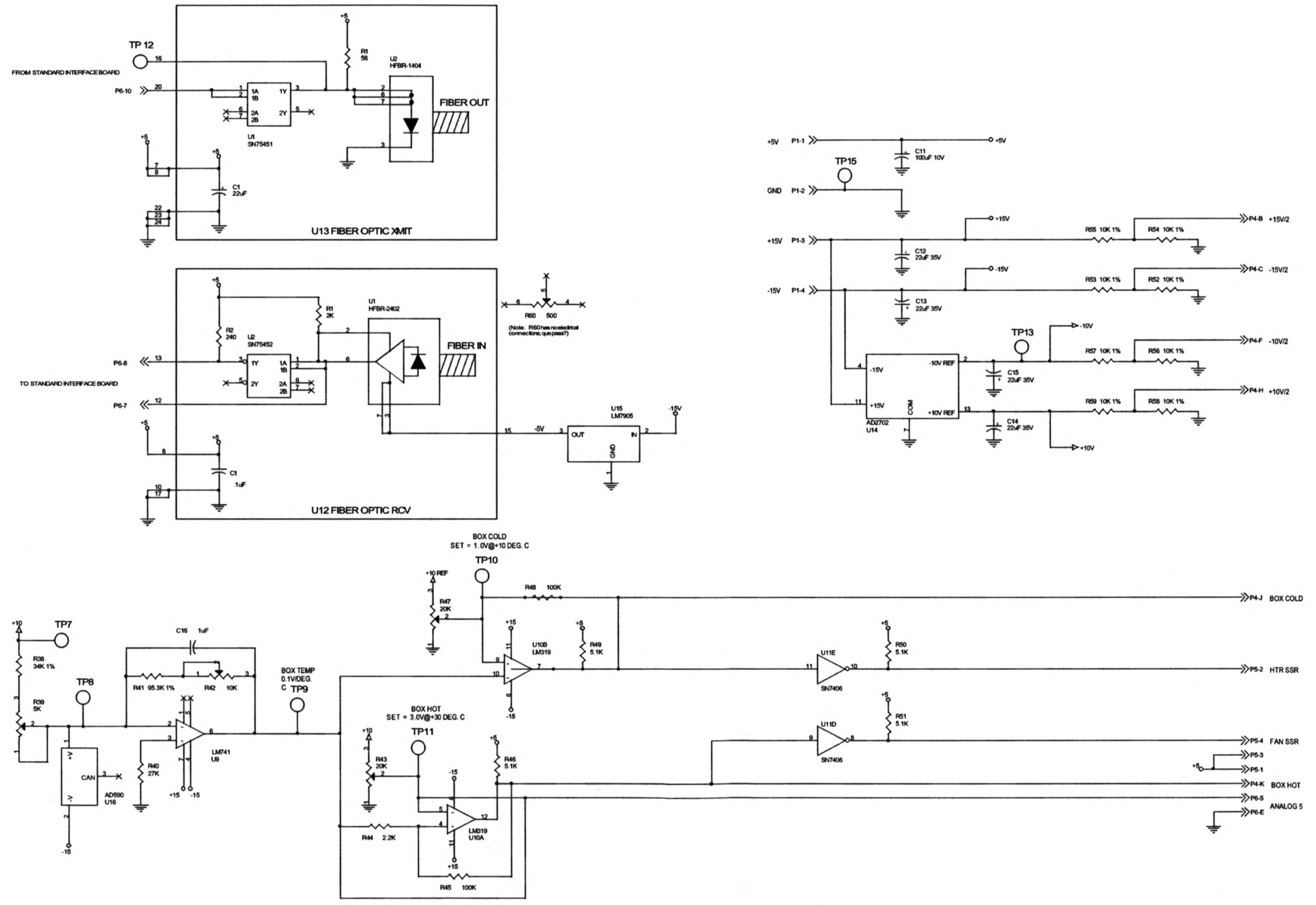
DRAWN BY ANDREATTA DATE 11/01/89

DESIGNED BY WEIMER DATE 11/01/89

APPROVED BY DATE

SHEET NUMBER 1 OF 3 DRAWING NUMBER C55006S005 REV A SCALE NONE

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
A	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



ORCAD : 55006S005

D55006A001	ASSEMBLY
D55006P001	DRILL DWG
D55006I002	SILKSCREEN
D55006Q002	ARTWORK
NEXT ASSEMBLY	DWG TYPE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS(.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA

PROJECT WEATHER STATION

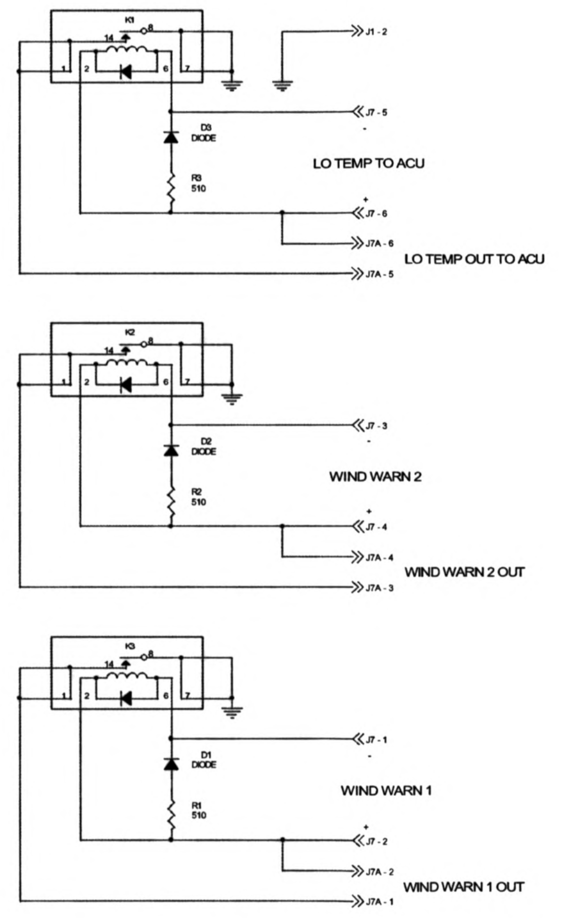
TITLE WEATHER STATION
"A3" CONDITIONER
PCB SCHEMATIC

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA DATE 11/01/89
DESIGNED BY WEIMER DATE 11/01/89
APPROVED BY DATE

SHEET NUMBER 2 OF 3
DRAWING NUMBER C55006S005 REV A SCALE NONE

REV	DATE	DRAWN BY	APPRVD BY	DESCRIPTION
A	08/23/01	G. DUFF	G. DUFF	DRAWN TO REFLECT WORKING MODEL



WARNING STATUS SUB-ASSEMBLY

ORCAD : 55006S005

D55006A001	ASSEMBLY
D55006P001	DRILL DWG
D55006I002	SILKSCREEN
D55006Q002	ARTWORK
NEXT ASSEMBLY	DWG TYPE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS(.XXX) ±
2 PLACE DECIMALS (.XX) ±
1 PLACE DECIMALS (.X) ±

MATERIAL:

FINISH:

VLA

PROJECT WEATHER STATION

TITLE WEATHER STATION
"A3" CONDITIONER
PCB SCHEMATIC

NATIONAL RADIO
ASTRONOMY
OBSERVATORY
SOCORRO, NEW MEXICO 87801

DRAWN BY ANDREATTA DATE 11/01/89
DESIGNED BY WEIMER DATE 11/01/89
APPROVED BY DATE

SHEET NUMBER 3 OF 3
DRAWING NUMBER C55006S005
REV A
SCALE NONE