

**VLBA Technical Report No. 39**

**VLBA 32MHZ Synthesizer  
Module L122**

**Alan E.E. Rogers  
November 1988**



# VLBA 32MHZ SYNTHESIZER - MODULE L122

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## Drawing List:

| Drawing Number | Title                | Type            |
|----------------|----------------------|-----------------|
| 54210K004      | Module Block Diagram | Block Diagram   |
| 54210S003      | 32 MHz Synthesizer   | Circuit Diagram |
| 54210S001      | 32 MHz Synthesizer   | Timing Diagram  |
| 54210M002      | Synthesizer Box      | Drilling Plan   |
| 54210M005      | Front Panel          | Drilling Plan   |
| 54210Q006      | Synthesizer PC Board | PC Artwork      |
| 54210I007      | Front Panel          | Silkscreen      |
| 54210M008      | Mounting plate       | Drill plan      |

## Specifications:

|                                           |             |
|-------------------------------------------|-------------|
| Output Frequency                          | 32 MHz      |
| Input Reference Frequency                 | 5 MHz       |
| Temperature Coefficient of<br>Phase Drift | <5 ps/deg C |

## General Description:

This module derives the 32 MHz needed for the sampling of the data. In addition, it includes 1 PPS buffered outputs for the baseband converters and I.F. distributor modules. The 1 PPS is used in the

synthesizer to synchronize the 32 MHz to the first positive going transition of the 5 MHz following the 1 PPS. On the next 5 MHz positive transition the synthesizer module (see timing diagram) generates a 31.25 nanosec wide sync pulse which is used by the formatter to identify the "first" data sample. It is very important that the 1 PPS be correctly timed with respect to the 5 MHz. The leading positive going edge of the 1 PPS should be coincident with the negative going transition of the 5 MHz coming from the maser or positive going transition of the 5 MHz going into the station timer (see drawing 54100D004 for more detail). Incorrect timing may lead to the sync pulse going out of the 32 MHz synthesizer module dropping pulses or jumping by 200 ns. If timing errors show up in the formatter they may be caused by timing problems in the station timer, 32 MHz synthesizer or sampler. The delay between the leading (positive going) edge of the buffered station sync (from the front panel output on the 32 MHz synthesizer module) and the leading (positive going) edge of the sync (from the front panel output) should be 362+/-20 ns in a system that has been correctly setup.

#### Theory of Operation:

An oscillator is divided to 1 MHz and phase locked to a 1 MHz reference derived from 5 MHz. The loop filter is designed using the same general principles as used in the baseband converter synthesizer.

#### Circuit Details:

The 32 MHz synthesizer uses the same general principles used in the more complex baseband converter synthesizer. Because the synthesizer is quite simple and uses a relatively high reference frequency of 1 MHz the entire unit including oscillator is packaged on a single printed circuit board. The 1 PPS buffer is the same circuit as the 5 MHz buffer with one stage to invert the input signal. In addition, coupling capacitor values are increased.

#### Front Panel Monitors:

The front panel BNC provide buffered outputs of the station sync (1 PPS), 32 MHz and "first" data sync.

#### I/O Connections:

| Pin # | Function                              |
|-------|---------------------------------------|
| 1     | Ground                                |
| 2     | +5v (100 ma)                          |
| 3     | 5 MHz Input + 13 dB Nominal           |
| 4     | Sync Output to Sampler #1             |
| 5     | 1 PPS Input (At Least 2 Volts Into 50 |

ohms)

|    |                             |
|----|-----------------------------|
| 6  | 1 PPS Output #1             |
| 7  | 1 PPS Output #2             |
| 8  | -5v (750 ma)                |
| 9  | 1 PPS Output #3             |
| 10 | Sync Output to Sampler #2   |
| 11 | 32 MHz Output to Sampler #1 |
| 12 | 1 PPS Output #4             |
| 13 | 1 PPS Output #5             |
| 14 | NC                          |
| 15 | +15v (250 ma)               |
| 16 | 1 PPS Output #6             |
| 17 | 1 PPS Output #7             |
| 18 | 32 MHz Output to Sampler #2 |
| 19 | 1 PPS Output #8             |
| 20 | 1 PPS Output #9             |

#### Test Procedures:

Check the 32 MHz output on a scope for frequency and phase stability (using 1 PPS as reference and/or 5 MHz as reference). Check that the sync pulse output occurs at the correct time - according to the timing diagram.

#### Replacement Instructions

Observe oscillator and reference signal through 10016 dividers to isolate faulty circuit. Use "solder wick" to remove defective component.

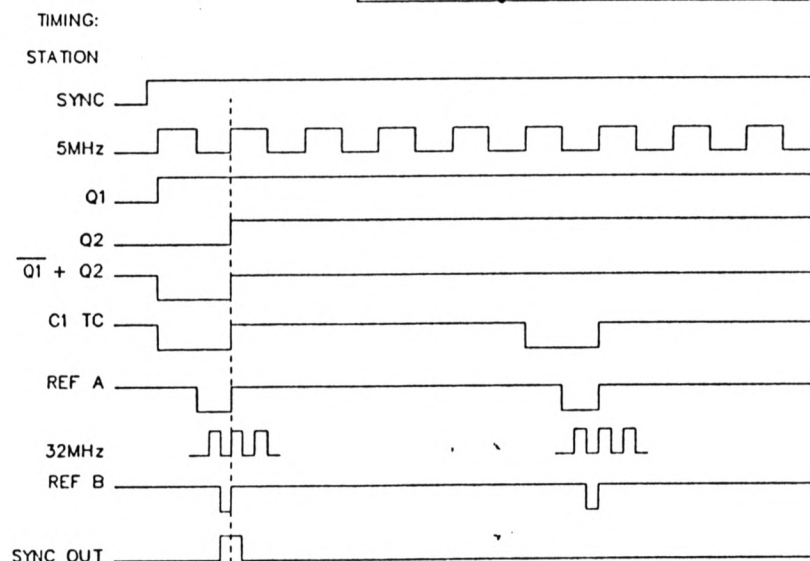
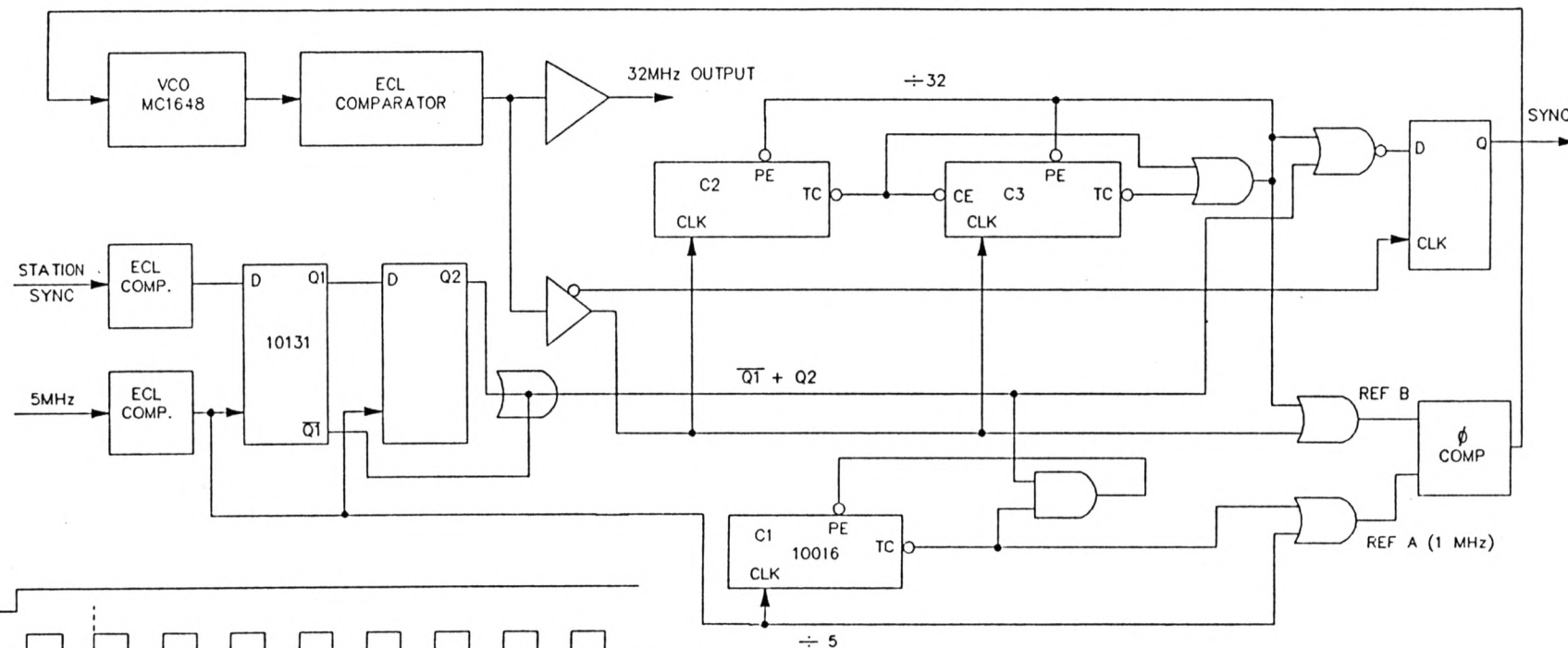
#### Parts List:

#### Data Sheets:

MV209

See baseband conv. for LH0033, 12040

| CHANGE LETTER | DWN BY | CHK'D BY | APP'D BY | DATE | D.C.N. & DESCRIPTION |
|---------------|--------|----------|----------|------|----------------------|
|               |        |          |          |      |                      |



WHEN IN LOCK

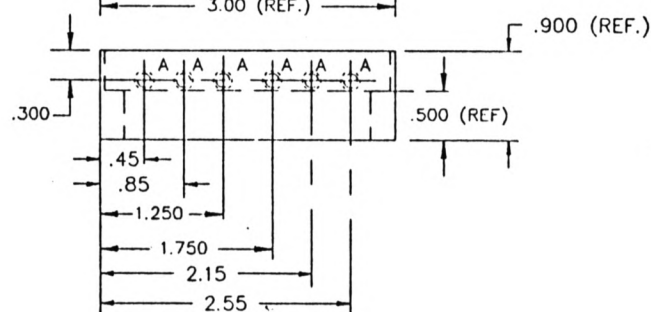
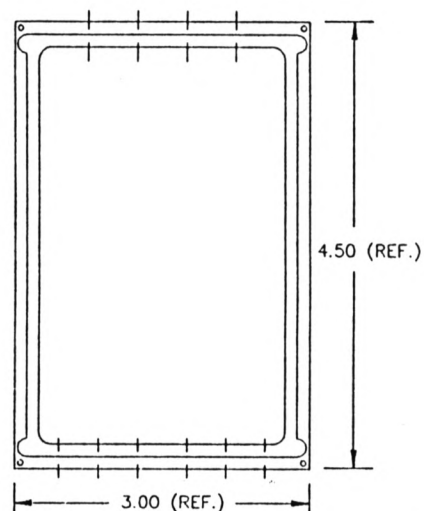
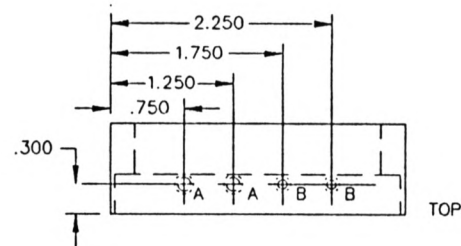
NOTES:

FIRST SAMPLE

|                                                                                             |          |                           |         |               |  |                                                                                            |  |   |           |
|---------------------------------------------------------------------------------------------|----------|---------------------------|---------|---------------|--|--------------------------------------------------------------------------------------------|--|---|-----------|
| ELECTRONIC NOTES:<br>UNLESS OTHERWISE NOTED:<br><br>RESISTORS:<br>CAPACITORS:<br>INDUCTORS: | USED ON  | DRAWN FOR:<br>A.E. ROGERS |         | DATE:<br>7-87 |  | NORTHEAST RADIO OBSERVATORY CORPORATION<br>HAYSTACK OBSERVATORY<br>WESTFORD, MASSACHUSETTS |  |   |           |
|                                                                                             |          | DRAWN BY:<br>A. PHILBROOK |         | 7-87          |  | 32MHz SYNTHESIZER TIMING                                                                   |  |   |           |
|                                                                                             |          | CHECKED BY:               |         |               |  |                                                                                            |  |   |           |
|                                                                                             |          | SCALE                     | PROJECT |               |  |                                                                                            |  | C | 54210S001 |
| CLASSIFICATION                                                                              | APPROVAL | E                         |         | AER 32MHz TIM |  | DWG.                                                                                       |  |   |           |

C - 54210S001

| CHANGE<br>LETTER | D'WN<br>BY | CHK'D<br>BY | APP'D<br>BY | DATE | D.C.N. & DESCRIPTION |
|------------------|------------|-------------|-------------|------|----------------------|
|                  |            |             |             |      |                      |



1. #10-32 TAPPED THRU (8) "A" HOLES.
2. # 8-32 TAPPED THRU (2) "B" HOLES.

## NOTES

MATERIAL  
MAKE FROM ITEM #4  
DWG # C-54120M011-A

FINISH AND/OR HEAT TREATMENT

SHOP NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES
2. TOLERANCE ON DIMENSIONS  
FRACTIONAL  $\pm 1/64$   
DECIMAL  $\pm .01$   
DECIMAL  $\pm .005$   
ANGULAR  $\pm 0'30''$
3. SURFACE ROUGHNESS  
PER MIL-STD-10
4. REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
5. SCREW THREADS PER MIL-STD-9
6. ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

USED ON

DRAWN FOR A.E. ROGERS 7-87

DRAWN BY A. PHILBROOK 7-87

CHECKED BY

PROJECT

ENGINEER

MATL. & PROCESS

STRUCTURES

THERMAL

MECH. ANALYSIS

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

DRILLING PLAN FOR  
32MHz SYNTHESIZER

C

54210M002

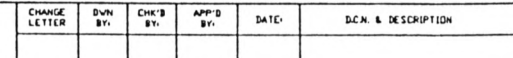
AERIAL DRILL

DWG. SIZE

DWG. NO.

REV.

C-54210M002

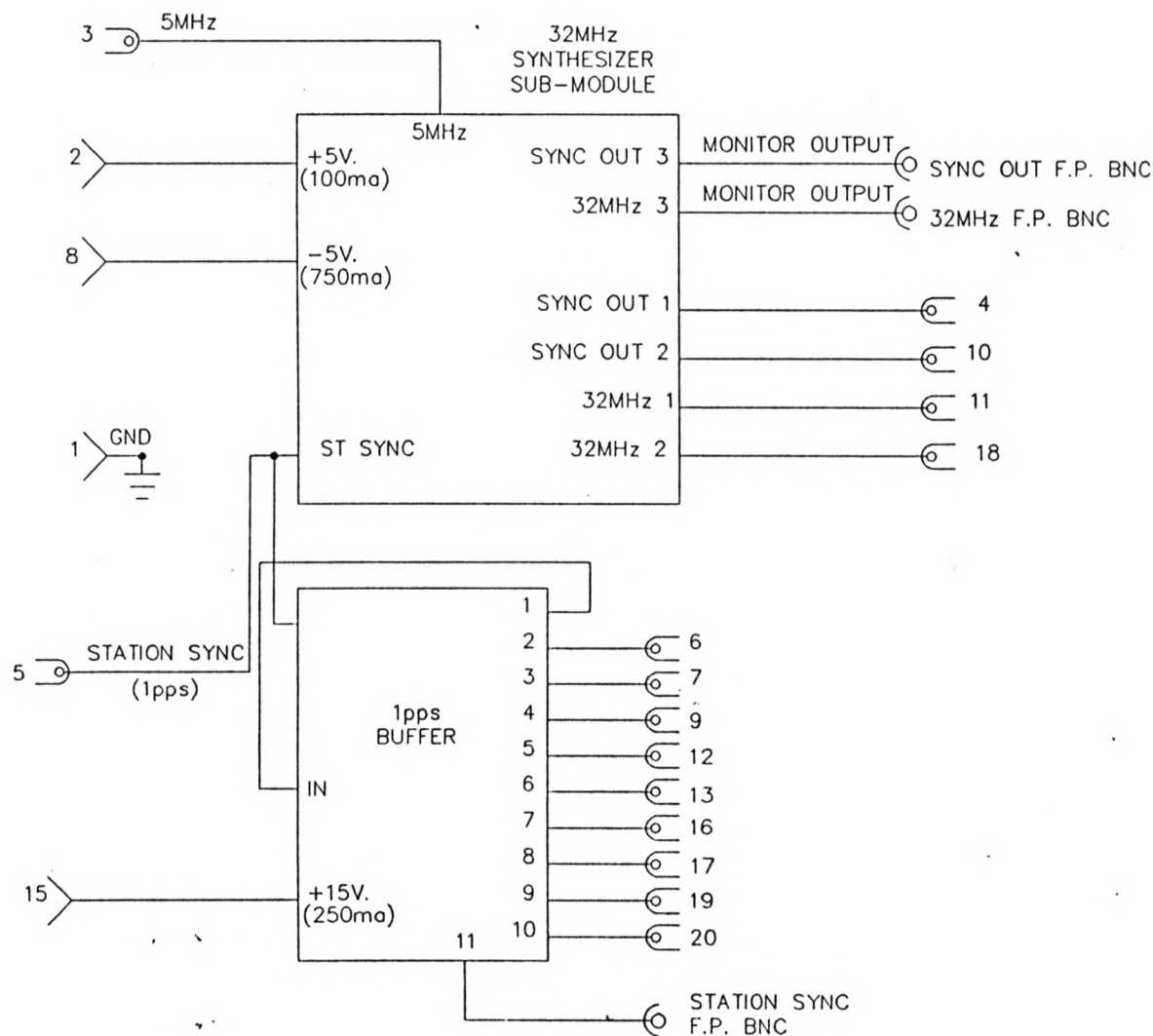


1. ALL RESISTORS ARE 330 OHMS UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE .01 $\mu$ F UNLESS OTHERWISE NOTED.

|                                                 |             |                          |               |                                                                                      |
|-------------------------------------------------|-------------|--------------------------|---------------|--------------------------------------------------------------------------------------|
| ELECTRONICS NOTES:<br>UNLESS OTHERWISE<br>NOTED | USED OR     | DRAWN BY:<br>A.E. ROGERS | DATE:<br>7-87 | NORTHEAST RADIO OBSERVATORY CORPORATION<br>HAYSTACK OBSERVATORY<br>WEST HADAMASSETTS |
| REVISIONS:                                      |             | DRAWN BY: PHIL BROOK     | 7-87          |                                                                                      |
| INDUCTIONS:                                     |             | CHECKED BY:              |               | 32MHZ SYNTHESIZER                                                                    |
| CALCULATIONS:                                   | SCALE: NONE | ENGINEER:                |               | DATE: 10-0003                                                                        |



| CHANGE<br>LETTER | D'WN<br>BY | CHK'D<br>BY | APP'D<br>BY | DATE | D.C.N. & DESCRIPTION |
|------------------|------------|-------------|-------------|------|----------------------|
|                  |            |             |             |      |                      |



## NOTES

- 1pps BUFFER IS THE SAME AS 5MHz BUFFER. EXCEPT: SECTION 1 IS USED TO INVERT SIGNAL.
- SECTION 1 OUTPUT IS CONNECTED TO INPUTS OF SECTION 2-11.
- 0.01uF INPUT CAPS ARE INCREASED TO 0.3uF.
- 0.1uF OUTPUT CAPS ARE INCREASED TO 0.3uF.

### MATERIAL

### FINISH AND/OR HEAT TREATMENT

### SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS FRACTIONAL  $\pm 1/64$  DECIMAL  $\pm 0.01$  ANGULAR  $\pm 0.30^\circ$
- SURFACE ROUGHNESS PER MIL-STD-10
- REMOVE BURRS AND BREAK SHARP EDGES  $1/64$  MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY BEFORE PLATING OR CONVERSION COATING.

### USED ON

|                 |              |      |      |
|-----------------|--------------|------|------|
| DESIGNED BY     | A. E. ROGERS | DATE | 7-87 |
| DRAWN BY        | A. PHILBROOK | DATE | 7-87 |
| CHECKED BY      |              |      |      |
| PROJECT         |              |      |      |
| ENGINEER        |              |      |      |
| MATL. & PROCESS |              |      |      |
| STRUCTURES      |              |      |      |
| THERMAL         |              |      |      |
| MECH. ANALYSIS  |              |      |      |

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

32MHz SYNTHESIZER  
BLOCK DIAGRAM  
2 WIDE MODULE

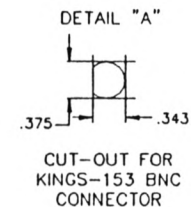
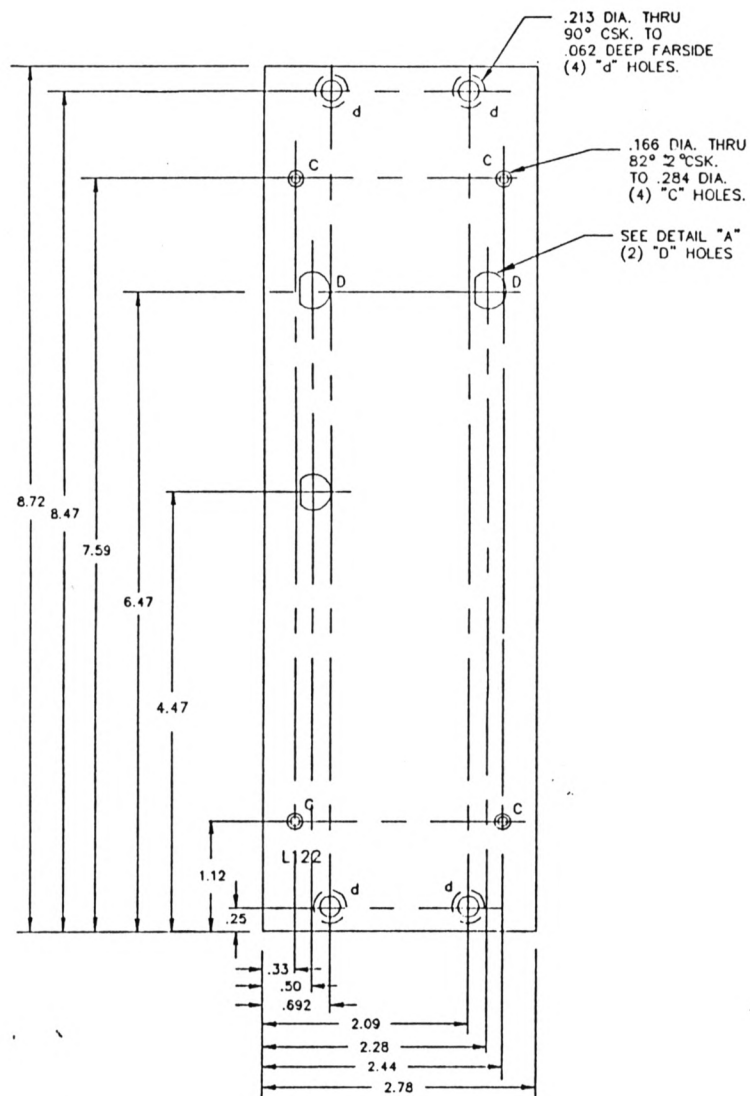
C

54210K004

REV.

C-54210K004

| CHANGE<br>LETTER | D'WN<br>BY | CHK'D<br>BY | APP'D<br>BY | DATE | D.C.N. & DESCRIPTION |
|------------------|------------|-------------|-------------|------|----------------------|
|                  |            |             |             |      |                      |



## NOTES

### MATERIAL

.125 THICK ALUM. 6061-T6  
REMOVE ALL BURRS AND  
SHARP EDGES.

### FINISH AND/OR HEAT TREATMENT

YELLOW CHROMATE  
CONVERSION ALL OVER

### SHOP NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES
2. TOLERANCE ON DIMENSIONS  
FRACTIONAL  $\pm 1/64$   
DECIMAL .XX  $\pm .01$   
DECIMAL .XXX  $\pm .005$   
ANGULAR  $\pm 0.30^\circ$
3. SURFACE ROUGHNESS  
PER MIL-S10-10
4. REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
5. SCREW THREADS PER MIL-S10-9
6. ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION CO.

### USED ON

DRAWN FOR A.E. ROGERS DATE 7-87

DRAWN BY A. PHILBROOK 7-87

CHECKED BY

PROJECT

ENGINEER

MATL. & PROCESS

STRUCTURES

THERMAL

ENVIRONMENTAL

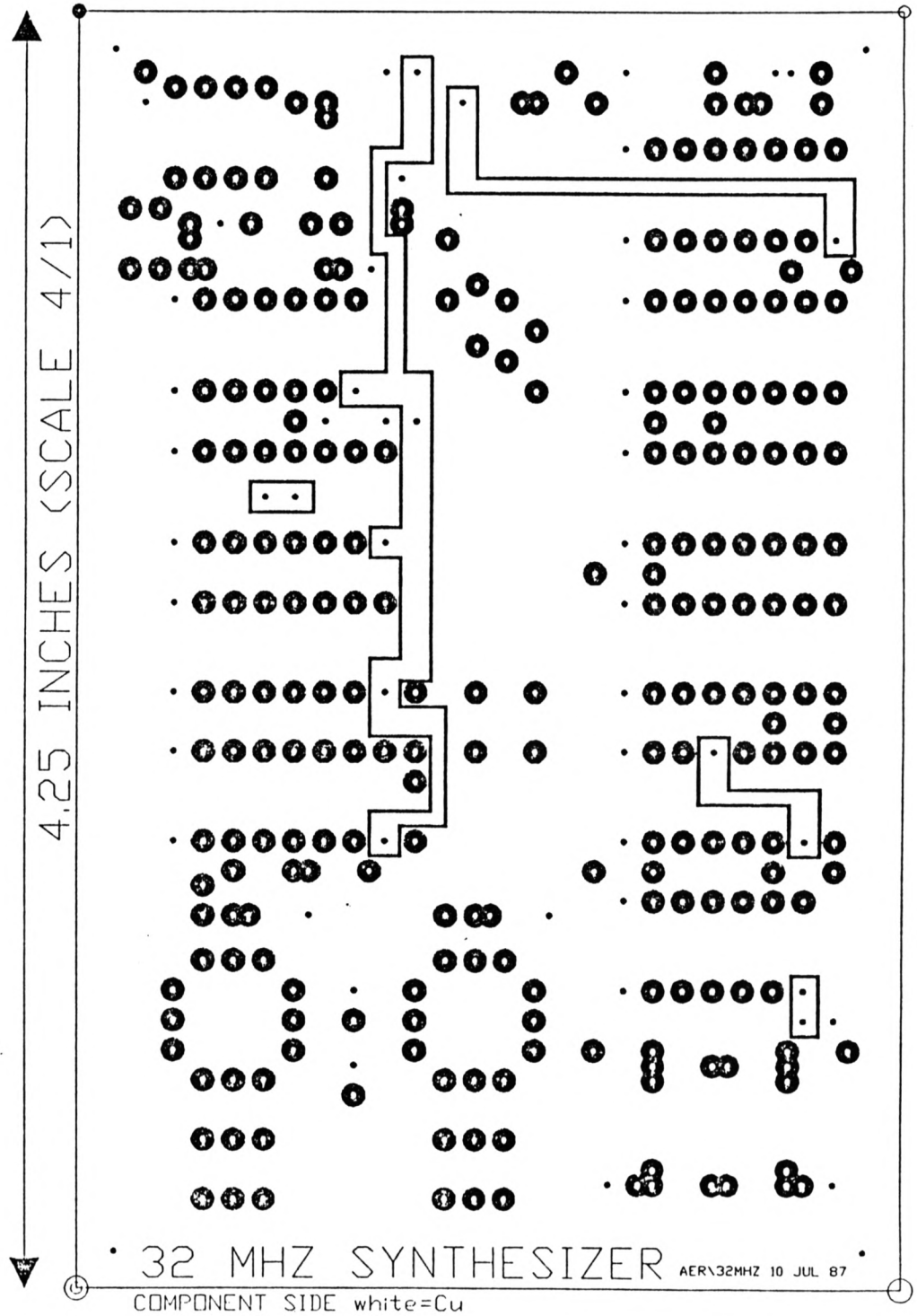
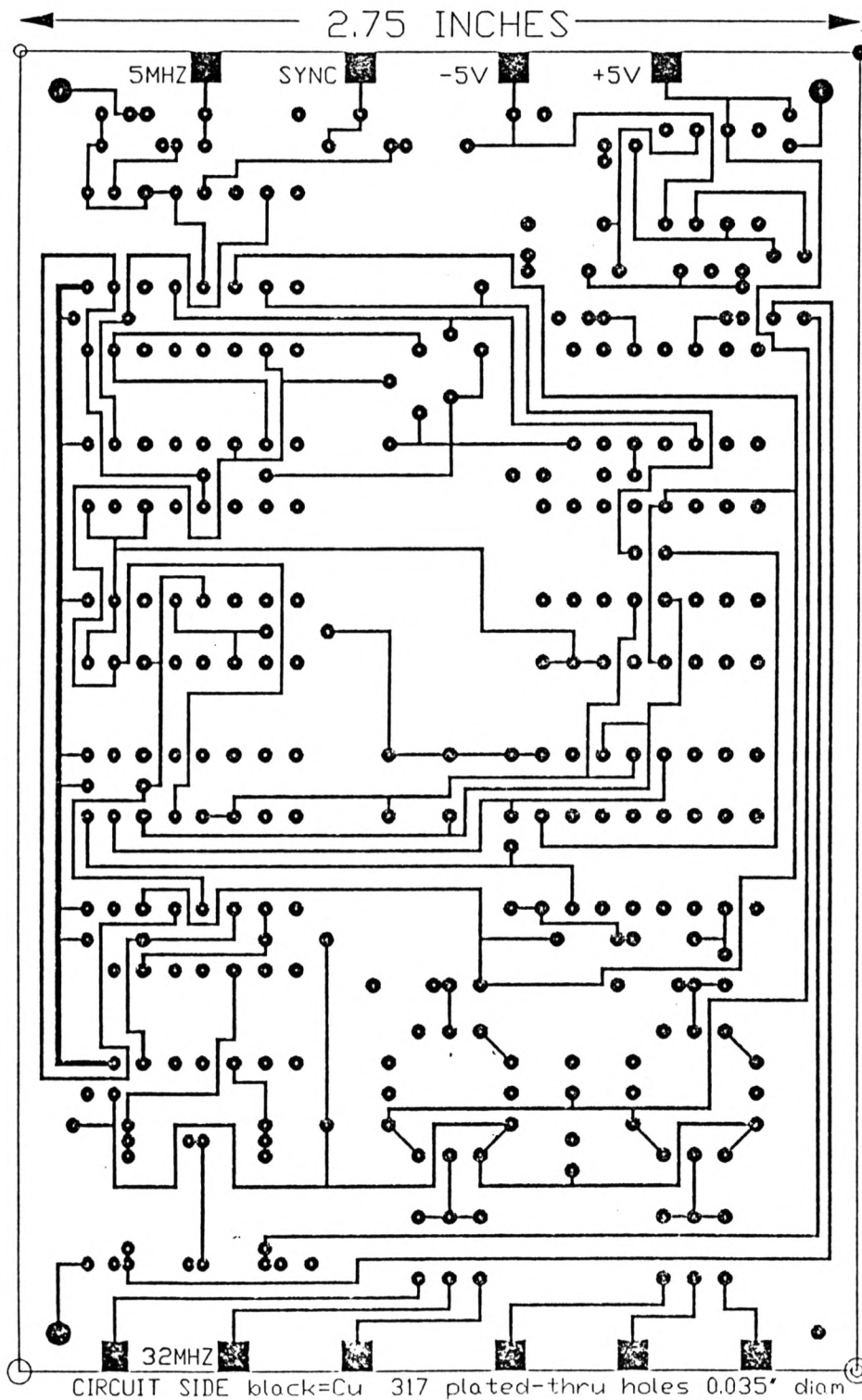
NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

DRILLING PLAN FOR  
32MHz SYNTHESIZER  
FRONT PANEL

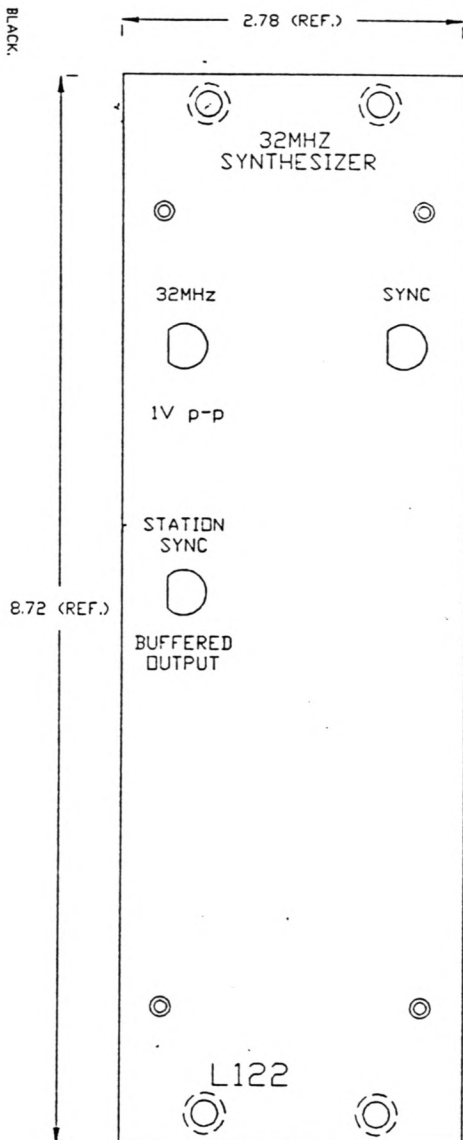
542

C-54210M005

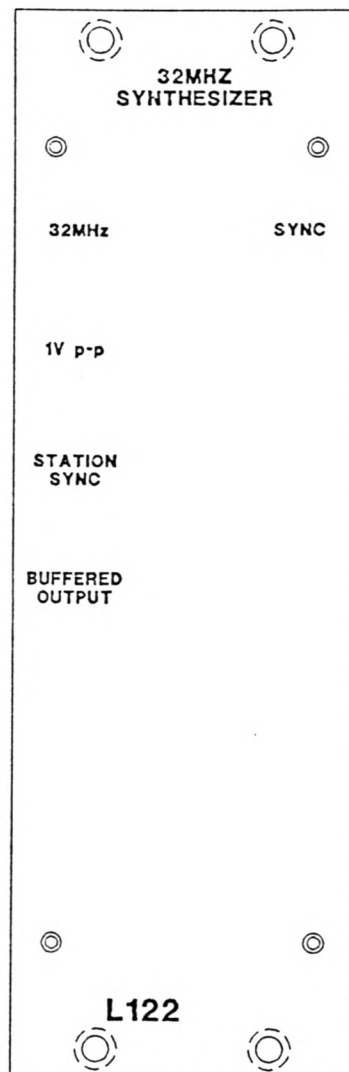
Drawing Number: 54210Q006



- NOTES:**  
1. SILK SCREEN CHARACTERS AND LINES BLACK.  
2. PAINT/HEVLETT PACKARD, MINI GRAY,  
P/N 6010-0577, FRONT AND EDGES ONLY,  
PER NRAD SPEC. NO A1030UN1.



SILK SCREENED PANEL

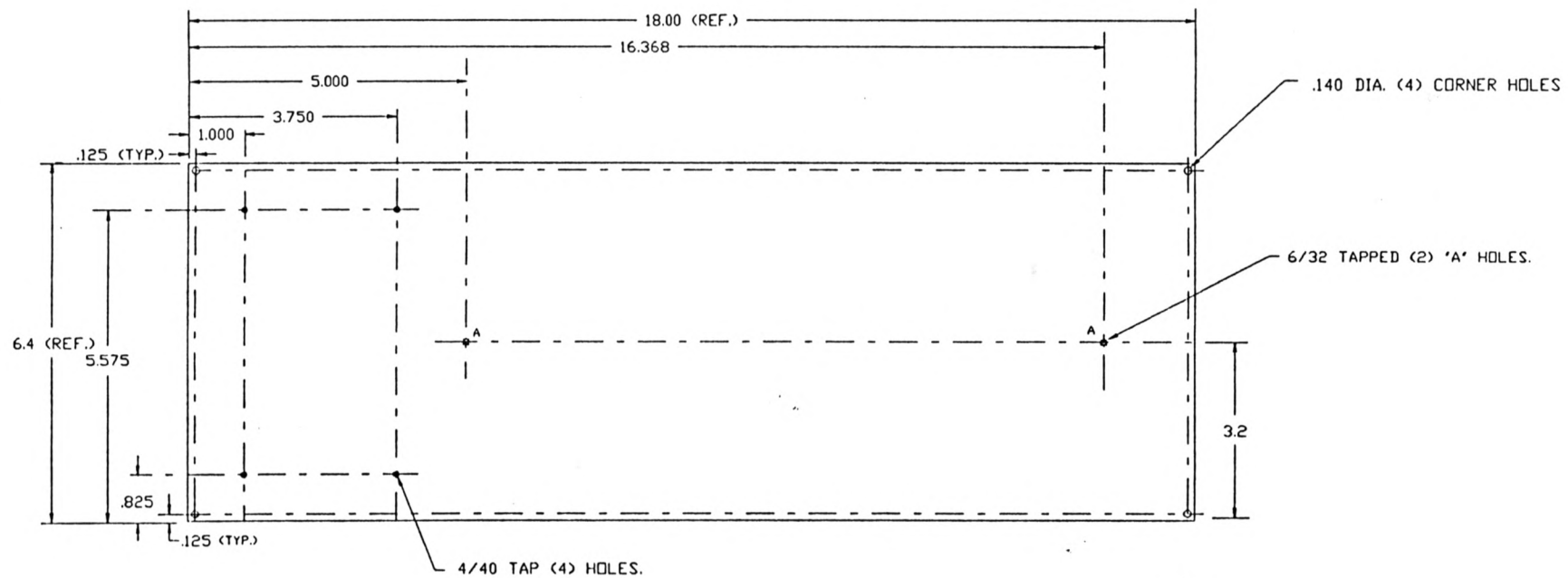


ARTWORK

[illegible]

| CHANGE<br>LETTER | DIV<br>BY | CHG'D<br>BY | APP'D<br>BY | DATE | D.C.N. & DESCRIPTION |
|------------------|-----------|-------------|-------------|------|----------------------|
|------------------|-----------|-------------|-------------|------|----------------------|

| CHANGE<br>LETTER | BY | DATE | APP'D<br>BY | DATE | DESCRIPTION |
|------------------|----|------|-------------|------|-------------|
|                  |    |      |             |      |             |



NOTES:

|                                                     |                                                                                                                                                                                                                                                                                                                                                                        |                             |                    |                                                                                                                                                             |
|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MATERIAL:<br>.125 ALUM. 6061-T6                     | SHOP NOTES: UNLESS OTHERWISE SPECIFIED<br>1. DIMENSIONS ARE IN INCHES<br>2. TOLERANCES UNLESS OTHERWISE SPECIFIED:<br>FRACTIONS: .005<br>DECIMALS: .010<br>ANGLES: .1°<br>HOLE LOCATIONS: .010<br>HOLE DIAMETERS: .010<br>HOLE LOCATIONS: .010<br>HOLE DIAMETERS: .010<br>HOLE LOCATIONS: .010<br>HOLE DIAMETERS: .010<br>HOLE LOCATIONS: .010<br>HOLE DIAMETERS: .010 | DESIGNED BY:<br>A. PHILIPPO | DATE:<br>12-85     | NORTH EAST RADIO OBSERVATORY CORPORATION<br>HAYSTACK OBSERVATORY<br>WESTFORD, MASSACHUSETTS<br><br>DRILLING PLAN FOR<br>32MHZ DISTRIBUTOR<br>MOUNTING PLATE |
|                                                     |                                                                                                                                                                                                                                                                                                                                                                        | CHECKED BY:<br>DATE:        | DRAWN BY:<br>DATE: |                                                                                                                                                             |
| FINISH AND/OR HEAT TREATMENT:<br>LIGHT GOLD ALODINE |                                                                                                                                                                                                                                                                                                                                                                        |                             |                    |                                                                                                                                                             |

D-5421U-0008

PARTS LIST FROM DBASE FILE:PARTS.DBF

| REF  | SUBMOD | PART           | DESC             | MFR          | COST   | QTY | TOTAL COST |
|------|--------|----------------|------------------|--------------|--------|-----|------------|
| U05  | 32M    | 10016          | 10016            | FAIRCHILD    | 5.53   | 3   | 16.59      |
| MP1  | 32M    | 1009-1511-000  | SMC PC CONN      | AEP          | 2.25   | 12  | 27.00      |
| U06  | 32M    | 10104          | 10104            | FAIRCHILD    | 0.69   | 1   | 0.69       |
| MP1  | 32M    | 1019-1511-000  | SMC BULKHEAD     | AEP          | 1.77   | 8   | 14.16      |
| C01  | 32M    | 103K           | 0.01 UF          | AVX          | 0.10   | 13  | 1.30       |
| C03  | 32M    | 103K           | 0.01 UF          | AVX          | 0.10   | 11  | 1.10       |
| C01  | 32M    | 104K           | 0.1 UF           | AVX          | 0.10   | 33  | 3.30       |
| C04  | 32M    | 105K           | 1 UF             | AVX          | 0.32   | 1   | 0.32       |
| MP   | 32M    | 1105-7521-003  | SMC CABLE PLUG   | AEP          | 2.49   | 8   | 19.92      |
| MP   | 32M    | 1105-7521-003  | SMC CABLE PLUG   | AEP          | 2.49   | 15  | 37.35      |
| MP2  | 32M    | 1250-003       | FEED THRU        | ERIE         | 1.53   | 2   | 3.06       |
| MP2  | 32M    | 1250-003       | FEED THRU        | ERIE         | 1.53   | 1   | 1.53       |
| CR3  | 32M    | 1N5222         | ZENER DIODE      | MOTOROLA     | 0.40   | 1   | 0.40       |
| MPX  | 32M    | 200458-1       | BLOCK            | AMP          | 3.00   | 1   | 3.00       |
| MPX  | 32M    | 200833-4       | GUIDE PINS       | AMP          | 0.36   | 2   | 0.72       |
| MPX  | 32M    | 200835-4       | GUIDE SOCKETS    | AMP          | 0.48   | 2   | 0.96       |
| MPX  | 32M    | 201142-2       | SPRING           | AMP          | 0.05   | 11  | 0.55       |
| MPX  | 32M    | 201143-5       | COAXICON PIN     | AMP          | 2.70   | 11  | 29.70      |
| MPX  | 32M    | 202394-2       | HOOD             | AMP          | 1.04   | 1   | 1.04       |
| MPX  | 32M    | 202422-1       | POWER PINS       | AMP          | 0.50   | 4   | 2.00       |
| Q01  | 32M    | 2N2857         | 2N2857           | MOTOROLA     | 0.81   | 11  | 8.91       |
| MPX  | 32M    | 328666         | FERRULE          | AMP          | 0.08   | 11  | 0.88       |
| C02  | 32M    | 330J           | 33 PF            | AVX          | 0.12   | 2   | 0.24       |
| C03  | 32M    | 336K           | 33 UF            | SPRAGUE      | 0.70   | 1   | 0.70       |
| C02  | 32M    | 4R7J           | 4.7 PF           | AVX          | 0.50   | 11  | 5.50       |
| CR2  | 32M    | 5082-2810      | DIODE            | HP           | 1.55   | 2   | 3.10       |
| MS   | 32M    | 54130M007      | PC BOARD SUPPORT | HAYSTACK     | 100.00 | 1   | 100.00     |
| SS   | 32M    | 54210I007      | F.P.SILK SCREEN  | NYES         | 100.00 | 1   | 100.00     |
| MS   | 32M    | 54210M002      | BOX DRILLING     | HAYSTACK     | 20.00  | 1   | 20.00      |
| MS   | 32M    | 54210M005      | FRONT PANEL      | HAYSTACK     | 100.00 | 1   | 100.00     |
| MS   | 32M    | 54210M008      | MOUNTING PLATE   | HAYSTACK     | 20.00  | 1   | 20.00      |
| MPX  | 32M    | 5807-1501-000  | SMC TEE          | AEP          | 12.70  | 1   | 12.70      |
| PC   | 32M    | AER\32MHZ      | PC BOARD         | PACLAB       | 40.00  | 1   | 40.00      |
| PC   | 32M    | AER\BUFFER     | PC BOARD         | PACLAB       | 40.00  | 11  | 440.00     |
| MS   | 32M    | C53306M013-2UA | FRONT PANEL      | PREC.MACHINE | 20.00  | 1   | 20.00      |
| MS   | 32M    | C53306M014-2UA | PERFORATED COVER | PREC.MACHINE | 10.00  | 2   | 20.00      |
| MS   | 32M    | C53306M015-2UA | MODULEREAR PANEL | PREC.MACHINE | 20.00  | 1   | 20.00      |
| MS   | 32M    | C53306M016     | BAR SUPPORT      | PREC.MACHINE | 10.00  | 4   | 40.00      |
| MS   | 32M    | C53306M017     | SIDE PLATE       | PREC.MACHINE | 10.00  | 2   | 20.00      |
| WORK | 32M    | ENGINEER       | CHECKOUT         | HAYSTACK     | 100.00 | 6   | 600.00     |
| MS   | 32M    | HAY45030       | BOX WITH COVERS  | PREC.MACHINE | 43.60  | 1   | 43.60      |
| MP19 | 32M    | KC19-153       | F.P.BNC          | KINGS        | 6.76   | 3   | 20.28      |
| U09  | 32M    | LH0033CG       | LH0033           | ANALOG DEV   | 22.00  | 2   | 44.00      |
| U001 | 32M    | LH0033CG       | LH0033           | ANALOG DEV   | 22.00  | 11  | 242.00     |
| U07  | 32M    | MC10103L       | 10103            | MOTOROLA     | 1.14   | 1   | 1.14       |
| U01  | 32M    | MC10116L       | 10116            | MOTOROLA     | 1.14   | 1   | 1.14       |
| U04  | 32M    | MC10131L       | 10131            | MOTOROLA     | 3.80   | 2   | 7.60       |
| U08  | 32M    | MC12040L       | 12040            | MOTOROLA     | 8.80   | 1   | 8.80       |
| U02  | 32M    | MC1648L        | 1648             | MOTOROLA     | 7.13   | 1   | 7.13       |
| CR1  | 32M    | MV209          | MV209            | MOTOROLA     | 0.71   | 1   | 0.71       |
| U03  | 32M    | OP-27EN        | OP-27            | ANALOG DEV   | 7.15   | 1   | 7.15       |
| R02  | 32M    | RCR05G100J     | 10 OHMS 1/8W     | AB           | 0.20   | 1   | 0.20       |
| R04  | 32M    | RCR05G102J     | 1K OHMS 1/8W     | AB           | 0.20   | 5   | 1.00       |
| R02  | 32M    | RCR05G102J     | 1K OHM 1/8W      | AB           | 0.20   | 22  | 4.40       |
| R03  | 32M    | RCR05G200J     | 20 OHM 1/8W      | AB           | 0.20   | 11  | 2.20       |
| R05  | 32M    | RCR05G203J     | 20K OHMS 1/8W    | AB           | 0.20   | 1   | 0.20       |
| R07  | 32M    | RCR05G224J     | 220K OHMS 1/8W   | AB           | 0.20   | 1   | 0.20       |
| R05  | 32M    | RCR05G271J     | 270 OHM 1/8W     | AB           | 0.20   | 11  | 2.20       |
| R09  | 32M    | RCR05G331J     | 330 OHMS 1/8W    | AB           | 0.20   | 19  | 3.80       |
| R06  | 32M    | RCR05G473J     | 47K OHMS 1/8W    | AB           | 0.20   | 4   | 0.80       |
| R01  | 32M    | RCR05G510J     | 51 OHMS 1/8W     | AB           | 0.20   | 7   | 1.40       |
| R    | 32M    | RCR05G510J     | 56 OHMS 1/8W     | AB           | 0.20   | 1   | 0.20       |
| R04  | 32M    | RCR05G510J     | 51 OHM 1/8W      | AB           | 0.20   | 11  | 2.20       |
| R01  | 32M    | RCR05G511J     | 510 OHM 1/8W     | AB           | 0.20   | 22  | 4.40       |
| WORK | 32M    | TECH           | ASSEMBLY WORK    | HAYSTACK     | 10.00  | 24  | 240.00     |
| L01  | 32M    | WEE 0.68       | 0.68 UH          | NYTRONICS    | 0.50   | 1   | 0.50       |
| MP1  | 5M     | 1009-1511-000  | SMC PC CONN      | AEP          | 2.25   | 12  | 27.00      |
| C03  | 5M     | 103K           | 0.01 UF          | AVX          | 0.10   | 11  | 1.10       |
| C01  | 5M     | 104K           | 0.1 UF           | AVX          | 0.10   | 33  | 3.30       |
| MP   | 5M     | 1105-7521-003  | SMC CABLE PLUG   | AEP          | 2.49   | 15  | 37.35      |
| MP2  | 5M     | 1250-003       | FEED THRU        | ERIE         | 1.53   | 1   | 1.53       |
| MPX  | 5M     | 200458-1       | BLOCK            | AMP          | 3.00   | 1   | 3.00       |
| MPX  | 5M     | 200833-4       | GUIDE PINS       | AMP          | 0.36   | 2   | 0.72       |
| MPX  | 5M     | 200835-4       | GUIDE SOCKETS    | AMP          | 0.48   | 2   | 0.96       |
| MPX  | 5M     | 201142-2       | SPRING           | AMP          | 0.05   | 11  | 0.55       |
| MPX  | 5M     | 201143-5       | COAXICON PIN     | AMP          | 2.70   | 11  | 29.70      |
| MPX  | 5M     | 202394-2       | HOOD             | AMP          | 1.04   | 1   | 1.04       |
| MPX  | 5M     | 202422-1       | POWER PINS       | AMP          | 0.50   | 4   | 2.00       |
| Q01  | 5M     | 2N2857         | 2N2857           | MOTOROLA     | 0.81   | 11  | 8.91       |
| MPX  | 5M     | 328666         | FERRULE          | AMP          | 0.08   | 11  | 0.88       |
| C02  | 5M     | 4R7J           | 4.7 PF           | AVX          | 0.50   | 11  | 5.50       |
| SS   | 5M     | 54130I003      | F.P.SILK SCREEN  | NYES         | 100.00 | 1   | 100.00     |
| MS   | 5M     | 54130M002      | FRONT PANEL      | HAYSTACK     | 100.00 | 1   | 100.00     |
| MS   | 5M     | 54130M007      | PC BOARD SUPPORT | HAYSTACK     | 100.00 | 1   | 100.00     |
| MS   | 5M     | 54130M008      | CENTER PLATE     | HAYSTACK     | 20.00  | 1   | 20.00      |
| MPX  | 5M     | 5807-1501-000  | SMC TEE          | AEP          | 12.70  | 1   | 12.70      |
| PC   | 5M     | AER\BUFFER     | PC BOARD         | PACLAB       | 40.00  | 11  | 440.00     |
| MS   | 5M     | C53306M013-2UA | FRONT PANEL      | PREC.MACHINE | 20.00  | 1   | 20.00      |

PARTS LIST FROM DBASE FILE:PARTS.DBF

| REF           | SUBMOD | PART           | DESC             | MFR          | COST   | QTY | TOTAL COST |
|---------------|--------|----------------|------------------|--------------|--------|-----|------------|
| MS            | 5M     | C53306M014-2UA | PERFORATED COVER | PREC.MACHINE | 10.00  | 2   | 20.00      |
| MS            | 5M     | C53306M015-2UA | MODULEREAR PANEL | PREC.MACHINE | 20.00  | 1   | 20.00      |
| MS            | 5M     | C53306M016     | BAR SUPPORT      | PREC.MACHINE | 10.00  | 4   | 40.00      |
| MS            | 5M     | C53306M017     | SIDE PLATE       | PREC.MACHINE | 10.00  | 2   | 20.00      |
| WORK          | 5M     | ENGINEER       | CHECKOUT         | HAYSTACK     | 100.00 | 1   | 100.00     |
| MP19          | 5M     | KC19-153       | F.P.BNC          | KINGS        | 6.76   | 1   | 6.76       |
| U001          | 5M     | LH0033CG       | LH0033           | ANALOG DEV   | 22.00  | 11  | 242.00     |
| R02           | 5M     | RCR05G112J     | 1.1K OHM 1/8W    | AB           | 0.20   | 22  | 4.40       |
| R03           | 5M     | RCR05G200J     | 20 OHM 1/8W      | AB           | 0.20   | 11  | 2.20       |
| R05           | 5M     | RCR05G271J     | 270 OHM 1/8W     | AB           | 0.20   | 11  | 2.20       |
| R04           | 5M     | RCR05G510J     | 51 OHM 1/8W      | AB           | 0.20   | 11  | 2.20       |
| R01           | 5M     | RCR05G511J     | 510 OHM 1/8W     | AB           | 0.20   | 11  | 2.20       |
| R06           | 5M     | RCR05G561J     | 560 OHM 1/8W     | AB           | 0.20   | 11  | 2.20       |
| WORK          | 5M     | TECH           | ASSEMBLY WORK    | HAYSTACK     | 10.00  | 24  | 240.00     |
| *** Total *** |        |                |                  |              |        |     | 4004.37    |

# MV209 (SILICON)

VVC 

## SILICON EPICAP DIODE

... designed for VHF TV tuning, AFC, general frequency control and tuning applications; providing solid-state reliability in replacement of mechanical tuning methods.

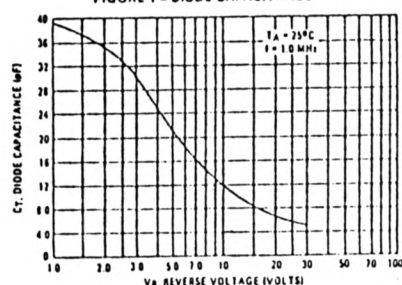
- High Q With Guaranteed Minimum Values at VHF Frequencies
- Controlled and Uniform Tuning Ratio
- Guaranteed Matching<sup>(1)</sup> Tolerance From Diode to Diode and Group to Group
- Supplied in One Piece, Unibloc Package for High Reliability.

(1) Upon request, diodes are available in matched sets of any number or in matched groups. All diodes in a set or group can be matched for capacitance to  $\pm 3\%$  or 0.1 pF (whichever is greater) along the entire specified tuning range.

## MAXIMUM RATINGS

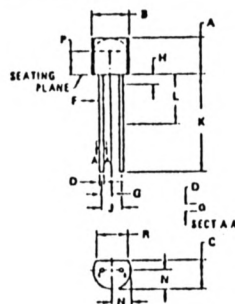
| Rating                                       | Symbol    | Value       | Unit                 |
|----------------------------------------------|-----------|-------------|----------------------|
| Reverse Voltage                              | $V_R$     | 30          | Volts                |
| Forward Current                              | $I_F$     | 200         | mA                   |
| Power Dissipation @ $T_A = 25^\circ\text{C}$ | $P_D$     | 280         | mW                   |
| Derate above $25^\circ\text{C}$              |           | 2.8         | mW/ $^\circ\text{C}$ |
| Junction Temperature                         | $T_J$     | $\pm 125$   | $^\circ\text{C}$     |
| Storage Temperature Range                    | $T_{stg}$ | -65 to +150 | $^\circ\text{C}$     |

FIGURE 1 - DIODE CAPACITANCE



## VOLTAGE VARIABLE CAPACITANCE DIODE

26-32 pF



STYLE 2:  
PIN 1, CATHODE  
PIN 2, ANODE

| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 4.32        | 5.32 | 0.170  | 0.210 |
| B   | 4.15        | 5.71 | 0.165  | 0.205 |
| C   | 5.18        | 6.18 | 0.205  | 0.245 |
| D   | 0.34        | 0.51 | 0.014  | 0.021 |
| E   | 0.40        | 0.48 | 0.016  | 0.019 |
| F   | 1.7         | 1.85 | 0.067  | 0.074 |
| G   | 1.7         | 1.85 | 0.067  | 0.074 |
| H   | 1.7         | 1.85 | 0.067  | 0.074 |
| J   | 1.7         | 1.85 | 0.067  | 0.074 |
| K   | 1.7         | 1.85 | 0.067  | 0.074 |
| L   | 2.35        | 2.54 | 0.093  | 0.100 |
| M   | 3.03        | 3.66 | 0.120  | 0.145 |
| N   | 3.03        | 3.66 | 0.120  | 0.145 |
| P   | 3.03        | 3.66 | 0.120  | 0.145 |
| R   | 3.03        | 3.66 | 0.120  | 0.145 |

ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED.

CASE 182-02

## MV209 (continued)

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted.)

| Characteristic                                                                                | Symbol | Min | Typ | Max | Unit                  |
|-----------------------------------------------------------------------------------------------|--------|-----|-----|-----|-----------------------|
| Reverse Breakdown Voltage ( $I_R = 10 \mu\text{A}$ )                                          | $BV_R$ | 30  | —   | —   | Vdc                   |
| Reverse Voltage Leakage Current ( $V_R = 25 \text{ Vdc}$ )                                    | $I_R$  | —   | —   | 0.1 | $\mu\text{A}$         |
| Series Inductance (Note 1) ( $f = 250 \text{ MHz}$ , Lead Length $\approx 1/8"$ )             | $L_S$  | —   | 6.0 | —   | nH                    |
| Capacitance (Note 2) ( $f = 1.0 \text{ MHz}$ )                                                | $C_C$  | —   | 0.2 | —   | pF                    |
| Diode Capacitance Temperature Coefficient ( $V_R = 3.0 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$ ) | $TC_C$ | —   | 300 | 400 | ppm/ $^\circ\text{C}$ |

| Device | $C_1$ , Diode Capacitance<br>$V_R = 3.0 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$<br>pF |     |     | $Q$ , Figure of Merit<br>$V_R = 3.0 \text{ Vdc}$<br>$f = 50 \text{ MHz}$<br>(Note 3) | $C_R$ , Capacitance Ratio<br>$C_2/C_1$<br>$f = 1.0 \text{ MHz}$<br>(Note 4) |     |
|--------|------------------------------------------------------------------------------------|-----|-----|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----|
|        | Min                                                                                | Nom | Max | Min                                                                                  | Min                                                                         | Max |
| MV209  | 26                                                                                 | 29  | 32  | 200                                                                                  | 5.0                                                                         | 6.5 |

FIGURE 2 - FIGURE OF MERIT

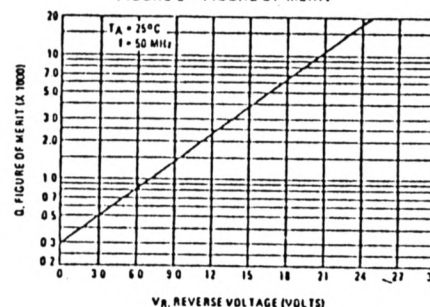


FIGURE 3 - LEAKAGE CURRENT

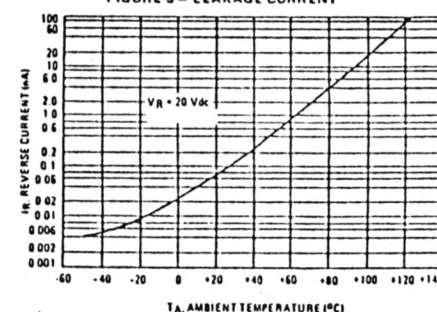
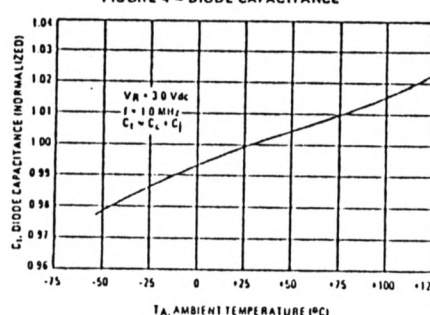


FIGURE 4 - DIODE CAPACITANCE



## NOTES ON TESTING AND SPECIFICATIONS

- $L_S$  is measured on a package having a short instead of a die, using an impedance bridge (Boonton Radio Model 250A RX Meter).
- $C_C$  is measured on a package without a die, using a capacitance bridge (Boonton Electronics Model 75A or equivalent).
- $Q$  is calculated by taking the  $G$  and  $C$  readings of an admittance bridge, such as Boonton Electronics Model 33ASB, at the specified frequency and substituting in the following equation:

$$Q = \frac{2\pi f C}{G}$$

- $C_R$  is the ratio of  $C_2$  measured at 3.0 Vdc divided by  $C_1$  measured at 25 Vdc.