10-28-99

Memorandum

To: A. R. Kerr
S. K. Pan
D. Koller
W. K. Crady
R. Groves

cc: J. Webber

From: J. Effland

Date: 1999-10-28

Subject: Preliminary Specifications New Mixer Bias Supply

The preliminary design concepts for the new mixer bias supply[1] have been revised based on input from A. R. Kerr, S. K. Pan, and W. K. Crady. The design concepts are attached to this memo in the form of specifications. Many of the specifications are again presented in graphical form by showing the proposed front panel design.

Other than the recommended revisions which I have hopefully incorporated into the design, the only new information of any importance is Section "2.1 Programmable Functions," which contains a table listing those functions that are, and are not, remotely programmable.

Please review and forward your comments to me.

[1] "Preliminary Design Concepts for New Mixer Bias Supply," CDL Internal Memo from J. Effland Dated 1999-10-26.

SIS Mixer Measurement System

Mixer Bias Supply Hardware Design Document

1999-10-28

Version 0.2

Revisions

Table 1: Document Revisions			
Revision Number	**Date**	**Who**	**Details**
0.1	1999-10-20	Jee	Initial: Requirements for switch sequencer
0.2	1999-10-28	Jee	Added Specifications section, based on comments from Kerr and Pan to "Preliminary Design Concepts for a New Mixer Bias Supply"

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1. Introduction

This document provides hardware design and assembly details for the SIS Mixer Bias Supply, which provides the appropriate voltage to the mixers and uses a 4-wire system to monitors the voltage actually supplied to the mixers. Mixer current is also monitored.

The system has the capability to be remotely operated.

2. Specifications

The new design uses Tucson's concept of locating weak-signal circuits in separate chassis mounted on the Dewar, and enclosing only the control electronics in the rack-mounted chassis.

Design details for the front panel are presented to serve as a visual aid for specifying important features of the bias supply. A more traditional specification table is also shown in Table 2 to describe details that cannot be addressed with the front panel drawings. Finally, a state diagram is included which is useful when designing the state machine to control the supply.

The most significant change from the existing design should simplify switching between states. Each time a new state is requested, the system will automatically cycle through the following states:

1) The op amps controlling the bias voltage are zeroed and the integrating capacitor in the feedback loop is shorted,
2) the bias source and bias monitoring lines are shorted,
3) the state change is performed,
4) shorts are removed from the supply and bias monitoring lines, and
5) the bias voltage control op amps are un-zeroed and the short is removed from the integrating capacitor in the feedback loop,

This is intended to replicate automatically the make-before-break switches in the existing design.

The following points address the major features on the front panel as shown in Figure 1:

1) Each device can be controlled from one of the four subsections on the panel. Kirk recommended naming each section "Device" to differentiate them from the mixer system, which will contain four mixer subsystems.

2) In an attempt to more clearly indicate their function, "Open Loop" and "Closed Loop" have replaced the existing labels "Source" and "Bias".

3) Ganged bias control is available for two pairs of devices and for all four devices. Polarity for each device is individually settable and is retained during ganged bias operation.

4) To simplify the front panel layout, a single control and single external input are used for both open and closed loop mode.

5) A common sweep oscillator can control each device by switching to "Sweep" on the appropriate subsection. The functions of the sweep oscillator are the same as the existing bias supply, except that the sweep voltage will be *added* to the preset bias voltage. This allows the preset bias voltage

to act as an offset adjustment, so its now possible to sweep about a fixed operating point. The sweep voltage will be added to the existing bias voltage using internal circuitry, which eliminates the need for external cables between the sweep oscillator and the "Ext" port for each device. Sweep capability is not available when using external inputs for the bias voltage.

6) Computer control will be provided for most functions. The computer can obtain control of the bias supply when the control switch is in "Remote" or "Local", but remote access is prevented when the switch is in "Rem Lockout". When the system requires computer control of the supply, "Remote" should be selected by the operator. "Local" is normally selected for manual control of the supply when the computer program running on the PC is dormant. If the operator must obtain local control while the computer program is controlling the supply, then "Remote Lockout" is selected. The distinction between "Local" and "Remote Lockout" should prevent a common problem that occurs when the computer is prevented from controlling the device because it is switched to "Local". When the computer actually addresses one of the devices in the bias supply, the LED next to the "Remote" position is illuminated.

7) The Monitor outputs and Ext. inputs are also available on the back of the chassis. The signals from the connectors in the back and front sides of the chassis are connected in parallel.

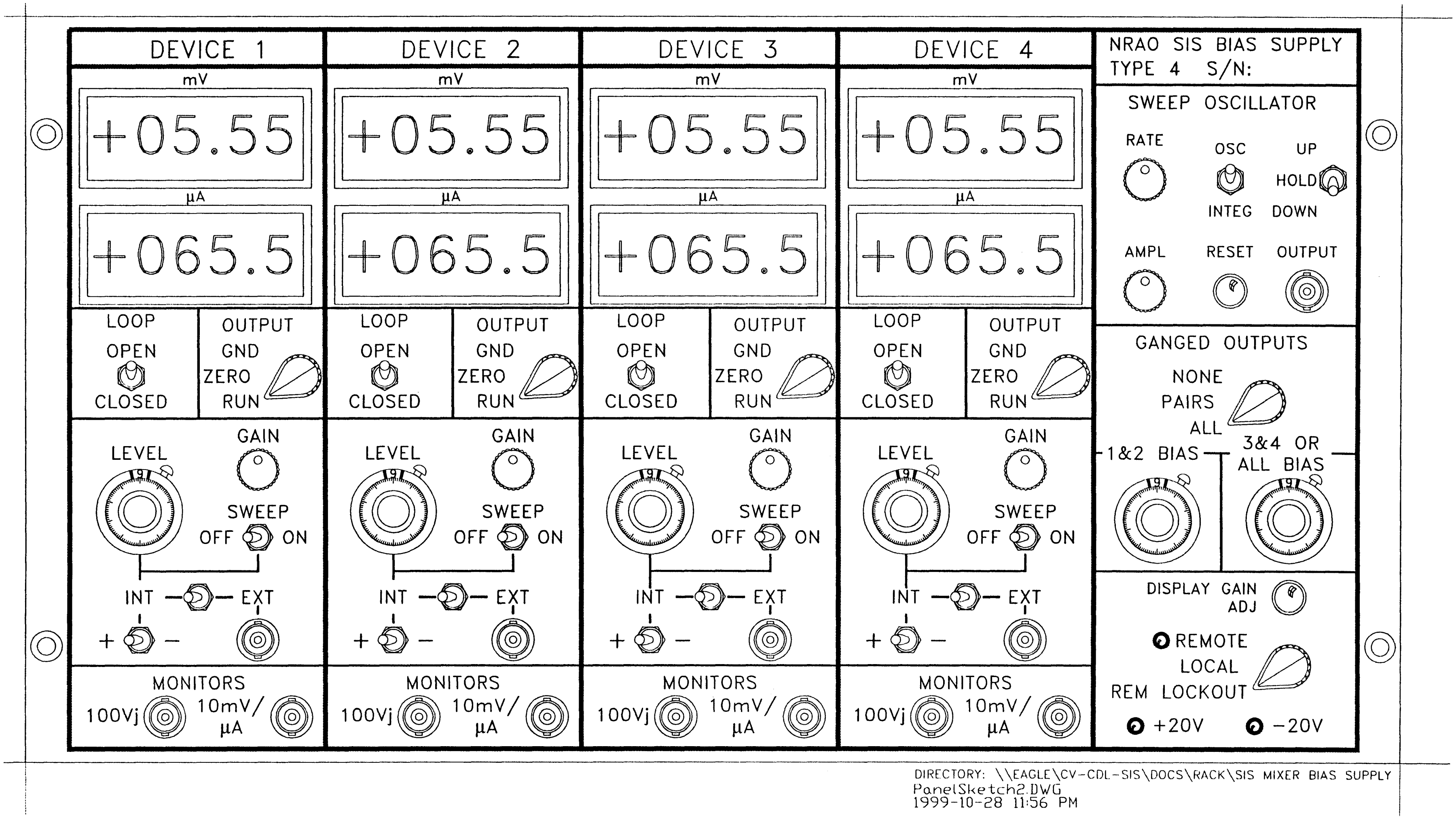

Figure 1: Front Panel Layout

Table 2 provides details that are not apparent from the front panel designs.

Table 2 : Mixer Bias Supply Specifications

Specification	Notes
Bias voltage *command* range	-100 to 100 mV
Bias voltage *measurement* range	-100 to 100 mV
Bias current *measurement* range	At least –1450 µA to + 1450 µA[1]
Output impedance manually selectable	A knob will be available at each mixer bias control box (*on the Dewar*) to manually switch the output impedance between: 10 KΩ, 2 KΩ, and 100 Ω
Current and voltage zero and gain	Adjustments will be available on each unit according to the following: Function — Control Unit — Dewar Unit V_{zero} — None[2] — screw driver adjust I_{zero} — None — screw driver adjust V_{gain} — None — screw driver adjust I_{gain} — Pot and meter — screw driver adjust The Gain control for each device allows calibration of the channel gain, which may require changing for each mixer block. When the "Display Gain Adj" button is pressed, the device current meters measure the relevant voltage for each channel, which is adjustable with the Gain control.
Manual voltage adjust	Using knob pots
Polarity change for bias	Either bias voltage can be independently switched from + to – bias. Manual mode only.

[1] The maximum bias current required results from a single junction with 5 Ω junction resistance driven to a maximum bias voltage of 4 times the gap voltage, or approx. 12 mV. The resistance looking toward the junction of the combination of the junction resistance (5 Ω) in series with the current sense resistor (5 Ω) and parrallel to a 50 Ω matching resistor, or 8.3 Ω. Thus, I = 12 mV / 8.3 Ω = 1,446 µA.

[2] Provided by the op-amp

Voltage tracking	The following tracking options are available: 1. No tracking – each of four supplies can be independently controlled 2. Paired tracking – Common voltage on the outputs for junctions 1 and 2 and the outputs for junctions 3 and 4. Adjustable with two knobs. 3. All - Common output voltage for all four junction outputs. In all cases, junction outputs polarity is independently switchable. If External input is selected with ganged outputs, the control voltage is obtained from: 1. Ext. inputs 1 and 3 when ganged in pairs 2. Ext. input 1 when all outputs are ganged
Voltage/Current Meters	Two meters for each junction measure bias voltage and current.
Mixer input line shorting	The bias command voltage as well as current and voltage monitor lines can be shorted: 1. *via* a switch on the front panel 2. programmatically 3. when the control cable is disconnected from the Dewar bias supply block.
Automatic shorting	The following switch changes will cause the bias supply to first short the output the respective device: 1. Switching between open and closed loop 2. Switching internal sweep off/on 3. Internal Level +/- change 4. Switching from internal to external input. 5. Switching any of the ganged output functions

Figure 2 is a diagram of the bias supply states. This will be used to design the sequencer that controls changing from one state to the other. Each arrow in the top two diagrams depicts a change in state, and will initiate the protection sequence shown in the bottom diagram.

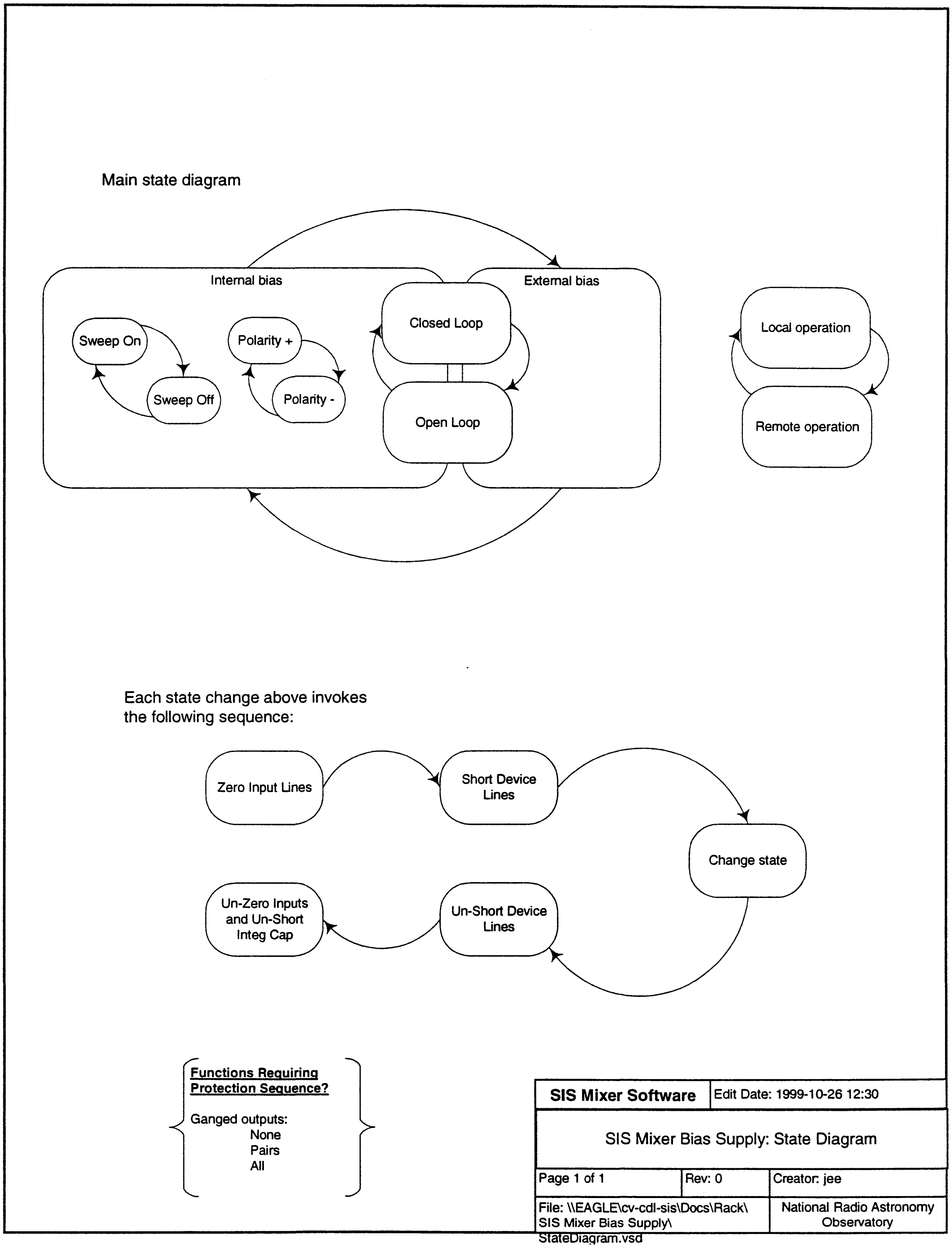

Figure 2: Sequencer State Diagram

2.1 Programmable Functions

Table 3 provides details for the functions in the bias supply that can be controlled by computer. Control and measurement of bias voltage by the computer is only possible through the analog input and output connectors on the supply. This relaxes the speed requirements for the supply's computer interface.

Table 3 : Programmable Functions for Mixer Bias Supply

Function	Notes
Open Loop/Closed loop	Programmable for each device
Output state: Run, Zero, or Gnd	Programmable for each device
Bias source: Internal or External	Programmable for each device
Ganged Outputs: None, Pairs, or All	Programmable. When External input is selected with ganged outputs, the control voltage is obtained from: Ext. inputs 1 and 3 when ganged in pairs Ext. input 1 when all outputs are ganged
Control of bias voltage	*Not* programmable: Available only using the Ext. Input on the rack-mounted chassis
Reading of bias voltage	*Not* programmable: Available only using Monitor outputs on front or back of the rack-mounted chassis
Reading of bias current	*Not* programmable: Available only using Monitor outputs on front or back of the rack-mounted chassis
Bias + or -	*Not* programmable: External input accepts both voltage polarities which eliminates programmable requirement

3. Bias Supply PCB

The Bias supply PCB is located on the Dewar to minimize the cable lengths between the mixer and bias supply that carry low bias levels.

3.1 Reed Relay Sequencer

Reed relays short all bias lines and voltage/current monitor outputs upon command from the system or if the cable is disconnected from the bias assembly housing. To minimize voltage transients presented to the mixers, either from the bias lines or the monitor outputs, the reed relays are sequenced so that the input to the voltage control op amp is shorted prior to shorting the bias supply lines. When the short command goes false, the op-amp inputs remain shorted until after the mixer bias lines are unshorted.

Figure 3 shows the timing sequence for the TTL lines that command the reed relays. After the short command is produced by the system, the op-amp inputs are first shorted, then the mixer input lines are shorted. When the system short command goes low, first the mixer inputs are unshorted, then the op-amp inputs are unshorted.

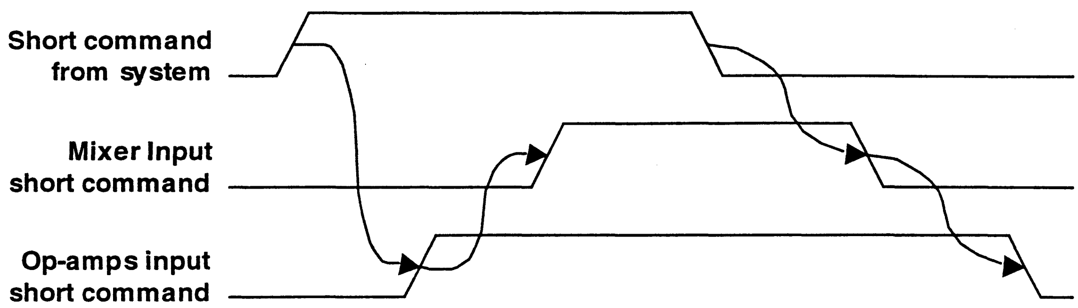

Figure 3: Timing Sequence for Reed Relay Switching