Maintenance Manual

MASTR® IIe
CONTROL SHELF

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ERICSSON

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NOTICE!

This manual covers Ericsson and General Electric products manufactured and sold by Ericsson Inc.

NOTICE!

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitution of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

NOTICE!

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SPECIFICATIONS*

POWER	
Input Voltage	13.8 Vdc nominal (20%)
Current Drain	
Receive	1.1 Amperes for nominal voltage input
Transmit	1.5 Amperes for nominal voltage input
AUDIO RESPONSE	
To Transmitter and Line	+1, -3dB from -6dB per octave response for 300 to 3000 Hz referenced to 1 kHz
To Speaker	+2, -8dB from -6dB/oct resp for 300-3kHz ref 1kHz
Line Output Level	-19 dBm to +7 dBm
Line Input Level	-19 dm to +7 dBm
LINE LOOP IMPEDANCE	11 K-Ohm maximum (8 k-ohm line, and 3 K-ohm matching)
LINE TERMINATING IMPEDANCE	600 Ohms
NOTCH FILTER RESPONSE	-45dB @ 2175 Hz
CARRIER CONTROL TIMER	Adjustable from zero to 10 minutes
DROP-OUT DELAY TIMER	Adjustable from zero to l0 seconds
OPERATING TEMPERATURE	-30°C to +60°C (-22°F to 140°F)
DISTORTION	Less Than 3%
PANEL DIMENSIONS (H x W)	5.2 x 18.3 inches (3 Rack Units)

* These specifications are intended primarily for use by service personnel. Refer to the appropriate Specification Sheet for complete specifications.

DESCRIPTION

The MASTR IIe station Control Shelf is designed for DC/tone remote, remote/repeater or repeater applications. The shelf consists of a Backplane Board housing the Power and System Modules.

The Power and System Modules connect to the backplane board through 96- pin DIN-type connectors. The control shelf is also equipped with a microphone connector, phone line connector, and five Molex® connectors on the Backplane Board for interfacing with other system components. These Molex connectors are identical to those formerly used. Additional interconnections can be provided by using an optional auxiliary backplane.

The Power Module contains the power supply that provides regulated voltages for the System Module. The System Module contains the timing circuits required for remote, remote/repeater or repeater base station operation. A Digital Signal Processor (DSP) board is added to the System Module for tone control applications, PC control voting and other options.

The Control Shelf utilizes programmable micro-computer circuitry to control the base station transmitter, receiver, power and control circuits. The basic Control Shelf can provide one or two transmit and receive frequencies in DC control applications, and up to four transmit and receive frequencies in tone control applications.

In addition, the Control Shelf can be configured for operation with other control shelves (including the GETC shelf for trunked systems), with auxiliary receivers, simulcast systems, receiver voting, E & M signaling and scan configurations. Options include a Drop-Out-Delay (DOD) timer, Carrier Control Timer (CCT), Channel Guard, and Squelch Operated Relay (SOR). Additional station configurations include:

- Station metering
- Battery alarm tone
- Type 90 or DTMF tone decoding
- 2/4-wire audio
- Morse code station identification
- Auxiliary control

Access to the Control Shelf is provided by opening the receiver/exciter door on the front of the station housing. A layout of the Control Shelf is shown in Figure 1.

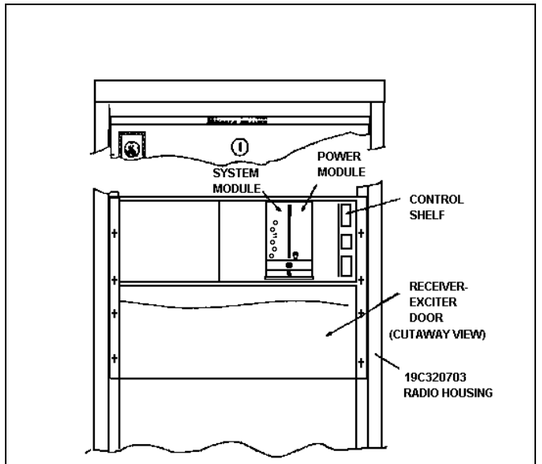


Figure 1 - Control Shelf Layout

NOTE

Minor modifications are required when retrofitting the MASTR IIe Control Shelf into some older MASTR II stations. Refer to the APPENDIX as listed in the Table of Contents for station modification instructions.

BACKPLANE BOARD

The MASTR IIe backplane (19D902459G1) fits into the same rack space as the earlier Mastr II Control Shelf. In addition to providing interconnections for the system and Power Modules, the backplane contains the necessary circuitry for:

- DC and Tone Control
- E & M Signaling
- Receiver +10-Volt Regulator
- Transmitter +10-Volt Regulator

The Control Shelf also accommodates an optional auxiliary Backplane Board.

POWER MODULE

Power Module 19D902589G1 contains switching power supplies for the +12 and the -12 volt supplies, and switching power supply for the +5 volt digital supply. The outputs of the +12 volt and -12 volt supplies are regulated to provide +5 volt and -5 volt outputs. A filtered A+ output is also provided.

Refer to Maintenance Manual LBI-38638 for complete information on Power Module.

SYSTEM MODULE

System Module 19D902590G1, G2 contains all audio processing and control circuitry.

System Module 19D902590G2 is a 19D902590G1 System Module with a "piggyback" Digital Signal Processor (DSP) board (19D902667G1) that is required for all tone remote operations. The DSP board is also required for other tone detection and generation functions.

Refer to Maintenance Manual LBI-38639 for complete information on System Module.

HARNESS

When the MASTR IIe station Control Shelf is shipped, the station will have the 19C320811G16 harness installed. This harness is designed to accommodate either metering or a GETC control shelf (for trunking operation). Adapter harnesses are required for Voice Guard and other types of installation. Refer to the notes on the harness Schematic Diagram before attempting any field modifications.

The Control Shelf may also be retrofitted into existing field installations using the existing harness. Refer to the appendix of this manual for detailed installation instructions.

AUXILIARY BACKPLANE

Auxiliary backplane 19D902459G1 contains circuitry to drive a Squelch Operated Relay (SOR) and two auxiliary control relays. The auxiliary backplane also contains the handset interface circuitry and the handset connector.

Refer to Maintenance Manual LBI-38532 for complete information on Auxiliary Backplane board.

SYSTEM OPERATION

The MASTR IIe Control Shelf can be programmed for operation in either a DC remote, tone remote, or repeater control application.

The Control Shelf is equipped with control and status indicators for test purposes. The controls allow the service technician to disable the transmit function, simulate a remote PTT to open up the line, select the station Channel Guard monitor function, and reset the Control Shelf.

Status indicators available in the Control Shelf include transmit, transmit disable, and CG monitor indicators.

There are several common options available for use in the Control Shelf that are applicable to DC remote control, tone remote control or repeater applications. These options are described in the following paragraphs.

CHANNEL GUARD

There are two types of Channel Guard (CG) available: tone and digital. The Control Shelf can decode either tone or digital CG information from received audio, and can generate CG tones or digital codes for transmission.

Multiple CG tones can be programmed into the Control Shelf through the personality EEPROM. Different CG tones can be used for decode and encode. The Control Shelf can be programmed for encode only CG, decode only CG, or to both encode and decode CG.

In addition, both digital codes and tone codes can be used in a station. For example, the station receiver can be programmed for tone codes, and the transmit frequency programmed for a digital code

Prior to any transmission, the CG monitor function can unmute the receiver when any on-frequency signal is received, allowing all on-frequency activity to be monitored.

When in the MONITOR mode, the transmitter is activated only if programmed as a repeater, and the proper CG information (tone or digital CG) is present. The monitor function is activated by the local CG Monitor switch, or by a remote console.

Tone Channel Guard

Standard CG tone frequencies range from 67 Hz to 210.7 Hz. Extended CG tones are available, but can cause some degradation in specifications.

The Control Shelf detects a 135-degree phase shift in the CG tone to determine when to mute the receiver in order to eliminate the squelch tail (STE). In addition, the Control Shelf generates a 135-degree phase shift in the CG tone, and continues to send the phase shifted CG tone for 160 milliseconds after the transmitter is unkeyed (PTT button released).

Digital Channel Guard

The Control Shelf also encodes and decodes digital CG. There are 83 digital codes available. Any of the digital codes can be assigned to any of the transmit or receive channels. A list of the octal codes (and their equivalent codes) is shown in Figure 2.

The encoding function provides continuous, repetitive digital word modulation to the transmitter. The decode function controls receiver muting to eliminate all calls that are not digitally coded with the assigned CG code.

BATTERY ALARM TONE

Whenever the station is operating on battery standby power, the station power supply applies a battery standby signal to the Control Shelf. The Control Shelf then generates a 1200 Hz alert tone and adds it to the transmit audio for transmission. The 1200 Hz tone is also sent down the line to any remote control unit in the system. The Control Shelf requires a minimum of 19.4 Vdc on BATT STDBY in order to activate the 1200 Hz tone.

NOTE

The station has to be keyed or unsquelched for the alarm tone to be heard at the remote control unit.

The repetition rate and on-time rate are adjustable through the personality **EEPROM**. The repetition rate sets the time from the beginning of a tone to the beginning of the next tone, and is adjustable from zero (0) to 25 seconds in increments of 1 second. The on-time rate sets the duration of the tone burst, and is adjustable from zero (0) to one (1) second in increments of 0.1 second.

If the battery standby signal is not connected to the input of the Control Shelf, the option must be disabled in the Control Shelf personality to prevent alarm tones from being generated.

STATION METERING

The metering function uses an Analog-to-Digital (A/D) converter located on the System Module. Meter switching kit 19B226293G1 must be installed in the station front door assembly as outlined in Maintenance Manual LBI-4848. However, the A/D converter on the System Module converts the DC metering level to a digital value which is output over the programming/ diagnostics serial port.

If an optional auxiliary backplane is present, the metering information can be displayed on Utility Handset 19A705965P1. The Utility Handset also requires cable 19D901619P2.

If the triple panel meter option (option MA) is installed, then Control Shelf metering via the utility handset, or over the programming/diagnostics serial port will not function.

MORSE CODE ID

Morse code identification can be programmed into the Control Shelf personality. The code is transmitted according to FCC publication 47 CFR, Chapter 1 (10-1-87 Edition), paragraph 90.425 for non-trunked communications; and paragraph 90.380 for trunked communications. Up to 12 characters in only one word can be programmed into the Control Shelf. This feature can be enabled or disabled in the programming, as required.

A 5 sec. transmitter quiet time is required before starting the Morse Code sequence. A 1000-Hz tone is used, with an element time of 50 milliseconds for 20 word-per-minute transmissions. The Morse code ID is sent every interval time. The interval time is programmable, but defaults to every thirty minutes. The ID may be programmed to be transmitted either with or without Channel Guard.

PRIM. CODE	EQUIVALENT CODE	PRIM. CODE	EQUIVALENT CODE	PRIM. CODE	EQUIVALENT CODE
023	340,766	142	174,270	266	655
025		143	333	271	427,510,762
026	566	144	466,666	274	652
031	374,643	145	525	276	326,432
032	137	147	303,306,761	307	362,565
036	560, 627	150	256,703	311	330, 456, 561
043	355	152	366, 415	312	515,663,743
047	375, 707	153	606,630	315	321, 673
051	520, 771	155	233, 660	317	546,614,751
053		156	517, 741	324	343,570
054	405, 675	157	322,503	325	550,626
056	465, 656	161	345,532	331	372, 507
060	116, 737	162	416, 553	332	433,552
065	301	163	460,607,654	344	471,664,715
066	737	164	207,732	346	616, 635, 724
067	516, 720	165	354	351	353, 435
071	603, 717, 746	171	265,426	356	521
072	470, 701	172		363	436,443,444,662
073	640	212	253	446	467,511,672
074	360, 721	213	263,736	447	473,474,731,744
075	501, 624	217	371,453,530	452	524,765
076	203, 754	222	445,457,575	454	513,545,564
104	226, 557	223	350, 475, 750	455	533,551
107	365	224	313,506,574	462	472,623,725
114	327, 615	225	536	523	647,726
115	534, 674	227	261,567	526	562,645
117	411,756	231	504,631,636,745		
122	535	234	423,563,621		
123	632,637	235	611,671,723		
125	172	236	251,704,742		
127	412,441,711	237	464,642,772		
130	364,641	243	267, 342		
131	572, 702	245	370, 554		
132	605, 634, 714	246	542,653		
133	413,620	252	661		
134	273	254	314,612,706		
135	205,610	255	425		
136	502,712	262	316,431,730		

Figure 2 - Primary And Equivalent Octal Codes

DC REMOTE CONTROL

The Control Shelf can be remotely controlled by DC control currents. A block diagram of a Control Shelf with a remote interface is shown in Figure 3. Refer to the INSTALLATION section as listed in the Table of Contents of this Manual for the different methods of connecting a DC remote control unit to the Control Shelf.

A DC remote control unit can initiate a transmission, listen to received audio, and select or deselect certain Control Shelf functions. The different current levels used and the control functions are described below.

Control Current Signaling

Control current signaling from a DC remote control unit consists of applying different current levels on a wire pair having DC continuity. The six control current levels used in the remote Control Shelf are:

- ± 11 milliamperes
- ± 6 milliamperes
- -2.5 milliamperes
- 0 milliamperes

Station functions which can be controlled by these currents are:

- Repeater Disable
- Channel Guard Monitor
- Transmit Frequency Selection
- Receive Frequency Selection
- Scan
- Receiver Selection (Auxiliary Receiver Selection)

See Table 1 for a list of DC Control Currents and their corresponding functions.

Transmit Functions

When a transmit frequency select control current is received from a remote, the Control Shelf initiates a transmission of received line audio on the selected transmit frequency. The transmission continues until the transmit control current is no longer detected.

In multi-frequency installations, the Control Shelf also provides a Squelch Tail Elimination (STE) function to prevent a transmission on the wrong frequency when the control current passes the 6 milliampere level when an 11 milliampere function has been selected. Similarly, when Channel Guard STE is used, the frequency remains selected for 160 milliseconds so that phase-shifted CG tone can be transmitted on the proper frequency.

Channel Guard Monitor

When the CG Monitor function control current is received from a remote control unit, the Control Shelf does not require the correct CG before unmuting the receiver.

The requirement for correct CG tones to initiate a repeat of received signals is **not** removed when the CG Monitor function is activated. This allows received audio to be passed down the line to a remote control unit regardless of CG content, allowing the remote operator to monitor all frequency activity prior to transmitting. This function is automatically reset when a remote control unit keys the transmitter.

Multi-frequency

Control currents applied to the Control Shelf can be used to select one of two transmit frequencies or one of two receive frequencies can be independently selected.

Repeat Function

When the Control Shelf receives a repeater enable/ disable control current, it enables/disables the repeater function. When the repeat function is enabled, the base station re-transmits the received (incoming) signal when a valid CG tone or code is present. When the repeat function is disabled, the Control Shelf does not initiate a transmission of received signals.

Auxiliary Receiver

When an auxiliary receiver is used, the Control Shelf inputs received audio from the auxiliary receiver and transmits it down the line to a remote control unit. The Control Shelf can also mute the auxiliary receiver using the **RX 2 MUTE** output line.

A remote control unit uses DC control currents to select one of the three auxiliary receiver functions listed below:

1. Main receiver audio only,
2. Auxiliary receiver audio only, or
3. Both main receiver and auxiliary receiver audio.

Table 1 - DC Control Currents And Functions

FUNCTION	CONTROL CURRENT IN MILLIAMPS					
1 FREQ TX 1 FREQ RX	-11	-6	-2.5	0 RECEIVE	+6 TRANSMIT	+11
2 FREQ TX 2 FREQ RX 2 FREQ TX 2 FREQ RX WITH SCAN	 RX-F2	RX-F2 RX-F1		RX-F1 SCAN	TX-F1 TX-F1	TX-F2 TX-F2
1 FREQ TX 1 FREQ RX WITH CHANNEL GUARD DISABLE			CG DISABLE	RECEIVE WITH CG	TRANSMIT	
2 FREQ TX 2 FREQ RX WITH CHANNEL GUARD DISABLE	RX-F2 CG DISABLE	RX-F2 WITH CG	RX-F1 CG DISABLE	RX-F1 WITH CG	TX-F1	TX-F2
REPEATER DISABLE		REPEATER DISABLE		RECEIVE	TRANSMIT	
REPEATER DISABLE & CHANNEL GUARD DISABLE	REPEATER DISABLE & CG DISABLE	REPEATER DISABLE	CG DISABLE	RECEIVE WITH CG	TRANSMIT	
1 FREQ TX 2 SEPARATE RECEIVERS (AUX RX)	RX-F2	RX-F1		RX-F1 & RX-F2	TRANSMIT	
2 FREQ TX 2 SEPARATE RECEIVERS (AUX RX)	RX-F2	RX-F1		RX-F1 & RX-F2	TX-F1	TX-F2

TONE REMOTE CONTROL

In tone remote applications, the Control Shelf is equipped with a Digital Signal Processor (DSP) that interfaces with a tone remote control unit through a two- or four-wire phone line. a block diagram of the Control Shelf remote interface is shown in Figure 3.

A tone remote control unit can initiate a transmission, listen to received audio, and select or deselect Control Shelf functions. Functions selected by the different available tones can be programmed so that a 1450-Hz function tone, for example, can be used for different functions in different control shelves.

Signaling from a tone remote control unit consists of a high level "**Secur-it**" tone, followed by the appropriate medium level

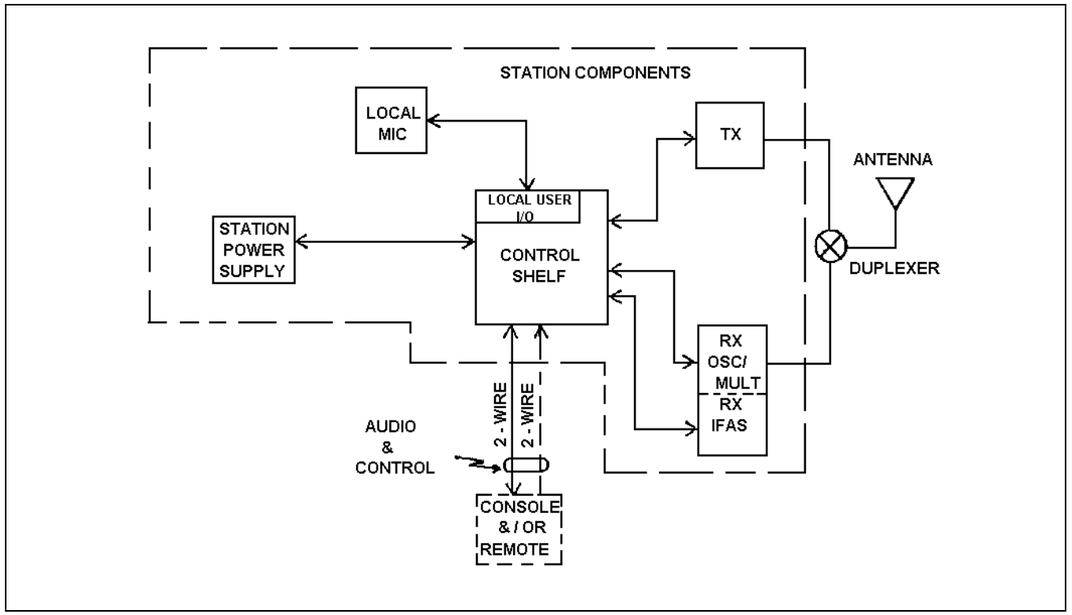


Figure 3 - DC/Tone Remote, DC/Tone Remote/Repeat

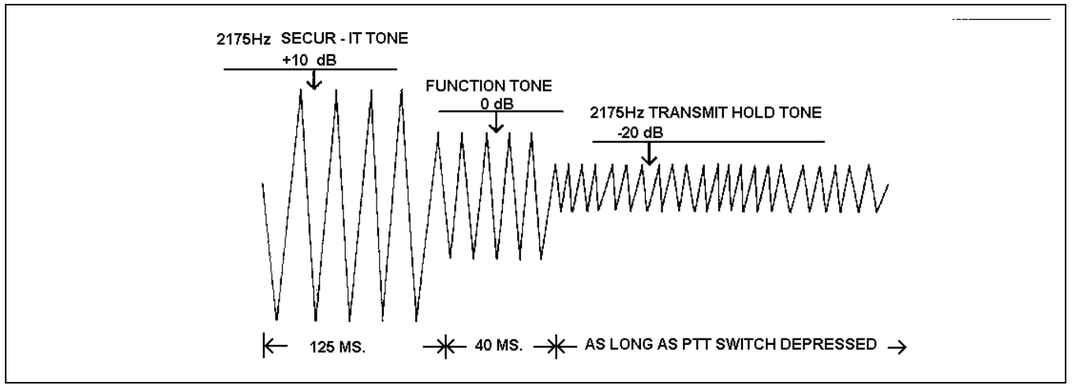


Figure 4 - Tone Control Sequence

function tone (as well as a **hold** tone if the transmitter is keyed). The tone control sequence is shown in Figure 4.

The "**Secur-it**" tone is a +10 dB, 2175 Hz tone that is present for 125 milliseconds. The "**Secur-it**" tone is followed by a 40 millisecond, 0dB function tone. The function tone can be followed by a -20 dB, 2175 Hz hold tone if PTT is selected. The hold tone is present as long as the PTT is pressed.

Function Tones

The frequency of the function tone determines the function selected by a tone remote control unit. Function tones range from 1050 Hz to 2050 Hz, and are spaced 100 Hz apart.

Tone Remote Functions

Station functions that can be controlled by tone signaling from a remote control unit are:

- Repeater Enable/Disable
- Channel Guard Enable/Disable
- Channel Guard Monitor
- Transmit Frequency Selection
- Receive Frequency Selection
- Scan
- Receiver Selection (Auxiliary Receiver Selection)
- Auxiliary Output Enable/Disable (Auxiliary control)

See Table 2 for a list of function tones and their corresponding function.

Table 2 - Tone Control Function And Frequency

FUNCTION	TONE
RX Channel Guard Disable (Reset by PTT)	2050 Hertz
TX-Freq. No. 1	1950 Hertz
TX-Freq. No. 2	1850 Hertz
RX-Freq. No. 1 or Receiver No. 1	1750 Hertz
RX-Freq. No. 2 or Receiver No. 2	1650 Hertz
Channel Guard On or Repeater Enable*	1550 Hertz
Channel Guard Off or Repeater Disable*	1450 Hertz
TX-Freq. No. 3 or Aux. Function 1 On	1350 Hertz
TX-Freq. No. 4 or Aux. Function 1 Off	1250 Hertz
Repeater Enable* Scan Disable	1150 Hertz
Repeater Disable* or Scan Enable or Simultaneous Monitor	1050 Hertz

NOTE

*Repeater Enable/Disable is 1150/1050 only when Channel Guard On/Off is present.

Repeat Enable/Disable

When a repeater enable (disable) function tone is received on the line from a remote, the Control Shelf enables (disables) the repeater function. When the repeat function is disabled, the Control Shelf will not initiate a transmission of received signals. However, the audio is still routed to the remote control unit if the transmitter is not keyed.

Channel Guard Enable/Disable

This function is the same as CG Monitor except that the Monitor function is not deselected by a remote PTT. The Monitor function is deselected only by a CG enable function tone.

Channel Guard Monitor

When a CG Monitor function tone is received from a remote control unit, received audio is sent down the line to a remote control unit and the local speaker regardless of CG content. This allows the operator to monitor all frequency activity prior to transmitting. The requirement for a correct CG tone or code to initiate a repeat of received signals is **NOT** removed.

The monitor function is disabled when a remote control unit keys the transmitter.

One-Four Frequencies

The Control Shelf receives function tones to select one of four frequencies. If more than two transmit and receive frequencies are used, the transmit and receive frequencies are tied together. For example; receive 3 is selected whenever transmit 3 is selected. In addition, receive 3 will remain selected until another transmit frequency is selected.

Transmit Functions

When a transmit frequency select function tone is received from a remote, the Control Shelf filters out the hold tone and initiates a transmission of received line audio. The transmission continues until the hold tone is no longer detected.

Intercom Function

The Control Shelf intercom function allows a service technician at the station to communicate with a remote control unit without keying the transmitter.

When no valid signal is present, the Control Shelf routes the line audio to the local speaker. A remote control unit can then select the intercom function and send audio (no control tones) over the line. This remote audio will be heard only at the station speaker, and will not be transmitted.

The service technician can communicate with the remote control unit by placing the Control Shelf transmit disable switch in the disable position. The local microphone at the station can then be keyed and audio sent only down the remote lines to the remote control unit. This audio is not transmitted by the station.

While in the intercom mode, receiver audio will continue to have priority over line audio to the local speaker, and local (station) mic audio will have priority over receiver audio to the remote line.

Auxiliary Receiver

When an optional auxiliary receiver is present, the Control Shelf takes received audio from the auxiliary receiver and transmits it down the line to a remote. The Control Shelf also mutes the auxiliary receiver using the **RX 2 MUTE** output line.

A remote control unit can control the state of the **RX 2 MUTE** output line using function tones. The function tones allow the Control Shelf to send the main receiver audio only, the auxiliary receiver audio only, or both the main receiver and auxiliary receiver audio output to a remote control unit.

Scan Function

The scan function allows the user to scan multiple frequencies using the station receiver. A priority channel can be selected, and all signals on the priority channel will be received, regardless of signal strength or which channel receives the first signal.

When no signal is being received on any channel, the scan function sequentially selects and monitors each channel. If a signal is detected, the Control Shelf locks onto the channel for the duration of the message and discontinues scanning. If the channel is not the priority channel and a priority channel has been selected, the Control Shelf switches to the priority channel periodically to check for activity on the channel.

When a signal is received on the priority channel while the scan is stopped on a non-priority channel, the scan reverts to the priority channel and locks on that channel for the duration of the message. If a priority channel is not selected, then the station searches all selected non-priority channels and locks on the channel receiving the first signal.

REPEAT FUNCTION

The Control Shelf performs a basic repeat function in which received signals are re-transmitted after filtering and level adjustments. Figure 4 shows the Control Shelf interface in a repeat only system.

Received signals are applied to the **VOL/SQ HI** line from the receiver, and are routed to the transmitter on the **TX AUDIO OUT** line for re-transmission. If Channel Guard is present, the Channel Guard information is filtered out prior to re-transmission.

Some repeater stations have timing restraints mandated by the FCC. Two timing circuits are available for use in these applications. The timing circuits are a Carrier Control Timer (CCT), and a Drop-out Delay Timer (DOD).

Carrier Control Timer

The Carrier Control Timer (CCT) limits the time the station transmitter remains keyed for a single transmission. The time limit can be preprogrammed from zero (0) seconds to 600 seconds (10 minutes) in one-second steps. All control shelves equipped with the CCT are shipped with the timer programmed for three minutes.

NOTE

Timing restraints apply to local and remote transmissions as well as the repeat function.

The timing cycle begins when the transmitter is keyed by pressing the PTT button on the local microphone, or the PTT button of a remote or mobile radio generating the signal activating the repeater. If the station is equipped with Channel Guard, the remote signal must contain the proper Channel Guard tone. Timing ends and the timer is reset when the transmitter is unkeyed.

If the timing limit is exceeded, the Control Shelf will turn off the transmitter through the **ANT RELAY** and **TX OSC CONTROL** outputs. The Carrier Control Timer function is reset whenever a PTT switch is released, whether it is at the remote control unit or other keying source.

Whenever the timing cycle is exceeded by a repeat PTT, the Control Shelf will not activate another repeat until the PTT is released from any source. However, the Control Shelf will retransmit from another source (such as a remote control unit) whenever the time limit has expired on a repeat PTT.

Drop-Out Delay Timer

In repeater applications, the Drop-Out Delay Timer (DOD) is designed to decrease the number of transmitter on/off cycles. This is achieved by keeping the transmitter keyed for a predetermined period after a repeat transmission has ended. This period can be programmed for zero (0) to ten (10) seconds in 100-millisecond (0.1 second) steps. All control shelves equipped with the DOD are shipped from the factory with the timer set for three seconds.

NOTE

The Drop-Out Delay Timer IS USED only for repeater functions. Other transmissions, including those originating from the local microphone, do not use a DOD timer.

The timer starts whenever a repeat transmission ends. The transmitter is not de-energized through the **TX OSC CONTROL** and **ANT RELAY** outputs until the timer runs out.

If a new transmission is initiated before the timer runs out, the transmitter remains energized and the new transmission completed. If no new transmission is initiated, the transmitter will remain on until the DOD times out.

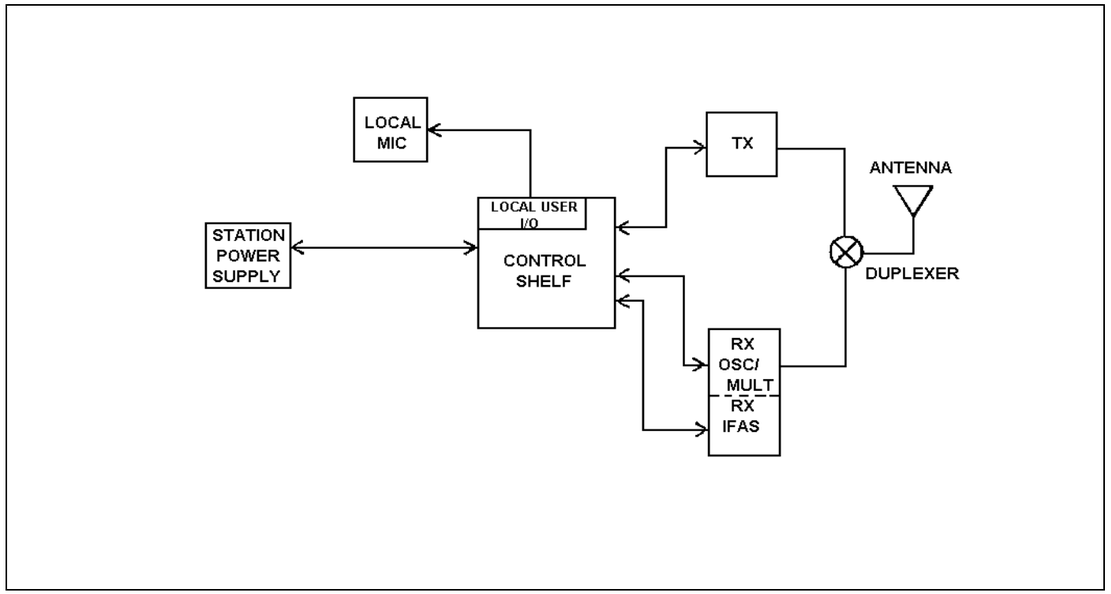


Figure 5 - Repeat Only Control Shelf

PROGRAMMING

All input and output audio levels for the Control Shelf are adjusted by electronic potentiometers. These potentiometers must be adjusted by a personal computer (PC) connected to RS-232 Programming port J6 on the Backplane Board, or by Utility Handset 19A705965P1 connected to an auxiliary backplane board through cable 19D901619P2.

The Control Shelf hardware includes an EEPROM containing the operating characteristics (or personality) of the Control Shelf. The contents of the EEPROM can be changed only through the use of a personal computer connected to the Programming port. Limited changes can also be made with the Utility Handset (with cable) connected to an auxiliary backplane board.

Complete instructions on the Control Shelf EEPROM personality settings are contained in the Programming Manual TQ-3353.

PROGRAMMABLE FEATURES

The Control Shelf personality programming parameters include:

Enable/Disable Parameters

- Channel Guard Encode
- Channel Guard Decode
- STE (Encode)
- Repeat Function
- CCT
- DOD Timer
- Simplex
- Auxiliary Control
- Scan
- Auxiliary Receiver
- Battery Alarm Tone
- DC Remote
- Tone Remote
- Station Metering

System Parameters

- DSP Line In
- DSP Line Cancellation
- DSP Compressor
- Two/Four Wire Remote
- Battery Alarm Tone "on time"
- Battery Alarm Tone
- Repetition Rate
- Morse Code ID
- Morse Code ID Interval
- Line Out level
- Line In level
- Transmit Audio output level
- Channel Guard output level
- Carrier Control Time
- Dropout Delay Time
- Channel Guard Encode Frequency
- Channel Guard Decode Frequency
- Type 90 Decode
- DTMF Decode

DEFAULT PROGRAMMING

If the control shelf has not been factory programmed or has lost its personality programming information, it will default to the following conditions:

- Morse code ID disabled
- Battery alarm disabled
- Repeat disabled
- Simplex operation
- CG encode disabled
- CG decode disabled
- Rx frequency 1 selected
- Tx frequency 1 selected
- 9600 Baud Serial
- 2 frequency DC remote enabled
- DSP-no functionality enabled
- CCT - 3 minutes
- DOD Timer - 3 seconds
- 2-wire remote

SYSTEM INTERFACES

This section contains a description of the interfaces to the Control Shelf, transmitter, receiver and operator. Also, interfaces to the GETC board, programming/ diagnostics serial port and other miscellaneous interconnections are described. The station interface names in **bold type** in the following descriptions are those shown on the MASTR IIe Station Interconnection Diagram (see Table of Contents).

TRANSMITTER EXCITER

TRANSMIT AUDIO HI - The Control Shelf drives the transmitter exciter 600-ohm **MIC HI** input, with a 40- to 250-millivolt rms (adjustable) signal that is AC-coupled (the transmitter exciter puts a DC bias of +10 Vdc onto this line) onto the Control Shelf **TRANSMIT AUDIO HI** output. The Control shelf is designed with a high impedance output so that other sources can drive this input to the transmitter without signal degradation.

TRANSMIT AUDIO LO - The common line for the **TRANSMIT AUDIO HI** output. It is grounded at the Control Shelf.

CG HI - The Control Shelf drives the transmitter exciter with tone or digital Channel Guard tone. The output level is adjustable.

TX OSC CONTROL - A high (+10 ± 0.5 Vdc @ 5 milliamperes) on this output activates the transmitter. This output appears as an open collector when the transmitter is not selected.

TX F1, TX F2/CLK, TX F3/DATA, TX F4/ENBL - These open collector outputs can withstand up to 30 Volts on the output when open, and sink at least 4.0 milliamperes with an output voltage of ≤ 0.7 volt. These outputs are grounded to select the F1-F4 crystal in the transmitter exciter, activating the transmitter. The transmit frequency is selected by a remote control unit, or by the Utility Handset (with cable).

RECEIVER OSCILLATOR/MULTIPLIER

RX OSC CONTROL - Same as the **10V TX** output on the Backplane board. The output is always active.

RX F1, **RX F2/CLK**, **RX F3/DATA**, **RX F4/ENBL** - These open collector outputs can withstand up to 30 Volts on the output when open and sink at least 4.0 milliamperes with an output voltage ≤ 0.7 volt. These outputs are grounded to select the F1-F4 crystal on the receive osc/mult board, activating the selected receive frequency.

RECEIVER IF AUDIO SQUELCH

VOL SQ HI - Audio from the station receiver is input on this line. The audio range is from 0 to 1.5 Volts rms. This output can consist of audio, Channel Guard or data.

VOL SQ LO - This is the common line for the **VOL SQ HI** input. It is grounded in the Control Shelf.

RUS (**R**eceiver **U**nsquelched **S**ensor) - A high on this input indicates that an on-frequency signal is being received. If CG is enabled, this input will not go high unless an on-frequency signal with the correct CG tone is applied to the receiver. A low (0.3 Vdc) indicates that an on-frequency signal is not being received or that an on-frequency signal which does not contain the proper CG tone is being received.

CAS (**C**arrier **A**ctivity **S**ensor) - A high (≥ +9.3 Vdc) on this input indicated that an on-frequency signal is being received. A low (≤ 0.2 Vdc) on this input indicates that no on-frequency signal is being received. This input is independent of the presence of a proper CG tone.

RX 1 MUTE - The Control Shelf presents a low (≤ 0.3 Vdc @ ≤ 30 milliamperes) on this open collector output when the audio from receiver one is muted.

A low on the receiver **RX MUTE** input inhibits the receiver **RUS** output from going high and turns off the entire audio circuit to eliminate current drain and disable the receiver audio.

RX 2 MUTE - The Control Shelf presents a low (≤ 0.3 Vdc @ ≤ 30 milliamperes) on this open collector output when the audio from receiver two is muted. This output is only used when a auxiliary receiver is connected to the Control Shelf through the **SECOND RCVR** input.

INTERCOM AUDIO - When an audio signal is being received from the receiver or from the line, the Control Shelf outputs a 325 millivolt rms audio signal. If an on-frequency signal is present (**CAS** ≥ 9.3 V), and the receiver is not muted (**RX 1 MUTE** = open collector), de-emphasized audio with no CG present is routed to the output.

If the receiver is muted, the local microphone not keyed, and no RF signal, "**Secur-it**" tone or function tone is present, compressed audio received from the line is routed to the **INTERCOM AUDIO** output.

GETC INTERFACE

The GETC and the MASTR IIe control shelf communicate through digital input and output signals.

The GETC sends the following signals to the MASTR IIe control shelf:

COMB PTT IN - Currently not used.

TX CG EN - used in Voiceguard end-to-end applications.

DELAYED PTT IN - Keys the transmitter when activated by the GETC. (Not used in Voiceguard applications.)

RUS IN - Keys the repeater when activated by the GETC. (Not used in Voiceguard or simulcast applications.)

1950 DIS - used in Voiceguard applications.

DETECT DIS - Currently not used.

REPEAT PTT IN - used in Voiceguard and back-to-back repeater applications.

VG SQ DSBL - used in Voiceguard encrypt/decrypt applications.

The MASTR IIe control shelf sends the following signals to the GETC:

REPEAT PTT OUT - Signals to the GETC when RUS is present and the MASTR IIe repeater is enabled.

VG PTT OUT - Used in Voiceguard encrypt/ decrypt applications.

CG MON - Signals to the GETC when the MASTR IIe is operating in channel guard monitor. (Not activated by switch.)

REMOTE PTT OUT - Signals to the GETC when the MASTR IIe is detecting "HOLD" tone or "HOLD" current.

COMB PTT OUT - Signals to the GETC when the station is keyed by any PTT except for MORSE CODE.

RX1 MUTE - Mutes the main receiver except when main receiver is required.

STATION POWER SUPPLY

Power Supply Inputs

13.8 VDC (A+) - The station power supply generates a +13.8 Vdc ±10% input rated at three amperes. The Control Shelf obtains all required voltages from this input. The station may also be powered by an external 13.8 Vdc source.

GND - The ground return is to the station power supply.

Power Supply Module Outputs

+10V RX - Supplies +10 Volts dc ± 0.3 Vdc at up to 500 milliamperes. The primary load is the station receiver.

+10V TX - Supplies a closely-regulated +10 volts dc ±0.3 volt at up to 500 milliamperes. The primary load is the station transmitter.

+12V VDC - Supplies a +12 Vdc ± 0.6 Vdc output rated at 100 milliamperes.

+5 VDC - Supplies a +5 Vdc ± 0.25 Vdc output rated at 1000 milliamperes.

-12 VDC - Supplies a -12 Vdc ± 0.6 Vdc output at 100 milliamperes.

-5 VDC - Supplies a -5 Vdc ± 0.25 Vdc output rated at 40 milliamperes for Control Shelf operation only.

+5VDC - Supplies a +5 Vdc ± 0.25 Vdc output rated at 40 milliamperes for analog circuitry.

CONTROLS AND INDICATORS

Controls

TX DISABLE - Activating this switch disables the transmitter by turning off the **TX OSC CONTROL** output, and de-energizing the antenna relay. When the transmitter is disabled, the station operates in the intercom mode.

REMOTE PTT - Activating this switch causes the station to react as though a PTT command has been received from a remote.

CG MONITOR - This switch selects the station Channel Guard Monitor function. When activated, all CG requirements on the receiver portion of the station are removed. This means all received transmissions will be heard regardless of their CG contents. However, the transmitter still requires the proper CG be present before it will repeat the audio.

When the CG Monitor function is not activated, the receiver requires the proper CG be present prior to unmuting. The transmitter requires the proper CG be present prior to repeating any transmission.

Indicators

TX - This LED indicates the transmitter is on.

CG MONITOR - This LED indicates the station is in the **CG MONITOR** mode.

TX DISABLE - This LED indicates the Control Shelf is in the **TX DISABLE** mode, and cannot initiate a transmission.

Local MIC Interface

LOCAL PTT - A low (1 volt or less) on this input indicates the local microphone is keyed. The Control Shelf establishes an audio path from the **LOCAL MIC HI** input to the **LINE** and **TX AUDIO** outputs. The Control Shelf also activates the transmitter oscillator and energizes the antenna relay if the transmitter has not been disabled by the **TX DISABLE** switch.

Normally, **LOCAL PTT** is the highest priority PTT function. Local PTT will preempt all other PTT functions including REPEAT and REMOTE PTT, and will continue to transmit on the currently selected frequency.

LOCAL MIC HI - This input line is DC biased at +12 Vdc by the station Control Shelf to supply power to the microphone. The microphone AC couples 100 millivolt rms audio into the Control Shelf 600 ohm input impedance through this line.

LOCAL MIC LO - This is the AC reference for the **LOCAL MIC HI** audio. It is grounded in the Station Control Shelf.

GND - This is the ground supply to the microphone.

Line

LINE - Audio is transmitted on this output pair. Audio is also received on this line pair if the Control Shelf is configured for two wire audio. The Control Shelf has an output impedance of 600 ohms, and can drive a 600-ohm line with an adjustable signal level from -19 to 7 dBm.

DUPLEX AUDIO - Audio is received on this wire pair in a four wire system.

SECOND RCVR - This is an audio input from an Auxiliary Receiver. Audio is present on this input when the Auxiliary Receiver has a valid signal and is not muted by the Control Shelf **RX 2 MUTE** output.

Programming/Diagnostics Serial Port

The programming/diagnostics RS-232 serial port is a multi-purpose port that is used to communicate with a personality programmer, automated test equipment and other system components. When the Utility Handset is connected to the auxiliary backplane, the Control Shelf must be reset while depressing a volume button. This provides communication from handset to shelf. The handset uses 300 baud data and the PC programmer uses 9600 baud data.

PGM TXD - The Control Shelf transmits 300- or 9600-baud RS-232 data on this line. When the Utility Handset is connected to the auxiliary backplane board, the Control Shelf must be reset to perform the autobaud function.

PGM RXD - The Control Shelf receives 300 or 9600 baud RS-232 data on this line.

Miscellaneous Interfaces

ANT RELAY - A low (< 1.0 Vdc) on this output line causes the antenna relay to energize before transmitting. A high (> 13.0 Vdc) on this output line de-energizes the antenna relay.

The TX LED follows the logic of this output. The **TX OSC CONTROL** output will not be activated until the **ANT RELAY** output has energized the antenna relay for at least 15 milliseconds. This delay allows the antenna relay to energize before applying RF.

BATT STBY - A high on this input indicates the station AC power supply is powering the station. A low on this input indicates that the battery backup system is supplying power to the station, and that power should be conserved.

When the transmitter is energized and operating from the battery backup system, the Control Shelf provides an alert tone in the **TX AUD** output signal. The alert tone is also heard at the remote control unit.

CIRCUIT ANALYSIS

The basic Control Shelf consists of a frame assembly and the following circuit boards or modules:

- Backplane Board 19D902459G1
- Power Module 19D902589G1
- System Module 19D902590G1 (DC control), or 19D902590G2 (tone control). System Module 19D902590G1 consists of a 19D902590G1 module with DSP board 19D902667G1.
- Optional Auxiliary Backplane board 19D902978G1 is also available.

A simplified block diagram of the Control Shelf is shown in Figure 6.

Refer to the individual Maintenance Manuals for the Power Module, System Module and Auxiliary Backplane Board for details.

BACKPLANE BOARD

The Backplane Board mounts on the back of the Control Shelf assembly, and provides slotted 96-pin DIN connectors P1, P2 and P3 for the plug-in modules. It is recommended that the System Module be installed in P1, the Power Module in P2, and an auxiliary backplane, if present, be installed in P3. Refer to the Interconnection Diagram for system connections (see Table of Contents).

NOTE

The 96-pin DIN connectors on the Backplane and Auxiliary Backplane Boards are pressed (not soldered) into the boards. Removal and/or replacement of these connectors is not recommended as damage may occur.

All signals to and from the Power Module, System Module, and other station modules are routed through the Backplane Board. The board also detects the DC control currents when installed in a DC remote-controlled system. The +10-Volt regulators for the Transmitter and Receiver and the drivers for the receiver ICOM select lines are located on the Backplane Board as well.

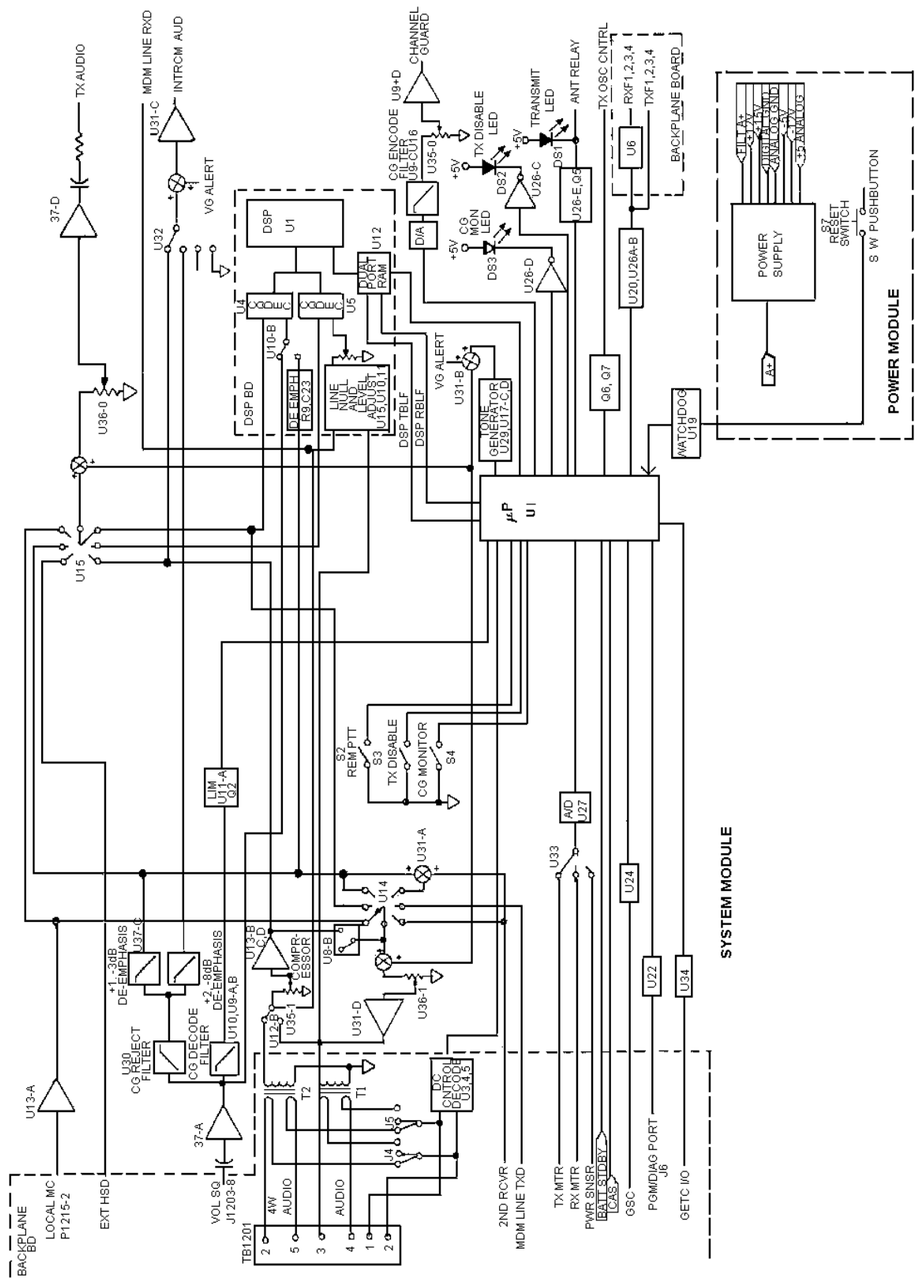


Figure 6 - Control Shelf Block Diagram

All system interconnections are made through the Backplane Board. Jacks J1201, J1202, J1203, and J1204 connect to the station harness, and are required for all installations. Diodes D13 and D14 on the antenna relay connection of J1201 (ANT RLY) protect the driver circuitry on the System Module from inductive spikes.

J1214 is also located on the backplane for connection to the station harness. This jack is required for metering and four frequency operation. It can also be used in other applications. P1215 is the local microphone connector.

Service Note: The pinout for four-frequency operation has been slightly modified (RXF3 has been moved to J1214-pin 5). Care should be taken when installing the backplane in the field. For field installation instructions, refer to the APPENDIX as listed in the Table of Contents.

An RS232 serial interface is included on the Control Shelf for programming and diagnostics, and can be accessed from the DB9 connector, J6, on the Backplane Board.

DC Control and Audio Inputs

There are three methods of applying control current to the Backplane Board through terminal block TB1201. The three methods are:

1. For separate control and audio pairs, the control current must enter the current detection circuitry directly. This is done by connecting the control pair to terminals TB1201-1 and -6. When in this configuration, the jumpers at J4 and J5 must be removed.

2. For a single wire pair used for both control and audio, the pair is connected to TB1201-3 and -4. With this configuration, the control current goes through the primary winding of line coupling transformer T1 where it is blocked by capacitor C1. The current is then applied to J5, where a jumper routes the current from pin 1 to pin 2. The output at pin 2 is applied to the current detection circuitry.

   The return path for the control current is through J4-2 where it is routed by a jumper to pin 3. It is then coupled through a portion of T1 and applied to TB1201-4.

3. For a 4-wire audio system, the control current can also enter TB1201-2 and -5. In this type of installation, the control current is coupled through the primary of T2 where it is blocked by C2. The control current is then routed through the current detection circuitry by connecting jumpers from J5-3 to J5-2, and from J4-2 to J4-1.

The Control Shelf utilizes DC currents selectively applied to a telephone pair at a remote control console. A remote control unit can apply up to six current levels to the line: ±6 milliamperes, ±11 milliamperes -2.5 milliamperes and 0 (zero) milliamperes. The currents are decoded by the Backplane Board to provide the **DC CTRL 1**, **DC CTRL 2** and **DC CTRL 3** outputs that activate the control circuits in the Control Shelf. A truth table of the decoding method is shown in Table 3.

Table 3 - Decoding Truth Table

CONTROL CURRENT (mA)	DC CTRL 1	DC CTRL 2	DC CTRL 3
0	High	High	High
-11	Low	Low	Low
+11	Low	Low	High
-2.5	High	High	Low
-6	High	Low	Low
+6	High	Low	High

Bridge Rectifier

When a DC control current is applied to the control pair, the full-wave diode bridge consisting of D1, D2, D3, and D6 directs the positive and negative line currents to the current detectors. Optoisolator U3 serves as a negative current detector, and is also a part of the diode bridge.

Negative Current Detect

A negative current applied to the line is coupled to the Control Shelf through TB1201-6. The current flow is blocked by D1, forward biasing the diode in optocoupler U3, turning it on. Turning on U3 causes the voltage on Pin 5 (collector) to go low, causing **DC CTRL 3** to go low (see Table 1).

The current then coupled through D6 where it is blocked by D3 and applied to the 6- and 11-milliampere current detection circuits (Q1, Q2, U4 and U5). The negative current returns from the current detection circuit through D2, and then out at TB1201-1.

A positive current applied to TB1201-1 is blocked by D2, and is coupled through D3. There it is then blocked by D6, and then applied to the current detection circuitry. Since D6 is reverse biased, optoisolator U3 does not conduct, keeping **DC CTRL 3** high. The return current is coupled through D1 to TB1201-6.

NOTE

A low (0) is considered to be 0.8 volts or less. A high (1) is considered to be 3.5 volts or more.

6- and 11-mA Detect

The 6 mA Detect circuit consists of 6.8 volt zener diode D2, transistor Q2 and opto-coupler U5. The 11-mA detect circuit consists of 15-volt zener diode D1, transistor Q1 and opto-coupler U1.

Control current enters the 6-milliampere and 11-milliampere current detection circuitry through the diode bridge. It then develops a voltage across 3K-ohm parallel resistors R5, R6, R17, and R18.

As the current approaches 6 milliamperes, the voltage across this 3K-ohm load rises above 6.8 volts, and zener diode D4 begins limiting. This causes the voltage at the emitter of Q2 to exceed the voltage at its base, turning the transistor off. The control current is then routed through U5 instead of Q2. This causes U5 to turn on, and the voltage at **DC CTRL 2** to go low.

As the control current continues to increase and approach 11 milliamperes, zener D5 begins to limit. This causes the emitter voltage of Q1 to exceed its base voltage, turning Q1 off. U4 then turns on and **DC CTRL 1** goes low. Debouncing and squelch tail elimination caused by control currents ramping up or down through valid control current detection levels is performed in software.

10-Volt Regulators

Transmitter and receiver +10-volt regulators U1 and U2 are also located on the Backplane Board. Each regulator is powered by the +13.8 volts (A+) from the station power supply. Low drop-out regulators are used to provide reliable output during battery standby operation. U1 and U2 typically provide regulation for voltages as low as 10.8 volts dc, and can source approximately 500 milliamperes each.

Capacitors C3, C4 and C7 provide filtering for U1. Capacitors C5, C6 and C8 provide filtering for U2. Diodes D7 and D8 are surge protectors.

Receiver Frequency Drivers

IC U6 provides four frequency select drivers for the receiver frequency. These open collector drivers are used only to select the appropriate receiver frequency. If other logic circuits require one of the receiver frequency select signals as an input, that logic circuit should be driven directly by the select outputs of the System Module, and not by U6.

The ground supply for U6 is taken directly from the receiver ground. This prevents noise getting into the frequency select signals and adversely affecting receiver performance. Care should be taken in the field to maintain the integrity of this configuration.

The System Module outputs open collector receiver frequency select lines which are pulled up to +5V by resistors R19 through R22. These outputs are applied to the positive node input of the quad comparator IC U6. The negative node inputs of U6 are biased by the resistor divider network R23 and R24.

When the system module pulls a receiver frequency select line low, the positive node input of the comparator is forced to ground and the negative node terminal of the comparator remains at +2.5V. This causes the output of the comparator to go to receiver ground. When the system module outputs an open on its receiver frequency select line, the output is pulled up to +5V. The +5V on the positive node and the +2.5V on the negative node of the comparator causes the output of the comparator to go to an open.

E & M Signaling

In 24-volt E & M signaling applications, 24 volts is applied at TB1201-1 and -6. This results in approximately 8 milliamperes flowing through the 3k-ohm load presented by the current detection circuitry. The current detection circuitry then detects 6 milliamperes.

When 48-volt signaling is used, resistors R100 and R101 must be clipped out. This increases the load to 6k-ohms, and the current detection circuitry then detects the 6 milliamperes when 48 volts is applied.

Lightning Protection

Lightning protection for the Control Shelf is provided by surge protectors SG1, SG2, SG3, SG4, SG5, and SG6. When a voltage spike enters on any pin of TB1201, the resistance of these devices decreases, shorting the spike to earth ground through the chassis. Secondary spike protection is provided by zener diodes D9, D10, D11, and D12. These devices limit the instantaneous voltage on the secondary of T1 or T2 to 6.8 volts.

TELEPHONE LINE CHARACTERISTICS

This section covers the characteristics of **"telephone lines"** that are commonly used between remote control units and remotely-controlled base stations. While specifically directed to systems that use tone signaling, it is also helpful in connection with systems that use direct current (dc) signaling.

Characteristics of these **"voice grade"** lines and their application to Land Mobile communications systems will be covered. This section refers to frequency response only as it affects tone signaling. It does not cover total audio frequency response as related to audio quality.

In some cases, the radio user will provide wires within his building or his complex of buildings. In these cases he will have much more freedom in the levels that he can use. Normally these are short lines that involve very little loss.

TYPES OF VOICE GRADE LINES

These lines are normally obtained from a communications common carrier (**"phone company"** for our purposes here). When a voice grade (as contrasted to a **"data line"**) telephone line is requested, there is no way of knowing just what type of line will be received from the phone company.

In addition, the telephone company may supply one type of line first, and later change it to another type without any notification to the user. One of the following types of telephone line can be expected:

1. Wire lines with no amplifiers
2. Wire lines with amplifiers added to compensate for line loss
3. Facilities derived from carrier (multiplex)

These lines have different operating characteristics, and each must be treated differently. In large systems, all three types of lines can be provided. In long haul applications, a system can consist of two or three of these types of lines in tandem (tied together end-to-end).

The first type is **WIRE LINE WITH NO AMPLIFIERS**. These are the same lines that have been used for years to control DC systems. These are the easiest to work with since they include no problem-causing electronic equipment. These are usable on tone systems, but cannot be used satisfactorily in DC control applications. These lines are normally found in less populated areas where the phone company has not yet switched to carrier systems.

These lines have a fixed amount of loss which varies with frequency, temperature, from deterioration of splices, and from moisture getting into the cables. When these cables get old, the phone company sometimes applies DC current to improve the joints and lower the line loss.

Normally, a +10 dBm test tone can be applied to these lines. These lines do not normally include any type of voice limiters.

The second type of line is a **WIRE LINE WITH AMPLIFIERS**. These lines are normally supplied when the loss of available lines is too high. An amplifier or several amplifiers are added to the line to make up for the loss.

One commonly used amplifier is the E-6 repeater. This amplifier will pass DC current and they have been used on dc lines for years. These amplifiers include limiters which start limiting at somewhere around 0 dBm input to the amplifier. The limiters do not cause any real problems on DC systems since only the voice peaks are clipped. However, special care must be used when applying them to tone remote control systems.

Each amplifier can be adjusted for up to 12 dB of gain. If the loss the phones company is making up is more than 12 dB, one or more amplifiers are added. The amplifier(s) can be placed at any point in the line.

The third type of telephone line is a **Derived Facility** using carrier equipment. Since this is the most complicated, more care is required when connecting radio equipment. This type of line will be available more often in the future.

The phone company supplies two wires at each end of the circuit. Each two-wire end goes to some point in the circuit where it is converted to a four-wire circuit and then connected to the carrier equipment. A four-wire circuit can be ordered if that is what is required. At the other end, it is taken out of the carrier equipment and converted back to the two-wire circuit. The carrier equipment has a transmit path and a receive path. The gain is adjustable each way.

The phone company wants to see a maximum three-second level of -13 dBm at the carrier equipment as measured on a modified Western Electric 3-type noise measuring set. The telephone equipment will limit the audio if the signal is above -13 dBm at the carrier input. This does not mean that the maximum that can be applied into the two wire end is -13 dBm.

If the radio equipment is a good distance from the carrier equipment, there will be some line loss. If the loss is 5 dB, for instance, then -8 dBm could be applied into the two wire end. Therefore, the phone company will have to be asked in each case what level is allowed to be applied at the two-wire end.

If the phone company checks and finds that too much audio is being applied into the carrier equipment, they will put a pad into the circuit to cut the audio down.

When the phone company is asked what levels can be applied to the line, they will either provide a level in **V**olume **U**nits (**VU**) or test tone. **VU** is average voice which is generally considered to be 10 dB below test tone. Test tone is a 1000 or 1004-Hz tone used to line up the circuit. Test tone is normally given in dBm. If the radio installer isn't careful, he and the phone company will be talking 10 dB apart. If the phone company says the limit is 0 VU, use +10 dBm for the lineup.

The two wire ends of these lines are normally designed to work with a 600-ohms impedance in and out. The transmit and receive carrier equipment gains are set up for 600 ohm terminations. If the line to the carrier equipment is fairly long, the impedance at which at the two-wire end is not very critical.

If the two-wire end is close to the carrier equipment, however, then the impedance is critical. If the impedance is not 600 ohms, it can cause the gain of the carrier equipment to go up or down. In some cases, feedback (oscillations) from the receive path to the transmit path will be present. A common problem which causes oscillations in the carrier equipment is gain change, whether from misalignment or other reasons.

American Telephone and Telegraph Company has published a reference for Voice Grade Lines entitled, **"Private Line Interconnections, Voice Applications"** (Publication Number 43201). It covers several types of private line interfaces. There is no publication that covers radio control alone. However, there are several parameters provided in the publication that are important to note.

The 1000-Hz loss design objective is 0 to 10 dB. If the loss is not specified, there will be a loss of 10 dB at 1000 Hz in most cases. The phone company allows itself a **SHORT-TERM** fluctuation of ± 3 dB and a **LONG-TERM** variation of ± 4 dB. If a 10 dB loss line at 1000 Hz is specified, up to 14-dB loss can be expected, and the phone company would still be within their design limits.

The loss between 500 and 2500 Hz can be +2 dB and -8 dB relative to 1000-Hz loss. Note that the phone man may refer to this as -2 and +8 in the telephone company way of talking. The loss between 300 and 3000 Hz can be +3 dB to -12 dB relative to the 1000 Hz loss. This says that if there is a line with 10 dB of loss at 1000 Hz, a loss of as much as 18 dB at 2500 Hz, and 22 dB of loss at 3000 Hz can be expected. A loss ± 4 dB of long-term variation should be added to this.

Noise on this type of line is measured at each end with a Western Electric 3-type noise meter. The allowable level of a line from 0 to 50 miles is 31 dBrnC, and for a line from 51 to 100 miles is 34 dBrnC. If this type meter is not available, an AC- VTVM can be used. If there is a noise reading of -50 dBm or less, generally this is considered an acceptable circuit.

TONE REMOTE CONTROL SYSTEMS

In contrast with dc systems, where audio level setting was not as critical, it is important that levels in tone applications be set properly. Failure to do so results in the control function not working properly. For example, after the installation when the user has gained a little experience, the user may find that they are not always picking up the function selected. A little extra time spent at the installation will save many problems of this type later.

This equipment is designed so that the tone sequence consists of either two or three parts. The first part is the **"Secur-it"** tone (2175 Hz) which is sent at the highest level for approximately 125 milliseconds. This is followed by the function tone which is sent at a level 10 dB lower for approximately 40 MS. In the case of a transmit function, the function tone if followed by 2175 Hz at a level 30 dB down from the **"Secur-it"** burst (therefore, it is 20 dB down from the function tone burst). This tone continues for the duration of the transmit function. The average voice (0 VU) is sent at the same level as the function tone, therefore, the test tone for the voice is sent at the same level as the **"Secur-it"** tone.

"Secur-it" tone must arrive at the base station at no less than -20 dBm. The transmit hold tone must arrive at the base station at no less than -50 dBm. The test tone for the voice must arrive at the base station at no less than -20 dBm. Therefore, the limits of system operation are usually established by only three things:

1. The maximum level at 2175 Hz that the phone company will allow to be sent from the most distant point in the system. Normally this will not be higher than 0 dBm. In some cases it can even be less, or on rare occasions it can be +5 or +10 dBm.
2. The loss of the circuit at 2175 Hz. Do not forget the long-term variation of up to 4 dB more.
3. The requirement that the **"Secur-it"** burst must arrive at the base station at no less than -20 dBm.

Normally, most systems will not crowd these limits. However, if the result is a few dB short, consider adding C-1 conditioning (at an added cost). Resist the natural desire to just turn up the tone sending level as this will cause improper system operation.

Increasing the level will cause the **"Secur-it"** tone burst to go into limiting in the phone company equipment. The limited tone causes the **"Secur-it"** tone filter in the base station to ring. This will result in picking up or dropping out functions which were not selected. **NEVER** allow the **"Secur-it"** tone to be in limiting.

There is an easy way to check and see if the **"Secur-it"** tone is in limiting. With the phone lines connected to the equipment at both ends connect an AC voltmeter across the phone line at the base station. Arrange to send a burst of **"Secur-it"** tone long enough to measure the incoming level on the AC voltmeter. Then arrange to send a burst of 1950 Hz function tone long enough to measure the incoming level on the AC voltmeter. If the 1950 Hz tone does not arrive 10 dB (± 1 dB) less than the **"Secur-it"** tone, then the **"Secur-it"** tone is in limiting. It will become necessary to lower the sending level at the remote controller until it is below limiting.

If the audio is high enough to cause the telephone equipment to go into limiting, it will cause amplitude distortion. On a high loss line the amplitude distortion will cause the **HOLD** tone (2175 Hz) to vary and the transmitter to drop out. This can be checked by monitoring the test point specified. If the level is below the amount indicated the transmitter will unkey from time to time.

On tone controlled remote controlled systems, care must be used when connecting two telephone lines in tandem. For example for a base station and two remotes, a phone line is ordered to connect the station to the first remote, and a second line to connect the second remote to the first remote. The loss of each line is now added together and the tones from the second remote can not operate the base station. The installer can either specify a low loss on each line, or run each line directly to the base station.

A check with the phone company can determine which approach is the least expensive over a period of time; i. e., an analysis of non-recurring costs versus recurring costs over the expected length of time the circuit will be used.

VOTING SYSTEM CONSIDERATIONS

A voting system uses a continuous 1950 Hz tone on the telephone line when the receiver is squelched. This voting tone is normally sent from the station to the voting selector 3 dB lower than the 1000 Hz test tone level. Most telephone lines have a frequency response which attenuates the 1950 Hz tone with respect to a 1000 Hz test tone, therefore care should be taken to ensure that the correct levels are received at the voting selector.

If the phone company will not allow a continuous tone as high as -8 dBm to be sent, then a lower loss circuit should be requested or C-1 conditioning added.

When ordering phone lines for a voting system, if possible, all lines should be of the same type. Different phone line responses will cause the voter to prefer one signal over others.

It is improper system design to have the received signal selection biased by a **"poorer"** telephone circuit. Many phone companies will add pads to build out the lines. If this is considered when the lines are ordered, it should not be difficult to build all of the lines out to have the same frequency response.

ORDERING VOICE GRADE PHONE LINES

If a standard voice grade circuit is ordered, and the loss is not specified, the following will normally result:

1. Loss at 1000 Hz will be 5 to 10 dB; normally 10 dB
2. Long-term variation ± 4 dB
3. Amplitude distortion (frequency response)
   Referenced to 1000 Hz; + = more loss
   300 to 3000 Hz: -3 to +12 dB
   500 to 2500 Hz: -2 to + 8 dB
4. Noise: 31 dBrnC maximum
5. Frequency translation error: ± 5 Hz
6. Normal impedance: 600 ohms
7. Maximum permitted signal into the line:
   -6 dBm to -13 dBm in-band three second average (the level arriving at the carrier equipment cannot be more than -13 dBm)

   By adding C-1 conditioning, the loss changes to:
   Amplitude distortion (frequency response)
   Referenced to 1000 Hz; + = more loss
   300 to 2700 Hz: -2 to +6 dB
   1000 to 2400 Hz: -1 to +3 dB

   One added advantage to C-1 conditioning is that the voice quality will be improved by boosting the high frequency components.

PHONE COMPANY ORDERING INFORMATION

When ordering a telephone line, the following must be considered:

1. Type of circuit:
   Voice grade, 2-wire termination, for radio control, and tone remote system - send/ receive; voting system - receive only.
2. DC continuity not required
3. Impedance: 600 ohms 20%
4. Line Loss:
   Tone remote system:
   Sends 125 MS of 2175 Hz tone, and it must arrive at the base station at no less than -20 dBm including long-term variation. Average voice is 10 dB below the 2175 Hz tone burst.

   Voting system:
   Sends a continuous 1950 Hz tone when the receiver is squelched, and it must arrive at the voting selector at no less than -30 dBm including the long-term variation.
5. C-1 conditioning if necessary. (If two phone lines are to be tied in tandem, it is usually proper to specify C-1 conditioning.
6. If more than one phone line is to be used, a block diagram showing locations and type of equipment to be used should be provided the telephone company.

INSTALLATION

If the Control Shelf panel is not purchased as a part of a station combination, it will be necessary to install it in the station frame using Control Shelf Installation Instructions contained in the APPENDIX to this Manual. Installation hardware is contained in Hardware Kit 19A149326G7. Refer to the Mechanical Layout Diagram 19D417483 included in the appendix of this manual for installation of the Hardware Kit (see Table of Contents).

CAUTION

Minor harness modifications may be required when field installing a control shelf with the 19C320811G16 harness. Refer to the notes located on the Interconnection Diagram before installing (see Table of Contents).

TWO-WIRE OPERATION

For two-wire operation, connect the pair to TB1201-3 and -4. If the remote control unit at the other end is an RCN1000, use J3-3 (red) and -4 (green). Refer to Methods 1 and 2 in Table 4 for examples.

NOTE

Polarity must be maintained if the metallic control pair is being used for DC control.

FOUR-WIRE OPERATION

For examples, refer to Methods 3 and 4 in Table 2, and the associated illustrations showing the different methods.

E & M SIGNALING

E & M lead signaling systems derive their name from certain historical designations of the signaling leads on circuit drawings. An "**M**" lead is associated with the trans**M**it function while the "**E**" lead is associated with the rec**E**ive function. In two-way radio systems with remote control, E & M Signaling can be the only type of supervision offered by the available carrier circuits.

Generally, both 4-Wire Audio and E & M Signaling options are used to interface between the radio and carrier systems. However, 2-Wire Audio can be used in the two-way radio portion of the control system if hybrids are installed to provide transition between the 2-Wire and 4-Wire connections. Usually the E & M Signaling is separated from the audio (separate line) in both 2-Wire and 4-Wire installations.

Figure 7 illustrates a typical interface between a two-way radio system and a multiplex/microwave system. The Remote Control Console and Base Station are equipped with the E & M Signaling Option and the 4-Wire Audio Option. The console provides a regulated -48 Vdc output (or -24 Vdc with minor modifications) to the "**M**" lead when the **TRANSMIT** switch is pressed. This -48 Vdc activates a tone encoder (usually 3825 Hz) in the multiplex rack. The tone encoder modulates the carrier frequency which is transmitted over the microwave link.

At the station end of the microwave link, the signal is demodulated and the 3825-Hz tone operates a tone decoder in the multiplex rack. The output of the decoder results in a contact closure which applies +48 Vdc (or +24 Vdc) to the control shelf. This voltage should be connected between J1201-1 and J1201-6 on the backplane board. Jumpers on J4 and J5 of the backplane board should also be removed. If +48Vdc is being used, resistors R100 and R101 on the backplane board should also be removed.

When the system is configured in this manner, approximately +8 milliamperes flows through the DC control decode circuitry on the backplane. This will cause the control shelf to decode a +6mA control current to key the transmitter and route line audio to the transmitter.

TONE REMOTE INSTALLATION

Jumpers P4 and P5 located on the backplane board are not required and may be removed. Refer to the sections on TELEPHONE LINE CHARACTERISTICS and LEVEL ADJUSTMENTS for additional installation information. Line connections are made to TB1201 on the control shelf's backplane board.

Two Wire Tone Remote

When the control shelf is used with a two wire tone remote/console, the audio pair should be connected to TB1201-3 and TB1201-4.

Four Wire Tone Remote

When the control shelf is used with a four wire tone remote/console, the remote control transmit pair (which modulates the transmitter) should be connected to TB1201-2 and -5. The remote control receive pair (which listens to the receiver) should be connected to TB1201-3 and -4.

CSI MODEL 32 COMMUNITY REPEATER PANEL

1) Make the following connections between the base station and the repeater panel. P3 is located on the Control Shelf Backplane 19D902459G1, and the connections to the repeater panel are located at the DB9 subminature "D" type connector at the rear of the unit.

RADIO END	SIGNAL NAME/(FUNCTION)	CSI END
P3-C21	A+/(DC Power	1
P3-B13,C13	GND/(Power Ground)	7,8
P3-C20	LocalPTT/(Service MIC PTT)	5
P3-B20	CAS/(Carrier Activated Squelch)	6
P3-A3	MICHI/(Service MIC Audio)	2
P3-B6	CGHI/(CTCSS Encode)	9
P3-B2	VOL/SQHI/(Demodulated Audio)	3

2) Program the base station to be used with an external repeater panel using standard PC-programming software. For proper operation, the station firmware must be 344A3307G11 (Group 11) or higher. Program the following paramters:

   A) No Repeat
   B) RF Duplex
   C) No CG Encode/Decode
   D) No CCT or DODT Timers
   E) Remote control is optional

3) Adjust the repeat RF modulation and subaudible tone (CG) modulation by adjusting the manual potentiometers on the repeater panel and/or by adjusting the station digital pots. Adjust the CG pot for subaudible tone modulation level and the TX audio pot for nominal speech modulation levels.

ZETRON MODEL 38 COMMUNITY REPEATER PANEL

1. Make the following connections between the base station and the repeater panel. P3 is located on the Control Shelf Backplane 19D902459G1, and the connections to the repeater panel are located at the terminal strip at the rear of the unit.

RADIO END	SIGNAL NAME/(FUNCTION)	CSI END
P3-C21	A+/(DC Power	1
P3-B13,C13	GND/(Power Ground)	3,4
P3-C20	LocalPTT/(Service MIC PTT)	7
P3-B20	CAS/(CarrierA ctivated Squelch)	10
P3-A3	MICHI/(Service MIC Audio)	11
P3-B6	CGHI/(CTCSS Encode)	13
P3-B2	VOL/SQHI/(Demodulated Audio)	15

2) Program the base station to be used with an external repeater panel using standard PC-programming software. For proper operation, the station firmware must be 344A3307G11 (Group 11) or higher. Program the following parameters:

   A) No Repeat
   B) RF Duplex
   C) No CG Encode/Decode
   D) No CCT or DODT Timers
   E) Remote control is optional

3) Adjust the repeat RF modulation and CTCSS (CG) modulation by adjusting the manual potentiometers on the repeater panel and/or by adjusting the station digital pots. Adjust the CG pot for CTCSS modulation level and the TX audio pot for nominal speech modulation levels.

LEVEL ADJUSTMENTS

Before making adjustments to the control shelf, the station RF equipment should have been properly aligned.

NOTE

If a utility handset is used, its MIC is inactive. The utility handset MIC may be enabled by adding R11 on the Auxiliary Backplane Board 19D902978.

TEST EQUIPMENT REQUIRED:

- A PC programmer or option B3MB1B auxiliary backplane with a Utility Handset (19A705965P1) and cable (19D901619P2).
- Audio oscillator
- AC voltmeter
- RF signal generator
- Deviation monitor
- Extender board 19D903197G1

Refer to Figure 8 for a basic block diagram of audio routing. The pot number circled by each pot is the corresponding pot number on the utility handset. Refer to the troubleshooting section for additional information on level adjustments.

TYPICAL POT VALUES FOR MIIe SYSTEMS

The following information provides typical values for the pot settings when used in the indicated configurations. These values are typical and are provided as a guide. Actual values may be different for your system due to line characteristics, system configurations, etc.

Repeater:

Line Out Pot 1 (POT1-LO)=0.
Transmit Pot 2 (POT2-TX)=64.
Line In Pot 3 (POT3-LI)=0.
Channel Guard Pot 4 (POT4-CG)=0 (without CG encode), =69 (with CG encode).
DSP Cancellation Pot 5 (POT5-DC)=0.
DSP Line In Pot 6 (POT6-DI)=0.
DSP Compressor Pot 7 (POT7-CP)=0.

DC Remote/DC Remote-Repeat:

Line Out Pot 1 (POT1-LO)=67 (0 dBm at 3 kHz. RX dev. @ 1 kHz.), =21 (-10 dBm at 3 kHz. RX dev. @ 1 kHz.), =7 (-20 dBm at 3 kHz. RX dev. @ 1 kHz.).
Transmit Pot 2 (POT2-TX)=64.
Line In Pot 3 (POT3-LI)=46 (0 dBm high level input @ 1 kHz.), =143 (-10 dBm high level input @ 1 kHz.), =255 (-20 dBm high level input @ 1 kHz.).
Channel Guard Pot 4 (POT4-CG)=0 (without CG encode), =69 (with CG encode).
DSP Cancellation Pot 5 (POT5-DC)=0.
DSP Line In Pot 6 (POT6-DI)=0.
DSP Compressor Pot 7 (POT7-CP)=0.

Tone Remote/Tone Remote-Repeat:

Line Out Pot 1 (POT1-LO)=46 (2 wire; 0 dBm at 3 kHz. RX dev.), =14 (2 wire; -10 dBm at 3 kHz. RX dev.), =4 (2 wire; -20 dBm at 3 kHz. RX dev.), =67 (4 wire; 0 dBm at 3 kHz. RX dev.), =21 (4 wire; -10 dBm at 3 kHz. RX dev.), =7 (4 wire; -20 dBm at 3 kHz. RX dev.).
Transmit Pot 2 (POT2-TX)=64.
Line In Pot 3 (POT3-LI)=0.
Channel Guard Pot 4 (POT4-CG)=0 (without CG encode), =69 (with CG encode).
DSP Cancellation Pot 5 (POT5-DC)=0 (4 wire), =75 (2 wire).
DSP Line In Pot 6 (POT6-DI)=12 (0 dBm high level input @ 1 kHz.), =39 (-10 dBm high level input @ 1 kHz.), =121 (-20 dBm high level input @ 1 kHz.).
DSP Compressor Pot (POT7-CP)=1297.

EDACS (GETC interface):

Line Out Pot 1 (POT1-LO)=64 (0 dBm at 3 kHz. RX dev.), =21 (-10 dBm at 3 kHz. RX dev.), =7 (-20 dBm at 3 kHz. RX dev.),
Transmit Pot 2 (POT2-TX)=115.
Line In Pot 3 (POT3-LI)=0.
Channel Guard Pot 4 (POT4-CG)=0.
DSP Cancellation Pot 5 (POT5-DC)=0.
DSP Line In Pot 6 (POT6-DI)=12 (0 dBm high level input @ 1 kHz.), =39 (-10 dBm high level input @ 1 kHz.), =121 (-20 dBm high level input @ 1 kHz.),
DSP Compressor Gain Pot 7 (PT7-CP)=1240.
DSP Compressor Threshold Pot 2 (Page2, PT2-CT)=2657.

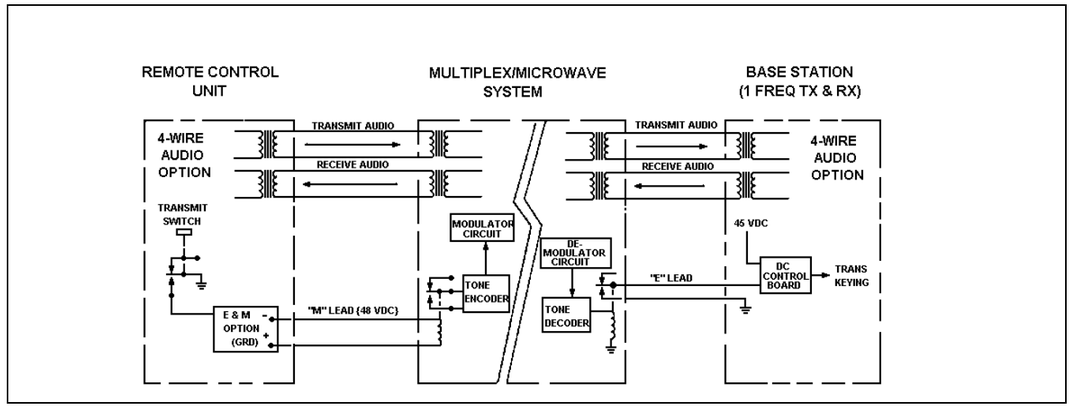
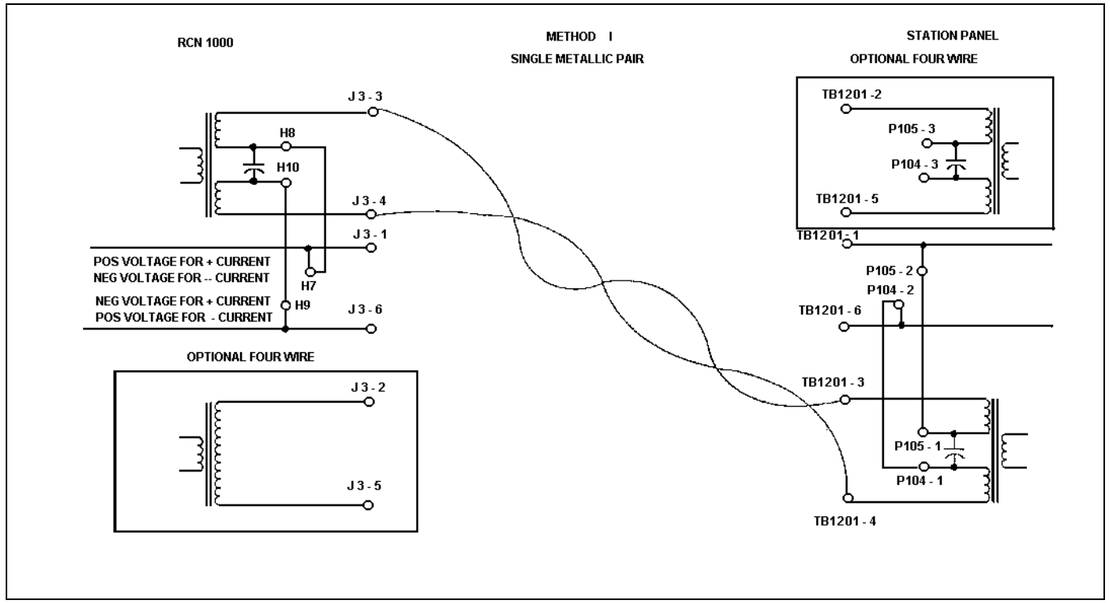


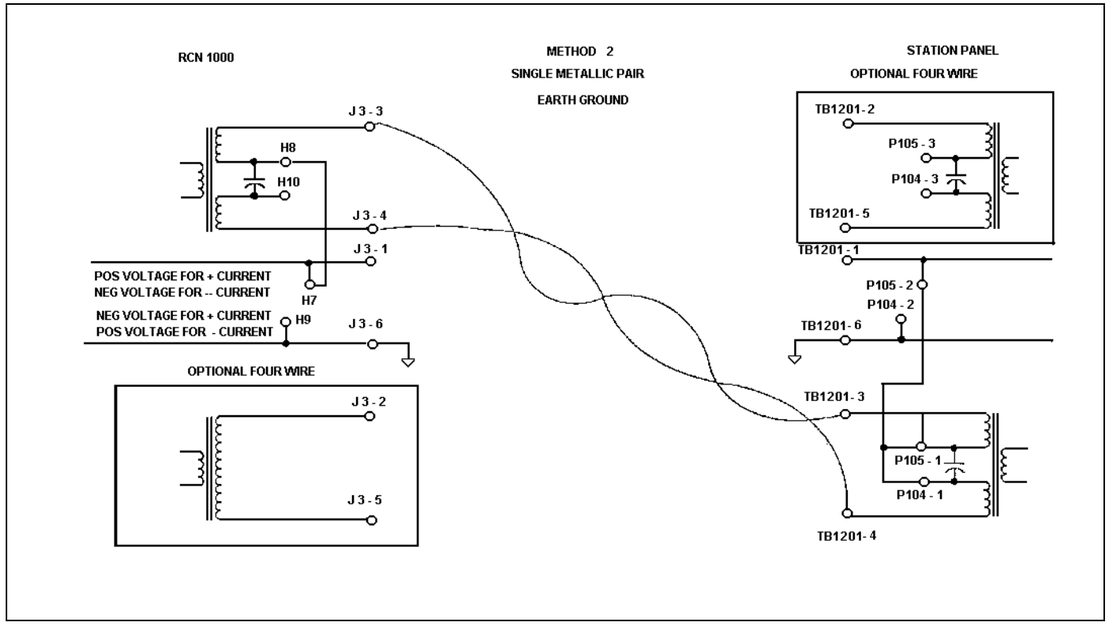
Figure 7 - Typical E & M Signaling Application

Table 4 - Wireline Installation Methods

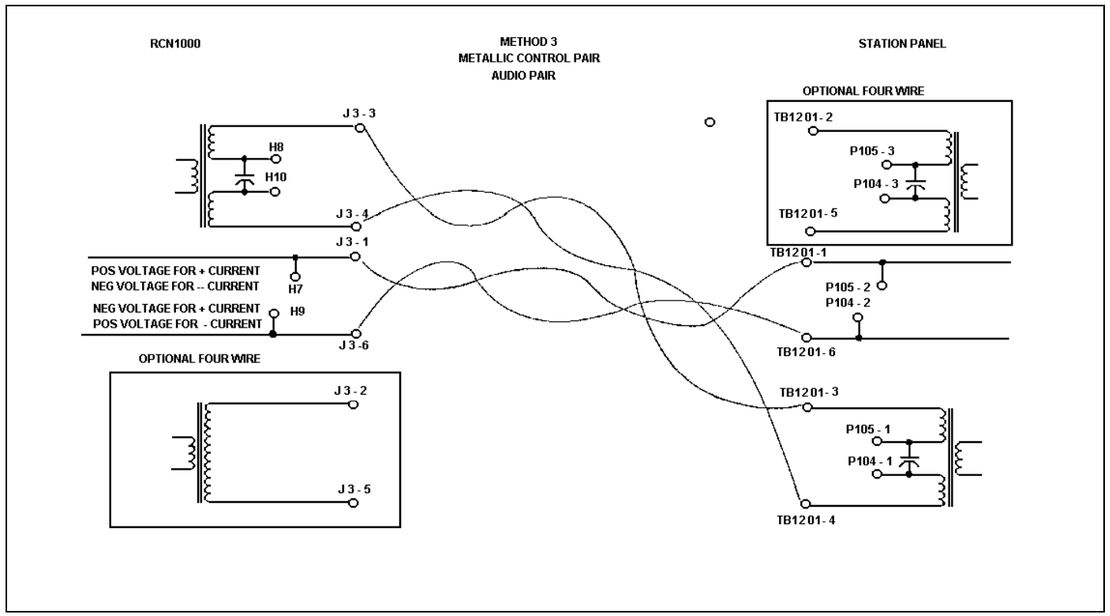
METHOD	DESCRIPTION	PROCEDURE	ADVANTAGES OR DISADVANTAGES
1	Single metallic pair (the control currents are simplexed to line, a two wire cable is required).	a. Connect the metallic pair to TB1201-3 and -4. b. Jumper J5-1 to J5-2, and J4-3 to J4-2 on the backplane Board.	Economical: dependable where earth ground currents may be large or good earth grounds cannot be obtained. The keying clicks will be heard on parallel remotes.
2*	Single metallic pari (the control currents are simplexed line to earth ground, a two wire cable is required).	a. Connect the metallic pair to TB1201-3 to 4. b. Jumper J5-2 to J4-3 on backplane board and connect TB1201-6 to earth ground.	Economical: minimizes keying clicks in paralleled remotes but large ground currents may result in interference with control function if located near sub-stations.
3	One voice grade circuit for bi-directional audio and the other a metallic pair for control voltages.	a. Connect audio pair to TB12101-3 and TB12201-4. b. Remove jumpers on J4 and J5 on backplane board. c. Connect control metallic pair to TB1201-1 and TB1201-6.	Provides excellent performance by eliminating keying clicks and providing no path for ground loop current, but requires two pair.
4	Single metallic pair for transmit audio and control currents. Single voice grade circuit for receive audio. A four wire line is required.	a. Connect the transmit metallic pair to TB1201-2 and 5 on backplane board. b. Connect a jumper from J4-1 to J4-2, and J5-3 to J5-2. c. Connect the remote receive pair to TB1202-3 and 4.	Provides full duplex operation in which the remote can operate in receive and transmit simultaneously. But requires two pair.



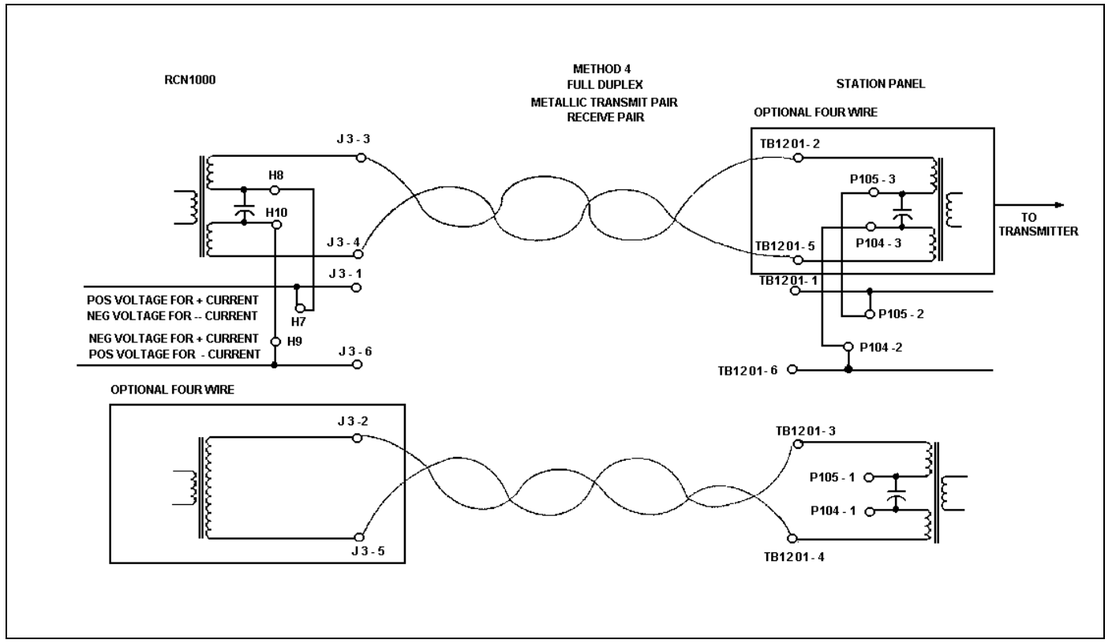
METHOD 1



METHOD 2



METHOD 3



METHOD 4

Table 5 - Potentiometer Settings

Potentio-meter	Description	Procedure
Line Out Pot 1	Adjusts the line out level.	Systems With Remote Normally set such that 3 kHz of usquelched receiver audio results in 0 dBm of line output audio.
		Repeater Only Set to zero.
Line In Pot 3	Adusts the gain on the line input. This pot is a gain in the linear region of the compressor. It determines the level of line input voltage which will lead to compression.	Systems With DC Remote Without DSP Compression Set so that nominal line input audio results in output audio which is at the “knee” of compression.
		Other Systems Set to zero because the line audio is either non-existent or is processed through a different, DSP board, path.
Tx Audio Pot 2	Adjusts the transmitter deviation.	Systems That Repeat Set such that 3 kHz of unsquelched receiver audio results in 3 kHz of transmitter audio.
		Other Systems Nominal audio must be sent into a fixed-gain input path like the local microphone. This pot is then used to set the desired nominal transmitter deviation.
DSP Line Cancellation Pot 5	Used only in two-wire remote systems. Cancels the control shelf’s line output audio from the line input audio (this is a hybrid adjustment).	Systems With Two-Wire Remote Using DSP Compressor* Before being subtracted from the contended two-wire line, the line output audio is attenuated according to this pot’s value.
		Other Systems Set to zero.
DSP Compressor Pot 7	Adjusts the gain on the DSP line input. This pot is a gain in the linear region of the DSP compressor. It determines the level of line input voltage which will lead to compression.	Systems With Remote Using DSP Compressor* Set so that nominal level 1 kHz line input audio results in 3 kHz of transmit audio.
		Other Systems Set to zero.
DSP Line In Pot 6	Adjusts the signal level entering the DSP. **NOMINAL SETTINGS**** MAX AUDIO IN / POT VALUES -20 dBm — approx. 121 -10 dBm — approx. 39 0 dBm — approx. 12	Systems With Remote Using DSP Compressor* Set so, under all operating conditions, the level does not overdrive the analog-to-digital converter on the DSP board (U5)
		Other Systems Set to zero.

* All tone remote and GETC systems use a DSP Compressor.
** Resolution is not as fine at lower end of pot. Therefore, a smaller range of "working" pot values exist with a high audio input line level.

Alignment Procedure for MIIe Base Station

Repeater, DC Remote, or DC Remote/Repeat Station

1. Key the transmitter by grounding LOCAL PTT (P1215-3).

For stations without Channel Guard, skip steps 2-4:

2. Do not apply any audio to the microphone inputs so that no audio modulation is obtained.

3. Adjust the Channel Guard deviation with the channel guard mod pot in the transmit exciter (refer to schematic for specific pot number). See Table 6 (b).

> **NOTE**
>
> Adjustment of the Channel Guard Output Level Pot (POT4-CG) may be required to get sufficient deviation.

4. Check Channel Guard deviation on each channel. The channel can be changed from the utility handset or the PC. Adjust the channel guard deviation of each channel using the Channel Guard Output Level Pot (POT4-CG) , if necessary.

5. Connect an RF Signal Generator to the receiver and input a 1 kHz tone at maximum sytem deviation. Set the transmit modulation pot to 255 (100%) and adjust the exciter modulation adjustment pot on the transmit exciter (refer to schematic for specific pot number as it may be called the voice level pot or the PA exciter pot in some applications) for maximum system deviation (this will include Channel Guard deviation, if it is being used). See Table 6 (a). Remember to disable Channel Guard decode, if necessary.

6. Set the RF Signal Generator to 60% of system deviation and adjust the Transmit Modulation Level Pot (POT2-TX) for 60% of system deviation. See Table 6 (d) or Table 6 (g) if operating with Channel Guard.

For DC Remote and DC Remote/Repeat stations, skip step 7.

7. If a Repeater only, adjust POT1, POT3, and POTS5-7 to zero. Unkey the transmitter by removing the ground on LOCAL PTT (P1215-3). This step ends the repeater only alignment.

8. Adjust the Line Output Pot (POT1-LO) for the desired telephone line system output level or 0 dBmW on TB1201-3 and -4. The line must be terminated with a 600 ohm load.

9. Unkey the transmitter by removing the ground on LOCAL PTT (P1215-3).

10. Connect the audio oscillator to the telephone line input TB1201-2 and -5 (TB1201-3 and -4 if a two wire system). The line must be terminated in 600 ohms. Key the transmitter by activating the REM PTT switch on the front panel. Adjust the audio oscillator to 1 kHz at the desired input level or -10 dBmW.

11. Adjust the Line Input Pot (POT3-LI) for 60% of system deviation. See Table 6 (d) or Table 6 (g) if operating with Channel Guard.

12. Unkey the transmitter by deactivating the REM PTT switch on the front panel and disconnect the audio oscillator.

DC Remote Station with DSP Compressor, Tone Remote, or Tone Remote/Repeat Station

> **NOTE**
>
> A 19D902590G3 system module is needed for these station configurations.

1. Set the Line Input Pot (POT3-LI) to zero.

2. Key the transmitter by grounding LOCAL PTT (P1215-3).

For stations without Channel Guard, skip steps 3-5:

3. Do not apply any audio to the microphone inputs so that no audio modulation is obtained.

4. Adjust the Channel Guard deviation with the Channel Guard mod pot in the transmit exciter (refer to schematic for specific pot number). See Table 6 (b).

> **NOTE**
>
> Adjustment of the Channel Guard Output Level Pot (POT4-CG) may be required to get sufficient deviation.

5. Check Channel Guard deviation on each channel. The channel can be changed from the utility handset or the PC. Adjust the Channel Guard deviation of each channel using the Channel Guard Output Level Pot (POT4-CG), if necessary.

6. Connect an RF Signal Generator to the receiver and input a 1 kHz tone at maximum sytem deviation. See Table 6 (a). Remember to disable Channel Guard decode if needed.

7. Set the Transmit Modulation Level Pot (POT2-TX) to 255 (100%).

8. Adjust the exciter modulation adjustment pot on the transmit exciter (refer to schematic for specific pot number as it may be called the voice level pot or the PA exciter pot in some applications) to maximum deviation (this may include Channel Guard deviation, if it is being used). See Table 6 (a).

9. Set the RF Signal Generator to 60% of system deviation and adjust the Transmit Modulation Level Pot (POT2-TX) for 60% of system deviation. See Table 6 (d) or Table 6 (g) if operating with Channel Guard.

For a 4 wire station, set the DSP Line Cancellation Pot (POT5-DC) to 0 and skip step 10.

10. Put the Sytem Module on an extender card and meter TP1 on the DSP board. An oscilloscope may be more helpful than an analog meter. Adjust the DSP Cancellation Pot for a null at TP1.

11. Adjust the Line Output Pot (POT1-LO) for the desired telephone line system output level or 0 dBmW on TB1201-3 and -4. The line must be terminated with a 600 ohm load. The line out level must never rise above 11 dBm, as measured across 600 ohms.

12. Unkey the transmitter by removing the ground on LOCAL PTT (P1215-3).

Table 6 - Deviation Settings

	Maximum System Deviation (A)	Channel Guard Deviation (B)	System Deviation (C)	60% of System Deviation (D)	Deviation for setting Line In Pot with Compression (E)	Deviation for setting Compressor Threshold Pot (F)	Deviation for setting Channel Guard with 60% System Deviation (G)
Standard (25 kHz bandwidth)	5.0 kHz	0.750 kHz	4.5 kHz	3.0 kHz	2.8 kHz	4.0 kHz	3.75 kHz
NPSPAC	4.0 kHz	0.600 kHz	3.6 kHz	2.4 kHz	2.2 kHz	3.2 kHz	3.0 kHz
Narrow (12.5 kHz bandwidth)	2.5 kHz	0.500 kHz	2.25 kHz	1.5 kHz	1.4 kHz	2.0 kHz	2.0 kHz

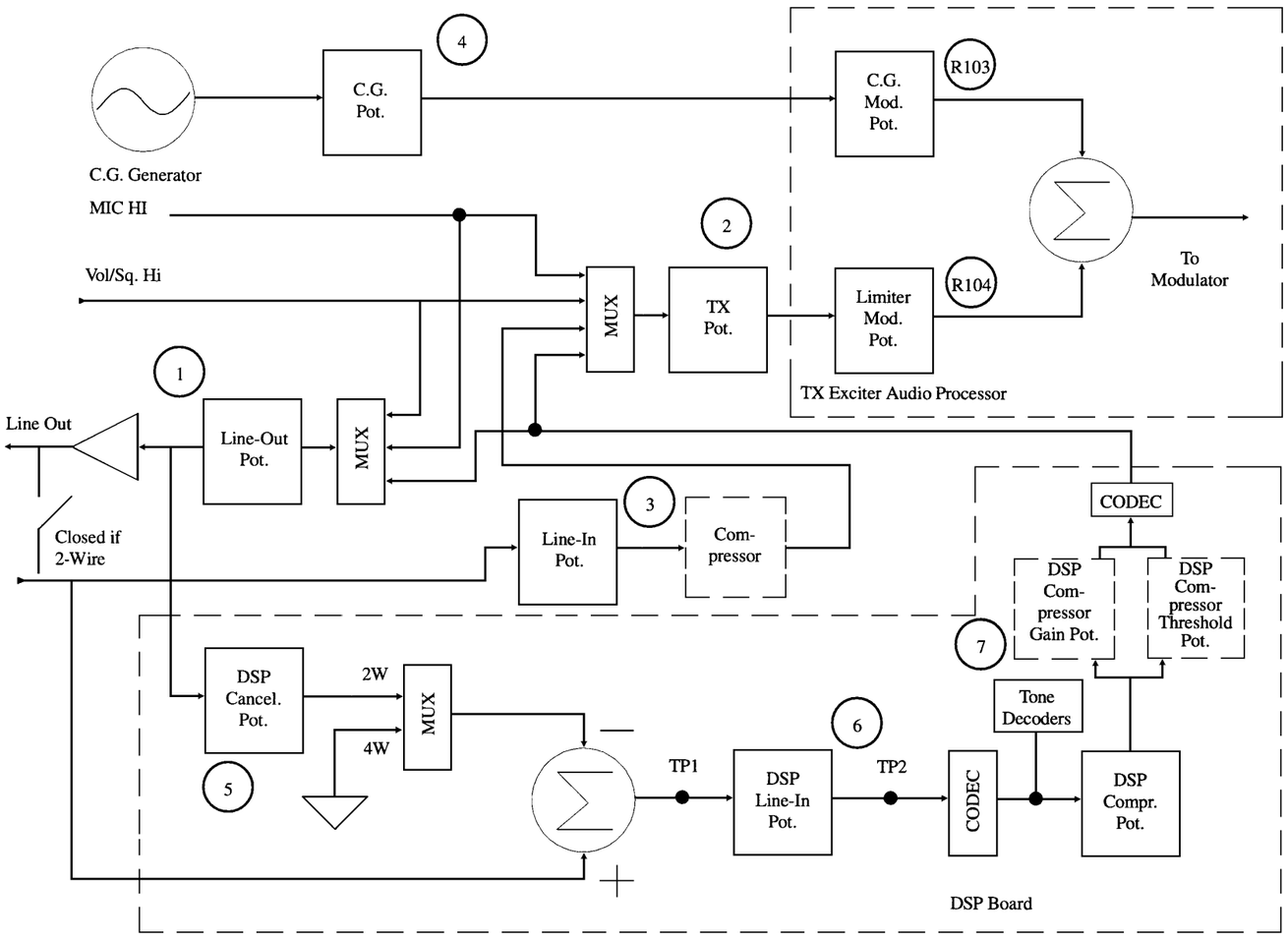


Figure 8 - Potentiometer Setting Block Diagram

13. Connect the audio oscillator to the telephone line input TB1201-2 and -5 (TB1201-3 and -4 if a two wire system). The line must be terminated in 600 ohms.

14. Key the transmitter by activating the REM PTT switch on the front panel.

15. Apply a 1 kHz tone at the average voice audio level across 600 ohms to the line input. (This level is usually -10 dBm across 600 ohms, or 245 mVrms. This level MUST be 10 dB below the maximum system audio level. This is true even if the actual Secur-it tone and function tone are at the same level in tone remote systems).

If operating with Channel Guard, disable Channel Guard operation for the remainder of the alignment.

16. Adjust the DSP Line In Pot (Pot 6-DLI) for less than 60 % of maximum system deviation if operating with compression. See Table 6 (e). If no compression is desired, set DLI pot to 60% of maximum system deviation [See Table 6 (d)] and skip to step 19.

17. Adjust the Compressor Gain Pot (Pot 7-CP) for 60 % of maximum system deviation. See Table 6 (d).

18. Increase the audio input level to the maximum system audio level. (This level is the Secur-it level, and is usually 0 dBm across 600 ohms, or 775 mVrms).

19. Adjust the Compressor Threshold Pot (Pot 9-CT) for desired compression deviation level. See Table 6 (f).

20. Unkey the transmitter by deactivating the REM PTT switch on the front panel and disconnect the audio oscillator. Enable Channel Guard, if needed.

For EDACS

Before making adjustments to the control shelf, the station's RF equipment should be properly aligned for audio.

1. Set the VSQ HI audio level.

2. Set the modulation limiting potentiometer in the transmit exciter.

3. Set the transmit deviations for Low Speed Data (LSD) and High Speed Data (HSD).

4. Disable the GETC's control of the MASTR IIe base station by unplugging GETC power cable P10 from

J10. This allows the MASTR IIe base station to operate like a conventional channel.

5. Follow the 4-wire adjustment procedure **For Tone Remote or Tone Remote/Repeat without Channel Guard:**

6. Restore the GETC power connection P10 to J10.

TROUBLESHOOTING

Once the control shelf is installed and programmed properly, audio level adjustments must be made for proper system operation. Level adjustments must be made with a handset (see LBI-38599). THERE ARE NO MANUAL ADJUSTMENTS IN THE CONTROL SHELF.

Integrated circuits (ICs) U35 and U36 on the system board are dual electronic potentiometers that are controlled by the microprocessor. IC U15 on the DSP board is also a dual electronic potentiometer controlled by the DSP.

TX AUDIO Level Adjustment

U36-0 is used to set the transmitter deviation by adjusting the TX AUDIO output level. Analog switch U15 selects which audio source is routed to the transmitter. Possible sources are LOCAL MIC, REPEAT AUDIO, DSP LINE/TX AUDIO, DSP TX AUDIO, EXTERNAL High Speed Data, LINE IN AUDIO, OPEN (used for Morse code ID), and GROUND (used for no transmission). A battery alarm tone may also be summed in with whichever source is selected with the exception of GROUND.

Normally, LOCAL MIC, REPEAT AUDIO, DSP TX AUDIO, LINE IN AUDIO, OPEN, or GROUND will be selected. The gains in the circuitry are set such that 100 mVrms in the MIC HI or 1 Vrms (3 kHz deviation) in on VOL/SQ HI (REPEAT AUDIO) will produce the same output level on TX AUDIO HI. The gains for morse code ID and battery alarm are also designed to provide the proper levels without adjustments. The TX AUDIO HI output level should be adjusted with a 100mVrms 1kHz signal in on MIC HI or a 1Vrms 1kHz signal in on VOL/SQ HI.

Channel Guard Level Adjustment

Typically the channel guard level adjustment should be made in the transmitter exciter section of the MIIe station. The control shelf does have the ability to adjust its CG output level, should it ever be necessary. However, this should rarely be required.

The control shelf has the ability to change its CG output level on a per channel basis. The CG level pot should be set to the same value for each channel in multiple transmit frequency stations unless it is a phase modulated transmitter. For multiple transmit frequency phase modulated transmitter stations, de-emphasis of the channel guard tones is provided by adjusting the CG level pot value for proper deviation on each transmit frequency.

REMOTE CONTROLLER TO STATION CONTROL PANEL ADJUSTMENTS

Although audio levels should be considered on a system basis, it is appropriate to set the levels of the remote controller and the control station panel by themselves with reference to the levels required by the transmission path and then connect the controller(s) and station to the path. The transmission path, if it is more than just a simple twisted pair, is usually set up with a "test tone". The "average voice" level is defined as being a certain number of decibels below the test tone. The test tone is normally the maximum level that can be sent through the path without clipping or being regulated. Although there is no definite agreement on the difference between the test tone and average voice levels, 10dB is an appropriate level.

In order to align the remote unit and Control Shelf properly, it will be necessary to have some information on the transmission path. This will help to determine the levels at each end required by the system. Specifications needed include:

1) Loss at 1kHz
2) Test tone or maximum level
3) Average voice level (if defined)
4) Loss at 2175 Hz (if tone remote)

The DSP board performs tone detection in a tone remote installation.

LINE OUT Level Adjustment

U36-1 is used to set the line out level. Analog switch U14 selects which audio source is routed to the line. Possible sources are LOCAL MIC, VOL/SQ, auxiliary receiver audio, auxiliary receiver audio summed with VOL/SQ (simultaneous monitor), DSP LINE/TX AUDIO, MODEM LINE data, OPEN (used for battery alarm), GROUND (used for no transmission), and LINE IN audio (used for four wire loop around). A battery alarm tone and/or VG ALERT tone may also be summed in with whichever source is selected with the exception of GROUND. Typically LOCAL MIC, VOL/SQ, DSP LINE/TX AUDIO, OPEN, GROUND, or LINE IN AUDIO will be selected.

The gains in the circuitry are set such that 100 mVrms in on MIC HI or 1 Vrms (3 kHz deviation) in on VOL/SQ HI (REPEAT AUDIO) will produce the same line output level. The gains for VG ALERT tone and battery alarm are also designed to provide the proper levels without adjustments. The LINE output level should be adjusted with a 100mVrms 1kHz signal in on MIC HI or a 1Vrms 1kHz signal in on VOL/SQ HI.

LINE IN Level Adjustment

Typically, the TX AUDIO and LINE OUT levels should be adjusted prior to adjusting the LINE IN level. DSP TX AUDIO and DSP LINE/TX AUDIO are typically line audio or VOL/SQ HI audio that has been processed by the DSP board.

If a DSP board is present, this DSP processed line in audio will normally be selected by analog switches U14 (DSP LINE/TX AUDIO to line out) and U15 (DSP TX AUDIO to transmit audio) on the System Module when line in audio is selected. The level for DSP TX AUDIO and DSP LINE/TX AUDIO must be adjusted on the DSP Board.

If no DSP board is present, then line in audio will be selected by U8, U15, and U32 on the System Module when line in audio is selected. This LINE IN AUDIO level is adjusted on the System Module with U35-1.

For access to internal test points on the system board and DSP board it may be helpful to temporarily swap the positions of the power module and the system module so that the system module plugs into the rightmost slot of the backplane board. STATION SPECIFICATIONS ARE NOT GUARANTEED WHEN THE CONTROL SHELF MODULES ARE IN THIS POSITION.

DSP Level Adjustments

The LINE IN level into the DSP must be adjusted using U15-0 (DSP line cancellation level) and U15-1 (DSP line input level) located on the DSP board. If two wire audio is used then both electronic pots must be adjusted. If four wire audio is used then only U15-1 needs to be adjusted.

CAUTION

The line in level to the DSP must be adjusted so that under all circumstances the level at TP2 of the DSP board does not exceed 1.4 Vrms. If the level exceeds 1.4 Vrms, distortion will occur and performance can not be guaranteed.

For two wire installations the DSP line cancellation level pot (U15-0) is used to remove what the control shelf is transmitting on the line. While the control shelf is transmitting received audio down the line, the line cancellation pot should be adjusted to minimize the signal level at TP1 on the DSP board. This leaves only what is received from the remote. This signal is then level adjusted using the DSP line input level adjust pot (U15-1) and input into the DSP.

If four wire audio is used then only DSP line input level (U15-1) needs to be adjusted.

The DSP also performs a compressor function on its line input. The threshold for this compressor must be adjusted as well. The line in level should be adjusted on the DSP board prior to setting the compressor threshold.

NOTE

1. Special Conditions for MUX and CARRIER

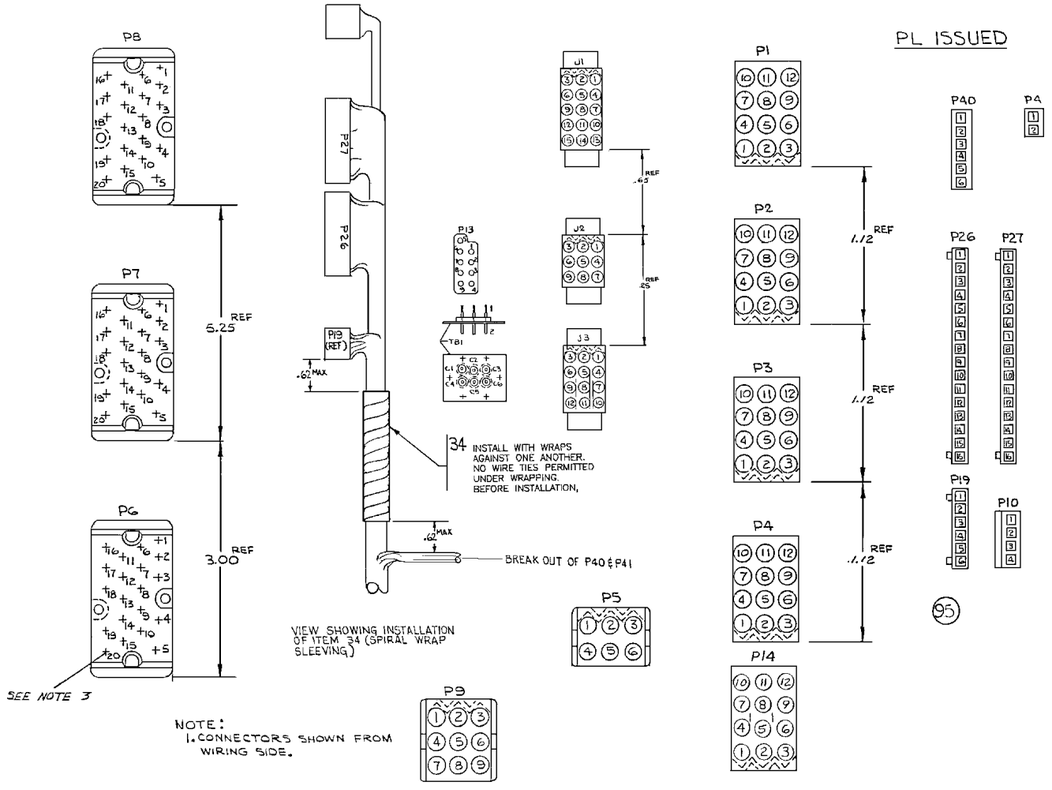
2. Add a pad of approximately 15 dB in the connection between the remote output and the MUX input. It is common for the MUX input to have a test tone level of -16 dB and an average voice level of -29 dB.

   Add a pad of approximately 15 dB in the connection between the Panel output and the MUX input.

MAINTENANCE

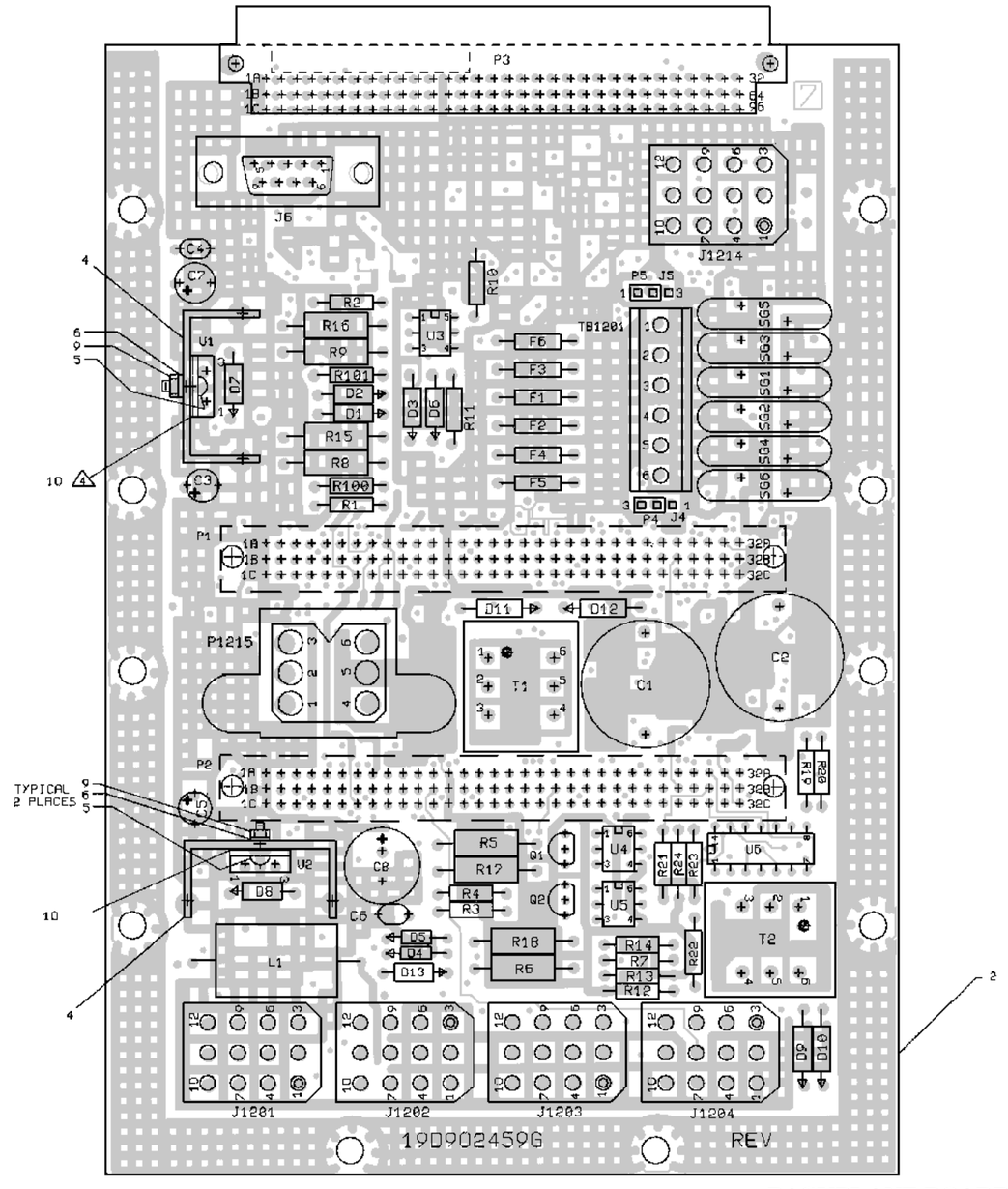
CAUTION

CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceperson should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or de-soldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to a outlet with a known good earth ground. A battery operated soldering iron may be used in place of the regular soldering iron.



STATION HARNESS
19C320811G16

(19C320811, Sh. 3, Rev. 2)



BACKPLANE BOARD
19D902459G1

(19D902459, Sh. 1, Rev. 5)
(19D902496, Layer 1, Rev. 7)

BACKPLANE BOARD
19D902459G1
ISSUE 2

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	7486445P5	Electrolytic, non polarized: 4 µF -10 + 100%, 150 VDCW.
C3	19A703314P10	Electrolytic: 10 µF -10+50%, 50 VDCW; sim to Panasonic LS Series.
C4	19A700121P106	Ceramic: 0.1 µF ±20%, 50 VDCW.
C5	19A703314P10	Electrolytic: 10 µF -10+50%, 50 VDCW; sim to Panasonic LS Series.
C6	19A700121P106	Ceramic: 0.1 µF ±20%, 50 VDCW.
C7	19A701534P8	Tantalum: 22 µF ±20%, 16 VDCW.
C8	19A701225P4	Electrolytic: 330 µF ±10%, 25 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D1 thru D3	T324ADP1041	Silicon: Rectifier; sim to 1N4004.
D4	19A700025P8	Silicon, zener: 400 mW max; sim to BZX55-C6V8.
D5	19A700025P11	Silicon, zener: 400 mW max; sim to BZX55-C12.
D6 thru D8	T324ADP1041	Silicon: Rectifier; sim to 1N4004.
D9 thru D12	344A3799P9	Silicon, Zener: 6.8 volts, 1 watt.
D13 and D14	T324ADP1041	Silicon: Rectifier; sim to 1N4004.
		- - - - - - - - - - FUSES - - - - - - - - - -
F1 thru F6	19A702169P3	Enclosed link: 3/8 A @ 125V; sim to Littlefuse 255.375.
		- - - - - - - - - - JACKS - - - - - - - - - -
J4 and J5	19A704852P2	Connector: 3 Pin Male Header.
J6	19B209727P31	Connector, shielded: 9 contacts; sim to 74951-1.
J1201	19A116647P4	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5121.
J1202	19A116647P6	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5927.
J1203	19A116647P4	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5121.
J1204	19A116647P6	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5927.
J1214	19A116647P4	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5121.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A149806P2	Coil.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 and P2	19B801587P3	Connector, DIN: 96-position; sim to AMP 535032-4.
P3	19B801587P7	Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1.
P4 and P5	19A702104P2	Connector: Shorting Jumper, Gold Plated. (Housing Color: White).
P1215	19B219627G1	Connector: 6 contacts.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A705953P1	NPN transistor.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	H212CRP022C	Deposited carbon: 22 ohms ±5%, 1/4 w.
R3 and R4	H212CRP315C	Deposited carbon: 15K ohms ±5%, 1/4 w.
R5 and R6	19A700113P74	Resistor, composition: 3k ohms ±5%, 1/2w.
R7	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R8 and R9	19A700113P74	Resistor, composition: 3k ohms ±5%, 1/2w.
R10	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R11	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R12 and R13	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R14	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R15 thru R18	19A700113P74	Resistor, composition: 3k ohms ±5%, 1/2w.
R19 thru R22	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R23	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R24	H212CRP227C	Deposited carbon: 2.7K ohms ±5%, 1/4 w.
R100 and R101	H212CRP910C	Deposited carbon: 1 ohm ±5%, 1/4 w.
		- - - - - - - - - - WIDGETS - - - - - - - - - -
SG1 thru SG6	19A701783P3	Arrestor, Electrical Surge. (MOV Varistor). Maximum voltage rating 150 VRMS (200 VDC).
		- - - - - - - - - TRANSFORMERS - - - - - - - -
T1	19A705947P1	Audio transformer: 600 ohm, 1:1; sim to Midcom 671-1752.
T2	19A705947P2	Audio transformer: 600 ohm, 1:1; sim to Midcom 671-9026.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - -
TB1201	19A705820P5	Terminal, block.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1 and U2	19A705863P1	Integrated circuit, Regulator.
U3 thru U5	19A705952P1	Optoisolator.
U6	19A134764P1	Linear: Quad Voltage Comparator; sim to LM339N.
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A702917P7	Heat Sink, Transistor: Sim to Thermalloy Cat 6030B-TT.
	19A702364P308	Machine screw, TORX Drive: No. M3-0.5 x 8.
	19A700032P5	Lockwasher, internal tooth: No. 3MM.
	19A700034P4	Nut, hex: No. M3 x 0.5MM.

*COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "revision Letter", which is stamped after the model number of the unit. Ther evision stamped on the unit includes all previous revisions. Refer to the Parts List for the description of the parts affected by these revisions.

REV. A - **BACKPLANE BOARD 19D902459G1**

To modify the DC current detection threshold from 11 mA to 8.5 mA, D5 was changed. The old part number was: D5 - 19A700025P12, Silcon, Zener: 400 mW max; sim to BZX55-C15.

REV. B - **BACKPLANE BOARD 19D902459G1**

To bring product into compliance with the updated National Electrical Code added F1 through F6. Also changed T1. The old part number was:

T1 - 19A705947P2, Transformer, audio: 600 ohm, 1:1; sim to Midcom 671-9026.

MASTR IIe STATION HARNESS
19C320811G16

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1 and E2	19A115370P1	Connector.
E3 and E4	19B209268P105	Solderless terminal; wire range 14 - 16 AWG, sim to AMP CAT No. 41107.
		- - - - - - - - - - JACKS - - - - - - - - - -
J1	19B209288P5	Shell: 15-Position; sim to Molex 03-09-1151.
J2	19B209288P3	Shell.
J3	19B209288P25	Connector.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P4	19B209288P20	Shell: 12-Position; sim to Molex 03-09-1122.
P5	19B209288P23	Shell: 6-Position; sim to Molex 03-09-2062.
P6	19A143191G1	Connector includes 19C330656P1 - SHELL and 19A115793P1 - CONTACTS.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C330656P1	Connector.
	19A115793P2	Connector.
P7 and P8	19A143191G1	Connector includes 19C330656P1 - SHELL and 19A115793P1 - CONTACTS
P9	19B209288P4	Shell.
P10	19A116659P17	Shell: 4-Position; sim to Molex 09-50-3041.
P12	19A115793P1	Contact, electrical: sim to Malco 2700.
P13	19B219534P1	Connector, plug: 9 male contacts.
P14	19B209288P20	Shell: 12-Position; sim to Molex 03-09-1122.
P18	19B209288P41	Connector, Receptacle.
P19	19A700041P32	Shell: 6-Position; sim to Molex 22-01-2065.
P26 and P27	19A700041P42	Shell: 16-Position; sim to Molex 22-01-2165.
P40	19A116659P80	Shell.
P41	19A116659P138	Shell.
P245	19A115793P1	Contact, electrical: sim to Malco 2700.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - -
TB1	19A130051G1	Plate.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 thru C6	5493392P7	Ceramic, feed thru: 1000 pF -0+100%, 500 VDCW.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B209288P29	Contact, female: 22-30 AWG; sim to Molex 02-09-1141.
	19B209288P30	Contact, male: 22-30 AWG; sim to Molex 02-09-2141.
	19B209288P2	Contact, male: 14-20 AWG; sim to Molex 02-09-2101.
	19B209288P1	Contact, female: 14-20 AWG; sim to Molex 02-09-1101.
	19A704779P26	Contacts: 22-30 AWG; sim to Molex 08-55-0101, Qty of 10.
	19A116781P3	Contacts: 16-20 AWG; sim to Molex 08-50-0105 (Qty. of 10).
	19B209260P103	Solderless terminal; sim to AMP 60495-1.
	19A116781P4	Contacts: 22-26 AWG; sim to Molex 08-50-0107, Qty of 10.
	19A149502P1	Sleeving.
	19B209288P42	Contact, female: 22-30 AWG; sim to Molex 02-09-5146.
	19A706152P5	Retainer Strap.
	19A700136P4	Insulated sleeving.
	19A700136P5	Insulated sleeving, electrical.
	19A701278P7	Insulated sleeving.
	19A115377P5	Cable.
	19A115377P3	Cable.
	7145310P1	Cable.
	7147255P1	Cable.

PRODUCTION CHANGES

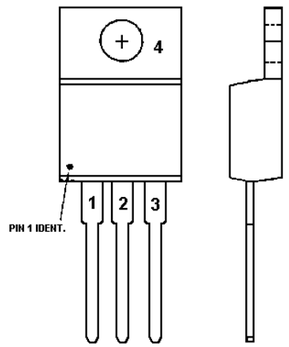
Changes in the equipment to improve performance or to simplify circuits are identified by a "revision Letter", which is stamped after the model number of the unit. Ther evision stamped on the unit includes all previous revisions. Refer to the Parts List for the description of the parts affected by these revisions.

REV. A - MASTR IIe STATION HARNESS 19C320811G16

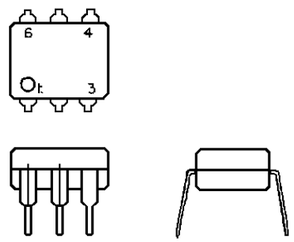
To accommodate the battery stand-by option a 3 foot SF22-BK wire was added from P14-11 (terminated with a 19B209288P29) to P9-7 (terminated with a 19B209288P30).

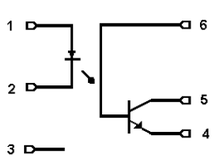
IC DATA

U1/U2
+10 Volt Regulator
19A705863P1

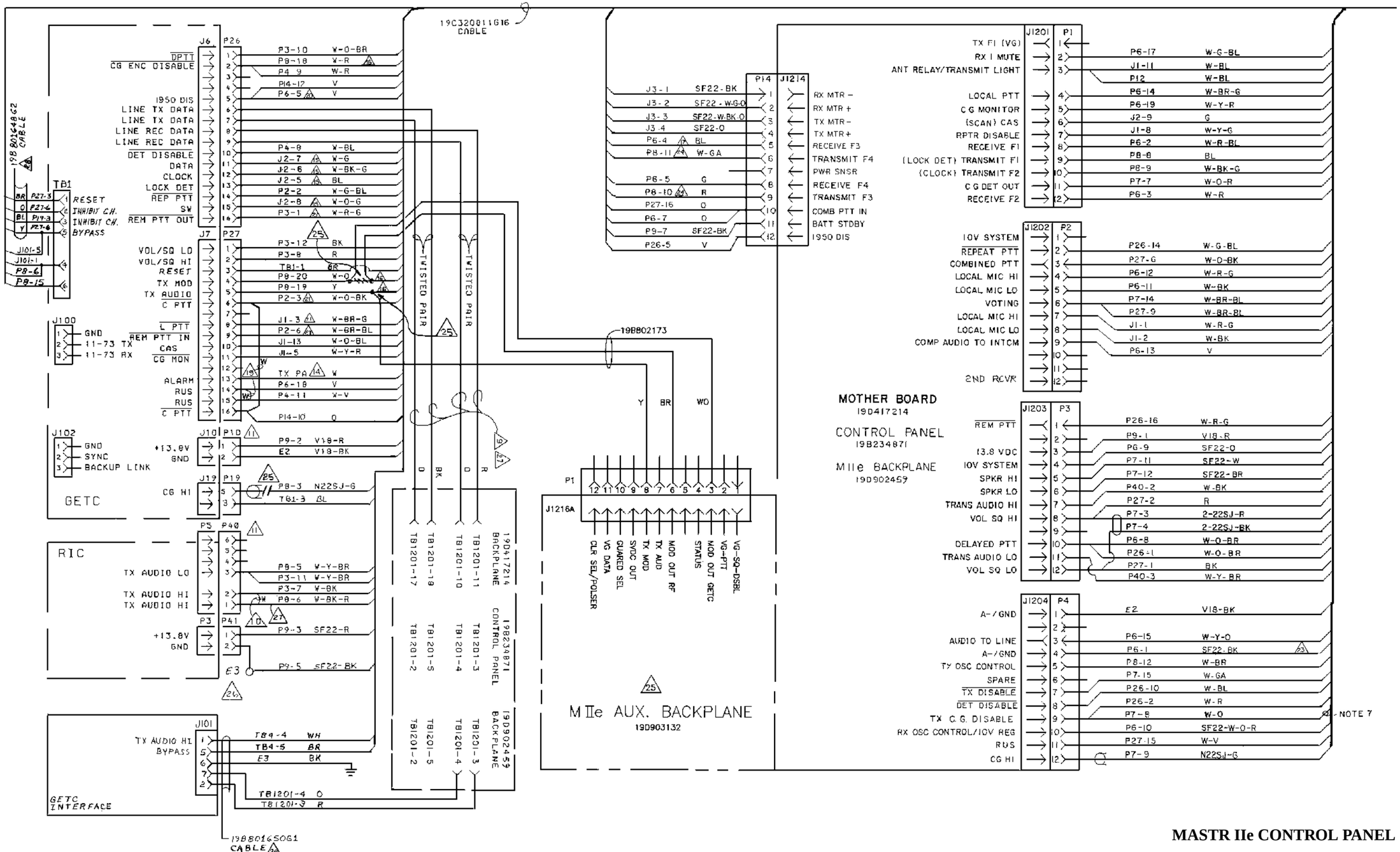


U3/U4/U5
OPTO-Isolator
19A705952P1



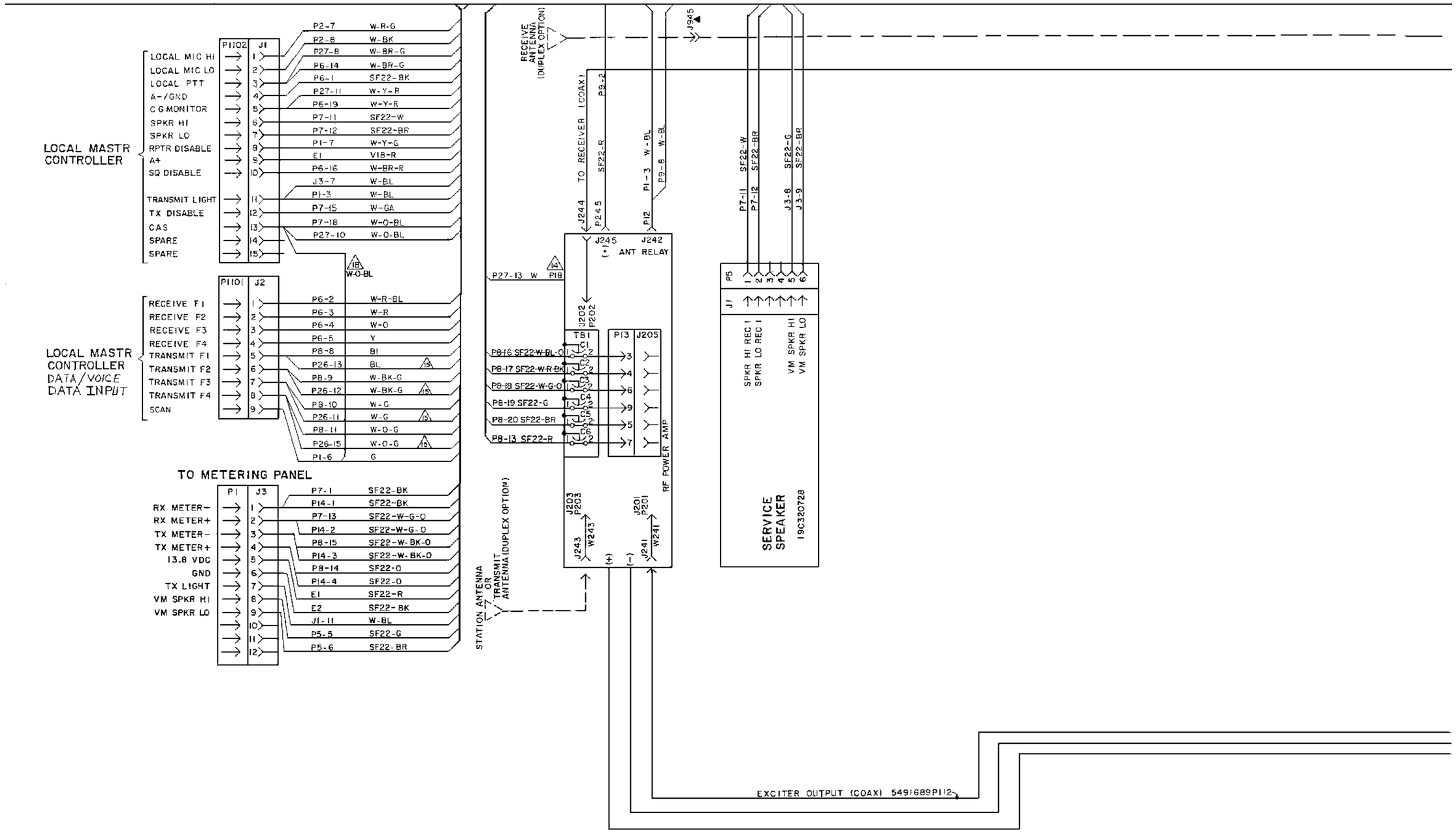


1. LED ANODE
2. LED CATHODE
3. N.C.
4. EMITTER
5. COLLECTOR
6. BASE



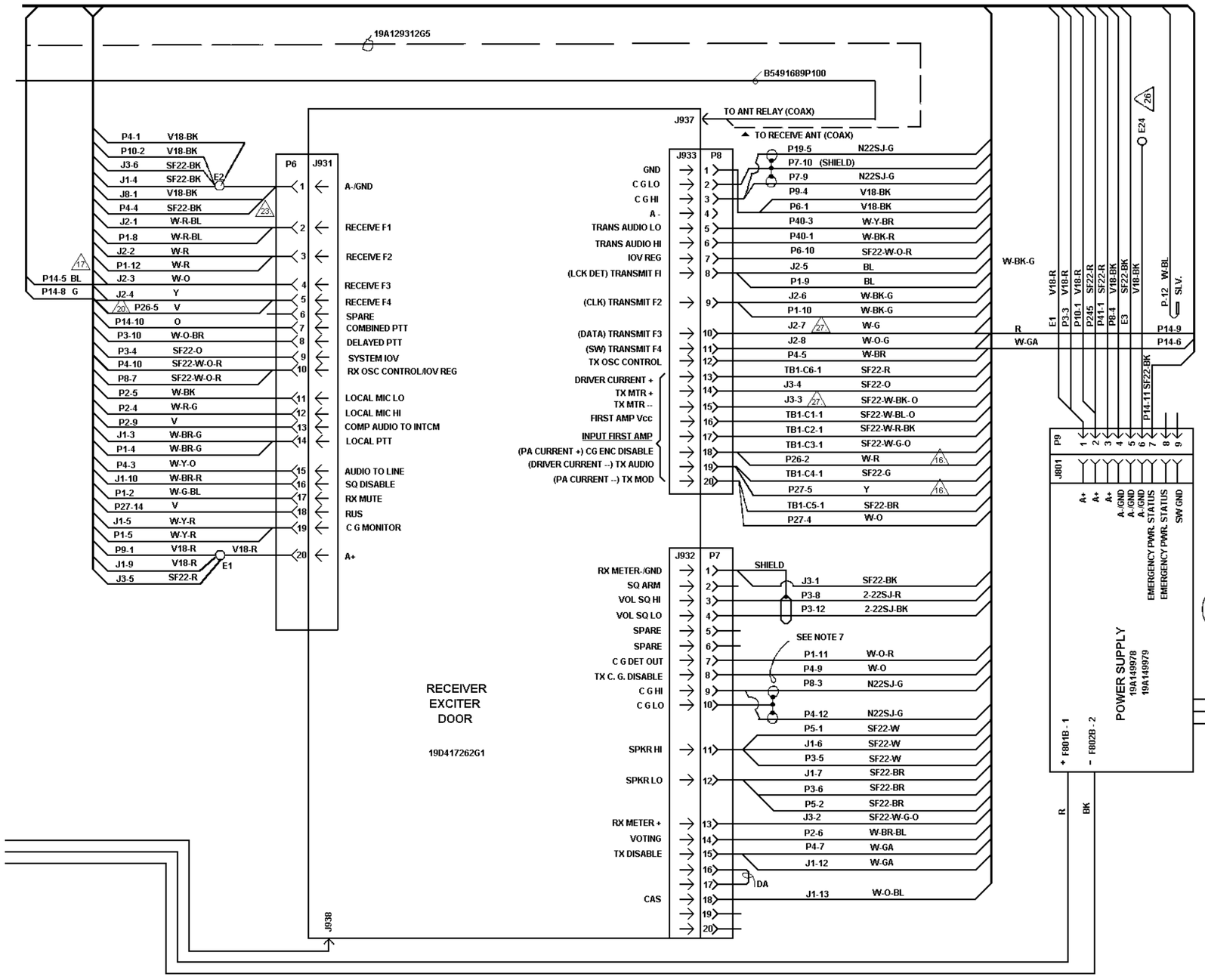
MASTR IIe CONTROL PANEL

(19D902787, Sh. 1, Rev. 9)



MASTR IIe CONTROL PANEL

(19D902787, Sh. 1, Rev. 9)

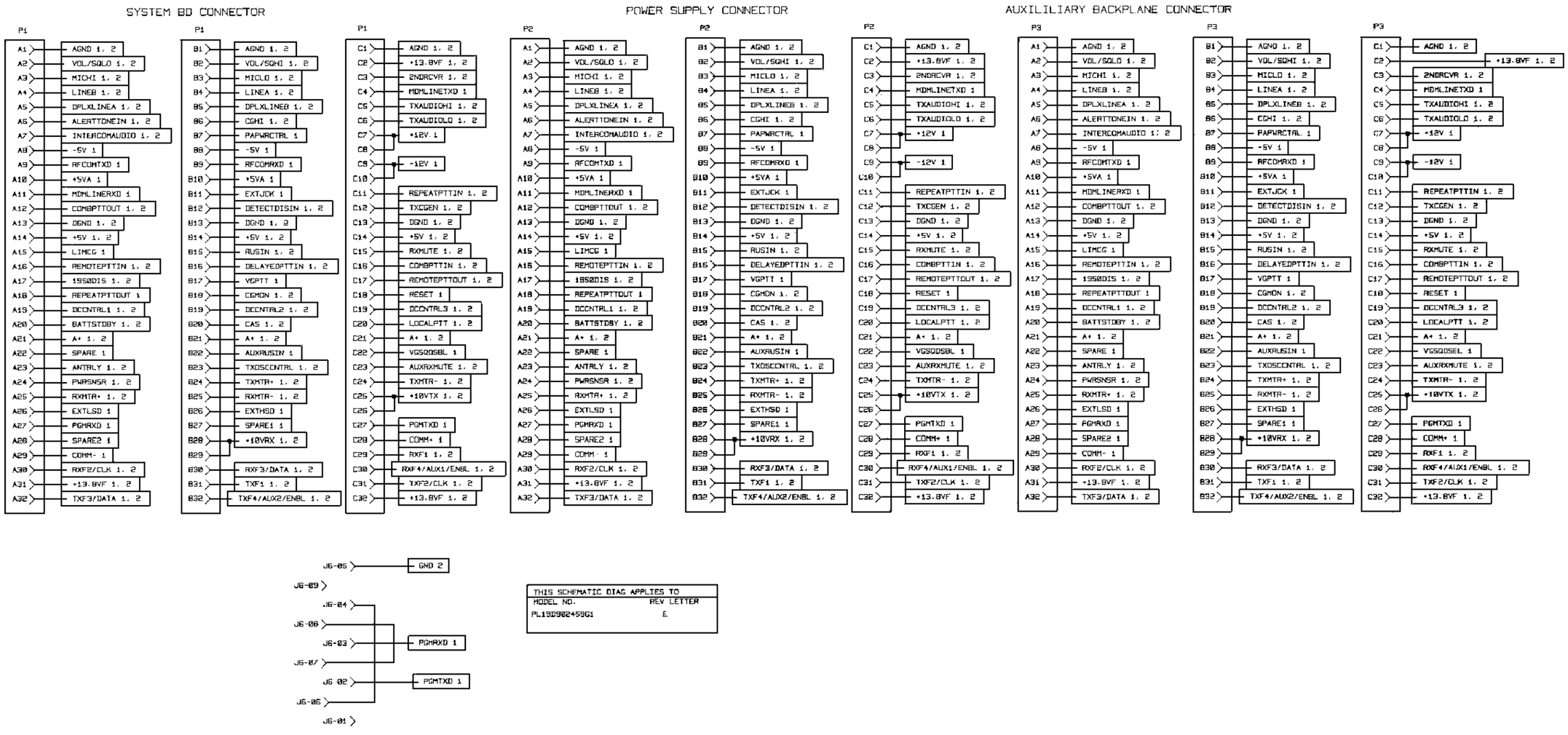


NOTES:

1. ALL WIRES ARE SF24 UNLESS OTHERWISE NOTED.
2. UNLESS OTHERWISE NOTED ALL WIRES TO J1,J2,J3,P1,P2,P3,P4, P5, & P14 TERMINATED WITH 19B209288P29
3. WIRES TO P2-3, P3-1, P4-3, P9-3, P9-5, P9-7, P9-8, P14-1, & P9-6. TERMINATED WITH 19B209288P30.
4. WIRES TO P9-1, P9-2 AND P9-4 ARE TERMINATED WITH 19B209288P2.
5. ▲ PRESENT WITH DUPLEX OPTION ONLY.
6. WIRES TO P3-3, P3-8, P3-12, P4-1, J1-9, J3-1, J3-2, J3-3, J3-4, & J1-13 ARE TERMINATED WITH 19B209288P1.
7. REMOVE WIRE IF DO NOT NEED TO DISABLE TRANSMISSION OF CG.
9. USE 19A115377P3, P5 TWISTED PAIR & TERMINATE WITH 19B209260P103.
10. REMOVE WIRE FORM P40-1 TO P40-2 WHEN USED WITH RIC PANEL.
11. TERMINATE WIRES AT P10 & P40 WITH 19A116781P3.
12. TERMINATE P19, P26, & P27 WITH 19A704779P26.
13. TERMINATE WIRES AT P41 WITH 19A116781P4.
14. TERMINATE WIRE AT P18 WITH ITEM 36, (ONLY USED WITH GENET).
15. WIRES TO P26-11, P26-12, P26-13, & P26-15 ARE REMOVED WHEN MODIFIED FOR UHF, HI BAND, OR LO BAND (NON-SYNTHESIZED RECEIVER).
16. METERING NOT COMPATIBLE WITH VG & PST.
17. MUST BE MOVED TO P14-4 IF 2 FREQUENCY & USED WITH SOMETHING OTHER THAN Mlle CONTROL SHELF.
18. MUST REMOVE JUMPER IF USING SCAN AND NOT USING Mlle CONTROL SHELF.
19. REMOVE JUMPERS FROM P27-14 TO P27-15, P27-6 TO P27-16 WHEN USED WITH PST, VG OR 2nd RCVR MASTR IIe APPLICATIONS.
20. WIRE MUST BE REMOVED UNLESS PST VOTING WITH 1950 Hz TONE BOARD INSTALLED IN FRONT DOOR REQUIRED.
21. INSULATE ALL UNUSED CONNECTORS FROM CHASSIS AND ALL OTHER ELECTRICAL CIRCUITS.
22. P245 & P12 MUST BE COVERED WITH HEATSINK TUBING THAT EXTENDS AT LEAST 1/2 INCH BEYOND THE CONTACT ON BOTH SIDES.
23. DISCONNECT WHEN NOT USED WITH A Mlle CONTROL SHELF TO AVOID GROUND LOOPS.
24. DISCONNECT WHEN USED WITH DIGITAL DATA BOARD.
25. BREAK WIRE & MAKE CONNECTIONS AS SHOWN FOR VOICE GUARD END-TO-END OPTION.
26. TERMINATE WITH 19B209268P105 AT E3 & E4.
27. MODIFY FOR SIMULCAST PER MODIFICATION INSTRUCTION 19A149823P2.
28. OVERLAY HARNESS FOR SIMULCAST ONLY.

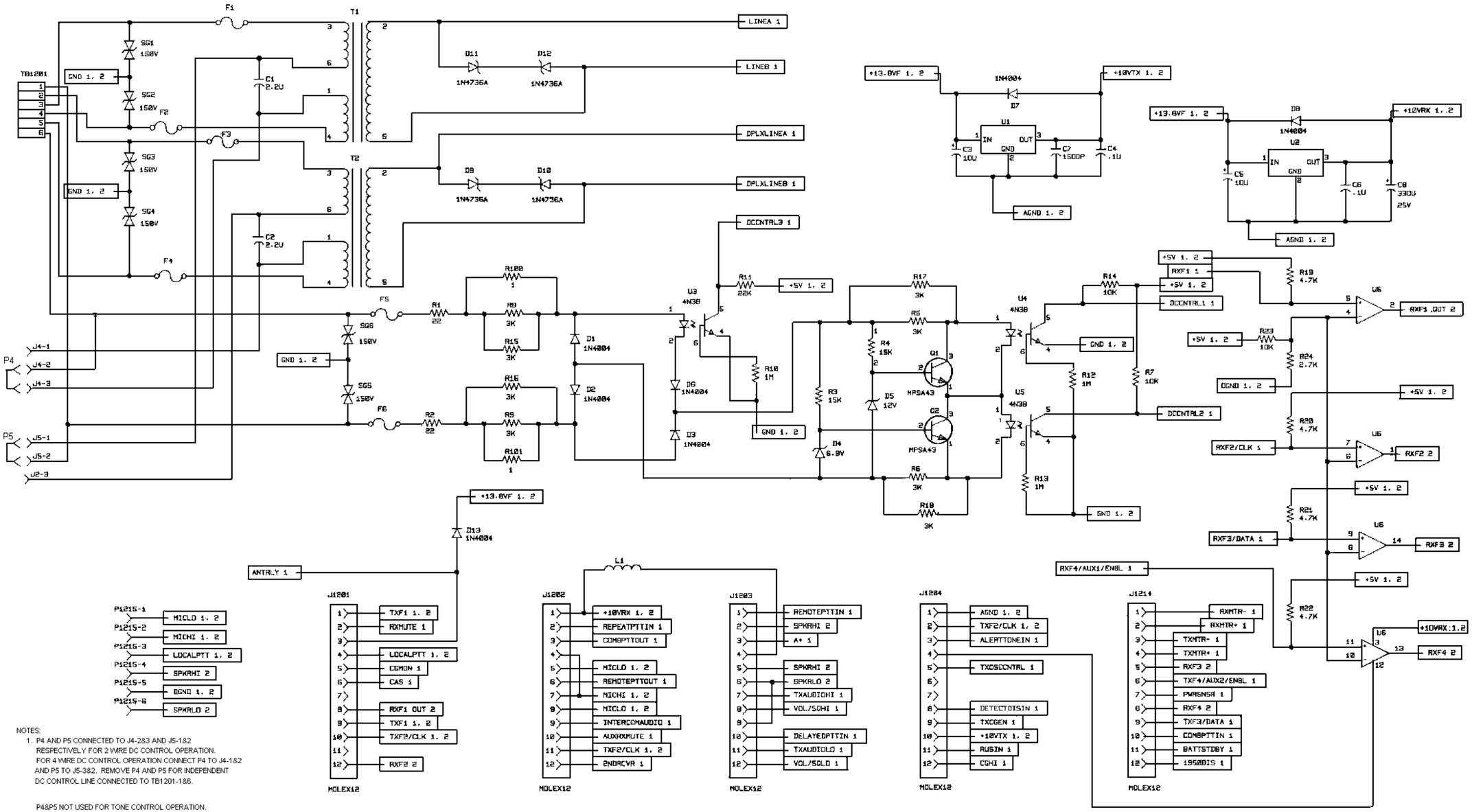
MASTR IIe CONTROL PANEL

(19D902787, Sh. 3, Rev. 9)



BACKPLANE BOARD
19D902459G1

(19D902908, Sh. 1, Rev. 5)



NOTES:

1. P4 AND P5 CONNECTED TO J4-2&3 AND J5-1&2 RESPECTIVELY FOR 2 WIRE DC CONTROL OPERATION. FOR 4 WIRE DC CONTROL OPERATION CONNECT P4 TO J4-1&2 AND P5 TO J5-3&2. REMOVE P4 AND P5 FOR INDEPENDENT DC CONTROL LINE CONNECTED TO TB1201-1&6.

P4&P5 NOT USED FOR TONE CONTROL OPERATION.

BACKPLANE BOARD
19D902459G1

(19D902908, Sh. 2, Rev. 7)

APPENDIX

TABLE OF CONTENTS

DESCRIPTION

This Appendix contains instructions for installing the MASTR IIe Control Shelf in earlier model MASTR II stations that are not equipped with a 19C320811G16 station harness. Hardware Kit 19A149326G7 is required for the installation. Refer to the appropriate Installation Diagrams as directed for component locations and board modifications.

WARNING

Before beginning the installation, make sure that the station power supply is turned OFF, and the station power cable is unplugged from the power source.

EQUIPMENT NEEDED

Tools:

PC or Auxiliary Backplane with utility handset and cable
1/8" Drill Bit
Drill (Right angle drill chuck recommended)
TX15 TORX® Screwdriver
#1 Philips Screwdriver
Wire Cutters
Wire Strippers
Solder Iron and solder

Parts:

1 - 19D902459G1	Backplane Board
1 - 19D902589G1	Power Module
1 - 19D902590G1 or G2	System Module
1 - 19D902615P1	Mounting Bracket
10 - 19A702381P525	TORX T-15 thread forming screws
4 - 19C315963P1	Card Guides
4 - 19A701534P4	1 microfarad 35V tantalum capacitor

The following parts are required if the original cable is used (not a 19C320811G16):

1 ft - 19A115871P33	SF24-G wire
3 ft - 19A115870P2	SF22-BK wire
3 - 19B209288P29	Molex Contacts

Optional Parts:

1 - 19D902978G1	Auxiliary Backplane
1 - 19D902615P1	Mounting Bracket
7 - 19A702381P525	TORX T-15 thread forming screws
1 - 344A3300G1	Intercom mod kit
1 - 19C320728G2	Speaker kit
1 - 19C320811G16	Harness

ERICSSON

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Printed in U.S.A.

INSTALLATION

1. Remove the old control shelf. First, disconnect all cables to the shelf. Next, remove the control shelf cards and backplane board, if present. Then remove the existing slide guides and retainer springs, if present.

2. Mount the new control shelf backplane board using the extender bracket as shown, and install the card guides in the proper slot as shown in the Control Shelf Modification Diagram. The card guides must be installed so that the Power Module and Control Module mate properly with the connectors P1 and P2 on the backplane board.

3. Remove wire at P1-6 and add a SF24 wire from J1-13 to P1-6 in the existing harness. This connects the receiver CAS output to the Control Shelf.

NOTE

Steps 3, 4, 5, and 6 should be skipped if a 19C320811G16 harness is used. Instead, connect P1, P2, P3, P4 and P14 to the Backplane Board at J1201, J1202, J1203, J1204 and J1214 respectively. Connect P6-P8 to the Receiver Exciter Door, P9 to the Station Power Supply and P5 to the speaker in the base of the radio housing. Connect P12, P245, P18, TB1 and P13 to the PA assembly as required. If not required, TB1 may be clipped out of the harness. Insert J1-J3 into opening in the radio housing. Secure P26, P27, P10, P19, P40 and P41 to the housing.

If metering is installed then clip and tie back the two W-R wires out of 19C320811G16 harness at P26-2.

4. Add an SF22-BK wire from P6-1 to P4-4 in the existing harness. This routes receiver ground to the backplane for ICOM selection.

5. Connect P1, P2, P3, P4, (and P14 if present) on the existing harness to J1201, J1202, J1203, J1204, and J1214 respectively on the new backplane board. Note that black wire to P14-4 must be moved to P14-5 if more than 2 receive frequencies used.

6. Disconnect the center conductor from P7-2, and the shield from P7-1 in the radio door. Re-connect the center conductor to P7-9, and the shield to P7-10. These connections route the Channel Guard from the new Control Shelf to the transmitter.

7. Remove the following option boards from the radio front door, if present:

- Carrier Control Timer 19B226617
- Intercom 19C320671
- Programmable Channel Guard 19D432500
- Programmable Channel Guard 19C331044
- Programmable Digital CG 19C331462
- Digital Channel Guard 19D432812
- Voting Tone Board 19C336900

If a CG Encoder board (19C331462 or 19C331044) is removed from the transmitter exciter compartment in the front door, then harness 19B226485G1 must be removed. This harness routes signals from J933 on the front door housing to J1 on the CG encoder board.

The following 19B226485G1 harness wires should be cut as close to J933 as possible: cut the BK wire on J933-4, the Red wire on J933-7, the BL wire on J933-3, and the BR wire on J933-2. The green wire should be cut from P1 on harness and re-connected to J933-3.

Also remove the orange wires from P8-2 & -3 and re-install original shielded cable originating from P7-9 and P10. The shield should connect to P8-2 and the center conductor to P8-3.

Use a portion of the BK wire from the 19B226485G1 harness to connect J933-2 to J933-4.

8. If the front door System Board is not a 19D417213G1 REV C or later, then the following modification should be made. Solder a 1 µF, 35 V tantalum capacitor (19A701534P4) from each of the RX ICOM select lines to ground. These capacitors can be soldered to pins and traces on the bottom of the front door system board close to J951 and J952. Care should be taken to solder the negative polarity side of the capacitors to ground.

9. Remove any Morse code ID equipment, if present.

10. Insert the Power Module into the slot on the right of the Control Shelf (P2 on the backplane board). Insert the System Module in the slot to the left of the Power Module (P1 on the backplane board).

11. If intercom is desired, the following modifications must be made to System Board A901 in the radio front door (refer to the Intercom Modification Diagram 19D417443P2). These modifications allow volume control pot R3 located on System Board A901 to operate as usual.

    a. Remove the wire from J952-19 and insulate to prevent any shorts.

    b. Remove R4 from system board located in the front door.

    c. Place the insulated wires on the bottom of the system board located in the front door as follows:

        1. P935-5 to P934-8.

        2. P934-2 to hole in PC board where R4 used to be. The hole closest to the radio housing should be used.

        3. P934-3 to hole in PC board where R4 used to be. The hole furthest from the radio housing should be used.

        4. J904-13 to J952-19. There are plated-through holes on the printed wire board to each of these pins that may be used to make the connection easier.

12. If a remote system has been installed, refer to the Installation section in Control Shelf Maintenance Manual LBI-38430 for remote control connections.

13. Add speaker (19C320728G2) to bottom of the radio housing if a speaker is not present. Connect P5 of harness to the speaker.

Service Note: If the System Module was not programmed before installation, it will be necessary to program the module with the PC Programming Software, TQ3353. If the System Module was programmed before installation, it may still be necessary to adjust audio levels using a handset. Refer to the programming and installation sections of LBI-38430 for additional information.

CONTROL SHELF HARDWARE KIT
19A149326G7
ISSUE 2

SYMBOL	PART NO.	DESCRIPTION
	19J706152P2	Retainer strap.
	19C315963P1	Card guide.
	19A702381P525	Screw, thd. form: No. M3.5-0.6 x 25.
	4037158P4	Rubber channel.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

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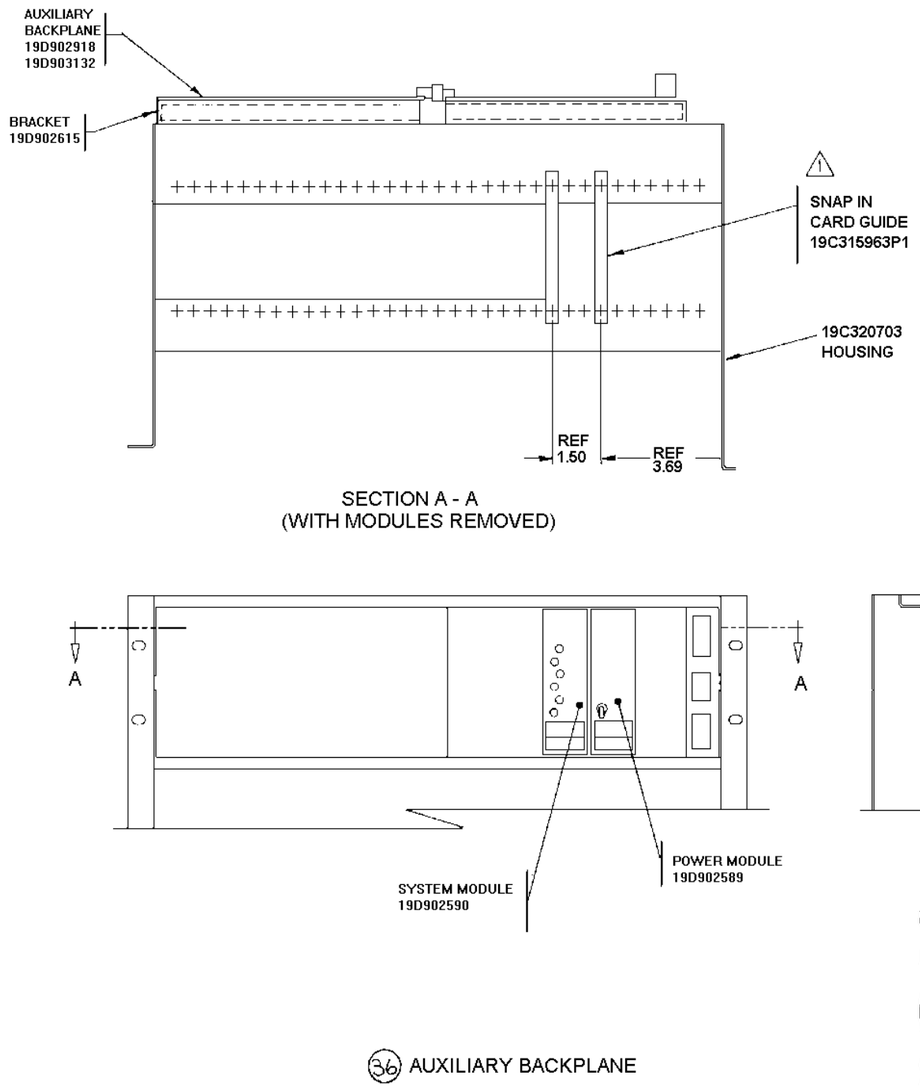
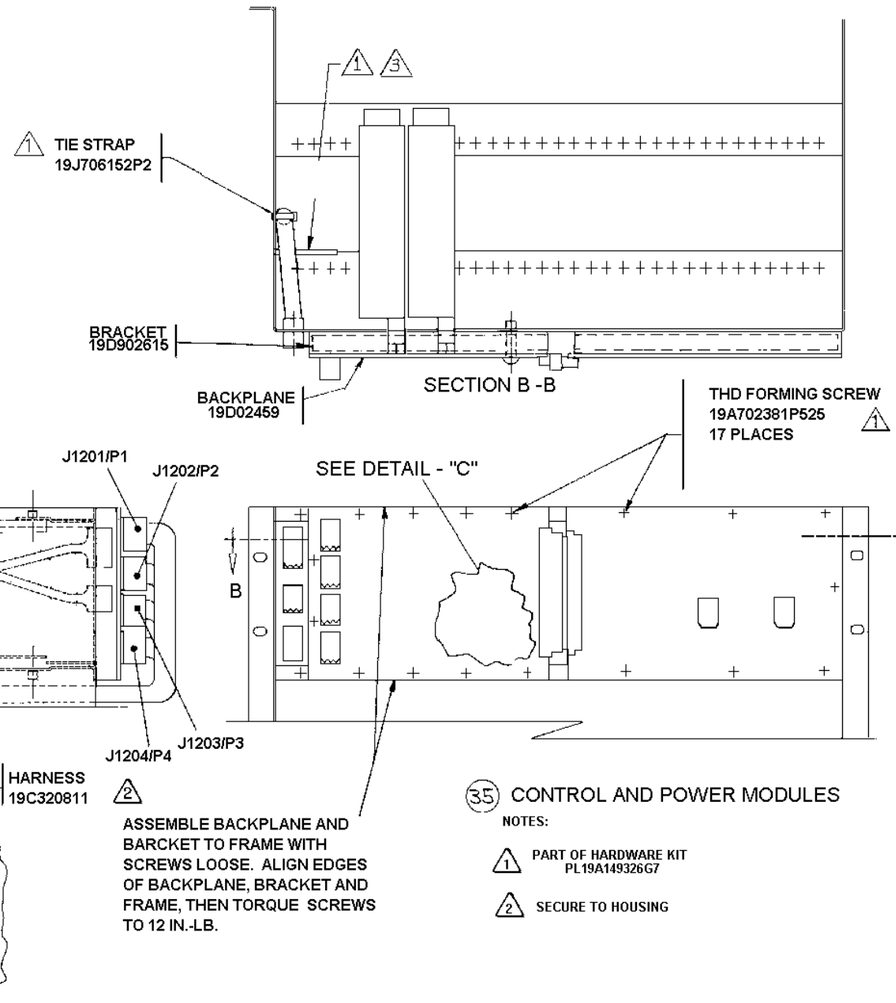
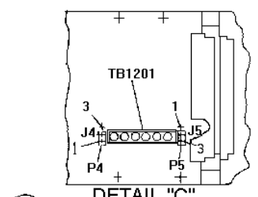


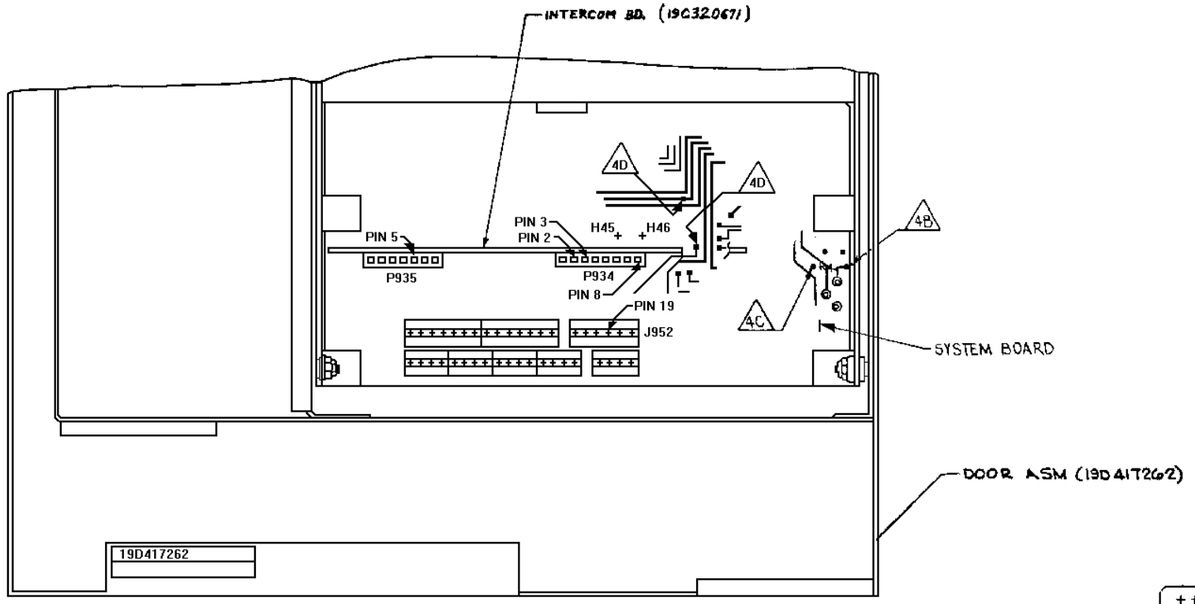




CONTROL SHELF MODIFICATIONS

(With Hardware Kit 19A149326G7)

(19D417483, Sh. 2B, Rev. 8)



(2) THESE INSTRUCTIONS COVER THE MODIFICATION TO THE DOOR ASM. PL19D417262 AND IFAS BOARDS: 19D416606, 19D417707, 19D902492, 19D432667 SO INTERCOM CAN BE APPLIED.

MODIFICATION TO STATION FOR OPERATION WITH INTERCOM

1A. ON IFAS BD PL19D416606, OR PL19D432667, REMOVE C635. OR:

1B. ON IFAS BD, PL19D902492 REMOVE C653.

2. REMOVE R4 FROM SYSTEM BOARD.

3. REMOVE WIRE FROM J952-19, CUT IWRE AS SHORT AS POSSIBLE, AND INSULATE TO PREVENT SHORTING.

4. PLACE WIRES ON THE BOTTOM OF THE SYSTEM BOARD AS INDICATED.
   A. 344A3293G1, FROM P935-5 TO P934-8
   B. 344A3293G2, FROM P934-2 TO R4
   C. 344A3293G1, FROM P934-3 TO R4
   D. 344A3293G3, FROM J904-13 TO J952-19 USE VIAS AS SHOWN.

(1) THESE INSTRUCTIONS COVER THE MODIFICATION TO THE DOOR ASM. PL19D417262 AND IFAS BOARDS: 19D416606, 19D417707, 19D902492, 19D432667 SO INTERCOM CAN BE APPLIED.

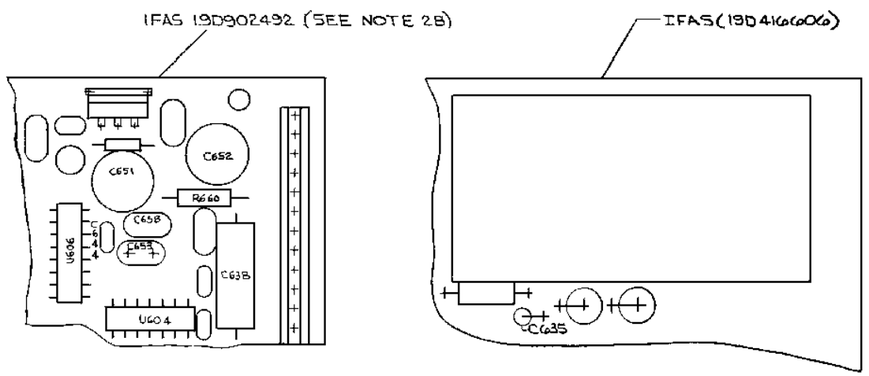
MODIFICATION TO STATION FOR OPERATION WITH INTERCOM

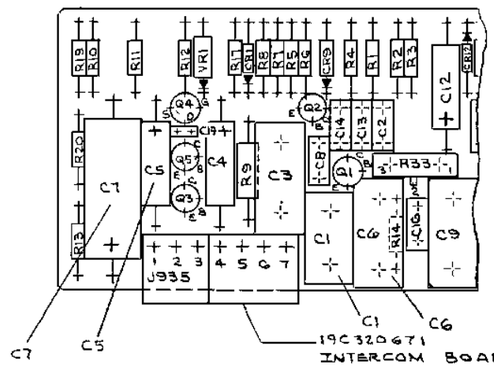
1. ON THE DOOR ASM. PL19D417262 REMOVE JUMPER FROM HOLE 45 TO HOLE 46.

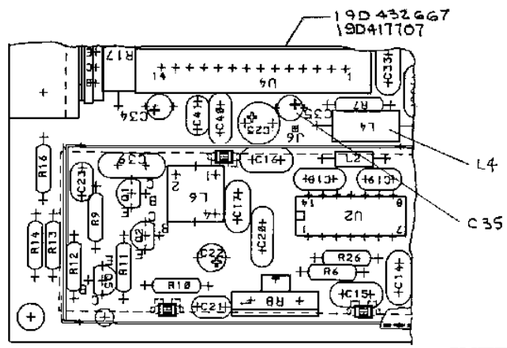
2A. ON THE IFAS BOARD PL19D416606 OR 19D432667 REMOVE C635.

2B. ON IFAS BOARD 19D902492, REMOVE C653.

3. PLUG IN INTERCOM BOARD AS SHOWN IN VIEW OF DOOR ASM.







INTERCOM MODIFICATIONS

(19D417443, Sh. 1, Rev. 6)