MAINTENANCE MANUAL
FOR
MASTR III T/R SHELF 19D902839G1

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Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

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SPECIFICATIONS*

POWER	
Input Voltage	13.8 Vdc nominal (20%)
Current Drain	4 Amperes maximum
AUDIO RESPONSE	
Receiver To Line	+1, -3 dB from -6 dB per octave response for 300 to 3000 Hz referenced to 1 kHz
Line to Transmitter	+1, -3 dB from -6 dB per octave response for 300 to 3000 Hz referenced to 1 kHz
Receiver To Speaker	+2, -8 dB from -6 dB per octave response for 300 to 3000 Hz referenced to 1 kHz
Line Output Level	-19 dBm to +11 dBm
Line Input Level	-19 dBm to +11 dBm
LINE LOOP IMPEDANCE	11K ohm maximum (8k ohm line, and 3K ohm matching)
LINE TERMINATING IMPEDANCE	600 ohms
NOTCH FILTER RESPONSE	-45 dB @ 2175 Hz
CARRIER CONTROL TIMER	Programmable from zero to 10 minutes
DROP-OUT DELAY TIMER	Programmable from zero to l0 seconds
OPERATING TEMPERATURE	-30° C to +60° C (-22° F to 140° F)
DISTORTION	Less Than 2%
SERVICE SPEAKER	1 watt into 8 ohms
PANEL DIMENSIONS (H x W)	8.75 x 19.0 inches (5 Rack Units)

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

DESCRIPTION

The MASTR III station control electronics are designed for dc/tone remote,remote/repeater, or repeater only applications. The station control electronics, also referred to as the Control Section, consists of a Backplane Board, Power Module, System Module, and an Interface Board. The backplane also connects the RF Section which consists of the Receiver Synthesizer Module, Receiver Front End Module, Receiver IF Module, and the Transmit Synthesizer Module. The Control Section and the RF Section combine into one assembly to form the T/R Shelf.

The Power Module, System Module, and the Interface Board connect to the backplane and thus to one another via 96 pin connectors. The Control Section contains five backplane slots with 3 presently unused. The Interface Board provides interconnection for a local microphone or handset, RS-232 programming or diagnostics, transmitter PA control, transmitter PA fan, auxiliary function relays, optional antenna switch, and optional circulator. Two connectors (terminal block and modular phone) are provided for telephone line connections to the MASTR III Station. Additional connectors are provided on the backplane for connection to GETCs used with systems such as EDACS, VOICE GUARD, GE-MARC, etc.

The Control Section uses programmable microcomputer technology to control the base station's transmitter, receiver, and audio processor. The System Module contains a Digital Signal Processor (DSP) Module used for audio processing and tone generation and detection. The basic Control Section 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. Options pro-vided by the Control Section include a transmitter drop-out delay (DOD) timer, Carrier Control Timer (CCT), Channel Guard, and Squelch Operated Relay output (SOR). Additional station options include:

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

BACKPLANE BOARD

The Backplane Board (A1), 19D902947G1 (see Assembly Diagram 19D902839 sheet 1), is a purely passive printed wiring board (pwb) that mounts to the T/R shelf 19D902839G1. The backplane is functionally and physically segmented into two sections. When viewed from the front, the four slots to the left connect the RF Modules. The five slots on the right connect the Control Section modules. The horizontal slot above the five Control Section slots is occupied by the Interface Board (A2). The slots are assigned as follows from left to right (as viewed from the front of the station):

- Transmitter Synthesizer Module (19D902780)
- Receiver Synthesizer Module (19D902781)
- Receiver Front End Module (19D902782)
- Receiver IF Module (19D902783)
- System Module (19D902590)
- Aux 1
- Aux 2
- Aux 3
- Power Module (19D902589)

INTERFACE BOARD

The Interface Board (A2), 19D902975G1 (see assembly Diagram 19D902839 sheet 1), mounts horizontally above the 5 backplane slots of the Control Section. The Interface Board provides the following functions:

- Rx and Tx Synthesizer loading
- Telephone line interface with current level detection for remote control
- Audio PA for local speaker
- Transmitter power output level and control
- Manual adjustment with front panel access of receiver squelch and local speaker volume
- LED indication of PA Alarm
- Various connectors including RS232 programming port and Mic/Handset port.

SYSTEM MODULE

The System Module 19D902590G3 contains all audio processing and control electronics. The System Module is equipped with a DSP board that rides "piggyback" on the 19D903771G1 System Board. Refer to Maintenance Manual LBI-38764 for complete information on the System Module.

POWER MODULE

The Power Module 19D902589G2 contains switching regulators for the +5V, +12V, and -12V DC supplies. The output of the +12V and -12V supplies are further regulated to provide +5V and

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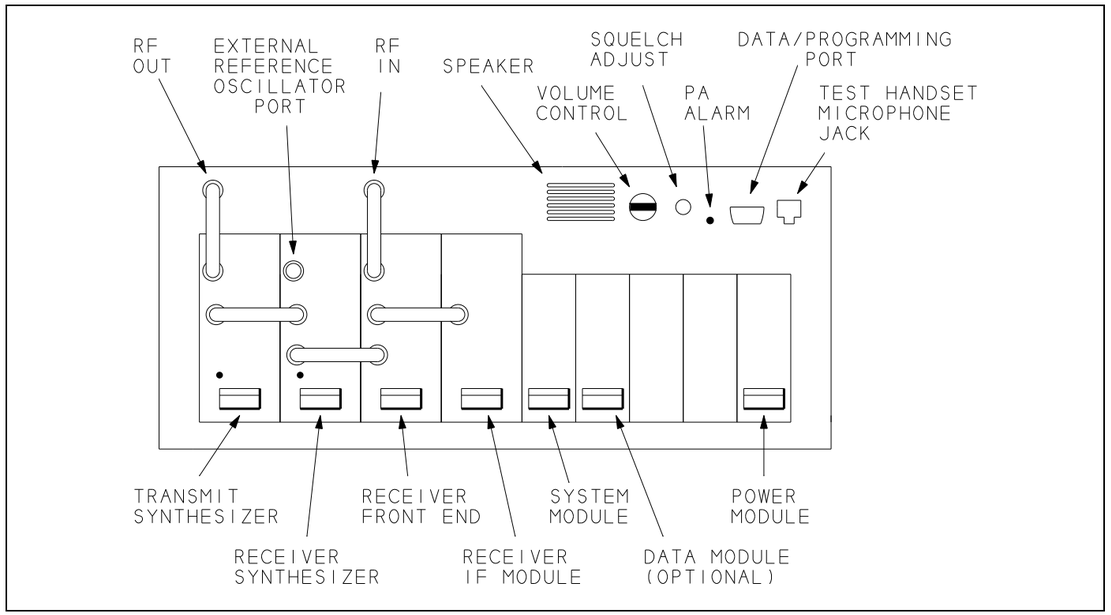

Figure 1 - T/R Shelf Layout

-5V required by the analog components. See Maintenance Manual LBI-38752 for complete information on the power module.

HARNESS

Station wiring for the MASTR III Base Station has been minimized due to the modular architecture. However, a small amount of wiring is necessary for interconnection of some station components. All cables connecting to the Control Section of the T/R Shelf terminate at the Interface Board. See LBI-38636 for Application Drawings and Interconnection Drawings for identification of these cables.

SYSTEM OPERATION

The MASTR III T/R Shelf can be programmed for operation as a DC remote, tone remote, remote re-peater, or repeater only application.

The T/R Shelf control section 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 T/R Shelf.

Status indicators available in the T/R Shelf control section include transmit, transmit disable, and CG mon-itor indicators.

There are several common options available for use in the T/R 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 T/R Shelf can decode either tone or digital CG information from received audio, and can generate CG tones or digital codes for transmission.

One of many CG tones can be programmed into the T/R Shelf through the personality EEPROM. Different CG tones can be used for decode and encode. The T/R 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 mon-itored.

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 Mon-itor 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 T/R 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 T/R 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 T/R 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 Table 1.

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 stand-by power, the station power supply applies a battery standby signal to the T/R Shelf. The T/R 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.

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 programmable 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 programmable from zero (0) to 25 seconds in increments of 1 second. The on-time rate sets the duration of the tone burst, and is programmable 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 T/R Shelf, the option must be disabled in the T/R Shelf personality to prevent alarm tones from being generated.

MORSE CODE ID

Morse code identification can be programmed into the T/R 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 T/R Shelf. This feature can be enabled or disabled in the programming, as required.

A 5 second 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.

DC REMOTE CONTROL

The T/R Shelf can be remotely controlled by DC control currents. A Block Diagram of a T/R Shelf with a remote interface is shown in Figure 2. 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 T/R Shelf.

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

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Table 1 - Primary and Equivalent Octal Codes

PRIM. CODE	EQUIVALENT CODE	PRIM. CODE	EQUIVALENT CODE	PRIM. CODE	EQUIVALENT CODE
023	340, 766	131	572, 702	235	611, 671, 723
025		132	605, 634, 714	236	251, 704, 742
026	566	133	413, 620	237	464, 642, 772
031	374, 643	134	273	243	267, 342
032		135	205, 610	246	542, 653
036	137	136	502, 712	252	661
037	560, 627	142	174, 270	255	425
043	355	143	333	262	316, 431, 730
047	375, 707	144	466, 666	266	655
051	520, 771	145	525	271	427, 510, 762
053		147	303, 306, 761	274	652
054	405, 675	150	256, 703	276	326, 432
056	465, 656	152	366, 415	307	362, 565
057	172	153	606, 630	311	330, 456, 561
060	116, 737	155	233, 660	312	515, 663, 743
065	301	156	517, 741	315	321, 673
066	734	157	322, 503	317	546, 614, 751
067	516, 720	161	345, 532	324	343, 570
071	603, 717, 746	162	416, 553	325	550, 626
072	470, 701	163	460, 607, 654	331	372, 507
073	640	164	207, 732	332	433, 552
074	360, 721	165	354	344	471, 664, 715
075	501, 624	171	265, 426	346	616, 635, 724
076	203, 754	176	244, 417	351	353, 435
104	226, 557	212	253	356	521
107	365	213	263, 736	363	436, 443, 444, 662
114	327, 615	217	371, 453, 530	446	467, 511, 672
115	534, 674	222	445, 457, 575	447	473, 474, 731, 744
117	411, 756	223	350, 475, 750	452	524, 765
122	535	224	313, 506, 574	454	513, 545, 564
123	632, 657	225	536	455	533, 551
125	173	227	261, 567	462	472, 623, 725
127	412, 441, 711	231	504, 631, 636, 745	523	647, 726
130	364, 641	234	423, 563, 621, 713	526	562, 645
131	572, 702	245	370, 554		

Control Current Signalling

Control current signalling 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 T/R Shelf are:

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

Station functions which can be controlled by these control currents are:

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

See Table 2 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 T/R 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.

Channel Guard Monitor

When the CG Monitor function control current is received from a remote control unit, the T/R 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.

Repeat Function

When the T/R Shelf receives a repeater disable control current, it disables the repeater function if the repeater function was previously enabled. If the repeater functiomnhas been disabled, a repeater disable control current will enable the repeater. When the repeat function is enabled, the base station re-transmits the

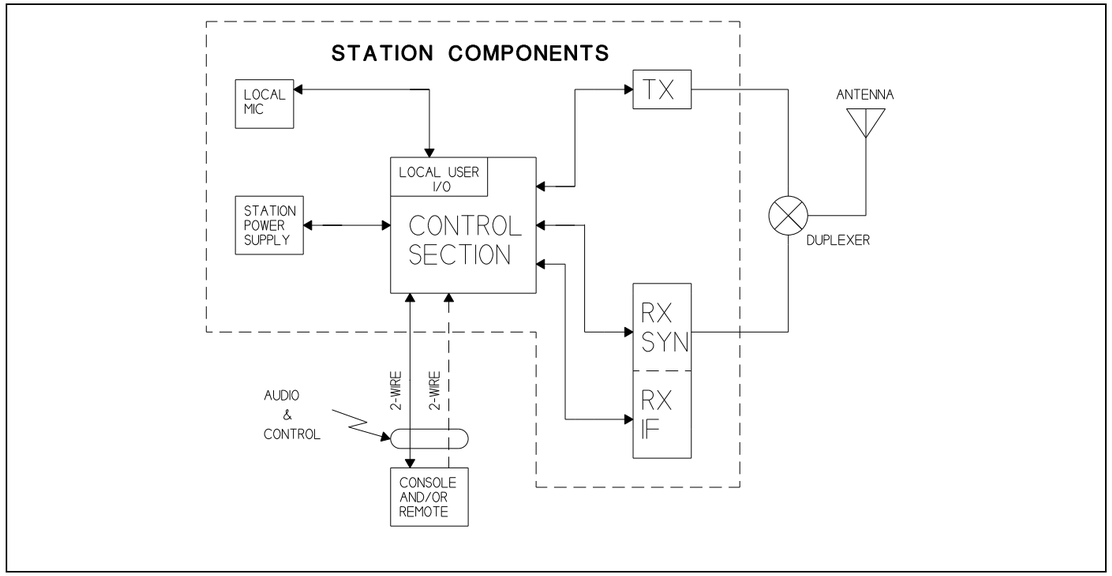

Figure 2 - DC/Tone Remote, DC/Tone Remote/Repeat

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Table 2 - 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

received (incoming) signal when a valid CG tone or code is present. When the repeat function is disabled, the T/R Shelf does not initiate transmission of received signals.

Auxiliary Receiver

With an auxiliary receiver connected to the T/R Shelf using wiring harness 19B802398P1, audio from this auxiliary (second) receiver may be routed to the telephone line connecting a remote control unit. A separate 600 ohm balanced output is also provided by the second receiver for applications requiring audio at a second remote location.

A remote control unit may apply DC control currents to select which receiver audio is heard at the remote as listed below:

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

For Channel Guard applications, CG Monitor monitors the traffic on the auxiliary receiver frequency and the main receiver frequency.

TONE REMOTE CONTROL

In tone remote applications, the T/R Shelf uses its Digital Signal Processor (DSP) to interface with a tone remote control unit through a two- or four-wire phone line. A Block Diagram of the T/R Shelf remote interface is shown in Figure 2.

A tone remote control unit can initiate a transmission, listen to received audio, and select or deselect T/R 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.

Signalling from a tone remote control unit consists of a high level "**Secur-it**" tone, followed by the appro-priate medium level "**Functi**on" tone (as well as a "**Hold**" tone if the transmitter is keyed). The tone control sequence is shown in Figure 3.

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, 0 dB "**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 signalling from a remote control unit are:

- Repeater Enable (disable)
- Channel Guard Decode 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 3 for a list of "**Function**" tones and their corresponding function.

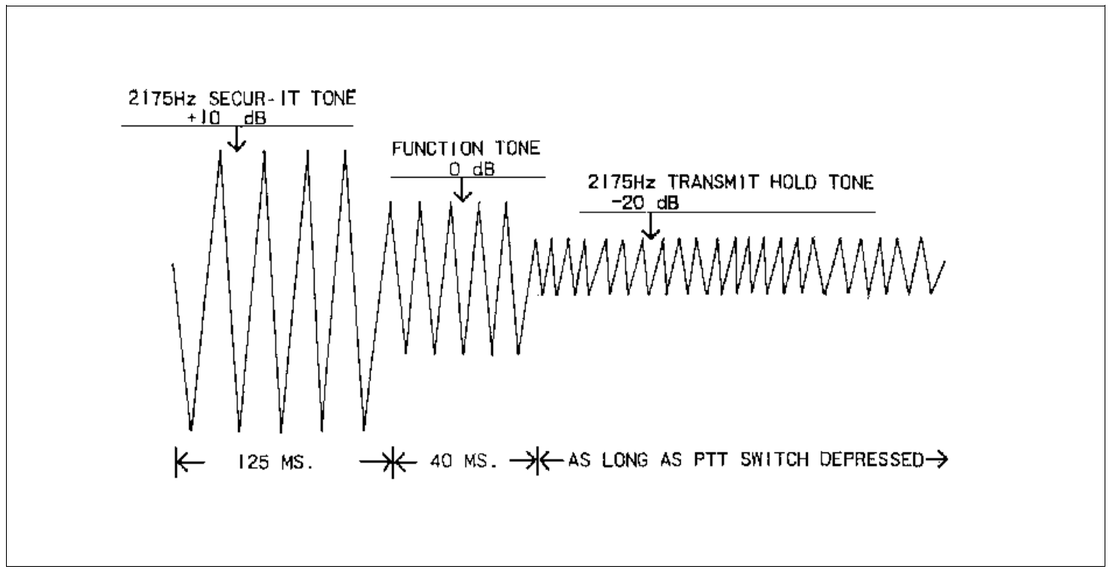

Figure 3 - Tone Control Sequence

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Table 3 - Tone Control Function and Frequency

FUNCTION	TONE
RX Channel Guard Disable (Reset by PTT)	2050 Hz
TX-Freq. No. 1	1950 Hz
TX-Freq. No. 2	1850 Hz
TX-Freq. No. 1 or Receiver No. 1	1750 Hz
TX-Freq. No. 2 or Receiver No. 2	1650 Hz
Channel Guard Decode On or Repeater Enable*	1550 Hz
Channel Guard Decode Off or Repeater Disable*	1450 Hz
TX-Freq. No. 3 or Aux. Function 1 On	1350 Hz
TX-Freq. No. 4 or Aux. Function 1 Off	1250 Hz
Repeater Enable*	1150 Hz
Repeater Disable* or Scan or Simultaneous Monitor	1050 Hz
* 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 T/R Shelf enables (disables) the repeater function. When the repeat function is disabled, the T/R Shelf will not initiate a re-transmission of received signals. However, the audio is still routed to the remote control unit if the transmitter is not keyed.

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.

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.

One-Four Frequencies

The T/R shelf receives "**Function**" tones to select one of four channels (frequencies). The Control Section then loads the Tx and Rx synthesizers with a 32 bit serial word that contains the appropriate frequency information.

Transmit Functions

When a transmit frequency select "**Function**" tone is received from a remote, the T/R 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 T/R 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 T/R 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 T/R 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

A remote control unit can control the state of the **RX 2 MUTE** output line using "**Function**" tones. The "**Function**" tones allow the T/R 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.

When no signal is being received on any channel, the scan function sequentially selects and monitors each channel. If a signal is detected, the T/R Shelf locks onto the channel for the duration of the message and discontinues scanning. The default sample time for each channel is 80 milliseconds. A channel with the receiver unsquelched will be locked on.

REPEAT FUNCTION

The T/R Shelf performs a basic repeat function in which received signals are re-transmitted after filtering and level adjustments. Figure 4 is a block diagram of the T/R 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 received Channel Guard information is filtered out and the transmit Channel Guard , if enabled, is encoded and summed with received audio and then re-transmitted.

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. Local, remote, and repeat PTT timers are each programmed separately and are completely independent timers.

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 T/R 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 stations will not activate another repeat until the PTT is released from any source. However, the T/R Shelf will re-transmit 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 stations equipped with the DOD are shipped from the factory with the timer set for three seconds.

NOTE

The Drop-Out Delay Timer is used primarily for repeater functions. Other transmissions, including those originating from the local microphone, typically 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.

PROGRAMMING

All input and output levels to/from the Control Section are adjusted by electronic potentiometers. These potentiometers are adjusted by the Utility Handset SPK9024 connected to the Mic/Handset port or by a personal computer (PC) connected to the Programming/Diagnostic port, both accessible from the front of the T/R shelf.

The T/R shelf contains an Electrically Erasable Programmable Read Only Memory (EEPROM) whose contents define the personality of the station. The contents of this EEPROM may only be modified through the handset or by running the appropriate software and a PC connected to the programming port.

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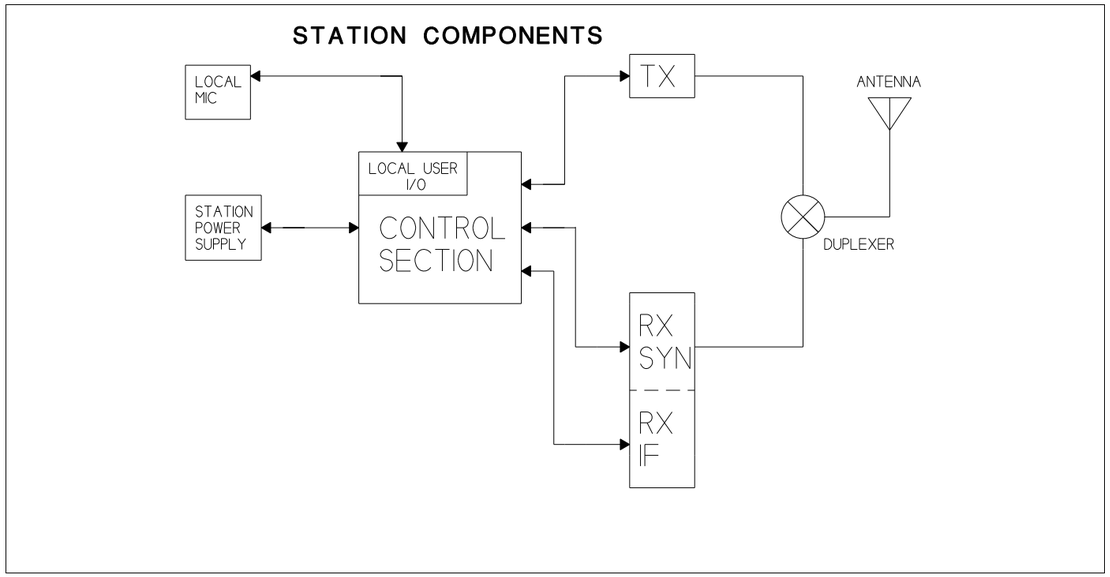

Figure 4 - Repeat Only

For complete instructions on the station personality definitions see TQ-3353, Programming Manual and software for MASTR III. If the T/R Shelf has not been programmed or has lost its personality, it must be reprogrammed.

PROGRAMMABLE FEATURES

The T/R Shelf personality programming parameters include:

Enable (disable) Parameters

- Channel Guard Encode (per channel)
- Channel Guard Decode (per channel)
- STE (Encode) (per channel)
- Repeat Function (per channel)
- CCT (per channel)
- DOD Timer (per channel)
- Simplex/Duplex (per channel)
- Auxiliary Control
- Scan
- Battery Alarm Tone
- DC Remote
- Tone Remote
- 2nd Receiver Simplex (per channel)
- Morse code parameters (per channel)
- Circulator
- Logic Standby
- Intercom
- External Reference Oscillator
- Sidetone

System Parameters

- DSP Line In
- DSP Line Cancellation
- DSP Compressor Gain
- Two/Four Wire Remote
- Battery Alarm Tone "on time"
- Battery Alarm Tone
- Battery Alarm Repetition Rate
- Morse Code ID (per channel)
- Morse Code ID Interval (per channel)
- Morse Code Wait Time (per channel)
- Morse Code Transmit Level
- Line Out level
- Line In level
- Transmit Audio output level (per channel)
- Channel Guard output level (per channel)
- Channel Guard Encode Frequency (per channel)
- Channel Guard Decode Frequency (per channel)
- Type 90 Decode
- Carrier Control Time (per channel)
- Drop-out Delay Time (per channel)
- DTMF Decode
- Transmitter Frequency (per channel)
- Receiver Frequency (per channel)
- Repeat Audio Output Level
- Reference Frequency
- DSP Repeater Gain
- DSP Compressor Threshold
- PA Power Level (per channel)
- Auxiliary 1 Relay Power Up Default State

SYSTEM INTERFACES

This section contains a description of the interfaces to the Control section, transmitter, receiver and operator. Also, interfaces to the GETC board, programming/diagnostics serial port and other miscellaneous interconnections are described.

TRANSMITTER SYNTHESIZER

TRANSMIT AUDIO HI - The Control Section drives the Transmit Synthesizer with this AC coupled signal. The backplane provides the necessary connection.

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

TX OSC CONTROL (PA KEY) - The Control Section generates this digital control signal which keys the RF Power Amplifier. The backplane routes this signal to the PA via connections on the Interface Board.

SERIAL_CLK - This digital signal provides a clock for loading the Tx and Rx Synthesizers. This signal originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

RXF4/AUX2 - This digital signal provides DATA for loading the Tx and Rx Synthesizers. RXF4/AUX2 originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

RXF2 - This digital signal provides an ENABLE pulse to the Tx and Rx Synthesizers. RXF2 originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

TXF1,TXF2,RXF1 - These digital signals provide addresses A0, A1, and A2 for the Tx and Rx Synthesizers. These signals originate at the System Module and are routed by the backplane to the RF Section and the Interface Board.

RECEIVER SYNTHESIZER

SERIAL_CLK - This digital signal provides a clock for loading the Tx and Rx Synthesizers. This signal originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

RXF4/AUX2 - This digital signal provides data for loading the Tx and Rx Synthesizers. RXF4/AUX2 originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

RXF2 - This digital signal provides an enable pulse to the Tx and Rx Synthesizers. RXF2 originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

TXF1,TXF2,RXF1 - These digital signals provide addresses A0, A1, and A2 for the Tx and Rx Synthesizers. These signals originate at the System Module and are routed by the backplane to the RF Section and the Interface Board.

INT_OSC - This digital signal is an output from the Interface Board. The Receiver Synthesizer uses to signal to select either the internal or external reference oscillator. A logic high selects the internal reference oscillator.

RECEIVER INTERFACES

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

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

CAS (**C**arrier **A**ctivity **S**ensor) - A TTL high on this input indicates an on-frequency signal is being received. A TTL low on this input indicates an on-frequency signal is not being received. This input is independent of the presence of a proper CG tone.

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

AUX RX MUTE - The T/R 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 an auxiliary receiver is connected to the T/R Shelf through the **SECOND RCVR** input.

INTERCOM AUDIO - If an on-frequency signal is present, and the receiver is not muted (**RX 1 MUTE** = open collector), de-emphasized audio with no CG present is routed to this output.

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

RUS IN - This RUS output from the second receiver indicates to the T/R shelf that the second receiver is unsquelched with the proper channel guard.

CG MON - This output from the T/R shelf to the second receiver causes the second receiver to drive its' audio output whenever it receives an on-frequency signal of sufficient strength to unsquelch the receiver (RUS is active).

2ND RCVR - This T/R shelf input is driven by the second receiver's line driver monitor output. Using this output instead of the balanced 600 ohm output allows the audio from the second receiver to drive both the remote line pair in addition to a seperate line pair at another remote site.

GETC INTERFACES

RCVR VOL/SQ HI - Receiver audio is routed to the GETC for recovery of 9600 bps digital data and recovery of 150 bps subaudible signalling data.

LINE A, LINE B - This 600 ohm balanced pair from the GETC connects to the T/R Shelf transmit pair telephone line. This provides a 9600 bps downlink from the GETC to a second remote GETC.

DPLX LINE A, DPLX LINE B - This 600 ohm balanced pair to the GETC connects to the T/R Shelf receive pair telephone line. This provides a 9600 bps uplink from a remote GETC to the station's GETC.

DELAYED PTT IN - When active this GETC output keys the station's transmitter.

TX CG EN - This GETC output is only used in Voice Guard End-to-End stations. When a guarded transmission is done, the GETC pulses the 1950 DIS line. The station then mutes the 1950 Hz voting tone. The GETC should then activate the TX CG EN line. If it does not activate it within a second of pulsing the 1950 DIS, the voting tone will come back on.

DETECT DIS - This T/R Shelf input from the GETC signals the T/R shelf whether receive audio or high speed data should be transmitted.

REPEAT PTT IN - This GETC output causes the station to perform a RUS PTT in Voice Guard and is used in back-to-back repeater applications to key the transmitter.

VG PTT IN - This open collector output from the T/R shelf is not used.

REPEAT PTT OUT - This T/R shelf output is true when the station is repeating or doing a guarded remote PTT in Voice Guard End-to-End.

GETC DATA - This T/R shelf input from the GETC provides a path to the transmitter for high speed data transmission.

COMB PTT OUT - This T/R shelf output signals to the GETC that the transmitter is keyed by any PTT except for Morse Code.

LOCAL PTT - This signal is an input to the T/R shelf and the GETC that indicates that PTT on the local mic port is true.

REMOTE PTT OUT - This T/R shelf output is true when a remote PTT function is being executed. However, turning on the REM PTT switch on the front of the System Module will not activate this output.

CAS - This T/R shelf output is driven true when the receiver is unsquelched.

COMB PTT IN - This T/R shelf input is currently not used.

RUS IN - This T/R shelf input is driven true by the GETC's RUS OUT or by an auxiliary receiver when it becomes unsquelched.

CG MONITOR - This T/R shelf output signals to the GETC that the station is operating in Channel Guard Monitor state.

EXT LSD - This T/R shelf input provides a path for subaudible signalling data from the GETC to the transmitter.

1950 DIS - This T/R shelf input from the GETC signals the T/R shelf to mute the 1950 Hz voting tone in Voice Guard End-to-End applications. In Voice Guard Encrypt/Decrypt stations, the 1950 DIS is used to toggle the station between guarded and clear modes.

RX 1 MUTE (SYS RUS OUT) - This T/R shelf output is true when CAS is true along with a valid CG or CG Monitor. In the case of a simplex station, this signal is false during a transmit.

VG MIC HI - This T/R shelf audio output provides a path from the station's mic to the VG-9600 used in Voice Guard applications.

SYS VOL SQ HI - This signal is normally hardwired to RCVR VOL SQ HI and is the signal routed to the System Module in the T/R shelf. In Voice Guard Encryp/Decrypt applications, the printed wire trace JP1 on the T/R shelf backplane is cut and SYS VOL SQ HI is driven by the VG-9600 Module.

VG PTT OUT - This T/R shelf output is true during a remote or local PTT, morse code ID, or drop out delay. Active for Voice Guard Encrypt/Decrypt applications only.

VG ALERT - This T/R shelf audio input from the VG-9600 provides a path for an alert tone to be heard at the station's local speaker and on the remote line.

VG SQ DSBL - This T/R shelf input is used in Voice Guard Encrypt/Decrypt repeater applications. The VG-9600 activates this input when it detects a valid key.

TXF3/DATA (VG CLR SEL) - This T/R shelf output signals the VG-9600 Module that clear voice is being transmitted. This is done only in Voice Guard Encrypt/Decrypt stations.

TXF4/ENBL (VG GRD SEL) - This T/R shelf output signals the VG-9600 Module that guarded (encrypted) voice is being transmitted. This is done only in Voice Guard Encrypt/Decrypt stations.

STATION POWER SUPPLY

Power Supply Inputs

13.8VDC (A+) - The station power supply generates a nominal 13.6 Vdc @ 33 Amps, 4 amperes of which are budgeted to the T/R Shelf. 13.8 Vdc is used by the Power Module to provide the regulated voltages for the T/R Shelf. Power is connected to the T/R shelf at the Interface Board which supplies a connector to mate with the station's power supply cable.

Power Supply Module Outputs

+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 T/R 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 to be present before it will repeat the audio.

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

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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 T/R Shelf is in the **TX DISABLE** mode, and cannot initiate a transmission.

PA ALARM - This LED indicates that the PA has detected an Alarm condition.

Local MIC Interface

LOCAL PTT - A low (1 volt or less) on this input indicates the local microphone is keyed. The T/R Shelf establishes an audio path from the **LOCAL MIC HI** input to the **LINE** and **TX AUDIO** outputs. The T/R 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 T/R Shelf to supply power to the microphone. The microphone AC couples a nominal 100 millivolt rms audio signal into the T/R Shelf's 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 System Module.

GND - This is the ground supply to the microphone.

Line Interface

LINE - Receive audio is sent on this output pair to the remote control device. Transmit audio is also received from the remote control on this line pair if the station is configured for two wire audio. The T/R Shelf has an output impedance of 600 ohms, and can drive a 600-ohm line with an adjustable signal level from -19 to 11 dBm.

DUPLEX AUDIO - Transmit audio is received from the remote control on this wire pair in a four wire system.

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 during manufacture and other system components. When the Utility Handset is connected, the T/R 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. After using the handset, toggle the RESET switch on the Power Module to reset the serial port to 9600 baud.

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

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

Miscellaneous Interfaces

ANT RELAY - This digital output controls the antenna switch in stations so equipped. This output becomes active 15 milliseconds before the PA is keyed to allow time for the mechanical switch to operate before RF power is applied. This output also functions as a Tx Synthesizer power switch control. The Tx Synthesizer oscillator power is switched off when the station is not transmitting and back on when the station is transmitting. The ANT RELAY signal originates at the System Module and is routed by the backplane to the RF Section and the Interface Board.

TX OSC CONTROL (PA KEY) - This digital output gates the RF Power Amplifier on and off. TX OSC CONTROL will not become active unless the Tx Synthesizer indicates it is locked onto the programmed frequency. TX OSC CONTROL originates at the System Module and is routed by the backplane to the RF Section.

MASTR III STATUS - This digital output provides data that indicates the status of the RF modules' fault flags. Each of the RF modules routes its fault status indicator (FLAG 0-FLAG 4) to the Interface Board. This data is then transmitted to the System Module over the same serial bus that loads the synthesizers.

BATT STBY - A high (22-23 Vdc) on this input indicates the station AC power supply is powering the station. A low on this input indicates 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 T/R Shelf provides an alert tone in the **TX AUD** output signal. The alert tone is also heard at the remote control unit.

CIRCUIT ANALYSIS

INTERFACE BOARD

Line Interconnect

Audio and control currents from a remote unit are connected to the T/R shelf via TB101 or J101 located on the Interface Board. TB101 is a terminal board and J101 is a 6 pin modular phone jack. TB101 and J101 carry identical pin assignments and are connected in parallel on the pwb.

Line audio from the base station to a remote unit is coupled onto the line via transformer T101 over signals LINE_A and LINE_B. T101 is designed for a termination impedance of 600 ohms, which should be provided by the remote unit. In two wire applications, line audio from the remote unit is coupled to the System Module by T101, also, over signals LINE_A and LINE_B. For 4 wire systems, line audio from the remote is coupled to the System Module by transformer T102 over signals DPLX_LINE_A and DPLX_LINE_B. The T/R shelf provides the appropriate 600 ohm line termination for T101 and T102.

DC Control

The current detection electronics indicate the following conditions:

1. No current
2. Negative current (in excess of 2 mA)
3. Current magnitude in excess of 5 mA
4. Current magnitude in excess of 10 mA.

Control current passes through a full wave bridge rectifier consisting of diodes D109, D110, D111, and D112. Negative current is directed through U101, D111, through the 6 mA and 12 mA detectors and then out through D110. This negative current causes the photo-transistor of U101 to saturate and thus pull the output DC_CNTRL_3 low.

Positive current flows through D112 of the bridge into the current level sense portion of the circuit which consists of Q101, U102, Q102, U103, D113, and D114. At current levels below 6 mA, Q101 and Q102 are "on" and act as current hogs preventing optoisolators U102 and U103 from turning "on". As the current level approaches 6 mA, the voltage developed across the parallel combination of R117 and R118 exceeds the sum of the zener voltage across D113 and the base-emitter voltage of Q102 which forces Q102 into cutoff. With no current flow through Q102, the 6 mA is forced through U103 which turns it on. As the current level continues to increase toward 11 mA, the same switching action occurs with Q101 and U102 but at a point set by D114. With 11 mA of current DC_CNTRL_1 is true (active low) as well as DC_CNTRL_2 (because 11 mA is greater than 6 mA).

Table 4 - 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

E & M Signalling

For E & M signalling applications, the E & M voltage is applied at TB101 pins 1 and 6 (or J101) which connect to the DC current detection circuit. For 24V signalling, about 8 mA of current is detected as 6 mA by U103 and output on DC_CNTRL_2. For 48V signalling, R105 and R106 should be removed in order to maintain 8 mA of E & M current. Remove P104 and P105 jumpers located on the Interface Board.

Audio Amplifier

Audio power amplifier U104 provides 1 watt of audio to the local service speaker. For convenience,the volume adjust pot R101 is accessible from the front of the station. Resistors R126 and R127 form the gain setting feedback network and C109 and R128 provide compensation for loop stability.

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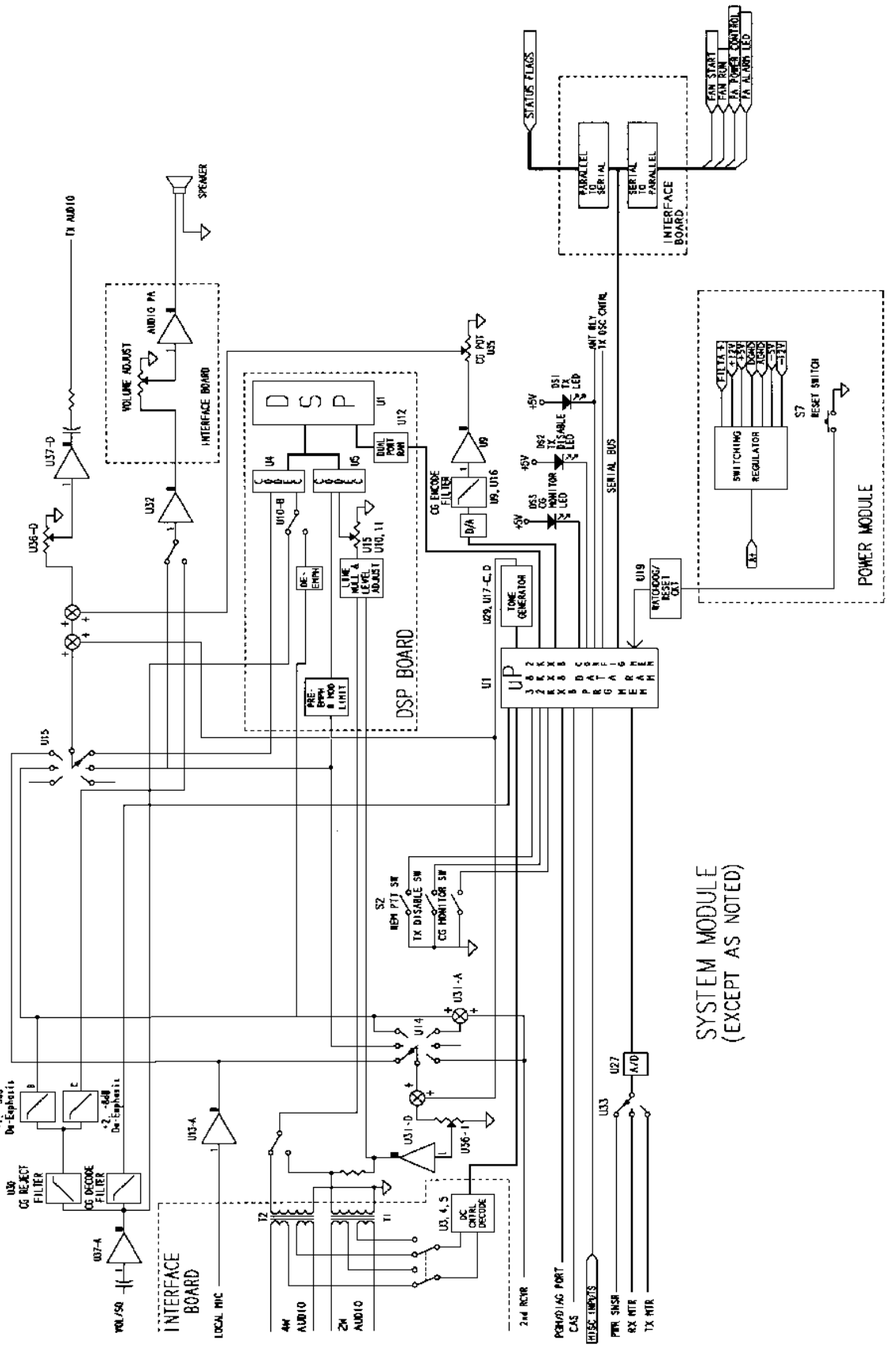


Figure 5 - Station Control Section Block Diagram

Serial Communications

The T/R shelf may be connected to a PC through the front panel connector J103 or it may be connected to the Utility Handset, also front panel accessible through J102. Serial TTL data from the handset (KEYPAD_SERIAL) is converted to RS-232 levels by comparator U110.2 and zener diodes D117 and D118. RS-232 data transmitted from the PC (PC_PGM_RXD) and the level converted data from the handset are switched by D101, D103, and R123 to form signal PGM_RXD. This signal is routed to a RS-232 receiver on the System Module where the UART is located.

Serial data transmitted by the T/R shelf to the PC through J103 (PGM_TXD) is RS-232 compatible and requires no processing. Data transmitted by the T/R shelf to the handset is first inverted and level shifted by Q103 then connected to the handset by signal DISPLAY_SERIAL.

PA Control Functions

The PA control harness connects to the Interface Board at P103. Flag_4 from the PA is the status bit for indicating a PA fault condition. This signal is connected to shift register U105 where it will be read by the System Module. PA_KEY (TX_OSC_CNTRL) is routed directly from the System Module to the PA and is used to key the PA on and off. PA_PWR_CNTRL is a dc voltage from 4 to 8 volts that sets the power output of the PA. This voltage is developed by electronic potentiometer U108 and is level shifted and buffered by U110.1 and U110.3. Electronic pot U108 is controlled by the System Module using RXF1,TXF2,TXF1 (A2,A1,A0), SERIAL_CLK (Clock), and RXF2 (Enable). The System Module first outputs address bits A2,A1, and A0. Then chooses whether to increment or decrement the pot by the logic state of ENABLE. With this done, the pot voltage is incremented or decremented on pulses from CLOCK.

PA Fan Controller

The DC fan mounted onto the RF Power Amplifier is rated at 12 Vdc and draws about 600 mA of current. Amplifier U110.4 with its associated feedback network along with Q108 and Q109 provide a closed loop current regulator. Since motor torque is proportional to current and motor speed is proportional to torque, we have a fan speed regulator. The circuit provides a constant 600 mA of current for the fan which is drawn from supply A+. This current is maintained constant as A+ varies form 15.6V to below 13.5V (as occurs when the station is transmitting). Two fan speeds are provided, one for start-up (to overcome any friction due to dust, aging, cold, etc.) and another for normal operation. Upon reset or power-up, the System Module sets the fan speed at high (FAN_RUN=1, FAN_START=1), then after 10 seconds sets the speed to normal (FAN_RUN=1, FAN_START=0).

Flag Status Register

Shift register U105 acts as a parallel to serial converter that holds the flag status of the 5 RF modules (TX SYN, RX SYN, RXFE, IF, and PA). U105 is controlled by the System Module using RXF1,TXF2,TXF1 (A2,A1,A0), SERIAL_CLK (Clock), RXF2 (Enable), and M3_STATUS. The System Module first outputs A2,A1, and A0. Then the flag bits are loaded into the shift register by setting ENABLE high followed by a low to high to low pulse on CLOCK. The flag bits are then shifted out (with ENABLE low) on M3_STATUS on succeeding CLOCK pulses. Since the register shifts right (LSB first) , the first three bits out are don't cares with the fourth bit out being FLAG_4 and the eighth bit out being FLAG_0.

Output Register

Shift register U106 acts as a serial to parallel converter that expands the System Module's output bits. U105 is controlled by the System Module using RXF1,TXF2,TXF1 (A2,A1,A0), SERIAL_CLK (Clock), RXF2 (Enable), and RXF4/AUX2 (DATA). The System Module first outputs A2,A1, and A0. Next, data is presented by the System Module on the signal DATA and is shifted into U106's buffer on the leading edge of CLOCK. After 8 bits of data have been shifted into U106's buffer, ENABLE is driven high and with the next CLOCK pulse, the 8 bits are loaded into U106's output register. The bits are shifted out of the System Module with the MSB first. The bits are defined as:

D7: NOT USED
D6: NOT USED
D5: NOT USED
D4: NOT USED
D3: PA ALARM - drives PA ALARM LED through inverter Q104
D2: FAN_START - input to PA fan current regulator. Provides max fan speed.
D1: FAN_RUN - input to PA fan current regulator. Provides normal fan speed.
D0: INT_OSC - input to Receiver Syntehsizer. Selects internal or external reference.

Microphone/Handset Interface

J102 provides an interface for either Microphone option SXMC3B (19B801398P11) or Utility Handset SPK9024. The Utility Handset not only provides serial communication with the T/R shelf, but also provides audio into MIC_HI from the handset mic and audio from the T/R shelf (INTRCM_AUDIO) to the handset speaker. Thus, when using the handset a local mic and service speaker are not required.

Circulator Connector

SMA type connector P108 connects the optional circulator power sense signal to the Interface Board and through the backplane to the System Module via signal PWR_SNSR. This signal is sampled by the System Module while the station is transmitting and if the voltage exceeds a predefined limit (indication of fault in antenna system) the System Module will unkey the transmitter and the PA ALARM LED will flash. The transmitter will be disabled until a system reset occurs.

Squelch Adjustment

The station provides for local squelch adjustment through front panel accessible R102 or remote adjustment via handset or remote/diagnostic ports. Signal RCVR_VOL_SQ_HI is connected to two separate voltage divider's formed by R102-R162 and U112-R197. U112 is a digitally programmable potentiometer that is adjusted in a manner similar to U108, the PA power adjustment potentiometer. The output of each divider is connected to analog switch U114. Thus the signal SQUELCH_WIPER, which is fed back to the IF Module, can be selected from either source. It is important to note that if digital (remote) adjustment is selected, the manual adjustment via R102 is disabled.

Relay Options (SXSU3D)

Stations equipped with REV A or higher interface boards, are designed to accept optional relays. The relays include a SOR (Squelch Operated Relay) and two AUX relays, AUX1 and AUX2.

The SOR (K3) contains four form "C" contacts and is rated for 2 amps at 20 Vdc. The relay operates under control of signal RX_1_MUTE, which is derived from CAS, with the coil of K3 being picked up by transistor switch Q110.

AUX1 relay (K1) and AUX2 relay (K2) each contain two form "C" contacts and operate under remote control. When AUX1 function is started via remote control, the system microprocessor sets signal RXF3/AUX1 to logic high which turns on transistor switch Q112 picking up the coil of K1. When AUX2 function is started, the system microprocessor sets bit 4 of output register U106 high, turning on transistor switch Q112 picking up the coil of K2. When the AUX functions are stopped, the control bits are toggled, and the relay coil drops out.

T/R SHELF ALIGNMENT

Instructions for system alignment, including the T/R Shelf, are contained in LBI-38636.

MAINTENANCE

CAUTION

CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the service person 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.

MASTR III STATION T/R SHELF 19D902839G1

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - ASSEMBLIES - - - - - - - - -
A1		**BACKPLANE BOARD 19D902947G1**
		- - - - - - - - - - JACKS - - - - - - - - - -
J1 thru J9	19B801587P8	Connector, DIN: 96-position; sim to AMP 650963-4.
J10	19B801587P11	Connector, DIN: 96-position, right angle mounting; sim to AMP 650895-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A704852P135	Printed Wiring Board Connector.
P2	19A704852P146	Connector, printed wire, two part: 16 contacts; sim to Dupont Berg 22-12-2164.
P3	19A704852P148	Connector, printed wire, two part: 16 contacts; sim to Dupont Berg 22-12-2164.
P4	19A704852P136	Printed Wiring Board Connector.
P5	19A704852P155	Printed Wiring Board Connector.
P6	19A704852P145	Connector, printed wire, two part: 16 contacts; sim to Dupont Berg 22-12-2164.
A2		**INTERFACE BOARD 19D902975G1**
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C101 and C102	7486445P5	Electrolytic, non polarized: 4 µF -10 + 100%, 150 VDCW.
C103	19A700121P106	Ceramic: 0.1 µF ±20%, 50 VDCW.
C104	19A701225P3	Electrolytic: 220 µF, -10+50%, 25 VDCW.
C105	19A700121P106	Ceramic: 0.1 µF ±20%, 50 VDCW.
C106	19A701534P5	Tantalum: 2.2 µF, ±20%, 35 VDCW.
C107	19A701225P3	Electrolytic: 220 µF, -10+50%, 25 VDCW.
C108	19A701534P7	Tantalum: 10 µF ±20%, 16 VDCW.
C109	19A700121P106	Ceramic: 0.1 µF ±20%, 50 VDCW.
C112 and C113	19A701534P5	Tantalum: 2.2 µF, ±20%, 35 VDCW.
C114	19A701534P8	Tantalum: 22 µF ±20%, 16 VDCW.
C115 thru C119	19A700121P106	Ceramic: 0.1 µF ±20%, 50 VDCW.
C121	19A701534P6	Tantalum: 4.7 µF ±20%, 35 VDCW.
C124	19A701534P5	Tantalum: 2.2 µF, ±20%, 35 VDCW.
C125	19A701225P3	Electrolytic: 220 µF -10 +50%, 25 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D101 thru D103	19A700028P1	Silicon: 75 mA, 75 PIV; sim to 1N4148.
D104	19A703595P10	Optoelectronic LED: Red; sim to HP HLMP-1301-010.
D105 thru D108	344A3799P9	Zener: 6.8 volts; sim to 1N4736A.
D109 thru D112	T324ADP1041	Silicon: Rectifier; sim to 1N4004.
D113	19A700025P8	Silicon, zener: 400 mW max; sim to BZX55-C6V8.
D114	19A700025P11	Silicon, zener: 400 mW max; sim to BZX55-C12.
D115 and D116	T324ADP1041	Silicon: Rectifier; sim to 1N4004.
D119	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
D121	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
D123	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
D125	19A700025P4	Silicon, Zener: 400 mA max; sim to BZX55-C3V9.
D126 and D127	19A700028P1	Silicon, 75 mA, 75 PIV; sim to 1N4148.
		- - - - - - - - - - FUSES - - - - - - - - - -
F101 thru F106	19A702169P3	Enclosed link, .375 Amps @ 125 volts; sim to Littlefuse 255.375.
		- - - - - - - - - - JACKS - - - - - - - - - -
J101	344A3288P1	Modular jack: 6-position; sim to AMP 520425-3.
J102	19J706197P3	Connector: 8 contacts; sim to AMP Type 520251-4.
J103	19B209727P43	Connector: Plug.
J104 and J105	19A702104P2	Connector: Shorting Jumper, Gold Plated. (Housing Color: White).
J107	19B209727P17	Connector: 25 contacts; sim to AMP 205738-2.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P101	19B801587P6	Connector, DIN: 96 male contacts; sim to AMP 531796-1.
P102	19A705822P1	Power connector, 4 positions; sim to Amp Cat. #641737-1.
P103	19A704852P32	Printed wire, two part: 6 contacts, sim to Molex 22-29-2061.
P104 and P105	19A704852P2	Connector: 3 Pin Male Header.
P106	19A700072P28	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-27-2021.
P107	19A704852P29	Connector; sim to: Molex 22-29-2031.
P108	19A705512P1	Connector, RF SMB Series: sim to AMP No. 221111-1.
P109	19A700072P28	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-27-2021.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101 and Q102	19A705953P1	Silicon, NPN: sim to MPSA43.
Q103 and Q104	19A700023P2	Silicon, NPN: sim to 2N3904.
Q108	19A700023P2	Silicon, NPN: sim to 2N3904.
Q109	19A700054P1	Silicon, NPN, 60 w; sim to BD-201.
Q110 thru Q113	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19B235632P1	Variable, conductive plastic: 1000 ohms.
R102	19B235632P2	Variable, conductive plastic: 10K ohms.
R103 and R104	H212CRP022C	Deposited carbon: 22 ohms ±5%, 1/4 w.
R105 and R106	H212CRP910C	Deposited carbon: 1 ohm ±5%, 1/4 w.
R107 thru R110	19A700113P74	Composition: 3.0K ohms ±5%, 1/2 w.
R111	H212CRP410C	Deposited carbon: 100K ohms ±5%, 1/4 w.
R112	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R113 and R114	H212CRP315C	Deposited carbon: 15K ohms ±5%, 1/4 w.

SYMBOL	PART NO.	DESCRIPTION
R115 thru R118	19A700113P74	Composition: 3.0K ohms ±5%, 1/2 w.
R119	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R120	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R121	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R122	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R123	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R124	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R125	H212CRP356C	Deposited carbon: 56K ohms ±5%, 1/4 w.
R126	H212CRP118C	Deposited carbon: 180 ohms ±5%, 1/4 w.
R127	H212CRP015C	Deposited carbon: 15 ohms ±5%, 1/4 w.
R128	H212CRP910C	Deposited carbon: 1 ohm ±5%, 1/4 w.
R129	19A700113P162	Composition: 1.0 ohms ±5%, 1/2 w.
R130	H212CRP410C	Deposited carbon: 100K ohms ±5%, 1/4 w.
R131	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R132	H212CRP315C	Deposited carbon: 15K ohms ±5%, 1/4 w.
R133	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R134	H212CRP220C	Deposited carbon: 2.0K ohms ±5%, 1/4 watt.
R135	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R136	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R137	H212CRP127C	Deposited carbon: 270 ohms ±5%, 1/4 w.
R138	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R139	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R144 thru R150	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R151	H212CRP191C	Deposited carbon: 910 ohms ±5%, 1/4 w.
R152	H212CRP110C	Deposited carbon: 100 ohms ±5%, 1/4 w.
R153	H212CRP191C	Deposited carbon: 910 ohms ±5%, 1/4 w.
R154	H212CRP251C	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R155	H212CRP239C	Deposited carbon: 3.9K ohms ±5%, 1/4 w.
R156	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R157	H212CRP282C	Deposited carbon: 8.2K ohms ±5%, 1/4 w.
R158	H212CRP147C	Deposited carbon: 470 ohms ±5%, 1/4 w.
R162	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R163	H212CRP315C	Deposited carbon: 15K ohms ±5%, 1/4 w.
R164	H212CRP412C	Deposited carbon: 0.12M ohms ±5%, 1/4 w.
R165	H212CRP312C	Deposited carbon: 12K ohms ±5%, 1/4 w.
R166	19A700050P11	Wirewound: 0.68 ohms ±10%, 2 w.
R167	H212CRP220C	Deposited carbon: 2.0K ohms ±5%, 1/4 watt.
R168	H212CRP420C	Deposited carbon: 200K ohms ±5%, 1/4 w.
R175 thru R178	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R179 thru R182	H212CRP147C	Deposited carbon: 470 ohms ±5%, 1/4 w.
R183	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R184	H212CRP312C	Deposited carbon: 12K ohms ±5%, 1/4 w.
R185	H212CRP147C	Deposited carbon: 470 ohms ±5%, 1/4 w.
R186	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R187	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R188	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R191	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R192	H212CRP356C	Deposited carbon: 56K ohms ±5%, 1/4 w.
R193	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R194	H212CRP356C	Deposited carbon: 56K ohms ±5%, 1/4 w.
R195	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R196	H212CRP156C	Deposited carbon: 560 ohms ±5%, 1/4 w.
R197	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R198	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R199	H212CRP324C	Ceramic film: 24K ohms, .2 w.
R200	H212CRP510C	Deposited carbon: 1M ohms ±5%, 1/4 w.
R201	H212CRP356C	Deposited carbon: 56K ohms ±5%, 1/4 w.
R202	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R203 thru R205	H212CRP051C	Ceramic film: 51 ohms, .2 w.
R206	H212CRP147C	Deposited carbon: 470 ohms ±5%, 1/4 w.
		- - - - - - - - - - VARSITORS - - - - - - - -
SG101 thru SG106	19A701783P3	Arrester, electrical surge (MOV): sim to V150La20A.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T101 and T102	19A705947P2	Audio: 600 ohm impedance.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - -
TB101	19A705820P5	Terminal Block.
		- - - - - - - - TEST POINTS - - - - - - - -
TP1 thru TP3	344A3367P1	Test point.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U101 thru U103	19A705952P1	Optoisolator; sim to 4N38.
U104	19A701830P1	Linear: Audio AMPLIFIER; sim to TDA 2003.
U105	19A703987P21	Digital: CMOS Shift resister with parallel I/O; sim to 74HC299.
U106	19A703987P24	Digital: CMOS 8-Bit shift register with tri-state outputs; sim to 74HC595
U107	19A704445P1	Digital: CMOS 1-of-8 Decoder/Demulti- plexer; sim to 74HC138.
U108	19A705180P2	Digitally Controlled Potentiometer: 40 - 10K ohms; sim to X9103P.
U109	19A703483P11	Digital: CMOS Quad 2-Input OR Gate; sim to 74HC32.
U110	19A701789P1	Linear: Quad Op Amp; sim to LM324.
U111	19A703483P11	Digital: CMOS Quad 2-Input OR Gate; sim to 74HC32.
U112	19A705180P2	Digitally Controlled Potentiometer: 40 - 10K ohms; sim to X9103P.
U113	19A701789P1	Linear: Quad Op Amp; sim to LM324.
U114	19A700029P38	Digital: CMOS Triple 2 Channel Multiplexer.
		- - - - - - - - SOCKETS - - - - - - - -
XK1 and XK2	19A700156P9	Socket, IC: 16 Pins, Tin Plated.
XK3A	19A700156P7	Socket, IC: 14 Pins, Tin Plated.
XK3B	19A700156P7	Socket, IC: 14 Pins, Tin Plated.

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
5	19A702917P7	Heat Sink, Transistor: Sim to Thermalloy Cat 6030B-TT.
6	19A702364P308	Machine screw, TORX Drive: No. M3-0.5 x 8.
7	19A700032P5	Lockwasher, internal tooth: No. 3MM.
8	19A700034P4	Nut, hex: No. M3 x 0.5MM.
9	19A705469P1	Insulator Plate, TO-220.
		- - - - - - - - - - JACKS - - - - - - - - - -
J1 and J2	19A115938P13	Connector, receptacle.
		- - - - - - - - - - LOUDSPEAKERS - - - - - - - -
LS1	344A3136P1	Speaker, permanent magnet.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
2	19D902721P1	Chassis.
3	19B801732P1	Speaker cloth.
4	19B801706P1	Knob.
5	19A700032P5	Lockwasher, internal tooth: No. 3MM.
6	19A123224P10	Button plug.
7	19A702381P506	Screw, threaded.
8	19A700034P4	Nut, hex: No. M3 x 0.5MM.

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. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

REV. A - INTERFACE BOARD 19D902975G1

To add new features to board including SOR and DSP. New board is backward compatible.
Added C125, D119-D127, R132-R134 and R186-R205, Q110-Q113 and I111-U114.
Changed C103, C105, C109, C115-C119, D105-D108, R111, R158, R179-R182 and R185.
C103, C105, C109 and C115-C119 were: Tantalum: 0.1µF ±20%, 35 VDCW.
D105-D108 were: 19J706030P2.
R111 was: H212CRP310C - 10K ohms ±5%, 1/4 w.
R158 was: H212CRP247C - 4.7K ohms ±5%, 1/4 w.
R179-R182 were: H212CRP247C - 4.7K ohms ±5%, 1/4 w.
R185 was: H212CRP247C - 10K ohms ±5%, 1/4 w.

REV. B - INTERFACE BOARD 19D902975G1

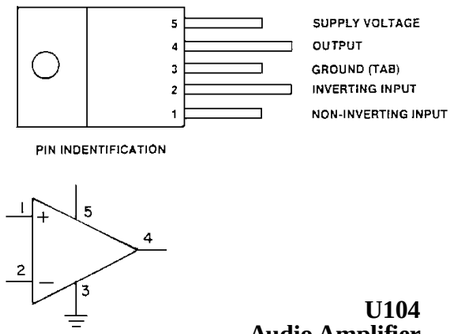
To make RX_1_MUTE Logic Level compatible with GETC level requirement. Added R206 and buffer U111 between RX_1_MUTE and the base of Q110.

REV. A - BACKPLANE BOARD

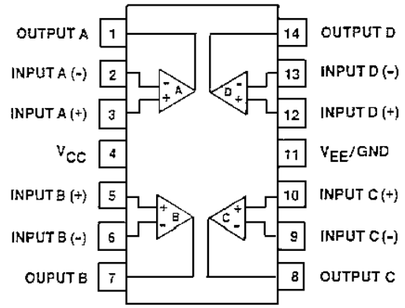
To support GETC and 2nd receiver applications, the printed wire board was changed. Also connectors P1, P3 and P6 changed.

REV. B - BACKPLANE BOARD

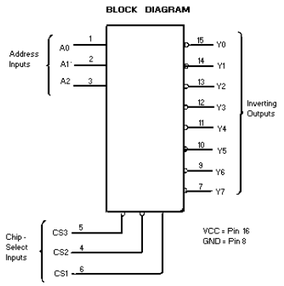
To correct errors on printed wire board, the baud was changed. Connections to J6, J7, J8 and J9, pin 7 were renamed.

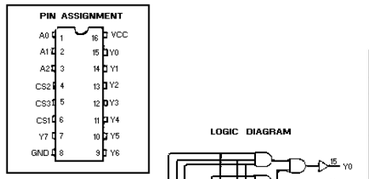


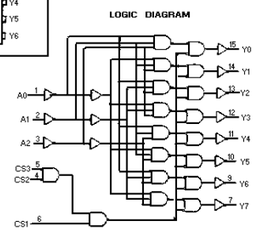
U104
Audio Amplifier
19A701830P1



U110 & U113
Quad OP Amp
19A701789P1





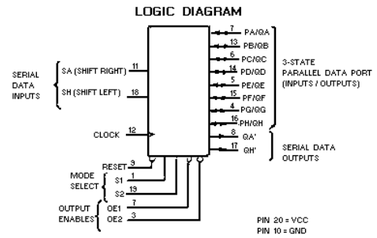


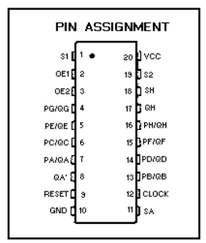
FUNCTION TABLE

Inputs						Outputs							
CS1	CS2	CS3	A2	A1	A0	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	X	H	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	H	L	H	H	H	H
H	L	L	H	L	L	H	H	H	H	L	H	H	H
H	L	L	H	L	H	H	H	H	H	H	L	H	H
H	L	L	H	H	L	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

H = High Level (steady state)
L = Low Level (steady state)
X = Don't Care

U107
1-of-8 Decoder/Demultiplexer
19A704445P1

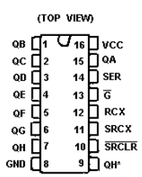


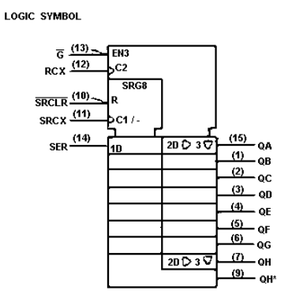


INPUTS									RESPONSE	
Mode	Reset	Mode Select		Output Enables		Clock	Serial Inputs		PA/QA PB/QB PC/QC PD/QD PE/QE PF/QF PG/QG PH/QH	QA' QH'
		S2	S1	OE1	OE2		DA	DH		
Reset	L L L	X L H	L X H	L L X	L L X	X X X	X X X	X X X	L L L L L L L L QA through QH = Z	L L L L
Shift Right	H H H	L H L	H H L	H X X	X H L	↗ ↗ ↗	D D D	X X X	Shift Right : QA through QH = Z ; DA - FA ; FA - FB ; etc. Shift Right : QA through QH = Z ; DA - FA ; FA - FB ; etc. Shift Right : DA - FA = QA ; FA - FB = QB ; etc.	D QG D QG D QG
Shift Left	H H H	H L L	L L L	H X X	X H L	↗ ↗ ↗	X X X	D D D	Shift Left: QA through QH = Z ; DH - FH ; FH - FG; etc. Shift Left: QA through QH = Z ; DH - FH ; FH - FG; etc. Shift Left: DH - FH = QH; FH - FG = QG ; etc.	QB D QB D QB D
Parallel Load	H	H	H	X	X	↗	X	X	Parallel Load: PN - FN	PA PH
Hold	H H H	L L L	L L L	H X L	X H L	X X X	X X X	X X X	Hold: QA through QH = Z ; FN = FN Hold: QA through QH = Z ; FN = FN Hold: QN = QN	PA PH PA PH PA PH

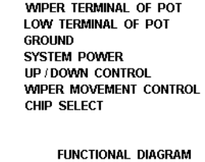
Z = high impedance
D = data on serial input
F = flip - flop (see Logic Diagram)
\When one or both output controls are high the eight input/output terminals are disabled to the high-impedance state; however, sequential operation or clearing of the registar is not affected.

U105
Shift Register
Parallel Output
19A703987P21



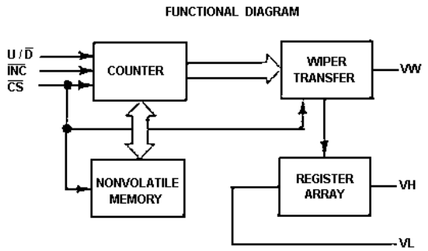


U106
Shift Register
Tri-State Output
19A703987P24

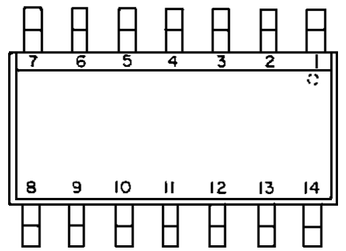


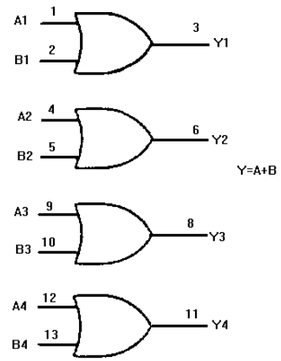
PIN NAME

VH	HIGH TERMINAL OF POT
VW	WIPER TERMINAL OF POT
VL	LOW TERMINAL OF POT
VSS	GROUND
VCC	SYSTEM POWER
U / D	UP / DOWN CONTROL
INC	WIPER MOVEMENT CONTROL
CS	CHIP SELECT



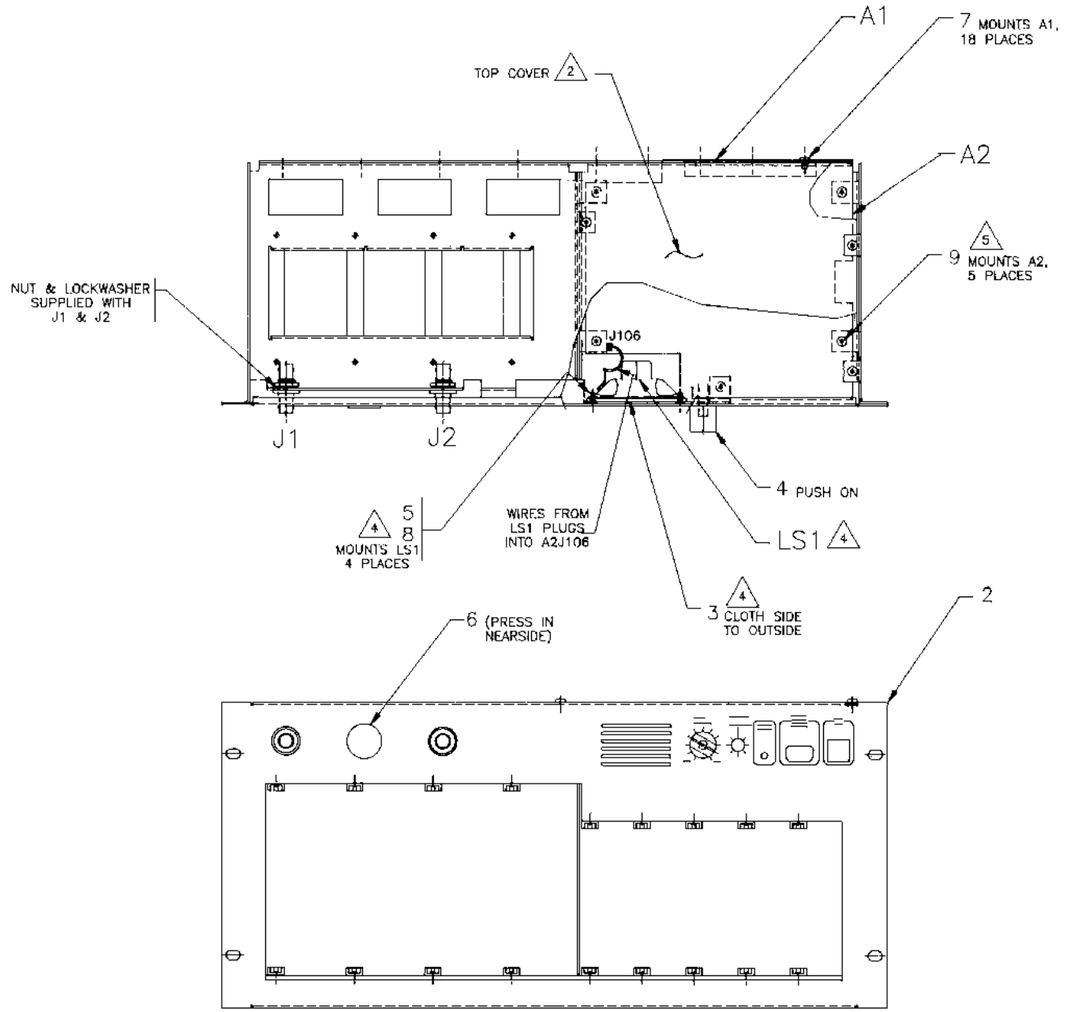
U108 & U112
Digital Controlled Potentiometer
19A705180P2

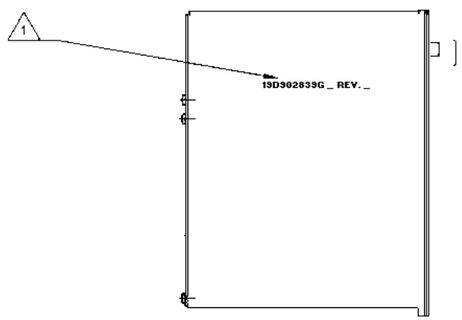


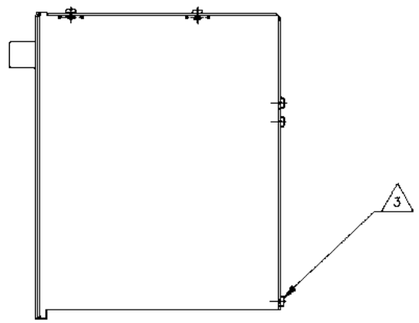


PIN 14 = Vcc
PIN 7 = GND

U109 & U111
Quad 2-input or Gate
19A703483P11





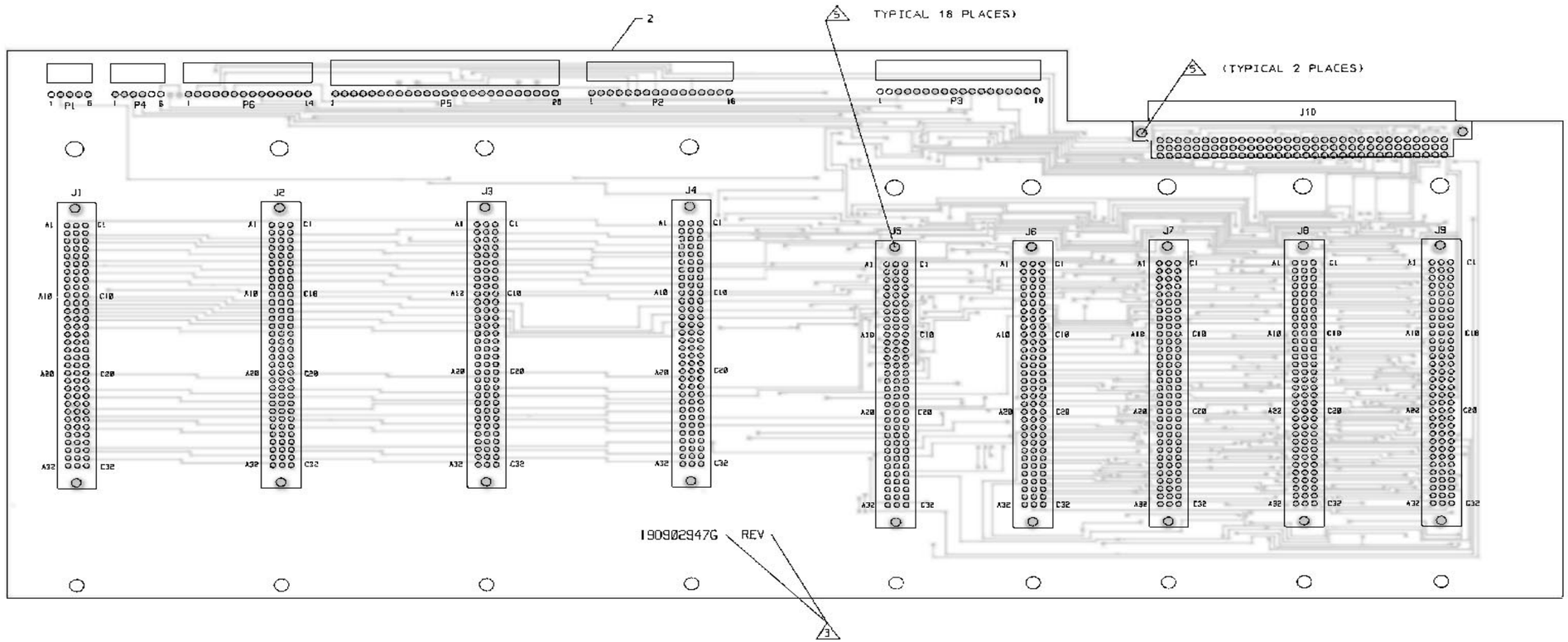


(1) NOTES:

1. MARK ERICSSON-GE DRAWING,GROUP, AND REVISION NUMBER IN THIS GENERAL AREA.
   CHARACTERS TO BE APPROX. .125 HIGH
   PER 19A115470P1
   COLOR TO CONTRAST TO BACKGROUND
2. TOP COVER MUST BE REMOVED TO MOUNT LS1 AND A2, THEN REASSEMBLED.
   TORQUE TOP COVER RETAINING SCREWS TO 11 ±1 in.lb.
3. ASSEMBLE BACKPLANE, A1, TO CHASSIS IN POSITION SHOWN AND SECURE IN PLACE WITH THE BOTTOM 9 SCREWS, ITEM 7, BEFORE DRIVING IN THE TOP 9 SCREWS.
   TORQUE SCREWS ITEM 7 TO 11 ±1 in.lb.
4. POSITION LS1 AS SHOWN AND ORIENTATE SPEAKER CLOTH ITEM 3 AS SHOWN. TORQUE NUTS ITEM 8 TO 6 ±1 in.lb.
5. TORQUE SCREWS ITEM 7 RETAINING BOARD A2 IN POSITION TO 11 ±1 in.lb.

MASTR III T/R SHELF
19D902839G1

(19D902839 Sh.1 Rev.2)

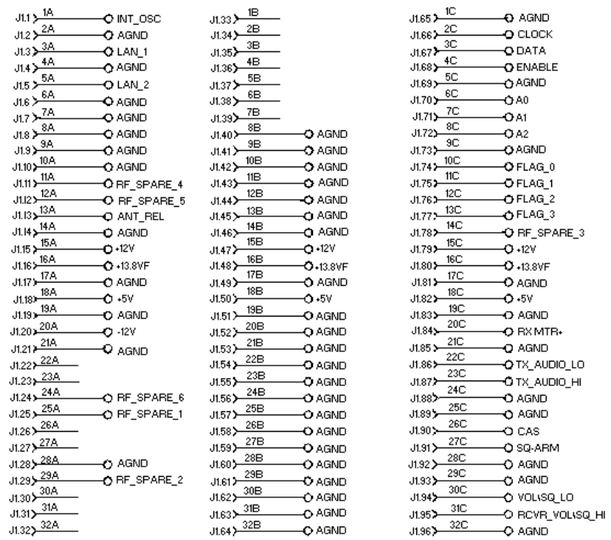


(19D902947, Rev. 4)
(19D902948, Layer 2, Rev. 5)

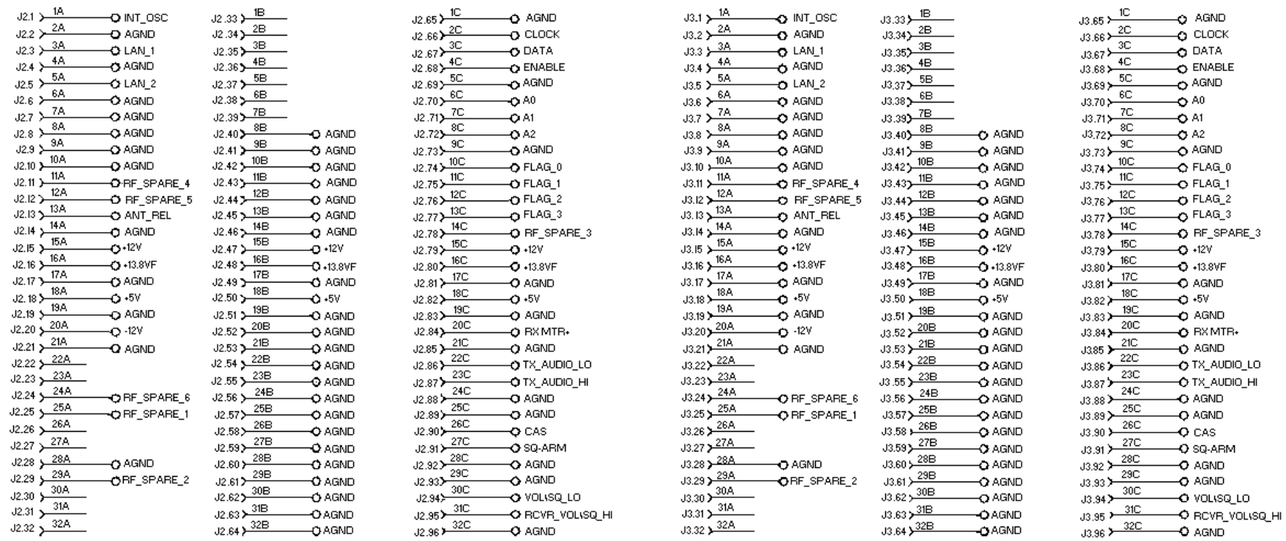
T/R SHELF BACKPLANE (A1)
19D902947G1

(19D902949 Sh.1 Rev.2)

TX SYNTHESIZER

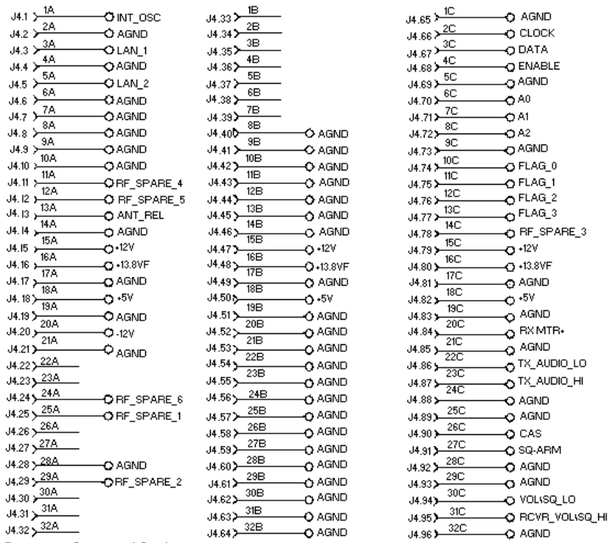


RX SYNTHESIZER

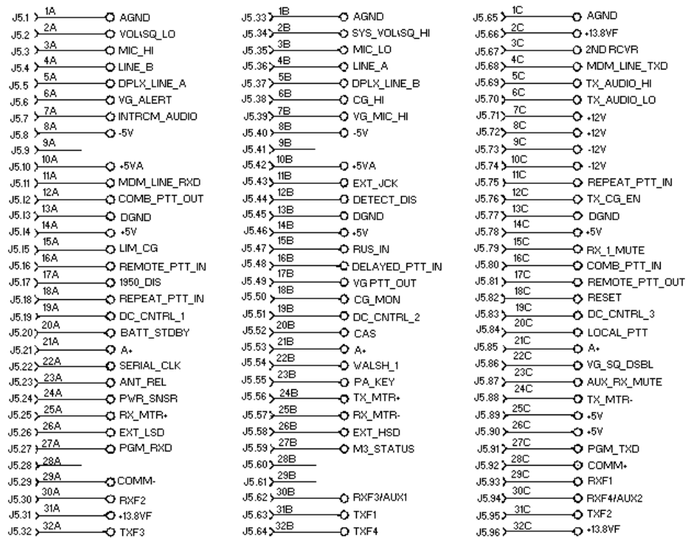


RX FRONT END

RX IF



SYSTEM MODULE

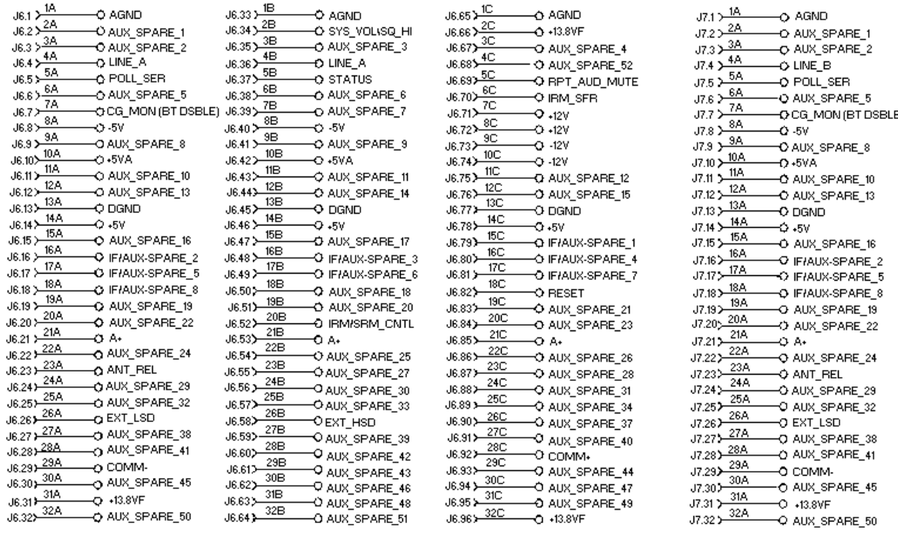


THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
PL19D902947G1	B

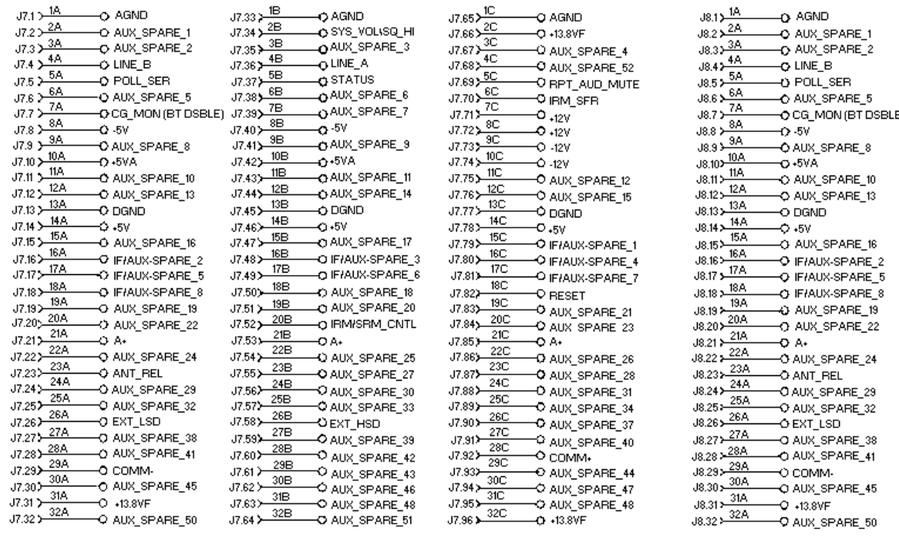
T/R SHELF BACKPLANE (A1)
19D902947G1

(19D902949 Sh.1 Rev.3)

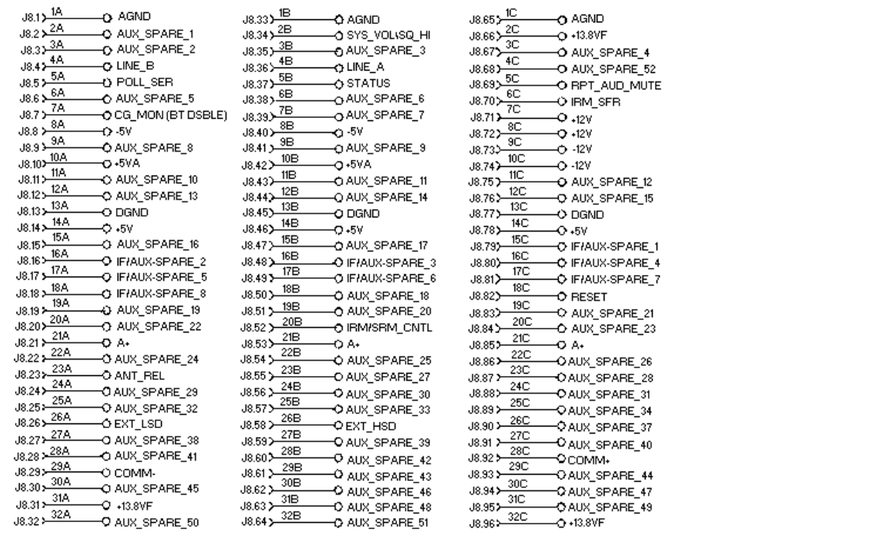
SPARE 1



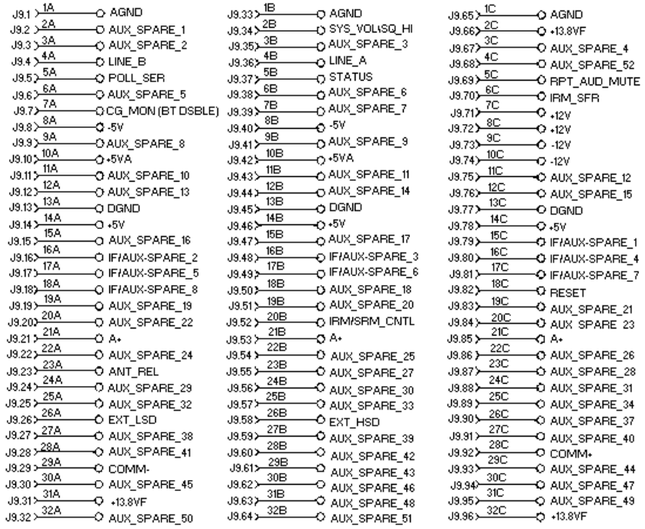
SPARE 2



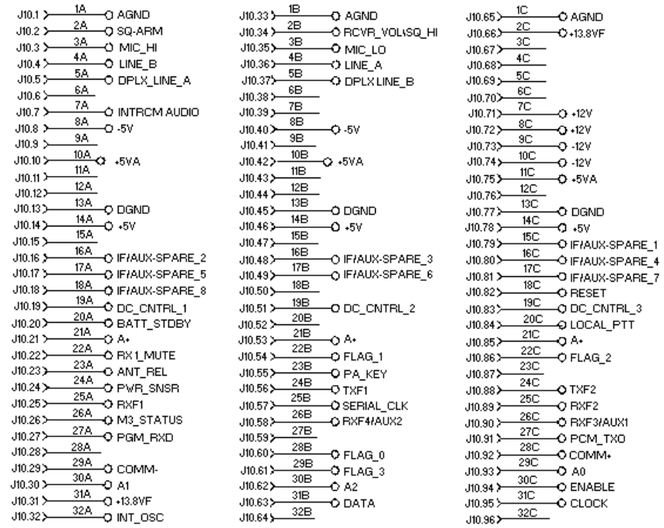
SPARE 3



POWER MODULE

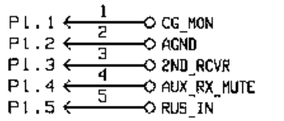


INTERFACE BOARD

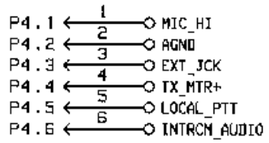


T/R SHELF BACKPLANE (A1)
19D902947G1

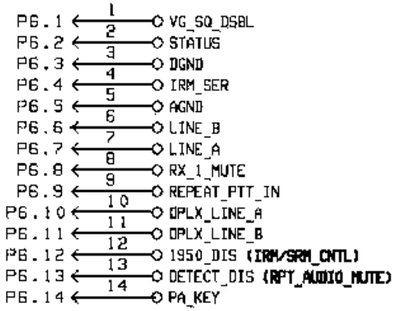
(19D902949 Sh.2 Rev.3)



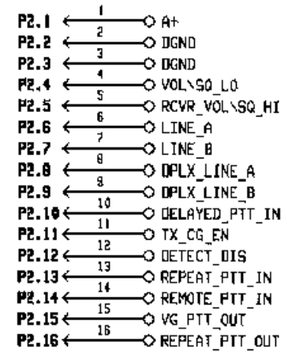
2ND RCVR



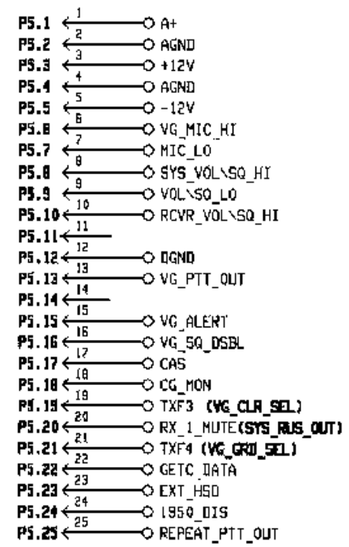
EXTERNAL METERING/RIC



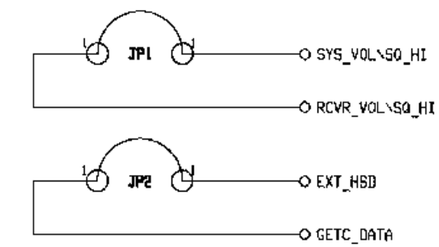
GE-MARC



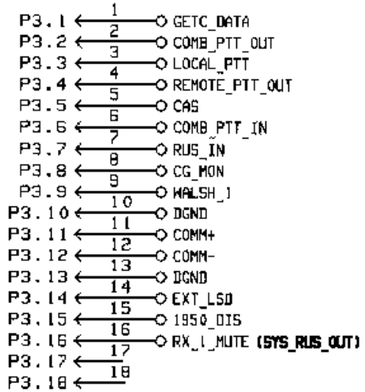
GETC



VOICE GUARD



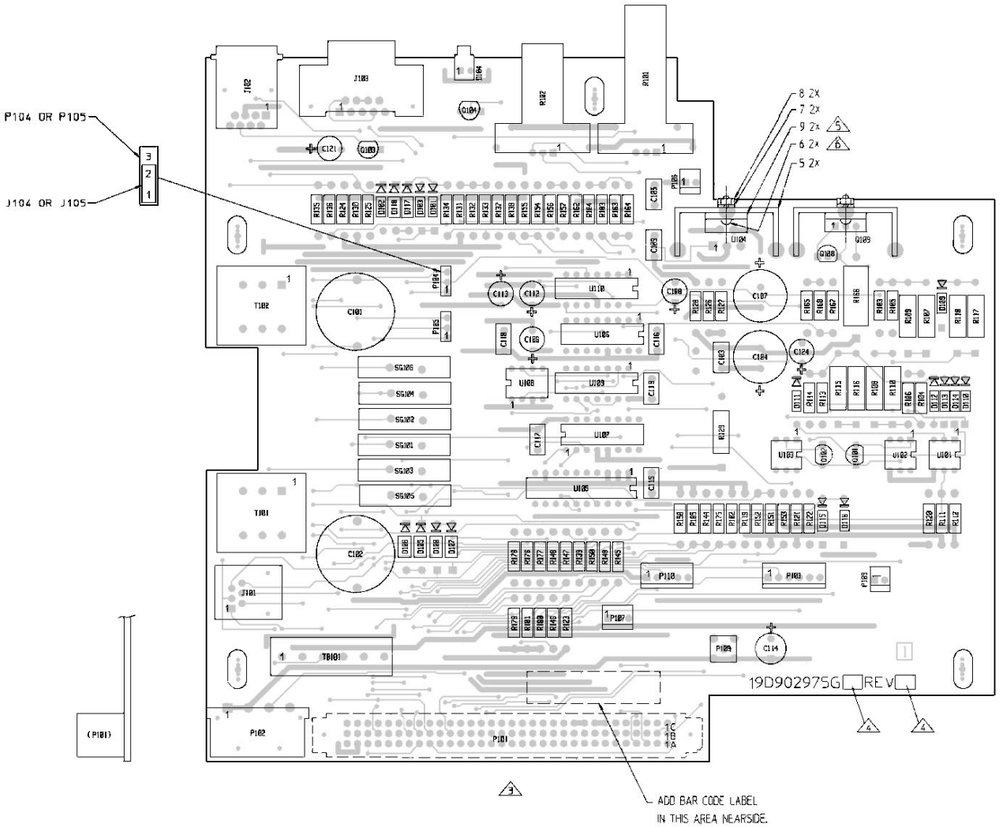
NOTE: CUT PWB RUNS FOR VG E/D ONLY



GETC

T/R SHELF BACKPLANE (A1)
19D902947G1
(19D902949 Sh.3 Rev.4)

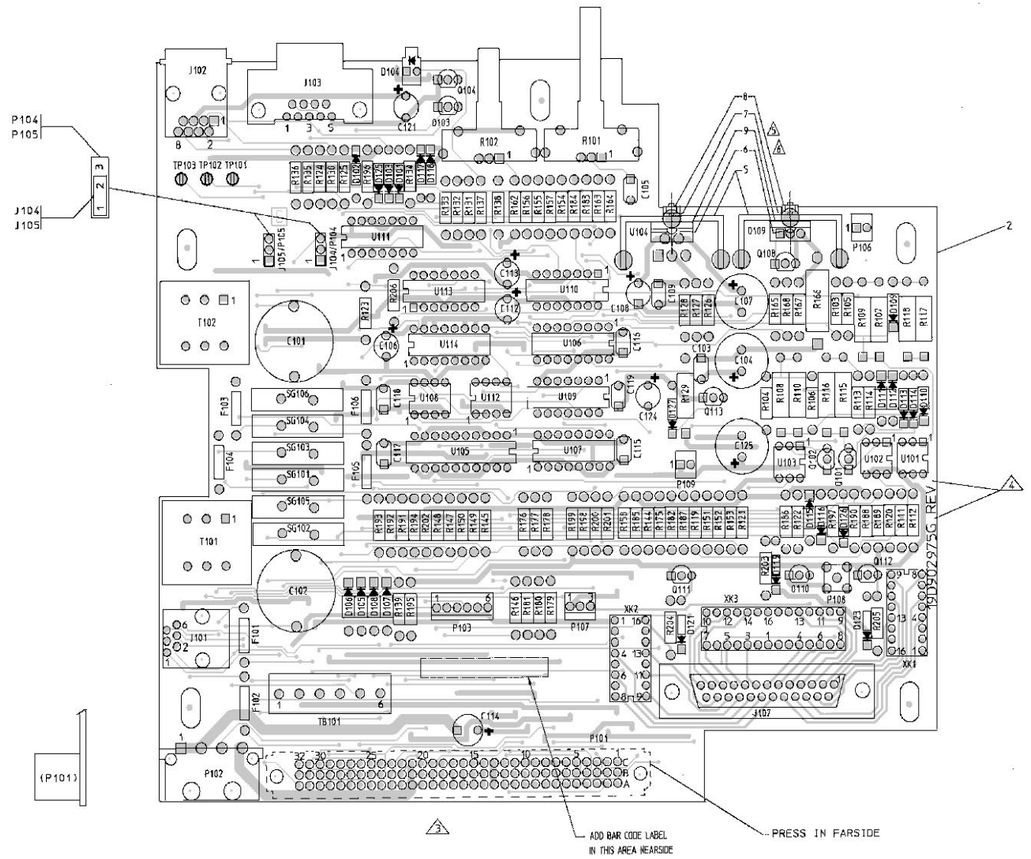
COMPONENT SIDE



(19D902975, Sh. 1, Rev. 2)
(19D902976, Rev. 1)

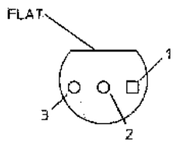
T/R SHELF INTERFACE BOARD (A2)
19D902975G1

COMPONENT SIDE



(19D902975, Rev. 4)
(19D902976, Rev. 3)

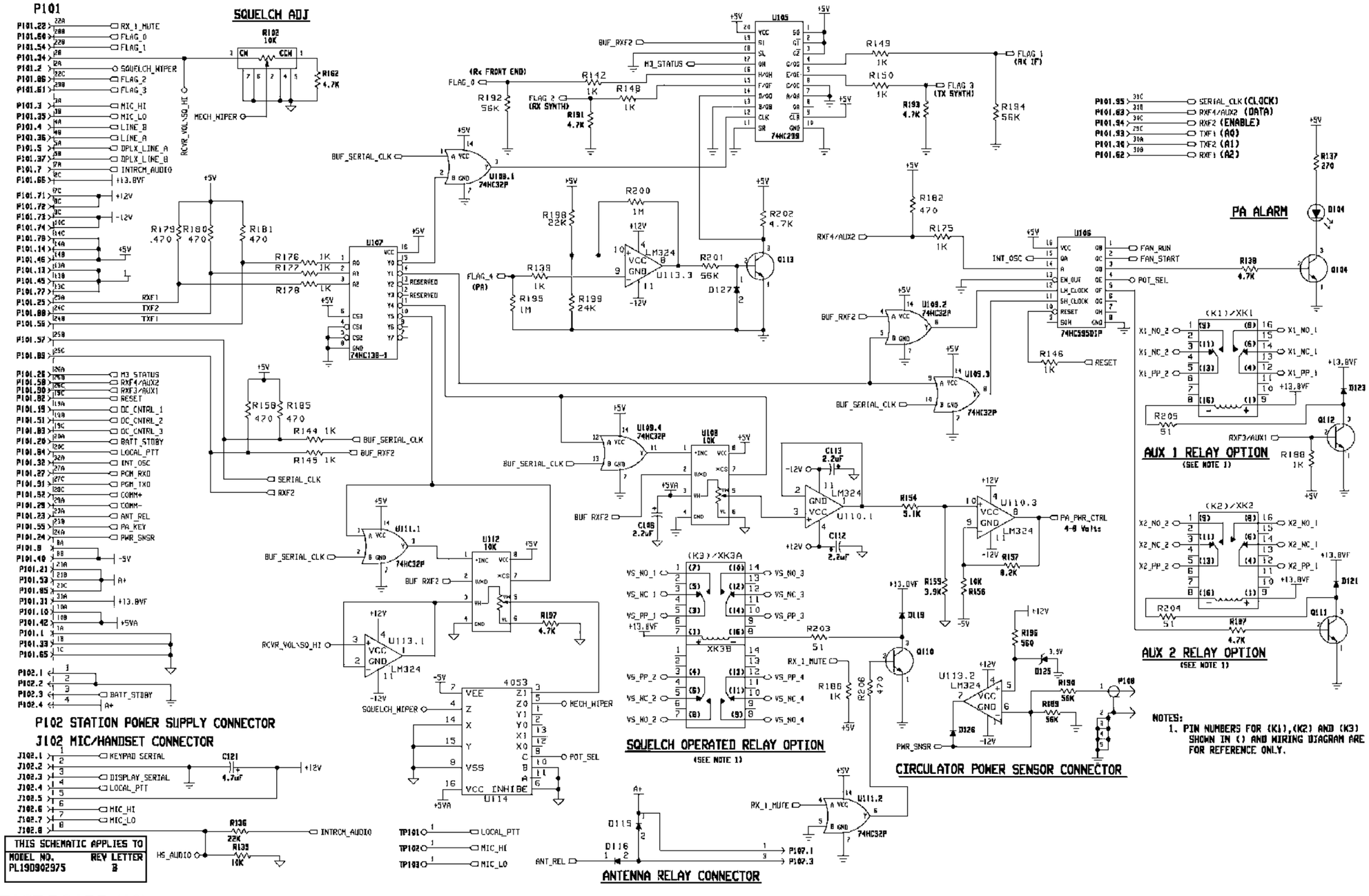
LEAD IDENTIFICATION
FOR Q101, Q102, Q103, Q104 AND Q108



IN-LINE
TOP VIEW

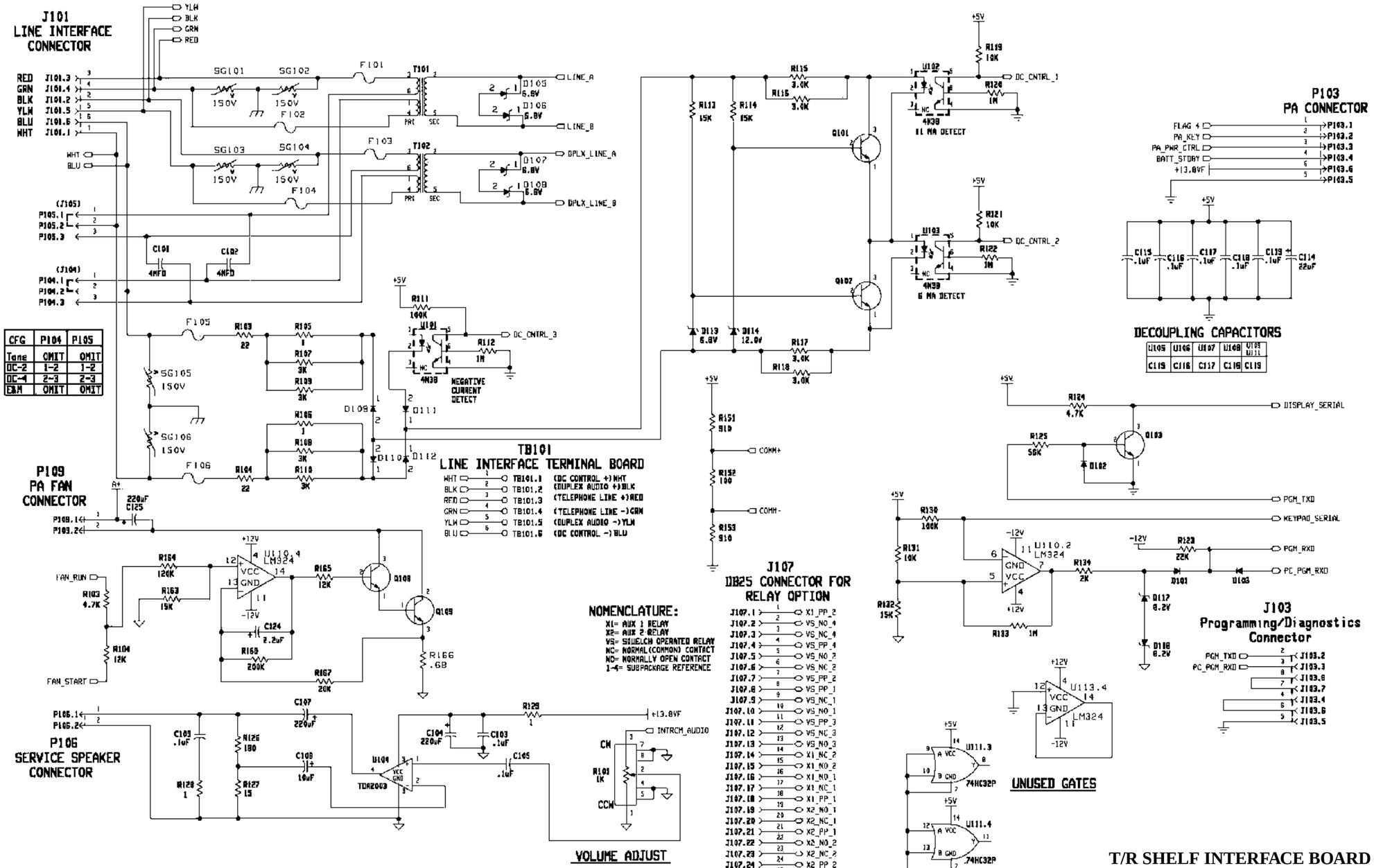
NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

T/R INTERFACE BOARD
(Rev. A and later) (A2)
19D902975G1



T/R SHELF INTERFACE BOARD (A2)
19D902975G1

(19D902977 Sh.1 Rev.7)



T/R SHELF INTERFACE BOARD (A2)
19D902975G1

(19D902977 Sh.2 Rev.7)