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Introduction and Interfacing of the Motorola® Quantar® station

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Note from Mike WA6ILQ:
The aricle below showed up at my QRZ address as a Word file and some JPGs on a floppy, in an envelope, with no return address. The note included stated that the author worked for Moto however had to have anonymity to keep his job. I've not been inside a Quantar nor seen the manuals.

The Motorola Quantar® / Quantro® family is a very capable station and available off the shelf in amateur frequency bands. The Quantro is essentially a high power version of the Quantar with an external PA deck. The Quantar is the current high-end unit of the Motorola fixed station product line and is available in several configurations handling conventional and trunking installations. For our purposes we will be looking for a Quantar that is <u>not</u> classified as an "IntelliRepeater®" (IR) or an "Intelligent Site Repeater®" (ISR) as they will not function as conventional repeaters without firmware changes. You want a conventional or SmartNet capable station. Most of the newer stations are Astro Digital® capable (APCO Project 25 Common Air Interface). Depending on the version of PA, they are capable of low power (20 watt) operation up to the standard high power PA at 110 watts for UHF and 125 watts for VHF. Quantros can be capable of up to 250 watts.

The general specifications of the Quantar stations are shown below. Click on any of the bordered images to see a larger view.

PERFORMANCE SPECIFICATIONS

General

TX Sub–Band Range	**VHF** 132–154 MHz (R1) 150–174 MHz (R2)	**UHF** 380–433 MHz (R0) 403–433 MHz (R1) 438–470 MHz (R2) 470–494 MHz (R3) 494–520 MHz (R4)	**800** 851–870 MHz	**900** 935–941 MHz
RX Sub–Band Range	**VHF** 132–154 MHz (R1) 150–174 MHz (R2)	**UHF** 380–433 MHz (R0) 403–433 MHz (R1) 438–470 MHz (R2) 470–494 MHz (R3) 494–520 MHz (R4)	**800** 806–825 MHz	**900** 896–902 MHz
Number of Channels	16			
Channel Spacing	**VHF:** 30, 25, 12.5 kHz **UHF/800:** 12.5, 25 kHz **900:** 12.5 kHz			
Frequency Generation	Synthesized			
Power Supply Type	Switching			
Power Supply Input Voltage	90–280 V ac			
Power Supply Input Frequency	47–63 Hz			
Battery Revert	12V (25W radios) 24V (100W, 110W, and 125W radios)			
T/R Separation (without duplexer option)	**VHF/UHF:** Any spacing within same sub-band **800:** 45 MHz **900:** 39 MHz			
T/R Separation (with duplexer option)	**VHF/UHF:** ≥ 1.5 MHz **800:** 45 MHz **900:** 39 MHz			
Temperature Range (ambient)	—30° C to +60° C			

The receiver specifications are shown below.

PERFORMANCE SPECIFICATIONS (Cont'd)

Receiver

I–F Frequencies	**VHF** 21.45 MHz (1st) 450 kHz (2nd)	**UHF** 73.35 MHz (1st) 450 kHz (2nd)	**800** 73.35 MHz (1st) 450 kHz (2nd)	**900** 73.35 MHz (1st) 450 kHz (2nd)
Preselector Bandwidth	**VHF/UHF:** 4 MHz **800:** 19 MHz **900:** 6 MHz			
Sensitivity (12 dB SINAD)	**VHF:** 0.25 µV **UHF:** 0.35 µV **800/900:** 0.30 µV			
Sensitivity (20 dB Quieting)	**VHF:** 0.35 µV **UHF:** 0.5 µV **800/900:** 0.42 µV			
Adjacent Channel Rejection	**VHF** 90 dB (25/30 kHz) 80 dB (23.5 kHz)	**UHF** 75 dB (12.5 kHz) 85 dB (25 kHz)	**800** 70 dB (12.5 kHz) 80 db (25 kHz)	**900** 70dB
Intermodulation Rejection	**VHF** 85 dB (25/30 kHz) 80 dB (30 kHz)	**UHF** 85 dB	**800** 85 dB	**900** 70 dB
Spurious and Image Rejection	100 dB			
Wireline Output	−20 dBm to 0 dBm @ 60% Rated System Deviation, 1 kHz			
Audio Response (Analog Mode)	+1, −3 dB from 6 dB per octave de–emphasis; 300–3000 Hz referenced to 1000 Hz at line input			
Audio Distortion	Less than 3% @ 1000 Hz			
FM Hum and Noise (300 to 3000 kHz bandwidth)	**VHF** 50 dB (25/30 kHz) 45 dB (12.5 kHz)	**UHF** 45 dB (12.5 kHz) 50 dB (25 kHz)	**800** 45 dB (12.5 kHz) 50 dB (25 kHz)	**900** 45 db
Frequency Stability	**VHF/UHF/800:** 1 ppm **900:** 0.1 ppm			
RF Input Impedance	50 Ω			
FCC Designation (FCC Rule Part 15)	**VHF:** ABZ89FR3776 **UHF:** ABZ89FR4796 **800:** ABZ89FR5757 **900:** ABZ89FR5768			

The transmitter specifications are shown below.

PERFORMANCE SPECIFICATIONS (Cont'd)

Transmitter

	VHF	UHF	800	900
Power Output	6−25W 25−125W	5−25W 25−110W	5−20W 20−100W	25−100W
Electronic Bandwidth	Full sub−band			

Intermodulation Attenuation	**VHF:** 20 dB (single circulator; standard on all PAs)
	           65 dB (triple circulator − requires triple circulator option)
	
	UHF: 50 dB (single circulator; standard on all PAs)
	
	800: 50 dB (single circulator; standard on all PAs)
	
	900: 20 dB (single circulator; standard on all PAs)
	           70 dB (triple circulator − requires triple circulator option)			

Spurious and Harmonic Emissions Attenuation	90 dB			
Deviation	**VHF, UHF, and 800** ±5 kHz (25 kHz) ±2.5 kHz (12.5 kHz)		**900** ±2.5 kHz	
Audio Sensitivity	−35 dBm to 0 dBm (variable)			
Audio Response (Analog Mode)	+1, −3 dB from 6 dB per octave pre−emphasis; 300−3000 Hz referenced to 1000 Hz at line input			
Audio Distortion	Less than 2% @ 1000 Hz @ 60% rated system deviation			
FM Hum and Noise (300 to 3000 Hz bandwidth)	45 dB nominal (12.5 kHz) 50 dB nominal (25/30 kHz)			
Frequency Stability	**VHF, UHF, 800:** 1 ppm **900:** 0.1ppm			
RF Output Impedance	50 Ω			
FCC Designation	**VHF** 25W: ABZ89FC3774 (FCC Rule Parts 22, 74, 80, 90) 125W: ABZ89FC3773 (FCC Rule Parts 22, 74, 80, 90) **UHF** 25W/R1−2: ABZ89FC4797 (FCC Rule Parts 22, 74, 90) 110W/R0: ABZ89FC4798-A (FCC Rule Part 90) 110W/R1−3: ABZ89FC4798 (FCC Rule Parts 22, 90) 100W/R4: ABZ89FC4798 (FCC Rule Part 74) **800** 20W: ABZ89FC5775 (FCC Rule Parts 22, 90) 100W: ABZ89FC5776 (FCC Rule Parts 22, 90)			
FCC Designation	**900** 100W: ABZ89FC5767 (FCC Rule Part 90)			

The stations are capable of operating either as a repeater (Full Duplex) with in-cabinet repeat, or as a base station (half duplex). They have built in CWID functionality as well on a programmable interval of 5 to 60 minutes. For Quantar stations to operate as a base station an external T/R relay controlled by J23 is needed for single antenna operation.

With a wireline board installed the stations are also capable of either programmable TRC (Tone Remote Control) or DC control operation.

To use the station for external audio and PTT, a wireline card is required. These cards come in either a 4 or 8 wire type and either will suffice for controller interface. All wireline and control signals are available from the back panel of the station at J17, which is a 50-pin telco connector. Audio is also available from connector 61 which is an orange block coming from a cable to the wireline board. Standard 4 wire designations are: Line1 is audio to the transmitter, Line2 is audio from the receiver. Audio line levels are software programmable and the transmit audio level will need to be calibrated to a standard tone level from the RSS alignment screens. The factory default programming is -10dBm (test tone level) for transmit of 60% rated deviation, and -11dBm (test tone level) receiver output level at full deviation. Remember that there is a 4.4 dBm difference between test tone level and peak audio level (-10dBm test tone = -5.6dBm peak).

The station can be programmed to use mixed mode (both analog and digital) operation but to use Astro Digital® modes from the wireline requires either an Astro Modem or V.24 daughter board for the wireline

card, as well as an external DIU® (Motorola Digital Interface Unit) as the station does not do the A/D conversion. I believe the DIU requires TRC operation as well but don't hold me to it…

Programming and alignment of the Quantar station takes Motorola RSS Software. I will not be covering programming or alignment for this document but will mention places where certain options must be programmed for a function. The stations do not require any modification to work on US amateur frequencies, only the correct frequency range modules.

General Overview:

The image below shows the major assemblies and connectors.
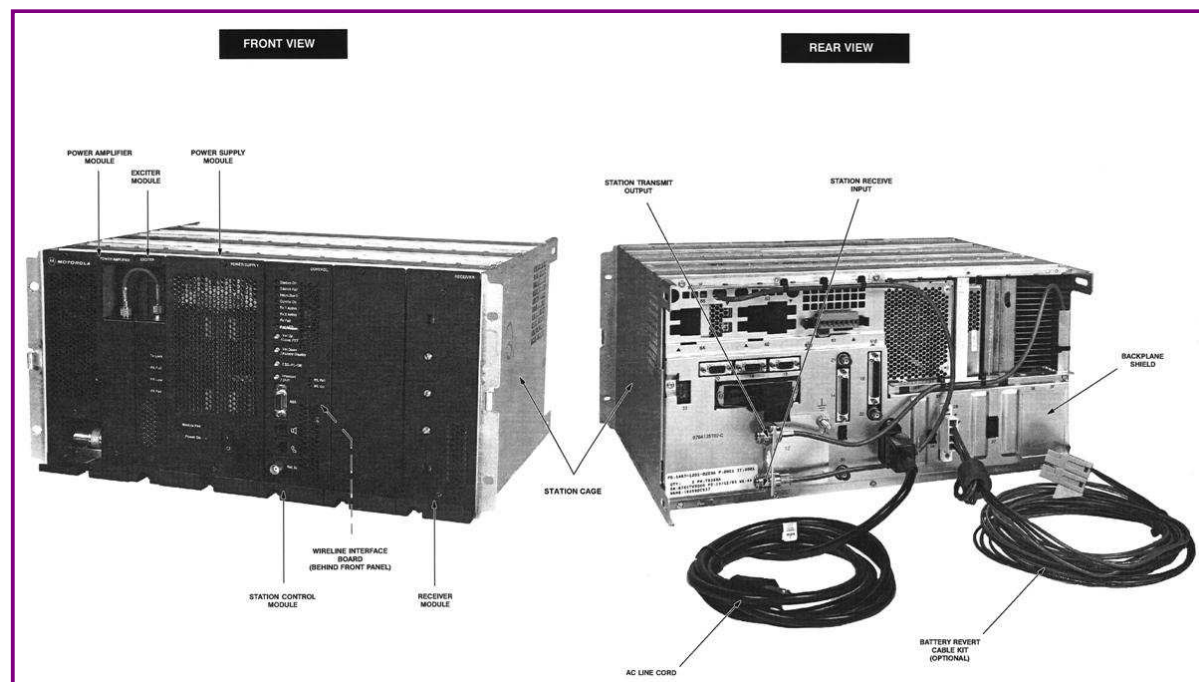
The image below details the front panel controls and indicators.
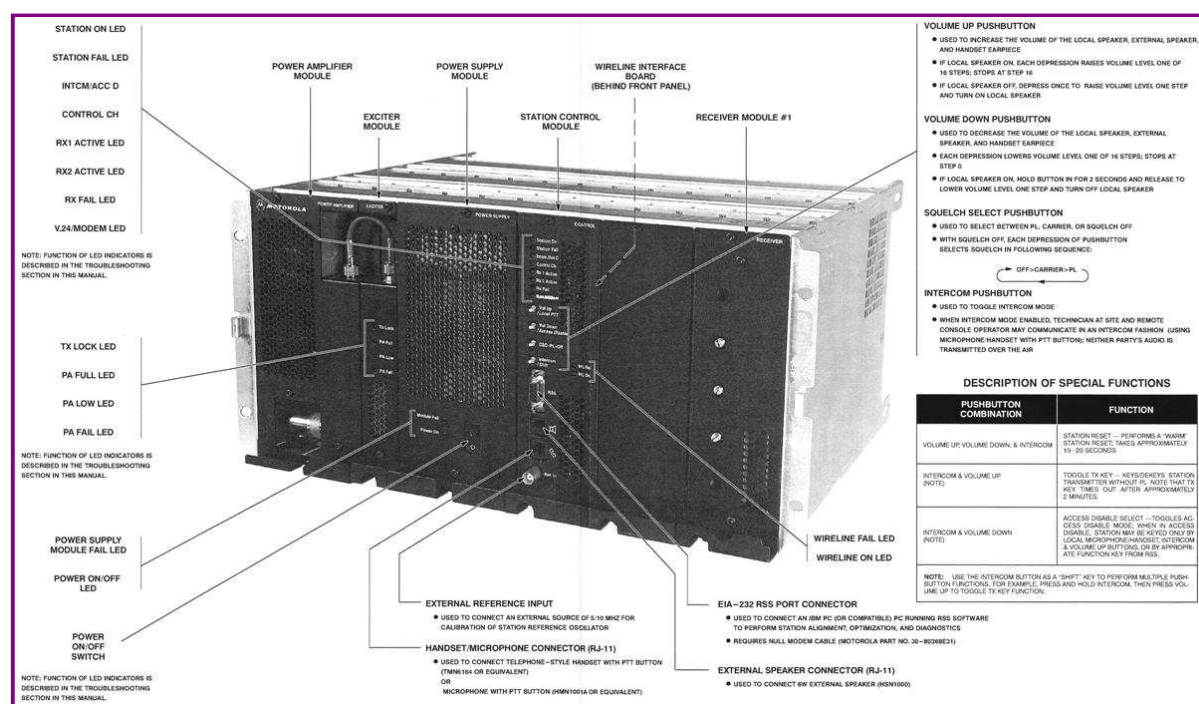
Interfacing to External Controllers:

The signals of interest for interfacing to an external repeater controller are: Transmit Audio, Receive Audio,

COS, PTT, and Transmitter Inhibit. Programming of the station for base or repeater operation depends on the application. If you intend to use the station only as a transmitter and receiver with the external controller doing the work of PTT and audio switching, then base station operation is call for. If you will be using it as a standalone repeater with a feed from and IRLP node computer or link radio with no other external controller, then repeater operation would be preferred. Again, this is a highly programmable radio with many features and functions and by turning on the Wildcard option in the station it can be even more programmable but that is beyond the basic scope of this article.

All of the functions described below are available by default without any special programming.

Audio Wiring:

Line1 = Transmit Audio: balanced 600ohm *(requires PTT from J17 to pass wireline audio to the transmitter).*
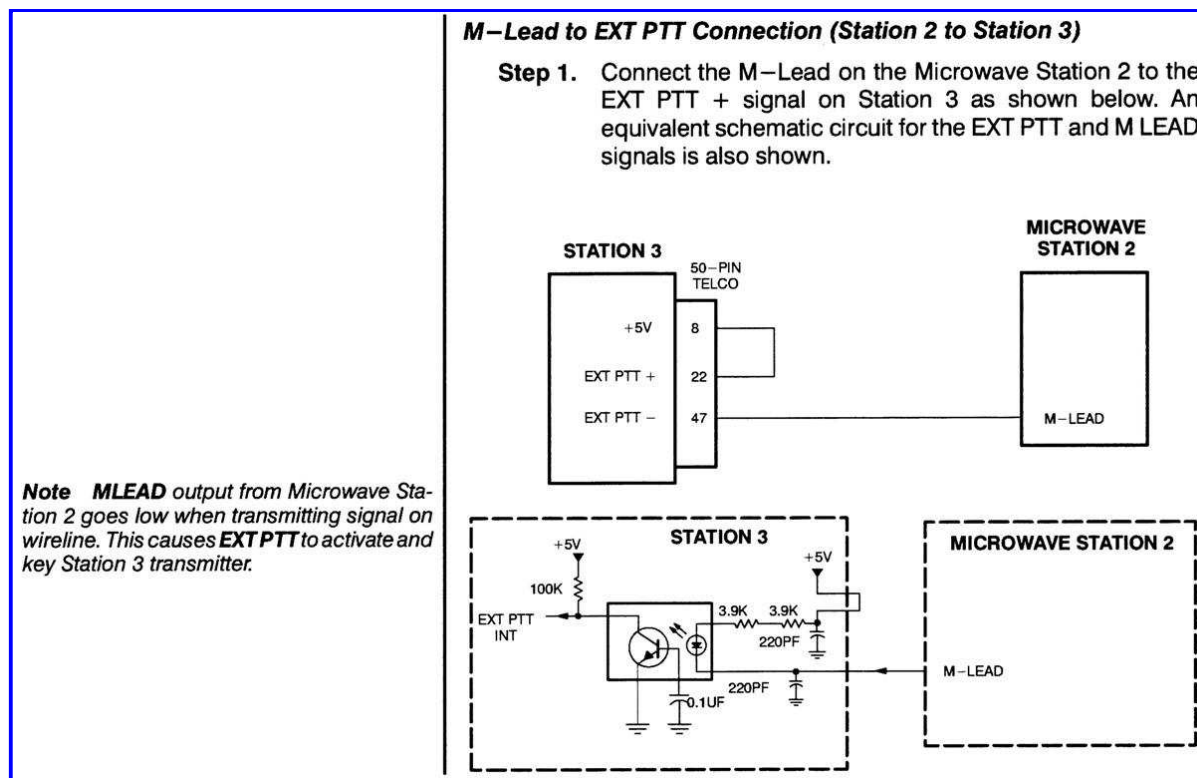
Line2 = Receive Audio: balanced 600ohm.
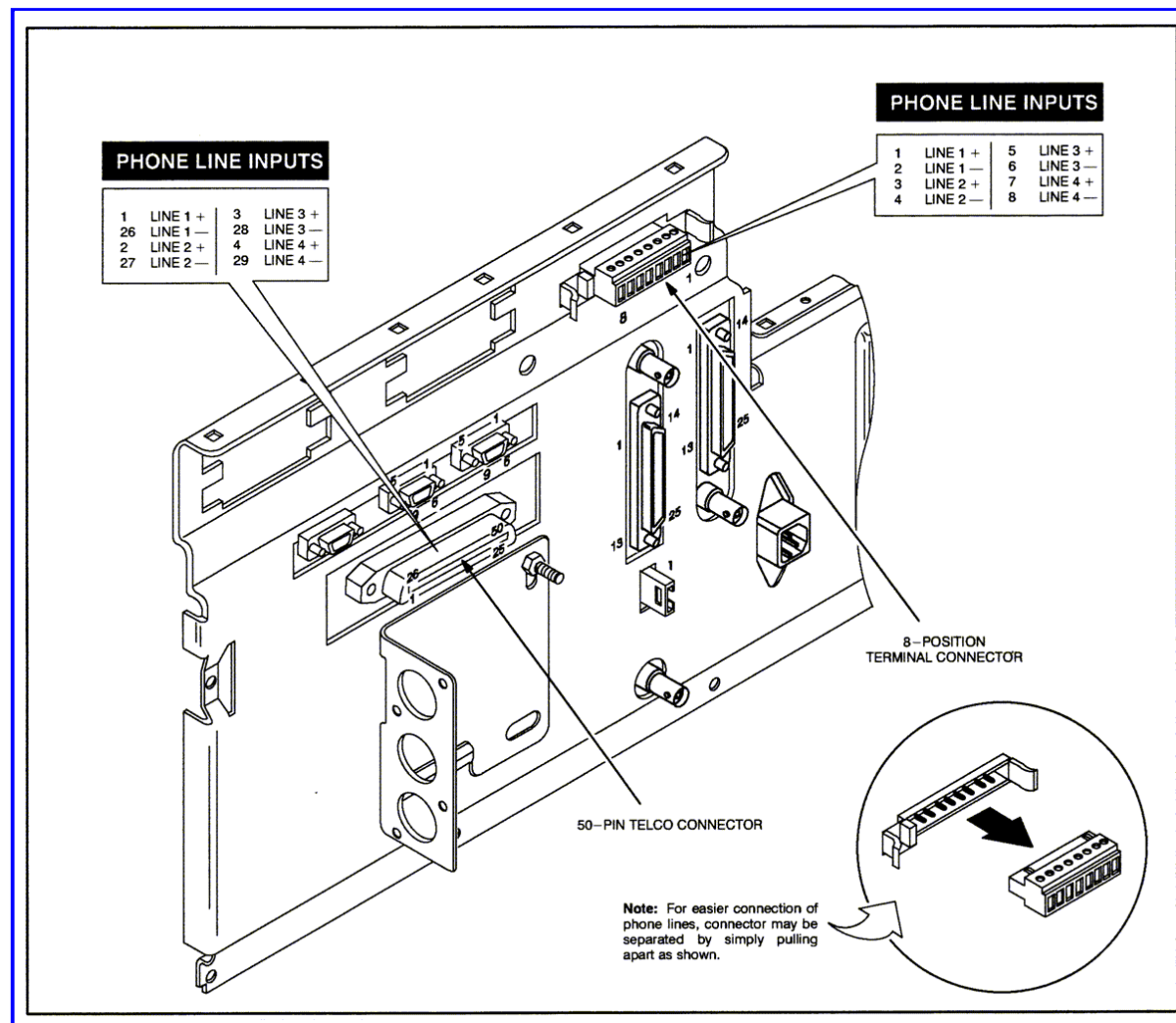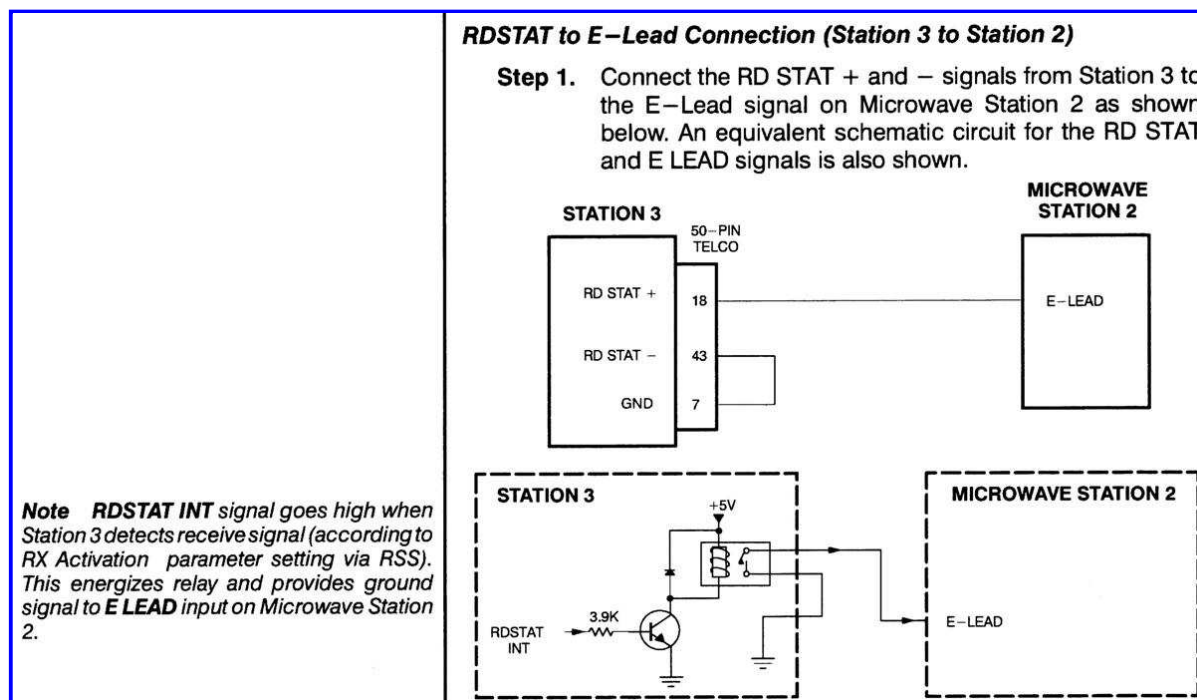

External PTT:

PTT requires applying ground to J17 pin 47. Ground is found on J17 pin 7.

A jumper between J17 pins 8 (+5VDC) and pin 22 (EXT PTT +) is required. This is an opto-coupled input.

M−Lead to EXT PTT Connection (Station 2 to Station 3)

Step 1. Connect the M−Lead on the Microwave Station 2 to the EXT PTT + signal on Station 3 as shown below. An equivalent schematic circuit for the EXT PTT and M LEAD signals is also shown.

Note **MLEAD** output from Microwave Station 2 goes low when transmitting signal on wireline. This causes **EXT PTT** to activate and key Station 3 transmitter.

COS:

A receiver unsquelched (RDSTAT) indication is available from a relay closure located at J17 pins 18 and 43. See the RD STAT E-Lead connection diagram below for more circuit details.

RDSTAT to E−Lead Connection (Station 3 to Station 2)

Step 1. Connect the RD STAT + and − signals from Station 3 to the E−Lead signal on Microwave Station 2 as shown below. An equivalent schematic circuit for the RD STAT and E LEAD signals is also shown.

Note **RDSTAT INT** signal goes high when Station 3 detects receive signal (according to RX Activation parameter setting via RSS). This energizes relay and provides ground signal to **E LEAD** input on Microwave Station 2.

Transmit Inhibit:

Applying a ground to J17 pin 12 will place the station in a transmit-inhibit state. The receiver will still be active and pass audio to the wireline output. This is a transistor buffered input. This may not be necessary if you use an external repeater controller.
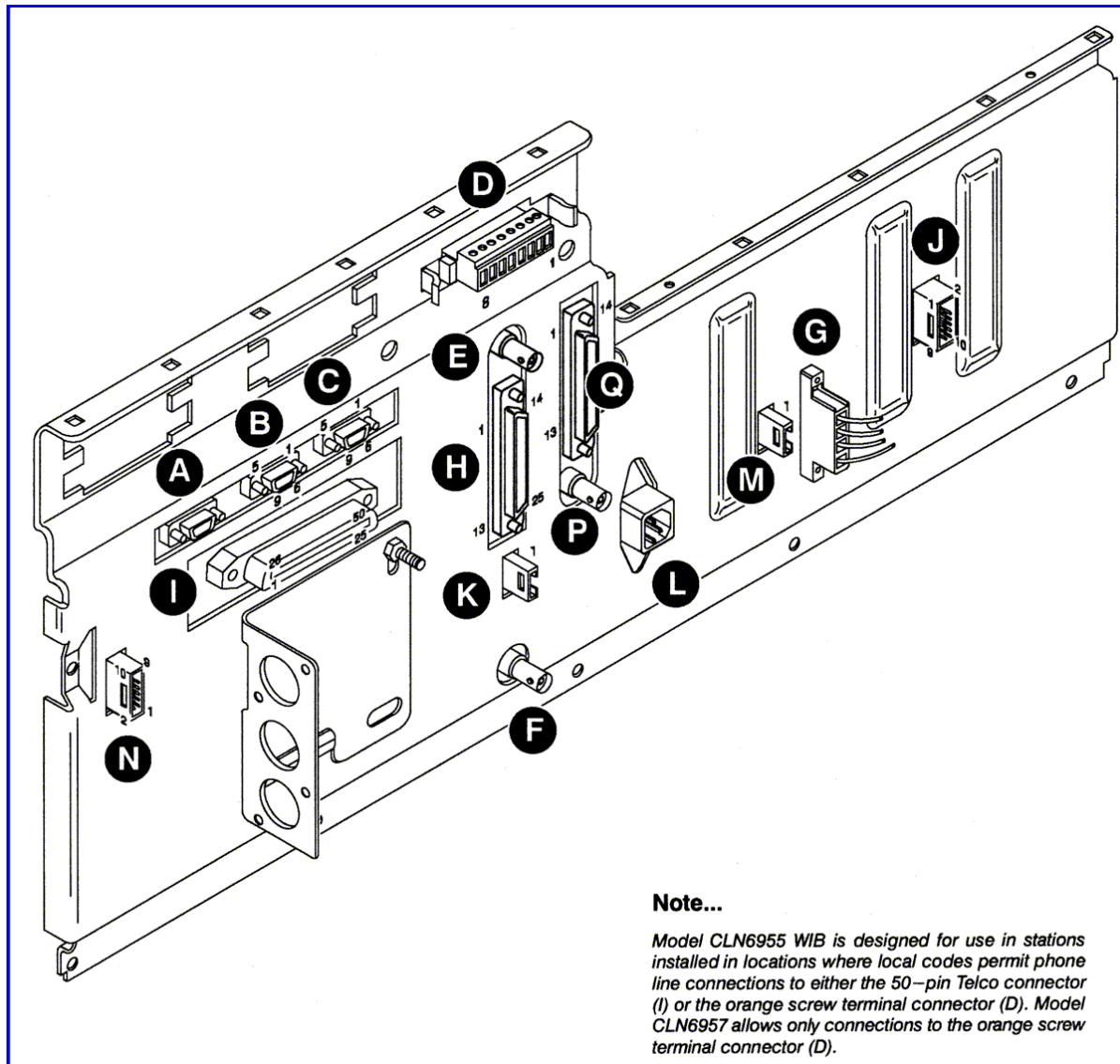
External Frequency Reference:

If you have a site standard frequency reference such as a GPS or rubidium oscillator, you can use J30 to

insert a 5 MHz or 10MHz reference signal. Injection levels are expected to be 1.0V RMS +/- 0.5V. To use an external reference it is necessary to program the station in the SERVICE / HARDWARE CONFIGURATION screen of RSS and set it to EXTERNAL 5MHZ or EXTERNAL 10MHZ Frequency Reference. Do not inject an external reference with the station programmed for internal or you will have issues with the two oscillators beating against each other.

Rear Panel Connectors:

For some reason, Motorola numbers all the connectors, while the documentation uses large letters to identify them. The descriptions luckily contain both, but they're in no particular order. Here's an image of all the rear panel connectors.

Note...

Model CLN6955 WIB is designed for use in stations installed in locations where local codes permit phone line connections to either the 50-pin Telco connector (I) or the orange screw terminal connector (D). Model CLN6957 allows only connections to the orange screw terminal connector (D).

Connectors "A-H" are described below.

A

CONNECTOR #20 — EIA−232 (Alternate RSS Port)

Pin #	Signal	Input	Output	Function
1	DCD1	✓		Data Carrier Detect
2	RXD1	✓		Receive Data
3	TXD1		✓	Transmit Data
4	DTR		✓	Data Terminal Ready
5	SIGNAL GND			Station Ground
6	DSR	✓		Data Set Ready
7	RTS1		✓	Request to Send
8	CTS1	✓		Clear to Send
9	Ring Indicator			Not used

B

CONNECTOR #18 — EPIC Fan Control (Early Models Only)

Pin #	Signal	Input	Output	Function
1	FAN GND			Ground for external fan
2				
3				
4				
5				
6				
7				
8	FAN +		✓	+14.2 V dc for external fan
9				

C

CONNECTOR #19 — DLAN1

Pin #	Signal	Input	Output	Function
1	Shield Gnd			Station Ground
2	WFI+			Future use
3	WFI −			Future use
4	DLAN1+	✓	✓	Differential Data (+)
5	DLAN1 −	✓	✓	Differential Data (−)
6	WFI+			Future use
7	WFI −			Future use
8	DLAN1+	✓	✓	Differential Data (+)
9	DLAN1 −	✓	✓	Differential Data (−)

D

PHONE LINE INPUTS

1	LINE 1 +	5	LINE 3 +
2	LINE 1 −	6	LINE 3 −
3	LINE 2 +	7	LINE 4 +
4	LINE 2 −	8	LINE 4 −

E

CONNECTOR #21 — 1 PPS

1 PPS clock signal from GPS Receiver for *ASTRO* Simulcast application. TTL levels @ 50 ohms.

F

CONNECTOR #30 — 5/10 MHZ INPUT

Accepts external 5 or 10 MHz Frequency Standard for Calibrating Station Reference Oscillator (located in Station Control Module);
5 MHz injection level = 1.0 ± .5 V RMS;
High Impedance Input

G

CONNECTOR #25 — BATTERY CHARGER OUTPUT

Two RED (top) and two BLACK (bottom) wires to battery revert connector mounted on station cage.

H

CONNECTOR #14 — 6809 TRUNKING/MRTI

| Pin #	Signal	Input	Output	Function
1	MRTI TX Audio			MRTI
2	MRTI PTT			MRTI
3	Open			MRTI
4	Monitor			MRTI
5	PL Strip			MRTI
6	Open			MRTI
7	MRTI RX Audio			MRTI
8	Patch INH			MRTI
9	Gnd			MRTI
10	AUX Indicate	✓		Future use
11	TPTT	✓		Control signal to key transmitter (active low) (6809)
12	TSTAT		✓	Indicates transmitter status (active high) (6809)
13	Tx Data +	✓		Modulation input from 6809 Controller (6809)
14	Open			
15	Rx Carrier			MRTI
16	Gnd			Station Ground (6809)
17	Gnd			Station Ground (6809)
18	Gnd			Station Ground (6809)
19	Gnd			Station Ground (6809)
20	Gnd			Station Ground (6809)
21	Tx Data −	✓		Modulation input from 6809 Controller (6809)
22	Rx Wideband Aud		✓	Receive output to 6809 Controller (6809)
23	MUTE	✓		Mutes station signals (active low) (6809)
24	CCI	✓		Indicates Control Channel status (active low) (6809)
25	RSTAT			Indicates receiver status (active high) (6809)

Connector "I" is described below.

Ⓘ

CONNECTOR #17   **SYSTEM 50-PIN TELCO**

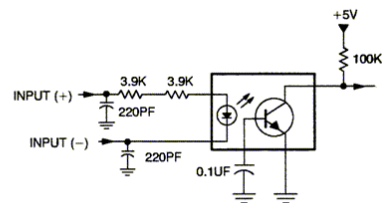| Pin #	Signal	Input	Output	Function
1	Line 1+	✓		Customer 4-wire Phone Line Input (Line 1+)
2	Line 2+	✓	✓	Customer 2-wire Phone Line Input/Output (Line 2+)
3	Line 3+	✓		Customer 4-wire Phone Line Input (Line 3+)
4	Line 4+		✓	Customer 4-wire Phone Line Output (Line 4+)
5	Aux TX Audio	✓		Input from external device
6	Open			Open
7	GND			Station Ground
8	5 VDC Out		✓	+5V dc from Power Supply (1 Amp Max.)
9	Gen TX Data —			Modulation signal from Simulcast equipment (Note 1)
10	PL (+) In	✓		Future Use
11	Aux In 1 (Ext Failsoft)	✓		Customer-defined transistor buffered Input (Note 1)
12	Aux In 2 (TX Inhibit)	✓		Customer-defined transistor buffered Input (Note 1)
13	Aux In 3 (Ext TX Code Det)	✓		Customer-defined transistor buffered Input (Note 1)
14	Aux In 4 (RX WL Inhibit)	✓		Customer-defined transistor buffered Input (Note 1)
15	Aux In 5 (Duplex Enable)	✓		Customer-defined transistor buffered Input (Note 1)
16	Aux In 6 (In Cabinet Repeat)	✓		Customer-defined transistor buffered Inpu (Note 1)
17	Aux In 7 (Channel 4)	✓		Customer-defined transistor buffered Input (Note 1)
18	Aux Out 7 (RD Stat +)		✓	N.O. contact of Relay A (Note 1)
19	Aux Out 8		✓	N.O. contact of Relay B
20	Aux Out 9		✓	N.O. contact of Relay C
21	Aux Out 10		✓	N.O. contact of Relay D
22	Aux In 9 (Ext PTT+)	✓		Opto-isolated customer-defined input (Opto A+)
23	Aux In 10 (Channel 1 +)	✓		Opto-isolated customer-defined input (Opto B+)
24	Aux In 11 (Chanel 2 +)	✓		Opto-isolated customer-defined input (Opto C+)
25	Aux In 12 (Channel 3 +)	✓		Opto-isolated customer-defined input (Opto D+)
26	Line 1 —	✓		Customer 4-wire Phone Line Input (Line 1—)
27	Line 2 —	✓	✓	Customer 2-wire Phone Line Input/Output (Line 2—)
28	Line 3 —	✓		Customer 4-wire Phone Line Input (Line 3 —)
29	Line 4 —		✓	Customer 4-wire Phone Line Output (Line 4—)
30	Aux RX Audio		✓	Output to external device
31	Open			Open
32	GND			Station Ground
33	14.2 VDC Out		✓	+14.2 V dc from Power Supply (1 Amp Max.)
34	Gen TX Data +			Modulation signal from Simulcast equipment
35	PL (—) In	✓		Future Use
36	Aux Out 1 (Failsoft Ind)		✓	Customer-defined transistor buffered output (Note 1)
37	Aux Out 2 (RX Code Det)		✓	Customer-defined transistor buffered output (Note 1)
38	Aux Out 3		✓	Customer-defined transistor buffered output
39	Aux Out 4		✓	Customer-defined transistor buffered output
40	Aux Out 5		✓	Customer-defined transistor buffered output
41	Aux Out 6		✓	Customer-defined transistor buffered output
42	Aux In 8	✓		Customer-defined transistor buffered input
43	Aux Out 7 (RD Stat —)		✓	N.O. contact of Relay A (Note 1)
44	Aux Out 8		✓	N.O. contact of Relay B
45	Aux Out 9		✓	N.O. contact of Relay C
46	Aux Out 10		✓	N.O. contact of Relay D
47	Aux In 9 (Ext PTT—)	✓		Opto-isolated customer-defined input (Opto A—)
48	Aux In 10 (Channel 1 —)	✓		Opto-isolated customer-defined input (Opto B—)
49	Aux In 11 (Channel 2 —)	✓		Opto-isolated customer-defined input (Opto C—)
50	Aux In 12 (Channel 3 —)	✓		Opto-isolated customer-defined input Opto D—)

Notes:

1. Many of the customer-defined inputs and outputs have been preassigned wtih signal names and functions usually required in typical Trunking and other systems. These default preassignments have been made for customer convenience only, and may be re-assigned as necessary. The preassigned signal names are shown in parentheses in the SIGNAL column. (Reassignment requires the use of the Wildcard Option.)
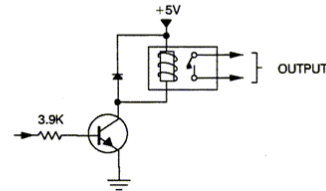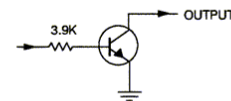
Typical Relay Closure Output Circuit
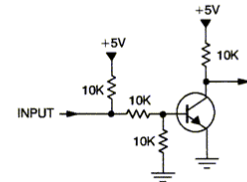
Typical Transistor-Coupled Input Circuit

Typical Opto-Coupled Input Circuit

Typical Transistor-Coupled Output Circuit

Connectors "J-M" are described below.

J

CONNECTOR #27 — PERIPHERAL TRAY INTERFACE

Pin #	Signal	Input	Output	Function
1	14.2 V		✓	+14.2 V dc from Power Supply (1 Amp Max.)
2	GND			Station Ground
3	ANT RLY KEYED A+		✓	Switched +14.2 V to energize antenna relay (if located in Peripheral Tray)
4	EXT I/O 2			Future Use
5	EXT I/O 1		✓	Switched +14.2 V to energize Main/Standby relay
6	EXT Circ Temp	✓		DC voltage proportional to temperature from sensor mounted on Dual Circulator Module
7	EXT WM Ref			Ground reference for External Wattmeter
8	EXT WM Vr	✓		DC voltage proportional to External Wattmeter reflected power
9	EXT WM Vf	✓		DC voltage proportional to External Wattmeter forward power
10	GND			Station Ground

K

CONNECTOR #23 — ANTENNA RELAY

Pin #	Signal	Input	Output	Function
1	GND			Station GND
2	ANT RLY KEYED A+		✓	Switched +14.2 V to energize antenna relay
3	GND			Station Gnd

L

CONNECTOR #50

AC INPUT

Connects to 110V/220V AC source via 3-wire line cord.

M

CONNECTOR #24 — BATTERY TEMPERATURE

Pin #	Signal	Input	Output	Function
1	GND			Station Ground
2	BATT TEMP	✓		Variable resistance proportional to battery temperature from sensor near storage batteries
3	GND			Station Ground

Connectors "N-Q" are described below.

N

Pin #	Signal	Input	Output	Function
CONNECTOR #31				EXTERNAL DC POWER
1	GND		✓	Station Ground
2	Spare			Not Used
3	Spare			Not Used
4	Spare			Not Used
5	Spare			Not Used
6	+14.2 V		✓	+14.2 V dc @ 1 Amp (if no connection to Connector #17−pin 33)
7	Spare			Spare
8	+5 V		✓	+5 V dc @ 1 Amp (if no connection to Connector #17−pin 8)
9	Spare			Not Used
10	GND		✓	Station Ground

P

CONNECTOR #22

ETHERNET PORT

Accepts 10BASE−2 coaxial cable (via T-connector) for connections to an *IntelliRepeater* Ethernet network or to download software via a locally connected PC running RSS.

Q

Pin #	Signal	Input	Output	Function
CONNECTOR #15				MULTI-PURPOSE RS-232
1	Shield Gnd			Station Ground
2	TxD3		✓	Transmit Data
3	RxD3	✓		Receive Data
4	RTS3		✓	Request to Send
5	CTS3	✓		Clear to Send
6	DSR3	✓		Data Set Ready
7	Signal Ground			Station Ground
8	DCD3	✓		Data Carrier Detect
9	OPEN			
10	OPEN			
11	OPEN			
12	OPEN			
13	Local Loopback 3		✓	Not Used
14	OPEN			
15	TCLK3		✓	Transmit Clock
16	OPEN			
17	RCLK	✓		Receive Clock
18	OPEN			
19	OPEN			
20	DTR3		✓	Data Terminal Ready
21	OPEN			
22	OPEN			
23	OPEN			
24	OPEN			
25	Remote Loopback 3		✓	Not Used

Acknowledgements and Credits:

All of the images came from the Quantar Digital-Capable Station Instruction manual, p/n 6881095E05-D, which covers VHF, UHF, 800 MHz, and 900 MHz Conventional, SECURENET, ASTRO, 6809 Trunking, and IntelliRepeater systems. At the time this article was revamped, the manual could be bought from Motorola for about $77US.

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