CODAN
RADIO COMMUNICATIONS

MT-3 Analog Radio Systems

USER GUIDE

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Codan MT-3 Analog Radio Systems

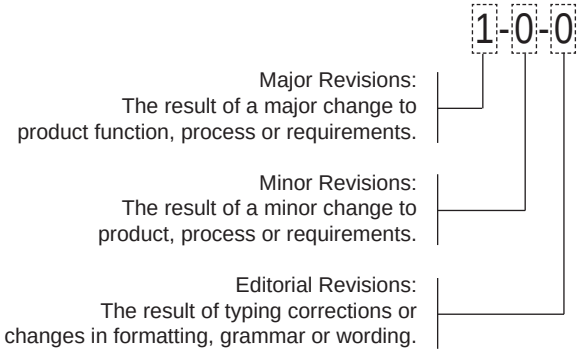
User Guide

NOTE

The English version takes precedence over any translated versions.

DOCUMENT REVISION DEFINITION

Documentation uses a three-level revision system. Each element of the revision number signifies the scope of change as described in the diagram below.



Three-level revision numbers start at 1-0-0 for the first release. The appropriate element of the revision number is incremented by 1 for each subsequent revision, causing any digits to the right to be reset to 0.

For example:
If the current revision = 2-1-1 Then the next major revision = 3-0-0
If the current revision = 4-3-1 Then the next minor revision = 4-4-0
If the current revision = 3-2-2 Then the next editorial revision = 3-2-3

Document revision history is provided at the back of the document.

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DANIELS ELECTRONICS IS NOW CODAN RADIO COMMUNICATIONS

On August 7th, 2012 - Codan Limited (ASX: “CDA”) announced the acquisition of Daniels Electronics Limited, a leading designer, manufacturer and supplier of land mobile radio communications (LMR) solutions in North America. The acquisition of Daniels delivers on Codan’s stated strategy of growing market share and diversifying its radio communications product offering. Codan Limited designs, manufactures and markets a diversified range of high value added electronic products, with three key business divisions; radio communications, metal detection and mining technology.

ABOUT CODAN RADIO COMMUNICATIONS

Codan Radio Communications is a leading international designer and manufacturer of premium communications equipment for High Frequency (HF) and Land Mobile Radio (LMR) applications. We’ve built our reputation for reliability and customer satisfaction over 50 years in radio communications, in some of the toughest conditions on the planet.

For over 50 years Codan has provided customers in North America and internationally with highly reliable Base Stations and Repeaters that are environmentally robust to operate in rugged and extreme temperature conditions where low current consumption (solar powered) is a key requirement.

Codan is a pioneering member of the P25 Digital standard, for radio system interoperability between emergency response governmental organizations, providing enhanced functionality and encryption. Our products operate between 29 - 960 MHz and are available in a variety of Base Station and Repeater configurations for two way voice and mobile data applications.

Our self-servicing customers range from Forestry and National Park services through Police and Fire departments and on to Utility and Transportation groups. Our products have been deployed in every imaginable situation from the Antarctic to Hawaiian mountaintops to Alaska, enabling respondents to Forest Fires, Ground Zero rescue and routine patrols.

Codan is an industry leader in Analog and P25 radio systems design. We offer modular rack-mounted Base Stations and Repeaters capable of operating in Low Band VHF,VHF AM , VHF FM, UHF FM, 700 MHz, 800 MHz, 900 MHz

RESOURCES

Codan Radio Communications provides many resources for the testing, tuning, maintenance and design of your Codan MT-4E Analog and P25 Digital Radio System.

Instruction Manuals

Codan instruction manuals are very comprehensive and include information on:

Theory of operation
Detailed Specifications
Testing and tuning instructions
Component layout illustrations

Instruction manuals can be obtained from the factory.

Technical Notes

Technical notes outline key aspects of tuning, installing, maintaining and servicing Codan Radio Systems.

Technical Notes can be found online at www.codanradio.com.

Codan MT-3 and IFR 1200 / IFR COM-120 Test Procedures

Technical Notes TN900 and TN910 are aids to configuring and testing Codan MT-3 radios using either an IFR 1200 or IFR COM-120 Service Monitor by Aeroflex.

TN900 and TN910 can be found online at www.codanradio.com.

Application Notes

Application Notes provide an overview of the range of applications in which Codan Radio systems can be used.

Application Notes can be found online at www.codanradio.com.

Codan MT-4E Analog and P25 Digital User Guide

The Codan MT-4E User Guide provides the reader with an introduction to Codan Radio Communications MT-4E Analog and P25 Digital Radio Systems

The Codan MT-4E User Guide can be found online at www.codanradio.com.

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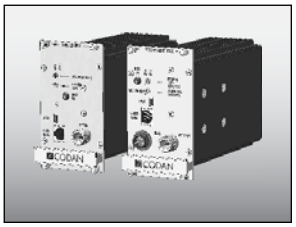

CHAPTER 1: INTRODUCTION

This document is written as an introduction to Codan MT-3 Analog Radio Systems. The document assumes the reader is familiar with conventional Two-Way Radio Communications systems.

MODEL NUMBERS

Daniels Electronics Ltd. has manufactured radio systems for more than 60 years. In the early years, Daniels manufactured AM and SSB radiotelephones for the marine industry, and more recently, the MT series of radios for mountain top repeaters and base station applications. Codan Radio Communications continues to manufacture the MT series of Land Mobile Radio (LMR) systems.

MT-2

The MT-2 series of radio modules were originally manufactured in the 1980s. This radio series was a crystal controlled analog radio system capable of wideband (25 KHz) operation. Although systems are still in operation throughout North America, this series of radio modules was discontinued in the 1990s and is no longer supported.

MT-3

The MT-3 series of radio modules were originally manufactured in the early 1990s. This radio series was available with both crystal controlled and synthesized analog radio modules capable of wideband (25 KHz) or narrowband (12.5 KHz) operation. The MT-3 radio modules were discontinued in 2006, with the exception of the VHF Lowband and VHF AM products.

MT-4

The MT-4 series of radio modules entered production during 2001. This radio series is the P25 compliant digital narrowband radio system, capable of analog (wideband and narrowband) or P25 digital operation. For more information on the MT-4 series of radios, see the MT-4R and MT-4D P25 Digital and Analog Radio Systems User Guide or Codan MT-4E Analog and P25 Digital Radio Systems User Guide.

DIFFERENCES BETWEEN MT-3 SERIES MODULES

The MT-3 series of modules were designed and manufactured with three different oscillators in the transmitter and receiver modules.

CRYSTAL

Crystal modules use a fundamental crystal in an oscillator circuit to determine the operating frequency of the oscillator. To maintain high frequency stability, the crystal oscillator has an on-board digital circuit board which provides temperature compensation information for each individual crystal element. To change the transmitter or receiver operating frequency, a new crystal oscillator assembly must be purchased. The crystal module was discontinued in the transmitter modules in 1995 and in the receiver modules in 2005. The crystal receiver had a current draw of less than 50 mA.

LOW CURRENT SYNTHESIZED

The Low Current Synthesized modules select the operating frequency in standard channel increments that are programmed into the synthesizer. The synthesizer uses a Voltage Controlled Oscillator (VCO) to generate RF frequencies. To maintain high frequency stability, the VCO is locked to a frequency reference (either an internal TCXO, or an external reference) by use of a Phase Locked Loop (PLL) circuit. The VHF (150 MHz) and UHF (400 MHz) low current synthesized transmitter module was discontinued in 1995. The 800 MHz and 900 MHz transmitter use the low current synthesizer. The low current synthesized receiver module had a current draw of less than 100 mA and was typically recommended for solar sites. The low current synthesizer was discontinued in 2006.

ENHANCED SYNTHESIZED

The Enhanced Synthesized modules operate with higher performance specifications and higher current draw than the Low Current Synthesized modules. The enhanced synthesizer circuitry is distributed between two printed circuit boards which are physically isolated from each other. This eliminates the electrical noise between the digital and analog circuitry in the oscillator. The boards are interconnected via photo-logic optical transceivers. The VHF (40 MHz), VHF (150 MHz) and UHF (400 MHz) transmitters all operate with enhanced synthesizers. The enhanced receiver has a current draw of approximately 400 mA and is typically recommended for AC powered sites. The enhanced synthesized receiver module is manufactured with an accompanied enhanced front end that has a higher L.O. injection than the standard low current front end.

The local oscillators that are used in the MT-3 receiver and transmitter modules can be determined by the frequency bands of those modules.

FREQUENCY BANDS AND OSCILLATORS

MT-3 analog radio systems were manufactured in a wide range of frequency bands. Table 1-1 shows the frequency bands and the local oscillators that were available for the receiver and transmitter modules in those bands.

Table 1-1: Frequency Bands and Local Oscillators

Band	Frequency	Transmitter	Receiver
VHF Lowband	29 – 50 MHz	Enhanced	Enhanced
VHF Highband	136– 174 MHz	Enhanced or Low Current or Crystal	Enhanced or Low Current or Crystal
UHF 400 MHz	406 – 430 MHz and 450 – 470 MHz	Enhanced or Low Current or Crystal	Enhanced or Low Current or Crystal
UHF 800 MHz	806 – 824 MHz and 851 – 869 MHz	Low Current	Low Current
UHF 900 MHz	896 – 902 MHz and 928 – 960 MHz	Low Current	Low Current
VHF AM	118 – 137 MHz	Enhanced	Enhanced

DISCONTINUED PRODUCTS

In 2006, the MT-3 VHF Highband, UHF 400 MHz, UHF 800 MHz and UHF 900 MHz radio modules were discontinued. The MT-4E series of radio modules supersedes the MT-3 series. The MT-4E product line is available with an “analog only” firmware version for customers that do not require P25 compliance. The MT-3 VHF Lowband and VHF AM products are still available.

IDENTIFYING MT-3 MODEL NUMBERS

Being able to identify the MT-3 module that you have is critical for understanding the capabilities and operation of the equipment, such as frequency band, wideband or narrowband, and local oscillator type. The model number of the MT-3 receiver or transmitter can be found on the bottom of the front panel of the receiver or transmitter module as shown in Figure 1-1. Figure 1-2 and 1-3 show the breakdown of the receiver and transmitter model numbers.

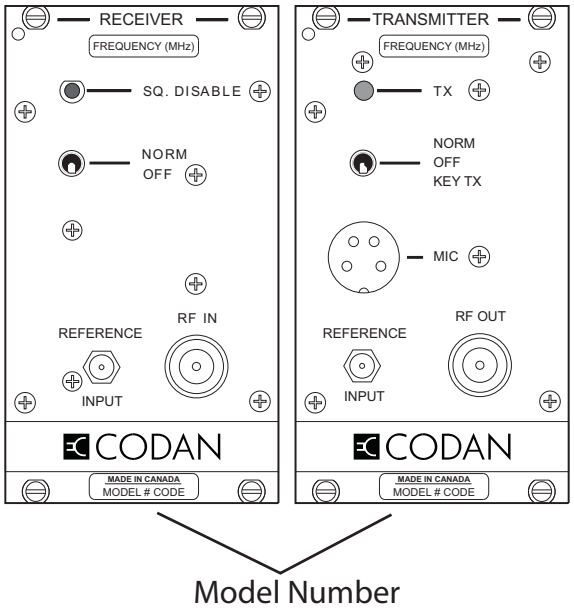

Figure 1-1: Model Number Location

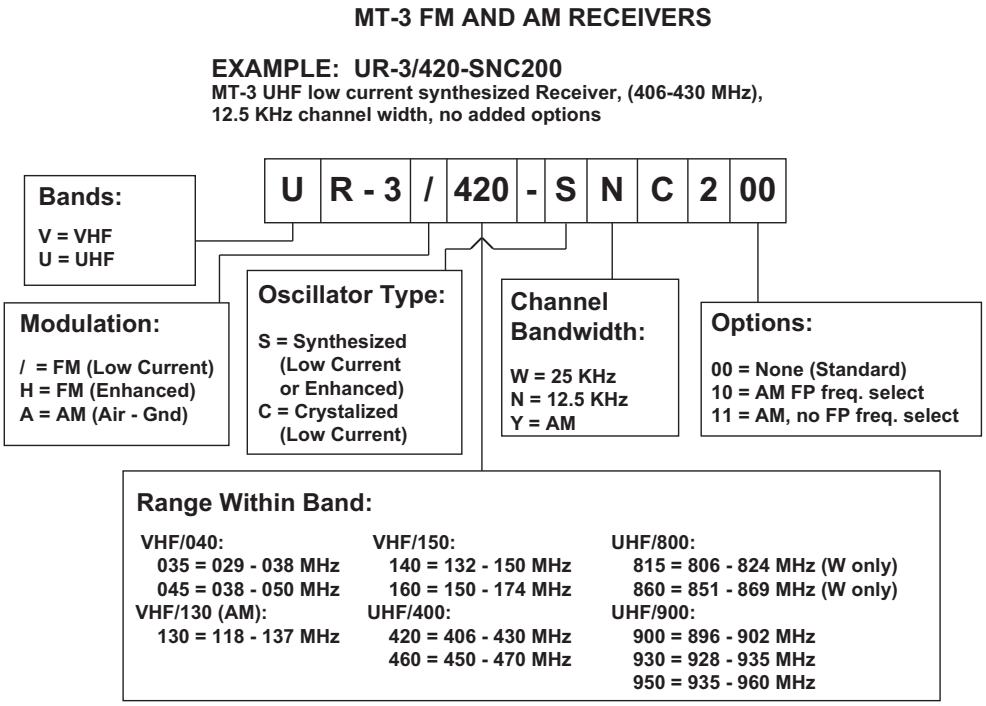

Figure 1-2: Receiver Model Numbers

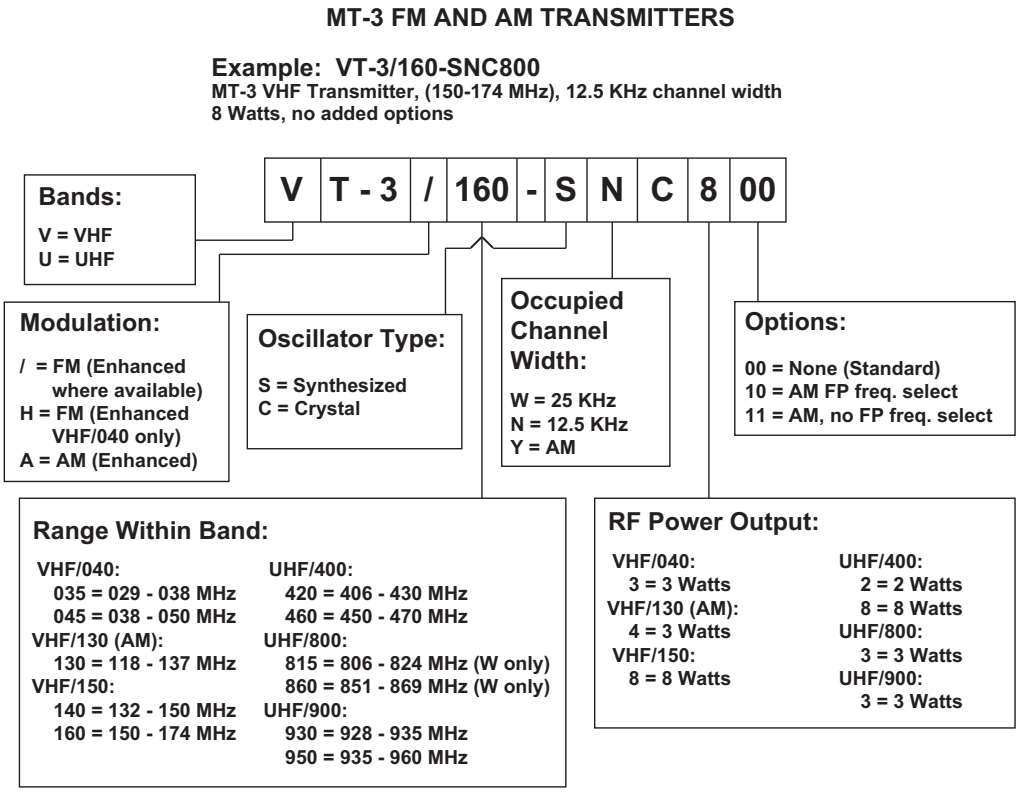

Figure 1-3: Transmitter Model Numbers

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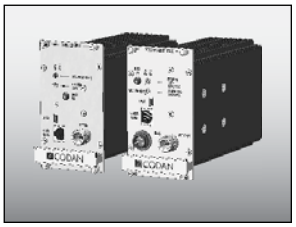


CHAPTER 2: TECHNICAL INFORMATION

WIDE OR NARROWBAND OPERATION

VHF and UHF receivers and transmitters were available in both wideband (25 KHz) and narrowband (12.5 KHz) bandwidths. Receiver modules that have been ordered as wideband can be converted to narrowband using a narrowband modification kit. The conversion from wideband to narrowband requires replacing crystal filters, shields and a number of surface mount components. Transmitter modules can be converted to narrowband by re-tuning deviation levels and typically component replacement is not required. It is usually recommended that the transmitter and receiver modules be returned to the factory for this conversion.

MT-3 SOFTWARE

MT-3 radio equipment does not use any software programming. Frequency selection, level adjustments, bandwidths, power outputs, etc. are all hardware programmable through variable resistors, capacitors, inductors, switches, and in some cases, parts selection.

FREQUENCY PROGRAMMING

Synthesized

MT-3 synthesized radio modules are capable of 16 channel operation. The channel selection operation is described further in Chapter 5.

The MT-3 synthesized receiver and transmitter modules operating frequency may be selected in standard channel increments through either four internal BCD rotary switches, or by the synthesizer's internal memory that can be programmed for 15 preset frequencies.

In order to set the desired frequency for each channel, a four digit code is used to represent each available frequency. The four digit code is used internally in the synthesizer to generate the desired RF frequency. This four digit code is found in the Channel Designation Tables that accompany the receiver or transmitter Instruction Manual. The Channel Designation Tables cross reference each frequency with a code number.

The code number can be found by looking up the desired frequency, noting the code number (Chan. Num.) located to the left, and programming this new value. For example, in a receiver, a frequency of 132.14500 MHz translating to code number (Chan. Num.) 0709, can be programmed.

Table 2-1: Channel Designation Table Example

VHF Receiver Channel Designation Tables 132 - 150 MHz 5 KHz Increments

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
0680	132.00000	0690	132.05000	0700	132.10000	0710	132.15000	0720	132.20000	0730	132.25000
0681	132.00500	0691	132.05500	0701	132.10500	0711	132.15500	0721	132.20500	0731	132.25500
0682	132.01000	0692	132.06000	0702	132.11000	0712	132.16000	0722	132.21000	0732	132.26000
0683	132.01500	0693	132.06500	0703	132.11500	0713	132.16500	0723	132.21500	0733	132.26500
0684	132.02000	0694	132.07000	0704	132.12000	0714	132.17000	0724	132.22000	0734	132.27000
0685	132.02500	0695	132.07500	0705	132.12500	0715	132.17500	0725	132.22500	0735	132.27500
0686	132.03000	0696	132.08000	0706	132.13000	0716	132.18000	0726	132.23000	0736	132.28000
0687	132.03500	0697	132.08500	0707	132.13500	0717	132.18500	0727	132.23500	0737	132.28500
0688	132.04000	0698	132.09000	0708	132.14000	0718	132.19000	0728	132.24000	0738	132.29000
0689	132.04500	0699	132.09500	0709	132.14500	0719	132.19500	0729	132.24500	0739	132.29500

(1) If Channel 1 is selected the synthesizer will scan the four digit code from four BCD switches mounted on the main circuitboard of the receiver or transmitter module. On newer modules the most significant BCD switch is hexadecimal, allowing for frequency steps in 5 KHz increments at 2.5 KHz offsets.

(2) If Channel 2 through 16 is selected, then the frequency is established by the preprogrammed four digit code entered in the synthesizer's internal memory. The internal memory is normally programmed at the factory, but can be field programmed using the CP-SC-3 synthesizer channel programmer module (see Chapter 5 for more information on the synthesizer channel programmer).

Crystal

The MT-3 crystal controlled receiver and transmitter modules operating frequency is selected by the control module's fundamental crystal frequency. The channel select lines and internal BCD rotary switches are not used by the crystal control module.

Crystal modules use a fundamental crystal in an oscillator circuit to determine the operating frequency of the oscillator. The output frequency of a VHF crystal module is three times the frequency of the fundamental crystal oscillator circuit. Output frequency of a UHF crystal module is nine times that of the fundamental crystal oscillator circuit.

To maintain ± 1 ppm frequency tolerance the crystal oscillator circuitboard has an on-board digital board which provides temperature compensation information for each individual crystal element. To change the transmitter or receiver operating frequency, a new crystal oscillator board must be purchased.

Frequency Switching Range

Although the receiver or transmitter channels can be programmed for any frequency in their band, the Maximum Frequency Switching Range of the module must not be exceeded or the module will require hardware re-tuning. The maximum frequency switching range of the modules are listed in the Technical Notes, and are typically shown as +/- 0.5 MHz +/- 1 MHz, +/- 2 MHz or Full Band, based on the individual specifications of the module. For example, a VHF receiver may be programmed for any frequency between 136 to 174 MHz, but the front end helical filter has a typical pass band of 5 MHz, requiring re-tuning if any frequencies are used that are outside of that pass band.

AM Front Panel Frequency Selection

The AM receiver and transmitter have a Frequency Select Handle that allows the user to select and display the frequency of Channel 16 on the front panel of the module. The frequency selection is achieved by pushing the up arrow or down arrow keys to increase or decrease the frequency. On older motherboards (Serial # 123125 and earlier), jumper JU73 on the subrack / motherboard must be installed for this operation. The frequencies of channels 1 through 15 are programmed the same as all other MT-3 modules. Figure 2-1 shows front panels of the AM receiver and transmitter and a larger representation of the Frequency Select Handle.

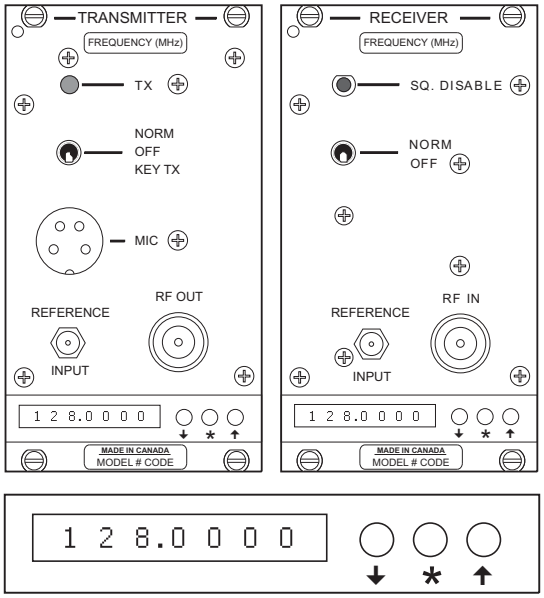


Figure 2-1: AM Front Panel Frequency Select Handle

CTCSS and DCS

CTCSS and DCS decoding and encoding is performed by a separate circuit board mounted in the control card. The receiver and transmitter modules do not typically contain the CTCSS and DCS decoder or encoder capability, although this can be installed if the system configuration requires it (eg. A voter system with no control card).

The CTCSS / DCS subtones are sent to the decoder from the receiver using the discriminator audio signal line and the receiver is controlled by the decoder via a receiver mute line that overrides the squelch circuitry. Subtones from the CTCSS and DCS modules are sent to the transmitter using the subtone 1 input signal line. This style of connecting the CTCSS / DCS externally from the receiver and transmitter allows for a greater flexibility for custom configurations.

A receiver could be configured so that one of two different CTCSS tones would unmute it, or a repeater could be configured such that a link transmitter could be activated only when a specific CTCSS or DCS subtone is received.

OTHER SETTINGS AND CONFIGURATIONS

The MT-3 Radio System has a wide array of settings and configurations that can be adjusted or turned on and off. The main configuration of the radio system is set in the Audio Control Card, however additional settings may be found throughout the system.

Hang Timer

The hang timer will keep the transmitter keyed once the receiver COR line has gone inactive. The hang timer can be turned on and off by setting jumpers in the Audio Control Card, and the length of the hang timer can be adjusted by variable resistors in the Audio Control Card.

Time Out Timer

The transmitter module contains a programmable PTT time out timer circuit. The time out timer will count down when the transmitter is keyed (PTT active). The timer will shut the transmitter output off once the timer has expired. To reset the timer, the PTT input must go to an inactive state. The time out timer is designed to reduce battery draw during a “stuck microphone” condition, by turning off the transmitter after a set period of time. The time out timer duration is jumper selectable in the transmitter module from 1 second to 8 hours (default 5 minutes). The time out timer can also be enabled or disabled on the subrack / motherboard by selecting a jumper position. The jumper is labeled PTT WTO (With Time Out) or PTT NTO (No Time Out).

Pre-emphasis and De-emphasis

The selection of flat or pre-emphasis audio is jumper selectable on the audio processor board in the transmitter module. The flat and pre-emphasis audios require slightly different tuning procedures to set up properly. The selection of flat or de-emphasis audio is jumper selectable in the receiver module for the 600 ohm balanced output. The receiver also has two additional signal lines dedicated to flat and de-emphasis audio output. In most configurations, the de-emphasis audio signal line drives the System Regulator speaker and the flat audio signal line is not used.

Squelch Settings

The receiver squelch settings can be jumper selected for one of two different squelch detection methods. The standard squelch method is a noise operated squelch, while the optional squelch method is based on carrier level (RSSI). The squelch point can be set (using either method) by a variable resistor in the receiver module. A second variable resistor is used to set the hysteresis between the squelch and unsquelch points. A receiver mute line attached to the squelch circuitry can squelch the receiver when active (typically used in CTCSS systems). A squelch override signal line can be used to unsquelch the receiver.

External Connections

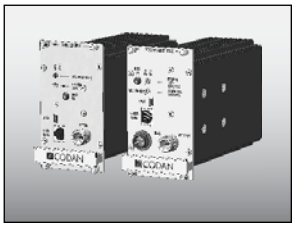
External audio and control (PTT/COR) signals are typically connected to a Codan radio system through the AC-3E Audio Control Card (the AC-3L-96, AC-3M-96 and AC-3S-96 Audio Control Cards have no external connections available). The AC-3E Audio Control Card contains four 600 ohm balanced transformers for two auxiliary audio inputs and two auxiliary audio outputs. Control signals (PTT/COR) to or from external equipment are optically isolated allowing for more flexibility in external equipment voltages.

It is recommended that external audio connections are made to the AC-3E Audio Control Card and NOT to the balanced audio connections on the receiver and transmitter modules.

Audio Level Adjustments

The AC-3E AC-3M-96 and AC-3S-96 Audio Control Cards allow independent level control of all audio in a Codan radio system (the AC-3L-96 Audio Control Card has no audio level control capability). The AC-3E Audio Control Card has four audio level control variable resistors on the front panel for receiver to transmitter level adjustments, and four audio level control variable resistors inside the module for auxiliary audio level adjustments. The AC-3M-96 and AC-3S-96 Audio Control Cards have six audio level control variable resistors on the front panel for receiver to transmitter (and slave to master / master to slave) level adjustments.

The AC-3L-96, AC-3M-96 and AC-3S-96 Audio Control Cards were discontinued in 2006.



CHAPTER 3: ANALOG RADIO SYSTEM CONFIGURATIONS

SIMPLE REPEATER OPERATION

The MT-3 modules may be configured to operate as a repeater or two independent repeaters using the AC-3L-96 control card. The AC-3L-96 control card was discontinued in 2006. The AC-3E control card is now used for all simple and complex repeater configurations. The AC-3L-96 allows a direct connection from RXA to TXA and RXB to TXB. No cross-banding, linking or external connections are capable with the AC-3L-96.

The receivers, transmitters and AC-3L-96 control card are shown in Figure 3-1.

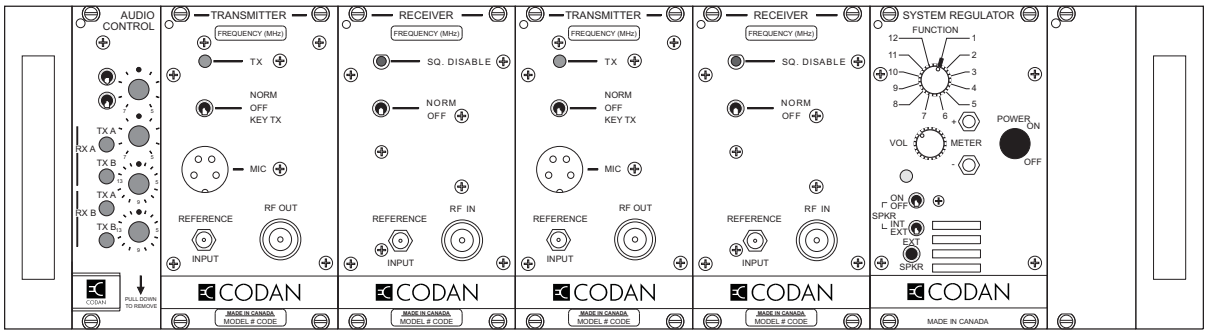


Figure 3-1: MT-3 Analog Simple Repeater System shown with two pairs of transceivers

The AC-3L-96 control card is hardware jumpered to control the interconnection between the modules. This allows the user to select the operation of this system (single repeater or dual repeater) by setting jumpers.

The AC-3L-96 has no auxiliary connections for connecting external equipment.

The AC-3L-96 does not allow for filtering of the CTCSS tones in the control card. The voice band filter in the receivers must be enabled if CTCSS is used in the system. The motherboard carries the signals from the receiver, through the controller to the transmitter(s). The signals on the motherboard are COR, PTT, Balanced Audio, Receiver Discriminator Audio, Receiver Mute and Transmitter Subtone 1 Input.

The AC-3L-96 has a current draw of less than 1 mA. The optional CTCSS decoders / encoders have a current draw of less than 13 mA each.

COMPLEX REPEATER OPERATION

The MT-3 modules may be configured to operate in more complex repeater configurations, such as a cross-band or linked system using the AC-3E control card. The AC-3E allows jumper selectable connections from RXA to TXA and/or TXB and RXB to TXA and/or TXB (any receiver to any transmitter).

The receivers, transmitters and AC-3E control card are shown in Figure 3-2.

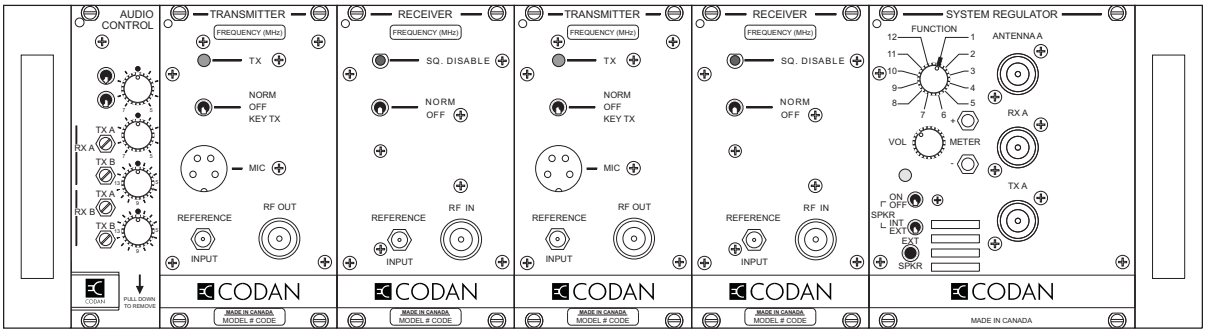


Figure 3-2: MT-3 Analog Complex Repeater System shown with two pairs of transceivers

The AC-3E control card is hardware jumpered to control the interconnection between the modules. This allows the user to select the operation of this system (single repeater, dual repeater, repeater with a link, cross-band repeater, etc.) by setting jumpers.

The AC-3E has auxiliary connections for connecting external equipment.

The AC-3E is jumper selectable to allow for filtering of the CTCSS tones in the control card. The voice band filter in the receivers can be enabled for additional CTCSS filtering if required, or to remove the CTCSS tones from the System Regulator speaker.

The motherboard carries the signals from the receiver, through the controller to the transmitter(s). The signals on the motherboard are COR, PTT, Balanced Audio, Receiver Discriminator Audio, Receiver Mute and Transmitter Subtone 1 Input.

The AC-3E has a current draw of less than 30 mA. The optional CTCSS decoders / encoders have a current draw of less than 13 mA each.

MULTIPLE LINK REPEATER OPERATION (DISCONTINUED)

The MT-3 modules may be configured to operate in a multiple link repeater configuration of up to four sets of transceivers. Many possible configurations are available such as a multiple cross-band, multiple linked system or multiple repeaters using the AC-3M-96 and AC-3S-96 Master-Slave control cards. The AC-3M-96 and AC-3S-96 control cards were discontinued in 2006. The MT-4E product line is now used for all multiple link repeater configurations. The AC-3M-96 and AC-3S-96 allows jumper selectable connections from any receiver to any transmitter.

The receivers, transmitters, AC-3M-96 and AC-3S-96 control cards are shown in Figure 3-3.

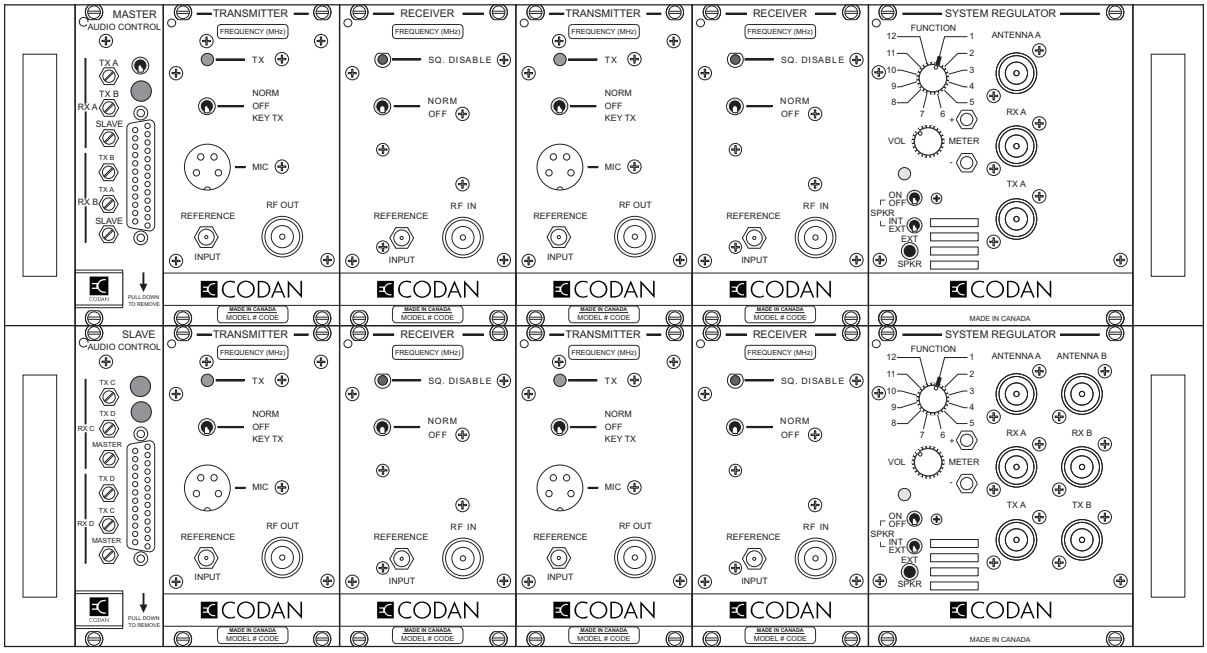


Figure 3-3: MT-3 Analog Multiple Link Repeater System shown with four pairs of transceivers

The AC-3M-96 and AC-3S-96 control cards are hardware jumpered to control the interconnection between the modules. This allows the user to select the operation of this system (single repeater, dual repeater, multiple linked repeater, cross-band repeater, etc.) by setting jumpers.

The AC-3M-96 and AC-3S-96 have no auxiliary connections for connecting external equipment.

The AC-3M-96 and AC-3S-96 are jumper selectable to allow for filtering of the CTCSS tones in the control cards. The voice band filter in the receivers can be enabled for additional CTCSS filtering if required, or to remove the CTCSS tones from the System Regulator speakers.

The motherboard carries the signals from the receiver, through the controller to the transmitter(s). The signals on the motherboard are COR, PTT, Balanced Audio, Receiver Discriminator Audio, Receiver Mute and Transmitter Subtone 1 Input. The connection between the AC-3M-96 (Master) and the AC-3S-96 (Slave) control cards is accomplished though the use of a DB-25 ribbon cable connected to the front panel of the control cards. The ribbon cable carries COR, PTT and Balanced Audio between the control cards.

The AC-3M-96 and AC-3S-96 have a current draw of less than 23 mA each. The optional CTCSS decoders / encoders have a current draw of less than 13 mA each. The optional DTMF decoder has a current draw of less than 14 mA.

BASE STATION (OR REPEATER-BASE) OPERATION

The MT-3 modules may be configured to operate in a base station configuration, such as a tone remote controlled base station, dual base stations or repeater-base system (repeater with external control) using the AC-3E control card. The system could also be configured as a single base station with a separate single repeater in the same subrack. The AC-3E allows jumper selectable connections from RXA to TXA and/or TXB and RXB to TXA and/or TXB (any receiver to any transmitter), as well as external connections for both pairs of receivers and transmitters.

The receivers, transmitters, AC-3E control card and tone remote adapter are shown in Figure 3-4.

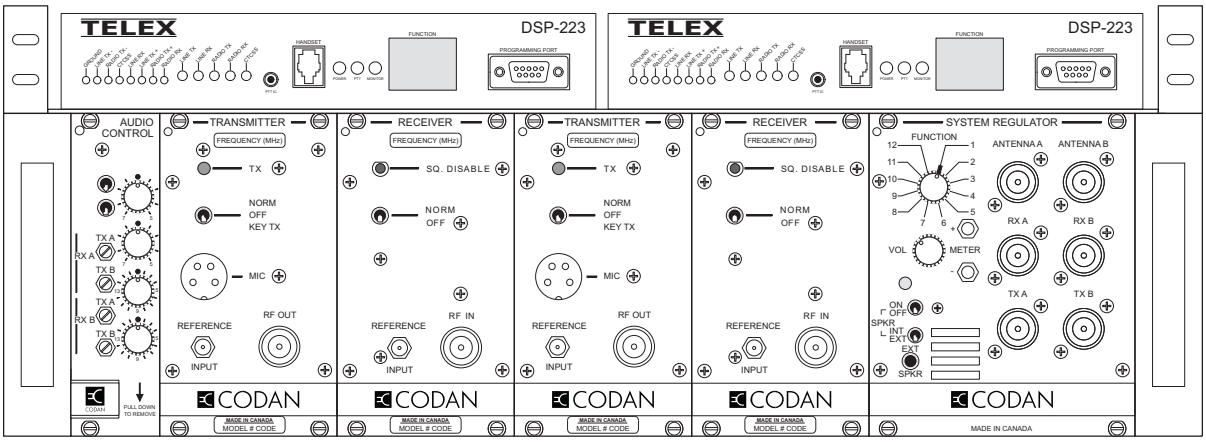


Figure 3-4: MT-3 Analog Base Station system shown with two pairs of transceivers and two tone remote adapters

The AC-3E control card is hardware jumpered to control the interconnection between the modules, as well as the interconnection to external equipment. This allows the user to select the operation of this system (single base, dual base, repeater-base, dual repeater-base) by setting jumpers.

The AC-3E is jumper selectable to allow for filtering of the CTCSS tones in the control card. The voice band filter in the receivers can be enabled for additional CTCSS filtering if required, or to remove the CTCSS tones from the System Regulator speaker.

The Telex DSP-223 tone-remote adapter provides the means of remotely controlling Codan base stations and repeaters. The adapters can be used in conjunction with tone-remote control consoles which use the industry-standard sequential tone keying format. The DSP-223 adapters are interconnected to the distant remote control console(s) by any analog voice grade transmission medium such as a microwave link, a leased telephone line, or a twisted-pair 600-ohm line.

The motherboard carries the outgoing signals from the receiver, through the controller to the external equipment (and/or the transmitter(s) in repeat operation). Signals from the external equipment are routed through the controller to the transmitter(s). The signals on the motherboard are COR, PTT, Balanced Audio, Receiver Discriminator Audio, Receiver Mute and Transmitter Subtone Input.

The AC-3E has a current draw of less than 30 mA. The optional CTCSS decoders / encoders have a current draw of less than 13 mA each. The Telex DSP-223 has a current draw of less than 500 mA.

PAGING SYSTEM OPERATION

The MT-3 modules may be configured to operate in digital and/or analog paging configurations, such as base station paging, remote paging or simulcast paging using the CI-PM-3 paging modulator. The CI-PM-3 is configured via the front panel switches and internal jumper settings.

The CI-PM-3 paging modulator supports both analog and digital paging formats, and can transmit POCSAG and other 2-level modulation schemes at transfer rates of 512, 1200 and 2400 baud. It can also be configured for use as a data repeater, whereby 2-level paging data is recovered, re-shaped and then re-transmitted to an additional repeater/paging transmitter.

The CI-PM-3 supports 4-level modulation formats at data transfer rates up to 6400 bps. Each of the four modulation deviation levels can be independently set, making the CI-PM-3 suitable for use in such pager signaling schemes as Motorola's FLEX™ paging protocol.

The receiver, transmitter and CI-PM-3 paging modulator are shown in Figure 3-5.

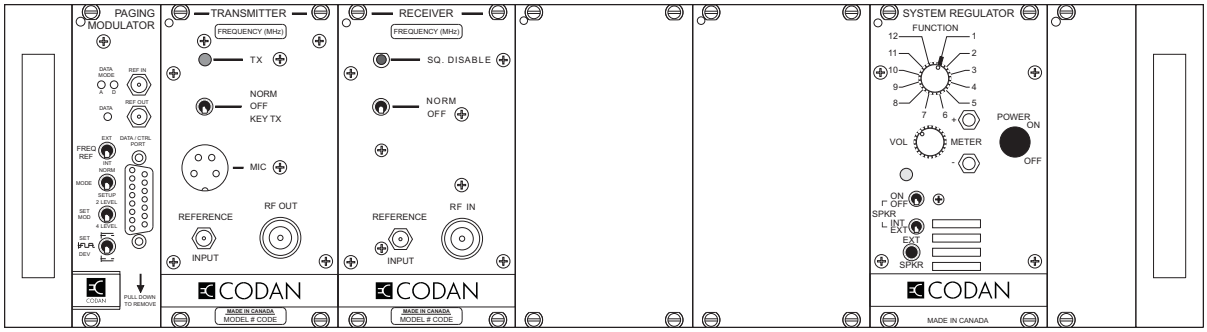


Figure 3-5: MT-3 Analog / Digital Paging system shown with one pair of transceivers

The CI-PM-3 uses an on-board frequency reference source consisting of a 10 MHz OCXO with a frequency stability of +/- 0.35 ppm from -30 C to +60 C. For high stability applications (such as Simulcast), the CI-PM-3 paging modulator may be configured to use an external high stability reference source (i.e. rubidium, GPS or WWV) with a standard stability greater than or equal to 0.002 ppm, to discipline the on-board phase-locked loop OCXO oscillator.

The CI-PM-3 has a current draw of less than 250 mA.

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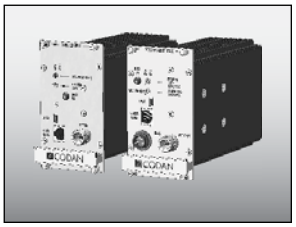

CHAPTER 4: ANALOG SYSTEM BLOCK DIAGRAMS

This chapter contains sample block diagrams of FM repeaters, AM and FM base stations and a paging transmitter system. These blocks are shown to give a basic understanding of the signal flow through a Codan radio system.

SIMPLE FM REPEATER BLOCK DIAGRAM

Figure 4-1 shows a block diagram of a Codan FM analog repeater system using an AC-3L-96 Audio Control Card.

The incoming FM transmission is routed through the Front End sub-module where the RF signal:
• is filtered (VHF and UHF 400 – high selectivity multiple pole, helical resonator filter, 5 MHz pass band; UHF 800/900 – dielectric bandpass filter)
• is amplified through a low noise amplifie
• is filtered again through an image rejection filter
• is mixed with a local oscillator
• produces an IF frequency of 21.4 MHz (VHF and UHF 400) or 45 MHz (UHF 800/900).

The first IF amplifier provides linear IF amplification and then crystal filters provide optimum bandpass characteristics for good selectivity and low distortion. A second L.O. source of 21.855 MHz (VHF and UHF 400) or 44.545 MHz (UHF 800/900) produces a second IF of 455 KHz. Second IF filtering is achieved through the use of a 455 KHz ceramic filter. The second IF is demodulated to recovered audio which is then sent to the discriminator output (for CTCSS decoding), the squelch circuitry and the flat and de-emphasis audio paths.

The squelch circuitry will produce the COR output and control the audio squelch gates. The audio will typically be routed through the de-emphasis circuitry and a jumper selectable voice band filter (flat audio is not commonly used). The de-emphasis audio output will drive the speaker in the System Regulator. The balanced audio output, as well as the other audio outputs, are typically set for -8.0 dBm (308 mVrms) using a 1.0 KHz tone at 60% of maximum modulation (3.0 KHz wideband; 1.5 KHz narrowband).

The COR signal and audio are then routed through the AC-3L-96 audio control card and are sent to the transmitter as a PTT signal and audio. The AC-3L-96 has no capability for multiple audio routes or audio level adjustments. The CTCSS decoder can also encode the same tone it is programmed to decode. If a separate tone is required for encoding, an optional CTCSS encoder can be installed and configured for the separate tone.

The transmitter will accept the incoming balanced audio and route it through the audio processor board in the transmitter. The balanced level control, compression control, and maximum deviation levels are all set in the audio processor. The balanced audio input level is typically set for a transmitter deviation of 60% of maximum modulation (3.0 KHz wideband; 1.5 KHz narrowband) at the RF output, using a 1.0 KHz tone at -8.0 dBm (308 mVrms) at the audio input.

The CTCSS tone is also added in the audio processor and set by the subtone 1 input level control. The incoming PTT signal will activate all circuitry in the transmitter and will key the transmitter. The transmitter will then modulate the audio signal to an FM carrier in the oscillator and then amplify the output of the oscillator.

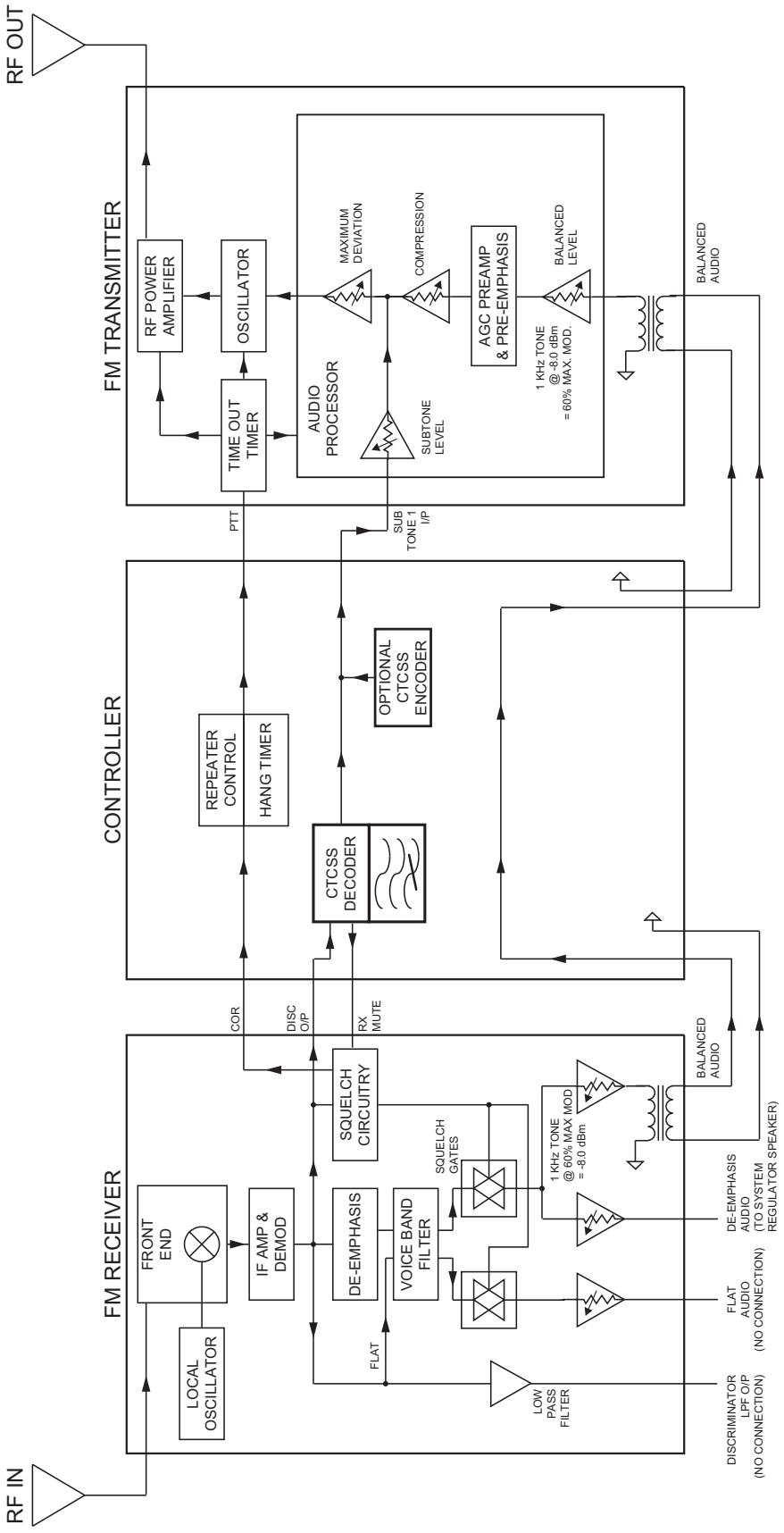

Figure 4-1: MT-3 Simple Analog Repeater Block Diagram

FM REPEATER / BASE STATION BLOCK DIAGRAM

Figure 4-2 shows a block diagram of a Codan FM analog repeater or base station system (or a repeater-base) using an AC-3E Audio Control Card. A block diagram of a repeater system using an AC-3M-96 and AC-3S-96 Audio Control Card would be identical, with the exception of the auxiliary COR, PTT and audio.

The incoming FM transmission is routed through the Front End sub-module where the RF signal:
• is filtered (VHF and UHF 400 – high selectivity multiple pole, helical resonator filter, 5 MHz pass band; UHF 800/900 – dielectric bandpass filter)
• is amplified through a low noise amplifie
• is filtered again through an image rejection filter
• is mixed with a local oscillator
• produces an IF frequency of 21.4 MHz (VHF and UHF 400) or 45 MHz (UHF 800/900).

The first IF amplifier provides linear IF amplification and then crystal filters provide optimum bandpass characteristics for good selectivity and low distortion. A second L.O. source of 21.855 MHz (VHF and UHF 400) or 44.545 MHz (UHF 800/900) produces a second IF of 455 KHz. Second IF filtering is achieved through the use of a 455 KHz ceramic filter. The second IF is demodulated to recovered audio which is then sent to the discriminator output (for CTCSS decoding), the squelch circuitry and the flat and de-emphasis audio paths.

The squelch circuitry will produce the COR output and control the audio squelch gates. The audio will typically be routed through the de-emphasis circuitry and a jumper selectable voice band filter (flat audio is not commonly used). The de-emphasis audio output will drive the speaker in the System Regulator. The balanced audio output level, as well as the other audio output levels, are typically set for -8.0 dBm (308 mVrms) audio output, using a 1.0 KHz tone at 60% of maximum modulation (3.0 KHz wideband; 1.5 KHz narrowband) at the RF input.

The COR signal and audio are then routed through the AC-3E audio control card and are sent to the transmitter as a PTT signal and audio. The AC-3E has audio routing capability that can be configured to use the audio distribution amplifier to send the audio from one receiver to both transmitters (or the AC-3M-96 and AC-3S-96 can send audio to all four transmitters). Audio level control variable resistors allow the user to adjust the audio levels between the receivers and transmitters using the front panel of the AC-3E. An additional benefit of the audio routing circuitry is the capability of routing audio through the CTCSS filter built into the CTCSS decoder board, allowing the voice band filter in the receiver to be disabled to save current draw.

The AC-3E audio control card also has auxiliary audio inputs and outputs for external control which can be used simultaneously with the internal audio routing, allowing a repeater-base configuration or just a base station configuration. For external control, the AC-3E also has optically isolated COR and PTT inputs and outputs for connecting external equipment with high voltage control signals such as E&M. The CTCSS decoder can also encode the same tone it is programmed to decode. If a separate tone is required for encoding, an optional CTCSS encoder can be installed and for the separate tone.

The transmitter will accept the incoming balanced audio and route it through the audio processor board in the transmitter. The balanced level control, compression control, and maximum deviation levels are all set in the audio processor. The balanced audio input level is typically set for a transmitter deviation of 60% of maximum modulation (3.0 KHz wideband; 1.5 KHz narrowband) at the RF output, using a 1.0 KHz tone at -8.0 dBm (308 mVrms) at the audio input.

The CTCSS tone is also added in the audio processor and set by the subtone 1 input level control. The incoming PTT signal will activate all circuitry in the transmitter and will key the transmitter. The transmitter will then modulate the audio signal to an FM carrier in the oscillator and then amplify the output of the oscillator.

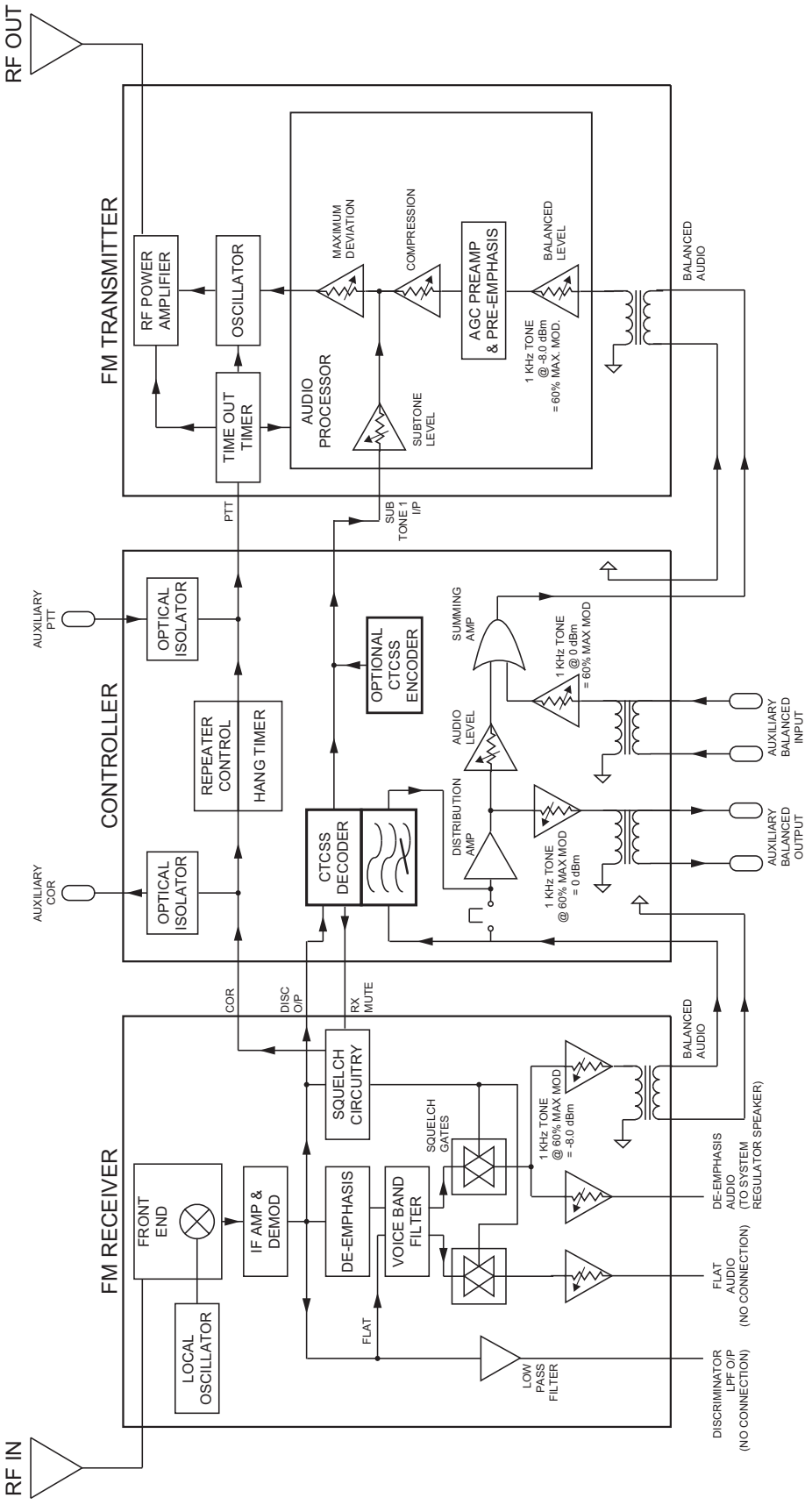

Figure 4-2: MT-3 Analog Repeater and/or Base Station Block Diagram

PAGING TRANSMITTER BLOCK DIAGRAM

Figure 4-3 shows a block diagram of a Codan digital or analog paging transmitter using a CI-PM-3 Paging Modulator Card.

The paging encoder can be connected to the CI-PM-3 through auxiliary connections on the subrack / motherboard or through a front panel DB-15 located on the front panel of the paging modulator card.

The analog / digital select control line of the paging encoder is fed to the transmitter and is used to control the signal path in the audio processor.

Analog audio is fed directly through the paging card to the balanced audio input of the transmitter.

The incoming paging data from the paging encoder is connected to the appropriate 2 or 4 level input. These signals are fed to control circuits that will turn on or off the appropriate pre-set control voltages, which are then routed to the modulation input of a high stability reference oscillator (OCXO). The modulated 10 MHz signal is fed to the reference in put of the transmitter's synthesizer. A component of the digital page is also sent to the modulation input of the transmitter synthesizer through the direct modulation input of the transmitter's audio processor.

If the system requires a great amount of frequency stability, as required in simulcast transmissions, an external high stability reference can be connected to the external reference input of the paging card. The reference signal in combination with the paging cards phase lock loop (PLL) circuit will condition the OCXO to +/-0.002ppm.

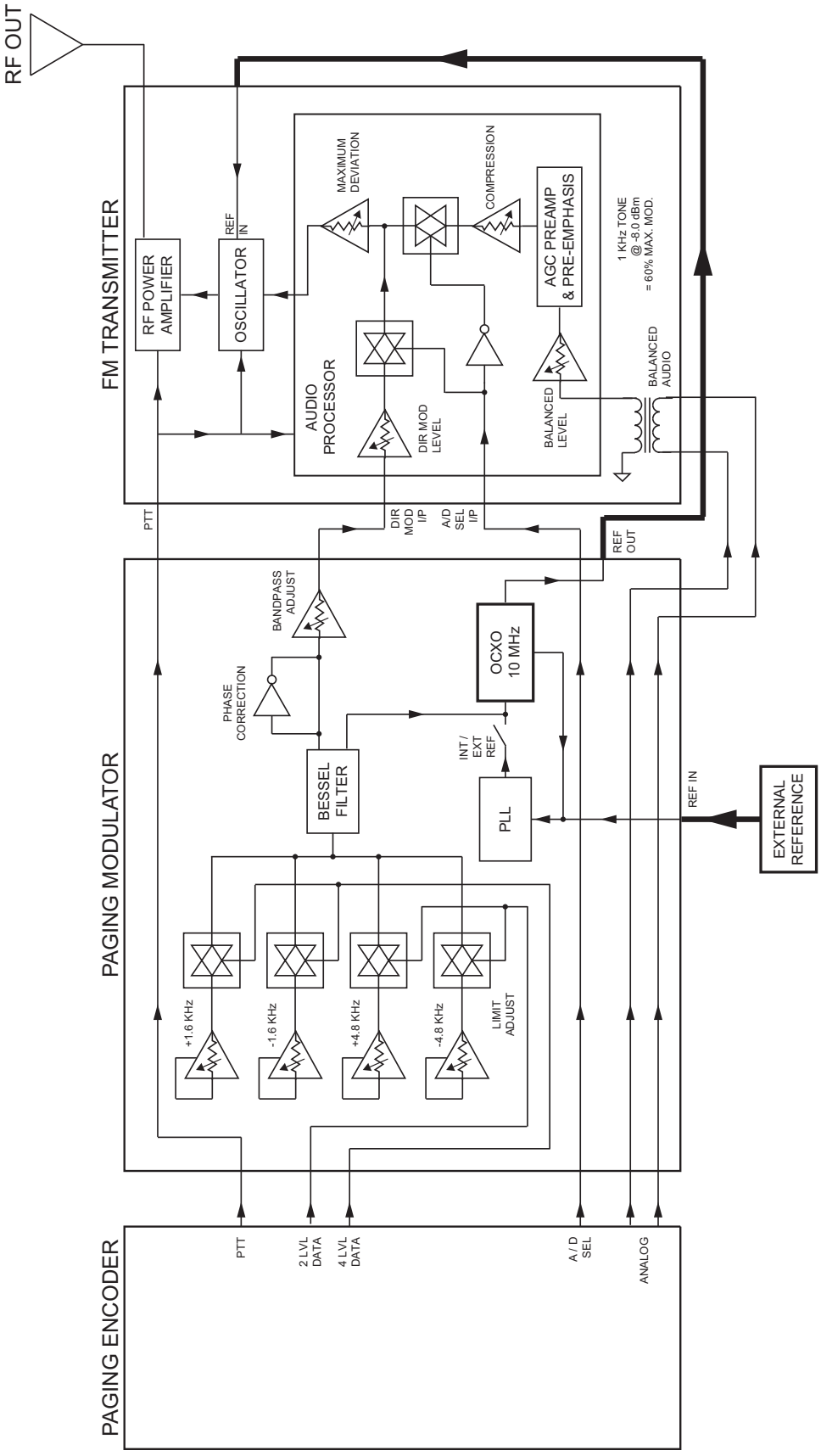

Figure 4-3: Analog / Digital Paging Transmitter Block Diagram

AM BASE STATION (OR AM / FM CROSS-BAND) BLOCK DIAGRAM

Figure 4-4 shows a block diagram of a Codan AM base station system (or AM/FM cross-band system) using an AC-3E Audio Control Card. In an AM / FM cross-band system, either the receiver or transmitter in the block diagram would be replaced with an FM receiver or transmitter.

The incoming AM transmission is routed through the preselector where the RF signal:
- is passed through a 20 MHz Elliptical Band Pass Filter
- is amplified through a low noise amplifier
- is filtered again through an image rejection filter
- is mixed with a local oscillator
- produces an IF frequency of 21.4 MHz.

The first IF amplifier provides linear IF amplification and then crystal filters provide optimum bandpass characteristics for good selectivity and low distortion. A second L.O. source of 32.15 MHz produces a second IF of 10.75 MHz. Second IF filtering is achieved through the use of a 10.7 MHz ceramic filter. The second IF is demodulated to recovered audio and an AGC output is applied to the RF amplifier in the preselector.

The recovered audio is sent to the squelch circuitry and the recovered (flat) audio path. The squelch circuitry will produce the COR output and control the audio squelch gate. The flat audio will be routed through the squelch gate and will then be split to the low level and high level audio adjust drivers. The low level audio output will drive the speaker in the System Regulator. The balanced audio output (high level), as well as the audio output (low level) to the system regulator speaker, are typically set for -8.0 dBm (308 mVrms) audio output, using a 1.0 KHz tone at 30% modulation at the RF input.

For an AM / FM Cross-band application, the COR signal and audio are routed through the AC-3E audio control card and are sent to the transmitter as a PTT signal and audio. The AC-3E has audio routing capability that can be configured to use the audio distribution amplifier to send the audio from one receiver to both transmitters. Audio level control variable resistors allow the user to adjust the audio levels between the AM and FM receivers and transmitters using the front panel of the AC-3E.

For an AM Base Station application, the AC-3E audio control card has auxiliary audio inputs and outputs for external control which can be used simultaneously with the internal audio routing, allowing a cross-band-base configuration or just a base station configuration. For external control, the AC-3E also has optically isolated COR and PTT inputs and outputs for connecting external equipment with high voltage control signals such as E&M.

The transmitter will accept the incoming balanced audio and route it through the audio processor board in the transmitter. The balanced level control and modulation control output level are set in the audio processor. The balanced audio input level is typically set for a transmitter deviation of 30% modulation at the RF output, using a 1.0 KHz tone at -25.0 dBm (44 mVrms) at the audio input. The incoming PTT signal will activate all circuitry in the transmitter and will key the transmitter. The transmitter will then modulate the audio signal to an AM carrier in the amplifier.

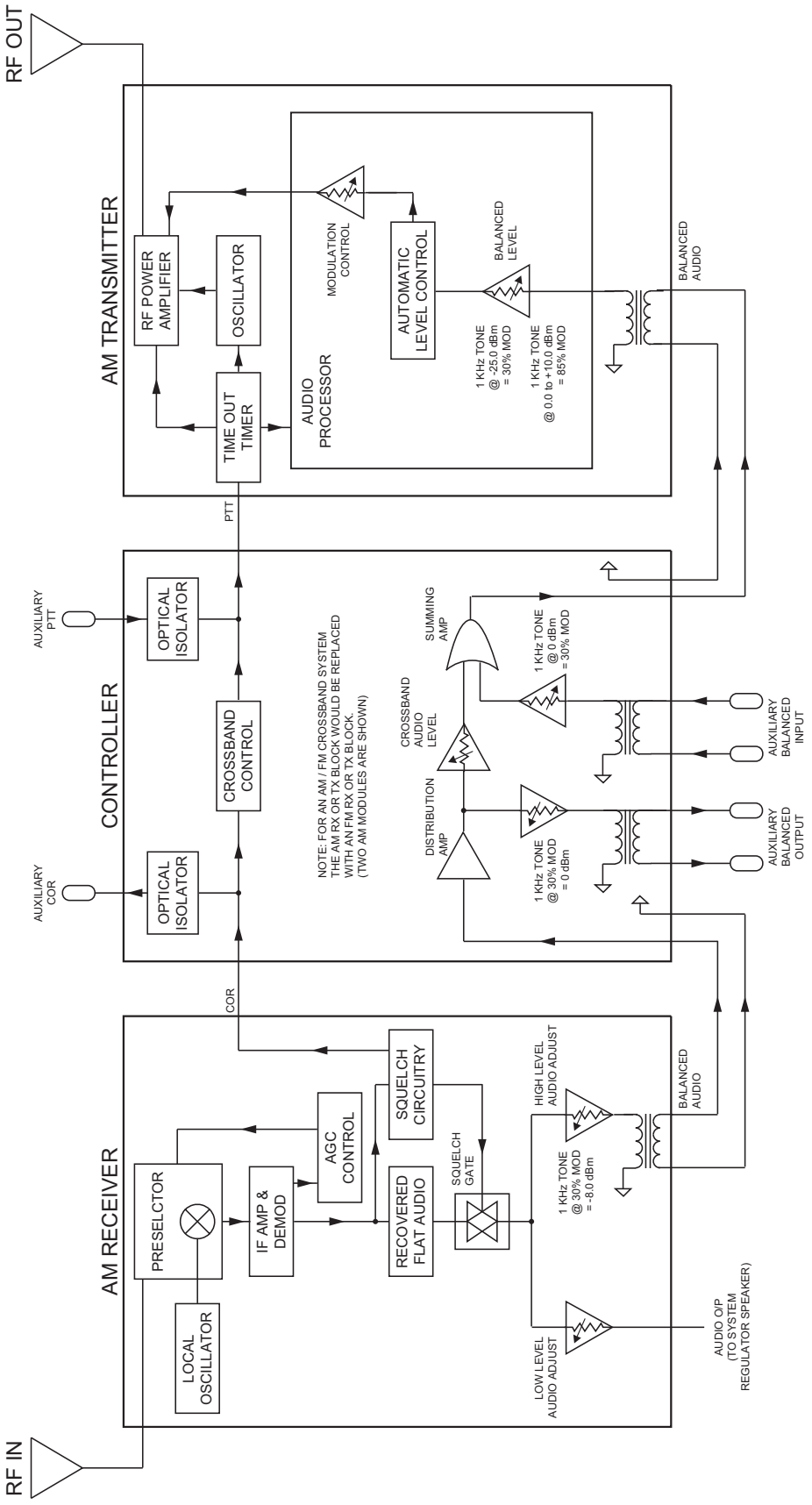

Figure 4-4: AM Base Station (or AM / FM Cross-band System) Block Diagram

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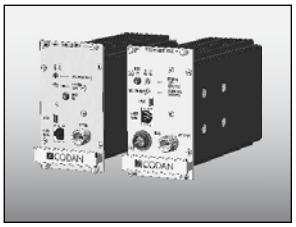


CHAPTER 5: RADIO SYSTEM COMPONENTS

CODAN ANALOG RADIO SYSTEM COMPONENTS

A Codan MT-3 Analog Radio System consists of:

- MT-3 Receiver and Transmitter Modules
- MT-3 controller (AC-3L-96, AC-3E, AC-3M-96, AC-3S-96, CI-PM-3)
- Subrack (with Optional Auxiliary Connector)
- System Regulator
- Power Amplifiers
- Channel Programmer
- Tuning and Maintenance Tools

The Receiver, Transmitter, and Controller were discussed previously. The other radio system components are further explained in greater detail in this chapter.

All Codan modules are hot swappable. There is no need to disconnect the power supply when inserting or removing the modules from the subrack. Most variable components are designed so that an increase in voltage, frequency, etc. is achieved by a clockwise turn, and a decrease is achieved by a counter-clockwise turn.

SUBRACK

The SR-39-1 subrack is designed to hold and interconnect the MT-3 series of receiver, transmitter and control modules on one universal motherboard. The subrack has room for two receiver and transmitter pairs. The left side connectors are reserved for transmitter A and receiver A, while the right side connectors are reserved for transmitter B and receiver B. See Figure 5-1.

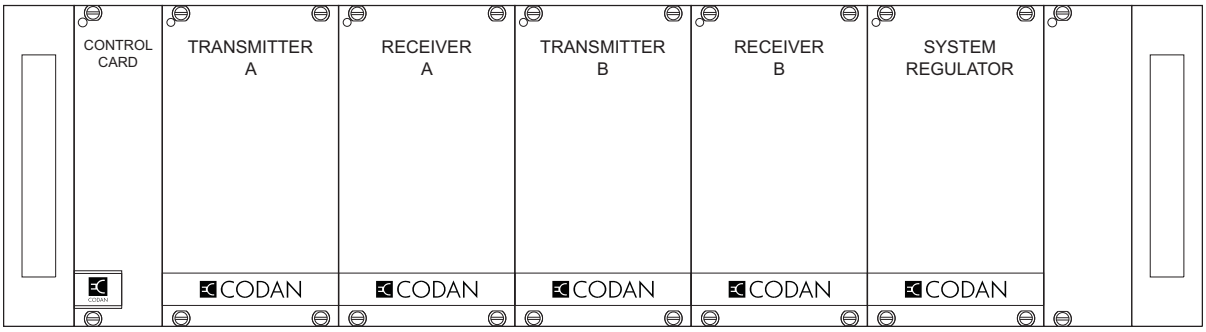


Figure 5-1: Standard Subrack Configuration

If a VHF or UHF 30 Watt power amplifier is installed, only one transmitter and receiver pair can be installed. The power amplifier takes up two slots as shown in Figure 5-2.

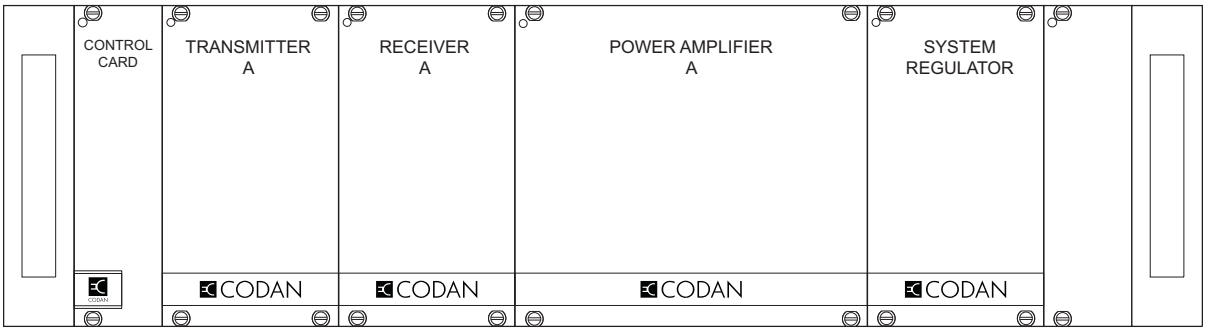


Figure 5-2: Standard Subrack with Power Amplifier

Power Input

The main power input (+10 to +17 Vdc; +13.8 Vdc nominal) connector is located at the back of the subrack, on the motherboard. There is an identical +9.5 Vdc power output connector on the motherboard that is used to power other Codan equipment at +9.5 Vdc.

NOTE: Do not connect the main power input to the +9.5 Vdc power output connector, as a transient suppressor (over voltage protection) will short to ground to protect the equipment.

Reverse voltage protection and over voltage protection (transient suppressor) is provided at the main power input as well as the +9.5 Vdc line. The main power input is protected with a standard fast-blow 15 amp fuse. These components may require replacing if the power supply is not connected properly, or even after a power surge or a lightning strike. The two transient suppressors have different voltage ratings for the main power input and +9.5 Vdc lines. Figure 5-3 shows the subrack / motherboard rear view.

Channel Selection

An MT-3 crystal controlled radio modules operating frequency is selected by the control module's fundamental crystal frequency. The channel select lines and internal BCD rotary switches are not used by the crystal control module.

MT-3 synthesized radio modules are capable of 16 channel operation. The 16 channels are controlled via four CSEL signal lines connected to each receiver and transmitter module. The CSEL signal lines are set as either a 0 (0 Vdc) or a 1 (+9.5 Vdc). Table 5-1 shows the channel selected for the CSEL input settings. Bank select jumpers / connections are not used for MT-3 radio systems.

Table 5-1: Channel Selection Settings

Channel	Decimal	CSEL3	CSEL2	CSEL1	CSEL0
1	0	0	0	0	0
2	1	0	0	0	1
3	2	0	0	1	0
4	3	0	0	1	1
5	4	0	1	0	0
6	5	0	1	0	1
7	6	0	1	1	0
8	7	0	1	1	1
9	8	1	0	0	0
10	9	1	0	0	1
11	10	1	0	1	0
12	11	1	0	1	1
13	12	1	1	0	0
14	13	1	1	0	1
15	14	1	1	1	0
16	15	1	1	1	1

There are 3 different ways to change the channel of a transmitter / receiver module:

1. The user can set jumpers mounted on the motherboard for each Channel Select signal line (Set of four for each Tx / Rx module). These jumpers can be used to permanently set a subrack slot at a specific channel.
   - Jumpers can be set for 0 (0 Vdc) "B" or "down" or 1 (+9.5 Vdc) "A" or "up".
   - Pull-up resistor jumpers to +9.5 Vdc must be installed.
2. CSEL signal lines can be controlled externally by a tone remote adapter, or other third party devices.
3. Sixteen-position rotary select switches mounted on the front of the base controller can control the CSEL lines. Optionally the Audio Control Card can have a rotary switch added.

The pull-up resistor jumpers to +9.5 Vdc must be removed and all channel select jumpers must be installed in the 1 or "up" position for both external control and rotary switch control of channel selection. The locations of the channel select and pull-up jumpers are shown in Figure 5-3.

Antenna Relay Activation

The motherboard on the subrack contains a set of jumpers that are used to activate the optional antenna relays in the System Regulator module from the Transmitter PTT IN and PTT OUT signal lines. Figure 5-3 shows the location of these jumpers.

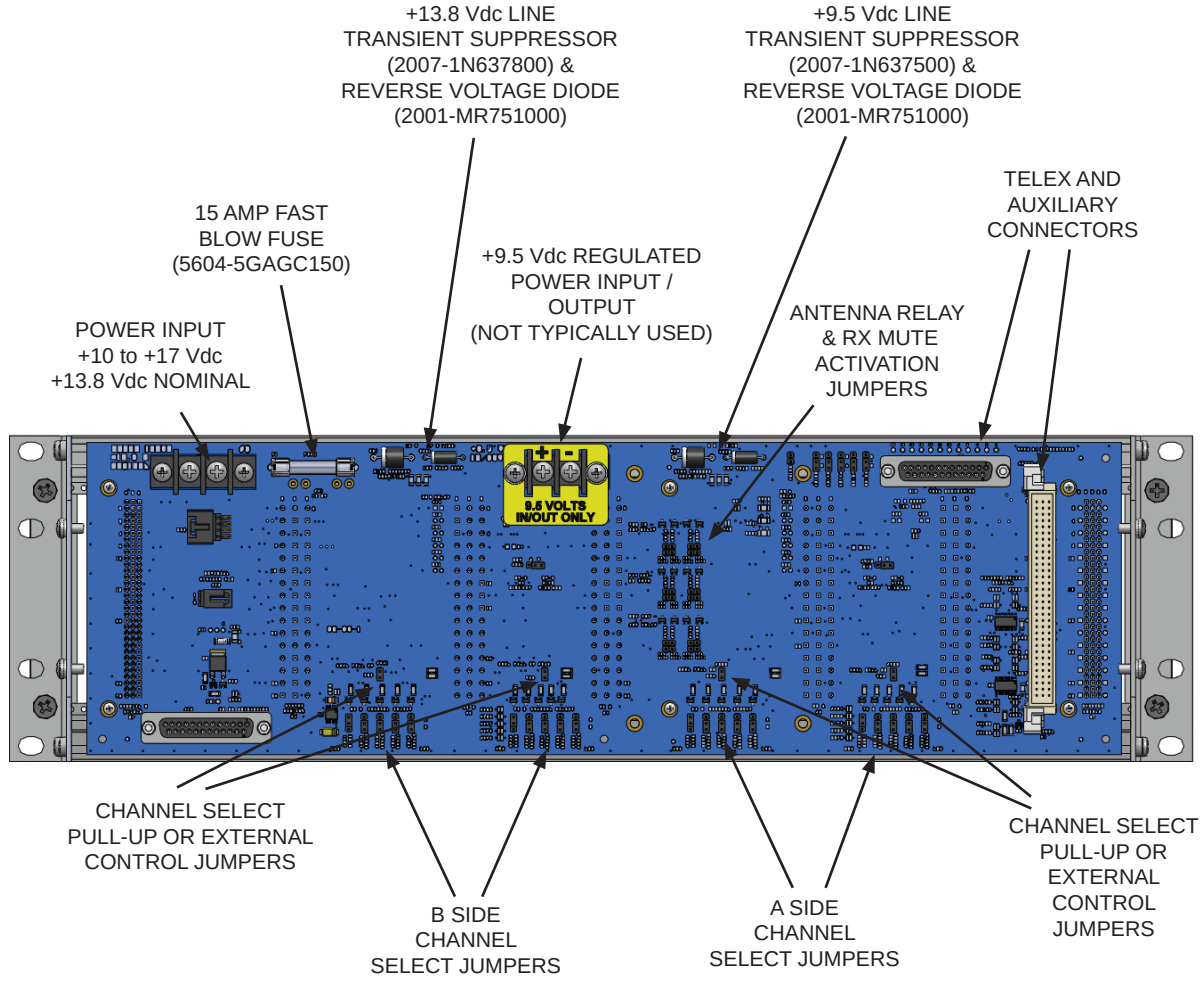
JU36	TXA PTT OUT activates Relay A	JU37	TXA PTT IN activates Relay A
JU39	TXA PTT OUT activates Relay B	JU40	TXA PTT IN activates Relay B
JU42	TXB PTT OUT activates Relay A	JU43	TXB PTT IN activates Relay A
JU45	TXB PTT OUT activates Relay B	JU46	TXB PTT IN activates Relay B

Simplex Operation

The motherboard on the subrack contains a set of jumpers that are enabled when the radio system is operated in simplex mode (simplex base station or simplex links). The jumper connects the Transmitter PTT OUT signal line to the RX MUTE. This jumper will cause the receiver to mute when the transmitter is keyed.

JU38	TXA PTT OUT mutes RXA	JU41	TXA PTT OUT mutes RXB
JU44	TXB PTT OUT mutes RXA	JU47	TXB PTT OUT mutes RXB

Figure 5-3: Subrack / Motherboard Rear View



Auxiliary Connectors

The motherboard on the subrack has two auxiliary connectors available, a DB25 connector for direct connection to a Telex DSP-223 or IP-223 and a 96 pin connector typically used to connect to the A-PNL-AUX96-3.

DB25 Connector to DSP-223 or IP-223

Connector J10 is a female DB25 connector which can be used for basic base connections. When connected to a Telex DSP-223 or IP-223, a standard straight-through male-to-male DB25 extender cable can be used with some motherboard jumper changes. The IP-223 also requires that 2 pins on the DB25 (PTT COM - pin2 and MON COM - pin 16) are wired to ground for proper operation.

WARNING: JU108 must be configured correctly for DSP-223 or IP-223 or damage can occur. JU108 A for +13.8 Vdc / DSP-223 or JU108 B for Rx A COR / IP-223

A-PNL-AUX96-3 Auxiliary Connector

An optional component that can be added to the subrack is the A-PNL-AUX96-3 Auxiliary Connector. The auxiliary connector mounts on the back wrap-around cover of the subrack and connects to the auxiliary connector on the motherboard. The A-PNL-AUX96-3 brings all of the auxiliary connector signal lines out to screw terminals for easy connection. These connections are ideal for interfacing external equipment and allowing easy access for testing and tuning points. The A-PNL-AUX96-3 Auxiliary Connector and the back wrap-around cover are shown in Figure 5-4.

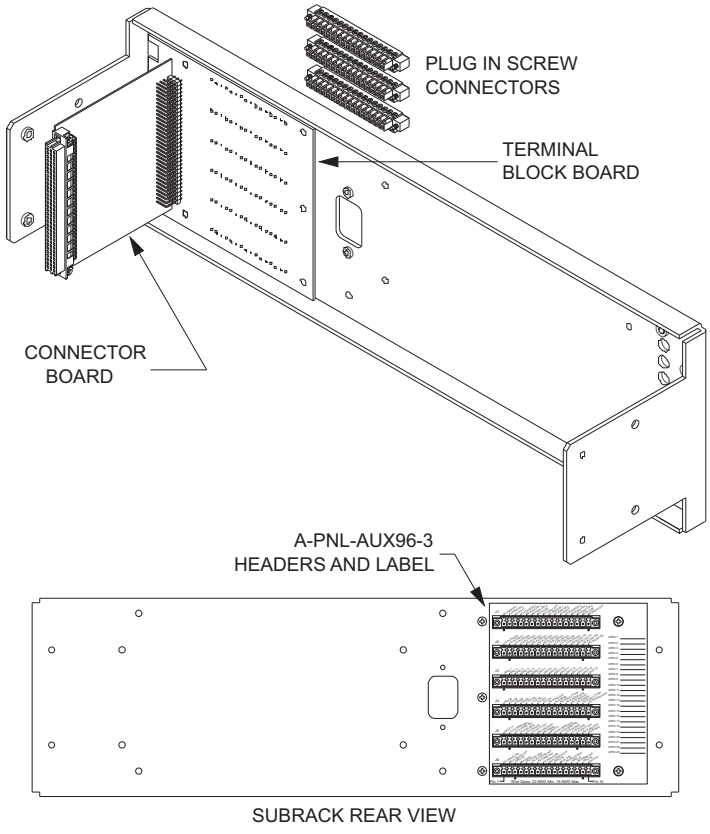


Figure 5-4: Auxiliary Panel Diagram

A close-up view of the auxiliary connector label, as shown in Figure 5-5, indicates the short signal name for each connection point. Definitions for these signals can be found in the SR-39-1 subrack manual. Extra General Purpose Input / Output connectors (GPIO) that can be used for different functions depending on the control card are listed to the right of the connectors. For example, the AC-3E audio control card uses these lines for auxiliary audio inputs / outputs and auxiliary COR / PTT connections. The custom functions of these connectors will be marked in the blank space next to the signal name.

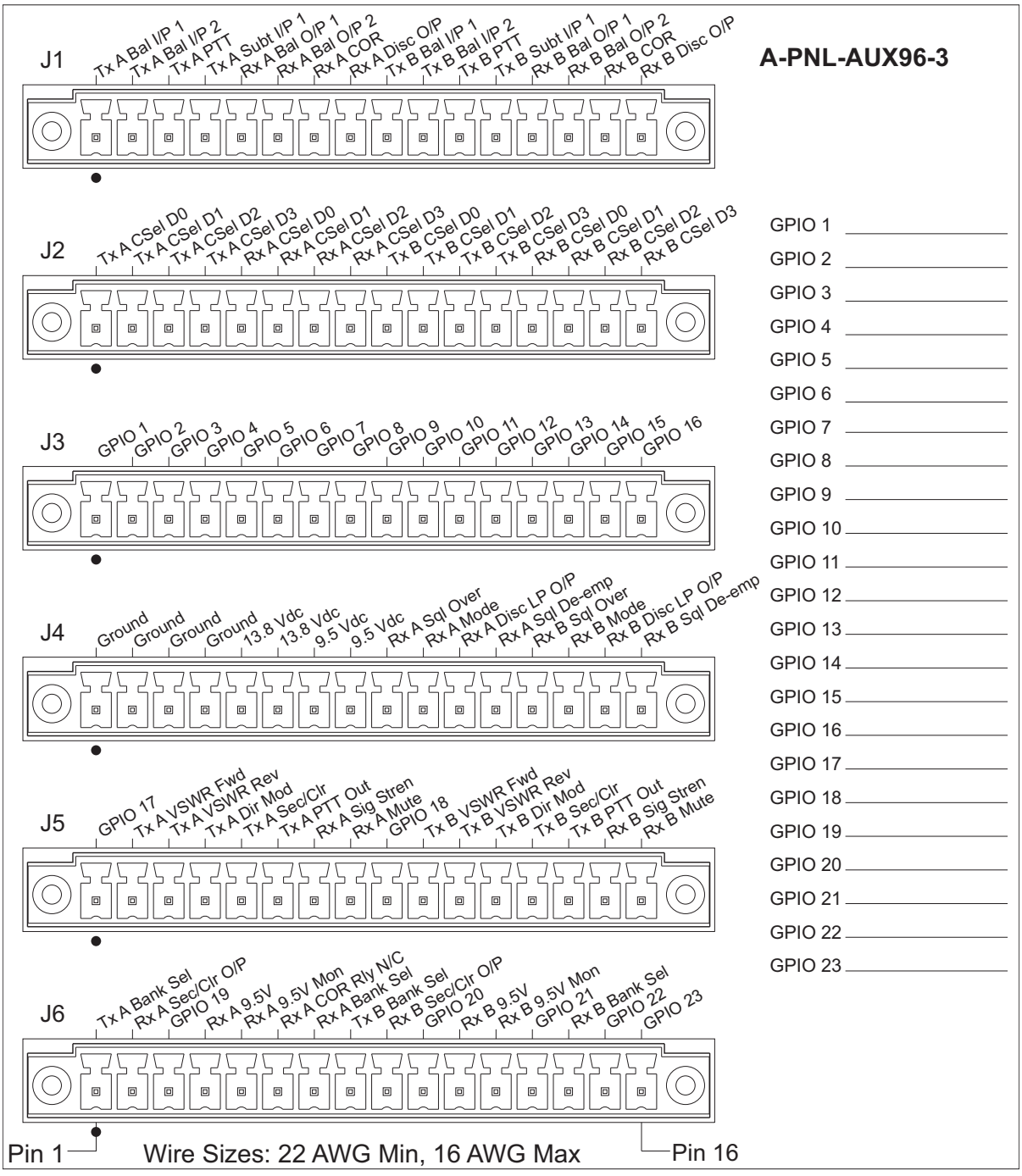


Figure 5-5: Auxiliary Panel Pin-Out

SYSTEM REGULATOR

The SM-3 System Regulator is a plug-in module which provides voltage regulation, system metering and audio monitoring for an MT-3 radio system. The SM-3 includes the following features:

- High current +9.5 Vdc voltage regulator with an anti-latchup hysteresis circuit.
- Front panel switch selectable meter outputs to check supply voltages, regulated voltages, etc.
- Audio amplifier and loudspeaker.
- Relay drivers for optional antenna relays.

There are several different models of System Regulators as shown in Figure 5-6. The basic SM-3 is the same size as a transmitter or receiver module. The System Regulator can also be purchased with 1 or 2 optional antenna relays.

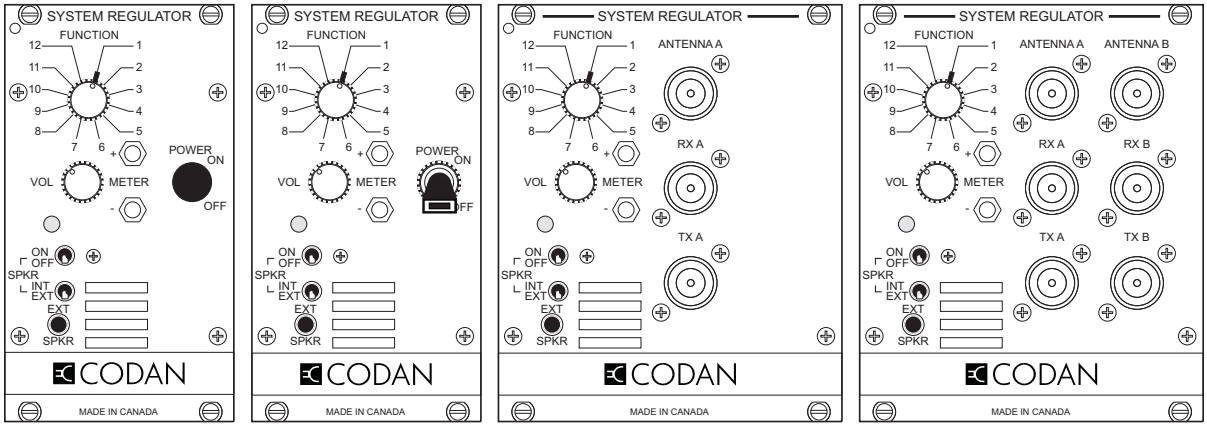


Figure 5-6: System Regulators

Backwards Compatibility

The SM-3 System Regulator is a direct replacement for the SM-3 System Monitor, however, the rotary switch positions for the front panel test points have been changed.

The simplex mode jumpers to connect the Transmitter PTT OUT signal line to the RX MUTE are now located on the new motherboard, but the System Regulators still contain the simplex mode jumpers for backwards compatibility with older motherboards.

System Regulator Testing

The System Regulator module is designed with a convenient and easy test point built in to the front panel. This test point allows a technician access to the DC supply and regulated voltages. Simply connect a standard Digital Volt Meter (DVM) to the METER jacks on the front panel of the System Regulator as shown in Figure 5-7. Turn the rotary switch to the desired position to measure the supply voltage, regulated voltages, receiver carrier strength, audio output or Priority COR as shown in Table 5-2. Note that the RSSI and Priority COR requires a carrier and the audio output requires an audio tone injected into the receiver.

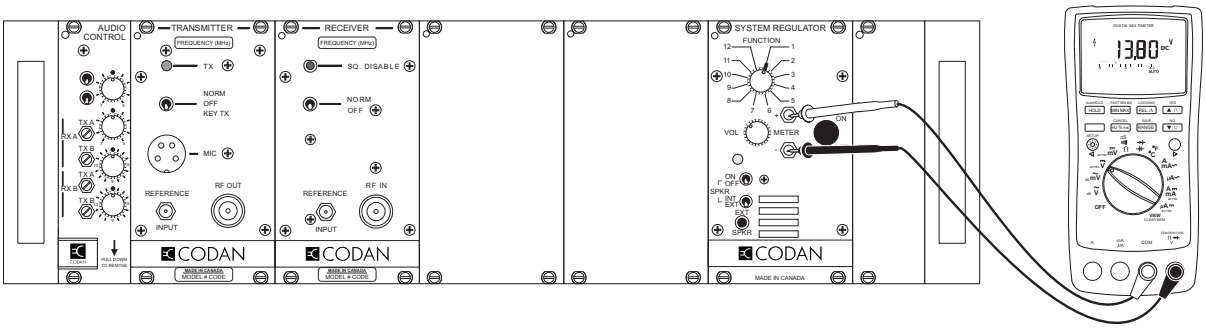


Figure 5-7: System Regulator Testing

Table 5-2: System Regulator Rotary Switch Functions

Position	Function	Parameter
1	Supply Voltage	+10 Vdc to +17 Vdc (+13.8 Vdc nominal)
2	+9.5 Volts Regulated	+9.5 Vdc (± 0.1 Vdc)
3	Rx A Audio	Receiver A Audio (NOT Rx Balanced Output)
4	Rx A Carrier Strength	+1 Vdc to +5 Vdc based on received signal strength (+1 Vdc is a low RF signal level, +5 Vdc is high)
5	Rx B Audio	Receiver B Audio (NOT Rx Balanced Output)
6	Rx B Carrier Strength	+1 Vdc to +5 Vdc based on received signal strength (+1 Vdc is a low RF signal level, +5 Vdc is high)
7	Rx A Priority COR	Open Collector Output; Measure with an Ohm meter. Ground for Active; Open for Inactive
10	Rx B Priority COR	Open Collector Output; Measure with an Ohm meter. Ground for Active; Open for Inactive
11	Rx A +6.0 Volts	+6.0 Vdc (± 0.1 Vdc)
12	Rx B +6.0 Volts	+6.0 Vdc (± 0.1 Vdc)

POWER AMPLIFIERS

Table 5-3 shows the RF Power outputs for the transmitter modules in each frequency band.

Table 5-3: RF Power Outputs

Band	Frequency	Transmitter
VHF Lowband	29 – 50 MHz	0.5 to 3.0 Watts
VHF Highband	136– 174 MHz	2.0 to 8.0 Watts
UHF 400 MHz	406 – 430 MHz and 450 – 470 MHz	0.5 to 2.0 Watts or 2.0 to 8.0 Watts
UHF 800 MHz	806 – 824 MHz and 851 – 869 MHz	0.5 to 3.0 Watts
UHF 900 MHz	896 – 902 MHz and 928 – 960 MHz	0.5 to 3.0 Watts
VHF AM	118 – 137 MHz	1.0 to 3.0 Watts (Carrier Only)

If a higher RF power output is required, the transmitter may be used as an exciter to drive a power amplifier. Codan Radio Communications manufactures a 30 Watt power amplifier for VHF highband and UHF 400 MHz, shown in Figure 5-8, that will fit into a standard subrack.

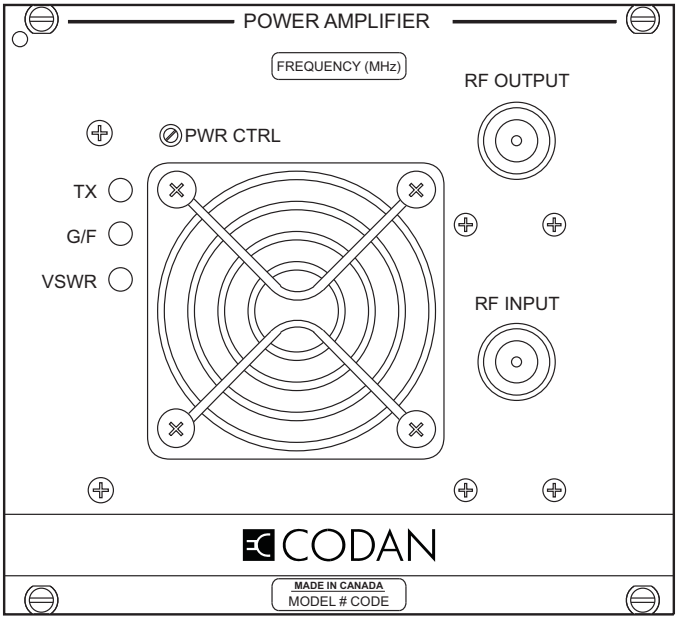


Figure 5-8: 30 Watt Power Amplifier

Codan Radio Communications can also supply higher power amplifiers (60 W, 100 W, 250 W) that are 19” rack mountable, as well as amplifiers for other frequency bands (Lowband and AM). All transmitters and power amplifiers are rated for 100% continuous duty.

CHANNEL PROGRAMMER

The CP-SC-3 synthesizer channel programmer is used to program channels 2 through 16 (and read channel 1) of Codan MT-3 synthesized radios. The CP-SC-3 synthesizer channel programmer is packaged in the same size of enclosure as the MT-3 receiver module, allowing it to be conveniently mounted in any receiver subrack slot position. An interconnect cable (Type F to DB-9) connects the front panel of the CP-SC-3 synthesizer channel programmer to any free standing synthesized receiver or transmitter. The programmer allows the four digit Channel Designation codes to be entered into channels 2 through 16 of the connected receiver or transmitter and will read the codes programmed into channels 1 through 16.

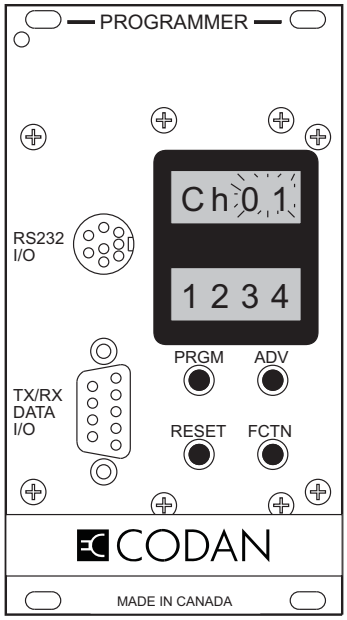


Figure 5-9: CP-SC-3 Synthesizer Channel Programmer

TUNING AND MAINTENANCE TOOLS

To facilitate testing, alignment and maintenance for the MT-3 radio systems, extender cards can be used to extend the individual modules out from the subrack. Extender kits (extender card plus a four foot cable) allow the modules to be extended out to a bench for servicing.

The following extender cards and kits are available:

EC-96D1 (direct connect) or **EC-96K-1.22** (card and cable)
Used for the 96 pin control cards (AC-3L-96, AC-3E, AC-3M-96, AC-3S-96 and CI-PM-3).

EC-48RD (direct connect) or **EC-48RK-1.22** (card and cable)
Used for all receiver, transmitter, power amplifier and system regulator modules.

Figure 5-10 shows the 96 pin and 48 pin direct connect extender cards.

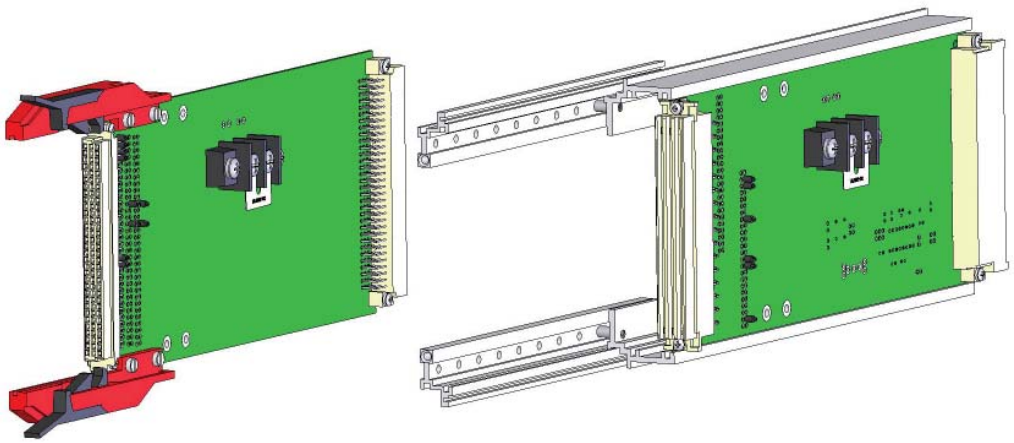


Figure 5-10: EC-96D1 and EC-48RD Direct Connect Extender Cards

The A-TK-01 tool kit includes a number of spare parts for the MT-3 radio system, including tuning tools, guide rails, transient suppressors, diodes, a fuse, dust caps, shunt jumpers, ESD wrist strap, and various screws and hardware.

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