Model RM-20

Repeater Maker *plus*

CES Wireless Technologies Corp.
925-122 South Semoran Blvd., Winter Park, FL 32792
(407) 679-9440
support@ceswireless.com
www.ceswireless.com

MAN79 Version 1.2
Updated 31-Jan-10
Printed in USA

Table of Contents

Warranty

CES Wireless Technologies Corp. warrants this product to be free from defects in material and workmanship for three years from date of shipment. If such malfunction occurs, it will be repaired or replaced (at our option) without charge for materials or labor if returned to the factory. This warranty does not apply to parts damaged due to improper use- including accident, neglect, unreasonable use, and improper installation - or to unauthorized alterations or modifications of the equipment. It does not extend to damage incurred by natural causes such as lightening, fire, floods, or other such catastrophes, nor to damage caused by environmental extremes, such as power surges and or transients. It does not extend to microprocessors if is determined that the failure of a micro is due to static damage, application of improper voltages to the unit, or other problems nor related to circuit design. In such case or in the case of a desire to update the micro to a different version of software, such request must be specified in writing, and there will be a charge agreed upon by both parties.

This product is warranted to meet published specification and to operate as specified only when properly installed in radio equipment which complies with US FCC specification and the applicable radio manufacturerÿs specifications. CES is not responsible for any operational problems caused by system design, outside interference, or improper installation. Installation and programming of this CES product must be completed by a qualified two-way radio technician or engineer.

Equipment for repair may be returned to the factory, freight prepaid, only with prior authorization. Please call 407-679-9440 for an RMA number. A brief letter describing the nature of the defect should be included with the merchandise. Repair by other than CES will void this guarantee. In-warranty merchandise must be shipped, freight prepaid, to CES. CES will return the repaired or replaced equipment to purchaser, within the United States.

This warranty applies to the original purchaser of the equipment only. CES is not liable under this warranty, or any implied warranty, for loss of use or for other consequential loss or damage experienced by the purchaser. Some states do not permit the exclusion or limitation of implied warranties or consequential damages. This warranty provides special legal rights, and the purchaser may have other rights that vary from state to state.

Copyright

All information contained in this document is carefully prepared and offered in good faith as a guide in the installation, operation, use and servicing of our products. Installers must insure that the final installation operates satisfactory, within relevant regulatory requirements. We accept no responsibility for incorrect installation.

Introduction

Thank you for choosing the **RM-20 Repeater maker *plus*.**

This product has been carefully engineered and manufactured to provide reliable service in virtually any wireless communications system. Occasionally, particular systems may require special functions not available in standard products. Please call your CES Applications Engineer to discuss special applications to meet other needs.

Because we are engaged in a program of continual product development, the specifications and descriptions outlined in this manual are subject to change. Please consult the amendment section for changes.

When you call CES for support, you will be asked for the version number of this manual. A manual is shipped free with each RM-20. If you do not have a manual, we are unable to provide telephone support. Manuals can be ordered from the CES Sales Department.

At CES, we strive to bring you products that meet your needs. If you have any comments about our products, manuals or service please call CES at 407 -679-9440, and thank you for your continued support.

SPECIFICATIONS & FEATURES

Features:

- Rugged construction for harsh environments
- Multi-user tone panel - up to 4 user groups
- Cross-tone encoding supported
- Programmed using DTMF telephone handset or over the air
- Optional plug in voice delay module
- Power and repeat inhibit switches
- Auxiliary relay controlled via programmable DTMF code

Benefits:

- Create a repeater using two transcievers
- Provide a backup repeater for continious duty systems
- Make a single/cross band repeater
- Provide a þportableý repeater
- Provide a multi user CTCSS repeater system

Specifications:

Dimensions:	4 x 4 x 1.5 inch.
Weight:	0.5 lb.
Cabinet:	Aluminum Extrusion
Voltage:	12 V DC
Current	Idle 30.7mA Transmit 90.00mA
Interface Cable:	6 ft shielded 9 conductor cable and RM-20 connectors provided

Potentiometers for level adjustments:

Receive Audio, Transmit Audio, CTCSS Output, Courtesy Beep, COR Threshold

Radio Interface Connections:

Power	5.5 - 18 V DC, reverse polarity protected
Ground	To transceiver ground
PTT Relay	Normally open, closed and common, connected to microphone PTT
Auxiliary relay	Normally open, closed and common. For user application.
RX Audio	Connected to discriminator or to squelched audio if transceiver has a suitable COR, level adjustable.
TX Audio	Normally connected to microphone audio, level adjustable.
COR	Required only if RX Audio input is connected to squelched audio.

Interconnect Interface Connections:

PTT, RX Audio, Ground, TX Audio, COR and 12V

1.0 General Description

This manual provides detailed information regarding the installation, operation, and maintenance of the CES model **RM-20 Repeater Maker *plus***.

The CES RM-20 is an advanced low cost, compact microprocessor controlled repeater controller unit that can make a repeater out of just about any two transceivers. The standard features and versatility makes this an ideal choice for commercial, industrial or amateur use.

The **M-20 Repeater Maker *plus*** includes:

- Programmable Roger Beep
- Programmable disconnect time out timer with disconnect warning beeps
- Programmable hang time
- Auxiliary relay controlled with programmable DTMF string
- PTT relay
- Power, COR and PTT LEDÿs
- Power and repeat front panel switches
- Repeat inhibit digital input with programmable polarity
- Up to 4 programmable CTCSS encode/decode
- Internal COR (discriminator)
- External COR with programmable polarity
- External interconnect DB-9 connector (pinout compatible with 4700VP Telephone Interconnect)
- Programmable interconnect repeat audio function
- Programmable Morse code ID
- Internal 8 pin connector for 4700DB audio delay module
- Local or over the air programming
- Low current draw

2.0 Installation Instructions

2.1 General Information

Installation of the model RM-20 should be performed by a qualified two-way radio or communications technician. Ensure that static precautions are observed and that power is not applied during installation.

Shielded audio cable should be used for all audio signal line connections to the transmitter-receiver combination. Terminate ground shields at the DB9 connector only to prevent hum and noise due to ground loops. The shield at the other end of the cable must be left unconnected. The best location for the units is as close as possible to the transmitter-receiver combination, thus allowing the shielded cables and wires to be as short as possible.

2.2 Material and Equipment Required for Installation

The following items are needed in order to install the model RM-20:

- #2 Phillips screwdriver
- Solder and soldering iron
- Service monitor or deviation meter (optional for transmitter deviation)
- 1/8ý flat blade adjustment tool or jewelerÿs screwdriver
- Oscilloscope or RMS meter voltmeter
- A DTMF telephone Handset
- Digital Multimeter
- Portable transceiver programmed with same frequencies as the receiver and transmitter interfaced with the RM-20

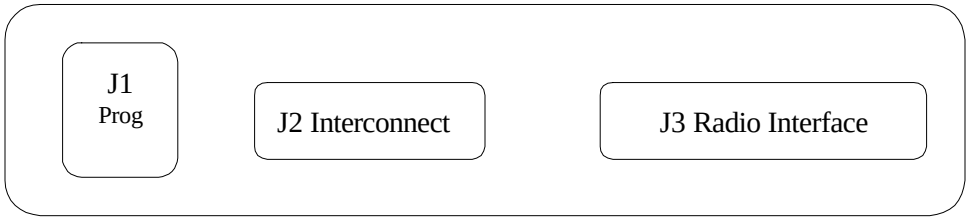
2.3 Mechanical Installation

Place the RM-20 on any surface away from sources of extreme heat or cold. The RM-20 should be close to a good grounding system if at all possible for maximum lightning protection.

2.4 Electrical Installation

Electrical installation of the model RM-20 involves connections to a radio receiver and transmitter via J3 (DB-15 male). An optional connector J2 (DB-9 female) is provided for the connection of a telephone interconnect such as the CES model 4700VP. Figure 1 shows the rear panel of the RM-20. Table 1 shows functional information for each pin of the DB-15 male on the rear panel. Table 2 shows functional information on each of the interconnect pins of the (DB-9 female) connector. And Table 3 shows the RM-20 programming jack.

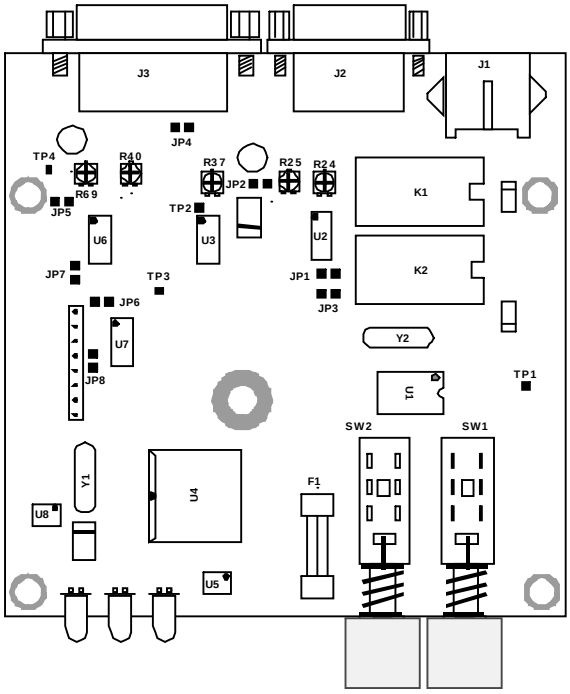
Fig. 1.0 RM-20 Rear Panel Diagram



2.5 Component Layout

Fig.2.0

RM-20 BOARD LAYOUT



2.6 Radio Interface Connection

Pin	Function	Signal	Description
1	PTT, NO	----------	PTT relay, normally open
2	PTT, NC	----------	PTT relay, normally closed
3	AUX. COMMON	----------	Auxiliary relay, common
4	TX DISABLE	Input	-35 to 35 volts, switch @ 2.5v, 47k pull up to 12v
5	TX CTCSS	Output	CTCSS Output to Transmitter
6	TX AUDIO	Output	Transmit (Repeat) audio to Transmitter
7	RX AUDIO	Input	Receive audio from Receiver
8	GROUND	----------	Ground
9	PTT, COMMON	----------	PTT relay, common
10	AUX. NO	----------	Auxiliary relay, normally open
11	AUX. NC	----------	Auxiliary relay, normally closed
12	NO CONNECTION		
13	COR (Channel Busy)	Input	-35 to 35 volts, switch @ 2.5v, 47k pull up to 12v
14	GROUND	----------	Ground
15	12 VOLTS	Input	Fused & reverse polarity protected

Table 1. Radio and Auxiliary Interface (DB-15) male connector

2.7 Interconnect Interface Pinout

Pin	Function	Signal	Description
1	PTT	Input	-35 to 35 volts, switched @ 2.5v, 47k pull up to 12v
2	RX audio	Output	Interconnect receive audio
3	Mode	Input	-35 to 35 volts, switched @ 2.5v, 47k pull up to 12v
4			
5	Ground	----------	Interconnect ground
6	TX audio	Input	Interconnect transmit audio
7	TX disable	Input	Same as radio connector pin 4
8	COR	Output	COR and CTCSS logic, open collector, 47k pull up to 12v
9	12 volts	Output	Interconnect 12 volts, not reverse protected

Table 2 Interconnect interface (DB-9) female connector

2.8 Programming Interface Connector Pinout

Pin	Function	Signal	Description
1	N/A		
2	Tip		
3	Ring		
4	N/A		

Table 3 Programming connector (RJ11)

2.9 Jumpers

Jumper No.	Function	Description	Default	Position
JP1	Future enhancements	N/A	**IN**	--
JP2	CTCSS TX output	High Z Low Z	**OUT**	OUT IN
JP3	Future enhancements	N/A	**OUT**	--
JP4	RX audio input	High Z Low Z	**OUT**	OUT IN
JP5	TX audio output	High Z Low Z	**OUT**	OUT IN
JP6	CTCSS high pass filter	300 Hz high pass filter in 300 Hz high pass filter bypass	**OUT**	OUT IN
JP7	CTCSS high pass filter	300 Hz high pass filter in 300 Hz high pass filter bypass	**IN**	IN OUT
JP8	Voice audio delay (optional)	No audio voice installed Audio voice installed	**IN**	IN OUT

Following are instructions for each connection and adjustment that is required by the RM-20 for proper pperation. Installation procedure will be outlined first followed by the adjustment procedures. All connections to the radio (s) are made via the rear panel DB-15 connector, and should be performed by a qualified two-way radio or communications engineer. Ensure that static precautions are observed and that power is not applied during installation. Shielded audio cable should be used for all audio signal line connections to transmitter-receiver combination. Terminate ground shields at DB-15 connector only to prevent hum and noise due to ground loops. The shield at the other end of the cable must be left unconnected. Place the unit as close as possible to the transmitter-receiver combination, thus allowing the shielded cables and wires to be as short as possible. Once the installation has been successfully completed, continue with the adjustment section of the manual. **Do not program the RM-20 until all the installation and adjustments have been successfully completed.**

2.10 Radio and Auxiliary relay interface. J3- DB-15

Pin 1- PTT-NO
Connect to the Push to Talk of the transmitter. This is normally connected at the microphone PTT input.
****** See Pin 9 (PTT Common)******

Pin 2- PTT-NC
This connection is generally not used. In applications where two RM-20ÿs are used for cross-band applications, this contact may be used. *See Figure 3.0*

Pin 3- Aux. Common
(optional)

Pin 4- TX Disable
This is an input that (when active) disables the RM-20s repeat and decode functions. This connection is typically used if two RM20 are used in a cross-band application. The active state of this input is programmable.

Pin 5- CTCSS TX
If CTCSS is to be used on the repeater system, this connection must be made to a suitable tone injection point in the transmitter. Consult the manual and/or schematic of your transmitter for this connection. The radios microphone audio input ***cannot*** be used for this connection.

Pin 6- TX Audio
This connection is normally made to the transmitter microphone high input.

Pin 7- RX Audio
Some consideration must be given to this input. The RM-20 must have a way to determine when there is activity on the receiver. If this input is connected to the IF detector (discriminator) output of the receiver, the RM-20s internal squelch circuit will provide the carrier detection. If a filtered or squelched audio source is used, then the internal squelch circuit will not function properly and an additional connection (External COR) will be required.
Also, if it is intended for the RM-20 to decode CTCSS (Sub Audible Tone), then this input must be connected to the discriminator.

Pin 8- Ground
Connect this pin to the common ground on the radio. If external power supply is used, tie all the grounds together.

Pin 9- PTT Common
Most transmitters require a ground for transmitter keying , in this case connect pin 9 to ground. In cases where positive voltage is required for keying, connect this pin to the appropriate voltage source.

Pin 10- Aux. NO
(optional)

Pin 11- Aux. NC
(optional)

Pin 12-
(Not used)

Pin 13- External COR Input
This connection is optional. The RM-20 can determine the presents or absents of a carrier either by its internal squelch circuit (see pin7 RX Audio) or the External COR Input. If squelched or filtered audio will be used for the RX Audio connection, then this connection will be required. Connect this input to a point in the receivers squelch circuit that changes state when the radio is receiving a signal (squelch is open). This signal must be a DC change that swings between 1 volt or lower to 3 volts or higher. The active state of this input is programmable.

Pin 14-Ground
(same as pin 8)

Pin 15- 12V DC
Connect to a source of regulated, filtered 12VDC supply. If separate power supplies are used for the transmitter and receiver units, the power source for the RM-20 should be the one used to power the receiver. This will lessen the chance of problems due to voltage fluctuation when the transmitter keys and unkeys.

Note: Pins 3, 10, and 11 are the auxiliary relay contacts. This programmable relay can be used to control external circuitry. A pre-programmed code will enable and disable the relay over the air. To program a code refer to the programming section in this manual.

2.11 Interconnect Interface J1- DB-9

The RM-20 provides an interconnect interface connector on the rear panel (pin by pin compatible with our model 4700VP). Following is a list of pins and functions of J1.

Pin 1 Push to Talk
Pin 2 RX Audio
Pin 3 Interconnect mode
Pin 4 N/C
Pin 5 Ground
Pin 6 TX Audio
Pin 7 TX Disable
Pin 8 COR
Pin 9 12 V DC

2.12 Level Adjustments

RX Audio
Inject a signal modulated with a 1 kHz tone at 4 KHz deviation into the receiver. Adjust R37 for 500 mV p-p at TP2. If this level is difficult to obtain, install or remove JP4 as follows. If level at TP2 below the 500 mV and R37 is at maximum, install JP4. If level is too sensitive at TP2 remove JP4 (factory default) and readjust.

Internal COR mobile detector
This adjustment sets the threshold for the RM-20s internal squelch circuit. This setting is critical for proper operation of the RM20. Apply power to the RM-20 and radios. Disable the transmitter via TX disable switch on the front panel of the RM-20. Then turn R23 clockwise until the COR LED (DS2) illuminates, then turn R23 counterclockwise ***just*** until the COR LED extinguishes. Generate carrier to the receiver and verify that COR LED illuminates when carrier is present and extinguishes when carrier is removed. The COR is now set correctly.
Note: Not required if external COR is used for carrier detection

TX / Repeat Audio
Inject a signal modulated with a 1 kHz tone at 4 kHz deviation into the receiver, and with TP2 adjusted to 500 mV p-p (175 mV rms.) adjust R69 for 4 KHz deviation measured with a deviation meter or service monitor on the transmitter frequency. If this level is difficult to obtain, install or remove JP5 as follows. If deviation is above 4 KHz and R69 is at minimum, remove JP2 (factory default). If deviation is below 4 KHz and R69 is at maximum install JP2 and readjust.

Roger Beep (if enabled)
Apply and remove carrier to the receiver and listen for the beep. If adjustment is needed, repeatedly apply and remove carrier in to the receiver to activate the beep. Adjust R40 until the desired level is obtained.

CTCSS RX
This level is also controlled with R37 (RX audio level control) and theoretically the RX Audio adjustment procedure above should be sufficient. However in cases where not enough audio level is obtained at TP2, increasing R37 will bring this level to a reliable operating range. The microprocessor will accurately decode CTCSS from 100 mV to 2v p-p. It is suggested that the input level at TP2 be kept at between 500 to 750 mV p-p.
Note: RECEIVE AUDIO MUST BE CONNECTED TO THE DISCRIMINATOR OF THE RECEIVER FOR THIS FEATURE TO OPERATE.

CTCSS TX
A CTCSS TX tone must be programmed prior to performing this adjustment. (Refer to the programming section on this manual). Apply carrier to the receiver and monitor the transmitter frequency. Adjust R25 for 800 Hz deviation. If this level is difficult to obtain install or remove JP2 as follows: if not enough CTCSS signal is obtained with R25 at maximum, install JP2. If the adjustment is too sensitive, remove JP2 (factory default) and readjust.

3.0 Programming Procedures

3.1 Programming the RM-20

Programming procedures
The model RM-20 can be easily programmed locally with a standard DTMF telephone. Programming can also be achieved þover the airý with a DTMF microphone.

Note: Programming over the air requires a program access code. This code must be programmed locally on initial installation.

Local programming
Local programming is accessed by plugging a DTMF telephone handset into the programming jack (J1) on the rear panel of the RM-20. To access the local program mode, turn the power off and back on and press the * (asterisk) key within two seconds of applying power to the unit. The RM-20 will generate a series of beeps to the programming **telephone earpiece** acknowledging the program mode entry. An easy way to insure that the * is received within 2 seconds is to have the * key pressed as power is applied, then release it as soon as the tone is heard.

Over the Air programming
The model RM-20 can also be programmed over the air using a DTMF microphone or a portable radio equipped with DTMF keypad. However an þover the airý program code (up to 9 digits) must be programmed into the unit. It is suggested that this code is programmed on initial installation. Once an þover the airý programming code is programmed, the RM-20 can be easily accessed and programmed over the air. Simply send the access code accompanied by carrier and monitor the transmitter frequency. If successfully entered in the program mode a series of beeps will be heard. Proceed to enter the program codes needed to be programmed by pressing each key slowly and firmly and monitor the frequency for the acknowledge tones. The programming code entry sequence is exactly the same as in local programming mode. Once the unit is programmed, press (00#) to exit the program mode.

To assist the programming process, a number of confidence toned will heard. They are:

Valid parameter beep	One 1 KHz tone (e.g. 1#)
Code accepted	Five 1 KHz tones (e.g. 1#0#)
Error beep	Three 400 Hz tones (e.g. 80#)

3.2 Programming Table Summary

Code	Function	Range	Default value
00 #	Exit program mode	n/a	n/a
1 #	COR Source	0 or 1	0 (discriminator)
2 #	External COR polarity	0 or 1	0 (active low)
3 #	Roger beep	0 ~ 2	1 (enabled)
4 #	CTCSS TX (tone 1)	0 ~ 50	0 (disabled)
5 #	CTCSS RX (tone 1)	0 ~ 50	0 (disabled)
6 #	CTCSS TX (tone 2)	0 ~ 50	0 (disabled)
7 #	CTCSS RX (tone 2)	0 ~ 50	0 (disabled)
8 #	CTCSS TX (tone 3)	0 ~ 50	0 (disabled)
9 #	CTCSS RX (tone 3)	0 ~ 50	0 (disabled)
10 #	CTCSS TX (tone 4)	0 ~ 50	0 (disabled)
11 #	CTCSS RX (tone 4)	0 ~ 50	0 (disabled)
12 #	CTCSS tone during hangtime	0 or 1	0 (disabled)
13 #	CTCSS tone 1	0 or 1	0 (disabled)
14 #	Repeater hangtime	0 ~ 9	2 (2 seconds)
15 #	Interconnect PTT input	0 or 1	0 (disabled)
16 #	Interconnect PTT input polarity	0 or 1	0 (active low)
17 #	Interconnect mode input	0 or 1	0 (active low)
18 #	Interconnect output polarity	0 or 1	0 (active low)
19 #	Interconnect active period	0 ~ 60	3 (3 seconds)
20 #	Interconnect repeat	0 ~ 2	1 (enabled)
21 #	Morse code ID send	0 ~ 3	0 (disabled)
22 #	Morse code ID interval timer	0 ~ 90	3 (3 minutes)
23 #	TX time out timer	0 ~ 90	2 (2 minutes)
24 #	TX time out penalty	0 ~ 30	0 (disabled)
25 #	TX disable input	0 or 1	0 (disabled)
26 #	TX disable input polarity	0 or 1	0 (active low)
27 #	COR Only produces CTCSS	0 ~ 4	0 (disabled)
28 #	Auxiliary relay code	8 digits max.	(null)
29 #	Morse code ID (call letters)	9 digits max.	(null)
30 #	Over the air programming code	9 digits max.	(null)
99 #	Program factory default	n/a	n/a

Table 4 Programming Summary

Programming Parameters Explained
The following is a list of available programmable features. **Parameters in bold letters denotes factory defaults**. (00# will exit the program mode).

COR Source (1#) ***(Means in which the RM-20 determines receiver activity)***
The model RM-20 can be programmed for internal or external COR. Internal COR which is the factory default requires that the RX Audio input be connected to the discriminator of the receiver. (See RX Audio description) Otherwise, the External COR input must be used and this item programmed to þExternal CORý To program this item enter the command code followed by a 1 or 0, (donÝt forget to enter a # (pound) key between commands and at the end of the entry sequence).
1#0# = internal 1#1# = external

External COR polarity (2#)
External COR signal can be active high or active low. If this signal is normally at a low state goes to a high state when carrier is detected (receiver squelch is open), program the polarity to active high. If this signal does the opposite, program it to active low. (See Description of External COR input) To program this item enter the command code followed by a 1 or 0, (don't forget to enter a # (pound) key between commands and the end of the entry sequence).
2#0# = active low **2#1# = active high**

Roger beep (3#)
The courtesy beep has three programmable options: (1) A tone will be generated every time the receiver carrier goes away, (2) it also can be programmed to send a tone after one second after receiver carrier goes away or (3) can also be turned off. To program this feature enter the command code followed by a 1 or 0, (don't forget to enter a # (pound) key between commands and the end of the entry sequence).
3#0# = off **3#1 = on** **3#2# = on with 1 second delay after receiver carrier goes away**

CTCSS (Continuous Tone Coded Squelch or Sub Audible Tone)
The RM-20 supports up to four (4) CTCSS TX tone pairs. Within each pair a separate transmit and receive tone frequency can be programmed. For example, tone #1 can receive a specific tone and transmit the same tone or it can receive one tone and transmit a different tone. Each tone pair works independently from each other. Codes **4#, 6#, 8#, and 10#** correspond to TX tones **1, 2, 3, and 4** respectively. And codes **5#, 7#, 9#, and 11#** to RX tones **1, 2, 3, and 4** respectively. If all receive tones are disabled, the RM-20 will operate on COR only. Refer to tone chart in this manual for tone number and frequency.

CTCSS during hangtime (12#)
When this code is enabled, the RM-20 will generate a CTCSS tone for the duration of the hangtime. A CTCSS TX tone must be programmed. To program this feature enter the command code followed by a 1 or 0, (don't forget to enter a # (pound) key between commands and the end of the entry sequence).
12#0# = disabled **12#1# = enabled**

CTCSS Tone 1 command (13#)
This feature limits "over the air" programming access to carriers with CTCSS tone 1. If this feature is enabled, programming over the air and the auxiliary relay will be inaccessible unless the codes are accompanied by the correct CTCSS tone. To enable or disable this feature, enter the command code followed by 0 or 1. (don't forget to enter a # (pound) between commands and the end of entry sequence).
13#0# = disabled **13#1# = enabled**

Hang-time timer (14#)
This code will control the time which the transmitter will stay keyed after COR and CTCSS (if programmed) goes away. The hangtime period can be programmed for up to nine seconds at one second intervals. To program the hangtime period enter the command code followed by number of seconds required, (don't forget to enter a # (pound) between commands and the end of entry sequence). It can also be disabled if no hangtime is needed. The factory default for this feature is 2 seconds.
14#0# = disabled **14#2# = 2 seconds**

Interconnect PTT in (15#)
This code is only used in applications where a telephone interconnect (Phone Patch) is used in conjunction with the RM-20. When enabled, it will control the PTT on the RM-20. This input can be programmed for active high or active low. To program this feature enter the command code followed by a 1 or 0, (don't forget to enter a # (pound) key between commands and the end of the entry sequence).
15#0# = disabled **15#1# = enabled**

Interconnect PTT in polarity (16#)
This code enables and disables the interconnect PTT input when a telephone interconnect (Phone Patch) is connected via J1. To enable this feature enter the command code followed by the 1 or 0 (donÝt forget to enter a # (pound) between commands and that the end of the entry sequence.
16#0# = disabled **16#1# = enabled**

Interconnect mode input polarity (17#)
This command is only used if an interconnect is used in conjunction with the RM-20. If an interconnect is used, connect pin 3 of J1 to the connect circuit on the interconnect and program for the proper polarity. To program this feature enter the command code followed by a 1 or 0, (donÝt forget to enter a # (pound) key between commands and the end of the entry sequence).
17#0# = active low **17#1# = active high**

Interconnect COR out polarity (18#)
This output controls the interconnect mobile detect polarity (COR). To program this feature enter the command code followed by a 1 or 0, (donÝt forget to enter a # (pound) after each command and at the end of sequence).
18#0# = active low **18#1# = active high**

Interconnect active timer (19#)
This timer will control the time period in which the RM-20 will stay inaccessible after a phone call is terminated. This code is programmable for up to 90 seconds at 1 second intervals. If cover tones are used (code 20#2#) set this parameter to zero. To program this feature enter the command code followed by the number of seconds. (donÝt forget to enter a # (pound) key between commands and the end of the entry sequence).
19#3# = 3 seconds **19#0 through 90# = 0 through 90 seconds**

Interconnect repeat (20#)
This parameter determines what audio is transmitted while an interconnect call is in progress. This feature consists of three programmable parameters, Enabled, Disabled or Cover Tone. When enabled, the RM-20 will transmit both (Land Line and Mobile Operator) sides of telephone interconnect audio. When Disabled, only the Land Line (Telco) audio will be transmitted .If programmed for cover tone, the RM-20 will generate a series of short beeps over the air while the mobile operator is transmitting. This serves as to indicate that the channel is in use while keeping the mobile operator side of the audio muted for privacy purposes.
Note: IF COVER TONE IS ENABLED, VERIFY THAT CODE 19# (INTERCONNECT ACTIVE PERIOD) IS SET TO ZERO. IF CODE 19# IS SET TO ANYTHING OTHER THAN ZERO, THE COVER TONES WILL BE TRANSMITTED OVER THE AIR UNTIL THIS TIME EXPIRES.

Morse code ID send (21#)
This code controls how often the Morse code identification is sent. There are four programmable parameters in this feature, Off, Timer, COR inactive for 3 seconds, and Timer / COR inactive. When programmed for Timer the RM-20 will ID at the interval that code 22# is programmed for. If programmed for COR inactive for 3 seconds, the RM-20 will ID 3 seconds after COR has been inactive. Programming it for Timer/COR inactive for 3 seconds the RM-20 will ID when the timer (code 22#) has expired and every time COR goes inactive for 3 seconds.

21#0# = off **21#1# = timer**
21#2# = COR inactive for 3 seconds **21#3# = timer and COR inactive for 3 sec**.

Morse code ID time interval (22#)
This command controls the time interval in which the RM-20 transmit the ID call letters. This feature is programmable for up 90 minutes at 1 minute interval (1 through 90) and up to two hours with code 22#0#.
22#0# = 2 hours **22#3# = 3 minutes**

Note: The initial ID will be generated at 5 minutes regardless of the time interval programmed, and at the rate on which the time interval is programmed for thereafter.

TX time out timer (23#)
This timer will control how long the transmitter will stay keyed continuously. This command can be programmed for up to 90 minutes at 1 minute interval and up to 2 hours with command 23#0#.
23#0# = 2 hours **23#2# = 2 minutes**

TX time out timer penalty (24#)
The TX time out timer will control how long the RM-20 will remain inactive after the TX time out timer (Code 23#) has expired. If the RM-20 stayed keyed for the length of the TX time out timer, the unit will unkey the transmitter and will stay in the idle mode until the TX time out timer penalty has expired. Once this timer has expired the unit will switch back to normal operation. This code is programmable for no penalty or up to 30 seconds at 1 second interval.
24#0# = no penalty **24#1 through 30# = 1 through 30 seconds**

TX disable in (25#)
This code is normally used when two RM-20ÿs are used for crossband application in order to keep both RM-20ÿs from transmitting at the same time. To program this feature enter the command code followed by a 1 or 0, (donÿt forget to enter a # (pound) key between commands and the end of the entry sequence).
25#0# = disabled **25#1# = enabled**

TX disable in polarity (26#)
This code controls the polarity of TX disable (code 25#) This command can be programmed for active high or active low. To program this feature enter the command code followed by a 1 or 0, (donÿt forget to enter a # (pound) key between commands and the end of the entry sequence).
26#0# = active low **26#1# = active high**

COR only with CTCSS (27#)
This parameter enables the generation of CTCSS when the RM-20 is in þCOR Onlyý repeat mode. This mode is enabled by setting all CTCSS RX program locations to 0 (Off). In this mode the unit can generate (transmit) CTCSS even though it does not require CTCSS to be received.
To program this feature enter the command code as follows:
0=Off 1 = CTCSS #1, 2 = CTCSS #2, 3 = CTCSS #3, 4 = CTCSS #4
DonÿÝt forget to enter the # (pound) key between commands and the end of the entry sequence.
27#0# = Off 27#1# = Transmit CTCSS Transmit Tone 1

Auxiliary relay code (28#)
The RM-20 is equipped with a auxiliary relay. This relay can be used to control external circuitry or devices by sending a code in DTMF format to the RM-20. A DTMF code (8 digits maximum) followed by digit 1 will energize the relay and a DTMF code followed by digit 0 will de-energize the relay. The normal state of this relay is disabled. When the enable code is received, the relay will energize and remain in this condition until the disable code is received. If power is removed from the RM-20 the relay will revert to its disabled condition. To program this feature with a code of 12345678 enter the following:
28#12345678#.
To control the relay enter the following:
123456781 to enable it or 123456780 to disable it

Note: If code 13# is enabled, the auxiliary relay can only be accessed by the proper code accompanied by the correct CTCSS tone programmed on CTCSS RX tone1 (code 5#)

Morse code ID letters (29#)
A Morse code ID can be sent based on a timer, when COR /CTCSS are deactivated or both. When programming the ID call letters, each character is entered by pressing two (2) numeric keys. This code cannot exceeds 9 characters in length. To program a call letter ID enter the command code (28#) followed by the 2 numerical keys for each character followed by the # (pound) key. Refer to the Morse code table in this manual.
Example:
To program the call letters KYZJ103 enter the following sequence,
29# 52 93 03 51 10 00 30 #

Over the Air Programming Code (30#)
The over the air programming code must be programmed into the unit before it will work (no factory default). This code can be up to 9 digits long. To program this code enter the programming mode locally, then program the remote programming code.
Example: To program a code of 1234 enter 30# 1234#

Factory defaults (99#)
When in the program mode and this code (99#) is entered, the RM-20 will immediately load the factory default values and any previous programmed parameters will be lost. Refer to programming table summary on this manual for factory default values.

4.2 CTCSS Tone Table

Tone	Number		Tone	Number
Off	0		156.7	26
67.0	1		159.8	27
69.3	2		162.2	28
71.9	3		165.5	29
74.4	4		167.9	30
77.0	5		171.3	31
79.7	6		173.8	32
82.5	7		177.3	33
85.4	8		179.9	34
88.5	9		183.5	35
91.5	10		186.2	36
94.8	11		189.9	37
97.4	12		192.8	38
100.0	13		196.6	39
103.5	14		199.5	40
107.2	15		203.5	41
110.9	16		206.5	42
114.8	17		210.7	43
118.8	18		218.1	44
123.0	19		225.7	45
127.3	20		229.1	46
131.8	21		233.6	47
136.5	22		241.8	48
141.3	23		250.3	49
146.2	24		254.1	50
151.4	25			

4.3 Morse Code Table

Char	Code	Char	Code	Char	Code	Char	Code	Char	Code
0	00	A	21	K	52	U	82	Ñ	44
1	10	B	22	L	53	V	83	Ö	45
2	20	C	23	M	61	W	91	CH,S	35
3	30	D	31	N	62	X	92	AR	07
4	40	E	32	O	63	Y	93	ERR	48
5	50	F	33	P	71	Z	03	,	16
6	60	G	41	Q	02	Ä	37	-	66
7	70	H	42	R	72	Á	38	.	46
8	80	I	43	S	73	É	39	/	36
9	90	J	51	T	81	Ü	47	?	94
								SPACE	05

4.0 User Code Chart

Code	Function	
00 #	Exit program mode	
1 #	COR Source	
2 #	External COR polarity	
3 #	Courtesy beep	
4 #	CTCSS TX (tone 1)	
5 #	CTCSS RX (tone 1)	
6 #	CTCSS TX (tone 2)	
7 #	CTCSS RX (tone 2)	
8 #	CTCSS TX (tone 3)	
9 #	CTCSS RX (tone 3)	
10 #	CTCSS TX (tone 4)	
11 #	CTCSS RX (tone 4)	
12 #	CTCSS tone during Hang-time	
13 #	CTCSS tone 1	
14 #	Repeater Hang-time	
15 #	Interconnect PTT input	
16 #	Interconnect PTT input polarity	
17 #	Interconnect mode input	
18 #	Interconnect output polarity	
19 #	Interconnect active period	
20 #	Interconnect repeat	
21 #	Morse code ID send	
22 #	Morse code ID interval timer	
23 #	TX time out timer	
24 #	TX time out penalty	
25 #	TX disable input	
26 #	TX disable input polarity	
27 #	COR only produces CTCSS	
28 #	Auxiliary relay code	
29 #	Morse code ID (call letters)	
30 #	Over the air programming code	
99 #	Program factory default	

5.0 Circuit Diagram

6.0 Amendments

Manual revised 01/31/10 5:26 PM