



TELEPOINT INC.

SR-20C USER'S MANUAL

Version B1005A9

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Chapter 1: Overview

1.1 Introduction

The Telepoint SR-20C is a UHF/VHF point-to-point radiotelephone link designed to provide affordable yet high quality telephone service to rural subscribers. It acts as a full-duplex telephone line extender providing wireless connectivity over a range of up to 60 miles (100 kilometers). It is easy to install and maintain, and offers a variety of features usually found on more expensive systems.

These types of systems provide telephone service to remote locations where service from the PSTN (Public Switched Telephone Network) would ordinarily be impossible or not cost-effective. Examples of locations for application of SR-20C systems are offshore platforms, mountainous environments, farmlands, etc.

Design highlights include:

- *Microprocessor Technology*
- *Programmable Frequency and RF Power*
- *Excellent Audio Quality Using Companders*
- *Voice / Fax / Data Capability*
- *End-to-End Transparency*
- *Loop Line Match to local Switching Systems Worldwide*
- *Compatible with DTMF or Pulse-Dial CO's*
- *CO lines can be Loop Start (normal), 4-wire E&M, or 2-wire E&M*
- *RF Module Redundancy (Interchangeable TX & RX Modules)*
- *QT (also called CTCSS) guards against activation by false signals on the air*

Options include:

- *Voice Privacy Scramblers*
- *Full-Duplex Repeaters to extend coverage*
- *Lease Line operation*
- *Compatibility with Caller-ID*
- *Compatibility with magneto phones and exchanges*
- *Polarity reversal for Pay-Phone operation*
- *Subscriber Pulse Metering (SPM) for pay-phone operation*

1.2 Major System Components

1.2.1 Base Unit

The Base station connects to any local central office (CO) line. A touch-tone telephone may also be connected to the Base for programming or to make intercom calls to the Subscriber unit's phone. When used with E&M, lease-line, or magneto equipment, the Base will connect to this instead of a loop-start CO line.

1.2.2 Subscriber Unit

Subscriber terminals connect to customers' telephone sets, fax, modems, or other standard customer premises equipment (CPE). Outside calls may be placed or received as well as intercom calls to the Base. If used with E&M, lease line, or magneto equipment, these will be connected instead, but a touch-tone phone may also be connected for programming and intercom calls.

1.2.3 Antennas

Each Base or Subscriber unit must be connected to an antenna.

1.2.4 Power Supplies

Each Base or Subscriber unit requires 12-14VDC for operation. Sources include:

- Standard AC-operated power supply
- Standard AC-operated power supply with backup battery
- Battery on vehicle
- Solar supply (such as Solarpoint system)
- Generator supply

1.2.5 Repeater Unit

Repeaters are available and are useful where there are obstructions such as mountains between the base and subscriber or where the required distance is longer than 60 miles.

1.3 Major Components of an SR-20C Unit

1.3.1 CPIUB2 Board

This performs control and audio functions. It also provides an interface to phones, phone lines, E&M equipment, etc.

1.3.2 Transmitter

Takes an audio signal from the CPIUB2 board, places it on an RF carrier, and sends this to the antenna.

1.3.3 Receiver

Takes the received RF signal from the antenna, amplifies it, demodulates it, and sends the resulting audio signal to the CPIUB board.

1.3.4 Duplexer

Makes it possible to use the same antenna for transmit and receive.

1.3.5 Repeater Differences

Repeater units contain one CPIUB2 board, two transmitters, two receivers, and two duplexers. The CPIUB2 board has additional components.

1.4 System Configurations - Standard

These configurations can be set up with standard SR-20C units.

1.4.1 Loop Start

The loop start configuration is the most common. In it, the Base unit connects to an ordinary 2-wire loop line from the CO and the Subscriber unit connects to a phone, fax, or modem.

Applications:

- Cost effective increase in Telco service coverage in rural settings.
- Temporary emergency communications in time of disaster.
- Temporary or permanent communications in industries such as, offshore drilling, mining, fishing, boating, etc.
- Cost effective loop line extension to remote, inaccessible sights.
- Internet access using a dial up modem.
- Order wire setup using computers or facsimile machines.

1.4.2 Mobile or Portable Radio Instead of a Subscriber Unit

For applications where compactness at the subscriber end or economy is important, the SR-20C Base can work directly with a mobile or portable radio. The radio must be capable of being set to different frequencies for transmit and receive, and it must have a DTMF keypad available.

1.5 System Configurations - Optional

These configurations require a hardware upgrade, mostly in the form of additional components on the CPIUB2.

1.5.1 Lease Line Eliminator

The SR-20C can extend 2 or 4-wire lease line service from a central office. It can also provide a private lease line, eliminating the need for central office service altogether.

Applications:

- An always-on voice link, such as between headquarters and a tower site.
- Computer-to-computer communications using 4 wire modems, eliminating costly local exchange charges.

1.5.2 E&M Signaling

Type I, II, III, IV, and V E&M signaling, known as international E&M, is available in 2 or 4 wire interface, and extends E&M signaling between two PBXs or CO's. It may also be used to extend E&M from a CO to a remote site.

Applications:

- Microwave drop and insert
- PBX-to-PBX connectivity
- E&M signaling extension between customer provided equipment.

1.5.3 Magneto

The SR-20C system has the capability to link a magneto phone and a magneto exchange, or two magneto phones. It provides a 6v supply so that no battery is necessary to power the phone.

1.6 Special Features - Standard

These features come on standard SR-20C units. Many can be enabled, disabled, or adjusted by programming through a touch-tone phone connected to the SR-20C unit. See Chapter 4 for details.

1.6.1 Flash

If a hookswitch flash is done on the subscriber phone, this flash will be passed on to the CO through the Base.

1.6.2 QT (also called CTCSS)

Guards against activation by false signals on the air. DQT is also available.

1.6.3 Compandor

This reduces audible noise.

1.6.4 DTMF or Pulse Dialing Output

The Base may be set to output either DTMF (touch-tone) or dial pulses to the CO at 10 or 20 pulses/sec.

1.6.5 Off-Hook Timeout

This shuts off a unit's transmitter if it is taken off-hook and no dialing takes place in a certain time. This feature prevents system transmitters from running indefinitely if the Subscriber phone is accidentally knocked off hook.

1.6.6 Call Timeout

This can put a limit on call time. Time is adjustable, or there can be no limit. This feature prevents system transmitters from running indefinitely if the Subscriber phone isn't hung up properly after a call.

1.6.7 Setup Mode

If put in this mode, the unit will constantly transmit a distinctive tone pattern. This is useful during system installation.

1.6.8 Call Waiting

If, during an intercom call, the Base receives ringing from an incoming call at **Line**, beeps will be heard in sync with the incoming ringing. If the Base hangs up, the Subscriber user may then receive the incoming call.

1.7 Special Features - Optional

These features all require a hardware upgrade, mostly in the form of additional components on the CPIUB2. Also, they can be enabled, disabled, or adjusted by programming. (See Chapter 4.)

1.7.1 Scrambler

This is available as a field-installable card. If one of these is installed in each unit and the feature is enabled in programming, voice signals will be scrambled before being sent over the air and descrambled when received. This provides security against casual listeners. The frequency-inversion technique is used.

1.7.2 Caller-ID Compatibility

This makes it possible for Caller-ID data to pass through the system. The Caller ID feature can then be fully operational on equipment connected to the Subscriber unit.

1.7.3 Polarity Reversal

If the CO reverses polarity on the line connected to the base, the sub will reverse polarity to the phone connected to it. This is necessary in some pay phone installations.

1.7.4 SPM

If this option is installed, 12 or 16kHz pulses coming in to the Base will be passed on to the Subscriber phone. SPM is necessary in some pay-phone installations.

1.8 Available Documentation

Besides this manual, SR-20C documentation is available which covers these subjects:

- Service Manual - Includes schematics, theory of operation, and adjustment procedures
- Repeater Unit installation
- Solarpoint installation
- Connection and operation with magneto equipment

Chapter 2: Installation

2.1 Pre-Installation Planning

2.1.1 Site Planning

The base station or subscriber terminal location should not be exposed to direct sunlight, high humidity, heat, dust or strong magnetic fields. For outdoor installations, enclose in a weatherproof cabinet.

The power supply requires an appropriate source of input power (normally AC line).

WARNING

The SR-20C unit operates on 13.8 VDC. Do not connect it directly to any AC source.

2.1.2 Supplies and Accessories Checklist

- Yagi directional antennas for both the Base and Subscriber. But, if the Subscriber is mobile, use omnidirectional antennas instead.
- Low loss 50-ohm coaxial cable such as Belden 9913. If the application requires lower loss cable due to critical signal levels, a different type of coaxial cable such as Andrew Company Heliac may be required.
- Gas-discharge lightning arrestors for both Base and Subscriber antenna cables.
- Appropriate connectors for cables (N type for connection to SR-20C and typically UHF type for antennas and lightning arrestors).
- Mounting hardware.
- One 110/220VAC input, 13.8VDC output constant-duty regulated power supply for each unit. Current rating should be as follows:

2W transmitter	3A
8W transmitter	5A
12W transmitter	6.5A
20W transmitter	9A
30W transmitter	12A

SolarPoint power system may be used in place of an AC-operated power source.

- A surge/spike protector with RFI and EMI noise filtering for the AC power line.
- Phone-line surge suppressors for Base and for Subscriber if needed.

2.2 Unpack and Inspect System

Unpack the system and inspect the Base station and Subscriber terminals for visual damage or missing items. Package should include:

- Base station with DC power cord
- Subscriber terminal with DC power cord.
- User's Manual.
- Any accessories in the order such as power supplies, antennas, cables, lightning arrestors, etc.

If any of the items are missing or damaged, contact Telepoint's Order Processing Department or your dealer immediately.

2.3 Unit Installation (Base or Subscriber)

2.3.1 Antenna and Cable

WARNING

- **Installation of antennas near power lines is dangerous.**
- **Do not transmit from any unit until the antenna is connected properly.**
- **Do not touch the antenna when the unit is on.**
- **Be safe. Follow antenna manufacturer's installation guide.**

Install antenna according to the manufacturer's instructions.

Most Yagi antennas are mounted with elements in the vertical position unless the FCC operating license indicates the polarization. If more than one antenna is installed in the same area, reverse polarization and 3 feet (1 meter) of vertical / horizontal spacing is recommended.

Run a coaxial cable from the antenna to the lightning arrestor, and another cable from that to the SR-20C unit. (The SR-20C's antenna connector is N female and is located on the far right as you face the back panel. If not there, it is on the duplexer and is visible through a rounded-corner square hole in the bottom of the SR-20C case.)

For adequate protection, the lightning arrestor must be grounded well. Run a #10 wire from the lightning arrestor's grounding screw to a reliable low-resistance earth ground.

2.3.2 DC Power Source

1. Plug the connector end of the DC power cord into the corresponding connector on a short cord coming from the back of the SR-20C unit.
2. Connect the opposite end of the DC power cord to a constant-duty regulated power supply. **The red wire connects to DC positive (+) and black to DC negative (-) of the power source.**
3. Plug DC power supply 110/220 cord into AC outlet (use surge/spike protector for added reliability).
4. Check that the antenna jack is terminated into an antenna or RF load.
5. Turn the Power Supply power switch to the "On" position. The SR-20C's **POWER** LED should come on.

2.3.3 Solar Power

The SolarPoint solar-powered system may be used at the subscriber terminal in place of an AC-operated DC supply. A separate installation manual is provided with SolarPoint.

2.3.4 Connections for Various Configurations

Connect the SR-20C units to phone lines and equipment using the wiring diagrams in Chapter 3.

CAUTION:

Do not run telephone wires alongside wires carrying AC power or any data cables. If this must be done, the AC power wiring should be in conduit and data cables should be shielded. Ground the conduit and the shield.

IMPORTANT NOTES:

- Verify dial tone on the CO line prior to connection to the SR-20C.
- For additional lightning and surge protection, install appropriate surge suppressors on the AC power line and on the CO phone line. Do this also on the phone line coming from the Subscriber unit if it is run outdoors.

2.4 System Installation Procedure

1. Install Base station according to Section 2.3. Connect an RF wattmeter between the unit's antenna connector and the antenna cable. Aim antenna in your best approximation of the subscriber's direction.
2. Connect a touch-tone phone to **Tel** of the base unit and lift handset. Fan and **TX A/B** light should come on.
3. Check RF wattmeter. Forward power should be close to the power level the transmitter is set to. Check the reverse power – it should be minimal. If not, adjust cable length and/or check for good connections between unit, cable, and antenna.
4. Hang up phone to shut off transmitter. Move wattmeter so it is between cable and antenna. Lift handset to start transmitter again.
5. Read forward and reverse power on meter. Forward power should be somewhat less than the transmitter power. If it's much less, reduce the length of cable or use low-loss cable. Reverse power should be minimal. If not, tune antenna.
6. Hang up phone to shut off transmitter. Remove wattmeter and reconnect antenna.
7. Place Base unit in Setup Mode by doing the following: Lift handset and dial ****874**. You will hear a long beep which indicates that the unit is now in Programming Mode. Dial **0** (you will hear a beep), then **1**. You will hear three beeps which indicate that the unit has been programmed into Setup Mode. Hang up. Unit should begin transmitting.
8. Using an RF monitor, tune to the Base transmitter's frequency. You should hear an alternating tone. Or, set up Subscriber unit temporarily nearby and test system.
9. With Base transmitter still on, go to subscriber location. **IMPORTANT: Make sure no one will turn off Base unit's power while you're traveling to, working at, or returning from the subscriber location.**
10. Connect RF monitor (or Subscriber unit with phone connected to **Tel**) to subscriber antenna and verify that you hear the alternating tone. Aim antenna for highest signal level.
11. Follow steps 1 to 6 for the Subscriber (except antenna is already aimed).
12. Lift Subscriber phone handset and dial ****874**. You will hear a long beep from the Base end which indicates that it is now in Programming Mode and can be remotely programmed. Dial **0** (you will hear a beep), then **3**. You will hear three beeps which indicate that the Base has been programmed into Test Mode. The Base will stop transmitting at this point. Hang up Subscriber phone.
13. Lift Subscriber phone handset and dial ****874**. You will hear a long beep which indicates that the unit is now in Programming Mode. Dial **0** (you will hear a beep), then **1**. You will hear three beeps which indicate that the unit has been programmed into Setup Mode. Hang up. Unit should begin transmitting.
14. Using an RF monitor, tune to the Subscriber transmitter's frequency. You should hear an alternating tone.
15. With Subscriber transmitter on, go back to base location. **IMPORTANT: Make sure no one will turn off Subscriber unit's power while you're traveling to or working at the base location.**
16. Pick up phone at Base. You should hear an alternating tone from the Sub.
17. Disconnect antenna cable from the Base unit and connect it to an RF monitor. Aim antenna for highest signal level. Reconnect antenna cable to Base unit.
18. Lift Base phone handset and dial ****874**. You will hear a long beep from the Sub end which indicates that it is now in Programming Mode and can be remotely programmed. Dial **0** (you will hear a beep), then **0**. You will hear three beeps which indicate that the Sub is back to normal operation. The Sub will stop transmitting at this point. Hang up Base phone.
19. Lift Base phone handset and dial ****874**. You will hear a long beep which indicates that the unit is now in Programming Mode. Dial **0** (you will hear a beep), then **0**. You will hear three beeps which indicate that the unit is back to normal operation. Hang up.
20. The system is now ready to use.

Chapter 3: Connections and Operation

3.1 Preliminary Information for this Chapter - Read this first!

3.1.1 Programming

Typically, programming is done at the factory according to the configuration the customer specifies and the installer or user doesn't need to reprogram. But in case of configuration changes, this chapter has "Normal Programming" settings, which will give correct operation in most cases.

These settings assume:

- No mobile radios used as subscriber terminals (except in 3.4)
- No SPM card installed
- DTMF (Touch-tone) output to CO (no pulse dialing.)
- No scrambler card installed

Refer to the Programming Chapter (4) if your requirements differ from these. Also refer there for basic instructions on how to program.

3.1.2 CPIUB2 Board Jumper Settings:

Typically, these are factory-set according to the configuration the customer specifies. The installer does not need to be concerned about them. They are given in this chapter in case changes are necessary. See Section 5.3 for a definition of "Default Settings".

3.1.3 SR-20C Equipment Connector

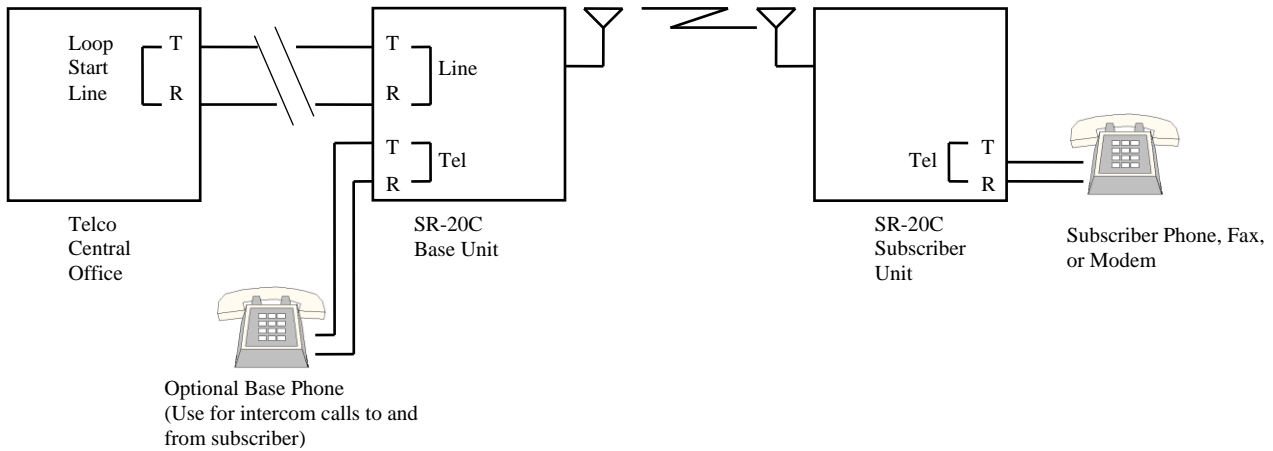
This is located on the rear panel and looks like this:



To connect a wire, strip it and insert it into the appropriate rectangular hole. Then tighten the screw just above the hole.

3.2 Loop Start CO Line to Telephone, Fax, or Modem

3.2.1 Connections



3.2.2 Normal Programming

On Base unit: Default except Pgm 1 = 0.

On Subscriber unit: Default

3.2.3 For Modems: Set Pgm 2 to 01 on both units for data rates up to 19200. If system is to be used for both voice and data calls, see Pgm 2 description.

3.2.4 Jumper Settings: Default

3.2.5 Operation: Subscriber dial-out

1. Lift handset and wait for CO dial tone.
2. Dial as you would normally and wait for called party to answer.
3. When done, hang-up. Link will shut down.

3.2.6 Operation: Receiving call from outside

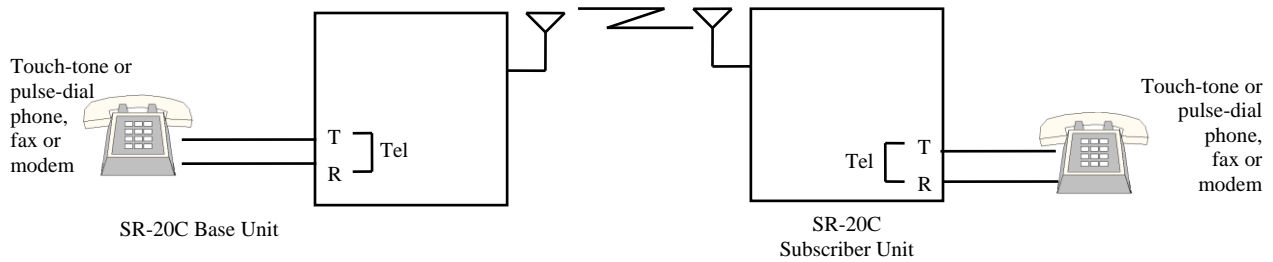
1. Base unit detects ring from CO
2. Sub unit rings sub phone.
3. When sub phone answered, link is established and conversation can begin.
4. When sub phone hangs up, link shuts down.

3.2.7 Operation: Intercom calls

1. From Sub phone, dial ## to ring Base phone. From Base phone, simply pick up to ring Sub phone.
2. When other end answers, conversation can begin.
3. When both ends hang up, link shuts down.

3.3 Telephone to Telephone

3.3.1 Connections



3.3.2 Jumper Settings: Default

3.3.3 Normal Programming: Default

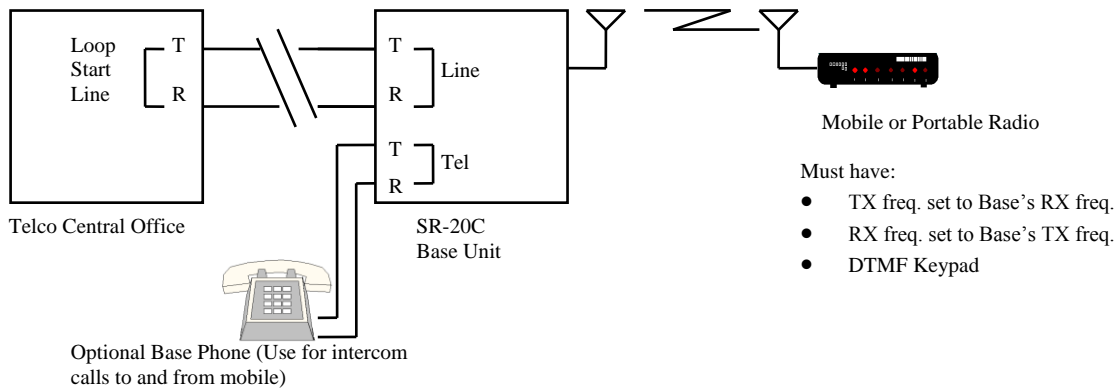
3.3.4 For Modems: Set Pgm 2 to 01 on both units for data rates up to 19200. If system is to be used for both voice and data calls, see Pgm 2 description.

3.3.5 Operation

1. Lift handset on either end. Other end's phone will ring automatically.
2. Conversation can begin when other end answers.
3. When both ends hang up, link shuts down.

3.4 Loop Start CO Line to Mobile or Portable Radio

3.4.1 Connections



3.4.2 Jumper Settings: Default

3.4.3 Normal Programming: Default except set Pgm 1 = 0, Pgm 2 = 1, Pgm 4 = 2, and Pgm *1 = 15.

3.4.4 Operation: Calling to outside from Mobile/Portable

1. Press PTT key briefly (to transmit), then release it. You should hear dial tone over radio.
2. Dial outside phone number and wait for called party to answer. **Note:** Press key periodically since Base must get COR from Sub at least every 15s (or whatever Pgm *1 is set to) to maintain the call.
3. Press key to talk, release it to listen.
4. When done, Base transmitter will shut off after the time set in Pgm *1.

3.4.5 Operation: Receiving Outside or Intercom Calls on Mobile/Portable

1. Mobile/portable power must be on and volume up to receive calls
2. When Base gets ringing from CO, you will hear tones on your mobile/portable in sync with the incoming ring.
3. Press key to answer call.
4. Talk, listen, and end call same as 3.4.4.

3.4.6 Operation: Intercom Call from Base to Mobile/Portable

1. Lift handset and wait for mobile to answer.
2. When done with call, hang up.

3.4.6 Operation: Intercom Call from Mobile/Portable to Base

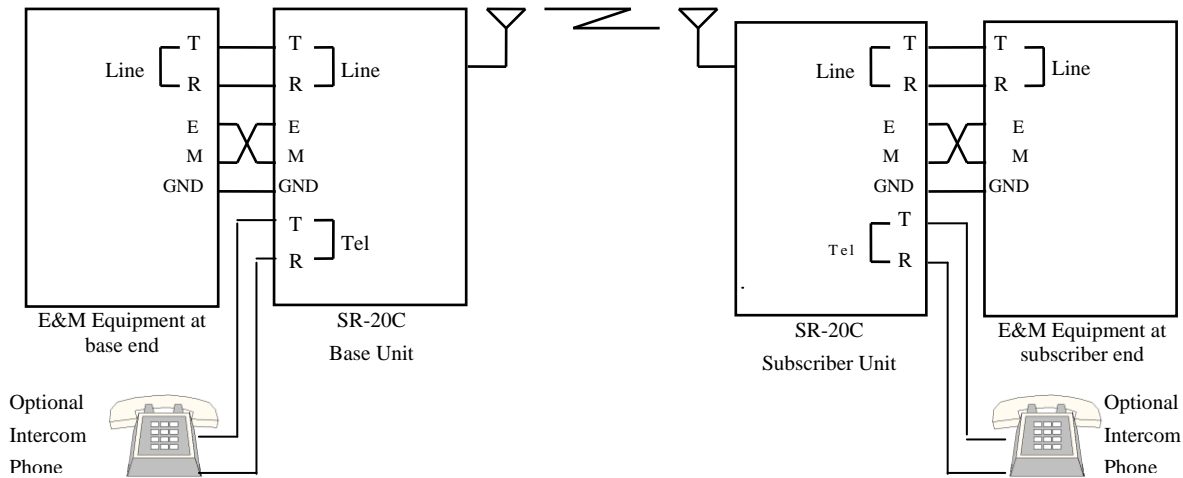
1. Press key briefly (to transmit), then release it. You should hear dial tone over radio.
2. Dial ## and wait for answer (Base phone will be ringing).
3. Press key to talk, release it to listen.
4. When done, Base transmitter will shut off when phone hung up.

3.5 Telephone to Mobile radio

Same as 3.4 but don't connect CO line.

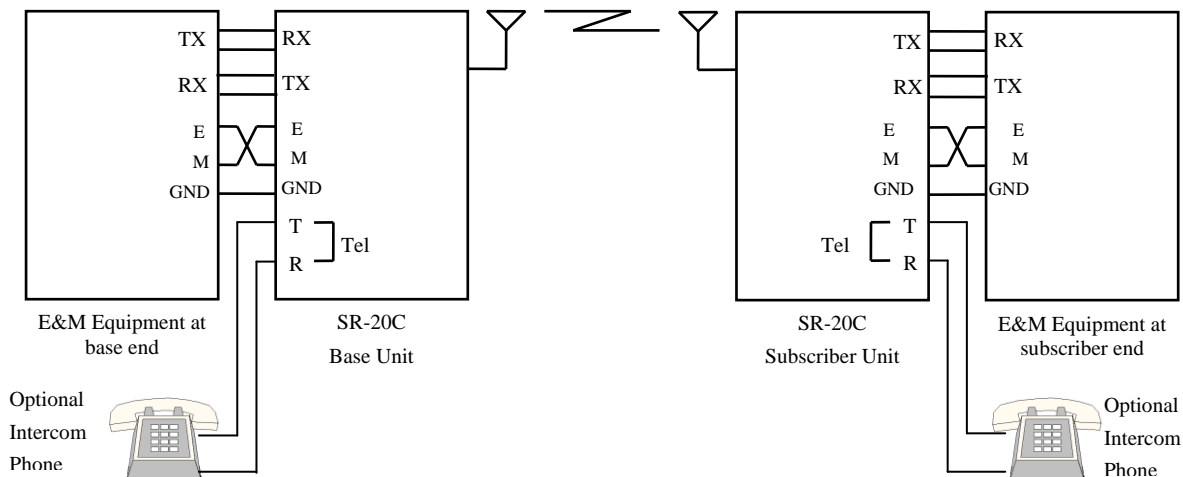
3.6 Type V E&M (Note: Type V is the most common)

3.6.1 Connections: 2-wire



3.6.2 Jumper Settings, 2-wire: Default

3.6.3 Connections: 4-wire



3.6.4 Jumper Settings, 4-wire: Default except JP5, 6, & 8 cut

3.6.5 Normal Programming: On both units, default except Pgm 1 = 2 and Pgm *8 = 2

3.6.6 Operation: E&M calls

1. E&M equipment at one end grounds its **M** to initiate a call. SR-20C unit on that end senses this through its **E** and turns on its transmitter.
2. SR-20C unit at other end receives carrier and grounds its **M**. E&M equipment on that end senses this through its **E** and responds by grounding its **M**. This grounds **E** on the SR-20C unit which then turns on its transmitter.

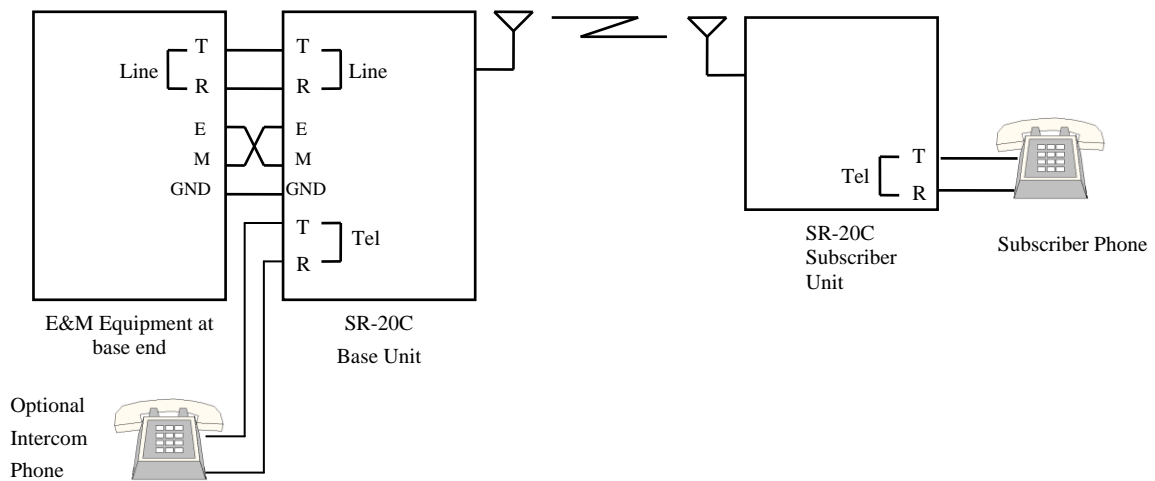
- SR-20C unit on originating end receives carrier and responds by grounding its M. 2 or 4-wire line is then connected on both ends and communication can take place.

3.6.7 Operation: Intercom calls

- From either end, dial ##.
- When other end answers, conversation can begin.
- When either end hangs up, link shuts down.

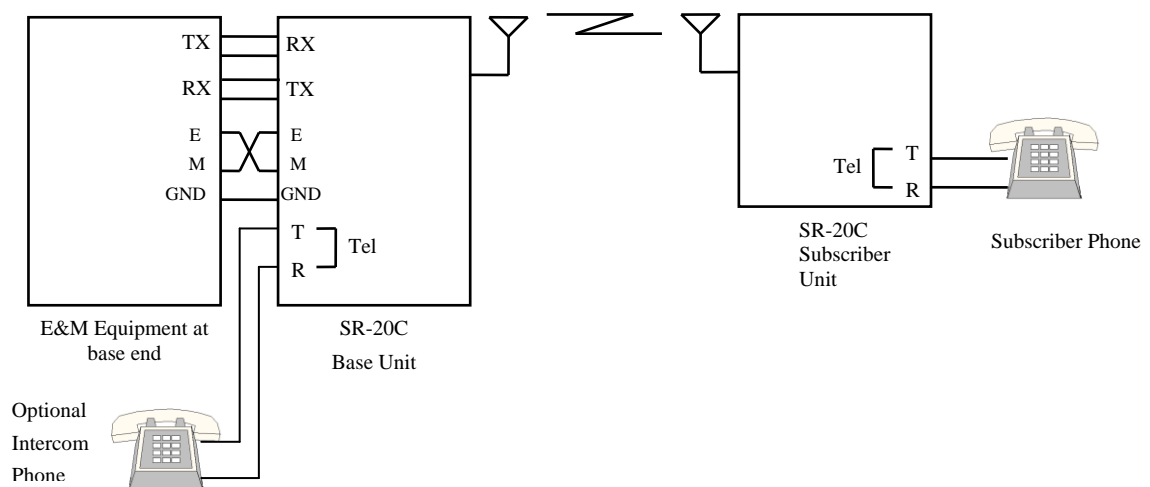
3.7 Type V E&M to Telephone

3.7.1 Connections: 2-wire E&M



3.7.2 Jumper Settings, 2-wire: Default

3.7.3 Connections: 4-wire E&M



3.7.4 Jumper Settings, 4-wire: Default except JP5, 6, & 8 cut

3.7.5 Normal Programming:

On Base unit: Default except Pgm 1 = 2.

On Subscriber unit: Default except Pgm 1 = 1 and Pgm *8 = 2.

3.7.6 Operation: E&M call to Subscriber

1. E&M equipment at Base end grounds its **M** to initiate a call. The Base unit on that end senses this through its **E** and turns on its transmitter.
2. The Sub unit receives carrier and responds by ringing its phone. When the phone is answered, The Sub turns on its transmitter.
3. The Base unit receives carrier and responds by grounding its **M**, which pulls **E** on the connected E&M equipment, signaling that conversation can now take place.

3.7.7 Operation: Subscriber call to E&M

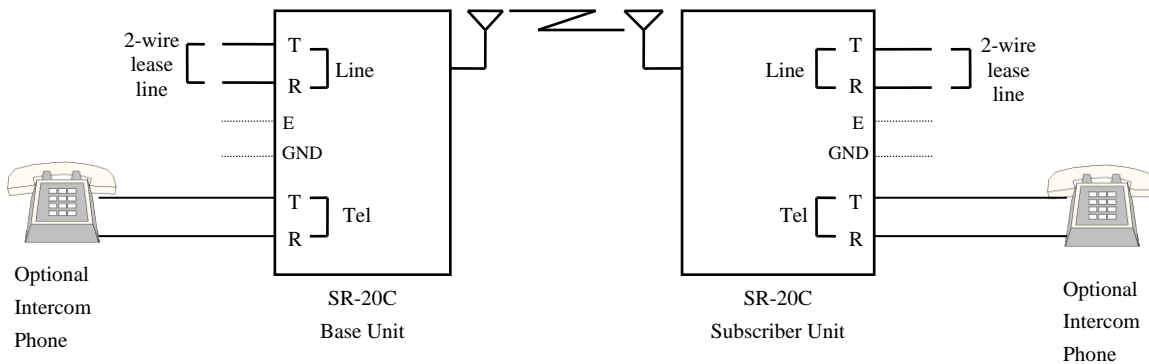
1. Pick up handset of Sub phone. Sub transmitter will turn on.
2. When Base gets carrier, it grounds its **M** and waits for the connected E&M equipment to respond by pulling the Base's **E**.
3. When Base **E** goes low, Base will turn on its transmitter.
4. When Sub gets carrier, system connects. Dialing and/or conversation can now take place.

3.7.8 Operation: Intercom calls

1. From Sub phone, dial # # to ring Base phone. From Base phone, simply pick up to ring Sub phone.
2. When other end answers, conversation can begin.
3. When both ends hang up, link shuts down.

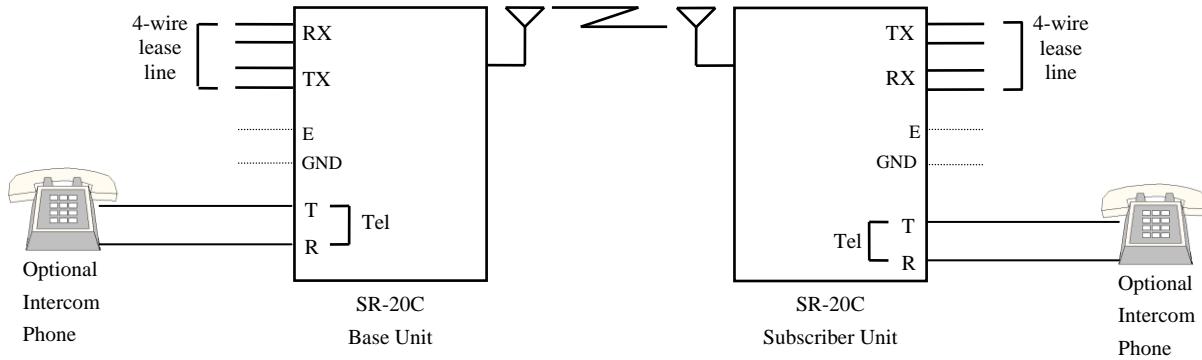
3.8 Lease Line

3.8.1 Connections: 2-wire



3.8.2 Jumper Settings, 2-wire: Default

3.8.3 Connections: 4-wire



3.8.4 Jumper Settings, 4-wire: On both units, default except JP5, 6, & 8 cut.

3.8.5 Normal Programming: On both units, default except Pgm 1 = 0.

3.8.6 Operation

- Ground E on either end to turn on link
- To shut down link, remove ground from E.

3.8.7 Operation: Intercom calls

1. From either end, dial ##.
2. When other end answers, conversation can begin.
3. When either end hangs up, link shuts down.

Chapter 4: Programming

4.1 Entering Programming Mode

4.1.1 Local

1. A touch-tone phone should be connected to Tel of the unit to be programmed.
2. Lift handset and dial **# * 8 7 4** . If you dialed correctly, you will hear a long beep which indicates that you are now in programming mode.

4.1.2 Remote

This is used to program the unit on the other end of the link.

1. A touch-tone phone should be connected to Tel of the unit you will do programming from
2. Lift handset and dial *** # 8 7 4** . If you dialed correctly, you will hear a long beep which indicates that you are now in the remote unit's programming mode. All beeps will have a "remote" sound to them.

4.1.3 From Outside

This is used to program either unit in the system from a phone outside the system.

1. Call into the system from outside using a touch-tone phone.
2. After some time of ringing (this time is set by Pgm *6) with no answer at the Sub, the system will answer with a beep. (Another way: System will answer on first ring if called within 15 seconds of power-up.) At this point, dial **# * 8 7 4** to program the Base unit or *** # 8 7 4** to program the Subscriber unit.
3. If you dialed correctly, you will hear a long beep which indicates that you are now in the unit's programming mode. If programming Subscriber, all beeps will have a "remote" sound to them. The programming session will last for a fixed 60 seconds (or just 15 seconds if you started the session by calling within 15 seconds of Base power-up).

4.2 Using Programming Mode

1. Dial a program number. You will hear a beep.
2. Dial a setting (1 or 2 digits). You will hear three beeps which indicate that the setting has been made.
3. Repeat the last two steps for as many settings as you need to make.
4. When done, hang up.

4.3 Description of programs:

Note: If not specifically stated, default settings are marked with a *.

Pgm 0: Setup and Test Modes

- 0* Normal operation
- 1 Setup Mode
- 2 Test Mode - Receive Only
- 3 Test Mode - Transmit and Receive
- 4 Test Mode - Transmit and Receive with Tone

Setup Mode is useful when installing a system. It causes a unit to continuously transmit an alternating tone which is easy to recognize when received. This mode can be used for aiming an antenna at the other end of the link. If you set a unit to this, it will begin transmitting the tone as soon as you exit Programming Mode. It will continue to do this for 12 hours regardless of whether COR is sensed or whether Tel phone is off hook or not. When 12 hours is up, it will stop

transmitting and automatically reprogram to Normal Operation (Pgm 0 = 0). This will also happen if power is turned off, then on. Units in Setup Mode may also be manually reprogrammed (either locally or remotely) in order to exit Setup Mode.

After putting a unit in Setup Mode, you can leave it and travel to the site of your system's other unit. You can be confident that the unit in Setup Mode will still be transmitting when you arrive as long as there hasn't been a power failure or a delay of more than 12 hours. If it does leave Setup Mode before you get to the other site, you can often put it back in Setup Mode using Remote Programming and an approximately aimed antenna.

When set to **Test Mode - Receive Only**, a unit operates like this:

- When a phone connected to Tel is taken off hook, an audio path is connected between the unit's receiver and Tel.
- When E is grounded, an audio path is connected between the unit's receiver and Line.
- The unit basically functions as a monitor receiver in this mode.

When set to **Test Mode - Transmit and Receive**, a unit operates like this:

- When a phone connected to Tel is taken off hook, an audio path is connected between the unit's receiver and Tel and also between Tel and the unit's transmitter, which is turned on.
- When E is grounded, an audio path is connected between the unit's receiver and Line and also between Line and the unit's transmitter, which is turned on.
- The unit will basically be on the air in a full-duplex mode for as long as you are off hook (or E is grounded).

When set to **Test Mode - Transmit and Receive with Tone**, a unit will operate like *Transmit and Receive* above except that a 941Hz tone is added to both the transmitted signal and the signal heard at Tel (or Line).

Pgm 1: Operating Mode

The setting of this depends mainly on the type of equipment to be connected to a unit:

- 0 Loop Start CO connected to **Line** (used for most Base units)
or, 2-wire Lease Line connected to **Line**
or, 4-wire Lease Line connected to **TX** and **RX**
- 1* Phone, Fax, or Modem connected to **Tel** (used for most Subscriber units)
- 2 2-wire E&M connected to Line or 4-wire E&M connected to **TX** and **RX** (**Requires E&M hardware option**)
- 3 Magneto phone connected to **Line** (**Requires Magneto hardware option**)
- 4 Repeater mode (**Requires Repeater unit**) All Repeater units should be set to this. **Note:** Units cannot be set to Repeater mode using Remote Programming. Also, Remote Programming cannot be done on a unit which is in Repeater mode.)

Pgm 2: Voice/Data

- 00* Voice mode Comandor is active and so is Scrambler if turned on in Pgm 3.
(The Comandor reduces audible noise.)
- 01 Data mode Comandor and Scrambler are bypassed.
(This is best for use with modem because highest data rate is obtained.)
- 02 – 99 Auto-switch Calls from Subscriber begin in Data mode and then automatically switch to Voice mode if there is no dialing within a time period equal to this setting times 0.1 sec. For example, if 25 is entered here, calls will start in Data mode but will switch to Voice mode in 2.5 sec unless dialing occurs first. This is used in applications where a modem needs to be used on some calls and voice on others. The setting should be for a time somewhat longer than the time between when the modem takes the line off-hook and when it begins dialing. To make a voice call, the user should go off hook, wait until noise stops (means system switched to Voice mode), then dial.

Pgm 3: Scrambler

- 0* Off
 1 On Note that Scrambler card must be installed for this to be effective.

Note: This setting must be the same on both units in a system.

Pgm 4: Ringing

- 0* Auto (use if you don't want tones sent over the air)
 1 Tone (must use in installations requiring Caller ID)
 2 Mobile (use in Base which will work with mobile or portable radio in field)

If a unit is programmed for **Auto** ringing, it will behave as follows:

- On receiving incoming ring at **Line**, it will turn on transmitter and send an unmodulated carrier for as long as the ringing lasts.
- On receiving carrier over the air, it will ring the phone connected to **Tel** using its own cadence for as long as the carrier lasts or until the phone is answered (assuming Pgm 1 = 1 or this is an intercom call).

If a unit is programmed for **Tone** ringing, it will behave as follows:

- On receiving incoming ring at **Line**, it will turn on transmitter and send tones (DTMF "D") over the air in sync with the ringing.
- If making an intercom call, a unit will send ringing tones (DTMF "D") over the air to make the other unit ring.
- If Pgm 1 = 1 or this is an intercom call, it will ring the phone connected to **Tel** in sync with any ringing tones it is receiving over the air.

If a unit is programmed for **Mobile** ringing, it will behave as follows:

- On receiving incoming ring at **Line**, it will turn on transmitter and send tones (DTMF "D") over the air in sync with the ringing. These will be heard on the mobile or portable if it is on and the volume is up.
- If making an intercom call from Base, it will send ringing tones (DTMF "D") over the air using its own cadence. These will be heard on the mobile or portable if it is on and the volume is up.
- If the mobile or portable is making an intercom call to the Base, it will ring the phone connected to **Tel** using its own cadence for as long as COR lasts plus time set in Pgm *1.

Pgm 5: Tel Ring during Incoming Line Ring

- 0* Off
 1 On

If this feature is on, a phone connected to **Tel** will ring whenever **Line** is receiving ring. The phone cannot be answered. This feature can be used on Base units to indicate incoming ring.

Pgm 6: Programming Availability

- 0* Programming Mode can always be entered
 1 Programming Mode can be entered during first 3 minutes after power-up only

Pgm 7: Call Waiting

- 0 Disabled The hookswitch is closed during intercom calls. Anyone calling in from outside during an intercom call will get a busy signal.
 1* Enabled During an intercom call, the parties in it will hear Call Waiting tones if a call from outside comes. If the Base party hangs up at this point, the Subscriber party can receive the incoming call by staying off hook. The Subscriber party will hear a click when the Base hangs up, then a softer click which indicates that the incoming call is connected. The Subscriber party should then say "hello" or some other greeting.

Pgm 8: Intercom Calls

0 Disabled
1* Enabled

This program is significant only on units where Pgm 1 is not set to 1, such as the Base in most systems. It controls whether it will go into an intercom ring on receiving ### (the intercom code) over the air. This is normally enabled, but can be disabled in situations where ## must be prevented from triggering intercom calls.

Pgm 9: Off-hook Timeout

0 Disabled
1* Enabled

If enabled, this will shut off a unit's transmitter if it is taken off hook but receives no dialing in 15 sec. This prevents system transmitters from running indefinitely if the Subscriber phone is accidentally knocked off hook.

Pgm *0: DTMF/Pulse Dialing

0* DTMF
1 Pulse: 10 pulses/sec
2 Pulse: 20 pulses/sec

If settings 1 or 2 are chosen on a Base unit, it will convert DTMF digits it gets over the air (typically from dialing at Sub end) to pulse-dialed digits which it sends out on **Line**. If the unit is set for E&M (Pgm 1 = 2), the pulses will come out on **M** rather than **Line**. If setting 0 is chosen, the DTMF digits pass straight through to the line.

Pgm *1: Carrier-Loss Timeout

Default: 00 (0s)

Two digits are entered here in the range of 00 to 99. This represents a time value in seconds. If, during a call, carrier is lost for this amount of time, the unit's transmitter will shut off. In most applications, this should be left at 00. In applications where hookswitch flash must be transmitted across link, this program *must* be set to 00 so that the unit reacts immediately to carrier loss. However, in applications where a Base is to work with a mobile or portable radio, there will be periods of time when the radio isn't transmitting. The Base should not react immediately to these, so in this case, set Pgm *0 for something longer than these periods.

Pgm *2: SPM (Subscriber Pulse Metering)

Default: 00 (no SPM)

Two digits are entered here in the range of 00 to 99. In the Sub, they specify SPM output pulse width in 10's of ms. For example, if 15 is entered, the pulse width will be 150ms. In the Base, any entry except 00 enables SPM. Entering 00 in any unit disables SPM. **Keep disabled unless SPM hardware option installed.**

Pgm *3: Reverse Polarity Debounce Time

Default: 2 (20ms)

One digit is entered here in the range of 0 to 9. It represents a time value in 10's of ms. For example, if 2 is entered, the time will be 20ms. In the Base, this setting specifies the time between when a polarity reversal is first detected and when it is considered valid if it continues. This time delay is necessary to prevent glitches and spikes from being interpreted as polarity reversals. In the Sub, this program is used to enable or disable Reverse Polarity. Any nonzero entry enables it in the Sub. Entering 0 on Base or Sub disables this feature. **Setting of this has no effect unless Reverse Polarity hardware option installed.**

Note: The Reverse Polarity feature works like this: Whenever the Base sees a polarity reversal at Line, it waits to see if the reversal remains solid for the time period specified in Pgm *3. If so, it then sends a short DTMF "C" over the air. When the Sub receives a DTMF "C", it reverses polarity at Tel if the feature is enabled.

Pgm *4: Caller ID Pretime

Default: 35 (350ms)

Two digits are entered here in the range of 00 to 99. They represent a time value in 10's of ms. For example, if 35 is entered, the time will be 350ms. This setting specifies the time between the end of the first ring and when audio switches close to allow passage of the Caller ID signal. It should be set longer than the gaps between successive short rings in any distinctive ringing pattern. It should also be set short enough that the switches will close before the Caller ID signal starts. If the ringing pattern is normal (not distinctive), this time can be set very short. **Note:** The audio switches in the Base include a relay - you can hear it click. **Setting of this has no effect unless Caller ID hardware option installed.**

Pgm *5: Caller ID Closure Time

Default: 99 (Disabled)

Two digits are entered here in the range of 00 to 99. They represent a time value in tenths of seconds. For example, if 30 is entered, the time will be 3.0s. This setting specifies the total time the audio switches are to be closed between the first and second rings. It should be set long enough that the switches won't open before the Caller ID signal ends. It should also be set short enough that the switches will open before the second ring starts. A setting of 99 disables Caller ID action in a unit. A setting of 30 (3.0s) should work in most Caller ID situations. **Keep disabled unless Caller ID hardware option installed.**

Pgm *6: Line Ring Time until Auto-Answer

Default: 90 (90s)

Two digits are entered here in the range of 00 to 99. This represents a time value in seconds. If a Base unit receives ringing at **Line** for a time greater than this, it will automatically answer so the caller can enter Programming Mode if necessary.

Pgm *7: Call Timeout

Default: 0 (Disabled)

One digit is entered here in the range of 0 to 9. It represents a time value in hours. This program can put a time limit on calls. Any call lasting longer than the time entered here will be automatically ended. An entry of 0 disables the timeout and gives unlimited call time. In a system, for proper operation, the Subscriber unit should be the one which is programmed for a Call Timeout.

Pgm *8: Operating Mode at Other End

Set this according the Pgm 1 setting of the system's other unit.

- 0* Other than E&M (Pgm 1 <> 2) at other end
- 2 E&M (Pgm 1 = 2) at other end

Pgm *9: Pilot Tone

Default: 0 (No Pilot Tone)

One digit is entered here in the range of 0 to 9. It represents a time value in tenths of seconds. For example, if 5 is entered, the time value will be 0.5 sec. This setting specifies the duration of the pilot tone (dtmf D) sent at the beginning of transmission by a unit which is initiating a call. No tone is sent if this setting is 0. On a unit receiving a call over the air, a nonzero setting for this will cause it to check for pilot tone on getting COR. This unit will only respond if pilot tone is received. If setting is 0, the unit will respond on getting COR regardless of whether the signal had Pilot Tone. If Pilot Tone is enabled on both units, it will guard the system against activation by false signals on the air since a signal will only be recognized if it begins with the correct pilot tone.

Pgm #0: Auto-Program to Defaults

This will cause the unit to set all other programs to their default values. A series of quick beeps is heard.

Chapter 5: Hardware

5.1 LED's

The indicator LED's are located on the front panel.

5.1.1 Power

This will come on about 1 sec after applying power to the unit. It tells you that power is connected and that the microprocessor started correctly. It remains on as long as power is connected.

5.1.2 Off-Hook

- Flickers when a phone connected to **Tel** is off-hook
- Flickers when the 6v supply is loaded (meaning that a magneto phone is off-hook).
- On solid when hookswitch is closed (in a Loop Start Base, means CO line has been taken off hook)

5.1.3 TX A/B

This will be on if transmitter is on. In a Repeater, it is on if either transmitter is on.

5.1.4 COR A

This will be on if the 2nd receiver (present only in Repeater units) is getting a signal

5.1.5 COR B

This will be on if the receiver is getting a signal

5.1.6 Ring/E

- Flickers on a Base when receiving ring from CO
- Flickers on any unit when **E** is grounded
- On solid when ringing a phone connected to **Tel**
- On solid when **M** is active (pulling to ground)

5.1.7 Scramble

This will be on whenever scrambling is on. It is turned on in Pgm 3. In order to work, a scrambler card must be installed.

5.1.8 SPM

On a base unit, this will be on when an SPM pulse is being received. On a subscriber unit, it will be on while outputting an SPM pulse. If SPM is not enabled using Pgm *2, the SPM light will remain off.

5.2 Equipment Connector

The equipment connector is located on the rear panel. Only **Tel T&R** and **Line T&R** are present on a typical unit configured for Loop-Start. The rest will be present only as needed by options.

5.2.1 Line T&R

These are used to connect Loop-Start CO lines, 2-wire lease lines, and the “line” wires from magneto phones, magneto exchanges, and 2-wire E&M equipment.

5.2.2 Tel T&R

Connect a Touch-tone phone, fax machine, or modem here.

5.2.3 TX and RX

Connect 4-wire lines here. TX should go to RX of the connected equipment, and RX should go to TX of the connected equipment.

5.2.4 E and M

E is a signaling input and M is a signaling output. In E&M configurations, E will usually go to M of the connected equipment, and M will go to E of the connected equipment. Grounds are also connected together. E and M are also used in other configurations for signaling to and from the SR-20C unit. With JP9 - JP13 at default, E can sense being grounded. M will be open when inactive and at ground when active.

5.2.5 SB and SG

These are used in non-Type V E&M connections.

5.2.6 -48v

The unit's -48VDC supply is made available here. The voltage will decrease if more than about 10mA is drawn from this. Internally, this supply is connected to provide talk battery for Tel. If a phone connected to Tel goes off-hook, this voltage will drop below -10v.

5.2.7 GND

These 2 connections go to the unit's ground.

5.2.8 +6v

Used mainly for powering magneto telephones.

5.3 CPIUB Board Jumpers

Default settings of these jumpers are those that would be on an unmodified SR-20C board with no options.

5.3.1 JP1, 2, 3, & 4 **Default: Open**

These should be open on all SR-20C units.

5.3.2 JP5, 6, & 8 **Default: Shorted**

Shorted: 2-wire line (use Line T&R)

Open: 4-wire line (use TX and RX)

5.3.3 JP7 **Default: HP position**

HP position: High-pass filter in

$\overline{\text{HP}}$ position: High-pass filter out

The 300Hz high-pass filter is necessary if QT (CTCSS) or DQT are used so that these signals won't be audible. Without the filter, response extends down to about 100Hz.

5.3.4 JP9, 10, 11, 12, & 13

These jumpers are used to select between Type I, II, III, IV, or V E&M. Their default positions give Type V. Defaults are as follows:

Jumper	JP9	JP10	JP11	JP12	JP13
Default position	2	2	No Connection	1	No Connection

To set up for E&M other than Type V, consult service personnel or Telepoint.

5.3.5 JP12 Position 5

This is not used for E&M, but for certain magneto applications. With JP12 in position 5, M will switch to ground through a 100 ohm resistor. Some magneto exchanges supply 6v to power phones. They sense off-hook by the loading of this supply by a particular phone. The 100 Ω to ground can simulate this load. This provides a way for the SR-20C unit to signal an off-hook to the exchange.

5.3.6 JP14 **Default: Shorted**

Open: Use if Reverse-Polarity detection option is installed.

Shorted: For all other applications.

5.3.7 JP15 **Default: Open**

The position of this is only significant on Base boards where the SPM option is installed.

Open: Can be open when no SPM option is installed or this is a Sub.

12kHz position: Will detect 12kHz SPM

16kHz position: Will detect 16kHz SPM

5.3.8 JP18 **Default: $\overline{\text{PE}}$**

PE position: 6dB/octave Pre-emphasis

$\overline{\text{PE}}$ position: Flat

5.3.9 JP19 **Default: $\overline{\text{DE}}$**

DE position: 6dB/octave De-emphasis

$\overline{\text{DE}}$ position: Flat

5.4 Scrambler Card Installation

1. Look for a series of holes marked "M1" in the center of the CPIUB board.
2. Cut traces running between M1-1&2 and M1-7&8. The cutting locations are marked with pairs of short lines.
3. Clear the holes of solder if necessary, then solder the scrambler card in. Note that it only fits one way.
4. When the unit is powered on, enable Scrambler using Pgm 3.

For correct operation of the scrambling feature, Scrambler cards must be installed in both Base and Subscriber units.

Chapter 6: Specifications

This chapter describes the overall and subsystem operating specifications.

6.1 General Specifications

Operation	System microprocessor control for all signaling and monitoring
Mode of operation	Full-duplex
Frequency range:	VHF: 136 to 174 MHz, UHF: 450 to 490 MHz, 400 to 430MHz available
Duplex channel spacing	4.5 - 15 MHz (5.0 MHz standard)
Maximum transmit power output:	VHF: 36 watts, UHF: 18W
Power requirements	13.6VDC +/- 15%
Audio frequency response	300 - 3000 Hz
DC current consumption at 13.8 VDC:	
2 watts	< 500 mA Stby < 1.2 Amp TX
8 watts	< 500 mA Stby < 4.0 Amp TX
12 watts	< 500 mA Stby < 5.5 Amp TX
20 watts	< 500 mA Stby < 7.5 Amp TX
30 watts	< 500 mA Stby < 10.0 Amp TX

6.2 CPIUB2 Board

6.2.1 Operation: System microprocessor control for all signaling and monitoring

6.2.2 Inputs and Outputs

LINE impedance	Complex – matched to typical line
LINE Trans-hybrid loss	-55 dB
LINE Audio input level	-30dBm to 0 dBm
LINE Audio output level	-30dBm to 0 dBm
TEL Audio input level	-30dBm to 0 dBm
TEL Audio output level	-30dBm to 0 dBm
TEL loop length	1,000 feet
TEL loop voltage	48 VDC
TEL ring output	70V rms at 25 Hz, up to 5 phones
TEL impedance	600Ω resistive
RX Audio input level	-30dBm to 0 dBm
RX input impedance	600Ω resistive
TX Audio output level	-30dBm to 0 dBm
TX output impedance	600Ω resistive

6.2.3 Compressor

Dynamic range	>110 dB
Output slew rate	± .5 V/ms typical
Expander output noise	20 NV typical
Unity gain level (1kHz)	0 dBm typical
Channel separation	60 dB

6.2.4 DTMF

Frequency deviation rejection	± 3.5% minimum
Frequency deviation acceptance	± 1.5%, ± 2Hz
Valid input signal level (from board)	- 29 dBm
Tone present detect time	5 ms minimum
Tone duration acceptance	40 ms maximum
Frequency generation deviation	± .7% typical

6.3 Transmitter/Receiver

The following are general specifications intended for use in testing and servicing the equipment. Specifications may change without notice.

6.3.1 VHF - General

Radio	Kenwood TK-762G (Normal) or TK-762GH (High power)
Frequency range	Type 1: 148 to 174MHz, Type 2: 136 to 162 MHz
Channel Spacing	Wide: 25 or 30kHz, Narrow: 12.5 or 15kHz
Frequency step	2.5, 5.0, 6.25, or 7.5kHz
Channel frequency spread	26MHz
Antenna Impedance	50 ohms
Supply voltage	13.6VDC+/-15%
Supply current, standby:	0.4A
Supply current at maximum transmit power:	Normal: 8.0A, "H" version: 12.0A
Operating temperature	-22 to +140°F (-30 to +60°C)
Frequency stability	+/-2.5 ppm (-30 to +60°C)
FCC ID	Normal, Type 1: ALH29373110, "H" version, Type 1: ALH29373210 Normal, Type 2: ALH29373120, "H" version, Type 2: ALH29373220
FCC compliance	Normal, Type 1: FCC parts 22, 74, 80, 90 Normal, Type 2: FCC parts 22, 90 "H" version, Type 1 or 2: FCC parts 22, 74, 90, 90.210

IC Normal, Type 1: 282195591A, "H" version, Type 1: 282195682A
Normal, Type 2: 282195624A, "H" version, Type 1: 282195708A

6.3.2 VHF Transmitter (Measurements made per EIA-152C)

Maximum RF Power output Normal: 25W, "H" version: 50W
FCC Modulation Wide: 16K0F3E, Narrow: 11K0F3E
Spurious and harmonics 70dB
FM Noise Wide: 50dB, Narrow: 45dB
Audio distortion Less than 3%

6.3.3 VHF Receiver (Measurements made per EIT/TIA-204D)

Sensitivity (12dB SINAD) Wide: 0.25uV Narrow: 0.33uV
Selectivity Wide: 85dB, Narrow: 75dB
Intermodulation distortion Wide: 75dB, Narrow: 65dB
Spurious response 90db

6.3.4 UHF - General

Radio Kenwood TK-862G (Normal) or TK-862GH (High power)
Frequency range Type 1: 450 to 490MHz, Type 2: 485 to 512MHz
Channel Spacing Wide: 25kHz, Narrow: 12.5kHz
Frequency step 5.0 or 6.25kHz
Channel frequency spread Type 1: 40MHz, Type 2: 27MHz
Antenna Impedance 50 ohms
Supply voltage 13.6VDC+/-15%
Supply current, standby: 0.4A
Supply current at maximum transmit power: Normal: 8.0A, "H" version: 12.0A
Operating temperature -22 to +140°F (-30 to +60°C)
Frequency stability +/-2.5 ppm (-30 to +60°C)
FCC ID Normal, Type 1: ALH29383110, "H" version, Type 1: ALH29383210
Normal, Type 2: ALH29383120
FCC compliance Normal, Type 1: FCC parts 22, 74, 90, 95A
Normal, Type 2: FCC parts 90, 90.210
"H" version, Type 1: FCC parts 22, 74, 90, 90.210, 95
IC Normal, Type 1: 282195590A, "H" version, Type 1: 282195681A

6.3.5 UHF Transmitter (Measurements made per EIA-152C)

Maximum RF Power output	Normal: 25W, "H" version: 40W
FCC Modulation	Wide: 16K0F3E, Narrow: 11K0F3E
Spurious and harmonics	65dB
FM Noise	Wide: 50dB, Narrow: 45dB
Audio distortion	Less than 3%

6.3.6 UHF Receiver (Measurements made per EIT/TIA-204D)

Sensitivity (12dB SINAD)	Wide: 0.28uV Narrow: 0.35uV
Selectivity	Wide: 80dB, Narrow: 65dB
Intermodulation distortion	Wide: 75dB, Narrow: 63dB
Spurious response	80db

6.4 Duplexers**6.4.1 VHF Duplexer: DHL1533-A**

Frequency range	136 - 174 MHz
Frequency spacing	4.5 – 7.0 MHz
Continuous power input	< 50 watts
Insertion loss, TX - ant.	< 1.2 dB
Insertion loss, ant. - RX	< 1.2 dB
TX noise suppression at RX frequency	80 dB
RX isolation at TX frequency	80 dB
VSWR	< 1.2:1
Impedance	50 ohms
Temperature range	- 22 to +140 °F, - 30 to +60 °C

6.4.2 UHF Duplexer: DCL4533-A

Frequency range	403 - 520 MHz
Frequency spacing	5.0 – 7.0 MHz
Continuous power input	< 50 watts
Insertion loss, TX - ant.	< 1.2 dB
Insertion loss, ant. - RX	< 1.2 dB
TX noise suppression at RX frequency	80 dB
RX isolation at TX frequency	80 dB
VSWR	< 1.2:1
Impedance	50 ohms
Temperature range	- 22 to +140 °F, - 30 to +60 °C

6.5 Service Conditions

Ambient temperature	-30° C to +60° C
Relative humidity	5 to 95% non condensing
Duty cycle	Continuous

6.6 Regulatory Compliance

FCC	Parts 22, 74, 90, and 90.210 (VHF) or 95A (UHF)
IC	282195682A (VHF) or 282195590A (UHF)

6.7 Mechanical Characteristics

Base or Subscriber unit:	Size: 3.5"H x 17"W x 13.9"D Weight: 14.2 lb. (5.4 kg)
Repeater unit:	Size: 7.0"H x 17"W x 13.9"D Weight: 26.2 lb. (10.0 kg)