



SC20-455 AD/RAD

Installation & System Manual

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SC20-455 AD/RAD

SSB Module Installation Manual

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INTRODUCTION

Multiple codes and high privacy levels are now available for narrow-band communications. The SC20-455 is a universal scrambler for all types of SSB radio equipment. Code programming does not require special equipment. It is universal to all radio makes and models. The SC20-455 requires no adjustment, and provides years of trouble free service. Audio recovery and voice recognition quality are excellent.

- **Auto Coded/Clear Operation** - The SC20-455 automatically switches to decode when scrambled signals are received. An optional on/off indicator is available.
- **High Security** - The SC20-455 is a Real-Time Multiple Audio Frequency Shifting scrambler under full digital control. During operation, the code frequency changes continuously.
- **Field Programmable** – Each scrambler is equipped with 128 code groups with 16 individual codes per group. These are easily selected by jumpers for a total of 2048 codes per scrambler system. User selection of the individual 16 codes can be provided by the addition of a switch to the radio (optional).
- **Easy to Install** – The SC20-455 is a complete scrambling encoder/decoder. Installation can be easily performed by any qualified service technician.
- **Fully Tested** – Every SC20-455 has been fully tested and comes ready to install in various SSB radios.
- **Support** - Scramblers from Transcript are designed with features that adapt to the wide variety of voltage and signal levels found in two-way radio equipment. Factory support is available to assist with installation and technical questions.

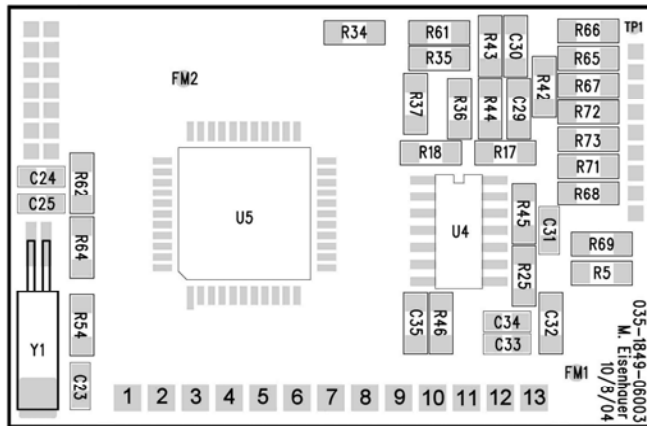
1.0 OPERATION

- **Transmit Mode** - When the transceiver is in transmit mode, the Push-to-Talk (PTT) line (Gray lead, pin 10) goes low, causing the input/output switches to select the TX IN (Orange, Pin 1) and TX OUT (Yellow, Pin 13) lines. Audio from the microphone is fed through the SC20-455, scrambled, and routed out through TX OUT.
- **Receive Mode** - When the transceiver switches to the receive mode, the PTT line goes high and the input/output switches select the RX IN (Green, Pin 2) and RX OUT (Blue, Pin 8) lines. Audio from the detector is routed through the SC20-455, decoded, and fed to RX OUT as recovered (clear) speech.
- **On/Off Mode Control** – To send a Clear transmission, place the Clear/Code switch (Violet, Pin 9) in the clear position before transmitting (PTT). To send a Coded transmission, place the switch in the Coded (Ground) position before or during transmission. Wait for the System Delay (refer to Page 6) and start talking. The receiving unit recognizes the initial data burst and starts decoding automatically. There is no need to change the Clear/Code switch setting while in receive mode. To respond to a Coded message, the receiving unit must select the Coded position before transmitting.

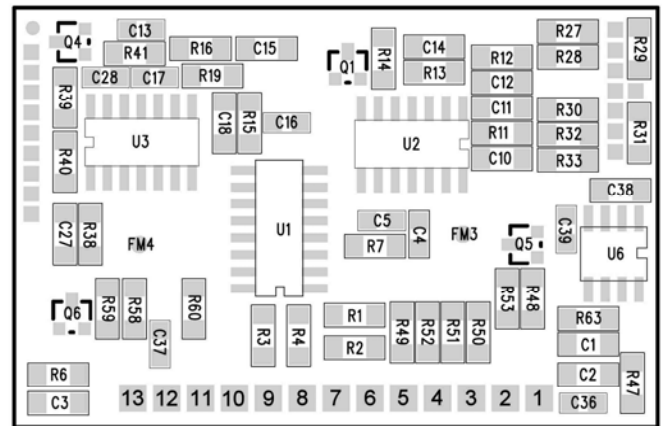
2.0 SPECIFICATIONS & DESCRIPTIONS

SPECIFICATIONS

Dimensions	1.9" x 1.24" x 0.3" (48.3mm x 31.5mm x 7.6mm)
Supply Voltage	6 to 15 VDC
Supply Current	4 to 8 mA
Operating Temperature	-20 to +60 degrees C
Transmit Audio Level	10 to 2500 mV, also programmable
Receive Audio Level	100 to 2500 mV, also programmable
System Distortion	Less than 5%
System SNR	60dB or better



Scrambler Top



Scrambler Bottom

Figure 1

SC20-455 LEAD FUNCTIONS

1	ORANGE	TX IN
2	GREEN	RX IN
3		On/Off Indicator
4		Binary Code Select 8
5		Binary Code Select 4
6		Binary Code Select 2
7		Binary Code Select 1
8	BLUE	RX OUT
9	VIOLET	Scramble (GND to enable)
10	GRAY	PTT (GND for TX Mode)
11	RED	+V
12	BLACK	GND
13	YELLOW	TX OUT

SC20-455 INSTALLATION BLOCK DIAGRAM

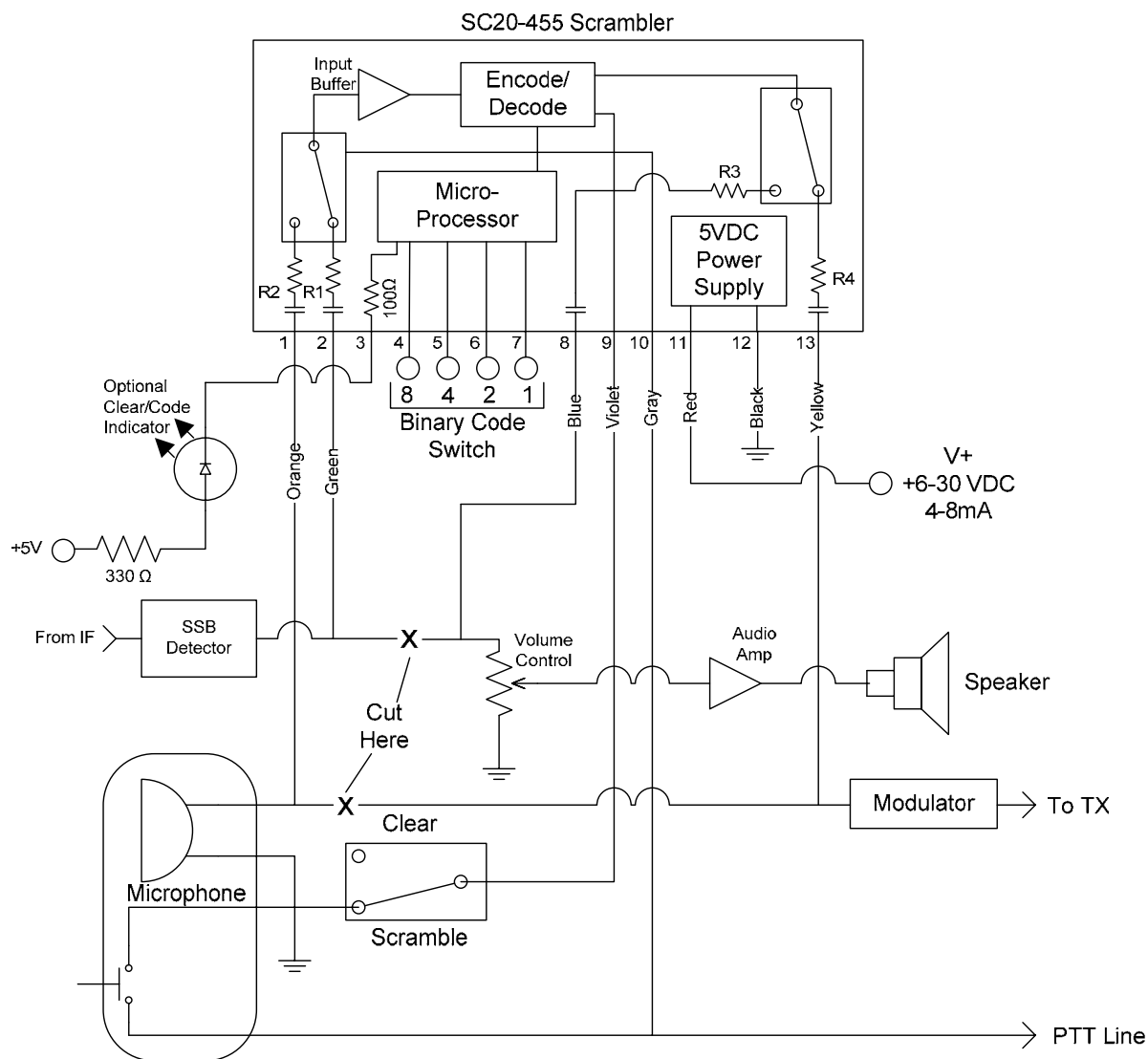


Figure 2 – Installation Block Diagram

3.0 INSTALLING THE SC20-455

Pre-Installation

The SC20-455 is a Real Time Multiple Audio Frequency Shifting scrambler with selectable codes. There are eight wires to connect, grouped as follows:

COMMON: Power (Red), Ground (Black), and On/Off Mode Control

TRANSMIT: TX Audio In (Orange), TX Audio Out (Yellow)

RECEIVE: RX Audio In (Green), RX Audio Out (Blue)

It is suggested that all levels (TX Audio, RX Audio, PTT, and V+) be measured before modifying the radio or the scrambler. An SPST switch is required for mode control. Various 1/8 Watt surface mount resistors may be required to complete the level settings for the installation.

Common

C1 – PTT Control

1. Check that the radio PTT (when On) is between 0-1 VDC.
2. When radio PTT is off (Receive mode), PTT should be 2.0 VDC or greater.
3. Connect Pin 10 (Gray) to radio PTT from MIC. Do not break the existing path.

C2 Connect Pin 12 (Black) to Ground, preferably near MIC Audio Ground.

C3 Connect Pin 11 (Red) to V+ (6 – 15 Volts DC).

C4 Obtain an SPST switch for Clear/Code mode control (refer to Figure 2, Page 3):

1. Connect one side of the switch to ground.
2. Connect other side of the switch to Pin 9 (Violet) of the SC20-455.

Transmit

T1 Determine if the microphone used on the particular radio is a power/amplified MIC. The MIC is most likely a power MIC if there is a DC potential across the MIC, as shown in Figure 6, Page 7. If the radio uses a power MIC, refer to Appendix A, Page 7.

T2 Locate the Transmit Audio path (between MIC and the modulator). Determine a cut point as shown in Figure 2, Page 3:

1. Talk loudly into the MIC (or inject a 1 KHz tone). Measure the audio level (voltage) at the cut point.
2. Record the level _____ mV.
3. Check the chart on Page 5 to determine the correct values for R2 and R4, and install different values if necessary.
Note: Values for resistors are not critical if audio levels are reasonably close.
4. Cut the Transmit Audio path at the cut point determined above.
5. Connect Pin 1 (Orange) to the MIC side of the cut.
6. Connect Pin 13 (Yellow) to the modulator side of the cut.

T3 Place the Clear/Code switch in Clear mode. Talk loudly into the MIC (or inject a 1 KHz tone). Check that the audio level on Pin 13 (Yellow) is about the same as that measured on Pin 1 (Orange) in Step T2. Check the transmit operation with a service monitor or other receiver. Place the Clear/Code switch in the Coded position and likewise check for scrambled audio.

Receive

R1 Locate the Receive Audio path (between the detector and volume high). Determine a cut point before any squelch muting takes place (refer to note in Step 3, below):

1. Using a known transmit reference (such as a carrier 1KHz above RX frequency for SSB), measure the audio level (voltage) at the potential cut location.
2. Record the level _____ mV.
3. Check the chart on Page 5 to determine the correct values for R1 and R3, and install different values as necessary.
Note: Values for resistors are not critical if audio levels are reasonably close.
4. Cut the Receive Audio path at the cut point determined above.
5. Connect Pin 2 (Green) to the detector side of the cut.
6. Connect Pin 8 (Blue) to the audio amp side of the cut.

R2 Using the same transmit reference as in step R1, check that the audio out of Pin 8 (Blue) is about the same as that measured in Step R1. Check RX operation with a service monitor or other transmit source.

AUDIO LEVEL ADJUST TABLES

RX Audio Level Peak – Peak Volts	R1 (Ohms)	R3 (Ohms)
50 – 150 mV	6.8K	6.8K
150 – 400 mV	15K	15K
400mV – 1V	39K	39K
1V – 2.5V	100K	100K

TX Audio Level Peak – Peak Volts	R2 (Ohms)	R4 (Ohms)
50 – 150 mV	6.8K	6.8K
150 – 400 mV	15K	15K
400mV – 1V	39K	39K
1V – 2.5V	100K	100K

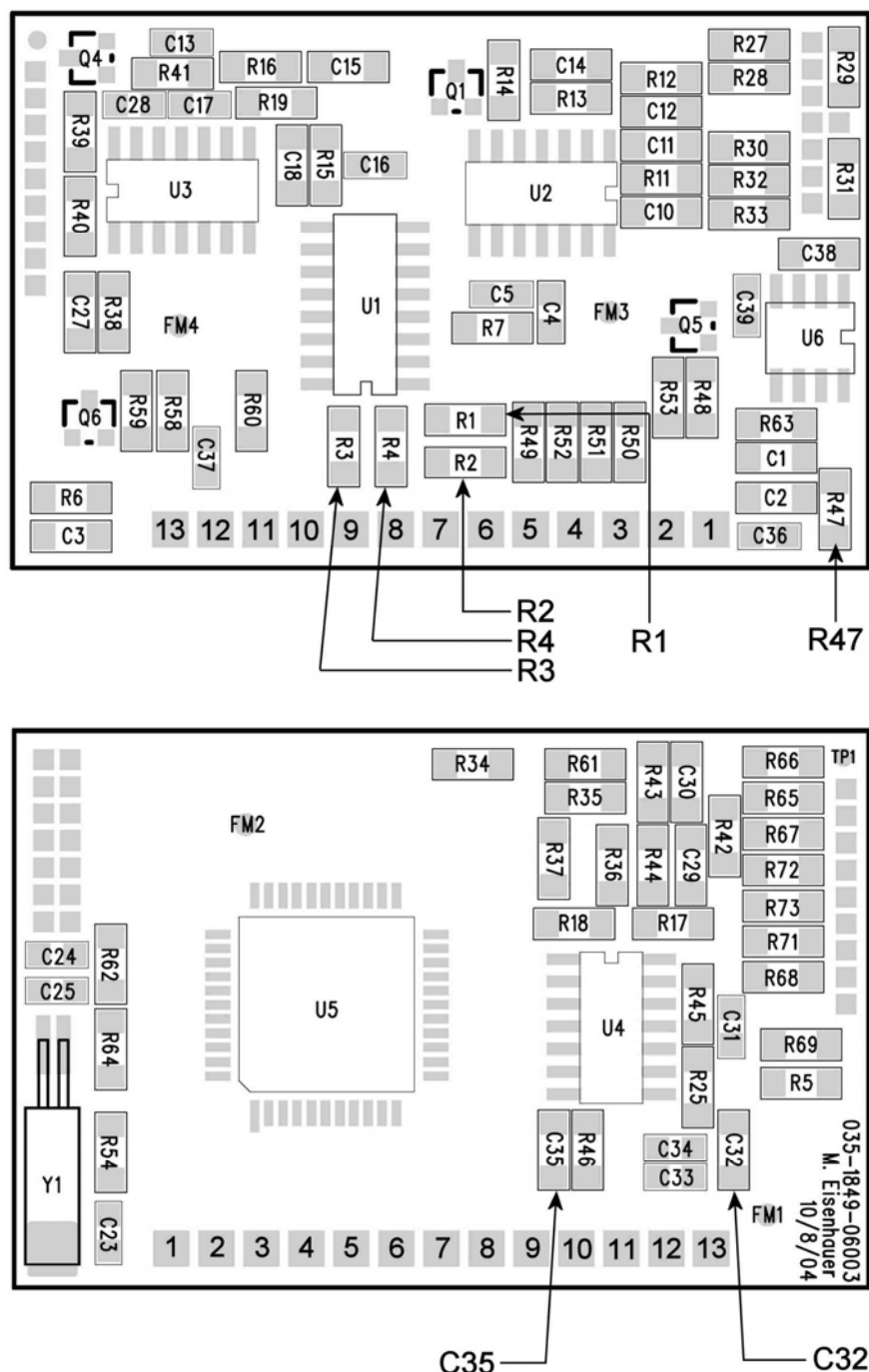


Figure 3 – Audio Level Set Component Locations

Individual Code Selection

To set the individual codes, ground pins 4, 5, 6, and 7 or attach a binary code switch as shown. Up to 16 codes can be selected in this manner.

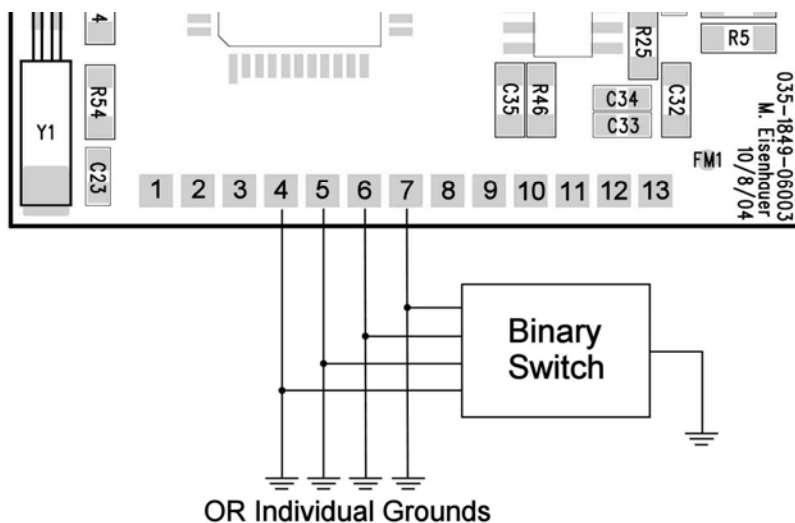


Figure 4 – Scramble Code Selection

Scrambler Testing

The SC20-455 uses a synchronizing data burst at the beginning of a coded transmission. Because radio circuits take some time to respond, a System Delay is needed to ensure proper synchronization.

Typical System Delay = AGC setting time = 50 – 100 mSec

System Delay Setting

To set the System Delay, short the proper pad(s) to ground:

A	B	Time(mSec)
OPEN	OPEN	150
OPEN	SHORT	350
SHORT	OPEN	550
SHORT	SHORT	750

Place Clear/Code switch of the transmitting unit in the Coded (ground) position. Key up the transmitting unit and listen on the receiving unit for proper synchronization. A brief data burst will be heard, followed by properly decoded audio.

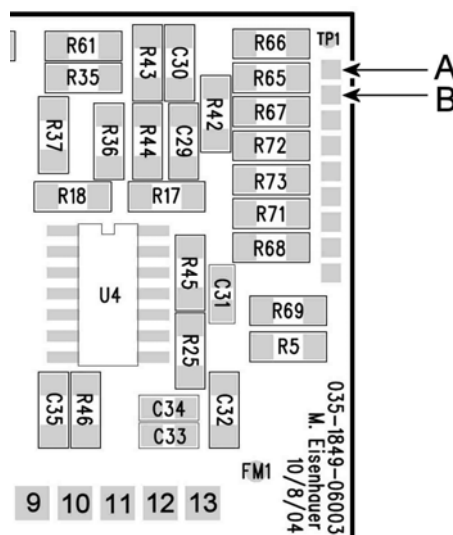


Figure 5 – Setting the System Delay

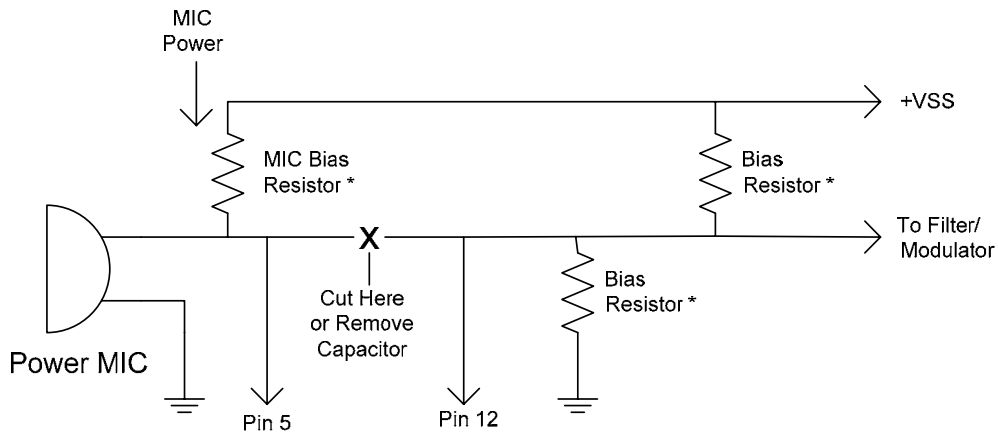
Appendix A: Power MIC Notes

The SC20-455 does not pass MIC BIAS (refer to Figure 6, below). If possible, make the cut in the TX audio path after this point by removing any coupling capacitors, etc. Also consider making the cut after the microphone amplifier circuit, if present.

If the MIC Amplifier circuit needs to be biased above ground, additional resistors may be needed for this purpose (refer to Figure 6, below).

If it is difficult to cut after the MIC bias resistor, a substitute resistor can be used if tied to a clean power supply, such as the internal +5VDC supply. Add R47 (usually 750 Ohms) as shown on Page 5.

The internal DC voltage is about 2.0 Volts. For most power MIC applications, the (+) side of the capacitor should face the radio interface.



* Bias resistors may be needed, depending on radio circuit.

Figure 6 – Power MIC Installation

Appendix B: Optional Scrambler On/Off Indicator

When in scrambled (Coded) operation, Pin 3 of the scrambler will go low (ground). This can be tied to an indicator for automatic Clear/Coded indication:

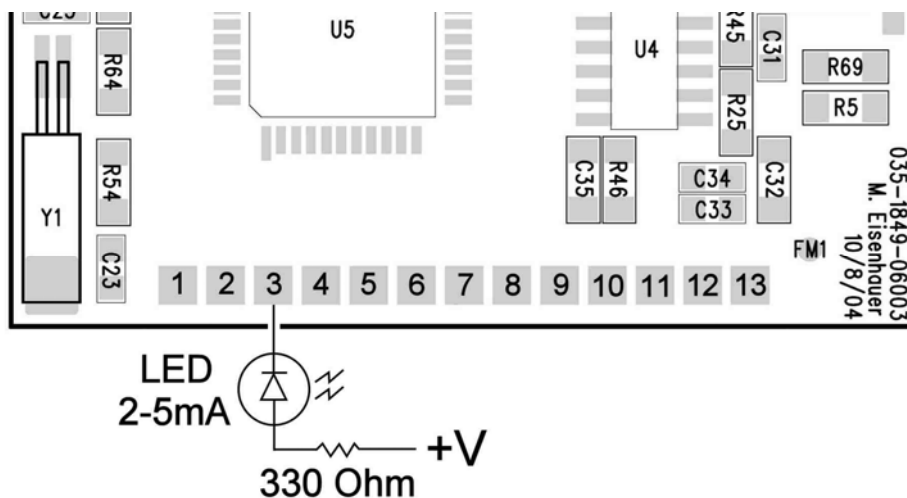


Figure 7 – Installation of On/Off Indicator

Appendix C: Installation Problems & Troubleshooting

C1 No transmit (or receive) audio

- Check PTT to be sure that the scrambler is switching correctly (refer to Page 4, Section C1).
- On transmit, check for proper power MIC operation (refer to Appendix A, Page 7).
- Check that the input wires (Pin 1 and 2) are going to the correct points (microphone or detector side). If Pin 1 and Pin 13 (or Pin 2 and Pin 8) are reversed, audio does not pass through the scrambler. Also refer to C2 below.

C2 Low transmit (or receive) audio

- Check resistor tables for proper values of R1, R2, R3, and R4 (Page 5). The audio can be “compressed” inside the unit if R1 (or R2) is too small. This results in lower output when R3 (or R4) cuts back the gain.
- The SC20-455 outputs are driven by an Op-Amp, so output impedance is relatively low. Any circuit with an impedance (resistance) greater than 5K Ohms should not show loading. If it is less, refer to Appendix A (Page 7) for output capacitor changes.

C3 Missed Synchronization

- Check Clear/Code switch for proper operation on the TX unit.
- Check that both the transmit and receive units are on the same individual code (Page 6).
- Check the System Delay calculations on Page 6 for proper delay. Add extra delay if needed, and try the system again.
- Due to filter delays/distortion, install RX Audio In (Pin 2) as close to the detector as possible.
- If this does not solve the problem, check radio performance. Both RX and TX units should be on frequency and the receiver IF and detector should be properly aligned. Radios exhibiting unsatisfactory operation may cause data distortion.

C4 RF Problems

- Although the SC20-455 is well bypassed, keep it away from the transmitter, RF amplifier, and antenna, with leads kept as short as possible. Running leads near a ground (or using shielded audio cable) may be required in extreme cases.

SC20-455 Accessories

SC20-455 Resistor Pack

- A selection of 1/8 Watt surface-mount resistors to adjust audio levels:
 - 2 ea. 6.8K Ohms
 - 4 ea. 15K Ohms
 - 2 ea. 39K Ohms
 - 4 ea. 100K Ohms

SPST Clear/Code Switch

- A miniature SPST switch for Clear/Code control.

On/Off Indicator LED

- A high efficiency LED for use as a Clear/Coded – On/Off indicator.