



MODEL SDI-50

TELEPHONE INTERCONNECT

USER/SERVICE MANUAL

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TECHNICAL SPECIFICATIONS

Physical:

Dimensions: 8.25" W X 1.5" H X 9.5" D
Weight: 3 lbs., 13 oz.
Mounting: Table top or 19" rack mount

Electrical:

Voltage: 10 to 15 Vdc
Current: 250 mA
Memory: EEPROM w/100 years memory retention
DTMF Error: -.54% to +.74% max

Transceiver:

Ground Keying: Source 100 mA @ .03 Vdc
Input from receiver: 50 mVrms to 2 Vrms, adjustable
Output to transmitter: 0 to 1.0 Vrms max., adjustable

Telephone:

Input from telco: -30 db to +2 db, 600 Ohm balanced
Output to telco: -10 db to +2 db, 600 Ohm balanced
Ring detect: Telco standard 90 Vac at 20 Hz
Hybrid isolation: -30 db minimum

Indicators:

Front Panel:

Power
PTT
Connect
COR/CTCSS

Board Mount:

DTMF Strobe Detect

Front Panel Controls:

Power
Manual Connect/Disconnect

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MODEL SDI-50 GENERAL DESCRIPTION

The CES Model SDI-50 Programmable Interconnect is a fully automatic microprocessor controlled telephone interconnect for use in land/mobile radio systems. The Model SDI-50 is designed as an interface controller between the Public Switched Telephone Network and land/mobile radio base station equipment. This interface allows mobile radios to originate and receive telephone calls from the Public Switched Telephone Network when the mobile is equipped with a standard DTMF encoder for interconnect control. The CES Model SDI-50 is capable of operating full duplex, half duplex or simplex.

2.1 FEATURES:

- * Remotely programmable from any DTMF telephone for convenience.
- * Single "*" and "^" connect and disconnect codes for simplicity.
- * Programmable multi-digit connect and disconnect codes for system security.
- * Regenerated DTMF or pulse dialing into the telephone network.
- * Intelligent, programmable toll restriction suitable to your application.
- * Programmable call limit and mobile activity timers to help control system loading.
- * Time out warning signals before automatic disconnection.
- * Morse code station identifier.
- * Busy channel transmit lock out.
- * Multiple relay contact closures for custom applications.
- * Repeater controller capability with programmable transmitter hang time and time out timer makes the SDI-50 an inexpensive back-up unit.
- * Regenerated DTMF land line to mobile selective signaling for confidence in any network.
- * Dial-up remote dispatch for simplex or repeater applications eliminates costly DC or tone remotes.

The Model SDI-50 is programmed by DTMF tones from any DTMF telephone for "remote" programming, or by the DTMF encoder supplied with the SDI-50 for "local" programming. Programming the Model SDI-50 allows the unit to be customized to suit the particular requirements of your interconnected system. All programming data is stored in an EEPROM that maintains data integrity without power for a minimum of 100 years.

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The Model SDI-50 is enclosed in an attractive cabinet with Mobile Detect, Transmit, Connect and Power status LEDs mounted on the front panel. Front panel Power and Connect/Disconnect switches provide for local operator control.

SYSTEM OPERATION

3.1 INITIATING A MOBILE TO LAND LINE CALL

A mobile to land line call can be initiated by using the following sequence of operations:

- A global Connect Code is an access code used by all users of the system. Key the proper global Connect Code; "*" plus two programmable numbers, or a single "*".
- Unkey the transmitter and listen for a dial tone.
- After dial tone is received, dial the desired phone number.
- When the call is complete, dial the appropriate Disconnect Code, which is a single "#"; or "#" plus two programmable numbers.

3.2 LAND LINE TO MOBILE CALL WITH AUTO-ANSWER

This is a form of selective calling and requires the mobiles to be equipped with a DTMF decoder. Dial the phone number of the line connected to the CES Model SDI-50. If the channel is busy, the interconnect will answer and give a series of three long beep tones; then disconnect the calling party. If the channel is not busy, the interconnect will answer on the programmed ring and return a single, beep tone to the phone line. The caller should then enter the number of the desired mobile; 1 to 5 DTMF digits terminated by a "#". The interconnect will regenerate this number out to the mobiles as DTMF. The mobile must answer with a "*", followed by the same number that was dialed from the phone line. After the communication is completed, the call may be terminated with the global disconnect from the mobile or the phone line. If the mobile does not answer the call, the call will be automatically terminated after the programmed wait period.

3.3 LAND LINE TO MOBILE CALL WITHOUT AUTO-ANSWER

Dial the phone number of the line connected to the CES Model SDI-50. The interconnect will detect the ring voltage on the phone line, key the transmitter, and send the message programmed into the Error Message area. The caller will hear the normal ring from the phone company until a mobile answers the call. Any mobile may answer by sending the global Connect Code. The call may be terminated from either the phone line or the mobile after the call is completed by sending the proper Disconnect Code.

3.4 INITIATING A DIAL-UP REMOTE CALL

This feature gives the caller dispatch capability and is available whenever the SDI-50 is set up to automatically answer

an incoming call. Dial the phone number of the line connected to the CES Model SDI-50. The interconnect will answer on the programmed ring and return a quick double "beep" tone to the phone line. The caller should enter the Dial-Up Remote Code followed by a "#" tone and proceed as a normal dispatch call. Anything said into the phone will be transmitted to the mobiles, and all mobile traffic will be passed to the caller. If the channel is busy at the time the caller enters the Dial-Up Remote Code, the interconnect will return three long tones and disconnect. After communications are complete, the call may be terminated with the global disconnect code from the mobile or the phone line.

Example: To initiate a Dial-up Remote call using Dial-Up Remote Code "8421"; dial the interconnect phone number. When the interconnect answers, dial "8421^". At this time the interconnect will key the transmitter and transmit any audio present on the phone line. There will be no tone to the caller to indicate that the unit is transmitting. The caller should remember that on simplex systems there will be a delay of up to 1 second (or the length of time of the programmed Sample Rate) before the mobile can capture the interconnect, and talk after the person on the phone finishes speaking.

INSTALLATION

This section describes each connection required by the Model SDI-50 Interconnect. This section also describes optional jumpers on the circuit board that can be used to customize the Model SDI-50 to your particular transmitter-receiver combination.

Installation of the Model SDI-50 should be done by a qualified two-way radio technician. Since the electrical components used are susceptible to static damage, be sure to use static protection techniques during the installation and level adjusting procedures. During the installation, be sure that no power is applied to the interconnect or radio.

Shielded cable should be used for all audio connections. To prevent hum and noise due to ground loops, terminate the cable shield only at the interconnect ground at the terminal block. The other end of the shield must be left unconnected. Other connections to the Model SDI-50 can be made using standard hook-up wire with sufficient current rating. The best location for the interconnect is as close as possible to the radio, thus allowing the shielded cables and wires to be as short as possible.

4.1 TERMINAL BLOCK CONNECTIONS

Use the following instructions to make all connections to the terminal block:

4.1.1 TB1-1,15,23 and 25 GROUND

These connection points are the main ground for the interconnect. The GROUND connections, and chassis are common. Ground should be connected directly to the "Common Ground Return" at the DC power supply.

4.1.2 TB1-13 +VDC

This connection supplies DC power to the interconnect. This connection should be made DIRECTLY to the +12 VDC power supply that powers the radio equipment. If this is not available, any regulated +12 VDC source with a current rating of at least 500 mA may be used.

4.1.3 TB1-22 RELAY PTT OUTPUT

This connection is used for controlling the transmit function in the associated transmitter. The PTT output should be connected to the PTT line on the transmitter. As shipped from the factory, the PTT output will provide a relay contact pull to ground to key the transmitter. If a pull to positive voltage is required to key the

transmitter, then move JMP7 on the interconnect circuit board (near the PTT relay K2), to position A.

4.1.4 TB1-20 LOGIC PTT

Logic PTT is similar to the relay PTT output except that it only provides a ground to key the transmitter. Using this PTT control will free the auxiliary relay contacts for user defined custom applications.

4.1.5 TB1-14 TRANSMIT AUDIO

This connection supplies the transmitter with processed audio from the telephone line. This connection should be made to the transmitter microphone voice audio input. The TRANSMIT AUDIO is normally shipped from the factory for a low impedance audio output. If the voice audio input to your transmitter is high impedance, then remove JMP5 on the interconnect circuit board to convert the TRANSMIT AUDIO output to high impedance, and to match your transmitter impedance more closely. This will permit the level adjustment to be less sensitive. Be sure to use shielded cable.

4.1.6 TB1-4 AUXILIARY TRANSMIT AUDIO IN

This input is an auxiliary transmit audio input which can be used for special applications when more than one audio source is needed or used. There are no controls or level adjustments associated with this input.

4.1.7 TB1-9,10 and 21 AUXILIARY RELAY CONTACTS

TB1-21 Relay Common
TB1-10 Relay Normally Closed (NC)
TB1-9 Relay Normally Open (NO)

These spare relay contacts are active when the interconnect keys the PTT line or follows the phone line connect relay. The contact arrangement can be used for switching logic signals, or audio signals. The most common use for these contacts is to allow the interconnect to switch between "Interconnect Transmit Audio" and "Repeat Transmit Audio" that is derived from a repeater panel connected in the system.

<u>Auxiliary Relay Control</u>	<u>JMP8 Position</u>
Auxiliary Relay follows the Connect Relay	B/C
Auxiliary Relay follows the PTT signal	B/A

4.1.8 TB1-3 CTCSS-DCS DECODE INPUT

This connection is optional, and can be left unconnected if not used. The purpose of the CTCSS-DCS DECODE INPUT is to inhibit the interconnect unless the proper CTCSS tone or Digital Coded Squeech (DCS) is present. Typically, this input is connected to an external CTCSS decoder which, upon decode, will cause the CTCSS DECODE INPUT to change state,

and thus permit access to the interconnect. This type of connection denies access and control to the interconnect if a mobile station does not have the proper CTCSS tone. If CTCSS or DCS isn't used, place JMP6 in D/A.

First, determine your CTCSS decoder's output signal when it detects the proper CTCSS tone. Jumper 6 should be in one of the two following positions for CTCSS use:

- > Jumper JMP6 should be in position D/B if the CTCSS decoder's output is normally high (or high impedance) and goes to ground in the presence of a valid tone.
Note: If the CTCSS decoder's output is open collector, a suitable value pull-up resistor should be installed between E3 and E4 on the SDI-50 PC board.
- > Jumper JMP6 should be in position D/C if the CTCSS decoder's output is normally low and goes to a positive voltage in the presence of the proper tone.

The COR/CTCSS LED on the front panel should light each time the proper CTCSS or DCS tone is transmitted.

Some decoders may only provide a small voltage change when detecting the proper tone. Resistor R45 enables the installer to set the reference of the voltage comparator to the midpoint between the high and low signals from the CTCSS decoder. Set the voltage at pin 2 of U17 to the midpoint by adjusting R45.

Example: D.C. voltage from decoder with no CTCSS = .7v
 D.C. voltage from decoder with CTCSS = 1.9v

 $1.9V - .7V = 1.2V$ (output change)
 $1.2V / 2 = .6V$ (midpoint of change)
 $.7V$ (low end) + $.6$ (midpoint) = $1.3V$

Set the voltage at pin 2 of U17 to 1.3v and place JMP6 in D/C since this output goes positive with tone.

4.1.9 TB1-24 RECEIVER DISCRIMINATOR AUDIO

This connection supplies unfiltered discriminator audio from the receiver to the interconnect for processing. THIS CONNECTION MUST BE MADE DIRECTLY TO THE DISCRIMINATOR OUTPUT IN THE ASSOCIATED RECEIVER. Because the SDI-50 has its own internal squeich circuits, and needs to detect carrier for proper operation, do not connect the RECEIVER DISCRIMINATOR AUDIO line after any de-emphasis circuits, or any squeich circuits. Improper operation of the interconnect will result. Be sure to use shielded cable with the shield terminated at the interconnect's ground.

Radios with external discriminator outputs usually do not provide raw discriminator audio and signals taken from this location may not function on the SDI-50.

Jumper JMP6 should be placed in position D/A unless CTCSS or DCS is being used. If so, see the CTCSS section 4.1.8. for proper placement of JMP6.

4.1.10 TB1-6 and 19 CONTROL OUTPUTS

TB1-19 Control Out 1 - CTRL 1

TB1-6 Control Out 2 - CTRL 2

These outputs are the open collectors of transistors Q22 and Q23. These outputs are controlled by the Special Connect code. Either of these outputs may be used for a customer defined purpose, i.e., remotely controlling other equipment.

TB1-19 CTRL 1 goes low true after receipt of the Special Connect code and returns high automatically after receipt of next disconnect code.

TB1-6 CTRL 2 goes low true after receipt of Special Connect code followed by the connect code. Returns high after receipt of next disconnect code. Temporary Toll Defeat (*5 20) must be on for CTRL 2 to work.

These codes are not available during the time the patch is temporarily disabled by code "*7 4".

4.1.11 TB1-17 and 18 FUNCTION OUTPUTS 1 & 2

TB1-17 Function 2 Output

TB1-18 Function 1 Output

These outputs are for user defined applications to control or switch other equipment or relays.

Both are the open collectors of transistors Q20 and Q21 and might need to be pulled to +5V or +12V depending on the intended use. These outputs are able to sink up to 500mA_{dc} continuously. When the interconnect is first powered up, Function 1 is in the "ON" state, and Function 2 is in the "OFF" state.

Both outputs are turned on and off by sending the user defined Function On/Off Codes (*7 2 and *7 3). See the section on programming for the use of these codes. They may still be used while the patch is temporarily disabled from code "*74".

4.2 TELEPHONE LINE CONNECTIONS

The Model SDI-50 interfaces directly with a "loop start" telephone line. Connection to the telephone line is accomplished by plugging the modular telephone cord supplied with the interconnect into your telephone company supplied RJ11-C jack. Please note that the telephone line interface on the interconnect is not polarity sensitive, and therefore the Tip and Ring connections can be reversed without any system degradation.

4.3 OPTIONAL CTCSS DECODER

Space has been set aside for the addition of a CTCSS decoder. The installation list below is for the C.E.S. Model 5732 CTCSS high speed decoder (although most CTCSS decoders will work without any problem). Connect the five wires and set the 5732 for the proper CTCSS tone according to the Frequency Selection Table. See the Jumper Summary Table in the next section to configure JP6, and follow any operating instructions sent with the 5732 decoder.

CTCSS is useful for two different applications. The first is for access security, and the second for an alternative carrier detect signal.

For access security, connect the decoder as shown below. To use the decoder as carrier detect, connect it as below but omit the DISABLE (E12) connection.

<u>5732 WIRE</u>	<u>IN SDI-50</u>
Decode output (yellow)	E8
Tone Input (green)	E9
+12 Vdc (red)	E10
Ground (black)	E11
Disable (orange)	E12
Add a 27K resistor between	E3 & E4

All connection points can be found in the upper, left hand corner of the printed circuit board.

Use the table on the next page to set the switches for the desired tone.

4.3.1 CTCSS FREQUENCY SELECTION TABLE

No	FREQ	CODE	SWITCH #					No	FREQ	CODE	SWITCH #				
			5	4	3	2	1				5	4	3	2	1
1	67.0	XZ	0	0	0	0	0	17	118.8	2B	1	0	0	0	0
2	71.9	XA	0	0	0	0	1	18	123.0	3Z	1	0	0	0	1
3	74.4	WA	0	0	0	1	0	19	127.3	3A	1	0	0	1	0
4	77.0	XB	0	0	0	1	1	20	131.8	3B	1	0	0	1	1
5	79.7	SP	0	0	1	0	0	21	136.5	4Z	1	0	1	0	0
6	82.5	YZ	0	0	1	0	1	22	141.3	4A	1	0	1	0	1
7	85.4	YA	0	0	1	1	0	23	146.2	4B	1	0	1	1	0
8	88.5	YB	0	0	1	1	1	24	151.4	5Z	1	0	1	1	1
9	91.5	ZZ	0	1	0	0	0	25	156.7	5A	1	1	0	0	0
10	94.8	ZA	0	1	0	0	1	26	162.2	5B	1	1	0	0	1
11	97.4	ZB	0	1	0	1	0	27	167.9	6Z	1	1	0	1	0
12	100.0	1Z	0	1	0	1	1	28	173.8	6A	1	1	0	1	1
13	103.5	1A	0	1	1	0	0	29	179.9	6B	1	1	1	0	0
14	107.2	1B	0	1	1	0	1	30	186.2	7Z	1	1	1	0	1
15	110.9	2Z	0	1	1	1	0	31	192.8	7A	1	1	1	1	0
16	114.8	2A	0	1	1	1	1	32	203.5	M1	1	1	1	1	1

1= switch turned on 0= switch turned off

4.4 SDI-50 JUMPER SUMMARY TABLE

Jumper Number	Jumper Name
JMP1	Phone in Use Detect Intact: the SDI-50 checks the phone line for a busy condition before allowing a mobile to connect, but, still allows the use of the Special Connect Code for selective override. (See Special Connect Code.) Cut: a mobile may break into land-line to land-line communication if the interconnect shares a common line with a telephone.
JMP2	Receive Audio Intact: This provides a fiat frequency response from the receiver to the telephone line. Cut: If the receive audio pick-up point is after de-emphasis, cut this jumper.
JMP3	Modified Pulse Dialing Intact: Make Break ratio = 40/60 at 10pps Cut: Make to Break ratio = 44/56 at 10 pps
JMP4	Transmit Control Intact: Half dúplex operation. Cut: Full dúplex and Simplex operation.
JMP5	Tx Level Intact: Low impedance output of Tx amp. Cut: High impedance output of Tx amp.
JMP6	Mobile Detect The center pin, D, is common and connects to one of the three other pins; A, B and C. Pin A: Selects Noise only as the mobile detect signal. Pin B: Selects CTCSS/DCS as the mobile detect signal for a HIGH to LOW change when the mobile keys. Pin C: Selects CTCSS/DCS as the mobile detect signal for a LOW to HIGH change when the mobile keys.

- JMP7 Relay PTT Level
The center pin, B, is common and connects to one of the other two pins; A or C.
Pin A: Relay PTT provides +12Vdc to key the transmitter.
Pin C: Relay PTT provides a ground to key the transmitter.
- JMP8 Aux. Relay Control
The center pin, B, is common and connects to one of two pins; A or C.
Pin A: The auxiliary relay follows the keying of the transmitter to connect and disconnect.
Pin C: The auxiliary relay follows the phone line connect relay for control.

LEVEL ADJUSTMENTS

Now that all connections have been made to the Model SDI-50, the next step is to perform all level adjustments required for proper operation in your system. An FM service monitor, an oscilloscope, or AC RMS voltmeter, and the DTMF encoder provided with the SDI-50 are required for level adjustments.

The numbers in parentheses show the location on the assembly drawing the pots can be found.

5.1 NOISE CONTROL R91

(5,C) The noise control is used for muting the audio (squeich noise), when no carrier exists on the radio channel. This condition is indicated by the MOBILE DETECT LED on the front panel of the Model SDI-50. When the LED is illuminated, this indicates that the SDI-50 detects carrier. When it's extinguished, no carrier is detected.

Jumper JMP6 should be in position D/A if carrier alone is used to detect mobile presence. If a CTCSS or DCS decoder is going to be used, see the CTCSS section in this manual for other JMP6 configurations.

To adjust the Noise Control, use a small alignment tool to rotate R91. Start from a fully counter-clockwise position and note that the Mobile Detect LED on the front panel is "On". Turn R91 clockwise until the LED turns "Off". Continue rotating the adjustments about 1/8 of a turn further. Please note that the Noise Control can be turned even further clockwise to inhibit very weak and noisy signals from accessing the interconnect. Use your own judgement as to the quality of transmissions from mobile stations required to use your system. If you can not adjust R91 so that the LED extinguishes, then re-check the Receiver Discriminator Audio connection in the Installation Section and re-check JMP6 for proper placement.

5.2 RECEIVE AUDIO LEVEL R60

(5,D) The RX AUDIO LEVEL controls the signal level from the radio receiver to the telephone line and DTMF level to DTMF decoder. To adjust the RX AUDIO LEVEL, set your service monitor to generate an 800 Hz. audio signal at 4.0 Khz. deviation on the receive frequency of your system. Connect an oscilloscope or AC RMS voltmeter to pin 7 of U16. Push the Connect switch on the front panel of the SDI-50, and carefully adjust the RX AUDIO LEVEL adjustment, R60, for a 3.0 volt peak to peak reading sine wave (1.0 Vrms). Adjusting R60 beyond this level will result in a distorted and clipped signal. If

a sufficient level can't be obtained, cut JMP2 to increase the gain of the receive amp U13 and re-try. This completes the RX VOICE LEVEL adjustment.

5.3 TRANSMIT VOICE LEVEL R75

(6,C) This adjustment is used to set the signal level from the telephone line to the radio transmitter. To adjust the TRANSMIT VOICE LEVEL, adjust your service monitor to listen to the output frequency of the transmitter. Adjust the Transmit Voice Level, R75, to 4.0 Khz deviation. If you encounter difficulty setting this level because the potentiometer is overly sensitive then remove JMP5.

5.4 HYBRID BALANCE R40

(5,B) The Hybrid Balance adjustment is used in "full duplex" systems only (where mobile stations are capable of receiving and transmitting simultaneously). If your system is "half duplex" or simplex, (where a mobile can only transmit, or receive at a given time), then this adjustment may not be required. This adjustment cannot be made unless the interconnect is programmed for "full duplex" operation.

The hybrid balance adjustment should be performed on the phone line which the interconnect is to be used on. During adjustment, the SDI-50 will have to be in the Connect Mode on a quiet line. To achieve this, call into the interconnect and answer the call by pushing the Connect button. Or, call time and temperature, and wait for the recording to stop.

Set your service monitor to generate an 800 Hz. audio signal at 4.0 kHz deviation on the receive frequency of your system, allowing the signal to pass through the hybrid circuit and back out through the TRANSMIT AUDIO OUTPUT. The calling party will also hear this tone.

Now while watching the deviation level of the signal generated by the Model SDI-50, adjust the HYBRID BALANCE adjustment, R40, for a minimum signal in the deviation level. This adjustment is critical, and if a sharp null is not found by turning the HYBRID BALANCE through a complete rotation, then an additional compensation capacitor may be required to match the telephone line impedance. Install a value from .047uf to .47uf in the location for C28, near the HYBRID BALANCE adjustment. After this capacitor is installed, try again to adjust the HYBRID BALANCE for a null. If the null is still not satisfactory then repeat this capacitor substitution process until until an acceptable null is achieved.

5.5 TONE OUTPUT LEVEL R68

(6,C) Set your service monitor to receive on your transmit frequency. Dial the phone number of the telephone line connected to the SDI-50. After the SDI-50 answers and returns

a tone to the telephone line, overdial a 5 digit DTMF number terminated with the #.

Note: the program switches "*5 12" and "*5 35" must be on. If this is a first time installation, they would have been turned on at the factory. If this is a re-installation, review the section on programming to set these switches on.

Set R68 to 3.0 - 3.5 kHz. peak deviation on the regenerated tones.

This level adjustment sets the level for the Morse code ID messages as well as the level of the DTMF tones. At any particular setting the DTMF tones will be twice the level of the ID messages. Therefore it is important to use DTMF tones for setting the level, and not the ID tones.

5.6 REPEAT AUDIO LEVEL R61

(5,C) If the Repeat function is to be used, it must be adjusted after programming.

Generate a signal on the receive frequency modulated by an 800 hz tone at 4.0 kHz deviation. Adjust R61 to 4 kHz deviation on the transmitter frequency.

5.7 VOX SENSITIVITY R99

(5,C) For simplex mode only. To adjust the VOX Sensitivity, the SDI-50 must be programmed for the simplex mode. First set R99 fully counter clockwise. Call the SDI-50 from a land line; answer the call and speak into the telephone in a normal voice. Monitor the DC voltage at pin 7 of U19 while adjusting R99 in a clockwise direction. Advance R99 until the voltage at pin 7 goes low with voice audio and returns high with no audio.

An easy way to make this adjustment is to call (from the mobile or handheid) a local recording such as Time and Temperature. While listening to the message turn R99 clockwise until you hear the sample rate change.

Before going on to program the CES SDI-50, you must have properly completed the previous installation section and have the interconnect connected to the radio and telephone line.

PROGRAMMING THE MODEL SDI-50

It is not necessary to program every parameter in the Model SDI-50 to get your interconnect properly set up and tested. In that interest two short programming procedures are listed for simplex and half/full duplex operation in the section which follows. It is suggested that you select and follow the appropriate required procedures for your application, then review the factory default values for optional program changes. Detailed instructions for the programming parameters can be found in the next section.

The SDI-50 can be programmed remotely through the telephone line or locally through the front panel with the use of the handheld DTMF encoder provided. In either case, the programming sequence is identical, and only the method by which programming access is obtained differs.

The Program Summary Table lists all of the programmable features of the Model SDI-50 interconnect. All of the features have factory programmed values which are listed in the center column.

6.1 ENTERING THE PROGRAM MODE

The program mode may be entered in one of two ways:

Local Programming Mode - With the supplied DTMF tone pad plugged into the front of the interconnect, dial "0", then press the connect button on the SDI-50 within five seconds. The SDI-50 will respond with a beep tone indicating that it is in the programming mode. (In order to hear response tones when locally programming the SDI-50, you will need to have a service monitor or receiver tuned to the transmit frequency).

NOTE: Because the SDI-50 is constantly monitoring receive audio for DTMF tones, it is possible that DTMF tones received from Rx audio may interfere with programming in the local programming mode. If the receiver is turned on, temporarily remove jumper JMP6 during programming to keep the SDI-50 from recognizing these tones.

Remote Programming Mode - The SDI-50 must have Auto Answer enabled to use this feature. Dial the telephone number of the line connected to the interconnect. When the interconnect answers, it will send two quick beep tones to the phone line. Enter the Remote Programming Code followed by a "#". If the correct code is entered, the SDI-50 will

send a single, quick, beep tone to indicate it is in the Program Mode. If the wrong code is entered, the SDI-50 will disconnect. The SDI-50 must be set for Auto Answer to have remote programming capability.

Enter the Program Codes according to the following instructions:

- Once a programming sequence is started (by entering a "*"), an inter-digit timer starts running and is reset each time another digit is entered. Time out is set to be within six seconds between digits for all programming entries except the messages, which are ten seconds between digits.
- To change any of the programmable features simply re-program the new values or codes over the existing ones. It is not necessary to "clear" the location of old data first.
- Any of the programmable features may be changed without reprogramming all of the others. Some of the codes may require specific switches to be set, or work in conjunction with other codes. These requirements are identified throughout the manual where ever applicable.
- When changing modes (i.e. Simplex to 1/2 Duplex) make certain that any commands pertaining to control functions in the exited mode are turned off.
- The programming codes are grouped by their functions. All codes start with the "*" key and follow a similar format; each of which is described in it's code group section.
- The examples in this manual show when the SDI-50 sends response tones to acknowledge receipt of DTMF tones, and help guide the entry of the program commands.

Exit the Programming Mode by sending a "#" tone. Some Control Codes that allow variable code lengths (*6 & *8) use the "#" to indicate the end of the code "string". This is expected in these programming sequences, and will merely terminate the sequence but will not exit you from the programming mode.

If the interconnect is being programmed remotely, it will automatically disconnect and terminate the programming mode if no DTMF tones are detected for one full minute. Thus, if you were to hang up before sending the "#" tone, the interconnect will revert to normal operating mode one minute after the last DTMF tone was sent.

6.2 SPECIFIC PROGRAMMING APPLICATIONS

The following section has required and optional programming for specific applications. Refer to the corresponding section in this manual for the use and function of the following program codes if you are not yet familiar with them. In the lists below, the "?" should be replaced with actual digits at the time of programming, to suit the particular needs and

timing of your system. The Program Summary Table lists the factory setting for these codes as well as the page specific information for each may be found.

6.2.1 SIMPLEX SAMPLING PROGRAMMING PROCEDURE

To use the SDI-50 in the simplex sampling mode, the following changes to the factory set-up need to be made. Any change made should be penciled into the Program Log in the back of this manual for future reference.

Required Programming for Simplex Operation

> Turn on Simplex Enable (*5 14)	*5	14	1
> Turn off Half/Full Duplex Enable (*5 36)	*5	36	0
> Set the Sample Rate (*1 0)	*1	0	?
> Set the Sample Rate Multiplier (*5 23, 24)	*5	23	?
	*5	24	?
> Set the Sample Window (*1 1)	*1	1	?
> Turn off the Repeat Enable (*5 37)	*5	37	0
> JMP4 should be cut or removed.			

6.2.2 HALF/FULL DUPLEX PROGRAMMING PROCEDURE

To use the SDI-50 in either duplex mode, the following changes to the factory set-up need to be made. Any change made should be penciled into the Program Log in the back of this manual for future reference.

Required Programming for Duplex Operation

> Turn off Simplex Enable (*5 14)	*5	14	0
> Turn on Half/Full Duplex Enable (*5 36)	*5	36	1
> Turn on Repeat Enable (*5 37)	*5	37	1
> Set the Repeater Time-Out Timer (*1 2)	*1	2	?
> Set the Repeater PTT Hang Time (*1 3)	*1	3	?
> JMP4 should be cut or removed if full duplex.			

? = User option

> JMP4 should be intact for half duplex.

6.3

PROGRAM SUMMARY TABLE

PROGRAM CODE	DESCRIPTION	FACTORY SETTING	SEC No.
*1	TIMERS		6.4
0	Sample Rate (Simplex)	1 sec.22	6.4.1
1	Sample Window (Simplex)	60 ms.	6.4.2
2	Repeater Timer Out Timer (Duplex)	7 min.	6.4.3
3	Repeater Hang Time (Duplex)	2 ms.	6.4.4
4	Call Limit Timer	3 min.	6.4.5
5	Mobile Activity Timer	20 sec.	6.4.6
6	I.D. Interval Timer	10 min.	6.4.7
*5	SOFTWARE SWITCHES		6.5
00	Toll restrict on number 7	off	6.5.1
01	Toll restrict on number 6	off	
02	Toll restrict on number 5	off	
03	Toll restrict on number 4	off	
04	Toll restrict on number 3	off	
05	Toll restrict on number 2	off	
06	Toll restrict on number 1	on	
07	Toll restrict on number 0	on	
10	Toll restrict on number 8	off	V
11	Toll restrict on number 9	off	6.5.1
12	Selective Signaling	on	6.5.2
13	"*" Call Limit Reset	on	6.5.3
14	Simplex enable (note 1) (simplex)	off	6.5.4
15	Toll restrict on 1st digit (note 2)	on	6.5.5
16	Toll restrict on 2nd digit	on	6.5.6
17	Pulse dialing	off	6.5.7
20	Toll Restriction Override	on	6.5.8
21	Single digit "*" connect	off	6.5.9
22	Single digit "#" disconnect	on	6.5.10
23	2X Sample Rate (note 2) (Simplex)	off	6.5.11
24	4X Sample Rate (Simplex)	off	6.5.11
23	Repeat enable (note 1) (Duplex)	on	6.5.12
24	Courtesy Beep Enable (Duplex)	off	6.5.13
25	Answer on 1,2,4 or 8 rings (note 2)	on	6.5.14
26	Used Together With #25.	off	6.5.14
27	Interconnect enable	on	6.5.15
30	Mobile Signalling Wait Time (note 2)	on	6.5.16
31	Used Together With Code #30	off	6.5.16
32	Ringout enable	on	6.5.17
33	Toll restrict	on	6.5.18
34	Auto I.D.	on	6.5.19
35	Auto answer	on	6.5.20
36	Half/Full Duplex Enable	on	6.5.21
37	Repeat Enable	on	6.5.22
40	Mute on Pulse Dial	on	6.5.23
41	Begin Overdial with "*"	off	6.5.24
42	Begin Overdial with "#"	off	6.5.25
44	Phone Line In Use Detect	on	6.5.27
47	DTMF Regenerate	on	6.5.28

PROGRAM CODE	DESCRIPTION	FACTORY SETTING	SEC No.
*6	Remote programming code	975310#	6.6.1
*7	Control Codes		
0	Connect/Disconnect Codes	*73/#73	6.6.2
1	Special Connect Code	*37	6.6.3
		ON OFF	
2	Control Function #1 Code	*14 *04	6.6.4
3	Control Function #2 Code	*25 *15	6.6.4
4	Interconnect Enable Code	*36 *26	6.6.5
5	Repeat Enable Code	*38 *28	6.6.6
*8	Dial-up Remote Code	8421#	6.6.7
*9	Messages		6.7
0	Connect Message	"ON"	
1	Disconnect Message	"OFF"	
2	Time out Message	"TO"	
3	Error/Signal/Message	"EEEEEEEE"	V
4	Station I.D. Message	"RING"	6.7

Note 1 - For repeater operation, *5 23 should be turned on and *5 14 should be turned off. When *5 14 is on, the patch is in simplex mode and *5 23, and *5 24 are used to modify the sample rate.

Note 2 - This is a two part switch. The following switch number must also be set. Refer to the section in the manual for more detail on setting these.

Note 3 - Switches 23 and 24 have different uses for simplex and duplex operation. If switch 14 is on and 36 is off, then 23 and 24 are used to adjust the sample rate for simplex use. If 14 is off, and 36 is on, then 23 is used for "Repeat Enable" and 24 is for "Courtesy Beep" during duplex use.

6.4 TIMERS

Several timers are available to configure the interconnect for optimum use or personal preference. All timers are set with the *1 code.

The format to program these is:

*1 N T T T

| | | Three digits must be entered to specify the length of time. Leading zeros are used for numbers smaller than three digits long.

| | This is a one digit number to identify which timer is being changed.

| All timer codes start with *1.

6.4.1 Sample Rate (*1 0)

For simplex operation only. The sample rate is the rate at which the interconnect unkeys the transmitter and checks for mobile activity. This value should be set to your liking, keeping in mind that the mobile cannot "capture" the interconnect until a sample window occurs, and may be modified by codes *5 23 and *5 24. This function is programmed in 0.1 second steps by entering a three digit multiplier.

Example: If you wished to set this value at 1.5 seconds enter the following sequence:

*1 (tone) 0 (tone) 015 (tone)

6.4.2 Sample Window (*1 1)

For simplex operation only. The sample window is the length of time the transmitter is unkeyed allowing the receiver to determine the presence of a mobile carrier. The sample window should be set as short as possible while still allowing the mobile to capture the interconnect on a weak signal. The function is programmed in 2 ms. steps by entering a three digit multiplier.

Example: 010 would give 20ms ($10 \times 2\text{ms} = 20\text{ms}$), and 100 would give 200 ms. To set the sample window to 100ms. enter the following:

* 1 (tone) 1 (tone) 050 (tone)

6.4.3 Repeater Time-Out Timer (*1 2)

For duplex operation only. This function is used to control the repeater use time. Up to 4 minutes and 10 seconds can be used. This function is programmed in 1 second steps by entering a 3 digit multiplier.

Example: To set the time out for 3 minutes:

*1 (tone) 2 (tone) 180 (tone)

6.4.4 Repeater PTT Hang Time (*1 3)

For duplex operation only. The hang time is the amount of time the repeater remains keyed after mobile carrier ceases. This function is programmed in 0.1 second steps by entering a 3 digit multiplier.

Example: To set the PTT hang time to 3 seconds:

*1 (tone) 3 (tone) 030 (tone)

6.4.5 Cali Limit Timer (*1 4)

This timer controls the maximum duration of the interconnected call. Time out will be preceded with double warning beeps once every two seconds. The time out warning is sent 20 seconds before the actual time out. After the interconnect has timed out the Time Out Message is sent. The time out timer can be reset by the mobile operator if the software switch *5-13 is turned on. This timer is programmed in 10 second steps up to a total of 21 minutes, by entering a 3 digit multiplier.

Example: To program the Call Limit Timer to three minutes enter the following sequence (18 X 10 seconds = 3 minutes):

*1 (tone) 4 (tone) 018 (tone)

6.4.6 Mobile Activity Timer (*1 5)

This timer is used to disconnect the interconnect and unkey the transmitter if the mobile should drive out of range, or go off the air. Each time the mobile transmits, the Mobile Activity Timer is reset. Actual time out is preceded with single warning tones, once every two seconds for ten seconds prior to time out. This function is programmed in 1 second steps up to a total of 4 minutes, by entering a 3 digit multiplier.

Example: Program the activity timer for 30 seconds:

*1 (tone) 5 (tone) 030 (tone)

6.4.7 Station Identification Interval (*1 6)

This Program Code determines how often the Station ID Message is transmitted automatically; but if desired the call sign could be programmed into any message location. The time is entered as multiples of 10 seconds.

Example: To set the Station ID timer for 10 minutes:

*1 (tone) 6 (tone) 060 (tone)

6.5 SOFTWARE SWITCHES

The Programming Codes starting with "*5" are actually switches that are turned on if the function is desired or off if the function is not wanted. The format used is:

*5	NN	X	
		_____	"1" to turn the function on.
			"0" to turn the function off.
	_____		This is the two digit number which identifies
			the function switch.
_____			This is used for all function switch changes.

Check the examples for each of the following codes.

6.5.1 Toll Restrictions (*5 00 through *5 11)

If you wish to restrict all users, except those who know the Special Connect Code (*7 1) from making toll calls, then program these restrictions. Attempted dialing of a toll restricted telephone number will result in the Error Message being transmitted, and then immediate disconnect.

For toll restriction to be active, software switch *5 33 should be turned on.

To program the toll restrictions you first need to determine what numerals dialed as either the first or second digit of a telephone number would result in a toll call. In most areas of the United States, toll calls start with the number "1". In areas where the area code can be dialed, the second number of the area code will be a "0" or a "1". The number "9" should also be considered for restriction because there is usually a charge to call numbers starting with "900" and "976".

When programming you will "Flag" these numerals as restricted numerals. You then program the unit to check for these "flagged" numerals in either the first, second, or both positions of the dialed number (using switches 15 and 16). Use the table on the following page to "Flag" the numerals.

NUMBERS TO		BE RESTRICTED *5		
		ON	OFF	
*5	06	1	0	NUMBER 1
*5	05	1	0	NUMBER 2
*5	04	1	0	NUMBER 3
*5	03	1	0	NUMBER 4
*5	02	1	0	NUMBER 5
*5	01	1	0	NUMBER 6
*5	00	1	0	NUMBER 7
*5	10	1	0	NUMBER 8
*5	11	1	0	NUMBER 9
*5	07	1	0	NUMBER 0

Example: To have the numeral "1" toll restricted enter the following sequence:

*5 (tone) 06 (tone) 1 (tone)

To have the numeral "9" restricted enter this sequence:

*5 (tone) 11 (tone) 1 (tone)

Restricted Digits (*5 15,16)

Numbers which were flagged by the switches 00 through 11 will be restricted as the first dialed digit by using Program Code "*5 15". Use Code "*5 16" for the second dialed digit.

Restrict	Program	
From	Sequence	
First digit	ON	"*5 15 1"
First digit	OFF	"*5 15 0"
Second digit	ON	"*5 16 1"
Second digit	OFF	"*5 16 0"

Example: To restrict the "flagged" numerals from being the first digit dialed, but allow it as the second, enter this sequence:

*5 (tone) 15 (tone) 1 (tone)

*5 (tone) 16 (tone) 0 (tone)

6.5.2 Selective Signalling (*5 12)

This Program Code Enables DTMF selective signalling to the mobiles by "overdialing" a DTMF ANI code from the telephone. Auto Answer (*5 35) must also be turned on for this to work. The Interconnect will answer on the

programmed number of rings that it's set for. When the caller hears two short beeps the number of the mobile desired should be entered followed with the "#". The "#" is used to terminate the mobile ANI number and isn't sent out as part of the signalling.

If this switch is turned off, and Auto Answer is on, the interconnect will still answer a call to allow remote programming, but won't allow signalling.

(Also set *5 switchs 30, 31, 41 and 42)

* 5 (tone) 12 (tone) 1 (tone) ;allow signalling
* 5 (tone) 12 (tone) 0 (tone) ;disallow signalling

6.5.3 "*" Reset of The Cali Limit Timer 1*5 13)

If turned on, this switch enables the mobile operator to reset the Call Limit Timer by transmitting the "*" tone. If turned off, the interconnect will time out after the time specified in the Call Limit Timer (*1 4).

*5 (tone) 13 (tone) 1 (tone) ;allow reset
*5 (tone) 13 (tone) 0 (tone) ;disallow reset

6.5.4 Simplex Enable (*5 14)

This function enables the simplex use of the interconnect. If simplex use is desired, turn this function on and turn *5 36 off. See section 6.2.1 for minimum requirements to enable the simplex mode.

* 5 (tone) 14 (tone) 1 (tone) ;enable simplex
* 5 (tone) 14 (tone) 0 (tone) ;disable simplex

6.5.5 Toll Restrict On The 1st Dialed digit (*5 15)

If the restricted numbers set by *5 00-11 are to apply to the first dialed digit, then turn this switch on. If any number designated as a restricted digit is dialed as the first digit of the phone number, then the interconnect will disconnect and send the Error Message.

*5 (tone) 15 (tone) 1 (tone) ;restrict 1st digit
*5 (tone) 15 (tone) 0 (tone) ;don't restrict

6.5.6 Toll Restrict On The 2nd Dialed digit (*5 16)

If the restricted numbers set by *5 00-11 are to apply to the second dialed digit, then turn this switch on. If any number designated as a restricted digit is dialed as the second digit of the phone number, then the interconnect will disconnect and send the Error Message.

```
*5 (tone) 16 (tone) 1 (tone)      ;restrict 1st digit
*5 (tone) 16 (tone) 0 (tone)      ;don't restrict
```

6.5.7 Tone To Pulse Dialing (*5 17)

This Program Code enables or disables tone to pulse dialing. Pulse dialing would be used wherever the local telephone company does not offer DTMF circuits to the interconnect location. Pulse Dialing can also be used on DTMF circuits to increase the reliability of dialing out from the mobile. If pulse dialing is used on a DTMF line, then switch *5 40 should be turned on also to keep the central office from detecting DTMF tones between pulses.

```
*5 (tone) 17 (tone) 1 (tone)      ;Pulse Dialing
*5 (tone) 17 (tone) 0 (tone)      ;DTMF Tone Dialing
```

6.5.8 Toll Restriction Override (*5 20)

This code allows the use of the Special Connect Code (*7 1) to defeat toll restriction for one call. After the call, the programmed toll restrictions are automatically rearmed. If this switch is turned off the toll restrictions will apply to all calls. See the "Special Connect Code" for details on it's use.

```
*5 (tone) 20 (tone) 1 (tone)      ;allow toll defeat
*5 (tone) 20 (tone) 0 (tone)      ;no toll calls
```

6.5.9 Single digit "*" Connect Code (*5 21)

This switch overrides the Connect Code so that it's only necessary to transmit the "*" tone to access the interconnect. If this switch is turned off, then "*" plus the two digits programmed into *7 0 are used to access the interconnect.

Note that using a single "*" for access to the interconnect, disables the use of all the mobile controlled options programmed with *7.

To enable or disable the single "*" Connect Code this function is turned on or off as follows:

```
*5 (tone) 21 (tone) 1 (tone)      ;single "*" connect
*5 (tone) 21 (tone) 0 (tone)      ;Connect Code required
```

6.5.10 Single digit "#" Disconnect (*5 22)

This switch overrides the Disconnect Code so that it's only necessary to transmit the "#" tone to disconnect the interconnect. If this switch is turned off, then "#" plus the two digits programmed into *7 0 are used to disconnect

the interconnect. To enable or disable the single "#" disconnect, this function is turned on or off as follows:

```
* 5 (tone) 22 (tone) 1 (tone) ;single "#" disconnect
* 5 (tone) 22 (tone) 0 (tone) ;Disconnect Code
```

6.5.11 Sample Rate Multiplier (*5 23, 24)

Switches 23 and 24 have a dual function. See below for duplex use of these switches.

When the SDI-50 is used in simplex mode, the VOX circuit monitors telephone audio and modifies the sample rate to reduce the interruptions in transmission and determine the optimum sample time. When phone line audio ceases, the sample rate returns to the programmed rate. On the initial connect, dial tone audio is ignored and the sample rate will be at the programmed rate. After dialing, the Model SDI-50 will begin responding to telephone line audio and decreasing the sample rate.

The sample rate will automatically be slowed down to provide less interruptions in the phone line audio. When turned on, switch 23 will multiply the sample rate by two, switch 24 multiplies it by four, and with both on, the rate is multiplied by eight.

23	24	Change to Sample
off	off	no sample rate change
on	off	rate change is X2
off	on	rate change is X4
on	on	rate change is X8

Example: The sample rate has been set to one sample per second and it is desired that it be once every two seconds when phone line audio is present. Enter the following:

```
*5(tone) 23(tone) 1(tone) ;turn on X2
*5(tone) 24(tone) 0(tone) ;turn off X4
```

6.5.12 Repeat Enable (*5 23)

For duplex use only. This switch allows receive audio to be repeated for mobile to mobile communication. This is most useful when the SDI-50 is connected to two separate radios and used as a repeater.

```
*5 (tone) 23 (tone) 1 (tone) ;enable repeat audio
*5 (tone) 23 (tone) 0 (tone) ;disable repeat audio
```

6.5.13 Courtesy Beep (*5 24)

When the SDI-50 is set up for Repeater Operation it can be programmed to generate a "Courtesy Beep" one second after the end of each transmission. This tone is useful for prompting the other party to begin speaking. Program this function as follows:

```
*5 (tone) 24 (tone) 1 (tone) ;courtesy beep
*5 (tone) 24 (tone) 0 (tone) ;no courtesy beep
```

6.5.14 Ring Counter (*5 25,26)

When the interconnect is set to automatically answer an inbound telephone call, it will answer on the 1st, 2nd, 4th, or 8th ring by setting these switches. Use the table that follows to set the ring counter to the desired number of rings.

<u>25</u>	<u>26</u>	<u>Ring Count</u>
off	off	1st ring
on	off	2nd ring
off	on	4th ring
on	on	8th ring

Example: To answer on 2nd ring enter a "1" for switch *5 25; and a "0" for switch *5 26.

```
*5 (tone) 25 (tone) 1 (tone)
*5 (tone) 26 (tone) 0 (tone)
```

6.5.15 Interconnect Enable (*5 27)

This enables or disables the interconnect function without affecting the repeater control function (if used). With this switch turned off, no interconnect calls are allowed. This differs from the function 7 4 in that it isn't under mobile control for a temporary state.

```
*5 (tone) 27 (tone) 1 (tone) ;interconnect enabled
*5 (tone) 27 (tone) 0 (tone) ;interconnect disabled
```

6.5.16 Mobile Signalling Wait Time (*5 30,31)

When selective signalling is used to call a mobile, these switches set the length of time the interconnect will wait for the mobile to answer before disconnecting the land line.

<u>30</u>	<u>31</u>	<u>Wait Time</u>
off	off	15 seconds
on	off	30 seconds
off	on	45 seconds
on	on	60 seconds

Example: To program a 30 second wait time enter a "1" and "0" for switches 30, and 31.

*5 (tone) 30 (tone) 1 (tone)
*5 (tone) 31 (tone) 0 (tone)

6.5.17 Ring Out (*5 32)

When a landline call comes into the interconnect, it will key the transmitter and send out the Error/Signal Message to notify the mobiles that a call is coming in. The ring-out will occur each time the SDI-50 senses the ring voltage on the phone line, up to the point that the interconnect answers if the Auto-Answer feature is on. The Ring Count (switches *5 25 and *5 26) should also be set if Auto-Answer is used.

During the global ring out, any mobile may answer by using the global Connect Code (switch *7 0). If no mobile answers before the interconnect answers the call, selective signalling may still be done as normal, if this feature is also turned on. However, only the called mobile may answer.

Ring Out may be turned off if only selective signalling is desired, or if its desired that the interconnect be dedicated to mobile to landline calls.

For the interconnect to continuously ring out; until either a mobile answers or the land line caller hangs up, Ring Out (switch *5 32) must be turned on, and Auto Answer (switch *5 35) must be turned off.

For example: If Ring Out and Auto Answer are enabled, and switches 25 and 26 are set for 8 rings, the ringout will occur 7 times before the SDI-50 answers.

*5 (tone) 32 (tone) 1 (tone) ;ring out enabled
*5 (tone) 32 (tone) 0 (tone) ;ring out disabled

6.5.18 Toll Restrict Enable (*5 33)

The toll restriction parameters are set using switches *5 00 through 11, 15 and 16. These switches only define the way toll restriction will work. Switch 33 is used to activate toll restriction. Toll restriction may be temporarily turned off then back on with this switch instead of changing all switches pertaining to toll restrict.

*5 (tone) 33 (tone) 1 (tone) ;toll restrict enabled
*5 (tone) 33 (tone) 0 (tone) ;toll restrict disabled

6.5.19 Automatic CW ID (*5 34)

When Automatic CW ID is turned on, the interconnect will automatically send the ID Message at programmed intervals only when the interconnect sees activity. If the ID interval has elapsed, the SDI-50 will automatically send the ID message the next time it sees activity on the channel. If this function is turned on, you must also program the Station ID in the ID Message area (*9 4), and the ID Interval (*1 6).

*5 (tone) 34 (tone) 1 (tone) ;enable CW ID
*5 (tone) 34 (tone) 0 (tone) ;disable CW ID

6.5.20 Auto Answer (*5 35)

Auto Answer allows the interconnect to automatically answer an incoming call from the phone. The Auto-Answer provides three separate functions:

- a. Land line to mobile selective signaling
- b. Dial up remote control
- c. Remote programming capability.

When auto answer is turned on, remote control and remote programming are always active while selective signaling and Ring Out may be turned on or off. If auto answer is off, then the interconnect will signal the mobile and wait for the mobile to send the connect code before the call is answered.

* 5 (tone) 35 (tone) 1 (tone) ;enable auto answer
* 5 (tone) 35 (tone) 0 (tone) ;disable auto answer

6.5.21 Half/Full Duplex Enable (*5 36)

For duplex operation. This function must be turned on for the SDI-50 to operate in a half or full duplex mode. Also see the minimum programming requirements for duplex operation in section 6.2.2.

*5 (tone) 36 (tone) 1 (tone) ;duplex mode
*5 (tone) 36 (tone) 0 (tone) ;simplex mode

6.5.22 Repeat Enable (*5 37)

For duplex operation. This function provides PTT logic to the transmitter whenever the SDI-50 detects mobile carrier so that receive audio is retransmitted. This function works independently of the Interconnect Enable Code, and can be used to provide mobile to mobile repeater service when the interconnect is disabled. Two timers are also provided; PTT hang time (*1 3), and repeater time out (*1 2). With this feature, two radios can be used as a

repeater. The repeater function can be turned on or off from the mobile with the Repeater Enable Code (*7 5).

*5 (tone) 37 (tone) 1 (tone) ;repeat path & PTT
*5 (tone) 37 (tone) 0 (tone) ;no repeat path

6.5.23 Mute on Pulse Dialing (*5 40)

This switch mutes receive audio into the phone line when the mobile first originates a call. If the interconnect is going to be used in the pulse dialing mode, then this switch may need to be turned on. Some exchanges will accept both Tone or Pulse dialing. Allowing the DTMF tone to be interrupted by the pulses will cause unreliable dialing. The mobile's carrier is monitored to determine when dialing is completed and un-mute the Receive Audio.

*5 (tone) 40 (tone) 1 (tone) ;mute is enabled
*5 (tone) 40 (tone) 0 (tone) ;no muting

6.5.24 Begin Outdial with Star (*) (*5 41)

When selective signalling is used, some systems may require a "*" tone to be sent before the mobile ID number. If this switch is turned on, the SDI-50 will automatically insert a "*" before the overdialed mobile number.

5 (tone) 41 (tone) 1 (tone) ;include a leading ""
*5 (tone) 41 (tone) 0 (tone) ;number sent as dialed

6.5.25 Begin Outdial with Pound (#) (*5 42)

When selective signalling is used, some systems may require a "#" tone to be sent before the mobile ID number. If this switch is turned on, the SDI-50 will automatically insert a "#" before the overdialed mobile number.

*5 (tone) 42 (tone) 1 (tone) ;include a leading "#"
*5 (tone) 42 (tone) 0 (tone) ;number sent as dialed

6.5.26 Phone in Use (*5 44)

Normally the interconnect won't allow a mobile to break into an existing phone conversation (with JMP1 in place). If the line is in use, the mobile operator will receive the Error Message when access is attempted. This switch will allow mobiles to brake into an existing call on the phone line only if the Special Connect Code is sent along with the normal Connect Code.

*5 (tone) 44 (tone) 1 (tone) ;allow access w/"SCC".
 *5 (tone) 44 (tone) 0 (tone) ;Error if line is busy.

6.5.27 DTMF Regenerate (*5 47)

This switch causes DTMF regeneration into the phone line when the mobile first originales a call. Often weak signais may not be adequate for the central office to decode. The mobile's carrier is monitored to determine when dialing is completed and regeneration stops.

*5 (tone) 47 (tone) 1 (tone) ;DTMF regeneration
 *5 (tone) 47 (tone) 0 (tone) ;no regeneration

6.6 CONTROL CODES**6.6.1 Remote Programming Code (*6)**

When the Auto Answer function is on, the interconnect can be remotely programmed from the telephone line by entering the Remote Programming Code after the interconnect answers. This code can be 1 to 6 digits in length. If you try to enter more than six digits, only the first six will be recognized. Enter the desired digits for the code, terminated by a "#". The "#" is not considered to be part of the code, only a terminator when fewer than six digits are used for the code. Also, the "#", in this case will not take you out of programming mode. A second "#" is required to discontinue programming mode if you wish to do so after changing the Remote Programming Code.

Example: To chango the remote programming code
 to "56789":

*6 (tone) 5 6 7 8 9 # (tone)

6.6.2 Connect and Disconnect Codes (*7 0)

This code sets the global 2 digit Connect and Disconnect Code used to access and disconnect the interconnect when selective signalling is not used. This Program Code establishes two numerals that must always follow the "*" sign to connect, and

the "#" sign to disconnect (except when the single "*" or "#" is used - *5 21,22).

Example: To use "*89" as the global connect code and "#89" as the global disconnect code, enter:

*7 (tone) 0 (tone) 89 (tone)

6.6.3 Special Connect Code (*7 1)

This code has three features which modify the normal Connect Code sent by the mobile. Each is explained in it's own paragraph below. In all cases, the Special Connect Code is sent directly in front of the normal Connect Code. For example, using the factory settings for the two codes, the mobile operator would send "*37 *73" to utilize a Special Connect Code feature. Because the Special Connect Code starts with a "*", it isn't available when the single tone "*" is used as the normal Connect Code.

Toll Restriction Bypass - This code will allow users which know the Special Connect Code to defeat the programmed toll restrictions for one call only. Toll restriction is automatically rearmed for the next call upon disconnect. To enable Toll Restriction Defeat, switch *5 20 should be turned on. If a toll call override isn't desired turn *5 20 off.

Phone Line In Use Detector - This code will allow a mobile originated call to break into a call already in progress. This could be the case when the interconnect shares a line with an active phone. Switch *5 44 should be off if it is desired to prevent mobiles from breaking into calls. To interrupt a call in progress only when the Special Connect Code is sent, turn switch *5 44 is on. Note that if jumper JMP1 is cut, all mobile calls will break into a call in progress, even without the Special Connect Code.

The Special Connect Code controls the two outputs "CTRL 1" and "CTRL 2". See the section describing these outputs for more information on them.

Program this exactly as the Connect Code in *7 0. To program 38 as the Special Connect Code, enter:

*7 (tone) 1 (tone) 38 (tone)

6.6.4 Functions (*7 2,3)

The control Function outputs are available at the back connector TB1-17 and TB1-18. These Functions have no predetermined use in the SDI-50's normal operation and are provided for customized applications. These Functions can be turned ON and OFF by DTMF command from the mobile operator. To use these Control Function

outputs a line should be run to an external transistor for switching. Since the function outputs pulse once per second, an electrolytic capacitor of some value should be tied to the transistor bases, to smooth the pulses.

Because the codos to control these functions require a leading "*", they may not be used when the interconnect is set for "*" only connect.

6.6.5 Interconnect Enable (*7 4)

This code is used in conjunction with Program Code *5 27. Code *5 27 configures the SDI-50 to be capable of interconnecting calls. This Control Code enables the system operator to remotely turn the interconnection capability On and Off from the telephone by using DTMF tones.

6.6.6 Repeater Enable (*7 5)

This code is used in conjunction with Program Code *5 23. Code *5 23 configures the interconnect to enable a repeat audio path when a telephone call is not being processed. This Control Code enables the system operator to to remotely turn the repeat capability On and Off from a the telephone using DTMF tones.

6.6.7 Dial-up Remote Code (*8)

The Dial-Up-Remote feature is always active when auto answer is on. There is a programmable Dial-up Remote Code that must be dialed after auto answer beep to access the radio transmitter and receiver. After entering this code, all phone audio is transmitted to the mobiles and all received audio is passed into the phone. This code can. be 1 to 6 digits in length. If you try to enter more than 6 digits the first six will be the Dial-up Remote Code. Enter the desired digits terminated by a "#". The "#" is not counted as part of the Dial-up Remote Code.

Example: To program a Dial-up Remote Code of 9654 enter the following: *8 (tone) 9654# (tone)

6.7 MESSAGES

Five separate user programmable Morse Code Messages are available in the CES SDI-50 to help establish the status of the interconnect. These are:

Connect Message (*9 0) - This message is sent each time a mobile operator sends the Connect Code to access the interconnect, whether to answer an incoming call or to originate a call.

Disconnect Message (*9 1) - This message is sent each time the SDI-50 is disconnected by the mobile operator.

Time Out Message (*9 2) - The time out message is sent if the Call Limit Timer or the Mobile Activity Timer has expired and the SDI-50 originates the disconnect.

Error/Signal Message (*9 3) - The Error/Signal Message is sent on two different occurrences:

> Signalling: It alerts the mobile operator of an incoming land line call. The SDI-50 will send the Error Message each time it detects ring voltage on the phone line. If the message programmed into the Error Message area is longer than four or five seconds in duration (the interval between rings), then the message will be sent on every other ring detected.

> Error: This Message is used to indicate to the mobile operator of an error in accessing the interconnect. For example, this condition exists when a mobile operator tries to dial a restricted phone number, or during programming if an invalid program code is entered.

NOTE: Never remove the Error Message. This Message is essential to inform the operator of several functions and error conditions during use and programming; thus, a programmed message should always be present. It's characters may be changed, but do not remove them all.

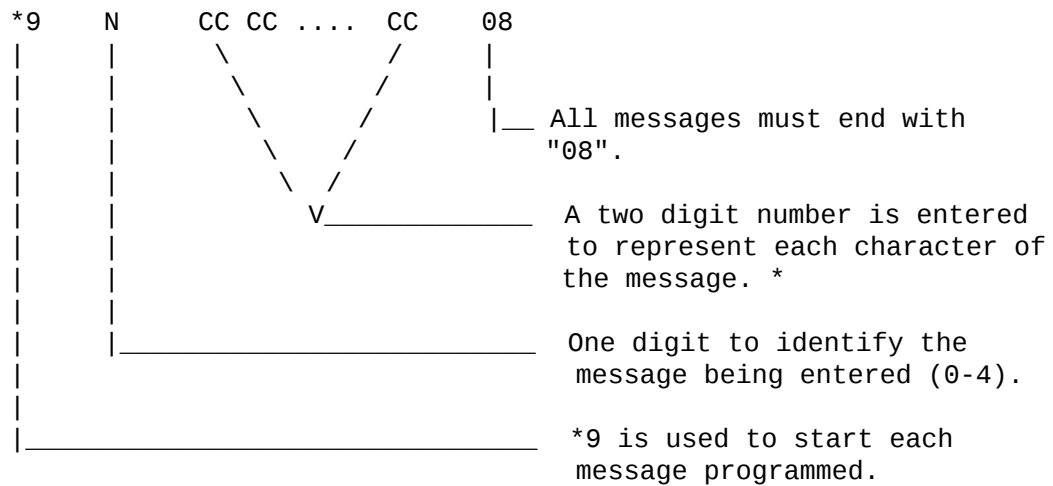
Station I.D. Message (*9 4) - The Station I.D. Message is sent each time the Station Identification Interval Timer (*1 6) has elapsed. It is only sent when carrier activity is seen on the channel. If the I.D. timer times out during a period of inactivity, the I.D. message will be sent upon the next occurrence of mobile activity.

All Messages are limited to eleven characters each and must be terminated with a stop bit ("08"). If an Message is removed, a stop bit ("08") must be entered in its place.

Example: To remove the Connect Message, enter *9
(tone) 0 (tone) 08 (tone)

Message's are programmed by selecting the two digit codes from the "Message Programming Table" which represents the alpha numeric characters used in the message.

The format for programming all messages is:



* - A beep tone will be sent by the SDI-50 between each two digit character number as they are entered.

Example: To program "OFF" in the disconnect Message enter the following: *9 (tone) 1 (tone) 63 (tone) 33 (tone) 33 (tone) 08 (tone).

Remember, when programuning the Message's not to forget the enter the stop bit; "08"

6.7.1

MESSAGE PROGRAMMING TABLE

CHAR.	CODE	CHAR.	CODE	CHAR.	CODE
0	00	I	43	A	37
1	10	J	51	A	38
2	20	K	52	E	39
3	30	L	53	U	47
4	40	M	61	N	44
5	50	N	62	O	45
6	60	O	63	CH	35
7	70	P	71	AR	07
8	80	Q	02	ERROR	48
9	90	R	72	,	16
A	21	S	73	-	66
B	22	T	81	.	46
C	23	U	82	/	36
D	31	V	83	?	94
E	32	W	91	SP ERROR	96
F	33	X	92	SPACE	05
G	41	Y	93	STOP	08
H	42	Z	03		

OPERATING THE SDI-50 AS A REPEATER CONTROLLER

The SDI-50 can be configured to function as a repeater controller when wired to a full duplex base station, separate transmitter and receiver, or an existing repeater. The SDI-50 will control the transmitter with programmable hangtime and timeout functions. The repeat audio path provides internal squelching, subaudible tone filtering, automatic gain control, and courtesy tone if desired. There is also a provision for CTCSS control. A programmable Morse code station identifier is provided specifically for this mode. If a telephone line is available, the interconnect or phone patch mode can also be used to take full advantage of all features included with the unit.

7.1 INSTALLATION AND SET UP

Installation as a repeater controller is essentially the same as with the duplex installation. The main exception is that a single transceiver generally can not be used. A transceiver that is capable of full duplex operation, or has been modified to so that the transmitter and receiver work independently of each other will usually work. Two transceivers may be used by making the appropriate connections to each.

Before adjustments can be made, all connections to the associated radios must be complete, and the repeat mode enabled. See section 6.2.2 to enable the repeat mode. However, before enabling the repeat mode you must make sure that the "Mobile Detect" LED is functioning properly. This is critical to any operation of the SDI-50 if noise squelch is to be used. Refer to the NOISE CONTROL level adjustment to make any necessary changes to the Noise Control R91.

If CTCSS is desired, a connection to a sub audible tone decoder or repeater tone panel will be necessary. See CTCSS control in section 4.1.8 for configuration of JMP6 and threshold adjustment. Once you have made the adjustments and established that the front panel "Mobile Detect" LED is functioning properly (normally extinguished; illuminated when a mobile is detected), programming changes and the final adjustments can begin. There are some repeater mode parameters to be programmed which should be set as in section 6.2.2.

There is one other audio level adjustment necessary for repeater operation. This is the Repeat Audio Level; R61. Adjust the repeat audio level as in the Level Adjustments in section 5.6.

SDI-50 PROGRAMMING LOG

PROGRAM CODE	DESCRIPTION	FACTORY SETTING	CHANGED TO
*1	<u>TIMERS</u>	<u>TIME</u>	
0	Sample Rate (Simplex)	1 sec.	_____
1	Sample Window (Simplex)	60 ms.	_____
2	Repeater Time Out Timer (Dúplex)	7 min.	_____
3	Repeater Hang Time (Dúplex)	2 ms.	_____
4	Call Limit Timer	3 min.	_____
5	Mobile Activity Timer	20 sec.	_____
6	I.D. Interval Timer	10 min.	_____
*5	<u>SOFTWARE SWITCHES</u>	<u>SETTING</u>	
00	Toll restrict on number 7	off	_____
01	Toll restrict on number 6	off	_____
02	Toll restrict on number 5	off	_____
03	Toll restrict on number 4	off	_____
04	Toll restrict on number 3	off	_____
05	Toll restrict on number 2	off	_____
06	Toll restrict on number 1	on	_____
07	Toll restrict on number 0	on	_____
10	Toll restrict on number 8	off	_____
11	Toll restrict on number 9	off	_____
12	Selectivo Signaling	on	_____
13	"" Call Limit Reset	on	_____
14	Simplex enable (note 1) (simplex)	off	_____
15	Toll restrict on 1st digit (note 2)	on	_____
16	Toll restrict on 2nd digit	on	_____
17	Pulse dialing	off	_____
20	Toll Restriction Override	on	_____
21	Single digit "" connect	off	_____
22	single digit "#" disconnect	on	_____
23	2X Sample Rate (note 2) (Simplex)	off	_____
24	4X Sample Rate (Simplex)	off	_____
23	Repeat enable (note 1) (Duplex)	on	_____
24	Courtesy Beep Enable (Duplex)	off	_____
25	Answer on 1,2,4 or 8 rings (note 2)	on	_____
26	Used Together With #25.	off	_____
27	Interconnect enable	on	_____
30	Mobile Signalling Wait Time (note 2)	on	_____
31	Used Together With Code #30	off	_____
32	Ringout enable	on	_____
33	Toll restrict	on	_____
34	Auto I.D.	on	_____
35	Auto answer	off	_____
36	Half/Full Dúplex Enable	on	_____
37	Repeat Enable	on	_____

PROGRAM CODE	DESCRIPTION	FACTORY SETTING		CHANGED TO
40	Mute on Pulse Dial	on		_____
41	Begin Overdial w/"*"	off		_____
42	Begin Overdial w/"#"	off		_____
43	Phone in Use	on		_____
47	DTMF Regenerate	on		_____
*6	<u>Remote programming code</u>	<u>975310#</u>		
*7	<u>Control Codes</u>			
0	Connect/Disconnect Codes	*73/#73		_____
1	Special Connect Code	*37		_____
		ON	OFF	
2	Control Function #1 Code	*14	*04	_____
3	Control Function #2 code	*25	*15	_____
4	Interconnect Enable Code	*36	*26	_____
5	Repeat Enable Code	*38	*28	_____
*8	<u>Dial-up Remote Code</u>	8421#		_____
*9	<u>Messages</u>			
0	Connect Message	"ON"		_____
1	Disconnect Message	"OFF"		_____
2	Time out Message	"TO"		_____
3	Error/Signal Message	"EEEEEEEE"		_____
4	Station I.D. Message	"RING"		_____

Note 1 - For repeater operation, *5 23 should be turned on and *5 14 should be turned off. When *5 14 is on, the patch is in simplex mode and *5 23, and *5 24 are used to modify the sample rate.

Note 2 - This is a two part switch. The following switch number must also be set. Refer to the section in the manual for more detail on setting these.

Note 3 - Switches 23 and 24 have different uses for simplex and duplex operation. If switch 14 is on and 36 is off, then 23 and 24 are used to adjust the sample rate for simplex use. If 14 is off, and 36 is on, then 23 is used for "Repeat Enable" and 24 is for "Courtesy Beep" during duplex use.

NOTES: _____

MODEL SDI-50 CIRCUIT DESCRIPTION

9.1 GENERAL DESCRIPTION

The CES Model SDI-50 consists of a microcomputer digital circuit system, and an analog circuit system. These two systems are separated on the circuit board, and have separate ground returns in order to minimize cross talk. The Model SDI-50 is totally controlled by the microcomputer program memory.

9.1.1 Microcomputer Control System

The CES SDI-50 is controlled by the Microcomputer chip U1. All operating parameters are controlled by the microcomputer program memory and are executed by U1.

9.1.2 Customer Programmable Memory

All customer programmable parameters are stored in Electrical Erasable Proms U3 and U4 (if equipped). These CMOS chips are 4096 bit serial prom, internally organized as two 256 x 8 pages. Data retention is specified to be greater than 100 years.

9.1.3 DTMF Encoding and Decoding

DTMF encoding and decoding is done by the DTMF Encoder-Decoder circuit, U2. This microprocessor controlled peripheral generates and decodes all 16 DTMF digits. DTMF data is passed to and from U2 via the audio circuits and the Microprocessor Control System. The Analog Switches control the path of encoding and decoding in the Model SDI-50 depending on its current state of operation. DTMF encoding signals are generated on pin 8. This chip also contains a call Progress Tone Detector. Pin 13 provides an output that is fed into the Microprocessor for call progress tone detection. LED CR9 is a DTMF strobe that flashes when the decoder has received a DTMF signal.

9.1.4 Power Supply

The Primary Power Supply for the Model SDI-50 consists of 5.0 volt regulators, U7 and U8. Regulator U7 is used to power the Microcomputer and the digital ICs. U8, which is also a 5.0 volt regulator, is used to power the Analog System in Model SDI-50. Separate power supplies are used to provide isolation between the two systems. The inputs to these regulators are connected together, and receive power from an external 12.0 volt power supply.

9.1.5 Power on Reset

The Model SDI-50 has a "Power on Reset" circuit to monitor the input voltage to the Model SDI-50, and provides a "Reset" pulse to the Microcomputer Control System in the

event there is a voltage drop to maintain system integrity. This function is provided by CR1, Q1, and Q3.

9.1.6 Watch Dog Timer

The parts consisting of Q2 and U5 form a missing pulse detector. Both halves of U5 are re-triggerable one shots. During normal operation, U1 constantly sends pulses to U5 to keep it from timing out. If for any reason the first half of U5 isn't re-triggered before its time-out time (set by the time constant of C1 and R1), it will in turn trigger the second half of U5 which will cause a reset to the microcomputer.

9.1.7 Telephone Line Circuit

The telephone line is connected directly to the back of the Model SDI-50 via a cable equipped with RJ11-C connectors. A ring detector (U10) provides a square wave output at the ring voltage frequency to Q8. This 20 to 40 Hz signal is filtered at the gate of Q8 to provide a single pulse for each ring to the microcomputer.

U11, Q9, and Q10 detect an "off hook" condition on the telephone line. Q12, Q13, Q14 and diodes CR18 through CR21 provide an electronic holding coil to sink off hook current. Line transformer TI couples telephone and radio audio. This single transformer provides 35dB of isolation as a full duplex hybrid.

Audio from the radio receiver is filtered by a high pass filter, U17, that removes frequencies below 300 Hz. The level of audio is adjusted by R60 and is de-emphasized by U13. Receive audio is then amplified and directed into the hybrid by U16. Where de-emphasis of RX audio is required, JMP2 is installed, which places C31 into the feedback path of U13.

Audio from the phone line is amplified and limited by U15. The level to the transmitter is controlled by R75 and is then amplified and buffered by U13.

Repeat audio level is controlled by R61 and returned to the transmitter by U13.

9.1.8 VOX Detect Circuit

U15 amplifies telephone line audio and drives a detector network that gives a peak DC reading on the amount of audio set by R99. This DC voltage is fed to comparator U19 which provides a logic level output to the microcomputer.

9.1.9 Noise Circuit

The noise circuit consists of U16 and U18. Audio from the receiver is coupled to U16, which is a high pass filter with cutoff of 8 KHz. This filter eliminates all voice signals and allows the noise circuit to monitor channel

noise only. The level of noise on the radio channel indicates the presence or absence of an RF carrier. The noise level is adjusted by R91 and sent to a network that gives a peak DC reading of the amount of noise on the channel. This signal is sent to a comparator (half of U18) that provides a logic level signal to the microcomputer.

9.1.10 CTCSS Level Comparator

U17 is a comparator with adjustable threshold (set by R45) which is used to convert the DC voltage from the radio decode circuit to the proper logic level for the microcomputer.