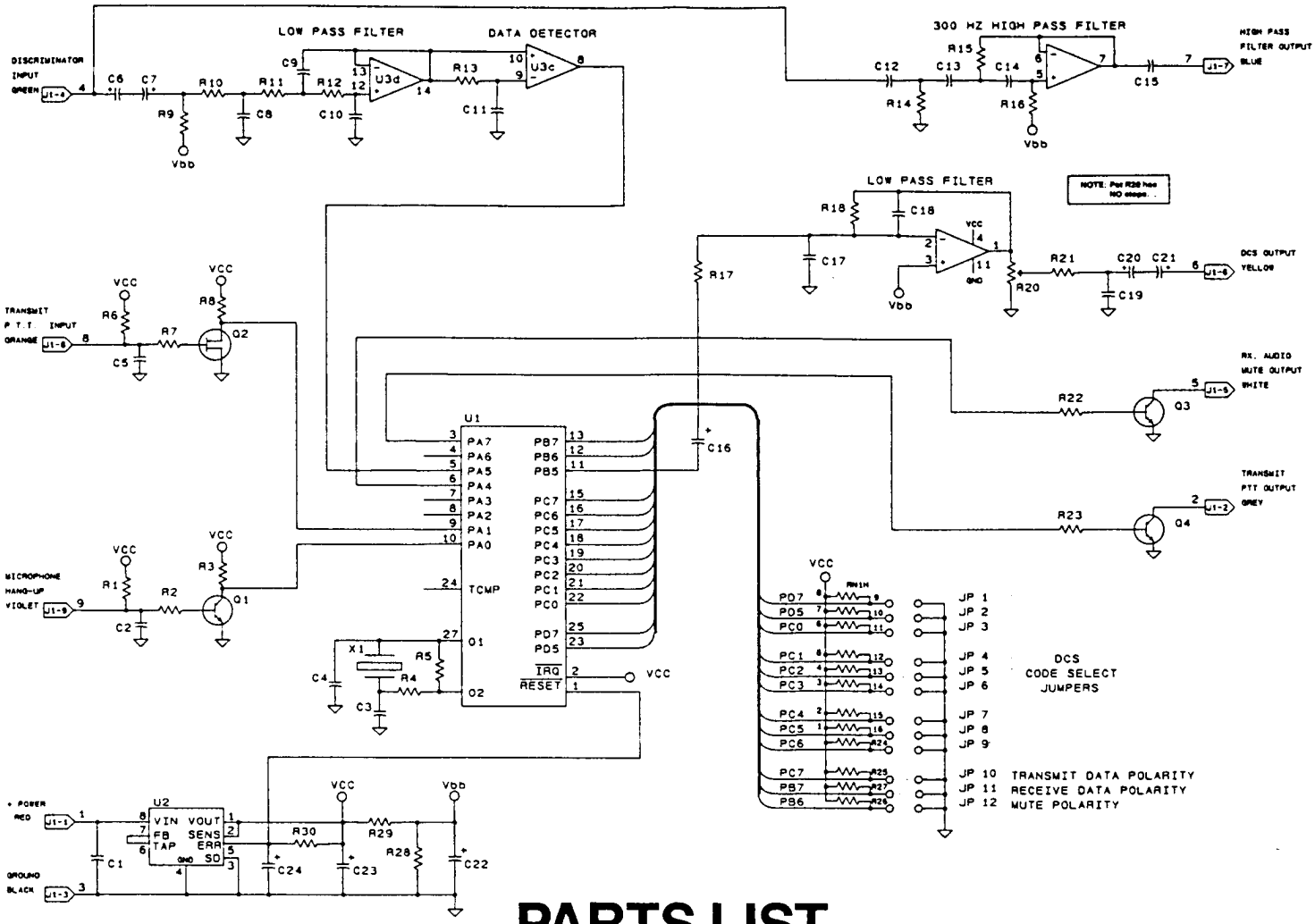
DCS-23 INSTRUCTION SHEET



PARTS LIST

DESIG.	CSI NO.	DESCRIPTION	PRICE
U1	51-6805	CMOS Microprocessor	15.50 ea.
U2	48-2951	LP2951CM Low Dropout 5V Regulator	2.85 ea.
U3	51-0064	TL064CD Quad OP Amp (SGS only)	1.35 ea.
Q1,Q3	48-4200	MMBTA42LT1 NPN H.V. Transistor	.28 ea.
Q2	48-7002	2N7002LT1 TMOS FET Transistor	1.02 ea.
Q4	48-0056	BCX56 NPN SOT-89 Transistor	.80 ea.
X1	48-3835	3.579 MHz Crystal	1.80 ea.
C20, C21	19-1066	10µf-16V Chip Tant. Capacitor	.87 ea.
C22	19-6826	6.8µf-4V Chip Tant. Capacitor	.84 ea.
C6,C7,C16, C23,C24	19-1056	1µf-20V Chip Tant. Capacitor	.78 ea.
C1,C9, C11,C15	22-1040	.1µf X7R 1206 Chip Capacitor	.25 ea.
C8,C17	22-1030	.01µf X7R 0805 Chip Capacitor	.25 ea.
C12,C13, C14	22-4720	4700pf X7R 0805 Chip Capacitor	.25 ea.
C18	22-3320	3300pf X7R 0805 Chip Capacitor	.25 ea.
C2,C5, C10,C19	22-1510	150pf NPO 0805 Chip Capacitor	.25 ea.
C3,C4	22-2200	22pf NPO 0805 Chip Capacitor	.25 ea.
R21,R23	06-2226	2.2K 5% 0805 Chip Resistor	.10 ea.
R15	06-3626	3.6K 5% 0805 Chip Resistor	.10 ea.
R22,R28, R29	06-6826	6.8K 5% 0805 Chip Resistor	.10 ea.
R1,R2, R4,R7	06-1036	10K 5% 0805 Chip Resistor	.10 ea.
R14	06-3336	33K 5% 0805 Chip Resistor	.10 ea.
R3,R8, R24-R27	06-4736	47K 5% 0805 Chip Resistor	.10 ea.
R6,R19	06-1546	150K 5% 0805 Chip Resistor	.10 ea.
R18,R30	06-2446	240K 5% 0805 Chip Resistor	.10 ea.
R9,R10, R11,R12	06-3046	300K 5% 0805 Chip Resistor	.10 ea.
R17	06-3946	390K 5% 0805 Chip Resistor	.10 ea.
R13	06-8246	820K 5% 0805 Chip Resistor	.10 ea.
R5,R16	06-2756	2.7Meg 5% 0805 Chip Resistor	.10 ea.
R20	18-4720	5K 3MM Chip Trimmer Pot	.72 ea.
RN1	51-1215	47K x 8 Resistor Network	.75 ea.
J1	09-8717	9 Pin Sub-Miniature Header	.87 ea.
	01-1023	9 Pin Plug-In DCS-23 Cable	2.50 ea.
	84-1055	DCS-23 PCB	7.10 ea.
	68-2082	DCS-23 Instruction Sheet	.50 ea.
	75-1002	Double Sided Tape Squares	.05 ea.
	56-1001	CSI Tuning Tool	.20 ea.

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

MODEL DCS-23
MINIATURE DIGITAL CODED SQUELCH ENCODER-DECODER

The Communications Specialists Model DCS-23 Miniature Digital Coded Squelch Encoder-Decoder is a microprocessor based product used for encoding and decoding the DCS 23 bit digital coded word. The DCS-23 is compatible with digital coded squelch systems used in land mobile radio such as 'Digital Private Line,' 'Digital Channel Guard,' and 'Digital Quiet Channel.'

Because of its small size and low power consumption, advanced engineering has resulted in a product that is ideal for mobile and portable direct FM radio installations. Simple field programming by PCB jumper straps allows the radio service shop to configure the DCS code, as well as the DCS transmit and receive data polarity. One additional jumper strap configures the Receive Audio Mute Output polarity. Squelch tail elimination is achieved by the use of a 'turn off code' at the end of each transmission. An audio high pass filter eliminates the DCS signal from the recovered audio.

1.0 OPERATING INSTRUCTIONS

The DCS-23 is designed to encode and decode DCS transmissions in conjunction with an associated FM radio transceiver. Upon receipt of a DCS coded transmission, the DCS-23 will unmute the receive audio and allow audio to pass. While the DCS-23 is decoding, an internal timer keeps the audio path open for approximately 750 ms during a loss of signal due to signal fade. Upon receipt of the turn off code, the DCS-23 will immediately mute the receive audio thus eliminating the squelch tail that is usually heard at the end of a transmission. The Microphone Hang-up Input allows the operator to override the decoder and open up the audio path for monitoring at any time. A high pass filter in the DCS-23 filters out the DCS signal from the discriminator audio. If the DCS code jumpers are changed during receive, the new code will be immediately exchanged for the previous one.

When the PTT switch is keyed on the microphone, the DCS-23 will immediately begin generating the programmed DCS code for transmission. The DCS-23 will continue to generate the DCS code for as long as the PTT switch is pressed. Upon release of the PTT switch, the DCS-23 will continue to key the transmitter for approximately 180ms. During this time, the DCS-23 will generate a turn off code which will mute the decoding unit at the other end of the transmission medium. At the end of the 180 ms period, the DCS-23 will unkey the transmitter, and revert back to the receive mode. If the DCS code is changed while the PTT is keyed, the new code will not be sent until the PTT is unkeyed and re-keyed. A transmit code can be "inverted" immediately without re-keying the PTT.

2.0 INSTALLATION INSTRUCTIONS

Installation of the DCS-23 should be done by a qualified two-way radio technician. Installation consists of mounting the DCS-23 in the radio set, connecting the wires to their proper places within the radio, programming the jumper straps, and setting the DCS Output Level Adjustment. When installing the DCS-23 be careful not to twist or bend the printed circuit board as this can damage the surface mount components. In addition, use static protection techniques while handling the unit. Be sure that all power is removed before installing or programming the DCS-23. The following paragraphs describe each of the external connections on the DCS-23:

+POWER (RED) J1 Pin 1
This wire should be connected directly to a filtered source of continuous positive DC voltage in the range of +6.0VDC to +20.0VDC. This connection should be made "downstream" from the power switch, and the power supply filter components in the radio set. If a regulated source of DC voltage is available, it may be used. Using a quiet and stable source of DC voltage inside the radio set will reduce the possibility of picking up power supply noise.

GROUND (BLACK) J1 Pin 3
The Ground wire should be connected to a location inside the radio set which will supply a DC power ground return to the DCS-23. To eliminate ground loops and power supply noise, the ground return to the DCS-23 should be the same power supply ground used in the transmit or receive audio stages.

PTT INPUT (ORANGE) J1 Pin 8
PTT OUTPUT (GREY) J1 Pin 2
The PTT Input detects a transmit condition by sensing a 'pull to ground' on the PTT line of the radio set. This information is used by the DCS-23 to determine transmit and receive status. The PTT Output line is an open collector transistor that pulls to ground to key the transmitter during DCS transmission.

To install the PTT Input and PTT Output lines, cut the PTT line on the radio set at the microphone connector, and insert the PTT Input and PTT Output on the DCS-23 in series with the transmitter's PTT line. The DCS-23 will now control the transmit PTT line.

DCS OUTPUT (YELLOW) J1 Pin 6

> Please note that due to the low frequency response required for DCS transmission (less than 1 Hz), DCS signalling is only useable on a transmitter that utilizes a 'direct FM' modulator circuit. The use of DCS signalling on a 'phase modulated' transmitter is not recommended and can result in poor system operation.

This output generates the DCS encode signal. The most common place to connect this line is just prior to the modulation stage in the transmitter. Typical connections would be to the center of the deviation pot, to the varactor diode in the modulator circuit, or to the manufacturer's suggested connection point. The connection point for a DCS signal is usually the same point as that of a CTCSS encoder. This connection point can vary from radio to radio. Do not connect the DCS Output to the microphone input as the microphone audio stages will distort and attenuate the DCS signal.

Since the DCS Output on the DCS-23 is low impedance, you may have to install a series resistor to reduce the loading effects of the DCS Output depending on the interface impedance. This is evident in the case of connecting to the center of a 100K deviation pot. In this case, a 100K series resistor will compensate for the impedance difference. In addition, a slight adjustment of the voice deviation may be required to compensate for the DCS Output circuit loading.

RECEIVE AUDIO MUTE OUTPUT (WHITE) J1 Pin 5
This output is an open collector transistor that either pulls to ground to mute receive audio, or pulls to ground to open receive audio. The configuration is determined by the PCB jumper strap JP12 on the DCS-23 PCB that is described in the Programming Section of this instruction sheet. The Receive Audio Mute Output is usually connected to the collector of the 'squelch switch transistor' in the receiver. To find the correct connection point for the Receive Audio Mute Output, locate a point in the receiver squelch circuit that will either 'mute' or 'open' the receiver audio upon application of a ground potential. This will be the correct point for connection. Then configure JP12 for the correct audio mute polarity.

DISCRIMINATOR INPUT (GREEN) J1 Pin 4
This wire feeds the DCS decoder and the Audio High Pass Filter in the DCS-23. This connection MUST be made directly to the receiver discriminator output in the receiver. Please note that many discriminator circuits have a low pass filter on the discriminator output that consists of a small inductor and a capacitor. This filter network is used to attenuate very high frequency components. In the case where this network is used, the DCS-23 Discriminator Input should be connected AFTER this network. Connecting the Discriminator Input after any major audio processing circuitry in the receiver may distort and attenuate the DCS signal and produce unreliable decoding.

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

HIGH PASS FILTER OUTPUT (BLUE) J1 Pin 7
The High Pass Filter Output removes the DCS signal from the receiver discriminator audio so that the operator will not hear it. In many cases, the audio response of the receiver will not pass the DCS signal, and the High Pass Filter on the DCS-23 will not be required. In those cases where the High Pass Filter must be utilized, break the discriminator audio path in the receiver just after the point where the DCS-23 Discriminator Input was connected. Then install the High Pass Filter Output so that it is in series with the audio path in the receiver.

MICROPHONE HANG-UP INPUT (VIOLET) J1 Pin 9
This input is used to control the 'monitoring' function in the DCS-23. When this input is floating or above ground potential, the DCS-23 will be in the monitor mode, and will unmute the receiver audio. If this input is grounded, such as through a mic hang-up button, then the receiver audio will be muted. The audio path in the receiver will only be enabled upon receipt of the correct DCS code. Connect the Microphone Hang-up Input to the microphone hookswitch connection on the microphone jack.

2.1 ADJUSTMENTS

The DCS Output Adjustment, R20, is the only adjustment required on the DCS-23. This control sets the level of the DCS Output. A very small slotted alignment tool or supplied CSI tuning tool should be used to make the adjustment on the DCS-23 PCB. Please note that there are NO stops on the DCS output adjustment Pot R20.

A special DCS code, '777' should be used for adjusting the deviation level to the proper value. The DCS code '777' is enabled when the PCB jumper straps, JP1 through JP9 are all removed. To adjust the DCS Output level to the correct deviation, key the PTT switch on the microphone, and while watching a deviation scope tuned to the transmit output frequency, carefully adjust the DCS Output Adjustment. The deviation level of the DCS Output should be set to 0.75 kHz (750 Hz).

A deviation scope on a service monitor is best for adjusting the DCS deviation. The DCS waveform on the scope will appear as square waves with the corners rounded. If the DCS signal appears to droop or if it has steep spikes, then the interface connection must be changed.

3.0 PROGRAMMING THE DCS-23

This section of the instructions describes how to program the DCS-23 to suit the needs of your radio system. These programming features are designed to be programmed by the installing technician. The DCS-23 may be programmed before or after it is installed in the associated radio set. The DCS-23 is programmed by installing 'solder bridges' across the various jumper straps, JP1-JP12 on the DCS-23 printed circuit board. A low wattage soldering iron with a small tip should be used to place a small solder bridge across the various jumper straps. When programming the unit, be careful not to damage the DCS-23 printed circuit board. The DCS-23 comes from the factory with all jumper straps out. See the Parts Layout diagram for the location of the jumper straps.

3.1 DCS CODE

DCS codes consist of three octal digits. The DCS codes available for use range from '000' to '777.' Although this range of octal numbers permits 512 possible codes, not all of these codes are usable, or unique. Therefore, only those codes listed in the "DCS Code Table" on the last page of these instructions should be used.

The first octal digit of a DCS code is programmed by jumper straps JP1, JP2 and JP3. The second digit of a DCS code is programmed by jumper straps JP4, JP5 and JP6. The third digit of a DCS code is programmed by jumper straps JP7, JP8 and JP9. The "DCS Code Table" on the last page may be used **instead** of the following programming instructions.

The following table shows the conversion from an octal number to the jumper strap configuration. This conversion table is used for programming the DCS jumper straps. In the case where the table indicates 'out,' this means that no solder bridge should be installed across the jumper strap. In the case where the table indicates 'bridge,' this means that a solder bridge should be installed across that jumper strap.

OCTAL DIGIT	JUMPER EQUIVALENT		
0	bridge	bridge	bridge
1	bridge	bridge	out
2	bridge	out	bridge
3	bridge	out	out
4	out	bridge	bridge
5	out	bridge	out
6	out	out	bridge
7	out	out	out

For example, to program the DCS code '152,' place a solder bridge across each jumper as shown in the table below:

DIGIT 1			DIGIT 2			DIGIT 3		
1			5			2		
JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8	JP9
bridge	bridge	out	out	bridge	out	bridge	out	bridge

Alternatively, a binary switch can be connected to the jumper straps, JP1 through JP9 to allow the user to change the DCS code at any time. When connecting a switch to the jumper straps, connect the switch common to ground, and the wires from the switch to the side of the jumper strap that has the hole.

3.2 DCS TX-RX POLARITY

The polarity of the transmit DCS code and receive DCS code can be set for either normal polarity or inverted polarity. The receive and transmit polarity for any given radio is dependant on the number of stages in the radio that might 'invert' the DCS signal. Since there is no easy way to determine what polarity to use, it must be determined experimentally.

If a solder bridge is installed across the Transmit Data Polarity Jumper, JP10, this will invert the transmit DCS code. Otherwise the DCS code will be transmitted in the normal data polarity. If the Receive Data Polarity Jumper, JP11, is bridged, this will invert the receive DCS code. Otherwise the DCS code will be received in the normal data polarity.

After installation and adjustments, try to communicate on your radio system. If communication is not possible, then install a solder bridge across the appropriate polarity jumper to invert the transmit or receive DCS code. Note the polarity for future installations in the same model of radio on the same radio system.

3.3 RECEIVER MUTE POLARITY

The receiver mute polarity is changed by using the RX Mute Polarity jumper, JP12. When JP12 is open, the Receive Audio Mute Output will pull away from ground to enable the audio circuits in the receiver when the correct DCS code is received. This is the normal configuration for most receivers. To program the Receiver Audio Mute Output for a 'pull to ground' to enable the audio, install a solder bridge across JP12.

4.0 SPECIFICATIONS

Encoding	Golay (23,12) 23 bit Digital Word
Encoding Data Rate	134.4 Hz. nominal
Turn off Code	134.4 Hz sine wave for 180 ms.
Encode Output Z	2.2 K ohms AC coupled
Encode Output Level	Adjustable from 0V to 3.0V
Decode Input Z	60K ohms AC coupled
Decode Input Level	15 Mv minimum
Signal to Noise	Better than 4 db Sinad
Decode time	171 Ms. Maximum (1 word length)
Fade Time	750 Ms.
Squelch tail elimination	By turn off code detection
DCS Code Programming	By 9 PCB jumper straps
Encode/Decode Polarity	By PCB jumper straps
RX Mute Output	Open collector transistor
TX PTT Output	Open collector transistor
Receive Audio Filter	3 pole 330Hz High-pass filter
Temperature Range	-30°C to +65°C
Supply Requirements	6.0 to 20.0 VDC @8 Ma.
Size	1.36" x 1.18" x 0.25"

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

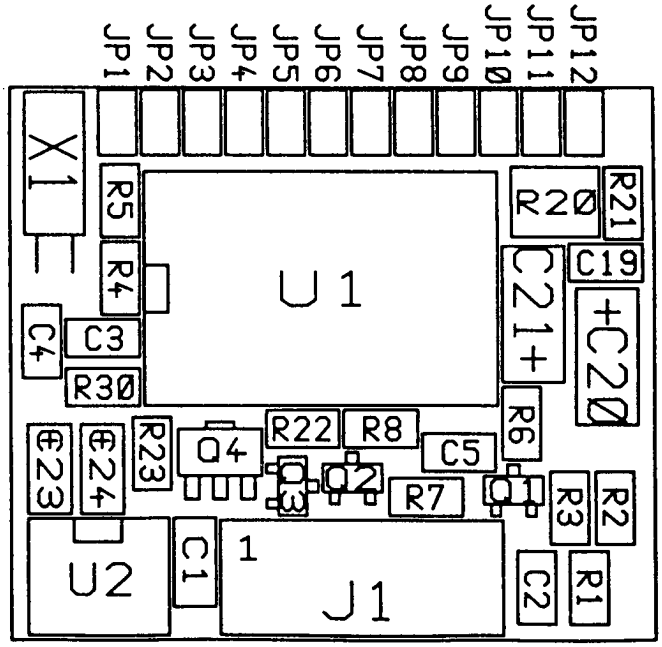
DCS CODE TABLE

OCTAL CODE	JU # 1	2	3	4	5	6	7	8	9	INVERT CODE	JU # 1	2	3	4	5	6	7	8	9
017*	X	X	X	X	O	O	O	O	O	050*	X	X	X	O	X	O	X	X	X
023	X	X	X	X	O	O	O	O	X	047	X	X	X	O	X	O	X	X	O
025	X	X	X	X	O	O	O	X	O	244	X	X	X	O	X	O	X	O	X
026	X	X	X	X	O	O	O	X	X	464	X	X	X	O	X	O	O	X	X
031	X	X	X	X	O	O	X	O	O	627	X	X	X	O	X	O	O	O	X
032	X	X	X	X	O	O	X	O	X	051	X	X	X	O	X	X	X	X	X
036*	X	X	X	X	O	O	X	X	O	172	X	X	X	O	X	X	X	X	O
043	X	X	X	X	O	O	X	X	X	445	X	X	X	O	X	X	X	X	X
047	X	X	X	X	O	X	O	O	O	023	X	X	X	O	X	X	O	O	O
050*	X	X	X	X	O	X	O	O	X	017*	X	X	X	O	X	X	O	O	X
051	X	X	X	X	O	X	O	X	O	032	X	X	X	O	X	X	O	X	O
053*	X	X	X	X	O	X	O	X	X	452*	X	X	X	O	X	X	O	X	X
054	X	X	X	X	O	X	X	O	O	413	X	X	X	O	X	X	X	O	O
065	X	X	X	X	O	X	X	O	X	271	X	X	X	O	X	X	X	O	X
071	X	X	X	X	O	X	X	X	O	306	X	X	X	O	X	X	X	X	O
072	X	X	X	X	O	X	X	X	X	245	X	X	X	O	X	X	X	X	X
073	X	X	X	X	X	O	O	O	O	506	X	X	X	X	O	O	O	O	O
074	X	X	X	X	X	O	O	O	X	174	X	X	X	X	O	O	O	O	X
114	X	X	X	X	X	O	O	X	O	712	X	X	X	X	O	O	O	X	O
115	X	X	X	X	X	O	O	X	X	152	X	X	X	X	O	O	O	X	X
116	X	X	X	X	X	O	X	O	O	754	X	X	X	X	O	O	X	O	O
122*	X	X	X	X	X	O	X	O	X	225*	X	X	X	X	O	O	X	O	X
125	X	X	X	X	X	O	X	X	O	365	X	X	X	X	O	O	X	X	O
131	X	X	X	X	X	O	X	X	X	364	X	X	X	X	O	O	X	X	X
132	X	X	X	X	X	X	O	O	O	546	X	X	X	X	O	X	O	O	O
134	X	X	X	X	X	X	O	O	X	223	X	X	X	X	O	X	O	O	X
143	X	X	X	X	X	X	O	X	O	412	X	X	X	X	O	X	O	X	O
145*	X	X	X	X	X	X	O	X	X	274*	X	X	X	X	O	X	O	X	X
152	X	X	X	X	X	X	X	O	O	115	X	X	X	X	O	X	X	O	O
155	X	X	X	X	X	X	X	O	X	731	X	X	X	X	O	X	X	O	X
156	X	X	X	X	X	X	X	X	O	265	X	X	X	X	O	X	X	X	O
162	X	X	X	X	X	X	X	X	X	503	X	X	X	X	O	X	X	X	X
165	X	X	X	X	X	X	X	X	X	251	X	X	X	X	X	O	O	O	O
172	X	X	X	X	X	X	X	X	X	036*	X	X	X	X	X	O	O	O	X
174	X	X	X	X	X	X	X	X	X	074	X	X	X	X	X	O	O	X	O
205	X	X	X	X	X	X	X	X	X	263	X	X	X	X	X	O	O	X	X
212*	X	X	X	X	X	X	X	X	X	356*	X	X	X	X	X	O	X	O	O
223	X	X	X	X	X	X	X	X	X	134	X	X	X	X	X	O	X	O	X
225*	X	X	X	X	X	X	X	X	X	122*	X	X	X	X	X	O	X	X	O
226	X	X	X	X	X	X	X	X	X	411	X	X	X	X	X	O	X	X	X
243	X	X	X	X	X	X	X	X	X	351	X	X	X	X	X	X	O	O	O
244	X	X	X	X	X	X	X	X	X	025	X	X	X	X	X	X	O	O	X
245	X	X	X	X	X	X	X	X	X	072	X	X	X	X	X	X	O	X	O
246*	X	X	X	X	X	X	X	X	X	523*	X	X	X	X	X	X	O	X	X
251	X	X	X	X	X	X	X	X	X	165	X	X	X	X	X	X	X	O	O
252*	X	X	X	X	X	X	X	X	X	462*	X	X	X	X	X	X	X	O	X
255*	X	X	X	X	X	X	X	X	X	446*	X	X	X	X	X	X	X	X	O
261	X	X	X	X	X	X	X	X	X	732	X	X	X	X	X	X	X	X	X
263	X	X	X	X	X	X	X	X	X	205	X	X	X	X	X	X	X	X	X
265	X	X	X	X	X	X	X	X	X	156	X	X	X	X	X	X	X	X	X
266*	X	X	X	X	X	X	X	X	X	454*	X	X	X	X	X	X	X	X	X
271	X	X	X	X	X	X	X	X	X	065	X	X	X	X	X	X	X	X	X
274*	X	X	X	X	X	X	X	X	X	145*	X	X	X	X	X	X	X	X	X
306	X	X	O	X	X	O	X	X	O	071	X	X	X	X	O	X	O	O	O
311	X	O	O	X	X	O	X	X	O	664	O	O	X	O	O	X	X	X	X

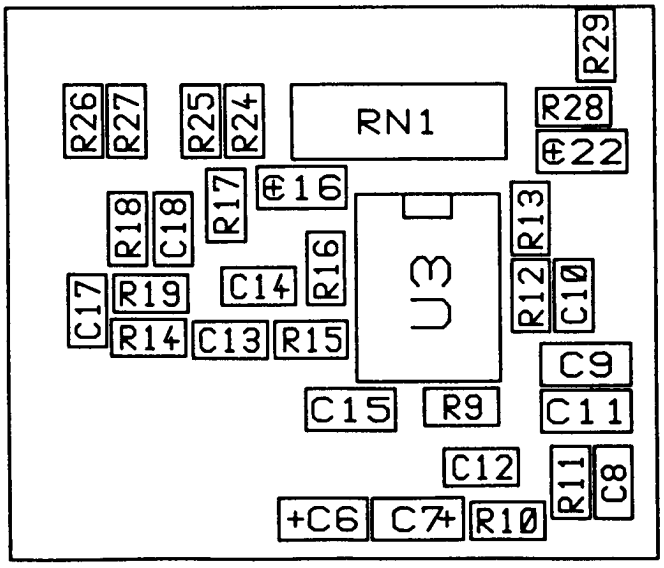
OCTAL CODE	JU # 1	2	3	4	5	6	7	8	9	INVERT CODE	JU # 1	2	3	4	5	6	7	8	9
315	X	O	O	X	X	O	O	X	O	423	O	X	X	X	O	X	X	O	O
325*	X	O	O	X	O	X	O	X	O	526*	O	X	X	O	X	O	X	X	O
331	X	O	O	X	O	X	O	X	X	465	O	X	X	O	X	O	X	X	X
332*	X	O	O	X	O	X	X	O	O	455*	O	X	X	O	X	X	O	O	O
343	X	O	O	X	O	X	X	O	X	532	O	X	X	O	X	X	O	O	X
346	X	O	O	X	O	X	X	X	O	612	O	X	X	O	X	X	O	X	O
351	X	O	O	X	O	X	X	X	X	243	O	X	X	O	X	X	O	X	X
356*	X	O	O	X	X	O	O	O	O	212*	O	X	X	O	X	X	X	O	O
364	X	O	O	X	X	O	O	O	X	131	O	X	X	O	X	X	X	O	X
365	X	O	O	X	X	O	O	X	O	125	O	X	X	O	X	X	X	X	O
371	X	O	O	X	X	O	O	X	X	734	O	X	X	O	X	X	X	X	X
411	O	X	X	X	X	O	O	O	O	226	O	X	X	X	O	O	O	O	O
412	O	X	X	X	X	O	O	O	X	143	O	X	X	X	O	O	O	O	X
413	O	X	X	X	X	O	O	X	O	054	O	X	X	X	O	O	O	X	O
423	O	X	X	X	X	O	O	X	X	315	O	X	X	X	O	O	O	X	X
431	O	X	X	X	X	O	X	O	O	723	O	X	X	X	O	O	X	O	O
432	O	X	X	X	X	O	X	O	X	516	O	X	X	X	O	O	X	O	X
445	O	X	X	X	X	O	X	X	O	043	O	X	X	X	O	O	X	X	O
446*	O	X	X	X	X	O	X	X	X	255*	O	X	X	X	O	O	X	X	X
452*	O	X	X	X	X	X	O	O	O	053*	O	X	X	X	O	X	O	O	O
454*	O	X	X	X	X	X	O	O	X	266*	O	X	X	X	O	X	O	O	X
455*	O	X	X	X	X	X	O	X	O	332*	O	X	X	X	O	X	O	X	O
462*	O	X	X	X	X	X	O	X	X	252*	O	X	X	X	O	X	O	X	X
464	O	X	X	X	X	X	X	O	O	026	O	X	X	X	O	X	X	O	O
465	O	X	X	X	X	X	X	O	X	331	O	X	X	X	O	X	X	O	X
466	O	X	X	X	X	X	X	X	O	662	O	X	X	X	O	X	X	X	O
503	O	X	X	X	X	X	X	X	X	162	O	X	X	X	O	X	X	X	X
506	O	X	X	X	X	X	X	X	X	073	O	X	X	X	X	O	O	O	O
516	O	X	X	X	X	X	X	X	X	432	O	X	X	X	X	O	O	O	X
523*	O	X	X	X	X	X	X	X	X	246*	O	X	X	X	X	O	O	X	O
526*	O	X	X	X	X	X	X	X	X	325*	O	X	X	X	X	O	O	X	X
532	O	X	X	X	X	X	X	X	X	343	O	X	X	X	X	O	X	O	O
546	O	X	X	X	X	X	X	X	X	132	O	X	X	X	X	O	X	O	X
565	O	X	X	X	X	X	X	X	X	703	O	X	X	X	X	O	X	X	O
606	O	X	X	X	X	X	X	X	X	631	O	X	X	X	X	O	X	X	X
612	O	X	X	X	X	X	X	X	X	346	O	X	X	X	X	X	O	O	O
624	O	X	X	X	X	X	X	X	X	632	O	X	X	X	X	X	O	O	X
627	O	X	X	X	X	X	X	X	X	031	O	X	X	X	X	X	O	X	O
631	O	X	X	X	X	X	X	X	X	606	O	X	X	X	X	X	O	X	X
632	O	X	X	X	X	X	X	X	X	624	O	X	X	X	X	X	X	O	O
654	O	X	X	X	X	X	X	X	X	743	O	X	X	X	X	X	X	O	X
662	O	X	X	X	X	X	X	X	X	466	O	X	X	X	X	X	X	X	O
664	O	X	X	X	X	X	X	X	X	311	O	X	X	X	X	X	X	X	X
703	O	X	X	X	X	X	X	X	X	565	O	X	X	X	X	X	X	X	X
712	O	X	X	X	X	X	X	X	X	114	O	X	X	X	X	X	X	X	X
723	O	X	X	X	X	X	X	X	X	431	O	X	X	X	X	X	X	X	X
731	O	X	X	X	X	X	X	X	X	155	O	X	X	X	X	X	X	X	X
732	O	X	X	X	X	X	X	X	X	261	O	X	X	X	X	X	X	X	X
734	O	X	X	X	X	X	X	X	X	371	O	X	X	X	X	X	X	X	X
743	O	O	O	O	X	O	O	O	X	654	O	O	O	O	X	O	O	O	X
754	O	O	O	O	X	O	O	O	X	116	X	X	O	X	X	O	O	X	X

X = JUMPER IN = BRIDGED = GROUNDED
O = JUMPER OUT = OPEN
* = GE DCS CODE

TOP SIDE PARTS LAYOUT



BOTTOM SIDE PARTS LAYOUT



COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547