Model TS-64WDS
Miniature 64 Tone CTCSS Encoder-Decoder with Dip Switch

The Communications Specialists Model TS-64WDS Miniature 64 Tone CTCSS Encoder-Decoder is a microprocessor based product used for encoding and decoding subaudible tones. The TS-64WDS is compatible with continuous tone controlled squelch systems (CTCSS) used in land mobile radio such as 'Private Line', 'Channel Guard', and '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 two-way FM radio installations. Simple field programming by a miniature dip switch and jumper pads allows the radio service shop to configure the CTCSS tone, Transmit Time-out-timer, Hang-up/Busy function, and on board LED indicator. Squelch tail elimination is achieved by the use of a 'reverse phase burst' at the end of each transmission. An audio high pass filter eliminates the CTCSS signal from the recovered audio.

Section	Description
1.0	Operating Instructions
2.0	Programming the TS-64WDS
2.1	CTCSS tone programming
2.2	Transmit time-out-timer programming
2.3	PCB LED indicator
3.0	Installation Instructions
3.1	Adjustment
4.0	Specifications

1.0 OPERATING INSTRUCTIONS

The TS-64WDS is designed to encode and decode CTCSS transmissions in conjunction with an associated FM radio transceiver. Upon receipt of a programmed CTCSS coded transmission, the TS-64WDS will unmute the receiver audio and allow audio to pass. While the TS-64WDS is decoding, an internal timer keeps the audio path open for approximately 350 ms during a loss of signal due to signal fade. Upon receipt of the turn off code, theTS-64WDS will immediately mute the receiver 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 channel monitoring.

When the PTT switch is keyed on the microphone, the TS-64WDS will key the transmitter and immediately begin generating the programmed CTCSS tone for transmission. The TS-64WDS will continue to generate the CTCSS tone for as long as the PTT switch is pressed. Upon release of the PTT switch, the TS-64WDS will continue to key the transmitter for approximately 160 ms. During this time, the TS-64WDS will generate a reverse phase burst which will mute the decoding unit at the other end of the transmission medium. At the end of the 160 ms period, the TS-64WDS will unkey the transmitter. If activated, an internal Transmit Time-out-timer will limit transmissions to a programmed length, thus eliminating problems with stuck microphones and the like.

2.0 PROGRAMMING THE TS-64WDS

This section of the instructions describes how to program the TS-64WDS to suit the needs of your radio system. These programming features are designed to be programmed by the installing technician. The TS-64WDS may be programmed before or after it is installed in the associated radio set. The TS-64WDS is programmed by the dip switch (setting CTCSS tone frequency) and installing 'solder bridges' across the four jumper pads, T01,T02,T03 and H/B (hang-up/busy) if needed. A low wattage soldering iron with a small tip should be used to place a small solder bridge across the various jumper pads. When programming the unit, be careful not to damage the TS-64WDS printed circuit board. The TS-64WDS comes from the factory with the jumper pads all open, which is the most common configuration. See the Parts Layout Diagram for the location of the jumper pads.

2.1 CTCSS TONE PROGRAMMING

CTCSS tone frequency is programmed using the miniature dip switch. A total of 64 different subaudible tones can be selected. Simply slide each of the 6 switches either ON or OFF to select the desired frequency. The table to the right shows the switch positions required to select each CTCSS tone frequency. Please note that tones marked with a '*' are not EIA tones, should only be used for special applications, and may not work in harmony with adjacent EIA tones.

2.2 TRANSMIT TIME-OUT-TIMER PROGRAMMING

The Transmit time-out-timer is used to limit the duration of a continuous transmission to a maximum length as programmed by the jumper pads T01, T02, and T03. The timer can be programmed with eight different timeout intervals. These are listed in the table below. The Transmit time-out-timer is disabled when received from the factory.

TIMEOUT INTERVAL	T01	T02	T03
DISABLED	out	out	out
15 seconds	bridge	out	out
30 seconds	out	bridge	out
45 seconds	bridge	bridge	out
1 minute	bridge	out	bridge
2 minutes	out	bridge	bridge
3 minutes	out	out	bridge
5 minutes	bridge	bridge	bridge

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92865-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547
http://www.com-spec.com

2.3 PCB LED INDICATOR

There is a small green LED on the component side of the TS-64WDS PCB to indicate status. There are 3 jumper pads on the bottom side of the PCB that can have a "solder bridge" installed between the center pad and either or both of the other 2 pads to indicate status as follows:

Center pad to MUTE 2 LED pad=LED only on when decoding or mike is off-hook (as shipped)
Center pad to MUTE 1 LED pad=LED only off when decoding or mike is off-hook
Center pad to both MUTE 2 and MUTE 1 pads=LED is a power on indicator only
Center pad not bridged=LED is always off

Tone	#1	#2	#3	#4	#5	#6
33.0*	OFF	ON	ON	OFF	OFF	OFF
35.4*	ON	ON	ON	OFF	OFF	OFF
36.6*	OFF	OFF	OFF	ON	OFF	OFF
37.9*	ON	OFF	OFF	ON	OFF	OFF
39.6*	OFF	ON	OFF	ON	OFF	OFF
44.4*	ON	ON	OFF	ON	OFF	OFF
47.5*	OFF	OFF	OFF	ON	ON	OFF
49.2*	ON	OFF	OFF	ON	ON	OFF
51.2*	OFF	ON	OFF	ON	ON	OFF
53.0*	ON	ON	OFF	ON	ON	OFF
54.9*	OFF	OFF	ON	ON	ON	OFF
56.8*	ON	OFF	ON	ON	ON	OFF
58.8*	OFF	ON	ON	ON	ON	OFF
63.0*	ON	ON	ON	ON	ON	OFF
67.0	OFF	OFF	OFF	OFF	OFF	OFF
69.4*	ON	ON	ON	OFF	ON	OFF
71.9	OFF	OFF	OFF	OFF	OFF	ON
74.4	ON	OFF	OFF	OFF	OFF	OFF
77.0	OFF	OFF	OFF	OFF	ON	ON
79.7	OFF	ON	OFF	OFF	OFF	OFF
82.5	ON	OFF	OFF	OFF	OFF	ON
85.4	ON	ON	OFF	OFF	OFF	OFF
88.5	ON	OFF	OFF	OFF	ON	ON
91.5	OFF	OFF	ON	OFF	OFF	OFF
94.8	OFF	ON	OFF	OFF	OFF	ON
97.4*	ON	OFF	ON	OFF	OFF	OFF
100.0	OFF	ON	OFF	OFF	ON	ON
103.5	ON	ON	OFF	OFF	OFF	ON
107.2	ON	ON	OFF	OFF	ON	ON
110.9	OFF	OFF	ON	OFF	OFF	ON
114.8	OFF	OFF	ON	OFF	ON	ON
118.8	ON	OFF	ON	OFF	OFF	ON
123.0	ON	OFF	ON	OFF	ON	ON
127.3	OFF	ON	ON	OFF	OFF	ON
131.8	OFF	ON	ON	OFF	ON	ON
136.5	ON	ON	ON	OFF	OFF	ON
141.3	ON	ON	ON	OFF	ON	ON
146.2	OFF	OFF	OFF	ON	OFF	ON
151.4	OFF	OFF	OFF	ON	ON	ON
156.7	ON	OFF	OFF	ON	OFF	ON
159.8*	OFF	ON	ON	OFF	ON	OFF
162.2	ON	OFF	OFF	ON	ON	ON
165.5*	ON	OFF	ON	OFF	ON	OFF
167.9	OFF	ON	OFF	ON	OFF	ON
171.3*	OFF	OFF	ON	OFF	ON	OFF
173.8	OFF	ON	OFF	ON	ON	ON
177.3*	ON	ON	OFF	OFF	ON	OFF
179.9	ON	ON	OFF	ON	OFF	ON
183.5*	OFF	ON	OFF	OFF	ON	OFF
186.2	ON	ON	OFF	ON	ON	ON
189.9*	ON	OFF	OFF	OFF	ON	OFF
192.8	OFF	OFF	ON	ON	OFF	ON
196.6*	OFF	OFF	OFF	OFF	ON	OFF
199.5*	ON	ON	ON	ON	OFF	OFF
203.5	OFF	OFF	ON	ON	ON	ON
206.5*	OFF	ON	ON	ON	OFF	OFF
210.7	ON	OFF	ON	ON	OFF	ON
218.1	ON	OFF	ON	ON	ON	ON
225.7	OFF	ON	ON	ON	OFF	ON
229.1*	ON	OFF	ON	ON	OFF	OFF
233.6	OFF	ON	ON	ON	ON	ON
241.8	ON	ON	ON	ON	OFF	ON
250.3	ON	ON	ON	ON	ON	ON
254.1*	OFF	OFF	ON	ON	OFF	OFF

*NON EIA STANDARD TONES

3.0 INSTALLATION INSTRUCTIONS

Installation if the TS-64WDS should be done by a qualified two-way radio technician. When installing the TS-64WDS 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 TS-64WDS. The following paragraphs describe each of the external connections on the TS-64WDS.

+VOLTAGE (RED) (Pin 3)
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) (Pin 9)
The Ground wire should be connected to a location inside the radio set which will supply a DC power ground return to the TS-64WDS. To eliminate ground loops and power supply noise, the ground return to the TS-64WDS should be the same power supply ground used in the transmit or receive audio stages.

PTT INPUT (ORANGE / WHITE) (Pin 4) THIS LEAD *MUST* BE GROUNDED TO ENCODE TONE

PTT OUTPUT (YELLOW / BLACK) (Pin 10)
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 TS-64WDS to determine transmit status. The PTT Output line is a FET that pulls to ground to key the transmitter during CTCSS transmission.

To Install the PTT Input and PTT Output lines, cut the PTT line in the radio set at the microphone connector, and insert the PTT Input and PTT Output on the TS-64WDS in series with the transmitter's PTT line. The TS-64WDS will now control the transmit PTT line.

As an alternative to simplify the installation, the PTT Input line on the TS-64WDS may be permanently grounded, and the PTT Output line can be left unconnected. This will enable the TS-64WDS encoder at all times. If this arrangement is used, be sure that the Transmit Time-out-timer on the TS-64WDS is disabled. A reverse phase burst will of course not be sent.

CTCSS OUTPUT (YELLOW) (Pin 6)
This output generates the CTCSS encode tone. 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. This connection point can vary from radio to radio. Do not connect the CTCSS Output to the microphone input as the microphone audio stages will distort and attenuate the CTCSS signal.

Since the CTCSS Output on the TS-64WDS is low impedance, you may have to install a series resistor to reduce the loading effects of the CTCSS 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 CTCSS Output circuit loading.

RX MUTE OUTPUT #1 (GREEN / WHITE) (Pin 13)
This output is a FET that pulls to ground when not decoding to mute receive audio. The RX Mute Output #1 is usually connected to the collector of the 'squelch switch transistor' in the receiver. To find the correct connection point for RX Mute Output #1, locate a point in the receiver squelch circuit that will 'mute' the receiver audio upon application of a ground potential. This will be the correct point for connection. If you choose this option, leave RX Mute Output #2 disconnected.

RX MUTE OUTPUT #2 (BROWN) (Pin 7)
This output is also a FET that is the reverse of Rx Mute Output #1 and pulls to ground when decoding to mute receive audio. To find the correct connection point for RX Mute Output #2, locate a point in the receiver squelch circuit that will "open" the receiver audio upon application of a ground potential. This will be the correct point for connection. If you choose this option, leave RX Mute Output #1 disconnected.

DISCRIMINATOR INPUT (GREEN) (Pin 12)
This wire feeds the CTCSS decoder in the TS-64WDS. 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 TS-64WDS Discriminator Input should be connected AFTER this network. Connecting the Discriminator Input after any audio processing circuitry in the receiver may distort and attenuate the CTCSS signal and produce unreliable decoding.

HIGH PASS FILTER INPUT (BLUE / WHITE) (Pin 1)
This wire feeds audio to the input of the High Pass Audio Filter. It is normally connected to the discriminator at the same point as the Discriminator Input above (green wire, Pin 12)

HIGH PASS FILTER OUTPUT (BLUE) (Pin 11)
The High Pass Filter Output removes the CTCSS 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 CTCSS signal, and the High Pass Filter on the TS-64WDS 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 TS-64WDS Discriminator Input was connected. Then install the High Pass Filter Output so that it is in series with the audio path in the receiver.

HIGH PASS FILTER MUTE (BROWN / BLACK) (Pin 8)
If this wire is shorted to ground, any audio flowing through the High Pass Audio Filter will be muted. Normally this is not used, however if you are using the High Pass Audio Filter, you may connect this wire to RX MUTE OUTPUT #1 to allow receive audio when the TS-64WDS is decoding the proper tone or the microphone hang-up is off hook.

MICROPHONE HANG-UP/BUSY INPUT (VIOLET) (Pin 2)
This is a dual function input that is determined by the H/B jumper pad. When the H/B jumper pad has no "solder bridge" across it, this input will operate as a Microphone hang-up input, and control the 'channel monitoring' function in the TS-64WDS. When the Hang-up Input is floating or above ground potential (mic is off-hook), the TS-64WDS 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, the receiver audio will be muted. The audio path in the receiver will only be enabled upon receipt of the correct CTCSS code. Connect the Hang-up Input to the microphone hookswitch connection on the microphone jack.

If the H/B jumper pad has a "solder bridge" across it, the Hang-up/Busy Input will operate as a Busy Input, and disable the transmit function in the TS-64WDS if the operator tries to transmit when the channel is busy. However, if the TS-64WDS is currently decoding a CTCSS tone, and the channel is busy, the transmit function will be allowed. Connect the Busy Input to a location in the receiver that will provide an indication as to the status of the channel. The usual location is the squelch switch transistor in the receiver. A busy channel is defined as a logic high, or a voltage level greater that 1.5VDC. Please note that this is the same connection point as the RX Mute Output. The Busy Input must be connected AHEAD of the RX Mute Output with a diode in series, and the cathode of the diode connected to the Busy Input. This arrangement will isolate the Busy Input from being controlled by the Receive Audio Mute Output.

ALERT TONE OUTPUT (ORANGE / BLACK) (Pin 5)
The Alert Tone Output (Busy Tone Output) generates a busy tone under two conditions. First, if the programmed interval for the Transmit Time-out-timer is exceeded, the Busy Tone Output will generate the busy tone until the microphone PTT switch is released. Second, if the Hang-up/Busy Input is configured for Busy operation and the PTT switch is pressed while the channel is busy, the Busy Tone Output will generate the busy tone until the microphone PTT switch is released.

This Output can be connected to the input of the audio amplifier stage in the receiver. The busy tone will then be heard in the speaker of the radio set.

3.1 ADUSTMENT

The CTCSS Output Adjustment, VR-1, is the only adjustment required on the TS-64WDS. This control sets the level of the CTCSS Output. A very small slotted alignment tool should be used to make the adjustment on the TS-64WDS PCB. To adjust the CTCSS 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 CTCSS Output Adjustment. The deviation level of the CTCSS Output should be set to 0.5kHz for wide-band or 0.25kHz or less for narrow-band.

A deviation scope on a service monitor is best for adjusting the CTCSS deviation. The CTCSS waveform on the scope will appear as a sine wave. If the CTCSS signal appears distorted, this indicates that the interface connection is incorrect, and must be changed to a more suitable location.

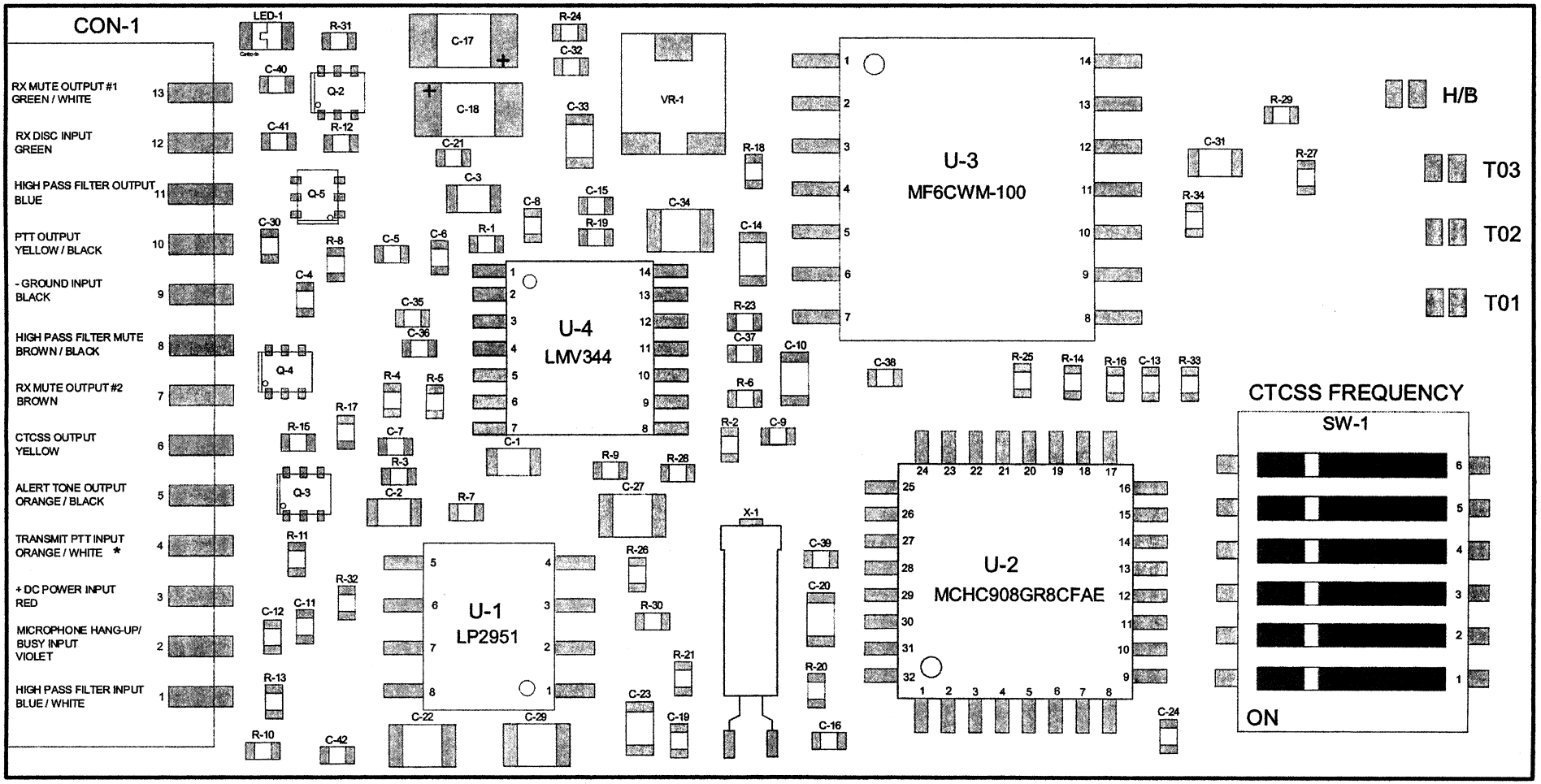
4.0 SPECIFICATIONS

Number of Tones	64
Tone Accuracy	Better than 0.05Hz
Tone Stability	Crystal controlled
Encode Output Z	2.2K ohms AC coupled
Encode Output Level	Adjustable from 0v to 3.0V
Discriminator Input Z	60K ohms AC coupled
Decode Input Level	5 Mv minimum
Signal to Noise	Better than 4dB Sinad
Decode Time	150 ms. Nominal
Fade Time	350 ms. Nominal
Squelch Tail Elimination	160 ms reverse phase burst
CTCSS Tone Programming	By 6 position dip switch
RX Mute Outputs	FETs
TX PTT Output	FET
Receive Audio Filter	3 pole 330Hz High-pass filter
Busy Tone Output	5V pk-pk at 1000Hz
Temperature Range	-30°C to + 65°C
Supply Requirements	6.0 to 20.0 VDC @11 Ma.
Size	0.9" x 1.8" x 0.19"
Price	**$54.95**

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92865-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547
http://www.com-spec.com

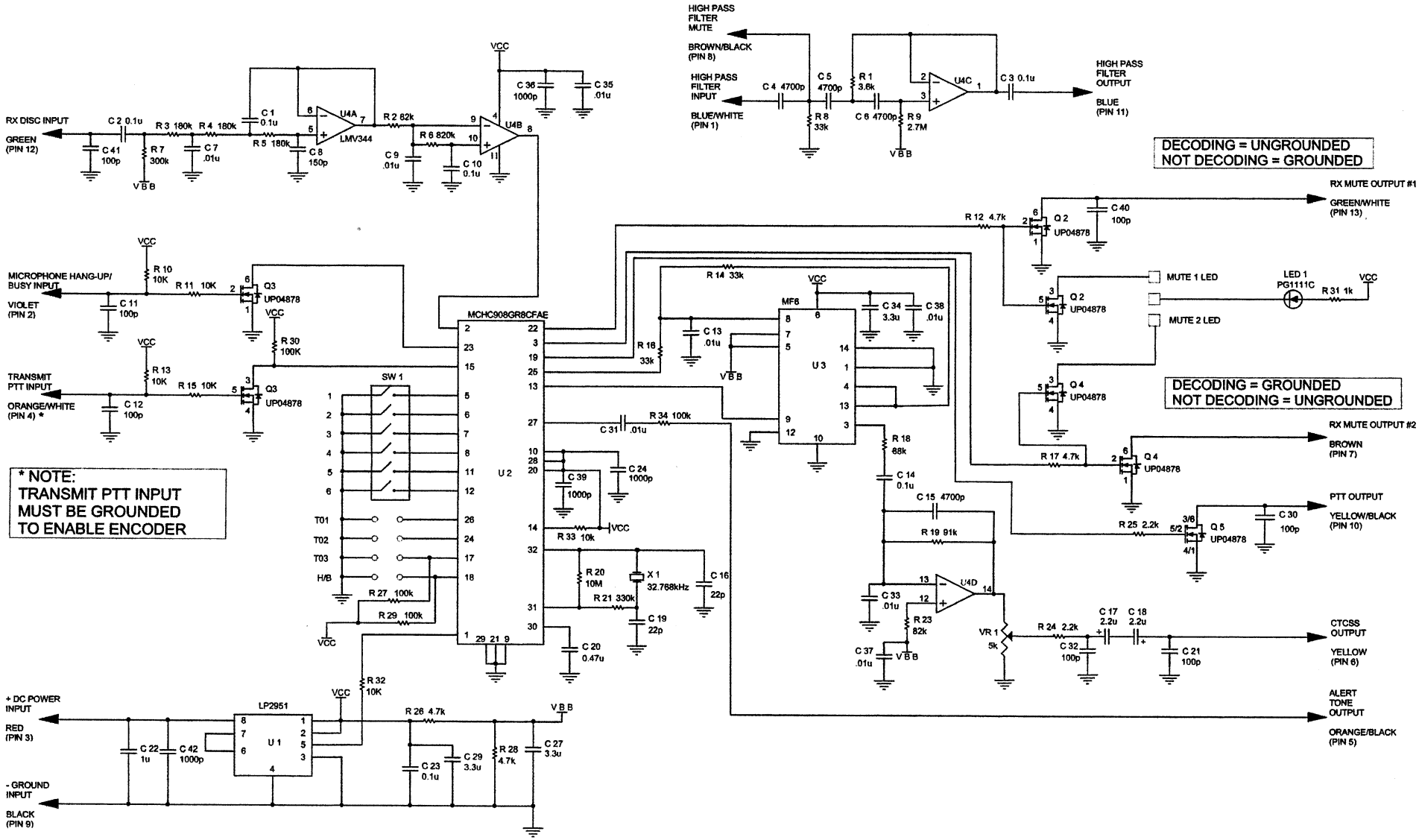
REV. 101512PL

PARTS LAYOUT DIAGRAM



COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92865-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547
http://www.com-spec.com

SCHEMATIC



COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92865-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547
http://www.com-spec.com