Tucson Amateur Packet Radio
8987-309 E. Tanque Verde Rd #337
Tucson, Arizona ¥ 85749-9399
Office: (817) 383-0000 ¥ Fax: (817) 566-2544
Non-Profit Research and Development Corporation

XR-2211

XR-2211 Assembly Manual

INTRODUCTION

The TAPR XR2211 DCD Upgrade is a kit designed to bring the owners of various manufacturers' TNCs which are based on the XR2211 phase-lock-loop demodulator improved "data carrier detect" (DCD) performance. Reliable DCD information is a necessity for proper multiple user access on today's crowded packet channels. See the paper "Can We Continue to Ignore Level One?" by N7CL in the **Proceedings of the 7th ARRL Computer Networking Conference** for details (ARRL, 225 Main Street, Newington CT 06111). Construction and check-out of the DCD Upgrade will probably take you only an evening or two. Warm up your soldering iron, take your time, and enjoy!

PARTS LIST

Sort the parts into egg cartons, muffin tins, or other containers as you inventory them. This will aid you in building.

Check off the part in the ( ) space provided as you locate and verify it against this list.

Resistors, 1/4 watt, 5%
( )	1	22 ohm	(red-red-black-gold)
( )	1	10k ohm	(brown-black-orange-gold)
( )	1	27k ohm	(red-violet-orange-gold)
( )	2	47k ohm	(yellow-violet-orange-gold)
( )	3	100k ohm	(brown-black-yellow-gold)
( )	2	180k ohm	(brown-gray-yellow-gold)

Capacitors

Capacitors may be marked in various ways. The typical markings are given but may vary. Find all that match the typical markings given and the remaining ones, if any, should become apparent by elimination.

Mylar or Monolithic
( )	1	0.01 uF	(103)

Electrolytic
Electrolytic (or tantalum) capacitors are polarized.
( )	1	2.2 uF Radial Lead	RAD-225

Diode
( )	2	1N4148 Silicon Diode	1N4148

Integrated Circuits
NOTE: Do not handle the IC at this time!
( )	1	40106 Hex Schmit Trigger

Transistors
( )	1	2N3904 PNP Transistor	2N3904

Sockets
( )	2	14-pin DIP Socket	DIPS-14

Connectors
( )	1	14-pin male header

Miscellaneous
( )	1	Printed Circuit Board, XR2211 DCD
( )	1	Assembly Manual, XR2211 DCD Upgrade

CONSTRUCTION

You are now ready to begin construction of the DCD upgrade. Use a temperature-controlled, fine-tipped soldering iron and good quality 60/40 or 63/37 rosin-core solder for construction. Follow standard construction practices when building the unit. In addition to the soldering iron and solder, you will need small flush or semi-flush cutting pliers and small-tipped long nosed pliers. A magnifying glass may prove helpful to identify the values of the small components.

Pay careful attention to the directions that follow. Keep the tip of your soldering iron bright and clean, wiping it frequently on a wet rag or sponge. Make solder joints carefully, but swiftly. Prolonged heat on a PC board pad can be as disastrous as too much heat, and ruining this PC board can be expensive! Two to three seconds should be enough time to apply heat to any joint.

IC Sockets

NOTE: If any socket pins are bent, <u>carefully</u> straighten them with a pair of long-nose pliers before assembly. Some types of IC sockets have crimps in the pins to hold them in place when automatic wave-soldering is performed. These sockets may be tricky to install if you are not familiar with them. If your kit contains these sockets, you may want to straighten the pins before attempting to insert them into the PC board.

When installing IC sockets, double check to ensure that the socket is seated properly against the board with the notch, beveled corner or "1" towards the silkscreened reference (U1, U2, etc.). Be sure that all IC socket pins are showing on the solder side of the board. Next, tack-solder two diagonally opposite corners first (such as pins 1 and 8 on a 14-pin socket).

Then solder the remaining pins of that socket before proceeding to the next one. If you find a socket is difficult to install, remove it and double-check for a bent pin.

NOTE: Take care now to avoid solder bridges!

Install the following IC sockets.

( )   U1   14-pin
( )   J1   14-pin

Now check your work. All leads should be soldered. There should be no solder bridges (a blob of solder that shorts two adjacent soldered connections) or cold (gray and/or grainy looking) solder connections. You should have no IC sockets remaining.

( )   OK so far.

Resistors

Resistors stand up on the PC board. The body of the resistor should be vertical and located over the hole with the silk-screened circle. The other leda should bend over sharply from the body of the resistor and enter the board hole indicated by the silkscreened line radiating from the body circle.

NOTE: Be careful when installing the resistors that the leads from adjacent resistors do not touch, causing a short circuit.

Install the following 5% resistors:
( )   R1   180k ohm   (brown-gray-yellow-gold)
( )   R3   10k ohm   (brown-black-orange-gold)
( )   R2   (skip this one for now)
( )   R4   47k ohm   (yellow-violet-orange-gold)
( )   R7   47k ohm   (yellow-violet-orange-gold)
( )   R6   100k ohm   (brown-black-yellow-gold)
( )   R5   22 ohm   (red-red-black-gold)

If your unit is going to be used for VHF operation only, install a 180K ohm resistor at R2. If you are going to be using the unit on HF, or combined HF and VHF operation, install a 27K resistor at location R2.

( )   R2   27k ohm   (red-violet-orange-gold)
        or   180k ohm   (brown-gray-yellow-gold)
( )   R8   100k ohm   (brown-black-yellow-gold)

WARNING! Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

( )   Solder and clip the leads (16 total)

( )   You should have two resistors left over.

Diode

Diodes are polarized, with the cathode end being banded. Observe polarity when installing the following diode. As with resistors, the diodes stand up on the board.

( )   D1   1N4148
( )   D2   1N4148

( )   Solder and clip the leads (4 total)

Capacitors

NOTE: All capacitors should be mounted as nearly flush to the board surface as practical without stressing the leads.

( ) C1   0.01 uF   (103)

The following capacitor is polarized. The silkscreen indicates the positive end of the capacitor; most capacitors have the negative lead marked. Observe polarity carefully!.

( ) C2   2.2 uF

( ) Solder and clip the leads (4 total)

Now check your work. All leads should be soldered. There should   be no solder bridges or cold solder connections. You should have no diodes or capacitors remaining.

( ) OK so far.

Remaining Components

NOTE: Transistors are polarized components. Match the body of the transistor with the silkscreened outline and carefully bend the transistor leads to match the hole pattern in the PC board. The bottom of the body of the transistor should be not more than 1/4" above the PC board.

( ) Q1   2N3904

( ) Solder and clip the leads (3 total)

Now you must get your TNC or modem in which you plan on installing the XR2211 DCD Upgrade. Open the case and:

( ) Locate the XR2211 demodulator IC

( ) Remove it from its socket. If the XR2211 is not socketed, it must be removed and a 14-pin IC socket installed.

( ) Insert the 14-pin male header in the XR2211 socket. The short, thin leads go into the socket; the long square leads should be free.

( ) Carefully thread the XR2211 DCD upgrade PC board onto the 14-pin mail header, observing polarity.

Note: In the following step, some TNCs have an electrolytic capacitor that will have to be replaced to clear the DCD PC board and allow the TNC to fit in its case. A Radio SHack 272-1437 22 uf tantalum capacitor has been used on MFJ 1270/1274 TNCs.

JMP8 on the MFJ units may have to be removed and replaced with a wire jumper.

( ) Carefully align the DCD PC board so that it is parallel to the TNC or modem PC board, it clears all components on the TNC or modem PC board, and it will clear the case when the TNC or modem is reassembled.

( ) Tack solder the XR2211 DCD upgrade PC board to the 14-pin male header at the top of the upgrade PC board at the four corners of the header.

( ) Creafully remove the upgrade PC board assembly from the TNC or modem.

( ) Solder the remaining 10 pins of the header to the top of the upgrade PC board.

( ) Resolder the four corner pins of the header to the top of the upgrade PC board.

( ) If the upgrade PC board has a 180K phm resistor at R2 (VHF only use), verify that the default trace shorting "J" is intact. If it has been cut, short across it with a small wire or component lead.

( ) If the upgrade PC board is to be used on HF, or has a 27K ohm resistor installed at R2, verify that the default trace shorting "J" has been cut. Then, connect a 100K ohm potentiometer (extra 100K ohm resistor included in kit) across the terminals marked J such that full counter-clockwise rotation places minimum resistance across "J" and full clockwise places 100K ohms across "J". Label this control "THRESHOLD" on the front panel of your TNC.

Observing static precautions and polarity, install the following ICs in their sockets:

( ) U1   40106
( ) J2   XR2211 (previously removed from TNC)

You might have one or two resistors remaining, depending on the configuration.

( ) Ok.

Now, install the XR2211 DCD upgrade PC board in your TNC or modem.

( ) Remove the 470K (yellow-violet-yellow-gold) or 510K (green-brown-yellow-gold) resistor from the TNC that connects to pin 3 of the XR2211. This is R48 on the TAPR TNC 1s and R73 on TAPR TNC 2s.

( )   Carefully insert the 14-pin male header in the XR2211 socket on the TNC or modem.

( )   Double check that the polarity is correct and all pins are seated in the XR2211 socket.

Note: If you are installing the DCD Upgrade in an MFJ-1274, perform the following three modifications to the MFJ unit.

( )   Remove the resistor from U18 pin 5 to C65.

( )   Remove C65

( )   Change C45 to a 0.1 uf capacitor

Reinstall the TNC or modem in its cabinet.

Note: If you are modifying a TNC 2 (or clone) which contains an MF-10 filter, you may want to remove the filter IC (U18) and resistor network (U17). If you do this, add a jumper from U17 pin 8 and U18 pin 1 and change capacitors C35 and C42 from 0.1 uF to 0.01 uF. This will dramatically increase the dynamic range of your XR2211 demodulator.

OPERATION

If you are using the unit on VHF (no "THRESHOLD" control added), you may operate your TNC as before. Improved DCD operation will result, although it may not be apparent to you.

If you have added a "THRESHOLD" control, operate it as follows.

With the radio tuned to an unused channel, squelch opened and the IF filter bandwidth properly selected (standard SSB filter for 1200 baud operation such as on 10 meters, 500 Hz or 600 Hz CW filter for 300 baud 200 Hz shift operation), set the THRESHOLD control so the DCD LED of the TNC or modem flickers occasionally. It should light solidly when you tune across a packet transmission at the data rate and shift to which your TNC is set.

Note: If the THRESHOLD control seems to lack sufficient adjustment range, remove the resistor from the XR2211 pin 3 located on the TNC or modem. This resistor will usually be in the range of 470K to 510K ohms.

If your radio allows you to select various filters, you will note that the THRESHOLD adjustment varies with the IF bandwidth selected. This is because the narrower bandwidth noise from a sharper filter is more nearly coherent, allowing the phase-lock-loop to more easily confuse signals and noise.

You should never operate your station with the DCD LED remaining off when you can hear another station. Operating in this manner wil allow your station to frequently transmit on top of other stations, resulting in reduced channel performance for everyone concerned.

Similarly, your DCD LED should not solidly illuminate on noise or you will never transmit!

THEORY OF OPERATION

Please refer to the schematic of the XR2211 upgrade along with your TNC's modem schematic.

DCD information from the XR2211 demodulator is available at pin 6 (positive) and pin 5 (negative), both of which are open-collector outputs.

Pin 5, which goes to ground when DCD is true, rapidly discharges C2 through R5. U1A inverts this information, turning Q1 on via R7. The low state of the Q1 collector is passed along to the TNC as an open-collector output of the same polarity as pin al XR2211.

The Q1 low state is alos inverted through U1D and reverse-biases D2, removing it from the circuit.

When DCD is no longer valid, C2 charges through R8, resulting in a "hang" time of a fraction of a second. The hang time is necessary in the case of multipath fades, collisions which result in a lack of detectable information to the XR2211 phase-locked-loop, etc.
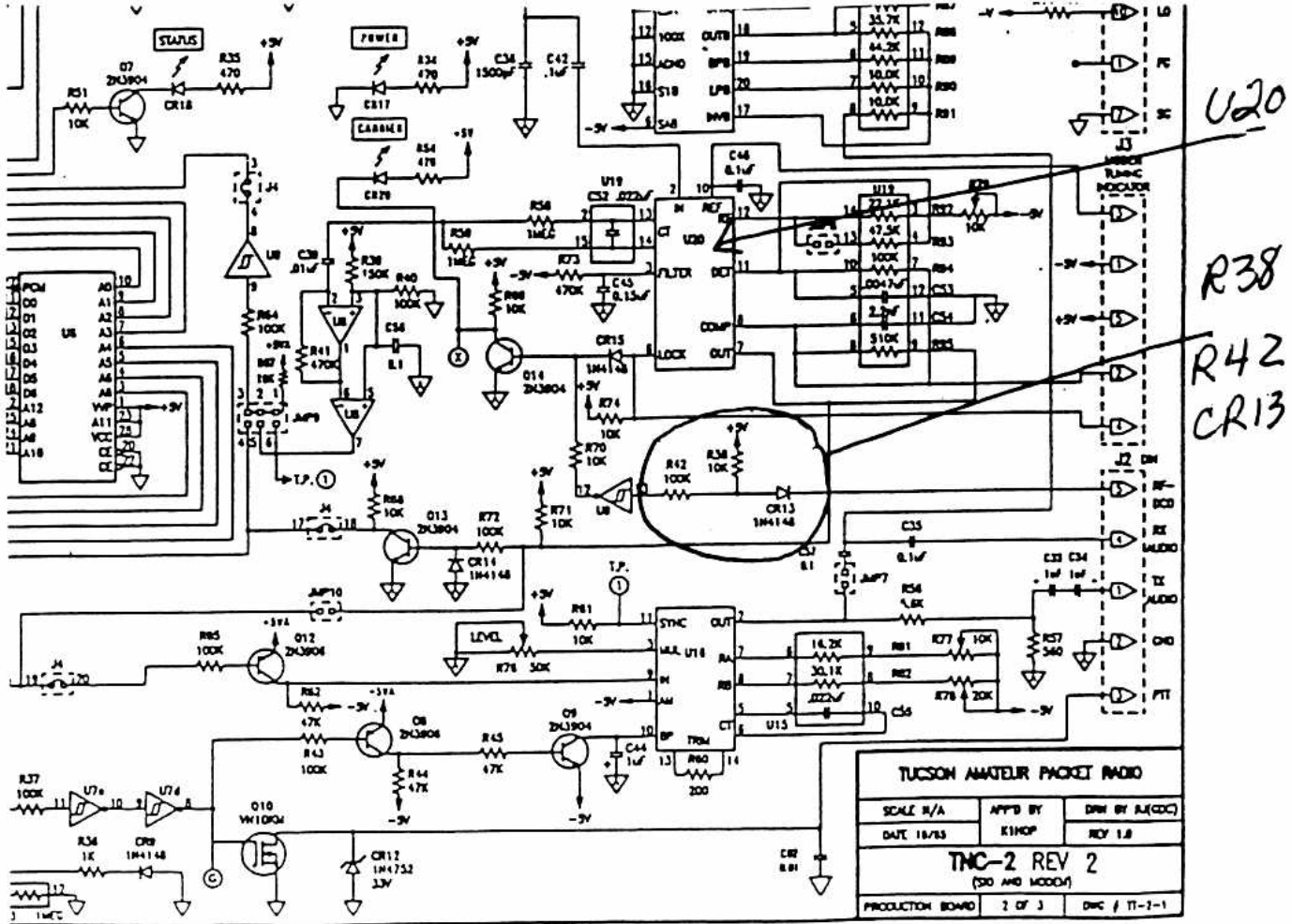
After the hang time elapses, U1A goes low, turning Q1 off. U1D then goes low, pulling the data output line (pin 7) low through D2. Since pin 7 is an open-collector output, this eliminates random transitions on the output from the demodulator.

R1, C1 and R3 provide a fast-attack to the DCD output by driving Q1 on (via D1 and R4) much faster than the R5/C2 path. In addition, this network provides hysteresis to the DCD decision circuitry within the XR2211 chip. The result is a more positive decision with less "chattering" in the presence of noise.
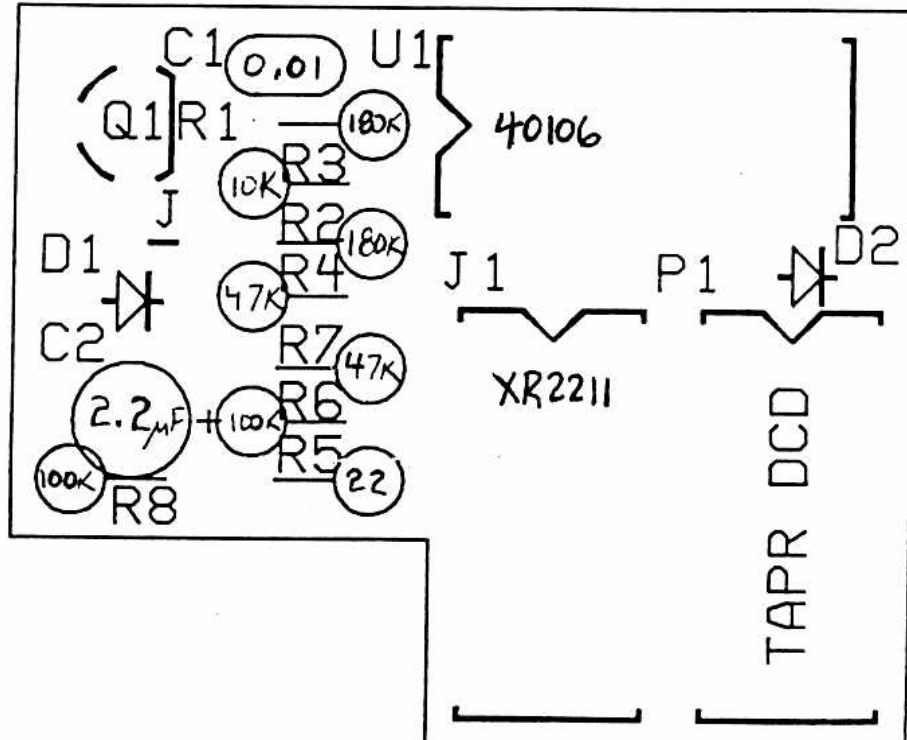
Finally, R2 (180L alone or 27K in series with a THRESHOLD control) balances the currents in the DCD circuitry of the XR2211 chip to reduce false decicions. The THRESHOLD control option allows tailoring the DCD response to the specific filters and noise levels in effect at a given time.
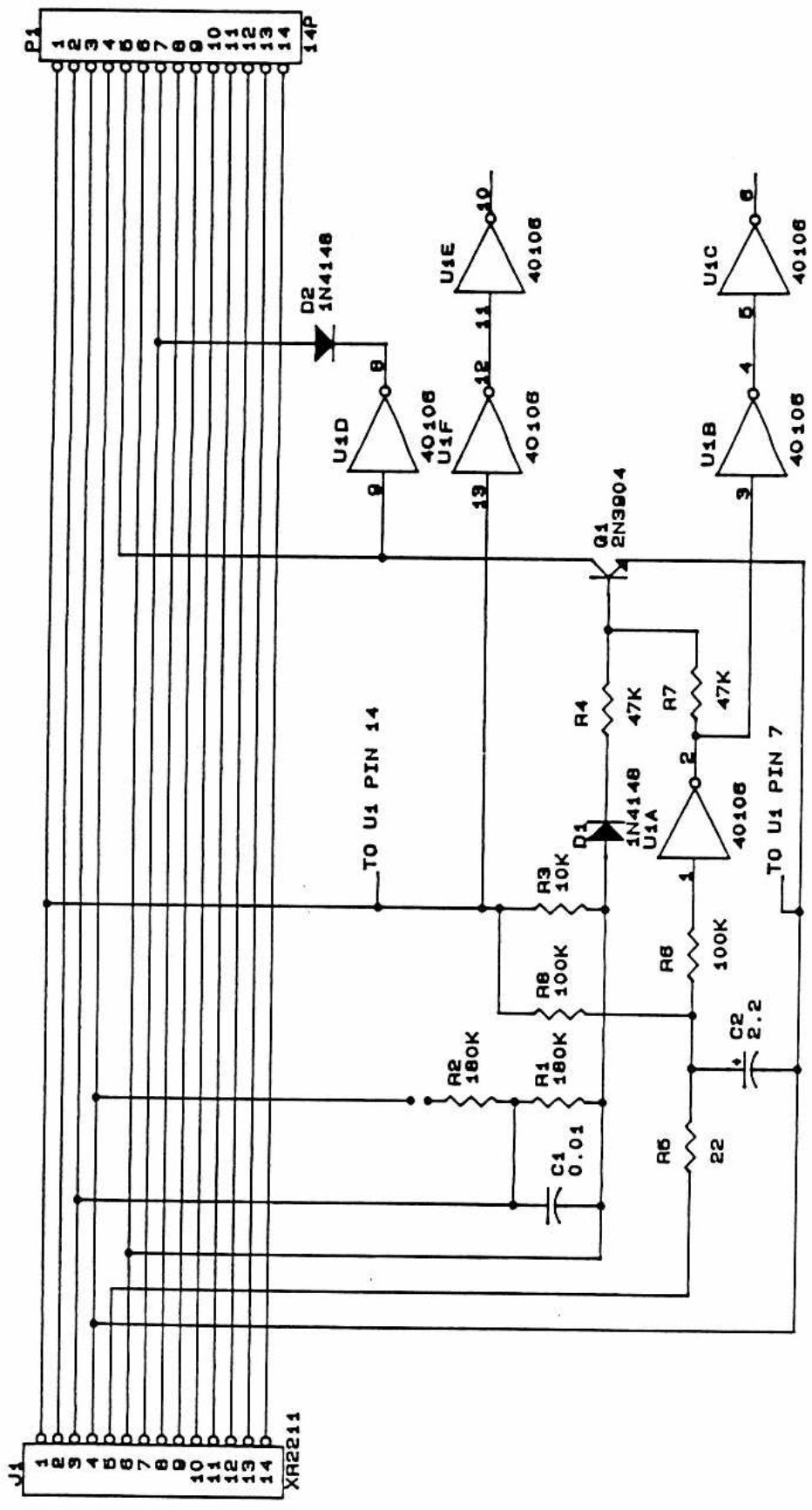
NOITCE for TNC 2s

Add a jumper wire from U20 pin 5 to the junction of R38 and R42 (the 100K resistor just above U16 on a TAPR TNC2 - see schematic below) and the annode of CR13. Put this on <u>bottom side</u> of the TNC circuit board.

XR2211 PARTS PLACEMENT

P1

1
2
3
4
5
6
7
8
9
10
11
12
13
14

14P

D2
1N4148

U1E
40106
10
12
11

U1F
40106
13

U1D
40106
8
9

U1C
40106
5

U1B
40106
4
3

Q1
2N3904

R4
47K

R7
47K

2

1N4148
U1A
D1

40106

TO U1 PIN 14

TO U1 PIN 7

R3
10K

1

R8
100K

R6
100K

R2
180K

R1
180K

C2
2.2

C1
0.01

R5
22

J1

1
2
3
4
5
6
7
8
9
10
11
12
13
14

XR2211

XR2211

E. GUSTAFSON/L. JOHNSON

Size Document Number REV
A XR2211 DCD UPGRADE A
Date: December 19, 1988 Sheet 1 of 1