

8.14 T2000-80 Line Interface Kit

The T2000-80 line interface kit enables connection of the T2000 receiver and transmitter audio circuitry to a two wire transmission line. The line interface PCB is mounted in the options position inside the T2000 Series II radio, and is application configurable using PCB links.

The following topics are covered in this Section:

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8.14.1 Components Required

The T2000-80 kit contains the following components:

Quantity	Description
1	T2000-80 Line Interface PCB assembly
1	15-way high density D-range plug
1	shroud (alternative shroud - not required for T2000 Series II radios)
28	0 Ω chip resistors
1	1 μ capacitor (*C64)
1	4 μ 7 capacitor (*C60)
3	M3x8 pan Pozi Taptite screws
2	4-40x $\frac{1}{4}$ pan Pozi Taptite screws (black)

8.14.2 Fitting

- 1 Refer to Figure 8.14.1.

Remove the top cover of the radio by unscrewing the four cover screws, unclip the D-range blanking plate in the rear of the T2000 radio, unscrew the logic PCB and fold-out.

Position the T2000-80 PCB as shown, and connect the Micromatch connectors P13 and P14 to S13 and S14 on the T2000 logic PCB.

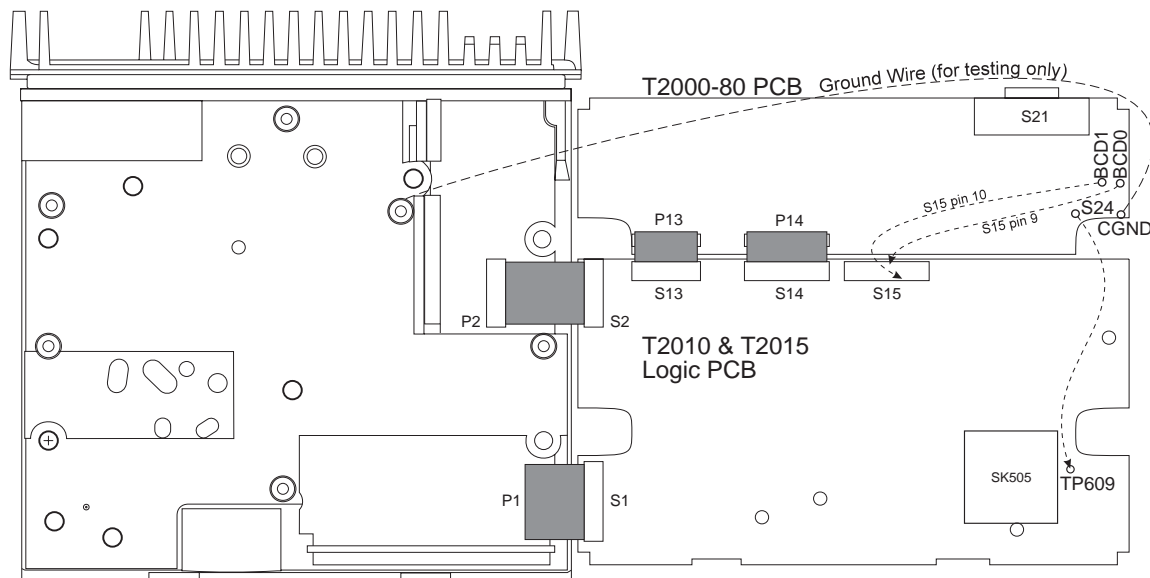


Figure 8.14.1 T2000-80 Line Interface PCB Mounting (T2010/T2015 shown)

- 2 T2010 & T2015: Remove R513 (0 Ω resistor) on the logic PCB.

3 Tx/Rx Out Function

Connect a wire from S24 on the T2000-80 PCB to S609 on the logic PCB, as shown in Figure 8.14.1.

4 External Channel Control (T2010 Only)

Connect the 2 BCD lines as shown in Figure 8.14.1.

5 Refer to Section 8.14.3, "Line Interface Options", Section 8.14.6, "Applications" and the circuit diagram before selecting the T2000-80 PCB linking options.

Set up the T2000-80, as described in Section 8.14.4, "T2000-80 Set-Up".

6 Carefully fold the logic and T2000-80 PCBs back in position, guiding the D-range connector through the hole provided in the T2000 chassis.

Secure using the three logic PCB retaining screws and the three M3x8 screws provided, and refit the top cover.

Plug the D-range assembly provided in the kit into the D-range connector (S21).

Note: Holes are provided in the T2000 chassis for the D-range plug locking screws. Use the two black 4-40 Taptite screws provided in the kit to form the threads.

8.14.3 Line Interface Options

T2000-80 Link Options

Provision has been made on the T2000-80 PCB for many different application conditions. Refer to the circuit diagram, PCB layout, the T2000 options connections table below, and the T2000-80 Signal Specifications table for details of options and links.

The PCB links are either solder shorted or fitted with 0Ω SMD resistors.

Note: To prevent the possibility of damage, check the Signal Specifications table before attempting to change the configuration.

The following table sets out the standard T2000-80 linking options for T2010 and T2020 models.

Link	Option
LINK1A	Rx de-emphasis
LINK2B LINK27B LINK28B	6 pole line output filter
LINK3A LINK4A	600 ohm output
LINK5	0dB line output attenuation
LINK9	Line input and output linked
LINK12B LINK13	Tx pre-emphasis
LINK16A	Mic. mute on line input PTT
LINK17A	Rx gate standard radio (T2010/T2020)
LINK18A	Opto control standard
LINK19A	Auxiliary control
LINK20A	PTT in
LINK21A	Key (0V)
LINK22B	Busy (0V)
LINK24A	Output (Tx5V/Rx0V)
LINK26B	Synth in Lock (0V)

Additional Components

*C60 (4μ7): This is provided to give a slight time delay to the Rx gate signal, if required.

*C64 (1μ): This is provided to give a slight time delay to the release of transmit, if required.

*C120 (4n7): Provision has been made on the PCB to fit an extra potted mylar capacitor for line matching, if required.

T2000-80 Pad Connections

The following table describes the T2000-80 pad connections found on the bottom side of the T2000-80 PCB.

Pad	Signal	Description
S22	BCD1	Connect to S15 pins 9 (BCD0) and 10 (BCD1) on T2010 logic PCB for channel remote switching. Enabled in software.
S23	BCD0	
S24	TX-REG	Output indicating whether the radio is transmitting or receiving. Used for modem control applications. Tx = +5V Rx = 0V
S25	Spare	Uncommitted line to S21
S35	CGND	True ground used for RF decoupling capacitors. Must be connected to radio chassis if logic and T2000-80 PCBs are folded out during set-up and test.

T2000 Options Connections

The following table described the signals used for line interface on P13 and P14.

Pin No.	Signal	Description
P13-1	DET-AF-OUT	Output, buffered and low pass filtered, for flat response (60% deviation, 0.25Vp-p, 1kHz).
P13-3	RX-LINE-OUT	De-emphasised and high pass filtered output (60% deviation, 0.4Vp-p, 1kHz). High pass filter circuit depends on presence of sub-audible tone signalling. Used for de-emphasised response.
P13-6	TX-LINE-IN	Input to pre-emphasis stage, bypasses compressor. Used for the pre-emphasised response (60% deviation, 0.3Vp-p, 1kHz). Line input will override microphone signal if both are present.
P13-8	TX-SIG-IN	Low gain input to T2000 limiter stage. Bypasses pre-emphasis and high pass filtering, used for the flat response (60% deviation, 2.2Vp-p, 1kHz).
P13-11	OPT-GND	Earth from the regulator section of the T2000 main PCB. Used to avoid earth loop noise.
P13-12	+13.8V-UNSW	Unswitched +13.8V supply from the T2000. Powers audio PA and external opto key circuits.
P14-1	+13.8V	Switched +13.8V supply from T2000. Powers line interface PCB +8V regulator.
P14-2	+5.0V	+5V from T2000 main PCB regulator. Powers hex inverter ICs and trunking switches.
P14-3	BUSY	Output BUSY = 0V is used to inhibit line input derived key and line input mutes. On trunked versions is used for inhibit logic.
P14-4	RX-GATE	Output port used to open the mute element in the T2000. Used to control line output mute. Note: Unmute = +5V for T2010 and T2020; Unmute = 0V for T2030 and T2040. This also drives the line key and opto driver indirectly.
P14-5	PTT-TO-OPT	Output mirrors PTT from microphone or signalling. PTT = 0V. On trunked versions is used for inhibit logic.
P14-6	PTT-FROM-OPT	Input port to key transmitter. Used for line input derived key and microphone derived key.
P14-7	IN-LOCK	Synthesiser phase lock detector output. Used for modem control applications. Lock = 0V.
P14-8	MIC-MUTE	Input port used to disable local microphone signal on line input derived PTT (not on microphone PTT). Mute = +5V.
P14-13	AUX	Auxiliary control output configurable in software. Used to enable/disable crossband linking, 2 wire linking etc. (see trunked versions). Aux on = +5V.
Trunking Models: Additional Functions		
P14-5	PTT-TP-OPT	For inhibiting modem output on PTT from microphone.
P14-10	EMERG	Performs a new function. 'External call request' = 0V input. Used for modem calls on a trunked system.
P14-11	CALL-SW	Performs a new function. 'Traffic channel allocated' = +5V output. Used for modem calls on trunked system.
P14-13	FCN/BELL/AUX	Performs a new function. 'Not clear to send' = +5V output. Used for modem calls on trunked system.

8.14.4 T2000-80 Set-Up

Test Equipment Required

- AF signal generator
- distortion analyser
- frequency counter
- Modulation analyser
- High impedance voltmeter (e.g. VTVM)
- Oscilloscope
- Power meter
- Power supply (+13.8V)
- RF signal generator
- 40dB RF attenuator
- 600Ω step attenuator

The following diagram shows the test set-up.

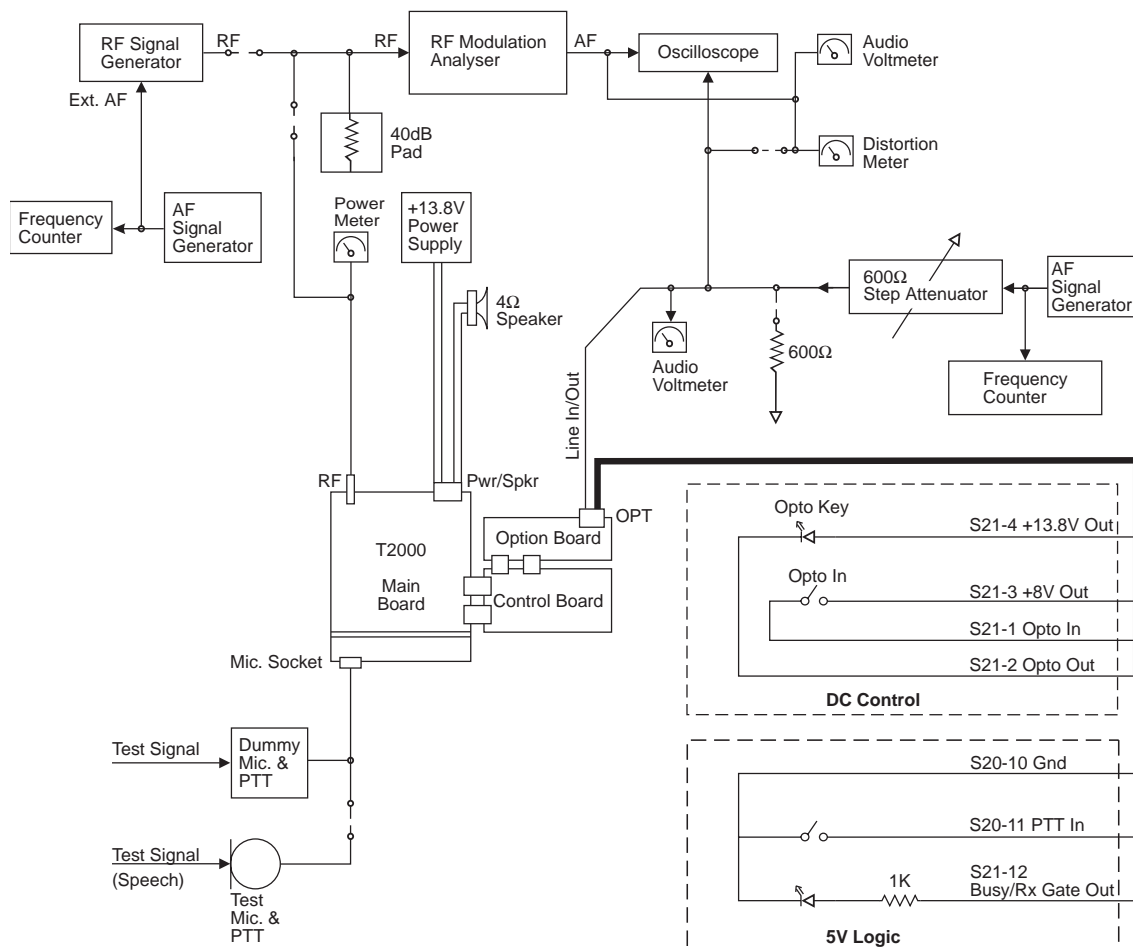






Figure 8.14.2 Test Equipment Set-Up

Set-Up Precautions

- 1 The adjustment section assumes that the T2000 radio has been correctly aligned for normal operation. Refer to Section 8.14.3, "Line Interface Options" and the circuit diagram for linking and application details.
- 2 If the logic and T2000-80 PCBs are unscrewed and folded out for adjustment, a wire should be temporarily fitted from the radio chassis to the options chassis ground pad (S35), as shown in Figure 8.14.1.
- 3 Signals for balanced transmissions are generally less than 0dBm, and are typically between -10dBm and -20dBm.
- 4 Ensure that the **auxiliary** LED  is on (**function** LED  on trunking radios).

Note: Deviation settings are given first for wide band radios, followed by settings for narrow band radios in brackets [].

Line Output Level

- 1 Ensure that the **auxiliary** LED  is on (**function** LED  on trunked radios).

- 2 Monitor the line output (S21 pin 5).

Apply an on channel signal from the RF signal generator at an output level of -70dBm, modulated to $\pm 3\text{kHz}$ [$\pm 1.5\text{kHz}$] deviation, at 1kHz AF.

Adjust the RV1 (line output control) for the required output level.

Note: If the line output level is to be less than -15dBm, short LINK6 (600 Ω output) and remove LINK5, to select 15dB of attenuation.

Line Input Sensitivity

- 1 Monitor the line input (S21 pin 15).

Ensure the **BUSY** indicator is off, and key the transmitter via the opto input (+8V).

- 2 Adjust RV2 (line input sensitivity control) until $\pm 3\text{kHz}$ [$\pm 1.5\text{kHz}$] deviation at 1kHz is achieved.

Note: For input signals of greater than -15dBm, set the line input attenuation for 15dB (LINK11 open).

Time Delay Circuit

This circuit delays audio gate turn on after PTT, to prevent squelch noise bursts in repeater applications.

- 1 Enable the time delay circuit by solder shorting LINK23.
- 2 Set the required time delay using RV3 (time delay control).

8.14.5 Signal Specifications

The following table describes the electrical specification of T2000-80 interface signals available at the 15 way high density D-type connector (S21), mounted on the heatsink at the rear of the radio.

S21 Pin No.	Signal	Description
1	OPTO-IN	Input for external opto coupled line current detector. +8V logic.
2	OPTO-OUT	Output to drive external opto coupled line current switch. 1k ohm series resistor for LED.
3	+8V-OUT	+8V output to supply external opto coupled line current detector.
4	+13.8V-OUT	Switched +13.8V output to provide an unisolated keying supply.
5	LINE-OUT	Output audio path to transmission line or transformer.
6	KEYING	Bi-directional key line for use with simple two wire linking (optionally linked to OPTO-IN internally). +8V logic.
7	BCD0-OUT	Inputs used for 4 channel remote switching with the T2010. +5V logic.
8	BCD1-OUT	
9	Spare	Decoupled uncommitted line.
10	GND	Options ground. This is earth derived from the regulator section of the T2000 main PCB. Used to avoid earth loop noise.
11	PTT-IN	Keys transmitter and operates line control logic. Trunking PTT selectable. +5V logic, sense selectable by links.
12	BUSY/GATE	Busy or Rx gate output. Trunking busy link selectable. +5V logic, sense selectable by links.
13	IN-LOCK-OUT	Synthesiser lock detector output. +5V logic, sense selectable by links.
14	TX/RX-OUT	Tx regulator control output. Indicates whether the radio is in Tx or Rx. +5V logic, sense selectable by links.
15	LINE-IN	Input audio path to transmitter audio stages. Normally linked to LINE-OUT for a bi-directional line but is able to be separated for other applications using two transmission lines.
-	CGND	Provided via S21 D-range and cable screen if required for RF susceptibility.

The following diagram shows the pin designations of S21, viewed from the rear of the radio.

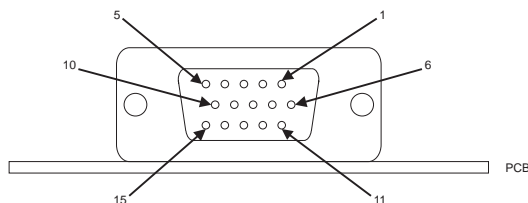


Figure 8.14.3 15 Way D-Range connector (S21)

8.14.6 Applications

Filters

The frequency response of the line output low pass filter is selectable by LINK2, LINK27 and LINK28.

- 2 pole: -12dB/octave stopband attenuation, $f > 4\text{kHz}$.
- 6 pole: -36dB/octave stopband attenuation, $f > 4\text{kHz}$.

The 2 pole LPF is for applications requiring minimal group delay and stopband attenuation, e.g. standard configuration, crossband 2 wire + earth, modem connection.

The 6 pole LPF is for applications requiring external network connection where stopband attenuation is mandatory above 4kHz, e.g. crossband via external network (balanced line + opto key), remote controlled audio via external network (balanced line + opto key).

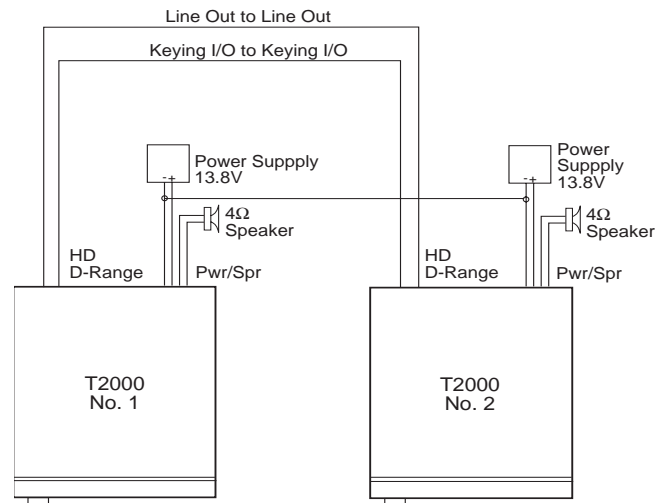
Simple 2 Wire Linking

This is the control of 2 radios operated together, crossband or repeater linked.

- 1 Check that LINE-OUT is linked to LINE-IN internally (LINK9 fitted).

Fit LINK15 to link KEYING to OPTO-IN. This provides control in both directions. The unit generating the keying signal is already Tx inhibited.

- 2 Wire LINE-OUT (S21-5) on one T2000 to LINE-OUT (S21-5) on the other T2000. Wire KEYING (S21-6) on one T2000 to KEYING (S21-6) on the other T2000.



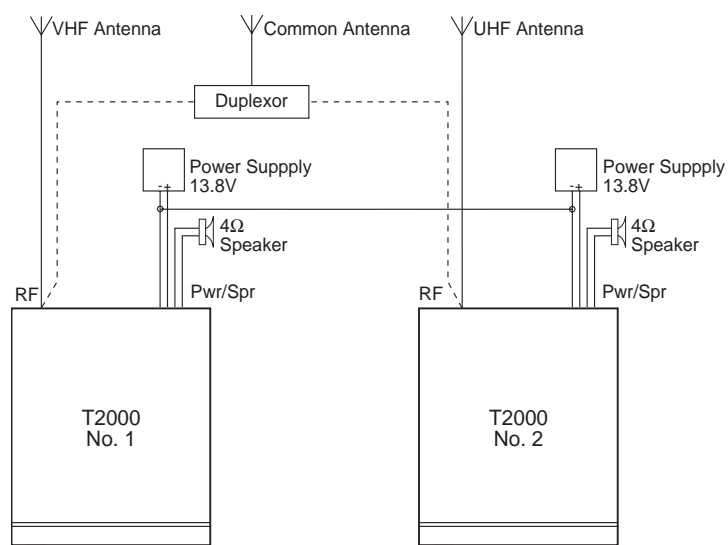
- 3 The time delay circuit may be required to eliminate squelch noise bursts for crossband operation with repeaters. LINK23 enables this circuit, which is adjustable using RV3 (refer to Section 8.14.4, "T2000-80 Set-Up").

Note: The 2 wire circuit assumes that the 2 radios are effectively earthed together at either the power supply or the power connector.

Note: A high line level is desirable to avoid earth noise i.e. 0dBm (0.775Vrms).

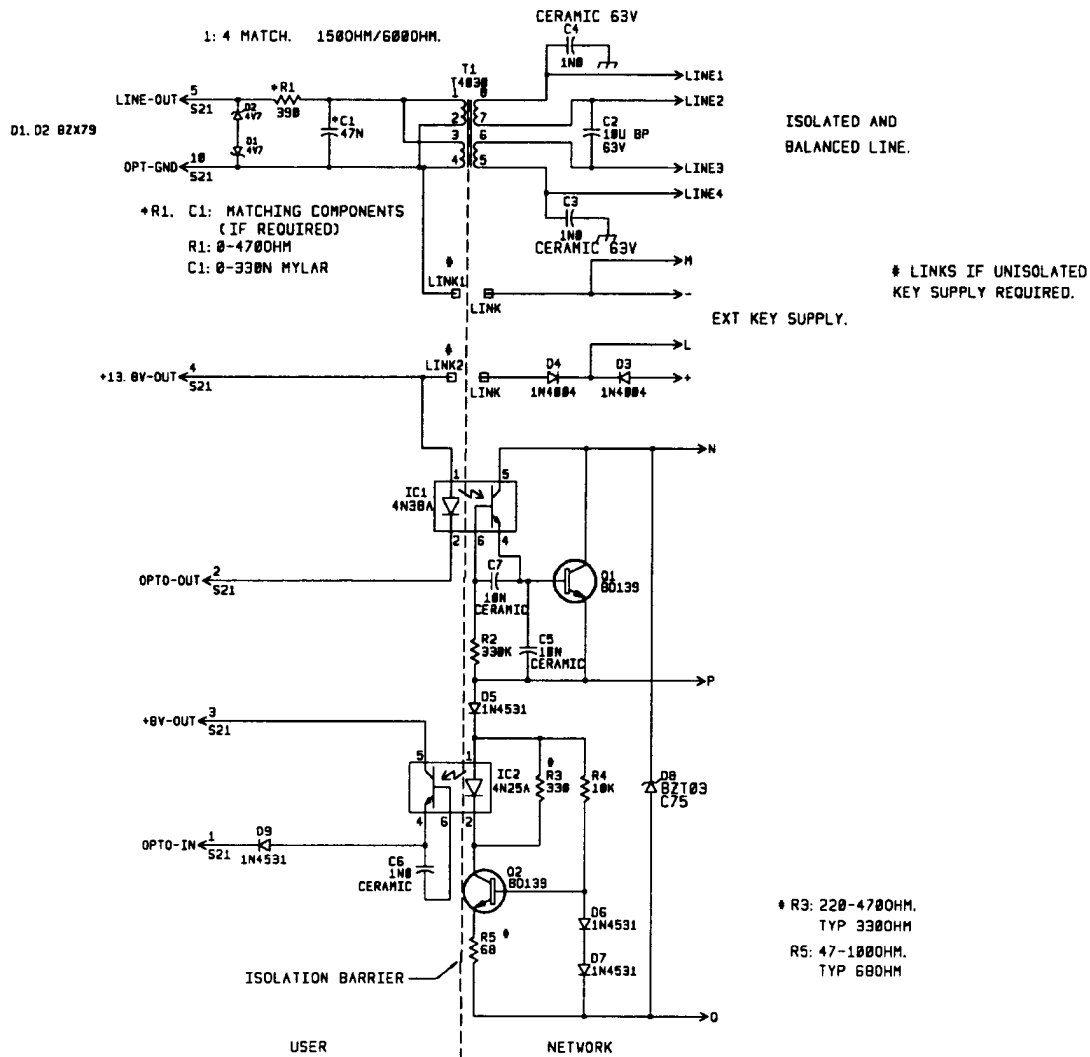
Crossband Radios

Crossbanded radios i.e. UHF/VHF, can be achieved by using space isolated antennas to avoid de-sensing, as shown below.



Alternatively, in-band linked radios will require a duplexor to feed a common aerial.

External Circuits For Opto Line Keying & Balanced Circuits

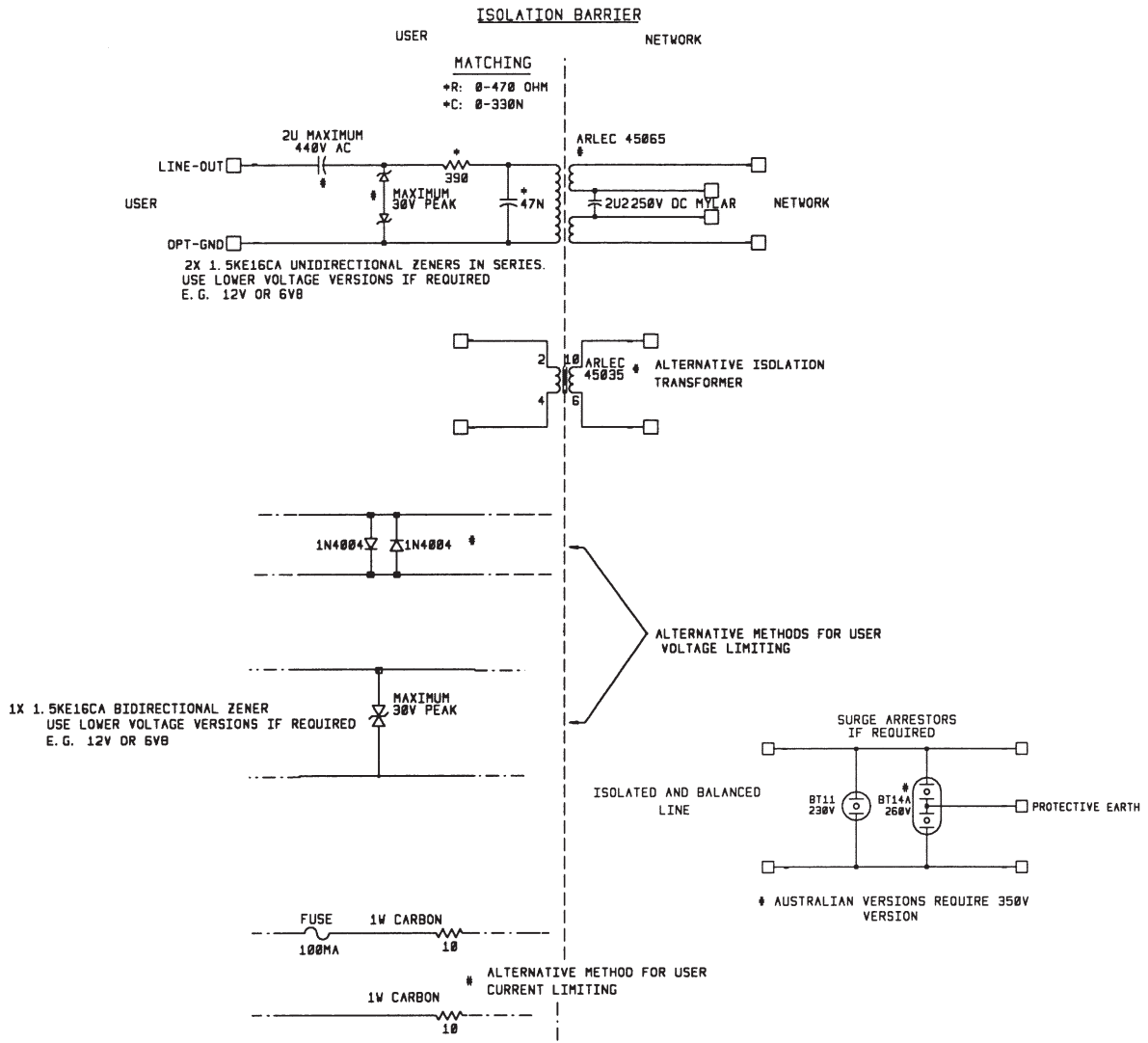


Note: The T4030, 4N38A and 4N25A are not intended for mains rated isolation.

- Mains rated transformer: Arlec 45035 (suitable for PSTN lines) 600/600 only, 4kVrms rated.
- HV rated transformer: Arlec 45065 (suitable for private lines) 600/600 or 600/150, 3.5kV rated.
- Transformer T4084: 2kVrms.
- Transformer T4030: no HV specification.
- Mains rated opto-isolators: CNY17G
CNW85

Refer to the M008-50 Service Manual for line keying connection diagrams.

Line Barrier, Private Lines

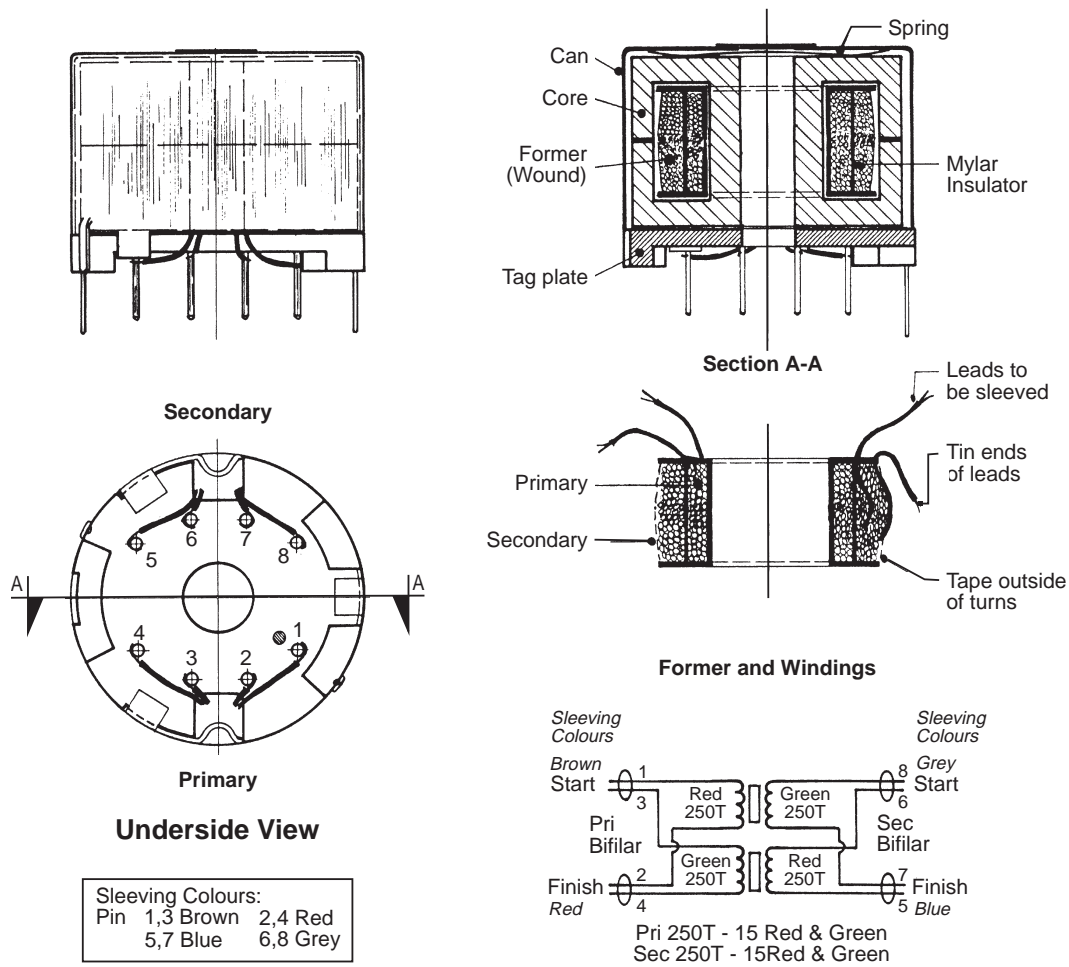


Refer to Austel Technical Standard TS 001:1991 'Safety Requirements For Customer Equipment' for other configurations.

Note: These circuits will require approval to the appropriate standards before use.

- Mains isolation: 4kVrms/8mm CrCl required + 2.5mm CrCl from protective earth on surge arresters.
- Private lines: 3.5kV.
- Arlec 45035: PSTN/mains rated.
- Arlec 45065: private line rated.

T4030 Transformer Specifications:

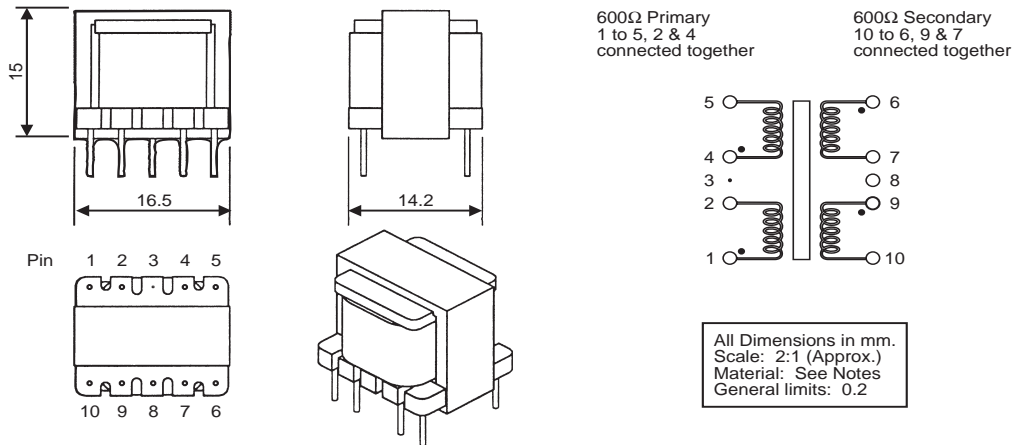


Transformer T4030 Pot Core IPN 053-01017-00

Note: Cores must be properly aligned when assembled.
 Core faces must be clean and free from grease and dirt.
 Ensure tag plate is firmly pressed against can before folding tabs.

Core	.. P26/16 - μ 1910
Former	.. single
Number of Turns:	
Primary	.. 250 bifilar
Secondary	.. 250 bifilar
Material	.. 15mm self flux
Tape	.. thermosetting electrical grade
Sleeving	.. inside diameter all colours, 0.5mm
Inductance 1	.. $6 \pm 1.5H$
(total series inductance, pin 1 to 5 - connect pins 2 & 3, 4 & 8 and 7 & 6)	
Inductance 2	.. $1.5 \pm 0.4H$
(any winding, with all others open circuit)	

T4084 Transformer Specifications:



Transformer T4084 IPN 053-01067-00

Impedance	.. 600Ω /600Ω centre tapped, separated
Output Level	.. 0dBm at 1kHz
Frequency Response	.. +0.2dB, -0.5dB 300Hz to 3400Hz relative to 1kHz at 0dBm output
Insertion Loss	.. <0.75dB, 0dBm output at 1kHz
Return Loss (relative to 600Ω):	
At 1kHz	.. >15dB
At 300Hz	.. >10dB
Distortion (unbalanced current):	
1kHz 0dBm out 0mA DC	.. <0.2%
1kHz 0dBm out 5mA DC	.. <0.7%
300Hz 0dBm out 0mA DC	.. <1.0%
300Hz 0dBm out 5mA DC	.. <6.0%
Level reduction due to 5mA DC at 300Hz	.. <2dB
Impedance Balance About Earth	.. >46dB over 50Hz to 3400Hz
Insulation:	
DC Primary to Secondary	.. 500V R>10MΩ
Primary & Secondary to core	.. 500V R>10MΩ
A.C.Primary to Secondary	.. 2kVrms 60sec.
Primary & Secondary to core	.. 2kVrms 60sec.
Ferrite Core	.. see 16 x 7 10 Pin Bobbin Harvard Inds. Ref. Cerf. 2611
Primary Inductance (1kHz 1 to 5, 2 & 4 connected together)	.. 500mH ±50mH typical
Leakage Inductance (10kHz; 1 to 5, 2 & 4 connected together, 6, 7, 9, & 10 connected together)	.. 700μH ±100μH typical
Primary DC Resistance:	
1-2	.. 8.3Ω typical
4-5	.. 8.3Ω typical
Secondary DC Resistance:	
10-9	.. 14.6Ω typical
7-6	.. 14.6Ω typical

8.14.7 Specifications

T2000-80

Input Voltage (from S13 & S14 on the T2000 logic PCB)	.. 10.8V to 16V DC
Operating Temperature Range	.. -10°C to +60°C ambient
DC Input Current	.. < 40mA total (+13.8V supply)
Line Input Sensitivity (60% deviation)	.. -20dBm to +6dBm (600Ω)
Line Output Level (60% deviation)	.. -20dBm to +6dBm (600Ω)
Line Impedance	.. 600 or 150Ω
Return Loss (300Hz to 3kHz).	.. > 20dB relative to 600 or 150Ω
Line Output Filter Response (stopband):	
2 pole	.. -12dB/octave, f > 4kHz
6 pole	.. -36dB/octave, f > 4kHz

T2000 + T2000-80 Line Interface

a Receiver + Line Output

Receiver Frequency Response (relative to 1kHz, 60% deviation):	
Receiver Processed:	
Bandwidth	.. 300Hz to 3kHz (standard) 400Hz to 3kHz (CTCSS)
Response	.. +1, -3dB relative to -6dB/octave
Receiver Unprocessed	.. +1, -3dB (300Hz to 3kHz)
Test signal	.. -70dBm RF, 60% deviation at 1kHz, 0dBm line output.
Signal-to-Noise Ratio:	
Narrow Band	.. > 39dB
Wide Band	.. > 45dB
Mute Ratio	.. > 65dB
Distortion (30kHz band width distortion meter):	
Wide Band De-emphasised	.. < 2%
Narrow Band De-emphasised	.. < 3%
Wide Band Flat	.. < 4%
Narrow Band Flat	.. < 6%

b Transmitter + Line Input

Transmitter Frequency response:

Transmitter Processed:

(relative to 1kHz, 20% deviation, below limiting)

Bandwidth	.. 300Hz to 2.55kHz (narrow band)
	300Hz to 3kHz (wide band)

Response	.. +1, -3dB relative to +6dB/octave
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Transmitter Unprocessed (relative to 1kHz, 60% deviation):

Bandwidth	.. 300Hz to 2.55kHz (narrow band)
	300Hz to 3kHz (wide band)

Response	.. +1, -3dB
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Test signal	.. 0dBm line input, 1kHz, 60% deviation
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Signal-to-Noise Ratio:

(demodulated, filtered 300Hz to 3kHz + de-emphasised 750 μ s rms)

Narrow Band	.. > 39dB
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Wide Band	.. > 45dB
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Distortion	.. < 2%
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(demodulated, filtered 15kHz low pass)

8.14.8 Circuit Description

Refer to Figure 8.14.4, Figure 8.14.4 and the circuit diagram.

Line Output Path

Flat or de-emphasised audio from the receiver is selected by links to DET-AF-OUT or RX- LINE-OUT. Receiver audio passes through a mute element to a buffer amplifier, and then to three stages of low pass filtering. Two responses are selectable by links: 2 pole or 6 pole roll-off beyond 4kHz.

The filtered signal passes to a second mute element and level control before passing to the line output drive amplifier. Line output impedance and attenuation are selectable by links. Line output can be linked to line input for a shared line in, line out.

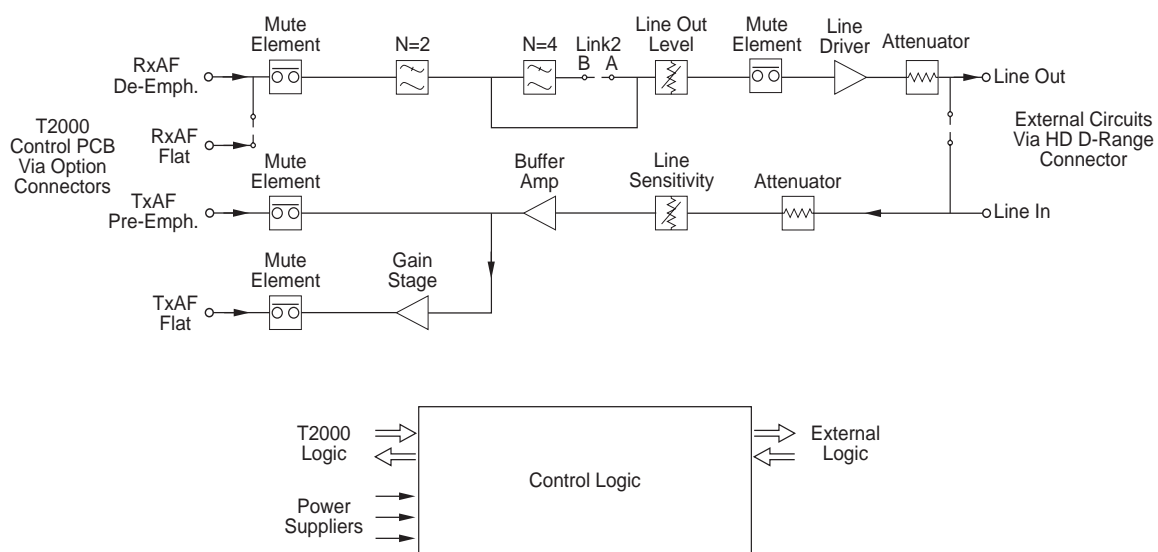


Figure 8.14.4 T2000-80 Line Interface PCB Block Diagram

Line Input Path

The line input has terminations for two line impedances which are link selectable. The line input level can be attenuated, if required, before passing to the line sensitivity control. Protection diodes are fitted to prevent the following amplifier stage from being overdriven.

The amplifier provides gain and buffers the signal, which is split into two paths for either pre-emphasis or flat response. The pre-emphasis path is via a mute element and options linking. This signal drives TX-LINE-IN, which will override the microphone signal. Normally, the microphone is muted on line derived PTT.

The flat response path is amplified and then passes to a mute element which drives TX-SIG-IN. This input requires a high signal level, due to the high input impedance. The amplifier is disabled by links, when not used, to prevent the possibility of crosstalk and leakage to other circuitry.

Control Logic

For standard mobiles in normal operation, the audio mute elements, transmit inhibit and opto driver are all inhibited by the auxiliary control. The radio can be used normally with 'auxiliary off', and line controlled with 'auxiliary on'.

With 'auxiliary on', the line output mute elements and opto driver are controlled from the RX-GATE. A signal on the BUSY line inhibits the transmitter line key circuitry. Line derived key signals, such as OPTO-IN, KEYING and PTT-IN, can be used to key the radio, provided the auxiliary control is on and the radio is not busy.

The KEYING line is used for back-to-back control of two radios, each with a line interface PCB. This enables crossband linking to be achieved with a minimum of external circuitry. In this case, the KEYING line can be linked to the OPTO-IN line on each unit, with a wire between the two OPTO-IN lines providing bi-directional control. KEYING is controlled by the receive gate and is used to drive the opto input of another line interface PCB.

The opto input is intended to be connected to the output of an optocoupler circuit (BJT) used for loop and tail keying via transmission lines (refer to Section 8.14.6, "Applications").

The opto output is intended to be connected to the input of an optocoupler circuit (LED) used for loop and tail keying via transmission lines (refer to Section 8.14.6, "Applications"). The sense of this circuit can be changed by a link.

An adjustable time delay circuit is available to prevent transmitter cycling when crossband connected radios are both operating on repeater channels. The circuit is adjustable to approximately 1.5 seconds, with the time delay control fully clockwise, and can be disabled completely by removing a link.

PTT-IN can be used to key the transmitter. Links are available to enable either logic sense. For trunked versions using modems, a circuit is provided to set up a call automatically.

Control logic for telemetry and modems is provided so that the radio can be operated automatically. IN-LOCK-OUT, BUSY/GATE and TX/RX-OUT outputs can be set by links for either logic sense.

Trunked modems operate in a different manner, and first have to set up a call to obtain a traffic channel allocation.

Logic is available which requires several link changes, as some of the radio options connections perform different functions:

Standard	Trunked
AUX on/off	not clear to send
emergency	external call request
call	traffic channel allocated

Power Supplies

+5V is provided from the main regulator via the options connector. +8V is provided by a TO-92 3 terminal regulator. This is also available on the T2000-80 PCB D-range connector, for powering an optocoupler transistor used for line key current detection. The +13.8V input of the regulator is derived from the options connector. The +3.2V rail provides bias to the audio stages and is derived from the +8V regulator. The unswitched +13.8V from the options connector powers the line drive amplifier, and is available on the T2000-80 D-range for use as an unisolated line key supply option.

8.14.9 PCB Information

T2000-80 Parts List (IPN 220-01272-02)

Ref	IPN	Description	Ref	IPN	Description
C6	015-23220-01	CAP CER 0805 CHIP 220P 5% NPO 50V	IC1	002-10040-53	(S) IC 4053 SMD TRIPLE 2CH MULTI-PLEXR
C9	015-23220-01	CAP CER 0805 CHIP 220P 5% NPO 50V	IC2	002-10003-58	(S) IC SMD LM358 DUAL OP AMP
C18	022-55100-10	CAP MYLAR AI 10N 5% 63V POTTED	IC3	002-10003-58	(S) IC SMD LM358 DUAL OP AMP
C45	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	IC4	002-10040-53	(S) IC 4053 SMD TRIPLE 2CH MULTI-PLEXR
C46	015-23470-08	CAP CER 0805 CHIP 470P 10% X7R 50V	IC5	002-10003-58	(S) IC SMD LM358 DUAL OP AMP
C47	022-54330-10	CAP MYLAR AI 3N3 5% 63V POTTED	IC6	002-10040-69	(S) IC 4069 SMD CMOS HEX INVERTERS
C48	015-23220-01	CAP CER 0805 CHIP 220P 5% NPO 50V	IC7	002-10040-69	(S) IC 4069 SMD CMOS HEX INVERTERS
C49	015-23220-01	CAP CER 0805 CHIP 220P 5% NPO 50V	IC13	002-00014-60	(S) IC 78L08A 8V 100MA REG TO-92
C50	015-23180-01	CAP CER 0805 CHIP 180P 5% NPO 50V	IC14	002-00014-05	(S) IC TDA7231 1.6W AF PWR
C51	015-23100-01	CAP CER 0805 CHIP 100P 5% NPO 50V			
C52	022-54470-10	CAP MYLAR AI 4N7 5% 63V POTTED	LINK1	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C53	015-23180-01	CAP CER 0805 CHIP 180P 5% NPO 50V	L1	056-00021-02	IND FXD 100UH AXIAL
C54	015-22220-01	CAP CER 0805 CHIP 22P 5% NPO 50V	LINK2	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C55	022-55100-10	CAP MYLAR AI 10N 5% 63V POTTED	LINK3	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C56	020-54740-10	CAP ELECT AI RDL 4U7 50V LO ESR	LINK4	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C57	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK5	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C58	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK6	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C59	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK7	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C61	020-57100-55	CAP ELECT AI RDL 1UF 50V 4X7MM	LINK8	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C62	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK9	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C63	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK10	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C65	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK11	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C66	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK12	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C67	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK13	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C68	015-25100-08	CAP CER 0805 CHIP 10N 10% X7R 50V	LINK14	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C69	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK15	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C70	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK16	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C71	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK17	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C72	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK18	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C73	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK19	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C74	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK20	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C75	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK21	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C76	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK22	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C77	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO	LINK23	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C78	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO	LINK24	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C79	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK25	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C80	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO	LINK26	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C81	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	LINK27	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C82	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	LINK28	036-10000-00	RES M/F 0805 CHIP ZERO OHM
C83	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO			
C84	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO	P13	240-00026-26	CONN PADLE BRD 12 WAY MICRO MATCH 1-215
C85	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	P14	240-00020-54	PLUG 16 WAY 2X8 FLAT CABLE TERMN MICROM
C86	015-23150-01	CAP CER 0805 CHIP 150P 5% NPO 50V	P15	240-00020-51	PLUG 12 WAY 2*6 FLAT CABLE TERMN
C87	015-23150-01	CAP CER 0805 CHIP 150P 5% NPO 50V			
C88	015-23150-01	CAP CER 0805 CHIP 150P 5% NPO 50V	Q1	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C89	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO	Q2	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C90	020-59100-13	CAP ELECT AI RDL 100UF 16V 7X7MM MICRO	Q3	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C91	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	Q4	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C92	015-22470-01	CAP CER 0805 CHIP 47P 5% NPO 50V	Q5	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C93	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	Q6	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C94	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	Q7	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C95	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	Q8	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C96	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	Q9	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C97	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	Q10	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C98	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	Q11	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C99	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	Q12	000-10008-48	(S) XSTR SMD BCW60/BC848B215 NPN SOT23 A
C100	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	Q13	000-10008-57	(S) XSTR SMD BCW70/BC857-215 PNP SOT23 AF
C101	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C102	015-22470-01	CAP CER 0805 CHIP 47P 5% NPO 50V	RV1	042-04470-07	RES PRESET 4K7 CARBON 6MM FLAT DUAL ADJ
C103	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	RV2	042-04470-07	RES PRESET 4K7 CARBON 6MM FLAT DUAL ADJ
C104	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	RV3	042-05470-07	RES PRESET 47K CARBON 6MM FLAT DUAL ADJ
C105	022-54220-10	CAP MYLAR AI 2N2 5% 63V POTTED	R50	036-15100-00	RES M/F 0805 CHIP 10K 5%
C106	020-58100-04	CAP ELECT AI RDL 10M 16V 4X7MM	R51	036-15330-00	RES M/F 0805 CHIP 33K 5%
C107	015-22470-01	CAP CER 0805 CHIP 47P 5% NPO 50V	R52	036-15330-00	RES M/F 0805 CHIP 33K 5%
C108	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	R53	036-15100-00	RES M/F 0805 CHIP 10K 5%
C109	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	R54	036-15330-00	RES M/F 0805 CHIP 33K 5%
C110	015-24100-08	CAP CER 0805 CHIP 1N 10% X7R 50V	R55	036-15330-00	RES M/F 0805 CHIP 33K 5%
			R56	036-14100-00	RES M/F 0805 CHIP 1K 5%
D1	001-10000-56	(S) DIODE SMD BAW56 DUAL SWITCH SOT-23 C	R57	036-15100-00	RES M/F 0805 CHIP 10K 5%
D2	001-10000-99	(S) DIODE SMD BAV99 DUAL SWITCH SNGLE INLI	R58	036-15220-00	RES M/F 0805 CHIP 22K 5%
D3	001-10000-56	(S) DIODE SMD BAW56 DUAL SWITCH SOT-23 C	R59	036-15220-00	RES M/F 0805 CHIP 22K 5%
D5	001-10000-70	(S) DIODE SMD BAV70 DUAL SWITCH SOT-23 CO	R60	036-14100-00	RES M/F 0805 CHIP 1K 5%
D7	001-10000-56	(S) DIODE SMD BAW56 DUAL SWITCH SOT-23 C	R61	036-14100-00	RES M/F 0805 CHIP 1K 5%
D8	001-10000-56	(S) DIODE SMD BAW56 DUAL SWITCH SOT-23 C	R62	036-17100-00	RES M/F 0805 CHIP 1M 5%
D9	001-10000-56	(S) DIODE SMD BAW56 DUAL SWITCH SOT-23 C	R63	036-15470-00	RES M/F 0805 CHIP 47K 5%
			R64	036-12100-00	RES M/F 0805 CHIP 10E 5%

Ref	IPN	Description	Ref	IPN	Description
R65	036-17100-00	RES M/F 0805 CHIP 1M 5%	R145	036-15470-00	RES M/F 0805 CHIP 47K 5%
R66	036-17100-00	RES M/F 0805 CHIP 1M 5%	R146	036-14100-00	RES M/F 0805 CHIP 1K 5%
R67	036-15100-00	RES M/F 0805 CHIP 10K 5%	R147	036-16100-00	RES M/F 0805 CHIP 100K 5%
R68	036-16150-00	RES M/F 0805 CHIP 150K 5%	R148	036-15100-00	RES M/F 0805 CHIP 10K 5%
R69	036-15220-00	RES M/F 0805 CHIP 22K 5%	R149	036-16100-00	RES M/F 0805 CHIP 100K 5%
R70	036-14270-00	RES M/F 0805 CHIP 2K7 5%	R150	036-16100-00	RES M/F 0805 CHIP 100K 5%
R71	036-17100-00	RES M/F 0805 CHIP 1M 5%	R151	036-17100-00	RES M/F 0805 CHIP 1M 5%
R72	036-15100-00	RES M/F 0805 CHIP 10K 5%	R152	036-15100-00	RES M/F 0805 CHIP 10K 5%
R73	036-15100-00	RES M/F 0805 CHIP 10K 5%	R153	036-15100-00	RES M/F 0805 CHIP 10K 5%
R74	036-15470-00	RES M/F 0805 CHIP 47K 5%	R154	036-15100-00	RES M/F 0805 CHIP 10K 5%
R75	036-14220-00	RES M/F 0805 CHIP 2K2 5%	R155	036-14270-00	RES M/F 0805 CHIP 2K7 5%
R76	036-16150-00	RES M/F 0805 CHIP 150K 5%	R156	036-12100-00	RES M/F 0805 CHIP 10E 5%
R77	036-14470-00	RES M/F 0805 CHIP 4K7 5%	R157	036-17100-00	RES M/F 0805 CHIP 1M 5%
R78	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R79	036-14270-00	RES M/F 0805 CHIP 2K7 5%	S21	240-00010-58	SKT 15WAY D-RANGE HI-DENSITY RGT AG PCB
R80	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R81	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R82	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R83	036-14100-00	RES M/F 0805 CHIP 1K 5%			
R84	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R85	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R86	036-12100-00	RES M/F 0805 CHIP 10E 5%			
R87	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R88	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R89	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R90	036-12100-00	RES M/F 0805 CHIP 10E 5%			
R91	036-12100-00	RES M/F 0805 CHIP 10E 5%			
R92	036-14270-00	RES M/F 0805 CHIP 2K7 5%			
R93	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R94	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R95	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R96	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R97	036-14100-00	RES M/F 0805 CHIP 1K 5%			
R98	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R99	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R100	036-12100-00	RES M/F 0805 CHIP 10E 5%			
R101	036-15120-00	RES M/F 0805 CHIP 12K 5%			
R102	036-14820-00	RES M/F 0805 CHIP 8K2 5%			
R103	036-12100-00	RES M/F 0805 CHIP 10E 5%			
R104	036-12100-00	RES M/F 0805 CHIP 10E 5%			
R105	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R106	036-15470-00	RES M/F 0805 CHIP 47K 5%			
R107	036-13560-00	RES M/F 0805 CHIP 560E 5%			
R108	036-13150-00	RES M/F 0805 CHIP 150E 5%			
R109	036-11470-00	RES M/F 0805 CHIP 4E7 10%			
R110	036-14220-00	RES M/F 0805 CHIP 2K2 5%			
R111	036-13220-00	RES M/F 0805 CHIP 220E 5%			
R107	036-13560-00	RES M/F 0805 CHIP 560E 5%			
R108	036-13150-00	RES M/F 0805 CHIP 150E 5%			
R109	036-11470-00	RES M/F 0805 CHIP 4E7 10%			
R110	036-14220-00	RES M/F 0805 CHIP 2K2 5%			
R111	036-13220-00	RES M/F 0805 CHIP 220E 5%			
R112	036-13390-00	RES M/F 0805 CHIP 390E 5%			
R113	036-13390-00	RES M/F 0805 CHIP 390E 5%			
R114	036-13560-00	RES M/F 0805 CHIP 560E 5%			
R115	036-13150-00	RES M/F 0805 CHIP 150E 5%			
R116	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R117	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R118	036-12560-00	RES M/F 0805 CHIP 56E 5%			
R119	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R120	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R121	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R122	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R123	036-16100-00	RES M/F 0805 CHIP 100K 5%			
R124	036-15120-00	RES M/F 0805 CHIP 12K 5%			
R125	036-15120-00	RES M/F 0805 CHIP 12K 5%			
R126	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R127	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R128	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R129	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R130	036-13100-00	RES M/F 0805 CHIP 100E 5%			
R131	036-17100-00	RES M/F 0805 CHIP 1M 5%			
R132	036-14220-00	RES M/F 0805 CHIP 2K2 5%			
R133	036-16150-00	RES M/F 0805 CHIP 150K 5%			
R134	036-16150-00	RES M/F 0805 CHIP 150K 5%			
R135	036-14100-00	RES M/F 0805 CHIP 1K 5%			
R136	036-15220-00	RES M/F 0805 CHIP 22K 5%			
R137	036-14220-00	RES M/F 0805 CHIP 2K2 5%			
R138	036-15470-00	RES M/F 0805 CHIP 47K 5%			
R139	036-14270-00	RES M/F 0805 CHIP 2K7 5%			
R140	036-15220-00	RES M/F 0805 CHIP 22K 5%			
R141	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R142	036-15100-00	RES M/F 0805 CHIP 10K 5%			
R143	036-14270-00	RES M/F 0805 CHIP 2K7 5%			
R144	036-15100-00	RES M/F 0805 CHIP 10K 5%			

Mechanical & Miscellaneous Parts

020-57470-10	CAP ELECT AI RDL 4U7 50V LO ESR (*C60)
020-57100-55	CAP ELECT AI RDL 1UF 50V 4X7MM (*C64)
205-00010-12	CABLE FLAT RBBN 16 CORE 16/70.1 GREY (2 X 25MM)
220-01272-02	PCB T2000 LINE INTERFACE UNIT
240-00010-80	PLUG 15 WAY DRANGE HI-DENS SUBMIN SOLD
240-00026-24	CONN PADLE BRD 16 WAY MICRO MATCH 1-215
240-06010-28	HOOD/COVER 9WAY DRANGE COMPACT NO LO
240-06010-29	HOOD/COVER 9WAY DRANGE LONG EAR THUM
349-00020-06	SCREW TAPTITE 4-40X1/4 PAN POZI BL (TO TAP CHASSIS HOLES)
49-00020-32	SCREW TAPTITE M3X8MM PAN POZI BZ
365-00011-54	LABEL WHITE RW1556/2 SPECIAL ADHESIVE
365-00100-20	LABEL WHITE S/A 28X11MM QUIKSTIK RW718/4
399-00010-51	BAG PLASTIC 75*100MM
399-00010-86	BAG STATIC SHIELDING 127X203MM
410-00010-60	CARTON 150X112X56MM VICTOR
418-20080-01	FITTING INS T2000-80 LINE INTERFACE KIT

T2000-80 Grid Reference Index (IPN 220-01272-02)

Device	PCB	Circuit	Device	PCB	Circuit	Device	PCB	Circuit	Device	PCB	Circuit
C6	2:C3	1-H8				P14	1:E1	1-B8	R107	2:J2	1-P7
C9	2:C2	1-H9	D9	1:C3	1-H3			1-B8	R108	2:J3	1-P7
C18	1:D3	1-L9			1-H3			1-B0	R109	2:G3	1-Q8
C45	1:B2	1-D7	IC1	1:B2	1-M0			1-B0	R110	2:G3	1-R8
C46	2:C3	1-H8			1-E8			1-B4	R111	2:H3	1-S8
C47	1:C3	1-H9			1-E5			1-B4	R112	2:H3	1-S8
C48	2:C2	1-J8			1-E7			1-B2	R113	2:H3	1-S8
C49	2:D2	1-J8	IC2	1:C2	1-K0			1-B3	R114	2:H3	1-R8
C50	2:D2	1-J8			1-H8			1-N0	R115	2:H3	1-R8
C51	2:C3	1-J8			1-G8	Q1	1:G3	1-H1	R116	2:H3	1-S8
C52	1:C3	1-J9	IC3	1:D2	1-L0	Q2	1:F3	1-E1	R117	2:H3	1-S8
C53	1:D2	1-L8			1-L8	Q3	1:G3	1-H2	R118	2:H3	1-S8
C54	1:D2	1-L8			1-J8	Q4	1:K1	1-D0	R119	2:D3	1-K8
C55	1:D3	1-L8	IC4	1:J2	1-N0	Q5	1:D3	1-E0	R120	1:G3	1-G2
C56	1:E2	1-N8			1-R3	Q6	1:D4	1-I3	R121	2:J1	1-C2
C57	1:B2	1-E8			1-Q3	Q7	1:D3	1-J3	R122	1:J3	1-F6
C58	1:E3	1-O8			1-Q2	Q8	1:E3	1-O8	R123	1:J3	1-G7
C59	2:J3	1-U8	IC5	1:H3	1-K0	Q9	1:E3	1-H0	R124	1:J3	1-G6
*C60	1:G3	1-G1			1-G7	Q10	1:L2	1-S1	R125	1:H3	1-G6
C61	1:C3	1-H3			1-I6	Q11	1:C4	1-H1	R126	1:M3	1-U9
C62	1:K2	1-U2	IC6	1:K2	1-F3	Q12	1:G2	1-N3	R127	1:M3	1-U9
C63	2:B3	1-D6			1-G3	Q13	1:G2	1-N3	R128	1:K3	1-V3
*C64	1:H2	1-L2			1-O0	RV1	1:E3	1-O8	R129	2:J2	1-U3
C65	2:J3	1-U7			1-F3	RV2	1:H2	1-L7	R130	1:K3	1-V1
C66	1:J3	1-U3			1-G3	RV3	1:E2	1-G0	R131	2:E2	1-H0
C67	1:K2	1-U2			1-L4	R50	2:G2	1-N3	R132	2:E3	1-D1
C68	2:E2	1-N8			1-M4	R51	1:C2	1-G8	R133	1:H4	1-I6
C69	1:K3	1-U1	IC7	1:L2	1-P0	R52	1:C2	1-H8	R134	1:H3	1-I7
C70	2:J3	1-U6			1-C0	R53	2:B3	1-I8	R135	1:H3	1-K7
C71	1:K3	1-U1			1-C0	R54	2:C2	1-I8	R136	2:H2	1-L7
C72	1:E3	1-N8			1-P3	R55	2:C2	1-J8	R137	1:H4	1-H6
C73	1:L3	1-U4			1-M5	R56	2:E2	1-M8	R138	1:H4	1-I6
C74	1:L3	1-U5			1-L5	R57	1:D3	1-M8	R139	1:K1	1-D0
C75	2:A2	1-Q0			1-C3	R58	2:C2	1-K8	R140	1:D3	1-G0
C76	2:A4	1-R0	IC13	1:A3	1-Q0	R59	2:D2	1-K8	R141	1:L2	1-S2
C77	1:A3	1-Q0	IC14	1:F3	1-P8	R60	2:E2	1-O8	R142	2:L2	1-R1
C78	1:B3	1-R0				R61	1:B2	1-E9	R143	2:L3	1-R1
C79	2:A3	1-S0	LINK1	2:B1	1-B8	R62	1:B3	1-E9	R144	1:E3	1-E1
C80	1:B3	1-T0	L1	1:E2	1-R9	R63	1:E4	1-P8	R145	2:D3	1-F1
C81	2:F2	1-Q9	LINK1A	2:F1	1-B0	R64	2:J3	1-U8	R146	1:K3	1-I1
C82	2:F2	1-R9	LINK1B	2:F1	1-B1	R65	1:B1	1-D6	R147	2:C2	1-G9
C83	1:F2	1-Q9	LINK1C	2:F1	1-B0	R66	2:G1	1-C0	R148	1:C2	1-G8
C84	1:F2	1-Q9	LINK1D	2:F1	1-B0	R67	1:K1	1-D0	R149	2:B2	1-F8
C85	1:L3	1-U4	LINK2	2:D2	1-M8	R68	1:E3	1-D1	R150	1:B3	1-F9
C86	2:M2	1-S6	LINK3	2:G3	1-R8	R69	1:H3	1-I1	R151	2:B3	1-F9
C87	2:F3	1-S6	LINK4	2:H3	1-T8	R70	1:G3	1-G1	R152	2:G2	1-O3
C88	1:D1	1-S6	LINK5	2:H4	1-S8	R71	1:E1	1-F3	R153	1:G2	1-O3
C89	1:G3	1-P8	LINK6	2:H4	1-S8	R72	2:G1	1-B1	R154	1:L2	1-P3
C90	1:F3	1-Q8	LINK7	2:H3	1-S8	R73	1:D4	1-I3	R155	2:G2	1-N3
C91	2:G3	1-Q8	LINK8	2:H3	1-S7	R74	1:D4	1-J3	R156	2:G2	1-M2
C92	1:J3	1-G7	LINK9	2:J3	1-U7	R75	2:H2	1-L2	R157	1:H1	1-D2
C93	1:H3	1-G6	LINK10	2:H3	1-P7	R76	1:D4	1-J3	S21	1:K3	1-V5
C94	1:M2	1-U9	LINK11	2:H2	1-L7	#R77	2:J2	1-H3			1-V4
C95	1:M2	1-U9	LINK12	2:G4	1-H7	R78	1:G2	1-F3			1-V3
C96	2:L3	1-U5	LINK13	2:B1	1-C5	R79	2:E3	1-E0			1-V3
C97	1:K3	1-U3	LINK14	2:B2	1-E6	R80	2:E3	1-D0			1-V2
C98	1:B2	1-D5	LINK15	2:H2	1-U2	R81	2:J2	1-U3			1-V2
C99	1:C2	1-D6	LINK16	2:J1	1-C2	R82	1:K3	1-V2			1-V1
C100	2:B2	1-D8	LINK17	2:K2	1-G3	R83	1:B2	1-D7			1-V1
C101	1:H3	1-J7	LINK18	2:D3	1-F1	R84	2:B2	1-E6			1-V9
C102	1:H4	1-I6	LINK20	2:J2	1-S3	R85	1:B2	1-D7			1-V9
C103	1:J4	1-J6	LINK21	2:K1	1-O3	R86	2:J3	1-U7			1-V8
C104	1:J4	1-J6	LINK22A	2:K2	1-I4	R87	1:J3	1-V3			1-V7
C105	1:C3	1-I8	LINK22B	2:K2	1-I3	R88	1:K3	1-V2			1-V6
C106	1:E2	1-G0	LINK22C	2:K2	1-I3	R89	1:E3	1-N8			1-V5
C107	2:C2	1-G8	LINK22D	2:K2	1-I3	#R90	2:K3	1-V1			1-Q0
C108	1:B3	1-F8	LINK22E	2:L2	1-S1	#R91	2:K3	1-U6	S22	1:M3	1-B9
C109	2:B2	1-F8	LINK22F	2:K2	1-R3	R92	1:E3	1-O8	S23	1:M3	1-B9
C110	2:C2	1-H8	LINK23	2:F3	1-H0	R93	1:G1	1-C4	S24	1:L2	1-B5
*C120	1:H4	1-T8	LINK24	2:K2	1-N5	R94	1:L3	1-U4	S25	1:L3	1-B5
			LINK25	2:K1	1-Q1	R95	1:L3	1-U4	S26	1:D2	1-M8
D1	1:G2	1-N3	LINK26	2:K2	1-N4	R96	1:L2	1-C5	S27	1:C2	1-M9
		1-M3	LINK27	2:C2	1-H8	R97	1:L2	1-C5	S28	1:C1	1-C7
D2	1:H3	1-K7	LINK28	2:C3	1-H8	R98	2:L3	1-U5	S29	1:D1	1-C6
		1-K6				R99	1:L3	1-U5	S30	1:B2	1-C9
D3	1:D3	1-F0	P13	1:B1	1-B8	R100	2:A2	1-Q0	S31	1:C4	1-I1
D5	1:L1	1-R1			1-B8	R101	2:B3	1-S0	S32	1:H3	1-J7
		1-R2			1-B6	R102	2:B3	1-S0	S33	1:D2	1-E7
D7	1:G3	1-H1			1-B8	R103	2:L3	1-U5	S34	1:F2	1-D5
		1-I1			1-B5	R104	1:L3	1-U5	S35	1:M2	1-V0
D8	1:H2	1-B2			1-B7	R105	2:H1	1-D3			
		1-C2			1-P0	R106	2:H1	1-D2			

	LINE OUTPUT AUDIO RESPONSE	LINE OUTPUT FILTER RESPONSE	LINE OUTPUT IMPEDANCE	LINE OUTPUT ATTENUATION PADS	LINE OUTPUT ATTENUATION PADS	LINE INPUT LINE OUTPUT	LINE INPUT IMPEDANCE	LINE INPUT ATTENUATION	LINE INPUT AUDIO RESPONSE					
	LINK1	LINK2	LINK3	LINK4	LINK5	LINK6	LINK7	LINK8	LINK9	LINK10	LINK11	LINK12	LINK13	LINK14
A	DE-EMPHASIS	2-POLE	600-OHM	600-OHM	00B	15DB	00B	15DB	LINKED	500-OHM	00B	FLAT	PRE-EMPHASIS	FLAT
B	FLAT	6-POLE	150-OHM	130-OHM						150-OHM		PRE-EMPHASIS		
C														
D														
E														
F														
NO LINK					150B	00B	150B	00B	SEPERATED	HIGH	150B			

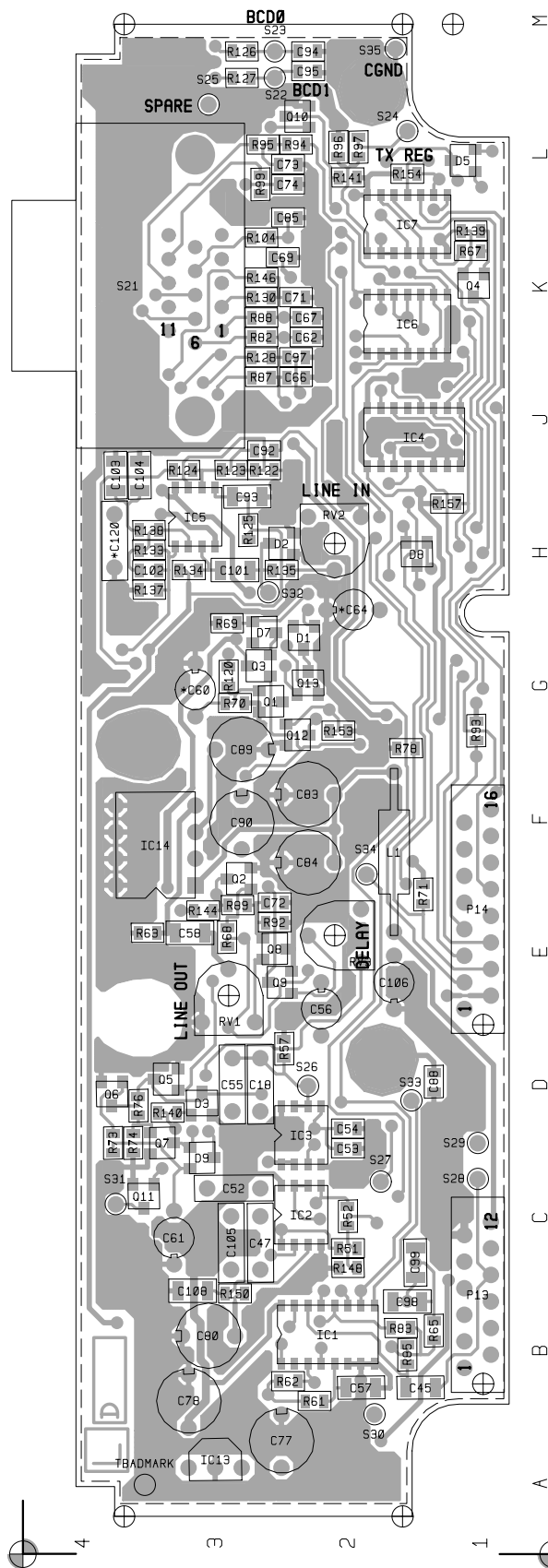
	KEYING I/O	MIC MUTE	RX-GATE SENSE	OPTO SENSE	LINE CIRCUIT ENABLE	PTT INPUT	PTT SENSE	RX-GATE / BUSY OUTPUT	TIME DELAY	TX / RX OUTPUT	NOT CLEAR TO SEND OUTPUT	IN-LOCK OUTPUT	LINE OUTPUT FILTER COMPONENTS
	LINK15	LINK16	LINK17	LINK18	LINK19	LINK20	LINK21	LINK22	LINK23	LINK24	LINK25	LINK26	LINK27
A	BIDIRECTIONAL	LINE PTT	STANDARD	STANDARD	ON AUX	STANDARD	KEY 0V	BUSY 5V	ENABLED	TX 5V / RX 0V	ENABLED	LOCKED 5V	2 POLE
B		NONE	T229	PERMANENT	TRUNKED	TRUNKED	KEY 5V	BUSY 0V		TX 0V / RX 5V		LOCKED 0V	6 POLE
C								RX-GATE 5V					
D								RX-GATE 0V					
E								TRUNKED BUSY 0V					
F	UNIDIRECTIONAL	PERMANENT	TRUNKED		DISABLED			TRUNKED BUSY 5V	DISABLED	DISABLED	DISABLED	DISABLED	

LINE MATCH	OPTO HOLD	RX_GATE DELAY
*CAPS	*C120	*C64
STANDARD	-	-
OPTIONAL	4N7YPI	1U0FI50

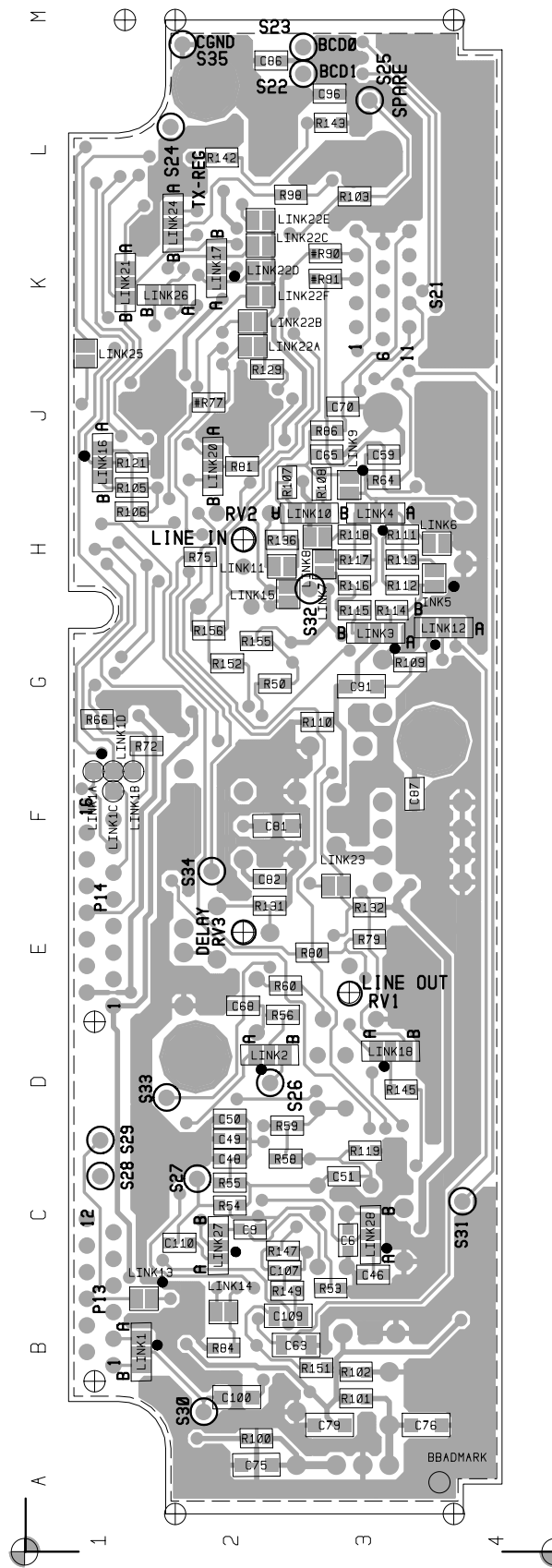
I/O PAD DESCRIPTIONS
S22 BCD1
S23 BCD0
S24 TX REG
S25 SPARE
S26 6 POLE FILTER OUTPUT
S27 2 POLE FILTER OUTPUT
S28 TX SIG IN
S29 TX LINE IN
S30 RX OUT
S31 OPTO DRIVER
S32 LINE INPUT AMPLIFIER
S33 LINE OUT MUTE
S34 LINE IN MUTE
S35 CHASSIS GROUND

- Notes:
- 1/ Remove R77 for trunked modem operation or, in non-trunked radios, to remove external inhibit on busy.
 - 2/ R90, R91 should be removed for two-wire crossband when moulded cord sets are used. (HD15M-HD15M)
This is to avoid PSU conflicts between radios. (+8V out, +13V out.)

T2000-80 Variant & Options Tables (IPN 220-01272-02)



T2000-80 Line Interface PCB (IPN 220-01272-02) Top Side



T2000-80 Line Interface PCB (IPN 220-01272-02) Bottom Side

8.15 T2000-A70 Data Modem Kit

The T2000-A70 conventional data modem allows a T2010 or T2015 radio to be used in data applications, and also provides remote channel control via six BCD lines.

The command protocol and some test procedures are provided for those wanting to write their own software. The protocol definition is based on the T2000 CCI protocol, with specific extensions to support binary transmission and reception.

Note: This interface is only compatible with radio firmware version 2.22, or later. If you have a Series II HC05 logic PCB (PCB IPN 220-01377-0X), with v2.05 radio firmware, contact your nearest authorised Tait dealer.

After upgrading from v2.05 radio software, it is necessary to change the link resistors on the top side of the logic PCB. Remove link resistor #R714 and fit #R714A.

The following topics are covered in this Section:

Section	Title	Page
8.15.1	Components Required	8.15.2
8.15.2	Fitting	8.15.2
8.15.3	T2000-A70 Link Options	8.15.4
8.15.4	Signal Specifications	8.15.5
8.15.5	Programming	8.15.6
8.15.6	Circuit Description	8.15.12
8.15.7	PCB Information	8.15.13

8.15.1 Components Required

The T2000-A70 kit contains the following components:

Quantity	Description
1	T2000-A70 data modem PCB assembly
1	Data interface decoupling PCB assembly (refer to Section 7.17)
1	connecting loom
2	M2.5x10mm pan Pozi Taptite screws
2	M2.5 shakeproof washer
2	M2.5 nut
1	female screw lock kit (in plastic bag)*
2	4-40x5/16 pan Pozi Taptite screws (black)

* Discard unused parts from the female screw lock kit.

8.15.2 Fitting

Refer to Figure 8.15.2.

- 1 Remove the top cover of the radio by unscrewing the 4 bottom cover screws, unscrew the logic PCB and fold out.
- 2 **T2000-A70 Mounting**

Position the data modem PCB on the top side of the logic PCB, as shown, matching P3 on the bottom side of the data modem PCB to connector S3 on the logic PCB.

Use the 2 M2.5x10mm screws, nuts and shakeproof washers to secure in place, as shown.

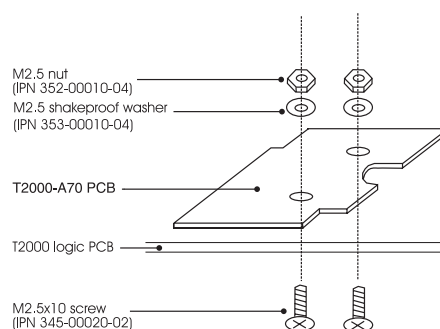


Figure 8.15.1 T2000-A70 PCB Mounting

The screws are fitted from the *bottom* of the logic PCB, and secured with the nuts and washers on the *top* side of the data modem PCB.

Torque the screws to 2.5in.lb.

Caution: Over-tightening the screws will cause damage to the data modem PCB, and compression of connector P3.

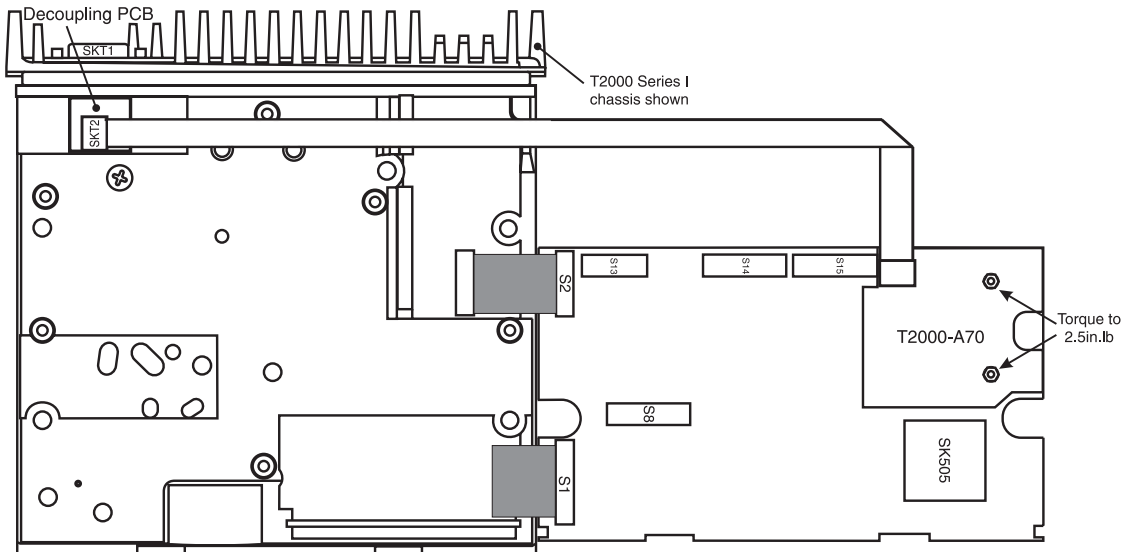


Figure 8.15.2 T2000-A70 Data Modem PCB Mounting

3 T2000 Data Interface Decoupling PCB Mounting

Unclip the D-range blanking plate in the rear of the T2000 chassis.

a T2000 Series I Chassis

Refer to Figure 8.15.3.

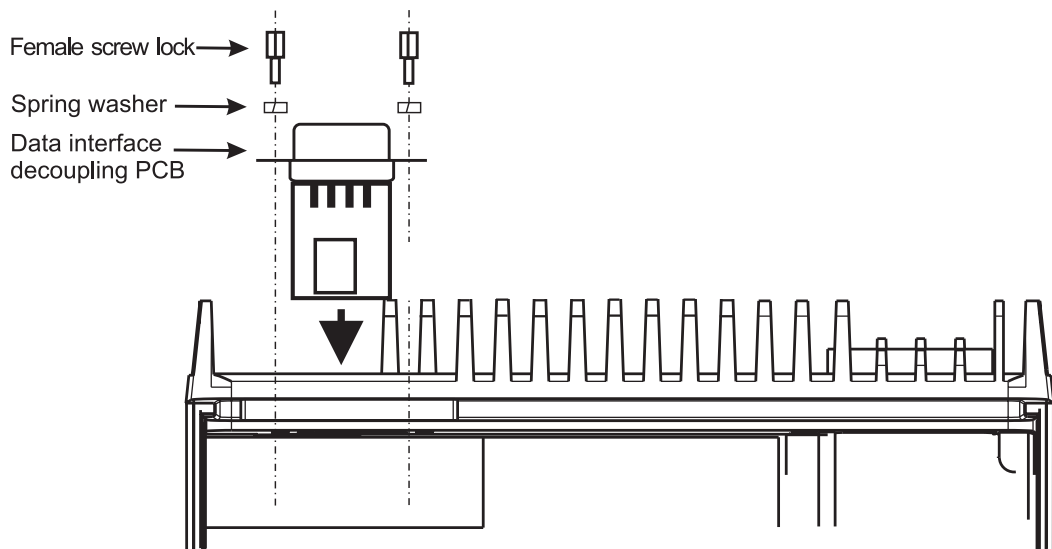


Figure 8.15.3 Data Interface Decoupling PCB Mounting: Series I Chassis

Holes are provided in the T2000 chassis for the D-range screw locks. Use the 2 black 4-40 Taptite screws provided in the kit to form threads.

Fit the decoupling PCB to the T2000 chassis, guiding the PCB through the hole provided, as shown.

Open the female screw lock kit, then secure the D-range using the 2 screw locks and spring washers.

b T2000 Series II Chassis

Refer to Figure 8.15.4.

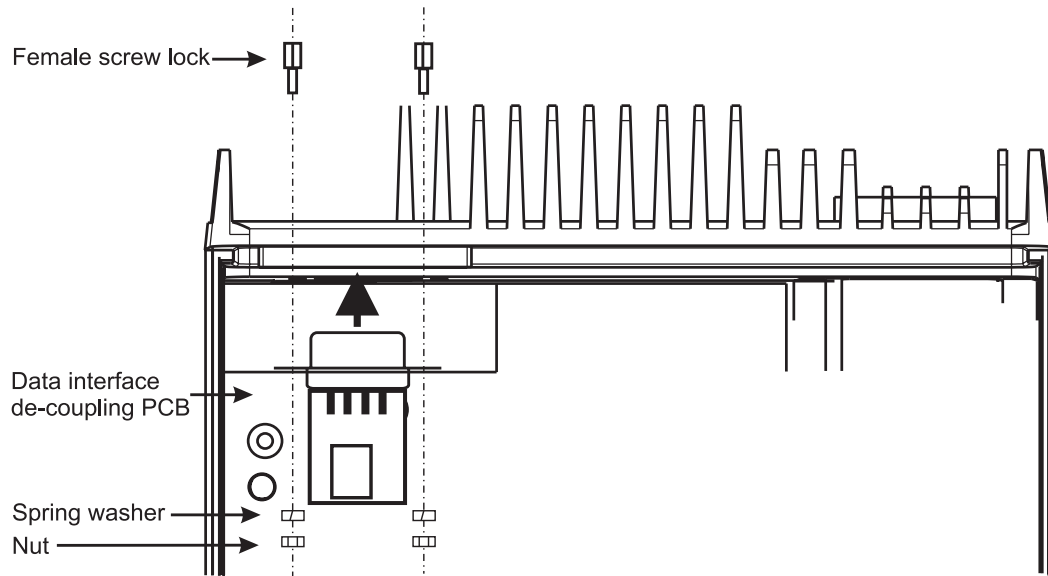


Figure 8.15.4 Data Interface Decoupling PCB Mounting: Series II Chassis

Fit the decoupling PCB to the T2000 chassis, from the inside rear of the radio, as shown.

Secure the D-range in position using the screw locks, spring washers and nuts provided in the female screw lock kit.

- 4 Fold the data modem loom as shown, then plug into SKT2 on the decoupling PCB.
- 5 Fold the logic PCB back in position, secure using the 3 logic PCB retaining screws, and refit the top cover.

Note: Check that the loom is not pinched by the cover or screws during reassembly.

8.15.3 T2000-A70 Link Options

PCB links have been provided on the T2000-A70 data modem PCB for different operational requirements. To change settings, the PCB links are either solder shorted, or fitted with 0Ω SMD resistors.

The following table sets out the link selection options on the T2000-A70 data modem PCB.

Option	#R19	#R2010	#R2015
Baud Rate:			
1200	Fitted	-	-
2400	Not fitted	-	-
Radio Type:			
T2010	-	Fitted	Not fitted
T2015	-	Not fitted	Fitted

8.15.4 Signal Specifications

Data Interface Decoupling PCB

The following tables describe the signals on the decoupling PCB 9 way D-range connector (SKT1) and 4 way connector (SKT2). The diagram shows the pin designations of SKT1, viewed from the rear of the radio.

Note: Pins 1, 4, 6, 7, 8 and 9 on SKT1 are connected to I/O pads, so that additional signals can be interfaced to the radio through the external connector.

SKT1 Pin No.	Signal	Description
1	PAD1	Spare
2	TXD	Transmit data
3	RXD	Receive data
4	PAD2	Spare
5	DGND	Ground reference for all digital signals
6	PAD3	Spare
7	RTS	Spare
8	CTS	Spare
9	PAD4	Spare

SKT2 Pin No.	Signal	Description
1	DGND	Ground reference for all digital signals
2	RXD	Receive data
3	TXD	Transmit data
4	DGND	Ground reference for all digital signals

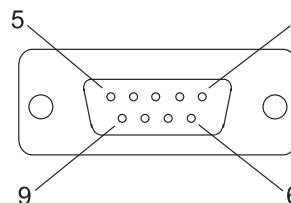


Figure 8.15.5 9 Way D-Range Connector (SKT1)

Data Modem PCB

The following tables describe the signals on the data modem PCB connectors P3 and PDL-1. For P3 signal descriptions, refer to Section 5.9, "Options Interface Specifications".

P3 Pin No.	Signal
1	BCD-0
2	BCD-1
3	BCD-2
4	BCD-3
5	BCD-4
6	BCD-5
7	TX-SIG-IN
8	DET-AF-OUT
9	/BUSY
10	N/C

P3 Pin No.	Signal
11	/PTT-TO-OPT
12	/RX-GATE
13	/IN-LOCK
14	/PTT-FRM-OPT
15	/SIG-SQUELCH
16	MIC-MUTE
17	DGND
18	PWR-CTRL
19	GND
20	+5V

PDL-1 Pin No.	Signal	Description
1	DGND	Ground reference for all digital signals
2	TXD	Transmit data
3	RXD	Receive data
4	DGND	Ground reference for all digital signals

8.15.5 Programming

For those wanting to write their own software, the command protocol and some test procedures are provided in this Section. The protocol definition is based on the T2000 CCI protocol, with specific extensions to support binary transmission and reception.

Note: For modem control of channel change, the **BCD Channel Selection** field in the **Edit - Options** menu must be set to *Enabled* during radio programming.

Common Abbreviations

CCI Computer Controlled Interface

DTE Data Terminal Equipment (e.g. Computer, *inform* data head)

RU Radio Unit

RXD Received Data

TXD Transmitted Data

Command Protocol Description

The DTE is connected to the RU via a serial port on the data modem PCB. Commands are generated by the DTE, and responses or unsolicited messages returned by the RU. There is a prescribed format for all messages, which allows transmission errors to be detected.

Control of the RU is accomplished by the DTE sending a command sequence (a "packet") and receiving a response (a "transaction"). Unsolicited messages may originate from the RU.

The RU will issue a prompt character to indicate to the DTE that it is ready to accept a new command. After issuing a command, the DTE must wait for another prompt before beginning the next transaction. The prompt character is "." (full stop, ASCII code = \$2E).

Messages directed to the RU will always be responded to, either explicitly by means of a return message ("Ready" or "Error"), or implicitly, by just the prompt "." being issued.

The RU will not originate a message: messages returned by the RU are for information purposes only, and no reply will be expected from the DTE.

This protocol definition is based on the T2000 CCI protocol, with specific extensions to support binary data transmission and reception.

Message Format

All message packets take the general form:

[IDENT][SIZE][PARAMETERS][CHECKSUM]<CR>

The following table explains each component of the message packet.

Message Component	Description
[IDENT]	The message identifier. Identifiers are single ASCII characters (lower-case alphabetical) which categorise the message type.
[SIZE]	The number of characters which make up the [PARAMETERS] field. [SIZE] is an 8-bit number expressed in ASCII-hex notation (two characters).
[PARAMETERS]	An optional field, depending upon the command. Parameter values are generally character strings, unless explicitly stated otherwise. Parameter type is dependent upon the command - there is no explicit type definition.
[CHECKSUM]	An 8 bit checksum of fields [IDENT], [SIZE] and [PARAMETERS]. It is expressed in ASCII-hex notation (two characters). Calculating [CHECKSUM]: [CHECKSUM] is calculated by applying the following algorithm: <ol style="list-style-type: none"> 1 Take the modulo-2 sum of all message bytes preceding [CHECKSUM]. 2 Retain bits 0 to 7, discarding any higher order bits resulting from the summation. 3 Form the two's complement of the remainder. 4 Convert the binary number into two ASCII-hex digits, MSD first.
<CR>	The packet terminator. It is the ASCII "carriage return" character (\$0D).

Table 8.15.1 Message Format

General message format characteristics:

- All fields in a message are encoded in ASCII, except for the [PARAMETERS] field of the transmit and receive commands, which is encoded in Binary.
- Where numeric values are represented in ASCII-hex notation (two characters per byte), digits A to F are upper case.
- The minimum length of a command packet is 5 characters (i.e. this is when [SIZE] = 00).
- The maximum length of the [PARAMETERS] field is 111 characters. The maximum length of the command packet is therefore 116 characters ([SIZE] = 0x6F).

Messages To The RU

If the RU receives a command without error, and all parameters are valid, then the command will be executed and an acknowledge will be returned to the DTE. If an error arises, the DTE will be notified with an appropriate response.

The following Table describes the commands available to the DTE to control operation of the RU.

Command	Description	Message		Comments
		[IDENT]	[PARAMETERS]	
Go To Channel	This forces the RU to change to another (conventional) channel.	g	[CHANNEL NUMBER] This is a string of characters representing the new channel number. The range of allowed characters is 0 to 9 only, and the maximum number of digits is 3. Valid channel numbers are 1 to [NUM CHANNELS].	The value of [CHANNEL NUMBER] must be valid for the RU being controlled. The range of allowed values depends upon the RU's programming, type and the link selections on the data modem PCB (refer to Section 8.15.3). The maximum allowable value is returned by the 'Query' command.
Query	This requests the RU to respond with a block of data identifying the type of RU attached, and the version of modem firmware.	q	None	The Query data is returned to the DTE as a 'Query Response' message (refer to "Messages from the RU").
Transmit	This requests the RU to broadcast a block of data on the radio channel.	b	The data to broadcast is encoded as binary data. Note that this field may contain unprintable ASCII characters (such as CR/LF) and protocol command characters (such as ".").	The maximum length of data that may be sent with the 'Transmit' command is 111 characters.
Null	This requests the RU to return an acknowledgement to the DTE. The DTE can use this command to check that an RU is connected.	n	None	

Table 8.15.2 Messages To The Radio Unit

Messages From The RU

Messages may be sent to the DTE by the radio as part of a transaction (i.e. in response to a command issued by the DTE) or unsolicited. In the case of solicited commands, the prompt character will be issued after the RU response to terminate the transaction and signify that another may begin.

Note: In the case of solicited commands, the prompt character, “.”, will be issued after the RU response, to terminate the transaction and signify that another may begin.

Unsolicited commands from the RU will not cause the issuing of the prompt character, as it is possible for an unsolicited command (e.g. Receive) to occur during a solicited command (e.g. Transmit).

The following Table describes messages from the RU to the DTE.

Command	Description	Message		Comments
		[IDENT]	[PARAMETERS]	
Receive	Unsolicited. This presents data received by the RU to the DTE. The data received by the RU has been broadcast by another RU/DTE, using the Transmit command.	i	The data received is encoded as binary data. Note that this field may contain unprintable ASCII characters (such as CR/LF) and protocol command characters (such as ‘.’).	
Query Response	Solicited The RU’s response to a Query command.	m	<p>[RU TYPE] A single character, representing the model of the RU. 0 = unknown 3 = T2010 4 = T2015</p> <p>[VERSION] Firmware version. A character string, in the format of X.XX, identifying the capabilities of the RU/modem.</p> <p>[PVERSION] Protocol Version. A character string, in the format of X.XX, identifying the command protocol version supported.</p> <p>[NUM CHANNELS] The number of channels supported by the Go To Channel command. A 3 digit ASCII number.</p>	<p>1 The value of [PVERSION] = 1.01 is reserved for the first release of firmware implementing this command protocol. Subsequent enhancements and major upgrades will increment this number accordingly.</p> <p>2 Additional fields may be added to this message in future releases to provide more information about the RU environment. In particular, it may be necessary to pass the DTE some information on how the RU has been programmed, or what optional hardware is fitted.</p>
Ready	“.” This response indicates that a transaction has been completed, and the RU is ready for the next command.	None	None	After issuing a command, the DTE must wait for another prompt before beginning the next transaction.

Continued on next page

Command	Description	Message		Comments
		[IDENT]	[PARAMETERS]	
Error	<p>Solicited response to a transaction error. This advises the DTE that the RU has detected an error condition and cannot proceed with the current transaction.</p> <p>Unsolicited response to a system error.</p> <p>In some cases, an exception condition in the RU may cause an 'Error' message to be sent to the DTE independently of any control transactions. A prompt or 'Ready' will be issued after an 'Error' occurs, to indicate the RU's availability to accept further commands.</p>	e	<p>[ETYPE] Error type. A single character representing the error category. 0 = transaction error. This indicates some problem with communications. All such errors result in the transaction being terminated, without the current command being executed.</p> <p>[ENUM] Error number. A character string representing a decimal number in the range of 00 to 99, which can identify the specific error condition. For [ETYPE] = 0, 01 = unsupported command 02 = checksum error 03 = parameter error 10 = communication failure 20 = invalid channel number</p>	<p>Transition error numbers ([ETYPE] = 0):</p> <p>1 0x01 = unsupported command error This may arise when the DTE expects a later version of RU than is attached, and attempts to use a command which is not recognised by the RU.</p> <p>2 0x02 = checksum error indicates that the checksum calculated by the RU did not match the one received in the command packet.</p> <p>3 0x03 = parameter error This encompasses values out of range, or missing fields.</p> <p>4 0x10 = communication failure This encompasses all low level mechanisms, i.e. framing error, overrun error, parity error etc.</p> <p>5 0x20 = invalid channel number This may arise when the DTE issues a 'Go To Channel' command with a [CHANNEL NUMBER] exceeding the maximum allowable number.</p>

Table 8.15.3 Messages From The Radio Unit

Software Tests

The following Table explains the commands that may be sent to test the software.

Command	Test Procedure	Expected Result
Go To Channel	1. Send command "g01206"	Radio changes channel to 2, then returns the command prompt.
	2. Send command "g0203D4"	Radio changes channel to 3, then returns the command prompt.
	3. Send command "g03004A2"	Radio changes channel to 4, then returns the command prompt.
	4. Send command "g0225D0"	Radio sends error message "e03020A6" (invalid channel)
Transmit	1. Send command "b04this82"	Radio transmits this data and "i04this7B" is received by the other radio.
	2. Send command "b17This is a test command.14"	Radio transmits this data and "i17This is a test command.0D" is received by the other radio.
	3. Send a "b" command while the PTT is pressed.	Radio sends error message "e03010A7" (communication error)
	4. Send a command while the busy led is lit	Radio sends error message "e03010A7" (communication error)
Null	Send command "n0032"	Radio returns a prompt ("•").
Query	Send command "q002F"	<p>T2010: a valid message could be "m0C31.011.01004D9" i.e. [RU TYPE] = T2010, [VERSION] = 1.01 [PVERSION] = 1.01 [NUM CHANNELS] = 04</p> <p>T2015: a valid message could be "m0C41.011.01024D6" [RU TYPE] = T2015, [VERSION] = 1.01 [PVERSION] = 1.01 [NUM CHANNELS] = 24</p>
Command Line Errors	1. Send command "b03this83"	Radio sends error message "e03003A5" (parameter error).
	2. Send command "b04this83"	Radio sends error message "e03002A6" (checksum error).
	3. Send command "t04this70"	Radio sends error message "e03001A7" (unsupported command).

Table 8.15.4 Software Test Commands

8.15.6 Circuit Description

The T2000-A70 data modem PCB is based on a CML FX469LS 1200/2400 baud FFSK modem IC (IC1) and the baud rate is selectable by PCB links.

Receive audio is recovered and fed into IC1 via a buffer amplifier, with filtering (IC5), to attenuate all but the FFSK tones. The signal is demodulated in IC1 and the data fed into the microprocessor, IC2. The data, complete with its length & checksum information, is fed to the DTE via IC4, which converts the 0V/5V TTL levels to RS232.

On transmit, data is sent from the DTE to IC2, via IC4. It is processed and sent on to IC1, where it is modulated and the output goes to the TX-SIG-IN input of the radio, via a unity gain buffer, IC6. IC2 also monitors inputs from the radio's logic PCB and controls various output lines.

The microprocessor checks that the radio is in lock, and is not busy. It then mutes the microphone, activates the radio PTT and 30ms later, the PWR-CTRL signal goes low, releasing the transmit inhibit.

Both buffer amplifiers are biased at half rail by IC1, pin11.

If a channel change is required, the data is sent to IC7, which toggles the appropriate BCD lines to change the radio channel.

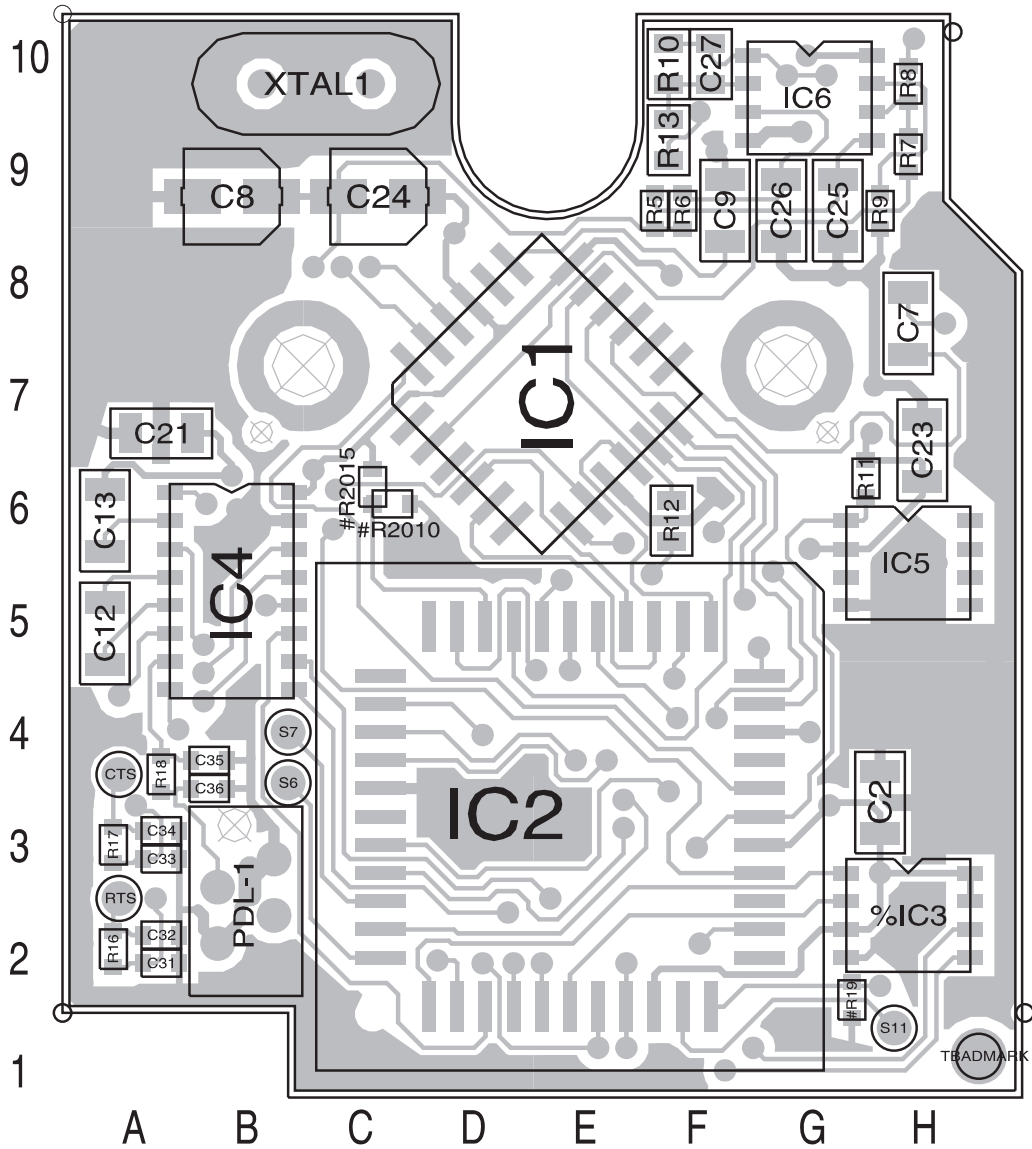
8.15.7 PCB Information

T2000-A70 Parts List (IPN 220-01378-01)

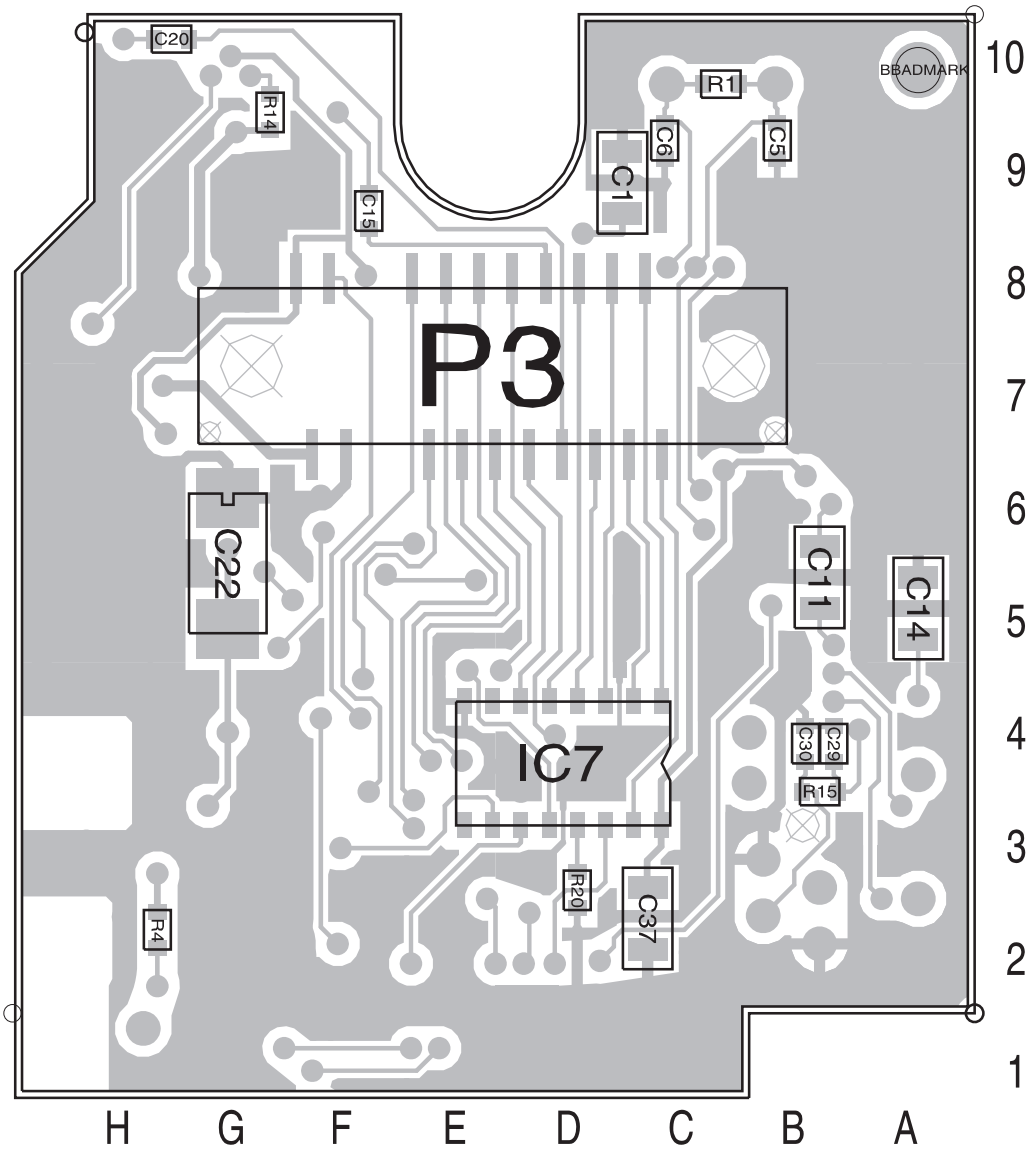
Ref	IPN	Description	Ref	IPN	Description
C1	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	365-00011-38		LABEL STATIC WARNING YELLOW A4A315
C2	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	365-00011-54		LABEL WHITE RW1556/2 90*24MM SPECIAL ADH
C5	018-12220-10	CAP 0603 CHIP 22P 50V NPO +-1%	399-00010-51		BAG PLASTIC 75*100MM
C6	018-12330-10	CAP 0603 CHIP 33P 50V NPO +-1%	399-00010-87		BAG STATIC SHIELDING 102X152MM
C7	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	410-00010-60		CARTON 150X112X56MM VICTOR
C8	016-07100-01	CAP ELECT 6X4MM CHIP 1M 20% 16V	418-27000-00		FITTING INS T2000-70 MODEM KIT
C9	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V	X2DC01		T2000 INT FACE DECOUPLING PCB ASSEMBLY
C11	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C12	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C13	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C14	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C15	018-15100-00	CAP 0603 CHIP 10N 50V X7R +-10%			
C20	018-15100-00	CAP 0603 CHIP 10N 50V X7R +-10%			
C21	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C22	014-08100-00	CAP TANT CHIP 10M 16VW +-20% 6X3.2X2.5MM			
C23	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C24	016-07100-01	CAP ELECT 6X4MM CHIP 1M 20% 16V			
C25	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C26	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
C27	015-23470-08	CAP CER 0805 CHIP 470P 10% X7R 50V			
C29	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C30	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C31	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C32	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C33	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C34	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C35	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C36	018-13150-00	CAP 0603 CHIP 150P 50V NPO +-5%			
C37	015-06100-08	CAP CER 1206 CHIP 100N 10% X7R 50V			
IC1	002-20046-90	(S) IC FX469LS FFSK MODEM 1200/2400 BAUD			
IC2	002-20068-07	(S) IC MC68HC705C8FN 1 TIME PROG MICRO-P			
IC4	002-10020-20	(LSH) IC SMD ADM202 RS-232 CONVERTOR SO-			
IC5	002-10340-64	(S) IC SMD MC34064 LO VOLT SENSE			
IC6	002-10003-58	(S) IC SMD LM358 DUAL OP AMP			
IC7	002-74905-95	(S) IC SMD 74HC595 SHIFT REGISTER			
PDL-1	240-00021-20	HEADER 4WAY PADDLE BRD STAGGERED PINS			
P3	240-10000-10	CONN SMD 20PIN SCREW DOWN PRICKLE CON			
R1	038-17100-00	RES 0603 CHIP 1M 1/16W +-5%			
R4	038-16100-00	RES 0603 CHIP 100K 1/16W +-5%			
R5	038-16100-00	RES 0603 CHIP 100K 1/16W +-5%			
R6	038-16100-00	RES 0603 CHIP 100K 1/16W +-5%			
R7	038-15100-00	RES 0603 CHIP 10K 1/16W +-5%			
R8	038-15100-00	RES 0603 CHIP 10K 1/16W +-5%			
R9	038-14470-00	RES 0603 CHIP 4K7 1/16W +-5%			
R10	036-15560-00	RES M/F 0805 CHIP 56K 5%			
R11	038-16100-00	RES 0603 CHIP 100K 1/16W +-5%			
R13	036-15330-00	RES M/F 0805 CHIP 33K 5%			
R14	038-14470-00	RES 0603 CHIP 4K7 1/16W +-5%			
R15	038-13100-00	RES 0603 CHIP 100E 1/16W +-5%			
R16	038-13100-00	RES 0603 CHIP 100E 1/16W +-5%			
R17	038-13100-00	RES 0603 CHIP 100E 1/16W +-5%			
R18	038-13100-00	RES 0603 CHIP 100E 1/16W +-5%			
R20	038-14100-00	RES 0603 CHIP 1K0 1/16W +-5%			
#R2010	038-10000-00	RES 0603 CHIP ZERO OHM 1/16W +-5%			
SK2	240-04020-42	SKT 44 PIN SMD PLCC CHIP CARRIER			
XTAL1	274-01070-00	XTAL 4.000MHZ HC49U/S C/W TEFLON INSULAT			
	205-00010-13	CABLE FLAT RBBN 10 CORE 10/7/0.1 GREY			
	220-01378-01	(L) PCB T201X SII 1200/2400 BAUD DATA MODEM			
	345-00020-02	SCREW M2.5 * 10 PAN POZI ST BZ			
	352-00010-04	NUT M2.5 MACH HEX ST BZ			
	353-00010-04	WASHER M2.5/M2.6 SHAKEPROOF INT BZ			
	316-80032-00	PKG FOAM A4M2495			

T2000-A70 Grid Reference Index (IPN 220-01378-01)

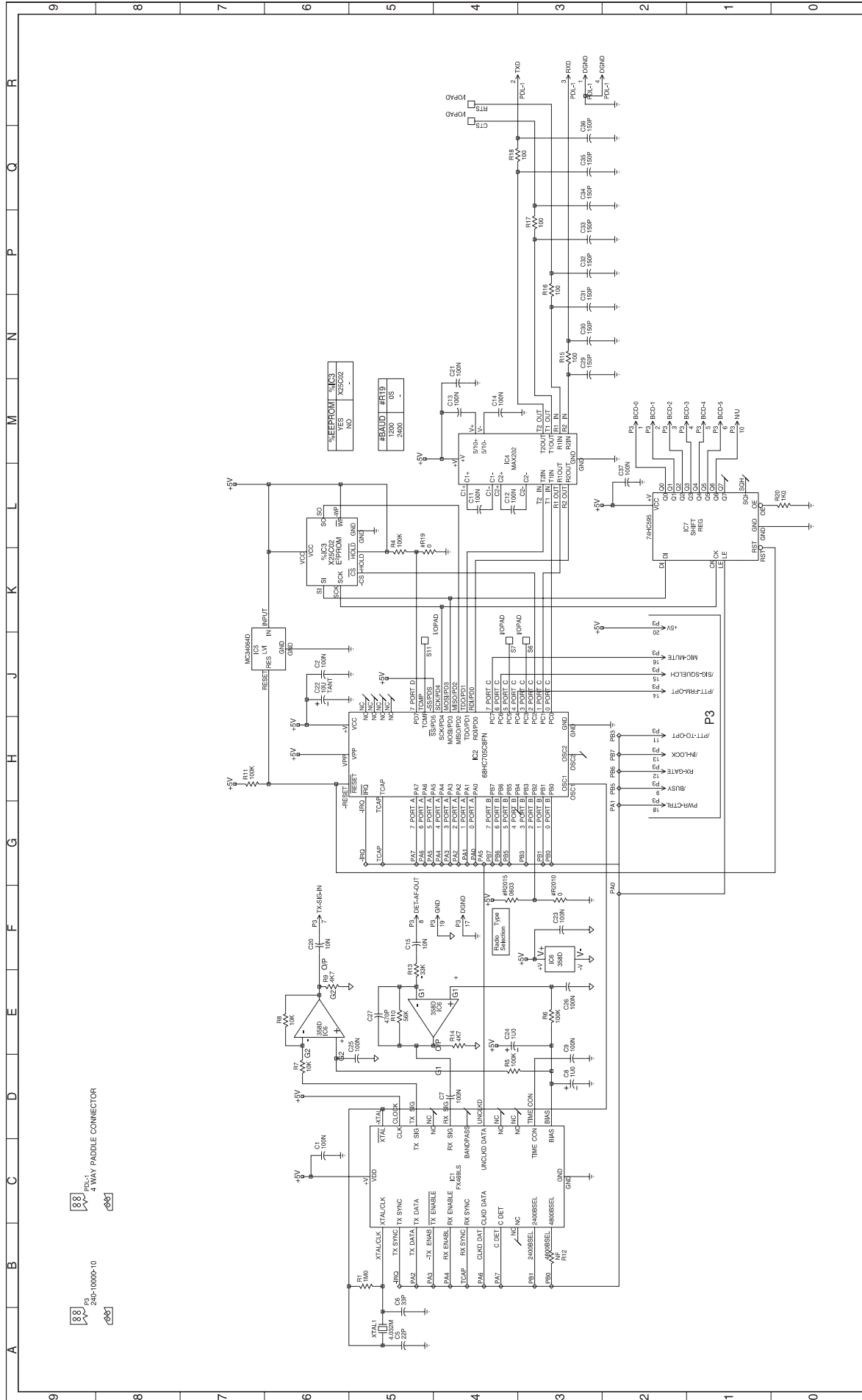
Device	PCB	Circuit	Device	PCB	Circuit	Device	PCB	Circuit
C1	2:D9	1-C6	S6	1:B4	1-J3			
C2	1:H4	1-J6	S7	1:B4	1-J4			
C5	2:B9	1-A5	S11	1:H2	1-J5			
C6	2:C9	1-A5						
C7	1:H8	1-D4	XTAL1	1:C10	1-A5			
C8	1:B9	1-D3						
C9	1:F9	1-D3						
C11	2:B6	1-L4						
C12	1:A5	1-L4						
C13	1:A6	1-M4						
C14	2:A5	1-M4						
C15	2:F9	1-F5						
C20	2:H10	1-F6						
C21	1:A7	1-M4						
C22	2:G6	1-J6						
C23	1:H7	1-F3						
C24	1:C9	1-E4						
C25	1:G9	1-D5						
C26	1:G9	1-E3						
C27	1:F10	1-E5						
C29	2:B4	1-N3						
C30	2:B4	1-N3						
C31	1:A2	1-N3						
C32	1:A2	1-P3						
C33	1:A3	1-P3						
C34	1:A3	1-Q3						
C35	1:B4	1-Q3						
C36	1:B4	1-Q3						
C37	2:C2	1-L2						
CTS	1:A4	1-R4						
IC1	1:E7	1-B3						
IC2	1:E3	1-H3						
%IC3	1:H3	1-K5						
IC4	1:B5	1-L3						
IC5	1:H6	1-K6						
IC6	1:G10	1-E6						
IC6	1:G10	1-E5						
IC6	1:G10	1-F3						
IC7	2:D4	1-K1						
P3	2:E7	1-A8						
PDL-1	1:B3	1-C8						
R1	2:C10	1-B5						
R4	2:H2	1-K5						
R5	1:F9	1-D4						
R6	1:F9	1-E3						
R7	1:H9	1-D6						
R8	1:H10	1-E6						
R9	1:H9	1-E6						
R10	1:F10	1-E5						
R11	1:H6	1-H7						
R12	1:F6	1-B3						
R13	1:F9	1-F5						
R14	2:G10	1-E4						
R15	2:B4	1-N3						
R16	1:A2	1-P3						
R17	1:A3	1-P3						
R18	1:A4	1-Q4						
#R19	1:G2	1-K5						
R20	2:D3	1-L0						
#R2010	1:C6	1-F3						
#R2015	1:C6	1-F4						
RTS	1:A3	1-R4						



T2000-A70 Data Modem PCB (IPN 220-01378-01) - Top Side



T2000-70 Data Modem PCB (IPN 220-01378-01) - Bottom Side



© TAIT ELECTRONICS
 T2000 SERIES II
 1K2/2K4 BAUD DATA MODEM
 REV. A
 220-01378-01
 PRODUCT DESIGNER FILE NAME: M38BETS
 T2000 S2 DJW 17/8/84 04/83/97 2

REV	DATE	BY	CHKD	APPD	DATE
1A					
PROTOTYPE FOR SERIES 2 T2000					
AMENDMENTS					
REV	DATE	BY	CHKD	APPD	DATE
1A	04/03/97				
1B	17/03/98				

8.16 T2000-A03/-A04/-A16 Remote Loom Kits

The T2000-A03 6m remote loom and T2000-A04 4m remote loom installation kits are for use with T2020, T2040 and T2050 radios in situations where the 3m remote loom or underdash mounting is unsuitable.

The T2000-A16 6m shielded remote loom is suitable for use with EMC model radios, and for installations where electromagnetic radiation may cause problems with sensitive equipment installed nearby or interference to the radio's own antenna.

Once installed, the loom should not be subjected to any pinching, crushing or chafing, nor should it interfere with the operation of the vehicle controls.

Note: These instructions must be read in conjunction with Section 3.1 "Servicing Precautions" and Section 3.2 "Disassembly Instructions".

The following topics are covered in this Section:

Section	Title	Page
8.16.1	Components Required	8.13.2
8.16.2	Fitting To Locally Mounted Radios	8.13.2
8.16.3	Fitting To Remote Mounted Radios	8.13.6

8.16.1 Components Required

The T2000 remote loom kits contain the following components:

Quantity	Description
1	remote loom, complete with 8 way connectors
1	remote mounting bracket
1	remote back panel
1	dummy front panel
2	remoting connector cover (fitted to the remote back panel & dummy front panel)
2	M4 pressed captive nut (for remote control head assembly)
2	thumbscrew (for remote mounting bracket)
4	ESD plug (to fit over remote back panel screw heads: T2000-A16 only)
2	No 6x3/4 self-tapping screw (for remote mounting bracket)
4	No 4x 3/8 pan Pozi Plastite screw (dummy front panel mounting)
2	M3x6 pan Pozi Taptite screw (connector PCB mounting)
4	M3x8 pan Pozi Taptite screw (EMC filter PCB mounting)
1	EMC filter PCB (Series II radio chassis)
1	connector PCB (Series I radio chassis)

8.16.2 Fitting To Locally Mounted Radios

- Remove the top cover of the radio by unscrewing the 4 bottom cover screws.

Remove the 3 logic PCB retaining screws and fold back the logic PCB. If necessary, remove the 3 option PCB mounting screws before lifting the logic PCB.

Remove the microprocessor shield retaining screws and the screw securing the control head ground lead, then remove the microprocessor shield.

Remove the bottom cover of the radio and unplug the loom running between the control head and the logic PCB (on EMC model radios, the loom runs between the control head and the EMC filter PCB).

The control head can now be detached from the chassis.

Remove the 4 adaptor plate retaining screws from the control head and remove the adaptor plate from the back of the control head.
- Refer to Figure 8.16.1.

Unclip the remote back panel remoting connector cover (3).

Pass one end of the remote loom through the connector cover hole and plug onto the 8 way connector (6) on the top side of the control head PCB.

T2000-A03 & T2000-A04 kits: Remove the ground lead from under one of the control head PCB screws, and discard the ground lead.

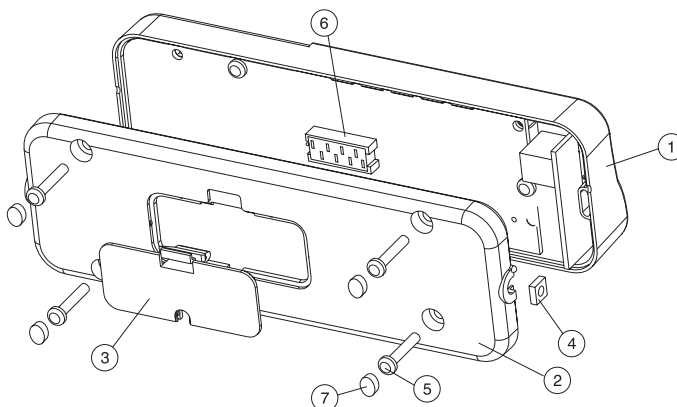
T2000-A16 kit: Remove the screw from the control head that secures the control head ground lead. Discard the ground lead, and use this screw to secure the remote loom drain wire solder tag to the control head PCB.

Note: Ensure that the tag does not make contact with any devices in the control head.

- 3 Fit the 2 captive M4 nuts (4) into the slots on the remote back panel (2), and mount the remote back panel onto the control head front assembly (1).

Secure in place using the 4 No. 4x5/8 Plastite screws previously used for the adaptor plate, and push the 4 ESD plugs (7) over the screw heads (T2000-A16 only).

Refit the remoting connector cover, pushing the slot in the cover onto the remote loom cable.



Item	Description	IPN	Quantity	Torque (in.lb)
1	CONTROL HEAD FRONT ASSEMBLY		1	
2	REMOTE BACK PANEL	316-06432-XX	1	
3	REMOTING CONNECTOR COVER	316-85125-XX	1	
4	CAPTIVE NUT M4 PRESSED	352-00010-17	2	
5	NO 4X5/8 SCREW (REMOTE BACK PANEL SCREWS)	349-00010-24	4	8 (0.9Nm)
6	MICROMATCH CONNECTOR 8 WAY	240-04020-50	1	
7	ESD PLUG (OVER REMOTE BACK PANEL SCREWS)	360-01057-00	4	

Figure 8.16.1 Remote Control Head Assembly

4 T2000 Series I chassis

Refer to Figure 8.16.2.

Mount the adaptor plate (2) onto the chassis and secure the connector PCB to the 2 chassis pillars, using the 2 M3x6 Taptite screws provided.

As the pillars are not threaded, care must be taken that the screws are not inserted at an angle.

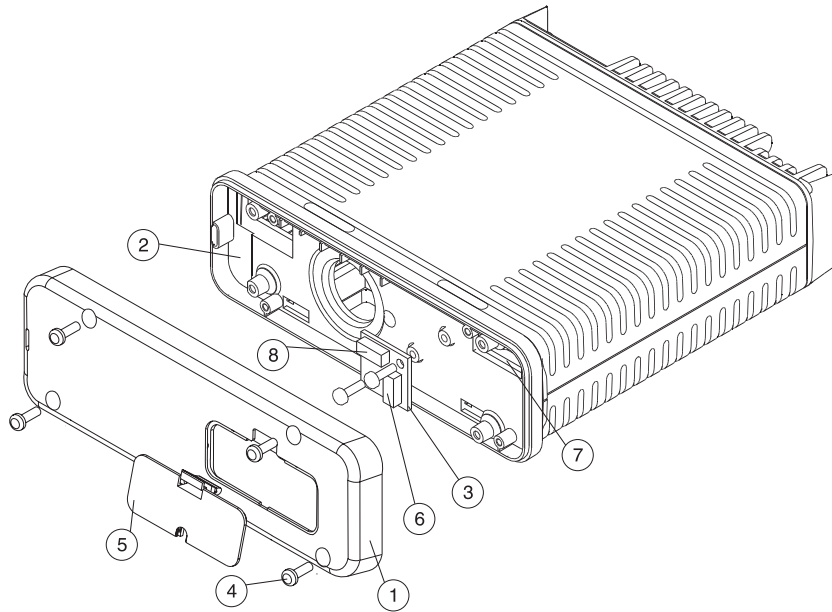
Pass the logic PCB loom through the slot in the adaptor plate and chassis (7) and plug the loom onto one of the 8 way connectors (8) on the connector PCB.

Unclip the remoting connector cover (5) from the dummy front panel and pass the unconnected end of the remote loom through the hole in the dummy head front panel.

Plug the 8 way remote loom connector onto the 8 way connector (6) on the connector PCB.

T2000-A16 kit: Secure the remote loom drain wire solder tag under one of the connector PCB screws.

Mount the dummy front panel (1) onto the adaptor plate (2), using the No 4x3/8 Plastite screws (4) provided.



Item	Description	IPN	Quantity	Torque (in.lb)
1	DUMMY FRONT PANEL	316-06433-XX	1	
2	ADAPTOR PLATE (T2000 SERIES I)	301-00001-XX	1	
3	CONNECTOR PCB	220-01274-XX	1	
4	NO 4X3/8 SCREW (DUMMY FRONT PANEL SCREWS)	349-00010-22	4	8 (0.9Nm)
5	REMOTING CONNECTOR COVER	316-85125-XX	1	
6	8 WAY CONNECTOR PCB SOCKET (FOR REMOTE LOOM)	240-04020-50	1	
7	SLOTS IN ADAPTOR PLATE & CHASSIS FOR LOGIC PCB LOOM			
8	8 WAY CONNECTOR PCB SOCKET (FOR LOOM TO LOGIC PCB)	240-04020-50	1	

Figure 8.16.2 Connector PCB Mounting

5 T2000 Series II Chassis

Refer to Figures 8.16.3 and 8.16.4.

Fit the EMC filter PCB (18) provided in the kit to the chassis, first passing the loom on the bottom side of the PCB through the chassis hole, as shown.

Secure the EMC filter PCB in place, using the 4 M3x8 Taptite screws.

Note: EMC model radios will already have an EMC filter PCB fitted. Check that the top side connector (SKT-1) is 8 way. If not, discard the existing filter PCB and fit the new PCB provided.

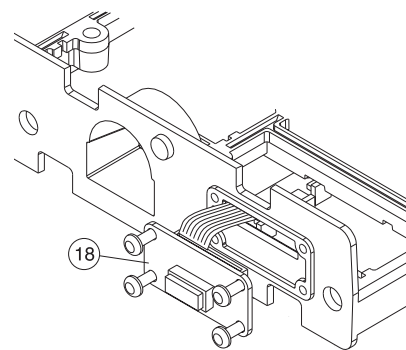


Figure 8.16.3 EMC Filter PCB Mounting

Plug the EMC filter PCB loom onto the logic PCB.

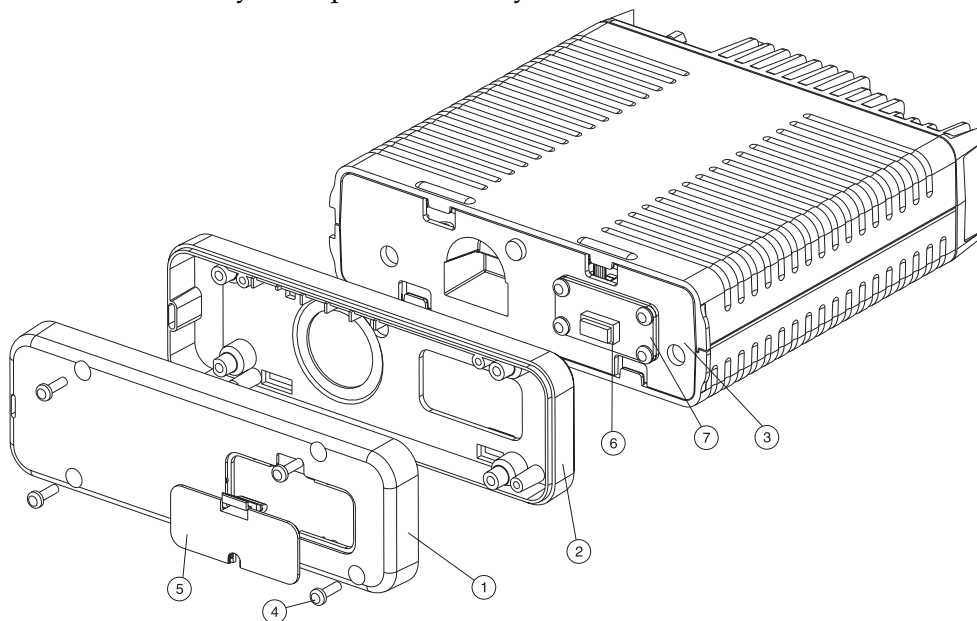
Unclip the remoting connector cover (5) from the dummy front panel (1), and pass the unconnected end of the remote loom through the holes in the dummy front panel and the adaptor plate (2).

Plug the 8 way loom connector onto the 8 way connector (6) on the top side of the EMC filter PCB.

T2000-A16 kit: Secure the remote loom drain wire solder tag under one of the EMC filter PCB screws.

Mount the dummy head front panel (1) onto the adaptor plate (2), using the 4 No 4x3/8 Plastite screws (4) provided.

Mount the dummy front panel assembly onto the chassis.



Item	Description	IPN	Quantity	Torque (in.lb)
1	DUMMY FRONT PANEL	316-06433-XX	1	
2	ADAPTOR PLATE	301-00001-XX	1	
3	MAIN CHASSIS ASSEMBLY		1	
4	NO 4X3/8 SCREW (DUMMY FRONT PANEL SCREWS)	349-00010-22	4	8 (0.9Nm)
5	REMOVING CONNECTOR COVER	316-85125-XX	1	
6	8 WAY EMC FILTER PCB SOCKET	240-04020-50	1	
7	EMC FILTER PCB	220-01383-XX	1	

Figure 8.16.4 Dummy Front Panel Assembly

- 6 Reposition the bottom cover of the radio and the microprocessor shield and replace the microprocessor shield retaining screws, tightening them to a torque of 12in.lb (1.4Nm).

Refit the logic PCB, any options PCBs that were fitted and the top cover. Tighten the top cover to a torque of 15in.lb (1.8Nm).

Refit the remoting connector cover, pushing the slot in the cover onto the remote loom cable.

- 7 Mount the remote mounting bracket in the desired position (this must be on a flat surface), using the 2 No 6x3/4 self-tapping screws.

Place the control head in the bracket, positioned for a good viewing angle, and secure in place with the 2 thumbscrews.

8.16.3 Fitting To Remote Mounted Radios

- 1 Refer to Figures 8.16.2, 8.16.3 & 8.16.4.

Remove the radio dummy front panel (1) by removing the 4 dummy front panel screws (4).

Note: In later T2000 radios, the radio dummy front panel is fitted with a remoting connector cover (3). This is unclipped to access the remote loom connector. When fitting a remote loom, it is therefore unnecessary to remove the dummy front panel.

Unplug the old remote loom from the connector PCB (Series I chassis) or EMC filter PCB (Series II chassis).

Series II chassis: Check that the top side connector (SKT-1) on the EMC filter PCB is 8 way. If not, discard the existing filter PCB and fit the new PCB provided in the kit (refer to Section 8.16.2, "Fitting To Locally Mounted Radios", step (5)).

If necessary, replace the old dummy front panel with the new dummy front panel, complete with remoting connector cover, provided in the kit.

Pass the new remote loom through the connector cover hole in the dummy front panel, and plug the 8 way remote loom connector onto the 8 way connector (6) on the connector PCB or EMC filter PCB.

T2000-A16: Fit the remote loom drain wire solder tag under one of the connector PCB or EMC filter PCB screws.

Mount the dummy front panel onto the adaptor plate (2), and secure in place using the 4 dummy front panel screws.

Refit the remoting connector cover, pushing the slot in the cover onto the remote loom cable.

- 2 Refer to Figure 8.16.1.

Remove the control head remote back panel (2) by removing the 4 remote back panel screws (5), taking care not to loose the captive nuts (4). EMC model radios will also have ESD plugs (7) over the remote back panel screws.

Note: In later T2000 radios, the control head remote back panel is fitted with a remoting connector cover (3). This is unclipped to access the remote loom connector. When fitting a remote loom, it is therefore unnecessary to remove the remote back panel.

Unplug the old remote loom from the 8 way connector on the control head PCB (6).

If necessary, replace the old remote back panel with the new remote back panel, complete with remoting connector cover, provided in the kit.

Pass the new remote loom through the connector cover hole in the remote back panel, and plug the 8 way connector on the new remote loom onto the 8 way connector on the control head PCB.

T2000-A16: Fit the remote loom drain wire solder tag under one of the control head PCB screws.

Note: Ensure that the solder tag does not make contact with any devices in the control head.

Fit the 2 captive M4 nuts into the slots in the remote back panel and mount the remote back panel onto the control head front assembly (1).

Secure in place using the 4 remote back panel screws, and push the 4 ESD plugs (7) over the screw heads (T2000-A16 only).

Refit the remoting connector cover, pushing the slot in the cover onto the remote loom cable.

9 Software

This Section outlines the production software history for each T2000 Series II model, and explains how to identify which software version is used.

The following topics are covered in this Section:

Section	Title	Page
9.1	Identifying The Software Version Number	9.2
9.2	Software History	9.3
9.2.1	T2010 & T2015 Radios	9.3
9.2.2	T2020 Radios	9.4
9.2.3	T2030 & T3035 Radios	9.5
9.2.4	T2040 Radios	9.6
9.2.5	T2050 Radios	9.7
9.2.6	T2060 Radios	9.8

9.1 Identifying The Software Version Number

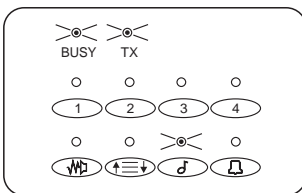
To read the radio software version of a T2000 Series II radio, hold in the PTT switch when turning on the radio. The version number will then be displayed briefly on the radio's front panel, using either the LEDs, the 7 segment display panel or a combination of both.

Where LEDs are used, they indicate Binary Coded Decimals (BCDs), with the most significant bit to the left.

The examples below show how each radio displays "Version 3.02".

Note: This is not necessarily a valid radio software version.

T2010



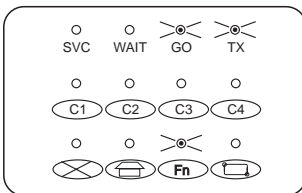
- The major version number is indicated as a BCD by the Busy and Tx LEDs. ("3" in the example on the right.)
- The two digit minor version number is indicated as BCD digits by the two lower rows of LEDs. ("0" on the middle row and "2" on the lower row in the example.)

T2015 & T2060



- The major version number will be indicated as a binary coded decimal (BCD) by the Busy and Tx LEDs.
- The minor version number is shown in the two digit display.

T2030



- The major version number is indicated as a binary coded decimal (BCD) by the top row LEDs.
- The two digit minor version number is indicated as BCD digits by the two lower rows of LEDs.

T2035



- The full version number is shown in the display.

T2020, T2040, T2050



- The full version number is shown in the display.

9.2 Software History

The following tables outline the production software history for each T2000 Series II radio.

Note: Previous revisions of the software cannot be used on Series II radios.

9.2.1 T2010 & T2015 Radios

Radio Software Version	Release Date	PGM Software Compatibility	Changes From Previous Version
2.20	6/12/96	PGM201X v1.22	Original

9.2.2 T2020 Radios

Radio Software Version	Release Date	PGM Software Compatibility	Changes From Previous Version
5.10	13/12/96	PGM2020 v2.31	Original

9.2.3 T2030 & T3035 Radios

Radio Software Version	Release Date	PGM Software Compatibility	Changes From Previous Version
3.10	6/12/96	PGM203X v1.34	Original

9.2.4 T2040 Radios

Radio Software Version	Release Date	PGM Software Compatibility	Changes From Previous Version
5.20	6/12/96	PGM2040 v2.45	Original

9.2.5 T2050 Radios

Radio Software Version	Release Date	PGM Software Compatibility		Changes From Previous Version
		Non-Trunked	Trunked	
1.05	13/3/96	PGM2020 v2.31	PGM2040 v2.45	Original

9.2.6 T2060 Radios

Radio Software Version	Release Date	PGM Software Compatibility	Changes From Previous Version
1.04	28/11/96	PGM2060 v1.03	Original