Programming and Service Manual

Tait Encrypted
TOP and T2000 Radios

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M2259-00-200-812   **Web: www.taitworld.com/**

About This Manual

Scope This manual provides installation and servicing information for service shops and large users of Tait Encrypted radios. It specifies the cables and information required to set up and manage a fleet of encrypted Tait Orca Portables or T2000s. Both Midian and Transcrypt versions of plug-in encryption modules are supported by this manual.

Errors If you find an error in this manual or have a suggestion on how it might be improved, please do not hesitate to contact the Technical Author, Tait Custom Integration, Tait Radio Systems Division, Tait Electronics Ltd, P.O. Box 1645, Christchurch, New Zealand.

Technical Information

Any enquiries regarding this manual or the equipment it describes should be addressed in the first instance to Tait Custom Integration (TCI), International Sales and Distribution, Tait Electronics Ltd, P.O. Box 1645, Christchurch, New Zealand.

Updating Equipment And Manuals

In the interests of improving performance, reliability or servicing, Tait Electronics Ltd reserve the right to update their equipment and/or manuals without prior notice.

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Ordering Tait Service Manuals

Service Manuals should be ordered from your nearest Tait Branch or approved Dealer. When ordering, quote the Tait product code and, where applicable, the version.

Date Of Issue

M2259-00-000-812 Encrypted Radio Programming and Service Manual

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M2259-00-200-812 Issue 200 published June 2004

Contents

1   Service Information

1.1   Servicing Accreditation

The procedures described in this manual should only be carried out by service personnel trained and accredited by Tait Electronics to service Tait Orca Portable (TOP) and T2000 product ranges.

1.2   Tools Required

Use only tools specified for TOP and T2000 radios in their service manuals, including:

- Fine tipped (1-2mm) temperature controlled soldering iron
- Tweezers
- Solder and flux pen
- Scissors
- Stainless steel spike (TOP only)
- #6 Torx drive screwdriver bit (TOP only)
- Adjustable spanner
- Pozidrive screwdrivers (T2000 only)

1.3   Warnings

The encryption module controls the radio PTT, and either during normal operation or while programming, can cause the radio to transmit. Always provide protection for test equipment (such as RF signal generators) so they cannot be damaged by transmitter power.

Each encryption module is provided with a sheet for recording programmable settings. As some module settings cannot be read back, it is strongly recommended that all settings be recorded for each fitted module and kept in a secure place.

1.4   Anti-Static Bench Set-Up

An anti-static bench set-up is required to service Tait equipment, to prevent static damage to components: metal framed bench, fitted with a conductive rubber bench mat connected by an earth lead to ground (c/w 1M series resistor). The technician should wear a wrist strap connected to the table.

to building earth (not mains earth) via 1M series resistor

conductive rubber bench mat

conductive wrist strap

metal frame
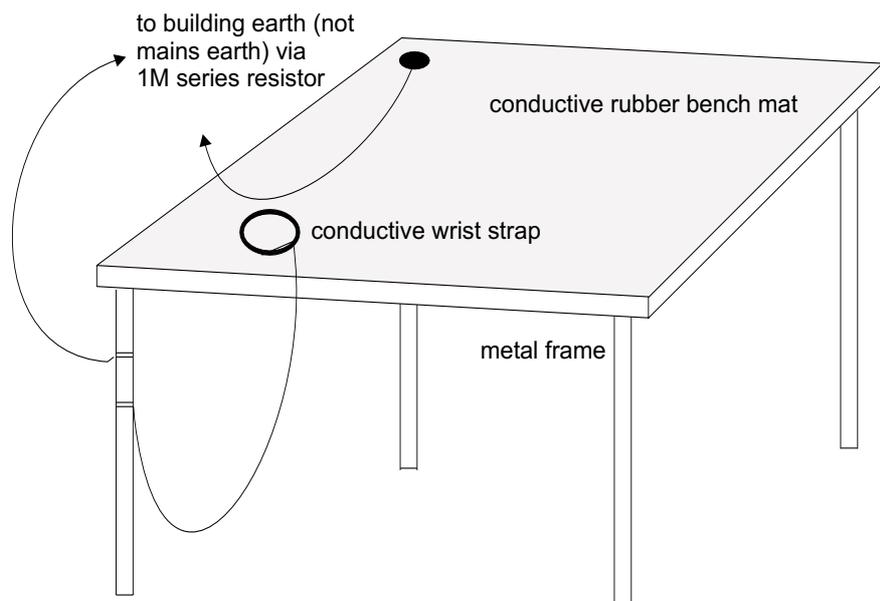
2   Introduction

This manual forms a part of the Tait Encrypted Radio Programming and Service Kit. The kit provides service centres and large users of Tait Encrypted radios with all cables and information required to set up, manage and maintain a fleet of encrypted Tait Orca Portable (TOP) radios and/or T2000 Mobile radios.

2.1   Encrypted Radio Programming and Service Kit

The kit contains the following items:

- Encrypted Radio Programming and Service Manual (IPN M2259-00-100-812) - this manual
- T2000 Programming Cable (IPN 219-02835-0X) to connect a Transcrypt OTAR Programmer to a T2000 radio used for OTAR programming. (See Transcrypt Programming section on page 69.) (See T2000 Programming Cable Specification on page 77.)
- TOP Programming Cables (IPN 219-02841-0X and IPN 219-02128-0X) to connect a Transcrypt OTAR Programmer to a TOP radio used for OTAR programming. (See Transcrypt Programming section on page 69 and TOP Programming Cable specifications on page 74.)
- T2000 Encryption Upgrade Flex PCB (IPN 228-22593-0X) for fitting into a T2000 radio used for OTAR programming. (See Transcrypt Programming section on page 69.)

Note: Dedicated direct programming cables are available if required, for direct programming Midian TVS2 modules, or any supported Transcrypt module. See Support Products on page 11.

2.2   Related Documents

This manual is intended to be read in conjunction with the following:

- Service and programming manuals for T2000 radios
- Service and programming manuals for TOP radios
- Service and programming manuals for Transcrypt or Midian Encryption Modules
- Service and programming manuals for Transcrypt OTAR Programmer or Midian Programmer

More information on Tait encryption technology is available online in the Tait Encryption White Papers at: **http://taitweb.co.nz/main/index/encryption**.

Information for programming and servicing Tait radios with either Transcrypt and Midian encryption modules is included in this manual.

2.3   Encryption Module Compatibility

At the time of printing, the following Encryption modules are compatible with Encryption Enabled TOP and T2000 radios.

- Transcrypt TZ20-430
- Transcrypt TZ20-460
- Transcrypt TZ20-416
- Midian TVS2-Tait (TOP radios only)
- Midian TVS2-T2000 (T2000 radios only)
- Midian VPU12-Tait

For other encryption modules, check with a Tait Service Centre, or **www.taitworld.com/**.

Modules listed can be fitted to either TOP or T2000 radios, with the exception of the Midian TVS-2 modules (see above). However, the modules will require some customisation to suit the radio type. Details are included in the module manufacturer's documentation, but differences include:

■   removal of snap-off sections to fit a module into a TOP radio. Note that these snap-offs include screw holes necessary to fit the module into a T2000 radio, **so should not be removed for T2000 application.**

■   some modules require module-specific link settings on the Encryption Upgrade Flex PCB, depending upon the radio type and the system configuration. These settings are described in the module manufacturer's documentation.

2.4   Radio Hardware Compatibility

Tait Orca Portable Radios

The TOP Encryption Upgrade Flex PCBs described in this manual are suitable for use in most TOP 5000 radios (5010, 5020, 5035, 5040). The flexes can be retrofitted to most radio models, but this should first be verified by providing the serial numbers to a Tait Service Centre for confirmation.

T2000 Radios

The T2000 Encryption Upgrade Flex PCBs described in this manual are suitable for radios which contain the Enhanced HC11 Control PCB (IPN 220-01344-XX). This can be verified by providing the serial numbers to a Tait Service Centre for confirmation.

2.5   Radio Firmware and Software Compatibility

Tait Orca Portable Radios

Encrypted TOP radios require specific encryption-capable radio firmware. This is fitted during manufacture of encryptable radios, but will need to be programmed separately where an encyption upgrade kit is used. Contact the Tait Strategic Sales Team for confirmation of encryption firmware support.

T2000 Radios

Encryption-capable T2000 radios require no firmware change to support encryption function.

2.6   Tait Encryption Products

Encryptable Radios

Note: New encryptable radio models will be added to the Tait product range as requested. The following are examples only:

IPN	Description	Comments
TOP-XXXXX-B3	(Standard description) + ENCRYPTION	Encryptable radio, flex fitted, no module. Requires module purchase separately
T20XX-XXX-XXXE	(Standard description) + ENCRYPTION	Encryptable radio, flex fitted, no module. Requires module purchase separately

Modules

IPN	Description	Comments
005-00015-00	MOD ECRYPT TZ20-416 TCRYPT	Transcrypt module TZ20-416
005-00016-00	MOD ECRYPT TZ20-430 TCRYPT	Transcrypt module TZ20-430
005-00017-00	MOD ECRYPT TZ20-460 TCRYPT	Transcrypt module TZ20-460
005-00018-00	MOD ECRYPT VPU-12-TAIT MIDIAN	Midian module VPU-12-Tait
005-00019-00	MOD ECRYPT TVS-2-TAIT MIDIAN	Midian module TVS-2-Tait (TOP)
005-00020-00	MOD ECRYPT TVS-2-T2000 MIDIAN	Midian Module TVS-2-T2000

Encryption Module Programs

IPN	Description	Comments
005-00021-XX	PROG KL3+S/W ENCRYPT MIDIAN	Programmer and software for radios equipped with Midian modules
005-00022-XX	PROG ENCRYPT TRANSC TR30-3060 *Note:* this option available in USA only	Programmer and software for radios equipped with Transcrypt modules - service version with editable master code
005-00023-XX	PROG ENCRYPT TRANSC TR30-3061	Programmer and software for radios equipped with Transcrypt modules - Customer version, fixed master code

Encryption Upgrade Kits (encryption modules not included)

IPN	Description	Comments
TOPA-EA-001	KIT ENCRYPT UPGRD FLEX 5000	Tait Orca encryption upgrade kit
T2000-EA-001	KIT T2K ENCRYPT UPGRD FLEX	T2000 encryption upgrade kit

Encryption Module Programming

IPN	Description	Comments
TOPA-EA-011	CHARGE PROGRAM/TEST ECRYPT KIT	Factory fitting and programming of encryption module
T2000-EA-011	CHARGE PROGRAM/TEST ECRYPT KIT	Factory fitting and programming of encryption module

Support Products

| IPN	Description	Comments
TOPA-EA-002	KIT ENCRYPT OTAR/SERV TOP+T2K	Tait Orca and T2000 Encrypted Radio Programming and Service Kit
TOPA-EA-008G	CBL ENCRYPT DIRECT TOP G	Direct programming cable for all radios fitted with Transcrypt modules
TOPA-EA-007G	CBL ENCRYPT DIRECT TOP TVS2	Direct programming cable for TOP radios fitted with Midian TVS-2Tait and -07 (or later version) flexes

Documentation

IPN	Description	Comments
M2259-00-X00-812	SERV/PROG MANL ECRYPT	This manual

Encryption Training

Tait offers training programmes for personnel responsible for fitting, programming and servicing encrypted radios. In order to provide successful support for this technology, **it is strongly recommended** that this training be undertaken.

3   System Operation

Encrypted radios provide increased privacy for conversations by jumbling speech so that only radios with the right hardware and settings can reconstruct it. The diagram below shows a typical radio system comprising portable radios, mobile radios, base stations or repeaters and an OTAR (Over-the-Air Reprogramming) programming station.
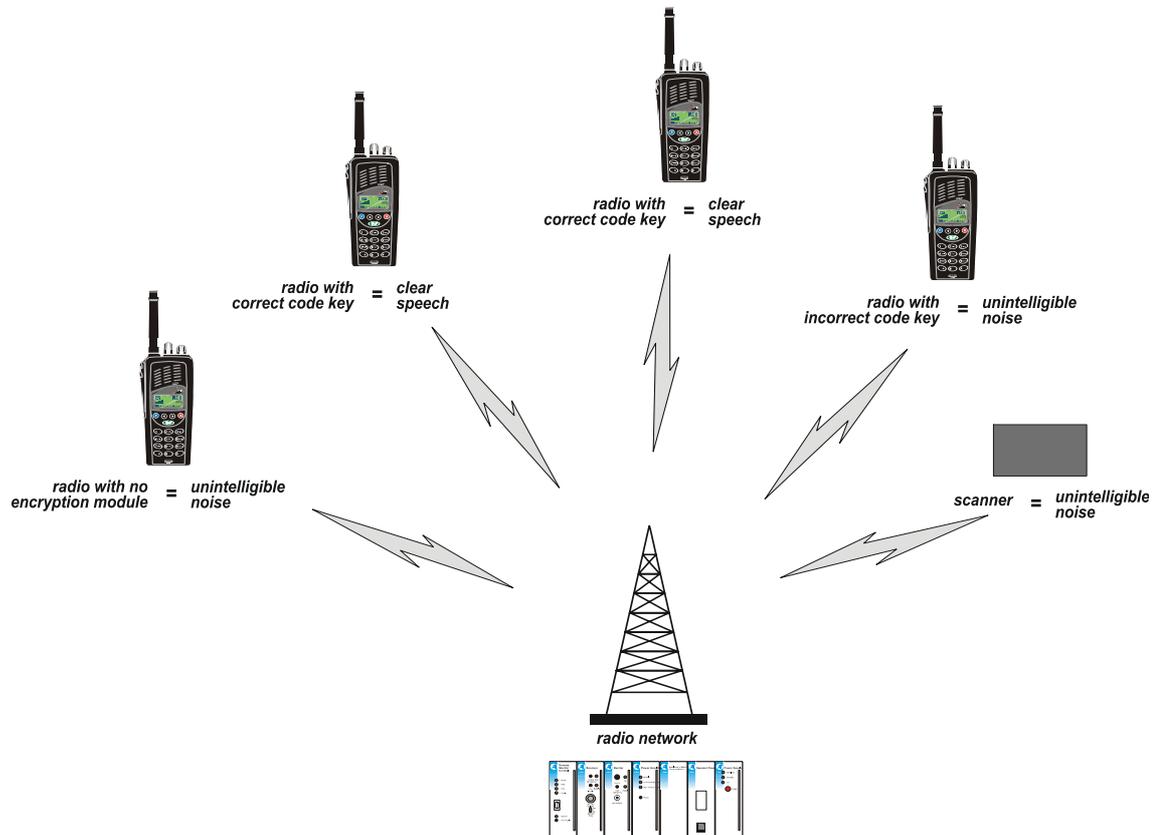
Whether or not a radio transmission is encrypted is the user's choice. When the encryption mode is selected, the radio sends and receives encrypted calls to and from other radios with compatible encryption module and settings (keys or codes). However, even when encryption is not selected, an encryption-enabled radio will always decode encrypted communication from any radio with compatible modules and settings.

When modules or settings are incompatible, communication is reduced to unintelligible noise.

3.1   Configuration

Both encryption modules and radios have many settings which affect encryption. You will need to refer to the installation and programming manuals provided with all your encryption hardware.

This manual describes how to connect your hardware for setup, testing and maintenance, but does not describe how to determine the settings you should use. These should be determined during system design by technical personnel trained in the relevant Tait and third-party products.

Contact your Authorised Tait Service Centre for further assistance.

3.2   Compatibility

Some combinations of encryption hardware, software, radio versions and configurations, accessories and programmable features may not be supported. In particular:

- Encryption modules from different manufacturers are not compatible
- Features available in a Tait Encryption-enabled radio are not necessarily the full list of features specified by the module manufacturer.

The system designer should confirm that the system meets user requirements.

3.3 Tait Encryption Interface Signal Specifications

For TOP Encryption Interface Signals, see page 15. For T2000 Encryption interface signals, see page 48.

4   Tait Orca Portable (TOP) Encryption

Tait Orca Portable (TOP) radios can be encryption-enabled at a Tait Authorised Service Centre using the TOP Encryption Upgrade Kit (IPN TOPA-EA-001) and a supported Transcrypt or Midian Encryption Module. This kit comprises a flex circuit which brings all the required connections for encryption to a single connector for plug-in encryption functionality. Full fitting instructions for the flex are included in this manual.

Note: Module component values change between TOP and T2000 radios. Ensure the module fitted has been configured for the TOP radio. See the encryption manufacturer's service manual for more information.

User Interface

This is a hardware and firmware solution. It offers:

■   user control of Encryption state (*On* or *Off*) by any Function button, programmed by the user, with either short or long press activation

■   menu access to Encryption state (where menu function is available)

Where the radio has both a display and a keypad, it also provides:

■   encryption state by text on the radio display

■   user control of up to 16 encryption codes by keypad

■   continuous display of the currently selected encryption code

■   programmable control of the number of user accessible codes

■   display of the 'accessory triangle' indicating when transmitting or receiving encrypted signals (Transcrypt modules) or if the encryption state is *ON* (Midian modules).

4.1   Circuit Operation

Functions of the interface are:

■   Transmit and receive audio is intercepted by the flex, where C572 and C567 are removed. Audio passes through the encryption module and is encrypted or not according to the encrypt state.

■   Links (not shown on the block diagrams, see the circuit diagram on page 21) allow the radio to function as a standard, unencrypted radio when an encryption flex is fitted with no module. To enable the radio to operate when a module is not fitted (-06 flex version only), solder-short *Link-6* and *Link-7* to loop the audio back to the normal radio path. Radios with -07 (or later version) flexes fitted do not require these links fitted.

■   The existing flex circuit that connects the Main PCB to the User Interface PCB is discarded, and is replaced by the encryption flex circuit.The low voltage reset from the radio is used to reset the module circuit.

Signal levels and pin assignments.

Function	Mode	Name	Pin	Module	TOP Radio
Power Supply		V+	1	5V regulated	
Reset	I/P	RS	2	Active low	Resets whenever supply lower than 4.75V
Tx pressel	I/P	PTT	3	Active low	CMOS
Busy	I/P	RX	4	Active low	CMOS
Mode	I/P	MO	5	Active low	Momentary or level sensitive
Data to Scrambler	I/P	D-SC	6	Hardwired module programming I/P	If reqd.

Data to Radio	O/P	D-RA	7	Hardwired module programming O/P	If required
Mode Indicator	O/P	IND	8	Active high	3mA into LED
Emergency	I/P	EMG	9	Active Low	Module pull-up to 5V
Code select 8	I/P	CS8	10	Active Low	Module pull-up to 5V
Code select 4	I/P	CS4	11	Active Low	Module pull-up to 5V
Code select 2	I/P	CS2	12	Active Low	Module pull-up to 5V
Code select 1	I/P	CS1	13	Active Low	Module pull-up to 5V
Ground		Gnd	14		
Transmitter to scrambler	I/P	TX-SC	15	AC coupled to 250Hz	200 mV p-p at 1kHz for 2/3 max deviation
Scrambler to transmitter	O/P	SC-TX	16	DC coupled	Approx. unity thru gain
Receiver to scrambler	I/P	RX-SC	17	AC coupled to 250Hz	650 mV p-p at 1kHz for 2/3 max deviation
Scrambler to Receiver	O/P	SC-RX	18	DC coupled	Approx. unity thru gain
Audio alert	O/P	AL	19	DC Coupled	
Trunking delay	I/P	TRK	20	Provision for future	

The diagram that follows shows the encryption circuit operation for both a TOP encrypted radio and a TOP radio as a programming radio.

Note: When using a TOP radio as an OTAR programming radio, ensure encryption mode is turned off.
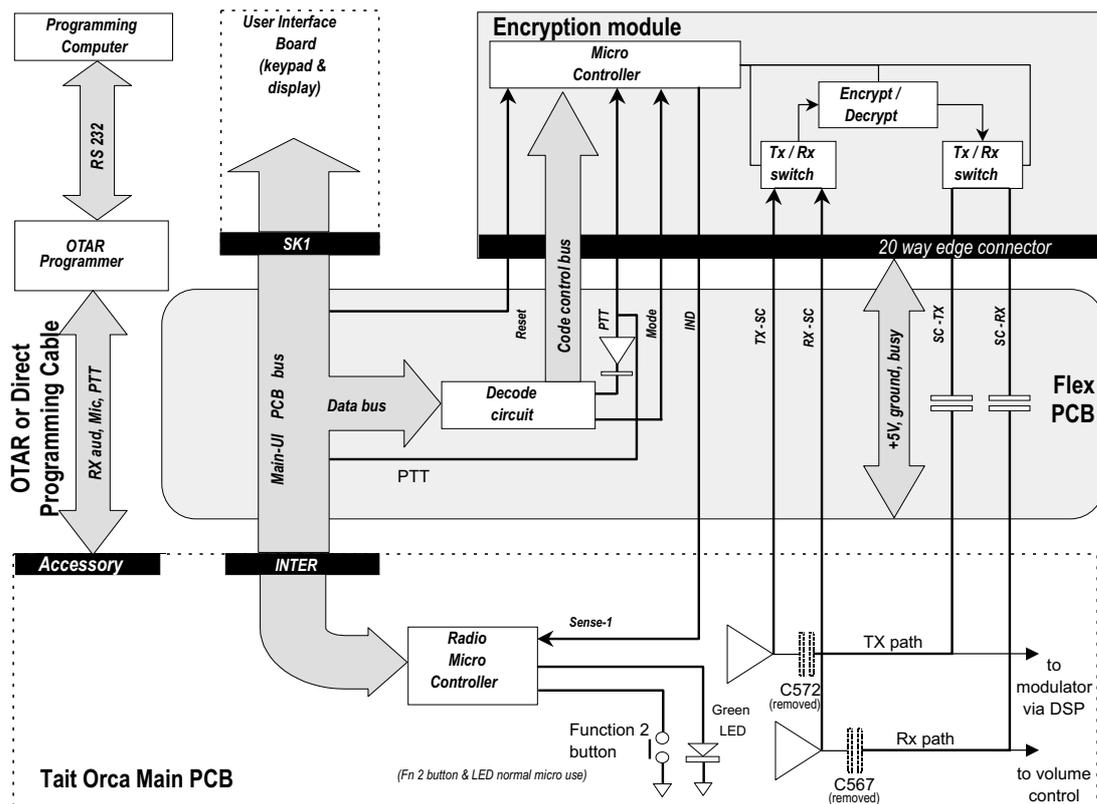
An addressable latch on the radio UI board is replicated on the encryption flex and driven by the same serial data bus. The radio micro uses four outputs of this latch to control the encryption code select bus. Two other outputs provide the PTT and Mode drives to the module. The remaining two pins function as normal for the UI board and are unused on the flex.

The external PTT and internal PTT are combined within the radio software to provide the PTT for the module.

The radio LED is under normal micro control, and provides no indication of encryption status.

The module IND (status) output is fed to the SENSE-1 input to the radio micro. This allows the software to display the status on the LCD accessory annunciator.

Encryption code control is achieved by keypad entry. Encryption Mode can be assigned to a function key when the radio is programmed or through a menu. (On most radios, this function is user-programmable.) This can be a long or short press of any valid function key, usually a long press of Function-2 key.

4.2   Programming the TOP Radio

Before programming the TOP Encryption radio, you will need:

- up-to-date standard Tait Orca Portable (TOP) Programming Applications installed, and familiarity with their operation. TOP Programming Applications are on the CD with the TOPA-SV-116 Programming Kit or from http://support.taitworld.com/ at Portable/ Programming Software which requires Tait Authentication System (TAS) access.

- The packages you require are:
    - the conventional and trunked programming applications
    - the download and configuration application
    - the calibration application

- Encryption flex fitted to the TOP radio. The flex is available in the TOPA-EA-001 Encryption Upgrade Kit. Instructions for fitting begin on page 17.

Back up Radio Data Files

Note: This procedure requires:
- TOPA-SV-116 Programming Kit

1.   Using the standard TOP programming software, save the existing programming data file (*.ops).

2.   Using the TOP calibration software, save the existing calibration data file (*.cps).

Download Custom Programming Software and Firmware

Note: This procedure requires:
- 'Tait Only' password for Tait World Technical Support - see your Tait dealer if you do not have access.

1.   Go to http://support.taitworld.com/custom/index.cfm
(Taitworld/Support/Login/Tait Only/Portable Radios/Encryption/).
Enter your login details, then click on **Tait only**.

2.   Select **Portable Radios** then **Encryption**.

3.   Select the correct Programming Software. As a guide, Select:
- 2259 for 501X and 502X radios
- 2275 for 503X and 504X trunked radios
- 2314 for 5021 radios

4.   Click on the Programming Software **[view/download]** link and save the file.

5.   Select the correct firmware.
Click on the Firmware **[view/download]** link and save the file.

Install Encryption Firmware in Radio

Note: This procedure requires:
- Tait Orca Portable Download Program and Custom Encryption Firmware

1.   Run the TOP download program.

2.   Select **Download** from the menu on the left.

3.   Browse to the encryption firmware file you previously downloaded and click **Open**.

4.   Click on **Download**.

5.   Power-up the radio in bootstrap mode (hold FN1 button while radio is turned on)

Note: Radio display is blank when entering bootstrap mode.

6.   Click on 'OK'. The radio firmware will download.

Note: If the radio displays 'DBASE ERROR', reload the saved programming data file

Note: If the radio displays 'CALIBRATION ERROR', reload the saved calibration data file.

7.   Power-off radio, power-on with PTT pressed, and check firmware version is correct.

Install and Run Encrypted Radio Programming Software on PC

This procedure requires a TOP-SV-116 Programming Kit and Encrypted Radio Programming Software

1.   Unzip the Programming Software file in the directory that you want to run it from.

2.   Run the *.exe file.

Encrypted Radio Programming Software Settings

1.   In the **Specification form** set the **Maximum Number of Encryption Codes** to a number between 1 and 16.

2.   In the **Key Settings form**, choose a function key to assign to **Encryption On/Off** and another for **Encryption Code Select**.
      The available function keys are:

- Function Key 1 (long or short press)
- Function Key 2 (long or short press)
- Function Key 3 (short press)
- Short Menu key (long press)
- External Function Key 1
- External Function Key 2

3.   In the **User Defined Menu form**, check the **ENCRYPT SETTINGS** box (ticking a top-level menu will enable all of that menu's submenu functions). This means that Encryption (on/off and code selection) will be available from the radio menu.

Transcrypt Module Programming

Note: All Transcrypt modules can be programmed directly, via a dedicated programming cable, or over the air (OTAR)

This procedure requires:

- a computer with OTAR programming software
- a Transcrypt Programmer
- a TOP or T2000 Lead (part of the TOPA-EA-002 Encrypted Radio Programming and Service Kit) for OTAR programming
  or
  a direct programming cable (TOPA-EA-008G) for direct programming
- a TOP or T2000 radio to use as a programming radio (OTAR only)

Transcrypt modules fitted to a TOP radio can be programmed using Over-The-Air-Reprogramming (OTAR). The OTAR programmer allows a computer to alter a radio's encryption module settings remotely, within the coverage range of the radio system.

For direct programming, the module is programmed directly, using a TOPA-EA-008G cable connected to the radio's accessory connector.

Note: Any TOP radio can be used for OTAR programming. However, if an encryption module is fitted, it is important that the encryption function is turned off when programming.

Note: If a T2000 radio is used for OTAR programming, a T2000 Encryption Flex must be fitted to the radio. A module is not required, however, if one is fitted, it is important that the encryption function is turned off when programming.

Refer to the following publications for detailed programming instructions

- Transcrypt OTAR Programmer Manual
- Transcrypt Module Manual
- Transcrypt Programming section (page 69) of this manual

4.2.1   Midian Module Programming

The Midian VPU-12 module is preprogrammed by the manufacturer and does not normally require programming. Its programmable functions can be programmed by open-radio direct programming. It does not support OTAR programming. The Midian TVS2 module supports OTAR programming of encryption codes only. However, the TVS2 supports direct programming of all programmable functions.

Refer to the following manuals for detailed programming instructions

- Midian Programming instructions
- Midian Module Manual
- Midian Programming section (page 79) of this manual

Important Additional Information

- Once encryption is enabled, set the function buttons to:
    - turn encryption ON and OFF
    - access **Code Change** mode (optional)
    - set the number of user-accessible codes (optional)
- Economy mode is the factory default, but **is *not* recommended** with encryption-enabled radios as it will cause loss of sync pulses. This may result in failure to decode some encrypted calls after a period of inactivity.
- If the flex version is -06 (or earlier), to enable the radio to operate as a standard, unencrypted radio when a module is not fitted, solder-short links **Link-6** and **Link-7** on the flex. This modification will loop the audio back to the normal radio path. See the PCB layout section on page 21 of this manual to locate the links.
- If radios have no display, ensure no other function (eg incoming selcall or repeater talkaround) is programmed to utilise the orange LED, or it will be too difficult to determine encryption status.

4.3   Programming the Encryption Module

Note: When using a TOP radio as a programming transmitter, if an encryption module is fitted, ensure the encryption function is turned off.

Equipment setup and programming instructions are described in the Transcrypt Programming section on page 69 or the Midian Programming section on page 79, depending upon the origin of the encryption module. Refer also to programming and service manuals with your Transcrypt or Midian encryption module and programmer.

Service Desk OTAR programming may be unsuccessful if:

■   the target radio is open during programming

■   the programming radio and the target radio are oriented differently eg one laying down, one upright

■   one radio is set to **High Power**

4.4   Testing the Encryption Module

Equipment setup and testing instructions are described in the Transcrypt Programming section on page 69 or the Midian Programming section on page 79, depending upon the origin of the encryption module.

With encryption off:

■   Check normal power-up of the radio, with the normal display messages and confirmation tones.

■   Check that receive and transmit audio are functioning, using a service instrument or another radio on the same channel.

With encryption on:

■   Check that receive and transmit audio are functioning, using another T2000 or TOP radio with the same encryption module, programmed with the same codes, on the same channel.

■   Where a code hopping module is fitted, confirm encryption is active by listening for the initial sync burst on the receiving radio

■   Where a code inversion module is fitted, confirm encryption is active by pressing any function key - the confidence tone will be a higher frequency than normal.

■   Check the Encryption User Interface features – status indicators, encryption settings etc. (See the TOP Encryption User's Guide information provided on page 37).

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4.5 TOP Encryption Upgrade Flex PCB Information

At the time of printing, there are two current versions of the Flex PCB. The numbers appear on the PCB top side. Be careful to ensure you are referring to the correct version information.
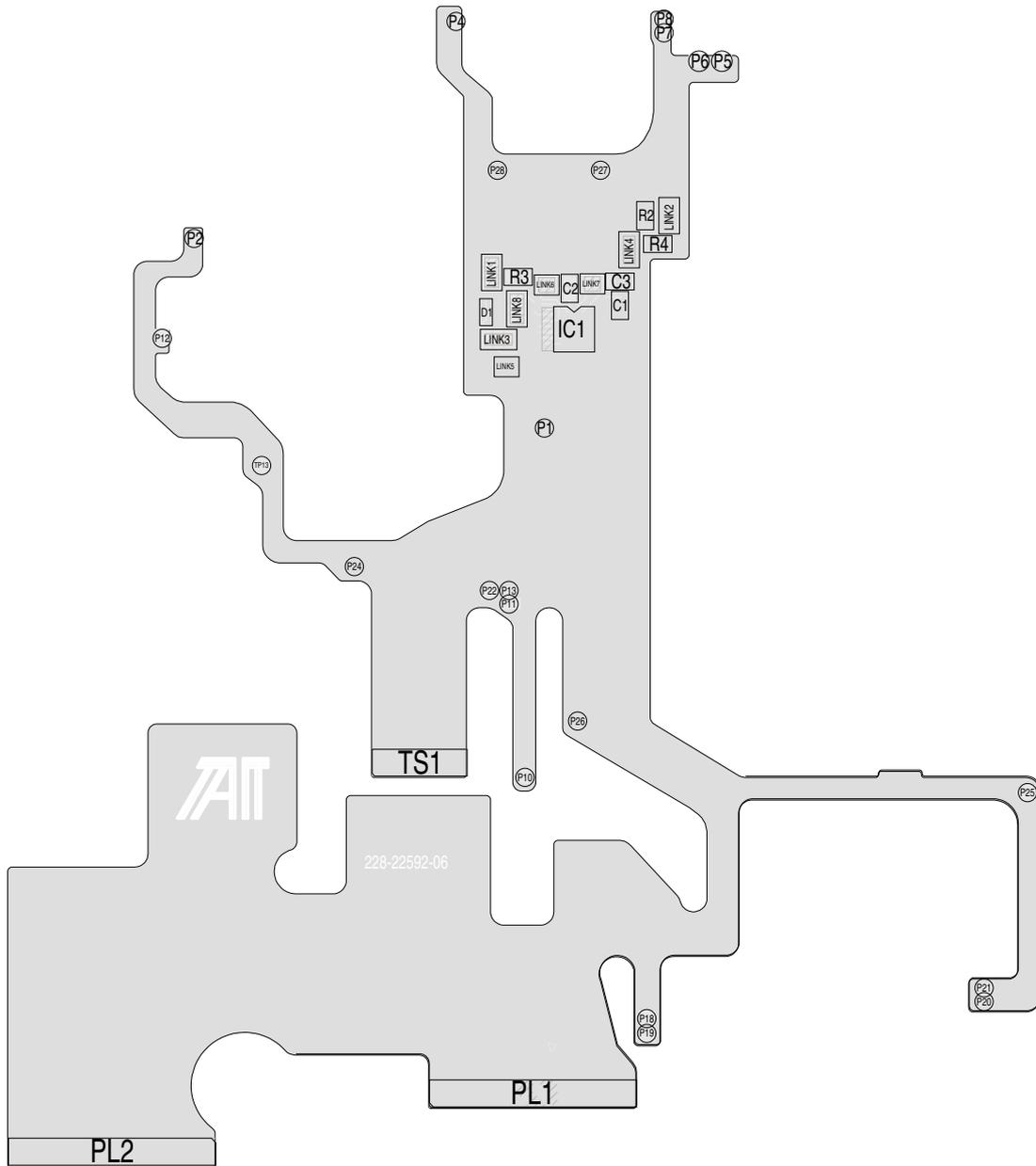
4.5.1 IPN 228-22592-06A

SMD Parts List IPN 228-22592-06A

Part	IPN	Description
TS1		SMD PADS FOR 20W .3MM FLEX BD 0.5MM PITCH
PL1	COPPER-PAD	SMD PADS FOR 22W .3MM FLEX BD 1MM SPAN
PL2	COPPER-PAD	SMD PADS FOR 22W .3MM FLEX BD 1MM SPAN
P5	I/O-PAD	SMD PADOFF BD WIRE CONN
P6	I/O-PAD	SMD PADOFF BD WIRE CONN
P1	I/O-PAD	PAD HOLE OFF BD WIRE CONN
P2	I/O-PAD	HOLE OFF BD WIRE CONN
P4	I/O-PAD	HOLE OFF BD WIRE CONN
P7	I/O-PAD	HOLE OFF BD WIRE CONN
P8	I/O-PAD	HOLE OFF BD WIRE CONN
P10	I/O-PAD	HOLE OFF BD WIRE CONN
P11	I/O-PAD	HOLE OFF BD WIRE CONN
P12	I/O-PAD	HOLE OFF BD WIRE CONN
P13	I/O-PAD	HOLE OFF BD WIRE CONN
P18	I/O-PAD	HOLE OFF BD WIRE CONN
P19	I/O-PAD	HOLE OFF BD WIRE CONN
P20	I/O-PAD	HOLE OFF BD WIRE CONN
P21	I/O-PAD	HOLE OFF BD WIRE CONN
P22	I/O-PAD	HOLE OFF BD WIRE CONN
P24	I/O-PAD	HOLE OFF BD WIRE CONN
P25	I/O-PAD	HOLE OFF BD WIRE CONN

Non-SMD Parts List IPN 228-22592-06A

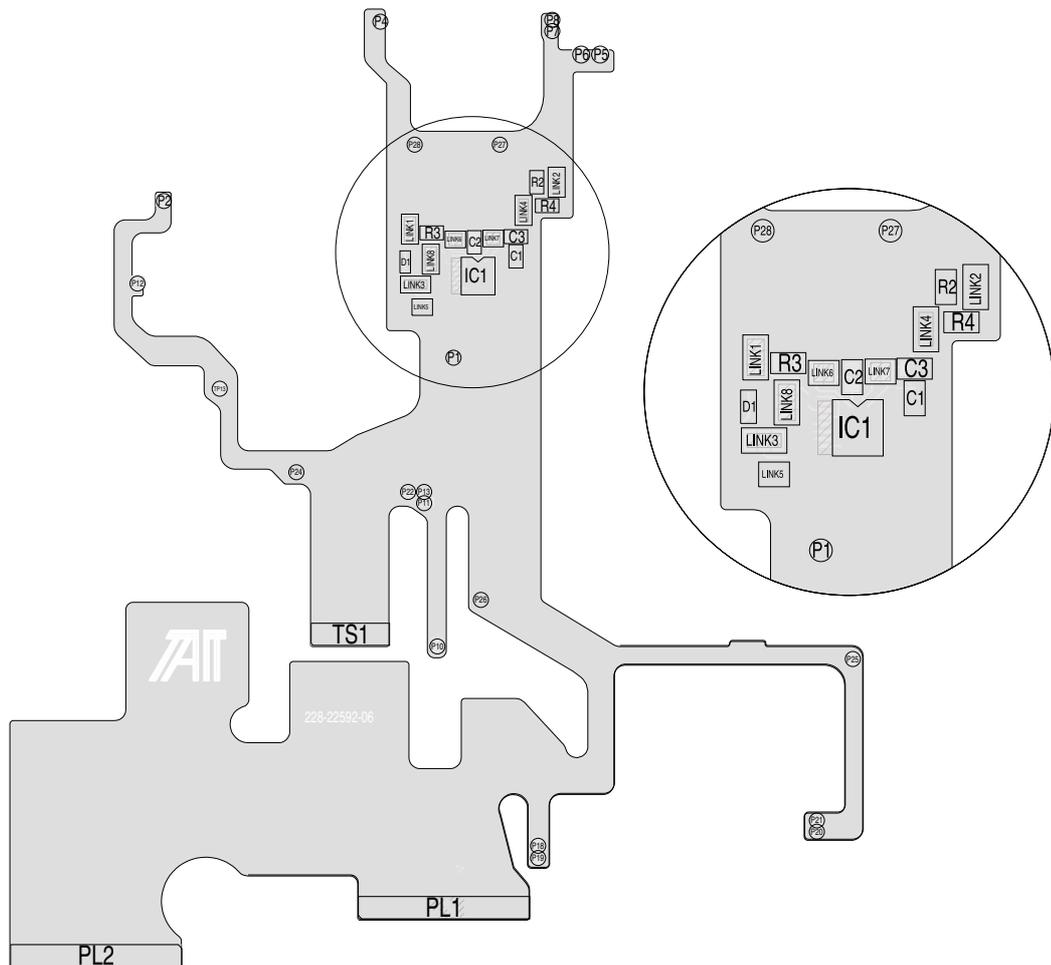| Part	IPN	Description
D1	001-10000-99	DIODE BAV99 DUAL SW (PIN 3 IS ANODE/CATH)
IC1	002-15595-00	IC 74AHC595PW 8-BIT SHIFT REGISTER
C1	015-26100-08	CAP 100N 10% 50V X7R
C2	015-26100-08	CAP 100N 10% 50V X7R
C3	015-26220-08	CAP 220N 10% 16V X7R
R2	036-14470-10	RES 4K7 1%
R3	036-15470-10	RES 47K 1%
R4	036-15470-10	RES 47K 1%
P26		I/O-PAD HOLE OFF BD WIRE CONN
P27		I/O-PAD HOLE OFF BD WIRE CONN
P28		I/O-PAD HOLE OFF BD WIRE CONN
TP13		I/O-PAD HOLE OFF BD WIRE CONN
LINK1	LINK-0805-SP	0805 CHIP SPACING USED AS 3-WAY LINK
LINK2	LINK-0805-SP	0805 CHIP SPACING USED AS 3-WAY LINK
LINK3	LINK-0805-SP	0805 CHIP SPACING USED AS 3-WAY LINK
LINK4	LINK-0805-SP	0805 CHIP SPACING USED AS 3-WAY LINK
LINK8	LINK-0805-SP	0805 CHIP SPACING USED AS 3-WAY LINK
LINK5	SOLDER-LINK	SOLDER LINK WITH TWO SMD PADS 0.05 SPAC
LINK6	SOLDER-LINK	SOLDER LINK WITH TWO SMD PADS 0.05 SPAC
LINK7	SOLDER-LINK	SOLDER LINK WITH TWO SMD PADS 0.05 SPAC

PCB Layout - top side IPN 228-22592-06A

Link Information IPN 228-22592-06A

Factory standard flexes links fitted as follows::

Link	Purpose	Setting
1	Encryption mode to module	Fitted - pads 2-3
2	Future development	Not fitted
3	Encryption indicator output	Fitted - pads 1-2
4	Future development	Not fitted
5	Future development	Not fitted
6	Link audio through flex	Fitted only if no module factory fitted
7	Link audio through flex	Fitted only if no module factory fitted
8	External PTT link	Fitted - pads 2-3

Circuit Diagram - page 1 of 1 IPN 228-22592-06A

4.5.2   IPN 228-22592-07A

SMD Parts List
IPN 228-22592-07A

Part	IPN	Description
C1	015-26100-08	CAP 100N 10% 50V X7R
C2	015-26100-08	CAP 100N 10% 50V X7R
C3	015-26220-08	CAP 220N 10% 16V X7R
D1	001-10000-99	DIODE BAV99 DUAL SW (PIN 3 IS ANODE/CATH)
IC1	002-15595-00	IC 74AHC595PW 8-BIT SHIFT REGISTER
LINK2	LINK-0805-SP	0805 CHIP SPACING 3-WAY LINK
LINK3	SOLDER-LINK	SOLDER LINK WITH TWO SMD PADS 0.05" SPACING
LINK4	LINK-0805-SP	0805 CHIP SPACING 3-WAY LINK
LINK5	SOLDER-LINK	SOLDER LINK WITH TWO SMD PADS 0.05" SPACING
LINK7	LINK-0805-SP	0805 CHIP SPACING 3-WAY LINK
P5	I/O-PAD	SMD PAD FOR OFF BOARD WIRE CONNECTION
P6	I/O-PAD	SMD PAD FOR OFF BOARD WIRE CONNECTION
PL1	COPPER-PADS	SMD PADS FOR A 22WAY .3MM FLEXI BRD 1MM SPAN
PL2	COPPER-PADS	SMD PADS FOR A 22WAY .3MM FLEXI BRD 1MM SPAN
R2	036-14470-10	RES 4K7 1%
R4	036-15470-10	RES 47K 1%
R5	036-15100-10	RES 10K 1%
R6	036-15100-10	RES 10K 1%
R7	036-10000-00	RES ZERO OHM 5%
R8	036-15100-10	RES 10K 1%
R9	036-15100-10	RES 10K 1%
TS1	COPPER-PADS	SMD PADS 20W .3MM FLEXI BRD 0.5MM PITCH

Non-SMD Parts List
IPN 228-22592-07A

Part	IPN	Description
P1	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P2	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P4	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P7	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P8	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P11	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P12	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P13	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P18	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P19	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P20	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P21	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P22	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P24	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P25	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P26	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P27	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
P28	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION
TP13	I/O-PAD	PAD HOLE OFF BD WIRE CONNECTION

**PCB Layout - top side only
IPN 228-22592-07A**
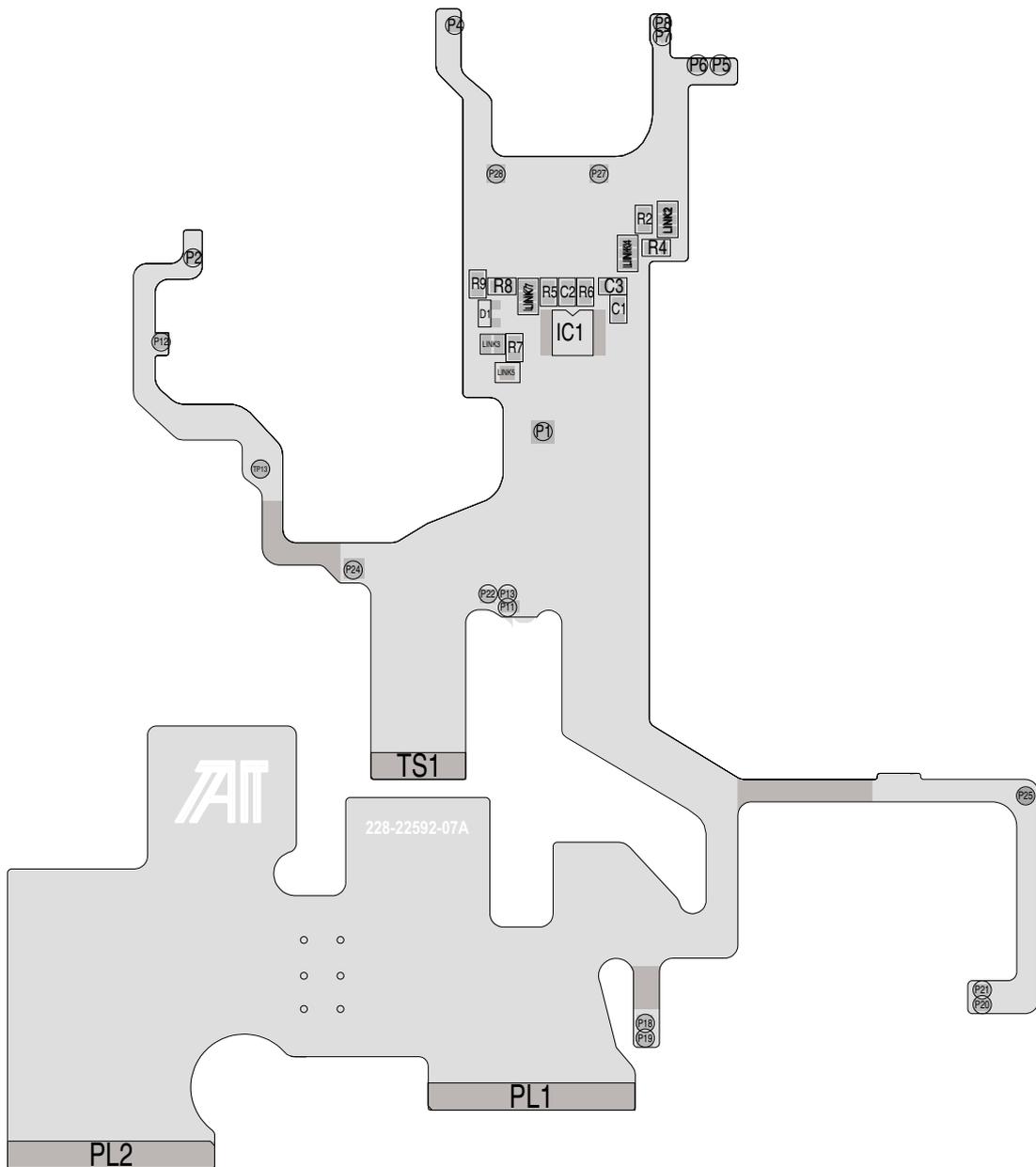
Link Information
### IPN 228-22592-07A

Factory standard flexes have no links fitted. However, the following information:may be helpful regarding link settings:

Link	Purpose	Setting
1	Not assigned	
2	Alarm output	Future development
3	Indicator output to LED	Not normally used
4	Rx Squelch	Future development
5	Audio Enable	Future development
6	Not assigned	
7	Enables direct programming (Transcrypt only)*	Link pads 2-3 (top pads) as shown
8	Not assigned	
9	Not assigned	

* Not required for Midian modules
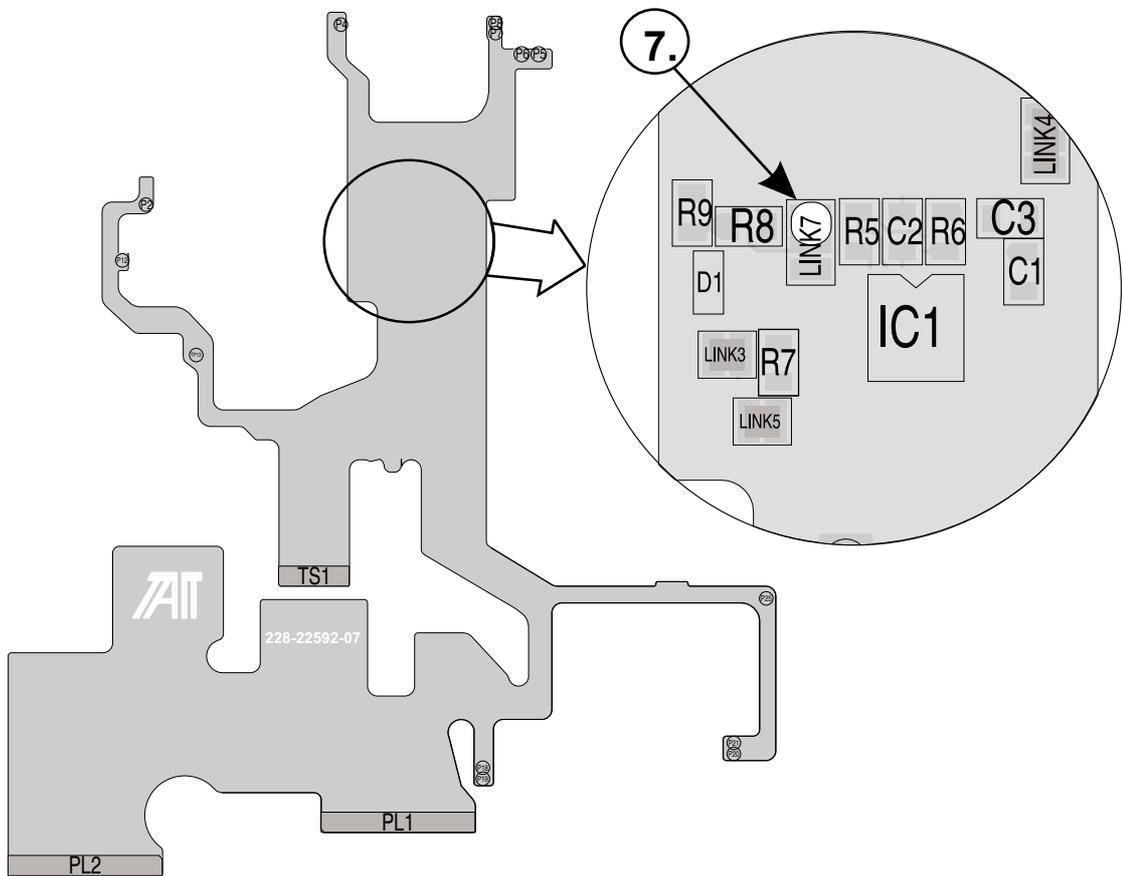
Circuit Diagram - page 1 of 1
IPN 228-22592-07A
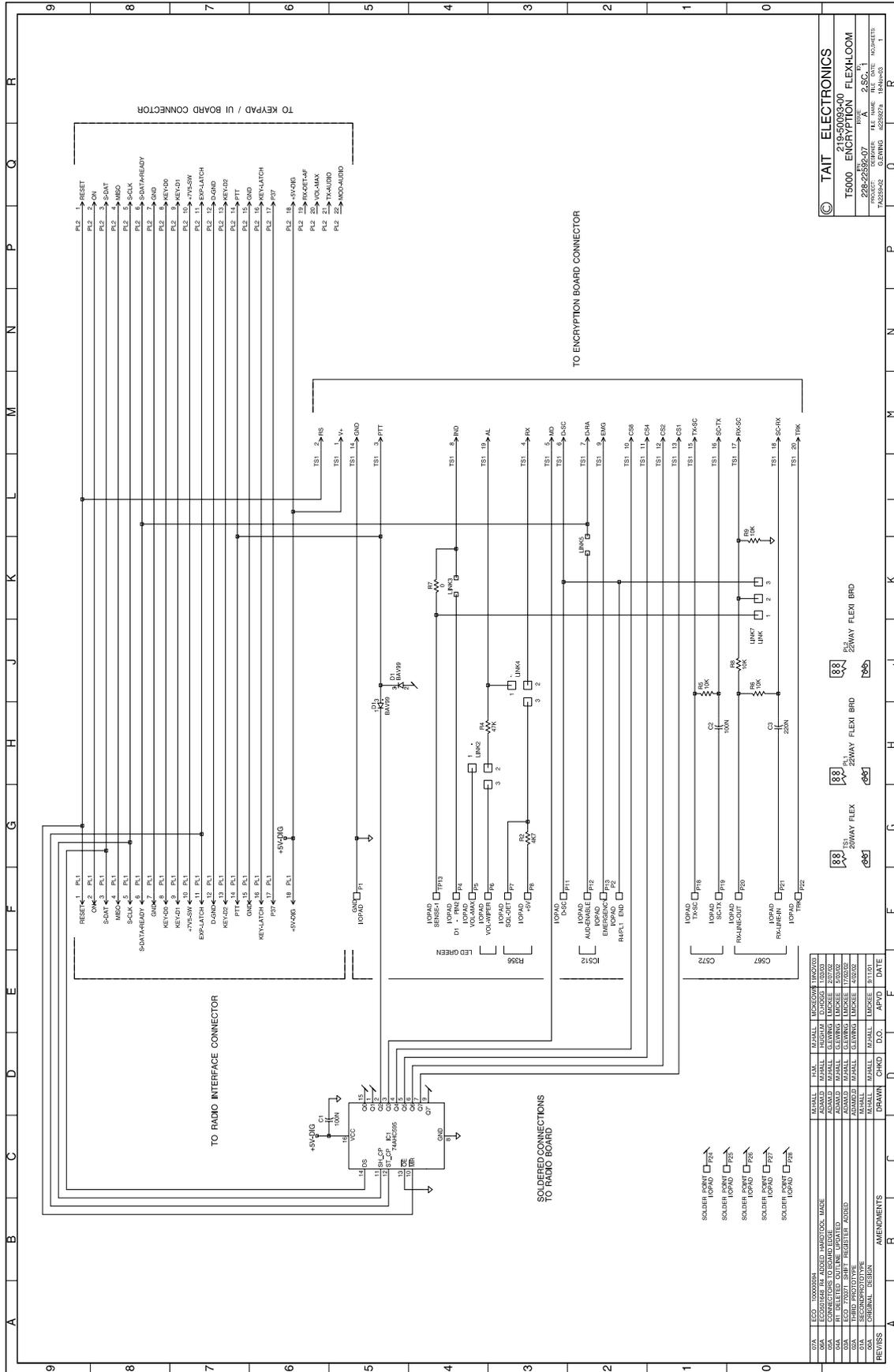
4.6   Encryption-Enabled TOP Operating Instructions

The following operating instructions apply to Encryption-Enabled TOP radios only. They should be used in conjunction with the TOP User's Guide issued with the radio.

Transmitting or receiving encrypted call (Transcrypt only)
Encryption On/Off Indicator (Midian only)
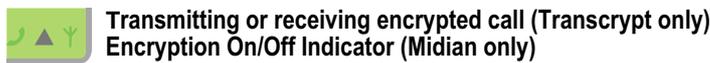
Note: **If your radio has no display, the LED indicates encryption status**

4.7   TOP Fault Finding

Diagnosis TIP
If unsure whether a radio with simple inversion encryption is in **encrypt** or **clear** mode: while in standby (without any incoming signal), hit a keypad or function key to produce an audible beep. If the radio is in **encrypt** mode, the beep will be a much higher frequency than normal.

Symptom	Cause	Action
Radio transmits regularly - goes into emergency mode Audio not operating Radio stopped working after it was dropped.	Module not squarely in connector	Re-plug connector to module (radio will need to be opened)
Receives okay, but no transmit audio.	Module may not be receiving PTT	Check PTT links.
External mic PTT does not operate.	Incorrect links on flex	Check PTT links.
Encryption on/off button only changes encryption state every second press	Module may be programmed for level-sensitive instead of edge-sensitive.	Reprogram encryption module.
Module does not decrypt audio.	Module may have been programmed differently to the rest of the fleet.	Reprogram with correct settings.
Module acknowledges its ID, but not accept any other commands.(Transcrypt modules only)	Module may be programmed with the wrong programmer, with a different Master code.	Reprogram with correct programmer - will need a 'Force Download' (Refer to Transcrypt Manual)
Module acknowledges its ID, but not accept any other commands. Force download does not fix. (Transcrypt module only)	Module may be damaged or have failed.	Replace with a new module.
Radio will not power up properly, shows database error, continuous Red LED.	Radio has been downloaded with incorrect firmware and/or programmed with incompatible software.	Contact Customer support.
Radio will not power up properly, display blank.	Flex-edge connectors may not be correctly plugged. Module faulty.	Replug connectors checking flex is square to connector. Replace module.
Poor audio quality	Module has links set for wrong radio type.	Set links according to manuals.
Radio set to one code can hear another radio no matter what code it is set to.	Module may have same code strings set in all code registers. IC1 on flex may not be working, or not getting address information from micro.	Reprogram module with different codes. Replug loom connectors, check circuit.
Audio sounds very muffled (Midian modules only)	Inversion module may have very low inversion frequency.	Program module to a higher frequency.
Audio sounds very "thin". (Midian modules only)	Inversion module may have very high inversion frequency.	Program module to a lower frequency.

| Symptom	Cause	Action
Audio sounds squeaky or croaky. (Midian modules only)	Transmit and receive inversion frequencies may be different.	Ensure both radios are using same frequency. If problem still exists, reprogram module
Receiving radio occasionally or frequently fails to decode sync pulse. Audio is unintelligible for several seconds then comes right. (Transcrypt modules only)	System delay may be set too short	Reprogram module, or consider if CTCSS can be removed from some parts of radio system.
	Radio may have economy mode enabled	Reprogram radio to disable economy mode
Radio confidence and alert tones are different, rapidly varying tones.	This is normal when either the transmitting or receiving radio creates an alert tone or confidence tone during an encrypted conversation.	No action - not a fault
Radio makes unusual, distorted beeps at turn on.	Radio confidence tones may be set to high. (Not all radios exhibit this)	Reprogram radio to set confidence tones to low.
Module OTAR programming does not work. (Transcrypt modules only)	Module may have been corrupted or damaged by high levels of radiated RF, eg a portable on high power while the radio has covers removed	Reprogram module.
Encryption indicator triangle turns on and off randomly.	Both LK-3 links on TOP flex may be connected, not just one.	Remove one LK-3 link. (See Fitting Instructions)

4.8   Fitting the TOP Encryption Upgrade Flex

Note: Extreme care is critical when disassembling the radio, as failure to disassemble it correctly may damage the seal and shield resulting in permanent damage. Disassemble according to standard procedures, using the recommended tools. (See page 7).

Prepare Flex

1.   Locate R9 and remove

2.   Locate R7 and fit 0Ohm chip (if not already fitted)

Note: When fitting a TVS-2 module to an -07 version flex, remove components R5 and R6.
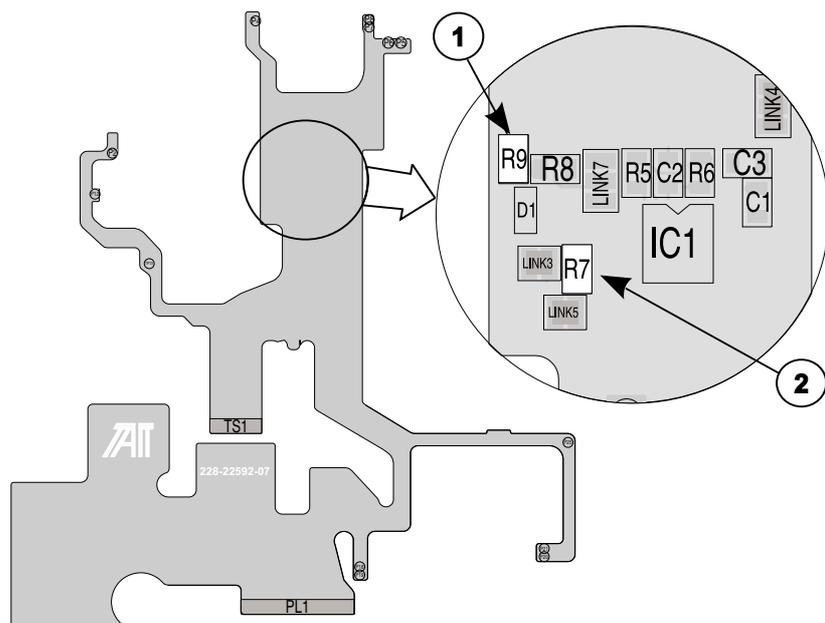
Modify Orca PCB (bottom side)

1. Use Torx screwdriver to undo screw and remove PCB from chassis

2. Remove component C572 using hot air gun and tweezers

3. Remove component Q532 using hot air gun and tweezers

4. Remove component R356 using hot air gun and tweezers

*Note:*   R356 is the left component of a pair with R365

5. Pre-wet cans in positions indicated.

*Note:*   These positions will correspond to earthing points on flex.
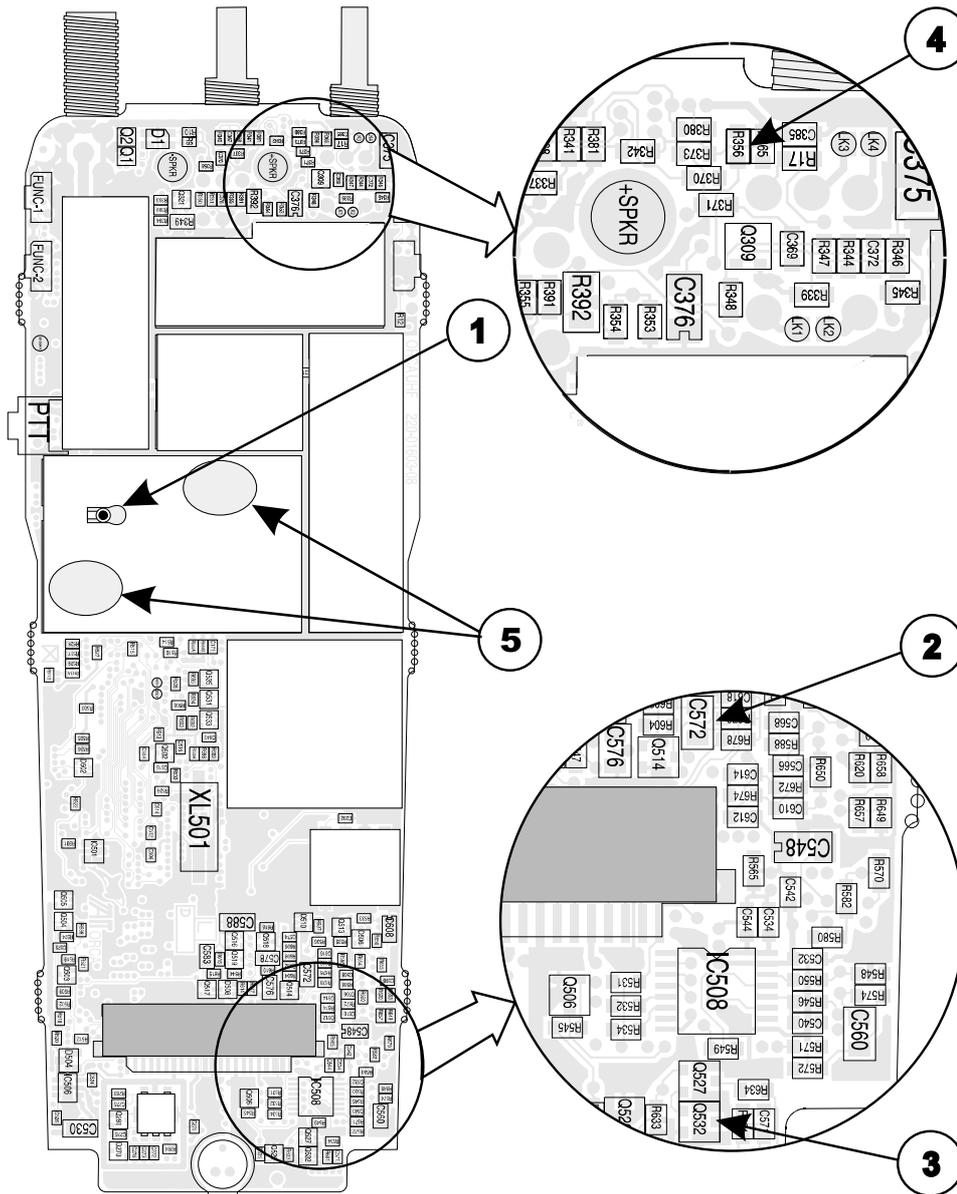
Modify Orca PCB (top side)

1. Locate can with large hole cut as shown

2. If no large hole in can, cut carefully with sidecutters where shown, and turn edges in

3. Remove capacitor C567 using hot air gun and tweezers

4. Remove component R646 using hot air gun and tweezers, and replace with 4K7 resistor (IPN 038-14470-00)

5. Remove component R4 using hot air gun and tweezers
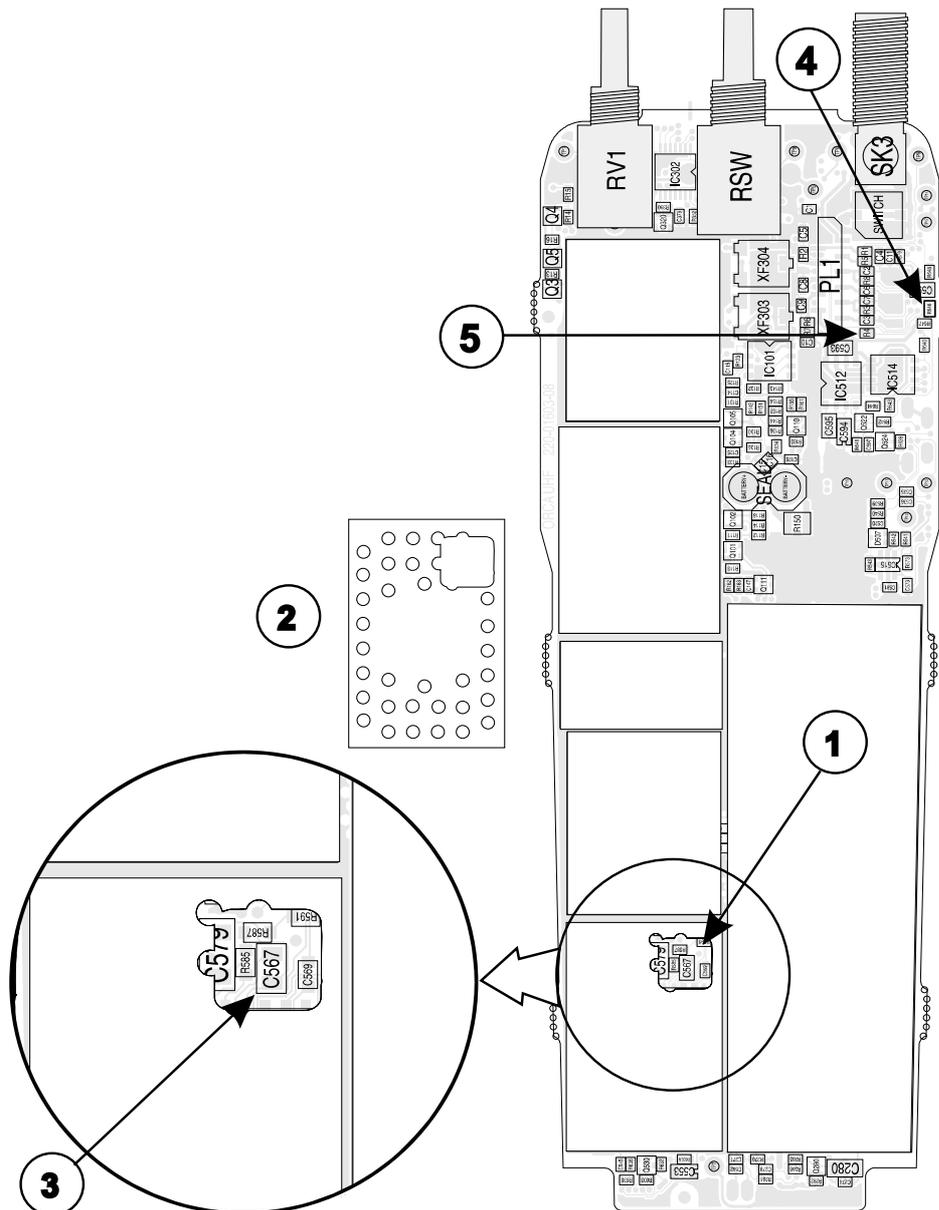
Fit Flex to Orca PCB (bottom side)

1.   Lay flex onto PCB exactly as shown
2.   Fit flex firmly into PL1 flex edge connector and press locking tabs closed
3.   Solder two flex pads to the position vacated by C572
4.   Ensure flex fits **exactly** to corner of can, with the edge clear of the PA can tag
5.   Solder flex to cans, holding soldering iron to each point for *at least three seconds* to ensure permanent joins
6.   Solder flex pad to **top** pin of LED1 as shown
7.   Solder flex pads to space vacated by R356
8.   Solder flex pads to volume control switch pins 2 and 3 as shown
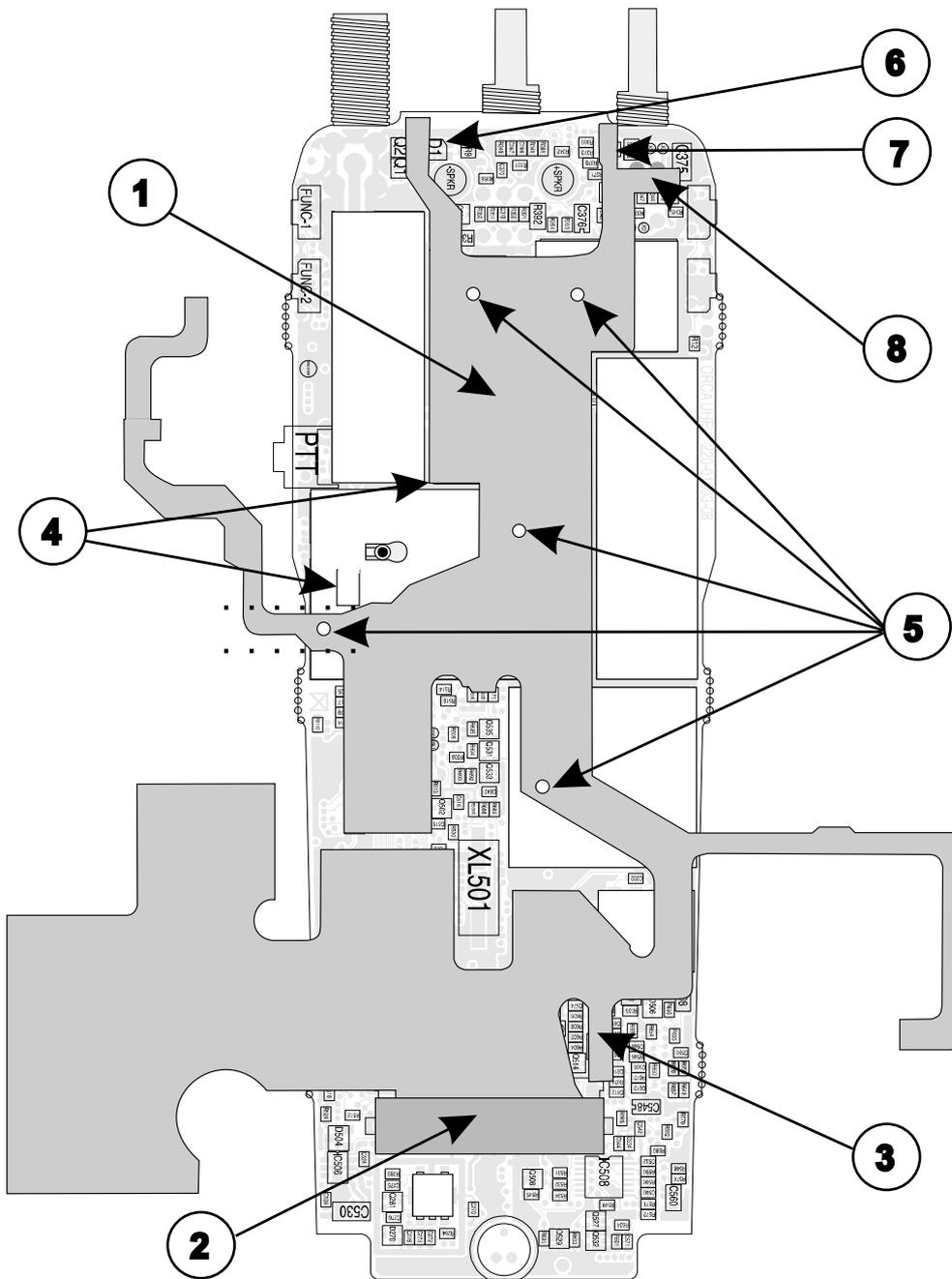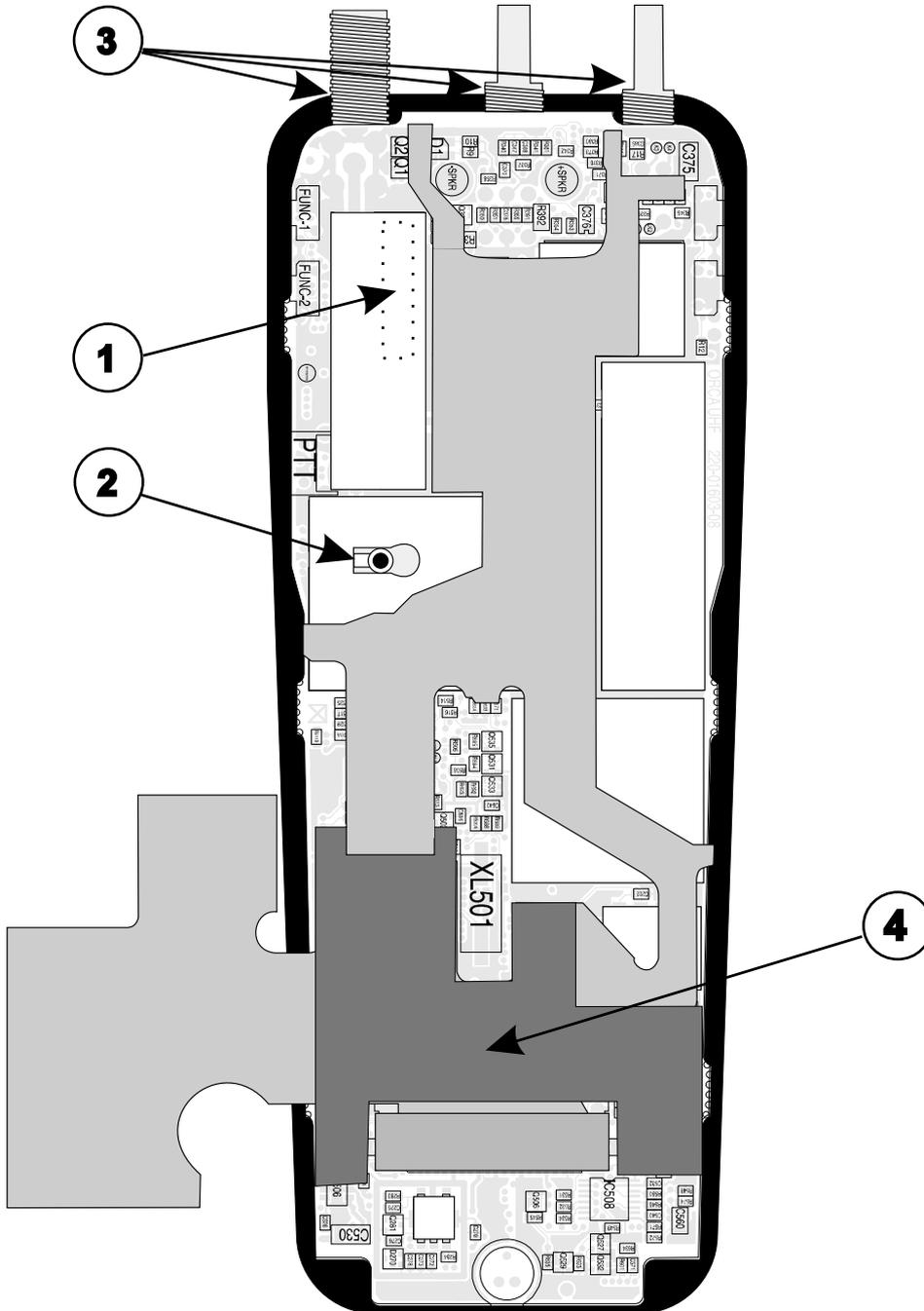
Fit Flex to Orca PCB (top side)

1. Turn PCB over and bend flex carefully around PCB as shown

2. Bend flex at crease, then holding flex in place with tweezers, solder flex pads to the pads vacated by C567

3. Solder flex to can, holding soldering iron to each point for *at least three seconds* to ensure permanent join

4. Solder single flex pad indicated to IC512 pin 1

5. Solder flex pad to pad vacated by R4, as indicated

6. Solder single flex pad indicated to TP13

Note: Take care not to short adjacent components when soldering to TP13
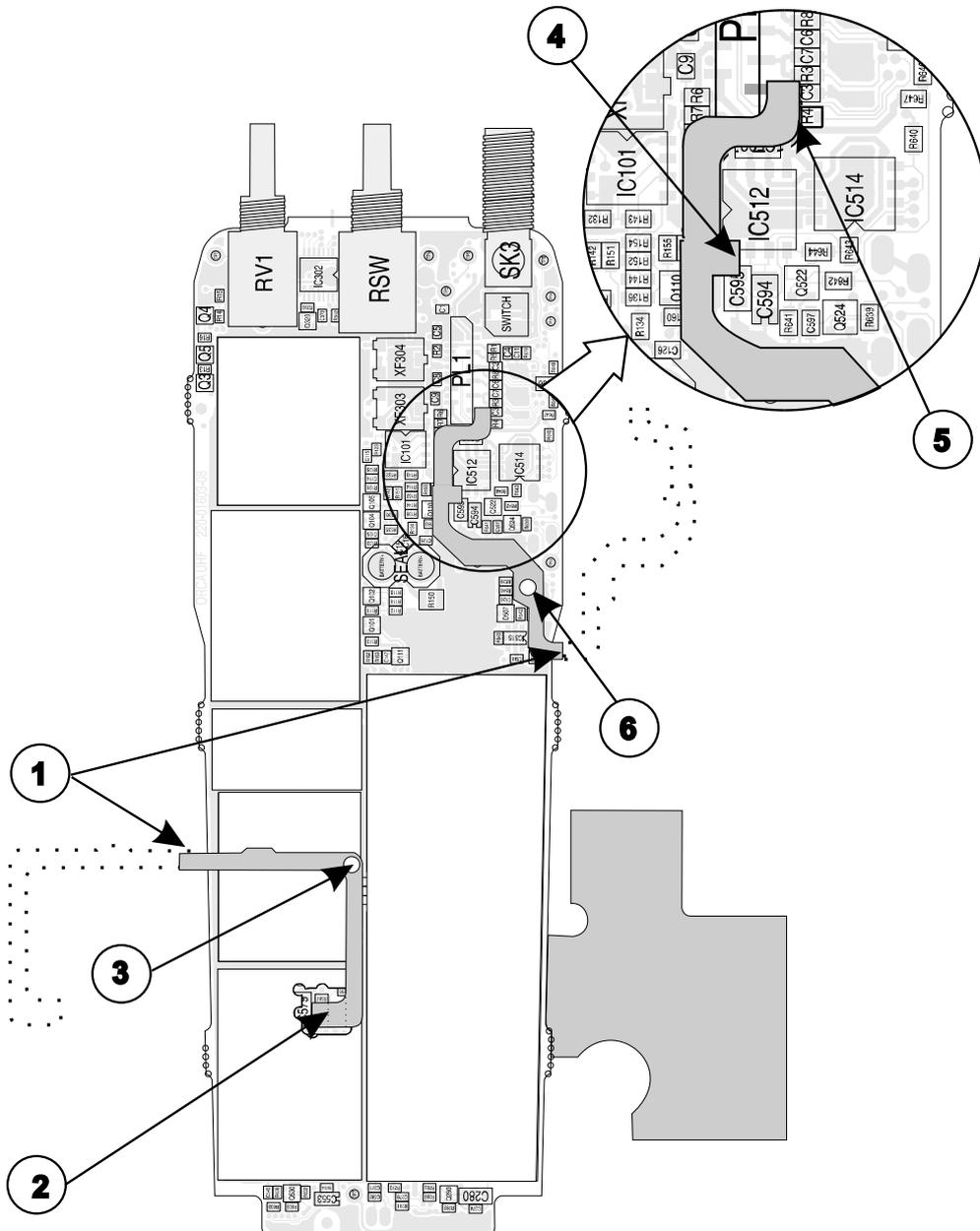
Fit Orca PCB back into chassis

1. Slide PCB back into chassis, carefully aligning the chassis Auxiliary Connector Flex into the PCB top side.

2. Replace the screw through the can where shown

3. Replace the washers, nuts and knob seal on the radio top

4. Fix the foam cushioning pad onto the flexiloom where shown, using double-sided tape

Fit Encryption Module

Note: Before performing these steps, ensure that the encryption module's flex edge connector is facing **toward** the Orca PCB

1.   Fit flexiloom firmly into module's flex edge connector

2.   With main RF shield beside PCB as shown, fit flex into RF shield flex edge connector

Note: ***There is no flex-edge connector in the Tait Orca Elan or T5010 models. If fitting to these radios, tape the flexiloom at this edge to prevent it shorting.***

3.   Gently fold the flexiloom to refit the RF shield into the chassis, then reassemble the radio according to standard procedures.

5 T2000 Radio Encryption

T2000 radios can be encryption-enabled in the field using the T2000 Encryption Upgrade Kit (IPN T2000-EA-001) and the appropriate Transcrypt or Midian Encryption Module.

This kit comprises a flex circuit which brings all connections required for encryption to a single connector for plug-in encryption functionality. This is the Tait standard encryption interface. Instructions for fitting the flex are on page 65 of this manual.

Note: Ensure the encryption module to be fitted has been configured for the T2000 radio. See the module manufacturer's service manual for more information.

This is a hardware-only addition to the radio. It offers:

■ user control of Encryption state – On or Off – by the Aux key (or a Function key programmed as Aux)

■ encryption state indicated by lighting the Green LED on the Aux (or a Function) key.

5.1 Circuit Operation

The diagram below shows the encryption circuit operation for both a T2000 encrypted radio and a T2000 radio as a programming radio.

Note: When using a T2000 radio as a programming radio, an encryption module should *not* be fitted.
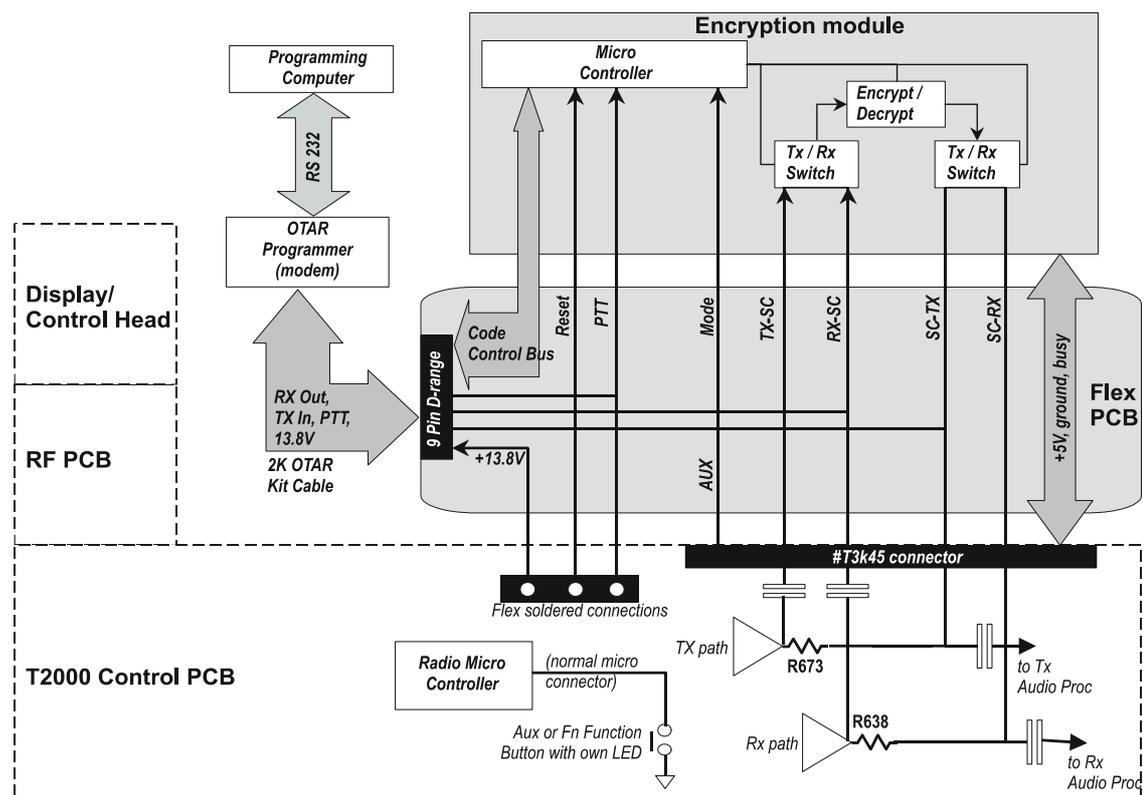
Connecting an encryption module automatically diverts the audio through the module. No link setting changes are required if a module is removed.

Transmit and receive audio is intercepted by the flex from the Scrambler/Vox connector, across R673 and R638. Audio passes through the encryption module and is encrypted or not, according to the user-selected encrypt state.

The module Mode input is driven from the Aux signal from the radio micro. When the radio is

programmed, this button function is set to *Aux, Latching*.

The low voltage reset from the radio is used to reset the module circuit.

Signal levels and pin assignments

Function	Mode	Name	Pin	Module	T2000
Power Supply		V+	1	5V regulated	
Reset	I/P	RS	2	Active low	Resets whenever supply lower than 4.75V
Tx pressel	I/P	PTT	3	Active low	5V – 0
Busy	I/P	RX	4	Active low	5V – 0
Mode	I/P	MO	5	Active low	Level sensitive
Data to Scrambler	I/P	D-SC	6	Hardwired module programming I/P	If reqd.
Data to Radio	O/P	D-RA	7	Hardwired module programming O/P	If reqd.
Mode Indicator	O/P	IND	8	Active high	3mA into LED
Emergency	I/P	EMG	9	Active Low	Module pull-up to 5V
Code select 8	I/P	CS8	10	Active Low	Module pull-up to 5V
Code select 4	I/P	CS4	11	Active Low	Module pull-up to 5V
Code select 2	I/P	CS2	12	Active Low	Module pull-up to 5V
Code select 1	I/P	CS1	13	Active Low	Module pull-up to 5V
Ground		Gnd	14		
Transmitter to scrambler	I/P	TX-SC	15	AC coupled to 250Hz	300 mV p-p at 1kHz for 2/3 max deviation
Scrambler to transmitter	O/P	SC-TX	16	DC coupled	Approx. unity thru gain
Receiver to scrambler	I/P	RX-SC	17	AC coupled to 250Hz	650 mV p-p at 1kHz for 2/3 max deviation
Scrambler to Receiver	O/P	SC-RX	18	DC coupled	Approx. unity thru gain
Audio alert	O/P	AL	19	DC Coupled	
Trunking delay	I/P	TRK	20	Provision for future	

## 5.2	Programming the T2000 radio

Standard radio programming software is used.

Ensure the *Accessory* function key is enabled and configured to *latching*. For T2000 versions with no accessory key, set a function (**Fn**) key for this function.

## 5.3	Programming the Encryption Module

Note:	To set up a T2000 radio as an OTAR programming radio, it should have a flex fitted, but no encryption module.

Equipment setup and programming instructions are described in the Transcrypt Programming section on page 69 or the Midian Programming section on page 79, depending upon the origin of the encryption module.

Refer also to programming and service manuals with your Transcrypt or Midian encryption module and programmer.

Service Desk OTAR programming may be unsuccessful if:
- the target radio is open during programming
- the programming radio and the target radio are oriented differently eg one laying down, one upright

■   programming radio is set to **High Power**

5.4   Testing the Encryption Module

Equipment setup and testing instructions are described in the Transcrypt Programming section on page 69 or the Midian Programming section on page 79, depending upon the origin of the encryption module.

With encryption off:

■   Check normal power-up of the radio, with the normal display messages and confirmation tones.

■   Check that receive and transmit audio are functioning, using a service instrument or another radio on the same channel.

With encryption on:

■   Check that receive and transmit audio are functioning, using another T2000 or TOP radio with the same encryption module, programmed with the same codes, on the same channel.

■   Where a code hopping module is fitted, confirm encryption is active by listening for the initial sync burst on the receiving radio

■   Where a code inversion module is fitted, confirm encryption is active by pressing any function key - the confidence tone will be a higher frequency than normal.

■   Check the Encryption User Interface features – status indicators, encryption settings etc. (See the TOP Encryption User's Guide information provided on page 37).

5.5   T2000 Encryption Flex PCB Information

At the time of printing, there are two current versions of the Flex PCB. The numbers appear on the PCB top side. Take care to ensure you are referring to the correct version information.
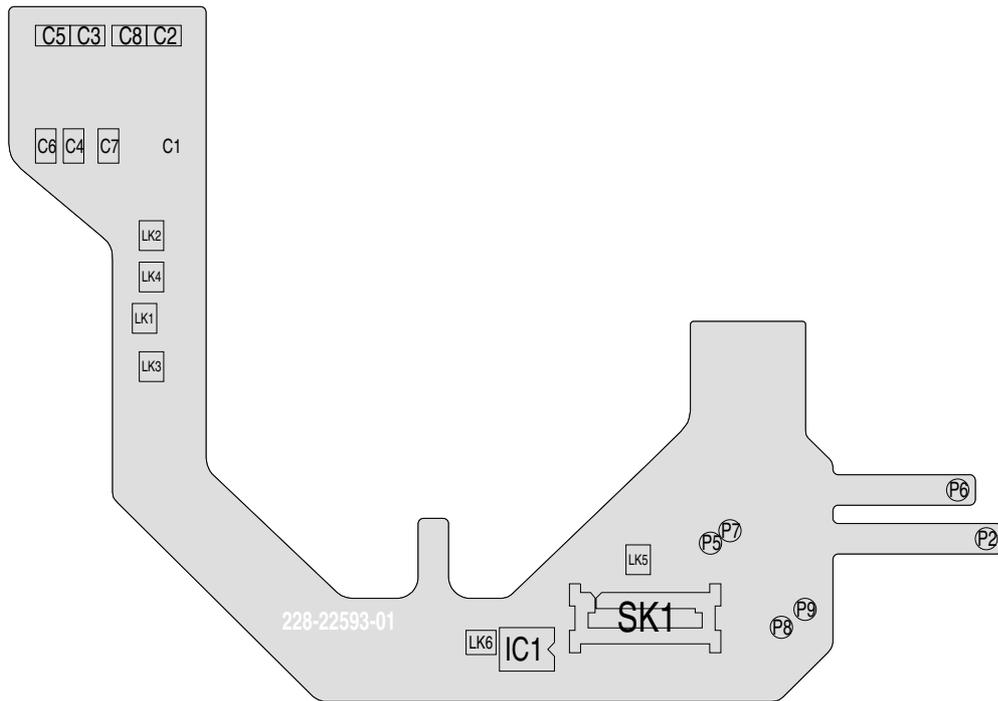
5.5.1   IPN 228-22593-01A

SMD Parts List IPN 228-22593-01A

Part	IPN	Description
C1	015-23150-01	CAP 150P 5% NPO 50V
C2	015-23150-01	CAP 150P 5% NPO 50V
C3	015-23150-01	CAP 150P 5% NPO 50V
C4	015-23150-01	CAP 150P 5% NPO 50V
C5	015-23150-01	CAP 150P 5% NPO 50V
C6	015-23150-01	CAP 150P 5% NPO 50V
C7	015-23150-01	CAP 150P 5% NPO 50V
C8	015-23150-01	CAP 150P 5% NPO 50V
SK1	240-10000-09	SKT 2-179397-4 24WAY 2ROW TOP ENTRY SMD

Non-SMD Parts List IPN 228-22593-01A

Part	IPN	Description
C1	015-23150-01	CAP 150P 5% NPO 50V
C2	015-23150-01	CAP 150P 5% NPO 50V
C3	015-23150-01	CAP 150P 5% NPO 50V
C4	015-23150-01	CAP 150P 5% NPO 50V
C5	015-23150-01	CAP 150P 5% NPO 50V
C6	015-23150-01	CAP 150P 5% NPO 50V
C7	015-23150-01	CAP 150P 5% NPO 50V
C8	015-23150-01	CAP 150P 5% NPO 50V
SK1	240-10000-09	SKT 2-179397-4 24WAY 2ROW TOP ENTRY SMD

PCB Layout - top side IPN 228-22593-01A

C5 C3 C8 C2

C6 C4 C7 C1

LK2
LK4
LK1
LK3

228-22593-01

P6

P7
P5

P2

LK5

SK1

P9
P8

LK6 IC1

PCB Layout - bottom side IPN 228-22593-01A

P1

P4 P3

PL1

SK2
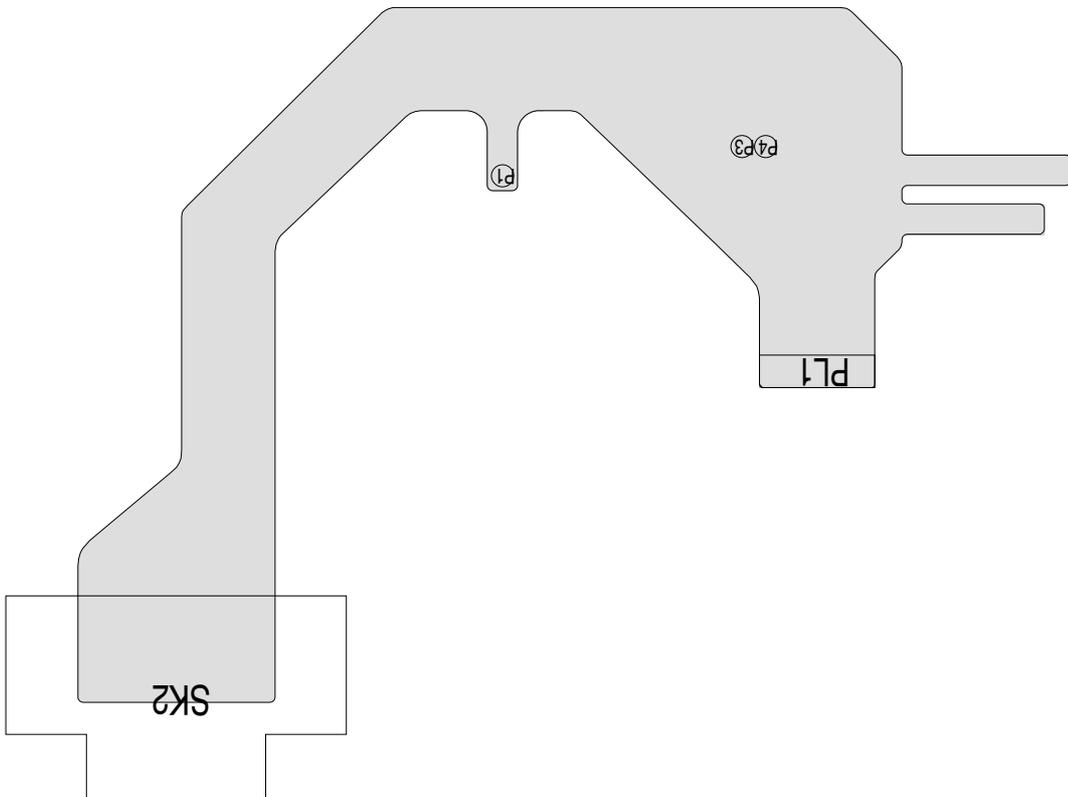
Circuit Diagram - page 1 of 1 IPN 228-22593-01A
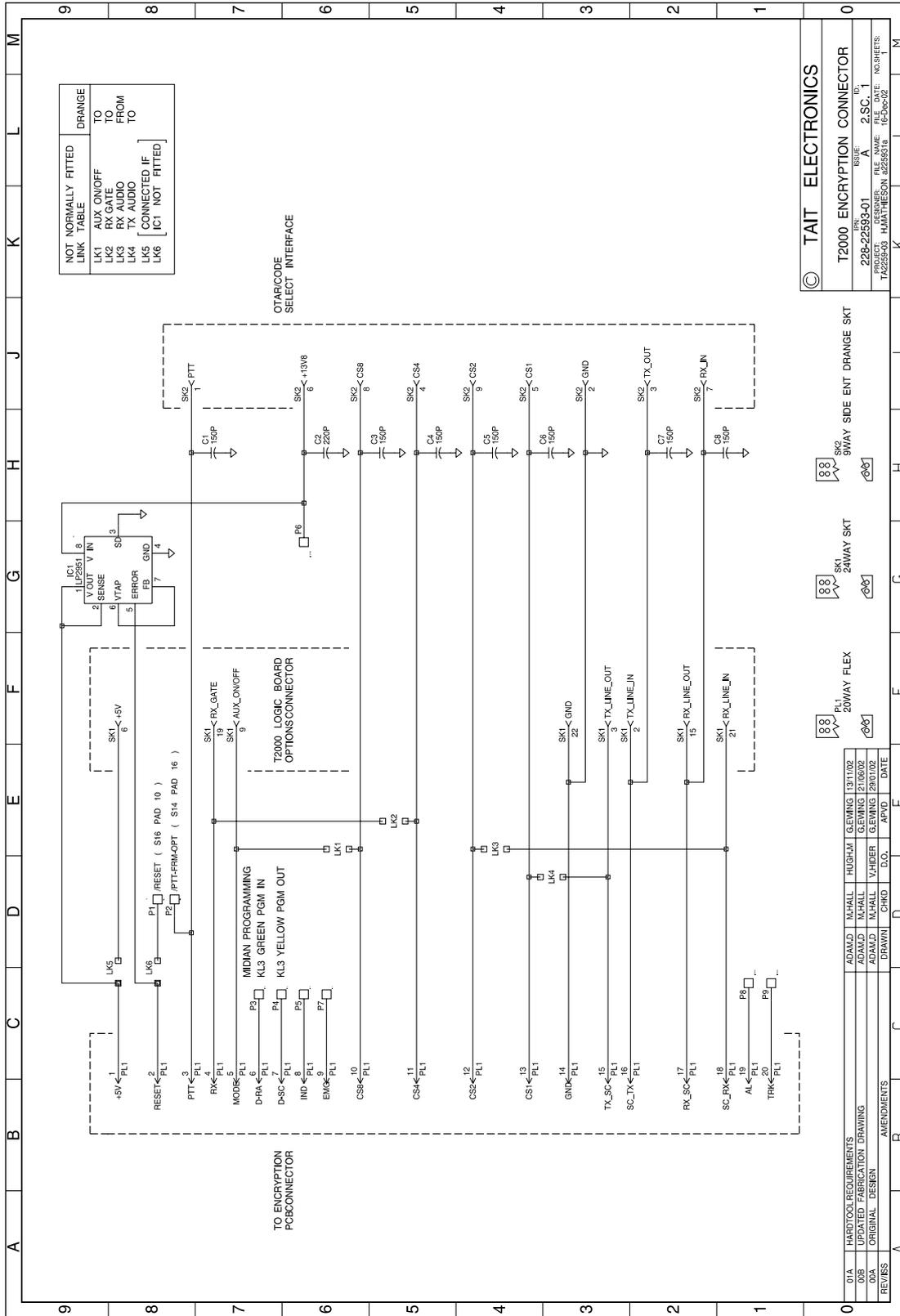
5.5.2   IPN 228-22593-02A

SMD Parts List IPN 228-22593-02A

Part	IPN	Description
C1	015-23150-01	CAP 150P 5% NPO 50V
C2	015-23220-01	CAP 220P 5% NPO 50V
C3	015-23150-01	CAP 150P 5% NPO 50V
C4	015-23150-01	CAP 150P 5% NPO 50V
C5	015-23150-01	CAP 150P 5% NPO 50V
C6	015-23150-01	CAP 150P 5% NPO 50V
C7	015-23150-01	CAP 150P 5% NPO 50V
C8	015-23150-01	CAP 150P 5% NPO 50V
IC1	002-12951-00	IC LP2951M REGULATOR 100MA SMD
LK1	SOLDER-LINK	SOLDER LINK 2 SMD PADS 0.05" SPAC
LK2	SOLDER-LINK	SOLDER LINK 2 SMD PADS 0.05" SPAC
LK3	SOLDER-LINK	SOLDER LINK 2 SMD PADS 0.05" SPAC
LK4	SOLDER-LINK	SOLDER LINK 2 SMD PADS 0.05" SPAC
LK5	SOLDER-LINK	SOLDER LINK 2 SMD PADS 0.05" SPAC
LK6	SOLDER-LINK	SOLDER LINK WITH TWO SMD PADS 0.05" SPAC
LK7	LINK-0805-SP	0805 CHIP SPACING AS 3-WAY LINK
SK1	240-10000-09	SKT 2-179397-4 24W2 2ROW TOP ENT SMD
PL1	COPPERPADS	SMD PADS FOR A 20WAY .3MM FLEXI BRD 0.5MM PITCH

Non-SMD Parts List IPN 228-22593-02A

Part	IPN	Description
P1	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P2	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P3	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P4	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P5	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P6	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P7	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P8	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
P9	I/O-PAD	PAD HOLE FOR OFF BOARD WIRE CONNECTION
SK2	240-00010-45	SKT 9WAY DRANGE SIDE ENTRY PTH MTG HOLES

PCB Layout - Top Side IPN 228-22593-02A

PCB Layout - Bottom Side IPN 228-22593-02A

Circuit Diagram IPN 228-22593-02A - page 1 of 1
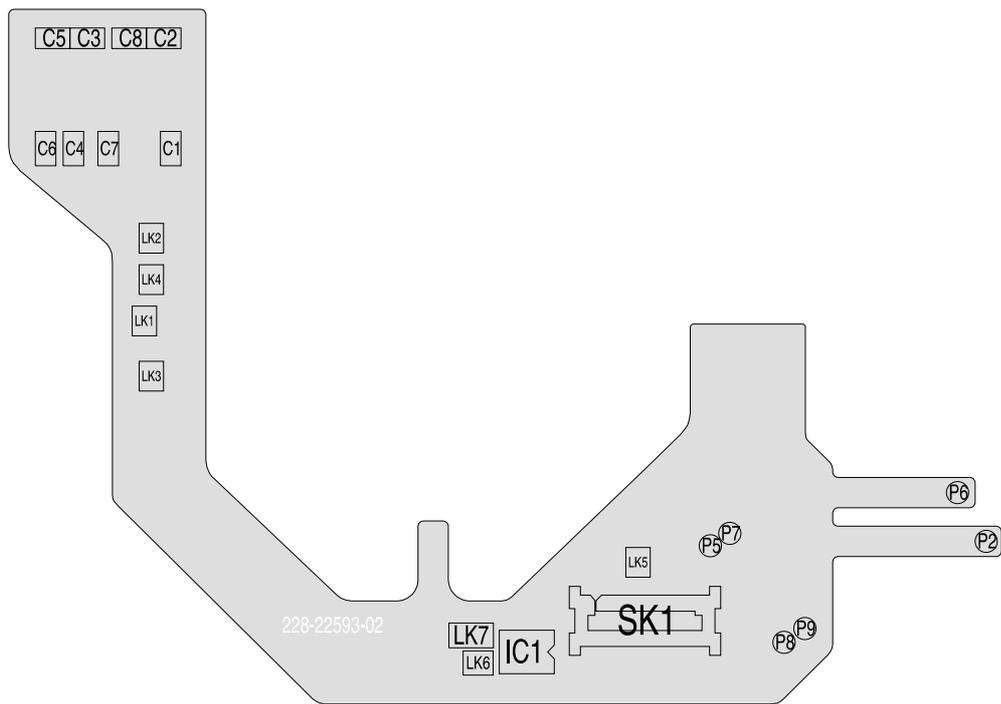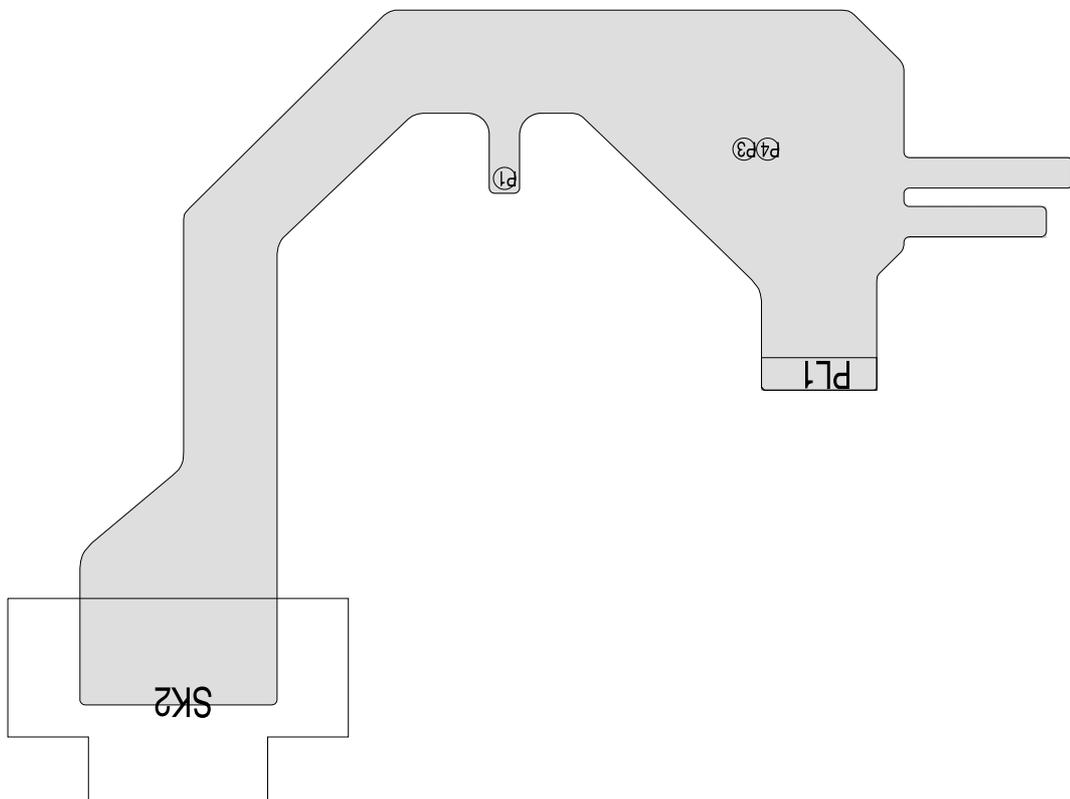
5.6   Encryption-Enabled T2000 Operating Instructions

The following operating instructions apply to Encryption-Enabled T2000 radios only. They should be used in conjunction with the T2000 User's Guide issued with the radio.

Conventional Radios (eg T2010*II* T2015*II* T2020*II)*

Turn encryption on and off by pressing the Auxiliary key.
The indicator light indicates encryption is on.

Trunked Radios (eg T2030*II* T2035*II* T2040*II)*

Turn encryption on and off by pressing the Function key.
The indicator light indicates encryption is on.

5.7   T2000 Fault Finding

Diagnosis TIP
If unsure whether a radio with simple inversion encryption is in **encrypt** or **clear** mode: while in standby (without any incoming signal), hit a keypad or function key to produce an audible beep. If the radio is in **encrypt** mode, the beep will be a much higher frequency than normal.

Symptom	Cause	Action
Radio transmits regularly - goes into emergency mode Audio not operating Radio stopped working after it was dropped.	Module not squarely in connector	Re-plug connector to module (radio will need to be opened)
Receives okay, but no transmit audio.	Module may not be receiving PTT	Check PTT links.
Encryption on/off button only changes encryption state every second press	Module or radio programmed for level-sensitive when it should be edge-sensitive.	Reprogram encryption module or radio.
T2000 has encryption on when Aux light is out and vice versa	Module or radio programmed for wrong Mode polarity	Reprogram module.
Module does not de-crypt audio.	Module has been programmed differently to the rest of the fleet.	Reprogram with correct settings.
Module acknowledges its ID, but not accept any other commands.(Transcrypt modules only)	Module programmed with wrong programmer and different Master code.	Reprogram with correct programmer - will need a 'Force Download'. (See Transcrypt Manual)
Module acknowledges its ID, but not accept any other commands. Force download does not fix.	Module may be damaged or have failed.	Replace with a new module.
Radio will not power up properly, display blank.	Flex-edge connectors may not be correctly plugged Module faulty.	Replace module.
Poor audio quality	Module links set for wrong radio type.	Set links according to the manuals.
Audio sounds very muffled (Midian modules only)	Inversion module has very low inversion frequency.	Program module to a higher frequency.
Audio sounds very "thin". (Midian modules only)	Inversion module has very high inversion frequency.	Program module to a lower frequency.
Audio sounds squeaky or croaky. (Midian modules only)	Transmit and receive inversion frequencies are different.	Ensure both radios are using same frequency. If problem still exists, reprogram module
Receiving radio fails to decode sync pulse, audio is unintelligible for several seconds then comes right. (Transcrypt only)	System delay set too short	Reprogram module, or consider if CTCSS can be removed from some parts of radio system.
Radio confidence and alert tones rapidly varying tones.	Not a fault - occurs when alert tones are injected before decrypting process in inversion or hopping code module in encrypt mode.	

Module OTAR programming does not work. (Transcrypt modules only)	Module may be programmed with radio connected to an adjacent aerial, so excessive RF fields have damaged the module.	Reprogram module.

## 5.8 Fitting the T2000 Encryption Upgrade Flex

Disassemble Radio

1. Remove four M4x35mm screws from radio bottom. Turn radio over and remove top cover.

2. Remove three M3x8mm screws from Logic PCB bottom side and fold out Logic PCB from radio cavity - do not unplug ribbon cables

Prepare Flex

1. Use scissors to trim flex where shown.

Note: Removing these parts will not affect encryption function. The parts removed are required for the T2000 OTAR unit only.
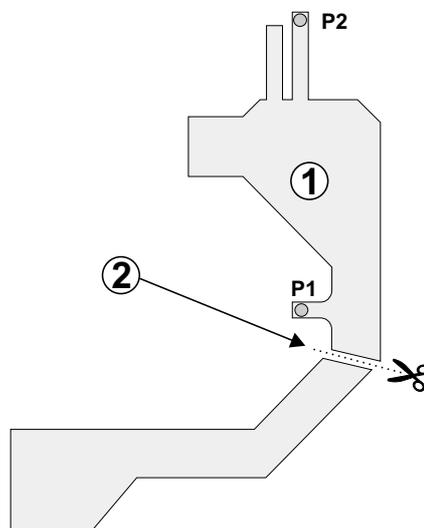
Prepare Radio

1. Remove two micromatch connectors S14 and S16 (where fitted) as shown
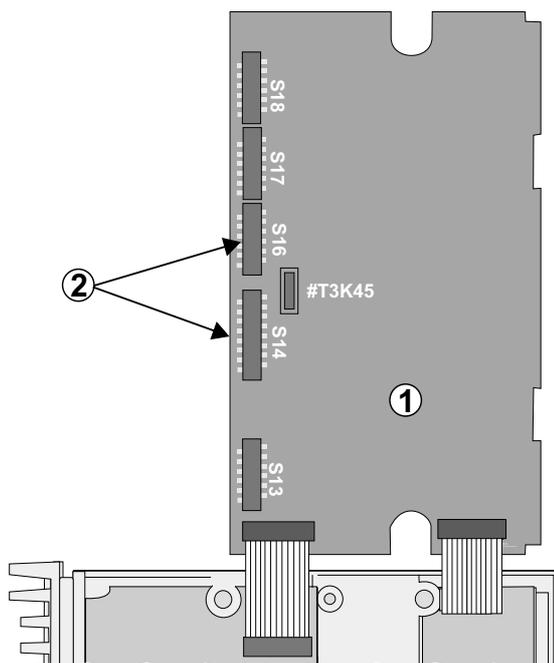
Fit flex

1. Lay flex onto Logic PCB as shown and solder P2 to Logic PCB S14 pad 6
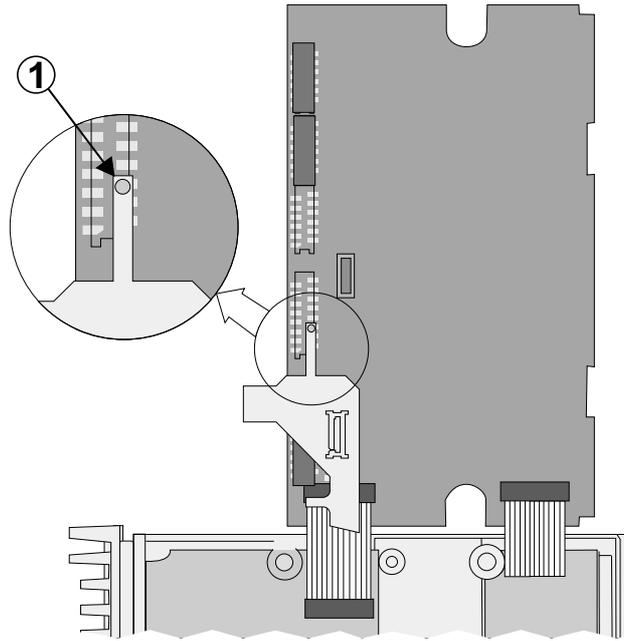
2. Gently fold flex up into position shown and plug SK1 into Logic PCB socket #T3K45

3. Solder flex P1 to Logic PCB S16 pad 10
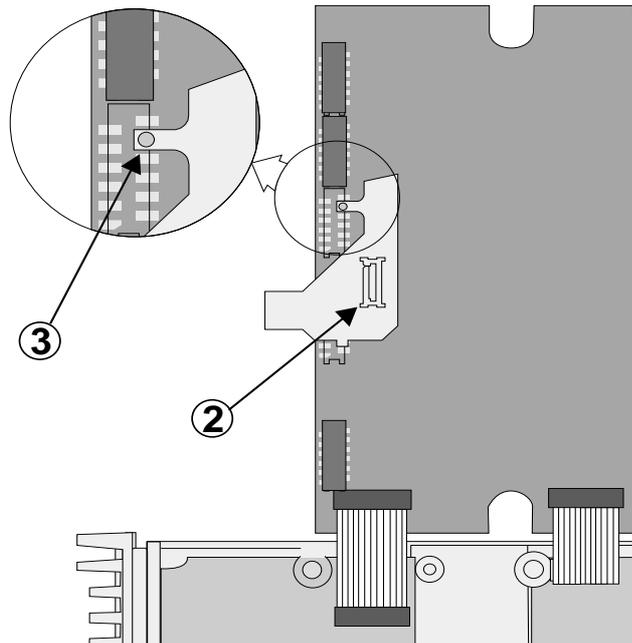
Fit Module

Note: **Do not** remove module snap-off sections.

Note: See manufacturer's documentation for module link settings.

1. Place Encryption module, IC side up, into radio chassis where shown

2. Use two screws provided to screw module to radio where shown
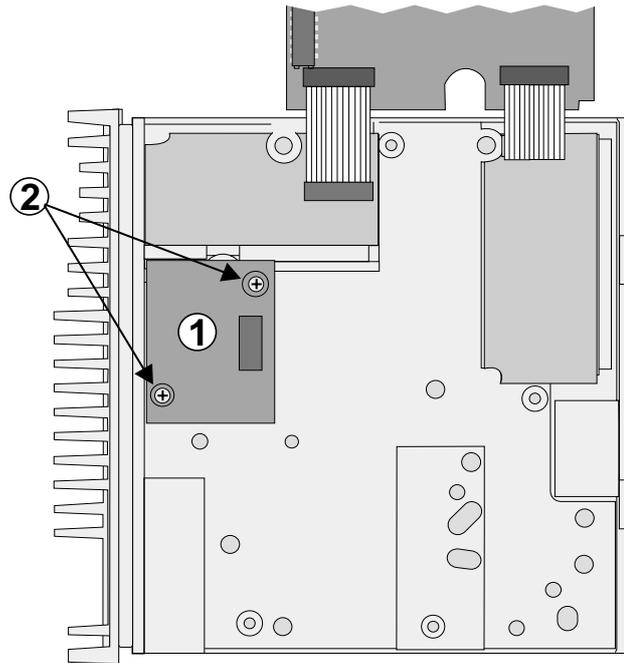
3. Fold Logic PCB back into radio chassis

4. Open module flex edge connector and insert flex tab. Close connector

5. Replace three screws in Logic PCB and reassemble radio
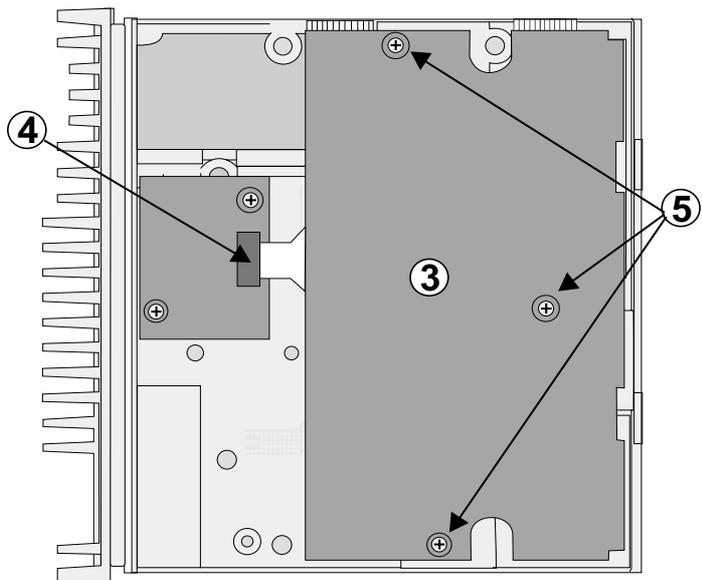
6   Transcrypt Programming

Transcrypt encryption modules can be programmed via Over-The-Air-Reprogramming (OTAR) or Direct Programming (TOP radios only).

6.1   OTAR Programming

The Transcrypt OTAR Programmer allows a computer to alter a radio's encryption module settings remotely, anywhere within the coverage range of the radio system.

The two applications for this are:

- at a service desk during initial setup, test or maintenance of a radio.
- while on normal operation in a fleet, to change the settings of modules in fleet radios for security or operational reasons.

Service desk OTAR programming may be unsuccessful if:

- the target radio is open during programming
- the programming radio and the target radio are oriented differently eg one laying down, one upright
- one radio is set to **High Power**

Refer to the OTAR Programmer and Module manuals for features which are programmable, what values they can have and how to set them.

Note: Some link settings and functions on the modules may be for future use, or require special set-up or additional components to operate. If a function is not documented, please ask for assistance before using it.
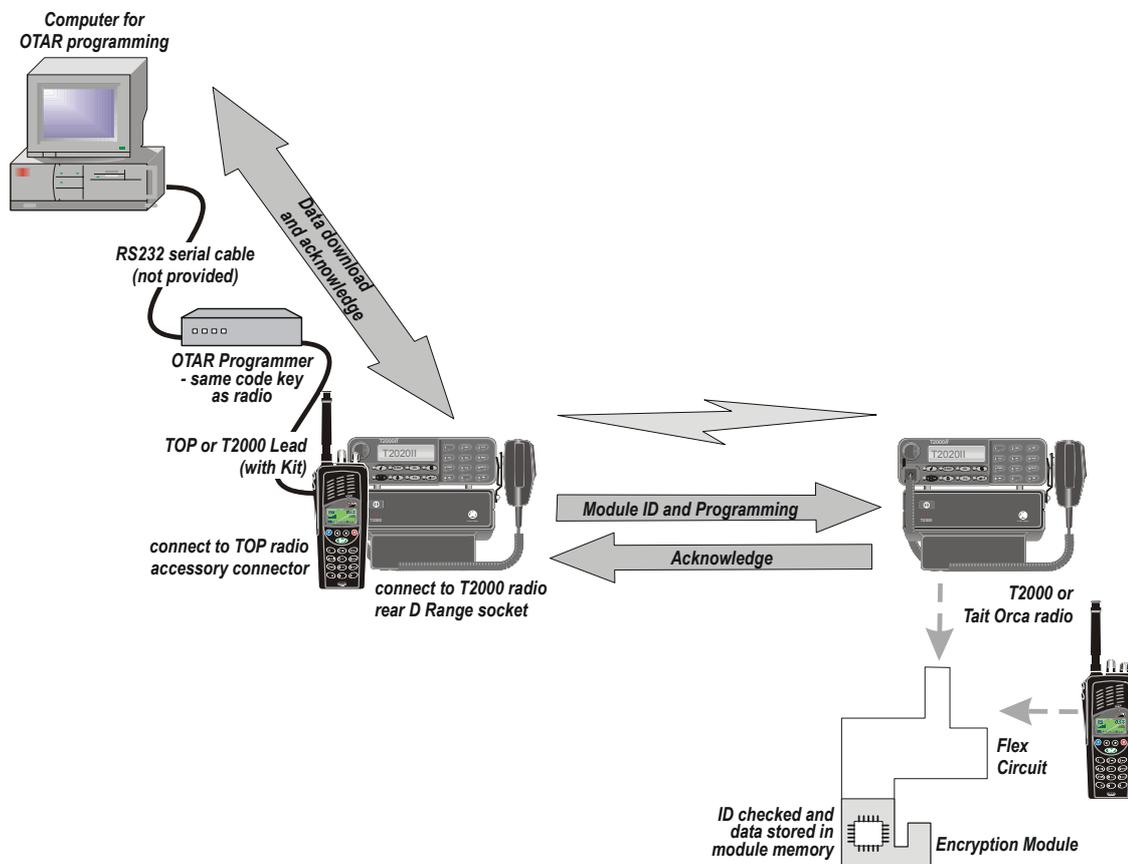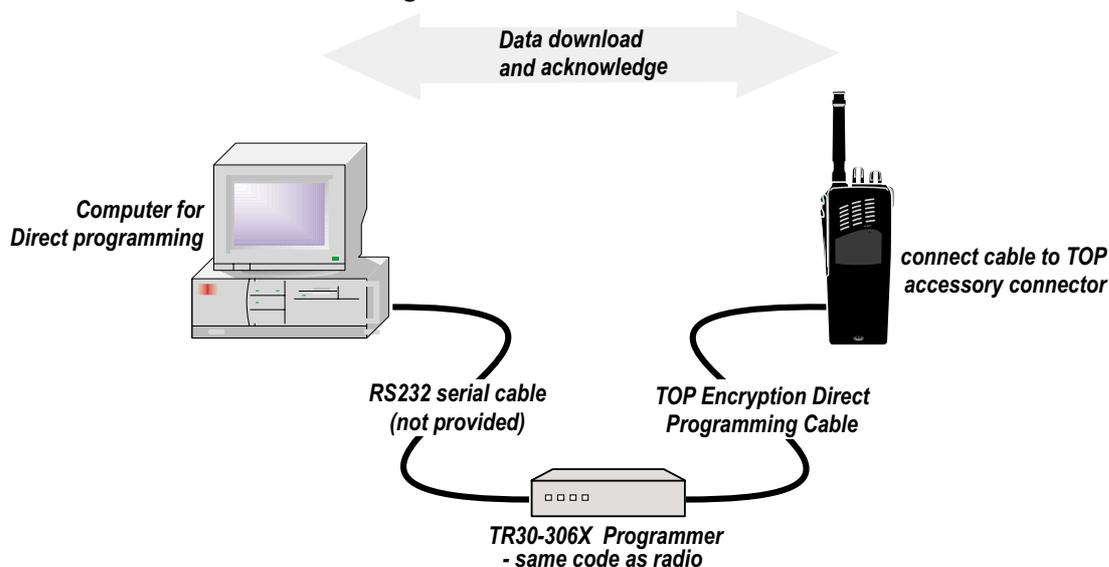
6.2   Direct Programming

Via direct programming, the Transcrypt Programmer allows a computer to alter a radio's encryption module settings by direct connection via the TOP Encryption Direct Programming Cable (IPN TOPA-EA-008G) as shown in the diagram below. This is used at a service desk during initial setup of the radio, testing or maintenance, or to change the way features are programmed.

Refer to the Transcrypt Programmer and Module manuals for features which are programmable, what values they can have and how to set them.

Note: Some link settings and functions on the modules may be for future use, or require special set-up or additional components to operate. If a function is not documented, ask for assistance before using it.

6.3   Operation

The following sequence of events occurs during Over-The-Air-Reprogramming and Direct Programming:

1.   Codes are typed, or menus selected on the program running on the PC

2.   The RS232 cable carries data to the Programming modem.

3.   The modem encodes this data to a sequence of audio tones using PSK signalling

4.   The OTAR lead applies these audio tones to the programming radio audio input, and transmits them over the radio channel.

5.   All radios on the channel receive the programming signal.

6.   As audio passes through the encryption modules, they check the ANI ID.

7.   Radios not matching the ANI ID ignore the data

8.   The single radio with the matching ID accepts the data, and updates its memory registers.

9.   It then transmits back an acknowledge message indicating successful data loading.

10.   The programming radio passes this message back to the modem which converts it to an 'acknowledge response' message displayed on the computer.

6.4   Using a TOP as an OTAR Programming Transmitter

A standard TOP radio - with no Encryption module fitted - on the correct frequency is all that is required for an OTAR programming transmitter radio. The TOP programming cable (IPN 219-

02841-0X) connects the OTAR Programmer to the TOP programming radio through the Accessory connector that has all signals required as standard.

For more information, see the TOP Programming Cable Specifications on page 74.

Note: Ensure the accessory connector is firmly latched, otherwise it may not make connection to all the required signals.

6.5   Using a T2000 as an OTAR Programming Transmitter

The T2000 programming cable (IPN 219-02835-0X) connects the OTAR Programmer to the T2000 programming transmitter radio through the 9 Way D Range socket fitted to the radio rear.

For more information, see the OTAR Programming Cable Specifications on page 74.

6.6   Programming a Transcrypt Encryption Module

Refer to the OTAR programmer manual for software commands and register values.

Each encryption module is provided with a sheet for recording programmable settings. As the module settings cannot be read back, it is strongly recommended that all settings be recorded for each radio and kept in a secure place.

It is important to understand the meaning of the various identifiers in the programmer's manual.

Transcrypt Identifier	Description
Unit ID	ANI for individual module addressing
Group number	ANI Group number for paging or alerting a group of radios
Electronic Serial Number (ESN) = Main number	Serial number for controlling access to parameter changes
Scramble Code	Unique multi-digit code sets which codes module can decipher.

A typical sequence for programming is:

1. Briefly transmit in secure mode from the radio to be programmed, and note the module id '*SXnnnn*' which appears on the computer terminal screen.

2. Check the radio acknowledges an *Annn* call, by returning the message confirmation *AK nnnn xx on the PCB*.

3. Enter programming commands as in programmer manual, for such things as system delay.

4. The radio confirms a successful operation by returning the message confirmation *AK nnnn xx*.

Note: After a *Move Download* command (see TR30-3061 Manual), turn the radio off then on, so that the module recognises the new scramble code.

6.7   Security Codes

Security Codes

Note: When programming a Transcrypt module, you may wish to change the default Transcrypt security codes. See the Transcrypt programming manual for more information on standard codes, and instructions for changing them if necessary.

Transcrypt assigns each customer a unique *master code*, and programs modules with this during manufacture. The security of an encryption module is provided by the *total code*. This is a very large number, resulting in too many different codes for an eavesdropper to find any code by trial.

This *total code* is a combination of the *master code* in the programmer used to program the module, and the *scramble code* in the module. The master code acts as a customer code, preventing accidental use of a scramble code in one fleet, which would allow decrypting of

another fleet's messages.

Normal programming of a module does not change the *master code*, just the *scramble codes*, and other settings. Force downloading should not normally be necessary – only use if you know you have the correct *master code* in your programmer.

Note: Service shops installing modules for specific customers must ensure they specify the end-customer when ordering from the supplier.

6.8   Programmer Configurations

	TR30-3061	TR30-3061	TR30-3060
	Customer Programmer with customer specific Master Code	**Service Shop Programmer with service shop's own Master Code**	**Service Shop Programmer with changeable Master Code - US only**
Acknowledge command	Works	Works	Works for any master code
Normal programming	Does not try to change module master code, all commands work	Does not try to change module master code, but since Master Codes do not match, no programming commands work	Does not try to change module master code. Programming only works if master code is first set to match module's
Force Download	Changes module master code to programmer master code. (Both are the same, so no effect.)	Changes module master code to programmer master code, so module no longer communicates with its fleet, as 'total code' does not match.	Changes module master code to programmer master code, so first set programmer master code to match intended fleet.

6.9   Transcrypt Module Default Settings

The screen dump at right illustrates the current Transcrypt programming interface and factory default settings.

For information regarding module programming codes and programming configuration for your system, see the Transcrypt Programming Manual.

6.10   Testing

Test Equipment

- A PC, with serial port
- If necessary a 25 way D-range plug to 9 way D-range socket adaptor
- A T2000 OTAR Transmitter radio (as described above) on the right radio channel and the 219-02835-0X lead from the kit

  or

  a TOP OTAR Transmitter radio (as described above) on the right radio channel plus the 219-02841-0X cable from the kit
- A TR30-3060 or TR30-3061 Transcrypt programmer

OTAR Programming Test

1. Set the radio to Encrypt On.
2. Briefly transmit from the radio to be programmed, and note the module id '*nnnn*' which appears on the computer terminal screen.


```
S1  00000000
ID  22
MG  00
RC  05
MT  00000000
MD  GG
QD  00
PC  00000000
SF  F0
M1  10001000
M2  10000000
M3  00000000
M4  00000111
M5  00000000
TX  00000000
DL  14
LE  14
C0  A0132852
C1  A0132862
C2  A0132872
C3  A0132882
C4  A0132892
C5  A0132902
C6  A0132912
C7  A0132922
C8  A0132932
C9  A0132942
CA  A0132952
CB  A0132962
CC  A0132972
CD  A0132982
CE  A0132992
CF  A0132852
PM  00000000
PD  00000000
CR  00
K1  00000000
GN  0000
FT  0000
DG  0000
LM  0000
PY  0000
AA  0000
S1  00000000
```

3. Enter *A nnnn*, press [Enter]. The radio will briefly transmit.
4. Enter a programming commands to change a register in the module:
    eg B 1234 LE to set the Late-entry time in module with ESN=1234 to the current
    programmer value.
5. Check the radio returns *AK nnnn xx*.

Note: After a ***Move Download*** command (see TR30-3061 Manual), turn the radio off then on,
so that the module recognises the new scramble code.

6.11   Transcrypt OTAR Programming Cables

The Tait Encrypted Radio Programming and Service Kit (IPN TOPA-EA-002) includes these dedicated TOP programming cables:

■   IPN 219-02841-00 - Top Encryption OTAR Programming Cable

■   IPN 219-02128-00 - Top Encryption OTAR Programming Cable

One of these will connect the radio your system uses as a programming transmitter, to the Transcrypt OTAR module. Only one of these cables is required - check which cable connects to the accessory connector on the radio model you have, and discard the other cable.

For Direct Programming a TOP encrypted radio, you will require the following cable:

■   TOPA-EA-008G - Top Encryption Direct Programming Cable.

6.11.1   TOP Encryption OTAR Programming Cables

Two TOP Programming Cables are included in the OTAR Service and Programming Kit. They can connect a TOP programming transmitter radio (via the Accessory connector) to the Transcrypt OTAR Programmer.

IPN 219-02841-00

Cable Signal Specification

Signal	TOP Signal	Sense/Level	TOP	Wire	TR30-306X
PTT	PTT	Active low	pin 3	Violet	pin 9
Ground	GND		pin 2	Black	pin 11
Tx Out	Mod-Audio (dc block in lead)	1V p-p	pin 9	Blue	pin 15
+13V8	(programmer requires power pack)		-		pin 1
Rx In	Rx-Det-AF (dc block in lead)	0.5V p-p	pin 8	Green	pin 5

.
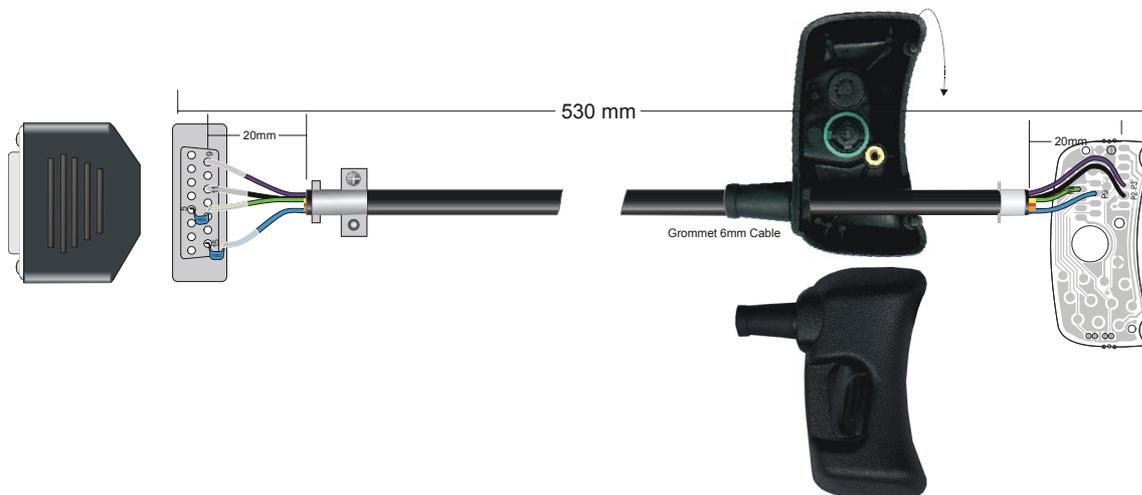
Parts List

Qty	IPN	Description
1	OPA-AA-001	T/ORCA SPKR MIC PCB ASSY
1	303-20058-01	LOK AUX CONN T/ORCA
1	303-20061-00	LOK RING AUX CONN T/ORCA
1	308-01055-03	HSNG T/ORCA ACC CONN CLIP
1	345-00020-09	SCRW M2*5MM SS PAN TORX PATCH
1	354-01044-00	BUSH PSM SHK-B-M2-4.0 INS

1	357-01049-01	CRIMP CBL T3K AUX CONN
1	360-02007-00	GROMMET 6MM CBL AUX CONN
1	362-01097-00	SEAL SPKR MIC OPT T/ORCA
40	400-00020-05	SLEEVING 1.5MM SIL RUBBER
500	205-00010-47	CBL 6WAY 24AWG 7/0.2MM FS+DW
1	240-00020-55	PLG 15W DRNG 105 DEG PNL MTG
1	240-06010-16	CONN 15W HOOD/CVR DRNG
2	019-06100-00	CAP MONO CER 100N 20% 50VX7R

IPN 219-02128-00

Cable Signal Specification

Signal	TOP Signal	Sense/Level	TOP	Wire	TR30-306X
PTT	PTT	Active low	pin 3	Violet	pin 9
Ground	GND		pin 2	Black	pin 11
Tx Out	Mod-Audio (dc block in lead)	1V p-p	pin 9	Blue	pin 15
+13V8	(programmer requires power pack)		-		pin 1
Rx In	Rx-Det-AF (dc block in lead)	0.5V p-p	pin 8	Green	pin 5
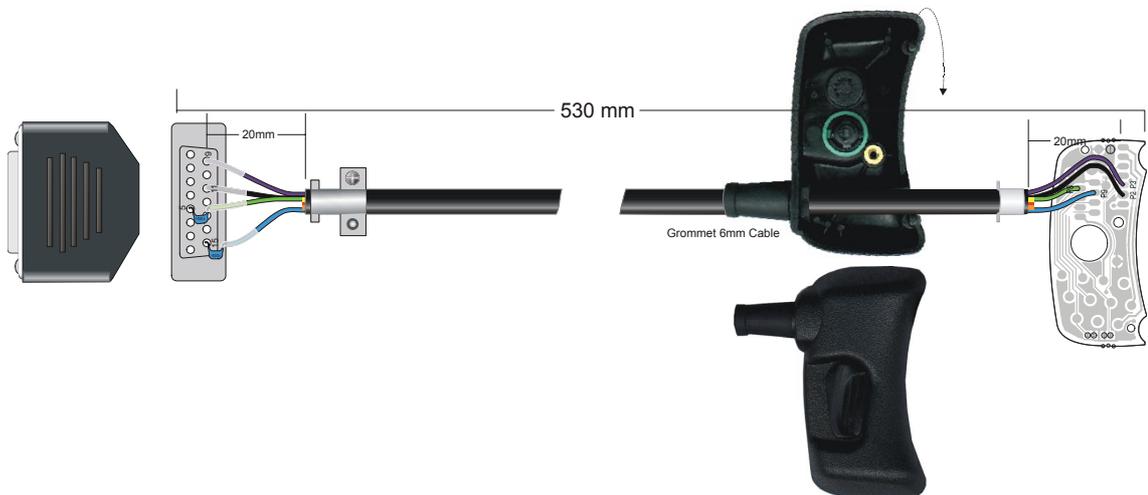
Parts List

Qty	IPN	Description
1	OPA-AA-00XG	T/ORCA ACC CONN SMT ASSY
1	303-20067-01	LOK SPRING RELEASE
1	345-00020-09	SCRW M2*5MM SS PAN TORX PATCH
1	354-01044-00	BUSH PSM SHK-B-M2-4.0 INS
1	357-01049-01	CRIMP CBL T3K AUX CONN
1	360-02007-00	GROMMET 6MM CBL AUX CONN
40	400-00020-05	SLEEVING 1.5MM SIL RUBBER
500	205-00010-47	CBL 6WAY 24AWG 7/0.2MM FS+DW
1	240-00020-55	PLG 15W DRNG 105 DEG PNL MTG
1	240-06010-18	CONN 15W HOOD/CVR DRNG MDJ15
2	019-06100-00	CAP MONO CER 100N 20% 50VX7R
1	308-01021-00	HSNG MIC ACC H/STMP GRN TOP5K
1	312-00001-00	LOK QTR TURN P TOP5K ACC 4GM
1	349-00010-24	SCRW 4-20X5/8 P/P TRILOBE-P BZ
1	362-01029-00	SEAL GENERIC ACC CONN 4GM
1	356-00022-00	TIP QTR TURN TOP5K ACC 4GRN
1	356-01076-00	SPRING PROBE TAPED T/ORCA ACC

6.11.2 Top Encryption Direct Programming Cable

A TOP Encryption Direct Programming Cable is required for direct programming the radios. It connects the TOP radio to be programmed, via its accessory connector, to the Transcrypt T306X Programmer.

Note: This cable can be used with any Transcrypt Encryption module. It is **not** included in the Programming and Service Kit but can be purchased separately through your Tait dealer.

IPN TOPA-EA-008G

Cable Signal Specification

TR30-306X	D-Range	Function	Wire	Acc PCB	TOP Signal	TOP
Tx Out	pin 15	Input to Module	Brown	pad 14	Rx-Det-AF	pin 7
Rx In	pin 5	Output from Module	Orange	pad 9	Mod-Audio	pin 8
GND	pin 11	Ground	Black	pad 2	GND	pin 1
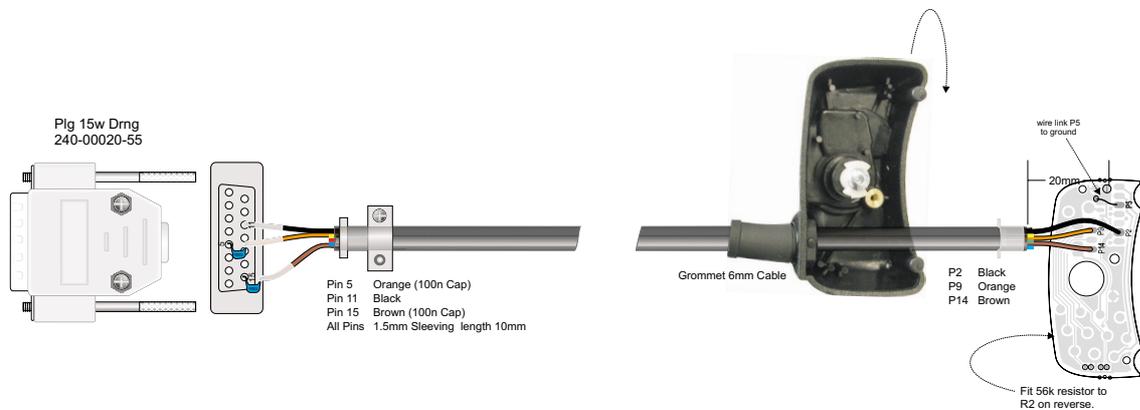
Parts List

Qty	IPN	Description
2	019-06100-00	CAP MONO CER 100N 20% 50VX7R
500mm	205-00010-47	CBL 6WAY 24AWG 7/0.2MM FS+DW
1	240-00020-55	PLG 15W DRNG 105 DEG PNL MTG
1	240-06010-18	CONN 15W HOOD/CVR DRNG MDJ15
1	303-20067-01	LOK SPRING RELEASE
1	308-01021-00	HSNG MIC ACC H/STMP GRN TOP5K
1	312-00001-00	LOK QTR TURN P TOP5K ACC 4GM
1	345-00020-09	SCRW M2*5MM SS PAN TORX PATCH
1	349-00010-24	SCRW 4-20X5/8 P/P TRILOBE-P BZ
1	354-01044-00	BUSH PSM SHK-B-M2-4.0 INS
1	356-00022-00	TIP QTR TURN TOP5K ACC 4GRN
1	357-01049-01	CRIMP CBL T3K AUX CONN
1	360-02007-00	GROMMET 6MM CBL AUX CONN
1	362-01029-00	SEAL GENERIC ACC CONN 4GM
40	400-00020-05	SLEEVING 1.5MM SIL RUBBER
10mm	200-00010-03	WIRE T/C 0.9MM
1	OPA-EA-008G	T/ORCA ACC CONN SMT ASSY

6.11.3   Tait T2000 Programming Cable

IPN 219-02835-00

This cable forms a part of the Tait Encrypted Radio Programming and Service Kit. It connects a T2000 radio used as a transmitter to the Transcrypt OTAR Programmer.

Cable Signal Specification

Signal	T2000 Signal	Sense/Level	T2000		Wire	TR30-306X
PTT	PTT	Active low	pin 1		Grey	pin 9
Ground	GND		pin 2		Brown	pin 11
Tx Out	Tx Line-in	1V p-p	pin 3		Yellow	pin 15
+13V8	+13V8 (programmer powered from radio)		pin 6		Red	pin 1
Rx In	Rx Line-out	0.5V p-p	pin 7		Blue	pin 5
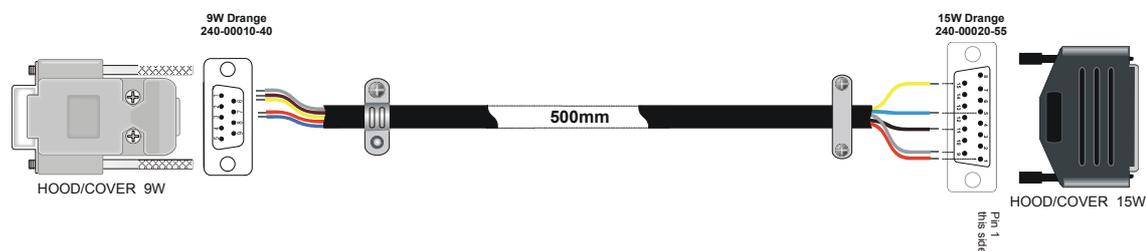
Parts List

Qty	IPN	Description
1	240-06010-16	CONN 15W HOOD/CVR DRNG
1	240-06010-29	CONN 9W HOOD/CVR LETS
1	240-00010-40	PLG 9W DRNG SUBMINATURE
1	240-00020-55	PLG 15W DRNG 105 DEG PNL MTG
500mm	205-00010-38	CBL DATA 8CORE SHLD B2108CS

7   Midian Programming

To program Midian Encryption Modules fitted to either a T2000 or a TOP radio usually requires a hard-wired connection from the Midian programmer to the module. This requires opening the radio and connecting the dedicated programming cable (provided with the Midian programmer) to pads on the Tait flex circuit.

Note: TOP radios fitted with Midian TVS2-Tait Encryption Modules and using -07 version encryption flex (or later) can be programmed without opening the radio, using TOPA-EA-007G Direct Programming Cable. Instructions for TOP TVS2-Tait Module Direct Programming are on page 81.

Refer to the Programmer and Module service manuals for specific information on module parameter settings and values.

Note: Some link settings and functions on the modules may be for future use, or require special setup or additional components to operate. If a function is not documented, please ask for assistance before using it.

TVS2-Tait Over-the-Air Programming (TOP and T2000 radios)

The Midian TVS2-Tait Encryption Module can be remotely programmed to change encryption code. Contact your Tait Service Centre for more information.

TVS2-Tait Direct Programming (TOP radios only)

A TOP radio with Midian TVS2-Tait Encryption Module and using -07 version encryption flex (or later) can be direct programmed without opening the radio, to change any of its programmable parameters. To utilise this feature, you require a dedicated direct programming cable TOPA-EA-007G (see page 86 for more information).

Note: This cable is *not* part of the Encryption Programming and Service Kit and must be ordered separately from your Tait Dealer.

7.1   Circuit Operation

The programming software on the PC sends data down the standard serial cable to the programmer, which is hardwired to the module microcontroller via pads on the TOP or T2000 Encryption Upgrade Flex.

7.2   Programming a Midian Encryption Module (Hardwired)

Note: See page 81 for information on direct programming a TOP radio with TVS2-Tait and -07 version (or later) flex using TOPA-EA-007G Direct Programming Cable.

Equipment

■   PC with serial port, and if necessary 25pin D-range plug to 9 pin D-range socket adaptor.

■   Midian KL3 programmer (including programming cable).

■   Midian software to suit the module to be programmed.

■   TOP or T2000 radio to be programmed with flex and module fitted

Configuration

The diagram below illustrates the programming setup.
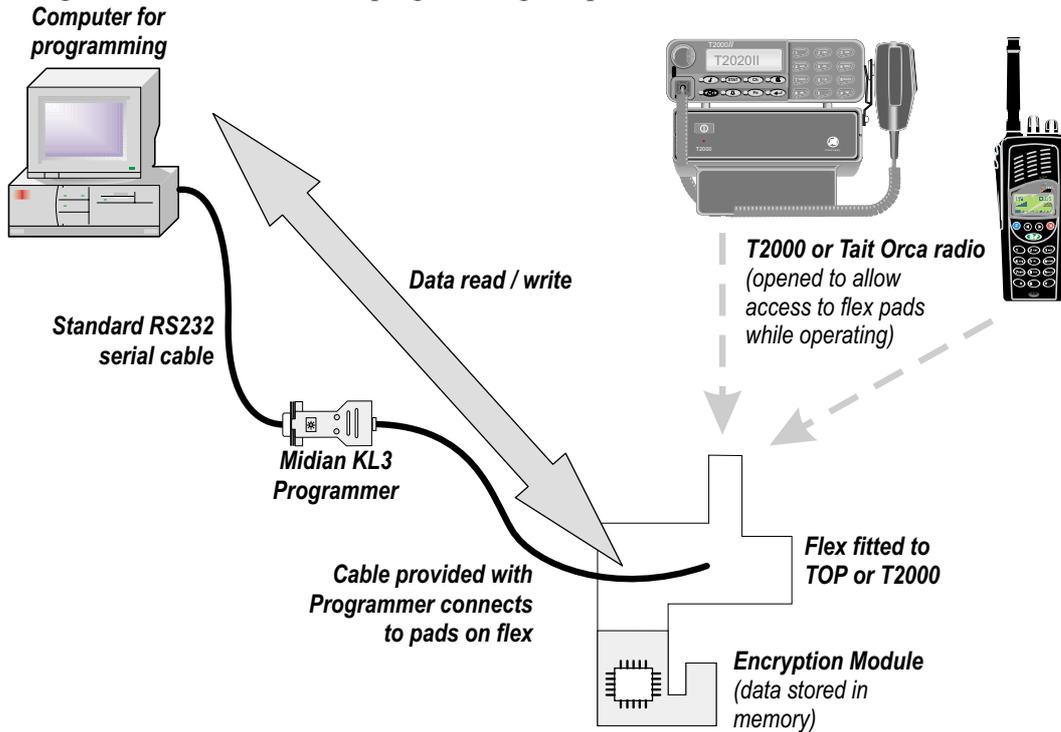
Use the cable provided with the Midian Programmer to connect the programmer to the pads on the flex circuit. See diagrams on the following pages for correct connection points.

## 7.2.1   TOP radio - Midian KL3 cable connection points

To connect the Midian programming cable according to the diagram below, first solder a short length of wire to the indicated pads, then attach the cable clip to it.
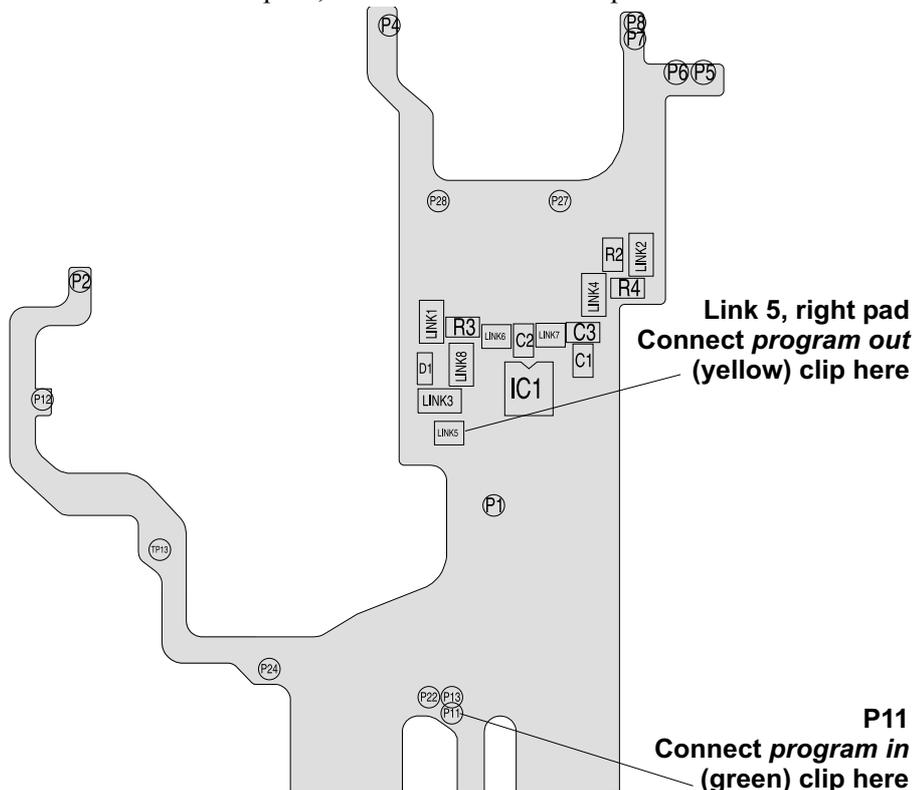
Note: The flex shown is 228-22592-06A. Other versions of this flex differ slightly, but the connection pads are the same. Refer to the PCB Information section.

7.2.2   T2000 radio - Midian KL3 cable connection points

To connect the Midian programming cable according to the diagram below, first solder a short length of wire to the indicated pads, then attach the cable clip to it.

Connect *program out* (yellow) clip here

Connect *program in* (green) clip here
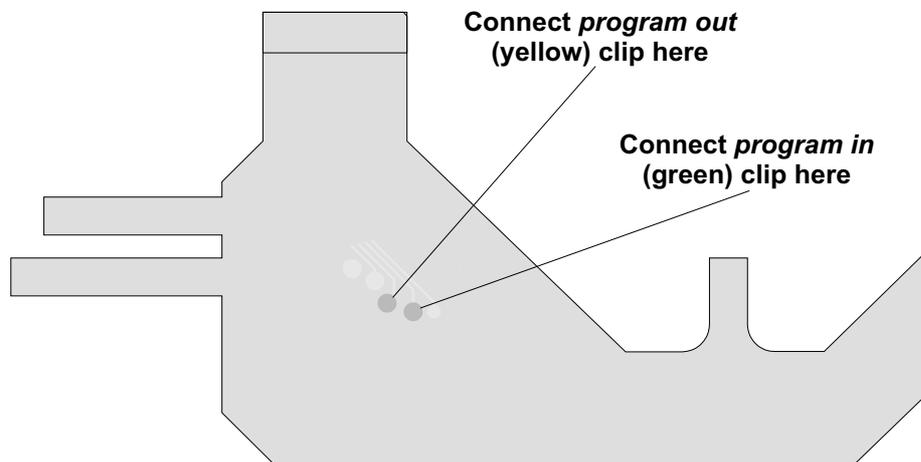
Programming information

Refer to the programmer manual for PC settings, software commands and register values.

Before programming the Midian encryption module, it is important to understand the meaning of various identifiers in the programmer manual. Some of these are outlined in the table below:

Midian Identifier	Description
ANI and Primary Individual decode ID	ANI for individual module addressing
Secondary Decode IDs	ANI Group number for paging or alerting a group of radios
Security Code	Unique multi-digit code sets which code a module can decifer.

Note: Each encryption module is provided with a sheet for recording programmable settings. As some module settings cannot be read back, *it is strongly recommended* that all settings be recorded for each radio and kept in a secure place.

Security Codes

When programming a Midian module, it is strongly recommended that you use the manufacturer's default security codes. See the Midian programming manual for more information on standard codes, and instructions for changing them if necessary.

7.3   Direct Programming a TVS2-Tait Module in a TOP radio

A TOP radio with Midian TVS2-Tait Encryption Module and using -07 version encryption flex (or later) can be direct programmed without opening the radio.

Equipment

- PC with serial port, and if necessary 25pin D-range plug to 9 pin D-range socket adaptor.
- Midian KL3 programmer (supplied cable not required).
- Midian software to suit the module to be programmed.
- TOP radio to be programmed with flex (-07 version or later) and TVS2-Tait module fitted
- TOPA-EA-007G Encryption Direct Programming Cable (see page 86)

Configuration
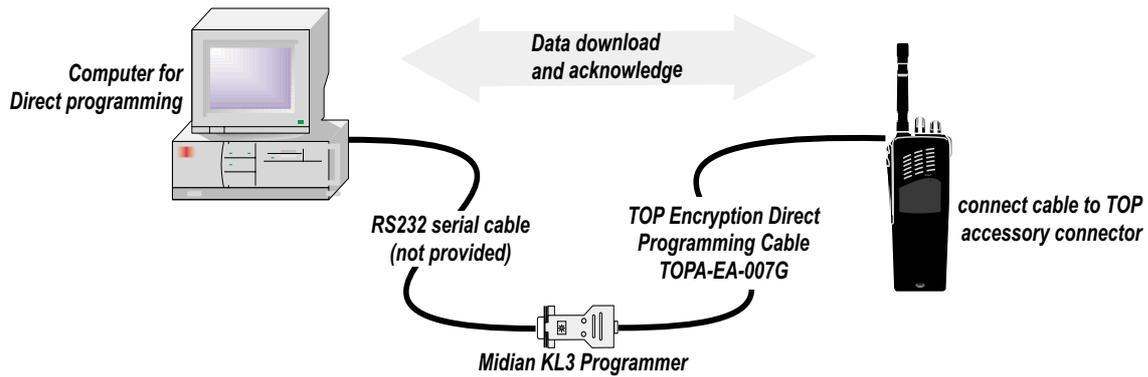
7.4 TVS2-Tait Factory Default Settings

The screen dumps that follow illustrate the current TVS2-Tait module programming interface and factory default settings. For information regarding module programming codes and programming configuration for your system, see the Midian Programming Manual.

Encode/Decode Tab

.

Security Keys Tab

Scrambler Tab

Input/Output Tab
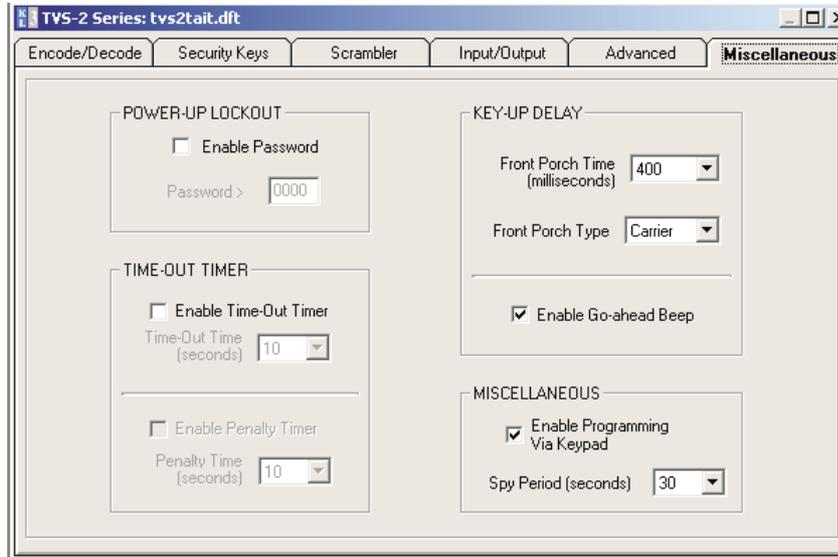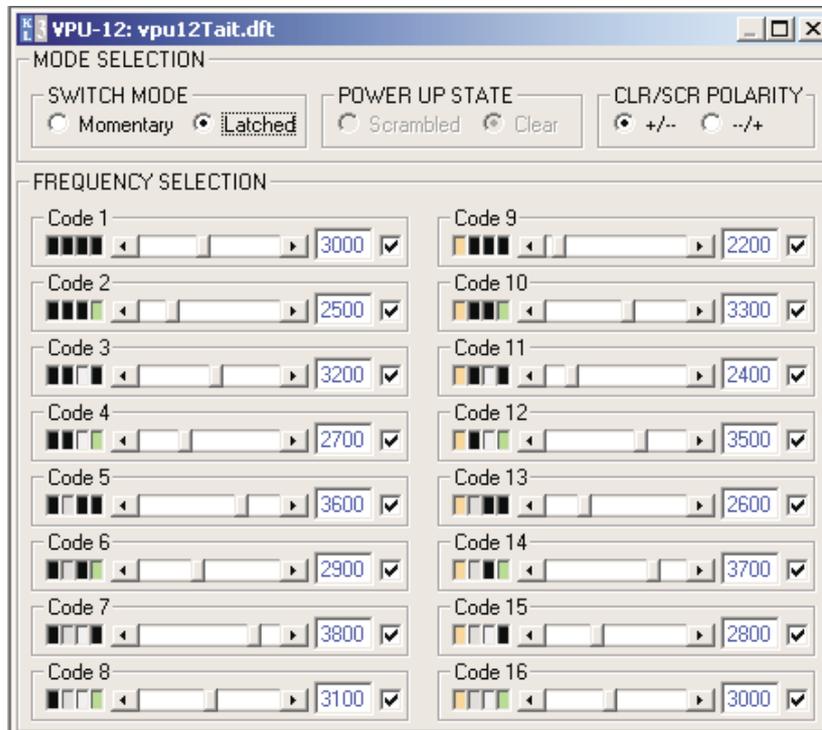
Advanced Tab

Miscellaneous Tab

7.5   VPU12-Tait Factory Default Settings

The screen dump that follows illustrates the current VPU12-Tait module programming interface and factory default settings. For information regarding module programming codes and programming configuration for your system, see the Midian Programming Manual.

7.6   Testing the Midian Encryption Module

With encryption off:

- Check normal power-up of the radio, with the normal display messages and confirmation tones.
- Check that receive and transmit audio are functioning, using a service instrument or another radio on the same channel.

With encryption on:

- Check that receive and transmit audio are functioning, using another T2000 or TOP radio with the same encryption module, programmed with the same codes, on the same channel.
- Confirm encryption is active (where a hopping code module is fitted) by listening for the initial sync burst on the receiving radio
- Confirm encryption is active (where an inversion code module is fitted) by pressing any function key - the confidence tone will be a higher frequency than normal.
- Check the Encryption User Interface features – status indicators, encryption settings etc. (See the TOP Encryption User's Guide information provided on page 37)

## 7.7   Midian TVS2-Tait Encryption Direct Programming Cable

A TOP Encryption Direct Programming Cable is required for direct programming the radios. It connects the TOP radio to be programmed, via its accessory connector, to the Midian KL3 Programmer.

Note: This cable can be used with any Midian encryption module. It is **not** included in the Programming and Service Kit but can be purchased separately through your Tait dealer.

IPN TOPA-EA-007G

Cable Signal Specification

KL3	RJ11	Function	Wire	Acc PCB	TOP Signal	TOP
Tx Data	pin 4	Input to Module	Green	pad 14	Sense 1	pin 7
Rx Data	pin 5	Output from Module	Yellow	pad 13	Sense 0	pin 10
Ground	pin 2	Ground	Black	pad 2	GND	pin 1
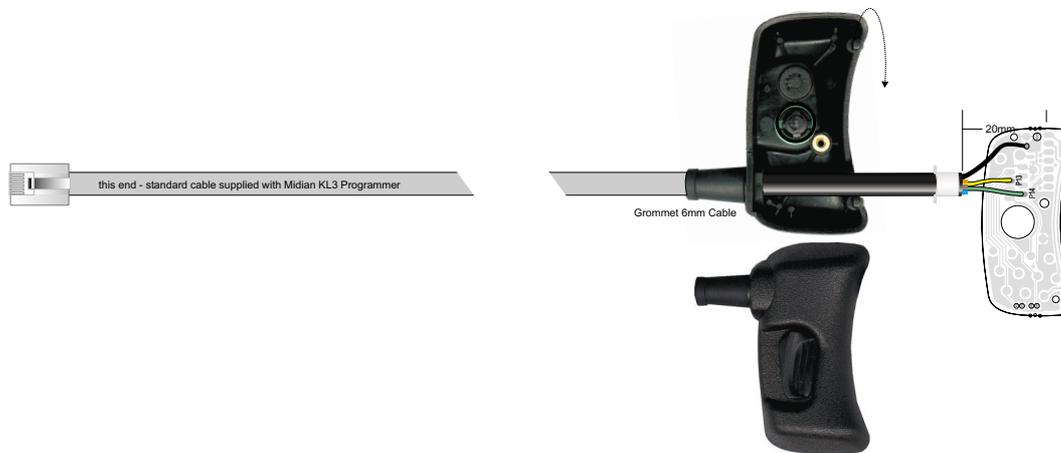
Note: This cable uses the standard cable supplied with the KL3 Programmer. Its length is reduced to 900mm by trimming the end with the black, green and yellow wired clips.

Parts List

Qty	IPN	Description
1	303-20067-01	LOK SPRING RELEASE
1	308-01021-00	HSNG MIC ACC H/STMP GRN TOP5K
1	312-00001-00	LOK QTR TURN P TOP5K ACC 4GM
1	345-00020-09	SCRW M2*5MM SS PAN TORX PATCH
1	349-00010-24	SCRW 4-20X5/8 P/P TRILOBE-P BZ
1	354-01044-00	BUSH PSM SHK-B-M2-4.0 INS
1	356-00022-00	TIP QTR TURN TOP5K ACC 4GRN
1	357-01049-01	CRIMP CBL T3K AUX CONN
1	360-02007-00	GROMMET 6MM CBL AUX CONN
1	362-01029-00	SEAL GENERIC ACC CONN 4GM
40	400-00020-05	SLEEVING 1.5MM SIL RUBBER
1	OPA-EA-008G	T/ORCA ACC CONN SMT ASSY