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Tait Custom Solution

**Transcript Encryption**  
for Tait TOP and TM8000 Radios  
**Operation and Service Manual**



# Tait Contact Information

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# Preface

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## Scope of Manual

This Programming and Service Manual provides information on installing, operating, programming and servicing TOP and TM8000 series radios fitted with Transcript encryption modules.

## Enquiries and Comments

If you have any enquiries regarding this manual, or any comments, suggestions and notifications of errors, please contact Technical Support (refer to "Tait Contact Information" on page 2).

## Updates of Manual and Equipment

In the interests of improving the performance, reliability or servicing of the equipment, Tait Electronics Ltd reserves the right to update the equipment or this manual or both without prior notice.

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## Disclaimer

There are no warranties extended or granted by this manual. Tait Electronics Ltd accepts no responsibility for damage arising from use of the information contained in the manual or of the equipment and software it describes. It is the responsibility of the user to ensure that use of such information, equipment and software complies with the laws, rules and regulations of the applicable jurisdictions.

## Associated Documentation

This manual should be read in conjunction with the following:

- TM8000 Service and Programming documentation
- Tait Orca Portable Service and Programming documentation
- Transcript module Service and Programming documentation
- Transcript TR30-3061 Programmer Service and Programming documentation
- Technical notes are published from time to time to describe applications for Tait products, to provide technical details not included in manuals, and to offer solutions for any problems that arise.

## Document Conventions

Within this manual, four types of alerts may be given to the reader. The following illustrate each type of alert and its associated symbol.



***Warning!!*** This alert is used when there is a potential risk of death or serious injury.



***Caution*** This alert is used when there is a risk of minor or moderate injury to people.



***Important*** This alert is used to warn about the risk of equipment damage or malfunction.

***Note*** This alert is used to highlight information that is required to ensure procedures are performed correctly.

## Publication Record

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1	June 2006	first release

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# Safety and Servicing Information

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This chapter contains general information on safety and servicing procedures for Tait radio equipment. The procedures described in this manual should only be carried out by service personnel trained and accredited by Tait Electronics to service encryption-enabled TOP and TM8000 series radios.



## **Important**

Any modifications you make to this equipment which are not authorised by Tait Electronics Ltd may invalidate your compliance authority's approval to operate the equipment.

## Equipment Safety

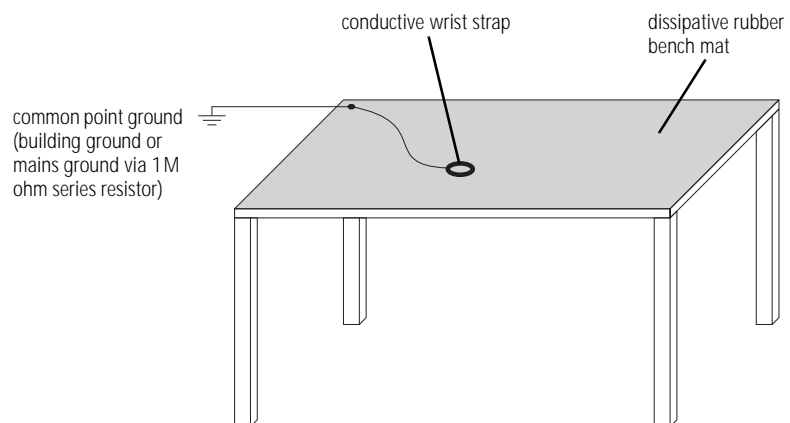
### ESD Precautions



## **Important**

This equipment contains devices which are susceptible to damage from static charges. You must handle these devices carefully and according to the procedures described in the manufacturers' data books.

We recommend you purchase an antistatic bench kit from a reputable manufacturer and install and test it according to the manufacturer's instructions. The diagram below shows a typical antistatic bench set-up.



You can obtain further information on antistatic precautions and the dangers of electrostatic discharge (ESD) from standards such as ANSI/ESD S20.20-1999 or BS EN 100015-4 1994.

## Screw Types

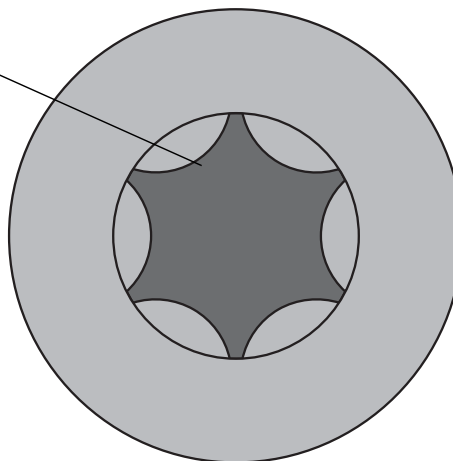
The TM8000 and TOP radios documented in this manual may have any of the following screw types used. For full disassembly instructions, see the relevant service information.

### Torx Recess Head Screws

Torx recess head screws are the standard type of screw used in most Tait equipment, although Pozidriv and Allen recess head screws are also used in a few special applications.

The diagram below shows a typical Torx recess head screw (actual hardware may differ slightly from this illustration due to variations in manufacturing techniques).

"star" shaped recess with  
six internal notches



### Pozidriv Recess Head Screws

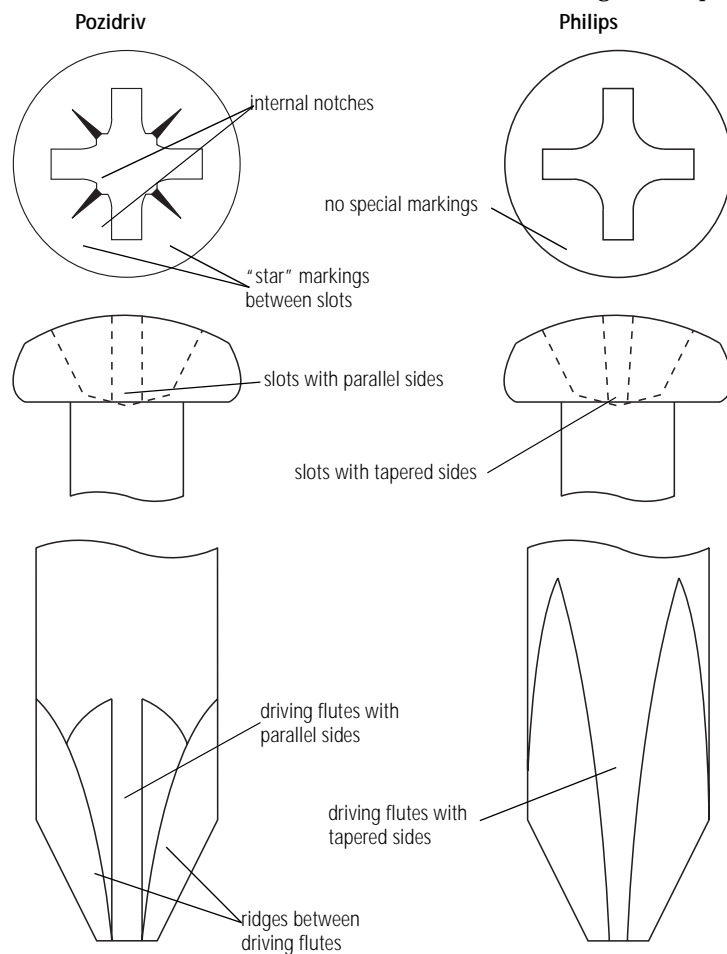
Pozidriv recess head screws are used in Tait equipment in a few special applications. It is important that you use the correct type and size screwdriver to avoid damaging the screw head.

It is particularly important that you do not use Philips screwdrivers on Pozidriv screw heads as the tapered driving flutes of the Philips screwdriver do not engage correctly with the parallel-sided slots in the Pozidriv screw head. This can result in considerable damage to the screw head if the screwdriver tip turns inside the recess.

**Note** If you find you need excessive downwards pressure to keep the screwdriver tip in the Pozidriv screw head, you are probably using the wrong type or size screwdriver.



The diagram below shows the main differences between typical Pozidriv and Phillips screw heads and screwdriver tips (actual hardware may differ slightly from these illustrations due to variations in manufacturing techniques).



## Recommended Tools

It is beyond the scope of this manual to list every tool that a service technician should carry. However, the tools specifically required for servicing encrypted TOP and TM8000 series radios are listed below.

- 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

# Components

## Replacing components

Ensure that any replacement components are of the same type and specifications as the originals. This will prevent the performance and safety of the encrypted radios from being degraded.

## Surface Mount Devices



### **Important**

Surface mount devices (SMDs) require special storage, handling, removal and replacement techniques. This equipment should be serviced only by an approved Tait Dealer or Customer Service Organisation equipped with the necessary facilities. Repairs attempted with incorrect equipment or by untrained personnel may result in permanent damage. If in doubt, contact your nearest Tait Dealer or Customer Service Organisation.

## Leaded Components

Whenever you are working on a PCB and removing or fitting components, you must take care not to damage any copper tracks or pads. The two satisfactory methods of removing components from plated-through hole (PTH) PCBs are detailed below.

### **Desoldering Iron Method**

This method requires the use of a desoldering station.

1. Place the tip over the lead and, as the solder starts to melt, move the tip in a circular motion.
2. Start the suction and continue the movement until three or four circles have been completed.
3. Remove the tip while continuing suction to ensure that all solder is removed from the joint, then stop the suction.
4. **Before** pulling the lead out, ensure it is not stuck to the plating.
5. If the lead is still not free, resolder the joint and try again.

**Note** The desoldering iron does not usually have enough heat to desolder leads from the ground plane. Additional heat may be applied by holding a soldering iron on the tip of the desoldering iron (this may require some additional help).

### **Component Cutting Method**

1. Cut the leads on the component side of the PCB.
2. Heat the solder joint **sufficiently** to allow **easy** removal of the lead by drawing it out from the component side: **do not** use undue force.
3. Fill the hole with solder and then clear with solderwick.

## Cased Mica Capacitors

Cased mica capacitors can be removed by heating the top with a heavy-duty soldering iron and gently lifting the capacitor off the PCB with a solder-resistant spike or equivalent. Make sure that the solder at the tab solder joint is melted or removed before attempting to lift the capacitor.

## Encryption Modules



### **Important**

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



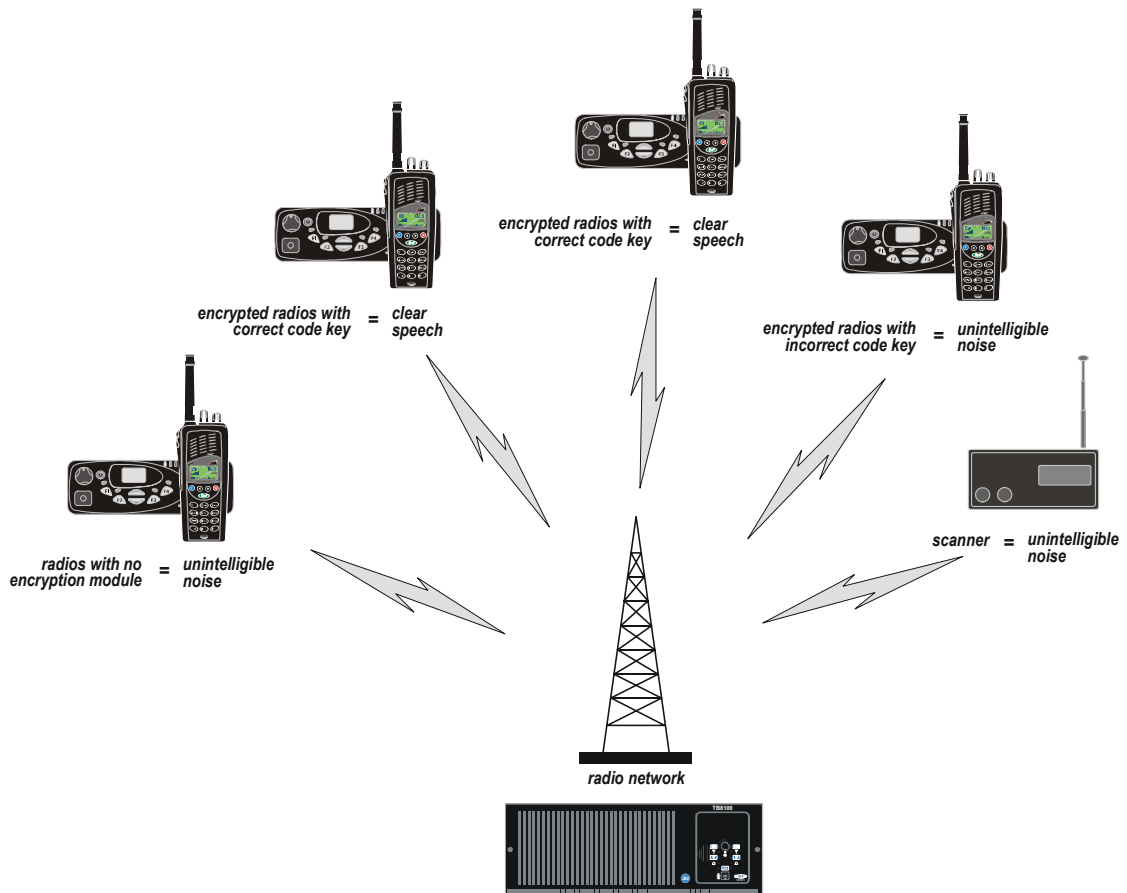
### **Important**

Each encryption module is provided with a sheet for recording programmable settings. As Transcript 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 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.



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. However, even when encryption is not selected, an encryption-enabled radio will always decode encrypted communication from any radio with compatible modules and settings.

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

## 1.1 Configuration

Both encryption modules and radios have many settings which affect encryption. Refer to the module manufacturer's installation and programming manuals provided with 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 are 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.

## 1.2 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.

## 1.3 Encrypted Radio Programming and Service Kit

This manual forms a part of the TOPA-EA-002 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 TOP and/or TM8000 series mobile radios.

The programming and service kit TOPA-EA-002 (KIT Transcript Prog + cables) contains the following items:

- Transcript Encryption for Tait TOP and TM8000 Radios Operation and Service Manual (IPN MAS-02434-TR-0X) - this manual - also available separately
- TOP Programming Cable (IPN 219-02128-0X) to connect Transcript programmer to OTAR programming radio
- TM8000 Programming Cable (IPN 219-03027-0X) to connect Transcript programmer to OTAR programming radio
- Transcript TR30-3061 programmer (IPN 005-00023-0X)

## 1.4 Related Documents

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

- Service and programming manuals for TOP radios
- Service and programming manuals for TM8000 radios
- Service and programming manuals for Transcript Encryption Modules
- Service and programming manuals for Transcript TR30-3061 Programmer

For more information on Tait encryption technology, see Tait Encryption White Papers at: <http://taitweb.co.nz>.

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

## 1.5 Tait Encryption Products

At the time of printing, the following encryption products were available for ordering. However, further encryption products are regularly being added. For further information, contact your Tait dealer.

### Encryptable Radios

New encryptable radio models are added to the standard Tait product range as requested.

### Modules

IPN	Description	Comments
005-00015-0X	MDL Ecrypt TZ20-416 Tcrypt	Transcript module TZ20-416
005-00016-0X	MDL Ecrypt TZ20-430 Tcrypt	Transcript module TZ20-430
005-00017-0X	MDL Ecrypt TZ20-460 Tcrypt	Transcript module TZ20-460

### Encryption Module Programmer

IPN	Description	Comments
005-00023-00	MDL Ecrypt Tcrypt TR30-3061	Programmer for radios with Transcript modules (included in TOPA-EA-003)

### Encryption Upgrade Kits (encryption modules not included)

IPN	Description	Comments
TOPA-EA-001	Kit Ecrypt Upgrd Flex 5000	Tait Orca encryption upgrade kit

## Encryption Module Programming

IPN	Description	Comments
TOPA-EA-011	Charge Program/Test Ecrypt Kit	Factory fitting and programming of encryption module

## Support Products

IPN	Description	Comments
TOPA-EA-002	Kit Transcript OTAR TOP+TMA	Tait Orca and TM8000 Encrypted Radio Programming and Service Kit - including this manual
219-02128-0X	CBL assy Ecrypt Otar Tcrypt	Programming cable for TOP radios fitted with Transcript modules (included in TOPA-EA-002)
219-03027-0X	CBL assy Ecrypt Otar Tcrypt	Programming cable for TM8000 radios with Transcript modules (included in TOPA-EA-002)

## Documentation

IPN	Description	Comments
MAS-02434-TR-01	MANL Serv TOP/TM8k Ecrypt Trnsci	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.



## 2 Transcript Encryption

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### 2.1 Encryption Module Compatibility

At the time of printing, the following Transcript encryption modules are compatible with encryption-enabled TOP and TM8000 series radios.

- Transcript TZ20-416
- Transcript TZ20-430
- Transcript TZ20-460

For other Transcript encryption modules, check with a Tait Service Centre, or [www.taitworld.com/](http://www.taitworld.com/).



#### **Important**

Either module can be fitted to TOP or TM8000 series radios without modification. However, module snap-off sections **must not be removed** when fitting a module into a TM8000 series radio, as these snap-offs include screw holes necessary to fit the module. The snap-offs are removed for TOP applications.

### 2.2 Radio Hardware Compatibility

#### TOP Radios

The TOP Encryption Upgrade Flex PCB described in this manual is suitable for use in most TOP 5000 radios (5010, 5020, 5035, 5040). The flex 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.

#### TM8000 Radios

At the time of printing, the TM8000 Encryption Options PCB described in this manual is compatible with any TM8000 series radio. However, the TM8000 firmware must be upgraded to support the TA2434-0X Encryption Options Board. For the current firmware version, consult your Tait dealer.

## 2.3 Radio Firmware and Software Compatibility

### TOP Radios

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

### TM8000 Radios

Encrypted TM8000 radios require a firmware change to support encryption function. This is normally fitted during manufacture. Standard TM8000 programming software supports encryption functions in TM8100 applications. A custom version of programming software is required for TM8200 applications. Some specific I/O settings are required to support encryption in all TM8000 radios. For more information, see “Programming the TM8000 radio” on page 52 .

## 2.4 Encryption Module Programming



**Important** When programming a Transcript module, **it is strongly recommended** that you retain the manufacturer’s customer-specific security codes, which have been preprogrammed in the factory. See the Transcript programming manual for more information on these codes, and further instructions for changing them if necessary.

If programming changes are required, Transcript module settings should be reprogrammed using over-the-air reprogramming (OTAR), without the radio being opened. This requires a Transcript TR30-3061 Programmer and cable 219-02128-0X OTAR Programming Cable for TOP or 219-03027-0X for TM8000. Instructions are on page 18.

**Note** Although not designed for direct programming, Transcript modules fitted in Tait radios may be able to be programmed directly in some instances. Enquire to your Tait dealer in the first instance.

Specific information on module parameter settings and values is available in the Transcript Programmer and Module service manuals. However, some useful module settings information is included in this manual on page 22.

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

## OTAR Programming

The Transcript OTAR Programmer allows a computer to alter an individual 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.



**Important** Service desk OTAR programming may be unsuccessful if:

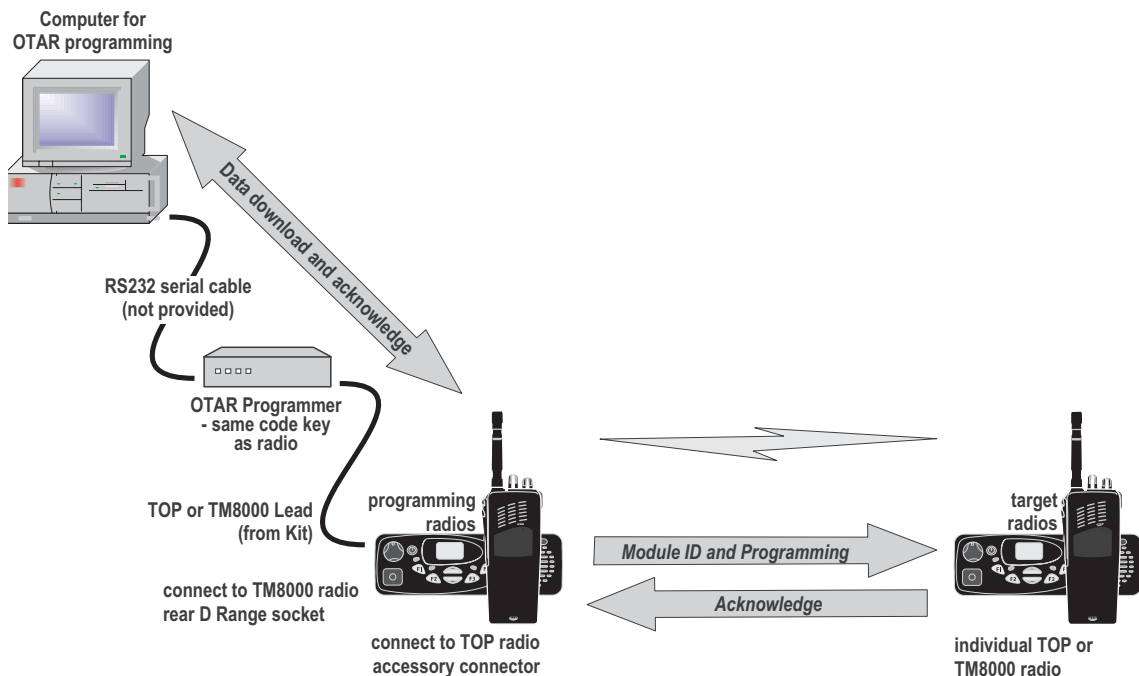
- the target radio is open during programming
- the programming radio and the target radio are oriented differently eg one laying down, one upright
- one radio is set to **High Power**
- the programming radio has a module fitted and encryption **ON**

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

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

### Programming setup

The diagram below illustrates the setup for OTAR programming Tait TOP or TM8000 series radios with Transcript encryption modules fitted.



**Note** 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.

#### Operation

The following sequence of events occurs during OTAR programming:

1. Codes are typed or menus selected on the program running on the PC
2. The RS232 cable carries data to the TR30-3061 OTAR Programmer.
3. The programmer encodes the data to 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. Radios not matching the ANI ID ignore the data
7. The one radio with the matching ID accepts the data and updates its memory registers.
8. The radio transmits back an acknowledge message indicating successful data loading.
9. The programming radio passes this message back to the programmer which converts it to an 'acknowledge response' message on the PC.

#### Using a TOP radio as an OTAR Programming Radio

A TOP encryption-enabled (flex PCB fitted) radio on the same frequency as the target radio is all that is required for an OTAR programming radio. Note that, if an encryption module is also fitted, the encryption function must be turned **OFF**.

The TOP OTAR programming cable (IPN 219-02128-0X) connects the OTAR Programmer to the TOP programming radio through the Accessory connector that has all signals required as standard. See the OTAR Programming Cable Specifications on page 23.

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

#### Using a TM8000 as an OTAR Programming Radio

An encryption-enabled TM8000 radio on the same frequency as the target radio is all that is required for an OTAR programming radio.

**Note** The programming TM8000 radio should have no encryption module fitted.

The TM8000 OTAR programming cable (IPN 219-03027-0X) connects the TR30-3061 OTAR Programmer to the TM8000 programming transmitter radio via the 15 Way High Density D Range socket on the radio rear. See the OTAR Programming Cable Specifications on page 25.

**Note** If programming is unsuccessful, ensure the TM8000 Encryption Options board has Link 3 and Link 4 fitted.

## Programming a Transcript Encryption Module

It is important to understand the meaning of the various identifiers in the programmer's manual. Some of the common identifiers are described below:

Transcript 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)	Serial number for controlling access to parameter changes
Scramble Code	Unique multi-digit code sets which module can decipher.
Master Code	Unique code assigned by the manufacturer a specific customer. This master code is also programmed into all modules supplied to that customer.

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

A typical sequence for programming is:

1. Briefly transmit in secure mode from the target radio, and note the unit 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 PC.
3. Enter programming commands as in programmer manual, to change codes or settings as required.
4. The target 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 codes.

## Security Codes



**Important** When programming a Transcript module, **it is strongly recommended** that you retain the manufacturer's customer-specific master and ANI codes, which have been preprogrammed in the factory. See the Transcript programming manual for more information on these codes, and further instructions for changing them if necessary.

The security of an encryption module is provided by the combination of the **master code** specific to the programmer used to program the module, and the **scramble code** in the module. This is a very large number, resulting in too many different codes for an eavesdropper to find any code by trial.

Transcrypt assigns each customer a unique **master code**, and programs all modules with this during manufacture. 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 cannot change the **master code**, only 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. See the TR30-3061 Programmer Manual for details.



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

### TR30-3061 Programmer Configuration

- Customer specific Master Code
- Acknowledge command works
- Normal programming does not try to change module master code, all commands work
- Force Download changes module master code to programmer master code. (Both are the same, so no effect.)

### 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.

```

S1 00000000
ID 22
MG 00
RC 05
MT 00000000
MD 00
QD 00
FC 00000000
ST 00
M1 10001000
M2 10000000
M3 00000000
M4 00000111
M5 00000000
TX 00000000
DL 14
LE 14
C0 A0132052
C1 A0132062
C2 A0132072
C3 A0132082
C4 A0132092
C5 A0132002
C6 A0132012
C7 A0132022
C8 A0132032
C9 A0132042
CA A0132052
CB A0132062
CC A0132072
CD A0132082
CE A0132092
CF A0132052
PM 00000000
PD 00000000
CR 00
K1 00000000
GM 0000
FT 0000
DG 0000
LM 0000
PY 0000
AA 0000
S1 00000000

```

## Testing Encryption Function

- Test Equipment
- A PC, with serial port
  - A TR30-3061 Transcript programmer
  - A TOP OTAR programming radio (as described on page 20) on the correct radio channel plus the 219-02128-0X cable from the kit **or**
  - A TM8000 OTAR programming radio (as described on page 20) on the correct radio channel and the 219-03027-0X cable from the kit

- OTAR Programming Test
1. Set the radio to Encrypt ON.
  2. Briefly transmit from the programming target radio, and note the unit ID '*nnnn*' on the computer terminal screen.
  3. Enter **A *nnnn***, press [Enter]. The programming radio will briefly transmit.
  4. The target radio returns **AK *nnnn xx***
  5. Enter a programming command 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.
  6. Check the target radio returns **AK *nnnn xx***.

**Note** After a **Move Download** (see TR30-3061 Manual), turn radio OFF then ON, so the module recognises the new scramble code.

## 2.5 OTAR Programming Cables

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

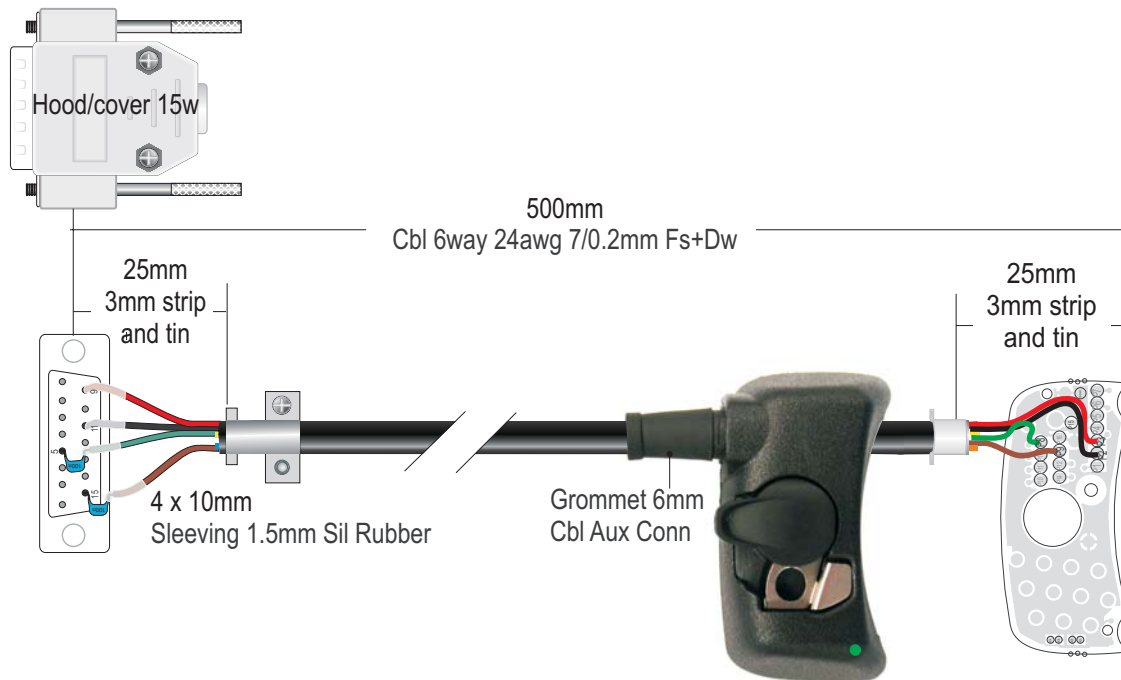
- IPN 219-02128-00 - Top Encryption OTAR Programming Cable
- IPN 219-03027-00 - TM8000 Encryption OTAR Programming Cable

### TOP Encryption OTAR Programming Cable (IPN 219-02128-00)

This cable is included in the OTAR Service and Programming Kit. It connects a TOP programming transmitter radio (via the Accessory connector) to the Transcript TR30-3061 OTAR Programmer.

## Signal Specification

Signal	TOP Signal	Sense/Level	TOP	Wire	TR30-3061
PTT	PTT	Active low	pin 3	Red	pin 9
Ground	GND		pin 2	Black	pin 11
Tx Out	Mod-Audio (dc block in lead)	1V p-p	pin 9	Brown	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
2	019-06100-00	CAP Mono cer 100n 50V 20% X7R
0.5 m	205-00010-47	CBL 6wy 24awg 7/0.2mm FS+DW 500mm x 1
1	240-06010-18	CONN 15wy hood/cvr drng MDJ15
1	303-20067-01	LOK spr Dclip rel
1	308-01021-00	HSNG mic acc h/stmp grn T/Orca
1	312-00001-00	LOK qtr turn P T/Orca acc 4grn
1	345-00020-09	SCRW M2x5 SST P/T ptch
1	349-00010-24	SCRW 4-20x5/8 P/P Trilobe BZ
1	354-01044-00	BUSH PSM SHK-B-M2-4.0 ins
1	356-00022-00	TIP qtr turn TOP5000 acc 4grn
1	357-01049-01	CRMP cbl T3K aux conn
1	360-02007-00	GROM 6mm cbl aux conn
1	362-01029-00	SEAL generic acc conn 4grn
0.04 m	400-00020-05	SLVG Si rbr 1.5mm 40mm x 1
1	OPA-AA-006G	T/Orca ACC Conn SMT Assy
1	240-00031-00	PLG 15wy drng UL-CSA pnl mtg

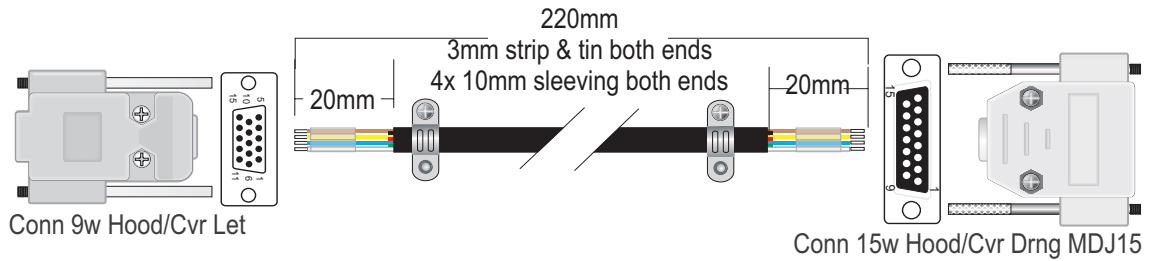


## TM8000 Encryption OTAR Programming Cable 219-03027-0X

This cable is included in the OTAR Service and Programming Kit. It connects a TM8000 programming transmitter radio (via ear 15 way High Density D Range connector) to the Transcript TR30-3061 OTAR Programmer to program any Transcript encryption module.

### Signal Specification

Signal	TM8000 Signal	Sense/Level	TM8000 Wire	Wire	TR30-3061
GND	Ground	GND	pin 15	Brown	pin 11
Tx In	Tx Audio from TR30-3061	1V p-p	pin 7	Yellow	pin 15
Rx Out	Rx Audio out to TR30-3061	0.5V p-p	pin 6	Blue	pin 5
PTT	PTT into TM8000	Active low	pin 5	White	pin 9



### Parts List

Qty	IPN	Description
0.22 m	205-00010-47	CBL 6wy 24awg 7/0.2mm FS+DW 220mm x 1
1	240-00031-00	PLG 15wy drng UL-CSA pnl mtg
1	240-00032-00	PLG 15wy drng Hi-D UL-CSA
1	240-06010-18	CONN 15wy hood/cvr drng MDJ15
1	240-06010-29	CONN 9wy hood/cvr LETS
0.08 m	400-00020-05	SLVG Si rbr 1.5mm 80mm x 1



## 3 Tait Orca Portable (TOP) Encryption

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Tait Orca Portable (TOP) radios are encryption-enabled using the TOP Encryption Flex PCB and a supported Transcript Encryption Module. This flex circuit 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.

### 3.1 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 is indicated by **SC** 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
- when transmitting or receiving encrypted calls, the 'accessory triangle' is displayed

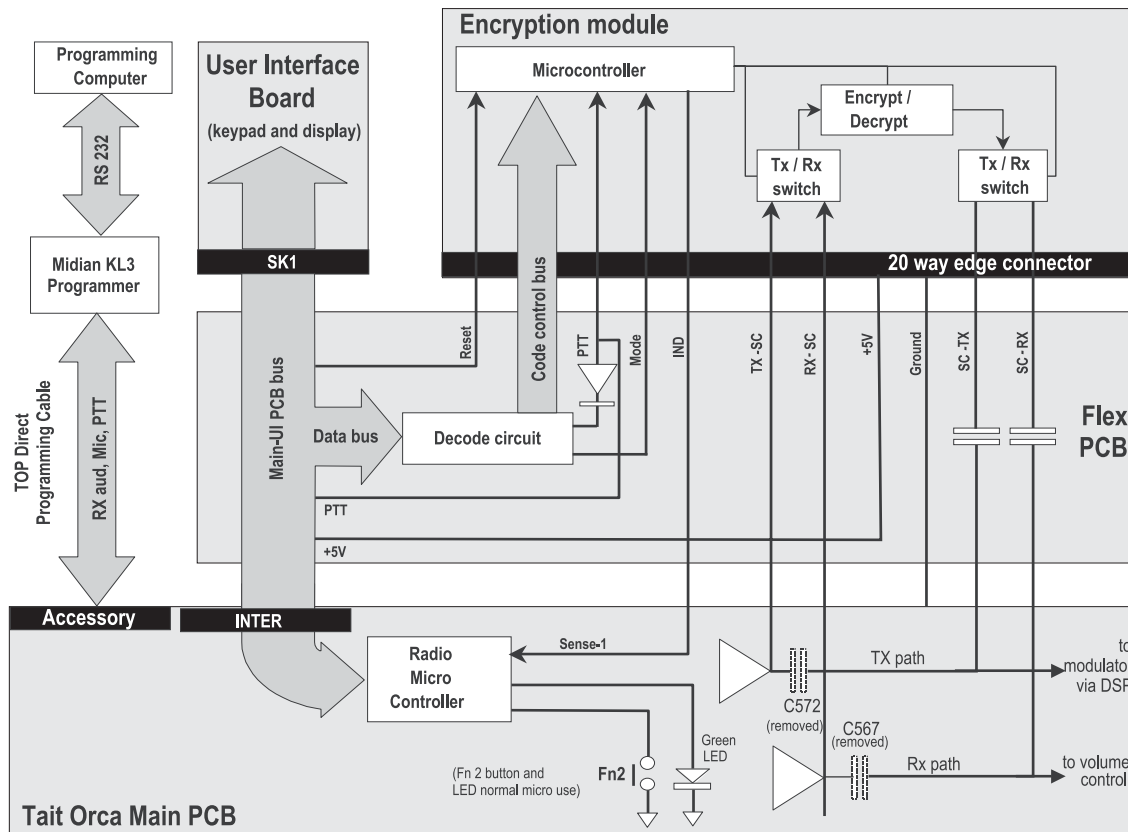
### 3.2 Circuit Operation

Functions of the interface:

- 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 selected encryption state.
- The standard TOP flex circuit that connects the TOP Main PCB to the TOP 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.

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 is turned **OFF**.



An addressable latch on the radio User Interface 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 User Interface 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 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 triangle. On TOP radios with no display (T5010 and T5030), the radio LED indicates encryption **ON/OFF**.

Encryption Mode can be assigned to a function key when the radio is programmed, or through the menu. (On most radios, this function is user-programmable.) This can be a long or short press of any valid function key, usually a **short** press of F2 key. Encryption code control is achieved by keypad entry or menu, usually a **long** press of F2 key.

## 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	

## 3.3 Programming the TOP Radio

Before programming the TOP Encryption radio, you will need:

- up-to-date standard Tait Orca Portable 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. This requires Tait Authentication System (TAS) access.
- conventional or trunked programming applications
- download and configuration application
- calibration application
- encryption flex fitted to the TOP radio. Instructions for fitting begin on page 34.

## Back-up Radio Data Files

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

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

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:

- TOPA-SV-116 Programming Kit
  - 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 enables all of that menu's submenu functions). This means that Encryption (on/off and code selection) will be available from the radio menu.

## 3.4 Encryption Module Programming

All Transcript module is preprogrammed by the manufacturer and do not normally require programming. Programmable functions can be programmed by OTAR programming.

Refer to the following manuals for detailed programming instructions

- Transcript programming instructions

- Trancrypt Module Manual
- Encryption Module Programming section on page 31 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 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.

**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 Trancrypt Encryption Module Programming section on page 31. Refer also to programming and service manuals with the Trancrypt 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**
- the programming radio has encryption turned ON

## 3.5 Testing the Encryption Module

Equipment setup and testing instructions are described in the Trancrypt Encryption Module Programming section on page 18 of this manual.

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 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 Operating Instructions that follow.)

## 3.6 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.

### Encryption On/Off

- 1 Press the appropriate Function Key (set in the Radio Programming Software)



### Alternative method:

- 1 (Menu) Long press
- 2 ENCRYPT SETTINGS
- 3 Short press
- 4 ENCRYPT ON
- 5 ENCRYPT ON ENCRYPT OFF to toggle

### Select Encryption Code

- 1 Press the appropriate Function Key (set in the Radio Programming Software)



- 2 Select code 2 digits
- 

- 3 Short press
- 

### Alternative method:

- 1 (Menu) Long press
- 2 ENCRYPT SETTINGS
- 3 Short press
- 4 ENTER CODE
- 5 2 digits or
- 6 Short press

 Transmitting or receiving encrypted call (Transcript only)  
Encryption On/Off Indicator (Midian only)

**Note:** If your radio has no display, the LED indicates encryption status

## 3.7 TOP Fault Finding

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 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 correct settings.
Module acknowledges its ID, but not accept any other commands.	Module may be programmed with the wrong programmer, with a different Master code.	Reprogram with correct programmer - will need a 'Force Download' (Refer to Transcript 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, 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 that the flex is square to connector. Replace module.
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.
Receiving radio intermittently fails to decode sync pulse. Audio unintelligible for several seconds then comes right.	System delay may be set too short	Reprogram module, or consider if CTCSS can be removed from part of radio system.
Radio confidence and alert tones are different, rapidly varying tones.	Normal when 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.
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)

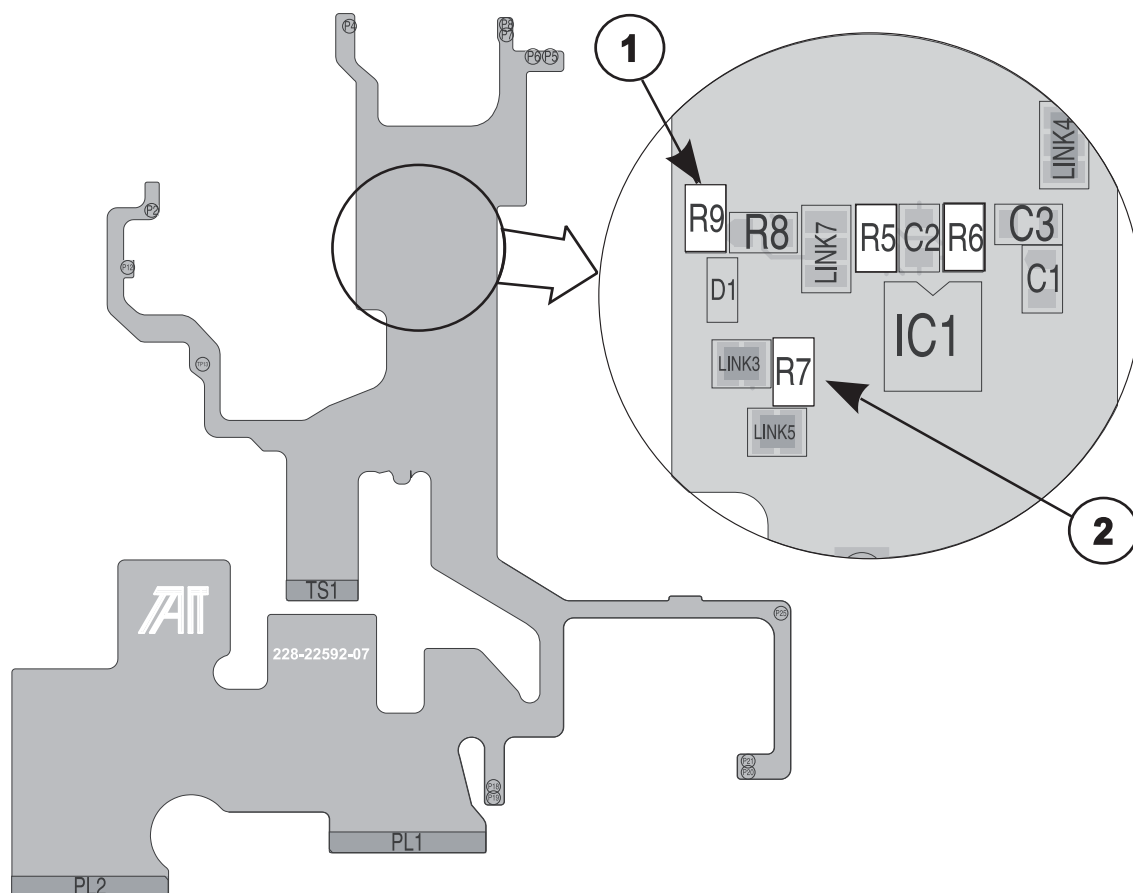
## 3.8 Fitting the TOP Encryption Upgrade Flex

**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 the standard procedures (documented in the TOP Service Manual), using the recommended tools which are listed on page 9.

## Prepare Flex

1. Locate R9 and remove
2. Locate R7 and fit 00hm chip (if not already fitted)

**Note** Before fitting a module, remove components R5 and R6.



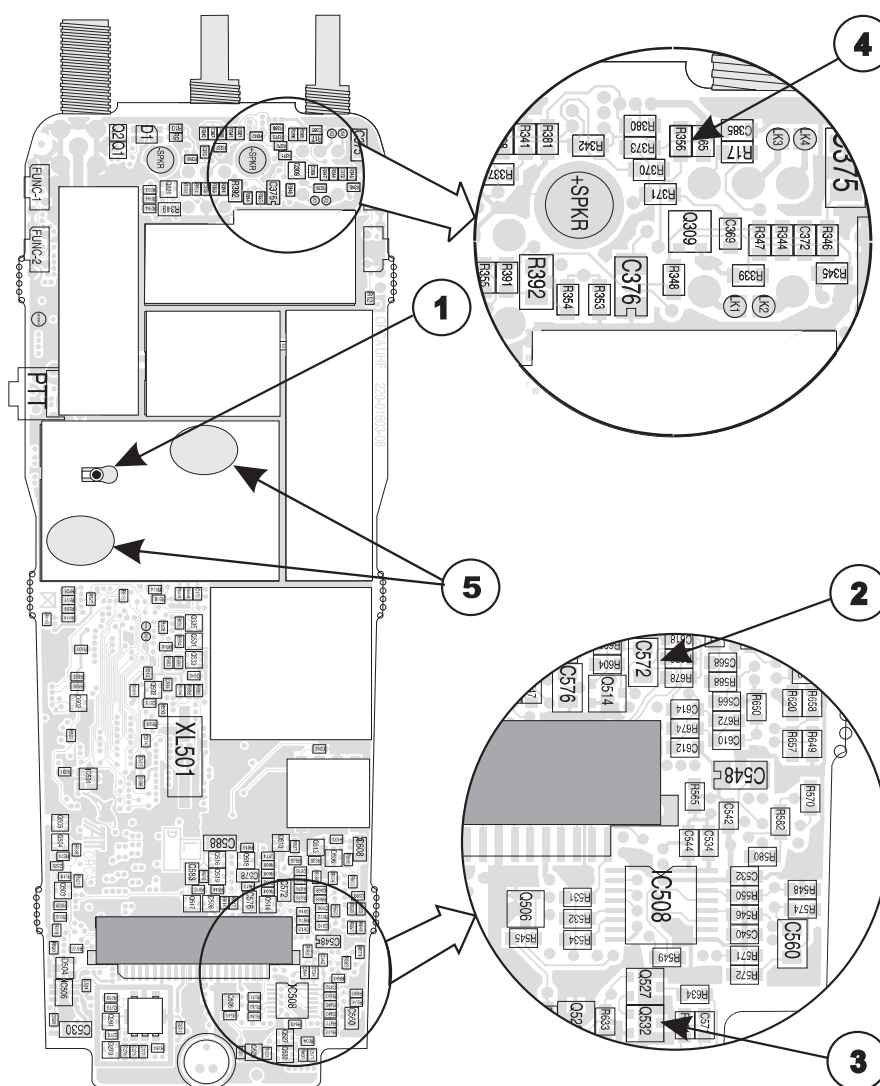
## Modify TOP PCB (bottom side)

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

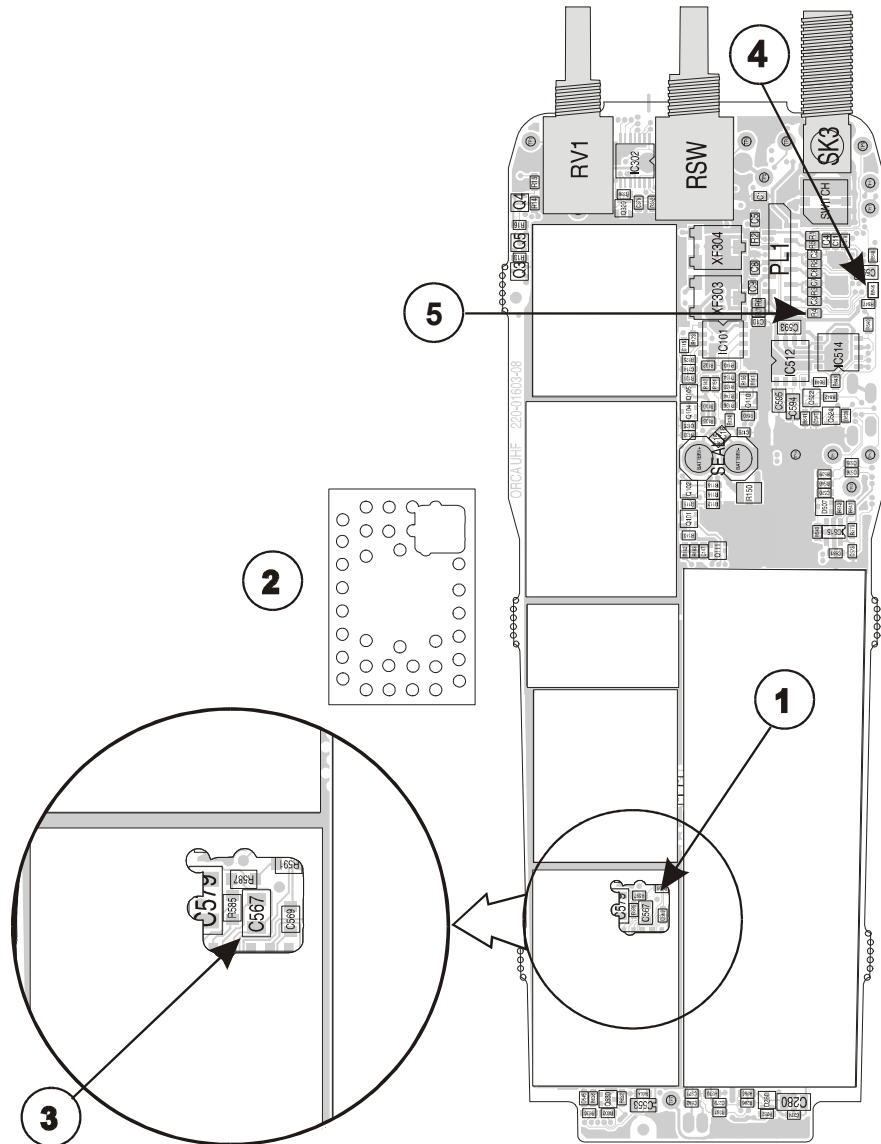
5. Pre-wet cans in positions indicated.

**Note** These positions will correspond to earthing points on flex.



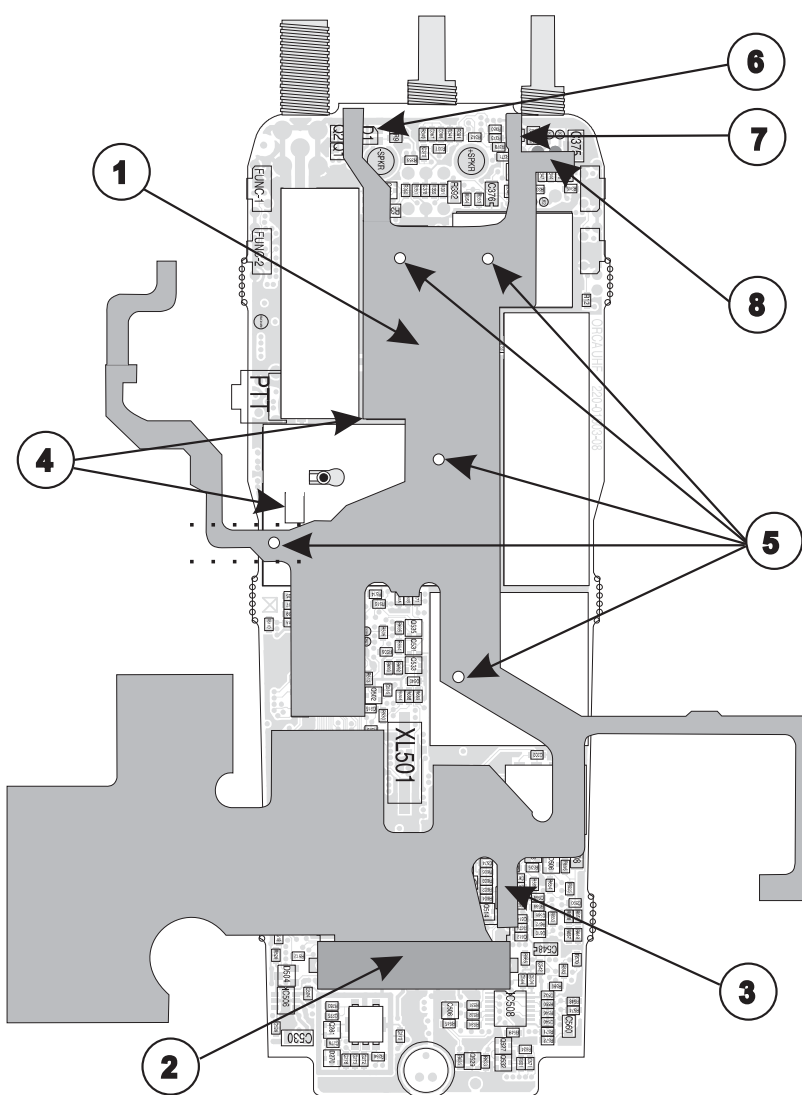
## Modify TOP PCB (top side)

1. Locate the can with large hole cut as shown
2. If there is no large hole in the can, cut carefully with sidecutters where shown, and turn the edges in
3. Remove capacitor C567 using a hot air gun and tweezers
4. Remove component R646 using a 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 TOP PCB (bottom side)

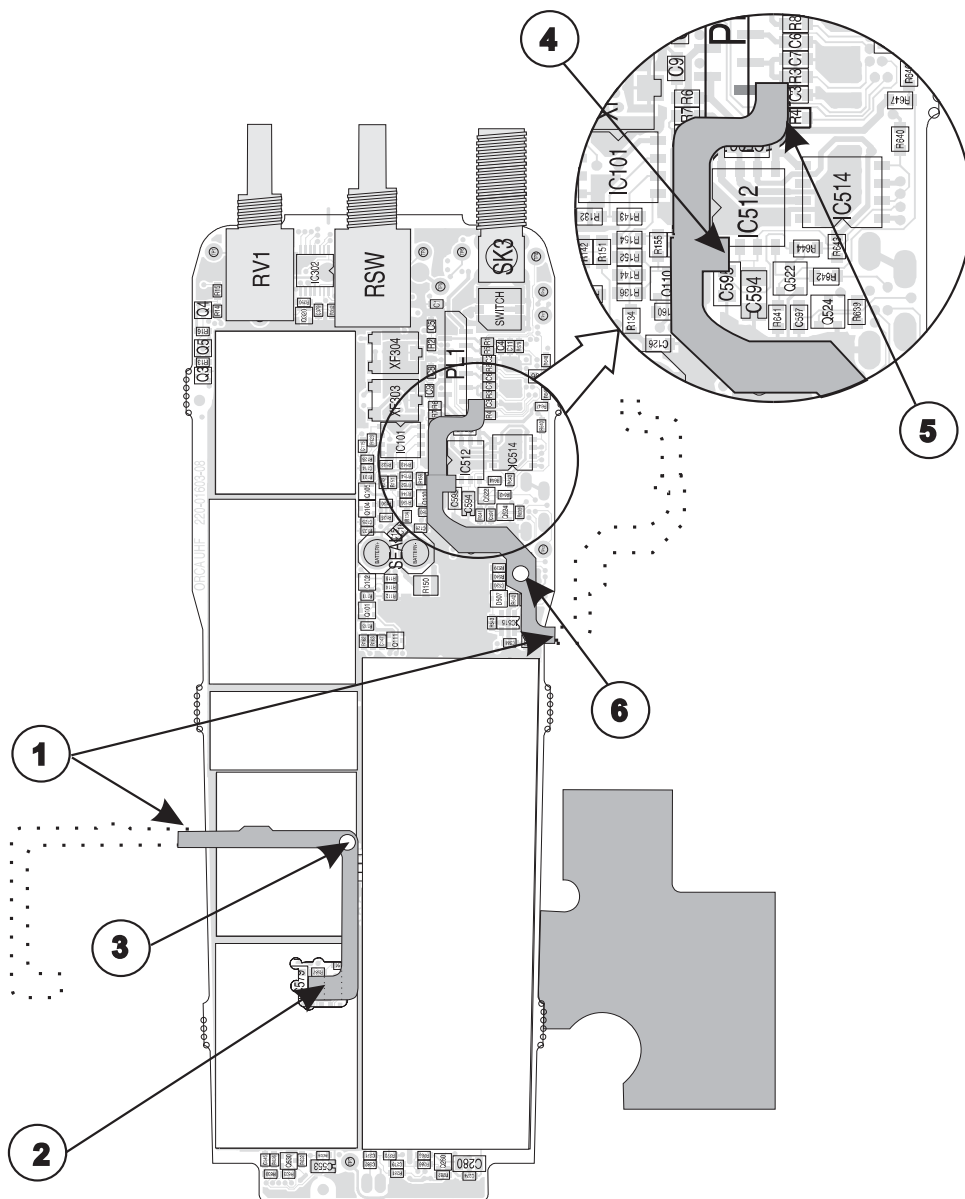
1. Lay flex onto PCB exactly as shown
2. Fit flex firmly into PL1 flex edge connector and press locking tabs closed
3. Solder two flex pads to the position vacated by C572
4. Ensure flex fits **exactly** to corner of can, with the edge clear of the PA can tag
5. Solder flex to cans, holding soldering 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 TOP PCB (top side)

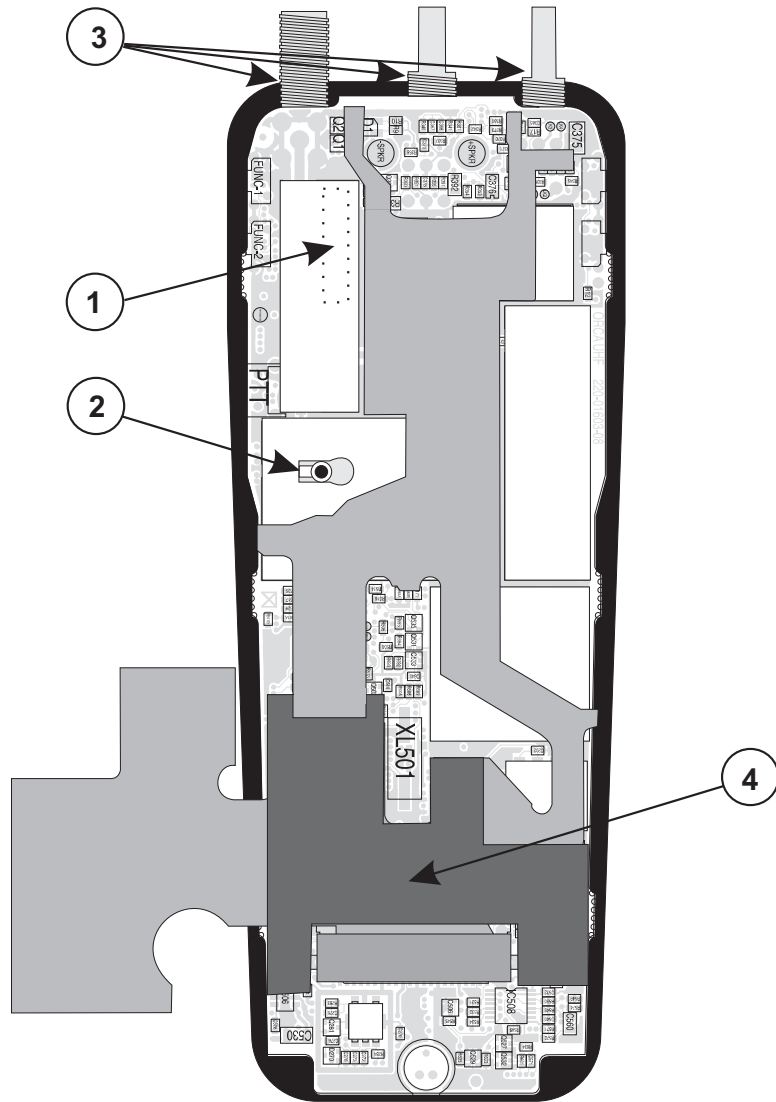
1. Turn PCB over and bend flex carefully around PCB as shown
2. Bend flex at crease, then holding flex in place with tweezers, solder flex pads to the pads vacated by C567
3. Solder flex to can, holding soldering iron to each point for **at least three seconds** to ensure permanent join
4. Solder single 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 TOP 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





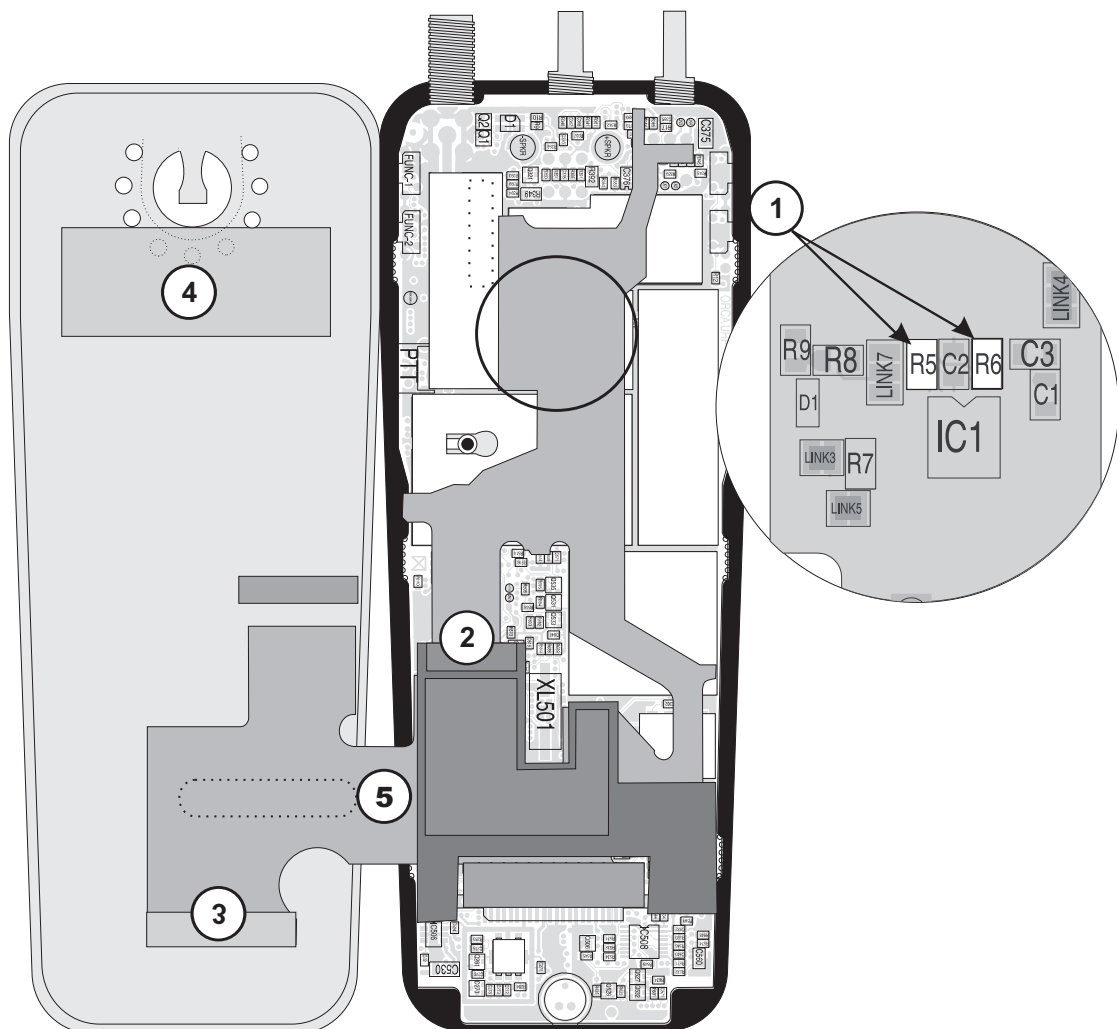
## Fit Encryption Module

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

1. Remove R5 and R6 on flex.
2. Fit flexiloom firmly into module's flex edge connector
3. 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.

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

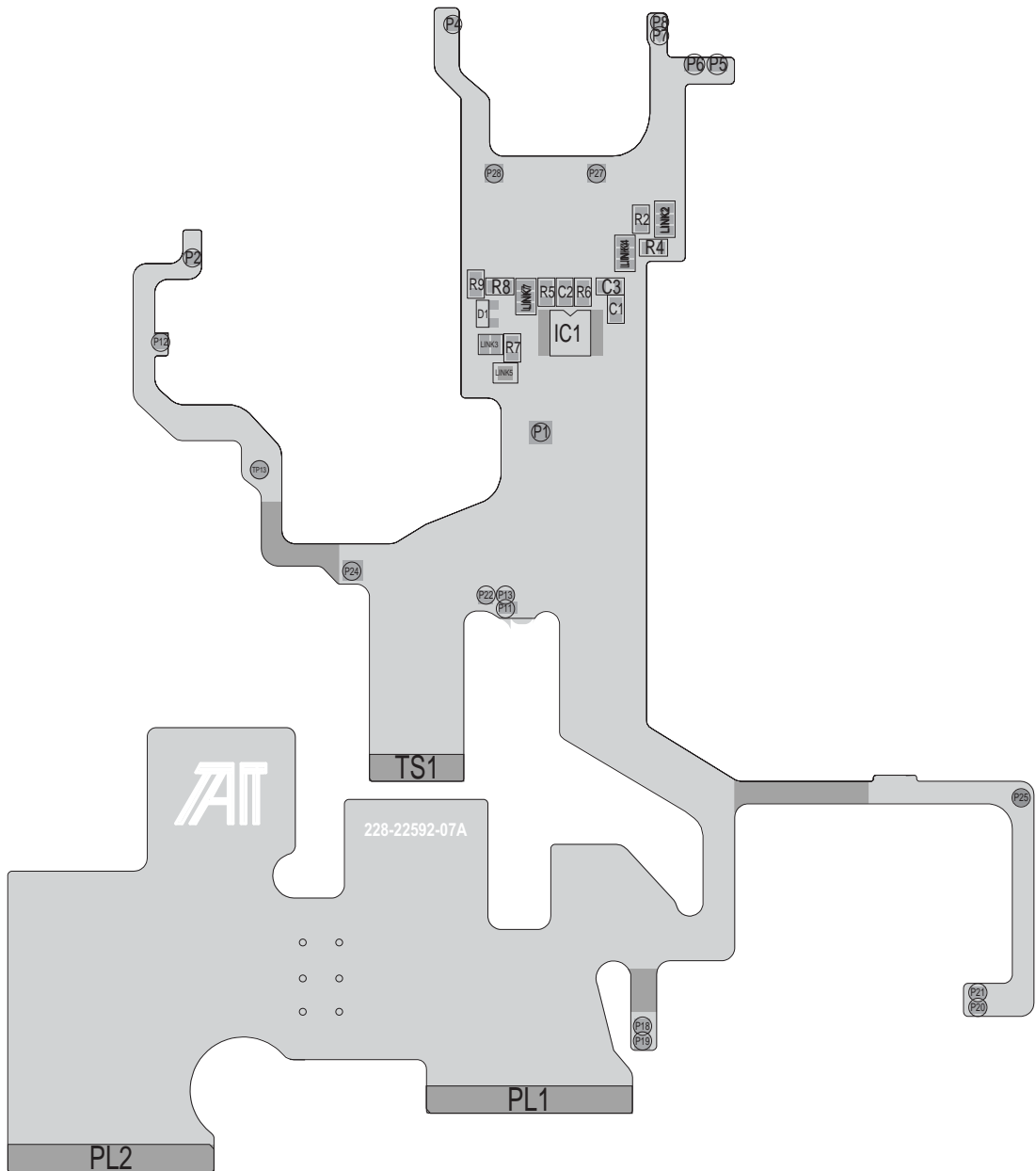


## 3.9 TOP Encryption Upgrade Flex PCB Information IPN 228-22592-07A

### Parts List

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
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

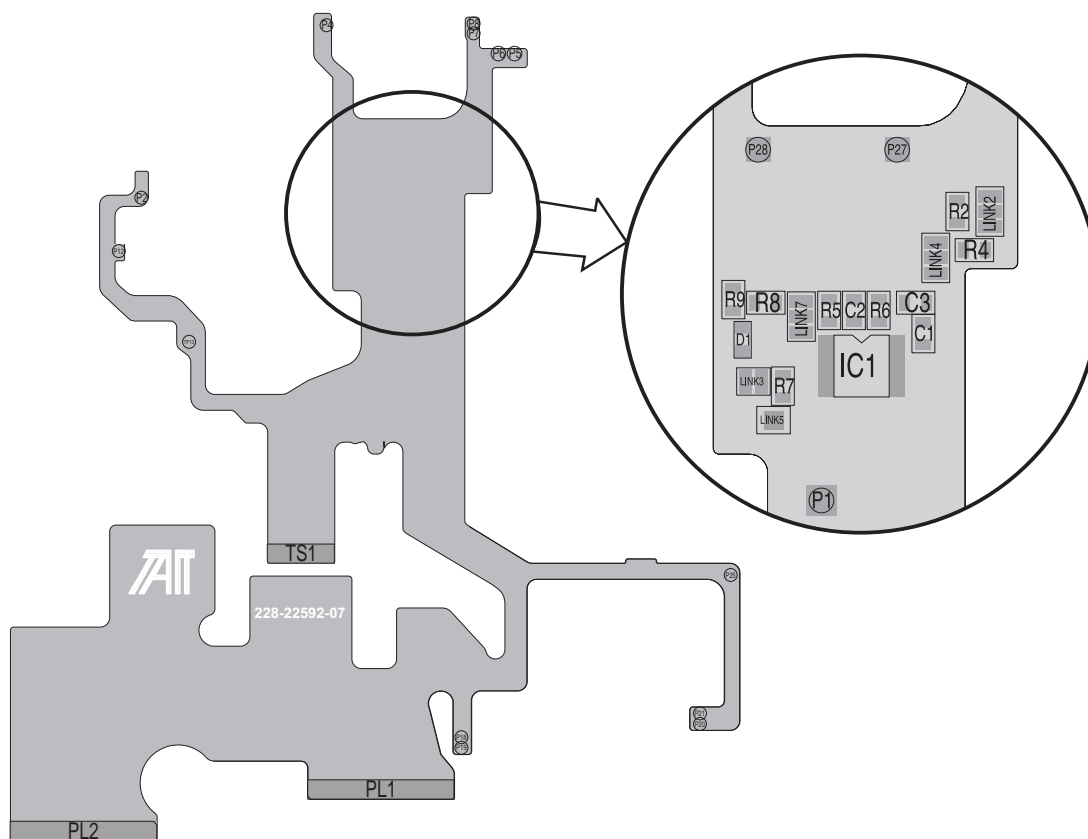
# PCB Layout - top side only



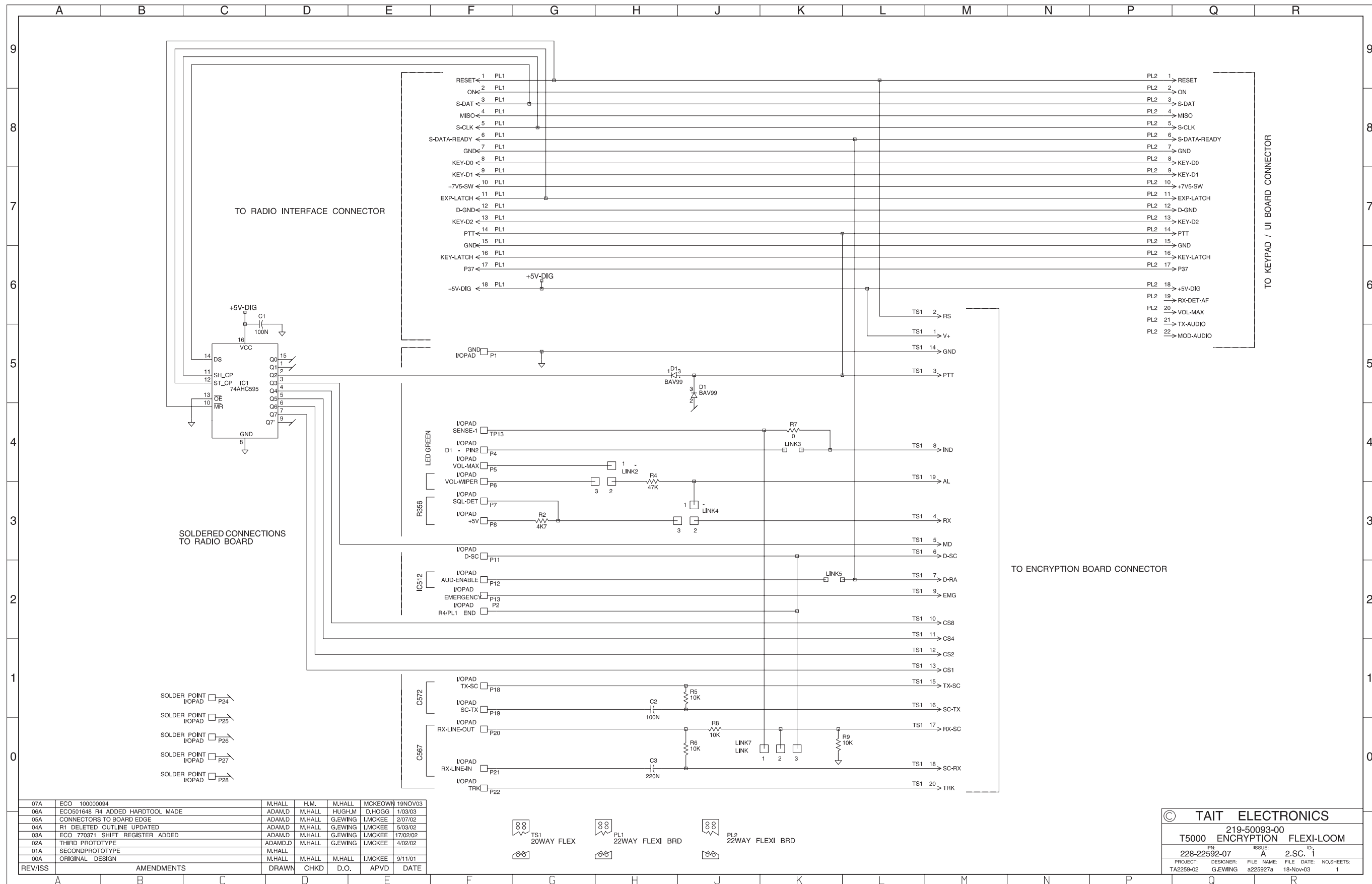
## Link Information

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	Not assigned	
8	Not assigned	
9	Not assigned	



Circuit Diagram - page 1 of 1



07A	ECO 10000094	M.HALL	H.M.	M.HALL	MCKEOWN	19NOV03
06A	ECO501648 R4 ADDED HARDTOOL MADE	ADAM.D	M.HALL	HUGH.M	D.HOGG	1/03/03
05A	CONNECTORS TO BOARD EDGE	ADAM.D	M.HALL	G.EWING	LMCKEE	2/07/02
04A	R1 DELETED OUTLINE UPDATED	ADAM.D	M.HALL	G.EWING	LMCKEE	5/03/02
03A	ECO 770371 SHIFT REGISTER ADDED	ADAM.D	M.HALL	G.EWING	LMCKEE	17/02/02
02A	THIRD PROTOTYPE	ADAM.D	M.HALL	G.EWING	LMCKEE	4/02/02
01A	SECOND PROTOTYPE	M.HALL				
00A	ORIGINAL DESIGN	M.HALL	M.HALL	M.HALL	LMCKEE	9/11/01
REVISS	AMENDMENTS	DRAWN	CHKD	D.O.	APVD	DATE

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 219-50093-00  
 T5000 ENCRYPTION FLEXI-LOOM  
 IPN: 228-22592-07 ISSUE: A ID: 2.S.C. 1  
 PROJECT: TA2259-02 DESIGNER: G.EWING FILE NAME: a225927a FILE DATE: 18-Nov-03 NO. SHEETS: 1



## 4 TM8000 Encryption

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**Note** At the time of printing, this section applied to TM8100 and TM8200 series radios, with approved Transcript encryption modules fitted.

The TA2434-01 TM8000 encryption options board allows compatible Transcript encryption modules to operate in the TM8000. Mounted in the options area of the TM8000, the board uses the same encryption modules as the TOP radios. No link or programming changes are required to the modules, so suppliers require only one version of each module.

The Encryption Options board provides all the required connections for encryption to a single connector for plug-in encryption functionality. It provides the following connections:

- to the TM8000 radio main board SK102 options connector via an 18-way micro-match loom
- for module programming, external control etc, 15way high-density D range external connector
- to the encryption module mounted on the options board, a 20-way connector via the flexible loom (IPN 219-02129-00 - supplied)

All encryption-enabled TM8000 series radios are factory-fitted with a special version of radio firmware. However, programming software is model-dependent as follows:

- in TM8100 radios, standard programming software is required, with encryption-specific I/O settings as default. These are documented under “Programming the TM8000 radio” on page 52 of this manual.
- in TM8200 radios, a custom version of the programming software is required, with encryption-specific I/O settings as default. These are documented under “Programming the TM8000 radio” on page 52 of this manual.

### 4.1 User Interface

This is a hardware and firmware solution. It offers:

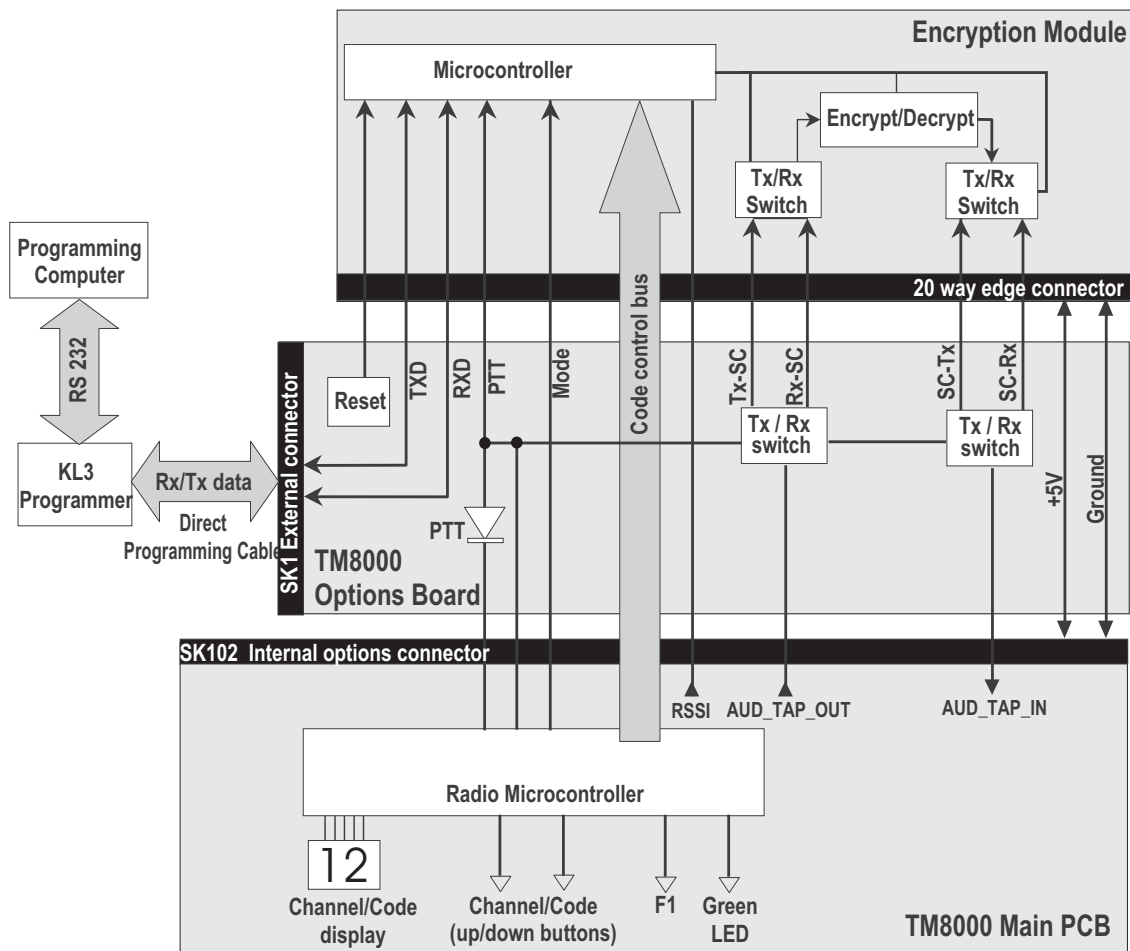
- user control of Encryption state (**ON** or **OFF**) by any Function button (default F1), programmed by the user, with either short or long press activation
- encryption state indicated by steady LED above F1
- in code change mode, user control of up to 16 encryption codes using the channel change buttons
- control of the number of user-accessible codes

## 4.2 Circuit operation

Audio buffering, gain reduction and amplification is provided by IC U7, a quad Op Amp. This reduces the higher Tx audio level in the TM8000 radio down to a similar level to the TOP radio, and then amplifies it back up again after the encryption module, to match the TM level. This allows the same module settings for TOP or TM8000.

**Note** TM8000 Rx levels similar to the TOP and the Op Amps in the Rx path are mainly buffering the Rx audio signal.

The diagram that follows illustrates the operation of the XA2324-01 circuitry:



### GPIO port

GPIO1 sends PTT to the module and GPIO2 detects PTT from the module. As the module's PTT line is common, D2 and IC U6 (a 4053) isolate the two PTT lines and prevent the radio from locking up on Tx.



Q1 to Q5 are level translators for interfacing between the TM8000 3V3 logic on GPIO (pins 3 to 7) and the module's 5V logic. Q1, Q2, Q4 and Q5 are on the code space lines and Q3 is on the Mode line.

## Wake-up Circuit

Comparator circuitry U2 and associated components provides a wake-up signal for modules with a low current (sleep) mode. This signal is derived from RSSI voltage exceeding a fixed level (set by R13 and R18). U5 acts as an inverter and the wake-up circuit links to the module via Link 1 (1-2). See "Link Setting" on page 51 for more information.

## RS232 Buffer (future development)

U3 and associated components provide an RS232 buffer for module programming.

## Filtering

All signals passed through SK1 are filtered by FL1 through to FL4.

## TM8000 Internal Options connector (SK102) 18way Micromatch Socket

Pin	Signal	Description	Signal Type	Levels	Conditions
1	13V8_SW	Switched 13.8v supply (switched)	Power	13.8V	
2	AUD_TAP_OUT	Programmable TAP OUT, DC coupled	Analogue	0.69Vp-p	600 ohms
3	AGND	Analogue ground	Ground		
4	AUX_MIC_AUD	Auxiliary microphone input (electret bias)	Analogue	7.5 mV	3.0 V Bias
5	RX_BEEP_IN	Receive sidetone Input, AC coupled	Analogue	0.76Vp-p	10 K ohms
6	AUD_TAP_IN	Programmable TAP IN, DC coupled	Analogue	0.69Vp-p	600 ohms
7	RX_AUD	Receive audio output post Vol, AC coupled	Analogue	1.0 Vp-p	100 ohms
8	RSSI	Analogue RSSI output	Analogue	.5-2.5 Vdc	1000 ohms
9	IOP_GPIO1	Programmable Port, PTT OUT	Digital	3.3 V	CMOS
10	IOP_GPIO2	Programmable Port, PTT IN	Digital	3.3 V	CMOS
11	IOP_GPIO3	Programmable Port, Encry Mode ON / OFF	Digital	3.3 V	CMOS
12	IOP_GPIO4	Programmable Port, CS 1	Digital	3.3 V	CMOS
13	IOP_GPIO5	Programmable Port, CS 2	Digital	3.3 V	CMOS
14	IOP_GPIO6	Programmable Port, CS 3/wakeup/indicator	Digital	3.3 V	CMOS
15	IOP_GPIO7	Programmable Port, CS 4/wakeup/indicator	Digital	3.3 V	CMOS
16	DGND	Digital ground	Ground		
17	IOP_RXD	Asynchronous serial port - receive data	Digital	3.3 V	CMOS
18	IOP_TXD	Asynchronous serial port - Transmit data	Digital	3.3 V	CMOS

## Signal levels and pin assignments

Function	Mode	Name	Pin	Module	TM8000 Radio
Power Supply		V+	1	5V regulated	
Reset	I/P	RS	2	Active low	Resets when supply below 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 required
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 dev
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 dev
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	

## External Connector (SK1) 15way D Range Socket

Pin	Signal	Description	Signal Type	Levels	Conditions
1	RX_MUTE	Comparator OP amp output from RSSI line	Digital	0 - 5 V	
2	AUX_MIC_IN	Auxiliary microphone input (electret bias)	Analogue	7.5 mV	3.0 V Bias
3	RX_AUD	Receive audio output post Vol, AC coupled	Analogue	1.0 Vp-p	100 ohms
4	+5V	+ 5 Volts regulated	DC	5V	
5	RSSI / Ext PTT	Analogue RSSI output / optional PTT input	Analogue	.5-2.5 Vdc	1000 ohms
6	D_RA	Programe out (Data to Radio)	Digital	5 V	
7	D_SC	Programe in (Data to Scrambler)	Digital	5 V	
8	IND	Module indicator output	Digital	Active high	3mA out
9	IOP_RXD	Asynchronous serial port - receive data	Digital	3.3 V	CMOS
10	IOP_TXD	Asynchronous serial port - Transmit data	Digital	3.3 V	CMOS
11	CS1	Code space 1 output/ Input (default is out)	Digital	3.3 V	CMOS
12	CS2	Code space 2 output / Input (default is out)	Digital	3.3 V	CMOS
13	CS3	Code space 3 output / Input / wakeup / ind.	Digital	3.3 V	CMOS
14	CS4	Code space 4 output / Input / wakeup / ind.	Digital	3.3 V	CMOS
15	GND	Ground	Ground		

## 4.3 Link Setting

The table below describes link setting for other available options.

Link	Description	Setting	1-2	Comment
Link 1	Rx Busy	1-2	Rx busy from RSSI detect	Factory fitted default
		2-3	External Rx Mute	SK1 pin1
Link 2	External PTT (OTAR base)	Fitted	Fit link and remove R19	R19 must be removed
Link 3	OTAR out/Direct PGM IN	Fitted	Fit for Transcript OTAR PGM	Required for OTAR use*
Link 4	OTAR in/Direct PGM OUT	Fitted	Fit for Transcript OTAR PGM	Required for OTAR use*
Link 5	Alert Tones	Not fitted	Fit link for go-ahead beep	Future Development
Link 6	External Encryption Indicator	Fitted	Fit for external indicator	Future Development
Link 7	Wake up	1-2	Fit for Wake up from GPIO7	Not used in this application
		2-3	Fit for Wake up from GPIO8	
Link 8	Indicator link	1-2	Fit for IND to GPIO6	Not normally fitted
		2-3	Fit for IND to GPIO8	
Link 9	Code space 8	1-2	Fit for GPIO7 to CS8 (Normal)	Factory fitted default
		2-3	Fit for ground on CS4	
Link 10	Code space 4	1-2	Fit for GPIO6 to CS4 (Normal)	Factory fitted default
		2-3	Fit for ground on CS4	

\* *Although not designed for direct programming, Transcript modules fitted in Tait radios may be able to be programmed directly in some instances. Enquire to your Tait dealer in the first instance.*

## 4.4 Programming the TM8000 radio

**Note** In addition to standard customer- and application-specific programming settings, all TM8000 radios require the following specific I/O settings for successful encryption operation:

### I/O Settings - Digital Tab

The screenshot shows the 'Programmable I/O' window with the 'Digital' tab selected. The table below lists the configured digital I/O pins and their parameters.

Pin	Mode	Direction	Label	Action	Active	Debounce	Signal State	Mirror
AUX_GPI1	All	None	None	No Action	None	None	None	None
AUX_GPI2	All	None	None	No Action	None	None	None	None
AUX_GPI3	All	None	None	No Action	None	None	None	None
AUX_GPI4	All	None	None	No Action	None	None	None	None
AUX_GPI5	All	None	None	No Action	None	None	None	None
AUX_GPI6	All	None	None	No Action	None	None	None	None
AUX_GPI7	All	None	None	No Action	None	None	None	None
IOP_GPI01	All	Output	PIN_9	Reflect PTT Status	Low	None	None	None
IOP_GPI02	All	Input	PIN_1C	External PTT 1	Low	10	None	None
IOP_GPI03	All	Output	None	No Action	Low	None	None	None
IOP_GPI04	All	Output	PIN_12	No Action	Low	None	None	None
IOP_GPI05	All	Output	PIN_13	No Action	Low	None	None	None
IOP_GPI06	All	Output	PIN_14	No Action	Low	None	None	None
IOP_GPI07	All	Output	PIN_1E	No Action	Low	None	None	None
CH_GPI01	All	None	None	No Action	None	None	None	None

Below the table, the 'Action Parameters' section is visible, showing settings for Emergency Mode (Stealth), Mute Audio Input (Audio Tap In), Mute Audio Output (Speaker Audio Path), and various channel and network preset options.

### I/O Settings - Audio Tab

The screenshot shows the 'Programmable I/O' window with the 'Audio' tab selected. The table below lists the configured audio I/O settings.

Rx/PTT Type	Tap In	Tap In Type	Tap In Unmute	Tap Out	Tap Out Type	Tap Out Unmute
Rx	R7	E - Splice	Rx Mute Open	R7	E - Splice	Rx Mute Open
Mic PTT	T4	E - Splice	On PTT	T4	E - Splice	On PTT
EPTT1	T4	E - Splice	On PTT	T4	E - Splice	On PTT
EPTT2	None	A - Bypass Ir	On PTT	None	C - Bypass O	On PTT

**Note** The encryption-enabled TM8200 has customised programming software file 2434A212. TM8100 radios use standard software.

## 4.5 Encryption-Enabled TM8000 Operating Instructions

### TM8100

**Note** Encryption changes to standard TM8000 firmware mean that the TM8000 encryption functions operate similarly to the TOP encryption interface in these radios.


An encryption-enabled TM8100 radio operates as standard, with the exception of the following:

- Press F1 button to enter (or exit) encrypt mode. Green LED above F1 lights.
- Long-press F1 to enter code-change mode. The current encryption code is only displayed when the radio is in code-change mode (flashing **SCXX** where XX represents the two-digit code number).
- Use channel change up/down buttons to change code.
- Use F1 to exit code-change mode and enter selected (flashing) code. If no further buttons are pressed, display reverts to channel display and enters displayed (flashing) code after approximately eight seconds.

### TM8200

**Note** Encryption changes to standard TM8000 firmware mean that the TM8000 encryption functions operate similarly to the TOP encryption interface in these radios.

An encryption-enabled TM8200 radio operates as standard, with the exception of the following:

- Press F1 button to enter (or exit) encrypt mode. Green LED above F1 lights and display shows key  icon (top left of display). The current encryption code (**SCXX** where XX represents the two-digit code number) is permanently displayed at bottom left of display, whether in encrypt mode or not.
- Long-press F1, or use the left scroll key to enter code-change mode.
- Use channel change up/down buttons to change code and right scroll key to select the code.

#### Menu selection

- To access Encryption ON/OFF via the menu:

MENU>RADIO SETTINGS>FUNCTION SETTINGS>ENCRYPTION

- To access Encryption and code change via the menu:

MENU>RADIO SETTINGS>FUNCTION SETTINGS>ENCRYPTION  
CODE

## 4.6 TM8000 Fault Finding

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 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.
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.
Module acknowledges its ID, but not accept any other commands.	Module may be programmed with the wrong programmer, with a different Master code.	Reprogram with correct programmer - will need a 'Force Download' (Refer to Transcript 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.	Replug connectors checking flex is square to connector.
	Module faulty.	Replace module.
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.	Reprogram module with different codes.
Receiving radio occasionally or frequently fails to decode sync pulse. Audio is unintelligible for several seconds then comes right.	System delay may be set too short	Reprogram module, or consider if CTCSS can be removed from some parts of radio system.
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.

## 4.7 Fitting the TM8000 Encryption Options Board

**Note** These instructions apply to all TM8000 series radios.

**Important** Do not remove the break-offs from the encryption module: these have the screw holes required for fitting the module to the TM8000 Encryptions Options Board.

A 20-way connector connects the flexible loom (IPN 219-02129-00 - supplied) to the encryption module. Three short 4/40 screws and fibre washers screws pass through the three holes, which are in the break-off areas of the encryption modules, and are screwed into three short 4/40 screw locks, which are mounted onto the encryption options adaptor board.

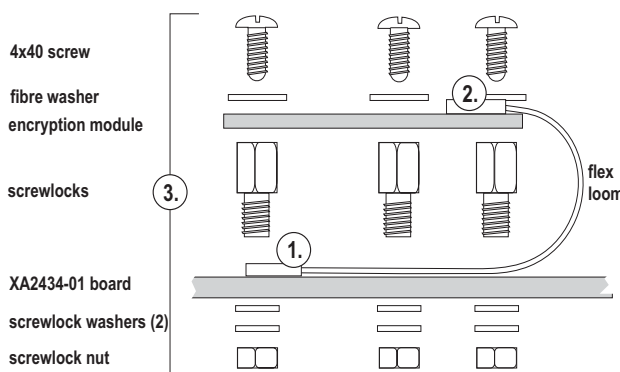
The following parts are supplied with the TM8000 Encryption Options Board:

Qty	IPN	Description
1	219-00329-00	Loom TMA Int Opt
1	219-50096-00	FFC Jumper 20w 0.5mm
1	228-24341-02	PCB TM8 ecrypt opt brd enig
2	354-01041-00	Fsnr Scrw Lok Kit 4-40
3	347-00011-00	Scrws 4-40*3/16 Unc P/P Blk
3	353-00010-15	Wshr M3 Fibre 8mm Od*1mm
6	349-02062-00	Scrws M3*8 T/T P/T ContiR

Use the diagrams and the instructions that follow to assemble or disassemble the encrypted TM8000 radio.

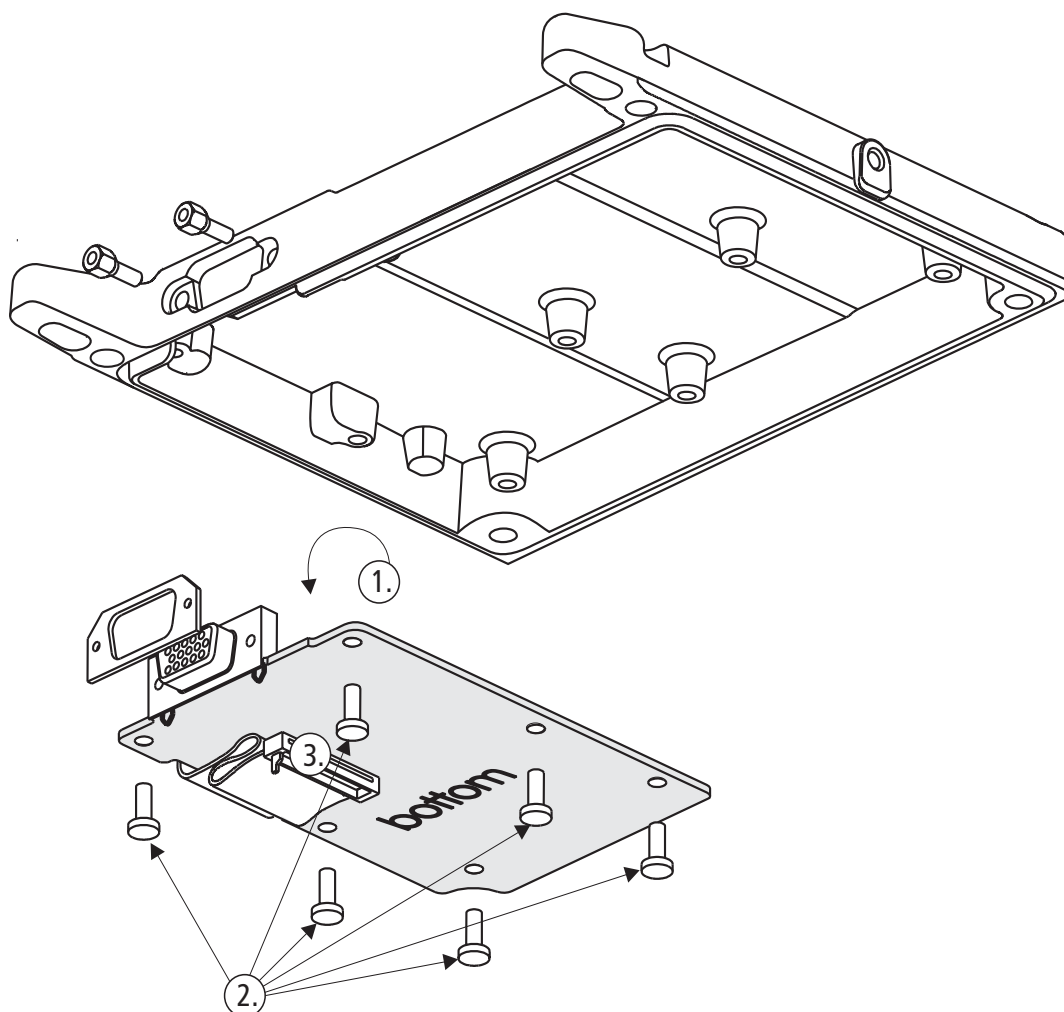
### Fit Encryption Module to TM8000 Encryption Options Board

- Fit the 20way flex loom (IPN 219-50096-00) into Encryption Options Board Flex-edge connector J5.
- Fit the other end of the flex loom to encryption module flex edge connector.
- Fit encryption module to Encryption Options Board using three Pan Pozis screws and fibre washers, screwlocks, washers and nuts as shown.



## Fit TM8000 Encryption Options Board to TM8000 radio

1. Fit TMA Internal Options Loom (IPN 219-00329-00) to Encryption Options Board at SK102 (top side - not shown).
2. Turn Encryption Options Board over, and place board so that the external D Range protrudes through the rear aperture of the chassis. Then using six Taptite screws, fit Encryption Options Board to radio lid as shown. (Encryption module will sit between the lid and the Encryption Options Board.)
3. Fit other end of options loom to TM8000 Main Board.
4. Close radio, according to standard TM8000 procedures (see standard TM8000 Service Manual).





## 4.8 TM8000 Encryption Options PCB Information IPN XA2343-01-PBA

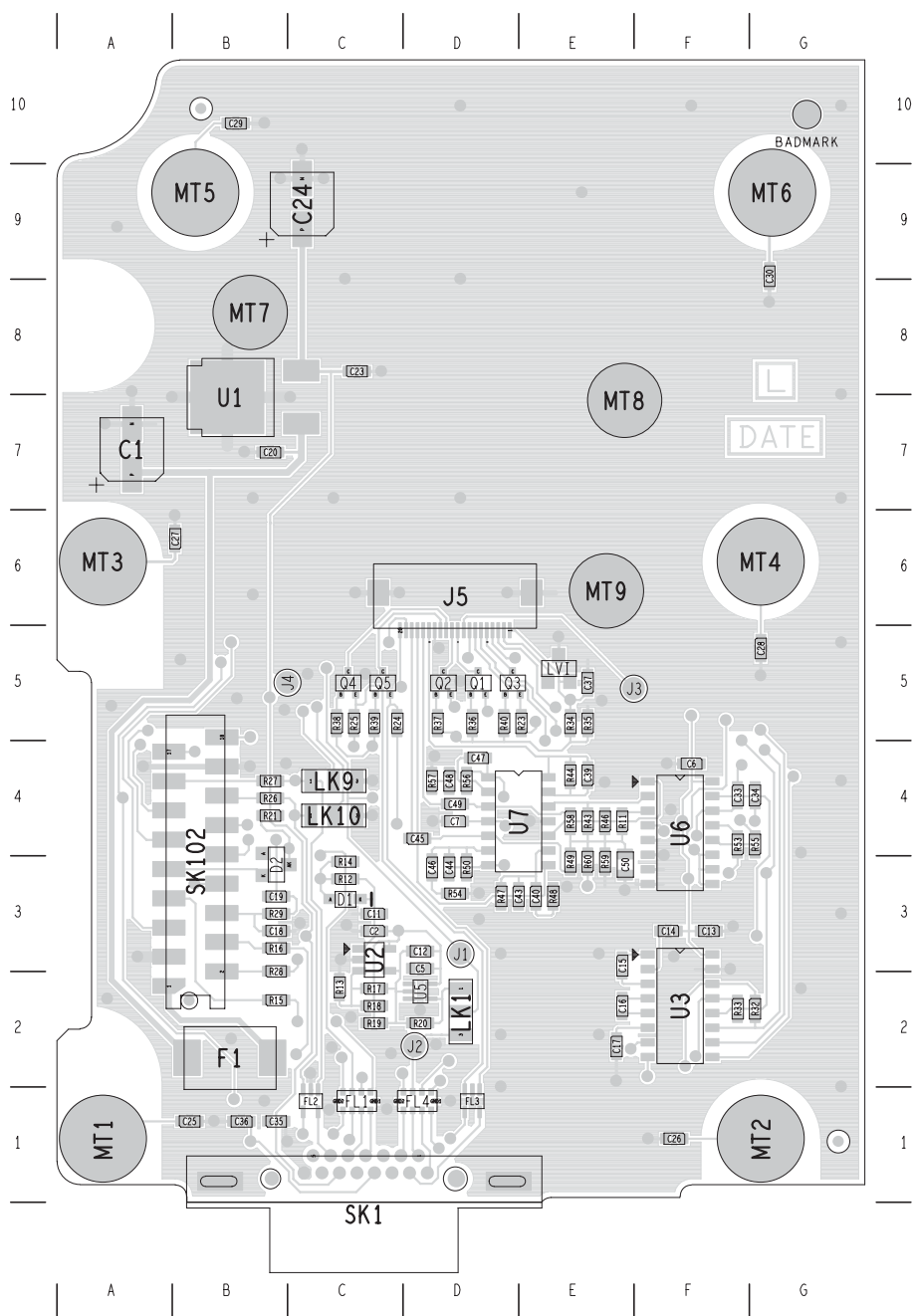
### Parts List

Part	IPN	Description		
C1	016-08100-02	Cap Elec SMD 10M 5.5*5 35v 20%	A7	1D6
C2	018-16100-00	Cap 0603 100n 16v x7r + - 10%	C3	1B6
C5	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D3	1B7
C6	018-16100-00	Cap 0603 100n 16v x7r + - 10%	F4	1B8
C7	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D4	1B9
C11	018-16100-00	Cap 0603 100n 16v x7r + - 10%	C3	1J3
C12	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D3	1J4
C13	not fitted in this application		F3	1H4
C14	not fitted in this application		F3	1H5
C15	not fitted in this application		E3	1H4
C16	not fitted in this application		E2	1G4
C17	not fitted in this application		E2	1H5
C18	not fitted in this application		B3	1E4
C19	018-16100-00	Cap 0603 100n 16v x7r + - 10%	B3	1E4
C20	018-16100-00	Cap 0603 100n 16v x7r + - 10%	B7	1D6
C23	018-16100-00	Cap 0603 100n 16v x7r + - 10%	C8	1D7
C24	016-08100-02	Cap Elec SMD 10M 5.5*5 35v 20%	C9	1D7
C25	not fitted in this application		B1	1A6
C26	not fitted in this application		F1	1A6
C27	not fitted in this application		B6	1A7
C28	not fitted in this application		G5	1A8
C29	not fitted in this application		B10	1A8
C30	not fitted in this application		G9	1A9
C33	018-16100-00	Cap 0603 100n 16v x7r + - 10%	F4	1F8
C34	018-16100-00	Cap 0603 100n 16v x7r + - 10%	G4	1F8
C35	018-16100-00	Cap 0603 100n 16v x7r + - 10%	B1	1J12
C36	018-16100-00	Cap 0603 100n 16v x7r + - 10%	B1	1H13
C37	018-16100-00	Cap 0603 100n 16v x7r + - 10%	E5	1G14
C39	not fitted in this application		E4	1D10
C40	018-16100-00	Cap 0603 100n 16v x7r + - 10%	E3	1D10
C43	not fitted in this application		E3	1D11
C44	not fitted in this application		D3	1D12
C45	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D4	1E12
C46	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D3	1D12
C47	not fitted in this application		D4	1B12
C48	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D4	1B13
C49	018-16100-00	Cap 0603 100n 16v x7r + - 10%	D4	1C13
C50	015-27100-08	Cap Cer 0805 X7R 1uF 16V 10%	E3	1C14
D1	001-10165-00	DIODE BAT165 sch SOD323	C3	1J2
D2	001-10054-00	DIODE BAT54S	B3	1F2
F1	265-10055-00	Fuse SMD 0.3a Rstbl 030-2	B2	1G2
FL1	012-14100-00	Cap Cer SMD 1N Array EMI Supr	C1	1J7 1J8 1H10 1J9
FL2	001-11001-85	DIODE Array ESD/EMI 15KV	C1	1G11
FL3	001-11001-85	DIODE Array ESD/EMI 15KV	D1	1H10
FL4	012-14100-00	Cap Cer SMD 1N Array EMI Supr	D1	1J6 1J7 1J8 1J9

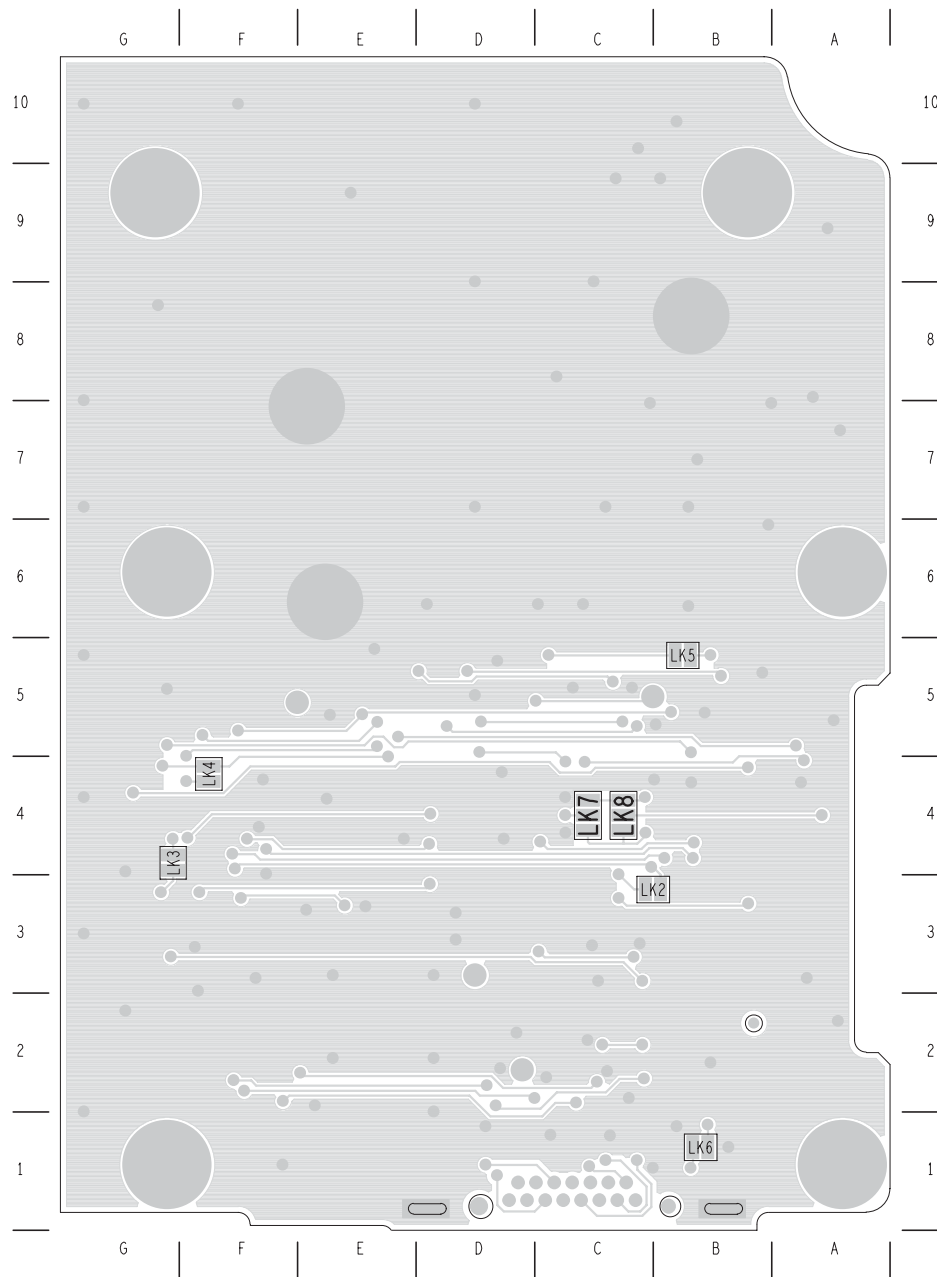
J1	not fitted in this application		D3	1J6
J2	not fitted in this application		D2	1J6
J3	not fitted in this application		F5	1F13
J4	not fitted in this application		C5	1D13
J5	240-00010-44	Skt 20w Hirose FH12 Flex Edge	D6	1F14
LK1	036-10000-00	RES 0805 OR 1/8W	D2	1J6
LK2	not normally fitted		C3	1G8
LK3	not normally fitted		G4	1F8
LK4	not normally fitted		F4	1F8
LK5	not normally fitted		B5	1E4
LK6	not normally fitted		B1	1G13
LK7	not normally fitted		C4	1F7
LK8	not normally fitted		C4	1F9
LK9	036-10000-00	RES 0805 OR 1/8W	C4	1F10
LK10	036-10000-00	RES 0805 OR 1/8W	C4	1F11
LVI	002-11810-50	IC DS1810R-5 5V 5% MCU reset	E5	1G14
Q1	000-10084-71	XSTR BC847BW NPN SOT323	D5	1G10
Q2	000-10084-71	XSTR BC847BW NPN SOT323	D5	1G11
Q3	000-10084-71	XSTR BC847BW NPN SOT323	D5	1G12
Q4	000-10084-71	XSTR BC847BW NPN SOT323	C5	1F11
Q5	000-10084-71	XSTR BC847BW NPN SOT323	C5	1E12
R11	038-16100-10	RES 0603 100k 1% 1/10W	E4	1H2
R12	038-17221-10	RES 0603 2M21 1% 1/10W	C3	1J2
R13	038-14560-00	RES 0603 5k6 5% 1/10W	C2	1J3
R14	038-10000-00	RES 0603 OR	C3	1H3
R15	038-10000-00	RES 0603 OR	B2	1J3
R16	038-10000-00	RES 0603 OR	B3	1J4
R17	038-15390-00	RES 0603 39k 5% 1/10W	C2	1J4
R18	038-16100-10	RES 0603 100k 1% 1/10W	C2	1K4
R19	038-15100-10	RES 0603 10k 1% 1/10W	C2	1J4
R20	not fitted in this application		D2	1J5
R11	038-16100-10	RES 0603 100k 1% 1/10W	E4	1H2
R12	038-17221-10	RES 0603 2M21 1% 1/10W	C3	1J2
R13	038-14560-00	RES 0603 5k6 5% 1/10W	C2	1J3
R21	038-16100-10	RES 0603 100k 1% 1/10W	B4	1H3
R23	038-10000-00	RES 0603 OR	E5	1F3
R24	038-10000-00	RES 0603 OR	C5	1F3
R25	038-10000-00	RES 0603 OR	C5	1F3
R26	038-10000-00	RES 0603 OR	B4	1F3
R27	038-10000-00	RES 0603 OR	B4	1F3
R28	038-16220-00	RES 0603 220k 5% 1/10W	B3	1E4
R29	038-10000-00	RES 0603 OR	B3	1E4
R32	not fitted in this application		G2	1G8
R33	not fitted in this application		F2	1G8
R34	038-14470-10	Res 0603 4k7 1% 100ppm	E5	1G10
R35	038-14820-00	RES 0603 8k2 5% 1/10W	E5	1G10
R36	038-16220-00	RES 0603 220k 5% 1/10W	D5	1G10
R37	038-16220-00	RES 0603 220k 5% 1/10W	D5	1G11
R38	038-16220-00	RES 0603 220k 5% 1/10W	C5	1G11
R39	038-16220-00	RES 0603 220k 5% 1/10W	C5	1G12
R40	038-16220-00	RES 0603 220k 5% 1/10W	D5	1G12

R43	038-15470-10	RES 0603 47k 1% 1/10W	E4	1E9
R44	038-10000-00	RES 0603 OR	E4	1D10
R46	038-16100-10	RES 0603 100k 1% 1/10W	E4	1E10
R47	038-15220-10	RES 0603 22k 1% 1/10W	D3	1D11
R48	038-15100-10	RES 0603 10k 1% 1/10W	E3	1C10
R49	038-16100-10	RES 0603 100k 1% 1/10W	E3	1E12
R50	038-10000-00	RES 0603 OR	D3	1D12
R53	038-10000-00	RES 0603 OR	F4	1C11
R54	038-15100-10	RES 0603 10k 1% 1/10W	D3	1C12
R55	038-10000-00	RES 0603 OR	G4	1B12
R56	038-15470-10	RES 0603 47k 1% 1/10W	D4	1B12
R57	038-15100-10	RES 0603 10k 1% 1/10W	D4	1B13
R58	038-16100-10	RES 0603 100k 1% 1/10W	E4	1C13
R59	038-15220-10	RES 0603 22k 1% 1/10W	E3	1C13
R60	038-15220-10	RES 0603 22k 1% 1/10W	E3	1C13
<hr/>				
SK1	240-00011-67	Skt 15w Drng Ra Slim Dsub 7912	D1	1J13
SK102	240-10000-11	Conn SMD 18w Skt M/Match	B3	1F1
<hr/>				
U1	002-10078-00	IC MC78M05CDT5V rgltr 0.5A	B7	1D6
U2	002-10397-00	IC LM397 cmptr SOT23-5	C3	1B6 1J3
U3	not fitted in this application		F2	1G4
U5	002-74910-41	IC 74V1G04 inv SC70	D2	1J5 1B7
U6	002-10040-53	IC 4053B break B4 make	F4	1D9 1C11 1B8 1G2
U7	002-19140-00	IC TS914ID CMOS R2R OP-Amp	E4	1D10 1B9 1C12 1D11 1D12

# PCB Layout - top side



# PCB Layout - bottom side





Circuit Diagram - page 1 of 1

