

# Command structure for Tait T640 MAP27 to V.24 converter

Version 1.01

## Introduction

The T640 is an options board for the T2030, T2032, T2035 and T2040 series of MPT 1327 trunked radios. It is fitted in conjunction with a single port UART (T2000-A66). It converts simple ASCII commands to MAP27 data commands. This eliminates the need for a MAP27 stack on the device controlling the radio and makes sending data via trunked radio a simple process.

This document describes the ASCII protocol used to control the T640.

## Preparation

In order to successfully use the T640 please make sure that the following steps have been considered.

- The board has been fitted in accordance with the instructions supplied in the T640 Kit. The instructions have been included within this document as Appendix A.
- The radio has been fitted with a Single port UART (T2000-A66) which has been connected to the T640 and 13.8 volts has been supplied to point E1 of the T640 from S14 pin 1 of the T2000 logic board.
- The connected radio has been programmed for MAP27 capability and the Speed of the Map 27 link has been set to **1200 Baud**. This option is under UIM setup – port a MAP27 data rate in the T2000 trunked programming software
- The cable used between the T640 and the controlling device is a “**null modem**” ie pins 2 and 3 are crossed.
- The speed of the controlling device is set to **9600 Baud**.

**Serial Interface**

Baud Rate	Bits per character	Stop bits	Parity	Handshake
9600	8	1	none	none

All command strings shall be in **upper case** and must not be terminated with <CR> <LF>. There is no local echo from the controller.

**Reserved characters**

The ASCII characters -

'NUL' CHR(0) (00H) through to, and including  
'US' CHR(31) (1FH)

Must not appear anywhere in a control string except in the data portion of a non-prescribed data packet whilst in Data Transfer Mode.

The ASCII characters -

] CHR(93) (5DH) and  
[ CHR(91) (5BH)

Are reserved as start and stop delimiters for the command strings, must not appear in any other position of a command string except in the data portion of a non-prescribed data packet whilst in Data Transfer Mode.

Short data messages are divided into two types –

**Control Short Data Messages**

These commands are used to send control strings to remote equipment. These are ignored by the radio and passed directly out of the MAP27 port to the unit being controlled. The message portion of the command string may contain both 7 bit and 8 bit ASCII characters but not the reserved characters as stated above.

**Text Short Data Messages**

These commands are used to send short text messages. These will be displayed on the alphanumeric display on full-feature radios and will also be passed out through the MAP27 port. Characters used in the message portion of the command string are limited to 7 bit ASCII, but may not include the reserved characters as discussed above.

Note that full-feature radios are only able to display the characters upper case A through Z and numbers 0 through 9, all other characters are converted to spaces by the radio.

## Data Transfer Mode

When sending NPDM's (Non-Prescribed Data Messages) - the unit is placed in the Data Transfer Mode thus allowing all 8 bit ASCII characters to be sent over air. However these 8 bit characters may only appear in the data section of the NPDM command string and may include the reserved characters discussed above

CONTROL COMMANDS			
Command to T640 from DTE		Response from T640 to DTE	
Description	ASCII string	Description	ASCII string
Enter control mode	]ECM[	Ready	]RDY[
Quit control mode	]QCM[	Quit OK	]QOK[
Send STATUS message	]SST:address:statno[	Acknowledge / Error	]ACK[ or ]ERR[
Send control SDM (SST)	]SS0:address:msg22[	Acknowledge / Error	]ACK[ or ]ERR[
Send text SDM (SST)	]SS1:address:msg25[	Acknowledge / Error	]ACK[ or ]ERR[
Set up voice/data call	]SSC:address:call[	Acknowledge / Error	]ACK[ or ]ERR[
Set up emergency voice/data call	]SEC:address:emergency[	Acknowledge / Error	]ACK[ or ]ERR[
Send non-prescribed data packet	]SLD:size:npd[	Acknowledge / Error	]ACK[ or ]ERR[
Disconnect (normal end)	]DIS:address[	Acknowledge / Error	]ACK[ or ]ERR[
Abort (cancel call in progress)	]ABT:address:abort[	Acknowledge / Error	]ACK[ or ]ERR[
Request local radio address	]RLA[	Address / Error	]ILA[ or ]ERR[
Request T640 status	]RSC[	Status / Error	]ILS[ or ]ERR[
Request T640 model information	]RSM[	Model / Error	]ILM[ or ]ERR[
Setup PSTN call	]PTN:digits:dialstring[	Acknowledge / Error	]ACK[ or ]ERR[
Setup PABX call (where available)	]PBX:04:dialstring[	Acknowledge / Error	]ACK[ or ]ERR[

**DESCRIPTOR VARIABLES USED IN CONTROL COMMANDS****address :**

Full MPT1327 address (3 digit prefix / 4 digit ident, e.g.: 023/0614).

**statno :**

Status message number, two ASCII digits in the range 01 - 30.

**msg23 :**

Twenty-three 7 or 8 bit ASCII data bytes making up a *CONTROL* SDM1 message.

**msg25 :**

Twenty-five 7 bit ASCII data bytes making up a *TEXT* SDM1 message.

**call :**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

bit position								details
8	7	6	5	4	3	2	1	
•								reserved, set to 0
	•							reserved, set to 0
		0						users may reply
		1						broadcast call, no replies
			0					voice call
			1					data call
				0				high priority call
				1				non-priority call
					•	•	•	reserved, set to 0

**emergency :**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

bit position								details
8	7	6	5	4	3	2	1	
•								reserved, set to 0
	•							reserved, set to 0
		0						users may reply
		1						broadcast call, no replies
			0					voice call
			1					data call
				•	•	•	•	reserved, set to 0

**abort :**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	1	0	0	0	transaction or call setup
0	0	0	0	1	1	0	0	data call setup
all others								reserved

**size:**

Nine ASCII digits : 001001001 to 999999100, made up as follows :

xxx	where :	xxx	= packet number being sent (000 – 999)
yyy	:	yyy	= total number of packets being sent in this message (000 – 999)
zzz	:	zzz	= number of data bytes in this packet (000 – 100)

Data packets have a minimum size of 1 byte and a maximum size of 100 bytes. **The maximum number of packets that may be sent at one time depends on the system time allocated for a voice/data call.** Packets should be filled where possible.

e.g.: A message of 325 characters is to be sent -

Packet 1 = ]SLD:001004100:100 data bytes[

Packet 2 = ]SLD:002004100:100 data bytes[

Packet 3 = ]SLD:003004100:100 data bytes[

Packet 4 = ]SLD:004004025:25 data bytes[

**npd:**

Any ASCII characters to be sent as an NPD packet, the quantity of which shall equal digits zzz of **size**.

**digits:**

Two ASCII characters representing a decimal number (00 – 20), which is the number of digits to be dialled.

**dialstring:**

A string of ASCII characters representing the number to be dialled in a PSTN or PABX call.

e.g.:

To dial a PSTN number 0119876543 - ]PTN:10:0119876543[

To dial a PABX number 2345 - ]PBX:04:2345[

**N.B. - PABX call strings may only contain 4 digits**

The following tables show the command outputs which can be expected after commands have been issued or upon incoming voice and data calls.

RETURN STRINGS - FROM INCOMING MESSAGES		
Output description	ASCII string	Caused by
Incoming Status message	]IST:address:statno[	
Incoming CONTROL SDM1	]IS0:address:message22[	
Incoming TEXT SDM1	]IS1:address:message25[	
Incoming OTHER SDM	]ISX:address:codnlb:message[	Incoming AVL string
Incoming voice/data call	]ISC:address:call[	
Incoming emergency voice/data call	]IEC:address:call[	
Set-up progress positive	]SPP:address:setup[	Voice/data call from DTE
Set-up progress queuing	]SPQ:address:setup[	
Set-up progress negative	]SPN:address:setup[	
Receive progress positive	]RPP:address:receive[	Incoming voice/data call
Receive progress queuing	]RPQ:address:receive[	
Receive progress negative	]RPN:address:receive[	
Acknowledge : positive	]AKP:address:acknowledge[	Status/SMD1 call from DTE
Acknowledge : queuing	]AKQ:address:acknowledge[	
Acknowledge : negative	]AKN:address:acknowledge[	
Call cleared	]CCN:address:clear[	]DIS[ or normal remote clear
Call aborted	]CCA:address:abort[	]ABT[ or abnormal clear
Outgoing NPD status positive	]ITS:reason[	Packet sent OK, send next packet
Outgoing NPD status queuing	]IQS:reason[	Wait while packet is sent
Outgoing NPD status negative	]IES:reason[	Error during NPD transmission
Incoming NPD packet	]ILD:size:npd[	NPD packet data received
Incoming T640 status	]IRS:address:cstat[	Response to ]RSR[ command
Incoming IT640 model	]ILS:cstat[	Response to ]RSC[ command
Local radio has service	]SVC[	Radio has regained signal
Local radio has lost service	]SIG[	Radio has lost signal
Local radio PTT pressed	]PT1[	
Local radio PTT released	]PT0[	
Local radio microphone on-hook	]HK0[	
Local radio microphone off-hook	]HK1[	
Local radio protocol difficulty	]IP1:protocol[	Unsupported message type
Self test error	]STE[	T640 failed self test

**DESCRIPTOR VARIABLES USED IN RETURN STRINGS****address:**

Full MPT1327 address (3 digit prefix / 4 digit ident) in ASCII.

**statno:**

Status message number in ASCII, range 00 - 31.

**message23:**

Up to 23 bytes (7 or 8 bit ASCII).

**message25:**

Up to 25 bytes (7 bit ASCII).

**Codnlb:**

Is a three digit DECIMAL number representing the CODING|NLB section of the MAP27 string

**call:**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

bit position								details
8	7	6	5	4	3	2	1	
•								reserved, set to 0
	•							reserved, set to 0
		0						individual call
		1						group call
			0					voice call
			1					data call
				0				call connected
				1				hook signal required
					0	0	0	standard call, no parameters
					0	0	1	reserved
					0	1	0	reserved
					0	1	1	reserved
					1	0	0	reserved
					1	0	1	reserved
					1	1	0	reserved
					1	1	1	reserved
others								reserved

**setup:**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

**positive**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	Call connected or include call connected
all others								reserved

**queuing**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	called unit alerting
0	0	0	0	0	0	1	0	system busy, wait for signalling

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0	0	0	0	1	0	1	0	called unit engaged, wait for signalling
0	0	0	0	0	1	0	1	emergency call is proceeding, wait for signalling
0	0	1	0	0	1	1	0	called units calls are diverted, wait for divert
0	0	1	1	0	1	1	0	called units calls are diverted to a group, wait for divert
all others								reserved

**negative**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	1	0	0	0	call set-up aborted
0	0	0	0	0	0	1	1	invalid call, call set-up rejected
0	0	0	0	1	0	1	1	system or called unit overloaded, call set-up rejected
0	0	0	0	0	1	0	0	called radio out of reach or call set-up abandoned
0	0	0	0	1	1	0	0	called unit engaged or user does not wish to accept the call
0	0	0	0	0	1	1	0	called units calls are diverted
0	0	0	1	0	1	1	0	called units calls are diverted to a group address
0	0	0	0	1	1	1	0	called units calls are diverted but diversion address is not available
0	0	0	0	0	1	1	1	called unit has accepted the call for call-back
all others								reserved

**receive:**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

**positive**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	Call connected
all others								reserved

**queuing**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	transmission disabled
0	0	0	0	0	0	1	0	system busy, wait for signalling
0	0	0	0	1	0	1	0	clear-down timer warning
all others								reserved

**negative**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	1	1	call set-up rejected
0	0	0	0	0	1	1	1	radio has accepted the call for call-back
all others								reserved

**acknowledge:**

Sent to acknowledge Status and SDM1 messages - positive, queuing or negative.  
Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

**positive**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	successful transaction
all others								reserved



**queuing**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	1	0	system busy, wait for signalling
0	0	0	0	1	0	1	0	called unit engaged, wait for signalling
0	0	1	0	0	1	1	0	called units calls are diverted, wait for divert
all others								reserved

**negative**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	1	0	0	0	transaction aborted
0	0	0	0	0	0	1	1	invalid call, message rejected
0	0	0	0	1	0	1	1	system or called unit overloaded, message rejected
0	0	0	0	0	1	0	0	called radio out of reach or transaction abandoned
0	0	0	0	1	1	0	0	called unit engaged or does not wish to accept the call
0	0	0	0	0	1	1	0	called units calls are diverted
0	0	0	1	0	1	1	0	called units calls diverted to a group address
0	0	0	0	1	1	1	0	called units call are diverted to unknown address
all others								reserved

**clear:**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	1	0	1	1	Voice or modem call disconnected, normal end
all others								reserved

**abort:**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following table :

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	not specified, all transactions cancelled
0	0	0	0	0	0	0	1	radio generated clear, timeout or on-hook
0	0	0	0	0	1	0	0	service not available
0	0	0	0	0	1	0	1	message or call too long, message rejected or call disconnected
0	0	0	0	0	1	1	0	message coding not possible, message rejected
0	0	0	0	1	1	1	0	voice or modem call disconnected, abnormal end
all others								reserved

**size:**

Nine ASCII digits : 001001001 to 999999100, made up as follows :

xxxxyyzzz        where :        xxx    = packet number being sent (000 – 999)  
                                       :        yyy    = total number of packets being sent in this message  
 (000 – 999)        :        zzz    = number of data bytes in this packet (000 – 100)

**npd:**

Any ASCII characters to be sent as an NPD packet, the quantity of which shall equal digits zzz of size.

**reason:**

Three ASCII characters representing a decimal number (000 - 255), calculated from the following tables :

**positive**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	Successful packet transfer
all others								reserved

**queuing**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	1	0	Data packet queued
all others								reserved

**negative**

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	TDP format mismatch
0	0	0	0	0	0	1	0	Internal modem failure
0	0	0	0	0	1	0	0	Data channel failure
0	0	0	0	1	0	0	0	Invalid data packet size
0	0	0	1	0	0	0	0	Data channel timeout
0	0	1	0	0	0	0	0	Modem busy
0	1	0	0	0	0	0	0	Transaction aborted
all others								reserved

**protocol:**

Three ASCII digits calculated from the following table:

bit position								details
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	Unrecognised message
0	0	0	0	0	0	1	0	Facility or addressing not supported
0	0	0	0	0	0	1	1	Protocol state mismatch
0	0	0	0	0	1	0	0	Message coding not supported
others								reserved

**cstat:**

Three ASCII digits calculated from the following table:

bit position								details
8	7	6	5	4	3	2	1	
							1	Reserved
							1	Reserved
					1			MAP27 link established
			1					Reserved
		1						Reserved
	1							Reserved
1								Radio is switched on

followed by a string of 18 ASCII characters representing the software version number and date/time stamp separated by a colon,  
e.g.: **131:1.1b\_<970101.1200>** - (version 1.1b), where ' ' = SPACE character

**model:**

A variable length string of ASCII characters showing the model of the unit.

e.g. **TAIT ELECTRONICS T640 MAP27 - ASCII TRANSLATOR VERSION 1.05 9600  
BAUD**

### LINK ESTABLISHMENT

When the T640 unit is inside a radio and powered up, the unit performs the following actions -

1. Self test
2. Initialisation of MAP27 timers and layer variables
3. Attempt to link to the radio using the MAP27 protocol
4. Interrogation of the radio unit once a link has been established
5. Commencement of MAP27 Data Transfer Layer
6. Commencement of Serial Command Acceptance Layer

As this can take some time - up to 15 seconds in some cases, it is advisable to wait for an ]ILS[ message with the appropriate status number before setting up calls.

An *unsolicited* ]ILS[ message from the T640 unit will be received in the following instances :

1. The radio unit is switched on
2. The MAP27 link has been lost
3. The MAP27 link has been re-established
4. A command requiring radio access is sent whilst the MAP27 link is lost or being established

Note that it can take up to forty-five seconds for a loss of MAP27 link to be discovered (this is a function of the MAP27 protocol - 'link failure detection time') and therefore commands sent to the radio during this time will be acknowledged with an ]ACK[ *but will not necessarily be processed by the radio*, once the MAP27 data transfer layer has established a loss of link an appropriate ]ILS[ message will be sent by the T640 unit, this may then be assumed to have cancelled the last command sequence.

A continuous series of two sequential ]ILS[ messages, at five second intervals, showing first that the MAP27 link is established and immediately thereafter that the MAP27 link is lost indicates that the TXD line to the radio unit is broken (the unit is still receiving data from the radio - hence the continuous Link-Up , Link-Down messages) and this situation should be handled appropriately by the DTE software.

An *unsolicited* ]STE[ message from the T640 unit will be received shortly after power-up if the T640 unit fails its' self test routine. If this message is received *the unit may still appear to work correctly in certain instances*, but the data from the unit may well be corrupted and the unit should be returned for testing and repair.

### Using a T640 to poll a GPS capable mobile

It is possible to use a T640 to poll a GPS capable mobile. In order to do this you must first check that:

- The firmware in your T640 is version 1.5 or above
- The firmware in your T2000 GPS mobile supports status polling.

Place a status call 30 to the mobile using the format described above

A response will be received:

]ISX:address:codnld:message[

Where *codnld* is a three digit DECIMAL number representing the CODING|NLB section of the MAP27 string.

Eg ]ISX:123/4567:135:message[,

*Message* is in Hexadecimal and is packed according to the following table:

Bit Position									Description
1	c	c	c	c	c	c	c	c	Command Type
2	D	L	L	L	L	L	L	L	GPS Message#1
3	M	M	M	M	M	M	m	m	GPS Message#2
4	m	m	m	m	m	m	m	m	GPS Message#3
5	W	G	G	G	G	G	G	G	GPS Message#4
6	G	N	N	N	N	N	N	n	GPS Message#6
7	n	n	n	n	n	n	n	n	GPS Message#7
8	n	V	V	V	V	V	V	V	GPS Message#8
9	V	d	d	d	d	d	h	h	GPS Message#9
10	h	h	h	M	M	M	M	M	GPS Message#10
11	M	s	s	s	s	s	s		GPS Message#11

Where;

cccccccc	AVL command 11: AVL report success (new data) 12: AVL report, no fix (old data) 13: AVL report, GPS not operational (no data) 14: AVL report, NMEA format error (no data) 21: Emergency AVL report success (new data) 22: Emergency AVL report, no fix (old data) 23: Emergency AVL report, GPS not operational (no data) 24 : Emergency AVL report, NMEA format error (no data)
D	Latitude Reference '0'=North, '1'=South
LLLLLLL	Latitude (Degrees)
MMMMMM	Latitude (Minutes)
mmmmmmmmmm	Latitude (Decimal Minutes)
W	Longitude Reference ('0'=East, '1'=West)
GGGGGGGG	Longitude (Degrees)
NNNNNN	Longitude (Minutes)
nnnnnnnnnn	Longitude (Decimal Minutes)
VVVVVVVV	speed over ground, knots
dddd	Time Day

hhhhh	Time Hour
MMMMMM	Time minute
sssss	Time Seconds

## **MAP27 TERMINOLOGY**

As there is some confusion with the nomenclature of the various messages in MAP27 please take note of the following descriptions of the terminology as is used in this document :

### **STATUS MESSAGE**

is termed STATUS or STATUS MESSAGE as per UADG MAP27 Version 1.4 Section 5.2.2 and **NOT** as an SDM1.

### **SHORT DATA MESSAGE**

is termed **SDM1** (Short Data Message type 1) or **SST** (Single Segment Transaction) as per UADG MAP27 Version 1.4 Section 5.2.2.2 and **NOT** as an SDM2.

### **EXTENDED DATA MESSAGE**

is termed **SDM2** (Short Data Message type 2) or **MST** (Multiple Segment Transaction) as per UADG MAP27 Version 1.4 Section 5.2.2.3. This is not presently supported.

### **MODEM MESSAGE**

is termed **NPDM** (Non-Prescribed Data Message) or **NPD** as per UADG MAP27 Version 1.4 Section 5.2.2.4.

### **CONNECTOR PINOUTS**

Refer appendix A

**EXAMPLES****Voice call setup**

To set up a normal voice call to 023/0610

Command	Explanation	Response	Explanation
]SSC:023/0610:008[	Setup normal voice call	]ACK[	Command acknowledge
		]SPP:023/0610:000[	Call has been connected
		]PT1[	Pressel on message
		]PT0[	Pressel off message
]DIS:023/0610[	Clear call in progress	]ACK[	Command acknowledge
		]CCN:023/0610:011[	Call has been cleared

**Voice call setup – Full Off-Air Call Setup**

To set up a normal voice call to 023/0610 where system uses FOACSU

Command	Explanation	Response	Explanation
]SSC:023/0610:008[	Setup normal voice call	]ACK[	Command acknowledge
		]SPQ:023/0610:001[	Called unit is ringing
		]SPP:023/0610:000[	Call has been answered
		]PT1[	Pressel on message
		]PT0[	Pressel off message
]DIS:023/0610[	Clear call in progress	]ACK[	Command acknowledge
		]CCN:023/0610:011[	Call has been cleared

**Send STAUS message**

To send status message 03 to 023/0610

Command	Explanation	Response	Explanation
]SST:023/0610:03[	Send status message 03	]ACK[	Command acknowledge
		]AKP:023/0610:000[	Message has been sent

**Send text SDM message**

To send text SDM message "CALL JOHN SMITH" to 023/0610

Command	Explanation	Response	Explanation
]SS1:023/0610:CALL JOHN SMITH[	Send SDM	]ACK[	Command acknowledge
		]AKP:023/0610:000[	Message has been sent

**Send Non-prescribed data**

To send data call to 023/0610

<b>Command</b>	<b>Explanation</b>	<b>Response</b>	<b>Explanation</b>
]SSC:023/0610:024[	Setup data call	]ACK[	Command acknowledge
		]SPP:023/0610:000[	Call has been answered
]SLD:001003100:100 data bytes[	Send first packet	]ACK[	Command acknowledge
		]QS:001[	Packet being sent – wait
		]TS:000[	Packet sent - send next packet
]SLD:002003100:100 data bytes[	Send second packet	]ACK[	Command acknowledge
		]QS:001[	Packet being sent – wait
		]TS:000[	Packet sent - send next packet
]SLD:003003100:050 data bytes[	Send third packet	]ACK[	Command acknowledge
		]QS:001[	Packet being sent – wait
		]TS:000[	Packet sent - send next packet
]DIS:023/0610[	Clear data call	]ACK[	Command acknowledge
		]CCN:023/0610:011[	Call has been cleared



## **Appendix A – Fitting instructions**

### **Introduction**

- The T640 board requires a T2000-A66 Single Port UART to be fitted to a trunked T2000 series radio.
- Installation of the T2000-A66 is described in section 8.13 of the T2000 SII Service manual.
- Installation of the T640 board is described in the following pages.

### **Description**

#### **Main features**

- Fits inside a T2030, T2032, T2035 or T2040 trunked mobile to act as an interface between MAP 27 and V.24.
- Plugs directly into a T2000-A66.
- Supports most common MAP 27 functions.
- Easy to use ASCII control protocol via V.24 port.
- High speed microprocessor.
- On board 5VDC regulator.
- Low current consumption.

#### **Components Required**

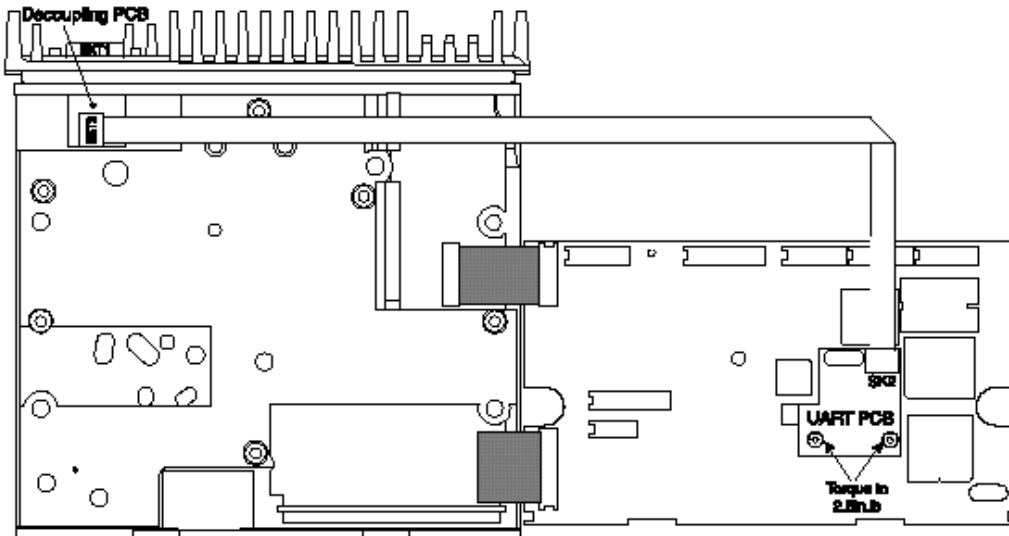
<b>Quantity</b>	<b>Description</b>
1	T640-XXX-XX
3	M3x8 pan Pozi Taptite screws
1	230 mm length of yellow hookup wire

### **Associated Documents**

- T2000-A66 Installation Manual

### **Fitting Instructions**

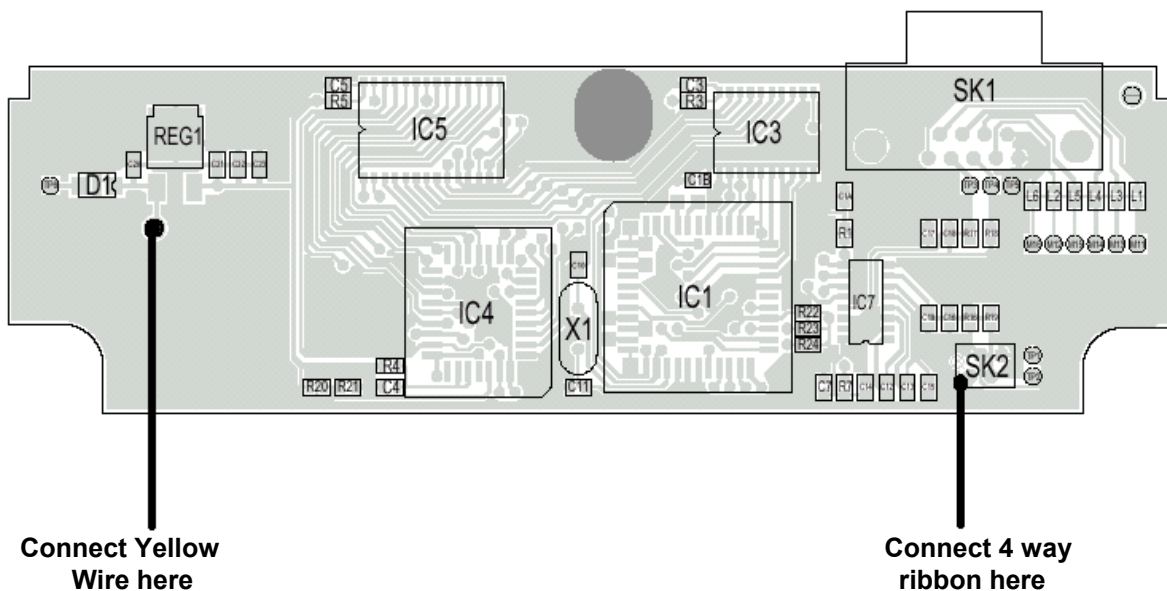
- Remove the radio from the cradle by inserting the cradle key into the slot on the left hand side of the radio.
- Remove the top cover of the radio by unscrewing the four cover screws, unclip the D-range blanking plate in the rear of the T2000 radio, unscrew the logic PCB and fold out. Figure 1 shows the opened radio with a T2000-A66 UART fitted.



**Figure 1. Logic PCB with Single Port UART fitted.**

- Fit a T2000-A66 according to the fitting instructions supplied with the kit but do not fit the decoupling PCB. Unplug the 4-way ribbon cable from the Decoupling PCB
- Solder the Yellow Cable to S14 pin1 on the T2000 logic board.
- Connect the other end of this cable to E1 on the T640 PCB.
- Plug the 4-way ribbon cable from the UART board to SK2 on the T640 PCB.

**Figure 2. T640 Board**



- Fold the logic PCB back in position, and secure using the three logic PCB retaining screws.
- Both wires (yellow & 4-way ribbon) should follow the route shown in Figure 3 ensuring that neither cable is in a position where it could be damaged when closing the radio. Note that this cable carries 13.8V (switched) and due care should be taken to prevent short circuits.

- Fit the T640 board introducing the D-range connector into the hole provided at the rear of T2000 chassis where the PCB decoupling board was previously fitted.
- Secure the T640 PCB using the three M3x8 retaining screws.
- Refit the top cover.

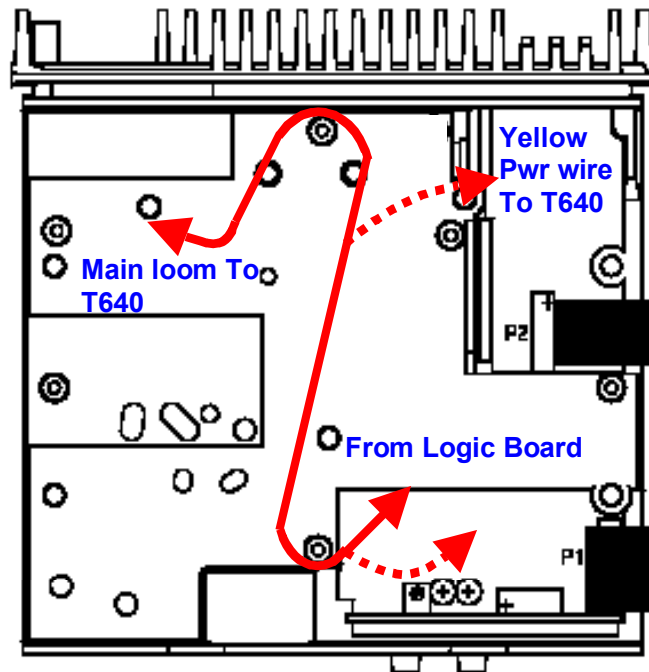


Figure 3. Route for the yellow and 4-way Ribbon Cable

### Signal Specifications

The following table describes the signals used on the 9 way D-range connector (SKT1). The unused pins may be used for other signals, if required.

SK1 Pin No.	Signal	Description
2	RXD	Receive data: Serial data input to UART PCB. This signal complies with the electrical requirements of the RS-232 specification.
3	TXD	Transmit data: Serial data output from UART PCB. This signal complies with the electrical requirements of the RS-232 specification.
5	DGND	Digital ground: Ground reference for all digital signals.

The following diagram shows the pin designations of SK1, viewed from the rear of the radio.

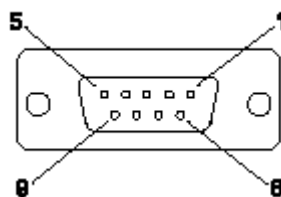


Figure 4. 9 Way D-range Connector (SK1)

**PCB Information**

Ref	IPN	Description
C10,C11	015-22270-01	CAP CER 0805 27P 5% NPO 50V
C16,C17,C18,C19	015-24100-08	CAP CER 0805 1N 10% X7R 50V
C1A,C23	015-27100-10	CAP CER 0805 1M+80-20% Y5V 16V
C1B,C3,C4,C5,C7,C12, C13,C14,C15,C20,C22	015-26100-08	CAP CER 0805 100N 10% X7R 50V
C21	015-25100-08	CAP CER 0805 10N 10% X7R 50V
D1	001-10011-74	DIODE SMD MRA4004T3 1A/400V
IC1	240-04020-42	SKT 44 PIN SMD PLCC
IC1A	002-10803-20	IC DS80C320 HI SPEED MICROP
IC3	002-74905-73	IC SMD 74HC573D 8X 3STATE
IC4	240-04043-20	SKT 32 PIN SMD PLCC
IC4A	002-20390-10	IC FLASH SST/ST 128*8K 32PLC
IC5	002-10525-60	IC SMD M5M5256BFP-15 32K*8
IC7	002-10020-20	IC SMD ADM202 RS-232 CON SO-16
L1,L2,L3,L4,L5,L6,R21	036-10000-00	RES M/F 0805 ZERO OHM
PCB	228-22311-00	PCB TA2231-01 T640 AVL I/F
R1,R3,R4,R5,R7	036-12100-10	RES M/F 0805 10E 1%
R16,R17,R18,R19	036-13100-10	RES M/F 0805 100E 1%
R22,R23,R24	036-15100-10	RES M/F 0805 10K 1%
REG1	002-10078-00	IC SMD MC78M05CDT 5V REG0.5A
SK1	240-00010-45	SKT 9 W D RANGE 90 DEG.PCB
SK2	240-04020-84	SKT 4W PCB MTG STAG PINS M-MAT
X1	274-00010-60	XTAL 22.1184MHZ LO PROF AT-51