RTM 2410
2400 Baud Radio Data Modem

♦ *For Tait ® 2010, 2015 and "Data" Radios*

♦ *Fits into the Option Space inside the radio*

♦ *9 Pin RS232 "D" data connector*
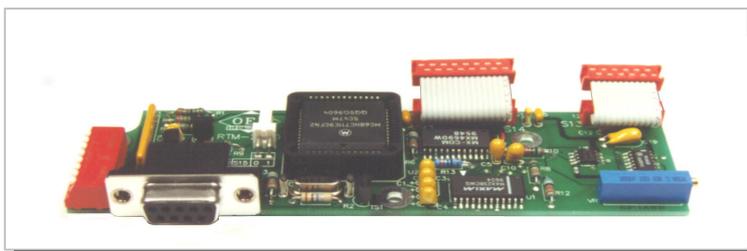
OED Electronics has developed the RTM2410 data modem to provide much more flexibility when implementing data modems into VHF/UHF radio systems using Tait ® radios.

The features built into this modem have been designed to ensure all functions are user configurable.

The RTM2410 uses the same modulation method as the RTM1200 and therefore retains the low Bit Error Rate but with greatly improved throughput.

Specifications:

Baud Rate (Bits Per Second)	*1200 or 2400*
Data Buffer Size	*260 Bytes*
TX Stabilise Delay	*50 - 500 mS*
Repeater Key Up Delay	*50 - 5000 mS*
Anti Collision Delay	*80 - 500 mS*
Channel Select	*24 Channels*
RSSI reading (-130 to -70dBm)	*0 - 200*
Temperature reading	*0 - 120 °C*
Default shutdown temperature	*65 °C*

Features:

● *Modem initialisation using AT Commands.*

● *All delay times can be adjusted and have an accuracy of 1 mS.*

● *Change the radio channel by using an AT Command (24 channels on 2015).*

● *Anti Collision to stop modems transmitting simultaneously.*

● *Voice Compatibility to coordinate Voice and Data on the same radio system.*

● *Repeater delay to enable repeaters to key up while retaining the fastest turn around time.*

● *Radio over temperature protection.*

● *The radio's temperature can be read from the modem.*

● *RSSI (Received Signal Strength Indicator) value can be read from the modem.*

● *DIP Switch settings can be used for fast installations that require no special initialisation.*

● *Full compatibility with the RTM1200 and RTM2400 modems.*

RTM-2410 RECOMMENDED DEFAULT SETUP.

The RTM-2410 Modem has the capability to be accurately setup to maximise data transmission and timing. This is achieved by programming the S-Registers.

However in most situations timing and through put are not critical and the modem can be set to default values using only the Dip Switches on the side of the modem card.

The following gives a list of recommended Dip Switch settings for both modes of operation. This will enable a fast installation.

Mode 0 Settings (recommended):

Mode 0 is for use on equipment that has the ability to raise RTS (Request to Send) when ever it requires data to transmitted, and to lower RTS to stop transmission. This type of equipment is usually specifically designed for use with Radio Telemetry for example DGPS Base Stations and special purpose data logging Microprocessor based equipment.

Use this mode for DGPS base stations or other equipment that requires permanent transmission of data. This type of equipment must have RTS (Request to Send) raised at all times. If the equipment doesn't have RTS then wire Pin 6 to Pin 7 of the 9 Pin "D" Connector at the RTM-2410 modem end.

Install the Modem card into the radio (Refer to the Installation section in the Manual).

Solder a piece of wire across the "MODE" pads on the solder side of the Modem.
Go to **Dip Switch Settings** section below.

Mode 1 Settings:

Mode 1 is for use on equipment that permanently raises RTS (Request to Send) when ever the serial port is active (usually all the time). PC's running standard off the shelf communications software will usually keep RTS active all the time. Software such as Pro Comm, Terminal for Windows and Hyper Terminal for Win95 fall into this category. The standard transfer protocols, X Modem, Z Modem, Kermit etc. can be used with Mode 1 to transfer data across the radio link.

This mode requires more time for transmission turnarounds, therefore it is recommended to use software written specifically for Radio Telemetry and to use the modem in Mode 0 if maximum performance is required.

Install the Modem card into the radio (Refer to the Installation section in the Manual).

Ensure the "MODE" pads on the solder side of the Modem, are not linked (open circuit).
Set the Dip Switches as follows:

Dip Switch Settings:

1. Set Dip Switch 1 ON if the radio system has repeaters.
    Set to OFF if the radios communicate directly.

2. Set Dip Switch 2 OFF for 2400 Baud.
    Set Dip Switch 2 ON for 1200 Baud.

3. Set Dip Switch 3 OFF

4. Set Dip Switch 4 ON

5. Set Dip Switch 5 OFF

6. Set Dip Switch 7 ON

7. Set Dip Switch 6 and 8 OFF

Refer to the manual for correct deviation adjustment procedure.
The modem should now be operational. If data is not getting through increase the TX Stabilise Delay using Dip Switches 6, 7 and 8. (Refer to the manual for settings).

RTM-2410 B © V1.3

2400 BAUD RADIO MODEM

(FOR TAIT 2010, 2015 AND DATA RADIOS)

1.   Specifications.

Baud Rate (bits/second)   1200 / 2400.

Transmission Mode   FSK (Half Duplex)

Frequency Assignments:

1200 Baud (Mark)	1200 Hz
1200 Baud (Space)	1800 Hz
2400 Baud (Mark)	1200 Hz
2400 Baud (Space)	2400 Hz

CD (Data Carrier Detect) raise time.   30mS (max)

Serial Interface   RS-232C

Data Connector: 9 Pin "D" Socket

I/O	PIN	Description
⇐	1	CD (Data Carrier Detect)
⇐	2	RD (Received Data)
⇒	3	TD (Transmit Data)
⇒	4	Not Normally Connected (See Data Radio Setup)
	5	SIGNAL GROUND (Radio Power Supply -VE)
⇐	6	DSR (+ 13.8 VDC via Radio On/Off Sw. and 1kΩ resistor)
⇒	7	RTS (Request to Send)
⇐	8	CTS (Clear to Send)
⇐	9	BUSY- (RF Carrier) (if **"G" and "R"** Pads linked)

⇐   Indicates signal is driven from the RTM-2410 Modem (ie RS232 Output).
⇒   Indicates signal is feed to the RTM-2410 Modem (ie RS232 Input).

2. Operation.

WARNING !!!

THIS MODEM BOARD IS <u>NOT</u> TO BE USED IN RADIOS THAT MAY BE REQUIRED

FOR EMERGENCY VOICE COMMUNICATION. THIS IS BECAUSE THE MODEM MAY

LOCK OUT VOICE COMMUNICATION WHEN IT IS SENDING DATA.

The RTM-2410 Modem Board is a semi-intelligent 2400 baud modem.

All Data Protocol, Error Detection and Error Recovery must be performed by the Customer's Data Equipment (DTE) connected to the modem.

The RTM-2410 modem will control all timing and radio functions to ensure the Radio Link is operational before transmitting data. This eliminates the need for timing loops etc. in the customer's communication software normally required for Radio Modem operation.

The modem can be made to change channel on the radio by sending an AT command to the modem.

It also has a separate Voice Channel and Data Channel. At power on, the Data Channel will be selected. The modem will select the Voice Channel when the Microphone PTT button is pressed, then re-select the Data channel when it is released. The Channels can be set with an AT Command.

The RTM-2410 modem monitors the radio's temperature and drops CTS (Clear To Send) to stop the customer's data if the radio is too hot. The modem will continue to receive and voice transmission (Mic PTT) remains operational. The temperature threshold can be set with an AT Command.

The Radio's Temperature and RSSI (Received Signal Strength Indicator) value can also be read from the modem using an AT Command.

Three Modes are possible with the RTM-2410 modem. The **MODE** solder pads on the solder side of the modem PCB are either left open or linked with a piece of wire.

Data received from a transmitting radio is only valid when CD (Carrier Detect) is asserted.

2.1 RTM-1200 Compatible Mode. (Mode Pads Linked)

The RTM-2410 can be made compatible with the RTM-1200 modems.

The Mode pads must be linked and the modem Baud Rate (Dip Switch 2) <u>must</u> be set to 2400.

The RTM-2410 operates in Mode 0 (see **2.3 Mode 0 - Hardware Handshake Mode. (Mode Pads Linked)**) however the data baud rate must be **1200** and the AT Commands must be sent at **2400,8,N,1**.

No change to the RTM-1200 is necessary.

2.2   Mode 1 - Three Wire Mode. (Mode Pads Open)

This Mode only operates with **8 Bit, No Parity, 1 Stop Bit** format and at the selected Baud Rate (see **Baud Rate Select. (Dip Switch 2) Page 8**).

When the RTM-2410 is set in Mode 1, the modem will initiate a transmission when data is sent to the modem from the customer's equipment. RTS (Request To Send) must be asserted by the customer's equipment for data to be recognised, however RTS can remain asserted at all times. The transmission will stop when the data buffer is empty.

No data should be sent to the modem until CTS (Clear To Send) is asserted by the modem.

2.2.1   Mode 1 Normal Operation.

With RTS asserted by the customer's equipment and CTS asserted by the modem, data can be sent to the modem and is stored in a 270 Byte buffer. If the buffer becomes full, the modem will drop CTS to stop customer's data. It re-asserts CTS when the buffer empties.

The modem keys the radio when the buffer contains customer data.

The modem waits for the **TX Stabilisation Time** to expire. This allows the transmitter to achieve full power and the receiving radio to open the RF Mute and assert the CD (Carrier Detect).

The modem then starts sending the Data to the receiving radio.

Data can be sent to the modem while waiting for the **TX Stabilise Time** to expire. CTS is dropped if the buffer becomes full and asserted when it empties.

The modem continues to transmit until the internal buffer is empty. Any AT Commands will be ignored until the buffer is emptied (max 270 bytes).

NOTE !!!   An Idle (1 Byte of no activity on TD pin), will be treated as the end of the data packet. CTS will be dropped until the packet has been transmitted.

2.2.2   Mode 1 with Anti Collision ON.

Collision Random Delay is added before **Repeater Delay (if ON)** and **TX Stabilise Delay**.

When data is sent to the modem, the modem looks for a TX Collision (Busy + CD) caused by other radios transmitting at the same time. If there is a collision detected, the modem loads a Random Delay Time (limits set by S53 and S54) and waits for this time to expire.

At the end of the time the modem again tests for a TX Collision. If the collision is still present it repeats the above Random Delay until the collision clears.

If there was initially no collision or the collision has now cleared, the modem continues with normal operation (see **2.2.1 Mode 1 Normal Operation.**).

Data can be sent to the modem while waiting for the Collision to clear. CTS is dropped if the buffer becomes full.

Continued….

2.2.3 Mode 1 with Repeater Delay ON.

Repeater Delay is added after **Collision Random Delay (if ON)** and before **TX Stabilise Delay**.

When RTS is seen, the modem looks for BUSY (RF Carrier). If BUSY is not active (channel not busy) then the modem assumes the Repeater is not keyed. It keys the radio and waits for the Repeater Delay Time (S52) to expire before continuing with normal operation (see **2.2.1 Mode 1 Normal Operation.**). This allows the repeater to key up before sending data.

If BUSY is active, then the repeater is assumed to be keyed and the modem does not wait for Repeater Delay Time.

Repeater Delay Time is set by S52.

Data can be sent to the modem while waiting for the Delay to expire. CTS is dropped if the buffer becomes full.

2.3   Mode 0 - Hardware Handshake Mode. (Mode Pads Linked)

This mode can operate with any Parity, Stop Bit or Data Bit format. However AT Commands must be sent with **8 Bit, No Parity, 1 Stop Bit** format.

The modem can accept 1200 or 2400 Baud Data when set to 2400 Baud (see **Baud Rate Select. (Dip Switch 2) Page 8**).
It can only accept 1200 Baud Data if set to 1200 Baud.

When the RTM-2410 is set in Mode 0, the modem will initiate a transmission when RTS (Request To Send) is asserted by the customers equipment. The transmission will stop when RTS is dropped.

Data should not to be sent to the Modem when CTS is not active.

2.3.1 Mode 0 Normal Operation.

When RTS is seen, the modem keys the radio to start transmission. CTS (Clear To Send) is asserted by the modem to indicate the customers equipment can start sending the Data. The incoming data is stored in a buffer in the modem.

The modem waits for the **TX Stabilisation Time** to expire. This allows the transmitter to achieve full power and the receiving radio to open the RF Mute and assert the CD (Carrier Detect).

The modem then starts sending the Data to the receiving radio.

When RTS is dropped by the customers equipment, the modem drops CTS but continues to receive the next **n Bytes** (as specified by S51). This is to overcome double buffering in UARTs.

The modem continues to transmit until the internal buffer is empty. Any AT Commands or re-asserting RTS will be ignored until the buffer is emptied (max 260 bytes), plus 20mS.

Continued….

2.3.2 Mode 0 with Anti Collision ON.

Collision Random Delay is added before **Repeater Delay (if ON)** and **TX Stabilise Delay**.

When RTS is seen, the modem looks for a TX Collision (Busy + CD) caused by other radios transmitting at the same time. If there is a collision detected, the modem loads a Random Delay Time (limits set by S53 and S54) and waits for this time to expire.

At the end of the time the modem again tests for a TX Collision. If the collision is still present it repeats the above Random Delay until the collision clears.

If there was initially no collision or the collision has now cleared, the modem continues with normal operation (see **2.3.1 Mode 0 Normal Operation.**).

CTS is not asserted until the collision has cleared.

2.3.3 Mode 0 with Repeater Delay ON.

Repeater Delay is added after **Collision Random Delay (if ON)** and before **TX Stabilise Delay**.

When RTS is seen, the modem looks for BUSY (RF Carrier). If BUSY is not active (channel not busy) then the modem assumes the Repeater is not keyed. It waits for the Repeater Delay Time (S52) to expire before continuing with normal operation (see **2.3.1 Mode 0 Normal Operation.**). This allows the repeater to key up before sending data.

CTS is not asserted until this delay has expired.

If BUSY is active then the repeater is assumed to be keyed and the modem does not wait for Repeater Delay Time.

The Repeater Delay Time is set by S52.

3.   Dip Switch and Link Pad Settings.
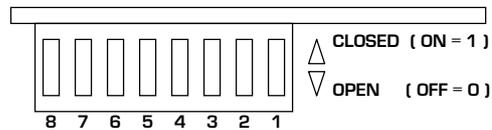
NOTE !!!   Always turn the Radio power switch off for at least 5 seconds when changing any Dip Switch.

3.1   TX Stabilise Delay. (Dip Switch 6, 7 and 8)

When data is sent to the RTM-2410 modem for transmission, the modem keys the radio and waits for TX Stabilise Delay time to expire before transmitting the data.

This allows the radio transmitter to stabilise and the receiving radio to open the RF Mute and assert CD (Carrier Detect).

Increase the TX Stabilise Time if the first characters are missing from the received data string.

This delay can be set by **Dip Switch 6, 7** and **8.** (0 = Off, 1 = On)

	SW8	SW7	SW6
50mS	0	0	0
60mS	0	0	1
80mS	0	1	0
100mS	0	1	1
150mS	1	0	0
200mS	1	0	1
300mS	1	1	0
400mS	1	1	1

The TX Stabilise Delay can be overridden by sending "ATS50=x" (x = delay time) to the modem with RTS inactive (see **AT Commands. Page 14**).

Changing Dip Switches 6, 7 or 8 will override the last ATS50 command setting.

This means that the last action performed will set the TX Stabilise Delay which is stored in Non Volatile Memory.

3.2   Baud Rate Select.   (Dip Switch 2)

Dip Switch 2 OFF = 2400 Baud
Dip Switch 2 ON   = 1200 Baud

The Baud rate Dip Switch can be overridden by sending "ATS57=1200" or "ATS57=2400" to the modem with RTS inactive (see *AT Commands. Page 14*).

Changing the Dip Switch will override the last AT command setting.

This means that the last action performed will set the Baud Rate which is stored in Non Volatile Memory.

3.3   AT Commands ON / OFF.   (Dip Switch 3)

Dip Switch 3 OFF = AT Commands are ignored.
Dip Switch 3 ON   = AT Commands will be executed.

The AT Commands are similar to the Hayes™ Command Set. The Commands will only be recognised and executed if Dip Switch 3 is ON **and** RTS (Request To Send) is **not** asserted when the command is sent to the RTM-2410 modem.

Set this switch to OFF after initialising the modem at installation time, unless you intend to allow the customer's equipment to use AT commands to alter the Modem settings.

Turning the switch off will ensure the initialised S Registers will not be accidentally altered.

NOTE !!!   When the modem is in Mode 1 (MODE Pads open), RTS (Pin 7) must be connected to DSR (Pin 6) when Dip Switch 3 is turned off.

3.4   Anti Collision ON / OFF.   (Dip Switch 4)

Dip Switch 4 OFF = Anti Collision Disabled.
Dip Switch 4 ON   = Anti Collision Enabled.

The Anti Collision system in the modem is designed to delay transmission of data if two or more modems try to transmit data at the same time. This is achieved by waiting for a Random Delay Time when a collision with another modem is detected. A collision is detected when CD (Carrier Detect) is active. At the end of the delay time the collision (CD) is again tested for.

If the collision is still present (ie the other modem is still transmitting) then a new Random Delay will be started and the process repeated until the channel is free.

If there is no collision after the delay, the modem will start the TX sequence which will include the *Repeater Delay*, if enabled *(Dip Switch 1)*, and the *TX Stabilise Delay. (Dip Switch 6, 7 and 8)*

A Random Delay is used instead of a fixed delay to separate the two modems that have collided. In other words the modem with the shortest random time will transmit first, the other modem will then detect a collision and restart its delay time.

The Random Timer has minimum and maximum time limits which can be set by using the AT commands (see *AT Commands. Page 14*).

If Dip Switch 4 is Off, the collisions are ignored and the modem will transmit regardless.

3.5   Voice Compatibility. (Dip Switch 5)

Dip Switch 5 OFF = Radio System used for Data Only.
Dip Switch 5 ON   = Radio System used for Voice and Data.

Set this Dip Switch to OFF if the Radio System does not have any Voice Communication and will be used for Data Telemetry only. When OFF, voice will interfere with data and vice versa.

If the Radio System has Voice and Data traffic (eg Taxi's, Police, etc), then the data and voice need to be coordinated to minimise interference with each other and to stop data noise being heard by the radio operators.

When this Dip Switch is turned On, the RTM-2410 modem will monitor the received audio. If the customer's data equipment wishes to transmit data, the modem will wait until the voice communication has finished before transmitting data (if in Mode 0, CTS will be held off).

If the operator presses the Mic PTT button while the modem is receiving data (CD active) or transmitting data, then the modem will hold off the Mic TX until the data transfer has finished.

For this feature to work properly <u>one</u> of following methods needs to be adopted.

1. Small fleets with low data use on a leased channel:

Use this method if you lease a channel from the local repeater company and have a small fleet that uses voice for primary communications. An example is a company that wishes to have a lap top in their vehicles to generate invoices and do stock queries with the office computer but still uses voice to issue job information.

Link the pads marked "**H**" on the solder side of the RTM-2410. This will enable the modem to mute the radio when data is received. Occasionally there will be a short (60mS) tone at the beginning of a data transfer due to the modems detection circuit. The tone is not annoying to the vehicle drivers if the data transfer is kept to a minimum AND the data traffic is not frequent (eg. Two data packets every minute). If the data transfer becomes annoying then use one of the other two Voice Compatibility methods below.

This is the cheapest method as no other changes need to be made however ALL FLEET VEHICLE RADIOS MUST BE FITTED WITH A MODEM TO MUTE THE DATA NOISE.

NOTE !!! Data Channel (S56) and Voice Channel (S57) registers <u>MUST</u> be programmed with the same channel number.
Any channel change must be done manually with the radio, not the AT Command.
Also the Data CTCSS (S64) and Voice CTCSS (S65) regs. must be programmed with "0"

2. High data use on a single leased or private channel (no channel changes):

This method will require the use of another CTCSS tone on the channel (frequency) that is presently being used. CTCSS (Continuous Tone Controlled Sub-audible Signalling) is programmed into the radio and is a tone (< 300Hz) that is transmitted by the radio. The repeater will transmit the same tone and only radios programmed with the tone will open the mute and allow the audio to be heard. Every company using the channel has their own individual tone.

The modem makes use of two CTCSS tones, one for voice (existing tone) and another tone for data. The second tone must be allocated to your company and could incur another full rental fee from the repeater provider.

Continued …

The radios will be programmed to recognise the Voice tone. When the modem transmits data the second tone is transmitted which will not be recognised by the radios and the audio will be muted. The modem receive circuitry is connected to the radio before the CTCSS muting so it will always receive data.

The modem sends different CTCSS tones by changing channel on the radio. The radio must have two channels programmed into it with the same frequencies but different tones.

The Data Channel (S55) and Voice Channel (S56) in the modem, must be set up as per the example in (S56) Voice Channel (see **S Registers. Page 17**)

NOTE !!!   This method will only work where the customer has only one channel.

3. **High data use on multiple leased or private channels:**

This method uses the same principle as in Method 2 above.

The difference with this method is the modem will generate the transmit CTCSS tones instead of changing channel in the radio to change the tones. This requires a capacitor to be removed from the radio control PCB and a wire soldered to the PCB.

This method will allow the operator to change channel on the radio if they use more than one channel or have multiple repeaters over a large geographical area. This method is also more suitable to customers who own their own repeater system.

The repeaters will need to have the capability of keying up when either Voice or Data CTCSS tone is received. Each tone should be regenerated by the Repeater.

Tone regeneration MUST stop immediately when the transmitting vehicle radio stops transmitting the tone.

The repeater should stay keyed up for at least 2 seconds after the last radio has stopped transmitting. There will be no tones transmitted from the repeaters during this tail period.

Install the CTCSS option loom into S1 of the RTM-2410 modem board. Locate and remove C604 4.7μF capacitor from the radio control board and solder the "C" wire to the + pad where the capacitor was.
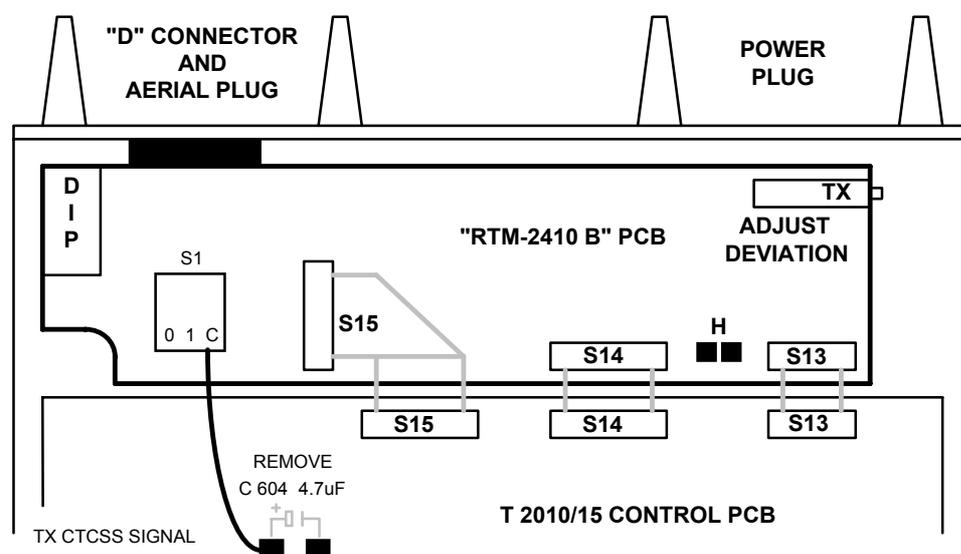
Program ALL used channels in the Tait 2010/15 radio for the Voice CTCSS (RX only required).

Program **S64** for the Data CTCSS tone # and program **S65** for the Voice CTCSS tone # in the RTM-2410 modem (see **S Registers. Page 17**). Program the Number # into the S Register NOT the tone itself. (ie for 100Hz tone then S64=12). See table below.

It is recommended to use CTCSS tones above 150Hz as this will help to speed up unmuting and repeater keying.

#	CTCSS Tone
0	Off
1	67.0 Hz
2	71.9 Hz
3	74.4 Hz
4	77.0 Hz
5	79.7 Hz
6	82.5 Hz
7	85.4 Hz
8	88.5 Hz
9	91.5 Hz
10	94.8 Hz
11	97.4 Hz
12	100.0 Hz
13	103.5 Hz
14	107.2 Hz
15	110.9 Hz
16	114.8 Hz
17	118.8 Hz
18	123.0 Hz
19	127.3 Hz
20	131.8 Hz
21	136.5 Hz
22	141.3 Hz
23	146.2 Hz
24	151.4 Hz
25	156.7 Hz
26	162.2 Hz
27	167.9 Hz
28	173.8 Hz
29	179.9 Hz
30	186.2 Hz
31	192.8 Hz
32	203.5 Hz
33	210.7 Hz
34	218.1 Hz
35	225.7 Hz
36	233.6 Hz
37	241.8 Hz
38	250.3 Hz

3.6   Repeater Delay ON / OFF. (Dip Switch 1)

Dip Switch 1 OFF = Repeater Delay Disabled.
Dip Switch 1 ON   = Repeater Delay Enabled.

The Repeater Delay system in the modem is designed to delay data transmission until the Repeater has keyed up.

When the modem is ready to transmit it looks for BUSY (RF Carrier). If BUSY is not active (channel not busy) then the modem assumes the Repeater is not keyed. It keys the transmitter and waits for the *Repeater Delay Time* (set by S52) to expire.

This allows the repeater to key up before sending data.

If BUSY is active then the repeater is assumed to be keyed and the modem does not wait for Repeater Delay Time.

3.7   Link Pads (solder side of RTM-2410)

The Link Pads are situated on the solder side of the RTM-2410 Modem PCB.(see below).
The pads can be linked with a piece of wire or solder across them.
Do Not connect links that are not mentioned below (grey pads = do not use).

WARNING!!!   *Never connect all pads on the three pad groups. Connect the centre pad with only __one__ of the outside pads.*

<u>**BUSY Signal**</u>.

If pads **G** and **R** are linked, the BUSY- (RF Carrier) signal from the radio will appear on Pin 9 of the "D" connector as an RS232 level signal.

NOTE !!!   Do Not connect Link Pads "G and R" when the modem is connected to a Personal Computer as the BUSY (RF Carrier) can cause RI (Ring Indicator) interrupts in the PC every time the channel becomes busy.
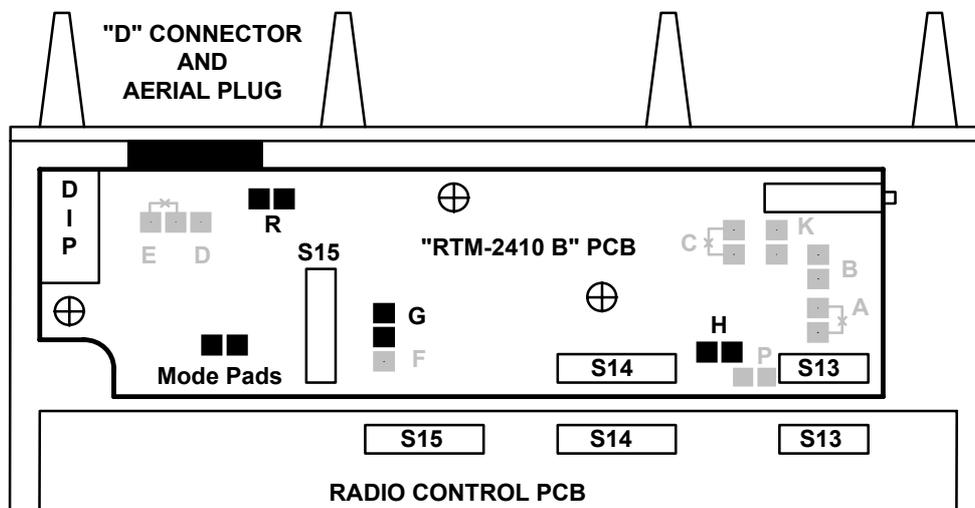
3.8 Tait Data Radio Setup

The RTM2410 Modem can be installed in the new Tait Data Radios. The data radios are fitted with a blank front panel and therefore cannot be programmed through the Microphone socket. There is also no On/Off switch or speaker.

To enable the power on the Data Radio the **"P"** Link Pads must be shorted. Use a piece of wire to link the **"P"** pads. Solder the **"K"** Link Pads to enable the speaker audio.

The Radio can be programmed through the RTM2410 9 Pin "D" connector. Solder **"D", "F"** and **"R"** Link Pads.

__DO NOT solder "G" Link Pads__. Link pad "E" can be left shorted by the PCB track.

Make up a **Programming Lead** as shown below to program the radio using the Tait PGM2000 program via the DB9 connector on the rear of the radio. Do Not use the Tait programming lead.

RADIO PROGRAMMING LEAD
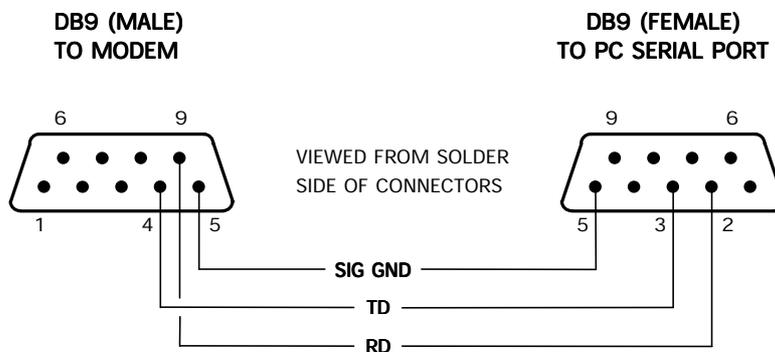
WARNING!!!   *Ensure Pins 4 and 9 are not connected when the RTM2410 modem is connected in normal use as a modem. DO NOT use a store purchased serial cable as these have all pins connected. You will need make up a cable with all but Pins 4 and 9 connected.*

If Pins 4 and 9 are connected, the modem will not be able to change channel or reset the radio.
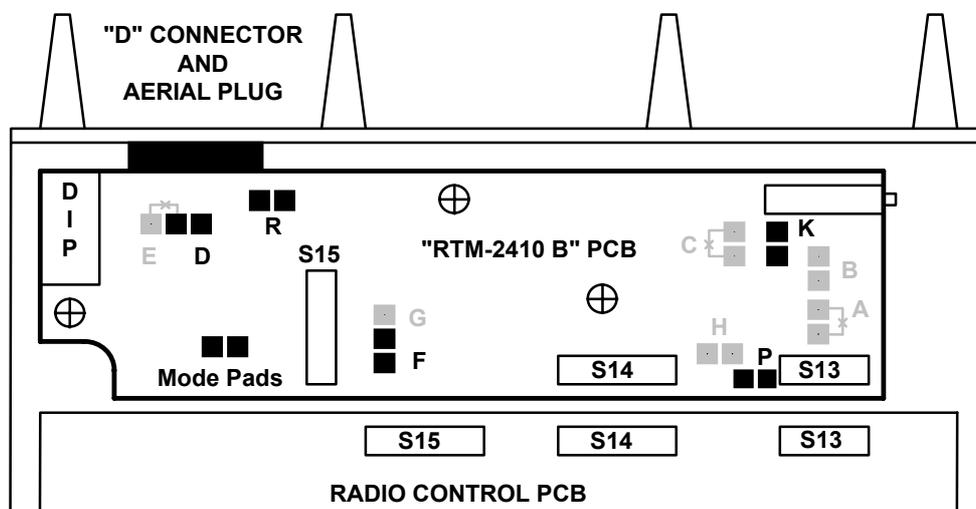
4.   AT Commands.

4.1   AT Command Requirements.

AT Commands can be sent to the RTM-2410 modem to change parameters or read information from the modem.

The commands must be sent to the modem with RTS (Request To Send) <u>Not</u> <u>Active</u>. This is different to the standard Hayes™ commands and is a substitute for the Escape Sequence Guard Time and **+++** characters, which are not required for the RTM-2410 modem.

<u>ALWAYS</u> allow at least 0.5 seconds of inactivity before sending any commands to the Modem.

The command must be sent at the Baud rate that was last selected by either an AT Command or by the Dip Switches.

The commands must also be sent with coms set to *8 Data Bits, No Parity, 1 Start and 1 Stop bit*. The echoed commands and messages will be in this format.

Lastly, Dip Switch 3 must be set to ON for the AT Commands to be recognised.

<div style="border:1px solid">

**WAIT FOR 2 SECONDS AFTER A POWER UP BEFORE SENDING
ANY COMMANDS OR INITIALISATION STRINGS TO THE MODEM.**

</div>

4.2   AT Command String Format.

<u>ALWAYS</u> allow at least 0.5 seconds of inactivity before sending any commands to the Modem.

The AT Commands are all ASCII characters and can have several commands in a string (30 characters max.). The string must have **AT** before the commands and must end with a **CR** (Carriage Return) character. A **CR** is commonly a **^M** in most communications programs.

Upon receiving a CR with RTS not active, the modem will search the received string until AT is seen. It then executes any valid command/s in the received string until it comes across the CR (Carriage Return).

If ANY command has invalid values in it (eg. S Registers that don't exist) the modem will return an ASCII message: **ERROR**. The modem will still execute the valid commands in the string.

If ALL commands were valid then **OK** is returned.

Command strings can have any or no characters between commands.
Eg. **+++ AT S50=3S51=20 S53=1200S60? ^M**

It is advisable to start the command string with **+++** but this is not essential. No delay is required after the **+++**.

The command buffer in the RTM-2410 is cleared when RTS is asserted and all previously sent command bytes are lost. All commands are ignored if the modem is still transmitting data.

4.3   AT Command List.

AT Commands must be sent when RTS (Request To Send) is not active.
<u>ALWAYS</u> allow at least 500mS of inactivity before sending any commands to the Modem.

Snn=xxxx   **Writes the value *xxxx* into the S Register *nn*.**

Use this command to enter a new value into any of the S Registers.
nn must be a valid S Register. ***xxxx*** must be ASCII characters 0-9.
xxxx must be within the range for the S Register.
Any incorrect command will return **ERROR**.

Example.   ***ATS50=250 ^M***   **Stores 250 into S Register #50**

Snn?   **Returns the value in the S Register *nn*.**

Use this command to read the value from any S Register. The returned
format will be four ASCII digits (0-9).

Example.   ***ATS50? ^M***   **requests the contents of S Register #50**
                 0250   **is returned if S Register #50 contains 250**

I0   **Returns the ID and Version of the Modem.**
                (eg RTM2410 V1.3).

Use this command to determine what features this modem has by reading
the Model and Version number.

Example.   ***ATI0 ^M***   **requests the Model and Version**
                 RTM2410 V1.3   **is returned for this modem**

I1   **Returns the state of the radio Busy signal.**
                (ie. RF Carrier Detect).

Use this command to determine the state of the Busy signal in the radio.
When this command is sent to the modem, a **1** (ASCII) will be returned
when there is an RF Carrier present (ie Busy active) and a **0** will be returned
when there is no RF Carrier. This is useful when detecting if repeaters are
keyed or not.

Example.   ***ATI1 ^M***   **requests the Busy status**
                 1   **Busy Active (RF Carrier)**
                 0   **Busy Not Active (No RF Carrier)**

Continued …

E0   **Command Local Echo Off**
E1   **Command Local Echo On**

Use these commands to enable the local echo mode. When on, the modem will echo any characters sent to it while RTS (Request To Send) is not active.

All **OK** and **ERROR** messages and requested S Register values will be echoed regardless of this setting.

This setting is not effected by the AT&F command.

%R   **Resets the Tait Radio <u>AND</u> the RTM-2410 Modem.**

Use **AT%R** to reset the radio and the modem. This is the same as turning the power off then on. The reset will take place immediately the **AT%R^M** is received. **There will be no response from this command**.

Allow 2 seconds for the modem to reset. The modem will ignore ALL inputs until the reset has finished. 2020 radios may take longer to reset depending on the length of the start up message programmed into the radio.

The S15 loom must be installed for this option to work.

&F   **Restores the factory defaults.**

Use this command to reset the S Registers to the default values in the
S Register List (see ***Table 2.   S Register Reference Table Page 24).***

Allow 2 seconds for the modem to set the defaults. The modem will ignore ALL inputs until the reset has finished.

4.4   S Registers.

S Registers contain the modem's operating parameters. They are stored in Non Volatile memory and are not effected by power down. The last written S Register value will remain current until a new value replaces it, or the AT&F command restores all the default values.

The S Registers are all Four (ASCII) Digits long. Sending more than four digits to an S Register will truncate all digits after the 4th digit.

For example a command to set S-Register #50 to a value of 80mS can be **ATS50=80** or **ATS50=0080**. Issuing **ATS50=0000080** will result in a value of **0000** being stored in the S Reg.

Most S Registers have a minimum and maximum range. If a command is sent that tries to set an S Register outside the range, the S Register will retain its old value and the **ERROR** message will be returned.

The S Registers also have default factory values which will be set when you receive the modem. The values can be reset to these defaults using the AT&F command. Defaults listed with **Dip Sw** will be set according to the Dip Switch settings. (See *3 Dip Switch and Link Pad Settings. Page 7*)

To set S Register #54 to 330, send **+++ ATS54=330 ^M**
OK will be echoed back.

To read the contents of S Register #54, send **+++ ATS54? ^M**
0330 will be echoed back followed by **OK**.

The **+++** is optional but recommended.

(S50)   TX Stabilisation Delay Time.

When data is sent to the RTM-2410 modem for transmission, the modem keys the radio and waits for *TX Stabilise Delay Time* (mS) to expire before transmitting the data.

This allows the radio transmitter to stabilise and the receiving radio to open the RF mute and assert CD (Carrier Detect).

Increase the *TX Stabilise Time* if the first characters are missing from the received data string.

This delay can also be set by **Dip Switch 6, 7** and **8,** which will set the default value.

Changing Dip Switches 6, 7 or 8 will override the last **ATS50=xxxx** command setting.

(S51)   Bytes Received after RTS drops (Mode 0 only).

When the modem is in Mode 0 (RTS - TX Mode), the customer's data is sent to the modem with RTS (Request To Sent) asserted by the customer's computer equipment.

Because most old style UARTs are double buffered, the RTS line is dropped before the contents of the UART have been sent to the modem at the end of the customers data.

The value in S51 will make the modem continue to receive data for a number of bytes after RTS is dropped. The bytes are considered to be 10 bit (1 Start, 8 Data, 1 Stop).

Increase this value by 1 byte at a time if the last bytes are missing from the end of a received string.

(S52)   **Repeater Delay Time.**

Dip Switch 1 must be set to ON for this function to operate.

This function is used on radio systems with repeaters installed to increase the coverage.
When a modem is ready to send data, it keys the transmitter. The repeater keys itself when it detects the RF Carrier from the modem's radio. This then finally opens the mute and asserts CD (Carrier Detect) on the receiving radio.

The time for the transmitting radio and receiving radio to stabilise is already allowed for by the **TX Stabilise Delay Time (S50)** however the repeater needs extra time to key up and stabilise.

This extra time can be added using the **Repeater Delay Time**. The time in **S52** is added to the **TX Stabilise Delay Time.**

However, repeaters will stay keyed up for a length of time after the transmitting radio stops transmission. This is because there is usually a reply to the message shortly after.

If the repeater is already keyed when the modem is ready to transmit data, there is no need to add the **Repeater Delay Time**. The modem monitors BUSY (RF Carrier) and only adds the **Repeater Delay Time** if the repeater is not keyed (ie BUSY not active).

(S53)   **Anti Collision Random Delay Lower Limit.**

Refer to **Anti Collision ON / OFF. (Dip Switch 4)** for more details on this function.

This S Register sets the shortest Random Delay Time possible.

The value in this S Register <u>MUST</u> be <u>LOWER</u> than the value in S Register #54.

(S54)   **Anti Collision Random Delay Upper Limit.**

Refer to **Anti Collision ON / OFF. (Dip Switch 4)** for more details on this function.

This S Register sets the longest Random Delay Time possible.

The value in this S Register <u>MUST</u> be <u>HIGHER</u> than the value in S Register #53.

(S55)   Data Channel (1 - 24).

This S Register contains the Radio Channel selected when modem data is being transmitted. This is also the channel selected for ALL radio reception (Data and Voice)

(S56)   Voice Channel (0 - 24). (Set to '0' to inhibit ALL channel changing)

This S Register contains the Radio Channel selected when the Microphone PTT button is pressed. The *Data Channel (S55)* is re-selected when the Mic PTT is released.

This function is useful if voice and data are being sent on the one channel and the customer wishes the operator to hear only voice traffic without data/voice interference (*see Voice Compatibility. (Dip Switch 5) Page 9*).

This can be achieved by programming the radio as per the diagram below.

Channels

Print

Maximum Called Party Sequences		4/4					
Chan	Rx.Freq (MHz)	Tx.Freq (MHz)	DCS/CTCSS Rx	Tx	TxCd Num	Rep Num	Tx Pwr Level	Scan

Chan	Rx.Freq (MHz)	Tx.Freq (MHz)	DCS/CTCSS Rx	Tx	TxCd Num	Rep Num	Tx Pwr Level	Scan
1	455.00000	455.00000	C210.7		1	N	High	No
2	455.00000	455.00000		C210.7	1	N	High	No
3	0.00000	0.00000			1	N	High	No
4	0.00000	0.00000			1	N	Low	No

Send the command string ***ATS55=1 S56=2 ^M*** to the RTM-2410 modem.
Channel 1 is the Data Channel, Channel 2 is the Voice Channel.

The TX and RX frequency can be different (for repeaters), but the frequency entries in Ch.1 <u>MUST</u> be the same as in Ch.2.

The CTCSS frequency can be any valid CTCSS Frequency. Do Not enter a TX CTCSS in Ch.1 (Data Channel).

When voice is sent (Mic PTT), the modem selects Channel 2 and sends a CTCSS tone with the transmission. This opens the Audio Mute on the receiving radio and allows the operator to hear the voice message.

When Data is sent, Channel 1 is selected and no CTCSS tone is sent. The receiver Audio will remain muted, but the data will get through to the RTM-2410 modem.

NOTE !!!   The S15 ribbon connector or the 3 pin channel select loom (S1) must be installed. The Radio must be programmed for BCD Channels Enabled (Options) if S1 is used instead of S15.

(S57)   Baud Rate Select (1200 or 2400).

Send *ATS57=1200 ^M* to set the baud rate to **1200**.
Send *ATS57=2400 ^M* to set the baud rate to **2400**.

The Baud Rate can also be set by **Dip Switch 2,** which will set the default value.

Changing Dip Switch 2 will override the last **ATS57=xxxx** command setting.

The Baud rate will be changed to the new value <u>AFTER</u> the **OK** message is returned.

(S58)   TX Start Up Temperature (°C).

The modem monitors the radio's temperature and will shutdown transmission if the value in S Register #59 (see next description) is exceeded.

When the radio temperature drops below the value set in this S Register, the transmission will again start.

Radio data and voice reception and Microphone PTT are always active. Only TX Data will be stopped.

It is advised to use the Default value as this will ensure the radio will function correctly and still be protected from over heating.

The value in this S Register <u>MUST</u> be 5°C <u>BELOW</u> the value stored in S Register #59.

(S59)   TX Shut Down Temperature (°C).

The modem monitors the radio's temperature and will shutdown transmission if the value in this S Register is exceeded.

When the radio temperature drops below the value set in S Register #58, the transmission will again start.

Reception and Microphone PTT are always active. Only Data will be stopped.

It is advised to use the Default value as this will ensure the radio will function correctly and still be protected from over heating.

The value in this S Register <u>MUST</u> be 5°C <u>ABOVE</u> the value stored in S Register #58.

(S60)   Radio Temperature (°C) (Resolution = 2°C).

The is a READ ONLY Register and returns the present Radio Temperature.

Example.   *ATS60? ^M*   **requests the Radio Temperature.**
                  0036   **is returned if the radio is at 36°C**

(S61)   **Radio RSSI (Received Signal Strength Indicator) Value.**

The is a READ ONLY Register and returns the present Radio RSSI (Received Signal Strength Indicator) value. The RSSI value is always an even number (ie. 0, 2, 4 etc).

| **Example.** | *ATS61? ^M* | **requests the present RSSI value.** |
| | *0126* | **is returned if the signal strength is 126** |

See **Table 1. RSSI value vs Signal Strength (dBm)** . to equate the RSSI value to the Received Signal Strength.

(S62)   **Radio RSSI Peak Average Value during last BUSY (RF Carrier) period.**

The is a READ ONLY Register and returns the Peak (Maximum) Averaged RSSI value while the BUSY (RF Carrier) was last active. This value is held until the next BUSY is detected when it will be updated. Power down sets this value to "**0000**".

The RF Carrier must be present for at least 80mS to obtain an averaged reading and should be present for as long as possible to obtain an accurate RSSI value.

| **Example.** | *ATS62? ^M* | **requests the last RSSI value.** |
| | *0180* | **is returned if the peak signal strength was 180** |

(S63)   **Radio RSSI Offset Adjustment Value.**

The RSSI value changes dramatically between radio models and to a lesser extent between individual radios. The RSSI curves (see **Table 1.   RSSI value vs Signal Strength (dBm)** .) will always be followed however there will be an offset.

That is, at a signal input of -100 dBm one radio might read 94 RSSI, while another identical radio might read 78 RSSI. The RSSI graph is based around -100 dBm = 100 (RSSI value).

To correct the difference between radios, the value in this S Register can have an offset correction value written to it.

Calculate the offset by writing 50 into S63, then feed an unmodulated rf signal of -100dBm (2.24 μV PD) to the aerial socket, then read the **RSSI** value from S Reg S61.

Calculate **OFFSET** using the formula below.

OFFSET = (100 - RSSI) + 50

Write the **OFFSET** value to **S63**   (min OFFSET = 0, max OFFSET = 100)

Reading the RSSI (S61) should now show 100.

| **Example.** | *ATS63=72 ^M* | **writes 72 to the offset.** |

NOTE !!!   The offset value written to S63 is not changed when the AT&F (Modem Reset) command is sent to the modem.

Table 1.   *RSSI value vs Signal Strength (dBm) .*

The graph show the different radio model RSSI reading variations. These results were obtained after the RSSI Offset was written to S Register (S63) to obtain an RSSI reading of 100 at a signal input of -100dBm (2.24 μV PD).

The RSSI value should always follow the curve however design changes made by Tait may alter the curves below.

No signal will give a reading of between 0 and 20 which will be constantly changing due to noise.
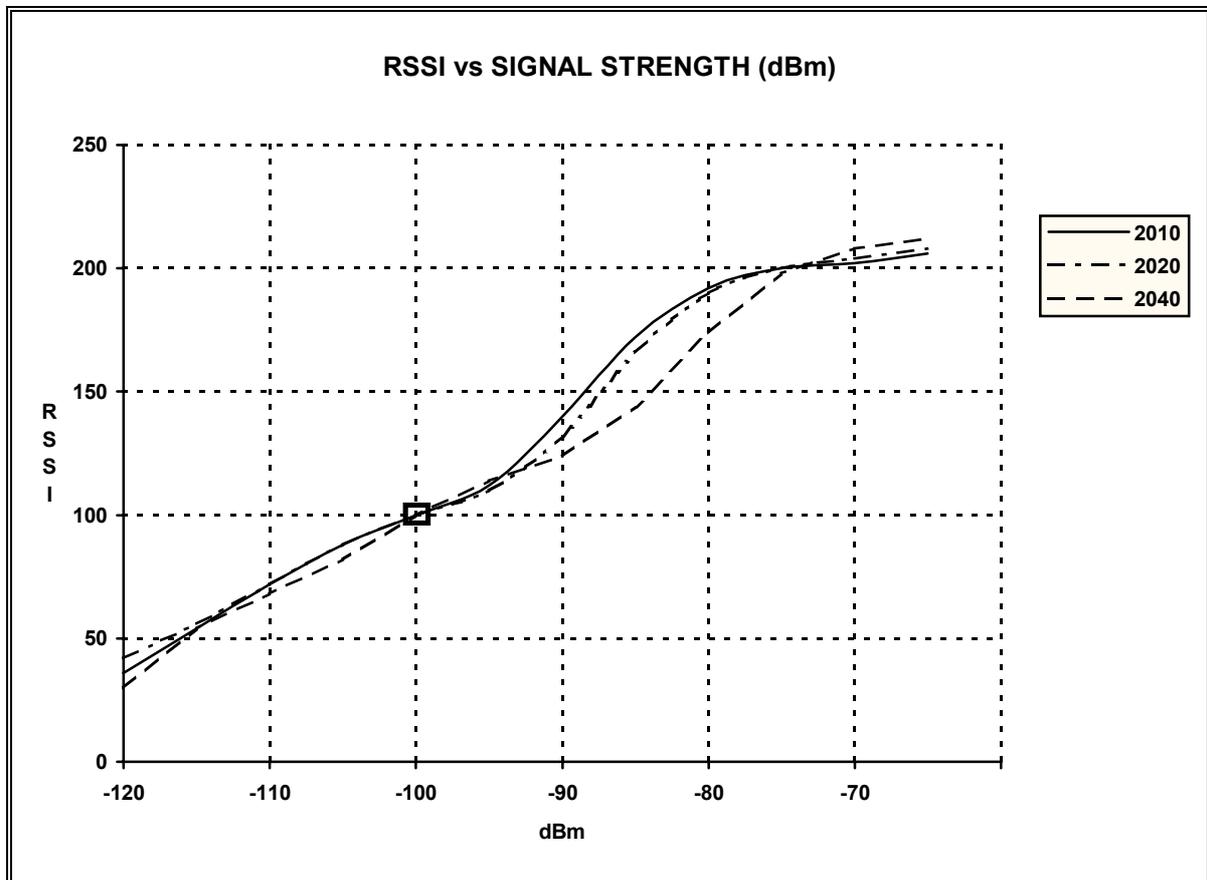
(S64)   Data CTCSS Transmit Tone.

This S Register determines the CTCSS Tone transmitted when Data is being sent over the radio. Write the Number # to this register NOT the CTCSS tone frequency.

Example.   *ATS64 = 12 ^M*   sets the TX tone to 100 Hz.

See the table below for the corresponding CTCSS Number.
See ***Voice Compatibility. (Dip Switch 5) Page 9*** for more information.

(S65)   Voice CTCSS Transmit Tone.

This S Register determines the CTCSS Tone transmitted when the microphone PTT is pressed and Voice is being sent over the radio. Write the Number # to this register NOT the CTCSS tone frequency.

Example.   *ATS65 = 25 ^M*   sets the TX tone to 156.7 Hz.

See the table below for the corresponding CTCSS Number.
See ***Voice Compatibility. (Dip Switch 5) Page 9*** for more information.

#	CTCSS Tone
0	Off
1	67.0 Hz
2	71.9 Hz
3	74.4 Hz
4	77.0 Hz
5	79.7 Hz
6	82.5 Hz
7	85.4 Hz
8	88.5 Hz
9	91.5 Hz
10	94.8 Hz
11	97.4 Hz
12	100.0 Hz
13	103.5 Hz
14	107.2 Hz
15	110.9 Hz
16	114.8 Hz
17	118.8 Hz
18	123.0 Hz
19	127.3 Hz
20	131.8 Hz
21	136.5 Hz
22	141.3 Hz
23	146.2 Hz
24	151.4 Hz
25	156.7 Hz
26	162.2 Hz
27	167.9 Hz
28	173.8 Hz
29	179.9 Hz
30	186.2 Hz
31	192.8 Hz
32	203.5 Hz
33	210.7 Hz
34	218.1 Hz
35	225.7 Hz
36	233.6 Hz
37	241.8 Hz
38	250.3 Hz

Table 2. *S Register Reference Table*

Reg	Range	Default	Units	Function
50	0 - 500	Dip Sw	0.001secs (mS)	TX Stabilise Delay Time
51	0 - 9	2	Bytes (10 bits)	Bytes Received after RTS drops (Mode 0)
52	50 - 5000	200	0.001secs (mS)	Repeater Key Up Delay Time
53	80 - 400	80	0.001secs (mS)	Anti Collision Random Delay Lower Limit
54	90 - 500	250	0.001secs (mS)	Anti Collision Random Delay Upper Limit
55	1 - 24 [note 1]	1	Channel No.	Data Channel
56	0 - 24 [note 1,2]	1	Channel No.	Voice Channel
57	1200 - 2400	Dip Sw	Bits Per Second	Baud Rate Select
58	0 - 70	65	°Celsius	TX Start Up Temperature Threshold
59	40 - 99	70	°Celsius	TX Shut Down Temperature Threshold
60	Read Only		°Celsius	Radio Temperature
61	Read Only		0 - 255	RSSI Present Value
62	Read Only		0 - 255	Peak Average RSSI when last BUSY active
63	0 - 100	50	(RSSI)	RSSI Offset Adjustment value
64	0 - 38	0 (Off)	CTCSS #	Data CTCSS Tone
65	0 - 38	0 (Off)	CTCSS #	Voice CTCSS Tone
67	Read Only	0 (Off)	ASCII	Last Reset Register (diagnostic use only)

Note 1. Only 4 channels (1 - 4) will be available when the modem is installed on older radios. The modem will accept channel numbers up to 24 but this will give undetermined results on 2010 radios.

Note 2. To stop the modem setting the radio Channel to 1 at power up set S56 = 0 (Voice Channel). This will inhibit the Modem from changing Channel at any time. This is used to allow the radio operator to select the Channel via the radio front panel buttons. The modem will not change the radio from this channel.

5.   Installation.

The RTM-2410B Modem Board is designed for the Tait T2010, T2015 and "Data" Radios.

1.   Disconnect all plugs from the radio and remove it from the cradle. Turn the radio over and undo the four screws on the bottom cover. Remove the top cover from the radio.

2.   Undo the three screws securing the Radio Control PCB and fold the board back so the component side is facing upwards.

3.   Remove the blanking plug from the "D" connector hole in the back of the radio. This is located above the aerial socket.

4.   Locate and carefully remove R513 (PTT 0 Ω link) on the Radio Control Board. This is just below S14. **This must be done to ensure correct operation**. See the next page for the T2000 radio control board component locations. The board is viewed from the component side. Newer radios may already have R513 removed.

5.   Plug the Channel Change ribbon cable assembly S15 on the RTM-2410 so the folded ribbon covers the RTM-2410 Microprocessor. (note the S15 plastic locating lug orientation.)

       If the RTM-2410 Modem is replacing an RTM-2400 Modem in an older T2010/15, then the existing white channel change plug can be plugged into P1 on the RTM-2410.

6.   If the CTCSS option on the Modem is not required skip to step 7.

       Remove C604 from the radio control board and solder the CTCSS wire on the 3 pin white plug (optional), (marked "C" on S1 of the RTM-2410 PCB), into the + pad of C604 on the radio board.

       Enable the CTCSS Reverse Tone feature in the Tait radio.

7.   Plug the three connecting plugs to S13, S14 and S15 on the radio board. Ensure they are seated properly. Check the other plugs on the Radio Control board and ensure they are also seated properly.

8.   **It is advisable to screw the mounting screws into the chassis before mounting the PCB or alternately use an M3 thread tap. This will establish the threads without damaging the PCB.**

       Fold both boards back into position. Locate the 9 Pin modem "D" connector into the hole in the back of the radio and ensure both boards are laying flat with no obstructions under the boards. The flat ribbon cables may need to be shaped on the connecting plugs if they are obstructing the PCB's.

9.   Secure the boards in place with <u>ALL</u> three screws provided. When securing the RTM-2410 board, align the "D" connector with the holes in the back panel before tightening the screws. Ensure the "D" connector is sitting flat against the back heatsink.

10.   If the modem is fitted to Narrow Band equipment where a repeater will be used, the solder pads on the RTM-2410 modem need to be changed. Use a sharp blade to carefully cut the shorting tracks on pad **"A"** and pad **"C"** then solder pad **"B"**. This changes the TX audio path in the Tait radio.

11.   Solder the **Mode Pads** if **Mode 0** is required. Solder any **Link Pads** for the required options. Solder the **"P"** Link Pads if the modem is installed in a Data Radio.

Tait T2010/2015 Control PCB (component side).

<u>Carefully</u> remove R513 with a small soldering iron. D500 can be left in place.
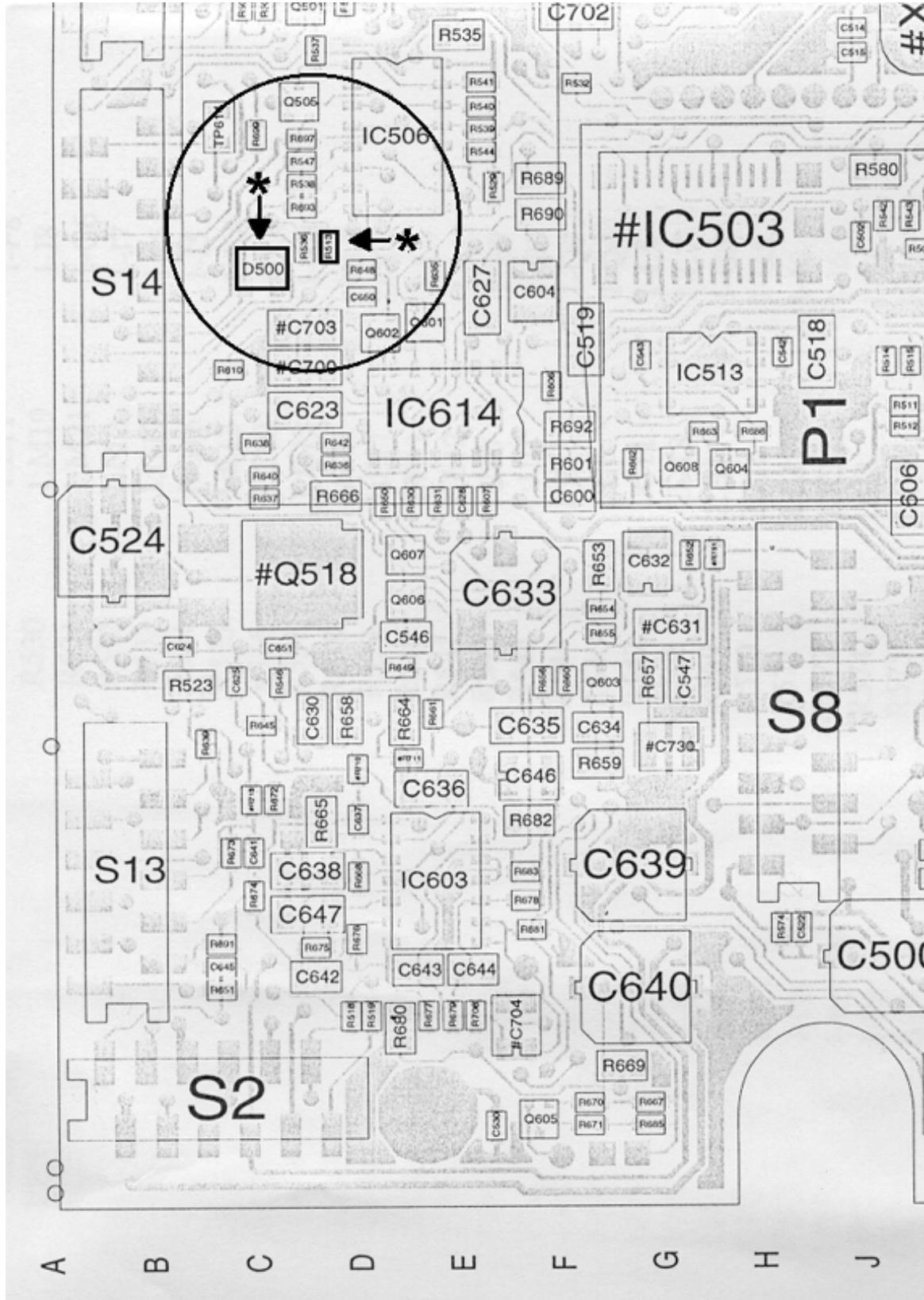
6.   Adjustment.

1.   Ensure the Tait radio is programmed for the requirements of the customer. Disable the CTCSS before adjusting the modulation.

2.   Connect the radio to a 13.8 VDC power source. **DO NOT TURN THE POWER ON**.

3.   Connect a deviation meter and dummy load to the aerial socket.

4.   Set the Dip Switches on the RTM-2410 to the customer's requirements.

5.   Link **Pin 2** to **Pin 3** of the "D" connector. Turn the power on to the radio to start the modem transmitting. (NOTE. Transmission will start 3 Seconds after power on.)

6.   Adjust the blue **TX** pot on the end of the modem board for **3.0 kHz** deviation **± 0.1 kHz** (Wide Band) and **1.5 kHz** deviation **± 0.1 kHz** (Narrow Band).

7.   Set the radio's TX power to 3 watts min. 4 watts max. to avoid overheating the radio.

8.   Ensure the TX carrier frequency is no more than ± 400Hz. Adjust the radio's TXO if necessary.

9.   Turn the radio off and then on again if it times out. It will beep several times before timing out and halting transmission.

10.   Remove the link on Pin 2 and 3 and test all required functions on the modem.

11.   If all functions work, installation is now complete. Remove the power and re-assemble the covers etc. Long screws may be required to secure a plug to the "D" connector.

12.   If a repeater is to be used, set it to "**Flat Audio Response**" (10Hz - 3kHz) and make sure there are no filters in the TX/RX audio paths (usually the CTCSS jumpers needs to be set but with the CTCSS tone turned off). Connect pin 2-3 on the RTM-2410 on the Tait <u>radio</u> to start it transmitting, then set the <u>repeater</u> TX deviation to **3.0 kHz** deviation (Wide Band) or **1.5 kHz** deviation (Narrow Band).

13.   Contact OED Electronics if the modem is used on a narrow band repeater system. The repeater will probably require modems to be fitted to regenerate the data.
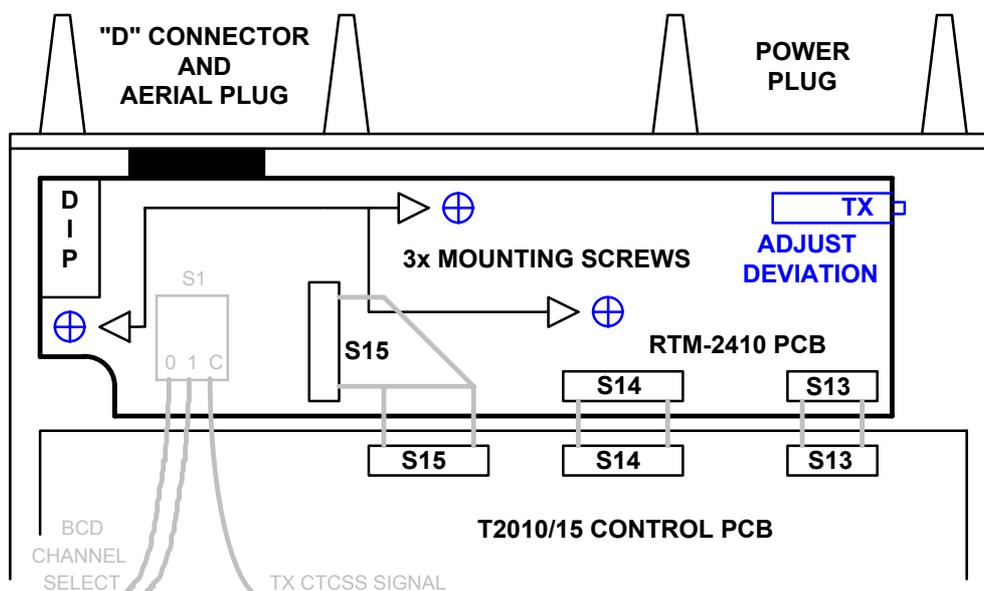
MODEM "AT" COMMAND PROGRAMMING CABLE.

NOT FOR PROGRAMMING THE RADIO

DB9 (MALE)
TO MODEM

DB9 (FEMALE)
TO PC SERIAL PORT

VIEWED FROM SOLDER
SIDE OF CONNECTORS

SIG GND

TD

RD
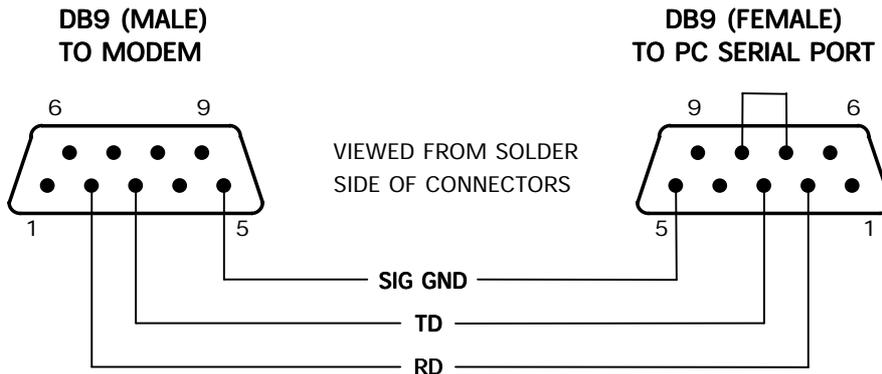
Make up this lead to connect the RTM2400 modem to a PC serial port. Use a program such as Terminal for Windows® to send AT Commands to the modem. (see *AT Commands. Page 14*).

TRANSMITTER DEVIATION ADJUSTMENT TEST PLUG.

DB9 (MALE)
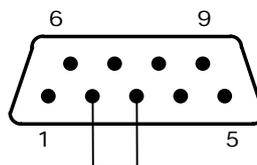
VIEWED FROM SOLDER
SIDE OF CONNECTOR

Make up a DB9 male plug with Pin 2 and Pin 3 linked. Plug this into the RTM2410 connector to enable the modem to transmit a tone used to adjust the deviation. (See *Adjustment. Page 27*)

MODEM DB9 to DB25 CONNECTION DIAGRAM.

DSR
CTS
RTS

6   9   14   25

1   5   1   13

SIG GND
TD
RD
CD
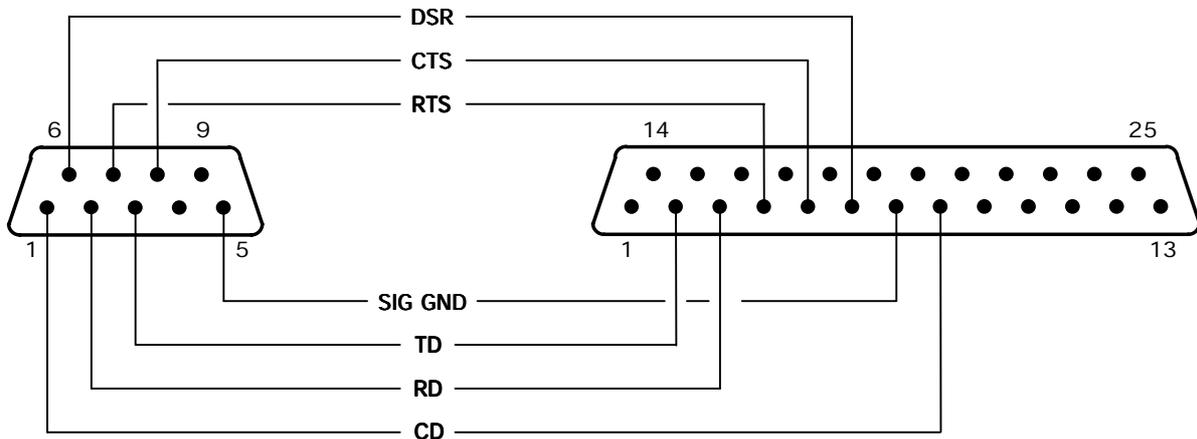
RTM-2410 DB9 Connector   **DB25 Connector**

PIN   PIN
 1 -------------- **CD** (Modem Carrier Detect) ------------   **8**
 2 -------------- **RD** (Received Data) ----------------------   **3**
 3 -------------- **TD** (Transmit Data) ---------------------   **2**
 5 -------------- **SIGNAL GROUND** -----------------------   **7**
 6 -------------- **DSR** (Data Set Ready) ------------------   **6**
 7 -------------- **RTS** (Request to Send) -----------------   **4**
 8 -------------- **CTS** (Clear to Send) --------------------   **5**

This is the cable wiring for connection to a **DB25** connector on Data Terminal Equipment.

If the DTE has a **DB9** connector, a standard **DB9** to **DB9** cable can be used. These can be obtained from most electronic retail shops or computer suppliers.

DB9 to **DB25** cables are also available from the above shops.

WARNING!!!   **If a pre-made cable is purchased, <u>DO NOT</u> Link the "D, G, F and R" Pads on the RTM-2410 Modem board, unless Busy is required on the RI Pin (Ring Indicator).**

DO NOT use a Null Modem cable or adaptor.