Instructions for the Galbraith Track05 APRS GPS sensor and modem, using the Byonics Tinytrack modem.

Date 17 November 2003 Branch05 projects team.

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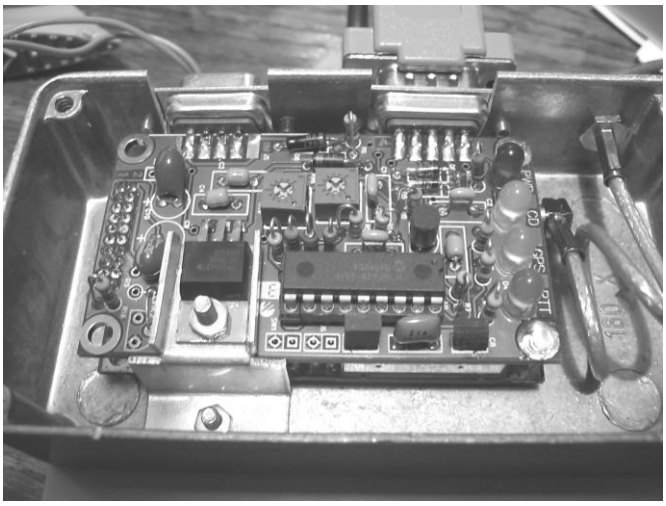


Figure 1 Track05 unit fitted into diecast box (with prototype heatsink)

Overall description.
The TRACK05 APRS sensor has been built to utilise the commonly available Byonics Tinytack3 modem chip, available from (1).
The general layout uses two boards, the top being the modem and the bottom board is the GPS receiver. The two boards plug together using a special 2mm pitch socket J2, which is mounted underneath the modem board.
The modem board has two I/O connectors, radio connector and PC serial comport, both DB9 type, mounted on one edge of the board. PC comport can be either plug or socket, see "options" below.

Technical description.

Modem chip

The heart of the modem is the Tinytrack3 microcontroller. This takes data in from the GPS receiver, decodes the position and speed information, and constructs the relevant packet data audio tones. It also controls all the LEDs and the PTT output.

Serial data

The serial data comes out of the GPS receiver on pin 11 of J2, passing through R5 and R14 to the Tinytrack3 processor. If a PC is connected to the programming port J9, this will override the data from the GPS receiver and allow the configuration PC software to send data to the Tinytrack3. Data from the Tinytrack3 pin 2 is connected directly to the PC port.
If a Tinytrack2 modem chip is used, the data from the GPS receiver must be inverted. This can be achieved by inserting the optional components Q2, R15 and R9. The PC comport can still intercept the serial data line during configuration.

Radio connector J1

This connector carries all the signals for the connection to the radio, the power supply input to the Track05.See table below for pin out.

Supply voltage

The 12vDc supply input can be supplied from an ignition controlled source or direct from the car battery. If the supply is active all the time the GPS receiver will maintain its clock and re-acquire satellites quickly, but has the penalty of a drain on the battery when parked.
Alternately an ignition-controlled source can be used, and the battery backup input connected directly to the car battery to keep GPS data valid.
The onboard regulator U2 regulates the 5 volt supply to the Track05. This will be passing 0.2A at a voltage drop of up to 8v. Therefore the power dissipation will be approx 1.6W, and will need a small heatsink, as shown in the diagram, or a small heatsink can be purchased.

GPS receiver

The GPS receiver is forced to output the standard NMEA data at 4800 baud by the ground connection on J2 pin 7. Other data formats are available but not suitable for the Tinytrack3 modem chip.

Configuration

Most of the information for configuration can be found in the document (1). Note the “Allow TTL” option must be checked to allow correct operation with this GPS receiver.
To force the modem to communicate with the PC, follow this sequence:

1. Turn Track05 off.
2. Connect PC and run configuration program. Reference (3)
3. Turn Track05 on.
4. Read configuration or version number using configuration program.
5. Communication is now established.

Options.

The Track05 project can be built with various options as listed below.

TT3 link.

The unit has been designed to primarily use the TinyTracker3 chip, which can accept the TTL data from the Track05 GPS receiver board. If the TinyTracker2 chip is used, the link TT3 must be replaced with Q2*,R9*,R15*
On early revision 05/03 boards the layout of these parts is slightly different, but all parts are marked on the silkscreen overlay.

External GPS receiver. Changing J9 socket for J5 plug.

The unit has been designed to use the Track05 GPS receiver supplied. If however, the user wishes to use an external GPS receiver, the PC comport connector can be changed for a Plug similar to the type used on the Byonics PCB. This then makes the Track05 unit look like the connection to a PC comport, with the drawback that a Null Modem cable must be made to connect the Track05 to a PC comport when configuration is required.
(On early revision 05/03 boards, the green solder mask on pads nearest J8 may need to be scraped away to allow for standard J9 socket to be fitted).

Battery backup.

Not really an option, but the components can be omitted if not needed. The Track05 GPS receiver can accept a separate backup 12v supply to keep the GPS receiver Real Time Clock and RAM operating when the remainder on the circuit is powered off. This has the advantage of a faster lock onto available satellites when the power is restored, as the receiver will know approximately where it is, and what time it is. The receiver will then know which satellites to look for.
The separate power input is accessed through the radio connector J1, pin 9. The components for this circuit are D8, C9, R6. and it is suggested these are fitted every time. However, they can be omitted with no ill effect if not required.

Antenna voltage.

The Track05 GPS receiver has been designed to feed power to the supplied active GPS antenna through the antenna coax. This voltage is 5vDC at a current of less than 50mA. If this voltage on the coax is not needed, e.g. a passive antenna is used, the supply can be removed by cutting the link J8.

LED disable.

Unlike the Byonics PCB, the LEDs on this board do not have a link to disable them. If the LEDs are not required, take them out!

10MHz ceramic resonator.

The board has been laid out to accept either a three-legged resonator, with built in capacitors, or a two legged resonator type. In the latter case, additional capacitors C7, C8 must be fitted. A 10MHz crystal can also be fitted, but again the capacitors must be fitted. The value of these will be in the order of 33pF, but some experimentation maybe needed to get the frequency correct.

Build Instructions

Preparation for PCB revision 05/03–

Before fitting components, check that all PCB pads have been cleared for J9 if it is to be fitted. Remove labels “AF out” and “CarrDet” next to RV6 & RV9. They are transposed.

Preparation for PCB revision 08/03–

None.

The components can be fitted in the following order:

1. J2 must be fitted *underneath* the PCB. **DO NOT make a mistake here**, they are almost impossible to remove! If in doubt, just solder two corner pins until the whole board has been filled.
2. Fit diodes D5,D6,D7,D8. Make sure they are the right way round.
3. Fit socket for U1. Make sure it is the right way round. Do not fit U1 until testing.
4. Fit Capacitors C1 through C6
5. Fit RV6 & RV9.
6. Fit all resistors.
7. Fit LEDs – check colours. Note the flat edge nearest the short pin, fit the right way round.
8. Fit connector J1 and J9. Double check they are the correct type and fitted the right way round. DO NOT make a mistake here, they are almost impossible to remove!
9. See picture below for guide on fitting J9.
10. Fit C9 & C10. Make sure they are the right way round, note + marks.
11. Fit remaining parts
12. Use screw M3x10mm and nut to fix U2 and heatsink to PCB.
13. Use screw M3x20mm and 3 nuts to fix two PCBs together as per drawing.

Note the following parts are optional: Q2,R9*,R15*,C7,C8*

Testing

1. Visual check.
   - Make a thorough inspection of all parts. Check they are all correct values.
   - Check all solder joints, and clear all solder splashes.
   - Set both RV6 and RV9 to mid range.
   - Remove U1 and the GPS receiver.
2. Connect 12vDC Power with current meter in series:
   - Check LED D1 (red) comes on.
   - Check DC voltage U1 socket pin 14 to pin 5 = 5vDC
3. Insert U1 into socket:
   - *(Beware of static damage. Earth yourself to the PCB before touching chip.)*
   - Check all LEDs flash in sequence.
   - Check supply current is 6mA approx.
4. Connect PC comport and power on.
   - Check PC can read version of chip.
   - Program unit with required configuration. More information on this can be found in (1)
5. Connect GPS receiver. Verify data from GPS receiver to Tinytrack modem.
   - Check supply current rises by approx. 180mA
   - Check Green LED flashes.
6. Connect GPS antenna. Verify GPS reception.
   - Place antenna in open area.
   - Check Green LED turns on solid after approx. 2 minutes
7. Configure unit for tone test.
   - Check transmitter goes into transmit mode.
   - Check audio level on J1 pin 1.
   - Adjust modulation level when APRS transmitter connected.

If any stage of this test fails, see fault-finding chart below. The section numbers in the test sequence correspond to the fault finding chart sections.

Fault Finding

There are some very good fault finding charts in the document (1).
Here are some more tips: The section numbers in the faultfinding chart correspond to the test sequence sections.

1. Check all values of components.
2. Check D7, U2, R10, D1, Check U1 socket, any short circuits on 5v rail.
3. Check U1, Y1, D2-5, R11, R12, and R13.
4. Check R14, J9, shorts on U1 pins 2,3.
5. Check J2, R16, LinkTT3,
6. Check GPS antenna connections. Check 5vDC on antenna socket.
7. Check RV6, R5, R1-4, C1, J1, R7, Q1 and R8

Installation

Enclosure.

The enclosure has not been included with this kit, to allow for users to install the unit inside their own radio if they wish. The Enclosure used with the prototype is a diecast box type Hammond 1590B size 112x60x32mm. If needed, the GPS antenna can be plugged into the GPS receiver through a clearance hole in the box side, and the LEDs can be viewed through holes in the lid.

GPS receiver

The receiver is connected to the modem board using socket J2. It can be fixed to the modem PCB by either M3 screws and nuts supplied as per drawing below, or just thick wire soldered into the fixing holes nearest the antenna socket.

Wiring

The Track05 unit must be wired to suitable radio, with the audio out connected to the microphone, and the “audio in” connected to the speaker. The “PTT Out” can be connected to the PTT input of the radio. However, some transmitters will transmit if a DC resistance is placed across the microphone input, as thisTrack05 does. Also. The PTT function can be performed using the transmitter VOX feature, but this is not the best way.

Adjustment

With the system all powered, adjust the CarDet (Carrier Detect) trimpot so that the CD LED comes on when the radio receives a data transmission, or becomes un-squelched.
The AF out trimpot must be adjusted to give adequate modulation on transmit. This can be tricky to perform without a modulation meter, but listening to your transmitter on another receiver will be a good guide. Increase the AF Out level until the transmission sounds distorted, then back it off until a clean audio is restored.
The GPS antenna should be placed on the outside of the car with a good all round view of the sky. Make sure the closing of car doors will not damage the cable.

Specification

Parameter	**Value**
Supply Voltage	+12vDC (9-16vDC)
Supply current	200mA
Backup supply	+5 to +18vDC @900uA
Antenna supply	+5vDC 50mA max
PTT output	100mA 50vDC max
Audio output	80mV RMS max

Table 1 Specification

Pin functions

J1 Radio Connector

1	Audio Out, with PTT current.	E	Low level audio to the transmitter microphone.
2	Carrier Detect	O	Digital input to inhibit Track05 transmission.
3	PTT out.	O	Open collector output to PTT of transmitter. Goes low when transmitting. This is not needed if the transmitter has VOX or will PTT on DC current on the mic input.
4	Pri/Sec	O	External control of Primary Secondary mode of Tinytrack modem.
5	Audio in	O	Audio input to inhibit Track05 transmission
6	Ground	E	Common connection for all grounds.
7	+V supply 12vDC	E	Supply input
8	PTT in	O	Input from transmitter microphone.
9	Backup supply	O	12v supply to keep GPS clock and data valid when main supply id turned off.

Table 2 J1 Radio connector

Note E=Essential connection. O=Optional connection

J9 PC Comport Connector

1	NC Note 1		6	NC Note 1
2	TX data Output from Track05		7	NC Note 1
3	RX data Input to Track05		8	NC Note 1
4	NC Note 1		9	+V supply 12vDC
5	Ground			

Table 3 J9 PC Comport Connector

Note 1 - Reserved - Do not connect

J5 External GPS connector, if fitted instead of J9.

1	Note 1		6	Note 1
2	RX data Input to Track05		7	Note 1
3	TX data Output from Track05		8	Note 1
4	Note 1		9	+V supply 12vDC
5	Ground			

Table 4 J5 External GPS connector

Note 1 - Reserved - Do not connect

Link functions

TT3	TTL data	Bypass for optional inverter for Tinytrack2 modem.
J6	TXEN	Optional output to enable the transmitter circuit
SW1	Pri/Sec	Switch input to change modem from primary to secondary mode. Can be used to signal change of vehicle state.
J8	ActAnt	Link to be removed if DC voltage is not wanted on GPS antenna coax.

Table 5 Link functions

GPS pin out

Pin #	Name	Description	Pin #	Name	Description
1	PREAMP	Preamp power input	11	SDO1	Serial data output port #1
2	PWRIN	Primary VDC power input	12	SDI1	Serial data input port #1
3	VBATT	Battery backup voltage input	13	GND	Ground
4	PWRIN	Primary VDC power input	14	N/C	Reserved (no connect)
5	M_RST	Master reset input (active low)	15	SDI2	Serial data input port #2
6	NA	NA	16	GND	Ground
7	NMEA	Select NMEA format	17	GND	Ground
8	GPIO3	ROM default select	18	GND	Ground
9	NA	NA	19	TMARK	1 PPS time mark output
10	GND	Ground	20	10KHZ	10 kHz clock output

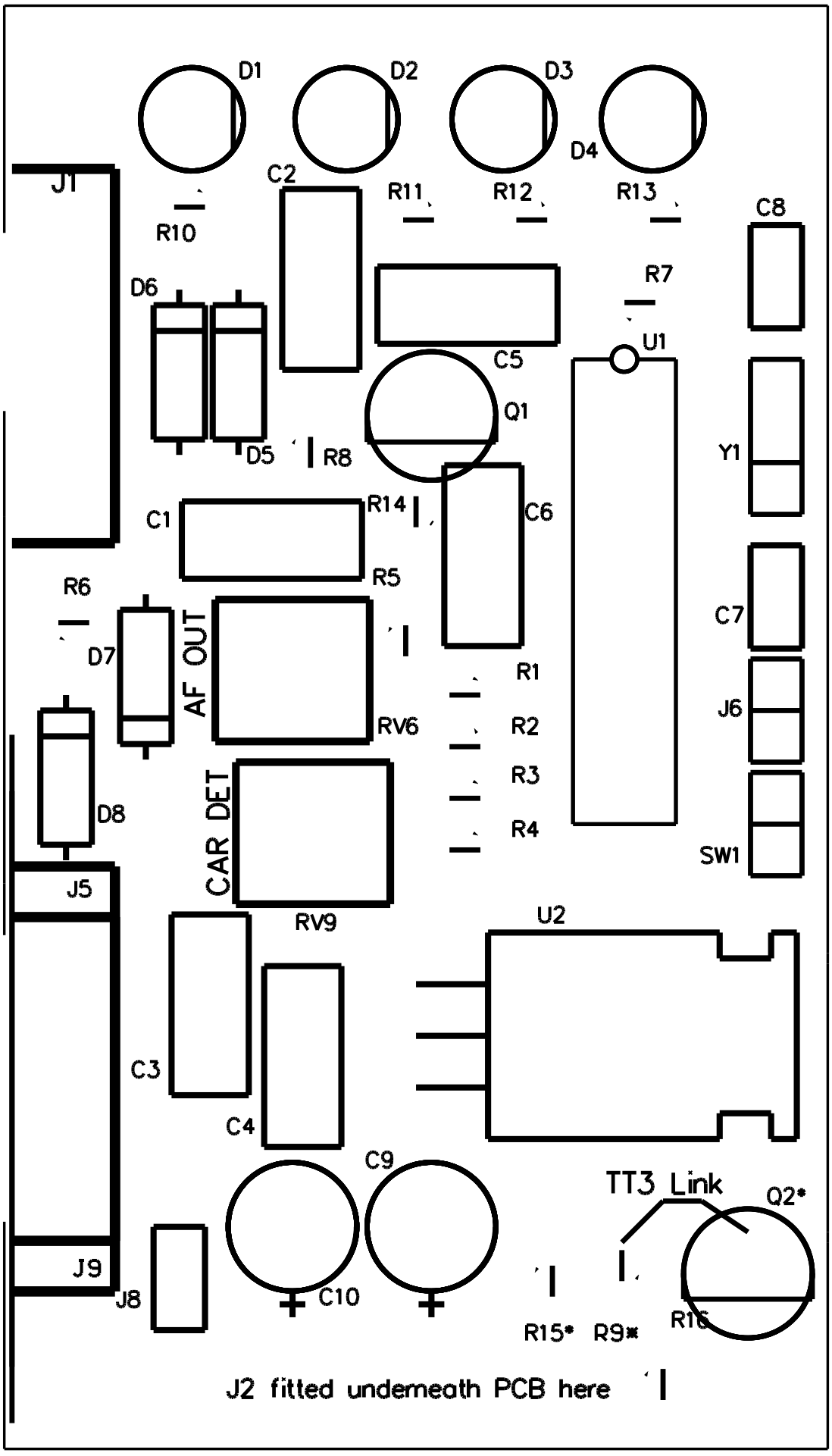
Table 6 Pinout of Conexant GPS module

Bill of Material for Track05 project				
Qnty	**Part Type**	**Designator**	**Footprint**	**Description**
6	100nF	C1 C2 C3 C4 C5 C6	RAD0.2	Capacitor radial 0.2"
2	15pF	C7 C8	RAD0.1	Capacitor radial 0.1"
2	10uF 16v	C9 C10	RB.1/.25	CAP ELECT 0.1" pitch
1	Power (Red)	D1	LED	LED 5mm
1	CD (Orange)	D2	LED	LED 5mm
1	GPS (Green)	D3	LED	LED 5mm
1	PTT (Yellow)	D4	LED	LED 5mm
2	1N4148	D5 D6	DIODE0.4	Switching diode
1	1N4004	D7	1N400X	Power diode
1	3V3	D8	DIODE0.4	Zener 300mW
2	DB9S Radio/PC	J1 J9	EDGE9\F	DB9 skt, solder bucket
1	BC546 or 547 or 548	Q1	TO-92	NPN TRANSISTOR
1	8k2	R1	RESUP	RESISTOR LEADED
1	3k9	R2	RESUP	RESISTOR LEADED
1	2k0	R3	RESUP	RESISTOR LEADED
5	1k	R4 R10 R11 R12 R13	RESUP	RESISTOR LEADED
1	220k	R5	RESUP	RESISTOR LEADED
4	10k	R6 R7 R14 R16	RESUP	RESISTOR LEADED
1	2k2	R8	RESUP	RESISTOR LEADED
2	10k Pot	RV6 RV9	VR7	Trim pot triangular footprint
1	LM7805	U2	TO-220	5v regulator 1A
1	10MHz Two leg type	Y1	SIP3	Ceramic Resonator 0.2" pitch
1	DIP18 socket	U1socket	DIP-18	Turned pin socket for U1
1	PIC16F628	U1	DIP-18	Microcontroller Tinytrack3
1	PCB	PCB1		PCB for Track05 project
1	Antenna GPS	ANT1		ALPS
1	GPS receiver	GPS1	See J2	Conexant Jupiter
1	GPS module socket	J2	2x10pin 2mm	Supplied with PCB by Branch05
4	Nut M3	N1 – N4		For SC1 and SC2
1	Screw 20mm M3	SC1		Fixing PCBs together
1	Screw 10mm M3	SC2		Fixing U2
1	Heatsink	HS1		For fitting to U2
Optional components if Tinytrack2 used.				
1	BC547*	Q2*	TO-92	NPN TRANSISTOR
1	10k*	R9*	RESUP	RESISTOR LEADED
1	3k9*	R15*	RESUP	RESISTOR LEADED
Optional component if external GPS used, to maintain compatibility with Byonics PCB.				
1	DB9P External GPS	J5	EDGE9\M	DB9 plug, solder bucket

Table 7 Bill of materials

References:

1. tinytrak3.pdf
2. http://www.byonics.com/tinytrak
3. TinyTrak3Config.exe


D1
D2
D3
D4
J1
C2
R11
R12
R13
C8
R10
R7
D6
C5
U1
Q1
D5
R8
Y1
C1
R14
C6
R5
R6
C7
D7
AF OUT
R1
J6
RV6
R2
R3
D8
CAR DET
R4
SW1
J5
RV9
U2
C3
C4
C9
TT3 Link
Q2*
J9
J8
C10
R15*
R9*
R16
J2 fitted underneath PCB here

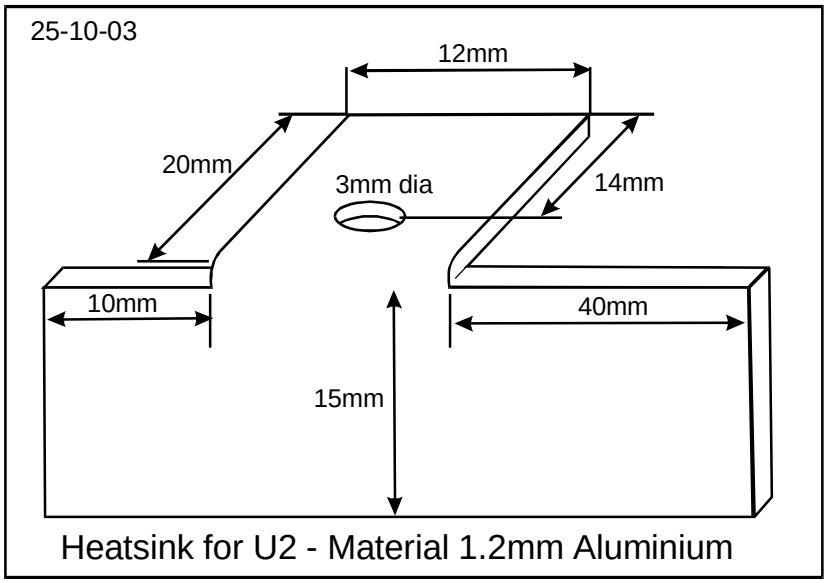


Figure 2 Heatsink for U2

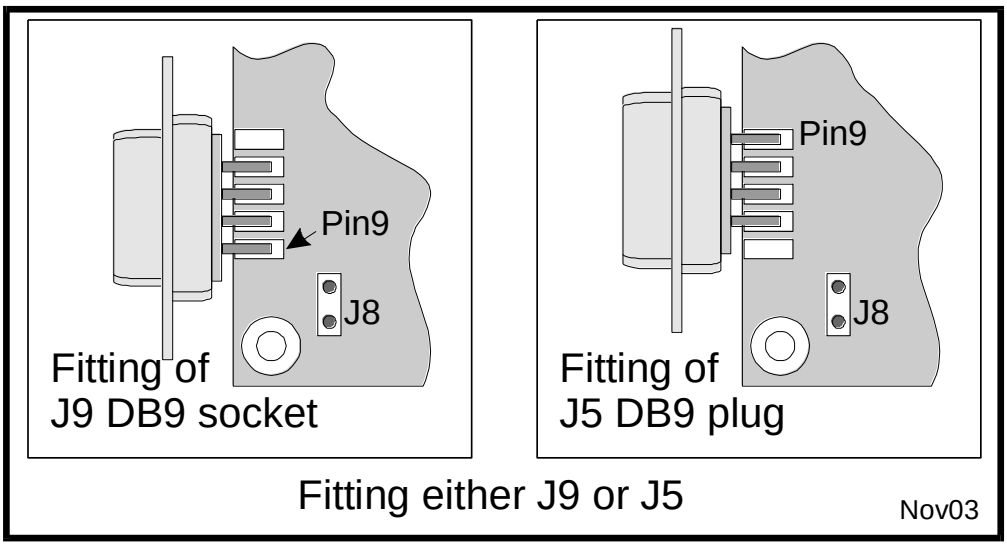


Figure 3 Fitting J9 (standard socket) or J5 (plug)

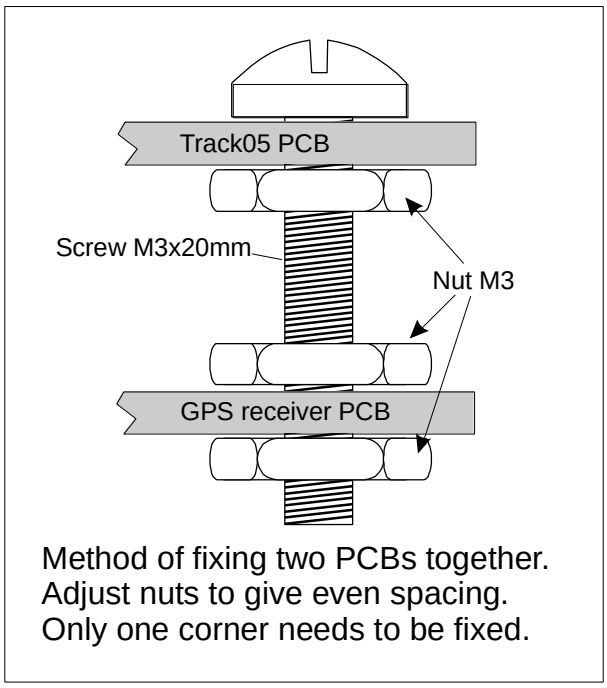


Figure 4 Method of fixing PCBs together

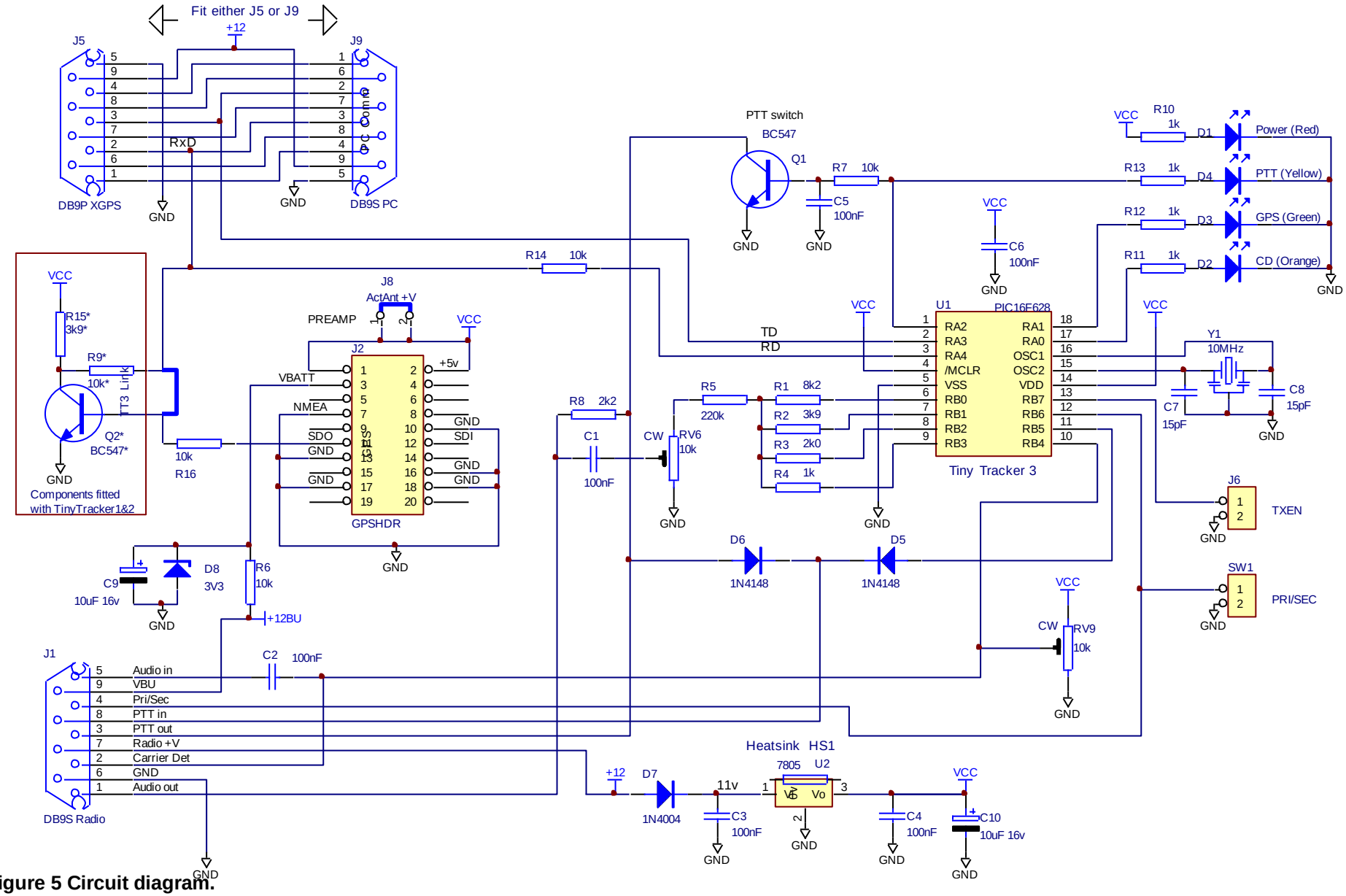


Figure 5 Circuit diagram.