Board Layout

9-12V MOD1 TP2 5V C2
TP1 + IN + OUT 5V
C1 9-12V GND GND C3
D3 T4 D6 MOD4 PHONE LINE
F1 C4 R5 RING TIP J15
0.5A IC2 R19 C12 MOD5
DC IN IC1 R7 TIM2015 (V1.0) 1
+ GND R17 R16 Mon Volume
J1 R18 R8 MOD3 R6 R20 C8 C16
C6 C11 C9
V+5V GPS J11 R14 R24 IC3 C10 R23
+3.3V R21 C7 R22 C15
GND MOD2 C5 CR2032 C13 C14
RX WIFI R12 LCD Contrast C27
GND R11 R10 R13 R25 MOD6
R9 R1 R15 T5
R4 R3 R2
T2 T1 T3

OUT RADIO LEDS ROTARY LCD MON VOLUME SPKR
SER 30S INPUT CALL SYNC PULSE PWR ENCODER
OUT GND OUT GND +5V IN GND A C A C A C A C PB GND B GND A GND +5V CON +5V SDA CLK +5V BL- O/P GND WIP GND I/P GND SW - +

TIM2015 Speaking Clock

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David Thorpe

Web Site
unusualelectronics.co.uk

Version 1.0

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Sheet 1

Component list

Component	Value	Package
C1	100µF	25V Working Electrolytic (Pitch 2.5mm)
C2	100µF	25V Working Electrolytic (Pitch 2.5mm)
C3	0.1µF	50V Working ceramic (Pitch 2.54mm)
C4	0.1µF	50V Working ceramic (Pitch 2.54mm)
C5	0.1µF	50V Working ceramic (Pitch 2.54mm)
C6	10µF	25V Working Electrolytic (Pitch 2.5mm)
C7	10µF	25V Working Electrolytic (Pitch 2.5mm)
C8	10µF	25V Working Electrolytic (Pitch 2.5mm)
C9	0.1µF	50V Working ceramic (Pitch 2.54mm)
C10	1nF	1000pF 50v ceramic (pitch 2.5mm)
C11	1nF	1000pF 50v ceramic (pitch 2.5mm)
C12	10µF	25V Working Electrolytic (Pitch 2.5mm)
C13	10µF	25V Working Electrolytic (Pitch 2.5mm)
C14	10µF	25V Working Electrolytic (Pitch 2.5mm)
C15	10µF	25V Working Electrolytic (Pitch 2.5mm)
C16	0.47µF	250V (pitch 15mm)Panasonic ECQE2474JF
D1	Yellow LED	5mm or 3mm led (high brightness)
D2	Red LED	5mm or 3mm led (high brightness)
D3	IN4004	1N4004 1Amp rectifier diode
D4	Green LED	5mm or 3mm led (high brightness)
D5	Blue LED	5mm or 3mm led (high brightness)
D6	1N4148	Diode 75v 150ma general purpose
F1	0.5A	PolySwitch fuse 0.5A hold
IC1	LD1117-3v3	Low drop-out 3.3V 800mA regulator (SOT-223)
IC2	PIC18F25K22	Programmed microcontroller
IC3	MC33072PG	Op Amp (DIL8)
J1	DC_IN	MOLEX 22-23-2021 2pin header
J2	SYNC_OK	MOLEX 22-23-2021 2pin header
J3	CALL_LED	MOLEX 22-23-2021 2pin header

J4	30S_OUT	MOLEX 22-23-2021 2pin header
J5	ENCODER	MOLEX 22-23-2051 5pin header
J6	SERIAL_OUT	MOLEX 22-23-2021 2pin header
J7	RADIO_IN	MOLEX 22-23-2031 3pin header
J8	POWER_LED	MOLEX 22-23-2021 2pin header
J9	LCD	MOLEX 22-23-2081 8pin header
J10	PULSES	MOLEX 22-23-2021 2pin header
J11	molex_5	MOLEX 22-23-2051 5pin header
J12	molex_5	MOLEX 22-23-2051 5pin header
J13	HEADPHONES	MOLEX 22-23-2021 2pin header
J14	SPEAKER	MOLEX 22-23-2021 2pin header
J15	PHONE_LINE	MOLEX 22-23-2021 2pin header
K1	C2x4	2.54mm 2x4way socket for wifi module
LS1	8Ω 2watt	34x34mm or similar speaker
MOD1	D-Sun Vreg	D-SUN 3A DC-DC Converter module
MOD2	ESP8266	ESP8266 wifi Module (type ESP-01)
MOD3	DS3231_Module	RTC_Module
MOD4	CATALEX Sound	CATALEX mp3 module
MOD5	MITEL_MODEM	MITEL modem module
MOD6	Amp 3W	3W PAM8403 Amplifier module
R1	10K	Sub-Miniature Resistor (0.25W)
R2	1K	Sub-Miniature Resistor (0.25W)
R3	1K	Sub-Miniature Resistor (0.25W)
R4	10K	Sub-Miniature Resistor (0.25W)
R5	10K	Sub-Miniature Resistor (0.25W)
R6	10K	Sub-Miniature Resistor (0.25W)
R7	10K	Sub-Miniature Resistor (0.25W)
R8	33K	Sub-Miniature Resistor (0.25W)
R9	10K	Sub-Miniature Resistor (0.25W)
R10	4K7	Sub-Miniature Resistor (0.25W)
R11	10K	Sub-Miniature Resistor (0.25W)
R12	2K7	Sub-Miniature Resistor (0.25W)

R13	10K	6mm Pre-set resistor (LCD contrast)
R14	10K	Sub-Miniature Resistor (0.25W)
R15	1K	Sub-Miniature Resistor (0.25W)
R16	1K	Sub-Miniature Resistor (0.25W)
R17	1K	Sub-Miniature Resistor (0.25W)
R18	1K5	Sub-Miniature Resistor (0.25W)
R19	47K	Sub-Miniature Resistor (0.25W)
R20	50K	Pre-set resistor (monitor headphones volume)
R21	10K	Sub-Miniature Resistor (0.25W)
R22	10K	Sub-Miniature Resistor (0.25W)
R23	47K	Sub-Miniature Resistor (0.25W)
R24	47K	Sub-Miniature Resistor (0.25W)
R25	68R	Sub-Miniature Resistor (0.25W)
R26	47K	Potentiometer (LOG) with switch
R27	10K	Sub-Miniature Resistor (0.25W)
T1	BC547B	General purpose NPN Transistor TO92B
T2	BC547B	General purpose NPN Transistor TO92B
T3	BC547B	General purpose NPN Transistor TO92B
T4	BC327.25	General purpose PNP 800mA TO92B
T5	BC547B	General purpose NPN Transistor TO92B

enc1	Rotary Encoder	20 step 12mm mechanical with push-button
LCD1	128x64 LCD	12864 128x64 Graphic LCD, Blue Back-light
IC socket	28 pin	0.3" DIP IC socket for microcontroller
socket	26 pin	Single Row Female 2.54mm Strip Header
		MOLEX 10-11-2023 2way Receptacle
		MOLEX 10-11-2033 3way Receptacle
		MOLEX 10-11-2053 5way Receptacle
		MOLEX 10-11-2083 8way Receptacle
		MOLEX 46999-0101 CONTACT crimps
		Knobs x2 for controls

power jack panel socket
headphone panel socket
3.5mm stereo jack plug for sound module
speaker grill
led bezel panel mounts (5mm or 3mm)
Right-angle 2.54mm header socket for LCD
2.54mm header pins for LCD module
micro sdcard (1gb or 2gb)
cr2032 3v coin-cell
3mm nuts and bolts for PCB
case
12v or 9v DC power supply (switching type)

Module Preparation

D-Sun Switching Voltage regulator module (MOD1)

GND

GND

+5V out

+9 TO 12V
DC in

Adjust output voltage
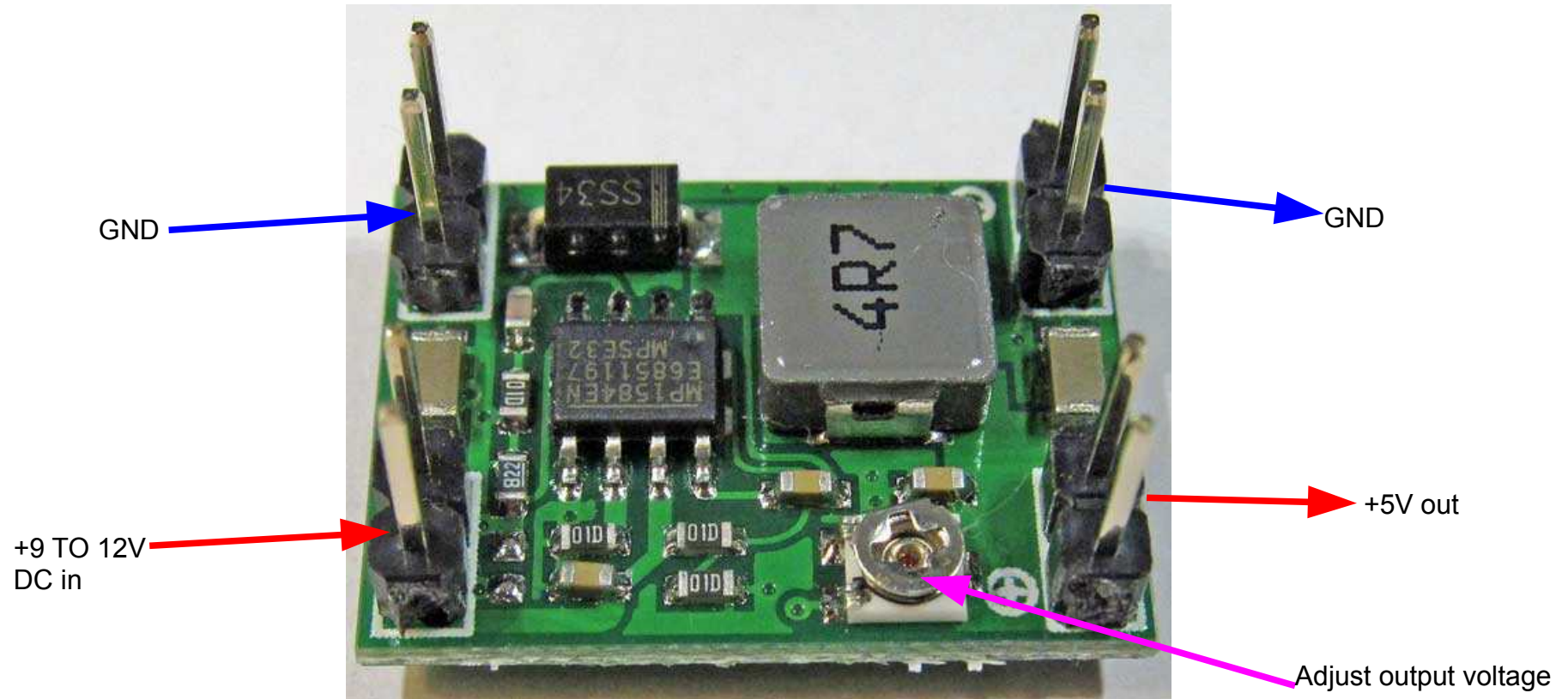
This module supplied is set to an unknown output voltage and must be calibrated to 5 volts <u>before</u> fitting to the PCB.

- Fit header pins to the board as shown (the board will later be fitted with the components facing down to the main PCB).
- Connect a volt meter and adjust the trimmer to exactly 5 volts (if you can't get it exact, slightly below is OK (do not set higher!))

DS3231 RTC (Real Time Clock) module (MOD3)

Remove Diode

Bend these pins straight

Fit 4 header pins

The glass diode (shown) must be **removed** as the module manufacturer originally provided it to charge a super-capacitor instead of the lithium coin-cell currently being used.

(Failure to remove the diode could cause the coin-cell to eventually burst)

To remove the diode, wear protective glasses and either break it off using pliers or unsolder it.

Bend the 6 existing header pins straight so that the module can be soldered to the main board.

Fit 4 header pins to the unused holes as indicated (these will help to secure the module to the main board).

Do not insert the coin-cell battery yet (leave it until the main board is finished)

Catalex Sound Module (MOD4)
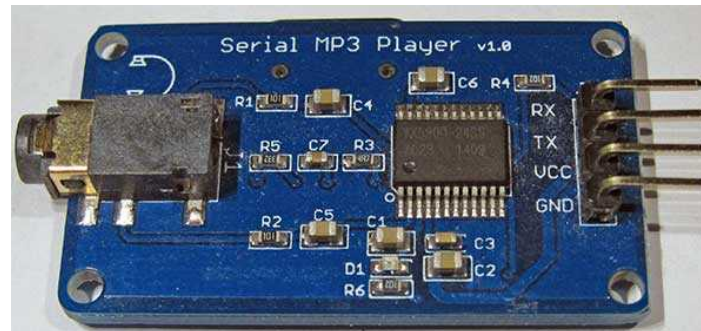
Bend these 4 pins straight

Bend the 4 header pins straight ready for attachment to the main board.
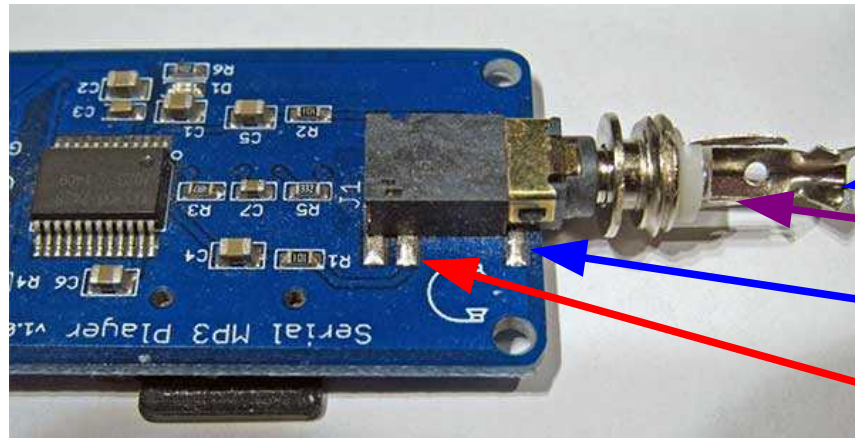
Ground (outer casing)

Audio output tag (inner)

Alternative ground connection

Solder audio output wire here if not using jack plug

Plug a 3.5mm stereo jack plug into module (without the outer plastic cover) The output can later be wired via the centre jack plug tag

or alternatively the jack plug can be omitted and the output wire soldered to the PCB pad as shown.

It is not essential to connect the jack ground tag or pad (as the module already has a ground header pin connection) but it may help to improve sound quality

Graphic LCD module (type QC12864b)

This module has the facility to use either a parallel or serial data interface .

They are usually supplied by the manufacturer pre-jumpered to the wrong, parallel mode using a tiny surface mount zero ohm resistor.

This 0Ω resistor (Marked R9) must be unsoldered and moved to the serial interface position Marked R10).
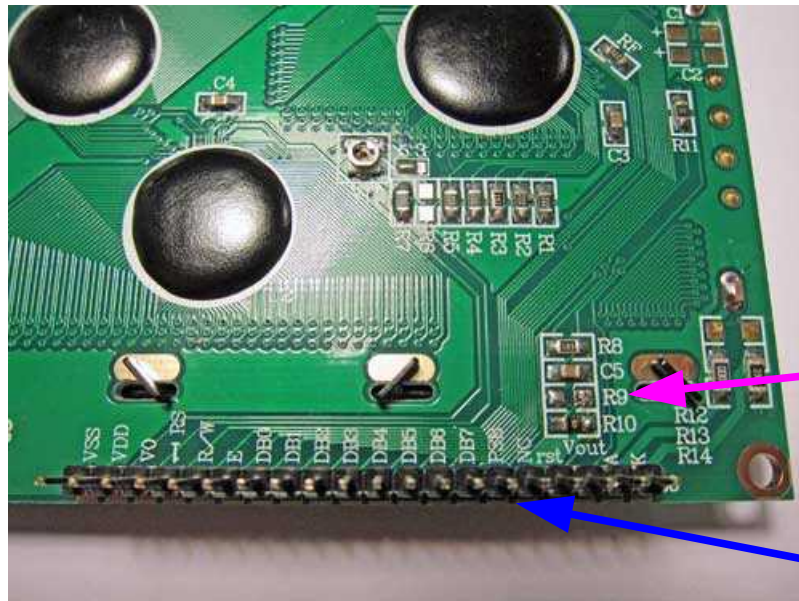
Remove R9 and solder into the R10 position

Fit Interface header pins

 You will need to use a magnifying glass and tweezers to move the resistor. (if you cant successfully place it in the R10 position,just use a solder blob to bridge the two solder pads for R10 instead).

If you wish to be able to plug-in the module easily, solder a length of header pins (20 pins) to the interface holes as shown.

(Alternatively, the interface cable wires could be directly soldered to the holes to save space in the case)

Assembly

1. Start by fitting all of the resistors, the small 1N4148 diode (D6)

2. Then the surface mount 3.3v voltage regulator (IC1). (Carefully solder all 3 leads and the small heat-sink tab)
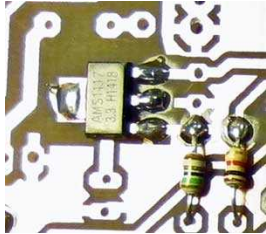
3. Now fit the four small 0.1µf decoupling capacitors.

4. Fit the two small 1nF capacitors (C10 & C11)

5. Fit the 28pin IC socket for the microcontroller

6. Fit the fifteen molex header sockets (ensuring the locking tabs are all correctly positioned)

7. Now the 8way header socket for the wifi module

8. The Mitel modem requires a special socket. Cut some Single-Row Female 2.54mm Strip Header into two lengths of 13 pins then solder them to the board ensuring good vertical alignment.
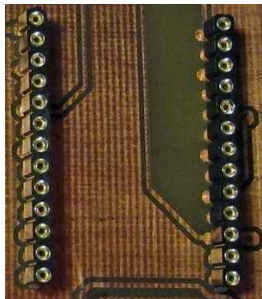
9. Solder the "D-Sun" voltage regulator to the board with its component side facing down and the white arrow pointing towards the diode D6
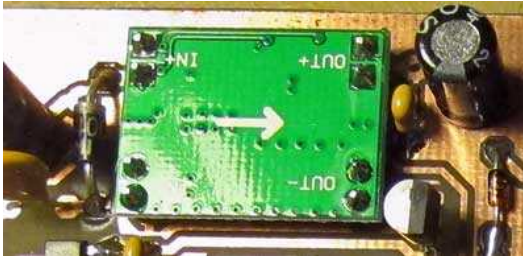
10. Now fit D3 and the two 100µf electrolytic capacitors (C1&C2) ensuring correct polarity.

11. Carefully solder fuse F1 (do not apply excessive heat)

12. Fit the only PNP type transistor T4 (BC327) near to the D-Sun module.

At this point it is possible to check that the regulator is still correctly set to 5 volts without risk of damaging any sensitive parts.

Plug-in a 9 to 12v DC supply into J1 and measure the voltage across the "out-" and "out+" pins of the D-Sun module.

If the voltage is OK then disconnect and proceed with the next stage of assembly.

13. The the PAM8403 Audio Amp module has to be manually wired to the board as normal 2.54mm header pins wont fit it.

First apply a piece of insulating tape to the underside of the module. Now place the module in position on the board and connect it up using individual lengths of bare single core wire threaded through each hole in the module and into the main board. (you can leave a small gap between the module and the board to make it easier to fit)
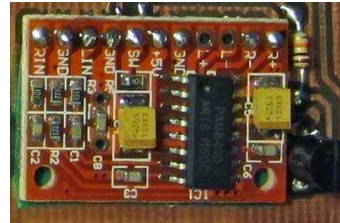
(There is no need to connect the L- and L+ holes).

14. Fit the remaining four transistors. Ensuring correct way round.

15. Solder the Catalex sound module to the board and connect the audio output either using a stereo jack or direct wiring as described earlier.

16. Fit the 8pin IC2 (this can be soldered direct to the board instead of using a socket for best audio quality)

17. Fit the two pre-set resistors (note they have different values, 10k for the LCD contrast (R13) and 50k for the headphone monitor volume (R20)

18. Fit the 10µf electrolytic capacitors ensuring correct polarity.

19. Solder-in the DS3231 RTC module and insert the Mitel modem module carefully into its socket.

20. fit the large 0.47µf capacitor next to the Mitel modem module.

21. Insert the micro-sdcard into the Catalex module

22. Insert the microcontroller chip with pin 1 nearest to the D-Sun regulator.

23. Plug-in the wifi module with the antenna section near the left edge of the main board.
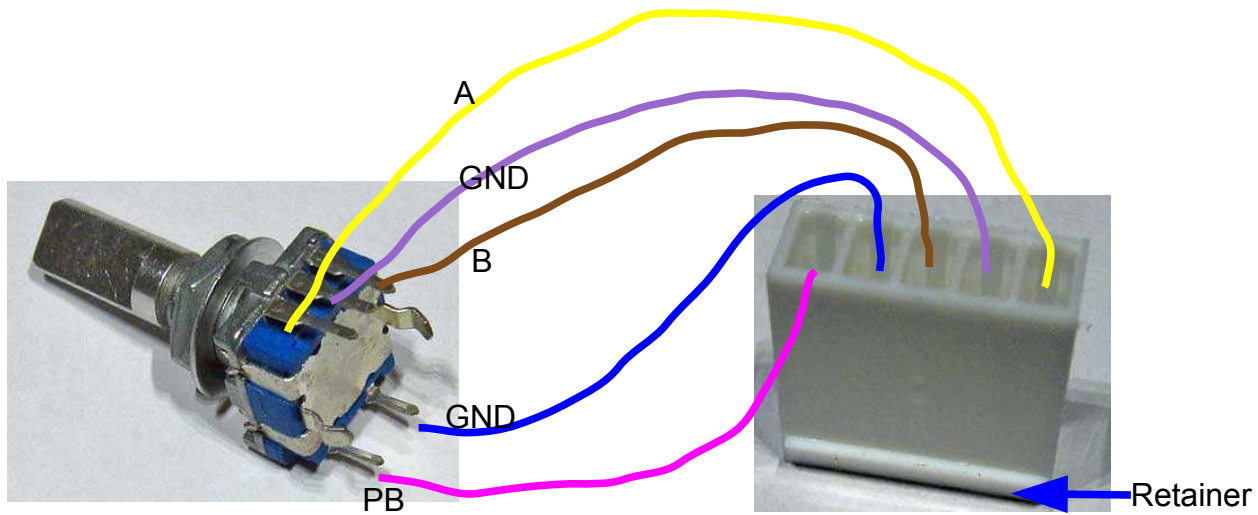
24. Insert the CR2032 coin-cell into the RTC module (with the + marking visible on top)

Wiring

A crimp tool is needed for wiring the Molex receptacles.

Use the outer crimp section

Rotary Encoder

A

GND

B

GND

PB
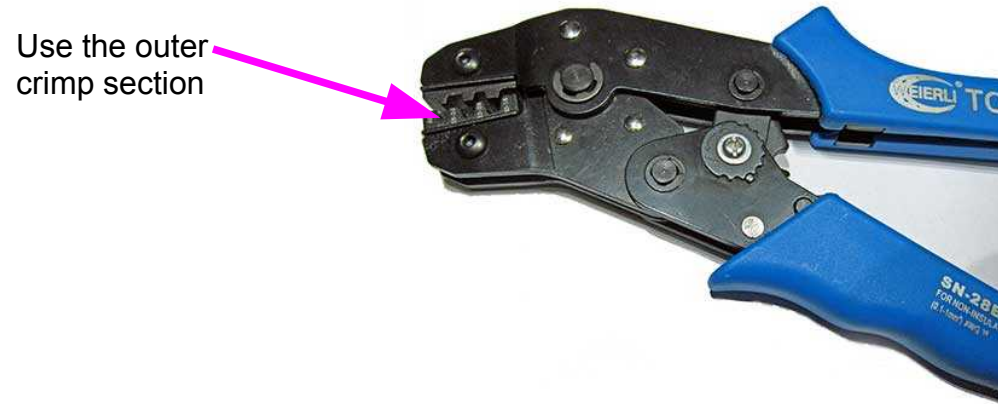
Retainer

LEDs

The LEDs can either be fitted into chrome bezels or glued to the front panel holes with hot melt glue.

If using a bezel the led may have to be fitted into the plastic holder section of the bezel before soldering.

The Cathode "C" connection is usually indicated by a shorter LED lead and a flat area on the side of the LED.

Solder a black or blue wire to the Cathode connection and a suitable colour to the Anode connection.

Cathode

Retainer

Anode

Typical Bezel

Plastic insert for LED leads
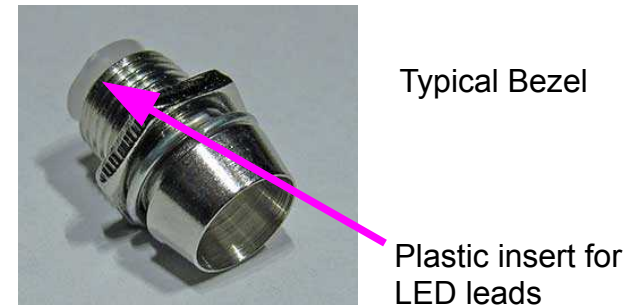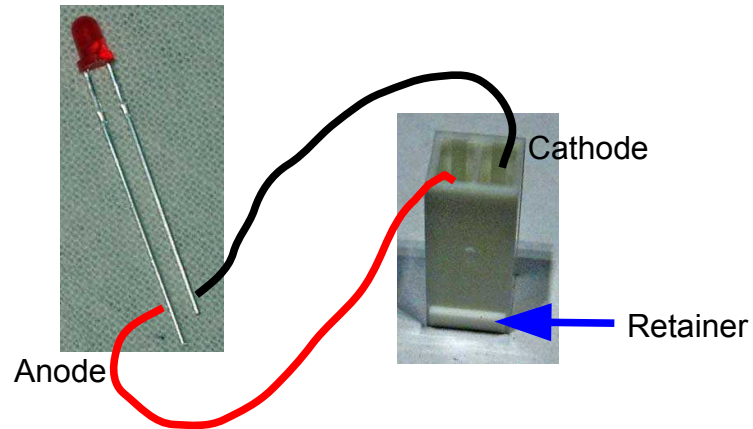
Each LED lead needs sleeving with 2.4mm heat-shrink tubing.

LCD

Either using a separate header and socket as described earlier or wire directly to the LCD module
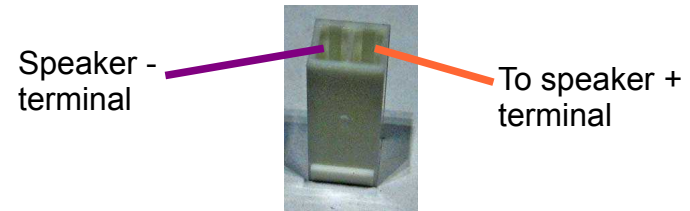

pin1

pin20
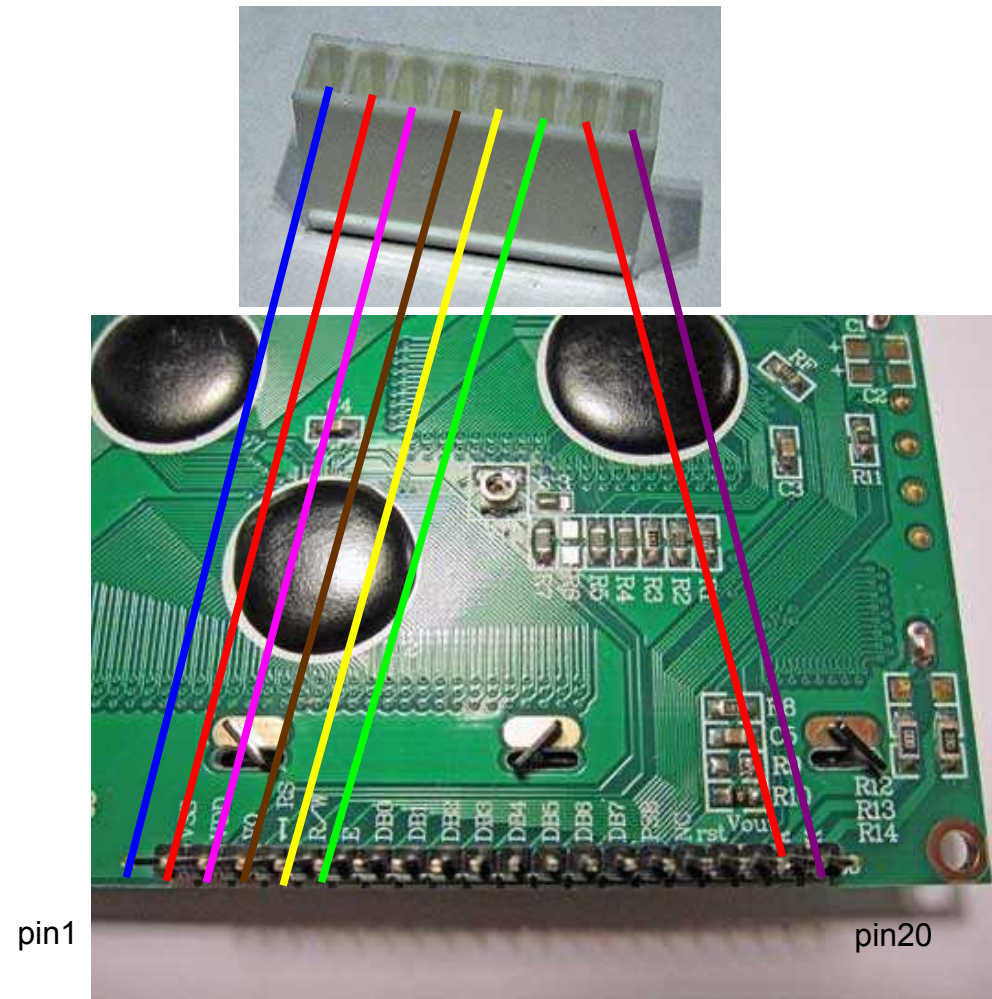
Volume Control

The volume control incorporates a switch to turn the amplifier off into standby mode for power saving.

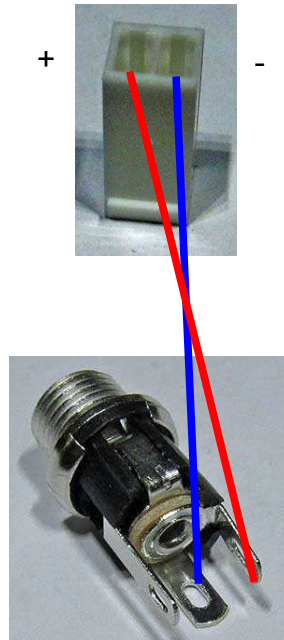(Screened cable could be used for improved audio quality)

Speaker

Speaker -
terminal
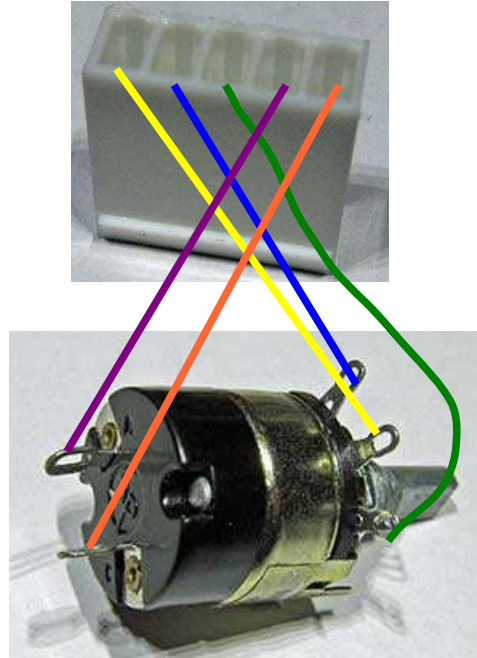
To speaker +
terminal

Power Jack socket

Typical connections shown (may vary for different types of power socket)

+   -

Use heat-shrink tubing over the entire socket to cover the connections after soldering.

Telephone line cable

Ideally obtain a telephone cable with the telephone line plug already fitted as it may require a special tool otherwise.

If the cable wires are the metal coated type, check the coating doesn't become damaged while crimping them to the molex pins.

Pin2 = "A"   Pin5 = "B"

BT 431A Plug
(Only pins 2 & 5 used)

RING "B"   TIP "A"
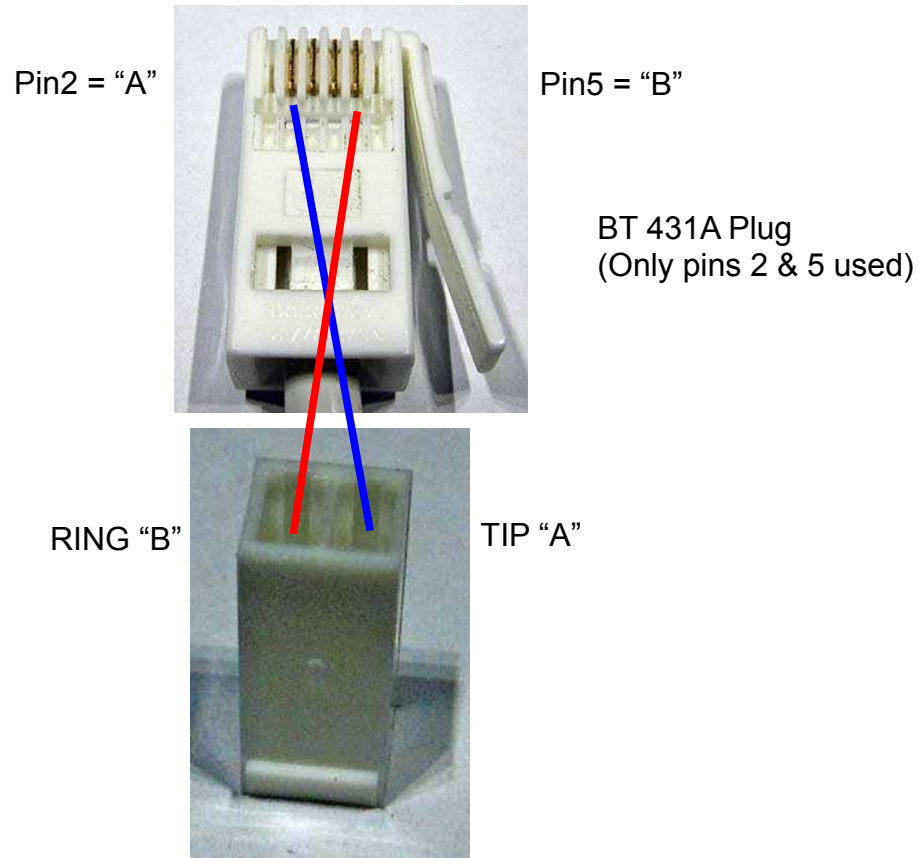
Initial testing

Connect the encoder, LEDS, Speaker, volume control and LCD

Do not connect the telephone wire yet.

Connect a 9 to 12v regulated DC power supply rated at 1 Amp or better.

The power led and the LCD back-light should light up.

All the other LEDs should also light briefly for a few seconds on power-on to indicate they are working.

If the LCD appears to be blank, adjust the contrast pre-set near the LCD molex connector until the display text is visible.

Press the encoder button to enter the menu.

Now turn the encoder left or right to navigate the LCD menu.

Set the time and date.

Turn the volume control and you should hear the voice.

If you have fitted the headphone monitor socket, plug in and adjust the headphone volume using the pre-set near the Catalex module.

Disconnect the power then re-connect and check the time is still valid.

If everything works so far, disconnect the power then connect the telephone wire molex connector and plug in to a telephone connection.

Power-on and try calling the phone number. It should answer and light the red call led.

To setup the wifi module and configure menu settings please see the user manual.

Board Dimensions (in mm)   140x85mm
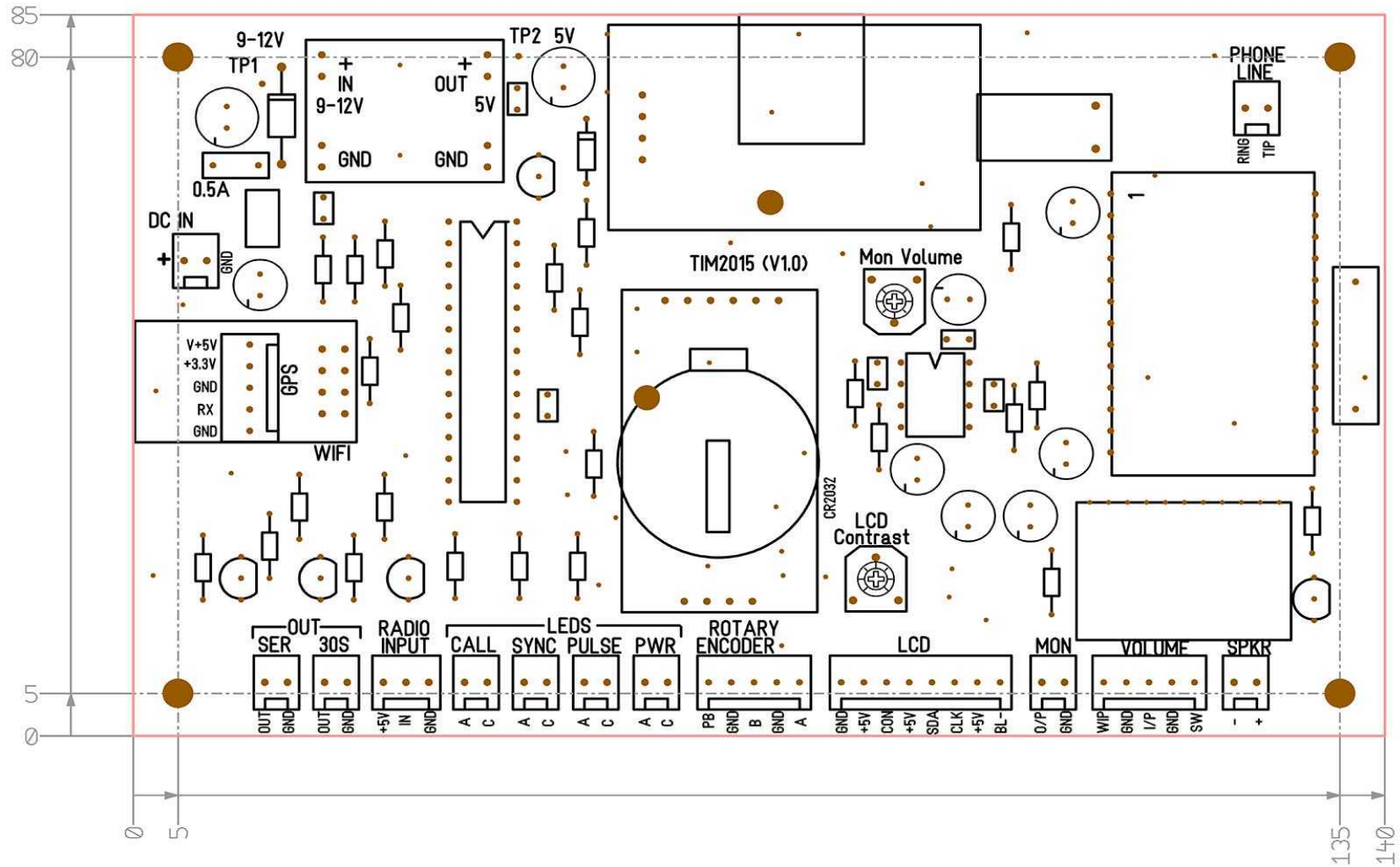
Specifications

Power supply requirements:

9 - 12 Volts DC @ 1Amp rating (Switching type adapter preferred)

3 Volts lithium coin cell (CR2032) for the RTC timekeeping battery backup.

Power consumption:

Approx 0.55W (Amplifier=off, WIFI=off, Display brightness setting=34 (half power)

Approx 0.7W (Amplifier=off, WIFI=off, Display brightness setting=Maximum brightness

Approx 1.14W (Amplifier=off, WIFI=active, Display brightness setting=Maximum brightness

Approx 2.35W (Amplifier=full volume (8Ω speaker), WIFI=active Display brightness setting=Maximum brightness

Backup timekeeping battery power consumption:

0.85µA (Estimated run-time >10 years (or the shelf life of the CR2032 battery))

Dimensions:

PCB only - 140mm X 85mm X 1.6mm

Timekeeping Accuracy:

Unadjusted RTC accuracy ±2ppm from 0°C to +40°C. (about ± 5.4 seconds per month)

(Timekeeping may be improved by timekeeping fine adjustment menu setting)

Crystal Aging:

First year: ±1ppm

0-10 Years ±5ppm (RTC Manufacturer's estimate)