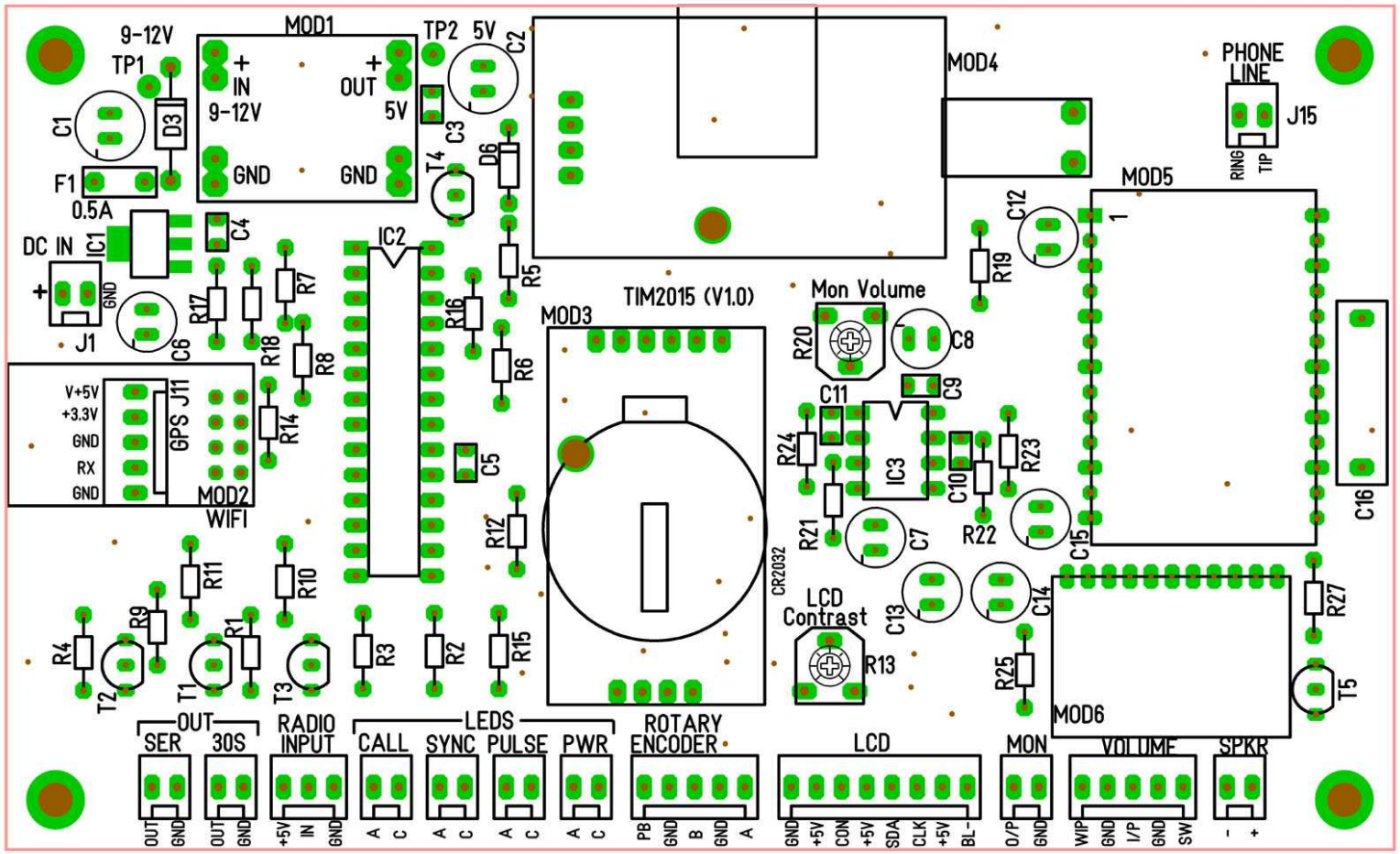
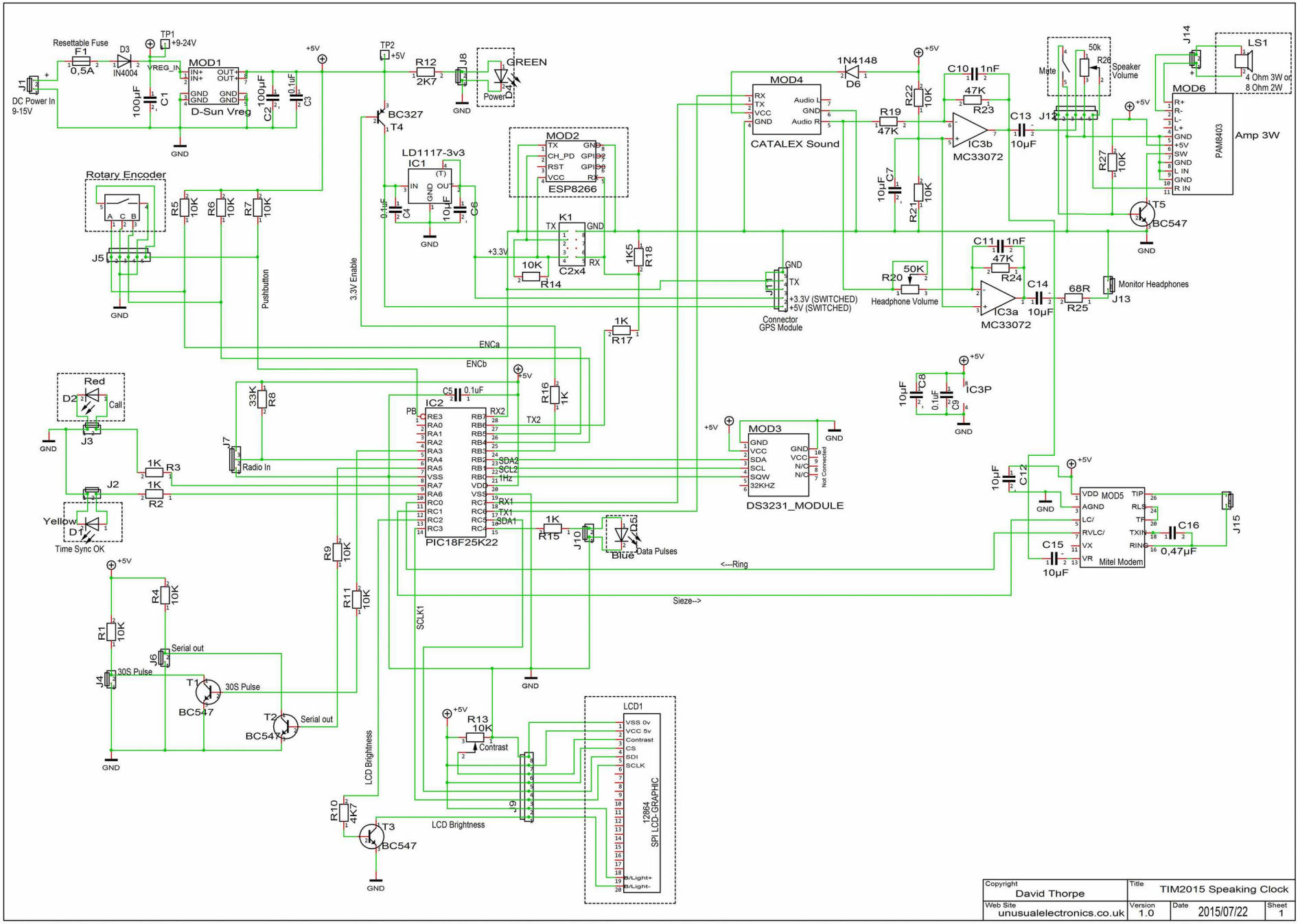
Board Layout




Resettable Fuse
F1
0,5A
D3
IN4004
TP1
+9-24V
J1
DC Power In
9-15V
MOD1
VREG_IN
D-Sun Vreg
100µF
C1
100µF
C2
0.1uF
C3
GND
+5V
TP2
+5V
R12
2K7
J8
GREEN
Power
D4
BC327
T4
LD1117-3v3
IC1
IN
GND
OUT
0.1µF
C4
10µF
C6
MOD2
TX
GND
CH_PD
GPIO2
RST
GPIO0
VCC
RX
ESP8266
K1
TX
GND
C2x4
RX
+3.3V
10K
R14
1K5
R18
3.3V Enable
Rotary Encoder
A C B
R5
10K
R6
10K
R7
10K
J5
Pushbutton
GND
ENCa
ENCb
1K
R17
Red
D2
Call
J3
GND
1K
R3
J2
1K
R2
Yellow
D1
Time Sync OK
33K
R8
J7
Radio In
C5
0.1uF
IC2
PIC18F25K22
PB
RE3
RA0
RA1
RA2
RA3
RA4
RA5
VSS
RA7
RA6
RC0
RC1
RC2
RC3
RB7
RB6
RB5
RB4
RB3
RB2
RB1
RB0
VDD
VSS
RC7
RC6
RC5
RC4
RX2
TX2
SDA2
SCL2
1Hz
RX1
TX1
SDA1
R16
1K
1K
R15
J10
J5
Blue
Data Pulses
R9
10K
R11
10K
SCLK1
R4
10K
R1
10K
J6
Serial out
J4
30S Pulse
T1
BC547
30S Pulse
T2
BC547
Serial out
GND
LCD Brightness
R10
4K7
T3
BC547
LCD Brightness
R13
10K
Contrast
J9
LCD1
VSS 0v
VCC 5v
Contrast
CS
SDI
SCLK
B/Light+
B/Light-
12864
SPI LCD GRAPHIC
MOD3
GND
VCC
SDA
SCL
SQW
32KHZ
GND
VCC
N/C
N/C
Not Connected
DS3231_MODULE
MOD4
RX
TX
VCC
GND
Audio L
GND
Audio R
CATALEX Sound
1N4148
D6
R19
47K
R22
10K
C10
1nF
47K
R23
IC3b
MC33072
C13
10µF
J12
C7
10µF
R21
10K
J11
GND
TX
+3.3V (SWITCHED)
+5V (SWITCHED)
Connector
GPS Module
R20
50K
Headphone Volume
C11
1nF
47K
R24
IC3a
MC33072
C14
10µF
68R
R25
J13
Monitor Headphones
50k
R26
Mute
Speaker
Volume
R27
10K
J14
LS1
4 Ohm 3W or
8 Ohm 2W
MOD6
R+
R-
L-
L+
GND
+5V
SW
GND
L IN
GND
R IN
PAM8403
Amp 3W
T5
BC547
GND
C8
10µF
0.1uF
C9
IC3P
GND
C12
10µF
GND
MOD5
VDD
AGND
LC/
RVLC/
VX
VR
TIP
RLS
TF
TXIN
RING
Mitel Modem
C16
0,47µF
C15
10µF
J15
<---Ring
Sieze-->
Copyright
David Thorpe
Web Site
unusualelectronics.co.uk
Title
TIM2015 Speaking Clock
Version
1.0
Date
2015/07/22
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)

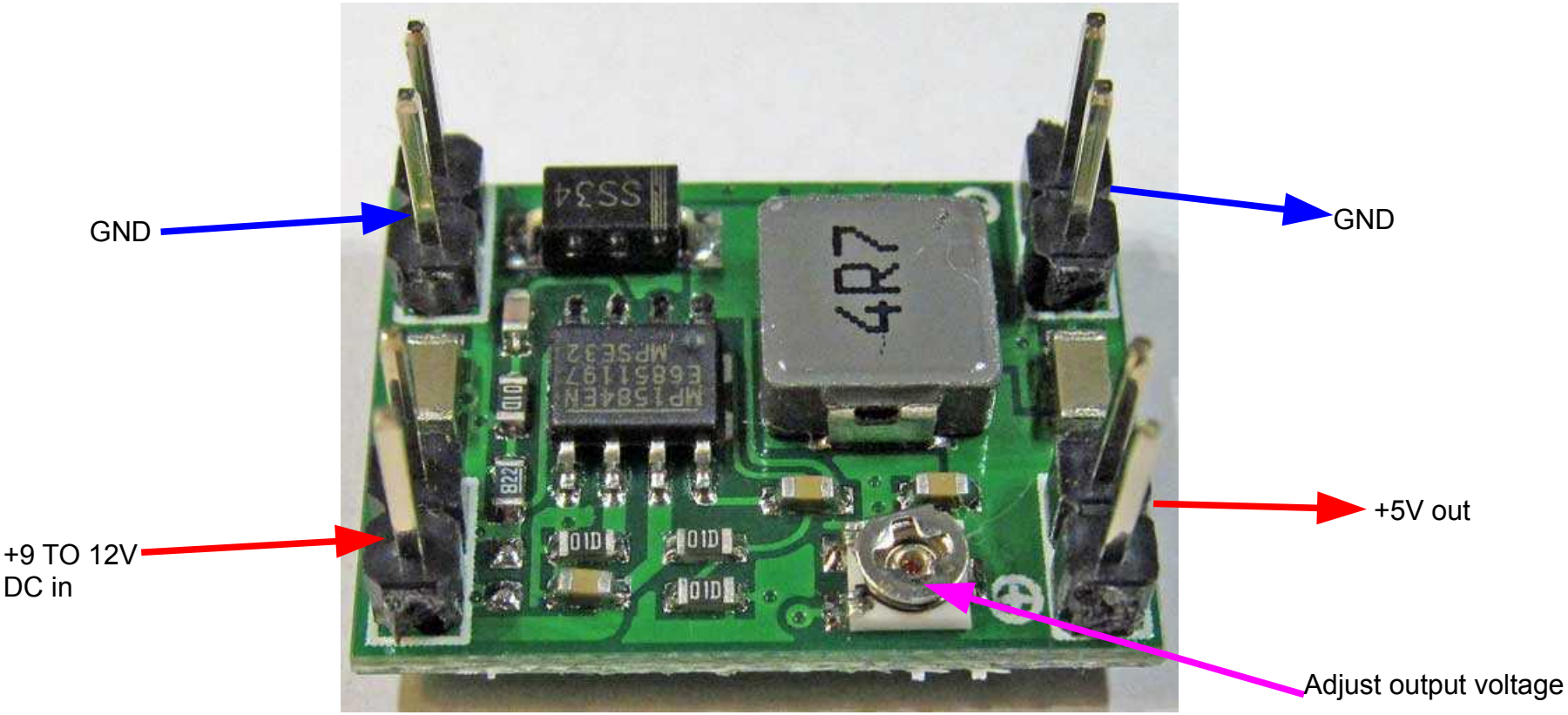
R13	10K	6mm Pre-set resistor (LCD contrast)
R14	10K	Sub-Miniature Resistor (0.25W)
R15	1K	Sub-Miniature Resistor (0.25W)
R16	1K	Sub-Miniature Resistor (0.25W)
R17	1K	Sub-Miniature Resistor (0.25W)
R18	1K5	Sub-Miniature Resistor (0.25W)
R19	47K	Sub-Miniature Resistor (0.25W)
R20	50K	Pre-set resistor (monitor 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

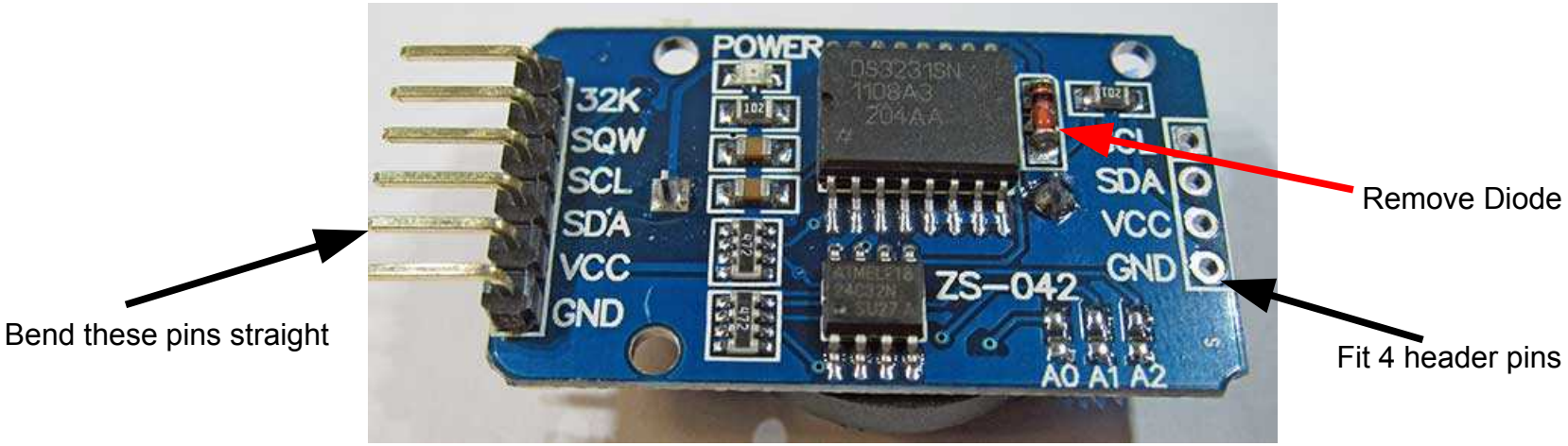
D-Sun Switching Voltage regulator module (MOD1)



This module supplied is set to an unknown output voltage and must be calibrated to 5 volts before 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)



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.

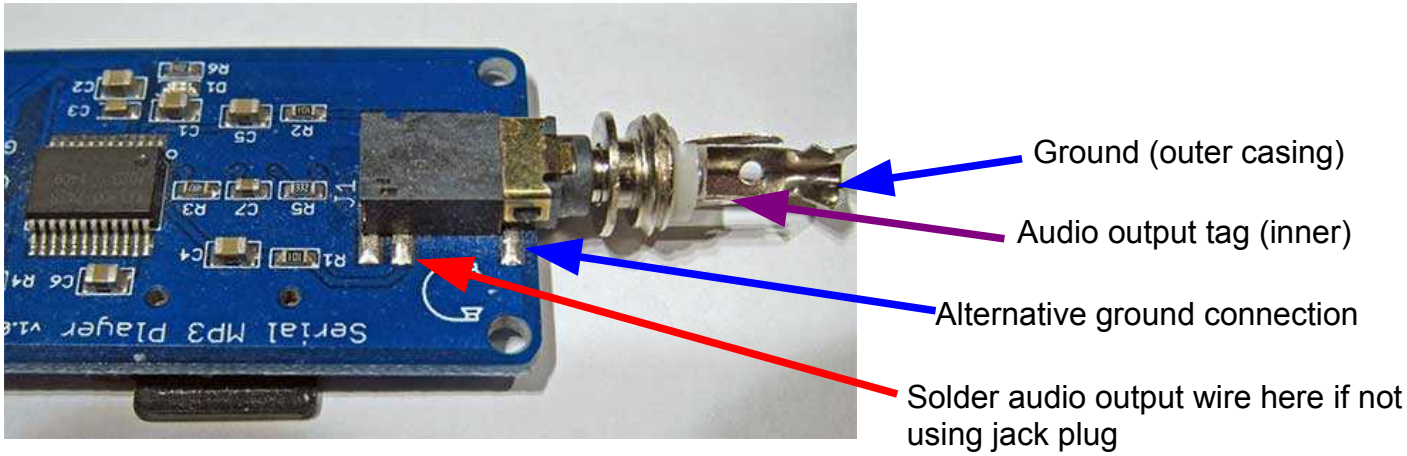
Bend the 6 existing header pins straight so that the module can be soldered to the main board.

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 the 4 header pins straight ready for attachment to the main board.



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.

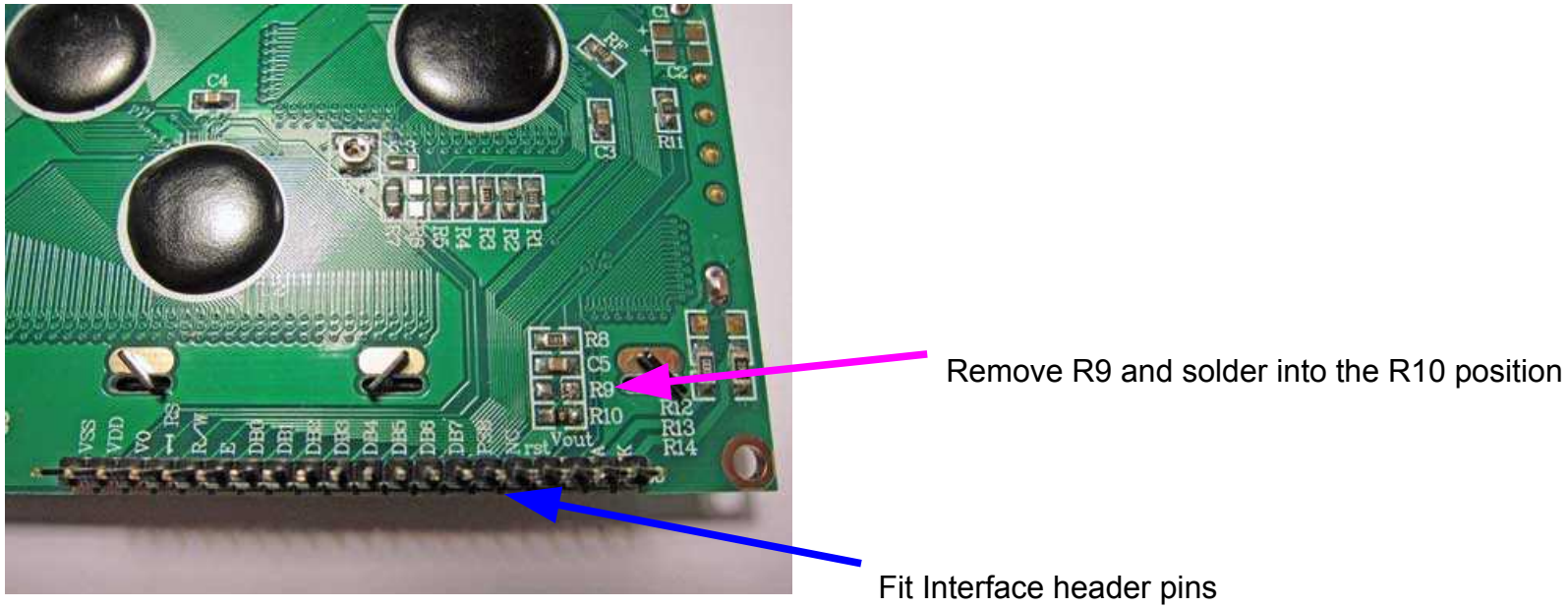
It is not essential to connect the jack ground tag or pad (as the module already has a ground header pin connection) but it may help to improve sound quality

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).



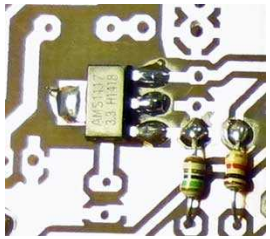
You will need to use a magnifying glass and tweezers to move the resistor. (if you cant successfully place it in the R10 position,just use a solder blob to bridge the two solder pads for R10 instead).

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.

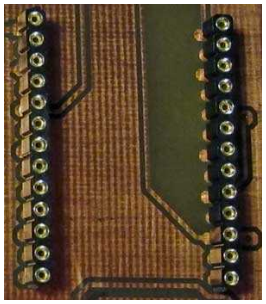
(Alternatively, the interface cable wires could be directly soldered to the holes to save space in the case)

Assembly

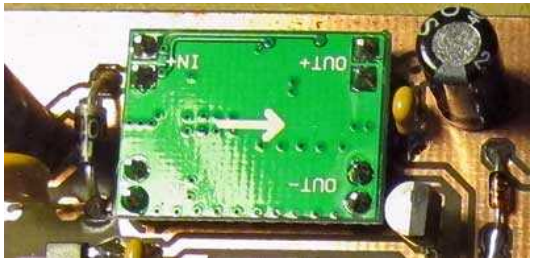
1. Start by fitting all of the resistors, the small 1N4148 diode (D6)
2. Then the surface mount 3.3v voltage regulator (IC1). (Carefully solder all 3 leads and the small heat-sink tab)



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.

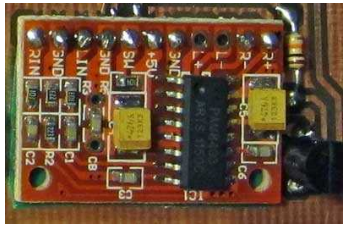
At this point it is possible to check that the regulator is still correctly set to 5 volts without risk of damaging any sensitive parts.

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)

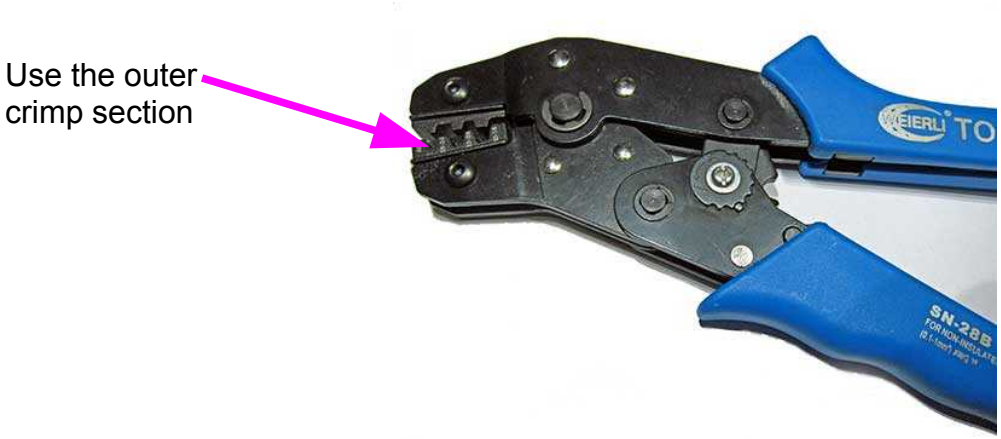


(There is no need to connect the L- and L+ holes).

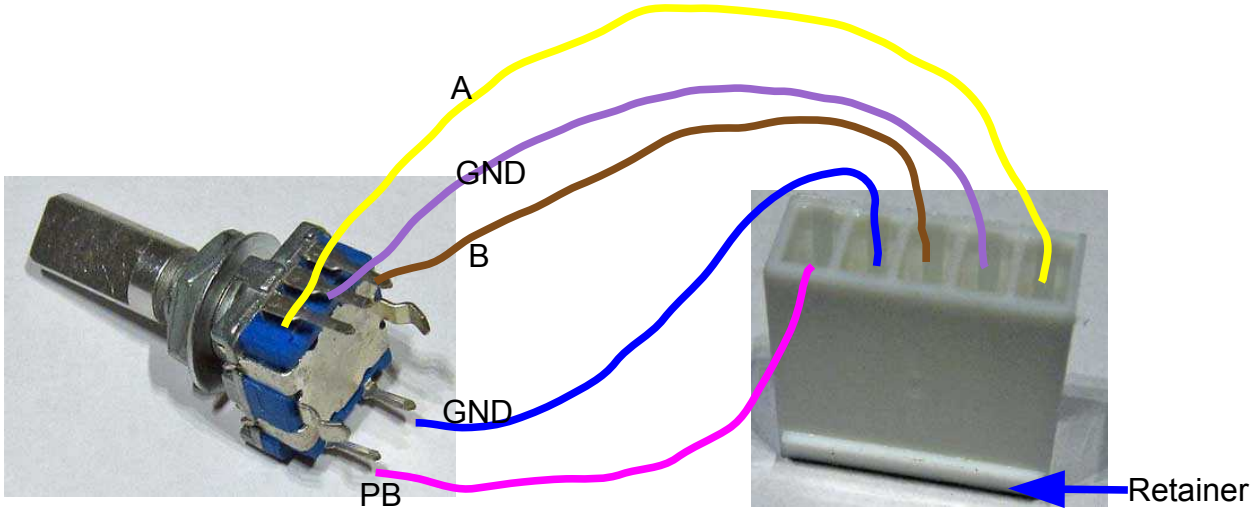
14. Fit the remaining four transistors. Ensuring correct way round.
15. Solder the Catalex sound module to the board and connect the audio output either using a stereo jack or direct wiring as described earlier.
16. Fit the 8pin IC2 (this can be soldered direct to the board instead of using a socket 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.



Rotary Encoder



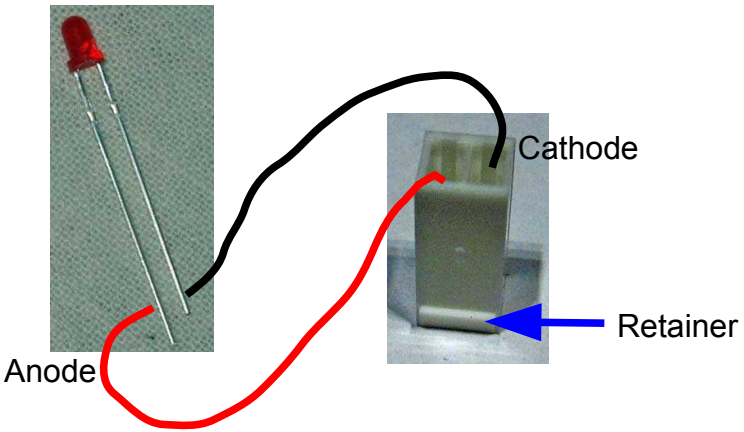
LEDs

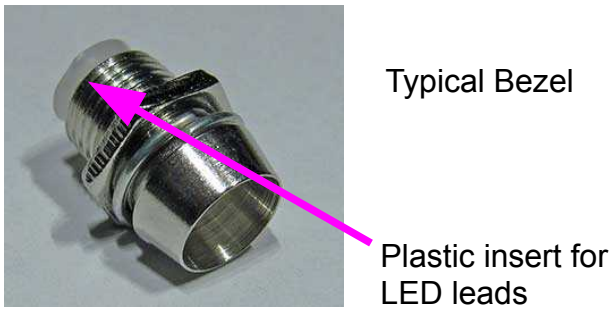
The LEDs can either be fitted into chrome bezels or glued to the front panel holes with hot melt glue.

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.

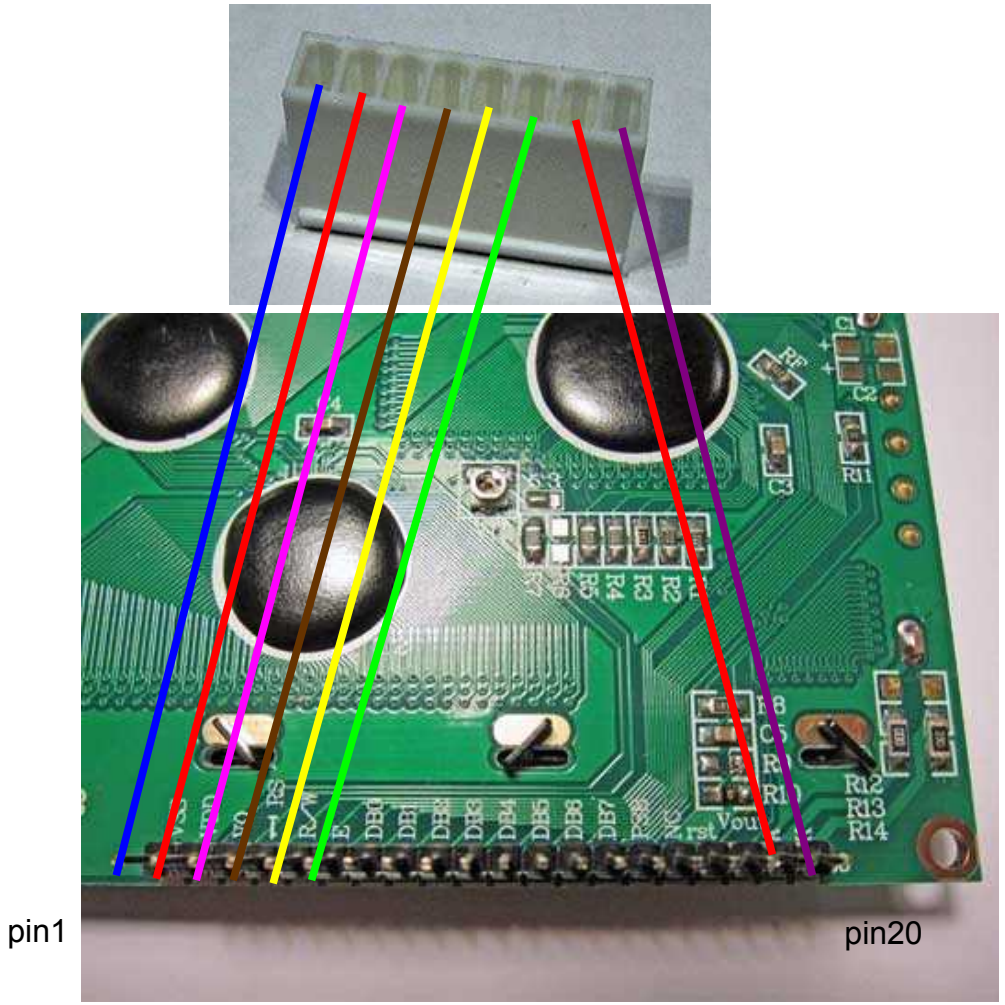




Each LED lead needs sleeving with 2.4mm heat-shrink tubing.

LCD

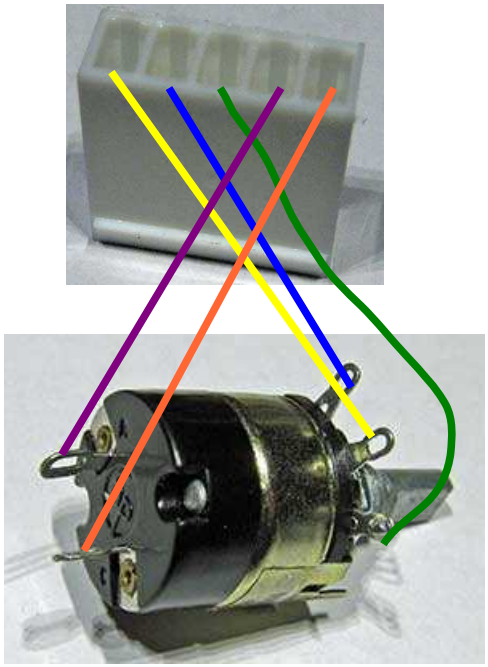
Either using a separate header and socket as described earlier or wire directly to the LCD module



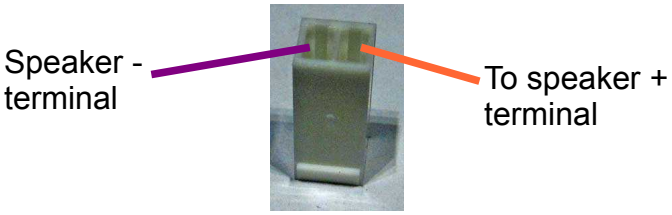
Volume Control

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)

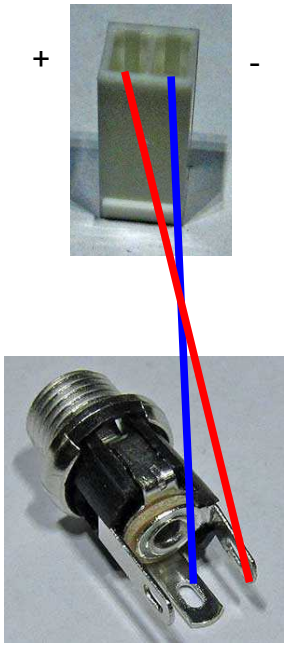


Speaker



Power Jack socket

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

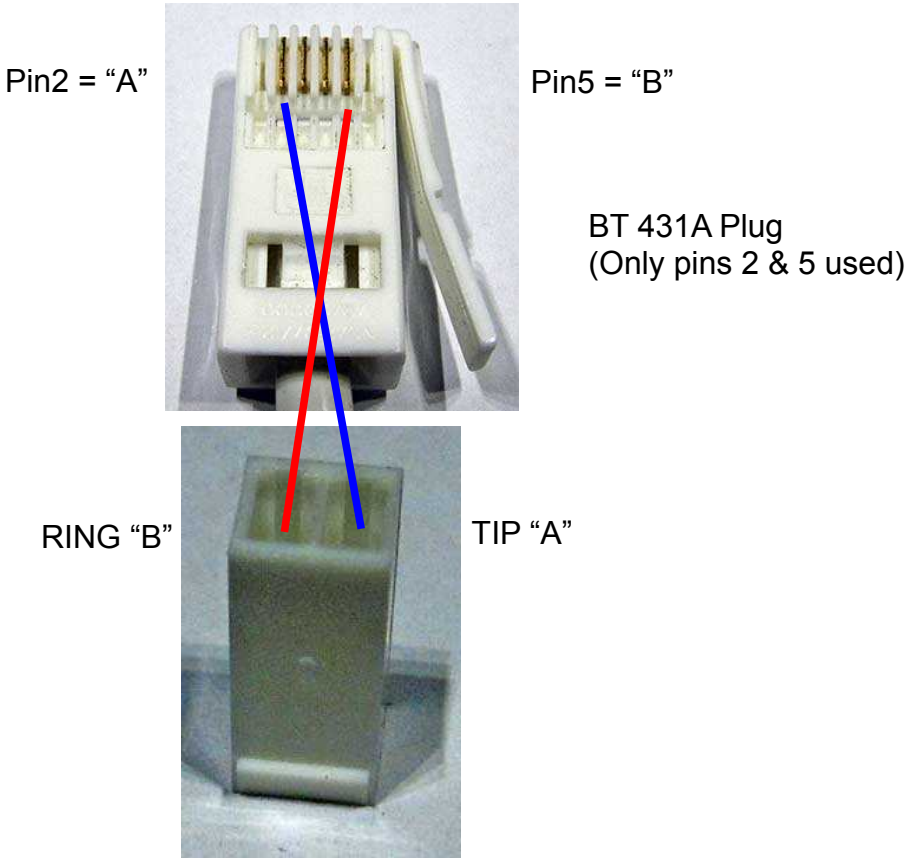


Use heat-shrink tubing over the entire socket to cover the connections after soldering.

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.



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.

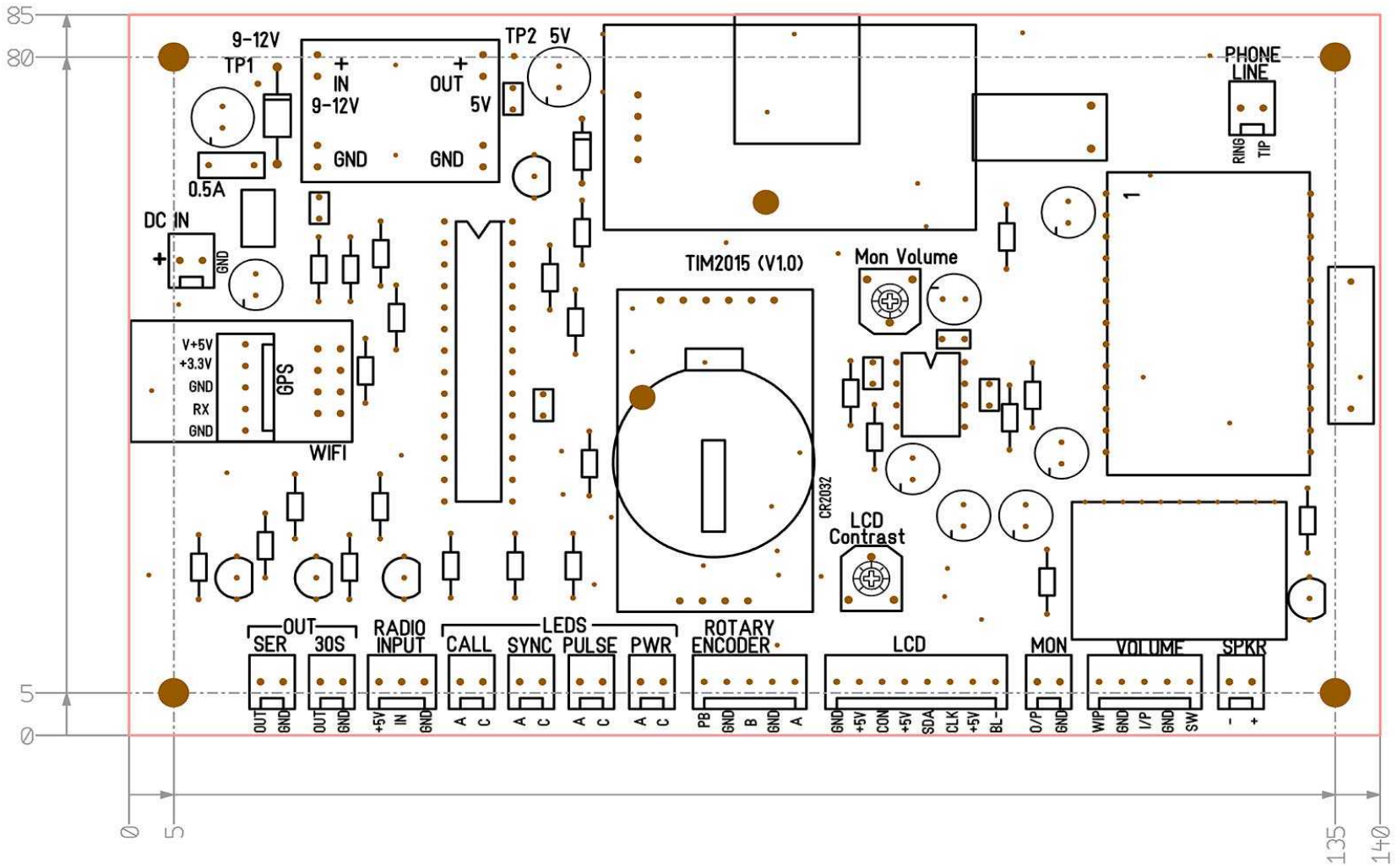
Disconnect the power then re-connect and check the time is still valid.

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)

