Magnis SDR

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Magnis SDR

WELCOME (Part 1 of 2)

Welcome to the Magnis SDR. The kit is designed as an advanced project for assembly by hand. It is a precision device and requires precision building. If the guide lines presented here and in the builders notes are followed, the result will be a high quality transceiver that will bring ham radio enjoyment for many years.

All support for the Magnis SDR Basic is located at: https://groups.io/g/TheVeteranSDR . Please join the group.

Also, please read the ECN and Errata documents for important information that may supersede the contents of this assembly document.

This is an advanced kit and requires fine detail work. Two of the ICs have very fine pitched leads. Installing these requires high level of attention to detail. However these ICs have been successfully installed many times IF the instructions presented here and in the builder notes are followed carefully and exactly. If you believe this beyond your skill level, it is suggested that the Semi DIY kit be purchased instead.

DO NOT ATTEMPT TO REMOVE INTEGRATED CIRCUITS EXCEPT WITH A HOT AIR TOOL. YOU WILL DAMAGE BOTH THE IC AND CIRCUIT BOARD.

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Required Tools

Safety glasses
Illuminated magnification
Soldering iron with 1/32" tip
Flux core solder, 0.020" or 0.015"
Solder flux, pen or syringe
Desoldering wick
ESD-safe work area and parts trays
#1 and #2 Phillips screwdrivers
Pliers for #4 & #6 nuts Electronics
Electronic multi-meter
Ruler
SMT tweezers
Wire cutters
X-ACTO knife or Scissors

Optional Tools / Supplies

Oscilloscope
RF signal generator
Hot air rework tool
Thermal Paste Compound Grease

Additional Equipment

CW or SSB receiver
USB cable, standard A-B
13.8V 1A regulated power supply
Power supply wire, 20AWG or better
50 ohm antenna, BNC terminated
50 ohm dummy load
Computer to run DSP software

PLEASE SEE THE BUILDERS GUIDE FOR ADDITIONAL INFORMATION

Most of the time, a simple multi-meter is the only diagnostic tool you will need to successfully assemble the Magnis SDR. If there's a difficult problem then you may find it necessary to use a signal generator and oscilloscope. Soldering errors can be found with a 5X or 10X illuminated magnifier. A bad part is extremely rare. Even electronics built by robotics will have problems due to soldering errors. Work slowly and take lots of breaks.
Please use the Yahoo Group to ask for help and help others.

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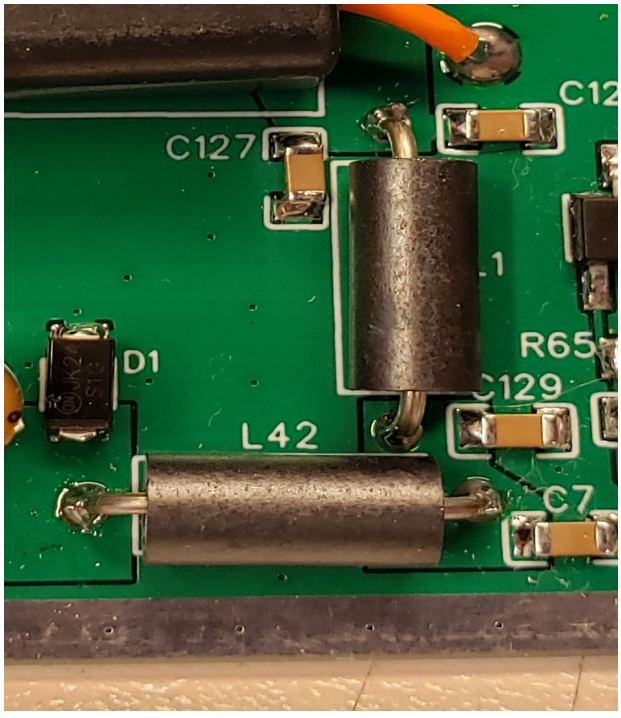
☐ 1. Preparation

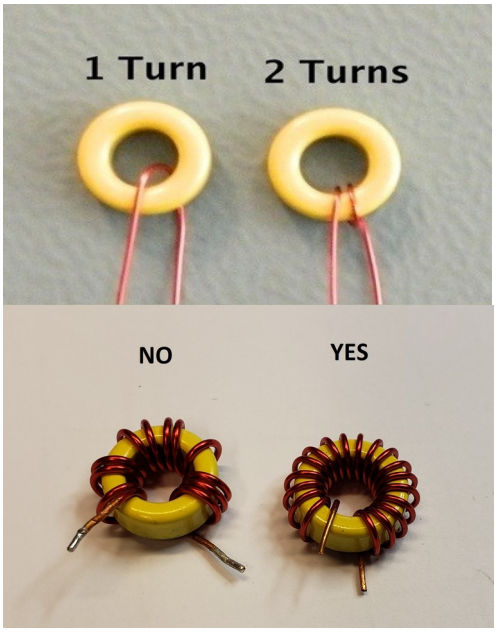
The first step is deciding whether you will install filters directly on PCB or if you will use plug in filter modules. Refer to the Band Plan PDF for details. If you require, for instance 2 bands that are low or high bands, I can customize the filter switching to meet your needs. Download the band chart and choose the bands you want to build. You may build the Magnis SDR to cover up to four bands. The options are a choice of a Low band(160M, 60/40M, 17/15M and a High band(80M, 30/20M.12/10M). Pick any Low band and any High band. ***For the purposes of this document and building the OSB, the primary winding is defined as the winding that uses a single wire. The secondary winding is defined as the winding that uses a bifilar (twisted pair) of wires. The primary winding is noted on the PCB with a white line.***

☐ 2. Wind the RF Chokes

Used the supplier Fair-Rite Products Corp beads and pass a 1 inch 18 AWG wire through and bend fairly tight to the ends of the beads as shown. Leave about ½ inch leads



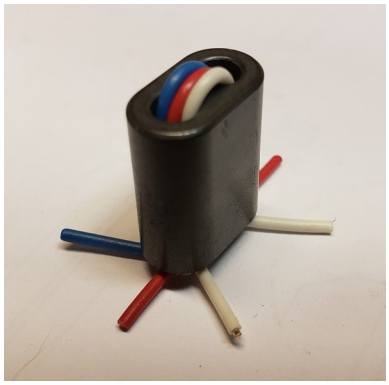
☐ 3. Wind the toroids

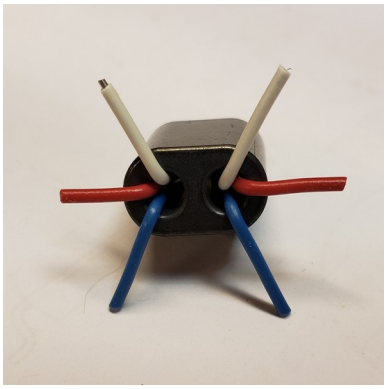


Use the Filter Band Plan to determine the configuration of toroids. Each pass through the core counts as one turn. There are two directions in which to wind these toroids. Electrically, it doesn't matter. However, you'll find that one direction will fit on the PCB better. The lower photo show the preferred direction. It's worth a test fitting after winding the first one just to make sure. The coils should be pulled tight with only your fingers. Don't use pliers and don't leave the loops sloppy. Space the windings evenly all the way around the toroid. Use the entire 360 degrees. Using the recommended wire size will allow you to fit all the windings without overlapping.

☐ 4. Wind transformer T1

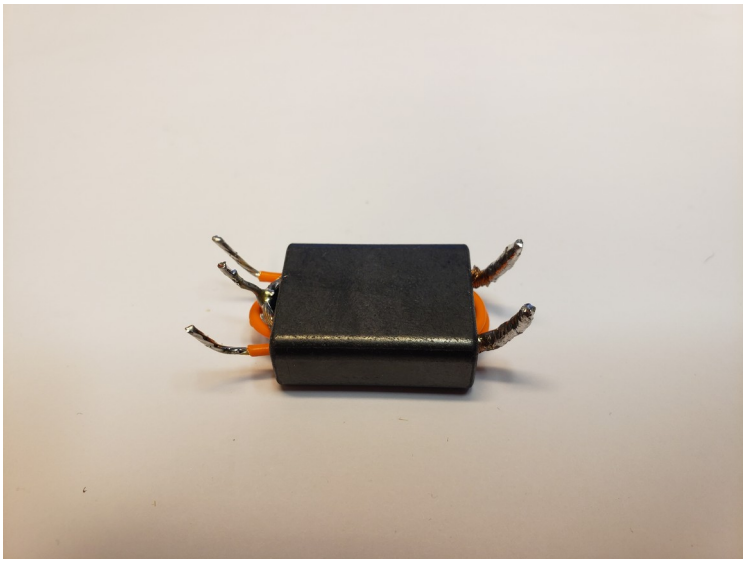
Cut off 3 wires 1.5 inches of #20 wire. Insert each wire one turn through the BN43-202 as shown. I used hook up wire so you can clearly see where ends should be. The 6 ends will now line up with the pads on the PCB.



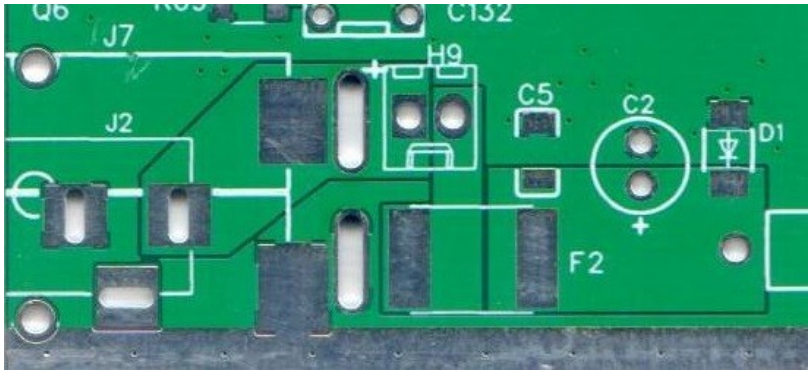


☐ 5. Wind the finals transformer T5

Take coax shield and pass through each hole once. At the end that has the ground attached poke holes through the shield carefully so the secondary wires can pass through as seen in picture. Take a short length of #20 hookup wire and bend a hook at one end. Then place this hook over the mid section of the radius and pinch tight to the coax shield. Apply solder to secure the connection. Use #20 Teflon wire and pass through each hole twice. It should end up like the picture. Now take the ends of the coax shield and twist them so they fit the holes on the PCB.



☐ 6. Power Protection



To start with you have a few options to connect 13.8V. You have Anderson Power Pole(J7), Barrel Jack(J2) or direct connection of wires to solder pads. H9 is used to connect radio on/off switch. Install the following parts. Make sure the diode is installed with the correct polarity. There is a line on the package that corresponds to the line on the PCB silkscreen.

☐ D1 – S1G
☐ C2 – 47uF
☐ C5 – 0.1uF
☐ F2 – Fuse
☐ H9 – 2 Pin Molex
☐ J2/J7 – Power Jack (Type is your choice)

Testing

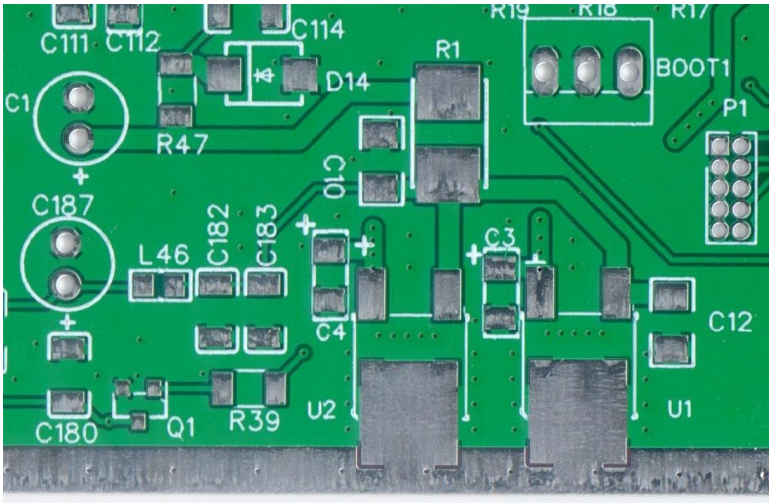
The diode tester in your multi-meter should see 0.5-0.7V of forward voltage.

☐ D1 forward voltage of 0.5-0.7V

If any of the tests fail at any point in this guide then it is best to stop building until the problem is resolved. There is no chance that continuing a build will magically resolve a problem. In fact, it will make things more difficult for others to assist you or possibly destroy parts. In almost all cases the problem is due to bad soldering or incorrect parts placement so an illuminated magnifier will be your best diagnostics tool.

☐ 7. Power supply

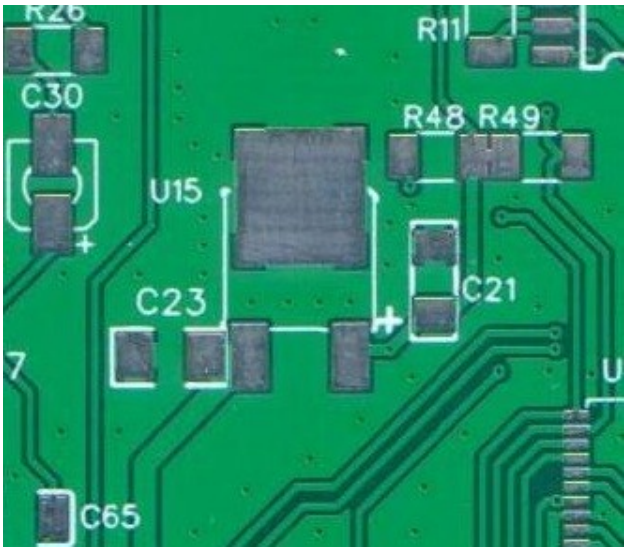
U1 and U2 will get warm during normal operation of the radio. With the 4 layer board and the surrounding vias the heat is transferred to the ground plane.



☐ R1 – 10Ω
☐ U1 – 5V regulator
☐ U2 – 5V regulator
☐ U15 – 3.3V regulator
☐ C3,C4,C21 – 10uF
☐ C10, C12, C23– 0.1uF
☐ C1 – 47uF

Testing

A power plug and an inline fuse holder are recommended. Wire it up to your 13.8V DC power supply with the center positive. Test the current draw of the radio. You will see a surge of power as the capacitors charge but this will settle in about a second.



Current measurements are not the perfect test for this radio. Your readings may differ by (+/-) 50mA or more.

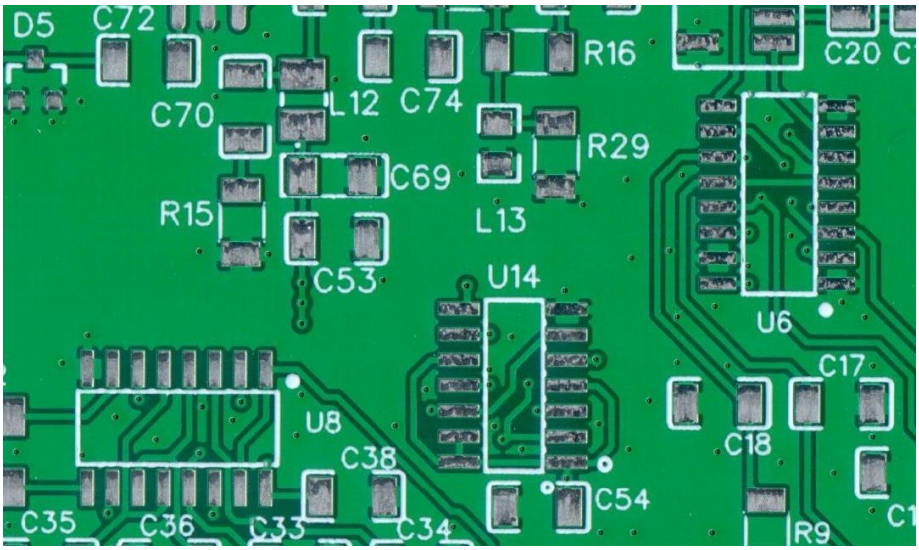
Measuring the voltage drop across R1 will provide an alternate method to determine current utilization if a current meter is not available. I=E(measured) / R1.

NOTE: This will not include current utilization by the Power Amplifier section of the transceiver. (See schematic).

Power Jack J2 – 30mA

Ensure the regulators are putting out the correct voltage.
U1 PIN 2 – 5.0V +/-2%
U2 PIN 2 – 5.0V +/-2%
U15 PIN 2 – 3.3V +/-2%

☐ 8. FET Mixers

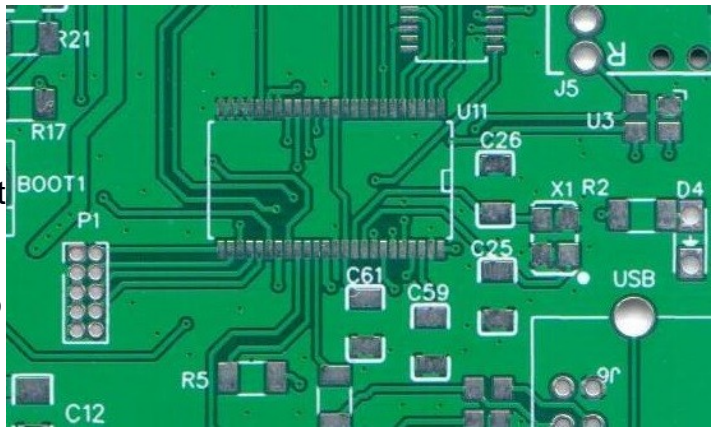


The Magnis SDR uses FET multiplexers for RF mixing. Before installing any IC make sure you identify pin 1 and match it to the PCB. Take your time and work carefully. When installing SMT ICs using a soldering iron always begin by attaching only a single corner pin. Any corner is fine. Once the alignment is perfect attach the opposite corner and proceed with the remaining pins. Before applying any solder it may be helpful to practice using tweezers to find a comfortable position and illumination.

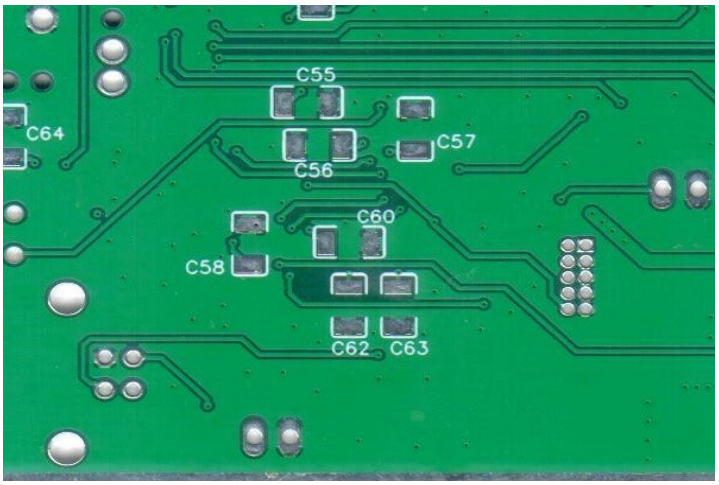
☐U6,U8 FET Mixers SN74CBT3253.

Testing
U6 pin 16 — 5.0V
U8 pin 16 — 5.0V
Power Jack J2 – 50mA

☐ 9. Cypress PSoC 3

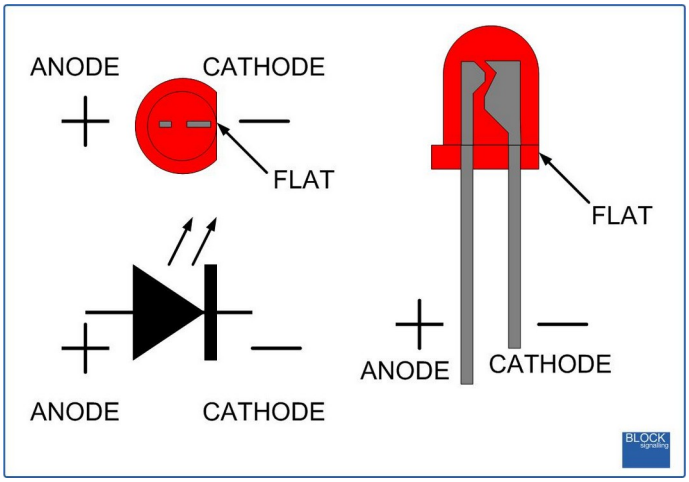


The PSoC should be preinstalled. Next the LED will be installed. The standard setup using the recommended enclosure uses an LED that is bent to a right angle. Make sure the Long pin is in the hole near R2. It is best if you position the LED with the PCB in the enclosure slot and front panel installed. After bending the LED leads(you will have to shorten them), put them in the holes and place LED lens into the front panel hole. Then tack solder the pins from the top. Afterwards complete soldering from bottom.



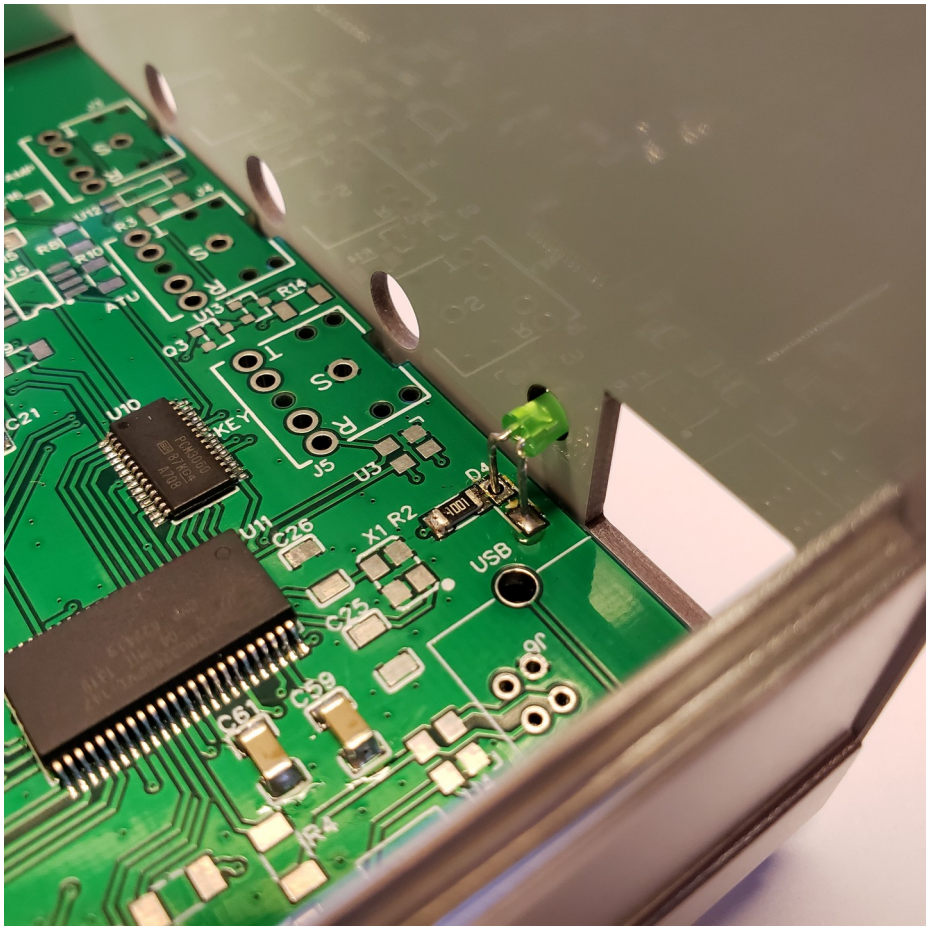
☐ U11 – CYPRESS PSoC 3
☐ C59, C61 – 1uF
☐ R2 – 1KΩ
☐ C55,C56,C57,C58,C60,C62,C63.C64
☐ D4 – LED

Power Jack J2 – 50mA



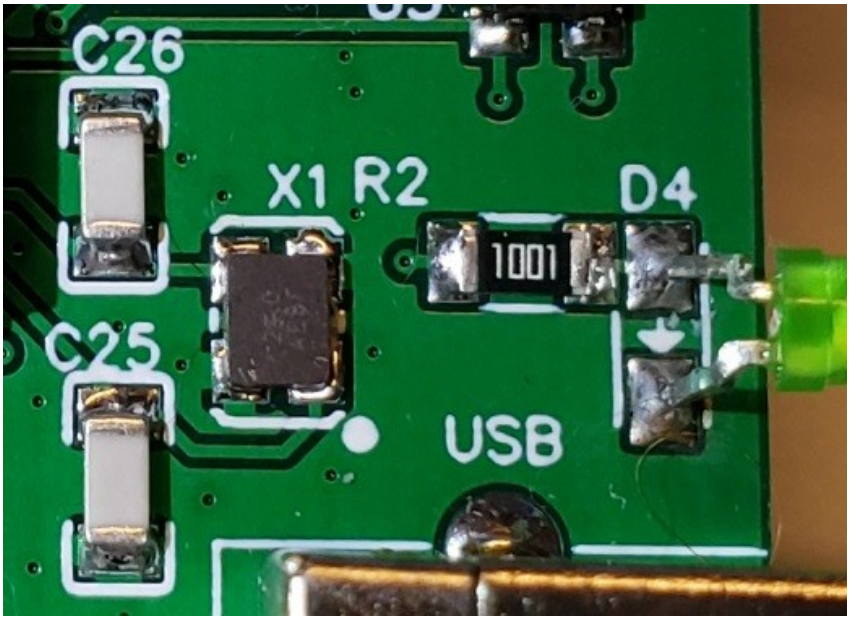
Magnis SDR

Here is an image of LED tacked into place



☐ 10. 24 MHz Crystal

☐X1 – 24 MHz XTAL
☐C25, C26 – 10pF



Here's a note from the XTAL Data Sheet:

Note: Due to the availability of raw materials, this part may be manufactured with the chamfer on pin 4. Be advised that this does not affect the electrical characteristics of the crystal in any way. Per the Top Marking from left to right, Pin 1 is always located on the bottom left.

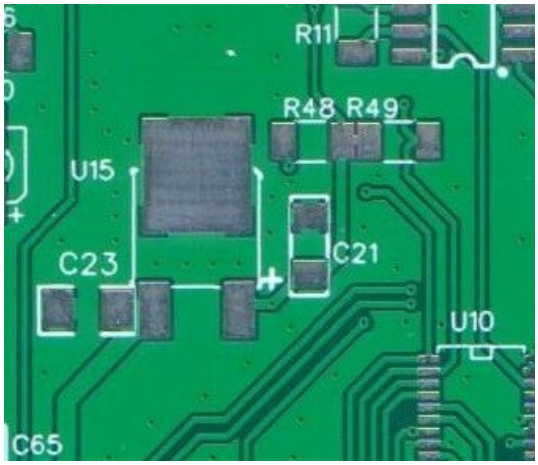
Testing
The PSoC will perform a power-on self-test and after a few moments, report critical failures. The LED sends errors using Morse code (see appendix A). At this stage the LED will report a critical error.

If the LED fails to light at all, check its polarity. The LED can withstand reverse voltage so just flip it around if that's the problem. If it's not the LED then PSoC is failing to start. Check for solder bridges, recheck the output of the voltage regulators, and re-flow all the PSoC pins. Other than power, no support circuitry is needed for the PSoC to drive the LED. Really, it's a very easy device to get running and extremely tolerant of soldering iron heat. It is not recommended to probe around the PSoC. Standard test leads can too easily short two pins which will overload the GPIOs. The LED should be used to isolate problems for physical inspection.

Power Jack J2 – 50mA
LED – sending I2C
With a working crystal the PSoC will attempt to initialize the Si570 and PCM3060. I2C is a digital bus protocol shared by these three chips. The I2C error message indicates a total failure to communicate with any other chip on the bus.

☐ 11. Si570

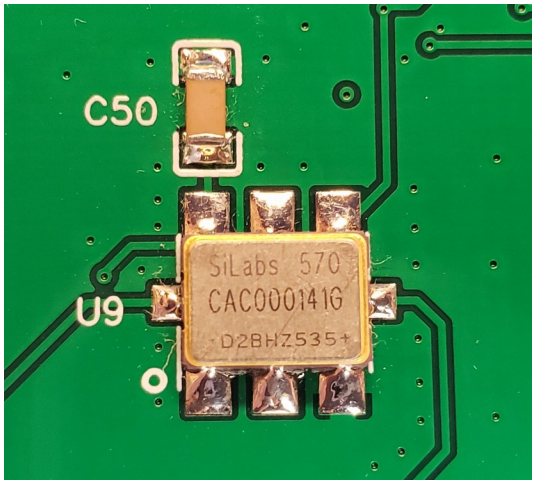
U9 has no leads so solder must flow under the chip. The pads on the bottom are also slightly exposed on the sides so the technique is have the iron tip to touch both the pad on the PCB and the pad on the edge of the Si570. With heat on both pads the solder will flow freely. The dot on the package aligns with the dot on the PCB. R48 and R49 are pull-up resistors for the open-drain I2C bus.



☐ U9 – Si570

☐ R48, R49 – 4.99kΩ

☐ C50 – 0.1uF



Testing

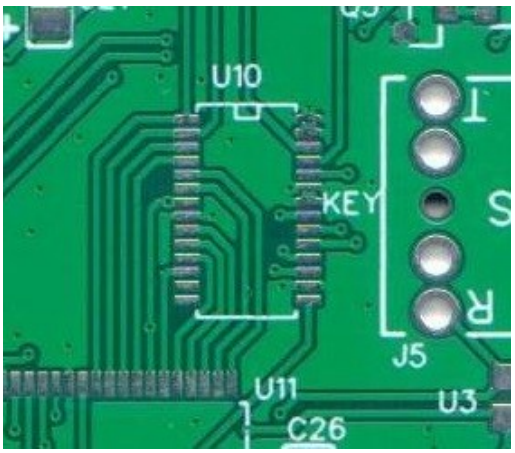
Power Jack J2 – 110mA

LED – sending PCM3060(unless already installed by seller)

U14 pin 3 – 3.3V p2p square wave 56.32MHz

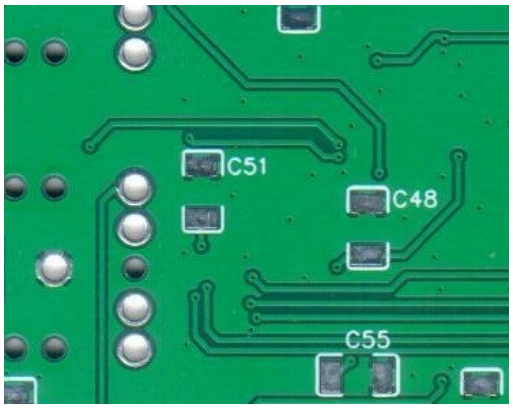
If an oscilloscope is not available, a multi-meter will read about 1.65VDC (3.3÷2) on U14 pin 3. Inexpensive oscilloscopes will show a sine wave instead of a square wave. Don't worry about getting an accurate reading. If the LED is still blinking I2C, the I2C bus may be shorted to ground. On the narrow sides of the Si570 package are two extra pads that must not get soldered. These are part of the housing, not intended for an electrical connection.

☐ 12. TI PCM3060



The PCM3060 is a 64x oversampling Delta-Sigma ADC and DAC. It is controlled with a custom program in the PSoC which allows it to appear on the host computer as a standard sound card.

☐ U10 – PCM3060
☐ C48,C51 – 0.1uF



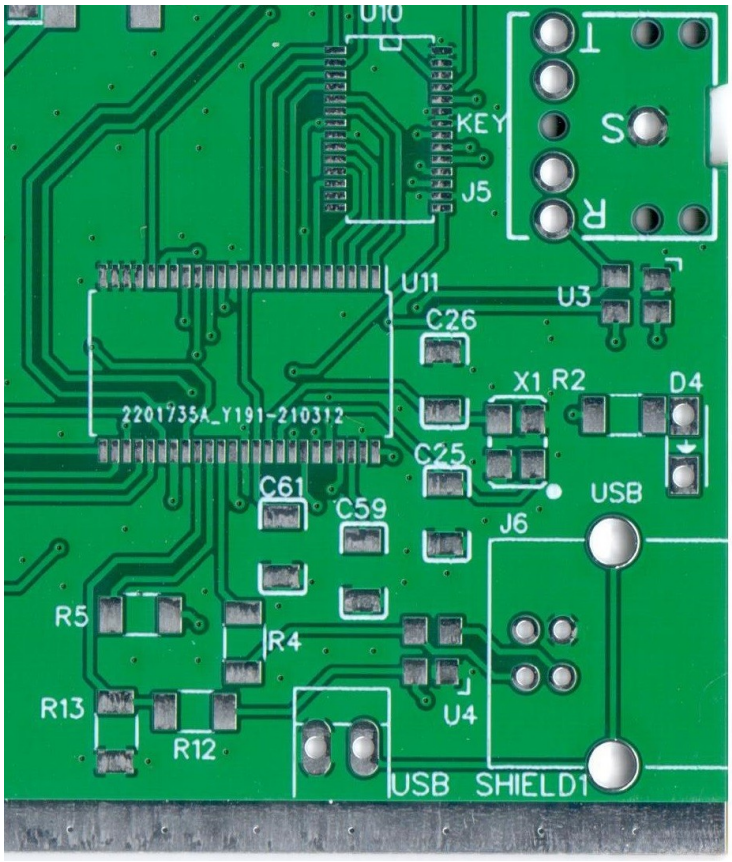
Testing
Power Jack J2-110mA
LED – Steady On

The PCM3060 sleeps when there is no USB connection so expect no additional current from adding this part. You should no longer be getting any error codes from the LED. The steady on LED indicates the PSoC has successfully completed all self-tests and is ready for operation.

☐ 13. USB and KEY

U3 and U4 protect the PSoC from ESD entering through the USB and KEY jacks. **NOTE: PIN 1 of U3,U4 is wider than the others. Refer to the photo for correct orientation.** Install a 2 PIN Header in the USB_SHIELD position on the PCB. Place a jumper on the header. This connects or disconnects the USB Shield from circuit ground. Useful for trouble shooting ground loops. Install the SMD components before installing the jacks.

- ☐ R4, R5 – 22.1Ω
- ☐ R12 – 10kΩ
- ☐ R13 – 100kΩ
- ☐ U3, U4 – PRTR5V0U2X
- ☐ J5 – Stereo jack
- ☐ J6 – USB jack
- ☐ 2 PIN HEADER WITH JUMPER OR WIRE JUMPER



Testing

Upon connecting the USB to a computer, the PSoC and PCM3060 will power up.
NOTE: When the OSB is attached to the host computer via the USB cable, and the OSB is power on, the LED may blink erratically for a short period of time and then go on a constant on state. This may also happen when the USB cable is detached and reattached. The blinking is the indication the OSB is syncing the PLL of the PSoC to the USB port.

Power Jack J2 – 155mA with USB connected with proper drivers installed. 110MA without USB connected

CONTINUE ON TO PART 2 OF THE ASSEMBLY MANUAL