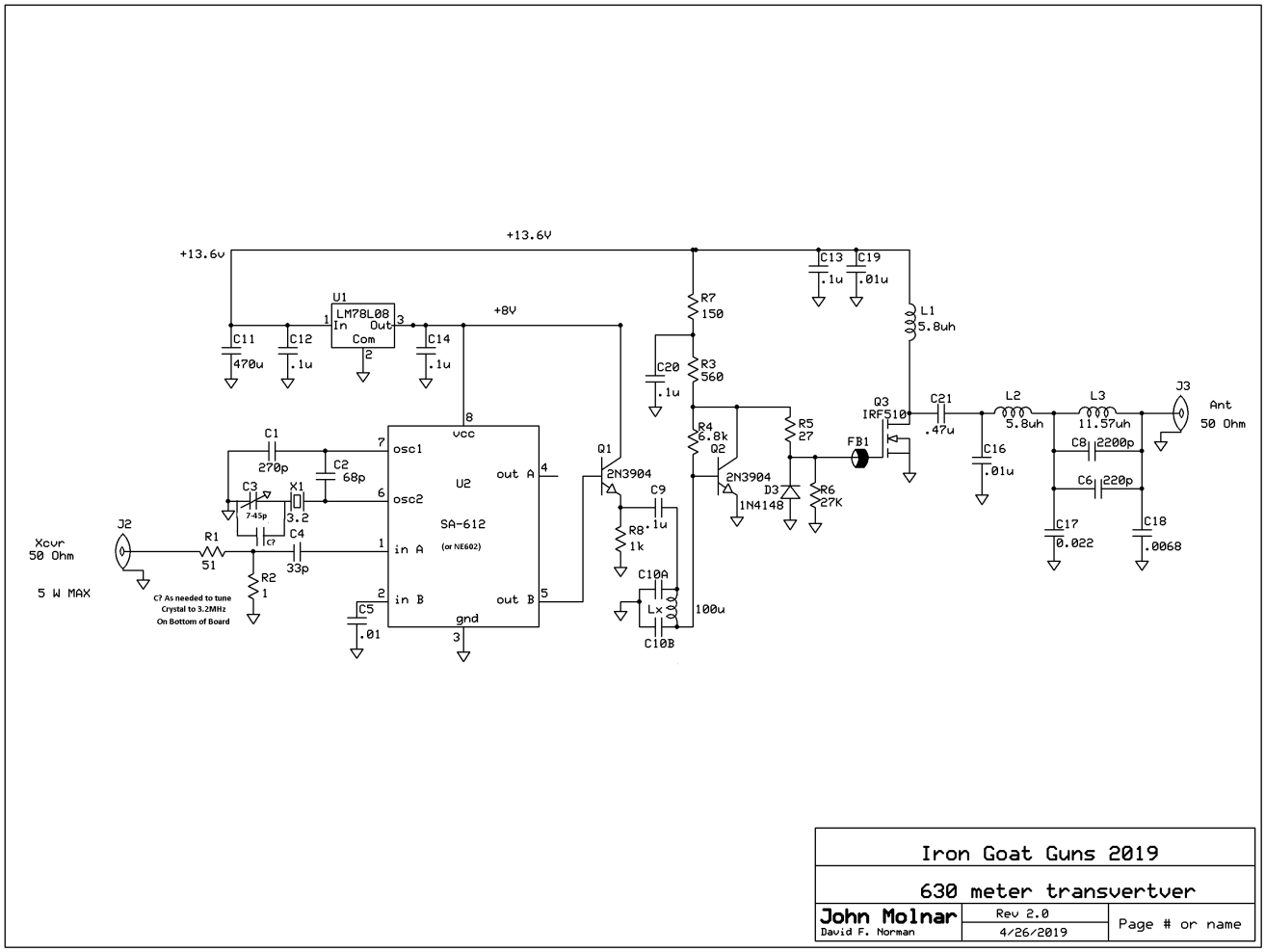
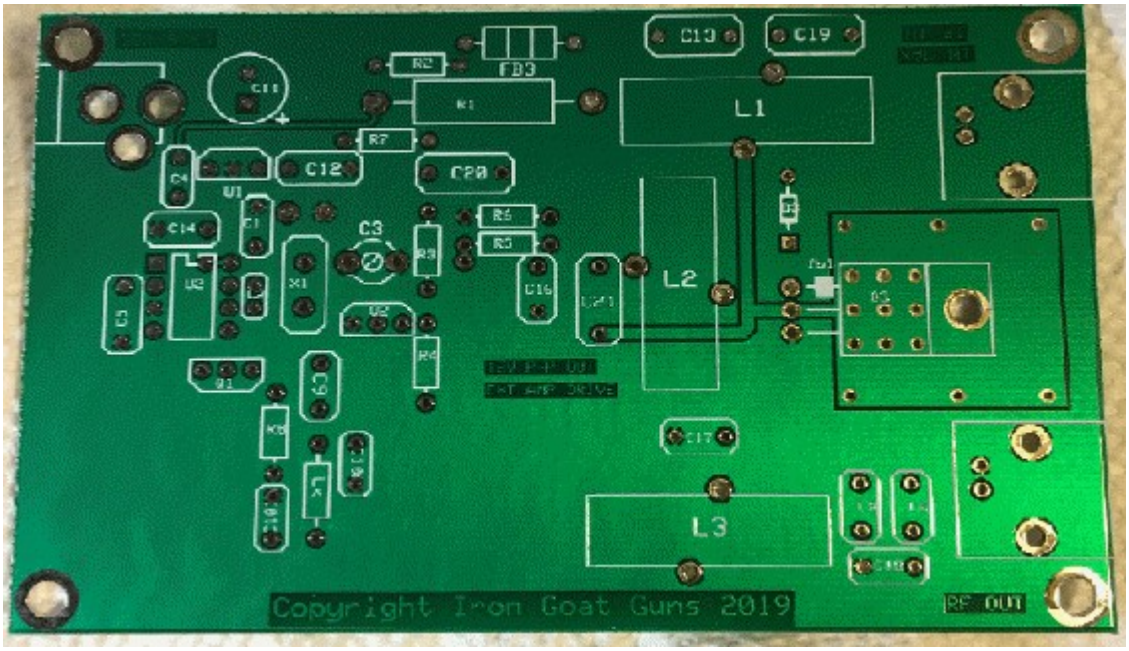
Iron Goat Guns/w5DFN 630 Meter Transverter



The simple schematic above shows the electrical connections of the transverter. The blank board shows the physical layout. The parts list has all of the actual components, giving a competent Amateur all he needs to know about repairing the unit should it ever become necessary. Observe the cautions listed below and you should expect years of good service until something better comes along.



Parts List

R1-51, 2W (GRN BN BL GOLD)
R2-1, .25W (BN BL BL SILVER BN)
R3-560, .25W (GRN BLU BL BL BN)
R4-6.8K, .25W (BLU YEL BL BN BN)
R5-28, .25W (RED GRY BL GOLD BN)
R6-27K, .25W (RED PURP BL RED BN)
R7-150, .25W (BN GRN BL BL BN)
R8-1K, .25W (BN BL BL BN BN)
C1-270pF NP0 (marked NP0 271J) – or blue
C2-68pF NP0 (marked NP0 68J) – or blue
C4-33pF-40pF (non-critical) – disc ceramic
C5, C19-.01uF (marked 103) – disc ceramic
C9, C12, C13, C14, C20-.1uF (marked 104)
MISC NON-PULSE CAPACITORS
C3-(7-40) pF VARIABLE (YELLOW, TRIM SCREW)
C11-470uF ELECTROLYTIC (NOTE: Exact value may vary)
PULSE CAPACITOR LPF COMPONENTS
C6-220pF, 2.5% (WIMA 220/100, 2.5 on back)
C8-2200pF, 2.5% (WIMA 2200/100, 2.5 on back)
C16-.01uF, 2.5%, (WIMA 0.01/100, 2.5 on back)
C17-.022uF (WIMA 22n on top), 2.5%
C18-6800pF (WIMA 6800/100) 2.5%
C21-.47uF (WIMA 0.47/100) 5% or 10%, non-critical
Lx-15uH, 5% (BN, BLU, BN, GOLD) Don’t confuse with resistors!
C10A and C10B – 6800pF, 10%, MLCC capacitor, .
(Actual value may vary slightly, C10A and C10B are the same value)
U1-78L05 Three Terminal Regulator
U2-SA-612 8-Pin IC (or NE602SA)
Q1-Q2 2N3904 NPN Transistor

Q3-IRF510 N-CHAN MOSFET, TO-220 Package
D3-1N4148 Diode
X1- 3.2 Crystal
FB1- Ferrite bead (FET Gate)
NOTE: FB3 replaced by jumper wire!
L1-L3 T94-2 Iron Toroid Cores (L1: 29t, L2: 29 turns, #22 L3: 38 turns, #22)
J1- DC PCB DC Power Jack
J2, J3-BNC PCB RF Jack, Right Angle
#22 Green or Red magnet wire for L1-L3, ~10'+ provided
HW1- Crystal Base Insulator, White
HW2-HW3 4-40x1/4 Pan Head Machine Screw and Lock Nut (FET Q3 Mount)
HW4-Heatsink, 'U' Shape (Q3 heatsink)
PTC thermistor – attached to the crystal
C? – May vary from ~33pF to 68pF (on bottom of board)
(On some boards, C? May not be present)

This simple and reliable transverter is easy to operate, but requires a General Class or higher Amateur License to operate on the 630 Meter Amateur Band. The output will be 20-25 watts into a 50 Ohm non-reactive load. Current at 13.6 V DC is less than 200 milliamps with no drive and no need to power down while receiving. Current drain with 5 watts is 2.5 to 3 amps at 13.6V DC.

Caution: DO NOT EXCEED 5 WATTS AT ~3.675 INTO THE RF IN TERMINAL. MORE DRIVE WILL NOT INCREASE OUTPUT AND WILL SERIOUSLY OVERHEAT THE 50 OHM PAD! IN FACT, IF YOU TRANSCEIVER CAN REDUCE OUTPUT BELOW 5 WATTS, TRY TO SEE HOW LOW YOU CAN DRIVE THE TRANSVERTER.

The output from most antenna analyzers will drive the unit.

Operation is simple. For example, if you wish to transmit at .474200 MHz tune your transmitter to 3.67420 MHz. The mixer provides the sum and difference of the input frequency and the sum frequency is removed by the Low Pass Filter.

If an oscilloscope is available, observe the p-p waveform at the RF output connector center pin (with 50 ohm load attached!). The observed waveform should be a perfect sine wave.
Output power can be calculated as follows:
Note p-p output voltage, will probably be between 92-100 V p-p
Divide that value by 2 to obtain peak voltage
Multiply the peak voltage by 0.707 to obtain RMS voltage
Square the RMS voltage
Divide the result by 50 (output load impedance)
The remainder is the the actual RMS power in Watt
(100V p-p = 25W out)

NOTE: The crystal/thermistor assembly runs HOT. Keep paper and any such material away from the crystal!

ANTENNA CONSIDERATIONS

The transmit downconverter is designed to drive a 50 +- j0 ohm load – meaning as close to a resistive 50 ohm load as possible with no reactive component. A properly designed and tuned vertical base loading system will be able to provide a good match. A load with significant reactance will reduce overall power output and cause FET heating. We have tested the unit into loads presenting up to a 2:1 resistive SWR mismatch without failure – but expect the FET and heatsink to become very warm (hot)! As the load becomes more reactive, more PA current will be drawn and efficiency will decrease.

NETTING THE LOCAL OSCILLATOR (ZERO BEATING)

C3 allows tweaking the LO crystal. Using your transceiver or accurate receiver, a piece of wire connected to its antenna will pick up the LO when brought close to, but not touching, the crystal. A small, metal bladed screwdriver is OK to use as a tweaking tool, as the slot in C3 is grounded. Zero beating a 3.2MHz low power CW signal from your transceiver into a dummy load and listening for the wah, wah, wah, beat on another receiver is the easiest way to do this. Higher or lower ambient temperture than normal, make make tweaking necessary. The thermistor/crystal is not a crystal oven. It will take 4 or 5 minutes when you power the transverter up for the thermistor to bring the crystal up to stability.

When the crystal is EXACTLY at 3.200000, and your transceiver is at EXACTLY 3.674200 as would be the case with WSPR on 630 meters, the output frequency will be EXACTLY .474200. If the crystal frequency goes up, the signal reports on WSPRNET.ORG will be lower than .474200 PLUS the tone frequency. For example, assuming no transmitter drift, at .474200 plus 1500Hz tone, the reported frequency by stations receiving you on WSPRNET.ORG will be .475700. A 10Hz drift up on the crystal to 3.200010 would give you a reported frequency of .475690. The same amount of crystal frequency down would give you a reported frequency of .475710. The reports may vary a few hertz because of receiver frequency drift or atmospheric conditions. For most weak signal modes, this is immaterial. Any new mode that requires super stability will require an external precision oscillator, and you are on your own achieving that. This transverter is designed to work within acceptable parameters for easy access to the 630 meter band for the average Amateur. Because of the extremely low efficiency of most antennas for 630 meters, some stations are running as much as several hundred watts to the antenna and still staying well under the 5 watt EIRP FCC limitation on the band.

A typical MF station will employ multiple antenna systems. The typical transmit vertical has been shown not to be the best for receiving. Consequently, some form of transfer relay will be required to switch the transceiver between a separate receive antenna system and the transmit vertical. There is no problem with leaving DC power applied to the converter while receiving. Only 30-40ı mA are drawn when the converter is not driven and the thermistor warms up.

If you transceiver has more than one antenna port or a dedicated port for receive only antenna, setting up to receive on one antenna and transmit on the other is straight forward.

W5DFN at present uses the same antenna, a full-size ½ wave dipole for transmitting and receiving most of the time on 630 meters. Here is a simple rf-sensing dpdt switch which can be built out of junk box parts. W5DFN has almost a year and many hours enjoying the new band with this transverter. During the late Spring and Summer, conditions due to storms and propagation characteristics make for tough conditions, Fall and Winter propagation is much better.

The view of the relay is from the bottom. Except for the BS170 and the 10 V Zener, most components are not critical. Either 50 or 72 OHM coax can be used to connect to transceiver, antenna, transverter input, and transverter output. The values of the caps will affect the latching time as well as the hold time. Experiment with different values. If you don't mind ugly haywire circuits that work, you can hang everything on the relay itself. Just tape or tie the coax leads to remove the strain on the wires. You can also paint the entire assembly with liquid tape to avoid inadvertent shorting.

Modes of Operation

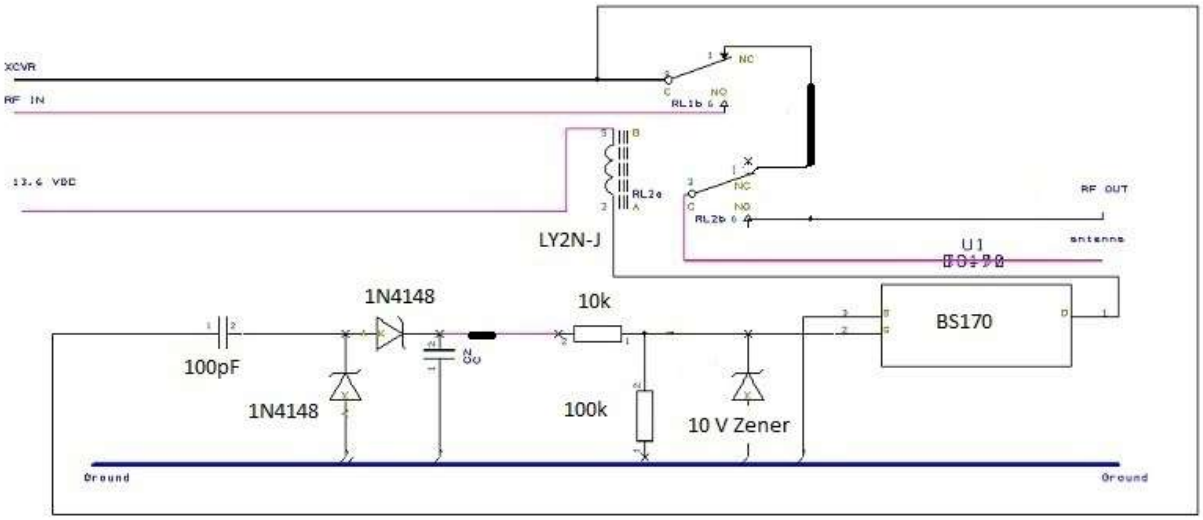
This transverter is non-linear. It works fine with modes such as WSPR, CW, JT9, FT8, and FT4. You cannot use it for voice SSB, PSK31, AM or other modes requiring linear output. Any such attempt puts really ugly – if not illegal – emissions on the air. DON'T!

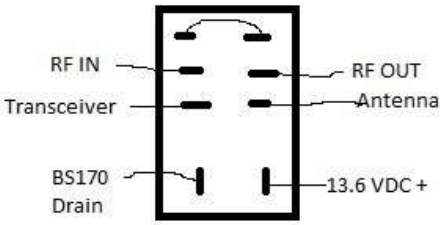
Suggested software is WSJT-X or JTDX(A derivative work based on WSJT. Mr. Jim Taylor is owed a debt by all who use these weak signal modes. While giving credit, John Molnar, WA3ETD, is the man who developed this transverter, When he retired the unit, W5DFN, acquired all rights to build and market it. Without John's effort, many Hams would have never tried 630 meters. We intend to continue to make it easy for those interested to try this new and exciting band. It has just begun!

Warranty

Are you kidding? Warrant a piece of gear that could be turned into charcoal or a fire by careless operation? What we will do is replace for 90 days from date of purchase any components besides the printed circuit board itself free of charge and postal costs. With the schematic and board layout, any reasonable competent solderer should be able to replace any components. Or you can do as W5DFN did, purchase a spare.

If you ALWAYS make certain to reduce in input rf to 5 watts or less and don't try to transmit into a coat hanger or similar mismatched antenna, and keep the circuit board itself off conductive surfaces, you should have no problem. Be nice to your spouse, because this band tends to get addictive once spring and summer are over. With a decent antenna, contacts of thousands of miles are possible.


XCVR
RF IN
13.6 VDC
NC
NO
RL1b
RL2a
RL2b
NC
NO
RF OUT
Antenna
LY2N-J
U1
BS170
1N4148
10k
100pF
1N4148
100k
10 V Zener
Ground
Ground


RF IN
Transceiver
BS170
Drain
RF OUT
Antenna
13.6 VDC +