

Conversion of MMDS surplus for 2304 MHz

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Overview

- Surplus S band Microwave Multi-point Distribution System equipment

Analog Version-
1750A



- Used for wireless cable TV and data transmission

Digital version-
5574



Highlights

- 5574 Designed for 64 QAM modulation with Feedforward high power amplifiers
- 1750A used for Analog TV with video and audio carriers. Currently available on EBay. (No RX chassis- no LNA)
- Units are translators, have most required components to convert to a transverter
- Crystal based LO, PLL has programming switches.
- 50W in one box
- Discrete construction, can be modified, parts replaced.
- Modification requires some electronic knowledge, solder, hand tools, test equipment, etc.
- Units are large and rack mount. 8 ¾" high - 5U

5 Primary Steps to Convert to 2304

- Change LO to new frequency
- Mechanical modifications
- Install TR control
- Tune amplifiers to 2304
- Install receive components

Additional Parts Required

Not Much!

- A TR relay, a good SMA relay will do, preferably one with contacts for sequencing, or add 12-15V DC relay or use TR sequence board.
- If using 1750A- will need to find a preamp
- Crystal for LO frequency desired
- Small tie wraps
- Connectors desired for station interface.
- Male SMA connectors for .141 hardline

LO Description

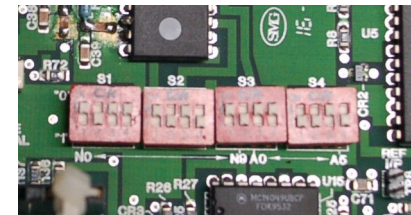
- Multiplied crystal, available from International crystal. ICM has xtal cataloged under ITS Transmitter
- 10 MHz Phase lock is a option, but not necessary
- LO is usable for other frequencies and bands.
- Auto switch if 10 MHz is not available.
- Filtered LO output to mixer, excellent spur performance.



LO Conversion

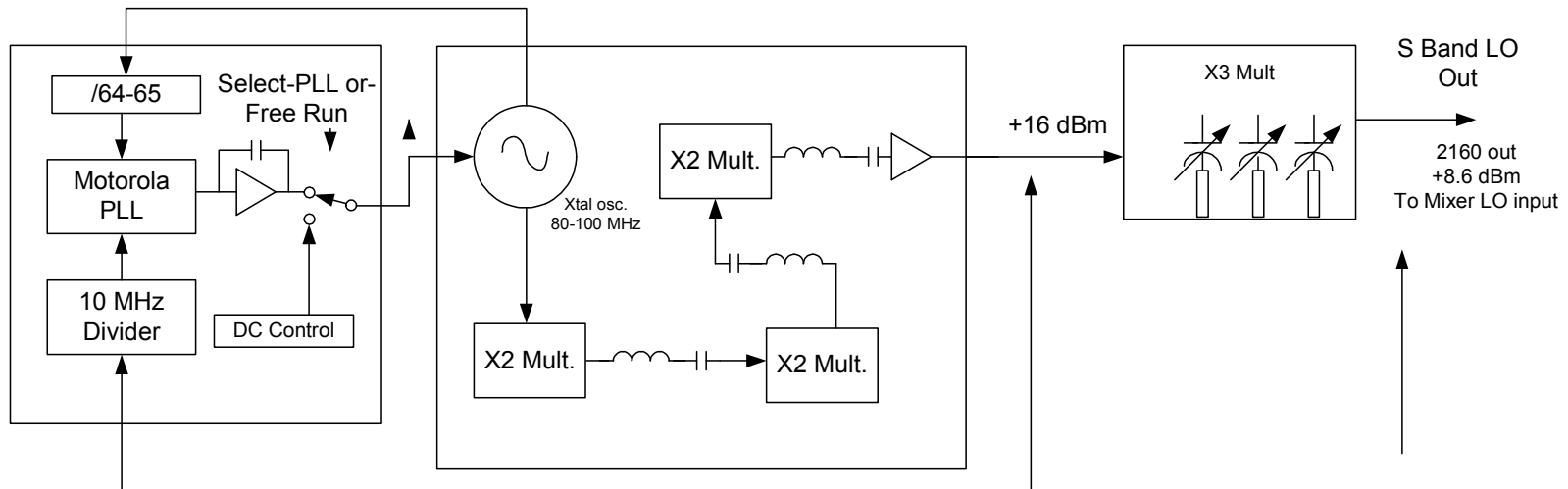
- Change crystal- use insulator on bottom!
- Tune crystal osc., & multiplier stages.
- Spectrum analyzer helpful but not necessary.
- Set PLL divider switches for new LO Freq.
- Tune x3 Multiplier

That's it!

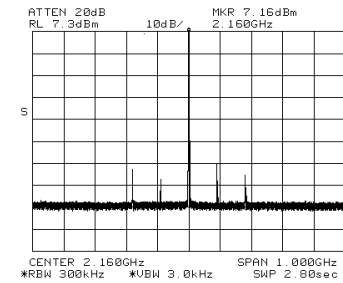
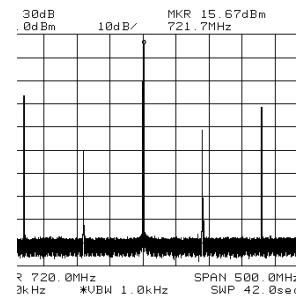
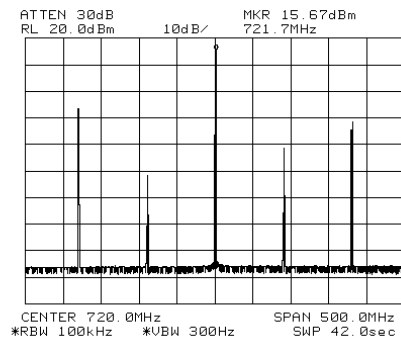


LO Block Diagram

Converted Local Oscillator
Simplified Block Diagram



10 MHz in



Mechanical Modifications

- Remove unnecessary boards, electronics, and cables.
 - Top tray can be cleaned off, leave power terminal
 - Remove data connections and boards from rear panel
 - Most cable wraps will need to be cut to remove and rewire for best results.

Add RF connectors as required to rear panel.

- TR control - IF Connections
- Spare female BNC panel mount provided!

Mechanical Continued

- Many other mechanical options can be considered, for example:

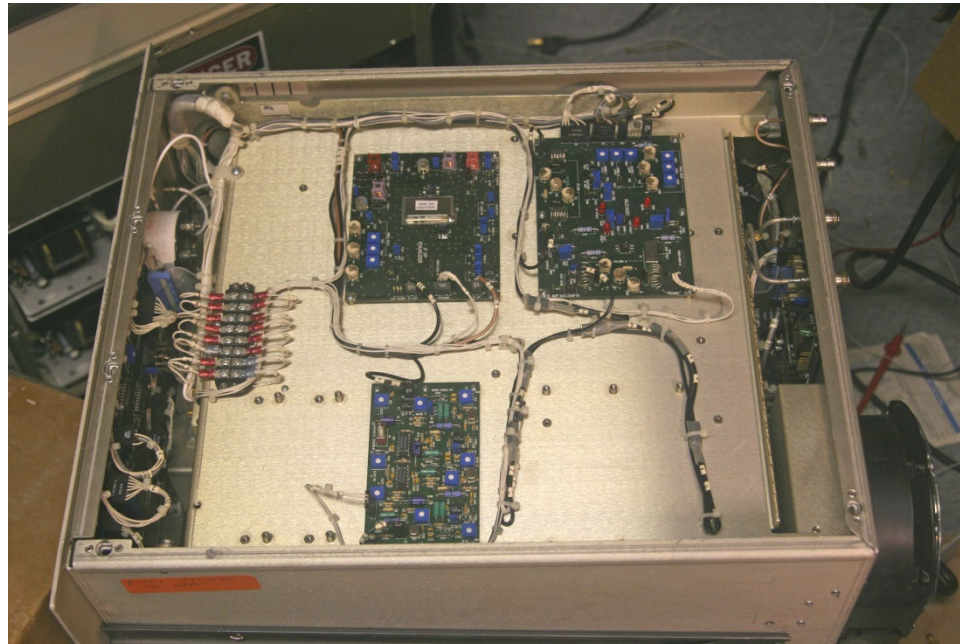
Add TR relay in or out of chassis

Add RX components to xmit chassis

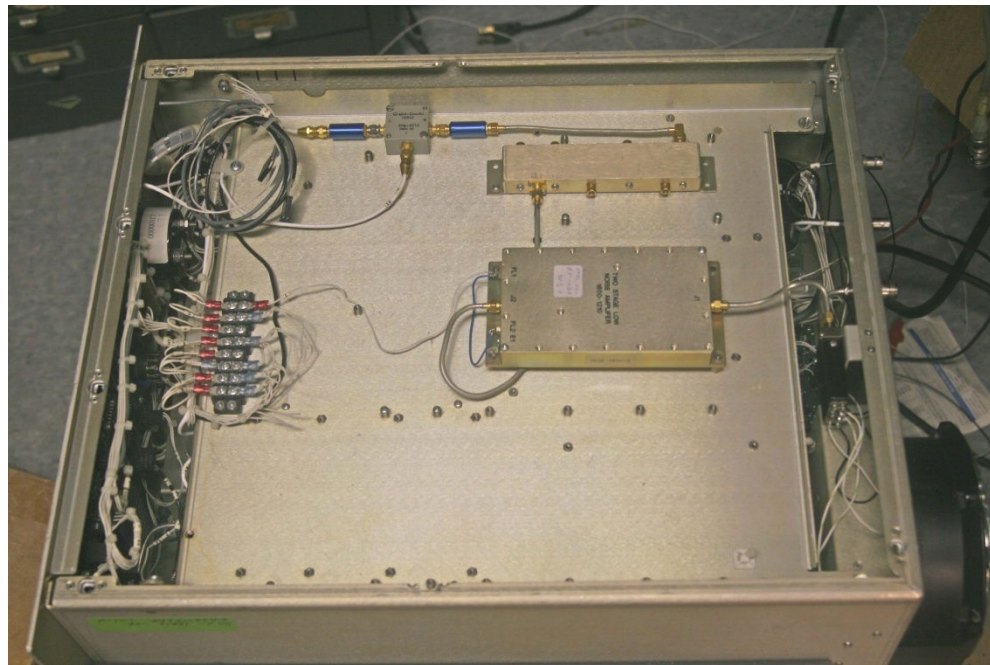
Use switches and functions to front panel

Some examples are shown.

Original
top tray

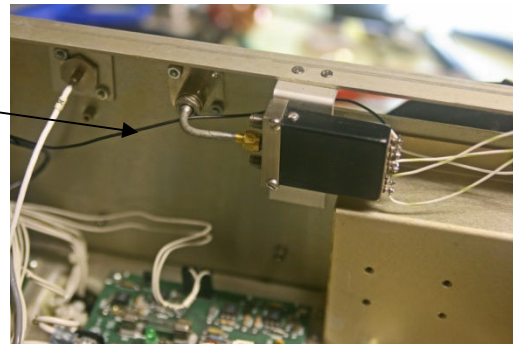


Modified with RX
components

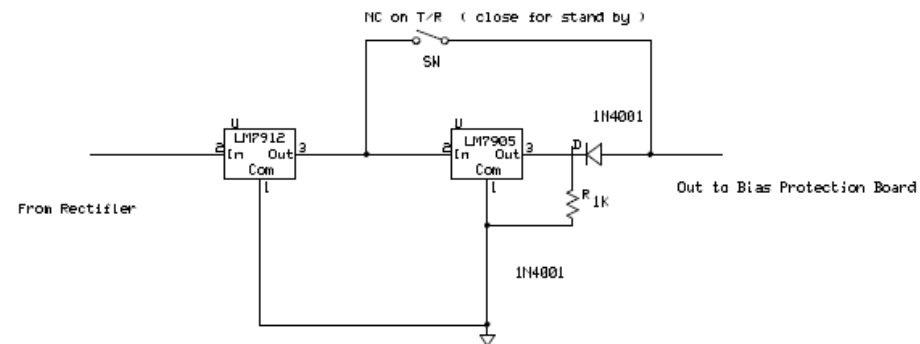


TR Control

- Bias to power amplifiers needs to be increased during receive
- Suggested circuit on next slide.
- Add connector to rear panel for TR control
- Amplifier bias needs to be set after TR control installed. Procedure attached
- Add TR Relay



TR Bias modification



NOTES :

1. This change requires re-adjustment the bias for all amp. stages. This best done before hand to reduce the possibility of excessive Drain current that can damage (destroy) the FET'S typical gate voltage is 1 vdc, recommend increasing this 0.15 to 0.2 vdc before performing this mod to the bias supply. Which will result in almost the same gate voltage after this mod. It is also recommended that the Drain current for each stage be checked after this change (0.245 vdc across test points)
2. This change results in the standby bias being about 2.5 vdc well within the max gate voltage

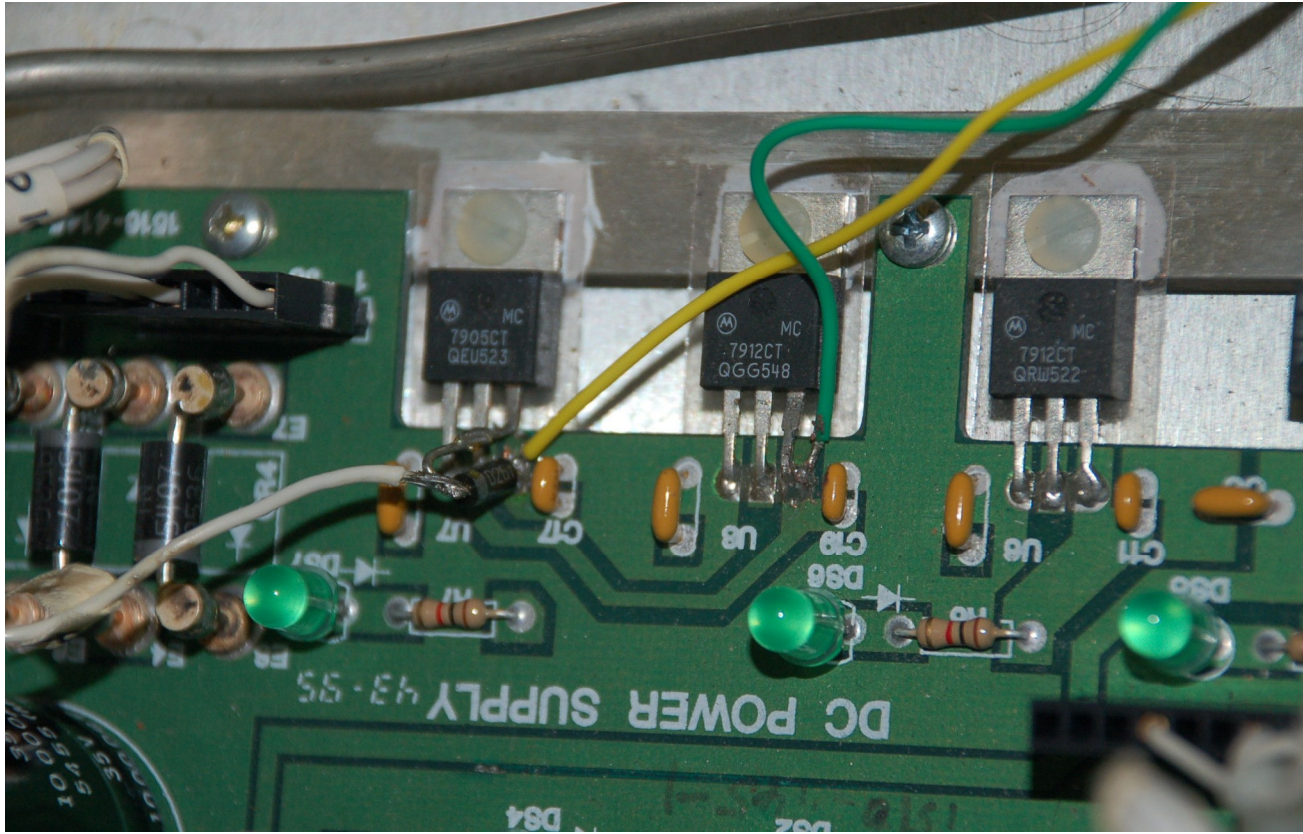
MMS Conversion

2304 Bias Standby

WASUYE - B. Loss

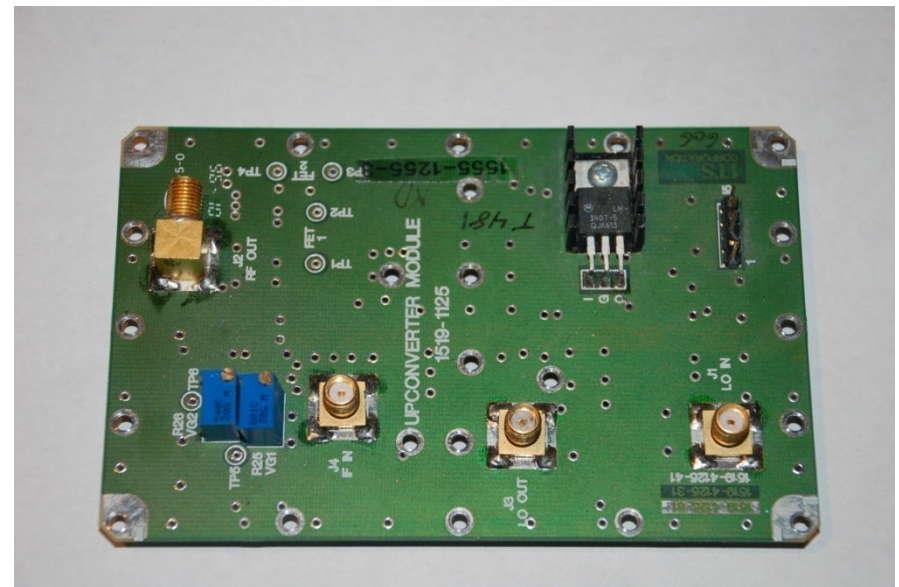
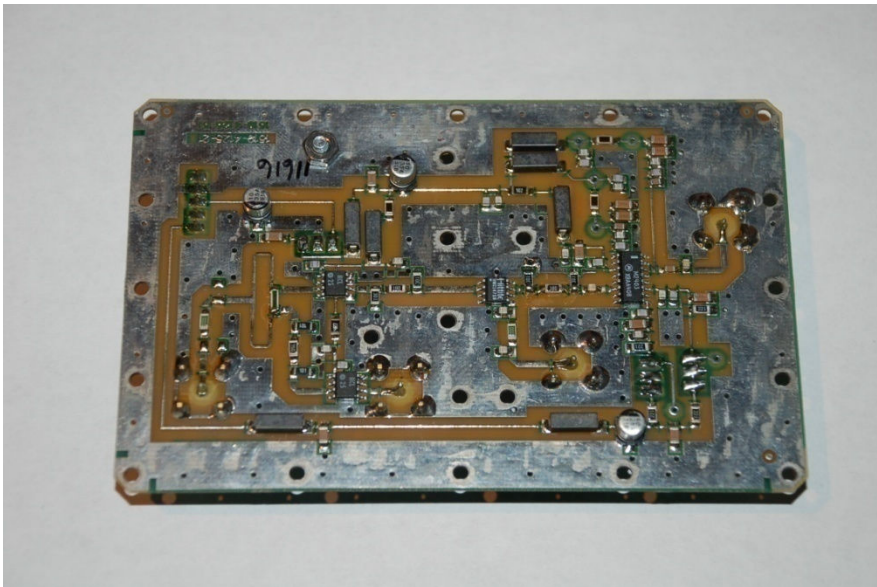
Rev 1.0

9/1/2009

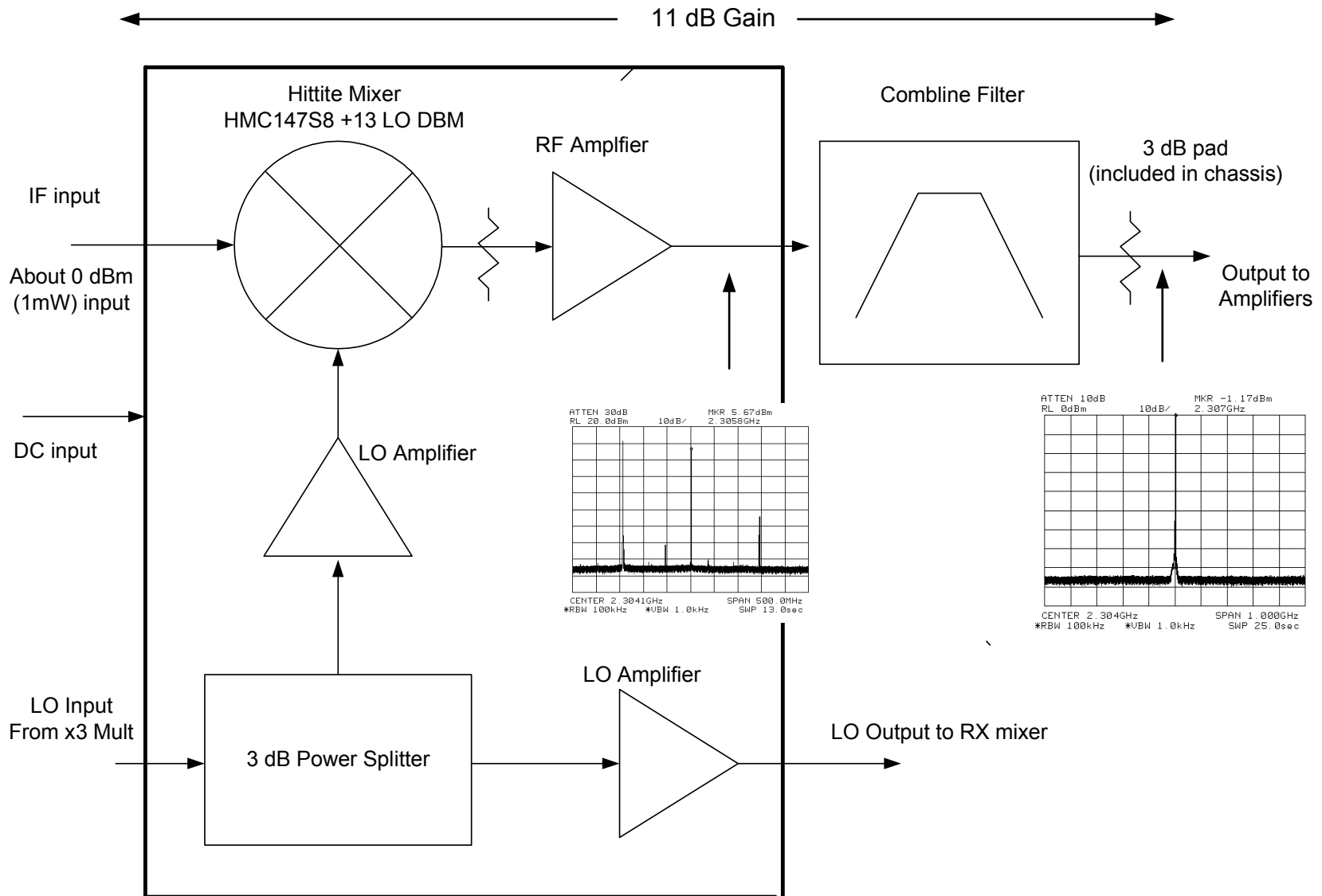


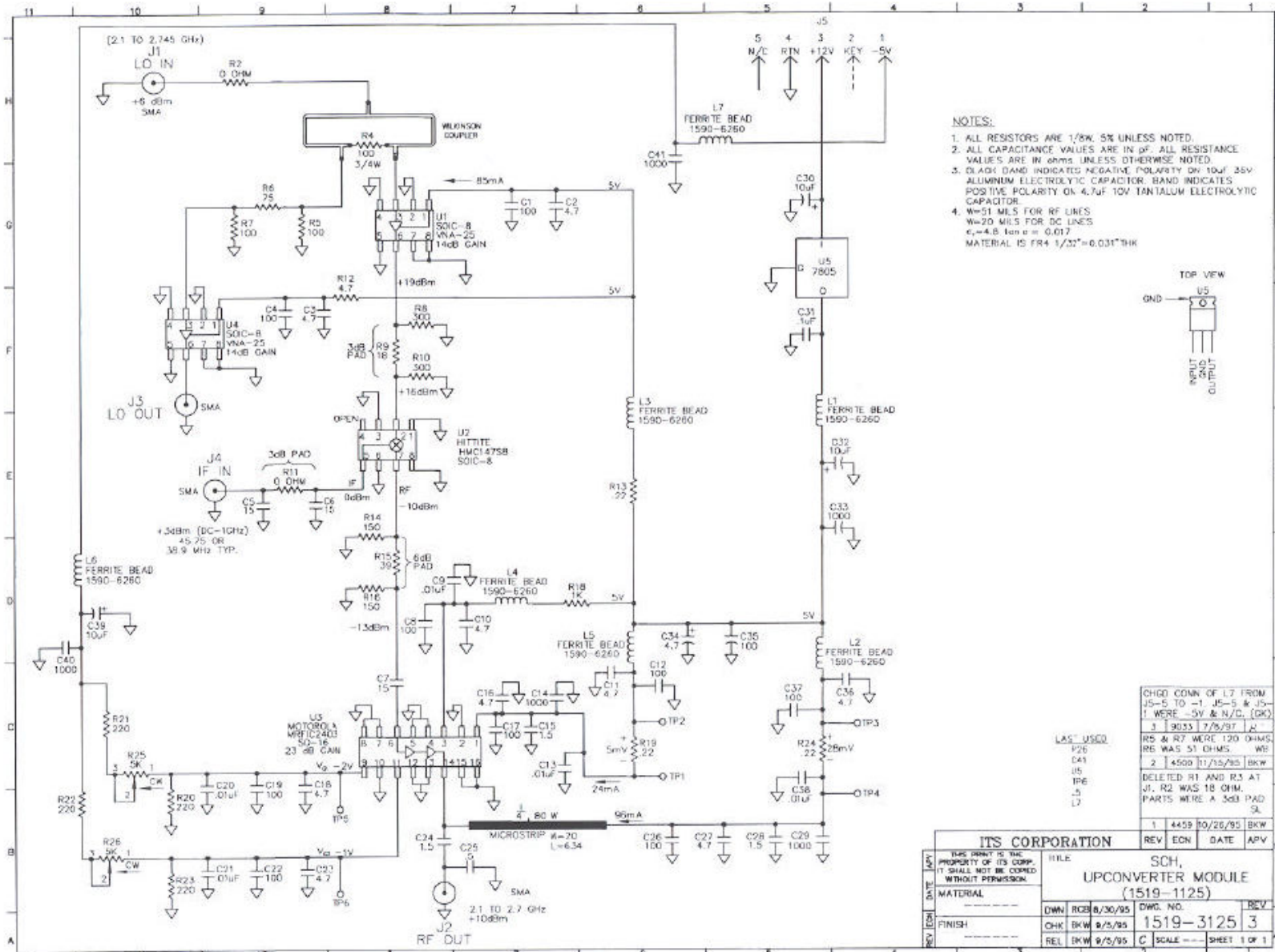
Mixer-Filter

- Mixer- No Conversion necessary. Use as is!
- LO splitter built in for RX mixer
- Filter will tune to 2304
- Narrow filter, 2 meter LO > 80 dBc
- 1st stage of low level gain built on board



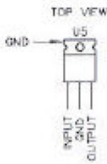
Mixer – Filter MMDS 2304 Conversion





NOTES:

1. ALL RESISTORS ARE 1/8W, 5% UNLESS NOTED.
2. ALL CAPACITANCE VALUES ARE IN pF. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.
3. BLACK DIAM INDICATED NEGATIVE POLARITY ON 100V 35V ALUMINUM ELECTROLYTIC CAPACITOR. BAND INDICATES POSITIVE POLARITY ON 4.7UF 10V TANTALUM ELECTROLYTIC CAPACITOR.
4. W=51 MILS FOR RF LINES
W=20 MILS FOR DC LINES
ε_r=4.8 for ε = 0.017
MATERIAL IS FR4 1/32"=0.031"THK



CHGD COUN OF L7 FROM J5-5 TO -1 J5-5 & J5-1 WERE -5V & N/C. (DK)

3 9033 7/9/97 AL

2 4500 11/15/95 BKW

DELETED R1 AND R3 AT J1. R2 WAS 18 OHM. PARTS WERE A 3dB PAD SA

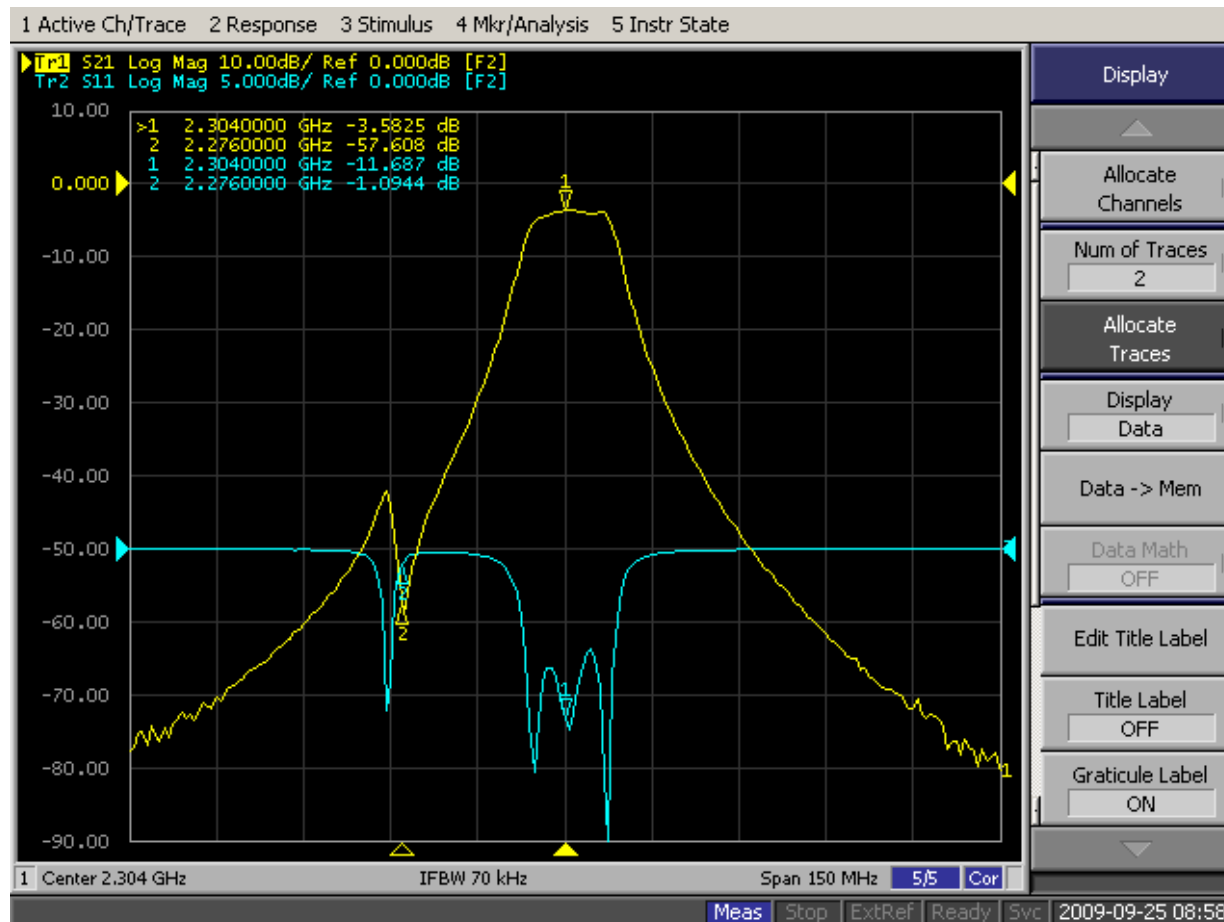
LAS⁺ USED

P26
D41
J5
R6
.5
L7

ITS CORPORATION <small>THIS PRINT IS THE PROPERTY OF ITS CORP. IT SHALL NOT BE COPIED WITHOUT PERMISSION.</small>		FILE: SCH, UPCONVERTER MODULE (1519-1125)	
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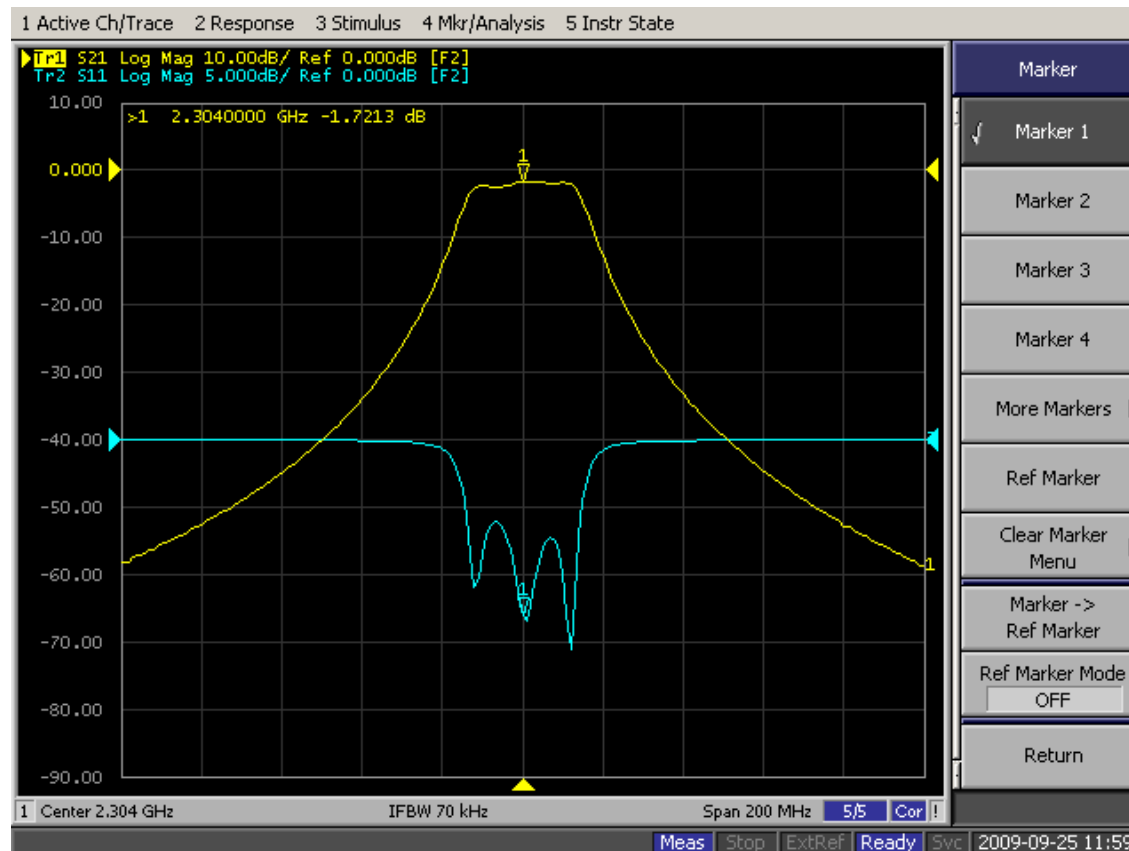
4 Pole Transmit Filter

- Excellent 2304 filter- one of the best!
- Adjustable notch for close IF, 28 MHz may be ok, 144/45 in use now.
- 1750A filter does not have notch, tunes to 2304 ok



1750A Filter

- Two filters provided – one for video, one for audio.
- Both tune to 2304, use one for xmit- one rx
- 1.7 dB I/L



RF Amplifiers

- RF power amplifiers will need to be tuned to 2304
- As built the amplifiers are on 2.5-2.7 GHz
- FET devices used, - bias must be applied at all times when the +10 V is on.
- Bias is controlled with a bias protection board
- Feedforward components can be removed
- Extra 10W amp in chassis after modification (not in model 1750A)

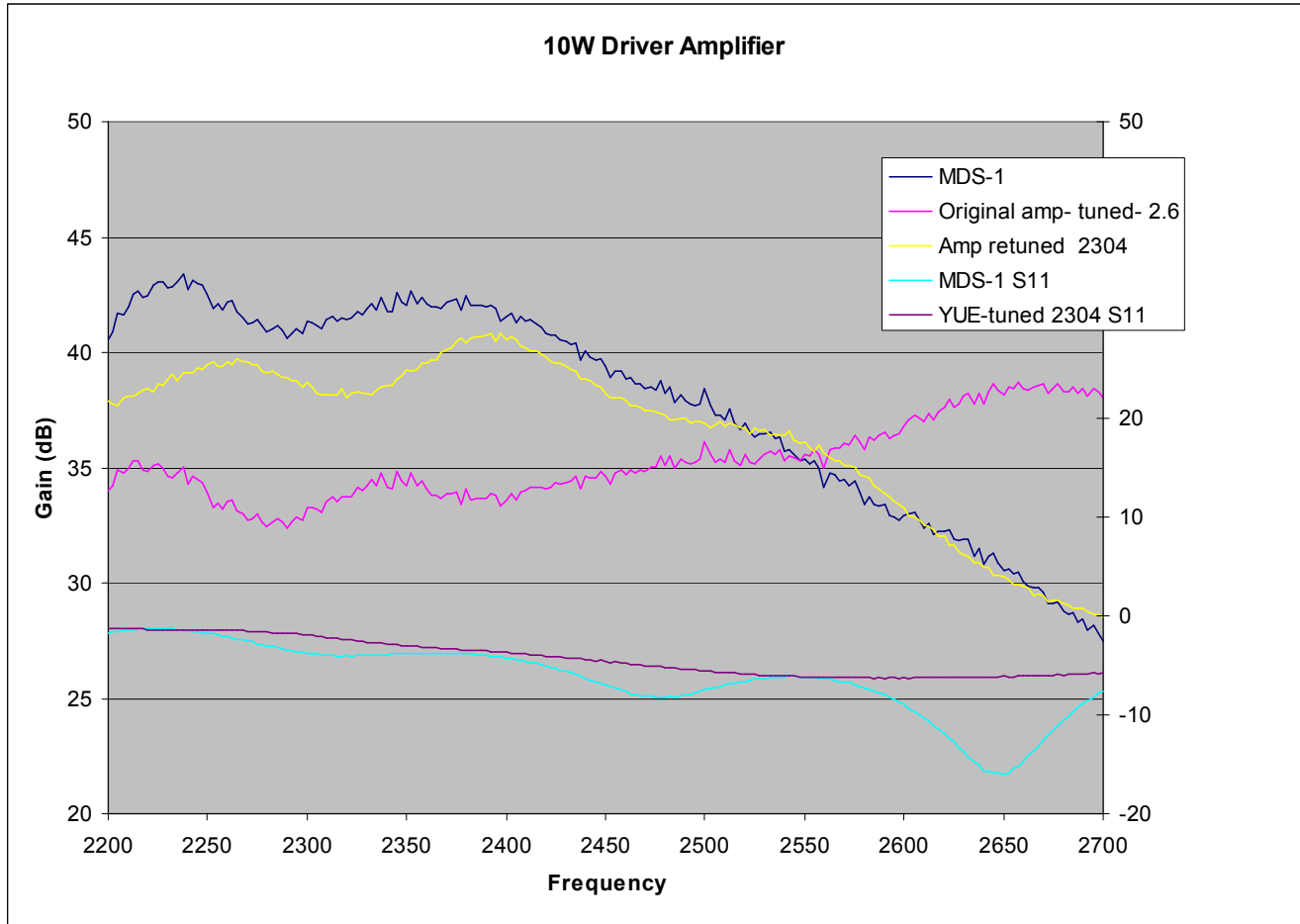
RF Amplifier Cont'd

- Rf tuning and performance was checked before and after modification to 2304
- Attenuator required between stages to prevent overdrive of power amplifier

10 Watt driver Amp

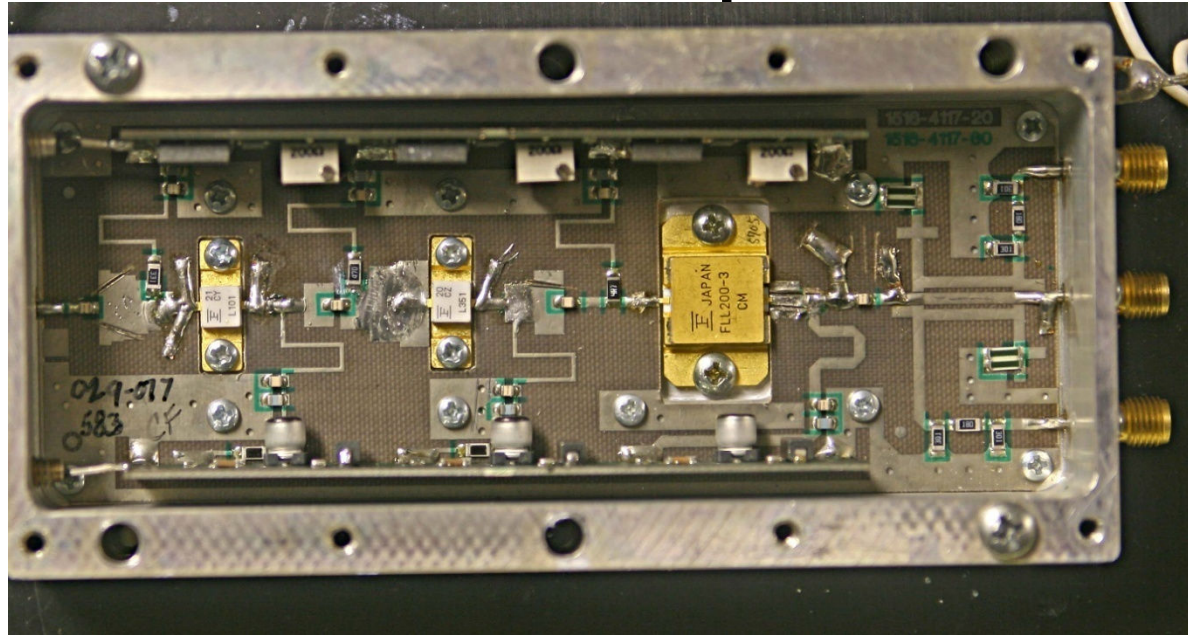
- 10 W driver starts to compress at 9 W
- 12 -14 W Saturated Power out
- 38-40 dB Gain depending on tuning.
- -5V Bias required

10W Amplifier

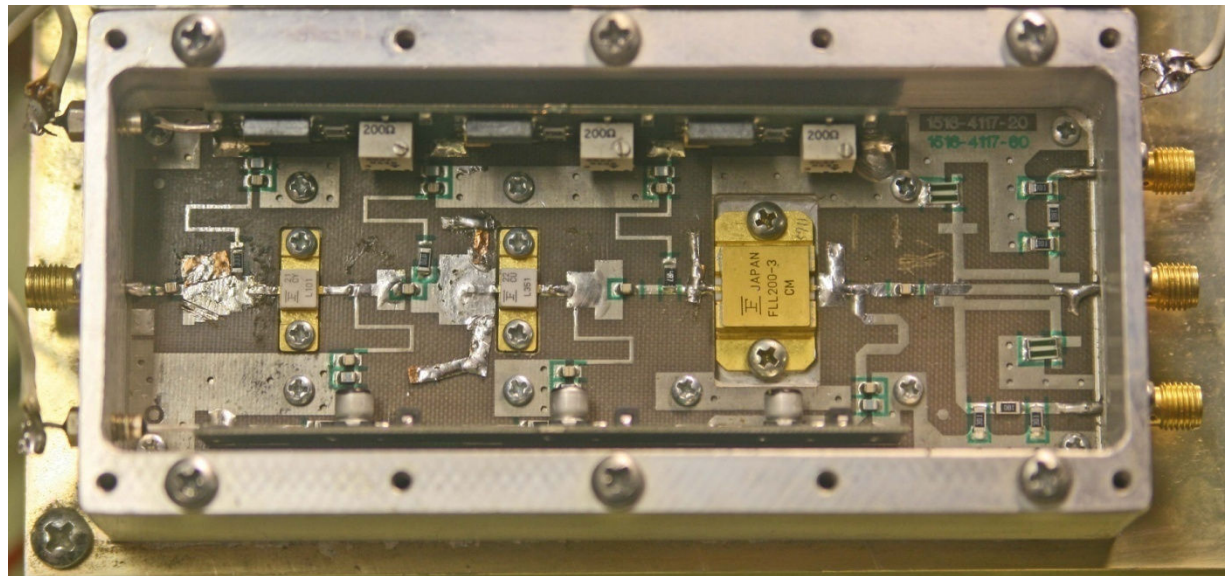


Retuned 10W 2304 Amplifier

Original amplifier



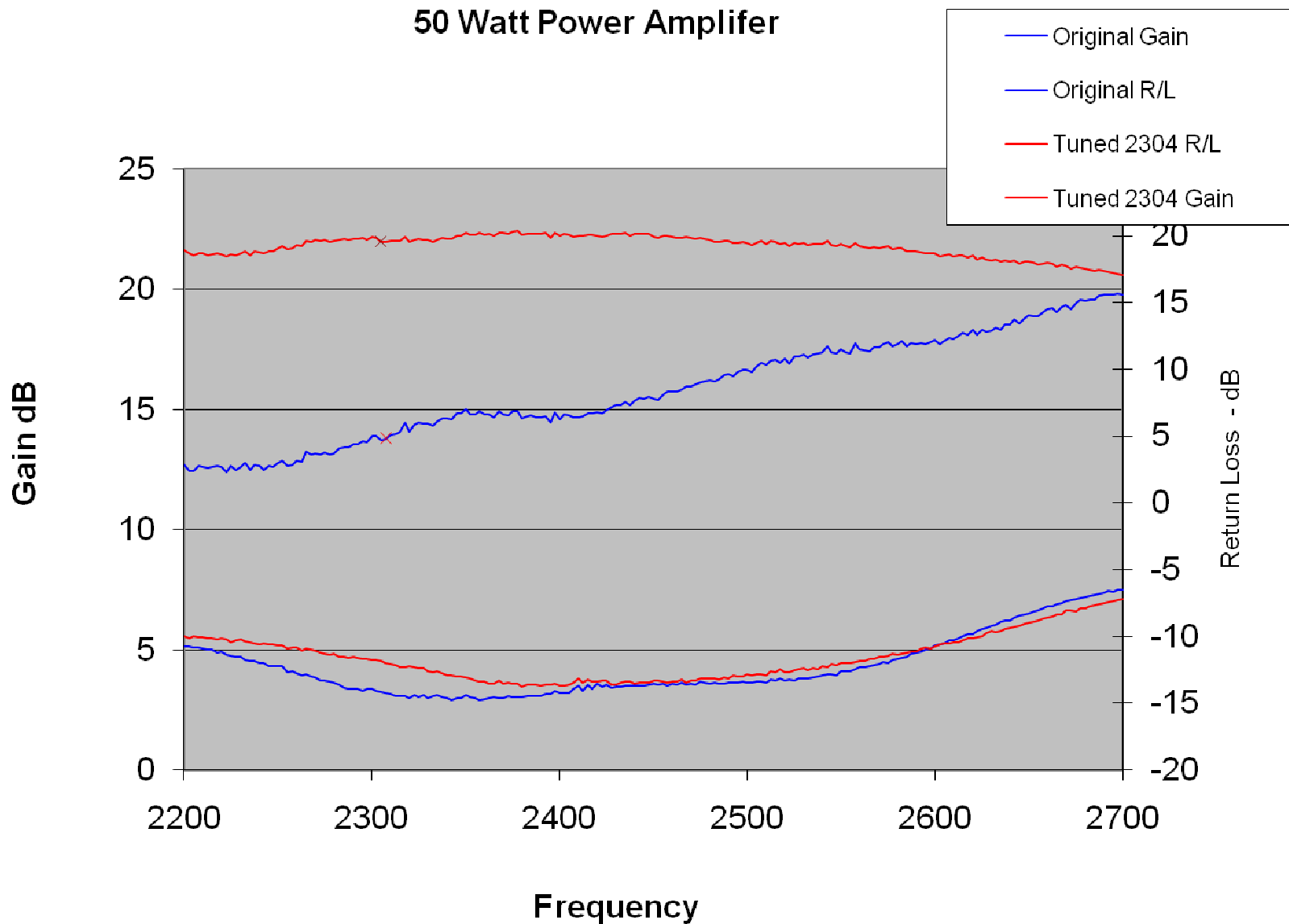
Retuned w/copper tape to 2.3



50 Watt Power Amplifier

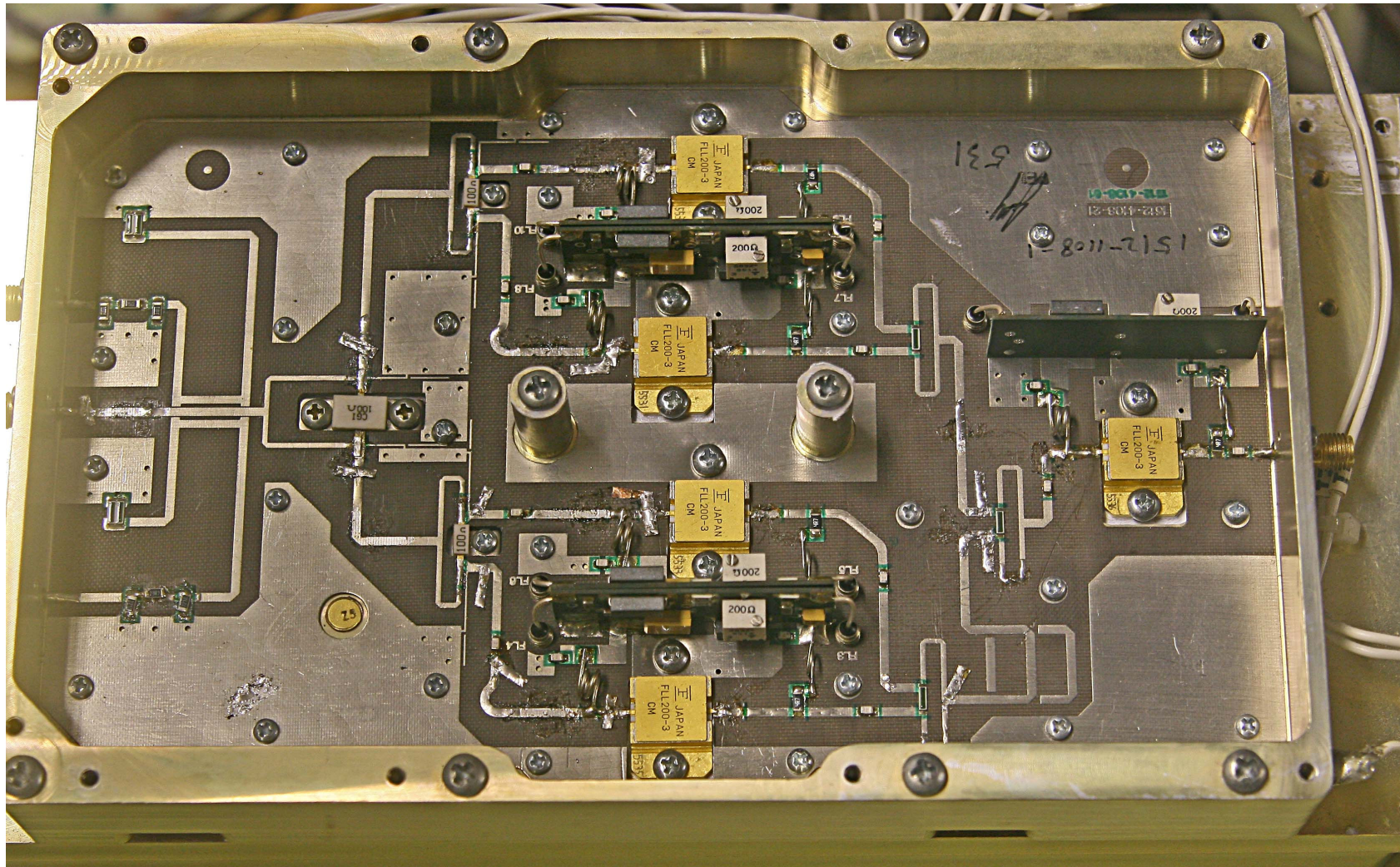
- 17-19 dB Gain, depending on Tuning
- -5V Bias required.
- 10V Drain Bias original design Class A
- Can be run at reduced bias for SSB.
- Needs tuning for best performance at 2304

50 Watt Power Amplifer

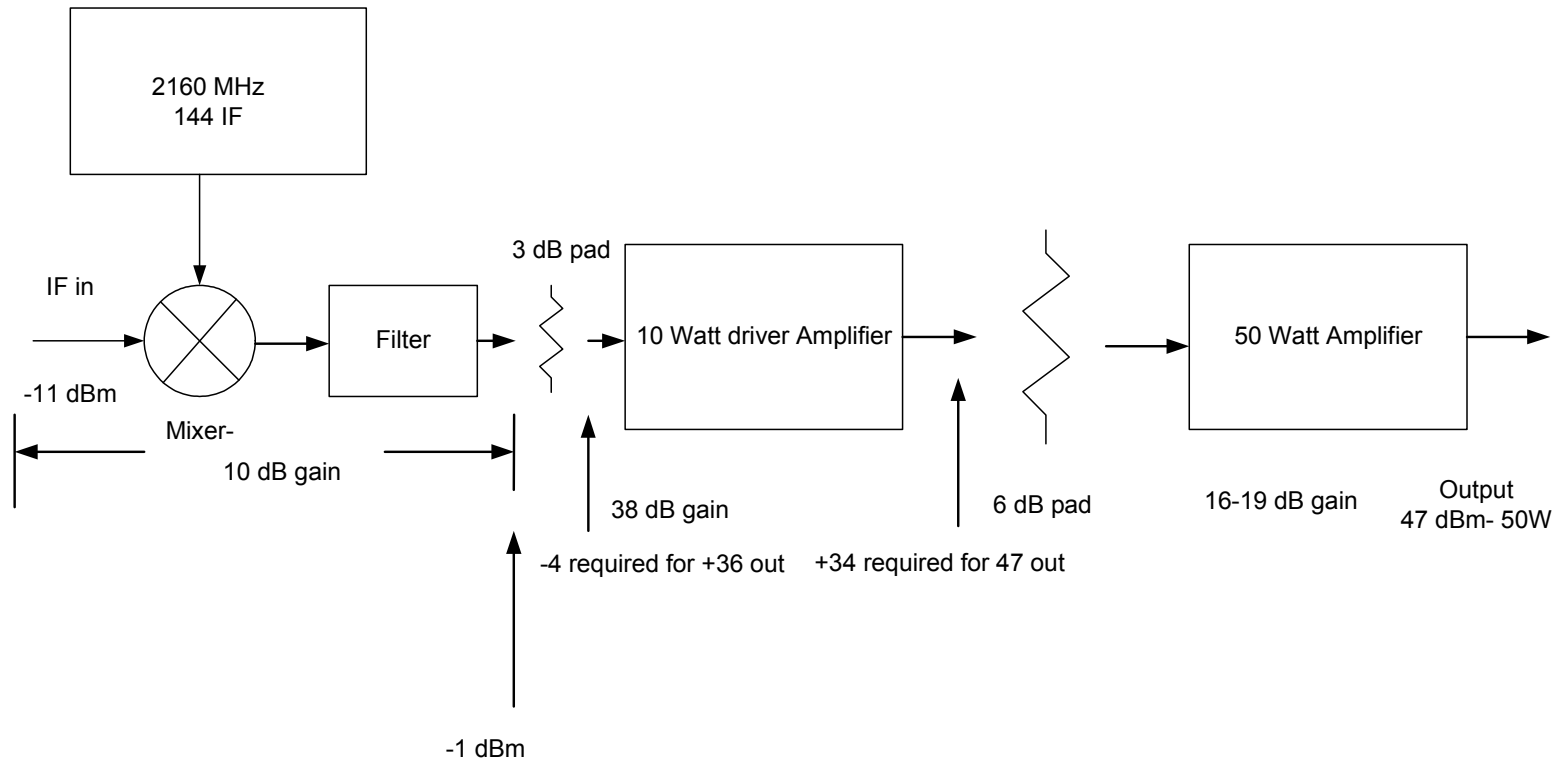


50 Watt 2304 Power Amplifier

Retuned to 2304

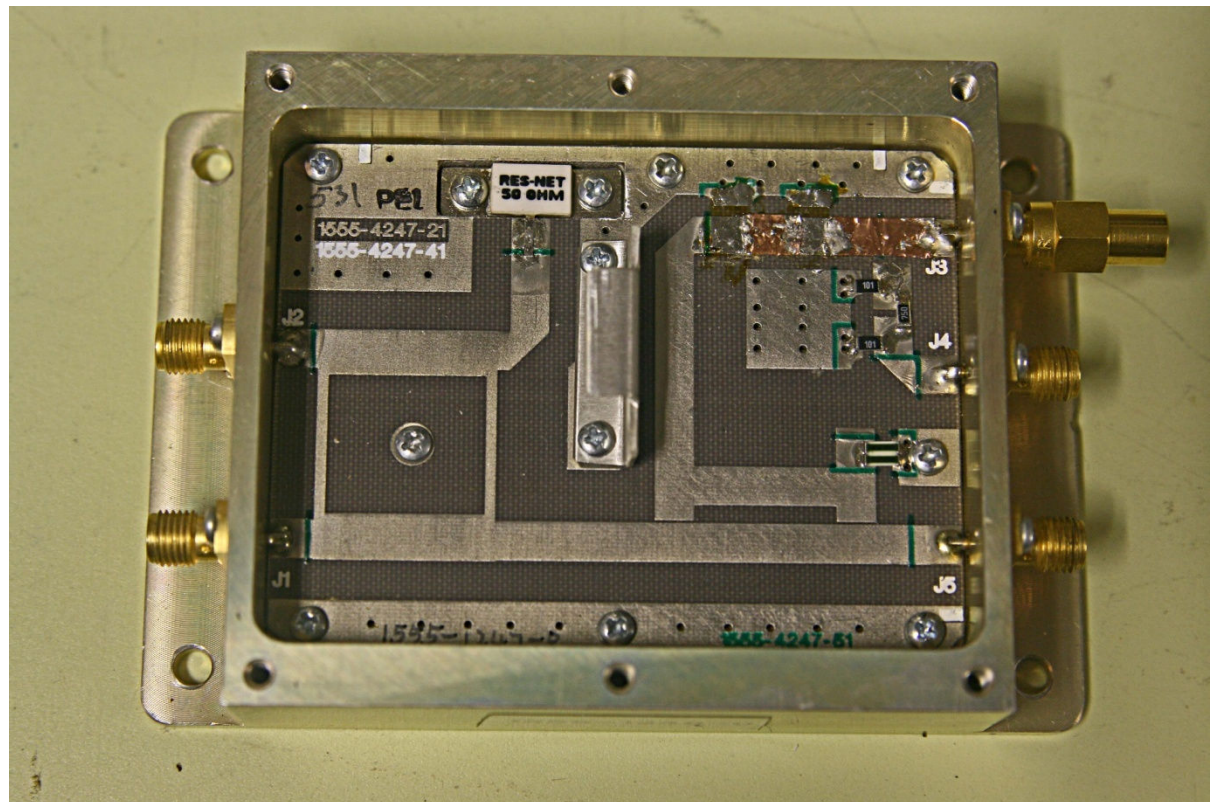


Transmit Level Block Diagram

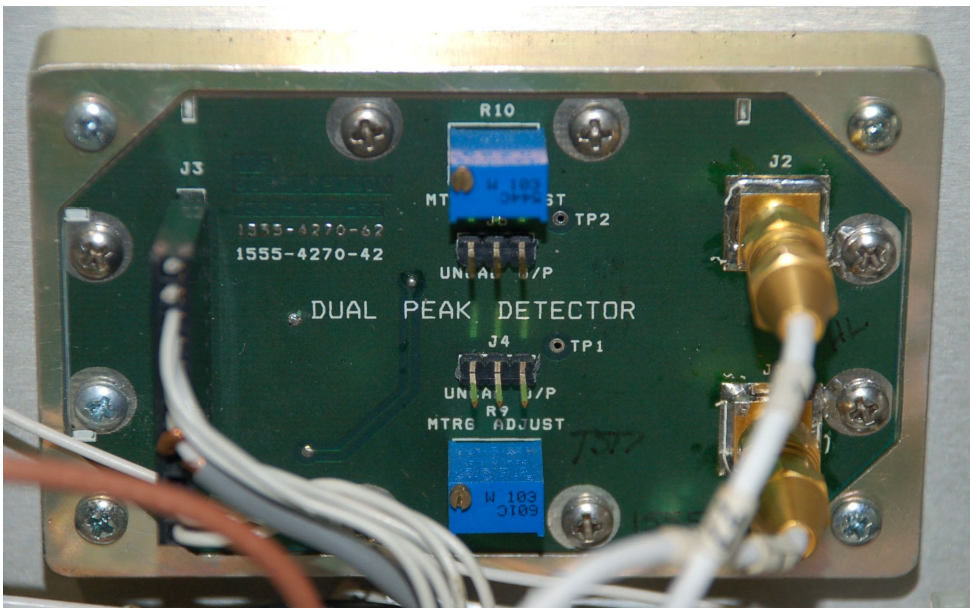
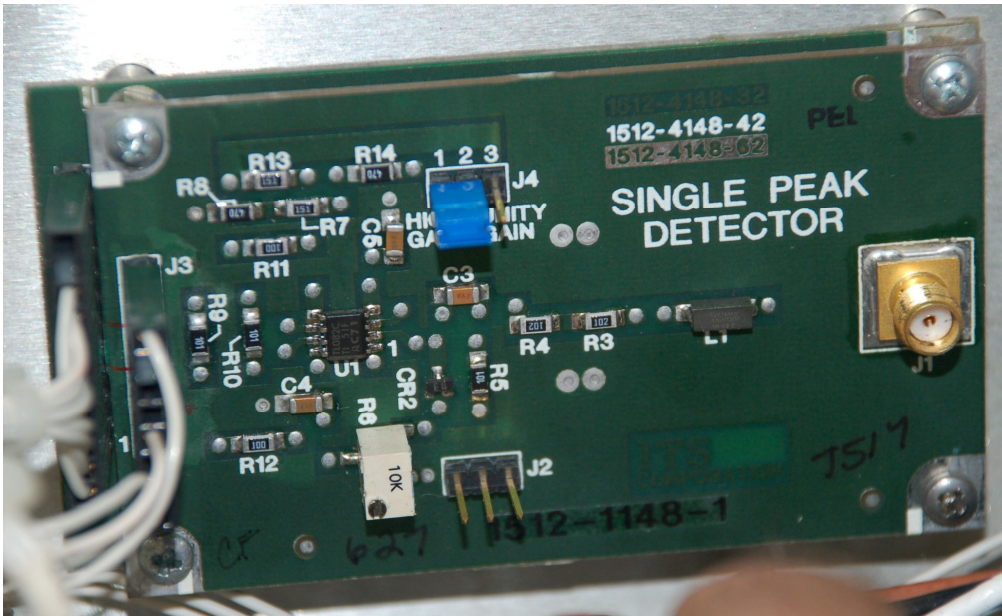


- A high power attenuator is necessary to prevent overdrive of PA
- This module from the feedforward parts may be modified for about 6dB loss
- An alternative would be to use a long length of RG174 allowing for greater attenuation, which may be needed.

6 DB Attenuator made from
FF module

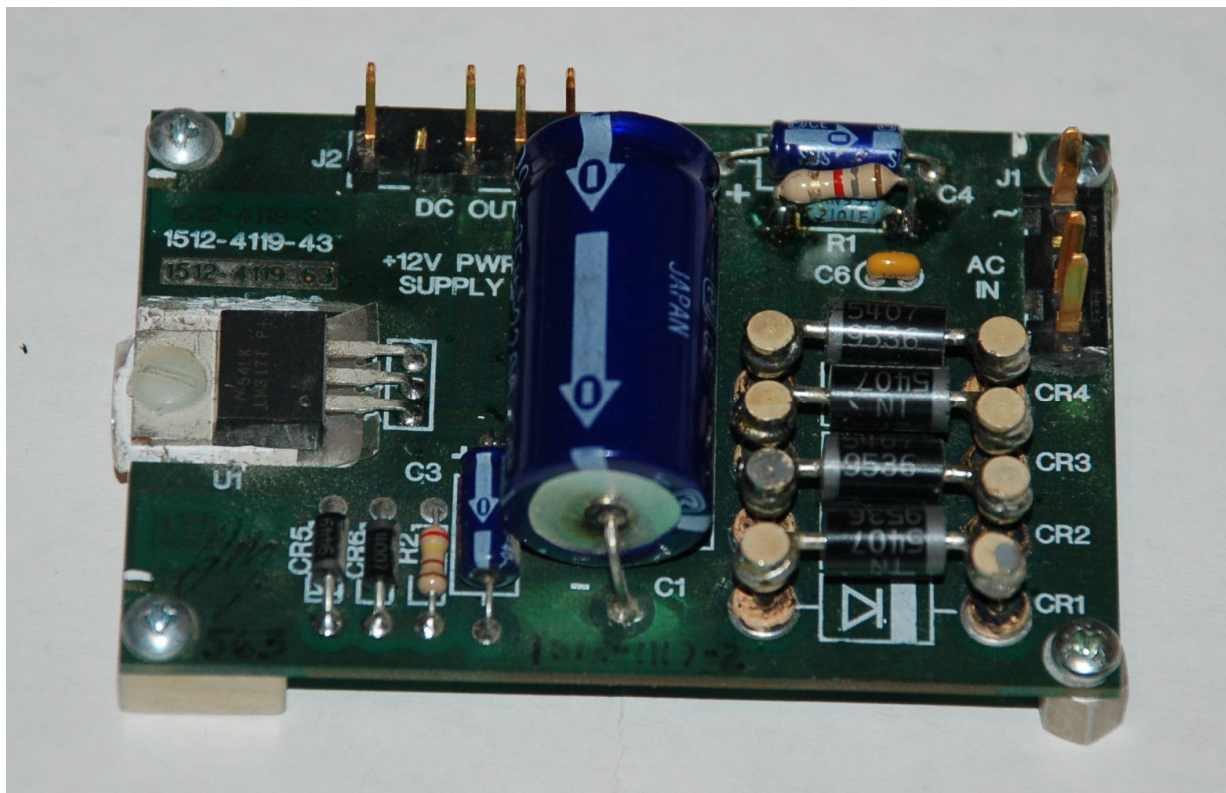


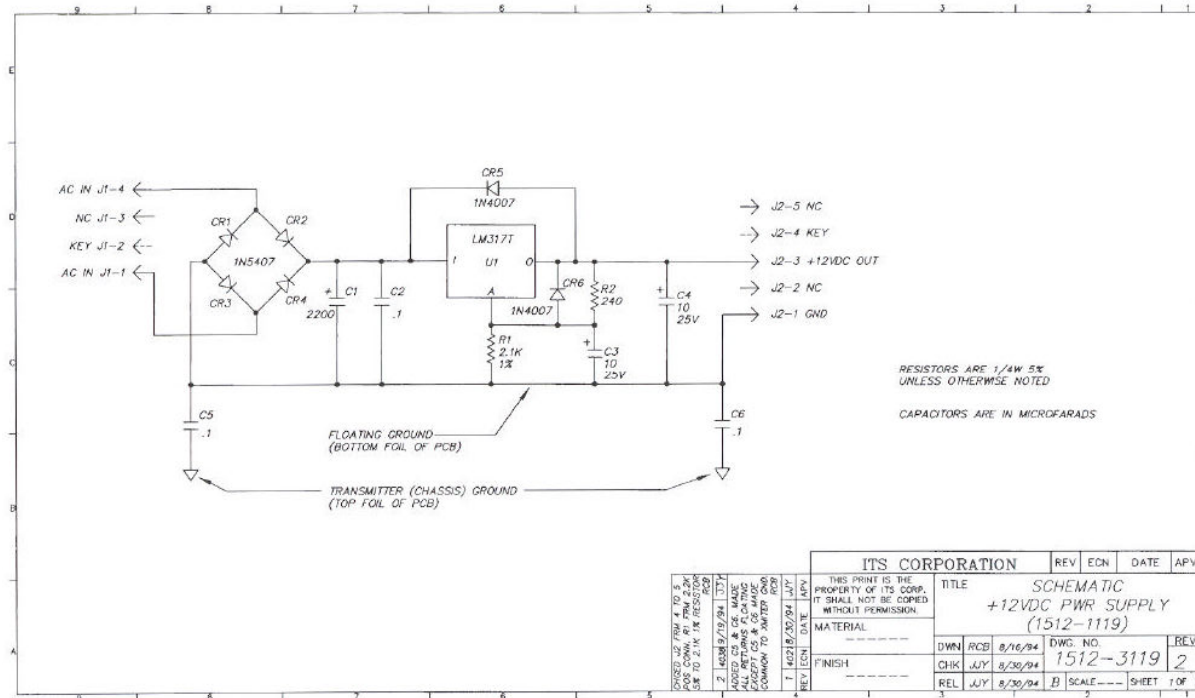
Power Monitor



Fan Speed Control

- Fan speed can be reduced, fan is fast and noisy.
- Parallel a 1.8K 1/8 or 1/4 watt resistor across R1 to reduce fan voltage / speed.
- Chassis was designed 24 Hrs- class A
- After bias is increased less idle A
- Intermittent use in transmit, PA not biased on all the time



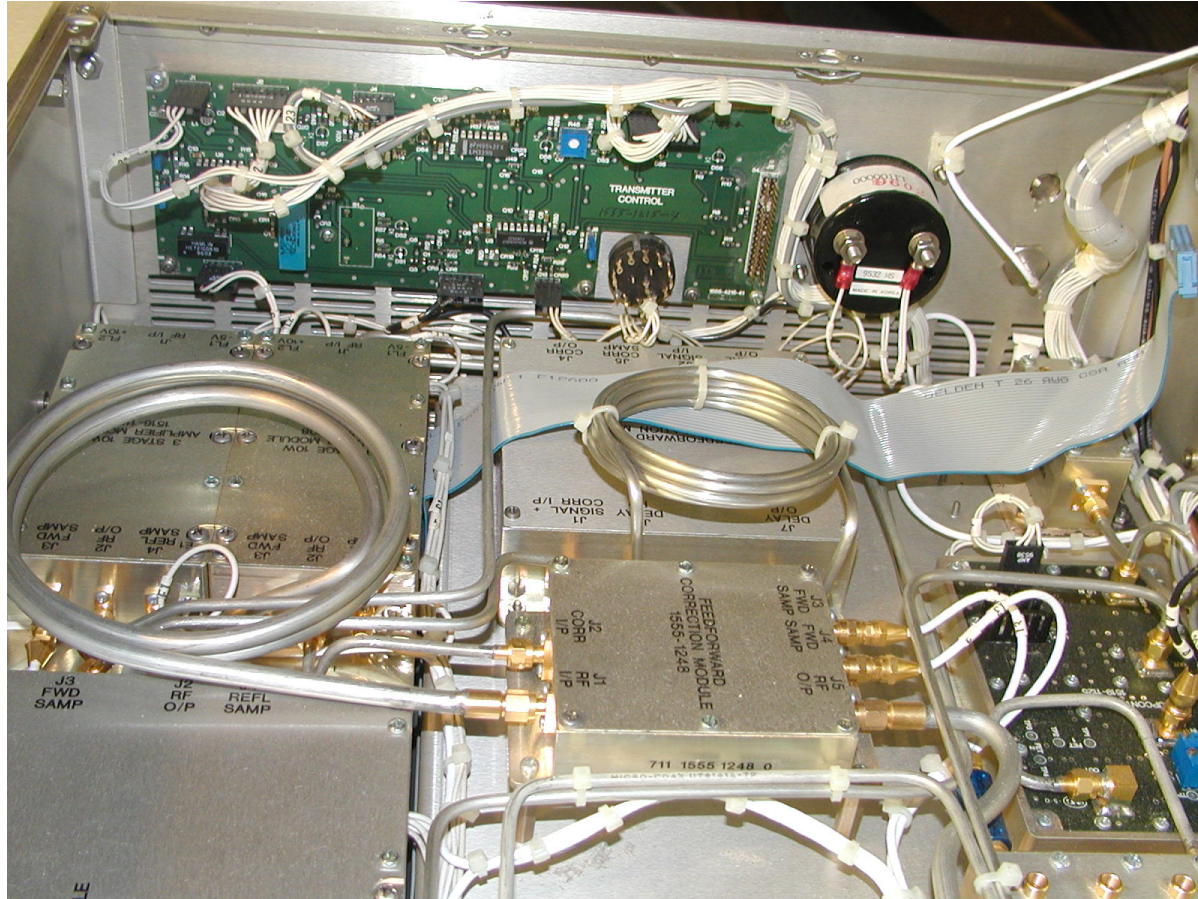


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TITLE		SCHEMATIC		+12VDC PWR SUPPLY (1512-1119)	
DWN	RCE	8/16/94	DWG. NO.	1512-3119	
CHK	JY	8/29/94	SCALE	2	
REL	JY	8/29/94	SCALE	SHEET 1 OF 1	

Original Inside Chassis

Behind front panel



Most of the components in the middle of the chassis are Feedforward parts. These can be removed.

Receiver Conversion

- Use Mixer as is. RX Mixer is a MC ZFM-4212 . +7 dBm LO
- LNA is usable as is, can be tuned for better performance.
- 1.3 dB NF and 24 dB Gain
- Needs + & -12V which is available in xmit chassis, easy to install.
- 4 pole Interdigital filter will tune to 2304 from RX chassis.

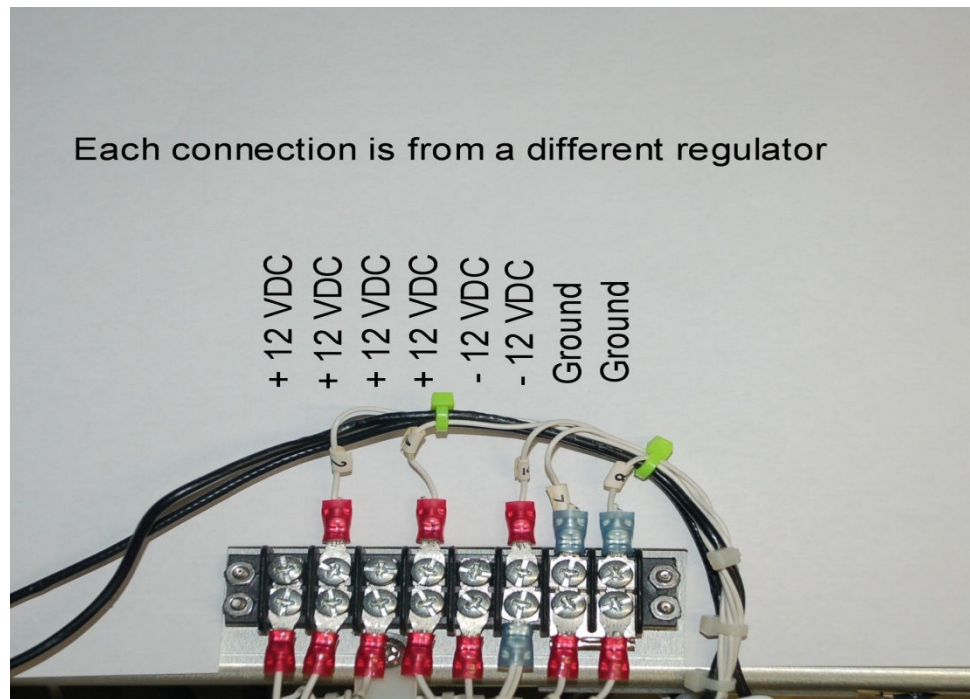
LNA Performance

Amplifier Power Supplies

- 12 V Power One supplies
- Voltage is dropped to about 10V for fet drain use with 2 large diode bridges.

Upper tray voltages.

DC Voltages available on top shelf after boards are removed.
Good for Installation of LNA from receiver, +/-12 is available
Bias protection board should be removed and installed with LNA



Weak Points

- High Current power supplies (under chassis) can fail. MOST failures are the rectifiers.
- Available from Mouser- PN 512-FEP16CT
- P-S PC board must be removed to replace parts.
- Feed through capacitors on amplifier DC connections have heavy wires attached, small pin, can break off.

Be Careful !

- Power supply board removed and ready for new rectifiers.



More Details to Follow

- Additional details in appendix of this document.
- Work is continuing on power amp bias, tuning and cascade of stages.
- Pictures will be available of complete converted units.

Appendix

- Detailed Conversion notes

Mixer Tune Procedure if – bias supply is modified

This change gets applied when making the change to the -5 bias supply for amp standby.

Looking at the PS board with the neg regulators at the top (front of unit to right) there are 2 connectors at the upper left , one larger and one smaller, smaller is marked J8
Pin 3 of J8 is the -5 vdc feed to the mixer.

Remove pin 3 from the connector, cut the socket off, and connected the wire to the directly

to the -5 regulator output (top of diode in both our cases).

The -5 output is the right lead when the leads are facing down.

This provides a fixed -5 to the mixer board that does not change from xmit / recv.

The voltages are

TP1 - TP2	5mv .005 vdc	(= 24ma drain current)	1st stage
TP3 - TP4	28mv .028 vdc	(= 96ma drain current)	2nd stage

PLL and UHF Oscillator,

The Xtal osc and multiplier chain is rather straight forward. When referring to frequencies assume a 144 IF with a final LO of 2160 mhz

The UHF Oscillator

Power is regulated +12

The xtal is at 90 mhz and in a oven. There are 3 doubler stages to get to 720 mhz. The doublers are MiniCircuits doubler blocks with Mimic gain blocks. There are 2 outputs, one at the xtal frequency, one at 8 times. There is an AFC input from the PLL board.

The output @ 720 mhz is about +5dbm

The VHF Generator Control Board

Power is regulated +12 and -12

The PLL board provides for a lock to a 10mhz (or 5mhz) reference such as a GPS Frequency reference. The design is based on standard PLL Frequency Synthesizer parts. The basic step is 781.25 hz, so programming for typical xtal frequencies is achievable, We have the switch settings (see below) for use with a 145 and 145 IF, others are easily calculated if needed. There is also a failover provision to provide a fixed bias (AFC voltage) if there is no reference signal.

For those that do not have a 10 mhz reference , this bias control can be used to tweak the xtal to the proper frequency, easier then trying to use the trimmer cap.

Tuning the UHF oscillator is easily done w/o a spectrum analyzer, though one is recommended to ensure there are no spurs. Each stage has a TP (simple diode detector) that measures the signal at the input of each doubler and the prior stage adjusted for max voltage.

A check for close in spurs needs to be done as we have seen being off a slight bit in tuning at the oscillator stage will result in a spur / double oscillation.

Following the UHF output is a varactor tripler to get to 2160 mhz, This can be tuned using the spare RF detector or, easier, using a spectrum analyzer

Crystal and PLL settings

144 IF = 2160 lo = 90 mhz xtal
VHF board divisor settings
N = 675 1010100011
A = 0

145 IF = 2159 lo = 89.958333 xtal
VHF board divisor
N = 674 1010100010
A = 44 101100

The dip switches are set to ON for a logic zero, OFF for logic one.

Notes to set bias before and after TR switching modification.

10W stage			
		Orig Bias	
Amp-- 1	FLL 101	-0.7	Adj- CC to -1.2V
	FLL-121	-0.83	Adj- CC to -1.2V
	FLL200-3	-0.58	Adj- CC to -1.2V

Turn pots counterclockwise to increase - bias volts, (less drain current).
Reset after TR diodes are installed.

Note: Do not turn pots too far, -12 V receive bias could damage the FETS if set too high.

Repeat for 2nd 10W amp if installed.
The 5 pots on the power amplifier must be set also.

Install series diode -5V

FLL 101	-1.04
FLL-121	-1
FLL-200-3	-0.99

Adj bias back to original values Adj- clockwise

FLL-101	-0.8
FLL-121	-0.8
FLL-200-3	-0.6

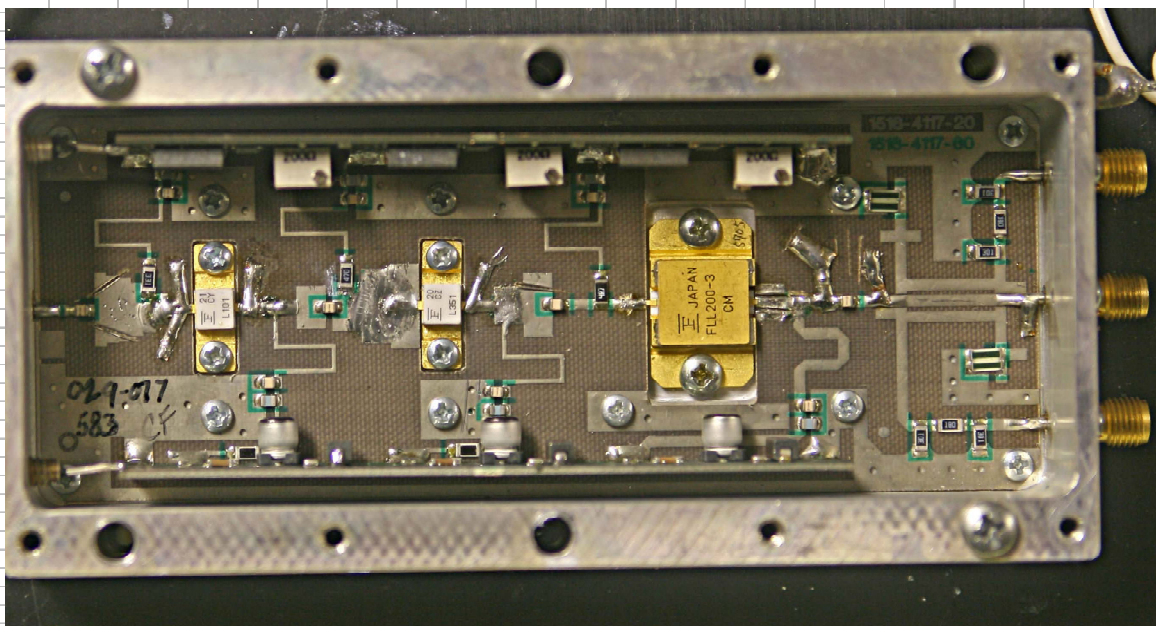
Unit goes into xmit ok.

Check-Drain mA .25 for 1- FLL200-3

Add -12 V	
FLL-101	-1.95
FLL-121	-2.44
FLL-200-3	-2.11

Turn on PS- Check xmit mA

FLL-200- 1.4 mV



Multi Voltage PS.

