ATLAS 210X (&LE) Mods

Kevin Murphy Thursday, August 02, 2007

PC200D Mods

I installed the PCB today and power up the transmitter and was horrified, it was as though I hadnt done anything. The RX was acting strangely as well. I looked at the LO on the Oscilloscope (CRO) and it was as though there was FM on it. I looked at the Spectrum analyser and there was everything,even 5.645 MHz.

Then the penny (10c) dropped. The LO /CIO switch normally feeds into a capacitor so that the switch can do its job properly, and I had neglected to fit one. I will fit two 10 nF capacitors on the LO/CIO switch PCB.

In the process of looking at the LO (VFO) with the CRO, I noticed that it was distorted and I suspected it was current limiting. It is the FET based VFO and there is an FET and a emitter follower buffer to feed the output into 50Ω (+/-). The current required to do this quite high, so insufficient current can cause clipping. The waveform was ok on the top portion but severely clipped on the bottom section. As an option I thought I could increase the current. I will be looking into this

Thursday, August 09, 2007

I had thought about temporarily installing the PC200D from the 210X LE in my Atlas to see what the performance was like, and to see if there was any problems. Today I did that, and the rejection of spurs was excellent. Mind you, there are two notches in circuit, however it was the rejection of mixing spurs thas was very apparent. I am adding some images in an appendix for reference. This leads to me to believe there may be problems with filter bank in the LE. The 2 filter PCB's are different. My unit is the one with the mica trimmers, whereas the LE version has the plastic trimmers, plus some additional earthing. Another difference is that I have replaced the FET VFO/CIO switch in my unit. I will look at the LO drive on a spectrum analyser to see if there is any effect there.

I also fed the MC1350 with a DC supply and RF drive with AGC volts set to 4 volts to check resonance of the tuned circuit, since I had changed the tuning capacitor. Resonance was spot on. I will recheck the gain as well

TX Bandpass filter

I decided to temporarily remove the PA, in order to look at the 210X LE transceiver output on the spectrum analyser, without adding power attenuators all the time.
I looked on the output of the TX bandpass filter, and noticed variation of levels on the spectrum analyser. I measured back into the filter with a DMM on ohms and noticed resistance of up too 110 ohms. What… I then had a close look at the PCB and noticed 4 preset resistors in series with the outputs. I assumed these were there in order to equalise tx output levels from the transceiver. Not on any diagram !!

PA

With the PA out of the unit, I took an opportunity to measure some parameters. I drove the unit with a signal generator and measured power with a attenuator and power meter, with the output set to 10 watts (+ 40 dBm) and noted drive. I measured overall PA current and calculated gain and estimated drive for 50 watts (+47 dBm) output.

Band (MHz)	Input level for 10 watts	Gain (dB)	~Input level for 50 watts	PA module current
3.5	-25.7 dBm	65.7	-18.7 dBm	4A
7.0	-32.1 dBm	72.1	-25.1 dBm	4A
14.0	-31.5 dBm	71.5	-24.5 dBm	4.3A
21.0	-29.0 dBm	69	-22.0 dBm	4.5A
28.0	-25.3 dBm	65.3	-18.3 dBm	4.4A

There is significant gain variation of about 7 dB across the bands from 3.5 to 28 MHz. There is rolloff at 3.5 MHz, possibly due to insufficient transformer inductance, and also at 28 MHz.
I had previously estimated that the optimum output level from the TX BPF was ~ -19 dBm. (with a 3 dB attenuator fitted) This agrees quite well with the drive to the PA on 3.5 and 28 MHz.
Removing the 3 dB pad would allow drive to 100 watts, but increase spurs due to mixer mismatch. Also 50 watts is estimated to be the maximum power out for 28 MHz.
It can be seen that the additional resistors fitted to the TX BPF, were used to equalise the transceiver gain.
I powered the PA and saw about 0.5 A with no RF drive. 300 mA is for the Final Base bias (0.7 / 2.35Ω) while the other 200 mA is for the other stages. I was noticed that the overall current increased from 0.5A to ~2A after the PA was on for a while at 10 watts. The 2 diodes used for the base bias network where in mid air, not thermally connected to the heatsink/devices. There is also an additional 100Ω across the diodes which is not noted on the diagram.

The formula for Z on the collectors of the Final is $Z = 2x(Vcc - Vsat)^2/P$ out. Solving it for P out = $2x(Vcc - Vsat)^2/Z$ (from Motorola RF handbook)
The turns ratio of the output transformer of the Atlas 210X is 3:1, or 9:1 for Z, the load on the primary is 5.5Ω. Using Vcc as 13.8v and Vce sat as 2.5 volts, then P out = 46 watts…Even using a very small value of Vsat of 0.5 v gives 64 watts.

At this point I added another turn to achieve 4 turns or 16:1 Zratio, which should achieve 82 watts with the 1st value of Vsat quoted in the previous paragraph, or 113 watts with the second value. This could possibly increase the gain at 80m due to increased inductance and also increase overall power

I set the input level for 10watts + 40 dBm (10 watts) and noted level and DC current into the PA module overall. I also seperated the driver from the small PCB and measured the power on the secondary of the small toroid, using DC isolating capacitor (relative level only)

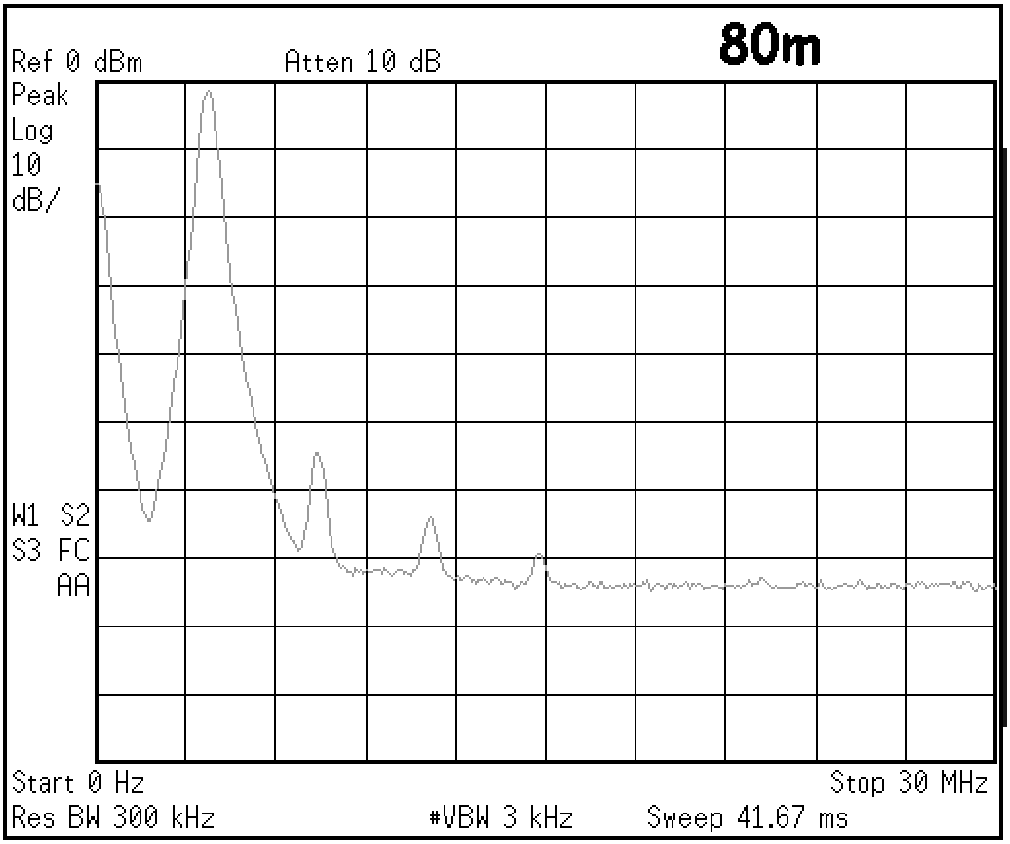
Band	RF level in	Gain (dB)	DC Current	Level from driver PCB	Gain from input
3.5	-25.1	65.1	5.2 A	-10 dBm	15.1 dB
7.0	-31.8	71.8	5 A	-7.5 dBm	24.3 dB
14.0	-32.3	72.3	5 A	-2.3 dBm	29.3 dB
21.0	-28.2	68.2	5 A	+1.21 dBm	29.4 dB
28.0	-25.7	65.7	4.9 A	+3.64 dBm	29.3 dB

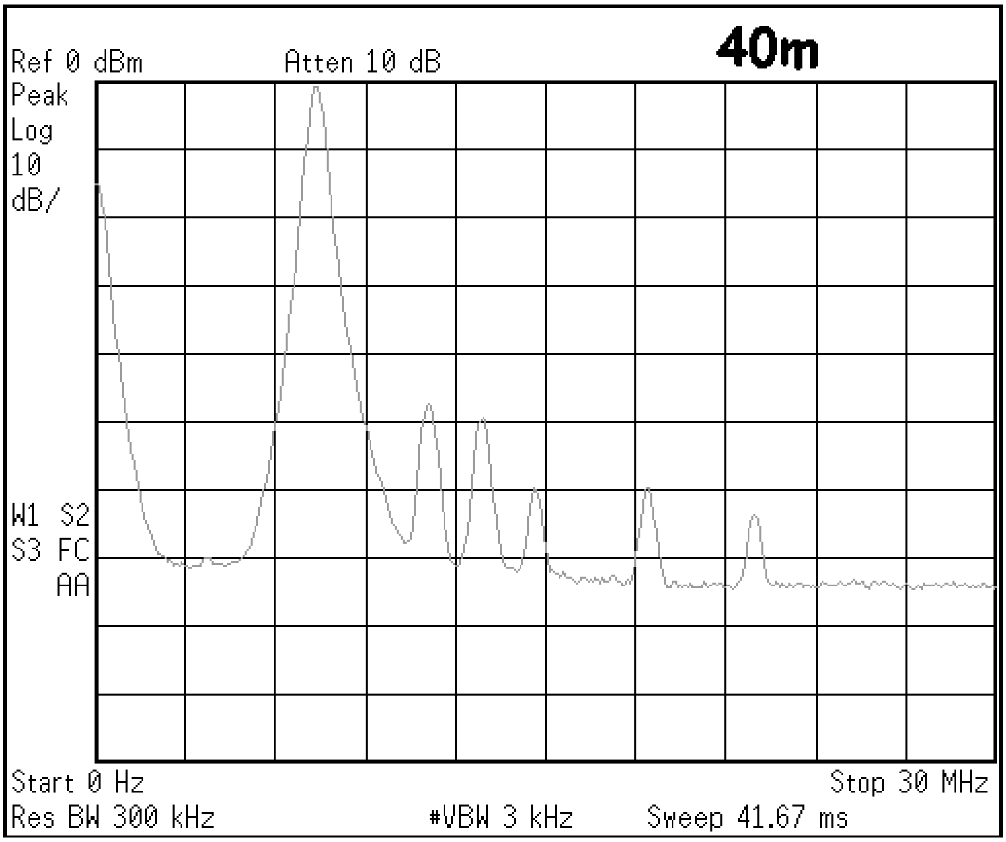
One can see that no significant improvement in gain at 3.5 MHz was made by increasing the turns ratio of the final output transformer. There was no significant gain change at other frequencies. The DC current was noticably higher due to a different power match into final transistors. The power coming from the driver, is only relative as the correct match is unkwown, but it does show an increasing (+) gain slope, to perhaps counteract the decreasing gain slope of the final amplifiers.

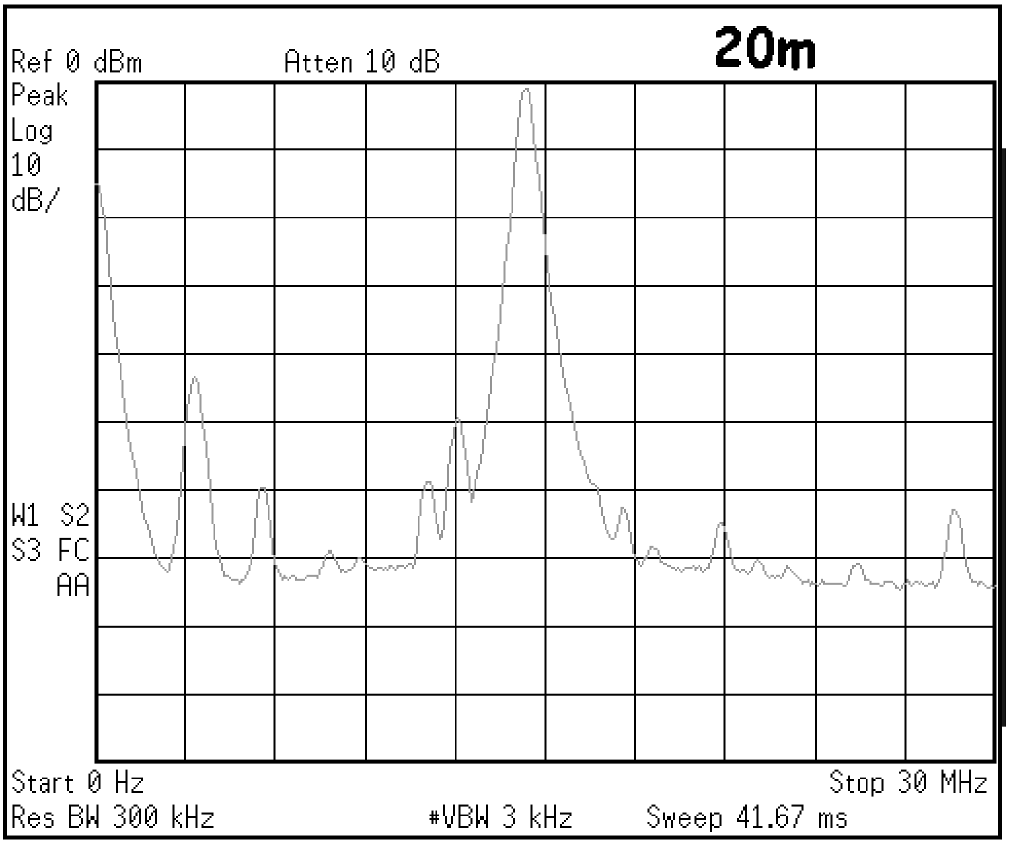
The gain slope appears mismatched as the table on the previous page shows. I have seen a feedback mod on the Internet and will try that to see if it flattens out the gain response. As the driver for the PA on the 210X LE is a MRF476 (rated at 3 watts PEP), which is similar to the 40852 performance of 3.5 watts(original device), I have decided to return the transformer turns ratio to 3:1. This is within the capability of the driver device at 10m. The PA device gain is of the order of 11 to 15 dB at 30 MHz. The power output of the ATLAS 210X at lower frequencies is higher due to increased PA stage gain, however the turns ratio of the final transformer is really only suitable for powers of the order of 50 watts due to driver limitations

Appendix

Images of my ATLAS 210X with the modified PC200D PCB from the LE unit.






20m
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
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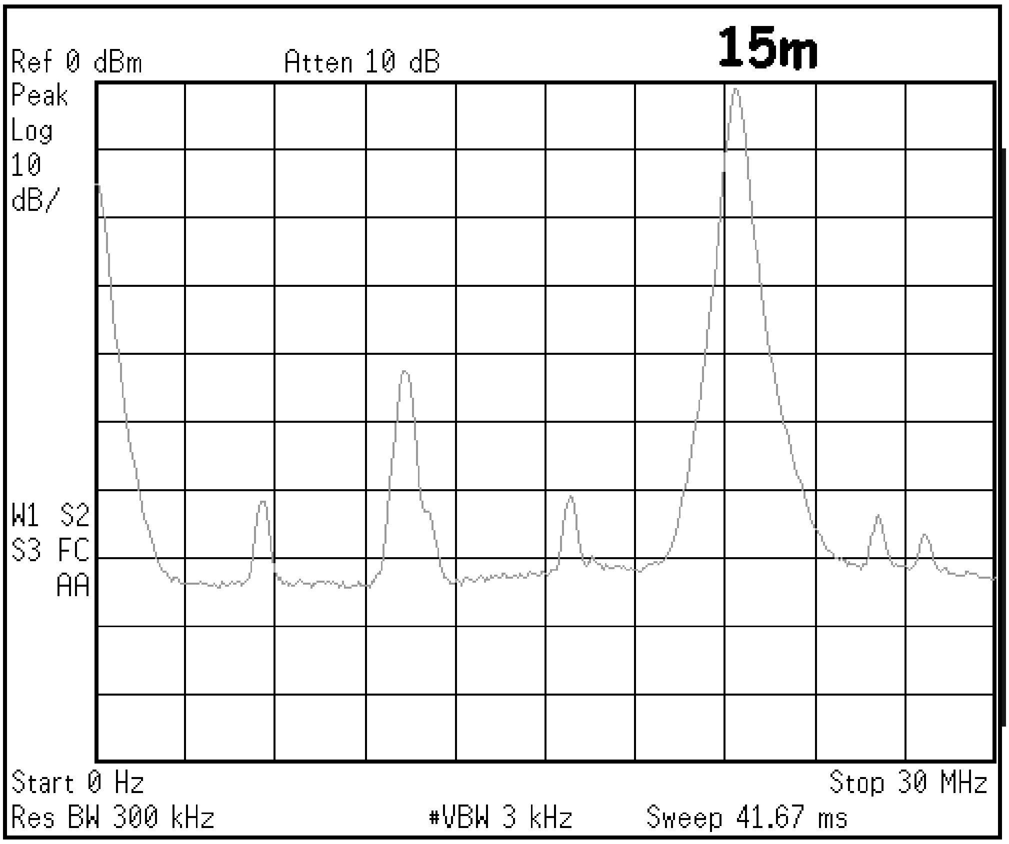
S3 FC
AA
Start 0 Hz
Stop 30 MHz
Res BW 300 kHz
#VBW 3 kHz
Sweep 41.67 ms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Ref 0 dBm
Atten 10 dB
Peak
Log
10
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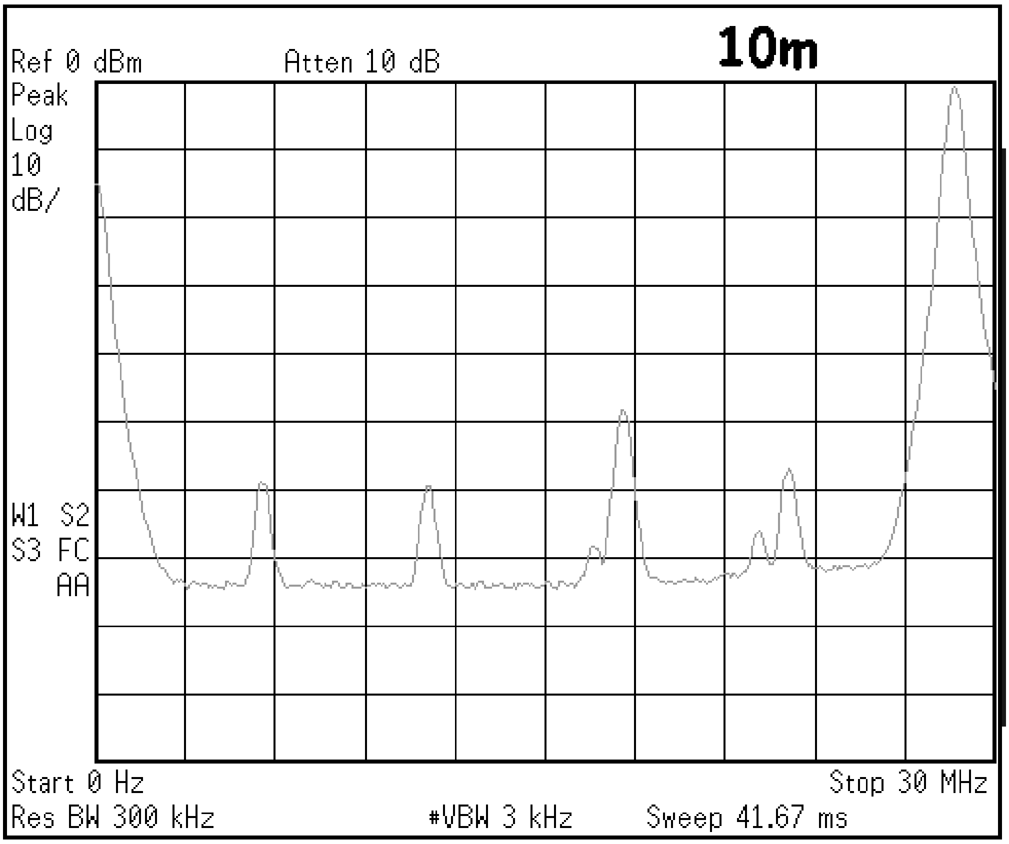
W1 S2
S3 FC
AA
Start 0 Hz
Stop 30 MHz
Res BW 300 kHz
#VBW 3 kHz
Sweep 41.67 ms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Ref 0 dBm
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