



PCS Electronics
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MAX PRO II

MAX PRO II is a stripped-down version of MAX PRO I, high performance FM broadcasting exciter. It was designed to offer excellent spectral cleanliness and ruggedness, as well as a fairly simple assembling procedure. High quality components and printed circuit board assure 24/7 operation for years.

Features

RF Output Power: 0 to 5-7 Watts (5W typ.), variable via on-board trimmer
Output connector: BNC
Output Impedance: 50 Ohms
Frequency Range: 86-108MHz
PLL Steps: 100 KHz
Frequency stability: +/- 100Hz
Spurious/Harmonic rejection: Harmonics: -60dB, Spurious: -80dB
Audio Frequency Response: 30Hz-75 KHz @ -3dB
Power Supply: 12-16V/2A
Dimensions:
-RF board: 100x85mm, double-sided professional PCB
-Extremely simple tuning, fool proof

Thank you for purchasing the MAX PRO II!

We hope you will enjoy it as much as we do and remember to tell your friends about it. Please feel free to send us your comments to feedback@pcs-electronics.com. For tech support please send email to techsupport@pcs-electronics.com

From all of us we wish you happy broadcasting!

Now go get that soldering iron:-)

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Before you start...

Let us clear up some basic things you need to know before we move on. You will find some very useful tips, a forum and tips on antennas and hooking things together at <http://www.pcs-electronics.com> so it's generally a good place to check before putting your MAX on the air.

Here is what you need to assemble MAX PRO II:

-Soldering iron 25-35 watt soldering iron. Weller and ERSa make excellent soldering tools. Radio Shack stuff is horrible, but will do if that's your only option. Radio Shack reminds me of The Dollar Tree in many ways, loads of cheap Chinese stuff. Practice soldering a bit (if necessary) before you go and burn that nifty PCB!

-Antenna and/or dummy load to setup and test your transmitter. If you don't have dummy load, you can build them easily from BNC RF connectors and the proper wattage/value of CARBON resistor(s). DO NOT USE WIREWOUND OR METAL FILM RESISTORS! A useful one can be constructed with 4 -220 Ohm 1/4 watt resistors in parallel ($220/4 = 55$ Ohms) with center conductor to outer shell (ground) of an RF connector. That is pretty close to 50 Ohms and if you use 1/4 watt resistors you get a nifty 2 Watt Dummy Load for testing your equipment without an antenna. Commercial Dummy loads are available if you insist. \$5.00 - \$25.00

An antenna...J-pole, 5/8 Comet, 1/4 wave, broadband etc. up high makes up for lots of power...and is money well spent! Remember propagation at FM frequencies (88-108MHz) is virtually line-of-sight. City miles are longer than country miles; Forest miles are farther than desert miles. Low VSWR and antenna height alone CAN MAKE UP FOR LOTS OF WATTS! You can build an inexpensive 1/4 wave antenna from 1 SO-239 chassis mount RF connector and 5 - 3' bronze welding rods, cut to the proper length. For further instructions regarding construction of this and other antennas please see the end of this document or our site: <http://www.pcs-electronics.com>

You have to realize that antenna was, is and will always be a crucial part of the system. Special care has to be taken! It is usually a good idea to place antenna away from your transmitter, power supply and audio system. If you cannot meet these requirements, you could experience

**A PIECE OF WIRE OR TV ANTENNA IS
NOT ANTENNAS FOR MAX-1 OR ANY
OTHER RADIO EXCITER!**

feedback and other RF problems. We cannot guarantee proper operation of MAX-1 unless suitable antenna system is used! Interestingly, RF energy can make CD players and other digital devices go bezerk. Try placing 30W-driven antenna next to yours. Finally, you need coaxial cable to connect antenna to the transmitter...

-Coaxial cable The common RG-58 from Radio Shack is NOT the best you can do and will lower your effective power out! Use it only for short runs. BELDEN makes terrific coax in various qualities and with very low loss (measured in dB's...decibels)...figure 3 dB loss = 1/4 of your signal strength...either lost or gained. Watch out for the correct impedance...RG-8 and RG-58 have 50 Ohms. RG-59 and RG-6 (Low Loss Version of RG-59) have 75 Ohms. Most antennas are 50 Ohm ones, but some antennas, including the Ramsey FM100, use the 75 Ohms stuff. Check our web site for good coax. Don't buy more than you need to make the long run to your antenna and make up a few "jumpers" to go between your exciter, VSWR meter and your antenna as all you'll do is create a higher SWR and more line losses. Don't use cheap TV cable.

-BNC connector comes between coaxial cable and your transmitter. It's a standard VHF RF connector for low power applications, just like the one used for Ethernet networks. You might get it along with your antenna. Try to find a quality BNC connector as PC type usually uses cheap plastic instead of Teflon.

-Power supply. You will need a good 12 volt, 2 (Minimum) - 10 (Future expansion) Ampere Regulated Power Supply. No "wall wart" please! You can always use a lead acid car battery and re-charge it when you are off the air. HAM or CB power supply units do the job nicely. Poor power supply can add hum to your signal! MAX-1 gives more output power when you increase supply voltage. We have tried up to 16V and had no problems at all. Of course too much voltage can fry your output transistor, especially if your antenna is not well matched. PCS electronics carries suitable power supplies at reasonable prices as well as many HAM or CB shops. Try our web site for finished products as well as schematics, if you want to make one by yourself.

-Audio equipment. For a start all you need is a simple CD player or cassette deck. If you want that really professional sound, you will eventually need low noise audio mixer, good microphone, audio Limiter-compressor and possibly stereo - encoder (for stereo). Behringer is a well known name for such equipment. Cheap stuff will give you noise, bad channel separation, distortion, over-modulation etc. Consider using PC as your audio platform, get a good sound board and it will do mixing, MP3-playing, limiting, audio processing, CD-playing etc, all at a minimal cost (provided you already own a PC).

-Enclosure Use aluminum, allow some free space for future add-ons (stereo encoders etc.) and heat dissipation, and make ventilation holes at the top and/or back of the enclosure. Fix the PCB with all screws tightly. There should be a shield between the RF and LCD board; flat cable should be wired away from the VCO assembly (L1). See mounting pictures. **MAKE SURE YOU SCREW THE RF BOARD TO THE ENCLOSURE AS THIS IS HOW THE FINAL DISSIPATES ITS HEAT!**

Finally, if you know nothing or little about electronics, I selected a few books that I find extremely useful and often read. The links to them are on our homepage. I suggest you start with ARRL HANDBOOK, the holy bible of amateur radio and electronics in general. Extremely valuable resource for every broadcaster.

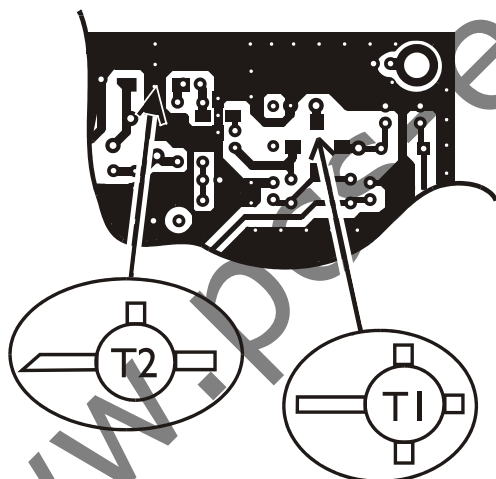
ASSEMBLING THE MAX PRO II

Step 1: Components check (KIT)

Clean-up that desk and carefully unwrap the package. First assemble the LCD board and then the RF board. Watch out, most of the parts are really small and once they get off the desk, they usually jump unbelievable far and reach darkest corners of your room. Let us know if you cannot find a part that's supposed to be in the package. Please contact us directly rather than my distributor, this will probably result in faster resolution of the problem. If you want to speed-up things a bit, purchase from one of the radio-shack outlets or try one of the many electronic components resellers on the web. On the other hand you might find some extra parts.

Step 2: Soldering/assembling the KIT

We recommend you start with the LCD board since it's simpler and easier to assemble. Then move on to the RF board. Start with coils, connectors, resistors and ceramic capacitors, jumpers, RFCs, trimmer resistors, transistors, sockets, IC's... Trimmer capacitors and LCD go in last!



T1 & T2 - Markings must be visible, NOT facing the board!

Diagram1: Placement of T1 & T2

When you start working with the LCD board, make sure you place P1 on the Component side, then cut the remaining leads and place keys on the soldering side (yes, unlike other components). Have a look at the documentation. Schematic, component layout and bill of materials are at the end of this document to help you place components where they belong. Most components should go all the way in the holes or as far as possible, especially ceramic capacitors. **Note that there's a tap at L1, just after the first winding.**

Step 3: Check everything carefully (KIT)

Clean-up that desk and carefully check placing of all the components, make sure all solder-joints are OK and that there are no shorts between pins. When you're done, check everything again!

- DON'T MOVE THE COMPONENTS THAT WE HAVE ALREADY PLACED FOR YOU.
- TAKE CARE SO YOU DON'T REVERSE POLARITY OF ELECTROLYTIC CAPACITORS.
- DON'T USE IC SOCKETS FOR THE RF BOARD!
- REMOVE THE INTERFERING PIN ON THE BNC CONNECTOR J2 (THE ONE NEXT TO THE CENTER CONDUCTOR THAT MAKES IT IMPOSSIBLE TO INSERT BNC CONNECTOR INTO THE PCB). YOU CAN DO THAT BY BENDING IT FORWARD/BACKWARD A FEW TIMES OR CUTTING IT OFF.
- SOME COMPONENTS MAY NOT BE USED, EVEN IF THEY'RE DISPLAYED ON THE PCB LAYOUT. IF A COMPONENT ISN'T MENTIONED IN THE BILL OF MATERIALS THEN IT SIMPLY ISN'T USED.

Step 4: Power up (KIT)

By the way, did you check everything as recommended? This is your last chance to save you in case of fatal error, make sure all ICs and transistors are placed exactly as on the components layout picture.

Step 5: The real power up

So did you check everything like suggested? OK, so let's proceed now. Set the desired frequency with jumpers (J1) according to the enclosed table at the end of this document. Connect dummy load to antenna connector (BNC). It's really a good idea to use dummy load for the first time. It takes only a couple of resistors to make (look under antenna above). Connect power supply wires in such manner that you can break contact or turn off power supply in case of smoke or funny smell. **Do not reverse polarity!**

Step 6: Setup

No smoke? OK, now you should see the LED on the control board blink a few times. You will have to tune two caps (C24 and C25) for the maximum output power. Use plastic screw driver to do this (available from Radio Shack). Repeating tuning on a daily basis is not necessary and might eventually wear down the caps. If you have voltmeter, measure voltage on the Power pin on the control board. Maximum voltage equals maximum power. You can use this voltage to drive a panel power meter. Now turn on your MP3 player, CD audio player or other AUDIO source. Turn on any fm radio and turn the tuning dial until you hear the MAX-1's audio through the fm radio. You will need to adjust audio level so that the sound on the radio sounds naturally and without distortion. Too much volume may sound good on your radio, but will sound horrible a few hundred meters from the transmitter! You shouldn't sound louder than other FM stations. You may want to try a few different frequencies because of better reception in different areas. Some spots on the dial may work better than others.

WARNING: PLEASE BE SURE THAT YOU ARE TUNING IN TO AN AREA ON YOUR LOCAL FM BAND THAT HAS NO STATION BROADCASTING ON IT, YOU DO NOT WANT TO INTERRUPT ANYONE ELSE'S LISTENING TO LOCAL RADIO STATIONS, IT'S RUDE AND ALSO ILEGAL!

Troubleshooting

We hope you'll never get to this step. We all know bad things happen. But do not despair! First, MAX-1 is reverse polarity protected so it should blow a fuse if you reverse polarity. If you have problems that you cannot solve yourself, please contact us directly (support@pcs-electronics.com) rather than my distributor, this will probably result in faster resolution of the problem. Customers from Indonesia should contact their distributor directly.

If you cannot get coverage from 86-108MHz, try to compress/expand L7.

Things to remember

Please remember to turn off the transmitter when not in use!

Remember that anything you broadcast through the transmitter can be heard by anyone tuning in to that frequency. Although it is unlikely certain weather conditions may allow the signal to go further than your immediate listening area so please don't broadcast anything you don't mind anyone else hearing.

Newsletter

You may want to sign up for our newsletter so you can receive the latest news and special deals. Also check our forum and discuss tips and tricks with other users, you never know you just may learn something. You can sign up at www.pcs-electronics.com

Appendix A: Using the MAX PRO II

The menu system from MAX PRO I was replaced by jumpers. They are used to set the frequency and enable/disable the automatic power off mode. Below is a table with various frequency settings for MAX PRO II.

TUNE-UP

MAX PRO II does not feature the easy tune system, which requires microcontroller. You will need a voltmeter to tune MAX PRO II. Connect the positive (red) terminal to the PWR pin on the smaller board and the negative (black) terminal to the negative supply line. Now tune C24 and C25 for maximum voltage.

LOCK jumper

Allows you to toggle **LOCK MONITOR** on or off. MAX PRO II doesn't check PLL lock status when this function is off and does not shut down power if the unit loses lock. When this function is On, MAX PRO II constantly checks PLL lock status and shuts down output power in case of lost lock. Unlocked PLL is also indicated by a LED going off. The LOCK jumper is found in the row of jumpers on the smaller control board, its position is indicated below.

JUMPERS

There are 10 jumper on the RF board. (J2 is not used). Bit0 to bit8 are used to set the frequency. Complete table is displayed at the end of this document.

Jumper	Pin1	Pin2	Pin3	Pin4	Pin5	Pin6	Pin7	Pin8	Pin9	Pin10
J1	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit8	LOCK

AUDIO LEVEL ADJUSTMENT

Adjust audio level with trimmer (P1) on the RF board so that you sound a bit less loud than other radio stations. This prevents interference to adjacent channels as you do not own expensive audio equipment that radio stations usually employ to make their stations sound louder.

OUTPUT POWER ADJUSTMENT

Adjust output power with trimmer (P2). This trimmer is located close to T5.

Appendix B: The most frequently asked question: How can I increase performance?

I'm pretty sure you are all interested in this, or at least you will be after a while. First let me warn you that some of you might have stability problems if you try to push MAX too far. You'll also have to account for additional heat.

First and most important, signal from VFO gets
power. Output filter consisting of L5-L7 and accompanying capacitors keeps harmonics down to

- Here is a list of simple things you can do to raise output power of MAX-1:
1. The maximum output power of MAX-1 (6W/16V) is UCEmax for 2SC1971, but make sure caps can take it).
 2. Tune (compress or expand) L2 and L3 for maximum power
 3. You can put a small metal shield around VCO (note designated square around L1/T1).

Any ideas and improvements are welcome, please let us know and we'll publish them on our home page. Some of them are already posted there.

Appendix C: The principles of operation

MAX-1 features a Phase Locked Loop (PLL) oscillator. This combines the ease of tuning and wide deviation of a VFO with the frequency stability of a crystal oscillator. Have a look at diagram 2; a crystal oscillator is used to provide a reference frequency. This is digitally divided to a frequency of relatively low 50 KHz. A VFO provides the wanted output frequency, which is also digitally divided to give another relatively low frequency. These two low frequencies are presented to a phase comparator which basically decides which frequency is higher by comparing the phases of the two signals. The phase comparator generates an error voltage which is connected back to the input of the VFO through a low pass filter (LPF). This is the loop bit. If the VFO is running too fast the phase comparator decreases the error voltage so as to slow it down till the phases at its input are the same. If it's running too slow the error voltage is increased to speed it until the phases are the same. All this happens instantaneously, of course so the output frequency remains constant. In this way the temperature stability of the VFO isn't important as its output frequency is phase locked to the crystal oscillator, and the frequency stability of this is very good. Clever eh? Two more things to explain. How do you change the output frequency? By making the VFO's divider programmable. Say it's set to divide by the number N. The phase comparator is a simple minded sort of soul, concerned only with equalizing the phases at its inputs, it doesn't know what's really coming out of the VFO, which are N times the divided reference signal. Because this signal is so low compared to the VFO frequency N can be made to have hundreds of different values, giving hundreds of different output frequencies from the VFO. So changing the frequencies is just a matter of changing division ratio. Since this is taken care by the uCPU, all you have to do is set the jumpers. By the way, almost all of the black boxes from the above diagram are contained in one single integrated circuit, IC 3. VFO is being frequency modulated by the audio input, so its frequency at any given instant depends on the voltage of the audio output. We don't want this variation of the VFO's frequency to be ironed out by the PLL system thus we 'iron out' the error voltage from the phase comparator, so it just contains the underlying trend rather than what's happening at any split second. This is the purpose of the low pass filter. Programmable PLL oscillators are used in majority of the professional communications equipment, including broadcast transmitters. The digital part of MAX PRO II is a small computer, based on ATMEL microcontroller. This little chip is actually doing all the »thinking« for MAX PRO II It sets the divider ratio for PLL, directs LED and reads the jumpers. VFO is employing a single MOSFET transistor. Weak signal from VFO gets amplified by T2 and T3 to few watts of pure power. Output filter consisting of L5-L7 and accompanying capacitors keeps harmonics down to minimum.

Diagram2: PLL block diagram

Appendix D: The resistor color codes

The easiest method is to get radio Shack part number 271-1210 for \$1.19; it is a pocket sized card with spin dials. Just spin the dials to show the correct colored bands and read the resistance off the card. Sort of a resistor slide rule. And as you've probably guessed, it's also on our site.

Appendix E: GP antenna design

You can build an inexpensive 1/4 wave antenna from 1 SO-239 chassis mount RF connector and 5 - 3' bronze welding rods, cut to the proper length. Here is how it looks:

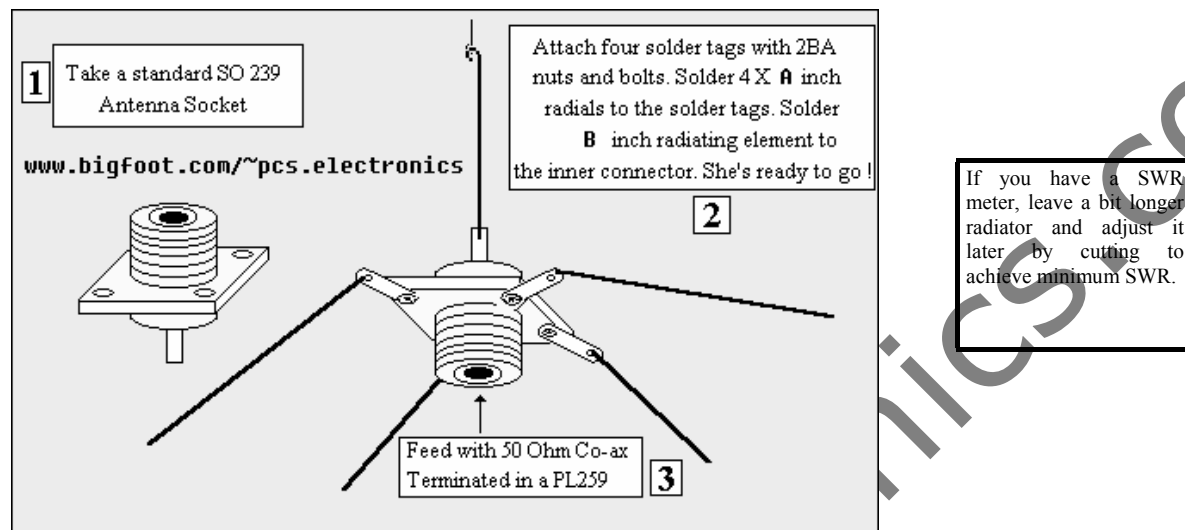


Diagram3: »Do it yourself« GP antenna

Most designs on the web don't compensate for the fact that GP antennas are not wideband antennas. Here is a Freq/element length chart for this simple GP antenna, all element lengths are in millimeters:

Frequency	Radiator - B	Radials - A
108MHZ	660	693
104MHZ	684	720
100MHZ	713	749
90MHZ	792	819

For other antenna designs check our web site.

Bill of Materials

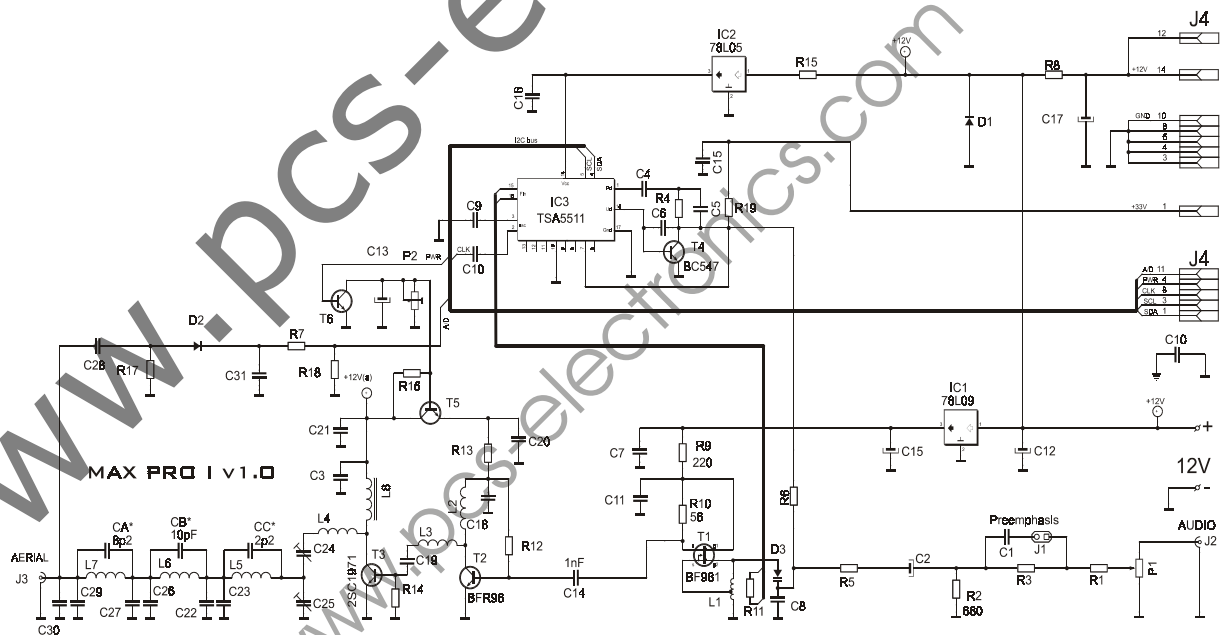
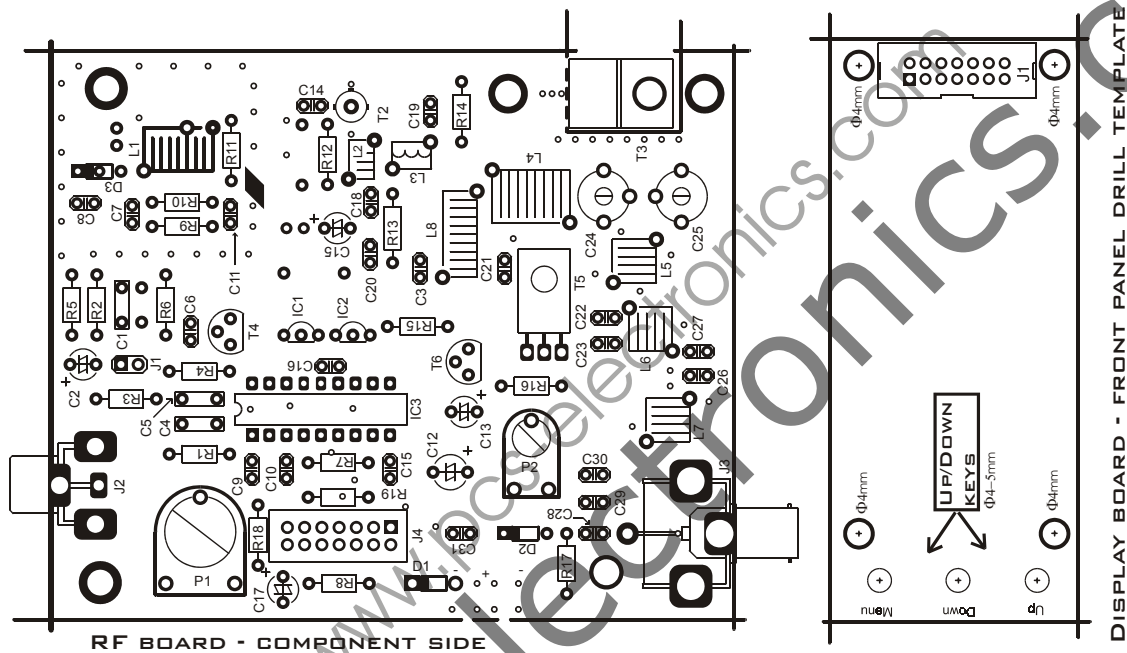
MAX PRO II - Control Board

Qty	Value	Reference	Notes
1	89C2051		
1	74HC04		
1	74HC4040		
1	78L05		
1	78L08		
1	LED diode, turn it in opposite way as on the PCB	LED1	
1	22uF	C1	
1	0.47uF-1uF		
1	33pF		
1	100pF	C2	
1	470 ohms		
1	560 ohms		
1	100K		
2	10K		
1	1K		
1	6.4MHz quartz	Q1	
1	PCB, smaller		
1	PIN, used to tune transmitter, tune for maximum V	PWR	
1	Connector to the RF board	J3	

Bill of Materials
MAX PRO II - RF BOARD

Qty	Value	Reference	Notes
1	8p2 (marked 8.2)	CA (under L7)	
1	4n7 (5mm, marked 4n7)	C1	
1	100uF	C2	
11	10nF (marked 103 or 10n)	C3,C7,C9,C10,C11,C15 C16,C18,C20,C21,C31	
1	150nF (5mm, marked 0.15 or 150nF)	C4	
1	68nF (red block, marked 0.068 or 68nF)	C5	
3	10pF (marked 10)	C6,C30,CB (Under L6)	
2	100pF (marked 101 or 100p) or 120pF (121)	C8, C14	
1	470uF/25V	C12	
3	22uF	C13, C15, C17	
1	39pF (marked 39 or 39p)	C19	
1	Trimmer, green	C24	
1	Trimmer, black	C25	
2	27pF; black top, (marked 27 or 27p)	C26, C23	
2	22pF (marked 22 or 22p)	C27, C22	
2	2p2 (marked 2.2 or 2.2p)	C28, CC (Under L5)	
1	6p8 (marked 6.8 or 6p8)	C29	
1	1N4001	D1	
1	BAT85	D2	
1	BB809 – A plastic diode with very short leads	D3	
1	78L09	IC1	
1	78L05	IC2	
1	TSA5511	IC3	
1	Jumper, Preemphasis	J1	
1	RCA connector	J2	Audio
1	BNC connector	J3	Antenna
1	14-pin connector, connects to LCD via flat cable	J4	
1	5 turns, tap after first turn	L1	See pics on our webpage
1	3 turns, two unmarked holes next to L2	L2	
1	2 turns	L3	
1	8 turns	L4	
1	4 turns	L5	
1	4 turns	L6	
1	4 turns	L7	
1	6 turns or VK200 (black oval with 6 holes)	L8	
1	470 ohms	R1	
1	680 ohms	R2	
1	12K	R3	
3	22K	R4, R6, R19	
2	1K	R5, R7	
1	1 or 2.2 ohms	R8	
1	220 ohms	R9	
1	56 ohms 1/4W	R10	
1	56 ohms, 1/4W resistor, it should be 5 mm above and in parallel with the board	R11	
1	15K	R12	
1	39 ohms, 1/2W. Blue resistor, size same as 1/4W. Mount 3-4mm above the board for improved cooling!	R13	
1	100 ohms	R14, R15	
1	330 ohms	R16	
2	39K	R17, R18	

1	500 ohms trimmer	P1	Audio level
1	2K5 trimmer	P2	Power level
1	BF981	T1	
1	BFR96	T2	
1	2SC1971	T3	
2	BC547	T4, T6	
1	BD135	T5	Preinstalled
1	PCB, 85x100mm		
2	Aluminum block, screws, and bolts for output transistor		



MAX PRO I RF board

Jumpers are presented as they appear on the board, assuming you've placed the board in such a way that all the jumpers appear above the microcontroller (89C2051). A "0" indicates that the jumper isn't installed, a "1" indicates that it is.

J1

Sw1	Sw2	Sw3	Sw4	Sw5	Sw6	Sw7	Sw8	Sw9	Frequency
1	0	1	0	0	0	1	1	1	86
1	0	1	0	0	0	1	0	1	86,1
1	0	1	0	0	0	0	1	1	86,2
1	0	1	0	0	0	0	0	1	86,3
1	0	0	1	1	1	1	1	1	86,4
1	0	0	1	1	1	1	0	1	86,5
1	0	0	1	1	1	0	1	1	86,6
1	0	0	1	1	1	0	0	1	86,7
1	0	0	1	1	0	1	1	1	86,8
1	0	0	1	1	0	1	0	1	86,9
1	0	0	1	1	0	0	1	1	87
1	0	0	1	1	0	0	0	1	87,1
1	0	0	1	0	1	1	1	1	87,2
1	0	0	1	0	1	1	0	1	87,3
1	0	0	1	0	1	0	1	1	87,4
1	0	0	1	0	1	0	0	1	87,5
1	0	0	1	0	0	1	1	1	87,6
1	0	0	1	0	0	1	0	1	87,7
1	0	0	1	0	0	0	1	1	87,8
1	0	0	1	0	0	0	0	1	87,9
1	0	0	0	1	1	1	1	1	88
1	0	0	0	1	1	1	0	1	88,1
1	0	0	0	1	1	0	1	1	88,2
1	0	0	0	1	1	0	0	1	88,3
1	0	0	0	1	0	1	1	1	88,4
1	0	0	0	1	0	1	0	1	88,5
1	0	0	0	1	0	0	1	1	88,6
1	0	0	0	1	0	0	0	1	88,7
1	0	0	0	0	1	1	1	1	88,8
1	0	0	0	0	1	1	0	1	88,9
1	0	0	0	0	1	0	1	1	89
1	0	0	0	0	1	0	0	1	89,1
1	0	0	0	0	0	1	1	1	89,2
1	0	0	0	0	0	1	0	1	89,3
1	0	0	0	0	0	0	1	1	89,4
1	0	0	0	0	0	0	0	1	89,5
0	1	1	1	1	1	1	1	1	89,6
0	1	1	1	1	1	1	0	1	89,7
0	1	1	1	1	1	0	1	1	89,8
0	1	1	1	1	1	0	0	1	89,9
0	1	1	1	1	0	1	1	1	90
0	1	1	1	1	0	1	0	1	90,1
0	1	1	1	1	0	0	1	1	90,2
0	1	1	1	1	0	0	0	1	90,3
0	1	1	1	0	1	1	1	1	90,4
0	1	1	1	0	1	1	0	1	90,5
0	1	1	1	0	1	0	1	1	90,6
0	1	1	1	0	1	0	0	1	90,7
0	1	1	1	0	0	1	1	1	90,8
0	1	1	1	0	0	1	0	1	90,9
0	1	1	1	0	0	0	1	1	91
0	1	1	1	0	0	0	0	1	91,1
0	1	1	0	1	1	1	1	1	91,2
0	1	1	0	1	1	1	0	1	91,3
0	1	1	0	1	1	0	1	1	91,4
0	1	1	0	1	1	0	0	1	91,5
0	1	1	0	1	0	1	1	1	91,6
0	1	1	0	1	0	1	0	1	91,7
0	1	1	0	1	0	0	1	1	91,8
0	1	1	0	1	0	0	0	1	91,9
0	1	1	0	0	1	1	1	1	92
0	1	1	0	0	1	1	0	1	92,1
0	1	1	0	0	1	0	1	1	92,2
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0	1	1	0	0	0	1	1	1	92,4

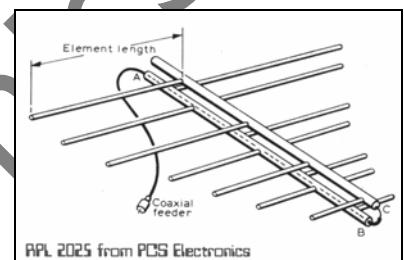
0	1	1	0	0	0	1	0	1	92,5
0	1	1	0	0	0	0	1	1	92,6
0	1	1	0	0	0	0	0	1	92,7
0	1	0	1	1	1	1	1	1	92,8
0	1	0	1	1	1	1	0	1	92,9
0	1	0	1	1	1	0	1	1	93
0	1	0	1	1	1	0	0	1	93,1
0	1	0	1	1	0	1	1	1	93,2
0	1	0	1	1	0	1	0	1	93,3
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0	1	0	1	1	0	0	0	1	93,5
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1	1	0	0	0	0	1	1	0	108
1	1	0	0	0	0	1	0	0	108

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