



PCS Electronics
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MAX-BOOSTER 5W & 10W (for KIT and assembled version)

MAX BOOSTER 10W is a high-gain, no-tune FM broadcasting amplifier with integrated mains power supply and SWR protection. It has been designed to boost the low power output of the PCI MAX cards, but can be used to amplify any other low power FM transmitter. Simple assembling procedure, high quality components and printed circuit board assure 24/7 operation for years.

Features

RF Input Power: 25-250mW (selectable hi/lo via jumper)
RF Output Power: 5W (5W model – 7W max.) or 10W (10W model – 15W max.)
RF output power can be hard-limited internally to 1W max.
Output connector: BNC
Output Impedance: 50 Ohms
Input connector: F (designed to match easily with the PCI MAX series of transmitters)
Input Impedance: 50 Ohms
Frequency Range: 86-108MHz
Harmonics rejection: >50dB
Built in SWR fold-back protection (with a warning LED)
Available points for measuring power and SWR inside the amplifier (built-in SWR meter)
Built-in stabilized DC (12-15V/1A) power supply for other projects or PCI MAX ULTRA
Power Supply: Mains (110-240V/ 50-60Hz)
Dimensions:
PCB board: 145x110mm, double-sided professional PCB
Enclosure: 210x115x40mm, black anodized aluminum



Fig. 1; 10W booster without the enclosure

Thank you for purchasing the MAX BOOSTER 5W or MAX BOOSTER 10W!

We hope you will enjoy it as much as we do and remember to tell your friends about it. If you discovered a bug and perhaps even found a solution or have an idea for improvement of this product, please don't hesitate to contact us. Please feel free to send us your comments to feedback@pcs-electronics.com. For tech support please send email to support@pcs-electronics.com

From all of us we wish you happy broadcasting! If this is a KIT version, you can now go and get that soldering iron:-)

Sincerely
PCS Electronics team
www.pcs-electronics.com

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>. It is generally a good place to check before putting your station on the air.

Here is what you need to assemble your MAX BOOSTER (for KIT version):

-**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. Practice soldering a bit (if necessary) before you go and burn that nifty PCB! You will probably need a bit stronger soldering iron for the input and output RF connectors (40W).

-**Antenna and/or dummy load** to test your amplifier. If you don't have a 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 AN ANTENNA FOR MAX BOOSTER 5W or MAX BOOSTER 10W!

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 a 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 MAX BOOSTER 5W. 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.

-**FM exciter (a transmitter)** This amplifier has been designed specifically for the PCI MAX family of PC based transmitters, but can be used with any FM exciter of a comparable power. If your exciter gives a little more, you could still add a small RF attenuator at the input of the amplifier.

-**Enclosure** Fix the PCB with all of the screws tightly. Make sure you screw the output transistor to the bottom of the enclosure through the provided Al block. Be careful with the mains voltage, it can kill. **DO NOT CONNECT THIS UNIT TO MAINS VOLTAGE UNTIL YOU HAVE CLOSED THE ENCLOSURE. EVERY TIME YOU OPEN THE ENCLOSURE FIRST DISCONNECT THE MAINS VOLTAGE! USE GROUNDED OUTLETS AND CABLES TO PROTECT AGAINST POSSIBLE SHOCK. FAILURE TO DO SO MAY RESULT IN A SERIOUS INJURY OR DEATH! PLEASE TAKE MAINS VOLTAGE SERIOUSLY AND ACT RESPONSIBLE.**

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 the ARRL HANDBOOK, the holy bible of amateur radio and electronics in general. Extremely valuable resource for every serious broadcaster! Another great book is "The art of electronics" by Horowitz and Hill. This one is for an advanced reader, though.

ASSEMBLING THE MAX BOOSTER

Step 1: Components check (KIT)

Clean-up that desk and carefully unwrap the package. 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. On the other hand you might find some extra parts. 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. Quickly check the PCB for any defects.

Step 2: Soldering/assembling the KIT

- 1.) We recommend that you start with the SMD component, there is one 100nF SMD capacitor designated as C29 (it looks brown) close to the BNC antenna connector. Continue with the resistors. Go through the entire list of resistors, starting with R1. Note that R9 should be placed vertically for better air flow and cooling.
- 2.) Continue with ceramic capacitors. The other types of capacitors go in last since they can be burned (melted) with a soldering iron. It sometimes happens to beginners and doesn't look good.
- 3.) Place all of the coils. Note number of turns in the instructions.
- 4.) T2, T3, T4, T5, D1, D2, D3, D4 (be careful to leave enough LED leg length to fit them to the enclosure later).
- 5.) Next all of the connectors. Also place the switches, mains connector, the fuse enclosure, and the potentiometer.
- 6.) Transformer. Make sure that the Primary is looking towards the edge of the PCB (see picture)
- 7.) Checking for errors at various stages is a good way to go. Check the underside of the PCB before you mount it to the enclosure. It might save you lots of time and troubleshooting.
- 8.) T1 and output transistor (T4) are cooled via aluminum block. When you screw the PCB board into the enclosure please make sure to place the Aluminum block under T4. Look at the picture of the assembled unit for some guidance and at the placement diagram on the next page. T1 is next.
- 9.) T1 is a bit tricky. It can be bolted directly to the enclosure or via the aluminum block, which brings it inline with the PCB for easier assembly. **NOTE THAT YOU HAVE TO USE PROVIDED ISOLATING PLASTIC BITS TO ISOLATE THIS TRANSISTOR FROM THE ENCLOSURE!** Only solder it once it has been firmly attached to the enclosure. This prevents strain that could destroy the transistor in the process of screwing it to the enclosure.
- 10.) Cut the appropriate mains voltage selection pads. **If you're in the US, cut the bridge denoted as 220V, for countries using 220-240V, cut the bridges denoted as 220V. This is extremely important!**
- 11.) Checking for errors at various stages is a good way to go. Check everything again visually.
- 12.) Install a 1A fast fuse into the fuse enclosure (F1).



Fig. 2: A carefully assembled unit will serve the proud owner for many years to come

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!

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

Did you cut the mains voltage selection bridges? And did you check everything as we suggested? OK, so let's proceed now. 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 mains cable in such manner that you can disconnect it fast enough in case of smoke or funny smell.

Step 6: Setup and operation

No smoke? OK, now you could check whether you're getting the correct supply voltage inside the unit. Do you see those large pads next to the PCS logo close to the transformer? Please measure voltage on those two pads. It should read about 12V. Accidentally, you can use those two pads to power other equipment. Make sure it doesn't use too much current and use a 1A fuse to protect the power supply.

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!

Now turn off the unit, set the power to the lower setting via J4 (install the jumper) and connect the FM exciter (transmitter) to the input (J1 – F connector). Set it somewhere around 100MHz. Turn the unit on again. D1 should illuminate, D3 (SWR protection) should stay off. If there's a problem with SWR (shorted antenna), it will turn on and light constantly. The amplifier will power off and remain off until you correct the condition. Turn your amplifier off immediately, if D3 (SWR protection) illuminates. If you own a power meter, you can now check how much power you're putting out. It should be about 1W. Remove J4 and it should be 4-5W (5W model) or 10W (10W model).

Troubleshooting

We hope you'll never get to this step. We all know bad things happen. But do not despair! If you have problems that you cannot solve yourself, please contact us directly support@www.pcs-electronics.com. Feel free to post questions to our forum and discuss matters with other users.

Things to remember

Please remember to turn the amplifier off 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. Since this amplifier doesn't need much power to start operating, it might work with PCI MAX turned off. Even when turned off, PCI MAX might be putting out a tiny amount of power, yet since booster is very sensitive it might produce a small signal.

WARNING

Please note that there is high voltage present inside the amplifier. Do not touch any of the exposed circuits or parts once the unit has been connected to the mains voltage. Failure to follow this might result in serious injury or even death. Always unplug the mains cable before opening this unit and tampering inside the unit!

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 BOOSTER

Basically there are two switches available. S1 controls output power, S2 is the ON/OFF switch.

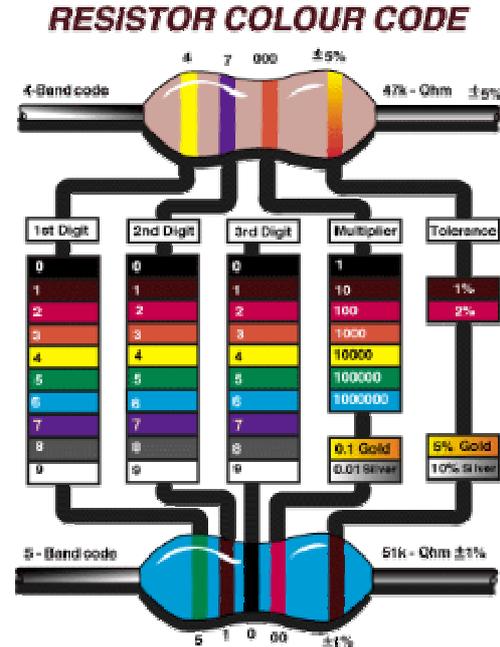
There are three pads available on the PCB. First there are the SWR and PWR pads close to the IC4. You can measure your power and SWR on these pads. Just make sure not to put too much of a load on those since it may interfere with the operation of the unit. Two operational amplifiers and a couple of meters could easily be used to display reflected and forward power here.

The third group of pads is close to the R21. You will find stabilized voltage on those two pins. 15V at the hi-power setting and 10V at the low-power setting. You can use this voltage for your devices, but remember to use a fuse to protect against a short. If you do make a short, check R21 as this is probably what will blow.

Item	Function	Default setting
J4 at C1	1W power limit	On for 1W maximum of RF power – hard limited
J4 at J1	Input attenuator selection	On for 50mW or less, off for 200mW or more
P1	Power adjustment	Turn clockwise to increase power and vice versa
D3-RED	SWR error	When lit, your antenna is either shorted or bad SWR
D1-GREEN	Power indication	Lit when you turn your unit on (on off indicator)

Appendix B: The resistor color codes

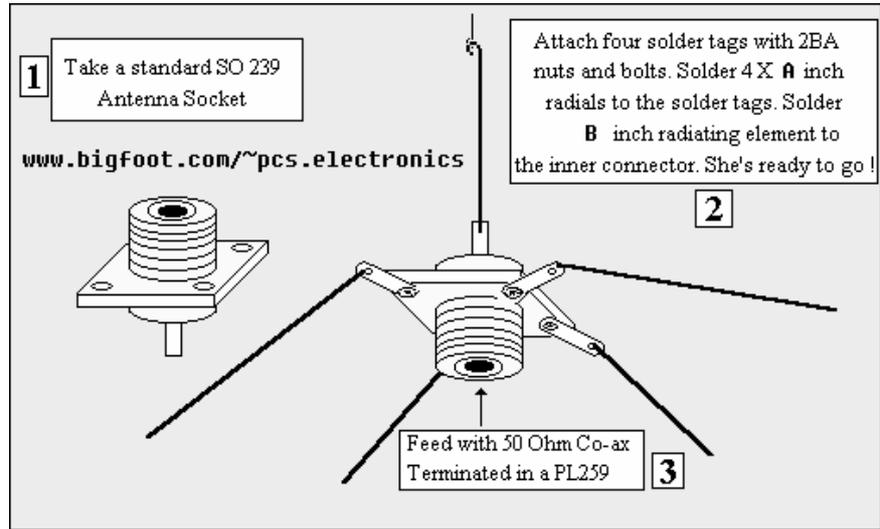
The easiest method is to get radio Shack part number 271-1210 for \$1.19; it is a pocket sized card with spin dials. Just spin the dials to show the correct colored bands and read the resistance off the card. Sort of a resistor slide rule. And as you've probably guessed, it's also on our site.



0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Grey
9	White

Appendix C: 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:



If you have a SWR meter, leave a bit longer radiator and adjust it later by cutting to achieve minimum SWR.

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.

Appendix D: The range

While it is not possible to accurately predict range of a transmitter, since this depends upon hard to measure parameters, for example, terrain configuration, type and exact position of antenna, receiver etc.

Bill of Materials
MAX BOOSTER 5W and 10W

Qty	Value	Reference	I placed this (√)
1	F connector	J1	
1	BNC connector	J2	
1	Mains connection, danger high voltage	J3	
1	Low power input when installed (50mW)	J4 next to J1	
1	High power input when installed (200mW)	J4 next to C1	
1	TIP147	T1	
1	BS170	T2	
1	2N4427	T3	
1	RF output transistor – preinstalled	T4	
1	BD135	T5	
1	Mains transformer	TR1	
1	Green LED – power on	D1	
1	Zener 5V1 or 6V8	D2	
1	Red LED (SWR error indicator)	D3	
1	BAT85	D4	
1	7.5V	D5	
1	11V (5W booster), 15V (10W booster)	D6	
1	40/3300 gretz	M1	
3	Coils, 4 turns	L2, L3, L4	
1	Coil, 3 turns	L1	
2	220	R3, R5	
2	100	R4, R6	
1	330	R1	
1	39 ohms, 1W	R9	
1	560	R2	
1	15K	R7	
1	56	R14	
2	Leave empty	R8, R15	
2	22	R10, R13	
2	2K2	R11, R12	
3	10uF	C2, C6, C10	
2	2200uF/35V	C3, C4	
1	100nF SMD (brown square)	C29	
8	10nF	C1, C8, C9, C11, C12, C13, C16, C28	
2	150pF	C7, C14	
1	470-1000uF/25V	C5	
1	68pF	C15	
2	47pF	C17, C18	
1	2p2	C19	
2	10p	C20, C27	
1	8p2	C22	
2	22pF	C21, C24	
2	27pF	C23, C25	
1	6p8	C26	
1	PCB		
1	Switches	S1	
1	Enclosure (If ordered)		
1	Potentiometer – output power selection – 1K	P1	
1	Isolation kit for T1 (two plastic bits)		
2	Aluminum block, screws, and bolts for T1 and T4		
1	Fuse enclosure	F1	
1	Fuse 1A F (fast)	F1	

NOTE THAT YOU NEED TO CUT THE 110V OR 220V MAINS BRIDGES (SEE INSTRUCTIONS)!

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LEGAL INFO

It may be illegal to operate this device in your county. Please consult local authorities before using MAX BOOSTER 5W or MAX BOOSTER 10W!

WARNING

Please note that there is high voltage present inside the amplifier. Do not touch any of the exposed circuits or parts once the unit has been connected to the mains voltage. Failure to follow this might result in serious injury or even death. Always unplug the mains cable before opening this unit and tampering inside the unit!