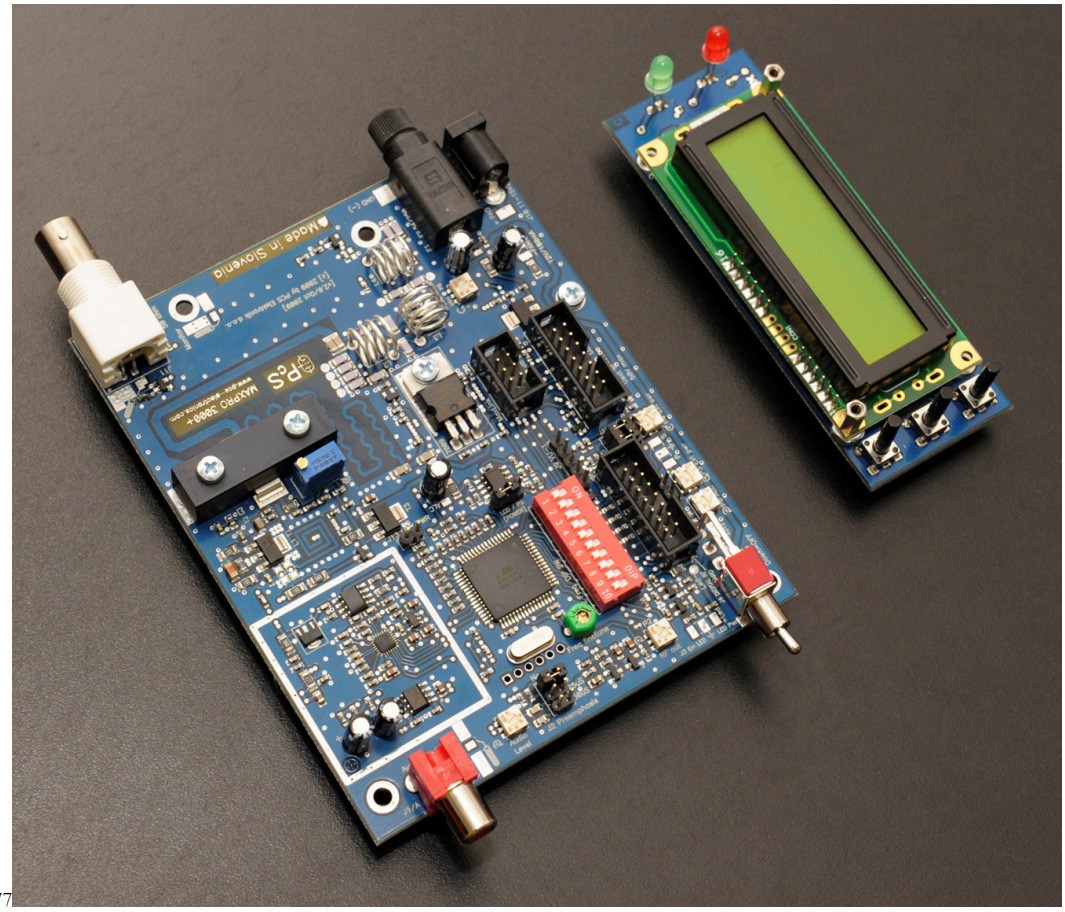

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MAXPRO3000+ v2.1

High performance FM radio broadcasting exciter

Manual

IMPORTANT NOTE

Upon receiving your order inspect the packaging material and unit for apparent damage. Any damage should be reported immediately so we can make a claim with the shipping company. Take photos, if you can, they can be used as a proof.

IMPORTANT!: If you want to connect an amplifier to this exciter please first make sure that output power is set correctly and does not exceed maximum allowable input power of the amplifier. See appendix for additional tips on connecting amplifiers and consider using a small 1-2dB attenuator.

Mains cable is typically not included with our mains power supplies and units. Since these cables vary from country to country and we had trouble finding the exact type we decided against including them, especially since finding them is so easy and cheap locally. They can be obtained in any radio/computer/hardware shop at the cost of about 1 US$. It is the type used in your PC for mains power.

Study local regulations and ensure you are operating in compliance.

Never ever operate any transmitter or amplifier without a properly tuned antenna!

BEFORE YOU CONNECT AMPLIFIER TO THE EXCITER FIRST MAKE SURE EXCITER OUTPUT POWER DOES NOT EXCEED AMPLIFIER MAX. INPUT POWER. EVEN A VERY BRIEF OVERLOAD OF YOUR AMPLIFIER'S INPUT COULD CAUSE DAMAGE TO THE AMPLIFIER.

Table of Contents

Chapter

1

Introducing the MAX PRO 3000+ FM exciter (v2.1)

Our best-selling series of MAXPRO+ radio exciters

This manual covers our MAX PRO 3000+ FM exciter. The design of these units started more than 15 years ago with MAX-1 and it evolved radically over the years. Exciters from this series always had an added punch that separated them from the competition and today still bring revolutionary solutions that you can't find in competing products. Today our customers enjoy better price/performance ratio and more reliability, power and features than ever before. In this manual you will find all of its exciting secrets.

What makes this FM exciter series so great?

Besides offering all the standard basic features these units also display a number of useful parameters on the LCD display: transmitted power, reflected power, exciter temperature, exciter voltage, frequency, audio modulation level, amplifier voltage, amplifier temperature and amplifier current. They are designed to easily connect to our stereo encoders so that you can control their parameters via shared LCD module. RDS (Radio Data System) is also available. A number of protection circuits helps prevent disasters. Temperature and SWR are monitored by on-board computer and alarm threshold can be set via LCD module. Hardware fold back SWR protection is also built-in as a backup. Of course this unit is completely no-tune and works either from car battery (12-15V) or with our universal mains power supply which works worldwide. Unit is rugged and made for 24/7/365 operation. In our opinion the best quality/price ratio possible.

Technical specifications:

- RF output power: 0 to 15 Watts (20W max., 15W typ, fully variable via LCD or trimmer)
- Output connector: BNC, 50 Ohms
- Frequency range: 87.5-108MHz and 76-90MHz in Japanese band
- Extended frequency range: PLL/VCO support 40-54MHz without modifications (requires output stage modifications for good performance)
- PLL steps: 5KHz (10/25/50/100/200KHz adjustable via lcd)
- Frequency stability: +/- 20Hz
- Spurious/Harmonic rejection: Harmonics: >50dB, Spurious: >90dB
- Power supply: 11-15V/2.5A or car battery (does not require 15V for full power)
- Power connector: 2.1mm power socket, center (+)
- Quartz locked PLL frequency control, ultra stable & clean output
- No expensive test equipment required
- Audio performance: Less than 0.2% distortion, 20Hz-75KHz
- RF output ruggedness: SWR protection, polarity protection, temp protection
- Pre-emphasis, 50uS, 75uS or none selectable
- Audio Input Impedance: 10Kohm, unbalanced, RCA jack, optional MCX
- Audio Input Level: 0 dB
- S/N ratio: >90 dB
- PC Board Size: 100x125mm (see this manual for drill template)

MAXPRO3000+ key features

- Displays frequency, power, audio level, reflected power, temperature, exciter voltage, amplifier voltage and amplifier current on the LCD.
- Extreme VCO isolation and RF field immunity (our exclusive innovative design)
- SWR and TEMP protection with adjustable sensitivity
- Power adjustment via LCD or trimmer
- Frequency adjustment via LCD display or dip switches
- Low PLL step (5KHz)
- ALC (Automatic Level Control) system for keeping output power level constant across entire FM band
- High power (15W typ, 20W max)
- True wideband no-tune operation
- Directly supports our SE5000 DSP+ and SE3000+ stereo encoders via LCD MENU system
- Mains power supply control module available, enables controlling output power by adjusting voltage
- RF control board with directional couplers and SWR protection is available

How is MAXPRO3000+ v2.1 better than previous versions?

- Improved efficiency; as a result reduced heat and higher maximum power output.
- MAXPRO3000+ v2.1 now has complete PC remote control (USB/RS232), software is available for free.
- MAXPRO3000+ v2.1 features ALC (Automatic Level Control); keeps output power level the same across the band
- MAXPRO3000+ v2.1 shows an additional parameter, that is Amplifier Current. Requires external board PCS LPF 5000+.
- MAXPRO3000+ v2.1 has new improved firmware.
- MAXPRO3000+ v2.1 now allows LCD module in DIP mode; LCD module shows frequency that is set via DIP switches
- MAXPRO3000+ v2.1 has a number of other smaller improvements
- MAXPRO3000+ v2.1 allows easy change of LOGO/welcome screen via USB/RS232, requires special unlocked software.

Thank you for purchasing MAX PRO 3000+ FM exciter

We hope you will enjoy it as much as we do and if you do remember to tell your friends and colleagues about it. Please feel free to leave your comments at our website or post your experience in our forum. And if you encounter a problem please let us know so that we may improve our products, offer advice and suggestion. From all of us we wish you happy broadcasting!

Your PCS Electronics team

Chapter

2

MAXPRO3000+ RF and LCD board layout

RF board layout

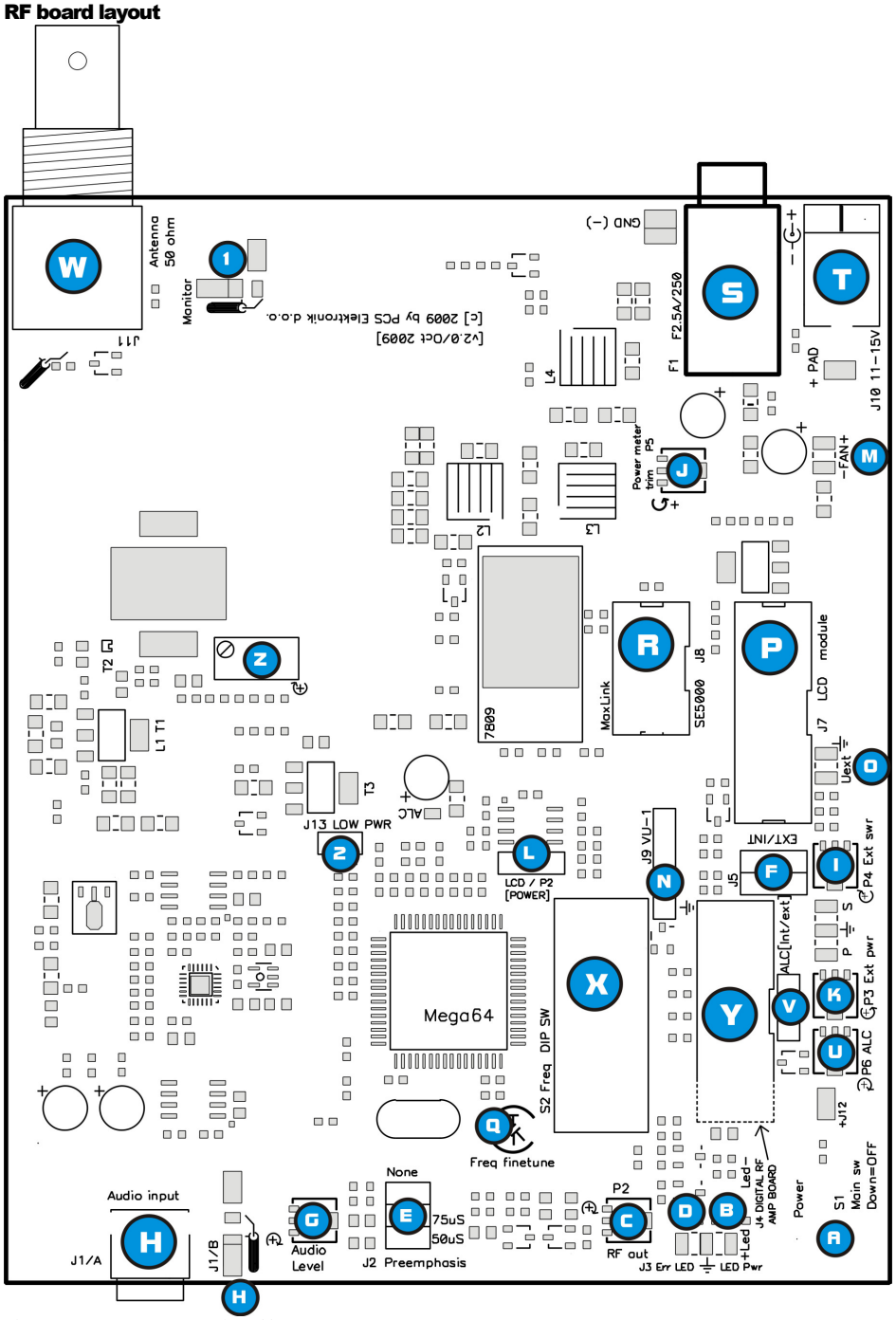

Fig. 1: MAX PRO 3000+ RF board layout

Ref.	Function
A	Place for ON/OFF switch (DOWN=OFF, UP=ON)
B	Optional power indicator LED can be connected here. This LED is also located on the LCD control module.
C	Output RF power adjustment, active when Jumper (L) in position P2. Potentiometer can be installed instead of this trimmer. Use 5-10K.
D	Optional ERROR indicator LED can be connected here. This LED is activated when RF output stage is NOT active. For example, whenever temperature protection is activated, this LED illuminates and RF power is reduced. This LED is also located on the LCD control module. Important: This LED is also illuminated whenever you change frequency as the control unit turns RF power off until PLL/VCO tuning is finished. In such case this does not signal a problem with temperature or SWR.
E	Pre-emphasis. Use this jumper to set pre-emphasis. This can either be 50uS (EU and most of the world) or 75uS (USA). If you plan to connect stereo encoder to the MAXPRO3000+ board, place the jumper in position None (top - this disables pre-emphasis).
F	The power and swr meter facility built into the MAXPRO3000+ can also read power from external sensor, which is a directional coupler such as this one here: http://www.pcs-electronics.com/output-board-with-swrpwr-pickup-p-1116.html By setting these jumpers to ext position (both jumpers right) LCD shows output power from external directional coupler (swr/power meter). This means you can mount this FM exciter in a box together with an amplifier and directional coupler and it will show the correct total output power after the amplifier. Accuracy can be set with two trimmers next to the solder pads (K and I). Solder pads between the trimmers are the voltage input from directional coupler, middle is ground as noted on the PCB. S= SWR, P=PWR.
G	Audio input sensitivity adjustment.
H	Audio input - RCA jack or coaxial cable.
I	Adjustment of accuracy for reflected power readout from external directional coupler/swr meter.
J	Internal power meter accuracy adjustment. If the internal power display on the LCD is a bit off you can correct its accuracy with this trimmer.
K	Adjustment of accuracy for power readout from external directional coupler/power meter.
L	This jumper selects the method of RF output power adjustment. It can either be LCD or trimmer P2.
M	Soldering posts for a small 12V fan. Output stage appreciates a bit of air flow, it does not have to be substantial. As long as the air slowly moves a bit it'll be more than enough so use weakest available FAN. Due to improved design this fan now spins down completely at low RF power output and our new 40x40x25mm unit is almost completely inaudible even at highest speed.
N	You can connect VUMAX-1 led vu-meter unit here, it will show output power and swr as bar graphs. The 2 remaining bar graphs can be connected to SE5000 DSP+ and will show audio volume.
O	Connect external power supply voltage up to about 60V and LCD control unit will show the voltage; typically this would be power supply for the additional 100-1000W amplifier.
P	LCD control unit. If you want to control this unit with LCD, attach your LCD control module here.
Q	Do not touch unless you understand what this is. This lets you fine-tune the reference frequency. Can be used to set the unit to any frequency, even though the PLL step is 5KHz. You can for example use this to set the frequency to 100.001KHz by first using the LCD to set it to 100.000KHz and than using this trimmer to shift it to 100.001.000Hz.
R	Maxlink connector for easy connection with the SE5000 or SE3000 stereo encoder. This lets you connect and control both units from the same LCD control units. Our Cyber Max FM+ units use this arrangement. This connection is now completely solder-free, just plug the connector in and voila, finished. Flat cable that runs

	between the units also carries supply voltage for the stereo encoder further reducing required wiring and work.
S	2.5A fast fuse. Always replace with this type for continued protection against short-circuit.
T	Power supply connector, center is positive. DO NOT use more than 15V.
U	ALC - automatic level control. Limits power to adjusted level. Works together with V. More in appendix below.
V	Power selection for ALC function. Lets you select which power level to monitor and limit.
Z	Output stage bias current. DO NOT touch unless you know what you're doing. You can use this to increase or decrease maximum available power. For example, you can set your transmitter to 15W with LCD control units and than use this trimmer to reduce maximum power to 4W or 1W. LCD will than control your output power from 0 to 1W or from 0 to 4W as it won't be able to give more power due to reduced bias. Warning: This allows setting output power in excess of 20W. Damage may result so proceed with care. There is NO WARRANTY for output transistor, replacement final transistors are available at our website.
X	DIP switches. These switches let you set frequency without LCD control unit. If you want to use LCD control unit, set all DIP switches to OFF. If you leave any switch in ON position, transmitter assumes that you want to use DIP switches and ignores LCD module commands (LCD will not allow changing frequency).
Y	Digiamp connector enables easy control of RF amplifiers and mains power supplies that power them. This greatly simplifies the process of building FM transmitters. You can read more about this connector in appendix.
W	RF output connection. BNC jack. Use a properly matched FM band antenna. The range and success of your transmissions will depend primarily upon the quality and position of your antenna so invest your energy and money into a proper solution. Poor unreliable connections may damage the final transistor.
1	RF monitor output. This output contains a small sample of output signal, suitable for monitoring RF signal quality with instruments such as frequency meter, frequency analyzer or modulation monitor.
2	Low power jumper. Limits power to about 5W max. Important: Only works when jumper L is in LCD mode!!

Table 1: Description of various elements of the MAX PRO 3000+ FM exciter board

LCD module layout

LCD control module is pretty simple and self-explanatory, but let us have a quick look, note you can disable keys by soldering over the "Lock Keys" solder bridge:

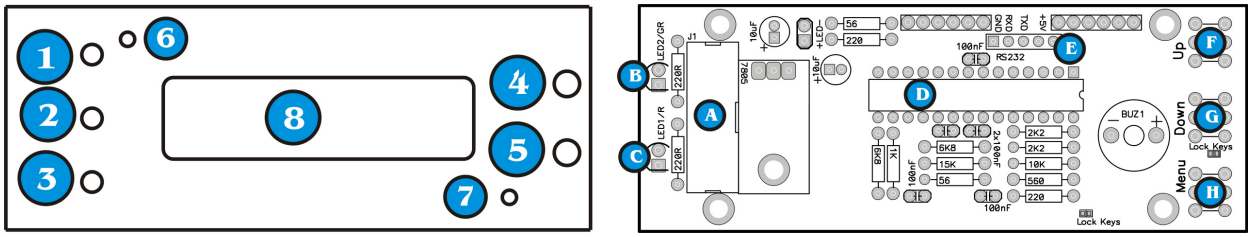

Fig. 2: LCD module layout, front and back

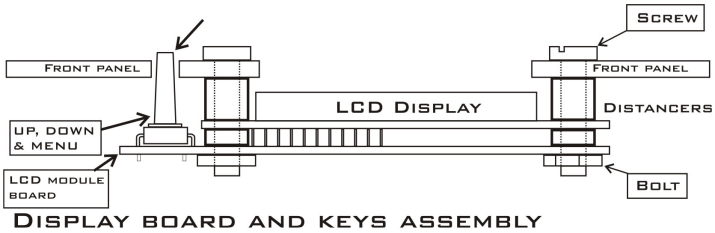

Fig 3: Installing display board into an enclosure, side view

Reference	Function
1, F	UP key
2, G	DOWN key
3, H	MENU key
4, B	POWER indicator LED. Illuminated whenever you turn on the exciter.
5, C	ERROR indicator LED. This LED is activated when RF output stage is NOT active. For example, whenever if temperature protection is activated, this LED illuminates and RF power is reduced. Important: This LED is also illuminated whenever you change frequency as the control unit turns RF power off until adjustments are finished and VCO is locked. In such case this does not signal a problem with temperature or SWR.
6,7	Mounting screws, M2.5 metric screw is to be used here.
8	LCD module, with backlight
A	14-pin connector for flat cable going to the RF board
D	Microcontroller with software
E	Connections to the IO board (RS232 or USB)

Table 2: Description of various elements of the LCD display module

RF and LCD module drill template/cutout

LCD control module is pretty simple and self-explanatory, but let us have a quick look;

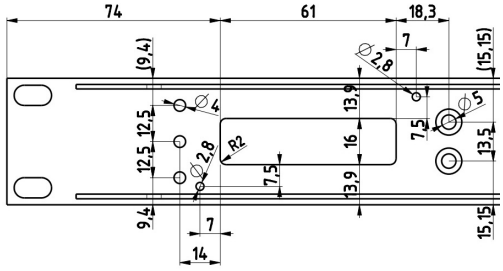

Fig. 4: LCD module cutout and holes, all measurements in mm

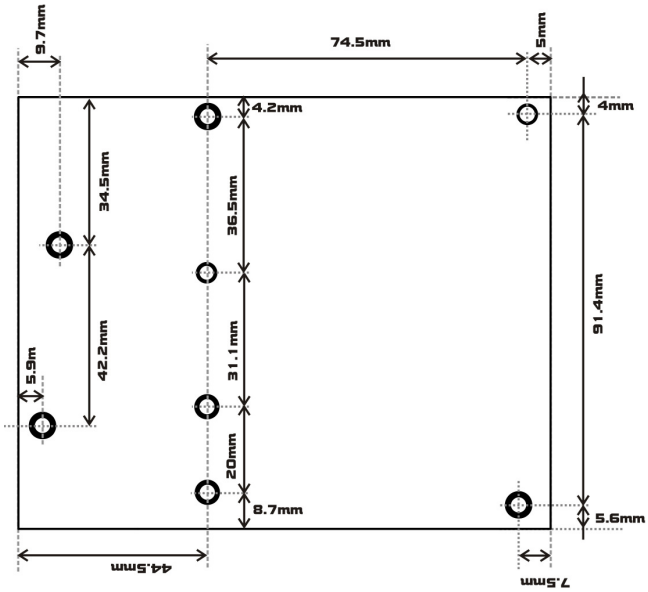

Fig. 5: RF module drill template, all measurements in mm, all holes are for M3 metric screws. Board is 10mm above the enclosure due to heatsink running under the entire length of the board.

Chapter

3

What's under the hood?

The block diagram of the MAXPRO3000+ exciter is shown below. It is simplified as the actual block diagram would be too complex for this manual. Only the basic building blocks of the exciter are shown and briefly explained one by one.

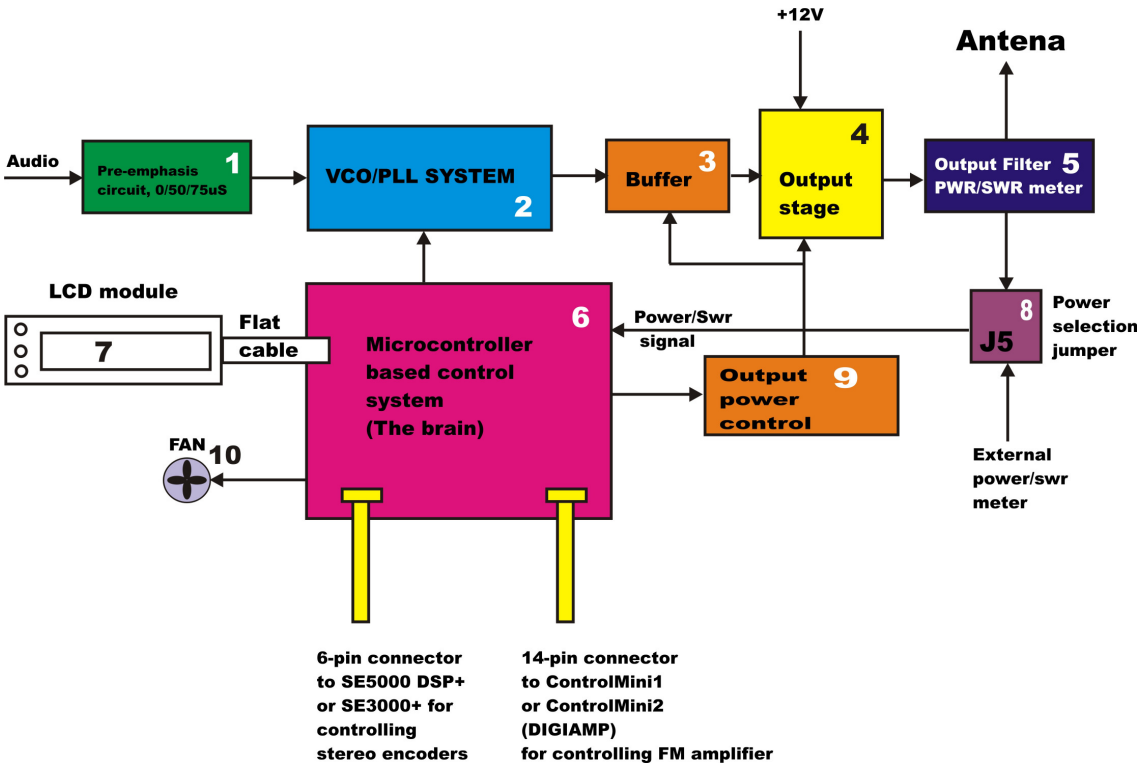

Fig. 6: Block diagram of the MAXPRO3000+ FM exciter

Reference	Function
1	Pre-emphasis is standard part of FM audio broadcasting. It helps minimize noise in received audio.
2	VCO/PLL system generates transmitter frequency and makes sure it is stable.
3	Buffer amplifies VCO signal to 1-2W.
4	Output stage additionally amplifies signal to full 15W.
5	Output filter with power and SWR meter ensures clean signal and provides signals for the power/SWR meter.
6	The microcontroller is a small computer which coordinates all of the functions of the transmitter.
7	LCD module makes it possible to monitor and set many of the parameters of this product.
8	Power/SWR meter selection jumper. You can either select internal power meter or external power meter (installed after the amplifier/pallet).
9	Output power control circuitry controls output power.
10	The microcontroller also provides control signal for a small fan which can be used to cool the unit.
MAXLINK	This is a 6-pin connector, designed for easy connectivity with stereo encoders. You can read more about stereo encoders at the back of this document.
DIGIAMP	This is a 14-pin connector, designed for controlling RF amplifiers. You can read more about connecting and controlling amplifiers at the back of this document.

Table 3: Description of various blocks of the MAX PRO 3000+ block diagram

Chapter

4

Before you start

It is recommended that you read this section before you power your unit up for the first time. Let us clear up some basics you should know about. You will also find some useful tips in our guides and forum at http://www.pcs-electronics.com. Here is what you need to get your TV transmitter on the air:

Antenna

Preferred type of antenna is affected by several factors, but mostly by desired radiation pattern, space available and your budget. If you are located in the middle of the area you want to cover you'll need an omni-directional antenna which transmits equally in all directions. If you are located at the edge of your desired coverage area you can beam the signal into the target area with a directional antenna. Directional antennas are also practical for point-to-point communications. Another thing to consider is that directional antennas usually have much higher gain than omni-directional antennas since the power which is radiated in all directions with omni antenna is concentrated mainly into one direction with directional antenna. Antennas with more gain thus have narrower beam. A compromise is usually made depending on budget and space available, higher gain antennas are often bigger and often more expensive.

Once you've chosen and installed your antenna there is another thing to consider. You can read more about it in the next section (So what is this SWR everyone talks about). Before powering up your transmitter on the air you should tune your antenna to get minimal SWR. This is typically done by adjusting the position of the antenna and any adjustable pieces. Aim for 2:1 or less. Use low power into the antenna when tuning it up and making adjustments. If you were using full power and a bit of the antenna came off in your hand the VSWR could be so bad as to blow the final transistor. For the same reason check the DC continuity of the antenna with an ohmmeter before plugging it in, to be sure it's what it's meant to be, either a short circuit or an open one, depending on the antenna type. For instructions regarding construction of antennas please see our website: http://www.pcs-electronics.com (guides section - antennas).

Antenna is a crucial part of the system so take special care. It is usually a good idea to place antenna away from your transmitter, power supply and audio system. Also any transmitter should be in a metal case which shields circuitry from the radiation of the antenna. If you cannot meet these requirements, you could experience feedback and other RF problems. We cannot guarantee proper operation of any transmitter/amplifier unless suitable antenna system is used and transmitters are in ventilated metal enclosure! This applies to any transmitter. Interestingly, strong RF field can make CD players and other digital devices go bezerk. Try placing antenna next to yours and see what happens. Most of the modern audio gear is not RF shielded – reducing costs is unfortunately the mantra today. This is why keeping antenna away from audio gear is a good idea.

If you are going to place your antenna outside, on your roof, please take care of the grounding. This should be done to prevent lightning hazard and should be done by a company specializing in lightning protection. You can read more about lightning protection in the book recommended below or many of the websites (Google up "lightning protection ham radio" for example) .

I hope this basic introduction will not scare you too much, it should be sufficient for the time being although we encourage you to explore this exciting subject further with the help of a book such as the ARRL Antenna Book:

http://www.amazon.com/exec/obidos/ASIN/0872598047/mightyspiraterad

So what is this swr (vswr) everyone talks about?

SWR is a measure of how well two devices are impedance matched to each other. Typical radio/TV transmission equipment is designed for 50 ohm load impedance, so we usually use 50 ohm cables and build or buy antennas that are specified for 50 ohm. While most cables have flat impedance over frequency (they measure 50 ohm at all frequencies you are likely to use) the same is not true of the antennas.

A 1.0:1 VSWR is a perfect match. That means the load impedance is exactly 50 ohms. A 2.0:1 VSWR is obtained when the load impedance is either 25 ohms or 100 ohms.

Because most transmitters will deliver full power with a load VSWR of up to 2.0:1, this value is usually considered the limit for acceptable operation. Many prefer to keep their VSWR below that however, but for all practical purposes, it is unnecessary to spend time or money trying to get much below a VSWR of 1.5:1. The benefits will be hard to measure and even harder to notice.

On the other hand, coaxial cable losses increase rapidly, for a given frequency of operation, when the antenna VSWR exceeds 2.0:1. This can even, in some extreme cases, result in the coaxial cable burning, even when running 100 W. Using a higher grade of cable will definitely improve things, but even high quality coaxial cable becomes very lossy when VSWR exceeds 3.0:1 at higher HF frequencies (or VHF and higher).

Coaxial cable

Coaxial cable is an electrical cable consisting of a round, insulated conducting wire surrounded by a round, conducting sheath, usually surrounded by a final insulating layer. The cable is designed to carry a high-frequency or broadband signal, usually at radio frequencies. Coaxial Cabling is a two conductor closed transmission medium that is often used for the transmission of RF energy. It yields excellent performance at high frequencies and superior EMI control/shielding when compared to other types of copper cabling. Coaxial cabling is commonly found in broadcast and networking systems. Most coaxial cables have a characteristic impedance of either 50 or 75 ohms. The RF industry uses standard type-names for coaxial cables. The U.S military uses the RG-# or RG-#/U format (probably for "radio grade, universal", but other interpretations exist).

The common RG-58 from Radio Shack is NOT the best you can do and can eat a lot of your effective power out! Use it only for short runs. BELDEN makes terrific coaxial cable in various qualities and with very low loss (measured in dB's…decibels). 3 dB loss = 1/4 of your signal strength - either lost or gained. Watch out for the correct impedance; RG58, RG213, H-500 and H-155 have 50 Ohms, RG-59 and RG-6 have 75 Ohms. Most antennas and transmitters including ours are 50 ohm. Check our website for good coax. Don't buy more than you need to make the long run to your antenna and don't make up a few "jumpers" to go between your exciter, VSWR meter and your antenna as all you'll do is create higher SWR and more line losses. H-155 or H500 are good choices! RG-142 with Teflon is recommended for wiring inside cabinets, for baluns, Wilkinson couplers and everywhere where resistance to heat is required as insulation won't melt during soldering or operation.

BNC connector

A 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 older Ethernet networks. You might get it along with your antenna. Try to find a good quality BNC connector as PC type usually uses cheap plastic instead of Teflon. The good ones are usually easily recognized by higher prices. Another reliable method is a test with soldering iron; Teflon won't melt while plastic will. BNC to N or BNC to SO239 converters are available and will make it possible to connect N or PL259 (CB type or UHF) connector directly.

Mains power supply and mains power cable

Do not underestimate the importance of mains power supply, despite abundance of all kinds of cheap units available today they unfortunately do not always meet requirements. What you need is a well stabilized DC 15V mains power supply that can supply at least 2.5 amps of continuous current without overheating, introducing buzzing, dropping the voltage down to 12V or lower (a classic case) or acting up in other way. Whenever in doubt please buy our mains power supply. One final note, our units are set for 15V and if you use less this may lower your output power a bit. The lower the supply voltage the lower the power. You can compensate for this by slightly increasing output stage bias current.

If you ordered and received our mains power supply (which is recommended) you'll notice the mains cable is not included, but can be obtained in any radio/computer/hardware shop at the cost of about 1 US$. It is the type used in your PC for mains power. Since these cables vary from country to country and we had trouble getting the exact type locally we decided against including them, especially since finding them is so easy locally.

Audio source with mixer, microphone etc

You need some kind of audio source to drive your transmitter. This will typically be either a computer (just plug the cable into your sound card outputs, a mixer and a variety of audio sources, such as a microphone, CD player, DAT player, tape deck, gramophone, MP3 player etc.

Enclosure and suitable cooling for MAX PRO 3000+

Use metal (preferably aluminum) for your enclosures and allow some free space for future add-ons (stereo encoders etc.) and heat dissipation, also make ventilation holes at the top and/or back of the enclosure. Fix the PCB and heat-sink with all screws tightly. Flat cable should be wired away from the VCO assembly. A small fan is also recommended, 40x40x25mm will run quietly, you can connect it to the provided pads which also regulate fan speed according to output power. **Make sure you tightly screw the rf board to the enclosure as this is how the output transistor dissipates its heat!**

Stereo encoder for stereo operation

If you want to transmit in stereo, you also need a stereo encoder. The cool thing about MAXPRO3000+ is that it directly supports SE3000 AN+ or SE5000 DSP+ stereo encoder. This makes it possible to set all audio parameters easily via LCD control module. SE5000 DSP+ comes with excellent DSP filters and 19KHz notch. When using other units look for good stereo separation, 19KHz notch filters, a limiter and balanced inputs, if possible. Balanced inputs are an instant cure for most noise problems and this is why all professional installations usually take advantage of balanced inputs. Of course you can use any stereo encoder out there.

Chapter

5

Wiring everything together

Wiring things up and first power-up

Wiring the MAXPRO3000+ is easy, just make sure you read the previous chapter and setup enclosure, antenna and coaxial cable correctly. Than proceed with the following:

- Install MAXPRO3000+ in a suitable enclosure and provide a small cooling fan which will blow across the board. If you have stereo encoder, you can install it in the same enclosure, but a metal separating/shielding wall is recommended.

- Erect antenna tower and install antenna securely. Make sure your antenna is well away from any metal objects. Ensure your antenna tower is grounded securely.

- Connect one end of your 50ohm coaxial cable to the antenna. If you have SWR analyzer you can now verify SWR of your antenna. If your antenna is already tuned connect the other end of coaxial cable to the antenna connector (BNC) at the back of the transmitter. If you have SWR/POWER meter, you can wire that one inline between antenna and exciter as well. Make sure the SWR meter supports the frequency band required (87-108MHz). Ensure all connectors are firmly secured and antenna is mounted securely.

- The following step depends on whether you are using LCD module or not:

If you have LCD module	If you don't have LCD module and want to use DIP switches
- Connect LCD module	- Set frequency with DIP switches (see table in appendix)
- Set jumper L (fig.1) to position LCD	- Set jumper L (fig.1) to position P2
	- Set P2 to middle

- While making sure power switch is off connect mains power cable into the mains power supply and connect mains power supply into the back of the exciter.

- Inspect all cables quickly again and make sure everything is secure.

- Turn on a radio receiver and set it to your intended transmitter frequency.

- Flip the POWER switch and wait for the unit to turn on. Enter the menu system by pressing the bottom key (Menu) repeatedly and look for the <RF power> menu item. Now set desired output power with the UP/DOWN keys. For tuning and testing use around 25-50% of full power. Press Menu again to exit back to main display. Now you can use the UP/DOWN keys to set the desired frequency of operation. Wait a few seconds for the red LED diode to turn off. Your radio should now mute since you did not connect any audio sources yet.

- You can now connect audio sources of choice and verify audio performance. You should not sound louder than other stations, in fact unless you have an expensive high performance software or hardware sound processor you should sound quieter than other stations.

- Observe SWR and output power. If everything seems ok you can enter <RF power> menu (or use trimmer P2; don't set more than 15W for safety reasons) again and increase power to full. Observe power and SWR.

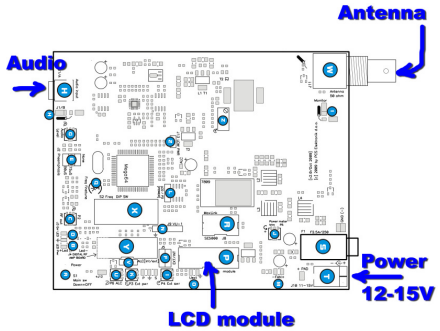

Fig. 7: Setting up MAX PRO 3000+

Chapter

6

Using the MAX PRO 3000+ exciter

Lcd control module

Basically there are three push-buttons available for the menu system; **UP**, **DOWN** and **MENU**. By pushing **UP** or **DOWN** you get a shift of frequency in corresponding direction. Hold any of these keys for a few seconds and the jumps will increase to 500 KHz. The new frequency is saved automatically. The third button (**MENU)** gives you an option to select and setup many of the options and DSP functions of this unit. Note that for most users setting frequency and power are the two important/useful settings, leave the rest alone at default.

Lcd control module menu system

The UP and DOWN keys are used to change parameter values. In normal mode the LCD simply shows the frequency and power or whatever view you select. Menu key can be used to enter the menu mode, repeatedly pressing this key brings up the following menus: <RF POWER>, <STEREO MODE>, <VIEW SELECT>, <TREBLE>, <BASS>, <COMPRESSION>, <THRESHOLD>, <ATTACK>, <DECAY>, <INTEGRATION>, <LCD CONTRAST>, <RIGHT CH VOL>, <LEFT CH VOL>, <PLL STEP>, <RF EQ>, <FIRMWARE VER>, <PWR/SWR METER>, <TEMP ALARM>, <SWR ALARM>, <BAND SELECT>, and <RF AMP CONTROL>. Pressing the UP or DOWN key selects the desired parameter and allows you to modify its value. Another press on the MENU key and you're back to the normal mode. Note that all these settings except power and frequency are already set as they should be so changing them should not be necessary and is not recommended.

Changing frequency

Simply press the UP/DOWN button to change frequency. Depending on PLL STEP setting your frequency will go down in 5/10/25/50/100/200KHz steps. If you keep pressing a key for a while the PLL STEP switches to fast tuning mode and jumps in 500KHz steps.

Note: UP/DOWN keys change frequency also when you have set a view type which does not show frequency, such as UPTIME.

<RF POWER>

This setting allows you to set output power. Select desired power with the UP/DOWN keys and press MENU key to exit the menu system and return to normal operation. Selected power is displayed on the LCD as a line of bars. Think of this setting as an accelerator (gas) pedal in your car. Think of the power in watts that is shown on the LCD as the speed meter in your car. Depending on the road going uphill or downhill speed meter will show different values even if your accelerator pedal is fixed in the same position. If you go downhill your speed will be greater with same amount of gas pedal. Likewise here your supply voltage can affect the actual output power slightly.

<STEREO MODE>

You can set your transmitter to MONO or STEREO here. This only works when you connect stereo encoder to the MAX PRO 3000+ with MAXLINK cable (6-pin flat cable).

<VIEW SELECT>

MAX PRO 3000+ is capable of displaying a number of various parameters. Since the LCD real-estate is limited to 2x16 characters we prepared a number of pre-programmed views that only show a selected number of parameters. At the time of writing these views were available:

- [Freq+Mode+Pwr] – This view shows frequency, mono/stereo mode and output power

- [Fr+Mode+Te+Ue] – This view shows frequency, mono/stereo mode, exciter temperature and exciter supply voltage

- [Po+Pr+Uamp+Ta] – This view shows output power, reflected power, amplifier supply voltage and amplifier temperature (if used)

- [Po+Pr+Uamp+Ia] – This view shows output power, reflected power, amplifier supply voltage and amplifier current (if used)

- [Audio Level] – This view shows audio level bar graph. For this to work you the W solder bridge on the LCD module needs to be closed-soldered.

- [Uptime D:H:M] – This view shows how long the transmitter has been operating without mains power going out. It is sometimes useful in diagnosing mains power failures.

- [Auto Scroll]D – This is the default view, it shows each of the above listed views for a short while and than moves on to the next in an endless loop. This way you can see all the relevant parameters without having to go through the menu system to change the view type, You just have to wait a few seconds for the view to change.

<TREBLE> and <BASS>

This option allows you to set the amount of TREBLE and BASS in your audio. Recommended values are marked with (D).

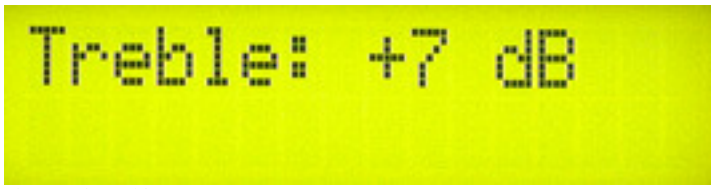

Fig. 8: Setting treble

Compressor Settings

A number of MENU settings control the operation of the compressor. Lets assume that the audio signal enters the transmitter at some low level. Compressor does nothing to the signal until at one point as the input signal increases the signal reaches the compression threshold. Digital signal processor starts compressing the signal beyond that point. The higher the compression ratio the higher the compression. For example, compression ratio of 1:∞ would in effect be a limiter.

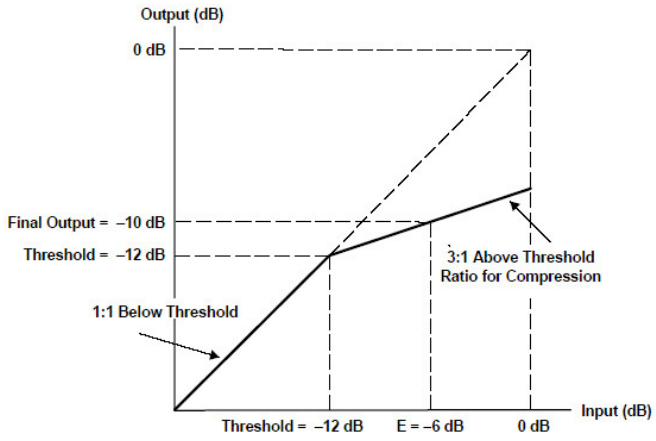

Fig. 9: Explanation of the compressor settings

Fig. 10: Setting the compression level

Fig. 11: Setting the compression threshold

Fig. 12: Setting the attack time, this is the time between the input signal and the actual response of the compressor

Fig. 13: Setting the decay time, this is the time the compressor needs to respond after the input signal falls back to normal level (below threshold).

Fig. 14: Setting the integration interval, this is the time the DSP evaluates the signal to establish whether it should respond or not

Integration interval determines the energy needed to trip the compressor. In simple words; it determines how long the audio needs to be loud for the compressor to respond by reducing the gain. This is not to be confused with attack time. Attack time of 50ms means the compressor will respond in 50ms after the signal spike is detected, regardless of duration of that spike, even if it is just a very short event. With longer integration interval, on the other hand, compressor only responds if a long spike or a substantial number of spikes is detected (meaning more signal energy).

<LCD CONTRAST>

Select for the best visibility. Contrast is slightly affected by ambient temperature and you can adapt it to your needs here.

Fig. 15: Changing contrast

Left and right channel volume (only with DSP stereo encoders)

This option allows you to precisely adjust the input sensitivity of both audio channels. This is very useful when your audio source has either too high or too low output level.

Fig. 16: Changing right input channel gain

<PLL STEP>

Frequency can normally be adjusted in smallest steps of 5KHz or larger steps of 10KHZ, 25KHz, 50KHz or 100KHz. We recommend you to select 100KHz as this lets you change frequency fast and there is rarely need for fine tuning. However, you can enter this menu and select a PLL step of 5KHz for example and take advantage of these small steps.

<RF EQ>

Just leave this setting at default. It is better suited for our 100-1000W units. It is a new setting that lets you control how your transmitter rolls off at the band edges. Several settings are available and are represented by a graphic. Default setting tries to provide the same amount of power across the whole band.

Another setting gives a slight power boost at the band edges around 88 and 108MHz helping flatten-out the frequency response of many RF amplifiers which tend to have lower output power and gain at the band edges.

There are additional two settings, one of these gives more power at the top of the band around 108MHz and the other does the opposite, providing more gain at the bottom of the band around 88MHz. These four settings should cover any situation you are likely to encounter, whatever your amplifier's attitude might be.

<FIRMWARE VER>

This option allows you to display current LCD module firmware version. At the time of writing firmware version was [MP3K+ V2.2 1/10]

<PWR/SWR METER>

This is how you tell the exciter that you are going to use external directional coupler and power amplifier. By selecting "External" the exciter assumes that you've set the J5 jumpers into external position and attached external directional couplers or our ControlMini2 board. You can read more about ControlMini2 in the MAX PRO 3000+ manual. We've recently added another option here (External HiSen). This is useful when your external directional couplers provide low output signals and the displays shows value that is too low. It boosts sensitivity.

<TEMP ALARM>

You can set the sensitivity of temperature alarm here. We recommend you set these to 70-80 degrees Celsius. A properly installed unit with a tiny fan will typically run at 55 degrees C at maximum output power. This alarm applies to externally sensed temperature (ControlMini2), if you are using external PWR/SWR METER.

<SWR ALARM>

You can set the sensitivity of software driven SWR alarm here.

<BAND SELECT>

CyberMaxFM+ supports three bands:

- [87.5-108MHz]D – This is default band, used in most of the world. CyberMaxFM+ works perfectly across the entire band.

- [76-90MHz/Japan] – This band was developed specifically for Japan. You can experience slightly lower output power below 87.5MHz. Also filtering is a bit less aggressive below regular FM band (87.5MHz).

- [44-54MHz] – While the PLL and driver fully support this frequency band, you will have to change coils in the output matching network and output filter to obtain usable RF signal out of the exciter. We have provided this band for the wireless links in the lower VHF band (around 50MHz). This last option is only for people who know how to use it so please don't use this setting unless you understand it.

<RF AMP CONTROL>

This menu option lets you choose how the MAX PRO 3000+ controls the amplifier. It offers three options, described in the manual for the MAX PRO 3000+. Please leave this setting at default value (D) No amplifier as it has no function in 15W exciters since they don't have additional external amplifiers.

- [No amplifier]D – Default option, you will not be using an amplifier

- [Controlmini1] – Basically mode A for the system described in appendix E

- [ControlMini2] – Basically mode B for the system described in appendix E

Troubleshooting

We hope you'll never get to this step. We all know bad things happen but do not despair! MAX PRO 3000+ is protected with a fuse, SWR and TEMP protection. Fuse is the first thing to check. Make sure your coaxial cable leading to the transmitter or antenna is not shorted or open. Next check the troubleshooting table on the next page. If you have problems you cannot solve yourself, please see our website for contact information and support resources in our forum.

Fig 17: So, do you think you can handle it? We think you sure can!

PROBLEM DESCRIPTION	POSSIBLE SOLUTIONS
LCD display keeps showing TEMP/SWR error warning	1. Unit is probably over-heating or your antenna is faulty. Let the unit cool off and ensure proper cooling in the future. Perhaps you adjusted TEMP ALARM too low. 2. It is very likely that your antenna is not working correctly, check cable and check SWR. You may need to adjust SWR ALARM slightly higher (but first make sure your antenna and cable are OK).
Red LED constantly on	1. High SWR. Check SWR and adjust antenna, if needed 2. Wait a few seconds. Unit turns this LED on when changing frequency just for a few seconds until VCO stabilizes. This is normal behavior at power-up and after changing frequency.
Audio too quiet	1. Open the modulation trimmer on MAX PRO 30000+ exciter board a little bit. 2. Increase level on your audio source a little bit, start using software or hardware compressor
Audio too loud	Close the modulation trimmer on MAX PRO 30000+ exciter board a little bit.
Audio without any treble	Set pre-emphasis to either 50uS or 75uS. If you're using stereo model, enable pre-emphasis there (see manual for stereo encoder module , SE5000 or SE3000).
Unit blows fuses and draws excessive current	You have managed the impossible: You have burned the output transistor. You've probably tried to squeeze out more output power by using higher supply voltage above 15V or even changing the bias current. It is time to order a replacement final transistor and get the soldering iron. Next time think twice about doing these things.
Power supply is blinking	Probably the same thing as above. Blinking power supply means its protection is shutting it off and back on, probably due to short caused by burned final.
Audio distortion on high peaks, for example on "s" sound.	Your audio input level is slightly too high, reduce input audio level slightly at your audio source. Use some kind of compressor to remove over-modulation peaks.
There is HUM in audio	- Move antenna as far away from the transmitter and audio gear as possible - Use balanced audio inputs (XLR audio connectors) rather than RCA - Make sure SWR is low - Did you miss the part about metal enclosure? Put your unit in enclosure!! - Keep audio cables short and away from antenna and RF coaxial cable - Form a coil from coaxial cable going to the antenna, make a few turns. This stops RF currents that might be flowing on the outer braid of the coaxial cable. This usually happens when you connect unbalanced cable to balanced antenna without proper BALUN (balanced-unbalanced converter) resulting in coaxial cable becoming part of the antenna and radiating RF energy as well…causing hum.
The audio level bar graph does not move with audio	Look at the LCD module and look at the "W" solder bridge. This bridge should be soldered over for this function to work. If it is not please solder this.
Output power less than expected	We set our transmitters to work best with our 15V power supply. If you intend to use 11-12V you can increase bias current a little bit, this is done with the blue trimmer next to the output transistor.
Output power less than expected	If unit is overheating it will start reducing output power, make sure it is sufficiently cooled!
I am using DIP switch mode (no LCD unit) and output power is 0.	If there is no output power in DIPSW mode, set jumper L (see fig 1) to P2 and turn trimmer P2 until desired power is reached.
Output power less than expected or zero.	Check the position of the ALC trimmer. If it is set too aggressively it may be limiting power to zero.

Chapter

7

Limiting maximum adjustable power

For some purposes 15W may be too much and you may want to limit maximum output power of this FM transmitter to a lower value and at the same time prevent accidental setting of higher power via LCD module. This is especially important when you use this exciter to drive an amplifier. Most amplifiers will not appreciate over-driving the input and may even be damaged by excessive power on the input. There are scenarios and ways to limit output power, they are described below with their advantages and disadvantages. Note you should **PERFORM THESE ADJUSTMENTS BEFORE CONNECTING AMPLIFIER** as otherwise it may be too late, a short burst of full power while you turn the trimmer may kill the amplifier. A very good design practice is also to use an attenuator (just a small 1-2dB) between exciter and amplifier, remember amplifiers input impedance can be a long way from prescribed 50 ohms and attenuator nicely equalizes that out.

Why the need for ALC?

As expected output power is not perfectly flat across the entire FM band. Also FM amplifiers that you may use with this exciter will probably not have flat frequency response. For this reason it is usually of great benefit to have some kind of a circuit to regulate and flatten output power across entire FM band. Out of this need came ALC – Automatic Level Control. If it sounds like something you need read below, it is built into MAX PRO 3000+ to make your life easier.

Limiting power when using LCD module – No ALC

Lets assume you are using MAX PRO 3000+ with LCD module and want to limit output power to 4W. This means you will be able to use LCD module (menu item <POWER>) to adjust output power nicely from 0W to 4W (in normal situation this would have been 0-15W). Here's what you have to do:

- Remove ALC jumper.

- Make sure jumper [Power] (reference L on fig. 1, page 7) is set to LCD to ensure unit is controlled by LCD module

- Install jumper J13 (LOW PWR, reference 2 on fig. 1, page 7). This will decrease output power range from 0 to around 6W when in LCD control mode.

- Set power to full with the LCD module, you will be getting around 4-6W of power at this moment.

- Now turn the bias adjustment trimmer (reference Z on fig. 1, page 7) in the opposite direction of the + sign (anti-clockwise) until your output power is exactly 2W.

You are done. If you wish to perform this procedure for power levels greater than around 5-6W proceed the same, but do not install that LOW PWR jumper.

Limiting power when using LCD module – With ALC based on internal power

You may notice that your power is not precisely 2W as you go across the entire FM band. You can activate ALC (Automatic Level Control) circuitry to additionally limit maximum output power to further flatten frequency response or simply as an additional backup security measure. To activate ALC do the following:

- Perform all steps from the procedure above without ALC

- Remove ALC jumper. Scan the entire FM band and first check if at any part of the frequency band your power level falls below 2W. If so, slightly increase that bias trimmer (see above) to achieve 2W of power at that part of the band.

- Next, look for the part of the band where your power exceeds 2W most (for example 2.4W at 101.000MHz). Now install ALC jumper (reference V on fig. 1, page 7) into position INT (pin 1-2) and turn trimmer P6 (reference U on fig. 1, page 7) until your output is exactly 2W. Now your output power is limited to 2W across the band.

Limiting power when using LCD module – With ALC based on external power

In this scenario you are using your exciter to power an amplifier. Lets assume that your amplifier requires exactly 1W of drive power and you are also using a 3dB attenuator. A 3dB attenuator will halve your 2W into 1W exactly. You will also be using an external directional coupler, possibly ControlMini2. You can use another one, but it is certainly needed to make ALC work and show output power after the amplifier.

- As a first step we are going to set maximum power to 2W just like in the first example above (without ALC). We will be performing this adjustment at around 100.000MHz.

- Make sure J5 (reference F on fig. 1, page 7) are set to measure power/swr from external source (to the right position)

- Once your power is set to 2W (1W after attenuator) you can connect your amplifier and test its performance. If you need slightly more power for full expected output, slightly increase power with bias trimmer (reference Z on fig. 1, page 7).

- Install ALC jumper (reference V on fig. 1, page 7) into position EXT (pin 2-3) and turn trimmer P6 (reference U on fig. 1, page 7) until you notice output power is slightly reduced. This indicates that at this level ALC is starting to limit output power.

- Test performance at other parts of the FM band. If output power is not adequate at the band edges slightly increase bias point with trimmer. You should now have pretty flat power output across entire FM band.

Setting power in DIP switch mode

If you are going to use DIP switch mode that probably means you do not intend to change frequency at all, you plan to set it once and never change it and you will be setting power with P2. In that case flatness of frequency response is not important. However since setting power with P2 is not very precise it is better to do it like this:

- Remove ALC jumper.

- Make sure jumper [Power] (reference L on fig. 1, page 7) is set to P2

- Set frequency with dip switches, table is in appendix at the end of this manual.

- Turn bear trimmer (reference Z on fig. 1, page 7) in the opposite direction of the + sign (**anti-clockwise**) 6 full turns, this will reduce maximum obtainable power to a safe level.

- Power on the unit and set full power out with P2 (reference C, fig. 1 on page 7), you should be getting some 1-3W at this point.

- Turn bias trimmer (reference Z on fig. 1, page 7) to your desired output power (lets assume this is 4W). You have now changed the range of P2 trimmer to 0-4W max which makes for a far easier adjustment.

- As a security precaution you can now install ALC jumper (reference V on fig. 1, page 7) into position INT (pin 1-2) and turn trimmer P6 (reference U on fig. 1, page 7) until your output power starts to decrease a bit. Now your output power is limited to 4W across the band.

- If you are also using an amplifier you can also set ALC for external power source in the same manner as described above for LCD mode.

PERFORM THESE ADJUSTMENTS BEFORE CONNECTING AMPLIFIER!

ALWAYS MAKE SURE OUTPUT POWER OF THE EXCITER DOES NOT EXCEED AMPLIFIER INPUT POWER!

Appendix

A

Appendix A: Dip switch frequency table

NOTE: If you want to use DIP switches instead of the LCD display module to set power, remove LCD display module and set DIP switch to a desired value. The only forbidden setting is all switches to off (this means you are going to use LCD module). **If you want to use LCD control module, set all DIP switches to OFF!!**

SW10	SW9	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	Frequency MHz
0	0	0	0	0	0	0	0	0	0	LCD MODE
1	0	0	0	0	0	0	0	0	0	76.050MHz
0	1	0	0	0	0	0	0	0	0	76.100MHz
1	1	0	0	0	0	0	0	0	0	76.150MHz
0	0	1	0	0	0	0	0	0	0	76.200MHz
1	0	1	0	0	0	0	0	0	0	76.250MHz
0	1	1	0	0	0	0	0	0	0	76.300MHz
1	1	1	0	0	0	0	0	0	0	76.350MHz
0	0	0	1	0	0	0	0	0	0	76.400MHz
1	0	0	1	0	0	0	0	0	0	76.450MHz
0	1	0	1	0	0	0	0	0	0	76.500MHz
1	1	0	1	0	0	0	0	0	0	76.550MHz
0	0	1	1	0	0	0	0	0	0	76.600MHz
1	0	1	1	0	0	0	0	0	0	76.650MHz
0	1	1	1	0	0	0	0	0	0	76.700MHz
1	1	1	1	0	0	0	0	0	0	76.750MHz
0	0	0	0	1	0	0	0	0	0	76.800MHz
1	0	0	0	1	0	0	0	0	0	76.850MHz
0	1	0	0	1	0	0	0	0	0	76.900MHz
1	1	0	0	1	0	0	0	0	0	76.950MHz
0	0	1	0	1	0	0	0	0	0	77.000MHz
1	0	1	0	1	0	0	0	0	0	77.050MHz
0	1	1	0	1	0	0	0	0	0	77.100MHz
1	1	1	0	1	0	0	0	0	0	77.150MHz
0	0	0	1	1	0	0	0	0	0	77.200MHz
1	0	0	1	1	0	0	0	0	0	77.250MHz
0	1	0	1	1	0	0	0	0	0	77.300MHz
1	1	0	1	1	0	0	0	0	0	77.350MHz
0	0	1	1	1	0	0	0	0	0	77.400MHz
1	0	1	1	1	0	0	0	0	0	77.450MHz
0	1	1	1	1	0	0	0	0	0	77.500MHz
1	1	1	1	1	0	0	0	0	0	77.550MHz
0	0	0	0	0	1	0	0	0	0	77.600MHz
1	0	0	0	0	1	0	0	0	0	77.650MHz
0	1	0	0	0	1	0	0	0	0	77.700MHz
1	1	0	0	0	1	0	0	0	0	77.750MHz
0	0	1	0	0	1	0	0	0	0	77.800MHz
1	0	1	0	0	1	0	0	0	0	77.850MHz
0	1	1	0	0	1	0	0	0	0	77.900MHz
1	1	1	0	0	1	0	0	0	0	77.950MHz
0	0	0	1	0	1	0	0	0	0	78.000MHz
1	0	0	1	0	1	0	0	0	0	78.050MHz
0	1	0	1	0	1	0	0	0	0	78.100MHz
1	1	0	1	0	1	0	0	0	0	78.150MHz
0	0	1	1	0	1	0	0	0	0	78.200MHz
1	0	1	1	0	1	0	0	0	0	78.250MHz
0	1	1	1	0	1	0	0	0	0	78.300MHz
1	1	1	1	0	1	0	0	0	0	78.350MHz
0	0	0	0	1	1	0	0	0	0	78.400MHz
1	0	0	0	1	1	0	0	0	0	78.450MHz
0	1	0	0	1	1	0	0	0	0	78.500MHz

1	1	0	0	1	1	0	0	0	0	78.550MHz
0	0	1	0	1	1	0	0	0	0	78.600MHz
1	0	1	0	1	1	0	0	0	0	78.650MHz
0	1	1	0	1	1	0	0	0	0	78.700MHz
1	1	1	0	1	1	0	0	0	0	78.750MHz
0	0	0	1	1	1	0	0	0	0	78.800MHz
1	0	0	1	1	1	0	0	0	0	78.850MHz
0	1	0	1	1	1	0	0	0	0	78.900MHz
1	1	0	1	1	1	0	0	0	0	78.950MHz
0	0	1	1	1	1	0	0	0	0	79.000MHz
1	0	1	1	1	1	0	0	0	0	79.050MHz
0	1	1	1	1	1	0	0	0	0	79.100MHz
1	1	1	1	1	1	0	0	0	0	79.150MHz
0	0	0	0	0	0	1	0	0	0	79.200MHz
1	0	0	0	0	0	1	0	0	0	79.250MHz
0	1	0	0	0	0	1	0	0	0	79.300MHz
1	1	0	0	0	0	1	0	0	0	79.350MHz
0	0	1	0	0	0	1	0	0	0	79.400MHz
1	0	1	0	0	0	1	0	0	0	79.450MHz
0	1	1	0	0	0	1	0	0	0	79.500MHz
1	1	1	0	0	0	1	0	0	0	79.550MHz
0	0	0	1	0	0	1	0	0	0	79.600MHz
1	0	0	1	0	0	1	0	0	0	79.650MHz
0	1	0	1	0	0	1	0	0	0	79.700MHz
1	1	0	1	0	0	1	0	0	0	79.750MHz
0	0	1	1	0	0	1	0	0	0	79.800MHz
1	0	1	1	0	0	1	0	0	0	79.850MHz
0	1	1	1	0	0	1	0	0	0	79.900MHz
1	1	1	1	0	0	1	0	0	0	79.950MHz
0	0	0	0	1	0	1	0	0	0	80.000MHz
1	0	0	0	1	0	1	0	0	0	80.050MHz
0	1	0	0	1	0	1	0	0	0	80.100MHz
1	1	0	0	1	0	1	0	0	0	80.150MHz
0	0	1	0	1	0	1	0	0	0	80.200MHz
1	0	1	0	1	0	1	0	0	0	80.250MHz
0	1	1	0	1	0	1	0	0	0	80.300MHz
1	1	1	0	1	0	1	0	0	0	80.350MHz
0	0	0	1	1	0	1	0	0	0	80.400MHz
1	0	0	1	1	0	1	0	0	0	80.450MHz
0	1	0	1	1	0	1	0	0	0	80.500MHz
1	1	0	1	1	0	1	0	0	0	80.550MHz
0	0	1	1	1	0	1	0	0	0	80.600MHz
1	0	1	1	1	0	1	0	0	0	80.650MHz
0	1	1	1	1	0	1	0	0	0	80.700MHz
1	1	1	1	1	0	1	0	0	0	80.750MHz
0	0	0	0	0	1	1	0	0	0	80.800MHz
1	0	0	0	0	1	1	0	0	0	80.850MHz
0	1	0	0	0	1	1	0	0	0	80.900MHz
1	1	0	0	0	1	1	0	0	0	80.950MHz
0	0	1	0	0	1	1	0	0	0	81.000MHz
1	0	1	0	0	1	1	0	0	0	81.050MHz
0	1	1	0	0	1	1	0	0	0	81.100MHz
1	1	1	0	0	1	1	0	0	0	81.150MHz
0	0	0	1	0	1	1	0	0	0	81.200MHz
1	0	0	1	0	1	1	0	0	0	81.250MHz
0	1	0	1	0	1	1	0	0	0	81.300MHz
1	1	0	1	0	1	1	0	0	0	81.350MHz
0	0	1	1	0	1	1	0	0	0	81.400MHz
1	0	1	1	0	1	1	0	0	0	81.450MHz
0	1	1	1	0	1	1	0	0	0	81.500MHz
1	1	1	1	0	1	1	0	0	0	81.550MHz
0	0	0	0	1	1	1	0	0	0	81.600MHz
1	0	0	0	1	1	1	0	0	0	81.650MHz
0	1	0	0	1	1	1	0	0	0	81.700MHz
1	1	0	0	1	1	1	0	0	0	81.750MHz
0	0	1	0	1	1	1	0	0	0	81.800MHz
1	0	1	0	1	1	1	0	0	0	81.850MHz
0	1	1	0	1	1	1	0	0	0	81.900MHz
1	1	1	0	1	1	1	0	0	0	81.950MHz
0	0	0	1	1	1	1	0	0	0	82.000MHz
1	0	0	1	1	1	1	0	0	0	82.050MHz
0	1	0	1	1	1	1	0	0	0	82.100MHz
1	1	0	1	1	1	1	0	0	0	82.150MHz

0	0	1	1	1	1	1	0	0	0	82.200MHz
1	0	1	1	1	1	1	0	0	0	82.250MHz
0	1	1	1	1	1	1	0	0	0	82.300MHz
1	1	1	1	1	1	1	0	0	0	82.350MHz +
0	0	0	0	0	0	0	1	0	0	82.400MHz
1	0	0	0	0	0	0	1	0	0	82.450MHz
0	1	0	0	0	0	0	1	0	0	82.500MHz
1	1	0	0	0	0	0	1	0	0	82.550MHz
0	0	1	0	0	0	0	1	0	0	82.600MHz
1	0	1	0	0	0	0	1	0	0	82.650MHz
0	1	1	0	0	0	0	1	0	0	82.700MHz
1	1	1	0	0	0	0	1	0	0	82.750MHz
0	0	0	1	0	0	0	1	0	0	82.800MHz
1	0	0	1	0	0	0	1	0	0	82.850MHz
0	1	0	1	0	0	0	1	0	0	82.900MHz
1	1	0	1	0	0	0	1	0	0	82.950MHz
0	0	1	1	0	0	0	1	0	0	83.000MHz
1	0	1	1	0	0	0	1	0	0	83.050MHz
0	1	1	1	0	0	0	1	0	0	83.100MHz
1	1	1	1	0	0	0	1	0	0	83.150MHz
0	0	0	0	1	0	0	1	0	0	83.200MHz
1	0	0	0	1	0	0	1	0	0	83.250MHz
0	1	0	0	1	0	0	1	0	0	83.300MHz
1	1	0	0	1	0	0	1	0	0	83.350MHz
0	0	1	0	1	0	0	1	0	0	83.400MHz
1	0	1	0	1	0	0	1	0	0	83.450MHz
0	1	1	0	1	0	0	1	0	0	83.500MHz
1	1	1	0	1	0	0	1	0	0	83.550MHz
0	0	0	1	1	0	0	1	0	0	83.600MHz
1	0	0	1	1	0	0	1	0	0	83.650MHz
0	1	0	1	1	0	0	1	0	0	83.700MHz
1	1	0	1	1	0	0	1	0	0	83.750MHz
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1	0	1	1	1	0	0	1	0	0	83.850MHz
0	1	1	1	1	0	0	1	0	0	83.900MHz
1	1	1	1	1	0	0	1	0	0	83.950MHz
0	0	0	0	0	1	0	1	0	0	84.000MHz
1	0	0	0	0	1	0	1	0	0	84.050MHz
0	1	0	0	0	1	0	1	0	0	84.100MHz
1	1	0	0	0	1	0	1	0	0	84.150MHz
0	0	1	0	0	1	0	1	0	0	84.200MHz
1	0	1	0	0	1	0	1	0	0	84.250MHz
0	1	1	0	0	1	0	1	0	0	84.300MHz
1	1	1	0	0	1	0	1	0	0	84.350MHz
0	0	0	1	0	1	0	1	0	0	84.400MHz
1	0	0	1	0	1	0	1	0	0	84.450MHz
0	1	0	1	0	1	0	1	0	0	84.500MHz
1	1	0	1	0	1	0	1	0	0	84.550MHz
0	0	1	1	0	1	0	1	0	0	84.600MHz
1	0	1	1	0	1	0	1	0	0	84.650MHz
0	1	1	1	0	1	0	1	0	0	84.700MHz
1	1	1	1	0	1	0	1	0	0	84.750MHz
0	0	0	0	1	1	0	1	0	0	84.800MHz
1	0	0	0	1	1	0	1	0	0	84.850MHz
0	1	0	0	1	1	0	1	0	0	84.900MHz
1	1	0	0	1	1	0	1	0	0	84.950MHz
0	0	1	0	1	1	0	1	0	0	85.000MHz
1	0	1	0	1	1	0	1	0	0	85.050MHz
0	1	1	0	1	1	0	1	0	0	85.100MHz
1	1	1	0	1	1	0	1	0	0	85.150MHz
0	0	0	1	1	1	0	1	0	0	85.200MHz
1	0	0	1	1	1	0	1	0	0	85.250MHz
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1	1	0	1	1	1	0	1	0	0	85.350MHz
0	0	1	1	1	1	0	1	0	0	85.400MHz
1	0	1	1	1	1	0	1	0	0	85.450MHz
0	1	1	1	1	1	0	1	0	0	85.500MHz
1	1	1	1	1	1	0	1	0	0	85.550MHz
0	0	0	0	0	0	1	1	0	0	85.600MHz
1	0	0	0	0	0	1	1	0	0	85.650MHz
0	1	0	0	0	0	1	1	0	0	85.700MHz
1	1	0	0	0	0	1	1	0	0	85.750MHz
0	0	1	0	0	0	1	1	0	0	85.800MHz

1	0	1	0	0	0	1	1	0	0	85.850MHz
0	1	1	0	0	0	1	1	0	0	85.900MHz
1	1	1	0	0	0	1	1	0	0	85.950MHz
0	0	0	1	0	0	1	1	0	0	86.000MHz
1	0	0	1	0	0	1	1	0	0	86.050MHz
0	1	0	1	0	0	1	1	0	0	86.100MHz
1	1	0	1	0	0	1	1	0	0	86.150MHz
0	0	1	1	0	0	1	1	0	0	86.200MHz
1	0	1	1	0	0	1	1	0	0	86.250MHz
0	1	1	1	0	0	1	1	0	0	86.300MHz
1	1	1	1	0	0	1	1	0	0	86.350MHz
0	0	0	0	1	0	1	1	0	0	86.400MHz
1	0	0	0	1	0	1	1	0	0	86.450MHz
0	1	0	0	1	0	1	1	0	0	86.500MHz
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0	0	1	0	1	0	1	1	0	0	86.600MHz
1	0	1	0	1	0	1	1	0	0	86.650MHz
0	1	1	0	1	0	1	1	0	0	86.700MHz
1	1	1	0	1	0	1	1	0	0	86.750MHz
0	0	0	1	1	0	1	1	0	0	86.800MHz
1	0	0	1	1	0	1	1	0	0	86.850MHz
0	1	0	1	1	0	1	1	0	0	86.900MHz
1	1	0	1	1	0	1	1	0	0	86.950MHz
0	0	1	1	1	0	1	1	0	0	87.000MHz
1	0	1	1	1	0	1	1	0	0	87.050MHz
0	1	1	1	1	0	1	1	0	0	87.100MHz
1	1	1	1	1	0	1	1	0	0	87.150MHz
0	0	0	0	0	1	1	1	0	0	87.200MHz
1	0	0	0	0	1	1	1	0	0	87.250MHz
0	1	0	0	0	1	1	1	0	0	87.300MHz
1	1	0	0	0	1	1	1	0	0	87.350MHz
0	0	1	0	0	1	1	1	0	0	87.400MHz
1	0	1	0	0	1	1	1	0	0	87.450MHz
0	1	1	0	0	1	1	1	0	0	87.500MHz
1	1	1	0	0	1	1	1	0	0	87.550MHz
0	0	0	1	0	1	1	1	0	0	87.600MHz
1	0	0	1	0	1	1	1	0	0	87.650MHz
0	1	0	1	0	1	1	1	0	0	87.700MHz
1	1	0	1	0	1	1	1	0	0	87.750MHz
0	0	1	1	0	1	1	1	0	0	87.800MHz
1	0	1	1	0	1	1	1	0	0	87.850MHz
0	1	1	1	0	1	1	1	0	0	87.900MHz
1	1	1	1	0	1	1	1	0	0	87.950MHz
0	0	0	0	1	1	1	1	0	0	88.000MHz
1	0	0	0	1	1	1	1	0	0	88.050MHz
0	1	0	0	1	1	1	1	0	0	88.100MHz
1	1	0	0	1	1	1	1	0	0	88.150MHz
0	0	1	0	1	1	1	1	0	0	88.200MHz
1	0	1	0	1	1	1	1	0	0	88.250MHz
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1	1	1	0	1	1	1	1	0	0	88.350MHz
0	0	0	1	1	1	1	1	0	0	88.400MHz
1	0	0	1	1	1	1	1	0	0	88.450MHz
0	1	0	1	1	1	1	1	0	0	88.500MHz
1	1	0	1	1	1	1	1	0	0	88.550MHz
0	0	1	1	1	1	1	1	0	0	88.600MHz
1	0	1	1	1	1	1	1	0	0	88.650MHz
0	1	1	1	1	1	1	1	0	0	88.700MHz
1	1	1	1	1	1	1	1	0	0	88.750MHz
0	0	0	0	0	0	0	0	1	0	88.800MHz
1	0	0	0	0	0	0	0	1	0	88.850MHz
0	1	0	0	0	0	0	0	1	0	88.900MHz
1	1	0	0	0	0	0	0	1	0	88.950MHz
0	0	1	0	0	0	0	0	1	0	89.000MHz
1	0	1	0	0	0	0	0	1	0	89.050MHz
0	1	1	0	0	0	0	0	1	0	89.100MHz
1	1	1	0	0	0	0	0	1	0	89.150MHz
0	0	0	1	0	0	0	0	1	0	89.200MHz
1	0	0	1	0	0	0	0	1	0	89.250MHz
0	1	0	1	0	0	0	0	1	0	89.300MHz
1	1	0	1	0	0	0	0	1	0	89.350MHz
0	0	1	1	0	0	0	0	1	0	89.400MHz
1	0	1	1	0	0	0	0	1	0	89.450MHz

0	1	1	1	0	0	0	0	1	0	89.500MHz
1	1	1	1	0	0	0	0	1	0	89.550MHz
0	0	0	0	1	0	0	0	1	0	89.600MHz
1	0	0	0	1	0	0	0	1	0	89.650MHz
0	1	0	0	1	0	0	0	1	0	89.700MHz
1	1	0	0	1	0	0	0	1	0	89.750MHz
0	0	1	0	1	0	0	0	1	0	89.800MHz
1	0	1	0	1	0	0	0	1	0	89.850MHz
0	1	1	0	1	0	0	0	1	0	89.900MHz
1	1	1	0	1	0	0	0	1	0	89.950MHz
0	0	0	1	1	0	0	0	1	0	90.000MHz
1	0	0	1	1	0	0	0	1	0	90.050MHz
0	1	0	1	1	0	0	0	1	0	90.100MHz
1	1	0	1	1	0	0	0	1	0	90.150MHz
0	0	1	1	1	0	0	0	1	0	90.200MHz
1	0	1	1	1	0	0	0	1	0	90.250MHz
0	1	1	1	1	0	0	0	1	0	90.300MHz
1	1	1	1	1	0	0	0	1	0	90.350MHz
0	0	0	0	0	1	0	0	1	0	90.400MHz
1	0	0	0	0	1	0	0	1	0	90.450MHz
0	1	0	0	0	1	0	0	1	0	90.500MHz
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1	0	1	0	0	1	0	0	1	0	90.650MHz
0	1	1	0	0	1	0	0	1	0	90.700MHz
1	1	1	0	0	1	0	0	1	0	90.750MHz
0	0	0	1	0	1	0	0	1	0	90.800MHz
1	0	0	1	0	1	0	0	1	0	90.850MHz
0	1	0	1	0	1	0	0	1	0	90.900MHz
1	1	0	1	0	1	0	0	1	0	90.950MHz
0	0	1	1	0	1	0	0	1	0	91.000MHz
1	0	1	1	0	1	0	0	1	0	91.050MHz
0	1	1	1	0	1	0	0	1	0	91.100MHz
1	1	1	1	0	1	0	0	1	0	91.150MHz
0	0	0	0	1	1	0	0	1	0	91.200MHz
1	0	0	0	1	1	0	0	1	0	91.250MHz
0	1	0	0	1	1	0	0	1	0	91.300MHz
1	1	0	0	1	1	0	0	1	0	91.350MHz
0	0	1	0	1	1	0	0	1	0	91.400MHz
1	0	1	0	1	1	0	0	1	0	91.450MHz
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1	0	0	1	1	1	0	0	1	0	91.650MHz
0	1	0	1	1	1	0	0	1	0	91.700MHz
1	1	0	1	1	1	0	0	1	0	91.750MHz
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1	0	1	1	1	1	0	0	1	0	91.850MHz
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1	1	1	1	1	1	0	0	1	0	91.950MHz
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0	1	0	0	0	0	1	0	1	0	92.100MHz
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1	0	1	1	0	0	1	0	1	0	92.650MHz
0	1	1	1	0	0	1	0	1	0	92.700MHz
1	1	1	1	0	0	1	0	1	0	92.750MHz
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1	0	0	0	1	0	1	0	1	0	92.850MHz
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1	1	0	0	1	0	1	0	1	0	92.950MHz
0	0	1	0	1	0	1	0	1	0	93.000MHz
1	0	1	0	1	0	1	0	1	0	93.050MHz
0	1	1	0	1	0	1	0	1	0	93.100MHz

1	1	1	0	1	0	1	0	1	0	93.150MHz
0	0	0	1	1	0	1	0	1	0	93.200MHz
1	0	0	1	1	0	1	0	1	0	93.250MHz
0	1	0	1	1	0	1	0	1	0	93.300MHz
1	1	0	1	1	0	1	0	1	0	93.350MHz
0	0	1	1	1	0	1	0	1	0	93.400MHz
1	0	1	1	1	0	1	0	1	0	93.450MHz
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1	0	0	0	0	1	1	0	1	0	93.650MHz
0	1	0	0	0	1	1	0	1	0	93.700MHz
1	1	0	0	0	1	1	0	1	0	93.750MHz
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1	0	1	0	0	1	1	0	1	0	93.850MHz
0	1	1	0	0	1	1	0	1	0	93.900MHz
1	1	1	0	0	1	1	0	1	0	93.950MHz
0	0	0	1	0	1	1	0	1	0	94.000MHz
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0	1	0	1	0	1	1	0	1	0	94.100MHz
1	1	0	1	0	1	1	0	1	0	94.150MHz
0	0	1	1	0	1	1	0	1	0	94.200MHz
1	0	1	1	0	1	1	0	1	0	94.250MHz
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1	1	1	1	0	1	1	0	1	0	94.350MHz
0	0	0	0	1	1	1	0	1	0	94.400MHz
1	0	0	0	1	1	1	0	1	0	94.450MHz
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1	1	0	0	1	1	1	0	1	0	94.550MHz
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1	0	1	0	1	1	1	0	1	0	94.650MHz
0	1	1	0	1	1	1	0	1	0	94.700MHz
1	1	1	0	1	1	1	0	1	0	94.750MHz
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1	0	0	1	1	1	1	0	1	0	94.850MHz
0	1	0	1	1	1	1	0	1	0	94.900MHz
1	1	0	1	1	1	1	0	1	0	94.950MHz
0	0	1	1	1	1	1	0	1	0	95.000MHz
1	0	1	1	1	1	1	0	1	0	95.050MHz
0	1	1	1	1	1	1	0	1	0	95.100MHz
1	1	1	1	1	1	1	0	1	0	95.150MHz
0	0	0	0	0	0	0	1	1	0	95.200MHz
1	0	0	0	0	0	0	1	1	0	95.250MHz
0	1	0	0	0	0	0	1	1	0	95.300MHz
1	1	0	0	0	0	0	1	1	0	95.350MHz
0	0	1	0	0	0	0	1	1	0	95.400MHz
1	0	1	0	0	0	0	1	1	0	95.450MHz
0	1	1	0	0	0	0	1	1	0	95.500MHz
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0	0	0	1	0	0	0	1	1	0	95.600MHz
1	0	0	1	0	0	0	1	1	0	95.650MHz
0	1	0	1	0	0	0	1	1	0	95.700MHz
1	1	0	1	0	0	0	1	1	0	95.750MHz
0	0	1	1	0	0	0	1	1	0	95.800MHz
1	0	1	1	0	0	0	1	1	0	95.850MHz
0	1	1	1	0	0	0	1	1	0	95.900MHz
1	1	1	1	0	0	0	1	1	0	95.950MHz
0	0	0	0	1	0	0	1	1	0	96.000MHz
1	0	0	0	1	0	0	1	1	0	96.050MHz
0	1	0	0	1	0	0	1	1	0	96.100MHz
1	1	0	0	1	0	0	1	1	0	96.150MHz
0	0	1	0	1	0	0	1	1	0	96.200MHz
1	0	1	0	1	0	0	1	1	0	96.250MHz
0	1	1	0	1	0	0	1	1	0	96.300MHz
1	1	1	0	1	0	0	1	1	0	96.350MHz
0	0	0	1	1	0	0	1	1	0	96.400MHz
1	0	0	1	1	0	0	1	1	0	96.450MHz
0	1	0	1	1	0	0	1	1	0	96.500MHz
1	1	0	1	1	0	0	1	1	0	96.550MHz
0	0	1	1	1	0	0	1	1	0	96.600MHz
1	0	1	1	1	0	0	1	1	0	96.650MHz
0	1	1	1	1	0	0	1	1	0	96.700MHz
1	1	1	1	1	0	0	1	1	0	96.750MHz

0	0	0	0	0	1	0	1	1	0	96.800MHz
1	0	0	0	0	1	0	1	1	0	96.850MHz
0	1	0	0	0	1	0	1	1	0	96.900MHz
1	1	0	0	0	1	0	1	1	0	96.950MHz
0	0	1	0	0	1	0	1	1	0	97.000MHz
1	0	1	0	0	1	0	1	1	0	97.050MHz
0	1	1	0	0	1	0	1	1	0	97.100MHz
1	1	1	0	0	1	0	1	1	0	97.150MHz
0	0	0	1	0	1	0	1	1	0	97.200MHz
1	0	0	1	0	1	0	1	1	0	97.250MHz
0	1	0	1	0	1	0	1	1	0	97.300MHz
1	1	0	1	0	1	0	1	1	0	97.350MHz
0	0	1	1	0	1	0	1	1	0	97.400MHz
1	0	1	1	0	1	0	1	1	0	97.450MHz
0	1	1	1	0	1	0	1	1	0	97.500MHz
1	1	1	1	0	1	0	1	1	0	97.550MHz
0	0	0	0	1	1	0	1	1	0	97.600MHz
1	0	0	0	1	1	0	1	1	0	97.650MHz
0	1	0	0	1	1	0	1	1	0	97.700MHz
1	1	0	0	1	1	0	1	1	0	97.750MHz
0	0	1	0	1	1	0	1	1	0	97.800MHz
1	0	1	0	1	1	0	1	1	0	97.850MHz
0	1	1	0	1	1	0	1	1	0	97.900MHz
1	1	1	0	1	1	0	1	1	0	97.950MHz
0	0	0	1	1	1	0	1	1	0	98.000MHz
1	0	0	1	1	1	0	1	1	0	98.050MHz
0	1	0	1	1	1	0	1	1	0	98.100MHz
1	1	0	1	1	1	0	1	1	0	98.150MHz
0	0	1	1	1	1	0	1	1	0	98.200MHz
1	0	1	1	1	1	0	1	1	0	98.250MHz
0	1	1	1	1	1	0	1	1	0	98.300MHz
1	1	1	1	1	1	0	1	1	0	98.350MHz
0	0	0	0	0	0	1	1	1	0	98.400MHz
1	0	0	0	0	0	1	1	1	0	98.450MHz
0	1	0	0	0	0	1	1	1	0	98.500MHz
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0	0	1	0	0	0	1	1	1	0	98.600MHz
1	0	1	0	0	0	1	1	1	0	98.650MHz
0	1	1	0	0	0	1	1	1	0	98.700MHz
1	1	1	0	0	0	1	1	1	0	98.750MHz
0	0	0	1	0	0	1	1	1	0	98.800MHz
1	0	0	1	0	0	1	1	1	0	98.850MHz
0	1	0	1	0	0	1	1	1	0	98.900MHz
1	1	0	1	0	0	1	1	1	0	98.950MHz
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0	1	1	1	0	0	1	1	1	0	99.100MHz
1	1	1	1	0	0	1	1	1	0	99.150MHz
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1	0	0	0	1	0	1	1	1	0	99.250MHz
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1	0	0	1	1	0	1	1	1	0	99.650MHz
0	1	0	1	1	0	1	1	1	0	99.700MHz
1	1	0	1	1	0	1	1	1	0	99.750MHz
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1	0	1	1	1	0	1	1	1	0	99.850MHz
0	1	1	1	1	0	1	1	1	0	99.900MHz
1	1	1	1	1	0	1	1	1	0	99.950MHz
0	0	0	0	0	1	1	1	1	0	100.000MHz
1	0	0	0	0	1	1	1	1	0	100.050MHz
0	1	0	0	0	1	1	1	1	0	100.100MHz
1	1	0	0	0	1	1	1	1	0	100.150MHz
0	0	1	0	0	1	1	1	1	0	100.200MHz
1	0	1	0	0	1	1	1	1	0	100.250MHz
0	1	1	0	0	1	1	1	1	0	100.300MHz
1	1	1	0	0	1	1	1	1	0	100.350MHz
0	0	0	1	0	1	1	1	1	0	100.400MHz

1	0	0	1	0	1	1	1	1	0	100.450MHz
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1	0	1	1	0	1	1	1	1	0	100.650MHz
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1	1	1	1	0	1	1	1	1	0	100.750MHz
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1	0	0	0	1	1	1	1	1	0	100.850MHz
0	1	0	0	1	1	1	1	1	0	100.900MHz
1	1	0	0	1	1	1	1	1	0	100.950MHz
0	0	1	0	1	1	1	1	1	0	101.000MHz
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0	1	1	0	1	1	1	1	1	0	101.100MHz
1	1	1	0	1	1	1	1	1	0	101.150MHz
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1	1	1	0	0	0	0	0	0	1	101.950MHz
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1	0	0	1	1	0	0	0	0	1	102.850MHz
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1	1	0	1	1	0	0	0	0	1	102.950MHz
0	0	1	1	1	0	0	0	0	1	103.000MHz
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1	1	1	1	1	0	0	0	0	1	103.150MHz
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1	0	1	1	0	1	0	0	0	1	103.850MHz
0	1	1	1	0	1	0	0	0	1	103.900MHz
1	1	1	1	0	1	0	0	0	1	103.950MHz
0	0	0	0	1	1	0	0	0	1	104.000MHz
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0	1	0	0	1	1	0	0	0	1	104.100MHz
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1	1	1	0	1	1	0	0	0	1	104.350MHz
0	0	0	1	1	1	0	0	0	1	104.400MHz
1	0	0	1	1	1	0	0	0	1	104.450MHz
0	1	0	1	1	1	0	0	0	1	104.500MHz
1	1	0	1	1	1	0	0	0	1	104.550MHz
0	0	1	1	1	1	0	0	0	1	104.600MHz
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0	1	1	1	1	1	0	0	0	1	104.700MHz
1	1	1	1	1	1	0	0	0	1	104.750MHz
0	0	0	0	0	0	1	0	0	1	104.800MHz
1	0	0	0	0	0	1	0	0	1	104.850MHz
0	1	0	0	0	0	1	0	0	1	104.900MHz
1	1	0	0	0	0	1	0	0	1	104.950MHz
0	0	1	0	0	0	1	0	0	1	105.000MHz
1	0	1	0	0	0	1	0	0	1	105.050MHz
0	1	1	0	0	0	1	0	0	1	105.100MHz
1	1	1	0	0	0	1	0	0	1	105.150MHz
0	0	0	1	0	0	1	0	0	1	105.200MHz
1	0	0	1	0	0	1	0	0	1	105.250MHz
0	1	0	1	0	0	1	0	0	1	105.300MHz
1	1	0	1	0	0	1	0	0	1	105.350MHz
0	0	1	1	0	0	1	0	0	1	105.400MHz
1	0	1	1	0	0	1	0	0	1	105.450MHz
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1	1	1	1	0	0	1	0	0	1	105.550MHz
0	0	0	0	1	0	1	0	0	1	105.600MHz
1	0	0	0	1	0	1	0	0	1	105.650MHz
0	1	0	0	1	0	1	0	0	1	105.700MHz
1	1	0	0	1	0	1	0	0	1	105.750MHz
0	0	1	0	1	0	1	0	0	1	105.800MHz
1	0	1	0	1	0	1	0	0	1	105.850MHz
0	1	1	0	1	0	1	0	0	1	105.900MHz
1	1	1	0	1	0	1	0	0	1	105.950MHz
0	0	0	1	1	0	1	0	0	1	106.000MHz
1	0	0	1	1	0	1	0	0	1	106.050MHz
0	1	0	1	1	0	1	0	0	1	106.100MHz
1	1	0	1	1	0	1	0	0	1	106.150MHz
0	0	1	1	1	0	1	0	0	1	106.200MHz
1	0	1	1	1	0	1	0	0	1	106.250MHz
0	1	1	1	1	0	1	0	0	1	106.300MHz
1	1	1	1	1	0	1	0	0	1	106.350MHz
0	0	0	0	0	1	1	0	0	1	106.400MHz
1	0	0	0	0	1	1	0	0	1	106.450MHz
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1	1	0	0	0	1	1	0	0	1	106.550MHz
0	0	1	0	0	1	1	0	0	1	106.600MHz
1	0	1	0	0	1	1	0	0	1	106.650MHz
0	1	1	0	0	1	1	0	0	1	106.700MHz
1	1	1	0	0	1	1	0	0	1	106.750MHz
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1	0	0	1	0	1	1	0	0	1	106.850MHz
0	1	0	1	0	1	1	0	0	1	106.900MHz
1	1	0	1	0	1	1	0	0	1	106.950MHz
0	0	1	1	0	1	1	0	0	1	107.000MHz
1	0	1	1	0	1	1	0	0	1	107.050MHz
0	1	1	1	0	1	1	0	0	1	107.100MHz
1	1	1	1	0	1	1	0	0	1	107.150MHz
0	0	0	0	1	1	1	0	0	1	107.200MHz
1	0	0	0	1	1	1	0	0	1	107.250MHz
0	1	0	0	1	1	1	0	0	1	107.300MHz
1	1	0	0	1	1	1	0	0	1	107.350MHz
0	0	1	0	1	1	1	0	0	1	107.400MHz
1	0	1	0	1	1	1	0	0	1	107.450MHz
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1	1	1	0	1	1	1	0	0	1	107.550MHz
0	0	0	1	1	1	1	0	0	1	107.600MHz
1	0	0	1	1	1	1	0	0	1	107.650MHz
0	1	0	1	1	1	1	0	0	1	107.700MHz

1	1	0	1	1	1	1	0	0	1	107.750MHz
0	0	1	1	1	1	1	0	0	1	107.800MHz
1	0	1	1	1	1	1	0	0	1	107.850MHz
0	1	1	1	1	1	1	0	0	1	107.900MHz
1	1	1	1	1	1	1	0	0	1	107.950MHz
0	0	0	0	0	0	0	1	0	1	108.000MHz
1	0	0	0	0	0	0	1	0	1	40.000MHz*
0	1	0	0	0	0	0	1	0	1	40.050MHz*
1	1	0	0	0	0	0	1	0	1	40.100MHz*
0	0	1	0	0	0	0	1	0	1	40.150MHz*
1	0	1	0	0	0	0	1	0	1	40.200MHz*
0	1	1	0	0	0	0	1	0	1	40.250MHz*
1	1	1	0	0	0	0	1	0	1	40.300MHz*
0	0	0	1	0	0	0	1	0	1	40.350MHz*
1	0	0	1	0	0	0	1	0	1	40.400MHz*
0	1	0	1	0	0	0	1	0	1	40.450MHz*
1	1	0	1	0	0	0	1	0	1	40.500MHz*
0	0	1	1	0	0	0	1	0	1	40.550MHz*
1	0	1	1	0	0	0	1	0	1	40.600MHz*
0	1	1	1	0	0	0	1	0	1	40.650MHz*
1	1	1	1	0	0	0	1	0	1	40.700MHz*
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1	0	0	0	1	0	0	1	0	1	40.800MHz*
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1	1	0	0	1	0	0	1	0	1	40.900MHz*
0	0	1	0	1	0	0	1	0	1	40.950MHz*
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1	1	1	0	1	0	0	1	0	1	41.100MHz*
0	0	0	1	1	0	0	1	0	1	41.150MHz*
1	0	0	1	1	0	0	1	0	1	41.200MHz*
0	1	0	1	1	0	0	1	0	1	41.250MHz*
1	1	0	1	1	0	0	1	0	1	41.300MHz*
0	0	1	1	1	0	0	1	0	1	41.350MHz*
1	0	1	1	1	0	0	1	0	1	41.400MHz*
0	1	1	1	1	0	0	1	0	1	41.450MHz*
1	1	1	1	1	0	0	1	0	1	41.500MHz*
0	0	0	0	0	1	0	1	0	1	41.550MHz*
1	0	0	0	0	1	0	1	0	1	41.600MHz*
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1	1	0	0	0	1	0	1	0	1	41.700MHz*
0	0	1	0	0	1	0	1	0	1	41.750MHz*
1	0	1	0	0	1	0	1	0	1	41.800MHz*
0	1	1	0	0	1	0	1	0	1	41.850MHz*
1	1	1	0	0	1	0	1	0	1	41.900MHz*
0	0	0	1	0	1	0	1	0	1	41.950MHz*
1	0	0	1	0	1	0	1	0	1	42.000MHz*
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1	1	1	1	0	1	0	1	0	1	42.300MHz*
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1	0	0	0	1	1	0	1	0	1	42.400MHz*
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1	1	0	0	1	1	0	1	0	1	42.500MHz*
0	0	1	0	1	1	0	1	0	1	42.550MHz*
1	0	1	0	1	1	0	1	0	1	42.600MHz*
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1	1	1	0	1	1	0	1	0	1	42.700MHz*
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1	0	0	1	1	1	0	1	0	1	42.800MHz*
0	1	0	1	1	1	0	1	0	1	4.850MHz*
1	1	0	1	1	1	0	1	0	1	42.900MHz*
0	0	1	1	1	1	0	1	0	1	42.950MHz*
1	0	1	1	1	1	0	1	0	1	43.000MHz*
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1	1	1	1	1	1	0	1	0	1	43.100MHz*
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1	0	0	0	0	0	1	1	0	1	43.200MHz*
0	1	0	0	0	0	1	1	0	1	43.250MHz*
1	1	0	0	0	0	1	1	0	1	43.300MHz*

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0	1	1	0	0	0	1	1	0	1	43.450MHz*
1	1	1	0	0	0	1	1	0	1	43.500MHz*
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1	0	0	1	0	0	1	1	0	1	43.600MHz*
0	1	0	1	0	0	1	1	0	1	43.650MHz*
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0	0	1	1	0	0	1	1	0	1	43.750MHz*
1	0	1	1	0	0	1	1	0	1	43.800MHz*
0	1	1	1	0	0	1	1	0	1	43.850MHz*
1	1	1	1	0	0	1	1	0	1	43.900MHz*
0	0	0	0	1	0	1	1	0	1	43.950MHz*
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1	1	1	0	1	0	1	1	0	1	44.300MHz*
0	0	0	1	1	0	1	1	0	1	44.350MHz*
1	0	0	1	1	0	1	1	0	1	44.400MHz*
0	1	0	1	1	0	1	1	0	1	44.450MHz*
1	1	0	1	1	0	1	1	0	1	44.500MHz*
0	0	1	1	1	0	1	1	0	1	44.550MHz*
1	0	1	1	1	0	1	1	0	1	44.600MHz*
0	1	1	1	1	0	1	1	0	1	44.650MHz*
1	1	1	1	1	0	1	1	0	1	44.700MHz*
0	0	0	0	0	1	1	1	0	1	44.750MHz*
1	0	0	0	0	1	1	1	0	1	44.800MHz*
0	1	0	0	0	1	1	1	0	1	44.850MHz*
1	1	0	0	0	1	1	1	0	1	44.900MHz*
0	0	1	0	0	1	1	1	0	1	44.950MHz*
1	0	1	0	0	1	1	1	0	1	45.000MHz*
0	1	1	0	0	1	1	1	0	1	45.050MHz*
1	1	1	0	0	1	1	1	0	1	45.100MHz*
0	0	0	1	0	1	1	1	0	1	45.150MHz*
1	0	0	1	0	1	1	1	0	1	45.200MHz*
0	1	0	1	0	1	1	1	0	1	45.250MHz*
1	1	0	1	0	1	1	1	0	1	45.300MHz*
0	0	1	1	0	1	1	1	0	1	45.350MHz*
1	0	1	1	0	1	1	1	0	1	45.400MHz*
0	1	1	1	0	1	1	1	0	1	45.450MHz*
1	1	1	1	0	1	1	1	0	1	45.500MHz*
0	0	0	0	1	1	1	1	0	1	45.550MHz*
1	0	0	0	1	1	1	1	0	1	45.600MHz*
0	1	0	0	1	1	1	1	0	1	45.650MHz*
1	1	0	0	1	1	1	1	0	1	45.700MHz*
0	0	1	0	1	1	1	1	0	1	45.750MHz*
1	0	1	0	1	1	1	1	0	1	45.800MHz*
0	1	1	0	1	1	1	1	0	1	45.850MHz*
1	1	1	0	1	1	1	1	0	1	45.900MHz*
0	0	0	1	1	1	1	1	0	1	45.950MHz*
1	0	0	1	1	1	1	1	0	1	46.000MHz*
0	1	0	1	1	1	1	1	0	1	46.050MHz*
1	1	0	1	1	1	1	1	0	1	46.100MHz*
0	0	1	1	1	1	1	1	0	1	46.150MHz*
1	0	1	1	1	1	1	1	0	1	46.200MHz*
0	1	1	1	1	1	1	1	0	1	46.250MHz*
1	1	1	1	1	1	1	1	0	1	46.300MHz*
0	0	0	0	0	0	0	0	1	1	46.350MHz*
1	0	0	0	0	0	0	0	1	1	46.400MHz*
0	1	0	0	0	0	0	0	1	1	46.450MHz*
1	1	0	0	0	0	0	0	1	1	46.500MHz*
0	0	1	0	0	0	0	0	1	1	46.550MHz*
1	0	1	0	0	0	0	0	1	1	46.600MHz*
0	1	1	0	0	0	0	0	1	1	46.650MHz*
1	1	1	0	0	0	0	0	1	1	46.700MHz*
0	0	0	1	0	0	0	0	1	1	46.750MHz*
1	0	0	1	0	0	0	0	1	1	46.800MHz*
0	1	0	1	0	0	0	0	1	1	46.850MHz*
1	1	0	1	0	0	0	0	1	1	46.900MHz*
0	0	1	1	0	0	0	0	1	1	46.950MHz*

1	0	1	1	0	0	0	0	1	1	47.000MHz*
0	1	1	1	0	0	0	0	1	1	47.050MHz*
1	1	1	1	0	0	0	0	1	1	47.100MHz*
0	0	0	0	1	0	0	0	1	1	47.150MHz*
1	0	0	0	1	0	0	0	1	1	47.200MHz*
0	1	0	0	1	0	0	0	1	1	47.250MHz*
1	1	0	0	1	0	0	0	1	1	47.300MHz*
0	0	1	0	1	0	0	0	1	1	47.350MHz*
1	0	1	0	1	0	0	0	1	1	47.400MHz*
0	1	1	0	1	0	0	0	1	1	47.450MHz*
1	1	1	0	1	0	0	0	1	1	47.500MHz*
0	0	0	1	1	0	0	0	1	1	47.550MHz*
1	0	0	1	1	0	0	0	1	1	47.600MHz*
0	1	0	1	1	0	0	0	1	1	47.650MHz*
1	1	0	1	1	0	0	0	1	1	47.700MHz*
0	0	1	1	1	0	0	0	1	1	47.750MHz*
1	0	1	1	1	0	0	0	1	1	47.800MHz*
0	1	1	1	1	0	0	0	1	1	47.850MHz*
1	1	1	1	1	0	0	0	1	1	47.900MHz*
0	0	0	0	0	1	0	0	1	1	47.950MHz*
1	0	0	0	0	1	0	0	1	1	48.000MHz*
0	1	0	0	0	1	0	0	1	1	48.050MHz*
1	1	0	0	0	1	0	0	1	1	48.100MHz*
0	0	1	0	0	1	0	0	1	1	48.150MHz*
1	0	1	0	0	1	0	0	1	1	48.200MHz*
0	1	1	0	0	1	0	0	1	1	48.250MHz*
1	1	1	0	0	1	0	0	1	1	48.300MHz*
0	0	0	1	0	1	0	0	1	1	48.350MHz*
1	0	0	1	0	1	0	0	1	1	48.400MHz*
0	1	0	1	0	1	0	0	1	1	48.450MHz*
1	1	0	1	0	1	0	0	1	1	48.500MHz*
0	0	1	1	0	1	0	0	1	1	48.550MHz*
1	0	1	1	0	1	0	0	1	1	48.600MHz*
0	1	1	1	0	1	0	0	1	1	48.650MHz*
1	1	1	1	0	1	0	0	1	1	48.700MHz*
0	0	0	0	1	1	0	0	1	1	48.750MHz*
1	0	0	0	1	1	0	0	1	1	48.800MHz*
0	1	0	0	1	1	0	0	1	1	48.850MHz*
1	1	0	0	1	1	0	0	1	1	48.900MHz*
0	0	1	0	1	1	0	0	1	1	48.950MHz*
1	0	1	0	1	1	0	0	1	1	49.000MHz*
0	1	1	0	1	1	0	0	1	1	49.050MHz*
1	1	1	0	1	1	0	0	1	1	49.100MHz*
0	0	0	1	1	1	0	0	1	1	49.150MHz*
1	0	0	1	1	1	0	0	1	1	49.200MHz*
0	1	0	1	1	1	0	0	1	1	49.250MHz*
1	1	0	1	1	1	0	0	1	1	49.300MHz*
0	0	1	1	1	1	0	0	1	1	49.350MHz*
1	0	1	1	1	1	0	0	1	1	49.400MHz*
0	1	1	1	1	1	0	0	1	1	49.450MHz*
1	1	1	1	1	1	0	0	1	1	49.500MHz*
0	0	0	0	0	0	1	0	1	1	49.550MHz*
1	0	0	0	0	0	1	0	1	1	49.600MHz*
0	1	0	0	0	0	1	0	1	1	49.650MHz*
1	1	0	0	0	0	1	0	1	1	49.700MHz*
0	0	1	0	0	0	1	0	1	1	49.750MHz*
1	0	1	0	0	0	1	0	1	1	49.800MHz*
0	1	1	0	0	0	1	0	1	1	49.850MHz*
1	1	1	0	0	0	1	0	1	1	49.900MHz*
0	0	0	1	0	0	1	0	1	1	49.950MHz*
1	0	0	1	0	0	1	0	1	1	50.000MHz*
0	1	0	1	0	0	1	0	1	1	50.050MHz*
1	1	0	1	0	0	1	0	1	1	50.100MHz*
0	0	1	1	0	0	1	0	1	1	50.150MHz*
1	0	1	1	0	0	1	0	1	1	50.200MHz*
0	1	1	1	0	0	1	0	1	1	50.250MHz*
1	1	1	1	0	0	1	0	1	1	50.300MHz*
0	0	0	0	1	0	1	0	1	1	50.350MHz*
1	0	0	0	1	0	1	0	1	1	50.400MHz*
0	1	0	0	1	0	1	0	1	1	50.450MHz*
1	1	0	0	1	0	1	0	1	1	50.500MHz*
0	0	1	0	1	0	1	0	1	1	50.550MHz*
1	0	1	0	1	0	1	0	1	1	50.600MHz*

0	1	1	0	1	0	1	0	1	1	50.650MHz*
1	1	1	0	1	0	1	0	1	1	50.700MHz*
0	0	0	1	1	0	1	0	1	1	50.750MHz*
1	0	0	1	1	0	1	0	1	1	50.800MHz*
0	1	0	1	1	0	1	0	1	1	50.850MHz*
1	1	0	1	1	0	1	0	1	1	50.900MHz*
0	0	1	1	1	0	1	0	1	1	50.950MHz*
1	0	1	1	1	0	1	0	1	1	51.000MHz*
0	1	1	1	1	0	1	0	1	1	51.050MHz*
1	1	1	1	1	0	1	0	1	1	51.100MHz*
0	0	0	0	0	1	1	0	1	1	51.150MHz*
1	0	0	0	0	1	1	0	1	1	51.200MHz*
0	1	0	0	0	1	1	0	1	1	51.250MHz*
1	1	0	0	0	1	1	0	1	1	51.300MHz*
0	0	1	0	0	1	1	0	1	1	51.350MHz*
1	0	1	0	0	1	1	0	1	1	51.400MHz*
0	1	1	0	0	1	1	0	1	1	51.450MHz*
1	1	1	0	0	1	1	0	1	1	51.500MHz*
0	0	0	1	0	1	1	0	1	1	51.550MHz*
1	0	0	1	0	1	1	0	1	1	51.600MHz*
0	1	0	1	0	1	1	0	1	1	51.650MHz*
1	1	0	1	0	1	1	0	1	1	51.700MHz*
0	0	1	1	0	1	1	0	1	1	51.750MHz*
1	0	1	1	0	1	1	0	1	1	51.800MHz*
0	1	1	1	0	1	1	0	1	1	51.850MHz*
1	1	1	1	0	1	1	0	1	1	51.900MHz*
0	0	0	0	1	1	1	0	1	1	51.950MHz*
1	0	0	0	1	1	1	0	1	1	52.000MHz*
0	1	0	0	1	1	1	0	1	1	52.050MHz*
1	1	0	0	1	1	1	0	1	1	52.100MHz*
0	0	1	0	1	1	1	0	1	1	52.150MHz*
1	0	1	0	1	1	1	0	1	1	52.200MHz*
0	1	1	0	1	1	1	0	1	1	52.250MHz*
1	1	1	0	1	1	1	0	1	1	52.300MHz*
0	0	0	1	1	1	1	0	1	1	52.350MHz*
1	0	0	1	1	1	1	0	1	1	52.400MHz*
0	1	0	1	1	1	1	0	1	1	52.450MHz*
1	1	0	1	1	1	1	0	1	1	52.500MHz*
0	0	1	1	1	1	1	0	1	1	52.550MHz*
1	0	1	1	1	1	1	0	1	1	52.600MHz*
0	1	1	1	1	1	1	0	1	1	52.650MHz*
1	1	1	1	1	1	1	0	1	1	52.700MHz*
0	0	0	0	0	0	0	1	1	1	52.750MHz*
1	0	0	0	0	0	0	1	1	1	52.800MHz*
0	1	0	0	0	0	0	1	1	1	52.850MHz*
1	1	0	0	0	0	0	1	1	1	52.900MHz*
0	0	1	0	0	0	0	1	1	1	52.950MHz*
1	0	1	0	0	0	0	1	1	1	53.000MHz*
0	1	1	0	0	0	0	1	1	1	53.050MHz*
1	1	1	0	0	0	0	1	1	1	53.100MHz*
0	0	0	1	0	0	0	1	1	1	53.150MHz*
1	0	0	1	0	0	0	1	1	1	53.200MHz*
0	1	0	1	0	0	0	1	1	1	53.250MHz*
1	1	0	1	0	0	0	1	1	1	53.300MHz*
0	0	1	1	0	0	0	1	1	1	53.350MHz*
1	0	1	1	0	0	0	1	1	1	53.400MHz*
0	1	1	1	0	0	0	1	1	1	53.450MHz*
1	1	1	1	0	0	0	1	1	1	53.500MHz*
0	0	0	0	1	0	0	1	1	1	53.550MHz*
1	0	0	0	1	0	0	1	1	1	53.600MHz*
0	1	0	0	1	0	0	1	1	1	53.650MHz*
1	1	0	0	1	0	0	1	1	1	53.700MHz*
0	0	1	0	1	0	0	1	1	1	53.750MHz*
1	0	1	0	1	0	0	1	1	1	53.800MHz*
0	1	1	0	1	0	0	1	1	1	53.850MHz*
1	1	1	0	1	0	0	1	1	1	53.900MHz*
0	0	0	1	1	0	0	1	1	1	53.950MHz*
1	0	0	1	1	0	0	1	1	1	54.000MHz*
0	1	0	1	1	0	0	1	1	1	54.050MHz*
1	1	0	1	1	0	0	1	1	1	54.100MHz*
0	0	1	1	1	0	0	1	1	1	54.150MHz*
1	0	1	1	1	0	0	1	1	1	54.200MHz*
0	1	1	1	1	0	0	1	1	1	54.250MHz*

1	1	1	1	1	0	0	1	1	1	54.300MHz*
0	0	0	0	0	1	0	1	1	1	54.350MHz*
1	0	0	0	0	1	0	1	1	1	54.400MHz*
0	1	0	0	0	1	0	1	1	1	54.450MHz*
1	1	0	0	0	1	0	1	1	1	54.500MHz*
0	0	1	0	0	1	0	1	1	1	54.550MHz*
1	0	1	0	0	1	0	1	1	1	54.600MHz*
0	1	1	0	0	1	0	1	1	1	54.650MHz*
1	1	1	0	0	1	0	1	1	1	54.700MHz*
0	0	0	1	0	1	0	1	1	1	54.750MHz*
1	0	0	1	0	1	0	1	1	1	54.800MHz*
0	1	0	1	0	1	0	1	1	1	54.850MHz*
1	1	0	1	0	1	0	1	1	1	54.900MHz*
0	0	1	1	0	1	0	1	1	1	54.950MHz*
1	0	1	1	0	1	0	1	1	1	55.000MHz*
0	1	1	1	0	1	0	1	1	1	55.050MHz*
1	1	1	1	0	1	0	1	1	1	55.100MHz*
0	0	0	0	1	1	0	1	1	1	55.150MHz*
1	0	0	0	1	1	0	1	1	1	55.200MHz*
0	1	0	0	1	1	0	1	1	1	55.250MHz*
1	1	0	0	1	1	0	1	1	1	55.300MHz*
0	0	1	0	1	1	0	1	1	1	55.350MHz*
1	0	1	0	1	1	0	1	1	1	55.400MHz*
0	1	1	0	1	1	0	1	1	1	55.450MHz*
1	1	1	0	1	1	0	1	1	1	55.500MHz*
0	0	0	1	1	1	0	1	1	1	55.550MHz*
1	0	0	1	1	1	0	1	1	1	55.600MHz*
0	1	0	1	1	1	0	1	1	1	55.650MHz*
1	1	0	1	1	1	0	1	1	1	55.700MHz*
0	0	1	1	1	1	0	1	1	1	55.750MHz*
1	0	1	1	1	1	0	1	1	1	55.800MHz*
0	1	1	1	1	1	0	1	1	1	55.850MHz*
1	1	1	1	1	1	0	1	1	1	55.900MHz*
0	0	0	0	0	0	1	1	1	1	55.950MHz*
1	0	0	0	0	0	1	1	1	1	56.000MHz*
0	1	0	0	0	0	1	1	1	1	56.050MHz*
1	1	0	0	0	0	1	1	1	1	56.100MHz*
0	0	1	0	0	0	1	1	1	1	56.150MHz*
1	0	1	0	0	0	1	1	1	1	56.200MHz*
0	1	1	0	0	0	1	1	1	1	56.250MHz*
1	1	1	0	0	0	1	1	1	1	56.300MHz*
0	0	0	1	0	0	1	1	1	1	56.350MHz*
1	0	0	1	0	0	1	1	1	1	56.400MHz*
0	1	0	1	0	0	1	1	1	1	56.450MHz*
1	1	0	1	0	0	1	1	1	1	56.500MHz*
0	0	1	1	0	0	1	1	1	1	56.550MHz*
1	0	1	1	0	0	1	1	1	1	56.600MHz*
0	1	1	1	0	0	1	1	1	1	56.650MHz*
1	1	1	1	0	0	1	1	1	1	56.700MHz*
0	0	0	0	1	0	1	1	1	1	56.750MHz*
1	0	0	0	1	0	1	1	1	1	56.800MHz*
0	1	0	0	1	0	1	1	1	1	56.850MHz*
1	1	0	0	1	0	1	1	1	1	56.900MHz*
0	0	1	0	1	0	1	1	1	1	56.950MHz*
1	0	1	0	1	0	1	1	1	1	57.000MHz*
0	1	1	0	1	0	1	1	1	1	57.050MHz*
1	1	1	0	1	0	1	1	1	1	57.100MHz*
0	0	0	1	1	0	1	1	1	1	57.150MHz*
1	0	0	1	1	0	1	1	1	1	57.200MHz*
0	1	0	1	1	0	1	1	1	1	57.250MHz*
1	1	0	1	1	0	1	1	1	1	57.300MHz*
0	0	1	1	1	0	1	1	1	1	57.350MHz*
1	0	1	1	1	0	1	1	1	1	57.400MHz*
0	1	1	1	1	0	1	1	1	1	57.450MHz*
1	1	1	1	1	0	1	1	1	1	57.500MHz*
0	0	0	0	0	1	1	1	1	1	57.550MHz*
1	0	0	0	0	1	1	1	1	1	57.600MHz*
0	1	0	0	0	1	1	1	1	1	57.650MHz*
1	1	0	0	0	1	1	1	1	1	57.700MHz*
0	0	1	0	0	1	1	1	1	1	57.750MHz*
1	0	1	0	0	1	1	1	1	1	57.800MHz*
0	1	1	0	0	1	1	1	1	1	57.850MHz*
1	1	1	0	0	1	1	1	1	1	57.900MHz*

0	0	0	1	0	1	1	1	1	1	57.950MHz*
1	0	0	1	0	1	1	1	1	1	58.000MHz*
0	1	0	1	0	1	1	1	1	1	58.050MHz*
1	1	0	1	0	1	1	1	1	1	58.100MHz*
0	0	1	1	0	1	1	1	1	1	58.150MHz*
1	0	1	1	0	1	1	1	1	1	58.200MHz*
0	1	1	1	0	1	1	1	1	1	58.250MHz*
1	1	1	1	0	1	1	1	1	1	58.300MHz*
0	0	0	0	1	1	1	1	1	1	58.350MHz*
1	0	0	0	1	1	1	1	1	1	58.400MHz*
0	1	0	0	1	1	1	1	1	1	58.450MHz*
1	1	0	0	1	1	1	1	1	1	58.500MHz*
0	0	1	0	1	1	1	1	1	1	58.550MHz*
1	0	1	0	1	1	1	1	1	1	58.600MHz*
0	1	1	0	1	1	1	1	1	1	58.650MHz*
1	1	1	0	1	1	1	1	1	1	58.700MHz*
0	0	0	1	1	1	1	1	1	1	58.750MHz*
1	0	0	1	1	1	1	1	1	1	58.800MHz*
0	1	0	1	1	1	1	1	1	1	58.850MHz*
1	1	0	1	1	1	1	1	1	1	58.900MHz*
0	0	1	1	1	1	1	1	1	1	58.950MHz*
1	0	1	1	1	1	1	1	1	1	59.000MHz*
0	1	1	1	1	1	1	1	1	1	59.050MHz*
1	1	1	1	1	1	1	1	1	1	59.100MHz*

(*) These frequencies are supported by PLL but output stage requires modification to produce full output power and required filtering. VCO/PLL subsystem will work well in the 40-54MHz range and 76-108MHz.
PLL/VCO coverage from 54-59MHz may require changes to the VCO LC circuit.
Using MAX PRO 3000+ outside FM band may violate local regulations!

Appendix

B

Appendix B: DIY antenna and improvement tips

Simple 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:

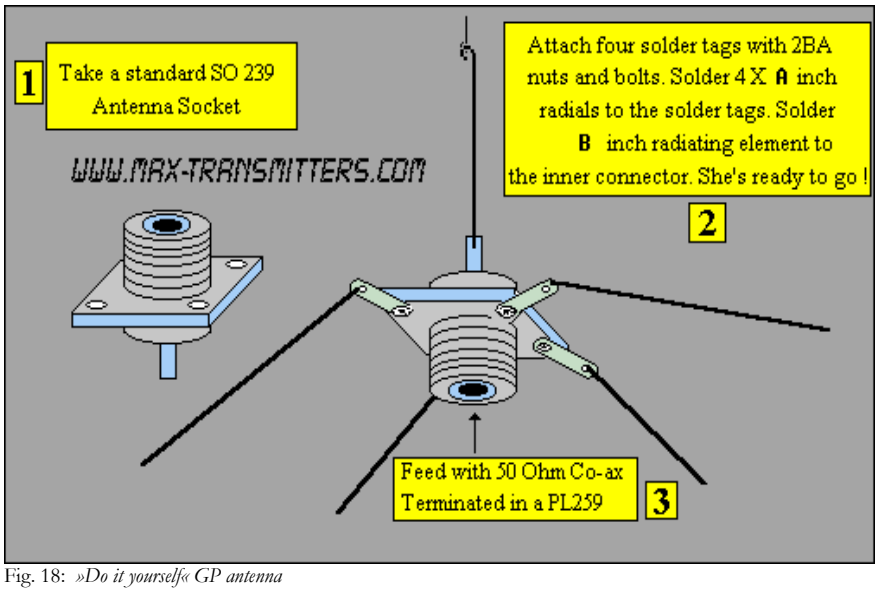

Fig. 18: *»Do it yourself« GP antenna*

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

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	660mm	693mm
104MHz	684mm	720mm
100MHz	713mm	749mm
90MHz	792mm	819mm

For other antenna designs check our web site here: http://www.pcs-electronics.com/guide_antenna.php

Some more improvement tips

Think about purchasing SWR meter to tune and align your antenna. A good antenna system is extremely important and can make up for a lot of power. For a suitable SWR meter check:

http://www.pcs-electronics.com/cn101l-daiwa-power-meter-p-347.html

If you can't get much range with your homebrew antenna, have a look at these:

http://www.pcs-electronics.com/antennas-c-38.html

Still not enough range? Well, how about a 750W amplifier?

http://www.pcs-electronics.com/750w-digital-amplifier-19inch-rack-p-1295.html

Appendix

C

Appendix C: Connecting stereo encoder

You will almost certainly want to upgrade to stereo capability at some point. Using our stereo encoders is a great idea as you can control all parameters through the same LCD unit used for FM exciter. Since the introduction of the new MaxLink interconnect system this is really easy to do, you do not have to fiddle with wires and soldering iron anymore. The MaxLink™ is a 6-wire flat cable interconnect system that is simply plugged into appropriate connector on the stereo encoder board and the other end into connector on FM exciter board. See fig. 19 below for wiring directions. You don't even have to wire a separate supply (12V) wire to the stereo encoder as the MaxLink cable delivers supply voltage as well. You still have to connect audio cable (MPX out to audio input of the FM exciter), but that is really easy to do. It is best to use shielded microphone cable.

Remember to set the following:

Set the Auto/LCD jumper (J10) on the SE5000 board to LCD (Remove it).

Remove the STEREO/MONO jumper as this is now controlled via FM exciter's LCD module. If stereo mode LED is illuminated, you are in STEREO mode.

Disable pre-emphasis in the MAX PRO 3000+ exciter board (jumper in position "None"). Pre-emphasis is now handled by stereo encoder(se5000 or other), you can set it there either to 50uS or 75uS.

Set the audio level (P1) on MAX PRO 3000+ so that the stereo indicator on the radio just turns on, than increase it slightly more (make sure you are in stereo mode when you do this alignment).

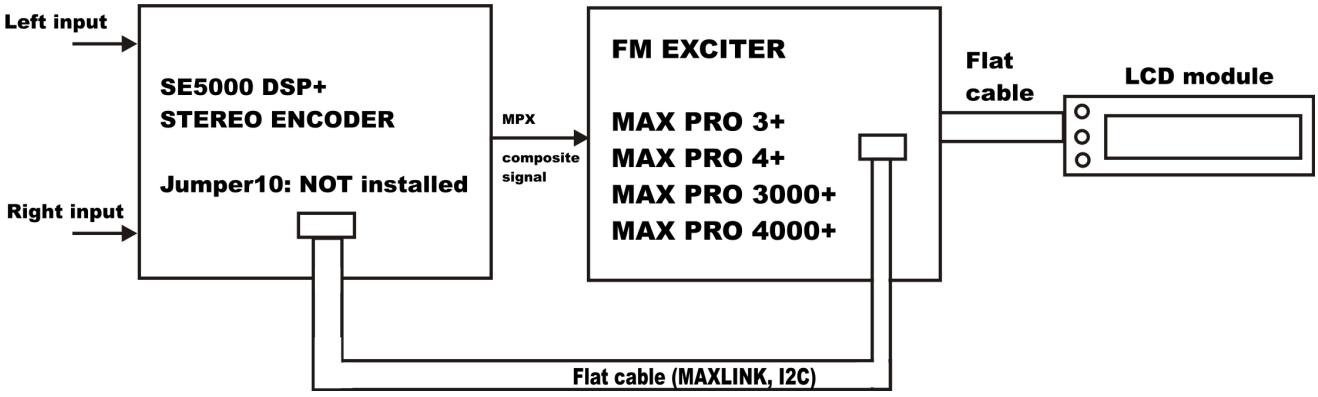

Fig. 19: Connecting stereo encoder to FM exciter.

Appendix

D

Appendix D: Connecting VUMAX-1

How about adding some flashing lights to your transmitter? It is much easier than you think. Fortunately we provided for VU meter, look for the 5-pin header (marked with N). You can connect our VU MAX I vu meter module to this header. Just be sure to orient the cable correctly. The square pin (ground) should be aligned on both sides. The remaining 3-pin header on the VU-MAX1 vu meter board can be connected to stereo encoder (SE5000 or SE3000). This way you get the 40 LEDs on the VU MAX board flash according to the power, swr and audio volume (left and right channel separately). Maxlink cable between exciter and SE3000 is not shown for simplicity. The block diagram is below:

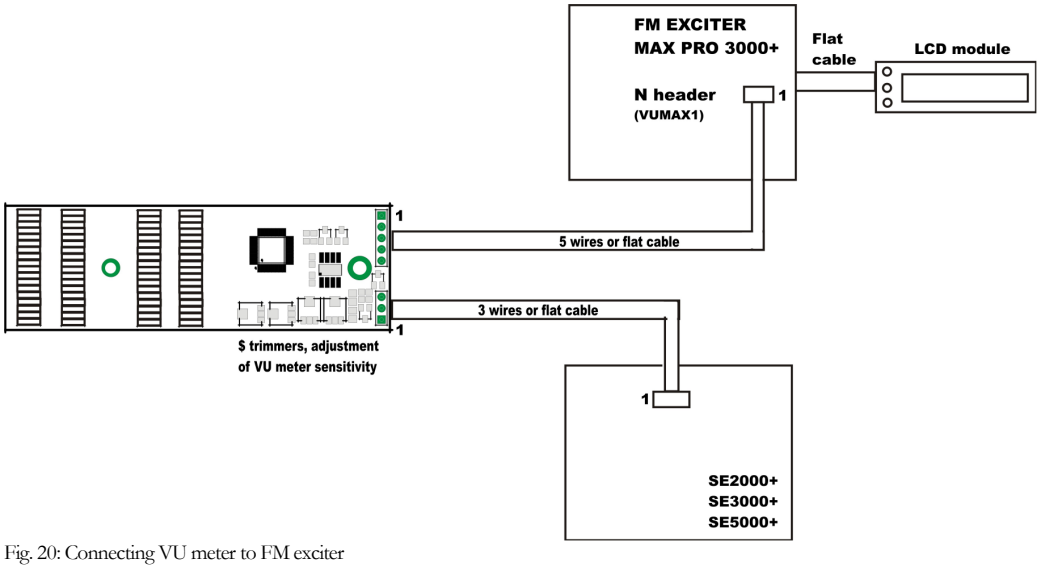

Fig. 20: Connecting VU meter to FM exciter

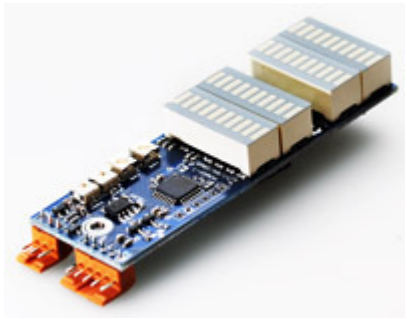

Fig. 21: VU MAX-1

Note: Sometimes (depending on case design) RF energy from transmitter interferes with VU meter operation. A typical sign of the problem would be 1-2 LEDs for audio constantly illuminated. If you experience this problem place two capacitors (100pF) on the VU MAX-1 PCB board, at the 3-pin jumper shown above. One capacitor goes from pin 2 to pin 1, the other goes from pin 3 to pin 1. This way you ground these two audio inputs for RF signal and the problem goes away.

Appendix

E

Appendix E: Adding an amplifier – complete fm transmitter block by block

Now that you've connected stereo encoder and already have nice stereo sound, it may be time to increase your power output. How about adding an external amplifier? Some of you will say, sure, but will the nice power/swr meter built into MAX PRO 3000+ know how to measure power with this amplifier added and will it show it properly on the LCD display? The good news is that we have a solution for this. Not only does the MAX PRO 3000+ have ability to read power/swr with external amplifier installed, it can also read amplifier temperature and amplifier supply voltage. To top this off, swr and temperature protection still works just like before.

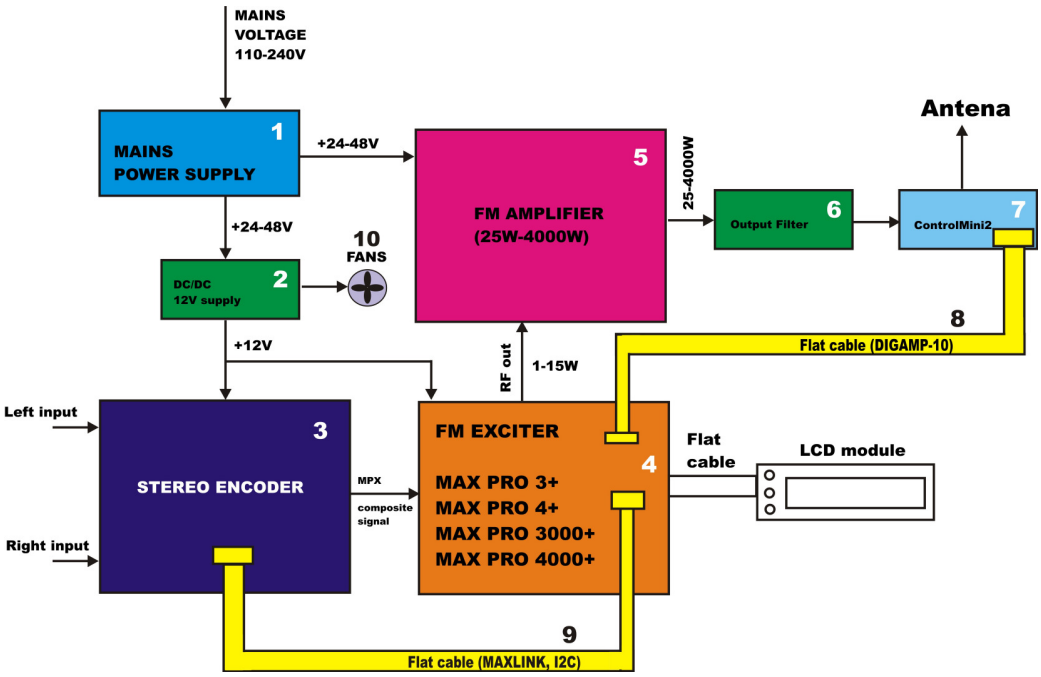

Fig. 22: Connecting an external amplifier module – Complete FM transmitter, block diagram

Diagram above explains the entire FM transmitter system, with mains power supply (1), DCDC converter (2), stereo encoder (3), FM exciter (4), FM amplifier pallet (5), output filter (6), ControlMini board (7), interconnect system (8 &9) and cooling fans. I will briefly explain each of the above subsystems:

1.) MAINS POWER SUPPLY: Provides power for the entire transmitter. Usually accepts mains voltage, from 110 to 240V, and outputs 24 or 48V DC. Exact power rating depends on the power consumption of the entire transmitter. A 300W transmitter usually consumes around 500W of power. A 1000W transmitter typically consumes around 1500W of power. An engineer should also consider safety margin and use a power supply that can provide slightly more power than needed. Voltage rating for mains power supply depends primarily on the type of amplifier used. Most pallets accept 24-28 or 48-50V. You can find all kinds of mains power supplies here at our website:

http://www.pcs-electronics.com/transmitter-accesories-mains-power-supply-c-71_74.html

2.) Stereo encoders and FM exciters typically operate from 12V DC stabilized voltage. Since at the moment we only have 24 or 48V inside our system shown in diagram above and we don't want to use another big 110-240V/12V mains power supply we are going to use own small DCDC converter. This conveniently converts any voltage from 17-50V down into 12-15V. Exact voltage can be adjusted with a trimmer. Another convenient bonus point for this tiny DC/DC converter is that it also provides power for fans (10). And you will need fans to cool the exciter, mains power supply and amplifier. Moreover, you can set temperature at which the fans start working or you can have fans work continuously.

You can find our DCDC converter with fan controller here at our website:

http://www.pcs-electronics.com/2048v-dcdc-converter-p-1549.html

3.) Stereo encoders, we covered this in detail above. You can find our stereo encoders here:

http://www.pcs-electronics.com/stereo-encoders-c-36.html

4.) Our FM exciters, at the moment MAX PRO 3000+ and MAX PRO 4025 support all the mentioned functions. Make sure to **limit the maximum output power** of the exciter in order not to damage the amplifier. The procedure is described in **Chapter 7** of this manful. By limiting the maximum output power the LCD module still works, but its adjustment range is decreased to go from 0 to 2W for example or from 0 to 4W. Another very important advice is to use an attenuator between exciter and amplifier. Amplifiers almost always have input impedance that does not match 50 ohms across the entire FM band. By using 1-3dB attenuator this can be brought closer to 50 ohms. Our attenuators are available here, but you can also construct your own from regular resistors, you can contact us for a schematic diagram:

http://www.pcs-electronics.com/mounted-attenuators-p-1105.html

BEFORE CONNECTING AMPLIFIER ALWAYS MAKE SURE THAT EXCITER OUTPUT POWER DOES NOT EXCEED MAXIMUM ALLOWABLE INPUT POWER OF THE AMPLIFIER!

LIMIT MAXIMUM OUTPUT POWER OF THE EXCITER, PROCEDURE IS DESCRIBED IN CHAPTER 7 IN THIS MANUAL!

5.) FM amplifier. This is typically a pallet amplifier such as any of these on our website, they all come with ControlMini2 included. Also make sure to include a heatsink with pallets as they require one. It is often a good idea to insert a small attenuator between exciter and amplifier.

http://www.pcs-electronics.com/amplifiers-pallet-amplifiers-c-41_109.html

You can also use any of these here, these already contain filters and heatsink so your work is easier:

http://www.pcs-electronics.com/amplifiers-complete-amplifier-modules-c-41_111.html

Amplifiers can have input impedance that does not match 50 ohms across the entire FM band. By using 1-3dB attenuator this can be brought closer to 50 ohms. Our attenuators are available here, but you can also construct your own: http://www.pcs-electronics.com/mounted-attenuators-p-1105.html

6.) Low pass filter for FM band. You can use any of these here, but make sure they are strong enough to handle the power level of the amplifier (note that complete amplifiers with heatsink and low pass filter do not require extra filter): http://www.pcs-electronics.com/transmitter-accesories-filters-transmitters-c-71_73.html

7.) ControlMini2 board. This board is connected to the MAX PRO 3000+ via flat cable (8 – DIGAMP-10). It makes it possible for MAX PRO 3000+ to read POWER and SWR of the amplifier module. There is also a solder post for temperature sensor and amplifier supply voltage. The board contains directional couplers for power and swr, SWR protection and ALC system. For better description look at the next appendix. We are now shipping these boards and 10 cm long flat cable with all our FM amplifiers (pallets and complete amplifier modules). This board can take about 500-750W of power maximum. However, when used with complete amplifier modules you can use them up to 2KW of RF power.

8.) MAXLINK flat cable connects stereo encoder with the FM exciter, it enables control and supplies 12-15V DC for the stereo encoder. You can purchase this cable along with stereo encoder here:

http://www.pcs-electronics.com/se5000-stereo-encoder-p-1274.html

9.) DIGAMP-10 flat cable connects MAX PRO 3000+ FM exciter with ControlMini2, it makes it possible for MAX PRO 3000+ to read power, swr, temperature and voltage of the amplifier module, you receive this cable along with ControlMini2 whenever you buy any of our pallets or complete FM amplifier modules:

http://www.pcs-electronics.com/fm-amplifiers-c-41.html

10.) Fans are very important, they ensure proper cooling of your amplifier, mains power supply and exciter. Usual fans that you can buy in local shops are often not strong enough and can fail far too soon. We carry a line of professional fans with higher reliability and very high airflow, you can order them here:

http://www.pcs-electronics.com/amplifiers-amplifier-accesories-c-41_112.html

11.) You will need to place all these items in a nice enclosure. Aluminum works well and is not too heavy. Keeping it conductive is an advantage (most types of anodizing make aluminum's surface non-conductive). We carry a line of professional rack enclosures, designed so that the above mentioned items fit perfectly. Now you can build your FM transmitter yourself, all the way up to 2000W:

http://www.pcs-electronics.com/rack-cabinets-boxes-c-93.html

Finally, we recommend that you use Teflon coaxial cable for all internal coaxial connections. The reason is primarily that Teflon does not melt while soldering or use. You can be sure no short will form between the center and shield, either immediately at soldering or with time, if the cable is under a lot of thermal stress (coax can warm up nicely already in a 300W transmitter). Insulation in RG58 or similar lossy cheap coaxial cables can literally melt and cause a short between the center and shield already at moderate power levels around 300W. You can buy suitable Teflon coaxial cable here (I suggest RG188 for low power and RG142, RG316, R303 for higher power levels):

http://www.pcs-electronics.com/semirigid-25ohm-other-special-coaxial-cable-p-1275.html

Appendix

F

Appendix F: ControlMini 2

We introduced the ControlMini2 board above, but since it is such a useful piece of equipment we should say a bit more about it. You can check the board layout below:

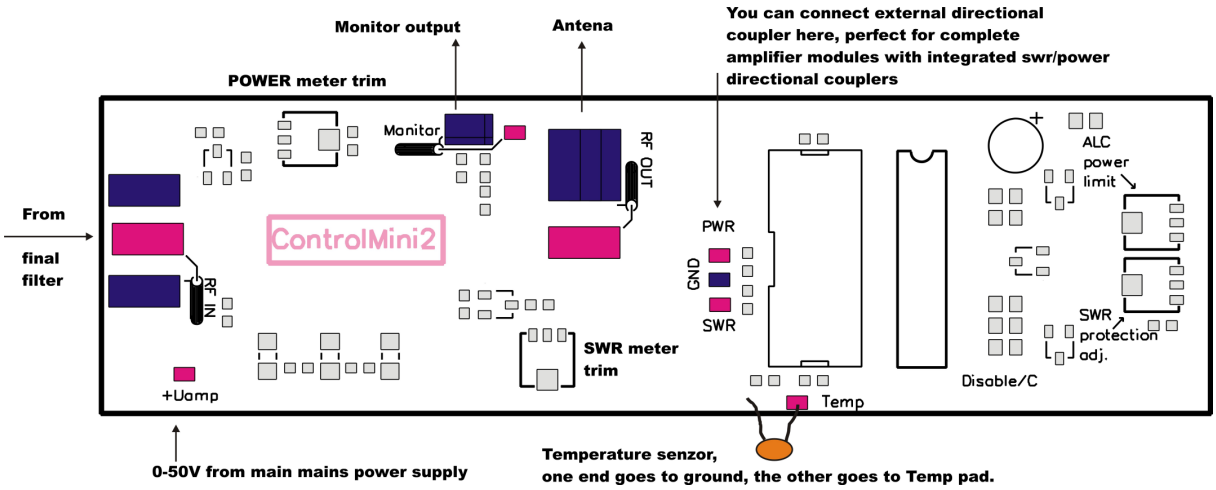

Fig. 23: ControlMini2, up close and personal

If you take a look at the FM transmitter block diagram several pages back you will see that the RF signal from the amplifier first passes through filter and than goes to the ControlMini2 board. You can see this input on the left. The two dark violet blocks are ground and the pink in the middle is signal (going to coax center). Some of our filters are designed so that you can simply place them next to the input and solder three short pieces of wire across all three terminals.

Monitor output at the top can be connected to a BNC connector, usually placed on the front panel of your transmitter. You can use this output to monitor performance with frequency meter, deviation meter or spectrum analyzer. Only a small fraction of output power is available here so your equipment is safe from overdrive (which is the point of this monitor output).

Antenna terminal is as the name suggests used to connect coaxial cable going to output connector/antenna. Use Teflon coaxial cable here (and elsewhere).

Note the 10-pin connector in the middle? Connect flat cable here and to the MAX PRO3000+ (other end). Wire flat cable away from any RF circuitry! The IC in the socket next to this connector is not installed and this is ok.

Note the two trimmers, power meter trim and swr meter trim? When using MAX PRO 3000+ set both of these to maximum, you will be adjusting accuracy of power/swr shown on the LCD with the trimmers on the MAX PRO 3000+ RF board. For example, set your transmitter to 300W (monitor power with a normal swr/power meter). Now adjust power meter trim until power shown on the lcd is 300W as well. You can do the same with SWR.

Note there is a special solder post for supply voltage (Uamp), connect +24 or +50V from your amplifier mains power supply here. You will be able to monitor this voltage on the LCD.

There is another solder post for temperature sensor. Solder one end from the sensor to the Temp soldering terminal and the other to ground (usually enclosure or any ground point on control board or RF amplifier module. Place temperature sensor close to the RF amplifier module. You will be able to monitor temperature on the LCD and you can set protection to reduce power should the amplifier overheat at any point.

There are two more trimmers on the board, one is for SWR protection and you can set SWR protection sensitivity here. You don't need these with MAX PRO 3000+ board.

Appendix

G

Appendix G: Controlling output power - ControlMini 1

Controlling output power of FM band RF amplifier is not as easy as one would think. The typical method of reducing drive only works to a degree. Since FM band amplifiers are typically non-linear they don't perform well when under-driven it isn't a good idea to control output power by adjusting the max pro 3000+ output power only. Fortunately, there is a better way to control output power; by changing power supply voltage. An amplifier that gives 300W at 48V will give only 50-80W at 24V. This is really a very effective and power efficient way of controlling output power, but how can you control mains power supply voltage with MAX PRO 3000+ you may wonder. This is where ControlMini 1 comes into play. It was designed specifically for the task. Lets look at the board layout below:

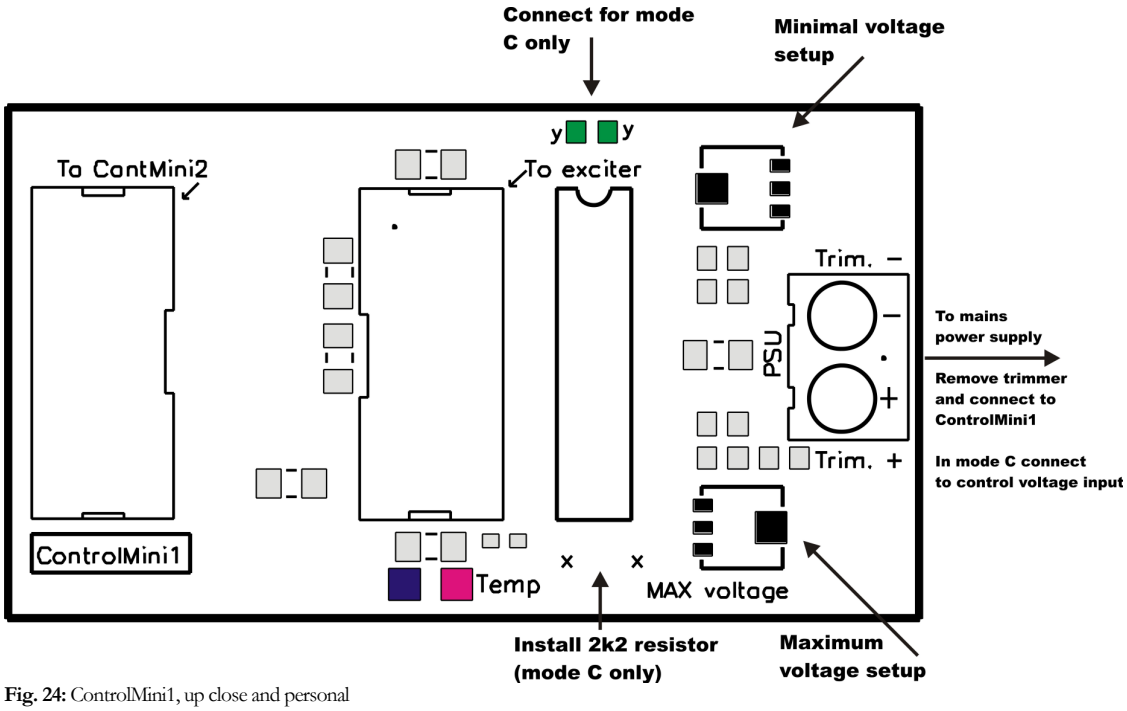

Fig. 24: ControlMini1, up close and personal

How do you connect this board to the max pro 3000+? Easy, simply just follow the markings on the board above. The first connector goes to control board2 (if you want to use it), the second goes to max pro 3000+. The usual Digiamp-10 flat cable is used for both connections. There are three modes of operation:

- Mode A and B: ControlMini1 is connected in place of the trimmer, remove voltage adjustment trimmer from your mains power supply and connect it to ControlMini1 header. Since output voltage can be proportional or inversely-proportional to resistance of the trimmer you have two selections in the MAX PRO 3000+ menu system, they let you select mode A or B. If you set this wrong, you will have maximum power when you set max pro 3000+ to zero and vice versa.

- Mode C: Some mains power supplies have a special dedicated input for controlling their output voltage. Typically 0-5V DC voltage is used to control them. To enable this mode install a 2K2 resistor and solder a bridge across two solder pads at the top. Now connect the output that usually goes to the trimmer to the power supplies controlling input. Select mode A or B depending on how output voltage follows control voltage (proportional or inversely proportional).

Appendix H

Appendix H: General tips for setting up transmitters

Typical FM transmitter setups

Below are several of the typical broadcasting systems that can be encountered worldwide.

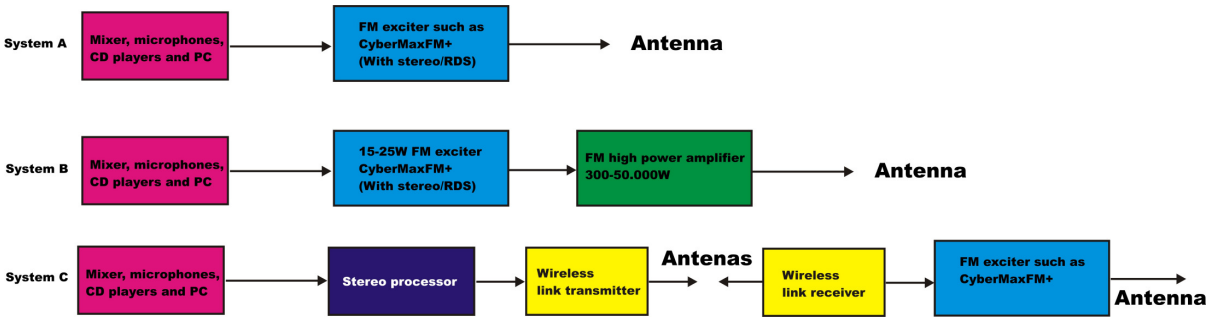

Fig. 25: Typical broadcasting systems

Lets look at **system A** first. It consists of audio source (mixer, microphones, CD players and a PC), FM exciter with integrated RDS and stereo encoder (such as our CyberMaxFM+ units from 15W-300W) and antenna. Note antenna in this system is located in the same location as the transmitter and studio, typically it would be placed on a small tower or a pole at the top of the building with studio. Disadvantage of this system is that you have to keep studio, transmitter and antenna close. Now you usually can't place studio on the top of a mountain for practical reasons so this limits your range. This is a typical small community radio with output powers of up to 300-500W.

System B is very similar to system A, but operators have decided to add an additional amplifier to boost the range. Such stations can go into kilowatts, but they are starting to hit another speed limit. Since the studio is typically located in a town, high RF powers aren't desirable due to interference with other services and safety regulations. So range is still limited compared to system C stations.

System C is radically different in one respect. Antenna and transmitter are no longer located at the same place with the studio. To accomplish this the two audio channels are first combined with stereo processor. Resulting MPX signal is than passed to the STL wireless link transmitter (STL=Studio Transmitter Link). Up in the mountains is a STL wireless link receiver that receives the signal from the studio and passes I to the exciter. In this case exciter does not need to be stereo anymore since composite MPX signal is passed to its MPX input (all mono transmitters have this input). Such exciters can than optionally drive big amplifiers with powers going into tens of KW with maximum range.

You can check our amplifiers here: http://www.pcs-electronics.com/fm-amplifiers-c-41.html

You can check our wireless STL links here: http://www.pcs-electronics.com/wireless-audio-links-c-42.html

Typical FM broadcasting antenna setups

Below are several of the typical broadcasting antenna systems that can be encountered worldwide.

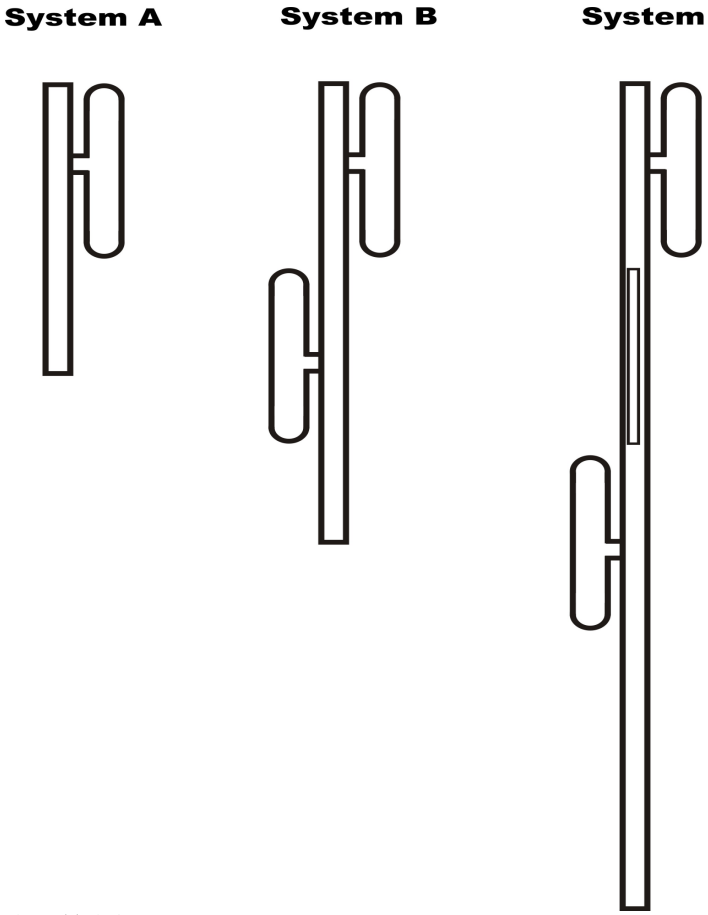

Fig. 26: Typical antenna setups

Lets look at **system A** first. It's a simple vertical dipole antenna, mounted on a pole. The gain of this antenna is 0dBd and if we assume that the coaxial cable does not have any losses the ERP of this system equals transmitter power. For example, a 1KW transmitter with this antenna system and perfect coaxial cable (losses=0) would have ERP of 1000W. Radiation pattern of this system is more-less omni-directional but since the metal pole holding the antenna blocks the signal there is a null of signal exactly on the opposite side of the pole.

System B has two simple dipole antennas mounted on a pole. The gain of this antenna is slightly less than 3dBd (due to losses in harness – splitter). If we assume that the coaxial cable does not have any losses the ERP of this system equals double transmitter power. For example, a 1KW transmitter with this antenna system and perfect coaxial cable (losses=0) would have ERP of 2000W. Note the antennas are mounted on the opposite sides of the pole to help make radiation pattern as omni-directional as possible.

System C has four simple vertical dipole antennas mounted on a pole. One of the antennas is behind the pole and is not visible. Note the antennas are mounted at an angle of 90 degrees between each other to help make radiation pattern as omni-directional as possible. The gain of this antenna is slightly less than 6dBd (due to losses in harness – splitter). If we assume that the coaxial cable does not have any losses the ERP of this system equals 4x transmitter power. For example, a 1KW transmitter with this antenna system and perfect coaxial cable (losses=0) would have ERP of 4000W.

System C has theoretically double the range of the System A although in practice it takes 4-6x increase of power to double the range. 4x increase of power is equal to 6dB of gain. And you get 3dB of gain by doubling the number of dipoles. So to upgrade system C to 9dBd you'd need 8 dipoles. And for 12dBd you'd need 16 dipoles. 16 dipoles would in theory increase your range 4x compared to a single dipole. In practice there would be some losses in combining so many dipoles. You can use circular dipoles in very similar configurations.

Wiring antennas in multi-bay configurations

We have observed typical multi-dipole (called multi-bay) antenna configurations on the previous page. However there are some things to keep in mind.

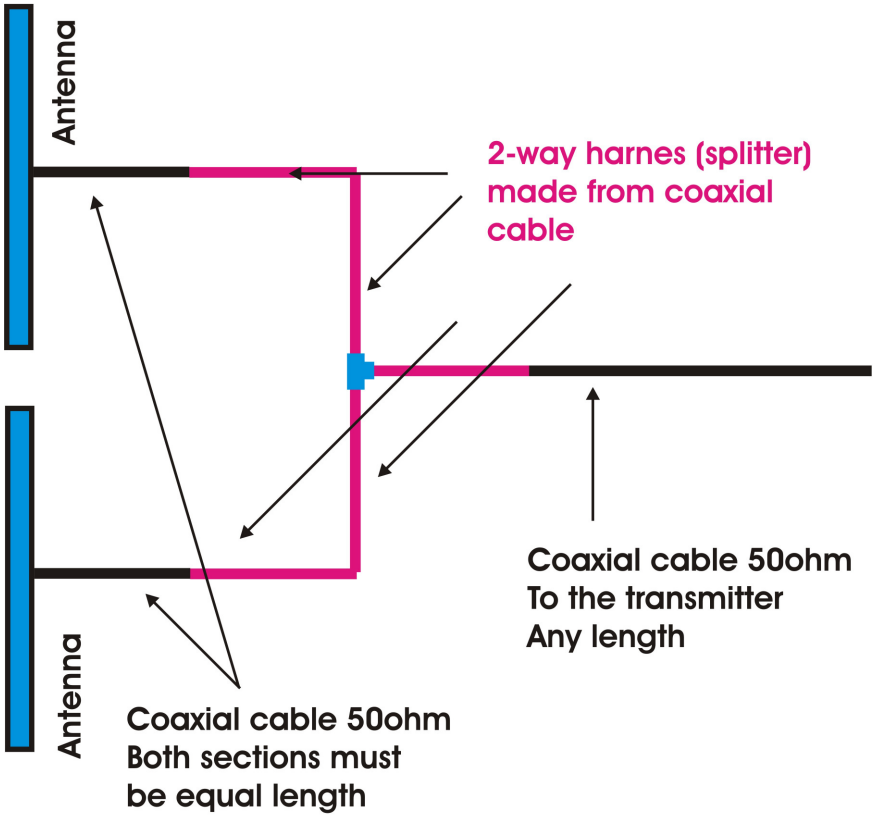

Fig. 27: Wiring multi-bay antennas

Look at the diagram above. This is a simple system with two dipole antennas and a 2-way coaxial splitter (harness). This splitter is made from sections of coaxial cable with such impedance and length which ensure perfect match at specific frequency. Do not attempt to assemble from regular 50-ohm coaxial cable. What is important here is that the two sections of coaxial cable going from antenna to the splitter should be of exact equal length. These two sections are shown in black. The same rule applies for system with more dipoles. It is also possible to have cables of different lengths, but you have to know velocity factor of the cable so we have omitted this for simplicity reasons. If you want more info please contact our technical staff.

Appendix

I

Appendix I – Using wireless audio links

If you are going to place your transmitter up in the mountains, you may prefer to keep your stereo/RDS encoder in your studio and stream MPX signal up to the transmitter. For example this could be because you want to have easy access to your stereo/RDS encoder so you can change parameters, if needed. Here is what your system would look like for MPX wireless studio-transmitter link:

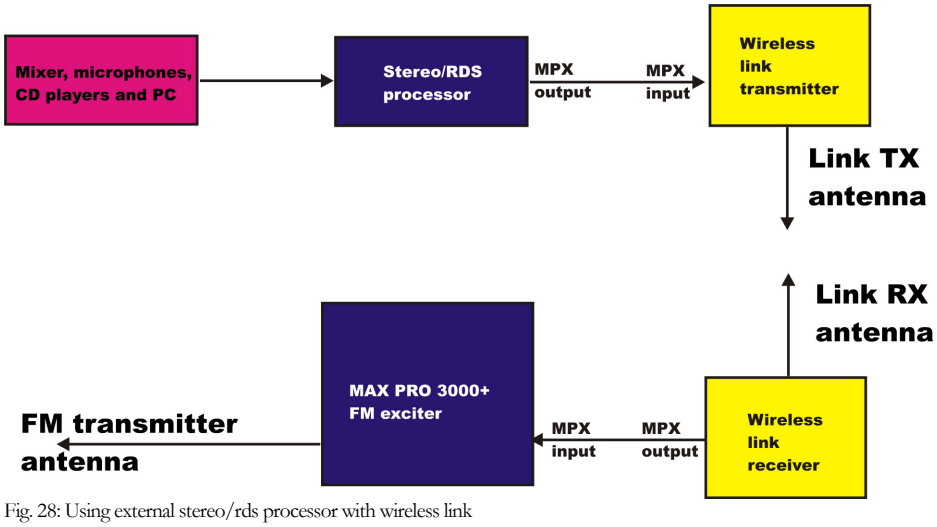

Fig. 28: Using external stereo/rds processor with wireless link

It is important that you set the pre-emphasis on the MAX PRO 3000+ board to Off (None). If you get stuck or need our advice please contact our technical department.

Appendix

J

Appendix J – IO board and PC remote control

Software installation

Look for the install_CyberMaxFM30.exe file on the provided CD or download the latest version from our website. You can find it here:

http://www.pcs-electronics.com/phpBB2/viewtopic.php?t=2204

Once you have the driver run the setup file and install the program on your computer. This process is very straight-forward and should only take a few minutes. Wait for the installation to complete and click Finish when done.

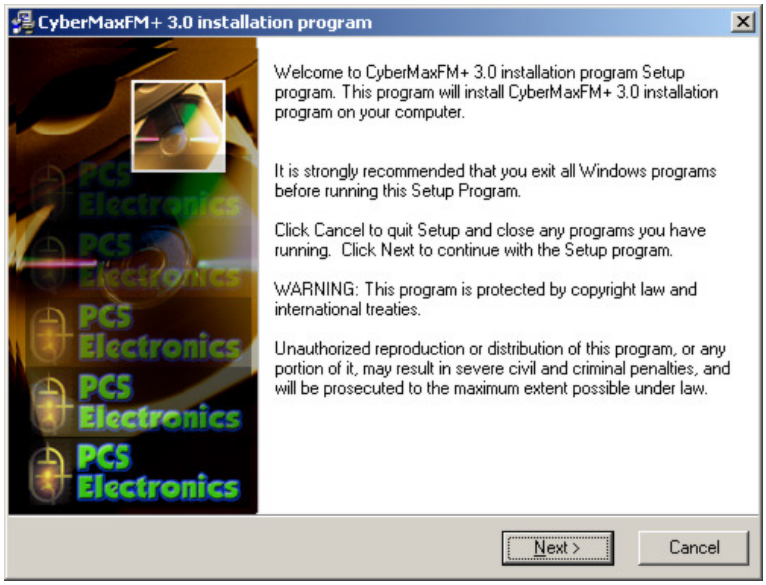

Fig. 29: Setup is about to start

Once the installation is done you are ready to start the program. You are now ready to establish connection with the MAX PRO 3000+ and configure all the parameters.

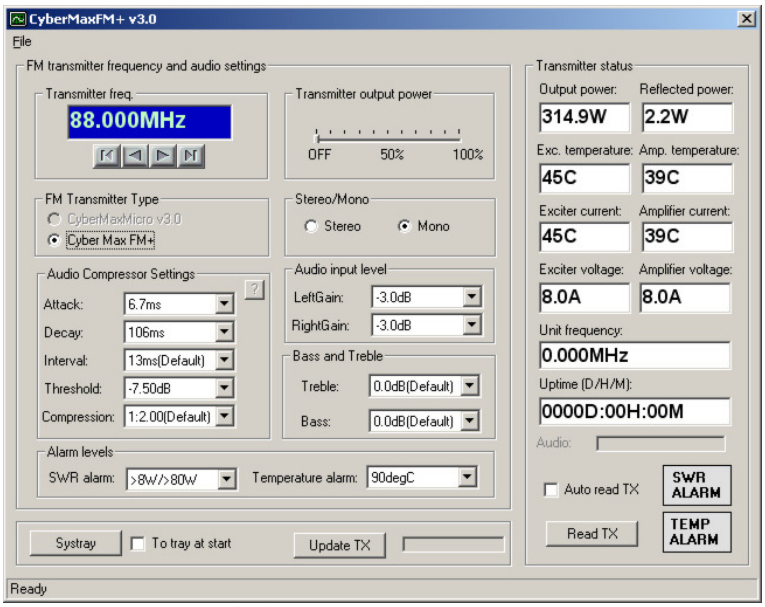

Fig. 30: MAXPRO3000+ application program

As you can see this program lets you control all parameters of your FM exciter board. It also lets you read all of the available information, such as output power, temperature, frequency, uptime etc.

Configuring communications port

The only setup required is minimal. Start the CyberMaxFM+ program, the icon should now be on the desktop. Now click File and setup. The following window will open. If you are using USB make sure to set COM port to 5! When using RS232 please set COM port to 1 or 2. These settings are usually correct. If not, we will explain the installation and setup process for USB control cable in more detail below.

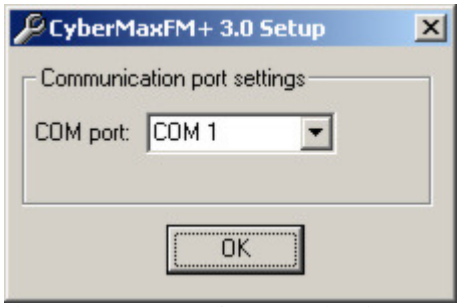

Fig. 26: Set COM port to 1 for RS232 IO board

Installing USB driver (only for USB IO board)

Unzip the archive_usb2comport_driver.zip file that you either downloaded off our website or located on installation CD. Now run the IO BOARD USB-COM port.exe file. Wait for the following screen to appear and select the installation directory (best left alone at default location). Click Install and wait for the installation to finish.

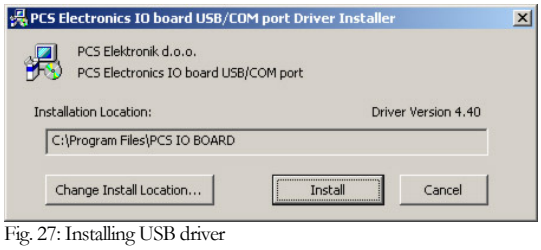

Fig. 27: Installing USB driver

Configuring USB driver

In Windows go to Start > Settings > Control Panel > System > Hardware tab > Device Manager (This can vary depending on your Windows version). You should have something like this on your screen at this point:

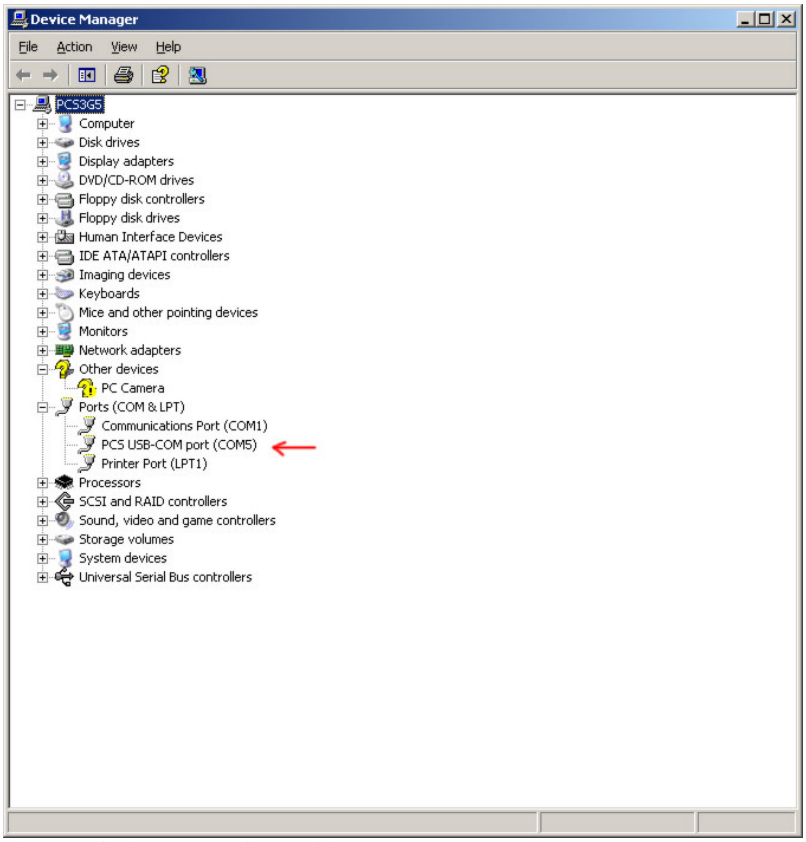

Fig. 28: Configuring Com port for USB driver

Take note of the COM port number here, you will need it later to configure the COM port inside CyberMaxFM+ windows control program. If you wish to change this port right click on the PCS USB-COM port and select Properties. Now select the Port settings tab and click Advanced. Note you can set the COM port number as you wish:

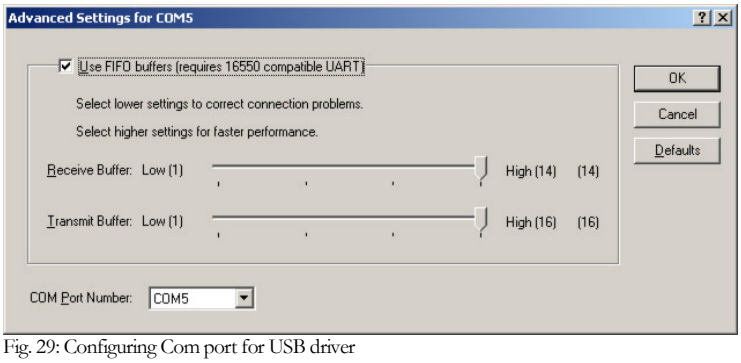

Fig. 29: Configuring Com port for USB driver

Appendix K – Warranty and legal info

Important notice!

Please remember to turn off the transmitter/amplifier when not in use! This goes especially for high powered transmitters. 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.

Warranty and servicing!

Within one (1) year of receiving your order, if any product proves to be defective; please contact us via e-mail or our feedback form. Please DO NOT ship the product back to us without contacting us first and receiving return instructions. After we receive the defective merchandise, we will test it if need be, and we will ship back to you a non-defective replacement product. Please note that this doesn't cover final RF transistor as it can be damaged by using defective or poorly matched antenna. An exception is as well any mishandling or abuse by the customer. If the product is defective, you will receive a replacement. If you choose to return the defective item, rather than replace it, we will charge a 20% restocking fee and your original shipping and handling charges will not be refunded. The return of the product is at your expense. We believe that this is a fair policy because lower overhead results in lower prices for all of our customers.

Legal info

It may be illegal to operate this device in your county. Please consult local authorities before using our products! PCS Elektronik d.o.o. is not responsible for any damage to your PC arising from use of this product and will not be held responsible for any violation of local laws pertaining to the use of this product. It is entirely your responsibility that you make sure you operate in accordance with local laws and/or regulations.

Limitation of liability

To the law, in no event shall PCS Elektronik d.o.o. or its suppliers be liable for any special, incidental, indirect, or consequential damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of or inability to use the PRODUCT, even if PCS Elektronik d.o.o. has been advised of the possibility of such damages. In any case, PCS Elektronik d.o.o.´s entire liability under any provision of this agreement shall be limited to the greater of the amount actually paid by you for the PRODUCT or U.S. $5.00; because some states and jurisdictions do not allow the exclusion or limitation of liability, the above limitation may not apply to you.

Also available from www.pcs-electronics.com

We also carry a big range of:

- FM transmitters in assembled and KIT form
- TV transmitters in assembled and KIT form, VHF and UHF
- AM transmitters with extremely clear modulation (PWM design)
- Various accessories for professional and hobby FM radio stations
- A large assortment of hard to obtain RF components (RF transistors; MRF, 2SC, coils, silver plated wire, coaxial cable, capacitors, quartz crystals and many others)
- PC based FM transmitters (PCI MAX pc based FM transmitter turns your PC into a radio station)
- A large number of beginners guides to get you started
- A large selection of free schematics is as well available at our website.

If you can't get much range with your homebrew antenna, have a look at these: http://www.pcs-electronics.com

Revisions and errata

V2.1 (Jan 2010): Released version of new manual format

V2.0 (October 8th, 2009): Added VU meter attachment, transmitter design guide, digital amplifier control board 1 and 2, updated troubleshooting table, various small improvements

V1.1 (Nov 22nd,2008): Added frequency table (dip switches), fixed se5000 wiring diagram, added revisions/errata at the end, updated troubleshooting table

V1.0 (June,2008): Release version

Please report any errors you see in this manual, you will be helping us and many other users out there. Thank you!

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