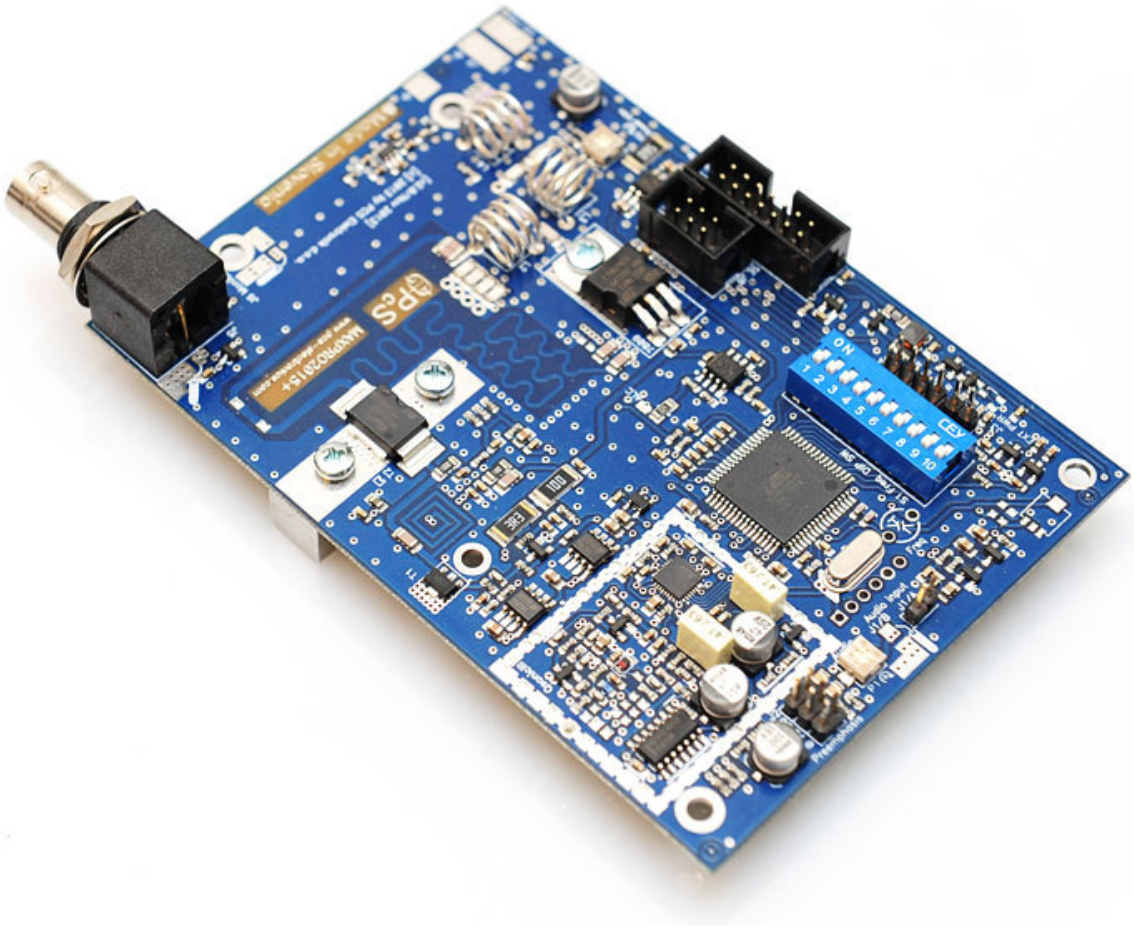

MAXPRO2015+ v1

High performance FM radio exciter and the perfect pallet driver

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 recommended input power of the amplifier. See appendix for additional tips on driving amplifiers.

WARNING: Stereo encoder needs to be plugged into main RF board and NOT into LCD display!

NOTE: Exciter ramps the power up slowly, allow 10-15 seconds for the power to reach specified power.

Study local regulations and ensure you are operating in compliance.

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

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Chapter

1

Introducing the MAX PRO 2015+ FM exciter series (v1.0)

Next generation of FM exciters with new Qsonic III VCO/PLL and up to 15W of power

Designed either as a perfect pallet driver or a stand-alone FM exciter, MAX PRO 2015+ series brings up to 15W of very clean RF power, updated Qsonic III double-speed PLL/VCO subsystem with impressive audio performance and excellent bass plus several brand new hot features.

What makes this FM exciter so great?

MAX PRO 2015+ displays a number of useful parameters on the LCD display: transmitted power, reflected power, temperature, frequency, audio modulation level, amplifier power and swr. Power and all other parameters can be controlled with keys on the LCD module or remotely via RS232/USB interface. Let us not forget about the power output, 15W is more than enough to drive most amplifiers out there on the market. Of course this unit is completely no-tune, directly supports our stereo encoders (SE2000, SE5000DSP+ and SE6000AN+), and offers impeccable performance 24/7/365. Even as a stand-alone unit this exciter doubles as an excellent community radio station and can easily cover a small city with suitable antenna.

How is MAXPRO2015+ better than the old MAXPRO2000+ or MAXPRO3000?

- MAXPRO2015+ has a new temperature-compensated power meter. This means output power is constant under all conditions, either changing temperature or supply voltage. Power is also very precisely maintained and controlled in the 0-2W range which was not possible with older units.

- MAXPRO2015+ enables a more precise power adjustment as there are more adjustment steps, also the power display in the 0-10W range has now been expanded to 2 decimal points (for example 1.55W).

- MAXPRO2015+ has slow power ramp-up to ensure safe pallet/amplifier operation

- MAXPRO2015+ series has output power completely flat across entire FM band and very low spurious output.

- MAXPRO2015+ series has four power range jumpers which let you set output power range from 0-1W, 0-2W, 0-3W, 0-4W etc all the way to the full 0-15W. If your pallet requires 4W simply set the power range to 0-4W (install only jumper 4W).

Technical specifications:

- RF output power at 15V DC: 0 to 15W

- Output connector: Solder posts or BNC, 50 Ohms

- Frequency range: 87.5-108MHz

- PLL steps: 100 KHz

- Frequency stability +/- 20Hz

- Spurious/Harmonic rejection: Harmonics: >50dB, Spurious: -80dB

- Power supply (15W): 13-15V/2,5A or car battery

- Power connector: solder posts on PCB, well marked

- Audio performance: Flat sensitivity across FM band, less than 0.25% distortion, 20Hz-60KHz

- RF output ruggedness: SWR protection

- Pre-emphasis, 50uS, 75uS or none selectable

- Audio Input Impedance: 1Kohm, unbalanced, 2 - pin jumper and solder posts

- Audio Input Level: 0 dB

- S/N ratio >80 dB

- PC Board Size: 90x125mm

- RF monitor output: Yes, solder pads, -30dB

MAXPRO2015 series + key features

- Displays frequency, power, audio level, reflected power, temperature and SWR/POWER from external directional coupler after amplifier.

- Extreme VCO isolation and RF field immunity

- SWR and TEMP protection with adjustable sensitivity

- Adjustable software power limit when driving external amplifier (up to 9900W)

- Four power range jumpers which let you set output power range from 0-1W, 0-2W, 0-3W, 0-4W etc all the way to the full 0-15W (25W/40W/50W). If your pallet requires 4W simply set the power range to 0-4W for precise and convenient drive.

- True wideband no-tune operation, constant power across entire FM band

- Flat audio response, excellent bass

- Directly supports our SE5000 DSP+, SE2000 and SE6000AN+ stereo encoders via LCD MENU system

- RF control board with directional couplers and SWR protection is available

Thank you for purchasing MAX PRO 2015+ series FM exciter

We hope you will enjoy it as much as we do and remember to tell your friends about it. Please feel free to leave your comments at our website or post your experience in our forum. From all of us we wish you happy broadcasting!

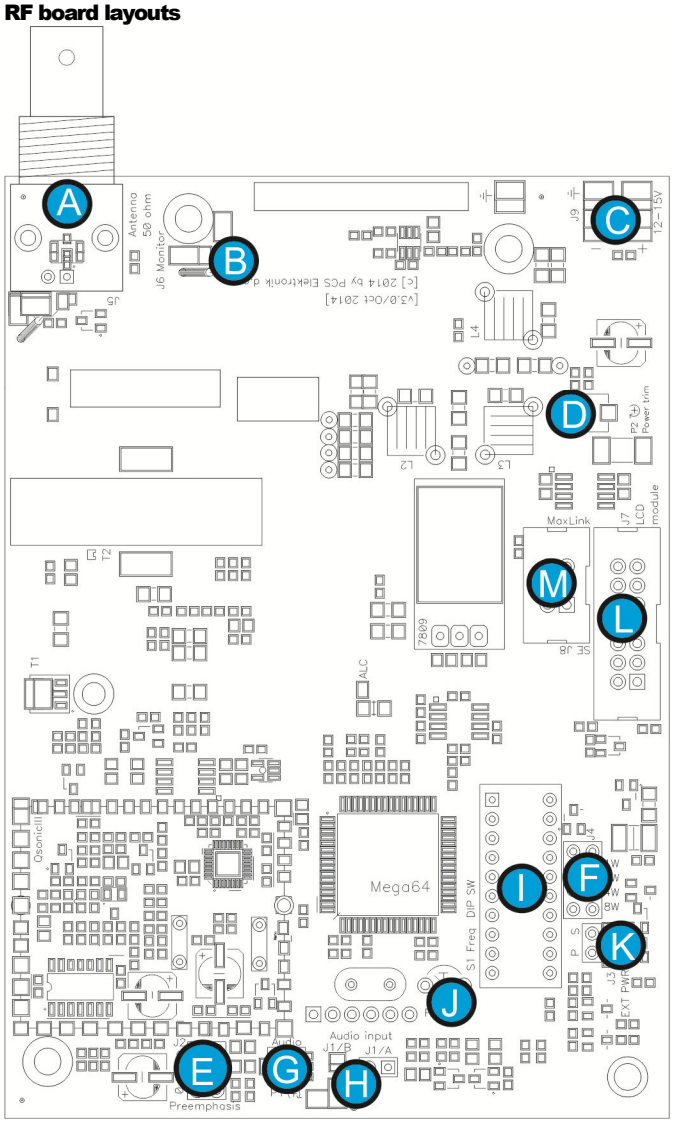
Your PCS Electronics team

Chapter

2

MAXPRO2015+ RF and LCD board layout

RF board layouts



A Antenna
B RF monitor
C Power (13-15V)
D Power fine tuning
E Pre-emphasis
F Power limit jumpers
G Audio sensitivity
H Audio input
I DIP switch
J Frequency fine adj.
K External power/swr meter
L LCD display (optional)
M Stereo encoder

Fig. 1: MAX PRO 2015+ RF board layout

Ref.	Function
A	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.
B	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.
C	Power supply pads. DO NOT use more than 15V!
D	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. You have to "reboot" to verify the setting as power detector has some DC offset which is measured once while the unit powers up.
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 MAXPRO5000+ board, place the jumper in position None (top - this disables pre-emphasis).
F	Power range jumper J4, use to set output power range to 0-1W,0-2W, 0-3W, 0-4W or any other range all the way to 0-15W. Setting is binary, that is if you place 1W and 8W jumpers the power range will be 1+8=9W (0-9W). No jumpers = full power 0-15W
G	Audio input sensitivity adjustment.
H	Audio input – audio coaxial cable or 2-pin header.
I	DIP switch for setting the frequency when not using LCD display. Set all these to zero, if you want to use LCD display!
J	Do not touch unless you understand what this is. Lets you fine-tune the reference frequency. You can use this trimmer to set the frequency to exactly 100.000KHz if it's slightly off (for example if frequency meter shows 100.002KHz).
K	External power and swr signals, display will automatically switch to external signal when voltage is detected
L	LCD control unit, attach your LCD control module here. Flat cable used is crossed.
M	Maxlink connector for easy connection with the SE2000, SE5000 or SE6000AN+ stereo encoders. 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 almost completely solder-free; simply plug the connector in and connect MPX out to audio input of the exciter. Flat cable that runs between the units also carries supply voltage and stereo/mono switch for the stereo encoder.

Table 1: Description of various elements of the MAX PRO 2015+ 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:

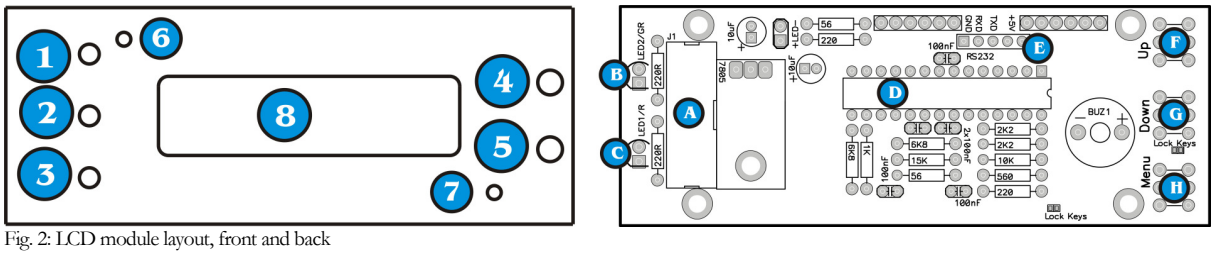


Fig. 2: LCD module layout, front and back

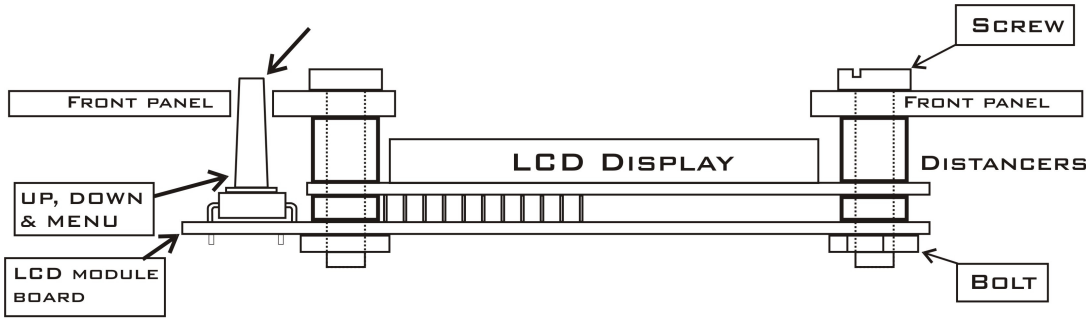


Fig 3: Installing display board into an enclosure, side view

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;

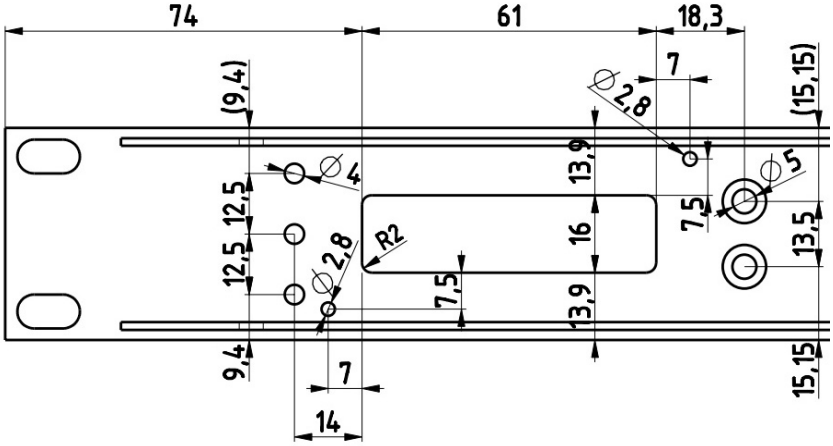


Fig. 4: LCD module cutout and holes, all measurements in mm

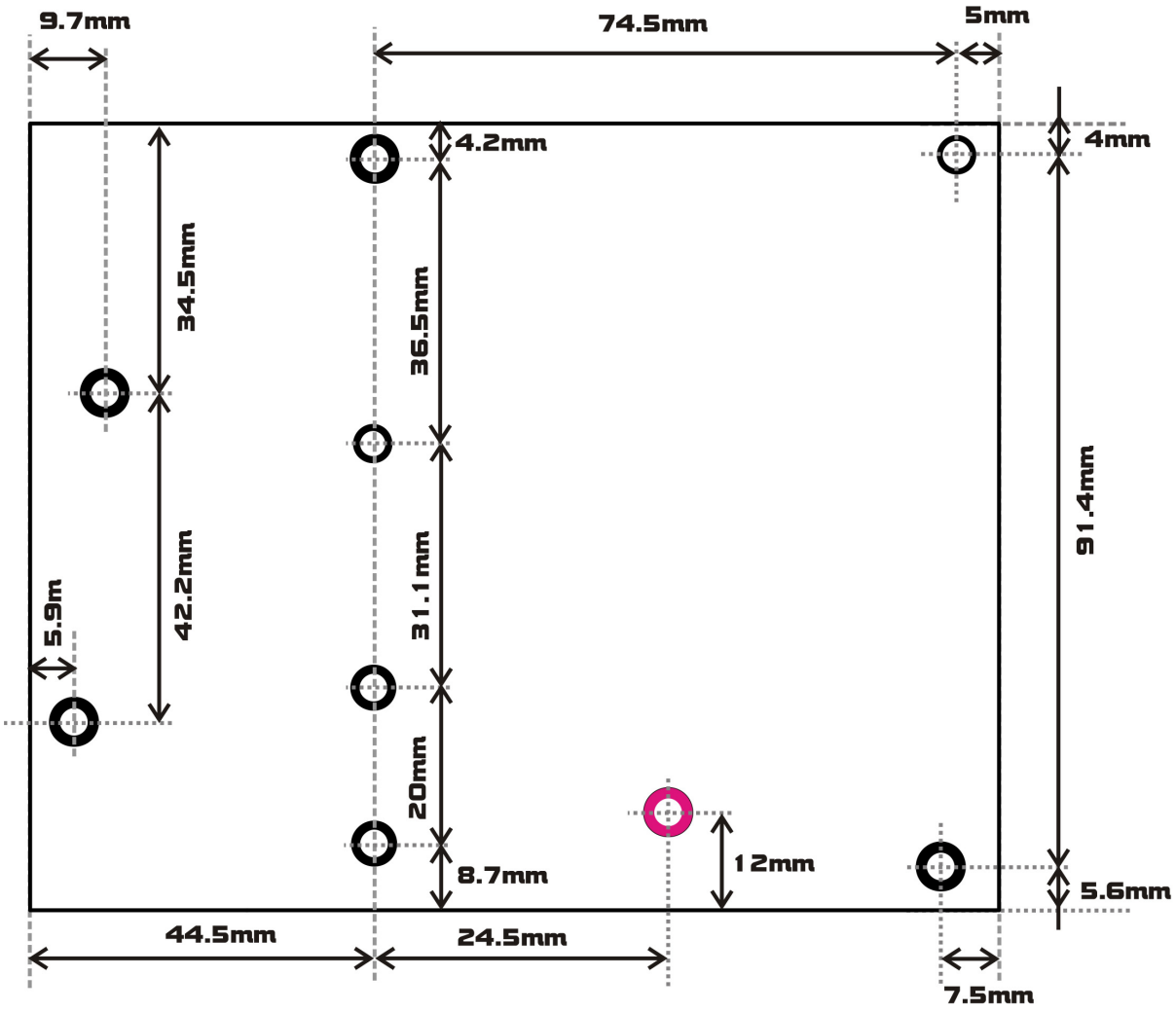


Fig. 5: NEEDS AN UPDATE! RF module drill template, all measurements in mm, all holes are for M3 metric screws. Board is 10mm above the enclosure due to heat sink running under the entire length of the board. Most of the holes are identical to those in MAXPRO2000+/MAXPRO3000+, but the board is slightly smaller.

Chapter

3

What's under the hood?

The block diagram of the MAXPRO2015+ 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.

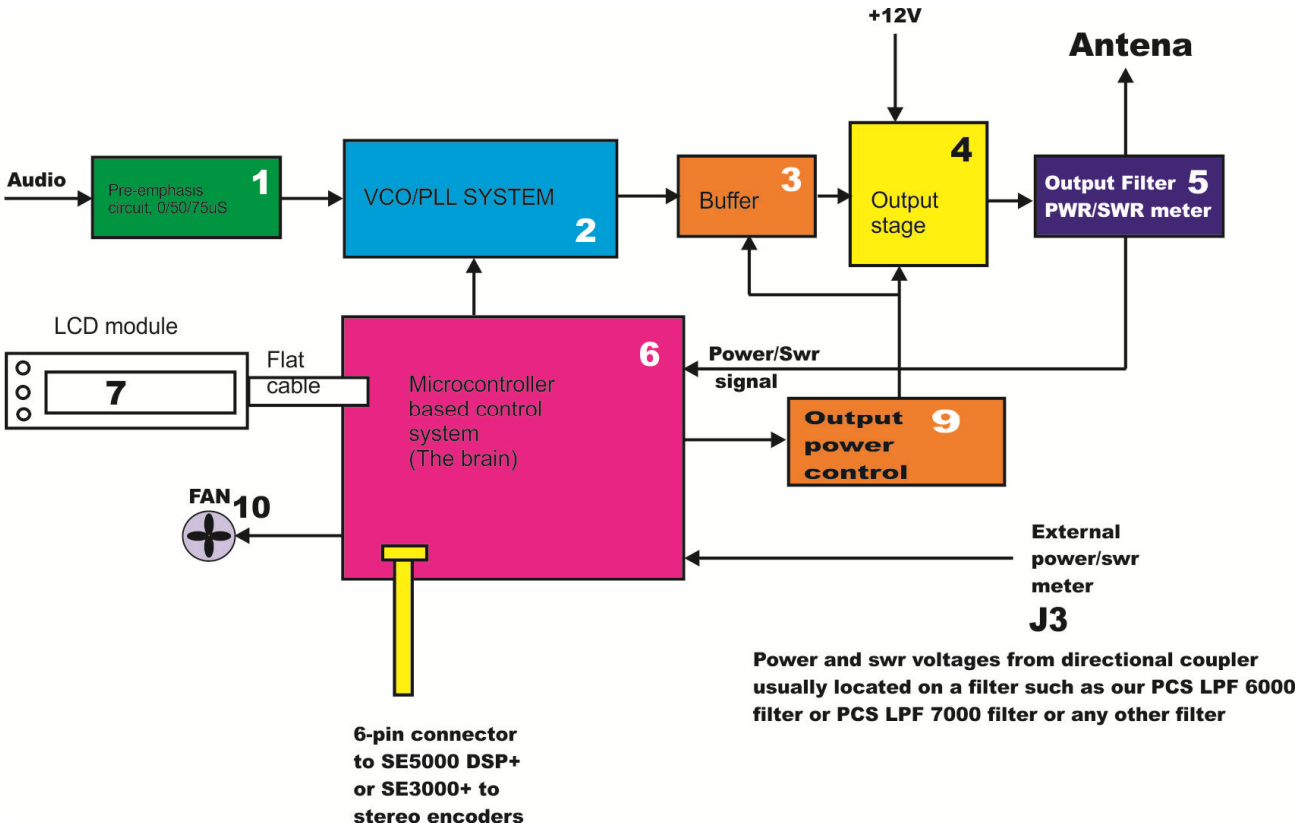


Fig. 6: Block diagram of the MAXPRO2015+ FM exciter

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 circuitry, this is handled via software (LCD selection) in MAXPRO2015+.
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	Not present in 2015 model.

Table 3: Description of various blocks of the MAX PRO 2015+ series 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 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 cooling for MAX PRO 2015+ series exciters

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. Read again, ALL screws. Make sure they make a good contact with the metal enclosure and if there is paint remember to remove it under the distancers. Use metal distancers, not plastic. Flat cable should be wired away RF sections or if you are not sure where that is move it away from the board in general. A fan is 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!** Since 50W is quite a lot of power it is important that you follow these guidelines. If you still experience instability, make sure there are metal shields between compartments in your enclosure. You can also sand off the black anodizing off the heat sink where the heat sink meets the enclosure and board to ensure better contact. Anodizing creates isolating layer. You can remove that also for the top heat sink where it meets the board.

Stereo encoder for stereo operation

If you want to transmit in stereo, you also need a stereo encoder. The cool thing about MAXPRO2015+ is that it directly supports SE6000AN+, SE2000 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 19 KHz notch. When using other units look for good stereo separation, 19 KHz 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 MAXPRO2015+ is easy, just make sure you read the previous chapter and setup enclosure, antenna and coaxial cable correctly. Then proceed with the following:

- Install MAXPRO2015+ 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 needed.

- Connect LCD module via flat cable

- Set the power limit jumper (J4) into the lowest position (1W), this will prevent any damage due to high SWR.

- If you don't have artificial load (dummy load) 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 inline between antenna and transmitter 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.

- 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. Remember, if you're using stereo encoder you do not need pre-emphasis so set it to none.

- Observe SWR and output power. If everything seems ok you can enter <RF power> menu again and increase power to full. Remove or reposition the power limit jumper (J4) if more power is desired.

Chapter

6

Using the MAX PRO 2015+ series 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>, <FIRMWARE VER>, <CURRENT ALARM>, <TEMP ALARM>, <SWR ALARM>, <U AMP ALARM>, <BAND SELECT>, <RF AMP CONTROL> and <RF POWER ALC>. 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. Your frequency will go down in 100KHz steps. If you keep pressing a key for a while the PLL STEP switches to fast tuning mode and jumps in 500 KHz 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 5000+ with MAXLINK cable (6-pin flat cable).

<VIEW SELECT>

MAX PRO 5000+ 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+Ie+Te+Ue] – This view shows frequency, Exciter output stage current, exciter temperature and exciter supply voltage

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

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

- [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 then 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. Let's 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.

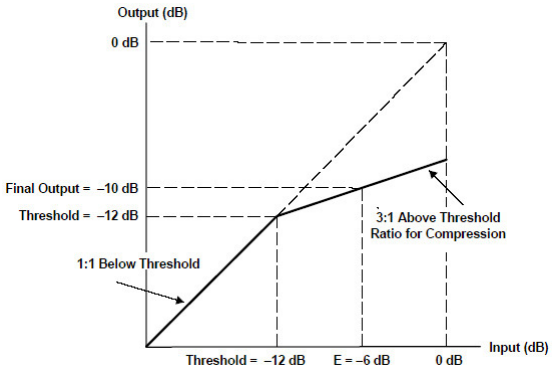


Fig. 9: Explanation of the compressor settings

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

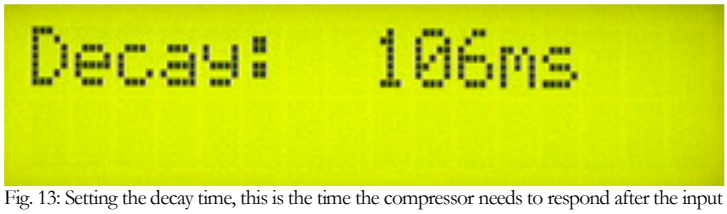


Fig. 13: Setting the decay time, this is the time the compressor needs to respond after the input signal falls back to normal level (below threshold).

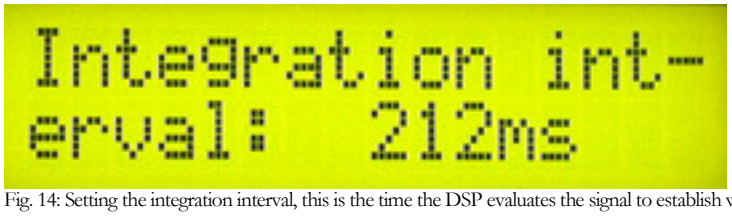


Fig. 14: Setting the integration interval, this is the time the DSP evaluates the signal to establish whether it should respond or not

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 are 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.

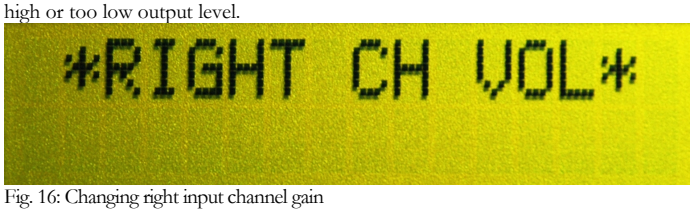


Fig. 16: Changing right input channel gain

<PLL STEP>

Frequency can normally be adjusted in smallest steps of 100 KHz. If you need smaller steps have a look at MAXPRO5015 series.

<FIRMWARE VER>

This option allows you to display current LCD module firmware version. At the time of writing firmware version was [MP2015+ V1.0]

<CURRENT ALARM>

If you need this function have a look at MAXPRO5015 series.

<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.

<SWR ALARM>

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

<U AMP ALARM>

If you need this function have a look at MAXPRO5015 series.

<BAND SELECT>

If you need this function have a look at MAXPRO5015 series. MAXPRO2015+ supports only FM band. Special version can be provided, if you order at least 50-100 boards.

<RF POWER ALC>

This menu option is useful for situations where MAX PRO 2015+ drives a pallet or other FM amplifier. It is possible to set a limit power level (for example 500W) and exciter will reduce its output power if needed to prevent overdriving. This is a very useful feature when you are for example building a 500W, 1000W or stronger FM transmitter; it ensures constant power across the band without overdriving. This is disabled by default to prevent tinkering with the settings by unauthorized personnel; you can enable it by soldering a particular bridge on the LCD module.

Chapter 7

WINDOWS CONTROL PROGRAM - CYBERMAXFM+

SOFTWARE INSTALLATION AND COMMUNICATION SETUP

Software installation and setting up connection via serial COM port or USB port are described in Appendix H.

COM PORT SETUP

Select correct COM port here. Usually this would be COM1. Baud rate is selected automatically according to the selected FM transmitter type. All recent models of MAX PRO 5000 series exciters use CYBERMAXFM+ v4.

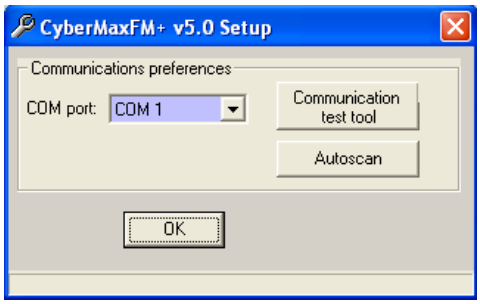


Fig. 17: COM port setup.

Communication test tool

Use this feature to find correct settings easily. Try different settings and check them by clicking the button.

Fig. 18: Communication was successful

Fig. 19: Wrong COM port

Autoscan

Use this feature to find correct settings even more easily. Just click it and wait to program find the connected transmitter by itself.

FM TX main tab – transmitter setup

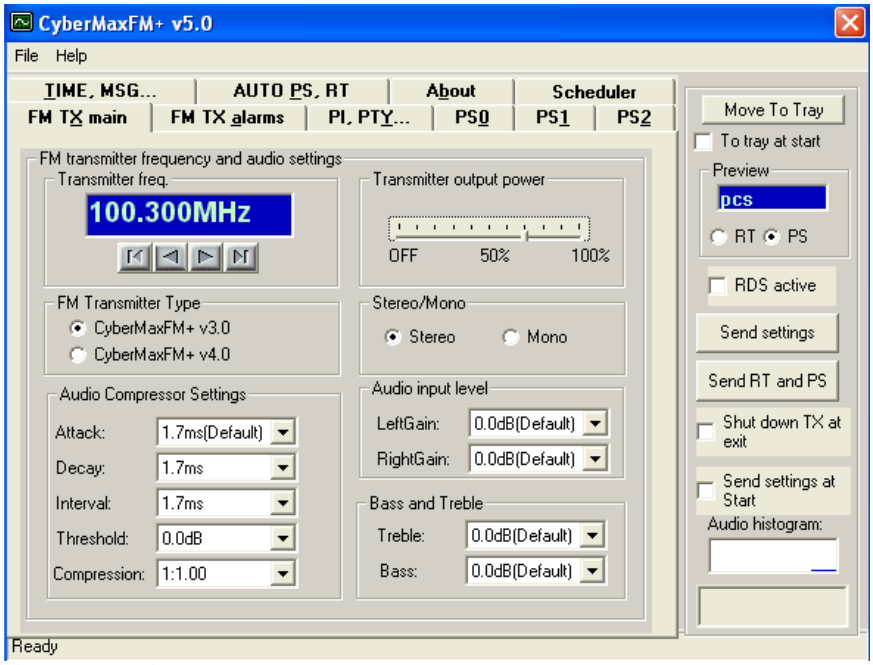


Fig. 20: FM transmitter setup

Main FM transmitter parameters are presented in this dialog, they are described below:

FM transmitter type

Select your FM transmitter type, this would be version 4 for all recent MAX PRO 5000 series exciter. Older units may have to be set to v3.

FM transmitter frequency

Set the frequency by 0.5 or 0.05MHz steps.

Transmitter output power

Set the desired output power.

Stereo/Mono

Select stereo mode here.

Audio input level

Select audio gain for left and right channel separately.

Bass and Treble

Select boost level for Bass and Treble.

Audio Compressor Settings (only with DSP stereo encoders)

These are settings which control the operation of the compressor. This only works if you are using SE5000 or SE6000 DSP stereo processor. Compressor settings are described here.

FM TX alarms

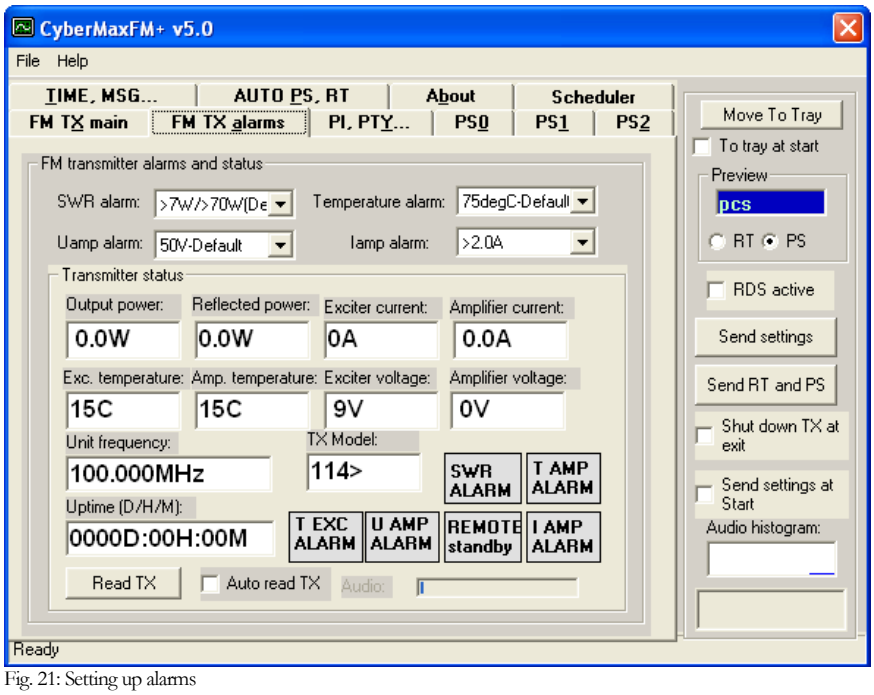


Fig. 21: Setting up alarms

In this tab you can observe several operating parameters including alarms. Threshold values of alarms can be set, too.

Read TX

Click this button to get the current status of your hardware.

Auto read TX

Check this box to activate automatic continuous hardware status reading.

PI, PTY... (RDS settings)

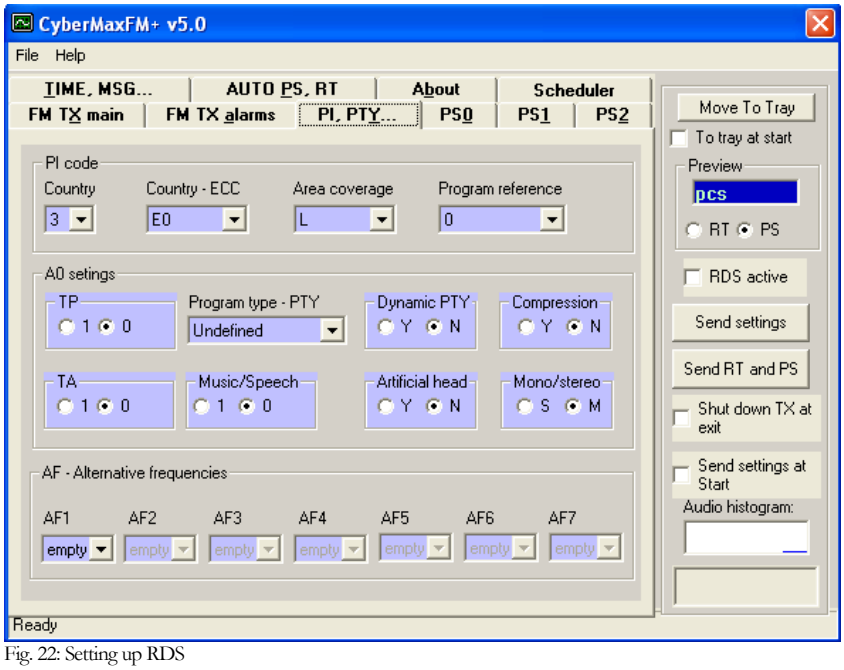


Fig. 22: Setting up RDS

PI code

This information consists of a code enabling the receiver to distinguish between countries, areas in which the same programme is transmitted, and the identification of the programme itself. The code is not intended for direct display and is assigned to each individual radio programme, to enable it to be distinguished from all other programmes. One important application of this information would be to enable the receiver to search automatically for an alternative frequency in case of bad reception of the programme to which the receiver is tuned; the criteria for the change-over to the new frequency would be the presence of a better signal having the same Programme Identification code.

TP/TA flag

TP is a flag to indicate that the tuned program carries traffic announcements. The TP flag must only be set on programs which dynamically switch on the TA identification during traffic announcements. The signal shall be taken into account during automatic search tuning, so I recommend turning this flag on even though you don't transmit any traffic announcements.

Program type PTY

This is an identification number to be transmitted with each program item and which is intended to specify the current Program type within 31 possibilities. This code could be used for search tuning. The code will, moreover, enable suitable receivers and recorders to be pre-set to respond only to program items of the desired type. The last number, i.e. 31, is reserved for an alarm identification which is intended to switch on the audio signal when a receiver is operated in a waiting reception mode.

Music/Speech

This is a two-state signal to provide information on whether music or speech is being broadcast. The signal would permit receivers to be equipped with two separate volume controls, one for music and one for speech, so that the listener could adjust the balance between them to suit his individual listening habits.

AF - Alternative Frequencies

The list of alternative frequencies gives information on the various transmitters broadcasting the same program in the same or adjacent reception areas. This facility is particularly useful in the case of car and portable radios. When the PI code indicates local coverage-area, i.e. only one frequency is used, AF list may contain this frequency.

PS0

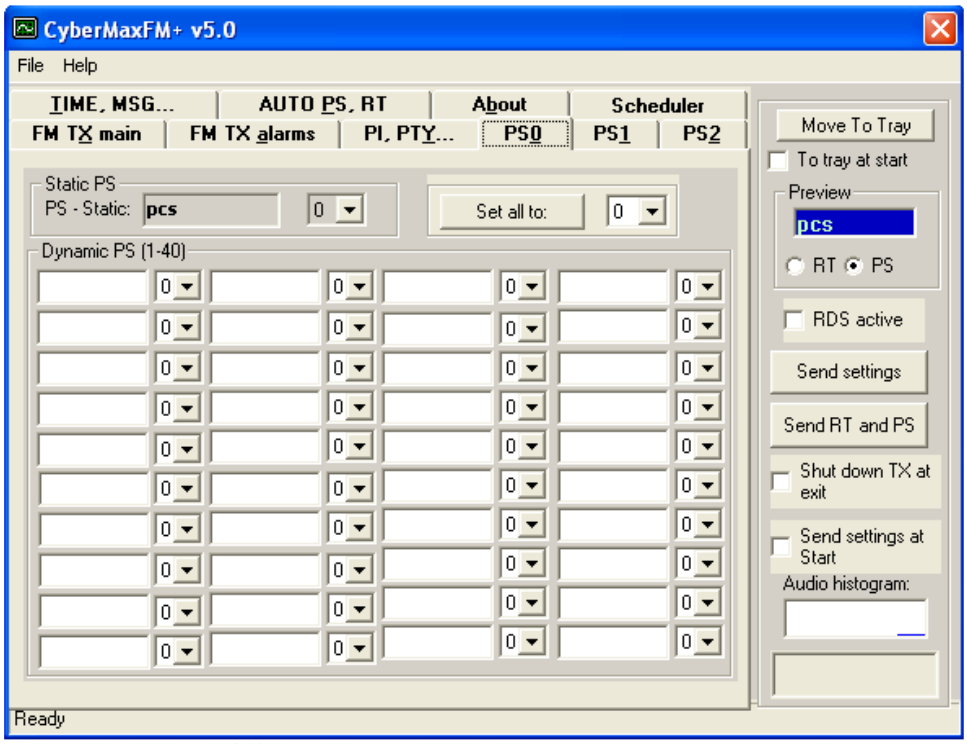


Fig. 23: Setting up RDS – PS fields

PS

This is the label of the program service consisting of not more than eight alphanumeric characters, which is displayed by RDS receivers in order to inform the listener what program service is being broadcast by the station to which the receiver is tuned. If you want to use just one PS setting please set delay for all others to 0. You can select delay for each of the PS labels. Note that setting a 0 disables associated PI. Labels will start at the start of the list once they reach the last defined PS label (they run in a loop). Do not exaggerate; fast changing PI labels can compromise driver safety!

More information about PS feature

This is the most interesting feature for 99% of customers out there so we will dedicate a bit more time to it. RDS standard provides for an 8-character PS string which is used to identify radio station and is displayed by RDS-enabled radio receivers. Some countries prohibit changing this text dynamically, but others don't. Whatever your decision may be, RDSMAX supports either static or dynamic PS. It is best to check with the local authorities before setting up the RDS encoder. The mechanism for handling dynamic (or static) PS text is best demonstrated by the following example: Imagine a train traveling in a round trip involving 100 train stations. The train starts on station 00 (PS00) and goes through stations 01, 02…. until it passes through station 99 and finally returns to station 00. Every time a train stops at the station it sends the message back to the headquarters (PS text shown on RDS receiver). The amount of time the train stays at the station (delay - PD00 to PD99) varies and can be from 0 minutes (train does not stop) to 9 minutes. I hope this little analogy has illustrated the process. You have 100 8-character strings (PS00 to PS99) which are displayed one after the other until the entire loop repeats itself. You can define how long each of these strings is displayed, the parameter which defines this is PD (PD00 to PD99).

Example: If you wish to just have one static PS, set all delays to 0 and set just PD00 to 1. Then set PS00 to desired states PS, which will be displayed indefinitely.

PS1

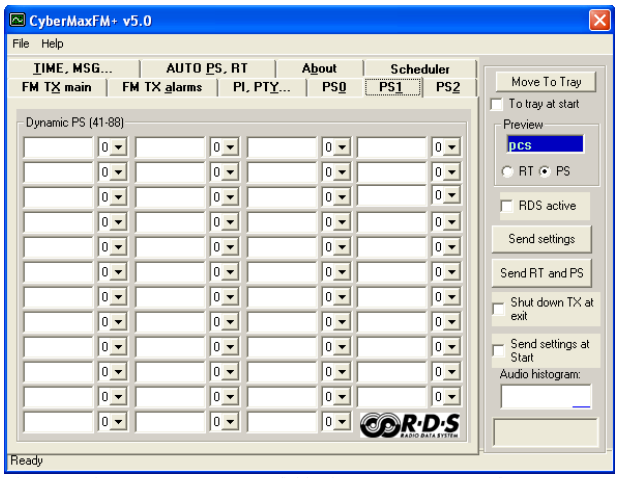


Fig. 24: Setting up RDS – More PS fields, there are too many to fit on one page

PS2

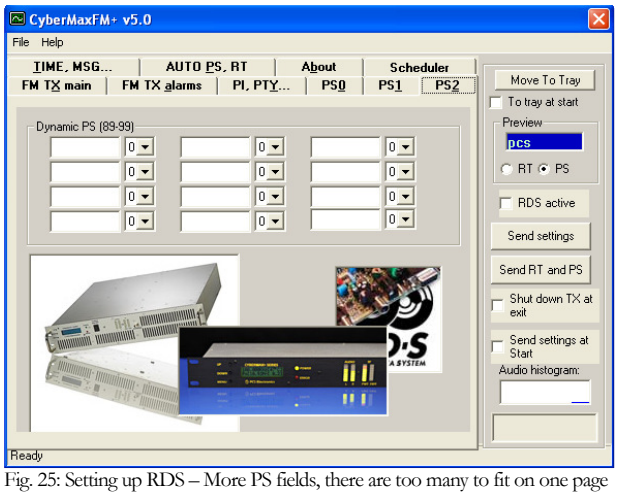


Fig. 25: Setting up RDS – More PS fields, there are too many to fit on one page

TIME, MSG...

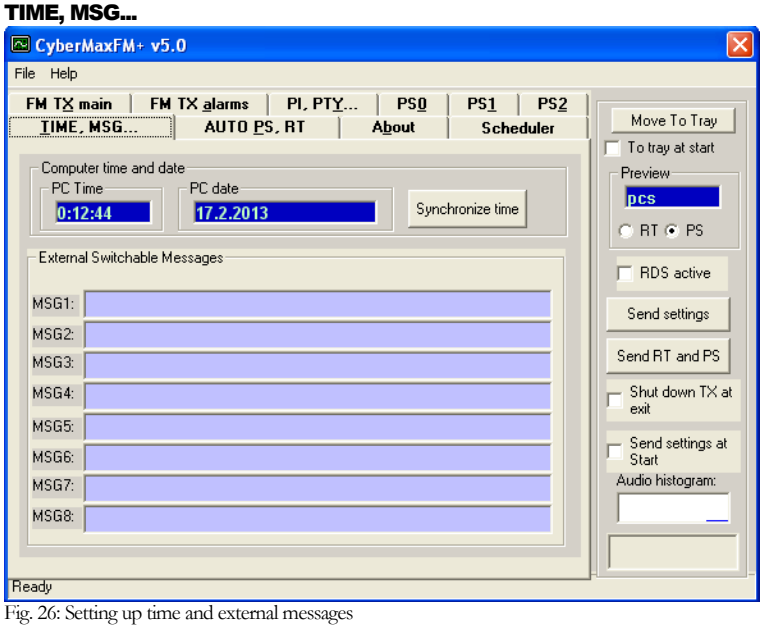


Fig. 26: Setting up time and external messages

Computer time and date

Select to Synchronize RDS RTC (Real Time Clock) with current PC clock.

External switchable messages

To activate these messages attach 8 switches to header J10 (EXTMSG). These switches must be going to ground from each of the 8 pins and are activated when you ground the corresponding pin. Message is scrolled, if larger than 8 characters.

AUTO PS, RT...

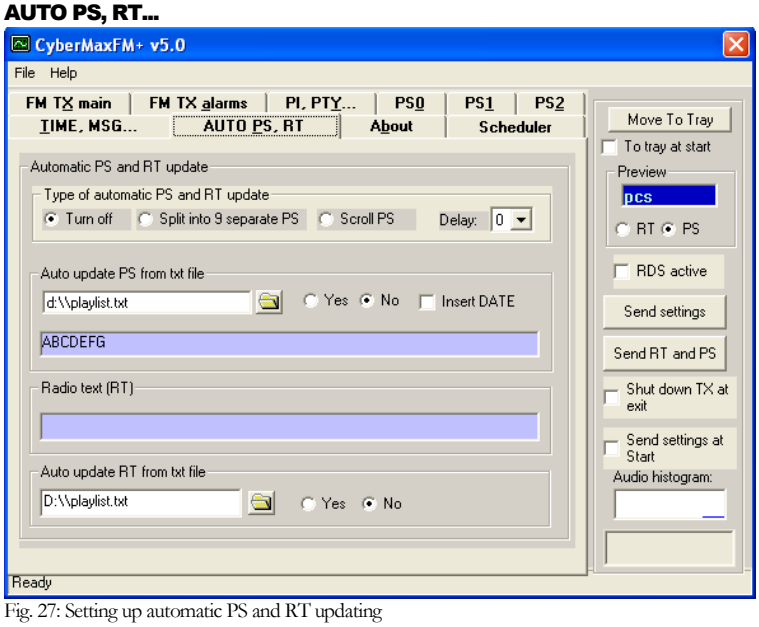


Fig. 27: Setting up automatic PS and RT updating

Auto PS and RT update is another hugely popular feature. Basically you can take the song title from Winamp or another program via text file. Winamp must be setup to write its song info into a text file; this is done with TitleSpy plug-in. Most other playback programs can easily be setup to write song info into a text file. You can use this info to update PS or RT text. PS text is limited to 8 characters so the entire song title can either be scrolled or split into 8-character blocks. You can set the speed of scrolling on the panel above. You can also insert DATE at the end of the scrolling block. A really popular and nifty feature indeed. This feature requires your PC to be connected to the RDS encoder at all times during music playback.

Auto update PS from txt file

This mode makes it possible to have the PS updated automatically. A number of very useful features make this mode extremely useful. It is possible to insert time, date or song name from external file. This external file can be updated via Winamp or any other program. If you want to collect data from Winamp (MP3 ID tag, song name) please use winamp plug-in called VtitleSpy. This little program is usually packaged into installation file; you will find it in the installation folder where you installed the program. Run the exe file and configure it to output winamp song info into your text file and then set CyberMaxFM+ program to read song name from that file. Also make sure you setup VtitleSpy plug-in to limit song name to 64 characters.

Auto update RT from txt file

This is another popular feature, RDS allows for 64-character text string to be displayed on the receiver. However this feature is rarely used as you need to press a button to display it (PS is always displayed by default). Another "nail in RTs' coffin" is the fact that typical receiver only displays a maximum of 8-characters at a time meaning the message needs to be scrolled. However popular or unpopular it may be, we support it. The field at the top (RT) shows the currently active RT message

The auto update RT field makes it possible to collect the RT from any text file. In order to pick RT from a text file select the text file with the browse button and enable auto update by selecting the Yes option. CyberMaxFM+ will check the file once every second and update the encoder automatically if it detects any changes of the text file. If you want to collect data from Winamp (MP3 ID tag, song name) please use winamp plug-in called VtitleSpy. This little program is usually packaged into installation file; you will find it in the installation folder where you installed the program. Run the exe file and configure it to output winamp song info into your text file and then set CyberMaxFM+ program to read song name from that file. Also make sure you setup VtitleSpy plug-in to limit song name to 64 characters.

About

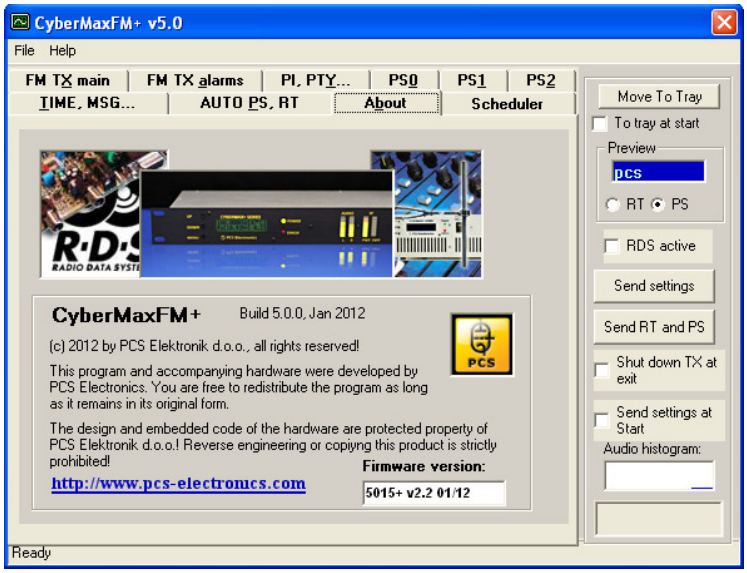


Fig. 28: About…

Firmware version

This is the firmware version of your FM transmitter board. For this to display you need to read data from the transmitter at least once (Read TX or Auto read TX).

Common controls

Fig. 29: Common controls

These are common controls belonging to all program tabs.

Move to tray

Click ***Move to tray*** to move this program into taskbar. Check ***To tray at start*** checkbox to start the program minimized in system tray.

Preview

This window shows PS and RT preview. Select desired preview type by clicking appropriate radio button.

RDS active

Check this box to activate or deactivate RDS altogether.

Send settings

Send TX settings and ***Send RT and PS*** buttons may change their appearance and accessibility according to currently active tab. Use ***Send settings*** to send parameter values + PS00 and RT to RDS encoder. Use ***Send RT and PS*** to send all PS and RT parameters to RDS encoder.

Shut down TX at exit

Check this box to automatically reduce transmitting power to 0 when exiting the program.

Send settings at start

Check this box to automatically send TX settings at starting the program. This may come handy when *Shutdown TX at exit* is activated to automatically raise TX power when next time starting the program.

Audio histogram

Every time the transmitter status is read, a new audio level value is added at the histogram. Status may be read manually (by clicking *Read TX button*) or automatically (by checking *Auto TX read* checkbox). Levels above 80% are marked in red color.

Status window

Some communication activities can be observed here.

Scheduler

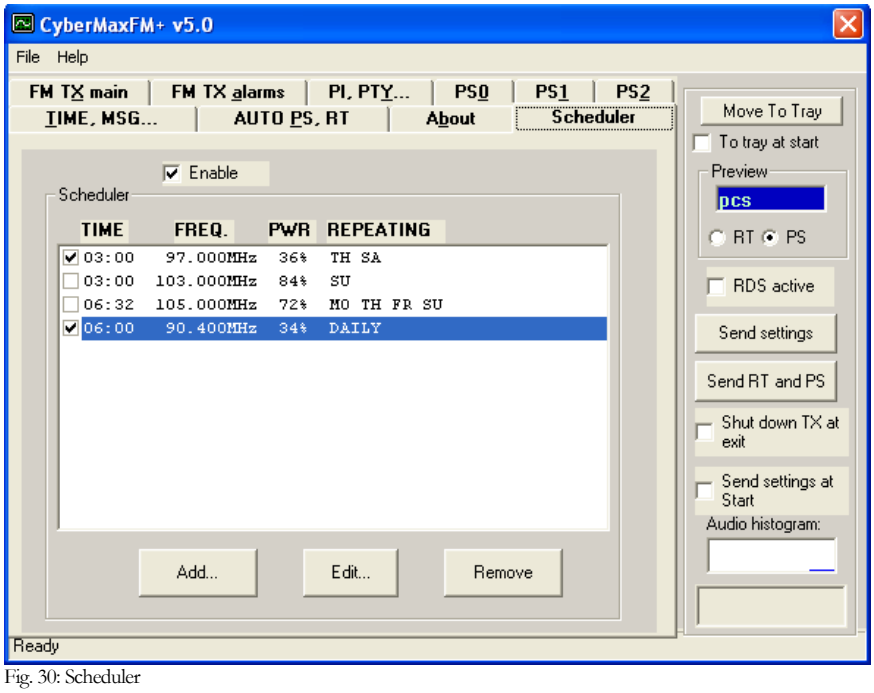


Fig. 30: Scheduler

Built-in scheduler allows to user determine automatic switching of transmitting power and frequency according to predefined scheme. Schemes can be defined on daily or weekly basis. **To accomplish this task the PC must be connected to the transmitter and the program must be running all the time!**

Up to 20 controlling lines can be entered into list box. Each line defines transmitting power, frequency and switching time. Put a tick at the beginning of each line to make that line active. There can be many lines active if desired. It is recommended to be careful while entering lines not to make time-overlapping lines active at the same time.

Example: if you define a line on daily basis and at the same time another weekly based line is active the results may be unpredictable. You can always enter many lines and then decide which of them should be momentarily active by putting ticks into checkboxes.

Enable
Check this box to make the scheduler active in general.

Add...
Click Add... button to open Add form to add a new line into list box.

Edit
Select desired line first, then click Edit to open Edit form.

Remove
Select desired line first, then click Remove to delete it.

Add scheme dialog

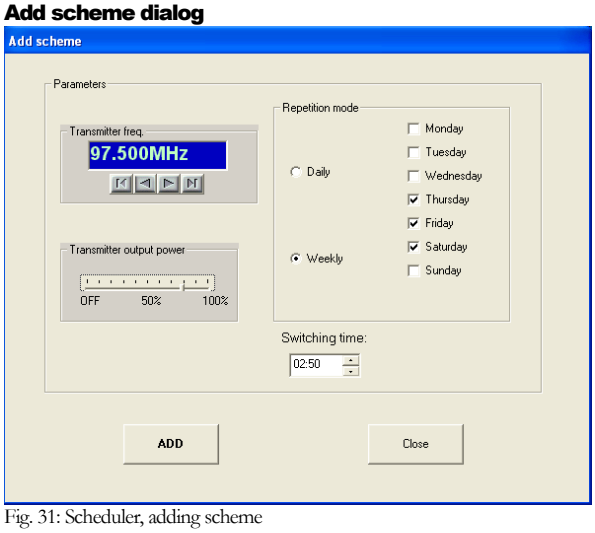


Fig. 31: Scheduler, adding scheme

Add scheme dialog lets you enter the following parameters:

Transmitter frequency, transmitter power and repetition mode which can be either Daily or Weekly. Daily repetition mode switches every day at the same time. To make sense, at least two daily based lines should be active at the same time. Weekly repetition mode allows individual selection for each day in the week.

Add or Modify

Click this button to accept changes. In the case of adding lines more lines can be entered subsequently.

Close or Cancel

Click this button to finish adding lines or to cancel editing.

Chapter

8

Troubleshooting

We hope you'll never get to this step. We all know bad things happen but do not despair! MAX PRO 5000+ series exciters are 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 32: So, do you think you can handle it? We think you sure can!

PROBLEM DESCRIPTION	POSSIBLE SOLUTIONS
Everything appears normal, but there is no RF power	1. Wait a few more seconds, MAX PRO 2015 series exciters need about 10-15 seconds to get their power to full 2. Maybe one of the alarms was triggered and power was reduced, try to power off and power back on, whenever an alarm is triggered power may be reduced until you power off and back on
DIP mode shown on LCD, controls don't work	Set all DIP switches to OFF, the unit is in DIP mode as soon as any switch is moved to ON.
RF output power is too low	1. Check the power limit jumper J4 2. Maybe one of the alarms was triggered and power was reduced, try to power off and power back on, whenever an alarm is triggered power may be reduced until you power off and back on 3. Find out which alarm was triggered, maybe your unit is over-heating or your antenna (SWR) may be way off. Let the unit cool off and ensure proper cooling in the future. Perhaps you adjusted TEMP ALARM or another alarm too low, set it slightly higher. 4. Exciter may not give full 15W when you use a supply voltage of less than 15V.
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, set it slightly higher. 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).
Audio too quiet/loud	1. Open or close the modulation trimmer on MAX PRO 2015+ series exciter board a little bit. 2. Increase or decrease level on your audio source a little bit, start using software or hardware compressor
Audio too loud	Close the modulation trimmer on MAX PRO 5000+ 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, SE2000 or SE6000).
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 excessive current draw 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 (for your stereo encoder, SE5000 and SE2000 have XLR inputs) - 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	Verify position of the J4 power limit jumpers. A jumper installed there will limit maximum power to 2W, 5W or 8W. If you want full power please remove the jumper.
I2C error	Did you plug the stereo encoder into LCD module by any chance? Stereo encoder should be plugged into main RF board!
Output power less than expected	If unit is overheating it will start reducing output power, make sure it is sufficiently cooled! Reduced power will return only after you power off and on the unit (or change power setting).

Table 6: Troubleshooting MAX PRO 2015+ series FM exciter

Chapter

9

Limiting maximum adjustable power for driving pallets

MAX PRO 2015 has been developed as a pallet driver and it is ideal for this task. Of course for most situations 15W will be too much and you will 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 will eventually 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. You should **PERFORM THESE ADJUSTMENTS BEFORE CONNECTING AMPLIFIER** as otherwise it may be too late, a short burst of full power before you turn the power off or adjust the trimmer may kill the amplifier. A very good design practice is also to use an attenuator (just a small 1-3dB) between exciter and amplifier, remember amplifiers input impedance can be a long way from prescribed 50 ohms and attenuator nicely equalizes that out.

Step1 – establish needed drive power

Check the datasheet/specs of your amplifier, it will state how much drive power is needed. For the purpose of simplicity let us assume that the datasheet asks for 3.7W of drive power. Since there is some variation from pallet to pallet and we want to have a tiny bit of headroom also for the attenuator lets set output power to 4W.

Step2 – set maximum output power to 4W

Look for power limit jumper J4 (F in fig 1), it is located close to the dip switch. Set J4 to 4W, this will limit output power to 4W. Thanks to the new design of the MAXPRO2015+ this output power is flat across the entire FM band, this is a great advantage compared to our older 2000 and 3000+ series exciters.

Step3 – reduce 4W down to the needed 3.7W

It is a good design practice to use an attenuator (just a small 1-3dB) between exciter and amplifier, remember amplifiers input impedance can be a long way from prescribed 50 ohms and attenuator nicely equalizes that out. However you can also simply turn the fine power meter adjust until the output power reaches 3,7W exactly. To do this follow simple procedure:

- Set power to full 4W and power up the unit with power meter and dummy load attached. Wait for the power to come all the way up to 4W.

- Now turn the fine power meter adjust trimmer (marked D on figure 1) until power meter shows exactly 3.7W

- Power the unit off and back on to make sure it gives exactly 3.7W (meter is calibrated at power-up). Repeat, if necessary.

By doing this your LCD adjustment range goes from 0 to 3.7W in nice even steps (LCD shows 4W max, but exciter will actually give 3.7W). This is perfect for driving your pallet.

Step4 – wiring up the pallet and final check

Make sure your exciter's output is set to zero and everything is powered off. Now connect the pallet, filter and power supply. Wire everything and verify it carefully to make sure there are no shorts. Make sure dummy load is connected for the test and wire power meter inline so you can monitor the power output.

Step5 – first power up and… DONE

Power up the entire setup and slowly increase drive power while observing the output power from the pallet on the power meter, also monitor temperature. Be careful never to exceed power rating of the pallet. A 500W pallet shouldn't be pushed beyond 500W. Congratulate yourself, you are done! If you want to optimize this further, read below.

Step6 – taking it further, external directional coupler

You can connect external power and swr meter (directional coupler) to J3 (K on fig 1). The two signals (pwr and swr) are provided by many filters available on the market, such as our PCS LPF 6000 or PCS LPF 7000, but any other will work, too. While running the transmitter at full power set the sensitivity trimmers for SWR and PWR on the filters so that the power shown on the LCD is the same as on the power meter. If you are getting SWR alarms you may need to reduce SWR trimmer on the filter. Cool, now you can read output power on the LCD display. Note the LCD switches to showing power measured from the filter as soon as there is some voltage on the PWR pin. But you can take things even further…

Step7 – cherry on the top - RF POWER ALC (software power limit)

After some time you may notice that while your pallet needs 3.7W of drive at 100MHz this won't necessarily be true at 108MHz. Most pallets have less gain at band edges and need more drive there. What to do?

Well, luckily we have included a very important new feature in MAX PRO 2015+ series exciters, we call it RF POWER ALC, and it is basically a software power limit. There is a menu option with this name and it lets you select the maximum power allowed. For example, you can set it to a number of pre-defined values, such as 50W, 300W, 500W, 1000W etc. This menu option is usually locked, to unlock it look at the LCD module board and solder a bridge across "Free". You will now be able to enter and change the RF POWER ALC setting. After changing this value please remove the solder bridge, accidental or malicious change will allow the exciter to overdrive the amplifier which will probably result in damage.

How does it work? It relies on the accurate power signal from directional coupler. After start-up the exciter will increase its drive slowly until the amplifier reaches for example 500W. As soon as power limit is reached the exciter will stop increasing its drive. This ensures 500W across the band without any over-driving problems. Obviously this only works well when the directional couplers are setup properly and power readout needs to be calibrated correctly with trimmers such as the PWR trimmer on the PCS LPF 5000/6000/7000 filter.

Once you have power limit working you can increase the exciter power back to 4W or more (trimmer D or power limit jumpers) as it is now impossible to overdrive the pallet, as long as the external power meter is setup and working). The system will also raise SWR alarm, if needed. And it will reduce the drive if you increase power supply voltage to the pallet, always making sure 500W is not exceeded.

Step8 – what if I use a DIP switch and no LCD?

No problem, the exciter power will always go to the max value set by the jumpers. So set the power limit jumpers and adjust the power trim trimmer, if necessary. Software power limit is available as well in DIP switch mode. Steps 1-5 are basically the same, after that connect external power/swr signals. First set the two sensitivity trimmers on the filter to zero, than slowly increase the power trimmer. Do this slowly and observe the power meter. At some point the power will start to decrease. At this point stop changing the trimmer; your software power limit is set. Do the same with SWR sensitivity, at some point a SWR alarm will trigger and power will decrease. Set the trimmer slightly above that setting and you are good to go.

PERFORM STEPS 1-4 BEFORE CONNECTING AMPLIFIER/PALLET!

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

Appendix

A

Appendix A: 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:

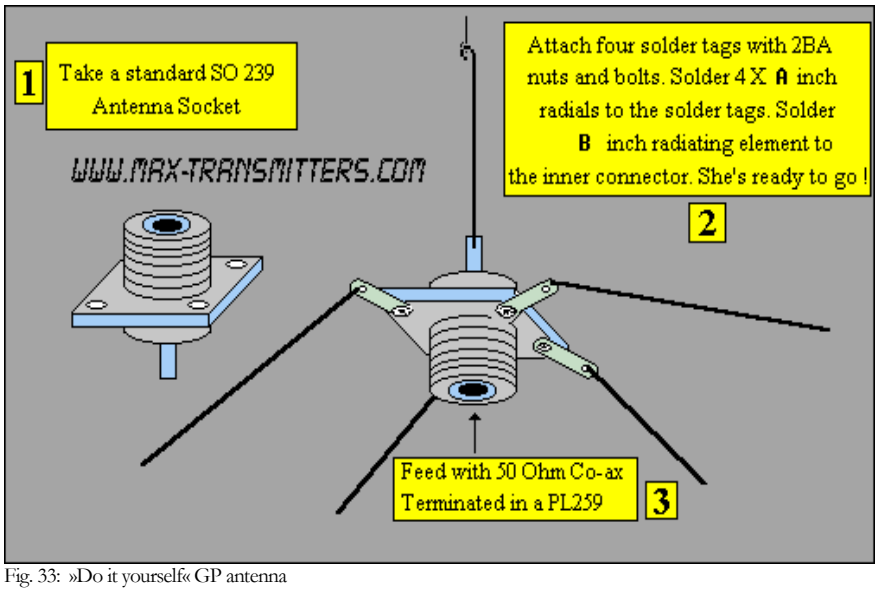


Fig. 33: »Do it yourself« GP antenna

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

B

Appendix B: 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 5000+ series 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 5000+ series exciter 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).

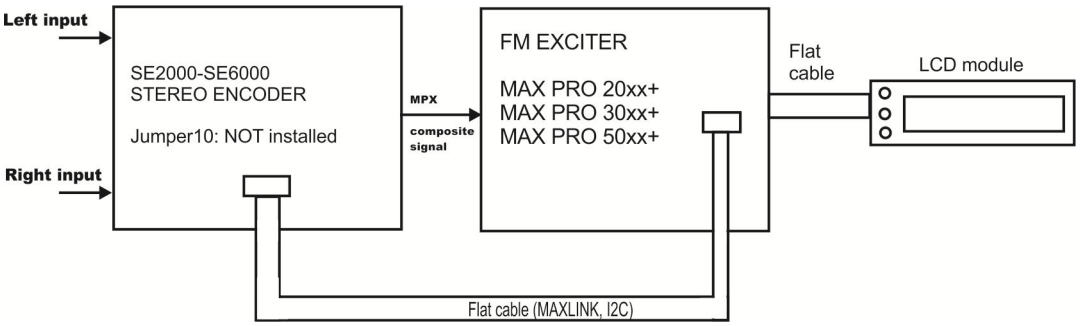


Fig. 34: Connecting stereo encoder to FM exciter.

Appendix

C

Appendix C: 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 2015+ 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. MAX PRO 2015+ have ability to read power/swr with external amplifier installed. To top this off, swr and temperature protection still works just like before.

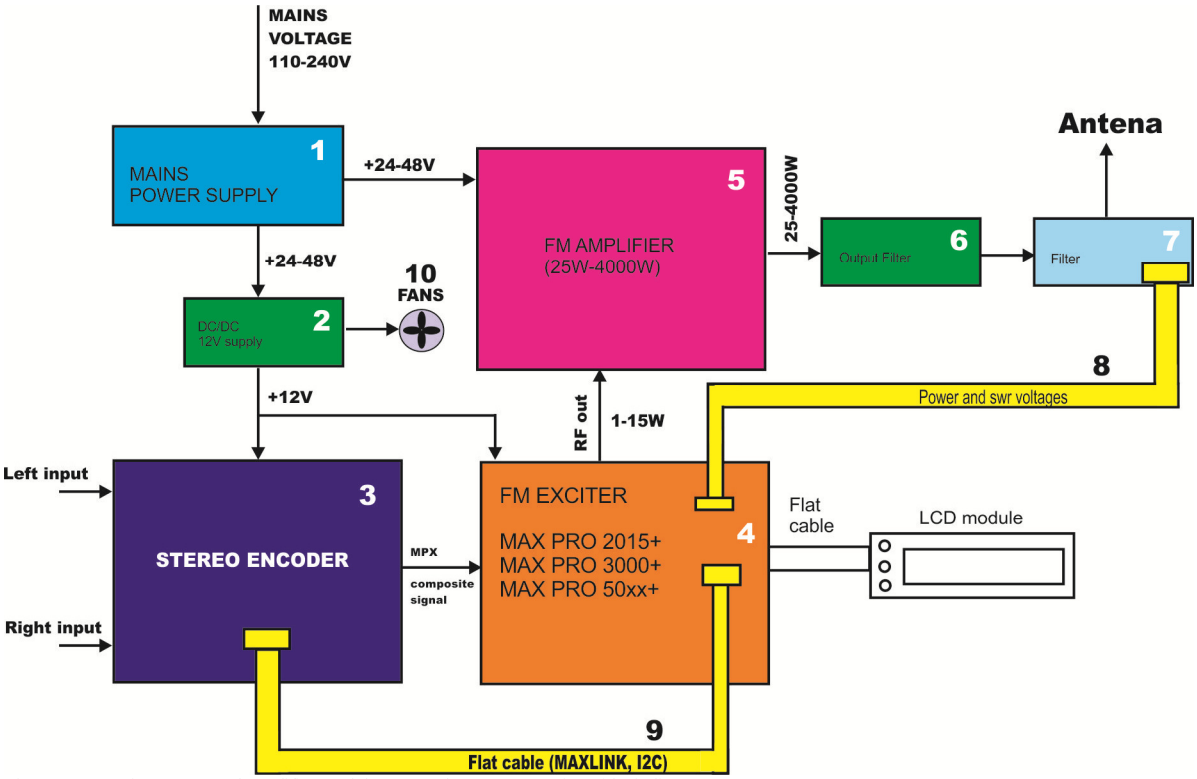


Fig. 35: Connecting an external amplifier module – Complete FM transmitter, block diagram

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), directional coupler sometimes part of filter (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 20-30% 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 2015+ series, 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 manual. 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 heat sink 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 heat sink 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.

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 heat sink and low pass filter do not require extra filter): http://www.pcs-electronics.com/transmitter-accesories-filters-transmitters-c-71_73.html

However, for best results use our filters with built-in DIGIAMP interface, such as PCS LPF 6000. Using this filter simplifies installation as most of the necessary signals are provided via DIGIAMP interface, also everything under 6 and 7 is than combined into one unit (PCS LPF 6000).

7. and 8.) Directional coupler, this is often a part of filter for your convenience. Power and swr signals are measured here and transferred to exciter board. It makes it possible for MAX PRO 2015+ to read POWER and SWR of the amplifier module.

9.) 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

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 (PTFE) 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

D

Appendix D: ControlMini 2 – directional coupler

This board measures the swr and power and you can use it to provide function od block 7 on Fig 35 a couple pages back. SWR and PWR signals are provided and enable MAXPRO2015+ to show Power and SWR after amplifier.

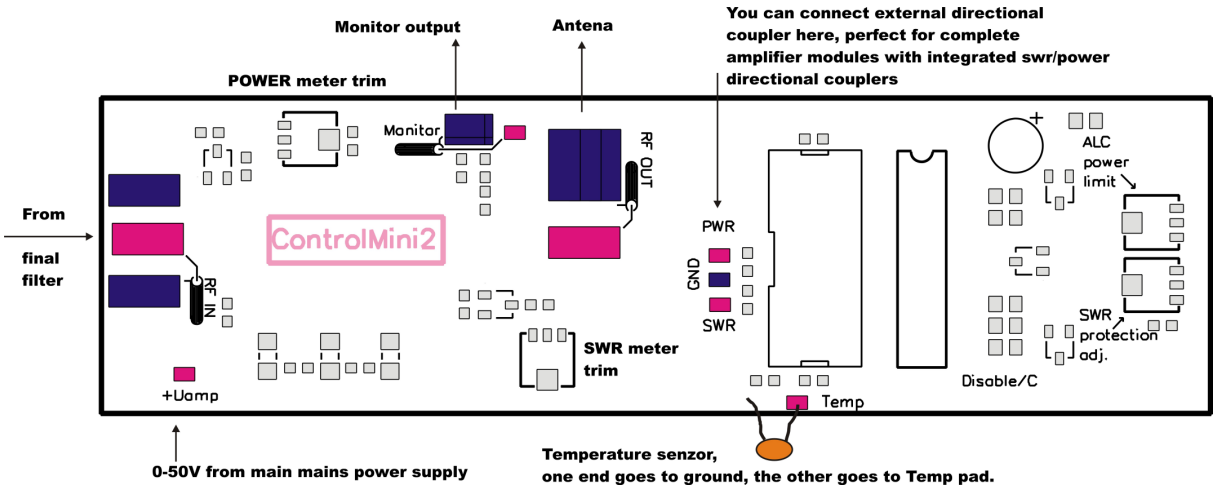


Fig. 36: ControlMini2, up close and personal

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 two trimmers, power meter trim and swr meter trim? Adjust trimmers until power shown on the LCD is correct, you can verify this with any reliable Power/Swr meter.

Note the 10-pin connector in the middle? It is not needed for MAXPRO2015+ The IC in the socket next to this connector is not installed and this is ok. Note there is a special solder post for supply voltage (Uamp), leave it unused. Also no need to connect temp sensor as MAXPRO2015+ does not support this.

Appendix

E

Appendix E: DIP switch frequency table

The telemetry header/connector makes it possible to remotely check various voltages without opening out the case. You can connect a DB9 or similar connector to the back panel of your transmitter rack. Telemetry header also makes it possible to disable transmitter remotely by pulling one of the lines low. This can be used to disable transmitter when a switch is closed, for example when a door is opened, if there is no signal from STL or similar.

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	Frequency MHz
0	0	0	0	0	0	0	0	0	0	LCD MODE
1	0	0	0	0	0	0	0	0	0	87000 MHz
0	1	0	0	0	0	0	0	0	0	87100 MHz
1	1	0	0	0	0	0	0	0	0	87200 MHz
0	0	1	0	0	0	0	0	0	0	87300 MHz
1	0	1	0	0	0	0	0	0	0	87400 MHz
0	1	1	0	0	0	0	0	0	0	87500 MHz
1	1	1	0	0	0	0	0	0	0	87600 MHz
0	0	0	1	0	0	0	0	0	0	87700 MHz
1	0	0	1	0	0	0	0	0	0	87800 MHz
0	1	0	1	0	0	0	0	0	0	87900 MHz
1	1	0	1	0	0	0	0	0	0	88000 MHz
0	0	1	1	0	0	0	0	0	0	88100 MHz
1	0	1	1	0	0	0	0	0	0	88200 MHz
0	1	1	1	0	0	0	0	0	0	88300 MHz
1	1	1	1	0	0	0	0	0	0	88400 MHz
0	0	0	0	1	0	0	0	0	0	88500 MHz
1	0	0	0	1	0	0	0	0	0	88600 MHz
0	1	0	0	1	0	0	0	0	0	88700 MHz
1	1	0	0	1	0	0	0	0	0	88800 MHz
0	0	1	0	1	0	0	0	0	0	88900 MHz
1	0	1	0	1	0	0	0	0	0	89000 MHz
0	1	1	0	1	0	0	0	0	0	89100 MHz
1	1	1	0	1	0	0	0	0	0	89200 MHz
0	0	0	1	1	0	0	0	0	0	89300 MHz
1	0	0	1	1	0	0	0	0	0	89400 MHz
0	1	0	1	1	0	0	0	0	0	89500 MHz
1	1	0	1	1	0	0	0	0	0	89600 MHz
0	0	1	1	1	0	0	0	0	0	89700 MHz
1	0	1	1	1	0	0	0	0	0	89800 MHz
0	1	1	1	1	0	0	0	0	0	89900 MHz
1	1	1	1	1	0	0	0	0	0	90000 MHz
0	0	0	0	0	1	0	0	0	0	90100 MHz
1	0	0	0	0	1	0	0	0	0	90200 MHz
0	1	0	0	0	1	0	0	0	0	90300 MHz

1	1	0	0	0	1	0	0	0	0	90400 MHz
0	0	1	0	0	1	0	0	0	0	90500 MHz
1	0	1	0	0	1	0	0	0	0	90600 MHz
0	1	1	0	0	1	0	0	0	0	90700 MHz
1	1	1	0	0	1	0	0	0	0	90800 MHz
0	0	0	1	0	1	0	0	0	0	90900 MHz
1	0	0	1	0	1	0	0	0	0	91000 MHz
0	1	0	1	0	1	0	0	0	0	91100 MHz
1	1	0	1	0	1	0	0	0	0	91200 MHz
0	0	1	1	0	1	0	0	0	0	91300 MHz
1	0	1	1	0	1	0	0	0	0	91400 MHz
0	1	1	1	0	1	0	0	0	0	91500 MHz
1	1	1	1	0	1	0	0	0	0	91600 MHz
0	0	0	0	1	1	0	0	0	0	91700 MHz
1	0	0	0	1	1	0	0	0	0	91800 MHz
0	1	0	0	1	1	0	0	0	0	91900 MHz
1	1	0	0	1	1	0	0	0	0	92000 MHz
0	0	1	0	1	1	0	0	0	0	92100 MHz
1	0	1	0	1	1	0	0	0	0	92200 MHz
0	1	1	0	1	1	0	0	0	0	92300 MHz
1	1	1	0	1	1	0	0	0	0	92400 MHz
0	0	0	1	1	1	0	0	0	0	92500 MHz
1	0	0	1	1	1	0	0	0	0	92600 MHz
0	1	0	1	1	1	0	0	0	0	92700 MHz
1	1	0	1	1	1	0	0	0	0	92800 MHz
0	0	1	1	1	1	0	0	0	0	92900 MHz
1	0	1	1	1	1	0	0	0	0	93000 MHz
0	1	1	1	1	1	0	0	0	0	93100 MHz
1	1	1	1	1	1	0	0	0	0	93200 MHz
0	0	0	0	0	0	1	0	0	0	93300 MHz
1	0	0	0	0	0	1	0	0	0	93400 MHz
0	1	0	0	0	0	1	0	0	0	93500 MHz
1	1	0	0	0	0	1	0	0	0	93600 MHz
0	0	1	0	0	0	1	0	0	0	93700 MHz
1	0	1	0	0	0	1	0	0	0	93800 MHz
0	1	1	0	0	0	1	0	0	0	93900 MHz
1	1	1	0	0	0	1	0	0	0	94000 MHz
0	0	0	1	0	0	1	0	0	0	94100 MHz
1	0	0	1	0	0	1	0	0	0	94200 MHz
0	1	0	1	0	0	1	0	0	0	94300 MHz
1	1	0	1	0	0	1	0	0	0	94400 MHz
0	0	1	1	0	0	1	0	0	0	94500 MHz
1	0	1	1	0	0	1	0	0	0	94600 MHz
0	1	1	1	0	0	1	0	0	0	94700 MHz
1	1	1	1	0	0	1	0	0	0	94800 MHz
0	0	0	0	1	0	1	0	0	0	94900 MHz
1	0	0	0	1	0	1	0	0	0	95000 MHz
0	1	0	0	1	0	1	0	0	0	95100 MHz

1	1	0	0	1	0	1	0	0	0	95200 MHz
0	0	1	0	1	0	1	0	0	0	95300 MHz
1	0	1	0	1	0	1	0	0	0	95400 MHz
0	1	1	0	1	0	1	0	0	0	95500 MHz
1	1	1	0	1	0	1	0	0	0	95600 MHz
0	0	0	1	1	0	1	0	0	0	95700 MHz
1	0	0	1	1	0	1	0	0	0	95800 MHz
0	1	0	1	1	0	1	0	0	0	95900 MHz
1	1	0	1	1	0	1	0	0	0	96000 MHz
0	0	1	1	1	0	1	0	0	0	96100 MHz
1	0	1	1	1	0	1	0	0	0	96200 MHz
0	1	1	1	1	0	1	0	0	0	96300 MHz
1	1	1	1	1	0	1	0	0	0	96400 MHz
0	0	0	0	0	1	1	0	0	0	96500 MHz
1	0	0	0	0	1	1	0	0	0	96600 MHz
0	1	0	0	0	1	1	0	0	0	96700 MHz
1	1	0	0	0	1	1	0	0	0	96800 MHz
0	0	1	0	0	1	1	0	0	0	96900 MHz
1	0	1	0	0	1	1	0	0	0	97000 MHz
0	1	1	0	0	1	1	0	0	0	97100 MHz
1	1	1	0	0	1	1	0	0	0	97200 MHz
0	0	0	1	0	1	1	0	0	0	97300 MHz
1	0	0	1	0	1	1	0	0	0	97400 MHz
0	1	0	1	0	1	1	0	0	0	97500 MHz
1	1	0	1	0	1	1	0	0	0	97600 MHz
0	0	1	1	0	1	1	0	0	0	97700 MHz
1	0	1	1	0	1	1	0	0	0	97800 MHz
0	1	1	1	0	1	1	0	0	0	97900 MHz
1	1	1	1	0	1	1	0	0	0	98000 MHz
0	0	0	0	1	1	1	0	0	0	98100 MHz
1	0	0	0	1	1	1	0	0	0	98200 MHz
0	1	0	0	1	1	1	0	0	0	98300 MHz
1	1	0	0	1	1	1	0	0	0	98400 MHz
0	0	1	0	1	1	1	0	0	0	98500 MHz
1	0	1	0	1	1	1	0	0	0	98600 MHz
0	1	1	0	1	1	1	0	0	0	98700 MHz
1	1	1	0	1	1	1	0	0	0	98800 MHz
0	0	0	1	1	1	1	0	0	0	98900 MHz
1	0	0	1	1	1	1	0	0	0	99000 MHz
0	1	0	1	1	1	1	0	0	0	99100 MHz
1	1	0	1	1	1	1	0	0	0	99200 MHz
0	0	1	1	1	1	1	0	0	0	99300 MHz
1	0	1	1	1	1	1	0	0	0	99400 MHz
0	1	1	1	1	1	1	0	0	0	99500 MHz
1	1	1	1	1	1	1	0	0	0	99600 MHz
0	0	0	0	0	0	0	1	0	0	99700 MHz
1	0	0	0	0	0	0	1	0	0	99800 MHz
0	1	0	0	0	0	0	1	0	0	99900 MHz

1	1	0	0	0	0	0	1	0	0	100000 MHz
0	0	1	0	0	0	0	1	0	0	100100 MHz
1	0	1	0	0	0	0	1	0	0	100200 MHz
0	1	1	0	0	0	0	1	0	0	100300 MHz
1	1	1	0	0	0	0	1	0	0	100400 MHz
0	0	0	1	0	0	0	1	0	0	100500 MHz
1	0	0	1	0	0	0	1	0	0	100600 MHz
0	1	0	1	0	0	0	1	0	0	100700 MHz
1	1	0	1	0	0	0	1	0	0	100800 MHz
0	0	1	1	0	0	0	1	0	0	100900 MHz
1	0	1	1	0	0	0	1	0	0	101000 MHz
0	1	1	1	0	0	0	1	0	0	101100 MHz
1	1	1	1	0	0	0	1	0	0	101200 MHz
0	0	0	0	1	0	0	1	0	0	101300 MHz
1	0	0	0	1	0	0	1	0	0	101400 MHz
0	1	0	0	1	0	0	1	0	0	101500 MHz
1	1	0	0	1	0	0	1	0	0	101600 MHz
0	0	1	0	1	0	0	1	0	0	101700 MHz
1	0	1	0	1	0	0	1	0	0	101800 MHz
0	1	1	0	1	0	0	1	0	0	101900 MHz
1	1	1	0	1	0	0	1	0	0	102000 MHz
0	0	0	1	1	0	0	1	0	0	102100 MHz
1	0	0	1	1	0	0	1	0	0	102200 MHz
0	1	0	1	1	0	0	1	0	0	102300 MHz
1	1	0	1	1	0	0	1	0	0	102400 MHz
0	0	1	1	1	0	0	1	0	0	102500 MHz
1	0	1	1	1	0	0	1	0	0	102600 MHz
0	1	1	1	1	0	0	1	0	0	102700 MHz
1	1	1	1	1	0	0	1	0	0	102800 MHz
0	0	0	0	0	1	0	1	0	0	102900 MHz
1	0	0	0	0	1	0	1	0	0	103000 MHz
0	1	0	0	0	1	0	1	0	0	103100 MHz
1	1	0	0	0	1	0	1	0	0	103200 MHz
0	0	1	0	0	1	0	1	0	0	103300 MHz
1	0	1	0	0	1	0	1	0	0	103400 MHz
0	1	1	0	0	1	0	1	0	0	103500 MHz
1	1	1	0	0	1	0	1	0	0	103600 MHz
0	0	0	1	0	1	0	1	0	0	103700 MHz
1	0	0	1	0	1	0	1	0	0	103800 MHz
0	1	0	1	0	1	0	1	0	0	103900 MHz
1	1	0	1	0	1	0	1	0	0	104000 MHz
0	0	1	1	0	1	0	1	0	0	104100 MHz
1	0	1	1	0	1	0	1	0	0	104200 MHz
0	1	1	1	0	1	0	1	0	0	104300 MHz
1	1	1	1	0	1	0	1	0	0	104400 MHz
0	0	0	0	1	1	0	1	0	0	104500 MHz
1	0	0	0	1	1	0	1	0	0	104600 MHz
0	1	0	0	1	1	0	1	0	0	104700 MHz

1	1	0	0	1	1	0	1	0	0	104800 MHz
0	0	1	0	1	1	0	1	0	0	104900 MHz
1	0	1	0	1	1	0	1	0	0	105000 MHz
0	1	1	0	1	1	0	1	0	0	105100 MHz
1	1	1	0	1	1	0	1	0	0	105200 MHz
0	0	0	1	1	1	0	1	0	0	105300 MHz
1	0	0	1	1	1	0	1	0	0	105400 MHz
0	1	0	1	1	1	0	1	0	0	105500 MHz
1	1	0	1	1	1	0	1	0	0	105600 MHz
0	0	1	1	1	1	0	1	0	0	105700 MHz
1	0	1	1	1	1	0	1	0	0	105800 MHz
0	1	1	1	1	1	0	1	0	0	105900 MHz
1	1	1	1	1	1	0	1	0	0	106000 MHz
0	0	0	0	0	0	1	1	0	0	106100 MHz
1	0	0	0	0	0	1	1	0	0	106200 MHz
0	1	0	0	0	0	1	1	0	0	106300 MHz
1	1	0	0	0	0	1	1	0	0	106400 MHz
0	0	1	0	0	0	1	1	0	0	106500 MHz
1	0	1	0	0	0	1	1	0	0	106600 MHz
0	1	1	0	0	0	1	1	0	0	106700 MHz
1	1	1	0	0	0	1	1	0	0	106800 MHz
0	0	0	1	0	0	1	1	0	0	106900 MHz
1	0	0	1	0	0	1	1	0	0	107000 MHz
0	1	0	1	0	0	1	1	0	0	107100 MHz
1	1	0	1	0	0	1	1	0	0	107200 MHz
0	0	1	1	0	0	1	1	0	0	107300 MHz
1	0	1	1	0	0	1	1	0	0	107400 MHz
0	1	1	1	0	0	1	1	0	0	107500 MHz
1	1	1	1	0	0	1	1	0	0	107600 MHz
0	0	0	0	1	0	1	1	0	0	107700 MHz
1	0	0	0	1	0	1	1	0	0	107800 MHz
0	1	0	0	1	0	1	1	0	0	107900 MHz
1	1	0	0	1	0	1	1	0	0	108000 MHz
Using MAX PRO 2015+ outside FM band may violate local regulations!										

Table 7: Lookup table for DIP switches for MAX PRO 2015+

Appendix

F

Appendix F: General tips for setting up transmitters

Typical FM transmitter setups

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

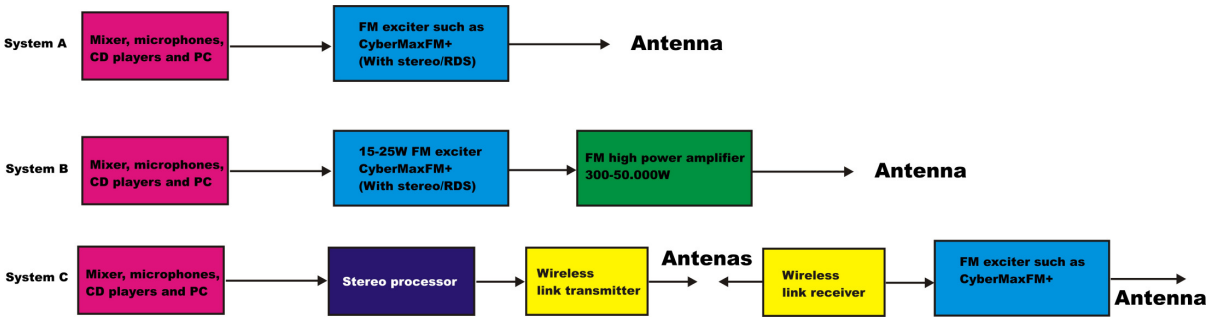


Fig. 37: Typical broadcasting systems

Let's 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 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.

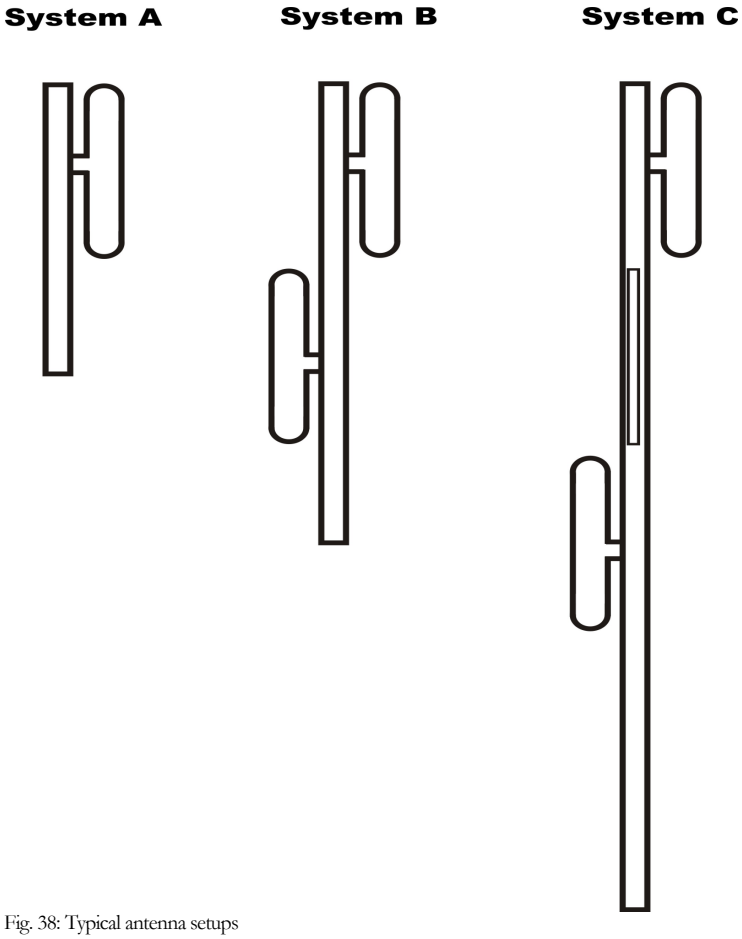


Fig. 38: Typical antenna setups

Let's 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's 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.

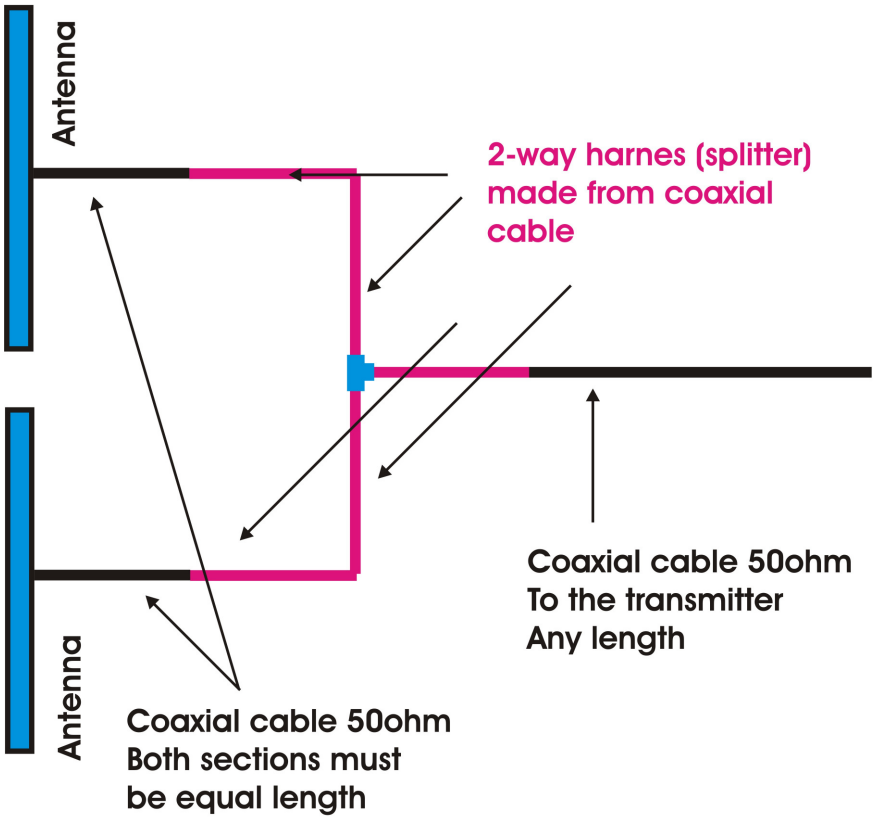


Fig. 39: Wiring multi-bay antennas

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

G

Appendix G – 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:

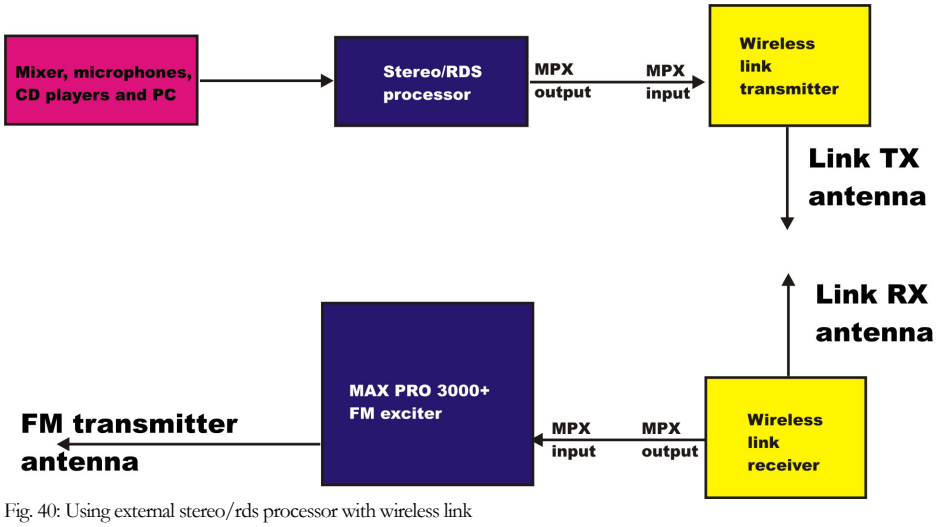


Fig. 40: Using external stereo/rds processor with wireless link

It is important that you set the pre-emphasis on the MAX PRO 50xx+ board to Off (None). If you get stuck or need our advice please contact our technical department.

Appendix H

Appendix H – IO board and PC remote control

Software installation

Download the latest CyberMaxFM+ setup file from our website. You can find it here: http://www.pcs-electronics.com/phpBB2/viewtopic.php?t=2505

Once you have the setup file run it 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.

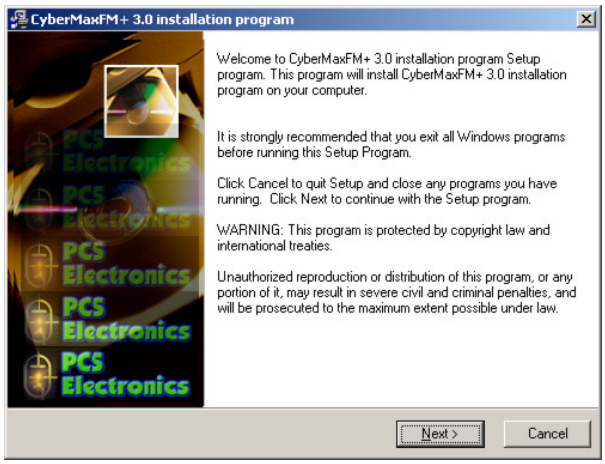


Fig. 41: Setup is about to start

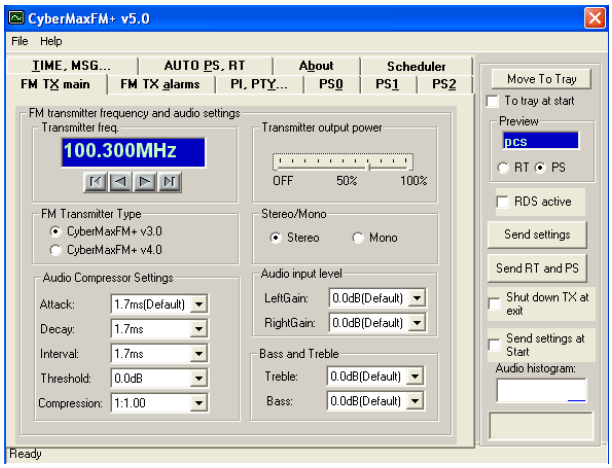


Fig. 42: CyberMaxFM+ remote control software

As you can see this program lets you control all the parameters of your FM transmitter including RDS parameters. It also lets you read all of the available information, such as output power, temperature, frequency, uptime etc. (you cannot read the RDS data, we are working on adding this functionality at some time in the future).

Once the installation is done you are ready to start the program. But before you do please establish physical connection between the transmitter and the PC, configure the COM port and take a note of the COM port used.

Using existing COM port

If you want to use the RS232 cable to connect to the transmitter board, connect the RS232 IO board and connect the RS232 cable to your computer. In this case the COM port to be used will usually be COM1 or COM2. Please note that our CyberMaxFM transmitters usually ship with only USB port active so to use RS232 you will have to open the cover and switch to RS232 internally. 99% of people nowadays prefer USB so this is not really a problem. Modern computers don't even have COM ports.

Installing USB driver (only for USB IO board)

Download the USB COM port driver, you can find it here:

http://www.pcs-electronics.com/phpBB2/viewtopic.php?t=2505

Now run the setup file. Wait for the following screen (or very similar) to appear and select the installation directory (best left alone at default location). Click Install and wait for the installation to finish.

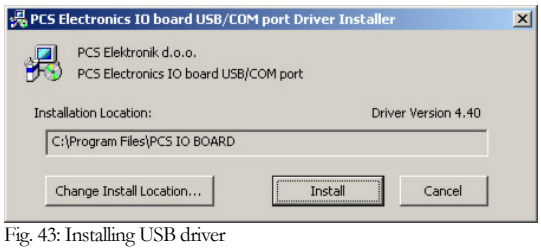


Fig. 43: Installing USB driver

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:

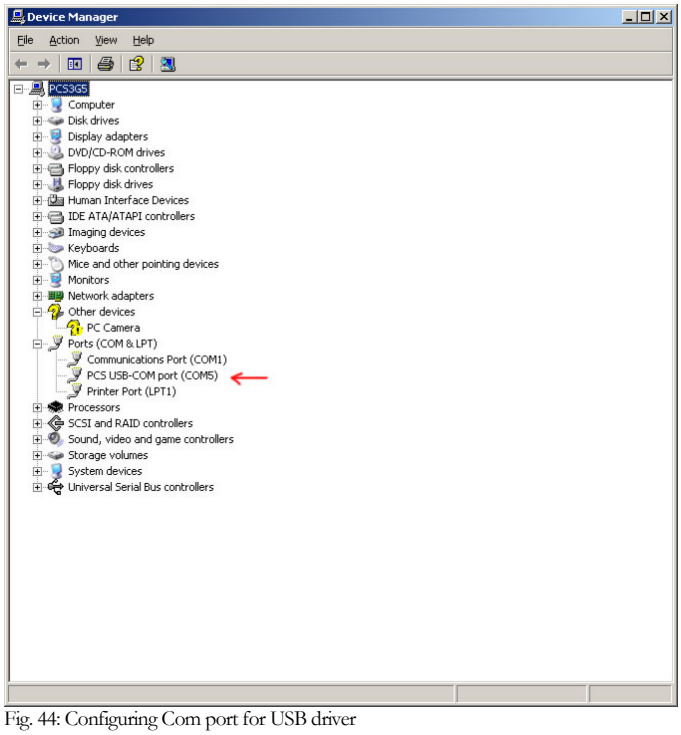


Fig. 44: Configuring Com port for USB driver

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:

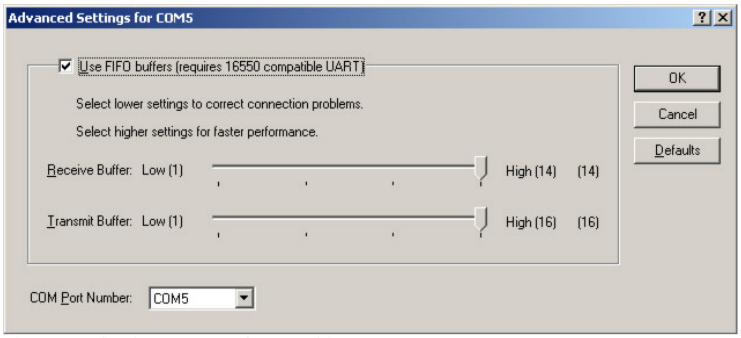


Fig. 45: Configuring Com port for USB driver

Setting up com port in CyberMaxFM+ program

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. You can set COM port manually or you can use the Autoscan feature. Make sure to set FM Transmitter type correctly (4.0 for new versions of MAXPRO5000 series) and make sure the exciter board is turned on! A short guide for manual settings: read above and make note of the used COM port. If you are using USB it will usually be COM5, when using RS232 it will usually be COM1 or 2. You can use Communication test tool to verify the selected COM port.

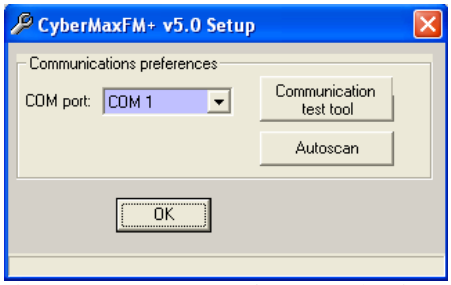


Fig. 46: Set COM port to 1 or 2 for RS232 IO board

Appendix

I

Appendix I – Setting up remote control via Ethernet

Software installation

Download the latest EthernetVirtualPort.exe from our website. You can find it here:

http://www.pcs-electronics.com/phpBB2/viewtopic.php?t=2268

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 then start the program.

Connect the MAXPRO5000 series exciter or CYBERMAXFM+ FM transmitter (which contains this exciter board) to your network via Ethernet cable (cable not included). The Ethernet adapter is setup to accept IP from your router's DHCP server. It is possible to setup Ethernet adapter with fixed IP or to login directly to ADSL modem. If you need MAC address of the Ethernet adapter open the cover of the unit and look at the Ethernet adapter, the MAC address is shown on the adapter. Now create and configure a connection between the PC and CYBERMAXFM+ as shown below. Note the IP will differ, but make sure the port is set to 5005!

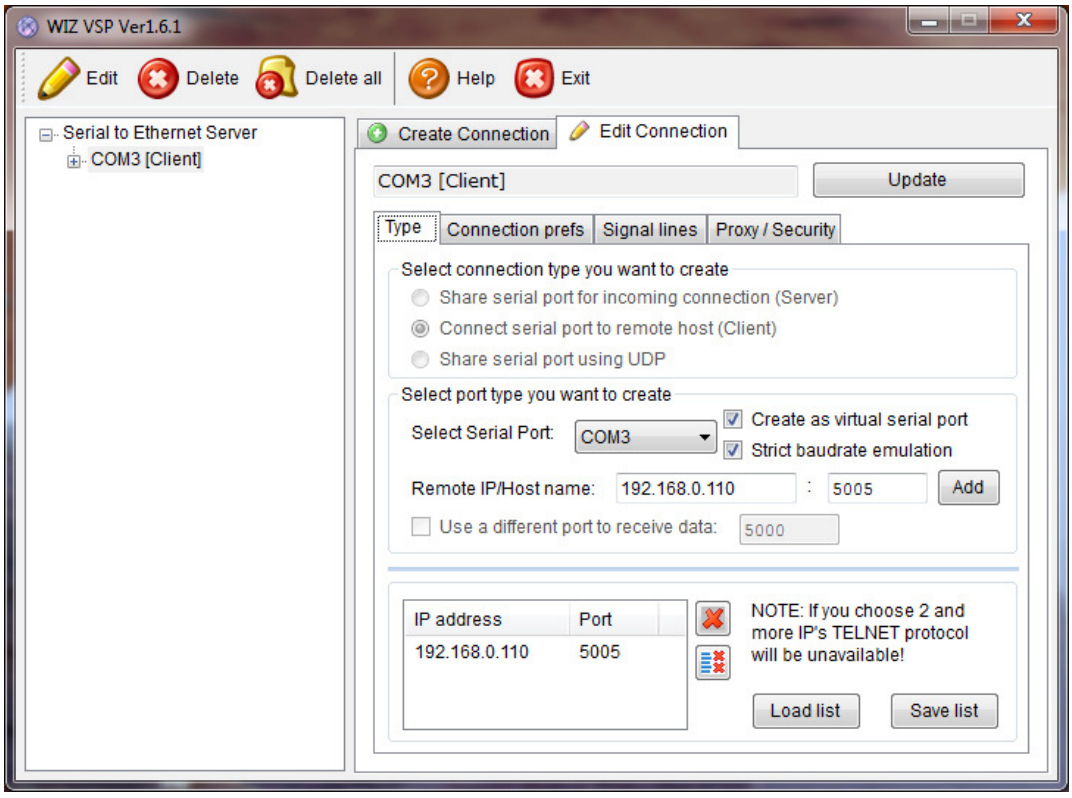


Fig. 47: Setting up Ethernet connection for CYBERMAXFM+, screen 1

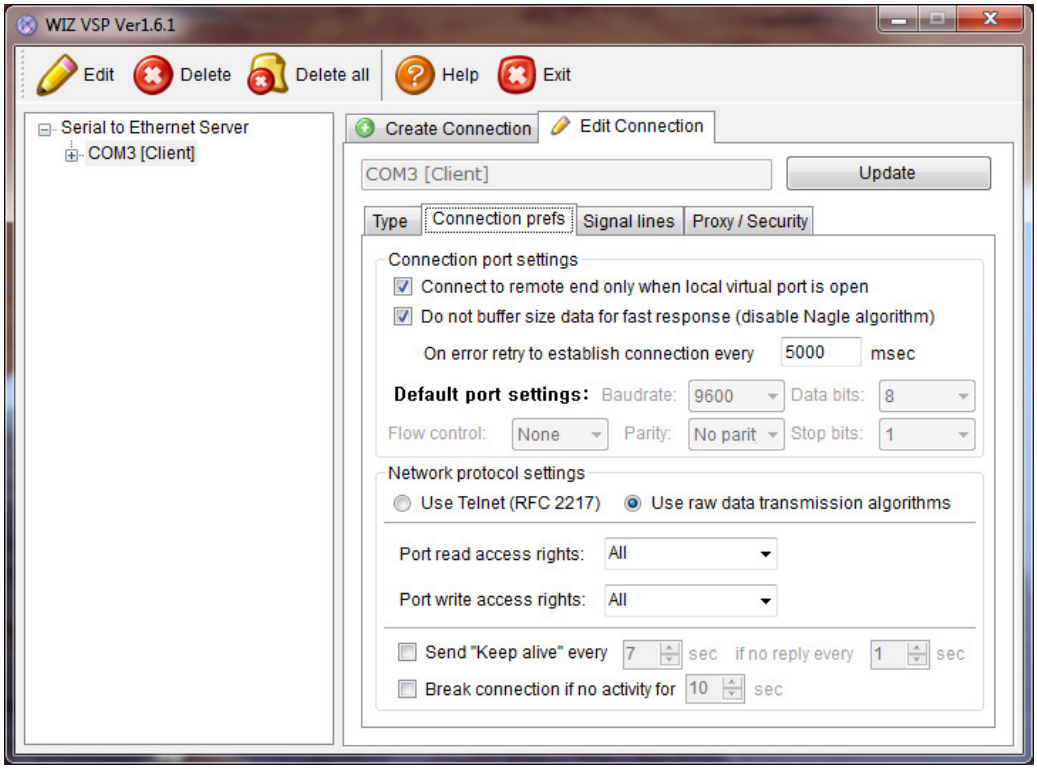


Fig. 48: Setting up Ethernet connection for CYBERMAXFM+, screen 2

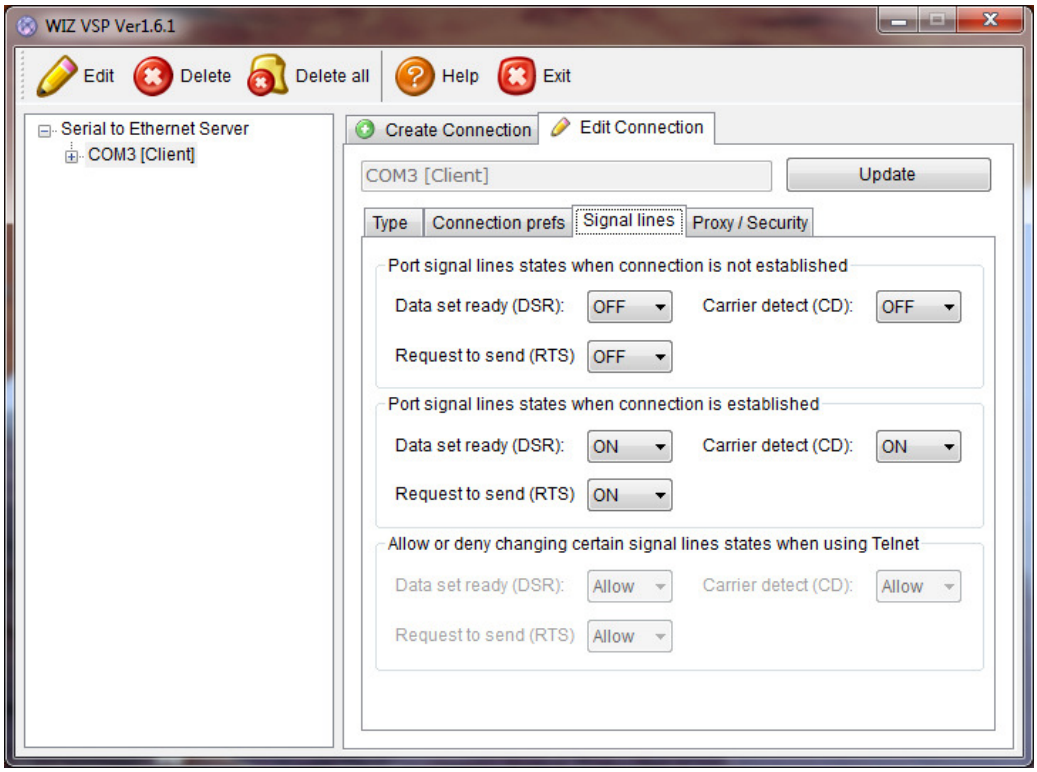


Fig. 49: Setting up Ethernet connection for CYBERMAXFM+, screen 3

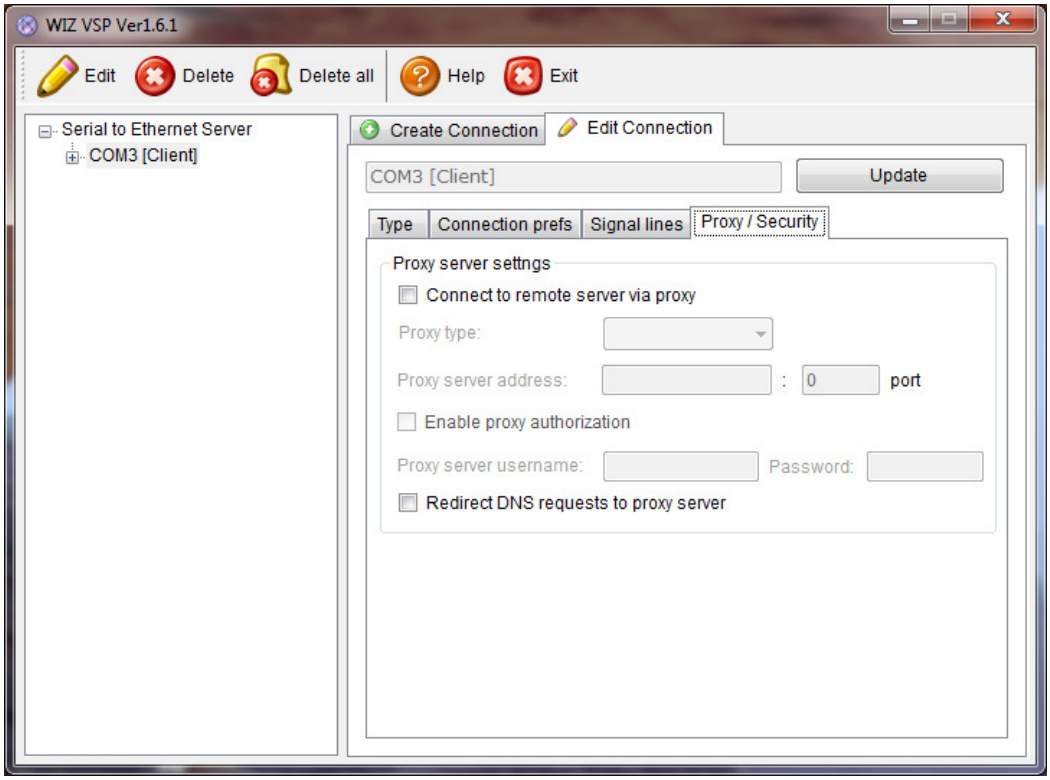


Fig. 50: Setting up Ethernet connection for CYBERMAXFM+, screen 4

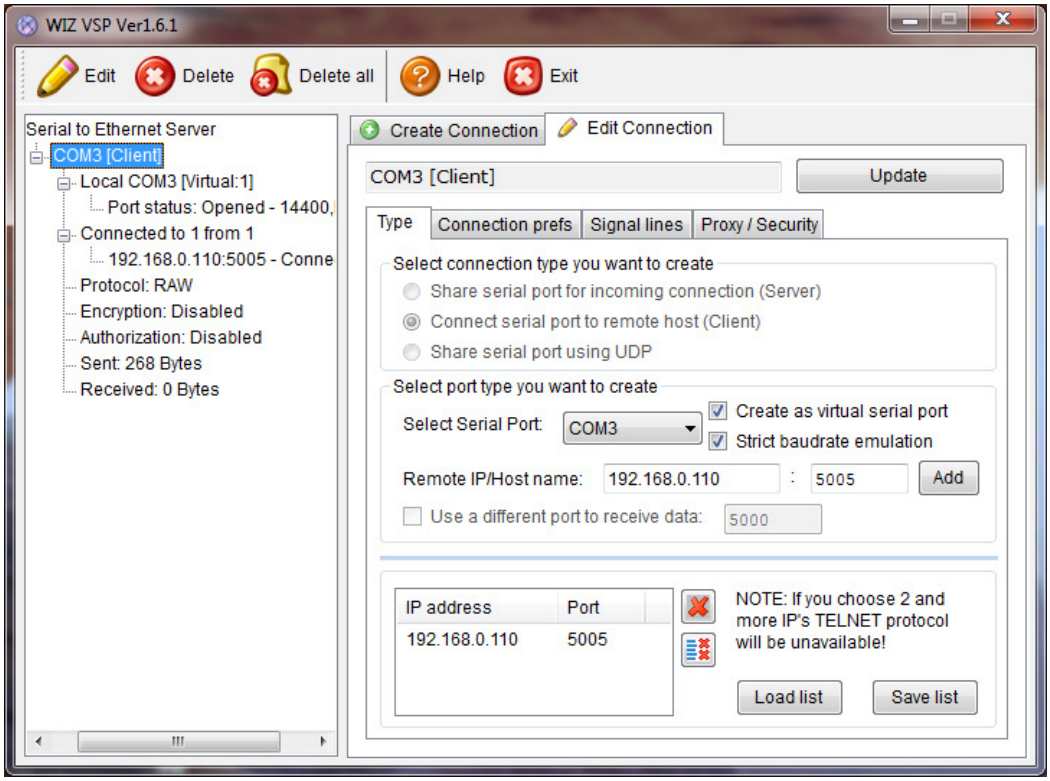


Fig. 51: Setting up Ethernet connection for CYBERMAXFM+, overview

Appendix

J

Appendix J: Communication protocol explanation

If you are one of the many interested in developing your own remote control application, look no further. The entire protocol will be explained here in detail. If you want our sample VB application do drop us an email and explain what you are trying to do, we will probably be able to supply with the source code.

Baud rate and COM port

Communication with CyberMaxFM+ uses RS232 serial protocol even when used with USB. Supported speed is 9600 baud.

A simple VB code would look like this:

```
MSComm1.Settings = "9600,N,8,1"
MSComm1.InputLen = 0
MSComm1.PortOpen = True
```

General Command Format

This is the format of a typical command sent to the RDSMAX encoder:
<StartByte>Command<EndCommandByte>Value<EndByte>

<StartByte>: Signals start of new incoming command/parameter
The hey/binary value of this byte is 0x00 (0b00000000).
VB basic example: MSComm1.Output = Chr$(0) 'Start (0)

Command: Command/parameter that you wish to send to the encoder
Simply send the command/parameter in ASCII form.
VB basic example: MSComm1.Output = "TA"

<EndCommandByte>: Signals end of the new incoming command, tells encoder to expect incoming command/parameter value
The hey/binary value of this byte is 0x01 (0b00000001).
VB basic example: MSComm1.Output = Chr$(1) 'End Command start of value(1)

Value: Command/parameter value that you wish to send to the encoder
The method varies a bit from parameter to parameter, but usually you can simply send the command/parameter value in ASCII form. Check each parameter individually for correct setting.
VB basic example: MSComm1.Output = "1" 'sets TA to ON

<EndByte>: Signals the end of complete incoming command including command/parameter value, it tells encoder to process the received data
VB basic example: MSComm1.Output = Chr$(2) 'End Command and value

PS (RDS parameters)

This is the most interesting feature for 99% of customers out there so we will dedicate a bit more time to it. RDS standard provides for a 8-character PS string which is used to identify radio station and is displayed by RDS-enabled radio receivers. Some countries prohibit changing this text dynamically, but others don't. Whatever your decision may be, RDSMAX supports either static or dynamic PS. It is best to check with the local authorities before setting up the RDS encoder.
The mechanism for handling dynamic (or static) PS text is best demonstrated by the following example:
Imagine a train traveling in a round trip involving 100 train stations. The train starts on station 00 (PS00) and goes through stations 01, 02…. until it passes through station 99 and finally returns to station 00. Every time a train stops

at the station it sends the message back to the headquarters (PS text shown on RDS receiver). The amount of time the train stays at the station (delay – PD00 to PD99) varies and can be from 0 minutes (train does not stop) to 9 minutes. I hope this little analogy has illustrated the process. You have 100 8-character strings (PS00 to PS99) which are displayed one after the other until the entire loop repeats itself. You can define how long each of these strings is displayed; the parameter which defines this is PD (PD00 to PD99).

Example: If you wish to just have one static PS, set all delays to 0 and set just PD00 to 1. Then set PS00 to desired static PS which will be displayed indefinitely.

General Command Format
This is the format of a PS00 command, which sets PS00 to **TEST**:
<StartByte>PS00<EndCommandByte>TEST**<EndByte>**

VB basic example:
```
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "PS00"
MSComm1.Output = Chr$(1)   'End Command start of value(1)
MSComm1.Output = "**TEST**"
MSComm1.Output = Chr$(2)   'End Command and value
```

This is the format of a PD00 command, which sets PD00 to 5:
<StartByte>PD00<EndCommandByte>5<EndByte>

VB basic example:
```
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "PD00"
MSComm1.Output = Chr$(1)   'End Command start of value(1)
MSComm1.Output = "5"
MSComm1.Output = Chr$(2)   'End Command and value
```

It is recommended to put a short delay of 10ms after sending of each data packet. So the example above becomes:

```
MSComm1.Output = Chr$(0)   'Start (0)
Sleep 10
MSComm1.Output = "PD00"
Sleep 10
MSComm1.Output = Chr$(1)   'End Command start of value(1)
Sleep 10
MSComm1.Output = "5"
Sleep 10
MSComm1.Output = Chr$(2)   'End Command and value
Sleep 10
```

RT (RDS parameters)
This is another popular feature, RDS allows for 64-character text string to be displayed on the receiver. However this feature is rarely used as you need to press a button to display it (PS is always displayed by default). Another "nail in RTs' coffin" is the fact that typical receiver only displays a maximum of 8-characters at a time meaning the message needs to be scrolled. However popular or unpopular it may be, we support it.

General Command Format
This is the format of a PS00 command, which sets PS00 to **TEST**:
<StartByte>RT<EndCommandByte>THIS IS A TEST OF RADIO TEXT FEATURE**<EndByte>**

VB basic example:
```
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "RT"
MSComm1.Output = Chr$(1)   'End Command start of value(1)
MSComm1.Output = "**THIS IS A TEST OF RADIO TEXT FEATURE**"
```

```
MSComm1.Output = Chr$(2)   'End Command and value
```

Format descriptions for the other supported parameters:

```
'Sending TP (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "TP"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(TP)
temp = LTrim(temp)
MSComm1.Output = temp

'Sending STEREO/MONO status  (FM transmitter parameter)
MSComm1.Output = Chr$(0)    'Start (0)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FS"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(TXStereo)
temp = LTrim(temp)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending RDS active (PWR) (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "PWR"    'Program reference, lower byte of PI
MSComm1.Output = Chr$(1)   'End command and start of data (1)
If Check1.Value = 1 Then
temp = "1"            'turn RDS on
Else
temp = "0"            'turn RDS off
End If
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finished transmission

'Sending CCAC  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "CCAC"    'Program reference, lower byte of PI
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(CountryCode * 16 + AreaCoverage)
temp = LTrim(temp)
If Len(temp) = 2 Then temp = "0" & temp
If Len(temp) = 1 Then temp = "00" & temp
If Len(temp) = 0 Then temp = "000"
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finished transmission

'Sending ProgReference  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "PREF"    'Program reference, lower byte of PI
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(ProgramReference)
temp = LTrim(temp)
If Len(temp) = 2 Then temp = "0" & temp
If Len(temp) = 1 Then temp = "00" & temp
If Len(temp) = 0 Then temp = "000"
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finished transmission

'Sending PTY  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "PTY"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(PTY)
temp = LTrim(temp)
If Len(temp) = 1 Then temp = "0" & temp
If Len(temp) = 0 Then temp = "00"
MSComm1.Output = temp

'Sending TP  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "TP"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(TP)
temp = LTrim(temp)
MSComm1.Output = temp
```

```
'Sending TA  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "TA"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(TA)
temp = LTrim(temp)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending MS  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "MS"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(MS)
temp = LTrim(temp)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending Did0  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "Did0"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Str$(DId0)
temp = LTrim(temp)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending AF0 (af number) (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "AF0"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Chr$(AFNum + 224 + 4)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending AF1  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "AF1"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Chr$(AF1 + 4)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending RT  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "RT"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = RT & Chr$(13) & Chr$(13) & String(64, Chr(13))
If Len(temp) > 64 Then temp = Left(temp, 64)
MSComm1.Output = temp   'RT
MSComm1.Output = Chr$(2)   'Finish command

'Send PS  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "PS00"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = “your text”
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending ECC  (RDS parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "ECC"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Chr$(ECC + 4)
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending RF POWER status  (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FO"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
If Option25(13).Value = True Then                    ‘check version
temp = Chr$((Int(TXPower / 100 * 34)) + 4)  'was 100*20 for max pro 4025        v3
```

```
Else
temp = Chr$((Int(TXPower / 100 * 44)) + 4)  'was 100*20 for max pro 4025       v4
End If
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending Frequency (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FF"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = Chr$((Int(TXFrequency / 5) - Int(Int(TXFrequency / 5) / 128) * 128) + 4) 'low part of freq
temp = temp & Chr$((Int(Int(TXFrequency / 5) / 128)) + 4) 'high part of freq
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings – Treble (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDT"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Treble + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings – Bass (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDB"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Bass + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings – Attack (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
                                                MSComm1.Output = "FDA"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Attack + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings – Decay (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDD"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Decay + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings - Threshold
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDH"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Threshold + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings – Compression (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDC"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Compression + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings – Integration (FM transmitter parameter)
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDI"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(Integration + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings - LeftGain
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDGL"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(LeftGain + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending DSP settings - RightGain
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FDGR"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
```

```
MSComm1.Output = Chr$(RightGain + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending settings - TEMP alarm
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FAT"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(TEMPAlarm + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending settings - SWR alarm
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FAS"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(SWRAlarm + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending settings - Uamp alarm
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FAU"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(UampAlarm + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending settings - Iamp alarm
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FAC"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
MSComm1.Output = Chr$(IampAlarm + 4)
MSComm1.Output = Chr$(2)   'Finish command

'Sending Store command, commits changes
MSComm1.Output = Chr$(0)   'Start (0)
MSComm1.Output = "FW"
MSComm1.Output = Chr$(1)   'End command and start of data (1)
temp = 0
MSComm1.Output = temp
MSComm1.Output = Chr$(2)   'Finish command
```

Appendix

K

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.

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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

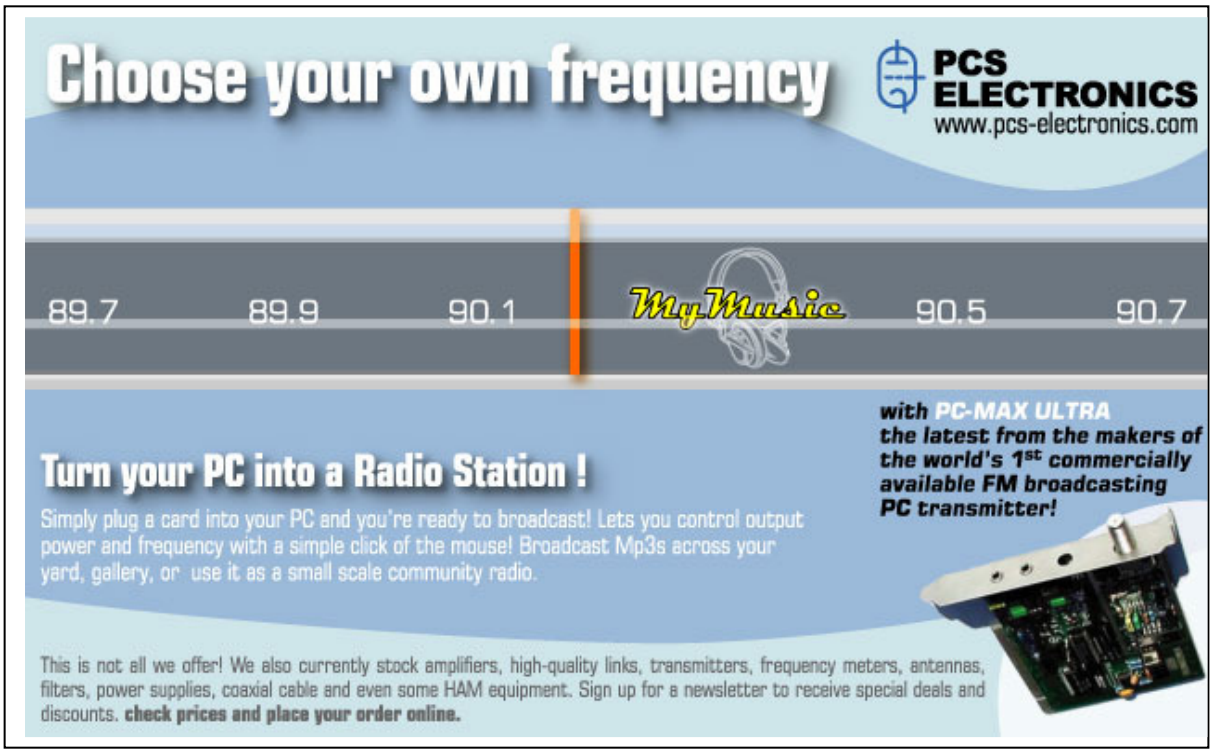
- A large assortment of hard to obtain RF components (RF transistors; MRF, 2SC, coils, silver plated wire, coaxial cable, capacitors, quartz crystals and many others)

- 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

V1.0 (August, 2014): 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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