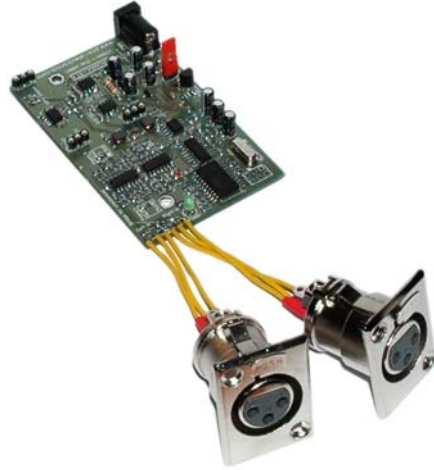




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## **μMAX ST-1**

High Performance Stereo Encoder With Easy RDS Upgrade Option



*μMAX ST-1 stereo encoder with XLR balanced audio inputs*

*This is our new miniature stereo encoder, performing somewhere between our low cost SE3+ and high performance SE4 DSP+. It is indeed amazing how much performance you can squeeze out from such a small unit, thanks to SMD technology; there's a limiter with peaking leds, balanced inputs (XLR), low pass filters, precise selectable pre-emphasis and MPX filter. This unit DOES NOT use crappy Rohm chips! It uses DSP techniques to generate pilot and process audio. And it does all that in an exceptionally small factor. If you're not impressed yet, note expansion pins on the pictures below. You can easily expand functionality by adding a plug-in RDS daughter-board. Wiring-up RDS encoder has never been easier than this. Plug it in and enjoy a wide array of Radio Data System functionality along with high quality audio with excellent channel separation without causing interference to nearby channels. High quality components and printed circuit board assure 24/7 operation for years.*

### **Why is MICROMAX ST-1 so great?**

- Perfect for any mono FM transmitter, output level of 1V or 4V can be selected with jumpers
- For the first time in a unit with such low price, balanced inputs! (prevents ground loops and hum!)
- Small (micro) form factor!
- Plug-in RDS upgrade board available, giving this stereo encoder RDS capability!
- On-board DC converter.
- You can attach balanced or unbalanced audio inputs.
- LC filtered MPX output signal.
- Built-in limiter & low pass filter

### **How is ST1 better than SE3+?**

- RDS upgrade capability
- Improved limiter and LC MPX filter
- Balanced inputs
- Smaller size
- Better bass response due to split voltage design

### **How does it compare against SE4+?**

- Se4+ DSP is of course a better product with DSP processing and LCD control module
- SE4+ requires a dedicated RDS encoder, such as RDS MAX 30+

**Technical specifications:**

- Audio Response: DC(0Hz)-15KHz
- Precise pre-emphasis, 50uS, 75uS or none, selectable via solder bridges
- Audio Input Impedance: 600 Ohms, balanced or unbalanced (can be raised to 10K, if necessary)
- Audio Input Level: 0 dB
- Distortion: <0.1%
- S/N ratio: -75 dBm
- Separation: >50 dB typ. (more than any radio receiver you can buy on the market)
- Pilot Frequency: 19 KHz, DSP generated with 32x oversampling
- Output Impedance: 75 Ohms
- Power Requirements: 12-15VDC / 100mA
- PC Board Size: 80x50mm
- Audio connectors: solder pads
- Power connector: 2.1mm power socket, center is positive
- Output level: Ueff 2V or 1V

**RDS plug-in upgrade board:**

- PS, RT, PTY, ECC, TP, AF, M/S, TA, DI, ECC supported
- 40 PS supported with scrolling

**What do the jumpers and controls do?**

- Audio input solder pads: see diagram on the next page. To wire-up XLR connector simply connect XLR connector pins to appropriate pads on the ST-1 board, pins on the connector are numbered so this makes your job very easy.
- Mono/stereo jumper: see diagram on the next page, install/remove a jumper or wire these two pins to on/off switch and mount it to the front panel of your transmitter.
- Power plug: see diagram on the next page, make sure to connect positive conductor to center, 12-15V DC stabilized power supply is required. Got hum? Your power supply is not stabilized, replace it!
- MPX output: see diagram on the next page, connect this to your FM transmitters' audio input.
- Pre-emphasis solder pads: Connect according to the diagram on the next page or leave all open to disable pre-emphasis.
- POWER LED: Signaling that your unit is powered up
- 2 LEDs in the LIMITER: Signaling that your input audio level is a bit too high, should only light very rarely during normal operation. If it lights, reduce audio level.
- RDS plug-in card, the microMAX RM-1: see diagram on the next page, note three 3-pin connectors. This is where you should insert the RDS plug-in card to obtain RDS operation.

**RDS OPERATION**

RDS (Radio Data System) requires that you install the MicroMAX ST-1 RDS plug-in board, available from our website or our distributors.

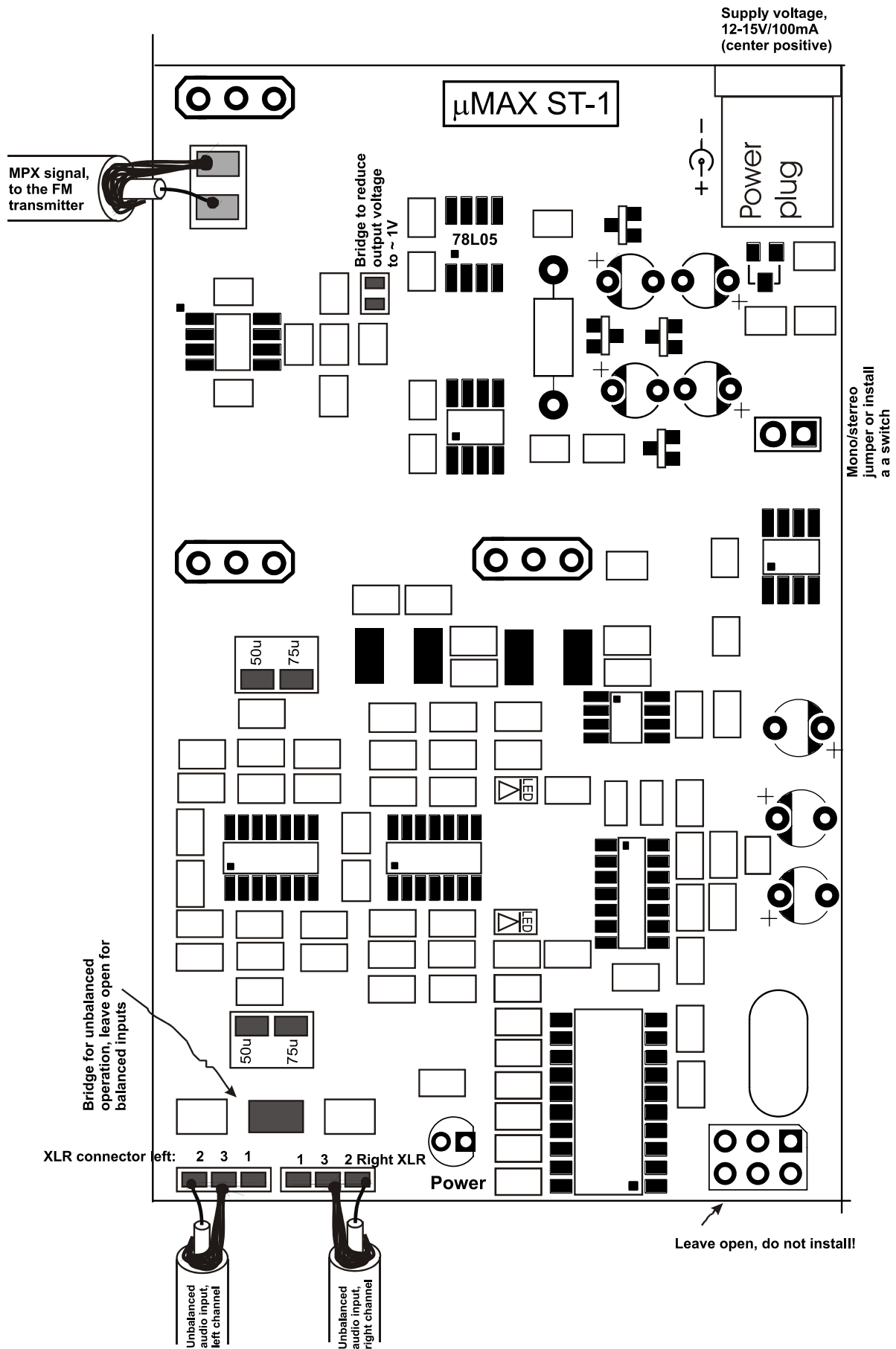


Figure 1: *MicroMax ST-1* wiring diagram

## INTRODUCTION - PRINCIPLES OF OPERATION

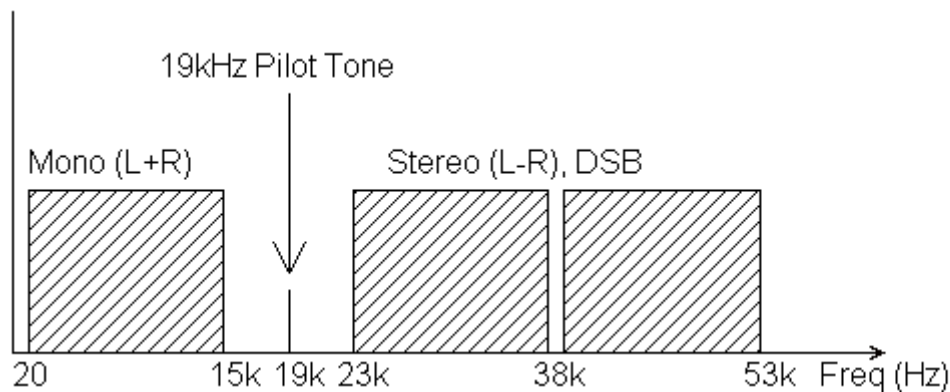


Figure 2: *Theoretical frequency spectrum of the stereo multiplexed signal*

Figure 2 above shows the theoretical frequency spectrum of the stereo multiplex signal (MPX-signal). The MONO signal on the far left goes from approx. 20Hz to 15KHz and is used to transmit the sum of both the left and right channel. This assures compatibility with older MONO receivers that only receive this part of the spectrum. Going from left to the right we stumble upon the 19 KHz pilot just above the MONO signal. This pilot has a couple of functions;

- 1.) It signals presence of the stereo signal; by detecting it the receiver switches to stereo
- 2.) It enables demodulation of the L-R signal and LEFT/RIGHT channel reconstruction

The 19 KHz signal is used to demodulate the DSB (Double Side Band Suppressed Carrier) signal stretching from 23 KHz to 53 KHz. This signal contains the L-R information (difference between the left and right audio channel). This is what the stereo encoder does to generate the Stereo Multiplex signal.

- A.) Add Left and Right signals to get an L+R signal.
- B.) Generate a Pilot Tone of 19 KHz.
- C.) Generate a 38 KHz carrier for the Doubly Balanced Mixer (DBM)
- D.) Generate the L-R (difference of the audio channels) signal for the DBM
- E.) Modulate the 38 KHz carrier with the L-R signal using DBM (DBM suppresses the carrier in the process)
- F.) Add up A, B and C above to get the complete MPX Signal.
- G.) Use the above MPX signal to Frequency Modulate a carrier in the 87.5-108 MHz band.

## SOME FACTS ABOUT STEREO

Even the best stereo encoder is by itself not enough to guarantee good channel separation at the receiving side over the whole audio frequency range. Many factors are involved:

### THE TRANSMITTER

The first problems usually occur at the transmitter. Badly designed audio stages of the modulator will produce low frequency phase shifts, affecting separation. But the main problem is the phase locked loop section of the transmitter. PLL tries to correct the frequency deviations caused by the audio effectively canceling modulation. The frequency correcting signal is passed through a low pass filter (loop filter). This loop filter dampens (smoothes and averages) the correcting pulses from the PLL circuit before passing the corrected voltage to the frequency control part of the modulator. The loop filter is usually the cause of the phase shifts due to not being able to sufficiently dampen and smooth the correcting pulses when the transmitter is fed with low frequencies. Variable frequency oscillators do not suffer from the problem at all due to no frequency correcting circuits (PLL). In short, a badly designed transmitter can be hugely detrimental to the stereo signal created by a stereo encoder Do not jump to the conclusion that the stereo sound that you are listening to is the stereo encoder only.

## THE RECEIVER

Filter Bandwidth and Stereo Decoder of a receiver. Even if the transmitter adds no phase shifts to the multiplex signal transmitted, the receiver (radio) at the listening end can still cause trouble. The filters in the radio can cause phase shifts to the multiplex if too narrow in bandwidth. Many cheaper tuners have less filtering (less manufacturing cost) which although not great for selectivity provides for excellent separation in strong signal environments. The above is only true if the stereo decoder in the radio or tuner is ok. It is very hard to obtain any modern stereo decoder chips that give more than 45 db of separation, some give only 35 db. So even with modern day DSP (digital signal processor) stereo encoders that achieve separations of more than 70 db, you will never hear it because the radio you will be listening to it on may only allow 45 db at best. As you see, stereo is not just about a stereo encoder!

## **HERE IS WHAT YOU NEED TO USE microMAX ST-1:**

### POWER SUPPLY

This unit is designed to work with a wall-wart that gives 12-15V at approx. 200mA, provided it has a good smoothing cap. You can connect the DC supply by inserting the power jack into provided socket.

### ENCLOSURE

If you want to make your own, use aluminum or other metal, ventilation holes are recommended. The 7805 regulator needs to be bolted to the enclosure via provided spacer as it does get quite hot. Fix the PCB with all screws tightly. A shield is recommended between the exciter and the encoder, if you have them both in the same enclosure. Attractive and predrilled enclosures of exact size are available, check our site for info. A 19" rack enclosure for SE4 DPS+ is available from our website.

## **SETUP AND TESTING**

MicroMAX ST-1 is very easy to setup. What we do have to do however is match the output level of the encoder and input level of the transmitter so that the pilot tone (19 kHz) alone (no audio) gives a deviation of the exciter of 6.75 kHz (9 percent). This automatically sets the remaining audio levels. If you're using our line of FM exciters just connect the stereo encoder to the transmitter, set encoder to Stereo, set audio level on the fm transmitter to zero and keep increasing it until the stereo led on the receiver comes on.

**DO NOT FORGET TO DISABLE PREEMPHASIS AT THE TRANSMITTER WHEN YOU CONNECT IT TO THE STEREO ENCODER** (failure to do so results in erratic operation, I my-self forgot to remove the jumper once and spent hours fixing the damn thing).

## **BALANCED AUDIO AND POWER CONNECTOR**

MicroMAX ST-1 features balanced audio inputs, just connect XLR connector to solder pins, as described in this document. Any hum problems usually magically disappear once the XLR input is used instead of the basic unbalanced RCA input. Note that you will have to purchase XLR connectors. You will also find the usual power socket (center is positive) at the side of the unit. Use either our 15V mains power supply or another power supply with appropriate ratings. See product specifications for more details. Next to the power socket is the MONO/STEREO jumper, install or remove according to your desires or wire this to an on/off switch.

Following is a list of the common or standard wiring pin-outs for XLR connectors. These are merely suggested pin-outs and is no way written in stone as the only way to terminate this connector. Keep in mind that outputs, by convention, are normally male. Inputs, by convention, are normally female. (EIA Standard RS-297-A is not adopted by some manufacturers. These manufacturers reverse pin 2 and pin 3)

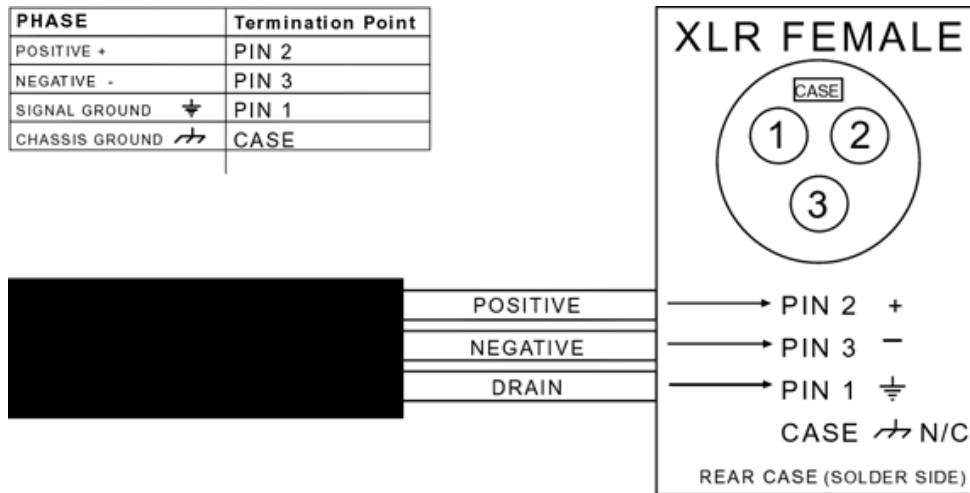


Figure 3: *Balanced audio input – XLR input, female, this is the one you need for microMAX-ST-1*

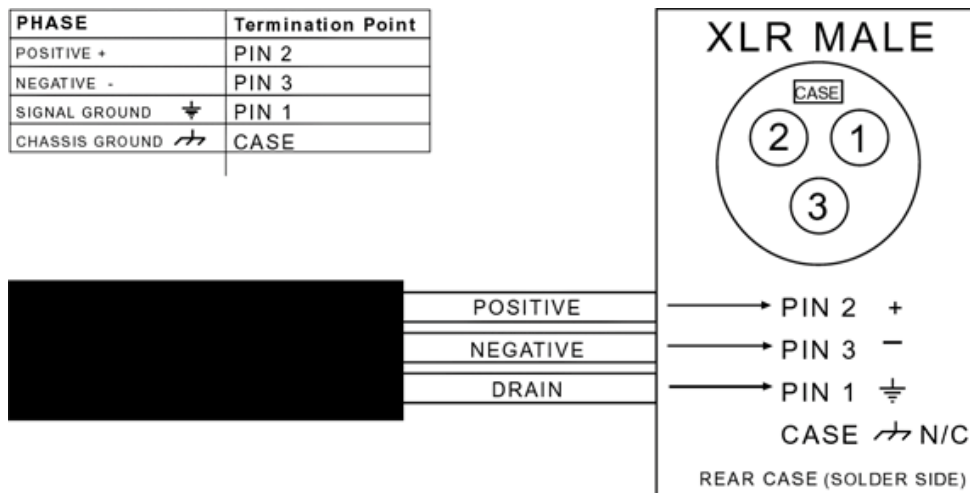


Figure 4: *Balanced audio output – XLR output, male (mixer board etc)*

## PRE-EMPHASIS

It is possible to adjust the pre-emphasis of this stereo encoder to either 50uS (standard for EU and most of the world) or 75uS (United states and Canada). Observe wiring diagram in this document and connect solder bridges in accordance with your current country of residence.

## LEGAL CONCERNS

If you have any legal questions concerning your microMAX ST-1 or any device from our product portfolio it is your responsibility to study the regulations. It is best that you personally read the rules (and consult with a lawyer if you're in doubt). It is up to you to operate within local laws and PCS Elektronik d.o.o. cannot be held responsible for any violation thereof.

**THANK YOU FOR PURCHASING microMAX ST-1!**

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!

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