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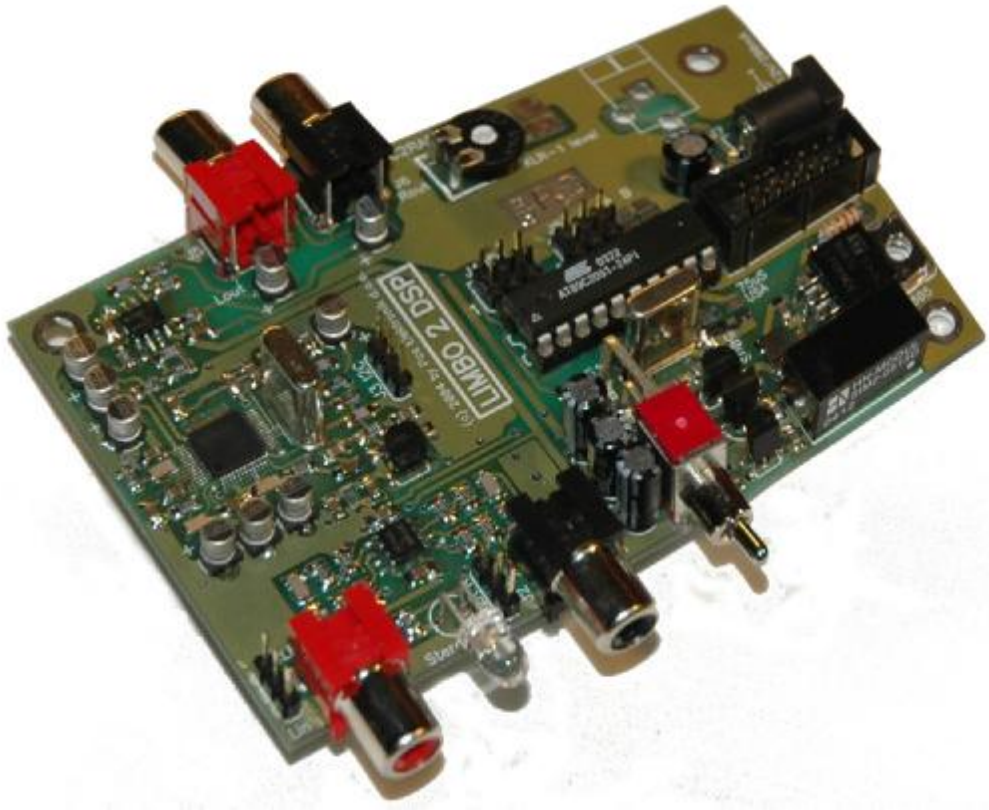
LIMBO II DSP

DSP audio processor (limiter, compressor, audio low pass filter, 19KHz notch and preemphasis)



LIMBO II DSP is a high performance stereo processor with DSP technology. DSP audio processor makes this unit stand out from the rest. It is perfect for a demanding, but cost-conscious broadcasters. Compressor, limiter, pre-emphasis circuit, very sharp low pass filter, balanced audio inputs and 19KHz stereo carrier notch filter make sure your signal stays where you want it, providing high quality audio without causing interference to nearby channels. High quality components and printed circuit board assure 24/7 operation for years.

Why is LIMBO II DSP so great?

- Perfect for any mono or stereo FM transmitter
- DSP technology enables extremely sharp filters and a very deep notch at 19KHz!
- Small form factor!
- Same size as SE3 or SE4 with same mounting holes!
- Wide power supply voltage range, from 7-15V.
- Balanced or unbalanced audio inputs. This eliminates those annoying ground loops and hum.
- Built-in low pass filter, pre-emphasis and compressor/limiter
- Optional backlit LCD display makes it possible to select pre-emphasis and adjust compressor/limiter parameters via the menu system. Same LCD unit can control MAX PRO 3 and LIMBO II DSP at the same time!

Technical specifications:
Audio Response: 20Hz-15KHz, brickwall filtered
DSP: 24-bit DSP
19KHz notch filter, >70 dB typ
Precise pre-emphasis, 50uS, 75uS or none
Audio Input Impedance: 600 Ohms, balanced or unbalanced
Audio Input Level: 0 dB
Distortion: <0.1%
S/N ratio: -70 dBm
Output Impedance: 75 Ohms
Power Requirements: 7-15VDC / 150mA
PC Board Size: 100x65mm
Audio connectors: all RCA jacks are mounted on the board, 3-pin jumpers for XLR
Power connector: 2.1mm power socket, center is positive

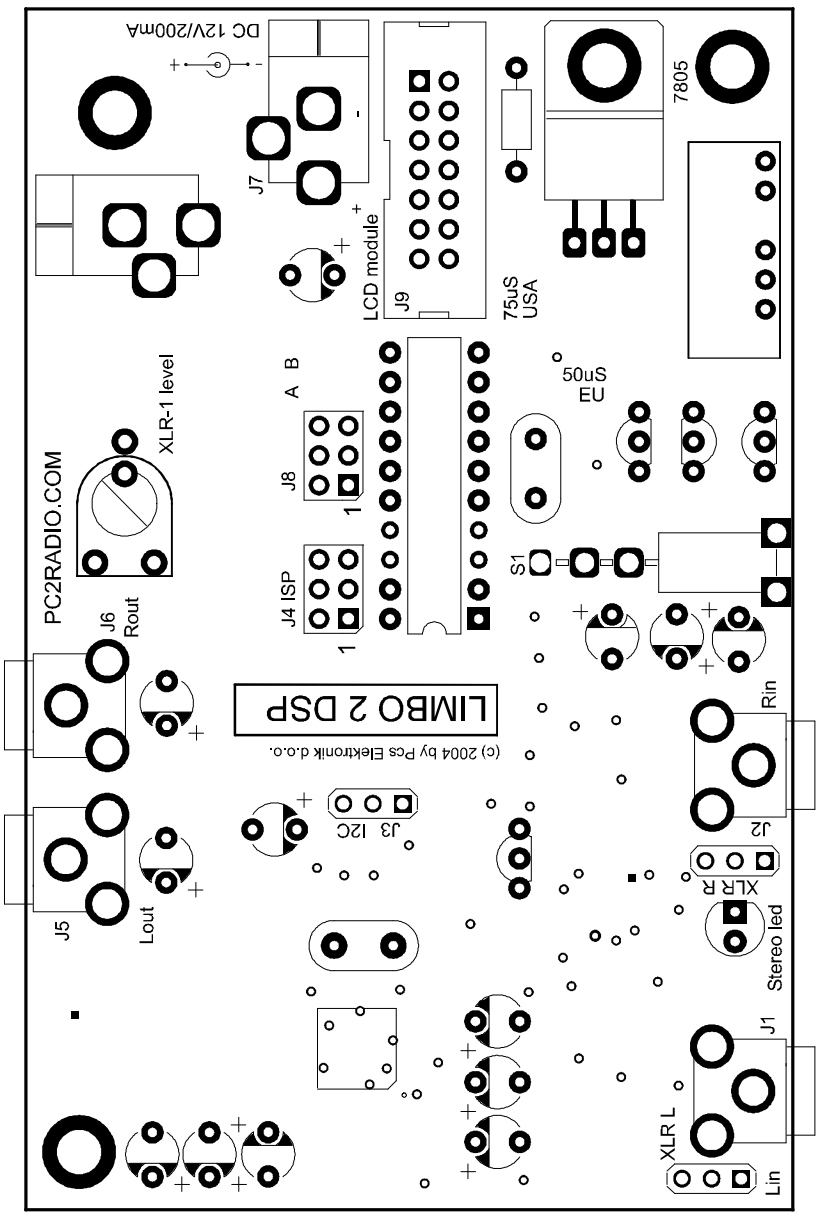


Figure 1: LIMBO II DSP

INTRODUCTION - CIRCUIT DESCRIPTION

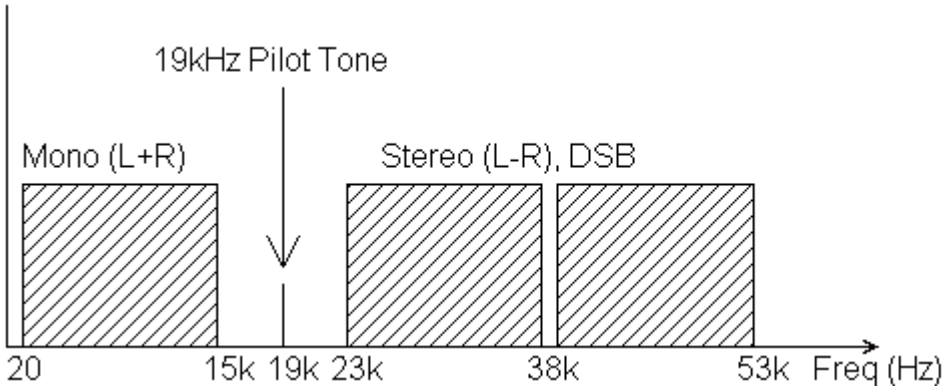


Figure 2: *Theoretical frequency spectrum of the stereo multiplexed signal*

Figure 1 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

It is important that the audio signal fed to the transmitter contains no signal at 19KHz as this can interfere with the stereo carrier. It is also required to provide attenuation of signals above 15KHz, with especially strong attenuation at 19KHz due to interference to stereo pilot signal. LIMBO II provides both and ensures both.

Another problem of FM radio is over-modulating. Your signal should not exceed deviation of 75KHz. Not complying with this requirement produces interference to near-by channels and audio distortion. LIMBO II contains a built-in compressor and limiter.

Let's not forget the balanced audio inputs, this feature will eliminate hum or other audio interference problems, usually caused by using long cable, ground loops or various interference sources.

Left and Right audio signals are applied to the connectors J1 and J2. Make sure not to ground the outer shield of the RCA connectors, this will help reject the noise on your audio lines. Alternatively balanced inputs can be used. Connect them to Rin and Lin 3-pin jumpers. The audio signals are fed from here into the balanced-to-unbalanced converter and passed over to DSP processor circuit. 24-bit DSP processor takes care of signal processing for us.

HERE IS WHAT YOU NEED TO USE LIMBO II:

<u>POWER SUPPLY</u>
This unit is designed to work with a wall-wart that gives 7-15V at approx. 200mA, provided it has a good smoothing cap. You can connect the DC supply by inserting the power jack into provided socket.

<u>ENCLOSURE</u>
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.

SETUP AND TESTING

LIMBO II 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 audio never exceeds the deviation of 75 KHz .

BALANCED AUDIO AND POWER CONNECTOR

LIMBO II features balanced audio inputs, just connect XLR connector to Lin or Rin. Pin 1 is ground, the other two are Audio + and Audio -. 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 as only RCA type is included on the PCB

Figure 3: *Balanced audio input – XLR input*

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 IDC14 connector for optional LCD control unit.

Notice stereo/mono switch in the middle. Unit is in stereo mode whenever you see LED illuminated.

LCD CONTROL MODULE MENU SYSTEM

The front of the unit starts with the three keys on the left, followed by the backlit LCD display. LCD control module is equipped with our new menu system. It can be modified on request to include your call sign or any other messages you want displayed on the LCD.

The UP and DOWN keys are used to change parameter value. In normal mode the LCD is simply showing the welcome screen. Menu key can be used to enter the menu mode, repeatedly pressing this key brings up the following menus: TREBLE, BASS, COMPRESSION RATIO, COMPRESSION THRESHOLD, ATTACK, DECAY, INTEGRATION INTERVAL and PREEMPHASIS. 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 normal mode.

TREBLE and BASS

This setting allows you to set amount of treble and BASS in your audio. Recommended value would be about 0dB.

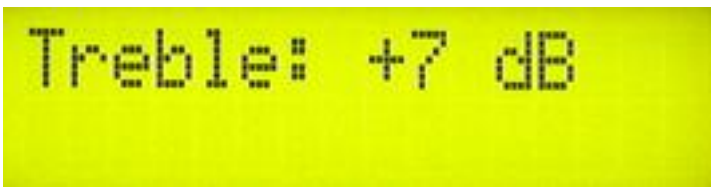


Figure 4: *Setting the treble, one of the many menu settings*

COMPRESSOR SETTINGS

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

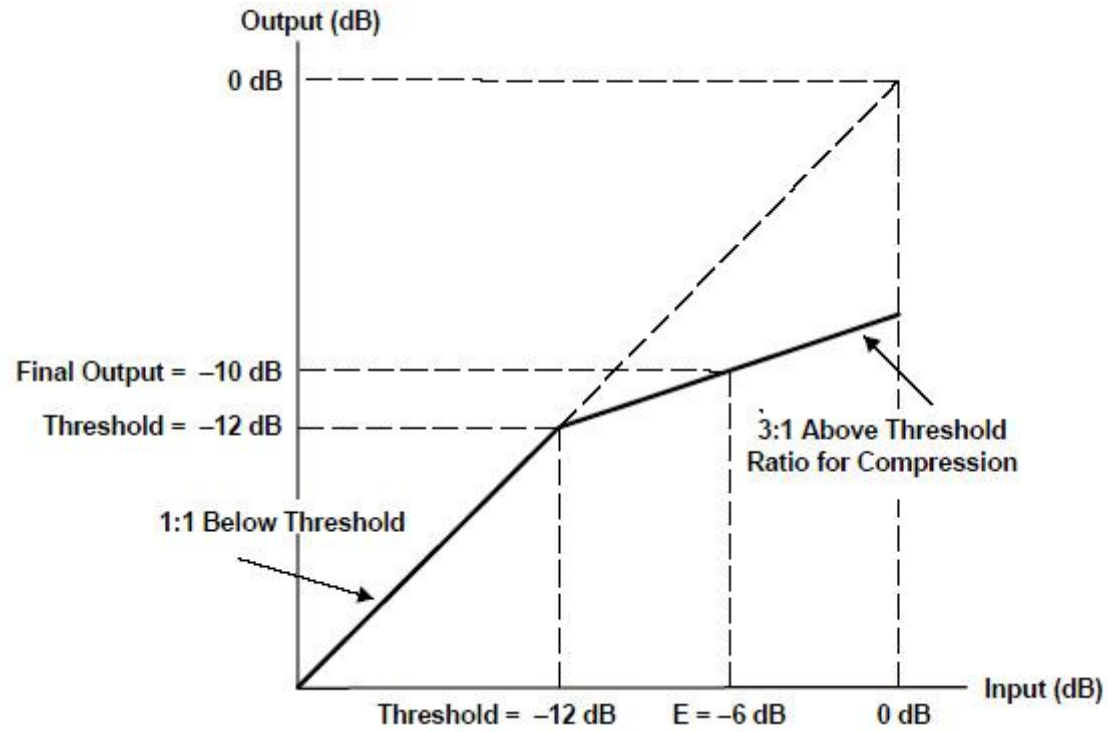


Figure 5: *Explanation of the compressor settings*

Figure 6: *Setting the compression level, levels between 1:2.00 to 1:4.00 are recommended*

Figure 7: *Setting the compression threshold, levels between 7 and 12dB are recommended*

Figure 8: *Setting the attack time, this is the time between the signal rise and the actual response of the compressor*

Figure 9: *Setting the decay time, this is the time the compressor needs to respond to a decrease of the signal*

Figure 10: *Setting the integration interval, this is the time the DSP extracts the samples*

PRE-EMPHASIS

It is possible to adjust the pre-emphasis of the transmitter to either 50uS (standard for EU and most of the world) or 75uS (United states and Canada).

LEGAL CONCERNS

If you have any legal questions concerning your LIMBO II DSP or any device it is your responsibility to study the regulations. It is best if you personally read the rules (and consult with a lawyer if you're in doubt). It is up to you to operate within local rules and PCS Elektronik d.o.o. cannot be held responsible for any violation thereof.

THANK YOU FOR PURCHASING LIMBO II DSP!

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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