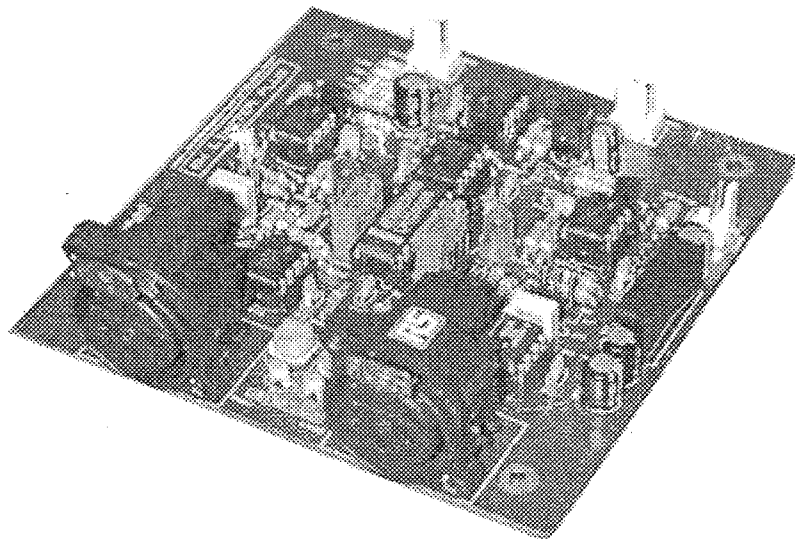


The Broadcast Warehouse Limiter Plus is a low cost, high specification stereo broadcast limiter. Designed specifically for radio stations to provide total protection and a maximum level as well as providing a clean sound rich sound. The limiter plus is a compact unit with built in broadcast specific features such as pre emphasis, clippers and interactive time constants for a loud but clean sounding broadcast.

Balanced input chips are onboard as standard allowing balanced output professional mixing desks and audio processors to be connected to the limiters inputs.

Features

- Gain controls
- Limit Indicator
- Distortion Trim adjustment
- Switchable pre emphasis
- Switchable loudness
- Balanced XLR pcb connectors
- RCA unbalanced option
- High grade low noise op amps
- Switched mode power supply
- Black oxide high grade PCB



Specifications

Input levels (for limiting)	-10dBu to +18dBu
Input connectors	
Balanced	XLR
Unbalanced	RCA
Input CMRR (BAL.)	>60dB
Distortion	
Tone	.1% 1Khz (clarity mode)
Program content	N/A
Frequency response	20Hz - 20Khz
Limiter control mode	>24 dB (pre emphasis off)
Input Impedance	10K ohms
Pre emphasis	0 (off), 50 or 75 uS
Process modes	Clarity and Loud

LIMITER PLUS

Circuit description.

The problem with controlling your signal completely from the peak waveform is that the main energy of the audio signal is in the average of it, not the peak. The higher the peak to average ratio the less dense the sound. The more dense the sound the better for FM broadcasting because we raise our average modulation closer to the ceiling of the system and away from the noise floor. The lower the peak to average ratio, the better the signal to noise. And Research has shown that people tend to prefer louder stations. A louder audio output from your transmitter gives the appearance of a stronger broadcast regardless of signal strength of the received broadcast.

In the broadcast Warehouse limiter plus we have chosen to let through fast transients and clip them rather than try and make the limiter attack time fast enough to react in itself without clipping. It has been proven that this technique boosts loudness significantly. Let me give you an example. If we were to have a limiter that limited at 1 volt (2.8 volt peak to peak) and had a zero attack time limiter then the limiter would not let any signals out above that. We feed the limiter with a burst of music at a level of 1.2 volts. With the zero attack limiter the output of the limiter will be fixed at 1 volt. If we let the initial part of the audio through the limiter (too fast for the attack time) then the signal out of the limiter has a 1.2 volt level (3.4 peak to peak). If we then clipped this waveform we would reduce the peak level back to 2.8 volt peak to peak (broadcasting is all about peaks) BUT the rms level is still at 1.2 volts. The peak to average ratio has been decreased and we have a louder sound for the same peak level and that is what we want for FM broadcasting. You might say to yourself why limit at all, why not just clip. Well clippers produce harmonic distortion and you can hear it if too much clipping is taking place. What you need to do is to use the limiter to get the sound into the range of inaudible distortion when the clipping is taking place. Tests have shown that a few db of clipping on programme material will be inaudible to detect to anything but the trained ear.

Circuit description.

Left and Right audio signals are applied to audio input connectors 1 and 2. The balanced audio signals are fed to IC1 and IC4 which are precision balanced receiver chips which convert the balanced audio signals to unbalanced for the rest of the limiters circuitry. If you decide to use the RCA unbalanced connectors for audio input then one of the legs of the metal frame provides a path to ground for pin 2 of the balanced input receiver chips which forces a 6db increase in gain which is the amount lost through running an unbalanced feed compared to a balanced feed.

The output from the balanced receivers feed a pre emphasis filter which can be switched in or out of circuit via the on board jumpers J1 and J4. The audio is then fed from the pre emphasis filters to one half of dual op amps IC2 and IC3 where input gain can be adjusted through VR1 and VR2 which form the feedback path for the op amps. The audio is then fed into the other half of IC2 and IC3. These dual op amps are also the gain control and output opamps.

The output of the input gain op amps also feed the full wave rectifier circuitry which provides a DC representation of the audio signal. This DC voltage is applied to a time constant circuit which provides the attack and release parameters for the limiter. The time constant capacitors C14 and C15 together with R16 and R17 provide a programme dependent interactive time constant for clear punchy sound at all levels of limiting. After passing through the time constant filter the DC signal is buffered by IC7 and then fed to IC8 which drives PNP transistors T1 and T2 which control the current passing through the gain control element, transconductance amplifier IC5. The buffered output also feeds LED3 which serves as an indicator of limiting / gain reduction when lit.

Transconductance amplifier IC5 is configured as a variable resistor which is placed in the feedback path of the gain control op amps. IC5 varies its resistance in accordance with the level of audio drive so that the output of the gain control op amps is fixed at 0dB. Leds 1 and 2 provide clipping of any overshoots that get through the limiter. This provides significantly more loudness than can be obtained by making the attack time quicker to catch the overshoots. The amount of clipping can be controlled by J2 and J3. These provide more drive to the gain control opamps by putting resistors R8 in parallel with R4 and resistor R29 with R33. This has the effect of a more commercial loud sound when in loud mode compared to a more true to the original sound when in clarity mode due to less clipping taking place. VR3 and VR4 provide offset adjustment which can null any distortions introduced by offsets inherent in the op amps.

Audio is output from connectors CON3 and CON4. The connector have been chosen to connect to the DIGILOG stereo encoder easily. The two ground connections will force the balanced inputs of the DIGILOG into unbalanced mode which is what the limiter outputs.

The power supply to the circuitry is a split rail system for maximum dynamic range. The split rail system is generated by a DC-DC convertor which converts 6V to +/-18V. REG1 provides a regulated DC feed to the DC DC convertor from your input supply voltage of 10-15 volts. The dual outputs from the DC to DC convertor are low pass filtered by L1-2 and C21-22 to further clean up the DC signals. The output from the DC low pass filters are fed to the rest of the circuitry.

LIMITER PLUS

Assembly Instructions

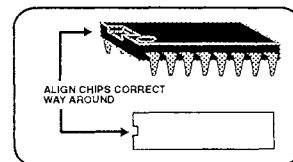
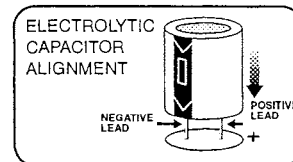
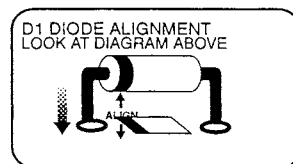
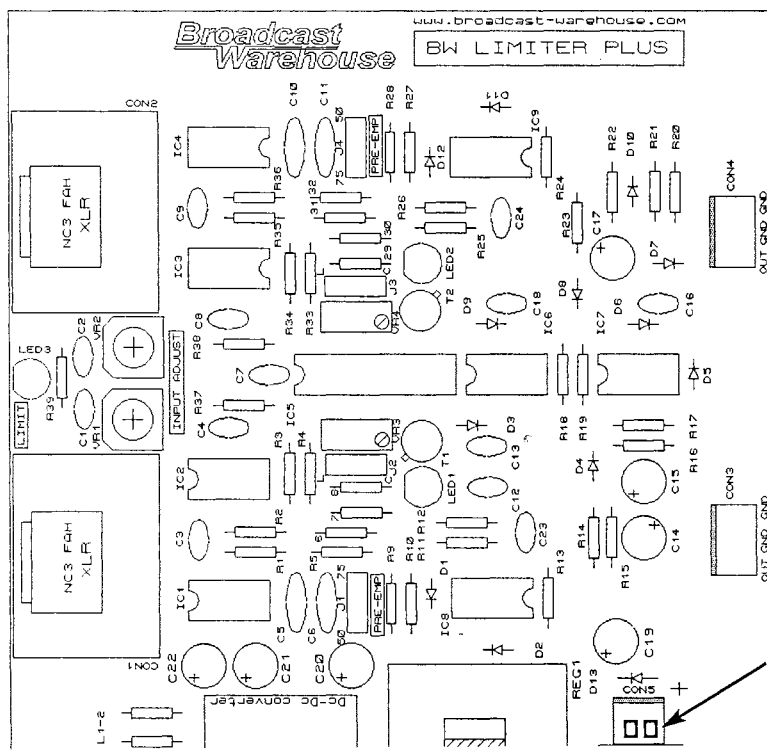
This kit is not really a first time kit builders project. If you have not soldered before we recommend you get some soldering experience from a simpler project or get this kit assembled by someone who has previous experience in electronic construction and soldering.

1. Empty the contents of the kit and proceed to check all of the components off against the component list, It is a good idea to tick off each component as you go through. When you have double checked all the parts proceed.
2. We always start with the lowest height components first which are resistors, Insert each resistor and solder one at a time taking care to make a good joint and not to short across any other pads/holes. Double check the component is the correct one before soldering.
3. Now insert Diode D1-12 followed by rectifier diode D13 observing the polarity (SEE DIAGRAM). Follow the diodes with axial inductors L1 and L2.
4. Next its time to insert the ceramic capacitors C1,2,4,8,13,18,23 and 24. Follow these with all of the decoupling capacitors which are C3,7,9,12. These are non polarized and can be inserted and soldered either way around.
5. Variable resistors VR1 and VR2 can be inserted and soldered next. Move on to the IC holders to fit in each of the chip positions. Make sure you line the notch on the chip holder with the notch on the ident on the printed circuit board. This wil help in making sure you insert the chip the correct way around in the socket.(SEE DIAGRAM)
6. Move on to transistors T1 and T2. Led's 1-3 can be inserted now making sure they are also the correct way around. They have a slant on one side, match it up with the slant on the ident.
7. Capacitors C6,7,11 and 12 are next. Now insert the polarized electrolytic capacitors C14,15,17,19,20,21 and 22 MAKING 100% SURE they are soldered in correctly. (SEE DIAGRAM) The board has a positive symbol next to the positive hole of each polarized capacitor. Insert the negative stripe side away from the positive (+) marking.
8. Insert and solder jumpers J1,J2,J3 and J4 . you may if you wish put the jumper tab's on,but we recommend you wait till the end when we will configure the settings of the board. Connectors 3-5 can be soldered in if you wish to use them. They are industry standard locking moxley types.
9. Next the DC-DC converter.
10. You must not choose if you want to have balanced or unbalanced inputs and insert and solder either the XLR or the RCA connectors.
11. Lastly push the voltage regulator REG1 into the silver heatsink so that in can not go up anymore (it will be pressed up to the blip in the metal). Once the heatsink and regulator are together insert and solder them into the circuit board.

Oh! you can now insert all of the chips into there correct chip holders.!!!

It is advisable that you check your work and all the components are where they should be and that there are no solder splashes or shorts underneath the circuit board. It is better to spend five minutes double checking everything rather than risk damage at switch on due to a mistake during assembly.

If you are sure everything is ok you can proceed to the setup and testing page.



live terminal of mp3 output connector

LIMITER PLUS

Component list

COMPONENT	VALUE	MARKING / IDENTIFICATION
R1,11,17,22,26,36	12K	BROWN,RED,BLACK,RED,BROWN
2,6,31,35,39	1K	BROWN,BLACK,BLACK,BROWN,BROWN
R3,34	36K	ORANGE,BLUE,BLACK,RED,BROWN
R4,33,18,19	7K5	VIOLET,GREEN,BLACK,BROWN,BROWN
R5,32	470R	YELLOW,VIOLET,BLACK,BLACK,BROWN
R7,30	75R	VIOLET,GREEN,BLACK,BLACK,BROWN
R8,29	100K	BROWN,BLACK,BLACK,ORANGE,BROWN
R9,10,12,13,15,24,25,27,28	24K	RED,YELLOW,BLACK,RED,BROWN
R14,23	200R	RED,BLACK,BLACK,BLACK,BROWN
R16	3K3	ORANGE,ORANGE,BLACK,ORANGE,BROWN
R20,21	470K	YELLOW,VIOLET,BLACK,ORANGE,BROWN
R37,38	16K	RED,RED,BLACK,RED,BROWN
VR1,VR2	20K POT	10K MINI POT
VR3,VR4	1K POT	1K MULTIURN POT
C1,2,4,8,13,16,18	47PF	47PF
C23,24	27PF	27PF
C3,7,9,12	100N	104 OR 100N OR .1N (2.5 MM PITCH)
C5,10	6N8	6N8 OR 6800
C6,11	4N7	4N7 OR 4700
C14,17,19,20,21,22	47UF	47UF
C15	10UF	10UF
IC1,IC4	SSM2143	SSM2143
IC2,IC3,IC6,IC7	TLO72	TL072
IC5	LM13600	LM13600
IC8,IC9	NE5532	NE5532 OR 5532
D1-12	1N4148	GLASS AXIAL MARKED 4148
D13	1N4001	PLASTIC AXIAL BLACK DIODE
D1,T2	BC327B	327
LED1,LED2	GREEN LEDS	GREEN LEDS
LED3	RED LEDS	RED LEDS
CON1,CON2	PCB XLR (BALANCED)	3 PIN PCB XLR SOCKET
	PCB RCA (BALANCED)	METAL FRAMED PCB RCA SOCKET
CON3,4	3 PIN MOLEX	3 TERM LATCHING MOLEX
CON5	2 PIN MOLEX	2 TERM LATCHING MOLEX
L1-L2	220UH	AXIAL INDUCTOR, RED RED BLACK SILVER
REG1	7805	7805 T0220 PACKAGE
HEATSINK	SILVER CLIP ON 7805	SILVER FINNED PUSH ON HEATSINK
DC-DC	NMA0515S	BLACK BLOCK NMA0515
J1-J4	3 PIN HEADER	3 GOLD PIN HEADER AND JUMPER
8 PIN IC SOCKET X 8	8 PIN IC SOCKET	8 PIN IC SOCKET
16 PIN IC SOCKET X 1	16 PIN IC SOCKET	16 PIN IC SOCKET
PCB	BLACK BOARD	OBVIOUS

LIMITER PLUS

Setup, testing and operation of the LIMITER PLUS

The Limiter Plus is very straightforward to set up. The input level is adjustable and the output level is fixed.

1. Connect 10-15 volts DC to the limiter.

2. The first step in setting up the limiter after it has been built is to trim any offsets in the op-amps. This will allow us to reduce the distortion of the system.

Connect a multimeter to the output of the left channel and set the meter onto millivolts DC range. Now adjust the multiturn pot VR4 for the minimum output voltage on the meter. Aim for a reading of a few millivolts or less. Repeat the procedure for the right channel with VR3.

3. Decide on your pre emphasis settings for your country / region. 75uS for the Americas and Japan and 50uS for the rest of the world.

Select the pre emphasis with the pre emphasis jumpers.

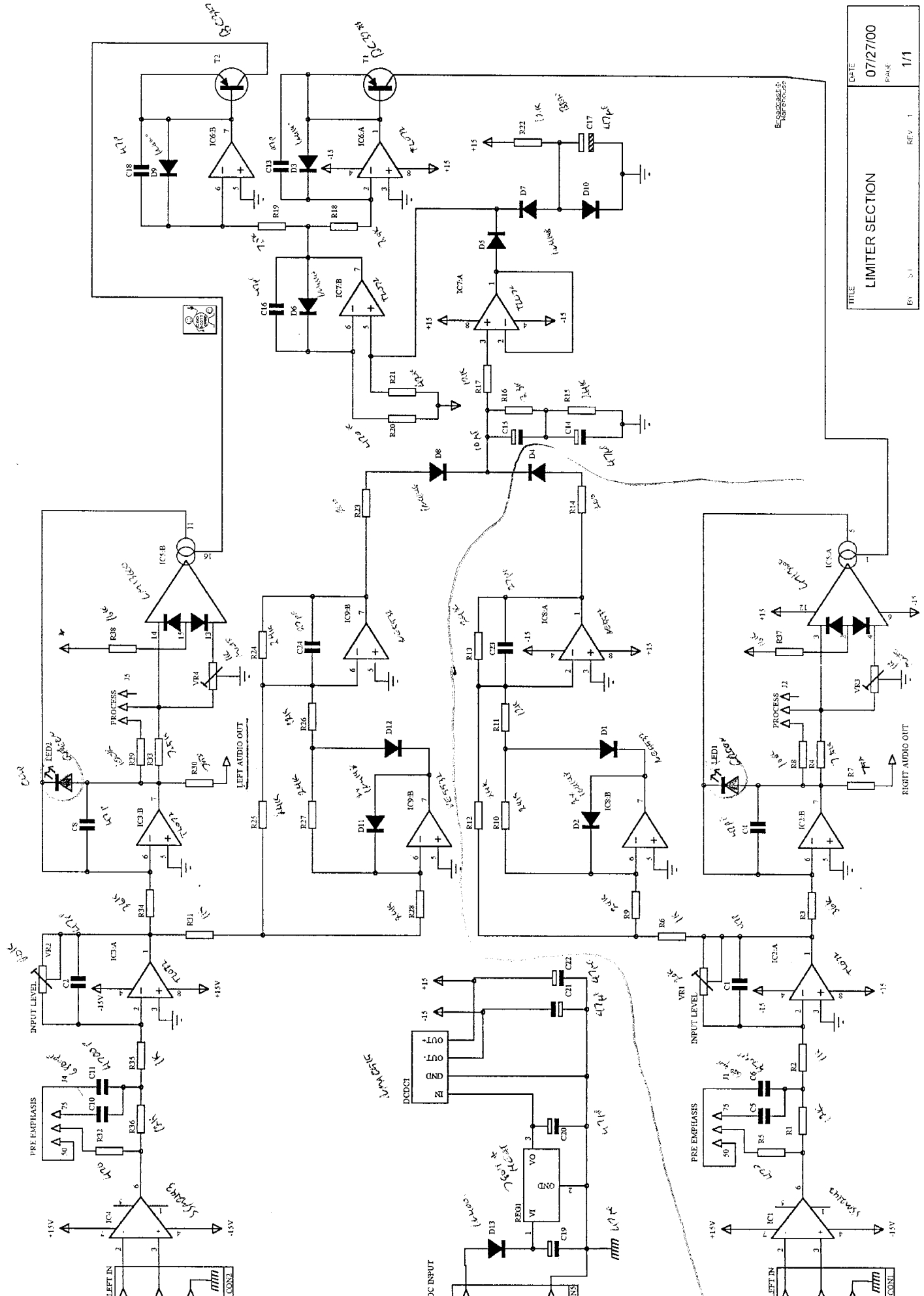
MAKE SURE YOU REMOVE PRE EMPHASIS IN THE STEREO ENCODER AND/OR TRANSMITTER WHERE FITTED

4. Decide on clarity or loud modes. Clarity will produce a closer to the original sound while loud will give you a more processed commercial sound. Set the jumpers to your chosen mode.

5. Apply audio to the inputs of the limiter and adjust the input gain controls to maximum. You should have the LED limit indicator flashing with the peaks of the audio, if not then you need to apply more audio level from your studio equipment. When the limiter is limiting (led is flashing) then you can adjust your transmitters modulation control for a peak deviation of +/-75khz. If you are using a stereo encoder then you will need to adjust the input gain controls on the stereo encoder for a peak deviation of +/-75Khz.

6. You may wish to readjust the input gain controls on the limiter so that the limiter starts to limit at your desired input level, or you can leave the input level controls at maximum to get the limiter to act more as a compressor and increase your average volume.

LIMITERPLUS



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TITLE	LIMITER SECTION