MC77 Limiting Amplifier
Effective with Serial Number 450

Operation and Service Manual
Table of Contents

1 Description
2 General Definitions
3 Specifications - Electrical
4 Specifications - General
5 Front Panel Controls
6 Back Panel Connections
7 Unpacking and Installation
8 Operating Instructions
9 Maintenance
10 Cleaning
11 Repairs & Warranty
12 News
13 Schematics
1. DESCRIPTION

The MC77 replaces the MC76 re-engineered 1176 type FET Limiter

After selling hundreds of the original MC76 units we incorporated new features based on user feedback.

The MC77 is a gain limiting amplifier. Units of this type have been used for many years to provide precise and automatic control of peak signal levels in recording studios, disc mastering facilities, broadcast stations and sound reinforcement applications.

Gain reduction in the MC77 is accomplished using a Field Effect Transistor (FET) as a voltage controlled variable resistor shunt. The FET is the first active component in the signal chain. Large amounts of limiting can occur without large increases in distortion. There are four compression ratios that can be used to best complement the program material and the specific application.

Attack Time is continuously adjustable from less than 20 microseconds to 800 microseconds. The fast attack time response is independent of peak frequency content or duration. Over the audio band the full limiting action will stabilize in under a half cycle. Release time is continuously variable from 50 msec to 1.1 sec. Release time is defined as the time it takes for the gain to recover to within 63% of the normal non-limiting gain.

Provisions have been made for the interconnection of two MC77 limiters for stereo operation.

2. GENERAL DEFINITIONS

Compressors and Limiters are used in many applications. A technical application for these devices is when the dynamic range of program material is too large to be processed by succeeding equipment, when the peak-to-peak amplitude is too large for the headroom of the following equipment. Compressors and Limiters are used to reduce the dynamic range of the program material so it “fits” through the equipment and systems that follow. Good examples are broadcast transmitters and public address systems. A non-technical application is as a production or creative tool. Any device that changes dynamic range will cause some subjective change in the sound of the program material. Reducing the dynamic range of an individual track in a multi-track recording and making it more consistent makes it easier to control in the mixdown process. Its applications as a production tool are limitless.

The two different terms (Compressors and Limiters) generally refer to the degree to which the dynamic range is reduced. The relationship of input level change to output level change is called the Compression Ratio. If, for example, an increase of 8 dB input signal level should cause the output to increase by 2 dB, this would represent a 4:1 compression ratio.

Amplifiers with compression ratios of up to 8:1 are often considered to be Compressors, while those with ratios higher than 8:1 are called Limiters. The MC77 can function as a compressor or a limiter since it has compression ratios from 4:1 to 20:1.

Signals at levels below the threshold will not be affected by the compression/limiting action. Any change in input level below threshold will result in a corresponding and equal change in output level while increases in input levels above the threshold will cause a controlled decrease in amplifier gain resulting in a reduced increase in the output level in proportion to the compression ratio. The MC77 Input Level control adjusts the amount of signal to be processed above the threshold, and hence the degree of compression, or limiting.
3. SPECIFICATIONS - ELECTRICAL

Note: the dB voltage level measurements listed here are referenced to 0.775 Volts RMS. We have seen dB measurements referenced to 0.775 Volts RMS labeled interchangeably as dBu or dBV (note the little "v") while dBV (a big "V") uses 1 volt as a zero reference... and to make things worse people still use the dBm scale to discuss voltage levels across what they are measuring.... A dBm level is a measurement of power that references to 1mW dissipated into a given load and is almost always measured indirectly as a voltage developed across a known load of 600 ohms. If someone tells us they are measuring +4dBm at the input terminals of a device with a 10K ohm input impedance what are we to think? We prefer the dBu scale because we are measuring voltages. Oftentimes, we are not measuring across a 600 ohm "line" AND later when we read these specifications over the phone we don't have to keep saying "dB little v"

**Input:** Constant Impedance Input Attenuator
Transformer Balanced and Floating

**Input Impedance:** 600 ohms at all input gain settings

**Maximum Input Level:** +30dBu with limiting active and input cranked up full
(Prolonged exposure to signal levels in excess of +30dBu may burn up the input attenuator)

**Maximum Gain:** 45dB ±1dB (with limit action switched off)

**Frequency Response:** 15Hz to 80KHz ±1dB typical

**Output:** Floating Transformer Balanced

**Output Load:** 150 ohms or higher

**Load Dependence:** The Output Level as measured while driving into a bridging load will drop by no more than 1/2 dB when a load of 600 ohms is added there will be a loss in headroom

**Maximum Output Level:** +24 dBm into 600 ohm load (12-1/4 volts RMS)
+30 dBu into bridging load (24-1/2 volts RMS)
**SPECIFICATIONS - ELECTRICAL - continued**

**Distortion:** Less than 0.5% THD+noise 22Hz-22KHz with limiting active
Release time set to 1.1sec (fast release times will increase distortion at low frequencies) - **NOTE:** The VU meter is now buffered from the audio and adds no appreciable distortion.

**S/N Ratio:** >81dB at threshold of limiting 22Hz - 22KHz unweighted

**Attack Time:** Less than 20µsec for full limiting action adjustable to 800µsec with front panel control

**Release Time:** Minimum 50msec adjustable to 1.1sec maximum (for 63% recovery) with front panel control

**Threshold and Ratio:** With the input control fully clockwise and the output gain control set 10dB below maximum (at about 6 on the dial)
The overall gain (before limiting) should be 35dB (±1dB)
The threshold of limiting is defined here as 1dB of limiting

- **at 20:1** the threshold of limiting will occur with an input of -24dBu (±2dB) and yield an output level of +10dBu

- **at 12:1** the threshold of limiting will occur with an input of -25dBu (±2dB) and yield an output level of +9dBu

- **at 8:1** the threshold of limiting will occur with an input of -26dBu (±2dB) and yield an output level of +8dBu

- **at 4:1** the threshold of limiting will occur with an input of -30dBu (±2dB) and yield an output level of +7dBu

**Note:** lower ratios make the limiting action kick in sooner
SPECIFICATIONS - ELECTRICAL - continued

**Power Requirements:** 100-125 Volts AC or 200-250 Volts AC selectable
At 115 Volts the current draw is 1/2 mA (typical) and the unit should be fused for 1/8 Amps
At 230 Volts the current draw is 1/4 mA (typical) and the unit should be fused for 1/16 Amps
Line Frequency can be 50-60Hz

**Temperature:** The MC77 can operate safely over a temperature range of 0°C to +50°C
The MC77 can be stored over a temperature range of -20°C to +60°C

4. SPECIFICATIONS - GENERAL

**Dimensions:** 2U 19" rack mounting enclosure (19" wide 3-1/2" high)
Depth behind front panel is 8" (not including connectors)

**Finish:** Front Panel is 1/8" thick aluminium purple anodized with some variation in color - this can be viewed as a feature and lends a certain individuality to each unit - Case finish is black powder coat. Legends are silk screened in white.

**Weight:** 12 pounds – loose, 15 pounds – shipping weight.
5. DESCRIPTION OF FRONT PANEL CONTROLS

Input Level Control: Continuously adjustable rotary attenuator

Output Level Control: Continuously adjustable rotary potentiometer

Attack Time: Continuously adjustable rotary potentiometer
Ranges from the slowest attack time of 800 microseconds to the fastest attack time of 20 microseconds at the full clockwise rotation

Limiting In/Out: The Attack Time control has a switch position at its full counter-clockwise rotation. This turns limiting action off

Release Time: Continuously adjustable rotary potentiometer
Ranges from the slowest release time of 1.1 sec to the fastest release time of 50 msec at the full clockwise rotation

Insert: Engage for Insert/Key input mode. Side Chain Insert Loop Switch places a differentially balanced send and return into the normal connection from the top of the output pot to the side chain detector and gain control circuitry. This loop allows EQ, filters and other external processors to be used to modify how the limiter responds i.e. as a vocal stressor or with a low cut filter to limit bass and improve its definition. This insert is always sending, return is bypassed until activated.

Link: Engage for stereo mode. New Stereo Link Circuit sums the audio feeding the control circuitry of a pair of MC77 limiters instead of simply joining the FET buses. This eliminates the need for alignment and the additive effect of attack and release times. Linked Stereo limiting is now plug and play and the limiting action is now just as fast as in an unlinked monaural MC76 or MC77.

Compression Ratio: Four Position Interlocked Push-button Switch allows selection of 4:1, 8:1, 12:1 and 20:1 compression ratios. Some users enjoy pushing more than one of these buttons at once.

Meter Function: The VU meter is switchable between I/O level and Gain Reduction. Top switch In position is for monitoring Gain Reduction, Out for monitoring I/O level. Second switch In for Input level, Out for Output Level, Both referenced at +4dBu.

*Note Input level is monitored across the 600 Ohm input. You may notice a level drop depending on source. This is normal loading and not a metering error

Bypass: The third switch is for system bypass, this connects the input directly to the output so the user can quick A/B limiter in vs limiter out. Unit defaults to bypass when the powered off.

Power Switch: The bottom switch is marked ON.

Gain Reduction "0" Adjust: Screwdriver accessible adjustment via small hole in front panel between input and output level controls
6. BACK PANEL CONNECTIONS

XLR Pin Assignments:
- PIN 1 = Chassis, Earth, Ground
- PIN 2 = Signal "Hot", Positive, ø+
- PIN 3 = Signal "Cold", Negative, ø-

Wiring systems vary from facility to facility. PIN 1 may or may not be used to terminate a shield or drain wire. In general this pin and the shield or drain wires connected to it are not to be used to “Ground” or “Earth” the unit. Shields and Drain Wires should NOT carry current and are generally connected at only one end of any given wire. For your convenience and to assure that the chassis can be easily grounded (earthed) there is a Chassis Ground Lug on the back of the unit and the center pin of the IEC power inlet is connected to the chassis as well.

PINS 2&3 of the input and output XLR connectors must be connected to get signal in and out of the unit. Since the inputs and outputs are transformer balanced there is no problem unbalancing either the input, the output or both. Because the input attenuator ahead of the input transformer takes PIN 3 of the input XLR to signal common is the preferred way to unbalance the input. To maintain consistent phase from input to output connection of PIN 3 to audio common is the preferred way to unbalance the output unless you WANT to flip the phase.

Input & Output XLR: Standard connections - Transformer isolating.

Insert Send & Return XLR: a differentially balanced send and return into the normal connection from the top of the output pot to the side chain detector and gain control circuitry. This loop allows EQ, filters and other external processors to be used to modify how the limiter responds i.e. as a vocal stressor or with a low cut filter to limit bass and improve its definition. This insert is always sending return is bypassed until activated.

Stereo Interconnection: Two 1/4” Jacks marked Link, Input and Output are used to connect two units together for stereo mode utilizing the link control on the front panel. Using two 1/4” TS or TRS cables connect the Out jack on each unit to the In Jack on the other unit.

IEC Power Inlet: Accepts standard IEC type power cable and includes:
- Fuse Holder - see back panel markings for fuse rating

Audio & Chassis Ground: Audio ground is connected to the audio circuit, Chassis ground is connected directly to the steel case and the IEC ground. These are shipped from the factory linked, leave these linked unless you have a reason to separated your audio and chassis grounds. If you do separate them leave the link on one of the lugs, otherwise you will lose it.
7. UNPACKING AND INSTALLATION

Your MC77 was packed with care at the factory. The packaging was designed to protect the unit from rough handling. However, once the unit leaves us, it may pass through the hands of those who have no idea what is in the box, may not be happy with their job, or may like to throw things. Despite the heavy duty carton and foam blocks the unit was packed with, we recommend you inspect the box and its contents immediately for any sign of damage that may have occurred in transit. If there is damage, you should save all the packing materials and contact your vendor immediately. We recommend you keep the packing materials. Murphy’s law states that once you throw away the box the likelihood you will need it back will increase in proportion to the square of the distance from your service center multiplied by the cost of replacement packing materials.

The carton we ship out contains:

* One MC77 Limiting Amplifier
* This Manual
* One six foot (two meters) IEC Cable
* Warranty Card
8. OPERATING INSTRUCTIONS

Start with all controls at mid-rotation. Insert Out, Link Out, Ratio 8, Meter GR with Bypass out.
Adjust input to show some gain reductions. Switch Meter to I/O, OUT. Adjust Output level for levels around 0 VU.

The Attack Time of the MC77 is the time it takes for the detector circuitry and FET to respond to a signal as it exceeds the threshold. This parameter is variable by the user since the adjustment may have a significant effect on the sound of the program material.

The Release Time may be defined as the time it takes the limiter to return to its normal gain, after the signal which has caused the gain reduction has dropped below the threshold. The release time is variable for the same reason that Attack time is and can substantially alter the sound of the program material passing through the MC77.

Together, Attack and Release times will define much of the sound or coloration in any given application.

For the dirtiest sound push in all four Ratio buttons, attack counter-clockwise, but not off, Release clockwise.

For Bypass Mode Push in Bypass Button.

Insert places a differentially balanced send and return into the normal connection from the top of the output pot to the side chain detector and gain control circuitry. This loop allows EQ, filters and other external processors to be used to modify how the limiter responds i.e. as a vocal stressor or with a low cut filter to limit bass and improve its definition. This insert is always sending, return is bypassed until activated.

Link connects input of the compression amplifier to the output of the Link summing amplifier. Link out is a buffered output that is also run into the summing amplifier with the Link In signal. This summed output is then run into the compression amplifier.
9. MAINTENANCE

METER ZERO ADJUST (Allow 15 minutes warm-up)

Push the "GR" meter function switch. The VU meter should read "0" on the VU scale since the limiting function is disabled (the attack control knob is turned to OFF). If the "0" indication has drifted beyond + or - 1 dB with no signal, it should be adjusted. This may be done through the hole in the front panel located between the Input and Output level controls using a small screwdriver. The trim pot is straight back through this access hole and requires a small slotted screwdriver.

INTERNAL SERVICE ADJUSTMENTS

These controls have been set at the factory and should not require adjustments except after service work. If re-calibration is necessary, the test procedure that follows should be performed very carefully, and adjustments performed in the exact manner and order specified.

Before attempting any calibrations, the limiter should be on for at least 15 minutes. This avoids subsequent drift.

WARNING: The full AC line voltage is present at several points inside the chassis. Be careful to avoid personal shock when you work with the MC77 with the covers removed. At worst you can be killed and at the very least it will make you unhappy.

POWER SUPPLY

The positive DC voltage should be +30 volts (+or-.5) the test point to measure the level is top trace end of R51.

The negative DC voltage should be -10 volt (+.5) the test point to measure the level is the right hand end of R90.

"Q" BIAS ADJUSTMENT - (R59, internal trimpot)

This is a very important parameter to assure the linear operation of the limiter. Therefore the adjustment should be performed very carefully. Set the controls as follows:

- Input = "24" mid rotation
- Output = "24" mid rotation
- Attack = full CCW (switched to off position)
- Release = full CW
- Compression ratio = 20:1
- Meter mode = "GR"
- Q-bias adjustment = full CCW
MAINTENANCE - continued

Apply a signal (1 KHz, 0 dB) to the input, and adjust the output to read +11db as read on an external meter. Slowly turn the Q-bias adjust (R59) CW until a drop of 1 dB occurs, and the external meter reads +10db. This places the gain reduction FET Q1 slightly into conduction.

GAIN REDUCTION METER TRACKING - (R75, internal trimpot)

Due to interaction of the adjustments, this procedure may have to be repeated to achieve satisfactory tracking.

Setup:

No signal
Disconnect R44
Voltmeter across R74

Calibration

1. Zero MC77 "GR" meter with R71 (Thru front panel Zero Adjust)
2. Adjust pot R75 for 0.0 Volts across R74.
3. Repeat 1 & 2 until both conditions are met.
4. Set controls as follows:
   Input = "24" mid rotation
   Output = "24" mid rotation
   Attack = full CW
   Release = full CW
   Compression ratio = 20:1
   Meter mode = "GR"

5. Apply a signal (1 KHz, 0db).
6 Set output control for 0db as read on an external meter.
7. Set attack full CCW (off position). Set input control for +10db as read on an external meter.
8. Turn the attack control OFF (CCW) and readjust the output level control for "0" if necessary.
9. Repeat 7 & 8 until the output drops 10dB whenever the attack control is turned ON.
10. Reconnect R44.
MAINTENANCE - continued

SIGNAL PREAMP LINEARITY

This control (R86) is in the feedback loop of the amplifier and affects the operation of Q1. It will never be necessary to perform any adjustment of R86 unless resistors in this section of the circuit have been replaced. If adjustment is required, set the controls as follows:

- Input = Full CW
- Output = to number "18" on the front panel
- Attack = full CCW (switched to off position)
- Release = Full CW
- Compression Ratio = 20:1
- Meter mode = "GR"

Apply an input signal (500 Hz, -30 dB) and measure THD of the resulting output signal. Adjust R86 until the minimum amount of distortion is achieved.

10. CLEANING THE LIMITER

The front panel of the MC77 may be cleaned with a non-abrasive cleanser such as Formula 409, or "Fantastic" applied with a soft clean cloth. Additional protection of the anodized panel can be afforded through a light application of a spray wax preparation such as Pledge. **NOTE: NEVER SPRAY THE PANEL DIRECTLY AS THE CLEANSER OR WAX MAY ADVERSELY AFFECT CONTROLS OR METER, AND CAN CONTAMINATE CIRCUIT BOARDS IF IT PENETRATES THE CHASSIS.**

11. REPAIRS AND WARRANTY

*We will service and repair the unit free of charge for three years from the date it is shipped. We track warranty by serial number therefore make sure to leave the serial number tag on the unit. We will not repair damage that results from misuse, abuse or neglect. We do not guarantee that the purple color of every unit will match the purple of every other unit.

Should a malfunction occur, please email the service department at service@purpleaudio.com. You will receive instructions for return. Be sure it is well packed in a sturdy carton with shock absorbing material. Tape a note to the top of the unit describing the malfunction and instructions for return. We will pay one-way return shipping cost on any in-warranty repair.

Because of specially selected components in this product, field repairs are not authorized during the warranty period. Attempts to perform repairs may invalidate the warranty.

Even if your unit is out of warranty, we recommend that you return it to the factory for repairs. Our experienced personnel, supported by special test equipment, will be able to find and eliminate any problem in the most efficient way.

12. NEWS

For current information about Purple Audio visit our website at: "http://www.purpleaudio.com".