Purple Audio, Inc.
38-62 Eleventh Street LIC, NY 11101
Tel. 718.482.8494 Fax. 718.482.8159
purple@purpleaudio.com
www.purpleaudio.com

MC77 Limiting Amplifier

Effective with Serial Number 450

Operation and Service Manual

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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 20microseconds to 800microseconds. 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 50msec to 1.1sec. 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 activeRelease 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 20microseconds 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 1.1sec to the
fastest release time of 50msec 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 busses. 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, O 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.

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”.

PRE-AMP

OUTPUT AMP

600 Ohm "T" Attenuator

TOP 2 DECK POT IN EARLY UNITS
R1A
IN HIGH
R2
R3
R2 & R3 620Ω 1/4W
R1B
IN LOW
R1A Front deck & R1B rear deck

BOTTOM 3 DECK POT IN LATER UNITS
IN HIGH
R1A 500Ω Lin
R1B 5K Z Tap
IN LOW
R1C 500Ω Lin
R1A FRONT, R1B MIDDLE, R1C REAR

T1 UTC 0-12 or Equivalent
500Ω: 200Ω

R13 1M
R14 22K
6K8 R17
R9 560K
R5 27K
C1 1uf
R8 1K
C4 100uf/25v
C815 .1uf
Q2 2N3391A
Q14 2N3391A
Q3 2N3391A
C816 .1uf
C600 100uf/25v
C7 1uf/50v
R4 270
Q1 2N5457
C817 .1uf
C28 100uf /25V
R10 10K
R18 180
R84 180
R85 150
R11 82
R12 910
C5 100uf/25v
R23 250K 2W Output F.P. Audio Taper
C8 .15
R24 2M7
Q4 2N3391A
R25 2M7
R27 1K5
R26 68K
C10 1uf/50v
C11 10pf
R29 1M2
Q5 2N5088
Q6 2N3053
R30 200K
CR1 IN4148
C12 100uf/25v
C818 .1uf
R31 10K
C13 270pf
C601 100uf/25v
C819 .1uf
C14 .033
R34 8K2
R33 560
C15 .0047
BROWN
BLACK
WHITE/BLACK
WHITERED
BLUE Pin 2 +
RED Pin 3 -
GREY
VIOLET
R32 39
R28 27K
meter buffer
J2 JUMPER
XLR M P2
OUT HI
XLR F P2
Relay RL1 W/ IN4003 D43 DS2 AROMAT
Meter buffer
J1 JUMPER
XLR M P3
XLR F P3
Bypass relay controlled by bypass on meter switch assembly
Power Off/ Bypass

R6 2M2
C9 .22
C22 .22
R7 2M2
C6 200pf
C3 200pf
R86 100
Distortion Adj
R15 6K8
Aromat TQ2E RL4 Loop Relay W/IN4003 D41
INSERT RETURN
INSERT LOOP DRIVE
TO LINK CIRCUIT
FROM LINK CIRCUIT
J3* Jumper
Link Relay Aromat TQ2E RL 3 W/IN4003 D40

Ratio PCB
R22 47K 1/4W
R21 56K 1/4W
R20 56K 1/4W
R19 68K 1/4W
R78 56K 1/4W
Top "In"
4:1
8:1
12:1
(T&C)
20:1

+30V @50ma Ripple = .25mv with load

R61 470 1/4W
R62 560 1/4W
R63 1K5 1/4W
R45 10M 1/4W
R58 150Ω

+30V
R88 10K
Q22 MPS3569
C820 .1uf
CR15 24V IN5252B
R87 200R

Controlled by Switch on rear of Attack
Switch on attack For use w/out relay
Aromat TQ2E RL5 Comp Off w/IN4003 D42
J6* Jumper

SIDECHAIN

R79 15K
+30V
TO METER SWITCH
28 Orange
TO METER SWITCH
29 Blue
R65 3M9
Q11 2N5457
R67 3K9
R74 2M7
Null Test
Q12 2N5088
Q13 2N5088
R44 (T&C) ~1K
R68 1K5
R69 1K5
R75 2K Null Adj P.C.B.
10K R66
R70 4K7
R72 1K5
R71 2K
R73 680
R76 8K2
"0" Set F.P.
METER DRIVER
-10V

R38 47K
C814 .1uf
C18 100uf/50v
R47 44K2
R51 4K7
R36 1M
C17 1uf/50v
Q7 2N5088
Q8 2N5088
Q9 2N5088
Q10 2N5088
R42 180K
R40 2K4
R39 4K7
R41 270
R37 470K
R43 38K3
R48 7K68
R49 2K4
R50 180
R46 47K
C19 10uf/35v
CR2 FDH333
Violet 21
C813 .1uf
C21 100uf/25v
R52 47K
R53 47K
C20 10uf/35v
FDH333 CR3

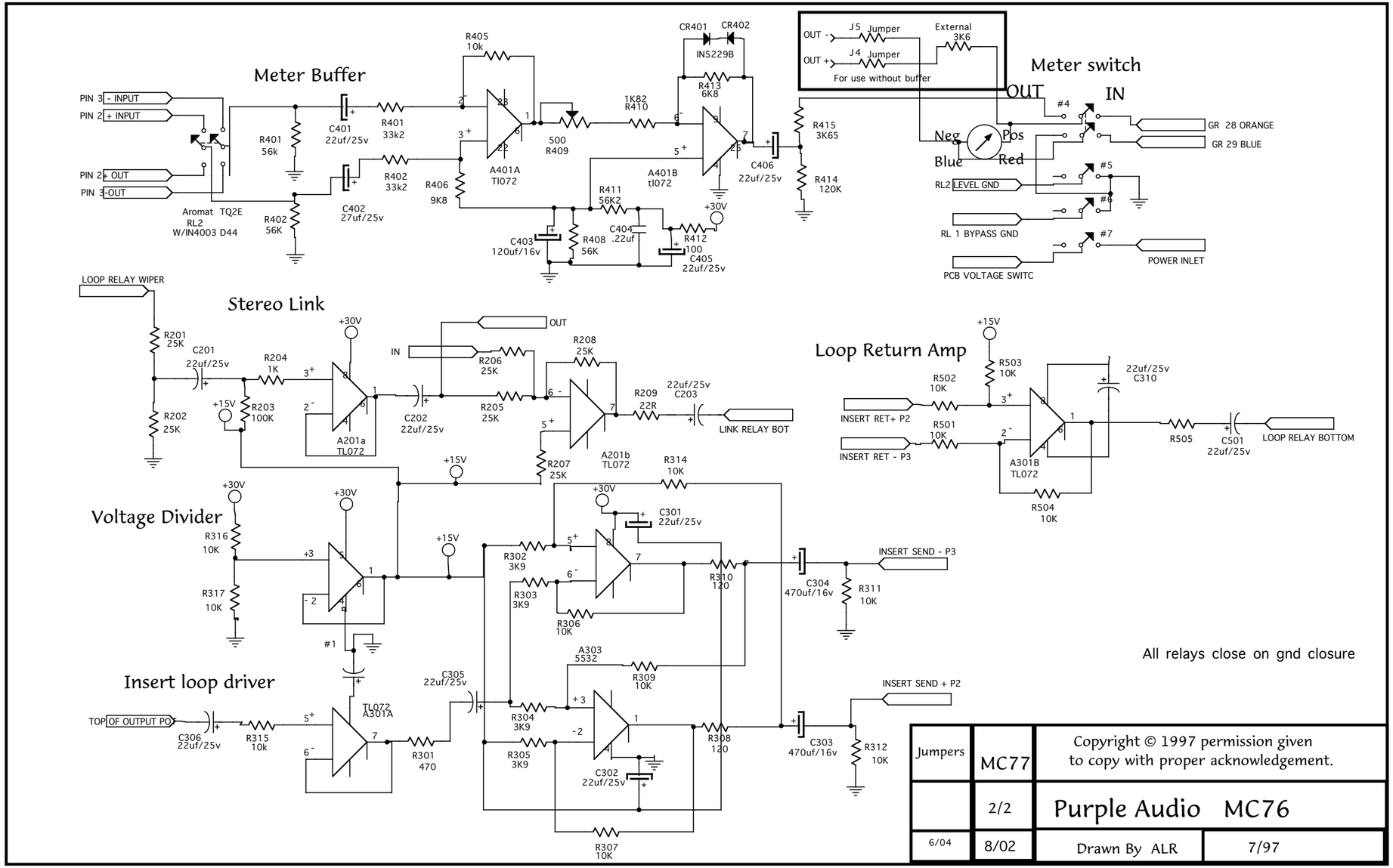
Attack Time Control F.P.
C27 .022
R54 470
R55 25K 1/2W
Red 19
Release Control F.P.
Blue 20
R64 1K5 1/4W
R56 5M 1/2W
R57 270K
Black 18
R59 2K
R35 10K
"Q" Bias Adj P.C.B.
Bias for 1db attenuation
R60 3K9
-10V

* J 1-6 used to bypass relays

+30V
R80 75 ohm 3W
CR28 Shunt Zener 30v/10w ECG5202A
C810 .1uf
C809 .1uf
C808 .1uf
CR4 1N4936
C24 3300uf/35v
C23 3300uf/63v
C805 .1uf
CR5 1N4936
C812 .1uf
C807 .1uf
R89 1K8
C811 .1uf
CR6 1N4936
C27 470uf/25v
R90 240
C26 3300uf/35v
C25 3300uf/35v
C806 .1uf
CR7 1N4936
Vout Adj Vin LM3xx
R82 100 1 W
R81 100 1W
-10V
-10V Ripple =.5mv with load
Center tapped 39.3vac x 2 41v DC/ .15A DC

T3
WHITE
YELLOW
ORANGE
BLACK
BLUE
GREY
BLUE
CKC3001 Voltage Selector
Power Switch
IEC NEUTRAL
IEC LOAD
FUSE 120V 1/8A SB / 240 1/16A SB
Dual Winding 115VAC .2A / 230VAC .1A 23VA

Relays	MC77	Copyright © 1997 permission given to copy with proper acknowledgement.	
	1/2	Purple Audio MC76	
6/04	09/02	Drawn By ALR	Date Drawn 7/97


Meter Buffer
PIN 3 - INPUT
PIN 2 + INPUT
PIN 2 - OUT
PIN 3 -OUT
Aromat TQ2E
RL2
W/IN4003 D44
R401
56k
C401
22uf/25v
R401
33k2
R402
33k2
C402
27uf/25v
R402
56K
R405
10k
R406
9K8
A401A
TI072
500
R409
1K82
R410
CR401
CR402
IN5229B
R413
6K8
A401B
tl072
R411
56K2
C403
120uf/16v
R408
56K
C404
.22uf
R412
100
C405
22uf/25v
+30V
R415
3K65
R414
120K
C406
22uf/25v
OUT -
J5 Jumper
External
3K6
OUT +
J4 Jumper
For use without buffer
Meter switch
OUT
IN
#4
Neg
Pos
Blue
Red
GR 28 ORANGE
GR 29 BLUE
#5
RL2 LEVEL GND
#6
RL 1 BYPASS GND
#7
POWER INLET
PCB VOLTAGE SWITC
LOOP RELAY WIPER
Stereo Link
R201
25K
C201
22uf/25v
R204
1K
R202
25K
R203
100K
+15V
+30V
A201a
TL072
IN
OUT
R206
25K
C202
22uf/25v
R208
25K
R205
25K
A201b
TL072
R209
22R
22uf/25v
C203
LINK RELAY BOT
R207
25K
R314
10K
C301
22uf/25v
Loop Return Amp
R503
10K
R502
10K
INSERT RET+ P2
R501
10K
INSERT RET - P3
A301B
TL072
R504
10K
22uf/25v
C310
R505
C501
22uf/25v
LOOP RELAY BOTTOM
Voltage Divider
R316
10K
R317
10K
#1
R302
3K9
R303
3K9
R306
10K
R310
120
C304
470uf/16v
R311
10K
INSERT SEND - P3
Insert loop driver
TOP OF OUTPUT PO
C306
22uf/25v
R315
10k
TL072
A301A
C305
22uf/25v
R301
470
A303
5532
R309
10K
R304
3K9
R305
3K9
C302
22uf/25v
R308
120
C303
470uf/16v
R312
10K
INSERT SEND + P2
R307
10K
All relays close on gnd closure
Jumpers
MC77
2/2
6/04
8/02
Drawn By ALR
7/97
Purple Audio MC76
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