

MODEL 522
COMPRESSOR/LIMITER/EXPANDER
GATE/DUCKER
OPERATING MANUAL
Revision 1.0 22 September, 1986

Symetrix, Inc.
4211 24th Ave West
Seattle, WA 98199

Telephone (206)282-2555
Telex 703282 SYMETRIX UD

SYMETRIX, INC.

4211 24TH AVE. WEST

SEATTLE, WA 98199, USA

TELEPHONE (206) 282-2555

TELEX 703282 SYMETRIX UD

MODEL COMPRESSOR/LIMITER/EXPANDER/GATE/DUCKER
INSTRUCTION MANUAL

TABLE OF CONTENTS

- 1.0 INTRODUCTION
- 2.0 TUTORIAL SECTION
- 3.0 CONTROLS AND CONNECTORS
- 4.0 GETTING STARTED
- 5.0 522 SPECIFICATIONS
- 6.0 SCHEMATIC DIAGRAM

Symetrix Model 522 Operation Manual

1.0 INTRODUCTION

The Symetrix model 522 Compressor/Limiter/Expander/Gate/Ducker is a precision dynamic range controller intended for use in professional audio applications.

The 522 is a two channel multi-function controller. Operating modes include compressor/limiter, expander, gate, and ducker. The two channels may be operated independently or in a stereo (master/slave) configuration. Either channel may be selected to operate in one and only one of the above modes at any time. If dual mode operation is desired (i.e. "gated compressor" for example) the user may simply create a series connection between the two channels of the 522 via an external patch cord and the desired dual mode operation will result.

Optimum audio performance of the 522 is ensured by the use of low noise and distortion VCA's and by sophisticated "side-chain" (control voltage processor) circuitry. A combination of peak and RMS signal detection assure that the 522 will perform faultlessly on any type of program material.

The 522 is easy to use, but not at the expense of flexibility. Unbalanced and balanced inputs and outputs are standard--not options. Sidechain insertion jacks allow for frequency dependent thresholds in all modes thereby permitting De-Essing and other special effects in addition to simple manipulation of problem tracks.

1.1 ABOUT THIS MANUAL

This manual is intended to supply the user with enough information to connect and use the 522 in most standard applications. The GETTING STARTED section explains the various controls and connectors on the 522 and suggests some starting control settings. The APPENDIX gives general information: Specifications, Schematic Diagrams, and Service Information. For application information not covered in this manual, contact the Symetrix Sales or Engineering departments in Seattle, Washington, USA.

2. TUTORIAL SECTION

This section of the manual covers the following topics:

- What is compression and limiting?
- What is expansion?
- What is gating?
- What is ducking?

2.1 What is compression and limiting?

Compression and limiting are both forms of the same thing: dynamic range (volume range) reduction. Musical and other audio signals can have extremely high peak to average ratios (the difference between the peak level and average level) which can cause overload in various parts of the audio recording or reproduction chain. A compressor or limiter is a special type of amplifier whose gain is dependent on the signal level passing through it. By changing the gain, based on signal conditions, the dynamic range of that signal can be automatically altered.

Strictly speaking, the terms "compressor" and "limiter" refer to two different devices. However, in the real world we most often find that one device, known as a "compressor/limiter" has been designed to perform either as a compressor or a limiter, but usually not both at once. It can be stated that a compressor/limiter is a device which allows the user to define or preset the maximum level of an audio signal. In other words, a device which causes automatic gain reduction above some defineable signal level.

2.1.1 Some definitions

In order to explain the difference between a compressor and a limiter it is first necessary to make several other definitions:

THRESHOLD - the level at which gain reduction begins.

RATIO - the number of decibels of change in input level divided by the number of decibels of change in output level. For example, if the input level to a compressor/limiter increases by 5 decibels (dB) and the subsequent change in output level is 1 dB then the ratios of the compressor/limiter is 5:1.

Now we can define "compressor" and "limiter".

COMPRESSOR - A compressor is a dynamic range control device whose input to output ratio is less than 10:1.

LIMITER - A limiter is a dynamic range control device whose input to output ratio is 10:1 or greater.

2.2 What is an expander?

If a compressor/limiter is a device which causes automatic gain reduction above some defineable signal level then an expander may be thought of as a device which causes automatic gain reduction below some defineable signal level. In other words an expander is really the "opposite" of a compressor/limiter. Compressor/limiters are used to prevent overload in audio systems and to create special musical effects. An expander does not prevent overload but it can be used for special musical effects, it can be used to increase the dynamic range of an audio signal,

and it can be used to reduce objectionable noise in the signal.

The reader should note that the action of a compressor/limiter begins as the input signal exceeds or "goes above" the threshold point. On the other hand the action of an expander begins as the input signal "falls below" the threshold point. Compressor/limiters exhibit unity gain below threshold. Expanders exhibit unity gain above threshold.

Expanders typically operate at very low ratios. When talking about expanders it is important to keep in mind that the ratio of an expander is the number of dB of decrease in output level divided by the number of dB of decrease in input level. Therefore an expansion ratio of 3:1 means that for every 3 dB that the output has decreased, the input has decreased by only 1 dB.

2.3 What is a gate?

A gate is a device very similar to an expander. Just like an expander, a gate only has effect "below" threshold. In fact it may just be easiest to think of a gate as a "high ratio" expander. You have probably noticed that gates are often referred to as "noise" gates. This can be somewhat misleading. Although gates are very effective at reducing noise they can also perform such other chores as eliminating crosstalk or leakage. In fact when it comes to doing these things the user will have to make a choice between using an expander or a gate. The "ear" often makes the final decision. The user should be ware that because gates operate at high ratios the audible effects can sometimes tend to be drastic. It's not too hard for a gate to introduce unwanted modulation distortion. There will be more discussion of this in section 4 (GETTING STARTED).

2.4 WHAT IS A DUCKER?

A ducker is a device that causes gain reduction upon command from an external audio signal. One of the most useful applications for a ducker is in a "voice-over" situation. In this case a music track is made to "duck" or decrease in gain whenever an audio signal (in this case an announcer's voice) exceeds the threshold level. Take note that in a ducker, it is usually an external signal and not an internal signal that initiates gain reduction. It is also important to note that when the external signal exceeds threshold the ducker responds with a fixed amount of gain reduction; i.e. the gain reduction is not dependent upon the amplitude of the external signal once the threshold has been exceeded.

3.0 CONTROLS AND CONNECTORS

3.1 The Front Panel

The Front Panel controls determine the operating conditions and

522 MANUAL REV C
performance parameters for the 522. This section explains the operation and use of each control.

3.1.1 THRESHOLD Control

The THRESHOLD control determines the signal level at which any dynamic range control begins. The control is calibrated in terms of the actual signal level needed at the unbalanced INPUT connector (or the CONTROL LOOP RETURN/EXT connector) to cause the onset of dynamic range control action in any mode (Compress/Limit, Expand, Gate, Duck). As the knob is rotated clockwise the threshold level rises. In the Compress/Limit and Duck modes 522 action begins after the input signal exceeds (goes above) threshold level. In the Expand and Gate modes 522 action begins after the input signal falls below threshold level.

Set the THRESHOLD control so that the gain reduction display indicates the desired amount of gain reduction in the presence of an input signal.

3.1.2 ATTACK Control

The ATTACK control determines how quickly the 522 responds to a signal whose level is above the setting of the THRESHOLD control. At the fastest setting, the 522 will respond to even momentary transients, like a handclap. As the attack time is increased, the 522 tends to "ignore" short-term peaks and responds more to the average signal level.

In the Compress/Limit mode set the attack time to control the amount of peak information the compressor/limiter will allow to pass. Faster times will prevent this information from getting through while slower times allow more and more peak information to pass.

In the Expand and Gate modes set the attack time to determine how quickly the signal will return to unity gain. (In the Gate mode you may wish to think of "attack" as the amount of time it takes for the gate to "open".)

In the Duck mode set the attack time to determine how quickly the external signal will cause gain reduction of your main signal.

3.1.3 RELEASE Control

The release control functions somewhat differently in the different modes (see following discussion). However, in general counterclockwise adjustment of the control produces fast release times while clockwise adjustment produces slow release times. An important feature of this control is its "program dependency". As the control is adjusted towards the center ("twelve o'clock") position, the release time becomes "program dependent". That is to say that in this position the nature of the signal itself helps to determine release time. For example, long, sustained tones will tend to automatically create long release times while short, staccato material will create fast release times. In this

way the 522 helps out in those situations where the nature of the program material is constantly changing by automatically determining the optimum release time.

In the Compress/Limit mode extremely short release times allow the 522 to readjust quickly after a peak, while longer release times make the readjustment more gradual. The release control adjusts the rate at which the compressor/limiter returns to linear amplification (output change equals input change). Both long or short release times can be audible, depending upon the dynamics (envelope) of the input signal.

In the Expand and Gate modes the release control adjusts the rate at which gain reduction (expanding and gating) occurs. Faster release times will increase the audibility of the effect.

In the Ducker mode the release control adjusts the rate at which the main signal returns to unity gain (linear amplification) once the signal at the RETURN/EXT jack falls below threshold.

3.1.4 RATIO/RANGE Control

As may be evident from its name the RATIO/RANGE control assumes different functions in different modes.

In the Compress/Limit mode the RATIO/RANGE control adjusts ratio. The ratio is the amount of compression or limiting that occurs once the input signal exceeds the threshold. As the control is turned clockwise (higher ratios) the output signal increases less and less as the input signal increases. Thus, the RATIO control is the final determiner of "how much" compression or limiting you get.

Set the RATIO control according to the desired usage and dynamic range desired in the output signal. For gentle gain-riding, the lower ratio settings are desirable. For absolute overload protection, the higher settings are advisable. This is described in further detail later in this manual.

In the Expand mode the RATIO/RANGE control adjusts the expansion ratio. This is the amount of downward expansion (gain reduction) of the signal which occurs once the input signal falls below threshold. As the control is turned clockwise (higher ratios) the output signal decreases more and more as the input signal increases. The result is an increase in dynamic range. Note that this effect is exactly the opposite of compression.

Set the Expander RATIO control according to the desired dynamic range in the output signal. For subtle increases in dynamic range and noise reduction the lower ratios are best. For special effects try high ratios.

In the Gate mode the RATIO/RANGE control adjusts the RANGE of attenuation or the amount of gain reduction which takes place once the input signal falls below threshold. The control is

calibrated in dB steps. In the full counterclockwise position there is 0dB of range or in other words no effect. As the control is adjusted clockwise more and more gain reduction takes place. For most applications you will probably choose the maximum (full clockwise) setting.

In the Ducker mode the RATIO/RANGE control adjusts the RANGE of attenuation or the amount of "ducking" which takes place once the external control signal exceeds the threshold setting. In the full counterclockwise position there is no ducking. As the control is adjusted clockwise there is more and more effect. Typical settings for this control will probably vary between 3 and 10 dB.

3.1.5 IN/OUT Switch

The IN/OUT switch disables 522 action when in the out (released) position. Use the IN/OUT switch to compare between effected and uneffected signal in all modes.

3.1.6 MODE DISPLAY

The MODE DISPLAY indicates which operating mode has been selected.

3.1.7 MODE SELECT Switch

The MODE SELECT Switch is a momentary action switch. When the switch is depressed the MODE SELECT light will advance to the next lower light. When the lowest light has been reached and the switch is depressed again the mode will advance to the top light.

3.1.8 SLAVE MODE

The lowest MODE light on Channel 2 is the SLAVE light. When this mode is selected all operating controls on Channel 2 are defeated. Control of both channels (stereo) is transferred to Channel 1's controls, except as noted below in paragraph 3.1.9.

3.1.9 INT/EXT Switch

The normal operating position of this switch is in the INT (in) position. In this position the control voltage processor circuitry (CVP) is activated by the incoming audio signal present at the INPUT jack. With the switch in the EXT (out) position the CVP is activated by the signal present at the RETURN/EXT jack. If no plug has been inserted into the RETURN/EXT jack then control automatically reverts to internal (incoming audio signal present at the INPUT jack) no matter which position the INT/EXT switch is in. For most applications place this switch in the INT (in) position for operation in the Compress/Limit, Expand, and Gate modes. Place this switch in the EXT (out) position for operation in the Ducker mode.

When operating in the SLAVE MODE (stereo operation) and selecting

External control on Channel 1 it is important for the user to note that the control signal is actually the sum (combination) of both Channel 1 and Channel 2 control signals. If the user does not want Channel 2's internal audio signal or its external control signal to affect the stereo operation then the INT/EXT must be switched to the EXT position, a plug must be inserted into Channel 2's INT/EXT jack, and there must be no signal present at the tip of the plug. IT IS ESPECIALLY IMPORTANT TO OBSERVE THIS WHEN DOING STEREO DUCKING, OTHERWISE CHANNEL TWO WILL ATTEMPT TO PERPETUALLY DUCK CHANNEL ONE AND YOU PROBABLY WON'T BE HAPPY WITH THE RESULT.

3.1.10 GAIN REDUCTION Display

The GAIN REDUCTION display shows the actual amount of gain reduction taking place in the system at any instant in time. Each LED is calibrated in dB. The overall range of the display is from -2 to -40dB. The input signal to the display is the same as the input signal to the VCA, thus the rise and fall characteristics of the display are the same as those of the control voltage. The amount of gain reduction is equal to the difference between the input signal and the output signal.

3.1.11 POWER Switch

The POWER switch applies and removes power from the 522. In the up position (power on) one of the mode lights on each channel will always light.

3.2 THE REAR PANEL

All of the 522's input and output connectors are located on the rear panel along with the fuse and power cord. All of these connections are described in this section. The connectors for both channels one and two are identical.

3.2.1 INPUT Connector

A 1/4" phone jack labeled "input" accepts balanced or unbalanced input signals. The pin connections are: Tip = hi, Ring = low, Sleeve = ground. Input plugs may be of the tip-ring-sleeve type for balanced operation or the tip-sleeve (mono) type for unbalanced operation. Unbalanced input impedance is 16.7k ohms and balanced input impedance is 23.1k ohms.

3.2.2 OUTPUT Connector

A 1/4" phone jack labeled "output" provides unbalanced or differential electronically balanced output signals. The pin connections are: Tip = hi, Ring = low, Sleeve = ground. Output plugs may be of the tip-ring-sleeve type for balanced operation or the tip-sleeve (mono) type for unbalanced operation.

3.2.3 TO EQ Connector

The TO EQ connector is a 1/4" tip-sleeve connector. This jack is the actual signal source for the detector (side-chain) circuit. When used for side-chain operation, the input jack from an external equalizer is connected here.

3.2.4 RETURN/EXT Jack

The RETURN/EXT jack is a 1/4" tip-ring-sleeve connector and accepts either balanced or unbalanced sources. This jack is the return (input) to the detector (side-chain) circuit. When used for side-chain operation and external control signal is connected here. The signal source may be the output of an equalizer fed by the TO EQ jack or it may be any independent audio source (typically the output of a mic pre-amp in the Ducker mode).

3.2.4 FUSE

Replace the fuse with a 0.5 amp fast blow type for 117 Volt operation and a 0.25 amp fast blow type for 220 Volt operation. Disconnect the AC cord before replacing the fuse.

3.2.5 LINE CORD

The 522 is prewired at the factory for one of two possible nominal AC power line voltages. Most of the units leaving the factory are wired for 117 Volt, 60 Hz operation or 220 Volt, 50 Hz operation. These are nominal operating voltages. In fact, the 522's power supply has been designed so that the unit will operate over a wide range of operating voltages both above and below these nominally designated voltages. If there is any question as to whether or not the 522 is suitable for operation on your local AC voltages do not hesitate to contact your local Symetrix distributor or the Symetrix factory.

4. GETTING STARTED

The following instructions are intended as a new user's guide to the 522. We will take you through the ins and outs of connecting the 522 into your system and a few pointers about setting up and using the 522.

If you aren't a first-time user read along anyway. There are a few goodies in here for you, too!

4.1 Interconnection Into Your System.

If you are using the 522 at the mixing console for dynamic range control of input channels, use the channel insert jacks provided on the mixing console to connect the 522. The channel insert sends should connect to the 522 inputs and the 522 outputs to connect to the channel insert returns. In this application, you

will get best results if the channel insert jack is PRE-FADER, PRE-EQ. In most recording applications, this is the preferred place to connect the 522. If your console does not have channel insert jacks, you can use the submaster insert jacks (if provided) or even connect the 522 between the console and the tape machine.

In installations involving a patch bay, be sure to bring the sidechain equalizer insert jacks (EXT/CTRL IN and SEND) out to the patch bay along with the audio input and output jacks. This way you can take advantage of the sidechain insert jacks with a minimum of hassle. These jacks should be "half-normalled".

When using the 522 to prevent overload of a subsequent amplifier (Compress/Limit Mode), the 522 should be the last item in the signal chain before the amplifier. In a PA system, this would be either at the electronic crossover outputs or input. Using the 522 at the crossover outputs allows the mixing engineer to determine the maximum output level of each frequency band presented to the various power amplifiers. Since each band is limited independently, amplifier overload can virtually be eliminated. Interaction between frequency bands is non-existent and each frequency band can be expected to perform to its limits, without fear of overload.

When using the 522 as a DUCKER the 522 will most often be connected at the final output of an audio console. The 522's EXT CTRL/RETURN input will probably be connected to the output of a console MIC PRE-AMP. It is important to remember to switch the 522's INT/EXT switch (located on the front panel) to the EXT position for DUCKER operation.

Compression ratio		variable from 1:1 to infinity:1
Threshold		variable from -40dBm to +20dBm
Equivalent input noise unity gain, 20-20kHz bandwidth		-85.2dBu (43 microvolts), 600 ohm source resistance
Frequency response		20-20kHz, +0dB, -1dB
Distortion	Not greater than .03% THD, 10dB gain reduction, 600 ohm load, 1kHz, 0dBm output level. Not greater than .09% THD, 10dB gain reduction,	600 ohm load, 20kHz, 0dBm output (all distortion components are primarily 2nd harmonic).
Maximum available gain reduction		60dB
Attack time	at full counterclockwise setting of control may be as fast as 120db/msec depending upon the nature	of the program, otherwise control is variable from 12dB/msec to .25dB/msec.
Release time		variable from 300dB/sec to 5dB/sec.
Input impedance		balanced input: 16.7k ohms unbalanced input: 23.1k ohms side-chain input: 9.1k ohms
Maximum output level		+20dBm into 600 ohms or greater
Minimum rated load impedance		600 ohms
Variable controls		threshold, attack time, release time, range, ratio
Other controls		channel in/out, mode select, internal/external control, stereo slave select, power on
Visual indicators		gain reduction (6 LEDs per channel), mode select (4 LEDs per channel)
Connectors		all connectors are 1/4" phone jax
Physical size		1 3/4" high, 19" wide, 7" deep 4.5 x 48.3 x 12.7cm
Shipping weight		6lbs
Power requirements	60Hz, 120VAC, standard	50Hz, 240VAC, upon request

In the interest of continuous product improvement and development Symetrix, Inc., reserves the right to change or modify any of the above

specifications or features, whenever, in our opinion, such a change produces an advantage mutual to our customers and ourselves.