Symetrix
425
Dual Compressor / Limiter

Owner's Manual

Signal Processing at it's Best!

Revision 2.0, 10/29/93
Part number: 530201

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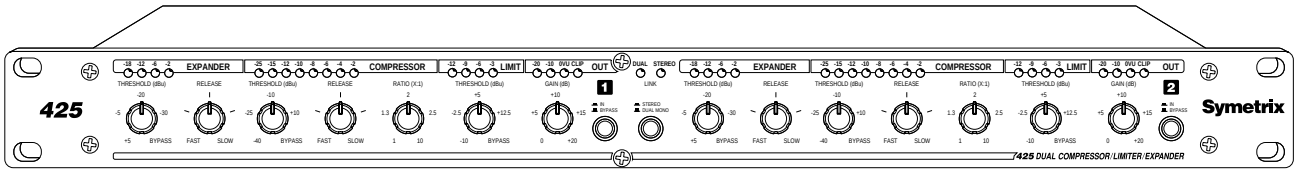


1. Introduction

The Symetrix 425 is a dual channel compressor/limiter/expander. The two channels may be operated in dual-mono mode, or in stereo mode. In stereo mode, both channels receive identical control signals, which minimizes image shifts caused by unequal gains in the two channels.

At Symetrix, we feel that the 425 represents the distillation of our 15 years of signal processing experience into a product that is at once versatile and easy to use without having important controls removed in the interest of simplicity. The 425 is unique because its processor sections are always in-line. There is no selector switch to select between expander, compressor, or limiter. Now you can expand the low-level parts of a signal to improve its signal-to-noise ratio, then apply compression to add punch and density and still have the security of a peak limiter for overload protection. We call this approach to total level control IDP or Integrated Dynamics Processing.

IDP also means powerful, streamlined controls that make the 425 easy to learn and quick to set up, even with three types of processing in one rack space. Each section has the controls that you need to respond to any audio situation fast. Individual LED meters show you what's going on inside each section.

The 425 is Listed by Underwriters Laboratories Inc. (UL). Samples of this product have been evaluated by UL and meet the applicable UL Standards for Safety.

In the final analysis, Integrated Dynamics Processing means clean, quiet sound that meets professional demands in any situation. High-quality components and a minimalist signal path make the 425 exceptionally transparent.

1.1 About this manual

We recommend that you read this manual from cover to cover. Somewhere between the confines of the two covers you should find the answers to most (98%) of your questions, both technical as well as musical.

If you're in a hurry (like most of us), or if you really don't believe that someone could write a decent owners manual that you can read and understand, then do us both a favor and read section 6, "Fast First Time Setup." This section will help you get connected, tell you what the knobs do, and send you on your way.

This manual contains the following sections:

Chapter 1. *Introduction*: introduces the 425 and this manual.

Chapter 2. *Using the* 425: describes how to use the 425. Covers installation, signal levels, input and output impedances, and physical features.

Chapter 3. *Technical Tutorial*: a basic and not-so-basic discussion of signal levels, input and output impedances and connection polarity.

Chapter 4. *Front Panel Overview*: a brief look at the controls and switches located on the front panel of the 425.

Chapter 5. *Rear Panel Overview*: a brief look at the rear panel of the 425.

Chapter 6. *Fast First Time Setup*: is the setion to read if you can't wait.

Chapter 7. *Using the* 425: describes the use of the 425 in detail.

Chapter 8. *Applications*: gives some hints for using the 425 in a variety of situations and provides a short introduction to dynamics processing..

Chapter 9. *Troubleshooting*: tells what to do when the 425 doesn't work.

Chapter 10. *Limited Warranty*: describes the 425's limited warranty.

Chapter 11. *Service Information*: tells how to get your 425 repaired, how to obtain parts, and how to contact the factory.

Chapter 12. *Specifications:* lists the technical specifications of the 425's performance.

Chapter 13. *Schematics*: contains the printed circuit board layout(s) and schematic diagrams.

Appendix A. *Appendix A*: contains the Architects and Engineer's specifications.

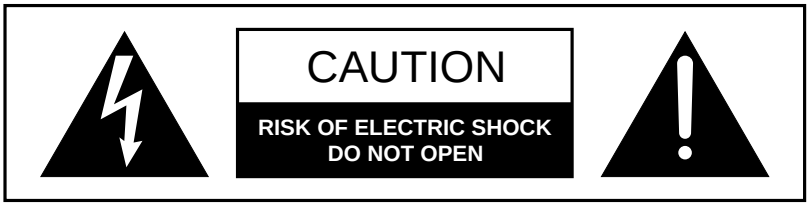
Appendix B. *Appendix B*: contains disassembly instructions.

1.2 Operator Safety Summary

The information in this summary is intended for persons who operate the equipment as well as repair personnel. Specific warnings and cautions are found throughout this manual wherever they may apply; they do not appear in this summary.

The notational conventions used in this manual and on the equipment itself are described in the following paragraphs.

1.2.1 Equipment Markings



No user serviceable parts inside. Refer servicing to qualified service personnel.
Il ne se trouve a l'interieur aucune piece pourvant entre reparée l'usager.
S'adresser a un reparateur compétent.

The lightning flash with arowhead symbol within an equilateral triangle is intended to alert the user of the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.	The exclamation point within an equilateral triangle is intended to alert the user of the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance (i.e. this manual).

Caution

To prevent electric shock, do not use the polarized plug supplied with this appliance with any extension cord, receptacle, or other outlet unless the blades can be fully inserted to prevent blade exposure.

1.2.2. Terms

Several notational conventions are used in this manual. Some paragraphs may use Note, Caution, or Warning as a heading. These headings have the following meaning:

Convention	Description
Caution	Identifies information that, if not heeded, may cause damage to the 425 or other equipment in your system.
NOTE	Identifies information that needs extra emphasis. A Note generally supplies extra information to help you use the 425 better.
Warning	Identifies information that, if ignored, may be hazardous to your health or that of others.

In addition, certain typefaces and capitalization are used to identify certain words. These situations are:

Convention	Meaning
CAPITALS	Controls, switches or other markings on the chassis.
Boldface	Strong emphasis.

1.3. Other Safety Information

Power Source	This product is intended to operate from a power source that does not apply more than 250V rms between the power supply conductors or between either power supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation
Grounding	The chassis of this product is grounded through the grounding conductor of the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle before making any connections to the product. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.
Danger from Loss of Ground	If the protective ground connection is lost, all accessible conductive parts, including knobs and controls that may appear to be insulated, can render an electric shock.
Proper Power Cord	Use only the power cord and connector specified for the product and your operating locale. Use only a cord that is in good condition.

Proper Fuse	The fuse is mounted internally and is not considered user serviceable. The fuseholder accepts American sized fuses (1/4 in dia.) or European sized fuses (5mm dia). For 117 VAC operation, the correct value is 1/4A, 250VAC, fast blowing (bussman type AGC) For 230 VAC operation, the correct value is 1/8A, 250VAC, slow blowing (Bussman type MDL or GDC.
Operating Location	Do not operate this equipment under any of the following conditions: explosive atmospheres, in wet locations, in inclement weather, improper or unknown AC mains voltage, or if improperly fused.
Stay Out of the Box	To avoid personal injury (or worse), do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.
User-serviceable parts	There are no user serviceable parts inside the 425. In case of failure, refer all servicing to the factory.

2. Dynamics Processing Tutorial and Functional Basics

The 425 brings together three widely-used signal processors: a downward expander, a compressor, and a peak-limiter. It's important to note that although the 425 is three processors in one box, it contains one-third less circuitry than there would be if each processor was in its own box. The reason is simple: there is only one VCA (voltage-controlled amplifier) in each channel of the 425. Smart analog computer signal processing circuitry (the sidechain by any other name) combines the three control signals from the downward expander, compressor, and limiter to control the one VCA. There is no compromise involved in doing this and the signal passes through two fewer VCAs.

This part of the 425 tells how to use your 425. If you are new to signal processors, read on; the remainder of this section is a primer on the three basic parts of the 425.

2.1 Dynamics Processing Basics

Audio signals possess several basic properties: amplitude or volume (measured in volts or dB), frequency or pitch (measured in Hertz), duration (measured in hours:minutes:seconds) and waveform (described graphically, like sine, square, triangle, pulse). Complex signals like musical sounds are made up of simpler waveforms such as sine waves, mixed in the proper proportions.

Signal processors allow you to manipulate various parameters of an audio signal. Equalizers change the amount of amplification given to different frequencies (a perfect amplifier amplifies all frequencies by the same amount). Dynamics processors change the dynamic range of audio signals.

The dynamic range of an audio signal is the difference between its loudest and softest moments. For audio equipment, this is the difference between the noise floor (residual noise output, with no input signal) and peak clipping (the point at which the output clips or distorts). A hypothetical black-box having a noise floor of -90 dBu and a maximum peak output level of +24 dBu would have a dynamic range of 114 dB (+24 minus -90). Audio storage devices like tape machines have worse limitations, a typical professional analog two-track tape machine may have a dynamic range of 65 to 70 dB.

If you've used an analog tape recorder before, then you are already familiar with the problem of setting recording level. Record too hot and you get distortion; record too cold and get noise in return. Many musical instruments have dynamic ranges that exceed that of most tape recorders. So, how do we squeeze a 80 or 90 dB signal into a 60 or 70 dB window?

The answer lies in a common audio signal processor: the compressor.

2.1.1 Compressors and Limiters

A compressor or limiter monitors the level or amplitude of a signal and reduces the amplitude according to a rule whenever the signal level exceeds a predetermined level. The predetermined level is known as the threshold level and is usually set by a front panel control. The rule by which the compressor lowers the level is the compressor's compression ratio and this parameter is also usually set via a front panel control.

Compression ratio refers to the ratio of a change at the input versus the change at the output of the device. Thus, if we apply a signal that changes 10 dB to the input of a hypothetical compressor, and measure a 2 dB change in the output signal, that compressor would have a compression ratio of 10:2, or 5:1 (reduce the fraction). Different compression ratios have different uses. Use lower ratios (6:1 or less) for level control, intermediate ratios (8:1 to 12:1) for leveling (making the signal level more or less constant), and higher ratios for limiting (putting an absolute ceiling on the signal level).

Limiters are nothing more than compressors, but being possessed of much higher compression ratios (20:1 or higher). Limiters are typically used to stop occasional peaks which

would have otherwise caused overload or distortion. Typically you set a limiter (via its threshold control) so that it "stays out of the way" until a peak comes along.

2.1.2 Expanders and Gates

While a compressor or limiter reduces the dynamic range of a signal by reducing its level once it has exceeded a threshold level, an expander does the opposite (well, almost). The easiest way to visualize an expander is to think of it making loud signals louder. This is fine, except that in the real world, you run into the limitations of processors and amplifiers after the expander going into terminal overload.

The solution is to make soft signals softer, or downward expansion. This is what the 425's downward expander does. When the signal level falls below the level set by the threshold control, the expander reduces the gain by the amount dictated by its expansion ratio. Thus, for a below-threshold signal, a 10 dB output change results from a 5 dB change in the input signal, if the expansion ratio is 1:2.

A gate is similar to an expander except that its ratio is much higher; thus the action is more like a switch once the signal falls below threshold. Some expander applications for the 425 may be quite similar to a gate, like tending a lone announce microphone, but the 425's expander isn't well suited to typical gate applications like removing leakage from drum microphones.

2.1.3 Ratio

The compression ratio of the 425 tells how much the output changes for a change in the input. A linear amplifier (like a simple preamp) has a ratio of 1:1 because a change of 1 dB at its input results in a 1 dB change at its output. A compressor alters the input/output relationship by its compression ratio. Thus a 20:1 ratio means that a 20 dB change at the input results in a 1 dB change at the output. In other words, a very audible change at the input (20 dB) turns into a barely discernible change at the output (1 dB).

Compressors are not the only devices to have an input/output ratio. Any device that is capable of changing the input/output relationship can be said to have a ratio. Thus expanders, gates, compressors and limiters all fit this category.

An expander maginifies output changes for a given input change. Thus, once the input signal falls below threshold, the expander changes the output by the amount of the ratio. The 425's downward expander has an expansion ratio of 1:2, which means that an input signal that gets 5 dB quieter turns into a 10 dB quieter output change.

A gate can be looked at as an expander with an infinite expansion ratio. Thus the slightest change in the input signal, above threshold, turns the gate full-on.

2.1.4 Gain vs Output

The *gain* control allows compensating for signal level lost to compression. As an example, try setting the 425 for a 4:1 ratio. Now adjust the THRESHOLD control for 10 dB of gain reduction as read on the compressor's gain reduction display. The output level should be significantly lower than what it was. You supply the additional gain (make-up gain) by adjusting the GAIN control until the input and output signal levels match.

2.1.5 Attack Time

The attack time represents the amount of time that a compressor (or limiter, or expander, or gate) needs to react to an input change. You might ask, why not just make it lightning fast? Because you may sometimes want to let occasional peaks through, which helps maintain the dynamic characteristics of the input signal. Usually, what we're after is *control* of the input signal, not total homogenization.

2.1.6 Release Time

Most dynamics processing equipment has a knob marked *release* on the panel. This refers to release time, and affects the length of time required for the gain to recover to the no-signal state.

For compressors, the no-signal point is unity gain and this applies to any signal whose level is below threshold. For expanders the no-signal point is the gain reduction set by the threshold control under no-signal conditions and this applies to any signal whose level is above threshold. In this case, the release time control governs how long it takes for the expander to reduce the gain when the signal disappears.

The release time control allows tailoring the compressor's recovery time to the program material. Generally, peak limiting is associated with short release times and compression or leveling associated with longer release times.

The 425's compressor release circuitry has a unique dual-release time feature designed to make life easier. The dual-release feature makes the release time partially program dependent, giving you the best of both worlds: fast release for short-duration peaks and a longer release time for longer-duration peaks. The release time control adjusts the speed of the longer of the two.

2.1.7 Threshold Setting

The *threshold* control sets the audio signal level where the compressor/expander/limiter begins working. In the case of the compressor or limiter, the processor begins working once the signal has exceeded the threshold level. For the expander, it begins working once the signal has fallen below the threshold level.

For any of the three processors, the threshold control setting also determines the degree or amount of gain reduction. Thus, for the compressor, rotating the control counter-clockwise (towards -40) results in increasing amounts of compression. For the expander, counter-clockwise rotation raises the level that the signal must exceed to pass through the expander untouched. This has the effect of "shutting off" the signal once you reach and then pass the threshold level.

For most compressor applications, moderate amounts of gain reduction are all that is required, 3-9 dB at the most. If you are using the compressor to minimize level changes of a wide range of program material (automatic level control), then higher amounts of gain reduction are needed; the amount of gain reduction corresponds to the range of change that you can respond to (slower release times are also indicated, too).

2.1.8 Interpreting the Displays

The 425 has many displays; one per processing section. The three displays associated with the expander, compressor and limiter indicate a parameter called gain reduction. Simply stated, the gain reduction indication shows how far the gain or amplification was reduced from unity. Another way of looking at this is: if the gain reduction display says 10 dB of gain reduction, switching the unit to bypass will result in a 10 dB increase in the output level.

The output display indicates output level, in VU (0 VU = +4 dBm = 1.23V RMS measured at the balanced outputs). For most applications, just make certain that you never see the CLIP LED illuminate.

2.2 Using the Sidechain

The sidechain is a patch point in the control circuit of a dynamic range processor, which provides access to the part of the circuitry that tells the VCA what to do. The 425's sidechain is routed through a TRS jack located on the rear panel that provides both a send and return via the same jack. The sidechain connection affects all three processors in the 425.

Look at the block diagram in Section 7. Notice the sidechain connections that come from the balanced input stage. They allow access to the control circuit's input signal. The control signal is derived from, but kept totally separate from, the audio signal path. This means the control signal can be processed outside the 425 without actually processing the signal that's going through the VCA (the audio signal itself). This presents some very interesting possibilities for changing or improving the operation of the dynamic range processor.

The best use of the sidechain is to make the action of the 425's compressor/limiter/expander frequency dependent, that is, to make it respond more (or less) to certain frequencies. Because the audio signal and the control signal remain completely separate (even while the control circuit tells the VCA whether to turn the gain up or down), you can equalize the sidechain without changing the EQ in the main audio path.

Removing unwanted frequencies from the control signal before it actually reaches the VCA prevents those frequencies from being used to create gain changes. Perhaps most importantly, this happens without actually equalizing the signal being processed through the 425.

To make the 425's processors more sensitive to high frequencies, use an equalizer (graphic or parametric) to boost the high frequencies in the sidechain signal. This increases the sensitivity of the control circuits to those particular frequencies so the compressor/limiter/expander responds more to those frequencies than any others. If the offending frequencies produce a control signal of greater amplitude than the desired frequencies they will control how the compressor/limiter/expander behaves with the rest of the signal as well. However, if the offending signals are of significantly greater amplitude than the rest of the signal, careful adjustment of the corresponding threshold control (combined with the boost provided by the EQ in the sidechain) will make the compressor/limiter/expander respond only to the boosted frequencies.

Keep in mind that the threshold level becomes a function of the amount of overall gain through the equalizer, including the boost. This technique can be used with any frequency that can be controlled by the equalizer.

Cutting a frequency creates the inverse effect, making the 425 less sensitive to the frequencies that were removed from the control signal.

Since the expander only discriminates between different levels (not different sounds), it can be fooled by signals whose levels are nearly the same, even if the frequency content of those signals is fundamentally different. When the 425's expander is used to shut out unwanted sounds, any signal exceeding the threshold setting triggers the expander. When this happens, it's often possible to eliminate the false triggering by equalizing the control signal.

For example, if low frequency signals transmitted through a desk or podium are triggering the 425's expander unnecessarily:

- ❒ **Use an equalizer in the sidechain to remove the low frequencies from the control signal.**

and/or

- ❒ **Use the equalizer to boost the voice-range frequencies in the control signal.**

When the offending frequencies are removed or minimized, the relative level of the desired frequencies increases and the expander can now tell the difference between the wanted and unwanted signals. Use this technique in any situation where levels are nearly the same, but the fundamental frequencies involved are different.

NOTE The ability of the expander to discriminate between wanted and unwanted signals is partially determined by mic technique. Be particularly careful of high frequency sounds entering the side or rear pattern of a cardioid mic. Most cardioid mics exhibit a sharply rising off-axis response characteristic at higher frequencies. Check the off-axis curve (the lower one) in the manufacturer's literature. If there's only a 3dB to 6dB difference between the on-axis (frontal) response and the off-axis (side or rear) response in the 5kHz to 10kHz reason, high frequency sounds will be picked up by the side or back of your mic.

Use the mic's directional pattern to keep other sources as far off-axis as possible - do everything you can do to extract all the source-to-source discrimination possible through good mic technique. The sounds picked up by individual mics must be primarily the sound of the desired signal, or the expander won't be able to tell the difference.

Hint: You can save time, and make life easier by listening to the output of the equalizer (instead of the 425's output) that you're using in the sidechain. Doing this allows you to hear the signal that will control the 425, and perhaps to find the range that you wish to emphasize or de-emphasize more easily.

Notes

3. Technical Tutorial

This section discusses a multitude of things, all related to getting signals in and out of the 425.

3.1. Matching Levels vs Matching Impedances

In any audio equipment application, the question of "matching" inevitably comes up. Without digging a hole any deeper than absolutely necessary, we offer the following discussion to (hopefully) clarify your understanding of the subject.

Over the years, we have all had impedance matching pounded into our heads. This is important only for ancient audio systems, power amplifiers, and RF. Technically speaking, the reason is power transfer, which reaches a maximum when source and load are matched. Modern audio systems are voltage transmission systems and source and load matching is not only unnecessary, but undesirable as well.

- ❒ Ancient audio systems operate at 600 ohms (or some other impedance value), and must be matched, both at their inputs and at their outputs. Generally speaking, if you are dealing with equipment that uses vacuum tubes, or was designed prior to 1970, you should be concerned about matching. These units were designed when audio systems were based on maximum power transfer, hence the need for input/output matching.
- ❒ Power amplifiers are fussy because an abnormally low load impedance generally means a visit to the amp hospital. Thus, it's important to know what the total impedance of the pile of speakers connected to the amplifier really is.
- ❒ RF systems are matched because we really are concerned with maximum power transfer and with matching the impedance of the transmission line (keeps nasty things from happening). Video signals (composite, baseband, or otherwise) should be treated like RF.

Some folks seem to believe that balanced/unbalanced lines and impedances are related; or even worse that they are associated with a particular type of connector. Not so. Unbalanced signals are not necessarily high-impedance and balanced signals/lines are not necessarily low-impedance. Similarly, although 1/4 inch jacks are typically used for things like guitars (which are high-impedance and unbalanced), this does not predispose them to only this usage. After all, 1/4 inch jacks are sometimes used for loudspeakers, which are anything but high-impedance. Therefore, the presence of 3-pin XLR connectors should not be construed to mean that the input or output is low-impedance (or high-impedance). The same applies to 1/4 inch jacks.

So, what is really important? Signal level, and (to a much lesser degree), the impedance relation between an output (signal source) and the input that it connects to (signal receiver).

Signal level is very important. Mismatch causes either loss of headroom or loss of signal-to-noise ratio. Thus, microphone inputs should only see signals originating from a microphone, a direct (DI) box, or an output designated microphone-level output. Electrically, this is in the range of approximately -70 to -20 dBm. Line inputs should only see signals in the -10 to +24 dBm/dBu range. Guitars, high-impedance microphones, and many electronic keyboards do not qualify as line-level sources.

The impedance relation between outputs and inputs needs to be considered, but only in the following way:

> **Always make sure that a device's input impedance is higher than the output source impedance of the device that drives it.**

Some manufacturers state a relatively high-impedance figure as the output impedance of their equipment. What they really mean is that this is the minimum load impedance that they would like their gear to see. In most cases, seeing a output impedance figure of 10,000 (10K) ohms or higher from modern equipment that requires power (batteries or AC) is an instance of

this type of rating. If so, then the input impedance of the succeeding input must be equal to or greater than the output impedance of the driving device.

Symetrix equipment inputs are designed to bridge (be greater than 10 times the actual source impedance) the output of whatever device drives the input. Symetrix equipment outputs are designed to drive 600 ohm or higher loads (600 ohm loads are an archaic practice that won't go away). You don't need to terminate the output with a 600 ohm resistor if you aren't driving a 600 ohm load. If you don't understand the concept of termination, you probably don't need to anyway.

The two facts that you need to derive from this discussion are:

- ❒ Match signal levels for best headroom and signal-to-noise ratio.
- ❒ For audio, impedance matching is only needed for antique equipment and power amplifier outputs. In all other cases, ensure that your inputs bridge (are in the range of 2 to 200 times the output source impedance) your outputs.

3.2. Signal Levels

The 425 is designed around studio/professional line levels: +4 dBu or 1.23 volts RMS. The unit is quiet enough to operate at lower signal levels such as those found in semi-pro or musical-instrument (MI) equipment (-10 dBu or 300 millivolts).

3.3. I/O Impedances

The 425 is designed to interface into almost any recording studio or sound reinforcement application. This includes:

- ❒ 600 ohm systems where input and output impedances are matched.
- ❒ Unbalanced semi-professional equipment applications.
- ❒ Modern bridging systems where inputs bridge and outputs are low source impedances (voltage transmission systems).

The 425's input impedance is greater than 30-kilohms balanced or unbalanced. The inputs may be driven from any source (balanced or unbalanced) capable of delivering at least -10 dBu into the aforementioned impedances.

The 425's output impedance is 300 ohms balanced, 150 ohms unbalanced. The output line driver delivers +23 dBm into 600 ohm balanced loads or +18 dBm into 600 ohm unbalanced loads.

3.4. Polarity Convention

The 425 uses the international standard polarity convention of pin 2 hot. Therefore:

XLR	Tip-Ring-Sleeve	Signal
1	Sleeve	Ground
2	Tip	High
3	Ring	Low

If your system uses balanced inputs and outputs, and uses the 425 this way, then the polarity convention is unimportant. If your system is both balanced and unbalanced, then you must pay attention to this, especially when going in and coming out through different connector types (like input on an XLR, output on a phone jack).

3.5. Input and Output Connections

Figure 3-1 illustrates how to connect the 425 to balanced and unbalanced sources and loads.

To operate the 425 from unbalanced sources, run a 2-conductor shielded cable (that's two conductors plus the shield) from the source to the 425. At the source, connect the low/minus side to the shield, these connect to the source's ground; connect the high/plus side to the source's signal connection. At the 425, the high/plus wire connects to pin 2, the low/minus wire connects to pin 3, and the shield (always) connects to pin 1. This is the preferred method as it makes best use of the 425's balanced input (even though the source is unbalanced). The other alternative shown in Figure 3-1 converts the 425's balanced input into an unbalanced input at the input connector. This works, but is more susceptible to hum and buzz than the preferred method. There is no level difference between either method.

You can drive unbalanced loads with the 425's outputs by using the XLR connector with pin 3 left open. In an emergency (the show must go on), you can ground pin 3, but if you have the choice...leave it open. If you must ground pin 3, it is must be grounded at the 425, rather than at the other end of the cable. The price, regardless of whether or not pin 3 is grounded is 6 dB less output level. This can be easily made up via the output gain controls. If your system is wired with pin 3 hot, **pin 2 must float** if you are driving an unbalanced load.

The 1/4-inch input jack is paralleled with the XLR-input and the screw terminals. In a large installation, it is permissible to use one of the connectors as the input connection and to use either or both of the remaining connections for paralleling other inputs with the 425.

The 1/4 inch output jack is a TRS (tip-ring-sleeve) jack wired for unbalanced operations. That is, the tip is the signal connection, and the ring and sleeve connections both go to circuit ground. This style of connection assures operation (passage of signal) regardless of the type of plug inserted into the jack. The unbalanced output is always 6 dB lower in level than the balanced output.

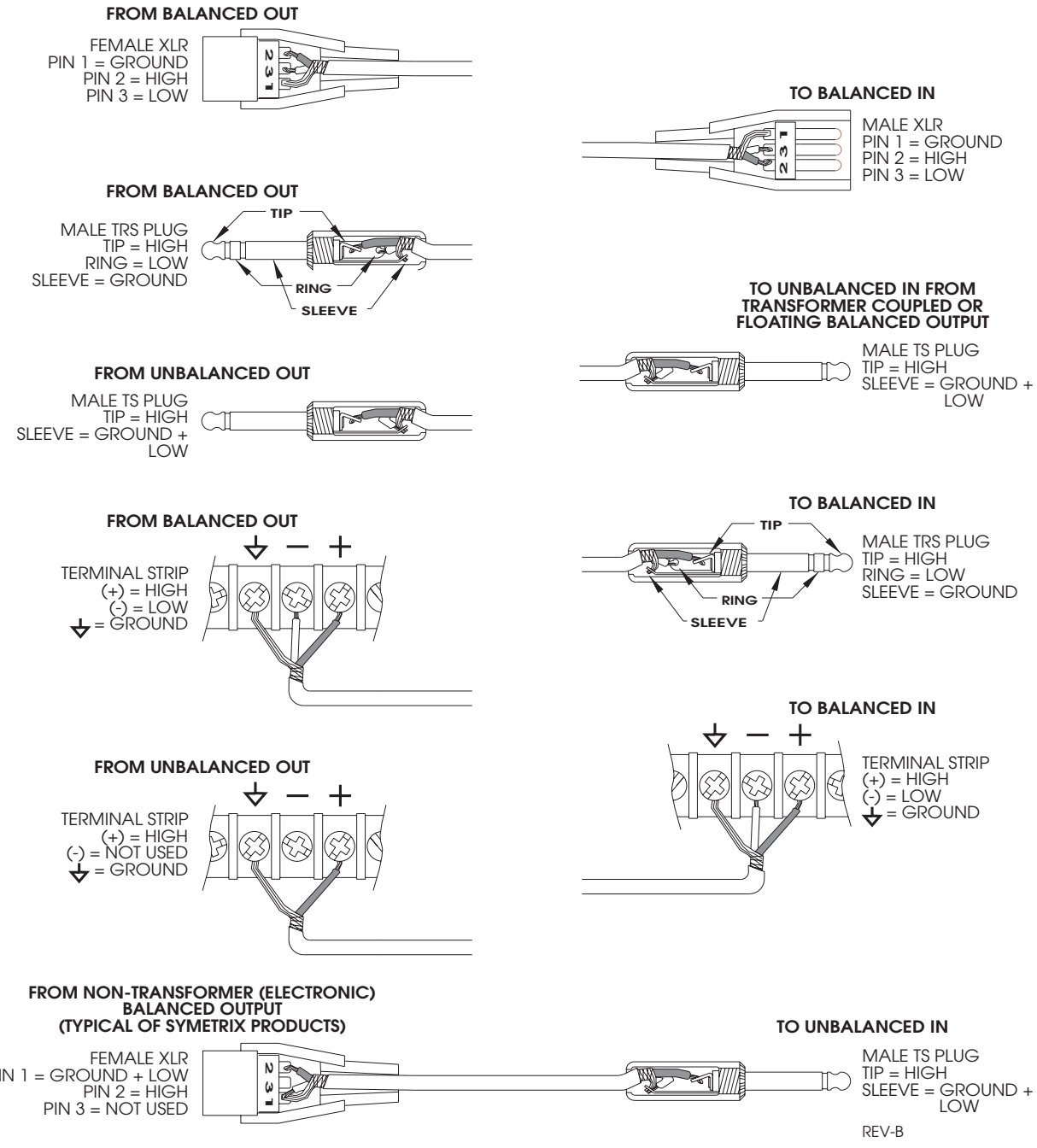
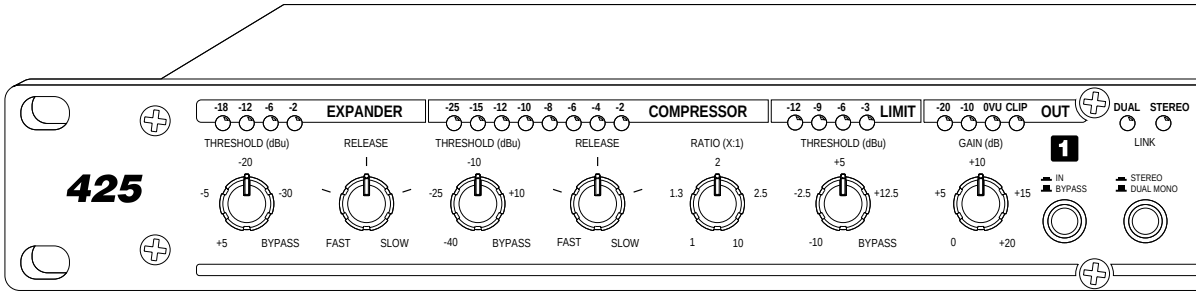


Figure 3-1. Input and output connector wiring. These diagrams represent the majority of connectors used in modern audio equipment. Locate the source connector in the left column and match it up with the destination connector in the right column. Wire your cable according to the diagrams.

4. Front Panel Overview



The 425 has the following controls, switches, and indicators on its front panel:

Expander

THRESHOLD — Sets the signal level below which the expander begins to operate. When the input signal falls below the level indicated on the knob, the expander begins reducing the gain. The LED display above the knob indicates how much the expander has reduced the gain.

RELEASE — Determines the speed at which the expander reduces the gain for an instantaneous change in the input signal (below threshold). Use the RELEASE control to prevent the expander from punching holes in the input signal.

LED Display — The expander display indicates how much the expander has reduced the level of the input signal.

Compressor

THRESHOLD — Sets the level above which the compressor begins reducing the output level.

RELEASE — Determines the speed at which the compressor restores the gain for an instantaneous change in the input signal. Use the RELEASE control to smooth the action of the compressor on staccato material.

RATIO — Determines the amount of change in the output for a given change in the input. If the ratio control is set to 10:1, this means that the output will change 1 dB (not much) for a 10 dB (3.16 times) change in the input. Use higher ratios to control peaks and lower ratios to smooth out average levels.

LED Display — Indicates how much the output level has been reduced by the compressor.

Limiter

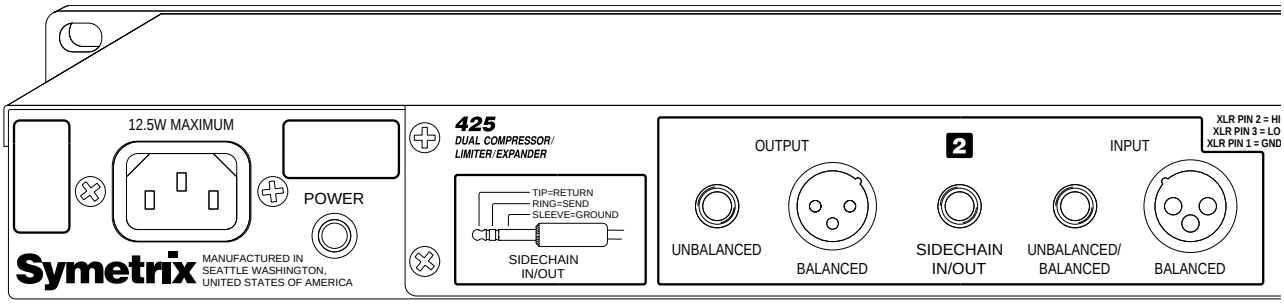
THRESHOLD — Sets the level above which the limiter begins reducing the output level.

LED Display — Indicates how much the output level has been reduced by the limiter. -3 to -6 dB indications are a good place to start.

Other Controls Switches and Displays

GAIN(DB)	Increases the output level of the 425. Use this control to restore signal level lost by compression or limiting. **Note:** the unity gain position of the control (0 dB) is referenced to the balanced output connector. If you are using the unbalanced output, unity gain occurs when the the GAIN control is set to +6 dB.
LED Display	Indicates the output level of the 425.
IN/BYPASS	This switch bypasses the 425. This is NOT a hard-wire bypass; the 425 will not pass signal unless the unit is powered and turned on.
DUAL / STEREO	This switch selects dual-mono or stereo-coupled mode. In dual-mono mode, each channel of the 425 operates independently. In stereo-coupled mode, the channel 1 controls determine the settings for both channel 1 and channel 2. Channel 1's sidechain receives a mono mix of the channel 1 and channel 2 signals. The LED displays for channel 2 blank (except for the output display) to remind you that the channels are stereo-coupled. The remaining controls and switches on the front panel duplicate those previously described for channel 1.

5. Rear Panel Overview



The following connectors and features are found on the rear panel of the 425.

Serial Number	Do yourself a favor and write this number down somewhere safe, and while you're at it, please send us the completed warranty card?
power cord	IEC power receptacle. Connect the power cord to an appropriate source of AC power. Observe the marked power supply voltage on rear panel.
UNBALANCED OUTPUT	1/4 inch tip-ring-sleeve (TRS) phone jack (wired tip = hot, ring & sleeve = ground). Use this jack when you need an unbalanced output. The nominal signal level here is +4 dBu. Note: the UNBALANCED OUTPUT connector is normally 6 dB lower in level than the BALANCED OUTPUT connector. You can easily make up the difference in level via the front panel GAIN control.l
BALANCED OUTPUT	XLR-3 male connector. Use this connector when you need a balanced output. The nominal signal level here is +4 dBu.
SIDECHAIN IN/OUT	1/4 inch tip-ring-sleeve connector. This is both an input and output on the same connector (tip = input/return, ring = output/send). Use this connector to connect equalizers and/or filters into the 425's sidechain for frequency-selective processing. The wiring diagram for the sidechain in/out connector is reproduced on the back panel of the 425.
UNBALANCED/BALANCED INPUT	1/4 inch TRS phone jack. This connector is wired in parallel with the XLR input connector. Connect either balanced or unbalanced sources here. Use a tip-sleeve plug for unbalanced sources and a tip-ring-sleeve (stereo) plug for balanced sources.
BALANCED INPUT	XLR-3 female connector. This connector is wired in parallel with the TRS input connector. Connect balanced sources here.

The remaining connectors on the rear panel are the channel 1 input/output/sidechain connectors. These connectors duplicate those used for channel 2.

Notes

6. Fast First Time Setup

Follow these instructions to get your 425 up-and-running as quickly as possible. The intent of this section is fast setup. If you need something clarified, then you'll find the answer elsewhere in this manual.

6.1 Connections

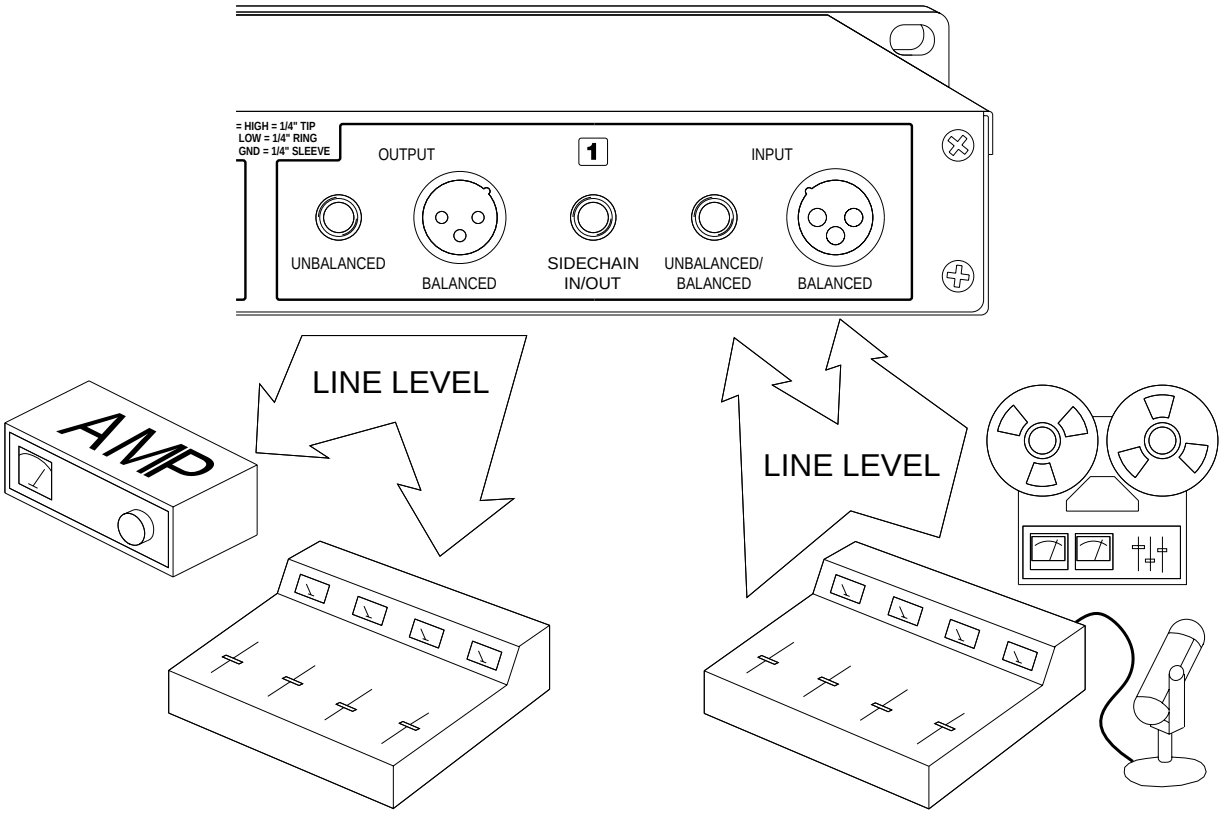
Connect the line-level signal source to either the female XLR connector or the 1/4 inch TRS (tip-ring-sleeve, stereo, 3 conductor) input jack. If the source is unbalanced, then use a 1/4 inch TS (tip-sleeve, mono, or guitar) plug fully inserted into the TRS input jack.

Connect the line-level signal return to either the male XLR connector or to the 1/4 inch TRS output jack. If you use the 1/4 inch jack, then use a TRS plug for balanced circuits or use a TS plug for unbalanced circuits. Additional information on the signal connections may be found in the Installation section of this manual.

Repeat for the second channel. Ignore the sidechain connections for now.

Connect the AC input to an AC power source of the proper voltage and frequency, as marked on the rear of the unit.

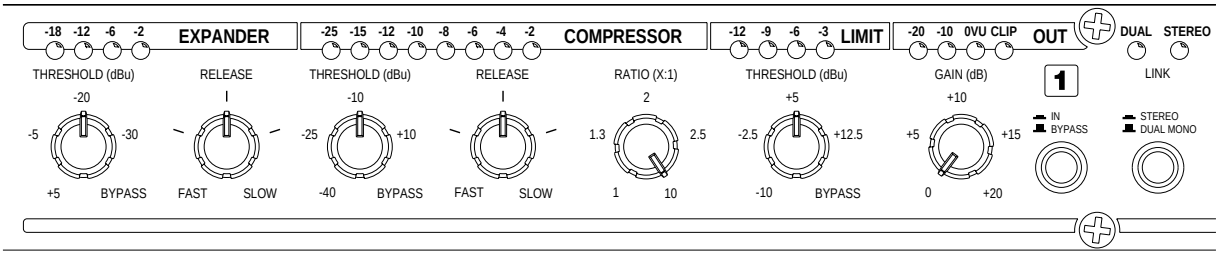
> ***Caution*:** *Failure to connect the* 425 *to the proper AC mains voltage may cause fire and/or internal damage. There are no user serviceable parts inside the chassis. Refer all service to qualified service personnel or to the factory.*
>
> **Warning: Lethal voltages are present inside the chassis. There are no user serviceable parts inside the chassis. Refer all service to qualified service personnel or to the factory.**



6.2 Settings

Make your initial switch and control settings as follows:

Usage	Switch	Setting
Dual mono	IN/BYPASS	depressed
	STEREO/DUAL	out
Stereo	IN/BYPASS	depressed
	STEREO/DUAL	depressed



Control	Setting	Control	Setting	Control	Setting
Expander:		**Compressor:**		**Peak Limiter:**	
THRESHOLD	-20	THRESHOLD	-10	THRESHOLD	+5
RELEASE	12 o'clock	RELEASE	12 o'clock		
		RATIO	10:1	GAIN	0

6.3 Initial Setup

The 425's controls and switches are now set according to the preceding section. All connections listed in Section 6.1 are now made. The 425 should now pass signal. The LED display should be illuminated.

Set the input level by increasing the setting of the input level control until the amber LEDs in the HEADROOM display illuminate. Ideally, the highest signal level should illuminate the -1 dB LED, and the CLIPPING LED should almost never illuminate (the CLIPPING LED operates 1 or 2 dB below clipping.).

6.4 Refining Your Settings

For most signals, the above settings should produce activity in each section of the 425. The expander and compressor sections tend to be complementary, that is, you probably won't be showing expansion when the signal level is high enough to cause compression.

Whenever the operation of two of the sections of the 425 overlaps (especially the compressor and limiter sections), whichever section has the highest gain-reduction reading on its display is the section controlling the signal at that instant.

Refine the expander THRESHOLD setting so that the expander reduces the gain when the input signal falls below the threshold setting. You can make the expander "ignore" momentary lapses in signal by increasing the setting of the RELEASE control. This also affects the rate-of-release once the signal falls below-threshold.

Refine the compressor THRESHOLD setting so that the compressor display shows the amount of gain reduction desired when the signal is within the operating range of the compressor. For most applications, 3 to 6 dB are all that's necessary. Choose a RATIO setting appropriate for your application: gentle level control demands low ratio settings (below 6:1), peak leveling requires higher settings (8:1 or higher). Choose a RELEASE time accordingly: percussive sounds like fast release times, speech and music like slower times. These settings are just guidelines, you can use whatever setting actually works.

If you're using a large amount of compression, for leveling or automatic gain control, you may need to adjust the output GAIN control to add makeup gain to compensate for the signal level lost to the compressor. You can set the makeup gain easily by comparing signal levels via the IN/BYPASS switch and adding gain via the GAIN control

Refine the peak limiter THRESHOLD setting so that the peak limiter display only shows gain reduction during the highest peaks, and then only momentarily. Large amounts of gain reduction showing on the peak limiter's display indicate that the limiter THRESHOLD setting may be too low. If this is what you want, fine, but bear in mind that peak limiters are designed to stop occasional peaks dead, and may not sound very pretty used semi-continuously. May we suggest using the compressor with the ratio control set at maximum.

6.5 Stereo Coupling

If you are using the 425 for a stereo signal, say for a stereo mixdown, depress the LINK switch so that the STEREO LED is lit. This disables the channel 2 control channel, and slaves the two VCAs together. Channel 1 's sidechain receives an equal mix of the two input signals. Only Channel 1's controls work (they control both channels now). The end result is the gain reduction applied to the two channels is identical, which prevents stereo image shifts caused by unequal gain reduction in the two stereo channels.

Notes

7. Using the 425

The 425's design emphasizes ease-of-use. This doesn't mean that we made it easy to use by removing everything except the power switch; instead we concentrated on keeping the controls that really make a particular feature work well and eliminating those that didn't. This section contains installation information and descriptions of each of the front and rear panel controls, switches, and connectors.

7.1 Block Diagram

Figure 7-1 is the block diagram of the 425.

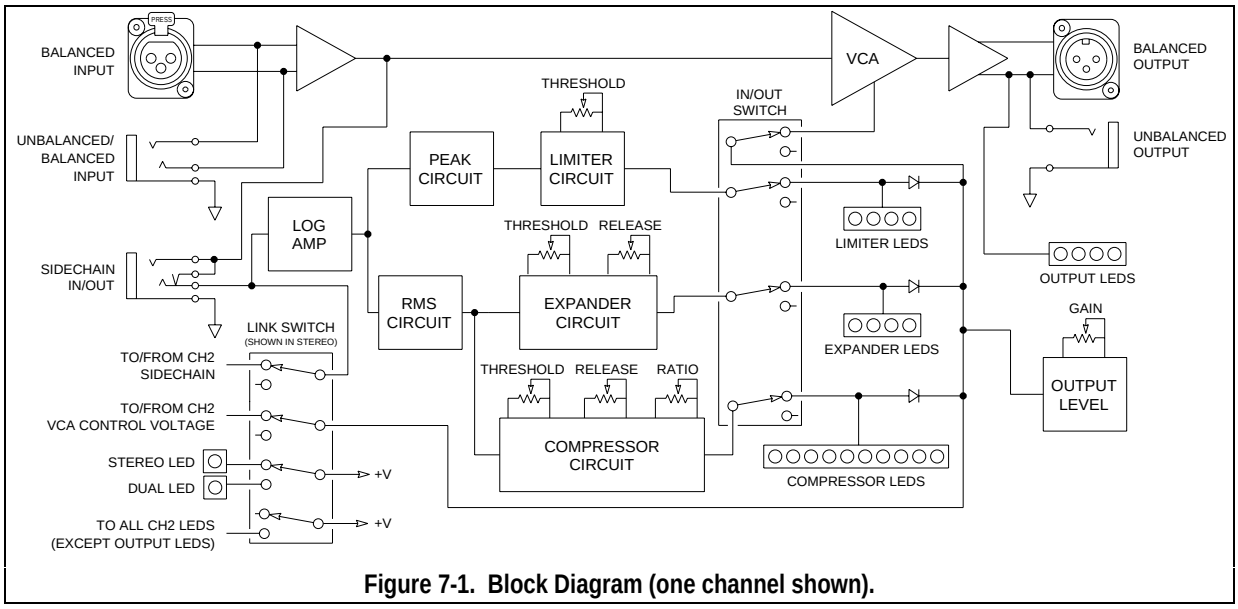


Figure 7-1. Block Diagram (one channel shown).

Please take a moment and take note of the following:

- ❒ There is only one VCA per channel.
- ❒ Bypass mode is not a hard-wire bypass for each channel.
- ❒ The TRS, and XLR input connectors are all paralleled.
- ❒ The TRS output jack is wired for unbalanced operation (tip hot, ring and sleeve grounded).

7.2 Installation

The 425 may be installed free-standing or rack mounted. No special ventilation requirements are necessary.

Installation Requirements	
Mechanical	One rack space (1.75 inches) required, 10 inches depth (including connector allowance). Rear chassis support recommended for road applications.
Electrical	105-125 VAC, 50-60Hz, 12.5 Watts maximum.
Connectors	XLR-3 female for inputs, XLR-3 male for outputs, Pin 2 of the XLR connectors is "Hot." TRS female connectors are also provided. **Note**: the unbalanced output uses a TRS output jack with the ring and sleeve connections connected to circuit ground.

7.3 The 425 as a Compressor

You can use the 425 as a compressor in two different ways:

1. the compressor operates occasionally, dispatching occasional peaks.
2. the compressor operates continuously, making the dynamic range smaller at the output.

For the first scenario, pick a threshold setting that results in occasional gain reduction, as displayed on the compressor display. Use a ratio setting suitable for your application; low (1.3:1 to 2.5:1 for gentle compression, higher for more drastic squashing). Low ratios are harder to hear, consequently you can operate with 6 dB or so of compression, without too many audible effects. Higher ratios require subtlety, especially in threshold selection. Pick your threshold setting so that no more than 6 dB of gain reduction occurs and you'll get the signal control that you need, without being too obvious. Pick a release setting that lets the gain recover fairly quickly.

Scenario two requires low ratio settings (unless you don't care about being obvious), and a lower (-10 or lower) threshold setting. Choose a threshold setting that results in more or less continuous gain reduction. Pick the ratio setting so that the dynamic range of the output signal corresponds to the maximum and minimum signal levels that you want. Pick a release setting that allows gain recovery during longer pauses.

7.4 The 425 as a Ducker

Well, almost. First, what is a ducker? (Hint: It's not something twisted utilizing waterfowl.) It is a way of making the level of one audio signal follow that of another. A prime example would be an announcer (the ducker) talking over a music bed (the duckee). What most people do is to simply ride the music facer when the announcer is talking. You can do the same thing automatically by using a compressor having a sidechain connection.

Now for some people, a "true" ducker must reduce the level of the duckee to some preset level whenever the ducker signal is present. The 425 will not do this. It will,however, reduce the level of the duckee whenever the ducker is present, but the amount of gain reduction follows the envelope of the ducker signal. Get it? See Figure 7-1 for a more graphic description.

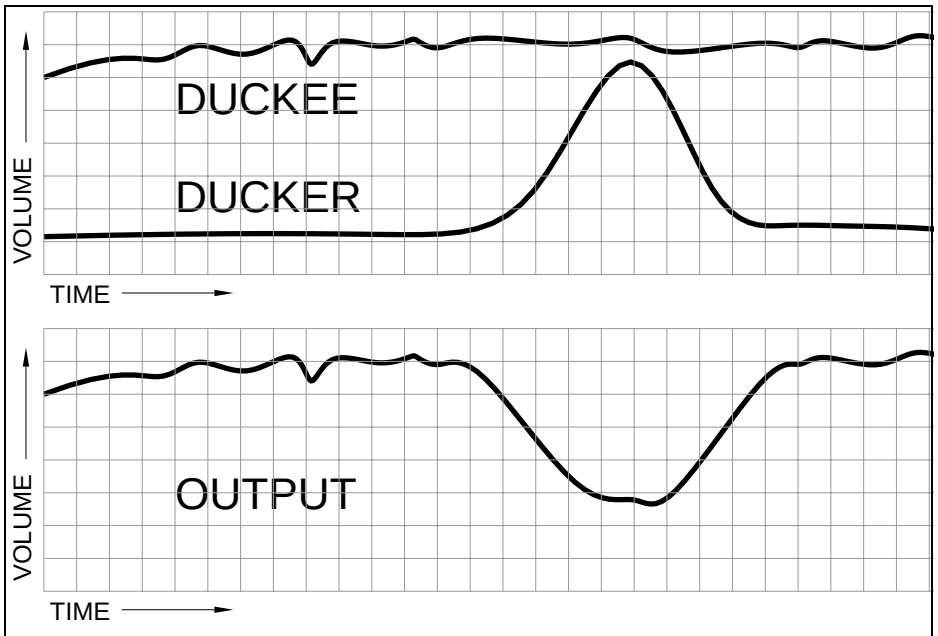


Figure 7-1. Signal relationships in a ducker.

Anyway, if this "limitation" isn't a problem, then refer to Section 8.4 for hookup. The ratio control determines the talkover ratio (how much the duckee gets reduced for a change in the ducker) and the threshold control determines the total amount of ducking action. The release time control govern's how rapidly the

duckee recovers after being ducked. Don't be meek with the knobs, most ducker applications require 20+ dB of gain reduction to be effective.

7.5 The 425 as a Limiter

The peak limiter section of the 425 is a fast-acting (200µS), steep slope (20:1) limiter. Peak limiters are generally used to stop signal peaks dead in their tracks. The peak limiter in the 425 has only one control: threshold. Set the control for occasional -3 dB gain reduction indications (you can let it hit 6 dB once in a great while). If you allow more gain reduction than 3-6 dB, that's ok, but the results may be quite audible (peak limiters are designed to stop peaks, not to sound pretty).

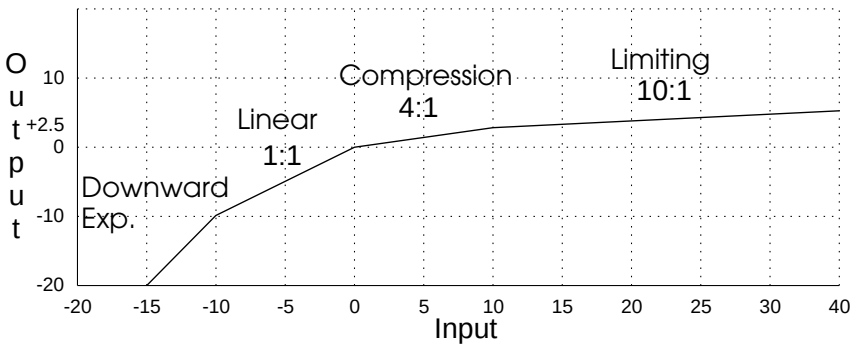


Figure 7-2. Simultaneous downward-expansion, compresion and limiting.

You can use the 425 as a dual-threshold peak limiter, with a gentle slope for lower-level peaks and a steep slope (20:1) for high-level peaks by setting the compressor ratio at 4:1, compressor threshold at 0dB or higher, and limiter threshold high enough to catch the highest peaks (or at recording media overload). The compressor catches most peaks, using a moderate ratio (which is more ear-pleasing), while the limiter gives you the freedom from overload that only a peak limiter can give.

7.6 The 425 as an Expander

As described before, the expander section of the 425 is a downward expander. When the input signal falls below the threshold control setting, the 425 reacts by reducing the gain of the VCA. This increases the dynamic range of the output signal (since the soft just got softer).

You can use the expander to reduce body noises picked up by an announce microphone, or to reduce amp noise from a noisy guitar amp, or how about reducing the amount of room sound in a guitar track that was recorded a little too loosely in a room that was a little too noisy? For sound reinforcement, how about using the expander to tend an announce mic that needs to be left on, but you really don't want it picking up every whisper in its vicinity.

Setup is easy, with no signal, adjust the THRESHOLD control counter-clockwise until you begin to see gain reduction on the expander's LED display, continuing until you hear the degree of expansion that you want. When the signal is present, you may need to refine the setting so that the expander doesn't reduce the gain during momentary pauses. You can slow things down a bit via the RELEASE control, which helps prevent expansion during momentary pauses.

7.7 Using the Expander and Compressor Simultaneously

There are times when you might want to expand and compress simultaneously. Now this isn't a game of tug-of-war between the expander and compressor. How about a track that has too much dynamic range and needs to be squashed to fit into the space available in your mix? After squashing, you notice a lot of room noise, amp noise, etc. whenever the track is not active. 425 to the rescue. Simply adjust the expander threshold to cause gain reduction during the quiet parts of the track and you'll make those ugly noises disappear.

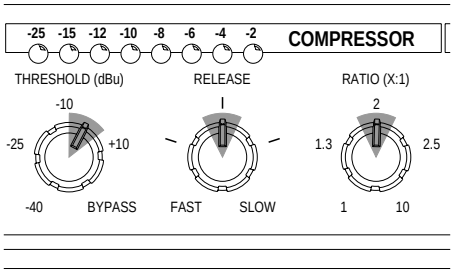
Another application for simultaneous expanding and compressing is voice processing. Close mic'ed voices tend to be a little un-natural. Things that we don't hear at conversational distance are heard quite well by the announce microphone. A bit of expansion will help to reduce lip-smacking noises and some compression will help even levels out and generally tighten up the sound.

8. Applications

Here are a few applications that the 425 lends itself to. The following applications make one assumption: settings for the threshold control(s) are a function of each individual system's actual operating level. Wherever specific threshold settings are mentioned, they are referenced to either a particular gain reduction level as indicated by the meter, or to a O dBu input level.

8.1 Vocal Level Smoothing

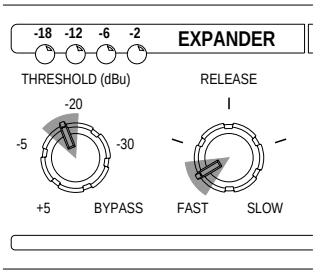
This application assumes that the voice source does not vary tremendously in level. Examples of this include narration, commercial voice-over production, seminar speaking, etc.



- ❑ Lower the threshold setting until the gain reduction display begins to show compression, then continue lowering the setting until the display shows 6-9 dB of gain reduction on peaks.
- ❑ To eliminate noises like paper rattling or breathing, try using the downward expander.

8.2 Removing Noise from Vocal Tracks

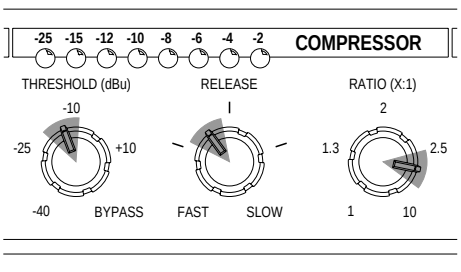
Sometimes, due to the more abrupt nature of gating, it may be more appropriate to clean up a noisy vocal track with a downward expander. The 425's expander is smooth, and can clean up vocals without cutting into phrasing.



- ❑ Set the expander threshold for 16 dB (or more) of gain reduction when the signal source is silent, and 0 dB of gain reduction when the signal is present.
- ❑ Use the release control to make the expander follow the phrasing.

8.3 Constant Level Paging

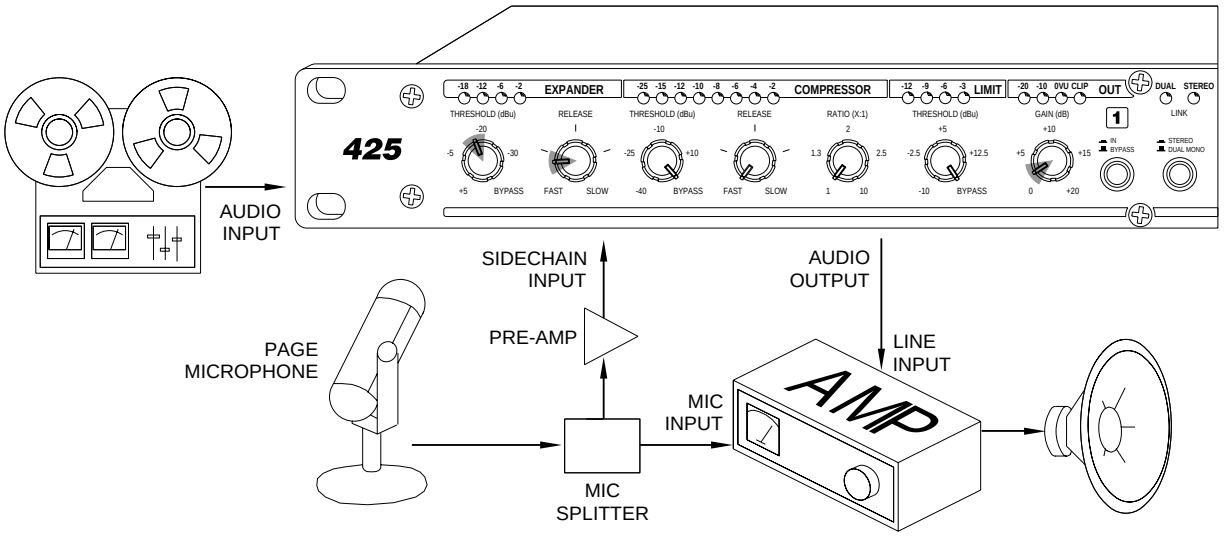
All too often, paging announcements are either sub-audible, or distorted. The problem is the result of changing input levels from different users (timid Tom vs Sam Screamer) and unpredictable environmental circumstances. To optimize system levels for intelligibility without overload, use the compressor section to even out levels, and the peak limiter to put a clamp on Sam Screamer.



- ❑ Set the compressor threshold for 6 dB of gain reduction with normal paging levels.
- ❑ Set the peak limiter threshold for 6 dB of gain reduction when Sam Screamer is on the system.
- ❑ All normal signals will be slightly compressed, and really loud signals will activate the peak limiter. With these settings a shy person will be audible, and the guy who thinks he has to shout won't be too loud, or cause distortion.

8.4 Paging with Ducking

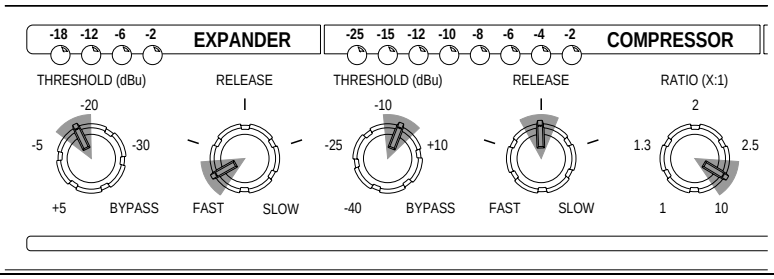
Many situations involving a "talking host" and any sort of musical background will require the background music to drop in level whenever the host signal is present. By splitting the host signal, part of it can be used to tell the 425 when to take action and lower the background source by an amount determined by the threshold control.



- ❑ Set the compressor threshold so that all the gain reduction LEDs for the compressor are illuminated when the host speaks. Although the display won't show it, you can set the threshold control even lower for more ducking action.
- ❑ Use the release control to vary the speed at which the music returns when the host stops talking.

8.5 Stage Monitors

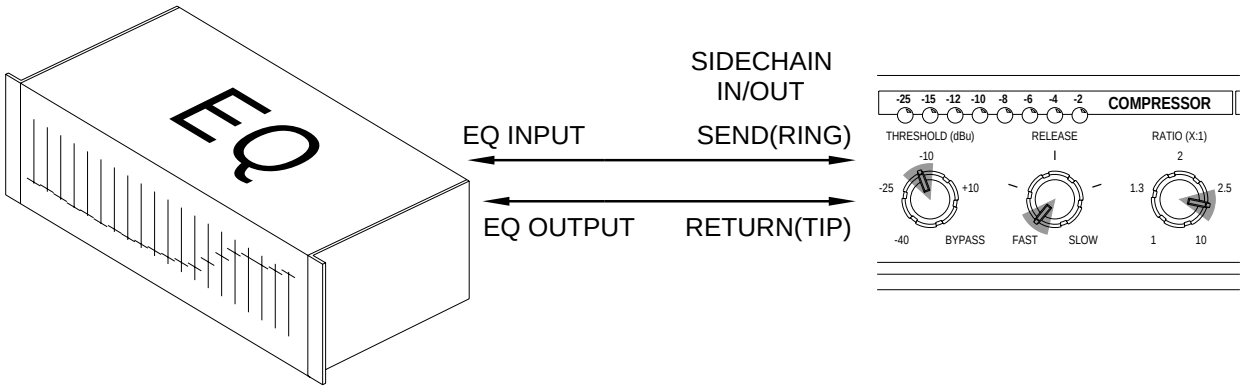
Public address and sound reinforcement situations that require comp/limiting are often plagued by feedback problems. The overall increase in level that results from compression can cause feedback in the absence of signal, when the compressor releases and brings levels back up to normal.



- ❑ Set the compressor threshold for no more than 9 dB of gain reduction on normal signals.
- ❑ Set the expander threshold for 16 dB (or more) of gain reduction when the signal source is silent, and 0 dB of gain reduction when the signal is present.
- ❑ Use the release control to make the expander follow momentary pauses.
- ❑ Since the successful implementation of this technique requires careful settting of the two threshold controls, be prepared to fine tune the settings to match the levels of your system and the vocalist's style.

8.6 Keyed Bass

As a special effect, try using the signal from a kick drum to key a gated bass. This technique will tighten the "signal start" relationship between the two instruments. Since the bass will not be heard until the drum is played, the result is a perfectly tight kick/bass combination.



- ❑ The expander threshold control varies the amount of action; higher settings are crisp, lower settings merely increase the volume when the kick drum keys the expander.
- ❑ Use the release control to make the expander follow the music.

8.7 Sibilance Control

Patching an equalizer into the sidechain can cause the 425 to respond more or less to selected frequencies, giving it the ability to make sibilance problems less apparent. Fine tuning between the compressor threshold, ratio, and the EQ boost applied in the sidechain will have to be made to arrive at premimum results.

- ❑ To find basic settings, start with a fairly high ratio (5:1 or so), and a compressor threshold setting between -20 and -5. Cut the low frequencies on the equalizer and give a 15 dB broadband boost to the EQ at around 5 or 6kHz. Now, carefully "tweak" the threshold setting as you count "four, five, six." What you're looking for is no compression on "four, five," and somewhere around 9 dB of gain reduction on the word "six."
- ❑ You can refine the setting by listening to the equalizer output and adjusting the EQ to emphasize the sibilance in the source. Remember that you're equalizing the signal to emphasize the sibilance, not to sound groovy. Let the 425 do that.
- ❑ Do you have a recording where the cymbals drive you nuts?...try the same technique on the overall mix.
- ❑ Set the peak limiter threshold for 6 dB of gain reduction when Sam Screamer is on the system.
- ❑ All normal signals will be slightly compressed, and really loud signals will activate the peak limiter. With these settings a shy person will be audible, and the guy who thinks he has to shout won't be too loud, or cause distortion.

Notes

9. Troubleshooting Chart

Symptom	Probable Cause
No output	Check cables and connections. Are inputs driven by outputs, and outputs driving inputs? Verify cables, source and load by patching input and output connections together, at the unit. Check for AC power presence. Check input by plugging headphones halfway into the sidechain jack and listening for input signal. Check output by plugging headphones into output connector . Do either of the output LED displays show anything?
Hum or buzz in output	Check input and output connector wiring (refer to Figure 3.1). Ground loop. check related system equipment grounding. Are all system components on the **same** AC ground?
Distortion	Check input signal. Is it too hot, or is it already distorted? Does the output LED display indicate clipping? If so, reduce setting of gain control and make up lost gain after the 425. Check output loading. Should be above 600 ohms. Are the power amplifier(s) clipping? Is something else clipping?
Noise (hiss)	Check input signal levels. The 425 is intended to operate at or near "line" level (-10 dBu or greater). Check gain settings on downstream equipment. The system gain structure should be such that the 601 operates at or near unity gain. Is the input signal already noisy?
No LED display	Is the unit plugged in, and turned on? Is the AC outlet OK?
No nothing	Is the unit in BYPASS mode?
Unit not plugged in, but works anyway	Call us.

Notes

10. 425 Dual Compressor Limiter Limited Warranty

This Symetrix product is designed and manufactured for use in professional and studio audio systems. Symetrix, Inc. (Symetrix) warrants that this product, manufactured by Symetrix, when properly installed, used, and maintained in accordance with the instructions contained in the product's operator's manual, will perform according to the specifications set forth in the operator's manual.

Symetrix expressly warrants that the product will be free from defects in material and workmanship for one (1) year. Symetrix' obligations under this warranty will be limited to repairing or replacing, at Symetrix' option, the part or parts of the product which prove defective in material or workmanship within one (1) year from date of purchase, provided that the Buyer gives Symetrix prompt notice of any defect or failure and satisfactory proof thereof. Products may be returned by Buyer only after a Return Authorization number (RA) has been obtained from Symetrix and Buyer will prepay all freight charges to return any products to the Symetrix factory. Symetrix reserves the right to inspect any products which may be the subject of any warranty claim before repair or replacement is carried out. Symetrix may, at its option, require proof of the original date of purchase (dated copy of original retail dealer's invoice). Final determination of warranty coverage lies solely with Symetrix. Products repaired under warranty will be returned freight prepaid via United Parcel Service by Symetrix, to any location within the Continental United States. Outside the Continental United States, products will be returned freight collect.

The foregoing warranties are in lieu of all other warranties, whether oral, written, express, implied or statutory. Symetrix, expressly disclaims any IMPLIED warranties, including fitness for a particular purpose or merchantability. Symetrix's warranty obligation and buyer's remedies hereunder are SOLELY and exclusively as stated herein.

This Symetrix product is designed and manufactured for use in professional and studio audio systems and is not intended for other usage. With respect to products purchased by consumers for personal, family, or household use, Symetrix **expressly disclaims all implied warranties, including but not limited to warranties of merchantability and fitness for a particular purpose.**

This limited warranty, with all terms, conditions and disclaimers set forth herein, shall extend to the original purchaser and anyone who purchases the product within the specified warranty period.

Warranty Registration must be completed and mailed to Symetrix within thirty (30) days of the date of purchase.

Symetrix does not authorize any third party, including any dealer or sales representative, to assume any liability or make any additional warranties or representation regarding this product information on behalf of Symetrix.

This limited warranty gives the buyer certain rights. You may have additional rights provided by applicable law.

Limitation of Liability

The total liability of Symetrix on any claim, whether in contract, tort (including negligence) or otherwise arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair, replacement or use of any product will not exceed the price allocable to the product or any part thereof which gives rise to the claim. In no event will Symetrix be liable for any incidental or consequential damages including but not limited to damage for loss of revenue, cost of capital, claims of customers for service interruptions or failure to supply, and costs and expenses incurred in connection with labor, overhead, transportation, installation or removal of products or substitute facilities or supply houses.

Notes

11. Repair Information

Should you decide to return your 425 to Symetrix for service, please follow the following instructions.

11.1 Return Authorization

Symetrix will service any of its products for a period of five years from the date of manufacture. However, no goods will be accepted without a Return Authorization number.

BEFORE SENDING ANYTHING TO SYMETRIX, CALL US FOR AN RA NUMBER. JUST ASK, WE'LL GLADLY GIVE YOU ONE! CALL (206) 282-2555 WEEKDAYS, 8AM TO 4:30 PM PACIFIC TIME.

11.2 In-Warranty Repairs

To get your unit repaired under the terms of the warranty:

1. Call us for an RA number.

2. Pack the unit in its original packaging materials.

3. Include your name, address, etc. and a brief statement of the problem. Your daytime telephone number is very useful if we can't duplicate your problem.

4. Put the RA number on the outside of the box.

5. Ship the unit to Symetrix, freight prepaid.

Just do those five things, and repairs made in-warranty will cost you only the one-way freight fee. We'll pay the return freight.

If you choose to send us your product in some sort of flimsy, non-Symetrix packaging, we'll have to charge you for proper shipping materials. If you don't have the factory packaging materials, then do yourself a favor by using an oversize carton, wrap the unit in a plastic bag, and surround it with bubble-wrap. Pack the box full of Styrofoam peanuts. Use additional bubble-wrap if you must ship more than one unit per carton. Be sure there is enough clearance in the carton to protect the rack ears (you wouldn't believe how many units we see here with bent ears). We won't return the unit in anything but original Symetrix packaging. Of course, if the problem turns out to be operator inflicted, you'll have to pay for both parts and labor. In any event, if there are charges for the repair costs, you will pay for return freight. All charges will be COD unless you have made other arrangements (prepaid, Visa or Mastercard).

11.3 Out-of-Warranty Repairs

If the warranty period has passed, you'll be billed for all necessary parts, labor, packaging materials, and any applicable freight charges.

Remember, you must call for an RA number before you send the unit to Symetrix.

Notes

12. Specifications

Input/Output

Inputs	XLR-female, >30-kilohms line-level balanced bridging, >30-kilohms unbalanced bridging.
	TRS-female paralleled with XLR connector.
Outputs	300-ohm source impedance, balanced. XLR-male
	TRS-female wired tip hot, ring & sleeve grounded (unbalanced), 150-ohm source impedance.
Maximum input level	+20 dBu, balanced
Maximum output level (onset of clipping/1% THD)	+25 dBu balanced
	+23 dBm balanced (600 ohms)
	+20 dBu unbalanced
	+18 dBm unbalanced (600 ohms)
Sidechain	100-ohm source impedance, 6800-ohm input impedance.
	TRS jack, tip is return.

Compressor

Type	RMS responding, soft-knee
Attack time	2ms
Release time	180ms to 2.5s long term
Auto-release time	20ms to 1s (based on 20ms tone burst)
Threshold	-40 dBu to +20dBu (bypass)
Ratio	1:1 to 10:1

Limiter

Attack time	200µs
Release time	100ms
Threshold	-10dBu to +20dBu
Ratio	20:1

Downward Expander

Attack time	4ms
Release time	250ms to 5s
Threshold	0dBu to -40dBu (bypass)
Ratio	1:1.5

Performance Data

Frequency Response	+0, -3 dB 10_Hz to 60 kHz
Distortion (THD)	.04 %, +4 dBu in, +4 dBu out, 10 dB gain reduction, 1 kHz, 30 kHz low-pass filter
	.01 %, +4 dBu in, +4 dBu out, 10 dB gain reduction, 20 kHz, 30 kHz low-pass filter
	.02 %, +18 dBu output, 0 gain reduction, 20-20 kHz, 30 kHz low-pass filter
Crosstalk	-95 db @ 1k, -95 dB @ 10k, + 4dBu in, remaining channel terminated in 600 ohms, 20k rolloff in analyzer.
Dynamic Range	115 dB (difference of maximum output and noise floor)
Input CMRR	greater than 40 dB @ 1kHz
Output Noise	-90 dBu, measured at balanced output, input terminated in 600 ohms, 20 kHz rolloff in analyzer.

Physical

Connectors	input: XLR-3F, 1/4" TRS
	output: XLR-3M, 1/4" TRS
	sidechain: 1/4" TRS (one)
Polarity	pin 2 of XLR is hot, tip of TRS jacks is hot.
Size (hwd), in & cm	1.75 x 19 x 7.25 in
	4.44 x 48.3 x 18.4 cm
Weight, lbs & kg	8 lbs (3.63kg) net 11 lbs (4.6kg) shipping

Electrical

Approvals	Listed by Underwriters Laboratories, Inc. Control number 2T38.
Power requirements	117V AC nominal, 105-125VAC 50-60 Hz, 12.5 Watts maximum 230V AC nominal, 205-253V AC 50 Hz, 12.5 Watts maximum

In the interest of continuous product improvement, Symetrix Inc. reserves the right to alter, change, or modify these specifications without prior notice.

13. PCB Layouts and Schematics

Note: The printed circuit board layouts and schematics in this section are intended for use only by qualified personnel.

Caution: *These servicing instructions are for use only by qualified personnel. To avoid electric shock do not perform any servicing other than that contained in the operating instructions portion of this manual unless you are qualified to do so. Refer all servicing to qualified service personnel.*

These schematics and layouts are provided for reference use only, for use by qualified service personnel and for use in answering certain technical questions that are beyond the scope and intent of this manual. The schematics and layouts in this manual were accurate at the time that this manual was written. Your actual product may contain changes not shown on these drawings. The inclusion of this material in this manual in no way obligates Symetrix to provide updated information or to inform users of any changes, past or pending.

A complete service manual is available from the factory for a nominal charge. Please contact the Symetrix Service Department at the address listed in Section 11 of this manual.

13.1 Troubleshooting Hints

If you are attempting repair of your 425, the following tips and hints may be useful, especially if you are not familiar with operational amplifiers.

The first thing that you should check are the power supplies. Their nominal voltage should be within 5% of the noted value on the schematic. The IC regulators used are current limited and short-circuit protected; their output voltage drops under excessive load (like something downstream that draws excessive current).

In audio amplifiers that utilize operational amplifiers as their active gain element, the two feedback resistors establish the working gain of the circuit. In Symetrix equipment, and other equipment using bipolar (separate plus and minus) power supplies, the nominal DC output voltage of each stage should be at or very near zero volts.

If an opamp's output is at or near one of the power supply rails, this usually means that the opamp has failed. The exception to this rule is when the circuit configuration uses the opamp as a DC amplifier or as a comparator.

When used as a DC amplifier, the output should follow the input signal (modified by the circuit's gain equation).

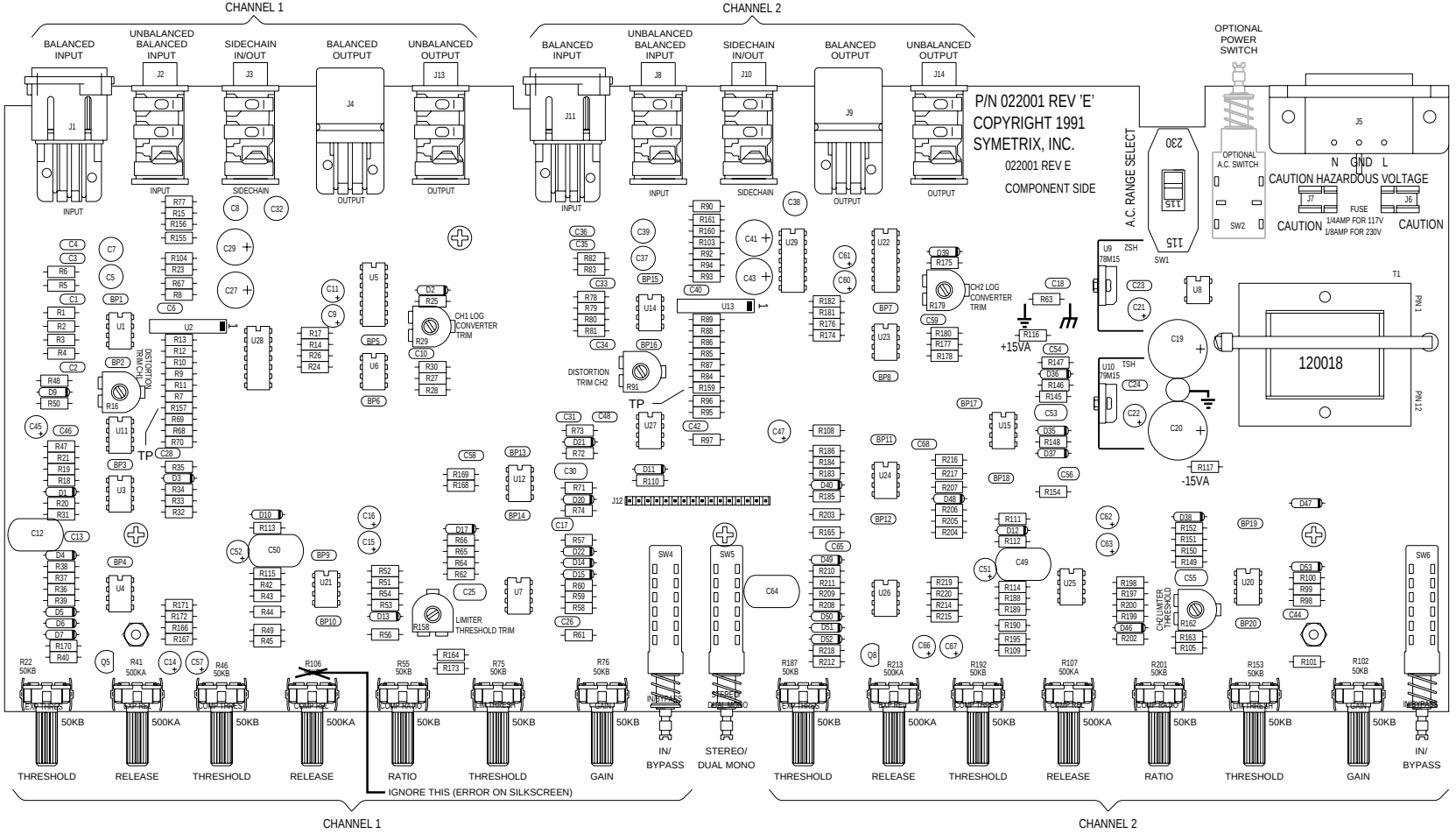
When used as a comparator, the opamp's output swings between the two supply rails and there should be no intermediate output state.

Units using substantial amounts of digital circuitry are probably best serviced at the factory.

13.2 Additional Reading

You can find additional information on the design and applications of operational amplifiers in the following text:

"Audio IC Op-Amp Applications," Walter G. Jung, Copyright 1987, *Howard W. Sams & Company*, Indianapolis, IN.



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B	BOARD REV'D TO REV#B	11/22/91			
C	BOARD REV'D TO REV#C	12/16/91			
D	BOARD REV'D TO REV#D (ECO#170)	3/10/99			
E	BOARD REV'D TO REV#E	12/1/92			
E1	NYLON STANDOFFS NOW METAL	7/6/93			

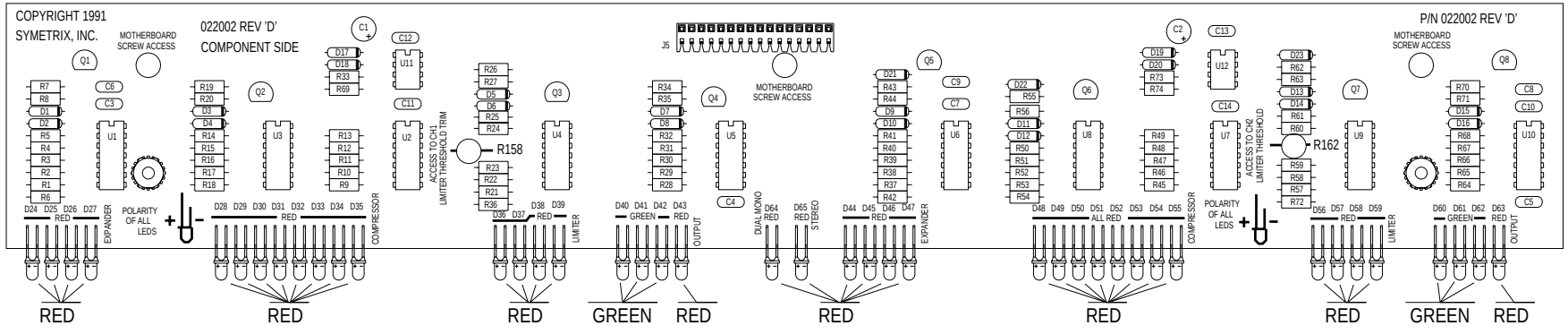
ENG.	
MANF.	
PURCH.	
DATE PRINTED	
DRAWN BY	James Husted

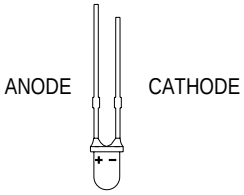
Symetrix

TITLE: 425MBOARD ASSY

DWG NO.	022001-ASY	DWG REV.	E2
DATE	10-1-91	SHEET 1 OF 1	

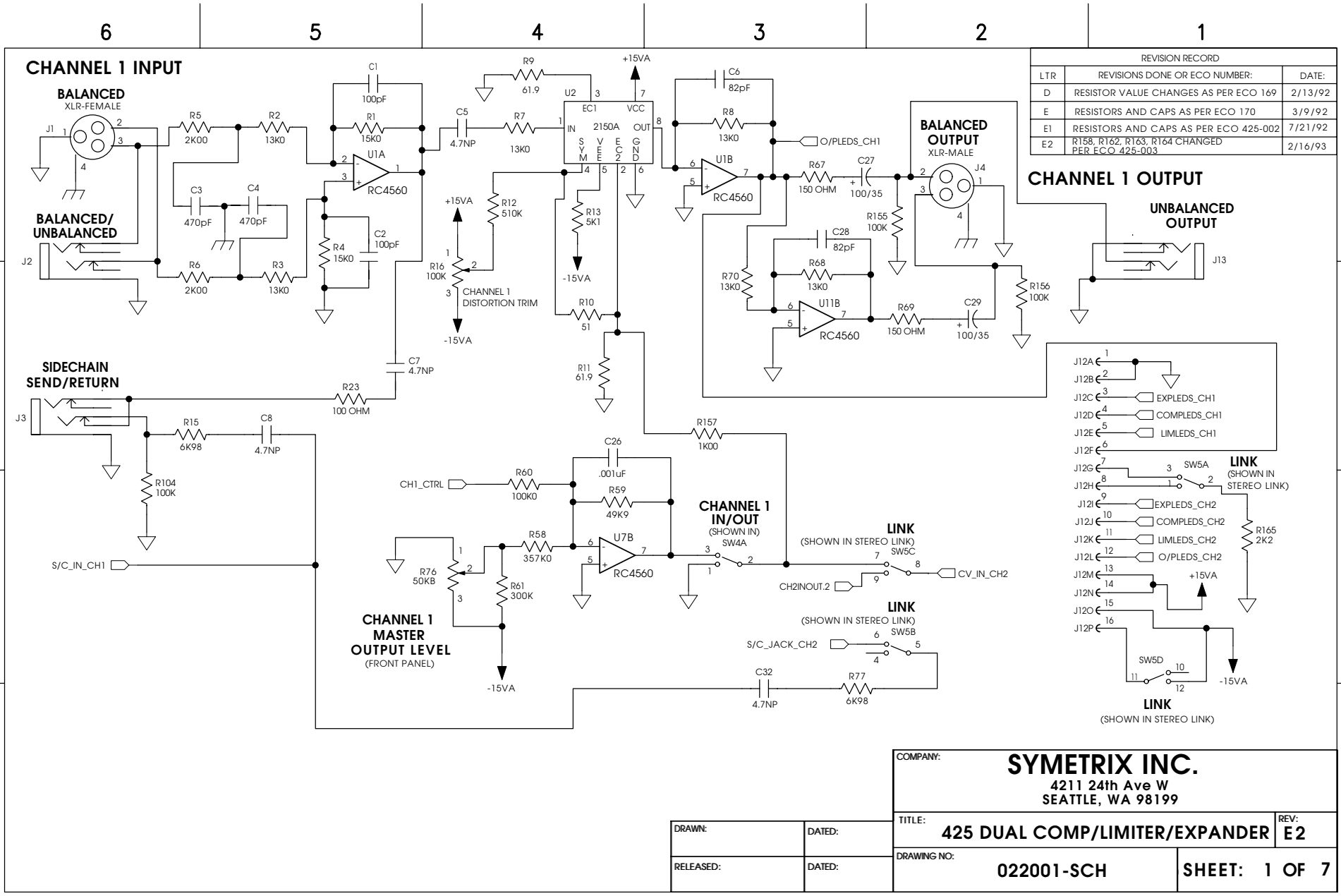
REV#	REVISIONS:	DATE	REV#	REVISIONS:	DATE
A	PCB REV'D TO REV 'B'	11/22/91	D	BOARD REV'D TO REV 'D'	12/2/92
B	ADDED C4 & C5 IN TOUCH-UP (ECO #169)	2/13/92	D1	NYLON STANDOFFS NOW METAL	7/6/93
C	BOARD REV'D TO REV 'C' (ECO #170)	3/10/92			





LED ORIENTATION

ENG.		Symetrix	
MANF.		TITLE	425DBOARD ASSY
PURCH.		DWG NO.	022002-ASY
DATE PRINTED	7/6/93	DWG REV.	D1
DRAWN BY	James Husted	DATE	10-2-91
		SHEET 1 OF 1	



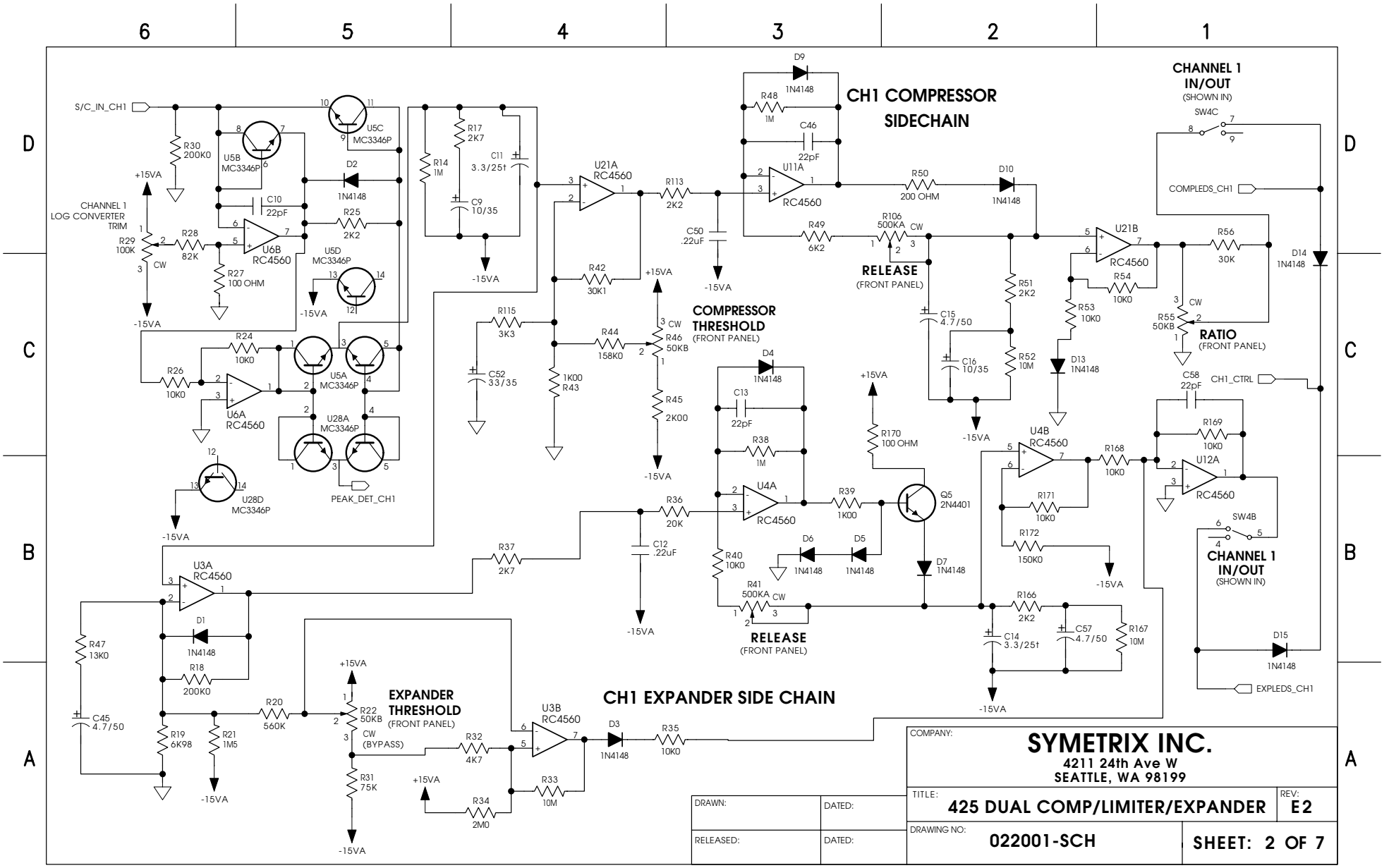
REVISION RECORD		
LTR	REVISIONS DONE OR ECO NUMBER:	DATE:
D	RESISTOR VALUE CHANGES AS PER ECO 169	2/13/92
E	RESISTORS AND CAPS AS PER ECO 170	3/9/92
E1	RESISTORS AND CAPS AS PER ECO 425-002	7/21/92
E2	R158, R162, R163, R164 CHANGED PER ECO 425-003	2/16/93

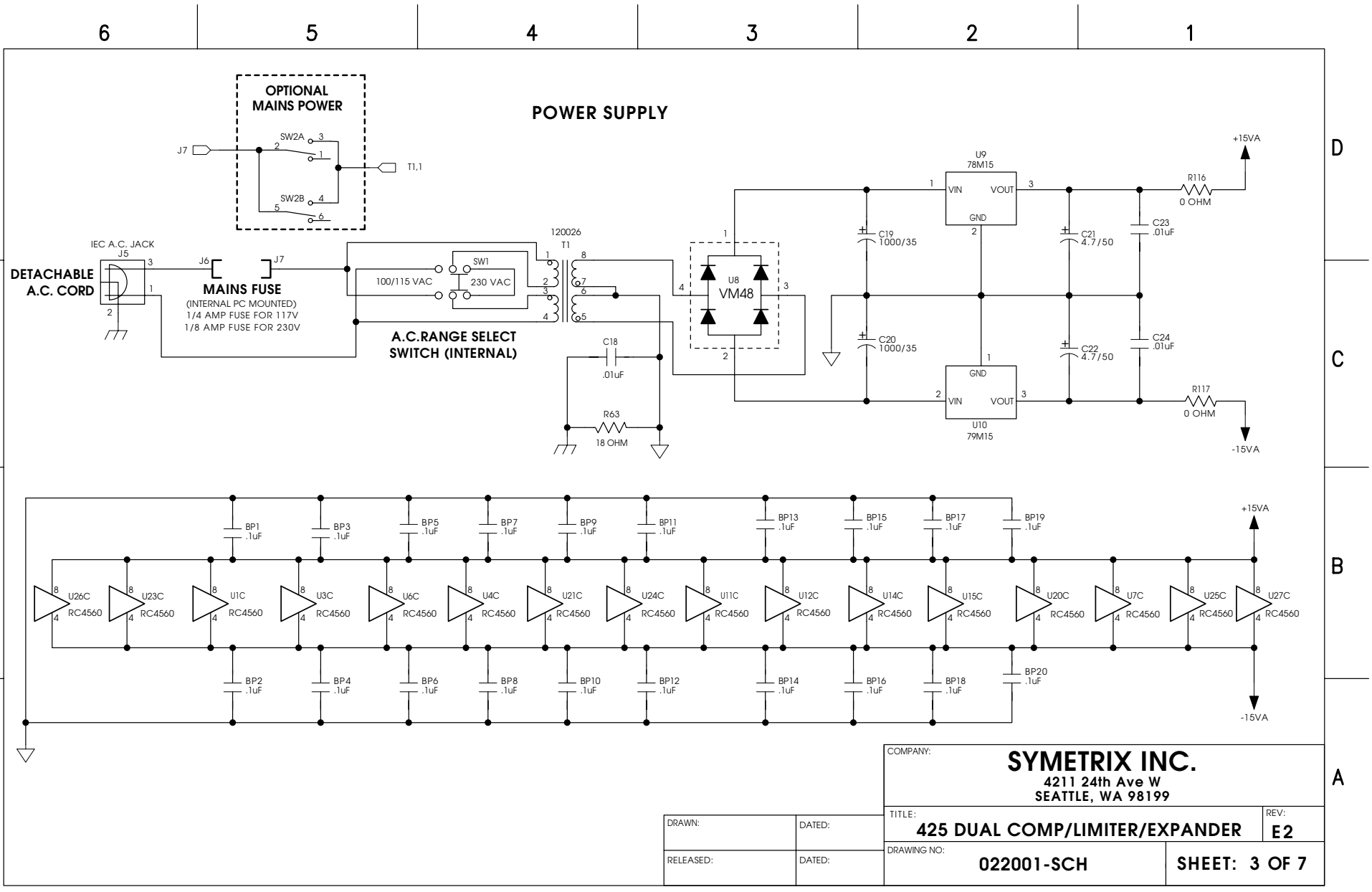
DRAWN:	DATED:
RELEASED:	DATED:

COMPANY: **SYMETRIX INC.**
4211 24th Ave W
SEATTLE, WA 98199

TITLE: **425 DUAL COMP/LIMITER/EXPANDER** REV: **E2**

DRAWING NO: **022001-SCH** SHEET: **1 OF 7**


CH1 COMPRESSOR SIDECHAIN
CHANNEL 1 IN/OUT (SHOWN IN)
COMPRESSOR THRESHOLD (FRONT PANEL)
RELEASE (FRONT PANEL)
RATIO (FRONT PANEL)
CH1 EXPANDER SIDE CHAIN
EXPANDER THRESHOLD (FRONT PANEL)
RELEASE (FRONT PANEL)
CHANNEL 1 LOG CONVERTER TRIM
S/C_IN_CH1
PEAK_DET_CH1
COMPLEDS_CH1
EXPLEDS_CH1
CH1_CTRL
COMPANY:
SYMETRIX INC.
4211 24th Ave W
SEATTLE, WA 98199
TITLE:
425 DUAL COMP/LIMITER/EXPANDER
REV:
E2
DRAWN:
DATED:
RELEASED:
DATED:
DRAWING NO:
022001-SCH
SHEET: 2 OF 7



COMPANY:	**SYMETRIX INC.** 4211 24th Ave W SEATTLE, WA 98199
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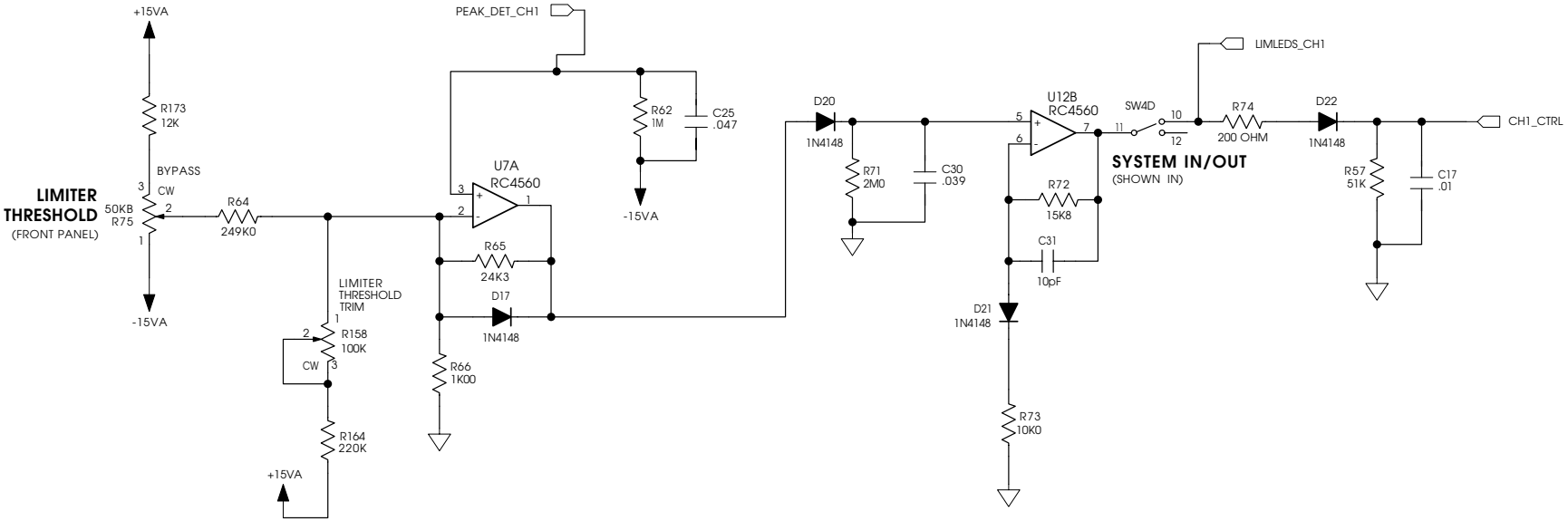
REV:	E2
DRAWN:	DATED:
RELEASED:	DATED:
DRAWING NO:	022001-SCH
SHEET:	3 OF 7

CH1 LIMITER SIDE CHAIN



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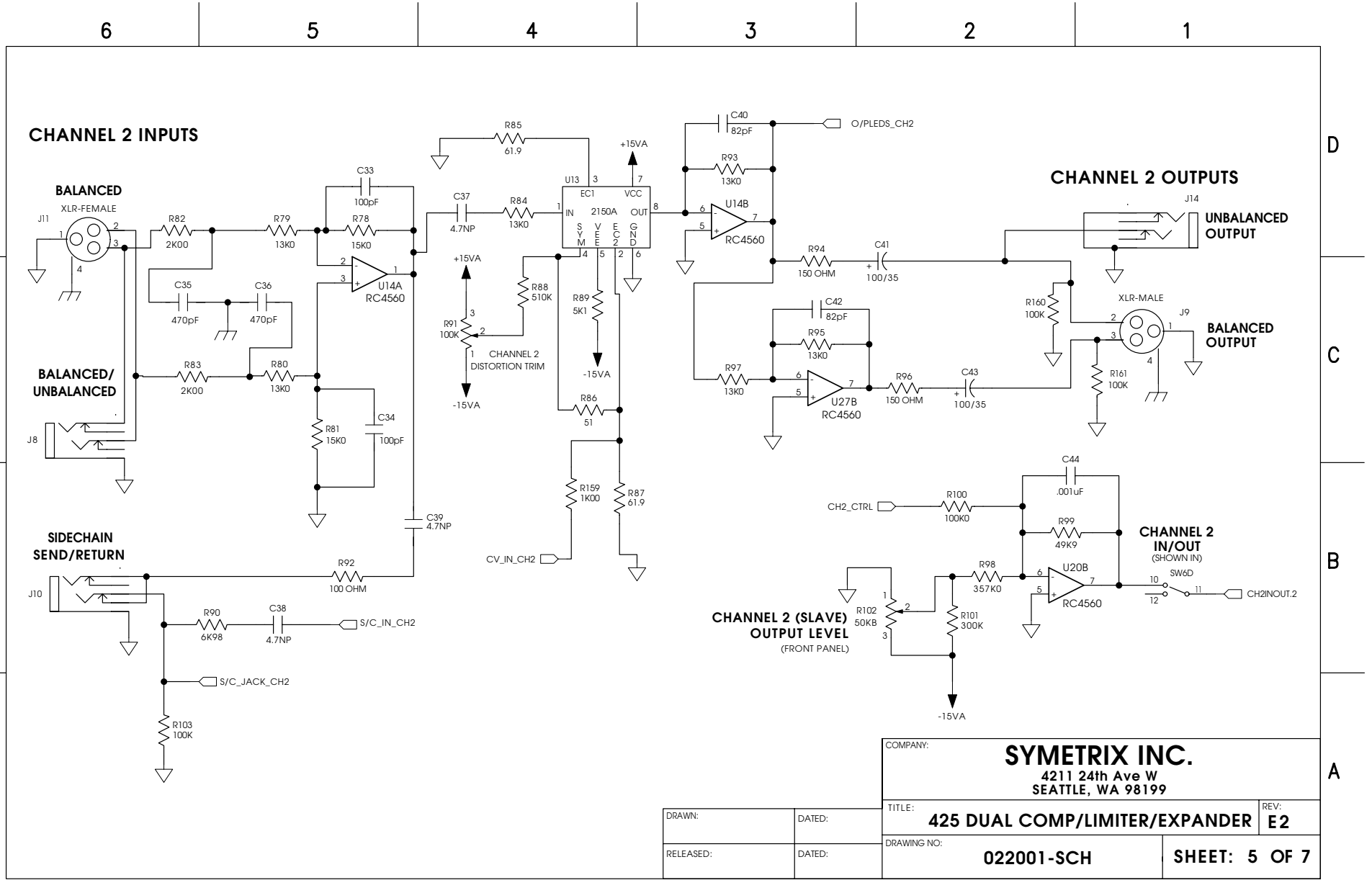
DRAWN:	DATED:	DRAWING NO:	**022001-SCH**
RELEASED:	DATED:	SHEET:	**4 OF 7**



COMPANY:	**SYMETRIX INC.** 4211 24th Ave W SEATTLE, WA 98199
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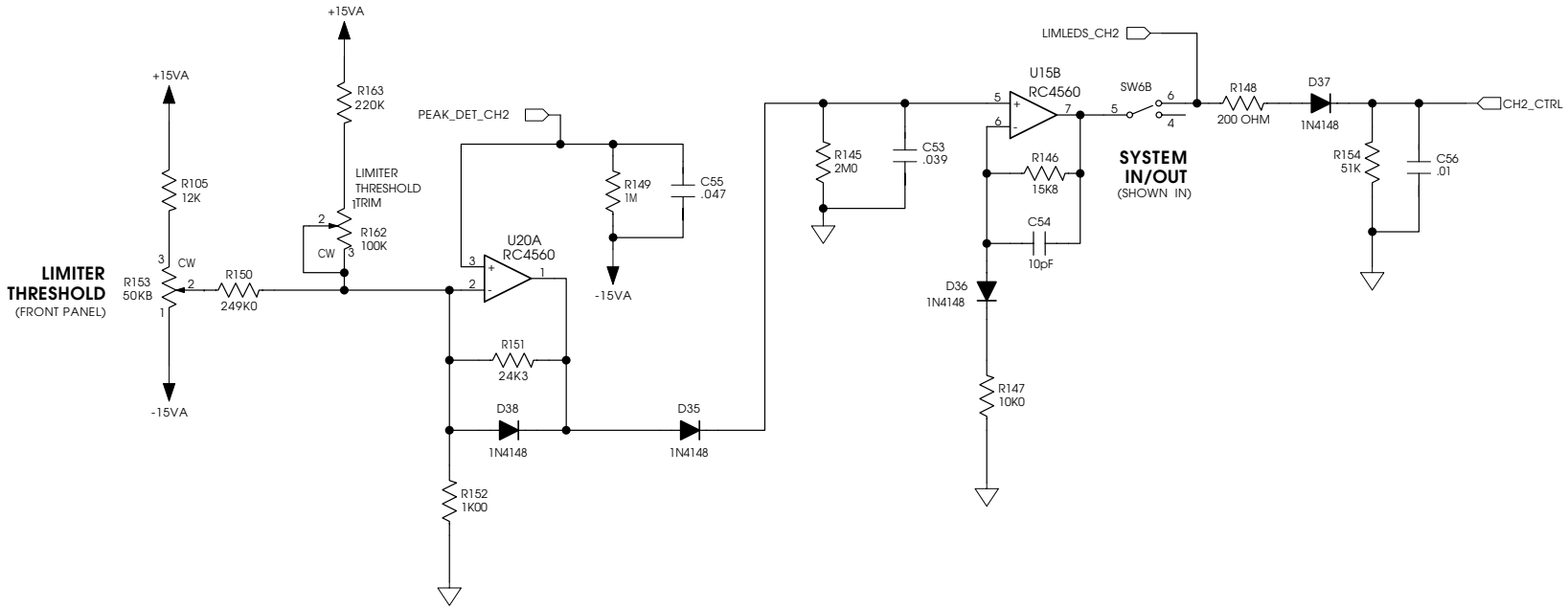
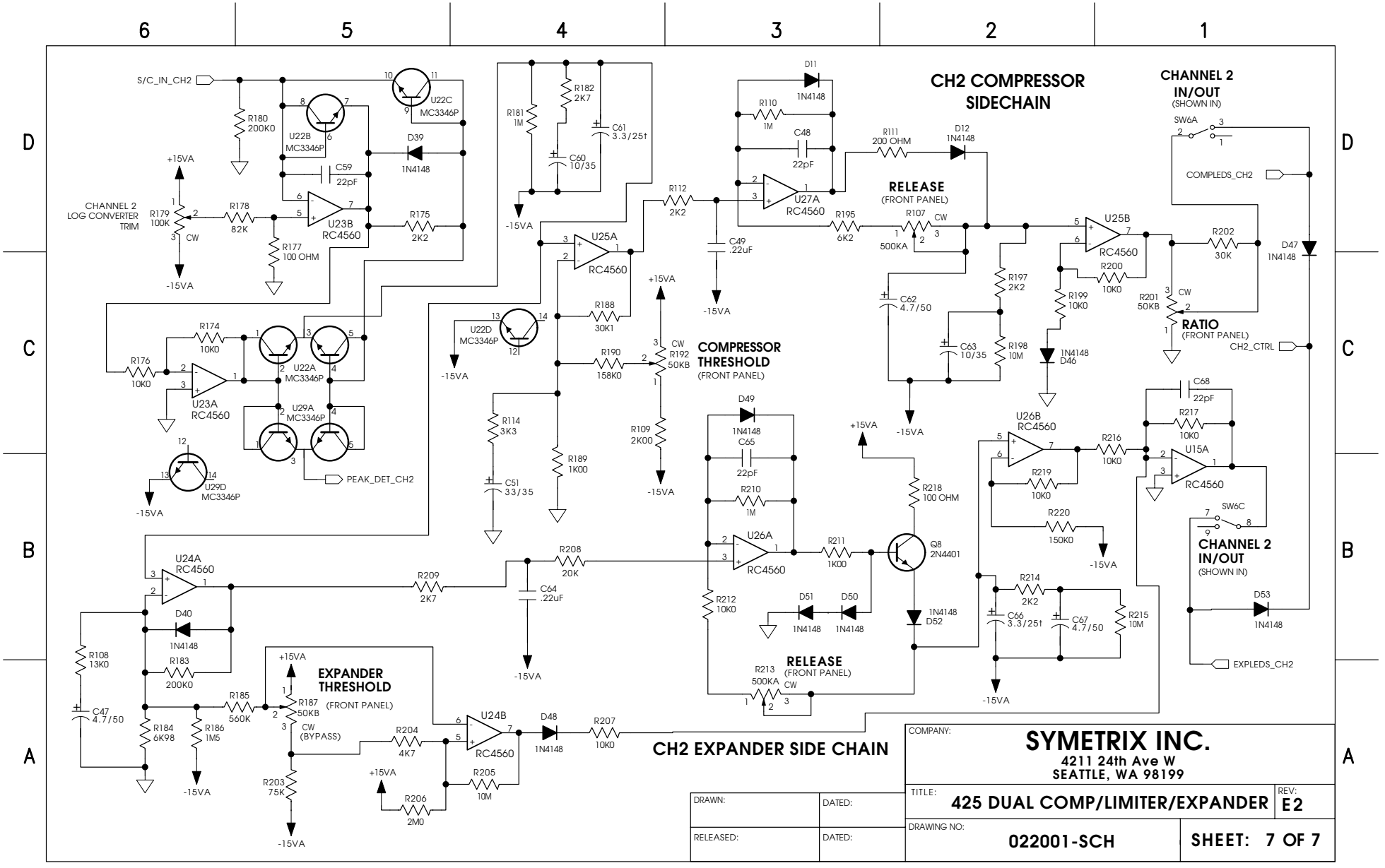
REV:	E2
DRAWN:	
DATED:	
RELEASED:	
DATED:	
DRAWING NO:	022001-SCH
SHEET:	5 OF 7

CH2 LIMITER SIDE CHAIN



COMPANY:	**SYMETRIX INC.** 4211 24th Ave W SEATTLE, WA 98199
TITLE:	425 DUAL COMP/LIMITER/EXPANDER
REV:	E2
DRAWN:	DATED:
RELEASED:	DATED:
DRAWING NO:	022001-SCH
SHEET:	6 OF 7


CH2 COMPRESSOR SIDECHAIN
CHANNEL 2 IN/OUT (SHOWN IN)
RELEASE (FRONT PANEL)
COMPRESSOR THRESHOLD (FRONT PANEL)
RATIO (FRONT PANEL)
EXPANDER THRESHOLD (FRONT PANEL)
RELEASE (FRONT PANEL)
CHANNEL 2 IN/OUT (SHOWN IN)
CH2 EXPANDER SIDE CHAIN
S/C_IN_CH2
CHANNEL 2 LOG CONVERTER TRIM
PEAK_DET_CH2
COMPLEDS_CH2
CH2_CTRL
EXPLEDS_CH2
+15VA
-15VA
U22B MC3346P
U22C MC3346P
U23B RC4560
U25A RC4560
U27A RC4560
U25B RC4560
U22D MC3346P
U22A MC3346P
U23A RC4560
U29A MC3346P
U29D MC3346P
U26A RC4560
U26B RC4560
U15A RC4560
U24A RC4560
U24B RC4560
Q8 2N4401
SW6A
SW6C
R180 200K0
R181 1M
R182 2K7
R183 200K0
R184 6K98
R185 560K
R186 1M5
R187 50KB
R188 30K1
R189 1K00
R190 158K0
R192 50KB
R107 500KA
R110 1M
R111 200 OHM
R112 2K2
R114 3K3
R174 10K0
R175 2K2
R176 10K0
R177 100 OHM
R178 82K
R179 100K
R195 6K2
R196 10K0
R197 2K2
R198 10M
R199 10K0
R200 10K0
R201 50KB
R202 30K
R203 75K
R204 4K7
R205 10M
R206 2M0
R207 10K0
R208 20K
R209 2K7
R210 1M
R211 1K00
R212 10K0
R213 500KA
R214 2K2
R215 10M
R216 10K0
R217 10K0
R218 100 OHM
R219 10K0
R220 150K0
R108 13K0
C47 4.7/50
C48 22pF
C49 .22uF
C51 33/35
C59 22pF
C60 10/35
C61 3.3/25t
C62 4.7/50
C63 10/35
C64 .22uF
C65 22pF
C66 3.3/25t
C67 4.7/50
C68 22pF
D11 1N4148
D12 1N4148
D39 1N4148
D40 1N4148
D46 1N4148
D47 1N4148
D48 1N4148
D49 1N4148
D50 1N4148
D51 1N4148
D52 1N4148
D53 1N4148
COMPANY:
SYMETRIX INC.
4211 24th Ave W
SEATTLE, WA 98199
TITLE:
425 DUAL COMP/LIMITER/EXPANDER
REV:
E2
DRAWN:
DATED:
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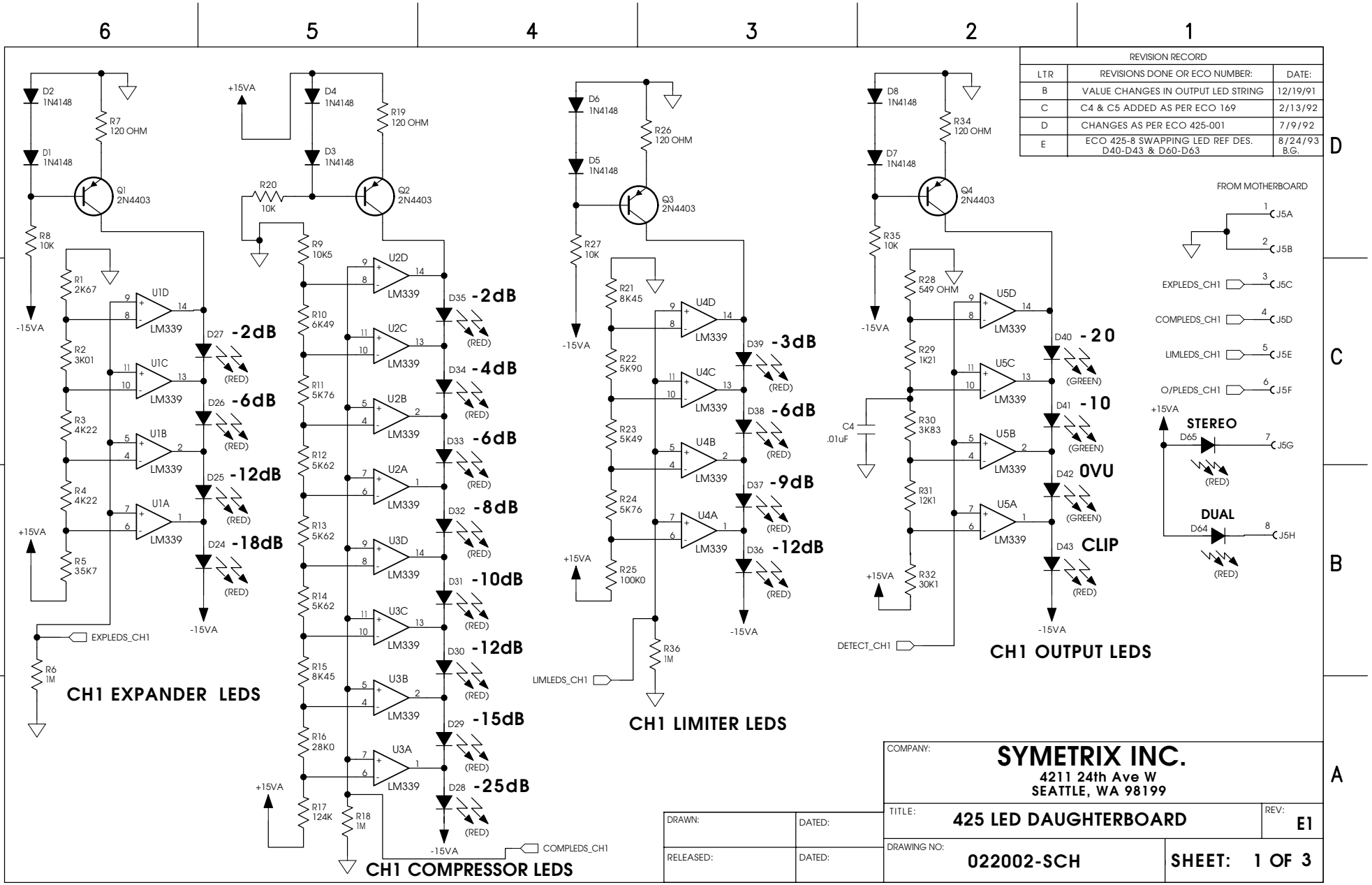
DATED:
DRAWING NO:
022001-SCH
SHEET: 7 OF 7


6
5
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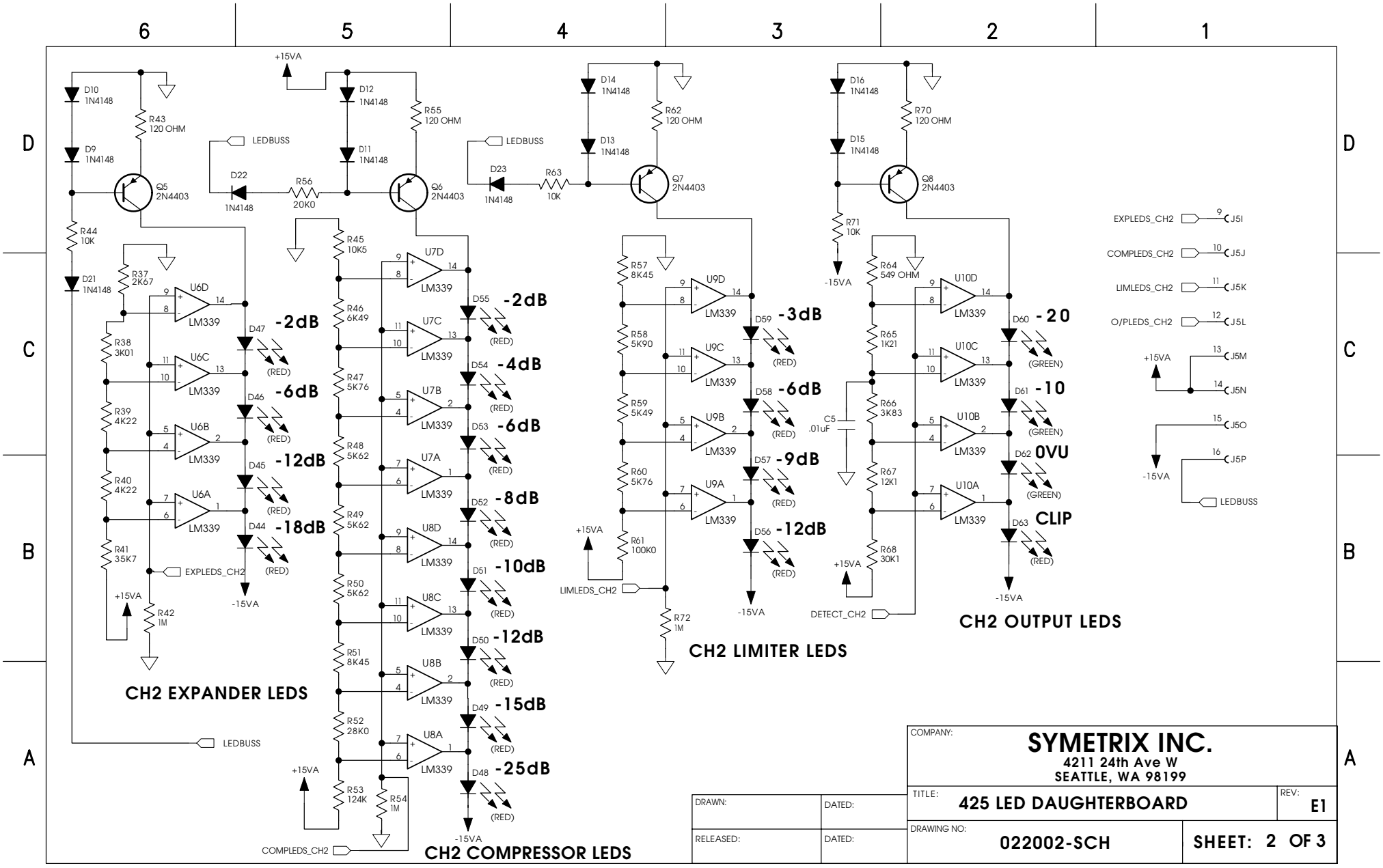
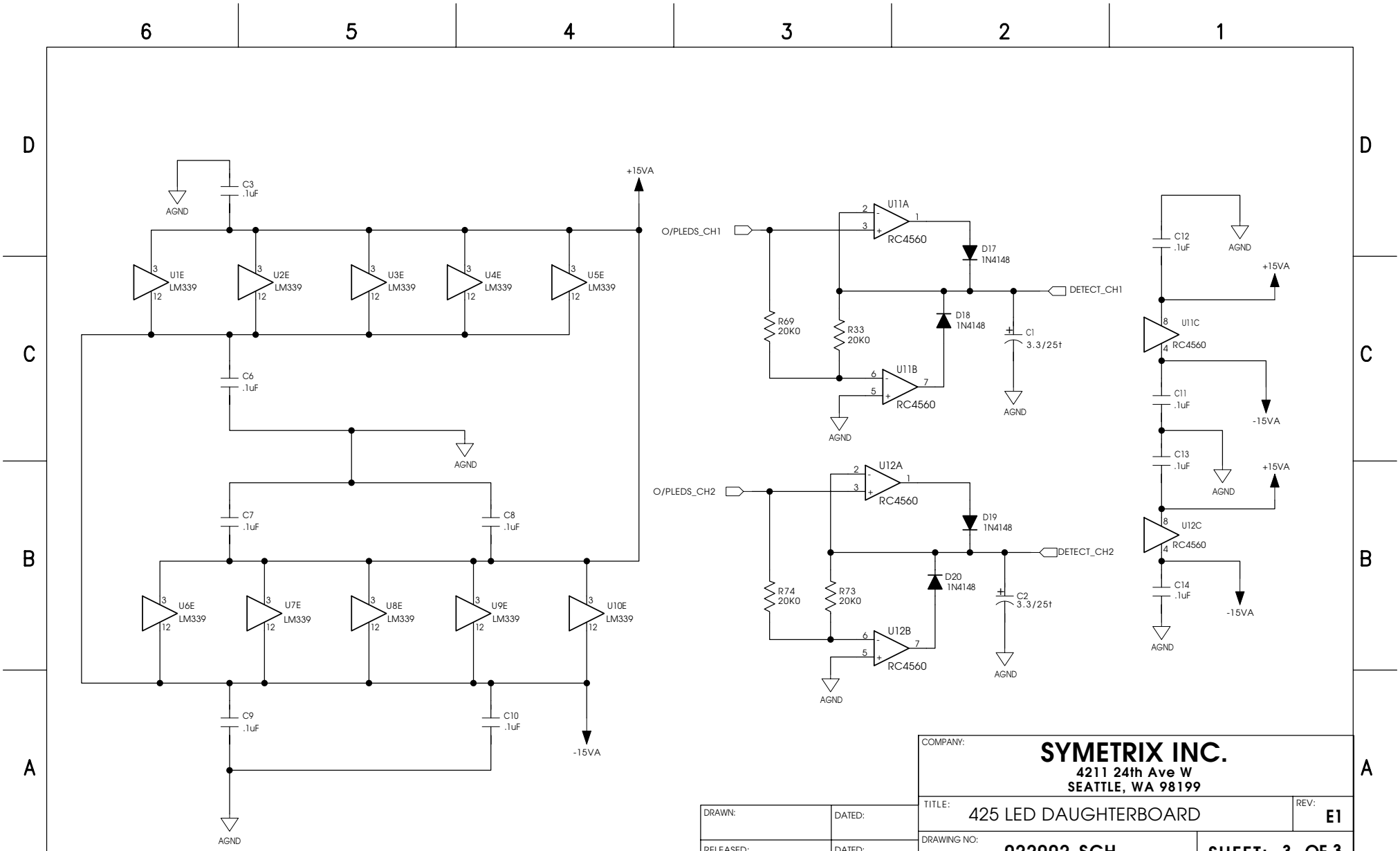
2
1
D
C
B
A
REVISION RECORD
LTR | REVISIONS DONE OR ECO NUMBER: | DATE:
B | VALUE CHANGES IN OUTPUT LED STRING | 12/19/91
C | C4 & C5 ADDED AS PER ECO 169 | 2/13/92
D | CHANGES AS PER ECO 425-001 | 7/9/92
E | ECO 425-8 SWAPPING LED REF DES. D40-D43 & D60-D63 | 8/24/93 B.G.
CH1 EXPANDER LEDS
CH1 COMPRESSOR LEDS
CH1 LIMITER LEDS
CH1 OUTPUT LEDS
FROM MOTHERBOARD
J5A
J5B
EXPLEDS_CH1
COMPLEDS_CH1
LIMLEDS_CH1
O/PLEDS_CH1
STEREO
DUAL
J5C
J5D
J5E
J5F
J5G
J5H
+15VA
-15VA
LM339
(RED)
(GREEN)
EXPLEDS_CH1
COMPLEDS_CH1
LIMLEDS_CH1
DETECT_CH1
C4 .01uF
COMPANY:
SYMETRIX INC.
4211 24th Ave W
SEATTLE, WA 98199
TITLE:
425 LED DAUGHTERBOARD
REV:
E1
DRAWN:
DATED:
RELEASED:
DATED:
DRAWING NO:
022002-SCH
SHEET: 1 OF 3


6
5
4
3
2
1
D
C
B
A
+15VA
D10 1N4148
D9 1N4148
R43 120 OHM
Q5 2N4403
R44 10K
D21 1N4148
R37 2K67
U6D
LM339
U6C
U6B
U6A
R38 3K01
R39 4K22
R40 4K22
R41 35K7
R42 1M
EXPLEDS_CH2
LEDBUSS
D47 -2dB
D46 -6dB
D45 -12dB
D44 -18dB
(RED)
-15VA
CH2 EXPANDER LEDS
D12 1N4148
D11 1N4148
R55 120 OHM
Q6 2N4403
D22 1N4148
R56 20K0
R45 10K5
R46 6K49
R47 5K76
R48 5K62
R49 5K62
R50 5K62
R51 8K45
R52 28K0
R53 124K
R54 1M
U7D
U7C
U7B
U7A
U8D
U8C
U8B
U8A
D55 -2dB
D54 -4dB
D53 -6dB
D52 -8dB
D51 -10dB
D50 -12dB
D49 -15dB
D48 -25dB
COMPLEDS_CH2
CH2 COMPRESSOR LEDS
D14 1N4148
D13 1N4148
R62 120 OHM
Q7 2N4403
D23 1N4148
R63 10K
R57 8K45
R58 5K90
R59 5K49
R60 5K76
R61 100K0
R72 1M
U9D
U9C
U9B
U9A
D59 -3dB
D58 -6dB
D57 -9dB
D56 -12dB
LIMLEDS_CH2
CH2 LIMITER LEDS
D16 1N4148
D15 1N4148
R70 120 OHM
Q8 2N4403
R71 10K
R64 549 OHM
R65 1K21
R66 3K83
R67 12K1
R68 30K1
C5 .01uF
U10D
U10C
U10B
U10A
D60 -20
D61 -10
D62 0VU
D63 CLIP
(GREEN)
DETECT_CH2
CH2 OUTPUT LEDS
EXPLEDS_CH2 9 J5I
COMPLEDS_CH2 10 J5J
LIMLEDS_CH2 11 J5K
O/PLEDS_CH2 12 J5L
13 J5M
14 J5N
15 J5O
16 J5P
LEDBUSS
COMPANY:
SYMETRIX INC.
4211 24th Ave W
SEATTLE, WA 98199
TITLE:
425 LED DAUGHTERBOARD
REV:
E1
DRAWN:
DATED:
RELEASED:
DRAWING NO:
022002-SCH
SHEET: 2 OF 3


6
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C
B
A
C3
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AGND
+15VA
U1E
LM339
U2E
LM339
U3E
LM339
U4E
LM339
U5E
LM339
C6
.1uF
C7
.1uF
C8
.1uF
U6E
LM339
U7E
LM339
U8E
LM339
U9E
LM339
U10E
LM339
C9
.1uF
C10
.1uF
-15VA
O/PLEDS_CH1
U11A
RC4560
D17
1N4148
DETECT_CH1
R69
20K0
R33
20K0
D18
1N4148
C1
3.3/25t
U11B
RC4560
O/PLEDS_CH2
U12A
RC4560
D19
1N4148
DETECT_CH2
R74
20K0
R73
20K0
D20
1N4148
C2
3.3/25t
U12B
RC4560
C12
.1uF
U11C
RC4560
C11
.1uF
C13
.1uF
U12C
RC4560
C14
.1uF
COMPANY:
SYMETRIX INC.
4211 24th Ave W
SEATTLE, WA 98199
TITLE:
425 LED DAUGHTERBOARD
REV:
E1
DRAWN:
DATED:
RELEASED:
DATED:
DRAWING NO:
022002-SCH
SHEET: 3 OF 3

Appendix A. Architects and Engineers Specification

The Compressor/Limiter/Expander shall be a dual channel model that controls the dynamic range of wide range, wideband audio signals, providing compression, peak limiting, and downward expansion simultaneously. The unit shall occupy one rack space (1U).

The threshold of the compressor section shall be adjustable over a range of -40dBu to +20dBu via a front panel control. When the control is fully clockwise the section shall revert to bypass mode. The input-to-output ratio (compression ratio) shall be adjustable from 1:1 to 10:1. Control of the compressor release time shall be program dependent within a range set by the front panel release time control. The compressor section shall have a dedicated eight segment LED ladder that displays the degree of gain reduction.

The Compressor/Limiter/Expander shall contain an integral peak limiter having a 20:1 compression ratio and adjustable threshold level. A dedicated four segment LED ladder shall be provided to indicate the amount of peak limiter activity.

A front panel switch, with LED indicator, shall select between dual mono and stereo master/slave operation. Each channel shall have a bypass switch which defeats all front panel controls for that channel.

The Compressor/Limiter/Expander shall also contain a downward expander having a 1:1.5 expansion ratio with threshold, and release time controls. A dedicated four LED display shall be provided to indicate the amount of downward expansion.

The inputs shall be active balanced bridging designs terminated with 3-pin XLR (AES/IEC standard wiring), and 1/4" TRS female. The input circuitry shall incorporate RFI filters. The outputs shall be active balanced designs having equal source impedances and terminated with 3-pin XLR (AES/IEC standard wiring), and 1/4" TRS female.

The balanced inputs shall accommodate +20 dBu signals without distortion, and the balanced outputs shall be capable of delivering +23 dBm into a 600 ohm load.

Overall frequency response shall be 10 Hz - 60 kHz (+0dB, -3dB). THD shall be .02% measured under the following conditions: +4 dBu input, +18 dBu output, BYPASS switch out, 20 Hz to 30kHz, 30kHz low-pass filter, 0dB gain reduction. Residual noise output shall be no greater than -90 dBu, measured with a 20 kHz noise bandwidth, input terminated in 600 ohms.

Access to each channel's sidechain shall be provided via a single 1/4" TRS female connector (per channel). The ring connection shall be the sidechain output and the tip connection shall be the sidechain return.

The unit shall be capable of operating by means of its own built-in power supply connected to 117V nominal AC (105-130V) 50/60 Hz (230V nominal, 207-253V AC, 50 Hz where applicable).

The unit shall be a Symetrix Incorporated model 425 Dual Compressor/Limiter/Expander.

Notes

Appendix B. Disassembly Instructions

Caution: *These servicing instructions are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than that contained in the operating instructions portion of this manual unless you are qualified to do so. Refer all servicing to qualified service personnel.*

Warning: Lethal voltages are present inside the chassis. Perform all service work with the unit disconnected from all AC power.

Tools Required

1. #2 Phillips screwdriver.
2. 5/64" allen wrench.

Top Cover Removal

1. Ensure that the 425 is disconnected from the AC power source.
2. Remove four 6-32 x 1/2 inch screws from the rear-panel.
3. Remove two 6-32 x 1/2 inch screws from each side of the chassis.
4. Remove one 6-32 x 1/2 inch screw from the top-middle of the front panel. Use caution to prevent the screwdriver from slipping and marring the front panel.
5. Lift the top cover free of the chassis.

Circuit Board Removal

1. Ensure that the 425 is disconnected from the AC power source.
2. Remove the top cover using the procedure described previously.
3. Remove the four screws from the four corners of the front panel and one screw in the bottom-center of the front panel.
4. Locate the LED board near the front panel.
5. Remove the LED board by removing the two screws located at the ends of the board, then applying upward pressure at the connector located at the middle-rear of the board to disengage the board.
6. Remove four 6-32 x 1/4 inch SEMS machine screws from the printed circuit board. Three are located near the front panel, the remaining screw is located near J13.
7. Remove the two 6-32 x 1/2 inch machine screws that fasten the IEC power connector to the chassis.
8. Remove four 6-32 x 1/2 inch screws from the ends of the front panel (two on left, two on right).
9. Disconnect the green safety ground wire at the chassis screw terminal by removing the nut. Ensure that this wire is reconnected when reassembling the 425.
10. Lift the circuit board, with the front panel attached clear of the chassis.

Notes