

GRACE DESIGN



M502

500 series Opto Compressor Module 2434 30th Street, Boulder, CO 80301 USA

owner's manual Rev A tel 303.443.7454 fax 303.444.4634

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Welcome and thanks for purchasing the Grace Design m502 optical compressor. We build all of our products to be completely reliable and easy to use, so you can concentrate on making great recordings. While you will find the m502 is completely straightforward to use, we do ask that you spend a little time reading this manual to help avoid any common user difficulties.

In the event that you do encounter any technical difficulties with this or any of our products, feel free to call us at 303-443-7454. Our office hours are 9:00 to 5:00, Monday through Friday, MST, or you may e-mail any technical questions to: info@gracedesign.com. Also, please check out our web site for complete product information, owner's manuals and technical documents.

Grace Design has been building audiophile quality products for the recording industry for over 18 years. The technology in the m502 is the result of extensive listening, field-testing and careful refinement. Your m502 represents a combination of absolutely pristine audio performance, robust mechanical construction and complete reliability at a reasonable price.

We sincerely hope our products help you achieve a new level of excellence in your work!

- The Grace Design Team



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Important Safety Information

GENERAL

Indoor use only

Ordinary Protection: This equipment should not be exposed to dripping or splashing.

Avoid placing objects filled with liquids, such as vases or glasses, on this equipment.

Mains supply voltage fluctuations are not to exceed $\pm 10\%$ of the nominal supply voltage.

Pollution Degree 2

Maximum Relative Humidity: $< 80\%$

Operation temperature range: $10\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$

Storage and transportation temperature range $-40\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$

Maximum altitude: 3000m (9843 ft.)

Equipment suitable for continuous operation

Weight: 316g / 0.7 lb

SAFETY



Please be sure to power off your 500 series rack before installing or removing this or any 500 series modules. Hot swapping could cause connection sparks at the card-edge connector that could damage this or other equipment.

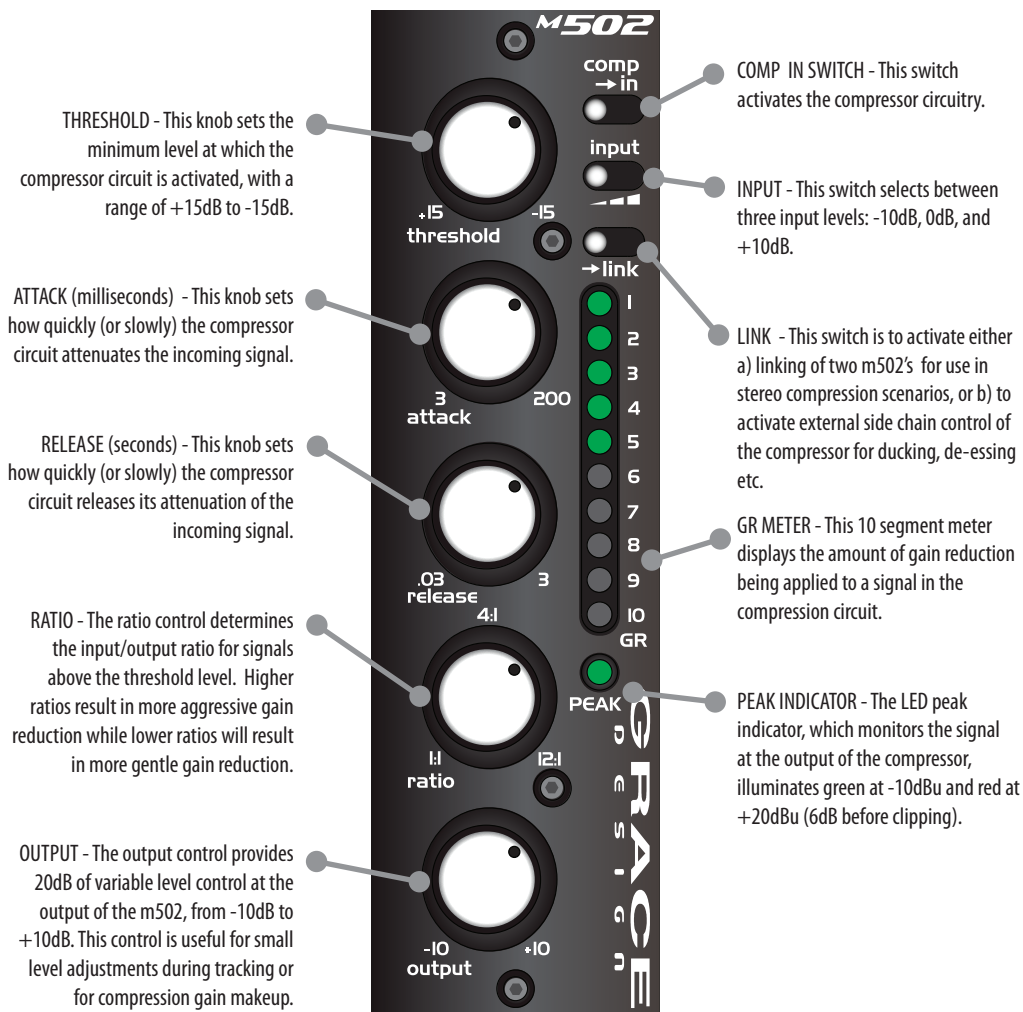
SERVICE INFORMATION

The Grace Design m502 contains no user serviceable components. Contact Grace Design for repair and upgrade information. In the event that your Grace Design m502 needs to be returned to the factory, please contact us for a return authorization number.

Features

- Elegantly simple, purist feedback design optical compressor for signal leveling with a minimum of sonic artifacts
- Subtle dynamic control to heavy compression, the sonic character of the source remains intact
- Comprehensive control set includes input level, threshold, attack, release, ratio and makeup gain
- Bright, easy to read 10 segment LED gain reduction meters
- Bi-color output peak LED lights green with signal present and red 6dB before clipping
- Pin 7 & 9 connections to Radial Workhorse™ and Purple Sweet Ten™ auxiliary connectors
- Pin 11 unbalanced audio out connection to Radial Workhorse™ BussFeed
- Five year transferable warranty on parts and labor
- Made in the USA

Front Panel Controls / Features



Installing and Connecting

Before you do anything, please register your unit with us as soon as possible. We provide a 5 year transferable warranty on all of our products and registering it with us makes it easy if and when help becomes necessary. So please take a few minutes to complete the enclosed warranty registration card and mail it in, or simply fill out the warranty registration form on our web site. Thank you!

Installing the m502 in a 500 series rack

1. Open your m502 box. The module is in a bag under the plastic 'korvu' retaining sheet, which you should be careful not to cut. Simply fold down the outer cardboard flaps, then the under side flaps, which will loosen the module from under the plastic sheet.
2. Turn off your 500 series rack frame (*hot swapping 500 series modules = **bad***). Inspect the card slot you intend you use to make sure that it is clean and free of any debris.
3. Before removing your m502 from its anti-static bag, discharge any static electricity buildup you may have by touching your 500 series rack or other gear that is properly grounded.
4. Pull your m502 module out of its anti-static bag and carefully slide it into place in the designated opening. Sight down the back of the module (use a flashlight if necessary) and ensure the card edge connector is aligned to seat into the card slot of the frame.
5. Firmly and evenly push the m502 module into place until it is positively seated in the card slot.
6. Use the 2 supplied #4-40 hex head screws and 3/32" hex wrench to mount the m502 front panel to the 500 series rack. These screws can have a tight fit so please be careful not to cross thread them.
7. Plug your 500 series rack back into the AC source and power up your rack. Your m502 will automatically power up with your 500 series rack.

BALANCED LINE INPUT

The m502 line input is located on the back of your 500 series rack. This connector should be wired pin 2 positive, pin 3 negative and pin 1 ground (check with your rack manufacturer's documentation for connector details).

BALANCED LINE OUTPUT

The balanced XLR line output connector is located on the back of your 500 series rack. This connector should be wired pin 2 positive, pin 3 negative and pin 1 ground (check with your rack manufacturer's documentation for connector details).

OTHER CARD CONNECTIONS

In addition to the basic I/O provided on the back of the 500 series rack, there are a couple other options for signal routing available on the m502 depending on which 500 series rack you are using. Typically, 500 series module card edge pins 7, 9 and 11 are left unconnected. However, Radial Engineering and Purple Audio both implement these locations in useful ways, so we have added connections to them.

- Pin 7 is connected to the ring of the 1/4" TRS connector labeled "OMNIPORT" on the Radial Workhorse or "OPT IN" on the Purple Sweet Ten Rack for stereo linking of two m502's.

- Pin 9 is connected to the tip of the 1/4" TRS connector labeled "OMNIPORT" on the Radial Workhorse or "OPT IN" on the Purple Sweet Ten Rack for stereo linking or side chain signal input.
- Pin 11 is connected to send an unbalanced audio output to the Radial Workhorse "BUSS FEED".

If you are using either of these racks, please refer to their documentation for operating with these connections. Also, please refer to the 'Card Edge Connector' and 'Jumper and DIP switch locations' diagrams on pages 9-10 of this manual.

Operation

The compressor circuit is based on an optical attenuator - the purest, high fidelity gain control mechanism available. It provides gentle to fairly heavy compression, while remaining neutral and transparent. This compressor is not designed for "brick wall" limiting.

Similar to an eq, dynamic range compression is a subjective tool - there is no wrong way to use it. However, using a compressor in a way that produces the best results can be tricky, and the more you know, the better it will work. If you are unsure about how a compressor works, we highly recommend some preliminary reading:

http://en.wikipedia.org/wiki/Dynamic_range_compression

It will pay greatly to understand the mechanism of dynamic range compression *BEFORE* you begin to record keeper tracks with the compressor on.

SETTING THE INPUT TRIM

This switch selects between three input levels: -10, 0, and +10dB. Select the setting which best suits the level of the incoming line signal and how much compression you require. This setting is interactive with the threshold control, as a higher input level setting will result in a relatively higher threshold setting to achieve the same amount of gain reduction. This control effectively sets how hard you drive the compressor circuit.

SETTING THE THRESHOLD

The threshold is the level at which the compressor begins to attenuate the incoming signal. A high threshold setting (counterclockwise) will result in only the dynamically highest passages of the signal being attenuated, while everything below that threshold is unaffected by the circuit. Conversely, a lower threshold means more of the signal at the input of the circuit will be attenuated resulting in *more compression*.

Begin with the knob fully counterclockwise and the compressor switched ON, then slowly begin turning clockwise until you begin to compress the signal. You will hear the signal compress, and you will begin to see the GR meter light up. The lower the threshold setting, the more the incoming signal will be attenuated and the more lights will light up on the GR meter.

SETTING THE ATTACK RATE

The rate at which you want the compressor to start the attenuation of the signal (*attack phase*) depends on the character, or envelope, of the signal entering the compressor. If the signal has sharp or fast attack (percussive sounds, snare drum) that you wish to attenuate, select a fast attack rate to sense the initial impulse of the signal and attenuate it in time. If you want the compressor to react slower and

not attenuate the initial impulse of the signal, select a longer attack time. Using a slower attack time may be more appropriate with signals with a slower, more gradual envelope (strings, woodwinds).

SETTING THE RELEASE RATE

The rate at which you want the circuit to release its attenuation of the signal (*release phase*) is set with the release control. This is the functional opposite of the attack control. If the signal has a shorter decay, it may be best to set a shorter release time. A helpful approach to setting the attack and release time may be to consider the basic pulse of the signal you're compressing. To avoid the typical artifact known as 'pumping', where you can clearly hear the compressor working, it is important to set the attack and release times to match the signal to where they are moving naturally with the dynamic and rhythmic fluctuations of the signal.

SETTING THE RATIO

The compressor's ratio control is used to set input/output ratio of signals above the threshold. For instance, a setting of 3:1 means that if the incoming signal is 3dB over the threshold level, that signal will leave the compressor around 1dB over the threshold level. The highest setting of this control is 12:1, meaning that signals far over the threshold setting are reduced by a much higher ratio – more compression. So lower ratio settings mean lighter compression amounts. We recommend starting with lower ratios and working upward as necessary.

LINK

This feature is used to link two m502 compressors together for stereo bus compression. In this mode, the side chain signals of both units are summed together into one. To operate in stereo link mode, both modules need to be connected together (see below) and both set to 'link' mode. With two units linked, one is the master and the other the slave, with the master's controls setting the compression threshold, attack and release of both units. The slaved unit's threshold control must be set to the highest, full counterclockwise position.

NOTE: The RATIO controls are not summed, and must be set the same on both units. Due to slight, unavoidable variances in the opto coupling devices, completely summing the side chain signals may result in a subtle shift in the stereo field one direction or the other. So the RATIO controls remain independent to allow you to make final, subtle corrections to the centering of the stereo image by ear.

LINK CONTROL CONNECTIONS

Stereo linking with the supplied jumper cable requires that both m502 modules be removed from the rack so the cable can be connected to both units' headers - labeled **J5** (page 9). Once connected together, gently slide both modules into two adjacent slots in your rack, making sure the jumper cable is cleanly routed under or over the right hand module and does not catch on anything in the rack. Carefully insert both modules all the way back until they just meet the card slot. Then fully seat each module one at a time into their respective card slot connectors.

Alternately, you can connect two m502's for stereo link control via the Radial Workhorse's 'Omniport' or the Purple Audio Sweet Ten's "Opt In". In this setup you will need to connect a 1/4" TRS jumper between the rack's two aux jacks. The two m502 modules are then connected via pins 7 (ring) and 9 (tip), which then must be switched on at the m502's DIP switch locations **S5 SW1 & SW2** (page 9). With any link scenario, make sure both m502's 'link' switches are switched on (to the right).

SIDE CHAIN CONTROL

For connecting a side chain signal to the m502, you need a 500 series rack which has a provision for an auxiliary input to the module via pin 7 (Radial Engineering Workhorse or the Purple Audio Sweet Ten win again in our book). Connect an unbalanced side chain signal via the **tip** of a 1/4" TRS cable to the aux in. This signal will be available for side chain input via pin 7. This pin must also be switched on at the m502's PC board DIP switch location **S5 SW2**, and the **S4 SW1** (page 9) must be switched off, which will disconnect the link internal audio path from the side chain input.

Normally, the compressor's side chain circuit uses the internal audio signal to trigger its response. But in side chain mode, the side chain circuit uses the external signal input to determine how the compressor responds.

Examples of using an external side chain signal include *ducking* and *de-essing*. Ducking is an effect used to automatically reduce the level of one signal when another signal is present. Think of a DJ's microphone automatically reducing the level of the music when they are speaking. It involves routing a separate signal from a microphone (or any other source) into the side chain input of the m502. This signal is what the compressor reacts to and thereby would typically reduce (or duck) the level of the main signal in the m502. You would use the compressor controls to determine the amount, rate and duration that incoming signal ducks the main signal.

De-essing is used to decrease excessive sibilant ('s' or 'sh') sounds in a voice. This is accomplished by inserting a copy of the signal into the side chain input which has been equalized (by an external equalizer) to emphasize the frequency where the sibilance lies (usually 6-9k). This inserted signal makes the compressor react to and thereby reduce only the places in the signal where troublesome sibilance lies.

There are many other functional and creative ways to use side chain input, more than can be illustrated here. Again, the more you know, the more powerful it can be.

GR METER

This meter shows the amount of gain reduction being applied by the compressor. The LED's illuminate top to bottom, with one LED representing 1dB of gain reduction and ten LED's representing 10dB's of gain reduction or more. Selecting a lower threshold setting will activate the compressor with relatively lower signal levels and will be reflected on the GR meter as more gain reduction. Selecting a faster ATTACK time will show on the meter as the LED's turning on faster, selecting a slower RELEASE will show on the GR meter as the LED's staying lit longer.

There is no correct setting for this meter – it is simply displaying how the compressor is working. If all the lights are on, you are probably squashing it and hopefully thereby rocking out. If only the first three are lighting up, you are applying gentle compression. The meter is a good place to start in getting the proper setting, but it doesn't necessarily mean that it sounds right. As always, let your ears be your guide.

SETTING THE OUTPUT CONTROL

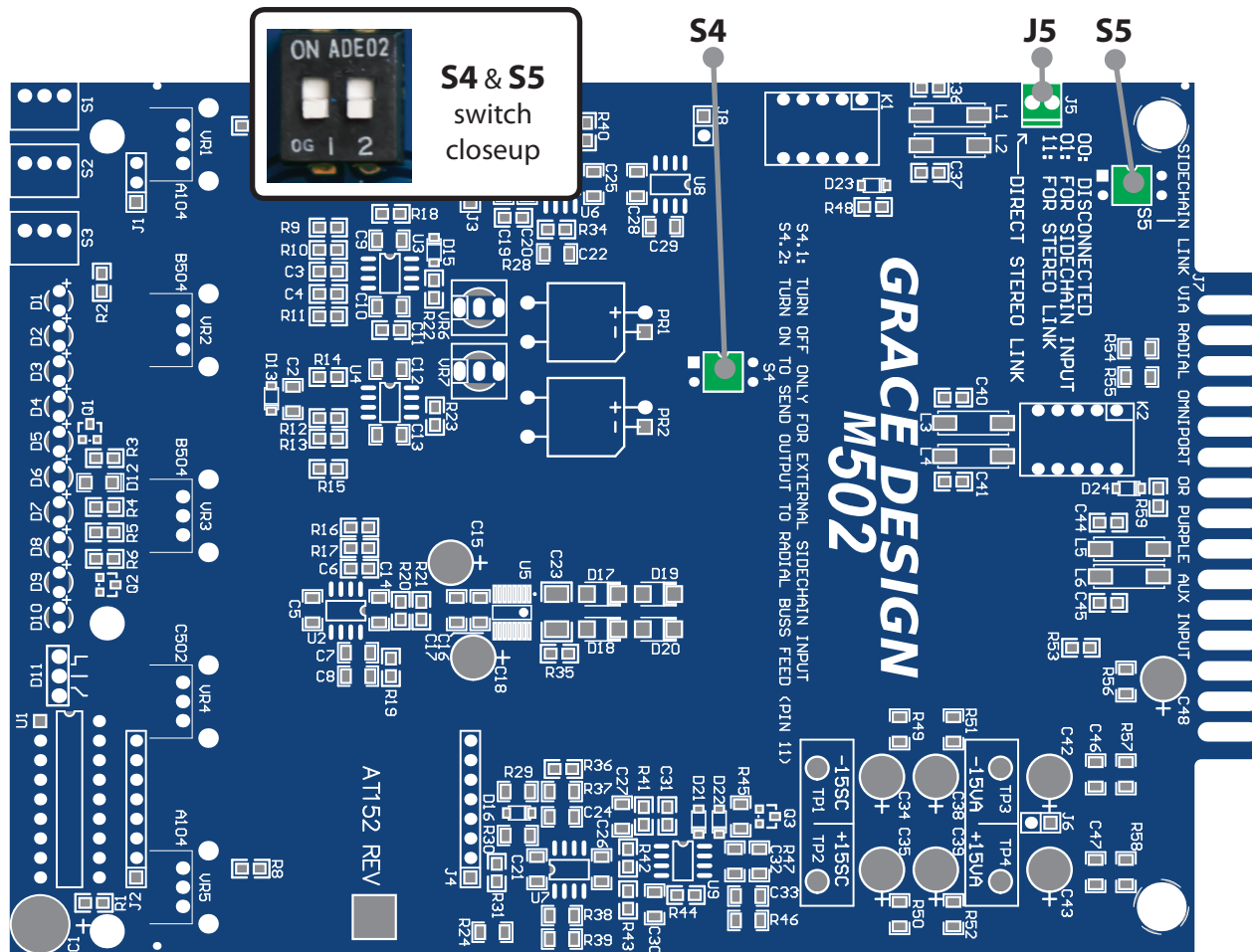
The OUTPUT control provides 20dB of variable level control at the output of the m502. After setting your desired input and threshold levels, you can set the over all output of the m502 with this control. Use the OUTPUT to properly match to the input of your converter, interface or whatever is next in your signal path. Also, your signal level may have been reduced by heavy compression settings, so the OUTPUT control can also be used to provide *makeup gain*.

PEAK LED

The PEAK LED is used to monitor any peaks within the m502. It turns green at -15dBu and red at +20dBu. The m502's internal headroom is +26dBu, so occasional red is fine, just a warning that you are 6dB away from clipping. If the light is mostly red, then you are probably clipping the unit and all your gear downstream.

Diagrams

JUMPER AND SWITCH LOCATIONS




J5 - use this jumper header to connect two m502's for stereo link control with the supplied 2 wire jumper cable.

S5 - for stereo link control, both switches must be set to on. For sidechain input, only switch 2 is set to on.

S4 - for normal compressor operation S4 switch **1** is set to ON, for sidechain input operation S4 switch 1 is set to OFF. To send compressor signal output to Radial Bussfeed (pin 11), S4 switch **2** is set to ON.

CARD EDGE CONNECTOR CONTACT ASSIGNMENTS



The diagram shows a vertical card edge connector with 15 gold contacts. The contacts are numbered 1 through 15 from top to bottom. The labels on the left side of the connector are: LINK, J7, U7A, RADIAL, OMNI, PORT, OR, PURPLE, AUX, INPUT, and 80. The contact assignments are listed to the right of the connector.

1. Chassis Ground
2. Output +
3. NC
4. Output -
5. Audio Ground
6. NC
7. Ring of the 1/4" TRS connector labeled "OMNI" on Radial Workhorse or "OPT IN" on Purple Sweet Ten Rack
8. Input -
9. Tip of the 1/4" TRS connector labeled "OMNI" on Radial Workhorse or "OPT IN" on Purple Sweet Ten Rack
10. Input +
11. Radial Workhorse BUSS FEED
12. +16VDC IN
13. Power Ground
14. -16VDC IN
15. NC

Specifications (Preliminary)

GAIN RANGE	
Input Trim	-10, 0, +10dB
Output Trim	-10 - +10dB
Compression	
Threshold Range	-15 - +15 dBu
Attack Range	3 – 200 ms
Release Range	0.03 – 3 s
Ratio Range	1:1 – 12:1
Gain Reduction	0 – 20dB
THD+N 1kHz, 22Hz-22kHz BW	
@ 0dB Gain +10dBu out	<0.002%
INTERMODULATION DISTORTION	
@ 0dB Gain +20dBu out	
SMPTE/DIN 4:1 7kHz/50Hz	<0.007%
OUTPUT NOISE 22Hz-22kHz BW	
@0dB Gain	<-84dB
CMRR @0dB Gain, 3.5Vcm	
100Hz	>75dB
1kHz	>75dB
10kHz	>75dB
FREQUENCY RESPONSE	
@0dB Gain -3dB	0.016Hz-150kHz
IMPEDANCE	
Line In	24k Ω
Main Out balanced	350 Ω
Main Out unbalanced	150 Ω
Link In – side chain mode	100k Ω
LEVEL METERS	
Output Peak Indicator	Green: -15dBu / Red: +20dBu
Gain Reduction Meter	0 -10dB Gain Reduction
MAXIMUM OUTPUT LEVEL	
100k Ohm load, 0.1% THD	+26dBu
WEIGHT and DIMENSIONS	
.7 lbs	H5.25" x W1.5" x D6.6"
316g	H13.3cm x W3.8cm x D16.7cm
POWER CONSUMPTION	
Current required from +16V and -16V power supplies	120mA Max

Warranty

Grace Design warrants all of our products to be free of defective parts and workmanship for a period of five years. This warranty period begins at the original date of purchase and is transferable to any person who may subsequently purchase the product during this time.

This warranty excludes the following conditions: normal wear and tear, misuse, customer negligence, accidental damage, unauthorized repair or modification, cosmetic damage and damage incurred during shipment.

During the time of this warranty, Grace Design will repair or replace, at its option, any defective parts or repair defective workmanship without charge, provided the customer has appropriate proof of purchase and that the product has its original factory serial number. In all warranty claims the customer is responsible for shipping costs to the Grace Design facility, and Grace Design pays for return ground shipping.

In order for Grace Design to provide efficient and timely warranty service, it is important that you mail the completed warranty registration card enclosed with all of our products within 10 days of the original date of purchase. You may also register your product directly with Grace Design by telephone (303-443-7454 Monday-Friday 9:00am to 5:00pm MST), or you can register your product online at www.gracedesign.com.

This warranty is in lieu of all other warranties whether written, expressed, or implied, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In no event will Grace Design be liable for lost profits or any other incidental, consequential or Exemplary damages, even if Grace Design is aware of the possibility of such damages. In no event will Grace Design's liability exceed the purchase price of the product.

This warranty gives the customer specific legal rights. The customer may also have other rights, which vary from state to state. Some states do not allow limitations on implied warranties or consequential damages, so some of the limitations of the above may not apply to a particular customer.

Manual Revisions

Revision	Page	Change	Date	Initials
A	all		1/30/2012	edg