

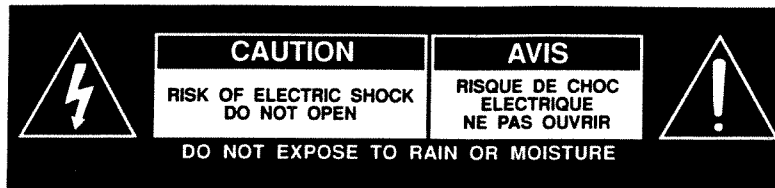
# MODEL 168A

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## STUDIO DYNAMICS PROCESSOR



OPERATION/SERVICE  
MANUAL



**CAUTION:** TO REDUCE THE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER (OR BACK). NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

**WARNING:** TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.



This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure — voltage that may be sufficient to constitute a risk of shock.



This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

This Manual is part number 18-2039-B

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## CAUTION

RISK OF ELECTRIC SHOCK  
DO NOT OPEN



**ATTENTION:** RISQUE DE CHOC ELECTRIQUE - NE PAS OUVRIR

**WARNING:** TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE

The symbols shown at left are internationally accepted symbols that warn of potential hazards with electrical products. The lightning flash with arrowpoint in an equilateral triangle means that there are dangerous voltages present within the unit. The exclamation point in an equilateral triangle indicates that it is necessary for the user to refer to the owner's manual.

These symbols warn that there are no user serviceable parts inside the unit. Do not open the unit. Do not attempt to service the unit yourself. Refer all servicing to qualified personnel. Opening the chassis for any reason will void the manufacturer's warranty. Do not get the unit wet. If liquid is spilled on the unit, shut it off immediately and take it to a dealer for service. Disconnect the unit during storms to prevent damage.

## U.K. MAINS PLUG WARNING

A moulded mains plug that has been cut off from the cord is unsafe. Discard the mains plug at a suitable disposal facility. **NEVER UNDER ANY CIRCUMSTANCES SHOULD YOU INSERT A DAMAGED OR CUT MAINS PLUG INTO A 13 AMP POWER SOCKET.** Do not use the mains plug without the fuse cover in place. Replacement fuse covers can be obtained from your local retailer. Replacement fuses are 13 amps and **MUST** be ASTA approved to BS1362.

## LITHIUM BATTERY WARNING

### CAUTION!

This product contains a lithium battery. There is danger of explosion if battery is incorrectly replaced. Replace only with an Eveready CR 2032 or equivalent. Make sure the battery is installed with the correct polarity. Discard used batteries according to manufacturer's instructions.

### ADVARSEL!

Lithiumbatteri - Eksplosjonsfare. Ved utskifting benyttes kun batteri som anbefalt av apparatfabrikanten. Brukt batteri returneres apparatleverandøren.

### ADVARSEL!

Lithiumbatteri - Eksplosjonsfare ved fejlagtig håndtering. Udsiktning må kun ske med batteri av samme fabrikat og type. Lever det brugte batteri tilbage til leverandøren.

### VAROITUS!

Paristo voi räjähtää, jos se on virheellisesti asennettu. Vaihda paristo ainoastaan laitevalmistajan suosittelemaan tyyppiin. Hävitä käytetty paristo valmistajan ohjeiden mukaisesti.

### WARNING!

Explosionsfara vid felaktigt batteribyte. Använd samma batterityp eller en ekvivalent typ som rekommenderas av apparatleverkaren. Kassera använt batteri enligt fabrikantens instruktion.

## THE FCC REGULATION WARNING

This equipment generates and uses radio frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interferences to radio and television reception. It has been type tested and found to comply with the limits for a class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception (can be determined by turning the equipment off and on), the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Move the equipment away from the receiver.

- Relocate the equipment with respect to the receiver.
- Plug the equipment into a different outlet so that equipment and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the US Government Printing Office, Washington D.C. 20402, Stock No. 004-000-00345-4.

## SAFETY INSTRUCTIONS (EUROPEAN)

**NOTICE FOR CUSTOMERS IF YOUR UNIT IS EQUIPPED WITH A POWER CORD.**

**WARNING: THIS APPLIANCE MUST BE EARTHED.**

The cores in the mains lead are coloured in accordance with the following code:

GREEN and YELLOW - Earth      BLUE - Neutral      BROWN - Live

As colours of the cores in the mains lead of this appliance may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

- The core which is coloured green and yellow must be connected to the terminal in the plug marked with the letter E, or with the earth symbol, or coloured green, or green and yellow.
- The core which is coloured blue must be connected to the terminal marked N or coloured black.
- The core which is coloured brown must be connected to the terminal marked L or coloured red.

The power cord is terminated in a CEE7/7 plug (Continental Europe). The green/yellow wire is connected directly to the unit's chassis. If you need to change the plug, and if you are qualified to do so, refer to the table below.

CONDUCTOR		WIRE COLOR	
		Normal	Alt
L	LIVE	BROWN	BLACK
N	NEUTRAL	BLUE	WHITE
E	EARTH GND	GREEN/YEL	GREEN

**WARNING:** If the ground is defeated, certain fault conditions in the unit or in the system to which it is connected can result in full line voltage between chassis and earth ground. Severe injury or death can then result if the chassis and earth ground are touched simultaneously.

## IMPORTANT!

### FOR YOUR PROTECTION, PLEASE READ THE FOLLOWING:

**WATER AND MOISTURE:** Appliance should not be used near water (e.g. near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool, etc). Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

**POWER SOURCES:** The appliance should be connected to a power supply only of the type described in the operating instructions or as marked on the appliance.

**GROUNDING OR POLARIZATION:** Precautions should be taken so that the grounding or polarization means of an appliance is not defeated.

**POWER CORD PROTECTION:** Power supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the appliance.

**SERVICING:** The user should not attempt to service the appliance beyond that described in the operating instructions. All other servicing should be referred to qualified service personnel.

**FUSING:** If your unit is equipped with a fuse receptacle, replace with only same type fuse. Refer to replacement text on the unit for correct fuse type.

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## QUICK SETUP

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To get your unit up and running as quickly as possible, do the following steps. For more detailed information, refer to the specified pages.

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|---|--------|
| <input type="checkbox"/> Unpack and Inspect the 168A Package. | Page 2 |
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## INSPECTION

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### 1. Unpack and inspect the 168A package.

Your 168A was carefully packed at the factory in a protective carton. Nonetheless, be sure to examine the unit and the carton for any signs of damage that may have occurred during shipping. If obvious physical damage is noticed, contact the carrier immediately to make a damage claim. We suggest saving the shipping carton and packing materials for safely transporting the unit in the future.

Verify that the 168A package contains the following:

- ☐ 168A Unit and AC Line Cord
- ☐ Operation/Service Manual (including Registration Card)

## INTRODUCTION

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### 168A Operation/Service Manual

Congratulations on choosing the dbx 168A. We recommend that you take a moment and read through the 168A manual. While your 168A manual provides all the necessary explanations of controls, operating notes and installation steps to help you get your unit up and running to its fullest extent, we've also included additional information to support the unit throughout its life. The 168A manual provides detailed servicing information, including a Performance Evaluation, Circuit Description, Block Diagram and a complete set of 168 Schematics and Assembly Drawings. In addition, we've included an Index (to help you find information as quickly as possible) and an Abbreviations Table (in case you are unfamiliar with any of the terms used in the text). Both the Index and Abbreviations Table can be found in the back of this manual.

### The dbx 168A Studio Dynamics Processor

The dbx Model 168A Studio Dynamics Processor is an integrated automatic gain control (AGC) device of the highest professional quality. The 168A has a versatile Compressor that can smoothly and unobtrusively ride gain or assertively increase punch and density. The 168A also controls excessive sibilance levels and provides high and low frequency spectral enhancement as desired. The 168A achieves its outstandingly transparent audio performance by finely-tuned control circuitry that eliminate the dynamic distortions that are present in most conventional compressors and limiters, and through use of a quiet, low-distortion dbx<sup>®</sup> VCA to ensure negligible static distortion and noise.

### Features

- ☐ The 168A uses dbx's newly-developed Servo Timed Binary™ level detection scheme and hybrid feedforward/feedback Compressor control circuit (patent pending) to achieve outstandingly smooth, low-distortion compression.
- ☐ Release time is adjustable to optimize processing for single tracks or mixed program material. Sound can be tight and punchy, or completely transparent.
- ☐ A defeatable "silence gate" prevents noise rush-up, holes, pumping, and breathing by inhibiting sudden gain increases once the signal level falls below a preset threshold (during pauses or low-level program material).
- ☐ Adjustable feedforward De-Esser guards against excessive sibilance, tracking input levels to ensure consistent de-essing over an input level range of greater than 20dB.
- ☐ High-Frequency Spectral Enhancement circuit is an "automatic equalizer" that adapts to the input program, continuously analyzing it to estimate the amount of equalization needed at every moment.
- ☐ Low-Frequency Spectral Enhancement is a special fourth-order bass equalizer that permits substantial boost around 80Hz without creating muddy-sounding mid-bass.
- ☐ Either stereo-tracking or independent two-channel operation is possible.
- ☐ Two LED meters per channel simultaneously display gain reduction and peak output levels.

- ☐ Balanced, floating inputs and outputs are EMI-suppressed; the 168A is compatible with the levels and impedances found in both professional and semi-professional applications.
- ☐ 30dB gain reduction range is achieved with industry-standard dbx VCAs.
- ☐ Hard-wire bypass switches allow the operator to preserve system continuity if the circuitry or AC power fails.

### Applications

The flexibility and natural sound of the 168A make it ideally suited to recording studio, broadcast production studio, motion picture, video sound applications, and sound reinforcement.

#### Recording Studios and Broadcast Production

The 168A can be used to protect any digital recording device, VTRs, ATRs, or cart machines from overload during transfer without coloring the audio, or it can be set to apply effects as desired.

With the DENSITY control set towards 0 the 168A will subtly reduce the dynamic range of an entire production or mix without affecting sound texture. Higher settings, towards 10 provide effective gain riding on single tracks, increasing "punch" and intelligibility and substantially changing the sound texture of the voice or instrument. Applied to a mix, higher settings increase apparent loudness and density without overt pumping or distortion. In all cases, the DENSITY control is useful in governing the uniformity of loudness in the processed audio.

Use the HIGH SPECTRAL ENHANCEMENT control to increase brightness and definition without excessive harshness. Use the LOW SPECTRAL ENHANCEMENT control to increase bass punch without making the low end sound tubby or boomy.

The 168A is an effective voice processor. With the DENSITY control set towards 10, the Compressor effectively tames the level variations usually found in a live mic output, while the De-Esser can subdue any excessive sibilance. The Spectral Enhancement circuits can add life to vocal tracks, making them sound crisp and authoritative. The 168A's smoothness and silence-gating guarantee uniform, punchy voice quality without noise rush-up during pauses.

#### Motion Picture and Video Post Production

The 168's processing can be used to maintain consistent audio levels between different scenes when editing. The Enhancer circuit can add intelligibility to poorly dubbed dialogue. The De-Esser can prevent sibilance from sounding harsh and/or becoming distorted in optical transfers. Even sound effects can benefit from the Enhancer's HF and LF circuitry by becoming fuller and more defined.

#### Sound Systems

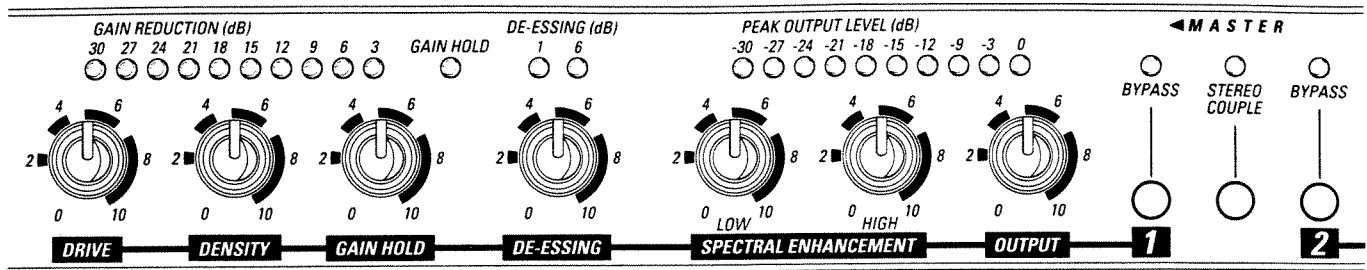
The 168A has several valuable applications in sound systems. With the DENSITY control set to the higher side of the scale, the 168A is excellent for treating individual sources (like vocal or instrument microphones) without overt side-effects. The De-Esser makes the 168A particularly valuable on vocal microphones.

Because the HF Enhancer is program-adaptive, it has less tendency to cause acoustic feedback than a fixed equalizer would. If feedback commences, the enhancer dynamically reduces the amount of enhancement to limit or stop the feedback.

You can use the Compressor to process the overall sound system. Set the DENSITY control between 0 and 2, and set the DRIVE control so that the indicator displays less than 12dB of gain reduction. This operates the 168A's Compressor on the "soft-knee" part of its curve, preserving much of the dynamics of the performance while still using the available amplifier power more effectively.

## OPERATING CONTROLS

### Front Panel



**Note:** The following controls are available for both channels of the 168A Studio Dynamics Processor (except for the STEREO COUPLE button — see below).

**GAIN REDUCTION (dB) Meter:** This meter shows the true peak gain reduction in dB. If the LED at the far right of the meter lights, no further gain reduction is available. When the STEREO COUPLE button is pressed in, the Channel 2 GAIN REDUCTION meter tracks the Channel 1 GAIN REDUCTION meter.

**DRIVE Control:** The DRIVE control determines the amount of gain reduction by adjusting the level of the audio being input into the Compressor.

**DENSITY Control:** Use this control to speed up or slow down the program-dependent release time (in order to match the processing to the type of audio being processed). The scale is arbitrary because the release time is automatically varied according to the nature of the program material (to minimize audible compression-induced side effects). Higher settings (towards 10) are faster.

**GAIN HOLD Control and GAIN HOLD LED:** The GAIN HOLD acts as a “silence gate,” determining the input level below which the Compressor Gain circuitry is “frozen” to prevent noise rush-up during pauses and low-level program material.

The GAIN HOLD LED lights when the input level falls below those set by the GAIN HOLD control. This indicates that the Compressor's Gain control circuitry is “frozen.”

**DE-ESSING Control and 1(dB) and 6(dB) LEDs:** Use this control to set the sensitivity of the De-Esser as a percentage of the average program level at the 168A's input. This means that the De-Esser tracks the input level so the amount of de-essing remains constant with changes in input level.

The first segment of the De-Esser meter (green LED, labeled 1) lights when the De-Esser has caused 1dB of gain reduction; the second segment (red LED, labeled 6) lights when 6dB of gain reduction occurs. It is normal for both segments of the meter to light when you are using a substantial amount of de-essing, but when the red segment lights, you should listen carefully to make sure that you are not over-de-essing the program material.

**LOW SPECTRAL ENHANCEMENT Control:** The 168A's LOW SPECTRAL ENHANCEMENT simultaneously applies an 80Hz boost and 250Hz cut to the program. This lets you apply substantial bass boost without making the program sound muddy or boomy due to excessive mid-bass boost.

**HIGH SPECTRAL ENHANCEMENT Control:** This control determines the amount of High-Frequency Spectral-Enhanced signal added to the input signal. Spectral Enhancement is a form of dynamic phase and amplitude equalization. Continuous analysis of the input signal intelligently and automatically determines the amount of equalization necessary at each moment to achieve detailed, defined audio that is never shrill or over-sibilant.

**OUTPUT Control and PEAK OUTPUT LEVEL (dB) Meter:** The OUTPUT control sets the level at the balanced line output.

The PEAK OUTPUT LEVEL meter indicates the absolute peak level at the 168A's XLR output, reading within 0.5dB of the true peak value of a 10-microsecond pulse. If the red segment of the meter lights, then the 168A is clipping and you should turn down the appropriate OUTPUT control.

**STEREO COUPLE Button and MASTER LED:** Press this button In to set the 168A for stereo operation. In this mode, Channel 1 becomes the "master," in that both channels are now controlled by the Channel 1 controls (the Channel 2 controls become inactive, "slaving" to the Channel 1 "master" controls). Both Compressors receive identical gain reduction to better preserve stereo imaging. The amount of gain reduction is determined by the channel that requires the most gain reduction at any given instant. The Channel 2 GAIN REDUCTION meter and GAIN HOLD LED will track the same indicators in Channel 1. (The De-Essers always operate independently because their short release times preclude stereo imaging problems. Their operation is unaffected by the STEREO COUPLE button, except that their thresholds are both controlled by the Channel 1 DE-ESSING control.)

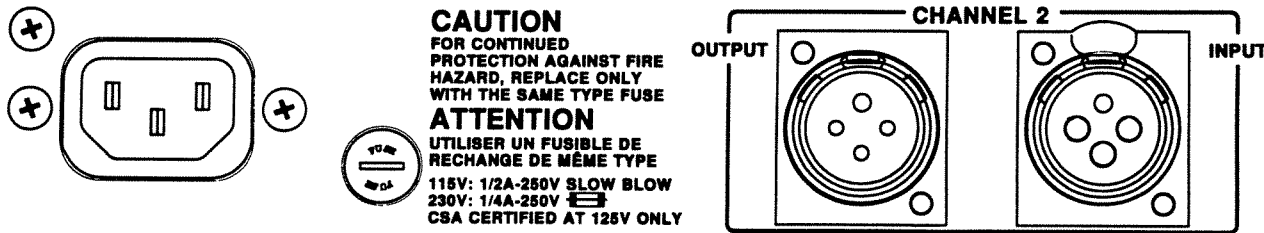
**Note:** With the STEREO COUPLE button Out, the two audio channels function independently.

The MASTER LED indicates Channel 1 and 2 are stereo-coupled, with Channel 1 as the master.

**BYPASS Button and BYPASS LED:** Press this button In to create a "hard-wire bypass" of the 168A's circuitry (i.e., unaltered input signal will pass through the unit even if the power cord connection is unplugged). In Bypass, the input is sent to the output, bypassing the 168A's processing and controls and presenting unaltered signal at the 168A's OUTPUT jacks. Bypass is especially useful for making comparisons between processed and unprocessed signals.

The BYPASS LED turns red when the BYPASS button is pressed In. It is green when the channel is active.

### Rear Panel



**AC Cord:** This jack accepts an IEC-type power cord (as shipped with the unit). Plug the cord into the unit and mains power. Note that the 168A does not have a power switch. It is recommended that the 168A be On at all times. Power consumption is low. If you do not plan to use the 168A for an extended period of time, unplug it.

**WARNING:** Be sure to verify both your actual line voltage and the voltage for which your Model 168A was set, as indicated on the rear panel of your unit. Connection to an inappropriate power source may result in extensive damage which is not covered by the warranty.



**FUSE:** For safety, the fuse must be Slow-Blow, 1/2-amp for 115V, or 1/4-amp (250mA) "T" type for 230V.

**INPUT Jacks (Channel 1 and 2):** The INPUT jacks accept either balanced or unbalanced signals. Pins 2 and 3 are symmetrically balanced and floating; thus, either can be used as "HOT" without difficulty. Pin 1 is connected to 168A chassis ground. Nominal input level is +4dBu and clipping level is +24dBu.

**OUTPUT Jacks (Channel 1 and 2):** The OUTPUT jacks are driven by floating active-balanced amplifiers that simulate a true transformer output. This allows the load at the OUTPUT to be either balanced with respect to ground, or single-ended to ground (unbalanced) with very little difference (less than 0.5dB) in the 168A's output level. *For proper unbalanced operation, the unused pin (either pin 2 or 3) MUST be grounded.*

Pins 2 and 3 are symmetrically balanced and floating; thus, either can be used as "HOT" without difficulty. Pin 1 is connected to 168A chassis ground. Nominal output signal level is +4dBu into 600Ω, and typical maximum output signal level is +25dBu into a balanced 600Ω load.



## OPERATING NOTES

### Leveling and Compression (Using the DENSITY, DRIVE and GAIN HOLD Controls)

Use the DENSITY control to set the ratio between leveling (i.e., compression with a slow release time) and compression with a fast release time. The DENSITY control determines the rate of correction, that is, how fast the gain recovers when the audio level drops. Lower rates (settings toward 0) apply a leveling effect that gives a more natural sound texture, but less consistent sound level. These settings are most useful for mixed material. Higher rates (settings toward 10) produce compression with a faster release time. This is useful for single tracks, increasing "punch" and "intelligibility" to substantially change the sound texture, while subtly changing the level of the material. When applied to mixed material, higher settings increase program density and apparent loudness.

The DRIVE control determines the overall amount of gain reduction by setting the signal level going into the gain control circuitry. Turning this control clockwise will increase the input signal, and therefore increase the amount of applied gain reduction. The GAIN HOLD control sets the level (with respect to the 168A's input) below which the gain circuitry will freeze its gain to prevent noise rush-up during pauses and low-level passages.

The 168A's gating function is *not* the same as a conventional "noise gate" because it is not intended to reduce noise or other undesired sounds below the level at which they occur in the original program. Its purpose is to prevent unnatural exaggeration of such material. (If needed, a dedicated expander/gate like the dbx 172 or 274 can be used before the 168A.)

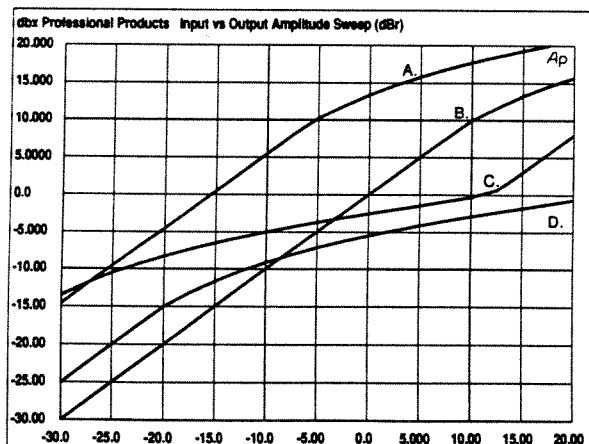
Be careful not to adjust the controls to produce so much gain reduction that the LED at the far left of each GAIN REDUCTION meter lights. When this LED is lit, the Compressor has run out of gain reduction range, the circuitry is being overloaded, and various nastinesses are likely to commence.

Because the 168A uses dbx's OverEasy circuitry to produce a soft-knee compression curve, the 168A's output level increases significantly as the input level increases from 0dB to 20dB. An input level 20dB above the threshold of compression produces 10dB gain reduction, and the 168A's output level is 10dB higher than it was at the threshold of compression.

10dB gain reduction is the end of the OverEasy curve; from 10dB to 30dB gain reduction the compression ratio is fixed at approximately 4.5:1. This 4.5:1 compression ratio retains some of the program's dynamic "feel" while still effectively controlling the level at the 168A's output.

Special circuitry forces the average level at the 168A's output to be approximately constant regardless of the setting of the DENSITY control. (Without this circuitry, the average level would tend to rise as the DENSITY control was advanced clockwise.)

With any setting of the DENSITY control, the release rate in dB/second is constant when there is more than 10dB gain reduction. Below 10dB, the release rate slows progressively.



- A. DRIVE: @ 2:00, OUTPUT: @ 12:00
- B. DRIVE: Fully CCW, OUTPUT: Fully CW
- C. DRIVE: @ 10:00, OUTPUT: Fully CW
- D. DRIVE: @ 12:00, OUTPUT: @ 12:00

Figure 1: Compression Ratio Versus Level

## De-Essing

The De-Esser is a very fast limiter that causes additional gain reduction in the main VCA whenever the amount of high frequency power in the input signal (above about 6kHz) exceeds a preset ratio of the total signal power, as set by the DE-ESSING control. Set the DE-ESSING control so that sibilance levels sound natural and well-balanced with the rest of the program material.

The De-Esser works best with voice that has not been mixed with other program material, because the De-Esser can confuse other sounds in mixed program (like cymbals) with sibilance, causing unnatural and undesired gain reduction. As always, experiment and let your ears determine if a given piece of program material can benefit from the 168A's De-Esser.

Because their short release times preclude stereo imaging problems, the two De-Essers in the 168A operate independently, regardless of the position of the STEREO COUPLE button. This prevents gain reduction in one stereo channel from causing audible "holes" and other modulation effects in the other channel. (When the 168A is in Stereo Couple, Channel 1's DE-ESSING control sets the threshold for both channels.)

The De-Esser controls sibilance by measuring the ratio between the power above 6kHz and the total program power, and by assuming that it has detected an "ess" if this ratio exceeds a threshold set with the DE-ESSING control. This process works over an input range of approximately 20dB; at lower levels it is gated so that the De-Esser does not mistake the normal program noise floor for sibilance and duck it unnaturally.

## Spectral Enhancement

The High Spectral Enhancement circuit constantly analyzes the relative high frequency spectral content of the input program material and dynamically boosts high frequency power as necessary on a moment-by-moment basis. Unlike a fixed equalizer, it does not over-equalize program material that already has enough highs. For example, it is smart enough not to exaggerate sibilance in voices, yet it equalizes other components of the vocal sound to significantly improve presence and intelligibility.

When you record tracks in the production studio, you usually set the HIGH SPECTRAL ENHANCEMENT control in the area between 3 and 5. Unlike a conventional fixed equalizer, the setting of this control is surprisingly non-critical because the circuit is always making intelligent decisions about how much equalization is needed at each moment. If the source material is dull-sounding, the circuit will automatically produce large amounts of EQ; if it is very bright, the circuit will create very little additional high frequency boost.

The Low Spectral Enhancement circuit is an equalizer with a specially shaped curve that simultaneously boosts the 80Hz region while cutting at a 250Hz center. Accordingly, it is useful in creating punchy bass (including a "big," chesty, male voice sound) without introducing a muddy or boomy quality in the mid-bass. Adjust it to taste by ear.

In broadcast production, use Low Spectral Enhancement sparingly. Bass frequencies use a great deal of modulation without creating proportional loudness. While a good multiband transmission processor (like an Orban OPTIMOD™) will tend to undo the worst of the damage, nothing takes the place of using this control with care and restraint.

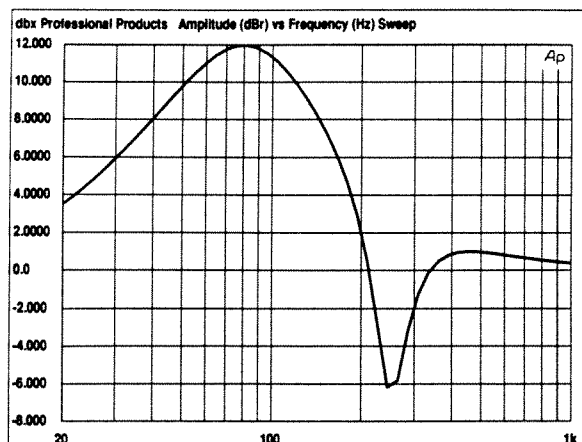


Figure 2: LF Detail Equalization Curve (LF DETAIL at 10)

### Stereo-Tracking and Independent Two-Channel Operation.

The 168A can be used for stereo or independent dual-channel operation. To ensure stable stereo imaging, press the STEREO COUPLE button In (so that the MASTER LED lights). In this mode, all gain reduction caused by the Compressor will track the channel requiring the *greater* amount of gain reduction, and only the Channel 1 operating controls are active (except for the BYPASS button, which controls the Channel 2 hard-wire bypass and which is always available). Additionally, the De-Essers always produce independent amounts of de-essing. However, their thresholds are both set by the Channel 1 DE-ESSING control when the STEREO COUPLE button is pressed In.

When the STEREO COUPLE button is Out, the left and right channels can produce different amounts of gain reduction. This is always appropriate when the 168A is processing independent program material in its two channels (which it can readily do because its interchannel crosstalk is very low). Additionally, uncoupled operation can sometimes benefit recorded material with significant channel imbalance (usually caused by sloppy production practices in broadcast applications). Independent operation of the 168A's Compressor can correct such imbalance, provided that you set the DENSITY control low enough to prevent it from causing major, disturbingly large shifts of the stereo image.

### OUTPUT Level Control and PEAK OUTPUT LEVEL Meter

The PEAK OUTPUT LEVEL meter monitors the peak signal level at the 168A's output and reflects the effect of all operating controls, including the OUTPUT level control. Unlike a quasi-peak meter such as an EBU-standard PPM, the 168A's PEAK OUTPUT LEVEL meter reads absolute, instantaneous peak levels, clearly indicating any clipping that occurs in the signal path. Ordinarily, it is unwise to permit the red LED in the PEAK OUTPUT LEVEL meter to light; if it does, turn the OUTPUT control counterclockwise to eliminate the overload.

## CONNECTING THE 168A TO YOUR SYSTEM

### Basic Connection/Installation

The 168A can be used with any +4dBu line-level device (See below to select for -10dBV operation). Some common examples include: mixing consoles, electronic musical instruments, patch bays, and signal processors. For more specific cabling information, refer to Audio Inputs and Outputs on the following pages.



**Caution:** The installation instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the Operating Controls and Operating Notes sections of this manual unless you are qualified to do so. Refer all servicing to qualified personnel.

For all connections, refer to the following steps:

Allow about 20 minutes for installation. Installation consists of optional resetting of input level jumpers, optional mounting of the 168A in a rack, connecting audio and connecting power.

#### 1. Turn Off all equipment before making any connections.

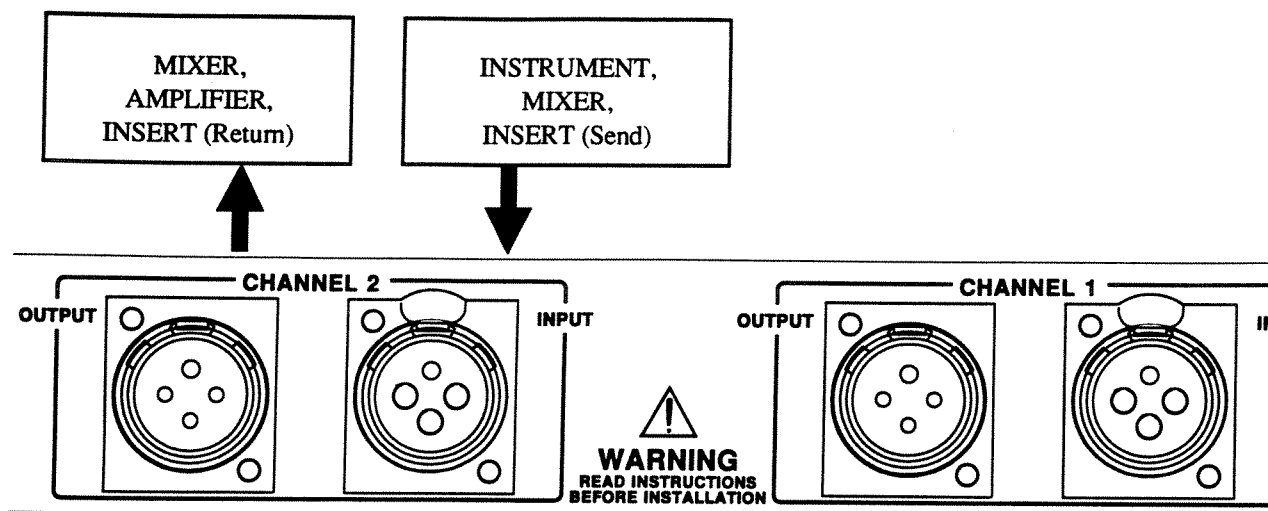


#### 2. Reposition input level jumpers. (Optional)

The 168A is shipped with its input ready for operation with +4 to +8dBu nominal levels. You can move internal jumpers to increase the input sensitivity so that the input will optimally accommodate -10dBV nominal levels.

A. Remove all screws holding the top cover in place, then lift it off.

- B. To operate the input with  $-10\text{dBV}$  nominal levels, reposition jumpers JA, JB, JC, and JD on the main circuit board to the  $-10$  position (see Figure 4).
- C. Replace the top cover. Replace all screws snugly. (Be careful not to strip the threads by fastening the screws too tightly.)



### 3. Mount the 168A in a rack. (Optional)

The 168A requires one standard rack unit ( $1\frac{3}{4}$  inches, 4.4 cm). There should be a good ground connection between the rack and the 168A chassis — check this with an ohmmeter.

Mounting the unit directly over large heat-producing devices (such as a vacuum-tube power amplifier) may shorten component life and is not recommended. Ambient temperature should not exceed  $113^{\circ}\text{F}$  ( $45^{\circ}\text{C}$ ) when equipment is powered.

### 4. Connect audio input and output.

Typical patch points include: a mixer's channel or subgroup inserts when using the 168A on individual instruments or tracks; the mixer's main outputs or bus inserts when mixing; an instrument preamp's effects loop when using the 168A for guitar or bass; main outs of a submixer (e.g., keyboard mixer) as the signal is sent to main mixer; between a DAT's output and an analog cassette input. When using a chain of processors, the 168A may be placed either before or after effects or dynamic processors. We recommend you use common sense and experiment with different setups to see which one provides the best results for your needs.

### 5. Plug in the AC power cable to power On the unit.

- A. Check the line voltage.

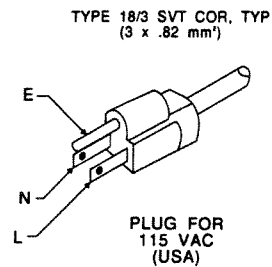
The 168A is shipped for 115V or 230V, 50 or 60Hz operation. Refer to the unit's rear panel to verify your unit's precise line voltage.

- B. Check the value of the fuse and change the fuse if the value is incorrect.

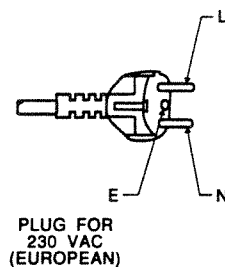
Use a  $\frac{1}{2}$ -amp 3AG 250V Slow Blow fuse for 115V operation; use a  $\frac{1}{4}$ -amp (250mA) "T"-type fuse for 230V operation.

- C. Check power cord.

AC power passes through an IEC-standard mains connector and an RF filter designed to meet the standards of all international safety authorities.



CONDUCTOR		WIRE COLOR	
		NORMAL	ALT
L	LIVE	BROWN	BLACK
N	NEUTRAL	BLUE	WHITE
E	EARTH GND	GREEN-YELLOW	GREEN



CONDUCTOR		WIRE COLOR
L	LIVE	BROWN
N	NEUTRAL	BLUE
E	EARTH GND	GREEN-YELLOW

Figure 3: AC Line Cord Wiring

## Audio Input and Output Cabling

### Wire

We recommend using two-conductor shielded cable (such as Belden 8451 or equivalent), because signal current flows through the two conductors only. The shield does not carry signal, is used *only* for shielding, and is ordinarily connected to ground at one end only.

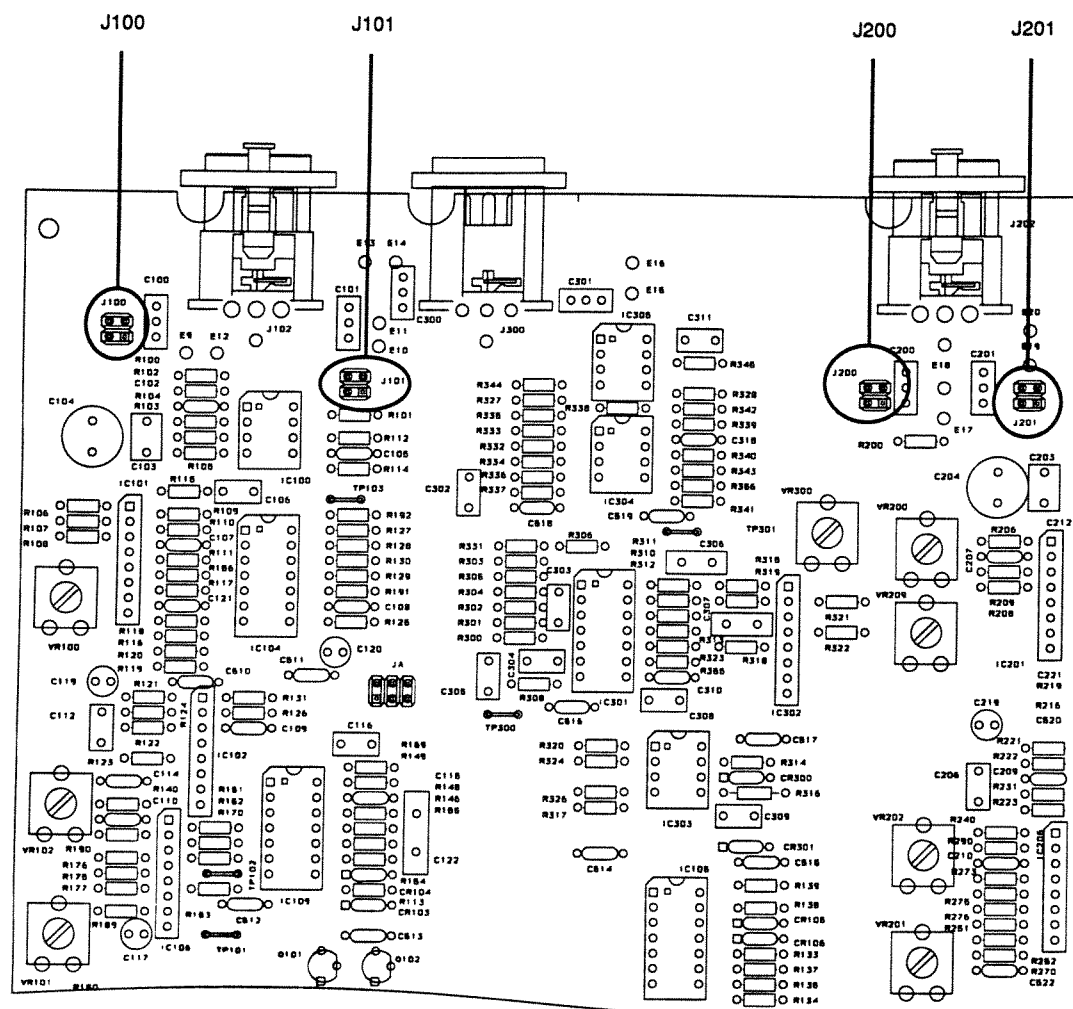
Because use of single-conductor cables virtually eliminates any possibility of carefully controlling the system grounding scheme, it is **NOT RECOMMENDED!** Even so, it often does work adequately in low-RF environments.

Sometimes, particularly if you are using the 168A with musical instruments or home-type equipment, single-conductor shielded cable may be the only practical alternative. In this case, the 1/4" phone to XLR cable should be wired as follows: The TIP (+) of the shielded cable (i.e., the cable's 1/4" phone plug) should be wired to pin 2 of the cable's XLR plug (because the 168A XLR jack is wired Pin 2), the shield of the 1/4" plug should be wired to pin 3 of the XLR plug, and pins 1 and 3 of the XLR plug should be tied (wired) to each other. This cable wiring is applicable for both input and output connections made to the 168A.

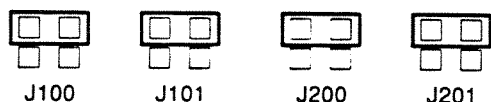
### Connectors

Input and output connectors are XLR connectors.

For the XLR connectors, pin 1 is CHASSIS GROUND, while pin 2 and pin 3 are a balanced, floating pair. This wiring scheme is compatible with *any* studio wiring standard: If one pin is considered COLD, the other pin is automatically HOT.



Jumper Settings  
+4dBu Input Level  
(as Shipped)



Jumper Settings  
-10dBu Input Level

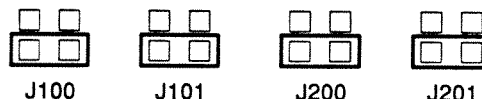


Figure 4: Input Level Jumpers

## Input

The nominal input level is between -10 and +8dBu, selectable in two ranges by jumpers. The absolute overload point is +24dBu.

(0dBu = 0.775Vrms; for this application, the dBm @ 600Ω scale on voltmeters can be read as if were calibrated in dBu.)

- ☐ The electronically-balanced input of each channel is compatible with most professional and semi-professional sound equipment, balanced or unbalanced, with a source impedance of 600Ω or less.

- ☐ Input connections are the same whether the driving source is balanced or unbalanced.
- ☐ Connect the red (or white) wire to the pin on the XLR connector (#2 or #3) that is considered HOT by the standards of your organization. Connect the black wire to the pin on the XLR connector (#2 or #3) that is considered COLD by the standards of your organization.
- ☐ In **low RF fields** (like a studio site), do not connect the cable shield at the 168A input — it should be connected at the source end only. In **high RF fields** (like a transmitter site), also connect the shield to pin 1 of the male XLR connector at the 168A input.
- ☐ If the output of the driving unit is unbalanced and does not have separate CHASSIS GROUND and – (or COLD) output terminals, connect both the shield and the black wire to the common (–) or ground terminal of the driving unit.

## Output

The electronically-balanced and floating output of each channel simulates a true transformer output. The *source* impedance is 30Ω. In addition, there is a 1000pF capacitor between each side of the output (HOT and COLD) to the chassis for RFI suppression. The output is capable of driving loads of 600Ω or higher to +24dBm (balanced) or +21dBm (unbalanced).

If an **unbalanced output** is required (to drive unbalanced inputs of other equipment), it should be taken between pin 2 and pin 3 of the XLR connector. Connect the COLD pin of the XLR connector (pin 2 or 3, depending on your organization's standards) to circuit ground, and take the HOT output from the remaining pin. No special precautions are required even though one side of the output is grounded

- ☐ Use two-conductor foil-shielded cable (Belden 8451, or equivalent).
- ☐ At the 168A's output (and at the output of other equipment in the system), connect the cable's shield to the CHASSIS GROUND (pin 1) on the XLR connector. Connect the red (or white) wire to the pin on the XLR connector (#2 or #3) that is considered HOT by the standards of your organization. Connect the black wire to the pin on the XLR connector (#3 or #2) that is considered COLD by the standards of your organization.

## Grounding

Very often, grounding is approached in a "hit or miss" manner. But with care it is possible to wire an audio studio so that it is free from ground loops (which induce hum and can cause oscillation) and provides maximum protection from power faults.

- ☐ All units in the system must have *balanced inputs*. In a modern system with low output impedances and high input impedances, a balanced input will provide common-mode rejection and prevent ground loops — regardless of whether it is driven from a balanced or unbalanced source. (The 168A has balanced inputs.)
- ☐ All equipment *circuit grounds* must be connected to each other; all equipment *chassis grounds* must be connected together.
- ☐ In low RF fields, *cable shields* must be connected at one end only — preferably the source (output) end.
- ☐ In high RF fields (such as transmitter sites), cable shields must be connected to a solid earth ground at both ends to maximize their RF shielding. This means that all equipment in such environments must have balanced inputs to prevent the ground loops that could otherwise be introduced.

## Power

- ☐ Ground the 168A chassis through the third wire in the power cord. Proper grounding techniques *never* leave equipment chassis unconnected to power/earth ground. *A proper power ground is essential to safe operation.* Lifting a chassis from power ground is a safety hazard. If there is a power fault to the chassis, death could result!

## Difficult Situations

Because it is not always possible to determine if the equipment driving or being driven by the 168A has its circuit ground internally connected to its chassis ground (which is always connected to the ground prong of the AC power cord, if present), and because the use of the AC power ground often introduces noise or other imperfections such as RFI, hum, clicks, and buzzes, the wiring techniques in Fig 5 are not universally applicable.

If you follow Figure 5 and hum or noise appears, don't be afraid to experiment. If the noise sounds like a low-level crackling buzz, then probably there isn't *enough* grounding. Try connecting the COLD pin on the 168A's XLR connector to ground and see if the buzz goes away. Either pin 3 or pin 2 will work as the COLD pin; the choice depends only on your organization's standards.

A ground loop usually causes a smooth, steady hum rather than a crackly buzz. If you have a ground loop, think carefully about what is going on, and keep in mind the general principle: one and *only one* circuit ground path should exist between each piece of equipment!

When a single-conductor shielded cable is used for audio connections, the shield will ordinarily receive chassis ground from the external equipment which it is connecting to the output of the 168A. To minimize hum or buzz, it may be necessary to connect pins 1 and 3 of a cable's XLR plug. This applies to both input and output connections.

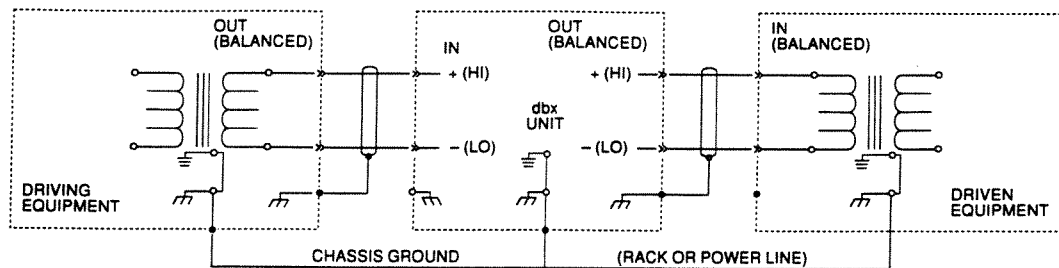


Figure 5: Suggested Ground Scheme

## TECHNICAL SUPPORT, FACTORY SERVICE

### Technical Support, Factory Service

The 168A is an all-solid-state product with components chosen for high performance and excellent reliability. Each 168A is tested, burned in and calibrated at the factory and should require no internal adjustment throughout the life of the unit. We recommend that your 168A be returned to the factory only after referring to the manual and consulting with Customer Service.

Our phone number, fax number and address are listed on the inside front cover. When you contact dbx Customer Service, be prepared to accurately describe the problem. Know the serial number of your unit — this is printed on a sticker attached to the rear panel.

**Note:** Please refer to the terms of your Limited Two-Year Standard Warranty, which extends to the first end-user. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing if you choose to use the factory service facility. In all cases, you are responsible for transportation charges to the factory. dbx will pay return shipping if the unit is still under warranty.

**Shipping Instructions:** Use the original packing material if it is available. Mark the package with the name of the shipper, and with these words in red: DELICATE INSTRUMENT, FRAGILE! Insure the package properly. Ship pre-paid, not collect. Do not ship parcel post.

### Registration Card and User Feedback

We appreciate your feedback. After you have an opportunity to use your new 168A, please complete the Registration Card (located at the back of this manual), detach it from the manual and return it.



## MAINTENANCE

### Servicing Note



**Important:** The servicing instructions in this manual are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the Operating Controls and Operating Notes section of this manual unless you are qualified to do so. Refer all servicing to qualified service personnel.

### Getting Inside the Chassis

The 168A has two circuit boards: a main board containing almost all audio circuitry and the power supply, and a piggyback board behind the front panel containing the display circuitry.



1. Access the circuit boards by removing the seven screws holding the top cover in place, then lift it off.
2. Access the solder side of the main circuit board by removing the board from the chassis. Refer to the following steps.
  - A. Remove the primary and secondary transformer lead power plugs from their board-mounted connectors. To remove the primary plug, you must release its lock; squeeze in both sides of the plug and pull the plug out from its connector. Note where both plugs go so you can reassemble the unit correctly later.
  - B. Remove the push-on knobs from the front panel by pulling them firmly away from the panel.
  - C. Unlock the XLR-type connectors by turning each connector's locking device with a small screwdriver.
  - D. Unfasten the piggyback display board by removing the three screws that hold the board in place (Use a Phillips screwdriver). Then lift off the board.
  - E. Loosen the four Allen-head screws that hold the front panel in place, then set the front panel aside.
  - F. Remove the three screws that fasten the main circuit board (Use a Phillips screwdriver).
  - G. Lift the circuit board out of the chassis.
3. Reassemble the unit by following the above instructions in reverse order.
 

When replacing the covers, replace all screws snugly. (Be careful not to strip the threads by fastening the screws too tightly.)

### Alignment and Performance Evaluation

These instructions are for thoroughly checking the performance of the 168A. The evaluation includes checks of the Power Supplies, Balanced Output Amplifier, Compressor, De-Esser, HF Enhancer, Gain Hold, LF Enhancer and Stereo Coupling.

This procedure is useful in detecting and diagnosing problems, and for routinely checking performance.

See assembly drawings in the back of this manual for locations of components, jumpers, and test points. *All jumpers and test points are located on the main circuit board.*

Perform procedures in order without skipping steps. The following equipment is required:

Oscilloscope:	DC-coupled, with at least 5MHz vertical bandwidth.
Digital voltmeter:	Accurate to 0.1%.
Audio voltmeter:	Accurate to 2%. Audio Precision System 1, Sound Technology 1710B (or equivalent) preferred.
Low-distortion audio oscillator:	With verified residual distortion below 0.003%. Audio Precision System 1, Sound Technology 1710B (or equivalent) preferred.
THD analyzer:	With verified residual distortion below 0.003%. Audio Precision System 1, Sound Technology 1710B (or equivalent) preferred.

**1. Remove the top cover.**

- A. Remove the seven screws that hold the top cover in place, then lift off the top cover.

**2. Record all Control and Internal Jumper Settings.****3. Check Power Supplies.**

- A. Verify the following resistances:

Between:	And:	Resistance:
Power cord ground pin	Chassis	Short circuit
Each of the power cord blades	Chassis	Open circuit
One power cord blade	The other blade	36Ω (for a 115V unit) 140Ω (for a 230V unit)

- B. Power the unit.

- C. Verify that the negative unregulated power rail is between -18V and -26V, and that the positive unregulated power rail is between +18V and +26V.

Measure the negative unregulated voltage across C505 and the positive unregulated voltage across C504.

- D. Verify that the outputs of the  $\pm 15V$  regulators are  $15.00V \pm 0.75V$ .

Measure the negative regulated voltage across C506 and the positive regulated voltage across C507. The positive regulated voltage can also be measured between ground and pin 8 of any 8-pin IC on the circuit board; the negative regulated voltage appears at pin 4.

- E. Verify with an oscilloscope that the noise and ripple on the regulated power supply rails is below 4mV peak.

- F. Set the Channel 1 and 2 controls as follows:

DRIVE	0
DENSITY	0
GAIN HOLD	0
DE-ESSING	0
LOW SPECTRAL ENHANCEMENT	0
HIGH SPECTRAL ENHANCEMENT	0
OUTPUT	10
STEREO COUPLE	Off

**4. Balanced Output Amplifier Test.**

- A. Connect a 600Ω resistor between pins 2 and 3 of the Channel 1 output connector.

A 620Ω 1/2-watt resistor will do.

- B. Using the DC voltmeter, verify that the DC voltage between pins 2 and 3 of the Channel 1 output connector is less than 100mV.

There should be no signal applied to the inputs.

- C. Connect pin 1 to pin 3. Verify that the DC voltage between pins 1 and 2 of the Channel 1 output connector is less than 50mV.

- D. Connect pin 1 to pin 2. Verify that the DC voltage between pins 1 and 3 of the Channel 1 output connector is less than 50mV.

- E. Verify (with an oscilloscope) that both pin 2 of the Channel 1 output connector and pin 3 of the Channel 1 output connector are free of "popcorn" noise or oscillation when observed against ground.
- F. Repeat steps 4-A through 4-E for Channel 2.

## 5. Compressor Test.

- A. Connect the audio oscillator between pins 2 and 3 of the Channel 1 input connector.

If the oscillator output is unbalanced, ground pin 3.

- B. Set the oscillator's frequency to 1kHz and its output level to +11dBu.

0dBu = 0.775Vrms. The dBm/600Ω scale commonly found on test instruments can be read as dBu for this application.

- C. Connect a THD analyzer, audio voltmeter, and oscilloscope to the 168A's output.

- D. Center VCA SYMMETRY trimmer VR100.

- E. Trim the audio oscillator's output level to make the audio voltmeter read +10dBu.

- F. Verify that the -15dB segment of the PEAK OUTPUT LEVEL meter lights, and that the output signal is a sine wave of normal appearance.

- G. Set the BYPASS 1 switch out. Verify that the BYPASS lamp turns Off and changes to green, and that approximately +11dBu (the oscillator's output) appears at the 168A's output connector.

The BYPASS 1 switch creates a hard-wire bypass when it is out and its associated BYPASS lamp is Off.

- H. Press the BYPASS 1 switch in.

Verify that the BYPASS lamp turns On.

- I. Adjust VCA SYMMETRY trimmer VR100 for minimum THD at the 168A's output.

Verify that THD is below 0.05% in a 20Hz to 20kHz bandwidth.

- J. Verify that THD is below 0.05% in a 20Hz to 20kHz bandwidth with the audio oscillator set to 20Hz, 2kHz, and 20kHz and the 168A's output level at +10dBu.

- K. Turn the DRIVE control clockwise until you observe clipping at the 168A's output.

This requires saturating the Compressor control loop, so all segments of the GAIN REDUCTION meter should be lit. Verify that this is true.

- L. Verify that the output level is at least +23.5dBu when you first see clipping and that all segments of the PEAK OUTPUT LEVEL meter are lit.

This test will only be successful if the 168A's output load is balanced. If one side of the 168A's output is grounded, the maximum output level before clipping is typically +21dBu and you will see the output clip slightly before the 0dB lamp on the PEAK OUTPUT LEVEL meter lights.

- M. Adjust the DRIVE control to make the GAIN REDUCTION meter indicate 27dB of gain reduction.

- N. Mute the oscillator and measure the time interval between the mute and when the 9dB lamp in the GAIN REDUCTION meter turns Off.

This time should be 13 seconds ±2 seconds.

- O. Reset the DRIVE control to 0.

Verify that no segments of the GAIN REDUCTION meter are lit.

- P. Measure the noise at the output in a 20-20kHz bandwidth.

The noise should be less than  $-82\text{dBu}$ . Verify that there is no "popcorn" noise or oscillation.

- Q. Repeat the above test of the Compressor for Channel 2.

**Substitute:**

**For:**

VR200

VR100

## 6. De-Esser and HF Enhancer Test and Alignment.

- A. Unmute the oscillator and set its frequency to 1kHz.

The oscillator level should still be set so that the 168A's output level is  $+10\text{dBu}$ .

- B. Observe TP100 (pin 7 of IC107) with the oscilloscope, AC-coupled. Adjust VR108 so that the waveform is as close as possible to pure second-harmonic (2kHz).

- C. Decrease the oscillator output level by 20dB (to approximately  $-4\text{dBu}$ ).

The exact level is not critical.

- D. Observe TP101 (pin 7 of IC106) with the oscilloscope, AC-coupled. Adjust VR102 so that the waveform is as close as possible to pure second-harmonic.

- E. Set the oscillator frequency to 20kHz and its level to make the level at the 168A's output  $+10\text{dBu}$ .

The oscillator's output level should be approximately  $+11\text{dBu}$ .

- F. Set the DE-ESSING control to 10.

- G. Adjust VR101 so that the 168A's output level is  $-8\text{dBu}$ .

- H. Set the oscillator frequency to 4kHz. Verify that the 168A's output level increases to  $+2.5\text{dBu} \pm 1\text{dB}$ .

This verifies the operation of the high-pass filter before IC107.

- I. Set the DE-ESSING control to 0.

- J. Set the HIGH SPECTRAL ENHANCEMENT control to 10.

Verify that the output level increases to  $+17\text{dBu}, \pm 1\text{dB} @ 4\text{kHz}$ .

- K. Adjust VR300 to minimize the THD at the 168A's output.

The THD should be less than 0.05%.

- L. Set the HIGH SPECTRAL ENHANCEMENT control to 0.

- M. Repeat the above test of the De-Esser and HF Enhancer circuits for Channel 2.

**Substitute:**

**For:**

TP200 (IC207 pin 7)

TP100 (IC107 pin 7)

TP201 (IC206 pin 7)

TP101 (IC106 pin 7)

VR400

VR300

VR201

VR101

VR202

VR102

VR208

VR108

**7. Gain Hold Circuit Test.**

- A. Set the GAIN HOLD control to 5.
- B. Reduce the output level of the oscillator until the GAIN HOLD light turns On.  
Verify that the 168A's output level is  $-16\text{dBu} \pm 4\text{dB}$ .
- C. Set the GAIN HOLD control to 0.  
Verify that the GAIN HOLD lamp turns Off.
- D. Repeat the above test of the Gain Hold circuit for Channel 2.

**8. LF Enhancer Test.**

- A. Set the oscillator frequency to 80Hz, and set its level to produce 0dBu at the 168A's output.
- B. Set the LOW SPECTRAL ENHANCEMENT control to 10.  
Verify that the 168A's output level increases to  $+12\text{dBu} \pm 2\text{dB}$ .
- C. Set the oscillator frequency to 250Hz.  
Do not change its output level.  
Verify that the 168A's output level decreases to  $-6\text{dBu} \pm 1\text{dB}$ .
- D. Set the LOW SPECTRAL ENHANCEMENT control to 0.
- E. Repeat the above test of the LF Enhancer circuit for Channel 2.

**9. Channel 2 Balance Adjustment.**

- A. Set the STEREO COUPLE switch to On.  
Make sure that the Channel 2 controls are still set as in step 3-F.
- B. Connect the oscillator to the 168A's Channel 2 input.
- C. Connect the AC voltmeter to the 168A's Channel 2 output. Adjust VR209 (ADJUST Channel 2 BALANCE) so that the meter indicates +10dBu.

**10. Stereo Coupling Test.**

- A. Verify that the STEREO COUPLE switch is On.  
Continue to drive the Channel 2 input and to observe the Channel 2 output. To test the stereo coupling function, you will verify that, with the STEREO COUPLE switch set to On, you can use the Channel 1 operating controls to control the Channel 2 processing circuitry.
- B. Advance the Channel 1 DRIVE control clockwise until you see the Channel 1 and Channel 2 GAIN REDUCTION meters indicate that gain reduction is occurring.  
Verify that both meters read identically. Verify that the Channel 2 output level increases approximately 3dB as you increase the gain reduction from approximately 12dB to 25dB G/R.
- C. Set the Channel 1 GAIN HOLD control to 5.

- D. Mute the oscillator.

Verify that both GAIN HOLD lamps turn On and that the readings of the GAIN REDUCTION meters do not change.

- E. Restore the oscillator.

- F. Set the Channel 1 DRIVE control to 0.

- G. Set the oscillator frequency to 4kHz. Do not change the level.

- H. Set the Channel 1 DE-ESSING control to 10.

Verify that the level at the 168A's output decreases to  $+2.5\text{dBu} \pm 2\text{dB}$ .

- I. Set the Channel 1 DE-ESSING control to 0.

- J. Set the Channel 1 HIGH SPECTRAL ENHANCEMENT control to 10.

Verify that the level at the Channel 2 output increases by approximately 7dB.

- K. Set the Channel 1 HIGH SPECTRAL ENHANCEMENT control to 0.

- L. Set the oscillator frequency to 250Hz. Do not change the level.

- M. Set the Channel 1 LOW SPECTRAL ENHANCEMENT control to 10.

Verify that the level at the Channel 2 output decreases by approximately 6dB.

- N. Set the Channel 1 LOW SPECTRAL ENHANCEMENT control to 0.

- O. Decrease the setting of the Channel 1 OUTPUT control, and verify that the level at the Channel 2 output decreases accordingly.

This concludes testing the stereo coupling function.

- P. Disconnect all test instruments from the 168A.

#### 11. Restore controls and internal jumpers to your desired operating settings.

Return all controls and jumpers to the positions recorded in step 2.

#### 12. Replace the top cover.

Replace the seven screws that hold it in place.

## PROBLEMS AND POSSIBLE CAUSES

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Always verify that the problem is not in the source material being fed to the 168A, or in other parts of the system.

### RFI, Hum, Clicks, Or Buzzes

Check grounding. (Review the information on grounding on page 12.)

The 168A's moderate RF suppression should suffice in most installations. However, installation next to a high-power transmitter could still cause problems. Additional RF suppression, careful examination of the grounding scheme, and other techniques familiar to the broadcast engineer may be required. In particular, the 168A's RF suppression is maximally effective above 10MHz, and installation at a powerful LW and MW (AM) site might require additional suppression (such as a  $0.01\mu\text{F}$  ceramic disk capacitor between pins 1 and 3 of the input XLR connector, and another  $0.01\mu\text{F}$  capacitor between pins 2 and 3 of the XLR connector).

### Power Supply Problems

The voltage regulators are operated conservatively and can be expected to be reliable. Before replacing the regulators, check to see whether other abnormalities in the circuitry (such as a shorted IC) have caused excessive current demand which is causing the regulator ICs to either current limit or go into thermal shutdown (their two built-in protective modes). If it becomes necessary to replace a regulator, be sure to replace its heat dissipator properly.

Regulators IC512 and IC513 are frequency-compensated by C506, C507 at their outputs to prevent high-frequency oscillations. If C506 or C507 is ever replaced, be sure to use a low-inductance aluminum electrolytic. (A tantalum can fail because the current-delivering capacity of the power supply can cause a runaway condition if the dielectric is punctured momentarily; a high-inductance aluminum can fail to prevent a regulator from oscillating.) Check for oscillation on the power bus with an oscilloscope if C506 or C507 is replaced.

### Noise Pumped Up During Pauses

The GAIN HOLD control is probably set too low. Set it so that the GAIN HOLD lamp turns On during pauses.

### Audible Distortion

First make sure that the program material presented to the 168A's inputs is clean and distortion-free.

If the GAIN REDUCTION meters display 30dB of gain reduction, reduce the amount of gain reduction by turning the DRIVE control more counterclockwise. If the PEAK OUTPUT LEVEL meters' red segments are lighting, reduce the output level by turning the OUTPUT control more counterclockwise.

Setting the DENSITY control higher than 5 can sometimes cause audible distortion in the bass because the very fast release time begins to modulate each individual cycle of the bass waveform. If this occurs, turn down the DENSITY control. (Special circuitry in the 168A greatly reduces this effect by comparison to many other compressors operated at equally fast release times.)

If peak input levels at the 168A's input exceed +24dBu, this will clip the input stage.

### De-Esser Causes Pumping or Distortion

The De-Esser is a wideband circuit that causes quick gain reduction of the entire program. If it is used to excess (particularly with mixed program material) it can have undesirable audible side effects. The De-Esser is most effective on voice that has not been mixed with other program material. It is far better to de-ess unmixed voice than to wait until the voice has been mixed with other material and then try to salvage the track.

Excessive leakage on the vocal track could cause the De-Esser to mis-behave. In this instance, try gating the track before the 168A.

### HF Spectral Enhancer Causes Excessive Noise

The High Frequency Spectral Enhancer tries to estimate how much high frequency boost is appropriate for a given piece of program material. If the program is dull but noisy (like a bad cassette), the HF Spectral Enhancer will try to make it brighter and can pull up hiss to objectionable levels. (The hiss will often be audibly modulated by the program because the HF Spectral Enhancer is program-adaptive.) The only option is to reduce the setting of the HIGH SPECTRAL ENHANCER control until the effect is no longer objectionable.

The AKG Acoustics group of companies manufactures several processors that are more suitable for this type of low-quality material because they also have built-in dynamic single-ended noise reduction circuits. The dbx Project 1 296 features hiss reduction and Spectral Enhancement at a lower price. The dbx 563X and 929 "Silencers™" provide over 30dB of hiss reduction only.

### Channel 2 Operating Controls Do Not Work In Stereo Mode

This is similar to most 2-channel dbx products. In Stereo mode, the 168A's Channel 1 operating controls affect both Channels 1 and 2 and the Channel 2 controls do nothing. The only exception is the BYPASS switches, which are always independent. Because the De-Essers always *operate* independently (even though their thresholds are both controlled by the Channel 1 DE-ESSING control in stereo mode), the Channel 1 and 2 De-Essers will often show different amounts of gain reduction even in stereo mode.

## SPECIFICATIONS

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**Note:** 0dBV = 1.0Vrms; 0dBu = 0.775Vrms

Specifications are subject to change.

### Performance

**Frequency Response (20-20kHz):**  $\pm 0.25$ dB below Compressor and De-Esser Thresholds (HIGH SPECTRAL ENHANCEMENT and LOW SPECTRAL ENHANCEMENT Off)

**RMS Noise (20-20kHz):**  $> 106$ dB (108dB typical) below output clipping (HIGH SPECTRAL ENHANCEMENT and LOW SPECTRAL ENHANCEMENT Off).

**Interchannel Crosstalk:** Better than  $-80$ dB, 20-20kHz.

### Audio Input

**Impedance:**  $> 10$ k $\Omega$ , active balanced, EMI-suppressed.

**Operating Level:** Usable with  $-10$ dBV to  $+8$ dBu lines. (2 ranges — selectable by internal jumpers)  
(0dBu = 0.775Vrms; for this application, the dBm @ 600 $\Omega$  scale on voltmeters can be read as if were calibrated in dBu.)

**Connectors:** Female XLR. Pin 2 and 3 are symmetrically balanced and floating; thus, either can be used as "HOT" without difficulty.

### Audio Output

**Impedance:** 30 $\Omega$ ,  $\pm 5\%$  electronically balanced and floating to simulate true transformer output. Minimum load impedance is 600 $\Omega$ . Output can be unbalanced by grounding pin 2 or 3 of output XLR.

**Level:** Front-panel controls allow use with  $-10$ dBm to  $+8$ dBm systems. Output clipping level is  $> +20$ dBm @ 600 $\Omega$  (unbalanced load);  $> +23.5$ dBm @ 600 $\Omega$  (balanced load).

**Connectors:** Male XLR. Pin 2 and 3 are symmetrically balanced and floating; thus, either can be used as "HOT" without difficulty.

### Compressor

**Attack Time:** Program-dependent:  $> 1$  Second for very small increases in level, decreasing to approximately 10mS for large increases

**Release Time:** Adjustable between approximately 1dB/sec and 75dB/sec, program-dependent.

**Compression Ratio** OverEasy<sup>®</sup> curve provides constantly increasing ratio as input level increases from 0dB to 20dB above threshold. For input levels beyond 20dB above threshold, ratio exceeds 4:1.

**Range of Gain Reduction:**  $> 30$ dB.

**Interchannel Tracking:**  $\pm 0.5$ dB (with STEREO COUPLE active; button pressed in).

**Total Harmonic Distortion (+10dBu Output Level):**  $< 0.05\%$  at 1kHz (with HIGH SPECTRAL ENHANCEMENT and LOW SPECTRAL ENHANCEMENT Off, DENSITY at 0 and 15dB gain reduction). Typically  $< 0.05\%$  20-20kHz. (As with any compressor, low frequency distortion will rise as the release time decreases.)

**SMPTE Intermodulation Distortion (+10dBu Output Level):**  $< 0.08\%$  (60/7,000Hz 4:1 with 15dB gain reduction; DENSITY control at 0).

**Gain Reduction Element:** dbx 2155 VCA.



**De-Esser**

**Characteristic:** The De-Esser performs quick, wideband gain reduction whenever the ratio of power above approximately 6kHz to the total signal power exceeds a threshold set by the user with the DE-ESSING control.

**Distortion:** The De-Esser uses the same VCA as the Compressor and therefore adds no significant distortion to the system specification.

**Release Time:** Approximately 30ms, program-dependent.

**Interchannel Coupling:** Each channel's De-Esser operates independently at all times (the use of fast release times precludes disturbances of the stereo image's stability).

**High Frequency Spectral Enhancer**

**Characteristic:** The HF Spectral Enhancer is a program-controlled shelving equalizer. Its control circuit monitors the relative high frequency power content of the program and dynamically adjusts the equalization to make this high frequency content more consistent at the HF Spectral Enhancer's output.

**Maximum HF Boost:** Approximately 15dB.

**Total Harmonic Distortion:** The HF Spectral Enhancer will add no more than 0.05% THD to the program material present at its input. (Because it receives the output of the Compressor and De-Esser, it will amplify any harmonics generated in this earlier circuitry as would any other HF equalizer.)

**Noise:** The noise floor of the HF Enhancer circuit itself at maximum boost is more than 106dB below its output clipping level, and is determined by the dbx 2155 VCA that it uses as a variable-gain element. (Because it receives the output of the Compressor and De-Esser, it will amplify any noise generated in this earlier circuitry as would any other HF equalizer.)

**Low Frequency Spectral Enhancer**

**Characteristic:** The LF Spectral Enhancer is a fourth-order equalizer with a bell-shaped boost at 80Hz and a bell-shaped cut at 250Hz. The ratio between the boost and cut (in dB) is approximately 2:1. The LOW SPECTRAL ENHANCEMENT control determines the absolute amount of boost and cut, 0 to +12dB. (see Figure 2.)

**Noise and Distortion:** The noise and distortion introduced by the LF Spectral Enhancer are well below noise and distortion introduced by the rest of the 168A's circuitry.

**Physical**

**Dimensions:** 19" (48.3 cm) wide, 10<sup>3</sup>/<sub>8</sub>" (26.4 cm) deep, 1<sup>3</sup>/<sub>4</sub>" (4.5 cm) high.

**Operating Temperature Range:** 32-113°F (0-45°C).

**Humidity:** 0-95% RH, non-condensing.

**Power Requirements:** 115/230 volts AC ±10%, 50-60Hz, 16VA. IEC-standard detachable mains cord. EMI-suppressed.

**Fuse:** Use a 1/2-amp 3AG 250V Slow Blow fuse for 115V operation; use a 1/4-amp (250mA) "T"-type fuse for 230V operation.

**Warranty**

**Two Year, Parts and Labor:** Subject to the limitations set forth in dbx's Standard Warranty Agreement.

## CIRCUIT DESCRIPTION

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On the following pages, a detailed description of each circuit's function is accompanied by a component-by-component description of that circuit. Keywords are highlighted throughout the circuit descriptions to help you quickly locate the information you need.

The circuitry is described in eight major blocks: Input Buffer, VCA (Voltage-Controlled Amplifier), Compressor, De-Esser, High Frequency Enhancer, Low Frequency Enhancer, Metering, and Power Supply.

Whenever circuitry is duplicated for the left and right channels, only the left channel will be described (except for details of the Stereo Coupling function).

### 1. Overview

The block diagram on page 38 illustrates the following overview of 168A circuitry.

The 168A signal path consists of a differential line receiver, a main VCA, a summing amplifier that adds the output of the main VCA to signals that create the high frequency and low frequency enhancement, and a balanced output buffer.

Low Frequency Enhancement is created by adding the output of a special filter circuit to the output of the main VCA.

The 168A control circuitry consists of a Compressor, De-Esser, and High Frequency Enhancer. The Compressor and De-Esser control signals (which are in dB-linear form) are summed and drive the main VCA. The High Frequency Enhancer control signal drives the enhancement VCA, which is fed from a high-pass filter, and whose output is summed with the output of the main VCA.

### 2. Input Buffer.

The signal enters the 168A in balanced form, receives modest RF suppression, and is then applied to a very low-noise opamp configured as a differential amplifier whose gain can be strapped for  $-2.8\text{dB}$  or  $+8.9\text{dB}$ . When both non-inverting and inverting inputs are driven by a source impedance that is small with respect to  $10\text{k}\Omega$  (as  $600\Omega$  or less would be), the amplifier is essentially insensitive to signal components that appear equally on the non-inverting and inverting inputs (such as hum), and responds with full gain to the difference between the non-inverting and inverting inputs. It therefore serves as an "active transformer."

#### Component-Level Description:

C100, C101 are integrated LC filters that remove most RF from the input leads to the chassis. Although this RF suppression is modest, it should be adequate for the vast majority of installations.

Opamp IC-100A receives the filtered signal. This opamp will overload if its differential input exceeds approximately  $+24\text{dBu}$  ( $0\text{dBu} = 0.775\text{Vrms}$ ; for this application, the  $\text{dBm}$  @  $600\Omega$  scale on voltmeters can be read as if were calibrated in  $\text{dBu}$ ).

### 3. Voltage-Controlled Amplifiers.

The voltage-controlled amplifier (VCA) used in the 168A is a low-noise dbx VCA. Its gain (in  $\text{dB}$ ) is proportional to the voltage applied to its gain control port. It is a current in/current out device, so its input is a virtual ground and its output must be applied to a current-to-voltage converter circuit.

#### Component-Level Description:

If IC101 is not perfectly balanced, "thumps" due to control current feedthrough can appear at its output. These are eliminated by applying DC offset to IC101 through R108 and VCA SYMMETRY control VR100.

The gain of IC101 is determined by the sum of (1) a fixed voltage produced by the

DRIVE control VR104, (2) a fixed voltage produced by the OUTPUT control VR103, (3) the Compressor control voltage appearing at output of IC105-D, and (4) the De-Esser control voltage appearing at the output of IC109-C. IC104-B sums all but the De-Esser control voltage.

C107 bypasses the gain control port of IC101 to prevent oscillation and possible noise contamination of the control signal.

IC100-B is a current-to-voltage converter that receives IC101's output current and outputs a proportional voltage. Servo IC104-A removes any DC offset at IC104-B's output.

#### 4. Compressor Control.

The Compressor is a hybrid feedback/feedforward circuit (patent pending). The Compressor's level detector is itself a feedback-type compressor containing a separate VCA. This "pilot compressor" is used only to develop a control voltage that is processed before being applied to the main audio VCA. (The audio passing through the second VCA is used only to develop the feedback control signal and is not applied to the audio path of the 168A.) The output of the second VCA is looped back to a level detector and smoothing circuit, which develops a gain-control signal that is applied to the second VCA, closing the feedback loop. This gain control signal is further filtered and then passed through a "soft knee" generating circuit before its application to the main audio VCA.

The Compressor timing circuit generates a control signal that enables the 168A to achieve natural-sounding control and very low modulation distortion. The DENSITY control allows a 75:1 variation in the basic release dynamics, which are determined by the timing circuit based on the history of the input. Recovery can be halted by the Gain Hold gating circuit, which freezes the release process if the input level falls below a level set by the GAIN HOLD control.

In stereo mode, both channels of the pilot compressor use Channel 1's front-panel operating controls and control circuitry. The output of the Channel 2 pilot VCA is applied to a second pair of comparators, whose outputs are ORed with the outputs of the comparators receiving the Channel 1 audio and then applied to the Channel 1 timing circuit. The gain control port of the Channel 2 pilot VCA is switched to receive the same control voltage as the Channel 1 pilot VCA. In turn, the gain control port of the Channel 2 main audio VCA is switched to receive the same Compressor control voltage as the Channel 1 main audio VCA. (The De-Essers remain independent to prevent de-essing in one channel from punching audible "holes" in the other channel's audio.)

The GAIN REDUCTION meter consists of ten comparators with open collector outputs. The ten LEDs in the meter are connected in series, and a current source forces a constant current into the LED string. As the input voltage to the comparators decreases, they progressively shunt to the -15 volt rail the current that would ordinarily flow through the LEDs, turning Off all LEDs closer to the -15 volt rail. The comparators are biased with equal voltage increments, producing a meter whose scale is linear. (Because the gain control voltage is linear in dB, this produces a dB-linear meter scale.)

##### Component-Level Description:

VCA IC102 receives the input signal. IC104-C translates the output current of VCA IC102 into a voltage, which is applied to comparators IC108-A and IC108-B. Resistors R142, R143, R144 create positive and negative reference voltages that determine the threshold of the comparators and thus, the threshold of compression.

The outputs of IC108 are open-collector transistors. They force a current through R145, which is mirrored at the collector of Q100, a common-base amplifier. The timing circuit receives this current and produces a well-smoothed control voltage output at the output of buffer IC105-B. Buffer IC105-A produces a control voltage suitable for application to the gain control input of IC102, closing the compression feedback loop. The gain control input of IC102 also receives the output of DRIVE control VR104 and, through buffer IC109-A, control VR105.

The DRIVE control applies a fixed gain control signal to IC102, attempting to adjust its gain. However, the Compressor feedback loop ensures that the output level of

IC102 stays roughly constant. So the more gain that the DRIVE control attempts to force IC102 to produce, the more gain reduction is produced by the Compressor. Thus the DRIVE control determines the amount of gain reduction in the Compressor.

Through current source Q102, control VR105 determines the average amount of current removed from the timing circuit (and thus the release speed). Pulling Q102's collector to  $-15\text{V}$  (through IC110-A) diverts the release current from the timing circuit, defeating the release process and freezing the gain.

OverEasy circuit IC105-C, IC105-D receives the output of the timing circuit and generates a soft-knee compression characteristic by progressively increasing its gain as its input increases. The circuit is arranged so that 20dB of gain reduction in the pilot compressor circuit becomes 10dB gain reduction at the output of the OverEasy circuit. Beyond this, the compression ratio becomes approximately 4.5:1. CR105 generates the increasing gain as it conducts more and more heavily with increasing input. CR106 and associated components provide temperature compensation.

IC104-B sums the output of the OverEasy circuit with fixed offset voltages from the DRIVE and OUTPUT controls. The output of IC104-B is summed with the output of the De-Esser (IC109-C) and applied to the gain control port of IC101. The output of IC104-B also feeds the STEREO COUPLE switch. When the unit is in stereo mode, the output of IC104-B thus determines the gain of both Channels 1 and 2 (other than de-essing; the De-Essers remain independent because the De-Esser control voltage is summed with the output of IC104-B directly at the gain control port of IC101).

The gain-holding gate is activated when the output of IC110-A is negative, and defeated when it is open (the outputs of quad comparator IC110 are open-collector). The gate circuit gets its information about the input level from the output of broadband rms detector IC106. IC110-A and IC110-B receive the output of IC106. GAIN HOLD control VR107 sets the reference voltage on IC110-A and IC110-B, determining the threshold (referred to the 168A's audio input level) where gating occurs. IC110-A's output defeats the release process by diverting release current from the timing circuit. IC110-B drives the GAIN HOLD indicator circuit.

To save current, the Channel 1 GAIN HOLD, Channel 2 GAIN HOLD, and MASTER lamps are in series. IC110-D turns the Channel 1 GAIN HOLD lamp On and Off by diverting its current to the  $-15\text{V}$  supply. When the channels operate independently, IC111-C turns the Channel 2 GAIN HOLD lamp On and Off by shorting it out with Q103. When the 168A is in stereo mode, the output of IC111-C is forced to the  $-15\text{V}$  rail by R180 and R181, turning Q103 Off. In stereo mode, the collector of Q104 goes to ground, permitting IC110-C and IC110-D to switch identically. Thus IC110-C causes both the Channel 1 GAIN HOLD and Channel 2 GAIN HOLD lamps to switch simultaneously, following the Channel 1 hold circuit.

Current source Q503, R542, R543, R544, CR506 applies a constant current to the series-connected diodes in LED assembly CR4. A string of ten comparators IC508-C to IC510-D receives the dB-linear gain reduction voltage. The comparators are biased with DC reference voltages (by voltage divider string R511, R513-R521, R546) from 0.9 to 9.0VDC in 0.9V steps. Each 0.9V step corresponds to 3dB additional gain reduction. When the gain reduction is less than 3dB, the gain reduction voltage is less than 0.9V and all the outputs of all comparators are active negative, shunting current from the series-connected LED string. As the gain reduction increases, the output of each comparator in turn becomes open collector and current is permitted to flow in the LED string until it encounters a comparator whose output is still active negative, at which point the active comparator shunts the current away from the rest of the LEDs.

A 50 or 60Hz "dither" signal is injected into the reference voltage string through C527, R512 (connected to the power transformer secondary). This AC signal modulates the turn-on threshold of each comparator, causing the LEDs to appear to smoothly fade

On and Off instead of switching abruptly.

## 5. De-Esser.

The De-Esser uses the outputs of a pair of dbx rms detectors, one which measures the power level of the broadband input signal to the 168A and the other which measures the power in this signal above 6kHz. The difference between the outputs of the two detectors (which are linear in dB) represents the ratio of these two powers (in dB). The De-Esser monitors this ratio. If it exceeds a threshold set by the DE-ESSING control, the De-Esser develops a control voltage that quickly reduces the gain of the main audio path VCA to effect de-essing.

### Component-Level Description:

IC106 is a dbx rms detector. It receives the 168A's input signal through C112 and R140, which roll off very low frequencies that do not appreciably contribute to the ear's perception of loudness. Its output (on pin 7) is linear in dB and is applied to the inverting input of differential amplifier IC109-B.

A second dbx rms detector IC107 receives the 168A's input signal as processed through third-order 6kHz high-pass filter IC109-D (and associated components). The output of IC107, corresponding to the power contained in the input signal's high frequencies, is applied to the non-inverting input of differential amplifier IC109-B. The output of IC109-B is thus proportional to the difference (in dB) between the broadband signal power and the high frequency signal power. This signal remains constant even if the absolute input level varies over a wide range, provided only that the ratio between the broadband and high frequency powers in the input signal does not change.

The output of IC109-B is summed with the output of the DE-ESSING control VR106 in threshold amplifier IC109-C and associated components. When the ratio between the broadband and high frequency powers in the input signal is small, the output of threshold amplifier IC109-C (at the anode of CR104) is at ground and no de-essing occurs. As the output of IC109-B goes more positive (showing that the ratio between the broadband and high frequency powers in the input signal has become larger and that an "ess" sound is probably occurring), the output of IC109-C starts to go negative, decreasing the gain of IC101 and controlling sibilance levels.

This de-essing control voltage is applied to the DE-ESSING meter, consisting of IC111-A, IC111-B, and associated components. It operates similarly to the Compressor GAIN REDUCTION meter (see page 24) except that it uses resistor R188 instead of an active current source.

The output of VR106 is applied to one input of electronic switch IC203-A. When the 168A is in stereo mode, this switch applies the voltage output from the Channel 1 DE-ESSING control to the Channel 2 de-essing circuitry so that the Channel 1 DE-ESSING control determines the threshold of de-essing in both channels. (Although their *thresholds* are the same, the Channel 1 and Channel 2 de-essing circuits continue to operate independently, usually applying different amounts of de-essing to Channels 1 and 2, depending on the program content in each channel.)

## 6. High Frequency Spectral Enhancer.

The signal representing the ratio between the broadband and high frequency powers in the input signal is applied to the smoothing circuit (with a much slower time constant than the De-Esser). The output of the smoothing circuit controls the gain of a VCA to effect a shelving high frequency equalizer by adding the output of a 6dB/octave high-pass filter to its input signal with gain determined by the VCA's control signal. The sum of the smoothed ratio signal and a fixed dB offset set by the HIGH SPECTRAL ENHANCEMENT control determines the amount of equalization. This system smoothly increases HF boost when input signals contain a relatively small amount of high frequency power, thus adapting the amount of equalization to the input program moment-by-moment.

**Component-Level Description:**

Summing amplifier IC303-A receives the output of differential amplifier IC109-B, representing the difference (in dB) between the broadband signal power and the high frequency signal power. This signal is summed with the output of VR302, the HIGH SPECTRAL ENHANCEMENT control. Because the control signals are linear in dB at this point in the circuit, this has the effect of attenuating or amplifying the control signal (by adding or subtracting a fixed dB offset). The taper of the control is chosen so that, in its extreme counterclockwise range, it abruptly applies large amounts of attenuation, ensuring that the HF enhancement signal is attenuated to negligible levels when the control is fully counterclockwise.

The output of IC303-A is applied to smoothing circuit R316, R317, C309, CR300, CR301. The smoothed signal is buffered by IC303-B, whose output is applied to the gain control port of VCA IC302.

IC302 receives the output of high-pass filter C306, R315. IC301-C transforms IC302's current output into a voltage. The output of IC301-C is applied through coupling capacitor C308 and summing resistor R313 to the input of summing amplifier IC301-D, which also receives the input signal. The summation of the output of high-pass filter C306, R315 with the input signal produces a high-pass 6dB/octave shelving equalizer whose breakpoint and amount of equalization are determined moment-by-moment by the gain of IC302.

The output of VR302 is applied to one input of electronic switch IC203-B. When the 168A is in stereo mode, this switch applies the voltage output from the Channel 1 HIGH SPECTRAL ENHANCEMENT control to the Channel 2 HF enhance circuitry so the amount of HF enhancement in both channels is controlled from the Channel 1 control panel.

**7. Low Frequency Spectral Enhancer.**

The low frequency enhancer is a fourth-order equalizer that simultaneously creates a bell-shaped boost at 80Hz and a bell-shaped dip at 250Hz. Equalization is created by summing the output of a filter sidechain with its input through the LOW SPECTRAL ENHANCEMENT control.

**Component-Level Description:**

IC301-A and associated components form a non-inverting band-pass filter centered at 80Hz. IC301-B and associated components form an inverting band-pass filter centered at 250Hz. IC301-B receives the sum of the equalizer's input signal and the output of IC301-A through R300 and R331 respectively. The LOW SPECTRAL ENHANCEMENT control VR301-A receives the sum of the outputs of IC301-A and IC301-B. This sum is mixed with the equalizer's input signal in summing amplifier IC301-D. It can be shown that this arrangement is equivalent to cascading two independent peaking and dipping equalizers.

VR301-A is half of a dual-gang control. When the 168A is in stereo mode, the other half of this control is connected in place of the Channel 2 LOW SPECTRAL ENHANCEMENT control so the amount of LF enhancement in both channels is controlled from the Channel 1 control panel.

**8. Balanced Output Driver.**

The output driver is a circuit that simulates the characteristics of a transformer by means of complex cross-coupled positive and negative feedback paths. It can drive balanced or singled-ended loads with essentially no change in output level. Its average DC output is forced to zero by a common-mode servo amplifier. Its gain (defined as the difference between its outputs divided by its input) is 1.5, and its output impedance is 30Ω.

**Component-Level Description:**

The two halves of an NE5532 opamp IC304 provide inverting (IC304-A) and non-inverting (IC304-B) outputs. The nature of the load is sensed by observing the voltage developed across R335 and R342 and feeding this information back to the opamps. The operation of the circuit can only be further justified by a detailed mathematical analysis, which is beyond the scope of this circuit description.

Servo amplifier IC305 and associated components ensures that the average DC voltage between the two outputs of the line driver is zero. These outputs are summed into integrator IC305, C311 through R344 and R345. The integrator develops a voltage at its output that is injected into the line driver through R338. Feedback forces the voltage at the inverting input of IC305 to be equal to ground (the voltage at its non-inverting input). When the circuit is at equilibrium, no current flows in or out of the integration capacitor C311. So the average voltage applied to R344 and R345 must also be zero, as desired.

The output of the line driver is applied to hard-wired BYPASS switch S300, and then to the output of the 168A through RFI-suppression components C300 and C301. These provide RFI suppression effective for most environments. However, their effectiveness decreases at low radio frequencies (below about 10MHz), and a 168A operated at a LW or MW (AM) transmitter site might require additional suppression if RF fields are very high there.

**9. PEAK OUTPUT LEVEL Meter.**

The PEAK OUTPUT LEVEL meter consists of ten LEDs that monitor the output level of the 168A's processing circuitry just before the balanced output driver. The meter is driven by a peak detector that can read the peak level of a 10-microsecond pulse with an accuracy of 0.5dB (typical) when compared to its reading on a steady-state tone. It thus provides a true peak-reading capability, rather than a quasi-peak capability like an EBU-standard PPM.

**Component-Level Description:**

The output of IC301-D is rectified by an inverting half-wave precision rectifier IC500-A and associated components. Double the output of the rectifier is summed (through R531) with its input to create a full-wave rectified signal at the (+) input of IC500-B (pin 5). The rectifier has a voltage gain of 0.89.

IC500-B operates as a dual-time constant peak detector. A DC voltage equal to the peak value of the rectified signal at pin 5 of IC500-B is developed at the top of C500, which is charged by IC500-B's pin 7 through diode-connected transistor Q500. IC-500C buffers this voltage and provides feedback to IC500-B's pin 6, "telling" IC500-B how to charge C500, C501 so that the output of IC500-C accurately follows the peak value of the waveform on IC500-B's pin 5.

To achieve the very fast response needed, the peak-holding capacitors C500 and C501 are relatively small. To achieve a sufficiently slow recovery time with a practical value resistor (R534 = 22M), R534 is bootstrapped to the output of IC-500C through R537. R536 introduces enough DC offset to always produce approximately 0.5V across R537. This multiplies the effective value of R534 by 30 and slows the recovery time as desired.

The meter driver circuit associated with LED array CR2 receives the output of peak detector IC-500C (pin 1). Other than its providing a VU (rather than a linear) scale and receiving dither voltage in a different part of the reference voltage divider, the operation of this circuit is identical to the operation of the circuit driving the CR4 LED array (see above).

### 10. Power Supply.

Two pairs of full-wave diode rectifiers supply unregulated voltage. The nominal unregulated voltage is  $\pm 22$  volts DC at rated line voltage. This will vary widely with line voltage variations. Regulator dropout will occur if the unregulated voltage falls below about  $\pm 17.8$  volts.

A pair of overrated 500mA "three-terminal" IC regulators supply regulated voltages. Because they are operated conservatively and are internally protected, the regulators can be expected to be reliable.

#### Component-Level Description:

The two pairs of full-wave diode rectifiers that supply unregulated voltage are located in package CR5. The rectifier pairs drive energy storage capacitors C504 and C505. The power transformer can be strapped for either 115-volt or 230-volt operation by a rear panel switch (the two sections of the primary are paralleled for 115-volt operation and connected in series for 230-volt operation).

The pair of ICs that supply regulated voltages are "three-terminal" IC regulators IC12, IC13. IC12 and IC13 are frequency-compensated by C506, C507 at their outputs to prevent high-frequency oscillations. Small 0.1 $\mu$ F/25V ceramic capacitors bypass the power busses to ground locally throughout the board to prevent signal-carrying ICs from oscillating due to excessive power-lead inductance.

(Replace C506 and C507 with low-inductance aluminum electrolytic capacitors *only* — see "Power supply problems" on page 20.)

## PARTS LIST

Parts are listed by ASSEMBLY, then by TYPE, then by REFERENCE DESIGNATOR. Widely used common parts are not listed; such parts are described generally below (examine the part to find exact value). See the following assembly drawings for locations of components.

SIGNAL DIODES, if not listed by reference designator in the following parts list, are:

dbx part number 22101-000, Motorola part number 1N4148, also available from many other vendors. This is a silicon, small-signal diode with ultra-fast recovery and high conductance. It may be replaced with 1N914 (BAY-61 in Europe).

(BV: 75V min. @  $I_r = 5\mu$ A;  $I_r$ : 25nA max. @  $V_r = 20$ V;  $V_f$ : 1.0V max. @  $I_f = 100$ mA;  $t_{rr}$ : 4ns max.) See Miscellaneous list for ZENER DIODES (reference designator VRxx).

RESISTORS should only be replaced with the same style and with the exact value marked on the resistor body. If the value marking is not legible, consult the schematic or the factory. If you do not use exact replacements, you will compromise performance and stability.

Unless listed by reference designator in the following parts list, you can verify resistors by their physical appearance:

Metal film resistors have conformally-coated bodies, and are identified by five color bands or a printed value. They are rated at  $\frac{1}{8}$  watt @ 70°C. Their resistance has a tolerance of  $\pm 1\%$  and a temperature coefficient of 100 PPM/°C. dbx part numbers 20038-xxx through 20045-xxx, USA Military Specification MIL-R-10509 Style RN55D, manufactured by Dale, KOA, Phillips, R-Ohm (CRB- $\frac{1}{4}$ FX), R-Ohm (R-25), SEI, Spectrol and Stackpole and TRW/IRC.

Carbon film resistors have conformally-coated bodies, and are identified by four color bands. They are rated at  $\frac{1}{4}$  watt @ 70°C. Their resistance has a tolerance of  $\pm 5\%$ . dbx part numbers 20001-xxx, manufactured by Dale, KOA, Phillips, R-Ohm (R-25), SEI, Spectrol and Stackpole.



Carbon composition resistors have molded phenolic bodies, and are identified by four color bands. The 0.090 x 0.250 inch (2.3 x 6.4 mm) size is rated at ¼ watt, and the 0.140 x 0.375 inch (3.6 x 9.5 mm) size is rated at ½ watt, both ±5% tolerance. dbx part numbers 2001x-xxx, USA Military Specification MIL-R-11 Style RC-07 (¼ watt) or RC-20 (½ watt), manufactured by Allen-Bradley, Stackpole and TRW/IRC.

Carbon trimmer potentiometers have .405-inch (10.287 mm) circular bodies, and are identified by printing on their sides. They are rated at .15 watt @ 40°C. Their resistance has a tolerance of ±20%. dbx part number 20535-xxx, manufactured by Piher and Murata.

Mini resistors have conformally-coated bodies. Carbon film mini resistors are identified by four color bands and are rated at ⅛ watt @ 70°C. Their resistance has a tolerance of ±5% and a temperature coefficient of 100 PPM/°C (dbx part numbers 20085-xxx through 20092-xxx). Metal film mini resistors are identified by five color bands and are rated at ⅛ watt @ 70°C. Their resistance has a tolerance of ±1% (dbx part numbers 20094-xxx through 20101-xxx) or ±0.1% (dbx part numbers 20102-xxx through 20109-xxx) and a temperature coefficient of 100 PPM/°C. All mini resistors are USA Military Specification MIL-R-10509 Style RN50D, manufactured by Dale, KOA, Phillips, R-Ohm (R-25), SEI, Spectrol and Stackpole.

### Obtaining Spare Parts

Special or subtle characteristics of certain components are exploited to produce an elegant design at a reasonable cost. It is therefore unwise to make substitutions for listed parts. Consult the factory if the listing of a part includes the note "selected" or "realignment required."

dbx normally maintains an inventory of tested, exact replacement parts that can be supplied quickly at nominal cost. Standardized spare parts kits are also available. When ordering parts from the factory, please have available the following information about the parts you want:

- dbx part number
- Reference designator (e.g., C3, R78, IC14)
- Brief description of part
- Model, serial, and "M" (if any) number of unit — see rear-panel label

To facilitate future maintenance, parts for this unit have been chosen from the catalogs of well-known manufacturers whenever possible. Most of these manufacturers have extensive worldwide distribution and can be contacted through their local offices. Addresses for each manufacturer's USA headquarters are given on page 36.