



**Model 443B02**

**Modular Series Power Supply**

**Installation and Operating Manual**

**This manual contains the 441A101, 441A33, 443B102 installation and operating manuals that comprise a Model 443B02 Modular Series Power Supply kit.**

**For assistance with the operation of this product,  
contact PCB Piezotronics, Inc.**

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**The information contained in this document supersedes all similar information that may be found elsewhere in this manual.**

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**Warranty** – All equipment and repair services provided by PCB Piezotronics, Inc. are covered by a limited warranty against defective material and workmanship for a period of one year from date of original purchase. Contact

PCB for a complete statement of our warranty. Expendable items, such as batteries and mounting hardware, are not covered by warranty. Mechanical damage to equipment due to improper use is not covered by warranty. Electronic circuitry failure caused by the introduction of unregulated or improper excitation power or electrostatic discharge is not covered by warranty.

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# **DUAL-MODE AMPLIFIER**

**Model 443B101/443B102**

## **OPERATING MANUAL**

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## 1.0 Chassis and Power Supply

### 1.1 Introduction: Safety Considerations

**WARNING 1:** *The power supply/signal conditioner should not be opened by anyone other than qualified service personnel.* This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid injury.

**WARNING 2:** This equipment is designed with user safety in mind; however, the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by PCB Piezotronics, Inc.

**Caution 1:** *Cables can kill your equipment.* High voltage electrostatic discharge can damage electrical devices. Similar to a capacitor, a cable can hold a charge caused by triboelectric transfer, such as that which occurs in the following:

- Laying on and moving across a rug.
- Any movement through air.
- The action of rolling out a cable.
- Contact to a non-grounded person.

The solution for product safety: 1) Connect the cables only with the AC power off. 2) Temporarily “short” the end of the cable before attaching it to any signal input or output.

**Caution 2:** *ESD considerations should be made prior to performing any internal adjustments on the equipment.* Any piece of electronic equipment is vulnerable to ESD when opened for adjustments. Internal adjustments should therefore be done ONLY in an ESD-safe work area. Many products have ESD protection, but the level of protection may be exceeded by extremely high voltage.

### WARNING SYMBOLS AND TERMS

The following symbols and terms may be found on the equipment described in this manual.



This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.



This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.



This symbol indicates safety, earth ground.

The **WARNING** heading used in this manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **Caution** heading used in this manual explains hazards that could damage the instrument.

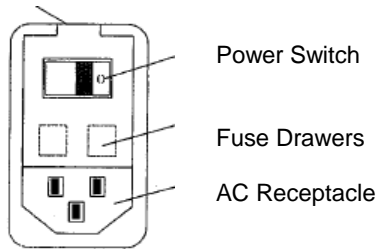
### EQUIPMENT RATINGS

For complete specifications, please refer to the enclosed Specification Sheet. This equipment operates at 104°F (40°C), in an environment having 93% relative humidity. Its frequency range is 50/60 Hz. Operation of this unit is limited to environments having an altitude of less than 2 000 meters. The pollution degree for operation of the Model 440 is Two (2), meaning that normally, only non-conductive pollution occurs. The overvoltage category is II, indicating the transient voltage levels that may be tolerated by the equipment.

The Model 441A101 requires 100 to 240 VAC with 1.3 amps to operate. It gets its power via an AC line cord that plugs into the receptacle on the rear panel. (*The Model 441A102 – DC supply does not use this receptacle.*)

Two rear panel fuses, located below switch in the AC receptacle, protect the power line inputs of the instrument. The fuse type is a T 1.6A, L 250 V. To change the fuse, disconnect the power cord. Find the slot just above the power switch and pull forward to open the door that exposes the fuse drawers. Pull the individual drawer forward and insert a new fuse. See Figure 1.

Slot – carefully pry to expose fuse drawers



**Figure 1.** Fuse Replacement

## 1.2 Description

The PCB Modular Signal Conditioning System is a flexible, compact means of coordinating and customizing the signal conditioning needs of vibration, pressure, or force sensing instrumentation. At its most basic level, the system consists of a rectangular chassis with a single-slot power supply on the right side of the chassis and one module (customer specified). This power supply is either AC or battery power, depending on customer requirements. It should be noted, however, that the AC and DC power supplies are separate units, having differing part numbers. See Section 1.2.3 and 1.2.4 for a more detailed description of the power supplies.

### 1.2.1 Chassis (Model 441A42, 441A43, 441A35, 441A39, 441A45, 441A49)

The chassis configuration varies, ranging from two slots to nine; one of these slots (extreme right) is reserved for the power supply. Situated on the rear panel behind the power supply slot is a power entry module that includes an on/off switch, fuses, and a power filter for use with the AC power supply only. See Figure 1.

Eurocard-style plug-in modules occupy the remaining slots. For a complete listing of available modules, see Section 1.4.

The standard chassis is constructed of molded plastic with molded ventilation slots. The 19-inch rack-mounted unit is constructed of metal.

The Model 441A33, 35, 39 are the computer controlled versions of the standard chassis. The back panel of this chassis has one RS-232 connector and two RS-485 connectors marked “in”

and “out”. Also located on the rear panel is a cooling fan.

A back plane on the inside rear of the unit unifies the circuitry, routing it to the power supply. Individual modules slide into the unit via the slot divisions and are secured to the inside frame using mechanical fasteners.

Models 441A45 and 441A49 are “slave” racks designed to be controlled by a “master” rack (441A33, 441A35, 441A38, 441A39). These racks do not have an RS-232 connector, but only two RS-485 connectors which may be connected to either a master, or another slave in a daisy chain fashion. At least one master must be in the system if it is desired to use computer control.

Located on the rear panel of these racks is a cooling fan which normally is on. If it is desired to turn off the fan in order to reduce acoustical noise, a jumper “J2” located on the motherboard must be removed. In order to access this jumper, the rear panel must be taken off. The fan may now be disabled via a command from the host computer controlling the master. The fan should be disabled for as short a period as possible to ensure continuous cooling. Contact the factory for more details.

### 1.2.2 AC Power Supply (Model 441A101)

The Model 441A01 is a single-slot, CE marked, AC-line power supply designed to fit only the extreme right slot of the PCB Series 440 Modular chassis. It supplies a maximum of 45 watts of power and may be used to operate single or multiple signal conditioning modules housed in the two-, three-, or nine-wide standard chassis and optional auxiliary chassis.

The power unit supplies a maximum of 45 watts of power. Please note that while this unit is rated for a maximum power of 45 W, CE requirements mandate that the load not exceed 30 Watts.

*Power requirements are found on the Specification Sheet for the individual module.* To determine the total power of your particular set-up, add the powers for all modules. The total must be  $\leq 30$  watts.



### 1.2.3 DC Power Supply (Model 441A102)

Model 441A102 is a single width, CE marked, rechargeable DC battery power supply designed to fit only the extreme right slot of the PCB Series Modular chassis. It supplies a maximum of 30 watt/hrs and may be used to operate single or multiple signal conditioning modules housed in the two-, three-, or nine-wide standard chassis and optional auxiliary chassis.

It can also be used with an external 12VDC supply like a car battery by using the supplied DC power cord Model 017A22. Or it may be line powered using the optional Model 488A09 AC power adaptor. Both these external power sources plug into the EXT DC jack located on the front panel. Refer attached operation guide for the Model 441A102 in appendix A.

### 1.3 Maintenance and Repair

Aside from battery replacement on units so equipped, no maintenance is required for this modular unit, other than wiping the exterior of the chassis with a soft cloth when dusty. If you experience difficulty with your particular unit, contact the factory for assistance. Because of the sophisticated nature of PCB instrumentation, **field**

**repair is typically not recommended** and voids the warranty. If factory service is required, return the instrument to PCB. A free quotation is provided prior to servicing.

To expedite the repair process, contact a PCB Customer Service Representative for a Return Materials Authorization (RMA) number prior to sending equipment to the factory. Please have pertinent information available, such as model and serial numbers, application information, what instruments are connected to the equipment, and so forth. Also, to insure efficient service, be sure to include a brief written description of the problem. International customers should return equipment to a local distributor, or contact PCB if no distributors are available.

PCB is an ISO 9001-certified company that has embraced its company mission of TOTAL CUSTOMER SATISFACTION. These two factors

assure that if at any time you are not satisfied with any of our products

or service, let us know and we will correct the problem. If you have any questions or concerns on the use of any PCB product or the aforementioned policies, please contact PCB at 716-684-0001.

## 2.0 Product Overview

The Model 443B Dual-Mode Amplifier is a comprehensively equipped charge and ICP<sup>®</sup> preamplifier intended for use with piezoelectric pressure, force and vibration sensors. This amplifier is particularly useful for field and laboratory measurement of acceleration, velocity, and displacement vibration.

The Dual-Mode Amplifier features an input for both charge and ICP<sup>®</sup> sensors. Sensor sensitivity may be digitally selected. ICP<sup>®</sup> accelerometers with TEDS electronics can be auto-normalized using the Auto TEDS feature. Full TEDS data may be read from the TEDS menu, or through the RS-232 port.

The unit has unified output ratings, built-in integrators for velocity and displacement, switchable low and high pass filters, and a built-in reference signal. The output is routed to portable Sony DAT Recorders, scopes, and frequency analyzers. Refer to Figure 3.1. In addition, the Model 443B102 offers medium and long time constant settings.

## 3.0 Description

Please refer to the **Block Diagram**, Figure 4.1, located in the Appendix of this manual. The Model 443B102 Dual-Mode Amplifier consists of a charge input stage and an ICP<sup>®</sup> sensor input stage with selectable current settings (the current may be set to 'Off' for voltage inputs). A reference oscillator is inserted right in front of the charge amplifier input and supplies a 100 pC RMS reference for charge and a 1 V RMS reference for the ICP<sup>®</sup> mode.

The charge input amplifier is followed by an inverter amplifier used to invert the signal in the ICP<sup>®</sup> mode. The inverter amplifier is followed by a selectable two-pole low pass filter section that provides low pass filtering of the vibration signal. The low pass filter section is followed by fixed gain

stages of x1, x2, x4, x5, x10. The signal is then routed via an AC coupling network to the acceleration input of a selector. Also from the fixed gain amplifiers, the signal is routed to the two integrators for velocity and displacement from which the signal is fed to the selector. The selector is followed by a x1 or x10 fixed gain amplifier to a 12 bit continuous gain stage and from there, to the output connector located on the front panel.

Overload indications are provided for the output of the charge amplifier, the output of the velocity and displacement amplifiers, and for the output. In ICP® mode, the sensor output is also monitored for overloads.

The amplifier can store up to five set-ups for easy recall. When the unit is powered up, it automatically returns to the state it was in when last powered down.

The Model 443B may be controlled remotely via an RS-232 interface when used with a 441A3X chassis with computer control.

A more detailed discussion of the individual components follows.

### 3.1 Input

The input signal is fed to the amplifier via the input connector on the front panel. When sensors having high temperature transient sensitivity are used, the high pass filter of the amplifier can be changed from 0.2 Hz to 2 Hz, reducing the influence from temperature-induced signals. The overall gain of the amplifier is the ratio of the output sensitivity to the sensor sensitivity.

### 3.2 Low Pass Filters

Six selectable upper cutoff frequencies are provided by the low pass filter, located just after the input amplifier to filter out unwanted signal components before further amplification. The filters are of the two-pole configuration, giving a 12 dB/octave cutoff. Refer to Figure 4.2. The low pass filter section may be turned off giving a frequency response of >200 kHz.

### 3.3 Integrator Amplifiers

The integrator amplifiers provide single integration

for velocity and double integration for displacement. Two low-frequency cutoff settings of 1 or 10 Hz are provided in the velocity and displacement modes to suppress low-frequency noise. Refer to figure 4.3 and 4.4.

### 3.4 Output Amplifier

The output amplifier provides a fixed gain of x1 or x10. The output amplifier provides the signal to the continuous gain stage and then to the BNC output connector on the front panel.

Typical frequency response as a function of capacitive load of the output of the 443B dual mode amplifier is shown in Figure 4.5. It can be seen that for a frequency range up to 10kHz a capacitive load of up to 50 nF may be applied. For standard cable with a shunt capacitance of 100pF/m up to 500 m of output cable can be used to cover this frequency range.

### 3.5 Overload Detector

The overload detector monitors the output of the charge amplifier, the low pass filter, and the output, so overload in various parts of the circuitry are not masked by filtering. The overload indicator is located on the front panel. In ICP® mode, the sensor output is also monitored for overloads.

### 3.6 Reference Oscillator

The Model 443B has a built-in reference signal source, providing a signal of 100 pC RMS at 159.2 Hz in charge mode. In ICP® mode, the reference signal is 1 V RMS. These signals can be used as a reference when using portable DAT recorders.

## 4.0 Operation

The Model 443B is designed to fit into the PCB Modular Signal Conditioning System. It may be used as a single-channel stand-alone system or as part of a four-channel package housed in a single cabinet. For further information on the PCB Modular System, consult the PCB Modular Signal Conditioning System sales sheet.

The Model 443B is designed to operate from 110 to 220 volts AC at 50/60 Hz. The unit may also be powered from an optional battery package powering all four 443Bs.

## 4.1 Grounding

Indiscriminate grounding of instruments can introduce ground loop interference. To prevent this, it is necessary to insure that the signal ground line of the 443B and of other instruments with which it is used are grounded at one point only in the measurement system.

Connect the signal ground lines of all the instruments together. This is done through the shields of the input and the output cables used to interconnect the instruments.

If an instrument with a mains socket chassis terminal is used in the measurement system, check that a) that only one of the instruments has its signal ground connected via the chassis to mains ground, (b) that the housing of the transducer is isolated from grounded measurement sources.

If the measurement set-up is mounted in a metal instrumentation rack, ensure that only one of the instruments has its signal ground connected to the chassis (and chassis connected to mains ground if the unit has a mains socket chassis terminal).

## 4.2 Set-Up and Measurement

The measurement procedure is as follows:

Connect the Model 443B to a suitable power source. Switch the unit on and let it stabilize for 30 seconds.

Connect the output of the 443B to a suitable indicating instrument, voltmeter, scope or frequency analyzer.

Select a suitable accelerometer to be used for the measurement and observe the correct mounting and installation instructions. Connect it to the input connector of the Model 443B.

From the accelerometer's calibration chart, select the sensitivity.

### 4.2.1 Setting the Operational Mode

Press the MENU button on the Model 443B. The main menu appears on the screen of the Model 443B.

Select the MODE position with the down button. Press the MENU button again.

The display now shows the following text:

Charge	Ref. On
ICP	Ref. Off

Select the mode by moving the cursor to Charge or ICP® depending upon which type of sensor is being used. Note that in ICP® mode, zero current can be selected which will put the unit in voltage mode.

The internal sinusoidal reference may be turned on by moving the cursor to Ref. On and pressing the MENU button. To turn off the reference, move the cursor to Ref. Off in the MODE menu and press MENU.

### 4.2.2 Setting the Sensor Sensitivity

Press the MENU button again and select SEN by pressing the right-facing arrow.

Press the MENU button again and the cursor is now in the sensor sensitivity position.

Enter the sensitivity for the selected accelerometer using the keys with the up and down arrows. Note that if the up or down key is held the display will increment or decrement continuously.

Press the MENU key again and the selected charge sensitivity now shows on the Model 443B's display.

### 4.2.3 Setting the Output Sensitivity

Press the MENU button. Move the cursor to OUT.

Press the MENU button again and the cursor is at the output position. Set the output to the desired setting.

Press the MENU button again and the desired output setting shows on the Model 443B.

### 4.2.4 Setting the Time Constant

Press the MENU button again and select the LF position.

Press the MENU button again , the display shows:  
0.2 Hz 2.0 Hz.  
low freq sel

Select the suitable lower-limiting frequency of 2 Hz for sensors with high temperature transient sensitivity. The Model 443B102 includes medium and long TC options as well

To access them press the down key again and the display shows:

med TC long TC  
low freq sel

Press the MENU button again after selecting the desired setting. For 0.2Hz, 2Hz and med TC the Model 443B now indicates the selected setting. Verify the setting by the indication on the front panel.

If long time constant is selected in charge mode (443B102 only), the display will briefly indicate:

time constant is  
>10,000 sec

or

time constant is  
>100,000 sec

depending on the gain selected

and then:

Autozero  
in progress

The autozero function zeros the output to within  $\pm 50$  mV of ground. The next display will be:

Null Drift?  
Yes No

The 443B102 has a built in automated drift nulling routine which insures that the drift is well within the stated specification. This should be run after the unit has been on for at least one hour in long TC mode to allow for proper warm up time. Selecting Yes begins the routine. The internal microprocessor will then begin adjusting the leakage current so that the drift is minimized. The process may take up to about 10 minutes

depending on how much adjustment is necessary. *It is recommended that the sensor be disconnected during nulling so that the input is not disturbed.* During nulling, the display will show:

Nulling Drift  
Comp Lvl = X.XXX

Where X.XXX is the voltage used internally to adjust the drift. It may range between  $\pm 5$ v. If it is desired to terminate nulling before it is complete, press the MENU key and the unit will return to normal operation. Once the nulling has been completed, the lcd will return to the operating display. If the microprocessor is unable to satisfactorily null the drift, the lcd will display:

Unable to Null  
Try again Exit

Selecting Try again will begin the nulling routine and Exit will return the unit to normal operation. Common reasons for nulling to fail are insufficient warm up time, or leaving the sensor connected to the input.

Long TC may be selected in ICP® mode, so that the amplifier is DC coupled. When long TC is selected, the lcd will display:

adjust DC offset  
X.XXXX V

The up and down keys may then be used to adjust the offset so that the sensor bias is removed from the signal.

#### 4.2.5 Zeroing the Output in Long Time Constant Mode (443B102 only)

To zero the output after making a long time constant measurement, simply push the ZERO key. Alternatively, a two conductor cable with an SMB connector may be plugged into the EXT ZERO receptacle on the front panel. When the center conductor is shorted to the shell, the ZERO will be actuated.

ZERO may be locked on in long time constant mode by holding down the ZERO key for several seconds. The display will then read:

ZERO LOCKED ON  
push ZERO to res

This will hold the output at about zero volts, regardless of the charge input. It is recommended to lock the zero on when connecting or disconnecting a sensor, or whenever there is a possibility of overloading the amplifier. To release the zero lock, simply push the ZERO key again.

#### 4.2.6 Setting the Low Pass Filter

Press the Menu button again. Select LPF using the down and right arrow keys. Press the MENU button again.

The 443B now shows the following:

0.1k 1k 3k  
10k 30k 100k Off

Using the up/down and right arrow keys, select the desired low-pass frequency setting.

Press the MENU button again and verify the correct LPF setting on the front panel.

#### 4.2.7 TEDS Features

The 443B incorporates several features which allow the use of sensors with TEDS electronics. The 443B can read the raw data from any TEDS sensor, and is able to locally decode the data from sensors using IEEE 1451.4, UTID 1, and UTID 116225. These are the most commonly used data format for accelerometers. Raw data in hex form is also available via the RS-232 interface which may then be decoded by the host computer. The RS-232 commands are described in Appendix A.

The easiest way to take advantage of TEDS sensors is the use the auto normalization feature. This feature automatically reads the data in a TEDS sensor when it is connected to the 443B and sets the sensitivity to the value stored in the sensor. Thus the user is spared the inconvenience (and potential error) of locating the sensor's data sheet and manually entering this information. The auto-normalize feature is normally enabled, but may be disabled if desired by selecting TEDS from the main menu and then selecting Off when the Auto TEDS Read menu is displayed.

**Note:** The Auto Teds feature can cause erratic output when used with certain sensors. To avoid this possibility, Auto TEDS should be disabled for sensors that have time constants of 1 second or

longer, or sensors with high sensitivities (1 V/g and up) .

The remainder of the TEDS data may be viewed by selecting TEDS from the main menu, and continuing through the Auto TEDS Read On/Off menu. The next display will read:

SELECT UNITS  
SI ENGLISH

This selection determines whether the TEDS data is displayed in SI or English units. Once this selection has been made, all stored data may be viewed by pushing the down key to scroll through it.

#### 4.3 Velocity Measurement

To measure velocity, proceed as follows:

Press MENU button.

The main menu appears on the display:

OUT SEN TED MEM  
MODE LF LPF LCD

Using down and right arrow keys, select LF.

Press the MENU button.

Press the down arrow key until the display shows:

1.0 Hz 10.0 Hz  
velocity

Select the desired setting and press the MENU button. The display shows:

SELECT UNITS  
SI ENGLISH

If SI is selected , then SI units are displayed.

Select the desired unit and press MENU. If ENGLISH is selected, the display shows:

XX.XX mV/in/s  
X.XXX pC/g

#### 4.4 Displacement Measurement

Press the MENU button. The display shows:

```
OUT   SEN TED MEM
MODE LF  LPF  LCD
```

Select LF and press the menu button. The display shows the previous setting.

Press the up arrow key until the display shows:

```
1 Hz           10.0 Hz
displacement
```

Select the appropriate lower frequency and press the MENU button. The display shows:

```
SELECT UNITS
SI      ENGLISH
```

Select the desired units and press the MENU button. If ENGLISH was selected the display shows:

```
X.XXX mV/mil
X.XXX pC/g
```

If SI is selected, SI units are displayed.

Set the desired output sensitivity and press the MENU button. The Model 443B is now set up and calibrated for displacement measurements.

#### 4.5 Using the Setup Memory

The 443B has the capability to save and recall up to five different setups so that the user can easily switch between frequently used configurations. To save a setup, first press MENU and move the cursor to the MEM position. Press MENU again. Move the cursor to SAVE and press MENU. Now move the cursor to the number (1-5) of the setup location you wish to save the current configuration in. If you decide not to save the setup, move the cursor to CANCEL. Press MENU again and the unit will then return to its previous state.

To recall a setup, first press MENU and move the cursor to the MEM position. Press MENU again. Move the cursor to RECALL and press MENU. Now move the cursor to the number of the setup location you wish to recall. If you decide not to recall the setup, move the cursor to CANCEL. Press MENU again and the unit will reset itself to the stored configuration.

#### 4.6 Setting the LCD Backlight Level

Press MENU and select LCD. Press MENU and the display shows:

```
LCD BACKLIGHTING
3      2      1      Off
Select the desired backlight level and press
MENU.
```

#### 5.0 Computer / RS-232 Control

The 443B series provides for remote control of all functions via an RS-232 interface when used with a model 441A3X chassis with computer control. Appendix A gives the setup information as well as the command set.

#### 6.0 Maintenance and Repair

Aside from battery replacement on units so equipped, no maintenance is required for this modular unit, other than wiping the exterior of the enclosure with a soft cloth when dusty. If you experience difficulty with your particular unit, contact the factory for assistance. Because of the sophisticated nature of PCB instrumentation, **field repair is typically not recommended** and voids the warranty. If factory service is required, return the instrument to PCB. A free quotation is provided prior to servicing.

To expedite the repair process, contact a PCB Customer Service Representative for a Return Materials Authorization (RMA) number prior to sending equipment to the factory. Please have pertinent information available, such as model and serial numbers, application information, what instruments are connected to the equipment, and so forth. Also, to insure efficient service, be sure to include a brief written description of the problem. International customers should return equipment to a local distributor, or contact PCB if no distributors are available.

PCB's is an ISO 9001-certified company that has embraced its company mission of TOTAL CUSTOMER SATISFACTION. These two factors assure that if at any time you are not satisfied with any of our products or service, let us know and we will correct the problem. If you have any questions or concerns on the use of any PCB product or the

aforementioned policies, please contact PCB at 716-684-0001.

**Appendix A:**

**Computer Control / RS-232 Control**

**Requires mainframe chassis  
Model 441A33/441A35/441A38 or 441A39  
443B software  
RS-232 Cable**



## Appendix A: RS-232 Control

For RS-232 communication, the port settings should be as follows:

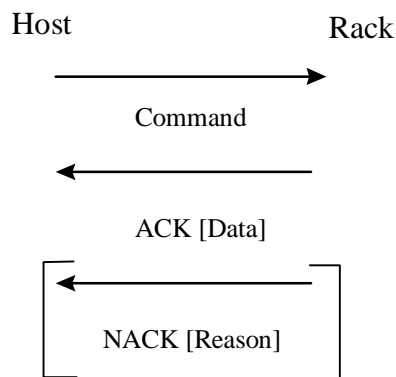
General	RS-232, DCE interface, XON/XOFF flow control, Asynchronous protocol
Baud Rate	9600 Baud
Start Bits	1
Data Bits	8
Parity	None
Stop Bits	1

The message format is as follows:

Start Byte (0x02)	Destination ID (Rack/Slot)	Command	End Byte (0x03)	Checksum
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Start Byte	STX (0x02) - marks the start of a new message.
Destination ID	16 bits - rack code (0-3 ASCII) followed by slot address (0-9 ASCII). Messages meant for the master will have "MM" in this field.
Command	Contains the command followed by any associated data. See below for command structure, and command set for examples.
End Byte	ETX (0x03) - marks the end of the message.
Data Checksum	16 bits - the ASCII hex of the 8-bit sum, ignoring overflows, of all bytes in the message including SOT and ETX bytes.

All messages sent to the rack will receive a response. A typical command transaction is shown below.



The ACK/NAK field conveys information concerning the delivery of messages. The results of command operations are contained in the data field of an ACK message. NAK reason bytes are defined below.

Start Byte (0x02)	ACK (0x06)	Data Field	End Byte (0x03)	Checksum
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**The format of an ACK message.**

Start Byte (0x02)	NAK (0x15)	Reason Byte	End Byte (0x030)	Checksum
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**The format of a NAK message.**

Reason Byte	Description
'C'	Check sum error in message received from external host.
'D'	Data overflow error – the size of the data field was larger than the message buffer. The buffer is 95 bytes long.
'F'	A framing error occurred – ETX was received before it was expected.
'I'	Check sum error occurred while communicating with internal module.
'T'	Time-out – message not sent, rack/slot address may be incorrect.

**NAK reason bytes.**

### Command Structure

Command format is shown below:

Module Type	Module Command	Data Field
-------------	-------------------	------------

Module Type	Three ASCII printable characters, this field identifies the type of module that command is meant for. For the 443B series, this will be either C01 (for 443B101) or C02 (for 443B102).
Module Command	Four printable ASCII characters, this field identifies the command for the module.
Data Field	Contains any data associated with the command.

**443B101/443B102 Command Set**

This list of commands is the currently supported set which are applicable to the 443B101 and 443B102 Dual Mode Amplifier modules.

**Command: MMOD**

Purpose:	This command returns the module type of the card at the location specified by the command.
Response:	The response string is 3 ASCII printable characters that correspond to the module type of the module at the location specified by the command.
Command Attribute:	This command is supported by all modules using the protocol defined for the 441 series racks (it is a common or "CMM" command).
Command String:	XYCMMMMMOD
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>CMM—Module type for the target. Specifying "CMM" in this argument indicates the intention of any module type that may be found in Rack X, Slot Y. (Range: 3 ASCII printable characters)</p> <p>MMOD—Commands target module to return its 3 character module type.</p>
Response String:	"C01" for 443B101 and "C02" for 443B102
Description:	These 3 ASCII printable characters are the module type of the module at the location specified by the command.
Example:	<p>Command String: "02CMMMMMOD"</p> <p>Response String: "C02"</p> <p>The module type of the card in rack 0 and slot 2 is a C02 (443B102).</p>

## Command: SVER

Purpose:	This command returns the software version number of the firmware in the target module.
Response:	The response string is 5 ASCII printable characters that correspond to the software version number of the module at the location specified by the command.
Command Attribute:	This command is supported by all modules using the protocol defined for the 441 series racks (it is a common or “CMM” command).
Command String:	<p>XYCMMSVER</p> <p>Description: X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)  Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)  CMM—Module type for the target. Specifying "CMM" in this argument indicates the intention of any module type that may be found in Rack X, Slot Y. (Range: 3 ASCII printable characters)  SVER—Commands the target module to return its 5 character software version number.</p>
Response String:	XX.XX
Description:	The first 2 ASCII printable characters are the major revision of the firmware. The next ASCII printable character is an ‘.’ and is used as a placeholder for the major and minor revisions of the firmware. The next 2 ASCII printable characters are the minor revision of the firmware.
Example:	<p>Command String: “04CMMSVER”  Response String: “03.00”</p> <p>The software version number of the card in rack 0 and slot 4 is 3.00.</p>

## Command: SER#

Purpose:	Returns the serial number of the card at the target location.		
Response:	The response string is 6 ASCII printable characters that correspond to the serial number of the module at the location sent by the command.		
Command String:	XYCMMSER#		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	CMM—Module type for the target. Specifying "CMM" in this argument indicates the intention of any module type that may be found in Rack X, Slot Y. (Range: 3 ASCII printable characters)		
	SER#— Commands target module to return its 6 character serial number.		
Response String:	ZZZZZZ		
Description:	These 6 ASCII printable characters are the serial number of the module at the location sent by the command.		
Example:	Command String:	“00CMMSER#”	
	Response String:	“000204”	
	The serial number of the card in rack 0 and slot 0 is 000204.		

## Command: OUTS

Purpose:	Sets the output sensitivity of the amplifier.
Response:	The module responds with a "0" to tell the calling process the command has been received.
Command String:	XYCOZOUTSXX.XX
Description:	<p>X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102. (Range: 3 ASCII printable characters)</p> <p>OUTS— Commands the module to set the output sensitivity</p> <p>XX.XX— 5 character output sensitivity. (Range: ASCII printable characters, 0 through 9)</p>
Response String:	"0"
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: "02C02OUTS1.001"</p> <p>Response String: "0"</p> <p>The output sensitivity of the 443B102 in rack 0, and slot 2 will be set to 1.001.</p>

## Command: XDCC

Purpose:	Sets the transducer sensitivity of the amplifier.
Response:	The module responds with a "0" to tell the calling process the command has been received.
Command String:	XYCOZXDCRXX.XX
Description:	<p>X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>XDCR— Commands the module to set the output sensitivity</p> <p>XX.XX— 5 character transducer sensitivity. (Range: ASCII printable characters, 0 through 9)</p>
Response String:	"0"
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: "04C01XDCC2.034"</p> <p>Response String: "0"</p> <p>The output sensitivity of the 443B101 in rack 0, and slot 4 will be set to 2.034.</p>

## Command: CHRG

Purpose:	Puts the amplifier into charge mode.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZCHRG		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.		
	CHRG— Commands module to charge mode.		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“00C01CHRG”	
	Response String:	“0”	
The 443B101 in rack 0 and slot 0 is set to charge mode.			



## Command: ICPM

Purpose:	Puts the amplifier into ICP mode and sets the constant current.
Response:	The module responds with a "0" to tell the calling process the command has been received.
Command String:	XYC0ZICPMZZ
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>ICPM— Commands module to charge mode.</p> <p>ZZ— specifies the constant current as follows:</p> <p>    "00" turns the constant current off (voltage mode).</p> <p>    "02" sets the constant current to 2 mA.</p> <p>    "04" sets the constant current to 4 mA.</p> <p>    "08" sets the constant current to 8 mA.</p> <p>    "12" sets the constant current to 12 mA.</p> <p>    "20" sets the constant current to 20 mA.</p>
Response String:	"0"
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: "06C02ICPM08"</p> <p>Response String: "0"</p> <p>The 443B102 in rack 0 and slot 6 is set to ICP mode and the constant current is 8 mA.</p>

## Command: SETF

Purpose:	Sets the cutoff frequency of the low pass filter.
Response:	The module responds with a "0" to tell the calling process the command has been received.
Command String:	XYC0ZSETFZ
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>SETF— Commands module to change the low pass filter setting.</p> <p>Z— specifies the low pass filter setting as follows:</p> <ul style="list-style-type: none"> <li>"0" turns the low pass filter off.</li> <li>"1" sets the low pass filter to the 100 Hz cutoff.</li> <li>"2" sets the low pass filter to the 1kHz cutoff.</li> <li>"3" sets the low pass filter to the 3 kHz cutoff.</li> <li>"4" sets the low pass filter to the 10 kHz cutoff.</li> <li>"5" sets the low pass filter to the 30 kHz cutoff.</li> <li>"6" sets the low pass filter to the 100 kHz cutoff.</li> </ul>
Response String:	"0"
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: "06C02SETF3"</p> <p>Response String: "0"</p> <p>The low pass filter of the 443B102 in rack 0 and slot 6 is set to the 3 kHz cutoff frequency.</p>

## Command: LOWF

Purpose:	Sets the low frequency response of the amplifier.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZLOWFZ		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.		
	LOWF— Commands module to change the low frequency response.		
	Z— specifies the low frequency response as follows:		
	“1” sets the low frequency response to 0.2 Hz.		
	“2” sets the low frequency response to 2.0 Hz		
	“3” engages the medium time constant.		
	“4” engages the long time constant.		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“06C02LOWF3”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is set to medium time constant mode.		

## Command: INTG

Purpose:	Engages the internal integration circuitry.
Response:	The module responds with a "0" to tell the calling process the command has been received.
Command String:	XYC0ZINTGZ
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>INTG— Commands module to engage integration circuitry.</p> <p>Z— specifies the integrator as follows:</p> <p style="padding-left: 40px;">"1" engages single integration down to 1 Hz.</p> <p style="padding-left: 40px;">"2" engages single integration down to 10 Hz.</p> <p style="padding-left: 40px;">"3" engages double integration down to 1 Hz.</p> <p style="padding-left: 40px;">"4" engages double integration down to 10 Hz.</p>
Response String:	"0"
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: "06C02INTG3"</p> <p>Response String: "0"</p> <p>The 443B102 in rack 0 and slot 6 is set to engage double integration circuitry with low frequency response down to 1 Hz.</p>

## Command: INTU

Purpose:	Sets the integration units used (SI or English).
Response:	The module responds with a "0" to tell the calling process the command has been received.
Command String:	XYC0ZINTUZ
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>INTU— Commands module to set the integration units.</p> <p>Z— specifies the integration units as follows:</p> <p style="padding-left: 40px;">"1" sets integration units to English.</p> <p style="padding-left: 40px;">"2" sets integration units to SI</p>
Response String:	"0"
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: "04C01INTU2"</p> <p>Response String: "0"</p> <p>The 443B101 in rack 0 and slot 4 is set use SI units for integration.</p>

## Command: REF1

Purpose:	Turns on the internal sinusoidal reference oscillator.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZREF1		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.		
	REF1— Commands module to turn on the internal oscillator.		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“04C01REF1”	
	Response String:	“0”	
The 443B101 in rack 0 and slot 4 is commanded to turn on the internal oscillator.			

## Command: REF0

Purpose:	Turns off the internal sinusoidal reference oscillator.
Response:	The module responds with a “0” to tell the calling process the command has been received.
Command String:	XYC0ZREF0
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>REF0— Commands module to turn off the internal oscillator.</p>
Response String:	“0”
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: “04C01REF0”</p> <p>Response String: “0”</p> <p>The 443B101 in rack 0 and slot 4 is commanded to turn off the internal oscillator.</p>

## Command: ZERO

Purpose:	Zeros the output of a 443B102 when in long time constant charge mode.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC02ZERO		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C02— Module type for the target. Only type “C02” (443B102) can accept this command since the 443B101 does not have long time constant.		
	ZERO—Commands the module to reset the charge stage.		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“04C02ZERO”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 4 is commanded to zero its output.		



## Command: ZLCK

Purpose:	Clamps the output of a 443B102 when in long time constant charge mode.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC02ZLCK		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C02— Module type for the target. Only type “C02” (443B102) can accept this command since the 443B101 does not have long time constant.		
	ZLCK—Commands the module to clamp the charge stage. <u>Note:</u> Zero lock is released upon receipt of any other valid command.		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“04C02ZLCK”	
	Response String:	“0”	
The 443B102 in rack 0 and slot 4 is commanded to clamp its output.			

## Command: NULL

Purpose:	Initiates the automated drift nulling routine when in long time constant charge mode.
Response:	The module responds with a “0” to tell the calling process the command has been received.
Command String:	XYC02NULL
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C02— Module type for the target. Only type “C02” (443B102) can accept this command since the 443B101 does not have long time constant.</p> <p>NULL—Commands the module to begin drift nulling.</p>
Response String:	<p>“0”</p> <p><u>Note:</u> subsequent commands will receive the response “NULLING”. The only way to end the nulling routine is to send a “TERM” command.</p>
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: “04C02NULL”</p> <p>Response String: “0”</p> <p>The 443B102 in rack 0 and slot 4 is commanded to begin nulling drift.</p>

## Command: TERM

Purpose:	Terminates the automated drift nulling routine when in long time constant charge mode.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC02TERM		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C02— Module type for the target. Only type “C02” (443B102) can accept this command since the 443B101 does not have long time constant.		
	TERM—Commands the module to terminate drift nulling.		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“04C02TERM”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 4 is commanded to terminate the drift nulling routine.		

## Command: OFFS

Purpose:	Sets the dc offset of the amplifier when in ICP long time time constant mode.
Response:	The module responds with a “0” to tell the calling process the command has been received.
Command String:	XYCO2OFFSXX.XXX
Description:	<p>X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C02— Module type for the target. Only type “C02” (443B102) can accept this command since the 443B101 does not have long time constant.</p> <p>OFFS— Commands the module to set the dc offset.</p> <p>XX.XXX— 6 character offset voltage. (Range: ASCII printable characters, 0 through 9). Only positive offsets are allowed, up to 20.000 volts.</p>
Response String:	“0”
Description:	This return indicates that the command was received by the card.
Example:	<p>Command String: “02C02OFFS10.361”</p> <p>Response String: “0”</p> <p>The dc offset level of the 443B102 in rack 0, and slot 2 will be set to 10.361 volts.</p>

## Command: OFF?

Purpose:	Returns the dc offset of the amplifier when in ICP long time time constant mode.		
Response:	The module responds with the 6 character dc offset voltage.		
Command String:	XYCO2OFF?		
Description:	X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C02— Module type for the target. Only type “C02” (443B102) can accept this command since the 443B101 does not have long time constant.		
	OFF?— Commands the module to return the dc offset.		
Response String:	XX.XXX		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“02C02OFF?”	
	Response String:	“10.361”	
	The dc offset level of the 443B102 in rack 0, and slot 2 is set to 10.361 volts.		

## Command: STAT

Purpose:	Returns the settings of the 443B.
Response:	The module responds with a string of the various settings delimited with semicolons.
Command String:	XYCOZSTAT
Description:	<p>X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>STAT— Commands the module to return its settings.</p>
Response String:	See next page.
Example:	See end of response string definitions for example.

## Command: STAT (continued)

Response String: Mode; Output Sensitivity; Transducer Sensitivity; Low Frequency Response; Low Pass Filter; Integration Units; Reference; Overvoltage; Fault (ICP mode only); Zero Lock (long time constant charge mode only)

Description:	Mode	CHRG	Charge mode.
		ICP 0mA	ICP mode with 0mA constant current (voltage mode).
		ICP 2mA	ICP mode with 2mA constant current.
		ICP 4mA	ICP mode with 4mA constant current.
		ICP 8mA	ICP mode with 8mA constant current.
		ICP 12mA	ICP mode with 12mA constant current.
		ICP 20mA	ICP mode with 20mA constant current.
Output Sensitivity		XX.XX mV/unit	Output sensitivity without integration.
		XX.XX mV/in/sec	Output sensitivity with single integration and English units.
		XX.XX mV/mil	Output sensitivity with double integration and English units.
		XX.XX mV/m/sec	Output sensitivity with single integration and SI units.
		XX.XX mV/mm	Output sensitivity with double integration and SI units.
Transducer Sensitivity		XX.XX pC/unit	Transducer sensitivity for a charge sensor without integration.
		XX.XX pC/g	Transducer sensitivity for a charge sensor using English units in integration mode.
		XX.XX pC/m/s <sup>2</sup>	Transducer sensitivity for a charge sensor using SI units in integration mode.
Low Frequency Response		0.2 Hz	Low frequency response 0.2 Hz.
		2.0 Hz	Low frequency response 2.0 Hz.
		Med TC	Medium time constant .
		Long TC	Long time constant.
		S Int 1 Hz	Single integration to 1 Hz
		S Int 10 Hz	Single integration to 10 Hz
		D Int 1 Hz	Double integration to 1 Hz
		D Int 10 Hz	Double integration to 10 Hz
Low Pass Filter		0.1 kHz	Low pass filter set to 100 Hz.
		1.0 kHz	Low pass filter set to 1.0 kHz.
		3.0 kHz	Low pass filter set to 3.0 kHz.
		10 kHz	Low pass filter set to 10 kHz.
		30 kHz	Low pass filter set to 30 kHz.

## Command: STAT (continued)

	100 kHz	Low pass filter set to 100 kHz.
Integration Units	SI	SI units will be used for input and output
	Eng	English units will be used for input and output sensitivities in integration mode.
Reference	Ref On Ref Off	The internal sinusoidal reference is on. The internal sinusoidal reference is off.
Overvoltage	OV=1 OV=0	The 443B is overloaded. The 443B is not overloaded.
Fault (only sent in ICP mode)	Fault=1 Fault=0	There is an open or short at the input. The sensor bias is within the acceptable range.
Zero Lock (only sent in long TC charge mode)	Zero Lock On	The reset is clamped on. Nothing is sent if zero lock is off.
Example:	Command String: Response String:	<p>“02C02STAT”            “ICP 2mA;10.00 mV/unit;            1.023 mV/unit;2.0 Hz;10kHz; SI;            Ref Off;OV=1;Fault=0;”</p> <p>The 443B102 in rack 0, slot 2 is setup as follows: ICP mode with a constant current of 2 mA, output sensitivity is 10.00 mV/unit, transducer sensitivity is 1.023 mV/unit, low frequency response is 2.0 Hz, low pass filter set to 10 kHz, integration units are SI, the internal reference is off, the unit is not overloaded, and there is no fault condition detected.</p>



Command:	TEDR	
Purpose:	Returns data stored in the TEDS sensor. Note: for sensors programmed with “Accelerometer, transfer function v0.91” (UTID 116225), use MTED in conjunction with TEDR to retrieve all of the stored data.	
Response:	The module responds with a string of data delimited with semicolons.	
Command String:	XYCOZTEDR	
Description:	<p>X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>TEDR— Commands the module to return data from the TEDS sensor.</p>	
Response String:	Manufacturer Model Number; Serial Number; Sensitivity; Reference Frequency; Calibration Date; Low Frequency Response; Output Phase; Sensitivity Direction; Measurement ID; User Data;	
Example:	Command String:	“04C01TEDR”
	Return String:	PCB 333M07; SN 17704; 100.2 mV/g; F ref 99.6; cal'd 3/21/2001; F hp 0.025 Hz; phase 0; sens dir N/A; meas ID 0; test sample 4;
	The 443B101 in rack 0 and slot 4 is commanded to return the data stored in the TEDS sensor connected to its input.	

Command:	MTED
Purpose:	Returns more data stored in the TEDS sensor . Note: sensors programmed with the “Accelerometer, transfer function v0.91” template (UTID 116225) contain more data than can be returned by the TEDR command so MTED must be used also to retrieve all of the stored data.
Response:	The module responds with a string of data delimited with semicolons.
Command String:	XYCOZMTED
Description:	<p>X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>MTED— Commands the module to return more data from the TEDS sensor.</p>
Response String:	Low pass cut-off frequency; Resonance Frequency; Quality factor; Amplitude Slope; Temperature coefficient; Reference temperature;
Example:	<p>Command String: “04C01MTED”</p> <p>Return String: F lp 10011; Fres 100336; Mounted Q 10.8; Amp Slope 1.002; Temp Coeff 0.236; Ref Temp 25.0;</p> <p>The 443B101 in rack 0 and slot 4 is commanded to return more data stored in the TEDS sensor connected to its input.</p>

## Command: TEDD

Purpose:	Returns raw hex data stored in the TEDS device.		
Response:	The module responds with the CRC followed by a 32 byte string of hex data.		
Command String:	XYCOZTEDD		
Description:	X— Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.		
	TEDD— Commands the module to return raw hex data stored in the TEDS device.		
Response String:	CRC followed by 32 bytes of hex data.		
Example:	Command String:	"04C01TEDD"	
	Return String:	C917D014D00E942200005C12EC64352D 87010000000000000000000000000000 (where C9 is the CRC byte)	

The 443B101 in rack 0 and slot 4 is commanded to turn return the raw hex data stored in the TEDS device.

## Command: TED1

Purpose:	Enables the auto TEDS normalization feature.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZTED1		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>TED1— enables the auto TEDS normalization feature.</p>		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“06C02TED1”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is commanded to enable the auto TEDS normalization feature.		

## Command: TED0

Purpose:	Disables the auto TEDS normalization feature.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZTED0		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>TED0— disables the auto TEDS normalization feature.</p>		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“06C02TED0”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is commanded to disable the auto TEDS normalization feature.		

## Command: TEDU

Purpose:	Writes to the user data field of a TEDS sensor (13 characters maximum).		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZTEDU		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>TEDU— tells the module to write to the user data field of a TEDS sensor.</p>		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“06C02TEDU13 Characters”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is commanded to write The string “13 Characters” to the user data field of a TEDS sensor.		

## Command: TMID

Purpose:	Writes a number (0 to 511) to the measurement position ID field of a TEDS sensor.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZTMID		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>TMID—tells the module to write to the measurement position ID field of a TEDS sensor.</p>		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“06C02TMID132”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is commanded to write the number 132 to the measurement position ID field of the TEDS sensor.		

## Command: TEDW

Purpose:	Writes 32 bytes of hex data to a TEDS device.		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZTEDW		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.</p> <p>TEDW— tells the module to write 32 bytes of hex data to a TEDS device.</p>		
Response String:	“0”		
Description:	This return indicates that the command was received by the card.		
Example:	Command String:	“06C02TEDWF517D014D08EC321 0000BC11C06F35718B0100202020 20202020202020202020”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is commanded to write 32 bytes of hex data to a TEDS device.		



## Command: RDAR

Purpose:	Reads the 8 bytes in the application register (or application register scratchpad if unlocked) of the TEDS chip (DS2430).		
Response:	The module responds with an 8 byte string of hex data in ASCII format.		
Command String:	XYC0ZRDAR		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>RDAR— tells the module to read the 8 bytes in the application register (or application register scratchpad if unlocked) of a TEDS device.</p>		
Response String:	8 bytes of hex data in ASCII format.		
Example:	Command String:	"06C02RDAR"	
	Response String:	"AABBCCDDEEFFAABB"	

The 443B102 in rack 0 and slot 6 is commanded to read 8 bytes of hex data from the application register of a TEDS device. The contents, "AABBCCDDEEFFAABB" are returned.

Notes:

1) After receiving the RDAR or WRAR command, the 443B will be left in TEDS mode and will not be able to power an ICP<sup>®</sup> sensor. This is because the application register memory is non-volatile when not locked so that whatever was written would be lost if the unit was returned to "analog" mode. This feature allows the host to check the data in the application register before locking it. The 'TOFF' command must be issued to return the unit to analog mode.

## Command: WRAR

Purpose:	Writes 8 bytes to the application register scratchpad of the TEDS chip (DS2430).		
Response:	The module responds with a "0" to tell the calling process the command has been received.		
Command String:	XYC0ZWRAR		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>WRAR— tells the module to write 8 bytes to the application register of a TEDS device.</p>		
Response String:	"0"		
Example:	Command String:	"06C02WRARAABBCCDDEEFFAABB"	
	Response String:	"0"	

The 443B102 in rack 0 and slot 6 is commanded to write 8 bytes of hex data ("06C02WRARAABBCCDDEEFFAABB") to the application register of a TEDS device.

Notes:

1) If the application register is locked, this command will have no effect on its contents. See STAT command description for information regarding how to determine the status of the application register.

2) After receiving the RDAR or WRAR command, the 443B will be left in TEDS mode and will not be able to power an ICP<sup>®</sup> sensor. This is because the application register memory is non-volatile when not locked so that whatever was written would be lost if the unit was returned to "analog" mode. This feature allows the host to check the data in the application register before locking it. The 'TOFF' command must be issued to return the unit to analog mode.

## Command: RDSR

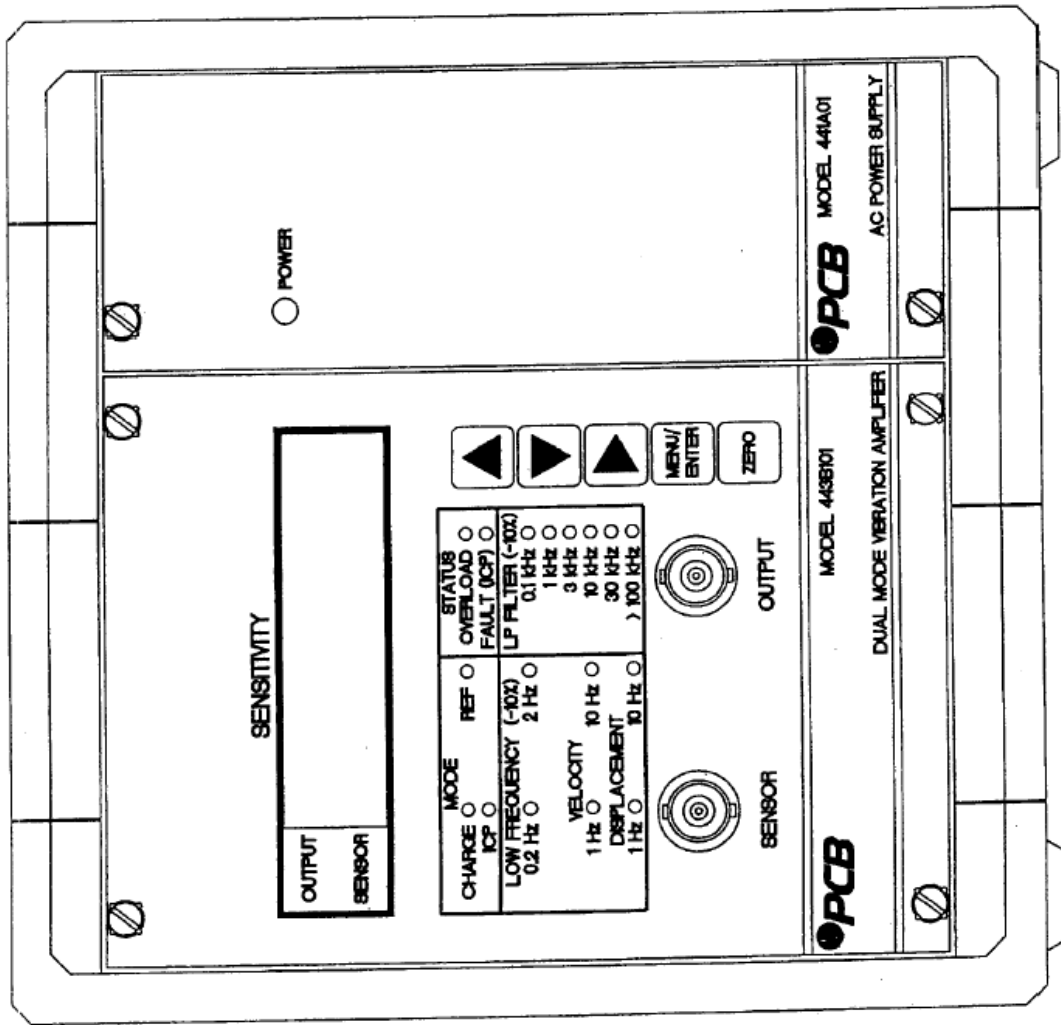
Purpose:	Reads the Status Register byte which indicates if the application register of the TEDS chip (DS2430) has been locked or not.		
Response:	The module responds with the Status Register byte which is 0xFF if the application register is unlocked and 0xFC if it is locked.		
Command String:	XYC0ZRDSR		
Description:	<p>X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)</p> <p>Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)</p> <p>C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying "C02" addresses a 443B102.</p> <p>RDSR— tells the module to read the Status Register byte.</p>		
Response String:	Status Register byte in ASCII format.		
Example:	Command String:	"06C02RDSR"	
	Response String:	"FC"	
	The 443B102 in rack 0 and slot 6 is commanded to read the Status Byte of a TEDS device. In this case, the Status Register is 0xFC, indicating that the application register is locked.		

## Command: LKAR

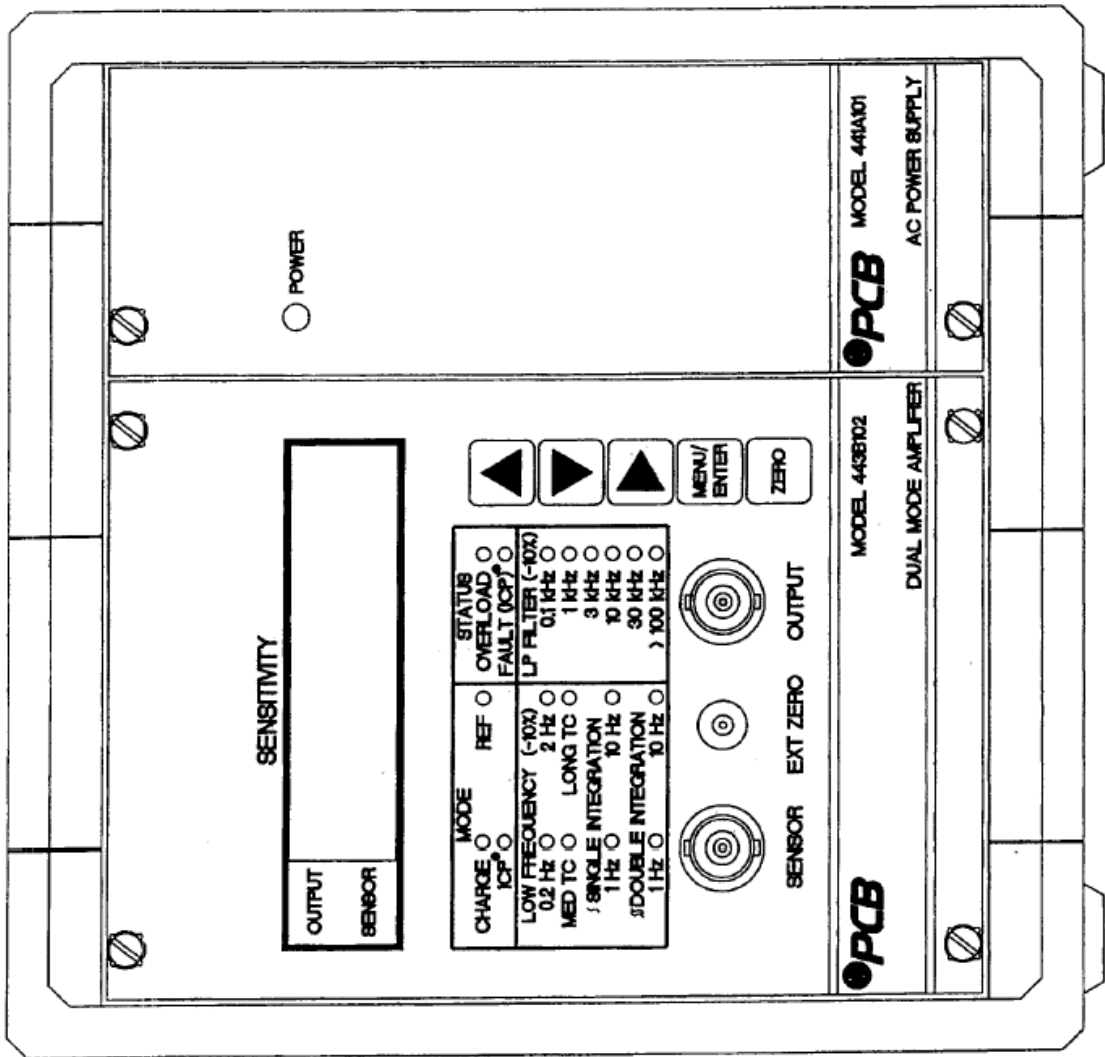
Purpose:	Permanently copies and locks the data in the application register scratchpad of the TEDS chip (DS2430) into the application register. <b>Warning:</b> <i>the application register <u>cannot be unlocked</u> after this command has been sent.</i>		
Response:	The module responds with a “0” to tell the calling process the command has been received.		
Command String:	XYC0ZLKAR		
Description:	X—Rack number of the target module (Range: ASCII printable characters, 0 through 3)		
	Y— Slot number of the target module. (Range: ASCII printable characters, 0 through 7)		
	C0Z— Module type for the target. Specifying "C01" in this argument addresses a 443B101, specifying “C02” addresses a 443B102.		
	LKAR— tells the module to permanently lock the application register.		
Response String:	“0”		
Example:	Command String:	“06C02LKAR”	
	Response String:	“0”	
	The 443B102 in rack 0 and slot 6 is commanded to lock the application register of a TEDS device.		

## **Appendix B:**

### **Figures**



Unit Face Plate (443B101)  
Figure 2

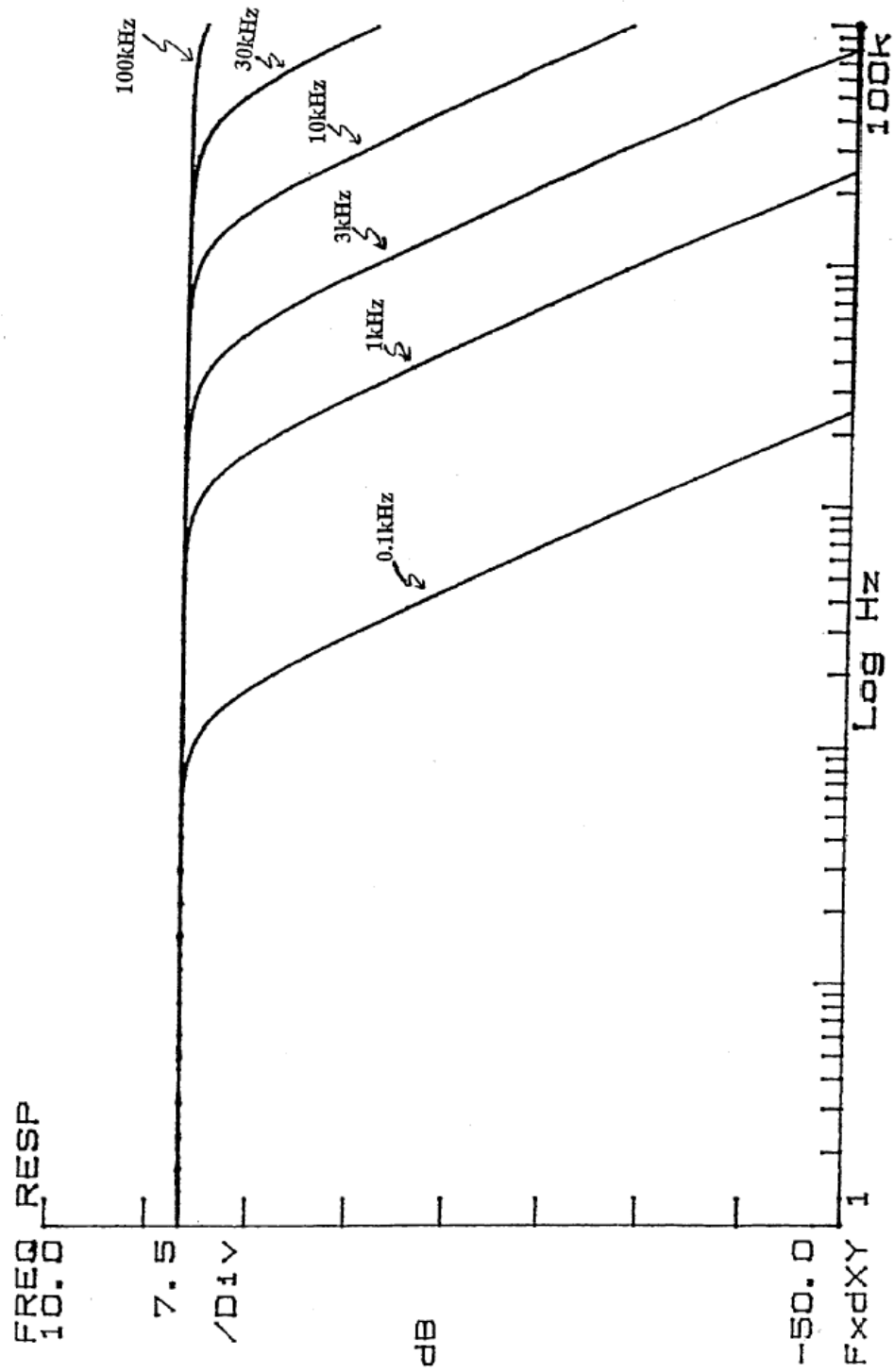


Unit Face Plate (443B102)  
Figure 3





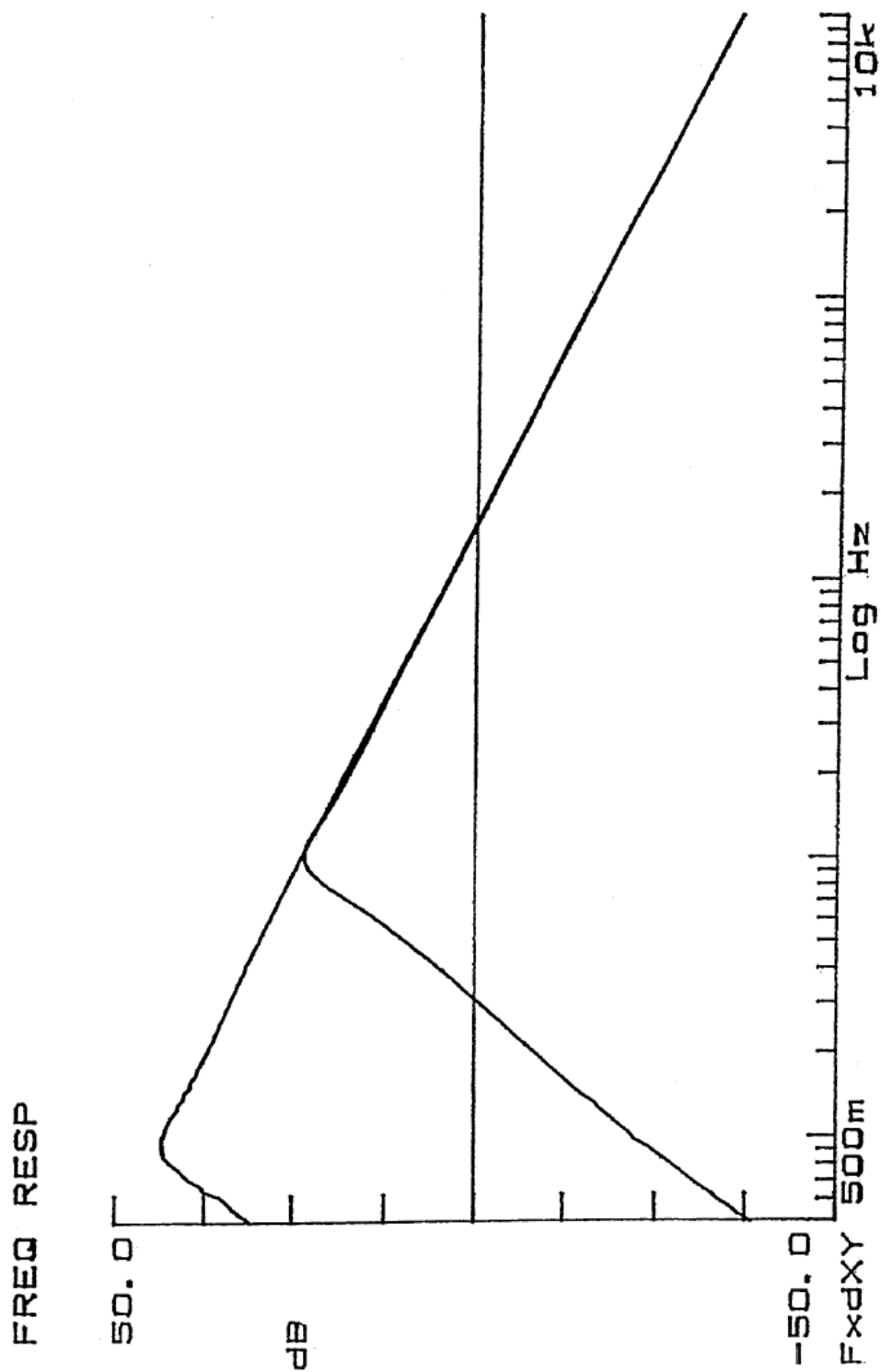
## PCB Piezotronics Model 443B Dual Mode Vibration Amplifier



Magnitude Response for Low Pass Filter in Charge Mode  
 (Output Sensitivity = 1.000 mV/unit, Sensor Sensitivity = 1.000 pC/unit, 1 nF source)  
 Figure 5

PCB Piezotronics Model 443B Dual Mode Vibration Amplifier

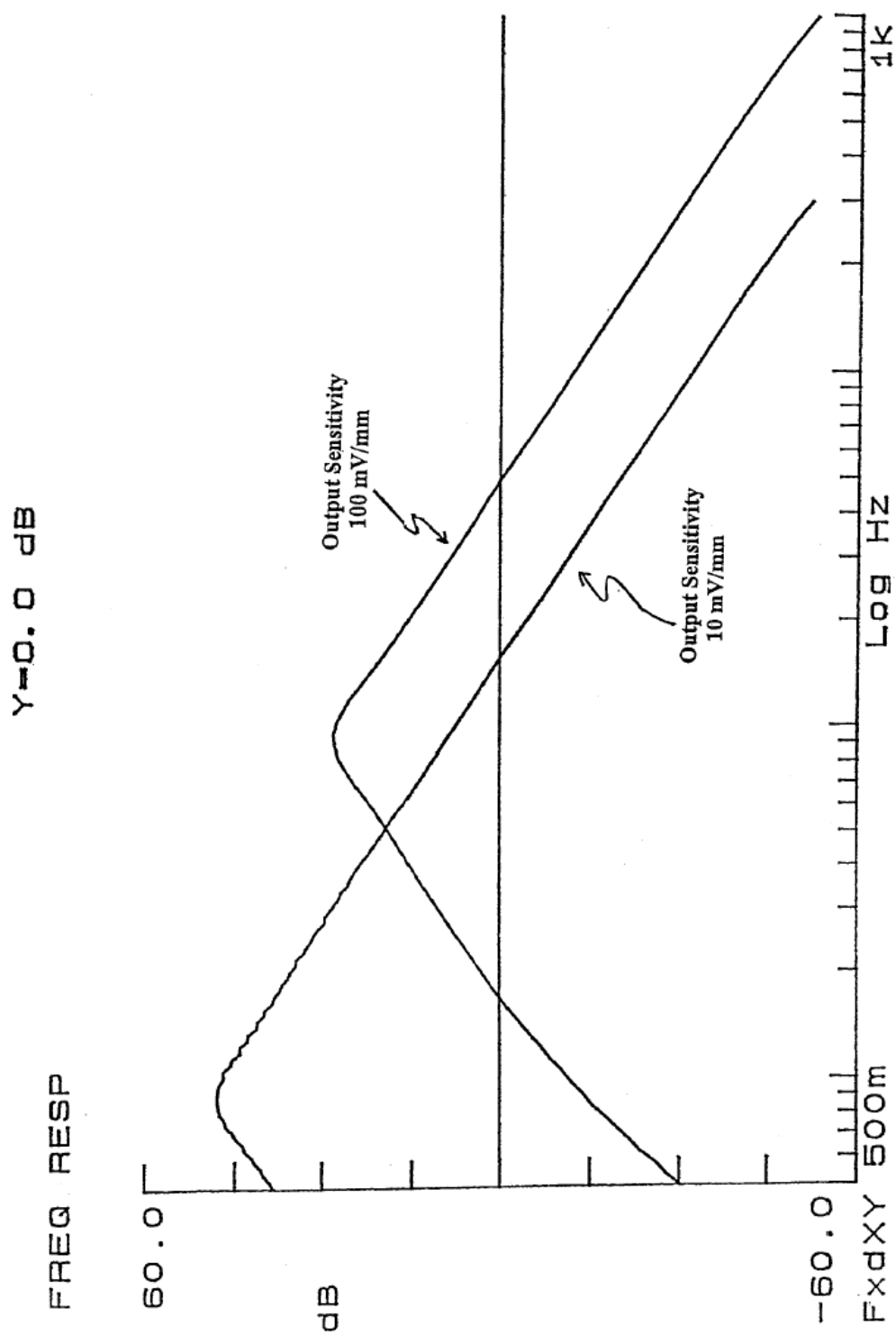
Y=0.0 dB



Velocity @ 1, 10 Hz  
(Output Sensitivity = 1000 mV/m/S, Sensor Sensitivity = 1.000 pC/m/S<sup>2</sup>, 1 nF source)

Figure 6

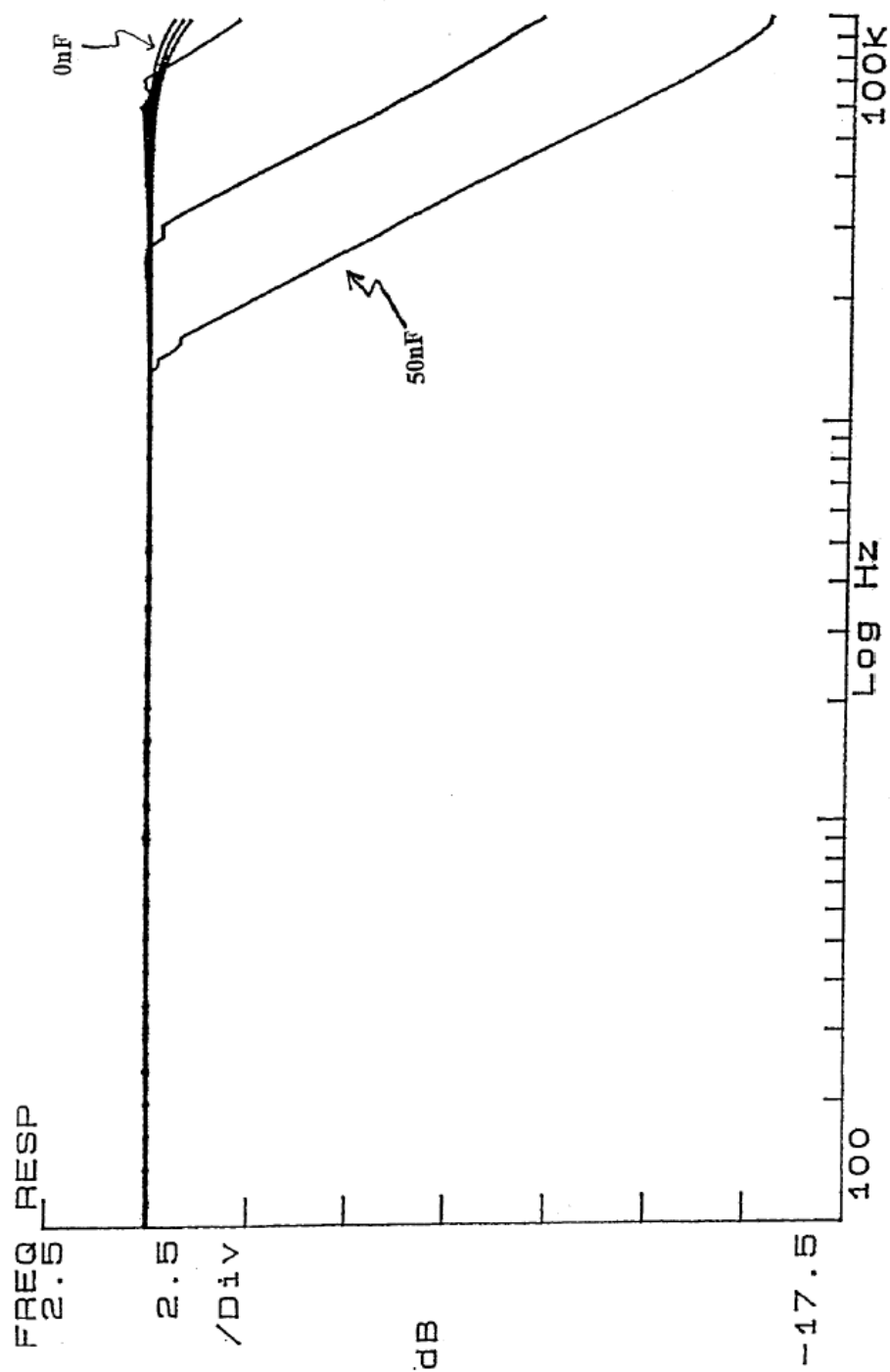
PCB Piezotronics Model 443B Dual Mode Vibration Amplifier



Displacement @ 1, 10 Hz  
(Sensor Sensitivity = 1.000 pC/m/S<sup>2</sup>, 1 nF source)

Figure 7

## PCB Piezotronics Model 443B Dual Mode Vibration Amplifier



Influence of Output Load Capacitance on Frequency Response  
(Capacitive Load = 0.5 nF, 10 nF, 20 nF, 50 nF, and 100 nF)

Figure 8

## 441A39 MULTIPLE CHASSIS CONFIGURATION

A chassis is the enclosure into which modules are inserted. Each chassis has a series of slots where a module can be inserted and plug into the backplane. The backplane is a circuit board assembly in the rear of the chassis that distributes power to the modules and provides the means by which modules communicate with each other, the rest of the system, and a personal computer.

The 441A39 is a mainframe chassis. A mainframe chassis is a chassis with on board RS-232 and RS-485 interfaces. Each mainframe chassis contains a master controller, which communicates to the computer via an RS-232 connection.

Each master controller can control up to four chassis filled with modules. Each chassis (or rack) must, however, be uniquely defined. This is accomplished by setting rack addresses. There are two jumpers on the upper right portion of the backplane labeled RAD1 and RAD0, shown on the *termination setting* drawing attached. The settings are as follows:

	RAD1	RAD0
Rack 1	Low	Low
Rack 2	Low	High
Rack 3	High	Low
Rack 4	High	High

When using a multiple chassis system, the master controller must communicate to the other modules via a common RS-485 network. This is accomplished by daisy chaining racks together through the 9 pin (male) "485 OUT" and "485 IN" connectors on the rear of the chassis. Correct terminations must be made at the beginning and the end of the network. The *multiple rack connections* drawing, attached, illustrates a four-rack configuration. Notice on the drawing, the "485 IN" connection on rack 1 requires termination, as does the "485 OUT" connection on rack 4.

The "485 IN" is terminated with the TER4, TER5, and TER6 terminators on the backplane. The "485 OUT" is terminated with the TER1, TER2, and TER3 terminators on the backplane (as shown on the *termination settings* drawing attached). The terminator settings (terminate or non-terminate) are also shown on the *termination settings* drawing.

MANUAL NUMBER: 19667  
MANUAL REVISION: NR

**APPLICATION**  
NEXT ASSY \_\_\_\_\_ USED ON \_\_\_\_\_ VAR \_\_\_\_\_ DATE \_\_\_\_\_ APP'D \_\_\_\_\_

**REVISIONS**  
ZONE REV DESCRIPTION EGN DATE APP'D

**Model 441A39**  
PCB  
485 IN  
485 OUT  
RS-232  
485 IN  
485 OUT

**Front View**

**Rear View**

**TERMINATOR SETTINGS**

TERMINATOR	1	2	3	4
TERMINATE	HI	HI	HI	HI
NON-TERMINATE	LOW	LOW	LOW	LOW

**TERMINATION SETTINGS**

TERMINATION	1	2	3	4
TERMINATE	HI	HI	HI	HI
NON-TERMINATE	LOW	LOW	LOW	LOW

**NOTE:** 485 IN Terminates with TER4, TER5, and TER6. 485 OUT Terminates with TER1, TER2, and TER3.

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APPLICATION			REVISIONS		
NEXT ASS'Y	USED ON	VAR	REV	DESCRIPTION	DATE

RACK 4

RACK 3

RACK 2

RACK 1

**NOTE:**  
TERMINATION  
IS REQUIRED  
ON THIS SIDE  
OF THE  
CHASSIS

**NOTE:**  
TERMINATION  
IS REQUIRED  
ON THIS SIDE  
OF THE  
CHASSIS

UNLESS SPECIFIED TOLERANCES  DIMENSIONS ARE IN INCHES DECIMALS: XX ±.01 XXX ±.005 ANGLES: ±2 DEGREES FILLETS AND RADII .003 - .005 EF-003 REV.NR	MATERIAL	DRAWN	MFG	CAGE CODE: 0X6U3 DWG. NO.
	HEAT TREAT	CHK'D	ENGR	
	FINISH	TITLE		
	MULTIPLE RACK CONNECTIONS			