

MODEL 433
Three Channel
PE/Smart Transducer/ISOTRON® Signal Conditioner

INSTRUCTION MANUAL

E

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INSTRUCTION MANUAL**

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1. INTRODUCTION

ENDEVCO[®], a leader in the vibration measurement field since 1951, has contributed many firsts in vibration sensor design. These include: the first piezoelectric accelerometer capable of continuous operation from cryogenic temperatures up to +750°F, the first shear design accelerometer and the world's smallest piezoelectric accelerometer. To support a broad family of vibration transducers, ENDEVCO has provided a wide variety of signal conditioners, including the first transistorized charge amplifier, the first computer-programmable charge amplifier and the first airborne vibration monitoring system that is based on a true digital tracking filter.

Other support systems include the introduction of the first Laser Interferometer absolute calibration system. Endevco is a pioneer in the science of Micro-Electro-Mechanical Systems (MEMS) design and manufacturing. Endevco provides various sensor technologies to include Gyro, Variable Capacitance and silicone Pressure Transducers.

1.1 SIGNAL CONDITIONERS

To support the use of its sensors in large scale testing, ENDEVCO has developed several generations of signal conditioning systems. Until recently, a state-of-the-art vibration laboratory set-up consisted of a rack of manually controlled signal conditioners. These signal conditioners have manually controlled switches and knobs to set full scale ranges, sensitivity and filter corners and the set up information is recorded by hand.

1.2 COMPUTER CONTROLLED SIGNAL CONDITIONERS

To support the use of its sensors in large scale testing, and to eliminate the risk of incorrect amplifier settings, ENDEVCO has developed several generations of computer-controlled signal conditioning systems. The first generation was the Multi-channel Amplifier Control system (MAC). The second generation was the Computer Controlled Amplifier Systems (CCAS). The CCAS family consists of five different systems that use the same rack and digital interface assemblies with different analog boards. These units receive their setup commands over an IEEE-488 interface bus from a computer/controller, so the tests can be pre-programmed. In addition, these units provide comprehensive self-test and self-calibration capabilities, which greatly improves the reliability of the test data. User feedback indicates these units pay for themselves by shortening test cycles, preventing re-tests and eliminating over-testing.

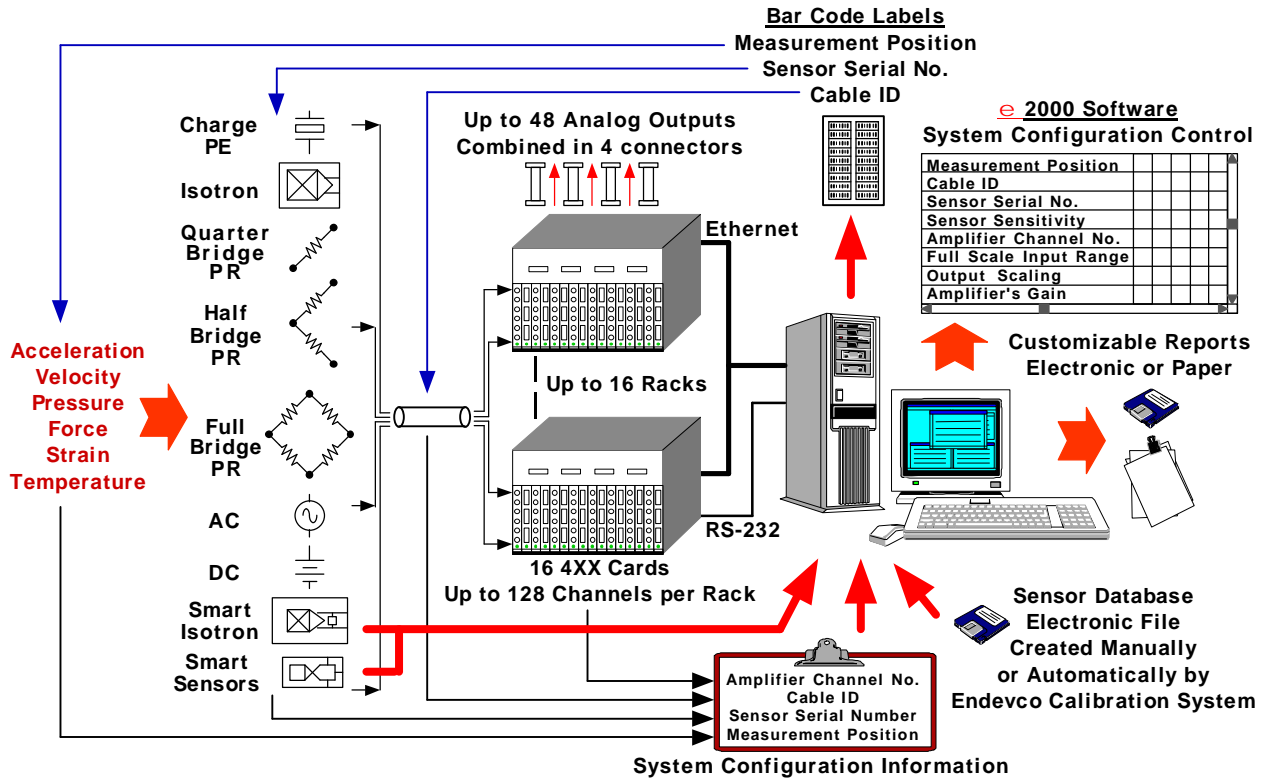
ENDEVCO is pleased to announce the third generation of computer controlled signal conditioners: the OASIS 2000 (Optimal Architecture Sensor Interface System). Utilizing Ethernet or EIA232 bus control, SMART Transducer technology, and a wide variety of signal conditioning modules, the OASIS 2000 will meet all the requirements of multi-channel testing.

1.3 OASIS 2000 HARDWARE

The OASIS 2000 system provides a flexible modular multi-channel measurement system that can interface to multiple sensor types (charge, voltage, full, half, quarter bridge PR, VC, ISOTRON[®], or IEEE 1451.4 compatible Smart ISOTRON[®]).

The OASIS 2000 system can be customized to meet most requirements and is adaptable to the developing needs of the user by using any combination of the 400 series signal conditioning cards housed in a 16 slot, 19" rack or 4 slot, 19" rack.

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1.4 OASIS 2000 SOFTWARE

The OASIS 2000 Configuration Editor software was developed to configure Model 400 series signal conditioners and amplifiers.

- Intuitive, simple to use, graphical interface provides quick configuration for up to 2048 channels.
- Ethernet (one or more 4990A racks) or RS232 (single 4990A rack communications.)
- Communicates with 1451.4 Transducer Electronic Data Sheet (TEDS) sensors with TEDS capability. Writes 1451.4 'User Data' (up to 8 characters) to TEDS capable sensors.
- Automatic Sensor Calibration due warnings.
- Customizes easily to user defined row definitions allowing for consolidation of all relevant information in a single file.
- Configuration table data imports easily into MS Excel spreadsheets.
- Convenient 'Online', 'Offline' modes to facilitate setup prior to hardware installation or to configure different setups without affecting the hardware.

1.5 MODEL 433 INTRODUCTION

The ENDEVCO® Model 433 Isotron/Charge Amplifier is a three-channel signal conditioner designed for use with piezoelectric accelerometers, ISOTRON accelerometers, and remote charge converters. The unit provides an AC output proportional to the AC input.

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The Model 433 Signal Conditioner has a 4-pole Butterworth lowpass filter installed in each channel. 20 different corner frequencies are available with 10 kHz set as default. A fixed 10 Hz 4-pole Butterworth high-pass filter can be selected or bypassed.

The Model 433 Signal Conditioner is designed for use with the Model 4990A 19" Rack. The Model 433 must be remotely programmed, as there are no front panel controls.

The ENDEVCO® Model 433 permits the user to read/write sensor-specific digital data in the form of a TEDS (Transducer Electronic Data Sheet, per IEEE-1451.4) from "smart transducers" that have TEDS capability.

Utilizing this technology, data, such as transducer sensitivity, manufacturer, serial number, date of last calibration, sensor location, and more can be obtained from the smart transducer and used for the following applications:

- Automatic gain selection for signal conditioner based on transducer sensitivity
- Automatic transducer identification
- Automated logging and/or scheduling for maintenance and calibration

Up to sixteen (16) Model 433 units can be installed in a Model 4990A 19" rack to provide 48 channels per rack.

1.6 KEY FEATURES

- Three-Channel Piezoelectric/Isotron Signal Conditioner
- 150 kHz Bandwidth (-3dB corner)
- Field Programmable 4-Pole Low Pass Filter Header
- Built-in 4-Pole Butterworth High-Pass Filter
- Fault indicator for open/short at the Isotron input
- Digital Communication with smart Isotron sensors
- Digital OutCal ID on Each Analog Output for Self-Identification
- Gain range from 0 to 1000
- Ethernet or RS-232 Interface through 19" 4990A Rack
- Selectable excitation current 8.5mA or 4.3mA
- External Calibration Input routed to the 433 from the Cal Input BNC on the 4990A rack

2. FUNCTIONAL CHARACTERISTICS

The functions are remotely programmable through the RS-232 or Ethernet. The same set of functions is available for each channel. The users can query/program the following functions for each of the three (3) channels:

- Input Select
- Current Excitation
- Sensor Sensitivity
- FS Output Range

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- HP Filter
- LP Filter
- Modes
 - Store in non-volatile memory
 - Reset,
 - Recall factory default settings,
 - Read/write calibration constants,
 - Read status/error,
 - Read digital rms or peak output signal.

The unit stores the settings of the functions in its internal memory and at power-up automatically restores the settings from the last session.

2.1 CHANNEL PROGRAMMING

The following functions are programmed via the RS232 or Ethernet interface with a computer:

1. Input Select
2. Isotron Current Excitation
3. Sensor Sensitivity
4. Full-Scale Output Range
5. Full-Scale Input Range,
6. Highpass Filter,
7. Lowpass Filter,
8. Modes.

2.1.1 Input Select

Selects the type of input to be enabled

- "Chrg": BNC Input set for piezoelectric PE/quartz sensors that produce a charge type output.
- "Volt": Excitation current disabled. BNC Input set for sensors/devices with voltage (AC) type output.
- "4.3": Excitation current set to 4.3 mA. For Isotron/RCC type devices
- "8.5": Excitation current set to 8.5 mA. For Isotron/RCC type devices
- "Ext_Cal": AC voltage signal from Model 4990A "Cal Input" BNC is routed to the Model 433. Sensor Input is disconnected, Isotron current excitation is disabled (0 mA).

The open/short circuit detection for the Isotron input will generate an error message if either "4.3mA", or "8.5mA" is selected and the DC bias voltage at the sensor input is lower than 1 V $\pm 10\%$ or higher than 19.8 V $\pm 5\%$.

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2.1.2 Sensor Sensitivity

Enters the sensitivity of the transducer (mV/EU or pC/EU). The Model 433 uses this information to determine the gain needed to achieve the required output scaling. The user can enter four significant digits ranging from 0.001 to 9999.

2.1.3 Full Scale Output Range (V)

The Full Scale Output is the maximum signal amplitude, in volts, at the output of the Model 433 when a signal level equal to the Full Scale Input setting is applied. The user programs three significant digits ranging from 0.5 to 10.0 in 0.5 steps.

If the Full Scale Output is incremented to the point where Amplifier's Gain is greater than 1000, the 433 amplifier will temporarily set an error message to indicate that the Full Scale Input Range has been modified to meet the Gain < 1000 constraint (Maximum Gain Limit Error).

2.1.4 Full Scale (FS) Input Range (EU)

Sets the maximum full scale input in Engineering Units (EU) that will be applied to the sensor. The maximum signal amplitude that will be applied to the input of the amplifier is given by multiplying FS Input Range by the sensitivity of the sensor.

The user can program four significant digits ranging from 0.001 to 1,000,000.

1. Determine the expected full scale EU input.
2. Divide the desired full scale output mV by the full scale EU input. The result is the number to be entered as Output Scaling.

$$\text{Output Scaling} = \frac{\text{Full Scale Output (mV)}}{\text{Full Scale Input (EU)}}$$

The 433 automatically divides the output scaling by the accelerometer's sensitivity to set the amplifier's gain such that the output scaling equals the overall sensitivity of the system. The amplifier's gain is not displayed.

In the example below we have an accelerometer with a sensitivity of 25 mV/EU, we expect no more than 10 EU's to be felt by the accelerometer, and we want those 10 EU's to be represented by 10,000 mV. This allows for the best system resolution.

Desired full scale voltage (mV)	10,000.00
Full scale EU's	10.00
Number for output scaling	1,000.00
Accelerometer sensitivity (mV/EU)	25.00
Amplifier's gain (mV/EU)	40.00

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The user can enter four significant digits ranging from 0.001 to 9999 limited by the following constraint.

$$0 \leq \frac{\text{Output Scaling}}{\text{Sensor Sensitivity}} \leq 1000$$

An error will occur if a number is entered in output scaling that falls outside this constraint. The 433 will enter the minimum or maximum number allowed.

The entry in Full Scale Input Range is modified automatically by the card if either Sensor Sensitivity or Full Scale Output Range causes the card to compute an amplifier's gain > 1,000.

2.1.5 Highpass Filter

This function selection provides for enabling or disabling the built-in 10 Hz 4-pole Butterworth High-Pass filter. The following messages will be programmed: (1) "OFF", and (2) "10.0".

1. "OFF": High-pass filter disabled.
2. "10.0": 10 Hz high-pass filter enabled.

2.1.6 Lowpass Filter

This function selection provides for enabling or disabling the built-in 4-pole Butterworth Low-Pass Filter (set by header module 31875). The following messages will be programmed: (1) "OFF", and (2) "XX.XX".

1. "OFF": Low-pass filter disabled.
2. "XX.XX": Low-pass filter enabled. XX.XX represents the corner frequency in kHz.

The unit displays the actual corner frequency in each channel by reading an ID Voltage (VID) set by the header module that sets the -3dB corner frequency of the low-pass filter. VID ranges from 0 to 2 VDC. The default 10 KHz LPF will be installed as a standard LPF.

2.1.7 Modes

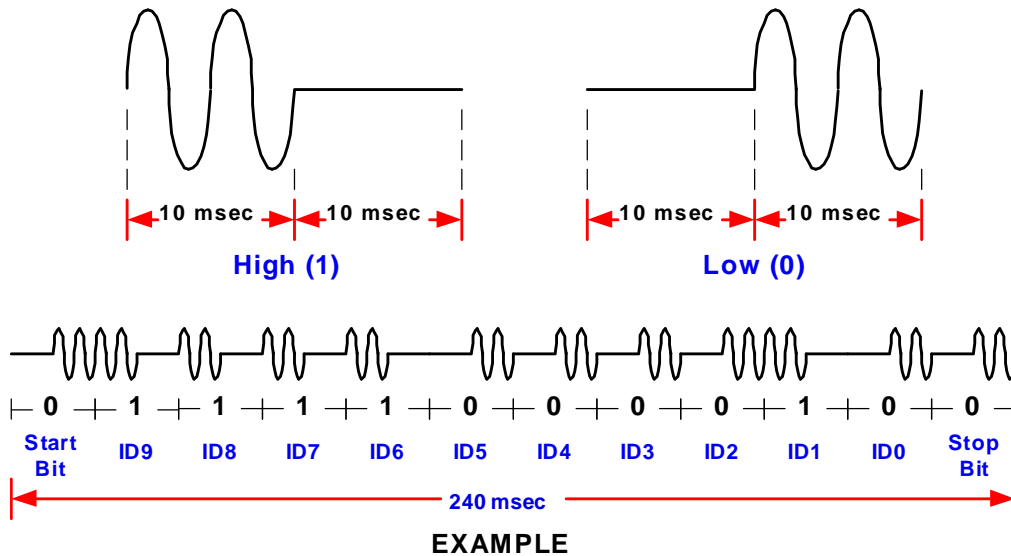
This function is used for selecting the following modes of operation:

"Normal": This mode is placing the CPU in idle mode in order to minimize power consumption and digital noise in the card.

"Out-Cal": AC Output of the corresponding channel provides a 170 Hz signal with an amplitude (V_{pk}) equal to the value entered in "Full Scale Out A Range".

"Out-Cal ID": AC Output of the corresponding channel provides a 10-bit ID assigned by the OASIS 2000 controller software. The ID is encoded by turning on (1) and off (0) the 170 Hz test signal. The sequence of the bits are: start bit (1), ID (most significant bit first), stop bit (1). 1's are represented by a transition from on to off (1 to 0). 0's are represented by a transition from off to on (0 to 1). Figure 1 shows the waveform representation of a logic "1" and a logic "0". Total transmission time will be 240 msec.

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The Endevco Model 433 can be programmed via the serial interface (RS-232) or Ethernet port of any PC connected to the Model 4990A Rack. All settings, such as gain, output scaling, current excitation etc. and all status information, such as faults, operating modes etc. are accessible via remote control.

When the Model 433 is not communicating with the PC, it will enter a low-power/low-noise mode. This design feature, along with the optimized layout and the low number of amplifier and buffering stages allows for extremely low noise operation.

2.2 STATUS INDICATION

A fault indicator on the front panel will emit green light if the card is operating normally. It will turn red if any of the 8 ISOTRON® inputs are either open or short-circuited. The user can turn off fault reporting for any of the 8 channels if desired.

2.3 COMMUNICATION WITH THE MODEL 4990A RACK

The Model 4990A Rack has a standard RS-232 serial interface via the 96-pin DIN connector located on the rear side. This interface was chosen because almost any commercially available PC provides this interface. Thus, standard PC's can be used without having to purchase upgrades and/or install hardware.

The model 4990A is also offered with an Ethernet option. Communication speed is greatly improved when communicating to multiple racks.

The following functions can be executed through the serial interface from the PC:

- Identification of the Unit Model Number, firmware revision, slot in rack, calibration date
- Configuration of the rack (number of installed cards)
- Read/Write settings for all of the programmable functions.

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- Read/Write calibration constants. The new calibration constant will take effect immediately and it will be stored into non-volatile memory.
- Query error list.
- Reset the unit.
- Query and program sensor-related data for each channel.
- Update of operational code through serial interface (“download”)

2.4 SMART TRANSDUCER COMMUNICATION

The communication-capability of the transducer is provided by a memory chip in the transducer itself and circuitry in the Model 433 that can establish a data communication with the memory chip.

Like a regular ISOTRON® sensor, the smart ISOTRON® contains an accelerometer and a charge amplifier. The charge amplifier is powered by direct current (4mA) provided by the Model 433 signal conditioner. The amplified sensor signal modulates the voltage of the supply current. This modulation is amplified by the signal conditioner when it is in normal operation.

The digital communication capability of the transducer does not interfere with its normal operation. This is achieved by separating the transducer with a diode that is operating in forward direction during normal operation. During the communication between the smart ISOTRON® and the signal conditioner, the transducer supply voltage is reversed thus disabling the transducer output.

Conversely, a semiconductor chip (Dallas DS2430A) providing 256 bits of EEPROM memory is separated from the transducer output with a diode during normal operation and activated when the transducer supply voltage is reversed. This chip is capable of communicating with the signal conditioner via the Dallas Semiconductor ®1-Wire Protocol ® that permits read and write operations from and to the memory chip.

The 1-wire protocol consists of a series of TTL-level pulses on the signal wire that have to be precisely timed in order to be interpreted properly by the DS2430A chip. Each channel can be switched to the communication mode separately. However, the extremely good noise characteristics cannot be guaranteed for the remaining channels that are operated in normal mode while communicating with a smart transducer.

When TEDS information is selected by the user for a sensor connected to an input channel of a Model 433, the software will automatically switch the corresponding channel to communication mode and obtain all sensor-related data stored in the smart transducer. This information will be displayed on the screen of the PC and will also be used for further processing.

Note: In TEDS mode, the sensor current will be disabled. Thus, all channel outputs will experience disruption of the signal.

2.5 SPECIAL PROGRAMMED FUNCTION

The special functions are not frequently used and they may be programmed by user.

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2.5.1 Error List (TBD)

Error reporting can be disabled on a per channel basic. User can clear any individual error flag through the digital communication port.

- a) EEPROM_WRITE_ERR (Status bit No.0)
- b) EEPROM_CHAN_SETUP_READ_ERR (Status bit No.1)
- c) EEPROM_CHAN_CALCONST_READ_ERR (Status bit No.2)
- d) RAM_ERR (Status bit No.3)
- e) ROM_ERR (Status bit No.4)
- f) SERIAL_MSG_ERR (Status bit No.5)
- g) GAIN_EXCEEDED_ERR (Status bit No.6)
- h) OUT_OF_RANGE_ERR (Status bit No.7)
- i) OPEN_SHORT_ERR (Status bit No.8)
- j) EEPROM_CALS_DEFAULT_ERR (Status bit No.9)
- k) MLAN_2430_BURN_ERR (Status bit No.10)
- l) MLAN_SPAD_WRITE_ERR (Status bit No.11)
- m) DS2480_DETECT_ERR (Status bit No.12)
- n) AUTORANGE_HIGH_ERR (Status bit No.13). Not available for 433
- o) AUTORANGE_LOW_ERR (Status bit No.14). Not available for 433
- p) DCDC_CONVERTER_ERR (Status bit No.15)

2.5.2 Reset

This special mode selection allows the user to reset the unit (equivalent to a power-up initialization).

After this special mode is programmed, the unit returns to the normal mode of operation immediately after initialization.

2.5.3 Store Setup in EEPROM

This special mode selection allows the user to force the unit to store all of the function settings into non-volatile memory. The unit then returns to the normal mode of operation immediately after writing all of the function settings into non-volatile memory.

2.5.4 Recall Default Setup

This special mode selection allows the user to recall the default function settings.

Function	Factory Default Setting
1. Input Select	Volt (Isotron)
2. Current Exc. (mA)	0.0 (off)
3. Sensitivity	1.000
4. Full-Scale Output	1.000
5. Full-Scale Input	1000
6. HP Filter	10.0 (on)
7. LP Filter	XX.XX (on)
8. Mode	Normal

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2.6 CALIBRATION

Calibration coefficients are stored in each card's internal non-volatile memory, and they can be read or written by a host remote computer.

The gain calibration constants are calculated by using the following general calibration procedure:

Set the gain of the amplifier somewhere within the gain range that the calibration constant is going to be applicable.

Inject a reference signal (measured with a calibrated voltmeter) with the proper amplitude and a frequency somewhere within the flat passband of the amplifier.

Measure the output signal with the same calibrated voltmeter to determine the % deviation from the ideal desired measurement.

Calculate the new calibration constant as follows:

$$\text{New Cal Constant} = \text{Original Cal Constant} * \left(\frac{\text{Ideal Desired Measurement}}{\text{Actual Measurement}} \right)$$

Write the corresponding calibration constant into the amplifier's internal non-volatile memory.

Verify that the amplifier outputs the desired signal level.

A checksum for the calibration constants is stored in non-volatile memory. The card will use this checksum at power up to verify that all calibration constants are good. The card will declare an error if the checksum test for the calibration constants fails.

A reference table for the calibration constants are designed in the 433 as following.

Calibration Constant	Input Select	Gain
k1 for 100 < Gain < 1000	Volt	200
k2 for 10 < Gain < 100	Volt	20
k3 for 0 < Gain < 10	Volt	2
k4 for 0 < Gain < 10	Chrg	2
K5 for 0 < Gain < 10	OutCal	2
K6 to calib. digital RMS slope	Volt	2 & 1
K7 to calib. digital RMS offset	Volt	1
K8 to calib. digital PEAK slope	Volt	2 & 1
K9 to calib. digital PEAK offset	Volt	1

2.6.1 Gain Calibration

Calibration constants k1 through k5 are used to calibrate the gain of the unit. This is accomplished by applying a 300 Hz calibration signal into the Isotron input for k1, k2, and k3, or into the Charge input for k4, and adjusting the calibration constant displayed on the OASIS 2000 Software

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Controller until the desired output (input signal multiplied by gain) is obtained. The amplitude of the input signal should be set to 30.0 mVRMS for k1, 0.300 VRMS for k2, 3.00 VRMS for k3, and 3000 pC-RMS for k4 (3.0 VRMS into a 1000 pF series capacitor).

2.6.2 OUTCAL Calibration

Calibration constants k5 is used to calibrate the OUTCAL gain of the unit. This is accomplished by activating an internal oscillator signal and adjusting the calibration constant displayed on the OASIS 2000 Software Controller until the desired output (1 V FS Output multiplied by gain) is obtained.

2.6.3 Digital RMS Reading Calibration

Calibration constants k6 and k7 are used to calibrate the Analog to Digital converter of the unit. The following procedure must be followed to accomplish this calibration:

Set the UUT for gain=1 and apply an approximately 3 Vrms at 300 Hz calibration signal into the Volt. Record the RMS OASIS reading (y1) and output reading by DVM (x1).

Set the UUT for gain=2 and apply an approximately 3 Vrms at 300 Hz calibration signal into the Volt. Record the RMS OASIS reading (y2) and output reading by DVM (x2).

Then compute the slope by $m = (y2-y1)/(x2-x1)$ and offset $b = y1-(m)x1$.

Using low-level command from OASIS, write slope and offset cal-constant numbers to properly channel respectively.

Note: Before performing digital RMS reading calibration, user must reset K6=1 and K7=0

2.6.4 Digital PEAK Reading Calibration

Calibration constants k8 and k9 are used to calibrate the digital Peak reading of the unit. The following procedure must be followed to accomplish this calibration:

Set the UUT for gain=1 and apply an approximately 3 Vrms at 300 Hz calibration signal into the Volt. Record the PEAK OASIS reading (y1) and output reading by DVM (x1).

Set the UUT for gain=2 and apply an approximately 3 Vrms at 300 Hz calibration signal into the Volt. Record the PEAK OASIS reading (y2) and output reading by DVM (x2).

Then compute the slope by $m = (y2-y1)/(x2-x1)$ and offset $b = y1-(m)x1$.

Using low-level command from OASIS, write slope and offset cal-constant numbers to properly channel respectively.

Note: Before performing digital Peak reading calibration, user must reset K8=1 and K9=0

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3. INSTALLATION AND OPERATION

3.1 INTRODUCTION

This section contains information on the incoming inspection, installation and checkout of the Model 433.

3.2 UNPACKING AND INSPECTION

WARNING

OBSERVE SOUND ESD PRECAUTIONS WHEN UNPACKING AND HANDLING THE MODEL 433

The Model 433 has been thoroughly tested at the factory before shipment and should be ready for operation when received. However, an inspection should be made to ensure that no damage occurred during shipment.

The Model 433 signal-conditioning module is shipped with its instruction manual in one packing box. Carefully unpack and check all items for shipping damage. Any obvious damage should be immediately reported to the carrier and no attempt should be made to operate the equipment. Also, carefully compare each item shipped in its packing box against the Packing List and notify the factory if any discrepancies are discovered.

It is recommended that all packing material be retained for future use.

3.3 INSTALLATION

The Model 433 is designed to be installed and operated in the ENDEVCO Model 4990A series rack utilizing SW2000 configuration editor software or SW400 matrix view software.

Install the Model 433 signal-conditioning module into the front side of the 4990A.

Carefully align the module with the card guides, push the module into the rack and secure it with the attached mounting screws. Check that all modules are secure in the rack.

3.4 PREPARATION FOR OPERATION

Prior to operating the Model 4990A the operator should verify the DIP switch setting per the following instructions. (Refer to IM4990A for further information)

3.4.1 BAUD RATE AND SIGNAL ROUTING SELECTION

Baud Rate and Signal Routing is selected through two 8-position DIP switches, located on the card-side of the back plane, accessible from the front side of the unit. To access the DIP switches, the card in slot 16 must be removed. The DIP switches offer three modes of operation:

- 4990A-2 mode: Serial connector on front panel connected to back plane for RS232 operation
- 4990A-1 mode: Serial connector of EDAS controller connected to back plane for ethernet operation. Optionally, the back plane signals may be monitored via the front panel serial connector.
- EDAS configuration mode: Serial connector on front panel connected to EDAS controller. This setting is to be used when configuring the ITP address and other characteristics of the EDAS controller.

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The baud rate of the rack is determined by position 8 of switch S2. It is also possible to accommodate reversed TX/RX cables (null-modem cables) using positions 1 and 2 of S2.

3.4.2 DEFAULT DIP SWITCH SETTINGS FOR RS-232 RACK (4990A-2):

POS	S1 SWITCH SETTING	REMARK	S2 SWITCH SETTING	REMARK
1	ON	front panel RX ← → back plane RX	OFF	(use POS1 ON for reversed cable, TX ← -> RX)
2	OFF		OFF	(use POS2 ON for reversed cable, RX ← -> TX)
3	OFF		ON	straight cable (TX ← → TX)
4	ON	front panel TX ← → back plane TX	ON	straight cable (RX ← → RX)
5	OFF		X	
6	OFF		X	
7	X		X	
8	X		ON	baud rate = 9.6 kbd (OFF for 19.2kbd)

3.4.3 DEFAULT DIP SWITCH SETTINGS FOR ETHERNET RACK (4990A-1):

POS	S1 SWITCH SETTING	REMARK	S2 SWITCH SETTING	REMARK
1	OFF	(ON for snoop mode)	OFF	
2	ON	EDAS RX ← → back plane RX	OFF	
3	OFF		OFF	(ON for snoop mode)
4	OFF	(ON for snoop mode)	OFF	(ON for snoop mode)
5	ON	EDAS TX ← → back plane TX	X	
6	OFF		X	
7	X		X	
8	X		OFF	baud rate = 19.2 kbd

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In snoop mode, the serial signals generated by the cards will appear on the RX pin of the front panel and the serial signals generated by the EDAS controller will appear on the TX pin of the front panel. This can be used for monitoring purposes. In this mode, only "listening" devices (i.e. RX inputs) may be connected to the serial connector on the front panel. TX outputs, i.e. devices that actively drive RS-232C signals, will interfere with the communication between the EDAS controller and the card. Jumper Settings for EDAS Configuration are listed in the table below. After configuring the EDAS controller, S1 and S2 must be switched back to the 4990A-1 default settings.

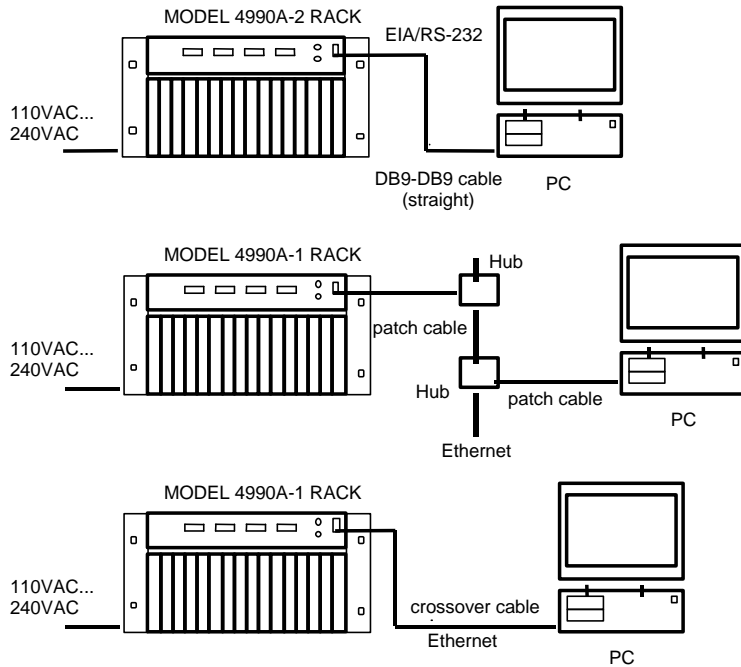
3.4.4 OPTIONAL DIP SWITCH SETTINGS FOR EDAS CONFIGURATION ONLY (4990A-1):

POS	S1 SWITCH SETTING	REMARK	S2 SWITCH SETTING	REMARK
1	OFF		OFF	
2	OFF		OFF	
3	ON	EDAS RX ← → front panel RX	ON	EDAS TX ← → front panel TX
4	OFF		ON	EDAS RX ← → front panel RX
5	OFF		X	
6	ON	EDAS TX ← → front panel TX	X	
7	X		X	
8	X		X	baud rate = 9.6 or 19.2 kbd

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3.4.5 CONNECTION OF MODEL 4990A WITH PC.

Connect the Model 4990A rack to your PC in one of the three configurations shown below. Connect the host computer interface cable to the RJ45 connector (4990A-1) or the 9 pin "D" connector (4990A-2). Refer to IM4990A.



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3.4.6 POWERING UP OF THE RACK ASSEMBLY

WARNING:

PRIOR TO INSERTING THE POWER CORD INTO THE POWER ENTRY MODULE, VERIFY THE FOLLOWING:

- POWER SOURCE IS BETWEEN 90 AND 264 VAC, 50 TO 440 Hz.
- THE INSTALLED FUSE IS THE SAME RATING AS LABELED ON THE RACK NEXT TO THE POWER ENTRY MODULE.
- COMMON CONNECTION (THIRD WIRE) OF THE POWER SOURCE IS CONNECTED TO EARTH GROUND.

Power up the Model 4990A by activating the switch on the power entry module. Verify the fan is operating. Verify the LED on the front of the Model 433 is lit.

CAUTION: The channel settings of the signal conditioning modules are not automatically stored in non volatile memory. If power is removed from the Model 4990A rack, or a signal conditioning module is removed while the rack is powered up, (not recommended) all channel settings will revert to whatever was last saved in non-volatile memory. Refer to IMSW2000 for instructions on saving the rack configuration to a file, or writing the individual module setup in EEPROM.

3.4.7 RUNNING THE OASIS 2000 SOFTWARE

OASIS 2000 Overview

The OASIS 2000 software works with all Endevco Model 4xx Series rack mounted signal conditioner and amplifier units. The Model 433 falls into this category.

Configuration Limits

The software can configure up to a maximum of 16 racks with up to 16 units in each rack. If 16 racks contained 16 Model 433 units then the channel count would be 2048 (16x16x8). The racks needn't however, contain the same unit type in each slot of each rack. The different unit types can be intermixed freely at the users discretion.

Using the OASIS Configuration Editor

The OASIS software can be run in both an ONLINE and OFFLINE mode. When OFFLINE no attempt is made to access the hardware. This mode can be used to setup and save multiple configurations with or without physical hardware present.

All the functions of the Model 433 are remotely programmable through the configuration editor. The same set of functions and modes are available for each channel.

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4. OPERATION

4.1 CONNECTIONS

- | | | |
|-------|------------------------|---|
| 4.1.1 | Sensor Input | BNC |
| 4.1.2 | AC Output | BNC |
| 4.1.3 | Connector to Backplane | DIN 41612 Type C, 96-pin contact, male, right-angle |

4.2 MODEL 433 CONFIGURATION

Control and configuration of the Model 433 is accomplished with the SW2000 OASIS configuration software. The leftmost column of this screen display contains the row headings. These break down into four categories, from top to bottom they are;

Physical Hardware Identification

Location and Status (rows Rack through Amplifier Output). This section provides the physical location of a particular channel in terms of rack and amplifier as well as its type and status.

Amplifier settings

Rows Sensor Power through Report Errors. This section allows the user to change the settings of a single or multiple amplifiers. If the hardware is ONLINE the setting will be sent to the hardware automatically after it is changed. Warnings are provided when a parameter is being set and is not applicable.

Sensor Data

Rows Sensitivity through Calibration Date. This section is where Smart Isotron 1451.4 TEDS data is displayed or where similar information for non-smart type sensors can be entered. Several of these fields also have pop-up lists for ease of entry. Row headings with ** indicate the associated cells are free text entry areas for non smart sensors. It should be noted that for Smart Isotron sensors the 'Write TEDS' operation will ONLY write the Position field to the sensor.

User Fields

These rows are available for customizing the application to a particular installation.

The columns to the right of the row headings represent individual channels. The intersection of a row and column specify one setting or data item for the indicated channel.

4.2.1 AMPLIFIER FUNCTIONS

These functions are accessed by selecting the Amplifiers menu bar item, then Functions and then the desired function.

All functions operate on a unit basis. To select the units, click on the starting channel in the Channel Row and drag the mouse to the last channel of the last unit of the selection. Then select Amplifier, Functions, Specific Function.

Following is a brief description of each function:

Auto Range

Auto-ranging is accomplished by automatically adjusting Full Scale Input Range (FSI) such that the maximum instantaneous absolute peak detected at the output during the specified duration is within the specified percentage (40% to 80%) of the Full Scale Out Range (FSO) setting.

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The user can stop auto-ranging any time by activating the Cancel button. Activating The OK button sends the command to the amplifier to start Auto-Ranging. The amplifier will auto-range for the duration specified in the seconds control. Valid duration times are from 15 to 200 seconds, in steps of 5 seconds.

When complete, the OASIS table will be updated with the new FSI values. In the event the amplifier gain could not be adjusted to achieve the desired percentage of FSO, an error will be indicated and the FSI values will be adjusted to achieve a value as close as possible to the desired value.

Output Calibration Channel ID Waveform

Activation of the Output Channel ID Waveform function will cause the Output Calibration Channel ID dialog box to appear. This function causes each selected amplifier unit to transmit a specified 10 bit id on each amplifier channel. The amplitude of this transmission is determined by the Full Scale Output setting. The ID value to be transmitted is specified by selecting the row on the OASIS configuration table, which has been set up to contain the id. The available rows to select are listed in a pull down menu and consists of the User Field Rows.

The purpose of this function is to provide a capability to verify the connections between the OASIS signal conditioning amplifier channels and the data acquisition system, which receives its output. To verify the connections, the data acquisition system would simply acquire and interpret the ID's and then determine if the channel ID's received are what were expected. Valid numbers for ID values are in the range 0-1023.

Adjust Full Scale Input (FSI)

This function simply increases or decreases the FSI setting on all channels of the selected units by a selectable factor of between 0.001 and 1000.0. When activated a dialog box will appear allowing the scaling factor to be specified.

Read Amplifier Output

This function returns one digitized A/D reading for each channel of the selected units. The reading can be requested as Peak or RMS and can be converted to Volts, Engineering Units or % Full Scale.

Activating the Sample button causes a reading to be taken from each selected channel. The results are presented in the Amplifier Output Row of the OASIS Table.

Note: Sampling will briefly interrupt the signal selected for the BNC output on the front panel of the 433.

Amplifier Output Diagnostics

This function allows a user to verify that the last reading from the output of the amplifier is within an expected range or value. Channels which have readings that fall outside the expected range or value are listed in a results window immediately and are flagged in the table with an asterisk.

If a comparison of Less than Minimum is selected then the analog reading in the OASIS table is compared to the Minimum Limit value. If the Table value is lower than the limit then the reading passes. If it is greater or equal to, it fails and is flagged with an asterisk. The Greater Than Maximum selection works the same way but uses the Maximum Limit. The Between selection uses both limits. Any value between the minimum and the maximum will be flagged. NOT Between also uses both limit values. In this case, any value less than the minimum or greater than the maximum will be flagged.

Activation of the Compare button causes the comparison.

Several readings are shown with an asterisk in the results display above. These channels readings were outside the limits established in the Analog Output Diagnostics dialog.

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5. TROUBLESHOOTING

Refer to IM4990A and IMSW2000 for additional information.

To aid in troubleshooting the rack, access to the power supply and module interconnect PCB is gained with the rear panel dropped down to the open position.

If 4990A or 433 do not respond, check:

- Power applied to 4990A rack. Check fuse. Fan must be audible, airflow must be present.

WARNING

LETHAL VOLTAGES ARE PRESENT AT THE POWER ENTRY MODULE. USE EXTREME CAUTION WHEN PERFORMING THE NEXT STEPS

- Check DC voltages inside the backplane. Jumpers W2/W4/W7/W8/W9 are labeled with their appropriate voltages.
- Serial cable/Ethernet cable connected?
- Serial cable connected from DB9 connector on rear panel to W1 on back plane for 4990A-2, serial cable connected from EDAS serial port to W1 on back plane for 4990A-1.
- Type of Ethernet cable to RJ-45 connector on rear panel (must be crossover when connecting PC, straight when connecting to in-house net).
- For Ethernet communication insure the IP address is correct.
- Type of serial cable (straight TX = 2, RX = 3 at 4990A end), if null-modem cable is used, change DIP switch settings (see 4990 Instruction Manual)
- Baud rate identical for OASIS SW2000 software and 4990A rack.
- Check if card is plugged in properly. Connector must latch, LED must be on (blinking when powering up).
- Check card function. When powered on, LED must go from OFF --> red --> green/red (depending on fault status). Reset of all cards can be initiated by briefly connecting pins 1 and 2 of J31 (RESET)
- Cards will blink upon receiving serial data in the proper format.

If 433 displays/reports fault status, check:

- Is a channel fault enabled for an unused channel?
- Are all inputs of enabled channels connected to a sensor?
- Check sensor cable and the sensor.
- Obtain fault status in OASIS SW2000 software menu

If no signal appears on outputs, check:

- Check if proper channel is selected in OASIS SW2000 menu
- Is the proper input selected for the unit and channel?
- Is the output cable connected?

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6. OUTLINE DRAWING

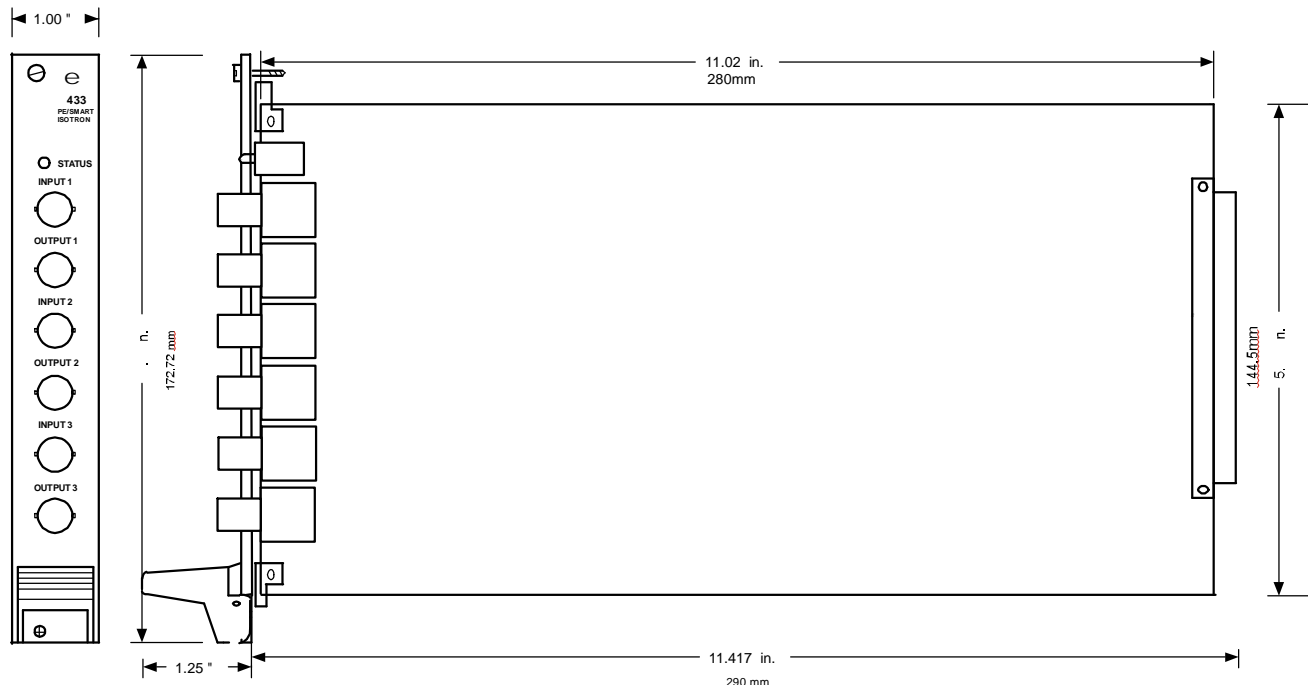


FIGURE 1 – Front panel and card dimension

7. SAFETY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. ENDEVCO assumes no liability for the customer's failure to comply with these requirements.

Ground the Instrument

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electro Technical Commission (IEC) safety standards.

Do Not Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Keep Away From Live Circuits

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the

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power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Do Not Service Or Adjust Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

Do Not Substitute Parts Or Modify Instrument

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to ENDEVCO for service and repair to ensure that safety features are maintained.

Dangerous Procedure Warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

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WARNING

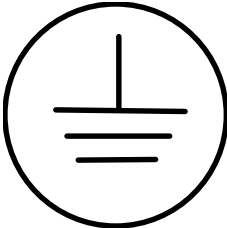
Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

Safety Symbols

General Definitions of Safety Symbols Used On Equipment or In Manuals.



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating the equipment.



The DANGER sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which could result in injury or death to personnel even during normal operation.



The WARNING sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.



The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

Line Fuse

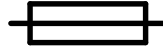
Verify that the correct line fuse is installed before connecting the line cord.

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100/115/230 VAC

50/60 Hz

3/3/1.5 A



250 V, 3A, T



CAUTION: For continuous protection against fire replace with same type of fuse only!

ACHTUNG: Zur Vermeidung von Brandgefahr darf die Sicherung nur durch identischen Typ ersetzt werden!

ATTENTION: Afin d'éviter tous risques de feu, n'utiliser que de fusible du même type!

PRECAUCION: Para proteccion contra fuego remplace fusible con el mismo tipo de fusible solamente!

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8. ROUTINE MAINTENANCE AND HANDLING

8.1 INTRODUCTION

The Model 433 is a self-contained electronic instrument that requires minimal maintenance.

The Model 433 is designed to require no component-level repair by the user. However, detailed schematics are available upon request.

The periodic maintenance function performed by the user is quality calibration. Any component failures simply require the user to return the unit to ENDEVCO for repair/replacement.

Should a faulty unit be returned to Endevco, it is suggested that the original or equivalent packaging be used. This will reduce damage to the equipment during shipment.

8.1.1 CALIBRATION

The unit has an external calibration input routed from the Cal Input BNC on the front panel of the Model 4990A rack.

8.1.2 EQUIPMENT REQUIRED

Model 36019 Input Breakout Panel with EW1198 cable

Model 36020 Output Breakout Panel with EW1201 cable

AC/DC generator

Precision pre-amplifier with band filter, e.g. Stanford Research SR-560

Phase Meter

DMM w/ true RMS display

Sensor simulator consisting of 12V Zener diode in series with a 100 Ω resistor and DS2430 1-wire memory chip.

Termination network consisting of 2.7k Ω resistor

8.1.3 GAIN CALIBRATION

Gain calibration is performed with a frequency of 1kHz at gains of 2 and 20.

1. The 433 is set to 0mA excitation current and a gain of 2. All filters are off. The AC signal generator is set to 1kHz, 3.535V RMS. The output voltage is calibrated to 7.07106V RMS (calibration constant K1).

2. The 433 is set to 0mA excitation current and a gain of 20. All filters are off. The AC signal generator is set to 1kHz, .3535V RMS. The output voltage is calibrated to 7.07106V RMS (calibration constant K2).

8.1.4 EXCITATION CURRENT

For this test, each channel excitation output is terminated with 2.7k Ω .

1. When 433 is set to excitation current = 0mA, current must be 0mA \pm 1mA.

2. When 433 is set to excitation current = 4mA, current must be 4.7mA \pm 20%.

8.1.5 FAULT DETECTION

For this test a DC voltage is applied to the sensor excitation output of the 433. The 433 is set to a

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mode where faults are detected and reported. On a channel-by-channel basis, the following test is performed:

1. With the DC voltage 0 to 2.5V, a short circuit fault condition is reported for the channel under test.
2. With the DC voltage 3.5V to 17.5V, normal operation is reported for the channel under test.
3. With the DC voltage 18.5V to 22.0V, an open circuit fault condition is reported for the channel under test

8.1.6 COMMUNICATION WITH SMART TRANSDUCERS (TEDS)

For this test, each channel excitation output is terminated with the sensor simulator. On a channel-by-channel basis, the following test is performed:

1. The TEDS information of the sensor is read and compared to the true information.
2. The TEDS information of the sensor is modified using Model 36018 TEDS Editor Software, written, read back and compared to the written information.

8.1.7 FREQUENCY RESPONSE/LPF

The 433 is set to a gain of 10. All LPF's of the 433 are switched off. The gain at the lower cut-off frequency is measured for all channels with the phase-meter. The following measurements are then taken on a channel-by-channel basis:

1. Gain at 1kHz
2. The upper cut-off 5% frequency relative to 1kHz gain must be > 50kHz
3. The lower cut-off 5% frequency relative to 1kHz gain must be < 0.1Hz
4. LPF (10kHz) is switched on
5. The measured gain at 10kHz (relative to 1kHz) must be $0.707 \pm 12\%$

8.1.8 GAIN LINEARITY

The 433 is set to 0mA excitation, all LPF's are off. The AC generator is use to feed an AC signal to the input, the DMM is used to display the output voltage.

1. The 433 is set to a gain of 50. The input voltage is 0.1416V RMS. The output voltage must be 7.07V RMS $\pm 0.5\%$, i.e. 7.0367...7.106V RMS.
2. The 433 is set to a gain of 5. The input voltage is 1.416V RMS. The output voltage must be 7.07V RMS $\pm 0.5\%$, i.e. 7.0367...7.106V RMS.
3. The 433 is set to a gain of 0.5. The input voltage is 7.07V RMS. The output voltage must be 3.5355V RMS $\pm 0.5\%$, i.e. 3.5178...3.553V RMS.

8.1.9 RESIDUAL NOISE

The 433 is set to 4mA excitation current and a gain of 100. All filters are off. Each channel input is terminated with the sensor simulator. The output of each channel is measured with a pre-amplifier/filter combined with a true RMS DMM. The pre-amplifier is set to a gain of 10 (overall system gain = 1,000). During the measurement, the 433 is not communicating with host PC of the ATE console.

The following maximum noise limits apply:

0.05 Hz to 10kHz: 10mV (equivalent to 10 μ V RTI)

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8.1.10 DC OFFSET ON CHANNEL OUTPUTS

The 433 is set to 4mA excitation current and a gain of 1. LPF (10kHz) is switched on in each channel. Each channel input is terminated with the sensor simulator. The DC offset of each channel output is measured with the DMM. The limits for the DC offset are -15mV and +15mV.

8.1.11 OUTPUTS OUT-CAL MODE

A FSO of 10.00V is selected for all channels of the 433. Then Out-Cal mode is selected for all channels of the 433. After a delay of five seconds, the positive peak voltage is measured for all eight outputs. All channels must be within 9.950V and 10.05V.

8.1.12 EXTERNAL CALIBRATION

The 433 is set to a gain of 5. The LPF's are off.

The signal from a function generator with 1.00V RMS sine at 300Hz is applied to the external calibration input of the 4990A rack. External calibration is then selected for channel 1. The output voltage of channel 1 is then measured with the DMM. The result must be within 5.05V and 4.95V.

These tests are repeated for channels 2 & 3.

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9. FACTORY SERVICE

ENDEVCO maintains factory service repair for all ENDEVCO instruments. To obtain repair or replacement of a defective instrument, call ENDEVCO at (949) 493-8181 and obtain a return material authorization number (RMA) then return the instrument to:

ENDEVCO

30700 Rancho Viejo Road

San Juan Capistrano, CA 92675

To return an instrument, please:

1. Ensure proper packaging, preferably the original shipping cartons.
2. Prepay shipping and insurance charges.
3. Attach the Return Material Authorization (RMA) number from ENDEVCO and include any information that may be pertinent to the description of the failure/problem.

9.1 WARRANTY RETURNS

ENDEVCO warrants each new electronic instrument to be free from defects in material and workmanship. Please refer to the appropriate Warranty Policies for the terms and warranty period. Instruments returned under warranty will be repaired or replaced at no charge, if the failure is due to defective material or workmanship; and the unit is returned within the time period and conditions of Endeveco's warranty policy.

9.1.1 OUT-OF-WARRANTY RETURNS

Enclose a purchase order not to exceed \$300.00, authorizing repair/calibration along with a full explanation of the failure or symptoms observed to help in fixing the problem. The instrument will be repaired/calibrated, returned and invoiced for the actual repair charges. If the instrument cannot be repaired for \$300.00 or less, ENDEVCO will submit a written quotation for the cost of the repair and/or replacement of the unit.

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10. ORDERING INFORMATION & ACCESSORIES

Description	Endevco Part No.	Quantity
Model 433	433	1
Instruction Manual	IM433	1
OASIS 2000	SW2000-95/98	0
16 Card Rack with Ethernet and RS232 Control	4990A-1	0
16 Card Rack with RS232 Control Single Rack Only	4990A-2	0
Adaptor	EJ21	3
Low Pass Filter Module	31875-1000-0	3