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USERS' MANUAL

DIGITAL INDICATOR

MODEL EDI-53P/L/I



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1 INTRODUCTION

EDI-53 Digital Indicator with engineering units display is a microprocessor-based indicator for use with Encardio-rite's range of potentiometric displacement transducers, resistive strain gage load cells and 4-20 mA DC current output transducers.

The EDI-53 indicator can store calibration coefficients of up to 500 transducers so that the value of the measured parameter from these transducers can be shown directly in proper engineering units. The user does not have to refer to look up tables or manually calculate the parameter values.

The indicator has an internal non-volatile memory with sufficient capacity to store about 3600 readings from any of the 500-programmed transducers in any combination. You can store either 6700 readings from any one transducer or 14 sets of readings from all 500 transducers. Each reading is stamped with the date and time the measurement was taken.

The stored readings can either be uploaded to a host computer using the serial interface or can be printed out on any text printer equipped with a RS-232C serial communications interface. The setup information (calibration coefficients) for all the channels can also be printed out for verification.

Setting up the EDI-53 indicator is easy as all the prompts and error messages are in plain simple English language. Power on self-tests and a separate test mode operation for more detailed diagnostics are an added advantage.

An internal 6V rechargeable sealed maintenance free battery is used to provide power to the indicator. A fully charged new battery provides nearly 60 hours of operation on a single charge. A separate universal battery charger is provided with the EDI-53 digital indicator that can charge the internal battery from AC mains available world wide (90 to 270 V AC, 50 / 60 Hz).

The EDI-53 indicator is housed in a splash proof plastic moulded enclosure with weatherproof connectors for making connections to the transducer, host computer and the battery charger.

1.1 Known issues

When power is turned ON the display may briefly flash "Err: ADC FAULT" as the internal ADC takes some time to settle down. This is normal behaviour and does not affect the functioning or calibration of the unit in any way.

If, however, the "Err: ADC FAULT" message continues to remain on display or is seen during any other time there may be some internal fault. Please see the paragraph below the section titled "Err: ADC FAULT" in chapter 8 – Error Messages for details.

2 FRONT PANEL AND CONTROLS

This section gives a brief description of the features of the front panel and a couple of additional controls.

2.1 Display

The display is a 16-character LCD dot matrix display. It can display any English alphabet, numbers and a number of special symbols. The display is used to show the measured value and also for communication with the operator during data entry.

2.2 Low Batt indicator

A red lamp marked 'Low Batt' to the left of the display window lights up to indicate that the remaining battery power is less than approximately 15 percent of its rated capacity.

2.3 ON / OFF key

An ON/OFF is provided on the lower right-hand side of the 16-key keypad. This key is used to turn on or off power to the indicator. If the indicator is in off condition it turns the indicator ON and if the indicator is in on condition it turns the indicator OFF.

2.4 Keypad

A 16 key weather sealed membrane keypad is provided for data entry, setup, storage, recall and other functions. Most of the keys have more than one function. The most used functions are marked on the keys. However, functions which are sparingly used are not marked to reduce clutter. The function of each key is briefly described below.

Number keys 0...9 - Keys marked with numbers 0 to 9 are used to enter the numbers 0 through 9 in the data entry mode whenever the indicator is expecting a number to be entered. All these keys also have other functions which may or may not be marked on the keys. The other functions which are marked are described below.

VOLTS / 0 - Used to select 'VOLTS' mode display when taking measurements or recalling results.

DATE / 4 - Used to show and set 'Date' while in measurement mode.

PREV / 5 - In 'recall' mode it fetches the previous stored reading of the transducer which has been selected for recall.

NEXT / 6 - In 'recall' mode it fetches the next stored reading of the transducer which has been selected for recall.

PRINT / 7 - In measurement mode it will start the process of sending formatted data to a serial printer connected to the RS-232C serial communications port of the indicator.

SEND / 8 - In measurement mode it will start the process of uploading data to a host computer connected to the RS-232C serial communications port of the indicator.

RECALL / 9 - Used to recall previously stored readings.

The function of the other keys are as follows

UNITS / • - In number entry mode it is used to enter the decimal point. In measurement mode it changes the display to 'engineering units' display mode.

STORE / EXP - In number entry mode it is used to enter the exponent of a floating-point number. In measurement mode it stores the currently displayed reading in the internal memory

TIME / SETUP - In measurement mode it is used to display and set the time of day. With a special power

on sequence this key allows entry to the setup mode so that the calibration coefficients of the transducers can be entered and stored.

CH NO / '–' - In the number entry mode it is used to enter the minus sign. In measurement mode it is used to select the transducer number (channel number) whose reading is being measured, or has to be stored or recalled.

ESC / CE - In the number entry mode it is used to clear an erroneous entry. The whole number entered earlier is erased; it is not possible to erase any single incorrect digit. In all other modes it is used to terminate an unwanted command which may have been erroneously selected or activated.

ENTER - In the number entry mode it signals the indicator that the number entry is complete and the value can be accepted by the indicator. In all other modes it is used as a confirmation key whenever prompted by the display to do so.

2.5 Units selection

When programming the transducer calibration coefficients, the engineering units symbol selection is also done through the number keys 1 through 9. These units are not marked on key tops as the units assigned to each number key is displayed on the display as soon as the key is pressed. To accept the displayed units the 'ENTER' key has to be pressed. The assignment of symbols is as follows:

Key 0	=	mm	milli metres
Key 1	=	m	metres
Key 2	=	tf	tons
Key 3	=	kN	kilo Newtons
Key 4	=	kPa	kilo Pascal
Key 5	=	Mpa	Mega Pascal
Key 6	=		(blank—no unit shown)

2.6 Battery charger connector

A high reliability 3-pin bayonet lock circular connector is provided on the left-hand side (marked as 7V DC) of the indicator for connecting the external battery charger to the indicator.

2.7 Sensor connector

A high reliability 7-pin bayonet lock circular connector for connecting the inclinometer probe to the data logger is provided on the right-hand side (marked as SIGNAL / RS-232) of the data logger.

2.8 Rechargeable battery

The rechargeable battery is mounted inside the indicator. To access the battery, remove the 12 screws at the back of the indicator and take aside the back panel.

3 OPERATING PRINCIPLE

3.1 Transducers

A transducer is basically a device that converts a measured variation in any physical parameter to a corresponding variation in an electrical parameter like voltage, current or resistance.

The EDI-53 series of indicators are available in three versions, EDI-53P for potentiometric displacement transducers, EDI-53L for resistance strain gage bridge-based load cells, and EDI-53I for 4 to 20 mA DC current loop transducers.

The EDI-53P accepts inputs from Encardio-rite series of potentiometric displacement transducers type EDE-PXX. The EDE-PXX series of displacement transducers have a displacement measurement range from 0...50 mm to 0... 250 mm and provide 0...2 V DC output proportional to measured displacement. These displacement transducers also need a 5 to 12 V DC excitation supply voltage. EDI-53P provides a 5 V DC excitation supply for the transducers. The EDI-53P can also be used with potentiometric transducers for geo-technical applications from some other manufacturers as well.

The EDI-53L accepts input from resistance bridge foil strain gage load cells. These load cells basically consist of four resistance strain gages connected as a bridge. They require an excitation voltage and their output is specified as between 1mV per Volt to 3 mV per Volt of excitation voltage at full rated load (i.e. load cell capacity). The output of these load cells is in the form of a voltage signal and is directly proportional to the applied load and the excitation voltage. The magnitude of the voltage signal is very small and special shielding precautions have to be taken to keep the output signal free of induced noise. Resistance strain gage bridge load cells can normally provide higher accuracies than possible with vibrating wire load cells but are more susceptible to damage from overloading and impact load than vibrating wire load cells.

Resistance strain gage-based load cells are commonly used for monitoring load on anchor bolts, struts, roof support, and cable tension, etc.

The EDI-53L provides an excitation voltage of 5 V DC. It can be programmed to accept input from load cells with a rated output between 1 mV/V to 3 mV/V.

The EDI-53I is for use with transducers that provide a 4-20 mA DC current loop output proportional to the measured input physical parameter. Although this type of transducers are widely used in the process control industry, their use in geo-technical applications is fairly limited. Current loop output is generally not used with vibrating wire sensors so their use is limited to other type of sensors based on resistance strain gauges, potentiometers and inductive coils.

Current loop output transducers need a two conductor twisted pair cable and the signal can be transmitted over fairly long distances without much degradation in signal. The same pair of conductors is used to carry both the supply voltage as well as the output signal saving on cable costs. Current loop output transducers are generally known as two wire transmitters in the process industry.

Current loop output transducers always require a supply voltage, generally between 12 to 24 V DC. The EDI-53I does not provide any power supply for the current loop transducers, so an external power supply will have to be used to power the sensors. When a number of current loop output transducers are used at a particular location, a single power supply with suitable output voltage and current rating can be used to power all the transducers.

3.2 Measurement of transducer output

The EDI-53 digital indicator converts the input voltage and current to a proportional 0... ± 2 V DC signal and measure this voltage with the help of an Analogue to Digital Converter, generally referred to as ADC. The ADC has a measurement resolution of 20,000 divisions or counts, so the ADC can measure the 2V

signal with a resolution of 0.1 mV or 100 micro volts.

The EDI-53P measures the output of potentiometric displacement transducers which is of the order of 2 V at full scale.

The EDI-53I measures the output of 4 – 20 mA current loop output transducers. The transducer current is changed to a corresponding voltage using a precision input resistor of 50.0 ohms. The resistor converts the 4 – 20 mA signal to a corresponding 0.2 – 1.0 V signal that is then measured by the ADC.

The EDI-53L measures the output of the load cells which have an output rating of 1 mV/V to 3 mV/V at rated load. As the EDI-53L provides an excitation voltage of 5 V, the load cell output correspondingly is between 5 mV to 15 mV at full load. This voltage is very small to be reliably measured by the ADC directly. A precision low drift preamplifier with a gain of 100 is used to amplify the load cell output signal 100 times before it is measured by the ADC. ADC input correspondingly sees a signal between 0.5 V to 1.5 V DC at its input.

3.3 Calculation of parameter value in engineering units.

In the 'VOLTS' mode, the ADC in the EDI-53 indicator displays the value of the voltage present at its input directly in volts on the display. This value is then used to calculate the value of the measured parameter in proper engineering units. Although the EDI-53 can do the required calculation automatically, it requires some additional information for each transducer for which it has to calculate the parameter value in engineering units.

For most transducers the transducer manufacturer will normally provide a figure called the gage factor of the transducer. The gauge factor is used to convert the measured transducer output value to corresponding transducer input value in engineering units.

Most transducers that will be used with the EDI-53 will have a non-zero output with zero input (i.e. when the value of the measured physical parameter is zero). This is known as the zero or offset reading of that particular transducer. This value is supplied by the manufacturer of the transducer in the transducer calibration sheet or can often be easily determined at the time of installation.

The gage factor and the offset value for each transducer that will be monitored by the indicator has to be entered in the memory of the EDI-53 indicator before it can display the measured value in engineering units. This process is called 'setup' and is discussed in more detail in section 5 on setup.

The EDI-53 uses the following equation to calculate the value of the measured parameter in applicable engineering units.

$$Y = G (R_1 - R_0) \text{ [Eqn. 3.3.1]}$$

Where, Y is the value of the measured parameter in engineering units, G is the gage factor of the transducer, R₀ is the reading in volts shown on EDI-53 display with zero input, and R₁ is the current reading (reading during measurement) in volts on the indicator display. The gauge factor G may be different from the gage factor supplied by the manufacturer and may need to be recalculated as explained below.

EDI-53P: For model EDI-53P the gauge factor G is specified as mm/Volts. If the gauge factor is specified by the manufacturer in terms of V/mm the inverse of the gauge factor should be used.

EDI-53L: Model EDI-53L indicator is for use with load cells. The load cell rated output, M, is generally specified in terms of mV/V for rated capacity L. The value of G should be calculated as

$$G = 2L / M \quad \text{[Eqn. 3.3.2]}$$

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EDI-53I: For Model EDI-53I the calculation of gauge factor is more involved. 4 – 20 mA output transducers have a non-zero output (4 mA) with zero input. Sometimes the transducers are provided with

what is known as suppressed zero or elevated zero. The measuring range of the transducer is known as Span. Discussion of these technical issues is not within the scope of this manual. However, gauge factor calculation for simpler transducers which provide 4 mA output at zero input is discussed below.

If a 4 – 20 mA current loop output transducer is calibrated to read 4 mA with zero input and M units (engineering units) at 20 mA, the gauge factor of the transducer should be calculated as follows.

$$G = M / 0.8 \quad [\text{Eqn. 3.3.3}]$$

and R_0 , in Eqn. 3.3.1 should be taken as 0.200 V if the zero-input reading cannot be determined at installation time.

Users may consult Encardio-rite for determination of gauge factors of transducers with zero suppression or elevation and/or cases where a constant offset need to be added to the measured parameter.

Although the internal ADC of the indicator has a full-scale resolution of 20,000 counts, it is recommended that the display resolution of the engineering units display be limited to 2000 counts full scale only. This will avoid fluctuation in the measured value due to induced noise on the transducer signal cables. Also, because most of the transducers for Geotechnical application will not have an accuracy and resolution better than 0.1% of full scale, a higher display resolution will not provide any additional benefit.

The EDI-53 provides an easy way of controlling the precision (or resolution) of the calculated engineering units value. The setup process allows the user to specify the number of decimal places up to which the result should be displayed.

3.4 Non-linearity correction using polynomial calculation

Transducers are generally so designed that their output is directly proportional to the measured parameter. However, this assumption is not true if a very high level of accuracy is desired. At higher resolutions the relationship does become sufficiently non-linear and other methods have to be found to get better accuracies. The deviation (or error) of the measured value from its ideal straight-line value is known as the non-linearity error of the transducer.

The traditional method of correcting errors due to non-linearity was to calibrate each transducer in the lab and use the calibration curve to correct the obtained readings. Due to limitation of the graphical methods a look up table in numerical format is generally tabulated. This method involves an amount of calculation by the user and is not suitable for automated data collection.

If errors due to repeatability and hysteresis of any non-linear transducer is smaller than the desired accuracy limits then polynomial calculation method can often be used to calculate the parameter value to a better accuracy than possible using a linear approximation.

For example, if a load cell has a non-linearity error of say 0.3% using a linear approximation it may be possible to get an accuracy better than 0.1% using polynomial calculation provided errors due to its repeatability and hysteresis is less than 0.05%.

A second order polynomial takes the form

$$Y = AX^2 + BX + C \quad [\text{Eqn. 3.4.1}]$$

where, in our case, X is the voltage measured by EDI-53 (i.e. the voltage shown on indicator display) and Y is the value of the measured parameter in engineering units. A, B and C are three polynomial constants.

The polynomial constants A, B and C are determined by Encardio-rite during calibration of individual transducers and is mentioned in the corresponding test reports. However, the polynomial constants are only available for higher accuracy transducers.

4 OPERATION

4.1 Charging the battery

The EDI-53 indicator uses an internal rechargeable Sealed Maintenance Free (SMF) battery. This battery does not need any maintenance other than maintaining its state of charge by charging it periodically as described below.

Before using the EDI-53 indicator ensure that the battery is fully charged. A separate battery charger is provided along with the indicator for charging the internal rechargeable battery. The battery charger is provided with mains cord terminated in 2 pin mains plug for inserting into a 2 pin 230 V AC mains outlet. The other cord has a 3-pin circular connector which is inserted in the 3-pin circular connector at the side of the indicator housing. The battery charger does not have any additional power on/off switch. A red lamp on the charger glows to indicate that the charger is powered ON.

A fully discharged battery requires 16 hours of charge. As soon as the battery attains full charge the charging current automatically reduces to a safe value which is known as float charge.

A partially discharged battery requires proportionately less charging time. However, as it is difficult to estimate the remaining battery capacity it is suggested that whenever charging the battery 16 hours charging schedule should be followed.

Although the battery will not get damaged if the charger is left on even after the battery gets fully charged, it is advised that charging should not be done for more than 16 hours at a time. If the internal battery is kept on float charge for very long time (say for days) the battery life gets reduced.

Whether the indicator is heavily or sparingly used the internal battery will need replacement every 3 to 5 years. The battery life depends on a number of variables including number of charge and discharge cycles, depth of discharge and operating temperature and is difficult to predict.

The red 'low batt' lamp on the display turns on if the battery capacity (charge) is reduced to less than approximately 15 percent of its rated capacity. Recharge the battery at the first opportunity after the 'low batt' lamp turns on.

CAUTION: A fully discharged battery should be put on charging immediately. If the battery is kept in discharged condition an irreversible reaction inside the battery takes place which can either severely reduce the battery life or may even make the battery unusable.

4.2 Turning on the indicator

Once the battery is charged you are ready to turn on the indicator for taking measurements. On the lower right-hand side of the keypad is a key marked ON/OFF. Press this key momentarily for turning on power to the indicator. (You have to press this key momentarily again to turn off the indicator). The LCD display should immediately show some message.

As soon as you turn on the power switch the display will flash the following messages in quick succession

```
EDI-53 V:02.00
-- SELF TEST --
---- PASSED ----
Date: 14/05/2004
```

The number following the EDI-53 in the first line can be different from that shown above. The decimal number following the V: is called the revision number. The number to the left of the decimal point (01) is the major revision number, also called the version number. The number to the right-hand side of the decimal point (00) is called the minor revision number. If you have any complaints about the indicator you

should always quote this number to enable our service engineers to know which version of the indicator you have.

The display will freeze after showing the current date. The date is shown in day/month/year format. The indicator is waiting for you to either accept the date or set the date if incorrect. For the time being press 'ENTER' to accept. The display will show

```
Time: 09:08:45
```

The exact time shown may be different. Again, the indicator is waiting for your response. Press 'ENTER'. The display will show something like

```
I/P: 0.0097 V
```

where the actual figure will vary depending on the transducer connected to the indicator.

We call the above sequence of display messages as the normal power on sequence. At this point the indicator is ready to take measurements.

4.3 First time use

If this is the first time you are going to use the indicator since it was dispatched from the factory you need to do some special tasks before the indicator becomes operational. These tasks are

Start the internal real time clock.

Clear the setup and data memory.

In the first step you will start the real time clock which is stopped before shipping from factory to conserve battery power.

In the second step you will erase (or clear) the setup and data memory of the indicator.

The EDI-53 indicator has a setup memory which can store the calibration coefficients for up to 500 transducers and a data memory which can store up to approximately 6700 readings.

Before using the EDI-53 indicator for the first time the internal data memory and setup memory has to be cleared of all existing data.

Both these operations are described in more detail in the following sub sections.

4.4 Starting and stopping the Real Time Clock

The indicator has an internal real time clock / calendar which keeps time and maintains date information. The real time clock (also known as RTC) is a sealed module with a separate small internal lithium battery. When the indicator is on the RTC draws power from the main indicator power supply. With the indicator powered off the RTC draws power from its own lithium battery.

However, with the indicator powered off the lithium battery has a life of less than 2 years. Indicators which are used for only a few hours each month are likely to lose time when kept in off condition. If the indicator is not going to be used for a long time (say for more than a month) it is prudent to shut down the clock to conserve battery power. Before using the indicator again, the clock can be restarted and set.

The EDI-53 indicator provides two functions for starting and stopping the clock (RTC). These functions are accessible from the test mode. The test mode operation is discussed in more detail later on in this section. For the present follow the steps outlined below.

To enter the test mode, turn on power to the indicator while keeping the 'VOLTS' key pressed. Release the 'VOLTS' key as soon as the SELF TEST message is flashed. The display will flash a series of messages and then prompt

```
Enter TEST # ?
```

To start the real time clock press 'DATE' key. Display will flash

```
CLOCK STARTED
```

To stop the real time clock press 'TIME'. Display will flash

```
CLOCK STOPPED
```

To get out of the test mode press 'ESC' at the 'Enter Test # ?' prompt. The indicator will now restart in normal measurement mode and you will see the normal power up sequence.

4.5 Clearing the Setup memory

Clearing the Setup memory erases all the transducer calibration coefficients stored in the indicator. It also erases the whole data memory because once the transducer setup data is modified the stored data will not correspond to the new transducer calibration coefficients which will be setup.

Later on, when you need to erase only the stored data without erasing the transducer setup data (i.e. calibration coefficients) you will use the 'Clear data memory' function described elsewhere in this section.

To clear the Setup memory, turn off the indicator and while pressing the 'CH NO' key turn on power to the indicator. The display will flash the following messages in succession

```
EDI-53 V:02.00  
SELF TEST  
--PASSED--  
REMOVE ALL TXDR?
```

If you are not sure that you want to proceed or you have erroneously entered this function there is still time. Press the 'ESC' key to exit this function.

If you are sure you want to proceed press the 'ENTER' key to confirm your action. The indicator gives you yet another chance to confirm your action or exit. The display will flash

```
ARE YOU SURE ?
```

Press the ESC key if you want to exit else confirm by pressing the ENTER key. If you have pressed ENTER the display will flash

```
* DONE *
```

to indicate that the Setup memory has been successfully cleared. The indicator will then reboot, that is, it will restart the indicator in the normal mode and you will see the power on sequence.

4.6 Clearing the Data memory

The EDI-53 indicator can store up to 6700 readings in its internal data memory. Before you can reuse this memory, it is necessary that all memory contents be cleared to accept fresh data. Using the clear data memory function only erases the readings (i.e., measurement data) stored in the indicator. The transducer calibration coefficients (or setup information) stored in the setup memory are left untouched.

You do not need to clear the data memory if you have already run the clear setup memory function. The clear setup memory function automatically clears the data memory also.

To clear the data memory, turn on power to the indicator while keeping the 'STORE' key pressed. Release the key as soon as the '—SELF TEST—' message appears. The display will flash the following messages in sequence.

```
EDI-53 V:02.00  
SELF TEST
```

```
--PASSED--
CLEAR ALL RDGS ?
```

If you are not sure that you want to proceed or you have erroneously entered this function there is still time. Press the 'ESC' key to exit this function.

If you are sure you want to proceed press the 'ENTER' key to confirm your action. The indicator gives you yet another chance to confirm your action or exit. The display will flash

```
ARE YOU SURE ?
```

Press the 'ESC' key if you want to exit else confirm by pressing the 'ENTER' key. If you have pressed ENTER the display will flash

```
* DONE *
```

to indicate that the Data memory has been successfully cleared. The indicator will then reboot, that is, it will restart the indicator in the normal mode and you will see the power on sequence.

4.7 Entering a number through the keyboard

Whenever you are asked to enter a number or a value press the keys corresponding to that number, most significant digit first. As you press the keys the associated number will also appear on the display. Then when the complete number appears on display, check to see if you have entered the number correctly and press 'ENTER' to signal the indicator that the entry is complete.

For example, if you wish to enter 123.5 press keys '1', '2', '3', '.', '5' and then press 'ENTER'.

4.8 Setting the date and time

There are two slightly different methods of setting the date and time. Every time you power up the indicator it shows the date and time and asks for your confirmation. Besides this while in the measurement mode you may press the 'DATE' or 'TIME' key to check and set the current date or time

Turn on power to the indicator. Wait for the power up sequence to complete till the display shows the date prompt (of course the exact date shown will be different)

```
Date: 01/01/2000
```

or, you can also press the 'DATE' key to get the above date display.

If the displayed date is correct press 'ENTER'. If not press 'DATE' key to set the date. Display will flash

```
SET DATE >
```

then show

```
Year ? 2000_
```

press the number keys corresponding to the year value you want to enter. For example, if you want to enter 2001 press '2', '0', '0', '1', and then press 'ENTER' when done. Display will show

```
Month ? 1_
```

enter the value for month (e.g. July is 7) and press 'ENTER'. Display will then show

```
Day ? 1_
```

enter the value for day of month and press 'ENTER'.

Display will revert to normal display. If you set the date as part of the power up sequence it will prompt you to set the time, else you can press the 'TIME' key to set the time. In both cases display will prompt

```
Time: 13:16:15
```

Press the 'ENTER' key to accept the time or press 'TIME' key to set the time. If you press 'TIME' the display will flash

```
SET TIME >
```

and then prompt

```
Time ? 0_
```

Enter the value of time in hours and minutes as a single number. For example to enter 12 hours 45 minutes, enter 1245 and press 'ENTER'. The new time will be set and the display will revert back to normal display.

Any time you want to check the date or time press the 'DATE' or 'TIME' key. Remember to press the 'ENTER' key if you do not want to change the displayed value.

4.9 Taking measurements

If you have followed the steps described above you are now ready to take measurements from any transducer.

The EDI-53 indicator is supplied with a cable assembly for connecting to the transducers. One end of the cable has a 7 pin circular plug. Insert this plug in the corresponding socket of the indicator. There is only one socket in the indicator which will accept this plug.

The other end of this cable has four leads terminated in crocodile clips. Two of the leads are of red and black colour and terminated with Red and Black clips. These are the transducer excitation supply leads. Connect these two leads to the transducer excitation supply terminals. The red lead should be connected to the transducer positive excitation supply terminal. Some transducers do not require an excitation supply and these leads should not be connected to the transducer terminals.

The other pair of red and black leads are terminated in yellow clips. These are the signal input leads. Connect these two leads to the transducer signal output terminals. The red lead should be connected to the more positive output of the transducer.

In the normal measurement mode with a transducer connected to the indicator input the display will show a voltage reading, something like

```
I/P: 0.8906 V
```

The value 0.8906 V is the converted voltage present at the ADC input (NOTE: *It is not the value present at the indicator input which is different*). This value is the raw ADC data and does not make much sense. You would like to see the parameter value calculated from this value and displayed in terms of applicable engineering units. The steps for displaying the parameter value directly in engineering units is discussed below.

4.10 Displaying parameter value in engineering units

The EDI-53 indicator can compute the value of most parameters measured by the transducers directly in proper engineering units like kPa, mm, degrees, tons etc. For this however the transducer calibration coefficients (also called transducer constants) like "Initial Reading" and "Gage Factor" and the "units symbol" itself have to be entered in the indicator setup memory.

The EDI-53 indicator can store calibration coefficients of up to 500 transducers. The set of memory locations containing the calibration coefficients of individual transducer is called a channel. So the indicator is said to have 500 channels setup memory.

Each transducer is assigned one unique channel number between 000 and 500 by which it is identified. However, we use the terms channel number and transducer number interchangeably.

The indicator needs to know the calibration coefficients for any transducer before it can compute the parameter value in engineering units. So before you can use the engineering units display feature of the indicator, the calibration coefficients of that particular transducer must have been stored in the setup memory. The process of entering the calibration coefficients is called 'Setup' and is described in detail in the section titled 'Setup'.

For the time being we assume that the transducer for which we want to see the engineering units display has already been setup.

With the transducer connected to the indicator check if you are getting a valid voltage reading. If yes then press the 'UNITS' key. Display will show

```
NO Ch SELECTED!
```

Before you can use the engineering units display function first you must tell the indicator which channel (or transducer) number to use for calculations.

To select the channel number press 'CH NO' key. Display will prompt

```
Ch # ? 0_
```

Enter the channel number corresponding to the transducer which you are measuring. Assuming that the channel number is 4, press '4' then 'ENTER'. Display will show

```
#004: 0.04 kPa
```

The #04: symbol shows that the engineering units conversion is being done with the calibration coefficients of channel 4. The value of the parameter is 0.04 and the engineering units is kPa (i.e. kilo Pascal).

If the indicator fails to find any calibration coefficient associated with the channel number which you have selected (i.e. the channel has not been setup) the display will flash an error message

```
NO TXDR SETUP !
```

and return back to VOLTS display mode. You can then either select the correct channel number (if you have made an error in entry) or else go to setup and enter the transducer coefficients in any unused channel.

4.11 Storing a reading

The EDI-53 indicator can store up to 6700 readings in any combination from any number of channels. You can store 6700 readings of only any one transducer or you may store 14 sets of readings from 500 transducers. The memory used to store the readings is called the Data memory.

When you store any data, the indicator stores the channel number (i.e. transducer number), engineering units value, date and time the reading was taken.

Before you can store a reading, you should select the channel number corresponding to the transducer which you are measuring by pressing the 'CH NO' key. The display automatically changes to engineering units display (known as 'units mode') and displays the measured parameter in your chosen engineering units.

After the reading on display has stabilized press the 'STORE' key once to store the reading. The display will flash

```
* DATA SAVED *
```

and revert back to units display. Remember, do not press the 'STORE' more than once. Every time you press the 'STORE' key, another reading will be saved in the memory.

When you have saved a lot of readings and only 50 or so memory locations are left for storing data you will see a message like the example shown below after the 'data saved' message

```
Memory LOW! 35
```

This message informs you that there are only 35 more free memory locations for storing data. If you need to store more number of readings you should first print out the current 'log data' or down load the 'log data' to a computer, use the 'Clear data memory' function to erase the data memory and then store further data.

Once the data memory gets full and there is no free memory location left to store any further reading, you will get the following message

```
Err: MEMORY FULL
```

If you press the 'STORE' key while in any mode other than the 'units mode' the display will flash an error message

```
GO TO UNITS MODE
```

Select the units mode by pressing the 'UNITS' key and then save the reading.

4.12 Recalling stored readings

If you have stored any readings in the indicator data memory you can recall the readings later on at any time.

The indicator groups the stored readings according to channel number, irrespective of in which order they were stored. Also, the readings are arranged chronologically in memory, i.e. the earliest reading is stored first and the latest reading stored last.

However, it may be noted that if due to some oversight you store some readings and then set the clock at an earlier date and time, subsequent readings will be stored at the end of the data memory. While recalling or printing the stored readings you will be surprised to find data with an earlier date stamp occurring after later data.

To recall a stored reading, you have to tell the indicator for which channel number (i.e. transducer) you want to recall the data. Press the 'RECALL' key. Display will flash

```
* RECALL *
```

then prompt

```
Ch # ? 0_
```

Enter the channel number whose data you want to recall. Assuming you select channel number 4. Display will show the last saved reading for this channel

```
R004: 1.05 kPa
```

The 'R' in symbol 'R004:' indicates that you are seeing recalled data (i.e. the indicator is not measuring anything) and 004 shows that you are looking at stored data of channel number 4. The stored value of the parameter follows.

If you need to find the date and time the reading was stored simply press the 'DATE' or 'TIME' key to see the date or time.

If you have stored a number of readings for a particular channel you can scroll through the data by using the 'PREV' and 'NEXT' key. Pressing the 'PREV' key shows the earlier stored data for this channel. Pressing the 'NEXT' key shows the next stored data for this channel. While pressing the 'PREV' or 'NEXT' key you reach the end of table, i.e. there is no more data to show, the display will prompt

R004: NO DATA!

When you are finished looking at the data for a particular channel just press 'ENTER' the display will prompt you for the next channel number whose data you want to fetch.

Ch # ? 0_

You can either enter another channel number to recall or you may press 'ESC' to exit the recall mode. Display will flash

* EXIT ! *

* RECALL ENDS *

and exit the recall mode. You can exit the recall mode any time by pressing the 'ESC' key. The display will flash

* RECALL ENDS *

and come out of the recall mode.

4.13 Printing the logged or setup data

You can send the logged data or the setup data directly to a alphanumeric printer (for example a dot matrix printer) provided with a RS-232C serial interface port for a hard copy printout.

See the section on 'RS-232C serial interface' for details on how to connect the indicator to the printer. You will also have to go through your printer manual to find out how to configure the printer's serial port parameters and generally how to operate the printer.

The indicator can provide formatted printout of either the logged data or the setup data.

Connect the printer to the indicator and turn on power. The print format is optimized for printing on 80 column wide continuous stationery. So load continuous stationery (paper) in your printer preferably using the tractor (see your printer manual for help). Align the paper in the printer so that the top edge of the paper is at 'top of form' position, i.e. the top edge of paper should just project beyond the print head. In most currently available dot matrix printers, whenever you load a fresh sheet of paper (or the first sheet of the continuous stationery) the paper is automatically positioned at the 'top of form' position.

Turn on the indicator. From the measurement mode press the 'PRINT' key. Display will first flash

PRINT DATA

ENTER CHOICE >

Then the display will show

1: LOG DATA

If you now press the '1' and '2' key and you will find the display toggles between

1: LOG DATA

2: SETUP DATA

When the display shows your choice press 'ENTER'. For example if you want to print the logged data, press '1'. When the display shows 'log data' prompt press 'ENTER' to accept.

Display will prompt

Press <ENTER>

Make sure that the paper is properly loaded, the printer is turned on and the 'online' lamp is glowing. Online means that the printer is ready to receive information for printing. Your printer may have a different

method of signaling that it is ready to accept data for printing. Just check your printer manual.

If your printer is ready press 'ENTER'. Display will show

SENDING DATA

This message will remain on display as long as the indicator is sending data to the printer. This time depends on the amount of data to be printed and can be very long if the data memory is nearly full (more than 6700 readings). As soon as the complete data has been transferred to the printer (but not necessarily printed) the display will flash

* DONE *

and revert back to normal measurement mode.

The indicator sends formatted data to the printer for print out. A typical example of data printout is shown below. You will find that the data is first sorted on 'channel number' and then on 'date' and 'time'. This makes it easier to find the data corresponding to a particular channel arranged chronologically, earliest first.

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Record of logged data Page 1

=====

Ch No	Value	Units	Date	Time
0	75.0	kPa	31/01/2000	14:21
0	79.7	kPa	31/01/2000	14:23
0	80.6	kPa	31/01/2000	14:24
1	-30.2	mm	31/01/2000	14:21
1	-30.1	mm	31/01/2000	14:22
1	-29.3	mm	31/01/2000	14:24
2	-42.9	mm	31/01/2000	14:22
2	-42.7	mm	31/01/2000	14:23
2	-42.3	mm	31/01/2000	14:24

A typical example of setup data printout is shown below.

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Record of Setup data

Page 1

=====

Ch No	Units	Coef_A	GF/Coef_B	IR/Coef_C	Dec pl.
0	kPa	0.0000E+00	2.7080E-04	1972.8	1
1	mm	0.0000E+00	6.0730E-05	2161.7	1
2	mm	0.0000E+00	6.2690E-05	2205.6	1

4.14 Sending data to a computer

The process for sending the data to a computer is same as that of sending the data to a printer. Turn off both the indicator and the computer. Connect the indicator to the computer with the help of the supplied serial interface cable. Turn on both the computer and the indicator.

You will need a standard commercially available terminal emulation program (software) like "Tango", "Crosstalk" or "Terminal" (included with Microsoft Windows 3.1) or HyperTerminal (included with Windows 95, 98, NT 4.0, 2000, XP) etc. to transfer data from the indicator to the computer. You will also need the users' manual for your terminal emulation program to find out how to set the communications parameter and how to receive text files.

Start your terminal emulation program, configure the serial port to which you have connected the indicator. Select 'receive text file' option and when the computer is ready to accept the file press the 'PRINT' or 'SEND' key on the indicator. The operation of the 'PRINT' and the 'SEND' key is identical. The difference is in the way the transferred data is formatted. This difference is explained a little later in this section.

As in the case of printing the display will prompt you to select either 'log data' or 'setup data'. Press the appropriate key, '1' for log data, '2' for setup data, then press 'ENTER' to confirm. The indicator will start sending data to the computer and the display will show

```
* SENDING DATA *
```

As soon as the data transfer is over the display will flash

```
* DONE *
```

and revert to normal measurement mode.

You should save the transferred file as a text file (with a .txt file extension). The file is a standard ASCII text file, i.e. it does not contain any non-printable character or any proprietary formatting information.

While transferring data to the computer you have two ways of formatting the data. If you want to send the data to the computer to be printed at a later time you should use the 'PRINT' key. The data transferred is exactly that which is sent to the printer and is formatted in a way which is easily readable by human

beings.

On the other hand if you would like to import this data in any other commercially available spread sheet program (e.g. Microsoft Excel) or database program (e.g. Microsoft Access) for further processing you should choose the 'SEND' key. When you press the 'SEND' key the data transferred is formatted in comma delimited ASCII text format. Most commercially available spread sheet, data base and many other analytical programs have an option for importing comma delimited ASCII text files.

If you care to look at the transferred comma delimited ASCII text file on the screen you will find that the data looks somewhat like the example shown below. This example is a typical 'logged data' file downloaded from the indicator.

```
"CHNO" , "DATE" , "TIME" , "VALUE"
```

```
0 , "2000/01/07" , "21:56" , 0.4
```

```
0 , "2000/01/07" , "21:58" , 38.9
```

```
1 , "2000/01/07" , "22:14" , 39.6
```

```
1 , "2000/01/07" , "22:20" , -0.3
```

```
2 , "2000/01/07" , "22:23" , -0.0
```

```
2 , "2000/01/07" , "22:28" , 0.0
```

```
3 , "2000/01/07" , "22:45" , 119.8
```

```
3 , "2000/01/07" , "22:49" , 10.4
```

```
4 , "2000/01/07" , "22:57" , 120.3
```

```
4 , "2000/01/07" , "22:58" , 48.7
```

The first line lists the name of the data fields, so that the program in which this data is imported can make out the sequence of fields in the following data records. The rest of the lines are data records with the data of each field separated by a comma delimiter. The comma delimited files can contain two types of data in a record.

Numeric data — a pure number consisting of digits 0 to 9, plus or minus sign and one decimal point

Character data — usually called as a character string. It consists of a string of alphabets, digits 0 to 9, and some printable symbols. Character strings are invariably enclosed in double quotes.

The coding method used by the indicator in sending each character of the data file to the computer is in ASCII (American Standard Code for Information Interchange) format hence it is called an ASCII text file.

The one peculiarity you will notice in the records is the date and time data are treated as character strings and not as numbers. This is because of the presence of the characters "/" and ":" in these data. The other thing you will notice is that in the date field the 'year' comes first, followed by the 'month' and finally the 'date'. This form of writing the date is generally known amongst software programmers as ASCII date string. The advantage in writing the date in this form is that the date field can be easily used for sorting the records either in ascending or descending order. Because the year is most important the dates are first sorted on year, then on month and then on 'day of month'.

In the above example of 'Logged data' file you will find that the records are sorted first on channel number, then on date and finally on time. That is, all the readings of same channel number are grouped together and arranged chronologically, earliest first.

Below is an example of a downloaded 'Setup data' file in comma delimited ASCII format.

```
"CHNO" , "UNITS" , "COEF_A" , "GAGEFACTOR" , "INITRDG" , "DECPL"
```

```
0 , "mm" , 0.0000E+00 , 6.0726E-05 , 2169.7 , 1
```

```
1 , "mm" , 0.0000E+00 , 6.2686E-05 , 2201.2 , 1
```

```
2 , "kPa" , 0.0000E+00 , 2.7080E-07 , 1995.6 , 1
```

```
3 , "mm" , 0.0000E+00 , 1.1722E-04 , 1800.4 , 1
```

```
4 , "mm" , 0.0000E+00 , 1.0381E-04 , 1815.9 , 1
```

5 SETUP

The process of entering the transducer calibration coefficient in the internal memory of the EDI-53 indicator is called 'Setup' and the portion of memory earmarked for this process is known as the setup memory.

Because this is a very critical information, to guard against accidental modification of entered data the 'Setup' function has to be activated through a special power on sequence.

5.1 Preparing Setup data

Before entering setup you should collect all relevant information and note it down on paper. At the end of this manual we have included a specimen of a suitable data entry form. You can make photo copies of this form and use it for collecting setup information.

Transducer manufacturers generally supply transducer calibration coefficients in two different forms for calculation of parameter value in engineering units. The most common practice is to mention the Linear Gage Factor and the Initial Reading or the Offset. For high accuracy transducers the manufacturer may additionally specify 2nd order Polynomial calculation constants. Calculation using both these methods is explained below:

Parameter calculation using Linear Gage Factor

For calculation using Linear Gage Factor, two constants **G** and **R₀** are supplied.

$$P = G (R_1 - R_0)$$

where, **P** is Parameter value in engineering units,

G is Linear Gage Factor (or simply Gage Factor)

R₀ is Initial Reading in Volts that may either be supplied by the manufacturer or determined at the time of installation. (Some manufacturers may instead specify an Offset value)

R₁ is the current reading in Volts during observation.

Parameter calculation using 2nd order Polynomial

For calculations using a second order Polynomial, three coefficients, **A**, **B** and **C** are supplied.

$$P = AR_1^2 + BR_1 + C$$

where, **P** is parameter value in engineering units,

R₁ is the current reading in Volts during observation'

A, **B** and **C** are called polynomial constants.

The setup form has seven columns. The entries to be made in each column is explained below.

- **Ch No.**— Enter the channel number (i.e. transducer number) that you want to assign to the transducer. It is recommended that for ease of reference you assign the channel numbers serially from 00 to 99 in ascending order.
- **Tag No.** — You can optionally enter an associated identification number in this column if such a number tag has been assigned to the transducer during installation.
- **Transducer type** – Enter the type of transducer, e.g. strain meter, peizo meter, displacement meter etc.
- **Units** — Enter the proper engineering units in which the parameter value is to be reported. You can only use those symbols which are provided in the indicator.
- **Initial Reading or Coefficient C** — For Linear Gage Factor calculation enter the value of initial volts. In transducers whose zero value do not change on installation (absolute reading) this figure

is provided by the manufacturer. Examples of such transducers are load cells. In relative reading transducers the voltage reading obtained just after installation is taken as the Initial Reading. Examples of such transducers are potentiometric transducers like extensometers, crack meter etc.

For Polynomial Calculation enter the value of Coefficient C in floating point format. An example of a Floating point number is 1.2345×10^{-3} . However, to enter this number in the indicator write down this number as 1.2345E-3. The part of the number before the symbol 'E' is called the mantissa. You should restrict the value of the mantissa to five digits. The part of the number following the symbol 'E' is called the exponent and can be a two digit number with an optional minus (-) sign. The plus (+) sign is the default sign, you do not need to enter the plus sign explicitly through the keyboard

- **Gauge Factor or Coefficient B** — For Linear Gauge Factor calculation enter the gauge factor of the transducer in floating point format. For polynomial calculation enter the value of coefficient B in floating point format.
- **Coefficient A** — Enter the value of coefficient A for polynomial calculation as for coefficient C above. For Linear Gauge Factor calculation ensure that this value is set to 0.0000E+00. If the display shows any other value then press '0' and 'ENTER'.

Filling up the Setup data entry form before entering data in the indicator will help avoid making mistakes during data entry and also make sure that you have access to all required data during programming.

5.2 Entering Setup data

After you have filled in the Setup data entry form or have collected all relevant data you are ready to enter the transducer calibration coefficients in the indicator through Setup program.

During the entry process if you make a mistake in entering a value, you can erase the wrong value by pressing 'CE' key. This is called the 'clear entry' key. On pressing this key the value currently being shown on display will be cleared and you will get an opportunity to enter the correct value or number. The 'CE' key erases the display only when you are in number entry mode. At all other times it behaves as an 'escape' key.

To enter the setup mode turn on power to the indicator while pressing the 'SETUP' key. Release the key after you see the 'passed' message. The display will show the following messages in sequence while starting in setup.

```
EDI-53 V:02.00
-- SELF TEST --
---- PASSED ----
* SETUP * >
```

Press 'ENTER' key to confirm entry to setup mode. Display will show

```
Ch # ? 0_
```

Enter the Channel number which you want to setup. (Remember, to enter a number you press the number keys followed by 'ENTER' key). The display will now prompt

```
UNITS ? _
```

For each and every transducer that you setup you must choose an available symbol. This field cannot be left blank. Leaving the unit field blank will cause the indicator to erase the transducer coefficients programmed in that channel (See 'Erasing setup data for a single channel' below).

Press the keys 0 through 9 to see the list of available symbols. When you see the symbol which you want to display for this transducer, press 'ENTER'. Display will now prompt

```
IR ? 0.0000E+00_
```

Enter the 'Initial Reading' in volts for linear gage factor calculation or the value of coefficient C for polynomial calculation. You can enter the value in fixed point format but while recalling this value the indicator will show the same value in floating point format. For example if you enter 'Initial Reading' as 1955.1 subsequently when you recall this channel the indicator will display the same value in floating point format as 1.955E+03. The next prompt on display is

```
GF ? 1.0000E+00_
```

Enter the 'gauge factor' in floating point format for linear gage factor calculation or value of coefficient B for polynomial calculation. Remember, the mantissa should not exceed five digits. You can enter the minus sign if required before the number and also after the exponent symbol 'E'. Display will now prompt

```
X2 ? 0.0000E+00_
```

Enter the value of coefficient A for polynomial calculation. Other wise set this value to 0 for linear gage factor calculation.

The next prompt on the display is for decimal places.

```
DP ? 0_
```

The display is prompting you to enter the number of digits to the right of the decimal point to be shown while displaying the parameter value in engineering units. For example you might want to show pressure for a 1 kPa pressure transducer as 1.000 kPa and a 10 kPa pressure transducer as 10.00 kPa. In the first case you would enter the value of 'DP' as 3 and in the second case as 2.

That completes all the information for setting up a transducer. As soon as you enter the decimal places the display prompts you to enter the next channel number to setup.

You will notice that by default the last programmed channel number appears on the channel number prompt. For example, if you had just programmed channel number 5, the channel number prompt will appear as

```
Ch # ? 5_
```

Should you want to verify the entry that you have just made, press enter and you can verify each of the entered parameter for channel 5.

To exit setup mode press 'ESC' key at the channel number prompt. The display will flash

```
* SETUP ENDS *
```

and then the indicator will reboot (i.e. restart) in the normal measurement mode.

5.3 Erasing setup data for a single channel

At times you may want to remove the calibration coefficients of a single transducer or some of the transducers individually from the setup memory. If you are replacing one transducer with another, setting the same channel number with the calibration coefficients of the replacement transducer will automatically erase the old data. However, if the channel number is to be left blank (i.e. you do not wish to setup any transducer in that channel) you need to erase the existing transducer data.

To erase any individual channel go to channel number prompt in the setup mode. Enter the channel number from which you want to erase the transducer coefficients. The display will show the units prompt and the last programmed units symbol.

```
UNITS ? kPa_
```

Press the 'CE' key (clear entry), the display will prompt to confirm whether you really want to delete the transducer data.

```
DELETE TXDR ?
```

Press 'ENTER' key to confirm or press 'ESC' key to cancel the operation. Display will revert back to the channel number prompt and show the same channel number by default.

CAUTION !

Before erasing any individual transducer you should make sure that there is no data for that transducer in the data memory. Otherwise if there is any earlier data of that particular transducer present in the data memory it will get corrupted. It is strongly recommended that you should printout the data in the data memory or transfer the data memory contents to a host computer before erasing any individual transducer. After that first erase the data memory and then erase the individual transducers from the setup memory.

5.4 Erasing setup data for all channels

If you want to erase the setup data for all the channels for any reason it is much easier to use the procedure described in 'Clearing the setup memory' described earlier in the section 'Operation'.

Generally you need to erase the whole setup memory either while you are about to program the setup memory for the first time or you are shifting the indicator to a new site or project.

You will also need to clear the whole setup memory if the internal Non-Volatile RAM memory (NVRAM) module becomes defective and has been replaced.

The whole setup memory should be cleared if for some reason you find that a part of the setup data has become corrupted (generally this is due to some hardware fault). If such a thing has happened then it is better to completely clear (erase) the whole setup memory and reprogram it to avoid the possibility of undetected errors remaining in the setup data.

In view of the above discussion it is advised you should always keep a printout of the 'Setup data' after you have completely programmed the setup memory or after you have made any modifications to setup data.

6 RS-232C SERIAL INTERFACE

EDI-53 Indicator is provided with a RS-232C serial communication interface. The serial communication interface is used by the EDI-53 indicator to transfer logged data or setup data directly to a computer without operator intervention.

The PRINT feature also uses the serial interface to send logged data or setup data to a serial printer. Any printer with a RS-232C serial interface can be used to print logged data from the EDI-53 Indicator.

The following sections describe the operation of the serial interface for use both with a computer and a printer.

6.1 Interfacing to a Computer or a Printer

The RS-232C serial interface in the EDI-53 Indicator employs a subset of the EIA standard RS-232C standard. A special interface cable for connecting the indicator serial port to a standard IBM PC/AT compatible computer with a 9 pin serial port is supplied with the indicator. This serial interface cable should also connect to serial ports of most commercially available printers using a 9-pin to 25 pin converter, if required.

The interface cable consists of a 7 pin circular connector for connecting to the indicator at one end and a 9-pin D shell sub-miniature connector for connecting to a Personal Computer at the other end.

It is assumed that the serial port of the users computer follows the IBM PC/AT convention. An intermediate patch cord will be necessary if this condition is not true. In such cases please contact factory for more information.

6.2 Serial Interface Specifications

Transmission Mode:

Asynchronous, Full duplex

Baud rate:

2400 (Default)

Serial Data Format:

1 Start bit, 8 data bits, No parity, 1 stop bit.

The format of serial data consists of a start bit, data bits, no parity bit, and a stop bit. The output is in a mark state when not in transmission. The data bits start with the least significant bit (LSB).

Signal levels:

-3 V or more for a mark condition (logical 1)

+3 V or more for a space condition (logical 0)

Input/Output circuit:

A Maxim 'MAX 232' or equivalent IC is used as the line driver (output) and receiver (input) and TTL to RS-232C level converter.

Connector (Indicator side):

7-pin weather proof circular bayonet latching connector. Manufacturer & Part # Amphenol 621N-16F-10-7S.

Connector (Computer side):

9-pin D-sub miniature, Female, O/E/N type DE 09 S or equivalent connector that conforms to EIA RS-

232C standards. Signal assignment for the connector pins are as follows

- 2 Transmit Data signal (TxD)
- 3 Receive Data signal (RxD)
- 5 Signal Ground (SG)
- All other pins have no connection

6.3 9 pin to 25 pin adapter wiring

The IBM/PC-AT compatible computers are generally supplied with two types of serial port connectors, 9 pin and 25 pin male D sub miniature connector. The serial interface cable supplied with the EDI-53 indicator has a 9-pin female connector at the computer end. If the free serial port on your computer is a 25 pin port you will need a 9 pin to 25 pin adapter to connect the serial interface cable to your computer.

The table below shows the correspondence between the pin numbers of a 25 pin and 9 pin serial port connector as implemented in IBM PC/AT compatible machines. Such adapters are easily available in computer hardware stores.

9 pin connector (pin number)	25 pin connector (pin number)	Signal Name
2	3	RxD
3	2	TxD
4	20	DTR
6	6	DSR
5	7	SG
7	4	RTS
8	5	CTS
1	8	CD

6.4 Connecting to a Computer

Turn off power to both the computer and the indicator. Plug in the circular connector of the supplied serial interface cable to the 7-pin input socket of the indicator. Connect the other end of the interface cable to a free serial port of your computer. If by chance the free serial port of your computer has a 25 pin connector you will need an additional 9 pin to 25 pin adapter described above.

Turn on power to the computer and the indicator.

6.5 Connecting to a printer

The indicator can be connected to any printer equipped with an RS-232C serial communications port using the supplied interface cable. If your printer has a 25 pin serial port connector then you will need a 25 pin to 9 pin adaptor described above.

Turn off power to both the printer and the indicator. Connect the indicator to the printer using the supplied interface cable. Configure the printer serial port as explained above by referring to the printer operation manual. Turn on power to both the printer and indicator..

7 TEST MODE OPERATION

The EDI-53 indicator does a self test of its hardware during power up which is known as 'Power On Self Test' (POST). During the POST it displays the message 'SELF TEST' on the display. A more detailed diagnostic test can be performed on some sub-systems in the 'Test mode'.

To enter the 'Test mode' turn off the indicator. While pressing the 'VOLTS' key turn on power to the indicator. The display will show the following messages in sequence. Remember, these are typical examples and the messages on your display might be slightly different.

```

EDI-53 V:02.00           [line 1]
-- SELF TEST --         [line 2]
---- PASSED ----        [line 3]
-- TEST MODE -          [line 4]
RevD May 14 2004        [line 5]
RevT 15:08:44           [line 6]
Enter TEST # ?         [line 7]

```

The first line [line 1] shows the Version number. The number on the left of the decimal point '02' is known as the major version number and the number '00' to the right of the decimal point is known as the minor version number.

The second message [line 2] indicates that the indicator is conducting some internal diagnostic checks. If these tests are satisfactory that the message in line 3 appears. Otherwise an error beep or an error number display is shown on display.

Line 4 indicates that the indicator has entered the 'test mode' operation. Line 5 shows the revision date of the software program, and line 6 shows the revision time of the software program. This information is useful for Encardio-rite's service engineer in trouble shooting software problems or bugs. As the product evolves over time, small corrections are made to the indicator software to overcome known problems. In technical terms we call it bug fixes.

While reporting any problem with the indicator you should quote the above review date and time along with the version number so that our service engineers can find out if any later release of the software can correct the problem.

The message in Line 7 freezes on the display and the indicator waits for you to enter the 'Test number'.

ADC Check (or re-calibration) — Key press '3'

[CAUTION: Should the indicator need recalibration it must only be done either by an Encardio-rite service engineer or by a qualified electronics technician with access to proper calibration equipment.]

NOTE: For accurate result the indicator should be kept at the place where calibration is to be checked for at least 30 minutes before recalibration so that the indicator components attain equilibrium with the ambient temperature.

This test is used to check and/or calibrate the indicator's Analogue to Digital Converter (ADC). The ADC converts the input current or voltage signal to a digital (numeric) form which is then sent to the microcontroller for further processing. To run the test press key '3'. Display will show

```

ADC CHECK                [line 1]
ADC:      0               [line 2]
ADC:     2140             [line 3]

```

The first message [line 1] tells that the indicator is going to start the ADC check mode. The second message [line 2] will sometimes appear briefly as the ADC settles down and completes its first conversion. The third line shows a numeric value proportional to the voltage measured by the internal ADC.

Connect the input signal leads to a precision voltage or current calibration source and apply signal corresponding to zero and full scale input values alternately. Check the corresponding voltage value on the display. If a precision calibration source is not available a stable variable voltage or current source may also be used together with a precision 5 ½ digit Digital Multi-Meter to measure the input signal.

The 'Zero' and 'Full Scale' calibration values for each version of EDI-53 is given below.

EDI-53P – Potentiometric input.

Input: 0.0000 V Display: (Note down the reading on display, say Z)

Input: 1.9000 V Display: $(1.9000 + Z) \pm 0.0010$ V

EDI-53L – Resistance strain gage bridge Load Cell input.

Input: 0.000 mV/V Display: (Note down the reading on display, say Z)

Input: 3.000 mV/V Display: $(1.5000 + Z) \pm 0.0020$ V

EDI-53I – 4 – 20 mA current loop input.

Input: 4.000 mA Display: (0.2000 ± 0.0010) V (note down this figure, say Z)

Input: 20.000 mA Display: $(1.0000 + Z) \pm 0.0010$ V

Recalibration

If the Full Scale value (i.e. calibration) is outside allowed limits, the indicator needs to be recalibrated.

To recalibrate the indicator, open the back cover by removing the 12 Allen head screws with a 2.5 mm Allen key. The top PCB is the analogue PCB. Locate the potentiometer marked SPAN. Rotate the brass screw on the top of the potentiometer to get the desired reading on the display with specified input.

System Zero adjustment

In the above section the non-zero reading, Z, is known as system zero offset. By carrying out system zero adjustment this offset value is set to zero so that with zero input the display shows 0.0000 V in VOLTS mode.

When the indicator is in ADC check mode (as discussed above) pressing the key '0' sets the system offset to zero, i.e. the display shows 0.0000 V with zero input. On pressing the '.' key the zero adjustment is removed and the actual non-zero system offset voltage, if any, is shown on the display.

To quit the ADC check mode Press 'ESC' key once.

Start RTC — Key press 'DATE/4'

Pressing key 'DATE / 4' starts the internal Real Time Clock. The RTC is turned off to prevent the RTC battery from draining out when the indicator is off. Display will flash

RTC STARTED

to confirm that RTC has been started and revert back to enter test number prompt.

Stop RTC — Key press 'TIME'

Pressing key 'TIME' stops the internal Real Time Clock. Display will flash

RTC STOPPED

to confirm that the RTC has been stopped and revert back to enter test number prompt.

Exit 'Test mode'

To exit the 'Test mode', you can either turn off and turn on the indicator again or you can press "ESC" from the enter test number prompt. Indicator will restart in the normal measurement mode.

8 ERROR MESSAGES

The EDI-53 indicator displays a number of appropriate error messages whenever it encounters a hardware fault, an invalid calculation, or a wrong entry etc.

As the display can show a maximum of 16 characters at a time most of the error messages directly announce the error without explicitly showing the word 'Error'.

The various 'Error' messages are listed below in alphabetical order. Most of these error messages are flashed for approximately one to two seconds on the display. For those messages which are not automatically cleared you will have to press the 'ESC' key to clear the message.

* EXIT ! *

This is not exactly an error message. This prompt only informs you that you have chosen to 'Cancel' the current operation, say by pressing the 'ESC' key, and the indicator has not fully executed the command you were trying to execute.

Err: ADC FAULT

The internal ADC or the associated circuit used for voltage measurement has probably developed some fault. You will need to get the indicator checked by a qualified service engineer or return the unit back to Encardio rite to remove the fault.

Err: MEMORY FULL

You are trying to store a reading in the data memory and the data memory is already full. That is, all the 6700 locations have stored data. You should either print out the logged data or transfer the logged data to a computer and run 'Clear data memory' function to be able to reuse this memory for storing further data.

Err: NVRAM FAILED

This error message appears only during Power On Self Test.

The 'Setup' and 'Logged data' are stored in an internal Non-Volatile Random Access Memory (NVRAM). The information stored in an NVRAM remains as intact even if the indicator is turned off. However if there is a hardware fault or the NVRAM module becomes faulty, the stored information gets corrupted. In such cases the indicator will detect the fault during power on self test and output the above message.

If you get this error the indicator will need servicing by a qualified technician.

Err: OUT OF RANGE

The value you just entered is beyond the acceptable limits for that parameter which you are modifying. Check the value which you had entered and re-enter the correct value.

INVALID INPUT

The indicator is not expecting the key pressing or the value which you just entered. Check the reason and press the correct keys.

NO Ch SELECTED

You are trying to switch over to the 'UNITS' mode for engineering units display without specifying which channel number data to use. First select the channel number associated with that transducer by pressing the 'CH NO' key then select the 'UNITS' mode.

NO TXDR SETUP

You are trying to select a channel number for engineering units display which has not yet been setup with any valid transducer coefficients. First you should setup the channel by entering the calibration

coefficients for the transducer which you want to associate with this channel.

RAM DATA LOST

This error message also appears only during Power On Self Test.

Whenever the setup information is changed the changed information is stored back in the NVRAM and a check sum is calculated and stored for checking the data integrity. If for any reason the stored 'setup' data gets corrupted you will get the above error message. Possible reasons include

- The NVRAM module has been replaced by a new module.
- The NVRAM module or the associated hardware has developed some fault.
- The internal Lithium battery has exhausted (The NVRAM is a sealed module and the internal battery can not be individually replaced).

When you get this error message clear the 'Setup' and 'Data' memory, reprogram (setup) a few of the channels and try to operate the indicator. If the indicator functions normally then most probably the NVRAM got corrupted due to a transient fault and you can 'Setup' the indicator again and make it ready for use. However, if the indicator fails to operate even after executing the above procedure the indicator probably needs servicing by a qualified technician.

Rnn: NO DATA!

Where nn is the channel number (from 000 to 500) whose data is being recalled. You are trying to recall data for a channel but there is no logged data corresponding to that channel number. Unless you have stored a valid reading earlier you cannot recall the data. Also if you are using the 'PREV' or 'NEXT' key and get this message it means that there is no earlier or later data that which has already been displayed.

RTC FAILED

This message appears during POST. The indicator has detected that the Real Time Clock has developed some fault and is not functioning properly. However, this message will not appear if the RTC has been stopped by using the 'Stop RTC' function described in the 'Operation' section.

9 SPECIFICATIONS

EDI-53P

Input : Potentiometric displacement transducers with 0...2V DC output.

Excitation voltage output: 5 V DC

EDI-53L

Input : Resistance strain gauge bridge load cell with 0...3 mV/V output.

Excitation voltage output: 5 V DC nominal.

Recommended minimum L/C input resistance : 350 ohms (i.e. excitation current = 14 mA)

Absolute Minimum L/C input resistance : 90 ohms (i.e. maximum excitation current = 55 mA).

Preamplifier gain : 100

NOTE: As the EDI-53 uses a four wire resistance bridge measurement system, signal lead resistance will introduce an error proportional to the ratio of signal lead resistance to the load cell input resistance. E.g. for a 350 ohms load resistance, 3.5 ohms lead resistance will introduce an additional full scale error of 0.1% [= (3.5 / 350) x 100].

EDI-53I

Input : 4-20 mA DC current input.

Input resistance : 50 ohms

GENERAL

(The following specifications are common for all versions)

Display

LCD dot matrix alphanumeric display.

16 characters x 1 line.

Red led provided for battery low indication.

Keyboard

16 key environmentally sealed membrane keypad. Keys are multiple function. Primary key function and numerical values are marked on keys.

Analogue to Digital Converter

Measurement resolution: +/- 20,000 counts resolution for 2V input.

Display resolution : Recommended maximum 2000 counts for 2V at ADC input.

ADC accuracy : +/- 0.1% FS for 2 V DC input.

Engineering Units Display

The indicator accepts linearization coefficients for linear scaling like $Y = BX + C$, or second order polynomial calculation like $Y = AX^2 + BX + C$, where X is measured value and Y is converted value in engineering units. Indicator can store calibration coefficients A, B and C for up to 500 transducers.

CPU

Atmel AT89C51RC, 8-bit microcontroller.

Memory

32 KB program memory (provided inside the microcontroller) and 64 KB Non Volatile RAM (NVRAM) data memory.

Data memory provides non volatile storage of 500 transducer calibration constants and 6700 sets of time stamped data readings. Each data set consists of one parameter reading together with date and time data was stored.

Real Time Clock

A real time clock is provided for time and date stamping of stored data. RTC is battery backed and will continue keeping time even if the indicator is kept off for short periods of time. However, if the indicator is used only sparingly the internal sealed battery will drain off and the RTC will lose time whenever the indicator is turned off.

RTC time keeping accuracy: ± 2 minutes / month, typical, over the operating temperature range with indicator powered on. Very sparingly used indicators will show much more variation.

RS-232C Serial port

RS-232C serial output is provided to connect the indicator to a serial printer or IBM compatible PC equipped with a RS-232C serial interface port.

Baud rate: 2400 baud fixed.

Format: 1 start bit, 8 data bits, no parity and one stop bit.

Data file uploaded to computer is in comma delimited ASCII text file format acceptable to most commercially available spreadsheet, database and analytical software.

Diagnostics

Power On Self Test plus additional diagnostic utilities are provided.

Power Supply

Internal rechargeable 6V sealed Valve Regulated Lead Acid battery (generally known as maintenance free battery). A suitable external battery charger is supplied with the indicator for charging the batteries. Do not use any other charger for charging the battery.

Always use Exide (India) EP4-6 or Hitachi HP4-6 (6M4) Sealed Maintenance Free battery or equivalent from other manufacturers for replacement. Different manufacturers specify battery rating as 6V/ 4Ah, 6V/ 4.2Ah, 6V/ 4.5Ah etc, any of them can be used.

Power consumption

Less than 60 mA from battery with Encardio-rite sensors connected at input. The indicator will typically operate for around 60 hours on a fully charged new battery with sensor connected. Power consumption reduces if sensor is disconnected from the indicator.

Input / Output Connectors

Circular weather proof 7-pin connector for sensor input and RS-232C serial interface port (combined) and 3-pin connector for battery charger.

Environment

Operating temperature range: 0 to 45 °C

Operating humidity range: 10% to 90% (no condensation)

Housing

ABS + PU impact resistant plastic moulded housing.

Dimensions: 277mm (W) × 248 mm (H) × 70 mm (D)

Battery Charger

Input: 90 – 270 V AC, 50 or 60 Hz, 60 mA max.

Output: 7 V DC nominal, 250 mA max.

Dimensions: 136 mm (L) x 67 mm (W) x 51 mm (H), Excluding power cords.

Weight

2.5 kg approx (including internal battery but without cables).

Recommended Calibration Interval

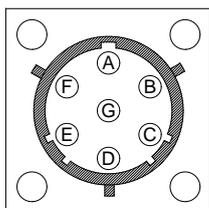
1 year.

Note: Due to continuous product development and improvement the specifications in this manual may change. Changes, if any, are described in the Errata Sheet or Addendum sheets enclosed with the instrument at the time of supply.

INPUT, SERIAL PORT AND POWER SUPPLY CONNECTOR WIRING**SENSOR /RS-232C CONNECTOR**

Connector type Amphenol Part # 621N-12E-10-7P

(7-pin box mounting receptacle)

**Figure 1**

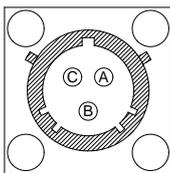
Front View

Pin No.	Signal
A	Excitation supply 0V
B	Excitation supply +5V
C	Signal input –
D	Signal input +
E	TxD
F	RxD
G	Gnd

BATTERY CHARGER CONNECTOR

Connector type Amphenol Part # 621N-12E-8-3P

(3 pin box mounting receptacle)

**Figure 2**

Front View

Pin No.	Signal
A	+ 7 VDC
B	0 V
C	(No connection)

BATTERY CHARGING AND CARE OF RECHARGEABLE BATTERY

Caution!

Always maintain internal battery in charged condition. Failure to do so will cause premature battery failure. A battery which gets damaged due to non-compliance with the instructions given below is not covered by our standard warranty and is also not eligible for free servicing.

The EDI-53 uses internal sealed maintenance free (SMF) battery as a power source.

A separate battery charger operating from AC mains supply is supplied with each indicator. A fully discharged battery needs 16 hours of charge to get fully charged. A partially discharged battery will require proportionately less time but the time is difficult to calculate. As soon as the battery is fully charged the charging current gets automatically reduced to a safe value. Though the battery will not get damaged if the charger is kept on for some time even after the battery is fully charged, it is recommended that the charger be switched off.

On receiving the indicator for the first time recharge the battery for 16 hours through the supplied mains powered battery charger.

If the EDI-53 is not going to be used for more than 15 days, fully charge the battery before storing the indicator. Also fully charge the battery before use if the indicator has not been used for more than 30 days.

If the indicator is not going to be used for more than 30 days, recharge the battery at least once every 30 days or so.

The red "LOW BATT" lamp turns on when approximately 15 percent of battery capacity is left. Fully recharge the battery at the first opportunity as soon as this lamp turns on.

The battery charger has two cords, one supplied with a two pin plug for inserting into an AC mains socket and a round 3 pin circular plug for inserting into the 3 pin power socket of the EDI-53 indicator. The charger does not have any separate power switch.

The rechargeable battery needs replacement every 3 to 5 years (irrespective of hours of use). Replace battery with the same type or an equivalent from another manufacturer. The different manufacturers specify battery rating as 6V / 4Ah, 6V / 4.2Ah, 6V / 4.5Ah etc, any of them can be used.

Battery replacement and disposal of discarded battery

Instructions on how to replace the internal battery or disposal issues regarding discarded battery is given on a separate page at the end of this manual.

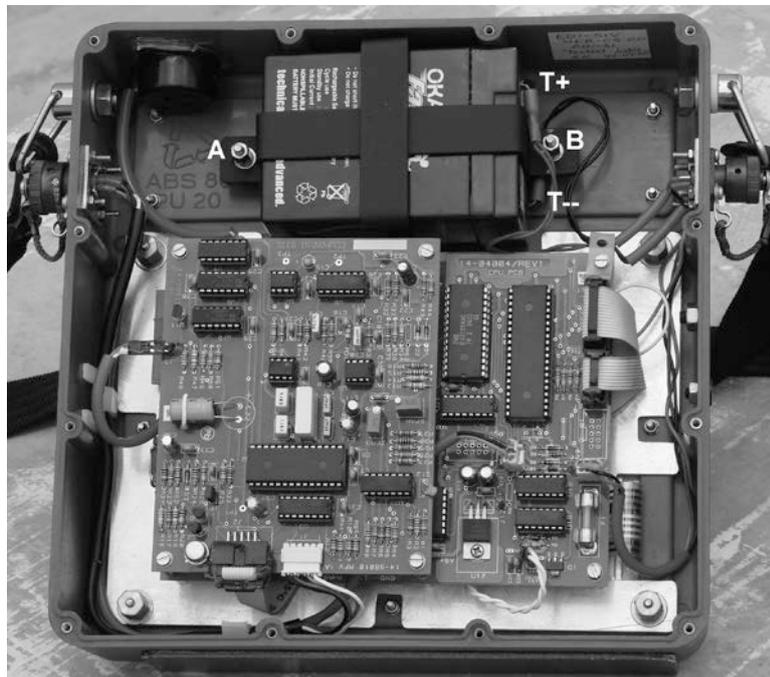
BATTERY REPLACEMENT

Replacement of sealed lead acid battery in Encardio-rite Model EDI-51V and EDI-53x series Digital Indicators / Dataloggers

Battery replacement should be done only by a person with some technical knowledge and experience in servicing electrical / electronics equipment.

Encardio-rite model EDI-51V and EDI-53x series of indicators / dataloggers are powered from an internal 6V, 4 or 4.5 Ah sealed lead acid battery, technically known as VRLA (Valve Regulated Lead Acid) battery.

Although 6V, 4 Ah or 4.5 Ah VRLA batteries are available world wide from many different manufacturers, they differ slightly in dimensions and terminal arrangement. However, any VRLA battery of equivalent rating and dimensions (approximately 70 mm length x 48 mm width x 102 mm



case height) will work in the datalogger.

To replace the battery, you will need a 2.5 mm allen key and a ¼" (6.35 mm) nut driver or a standard long nose plier. Follow the steps given below to replace the battery:

Power off the datalogger if it is on.

Lay the datalogger face down on a flat table. Open the back cover of the datalogger by unscrewing the 12 retaining screws using a 2.5 mm allen key. The photograph shows the rear view of the datalogger with the back cover removed.

Remove the two long nuts, marked A and B, holding down the battery clamp using a ¼" (6.35 mm) nut driver. Alternately a standard nose plier can also be used. Remove the spring washers then the plain

washers from the battery clamp studs on the datalogger.

Remove the battery together with the battery clamp by guiding the battery with the clamp straight out off the holding studs.

Separate the clamp from the battery.

The battery is provided with two-tab terminals one of which is marked with a + sign (marked T+ on photo). This terminal is also identified with a red colour and is the positive terminal of the battery. The unmarked terminal is the negative terminal (marked T – on photo). The datalogger supply is connected through two wires terminated in female tab connectors. The positive supply wire is of red colour and the negative supply wire is of black colour. Disconnect the two datalogger supply wires from the battery by pulling out the respective tab connectors.

To connect a new battery, identify the positive terminal and push in the red wire tab connector firmly on the terminal. Similarly connect the black wire to the negative terminal of the battery.

Position the battery clamp over the side of the battery, as shown in photo, and route the wires over or under the battery clamp as may seem necessary.

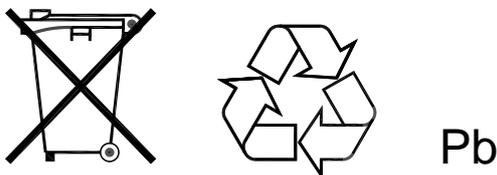
Lower the battery together with the clamp over the battery holding stud in the datalogger so that the studs pass through the holes in the battery clamp.

For each stud, first put on the plain washer, followed by the spring washer and then screw on the long nut thus securing the battery clamp to the datalogger. Tighten the long nuts using a moderate force so that the battery is securely held by the clamp. Due to small dimensional variations between batteries from different manufacturers a piece of card board or foam rubber tape packing may be required to eliminate any free space between the battery and the clamp.

Assemble the back cover by screwing back the 12 retaining screws.

The datalogger is now ready for use. Turn the datalogger face up, turn on the datalogger and check for proper operation.

Disposal of discarded battery



As the sealed lead acid battery contains lead, which is considered a hazardous substance, there are strict regulations regarding method of disposal of discarded batteries in most countries. Discarded batteries should be disposed off in a manner as required by your local laws or regulations. Your local laws may require the battery to be returned to a collection centre for recycling.

For more help you may refer to your local distributor who sold you the unit or contact the manufacturer, at the link given below, if you have bought the unit directly

Website: www.encardio.com

Email: geotech@encardio.com

Addendum

Model EDI-53UTM Digital Indicator for Encardio-rite Model EAN-70M Uniaxial Portable Tilt Meter

1 INTRODUCTION

The EDI-53UTM Indicator is a customized version of EDI-53 series indicator that is suitable for use with Encardio-rite Model EAN-70M type tilt meter.

Except for the differences described below, the EDI-53 Series Digital Indicator User's Manual [ER document No. WI-6002.67] is valid for most of the other operations and technical specifications of this indicator. The section numbers given below refer to the original section numbers of the User's Manual that are affected by the change.

2 TRANSDUCERS

2.1 The EAN-70M Portable Tilt Meter

The EDI-53UTM Indicator is meant for use with Encardio-rite Model EAN-70M type tilt meters only. The EAN-70M tilt meter has a measurement range of $\pm 15^\circ$ from vertical. It provides a full-scale output of $\pm 4.14\text{V}$ (nominal) at $\pm 15^\circ$. The output voltage is proportional to the sine of the measured tilt angle rather than the tilt angle in arc degrees. EAN-70M tilt meter requires an excitation supply of ± 9 to 12V , which is supplied by the indicator.

2.2 Measurement of transducer output

The EDI-53 series indicator can measure full-scale input voltages only up to $\pm 2.0\text{V}$. So the EAN-70M output voltage is internally attenuated by a factor of 2 to yield a full-scale value of $\pm 2\text{V}$. In the Volts mode the full-scale tilt output from the EAN-70M would be shown as 2.0000V by the indicator.

2.3 Calculation of parameters value in engineering units

As explained in section 3.2 above, the indicator in volts mode will show the EAN-70M output at 15 degrees as 2V . However the value of $\text{Sin}(15^\circ)$ is 0.2588 . As the EAN-70M output is linear with sine of the measured angle, it makes more sense to display the tilt meter output in terms of $\text{sin}(A)$ where A is the angle of tilt.

For the indicator EDI-53UTM to show the tilt value in terms of sine of angle, at least one of the channels of the indicator should be configured with a fixed gage factor 0.125 and offset value 0 as described in **section 5** below. The tilt meter output will now appear on the indicator display as $\text{Sin}(A)$.

If the value of tilt angle A is required in arc degrees, the indicator reading 'x' can be converted to arc degrees as follows:

$$A = \sin^{-1}(x)$$

As the EDI-53UTM allows the logged readings to be stored in memory and later down loaded to a computer, a large number of indicator readings can be easily and quickly converted to corresponding 'arc degree' values using any commercially available spreadsheets program like Microsoft Excel.

2.4 Non-linearity correction using polynomial calculation

Polynomial correction is not required for EAN-70M tilt meter output, and hence the correction coefficients are not provided in the supplied calibration certificates (test report) supplied with individual tilt meters.

3 TAKING MEASUREMENTS

The Sensor Cable supplied with EDI-53UTM consists of 6-core cable with 7-pin circular connectors on one end & 6-pin circular connector on other end of the cable. Fig. 1 shows how the EAN-70M tilt sensor is connected to the EDI-53UTM indicator using the supplied sensor cable.

4 PREPARING SETUP DATA

To measure the tilt meter output with EDI-53UTM at least one channel has to be setup using calibration coefficients as described below. This channel can then be used to measure the output from any EAN-70M Portable tilt meter.

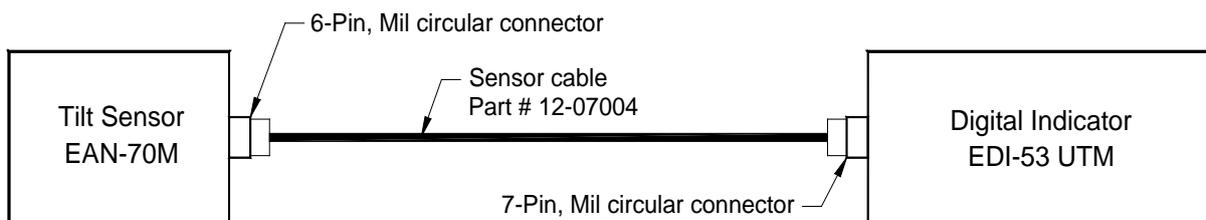


Figure 4-1 Connecting Tilt Meter to Indicator through Sensor Cable

1. **Ch No.** Enter the channel number (i.e. transducer number) that you want to assign to the portable tilt meter for taking readings. As the same portable tilt meter will be used for taking measurements from different tilt plates, only a single channel need to be configured.
2. **Units** Press Key '9' when prompted for 'Units', to select 'blank'.
3. **Initial Reading** Press Key '0' when prompted for 'IR'
4. **Gauge Factor** $2 / [\text{Tilt Meter gauge factor in Volts/Sin}(90^\circ)]$
(For EAN-70M $\pm 15^\circ$ range tilt meter, enter 0.125)
5. **Coefficient A** This value should be left at zero
6. **Decimal Point 'DP'** Press key '4' when prompted for DP, to see the sine value up to four significant decimal places.

NOTE:

The EAN-70M 15° tilt meter outputs 4.1411 V (nominal) at 15-degree tilt, which corresponds to a sine value of 0.2588. However, to increase display resolution the EDI-53UTM attenuator setting is kept at 2:1 which allows to display sine value of up to 0.2500 corresponding to a tilt angle of 14.48 degrees instead of 15 degrees. As the EAN-70M is generally used to measure small angles, typically less than ± 5 degrees, this should not be a disadvantage.

Addendum

Model EDI-53ELV Digital Indicator for Encardio-rite EL-Tilt Meter

1 INTRODUCTION

The EDI-53ELV Indicator is a customized version of EDI-53 series indicator that is suitable for use with Encardio-rite EL-Tilt Meter, Model: EAN-31ELV.

Except for the differences described below, the EDI-53 Series Digital Indicator User's Manual [ER document No. WI-6002.67] is valid for most of the other operations and technical specifications of this indicator. The section numbers given below refer to the original section numbers of the User's Manual that are affected by the change.

2 TRANSDUCERS

2.1 The EAN-31ELV EL Tilt Meter

The EDI-53ELV Indicator is meant for use with Encardio-rite EL-Tilt Meter, Model: EAN-31ELV only. The EAN-31ELV tilt meter has a measurement range of $\pm 0.5^\circ$. It provides a full-scale output of $\pm 1V$ (nominal) at $\pm 0.5^\circ$. EAN-31ELV tilt meter requires an excitation supply of 12Vdc, which is supplied by the indicator.

2.2 Measurement of transducer output

The EDI-53 series indicator can measure full-scale input voltages up to $\pm 2.0 V$. So the out put voltage of EAN-31ELV which is $\pm 1V$ (nominal) can directly be read by this indicator as $\pm 1V$.

2.3 Calculation of parameters value in engineering units

EDI-53ELV can display the tilt meter output in engineering units (mm/m). It calculates the tilt in mm/m using the equation $y = mx + b$, where 'm' the gauge factor (GF) & 'b' is the initial reading (IR). The values of GF & IR are provided in test certificates supplied with every sensor. To read the tilt in mm/m the values of GF & IR has to be entered in EDI-53ELV in setup mode.

2.4 Non-linearity correction using polynomial calculation

The second order polynomial calculation feature of EDI-53ELV cannot be used with 5th order coefficients provided in test certificates. However the 5th order calculation can be done by down loading the data on pc on any "excel sheet" or "open office calc"

3 TAKING MEASUREMENTS

The Sensor Cable supplied with EDI-53ELV consists of 6-core cable with a 10-pin circular connector at one end & a 9-pin D-Shell connector at other end of the cable. Figure 3-1 shows how the EAN-31ELV tilt sensor is connected to the EDI-53ELV indicator using the supplied sensor cable.

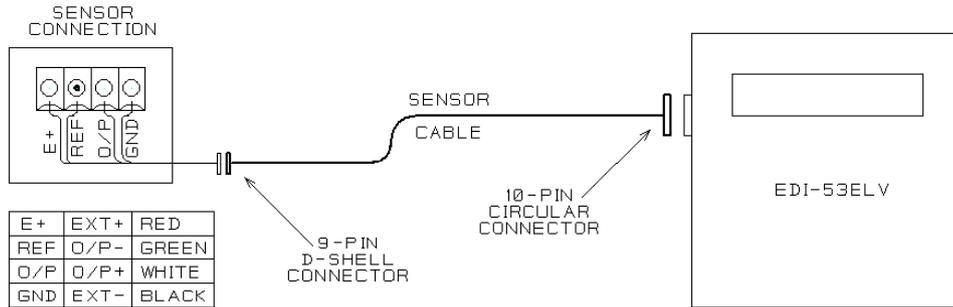
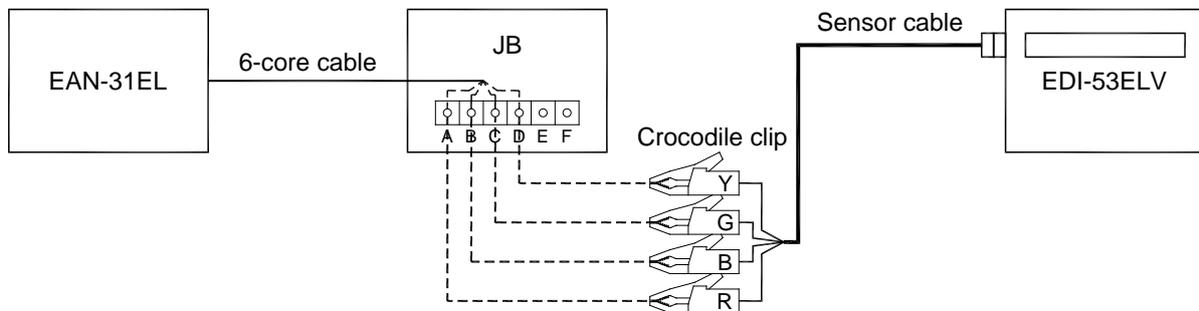


Figure 3-1 Connecting Tilt Meter to Indicator through Sensor Cable

Figure 3-2 shows how the EAN-31ELV tilt sensor is connected to the EDI-53ELV indicator using the supplied six core sensor cable with optional junction box.



Terminal No.	Outgoing cable Configuration		Crocodile clip
	Colour	Description	
A	Red	+12V	Red
B	Black	GND	Black
C	Green	Output (+)	Green
D	White	Output (-)	Yellow
E	Brown	Thermistor	Optional
F	Blue	Thermistor	

Figure 3-2 Connecting Tilt Meter to Indicator through Sensor Cable and Optional Junction Box

4 PREPARING SETUP DATA

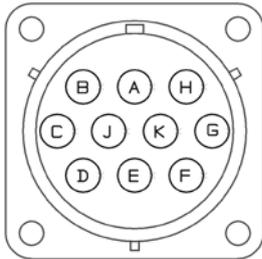
To measure the tilt meter output with EDI-53ELV any one channel has to be setup using GF &IR (provided in test certificates) as described below. This channel can then be used to measure the output of that EAN-31ELV tilt meter.

1. **Ch No.** Enter the channel number (i.e. transducer number) that you want to assign to the EL tilt meter for taking readings.
2. **Units** Press Key '9' when prompted for 'Units', to select 'blank'.
3. **Initial Reading** Enter the value as provided in test certificate when prompted for 'IR'
4. **Gauge Factor** Enter the value as provided in test certificate when prompted for 'GF'
5. **Coefficient X²** This value should be left at zero
6. **Decimal Point 'DP'** Press key '1...4' (as desired) when prompted for DP, to see the mm/m value up to required significant decimal places.

5 INTERFACING TO A COMPUTER OR PRINTER

The interface cable consists of a 10-pin circular connector at one end for connecting to the indicator and a 9-pin D-shell connector at the other end for connecting to pc.

INPUT & SERIAL PORT CONNECTOR WIRING
 Connector type Amphenol Part # 62IN-12E-12-10P
 (10-pin box mounting receptacle)



Pin #	Signal Name	
H		-12V
A	Excitation	0V
B		+12V
C	Input Ch- A	Hi
J		Lo
K	No Connection	
G		
D	RS-232	TxD
E		GND
F		RxD

Addendum

Model EDI-53P-C Digital Indicator for Potentiometric Sensors

1 INTRODUCTION

The EDI-53P-C is a modified version of Encardio-rite's EDI-53P potentiometric indicator. The standard EDI-53P indicator is meant for use with Encardio-rite's EDE-PXX series potentiometric displacement transducers that need 5Vdc excitation and output 0-2V dc signal.

The **EDI-53P-C** is a customised version that is intended for use with passive potentiometric sensors, like Glotzl series GWL../.. potentiometric displacement transducers.

Except for the differences described below, the EDI-53 Series Digital Indicator User's Manual [ER document No. WI-6002.67 Rev. 0] is valid for all other operations and technical specifications of this indicator. The section numbers given below refer to the original section numbers of the User's Manual.

2 TRANSDUCERS

The EDI-53P-C is designed for measurement of wiper position of passive potentiometric sensors relative to the reference terminal.

An example of such sensors is passive potentiometric displacement transducers from some manufacturers, e.g series GWL ../.. potentiometric displacement transducers from Glotzl.

2.1 Measurement of transducer output

The indicator applies a nominally 2V dc excitation across the potentiometer terminals and measures the output voltage between the reference terminal and the wiper of the potentiometer. The ratio of the two voltages is the ratio of the total potentiometer resistance and the resistance between the reference terminal and the wiper of the potentiometer. The indicator displays the ratio of the two resistances on a scale of 1.000 in the basic voltage measurement mode.

In other words, when the wiper is at 0% of its travel the display will show 0.0000 volts, at 50% travel it will show 0.5000 Volts and at 100% position it will show 1.0000 Volts.

2.2 Calculation of parameter value in engineering units

The EDI-53P-C uses the following equation to calculate the potentiometric output directly in terms of proper engineering units.

$$Y = G \times (P \div 100) \quad [\text{Eqn. 3.3.4}]$$

where, Y is the measured parameter in appropriate engineering units, G is gage factor to be calculated from the sensor manufacturer's data sheet, and P is the potentiometer wiper position expressed in % of full scale.

The gauge factor, 'G' is calculated in the following way. Let's say, for a displacement transducer with a measuring range of 50 mm the calibration certificate mentions that 50 mm corresponds to 99.85 % of full scale (or gives an output of 0.9985 volts with 1 V excitation across potentiometer) the gauge factor would be given by

$$G = (50 \div 0.9985)$$

The value of 'G' for each individual transducer has to be entered in setup for displaying the measured value in engineering units.

3 TAKING MEASUREMENTS

The EDI-53P-C is intended for use with three terminal passive potentiometric transducers. The standard EDI-53P indicator signal leads consist of four leads out of which only three are used. The fourth lead is not used for measurement and is also not internally connected inside the indicator.

The method of connecting the signal leads of the indicator is illustrated in the figure below.

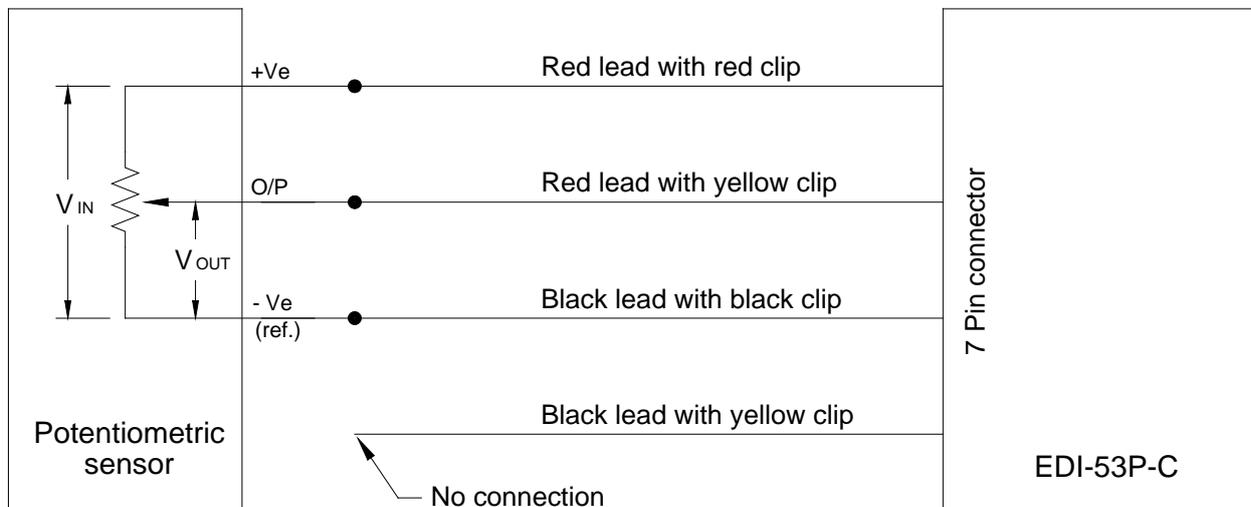


Figure 3-1

As the input signal cable is a standard EDI-53 indicator cable it can be used with any other version of EDI-53 as a replacement.

Special precaution: Three wire potentiometric transducer output is subject to measurement errors due to conductor resistance of long signal leads. Use the shortest possible length of cable between the transducer and the indicator. If that is not possible always use the same cable for taking the measurements. A five wire measurement technique is required to eliminate this error.

4 PREPARING SETUP DATA

1. **Units** – Choose the appropriate symbol if available in the indicator (i.e. select key '4' when prompted for the units value to use 'mm') else select blank (key 9).
2. **Initial Reading or Coefficient C** – Enter the zero offset value if given in the calibration certificate or the initial value after installation as required by the application. To use the initial setting as zero reference, after installation of the potentiometric transducer, measure its initial value in 'VOLTS' mode. This value should be entered as Initial Reading and will serve as the zero-reference value for all subsequent measurements, i.e., this zero value is subtracted from all subsequently measured values to get the actual change in parameter value.
3. **Gauge Factor or Coefficient B** – Enter the calculated value of gauge factor 'G' as explained above.
4. **Coefficient A** – This value should be left at 0.0000E+00 as polynomial calculation coefficients are not generally provided for potentiometric transducers by the manufacturers. However, if available the coefficient of x^2 can be entered for better accuracy.

5. **Decimal point 'DP'** – This value should be kept at the required number of decimal places. For example, to display 50 mm as 50.00 mm the value of 'DP' should be 2.

5 TEST MODE OPERATION

ADC Check (or recalibration) – Key press '3'

The following procedure should be used to check or recalibrate the EDI-53P-C indicator.

Connect a resistor with a value between 1k ohms to 10 k ohms between the Red/Red and Black/Black signal leads.

Connect the Red/Yellow lead to the Black/Black lead end of the resistor. The indicator display should show 0.0000 volts.

Connect the Red/Yellow lead to the Red/Red lead end of the resistor. The indicator display should show 1.0000 volts.

Addendum

Model EDI-53S-350 Digital Indicator for 350 Ohms Quarter Bridge Resistance Strain Gage type sensor

1 INTRODUCTION

The EDI-53S-350 is a modified version of Encardio-rite's EDI-53L indicator. It contains internal bridge completion network for measurement of 350 Ohms foil resistance strain gauge output in a quarter bridge configuration. Except for the differences described below, the EDI-53 Series Digital Indicator User's Manual [ER document No. WI-6002.67 Rev. 0] is valid for all other operations and technical specifications of this indicator. The section numbers given below refer to the original section numbers of the User's Manual.

2 TRANSDUCERS

The EDI-53S-350 is designed for measurement of strain using two wire 350 Ohms resistance strain gages in a quarter bridge circuit. The other 3 precision 350 Ohms bridge completion resistors are provided inside the indicator.

Quarter bridge measurement technique introduces a non-linearity error that increases with the measured value. Although the indicator can work with strain gages of any gauge factor, its calibration is optimised to work with strain gages with a gage factor of around 2 and a measurement range of ± 3000 micro strain to minimize non-linearity errors. The indicator, however, is suitable for measurement of up to ± 5000 micro strain at a nominal gage factor of 2.

3 MEASUREMENT OF TRANSDUCER OUTPUT

The 350 Ohms measurement bridge formed by the external strain gage and the three internal 350 Ohms resistors is excited using a 5 V excitation supply. The strain gage value (output) can be displayed either as bridge voltage output multiplied by 100 in Volts or in engineering units if the gage factor and the initial offset values have been programmed using one of the available channels in setup. The symbol for micro strain cannot be displayed on the display, so the units position remains blank.

3.1 Calculation of parameter value in engineering units

The EDI-53S-350 uses the following equation to calculate the strain value sensed by the strain gage.

$$S = Vop \times (8000 \div G) \quad \text{[Eqn. 3.3.4]}$$

where, S is measured strain value in micro strain, G is gage factor as supplied by the strain gage manufacturer, and Vop is the bridge output voltage as indicated by the EDI-53S-350 indicator in 'VOLTS' mode.

4 TAKING MEASUREMENTS

As the EDI-53S-350 is intended for use with two wire resistance strain gages, only the red and black input signal leads terminated with yellow clips are used for measurement. The signal leads are polarity insensitive so any input lead can be connected to any of the two strain gage terminals.

The remaining pair of red and black leads terminated with red and black coded clips are not used in this indicator. In the standard EDI-53 indicator these provide the bridge excitation voltage that is not required for quarter bridge measurement. These leads are also not connected internally in the indicator.

As the input signal cable is a standard EDI-53 indicator cable it can be used with any other version of EDI-53 as a replacement.

5 PREPARING SETUP DATA

1. **Units** – Choose the blank option as the symbol for micro strain ($\mu\epsilon$) is not available in the indicator (i.e. select key '6' when prompted for the units value).
2. **Initial Reading or Coefficient C** – Enter the value of the initial value of the strain gage measured in Volts. After installation of the strain gage, measure its value in Volts in 'VOLTS' mode. This value will serve as the zero reference value for all subsequent measurements, i.e. this zero value is subtracted from all subsequent measured values to get the actual change in strain.
3. **Gauge Factor or Coefficient B** – Enter the value ($8000 \div G$), where G is the gage factor of the strain gage to be measured, as supplied by its manufacturer.
4. **Coefficient A** – This value should be left at 0.0000E+00 as polynomial calculation coefficients are not generally provided by the foil resistance strain gage manufacturers. However, if available the coefficient of x^2 can be entered for better accuracy.
5. **Decimal point 'DP'** – This value should be kept at 0

6 TEST MODE OPERATION

ADC Check (or recalibration) – Key press '3'

The following procedure should be used to check or recalibrate the EDI-53S-350 indicator.

The EDI-53S-350 requires a precision resistance box in which the resistance can be varied in steps of at least 0.01 Ohms. The resistors should have an accuracy of at least 0.01% of value.

Program one of the transducer channels for 'Units' = blank, 'Initial reading' = 0.000, 'Gage Factor' = 4000 and 'DP' = 0. Select the programmed transducer channel in units mode.

Connect the input signal leads to the decade resistance box output terminals. The 'zero' and 'span' readings should be as follows:

Input : 350 Ohms	Display : (Note down the reading on display, say Z)
Input : 352.10 Ohms	Display : $(3000 + Z) \pm 9$ [<i>This value is in micro strain</i>]

Addendum

Model EDI-53ST Digital Indicator for Encardio-rite Model EAN-70 Tilt Meter

1 INTRODUCTION

The EDI-53ST Indicator is a customized version of EDI-53 series indicator that is suitable for use with Encardio-rite Model EAN-70 Servo accelero-meter type tilt meter.

Except for the differences described below, the EDI-53 Series Digital Indicator User's Manual [ER document No. WI-6002.67] is valid for most of the other operations and technical specifications of this indicator. The section numbers given below refer to the original section numbers of the User's Manual that are affected by the change.

2 TRANSDUCERS

The EDI-53ST Indicator is meant for use with Encardio-rite Model EAN-70 servo accelerometer type tilt meters only. The EAN-70 tilt meter has a measurement range of $\pm 30^\circ$ from horizontal. It provides a full-scale output of ± 5.000 V at $\pm 30^\circ$. The output voltage is proportional to the sine of the measured tilt angle rather than the tilt angle in arc degrees. EAN-70 tilt meter requires an excitation supply of ± 12 V, which is supplied by the indicator.

2.1 Measurement of transducer output

The EDI-53 series indicator can measure full scale input voltages only up to ± 2.0 V. So the EAN-70 output voltage is internally attenuated by a factor of 4 to yield a full-scale value of ± 1.25 V. In the Volts mode the full-scale tilt output from the EAN-70 would be shown as 1.2500 V by the indicator.

2.2 Calculation of parameters value in engineering units

As explained in section 3.2 above, the indicator in volts mode will show the EAN-70 output at 30 degrees as 1.25 V. However, the value of $\text{Sin}(30^\circ)$ is 0.5000. As the EAN-70 output is linear with sine of the measured angle, it makes more sense to display the tilt meter output in terms of $\text{sine}(A)$ where A is the angle of tilt.

For the indicator EDI-53ST to show the tilt value in terms of sine of angle, at least one of the channels of the indicator should be configured with a fixed gage factor (= 4000) and offset value (= 0.0000) as described in **section 5** below.

The tilt meter output will now appear on the indicator display as $\text{Sin}(A) \times 10000$, i.e. sine of the measured angle multiplied by a factor of 10,000. The multiplication factor of 10,000 is often known as the 'instrument constant'. Consequently, if the measured tilt angle 'A' is 30° , $\text{sin}(A)$ will be 0.5000 and the indicator display will show 5000.

If the value of tilt angle A is required in arc degrees, the indicator reading 'x' can be converted to arc degrees as follows:

$$A = \sin^{-1} (x / 10000)$$

As the EDI-53ST allows the logged readings to be stored in memory and later down loaded to a computer, a large number of indicator readings can be easily and quickly converted to corresponding 'arc degree' values using any commercially available spreadsheet program like Microsoft Excel.

2.3 Non-linearity correction using polynomial calculation

Polynomial correction is not required for EAN-70 tilt meter output, and hence the correction coefficients are not provided in the supplied calibration certificates (test report) supplied with individual

tilt meters.

3 TAKING MEASUREMENTS

Sensor Cable of EDI-53ST consists of 6-core cable with 6-pin Lemo-plug on one end & 7-pin circular connector on other end of the cable. Fig. 1 shows how the EAN-70 tilt sensor is connected to the EDI-53ST indicator using the supplied sensor cable.

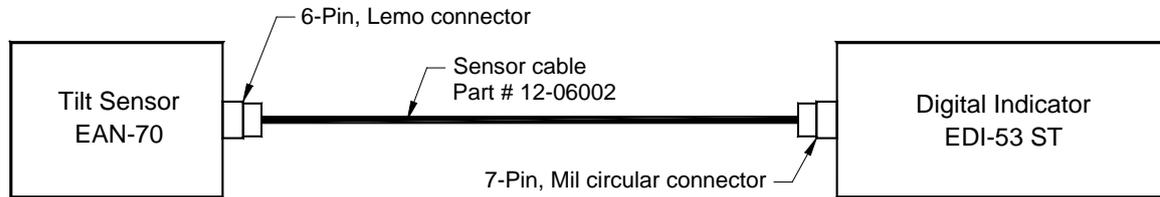


Fig. 1
Connection diagram for EAN-70 to EDI-53 ST

4 PREPARING SETUP DATA

To measure the tilt meter output with EDI-53, ST at least one channel has to be setup using calibration coefficients as described below. This channel can then be used to measure the output from any EAN-30 tilt meter.

- | | |
|------------------------------|--|
| 1. Ch No. | Enter the channel number (i.e. transducer number) that you want to assign to the portable tilt meter for taking readings. As the same portable tilt meter will be used for taking measurements from different tilt plates, only a single channel needs to be configured. |
| 2. Units | Press Key '9' when prompted for units values to select 'blank'. |
| 3. Initial Reading | 0.0000E+00 |
| 4. Gauge Factor | 4.0000E+03 |
| 5. Coefficient A | This value should be left at 0.0000E+00 |
| 6. Decimal Point 'DP' | Press key '0' when prompted for DP, i.e. no decimal point |