

## FE-083-ISO Din Rail Isolation Amplifier



- Battery Stack monitoring
- Power Line Monitoring
- Ground Loop Elimination
- Current Shunt Measurements
- Data Acquisition or Oscilloscope front end

A single channel DC coupled galvanically isolated amplifier in a DIN rail enclosure, the FE-083-ISO has input ranges of 1kV, 100V, 10V and 1V fullscale, with an isolation voltage of 1000V and a bandwidth exceeding 50kHz.

Range programming is by simple screw terminal links.  $\pm 10V$  and a 4-20mA output are available simultaneously.

The FE-083-ISO is ideal for monitoring of vehicle battery stacks where its high voltage input is able to measure the total stack voltage, a single cell voltage or a current shunt voltage in high side or low side applications with complete safety.

The wide range power supply enables operation from 10-36V DC and the amplifier is fully protected against overload or incorrect range selection.

## Description

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## Specification

ISOLATION	Voltage	>1kV pk or DC.
	Capacitance	15pF.
	Resistance	>50 x 10 <sup>9</sup> ohms.
	Mode Rejection	>130dB (DC-60Hz).
	Leakage current	<2 $\mu$ A RMS @ 230V RMS 50Hz.
INPUT	Impedance	1M $\Omega$ .
	Ranges	1kV, 100V, 10V, 1V F.S. (By screw terminal links).
	Accuracy	$\pm 0.2\%$ .
	Linearity	$\pm 0.2\%$ F.S. Typ.
	Temp. Coef.	<0.01% °C.
DYNAMIC	Response	Full bandwidth DC- 50kHz (-3dB).
NOISE	Referred to Voltage O/P	5mV RMS (1V range), 3mV RMS other ranges. (1)
	Referred to Current O/P	4 $\mu$ A RMS.
OUTPUT	Voltage	$\pm 10V$ into 2k $\Omega$ 5nF max.
	Current	Into 600 $\Omega$ (ref. int. supply) 1k $\Omega$ (ref. ext 24V ). 4mA for -10V @ voltage O/P. 12mA for 0V @ voltage O/P. 20mA for +10V @ voltage O/P ( $\pm 0.2\%$ ).
POWER SUPPLY	Requirement	10-36VDC 2W max .
	Protection	Reverse supply & spike overvoltage. Internal fuse.
	Indication	Green LED.
PHYSICAL	Environment	Temp. Range 0°C to 50°C operating.
ENCLOSURE	DIN box	100mm x 75mm x 22.5mm.
CONNECTIONS	Type	Screw terminals.

(1) Measured at Full bandwidth.

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**SAFETY ADVICE****Please read these notes before operating your Isolation Amplifiers.**

1. Do not use amplifiers with their overall plastic covers removed.
2. Ensure that all input leads are made off to the highest standards. It is always wise to 'Megger' test all cable assemblies (disconnected from the amplifiers) to ensure a working safety margin.

**INSPECT CABLES REGULARLY FOR CUTS AND BREAKS**

**CAUTION! HIGH VOLTAGES MAY EXIST ON THE INPUT CONNECTIONS**

3. When making ANY wiring changes, be sure to remove or isolate any high voltage input to the amplifier before touching ANY wiring.
4. Where high voltage measurements are being made, it is advisable to include fuse links in circuit between the power equipment and the instrumentation equipment.
5. Be sure to select the correct power supply voltage for your amplifiers. The FE-083-ISO Isolation Amplifier has a supply range of 10-36V DC.

## 1.0 FE-083-ISO Isolation Amplifier Initial Operation & Verification

The FE-083-ISO is a general purpose Isolation Amplifier. Users familiar with Isolation Amplifier operation may take advantage of the following initial operating procedure.

### 1.1 Selecting the Power Source



The FE-083-ISO Isolation Amplifier is powered from 10-36V DC and generally this will mean that a 12V or a 24V supply will be selected. Vehicle 12V battery power is inherently suitable. Power requirement is below 2W.

### 1.2 Connecting the Input



The application of isolation amplifiers may result in connection being necessary to high voltage conductors with a consequential **serious risk of injury**. It is **essential** to ensure that power to high voltage input circuits is removed prior to any connections being made. IF IN ANY DOUBT, consult a qualified electrician or contact the factory for advice.

The FE-083-ISO has a single ended input configuration, that is to say the input is two wire, having a signal and common connection. In practice, since the amplifier is isolated, these may be regarded as “high” and “low” and should be connected across the voltage to be measured with the low side of the signal to common, chassis or the expected lower potential of the signal source.

**TAKE CARE only to make input connections to the terminals marked 'Hi' and 'Lo'.**

### 1.3 Connecting the Voltage Output

The voltage output is in the range  $\pm 10V$  for linear outputs. Voltages higher than this should be treated with caution and indicate an overload condition at the input. Output impedance is approximately  $100\Omega$ .

### 1.4 Initial Setting

The amplifier is delivered set for a 10V range. No 'Link' is required for this range. For input ranges other than 10V, fit a short insulated linking wire from the screw terminal 'Link' to the desired range terminal, ie, '1V', '100V' or '1kV'.

### 1.5 Switching On

The LED indicator will illuminate as soon as power is applied. In the event that the input is too high for the selected range, the amplifier input protection will ensure that no damage to the amplifier or danger to the operator ensues.

### 1.6 Bandwidth

The amplifier is supplied set for a bandwidth of 50kHz.

**Detailed operating instructions are given in sections 3 & 4.**

## 2.0 FE-083-ISO Amplifier Description

The FE-083-ISO is an Isolation Amplifier in a DIN rail case and is a general purpose isolation amplifier for use when hazardous voltages must be measured. Voltage isolation is up to 1000V DC or peak, with input signal up to 1000V DC or peak. The amplifier utilises a proprietary isolation amplifier device and a high quality isolated DC converter which is proof tested to greater than 5kV.

The module may be most easily appreciated by consideration of its constituent parts :-

- |    |                           |    |                        |
|----|---------------------------|----|------------------------|
| 1. | 10-36VDC power supply     | 5. | Isolation power supply |
| 2. | Switched input attenuator | 6. | Low Pass Filter        |
| 3. | Input preamplifier        | 7. | Output Stage           |
| 4. | Isolation Amplifier       |    |                        |

### 2.1 Wide Range DC Power Supply

The amplifier has a built-in wide range DC power supply which operates from 10-36V DC. Thus 12V DC or 24V DC battery or mains powered DC supplies are all suitable and vehicle applications are straightforward. The amplifier is protected against incorrect polarity for up to 36VDC.

### 2.2 Switched input attenuator

In order to be able to accept high voltage inputs, an input attenuator is switched into circuit ahead of the preamplifier. Note that the amplifier input impedance is always 1M $\Omega$  whether direct or attenuated.

### 2.3 Input preamplifier

The input preamplifier has selectable gain which is utilised for the more sensitive settings. The amplifier is protected (up to the specified limits) against overvoltage arising from incorrect range setting.

### 2.4 Isolation Amplifier

The isolation amplifier integrated circuit operates by capacitance coupling using a digital technique, and enables the input preamplifier to be isolated to as high as 1000V pk or DC.

### 2.5 Isolation power supply

An isolation power supply which operates at high frequency supplies the preamplifier and input stages of the isolation amplifier. The power supply utilises a DC converter specially designed for high voltage application which is proof tested to greater than 5kV.

### 2.6 Low Pass Filter

A low pass filter receives the isolated signal from the isolation amplifier integrated circuit and filters out any sampling frequencies remaining in the signal. Factory setting for the low pass filter is 50kHz.

### 2.7 Output Stage

The output stage is designed to buffer the filtered signal in order to enable high cable loads to be driven. Note that the amplifier is capable of providing  $\pm 10V$  output and 4-20mA output simultaneously.

## 3.0 Installation and Configuration

### 3.1 Mechanical Fixing

The amplifier is suitable for attaching to 35mm DIN rail fixtures via its integral spring activated clip.

### 3.2 Connection of the Power Supply

Connect +ve of your supply (10V to 36V range) to the terminal marked '+V'.  
Connect the return of your supply to the terminal marked '0V'.

### 3.3 Connection of the Voltage Output

Connect from 'Vo' to the data collector (data acquisition, oscilloscope, recorder or meter)  
Connect from 'Com' to the data collector low.

### 3.4 Connection of the Current Output

For those users who need a current output from the amplifier, a 4-20mA feed is available with the scaling as follows:

For  $V_o = +10V$ ,  $I_o = 20mA$

For  $V_o = 0V$ ,  $I_o = 12mA$

For  $V_o = -10V$ ,  $I_o = 4mA$

Connect from 'Io' to the data collector (data acquisition, oscilloscope, recorder or meter)  
Connect from 'Com' to the data collector low.

In this instance the current output needs to work into a receiving resistor or 'burden'. The recommended value is  $200\Omega$  with the maximum value being  $500\Omega$ .

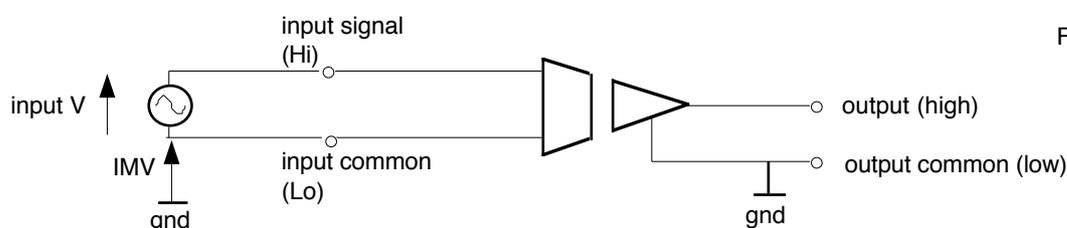
### 3.5 Connection of the Input

The input is via two connection, 'Hi' and 'Lo'.



Connect the signal voltage to be measured across these two terminals only. DO NOT connect the input voltage to any other pin of the amplifier otherwise damage to the amplifier may result.

**TAKE CARE only to make input connections to the terminals marked 'Hi' and 'Lo'.**



\*In this instance, the term IMV is interchangeable with CMV (Common Mode Voltage)

Note that the IMV is specified as the average voltage of the input high and input low with respect to ground.

Wiring type may be coaxial or twisted pair. In each instance consideration must be given to the voltage withstand of the cable and whether it is capable of operating safely at the signal and IM voltages anticipated.

The input impedance of the amplifier is  $1\text{M}\Omega$  under all conditions. This may result in a loading (attenuation of the signal) for higher source impedances. For example, a 1% attenuation will occur when connected to source impedances of  $10\text{k}\Omega$  but only 0.1% for sources of  $1\text{k}\Omega$ .

### 3.6 Connection of the Output

The length of the cable should, if possible, be kept below 10m in length as this maintains amplifier maximum bandwidth and reduces the possibility of capacity load instability.

#### 3.6.1 EMC Filter

The output buffer include an EMC filter for compliance with regulations governing the performance of electrical equipment. The output impedance of the amplifier due to the filter is  $<100\Omega$ . In nearly all cases this will be insignificant when compared to the input impedance of following equipments (often  $1\text{M}\Omega$ ), but should be considered if low impedance equipments are to be connected. Following equipment with an input source impedance of  $10\text{k}\Omega$  would result in a drop in the amplifier output of 1% ( $<0.1\text{dB}$ ).

### 3.7 Setting the Range

The FE-083-ISO has a choice of 4 input ranges, and these are identified as the maximum voltage required to develop 10V at the output (Full Scale). Ranges 1V, 10V, 100V, and 1kV can be set by making the appropriate link as shown below. Note that for the 10V range, no link is required.

**IMPORTANT:** Note that the 'Link' wire is at isolation potential. For this reason it should be made using insulated wire.

Shown right, Range set for 100V Input (FullScale)



## 4.0 Operation

Before operating the equipment, it is advisable to study the previous pages referring to setting up the amplifier and making the input and output connections.

### 4.1 Switching On

On applying the power, the green led should illuminate. If it does NOT illuminate, be sure to isolate the signal input connections to Hi and Lo as these may be at high voltage. When the input is safe, but only then, check the power wiring for correct polarity, security of connections, and to ensure that the selected power source is operating.

#### 4.1.1 Output Voltage

The output of the amplifier should be in the range  $\pm 10V$ . If the output is greater than these limits it is likely that the range setting selected is too high for the input signal. In this case BEFORE making any change to the Range 'Link', be sure to isolate the signal input connections to Hi and Lo as these may be at high voltage. When the input is safe, but only then, check that the Link setting is suitable for the anticipated input range. If in doubt, select a higher range!

## 5.0 Measurement Accuracy

### 5.1 Low Pass Response

The low pass frequency response is factory set and is normally 50 kHz.

### 5.2 Input impedance and Cable capacitance

#### 5.2.1 Loading of Input Source

The amplifier input impedance is  $1M\Omega$  on all ranges. In most situations this will produce minimal attenuation of the signal source but should be borne in mind if source impedances are likely to exceed  $10k\Omega$  when the attenuation will be approximately 1%.

#### 5.2.2 Bandwidth limiting caused by Input capacitance

Where input cables become long, and particularly when input source resistance may be high, attention should be given to the likely dynamic consequences for the signal caused by the input low pass filter so formed.

For example, consider the situation when a coaxial cable of 30m length is used when the signal source exhibits an impedance of  $5k\Omega$ .

The low pass filter pole occurs at  $F = 1 / 2\pi RC$  where : R = source impedance  
C = cable capacity

For typical coax at 100pF/m  $F = 1 / 2\pi \times 5 \times 10^3 \times 3000 \times 10^{-12}$

$$F = 10.6\text{kHz}$$

It can be seen that in certain circumstances the full amplifier bandwidth may not be realised unless the cable length or capacity can be reduced

## 6.0 Calibration

The FE-083-ISO will remain within its stated specification without routine adjustment as high stability components have been used in the construction of the amplifier. However, some ageing is inevitable, and the results should only be considered valid within the calibration interval.

### 6.1 Calibration Interval

A calibration interval of 2 years recommended for the FE-083-ISO

FYLDE offer servicing for the FE-083-ISO and are able to test, repair and recalibrate the amplifiers quickly and cost effectively using instruments traceable to national standards and to ISO9000 quality standard. Please contact the factory for advice.

### 6.2 User Calibration Procedure

Calibration may require specialist equipment (especially for the higher ranges). However, calibration for at least some of the ranges may be checked by use of an external signal generator applied via the rear panel connectors, and a calibrated AC DVM. A sinusoidal signal of frequency 110 Hz is recommended.

Input amplitude must be set so that the output amplitude does not exceed 20 V pk-pk. Input and Output signal amplitudes may then be measured using a calibrated AC DVM and absolute gain accuracy derived.