

## **SERIES AP5101**

### **DIN-Rail Amplifier for Strain Gage Transducers**



ISO 9001:2000

# INDEX

2.0	INSTALLATION INSTRUCTIONS.....	3
2.1	EMC Requirements.....	3
3.0	CONNECTIONS.....	4
3.1	Connections General .....	4
3.2	Internal Controls.....	4
3.3	Transducer connections.....	5
3.4	Full bridge Strain Gauge Transducer.....	5
3.5	1/4 or 1/2 bridge transducer connections.....	5
3.6	Potentiometric Transducers .....	5
4.0	CONTROLS .....	6
4.1	Voltage/Current Output: .....	6
4.2	Excitation .....	6
4.3	Zero.....	6
4.4	Fine Gain .....	6
4.5	Gain Range (X1 to X1250).....	6
4.6	Shunt Calibration .....	6
4.7	Bandwidth/Noise Sliders .....	6
4.8	4-20mA Offset Jumper Link J1.....	7
5.0	SETTING-UP PROCEDURE FOR VOLTAGE OUTPUT .....	7
6.0	SETTING-UP PROCEDURE, 4-20mA OUTPUT .....	7
7.0	SHUNT CALIBRATION FACILITY .....	8
8.0	SPECIFICATIONS .....	9
9.0	FUNCTIONAL CHECKS .....	10
10.0	WARRANTY AND SERVICE .....	10

## Description

The AP5101 Series is a DIN-rail mounted single channel DC amplifier designed to provide variable excitation and signal conditioning for Stellar Technologies strain gage, mV/V, pressure transducers, load cells, and force sensors. This DIN-rail amplifier provides up to 10V output or 4-20 mA output with transducer signals from 10 mV to 10V. This amplifier accepts both uni-polar or bi-polar input signals and can produce corresponding uni-polar and bi-polar voltage outputs. Current outputs are uni-polar. The AP5101 incorporates a DC-DC converter that ensures the output of the unit is electrically isolated from the supply. The DIN-rail housing is constructed of a high-impact thermoplastics case with recessed screw-clamp terminals for all connections and a 25-turn zero and fine gain adjustment accessible from the front panel. A push switch and the capability to connect remotely to an internal shunt calibration resistor are also located on the front panel. Excitation coarse gain and switches to filter the output are internal and easily accessible by disengaging the front panel and board assembly from the housing.

## Standard Features

- Standard DIN-rail Package
- Voltage and Current Output
- Input/Output Isolation
- Broad Range of Inputs (10mV to 10V)
- Internal Coarse Gain Easily Accessible
- Selectable Excitation for Wide Selection of Transducers
- Accepts Both Uni-Polar and Bi-Polar Inputs
- Zero and Fine Gain Adjust From Front Pane
- Remote Shunt Calibration From Front Panel
- Internal Filters Easily Accessible

## **2.0 INSTALLATION INSTRUCTIONS**

### **2.1 EMC Requirements**

For optimum EMC performance use shielded multi-core cables for connection to this instrument; the cable shield may be terminated by means of a short “pig-tail” and connected to the terminals marked:

- (a) Pin 5 – Transducer cable
- (b) Pin 15 – Supply/Output cable

The DIN-rail to which the unit is attached should be earthed.

The screw clamp terminals can accept either solid or stranded wire sizes from 0.2 mm (24 AWG) to 2.5 mm (12 AWG).

#### **NOTES:**

1. Cable shields to be grounded at only one end - the AP5101 end, although grounding at both ends may reduce the effects of high frequency EMI.
2. When the AP5101 is a small part of a large electrical installation, ensure the cables to and from the AP5101 are segregated from electrically noisy cables.
3. ESD precautions should be used when working on the instrument with the lid removed. The user should ensure he is “grounded” by use of a grounded wrist strap or at least touching ground before touching any component, including wires, terminals or switches.
4. Segregate signal/supply/output cables. Route signal cables away from possible sources of EMI, e.g. motor/solenoid/relay cables, etc.
5. The transducer body should be grounded. The transducer body being clamped or bolted to grounded metalwork, e.g. on a machine usually achieves this. Where this does not apply and also where there is no grounding connection via the connection cable to the AP5101, then a separate grounding wire should be connected from the transducer body to the AP5101 SCN terminal.

### **2.2 Unit Mounting**

The AP5101 housing is a standard DIN rail enclosure which can clip directly to a 35 mm top hat rail. The units can be mounted side by side if an ambient temperature up to 105°F. Above this temperature, a gap of 15 mm should be left in between each unit.

3.0 CONNECTIONS

3.1 Connections General

Transducer, supply and output connections are made by 4 x 4 way screw-clamp terminals as shown in Fig 1.

To reverse output polarity, reverse signal hi/signal lo. Voltage output is between Volts Out and common, current output is between current out and common.

**WARNING:        INCORRECT        SUPPLY  
CONNECTION, E.G. CONNECTING SUPPLY  
WIRE TO OUTPUT (O/P) MAY DAMAGE THE  
UNIT AND INVALIDATE THE WARRANTY.**

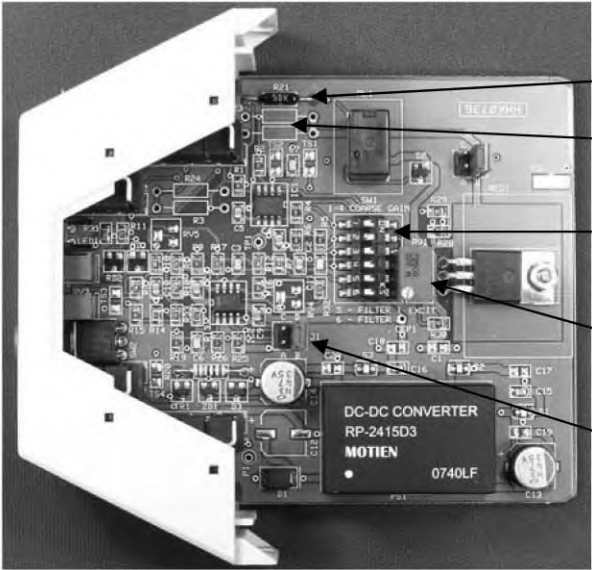
**Fig. 1 Connections**



1	Excitation Hi
2	Excitation Lo
3	Signal Hi
4	Signal Lo
5	Screen
6	R. Cal com
7	R. Cal
8	CAL
9	Volts Out
10	Common
11	Common
12	Current Out
13	Supply +
14	Supply -
15	Screen
16	N/C

3.2 Internal Controls

To access internal controls the front part of the AP5101 case needs to be removed. To do this, use a small screwdriver to gently press in the clips behind terminal 1-4 and 13-16. At the same time pull forward the front of the case. The front of the case and pcb assembly should now slide forward.



**Fig. 2 Internal Controls**

Shunt Calibration Resistor

Bridge Completion Resistors (section 3.5)

1-4 Coarse Gain (section 4.5)

5-6 Bandwidth/Noise filter (section 4.7)

Transducer excitation (section 4.2)

4-20mA Offset Link J1 (section 4.8)

To put case back together, gently slide pcb assembly into case guide slots. Ensure pcb earth pad CG1 is lined up with the earth clip inside the case, and push back until the front of the case clicks back into place.

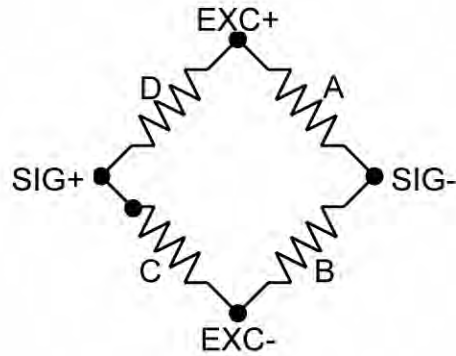
### 3.3 Transducer connections

Before connecting the transducer, check the excitation voltage.

Applying an excitation voltage that is too high may destroy the transducer

### 3.4 Full bridge Strain Gauge Transducer

Transducer connector details are as shown in Fig. 1. (Section 3.1)



### 3.5 1/4 or 1/2 bridge transducer connections

For 1/4 bridge transducers, 3 bridge completion resistors are required. The active gauge should be fitted on arm 'C' and the bridge completion resistors in arms D, A & B.

For 1/2 bridge systems, the active gauges should be C and A, and 2 completion resistors are required.

The bridge completion resistors should be high stability, the same resistance as the active gauge and may be fitted either in the transducer connector, or in the designated position on the AP5101 PCB. This requires removal of the PCB from the case.

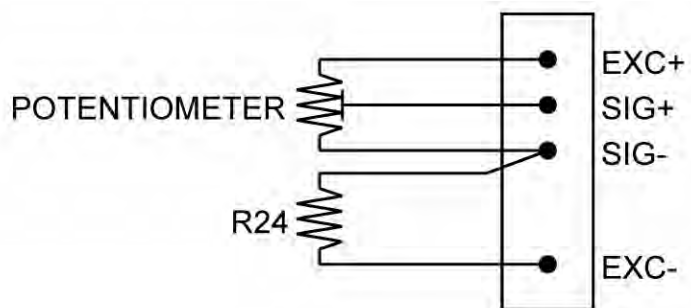
R22 replaces bridge arm D, R23 replaces bridge arm A, R24 replaces bridge arm B

**Note:** Mounting these resistors in the instrument is a compromise. To reduce temperature and long lead effects, completion resistors should preferably be mounted at the transducer and be of close tolerance and low t.c., e.g. 0.1%, 15 ppm.

### 3.6 Potentiometric Transducers

Select R24 value to drop at least 1.5V.  
For example, with an excitation of say 10V and a potentiometer resistance of 500 ohms and R24 value of 100 Ohms, the voltage drop across R24 =  $10V / (500+100) \times 100 = 1.7V$ .

R24 This raises terminal 4 to within the common mode voltage range of the amplifier.



Input signal =  $10 - 1.7 = 8.3V$  so use the lowest gain range for  $\pm 10V$  output. For lower output voltage or 4-20mA output, use lower excitation, e.g. 5V.

R24 can be added either in the location on the PCB, or more easily into the transducer screw terminals, between pin 4 (sig LO) and pin 2 (EXC LO).



## 4.0 CONTROLS

### 4.1 Voltage/Current Output:

Voltage output is between pins 9 and 10 (common). Current output is between pins 12 and 11 (common). Pins 10 and 11 are internally connected.

### 4.2 Excitation

allowing continuous variation of excitation between 3v and 10v.

### 4.3 Zero

allowing a fine adjustment of output zero of approximately  $\pm 2V$  (or 0-10mA) depending on Fine Gain setting.

### 4.4 Fine Gain

allowing a 4:1 variation in amplifier gain, used in conjunction with 4.5.

### 4.5 Gain Range (X1 to X1250)

sliders 1 to 4 of the 6-slider DIL switch, when used with the fine gain control, provide an output of 5V or 4-20mA with an input signal range of approx. 4mV to 5V as shown below: (also output  $\pm 5v$  for input  $\pm 4$  mV to  $\pm 5v$ ).

SLIDERS ON	INPUT SIGNAL RANGE		<b>Note:</b> for the two lowest gain ranges (with slider 4 off), the excitation voltage must be $\geq 5V$ to provide signals within the required common mode voltage range of the amplifier.
	for: 5V or 4-20mA OUTPUT	For $\pm 10V$ OUTPUT	
4 + 3 + 2	4 – 16mV	$\pm 8$ to $\pm 32mV$	
4 + 3	5 – 20mV	$\pm 10$ to $\pm 40mV$	
4 + 2	18 – 70mV	$\pm 35$ to $\pm 140mV$	
4 + 1	65 – 270mV	$\pm 130$ to $\pm 500mV$	
4	0.25 – 1V	$\pm 0.5$ to $\pm 2V$	
1	0.34 – 1.35V	$\pm 0.7$ to $\pm 2.7V$	
None	1.25 – 5V	$\pm 2.5$ to $\pm 10V$	

### 4.6 Shunt Calibration

The front panel push-button switch 'CAL', when pressed connects an internal 59k $\Omega$  0.1% resistor across one arm of the bridge.

**Remote Cal.** - an internal relay may be used to remotely connect the 59k $\Omega$  resistor. To operate this relay, connect the R-Cal. terminal (pin 7) to R. Cal com (pin 6), (lead length is irrelevant) via a switch, etc.

If long cables are used, then cable voltage drop may cause significant shunt calibration errors. In this case, remove SP1 on PCB and connect pin 8 via a separate wire to the relevant bridge node as near as possible to the transducer.

### 4.7 Bandwidth/Noise Sliders

slider 5 (filter 1) and slider 6 (filter 2) when switched to 'ON' reduce the units output bandwidth as shown in the table.

Slider	Bandwidth
5+6 OFF	5 kHz
5 ON	500 Hz
6 ON	20 Hz

#### **4.8 4-20mA Offset Jumper Link J1**

Normally, with J1 set B-D, the relationship between signal/voltage output/current output is Zero to F.S. signal = 0 to 5V or 4-20mA output.

For bipolar operation, e.g. for compressive/tensile load applications, J1 may be changed to A-C which makes the relationship  $\pm$ F.S. signal =  $\pm$ 2.5V or 4-20mA O/P.

i.e. J1 provides a 1/2 F.S. offset for the current output and increases the voltage head room in the amplifier.

### **5.0 SETTING-UP PROCEDURE FOR VOLTAGE OUTPUT**

Refer also to Section 7 for Shunt Calibration Method.

- 5.1** Determine the transducer bridge output from the manufacturer's data sheet and adjust the coarse gain control as shown in Section 4.5. Check that sliders 5 and 6 are set to OFF.
- 5.2** Connect the monitor and supply as detailed in Sections 2 and 3. With transducer DISCONNECTED switch ON power. Set excitation voltage, via the **EXCIT(ATION)** control, to the value indicated in the transducer data. Note, excessive excitation voltage or incorrect connection may irreparably damage the transducer. Connect transducer and allow a 20-minute warm-up period (for maximum accuracy)
- 5.3** With zero load (pressure, etc.) applied to the transducer, adjust the ZERO control for zero output.
- 5.4** Apply a precise load (pressure, etc.) to the transducer and adjust the F.GAIN control for the desired output.
- 5.5** Repeat steps 3 and 4 until repeatable readings are obtained.
- 5.6** Operate the Cal. switch or Remote Cal. (Sections 4.6 and 7) and note output for future reference.

### **6.0 SETTING-UP PROCEDURE, 4-20mA OUTPUT**

- 6.1** Refer to Section 4.08 for bipolar input signal operation.
- 6.2** Proceed with 5.1 and 5.2 above, then:
- 6.3** With transducer output approximately zero, adjust the ZERO control for an output current of 4mA approx.
- 6.4** Apply a known value to the transducer and adjust FINE GAIN for the desired output (preferably full scale for 20ma output). Repeat steps 3 & 4 for consistent results.
- 6.5** Operate the Cal. switch or Remote Cal. (see Section 4.6) and note output for future reference. Refer to Section 7. Reference may be made to Section 7.2 but note that full scale of output is  $20-4 = 16\text{mA}$ .

## 7.0 SHUNT CALIBRATION FACILITY Refer to Section 4.6 for Operation

This is applicable to resistance bridge transducers only, e.g. most load cells and pressure transducers (not semi-conductor gauges).

The Shunt Calibration Facility can be used as:-

- 7.1 A Calibration Check.** When the prime calibration has been made by applying a precise known pressure or load to the transducers as described in Section 5 or 6, the R-CAL relay can be operated (normally with zero pressure or load applied) and the output recorded as the Calibration Check figure. A quick check can then be made at anytime by comparing new CAL outputs with the original.

**Note** that if the output is not at zero when the CAL switch is operated, the true CAL CHECK figure is the CAL output plus or minus the initial output.

- 7.2 A Shunt Calibration.** The shunt calibration method can be used to calibrate the transducer and electronics without having to apply a known pressure or load to the transducer.

- 7.2.1** Calculate the shunt calibration figure required from the data given on the transducer Calibration Record Sheet (CRS).

From CRS - output for 100% = WmV

- output with shunt = YmV

Therefore output required in CAL is  $Y/W \times$  required full scale output.

**Note:** If CRS states shunt resistor different from the one fitted (59k ohm is standard, other values to order) then it may still be possible to obtain a calibration from:

CAL figure calculated  $\times (R \text{ shunt} / 59k) = \text{new CAL figure}$

- 7.2.2** Set the COARSE GAIN switch for the required input sensitivity (see Section 4.5).

- 7.2.3** Connect the monitor and supply as detailed in Sections 2 and 3. With transducer DISCONNECTED switch ON power. Set excitation voltage, via the EXCIT control, to the value indicated in the transducer data. Note, excessive excitation voltage or incorrect connection may irreparably damage the transducer. Connect transducer and allow a 20-minute warm-up period (for maximum accuracy)

- 7.2.4** Ensure no load or pressure applied to the transducer.

- 7.2.5** Operate CAL relay and adjust FINE GAIN control to give the required output as calculated in 7.21.



## 8.0 SPECIFICATIONS

### Supply Voltage

9 to 36V DC.

### Supply Current

120mA typical with 24V supply, 10V excitation and 350Ω bridge. (80-250mA depending on supply, excitation & bridge resistance)

### Output

±3V to ±10V max into >2kΩ , 4-20mA into 0-500Ω.

### Excitation

Voltage

3 to 10V , 100mA max (See Section 4.2)

Regulation

Excitation change = 0.10% typical with load change 0-100 mA

Tempco

0.005%/°C typical

### Amplifier

Linearity

0.02% of FS output

Bandwidth

5kHz typical as standard or 500 Hz or 20 Hz with filters ON.  
See section 4.7.

Noise

5mV or 20μA rms (less with filter ON) typical

Zero Tempco

0.002% FS/°C typical

Gain Tempco

0.003% FS/°C typical

Input Impedance

>10M ohm

CMRR

95dB typical, dc to 50Hz

Zero Adjustment

±2V (or 0-10mA) output typical. Depends on Fine Gain setting.

Sensitivity Range

4mV – 10V input for 5V (or 20mA) output in 6 ranges with 4:1  
(Gain range x1 to x1250). See Section 4.5.

Fine Gain Control

### Shunt Calibration

Push switch operation or R.Cal. Connection to R.Cal common connects 59k via relay. Relay current 10mA.

### EMC Specification

When subjected to radiated electromagnetic energy (as IEC 801-3) an additional error can occur at certain frequencies:

<u>Field Strength</u>	<u>Typical Maximum Error</u>
10V/m	5%
3V/m	0.5%

### Mech. & Environmental

Working Temp. Range

+14 to +140°F.

Dimensions (nominal)

4.5" x 3.875" x .875"

Weight (nominal)

4.6 oz.

Seals

IP20 Specification

## 9.0 FUNCTIONAL CHECKS

- A = Measure EXCITATION voltage at transducer terminals.
- B = Check function of ZERO control while monitoring output signal for 0v.
- C = Adjust EXCITATION voltage control for specified voltage. Refer to transducer CAL. SHEET for correct voltage.
- D = Connect transducer SIGNAL terminals together and repeat B.
- E = Check the transducer is correctly wired.
- F = Check that SUPPLY and OUTPUT circuits are wired correctly.
- G = Disconnect transducer and repeat D.
- H = Check that if D works, the transducer is zero when attempting to obtain ZERO o/p.
- J = Check EXCITATION setting with the transducer disconnected.
- K = Try another transducer if possible, otherwise return transducer to factory.
- L = Try another AP5101 if possible, otherwise contact us for a returns number.

**WARRANTY:** Stellar Technology warrants that its product shall be free from defective workmanship and/or material for a twelve month period from the date of shipment, provided that Stellar Technology's obligation hereunder shall be limited to correcting any defective material FOB our factory. No allowance will be made for any expenses incurred for correcting any defective workmanship and/or material without written consent by Stellar Technology. This warranty is in lieu of all other warranties expressed or implied.

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