## Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

### TEMPERATURE

- ☑ Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- ☑ Wire: Thermocouple, RTD & Thermistor
- ☑ Calibrators & Ice Point References
- ☑ Recorders, Controllers & Process Monitors
- ☑ Infrared Pyrometers

### PRESSURE, STRAIN AND FORCE

- ☑ Transducers & Strain Gauges
- ☑ Load Cells & Pressure Gauges
- ☑ Displacement Transducers
- ☑ Instrumentation & Accessories

### FLOW/LEVEL

- ☑ Rotameters, Gas Mass Flowmeters & Flow Computers
- ☑ Air Velocity Indicators
- ☑ Turbine / Paddlesheel Systems
- ☑ Totalizers & Batch Controllers

### pH/CONDUCTIVITY

- ☑ pH Electrodes, Testers & Accessories
- ☑ Benchtop/Laboratory Meters
- ☑ Controllers, Calibrators, Simulators & Pumps
- ☑ Industrial pH & Conductivity Equipment

### DATA ACQUISITION

- ☑ Data Acquisition & Engineering Software
- ☑ Communications-Based Acquisition Systems
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- ☑ Datalogging Systems
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### HEATERS

- ☑ Heating Cable
- ☑ Cartridge & Strip Heaters
- ☑ Immersion & Band Heaters
- ☑ Flexible Heaters
- ☑ Laboratory Heaters

### ENVIRONMENTAL MONITORING AND CONTROL

- ☑ Metering & Control Instrumentation
- ☑ Refractometers
- ☑ Pumps & Tubing
- ☑ Air, Soil & Water Monitors
- ☑ Industrial Water & Wastewater Treatment
- ☑ pH, Conductivity & Dissolved Oxygen Instruments

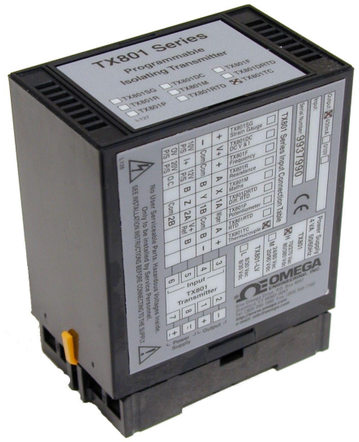
M-3796-0302

CE

# User's Guide

OMEGA ENGINEERING, INC.

*An OMEGA Technologies Company*




***http://www.omega.com***
***e-mail: info@omega.com***

# TX801M SERIES PROGRAMMABLE ISOLATING MATH FUNCTION TRANSMITTER

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ΩOMEGA

| OMEGAnet℠ On-Line Service<br>http://www.omega.com | Internet e-mail<br>info@omega.com |
|---|---|

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The information contained in this document is believed to be correct but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.
WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

## WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

## RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.
The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:
1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:
1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.
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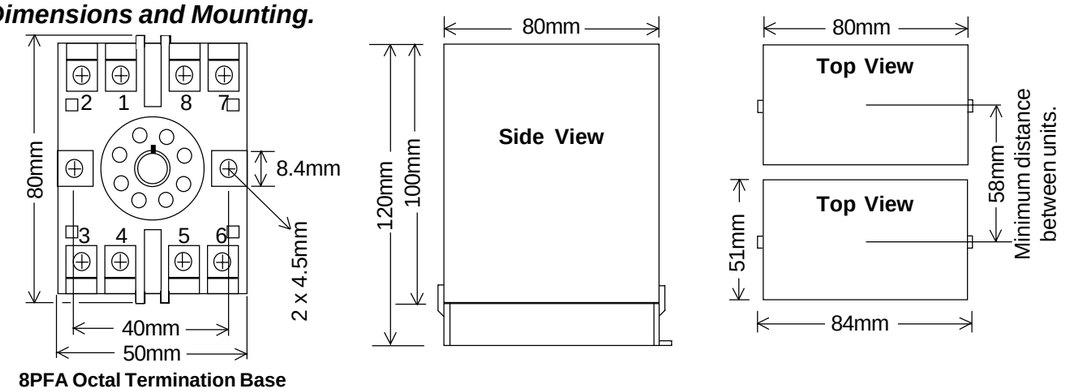
## *Output Range Programming Table.*

**Notes:** 1/ Switch status 1 = ON 0 = OFF
2/ Output ranges with '*' beside them reverse the polarity of the output connections.

| Output Range (V) | S1-SPAN | | | | | | S2-Function | | | | Output Range (I) | S1-SPAN | | | | | | S2-Function | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 |
| 0~500mV | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0~1mA | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0~1V | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0~2mA | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0~2V | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0~5mA | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0~3V | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0~10mA | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0~4V | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0~16mA | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0~5V | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0~20mA | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0~6V | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1~5mA | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0~8V | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 2~10mA | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0~10V | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 4~20mA | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0~12V | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | -1~1mA | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1~5V | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | -2~2mA | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 2~10V | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | -5~5mA | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| -1~1V | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | -10~10mA | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| -2~2V | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | -20~20mA | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| -5~5V | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0~-10mA * | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| -10~10V | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0~-20mA * | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| -12~12V | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | | | | | | | | | | | |
| 0~-5V * | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | | | | | | | | | | | |
| 0~-10V * | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | | | | | | | | | | | |

## *Dimensions and Mounting.*




**8PFA Octal Termination Base**

## *The Proper Installation & Maintenance of TX801M.*

**MOUNTING.**

(1) Mount in a clean environment in an electrical cabinet on 35mm, symetrical, mouning rail.
(2) Do not subject to vibration or excess temperature or humidity variations.
(3) Avoid mounting in cabinets with power control equipment.
(4) To maintain compliance with the EMC Directives the TX801M is to be mounted in a fully enclosed steel cabinet. The cabinet must be properly earthed, with appropriate input / output entry points and cabling.

**WIRING.**

(1) A readily accessible disconnect device and overcurrent device must be incorporated in the the power supply wiring.
(2) All cables should be good quality overall screened INSTRUMENTATION CABLE with the screen earthed at one end only.
(3) Signal Cables should be laid a minimum distance of 300mm from any power cables.
(4) For 2 wire current loops and 2 wire voltage signals or 2 wire current signals, Austral Standard Cables B5102ES is recommended. For 3 wire transmitters Austral Standard Cables B5103ES is recommended.
(5) It is recommended that you do not ground current loops and use power supplies with ungrounded outputs.
(6) Lightning arrestors should be used when there is a danger from this source.
(7) Refer to diagrams for connection information.

**COMMISSIONING.**

(1) Once all the above conditions have been carried out and the wiring checked apply power to the PI-M and allow five minutes for it to stabilize.
(2) Take a low (approx 10%) and high (approx 90%) reading of the variable being measured by the transducer supplying the signal to the PI-M, and ensure that this agrees with the level being indicated by the PLC or indicator, etc, that the TX801M is connected into. Adjust for any difference using the Zero and Span trimpots in the top of the PI-M enclosure with a small screwdriver until the two levels agree. (Clockwise to increase the output reading and anti-clockwise to decrease the output reading.)

**MAINTENANCE.**

(1) Repeat (2) of Commissioning.
(2) Do it regularly - at least once every 12 months.

# TX801M Programmable Isolating Maths Function Transmitter.

**Programmable Isolating Maths Function Input to DC Current or DC Voltage Output Transmitter.**

## *Features.*

- **Field Programmable Input and Output Ranges.**
- **29 Predefined Math Functions.**
- **12 Bit Resolution. (0.025%)**
- **Input to Output Isolation 1.6kV.**
- **High Accuracy 0.1%.**
- **Universal AC/DC Power Supply.**
- **Compact DIN Rail Mount Enclosure.**
- **120 Point User Definable Curve Fitting.**

## *TX801M Specifications.*

| | | | |
|---|---|---|---|
| Input | -Voltage | | Field Programmable 0~5Vdc / 0~10Vdc / 1~5Vdc / 2~10Vdc. |
| | | | Minimum Input Resistance = 180kΩ. |
| | | | Maximum Over-range = 24Vdc Continuous. |
| | -Current | | Field Programmable 0~20mAdc / 4~20mAdc. |
| | | | Input Resistance = 250Ω. |
| | | | Maximum Over-range = 50mAdc Continuous. |
| | -Maths Functions | | 29 Field Selectable, Predefined, Maths Functions. |
| | | | RS-232 Interface for Calibration and Testing. (Using a PI-RAC.) |
| | -User Defined Curve | | Up to 120 Point Look-up Table, Linear Interpolation Between Points. |
| | | | RS-232 Interface for Programming of User Curves. (Using a PI-RAC.) |
| | **IMPORTANT:** | | **The RS-232 communications port is NOT ISOLATED from the TX801M inputs.** |
| Universal P/S | -Standard High (H) | | 70~270Vac and 80~380Vdc; 50/60Hz; 4VA. |
| | -Standard Mid (M) | | 24~80Vac and 20~90Vdc; 50/60Hz; 4VA. |
| | -Low Voltage (L) | | 8~30Vac and 8~30Vdc; 50/60Hz; 4VA. |
| | -Circuit Sensitivity | | <±0.001%/V FSO Typical. |
| Resolution | -Input | | 12 Bit. |
| | -Output | | 12 Bit. |
| Accurate to | | | <±0.1% FSO Typical. |
| Linearity & Repeatability | | | <±0.1% FSO Typical. |
| Ambient Drift | | | <±0.01%/C FSO Typical. |
| Noise Immunity | | | 125dB CMRR Average. (1.6kV Peak Limit.) |
| R.F. Immunity | | | <1% Effect FSO Typical. |
| Isolation Voltage | | | 1.6kVac/dc Peak Input to Output for 60sec. |
| Response Time | | | 200msec Typical. (10 to 90% 100msec Typical.) |
| | | | Note. The %RH Function has Software Dampening of 2sec Typical. |
| Operating Temperature | | | 0~70C. |
| Storage Temperature | | | -20~80C. |
| Operating Humidity | | | 90%RH Max. Non-Condensing. |
| Construction | | | Socket Plug-In Type With Barrier Terminals. |
| Relative Humidity (Function 29) | -Input | | 0~100C for Input Range. |
| | -Range | | 0~100%RH Over 0~100C Input. |
| | -Accurate to | | <±1% FSO Typical. |

Note 1. Refer to *IN-HWD Humidity and Temperature Converter* for Wet and Dry Bulb installation guide.
Note 2. Specifications based on Standard Calibration Unit, unless otherwise specified.
Note 3. Due to ongoing research and development, designs, specifications, and documentation are subject to change without notification. No liability will be accepted for errors, omissions or amendments to this specification.

## *Quality Assurance Programme.*

The modern technology and strict procedures of the ISO9001 Quality Assurance Programme applied during design, development, production and final inspection grant long term reliability of the instrument.

## *TX801MInput Range Programming Table.*

Always set **OUTPUT range first**, then INPUT range.
DIP switches and trimpots are accessed by removing the small rectangular lid on the top of the TX801M enclosure.

**Notes:** 1/ Switch status 1 = ON, 0 = OFF, X = DON'T CARE.
2/ All inputs must be of the same signal type.
3/ If using voltage inputs, short unused inputs to 'COM' (terminal 6).

| | INPUT RANGE | S4-1 | S4-2 | S4-3 | S4-4 | S4-5 | S4-6 |
|---|---|---|---|---|---|---|---|
| Vin | 0~5V | 0 | 0 | 0 | 0 | 1 | 1 |
| | 0~10V | 0 | 0 | 0 | 1 | 1 | 1 |
| | 1~5V | 0 | 0 | 0 | 0 | 0 | 0 |
| | 2~10V | 0 | 0 | 0 | 1 | 0 | 0 |
| Iin | 0~20mA | 1 | 1 | 1 | 0 | 1 | 1 |
| | 4~20mA | 1 | 1 | 1 | 0 | 0 | 0 |

## *How to Use the Maths Function Formulae.*

X, Y, and Z are taken as 0 to 1.0000, representing the full input range.

eg.
4.000mA = 0.0000
8.000mA = 0.2500
12.000mA = 0.5000
16.000mA = 0.7500
20.000mA = 1.0000

The selected calculation is then performed on the inputs. The output is then *SCALED* so the resultant range is between 0 and 1.000. (The scaling factor is the factor the largest output must be scaled by to get the result = 1.) This 0 to 1.000 range represents the full output range, as set by the output DIP switches.

## *Examples of Using the Maths Function Formulae.*

NOTE: For these examples inputs and outputs are configured as 4~20mA.

| Examples | Inputs (mA) X | Y | Z | Converted Value X | Y | Z | Resultant Value | Scaling Factor | Output Signal (mA) |
|---|---|---|---|---|---|---|---|---|---|
| X + Y | 4 | 4 | - | 0.0 | 0.0 | - | 0 | .5 | 4.00 |
| | 12 | 12 | - | 0.5 | 0.5 | - | 1 | | 12.00 |
| | 20 | 20 | - | 1.0 | 1.0 | - | 2 | | 20.00 |
| X x Y x Z | 4 | 4 | 4 | 0.0 | 0.0 | 0.0 | 0 | 1 | 4.00 |
| | 12 | 12 | 12 | 0.5 | 0.5 | 0.5 | 0.0156 | | 4.25 |
| | 16 | 16 | 16 | 0.75 | 0.75 | 0.75 | 0.4219 | | 10.75 |
| | 20 | 20 | 20 | 1.0 | 1.0 | 1.0 | 1 | | 20.00 |
| X^(1/2) | 4 | - | - | 0.0 | - | - | 0 | 1 | 4.00 |
| | 8 | - | - | 0.25 | - | - | 0.5 | | 12.00 |
| | 12 | - | - | 0.5 | - | - | 0.7071 | | 15.31 |
| | 16 | - | - | 0.75 | - | - | 0.8660 | | 17.86 |
| | 20 | - | - | 1.0 | - | - | 1 | | 20.00 |
| $X^2$ | 4 | - | - | 0.0 | - | - | 0 | 1 | 4.00 |
| | 8 | - | - | 0.25 | - | - | 0.0625 | | 5.00 |
| | 12 | - | - | 0.5 | - | - | 0.25 | | 8.00 |
| | 16 | - | - | 0.75 | - | - | 0.5625 | | 13.00 |
| | 20 | - | - | 1.0 | - | - | 1 | | 20.00 |

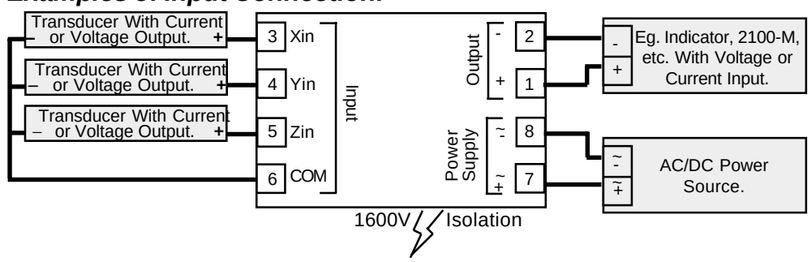
| INPUT RANGES Input | IR | MATHS FUNCTION Maths Funct. (Output =) | MF | Maths Funct. (Output =) | MF | OUTPUT RANGES Voltage | OR | Current | OR |
|---|---|---|---|---|---|---|---|---|---|
| 0~5V | A | X + Y | 1 | Sample and Hold | 26 | 0~500mV | A | 0~1mA | 1 |
| 0~10V | B | X + Y + Z | 2 | Tare | 27 | 0~1V | B | 0~2mA | 2 |
| 1~5V | C | X - Y | 3 | | 28 | 0~2V | C | 0~5mA | 3 |
| 2~10V | D | X - Y + Z | 4 | %RH, X=Dry, Y=Wet | 29 | 0~3V | D | 0~10mA | 4 |
| 0~20mA | E | X × Y | 5 | User Defined Curve | 30 | 0~4V | E | 0~16mA | 5 |
| 4~20mA | F | X × Y × Z | 6 | *Program User Defined Curve* | 31 | 0~5V | F | 0~20mA | 6 |
| | | X / Y | 7 | Pressure Comp. Steam Flow | 32 | 0~6V | G | 1~5mA | 7 |
| | | ( X / Y ) × Z | 8 | *Program PCSF Values* | 33 | 0~8V | H | 2~10mA | 8 |
| | | $X^{\wedge}(1/2)$ {Square root X} | 9 | Hi Select of X or Y | 34 | 0~10V | I | 4~20mA | 9 |
| | | $X^{\wedge}(1/3)$ {Cube root X} | 10 | Lo Select of X or Y | 35 | 0~12V | J | -1~1mA | 10 |
| | | $X^{\wedge}(3/2)$ | 11 | | 36 | 1~5V | K | -2~2mA | 11 |
| | | $X^2$ | 12 | | 37 | 2~10V | L | -5~5mA | 12 |
| | | $X^3$ | 13 | | 38 | -1~1V | M | -10~10mA | 13 |
| | | ln X {Natural log X} | 14 | | 39 | -2~2V | N | -20~20mA | 14 |
| | | log X {Base 10 log X} | 15 | | 40 | -5~5V | O | | |
| | | $(X^2 + Y^2)^{\wedge}(1/2)$ | 16 | | 41 | -10~10V | P | | |
| | | ( X + Y ) / 2 | 17 | | 42 | -12~12V | Q | | |
| | | ( X + Y + Z ) / 3 | 18 | | 43 | | | | |
| | | X^1.569 {Parshall Flume} | 19 | | 44 | | | | |
| | | $X^{\wedge}(5/2)$ {V Notch Weir} | 20 | | 45 | | | | |
| | | X {ie Xin=Xout} | 21 | | 46 | | | | |
| | | Inverse of X {ie.(100-X)%} | 22 | | 47 | | | | |
| | | X / ( X + Y ) | 23 | | 48 | | | | |
| | | Antilog X | 24 | | 49 | | | | |
| | | ( X - Y ) x Z | 25 | | 50 | | | | |
| Special Input | Z | | | | | Special Output Range | | | Z |

Note: Hi Select and Lo Select available from S/No. 9844000 onwards.

| POWER SUPPLY | PS |
|---|---|
| High Voltage Power Supply: 70~270Vac and 80~380Vdc | H |
| Mid Voltage Power Supply: 24~80Vac and 20~90Vdc | M |
| Low Voltage Power Supply: 8~30Vac and 8~30Vdc | L |

Note: Power supply H is field selectable for M, and M for H. Power supply L must be ordered separately.

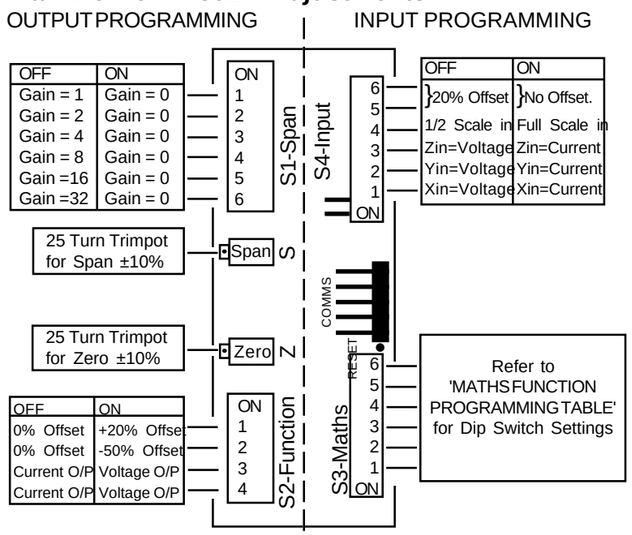
## *Examples of Input Connection.*




## *Terminations.*

| | | |
|---|---|---|
| Output | 1 | +Ve |
| | 2 | -Ve |
| Input | 3 | Xin |
| | 4 | Yin |
| | 5 | Zin |
| | 6 | COM |
| P/S | 7 | ~AC/+DC |
| | 8 | ~AC/-DC |

## *Plan View of TX801M Adjustments.*




## *TX801M H1 Power Supply Link Settings.*

**WARNING: High Voltages Maybe Present.**
**Only adjust link with power disconnected.**

| Power Supply Link Settings | |
|---|---|
| **H1** | **Power Supply Voltage Range** |
| H | Link for High: 70~270Vac / 80~380Vdc |
| M | Link for Mid: 24~80Vac / 20~90Vdc |

Notes:
1/ H1 is approx 4cm (1½") behind the 'S' trimpot.
2/ Exceeding voltage ranges may damage the unit.
3/ Ensure the enclosure label is correctly labelled for the link position.
4/ Adjust H1 jumper with a pair of needle nose pliers.
5/ Low Voltage Power Supply version is fixed, and has no link. This must be ordered separately.