

Two Inch Round Instruments

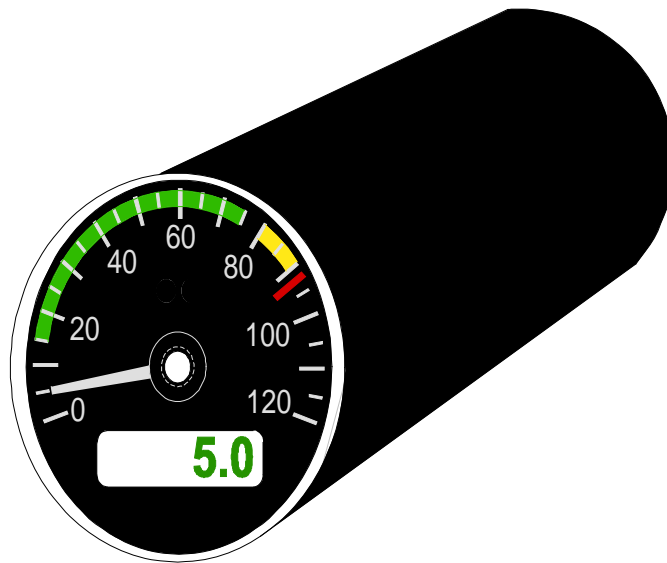
TR-1-()

Operating and Installation Instructions

05/3/2016
Rev. B

II 0503165

You must read this manual before installing or operating the instrument. This manual contains warranty and other information that may affect your decision to install this product and/or the safety of your aircraft.



Part #: _____

S/N: _____



Electronics International Inc.[®]

63296 Powell Butte Hwy • Bend, OR 97701 • (541) 318-6060 • iFlyEi.com 

Important Notice

******* MUST READ *******

Page 1 of 2

If you think it is not important to read this manual, you're wrong! This manual contains important operating information that may affect the safety of the pilot, passengers, aircraft, operation of the system or time to install the system. You **MUST** read the manual prior to installing this system. Any deviation from these installation instructions is the sole responsibility of the installer and should be done in accordance with AC 43.13.

Read the Warranty/Agreement. There is information in the Warranty/Agreement that may alter your decision to install this product. **If you do not accept the terms of the Warranty/Agreement, do not install this product.** This product may be returned for a refund. Contact Electronics International Inc. for details.

If you are not an FAA Certified Aircraft Mechanic familiar with the issues of installing aircraft instruments, Do Not attempt to install this unit. The installer should use current aircraft standards and practices to install this system (refer to AC 43.13).

If the installer does not have the skills, knowledge, tools, equipment or facility, to perform and determine whether the installation of this product is safe, reliable and accurate and to determine whether this product is operating properly after installation, **DO NOT INSTALL THIS PRODUCT.** If the owner/pilot and/or installer are unwilling to take the responsibility for the installation and operation of this product, **DO NOT INSTALL THIS PRODUCT.** This product may be returned for a refund. Contact Electronics International Inc. for details.

By installing this product, the aircraft owner/pilot and installer agree to hold Electronics International Inc. harmless and in no way responsible for monetary compensation, including punitive damages for any incident, harm and/or damage associated with this product. If you do not agree to the above, **DO NOT INSTALL THIS PRODUCT.** This product may be returned for a refund. Contact Electronics International Inc. for details.

Electronics International Inc. is not liable or responsible for a pilot's action or any situation that results in personal injury, property damage, missed commitments, lack of use of an aircraft or any expenses incurred due to: product failure, inaccuracy in displayed data or text files, display or display format issues, software bugs or problems, upgrade or customization issues, misinterpretation of the display, warning and/or limit settings, calibration problems, installation issues (leaks, mis-wiring, obstructions, damage to aircraft or components, incorrect installation of any parts, wrong parts, parts that don't fit, etc.) or any other issues related to the installation or operation of this product. All of the above are solely the pilot's and/or installer's responsibility. The pilot **must** understand the operation of this product before flying the aircraft. The pilot must not allow anyone to operate the aircraft that does not know the operation of this product. If you do not agree to the above, **DO NOT INSTALL THIS PRODUCT.** This product may be returned for a refund. Contact Electronics International Inc. for details.

Before starting the installation make sure the unit will fit in the location you intend to install it without obstructing the operation of any controls.

Important Notice

******* MUST READ *******

Page 2 of 2

When the installation is finished, inspect the system for loose fittings, connections, clamps, probes and inspect for leaks, chafing, obstructions, heat damage and anything that may cause unsafe flight before the 1st run-up, after the 1st run-up and after the first flight.

If you do not agree or are unwilling to comply with the information/requirements contained within this Important Notice, **DO NOT INSTALL THIS PRODUCT.** This product may be returned for a refund. Contact Electronics International Inc. for details.

Contents

Warranty/Agreement-----	1A
1.0 Operating Instructions -----	1
1.1 System Description -----	1
1.2 Operation -----	1
2.0 Installation Instructions -----	3
2.1 Install the TR-1 -----	3
2.2 Periodic Maintenance -----	4
2.3 Continued Airworthiness -----	4
2.4 Inspection Intervals -----	4
2.5 Service Life -----	4
2.6 Limitations -----	4
2.6 SAE Standards, TSOs and MPS -----	5
3.0 Mechanical and Wiring Data -----	11
4.0 DO-160G Environmental Qualification Form -----	13
5.0 Specifications / Features -----	17

Warranty / Agreement

Electronics International Inc. (EI) warrants this instrument and system components to be free from defects in materials and workmanship for a period of one year from the user invoice date. EI will repair or replace any item under the terms of this Warranty provided the item is returned to the factory prepaid.

1. **If you do not agree to and accept ALL the terms of this Warranty/Agreement, DO NOT Install This Product.** You may return the product for a refund, contact Electronics International Inc. for details.

2. Electronics International Inc. is not liable or responsible for a pilot's action or any situation that results in personal injury, property damage, missed commitments, lack of use of an aircraft or any expenses incurred due to: product failure, inaccuracy in displayed data or text files, display or display format issues, software bugs or problems, upgrade or customization issues, misinterpretation of the display, warning and/or limit settings, calibration problems, installation issues (leaks, mis-wiring, obstructions, damage to aircraft or components, incorrect installation of any parts, wrong parts, part that don't fit, etc.) or any other issues related to the installation or operation of this product. All of the above are solely the pilot's and/or installer's responsibility. The pilot **must** understand the operation of this product before flying the aircraft. The pilot will not allow anyone to operate the aircraft that does not know the operation of this product.

By installing this product, the aircraft owner/pilot and installer agree to hold Electronics International Inc. harmless and in no way responsible for monetary compensation, including punitive damages for any incident, harm and/or damage associated with this product (including but not limited to the ones listed above). If you do not agree to any part of this Warranty/Agreement, **DO NOT INSTALL THIS PRODUCT.**

3. It is possible for any system to fail thereby displaying inaccurate high, low or jumpy readings. Therefore, you **must** be able to recognize a system failure and you **must** be proficient in operating your aircraft safely in spite of a system failure. If you do not have this knowledge, contact the FAA or a knowledgeable flight instructor for training prior to flying the aircraft with this system.

4. This Warranty/Agreement shall not apply to any product that has been repaired or altered by any person other than Electronics International Inc., or that has been subjected to misuse, accident, incorrect wiring, negligence, improper or unprofessional assembly or improper installation by any person. **This warranty does not cover any reimbursement for any person's time for installation, removal, assembly or repair.** Electronics International retains the right to solely determine the reason or cause for warranty repair.

5. This warranty does not extend to any machine, vehicle, boat, aircraft or any other device to which the Electronics International Inc. product may be connected, attached, interconnected or used in conjunction with in any way.

6. Personal injury or property damage due to misinterpretation or lack of understanding of this product is solely the pilot's responsibility. The pilot **must** understand all aspects of the operation of this product before flying the aircraft. If he/she does not, he or she agrees to seek training from a knowledgeable instructor. The pilot also agrees that no one will be allowed to operate the aircraft that does not know the operation and limitations of this product.

More On Back of this Page

7. The obligation assumed by Electronics International Inc. under this warranty is limited to repair, replacement or refund of the product, at the sole discretion of Electronics International Inc.
8. Electronics International Inc. is not liable for expenses incurred by the customer or installer due to factory updates, modifications, improvements, changes, or any other alterations to the product that may affect the form, fit, function or operation of the product.
9. Electronics International is not responsible for shipping charges or damages incurred under this Warranty.
10. No representative is authorized to assume any other liability for Electronics International Inc. in connection with the sale of Electronics International Inc. products.
11. **You must read the entire Operating and Installation Instructions for this unit. If you do not agree to and accept the terms of this Warranty/Agreement and the responsibilities set forth in these manuals, DO NOT install this product, contact E.I. for a refund.**

This Warranty is made only to the original user. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS: EXPRESS OR IMPLIED. MANUFACTURER EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. PURCHASER AGREES THAT IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS OR LOSS OF USE OR OTHER ECONOMIC LOSS. EXCEPT AS EXPRESSLY PROVIDED HEREIN, MANUFACTURER DISCLAIMS ALL OTHER LIABILITY TO PURCHASER OR ANY OTHER PERSON IN CONNECTION WITH THE USE OR PERFORMANCE OF MANUFACTURER'S PRODUCTS, INCLUDING SPECIFICALLY LIABILITY IN TORT.**

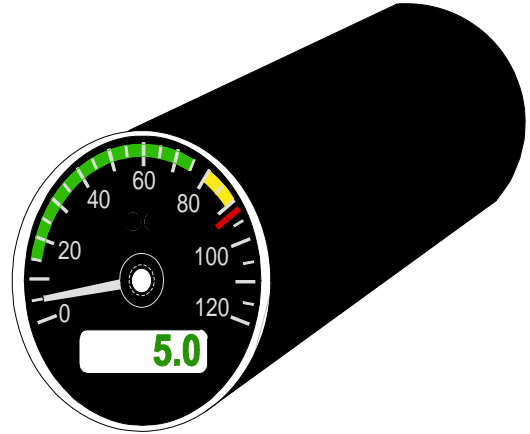
1.0 Operating Instructions

1.1 System Description:

The TR-1 is a TSO'd, single function monitor and display unit designed to measure Np, Ng, NL, NH, RPM, Torque, ITT, EGT, Oil Temp, Fuel Temp, Oil Pressure, Hydrolytic pressure, Fuel Pressure, MP, Fuel Level, Oil Level, Fuel Flow, Volt, Amps, AOA and other aircraft and engine functions. It is a TSO'd replacement for the old inaccurate and unreliable standard 2" round aircraft instruments.

The TR-1 can be installed in the standard 2 inch MS28042-1A clamp. The case measures 1.932" in diameter and 4.23" long, one of the shortest 2 inch instruments in the industry. The bezel measures 2" in diameter and the unit weighs 0.3 pounds.

The TR-1 incorporates a high accuracy reliable stepper motor to drive the needle and a digital display (which provides a backup for the analog needle). The display area is backlit for night operation which is controlled by an automatic dimming circuit built into the instrument. Also, the TR-1 can be configured to dim by way of an external control voltage.



The TR-1 will record 1000 hours of flight data at a rate of one record per second. The data may be downloaded via a RS232 port located on the back connector. The data is in a comma delimited format, ready for graphing using Microsoft Excel or a similar program.

Depending on the caution and warning requirements for the function monitored, the TR-1 can be configured to display a red and/or yellow warning LED in the display area. Also, the TR-1 can control an external caution and warning light or annunciator on a panel.

1.2 Operation:

The TR-1 has only one operating mode. On power-up the unit performs a self test and within four second the unit is displaying the current value for the function monitored. During power-down the needle will display the last temperature indicated. If the aircraft battery or a 9-volt battery is connected to the Constant Power Input pin, the needle will be set to the full counterclockwise position before turning off. The Constant Power Input pin draws no current during shutdown; therefore continuous battery drain is not an issue.

2.0 Installation Instructions

2.1 Install the TR-1:

Install the TR-1 as follows:

1. Un-box and inspect the TR-1 unit for defects. Do not install a defective unit.
 2. Check the model number and insure the configuration is appropriate for the aircraft and function to which it is to be installed.
 3. Check the range markings are appropriate for the aircraft and function to which it is to be installed.
 4. Check that the Wiring Diagram provided with the unit matches the TR-1-()'s configuration.
 5. Read the Warranty/Agreement. If you, your company or the aircraft owner does not agree with the Warranty/Agreement, do not install this unit. Return the unit for a refund.
 6. If you are not an FAA Certified Aircraft Mechanic familiar with the issues of installing engine and aircraft instruments, do not attempt to install this unit. The installer should use current aircraft standards and practices to install this unit (refer to AC 43.13).
 7. Remove the existing gauge and wire the DB-15 connector as shown in the wiring diagram provided with the unit. Normally only the signal, power and ground wires are all that are required.
 - a) The power wire should be connected to a 2 to 5 amp breaker.
 - b) Routed and connect all wires to the external devices (20ga. wire is preferred). When routing wires insure they do not obstruct the operation of any controls.
 - c) Tie off the routed wires. Wires should not come in contact with metal. Also, wires should not have long sections without supports.
- b) Before crimping the D-Sub pins onto the wires, perform a qualification test to be sure the pins you are using are adequate. A MIL Standard pin does not insure an adequate connection. Using a sample wire (the same as the routed wire) crimp a pin onto the wire and perform a pull test. Test a wire from each group of different wire material. The wire retention strength for Electronics International's D-Sub pins are approximately:

20 ga Copper Wire – 95 lbs
20 ga Type K TC Wire – 60 lbs
22 ga Type K TC Wire – 37 lbs.

- c) Crimp the D-Sub pins onto the routed wires using the proper crimp tool recommended for the pin. Insert the pins into the correct locations on the D-Sub connectors. Be sure you leave some slack in the wire so there is no tension on the pins when the D-Sub connectors are installed onto the TR-1 connector.

A D-Sub clam shell can be used, but is not necessary unless the unit will be subjected to standing water due to condensation or excessive dust and sand. If a clam shell is not used, place a tie wrap 3" back from the connector.

7. Connect the DB-15 to the TR-1 and secure the mounting screws.
8. Install the TR-1 into the MS28042-1A two inch clamp and secure the clamp to the unit.
9. Ground Test:
 - a) Power-up the TR-1 and check for accurate readings.
 - b) Start the aircraft engine(s) and check the TR-1 for proper readings.
 - c) Check all other instruments that may be affected by the installation for proper operation.
10. Flight Test - Fly the aircraft and check the TR-1 and all devices and instruments that may be affected by the TR-1 installation for proper operation.

2.2 Periodic Maintenance:

The TR-1 unit does not require periodic maintenance.

2.3 Continued Airworthiness:

Servicing is “on condition” only. There are no field adjustments or calibration requirements for the TR-1 after it has been properly installed and approved. All servicing of the TR-1 must be accomplished by Electronics International (EI).

2.4 Inspection Intervals:

The TR-1 does not require periodic inspections.

2.5 Service Life:

Service Life is only limited to the availability of replacement parts.

2.6 Limitations:

There are no unique aspects to the installation that will keep the TR-1 from meeting the TSO requirements.

The conditions and tests required for TSO approval of this article are minimum performance standards. Those installing this article either on or within a specific type or class of aircraft must determine that the aircraft installation conditions are within the TSO standards which include any accepted integrated non-TSO functions. TSO articles and any accepted integrated non-TSO function(s) must have separate approval for installation in an aircraft. The article may be installed only according to 14 CFR Part 43 or the applicable airworthiness requirements.

This article is an incomplete TSO article, less the sensors/probes and transducers which are required to form a complete instrument system.

2.7 SAE Standards, TSOs and MPS:

The TR-1 has the following TSO authorization:

- TSO-C43c, Temperature
- TSO-C44c, Fuel Flow
- TSO-C45b, Manifold Pressure
- TSO-47a, Fuel, Oil and Hydraulic Pressure
- TSO-C49b, Electric Tachometer
- TSO-C55a, Fuel and Oil Quantity

A deviation to use DO-160G in place of older versions list in the applicable TSOs was approved by the FAA.

The TR-1 meets the following MPS for the given SAE aeronautical standards list in the above TSO's:

AS8005, Minimum Performance Standard Temperature Instruments, 1-15-77

Para #	Paragraph Text
3.	General Standards:
3.1	Classification by Instrument Accuracy:
3.2	Method of Indication:
3.3	Power Malfunction:
3.4	Marking:
3.5	Signal (Sensor) Characteristics:
3.6	Adjustments:
3.7	Accessibility of Controls:
3.8	Effects of Tests:
3.9	Interchangeability:
3.10	Fire Resistance:
3.11	Instrument Cover Glass Reflectance:
4.	Minimum Performance Standards Under Standard Conditions:
4.1	Standard Atmospheric Conditions:
4.2	Attitude:
4.4	Power Input Voltage:
4.4.1	Direct Current:
4.5	Scale Error:

4.6	Position Error:
4.7	Lead Resistance Effects:
4.9	Magnetic Effects:
5.	Minimum Performance Standards Under Environmental Conditions
5.1	Temperature Altitude:
5.1.1	Low Temperature:
5.1.2	High Temperature:
5.1.3	Altitude:
5.2	Power Input:
5.2.1	Electrical Input Variation Test
5.2.2	Low Voltage Test:
5.3	Conducted Voltage Transients:
5.4	Conducted Audio Frequency Susceptibility Test:
5.5	Audio Frequency Magnetic Field Susceptibility:
5.6	Radio Frequency Susceptibility:
5.7	Emission of Radio Frequency Energy:
5.9	Humidity:
5.15	Shock:
6.1	Fire Resistance:

**AS407c, Fuel Flowmeters,
Revised 2007-07**

Para #	Paragraph Text
3.	General Standards:
3.1	Materials and Workmanship
3.2	Identification:
3.3	Environmental Conditions:
3.3.1	Temperature:
3.3.2	Humidity:
3.3.3	Vibration:
3.3.4	Altitude (51,000')
3.4	Radio Interference
3.5	Magnetic Effect:
4.	Detail Requirements:
4.1	Indicating Method:
4.2	Dial Markings
4.5	Power Variations
5.	Test Conditions
5.1	Atmospheric Conditions
5.2	Vibration (to minimize friction)
5.3	Vibration Equipment
5.4	Power Conditions
5.5	Position
6.	Individual Performance Requirements
6.1	Scale Errors
6.3	Leak Test
6.4	Position Error

Para #	Paragraph Text
7.	Qualification Tests
7.1	Low and High Temperature
7.2	Extreme Temperature Exposure
7.3	Magnetic Effect
7.4	Humidity
7.5	Vibration
Added	TSO-C44c Appendix1 added, DO-160E, Section 16
Added	TSO-C44c Appendix1 added, DO-160E, Section 17
Added	TSO-C44c Appendix1 added, DO-160E, Section 18
Added	TSO-C44c Appendix1 added, DO-160E, Section 19
Added	TSO-C44c Appendix1 added, DO-160E, Section 20

**AS8042,
Manifold Pressure Instruments,
Issued 12-1-85**

Para #	Paragraph Text
3.	General Standards:
3.4	Compatibility
3.5	Accessibility of Controls
3.6	Self-Test Provisions
3.7	Malfunction Indication
3.7.1	Power Failure Indication
3.7.2	Remote Indicator
3.8	Fail-Safe Provisions
3.9	Multiple Mode
3.10	Display
3.11	Cover Glass
3.12	Integral Lighting
3.13	Temperature
3.14	Altitude
3.15	Vibration
3.16	Humidity:
3.17	Operation:
3.18	Pressure Stops
3.20	Power Variations
3.22	Decompression
3.23	Outgassing

Para #	Paragraph Text
3.24	Fire Hazard (as amended by TSO-C45b appendix 1).
3.26	Radio Interference
3.27	Case Ground
3.28	Magnetic Effect
3.30	Identification
4.	Minimum Performance Under Standard Conditions
4.1	<u>Test Conditions</u>
4.1.1	Atmospheric Conditions
4.1.2	Vibration to Minimize Friction
4.1.3	Power Conditions
4.1.4	Position
4.4	Scale Error at Room Temperature
4.5	Scale Error at High Temperature
4.6	Friction Error
4.7	Position Error
4.8	Leakage
4.11	Damping
5.	Minimum Performance Under Adverse Environmental Conditions
5.1	Test Procedures
5.2	<u>Temperature Tests</u>
5.2.1	Categories
5.2.2	Low Temperature
5.2.3	High Temperature
5.2.4	Thermal Shock
5.3	Altitude Exposure Test

Para #	Paragraph Text
5.4	Overpressure Tests
5.5	Humidity Tests
5.6	Vibration Tests
5.9	Fluids Susceptibility Tests
5.10	Magnetic Effect Tests
5.11	Power Input Tests
7.	Qualification Tests

**AS408c, Pressure Instruments –
Fuel, Oil and Hydraulic
Revised 2001-07**

Para #	Paragraph Text
Note	Appendix 1 of TSO-C47a Removed the heading "(Receproating Engine Powered Aircraft)."
3.	General Requirements:
3.1	Materials and Workmanship
3.2	Identification:
3.3	Environmental Conditions:
3.3.1	Temperature:
3.3.2	Altitude:
3.3.3	Vibration:
3.3.4	Humidity
3.6	Radio Interference
3.7	Magnetic Effect:
3.9	De-Compression:
4.	Detail Requirements:
4.1	Indicating Means:
4.2	Pressure Bosses
4.3	Cover Glass
4.4	Operation:
4.5	Overpressure Stop:
4.8	Power Variation:
5.	Test Conditions
5.1	Atmospheric Conditions

Para #	Paragraph Text
5.2	Vibration to Minimize Friction
5.3	Vibration Equipment
5.4	Power Conditions
5.5	Position
6.	Individual Performance Requirements
6.1	Dielectric
6.2	Scale Error at Room Temperature:
6.3	Friction Error:
6.4	Position Error
7.	Qualification Tests
7.1	Temperature Characteristics:
7.1.1	Low Temperature Operation
7.1.2	High Temperature Operation:
7.1.3	Extreme Temperature Exposure
7.1.4	Altitude:
7.2	Vibration
7.3	Humidity
7.4	Magnetic Effect
7.5	Thermal Shock:
7.9	Damping:
7.10	Dielectric Test:
Note	TSO-C47a Appendix 1 added 7.13, 7.14, 7.15, 7.16, 7.17 and 7.18
7.14	Test conditions in RTCA/DO-160E, Section 16, Power Input.
7.15	Test conditions in RTCA/DO-160E, Section 17, Voltage Spike.

Para #	Paragraph Text
7.16	Test conditions in RTCA/DO-160E, Section 18, Audio Frequency Conducted Susceptibility - Power Input.
7.17	Test conditions in RTCA/DO-160E, Section 19, Induced Signal Susceptibility.
7.18	Test conditions in RTCA/DO-160E, Section 20, Radio Frequency Susceptibility.

**AS404b, Electric Tachometer:
Magnetic Drag (Indicator & Generator),
Revised 2/1/59**

Para #	Paragraph Text
3.	General Requirements:
3.1	Materials and Workmanship
3.3	Environmental Conditions:
4.	Detail Requirements:
4.1	Indicator
5.	Test Conditions
6.	Individual Performance Requirements
6.1	Scale Error at Room Temperature:
6.3	Position Error
6.4	Sealing
7.	Qualification Tests
7.1	Low Temperature
7.2	High Temperature
7.3	Extreme Temperature Exposure
7.4	Magnetic Effect
7.5	Vibration
7.6	Humidity
7.7	Acceleration Endurance
7.8	Thermal Shock:

**AS405c,
Fuel and Oil Quantity Instrument,
Revised 2001-07**

Para #	Paragraph Text
3.	General Requirements:
3.1	Materials and Workmanship
3.2	Identification:
3.3	Environmental Conditions:
3.3.1	Temperature:
3.3.2	Humidity
3.3.3	Vibration:
3.3.4	Altitude:
3.4	Radio Interference
3.5	Magnetic Effect:
4.	Detail Requirements:
4.1	Indicator Methods
4.2	Dial Markings
4.3	Power Variation
4.4	Power Indication
5.	Test Conditions
5.1	Atmospheric Conditions
5.2	Vibration (to minimize friction)
5.3	Vibration Equipment
5.4	Power Conditions
5.5	Position
Note	TSO-C55a, Appendix 1 adds the following paragraphs:
5.8	Accuracy Tolerances

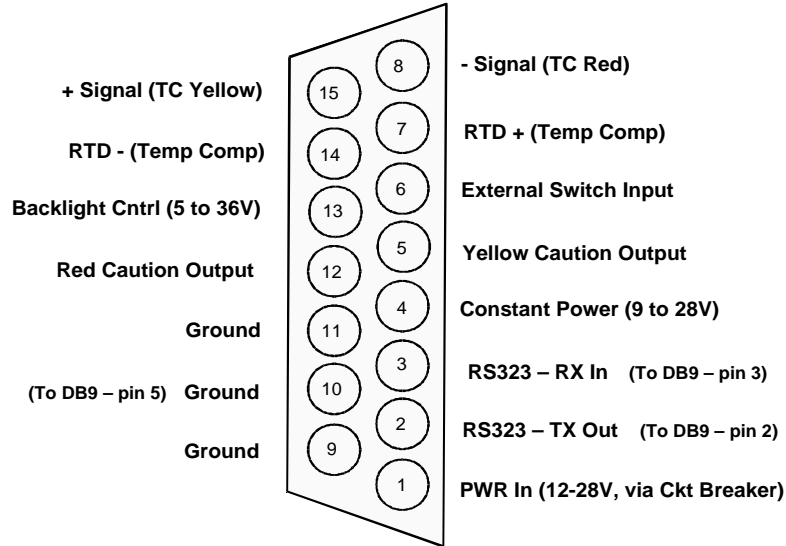
Para #	Paragraph Text
5.9	Ambient Room Conditions
5.10	Applicable Environmental Conditions.
6.	Individual Performance Requirements
6.2	Friction (Modified by TSO-C55a, appendix 1)
6.4	Position Error (Modified by TSO-C55a, appendix 1)
6.5	Power Variation Test
6.7	Maximum Operating Temperatures
6.8	Hysteresis Error (Added by TSO-C55a, appendix 1)
6.9	Speed of Response (Added by TSO-C55a, appendix 1)
7.	Qualification Tests
7.1	Temperature Characteristics
7.1.1	Low Temperature (-55°C)
7.1.2	High Altitude-Low Temperature
7.2	Water Immersion Test
7.3	Vibration
7.4	Humidity
7.5	Magnetic Effect
7.7	Operational Shocks Tests. (Added by TSO-C55a, appendix 1)

Para #	Paragraph Text
7.9	Power Input Test (Added by TSO-C55a, appendix 1)
7.10	Voltage Spike Test (Added by TSO-C55a, appendix 1)
7.11	Audio Frequency Conducted Susceptibility Test (Added by TSO-C55a, appendix 1)
7.15	Lightning Induced Transient Susceptibility Test (Added by TSO-C55a, appendix 1)
7.17	Electrostatic Discharge Test (Added by TSO-C55a, appendix 1)
7.18	Flammability Test (Added by TSO-C55a, appendix 1)

3.0 Mechanical and Wiring Data

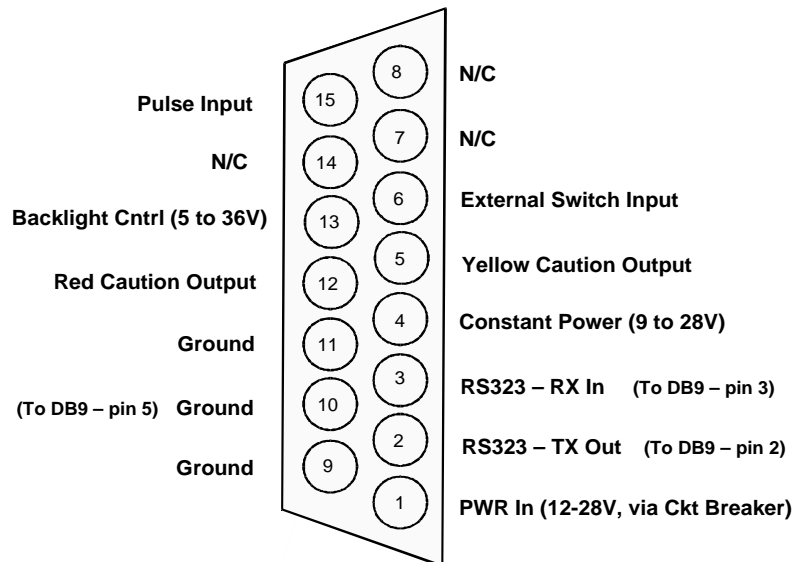
Sample Wiring for a Analog Input

(Back View, Wire Side)



Sample Wiring for a Pulse Input

(Back View, Wire Side)



Electronics International Inc.

DO-160G
Environmental Qualification Form

EQF 1005165

Rev. New: 3/1/17

Nomenclature: Single Function Display Unit

Models: TR-1-()

Note: “()” provides a designation for the configuration.

Specifications: Can be found in the Operating and Installation Instructions (II 0503165)

Manufacturer: Electronics International Inc.
63296 Powell Butte Hwy
Bend, OR 97701

Test Requirements: DO-160G, Dec 8, 2010

The TR-1-() was subjected to and passed the following tests:

Conditions	Section	Description of Tests Conducted
Temperature and Altitude	4	Tested to Category C4: Operating Temp: -40°C to +70°C Short Time Low Temp: -40°C Short Time High Temp: +70°C Ground Survival Low Temp: -55°C Ground Survival High Temp: +85°C In-Flight Loss of Cooling: N/A Altitude: 55,000 feet Decompression: 8,000 to 55,000 feet Overpressure: -15,000 feet
SAE Requirements	N/A	Low Temp Operating: -55°C Low Temp Non-Operating: -65°C
Temperature Variation	5	Tested to Category B: 5°C/min
Humidity	6	Tested to Category A:

Operational Shock and Crash Safety	7	Tested to Category B Type 5F: Operational: 6 g's at 11ms and 20ms Impulse: 20 g's at 11ms Sustained: 20 g's all axes for 3 sec.
Vibration	8	Tested to Category R, Curves C1. Robust Vibration Tests. Covers fixed wing turbojet or turbofan engine (subsonic and supersonic). Note: There were no changes in critical frequencies noted during any test.
Explosive Atmosphere	9	Category X: No test performed.
Waterproofness	10	Category X: No test performed.
Fluids Susceptibility	11	Category X: No test performed.
Sand and Dust	12	Category X: No test performed.
Fungus	13	Category X: No test performed.
Salt Fog Test	14	Category X: No test performed.
Magnetic Effect	15	Tested to Category Z: Less than .3m, measured 2.0 inches.
Power Input	16	Tested to Category Z: Applicable for 14 and 28 volts systems. Emergency Electrical System Operation tested.
Voltage Spike	17	Category A: High degree of protection.
Audio Frequency Susceptibility	18	Category Z: Applicable for all other types of aircraft electrical systems.
Induced Signal Susceptibility	19	Category ZC: Applicable for aircraft whose primary power is constant frequency (e.g. 400 Hz) or DC.

Radio Frequency Susceptibility	20	Tested to Category R (HIRF for systems with high criticality and requiring T-PED tolerance). Tested to Category W between 100MHz and 400 MHz at 100V/m.
Radio Frequency Emission	21	Tested to Category M: Suitable for transport aircraft.
Lightning Induced Transient Susceptibility	22	Categories A3G3L3: Suitable for installation in a metal aircraft where the installation is only partially protected from lightning. Unshielded aperture coupling.
Lightning Direct Effects	23	Category X: No test performed.
Icing	24	Category X: No test performed.
Electrostatic Discharge	25	Category A: +/- 15,000 volts.
Fire, Resistant	26	Category C: Flammability (enclosures housing electronics).

Specifications / Features

1022165

Rev.New: 10/22/16

Models: TR-1-()

Size: 1.932" dia, 4.23" length (not including the Connector), 2.0" bezel.

Mount: MS28041-1A, Two Inch Round.

Weight: 0.3 Lbs.

Environmental: Designed and Tested to TSO (DO-160G).

Software: Designed and Documented to TSO (DO-178C, Level C).

Minimum Performance Standards: TSO-C43c, TSO-C44c, TSO-C45b, TSO-C47a, TSO-C49b and TSO-C55a.

Power Requirements: 6.0 to 55 Volts, 0.075 amps @ 28V (Typ), 0.05 amps @ 14 Volts (Typ).

Communication Port: RS232

External Red Warning and Yellow Caution Outputs: Open-Collector (pull-down), 0.1 Ams max.

Display Area: Backlit for night operation. Optional Red and/or Yellow Warning Light.

Dimming Circuits: Electric eye and Control Voltage Input.

Analog Pointer: 210' sweep, Backlit.

Digital Display: 4 digits, 9999 max reading, Dimable.

Data Recording: 1000 Hrs at 1 second per record, accessible via RS232 Port.