

DELTA ELECTRONICS



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MODEL TCA-EX RF AMMETER INSTRUCTION SHEET

INTRODUCTION

The Transformer Coupled Ammeter (TCA) series of RF Ammeters provides AM broadcasters with an accurate and reliable instrument for measuring common point and antenna base currents. The ammeter uses a toroidal current transformer to obtain a sample voltage proportional to the RF current flowing in a conductor. This voltage sample is connected by a 50 ohm coaxial cable to a patented¹ rectifier circuit. This circuit converts the RF voltage to a DC voltage which is applied to a linear scale meter, calibrated in RF Amperes, for display of current magnitude. The TCA-EX RF Ammeter series also provides a DC output voltage to drive a remote indication instrument.

This instruction sheet provides operation and maintenance information for the Model TCA-EX RF Ammeter system and installation information applicable to the rectifier/meter unit. Refer to the instruction sheet supplied with the TCT-N, TCT-N-HV or TCT-N-XHV transformer for additional installation information applicable to the transformer unit.

DESCRIPTION

The TCA-EX RF Ammeter system comprises a toroidal current transformer unit, a rectifier/meter unit and an interconnecting coaxial cable. Depending on the RF conductor voltage, the transformer unit may be either the TCT-N (10 kV_{RMS} rating) transformer, the TCT-N-HV (20 kV_{RMS} rating) transformer or the TCT-N-XHV (42.4 kV_{RMS} rating) transformer. These transformer voltage ratings are the RMS equivalent of the peak modulation voltage. Within each TCT type, several versions are available depending on the RF current magnitude. The TCT provides an RF voltage sample directly proportional to the current. The voltage sample is applied to the rectifier/meter unit by a 50 ohm coaxial cable. The rectifier circuit provides a 50 ohm load resistor for proper termination. This circuit converts the RF voltage sample to a DC voltage for meter display. The rectifier filter circuit is designed to follow the modulation envelope accurately on both positive and negative meter excursions. The meter ballistics average the audio content and thus, the meter indicates the RF carrier current. The meter provides a stable reading independent of modulation, but may deflect slightly under high modulation

¹ U. S Patent No. 3,914,689

conditions due to carrier shift. A switch on the unit controls operation of the meter. When the switch is in the off position, the rectifier circuit input is disconnected from the RF input and grounded for lightning damage protection. The rectifier/meter unit also provides a DC output voltage to drive a remote indicating instrument. This DC output voltage is present only when the meter switch is in the on position.

The TCA-EX RF Ammeter series provides single scale models for RF current measurement over the range from 5 Amperes full scale to 160 Amperes full scale. Each ammeter enables current measurement from 20 to 100% of the full scale value. Refer to page 7 for a list of available models and accessories.

AMMETER CALIBRATION

Every TCA-EX RF Ammeter is calibrated and sealed at the Delta laboratory. **Do not make any field adjustments except for the mechanical zero of the meter as described in the Operation section.**

Each TCA-EX RF Ammeter is calibrated at a frequency of 1 MHz. The flat frequency response and compensated temperature characteristics of the ammeter assure accurate current measurement over the broadcast frequency range and over a wide temperature range. The calibration of the TCA-EX is guaranteed for a period of one year under normal use conditions. Excluding damage due to lightning, Delta will recheck the calibration and make repairs, if necessary, without charge during this period. These services are available at a nominal charge at any time thereafter.

INSTALLATION

CAUTION

The current transformer enclosure and the meter enclosure must be securely grounded. Improper grounding of either unit may result in a shock hazard to station personnel.

The operation of this equipment may expose the user to high RF fields and RF radiation. Locate the meter unit to limit occupational exposure in accordance with FCC regulations. Longer interconnecting coaxial cable is optionally available to allow meter unit installation at a compliant RF field strength location.

Delta recommends that the coaxial cable interconnecting the current transformer and rectifier/meter unit be connected at all times when RF current is flowing through the transformer. In particular, the coaxial cable must not be disconnected while the 5 or 10 Ampere RF ammeters are in operation since these units employ an unterminated sampling transformer. Disconnection with RF power applied will result in a shock hazard and/or arcing with resultant damage to the RF connector or transformer.

Install the transformer at the location where the current is to be measured. Note that when a TCT transformer for an antenna monitor and a TCT transformer for a TCA RF Ammeter system are installed together, the TCT transformer for the ammeter must be located closest to the tower. Refer to the TCT instruction sheet for additional installation information. Install the meter unit at a convenient location which allows the two units to be interconnected with the factory supplied coaxial cable. The standard cable length is 6 feet. Longer cable and double shielded cable are optionally available for high RF field conditions and for RF radiation exposure

reduction. The system is calibrated with this cable and a user supplied cable must not be substituted. Securely ground both the transformer enclosure and the meter enclosure by mounting the unpainted bottom surface of each unit on a ground strap and bonding the strap to the system ground. The meter unit mounts with two each 1/4"-20 bolts located on 2.0" centers as shown in Figure 1. Maximum penetration of the bolts into the meter enclosure is approximately 0.5". Use only brass or other non-magnetic bolts to mount the enclosure.

Connect the transformer unit to the ammeter unit using the factory supplied coaxial cable. Dress the coaxial cable for maximum separation from the antenna conductor and other RF conductors.

Certain TCT transformers incorporate internal resistors to provide a 50 ohm source impedance. These internal resistors also terminate the transformer output when the 50 ohm load resistance of the meter unit is not connected to the TCT. However, the high output voltage TCT-4 and TCT-5 transformers do not incorporate internal resistors and are terminated only by the meter unit. **The coaxial cable interconnecting the TCT-4 or TCT-5 with the meter unit must not be disconnected when RF current is flowing through the transformer. Cable disconnection on these systems with RF power applied will result in a shock hazard and/or arcing with resultant damage.**

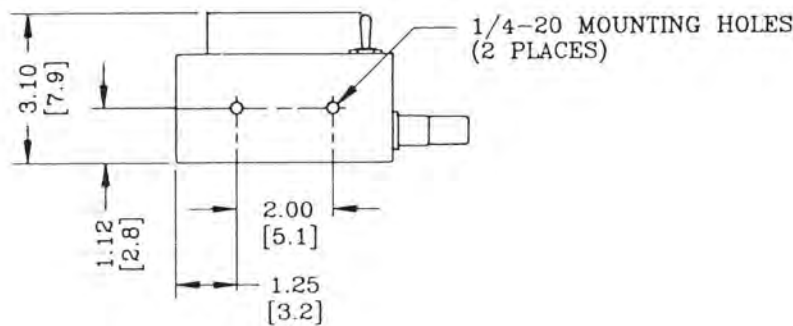
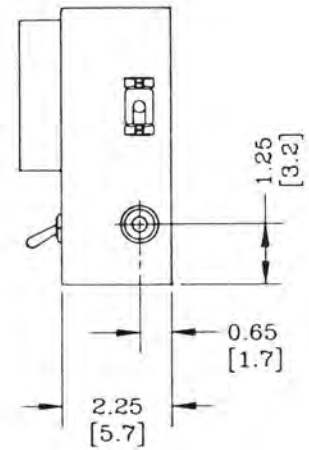
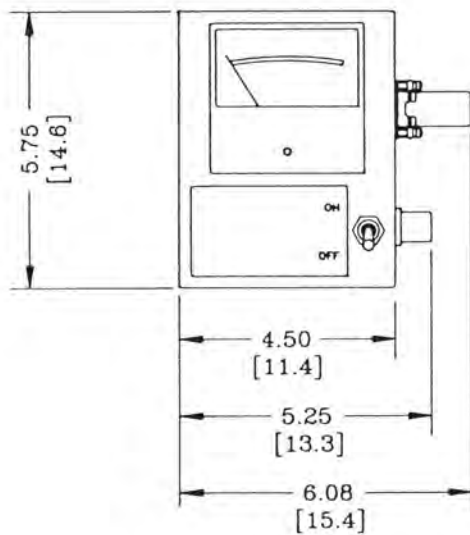
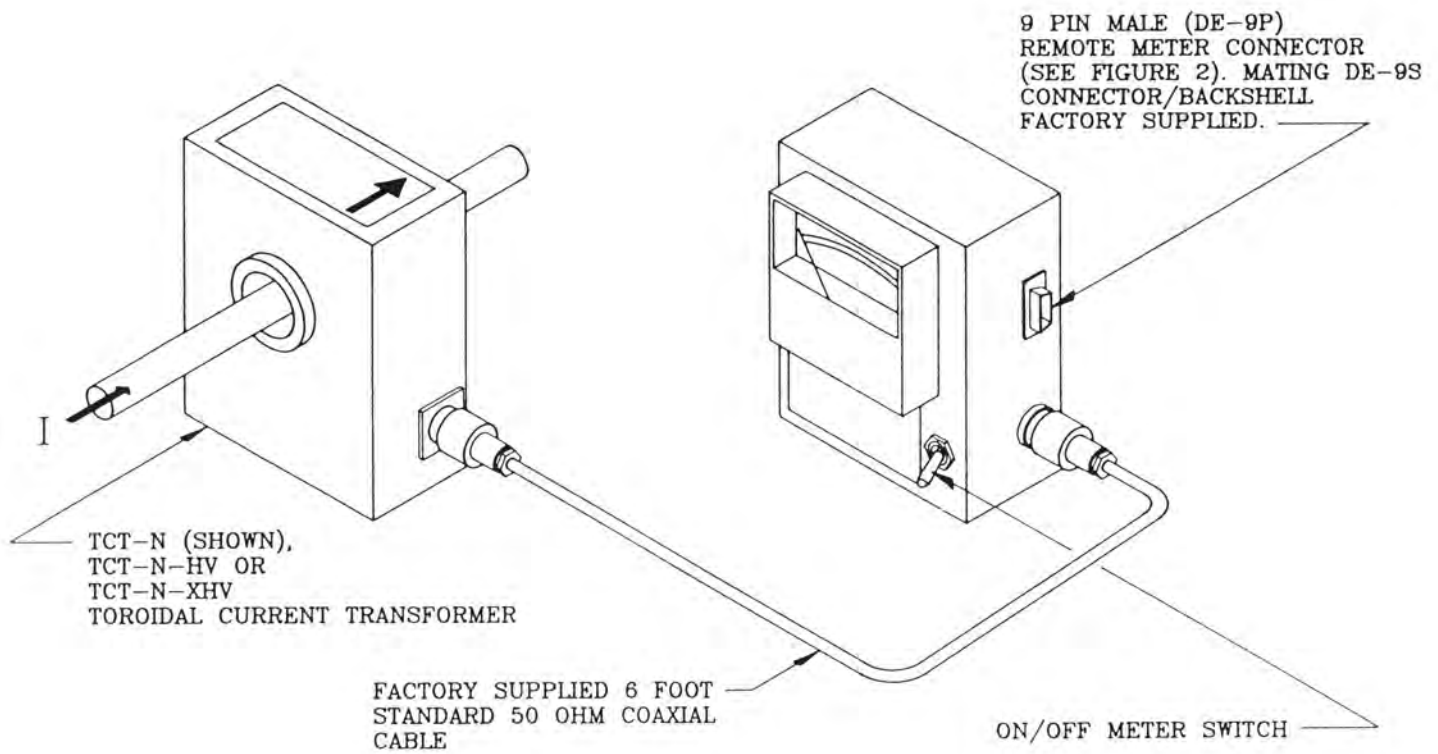
Connect the Model TCA-N-EXM remote meter or user furnished 100 μ ADC full scale indicating instrument to the external output connector of the meter unit as shown in Figure 2. Pin 5 on the external output connector is the meter positive and pin 9 is the meter common. A 10K Ohm variable resistor is required for external meter calibration. Use a shielded pair cable for the external meter connections. Bypass the remote meter connection with a 0.01 μ F shunt capacitor and/or use a series RF choke to eliminate RF on the remote output circuit. The monitoring inputs of many remote control systems provide a low input impedance and require a relatively steady-state signal for accurate monitoring. For this application, Delta recommends use of the Model TCA-IBA integrating buffer amplifier assembly to remove the modulation components and to amplify the signal to approximately 10 VDC full scale.

OPERATION

Before making an RF current measurement, the mechanical meter zero must be checked and adjusted if necessary. Turn the meter off using the front panel switch or remote control system. To adjust the mechanical zero, rotate the meter zero screw until the pointer is aligned with the zero scale marking. Then counter rotate the screw slightly to remove the tension.

The TCA meter measures and displays the RF current flowing through the clearance hole of the current transformer. The RF voltage sample applied to the meter unit is directly proportional to this current. The meter unit rectifies and displays on the meter the magnitude of the RF current. The meter unit switch provides on/off operation. This switch must be in the on position for both local and remote meter indication. When the switch is in the off position, the rectifier circuit input is disconnected from the RF input and grounded for lightning damage protection. Delta recommends that the meter be in the off position when readings are not being taken for maximum protection from lightning damage. For remote control applications, the TCA-EX RF Ammeter series can be factory modified to incorporate an internal relay to enable remote on/off control of the meter.

For remote indication, connect the Model TCA-N-EXM remote meter or user furnished 100 μ ADC full scale indicating instrument as shown in Figure 2. The DC output voltage is approximately 2.3 VDC at full scale with a source resistance of 16.7K Ohm. Calibrate the external meter to the TCA-EX Ammeter using a 10K Ohm variable resistor.



DIMENSION KEY
0.00 = INCHES
[0.0] = CM

FIGURE 1
TCA-EX INSTALLATION DIMENSIONS

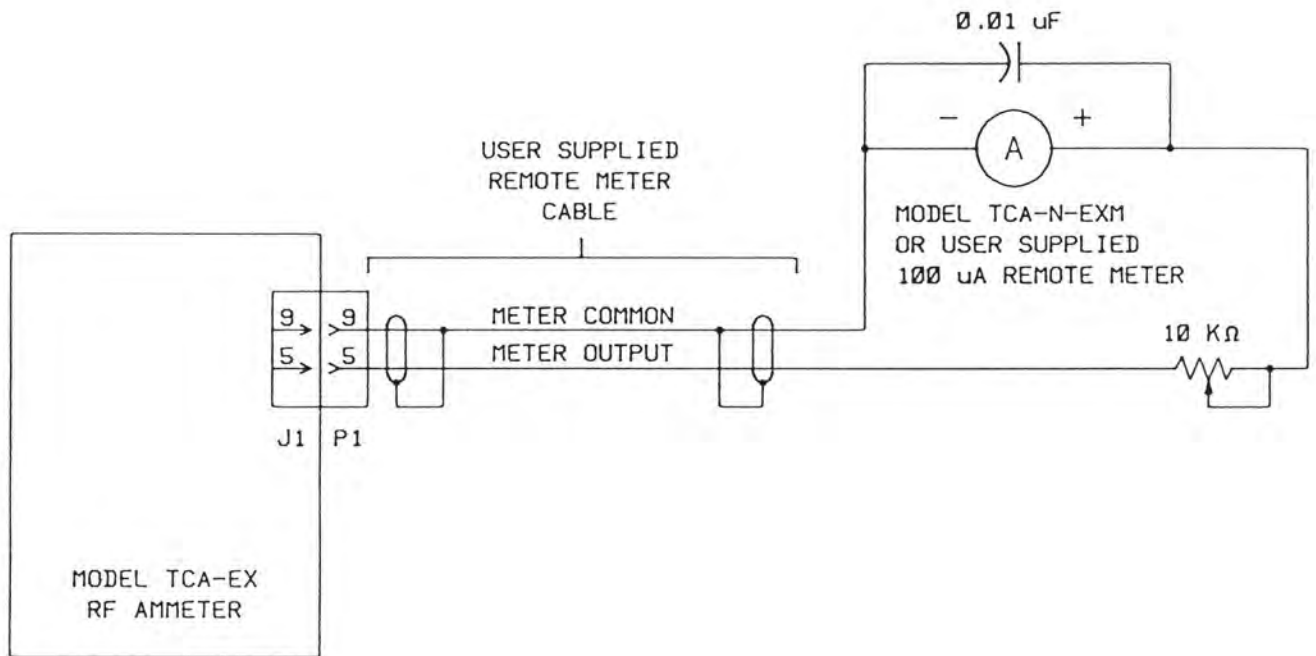


FIGURE 2
TCA-EX EXTERNAL METER CONNECTION DIAGRAM

MAINTENANCE

NOTICE

Field repair of a TCA-EX Ammeter voids the equipment calibration and warranty. Use of field repaired equipment violates the FCC specifications for indicating instruments.

The TCA-EX Ammeter is calibrated and sealed at the Delta laboratory. No repairs or adjustments should be made to the system except for the mechanical zero of the meter. All repairs and recalibration should be performed by the factory. The transformer and interconnecting coaxial cable must be returned with the meter unit so that the equipment may be calibrated as a system to insure rated accuracy.

To return an ammeter system for repair or recalibration, first contact our Customer Service Department using the 800-8-DELTA-8 toll free phone number or the 703-354-3350 phone number. A return authorization number will be assigned and this number should be marked on the shipping container. Include a brief description of the equipment problem and service desired. If possible, use the original shipping container to protect the equipment.

SUSCEPTIBILITY TO EXTRANEEOUS CURRENT

The TCA-EX Ammeter is responsive to all AM broadcast frequencies. The user should determine that any current induced from another station is less than about 5% of the current to be measured. If cooperation can be arranged, the current should be measured with and without the interfering station on the air to determine the magnitude of this effect.

ACCURACY

The TCA-EX is capable of measuring RF current with excellent accuracy. The accuracy specification of $\pm 2\%$ full scale is guaranteed over a temperature range of -40°C (-40°F) to $+65^{\circ}\text{C}$ ($+150^{\circ}\text{F}$) and over a frequency range of 500 kHz to 2000 kHz. By using the linearity chart on the calibration sheet included with the ammeter, the meter accuracy may be improved to within $\pm 1\%$ full scale.

METER LINEARITY CORRECTION

Use of the meter linearity correction curve provided on the calibration sheet supplied with the TCA-EX will improve the accuracy. Note the meter reading and compare with the linearity curve. A positive or negative correction current is obtained from the linearity curve. This correction current is added to the meter reading if positive or subtracted from the meter reading if negative to obtain the actual current.

AVAILABLE MODELS	
Current Range (A_{RMS})	Model TCA-N-EX
1 - 5A	TCA-5-EX
2 - 10A	TCA-10-EX
4 - 20A	TCA-20-EX
8 - 40A	TCA-40-EX
16 - 80A	TCA-80-EX
32 - 160A	TCA-160-EX

NOTE: All models can be supplied with a high voltage transformer by appending -HV to model number for 20 kV_{RMS} transformer voltage rating or by appending -XHV to model number for 42.4 kV_{RMS} transformer voltage rating. Examples: TCA-20-EX-HV specifies a 20A meter with 20 kV_{RMS} transformer and TCA-160-EX-XHV specifies a 160A meter with 42.4 kV_{RMS} transformer.

RF AMMETER ACCESSORIES	
TCA-N-EXM	Remote Meter Set, Single Scale (3" or 4" meters available)
TCA-N/N-EXM	Remote Meter Set, Dual Scale (3" or 4" meters available)
TCA-EXMP	Standard Meter Panel (Mounts up to four 3" remote meters or three 4" remote meters)
TCA-EXMCP	Enclosed Meter Panel (Mounts up to four 3" remote meters or three 4" remote meters and includes TCA-PS2 power supply and provision for TCA-IBA amplifier)
TCA-IBA	Integrating Buffer Amplifier Assembly
TCA-PS2	Power Supply (120/240 VAC, 50/60 Hz input, ± 15 VDC/100 mA and 24 VDC/500 mA outputs)
TCA-LS	Conductor Bushing (Increases standard TCT transformer voltage rating to 15 kV _{RMS})
TCA-MB	Mounting Bracket (Mounts one or two standard TCT transformers or one meter unit)
TCA-TS	Transient Suppressor Assembly (Type N T-Adapter with connector mounted suppressor)
TCA-RFR	EMI/RFI Shielded Enclosure (Houses TCA-EX rectifier/meter unit and protects from dust, dirt, oil and water)

SPECIFICATIONS

Frequency Range:

0.5 to 2 MHz

Current Ranges:

1 to 160 Amperes, see table of available models

Accuracy (Direct Reading):

Better than 2% of full scale from 20 to 100% of full scale. Calibration curve supplied for greater accuracy. Accuracy may be reduced if RF currents induced by other stations are 5% or greater than the current to be measured.

Current Transformer:

Shielded Toroidal Current Transformer (TCT series)

Conductor Voltage to Ground

(RMS Equivalent of Peak Modulation Voltage):

TCT-N Series: 10 kV_{RMS}

TCT-N-HV Series: 20 kV_{RMS}

TCT-N-XHV Series: 42.4 kV_{RMS}

Electric Field Rejection:

>100 dB

Rectifier Circuit:

Temperature compensated, linearized silicon rectifier circuit

Temperature Range:

-40°C (-40°F) to +65°C (+150°F) with rated accuracy

Lightning Protection Switch:

Toggle switch mounted on meter unit disconnects and grounds rectifier circuit.

Interconnecting Cables:

Standard six foot, 50 ohm coaxial cable supplied to connect transformer unit to rectifier/meter unit. Longer cable lengths and double shielded coaxial cable are optionally available.

Indicating Instrument:

Taut band, mirror scale, ruggedized 1% linearity meter with 2.75 inch scale length.

Scale Expansion:

Linear over useful range.

Scale Divisions:

Scale divisions above 1/5 full scale not greater than 1/50 full scale (FCC specification)

Modulation Characteristics:

Indicates average RMS current (Minimum modulation effect. Will show carrier shift.)

CERTIFICATE OF WARRANTY

Delta Electronics, Inc. warrants to Purchaser that the product it delivers is free of defects in materials and has high standards of quality and workmanship. This warranty applies to the period of one year from the date of delivery.

Delta Electronics, Inc. will, at its own expense and, after written notice has been received and acknowledged by Delta, repair or replace any product which is defective (according to the usage of the trade) during the above designated warranty period when Delta Electronics, Inc. receives such product at its Alexandria address with shipment costs prepaid by Purchaser.

Delta Electronics, Inc. is not liable for consequential damages.

No other warranty is expressed or implied.