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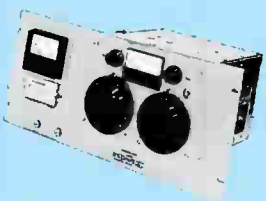
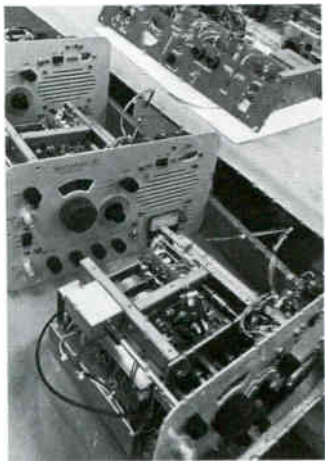
BROADCAST PRODUCTS



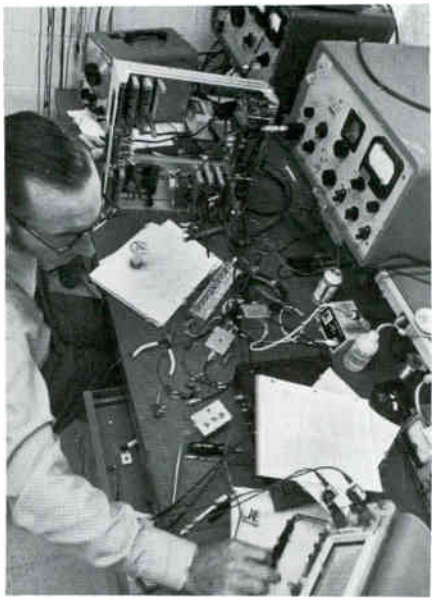
DELTA ELECTRONICS ®

An Introduction to...
DELTA ELECTRONICS



Delta Electronics was founded in 1962 to develop, manufacture and market professional quality proprietary products to meet the requirements of the communications, broadcast and allied industries. In addition to general electronic design and manufacturing capability, Delta has special expertise in the areas of RF instrumentation, transmitter/receiver to antenna interfacing and remote monitor/control systems. This expertise has led to a number of developments which have been patented, including basic design features of "stripline" coaxial RF switching matrices, the operating impedance bridges, and balanced line antenna switches.

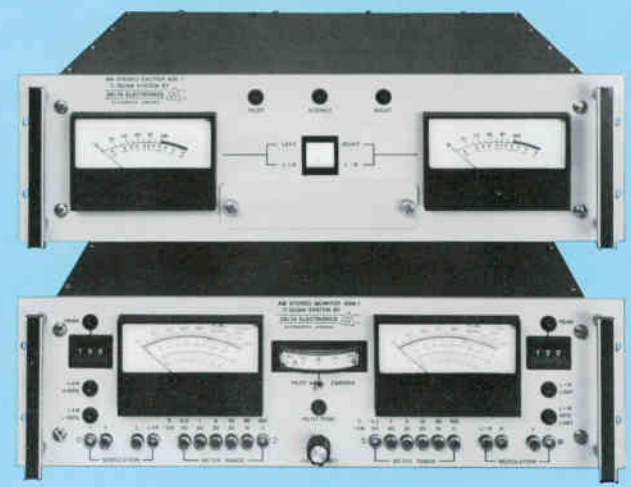
Delta Electronics is located in Virginia – just a few miles from Washington, D.C. Manufacturing, testing, laboratory, engineering, and administrative functions are in a single modern 35,000 square foot building. Additional roof and ground level areas are available for antenna testing.



Staff and equipment are available to handle general electronic development, fabrication, assembly and testing. In-house production operations include sheet metal work, machining, heli-arc welding, iriditing, spray painting and automatic wire preparation. Laboratory and testing facilities include the capability for radio power testing of equipment and components.

This catalog contains Delta's products that are of particular interest to the commercial broadcasting industry. Some unique products – such as the Operating Impedance Bridge, RF Ammeters, Remote Control Systems, and Audio Processing equipment and true digital monitor – are presented herein. Your inquiries are invited concerning these products or other requirements.

Model ASE-1 & ASM-1 C-QUAM® Stereo System



DESCRIPTION

The C-QUAM® Stereo transmission system produces a low distortion AM stereo quadrature modulated signal having superior separation throughout the audio spectrum. The C-QUAM signal is demodulated by envelope detectors to produce a low distortion monophonic audio signal. Stereo receivers demodulate the same signal to full stereo. All listeners receive a clean, low distortion audio signal.

ASE-1 Exciter

The ASE-1 Exciter generates an audio drive signal for the transmitter's modulator and an RF drive signal to replace the transmitter's crystal oscillator output. The resulting transmitter output is a quadrature amplitude modulated signal.

Left and Right audio inputs to the Exciter are equalized and matrixed to produce composite L + R and L–R audio signals.

The L + R audio and a 0° phase shifted carrier are fed to the in-phase suppressed carrier modulator (I).

The L–R audio and a 90° phase shifted (quadrature) carrier are fed to the quadrature suppressed carrier modulator (Q). The 25 Hz pilot tone, used to activate the stereo decoders, is also fed to the Q modulator.

The outputs of the I and Q modulators are summed with the 0° phase carrier to produce a quadrature amplitude modulated (QUAM) signal. A limiter strips the amplitude variations from the QUAM signal, leaving only a phase angle modulated carrier. This carrier is input to the RF chain of the broadcast transmitter, replacing the crystal oscillator signal.

The L + R audio input to the I modulator is also input to the transmitter to amplitude modulator the phase angle modulated carrier to produce the C-QUAM signal.

Envelope detectors sense the AM component of the C-QUAM signal to produce pure, undistorted L + R (mono) audio. Stereo decoders demodulate the C-QUAM signal to derive the L–R and L + R signals. The L–R and L + R signals are combined to generate Left and Right audio signals.

The ASE-1 Exciter circuitry includes all required processing features. Limiters are provided to prevent excessive positive and negative modulation. A blend processor makes high single channel modulation possible by blending a little of each channel with the other. Pre-emphasis is not required.

Large lighted meters and easily accessible controls simplify operation. The meters display either Left and Right audio levels, or L + R and L–R audio levels in dB and percent modulation. A Mode switch selects stereo or mono operation and the pilot switch controls the 25 Hz tone. A Day/Night switch selects one of two audio equalization circuits, adjusted to match separate, alternate transmitters. The equalization circuits can be remotely selected.

ASM-1 Modulation Monitor

The ASM-1 Modulation Monitor helps maintain and ensure AM broadcast system performance. The Monitor incorporates a high performance C-QUAM decoder to demodulate the RF sample. The Monitor provides all the demodulated signals necessary for annual proof of performance when used with standard AM proof equipment.

The signals available on the rear panel of the Monitor include L + R, L–R, Envelope Detector Output, and Left and Right audio (both balanced and unbalanced). The 25 Hz pilot tone is also available.

Available through front panel meters are: positive and negative L + R, L–R, L and R modulation levels. Peak flashers indicate –100%, +125%, L–R Limit, and negative limit modulation conditions.

Two thumbwheel controlled peak flashers can be set to flash at any level of modulation. The modulation meters and the thumbwheel controlled peak flashers are accessible through rear panel connectors for remote indication.

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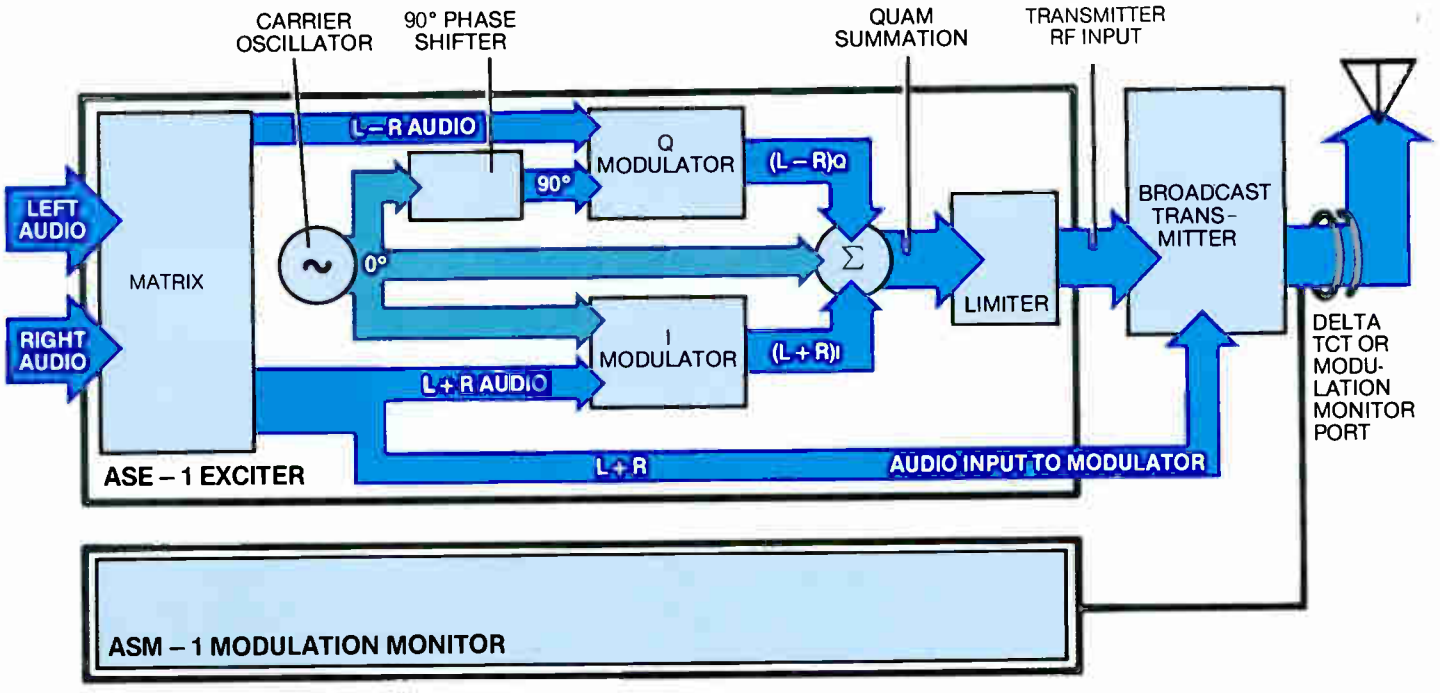


SYSTEM SPECIFICATIONS

The following is typical closed loop performance of the Exciter operating into the Monitor.

Stereo Separation at 50% single channel:
40 dB minimum 50 Hz to 5 kHz
30 dB minimum 5 kHz + to 10 kHz
25 dB minimum 10 kHz + to 15 kHz

Stereo Separation at 70% single channel:
35 dB minimum 100 Hz to 5 kHz

Frequency Response:
50 Hz to 10 kHz ±0.5 dB any modulation
10 kHz + to 15 kHz ±1 dB any modulation

Harmonic Distortion
L = R monaural 0.5% max., at 95% mod.
L = –R pure stereo 0.5% typical at 100% mod.
L, R single channel 1.0% typical at 75% mod.*

EXCITER

Audio Input:
Right 0 dBm to 10 dBm balanced 600 Ohms
Left 0 dBm to 10 dBm balanced 600 Ohms
Both inputs adjustable with factory installed pad per customer requirements.

Meter Functions:
$(L+R)_Q$ and $(L-R)_Q$ or L and R meter functions switched at the front panel between meters.
$(L+R)_I$ can be monitored on (L + R) meter by using (L + R) Env switch under the cover on the front panel.

Meter Range:
–20 to + 3 dB
0 dB = 100% modulation

RF Outputs:
Dual square wave to 38 V p-p into 50 ohms.
Dual TTL level outputs

(L + R) Outputs:
Dual output, adjustable under cover on front panel via 10-turn potentiometer up to 16 dBm, 600 ohms balanced.

Stereo-Monaural:
Switched under cover on front panel. Switches L = R for monaural. Stereo or monaural mode is indicated by LED on front panel. May also be remotely switched via rear panel terminals.

Phase Equalization:
Internally adjustable phase equalization is provided to compensate for phase variations in the transmitter chain. Two paths are available for Day/Night or Main/Aux modes.

Sample Transmitter Output:
A sample transmitter output is provided on the rear panel for diagnostic, comparison of station's transmitter characteristics. This output contains all the modulation aspects $(L+R)_Q$, $(L+R)_I$, and $(L-R)_Q$. Sample transmitter output 2 volts peak-to-peak into 50 ohms.

MONITOR

RF Input:
Frequency crystal controlled
Input level 1 volt to 10 volts RMS
Impedance 50 ohms

Modulation Meters:
Meter range 0 to 140% –20 dB to + 2dB
Attenuator range 0 to –50 dB in –10 dB steps
Accuracy at 100% modulation 400 Hz ±2% Meters switchable to + or – L, R, (L + R), (L – R)

Peak Modulation Indicators:

(L + R) Group:
–100% indicator internally set to flash when modulation exceeds –99%.
+ 125% indicator internally set to flash when modulation exceeds + 124%. Peak Indicator adjustable via thumbwheel switches from 30% to 150%. Modulation indicators selectable via pushbutton switches + or –.

(L – R) Group:
Negative limit set internally to flash at 1.46 radians or 83.67°
(L – R) limit set internally to flash when phase modulation exceeds 99%
Peak flasher adjustable via thumbwheel switches for 30% to 125%

Output BNC connectors on rear:
Remote Flashers (L + R), (L – R)
Remote Meters (L + R), (L – R)

Left Audio 600 ohms balanced and unbalanced
Right Audio 600 ohms balanced and unbalanced
(L + R), (L – R), and 25 Hz Pilot tone

*NOTE: This is equivalent of 140% modulation, 70% envelope modulation, simultaneous with 70% stereo information.

Specifications subject to change without notice.

Model RCS-1V Remote Control System

Introduction

Delta Electronics has developed a new Remote Control/ATS [1] System intended primarily for unattended monitoring and control of standard broadcast, FM, and TV stations. Emphasis has been placed on simplicity of operation, reliability, and cost-effectiveness in the design of this equipment. The latest proven microprocessor technology has been employed to accomplish the many attractive features of this system with a minimum of hardware. This approach, along with careful attention to the station operator's basic requirements during design, provides what we believe is the best available system today—and at quite a moderate price.

The system can be thought of (without regard, just now, to physical packaging) as three basic components: (1) a human interface, where the operator receives information from, and gives commands to, the system; (2) a machine interface, where the system receives information from the station's equipment and controls elements of that equipment; and (3) a microprocessor logic system that converts the information from the station equipment to the most usable form for the operator and converts the commands of the operator to control station equipment.

When the system is considered in these terms, it is apparent that only a change in logic is required to make the system perform the ATS function.

Thus a station operator may equip himself now for remote control operation and immediately receive the benefits of that mode of operation. He may, at a later date, begin ATS operation with the same system. Then he will retain the ability to revert to the remote control mode to avoid a possibly expensive ATS shutdown.

Basic System

Three basic components are required in the RCS-IV system: a control unit at the control point (studio location, perhaps,) a control unit at the transmitter location, and an I/O (Input/Output) unit at the transmitter location.

The front panel contains a 12-inch monochrome video display, a 20-key pushbutton assembly, a key switch, and separate main and video power switches.

The video display shows, at a glance, the value of all the monitored station parameters in a format programmed by the chief engineer. Predesignated parameters (such as antenna base current, plate current, etc.) are continuously updated by the system. Others (such as antenna monitor readings) are updated at selected time intervals. Thus the duty operator can copy the log data directly from the screen, hands off. His readings are unambiguous and should be error-free.

The duty operator needs to touch the system only when a control command is required. He is alerted to this requirement by the appearance of a reverse video flag on the descriptor of a parameter that has drifted out of the maximum/minimum tolerance limits (values previously programmed by the chief engineer).

Automatic logging may be set up by connecting a serial printer to the RCS-IV system. A log interval and starting time are entered by the chief engineer. Other logging options are log on command and log on alarm.

The RCS-IV has a BNC connector on the rear panel for a composite video output. This may be used to feed additional monochrome video monitors (of the closed circuit video type) for display in the chief engineer's office, manager's office, or other work areas.

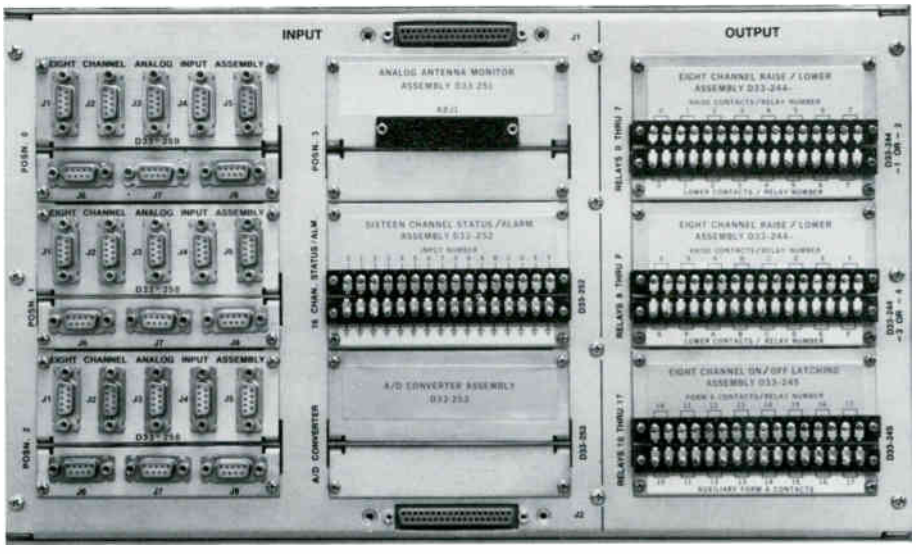
The I/O unit as pictured houses the input and output cards used to measure station parameters and to control station functions. The basic I/O unit is initially equipped with one card: the A/D converter card used to convert analog data (2-20 V full scale) to digital format for processor manipulation. Other cards may be installed as required. The unit is compartmentalized to accept three output boards in one shielded compartment and five input boards in a separate compartment in the combinations shown in the following table:

Type of Output Board	Maximum Number per I/O Unit
8-Channel Raise/Lower Momentary Control	2
8-Channel On/Off Latching Control	1

Type of Input Board	Maximum Compliment per I/O Unit	
16-Channel Status Input (On/Off)	1	
8-Channel Analog Input	4	ANY COMBINATION OF UP TO FOUR CARDS.
Antenna Monitor Input-Analog or Digital	4	
Additional Status Input (On/Off)	3	

Up to 3 I/O boxes may be connected to an RCS-1V Unit.

[1] Automatic Transmission System



Rear of I/O Unit

Options

The flexibility of the microprocessor-based design readily allows the addition of optional operating features to further enhance the usefulness of the RCS-IV system. Two such optional enhancements are presently available. They are a remote modulation display option and a telephone access option. These options are implemented by plugging additional circuit boards into the bus system of the RCS-IV. They may be installed in the original equipment or added to existing equipment in the field. It is contemplated that additional options will be developed in the future and the bus system is designed for this eventuality. The presently available options are described below.

Remote Modulation Display [2]

This option requires two additional boards. One is installed in the transmitter site unit (D33-277-T), and one in the control site unit (D33-277-C). Together they will display, in bargraph format, remote modulation monitor meter and flasher readings for one or two monitors (typically an AM and an FM monitor). Audio output signals and flasher contact data from the monitors are connected to the transmitter site unit. The audio signals are rectified to give DC voltages proportional to both the positive and negative percentage modulation and filtered to give the F.C.C. required ballistics characteristics. The voltages are then converted to digital words for display on the transmitter unit screen and transmission to the control unit. The flasher information is displayed on both units as reverse video flags (see the front photo for an illustration of these displays).

When this option is used, it eliminates the need for additional modulation monitor units and off-the-air pickup amplifiers at the control point.

Telephone Access

This option is a single board that may be installed in the transmitter site unit. It permits outside access to the unit from any Touch Tone® telephone. The chief engineer may dial into the system from his home or other location. When the telephone access board senses a ring, it will go off hook and will alternate two tones. A security code is then entered by depressing a series of numbers on the originating telephone key pad. If the security code is entered correctly, the RCS-IV will voice an answer message and the control unit is accessed. The security code and the answer message are programmed into the system by the chief engineer and may be changed at any time.

When security access is accomplished, the caller may select a channel number by depressing two number keys. The telephone access board will then confirm his channel selection by voicing the channel number (with a voice synthesizer). After the channel has been confirmed, depression of the key "*" causes the synthesizer to voice the actual parameter data. All voicing is done in the English language.

The telephone access option may also be programmed to originate up to four calls. A call origination would take place when an event occurs on a selected status channel. For example: the RCS-IV detects a transmitter plate current out of predesignated limits and closes the rear panel alarm contacts. These contacts are connected to a status (on/off) channel programmed to trigger a call out. If the alarm condition were not corrected in a predetermined time interval (entered by the chief engineer along with the telephone number), the RCS-IV would cause the companion telephone coupler unit to go off-hook and begin the dialing sequence of the first call.

If the call is not answered in 30 seconds, the telephone access will hang up and dial the second number, etc. When the call is answered, the unit will voice the answer message. After that, it will respond to commands in the same manner as an incoming call described above.

Accessories

In addition to the basic system components and options described above, several accessory items are required to complete an operating system. These items are not manufactured by Delta Electronics and can be purchased from other sources if desired. These devices are described here so that the station operator may investigate other sources if he desires. The units available through Delta are identified.

Modems

The data channels connecting the transmitter site unit and control site unit must be full duplex (two-way) circuits capable of handling RS232 level ASCII formatted data at 1200 baud.

Printer

A serial printer is required for automatic logging. The logging output of RCS-IV is either 20mA loop or RS232 level in ASCII format. All standard baud rates for ASCII data up to 9600 baud are selectable. Thus, there is a wide range of printing devices that can be used.

Station Coupler

The telephone access unit requires an approved coupler for connection to a subscriber telephone line. There is relatively little choice in this equipment since couplers of this type must be F.C.C. approved.

Future Developments

System development is now underway to provide full ATS capability to the RCS-IV for FM, TV and non-directional AM stations. In addition, a dual site option will allow a common studio site to control separately located transmitter sites.

[2]Patent Pending.

*®Registered Trademark-Bell Telephone Company

Call Delta for pricing and a detailed brochure.

DELTA ELECTRONICS

Model APC-1 Automatic Power Controller

FEATURES

- AUTOMATICALLY CONTROLS THE TRANSMITTERS OF EITHER AM OR FM STATIONS TO INSURE THAT THE POWER IS KEPT WITHIN FCC LIMITS.
- REQUIRES DC SIGNAL FROM LINEAR RECTIFIER OR FROM DELTA'S TCA/TCT LINE OF CURRENT TRANSFORMERS AND AMMETERS. PROVISION FOR CONTROLLING UP TO THREE POWER LEVELS FOR DAY, NIGHT, AND PRE-SUNRISE OPERATING MODES.
- LONG TIME CONSTANT CIRCUIT MINIMIZES EFFECTS OF MODULATION AND CARRIER SHIFT.
- METER SHOWS DEVIATION FROM CORRECT POWER LEVEL. LED INDICATORS SHOW STATUS OF POWER CONTROLLER.
- RELAY CHATTER AND "HUNTING" IS PREVENTED BY USING SPECIAL DIGITAL LOGIC CIRCUITS TO PROVIDE SELECTABLE INCREMENTS FOR ON-OFF TIMING OF RAISE AND LOWER MOTORS DEPENDING ON THE CHARACTERISTICS OF THE RAISE/LOWER CONTROLS. DIFFERENT TIMING AVAILABLE FOR MAIN AND ALTERNATE TRANSMITTERS (OR FOR DAY AND NIGHT TRANSMITTERS).

DESCRIPTION

The APC-1 Automatic Power Controller measures the operating power of an AM or FM station, and by interconnection to the transmitter's RAISE/LOWER controls causes the power to remain well within FCC limits. The unit monitors a DC voltage from an external linear rectifier driven by an RF sample of the common point or base antenna current in AM applications, or a similar linear DC sample from the FM power meter or directional coupler. A special long time constant circuit removes modulation components and averages carrier shift variations in AM applications. The DC voltage is then compared to several fixed voltages and the comparator outputs enable appropriate operation of the RAISE/LOWER controls and front panel indicators. A relative power meter provides continuous display of the power level and facilitates setup adjustments.

The input circuits provide for adjusting the gain of up to three instrument amplifiers and selecting the appropriate signal depending on mode of operation. (Day, Night or Pre-Sunrise Authority). Front panel adjustments are provided to set the power meter to 100% when the correct power is indicated by the official RF ammeter or power determining device.

Comparator circuits provide for operation of the RAISE and LOWER relays and LED indicators and provide rear panel alarm outputs and LED indicators when the power exceeds the FCC high limit of 105% or the FCC low limit of 90%. A front panel pushbutton permits testing the FCC high alarm at 100% power level instead of 105% power level. An additional comparator determines when the power is below a selectable value of 70 or 80% so as to prevent operation of the RAISE relay should the power be well below the normal level.

Special digital timing circuits permit separate adjustments (by changing circuit board jumpers) for two transmitters so that the Power Controller will return the power to near 100% on each correction. This prevents relay chatter and hunting which would otherwise occur as the power level remains near the RAISE or LOWER limit.

The RAISE and LOWER limits may be set to select from three incremental thresholds at which power correction occurs (by changing circuit board jumpers). Front panel controls are available for manual transmitter control when needed.

The ATS option includes additional circuits and indicators to determine if the FCC power levels are exceeded for three minutes.

DELTA ELECTRONICS

The APC-1 circuits utilize CMOS digital circuitry and conservatively rated IC operational and instrument amplifiers. A single printed circuit board accommodates the input and control logic circuits and two additional boards are used for the regulated power supply and the ATS option circuits. Adequate RF shielding and filtering are provided to insure reliable operation in high RF fields as experienced by some transmitting stations.

SPECIFICATIONS

MODE INDICATORS:
Three LED's to indicate Day, Night or PS mode.

MAIN/ALTERNATE INDICATORS:
Two LED's to indicate transmitter in use.

POWER LEVEL INDICATORS:
Disable (70% or 80%), FCC Low (90%), Raise (90%, 93.3% or 96.7%), Lower (101.5%, 103.3% or 105%), FCC High (105%).

RAISE AND LOWER RELAYS:
Two form A contacts (2A, 115 VAC or 28 VDC) available on rear panel terminal strip for each relay.

REMOTE INPUTS FOR RAISE/LOWER RELAYS:
Parallels front panel pushbuttons–relay or open collector pulldown (40 mA, 24 V) enables relays.

POWER LEVEL METER:
Taut band meter with scale from 80 to 110%.

INPUT SIGNALS:
Three separate differential inputs available on rear panel. Amplifiers provide for common mode rejection and gain programming.

SIGNAL LEVEL RANGE:
0.5 to 4.5 VDC for 100% power.

MODE SELECT INPUTS:
Normally on Day mode. Relay or open collector transistor pulldowns (5 mA, 12 VDC) selects Night or PS mode.

TRANSMITTER SELECT INPUT:
Normally on Main mode. Relay or open collector transistor pulldown (5 mA, 12 VDC) selects ALTERNATE mode.

DISABLE INPUT (REMOTE):
Relay or open collector pulldown (5 mA, 12 VDC) disables all outputs except disable output.

AUTOMATIC POWER CONTROLLER PART NUMBERS:

D13-51-1	AM A.P.C.-1
D13-51-2	AM A.P.C.-1 with A.T.S. Option
D13-51-3	FM A.P.C.-1
D13-51-4	FM A.P.C.-1 with A.T.S. Option

ALARM OUTPUTS:
Available on rear panel terminal strip: FCC High, FCC Low (both outputs normally low, high if FCC limits exceeded).

DISABLE STATUS:
Output low when in disable mode. Rear panel terminal strip.

OUTPUT SIGNAL LEVELS:
Open collector grounded emitter NPN transistors rated at 40 V, 500 mA. Will operate relays or digital logic circuits.

ATS OUTPUTS (ORDER ATS OPTION):
Two minute FCC High warning, 3 minute FCC High alarm, 3 minute FCC Low alarm (dry contact closure rated at 2 A, 28 VDC, or 115 VAC).

ATS RESETS (ORDER ATS OPTION):
Contact closures or solid state pulldown from ATS system will reset 3 minute FCC Low and FCC High relays.

ACCURACY OF POWER LEVEL COMPARATORS:
Within ±0.5% for 90 to 105% power levels.

ACCURACY OF POWER METER:
Within ±1% for 90 to 105% power levels.

REMOTE POWER METER OUTPUT:
4.0 volts for 100% power for all modes. Source impedance 10K ohms.

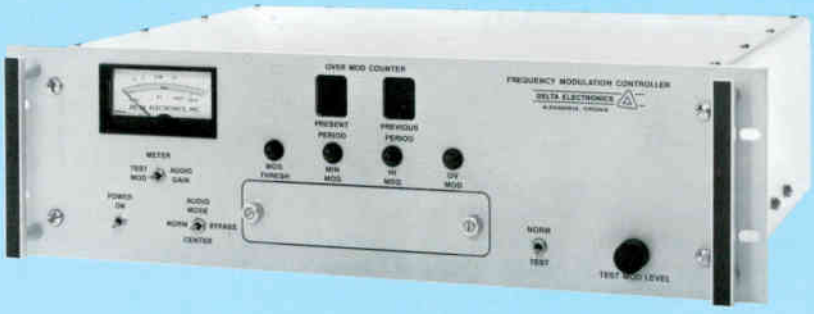
POWER REQUIREMENTS:
115/230 V, 50/60 Hz, 10 watts.

DIMENSIONS:
19" x 3-1/2" x 12" (48.3cm x 8.9cm x 30.5cm) rack mounting cabinet.

OPERATING TEMPERATURE FOR STATED ACCURACY:
10^{o} to 40^{o}C (50^{o} to 104^{o}F).

DELTA ELECTRONICS

Model FMC-1 Frequency Modulation Controller



FEATURES

- AUTOMATICALLY CONTROLS THE MODULATION LEVEL OF AN FM OR AURAL TELEVISION TRANSMITTER TO PREVENT EXCESSIVE OR UNDESIRABLY LOW MODULATION.
- USES AN INPUT SAMPLE FROM THE AUDIO OR COMPOSITE OUTPUT OF MODULATION MONITOR.
- INTERFACES MONAURAL OR STEREO COMPOSITE SIGNAL WITH 600 OHM BALANCED INPUT AND OUTPUT CIRCUITS.
- PROVIDES A ±8 DB WINDOW OF ADJUSTMENT OF STEREO, AUDIO OR COMPOSITE.
- FRONT PANEL METER INDICATES AUDIO OPERATING GAIN OF SYSTEM, AND TEST MODULATION PERCENTAGE.
- TWO ONE-DIGIT COUNTERS WITH OVERFLOW INDICATORS SEPARATELY DISPLAY OVER MODULATION PEAKS FOR PRESENT AND PREVIOUS ONE MINUTE COUNT PERIOD.
- RECESSED FRONT PANEL CONTROLS PROVIDE ADJUSTMENT OF FOUR MODULATION CONTROL LEVELS AND THE AUDIO LEVEL ADJUSTMENT RATES.
- TEST MODE CHECKS OPERATION OF CONTROLLER AND FACILITATES PARAMETER ADJUSTMENT.
- PROOF OF PERFORMANCE TESTS MAY BE CONDUCTED WITH UNIT IN CIRCUIT.
- REVERTS TO HARDWIRE THROUGH MODE ON POWER OR CIRCUIT FAILURE.

DESCRIPTION

The Model FMC-1 Frequency Modulation Controller provides automatic control of the modulation levels of an FM broadcast transmitter or audio channel of a TV transmitter. The FMC-1 provides a closed loop system around the transmitter which allows the broadcast engineer to maintain modulation at the desired level despite variations in the audio level from different program sources and other system variances. Through gain is controlled by a digital attenuator maintaining true transparency at all gain settings. No clipping or compression is used.

By using a closed loop approach, the FMC-1 allows modulation levels to be maintained independent of audio program levels, output level variations of the stereo generator or other exciter/transmitter variations which may affect the audio baseband level.

Two basic models of the FMC-1 are available:

FMC-1S - Single Channel and

FMC-1D - Dual Channel

The FMC-1S is a single channel unit designed for use in monaural FM or TV applications or in stereo FM applications where control of the composite level from the stereo generator is desired.

For stereo operation, the FMC-1S is placed in the circuit between the stereo generator and the baseband input of the exciter. In this system, a composite sample from the station's modulation monitor is used to provide the output sample for the FMC-1S. The FMC-1S will continuously sample the composite level and compare this level with internal preset minimum and maximum thresholds. The FMC-1S then uses a digital logic process to adjust the stereo generator's output to the exciter. The composite control circuit is strictly linear so that no compression or clipping is added.

The FMC-1S may also be used, in monaural systems (FM or TV) where its sample is derived from the audio output of the station's modulation monitor. In this application it is placed in the audio chain between the last stage of audio processing equipment and the audio input of the transmitter.

The FMC-1D is a dual channel unit designed for stereo FM applications where control action is taken on the individual left and right audio channels. As described above, the composite signal sample from the station's modulation monitor is fed to the FMC-1D. The FMC-1D compares the composite level to preset thresholds and then uses a digital logic process to control the levels of the right and left audio channels. Accurate gain tracking is maintained on the two channels. In this configuration, the unit is installed ahead of the stereo generator but after the audio processor chain.

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The FMC-1S/FMC-1D makes the following comparisons simultaneously to establish the desired modulation conditions:

1. Modulation Threshold
2. Minimum Modulation
3. High Modulation
4. Over Modulation

The modulation threshold comparison is used to determine when modulation is present. No corrections are made when the modulation is below this threshold. This prevents pumping, which is common in most gain control amplifiers. The accumulated time during which the threshold is exceeded establishes a modulation sample period. The duration of this period is selectable.

The minimum modulation comparison establishes the minimum desired amount of modulation. If the modulation does not exceed this level within the established modulation period, the gain is increased until the comparison is satisfied.

The high modulation comparison establishes the maximum desired amount of modulation. Should the modulation exceed this level at any time, the gain is decreased until the modulation no longer exceeds this level.

The over modulation comparison is used to determine the number of over modulation peaks occurring during a one minute period. The over modulation counts are displayed on two front panel digital displays. Counts for the current period accumulate on the current count display. At the end of a period, this count is transferred to a second display showing the total count for the last period.

The actual control of the audio or composite level is performed by an eight bit multiplying D-to-A converter. This device is basically a linear attenuator, adjustable in approximately 0.1 dB steps as determined by an eight bit binary word. The total range of adjustment is minus 8 dB to plus 8 dB in 256 discrete steps as the binary number varies from 0000 0000 to 1111 1111. The adjustment steps are so small that gain changes are not discernible in the program material. Programmable minimum and maximum count circuits enable selection of a reduced dynamic range if desired.

The value of the eight bit binary word is controlled by an up-down counter. When the negative and positive minimum modulation comparisons are not satisfied, the counter increments, increasing the audio level until the low modulation condition is corrected. When the high modulation comparison is satisfied, the counter decrements, decreasing the audio level until the high modulation condition is corrected. The rates at which the counter increments and decrements are separately adjustable thereby providing flexibility to suit the program requirement of the station.

Both the single channel FMC-1S and the dual channel FMC-1D may be equipped with the ATS (Automatic Transmission System) option. This option provides for a count of over modulation peaks occurring in three consecutive one minute periods. Dry contact closures accessible on the rear panel of the FMC-1S/FMC-1D are provided for warning and alarm functions.

SPECIFICATIONS

MODULATION INDICATORS:
Four LED's to indicate threshold, minimum modulation, high modulation, and over modulation conditions.

OVER MODULATION COUNTERS:
Two one digit counters with overflow indicators to separately count over modulation peaks for present and previous one minute period.

AUDIO LEVEL ADJUSTMENT RATE CONTROLS:
Three rotary switches select increment rate of 0.5, 1, 2, 4, 8, or 16 counts per second; decrement rate of 8, 16, 32, 64, 128, or 256 counts per second; and pause period of 0.9, 1.9, 3.8, 7.5, 15, or 30 seconds.

AUDIO INPUT/OUTPUT:
600 ohms balanced, +10 dBm nominal, +20 dBm maximum range.

AUDIO ADJUSTMENT RANGE:
±8 dB maximum, programmable jumpers enable reduced dynamic range.

FREQUENCY RESPONSE:
20-80,000 Hz, ±0.50 dB.

HARMONIC DISTORTION:
1% maximum at +20 dBm output, typically less than 0.1% to 20 kHz; 0.4% to 80 kHz, (typ. 0.1% to 80 kHz at +10 dBm output).

CHANNEL TRACKING (FMC-1D):
±0.25 dB over full gain range, 20 to 20,000 Hz (typically <0.1 dB).

SAMPLE INPUT:
600 ohms unbalanced, 0 to +20 dBm.

POWER REQUIREMENTS:
115/230 Vac, 50/60 Hz, approximately 35 Watts.

UNIT DIMENSIONS:
19" wide standard EIA rack panel X 5-¼" high X 15" deep (483 X 133 X 381 mm). Weight: 20 lbs (9 kg).

ATS OUTPUT (OPTIONAL):
Dry contact closures for 1 and 2 minute warnings and 3 minute alarm for uncorrected over modulation. Contacts rated 2A at 28 Vdc, 1A at 115 Vac.

DELTA ELECTRONICS

Amplitude Modulation Controllers

AMC-1 Mono

AMC-1D Stereo

APPLICATION

The Model AMC-1 Amplitude Modulation Controller provides automatic control of the modulation levels of an AM monaural or stereo broadcast transmitter. The AMC-1 analyzes the modulation characteristics of a transmitter output sample, comparing them with preset reference values to detect insufficient or excessive modulation. A digital logic process is used to adjust the audio level to the transmitter to maintain the desired modulation characteristics. For AM stereo applications, the AMC-1D provides dual audio amplifiers. The amplifiers adjust both audio channels by the same amount, applying a technique superior to independent processing which may produce undesirable separation and image modulation of the stereo signal. The AMC-1 and AMC-1D also may be equipped to detect and indicate if the FCC ATS overmodulation criteria are exceeded.

The AMC-1 has been developed for use by broadcast engineers to maintain the high average modulation levels emphasized in AM broadcasting. It is designed to enhance the performance of conventional audio processors and to address system variances outside the scope of those processors.

ADVANTAGES

The AMC-1 is unique (Patent No. 4,088,956) because it provides a closed loop control system around the transmitter. The modulated RF sample used by the AMC-1 is taken from the transmitter output. Broadcast modulation characteristics are evaluated against desired modulation characteristics. Modulation level comparisons are made using adjustable reference values. Gain correction signals are applied to a digitally-controlled attenuator that adjusts the audio input to the transmitter.

No compression, limiting or asymmetry is introduced in the program material. Gain corrections are timed to particular program formats by variable switch settings. Gain pumping is eliminated by setting a modulation threshold. Overmodulation is identified and corrected, ensuring compliance with FCC regulations. Modulation is maintained within the desired range despite variations in program sources, transmitter characteristics and supply voltages.

FEATURES

- Automatic modulation level control of AM monaural or stereo transmitter.
- RF source select/display for Main or Alternate transmitter and Level 1 or 2 input.
- RF sample voltage from Delta TCT or transmitter monitor output.
- Balanced 600 ohm input and output audio circuits.
- Audio level adjustment to ± 8 dB.
- Multi-scale meter shows audio operating gain, RF carrier level and test modulation percentage.
- LED indicators for Threshold, Negative Minimum, Positive Minimum, Negative High, Positive High, Negative Overmodulation and Positive Overmodulation.
- One-digit counters separately count/display Positive and Negative Overmodulation bursts for Present and Previous one minute count period.
- Recessed front panel controls for modulation comparison levels and the audio adjustment rates.
- Audio adjustment rates: 0.5, 1, 2, 4, 8 or 16 Increments per second; 8, 16, 32, 64, 128 or 256 Decrements per second; and 0.9, 1.9, 3.8, 7.5, 15 or 30 seconds Sample Period.
- Test mode for operation checks and parameter adjustment.
- Proof of performance tests may be conducted with unit in circuit.

DELTA ELECTRONICS

DESCRIPTION

The AMC-1 adjusts the audio input level to the transmitter based on continual analysis of broadcast modulation characteristics. A modulated sample from the transmitter output connects to the unit. This sample is demodulated by an envelope detector producing a DC voltage proportional to the carrier level with the AC modulation voltage superimposed. This signal is also processed by a unity gain low pass filter to produce a voltage proportional to the carrier level alone. Seven modulation comparators continually compare these two signals in preset ratios to determine modulation levels. The preset comparison ratios represent values for:

Modulation Threshold
Negative Minimum Modulation
Positive Minimum Modulation
Negative High Modulation
Positive High Modulation
Negative Overmodulation
Positive Overmodulation

All comparison levels are adjustable to permit calibration against an approved modulation monitor and variations to suit individual program requirements. The output of the modulation comparators are logic level signals that drive the control logic circuit.

The control logic circuit analyzes the logic signals to determine if the desired modulation characteristics have been maintained within a preset sample period. If not, digital information is presented to the audio amplifier circuit to correct the modulation. A sample period counter is enabled by the modulation threshold signal. Thus, the sample period is accumulated time when modulation exceeding the threshold is present. No corrections are made when the modulation is below the threshold. If there are no logic signals indicating that the minimum modulation levels have been achieved within the sample period, the logic circuit instructs the audio amplifier to increase the audio level until one of the minimum levels is achieved. Conversely, when the logic signals indicate that a high modulation level is exceeded, the amplifier is instructed to decrease the audio level until neither high modulation level is exceeded. The overmodulation logic signals cause rapid audio level reduction and are routed to the overmodulation counter circuit and optional ATS control logic circuit. The overmodulation counter circuit displays the number of positive and negative overmodulation burst counts accumulated during the present and previous one minute periods.

The audio amplifier circuit takes the incoming balanced program source, applies it through a digitally-controlled attenuator, and produces a balanced signal for the transmitter input. An eight-bit binary number derived in the control logic sets the attenuator. The total range of adjustment is ±8 dB in steps of approximately 0.1 dB. For stereo applications, a second audio amplifier circuit is controlled identically to the first amplifier circuit. The high linearity of the digitally controlled attenuator enables gain tracking within ±0.1 dB between the two audio amplifier circuits.

The optional ATS control logic provides the additional circuits to determine and indicate if the FCC ATS overmodulation criteria are exceeded. Dry contact closures are accessible on the rear panel for one and two minute warning functions and the three minute uncorrected overmodulation alarm function.

SPECIFICATIONS

MODELS:

AMC-1	Single Channel Standard
AMC-1/ATS	Single Channel with ATS Option
AMC-1D	Dual Channel Standard
AMD-1D/ATS	Dual Channel with ATS Option

AUDIO INPUT/OUTPUT:
600 ohms balanced
+10 dBm nominal
+20 dBm maximum output

RF INPUT:
50 ohms unbalanced
2 to 20 VRMS

AUDIO ADJUSTMENT RANGE:
±8 dB maximum

FREQUENCY RESPONSE:
20 to 80 kHz ±0.5 dB (typically ±0.1 dB)

HARMONIC DISTORTION:
1% maximum at +20 dBm output (typically <0.1% to 20 kHz and <0.4% 20 to 80 kHz)

AUDIO GAIN TRACKING (AMC-1D Only):
±0.1 dB between channels

ATS OUTPUT (Optional):
Dry contact closures 2A at 28 VDC, 1A at 120 VAC

POWER REQUIREMENTS:
120/240 VAC, 50/60 Hz 35 watts (approximate)

DIMENSIONS:
19" wide (483 mm); 5-¼ high (133 mm); 15" deep (381 mm)

WEIGHT:
20 lbs (9 kg)

MOUNTING:
Standard 19" EIA rack

Transmission Line Switches

Model 6730E/6732E
1-5/8" Coaxial Transfer Switch

Model 33630A
Coaxial Switch Control Panel

Model 6740B/6742B
3-1/8" Coaxial Transfer Switch

The manually or remotely operated Coaxial Transfer Switches are designed to change coaxial connections with a minimum of changeover or off-air-time. They can switch pairs of transmission lines in less than two seconds.

The Models 6730E and 6732E Coaxial Transfer Switches are manufactured for use with 1–5/8-in. 50-ohm transmission line. The 6740B and 6742B Coaxial Transfer Switches are designed for use with 3–1/8-in. 50-ohm transmission line. The Models 6730E and 6740B operate on 120 V, 50/60 Hz. The Models 6732E and 6742B operate on 220/240 V, 50/60 Hz.

Transfer switches are used to switch transmitters, transmission lines, antennas, dummy loads and auxiliary equipment quickly and efficiently when failures occur, when operating procedure is changed, or during scheduled maintenance periods. They also simplify equipment tuning, testing, and emergency repairs by facilitating quick checks under actual operating conditions.

Many switching requirements in a station are greatly reduced by the use of transfer switches. In complex systems, only one-third or one-fourth as many transfer switches are needed to accomplish the same switching function as a system using SPDT or SP3T type switches. If only three of the terminals of the switches are employed, the switches can be used as SPDT types.

The Models 6740B and 6742B can be pressurized up to 15 lb./sq. in. (1.1 kg./sq. cm.). A gas barrier is built into each terminal, and an air inlet port is provided.

The Coaxial Transfer Switch provides two isolated interlock circuits for switch connection that duplicate the RF path exactly. All interlock switches open before the RF contacts open, and close after the RF contacts close to prevent switching with RF power applied. Additional internal switch contacts enable remote control and status indication. All interlock, indicator, and control circuits interface the transfer switch through a connector. Each transfer switch can be remotely controlled by a SPDT switch or by the Model 33630A Coaxial Switch Control Panel. The panel is designed to control either a Model 6730E/32E or Model 6740B/42B Coaxial Transfer Switch and indicate the switch connections. The control panel operates on 120 V or 220/240 V, 50/60 Hz and mounts in a standard equipment rack space of 3–½" high by 19" wide (89 by 483 mm).

DELTA ELECTRONICS

Model 6730E/6732E

SPECIFICATIONS

MODEL NUMBER	6730E	6730E1	6732E	6732E1
Termination, Male EIA flange	1-5/8 in.	1-5/8 in.	1-5/8 in.	1-5/8 in.
Frequency Range, MHz	0-400	0-900	0-400	0-900
Impedance, ohms	50	50	50	50
Average Power Rating, *kW @ 50 MHz	20	20	20	20
@ 400 MHz	6.4	6.4	6.4	6.4
@ 900 MHz	–	5	–	5
Peak Power Rating, *kW	145	145	145	145
VSWR, Guaranteed Max.,				
@ 0-216 MHz	1.02	1.02	1.02	1.02
@ 216-400 MHz	1.03	1.03	1.03	1.03
@ 400-900 MHz	–	1.06**	–	1.06**
Isolation, Typical, dB, @ 0-216 MHz	60	60	60	60
@ 216-400 MHz	55	55	55	55
@ 400-900 MHz	–	40	–	40
Switching Time, Max., seconds	2	2	2	2
Pressurization	No	No	No	No
Power Source	120V, 50/60 Hz	120V, 50/60 Hz	220/240 V, 50/60 Hz	220/240 V, 50/60 Hz
Power Drain (during switching), watts	40	40	40	40
Dimensions, LxWxD, inches	8x8x10	8x8x10	8x8x10	8x8x10
(mm)	(200x200x250)	(200x200x250)	(200x200x250)	(200x200x250)
Net Weight, pounds	13	13	13	13
(kg)	(6)	(6)	(6)	(6)

*At Unity VSWR, and 40 Degrees C (104 Degrees F) Ambient Temperature.
**Adjusted For A Specified 10MHz Band. VSWR May Be Higher At Other Frequencies.

Model 6740B/6742B

SPECIFICATIONS

TYPE NUMBER		6740B	6742B
Termination, Male EIA flange		3-1/8 in.	3-1/8 in.
Frequency Range, MHz		0-216	0-216
Impedance, ohms		50	50
Average power Rating, *kW	@ 50 MHz	70	70
	@ 216 MHz	30	30
Peak Power Rating, *kW		400	400
VSWR, Guaranteed Max.,	@ 0-216 MHz	1.04	1.04
Isolation Minimum, dB	@ 0-216 MHz	60	60
Switching Time, Max., seconds		2	2
Pressurization		Yes	Yes
Power Source		120V, 50/60 Hz	220/240V, 50/60 Hz
Power Drain (during switching), watts		200	200
Dimensions, LxWxD, inches		14x14x14	14x14x14
(mm)		(360x360x360)	(360x360x360)
Net Weight, pounds		65	65
(kg)		30	30

*At Unity VSWR, And 40 Degrees C (104 Degrees F) Ambient Temperature.

DELTA ELECTRONICS

Model OIB-1 Operating Impedance Bridge

*U.S. Patent No. 3,249,863

DESCRIPTION

The Model OIB-1 Operating Impedance Bridge*measures the operating impedance of the individual radiators, networks, transmission line sections, and common point of directional antenna systems *while they are functioning under normal power.* This "operating impedance" cannot be measured by usual impedance bridge methods because the system characteristics are disrupted when the bridge is inserted in the circuit. The OIB-1 thus satisfies a critical requirement long felt by consulting and broadcast station engineers. In addition it has many applications in other fields that cannot be duplicated by any other instrument.

The OIB-1 is inserted directly in series with the transmission line, network, or antenna. The transmitter power is applied and a bridge balance is obtained by manipulating the R and X dials on the face of the bridge. Balance is indicated by a null reading on the meter which is mounted on the front panel of the bridge. Operating resistance and reactance are then read directly from the bridge dials. The VSWR on a transmission line can be read directly from a scale on the meter. It can be used with the RG-4 or other Receiver/Generator combinations to make routine bridge measurements. Accepted by the FCC for measurements of license common point impedance. Application Bulletins No. 1 & 3, available at no cost, further describe the uses of the OIB-1.

ACCESSORIES

1. TC-1 Transport Case
2. Factory installed DC Amplifier for use with power sources as low as 25 watts.
3. MJ-50 Meter Jack
4. BP-50 Bridge Plug
5. Factory installed Range Extension (See Specifications)
6. Connector Adapters:
   - Large UHF to BNC female (D81-13)
   - BNC female to GR (D81-59)
   - BNC female to N male (D81-76-1)
   - BNC male to N male (D81-76-2)
   - Large UHF to N female (D81-77)

SPECIFICATIONS

FREQUENCY RANGE:
500 kHz to 5 MHz.

THROUGH POWER RATING:
5 kW modulated, 10 kW carrier only, with VSWR 3:1.

INSERTION EFFECT:
Equal to 9" of 150-ohm line.

FUNCTIONS:
Direct reading in R, –400 to +400 ohms. Direct reading in X, –300 to +300 ohms. Measures VSWR, Z_o = 0 to 400 ohms. Indicates relative forward and reflected power. Range extension (factory installed) to extend R & X ranges to 1000 and 900 ohms respectively available on special order.

ACCURACY:
R and X, ±2%, ±1 ohm. Dials individually calibrated and engraved. (Accuracy slightly reduced on extended ranges.)

RF SOURCE:
Transmitter, transmission line, etc., or signal generator with adapting connector.

DETECTOR:
Internal for high power source. Connector on front panel for external detector when used with signal generator. Amplifier for internal detector available as factory installed option if high sensitivity is desired.

TERMINALS:
Input and output are large UHF receptacles (UG-357/U). 12" input and output clip leads are supplied as standard with bridge. 18" leads optional at no extra cost when specified with order. External detector connection is BNC.

DIMENSIONS:
12½" x 9½" x 5¼"

WEIGHT:
10 lbs.

DELTA ELECTRONICS

Model OIB-3 Operating Impedance Bridge

*U.S. Patent No. 3,249,863

INTRODUCTION

The OIB-3 is an advanced version of the industry standard OIB-1 operating impedance bridge. It has all of the OIB-1 features plus an extended resistance and reactance range and an improved meter amplifier. It is built in a heavy drawn aluminum case and no additional carrying case is required.

DESCRIPTION

The Model OIB-3 Operating Impedance Bridge* measures the operating impedance of the individual radiators, networks, transmission line sections, and common point of directional antenna systems *while they are functioning normally and under power.* This "operating impedance" cannot be measured by normal impedance bridge methods because the system characteristics are disrupted when the bridge is inserted in the circuit. The OIB-3 thus satisfies a critical requirement long felt by consulting and broadcast station engineers. In addition it has many applications in other fields that cannot be duplicated by any other instrument.

The OIB-3 is inserted directly in series with the transmission line, network, or antenna. The transmitter power is applied and a bridge balance is obtained by manipulating the R and X dials on the face of the bridge. Balance is indicated by a null reading on the meter which is mounted on the front panel of the bridge. Operating resistance and reactance are then read directly from the bridge dials. It can be used with the RG-4 or other Receiver/Generator combinations to make routine bridge measurements. Accepted by the FCC for measurements of license common point impedance. Application Bulletins No. 1 & 3, available at no cost, further describe the uses of the OIB-3.

FEATURES

1. Self-contained in field transport case.
2. Increased ranges factory installed as standard.
3. Internal RF amplifier with meter for use with low power measurements.

SPECIFICATIONS

FREQUENCY RANGE:
500 kHz to 5 MHz.

THROUGH POWER RATING:
5 kW modulated; 10 kW carrier only, with VSWR 3:1.

INSERTION EFFECT:
Equal to 9" of 150-ohm line.

FUNCTIONS:
Direct reading in R, −1000 to +1000 ohms. Direct reading in X, −900 to +900 ohms.

ACCURACY:
R and X, ±2% ±1 ohm over most of the range. For high reactance to resistance ratio the resistance accuracy is reduced. A correction equation and curve is supplied for these high Q measurements.

RF SOURCE:
Transmitter, transmission line, etc., or signal generator with adapting connector.

DETECTOR:
Internal for high power source. Connector on front panel for external detector when used with signal generator. RF amplifier for internal detector factory installed for high sensitivity.

TERMINALS:
Input and output are large UHF receptacles (UG-357/U). 12" input and output clip leads are supplied as standard with bridge. 18" leads optional at no extra cost when specified with order. External detector connection is BNC.

DIMENSIONS.
13½" x 10" x 8"

WEIGHT:
15 lbs.

DELTA ELECTRONICS

Models CPB-1 & CPB-1A Common Point Impedance Bridge

*U.S. Patent No. 3,249,863

DESCRIPTION

The Delta Electronics Model CPB-1 and CPB-1A Common Point Impedance Bridges* are operating impedance bridges similar to the Model OIB-1, but designed for permanent installation in your phasing equipment at the antenna common point. The CPB-1 will handle common point powers up to 5 kW with 100% amplitude modulation on a continuous basis. The CPB-1A is designed for transmitter powers up to 50 kW. Both instruments have two 4" dials calibrated directly in resistance and reactance. A panel meter is provided for use as a null detector. The R & X dials are manipulated as a normal bridge to give a null indication on the panel meter while the transmitter is operating at full or reduced power. The value of the common point resistance and reactance can then be read directly from the two dials.

It has been found that many directional antennas have common point impedances which vary from time to time due to seasonal changes in the ground system and minor tuning drift of the antenna parameters. On many occasions, it was found from remeasurement of the common point impedance that the station had been transmitting with somewhat less than full power for some time because of these changes. The CPB-1 and CPB-1A permit the station operator to determine the common point impedance at any time, even during normal operating hours. By minor adjustment of the common point resistance control, he can maintain radiated power at the full license value at all times. He also has a method of detecting changes in his antenna system which affect the common point. This may alert him to equipment faults and prevent citations for antenna misadjustment. The development of the CPB-1 and CPB-1A has thus satisfied a requirement long expressed by leading broadcast station engineers.

The CPB-1 and CPB-1A are also available with a Delta TCA RF Ammeter System factory installed. See page 25 for available ranges.

SPECIFICATIONS

FREQUENCY RANGE:
500 - 1650 kHz.

POWER RATING:
CPB-1 –5 kW - 100% modulation continuous.
CPB-1A –50 kW - 100% modulation continuous.

RESISTANCE RANGE:
30 - 100 ohms.

REACTANCE RANGE:
±50 ohms (1000 kHz)

ACCURACY:
Resistance ±2% ±1 ohm.
Reactance ±2% ±1 ohm.
(Provision is made for your consultant to adjust the calibration to agree exactly with your licensed resistance value.)

R.F. SOURCE:
Your transmitter operating at normal or reduced power acts as source - no generator is required.

DETECTOR:
Tuned internal detector with 25 μa panel meter – no external detector is required. BNC output connector for use with external detector.

TERMINALS:
Screw terminals or standoff insulators at rear of bridge box for connection to tubing, strap, or jumper to coax are provided.

MOUNTING:
Standard 8¾" x 19" engraved gray rack panel – can be supplied without panel for mounting behind your phasor panel (drill template supplied).

DIMENSIONS Bridge box without panel:
Height: 7"
Width: 9"
Depth: 9¼"
Panel Dimensions: 8¾" x 19"

DELTA ELECTRONICS

Model RG-4 Receiver/Generator

DESCRIPTION

The RG-4 Receiver/Generator is Delta's newest model in its continuing line of precision Impedance Bridge RF excitation generators and null detection receivers. It is designed as the ideal companion instrument for Delta's OIB-1, OIB-2, and OIB-3 impedance bridges. These bridges and the RG-4 thus form a complete, portable impedance measuring system. Its lightweight construction, combined with a rugged weatherproof aluminum case make this instrument equally at home on the service bench or in the field.

The operating frequency range is from 100 Khz to 30 Mhz. The generator output level is two watts, 100 Khz to 20 Mhz, and one watt, 20 Mhz to 30 Mhz. Receiver sensitivity is 10 microvolts, with separate front panel gain controls for RF and audio. Generator/Receiver isolation is greater than 120 dB.

In noisy environments or under conditions of interfering signals, the generator can be modulated by an internal 50 Hz squarewave source and the receiver's coincidence detector circuit will provide clean positive nulls. Additionally, the generator can be modulated by an internal 400 Hz, signal at 90% modulation. The receiver will then provide audible null indications.

Frequency selection is accomplished by a front panel keypad assembly, controlling a precision Phase locked loop digital frequency synthesizer. Selected frequencies are displayed on a large LCD readout panel. To help speed test processes, nine storage registers provide store and recall of your frequently used test frequencies.

Frequency increment and decrement keys provide manual sweeps of a chosen frequency in 1, 10, 100, or 1000 kHz steps. Separate 5 kHz step keys simplify FCC required antenna resistance measurements.

Modern gel-cell batteries power the unit for field measurements, for up to four hours from a full charge condition. The AC supply/charger operates from either 120 Vac or 240 Vac. The power supply will both power the unit and charge the batteries at the same time. Automatic switching in the power supply to a "trickle" charge condition prevents battery damage.

FEATURES

GENERATOR MODULATION:
400 Hz 90% AM
50 Hz squarewave

RECEIVER TYPE:
Dual Conversion Superheterodyne with AGC

RECEIVER SELECTIVITY:
– 3 dB bandwidth 3.8 kHz
– 45 dB bandwidth 18 kHz

METERING:
Generator output in VRMS
Receiver AGC Level

SPECIFICATIONS

- UP TO 2 WATTS OUTPUT
- 10 MICROVOLT RECEIVER SENSITIVITY
- RECEIVER/GENERATOR ISOLATION >120 dB
- 100 kHz TO 30 MHz OPERATING RANGE
- DIGITAL FREQUENCY SYNTHESIZER DESIGN
- KEYPAD ENTRY OPERATIONS
- 9 FREQUENCY TEST STORAGE REGISTERS
- COINCIDENCE DETECTOR
- LCD READOUT
- GEL-CELL BATTERY PACK

DELTA ELECTRONICS

Model MJ-50 In-Line High Power Meter Jack and Accessories

SPECIFICATIONS

FREQUENCY RANGE:
500 kHz - 5 MHz

CURRENT RATING:
50 amperes max.

VOLTAGE RATING:
10 kV RMS

MOUNTING DIMENSIONS:
4½" x 2"

OVERALL DIMENSIONS:
9½" L x 3" W x 6" H

ACCESSORIES:
MP-( ) Meter Panel
BP-50 Bridge Plug for OIB-1 or OIB-3 Bridges

DESCRIPTION

The Delta Electronics Model MJ-50 Meter Jack is a make-before-break in-line jack assembly especially designed for permanent installation in broadcast antennas, transmission lines, and networks to permit the "hot" insertion of a Delta OIB-1 Operating Impedance Bridge or ammeter without interruption to normal program operation. The Meter Jack is rated for continuous operation at currents of up to 50 amperes and is insulated for 10 kV RMS. Accessory plug panels are available for use with the OIB-1 and for all of the most commonly used ammeters. The BP-50 Bridge Panel is a plug panel designed for insertion in the Meter Jack and has terminals suitable for connection to the Delta OIB-1 bridge leads and is also rated for 50 ampere operation. The MP-308 is a plug-panel for use with a Weston Model 308 Ammeter for "hot" ammeter insertion. Plug panels for use with other meters are also available on request.

The MJ-50 Meter Jack is normally installed in each antenna lead, in each network input lead connecting to the transmission lines, and in other circuit locations where operating impedance or current measurements are required. A Universal Mounting Bracket, Delta Part No. UB-1, is supplied to assist in permanent installation of the Meter Jack. Where an operating impedance measurement is desired at any of these points, the OIB-1 red bridge leads are clipped on the BP-50 plug panel and the OIB-1 black bridge leads are clipped on the nearest ground terminal. The plug panel is then inserted into the MJ-50 Meter Jack and impedance measurements are made without power interruption. Alternatively, an MP-( ) Meter Panel fitted with a suitable ammeter is then plugged into the MJ-50 Meter Jack for current measurements without interruption of radiated power.

The use of the MJ-50, BP-50, and MP-( ) permits measurements and preventive maintenance during operating hours, thus reducing after hours engineering time. For 24 hour scheduled stations these measurements would not be otherwise possible without operational interruptions. With these "hot" jack and plug units, antenna and line ammeters are protected from damage by atmospheric discharge and network component failures.

DELTA ELECTRONICS

Models TCT-N and TCT-N-H.V. Toroidal Current Transformers

SPECIFICATIONS

FREQUENCY RANGE:
.5 to 2 MHz

SENSITIVITY:*
TCT-1: .5V/ampere
TCT-2: .25V/ampere
TCT-3: 1V/ampere

SOURCE IMPEDANCE:
50 ohms

CURRENT RANGE:
TCT-1: 0 - 40 amperes
TCT-2: 0 - 75 amperes
TCT-3: 0 - 25 amperes

ABSOLUTE MAGNITUDE ACCURACY:
±2%

ABSOLUTE PHASE ACCURACY:
TCT-1 and 2: +2 degrees
TCT-3: ±3 degrees

MAGNITUDE TRACKING ACCURACY:
±1%

PHASE TRACKING ACCURACY:
TCT-1 and 2: ±0.5 degrees
TCT-3: ±1 degree

INSULATION:
10 kV

ELECTRIC FIELD REJECTION:
>100 dB

COMPENSATED RECTIFIER CIRCUIT:
TCTR-1 Rectifier available for DC output. See reverse side of this sheet.

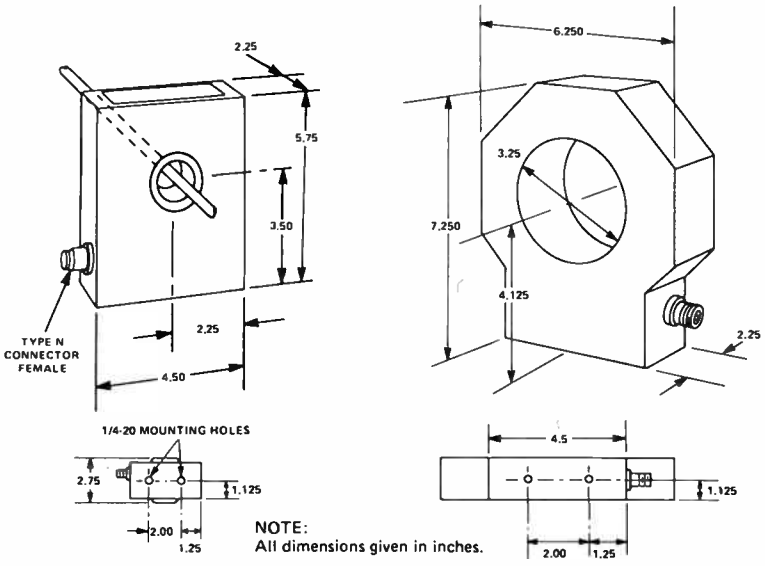
* When terminated in external 50 ohm load
(Other sensitivities available on special order.)

DESCRIPTION

The TCT-1, TCT-2 and TCT-3 are precision toroidal current transformers designed primarily for obtaining sampling voltages for phase and magnitude measurements on broadcast arrays. The units are housed in rectangular aluminum shield enclosures with a 1-1/4" teflon lined pass hole through which the current carrying conductor is passed.

The TCT-1 and TCT-2 may both be used in the same system since they have identical tracking characteristics. The TCT-3 has somewhat different characteristics and preferably should not be mixed with the other two types.

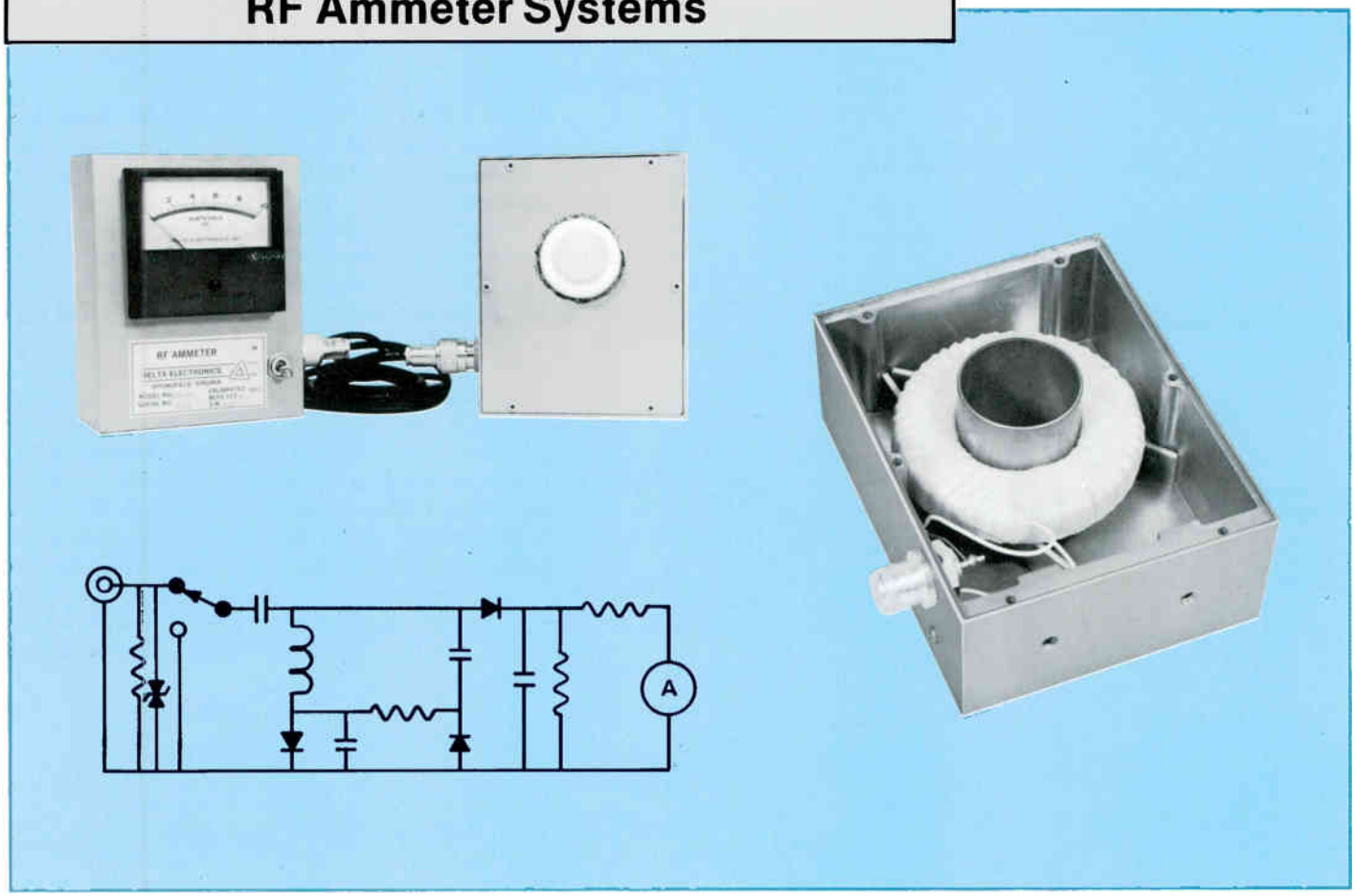
The TCT-N-HV specifies the current transformer is the high voltage type. The passhole in this transformer is 3¼ inches. The conductor voltage to ground can be as high as 20 kV (RMS on modulation crests).



MODEL TCT-N MODEL TCT-N-HV

DELTA ELECTRONICS

RF Ammeter Systems



ABOUT THE TCA DESIGN

The TCA (Transformer Coupled Ammeter) series uses a toroidal current transformer (TCT) to obtain a sample voltage proportional to the RF current flowing in a conductor. This sample is connected by a 50 ohm coaxial cable to a special rectifier circuit where it is converted to a DC current to drive the indicating instrument. A DC voltage output for driving a remote indicating instrument which may be calibrated to agree with the primary meter and used for remote indication is also provided.

THE COUPLING TRANSFORMER

The primary winding of the transformer is the current carrying conductor passed through the hole in the transformer box. This is usually a tubular lead feeding a tower base, a network lead, or the conductor connecting the transmitter output to the "common point" of the antenna phasing networks. The conductor size and its location in the passhole of the transformer have no practical effect on the meter calibration.

METER CIRCUIT

The meter circuit has a 50 ohm load resistor for proper termination of the cable. Thus, the cable is both source and load terminal for a match. A patented* three-diode rectifier circuit converts this sample to a DC voltage for display.

The rectifier filter circuit is designed to follow the modulation envelope accurately on both positive and negative excursions. The meter ballistics will thus average out the audio content and give a stable carrier reading independent of modulation.

A switch is provided on all meters to remove and ground the rectifier portion of the circuit when not required. This greatly enhances its immunity from lightning damage.

METER CALIBRATION

Every TCA system is calibrated in the Delta laboratory at an RF frequency of 1 MHz. Since the frequency response is extremely flat, accuracy is assured over the entire range of broadcast frequencies. The accuracy specification of ±2% of full scale is guaranteed without corrections. In addition, a correction curve is supplied with each meter for those users requiring even greater accuracy. The standard RF currents used for calibration are generated by special calibration equipment developed in the Delta laboratory. Development and perfection of this equipment required more than 18 months of effort including cross checks with the National Bureau of Standards at Boulder, Colorado.

Delta engineers believe that the overall accuracy of the calibration equipment is better than 0.5%. We know of no other source of RF current calibration comparable to this.

The calibration accuracy of TCA instruments is guaranteed for a period of 1 year under normal use conditions. If the user suspects that a meter has become defective or its calibration is incorrect, we will recheck the calibration and make repairs, if necessary, without charge within that period. These services are available at a nominal charge at any time.

*U.S. Patent No. 3,914,689

Meter Nomenclature

TCA-20-EX

TCA-20/40-EXR
METER BOX

The TCA-EX and TCA-XM series of RF Ammeters include a wide variety of scales, scale combinations, and optional features, all of which are uniquely defined in the model numbering system.

TCA-N-EX. This model is a single-scale meter with external output. The system consists of a current transformer; a six-foot coaxial cable; and a meter box housing the meter movement, rectifier circuitry, and external output connector. The external output can be used in conjunction with a series 10K-ohm potentiometer connected to a second meter to provide for "remote metering." The external output may also be used to drive automatic logging, remote control, or ATS equipment. A two-position toggle switch mounted on the front of the meter box turns the circuit on and off, and when switched off, effectively protects the rectifier circuit against lightning damage. A spring-loaded, momentary contact toggle switch is also available to prevent leaving the ammeter in the "on" position. The "N" designation represents the full-scale current value, and the following models and current ranges are available:

Model	Current Range
TCA-5-EX	1 to 5 Amperes
TCA-10-EX	2 to 10 Amperes
TCA-20-EX	4 to 20 Amperes
TCA-40-EX	8 to 40 Amperes
TCA-80-EX	16 to 80 Amperes

These current ranges follow the FCC rule for linear scale meters. The minimum normal reading must be at least 1/5 full scale, and the maximum reading must not exceed full scale under normal variations or modulation. Since the TCA series meters do not respond to modulation, it is practical to use the meters up to 95% of full scale.

TCA-N-EXR, TCA-N/N-EXR. Meters with the "-EXR" suffix provide an auxiliary output connector along with an internal relay to ground the rectifier circuit (turn the meter off). The dual-scale models include a second relay for changing scales remotely. These relays may be operated by a 24 volt, 25 mA DC source and are connected to the pins of the same output connector. The dual-scale system allows selection of any two of the adjacent scale ranges as shown above. For example, the TCA-20/40-EXR has a 4 to 20 ampere range on its lower scale, and an 8 to 40 ampere range on its upper scale. A three position toggle switch controls the metering function, where the upper position is for the high scale, the lower position is for the low scale, and

TCA-10/20-EXR

the center position grounds the rectifier circuit, turning the meter off. TCA RF metering systems can be calibrated with up to 20 feet of connecting coaxial cable if required; however, the unit is shipped with a standard cable length of six feet.

TCA-N-XM3R. The addition of the "XM" after the range number specifies a metering system in which the rectifier circuit is housed in a metal box, and the indicating instrument is unmounted and provided with a six foot shielded-pair cable for separate panel mounting. Both 3-inch and 4-inch meter movements are available. The suffix "XM3" indicates that a 3-inch meter is supplied, "XM4" refers to a 4-inch meter. Dual ranges are also available in this series. Either single or dual scale meters in this series can be supplied calibrated, but unsealed, and the DC indicating instrument leads can be extended to any practical length. Therefore, the unit can be used as an economical remote indicating meter. The customer can adjust the calibration of the meter to agree with the primary current measuring instrument. For this option, the letter "A" should follow the model number along with the word "unsealed." For example, "TCA-5-XM4A (unsealed)." It should be noted that if the "XM" series is used as a remote meter, it must be calibrated against another instrument of known accuracy. The "XM" series also provides an external output.

TCA-N-EXHV. The suffix "HV" appended to any of the TCA series model numbers specifies that the current transformer supplied with the meter is the high voltage type. High power installations find this type of transformer useful in preventing flash-over as the conductor voltage to ground can be as high as 20 kV (RMS on modulation crests). The conductor passhole for this transformer is 3¼ inches (unbushed).

TCA-10/20-XM3R

TCA-20EXHV

RF Ammeter Systems

Delta's
Precision
Calibration
System
For
TCA Series
RF Ammeters

SPECIFICATIONS

Frequency Range:
0.5 to 2 MHz.

Current Ranges:
1-80 Amperes, see table.

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).

Maximum Conductor Size:
1¼" Diameter. (3¼" on HV models)

Conductor Voltage to Ground:
10 kV RMS (Modulation Peaks).
20 kV RMS (Modulation Peaks) – HV Models.

Electric Field Rejection:
100 dB.

Rectifier Circuit:
Temperature compensated, linearized silicon rectifier circuit – housed in meter box to TCA models and in separate shielded enclosure for TCA-XM models.

Temperature Range:
–40°F to +150°F with rated accuracy.

Lightning Protection Switch:
Model TCA has toggle switch mounted on meter box to disconnect rectifier circuitry when not being read. TCA-XM models have switch on rectifier unit. Dual range models have 3 way switch with center off position.

Interconnecting Cables:
Six foot, 50 ohm coaxial cable supplied to connect current transformer to rectifier circuit. Six foot shielded pair supplied to connect indicating instrument to rectifier circuit for TCA-XM models.

Indicating Instrument:
Taut band, mirror scale, ruggedized .5% linearity, d'Arsonval meter. 3 inch meter housed in shielded enclosure for TCA models – TCA-XM models have separate 3 inch or 4 inch meters for panel mounting.

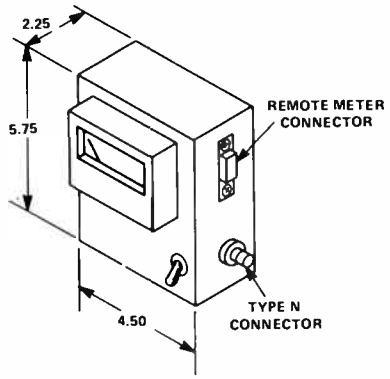
Scale Expansion:
Linear over useful range.

Scale Length:
2.75 inches on 3 inch Meter.
4.34 inches on 4 inch Meter.

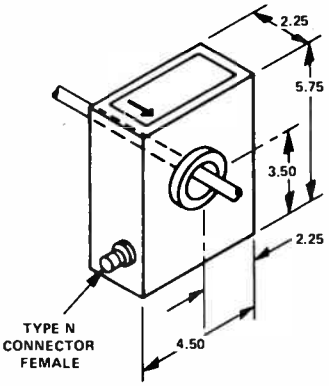
Scale Divisions:
Scale divisions above 1/5 full scale not greater than 1/50 full scale. (FCC Spec.)

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

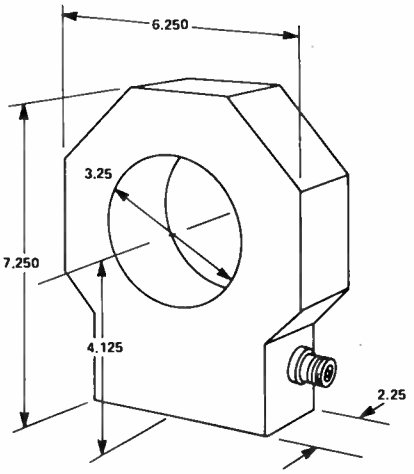
RF Ammeter Systems



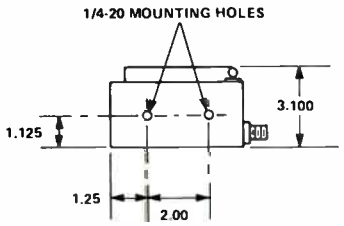
Meter Box

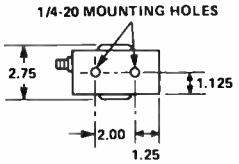


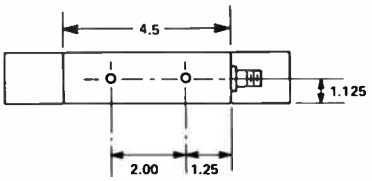
Transformer Box

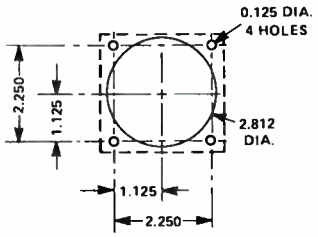


High Voltage Transformer

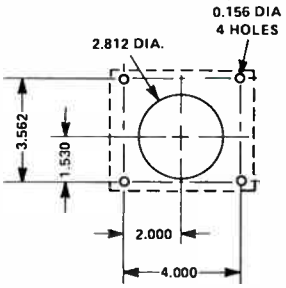








3" Meter Mounting Hole Pattern



4" Meter Mounting Hole Pattern

AVAILABLE MODELS

Current Range	TCA-N-XM				TCA-N-EX	TCA-N-EXR
1 - 5A	TCA-5-XM3	TCA-5-XM3R	TCA-5-XM4	TCA-5-XM4R	TCA-5-EX	TCA-5-EXR
2 - 10	TCA-10-XM3	TCA-10-XM3R	TCA-10-XM4	TCA-10-XM4R	TCA-10-EX	TCA-10-EXR
4 - 20	TCA-20-XM3	TCA-20-XM3R	TCA-20-XM4	TCA-20-XM4R	TCA-20-EX	TCA-20-EXR
8 - 40	TCA-40-XM3	TCA-40-XM3R	TCA-40-XM4	TCA-40-XM4R	TCA-40-EX	TCA-40-EXR
16 - 80	TCA-80-XM3	TCA-80-XM3R	TCA-80-XM4	TCA-80-XM4R	TCA-80-EX	TCA-80-EXR

	DUAL SCALE MODELS		TCA-N/N-EXR
1 - 5A 2 - 10A	TCA-5/10-XM3R	TCA-5/10-XM4R	TCA-5/10-EXR
2 - 10 4 - 20	TCA-10/20-XM3R	TCA-10/20-XM4R	TCA-10/20-EXR
4 - 20 8 - 40	TCA-20/40-XM3R	TCA-20/40-XM4R	TCA-20/40-EXR
8 - 40 16 - 80	TCA-40/80-XM3R	TCA-40/80-XM4R	TCA-40/80-EXR

Note: All models can be supplied with high voltage transformer by appending HV to model number:
Example: TCA-10/20-EXRHV.

RF Ammeter Accessories

Remote Meter Sets

Meter movements and calibration potentiometers are available in separate sets in both single and dual scale models with 3– or 4–inch movements. All are available for EX and EXR TCA series meters and are complete with mirror scales identical to the TCA meters. Single scale sets can be mounted on the customer's panel with the potentiometer in series with the meter movement and connected to the TCA-N-EX by a shielded pair cable. Dual scale models are available for use with the TCA-N/N-EXR series meters. A set consists of an appropriate dual meter, two calibration potentiometers and a three position switch for operation of the relays and selection of separate potentiometers for the two scales.

Standard Meter Panels

Standard 19-inch wide panels are available to accommodate Delta's remote meters. The panels are equipped with mounting holes for the remote meter selected as well as holes for the calibration potentiometer and the ON/OFF or Scale Select toggle switch. Please note that remote meters and meter panels are sold as separate items but will be supplied assembled if requested.

Enclosed Meter Panels

The Enclosed Meter Panel has all the features of the Standard Meter Panel plus a rear panel enclosure with connections for each meter circuit and a Power Supply and has provision for an Integrating Buffer Amplifier Board. The rear panel also provides a hole pattern for an output connector used for connecting automatic logging, remote control or ATS equipment to the meter circuits.

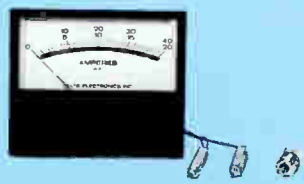
Integrating Buffer Amplifier Board

This printed circuit board contains up to four integrating instrumentation amplifiers to be used when metering outputs for automatic logging, remote control or ATS applications. Each amplifier acepts the output of one TCA-EX or TCA-EXR meter, removes the modulation components and raises the level to 10 Vdc full scale. The outputs are low impedance so that the panel meters and auxiliary equipment can operate simultaneously. The board requires a ± 15 Vdc supply at 10 mA for the four amplifiers. This board is intended for use in the Enclosed Meter Panel but may be incorporated in customer designed circuits.

TCA Power Supply

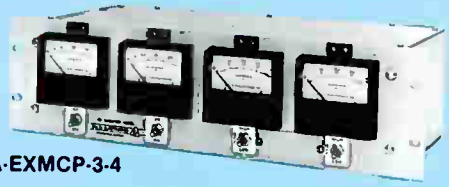
This modular power supply is for use in the Enclosed Meter Panel and is available for incorporation in customer designed circuits. The TCA-PS2 operates from 115/230 Vac, 50/60 Hz and provides two outputs: a regulated ± 15 Vdc at 100 mA for the Integrating Buffer Amplifier; and 24 Vdc at 0.5 A for operating the relays in the EXR series ammeters.

TCA-20-EXM3

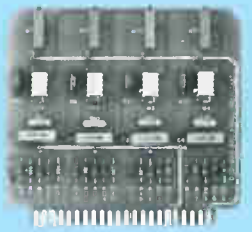


TCA-20/40-EXM4

TCA-EXMP4-1



TCA-EXMCP-3-4



TCA-IBA-4A

TCA-PS2

DELTA ELECTRONICS

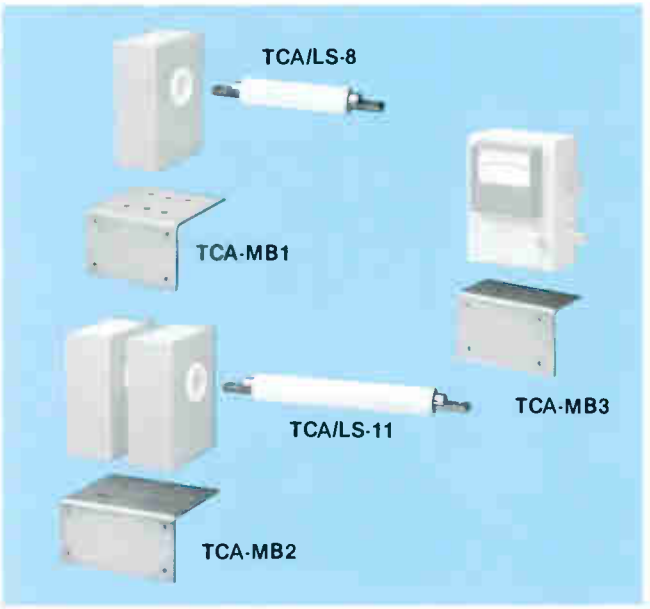
RF Ammeter Accessories

Mounting Brackets

There are three special mounting brackets availble for mounting TCA meters on network panels. The TCA-MB1 is used for mounting one TCA current transformer on a panel. The TCA-MB2 mounts two TCA current transformers on a panel (the second transformer is typically used for a phase monitor sample). The TCA-MB3 mounts a TCA meter box to TCA-N-XM rectifier box.

Conductor Bushings

A conductor bushing can be used to increase the voltage rating of a TCA or TCT to approximately 15 kV (RMS crest). The TCA/LS-8 has a 5-inch teflon bushing and an 8-inch conductor for use with a single TCA or TCT current transformer. The TCA/LS-11 has an 8-inch bushing and an 11-inch conductor for use with two TCA or TCT current transformers.



Ordering Information

Current Range	3-INCH METERS Model Number	Part Number	4-INCH METERS Model Number	Part Number
		REMOTE METER SETS		
		Single Scale Models		
1–5 A	TCA-5-EXM3	924-0015-001	TCA-5-EXM4	924-0016-001
2–10 A	TCA-10-EXM3	924-0015-002	TCA-10-EXM4	924-0016-002
4–20 A	TCA-20-EXM3	924-0015-003	TCA-20-EXM4	924-0016-003
8–40 A	TCA-40-EXM3	924-0015-004	TCA-40-EXM4	924-0016-004
16–80 A	TCA-80-EXM3	924-0015-005	TCA-80-EXM4	924-0016-005
		Dual Scale Model		
1–5 A 2–10 A	TCA-5/10-EXM3	924-0015-006	TCA-5/10-EXM4	924-0016-006
2–10 A 4–20 A	TCA-10/20-EXM3	924-0015-007	TCA-10/20-EXM4	924-0016-007
4–20 A 8–40 A	TCA-20/40-EXM3	924-0015-008	TCA-20/40-EXM4	924-0016-008
8–40 A 16–80 A	TCA-40/80-EXM3	924-0015-009	TCA-40/80-EXM4	924-0016-009
# of meters		**STANDARD METER PANELS**		
1	TCA-EXMP3-1	922-0008-001	TCA-EXMP4-1	922-0009-001
2	TCA-EXMP3-2	922-0008-002	TCA-EXMP4-2	922-0009-002
3	TCA-EXMP3-3	922-0008-003	TCA-EXMP4-3	922-0009-003
4	TCA-EXMP3-4	922-0008-004	—	—
		ENCLOSED METER PANELS		
1	TCA-EXMCP3-1	922-0010-001	TCA-EXMCP4-1	922-0011-001
2	TCA-EXMCP3-2	922-0010-002	TCA-EXMCP4-2	922-0011-002
3	TCA-EXMCP3-3	922-0010-003	TCA-EXMCP4-3	922-0011-003
4	TCA-EXMCP3-4	922-0010-004	—	—
# of channels		**INTEGRATING BUFFER AMPLIFIER BOARD**		
1	TCA-IBA-1A	933-0302-001		
2	TCA-IBA-2A	933-0302-002		
3	TCA-IBA-3A	933-0302-003		
4	TCA-IBA-4A	933-0302-004		
		POWER SUPPLY		
	TCA-PS2	933-0183-002		

DELTA ELECTRONICS

Other DELTA Products

Transmission Line Switches

SLS Coaxial stripline switching matrix Systems

SLS-1	80 kW average	320 kW PEP
SLS-3	300 kW average	1200 kW PEP
SLS-4	30 kW average	100 kW PEP
SLS-5	4 kW average	20 kW PEP

BLS balanced line switching matrix systems

BLS-3	300 kW average	1200 kW PEP

MCU-8 Microprocessor-based matrix control unit for control, status and monitoring of matrix systems.

Transmitting Antenna Systems

HFAS High frequency remote controlled, pre-settable antenna systems

HFAS-1A	1 kW (dipole)
HFAS-3A	5 kW (dipole)
HFAS-4D	10 kW (vertical whip)
HFAS-9A	1 kW (vertical whip)

MAC-1000 1 kW Marine Antenna Couplers

RCU line of remote control units and other accessories for use with antenna systems.

Receiving Antenna Systems (High Frequency)

SRMC Solid state receiving multicoupler

TNF Tunable notch filters

RAS-10A Horizontal Dipole Receiving Antenna

European Representative
Mr. John H. Gurr
P.O. Box 189A
Surbiton, Surrey KT6 6PT
United Kingdom
Telephone: 01-3907499
Telex: 943011

DELTA ELECTRONICS INC.
5730 General Washington Drive • P.O. Box 11268
Alexandria, Virginia 22312
Telephone: 703-354-3350 • TELEX 90-1963

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