

Accu-Wave Radar Gauge

Radar-Based Continuous Level Measurement

Installation Manual

DRAFT

Part No. 717790



TN Technologies

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Version 1.0

March 2000

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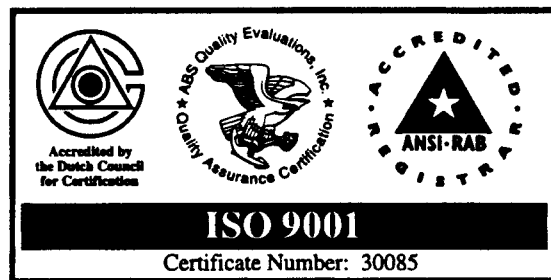
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Refer to the equipment tag shipped with your gauge to verify the certifications for hazardous location use applicable to your gauge. Refer to the Installation Manual and the Installation/Wiring Drawings for installation instructions.

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Chapter 1 Introduction

The Accu-Wave Model 1440 Radar Level Gauge uses a microwave signal to continuously measure the level of the process material. The Accu-Wave provides better performance than sonic measurement systems, particularly in hostile environments, because the microwave signal is unaffected by mist, surface agitation, temperature changes, or pressure changes. The standard menu-driven user interface, with built-in help screens, the optional Windows-based Setup Software are designed to make the gauge easy to set up and operate.

The Accu-Wave transmits a microwave signal that is reflected from the surface of the process material. The reflected signal or echo is received by the Accu-Wave. The Digital Signal Processing (DSP) software detects the echo and computes the distance to the liquid or solid material in the tank. The Accu-Wave firmware uses the distance measurement to calculate level, volume, and other user-selected measurements.

Description

The Accu-Wave Radar Level *gauge* consists of an integrated *sensor* and *transmitter* with the microwave sensor and transmitter circuitry combined on a single electronics board. The microwave signal is launched from the bottom of the board via a cup/probe assembly into the antenna. The antenna serves to focus the transmitted signal as well as to receive the reflected echo. Currently, the Accu-Wave is available with dielectric rod antennas. Horn antennas will be available as a future option.

Antennas

The standard antenna configuration for the Accu-Wave gauge consists of a dielectric-filled, 1 inch O.D. stainless steel waveguide with a dielectric rod antenna. The dielectric rod antenna is available in either polypropylene or Teflon (PTFE). The stainless steel (SS 316) waveguide material is swaged (crimped) over the dielectric-fill material. The swage serves both as a process seal as well as a pressure seal. The PTFE antenna design also uses O-rings to ensure the integrity of the process seal. Viton and Kalrez O-rings are available.

Horn antennas, with diameters ranging from 2 to 8 in., will be available as a future option.

Mounting Configurations

The dielectric rod antennas are fitted with either a 1-inch NPT threaded bushing, welded to the waveguide, or with a welded flange. The available flanges sizes are 150 lb. or 300 lb., with diameters of 2, 3, 4, or 6 inches. Waveguides are provided in lengths of 6, 9, 12, or 15 inches lengths, where the length refers to the portion of the waveguide that extends below the bushing or the flange. For optimum performance, the end of the waveguide should extend to the bottom of the tank nozzle or below.

Level measurements can be made even when the process material level is in contact with the dielectric antenna to within ~3.5 inches of the bottom of the steel waveguide.

Measurement accuracy, however, is degraded when the process level is above the bottom of the probe.

Approvals

The Accu-Wave is certified for use in hazardous locations as follows (approvals are pending as of 1 March 2000):

FM

- Class I, II, III, Division 1, Groups B, C, D, E, F, G
- Class I, II, III, Division 2, Groups B, C, D, F, G
- NEMA 4X

CSA

- Class I, II, III, Division 1, Groups B, C, D, E, F, G
- Class I, II, III, Division 2, Groups B, C, D, E, F, G
- TYPE 4X

CENELEC

- EEx d IIB + H₂
- Eex n IIB + H₂

See Appendix C for additional information regarding specifications and safety approvals.

Note: Verification of chemical compatibility with the exposed antenna materials is ultimately the responsibility of the customer.

Sensor-Transmitter

The sensor and transmitter are integrated on a single electronics board. The transmitter detects the signal reflected from the process material, determines the distance to the surface of the process material, and calculates other measurement values. These values can be displayed on a local/remote display, sent to the serial ports (RS-485 standard, RS-232 optional), and can be used to drive the 4-20 mA current output or process alarms.

The RS-485 and optional RS-232 serial ports support communications from a PC with the Accu-Wave Window's based Setup Software, a PC with terminal emulation software, or a TN Technologies' Hand Held Terminal.

The Accu-Wave supports 4-20 mA current output, serial communications, a contact closure input, and a 2-line local/remote display. The Accu-Wave inputs and outputs are summarized in the following Input/Output Characteristics Table.

| Input/Output Characteristics | | |
|-------------------------------------|---|---|
| Type | Characteristics | Comments |
| Current output | 0-20 mA dc (adjustable range) Isolated, Loop-Powered, 24 Vdc Nominal Supply Voltage, 700 ohm max. load | Default range is 4-20 mA dc. One current output is provided. |
| Serial communications | RS485: One terminal block and one RJ11 Jack RS 232: One terminal block (Requires optional board.) | Half-duplex party line communication to host computer or Hand-Held Terminal. Full duplex communication with a remote terminal or PC. |
| Contact closure input | One (1) contact closure input is provided. | The user can assign a command to execute based on user-provided contact opening or closure input to the gauge. |
| Remote Display | 2 Line x 16 Character Display - Backlit | |

Features and Benefits

Dynamic Menu System

You see only the menu options pertinent to your application. The initial “Set up level, ...” menu takes you through a basic setup to get your instrument up and running quickly. Help screens are available at appropriate points.

Built-in Volume Measurement

Select one of the pre-defined tank shapes, enter its dimensions, and the gauge computes volume from an internal equation library. Alternately, you can define volume as a polynomial expression based on the level (height) or as a break table of volume and height value pairs.

Instantaneous Response

TN Technologies Dynamic Process Tracking™ (DPT) ensures no lag time in the system response to level changes. When sudden process changes occur, the DPT feature reduces the normal averaging time constant by a factor of eight, ensuring a smooth and rapid output response. When the process stabilizes, the longer time constant is applied to reduce spurious fluctuations in the measurement. In this way, actual changes in process level are immediately reflected in the transmitter output, while the effects of signal variations from turbulence and other short term factors on the measurement are greatly reduced.

Extensive Alarms

You can set up as many as 16 process alarms in addition to system fault alarms and warning alarms.

Quick and Easy Setup

The menus take you through the setup procedure step-by-step. Built-in help screens are provided at appropriate points in the menu structure.

Multiple Readouts

You can select up to six of the following values for display: level, distance, volume, unfilled volume, percent full, percent empty, percent distance, percent level, signal strength, or alarm relay status. The screen automatically displays the measurement values three at a time in alternation. The measurement values can also be sent to a remote terminal or a computer.

Marker Sweep Software

TN Technologies' patented Marker Sweep software continually adjusts the transmitter output signal to maintain linearity. This highly consistent microwave signal ensures reliable, stable system operation and accurate level measurements.

Digital Signal Processing (DSP)

The gauge uses DSP hardware and software to process the received microwave signal (the echo) and to provide accurate, real-time measurements of the distance to the surface of the process material.

How the Accu-Wave Works

The sensor generates a microwave signal composed of electromagnetic waves – two perpendicular oscillating fields (electric and magnetic) that travel together. The transmitted signal is reflected from the surface of the process material. This echo is detected and evaluated for changes in frequency to determine the distance to the liquid or solid material in the tank.

The Marker Sweep software continually adjusts the signal output to maintain the linearity of the transmitted frequency sweep. This highly consistent microwave signal ensures that changes in level are reported accurately in real-time. Dynamic Process Tracking software ensures quick system response to changing process levels by automatically reducing the response time when level changes occur. A variety of tools are provided in the menus to “fine tune” the signal in order to eliminate many of the problems associated with measuring levels in an active process.

TN's exclusive DSP software processes the microwave signal and converts it to measurement information displayed in the readout. You can also program measurements to drive alarms, or open and close switches. The alarms, user inputs, and selected outputs are saved in non-volatile memory.

Automatic verification and error correction software continuously monitors system operations. System faults can be programmed to set off alarms.

How to Use This Manual

This manual provides installation and maintenance/troubleshooting procedures for the Accu-Wave gauge.

Installation and Maintenance

Note: Reduced-size copies of the drawings referenced in this manual are included in .

Chapter 2, “Hardware Installation,” provides instructions for mounting the Accu-Wave sensor and transmitter.

Chapter 3, “Wiring Procedures,” describes how to wire the power source to the gauge and other wiring, such as the current output and serial communications.

Additional Information

Appendix A, “How to Return Equipment for Service,” gives you shipping information for returning equipment to TN Technologies for service.

Appendix B, “Parts List,” lists the parts of the Accu-Wave. Refer to this list if you need to order parts.

Appendix C, “Specifications,” contains the specifications for the Accu-Wave.

Appendix D, “Installation Drawings,” contains reduced-size copies of the drawings referenced in this manual.

Setting Up and Using the Gauge

The companion manual “Accu-Wave Operation Manual” (717791) provides detailed information on how to set up the Accu-Wave software and operate the Accu-Wave gauge.

TN Technologies’ Service Department

The TN Technical Services Department is available to help you with any problems you may have installing or operating your gauge. Call us with your questions or comments:

- Phone: (800) 736-0801 (US only)
- Main Office: (512) 388-9100
- FAX: (512) 388-9200

Chapter 2 Hardware Installation

Licensing

All microwave frequency tuning is completed at the factory (TN Technologies Inc., Round Rock, Texas).

United States

For installations on metal tanks, the Accu-Wave complies with FCC Part 15 requirements, FCC ID MCO1440-15, and no additional licensing is required (Part 15 certification is pending)

Note:

Operation under Part 15 of the FCC Rules is subject to the two following conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For installations other than on metal tanks, you must obtain and display a FCC Part 90 license at the installation site, FCC ID MCO1440 (Part 90 certification is pending). TN Technologies can assist you with licensing. For assistance, call or fax one of the following numbers:

- Phone: (800) 736-0801 (US only)
- Main Office: (512) 388-9100
- FAX: (512) 388-9200

Canada

- (i) **This device shall be installed and operated in a completely enclosed metal container to prevent RF emission which otherwise can interfere with aeronautical navigation. Installation shall be done by trained installers, in strict compliance with the manufacturer's instructions.**
- (ii) **The user of this device is on a "no-protection non-interference" basis. That is, the user shall accept Government and NAV CANADA operations of high powered radar in the same frequency band which may interfere with this device. Devices found to interfere with Government and NAV CANADA operations will be required to be removed.**
- (iii) **The user is required to notify the TN Technologies at 2555 N. IH 35, Round Rock, TX, 78680 of the postal address of the user, the address where the device is installed, the device model number, and the date of installation.**

Hazardous Location Approvals

The Accu-Wave is certified for use in hazardous locations as follows (approvals are pending as of 1 March 2000):

FM

- Class I, II, III, Division 1, Groups B, C, D, E, F, G
- Class I, II, III, Division 2, Groups B, C, D, F, G
- NEMA 4X

CSA

- Class I, II, III, Division 1, Groups B, C, D, E, F, G
- Class I, II, III, Division 2, Groups B, C, D, E, F, G
- TYPE 4X

CENELEC

- EEx d IIB + H₂
- Eex n IIB + H₂

Warning: Do not locate the unit in any hazardous area other than those approved. Follow all instructions on the installation drawings.

Do not apply power to the unit in any hazardous area unless the safety ground is properly wired inside the unit and the cover is properly installed. See Chapter 3 for installation wiring instructions.

Hazardous Location Installations: The cable entries must be sealed per the Installation Layout Drawing (868502).

Non-Hazardous Location Installations: The cable entries into the enclosure must be sealed with a compound to protect against the passage of gas or vapors. The sealing compound should not be affected by the surrounding atmosphere or liquids. The minimum thickness of the sealing compound should be 5/8 in (16 mm).

Selecting a Location

Selecting a good location to mount the transmitter can ensure the accuracy and ease of operation of your gauge.

Guidelines

Follow these guidelines when selecting a location for the Accu-Wave gauge:

1. The operating temperature range is -40°C to 70°C (-40°F to 158°F).
2. The sensor should be mounted above the smoothest portion of the process material surface.

3. There should be a clear path between the sensor and process material to avoid false reflections. Verify that the path is clear of pipes, beams, or any intermittent liquid sprays that could block the microwave beam. Also try to locate the sensor to keep the beam path (approximately 18° wide) clear of the following:
 - Turbulence, splashing, or waves such as those caused by filling, recirculation, or sparging of light material entrances near the bottom of the tank.
 - Pipe entrances near the top or side of the tank.
 - Agitator blade passing directly through the beam path. If this can not be avoided, use the “agitator reject time” feature on the “Radar fine tuning” menu, discussed in the Accu-Wave Operation Manual (717791).
 - Vortices caused by baffles, drains, or any other obstructions.
4. The mounting location should also avoid horizontal structural surfaces such as baffle support brackets, side wall joints, and so forth, because these surfaces reflect a strong false signal. If this cannot be avoided, refer to the section “False Echo Management” in Chapter 5 of the Operation Manual (717791).
5. If the vessel has a dome top, a good guideline is to mount the sensor away from the vessel’s center point by at least 10% of the vessel diameter.

Note: If the sensor is mounted in the center of the vessel, the dome top will act as a parabolic antenna, potentially enhancing “false” echoes due to multiple reflections of the transmitted energy.

The tank’s nozzle must meet the following requirements.

1. Rod antennas: the internal diameter of the nozzle must be larger than 1 inch. For best performance, the bottom of the stainless steel waveguide tube must be even with the bottom of the nozzle or extend below the bottom of the nozzle.
2. Intrusive horn antennas: the internal diameter must exceed the horn diameter (3, 4, 6, or 8 inches). The nozzle must be free of burrs and other obstructions.
3. Process isolation horn antennas: The internal diameter of the nozzle section needs to be the same along the length of the nozzle. The nozzle must be free of weld beads, steps, burrs, or abrupt changes in nozzle diameter.
4. Nozzle must meet or exceed tank pressure requirements.
5. Align nozzle within 3° of vertical (verify this with a carpenter’s combination level). Flange surface must be aligned within 3° of horizontal (verify this with a carpenter’s combination level).

Dimensional Drawings

Refer to the appropriate drawings for the sensor mounting dimensions:

- Rod Antennas – refer to drawing 868656.
- Horn Antennas – refer to drawing TBD (future option).

Reduced-size copies of the drawings are provided in Appendix D.

Mounting the Gauge

When mounting the gauge, ensure there are no obstructions between the antenna and the surface of the process material. If obstructions cannot be avoided, refer to “False Echo Management” in the Accu-Wave Operation Manual (717791).

Caution: Use proper lifting procedures to avoid injury.

Rod Antenna

1 Inch NPT Bushing Mounting

To mount a gauge with the 1 inch NPT bushing mounting option, simply screw the threaded bushing into the corresponding fitting on the tank.

Note: Do not apply force to the housing to tighten the bushing. Use a wrench on the hexagonal portion (1 3/8 in.) of the bushing.

Mount the gauge to the tank before attaching any wires or conduits.

Flange Mounting Instructions

You need the following (supplied by the customer):

1. 1 gasket suitable for the process material
2. 16 steel washers
3. 8 nuts and bolts
150 lb flange – use 5/8 inch hardware
300 lb flange – use 3/4 inch hardware

Refer to dimensional drawing 868656. Follow these steps to mount the gauge.

1. Center the gasket, suitable for your process material, on the nozzle flange.
2. Slide the antenna into the opening. Center the sensor flange on the gasket and line up the bolt holes in the sensor flange and the nozzle flange.
3. Install the bolts and washers, and attach the nuts. Tighten the bolts in a star-patterned sequence to equalize compression.

Chapter 3 Wiring Procedures

The Accu-Wave electronics includes the following boards.

- Main Electronics Board
- RS-232 daughter board (optional).
- Hart Communications daughter board (future option).

The required wiring steps are:

- connect 24 Vdc power supply to the gauge, and
- connect a remote computer terminal or Hand Held Terminal to the gauge via the serial communication port.

Additional, optional wiring may include:

- 4-20 mA current output,
- contact closure input, or
- optional, remote display (2 line x 16 characters).

Caution: Remove all power from the unit before making any connections.

WARNING: All wiring must be done by qualified individuals in accordance with applicable codes such as the NEC (National Electric Code) ANSI/NFPA 70 specifications or the Canadian Electrical Code Part 1.

Initial Wiring Preparations

Warning: Do not apply power to the unit in any hazardous area unless the safety ground is properly wired inside the unit and the cover is properly installed.

Hazardous Location Installations – The cable entries must be sealed per the Installation Layout Drawing (868502).

Non-Hazardous Location Installations – The cable entries into the enclosures must be sealed to prevent passage of gas or vapors. The sealing compound should not be affected by the surrounding atmosphere or liquids. The minimum thickness of the sealing compound should be 5/8 in (16 mm).

If metal conduit is used, the conduit must be grounded.

Caution: Insulate the drain wire to eliminate ground loops.

Caution: CSA certified fittings must be used to maintain CSA rating for enclosure.

Wiring Instructions

You will need a 1/8 inch bladed screwdriver to connect the wires to the plug-in connector.

Refer to the Installation Layout drawing 868637 and Wiring diagram 868641. Follow all notes on the drawings.

To wire the gauge:

1. Loosen the retaining screw at the base of the enclosure lid, then unscrew and remove the enclosure lid.
2. Pull the cable(s) through the conduit opening(s) in the enclosure.
3. Connect the power cable ground to the internal ground on the bracket (the bracket is grounded to the enclosure).
4. Remove the plug-in screw-terminal connector from the board. Loosen the terminal screws. Insert the wires and make connections as shown in the appropriate installation wiring diagram. Tighten the screws in the plug-in connector to secure the wires. Replace the connector on the board when all wires are secured.
5. Screw the enclosure lid back onto the housing and tighten the retaining screw.

DC Power Wiring

The Accu-Wave is designed to operate on 24 Vdc \pm 25%. The maximum input power requirement is 12 W. As shown in this wiring diagram (868641), to connect DC power to the main board:

1. Connect +24 Vdc to Pin 1 of the J1 connector, and
2. Connect the return for the +24 Vdc supply to Pin 2 of the J1 connector.

Note: To meet the requirements of CSA 1010.1, the input DC terminals shall be supplied from an SELV (Safety Extra Low Voltage) source. In addition, protective bonding (grounding) must always be provided.

4-20 mA Current Output

The current output range is programmable (refer to the Accu-Wave Operation Manual). The maximum range is 0.4 to 20 mA and the default range is 4 to 20 mA.

Isolated, loop-powered, nominal voltage requirement is 24 Vdc for a 700 Ω load. As indicated in the Wiring Diagram (868641), connect the +24 Vdc input to Pin 7 of the J1 connector on the main board.

Contact Closure Input

The contact switch input is dry contact input between ground and switch closed position.

Serial Communications

The gauge provides an RS-485 multi-drop serial interface port. An RS-232 single-drop is available with the optional RS-232 daughter board. Both ports provide independent access to the measurements and software functions. The ports can be used simultaneously.

The RS-485 port can communicate with a PC running the Accu-Wave Setup Software, a PC running a terminal emulation program, TN Technologies' Hand-Held Terminal, ANSI terminals, or VT100 terminals.

The RS-232 port can connect directly to a PC serial (COM) port using a serial cable.

Note: In order to communicate with a PC via the RS-485 port, an RS-485 to RS-232 converter (TN part No. 885960) is required.

Appendix A How to Return Equipment for Service

Call the TN Technical Services Department (Factory Service division) before returning equipment for repair. Many problems can be diagnosed and resolved over the phone. For after hours or weekend service, call our 24-hour Service number: 512-388-9320.

Please include the following information with all units returned for repair:

1. Specific information about the problem.
2. A point-of-contact name and phone number, in case we need more information.
3. A purchase order authorizing repairs, or a request for a quote.
4. Ship prepaid to the address below:

Factory Service Department
TN Technologies
2555 North IH 35
Round Rock, Texas 78664

The Receiving Department will not accept collect shipments.

Do not ship to our P. O. Box.

Appendix B Parts List

| Part No. | Description |
|-----------------|---------------------------------|
| 886639 | Main Electronics Board |
| 886641 | RS-232 Daughter Board (option) |
| | Windows Set-up Software (CDROM) |
| 717790 | Installation Manual |
| 717791 | Operation Manual |
| 885960 | RS-485 to RS-232 converter |

Appendix C Specifications

Operating Principle

Frequency modulated continuous wave (FMCW) radar signal which measures distance; microprocessor based transmitter computes level, volume and nine other measurements.

Range

Up to 115 ft. (35 m.)

Reference Accuracy

±3 mm (1/8 in.)

Repeatability

±3 mm (1/8 in.)

Input Power

24 Vdc ±25%, 12 W

Serial Outputs & Inputs

RS-485 (Standard): Half duplex partyline communication to a host computer or hand-held terminal.

RS-232 (Optional): Full duplex communication with a remote terminal, printer, PC or host computer.

Current Output

4 to 20 mA, isolated, loop-powered (24 Vdc). Maximum load – 700 ohms. Compliant with NAMUR 43 specification for fault current.

Contact Closure Input

1 contact closure input provided. (User provides switch.)

Circuit Protection

Meets IEC 801-1,-2, and -3

Current output is isolated.

Microwave Emissions

In compliance with ANSI C95.1, “RF Field Exposure Safety Guidelines”

Dimensions

Refer to Dimensional Drawings

Rod Antenna: D868217

Horn Antenna: TBD

Weight

Rod Antenna: ~15 lbs.

Horn Antenna: TBD.

Temperature Range (Electronics)

-40° C to +70°C (-40° F to +158° F)

Pressure

Rod Antenna

PP 600 psig. max.

PTFE 300 psig. max.

Exposed Materials (Process)

Rod Antenna

SS316 and Polypropylene, or

SS316, PTFE, and O-ring material.

Horn Antenna

TBD

Mounting

Rod Antenna

1 inch NPT bushing, or

Welded flange (150/300 lb.; 2, 3, 4, 6 inch)

Horn Antenna

TBD

Hazardous Location Approvals

FM

Class I, II, III, Division 1, Groups B, C, D, E, F, G

Class I, II, III, Division 2, Groups B, C, D, F, G

NEMA 4X

CSA

Class I, II, III, Division 1, Groups B, C, D, E, F, G

Class I, II, III, Division 2, Groups B, C, D, E, F, G

TYPE 4X

CENELEC

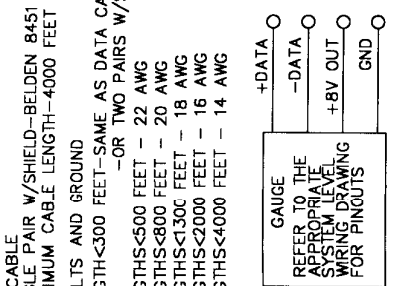
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Eex n IIB + H₂

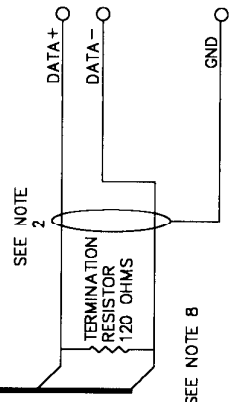
Appendix D Installation Drawings

This Appendix contains reduced size copies of the drawings referenced in this manual. The drawings are provided in the order listed below.

1. SYSTEM CAN ACCOMMODATE UP TO 32 UNITS WITHOUT REPEATER. UNITS CAN BE ANY COMBINATION OF GAUGE, RS-485 TO RS-232 CONVERTERS AND HAND-HELD TERMINALS.
2. SUGGESTED CABLE:
 - DATA CABLE
 - SINGLE PAIR W/SHIELD-BELDEN 8451 (TN P/N 761360)
 - MAXIMUM CABLE LENGTH-4000 FEET
 - +8 VOLTS AND GROUND
 - LENGTH<300 FEET-SAME AS DATA CABLE
 - OR TWO PAIRS W/SHIELD (BELDON 9770)
 - LENGTHS<500 FEET - 22 AWG
 - LENGTHS<600 FEET - 20 AWG
 - LENGTHS<1300 FEET - 18 AWG
 - LENGTHS<2000 FEET - 16 AWG
 - LENGTHS<4000 FEET - 14 AWG

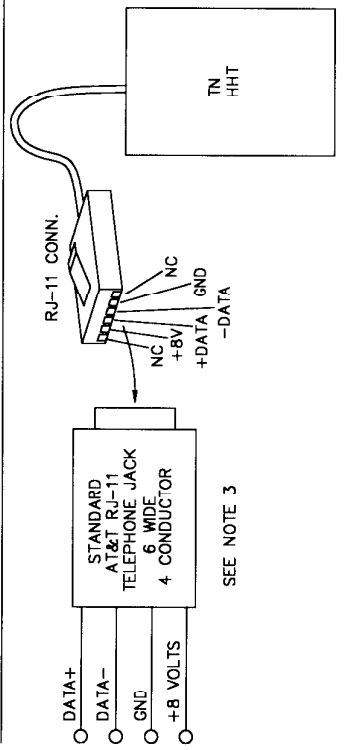
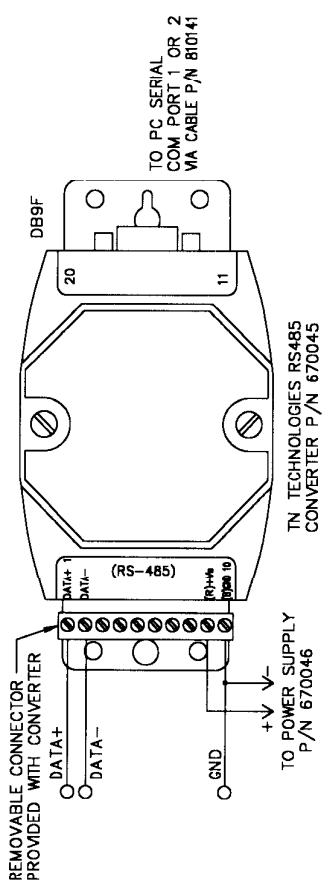


THREE UNITS SHOWN FOR CLARITY.



- TN SUPPLIED
 - CUSTOMER SUPPLIED
- ALL UNITS ARE CONNECTED IN PARALLEL. 32 UNITS MAXIMUM.

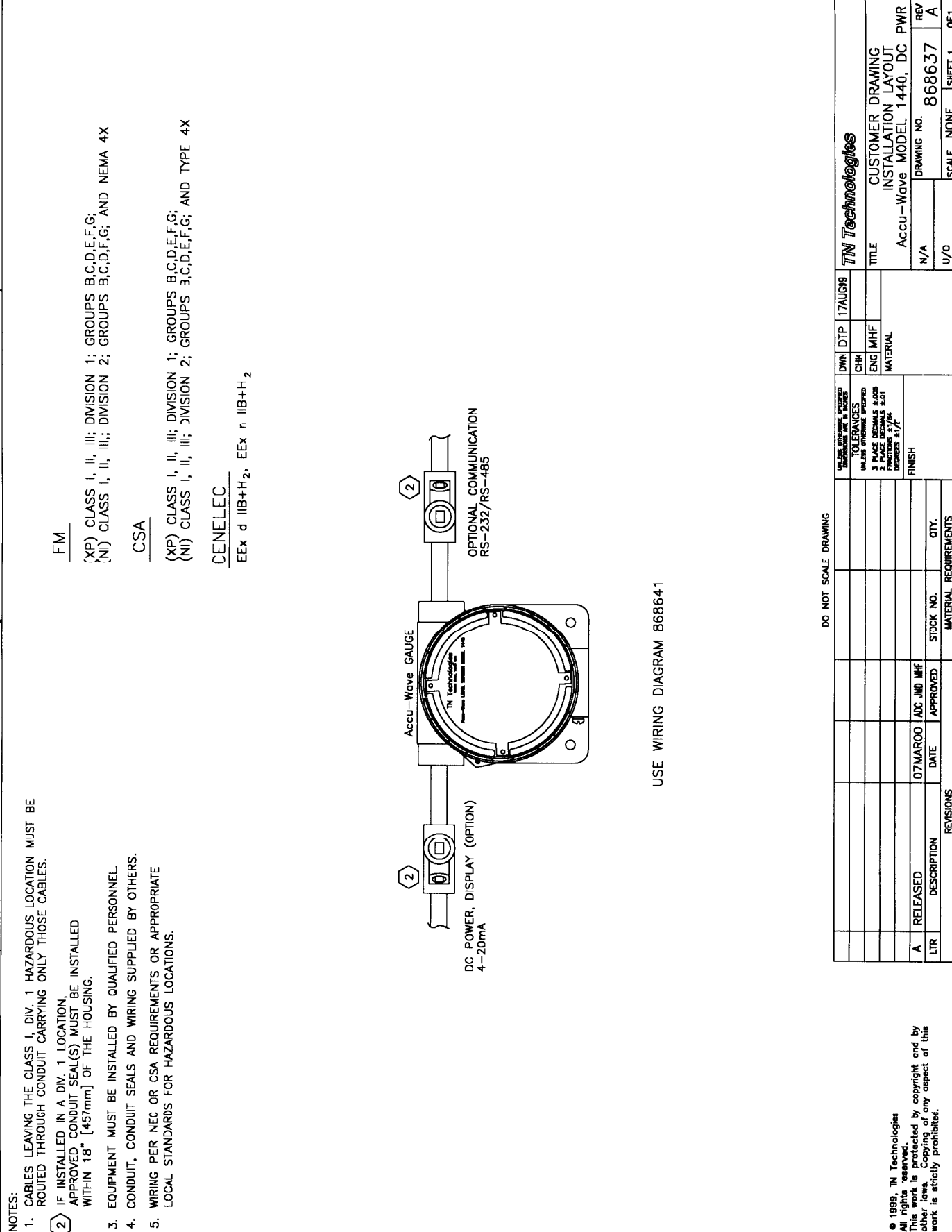
3. TN HAND-HELD TERMINALS REQUIRE ADDITIONAL WIRES AS SHOWN TO SUPPLY +8 VOLTS AND GND. THESE SHOULD BE CONNECTED TO A GAUGE WHICH WILL REMAIN POWERED AT ALL TIMES WHEN SYSTEM IS IN USE AS ALL COMMUNICATIONS WILL BE LOST WHEN THE GAUGE SUPPLYING THE +8 VOLTS IS TURNED OFF. ALL OTHER GAUGES MAY BE TURNED ON AND OFF AS DESIRED WITHOUT AFFECTING THE SYSTEM COMMUNICATIONS STATUS. DO NOT MAKE CONNECTIONS TO THE +8 VOLT TERMINAL ON THE OTHER GAUGES IN THE SYSTEM, OR ATTEMPT TO PARALLEL THE +8 VOLT TERMINALS AS DAMAGE MAY RESULT.
4. GAUGE TERMINAL BLOCKS ARE DESIGNED TO ACCEPT ONLY 1 WIRE PER TERMINAL. MULTIPLE WIRES, TERMINATION RESISTORS, ETC MUST BE CONNECTED SEPARATELY.
5. CLASS II WIRING ACCEPTABLE. MAXIMUM VOLTAGE ON COMMUNICATIONS BUSS IS 10 VOLTS.
6. COMMUNICATIONS BUSS TO BE TERMINATED AT EACH END AS SHOWN WITH 120 OHM 1/4 WATT RESISTORS. A TOTAL OF TWO RESISTORS IS REQUIRED.
7. FOR DETAILS REGARDING GAUGE COMMUNICATIONS, SEE MANUAL.
8. SHIELD GND OPTIONAL FOR RS-485 TO RS232 CONVERTER.



| | | | | | |
|--------------------------------|-----|--------------|--|---------------|--|
| DWG | | DTP | | 27FEB98 | |
| CHK | ENG | MHF | | | |
| TITLE | | | | | |
| RS-485 | | | | | |
| INSTALLATION & WIRING | | | | | |
| NORMAL DIMENSIONS | | | | | |
| INCHES 1/16 (1mm .01) | | | | | |
| EXCEPT HOLE CENTERS 1/32 (.01) | | | | | |
| ECO 6925 | | 30AUG98 | | EB KS | |
| A RELEASED | | 15APR98 | | JAC | |
| LTR | | DESCRIPTION | | DATE APPROVED | |
| REVISIONS | | SYSTEMS | | LIBS. | |
| REV | | DRAWING NO. | | 868519 | |
| SCALE | | SHEET 1 OF 1 | | B | |

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4 3 2 1



USE WIRING DIAGRAM 868641

D C B A

- NOTES:
1. CABLES LEAVING THE CLASS I, DIV. 1 HAZARDOUS LOCATION MUST BE ROUTED THROUGH CONDUIT CARRYING ONLY THOSE CABLES.
 - 2 IF INSTALLED IN A DIV. 1 LOCATION, APPROVED CONDUIT SEAL(S) MUST BE INSTALLED WITHIN 18" [457mm] OF THE HOUSING.
 3. EQUIPMENT MUST BE INSTALLED BY QUALIFIED PERSONNEL.
 4. CONDUIT, CONDUIT SEALS AND WIRING SUPPLIED BY OTHERS.
 5. WIRING PER NEC OR CSA REQUIREMENTS OR APPROPRIATE LOCAL STANDARDS FOR HAZARDOUS LOCATIONS.

FM

(XP) CLASS I, II, III; DIVISION 1; GROUPS B,C,D,E,F,G;
(NI) CLASS I, II, III; DIVISION 2; GROUPS B,C,D,E,F,G; AND NEMA 4X

CSA

(XP) CLASS I, II, III; DIVISION 1; GROUPS B,C,D,E,F,G;
(NI) CLASS I, II, III; DIVISION 2; GROUPS B,C,D,E,F,G; AND TYPE 4X

CENELEC

EEx d IIB+H₂, EEx r IIB+H₂

DO NOT SCALE DRAWING

| | | | | | | | | | | | |
|-----------|-------------|-----------------------|-------------|-----------|------------------------|----------|-----|---------|--|-----------------|------------------------------|
| REVISIONS | | MATERIAL REQUIREMENTS | | FINISH | | DWN DTP | | 17AUG98 | | TN Technologies | |
| A | RELEASED | 07MAR00 | ADC JMD MHF | 3 | PLATE DIMENSIONS ±.005 | ENG MHF | CHK | | | | CUSTOMER DRAWING |
| LTR | DESCRIPTION | DATE | APPROVED | STOCK NO. | FRACCTIONS ±1/64 | MATERIAL | | | | | INSTALLATION LAYOUT |
| | | | | | DIMENSIONS ±1/8" | | | | | | Accu-Wave MODEL 1440, DC PWR |
| | | | | | | | | | | | N/A |
| | | | | | | | | | | | DRAWING NO. 868637 |
| | | | | | | | | | | | U/O |
| | | | | | | | | | | | SCALE NONE |
| | | | | | | | | | | | SHEET 1 |
| | | | | | | | | | | | OF 1 |

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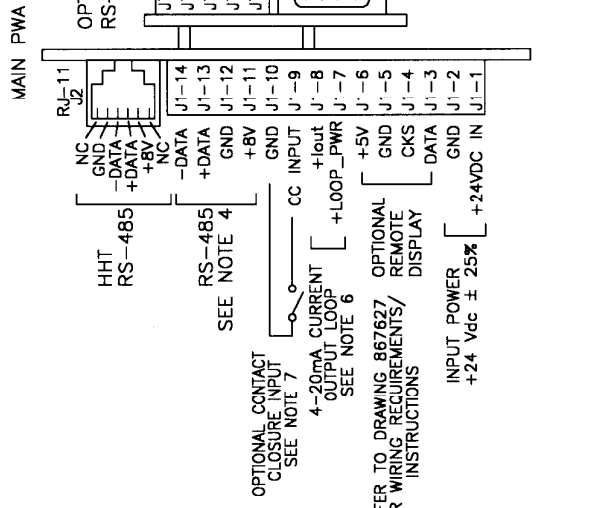
D C B A

NOTES:

- INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 AND THE NEC ANSI/NFPA 70, OR (CANADA) ACCORDING TO THE APPLICABLE REQUIREMENTS OF THE CANADIAN ELECTRICAL CODE PART 1.
- USE 22-16 AWG WIRE WITH A MINIMUM INSULATION RATING OF 85°C.
- NON-HAZARDOUS LOCATIONS:
THE CABLE ENTRIES INTO THE ENCLOSURE MUST BE SEALED WITH A COMPOUND TO PROTECT AGAINST THE PASSAGE OF GAS OR VAPORS. THE COMPOUND SHOULD NOT BE AFFECTED BY SURROUNDING ATMOSPHERE OR LIQUIDS. THE MINIMUM THICKNESS OF THE SEALING COMPOUND SHOULD BE 5/8" (16mm).
- HAZARDOUS LOCATIONS:
THE CABLE ENTRIES INTO THE ENCLOSURE MUST BE SEALED PER THE INSTALLATION LAYOUT DRAWING (DRAWING NO. 868637).
RS-485 WIRING INSTRUCTIONS
THE RS-485 PORT IS NORMALLY USED TO SETUP THE GAUGE.
THE RS-485 WIRING SHOULD BE ROUTED TO AN ACCESSIBLE NON-HAZARDOUS LOCATION FOR USER CONVENIENCE.
REFER TO DRAWING NO. 868519 FOR RS-485 WIRING INSTRUCTIONS.
IN NON-HAZARDOUS AREAS, THE TN MODEL 9733 HAND HELD TERMINAL CAN BE CONNECTED DIRECTLY TO THE RJ-11 PHONE JACK (J2).
IN HAZARDOUS LOCATIONS, THE MODEL 9733 HAND HELD TERMINAL CAN BE CONNECTED TO THE GAUGE VIA THE MODEL 9721 SAFETY BARRIER.
REFER TO MANUAL 717684 FOR DETAILS.
- RS-232 WIRING (OPTIONAL RS-232 BOARD)
A STANDARD 9-PIN (DB9) SERIAL EXTENSION CABLE CAN BE USED TO CONNECT FROM JB ON THE OPTIONAL RS-232 BOARD DIRECTLY TO A PC SERIAL (COM) PORT IN NON-HAZARDOUS LOCATIONS. THE MAXIMUM RECOMMENDED CABLE LENGTH FOR RS-232 COMMUNICATIONS IS 50 FEET.
- 4-20mA CURRENT OUTPUT
USER SUPPLIES +24VDC TO J1-7,
MAX USER LOAD IS 700 OHMS.

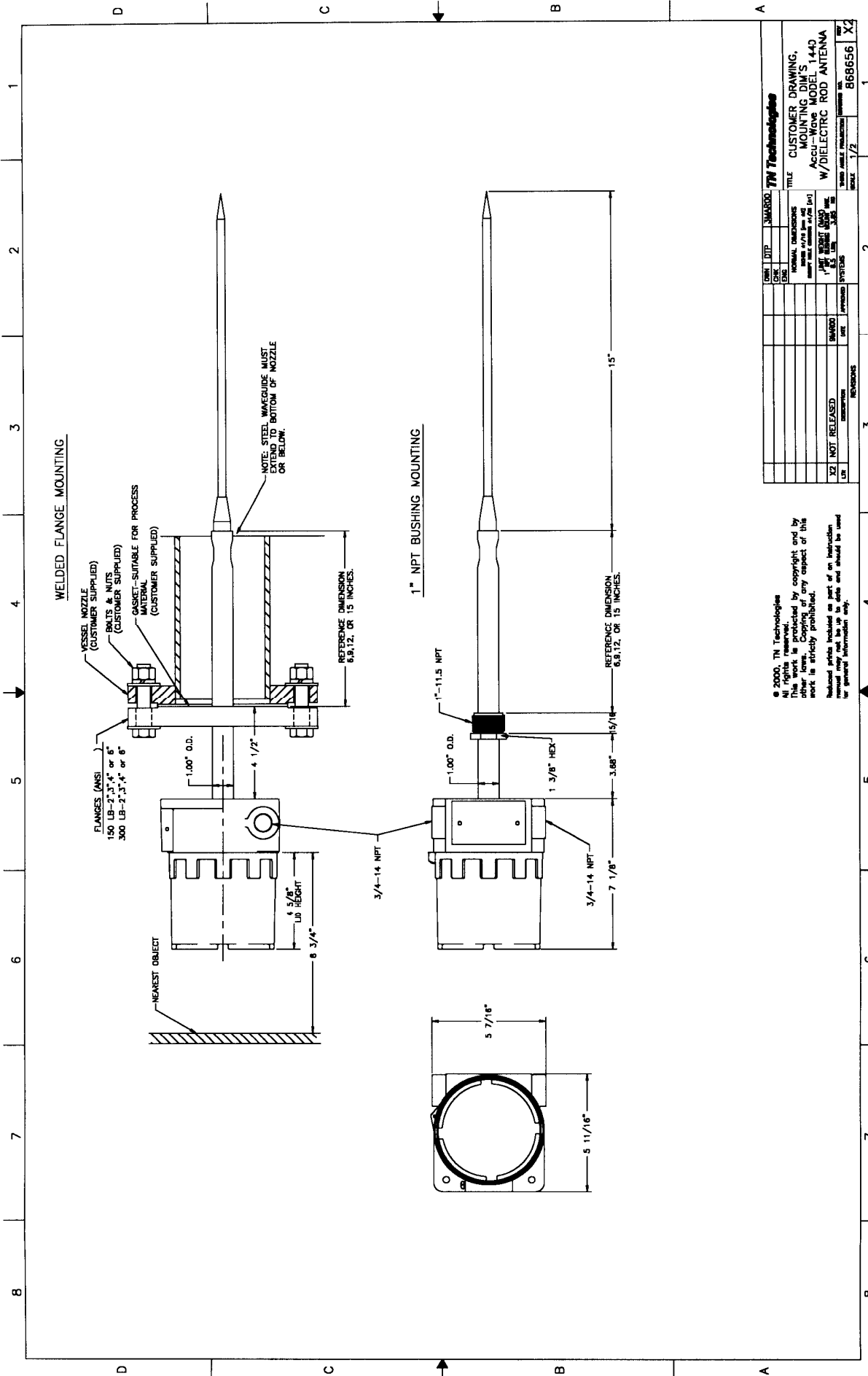
- CONTACT CLOSURE INPUT.
THE SOFTWARE CAN BE USED TO CONFIGURE THE GAUGE TO EXECUTE A COMMAND UPON RECEIVING A CONTACT CLOSURE/OPENING.
CLOSURE RESISTANCE <1K OHM
OPENING RESISTANCE >200K OHM
(SEE MANUAL FOR A LIST OF COMMAND OPTIONS)

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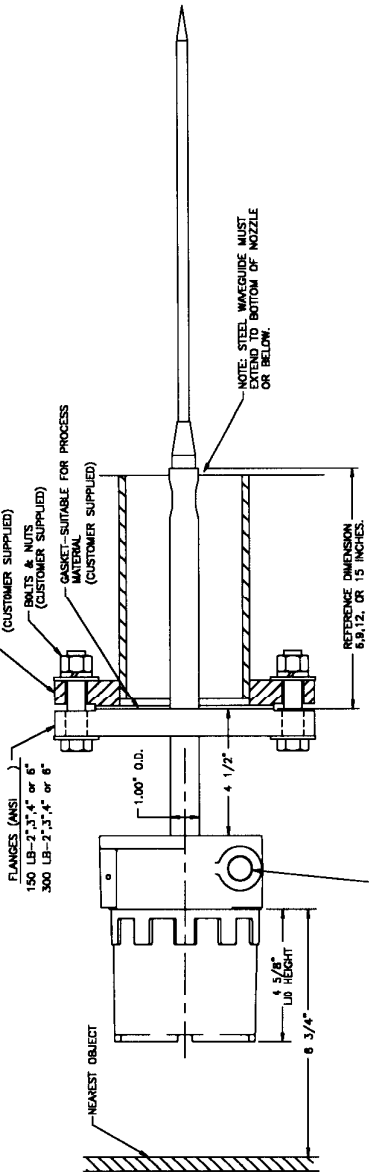


DO NOT SCALE DRAWING

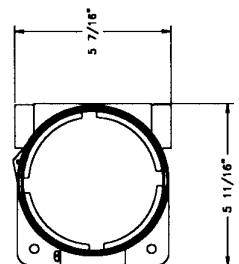
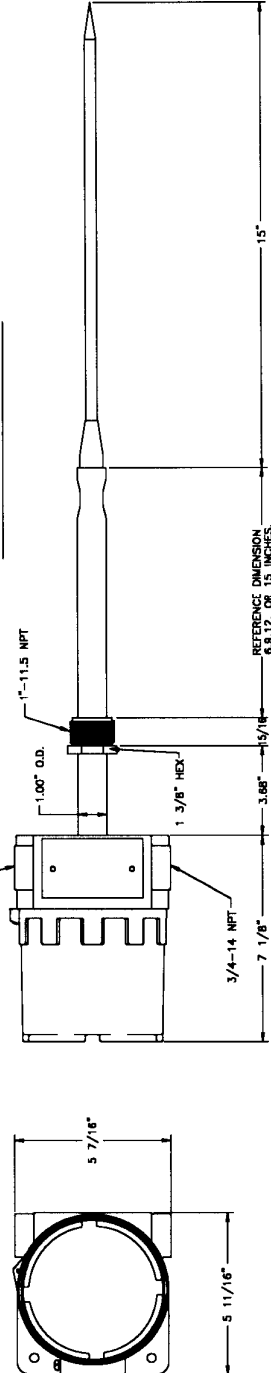
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|---|--|-----------------------|-----|----------------------------------|-----------------|--|
| UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES | | DWN | DTP | 16NOV99 | TN Technologies | |
| TOLERANCES UNLESS OTHERWISE SPECIFIED | | CHK | ENG | MHF | TITLE | |
| 3 PLACE DECIMALS ±.005 | | MATERIAL | | MODEL 1440 Accu-Wave LEVEL GAUGE | | |
| 2 PLACE DECIMALS ±.01 | | FINISH | | DRAWING NO. 868641 | | |
| FRACTIONS ±1/64 | | MATERIAL REQUIREMENTS | | SCALE NONE | | |
| DEGREES ±1/2 | | QTY. | | REV B | | |
| STOCK NO. | | APPROVED | | U/O 1440 | | |
| DATE | | MATERIAL REQUIREMENTS | | SHEET 1 OF 1 | | |
| REVISIONS | | REV B | | REV B | | |
| ECO PENDING | | 13MAR00 | | REV B | | |
| RELEASED | | 7MAR00 | | REV B | | |
| DESCRIPTION | | ADC MHF EB | | REV B | | |



WELDED FLANGE MOUNTING



1" NPT BUSHING MOUNTING



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| REV | DTP | DATE | BY | DESCRIPTION |
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| | |
|------------|----------|
| DWG NO. | 300000 |
| REV | |
| DATE | 10/20/00 |
| BY | SKB |
| CHECKED BY | SKB |
| DATE | 10/20/00 |
| PROJECT | 868656 |
| DWG NO. | |
| REV | |
| DATE | |
| BY | |
| CHECKED BY | |
| DATE | |
| PROJECT | |

TN Technologies
 TITLE
 CUSTOMER DRAWING,
 MOUNTING DIM'S
 ACCU-WAVE MODEL 1440
 W/DIELECTRIC ROD ANTENNA
 1 3/8" HEX
 1" NPT
 1.00" O.D.
 300 LB-2" 3/4" or 6"
 150 LB-2" 3/4" or 6"
 3.06"
 15 7/16"
 7 1/8"
 5 7/16"
 5 11/16"
 6 3/4"
 4 5/8" LB. HEIGHT
 4 1/2"
 1.00" O.D.
 3/4"-14 NPT
 1"-11.5 NPT
 1 3/8" HEX.
 3.06"
 15 7/16"
 REFERENCE DIMENSION 8.9, 12, OR 15 INCHES.
 REFERENCE DIMENSION 8.9, 12, OR 15 INCHES.
 REFERENCE DIMENSION 8.9, 12, OR 15 INCHES.
 NOTE: STEEL WAREGUIDE MUST EXTEND TO BOTTOM OF NOZZLE OR BELOW.
 GASKET-SUITABLE FOR PROCESS (CUSTOMER SUPPLIED)
 INTERIOR (CUSTOMER SUPPLIED)
 PARTS & NUTS (CUSTOMER SUPPLIED)
 VESSEL NOZZLE (CUSTOMER SUPPLIED)
 HEAREST OBJECT
 5 11/16"
 5 7/16"
 7 1/8"
 3 3/4"
 4 5/8" LB. HEIGHT
 3/4"-14 NPT
 1 3/8" HEX.
 3.06"
 15 7/16"
 REFERENCE DIMENSION 8.9, 12, OR 15 INCHES.
 1"-11.5 NPT
 REFERENCE DIMENSION 8.9, 12, OR 15 INCHES.
 1.00" O.D.
 4 1/2"
 1.00" O.D.
 FLANGES (ANSI)
 150 LB-2" 3/4" or 6"
 300 LB-2" 3/4" or 6"
 WELDED FLANGE MOUNTING
 1" NPT BUSHING MOUNTING