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AMCO Automated Systems
Remote Gas Meter Transponder
FCC ID: G8JVRT02
FCC Part 15.231
RTL WO# 2003164

APPENDIX H: MANUAL

Please see the following pages.

USER GUIDE

TRACE[®]

**VRT
Gas
Transponder**



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FCC Compliance

The TRACE VRT Transponder™ has been type accepted by the Federal Communications Commission under Part 15C, low power communication device transmitter.

This device complies with Part 15 rules. Operation is subject to the 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation distance between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by AMCO Automated Systems could void the user's authority to operate the equipment.

VRT Gas Transponder USER GUIDE

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Chapter One

Introduction

The TRACE® VRT™ Transponder is the heart of AMCO Automated Systems' portfolio of products for automated meter reading (AMR).

About this Document

The *VRT Gas Transponder User Guide* provides instructions for installing and troubleshooting transponders. It also includes an overview of both AMR in general and TRACE technology in particular.

Actual procedures are covered in two sets of chapters. One is set for direct mounted transponders (transponders connected directly to the meter index) and the other set is for remote-mounted transponders (transponders mounted some distance away from the meter index):

- Chapters 3 and 4 discuss the installation, operation and programming of direct-mounted transponders. These are typically used for residential applications with 1ft and 2 ft meters.
- Chapters 5 and 6 cover installation, operation and programming of remote-mounted transponders. These are typically used for commercial applications with 5 ft and 10 ft meters.

Audience

This document is designed for utility industry installers and supervisory staff. In order to establish appropriate levels of detail for the material, this document assumes the following:

- The user is proficient in installing and reading meters of the type currently compatible with TRACE transponders and possesses all the skills necessary to conduct meter installation and reading by conventional means.
- The user has little or no prior expertise in the TRACE AMR technology.
- The user is familiar with common data entry devices and techniques.
- The user will receive (or has received) instructions for operation of an appropriate TRACE interrogator/programmer elsewhere (in a separate document or training program).

Conventions

In the interest of brevity and simplicity, this document uses the following conventions:

- Additional information relevant to a given instruction step may be shown in one of three ways:
 1. A bulleted item covers “how-to” and verification information.
 2. *An italicized NOTE contains relevant background information.*
 3. *An italicized and bolded **CAUTION** contains information important to the safety of either the user or the equipment.*
- Where reference to other parties is made, the generic masculine pronouns (he, his, him) are used. This in no way reflects bias or gender discrimination in any manner related to the users, publishers or authors of this document.

Chapter Two

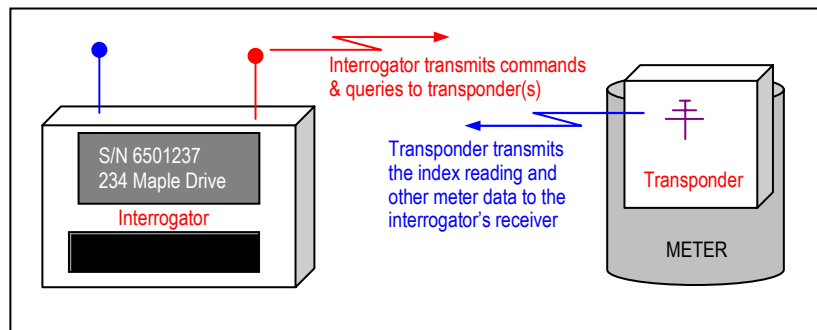
Automated Meter Reading Overview

The TRACE system uses radio frequency (RF) signals to allow utility personnel to read meters from a distance while the reader is in motion. This technology is called automated meter reading (AMR). This technology greatly increases the speed at which routes can be covered with a high degree of accuracy.

Basic AMR Components

An automated meter reading system requires the following basic components:

- **Transponder**—The VRT Gas Transponder interfaces with the meter index drive, counts the number of drive dial (proving dial) rotations, receives commands from an interrogator and transmits the index reading and other meter data.
- **Interrogator**—At its simplest, the interrogator remotely reads meter data transmitted by transponders. At more sophisticated levels an interrogator may also program transponders, store route data and verify transponder conditions and data, among other functions.
- **Antennas**—Both the transponder and the interrogator use antennas to broadcast and receive RF signals. The transponder's antenna is typically located on the circuit board inside the transponder housing. Some interrogators use external antennas (as shown in the illustration below), one for transmitting and one for receiving. Many handheld interrogators use a single antenna for both transmitting and receiving (antenna may be internal or external).



The interrogator sends out an RF signal to the desired transponders. Upon receiving an authorized command the transponder transmits its stored meter data.

TRACE AMR System Overview

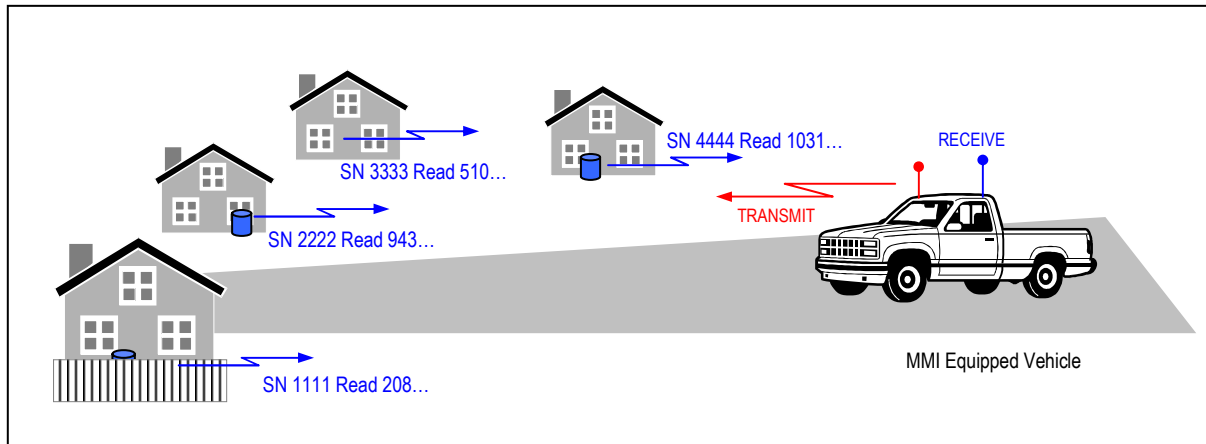
In addition to standard automated meter reading functions, AMCO Automated Systems TRACE system portfolio of products permits the remote recording of tamper conditions and the linking of meter latitude and longitude data using the Global Positioning System (GPS). With the optional Vehicle Interactive Display (VID), TRACE makes driver-to-meter orientation more intuitive and efficient.

TRACE interrogators transmit commands at 451.35 MHz and receive transponder messages at 415 MHz. (Transponders transmit at 415 MHz and receive at 451.35 MHz.)

VRT gas transponders, normally in a low power state, "wake up" and listen for an interrogation signal once every 1.5 seconds. Only if a transponder hears its unique serial number will it transmit data back to the interrogation device, after which it enters back into a low power state.

How the TRACE System Works

Utility personnel no longer have to walk up to each meter, look at its index and record its reading. Once VRT gas-meter transponders are installed on meters and programmed, meter readers simply walk or drive down each street in the route allowing the TRACE interrogator to request and record meter data automatically.



The interrogator addresses each transponder in the interrogation window individually. When the transponder "hears" its serial number, it transmits the current meter data. The TRACE system's frequency band allows remote reading of transponders even through walls and fences.

Acquisition of meter information begins with the transponder where data is stored and updated continuously for later retrieval by an interrogator. The acquired data from a given route can be transferred to a host computer via floppy disk for processing.

The information acquisition, storage and handling process includes several basic elements:

Meter interface. Using a mechanical-to-digital interface, the VRT gas transponder senses the output of a utility meter, translates this into electronic form and stores it in the transponder's memory.

Tamper sense and flagging. When the VRT gas transponder is installed and programmed, a baseline orientation for its internal tamper sense is set. Any deviation from that baseline setting will trigger a tamper indication.

Transponder data acquisition. The VRT gas transponder is programmed with a unique serial number at the time of manufacture. Upon installation on a meter, the current (or baseline) meter index reading is also programmed into the transponder's memory. As the meter measures consumption and the index is advanced, the index reading stored in the transponder's memory is automatically updated. The transponder also records changes to the tamper detection sensor.

Pressure-compensation factor. For VRT gas transponders using firmware version category 9 or higher, a pressure-compensation factor can also be programmed into the transponder memory ensuring the transponder readings match the pressure-compensated mechanical index reading.

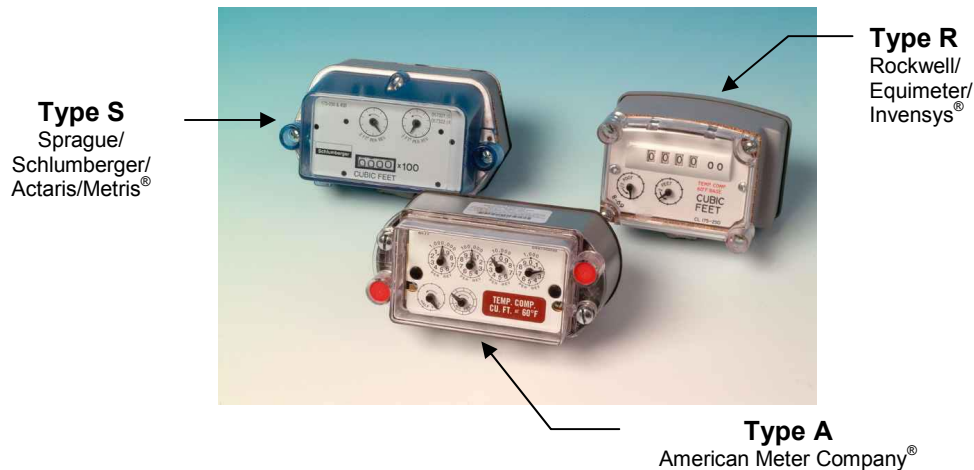
Route information loading. Route data includes transponder serial number, meter account address, and latitude/longitude coordinates (when available), among other items. This information is downloaded to the interrogator prior to commencing automated meter reading. By also tracking the vehicle or interrogator's coordinates, a GPS-equipped system determines which transponders in the route should lay within range at any given time and transmits those serial numbers requesting meter data.

Interrogation. Once placed in an interrogation mode by the meter reader, the TRACE interrogator transmits serial number(s) of the desired transponder(s) along with a command (or commands) requesting the contents of each transponder's memory. Transponders are selected for reading on the basis of route and meter location information stored in the interrogator and presence of the transponder within range of the interrogator.

Route data processing. Meter data from a transponder is stored in the interrogator's memory for transfer to the utility's host computer for processing. AMCO Automated Systems Route Manager software makes it easy for the utility to process route data and configure routes for AMR.

Chapter Three

VRT Direct Gas-meter Transponder Overview



The TRACE VRT™ Direct Gas-meter Transponder (DGT) is designed for use with most residential diaphragm meters. VRT Direct Gas-meter Transponders for residential meters are available in three distinct types:

- **Type A** = American Meter Company® products
- **Type R** = Rockwell / Equimeter / Invensys®
- **Type S** = Sprague / Schlumberger / Actaris / Metris®

The VRT DGT can be programmed for use with a fixed factor, pressure-compensated index.

The VRT DGT maintains the current time and date, which are used to manage the recording of real-time data for retrieval as required during the normal read cycle.

In addition to maintaining index reading, the transponder:

- Stores 35 daily index readings in separate electronic indexes recorded at the start of the utility day. (The utility day start time is programmable).
- Maintains up to four time-of-use (TOU) electronic indexes that each have programmable start and stop times.

VRT Direct Gas-meter Transponder and Components

The VRT Direct Gas-meter Transponder is available for three types of meters. The transponder has a high impact plastic housing with rubber gasket and it includes the following components:

- RF transmitter
- RF receiver
- Tamper switch
- Transmit and receive antennas
- Battery
- Electronic components

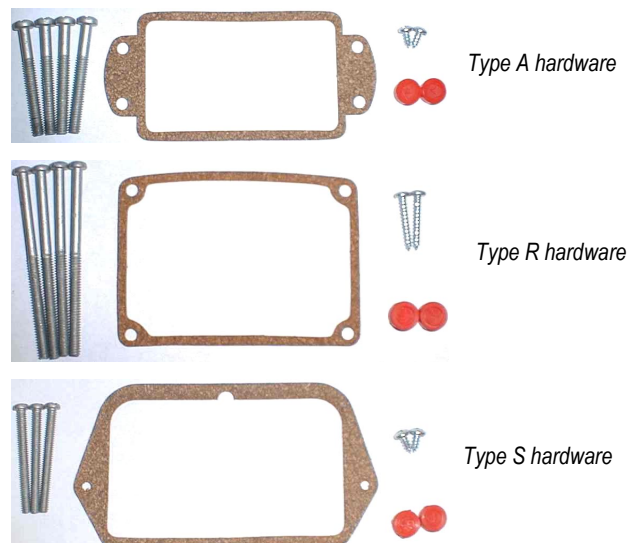
The meter's existing index and index cover are attached to the VRT gas-meter transponder during installation.

The index cover is not shipped with the standard transponder, but may be purchased separately, if needed. (See page 16)

Identifying the Components

To determine the transponder type for each meter, refer to the photo on the previous page.

Each shipment of transponders includes all of the hardware necessary to successfully install a transponder onto a meter. This hardware includes index screws to attach the index to the transponder, three or four longer bolts to attach the transponder/index assembly to the meter, two vandal plugs, and an index cover gasket as shown in the photos below. Index covers are sold separately.



This hardware can also be purchased separately.

VRT Direct Gas-meter Transponder H/W by Meter Type (and P/N)						
Meter Manufacturer	American (A)		Invensys/Rockwell (R)		Metris/Sprague (S)	
Index screw	52800P063	1	10528P002	2	52800P063	1
Meter mounting bolt	10529P001	3	10529P003	4	10529P002	5
Index cover gasket	11401P001	6	11401P002	7	11401P003	8
Vandal plug (tamper seal)	52548P010	---	11302P002	---	11302P003	---

Screws

The following photos indicate the actual size and shape of the different screws and index cover gaskets used.

**Index
Screws**



1
3/8" Sheet Metal
(A, S)



2
7/8" Sheet Metal
(R)

**Meter
Mounting
Bolts**



3
2 1/4" partial
thread
(A)



4
3" partial
thread
(R)



5
2" full
thread
(S)

**Index Cover
Gaskets**



6
Cork Index
Cover Gasket
(A)



7
Cork Index
Cover Gasket
(R)



8
Cork Index
Cover Gasket
(S)

How the VRT Direct Gas-meter Transponder Works

When a VRT DGT is installed on a meter the installer programs the mechanical index reading into the transponder.

Converting Mechanical Count into Electronic Form

During normal operation, the mechanical index accumulates its count. The transponder keeps track of the index reading by counting the number of rotations of the index's drive dial.

Storing Readings

Once a day, at a pre-programmed time specified by the utility, the transponder stores the current index reading into the electronic index for that day.

The transponder maintains daily reading history for the past 35 days.

Four time-of-use registers—each with programmable start and stop times—can accumulate consumption in separate electronic indexes as well.

Operation Cycle

To maximize battery life, the VRT gas-meter transponder changes from its normal, low-power quiescent state every 1.5 seconds into an intermediate power state for 2.5 milliseconds in order to perform three tasks:

- Update the electronic indexes for the meter reading, daily reading and time-of-use reading
- Poll the tamper detection switch
- Check to see if a valid interrogation signal is being received

If and when a valid interrogation signal is received, a two-way communication link is established.

Meter reading data is then transmitted to the interrogator.

Data collected by an interrogator is validated and stored for uploading to TRACE Route Manager VRT Software later.

VRT Direct Gas-meter Transponder Programmed Values

At the time of manufacture transponders are programmed with the current date, time of day, and other values as specified by the utility. Each type of data shown in the table below may be programmed/recorded at some or all of the following four stages:

1. **At the factory** during the manufacturing process
2. **At the time of installation** once the transponder has been attached to the meter
3. **In the field** as required by the utility
4. **During the course of normal transponder operation**

Columns showing a check mark (✓) indicate the data **must** be programmed at the given stage. The “+” indicates an optional reprogramming stage for this item. An X in the column indicates the data is not programmed during this stage.

Function/ Data	When Programmed/Recorded				Comment
	Factory	Install	Field	Ops	
1a. Initial electronic index reading	x	✓	+	x	User manually sets electronic index to current mechanical index.
1b. Record cumulative electronic index reading	x	x	x	✓	Transponder automatically reads counts and logs electronic index reading.
2. Current date	✓	+	+	x	Programmed at factory.
3. Current time	✓	+	+	x	Time of day for the time zone specified by the utility. Can be manually set/ reset or synchronized to the interrogator's real-time clock upon each reading.
4. Daily read capture time (History start time)	✓	+	+	x	Time of day at which the transponder will capture the daily read value.
5. Record Daily read history	x	x	x	✓	Read history accumulates daily, transponder stores up to 35 days of readings.
6. Time-of-use (TOU) start and end times (optional)	✓	+	+	x	Indicates the TOU time slots selected by the utility. Readings are accumulated between the specified start and stop times. (See TOU time slots table in Appendix)
7. Record Time-of-use (TOU) readings (optional)	x	x	x	✓	Accumulates counts in the TOU time slots.
8. Pre-divider	✓	+	+	x	Specifies the rollover of subcounts into counts.
9. Pressure- compensation factor	x	✓	+	x	User sets the proper pressure-compensation factor after transponder is installed. Transponder calculates adjustments to readings accordingly.
10. Next Daylight Savings Time Start Date	✓	+	+	x	This is the date Daylight Savings Time starts. If daylight savings time is observed, the initial settings are programmed at the time of manufacture. Updates to daylight savings time are communicated through the VRT Route Manager and interrogators.
11. Next Daylight Savings Time End Date	✓	+	+	x	This is the date Daylight Savings Time ends. If daylight savings time is observed, the initial settings are programmed at the time of manufacture. Updates to daylight savings time are communicated through the VRT Route Manager and interrogators.

Specifications

The following table shows the specifications of the VRT Direct Gas-meter Transponder:

VRT DGT Specifications	
Power	One (1) lithium-thionyl chloride 2750 mAmp-hours; 20 years calculated life under normal working conditions. The battery can be easily replaced in the field.
FCC Compliance	Part 15, Subpart C: A user license is not required (FCC ID G8JVRT01)
RF Transmitter	414.5 MHz, +.05, -1.0 MHz; 4,000 uV/m @ 3m.
RF Receiver	451.35 MHz; -70 dBm sensitivity
Materials	<ul style="list-style-type: none"> • Housing: high-impact plastic, weatherproof, UV protected for outdoor installation. • Circuit-card assembly: conformal-coated • Corrosion-protected external-housing screws
Operating Temperature Range	-22°F to 158°F (-30°C to 70°C)
Storage Temperature Range	-40 °F to 185°F (-40°C to 85°C)
Humidity	5-95% Relative (non-condensing)
Weight	6 oz. Excluding index and index cover.
Serial Numbers	Up to eight digits, starting at 6500000

Chapter Four

VRT Direct Gas-meter Transponder Installation

Installing the VRT DGT on any of the three types of meters (A, R and S) is quick and easy.

We estimate the complete process (including initial baseline programming) will take an experienced installer about five minutes to complete, assuming all tools, equipment and materials are on hand.

Tools, Equipment and Materials

All or some of the following items may be needed in order to install the transponder, depending upon the type of meter/index and the condition of the old index cover and gaskets:

- VRT Direct Gas-meter Transponder
- TRACE SRP, PI or other suitable interrogator/programmer
- Index screws (2 each) *
- Meter mounting bolts (3 or 4 each, depending upon the meter type) *
- Index cover (if old one is not reusable)
- Index cover gasket *
- Putty knife or scraper (to remove old gaskets)
- #2 Phillips screwdriver
- Awl (to remove existing vandal plugs)
- Vandal plugs (2 each) *
- Pressure-compensation factor value, if needed (obtain from AMCO Automated Systems)

* Supplied with the transponder

Preparation and Installation

Preparation

1. Prior to removing the existing index and index cover, verify that the transponder style is compatible with the meter style.

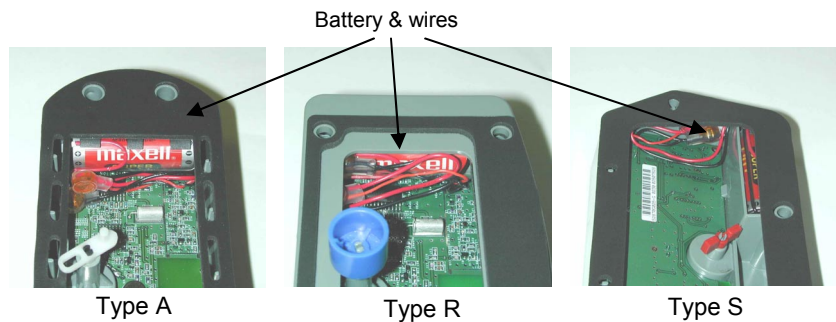


Type A

Type R

Type S

2. Verify the transponder battery is properly seated, and that the battery wires are tucked neatly beside it, out of the way of the wiggler and other transponder components.



Type A

Type R

Type S

NOTE: When transporting transponders to the field for installation please take care not to jar the housing and dislodge the battery from the bracket.

Installing Index onto Transponder

1. Remove the existing index cover and index (or transponder) from the meter (An awl can be used to remove the existing vandal plugs)
 - Clean any debris from index and cover.

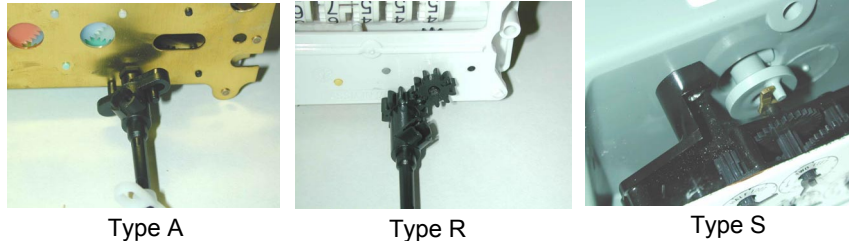


Type A

Type R

Type S

2. Remove the gasket and any adhesive material from the meter.
 - Use a scraper or putty knife.
3. Align index wiggler with transponder wiggler, as shown below.



4. Attach the index to transponder.
 - Use two (2) appropriate index screws.

CAUTION: Do not over tighten index screws.

Checking Mechanical Operation

This procedure will verify the attached index rotates freely and without resistance.

1. Rotate the index drive dial 3 times clockwise.
2. If it turns easily, rotate the drive dial 3 times counterclockwise.
 - This will remove counts or subcounts from the mechanical index.)
 - If it does *not* turn easily, first rotate the drive dial 3 times counterclockwise to remove subcounts from the mechanical index. Second, unscrew the index/transponder assembly and repeat from Step 3 of the previous section.

NOTE: Subcounts added to the electronic index during this procedure will be cleared when the index reading is programmed into the transponder.

Checking Mechanical Index to Electronic Index Operation

This procedure will verify the electronic index is properly recording counts and subcounts corresponding with those of the mechanical index.

1. Rotate the transponder wiggler till the drive dial is in the 12 o'clock position.

Drive dial hand in 12 o'clock position



Type A

Type R

Type S

2. Electronically read the transponder subcounts.
 - Use an SRP or other suitable interrogator/programmer.
 - Remember the subcount value.
3. Facing the index, rotate the drive dial 3 times counterclockwise. Stop at the 12 o'clock position.
4. Electronically read the new transponder subcounts.
 - Use an SRP or other suitable interrogator/programmer.
 - Observe the new subcount value and calculate the difference between it and the starting subcount value.
5. If the new subcount value is *exactly* 3 subcounts higher than the original reading, proceed to step 8.
6. If the new subcount value is *less than* 3 subcounts higher, consider whether the subcounts may have rolled over during the test.
 - If it appears the discrepancy *is* due to rollover, proceed to step 8.
7. If the new subcount value is *less than* 3 subcounts higher, repeat this procedure from Step 1.
 - If the procedure fails a second time, replace transponder with a new one.

8. By using an SRP or other suitable interrogator/programmer, verify that the pre-divider is correct. (The pre-divider for a 1-ft drive is 100 and the pre-divider for a 2-ft drive is 50; refer to the Appendix for the definition of pre-divider).
9. Remove any subcounts or counts from the mechanical index by rotating the drive dial clockwise by the same number of counterclockwise rotations that were placed on the mechanical index in the previous steps.

Mounting the Transponder/Index Assembly

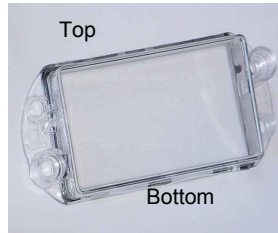
NOTE: Be sure to have your transponder/index assembly, screwdriver, index cover and index cover gasket within easy reach before starting this procedure.

1. Visually align transponder wiggler with meter wiggler (drive dog).
 - If wiggler cannot be put in a fixed position, position it correctly by rotating the drive dial with your finger.
2. Mate the transponder wiggler with the meter wiggler (drive dog) and hold the mated assembly against the meter.
3. While holding the assembly against the meter, gently try to turn the drive wheel clockwise, then counterclockwise.
 - If the drive wheel meets resistance in both directions, it is properly mated. Proceed to Step 4.
 - If it meets no resistance in either direction, and can rotate freely through an angle of 360 degrees and beyond, then make sure the meter is completely free of old gasket material and forcefully press the transponder into the meter. Repeat this step (Step 3). If the unit still does not correctly engage with the meter, return it to AMCO Automated Systems.
 - **For AMCOAS Transponders Only:** If the AMCOAS transponder meets resistance in one direction then turns 360 degrees the other way before again meeting resistance, it is not properly mated. Repeat from Step 1.

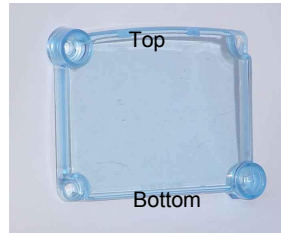
CAUTION: *It is very important that the wiggler on the transponder is correctly engaged onto the meter. If it is not, it could produce an erroneous indication during utility leak test procedures that monitor drive dial (proving dial) movement. Incorrectly engaged wigglers could also cause meter damage. CORRECT EXECUTION OF STEPS 1, 2 and 3 IS CRITICAL.*

4. Verify that the gasket material on the index cover is free of rips or tears.
 - If it is not, remove the damaged gasket from the index cover and replace with a new one.

5. Place the index cover and index cover gasket onto the transponder/ index assembly.
 - Verify the index cover is properly oriented with its vent holes at the bottom.
 - See photos below for orientation cues.

**Type A**

Top edge of lens has continuous ridges; bottom has intermittent ridges. Left flange contains an "L"
P/N 10001P001

**Type R**

Rectangular lens with a curved top and flat bottom.
P/N 10001P003

**Type S**

Angled lens with a single screw groove at the top and two screw holes on the sides.
P/N 10001P002

6. Screw the transponder/index/cover assembly to the meter and tighten bolts to secure assembly to meter.
 - Use the appropriate mounting bolts provided.
 - Recommended torque range is 16-24 in-lbs.
7. Install the tamper seals into the index cover receptacles.

**Type A****Type R****Type S**

8. Remove the semi-detached label from the transponder and attach it to your paperwork.

Programming the VRT Direct Gas-meter Transponder

Although transponders may contain default or utility-specified values that are programmed during manufacturing, it is important to program certain data only *after* the transponder has been installed in the field:

- Transponders can accumulate subcounts during shipping, handling and installation due to the movement of its wriggler.

- The transponder's tamper sensing switch must be told which orientation should be considered its normal (not tampered) condition.

Therefore, all transponders (even those mated with indexes set at 0000) should be programmed *after installation on the meter.*

When the transponder is programmed, it also automatically sets the tamper flag to "false" or "not tampered," establishing its normal condition in the transponder's memory.

NOTE: Even transponders factory-installed on meters must be programmed at the time the meter is installed in the field.

Programming Procedure

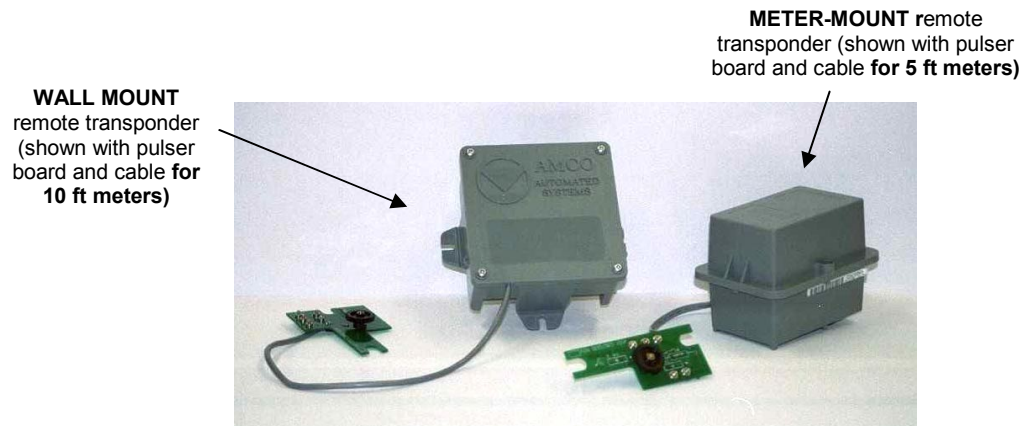
NOTE: For specific instructions for programming transponders, please refer to the appropriate interrogator/programmer user guide.

NOTE: If required, be sure to have on hand the pressure compensation factor. (Obtain from AMCO Automated Systems.)

1. Read the transponder.
 - Place interrogator/programmer close to the transponder, especially if other transponders are nearby.
 - If no other transponders are within 6 feet, use Wildcard function to find transponder serial number.
 - If other transponders are within 6 feet, enter the serial number of the desired transponder.
2. Visually read the meter's mechanical index.
3. Program the electronic index to match the meter 's mechanical index.
 - This will also reset the transponder subcounts to zero.
4. If required, program the pressure compensation factor now.
 - Compensation factors are unique for specific indexes and can be obtained by contacting AMCO Automated Systems Customer Service Department at (304) 757-3300.
5. Read the transponder.
 - If the electronic index matches the meter 's mechanical index, installation is complete.
 - If the electronic index does not match the meter 's mechanical index, repeat procedure from Step 1.
 - If the transponder still does not program, replace it with a new one.

Chapter Five

VRT Remote Gas-meter Transponder Overview



The TRACE VRT™ Remote Gas-meter Transponder (RGT) is compatible with American Meter C&I meters. VRT RGTs for C&I meters are available in four types as shown below:

VRT RGT Style	Meter Type	Part Number*
Wall Mount	5 ft.	52807K501-118
	10 ft.	52807K501-136
Meter Mount	5 ft.	52807K551-118
	10 ft.	52807K551-136

* Part numbers are subject to change. Be sure to include item description when ordering.

NOTE: The VRT RGT can be purchased without the 5-ft or 10-ft pulser board so that third-party pulser kits may be attached.

Additional TRACE pulser boards with mounting kits are also available:

TRACE Pulser Board w/ Mounting Kit	Part Number*	
Pulser board, 2 mounting screws, 6 spacers	5 ft.	52807K001
	10 ft.	52807K002

* Part numbers are subject to change. Be sure to include item description when ordering.

How it Works

The VRT RGT is designed for use with commercial gas meters where the meter/index design prohibits direct transponder attachment.

A “pulser” circuit board is interfaced with the index gears to provide an electronic “pulse” that translates each turn of the mechanical gear into electronic pulses. These pulses are sent via a cable to the transponder where they are recorded as consumption values.

Most applications accommodate connection of the transponder within one foot of the meter. However, certain applications (where the meter is obscured by metallic materials that can block radio signals, for example) a remote transponder with a longer cable may be special ordered so that the transponder can be mounted farther away from the meter in a position more favorable for interrogation.

Features and Capabilities

The VRT RGT can be programmed for use with a fixed factor, pressure-compensated index.

The transponder maintains current time and date, which are used to manage the recording of real-time data for retrieval as required during the normal read cycle.

In addition to maintaining index reading, the transponder:

- Stores 35 daily index readings in separate electronic indexes recorded at the start of the utility day. (The utility day start time is programmable.)
- Maintains up to four time-of-use (TOU) electronic indexes that each have programmable start and stop times.

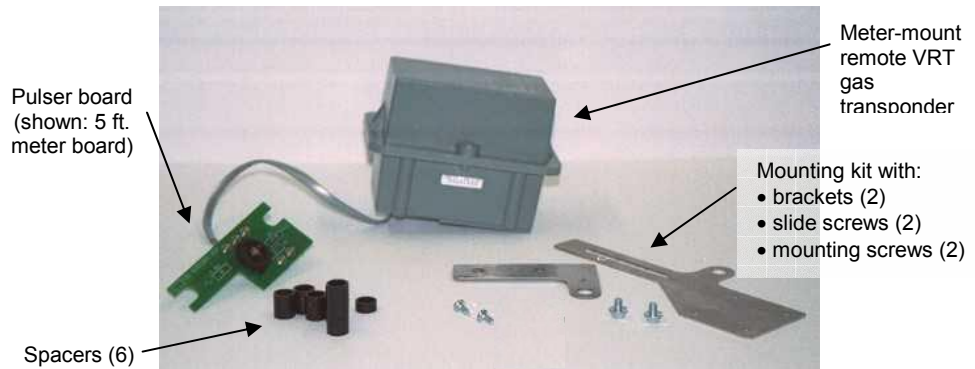
VRT Remote Gas-meter Transponder Construction

The VRT RGT is available for American Meter 5-foot and 10-foot meters. The transponder has a high impact plastic housing with rubber gasket and it includes the following internal components:

- RF transmitter
- RF receiver
- Tamper switch
- Transmit and receive antennas
- Battery
- Electronic components

The meter's existing index and index cover are attached to the VRT RGT pulser board during installation.

Identifying the Components (Meter Mount)



Each shipment of VRT RGTs includes all the hardware necessary to successfully install a transponder onto a meter.

You will receive:

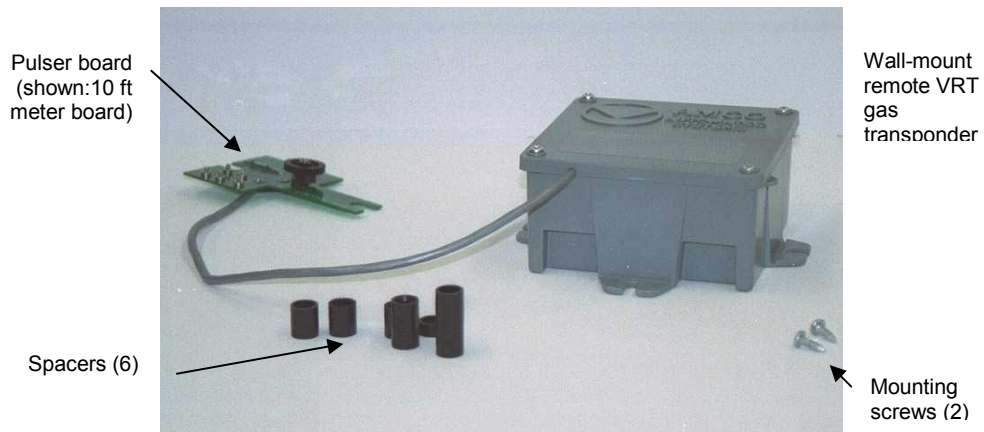
- The meter-mount transponder
- A 5-ft or 10-ft meter pulser board connected to the transponder by a standard one-foot cable (*longer cable may be special-ordered with the transponder*)
- Six (6) plastic spacers (2 short, 2 tall/fat post, 2 tall/thin post) to position the pulser board on the index
- Meter mounting kit (2 brackets with 2 hex-head slide screws and 2 Phillips-head screws)

Meter-mounting hardware can also be purchased separately. See table below for part numbers.

To Order Additional Meter-mount Hardware	
Item	Part Number
Meter Mounting Kit (2 brackets, 2 mounting screws, 2 hex slide screws)	52805K004
Pulser Mounting Kit (6 spacers)	52807K003

** Part numbers are subject to change. Be sure to include item description when ordering.*

Identifying the Components (Wall Mount)



Each shipment of Wall Mount VRT RGT transponders includes all the hardware necessary to successfully install a transponder onto a meter.

You will receive:

- The wall-mount transponder
- A 5-ft or 10-ft meter pulsar board connected to the transponder by a standard one-foot cable (*longer cable may be special-ordered with the transponder*)
- Six (6) plastic spacers (2 short, 2 tall/fat post, 2 tall/thin post) to position the pulsar board on the index
- Two Phillips-head mounting screws for the wall-mount housing

Wall-mounting hardware can also be purchased separately. See table below for part numbers.

To Order Additional Wall-mount Hardware	
Item	Part Number*
Mounting Screws (2)	10502P005
Pulsar Mounting Kit (6 spacers)	52807K003

** Part numbers are subject to change. Be sure to include item description when ordering.*

Chapter Six

VRT Remote Gas-meter Transponder Installation

Installing the VRT RGT on American Meter 5-ft and 10-ft meters is quick and easy.

We estimate the complete process (including initial baseline programming) will take an experienced installer about five minutes to complete, assuming all tools, equipment and materials are on hand.

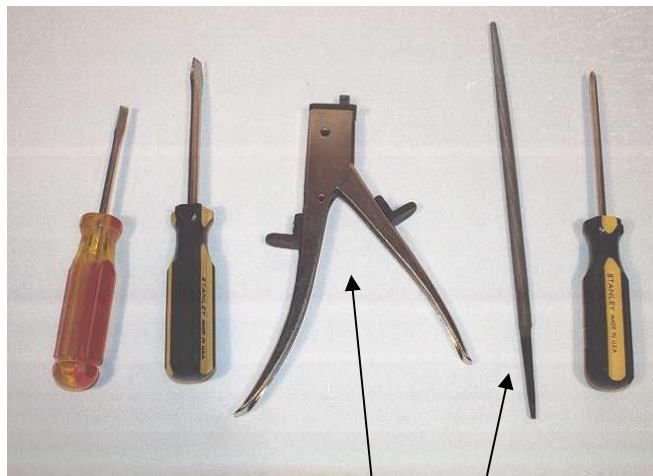
Tools, Equipment and Materials

All or some of the following items may be needed in order to install the transponder.

Tools Required:

- 3/8" flat blade screwdriver
- 3/16" flat blade screwdriver
- Nibbling tool or small file
- #1 Phillips screwdriver

Flat blade
screwdrivers



Phillips
screwdriver

Nibbling tool or small file

Not shown:

- Awl
- 5/16 English socket or adjustable wrench (optional, for meter-mount only)

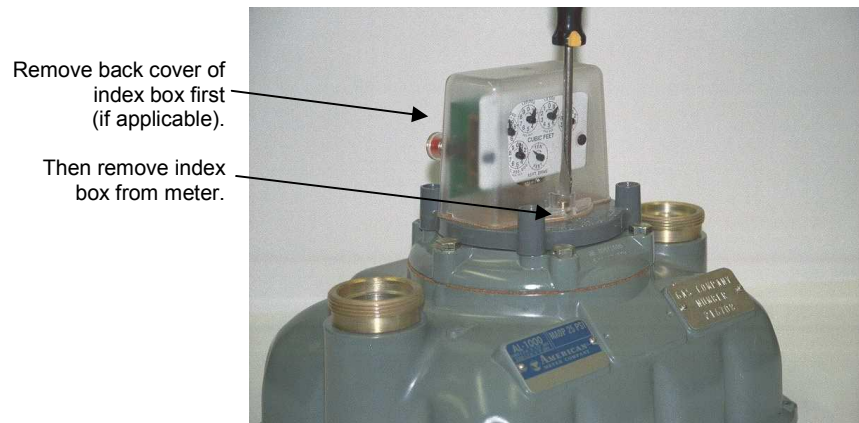
Equipment & Materials

- Replacement seals

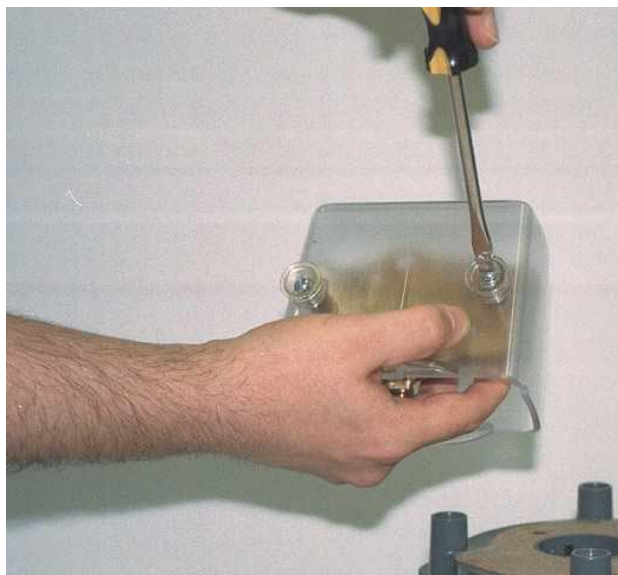
Pulsar Installation (Meter- and Wall-mount)

NOTE: Although this section illustrates installation of the 5 ft pulsar board, the procedure is essentially the same for the 10 ft pulsar board.

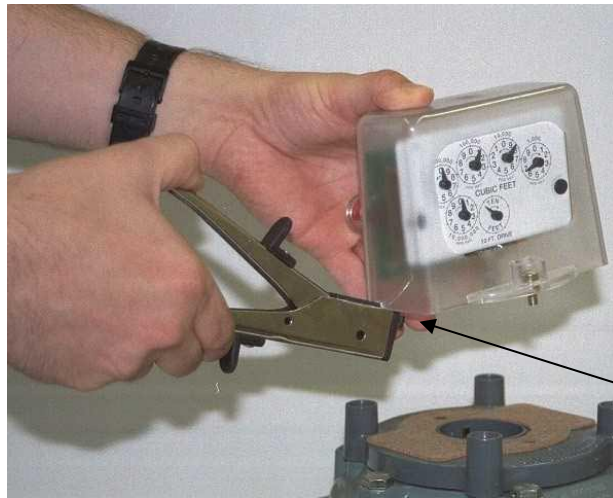
1. Remove the index box from the meter.
 - If the meter index box has a back cover, remove the 2 screws that secure it first.



- Remove the screws securing the index box to the meter.
 - Save all screws.
2. Remove the 2 screws that secure the index to the index box.
 - Save the screws.



- Cut a small notch in the base of the index box (on the left side near the back).

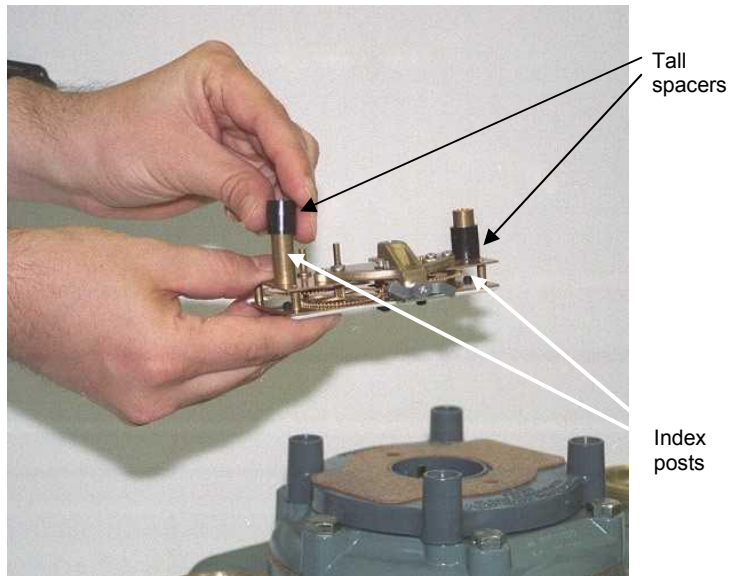


Cut a small notch on left side of the base (near the back) to pass cable through.

- Use either the nibbling tool or file.
- The notch should be only large enough to allow the connecting cable to pass through.

CAUTION: The notched index cover should fit snugly over the cable but not so tightly that the wires inside may be broken or crimped when the box is tightened down.

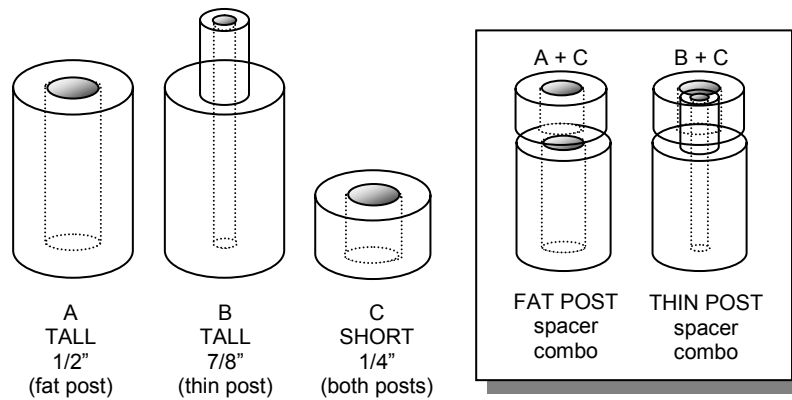
- Place a tall spacer over each of the 2 posts protruding from the back of the index.



Tall spacers

Index posts

- Use either tall spacer A (1/2") or B (7/8") depending upon the width of the index post. (See illustration below.)



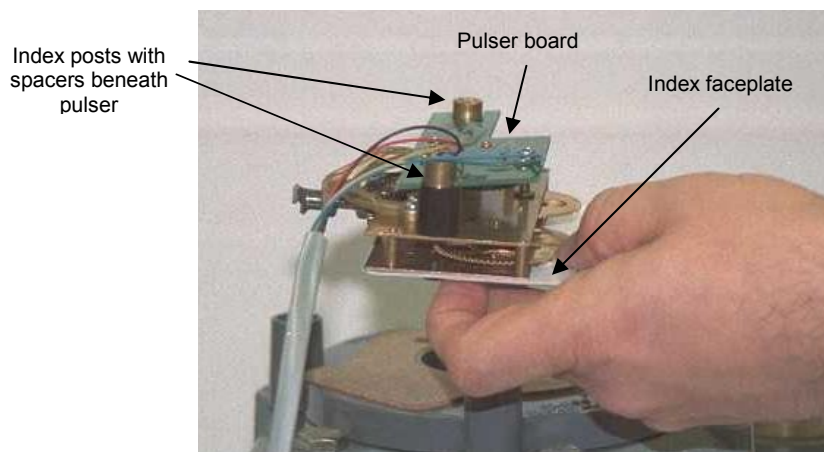
Pulsar board spacer types (2 of each type in kit)

To Order Additional Spacers			
Item			Part Number*
A	1/2"	Tall spacer for fat post	52807P002
B	7/8"	Tall (2 tiered) spacer for thin post	52807P003
C	1/4"	Short spacer (all)	52807P004

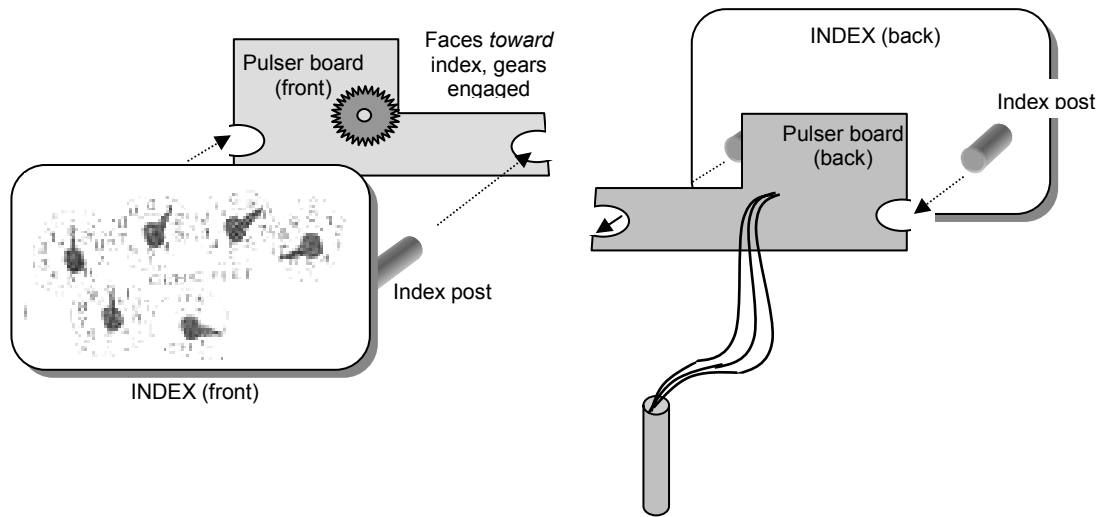
* Part numbers are subject to change. Be sure to include item description when ordering.

5. Fit the pulsar board over the index posts onto spacers:

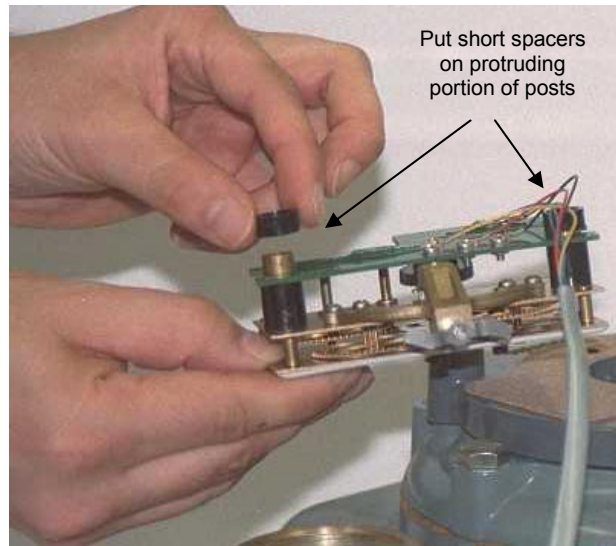
- Hold index in one hand, face-down.
- Position pulsar board so that its circular notches align with the index posts and the pulsar gear faces the index gears.



- Slide the pulsar board onto the posts.
- Ensure pulsar gears mate with index gears.
- Ensure the gears mesh smoothly by turning the input wiggler.
- See assembly illustration below.



6. Slip one of the short spacers over the portion of each post protruding above the pulser board.



7. Route the pulser wires toward the notch cut earlier in the index box.
 - Be sure the wires are not pinched under either the posts or the spacers.

8. Slide the index/pulser assembly into the index box.

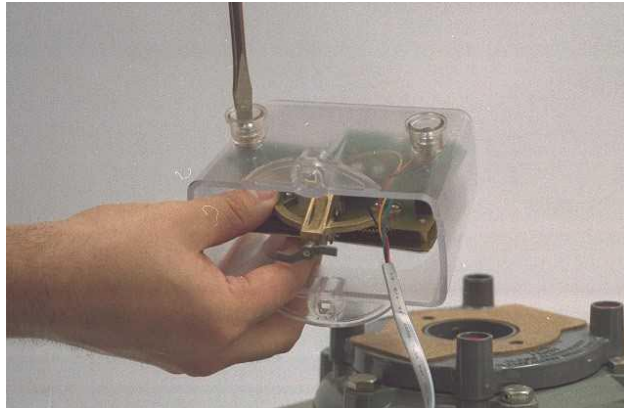


Route wires toward the notch in the index box. Make sure they're not pinched under posts or spacers

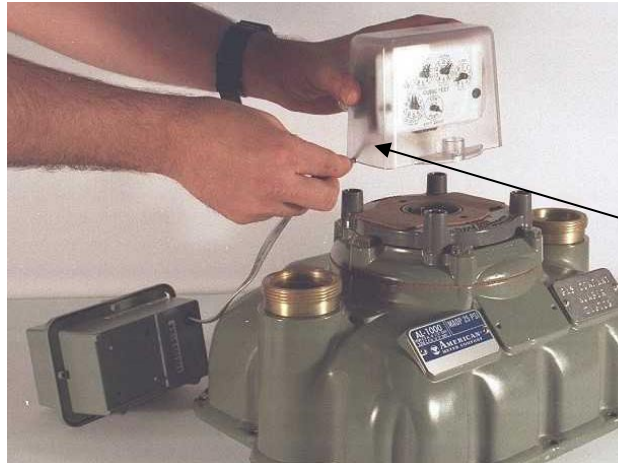
Notch

9. Reattach the index/pulser assembly to the index box.

- Use the 2 screws removed in Step 2.
- Ensure that the wires are not pinched anywhere before tightening screws.
- Verify that the index turns without binding.



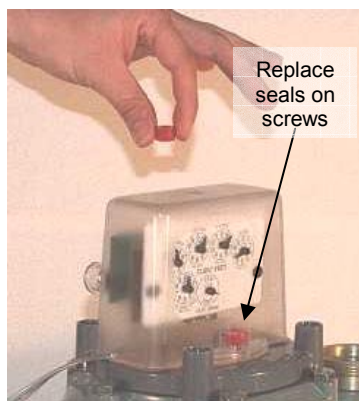
10. Position the index box (with index/pulsar assembly) over the screw holes in the meter flange.



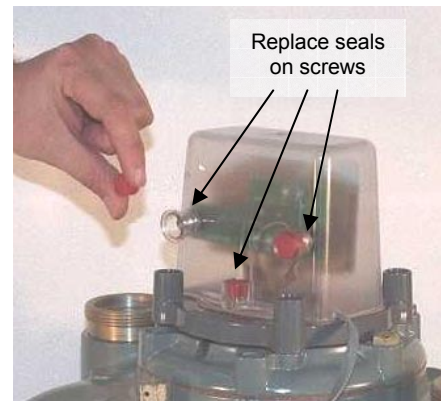
Route the cable through the notch.

Make sure the end of the insulated covering is well inside the box.

- Ensure that the individual pulser wires are well *inside* the box and the insulated section of cable exits via the notch made in Step 3.
11. If the index box has a back cover, reinstall it now.
 - Use the screws removed in Step 1.
 12. Mount the index box (and attached index/pulsar assembly) to the meter flange.
 - Use the screws removed in Step 1.
 13. Reseal all screws with new seals.



FRONT



REAR

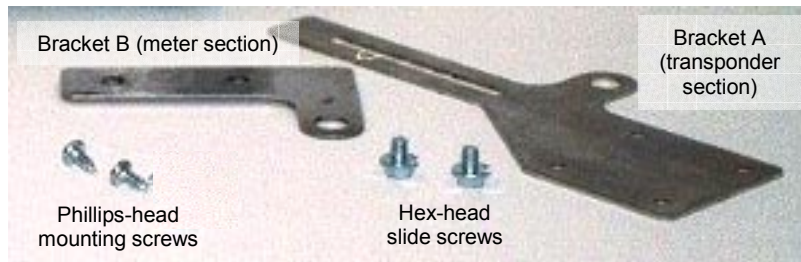
14. Mount the transponder to the meter or wall.
 - Refer to the applicable transponder mounting procedure below for specific instructions.

VRT RGT Mounting (Meter-mount)

Tools, Equipment and Materials

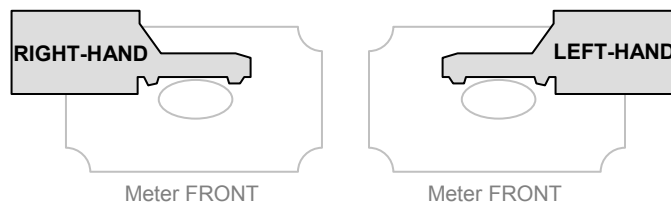
For this part of the installation you will need the following:

- Metal bracket sections (A & B)
- Hex-head slide screws (2)
- Phillips-head mounting screws (2)
- (Optional) 5/16ths English socket or adjustable wrench

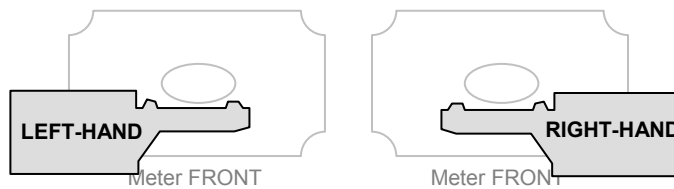


Meter Mounting Positions

The transponder may be installed in either of two positions (left-hand or right-hand) on either the front or back of the meter.



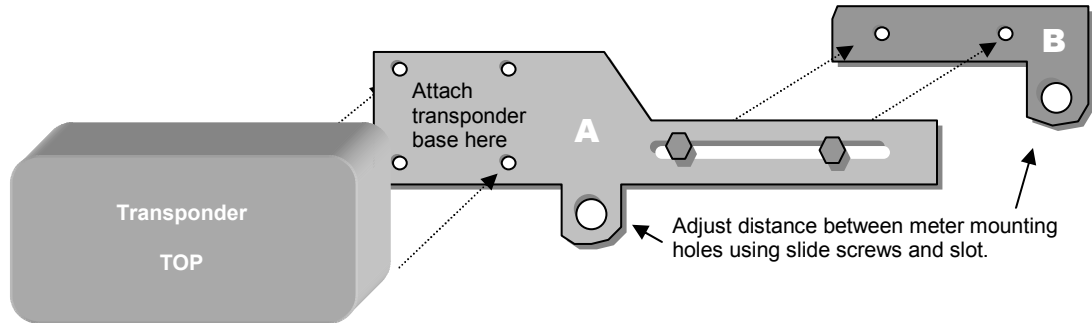
Mounting positions: meter rear



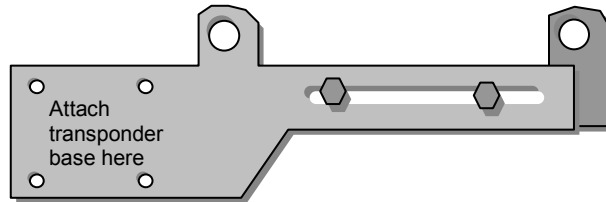
Mounting positions: meter front

Meter-mounting Procedure

The illustrations below show how the meter-mount brackets should be assembled (for right-hand or left-hand mounting) prior to attaching them to the meter.

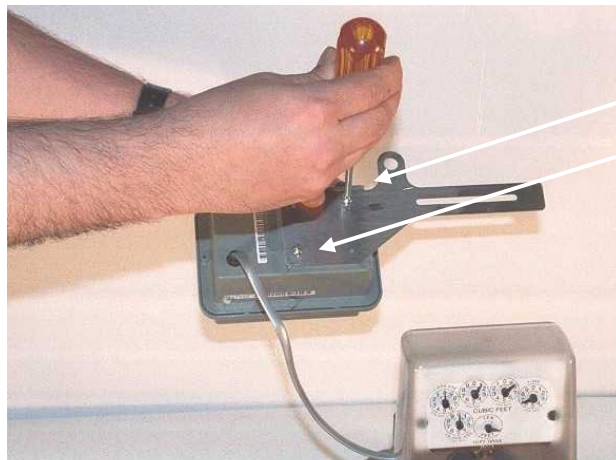


Brackets assembled for RIGHT-HAND mounting



Brackets assembled for LEFT-HAND mounting

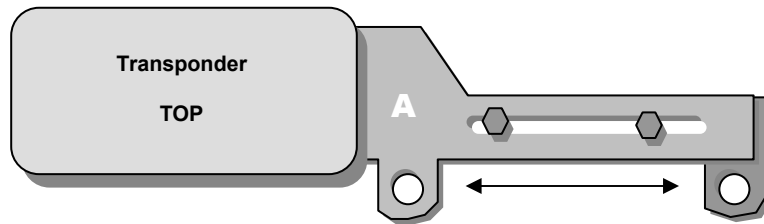
1. Attach bracket A to bottom of the transponder.
 - Use the 2 Phillips-head screws, placed in diagonal positions.
 - Although transponder has only 2 holes on its base, the bracket has 4 holes to accommodate left- or right-hand mounting.
 - Do not over-tighten the screws.



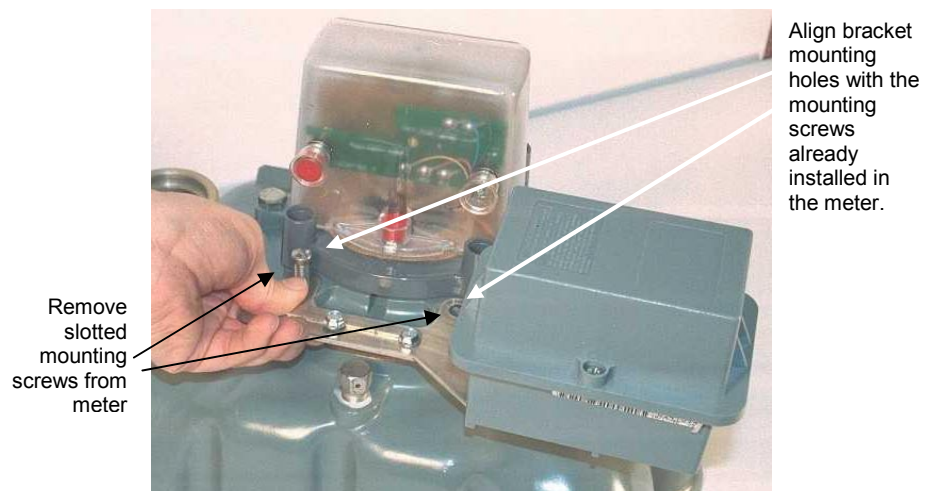
Mount transponder to bracket using the 2 Phillips-head screws in diagonal positions.

2. Connect brackets A and B using the 2 hex-head slide screws.

- The screw heads should be on the outside of the slot on bracket A, with their threads started in bracket B holes.
- Slightly finger-tighten the screws so that the bracket width can still be adjusted.
- The hex screws should be on top—regardless which mounting position you use—when the bracket assembly is connected to the meter.



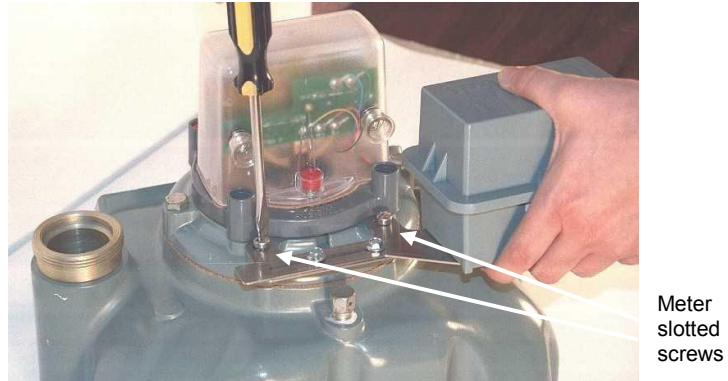
3. Remove the two slotted screws already attached to the meter in the selected mounting location (front or back).



Shown: RIGHT-HAND mounting, meter REAR

4. Position the transponder brackets in the mounting location and adjust the bracket mounting holes to the width of the meter holes.

5. Secure slide screws into position.
 - You may be able to finger-tighten these sufficiently, but it is recommended you use either an adjustable wrench or a 3/16th English socket to secure the slide.
6. Mount the transponder to meter in desired location.



- Use the 2 slotted screws previously removed from the meter.
 - Do not over-tighten screws.
7. Dress pulser cable neatly.
 - Tie up or bind any excess cable and position it out of harm's way.
 8. Program the transponder to the reading on the index.
 - Refer to the programming procedure at the end of this chapter for specific instructions.

VRT RGT Mounting (Wall-mount)

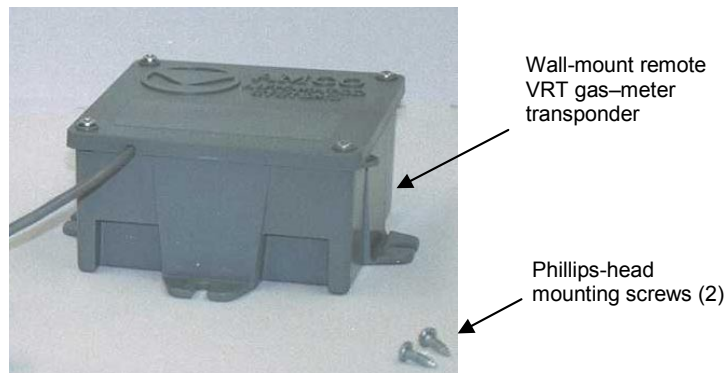
Tools, Equipment and Materials

For this part of the installation you will need the following:

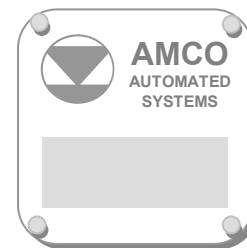
- Phillips-head mounting screws (2)
- Phillips screwdriver

Wall-mount Procedure

The wall-mounted VRT RGT can be installed on any flat, vertical surface via the mounting flanges on the transponder's enclosure.



1. Attach the transponder directly to the desired surface.
 - Position the transponder with the AMCO Automated Systems logo facing upright.
 - Use the 2 mounting screws.
 - Ensure there is no excess tension on the pulser cable when transponder is tightened down.
2. Dress pulser cable neatly.
 - Tie up or bind any excess cable and position it out of harm's way.
3. Program the transponder to the reading on the index.
 - Refer to the programming procedure below for specific instructions.



VRT RGT Programming (All)

NOTE: The procedure for programming the VRT Remote Gas-meter Transponder is identical to that used for programming the VRT Direct Gas-meter Transponder as described earlier in this manual.

Although transponders may contain default or utility-specified values that are programmed during manufacturing, it is important to program certain data only *after* the transponder has been installed in the field:

- Transponders can accumulate subcounts during shipping, handling and installation due to the movement of its wiggler.
- The transponder's tamper sensing switch must be told which orientation should be considered its normal (not tampered) condition.

Therefore, all transponders (even those mated with indexes set at 0000) should be programmed *after installation (on meter or wall)*.

When the transponder is programmed, it also automatically sets the tamper flag to “false” or “not tampered,” establishing its normal condition in the transponder’s memory.

NOTE: Even transponders factory-installed on meters must be programmed at the time the meter is installed in the field.

Programming Procedure

NOTE: For specific instructions for programming transponders, please refer to the appropriate interrogator/programmer user guide.

NOTE: If required, be sure to have on hand the pressure compensation factor. (Obtain from AMCO Automated Systems.)

1. Read the transponder.
 - Place interrogator/programmer close to the transponder, especially if other transponders are nearby.
 - If no other transponders are within 6 feet, use Wildcard function to find transponder serial number.
 - If other transponders are within 6 feet, enter the serial number of the desired transponder.
2. Visually read the meter’s mechanical index.
3. Program the electronic index to match the meter ‘s mechanical index.
 - This will also reset the transponder subcounts to zero.
4. If required, program the pressure compensation factor now.
 - Compensation factors are unique for specific indexes and can be obtained by contacting AMCO Automated Systems Customer Service Department at (304) 757-3300.
5. Read the transponder.
 - If the electronic index matches the meter ‘s mechanical index, installation is complete.
 - If the electronic index does not match the meter ‘s mechanical index, repeat procedure from Step 1.
 - If the transponder still does not program, replace it with a new one.

Chapter Seven

Troubleshooting

The following table offers troubleshooting tips for some common transponder conditions. For all other matters, contact AMCO Automated Systems.

Symptom	Possible Cause	Solution
Transponder cannot be interrogated with an SRP, MMI or PI Device	The incorrect serial number has been entered into the interrogator	Verify that the correct serial number is being interrogated
	The transponder is either too close or too far away from the interrogation device	Be certain that the interrogator is within range of the transponder. An SRP should be within 3 to 12 inches of the transponder. If operating an MMI in Lat/Lon or GEO Mode be certain that the transponder is in the reading window.
	Interference from another interrogation device.	Verify that no other interrogations are taking place, either with an SRP, PI, URFI, or MMI. Any MMI within range of the transponder must have the transmitter turned off while you are interrogating with the SRP.
Transponder will not program	The SRP is either too close or too far away from the transponder.	Move the SRP (and particularly the top, where antenna resides) closer or farther away from the transponder. An SRP should be with 3 to 12 inches of the transponder.
	The programming device (SRP, PI) is attempting to communicate with the incorrect transponder serial number	Correct the serial number in the programming device.
Transponder will not read from the street	Malfunctioning Interrogator	Check operation of interrogator on known good transponder
	Interference from external sources	Clear area around transponder of metal objects (lawn chairs, bicycles, etc.).
	Hard-to-read location	Reposition the interrogator and try re-reading the transponder. If this does not work, then place a known good transponder at the same location and attempt to read both units from the street. If the new unit will read replace the old unit with the new unit.
Tamper flag will not reset	The orientation of the transponder at the time it was programmed is different from the current orientation of the transponder.	Reprogram the electronic index reading. This will reset the tamper to "false" and establish the "no tamper" position of the transponder.
I rotated the drive hand forward three times and back three times but the subcount increased anyway.	Transponders will accumulate subcounts with rotation of the drive hand in either the counterclockwise or clockwise direction.	If the index is rotated in reverse during installation and/or during troubleshooting, the transponder should be reprogrammed to the current index reading to reset the subcounts to zero.

Appendix

VRT Direct Gas-meter Transponders can be programmed (at the factory or in the field) with values specified by the utility.

This Appendix highlights some of the types of data that can be programmed at the factory and the range of selections within each type.

For comprehensive discussion of all programmable transponder data, please refer to the applicable interrogator/programmer user guide.

Pre-Divider

The number of subcounts recorded with each revolution of the drive dial on 1-ft³ and 2-ft³ indexes is one. A 1-ft³ index requires 100 revolutions to yield 100 ft³ (1 count) and a 2-ft³ index requires 50 revolutions to yield 100 ft³ (1 count). Therefore, the pre-divider for a 1-ft³ index is 100 and for a 2-ft³ index it is 50.

Pressure-Compensation Factor

When a transponder is used in conjunction with a pressure-compensated index, a pressure-compensation factor can be programmed into the transponder memory by the utility at the time of installation to ensure that the electronic index reading agrees with the mechanical index.

Pressure-compensation factors are unique for specific indexes and can be obtained by contacting AMCO Automated Systems' Customer Service Department at (304) 757-3300.

Time-of-Use (TOU) Registers

Time of use registers, if activated, accumulate consumption recorded by the transponder between the start and stop time set for each TOU register. Certain rules apply to the TOU values, including:

- If activated, the TOU register must be active for a minimum of 00:29:59 (hh:mm:ss) and a maximum of 23:59:59 (hh:mm:ss).
- TOU registers can start on the hour or in 15-minute intervals after the hour. For example: 12:00:00 PM and 12:15:00 PM are valid start times, while 12:07:00 PM is not a valid time.
- TOU registers must also end at the end of the hour or in 15-minute intervals thereafter. Thus, 01:59:59 PM and 02:14:59 are valid stop time, while 02:13:59 is not.

- TOU registers can overlap – for example, TOU 1 can run from 08:00:00 AM until 10:29:59 PM and TOU 2 can run from 10:15:00 AM until 2:29:59 PM.
- TOU registers can span midnight – a start time of 08:00:00 PM with a stop time of 01:59:59 AM is valid.

The table below shows the TOU time slots that are available.

Table 1 - TOU Time Slots

Time Slot	Start Time	End Time	Time Slot	Start Time	End Time	Time Slot	Start Time	End Time
1	12:00:00 AM	12:14:59 AM	33	8:00:00 AM	8:14:59 AM	65	4:00:00 PM	4:14:59 PM
2	12:15:00 AM	12:29:59 AM	34	8:15:00 AM	8:29:59 AM	66	4:15:00 PM	4:29:59 PM
3	12:30:00 AM	12:44:59 AM	35	8:30:00 AM	8:44:59 AM	67	4:30:00 PM	4:44:59 PM
4	12:45:00 AM	12:59:59 AM	36	8:45:00 AM	8:59:59 AM	68	4:45:00 PM	4:59:59 PM
5	1:00:00 AM	1:14:59 AM	37	9:00:00 AM	9:14:59 AM	69	5:00:00 PM	5:14:59 PM
6	1:15:00 AM	1:29:59 AM	38	9:15:00 AM	9:29:59 AM	70	5:15:00 PM	5:29:59 PM
7	1:30:00 AM	1:44:59 AM	39	9:30:00 AM	9:44:59 AM	71	5:30:00 PM	5:44:59 PM
8	1:45:00 AM	1:59:59 AM	40	9:45:00 AM	9:59:59 AM	72	5:45:00 PM	5:59:59 PM
9	2:00:00 AM	2:14:59 AM	41	10:00:00 AM	10:14:59 AM	73	6:00:00 PM	6:14:59 PM
10	2:15:00 AM	2:29:59 AM	42	10:15:00 AM	10:29:59 AM	74	6:15:00 PM	6:29:59 PM
11	2:30:00 AM	2:44:59 AM	43	10:30:00 AM	10:44:59 AM	75	6:30:00 PM	6:44:59 PM
12	2:45:00 AM	2:59:59 AM	44	10:45:00 AM	10:59:59 AM	76	6:45:00 PM	6:59:59 PM
13	3:00:00 AM	3:14:59 AM	45	11:00:00 AM	11:14:59 AM	77	7:00:00 PM	7:14:59 PM
14	3:15:00 AM	3:29:59 AM	46	11:15:00 AM	11:29:59 AM	78	7:15:00 PM	7:29:59 PM
15	3:30:00 AM	3:44:59 AM	47	11:30:00 AM	11:44:59 AM	79	7:30:00 PM	7:44:59 PM
16	3:45:00 AM	3:59:59 AM	48	11:45:00 AM	11:59:59 AM	80	7:45:00 PM	7:59:59 PM
17	4:00:00 AM	4:14:59 AM	49	12:00:00 PM	12:14:59 PM	81	8:00:00 PM	8:14:59 PM
18	4:15:00 AM	4:29:59 AM	50	12:15:00 PM	12:29:59 PM	82	8:15:00 PM	8:29:59 PM
19	4:30:00 AM	4:44:59 AM	51	12:30:00 PM	12:44:59 PM	83	8:30:00 PM	8:44:59 PM
20	4:45:00 AM	4:59:59 AM	52	12:45:00 PM	12:59:59 PM	84	8:45:00 PM	8:59:59 PM
21	5:00:00 AM	5:14:59 AM	53	1:00:00 PM	1:14:59 PM	85	9:00:00 PM	9:14:59 PM
22	5:15:00 AM	5:29:59 AM	54	1:15:00 PM	1:29:59 PM	86	9:15:00 PM	9:29:59 PM
23	5:30:00 AM	5:44:59 AM	55	1:30:00 PM	1:44:59 PM	87	9:30:00 PM	9:44:59 PM
24	5:45:00 AM	5:59:59 AM	56	1:45:00 PM	1:59:59 PM	88	9:45:00 PM	9:59:59 PM
25	6:00:00 AM	6:14:59 AM	57	2:00:00 PM	2:14:59 PM	89	10:00:00 PM	10:14:59 PM
26	6:15:00 AM	6:29:59 AM	58	2:15:00 PM	2:29:59 PM	90	10:15:00 PM	10:29:59 PM
27	6:30:00 AM	6:44:59 AM	59	2:30:00 PM	2:44:59 PM	91	10:30:00 PM	10:44:59 PM
28	6:45:00 AM	6:59:59 AM	60	2:45:00 PM	2:59:59 PM	92	10:45:00 PM	10:59:59 PM
29	7:00:00 AM	7:14:59 AM	61	3:00:00 PM	3:14:59 PM	93	11:00:00 PM	11:14:59 PM
30	7:15:00 AM	7:29:59 AM	62	3:15:00 PM	3:29:59 PM	94	11:15:00 PM	11:29:59 PM
31	7:30:00 AM	7:44:59 AM	63	3:30:00 PM	3:44:59 PM	95	11:30:00 PM	11:44:59 PM
32	7:45:00 AM	7:59:59 AM	64	3:45:00 PM	3:59:59 PM	96	11:45:00 PM	11:59:59 PM

Note: TOU registers cannot start and end with the same time slot.

Daylight Savings Time

The transponder can be set to switch between daylight savings time and standard time. To do this, however, the transponder must be told when Daylight Savings Time starts and ends.

The table below shows the dates (through the year 2030) when Daylight Savings Time begins and ends.

Next Daylight Savings Time Start Date

The transponder's internal clock will automatically switch to daylight savings time on the date represented by the value entered into this field.

The value must represent a future date. Please refer to table [TABLE 02] for a list of valid entries.

This value is programmed at the factory for the next valid date after it is shipped, but must be updated by the utility for subsequent periods.

Next Daylight Savings Time End Date

The transponder's internal clock will automatically switch to standard time on the date represented by the value entered into this field.

The value must represent a future date.

Please refer to table [TABLE 2] for a list of valid entries.

This value is programmed at the factory for the next valid date after it is shipped, but must be updated by the utility for subsequent periods.

Table 2 – Daylight Savings Time Start and End Dates

Year	DST Start Date	DST End Date
2002	04/07/02	10/27/02
2003	04/06/03	10/26/03
2004	04/04/04	10/31/04
2005	04/03/05	10/30/05
2006	04/02/06	10/29/06
2007	04/01/07	10/28/07
2008	04/06/08	10/26/08
2009	04/05/09	10/25/09
2010	04/04/10	10/31/10
2011	04/03/11	10/30/11
2012	04/01/12	10/28/12
2013	04/07/13	10/27/13
2014	04/06/14	10/26/14
2015	04/05/15	10/25/15
2016	04/03/16	10/30/16
2017	04/02/17	10/29/17
2018	04/01/18	10/28/18
2019	04/07/19	10/27/19
2020	04/05/20	10/25/20
2021	04/04/21	10/31/21
2022	04/03/22	10/30/22
2023	04/02/23	10/29/23
2024	04/07/24	10/27/24
2025	04/06/25	10/26/25
2026	04/05/26	10/25/26
2027	04/04/27	10/31/27
2028	04/02/28	10/29/28
2029	04/01/29	10/28/29
2030	04/07/30	10/27/30

For values after the year 2030 please contact
AMCO Automated Systems Customer Service
Department