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Chapter 1: System Overview

This document covers the setup and operation of the FIREFLY Radio Frequency Automatic Meter Reading (AMR) system, used in conjunction with the RouteSTAR® Meter Reading System (RouteSTAR MVP®).

All information presented herein assumes the installation and understanding of the RouteSTAR MVP software and associated ROADRUNNER ruggedized, handheld computers. *Refer to the ROADRUNNER system manual for additional information.*

The RouteSTAR MVP system is designed to provide a fast, efficient method of collecting meter reading data from a variety of sources. This includes FIREFLY AMR meter readings as well as ProfilePlus™ historical usage data.

More specifically, utility meters are outfitted with FIREFLY Meter Interface Units (MIUs) that transmit meter readings and associated information. Field personnel collect these radio frequency readings via ROADRUNNERs equipped with an integrated Radio Frequency Receiving Unit (RFRU).

Likewise, the MIUs provide a feature called ProfilePlus to keep track of historical usage data. This data helps solve billing disputes, and enable variable rate billing and load management studies. ROADRUNNERs are used in conjunction with Programming/Profiling Units (PPUs) to extract this data on demand.

System Features

FIREFLY AMR System Features

- ProfilePlus: Usage data based on programmable interval setting.
- Quick and easy installation.

Interfacing Options

- 1. Optical "through-the-glass" sensor end.
- 2. Pulse or encoded wire-end.
- 3. Under-glass interfacing (electric meters).

RF Receiver Diagnostics

■   The Low Output Test Transmitter (LOTT) tests the RF reception of each
    ROADRUNNER.

Meter Options

Water	Electric	Gas
Pulse meters	Single-Phase Meters	Analog Index Meters
Encoded meters		
Analog meters with one or more sweep hands		

Installation Options

— Field installation in less than 10 minutes —

■   Above ground.

■   Below ground: Pits, vaults, and basements.

Reading Methodologies

■   Walk-by.

■   Drive-by.

Customized Programming Options

■   Programmable ID, communications, and profiling interval.

■   Profiling capability: Interval consumption logging.

Equipment

ROADRUNNER Handheld Computer

Key Descriptions

There are two different types of keys on each keypad: data keys and function keys.

Data keys are the letter and number keys, $\boxed{A}$ - $\boxed{Z}$ and $\boxed{0}$ - $\boxed{9}$. They are used to insert data into the ROADRUNNER.

Function keys are labeled on the keyboard or the template. They are used to perform a special procedure or function.

The $\boxed{\text{SHIFT}}$ key shifts between the numeric and alphabetic keyboard on the Telxon 860ES and activates some of the function keys.

Note: Under the column for the **ROADRUNNER X7**, the following keys: [A] , [V] , [◄] , [►] refer to the cursor pad located in the upper right corner of the keyboard. This key groups together the four arrow keys, also called the direction keys.

Cursor Pad

Function	ROADRUNNER X7	Telxon 860
Menu Displays the Main Menu	**[F1]**	**[F1]**
Contrast Up Lightens the screen intensity when the APD is displayed.	**[FNCTN] [F4]**	[A]
Send Initiates the communication procedure to send/receive data to/from the MVP PC.	**[F3]**	**[F3]**
Contrast Down Darkens the screen intensity when the APD is displayed.	**[FNCTN] [F5]**	[V]
Light Turns the display backlight on/off. The light will turn off automatically after approximately 2½ minutes of inactivity, to conserve power.	**[FNCTN] [F3]**	**[F5]**
On/Off Turns power on and off to the ROADRUNNER. To conserve battery power, the ROADRUNNER automatically turns itself off after approximately 2 ½ minutes of non-use.	**[F1] / [FNCTN+F1]**	**[ON/OFF]**
Search Initiates the Search function.	**[F2]**	**[A]**
Correct Corrects entered data; used in conjunction with other function keys to make corrections to codes or messages.	**[F4]**	**[C]**
End Erases data in the current field, or acts as an escape key, exiting a menu or function and returning to the APD.	**[FNCTN] [ESC]**	**[END]**
Skip Enters a Skip Code in the reading field which specifies the reason a reading was not entered.	**[E]**	**[E]**
Trouble Enters a Trouble Code, designating that an unusual condition or problem exists at the meter.	**[F]**	**[F]**

Function	ROADRUNNER X7	Telxon 860
Survey Survey messages are displayed and allows the meter reader to enter survey responses.	**[G]**	**[G]**
Interrogate Allows manual interrogation of FIREFLYs one at a time.	**[I]**	**[I]**
Special Message Displays special messages, if present, which have been sent from the Host. If used in conjunction with the **[CORRECT]** key, a special message may be entered.	**[J]**	**[J]**
Totals Displays the total number of normal, demand, checks and total devices in the route. Also displays the total devices read, skipped, blank, with trouble codes, failed audits and the route number.	**[K]**	**[K]**
New Meter Adds a new meter to the current route.	**[L]**	**[L]**
Shift On the X7, switches between upper and lower case alpha characters. On the 860ES, switches back and forth between the numeric function mode and alpha mode.	⬆	**[SHIFT]**
Account Info Displays the customer's name, address, account number, and sequence number.	**[N]**	**[N]**
Meter Info Displays the device information associated with the device record displayed on the APD. Information includes meter number, meter type, number of dials and number of decimals.	**[O]**	**[O]**
Route Info Displays route information including route number, current date and time, meter reader ID, total meters, total read, total skips, total blanks, trouble codes, and failed audits. A second screen contains vehicle information including vehicle ID, and beginning and ending mileage.	**[P]**	**[P]**
Clear Erases data in the current field.	**[FNCTN] [DEL]**	**[CLEAR]**
Account Number Displays the account number during a search, correction, or view.	**[Q]**	**[Q]**
Meter Number	**[R]**	**[R]**

Function	ROADRUNNER X7	Telxon 860
Displays the meter number during a search, correction, or view.		
Sequence Number Displays the sequence number during a search, correction, or view.	[S]	[S]
Top Scrolls backward through the route and may also be used as a backspace when entering data in a field. Finds the beginning of a route when used with the **[SEARCH]** key. _TIP: Press the **[SEARCH]** then the **[TOP]** key to find the beginning of the route._	◁ [F2] △	[A] ◁
Instruction Displays the instruction message during a search, correction, or view.	[T]	[T]
Location Displays the meter location during a search, correction, or view.	[U]	[U]
Read Type Displays the meter type during a search or correction.	[V]	[V]
Bottom Scrolls forward through the route and to the next meter in a route. Finds the end of a route when used with the **[SEARCH]** key. _TIP: Press the **[SEARCH]** then the **[BOTTOM]** key to find the end of the route._	▷ [F2] ▽	[A] ▷
Blank Displays blank devices during a search.	[W]	[W]
Constant Displays the device constant during a search, correction, or view.	[X]	[X]
Previous Est Displays the previous estimate for a device.	[Y]	[Y]
Repeat Repeats the last search criteria entered.	[F2] [ENTER]	[A] [ENTER]

Function	ROADRUNNER X7	Telxon 860
No Responds "NO" to Yes/No questions.	**[ESC]**	**[NO]**
Space Enters a space when typing in text.	**[SP]**	**[SP]**
Enter/Yes Accepts entry of information typed in for is the 'Yes' answer for Yes/No questions.	**[ENTER]**	**[ENTER]**
FIREFLY Menu Displays the FIREFLY Menu when the ROADRUNNER application includes AMR.	**[F5]**	**[SHIFT] [I]**
Backspace Move the cursor to the left one character and erases the character.	**[BKSP]** **OR** ◁	◁

Keyboards

Telxon 860ES   **ROADRUNNER X7**

Radio Frequency Receiving Unit (RFRU)

The ROADRUNNER Radio Frequency Receiving Unit (RFRU) receives and buffers radio readings, then downloads them to the ROADRUNNER handheld unit when interrogated ("I" key).

The ROADRUNNER RFRU is an integrated, internal unit, powered by a rechargeable NiCad battery pack.

FCC ID: ODYD740 Datamatic, Ltd.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two 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.

***WARNING**: These devices operate under Part 15 of the FCC rules. Modifications to these devices not expressly authorized by Datamatic, Ltd. May affect your ability to legally operate these devices.*

Programming/Profiling Unit (PPU)

The Programming/Profiling Unit (PPU) is used to configure the MIUs, and to extract ProfilePlus historical reading information.

The PPU creates a "positive snap" interface with the MIU for hands-free operation, and when cabled to the ROADRUNNER handheld, enables communication.

The PPU is powered with one 9-volt battery.

Programming/Profiling Unit (PPU) Cable

A cable is used to connect the PPU to a ROADRUNNER for programming and extraction of profile data.

Config Tester (CT)

The Config Tester (CT) is similar to the PPU. It is a stand-alone device for resetting the FIREFLY to dormant and factory configurations. Once coupled with the MIU and activated, there are three lights to display the status:

> Yellow = Updating
> Green = Successful
> Red = Unsuccessful

FIREFLY Meter Interface Unit (MIU) – Water

The FIREFLY Meter Interface Unit (MIU) tracks and transmits reading data. Each MIU includes ProfilePlus that tracks and stores over 1,700 of the most recent readings. For example, the MIU can be configured to record 72+ days of hourly consumption readings, enabling the resolution of billing complaints.

The FIREFLY signal includes the meter number, meter reading, battery voltage, tamper flag, and a leak indicator.

The FIREFLY MIU is powered with a 3.6-volt lithium chloride D-cell battery.

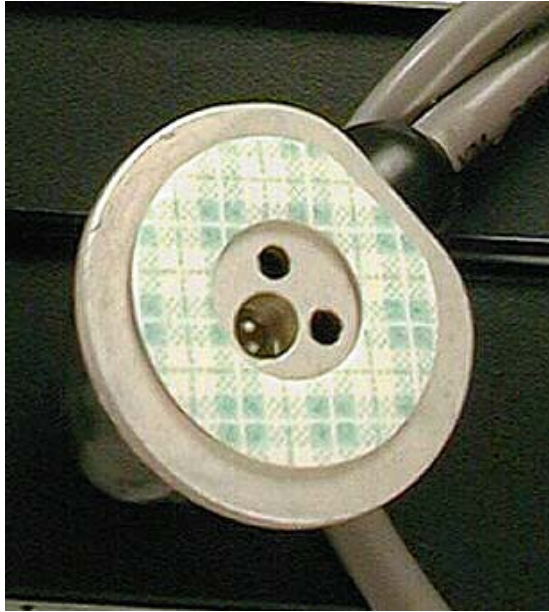|	
Material:	Polycarbonate
Construction:	Ultrasonic welding

Temperature Rating:	-40° F to 185° F
Radio communications:	916.5 MHz
Radiated power:	1 milliwatt per millisecond

FIREFLY Optical Sensor

The FIREFLY MIU uses a unique and highly sophisticated optical sensor unit to track meter activity. An infrared strobe is integrated into the sensor and generates its own light, regardless of ambient conditions. The sensor is oriented so that the register needle approaches the sensor from the cable side and perpendicular to the cable. The indicators on the top side of the sensor need to be aligned with the passing sweep hand. As the needle sweeps past the sensor, it changes the light reflected back from the meter face, and an incremental count is registered.

The Optical Sensor is affixed to the meter face using a high-bond adhesive tape. Specifications for the tape follow.

Optical Sensor Tape Specification

|	
Manufacturer	3M.
Part Number	4951VHB.
Material	Acrylic Foam-Closed Cell.
Thickness	.045 inch.
Color	White.
Release Liner	.002 inch clear polyester.
Application Temp	32°+ Fahrenheit.
Curing	24 hours minimum.
Peel Adhesion Test	18lb. per square inch (to stainless at room temp).
ASTM	B-3330. D-897.
Tensile Strength	110 lbs. per square inch.
Static/Sheer Test	At 72 degrees – 1250 lbs.
(Slide pressure)	At 150 degrees – 500 lbs.

Temperature Tolerance	300 degrees

Electric FIREFLY MIU
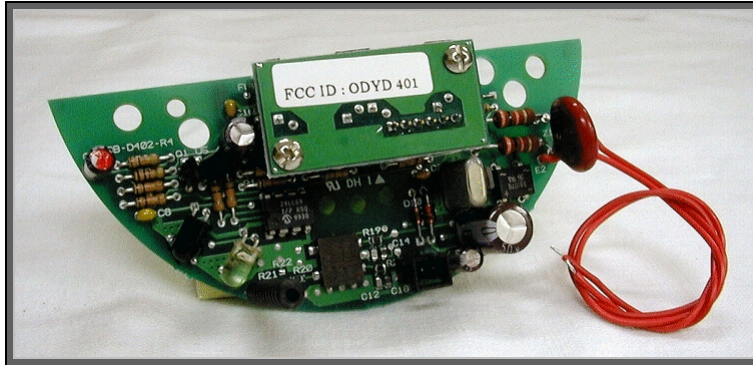
Meter Reading

 The Electric FIREFLY MIU unit counts disc rotations, which are typically 7.2 watt-hours per rotation. The meter reading is stored in a 32-bit register in units of 0.1 watt-hours with a rollover at 99,999,999.9 watt-hours. The sensor constant, watt-hours per rotation, is set in the configuration data, and is typically initialized to 72 decimal (48 hexadecimal).

The meter reading tracks the electric meter mechanical registers, this includes both forward and reverse rotations. That is, when the meter rotates forward, the meter reading goes up, and if the meter rotates in reverse direction, the electronics reading decreases just as the mechanical register decreases. The reverse rotation reading is also stored in a 32-bit register, which cumulates the reverse rotations in units of 0.1 watt-hours. This reverse rotation register increases only with reverse rotations; it never decreases.

Demand Data

Demand data is based on the change in the meter reading register over a demand interval. The demand interval is fixed to 15 minutes. The demand is recorded in units of kilowatts. Demand is only calculated on the net forward power for the interval. If there is net reverse consumption for the interval, then that interval is discarded. The peak demand of the current 30-day cycle that is in process and the peak demand of the previously completed 30-day cycle are stored.

Profile Data

The unit gathers and stores consumption profile data. The individual profile data elements are calculated from the change in the meter reading over the interval time, and then divided by the scale factor. The profile data is gathered according to configurable parameters, interval length, and scale factor. Valid values gathered range from + 32768 to –32767; positive and negative consumption is monitored. The data is stored in non-volatile memory in a LIFO (Last In, First Out) manner. A total of 3,968 intervals are saved in the LIFO. The profile data is extracted from the optical port using the optical interface and handheld computer.

Powering

The unit is powered from the 240VAC line or through the battery connector with five to12-volts or both simultaneously. The current from the AC line has been limited to about 4 milliamps for safety considerations. Beware that the unit is not grounded, but is floating at the AC line potential. ***DO NOT TOUCH*** the electronics when connected to 240VAC. Also be aware that the resistors that connect to the AC line do heat up. Typically, a 1/4 to 1/2 watt is being dissipated continuously.

Electric FIREFLY Specifications

Functional	
Meter reading	9 digit 99,999,999.9 watt-hours, 0.1 watt-hour units; tracks mechanical register—forward and reverse.
Reverse meter reading	9 digits 99,999,999.9 watt-hours, 0.1 watt-hour units cumulative reverse consumption.
Meter constant	User configurable, 0.1 watt-hour revolution. Typically 7.2 watt-hours per rotation: constant 72.
Reverse rotation flags	Set if reverse rotation observed, 2 day FIFO.
Demand data	Units of kilowatts, constant 72 15-minute demand, and 30-day interval, 2 interval FIFO.
Power outage	Counts and day/time stamps power outage.
Profile data	User set interval, between 1 minute and 4 1/4 hours. User set scale factor. Signed 16-bit data. Units of 0.1 watt-hours, adjusted by scale factor. 3968 intervals in FIFO organization. *Example: 15 minutes per interval provides 43 days data.*
Sensor tamper	Counts and day/time stamps abnormal sensor values.
Local clock	Crystal based.

Operating	
Operating temperature	-8° to +117° F.
Operating voltage	230 VAC nominal.
Operating current	4 milliamps.
Size of unit	4.5" x 2.0" x 0.8" approx.
Size of optical sensor	1.25" oval, 1" high (to verify).
Weight	1.4 oz (40 grams).
Local clock	Crystal based, nominal 100ppm.
Sensor	Infrared, optical.
Meter disk marking	Black decal/Painted disk.

Radio communications

FCC Part 15.	Unlicensed low power 902-928MHz band .
Data rate	9600 BPS.
Radiated power	Per low power requirement 1 milliwatt nominal.

Note: 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 radiates radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation.

If this equipment causes interference to radio or television reception, as 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 between the equipment and the 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.

Optical port programming unit interface
19.2 KBPS