TRANSPARENT TECHNOLOGIES

M2 Utility Radio

Operations Manual

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Version

M2 Version 01.14

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M2

Utility
Radio
Transceiver

Operations Manual

OVERVIEW

M2

Utility
Radio
Transceiver

Universal
The M2 radio is a universal AMR device designed for every utility. Encoder and digital inputs for all major water meter registers.

Simple
The M2 operates in an unlicensed mode in the 900-Mhz range which requires no utility regulation. The radio is easily configured and interfaced with an off-the-shelf PDA or via the G2 Mobile System.

Powerful
In addition to reliable meter reading, the M2 also provides powerful datalogging, consumption profiling and leak detection. The M2 transmits basic meter consumption data and customer service information through the RF signal.

Basic Specifications

Transmission:	One-Way
Config/Datalogging:	Two-Way (unregulated)
Regulatory:	FCC 15.247
Temperature:	-40°F to 158°F (-40°C to +70°C)
Humidity:	100%
Submersion:	IP-68 Rating Fully submersible
Packaging:	PCB 100% encapsulated
Housing:	Neutral or Clear Polycarbonate
Interface:	All Major Encoders All Major SC/Pulse See Chart
Battery:	Replaceable 19.0 A-hr D-cell
Battery Life:	Up to 20 years

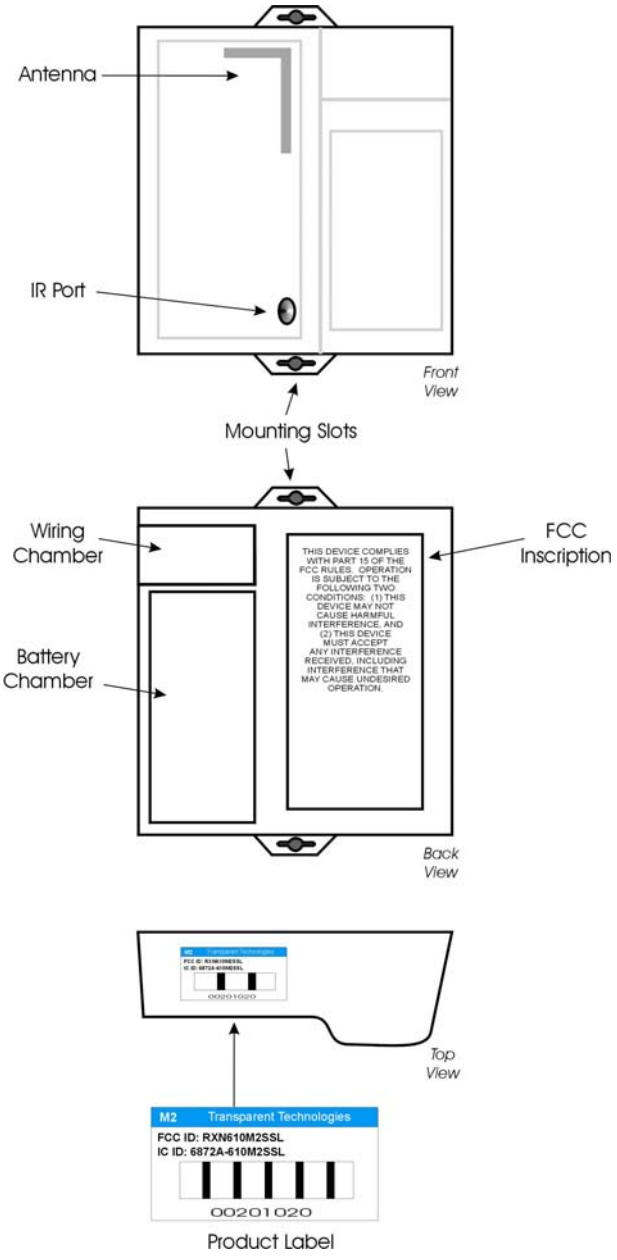
M2 Packaging

The M2 is housed in a polycarbonate shell with multiple levels of waterproofing. The housing is available in either a clear or smoke tint.

The housing is assembled with a UV-cure adhesive which provides the first level of environmental protection. The radio electronics are 100% encapsulated in a dielectric gel for 100% moisture protection. Finally, all cable entry/exit points are sealed with gel grommets to protect against long-term moisture penetration.

The rear of the radio unit provides the access chambers for the wiring connections and the replaceable battery.

The product label indicates a model number, a lot/serial number and the FCC identifier.



INSTALLATION & WIRING

Installation

The M2 is designed for all environments and can be installed either in indoor or outdoor environments.

Mounting Orientation

The most important consideration is to keep the M2 radio unit **UPRIGHT** when it is installed.

The antenna is located on the top of the radio board and the RF transmission pattern is optimized with an upright orientation.

In the UPRIGHT position:

- The hanging slot is at the top of the unit
- The T2 logo will be readable at the top of the housing
- The battery will be at the bottom

Other primary considerations for optimum transmission:

- Avoid mounting the radio unit directly against metal surfaces (pipes, valves, etc.)
- Avoid mounting the unit below typical water levels.
- Do NOT drive screws or mounting hardware into the unit's plastic housing.
- Always mount the unit at the highest grade possible.

In all cases, the installer should experiment with mounting techniques and RF performance prior to mass quantity installation.

Pit & Vault Installations

For best transmission, the unit should not be mounted directly on any metal surfaces, such as pipes or valves, or mounted below known water levels.

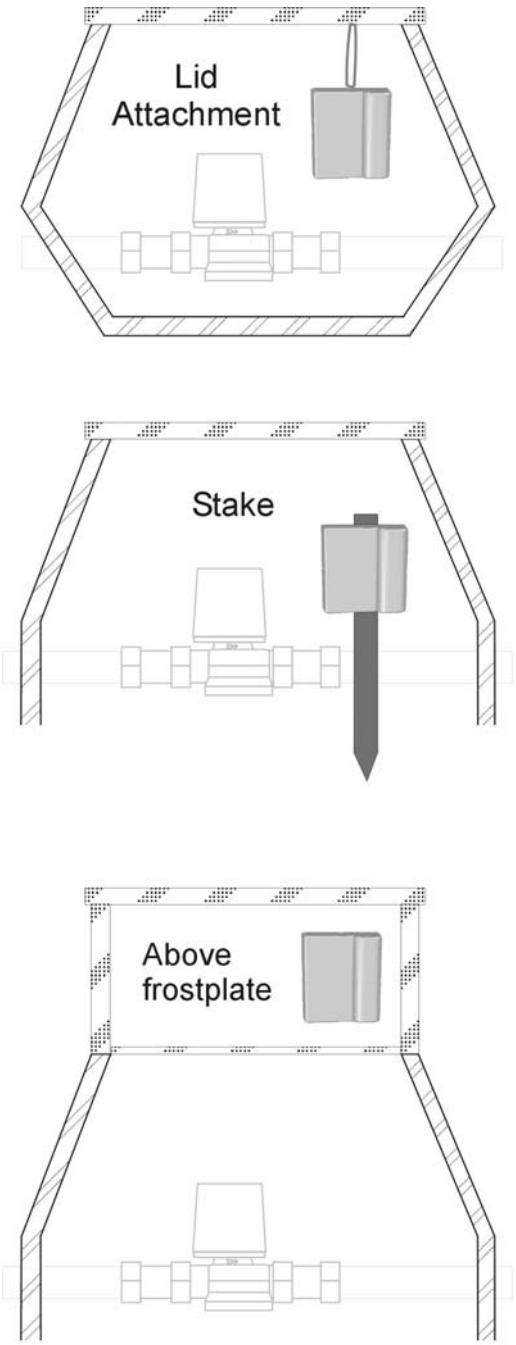
The M2 has multiple mounting options, including a slot for wire ties to hang the M2, attach on a plastic stake or screw directly onto a wall.

An effective mounting technique for commercial meter vaults is to hang the M2 unit from a fixture (such as a ladder rung or the lid itself) near the top of the vault. Proper mounting in these types of vaults is essential for good RF performance.

For smaller vaults and meter boxes, a variety of acceptable mounting options are available. Two simple methods are hanging from the lid/cover and staking into the ground.

If time and space are available, the M2 can also be mounted on the side of a pit with a wall bracket.

For vaults or pits with metals lids, the M2 should be optimally mounted 6-18 inches below the lid/cover.



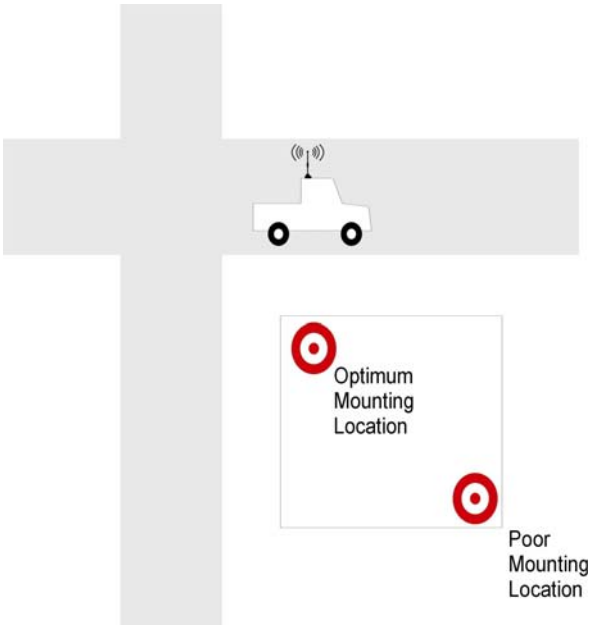
example
meter box
installations

Indoor & Wall Installations

For best transmission, the unit should not be mounted backing on metal surfaces, reinforced concrete or other dense surfaces.

In indoor mounting situations, a higher mounting site will improve RF performance.

Also, the optimum mounting location will be closer to the reading location (i.e. the street, parking lot, etc.)



In below grade sites (e.g. basements), the installer should experiment with the best location before the final mounting. In these instances, the direction/bearing of the receiver should be considered.

For instance, if a unit is to be mounted in a basement with reinforced concrete walls, the best mounting location could be on the opposite wall, although this increases the overall distance.

Wiring

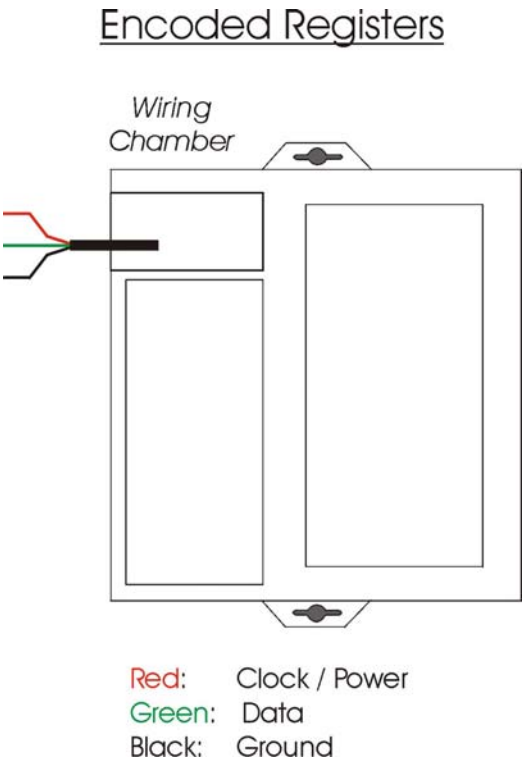
Encoders
As a default communication The M2 utilizes the ECR-II communications defacto-standard wiring conventions for encoder interfaces:

Red: Clock/PWR
Green: Data
Black: Ground

This wiring convention should be consistent with all Metron-Farnier, ECR-II and ECR-III registers.

The unit can be ordered with a pre-wired cable in 5-ft increments. In this case, the cable with leads will exit on the side or bottom of the unit.

For field retrofit applications, the unit can be ordered with leads ready for splicing in the wiring chamber.



Note: Always terminate the ground wire (black) first when wiring the unit.

Wire Connections

The wiring connections are critical for reliable radio-to-register communications.

T2 recommends the use of 3m gel-cap type terminations. These connectors and the crimping tools are available at many hardware stores and online distributors.

Follow directions included with the gel-cap packaging to ensure proper terminations.

Pulse Wiring
For standard pulse wiring, the red and black wires should be connected to the pulse output of the register.

Check the T2 wiring guide for color coding for most registers.

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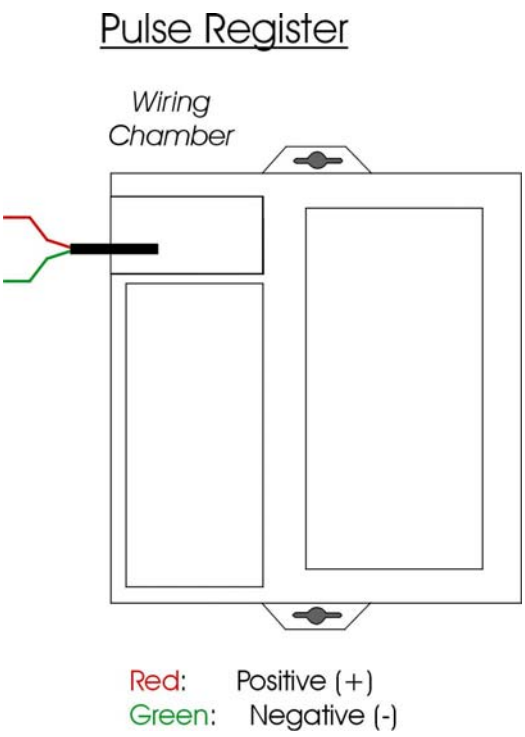

Note: Always terminate the ground wire (black) first when wiring the unit.

Wiring Chart

Encoded Registers

	M2 Radio		
	Clk/Power RED	Data GREEN	Ground BLACK
Metron-Farnier			
Hawkeye OER	RED	GREEN	BLACK
MIU	RED	GREEN	BLACK
Sensus			
ICE (ECR-III)	RED	GREEN	BLACK
ECR-II	RED	GREEN	BLACK
Neptune			
ARB-V (Potted cable)	BLACK	RED	GREEN
ARB-V (terminal blocks)	B	R	G
ProRead (Potted cable)	BLACK	RED	GREEN
ProRead (terminal blocks)	B	R	G
Auto (Potted cable)	BLACK	RED	GREEN
Auto (terminal blocks)	B	R	G
Hersey			
Translator	RED	GREEN	BLACK
Badger			
ADE	RED	GREEN	BLACK
Elster (ABB/AMCO)			
Invision/Scancoder	RED	GREEN	BLACK
Fusion/Sevren-Trent			
Smartmeter	RED	GREEN	BLACK
Any Pre-wired Itron			
Pre-wired ERT cable	BLACK	RED	BARE

Notes

1. Due to changes in manufacturer's products, T2 cannot guarantee the accuracy of the wiring chart.
2. TB refers to terminal blocks located on the register head
3. Metron-Farnier, Sensus, Neptune, Badger, Hersey, Elster Sevren-Trent and Itron and associated product names are reserved names or trademarks.

Wiring Chart

Switch & Pulse Registers

	M2 Radio	
	Positive + RED	**Negative -** GREEN
Metron-Farnier		
Hawkeye OER Switch	RED	BLACK
Hawkeye OER DHP	RED	BLACK
Sensus (Rockwell)		
Pulse Generator	TB+	TB-
Pulse Generator	RED	BLACK
Neptune/Schlumberger		
Pulse Generator	TB+	TB-
Hersey		
Switch	RED	WHITE
Badger		
RTR	RED	BLACK
Read-O-Matic	TB+	TB-
Elster (ABB/AMCO)		
Switch	RED	BLUE
Any Pre-wired Itron Switch		
Pre-wired ERT cable	BLACK	RED
Magmeters		
Low Freq. Output	Check with T2	

Notes

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OPERATION

Operation

The M2 radio operation is covered in five topics:

- ON/OFF Control
- Configuration
- Meter Reading
- Datalogging
- RF Operations

Refer to the Appendix of this manual for additional instructions on the operation of the M2 radio.

Also refer to the Field PDA manual for additional programming details.

This section only provides an overview on these topics.

ON/OFF Control

If the M2 radio has been purchased as a separate unit, it will be shipped in the default setting. This will be in the OFF mode.

The Field PDA, H2 handheld or G2 provides the ability to set the M2 into one of three modes:

OFF: The RF transmission, meter interface and all data functions are off. The unit will monitor the IrDA port for ON/OFF commands.

Standby: The RF transmission function is off but the meter interface and all data functions are on. The unit will monitor the IrDA port for ON/OFF commands.

ON: The RF transmission, meter interface and all data functions are on. The unit will monitor the IrDA port for ON/OFF commands.

Configuration

The M2 radio is a flexible unit with configuration options available for tailoring the unit for a specific utility's needs.

Field PDA
The configuration is performed by the T2 Field PDA (FPDA). ***Refer to the FPDA Manual for detailed instructions on the configuration process.***

Configurable Parameters
The following items are configurable on the M2 radio:

Meter Settings
This screen allows the user to customize the settings the radio uses for the meter interface.

Transmit Settings
This screen allows the user to customize the settings the radio uses during its RF transmission. This screen also contains the settings for the Conservation function.

Log Settings
This screen allows the user to customize the settings the radio uses during its data functions:

- Datalogging
- Leak Detection
- High Usage
- Backflow
- Zero Usage

M2 Configuration Parameters

Meter Settings
ID Type
Input Type
Encoder Value
Pulse Value
# of Encoder Digits
Meter Units
Meter Size
Meter Type
Meter Read (Pulse Inputs)

Transmit Settings
Transmit Scaling
Transmit Period
Group ID (extended ID)

Conservation Settings
Unallowable Begin Time
Unallowable End Time
Allowable Hourly Threshold
Allowable Days

Log Settings
Query Interval
Log Interval.

Leak Detection
- Leak Window
- Leak Period

High Usage
- High Usage Threshold
- High Usage Days

Backflow Detection
- Trigger level

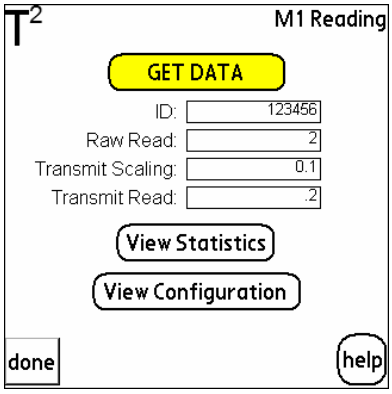
Zero Usage
- # of Days for trigger

Meter Reading

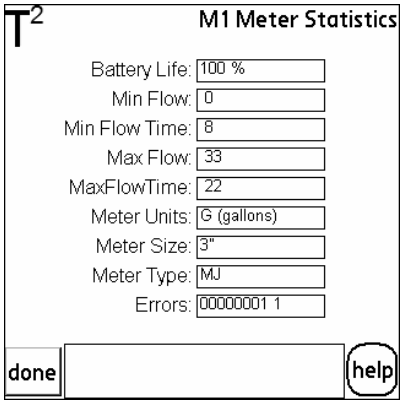
Local Data Access

The M2 radio can be read locally via the FPDA or the H2 handheld.

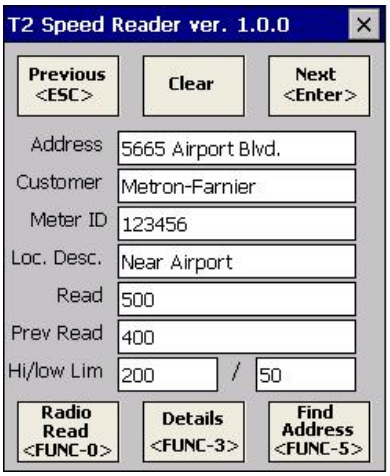
All configuration, meter reading and datalogs are accessible with the PDA software, the H2 software or with the G2 software



Meter Reading PDA Screen



Meter Statistics PDA Screen



Meter Reading H2 Handheld Screen

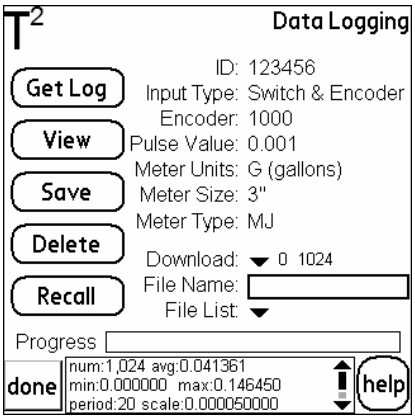
Datalogging

The M2 radio logs data as an enhanced data function.

The basic data functions of the M2 radio – leak detection, backflow, high usage – are all detectable through the normal remote AMR operations (via the reading system).

The datalogging function offers a first-hand customer-service tool to examine the consumption pattern of a specific meter. For instance, if a customer has been flagged as having a possible leak, the water utility can use the FPDA, H2 or G2 to download the meter/radio's data and immediately discuss the site's usage data.

The FPDA, H2 and G2 will allow the user to view the data in a time bucket format (1, 2, 4, 6, 12 or 24 hr) consumption bar chart format or in a flowrate line graph (for pulse-based systems only)



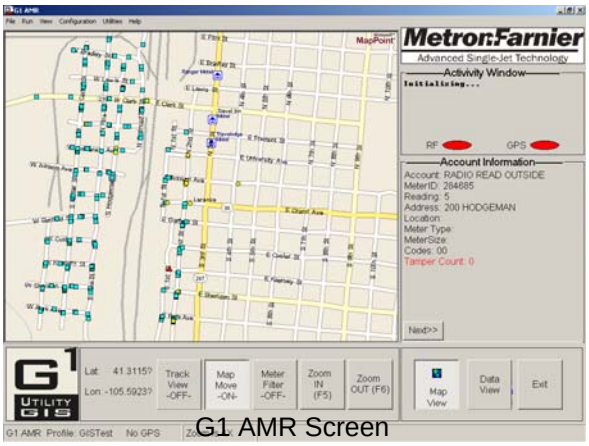
Data Logging PDA Screen

RF Operations
- Normal AMR Reading

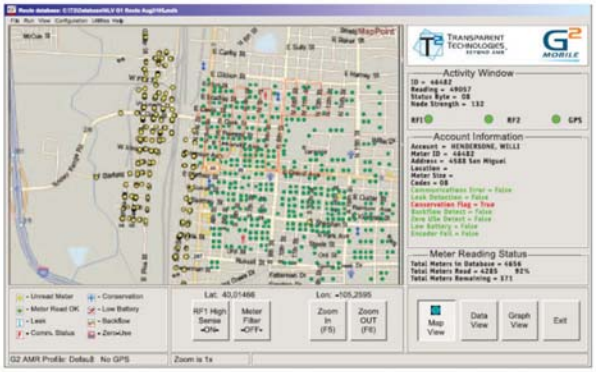
The M2 radio transmits its RF signal on a regular interval (set by the transmit interval). The data is received by the R1 or R2 mobile AMR receiver. The R2 is a transceiver which provides the two-way capability for the G2 software.

The following data is available through the RF transmission:

- Meter Reading
- ID Number
- Leak Detect Flag
- Conservation Violation
- Backflow Flag
- High Usage Flag
- Zero Usage Flag
- Low Battery Flag
- Register Fault Flag
- Register Communications Status



G1 AMR Screen



G2 AMR Screen

BATTERY

The M2 radio has a replaceable battery with an anticipated battery life of 20 years
.

Battery Specifications

Mfg:	Vitzrocell
Type:	Thionyl Lithium Chloride
Size:	D-cell
Capacity:	19.0 A-hr

Battery Life

All battery calculations include a environmental impact factor and use a baseline of regular function usage (PDA reads, datalogging, etc.)

The M2's transmit period is directly related to the battery life of the M1 radio. The RF transmission is the largest power consumer and thus drives battery life.

Check with Transparent Technologies for a detailed battery life calculation based on specific configurations.

Battery Replacement
Transparent Technologies can provide replacement batteries for M2 radios.

The battery is replaced by first removing the battery cover and then removing the battery cell. The battery is connected to the board with a quick disconnect plug. Some versions do not have a connector. In these cases, the battery wires can be cut and spliced with standard gecap connectors.

The replacement battery will come with the identical plug.

Once the replacement battery has been re-installed, the battery chamber will need to be filled with commercial grade silicone filler for waterproofing.

A

APPENDIX – M2 CODES

The following charts present all possible codes/flags generated by the M2 radio.

M2Codes

version 2.00

Conservation	Register Fault	Zero Usage	Low Battery	High Usage	Comm Error	Backflow	Leak Detect	Transmit Code	
7	6	5	4	3	2	1	0	Code	
0	0	0	0	0	0	0	0	**00**	**No Flags/Errors**
0	0	0	0	0	0	0	1	**01**	**Leak Detect**
0	0	0	0	0	0	1	0	**02**	**Backflow**
0	0	0	0	0	0	1	1	**03**	
0	0	0	0	0	1	0	0	**04**	**Comm Error**
0	0	0	0	0	1	0	1	**05**	
0	0	0	0	0	1	1	0	**06**	
0	0	0	0	0	1	1	1	**07**	
0	0	0	0	1	0	0	0	**08**	**High Usage**
0	0	0	0	1	0	0	1	**09**	
0	0	0	0	1	0	1	0	**10**	
0	0	0	0	1	0	1	1	**11**	
0	0	0	0	1	1	0	0	**12**	
0	0	0	0	1	1	0	1	**13**	
0	0	0	0	1	1	1	0	**14**	
0	0	0	0	1	1	1	1	**15**	
0	0	0	1	0	0	0	0	**16**	**Low Battery**
0	0	0	1	0	0	0	1	**17**	
0	0	0	1	0	0	1	0	**18**	
0	0	0	1	0	0	1	1	**19**	
0	0	0	1	0	1	0	0	**20**	
0	0	0	1	0	1	0	1	**21**	
0	0	0	1	0	1	1	0	**22**	
0	0	0	1	0	1	1	1	**23**	
0	0	0	1	1	0	0	0	**24**	
0	0	0	1	1	0	0	1	**25**	
0	0	0	1	1	0	1	0	**26**	
0	0	0	1	1	0	1	1	**27**	
0	0	0	1	1	1	0	0	**28**	
0	0	0	1	1	1	0	1	**29**	
0	0	0	1	1	1	1	0	**30**	
0	0	0	1	1	1	1	1	**31**	
0	0	1	0	0	0	0	0	**32**	**Zero Usage**
0	0	1	0	0	0	0	1	**33**	
0	0	1	0	0	0	1	0	**34**	
0	0	1	0	0	0	1	1	**35**	
0	0	1	0	0	1	0	0	**36**	
0	0	1	0	0	1	0	1	**37**	
0	0	1	0	0	1	1	0	**38**	
0	0	1	0	0	1	1	1	**39**	
0	0	1	0	1	0	0	0	**40**	
0	0	1	0	1	0	0	1	**41**	
0	0	1	0	1	0	1	0	**42**	
0	0	1	0	1	0	1	1	**43**	

M2Codes

version 2.00

Conservation	*Register Fault*	*Zero Usage*	*Low Battery*	*High Usage*	*Comm Error*	*Backflow*	*Leak Detect*	***Transmit Code***	
7	6	5	4	3	2	1	0	Code	
0	0	1	0	1	1	0	0	**44**	
0	0	1	0	1	1	0	1	**45**	
0	0	1	0	1	1	1	0	**46**	
0	0	1	0	1	1	1	1	**47**	
0	0	1	1	0	0	0	0	**48**	
0	0	1	1	0	0	0	1	**49**	
0	0	1	1	0	0	1	0	**50**	
0	0	1	1	0	0	1	1	**51**	
0	0	1	1	0	1	0	0	**52**	
0	0	1	1	0	1	0	1	**53**	
0	0	1	1	0	1	1	0	**54**	
0	0	1	1	0	1	1	1	**55**	
0	0	1	1	1	0	0	0	**56**	
0	0	1	1	1	0	0	1	**57**	
0	0	1	1	1	0	1	0	**58**	
0	0	1	1	1	0	1	1	**59**	
0	0	1	1	1	1	0	0	**60**	
0	0	1	1	1	1	0	1	**61**	
0	0	1	1	1	1	1	0	**62**	
0	0	1	1	1	1	1	1	**63**	
0	1	0	0	0	0	0	0	**64**	**Register Fault**
0	1	0	0	0	0	0	1	**65**	
0	1	0	0	0	0	1	0	**66**	
0	1	0	0	0	0	1	1	**67**	
0	1	0	0	0	1	0	0	**68**	
0	1	0	0	0	1	0	1	**69**	
0	1	0	0	0	1	1	0	**70**	
0	1	0	0	0	1	1	1	**71**	
0	1	0	0	1	0	0	0	**72**	
0	1	0	0	1	0	0	1	**73**	
0	1	0	0	1	0	1	0	**74**	
0	1	0	0	1	0	1	1	**75**	
0	1	0	0	1	1	0	0	**76**	
0	1	0	0	1	1	0	1	**77**	
0	1	0	0	1	1	1	0	**78**	
0	1	0	0	1	1	1	1	**79**	
0	1	0	1	0	0	0	0	**80**	
0	1	0	1	0	0	0	1	**81**	
0	1	0	1	0	0	1	0	**82**	
0	1	0	1	0	0	1	1	**83**	
0	1	0	1	0	1	0	0	**84**	
0	1	0	1	0	1	0	1	**85**	
0	1	0	1	0	1	1	0	**86**	
0	1	0	1	0	1	1	1	**87**	

M2Codes

version 2.00

Transmit Code

Conservation	*Register Fault*	*Zero Usage*	*Low Battery*	*High Usage*	*Comm Error*	*Backflow*	*Leak Detect*	Code	
7	6	5	4	3	2	1	0		
0	1	0	1	1	0	0	0	**88**	
0	1	0	1	1	0	0	1	**89**	
0	1	0	1	1	0	1	0	**90**	
0	1	0	1	1	0	1	1	**91**	
0	1	0	1	1	1	0	0	**92**	
0	1	0	1	1	1	0	1	**93**	
0	1	0	1	1	1	1	0	**94**	
0	1	0	1	1	1	1	1	**95**	
0	1	1	0	0	0	0	0	**96**	
0	1	1	0	0	0	0	1	**97**	
0	1	1	0	0	0	1	0	**98**	
0	1	1	0	0	0	1	1	**99**	
0	1	1	0	0	1	0	0	**100**	
0	1	1	0	0	1	0	1	**101**	
0	1	1	0	0	1	1	0	**102**	
0	1	1	0	0	1	1	1	**103**	
0	1	1	0	1	0	0	0	**104**	
0	1	1	0	1	0	0	1	**105**	
0	1	1	0	1	0	1	0	**106**	
0	1	1	0	1	0	1	1	**107**	
0	1	1	0	1	1	0	0	**108**	
0	1	1	0	1	1	0	1	**109**	
0	1	1	0	1	1	1	0	**110**	
0	1	1	0	1	1	1	1	**111**	
0	1	1	1	0	0	0	0	**112**	
0	1	1	1	0	0	0	1	**113**	
0	1	1	1	0	0	1	0	**114**	
0	1	1	1	0	0	1	1	**115**	
0	1	1	1	0	1	0	0	**116**	
0	1	1	1	0	1	0	1	**117**	
0	1	1	1	0	1	1	0	**118**	
0	1	1	1	0	1	1	1	**119**	
0	1	1	1	1	0	0	0	**120**	
0	1	1	1	1	0	0	1	**121**	
0	1	1	1	1	0	1	0	**122**	
0	1	1	1	1	0	1	1	**123**	
0	1	1	1	1	1	0	0	**124**	
0	1	1	1	1	1	0	1	**125**	
0	1	1	1	1	1	1	0	**126**	
0	1	1	1	1	1	1	1	**127**	
1	0	0	0	0	0	0	0	**128**	**Conservation**
1	0	0	0	0	0	0	1	**129**	
1	0	0	0	0	0	1	0	**130**	
1	0	0	0	0	0	1	1	**131**	

M2Codes

version 2.00

Conservation	Register Fault	Zero Usage	Low Battery	High Usage	Comm Error	Backflow	Leak Detect	Transmit Code
7	6	5	4	3	2	1	0	Code
1	0	0	0	0	1	0	0	**132**
1	0	0	0	0	1	0	1	**133**
1	0	0	0	0	1	1	0	**134**
1	0	0	0	0	1	1	1	**135**
1	0	0	0	1	0	0	0	**136**
1	0	0	0	1	0	0	1	**137**
1	0	0	0	1	0	1	0	**138**
1	0	0	0	1	0	1	1	**139**
1	0	0	0	1	1	0	0	**140**
1	0	0	0	1	1	0	1	**141**
1	0	0	0	1	1	1	0	**142**
1	0	0	0	1	1	1	1	**143**
1	0	0	1	0	0	0	0	**144**
1	0	0	1	0	0	0	1	**145**
1	0	0	1	0	0	1	0	**146**
1	0	0	1	0	0	1	1	**147**
1	0	0	1	0	1	0	0	**148**
1	0	0	1	0	1	0	1	**149**
1	0	0	1	0	1	1	0	**150**
1	0	0	1	0	1	1	1	**151**
1	0	0	1	1	0	0	0	**152**
1	0	0	1	1	0	0	1	**153**
1	0	0	1	1	0	1	0	**154**
1	0	0	1	1	0	1	1	**155**
1	0	0	1	1	1	0	0	**156**
1	0	0	1	1	1	0	1	**157**
1	0	0	1	1	1	1	0	**158**
1	0	0	1	1	1	1	1	**159**
1	0	1	0	0	0	0	0	**160**
1	0	1	0	0	0	0	1	**161**
1	0	1	0	0	0	1	0	**162**
1	0	1	0	0	0	1	1	**163**
1	0	1	0	0	1	0	0	**164**
1	0	1	0	0	1	0	1	**165**
1	0	1	0	0	1	1	0	**166**
1	0	1	0	0	1	1	1	**167**
1	0	1	0	1	0	0	0	**168**
1	0	1	0	1	0	0	1	**169**
1	0	1	0	1	0	1	0	**170**
1	0	1	0	1	0	1	1	**171**
1	0	1	0	1	1	0	0	**172**
1	0	1	0	1	1	0	1	**173**
1	0	1	0	1	1	1	0	**174**
1	0	1	0	1	1	1	1	**175**

M2Codes

version 2.00

Conservation	*Register Fault*	*Zero Usage*	*Low Battery*	*High Usage*	*Comm Error*	*Backflow*	*Leak Detect*	***Transmit Code***
7	6	5	4	3	2	1	0	Code
1	0	1	1	0	0	0	0	**176**
1	0	1	1	0	0	0	1	**177**
1	0	1	1	0	0	1	0	**178**
1	0	1	1	0	0	1	1	**179**
1	0	1	1	0	1	0	0	**180**
1	0	1	1	0	1	0	1	**181**
1	0	1	1	0	1	1	0	**182**
1	0	1	1	0	1	1	1	**183**
1	0	1	1	1	0	0	0	**184**
1	0	1	1	1	0	0	1	**185**
1	0	1	1	1	0	1	0	**186**
1	0	1	1	1	0	1	1	**187**
1	0	1	1	1	1	0	0	**188**
1	0	1	1	1	1	0	1	**189**
1	0	1	1	1	1	1	0	**190**
1	0	1	1	1	1	1	1	**191**
1	1	0	0	0	0	0	0	**192**
1	1	0	0	0	0	0	1	**193**
1	1	0	0	0	0	1	0	**194**
1	1	0	0	0	0	1	1	**195**
1	1	0	0	0	1	0	0	**196**
1	1	0	0	0	1	0	1	**197**
1	1	0	0	0	1	1	0	**198**
1	1	0	0	0	1	1	1	**199**
1	1	0	0	1	0	0	0	**200**
1	1	0	0	1	0	0	1	**201**
1	1	0	0	1	0	1	0	**202**
1	1	0	0	1	0	1	1	**203**
1	1	0	0	1	1	0	0	**204**
1	1	0	0	1	1	0	1	**205**
1	1	0	0	1	1	1	0	**206**
1	1	0	0	1	1	1	1	**207**
1	1	0	1	0	0	0	0	**208**
1	1	0	1	0	0	0	1	**209**
1	1	0	1	0	0	1	0	**210**
1	1	0	1	0	0	1	1	**211**
1	1	0	1	0	1	0	0	**212**
1	1	0	1	0	1	0	1	**213**
1	1	0	1	0	1	1	0	**214**
1	1	0	1	0	1	1	1	**215**
1	1	0	1	1	0	0	0	**216**
1	1	0	1	1	0	0	1	**217**
1	1	0	1	1	0	1	0	**218**
1	1	0	1	1	0	1	1	**219**

M2Codes

version 2.00

Conservation	Register Fault	Zero Usage	Low Battery	High Usage	Comm Error	Backflow	Leak Detect	Transmit Code
7	6	5	4	3	2	1	0	Code
1	1	0	1	1	1	0	0	**220**
1	1	0	1	1	1	0	1	**221**
1	1	0	1	1	1	1	0	**222**
1	1	0	1	1	1	1	1	**223**
1	1	1	0	0	0	0	0	**224**
1	1	1	0	0	0	0	1	**225**
1	1	1	0	0	0	1	0	**226**
1	1	1	0	0	0	1	1	**227**
1	1	1	0	0	1	0	0	**228**
1	1	1	0	0	1	0	1	**229**
1	1	1	0	0	1	1	0	**230**
1	1	1	0	0	1	1	1	**231**
1	1	1	0	1	0	0	0	**232**
1	1	1	0	1	0	0	1	**233**
1	1	1	0	1	0	1	0	**234**
1	1	1	0	1	0	1	1	**235**
1	1	1	0	1	1	0	0	**236**
1	1	1	0	1	1	0	1	**237**
1	1	1	0	1	1	1	0	**238**
1	1	1	0	1	1	1	1	**239**
1	1	1	1	0	0	0	0	**240**
1	1	1	1	0	0	0	1	**241**
1	1	1	1	0	0	1	0	**242**
1	1	1	1	0	0	1	1	**243**
1	1	1	1	0	1	0	0	**244**
1	1	1	1	0	1	0	1	**245**
1	1	1	1	0	1	1	0	**246**
1	1	1	1	0	1	1	1	**247**
1	1	1	1	1	0	0	0	**248**
1	1	1	1	1	0	0	1	**249**
1	1	1	1	1	0	1	0	**250**
1	1	1	1	1	0	1	1	**251**
1	1	1	1	1	1	0	0	**252**
1	1	1	1	1	1	0	1	**253**
1	1	1	1	1	1	1	0	**254**
1	1	1	1	1	1	1	1	**255**

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APPENDIX – SCALING REFERENCE

The following charts show all of the scaling options for the M2 radio.

Typically, the meter register is programmed to transmit the utility's standard billing units. The M2 radio also allows transmission scaling for datalogging and data-standardization flexibility.

Encoder Value: This is the register's data resolution (i.e. the value of the lowest digit transmitted from the register).

Transmit Scaling: This scaling factor allows the user to shift the encoded register's data (i.e. truncate or add dummy zeroes).

Billing Value: This is the "value" of the data read by the reading system and uploaded into the billing system. This is standard quantity of water billed to the end-customer.

The User must know details about the meter register and billing system prior to configuration.

The User must know the encoder value, which should be provided by the meter manufacturer.

- The Encoder Value scales the logged data to even gallon, ft3 or m3 units.

  An incorrect Encoder Value will cause inaccurate datalogs.

- The Transmit Scaling scales the raw register reading to the billing or AMR read.

  An incorrect Transmit Scaling will cause incorrect meter readings and bills

M2 Scaling Settings
Ft3 Registers **Ft3**

Encoder Value		Transmit Scaling	Billing Value
0.1	Ft3	0.001	0.0001
0.1	Ft3	0.01	0.001
0.1	Ft3	0.1	0.01
0.1	Ft3	1	0.1
0.1	Ft3	10	1
0.1	Ft3	100	10
0.1	Ft3	1000	100

Encoder Value		Transmit Scaling	Billing Value
1	Ft3	0.001	0.001
1	Ft3	0.01	0.01
1	Ft3	0.1	0.1
1	Ft3	1	1
1	Ft3	10	10
1	Ft3	100	100
1	Ft3	1000	1000

Encoder Value		Transmit Scaling	Billing Value
10	Ft3	0.001	0.01
10	Ft3	0.01	0.1
10	Ft3	0.1	1
10	Ft3	1	10
10	Ft3	10	100
10	Ft3	100	1000
10	Ft3	1000	10000

Encoder Value		Transmit Scaling	Billing Value
100	Ft3	0.001	0.1
100	Ft3	0.01	1
100	Ft3	0.1	10
100	Ft3	1	100
100	Ft3	10	1000
100	Ft3	100	10000
100	Ft3	1000	100000

Encoder Value		Transmit Scaling	Billing Value
1000	Ft3	0.001	1
1000	Ft3	0.01	10
1000	Ft3	0.1	100
1000	Ft3	1	1000
1000	Ft3	10	10000
1000	Ft3	100	100000
1000	Ft3	1000	1000000

M2 Scaling Settings
USG Registers

Encoder Value		Transmit Scaling	Billing Value
0.1	Gal	0.001	0.0001
0.1	Gal	0.01	0.001
0.1	Gal	0.1	0.01
0.1	Gal	1	0.1
0.1	Gal	10	1
0.1	Gal	100	10
0.1	Gal	1000	100

Encoder Value		Transmit Scaling	Billing Value
1	Gal	0.001	0.001
1	Gal	0.01	0.01
1	Gal	0.1	0.1
1	Gal	1	1
1	Gal	10	10
1	Gal	100	100
1	Gal	1000	1000

Encoder Value		Transmit Scaling	Billing Value
10	Gal	0.001	0.01
10	Gal	0.01	0.1
10	Gal	0.1	1
10	Gal	1	10
10	Gal	10	100
10	Gal	100	1000
10	Gal	1000	10000

Encoder Value		Transmit Scaling	Billing Value
100	Gal	0.001	0.1
100	Gal	0.01	1
100	Gal	0.1	10
100	Gal	1	100
100	Gal	10	1000
100	Gal	100	10000
100	Gal	1000	100000

Encoder Value		Transmit Scaling	Billing Value
1000	Gal	0.001	1
1000	Gal	0.01	10
1000	Gal	0.1	100
1000	Gal	1	1000
1000	Gal	10	10000
1000	Gal	100	100000
1000	Gal	1000	1000000

M2 Scaling Settings
M3 Registers

Encoder Value		Transmit Scaling	Billing Value
0.01	m3	0.001	0.00001
0.01	m3	0.01	0.0001
0.01	m3	0.1	0.001
0.01	m3	1	0.01
0.01	m3	10	0.1
0.01	m3	100	1
0.01	m3	1000	10

Encoder Value		Transmit Scaling	Billing Value
0.1	m3	0.001	0.0001
0.1	m3	0.01	0.001
0.1	m3	0.1	0.01
0.1	m3	1	0.1
0.1	m3	10	1
0.1	m3	100	10
0.1	m3	1000	100

Encoder Value		Transmit Scaling	Billing Value
1	m3	0.001	0.001
1	m3	0.01	0.01
1	m3	0.1	0.1
1	m3	1	1
1	m3	10	10
1	m3	100	100
1	m3	1000	1000

Encoder Value		Transmit Scaling	Billing Value
10	m3	0.001	0.01
10	m3	0.01	0.1
10	m3	0.1	1
10	m3	1	10
10	m3	10	100
10	m3	100	1000
10	m3	1000	10000

Encoder Value		Transmit Scaling	Billing Value
100	m3	0.001	0.1
100	m3	0.01	1
100	m3	0.1	10
100	m3	1	100
100	m3	10	1000
100	m3	100	10000
100	m3	1000	100000

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APPENDIX – LEAK DETECTION REFERENCE

The M2 Radio Leak Detection function requires a Leak Window and a Leak Period. The following chart explains the configuration of these parameters.

A

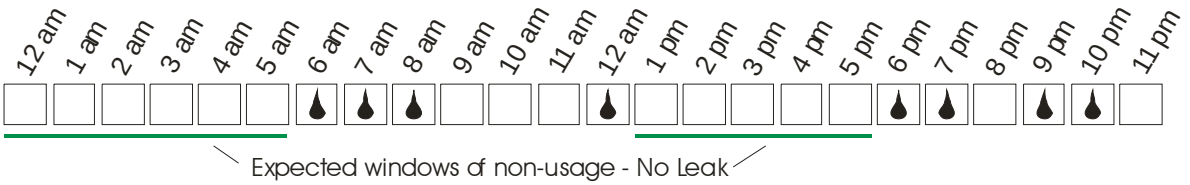
Leak Detection Function

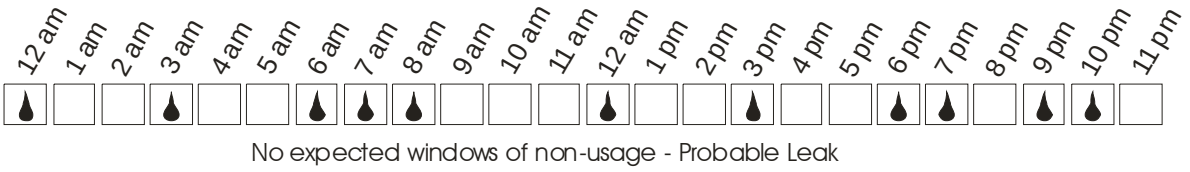
Description

The leak detection function looks for a leak by monitoring expected durations of non-usage. If water is near-continuously used in these expected non-usage periods, a leak is probable. The function allows the user to specify the duration of non-usage and the length of days to sample. This configurable leak window and periods allow the leak detection function to operate on lower resolution (i.e. 1000G or 100ft3) registers. Furthermore, the radio's real-time clock allows aggregate meter comparisons for leak and water balance studies.

Set leak window
- Number of consecutive periods of consumption.

Set leak period
- Length (in days) that the radio should look for the pattern. Lower resolution registers require longer sampling.



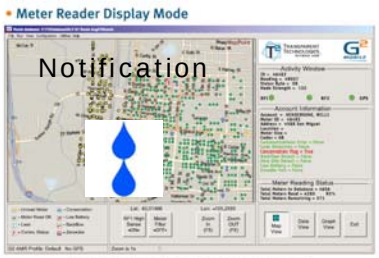


Operation

The radio monitors consumption continually. If the leak conditions are met, the radio sets a flag indicating a leak has been detected and transmits the flag with every transmission. The G2 Mobile System displays an icon for the meter indicating the possible leak and also passes this information to the Data Center or the billing system. A datalog can be downloaded showing the consumption pattern of the leak.

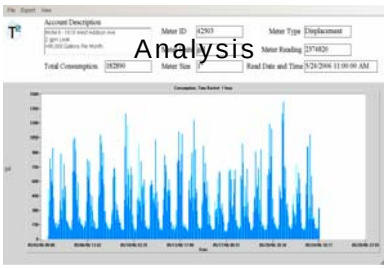
Measurement

Notification



Typical MapView of G2 Mobile Software showing dynamic customer service icons in a meter-read mode.

Analysis



M1 Settings
Leak Detection

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
0 hr	1	0	0	0	1	1	1
1 hr	0	1	0	0	0	0	0
2 hr	0	0	0	0	0	0	0
3 hr	1	1	1	1	1	1	1
4 hr	0	0	0	0	0	0	0
5 hr	0	0	0	0	0	0	0
6 hr	0	0	0	0	0	0	1
7 hr	1	1	1	1	1	1	0
8 hr	2	1	2	1	3	1	1
9 hr	0	0	0	0	0	0	0
10 hr	0	0	0	0	0	0	0
11 hr	0	0	0	0	0	0	0
12 hr	0	0	0	0	0	0	0
13 hr	0	0	0	0	0	0	0
14 hr	0	0	0	0	0	0	0
15 hr	1	1	1	1	1	1	1
16 hr	1	1	1	1	0	1	1
17 hr	1	2	0	2	2	1	2
18 hr	1	1	1	1	1	3	1
19 hr	0	0	0	0	0	0	0
20 hr	0	0	0	0	0	0	0
21 hr	0	1	0	0	0	0	0
22 hr	1	1	1	1	1	1	1
23 hr	0	0	0	0	0	0	0
24 hr	1	1	1	1	1	0	1

Leak Window: Duration (in Days) that is monitored
Leak Period: Consecutive Hours that dictate No Leak

The chart shown represents the logged consumption on an M1A radio.
Any cell with a number shows that there was at least one billing unit of water measured. Any cell with a zero indicates that less than one billing unit of water was measured.

The Leak Detect Function checks to see if there was at least one Leak Period (i.e. 4 or 6 hours) of zero consumption within the Leak Period.

M1 Settings
Leak Detection

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
0 hr	1	0	0	0	1	1	1
1 hr	0	1	0	0	0	0	0
2 hr	0	0	0	0	0	0	0
3 hr	1	0	0	0	1	0	1
4 hr	0	0	0	0	0	0	0
5 hr	0	0	0	1	0	0	0
6 hr	0	0	0	0	0	0	1
7 hr	1	1	1	1	1	1	0
8 hr	2	1	2	1	3	1	1
9 hr	0	0	1	0	0	0	0
10 hr	0	0	0	0	0	0	0
11 hr	0	0	0	0	0	0	0
12 hr	0	0	0	0	0	0	0
13 hr	0	0	0	0	0	1	0
14 hr	0	1	0	1	0	0	0
15 hr	1	1	1	1	1	1	1
16 hr	1	1	1	1	0	1	1
17 hr	1	2	0	2	2	1	2
18 hr	1	1	1	1	1	3	1
19 hr	0	0	0	0	0	0	0
20 hr	0	0	0	0	0	0	0
21 hr	0	1	0	0	0	0	0
22 hr	1	1	1	1	1	1	1
23 hr	0	0	0	0	0	0	0
24 hr	1	1	1	1	1	0	1

Leak Window: Set @ Seven (7) Days
Leak Period: Set @ Six (6) Hours

All Zero Consumption cells are highlighted YELLOW
All consecutive zero cells greater than or equal
to the Leak Window (4 hours) are outlined in RED

Since there is at least one (actually five) period of
consecutive zero flows as long as the Leak Window,
the Leak Detect Flag is set at False in the M1A

NO LEAK

M1 Settings
Leak Detection

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
0 hr	1	0	0	0	1	1	1
1 hr	0	1	1	0	0	0	0
2 hr	0	0	0	1	0	0	0
3 hr	1	0	0	0	1	0	1
4 hr	0	1	1	0	0	1	0
5 hr	0	0	0	1	0	0	0
6 hr	0	0	0	0	0	0	1
7 hr	1	1	1	1	1	1	0
8 hr	2	1	2	1	3	1	1
9 hr	0	1	1	0	0	1	0
10 hr	1	0	0	1	1	0	1
11 hr	0	1	1	0	0	1	0
12 hr	0	0	0	1	1	0	1
13 hr	1	0	1	0	0	1	0
14 hr	0	1	0	1	1	0	1
15 hr	1	1	1	1	1	1	1
16 hr	1	1	1	1	0	1	1
17 hr	1	2	0	2	2	1	2
18 hr	1	1	1	1	1	3	1
19 hr	0	0	1	0	0	0	0
20 hr	1	0	0	0	1	0	1
21 hr	0	1	0	1	0	1	0
22 hr	1	1	1	1	1	1	1
23 hr	0	0	0	0	0	0	0
24 hr	1	1	1	1	1	0	1

Leak Window: Set @ Seven (7) Days
Leak Period: Set @ Six (6) Hours

All Zero Consumption cells are highlighted YELLOW
All consecutive zero cells greater than or equal
to the Leak Window (4 hours) are outlined in RED

Since there is no period of consecutive zero flows
as long as the Leak Window,
the Leak Detect Flag is set at TRUE in the M1A

LEAK DETECTED

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APPENDIX – CONSERVATION REFERENCE

The M2 Radio Conservation function requires an unallowable start/end time, an allowable hourly threshold and allowable water days.

The following chart explains the configuration of these parameters.

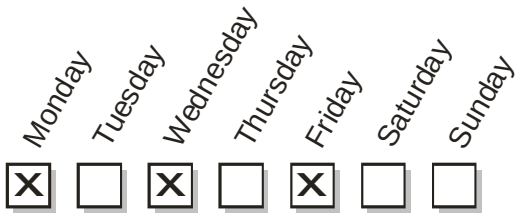
A

Conservation Function

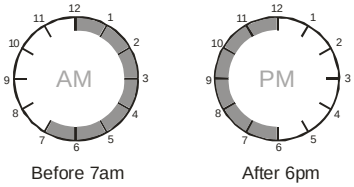
Description

The conservation function allows the user to establish allowable days, hours and consumption quantities for an account. Combinations of the allowable days and times can match virtually any conservation program's parameters. The radio's real-time clock ensures that the information matches the real-time consumption for all accounts.

Set allowable watering days
- Any combination of days
- Different for each watering group



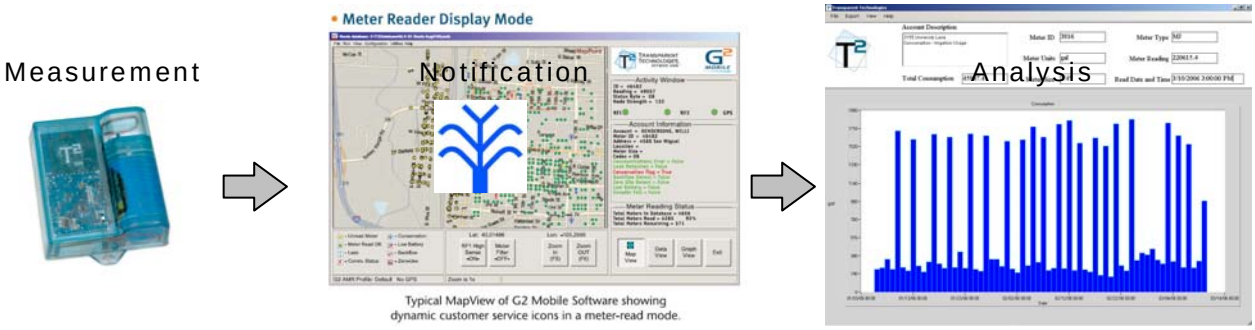
Set allowable watering times
- Before (AM)
- After (PM)



Set allowable quantity
- Determines irrigation from normal use
- Set to ZERO to turn function OFF

Operation

The radio monitors consumption continually. If the watering conditions are met, the radio sets a flag indicating a conservation violation and transmits the flag with every transmission. The G2 Mobile System displays an icon for the meter indicating the conservation violation and also passes this information to the Data Center or the billing system. A datalog can be downloaded showing the consumption pattern that caused the violation.



Typical MapView of G2 Mobile Software showing dynamic customer service icons in a meter-read mode.

A

APPENDIX – HIGH USAGE REFERENCE

The M2 Radio High Usage function requires a high usage threshold and a number of days counter.

The following chart presents sample flowrates converted to daily consumption for assistance in configuration.

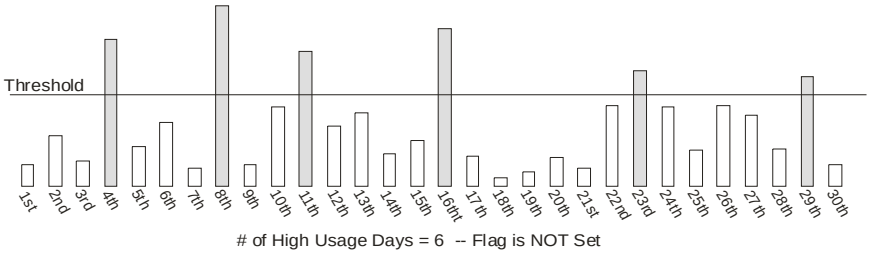
A

High Usage Function

Description

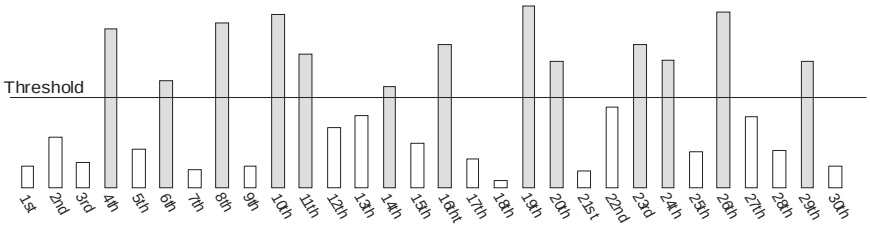
The high usage function simply looks for accounts which use a significant amount of water consistently throughout the month. The function allows the user to define “high usage” by the quantity of consumption (in gallons) and the number of times this quantity is used during a month. This function is targeted toward commercial and industrial accounts which may not be closely monitoring their own consumption. Indication of this condition could mean an undetected internal process problem. Also, with the radio’s real-time clock, larger leak studies and water balance studies can be implemented.

- **Set High Usage Threshold (gallons)**



# of High Usage Days = 6 -- Flag is NOT Set

- **Set # of Days limit**

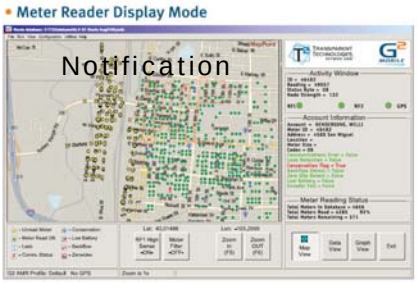


# of High Usage Days = 13 -- Flag is Set

Operation

The radio monitors consumption continually. If the high usage threshold is exceeded the set number of days, the radio sets a flag indicating the condition and transmits the flag with every transmission. The G2 Mobile System displays an icon for the meter indicating the high usage and also passes this information to the Data Center or the billing system. A datalog can be downloaded showing the consumption pattern that caused the flag.

Measurement



Typical MapView of G2 Mobile Software showing dynamic customer service icons in a meter-read mode.

M2 Settings
High Usage Threshold

Calculation: **gpm * 60min * 10 hrs**

Flowrate	Gallons	Ft^3	M^3
0.5 gpm	300	40	1.14
1 gpm	600	80	2.27
2.5 gpm	1,500	201	5.68
5 gpm	3,000	401	11.36
7.5 gpm	4,500	602	17.03
10 gpm	6,000	802	22.71
12.5 gpm	7,500	1,003	28.39
15 gpm	9,000	1,203	34.07
20 gpm	12,000	1,604	45.43
25 gpm	15,000	2,005	56.78
30 gpm	18,000	2,406	68.14
40 gpm	24,000	3,209	90.85
50 gpm	30,000	4,011	113.56
60 gpm	36,000	4,813	136.28
70 gpm	42,000	5,615	158.99
80 gpm	48,000	6,417	181.70
90 gpm	54,000	7,219	204.41
100 gpm	60,000	8,021	227.13
125 gpm	75,000	10,027	283.91
150 gpm	90,000	12,032	340.69
175 gpm	105,000	14,037	397.47
200 gpm	120,000	16,043	454.25
250 gpm	150,000	20,053	567.82
300 gpm	180,000	24,064	681.38
350 gpm	210,000	28,075	794.94
400 gpm	240,000	32,086	908.51
450 gpm	270,000	36,096	1,022.07
500 gpm	300,000	40,107	1,135.63
600 gpm	360,000	48,128	1,362.76
700 gpm	420,000	56,150	1,589.89
800 gpm	480,000	64,171	1,817.01
900 gpm	540,000	72,193	2,044.14
1000 gpm	600,000	80,214	2,271.26
1100 gpm	660,000	88,235	2,498.39
1200 gpm	720,000	96,257	2,725.52
1300 gpm	780,000	104,278	2,952.64
1400 gpm	840,000	112,299	3,179.77
1500 gpm	900,000	120,321	3,406.90
1600 gpm	960,000	128,342	3,634.02
1700 gpm	1,020,000	136,364	3,861.15
1800 gpm	1,080,000	144,385	4,088.28
1900 gpm	1,140,000	152,406	4,315.40
2000 gpm	1,200,000	160,428	4,542.53

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APPENDIX – BACKFLOW REFERENCE

The M2 Radio Backflow function requires a backflow trigger quantity setting.

A

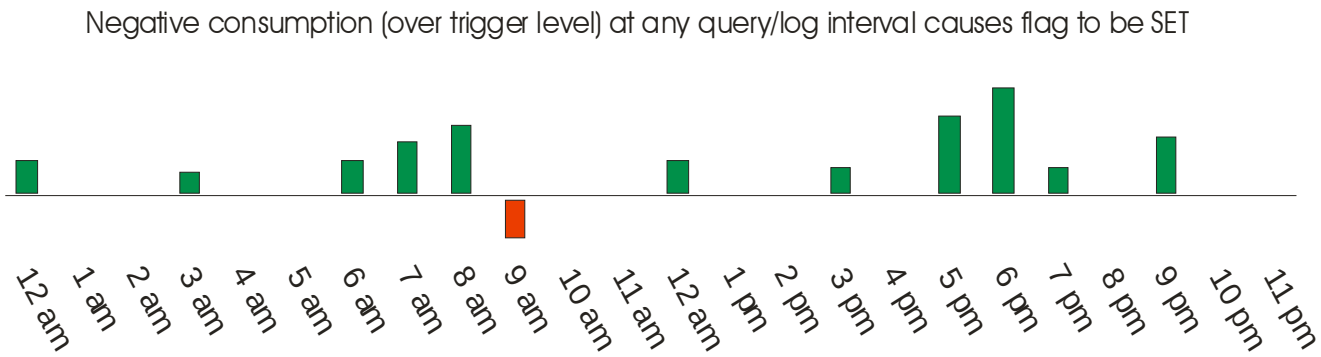
Backflow Function

Description

The backflow function simply monitors consumption and checks for any period where negative consumption occurs. This function only works for encoded registers.

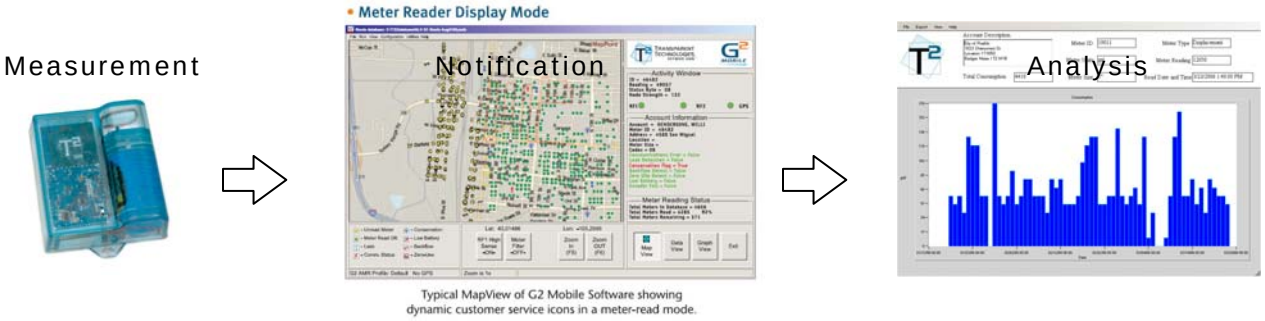
The configurable backflow trigger quantity is typically set at 2X the encoder value to eliminate false backflow flags due to register jitter. Register jitter is where the encoder wheels are at an uncertain position between a rollover from nine to zero. In this scenario, the radio interprets the encoder as moving backward and then forward repeatedly. True backflow occurs when pressure conditions cause water to move backward through the meter.

Set Backflow Trigger Level
- Quantity of backflow water to trigger flag



Operation

The radio monitors consumption continually. If the backflow conditions are met, the radio sets a flag indicating the condition and transmits the flag with every transmission. The G2 Mobile System displays an icon for the meter indicating the backflow and also passes this information to the Data Center or the billing system. A datalog can be downloaded showing the consumption pattern that caused the flag.



Typical MapView of G2 Mobile Software showing dynamic customer service icons in a meter-read mode.

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APPENDIX – ZERO USAGE REFERENCE

The M2 Radio Zero Usage function requires a number of days setting.

A

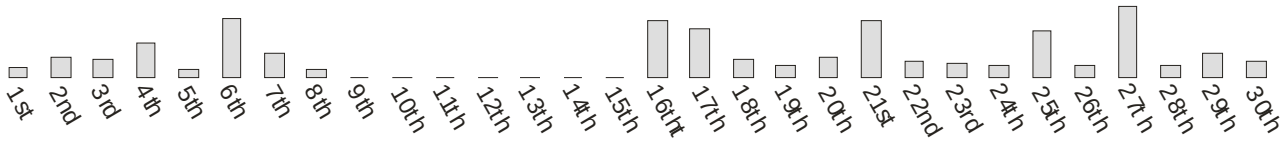
Zero Usage Function

Description

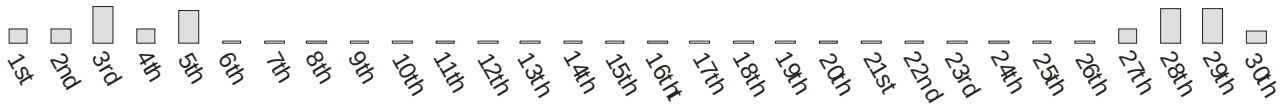
The zero usage function simply looks for accounts which do not show consumption over a period of days. The number of days is a configurable number to allow the user to target the function for different uses, such as unexpected move-outs, seasonal move-outs and water theft.

Set # of Zero Usage Days

- Total Number of days of zero consumption in 30 day period to set flag



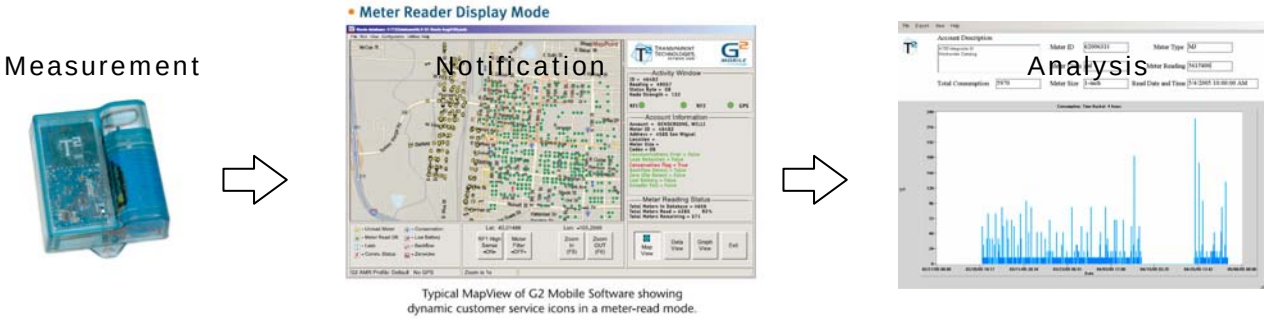
# of Zero Usage Days = 7 -- Flag is NOT Set



# of Zero Usage Days = 15 -- Flag is Set

Operation

The radio monitors consumption continually. If the zero usage conditions are met, the radio sets a flag indicating the condition and transmits the flag with every transmission. The G2 Mobile System displays an icon for the meter indicating the zero usage and also passes this information to the Data Center or the billing system. A datalog can be downloaded showing the consumption pattern that caused the flag.



Typical MapView of G2 Mobile Software showing dynamic customer service icons in a meter-read mode.

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APPENDIX – FCC / IC INFORMATION

FCC Information

Information to user. - The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Special accessories.

(a) Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors, are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e., shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without additional charge, at the time of purchase. Information detailing any alternative method used to supply the special accessories shall be included in the application for a grant of equipment authorization or retained in the verification records, as appropriate.

The party responsible for the equipment, as detailed in §2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of the text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

(b) If a device requiring special accessories is installed by or under the supervision of the party marketing the device, it is the responsibility of that party to install the equipment using the special accessories. For equipment requiring professional installation, it is not necessary for the responsible party to market the special accessories with the equipment. However, the need to use the special accessories must be detailed in the instruction manual, and it is the responsibility of the installer to provide and to install the required accessories.

(c) Accessory items that can be readily obtained from multiple retail outlets are not considered to be special accessories and are not required to be marketed with the equipment. The manual included with the equipment must specify what additional components or accessories are required to be used in order to ensure compliance with this part, and it is the responsibility of the user to provide and use those components and accessories.

(d) The resulting system, including any accessories or components marketed with the equipment, must comply with the regulations.

FCC Definitions

Class A digital device. A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

Class B digital device. A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

NOTE: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

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 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.

The provisions of paragraphs (a) and (b) of this section do not apply to digital devices exempted from the technical standards under the provisions of §15.103.

FCC / IC Declarations

The M2 Utility Radio Tranceiver is an approved intentional radiator device under FCC 15.247 and Industry Canada under RSS-210.

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.

The M2 Radio is a self-contained unit and access to its circuitry by an end user, other than replacement of the battery, is not intended. Changes or modifications not expressly approved by Transparent Technologies or use of the radio other than the purposes described herein voids the user's authority to operate the equipment.