Appendix C

SWEEP Metering Equipment Technical Data

Data Logging Equipment

End Use Clothes Washer/Dryer Data Logging Equipment. From left to right, clothes washer watt transducer, clothes dryer watt transducer, data logger, hot water meter, cold water meter.

End Use Hot Water Heater Logging Equipment. At the top of picture is the current transformer; below is the data logger.

Meter-Master Data Logger. The yellow cable at the top with sensor gets attached to "barrel" of water meter.

Meter-Master Data Logger as installed in metering pit.

Metering Equipment Specifications

Data Logging Equipment – Clothes washer/dryer data logger

ULTRALITE LOGGER™

A Recording 4 Channel Data Logger in Several Configurations:

ELECTRIC CURRENT
•
TEMPERATURE
•
PULSES

Ideal for any pulse initiating meters, such as gas, water, electric, steam, or sewer. Use the UltraLite Logger for metering plant operations, industrial facilities, commercial and residential buildings.

- Temperature, True-RMS Current and Pulse Recording
- 128K of memory (~30,000 records) or 512K (~120,000 records)
- Self-Powered, no cords to plug in!
- Remote downloading using the optional modem
- Use for submetering, Time-Of-Use metering, or bill disaggregation
- Add a modem for remote data collection

1T/3P ULTRALITE™

OUR MOST POPULAR MODEL!

This unit is capable of monitoring 1 temperature and 3 pulse output meters. It is ideal for monitoring cummulative use of gas, water and electric utilities, as well as the indoor or outdoor temperature.

No pulses are ever missed, and it can count up to 10 pulses per second. The temperature range covered is -40° C to 60°C (-40°F to 140°F) Resolution is .5°F. Utility companies have made the UltraLite 1 T/3P our biggest seller!

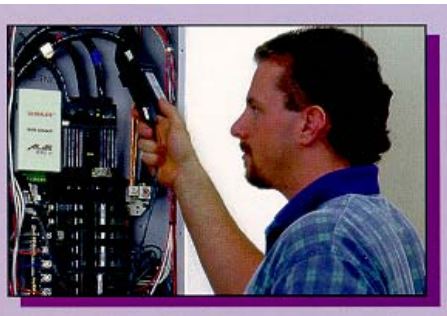
Pacific Science & Technology
64 NW Franklin Avenue
Bend, Oregon 97701
1-800-388-0770 in the USA
541-388-4774 or Fax 541-385-9333
info@pacscitech.com
http://www.pacscitech.com

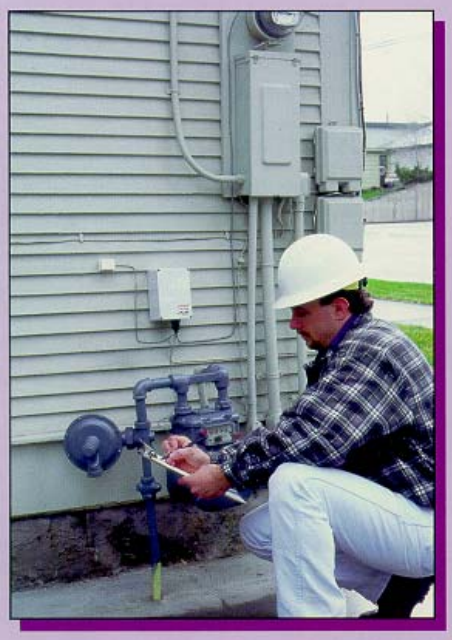
CE

Data Logging Equipment (con't)

4C ULTRALITE™

4 Channels of True-RMS Current can be monitored simultaneously with this unit. Great for monitoring several motors in an HVAC equipment room or 4 branch circuits. Both split-core and clamp-on current transformers are available and come in various sizes, ranging from 5A to 3000A. The UltraLite 4C measures True-RMS current, even for highly distorted waveforms.





4P ULTRALITE™

Monitor up to 4 pulse channels!

The UltraLite 4P is used for applications where multiple utilities need to be recorded. Use it with electric, gas, water, sewer and steam meters. This unit also records up to 10 pulses per second. If your meter does not have a pulse output, contact us for pulse initiating retrofit kits for electric and gas meters.

Three options available:

Weather Proof - this version is dust and liquid resistant, allowing the UltraLite to operate in harsh, wet, and outdoor environments.

Internal Modem - any of the UltraLites can come equipped with a built-in internal modem. This will enable easy remote data collection and eliminate the possibility of modem incompatibility. Your choice of 2400 or 9600 baud.

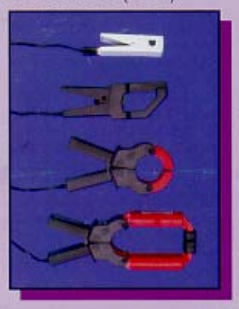
High Memory - this is one option you will want if you do not have telephone lines available. Quadruples the logger memory to 512 kbytes (120,000 records) allowing for long recording periods before downloads are necessary.

Shunted and Safe Current Transformers (CTs)

The UltraLite 4C connects directly to CTs with a voltage output.

Clamp-On CTs

This style combines ease of use, convenience and accuracy. (from top) 150A CT, 500A CT, 1000A CT, 3000A CT



Split Core CTs

are also available in a large number of current ranges.

UltraLite Monitoring Specifications

Inputs.....4 channels of current, pulse count, or temperature
Measurements.....True RMS (current)
Frequency.....10 Hz (pulse) and 50 or 60 Hz (current)
Accuracy.....<1% of reading exclusive of sensor accuracy
Baud Rate.....1200, 2400, 4800, 9600, 19200 or 2400 and 9600 (Internal Modem)
Resolution.....12 bit (1 part in 4,096; ±1 pulse, 0.01 Amp, 0.1°F or °C
Memory.....128k (30,000 readings) or 512k (120,000)
Dimensions.....8 X 15 X 6 cm (3.2" X 5.9" X 2.4")
Weight.....0.4 kg (12 ounces)
Sampling Frequency...7.68 kHz (128 points per current waveform) or 10 Hz, interrupt driven
Recording Intervals.....1,5,15,30,60 minutes and 12,24 hours
Real Time Clock.....20 ppm accuracy (<1 min/month)
Operating Temp. .....-7 to 60° C (20 to 140° F)
Operating Humidity.....5% to 95% non-condensing
Battery Life.....3+ years @ 1 min. sampling, with LED indicator of low battery charge

Water Meters

Model Industrial RCDL

Nutating Disc Meter (Bronze and Thermoplastic)

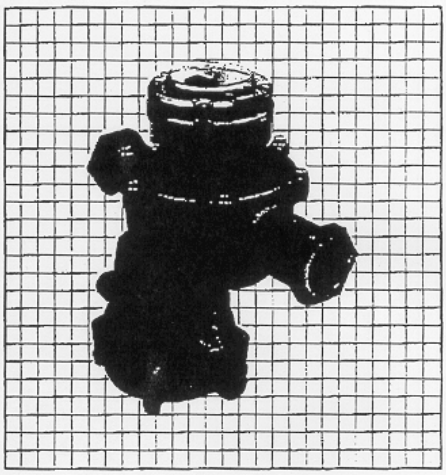
Technical Brief

GENERAL

Badger's RCDL positive displacement meters are one of the most cost effective methods in metering industrial fluids. The RCDL meter's simple but efficient design assures high accuracy and repeatability over the entire meter flow range.

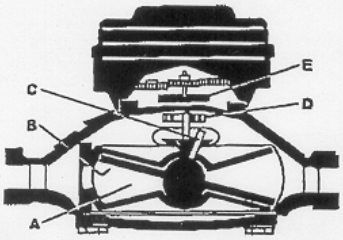
Available in sizes, 1/2" through 2" for flows up to 170 GPM, these meters are extremely rugged and reliable. Maintenance is seldom required, but if necessary, takes but a few minutes. All parts are designed and built of materials to meet your application, providing you with long life and a trouble-free, precision flow meter.

To complement the RCDL meter line, Badger offers a complete line of accessories that includes totalizers, electromechanical and electronic transmitters, rate of flow indicators and batch/process controllers.



OPERATION

The metering principle, known as positive displacement, is based on the continuous filling and discharging of the measuring chamber. Controlled clearances between the disc and the chamber insure minimum leakage for precise measurement of each volume cycle. As the disc nutates, the center spindle rotates a magnet, whose movement is sensed through the meter wall by a follower magnet or by electronic sensors. Each revolution of the magnet is equivalent to a fixed volume of fluid, which is converted to any engineering unit of measure for totalization, indication or process control.



Liquid flowing through the meter chamber (A) causes a disc (B) to nutate or wobble. This motion, in turn, results in the rotation of a spindle (C) and drive magnet (D). Rotation is transmitted through the wall of the meter to a second magnet (E) which operates the transmitter.

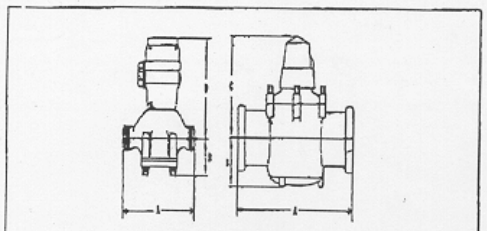
FEATURES

- Accuracy: ±1.5% over full range
- Repeatability: ±0.5%
- Wide flow range
- Rugged bronze or thermoplastic housing
- Maximum Operating Temperature
  Plastic Housing: 100° F
  Bronze Housing: 120° F
  Models 25, 70 and 120; Bronze: 250° F Option
- Maximum Operating Pressure: 150 PSI
- Easily maintained without removing from line
- Durable components for minimal maintenance
- Wide range of compatible accessories
- Direct replacement for SC-ER

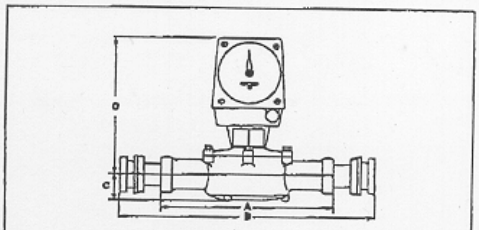
BadgerMeter,Inc.®

Bulletin No. ITB-072-08
December 1999

Water Meters (con't)



Model 25, 35 & 70



Model 120 & 170

SPECIFICATIONS

Dimensions in inches (Without Register)

Meter Model	Meter Size Inches	Housing Material	A Meter Length	B Meter Length w/ Conn.	C Center Line To Base	Flow Rates - Gallons: Cold Liquids 32° F to 120° F	Flow Rates - Gallons: Hot Water Chemicals & Oils 32° F to 250° F (BZ) 32° F to 100° F (PL)	Approx. Weight Pounds
M25	5/8	BZ or PL	7-1/2	12-7/16	1-3/8	1/2 - 25	1 - 25	5
M25	3/4	BZ or PL	7-1/2	12-5/8	1-3/8	1/2 - 30	1 - 30	5
M35	3/4	BZ	9	14-1/8	1-3/4	3/4 - 35	N/A	6
M40	1	PL	10-3/4	16-3/16	2-1/4	3/4 - 50	N/A	5
M70	1	BZ	10-3/4	16-5/8	2-1/4	1 - 70	5 - 70	12
M120	1-1/2	BZ	12-5/8	19-3/4	2-5/8	2 - 120	10 - 120	20
M170	2	BZ	15-1/4	22-7/8	3-3/8	2 - 170	N/A	30

BZ = Bronze; PL = Plastic
Connection set assemblies available, all having NPT threads.

N/A = Not available in High Temperature / Chemical option.

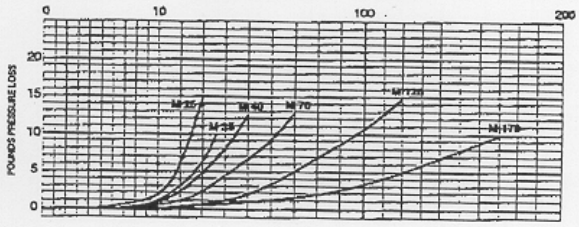
HEIGHT DIMENSIONS (INCHES) (D) WITH REGISTER AND ACCESSORIES

Meter Size	With Non Resetable Register	With Transmitter	With MS-ER1 Transmitter	With ECA Transmitter	With 258 Register	With Series 76 Registers
5/8 & 5/8 x 3/4	5-3/4	7-3/8	11-1/4	9-3/8	8	15-1/4
3/4	6-1/8	7-3/4	11-5/8	9-3/8	8-3/8	15-5/8
1 & 1 x 1-1/4	7-1/2	9-1/8	13	11-3/16	9-3/4	17
1-1/2	9-1/8	10-3/8	14-1/4	12-3/4	11	18-1/4
2	10-3/4	12-1/4	16-1/8	14-3/8	12-7/8	20-1/8

MATERIALS OF CONSTRUCTION

	Cold Liquid Units	High Temp. and/or Chemical Units Models 25, 70 & 120
Housing:	BZ or PL	BZ - 250° F PL - 100° F
Chamber:	Noryl	LCP
Disc:	SAN	LCP
Crossbar:	Nylon	Ultem
Magnetic Assembly:	Nylon	Ultem
Chamber Retainer:	Polyethylene	Metal Clip
Screen:	Polypropylene	None

PRESSURE LOSS CHART
Industrial Disc Meters
Rate of Flow in Gallons Per Minute



PERFORMANCE

Accuracy: ± 1.5%
Repeatability: ± 0.5%
Max. Operating Pressure: 150 PSI

BadgerMeter,Inc.
P. O. Box 245036 Milwaukee, WI 53224-9536
Telephone: (414) 355-0400
Fax: (414) 355-7499

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice.
All rights reserved.

Water Meters (con't)

Models MSE5, PM5, & MSE5XP

Mechanical Scalable Transmitters

Technical Brief

GENERAL

The PM5, MSE5, amd MSE5XP models are pulse transmitters designed to be used with Badger Meter's magnetic drive meters. The pulse transmitter provides a scaled electrical pulse signal (switch closure type) for each discrete unit of liquid volume metered. The signal is used to operate instruments and controls.

These transmitters are identical except for the housing. The PM5 transmitter has a glass filled plastic housing and a NEMA 4X rating. The MSE5 and MSE5XP housings are bronze with a NEMA 4 rating.

The transmitters are available in a wide range of gear ratios and pulse rates up to 1500 contact closures per minute.

OPERATION

The flow of liquid through the meter is measured by a disc or piston metering element. The motion of the measuring element is transferred to a magnetic coupling. One of these magnets is in the measuring chamber, the other in the transmitter.

The driven magnet (inside the transmitter) then rotates a gear train and pulse magnet. As the pulse magnet turns, it causes the reed switch to open and close. Contact closures from the switch are transmitted to a remote instrument or counter which records the quantity of flow.

APPLICATIONS

These transmitters are used in metering systems that require pulse closures for recording rate of flow, quantity of flow, liquid feeding, blending and batching.

MSE5 (rear) and PM5 Transmitters

FEATURES

- MSE5 and MSE5XP transmitters are explosion-proof with CSA listing for Class 1, Group D, Division I (Hazardous Locations)
- Does not require external power
- Rugged, Cast Bronze Housing (MSE5 only)
- Corrosion resistant, glass filled plastic enclosure (PM5 only)
- High Temperature Rating: 250° F.
- Watertight - NEMA 4 (Bronze) or NEMA 4X (Plastic) Housing
- Hermetically sealed reed switch output

BadgerMeter,Inc.

Bulletin No. ITB-074-04
Part No. 53406-074
October 1998

Watt Transducers

OSI WATT/WATTHOUR TRANSDUCER MODEL AGH

UL LISTED, ACCURATE TO 0.2% OF READING

FEATURES

- Accurate regardless of variations in voltage, current, power factor, or load.
- Dual outputs. 0 - 1mA proportional to instantaneous watts, relay closure proportional to watthours.
- Calibrated with standards traceable to **NIST**.

APPLICATIONS

- Designed for applications which require UL listed devices.
- Integration into energy management systems, or a variety of sub-metering applications.
- Measurement using direct-connection, current and/or potential transformers.

5 YEAR WARRANTY

LISTED 87X9
Energy Management
Equipment Accessory
E134941

INPUTS		PHASE CONNECTION	NO. OF ELEMENTS	F.S. (WATTS)	STANDARD OUTPUT MODEL AGH- OUTPUT OPTIONS			WATT HOUR COUNTS /HOUR
VOLTS	AMPS				±1mA	±10V	4-20mA	
0 - 150	0 - 5	1 phase, 2 wire	1	500	AGH-001B	AGH-001D	AGH-001E	500
0 - 300	0 - 5	1 phase, 2 wire	1	1000	AGH-002B	AGH-002D	AGH-002E	1000
0 - 600	0 - 5	1 phase, 2 wire	1	2000	AGH-003B	AGH-003D	AGH-003E	1500
0 - 150	0 - 5	3 phase, 3 wire	2	1000	AGH-004B	AGH-004D	AGH-004E	1000
0 - 300	0 - 5	3 phase, 3 wire	2	2000	AGH-005B	AGH-005D	AGH-005E	2000
0 - 600	0 - 5	3 phase, 3 wire	2	4000	AGH-006B	AGH-006D	AGH-006E	4000
0 - 150	0 - 5	3 phase, 4 wire	3	1500	AGH-007B	AGH-007D	AGH-007E	1500
0 - 300	0 - 5	3 phase, 4 wire	3	3000	AGH-008B	AGH-008D	AGH-008E	3000
0 - 150	0 - 5	3 phase, 4 wire	2 1/2	1500	AGH-007.5B	AGH-007.5D	AGH-007.5E	1500
0 - 300	0 - 5	3 phase, 4 wire	2 1/2	3000	AGH-008.5B	AGH-008.5D	AGH-008.5E	3000

To calculate full-scale Watts when using potential and/or current transformers:
a = initial transducer calibration (from table above)
b = current transformer ratio (e.g. 100:5, or 20)
c = potential transformer ratio (e.g. 600:120, or 5)
F.S. WATTS = a x b x c
NOTE: UL recognized current transformers available from factory on page 77.

MODEL AGH SPECIFICATIONS

INPUT
VOLTAGE: See table
CURRENT: 5A
FREQUENCY RANGE: 58-62 Hz.
POWER FACTOR: Any
BURDEN:
Voltage: Less than 0.1VA per phase
Current: Less than 0.25VA per phase
Output amplifier: 2 Watts
OVERLOAD:
Voltage (cont.): 150V range: 175V
300V range: 350 V
600V range: 600V
Current (cont.): 2 Times full-scale
(transient): 50A (10 sec./hr.)
250A (1 sec./hr.)
DIELECTRIC TEST (Input/Output/Case):
(150V & 330V)1800Vac
(600V) 2200Vac
Surge: Withstands IEEE SWC Test

OUTPUT
ACCURACY: ± 0.2% RDG.; ± 0.04% F.S.
(Includes combined effects of voltage, current, load and power factor.)
WH RELAY: N/O SPST; 120Vac, 0.5A rated
Contact closure period: 200 milliseconds
CLOSURE CALIBRATION (STD.): 1 watthour/closure
ANALOG OUTPUT RIPPLE: Less than 0.5% F.S.
ANALOG OUTPUT LOADING (OHMS): 0 - 1mA 0 - 10K
0 - 10Vdc: 2K min.
4 - 20mA: 0 - 500
RESPONSE TIME (99%): Less than 400 milliseconds
TEMPERATURE EFFECT (-20° - +60°C):
± 0.005% per degree C
INSTRUMENT POWER: 90 - 135Vac, 60 Hz, 7.5VA

CONNECTION DIAGRAMS AND DIMENSIONS SHOWN ON PAGES 26 - 27

OHIO SEMITRONICS, INC.
4242 REYNOLDS DRIVE * HILLIARD, OHIO * 43026-1264
PHONE: (614) 777-1005 * FAX: (614) 777-4511
WWW.OHIOSEMITRONICS.COM * 1-800-537-6732

Watt Transducers (con't)

WATTHOUR METER WITH INTEGRATED CT **SWH SERIES**

DESCRIPTION

The model SWH is a single phase watthour transducer with integrated current transformer. The model SWH has a form A solid state contact closure pulse output.

VOLTAGE (Volts)	CURRENT (Amps)	MODEL
115	100	SWH-1100
	200	SWH-1200
	400	SWH-1400
208/230	100	SWH-2100
	200	SWH-2200
277	100	SWH-3100
	200	SWH-3200

FEATURES

- Easy to install split core design
- LED indications of proper installation/operation

APPLICATIONS

- Energy Allocations
- Sub Metering
- Revenue Metering
- Process Control

ORDERING INFORMATION
Example: 100Amp input for use on 230Vac L-N Voltage
SWH-2100

SPECIFICATIONS

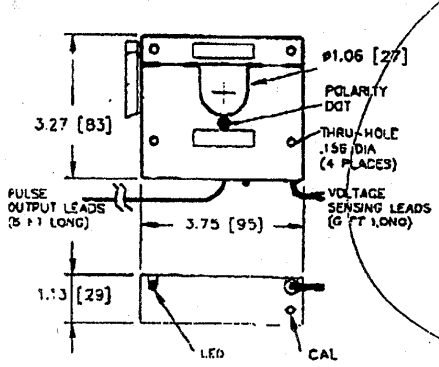
INPUT

CURRENT:		0 to 125% rated
	BURDEN:	VA < .1(100A), .4 (200A)
VOLTAGE:		± 10% rated
	BURDEN:	<0.2VA
POWER FACTOR:		any
FREQUENCY:		48 to 62Hz
INSTRUMENT POWER:		self powered

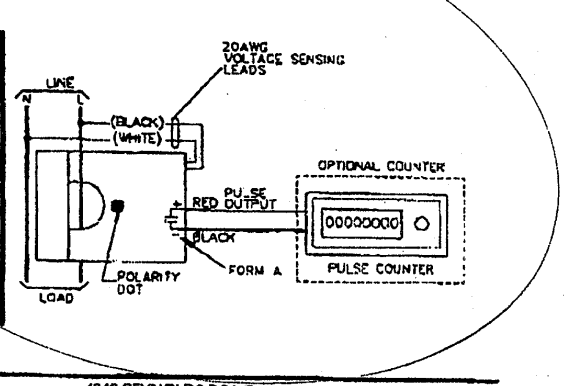
OUTPUT

LED:		Energy Rate & Direction Indicator Scaling same as pulse output Green = Forward Red = Reverse
PULSE:		10 WH / pulse, 71 ms min std
CONTACT RATING:		Form A, 30V peak, 100mA max
ACCURACY:		1% F.S.
ISOLATION:	(current/potential/output)	2250Vac
TEMPERATURE:		-20 to 70°C

CASE DIMENSIONS



CONNECTION DIAGRAMS



OHIO SEMITRONICS, INC.

4242 REYNOLDS DRIVE HILLIARD, OHIO 43026-1264
Phone: (614) 777-1005 FAX: (614) 777-4511
TO PLACE AN ORDER: 1-800-537-6732

B902-383B1 08/09/99

Hot Water Heater Data Logger

HOBO® 4-Channel External Indoor Logger

Specifications

Accepts external sensors and input cables for temperature, AC current,
0-2.5 Volt DC and 4-20 mA. Capacity: 32,520 measurements total

User-selectable sampling interval: 0.5 seconds to 9 hours, recording times up to 1 year. Readout and relaunch with optional HOBO Shuttle.
Drop-proof to 5'. Mounting kit included (hook/loop, magnet, and tape)
Programmable start time/date
Memory modes: stop when full, wrap-around when full
Nonvolatile EEPROM memory retains data even if battery fails
Blinking LED light confirms operation
User-replaceable battery lasts 1 year
Battery level indication at launch
Operating range: -4°F to +158°F (-20°C to +70°C), 0 to 95% relative humidity, non-condensing, non-fogging
Time accuracy: ±1 minute per week at +68°F (+20°C)
Size/Weight: 2.4 x 1.9 x 0.8" (60 x 48 x 19 mm)/approx. 1 oz (27 gms)
NIST-traceable temperature accuracy certification available
Compliance certificate available

Meter-Master Data Logger

METER-MASTER MODEL 100EL
FLOW RECORDER

The MODEL 100EL offers a solution for portable flow recording from existing water meters. The instrument is compatible with Sensus/Rockwell, Schlumberger/Neptune, Badger, Hersey, ABB/Kent, Precision, Master Meter, Water Specialties, Meineke, and other meters worldwide. It is submersible, small enough to fit inside a residential meter box. An integral handle enables the unit to be chained for security.

The Model 100EL uses a patented, strap-on magnetic sensor to digitize a meter's magnetic drive signal. Set-up requires velcro straps to secure the sensor in position. A rocker switch toggles the recording on/off and initiates a test of the sensor pick-up. An LED signal light flashes in unison with the meter's dial movement in order to verify accurate recording.

Memory capacity for continuous recording ranges from 7.5 days using a 5 second data storage interval to 3 months using a 60 second data storage interval. Recording automatically stops when the memory is used up; the recorder will not overwrite.

Two internal, rechargeable batteries provide approximately 3-4 months of battery life on each charge; much longer continuous operation is available through external battery or AC operation. The unit automatically stops recording and powers down the batteries are low to preserve recorded data and avoid battery damage.

The flow data from the meter is logged into memory for later downloading and analysis on a computer. The 100 Program for Windows verifies the accuracy of downloaded data by comparing the total volume of water registered by the water meter during the recording period to the total volume of water recorded by the Meter-Master. The Model 100 Program functions with all Meter-Master recorders and provides a variety of report and graph options. Data may also be exported to the MeterSizer program, the Trace Wizard end-use recognition program, and other widely used software, such as Lotus®, Excel®, Quattro Pro®, WordPerfect®, and Microsoft Word®. The Meter-Master software also offers a real-time 3-D graphic display of the current flow through a meter. New meters can be added to the database by the user at any time so that they appear as standard meter options.

Meter-Master Data Logger (con't)

Specifications:

Size: 8.6" x 5.4" x 2.1" (225 mm x 139 mm x 54 mm).
Data Storage Capacity: ranges from 7.5 days (5 sec.) to 90 days (60 sec. resolution).
Battery life (internal): 3+ months before recharging.

Capacity to make 20 records before downloading. Approximately 1200 different pre-programmed meter options.

Flashing LED verifies recording accuracy based on preset meter selections.

Software verifies data accuracy by comparing Meter-Master volume to register volume.

Meters may be added or deleted from database.

Aquacraft Trace Wizard© Software (adapted from AWWA 1999)

Trace Wizard is a 32-bit software package developed by Aquacraft, specifically for the purpose of analyzing flow trace data. Trace Wizard provides the analyst with signal processing tools and a library of flow trace patterns for recognizing a variety of residential fixtures. Any consistent flow pattern can be isolated, quantified, and categorized using Trace Wizard including leaks, evaporative coolers, humidifiers, and swimming pools. Trace Wizard is integrated with the Meter-Master for Windows software that comes with the F.S. Brainard data logging system.

Analysis with Trace Wizard is currently a multi-step, iterative process. First Trace Wizard takes the raw gallons per minute flow data from the Meter-Master for Windows program and disaggregates the data into individual water use events from the smallest leak to the largest automatic sprinkler session. During the event calculation process, Trace Wizard calculates a specific set of statistics about each water use event. These statistics are: start time, stop time, duration, volume (gal), peak flow rate (gpm), mode flow rate (gpm) and mode frequency. All of these statistics are included in the final database of water use events.

Once all the water use events have been isolated and quantified and statistics generated, Trace Wizard implements a user defined set of parameters developed for each individual study residence to categorize the water use events and assign a specific fixture designation to each event. These parameters can include the volume, duration, peak flow rate, and mode flow rate of each specific fixture. For example, a toilet may be defined as using between 3.25 and 3.75 gallons per flush, the peak re-fill flow rate is between 4.2 and 4.6 gpm, the duration of flush event is between 30 and 50 seconds, and the mode flow rate is between 4 and 4.5 gpm. Similar parameters are established for each of the fixtures found in the household. This simple signal processing routine runs quickly and assigns a fixture category (toilet, shower, clothes washer, etc.) to each water use event. The routine is re-run by the analyst frequently during the analysis process as the parameters are "fine tuned" to fit the fixtures in each specific house. The analyst uses the survey response data detailing the specific water-using appliances and fixtures in the house to build the parameter file which assigns fixtures to water use events. The graphical interface of Trace Wizard allows the analyst to visually inspect water use events and build the parameter file so that it correctly identifies as many of the water use events as possible. Trace Wizard is also capable of recognizing simultaneous events that frequently occur in residential households. For example, if someone is taking a shower in one bathroom and someone else in the house flushes the toilet and uses a faucet, Trace Wizard is able to separate these three distinct events through a set of user defined parameters.

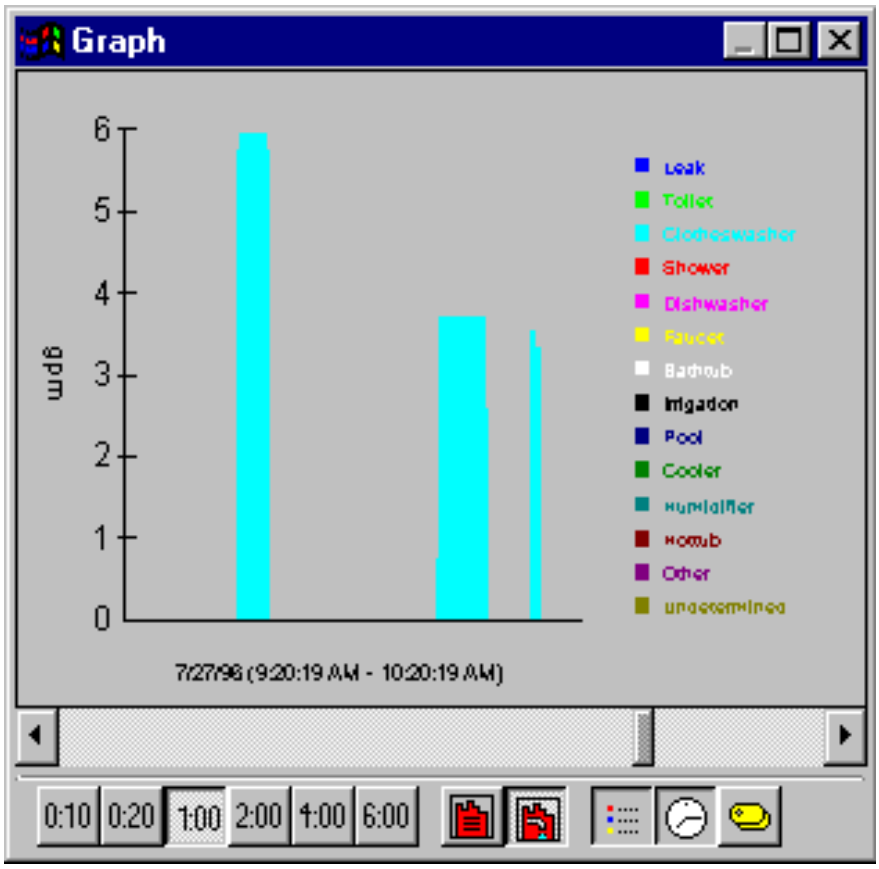


Figure C.1. Sample Flow Trace from Trace Wizard Showing a One-Hour View. Water events depicted include a three-cycle clothes washer.

Figure C.1 shows a one-hour portion of a typical flow trace in Trace Wizard. The three light blue spikes are clothes washer cycles. The first is the wash cycle, the second is a rinse cycle, and the third is a spin cycle. Note that the times shown on the graph's x-axis are the time interval depicted in the graph. In Figure C.1, this is a one-hour time interval. The Trace Wizard graph has six time interval settings: 10 minutes, 20 minutes, 1 hour, 2 hours, 4 hours, and 6 hours. The analyst may use any of these "views" during the flow trace analysis process.

Figure C.2 shows two toilet flushes, miscellaneous faucets, and another three cycle clothes washer. The first green spike in a toilet flush with a refill rate of approximately 5 gpm. The small yellow spikes are miscellaneous faucet uses and the small dark blue spike is a leak. The three light blue spikes are clothes washer cycles. A second toilet flush occurs during the first clothes washer cycle and is easily distinguished by Trace Wizard as a simultaneous event.

Additional simultaneous water use events can be seen in Figure C.3. Here, in a six-hour view, two toilet flushes can be observed occurring simultaneously with a seven-zone drip/ combination irrigation system. The irrigation system zones are clearly delineated by small and

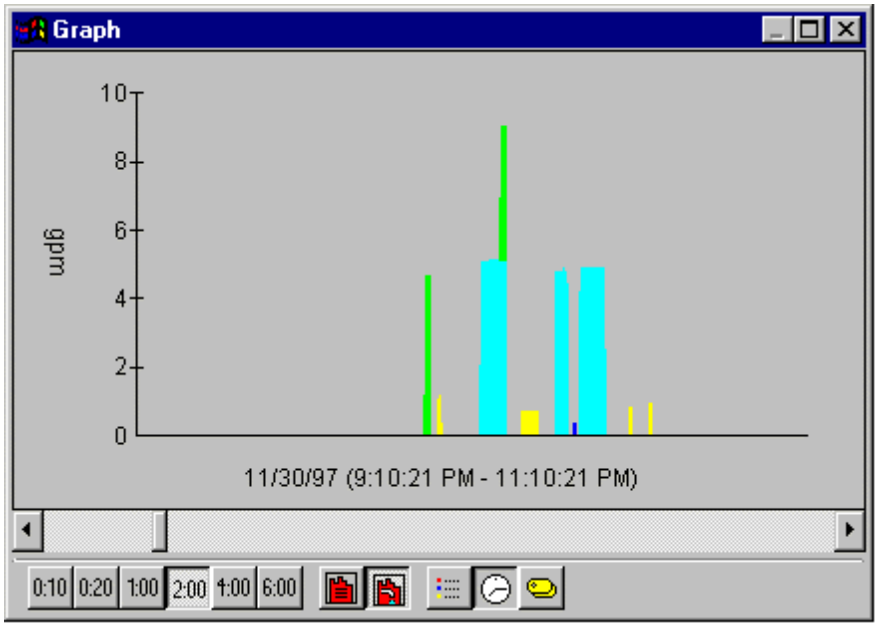


Figure C.2. Sample Flow Trace from Trace Wizard Showing a Two-Hour View. Water events depicted include two toilet flushes, a three-cycle clothes washer, and several faucets.

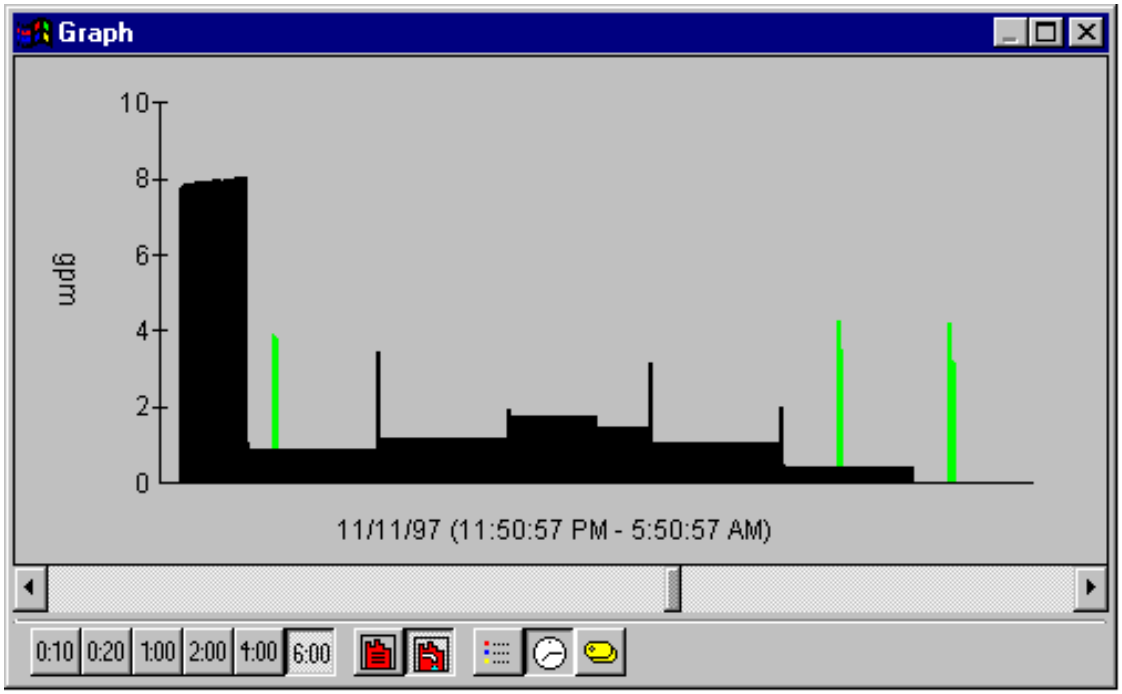


Figure C.3. Sample Flow Trace from Trace Wizard Showing a Six-Hour View. Water events depicted include a multi-zone automatic irrigation system and three toilet flushes.

consistent differences in flow rate over the 4.5-hour irrigation session. The first zone with an 8-gpm flow rate is a turf area and the remaining six zones cover different drip irrigation areas.

Figure C.4 shows a typical five-cycle dishwasher that was run between approximately 9:30 and 10:30 p.m. Dishwashers typically have between three and eight cycles and use a total of between 8 and 20 gallons for a full load. They are easy to distinguish because of their box-like shape and consistent volume, flow rate, and duration.

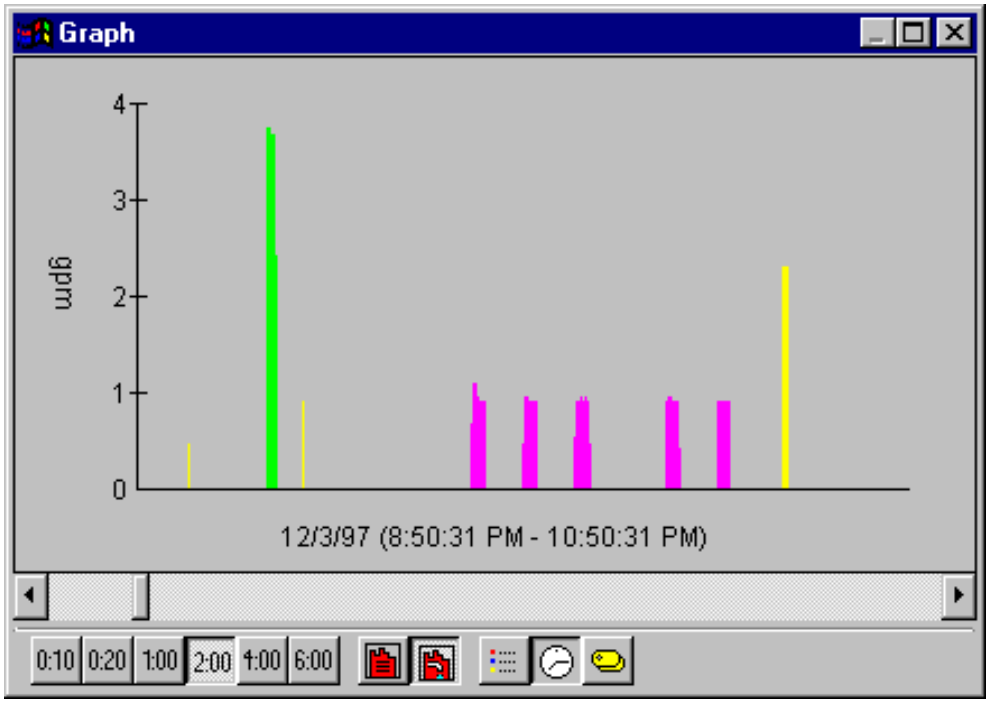


Figure C.4. Sample Flow Trace from Trace Wizard Showing a Two-Hour View. Water events depicted include a toilet flush, a five-cycle dishwasher, and various faucet uses.

Figure C.5 shows the capability of Trace Wizard's simultaneous event calculating routine. The red shower event is typical of bath/shower combination traces. The water is started in the bath for about 30 seconds while the temperature is adjusted then the shower diverter valve is pulled and the water starts to flow through the showerhead—in this case a low-flow head which restricts the flow to 2.5 gpm. The shower continues for about 10 minutes at this consistent flow rate until the water is shut off. What makes this example unusual are the blue clothes washer extraction and rinse cycles which are plainly visible on top of the shower. The second set of extraction cycles occur shortly after the shower had ended.

At the conclusion of analysis, the final product is a database of water use events, which have been given fixture identification. This database is created in the Microsoft Access 7.0 or 97 formats and can be further analyzed using either version of Access or any compatible database product.

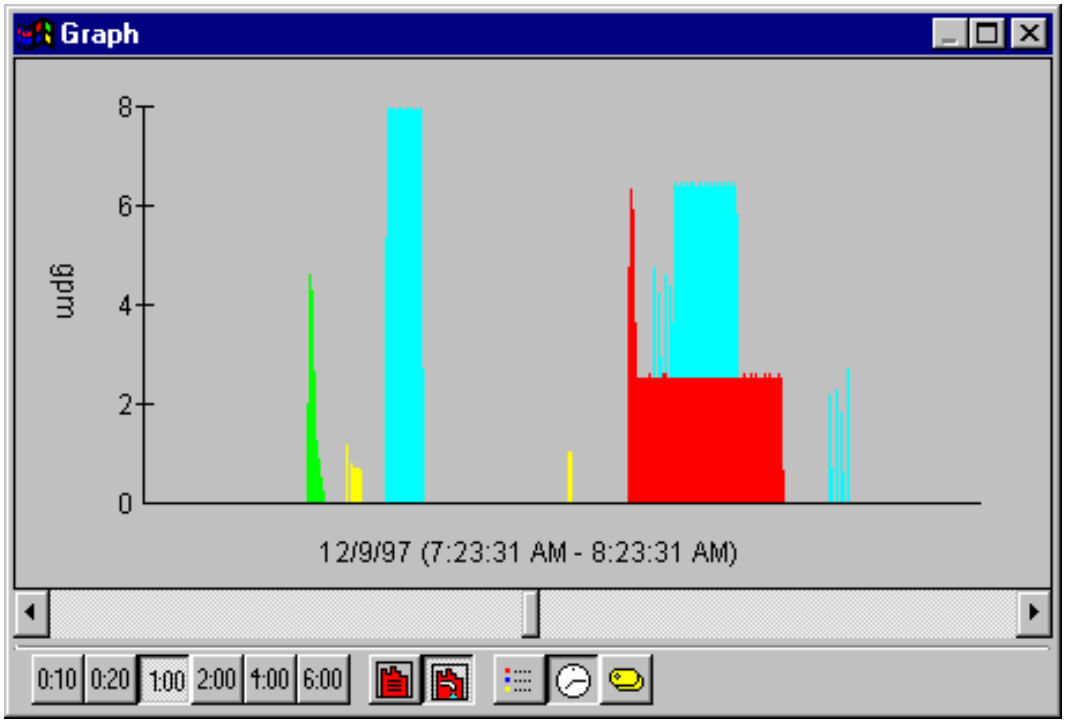


Figure C.5. Sample Flow Trace Showing a One-Hour View. Water events depicted include a toilet flush, multi-cycle clothes washer, and shower.