VATA VERKS
water and gas intelligence for buildings

Non-Invasive Whole Building
Water/Gas Data Acquisition
VV – 103 – XX – G
VV – 103 – XX – W

Instructions for
WATER & GAS METERS

Sprint Kit

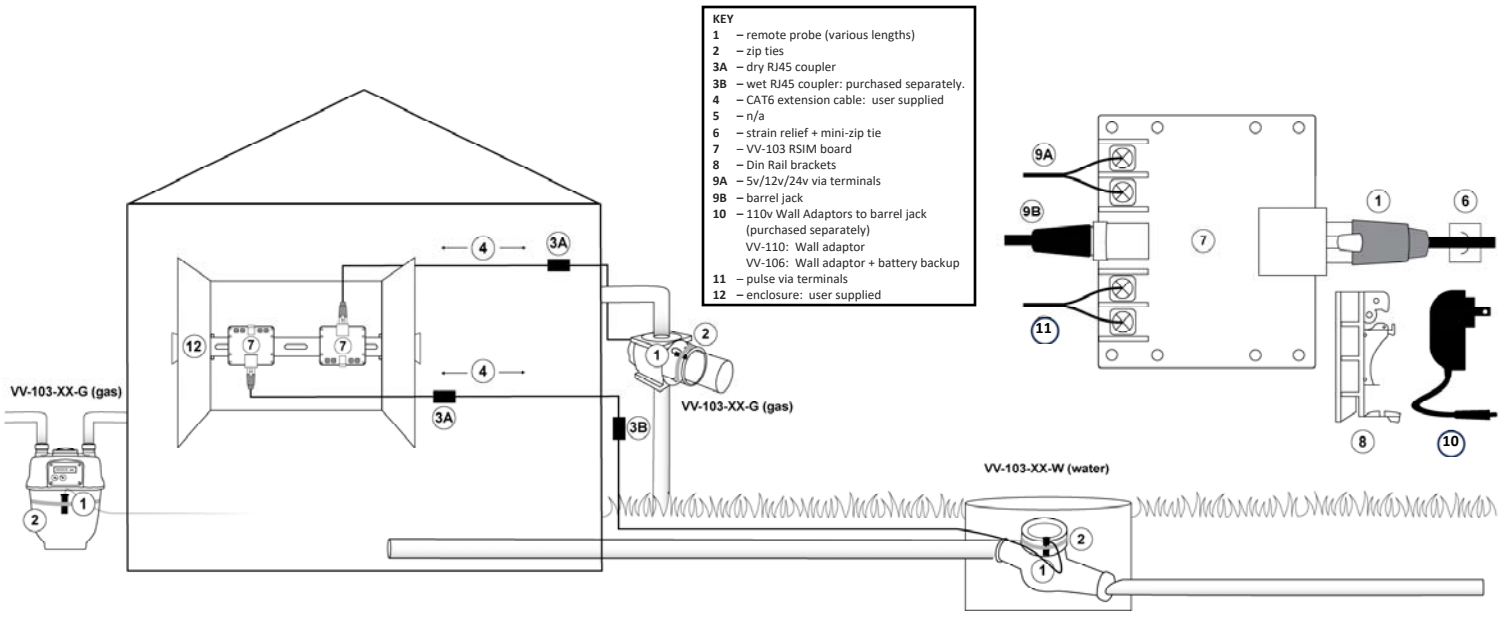
Pre-Configured Pulse Output Flow Sensor for Water or Natural Gas Meters

OPTIONAL ACCESSORIES

AC-104 : Installation Convenience Kit
AC-110 : 110v power supply
AC-106 : 110v power supply + battery backup
VV-301 : Configuration Kit
VVA-114 : Wet RJ45 coupler

Setup

Supplement

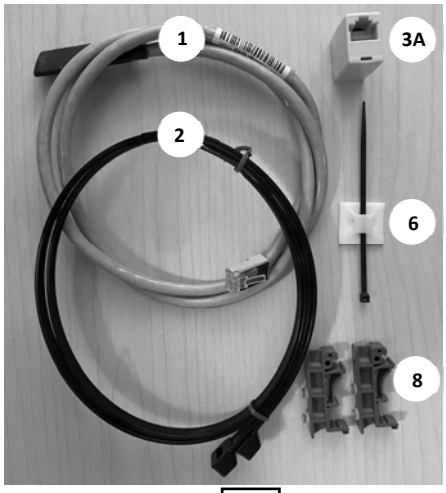


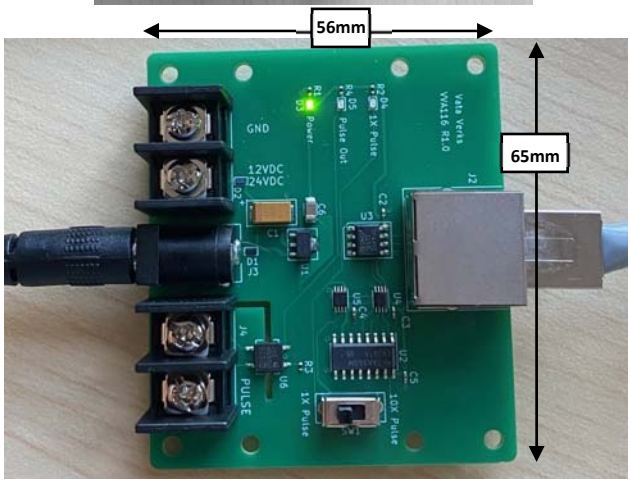
*****IMPORTANT WARNINGS*****

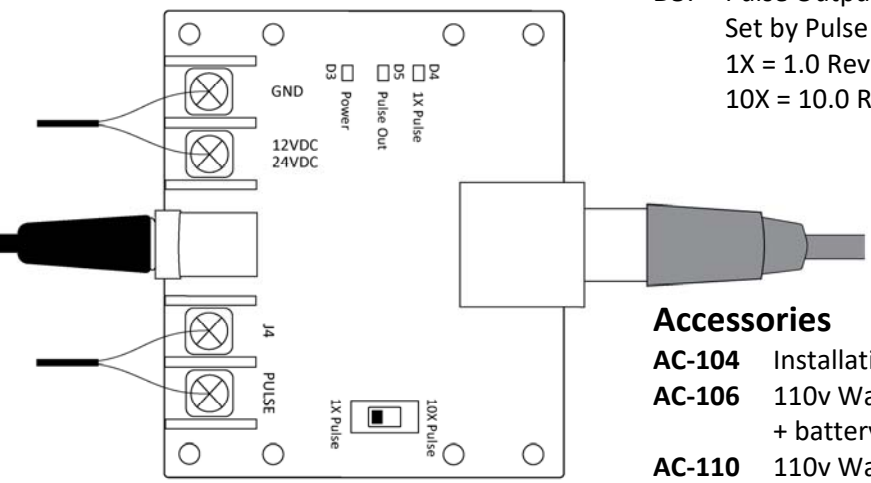
NOT FOR USE IN HAZARDOUS OR EXPLOSIVE ENVIRONMENTS

- **CONFIRM METER COMPATIBILITY** before invasive site work. See Meter Guide pg: 5, pre-test On-site, or contact Vata Verks.
- **DO NOT INSERT** this device's RJ45 connectors into any ethernet device (ex: your laptop). Permanent damage may result.
- VataVerks reserves right to alter offerings and specifications at any time without notice and is not responsible for errors that may appear in this document.
- Sensors are used to acquire Water / Gas utility meter flow data. Vata Verks assumes no liability for their use beyond cost of repair or replacement within warranty period. See Warranty for full details.

HARDWARE LAYOUT / SPECIFICATIONS







Kit Components

1 Remote Probe (various lengths)
2 Zip Ties (2)
3A Probe Extension indoor Coupler
4 CAT6 Extension (not included)
6 Strain Relief + mini-Zip Tie

Board Components

7 VV-103 RSIM Board
8 Din Rail Brackets
9 Power Options
9A: Screw Down Terminals
5v*, 12v, 24v
*See Specifications for 5v limitations
9B: Barrel Jack
110v via Wall Adaptor (sold sep)
11 Pulse Output
12 Enclosure (not included)

LED Key

D3: Power On indicator

D4: Meter Revolution indicator
1.0 Meter Rev per 1 blink
Solid = Probe disconnected

D5: Pulse Output indicator
Set by Pulse Toggle Switch
1X = 1.0 Rev / Pulse = D4
10X = 10.0 Revs / Pulse

Accessories

AC-104 Installation Convenience Kit
AC-106 110v Wall Power Adaptor + battery backup
AC-110 110v Wall Power Adaptor
VV-301 Configuration kit
VVA-114 Probe Exterior / Wet Coupler

VV-103 SPECIFICATIONS

Water Version: **VV-103-XX-W**
Compatible 95% of utility meters
All positive displacement, piston compound, multi-jet, single jet
Incompatible: Ultra-sonic.
For Sensus Omni: Use VV-200 series

Gas Version: **VV-103-XX-G**
Compatible >99% of utility meters
All diaphragm, rotary, turbine.
Incompatible: Ultra-sonic

Configuration
The VV-103 is designed for normal flows with occasional extremes.
If deploying for continuous extreme flows, ask for a high flow configuration.

Data Protocols Supported
- Pulse

Typical Accuracy (12 month)
- Water >99% Gas >97%

Installation Limits
- -20C to 40C
- 10% - 95% RH non-condensing
- Not for hazardous locations

Sensor Probe
- Outdoor, immersion, burial
- 2M, 7M, 15M long burial CAT6, AWG 23, RJ45, Pin out T568B
- Extendable to 60M / 200 ft. 75 ft Max when 5v powered.

103 RSIM Board (65mm x 56mm)
- Indoor or in User enclosure
- Mounts on Din Rails
- Mounts on Raspberry Pi
- Direct fasten to enclosure

Pulse Specification
- Solid State Optically Isolated Relay: DC or AC ok. No Polarity.
- Width= 10 – 100 msec (default=50)
- Max Voltage: 24v DC / 17V RMS AC
- Max Current: 1A DC / 0.5A AC RMS
- Isolation Voltage: 1kv RMS
- Device is a CPC 1020N
- Pulses over Max Pulse rate are accrued until flow slows

Power Consumption: <45mA Max

Standard Power
- 5v/12v/24v via terminals

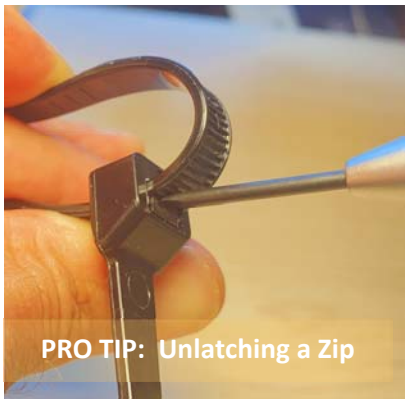
Optional Power
- 110v: AC-110
- 110v + Battery Backup AC-106

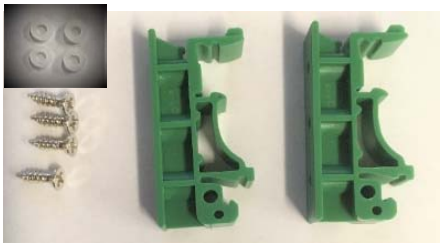
Certifications
Complies with Part 15 of FCC Rules

HARDWARE ASSEMBLY / INSTALLATION / COMMISSIONING

1. Assemble / Install: See pg 1 and pg 2 diagrams

1. Run Probe cable + probe extension from Meter to Enclosure (see pg 1)
   - Probe + Probe Extension: **NOT to exceed 60M /200 ft max**
   - **PRO TIP**: If removing /re-crimping probe RJ45 connector, Pin out is Ethernet T568B
2. Zip Tie Probe to Meter, cable to pipe. **see pg 5**
   - **PRO TIP**: Re-use Zip Ties. Flat head Jeweler screwdriver to open latch. (**see right**)
3. Inside your Enclosure: Mount Sensor Board. Choose:
   - on Din Rails: **(see included brackets right)**
   - on Raspberry Pi
   - on enclosure wall with screws or Velcro tape
4. Make Final Connections **(see pg 2)**
   - Connect Probe to RSIM board
   - Connect Power to Power Inputs. D3 LED lights solid. D4, D5 LEDs OFF
   - Connect Pulse Counter to Pulse Output
   - **ALWAYS**: If probe is moved, power cycle probe **AFTER** re-securing probe
5. Set Pulse Toggle Switch to 1X
6. Option: Confirm function / familiarize. See pg 4 for Desktop Simulation
   - Discover your Pulse Volume. See pg 7





Troubleshooting: Assembly: If D4 and D5 LEDs light solid ON, there's a problem
- Probe not inserted OR not fully inserted into board.
- Extension Cable Problem: Connect probe directly to board without extension.
- Wrong Probe. Check probe bar code label. Should say "PSW202 (for VV-102)"
- Probe unconfigured. Contact Vata Verks. info@vataverks.com

2. Commission

1. **Flow Water or Gas safely and as instructed by appliance manufacturer.**
   - Confirm Tracking.
     - **a.** D4 blinking @ 1 Rev.
     - **b.** D5 blinking @ Pulse Toggle setting. (1 Rev or 10 Rev)
   - Confirm Pulse Communications to database.
2. **Shut OFF Water or Gas flow.**
   Pulse Volume. If Pulse Volume is not already discovered, do so now. Review discovery options, pg 7.
3. If desired, change Pulse K-factor to: 1.0 or 10.0
   (and adjust Pulse Vol accordingly)
4. **Document Installation**
   - Record: Meter Model, Pulse Volume, Pulse K-factor & Probe Serial No. (located on cable label), Meter / Probe Installation Photo
   - Send to: info@vataverks.com and for your records.

   Installation Complete

Trouble Shooting: Tracking on Meter
- **No Pulse: Possible Tracking Problem**
  - Mag. field strength too weak.
    - Refer to **pg** 7 and shift probe to a stronger location.
  - Meter possibly incompatible.
    - Refer to pg 2 and review meter compatibility. Send photo to info@vataverks.com
- **No Pulse: Possible Pulse problem**
  - Check Pulse output wiring.
  - Unlikely: Pulse width too short for Pulse Counter. Contact Vata Verks

SUPPLEMENT: Familiarize with Sensor, Pulse Volume, Pulse Settings

1. Optional: Fast Familiarize

SIMULATE FLOW AT DESK

1. Follow Step 4, pg 3 Assemble
2. **Set Toggle Switch to 1X**
3. Roll Probe back and forth **(as below)**

3. D4 & D5 LED will flash with each cycle
4. Change Switch to 10X, and continue
5. D4 LED will flash with each cycle
   D5 LED will flash with each 10th cycle.
6. Unplug Probe to Power Cycle unit, clearing the Calibration before each use.

If using a Pulse Counter, connect to the Pulse Terminals as shown pg 2.

Output Explained

- Tracking an identical path through Earth's magnetic field is similar to tracking the magnetic field of a meter.

TRACK FLOW ON METER

Water Probes are for Water meters only.
Gas Probes are for Gas or Water meters.

1. Strap Probe to the meter as shown **pg 5**
2. **Power Cycle Probe (unplug / plug)**
3. If Run water or gas (safely follow manufacturer instructions)
4. Observe LED flashes
5. **Shut OFF Water / Gas flow**

2. Required: Pulse Volume

Calculating Pulse Volume

The VV-103 Pulses at a 1X or 10X revolution count. This is the Pulse K-factor (revs/pulse). Each Pulse = a Pulse Volume. The Pulse Volume will be used to convert received Pulses into flow data.
Choose a Pulse Vol. Method. pg 8

Pulse Volume can also be calculated from a meter's K-factor if known
(k-factor = meter size in revs/unit vol)
Pulse K-factor = Pulse Volume
Meter K-factor

Is your K-Factor Already Known?

Many meter models are known.
Email to: info@vataverks.com

- Photo of Meter data / face plate
- Photo of Probe Serial #.

One K-factor per serial #.
Same day requests are not recommended.

PRO TIP: K-factors and Pulse Volumes, can vary for specific installations.
Measuring k-factor or Pulse Volume for the specific meter on-site is **Highly Recommended** and **REQUIRED** for highest accuracy.

Choose Your Method

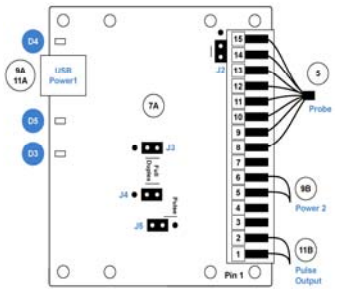
Review and choose the best Pulse Volume Discovery Method for your project. pg 7

Choose Method

3. Optional: Pulse Settings

Changing Pulse Settings

The VV-103 is Factory Configured.
For Pulse K-factor see probe label.
For Pulse Width: default 50 msec.
To change settings use either:
Accessory Kit: VV-301
Sensor Kit: VV-102 RSIM board

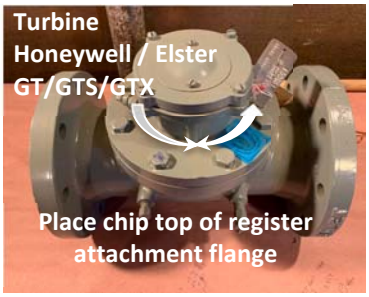


To change Pulse K-factor & Width

1. Download VV-102 Instruction at http://vataverks.com/support
2. Follow instructions pg 3 to connect to the board, and download Tera Term and drivers.
3. Pulse Width is default 50msec. and accepted by most Pulse Counters, but changed if required for your pulse counter OR if a higher pulse rate is desired.
   Pulse width can be 10-100msec
4. Pulse K-factor is default 1.0. Increasing to 2.0 or 5.0 will improve the units peak flow performance for deployments with High RPM meters in high flow areas.
   If Pulse K-factor is changed to (ex: 2.0), when returned to the VV-103 board
   1X Toggle = 2.0 revs
   10X Toggle = 20.0 revs
5. Record changes on Probe label.

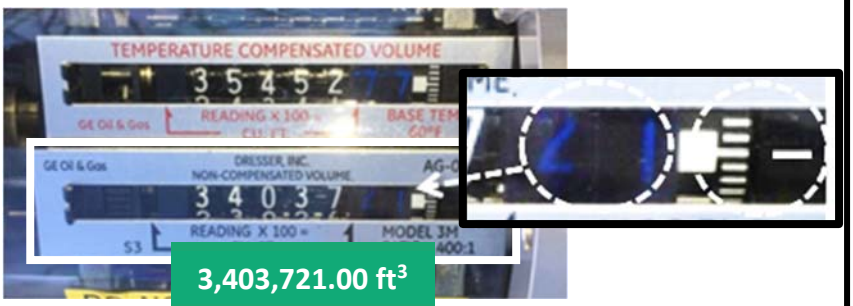
METER GUIDE

Rotary or Turbine Gas Meters



How to Read a Rotary Meter

- Use the "Non-Compensated Volume" reading.
- Dresser: Use a light to see 10's and 1's. (see below).
- Snap photo of the register and read from the photo.
- Dresser: Each "hash" mark on right side = 0.2 ft^3.
  - Rollover (X.00 ft^3) = main hash aligns with fixed hash.
  - Estimate to the 2nd decimal place. (ex: 3,403,721.36 ft^3)

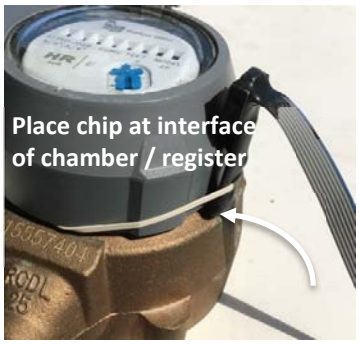


When Compensated & Non-Compensated output is greatly different the utility may be using a high pressure feed.

Confirm K-factor with the Monthly Bill

Need some help? Send Meter photos to info@vataverks.com

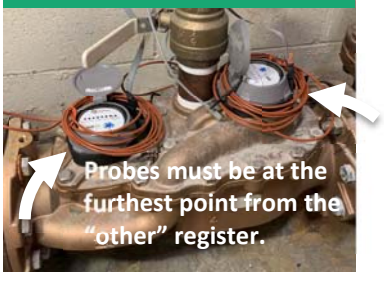
Water Meters



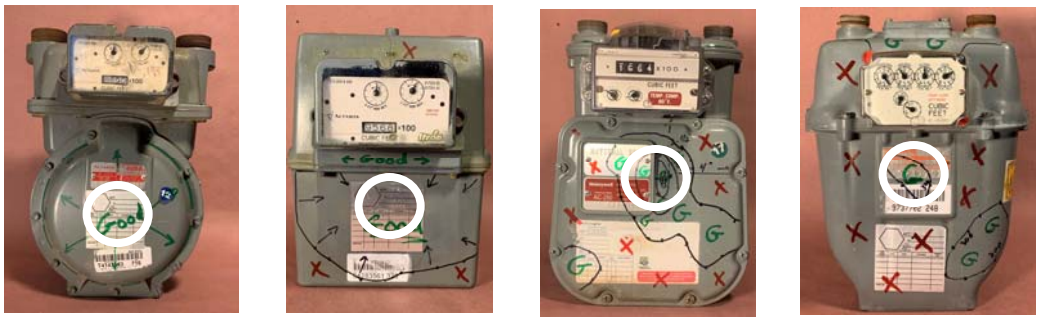
METER READING

1. **Take meter readings from a photo**
2. Read digits / dial. Estimate last digit between "hash" marks
3. Check Meter units (ex: Gal or Cubic Feet)
4. Avoid register voids and rollovers.

Compound Meters
Requires (2) Units



Diaphragm Gas Meters:
Place Probe Vertically + Horizontally Centered <u>Front OR Back</u>



Pulse Volume DISCOVERY METHOD "D2"

PRO TIP: During Peak flows, Pulses over what can be transmitted in 1 second are "banked" and transmitted when flow slows. Pulse Volume cannot be accurately discovered if Meter is past Peak Pulse at moment of **START** or **STOP**. If D5 LED is pulsing at 10X per sec. (when Toggle is 1X) or 1X per second (when Toggle is 10X), do not **START** until it slows. If started, do not **STOP** until it slows.

For all Meters with Resolution < 1 ft³

(If resolution = 100 ft³ this method may be unsuitable)

Temporary Install at Meter

NOTE: Keep Board Safe in Plastic Bag

1. Strap Probe to meter. See Meter Guide **pg 5**
2. **Start flow (Water or Gas) to Track so D4 / D5 LED Pulses**
3. **If using Pulse Counter, set Pulse Toggle Switch = 1X**
   If eye balling D5 Flashes, set Pulse Toggle Switch = 10X

Data Collection

4. **START Test at Instant of D5 Pulse Flash**
   SIMULTANEOUSLY:
   a. **M1**: take **Photo1** of Meter (as below)
   b. **Pulse1**: Record Pulse Counter Count
   NOTE: If Eyeballing, DO NOT COUNT **START** Pulse.

If Gas: Use **"Non-Compensated"** output

Photo1

62.00 ft³

Photo2

62.10 ft³

5. **During Test PERIOD**
   a. **Run Water or Gas.**
   More is better.

6. **STOP Test at Instant of D5 Pulse Flash**
   SIMULTANEOUSLY:
   a. **M2**: take **Photo2** of Meter (as above)
   b. **Pulse2**: Record Counter's Count.
   If Eyeballing: record total D5 Pulses

SHUT OFF WATER OR GAS FLOW

Pulse Volume Calculation

7. **Read the Meter1 and Meter2 in Photo1 and Photo2**

8. **Pulse Volume = Total Flow = Meter2 – Meter1** (Meter)
   Total Pulses Pulse2 – Pulse1 (Sensor)

For Diaphragm Gas Meters

Diaphragm Gas Meters lack 10 ft³ & 1 ft³ register resolution. Therefore the ½ ft³ dial must be used.

Temporary Install at Meter

NOTE: Keep Board Safe in Plastic Bag

1. Strap Probe to meter. See Meter Guide **pg 5**
2. Set Pulse k-factor = 1X
3. **Start Gas flow to Tracking so D4 / D5 LED flashes**

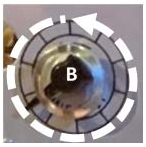
Data Collection

**While Gas Continues to flow:*
Note: If Eyeballing, hold RSIM Board next to meter register

4. **START** Test at **Instant of D5 Pulse Flash**

   SIMULTANEOUSLY:
   a. **M1**: take Photo A of Meter ½ ft³ Dial
   b. **Pulse1**: Record Pulse Counter Count.
   c. NOTE: If Eyeballing, DO NOT COUNT **START** Pulse.

0.67
(7 is est)



21.00

0.84
(4 is est)

5. **During Test PERIOD**
   Carefully Count full rotations of the ½ ft³ dial. Watch closely.
   ~10 rotations acceptable, 20 preferred.
   Eyeballers: You ALSO need to carefully count D5 Flashes

6. **STOP Test at Instant of D5 Pulse Flash**
   SIMULTANEOUSLY:
   a. **M2**: take Photo C of Meter ½ ft³ Dial
   b. **Pulse2**: Record Pulse Counter Count.
   c. If Eyeballing: record total D5 Pulses

SHUT OFF GAS FLOW

Pulse Volume Calculation

7. **Totalize flow volume from Photos**
   Ex: **Total = 0.67 + 21.0 + 0.84 = 22.51 rotations of ½ ft³ dial**
   Total Vol = 11.255 ft³

8. **Pulse Volume = Total Flow = Meter2 – Meter1** (Meter)
   Total Pulses Pulse2 – Pulse1 (Sensor)

VV-103 Pulse Volume Discovery Methods: Choose One

Pre-Configurated Sensors
On OR Off-Site Pulse Volume Calculation

PRO TIP: During Peak flows, a Pulse-rate over what can be transmitted in 1 second are "banked" and transmitted when flow slows. Because of this, Pulse Volume cannot be accurately discovered if Meter is past Peak pulse at moment of **START** or **STOP**. If D5 LED is pulsing at 10X per sec. (when Toggle is 1X) or 1X per second (when Toggle is 10X), do not **START** until it slows. If Started, do not **STOP** until it slows. The Unit can be re-configured to accomodate continuous Peak Pulse rates.

METHODS	C	D1	D2	E	F
		DIFFICULT	***PREFERRED***	***PREFERRED***	***GOOD***
Revs from:	**Pulse Flashes**	**Pulse Flashes**	**Pulse Counter**	**Customer Database**	**Customer Database**
Flow from:	**Measured Container***	**Meter Photo (or video)**	**Meter Photo**	**Meter Photo**	**Utility Bill**
Situational Limits	Water ONLY Small or Controlled Buildings No Compound water meters Electricity avail. at faucet	Electricity avail. at meter Meter Resolution <1 ft3	Electricity avail. at meter Meter Resolution <1 ft3	For Water and Gas. NOTE: If gas meter resolution = 100 ft3 START/STOP at 100.00 ft3 rollover	No Compound water meters Test month + Prior month MUST be Actual meter reads. No Est. reads
Flow Limits	Test faucet ONLY. All other = 0	All Flows OK	All Flows OK	All Flows OK	All Flows OK
Accuracy	>95%.	Video: >99%, Eye: ~95%	99%	>99%	1 month >97% 2 mon >98%
Poss. Error	Pulse Flash mis-count Secondary flows	Pulse Flash mis-count	Pulse Flash mis-count	Meter reading	Time of Bill Start/Stop Low seasonal usage
On-site Effort	Low	Medium	Medium	Low	Zero
Total Time	15 Minutes	15 Minutes	15 - 30 Minutes	Hours or days or weeks	32 - 63 days after install

VV-103 Pulse Volume Discovery Methods: Instructions

Off - Site Prep	***Bring a measured container. The larger the better.**	**None**	**None**	**Preferably Know Pulse Counter upload period**	**None**
On - Site Prep	**Temporary Install** -Strap Probe on Meter (pg 5) -Connect probe to 103 RSIM Board at Faucet (board protected in plastic bag) -connect to power -connect Pulse counter if using -Set Pulse k-factor Switch: 1X	**Temporary Install** -Strap Probe on Meter (pg 5) -Connect probe to 103 RSIM Board at Meter (board protected in plastic bag) -connect to power -connect Pulse counter if using -Set Pulse k-factor Switch: 1X	**Temporary Install** -Strap Probe on Meter (pg 5) -Connect probe to 103 RSIM Board at Meter (board protected in plastic bag) -connect to power -connect Pulse counter if using -Set Pulse k-factor Switch: 1X	**Permanent Install. Pg 3** Probe on Meter connected to 103 RSIM Board Permanently Installed, tracking, communicating to database. **Confirm data reception** Set Pulse k-factor (1X or 10X), and record choice.	**Permanent Install. Pg 3** Probe on Meter connected to 103 RSIM Board Permanently Installed, tracking, communicating to database. **Confirm data reception** Set Pulse k-factor (1X or 10X), and record choice.
On - Site Data Collection	-run low flow, unit tracks **D5 LED flash** -Stop Flow. Confirm meter flow=0 -Start a low Flow down Drain. **START:** at D5 LED Flash **Pulse0**, **Instantly** divert into container -**Do Not Overflow**. -Count D5 Pulses **(Do not count 1st Pulse0)** **STOP:** at D5 LED Flash **Pulse#**, **instantly** divert flow to Drain. -if Container Overflow: Do over **-Stop flow**. Confirm meter flow=0 -Repeat Test to Confirm Results	***If Diaphragm Gas Meter*** *: pg 6* -run low flow, unit tracks **D5 LED flashes** Set Pulse k-factor Switch: 10X **If Video:** Start recording with D5 LED & Meter register in 1 frame. Continue flow More flow=more accuracy. **STOP Flow** **STOP Video**	***If Diaphragm Gas Meter*** *: pg 6* -run med flow, unit tracks **D5 LED flashes** Set Pulse k-factor Switch: 10X **START** at 1st D5 LED **Pulse0**: **Simultaneously** -Take Photo1 of Meter -Record Pulse Count1 Continue flow. More flow=more accuracy. **STOP** at last D5 LED **Pulse#:** **Simultaneously** -Take Photo2 of Meter -Record Pulse Count2 **STOP Flow**	****Take Photos simultaneous with Pulse Counter upload. If not known, take photo every minute for an upload period. (ex:15 photos over 15 min) **START** Take Photo1 of Meter** To minimize error, Maximize flow between START / STOP: hours, days, weeks. **STOP** Take Photo2 of Meter.**	**No On-Site Data Collection**
Calculation & Final Install	**Permanent Install. Pg 3** **Total Flow** = Measured Volume **Total Pulses** = Pulse Count Pulse0 to last Pulse# **(Do not count 1st Pulse0)** **Volume per Pulse = Total Flow / Total Pulses** -Can Switch Pulse 1X to 10X. Pulse Volume will be 10X too.	**Permanent Install. Pg 3** Review Video / Photos -Read Meter1 at first Pulse0 -Read Meter2 at last Pulse# **Total Flow** = Meter2 - Meter1 **Total Pulses** = Pulse Count Pulse0 to last Pulse# **(Do not count 1st Pulse0)** **Volume per Pulse = Total Flow / Total Pulses**	**Permanent Install. Pg 3** Review Photos -Read Meter1 in Photo1 -Read Meter2 in Photo2 **Total Flow** = Meter2 - Meter1 **Total Pulses** = (Count2 - Count1) **Volume per Pulse = Total Flow / Total Pulses**	Choose Photos time stamped closest to Pulse Counter Uploads -Read Meter1 in Photo1 -Read Meter2 in Photo2 **Total Flow** = Meter2 - Meter1 Use Photo1 & 2 time stamps to calculate **Total Pulses** received in database during period. **Volume per Pulse = Total Flow / Total Pulses**	Review Utility Bills Test month and prior month MUST be "Actual" reads. **Total Flow** = Utility Bill volume (converted to std units ex: ft3) From your database, calculate **Total Pulses** from noon 1st day to noon last day of bill **Volume per Pulse = Total Flow / Total Pulses**