



THE ENERGY OF THINGS

# Joule heat meter installation manual

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**Congratulations** on the purchase of one of the most accurate and cost effective heat meters available.

This kit ensures that you have all parts necessary to successfully complete your installation. Before you continue, let's check to be sure everything is present:

**Top Shelf:**

- 1 AM-BR: border router  
(connects meter to the Internet)
- 1 Joule meter
- 1 composite Vortex flow sensor
- 1 optional pump Current Transducer
- Velcro tape to adhere AMBR to tank



**Bottom Shelf:**

- 2 Wye fixtures with thermowells inserted
- 1 Black power supply (12V) for Joule
- 1 White power supply (5V) for AM-BR
- 2 Digital temperature sensors
- 1 Pack of thermal grease
- 1 Lead for flow sensor
- 1 Grounding lead
- 1 Metal grounding strap
- 1 CAT5 Ethernet Cord, 1' long



### Pre-Install Site Survey

- 1) Installer conducts Pre-Install Survey with Site Owner via phone
  - Is there high speed Internet available?
  - Is there a spare jack into which Joule can plug?  
(if not ask the Internet Service Provider for this or bring along a separate Ethernet switch)
  - Is there a spare electrical outlet near the site router?
  - Is there a spare electrical outlet in the mechanical room?

### Amatis' Meter-to-Cloud design



System sensors feed data to Amatis Meter



Meter transmits data wirelessly to AM-BR, the border router



AM-BR stores data to Amatis Cloud



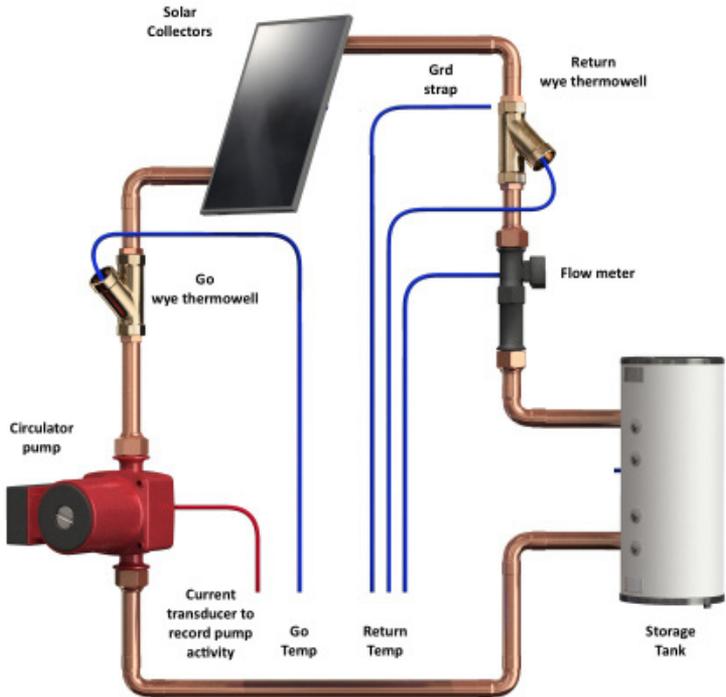
Users access data from any web-enabled device

### Install Protocol

- 2) Drain system, install the meter, refill the system and confirm correct operations of the solar thermal system.
- 3) Check Joule for blue, green and red LEDs illuminated.
- 4) Leave Owner's Manual with your customer.
- 5) Take this manual with you in order to register this meter online.
- 5) Instruct Customer to register themselves and join the Energy Dashboard.
- 6) Review system operations periodically to ensure the system functions well.

## Amatis Solar Hot Water Metering Install Schematic

Schematic for illustrative purposes. Does not represent exact system set up



Joule Connections

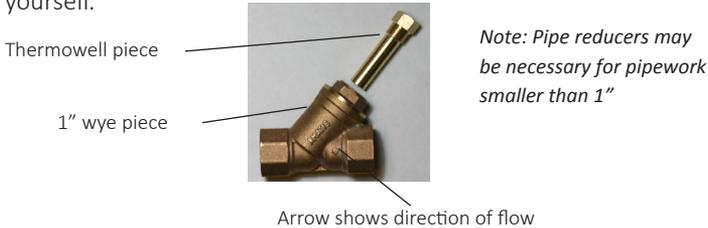
The overall meter accuracy for Joule is better than 1.3%, certified by TÜV Rhineland PTL. To achieve this accuracy the temperature sensors and the flow meter need to be correctly installed.

Flow is measured with a Grundfos vortex flow meter. A grounding lead and strap are supplied with this kit and should connect to nearby metal pipework.

Temperature is measured via the wye pipe fitting assembly provided which are installed on the "Supply" and "Return" pipes. The flow meter is generally installed adjacent to the Supply or Return temperature sensors. These assemblies should be installed within 6 feet of the meter, otherwise cables will need to be extended. Joule can be affixed using Velcro tape, or with screws, at the installer's discretion. Strapping on temperature sensors to the outside of pipes **is NOT sufficient** to obtain sufficient accuracy.

## Installing the Temperature Sensor Assembly

To accurately read the temperature of the heat transfer fluid, Amatis provides a two-part assembly. Your kit includes two x 1" wye + thermowell pipe fittings. Should larger pipes be necessary for commercial jobs, please contact Amatis, or supply thermowells yourself.



**Solder** one assembly on the "Supply" pipe, and one assembly on the pipes that "Return" from the solar collectors. Align the wye assembly so that the wye branch faces upward. The assemblies should fit close to the hot water tank on the appropriate pipes.

**Coat** the metal tip of the temperature sensor into the packet of thermal grease.

**Next, insert** the temperature sensor as deeply into the thermowell as possible. The thermowell holds the temperature sensor into the flow of the heat transfer fluid, and the thermal paste increases the sensor's sensitivity. Together, these steps ensure accurate and consistent temperature readings. The digital temperature sensors are supplied as matched pairs; one for each wye. Temperature sensors are qualified between -58°F and 300°F. Temperature sensor cable is made of Teflon to afford operations to 400°F. Between 300°F and 400°F the accuracy declines. . Temp sensor cap is stainless steel.

**Connect** the temperature sensor into Joule. The sensor is pre-terminated with the RJ11 for plug and play installation.

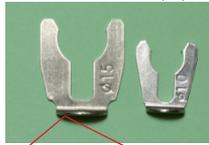


Wye fitting shown with fully installed temperature sensor, with RJ11 plug ready to be inserted into oule.

## Installing the Vortex Flow Sensor

The flow sensor assembly is supplied in parts.

Two large clips are used to hold the ends of the pipe to the body of the flow sensor. Note that the flow pipe is a composite, as strong as stainless steel. It is not plastic.



Big clip  $\varnothing$  15 is for flow tube.  
Small  $\varnothing$  10 is for the sensor



By placing O ring as pictured, the parts can be assembled using finger force only.



O rings

**Assemble** the flow meter by placing the O rings, as pictured. Note that the Green O ring is placed at the bottom of the housing. The black O-ring at the edge of the FIRST groove. DO NOT mount the black o-ring at the SECOND, bigger groove. This is for the  $\varnothing$  10 sensor clip. Beware that if O ring is mounted differently, it will get damaged.

**Fit** the two large clips to hold the flow tube to the ends of the pipe.

**Use the** small clips to hold the electronic sensor to the flow sensor.

**Complete** all soldering and clean pipe of any debris remaining from soldering process. Do not mount flow sensor before the cleaning proces is complete. Do not expose flow tube to any cleaning agents.

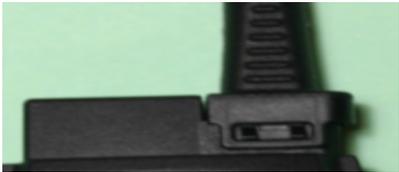
**Now** insert the the flow meter into the Return (from collector) pipe, just below the Wye Temperature assembly. Observe the flow direction on the flow pipe, and match these up.

**Attach** the wire to the flow sensor. The round end plugs in to the flow meter. The cable fits snugly and permanently into the flow meter. (See pictures, next page.)



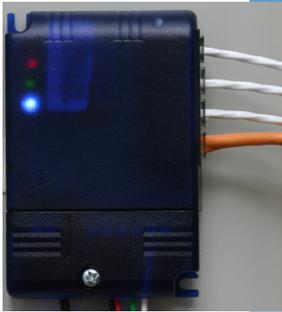
Flow sensor depicted with connector fitted properly

Notice plastic snaps. These should snap over each other to make a good connection.



**Connect** the other end of the flow meter's cable into AM-Joule using the RJ11 jack. The maximum cable length is 10' and is the maximum permissible length. Amatis does not allow any splicing or extension of the cable.

Flow meter plugs into the last port on the meter, depicted here with an orange colored lead.



**Flow sensor cabling detailed**

- Brown = +5V power supply for flow sensor
- White = flow sensor activity
  - minimum voltage = no flow = 0.5V
  - maximum voltage = maximum flow = 3.5V
- Green = 0V power supply for Vortex flow sensor
- Yellow = unused

For diagnostic purposes, the flow meter is connected correctly when:  
White wire = 0.5V, and Green = 0V, with no flow.  
Yellow LED on AM-Joule is on when flow > 1.3 GPM.

**Notes on Select the right flow meter**

Choose your flow sensor based upon your maximum design flow rate rather than your pipe size. The adjoining pipe size influences this to a far lesser degree. The majority of thermal harvest (and flow) takes place during the peak of the day therefore, select a sensor based on the highest flow predicted. Grundfos recommends VFS 2-40 with pump for up to 10 GPM, which assumes a 4.5 PSI drop at maximum flow. Note: under sizing copper piping to reduce costs will damage the pipe. Never exceed 5 ft/sec velocity in copper pipe. Properly sizing the piping and flow sensors for your maximum predicted flow will allow you to maximize thermal harvest and minimize pump energy.

## Installing AM-BR: Overview

AM-BR delivers performance data from Joule to the Cloud database. This database populates your customer's Energy Dashboard, and your Installer Fleet View. AM-BR sits beside the site's normal Internet router.

### AM-BR



Joule sends AM-BR metered data via IP6 radio. The meter can be installed without cabling between Joule and AM-BR. AM-BR monitors your Internet connection and will store data locally if there is an Internet disruption so the performance data remains coherent.

## Installing AM-BR

AM-BR requires high-speed Internet service. High-speed Internet is provided via a Cable/DSL modem or Fiber. There are two likely installation scenarios.

### 1. Cable/DSL Modem



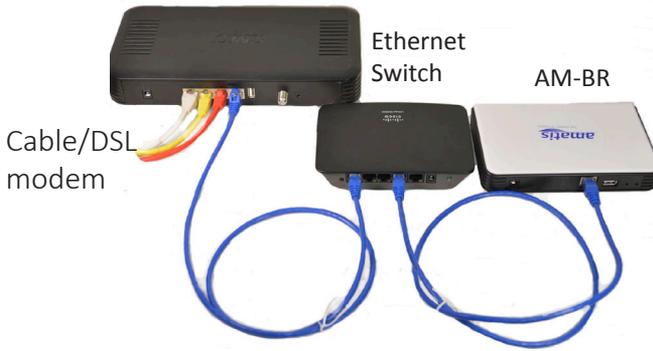
### 2. Ethernet Bridge/Router



If a modem and a router are both already at the job site, there will be sufficient ports at the back of the router in which to connect AM-BR to the router, with the kit's Cat5 cable.

## Connecting AMBR to the Internet

Most modems have 1 Ethernet jack. To connect AM-BR you will need to add another connection. To add a connection you will need to install an Ethernet Switch. This arrangement is shown here:



Ethernet Port on AM-BR showing 3' Ethernet cable, provided with your kit, installed.



Your DSL/Cable modem plugs into then WAN port of your router/ The Modem plugs into the WAN port of your Ethernet Switch. The existing computers and AM-BR plug into your LAN port of the switch.

**Note:** If the modem is configured to only one computer, you may need call the Internet Service Provider to allow for DHCP connection and multiple connections.

AMBR requires a DHCP (this is where AMBR received an Ethernet Address by the Router, which allows AMBR to talk to other devices such as the Router). If your installation has been configured as a “static IP type connection” you may need to contact the Internet Service Provider to update the Internet settings.

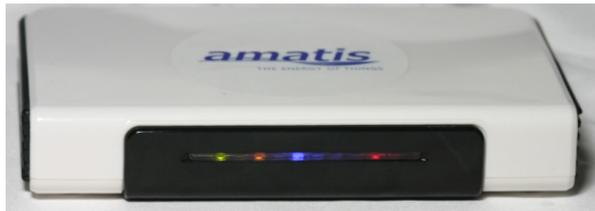
## Powering Up AM-BR

**Plug** AM-BR in to an available high speed ethernet connection.

**Plug** in the white (5V) power supply. The Red LED on the front of AM-BR will illuminate indicating power.

**Wait** for 1-2 minutes, while AM-BR connects with the Cloud. During this period the Green, Yellow and Blue LEDs will come on. Blue LED will go off, then come back on.

**Verify** that the device works when you see Green/Yellow/Blue and Red LED lights turn on.



## Light Indicators on AM-BR

Green LED	= flashes; successful processor boot
Orange LED	= illuminated; successful activity in local memory
Blue LED	= illuminated, successful connection to the Cloud
Red LED	= illuminated, successful connection to power

AM-BR features an ARM processor running at 400Mhz  
4Gbytes of SD flash, 128M Ram and 512M of Nand flash.

## Restoring to factory default

Unplug AM-BR. Use a paper clip to depress the wk-up button as shown in the figure.

Plug unit back in.



## Still no connection

Power down the Cable/Modem and Bridge/Router and AM-BR. Now, power up Cable/Modem followed by Bridge/Router and finally AM-BR.

## Joule

Joule is the heart of your metering system. Joule reads and records all sensed temperature and flow data. After calculating thermal measurements within the device, this data is sent via wireless, radio frequency) to the Amatis Border Router (AM-BR) which controls and manages data upload to the Cloud.

Yellow = FLOW present

Red = Power

Green = Temp Sensors

Blue = AM-BR found



Ground lead

Return Temp sensor

Go temp sensor

Flow meter

Joule can take 9-24V DC or AC. The terminals are polarity insensitive. Wire in, as depicted.



## Installing the Meter

**Mount** Joule with self-adhesive Velcro tape (supplied) backing to affix the meter to a tank or other surface. Alternatively, mount Joule to an adjacent wall by screwing it in using the two fixing centers available on the box.

**Plug** in the Flow Sensor in the lowest jack.

**Plug** in Supply temperature sensor into the next jack.

**Plug** in Return temperature sensor.

**Plug** in the Ground connection and use 10" galvanized steel ground strap to connect to plumber ground.

**Connect** the black 12V DC power adapter to inside terminals as shown.

**The meter** is now ready to power up.

## Light Indicators on Joule

Red light labeled **Power** indicates electricity to the meter.

If illuminated, the device is successfully receiving power.

If not illuminated, begin to troubleshoot:

- a) verify that the wall outlet is live.
- b) check that cable terminations are securely fit.
- c) test with a multi-meter to verify that 9VDC at the terminals is present.

Green light labeled **Temp** indicates temperature sensors.

When both temperature sensors are plugged in, the green LED will light up continuously.

2 flashes of the green light indicates a fault message. The error indicates a defective or unplugged temperature sensor located on the Supply pipe.

3 flashes of the light indicates a defective or unplugged sensor on the Return pipe.

Yellow light labeled **Flow** indicates flow meter.

If illuminated, the device is successfully receiving data from the flow sensor. To test, run a hot water source. As long as flow > 1.5 liters/m, the yellow LED will illuminate.

Blue light labeled **Internet** indicates connection to AM-BR.

Joule finds the Amatis Border Router, because the router is plugged in first.

### Test the range between Joule and AM-BR

The radio in your meter is very efficient and can transmit up to 500 feet in open air. However certain objects in the built environment affect the range such as rebar in concrete, airhandling ducts, metalwork etc. Before you attach Joule, it is recommended that you try with a temporary location to see if a connection is made to AM-BR (Blue LED).

Contact tech support for advice on overcoming obstacles in specific locations or options to add repeater devices.

## Installing the \*optional\* Current Transducer

A current transducer (CT) measures electrical current. The CT measures the power in your solar circulation pump (Channel 1), and the water tanks' auxiliary backup/preheat (Channel 2), (if the auxiliary is electrical). The CT is available in 25 and 100 amp ratings. It will work with 120 or 240V AC pumps and heating elements. Because the connections are all safe, UL listed low voltage Class 2, they do not require any form of electrical containment.



**Run** the live connection to the pump (black or red) through the hole in the CT. While some CTs are directional, that is not the case with this device.

**Wire** the + and - signals from pump CT into the port labeled CT1 on the AM-Joule.

**Wire** the + and - signals from the auxiliary tank to CT2 input.

**Select** the current and voltage presets for the CT when you set up the dashboard.

**Verification:** Using a multi-meter, set to DC voltage, check the reading. If the CT is accurately wired in, and polarity has been accurately observed, the multi-meter will vary from 0 to 5V DC.

## Install an optional Pulsed Meter for Gas, Oil, Propane

If the auxiliary power for the water tank is natural gas, propane or heating oil, then a pulsed energy meter is necessary. This must be acquired separately from the natural gas company. AM-Joule can record 2 channels of pulsed energy data.

Wire the pulsed energy meter according to its instructions, to the auxiliary power source.

Pulse meters provide a dry contact closure, so connect "Com" on pulse meter to "Com" terminal on AM-Joule and P1 (pulse) to PLS2 on AM-Joule.

Ch2 is designed to read the energy supplied to the auxiliary heating element in your tank. Connect to Com and PLS2 terminals.



Pulse meter accuracy:

The accuracy at which pulsed measurements are read depends on the accuracy of the pulse meter acquired. Meters are available up to utility grade metering, and vary in price.

## Connecting the hardware to the Energy Dashboard

Once the AMBR, AM-Serial, and EagleSun are all installed, you are ready to register the hardware with the Amatis database. You will do this by bonding the particular Device ID from the recently installed AMBR to the Amatis Dashboard. You do this by registering it. Finally, you will help the customer register themselves and create a user login and password.

### Step by Step joining the hardware with the Cloud:

**Navigate** to [www.amatisdash.com](http://www.amatisdash.com) and complete the fields for Register My System.

**Select** the *I am an Installer* button to identify yourself.  
**Enter** your email address as username and create a password.  
**Check** your email. Amatis will send you an the email confirmation.



**Click** on the link to activate your account.  
**You'll return** to the same login screen where you just registered.  
**Enter** your email address and password under **Log In**.  
**Enter** the Device ID accurately from the front of this manual. The same number is also located on the back of the AMBR you just installed

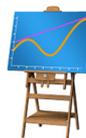
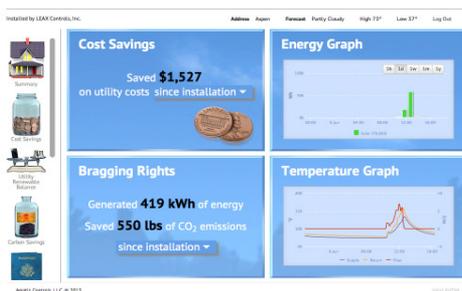


**Upon first login**, you'll be directed to the System Set Up form. These forms are necessary to set the measurement parameters and identification of the system. Complete this form.  
**Now** your system is successfully joined to the Amatis Dashboard.  
**Upon** subsequent login, you will be guided to your Installer Fleet View.

Residence/Site	Zip Code	Installer	Thermal Harvest	CO <sub>2</sub> Savings	System Status
Miles Hill Residence	80303	Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Valero on 82 Carwash		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Energy Smart Resource Center		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Herzog Residence		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Denver Housing Authority - Mariposa		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Alpen Youth Zone	81611	Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Caldwell Residence	81611	Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Lohi Residence		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
Sunnoventions Labs (51)		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>
CEFA demo		Mike Tierney			<span style="color: green;">●</span> <span style="color: yellow;">●</span> <span style="color: grey;">●</span>

In Fleet View, Installers can view all systems installed, or under management. Performance status is explained with color coded traffic lights. View your customer's Energy Dashboard by clicking on the site name. Edit customer's System Set Up tabs by clicking the

## Customer Energy Dashboard



**Teach** your customer how to register and log themselves in using the same process at [www.amatisdash.com](http://www.amatisdash.com). Select “system owner.” Help the customer create their username and password.

**Navigate** your Energy Dashboard using the widgets displayed above.

### Diagnostics

Should the Dashboard not be reporting, you may need to troubleshoot.

- 1) Verify that the normal household Internet router is working (i.e. are you online with other devices?)
- 2) Reset AMBR by unplugging and replugging it. Wait 2 minutes.
- 3) Verify that the lights on AMBR are on: orange, red, blue & green.
- 4) If you don't see the blue LED, this means AM-Joule needs to be unplugged and replugged.
- 5) If these measures are not effective, contact Amatis Controls.

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**Technical Specifications**

Vortex flow sensors are available from Amatis in the following sizes:

1-12	l/m	0.25 - 3.7	gpm	Pipe size	3/4"
2-20	l/m	0.5 - 5.2	gpm	Pipe size	3/4"
2-40	l/m	0.5 - 10.5	gpm	Pipe size	3/4"
5-100	l/m	1.32 - 26.4	gpm	Pipe size	3/4" - 1"
10-200	l/m	2.5 - 53	gpm	Pipe size	1.5" - 2"
20-400	l/m	5.28 - 105	gpm	Pipe size	1.5" - 2"

- Approved for potable water: WRAS/KTW/W270/ACS
- Absolute overall energy readings accuracy better than 1.3%
- Suitable for use with liquids of <2 mm2/s kinematic viscosity
- Suitable for use with fluids up to 100°C/ 212°F
- Seal type: EPDM rubber
- Housing made of: PPS /PA66 composite
- Enclosure class: IP44
- Electromagnetic compatibility: EN 61326-1
- Wireless communication distance: from AM-Joule to AM-BR via radio frequency: range 100 feet, via 6LoWPAN (2.4Ghz)
- Range is subject to normal Radio Frequency interference such as solid or metal objects. Repeaters are available if required. Email info@amatiscontrols.com for support.
- Wired communication from AM-BR is via 10/100bit Ethernet IP4 protocol
- Local memory: 4 GB SD flash. Suitable to store lifetime of metering data
- AM-BR processor is 400Mhz ARM with 4Gbyte onboard memory running Linux and Contiki operating systems.
- All communications via IP4 or IP6 open protocol.

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