amatis™

THE ENERGY OF THINGS

Joule Heat Meter
Residential and Commercial
Installation Manual

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Version5.100114

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:

1 AMBR: border router (connects meter to the Internet)
1 Joule meter
1 Black power supply (12V) for Joule
(optional) pump Current Transducer
2 brass Wye fixtures with thermowells, loosely inserted
1 White power supply (5V) for AMBR
2 Digital temperature sensors
1 Packet of thermal paste
1 flow sensor, sized to your specifications
1 cable for flow sensor
1 Grounding lead
1 Metal grounding strap
1 CAT5 Ethernet Cord

Pre-Install Site Survey

Installer conducts Pre-Install Survey with Site Owner via phone:

* Is there high speed Internet available?
* Is there a spare port in the router into which AMBR 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?
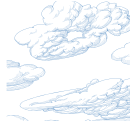*Is there a spare electrical outlet in the mechanical room?

Amatis' Meter-to-Cloud design
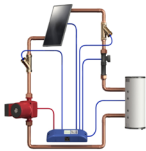
System sensors feed data to Amatis Joule

Meter transmits data wirelessly to AMBR, the border router

AMBR stores data to Amatis Cloud

Users access data from any web-enabled device

Install Protocol

1) Install AMBR

2) Drain system, install the Joule meter, refill the system and confirm correct operations of the solar thermal system.

3) Check Joule for the following lights:

Blue: Indicates the unit is connected to AMBR and internet.

Red: Indicates the unit is connected to power.

Green: Indicates a temperature sensor is connected.

Orange: Indicates that flow is detected; illuminated after system is recharged.

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.

Proper
Install
Schematic

and
Best
Practices

Amatis Solar Hot Water Metering Install Schematic

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

Solar collector array

Grounding strap — attach to pipe

Return Wye + thermowell assembly

Supply Wye + thermowell assembly

flow meter

Circulator pump

Storage tank
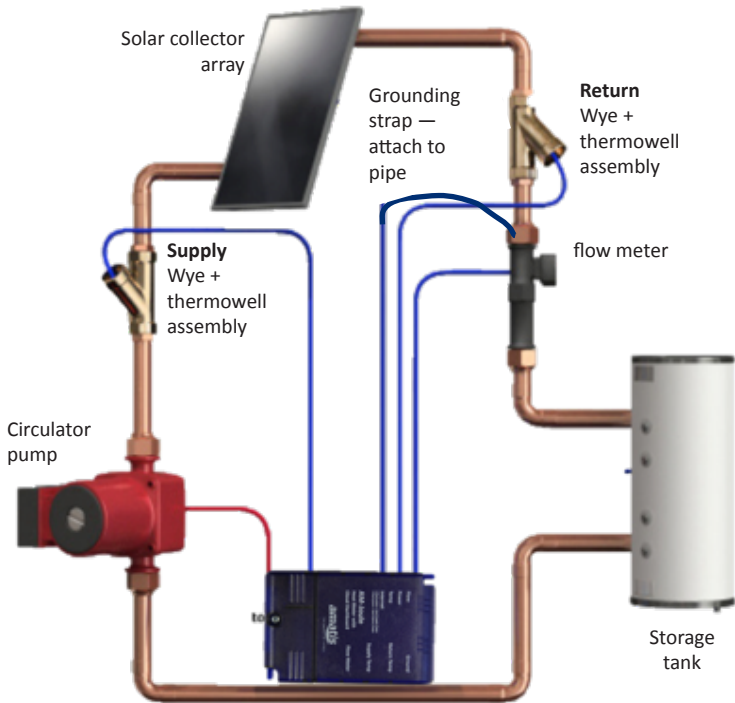
The overall meter accuracy for Joule is within 98.7%, certified by TÜV Rhineland PTL. To achieve this accuracy the temperature sensors and the flow meter need to be correctly installed.

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, with screws, or at the installer's discretion. Strapping temperature sensors to the outside of pipes **is NOT sufficient** to obtain rated accuracy.

Installing AMBR: Overview

AMBR delivers performance data from Joule to the Cloud database. This database populates your customer's Energy Dashboard, and your Installer Fleet View. AMBR sits beside the site's normal Internet router. Joule sends AMBR metered data via IP6 radio communications. This method of wireless communications doesn't demand cabling between Joule and AMBR. The devices form a mesh network autonomously. AMBR monitors your Internet connection and will store data locally if there is an Internet disruption so the performance data remains intact.

Installing AMBR

AMBR 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 should be sufficient ports at the back of the router in which to connect AMBR to the router, with the kit's Cat5 cable. Bring an ethernet switch in case.

Connecting AMBR to the Internet

Most modems have 1 Ethernet jack. To connect AMBR you will need to add another connection to provide more ports. An Ethernet Switch works like a power strip, enabling more ports. This arrangement is shown here:

Cable/DSL modem
Ethernet Switch
AM-BR
WAN port
LAN port
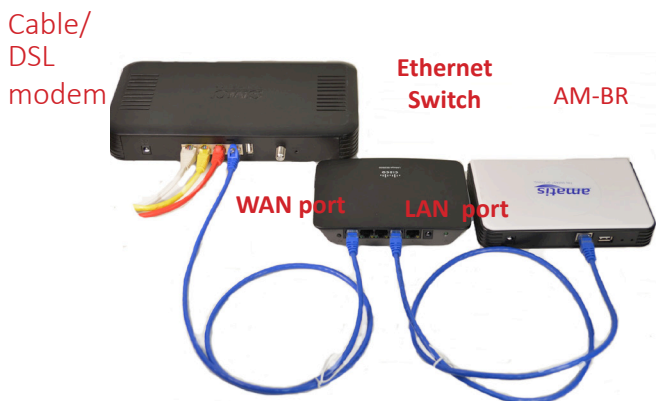
Your DSL/Cable modem plugs into then WAN port of the primary router. The modem plugs into the WAN port of your Ethernet Switch. Computers on site, and AMBR, plug into your LAN port of the switch.

Ethernet Port on AMBR showing the Ethernet cable, provided with your kit, installed.

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

AMBR requires a DHCP. (This protocol allows AMBR to receive an Ethernet Address from the Router. Then AMBR can 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 AMBR

Plug AMBR in to an available high speed ethernet connection.
Plug in the white (5V) power supply. The Red LED on the front of AMBR will illuminate indicating power.

Wait for 1-2 minutes, while AMBR connects with the Cloud. During this period the Green, Orange and Blue LEDs will come on. Blue LED will go off, then come back on and continues to pulse.

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

Light Indicators on AM-BR

When AMBR is connected to power, all lights will initially illuminate, then turn off, then turn back on one by one. The following lights should be illuminated within five minutes of installation.
Green LED = flashes; successful processor boot
Orange LED = Illuminated; successful activity in local memory
Blue blinking LED = Illuminated, successful connection to the Cloud
Red LED = Illuminated, successful connection to power

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

Restoring to factory default

Unplug AMBR. Use a paper
clip to depress the "**wk-up**" button as
shown in the figure.


Plug AMBR back in.

Still no connection

Power down the Cable/Modem and Bridge/Router and AMBR. Now, power up Cable/Modem followed by Bridge/Router and

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.

Thermowell piece

1" wye piece

Arrow shows direction of flow
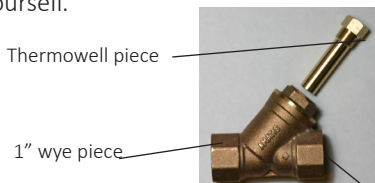
Note: Pipe reducers may be necessary for pipework smaller than 1"

Solder one assembly to the "Supply" pipe, and one assembly to the pipes that "Return" from the solar collectors. Align the wye assembly so that the wye branch faces "upstream". 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 compound.

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 compound 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 Joule. Using Teflon thread seal tape, install brass thermowell into brass wye.

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. Commerical and VFI flow sensors do not use clips; they screw on.

Big clip ø 15 is for flow tube.

O Ring

Fit the two large clips to hold the flow tube to the ends of the pipe.
Solder the pipe adaptors into the pipe work, to accomodate the flow meter.
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. Insert the the flow meter into the Return (from collector) pipe, just below the Wye Temperature assembly. To orient the flow tube correctly, align the arrow on the flow tube with the direction of flow.
Attach the wire to the flow sensor. The rounded end plugs in to the flow meter. The cable fits snugly and permanently into the flow meter. (See pictures, next page.) The opposite end with an RJ11 plug connects to the Amatis Joule.
Ground the flow meter by attaching the grounding lead to the pipework. Establishing a ground is crucial for accurate flow readings.

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 Joule using the RJ11 jack. The maximum cable length is 10' and is the maximum permissible length. Splicing or extending the cable voids Amatis' warranty.

Flow meter plugs into the last port on the meter, depicted here with a black lead.

Flow sensor cabling detailed
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.
Orange LED on AM-Joule is on when flow > 1.3 GPM.

Notes on Selecting the right flow meter
Select the correct flow meter based **first** upon maximum flow rate, **then** pipe size, and **finally**, pressure curves. 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.

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 (AMBR) which controls and manages data upload to the Cloud.

Diagnostic Light Indicators

Yellow = FLOW present

Red = Power
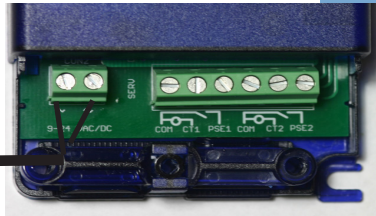
Green = Temp Sensors

Blue = AMBR found

Grey ground lead

Return Temp sensor

Supply Temp sensor, Black flow meter lead

Joule can take 9-24V DC or AC. The terminals are polarity insensitive. Joule is shipped pre-wired.

Installing the Meter

Mount Joule 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 metal piping near the flow sensor.

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

Test the range between Joule and AMBR

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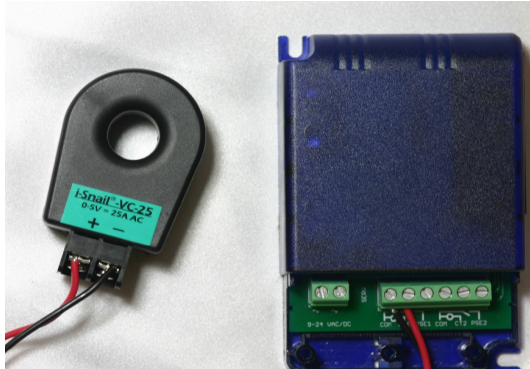
Run the live connection to the pump (black or red) through the hole in the CT. While some CTs are directional, that is not the case with this device.

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 and complete the fields for Register My System.

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

Confirmation email was sent. Please follow the link to complete your registration. Thank you for signing up!

OK

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 perameters 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.

Installer Fleet View

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
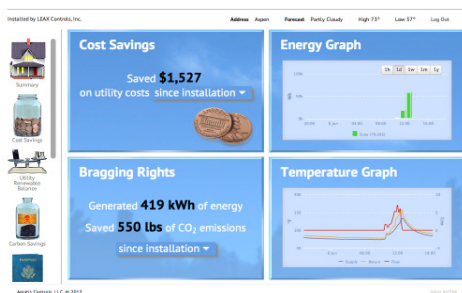
Teach your customer how to register and log themselves in using the same process at www.amatisdash.com. Select "system owner." Help the customer create their username and password.

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 Joule needs to be unplugged and replugged ("power cycled").

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:

1-20	l/m	0.2 - 5.2	gpm	Pipe size	3/4"
2-40	l/m	0.4 - 10.7	gpm	Pipe size	3/4"
5-100	l/m	1.5 - 26.5	gpm	Pipe size	3/4" - 1"
10-200	l/m	2.6 - 53	gpm	Pipe size	1.5" - 2"
20-400	l/m	5.2 - 105	gpm	Pipe size	1.5" - 2"

Vortex Flow Industrial meters available

- 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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