RM2-1000 EnviroGrid Controller

INSTALLATION, CONFIGURATION AND OPERATION INSTRUCTIONS

DESCRIPTION

A network of EnviroGrid Controllers provides control for connected electrical loads with the target of

- Smoothing out Peak electrical usage (Peak Demand)
- Providing the ability to reduce electrical usage (Demand Response) based on a control signal

Function	Description
Communications	• 2.4 GHz band (2405MHz – 2480MHz) channel selectable • External modem capability to send monitoring data or receive control requests • Repeater functionality to extend range of network • Up to 800 metre (875 yards) communication distance
Control	• 1 – 2 stage control of HVAC units (Internal relays up to 30VAC) • 3 or more stage control of HVAC units (external relays) • High Voltage control of resistive heaters (Up to 600VAC with external contactors) • High Voltage control of Domestic Hot Water tanks (Up to 600VAC with external contactors) • 1 – 2 stage control of Heat Pumps • Thermostatic control of freezer units (Internal relays up to 30VAC) • 0-100% duty cycle settings • Adaptive duty cycle mode
Sensors	• Up to 3 phase 600VAC monitoring • 0-15 Amps per phase low current monitoring • 0-30 Amps per phase medium current monitoring • 0-65 Amps per phase high current monitoring • Custom designed very high current monitoring

INSTALLATION

CAUTION: Ensure Power is disconnected before installing!

Materials Provided for Installation

The following materials are provided for installation of an EnviroGrid controller:

1. EnviroGrid controller front cover, including pre-programmed integrated circuit board
2. EnviroGrid controller back cover
3. EnviroGrid Terminal Block (to connect wiring to the controller)
4. EnviroGrid waterproof gasket (to seal the back cover on to the front cover
5. 4 screws of *type pan head hex #4-40*,to secure the back cover
6. Antenna of *type 5.5 dBi RP-SMA*
7. Antenna extension cable with magnetic mount (if the antenna cannot be secured directly to the controller and provide clear communications with other controllers)
8. Tie wrap (to secure wire inside controller case)
9. 1 – 3 CTs *(CR3110-1000)* as required (to attach to the power mains)
10. Molex 39-01-3022 power connector housing
11. Molex 39-00-0039 contact pins (qty 2)

Additional Materials Required

1. Indoor/Outdoor 18AWG UL approved 12 conductor stranded wire for connecting the sensors, relays, and power.
2. Additional contactors or power transformers may be required for certain types of installations, e.g. resistive heater banks or HVAC units with more than 2 stages requiring more than 2 control relays.

Tools for Installation

Specific tools are required for installation of an EnviroGrid controller:

- Flat head precision screwdriver to secure wires to the terminal block
- 1.5mm hex screwdriver to fasten screws through the back cover to the front cover
- Volt meter with positive and negative pin-point leads and a clamp-on inuctive measurement tool, to test voltage and line amperage of the attached load
- Appropriate screwdriver and screws to mount the controller to the appropriate surface. The screws should be
- Wirestrippers for AWG 18 wire, to prepare the cable for attachment to the controller at the attached load.
- Molex crimping tool 63811-1000 - universal or 63811-5000 for 18-24 AWG wires

Controller Wiring

Use 18 AWG stranded outdoor 12 conductor cable to hook up the sensors, relays and power supply. The cable should have a 9.5mm to 10.5mm outer diameter and be rated for Indoor/Outdoor. To hook up the wire, remove the back of the controller by unscrewing the four screws on the back of the controller (hex screw 1.5mm). See Fig. 1

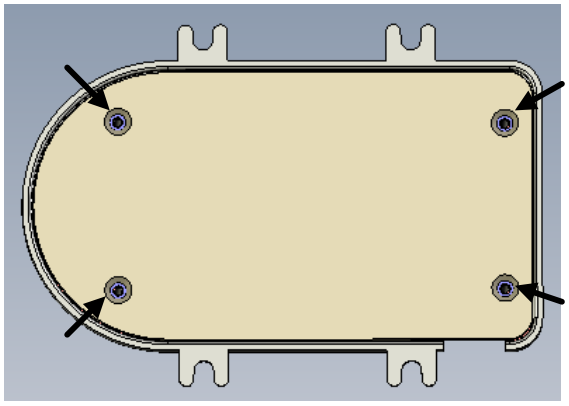

Fig. 1

Use the terminal block to attach the cable. See Fig. 2

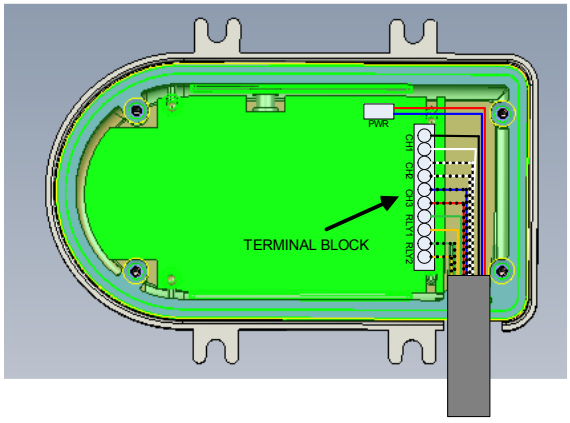

Fig. 2

Cable colour coding. See Table 1

Colour	Function
RED	Power
BLUE	Power
BLACK	Channel 1
WHITE	Channel 1
BLACKK/WHITE	Channel 2
WHITE/BLACK	Channel 2
RED/BLACK	Channel 3
BLUE/BLACK	Channel 3
GREEN	Relay 1
ORANGE	Relay 1
GREEN/BLACK	Relay 2
ORANGE/BLACK	Relay 2

Table 1

NOTE: Ensure the cable passes through the opening in the gasket that seals the back cover to the front case.

Power Inputs:

- 9.5VDC – 42VDC
- 8VAC – 30VAC
- Use the connector/contact pins provided

Channels:

- 1 channel per phase
- Connected to CR3110-3000 Split Core current transformer from CR Magnetics

Relay:

- 0 – 30VAC
- 1 Amp
- Dry Contact

Attach a tie wrap around the cable to provide strain relief and trim the end. See Fig. 3

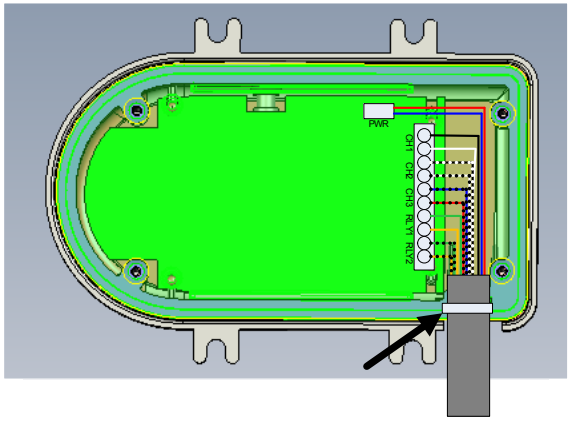

Fig. 3

Controller Location

Select an appropriate location when installing the controller. Keep at least 1-foot distance between the controller/cabling and any high voltage power lines to minimize interference

with radio communications. Use 4 screws to attach the controller as illustrated in Fig. 4

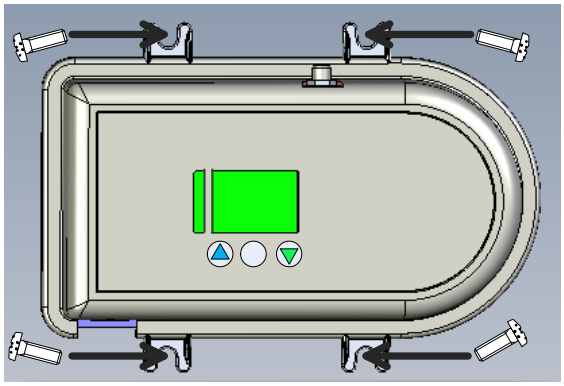

Fig. 4

Note that the controller antenna cannot be mounted inside a metal enclosure as the metal will not allow the radio communication signal to penetrate well.

Cable Routing

It may be necessary especially when dealing with outdoor situations especially roof-top HVAC units, to route the cable from the outside where the controller is mounted, to the inside of the equipment where the control board is. In such a case it may be necessary to drill a hole in the HVAC rooftop enclosure. This hole should have a weatherproofing cable gland inserted (size PG13.5). The cable should be routed through this gland and the gland tightened.

Antenna Installation

Attach the mag mount antenna SMA Plug shown in Fig. 5 to the controller as illustrated in Fig. 6 below. Ensure to only 'finger tighten' the wire and do not over tighten or the antenna could be damaged.

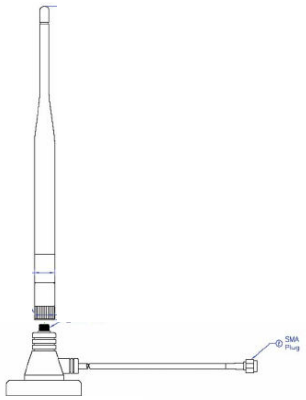

Fig. 5

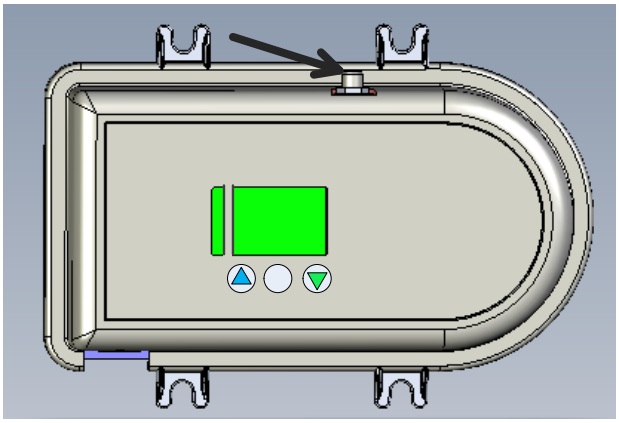

Fig. 6

Mount the magnetic base so that it has line of sight to the other controllers in the network. If line of sight mounting is impossible, ensure all the antennas in the network are positioned as close to perpendicular as possible to all other controllers in the network.

Sensor Connection

The sensors measure current in each phase to which they are attached. If connected to a single load, each sensor is typically attached to the incoming power mains to the load. If multiple loads are being controlled (as may be the case for resistive electric heating), multiple heaters may be measured by the sensor by running each of the heater power lines through the sensor with the understanding that a single sensor can only measure a single phase

(Multiple power lines that are on the same phase may be measured by a single sensor

Fig. 7

REGEN uses the CR3110-3000 split core current transformer from CR Magnetics as the sensor. The wiring diagram below (Fig. 7) shows how the sensors are connected for single phase, two phase and three phase systems (both with and without a neutral).

Relay Connection

The relays provided by REGEN's EnviroGrid Controller are dry contact relays rated for 1 Amp per relay at 30VAC. Common equipment that the controllers are connected to include resistive heaters, air conditioners, chillers and domestic hot water tanks. For a typical roof-top packaged air conditioner, Fig. 8 shows the connection for a typical 2 stage unit. If the unit only has 1 stage, the Orange/Black and Green/Black wires are left unconnected.

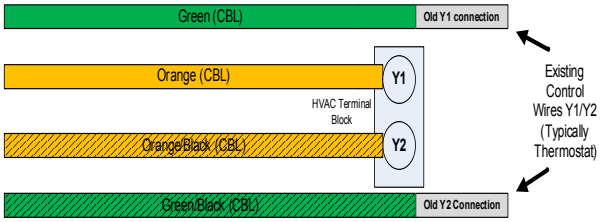

Fig. 8

Equipment that has more than 2 stages or requires high voltage/high current control must be outfitted with an external relay/contactor with a 24VAC control voltage. The wiring diagram for a typical multi-stage HVAC rooftop unit is illustrated in Fig. 9.

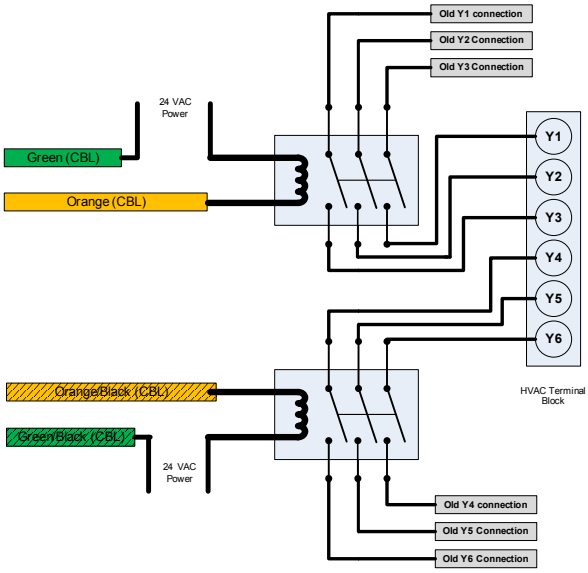

Fig. 9

For a typical resistive heater connection, the wiring is shown in Fig. 10.

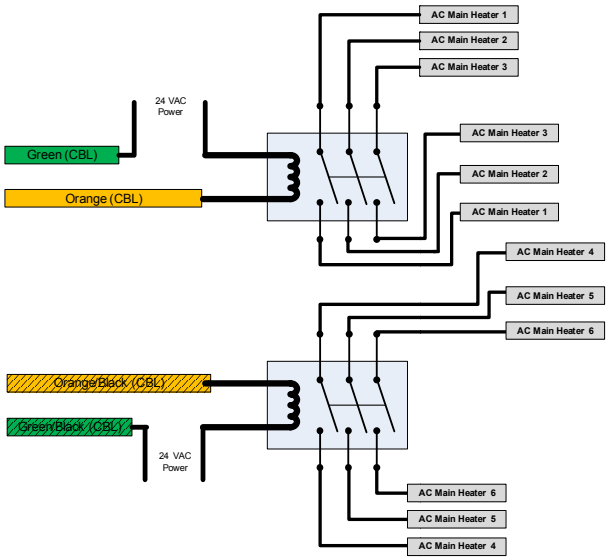

Fig. 10

In this case (Fig. 10) the contactor is placed in series with the AC Mains power used to supply the resistive heaters.

Power Connection

The Blue and Red wires on the cable are used to power the controller. They are connected to an external power supply (isolated transformer). Most HVAC equipment have such a power supply. Both AC and DC connections are acceptable. Voltage ranges for DC are 9.5VDC – 42VDC or for AC are 8VAC – 30VAC. The connection order/wiring colour is irrelevant.

CONFIGURATION

Powering Up

Now that the controller's CTs, relays, power feed and antenna have been connected, any disconnects or breakers powering the load should be turned on. The EnviroGrid controller has an ON and an OFF button on the front panel. Press the ON button to power on the unit. Once powered on, the unit will enter into its configuration mode. The particular configuration step will be enunciated by with the given step displayed on the LCD panel (e.g. configuration step #1 will flash 001 on the LCD panel). Subsequently, the configuration step will wait for user input for 5 seconds before accepting the previously defined value. The up and down arrows are used to adjust the value, and the 'Enter' key is used to accept the value. The front panel is shown in Fig. 11.

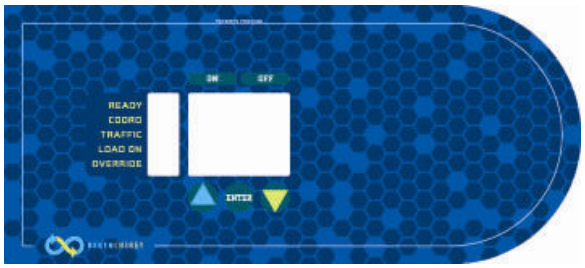

Fig. 11

Config Setting 001 – Phase Voltage

This configuration setting specifies the phase voltage used for computing power consumption as measured by the sensors. Note that one must identify the phase voltage (i.e. voltage per phase), and not simply the overall voltage for the load. The up arrow will increment the value by 10 and the down arrow will decrement the value by 1. Typical settings are shown in Table 2 below.

System	Phase Voltage Setting
3-phase 575VAC	332
3-phase 600VAC	346
1-phase 220VAC	220
1-phase 120VAC	120

Table 2

Config Setting 002 – Sensor Range

The sensors are adapted for accuracy therefore it is important to select the appropriate range. Using the up/down arrow will cycle this configuration option through the settings described in Table 3 below. Note that it is the maximum amperage per phase that is relevant, not the overall amperage for the load.

Config Value	Sensor Range
11	0-15 Amps
22	0-30 Amps
33	0-65 Amps

Table 3

Often, electrical loads will have an informational plate indicating maximum Amperage per phase.

Config Setting 003 – Relay Sense

Depending on the type of equipment being connected to, the load will be disabled if the control relay circuit is open, whereas in other cases the load will be disabled if the control relay circuit is closed.. The settings for the EnviroGrid relay sense are shown in Table 4.

Config Value	Relay Sense
01	Open = disabled
00	Open = enabled

Table 4

Config Setting 004 – Repeater Selection

When a group of EnviroGrid controllers power up, all controllers must be able to communicate with the "coordinator" (which is typically the first node to be powered up). This node should have line of site (or be within communication range) of all other nodes. If this is not possible, a node that is within communication range of the coordinator and the target node may be set as a "repeater". Repeaters repeat all messages from the coordinator and the target node (as well as all other nodes within range). This has the effect of increasing the network range. The settings for this configuration option are shown in Table 5.

Config Value	Controller Type
00	End node
11	Repeater
22	Coordinator Capable

Table 5

Config Setting 005 – Channel Selection

The controller allows the selection of the radio channel to be used for communication. Available channels range from 2405MHz to 2480MHz. If poor communications range is experienced, changing the channel may alleviate the problem. Note that all controllers in the network must communicate on the same channel. The configuration options are specified in Table 6.

Config Value	Radio Channel
01	2405MHz
02	2410MHz
03	2415MHz
04	2420MHz
05	2425MHz
06	2430MHz
07	2435MHz
08	2440MHz
09	2445MHz
10	2450MHz
11	2455MHz
12	2460MHz
13	2465MHz
14	2470MHz
15	2475MHz
16	2480MHz

Table 5

Config Setting 006 – Sensor Test

If desired, this configuration setting may be used to test the power consumption measured by each of the sensor channels. The power consumption is measured in 10 Watt increments (0-9990 Watts). To scroll through the various channels, use the up arrow.

OPERATION

Joining the Network

Upon completion of the configuration process, an EnviroGrid controller attempts to join the local network of controllers.

The "READY" indicator will remain solid, indicating it has joined the local network (or if the controller is a coordinator, indicate that this device is ready to accept connections from other controllers). If the READY indicator does not appear within 10 seconds of completion of the configuration process, consult the Troubleshooting section of this manual to determine corrective measures.

Duty Cycle Adjustment

The duty cycle of an EnviroGrid controller represents the percentage of time the controller must permit its attached load to function if it so desires. This setting computes the number of 15 minute blocks within successive 3 hour periods when the controller's relays should enable the attached load to operate.

Display Panel

To the left of the duty cycle display, there is a vertical row of LED elements, providing the following information:

- READY: A solid light indicates that the controller has completed its start-up and configuration cycle, and has joined a local network. *Does it blink during config?*
- COORD: A blinking light indicates that the device is a coordinator.
- TRAFFIC: This indicator will flicker when the device receives any wireless traffic in the configured wireless channel
- LOAD ON: A solid light indicates that the load is drawing power
- OVERRIDE: A solid light indicates that the controller is currently overriding the attached load's control circuit and requesting that it curtail operation.

TROUBLESHOOTING

The following provide guidance to resolving common issues encountered when configuring EnviroGrid controllers.

1. The controller does not display any information upon power up
   A. Wait at least 10 seconds after initially powering up the device (to allow for the controller to complete its self-test mode)
   B. If the display is still empty, turn off the device, and confirm that the power leads are attached to the appropriate wires connected to the EnviroGrid terminal block.
   C. If both power leads are determined to be properly connected, use a volt meter to confirm that power is available (and in a range acceptable for an EnviroGrid controller).
2. The Sensor Test (Config Step 6) does not show any non-zero power readings, yet the load is operating and obviously drawing power.
   A. Confirm that the CTs are securely closed, with the connection clips fastened completely.
   B. Confirm that the leads from each of the CTs are securely attached to the

appropriate wire connected to the EnviroGrid terminal block.

C. If the CTs have been confirmed to be securely attached, and correctly connected to the EnviroGrid controller, use a clamp-on power meter to confirm if the load is in fact drawing power.

3. The controller cannot connect to the local network. *Note that in Steps C-F below, the controller should be powered off before implementing the step, then powered on.*
   A. Confirm that at least one coordinator controller is currently operational. Note that the very first controller powered up should be a coordinator, and it obviously will not connect to any other controllers.
   B. Confirm that the antenna (and extension mounting cable, if used) is attached securely to the top of the controller. Take care not to overtighten the antenna (and extension wire if used).
   C. Reposition the antenna to achieve a better line of sight angle to the coordinator
   D. Replace the antenna (and extension mounting cable if used).
   E. Reconfigure a closer controller to be a Repeater, restart the Repeater, and then restart the controller that could not connect to the network.
   F. Reposition the controller further away from the power source of the attached load (to minimize electrical interference).
4. The attached load does not operate, despite setting the controller to a duty cycle of 100%.
   A. Confirm that all EnviroGrid relay control wires are securely fastened to the terminal block, as well as the correct mounting points on the attached load.
   B. Confirm that the Relay Sense configuration setting (Step 003) is set properly (or toggle the value if set incorrectly).
   C. Detach the EnviroGrid relay control wires and restore the attached load's control wires to their original state to determine if the load can operate using its native control circuitry.

