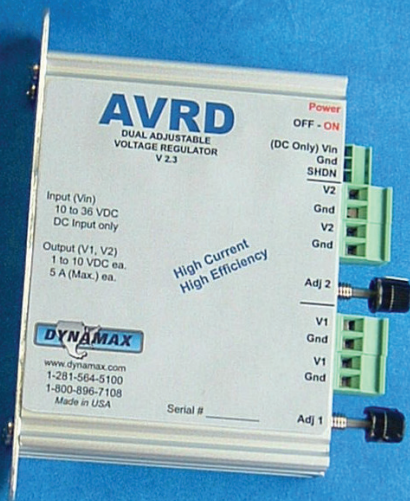




# Dynamax



# AVRD

version 3.2

## Voltage Regulator Installation and Operation Manual

10808 Fallstone Road #350  
Houston, TX 77099, USA  
Tel: 281-564-5100 Fax: 281-564-5200  
Toll Free: 800-896-7108  
admin@dynamax.com dynamax.com

# TABLE OF CONTENTS

|            |                                                      |           |
|------------|------------------------------------------------------|-----------|
| <b>1.0</b> | <b>Introduction to AVR D .....</b>                   | <b>2</b>  |
| 1.1        | AVRD System Features .....                           | 3         |
| 1.2        | Unpacking, Bill of materials .....                   | 4         |
| 1.2.1      | <i>Bill of materials</i> .....                       | 4         |
| 1.3        | Specifications .....                                 | 4         |
| <b>2.0</b> | <b>Installation &amp; Operation.....</b>             | <b>5</b>  |
| 2.1        | Installation .....                                   | 5         |
| 2.1.1      | <i>List of Tools required to install AVR D</i> ..... | 5         |
| 2.1.2      | <i>Assembly Steps</i> .....                          | 6         |
| 2.2        | Power sources .....                                  | 7         |
| 2.3        | Operation .....                                      | 7         |
| <b>3.0</b> | <b>AVRD Applications.....</b>                        | <b>8</b>  |
| <b>4.0</b> | <b>Safety and Maintenance .....</b>                  | <b>9</b>  |
| <b>5.0</b> | <b>Warranty .....</b>                                | <b>10</b> |

Copyright 2005, Dynamax Inc  
All Rights Reserved

This manual refers to AVR D ver. 3.1, Dual adjustable voltage regulator.

Specifications are subject to change. Dynagage is a new product for experimental purposes under development. DYNAMAX Inc assumes no liability for customer assistance, infringements of patents or copyrights arising from the use of this product. US Patents covering the construction of various stem flow gauges are No 5,337,604 and 5,269,183. DYNAMAX does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, or other intellectual property right of DYNAMAX relating to this product, or process. There are no implied warranties of merchantability or of fitness for a particular purpose given with the sale of any goods. DYNAMAX Inc shall not be liable for consequential, incidental or special charges.

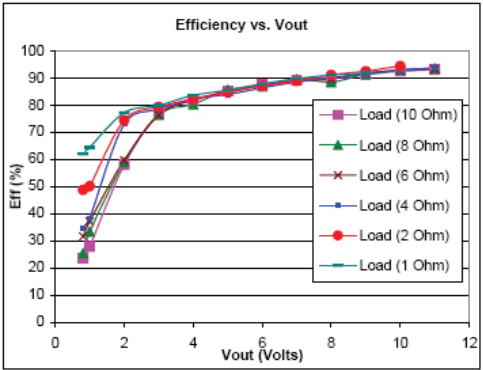
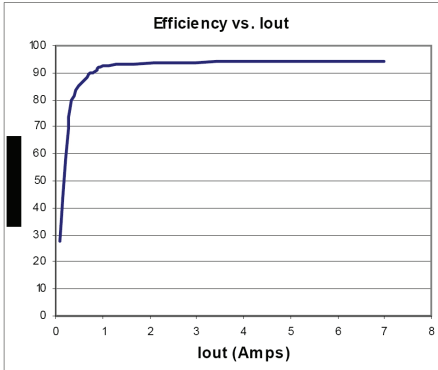
*Dynagage, TDP, Dynamet, Flow32, Flow32W and Dynamax are trade marks of Dynamax Inc PC208W PC400 and LoggerNet are trade marks of Campbell Scientific Inc.*

**Updated: 10/29/2008**

# 1.0 Introduction to AVR D

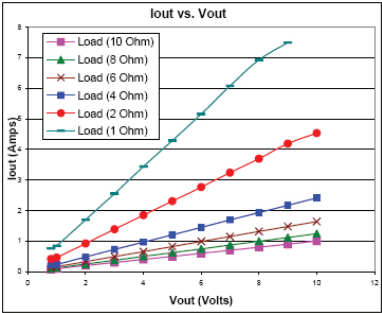
The adjustable - regulated power supplies in the electronics industry are seldom available for field applications, yet is possible to find adjustable versions, which are good for small labs and indoor application. In these cases the voltage regulation may be good, and the voltage adjustment may be within the range, however if AC power is lost for a few moments, again there is certainly a loss of data as well as false readings due to the heat lost during a brownout. Thus the best field solution is to have a battery charging source or solar panel supplying current to a suitable battery, which in turn supplies the datalogger with a primary (or backup) source of power, and then regulate the battery output to the sensors as needed. In this application, the solar or battery charger source can vary significantly, the battery has a significant reserve capacity, and yet the sensors power source is regulated and will not fluctuate.

The new AVR D is a dual adjustable voltage regulator for supplying excitation power to sensor heater elements. This can be used as a general-purpose regulator for powering dc systems or for exciting sensors with voltages in the range of 1-10 VDC and current not exceeding 5A on each channel (10A combined). Refer to specifications for more detailed voltage and current parameters. New AVR D uses a Step-down switching controller with external FET switch and frequency control, enabling the regulator to achieve higher current and higher efficiency. In addition AVR D circuit is designed to dissipate the excess heat from the switching with in the circuit thus eliminating the necessity of bulky heat sinks or cooling systems. User can connect input source and the heater element s to the quick terminal simply by inserting wire in the appropriate terminal slot and use screwdriver to secure the wire properly. AVR D operates at a constant frequency of 330 KHz in the voltage range 2.5V – 8.5V. This range being most commonly used excitation voltage for Dynamax sensors. A constant frequency operation enables the AVR D to achieve better stability and higher input output power efficiency.



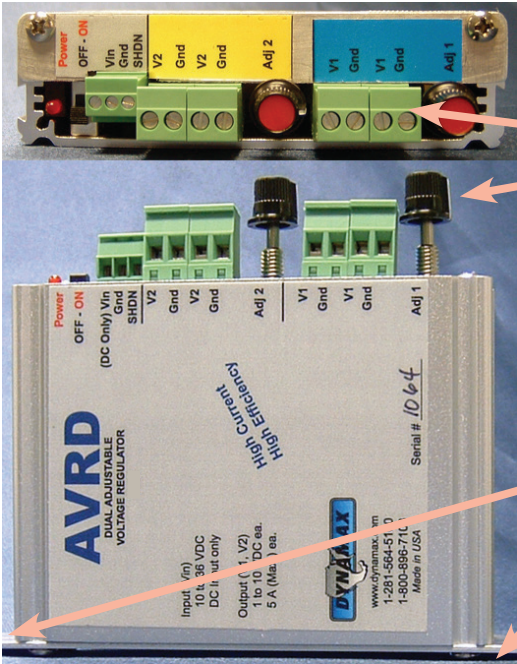
AVRD operates in discontinuous mode at lighter loads and switches to continuous mode at higher loads thus achieving a higher efficiency of at least 80% for loads of 2W and increasing efficiency at higher loads. The variation of efficiency with load current is shown below. Also shown is the variation of efficiency with voltage at various load currents.

Chart on the right shows the linearity in the output voltage and current at various resistive loads.



### 1.1 AVR System Features

- General purpose adjustable voltage regulator
- High Current 5A on each output (a total of 10A)
- High Efficiency of 91%
- Supply regulated DC output from unregulated DC input
- Output voltage adjustable using a 15-turn knob (each turn approximately 0.6V)
- Dual variable output voltages from a single AVR
- SHDN signal to power OFF AVR and the sensors at night to conserve power. (output voltage when shutdown is 0V)
- In circuit over current latch protection
- Additional In-line fuse to protect from any over currents due to short circuit.
- Software power down from data logger
- Compatible to most sensors requiring DC excitation
- Compatible to Dynamax data loggers
- ON/OFF slide switch, LED indicator showing power ON



Wiring terminals, Control knobs, ON/OFF switch and LED

Base plate with Mounting holes 6/32 size screws

## 1.2 Unpacking, Bill of Materials

Using the following bill of materials, open the cartons and check off the items to see that all material was received in good condition. Notify Dynamax no later than 10 days after receipt if there are any discrepancies. Notify the shipper and Dynamax immediately if goods are damaged in transit by mishandling.

If AVR D is purchased as part of a data logger system, items in the BOM would be assembled in to the logger and ready for operation. Other wise the items in BOM will be supplied as mentioned below.

### 1.2.1 Bill of materials

1. AVR D - Dual High current, High efficiency voltage regulator
2. In-line fuse holder with fuse (5 mm x 20 mm, 15A)
3. Spare male (2 ea.) and female (2 ea.) quick disconnect spade terminals
4. Mounting kit
  - a. Screws (6/32-1/2") – qty 2
  - b. Hex nut 6/32 - qty 4

#### Optional:

1. 12V/ 5Ahr battery
2. 12V/ 7Ahr battery
3. AC outlet adapter 15V / 4A
4. Solar Panel, 10W (MSX10), 30W (MSX30), 60W (MSX60) as per the sensor requirement

## 1.3 Specifications

### OUTPUT

|                                          |                                                                           |
|------------------------------------------|---------------------------------------------------------------------------|
| Output voltage Range                     | 1-10 V variable                                                           |
| Output current                           | 5 A max. per channel                                                      |
| Output Control                           | 15 turn precision potentiometers (~0.6 V/turn) ON/OFF switch; SHDN signal |
| Reference Voltage                        | 0.8 V                                                                     |
| No. of regulated outputs                 | 2                                                                         |
| No. of terminals per output              | 2                                                                         |
| No. of terminal per output expandable to | 6 (requires custom assembly at the factory)                               |
| Efficiency                               | 80% (3 V to 8 V)<br>90% (8 V - 10 V)                                      |

### INPUT

|                       |           |
|-----------------------|-----------|
| Input voltage range   | 10-36 VDC |
| Minimum input voltage | 10 V      |

## SHDN LINE (Power Down)

|                                        |                                        |
|----------------------------------------|----------------------------------------|
| SHDN line input for power down         | <0.8 V                                 |
| Output when shut down                  | 0 V                                    |
| SHDN line off state (Normal/output ON) | >0.8 V (or open circuit/no connection) |
| SHDN line drain current                | 1 mA                                   |

## Temperature Specifications

|                |                                                      |
|----------------|------------------------------------------------------|
| Operating Temp | -40 to 85 C                                          |
| Junction Temp  | 125 C (T <sub>J</sub> =T <sub>a</sub> +p.d. 130 C/W) |
| Storage Temp   | -65 to 150 C                                         |

## Protection

|                        |                               |
|------------------------|-------------------------------|
| Primary: Current limit | In circuit current limit      |
| Secondary: Fuse        | 15 A in-line fuse (5 x 20 mm) |

## Mechanical

|                              |                                                 |
|------------------------------|-------------------------------------------------|
| Enclosure                    | Aluminum, Anodized                              |
| Weight                       | 1.5 lb (680 g)                                  |
| Dimensions - Enclosure LxWxD | 4-1/4" x 3-1/4" x 1-5/32"<br>108 x 83 x 29 mm   |
| Dimensions - Overall         | 5-1/4" x 4-1/16" x 1-5/32"<br>133 x 103 x 29 mm |

## 2.0 Installation and Operation

### 2.1 Installation

Provided that your system came with a regulator installed, there is nothing more to do but skip to the next section on operation. Refer to data logger manual for operating instructions specific to the logger. For custom, upgrades, or all other kits this section describes the tools, recommended parts, and assembly.

#### 2.1.1 List of Tools required to install AVR D

- 11/64" drill bit
- Electric drill
- Philips screw driver
- 5/16 Hex nut driver
- Wire cutter
- Wire stripper
- Flat blade screw driver
- Phillips head screwdriver

In addition required are wires for connecting AVR D input terminals to the power source (battery/ solar panel/ AC outlet adapter) and AVR D output terminals to the sensor heater elements.

### 2.1.2 Assembly Steps

1) Assuming a panel mounting: (if not skip to #4)

2) Position AVRDC vertically on the panel in a desired location with terminals pointing up and mounting flanges and holes on the panel. As shown in the picture.

3) Mark the position of the two mounting holes on the panel with a pencil marker.



4) Drill two small mounting holes in the marked locations using a 9/64" drill bit and electrical drill. Smooth the drill edges using a file of sand paper.

5) Insert 6/32 – 1/2 " screws (supplied with AVRDC) from the bottom of the panel in the two mounting holes. Secure these screws with hex nuts. Use thread lock to secure the screws to the panel and upright.

6) Now place the AVRDC in on the panel such that the two screws on the panel align and slide into the AVRDC mounting holes.

7) Once the unit is adjusted and aligned to be upright secure by using hex nuts on the screw portion protruding out of the mounting holes.

8) Use thread lock to secure the screw threads from loosening.

9) Slide the ON/OFF switch to the OFF position, rotate the adjust 1 and adjust 2 knobs fully counter-clockwise (to the minimum settings) and then you are ready to attach the battery leads.

10) Insert the sensor or heater wires in the output terminals and secure by tightening the screws. Connect +ve to Vout (V1 or V2) and -ve to the GND terminals adjacent to the Vout.

11) Attach the red battery wire terminal to the AVRDC Vin (+) with an in-line fuse (optional).

12) Attach the black battery wire terminal to AVRDC GND (-), either one is ok.

13) Decide which sensor cables will be assigned to the V1, and which are to be assigned to V2.

14) After these steps, you will have a neatly arranged set of heater wires attached to the appropriate Vout1, and Vout2.

15) In the case of the AVRDC is to be operated with power down option, connect a wire from the SHDN to the control output designated for controlling the power down timing. In the case of the AVRDC not being used with the power down feature, do not connect anything to the SHDN terminal. Keeping SHDN open will disable the controlled power down feature, keeping outputs enabled.

16) Check the wiring one more time with a continuity meter, making sure that Vout is not connected to ground, and that all leads are connected properly.

## 2.2 Power Sources

AVRD can be powered from any DC Power source supplying at least 10V and capable of supplying a current of 5A maximum on each output (10A max. total). Operating voltage range is 10V to 36VDC. The following are recommended DC power sources,

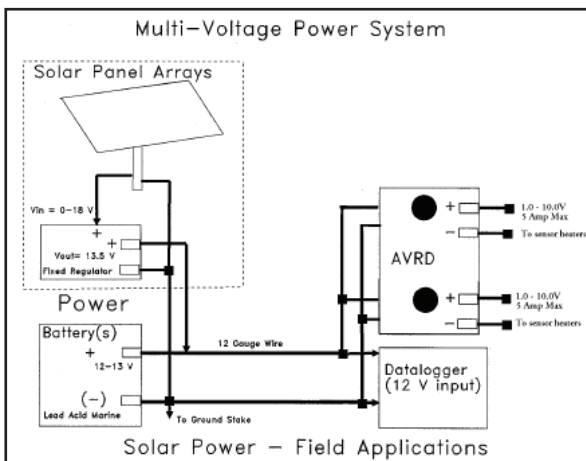
- **Battery**
- **Solar Panel with backup battery**
- **AC outlet adapter with regulated DC output**
- **Regulated DC power**

Some chargers will ground the output (-) lead, and have a common earth. In any case be sure that the earth ground of the source is not used to ground the AVRd or in turn the chassis. Only one ground can be allowed, and that is the earth ground next to the logger. This is supposed to be attached with a green wire to indicate the earth connection, differentiated from the electrical neutral (or ground wires) that are black.

## 2.3 Operation

A typical system diagram shown below gives an example of a logger, battery, and power from a solar panel, and how the regulators fit into the overall system.

As shown in the example, one may control two different voltages from a single AVRd. More adjustable voltages require additional AVRd regulator units. The adjustment knob on each regulation output will vary the voltage up to 10Vdc or as low as 1.0 Vdc. The logger connection to the 12V battery can be connected at the AVRd terminals, where the battery connection is made. The wiring is simpler this way, and the connection is sturdy. One may elect to have the logger independently supplied with power from an internal battery, or as shown below.



Normally the first time user will start with a choice of one AVRd regulator, anticipating that two types of sensors may be selected, or two different voltages would be sufficient. Refer to the section on applications and sensor requirements for the different voltage settings on your application.

When the customer has 120 V AC or 220 V AC line power supplied nearby, the solar panel is simply replaced by the battery charger and the battery size may be smaller than indicated. A 7 A-hr sealed lead acid battery has sufficient capacity for most applications. Model numbers BA5A, and BA7A are the Dynamax products for 5A-hr and 7 A-hr batteries, respectively. The 4A-hr battery is recommended for measurement systems having four sensors or less.

### Setting / Changing Voltage

Once the logger, AVR D and all cables are connected, the operation and set-up is quite easy, simply follow the steps below.

1. The first time user should get a voltmeter and attach it to the Vin, and referencing to ground. Make sure the voltage is greater than 10V if not charge the batteries before proceeding.
2. If the voltage is greater than 10 VDC, turn the ON/OFF slide-switch to ON position. Make sure Power LED is ON, if not check wiring to Vin terminal.
3. Attach voltmeter +ve to the Vout1 (V1), and referencing to ground. Then check the sensor manual for the heater voltage. Turn on the AVR D adjustable knob labeled Adj1. When you are ready, and turn the adjust knob clockwise to slowly increase the voltage until the right setting is achieved. One turn is approximately 0.6 V increase (in clockwise direction) or decrease (in counter clockwise direction).
4. Repeat the above step for setting the output voltage Vout2 (V2) from the AVR D.
5. Once the customer gets familiar with the logger operation, one may use the logger to monitor the sensor supply, and make adjustments as needed. In this case the logger acts as a voltmeter.

## **3.0 AVR D Applications**

The purpose of the adjustable regulators from Dynamax is to have a stable, noise free voltage excitation for sap flow sensors. Sap flow sensors offered by Dynamax are constant heat energy balance sensors, and the TDP sap velocity sensors are steady state heat dissipation sensors. In both methods one major benefit is the ease of supplying a constant voltage to the heater elements. The devices that are responsible for providing a steady regulated supply of voltage are the AVR D series of regulators.

In both methods of measuring sap flow differential temperature readings within the sensors are functions of the heat flux or the dissipation of heat. In general, an accurate heat flux measurement depends on the steady application of power to the heater elements. Otherwise, a fluctuation in the power will cause an arbitrary temperature change, and therefore a misrepresentation in heat flux as a change in sap flow.

New AVR D is a general-purpose adjustable voltage regulator for supplying excitation voltage to a variety of sensors and DC powered systems. High current and high efficiency of this regulator makes it extremely versatile for field applications where power consumption is critical. The following table shows application and number of AVR D's configured with several Dynamax systems / kits.

## SYSTEMS WITH VOLTAGE REGULATION

| Model                     | Regulator Included Standard | Maximum Upgraded System - Add: |
|---------------------------|-----------------------------|--------------------------------|
| Flow2                     | Internal 1A                 | AVRD                           |
| Flow32-A                  | AVRD                        | AVRD                           |
| Flow32-B                  | AVRD                        | AVRD                           |
| Flow32-C                  | AVRD                        | AVRD                           |
| FLGS-TDP                  | (2) AVR                     | -                              |
| FL32-GS8                  | AVRD                        | AVRD                           |
| FL32-GS16                 | (2) AVR                     | -                              |
| FLDL-TDP                  | -                           | AVRD                           |
| DL2e                      | -                           | AVRD                           |
| DL3000                    | -                           | AVRD                           |
| SV1 (Delta-T Devices Kit) | -                           | AVRD                           |

The specific sensor excitation voltage requirements are found in the installation manual for that sensor. To determine the voltage for specific conditions and the type of sensor refer to the sensor installation manual. The following table gives a quick picture of the typical voltage requirements.

## SENSOR REQUIREMENTS

| Model       | Type                        | Range     |
|-------------|-----------------------------|-----------|
| SGA2-3      | Dynagage Microsensors       | 2-3 V     |
| SGA5        | Dynagage Microsensor        | 3.5-4.5 V |
| SGA10-SGB25 | Dynagage Stem Gauges        | 3.5-5 V   |
| SGB35-SGA70 | Dynagage Trunk Gauges       | 5-7 V     |
| SGA100      | Dynagage Trunk Gauges       | 6-10 V    |
| TDP-10-50   | Granier Sap Velocity Sensor | 2-5 V     |
| TDP-80      | Dual Sap Velocity Sensor    | 7.5 V     |
| TDP-100     | Triple Sap Velocity Sensor  | 8 V       |

## 4.0 Safety and Maintenance

### PRECAUTIONS

1. The AVR series regulators are not waterproof. The AVR's should be installed in protected enclosures, NEMA 2,3 or 4 rated.
2. The regulator is internally protected from over-current. Nevertheless, do not short output (+) leads to ground or minus leads. This can cause damage to wires, the regulator and eventually burn up the device.
3. In addition to over-current latching AVR is protected by an external in-line fuse 15A; 5 x 20mm (considering 5A max current on each).

4. Use wire with gage 16AWG or higher on the input to handle the higher current requirements
5. +ve and –ve from the battery or any power source at the input must be wired with correct polarity. +ve from battery connected to Vin and –ve from battery connected to the Gnd terminal next to the Vin terminal.

## **MAINTENANCE**

1. No regular maintenance is required. The regulators are sturdy devices, and give years of trouble-free performance.
2. In case external fuse blows out due to over current or terminal short circuit replace the fuse with same rating.
3. If the AVR D shuts down due to over current latch restart the AVR D by turning the slide-switch OFF and ON.

## **5.0 Warranty**

In an effort to provide at most reliability of products in field applications all Dynamax products are tested for trouble free operation in the field. AVR D along with all components are warranted to be free from defects for one year after the purchase.



# **Dynamax**

10808 Fallstone Rd #350  
Houston, TX 77099, USA  
Tel: 281-564-5100  
Fax: 281-564-5200  
[www.dynamax.com](http://www.dynamax.com)