Identifier: **SOP-5234**	Revision: **1**	Los Alamos NATIONAL LABORATORY EST.1943
Effective Date: 8/2/2010	Next Review Date: February 9, 2014	

ESH&Q Directorate

Waste & Environmental Services

Standard Operating Procedure

for

Installation and Operation of the Portable Solar-Powered AIRNET Station

APPROVAL SIGNATURES:

Subject Matter Expert:	**Organization**	**Signature**	**Date**
William Eisele	WES-EDA	Signature on File	7/13/2010
Responsible Line Manager:	**Organization**	**Signature**	**Date**
Jackie Hurtle	WES-EDA	Signature on File	7/13/2010

1.0 PURPOSE AND SCOPE

This procedure describes the steps for installation and operation of the portable solar-powered air sampling station used in the sampling of air for the AIRNET project. This procedure applies to the individuals assigned to install, operate and maintain the portable solar-powered AIRNET station.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

The portable solar-powered AIRNET station is a battery-powered sampling unit that will pull air at a rate of up to approximately 2 cubic feet per minute through a particulate air filter. Airborne radioactive particulate matter will be collected using the standard particulate filter holder (called out in SOP-5143). A water vapor sample will also be collected using the standard silica gel cartridge used by the AIRNET project (called out in SOP-5144). The solar powered sampling station uses up to eight photovoltaic panels to recharge the external 12V battery bank to insure continuous operation of the sampling station. The air flow into the filters is controlled by a mechanical air flow control valve and a needle valve on a silica gel cartridge. The total sample time is recorded by a timer.

2.2 Precautions

1. This document establishes the basic requirements for installing and operating a solar-powered AIRNET station. Work performed under this procedure by LANL personnel will occur only after required training to applicable documents has been completed and documented.
2. A minimum of two people is required to install, disassemble, or move the portable solar-powered AIRNET station.
3. Batteries are a chemical and explosion hazard. Visually inspect the exterior of the battery packaging and the batteries for damage and chemical leakage. Contact your WSST representative for help in the disposition of leaking or damaged batteries. A sealed type battery should be used to avoid the hazards of a wet battery that contains acid. Sealed batteries may be transported or stored in any position without fear of leakage.
4. Two people should be used to move batteries.
5. Do not package batteries with any other materials. During transport, box and secure batteries so that the batteries do not shift or tip. To help prevent accidental shorting of the terminals, label each outer box "Sealed Batteries - This Side Up" with an arrow indicating the top. If the batteries are not in the original shipping packaging and are open to the environment, they must have the plastic terminal protectors on the battery terminals (or the terminals covered with electrical tape) prior to the AIRNET technicians handling the batteries for shipping and installation. If possible, leave plastic terminal protectors in place during operation.
6. **Use extreme caution when working with a battery**. Do not allow wrenches or other metallic objects to come in contact with both terminals simultaneously. Serious injury and destruction of the battery may occur.
7. All electrical work (e.g., “making” and “breaking” electrical connections, installing wiring, etc.) is to be performed only by a qualified electrician except as noted in step 8 below inside the environmental housing when the de-energized electrical state has been verified by a qualified electrician. Contact a qualified electrician to connect and disconnect all electrical wiring outside of the housing, including cables inside battery enclosure and to power up and power down the system.
8. Prior to removing or installing pumps or any other component that connects to the terminal block inside the housing when an electrical connection has been made to the housing from the battery bank:
    - The main power switch to the housing must be in the “OFF” position,
    - The main power switch must be locked out by a qualified electrician using Form 2002, Lockout/Tagout Tag for Simple Lockout/Tagout Procedures on main power switch (refer to P101-

3, Lockout/Tagout for Hazardous Energy Control, Attachment A, for appropriate steps to follow), **and**

- The de-energized electrical state within the housing must be verified by the qualified electrician.

9. **Wear safety shoes** whenever moving the housing, photovoltaic panels, structural supports, timbers, batteries or the battery enclosure.
10. Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").
11. Hold a tailgate meeting addressing potential safety issues before initiating any work under this SOP.
12. Do not perform work under conditions you consider unsafe. Before beginning work described in this procedure, review safety needs and requirements, identify hazards, and develop hazard mitigation measures.

3.0 PREREQUISITES AND INITIAL CONDITIONS

1. Assemble equipment needed for the sampling activity. Reference Attachment A, Installation and Operating the Solar-Powered AIRNET Station Equipment Checklist
2. Check the condition of the vehicle and the fuel level. Identify a Point-of-Contact (providing pertinent information of destination, expected time-in, and how to notify field team). When leaving Los Alamos County, notify the group office (667-0808) to place you on travel status. If allowed, ensure that you have a working cell phone and a pager.

4.0 EQUIPMENT AND TOOLS

Refer to "Installing and Operating the Portable Solar-Powered AIRNET Station Equipment Checklist" (Attachment A).

5.0 TRAINING

Personnel performing this procedure shall be trained on this procedure in accordance with the provisions of the WES division training program.

In addition to training to this procedure, the following initial (and refresher) training is also required prior to performing activities covered by this procedure:

- First Aid: Standard Training (course #3574)
- Cardiopulmonary Resuscitation (CPR)/Automated External Defibrillation (AED) Training: LANL Workplace (course #43562)

6.0 DEFINITIONS

None

STEP-BY-STEP PROCESS DESCRIPTION

7.1 Site Solar-Powered AIRNET Station

Field Team Members (FTM)	1.	The sampler will generally be used in remote locations where electrical power is not available. The **AIRNET Technical Task Leader** will determine the location.
	2.	At the sampling site, use SOP-5147 to provide guidance as to where the station should be located within the site.

3. In addition to SOP-5147, take in account that the solar array for the AIRNET System must face true south and have unobstructed access to the southern sky. Any shading of the modules by trees, buildings, wires, antennas, etc. will substantially reduce the performance of the system, and may cause eventual failure.
    - Use a magnetic compass to find true south. Be sure to adjust for the magnetic declination in your area (for example, North Central New Mexico, true south is 12 degrees east of magnetic south).
    - Observe the solar access to the southern sky. If there are obstructions that cannot be removed, try to find another location where the array will not be shaded.

7.2 Install Weather-Resistant Housing

FTM

1. Bolt the 4 x 4 timbers to the legs of the housing by using the appropriate tools (start bolt with hammer).
2. Check the level of the ground surface; if needed, use shovel to level the ground (excavation permit is required).
3. Ensure the height of the access door is in the breathing zone (about 5 to 6 feet).
4. If necessary, place filled sand bags over supports to provide additional anchoring weight in the event of high winds.

7.3 Mechanical Installation of Pumps and Internal Cabinet Components

FTM

1. Connect two T-Squared T201 heavy-duty twin head 12 volt pumps in parallel with reinforced tygon tubing, hose clamps, and the air dampening reservoirs as shown in Attachment B. Secure pumps by fastening tabs on the bottom of the pumps to the floor of the housing.
2. Install the following as shown in Attachment B:
    - Mechanical flow control valve
    - Particulate filter holder
    - 250cc rotameter with needle valve
    - If necessary, install the PVC holder for the silica gel cartridge on the floor of the housing (See Attachment C for installation of flow meter)
    - Venturi flow meter
    - Timer

    Use any necessary fasteners to secure equipment to the housing.
3. **Note:** Cable installation and all electrical connections will be made by a qualified electrician.

    Attach, using necessary fasteners, an electrically shielded terminal block of appropriate rating (refer to Attachment A for recommended terminal block) inside the housing on the

wall closest to the pumps. Drill a hole through the housing below the terminal block and thread the cable from the battery enclosure through the hole. Terminate the positive side of the cable to the "positive" side of the terminal block and terminate the negative side of the cable to the "negative" side of the terminal block. Label each side as "positive" and "negative" appropriately. Use silicone sealant or a grommet to plug the hole the cable passes through to prevent moisture intrusion.

4. Note: Cable installation and all electrical connections will be made by a qualified electrician.

   Connect the positive leads of both pumps to the positive side of the terminal block and the negative leads of both pumps to the negative side of the terminal block. Do the same for any other 12 volt equipment inside the housing.

5. Lock both sides of the housing with a padlock cored the same as the other AIRNET housing locks.

6. Label the housing with its unique station number and the power-off notice label with the group phone number.

7. Recheck the housing is level.

8. Determine the coordinates of the new location, using either map techniques or a GPS unit.

7.4 Mechanical Set Up and Installation of Photovoltaic Panels

FTM

1. Select a location on level ground upon which the Unirac RapidRac bay frames can rest. This location should be within close proximity of the AIRNET housing given the length of cable supplied with the solar power equipment.

   NOTE: For optimum performance, the solar array must face true south and have unobstructed access to the southern sky.

2. Assemble the Unirac RapidRac support systems for the two arrays (4 panels per array) following the RapidRac G10 installation manual 601 which is attached to this SOP as Attachment D.

   NOTE: Ensure the front of the panels are covered with opaque material during the installation process and prior to the electrician making all the necessary connections from the panels to the array combiner, charge controller, battery bank, and housing.

3. Load 12 ballast blocks (26 pounds minimum per block) per array into the bay frames. There should be 6 blocks in each bay frame (i.e., 2 bay frames per array of 4 panels). Refer to the Unirac RapidRac Engineering Report for detailed calculations on how the ballast requirements were determined (Attachment E)

4. Mount battery charge controller and array combiner onto one or more of the RapidRac module brackets. It may be necessary to perform some field engineering to provide a secure mounting surface for the controller and breaker box.

   Note: If a question exists on how or where to mount the battery charge controller and array

		combiner consult a qualified electrician for direction and assistance.

7.5 Set Up Battery Bank Enclosure and Install Batteries

WARNING

Use extreme caution when working with a battery. Do not allow wrenches or other metallic objects to come in contact with both terminals simultaneously. Serious injury and destruction of the battery may occur.

FTM	1.	Place battery enclosure onto level ground or elevate on pressure treated timbers. Two people will be required to move the enclosure around.
	2.	Note: Do NOT handle the batteries if the plastic battery terminal covers are missing. Reinstall protectors if available or cover terminals completely with electrical tape prior to further handling and installation of the batteries into the battery bank enclosure. Place plastic protectors over each battery terminal if not already installed. Lower each battery into the enclosure on top of the bracings being careful not to short the battery terminals across the side wall of the enclosure. Leave protectors in place. The electrician will remove them and re-install them when he is ready to connect the batteries, i.e., they should be left in place if possible.

WARNING

Have a qualified electrician confirm the proper size fuse (10 amps, 250 volts) is installed in the inline fuse holder of the power cable between the battery bank and the AIRNET station.

	3.	Contact a qualified electrician to connect all electrical wiring outside of the housing, including cables inside battery enclosure and to power up the system. Refer to section 2.2.8 for precautions specific to working inside the housing.
	4.	Have a qualified electrician and/or an ESO confirm the electrical connections and electrical safety of the installation prior to requesting the electrician to power up the battery charging system.

7.6 Final Inspection and Initiation of Operation

FTM	1.	Allow the batteries to charge for at least five days prior to initial start-up. After approximately five days, the main power switch may be turned on to start pump operation.
	2	Measure the air flow through the particulate filter and cartridge according to procedure SOP-5145.
	3.	Confirm solar panel orientation using the compass; make sure it is facing true south. Verify that there are no obstructions to the panels.
	4.	Confirm all air line connections are free of leaks and all mounting fasteners are tight.
	5.	Document the housing installation, flow measurements, and start-up time and date in the field logbook.

7.7 Adding the New Station to the AIRNET System

FTM

1. The new station's identification number and location name must be added to the appropriate records:
   - Ask the AIRNET Technical Task Leader to add the new station (and the coordinates determined in Section 7.3 step 7) to the Access database of locations.
   - Request that the AIRNET Technical Task Leader and the Chemistry Data Coordinator revise the clumping paperwork and the shipping documents for filters, tritium, and composites.

7.8 Sampling Parameters and Changing the Filter

FTM

1. During sampling, the sampler will be run continuously (as the battery charge allows) and the samples will be collected every two weeks during the regular AIRNET sample change-out (see SOP-5143 and SOP-5144).
2. If different sampling schedules are called for, follow the schedule specified by the AIRNET Technical Task Leader. Follow the instructions of the AIRNET Technical Task Leader for changing the collected particulate filter and tritium samples. Generally, the samples will be collected, labeled, and shipped in the same manner as those collected under procedures SOP-5143 and SOP-5144.

7.9 Disassembly and Transportation (as needed)

FTM

1. Cover photovoltaic panels with opaque material and secure with tape.
2. Contact electrician to power down system and disconnect all electrical wiring from system outside of housing, including cables inside battery enclosure.
3. Place plastic protectors (or electrical tape) over each battery terminal if not already installed. Carefully remove each battery from the enclosure and place the battery inside storage/transportation box in vehicle.
4. Lift battery enclosure off ground or timbers. This will require two people to move enclosure.
5. Remove panels from RapidRac systems and repack in original boxes.
6. Remove charge controller and array combiner and pack for transportation.
7. Disassemble RapidRac systems if necessary for transport.
8. Remove housing from timbers. Internal components need not be removed if they are secured inside enclosure. Secure housing in vehicle so as to prevent it from moving around during transportation.
9. Unbolt timbers.
10. Load remaining items in vehicle ensuring that items will not move around during transport.

7.10 Maintenance

FTM 1. The T-Squared pumps need to be replaced every 6 months with new pumps.

RECORDS

FTM 1. The following records generated as a result of this procedure are to be submitted as records to the Records Coordinator in accordance with EP-DIR-SOP-4004:

- Entries in the field log book (entries completed in accordance with SOP-5181)
- New or edited records in the AIRNET station database

9.0 REFERENCES (WES PROCEDURES) HTTP://INT.LANL.GOV/ENVIRONMENT/ALL/QA/ADEP.SHTML

1. RRES-ES-Field, General Field Safety for All Employees
2. RRES-ES-Driving, Driving and Towing Safety for All Employees
3. SOP-5143, Environmental Sampling of Airborne Particulate Radionuclide
4. SOP-5144, Sampling of Ambient Airborne Tritium
5. SOP-5145, Calibration of Air Sampling Stations
6. SOP-5147, Evaluation of AIRNET Sampler Sites Against Siting Criteria
7. SOP-5150, Installation of New AIRNET Stations
8. SOP-5181, Notebook Documentation for Waste & Environmental Services Technical Field Activities
9. EP-DIR-QA-SOP-4004, Records Transmittal and Retrieval Processes

10.0 ATTACHMENTS

Attachment A: Installing and Operating the Portable Solar-Powered AIRNET Station Equipment Check List

Attachment B: Equipment Housing Installation Schematic (Example)

Attachment C: Silica Gel Cartridge Flow Meter Diagram (Example)

Attachment D: UniRac RapidRac G10 Installation Manual 601

Attachment E: UniRac RapidRac Engineering Report

Attachment F: Battery Technical Specification

Attachment G: Battery Bank Enclosure Technical Specification

Attachment H: Battery Charge Controller Technical Specification

Attachment I: Photovoltaic System Electrical Array Combiner Technical Specification

Attachment J: Photovoltaic Panel Technical Specification

11.0 REVISION HISTORY

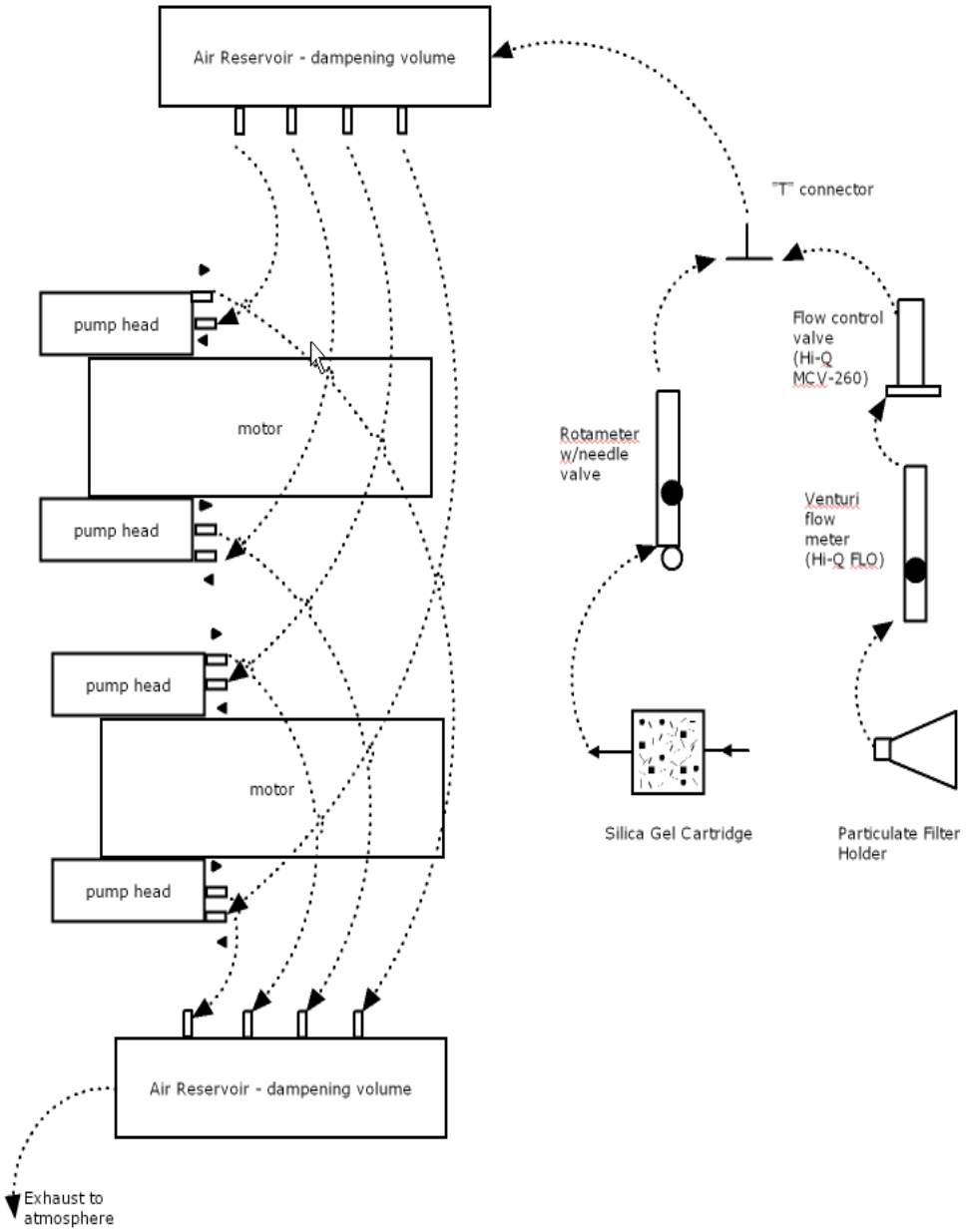
Revision No. *[Enter current revision number, beginning with Rev.0]*	Effective Date *[DCC inserts effective date for revision]*	Description of Changes *[List specific changes made since the previous revision]*	Type of Change *[Technical (T) or Editorial (E)]*
0	4/2/2009	New Procedure	T
1	8/2/2010	Updated document to enhance electrical safety by requiring use of a qualified electrician for any work involving potentially live electrical circuits.	T

If you have read and understand the preceding document, click here to receive EDS credit.

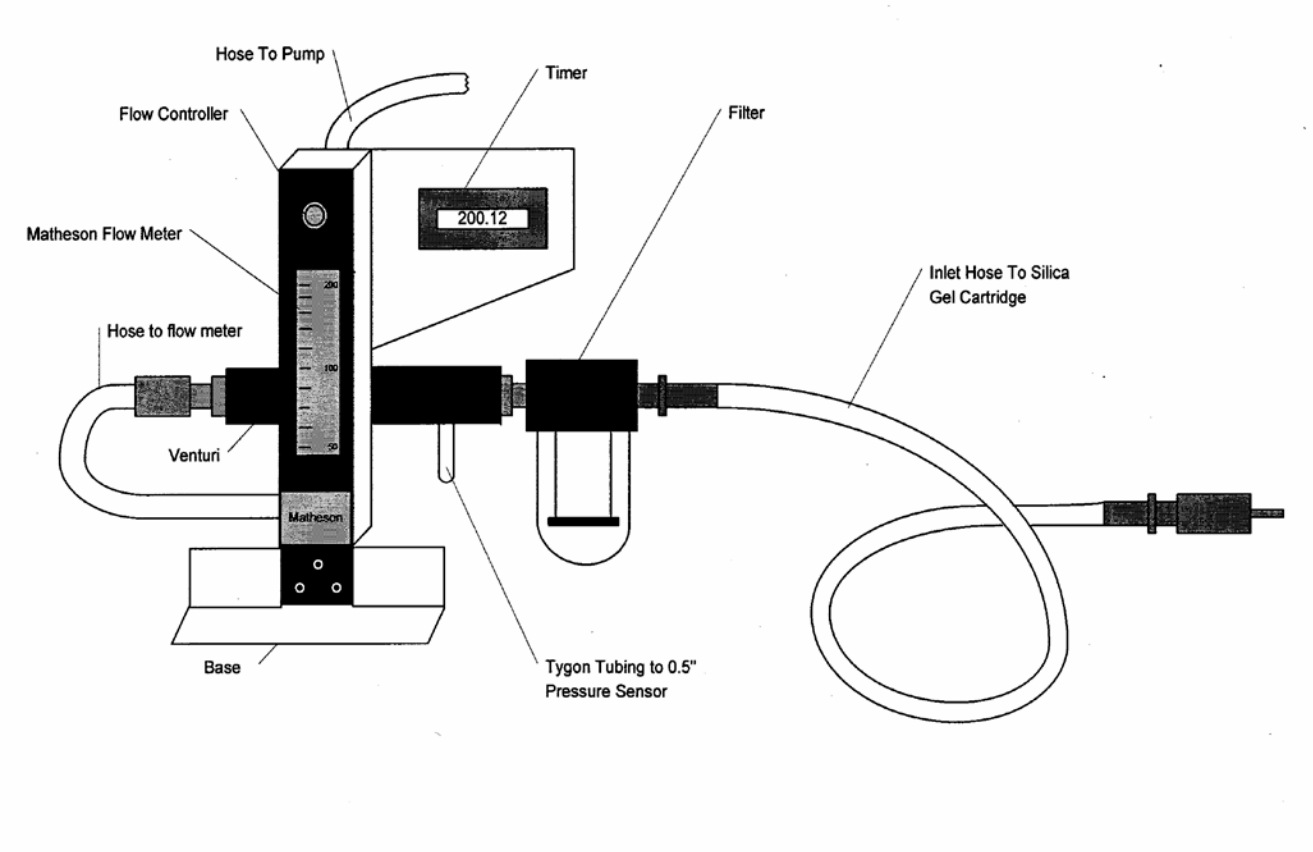
ATTACHMENT A	
SOP-5234-A **Installation and Operating the Portable Solar-Powered AIRNET Station Equipment Checklist (Example)**	Records Use only 

- ☐ Pre-weighed silica gel cartridge
- ☐ Filter Holder
- ☐ Calibrators (for silica gel and air filters flows)
- ☐ 2 pad locks with same key core as other station locks
- ☐ Level
- ☐ Stations label and disconnect notice
- ☐ Palm computer
- ☐ Chain-of-custody form from MAQ-204, or equivalent
- ☐ GPS Unit
- ☐ Personnel Protection Equipment (e.g. leather/protective gloves, safety glasses, safety shoes, field shoes)
- ☐ 5/16” Straight blade screw driver
- ☐` 9/64” Straight blade screw driver
- ☐` Combination Wrench Set
- ☐ 3/8” Drive Socket Set
- ☐ Hammer
- ☐ Portable battery-powered drill with 3/8” bit rated for metal drilling
- ☐ Waterproof sealant or grommet
- ☐ Electrically shielded terminal block rated at a minimum of 20 amps, 250 volts (e.g., Ideal model #89-208 terminal strip with Ideal model #89-237 terminal strip cover)
- ☐ Outdoor/indoor watertight ON/OFF power switch (e.g., Hubbell model #HBLDS3)
- ☐ Weather-resistant adhesive labels for terminal blocks
- ☐ Pressure-treated timbers for AIRNET housing and battery enclosure
- ☐ Magnetic Compass
- ☐ Housing with pumps, flow meters, timer, reinforced tygon tubing, hose clamps, etc.
- ☐ Solar power equipment, battery enclosure, batteries
- ☐ 2 Unirac RapidRac systems with 24 ballast blocks (solid cap concrete blocks) (26 pounds minimum per block)
- ☐ Felt tip permanent marker and pen
- ☐ Cellular Phone or Radio and pager
- ☐ First Aid Kit
- ☐ Sun Screen and insect repellent (optional)

ATTACHMENT B	
SOP-5234-B **Equipment Housing Installation Schematic (Example)**	Records Use only Los Alamos NATIONAL LABORATORY EST.1943



ATTACHMENT C	
SOP-5234-C **Silica Gel Cartridge Flow Meter Diagram (Example)**	Records Use only Los Alamos NATIONAL LABORATORY EST.1943



ATTACHMENT D	
SOP-5234-D **RapidRac G10** **Installation Manual 601**	Records Use only 

To access the Installation Manual 601 select the following link:

http://www.lanl.gov/environment/all/docs/qa/ep_qa/SOP-5234-AttD.pdf

ATTACHMENT E	
SOP-5234-E **UniRac - RapidRac Engineering Report**	Records Use only Los Alamos NATIONAL LABORATORY EST. 1943

To access the RapidRac Engineering Report select the following link:

http://www.lanl.gov/environment/all/docs/qa/ep_qa/SOP-5234-AttE.pdf

ATTACHMENT F	
SOP-5234-F **Battery Technical Specification**	Records Use only Los Alamos NATIONAL LABORATORY EST. 1943

8A31DT

SPECIFICATIONS

Nominal Voltage (V)	12V
Capacity at C/100	110 Ah
Capacity at C/20	104 Ah
Weight	69 lbs. (31 kg)
Plate Alloy	Lead Calcium
Posts	Forged Terminals & Bushings
Container/Cover	Polypropylene
Operating Temperature Range	-40°F (-40°C) - 140°F (60°C)
Charge Voltage @ 68°F (20°C)	
Cycle	2.40 - 2.43 VPC
Float	2.25 - 2.30 VPC
Vent	Self-sealing (2 PSI operation)
Terminal	S/X (SAE/STUD)

Made in the U.S.A. by East Penn Manufacturing Co., Inc.

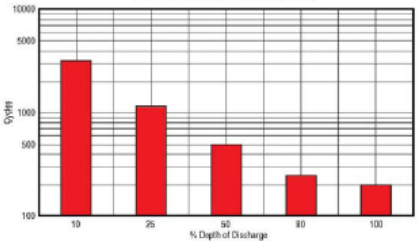
Distributed by:

Valve-Regulated, Absorbed Glass Mat Technology

DIMENSIONS

Length (mm)	12.94 (329 mm)
Width (mm)	6.75 (171 mm)
Height (mm)	9.38 (238 mm)

AGM Cycle Life vs Depth of Discharge at +25°C (77°F) Based on BCI 2-hour Capacity

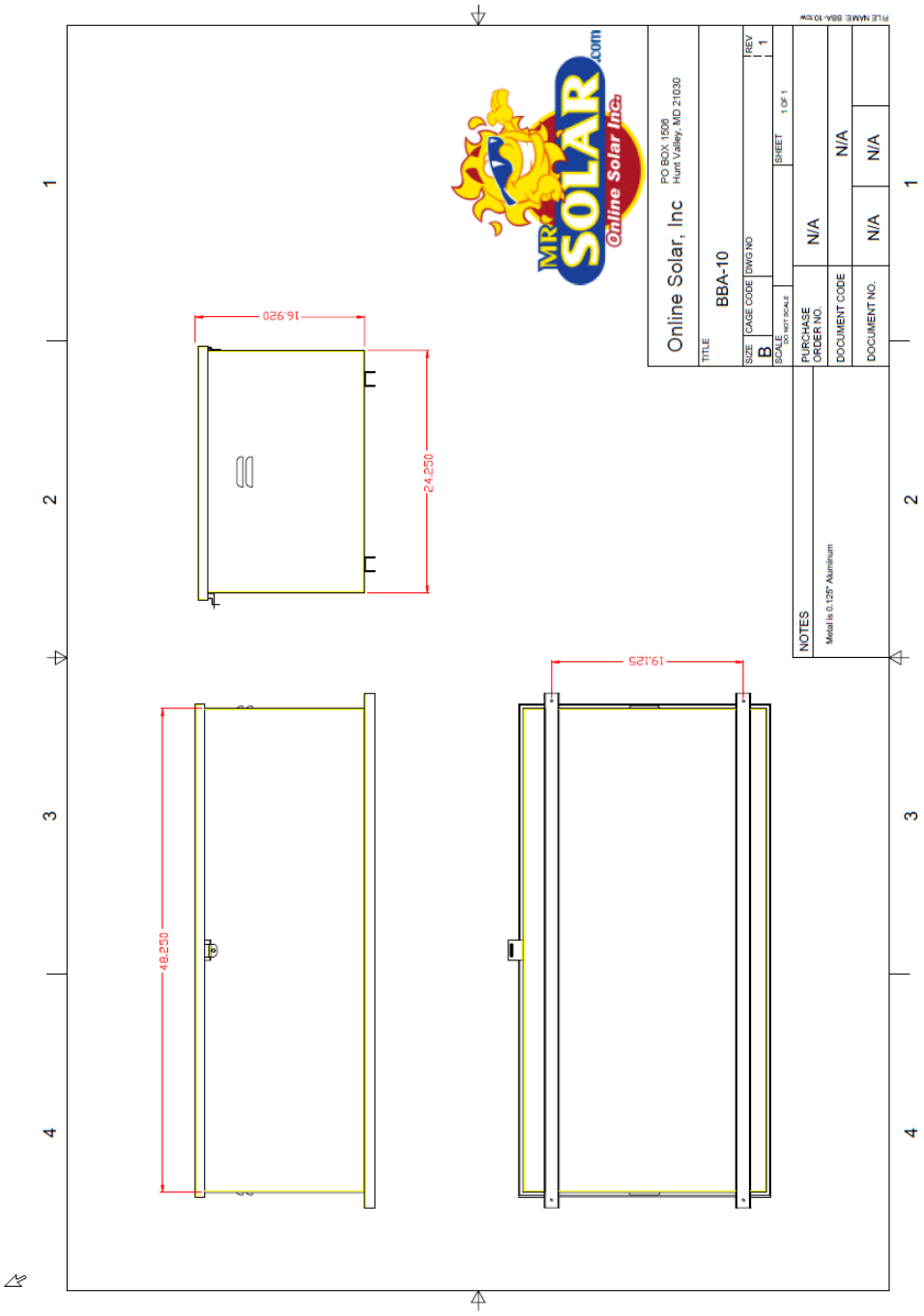


MK Battery

1631 South Sinclair Street ● Anaheim, California 92806

Toll Free: 800-372-9253 ● Fax: 714-937-0818 ● E-mail: sales@mkbattery.com

ATTACHMENT G	
SOP-5234-G **Battery Bank Enclosure Technical Specification**	Records Use only Los Alamos NATIONAL LABORATORY EST. 1943



ATTACHMENT H	
SOP-5234-H **Morningstar TS-60 (60 Amp) Battery Charge Controller Technical Specification**	Records Use only Los Alamos NATIONAL LABORATORY EST. 1943

MORNINGSTAR corporation

TRISTAR™

THREE-FUNCTION SOLAR CONTROLLER

Morningstar's ***TriStar Controller*** is a three-function controller that provides reliable solar battery charging, load control or diversion regulation. The controller operates in one of these modes at a time and two or more controllers may be used to provide multiple functions.

The TriStar uses advanced technology and automated production to provide exciting new features at a competitive cost. The optional TriStar meter is the most sophisticated and informative controller meter on the market. The controller is UL listed and is designed for both solar home systems and professional applications.

Product shown with optional meter.

Key Features and Benefits

Highest Reliability
Large heat sink ❶ and conservative design enables operating at full ratings to 60°C. No need to de-rate.

More Power
Ratings to 60A at 48VDC will handle solar arrays up to 4kW.

Communications Capability
RS-232 ❷ connects to a personal computer for custom settings, data logging and remote monitoring and control.

Fully Adjustable
DIP switch ❸ provides user with a choice of 7 different digital presets and custom settings via RS-232.

Extensive Electronic Protections
Fully protected against reverse polarity, short circuit, overcurrent, high temperature and overvoltage.

Simple Mechanical Interface
Larger power terminals ❹ and conduit knockouts ❺. Extra space for wire turns. Fits on power panels.

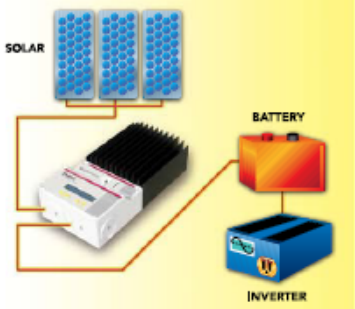
Better Battery Charging
Connecting battery sense wires ❻ and optional remote temperature sensor ❼ will improve control accuracy. Constant voltage series PWM algorithm increases battery capacity and life.

More Information
3 LED's ❽ to indicate status, faults and alarms. Optional meter ❾ displays extensive system and controller information, automatic self-test and reset capabilities. Meter connection via RJ-11 phone jack ❿.

Easy to Reset
Pushbutton ⓫ provides manual reset and stop/start battery equalization or load disconnect.

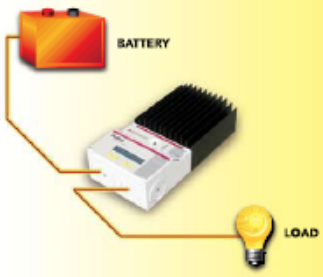
Low Telecom Noise
DIP switch setting will change PWM to "On-Off" battery charging.

CHARGE CONTROL



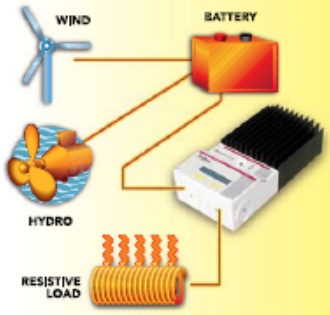
- Constant voltage series PWM design to provide highly efficient battery charging
- 4-stage charging to increase battery capacity and life: bulk charge, PWM regulation, float and equalize
- Parallel for larger solar arrays up to 300 amps or more

LOAD CONTROL



- Starts large loads including motors and pumps with no damage to controller
- Allows inrush current to 300 amps
- Electronic short-circuit and overload protection with automatic reconnect
- LVD is current compensated and has a delay to avoid false disconnects

DIVERSION CONTROL



- May be used for solar, wind or hydroelectric
- To protect against battery overcharge, excess energy is diverted from primary battery to a secondary battery or alternate DC resistive load
- PWM reduces power into diversion load during overcurrent conditions

Electrical Specifications

- Rated solar, load or diversion current:
  - TriStar-45 45A
  - TriStar-60 60A
- System Voltage 12-48V
- Accuracy 12/24V: ≤0.1% ±50mV
  48V: ≤0.1% ±100mV
- Min. voltage to operate 9V
- Max. solar voltage (Voc) 125V
- Self-consumption:
  - Controller <20mA
  - Meter 7.5mA

Electronic Protections

- Reverse polarity protection (any combination)
- Short-circuit protection
- Overcurrent protection
- Lightning and transient surge protection using 4500W transient voltage suppressors
- High temperature protection via automatic current reduction or complete shut down
- Prevents reverse current from battery at night

TriStar Options:

- **TriStar Meter** — 2 x 16 display mounts to controller and provides system and controller information, data logging, bar graphs and choice of 5 languages

- **TriStar Remote Meter** — Includes 30 meters of cable for mounting meter away from the controller
- **Remote Temperature Sensor** — Provides temperature compensated charging by measuring temperature at the battery (10 meter cable)

Environmental Specifications

- Operating ambient temperature:
  - Controller –40°C to +60°C
  - Meter –40°C to +60°C
- Storage temperature: –55°C to +85°C
- Humidity: 100% (non-condensing)
- Tropicalization: Conformal coating on both sides of all printed circuit boards

Mechanical Specifications

- Dimensions: Height: 26.0cm/10.3 inch
  Width: 12.7cm/5.0 inch
  Depth: 7.1cm/2.8 inch
- Weight: 1.6 kg/3.5 lb
- Largest Wire: 35mm²/2 AWG
- Conduit knockouts: Eccentric 2.5/3.2 cm (1.0/1.25 inch)
- Enclosure: Type 1, indoor rated

Certifications

- CE Compliant
- UL Listed (UL 1741)
- cUL (CSA-C22.2 No.107.1-95)
- Complies with U.S. National Electric Code
- Manufactured in a certified ISO 9001 facility

WARRANTY: *Five year warranty period. Contact Morningstar or your authorized distributor for complete terms.*

AUTHORIZED MORNINGSTAR DISTRIBUTOR:

MORNINGSTAR corporation

1098 Washington Crossing Road
Washington Crossing, PA 18977 USA
Tel: 215-321-4457 Fax: 215-321-4458
E-mail: info@morningstarcorp.com
Website: www.morningstarcorp.com

PRINTED IN USA 2126-R1-12/07

Link to operators manual:
http://www.morningstarcorp.com/en/support/library/TS.IOM.Operators_Manual.04.EN.pdf

ATTACHMENT I	
SOP-5234-I **Photovoltaic System Array Combiner Technical Specification**	Records Use only Los Alamos NATIONAL LABORATORY EST. 1943

OutBack Power Systems

ETL LISTED

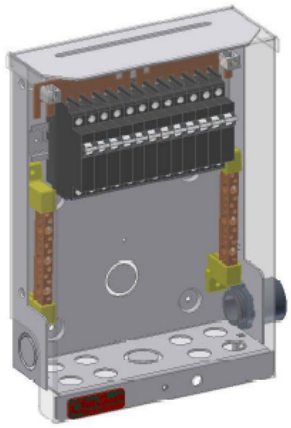
PSPV

POWER SYSTEM PV

OutBack Power Systems now offers a PV array combiner which can be used with a wide variety of PV system designs and module configurations. Can be configured with DC breakers for low voltage systems (under 125 VDC) or touch safe type fuse holders for high voltage systems (up to 600 VDC).

The **PSPV** is designed to provide NEC code compliant overcurrent protection and interconnection of multiple PV panels or subarrays into one or more PV arrays for connection to charge controllers or inverter systems.

The **PSPV** is easily field configured to match your system design and ampacity requirements - It is shipped without the breakers or fuse holders installed – order the quantity, type and amperage needed.



Shown with twelve 125 VDC PV breakers and second TBB option
Also available with touch safe type fuse holders for 600 VDC KLKD fuses

Standard Features and Components

- Outdoor, rainproof powdercoated aluminum enclosure – can be installed on vertical or sloped surfaces or pole mounted
- Snap in DIN rail mounting spaces for up to twelve 125 VDC rated OutBack PV breakers. PV Breakers are hydraulic-magnetic type and are not affected by high ambient temperatures. 10 year warranty on the PV breakers. For 12, 24, 48 and 60 VDC systems with PV array open circuit voltages up to 125 VDC. Load break rated.
- Also available with touch safe type midget fuse holders for high voltage systems up to 600 VDC
- Dual positive breaker combiner busbars – can be installed to provide one or two PV output circuits
- PV negative terminal bus bar with mounting holes for an additional TBB
- #1/0 AWG set-screw compression type box lug terminals for output wiring – accepts bare cable
- Four ¾ and 1 inch conduit knockouts – one on the bottom, back and each side – enough space provided on bottom and back to allow up to a 2 inch conduit punch for larger cabling
- Eight ½ inch knockouts on bottom for PV module or subarray input conduits or strain reliefs
- #1/0 AWG ground lug - can be mounted either on the inside or outside surface
- For negative or positive ground PV systems
- Space allowed for the addition of current sensors and lightning protection components

Optional Components

- **OBPV-6, OBPV-10 OBPV-15** - UL listed DC breakers - 125 VDC max open circuit with elevator type compression terminals for #2-14 AWG bare wire - 6, 10, 15 amp models available
- **OBPV-FH** -Touch safe type fuse holder 600 VDC fuses – accepts #8-14 AWG wire
- **OBPV-F15** - 15 amp 600 VDC KLKD fuses for the OBPV-FH fuse holder
- **TBB** - Insulated terminal bus bar for adding a second isolated negative circuit (required when using with two RV Power Products Solar Boost MPPT controller)

Physical Dimensions

- **PSPV** enclosure: 9.2" wide x 3.5" deep x 13.1" tall (23.1cm x 8.7cm x 33.2cm)
- Shipping size: 10" x 4" x 14" Shipping Weight: 6 pounds (2.7 kG) + options

Easily configured in the field for YOUR specific PV system design

OutBack Power Systems, Inc. **Tel 360.435.6030 Fax 360.435.6019**

ATTACHMENT J	
SOP-5234-J **Photovoltaic Panel Technical Specification**	Records Use only Los Alamos NATIONAL LABORATORY EST.1943

MITSUBISHI ELECTRIC PV MODULE

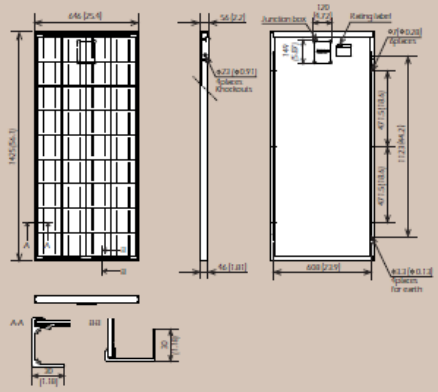
PV-MF110EC3 110Wp

SPECIFICATIONS

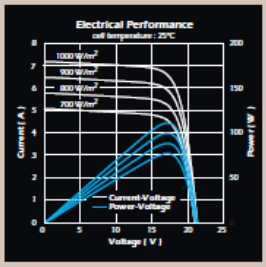
Model name	PV-MF110EC3
Cell type	Polycrystalline silicon 150mm square
No. of cells	36 in series
Maximum power rating [Pmax]	110W
Warranted minimum Pmax	104.5W
Open circuit voltage [Voc]	21.2V
Short circuit current [Isc]	7.16A
Maximum power voltage [Vmp]	17.1V
Maximum power current [Imp]	6.43A
Maximum system voltage	DC 780V
Fuse rating	15A
Output terminal	Terminal block
Dimensions	1425x646x56mm (56.1x25.4x2.2")
Weight	11.5kg (25.4lb)
Module efficiency	11.9%
Packing condition	2pcs-1 carton

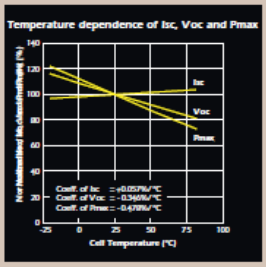
Electric performance represents values under Standard Test Conditions (STC:25°C, AM1.5, 1000W/m²). Specifications are subject to change without notice.

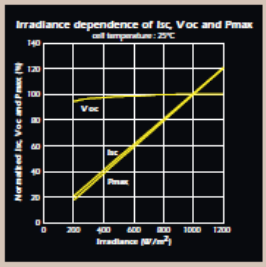
DRAWINGS AND DIMENSIONS



ELECTRICAL CHARACTERISTICS







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