CIVIL ENGINEERING DIVISION
UNITED STATES COAST GUARD
WASHINGTON, DC

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SPECIFICATION FOR SOLAR AID CONTROLLER III

SPECIFICATION NO. G-SEC-501

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1. SCOPE.

1.1 General. The Solar Aid Controller III, hereafter referred to as the controller, monitors and controls light and sound signal systems in 12VDC-powered lighthouses. The controller will be operated in environmental extremes found along the navigable waterways of the United States.

1.2 Deliverables. The deliverables under this specification shall be as listed in the quantities specified below or on the procurement schedule. All design artwork including drawing masters and photo masters will become property of the U.S. Government and will be used for future competitive procurements.

a. First Article controllers – one (1) each potted and three (3) each unpotted.
b. Production controllers.
c. All master artwork engineering drawings used in the production of the printed circuit board.
d. All photo masters used in the production of the controller.

1.3 Government Furnished Property (GFP). The government will supply to the contractor upon request and for the duration of the contract the following GFP:

a. One (1) each earlier generation controller (Solar Aid Controller II), potted, as an example.
b. One (1) each earlier generation controller (Solar Aid Controller II), unpotted, as an example.
c. Master artwork drawings of the printed circuit board from a previous but obsolete earlier generation controller (Solar Aid Controller II), as an example.
d. One (1) each CG-6P Lampchanger, required for testing.
e. 10 each, 12-V, 2.03-A, marine signal lamps, required for testing.
f. Instruction Sheet (one supplied for each deliverable production controller, to be packed with each unit).

2. APPLICABLE DOCUMENTS.

2.1 General. The documents listed in this section are needed to meet the requirements specified in sections three (3) and four (4) of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, users of this specification are cautioned that they must meet all specified requirements of the documents cited in sections three (3) and four (4) of this specification, whether or not the documents are listed in this section.

2.2 Extent of Applicability. The following documents of the issue in effect on the date of solicitation form a part of this specification to the extent specified herein:

2.2.1 Federal Regulations.

a. Federal Acquisition Regulations (FAR).

2.2.2 Military Specifications.

a. MIL-S-46844 - Solder Bath Soldering of Printed Wiring Assemblies, Automatic Machine Type.

b. MIL-M-43719 - Marking Materials and Markers, Adhesive, Elastomeric, Pigmented; General Specification for.

2.2.3 Military Standards.

a. MIL-STD-275 - Printed Wiring for Electronic Equipment.

b. MIL-STD-454 - Standard General Requirements for Electronic Equipment, requirements 5 and 9.

2.2.4 Federal Specifications.

a. QQ-A-250-7E - Aluminum Alloy 5086, Plate and Sheet.

b. QQ-A-250-8F - Aluminum Alloy 5052, Plate and Sheet.

3. REQUIREMENTS.

3.1 Construction and Material.

3.1.1 Contractor Furnished Items. The contractor shall furnish material, printed circuit boards, circuit components, fabrication, assembly processes, and all other items and services necessary to produce the deliverables (1.2) and otherwise comply with the requirements of this specification.

3.1.1.1 Artwork. The contractor shall design and draw a master artwork printed circuit board wiring pattern, drilling detail, and parts layout to conform to all physical dimensions (appendix A, pages A-1 and A-2) and electrical integrity of the schematic diagram (appendix A, page A-3). Master engineering drawings and artwork from a previous but obsolete earlier generation controller (Solar Aid Controller II) are available as GFP to give the contractor an idea of what is expected. These documents and all other GFP will be shipped upon request after contract award. The contractor may use these obsolete master artwork engineering drawings as an aid in the development and fabrication of the new deliverable master artwork engineering drawings from which the deliverable controllers shall be produced.

3.1.1.2 Photo Masters. The contractor shall provide the 1:1 Photo Masters used to produce printed circuit boards for the controller.

3.1.2 Workmanship. The controllers delivered under this specification shall be constructed in accordance with MIL-STD-454, Requirement 9.

3.1.3 Soldering. General soldering shall conform with MIL-STD-454, Requirement 5. Printed circuit board assembly soldering shall conform with MIL-S-46844.

3.1.4 Corrosion Resistance. Each controller shall be constructed of materials so as to be resistant to corrosion from exposure to salt air ranging in relative humidity from 0% through 100%.

3.1.5 Potting. The controller's circuit board and electronic components shall be encapsulated in potting material (as specified next) to form a solid rectangular (modular) block no larger than 4.75" x 3.375" x 1.5." The controllers shall be potted with Castall No. E401 resin and RT2485 hardener mixed and applied in accordance with the manufacturer's instructions; however, the contractor may propose to the Contracting Officer in writing, the choice of a different potting material better suited to the construction and overall performance of the controllers. No potting material substitutions shall be made without prior written approval from the Contracting Officer. Potting shall completely fill all voids, except that potting shall not prevent adjustment of R5; potting shall not prevent the normal switching operations of switches S1 and S2; and, potting shall not prevent access to test point TP1 (see appendix A, page A-1). As such, the contractor shall seal off possible ingress points, if any, in, around, and on R5, S1, S2, TP1, TB1, and TB2 prior to potting. Potting flow-through holes may be drilled in the printed circuit board at various strategically placed locations to aid potting flow to the spaces above and below the printed circuit board; however, potting flow-through holes shall not touch, cut into, sever, or otherwise interfere with any printed circuit board wiring. The exterior of each controller shall be free from protrusions and sharp edges that may catch the clothing of or lacerate servicing personnel. Any exposed meniscus "knife-edge"

formed along and around the edges of the controller, which occurs due to shrinkage of the potting material upon curing in the mold, shall be removed.

3.1.6 Printed Wiring. Printed circuit wiring shall be fabricated in accordance with MIL-STD-275.

3.1.6.1 Printed Wiring Gauge. As indicated in the schematic diagram in appendix A, page A-3, the printed circuit wiring between TB2-1 and transistor Q3-DRAIN and between TB2-2 and transistor Q3-SOURCE must be able to carry 30-amps under normal operation. Therefore, the printed wiring runs in these two areas shall be made sufficiently heavy in order that, at a minimum, the controller passes the MOSFET VOLTAGE DROP and BURN IN tests (steps 7 and 8 of the Final Electrical Test, Appendix B). The contractor may choose, instead, to reinforce these printed circuit wiring runs with a heavy gauge copper hookup wire.

3.1.7 Test Point. Test point, TP1, shall be either a #4-40 stainless steel machine screw or an appropriately sized gold-plated cup socket pin. TP1 shall extend from the circuit board to the top surface of the controller. The accessible end of the test point shall be cut or filed flush and smooth to the top surface of the potted controller so as to keep it undetectable under the Identification Label (3.2.2). A small dot marking the location of TP1 shall be applied to the identification label either as part of the label artwork or applied later with a permanent marker.

3.1.8 Wire Jumper. A one and one half inch (1.5”) long, insulated, blue, 22AWG, tinned solid copper hookup wire shall be stripped 3/16" on both ends and installed outside the controller to form a jumper (J1) between terminals TB1-2 and TB1-3.

3.1.9 Base-Plate. The controller's base-plate shall be made from marine-grade aluminum alloy sheet stock type 5086 conforming to QQ-A-250-7E or type 5052 conforming to QQ-A-250-8F. The base-plate shall have a thickness of 0.125" ± 0.03125" and conform to all physical dimensions as shown in appendix A, page A-2. A single 0.375” maximum diameter hole may be drilled in the base-plate for potting injection.

3.1.10 Heat-Sinking and Insulation. The tab of transistor Q3 (connected to DRAIN) shall be electrically isolated from the aluminum base-plate. Transistor Q3 shall be mounted underneath the circuit board and flush up against the base-plate with a thermally conductive insulating pad sandwiched in between its metal heat-sinking tab and the base-plate to insure complete electrical isolation. Heat sinking compound shall be used to insure proper heat transfer.

3.2 Identification and Markings.

3.2.1 Serial Numbers. Controllers shall be numbered sequentially beginning with the number X1, and continue consecutively X2, X3, etc., where “X” represents an upper case letter prefix (the Contracting Officer will issue the serial number prefix upon contract award). Serial numbers shall be stamped on the base-plate (3.1.9) or permanently printed on the identification label (3.2.2) and legible from a distance of two feet when the controller is mounted on a flat vertical surface. Minimum type size shall be 1/8.”

3.2.2 Identification Label. An identification label containing the information in figure 3.1 shall be affixed to the top surface of the controller between TB1 and TB2. The dimensions of this label shall be such that the legends on the label line up exactly with the corresponding terminals of TB1 and TB2, the two positions of slide switch S1, and the location of the pushbutton reset switch S2. The label, when adhered to the controller, shall cover the access hole to potentiometer R5 (see appendix A, page A-1); the label shall cover the test point TP1 (3.1.7)(see appendix A, page A-1); however, the label shall not cover the access holes to switches S1 and S2 (see appendix A, page A-1). This label shall conform with MIL-M-43719 Type I, Class I.

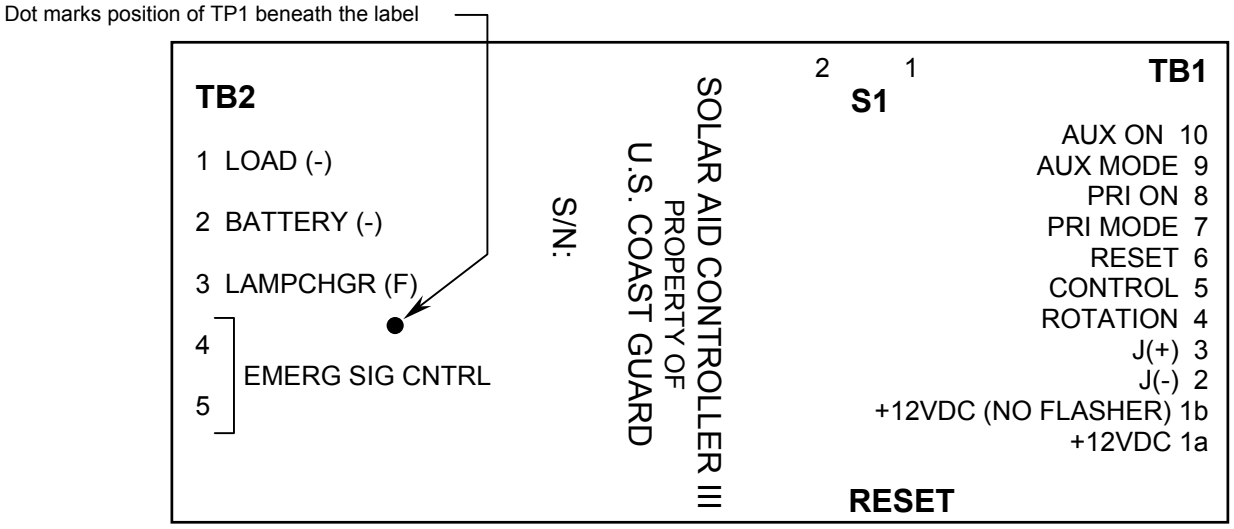


Figure 3.1

3.4 Parts and Parts Substitution. The contractor shall use parts specifically listed on the Solar Aid Controller III Parts List, appendix A, pages A-4 and A-5, except that the contractor may propose to the Contracting Officer in writing, the substitution of parts equivalent in design, performance, quality, and/or construction, accompanied by supporting technical documentation which proves such equivalency. The contractor may also propose to the Contracting Officer in writing, the substitution of parts, although not necessarily equivalent in design, performance, quality, and/or construction, that are, in the contractor's opinion, better suited for the application in question. In any event, no substitutions shall be made without prior written approval from the Contracting Officer.

3.5 Logic Gate Rearrangement. The contractor may propose to the Contracting Officer in writing, a rearrangement or substitution of logic gates and/or logic gate input and output pins to help in the printed circuit design if the gates and their pin numbers as indicated in the schematic diagram (see appendix A, page A-3) cause printed circuit design difficulties. The circuit itself, however, shall remain electrically identical to the schematic diagram even if the pin numbers change. A logic gate substitution shall be made with exactly the same type logic gate. No circuit changes or rearrangements of any kind shall be allowed without prior written approval from the Contracting Officer.

3.6 First Article. The contractor shall provide three unpotted first article controllers and one potted first article controller. The purpose of the first articles is to demonstrate, prior to continuing production, that construction details, component selection, production methods, and controller operation comply with and meet all requirements set forth in this specification. The contractor is strongly urged to wait until after first article approval to purchase parts in production quantities.

3.7 Controller Current Threshold Adjustment Procedure. The contractor shall set the controller current threshold prior to potting according to the following procedures:

a. Equipment Required:

- Digital Multimeter, Fluke 77 or equivalent
- 12-volt, 8-Amp DC power source
- Jumper leads
- CMOS logic probe (optional)
- Resistive load (e.g., lamp), 1.0-amp ±0.1-amp
- Resistive load (e.g., lamp), 0.5-amp ±0.05-amp

b. Current Adjustment: With switch S1 in the "1" position, apply +12.0-volts DC from the power supply to the controller at TB1-1b, connect both loads in parallel from +12-volts DC at the power supply to TB2-1, connect TB2-2 to the 12-volt DC power supply return, and press switch S2 to reset the controller to the primary mode. Ensure wire jumper J1 is installed between TB1-2 and TB1-3. Turn R5 fully CCW (R5 is a 25-turn pot). The signal at test point TP1 should be logic zero (logic lo). While monitoring TP1, quickly turn R5 CW until logic at TP1 changes to one (logic hi) and stop. Then, very slowly turn R5 CCW until logic at TP1 changes back to zero and stop. Very very slowly turn R5 CW again until logic at TP1 just changes back to one and stop. Finally, carefully rotate R5 CW one-quarter turn (90º) to set the current threshold. Remove the 0.5-amp load. The signal at TP1 should be logic zero with only the 1.0-amp load and logic one with both loads. If the controller times-out before this procedure is completed, simply press S2 to reset the controller, and continue. Once the threshold has been set and confirmed, a small dab of trimmer screw locking paint, such as ThreeBond 1401, shall be applied to the potentiometer R5's trimmer screw to "lock" it in place.

4. QUALITY ASSURANCE PROVISIONS.

4.1 General. The contractor shall maintain an inspection system which shall ensure that each item offered to the government for acceptance or approval conforms to the contract requirements. The inspection system shall be documented and available for review by the Contracting Officer's Technical Representative, hereafter referred to as the COTR.

4.1.1 Records. The contractor shall maintain records of all inspections and tests. The record shall indicate the nature and number of observations made, the number and type of deficiencies found, and the corrective action taken.

4.1.2 Contractor's Calibration System. The contractor shall maintain a calibration and maintenance system to control the accuracy of measurement and test equipment used in the fulfillment of this contract. The system shall include, as a minimum, prescribed calibration intervals, source of calibration, and a monitoring system to ensure adherence to calibration schedules. Proof of conformance to this paragraph shall be readily available to the COTR.

4.1.3 Responsibility for Inspection and Testing. The contractor shall conform to all requirements of the Federal Acquisition Regulations (FAR) Part 52.246-01 and 52.246-02. The contractor shall provide space, personnel, test equipment, and data sheets for conducting all inspections and tests. All inspections and testing shall be performed at the contractor's plant, or at other facilities acceptable to the government. The government reserves the right to verify any of the inspections and tests set forth in this specification where such inspections and tests are deemed necessary to assure that supplies and services conform to the prescribed requirements. The contractor shall notify the Contracting Officer 15 calendar days prior to the scheduled commencement of any inspections and tests required by this specification.

4.2 Quality Assurance Inspections.

4.2.1 First Article Inspection. The four first article controllers will be examined by the COTR prior to production to ensure compliance with this specification. The potted first article controller shall be subjected to all production inspections (4.2.2). The three unpotted first article controllers shall be subjected to inspections as follows:

a. Artwork (3.1.1.1)
b. Photo Master (3.1.1.2)
c. Workmanship (internal) (3.1.2)
d. Soldering (3.1.3)
e. Printed Wiring (3.1.6)
f. Final Electrical Test (appendix B)

4.2.1.1 Acceptance-Rejection Criteria for First Article Potted and Unpotted Controllers. Any defect found in the first article controllers revealed by the first article inspection shall be cause for failure of the first article test.

4.2.2 Production Inspection. The inspections required in this paragraph are not intended to supplant any controls, examinations, inspections, or tests normally employed by the contractor to assure quality of this product. The sample controllers (4.2.2.2) shall be subjected to the following tests/inspections:

a. Workmanship (3.1.2)
b. Potting (3.1.5)
c. Serial Numbers (3.2.1)
d. Identification Label (3.2.2)
e. Final Electrical Test (appendix B)

4.2.2.1 Inspection Lot. A lot shall be all of the production controllers from an identifiable production period from one manufacturer and one plant submitted for acceptance at one time.

4.2.2.2 Sampling. For lot sizes of up to 500 production controllers, the sample size shall be thirteen (13). For lot sizes greater than 500, the sample size shall be specified in the solicitation package.

4.2.2.3 Acceptance-Rejection Criteria for Production Controllers. For a sample size of thirteen (13), zero (0) failures of the tests/inspections set forth in subparagraph 4.2.2 shall be cause for acceptance of the entire lot; and, one (1) failure/defect shall be cause for entire lot rejection. In other words, any defect found shall be cause for entire lot rejection. The government does not accept defective controllers. For sample sizes other than thirteen (13), the acceptance-rejection criteria shall be specified in the solicitation package

5. PREPARATION FOR DELIVERY.

5.1 Pre-Packing Check. Before packing each production controller, the contractor shall ensure that:

a. Wire jumper J1 is securely fastened between TB1-2 and TB1-3;
b. Switch S1 is set to position "1";
c. One Instruction Sheet (GFP) is packed with each controller; and,
d. Serial number is applied according to subparagraph 3.2.1 of this specification.

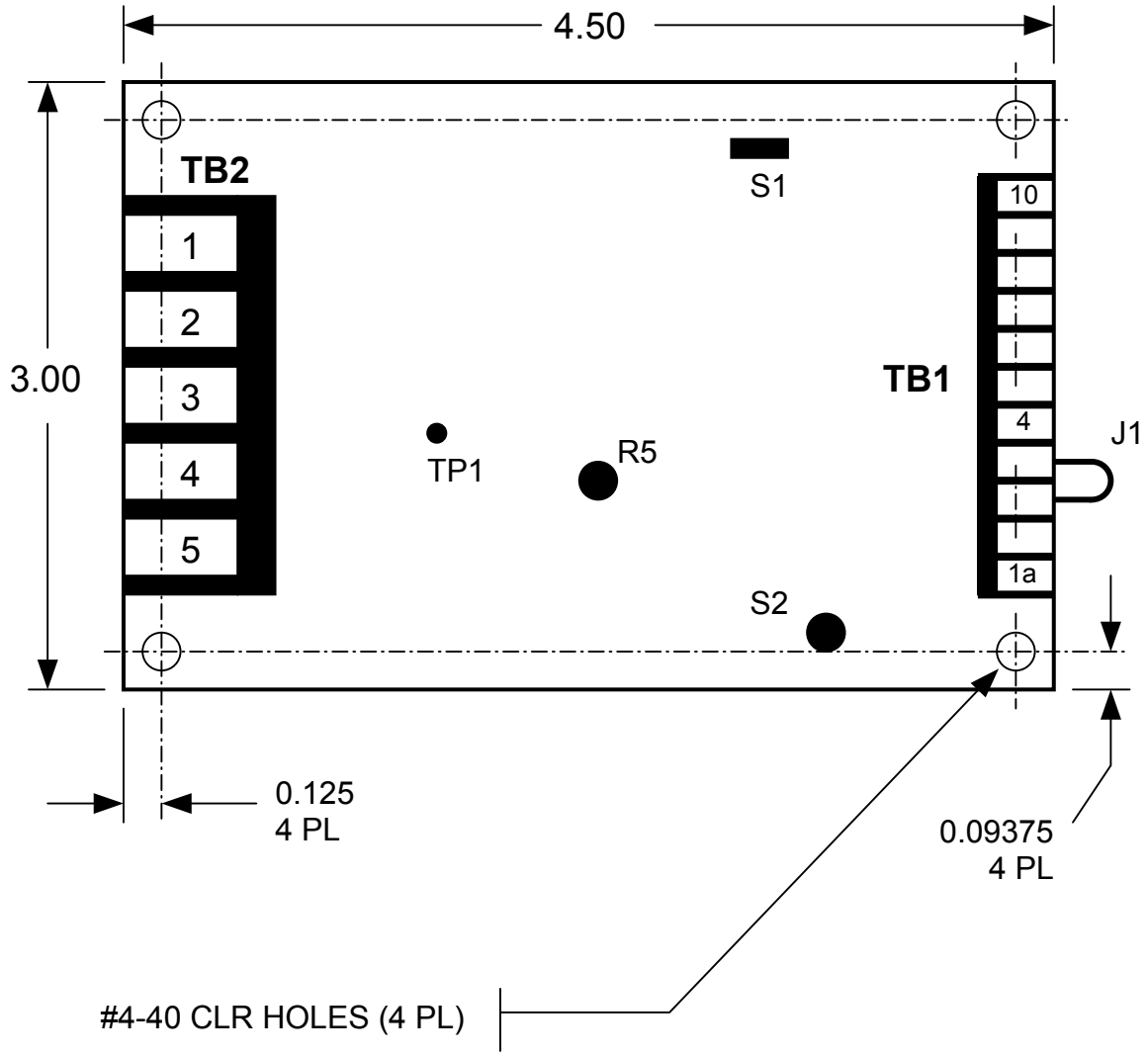
5.2 Packaging. Packaging requirements and description of unit packs shall be as specified in the contract or order.

5.3 Marking. Unless otherwise specified in the contract or order, marking shall be in accordance with MIL-STD-129.

5.4 Material Inspection and Receiving Report (Form DD-250). A form DD-250 shall be used as certification of Procurement Quality Assurance (PQA), packing list, and certification of acceptance. A separate DD-250 shall be prepared by the contractor for each shipping lot of 50 units (two shipping containers of 25 each). Each controller lot shall be listed by beginning and ending serial number as well as quantity on the form DD-250. Six copies of the signed DD-250 shall be submitted to the Contracting Officer.

APPENDIX A

Engineering Documents

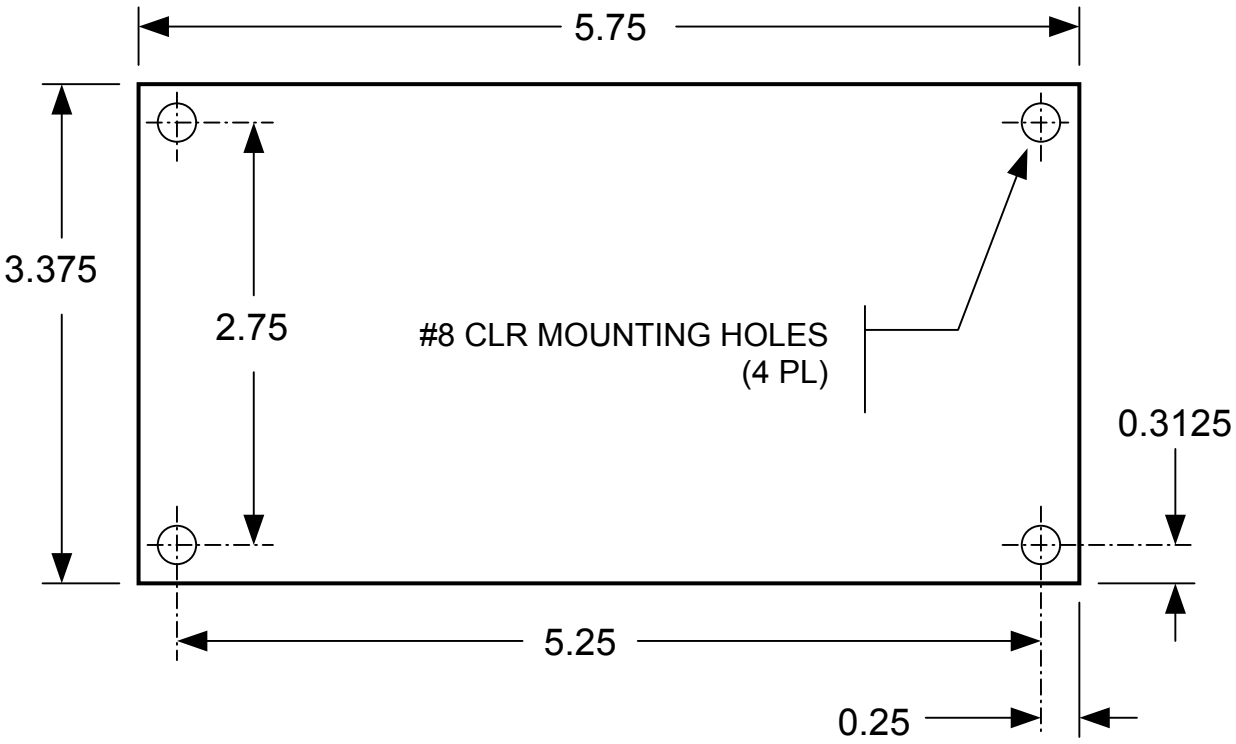


LOCATIONS OF R5, S1, S2, AND TPI ARE APPROXIMATE

ALL DIMENSIONS IN INCHES

SOLAR AID CONTROLLER III

PC BOARD ARRANGEMENT



ALL DIMENSIONS IN INCHES

SOLAR AID CONTROLLER III

BASE-PLATE

SOLAR AID CONTROLLER III

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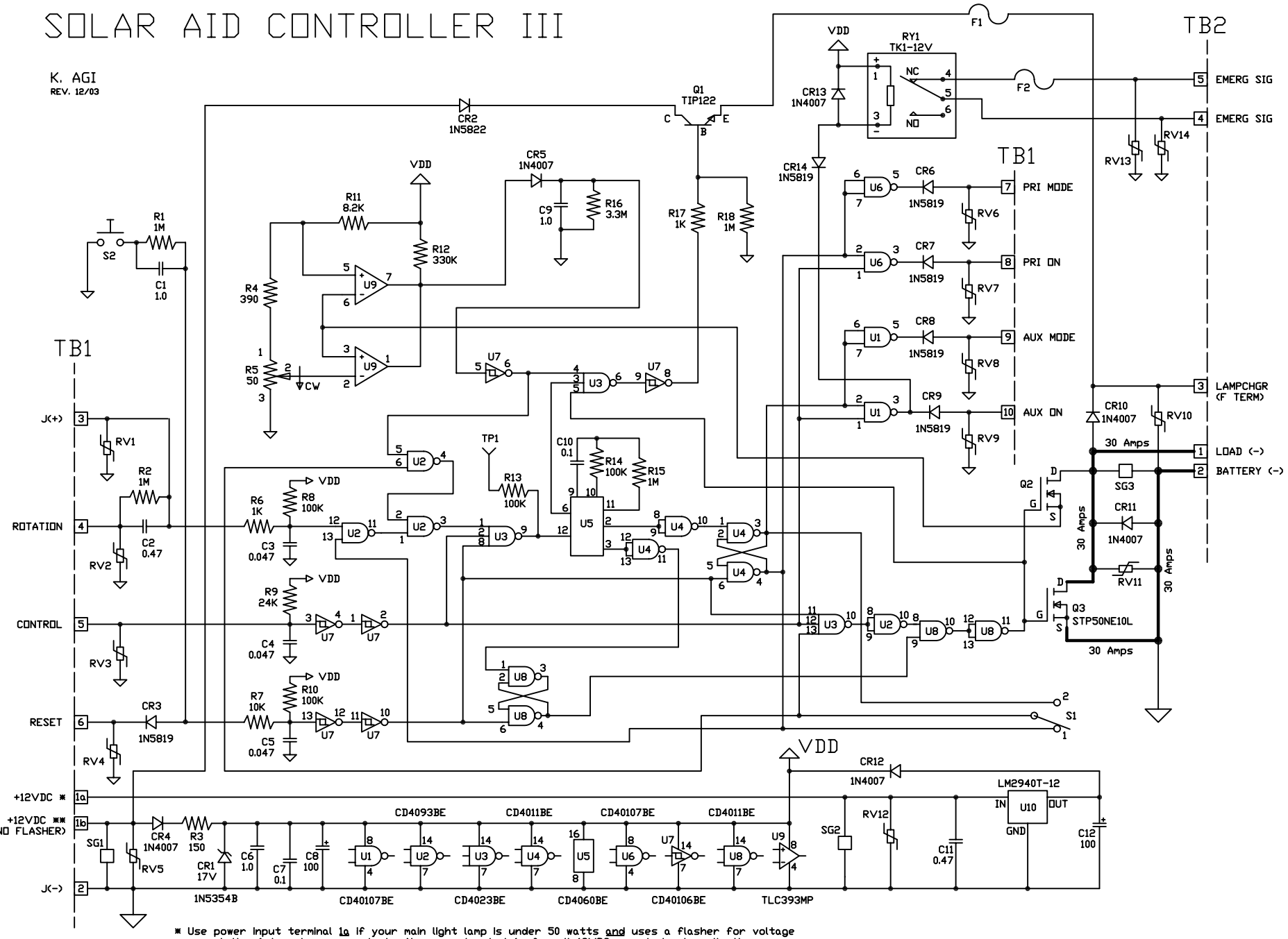

* Use power input terminal 1a if your main light lamp is under 50 watts and uses a flasher for voltage regulation & lampchanger control. Also, use terminal 1a for all 12VDC sound signal applications.

** Use power input terminal 1b if your main light lamp is 50 watts or higher and uses no flasher (in these cases, the SACIII operates the lampchanger).

SOLAR AID CONTROLLER III PARTS LIST

CKT SYMBOL	DESCRIPTION	MFGR	P/N
--	Base-plate	Fabricate	--
--	Printed Circuit Board	Fabricate	--
TB1	Terminal Block	Buchanan	3PCV-11-006
TB2	Terminal Block	Buchanan	8PCV-05-006
C1, C6, C9	Capacitor, 1.0uf	Sprague	2C20Z5U105M050B
C2, C11	Capacitor, 0.47uf	Sprague	2C37Z5U474M050B
C3–C5	Capacitor, 0.047uf	Sprague	1C25Z5U473M050B
C7, C10	Capacitor, 0.1uf	Philips	CW-20C104K
C8, C12	Capacitor, 100uf	Xicon/Mouser	140-ESRL50V100
CR1	Zener Diode, 17V, 5W	Motorola	1N5354B
CR2	Schottky Rectifier Diode, 3A	STMicroelectronics	1N5822
CR3, CR6–CR9, CR14	Schottky Rectifier Diode, 1A	STMicroelectronics	1N5819
CR4, CR5, CR10–CR13	Diode, 1A, 1KV PRV	Rectron	1N4007

All resistors in ohms:

R1, R2, R15, R18	Resistor, 1M, 0.25W, 5% tolerance		
R3	Resistor, 150, 2W, 5% tolerance		
R4	Resistor, 390, 0.25W, 1% tolerance, metal film, **±50 ppm/ºC** TC		
R5	Trimmer pot, 50 ohms, **±50 ppm/ºC** TC	Bourns	3290W
R6, R17	Resistor, 1K, 0.25W, 5% tolerance		
R7	Resistor, 10K, 0.25W, 5% tolerance		
R8, R10, R13, R14	Resistor, 100K, 0.25W, 5% tolerance		
R9	Resistor, 24K, 0.25W, 1% tolerance, metal film, **±50 ppm/ºC** TC		
R11	Resistor, 8.2K, 0.25W, 1% tolerance, metal film, **±50 ppm/ºC** TC		
R12	Resistor, 330K, 0.25W, 5% tolerance		
R16	Resistor, 3.3M, 0.25W, 5% tolerance		
RV1–RV4, RV6–RV9, RV13, RV14	Varistor, ZNR, 22V	Panasonic	ERZ-V07D220
RV5, RV10–RV12	Varistor, ZNR, 22V	Panasonic	ERZ-V10D220
SG1, SG2, SG3	Gas Tube Surge Arrestor	Xicon/Mouser	444-GT-90L
F1	PolySwitch Resettable Fuse	Raychem	RUE135
F2	PolySwitch Resettable Fuse	Raychem	RUE090
Q1	Transistor, Darlington, NPN	STMicroelectronics	TIP122

Q2 ……..	MOSFET, N-Channel ……	Vishay Siliconix …..	BS170
Q3 ……..	Power MOSFET, N-Channel …….	STMicroelectronics .	STP50NE10L
U1, U6 ……	Integrated circuit ……	Harris or National ……	CD40107BE
U2 ……..	Integrated circuit ……	Harris or National ……	CD4093BE
U3 ……..	Integrated circuit ……	Harris or National ……	CD4023BE
U4, U8 ……	Integrated circuit ……	Harris or National ……	CD4011BE
U5 ……..	Integrated circuit ……	Harris or National ……	CD4060BE
U7 ……..	Integrated circuit ……	Harris or National ……	CD40106BE
U9 ……..	Integrated circuit ……	Texas Instrument …….	TLC393MP
U10 ……	Voltage regulator ……...	National ……	LM2940T-12
S1 ……..	Switch, slide ……..	C&K ……	GS01MCKE
S2 ……..	Switch, pushbutton, N.O. ……..	AUGAT/Alcoswitch …	TSPD11CGPC2 (red button)
RY1 ……	Relay, miniature ……..…...	NAIS (Aromat) ……...	TK1-12V
J1 ……	Insulated wire, 1.5 inches long, 22 AWG, solid, blue		
TP1 …….	Test point, stainless steel, #4-40 machine screw, or gold-plated cup socket pin		
-- ……..	Misc. hardware …….	as required, stainless steel	

GENERAL SPECIFICATIONS

ELECTRICAL:

INPUT POWER:
- Separate 12VDC power inputs for regulated and unregulated loads
- 11 to 18-VDC at 20.0-ma max (15.0-ma typical), w/o CG6P Lampchanger connected and w/ground strapped to RESET or CONTROL
- 11 to 18-VDC at 1.2-amp max w/CG6P Lampchanger and w/no ground strapped to RESET or CONTROL
- High current ground

INPUTS: All inputs may be grounded safely at any time

- RESET (TB1-6): To primary mode
- CONTROL (TB1-5): For daylight or manual control
- ROTATION (TB1-4): Rotation detector (remove blue wire jumper (J1) between TB1-2 and TB1-3 when using the ROTATION detector input, e.g., in a rotating light system)

OUTPUTS:

POWER CONTROL:

- Primary: Ground side, open drain switch
- Max load: 25-A
- Voltage drop: 0.10-V at 5-Amp

EMERGENCY SIGNAL CONTROL:

Normally closed (NC) dry contact output to toggle emergency signal on and off depending on input signal at TB1-5, during aux mode of operation only

STATUS: Ground from open drain FET switch (ground true), 100-ma max each output

- PRI MODE: The primary aid is normal
- PRI ON: The primary aid is on
- AUX MODE: The primary aid has failed
- AUX ON: The auxiliary backup aid is on (also can be used to indirectly control the backup aid)

LAMPCHANGER CONTROL:

- Signal: 0.37-Hz $\pm$20% square wave
- Max load: 1.35-Amp

PHYSICAL:

Modular and expendable

Dimensions: 5.75" x 3.375" x 2.0" maximum

TB1: 11 terminals – For low-current power, control, and aid status signals
TB2: 5 terminals – For high-current primary load switching, lampchanger control, and emergency signal control

APPENDIX B

Final Electrical Test

SOLAR AID CONTROLLER III FINAL ELECTRICAL TEST PROCEDURE

1. INTRODUCTION

This test procedure is designed to test the controllers fabricated by commercial manufacturers under government contract. Although this entire procedure is required after potting, it may be used at the discretion of the contractor at any time. This procedure shall be performed after controller current adjustment is completed (3.7)

2. EQUIPMENT REQUIRED

- Digital Multimeter, Fluke 77 or equivalent with audible-continuity/diode-test mode
- 12-volt, 8-Amp DC power source
- 20-volt, 500-mA DC power source
- Jumper leads
- CMOS logic probe (optional)
- Resistive Load (e.g., lamp), 1.0-amp ±0.1-amp
- Resistive Load (e.g., lamp), 0.5-amp ±0.05-amp
- Resistive Load (e.g., lamp), 6.0-amp ±0.6-amp
- Hookup wire

3. OPERATING CURRENT

Set switch S1 to the "1" position. S1 shall remain in position "1" until procedure number 10 of this test. Ensure wire jumper J1 is installed between TB1-2 and TB1-3. Strap the CONTROL input terminal at TB1-5 to ground. Apply power to the controller. Make the positive DC power supply connection to the controller at **TB1-1b** and the negative connection at TB2-2. The connection at TB2-2 must be able to carry 6-amps in later sections of this test. Measure the operating current with 20-volts DC applied. Repeat measurement with 12-volts DC applied. The current with 20-volts DC applied shall be less than 20-mA. The current with 12-volts DC applied shall be less than 5-mA.

Repeat test with positive 12-volts DC connection to the controller at **TB1-1a**. The current with 20-volts DC applied shall be less than 20-mA. The current with 12-volts DC applied shall be less than 15-mA.

Leave 12-volt DC power applied to TB1-1a.

4. RESET & CONTROL

Disconnect ground strap at TB1-5. With logic probe at TB2-1, press the RESET switch S2 to reset the controller. TB2-1 should be logic lo after the reset. Momentarily ground the CONTROL input terminal (TB1-5). TB2-1 should float while the CONTROL terminal is grounded.

Now momentarily ground the RESET terminal (TB1-6). TB2-1 should float during the reset (i.e. while the RESET terminal is grounded) and go lo after reset. Ensure that TB2-1 returns to float (time-out) in 80 to 120 seconds after the final reset.

5. STATUS OUTPUTS

While still in the aux mode (timed-out), check for electrical continuity between TB2-4 and TB2-5 with the multimeter. Ensure a closed circuit (short) is observed when TB1-5 is grounded and an open circuit when ground is removed from TB1-5. With ground removed from TB1-5, use the logic probe to observe the states of all status outputs (TB1-7,-8,-9,-10) and use the multimeter to check electrical status between TB2-4 and TB2-5 after time-out (see previous step). Then, press the RESET switch S2 to reset the controller to primary mode and observe all outputs again, this time before time-out. Results should be as shown in the table below:

	BEFORE TIME-OUT	AFTER TIME-OUT
TB1-7	lo	floating
TB1-8	lo	floating
TB1-9	floating	lo
TB1-10	floating	lo
TB2-4/TB2-5	closed	open

6. CURRENT SENSOR

Connect a 1.5-amp load (the 1.0 and 0.5-amp loads in parallel) from +12-volts DC to TB2-1. Push the RESET switch S2 to reset the controller to the primary mode. After 120 seconds, the controller shall still be in primary mode. Remove the 0.5-amp load. Push the RESET switch S2. The controller shall switch to aux mode in 80 to 120 seconds. Restore the 0.5-amp load and push the RESET switch S2. Disconnect either end of jumper J1 from the terminal strip and let it float. The controller shall switch to aux mode in 80 to 120 seconds after disconnecting J1. Reconnect the floating end of J1 to its proper place and push the RESET switch S2 to reset the controller.

7. MOSFET VOLTAGE DROP

Measure the voltage drop across the Power MOSFET (Q3) at TB2-1 and TB2-2. It shall be less than 0.035-volts.

8. BURN IN

Remove the 1.5-amp load and connect the 6-amp load from +12-volts DC to TB2-1. Push the RESET switch S2 to ensure the controller is operating in the primary mode. After one hour the voltage drop across the Power MOSFET (Q3) at TB2-1 and TB2-2 shall be less than 0.15-volts. Remove the 6-amp load.

9. LAMPCHANGING SIGNAL

Disconnect 12-volt DC power from TB1-1a and reconnect to TB1-1b. Using hookup wire connect the (-) terminal of the CG6P lampchanger to TB2-1. Strap the CONTROL input terminal (TB1-5) to ground. Using hookup wire again, connect TB2-3 to the "F" terminal of the CG6P Lampchanger. Connect +12-volts DC to terminal "L" of the lampchanger. With the lampchanger set to its first position and 2.03-amp lamps set in positions 1, 3, and 5, remove ground strap from CONTROL input at TB1-5. Lamp 1 shall light up. Disrupt the +12-volt DC power going to lampchanger's "L" terminal for about six (6) seconds, simulating lamp failure. The lampchanger shall begin to ratchet after a delay of about four-and-one-half (4.5) seconds and continue to ratchet until the next good lamp is found (at position 3) and stop. With lamp 3 now lit, again disrupt power to the "L" terminal for about six (6) seconds. The lampchanger shall again ratchet until a good lamp is found (at position 5) and stop. With lamp 5 burning, disrupt power to terminal "L" again for about six (6) seconds. Since no good lamp will be found after position 5, the lampchanger shall ratchet to position 6 and keep attempting to ratchet there until the controller times-out and switches to aux mode in 80 to 120 seconds. Strap TB1-5 to ground then push S2 to reset the controller. Leave the lampchanger circuit intact, as it will be required for the next procedure, Auxiliary Signal Control.

10. AUX SIGNAL CONTROL

So far all testing has been done with switch S1 in the "1" position. This procedure requires S1 to be set in the "2" position. After setting S1 to position "2," reset the lampchanger and ensure the test circuit is connected to the controller as described in step 9. Push switch S2 to ensure the controller is in primary mode. Remove the ground strap from TB1-5. Nothing shall happen; i.e., the lamp in the lampchanger's first position shall not light up nor shall the lampchanger ratchet. The lamp and lampchanger shall have remained in this quiescent state even after 120 seconds. Disconnect either end of jumper J1 from the terminal strip TB1 and let it float. 80 to 120 seconds after disconnecting

J1, the controller shall switch to aux mode and lamp 1 shall light up. Disrupt the +12-volts DC going to lampchanger's "L" terminal for about six (6) seconds, simulating lamp failure. The lampchanger shall begin to ratchet after a delay of about four-and-one-half (4.5) seconds until the next good lamp is found (at position 3) and stop. With lamp 3 now lit, again disrupt power to the "L" terminal for about six (6) seconds. Lampchanger shall again ratchet until a good lamp is found (at position 5) and stop. With lamp 5 burning, momentarily disrupt power to terminal "L" again for about six (6) seconds. Since no good lamp will be found after position 5, the lampchanger shall ratchet to position 6 and keep attempting to ratchet there until the controller secures power in 160 to 240 seconds. Return switch S1 to position "1."

11. BASE-PLATE ISOLATION — Using the Digital Multimeter in the continuity test position, confirm that the base-plate is electrically isolated from the DRAIN pin of MOSFET Q3 (the tab of Q3 is internally connected to its DRAIN pin).