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DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150771

MASTER

SOLAR CONTROL DESIGN PACKAGE

Prepared from documents provided by

Solar Control Corporation
5595 Arapahoe Road
Boulder, Colorado 80302

Under Contract NAS8-32258 with

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy

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U.S. Department of Energy

Solar Energy

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15. SUPPLEMENTARY NOTES This work was done under the technical management of Mr. James Hankins, George C. Marshall Space Flight Center, Alabama.			
16. ABSTRACT This report contains information used in the evaluation of design of Solar Control's solar heating and cooling system controller and the Solarstat. Some of the information includes system performance specifications, design data brochures, and detailed design drawings. Slight modifications have been made for clarification only.			
17. KEY WORDS		18. DISTRIBUTION STATEMENT Unclassified-Unlimited <i>William A. Brooksbank Jr.</i> WILLIAM A. BROOKSBANK, JR. Mgr, Solar Heating and Cooling Project Office	
19. SECURITY CLASSIF. (of this report) Unclassified	20. SECURITY CLASSIF. (of this page) Unclassified	21. NO. OF PAGES 56	22. PRICE NTIS

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SUBSYSTEM PERFORMANCE SPECIFICATION

Specification No. SHC-3064

Page Date 3-9-77

Page _____ of _____

1.0 INTRODUCTION

This Performance Specification establishes the requirements for the design and performance of the subsystem. It designates the Interim Performance Criteria applicable to the subsystem and defines the deviations.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

See Appendix F

2.2 Contractor Documents

-Application Note 74-116 for Solar Heating and Cooling, 1974.

-Zia Four Mode Controllers - #75-140 and #75-160, 1975.

-Zia Modular Controllers - #75-170 Series, 1975.

-Zia #75-150 Solar Air Handling Moduls (SAM), 1975.

2.3 Other Documents

-Proceedings of the Solar Heating and Cooling For Buildings

Workshop, Part I: Technical Sessions, March 21 and 22, NSF/RA/N-73-004.

-Solar Heating Handbook For Los Alamos, LA-5967 May 1975.

3.0 APPLICATION OF INTERIM PERFORMANCE CRITERIA

The application of each paragraph of the Interim Performance Criteria to the subsystem is provided in the following table, Number 1.

4.0 DEVIATIONS FROM INTERIM PERFORMANCE CRITERIA

None

SUBSYSTEM PERFORMANCE SPECIFICATION

Specification No. SHC-3064

Page Date 3-9-77

Page _____ of _____

5.0 GOVERNMENT FURNISHED PROPERTY

None

6.0 GOVERNMENT DIRECTED REQUIREMENTS

7.0 SUBSYSTEM GENERAL SPECIFICATION AND FEATURES

The following _____ page delineates the general specifications and features of the Series 75-170, Modular-Control Subsystem.

Modular Controller Series 75-170

Table I

Residential subsystems: Interim Performance Criteria Summary

The following Interim Performance Criteria paragraphs are applicable:

- 1.7 Control
 - 1.7.1 Installation and Maintenance
 - 1.7.3 Inhabited Space Temperature
- 2.5 Subsystem Isolation
 - 2.5.1 Shutdown in Multi-Family Housing
- 4.1 Plumbing and Electrical Installation
 - 4.1.2 Electrical Codes
- 4.2 Fail-Safe Controls
 - 4.2.1 System Failure Prevention
- 5.2 Temperature and Pressure Resistance
 - 5.2.1 Thermal Degradation
- 6.1 Accessibility for Maintenance
 - 6.1.1 Access for System Maintenance
 - 6.1.2 Access for System Monitoring
- 6.2 Installation, Operation, and Maintenance Manual
 - 6.2.1 Installation Instructions
 - 6.2.2 Maintenance and Operation Instructions
 - 6.2.3 Maintenance Plan
 - 6.2.4 Replacement Parts
- 6.3 Repair and Service Personnel
 - 6.3.1 Maintenance of H and HC Systems
- 11.3.1 Material Compatibility

SCC 75-171 Solid State Solar Differential Controller

General Specifications:

1. Input Voltage:	Either 120 VAC $\pm$ 10 V or 24 VAC $\pm$ 4 V
2. Input Power:	3 watts (no-load)
3. Outputs	DPDT (3PDT available)
4. Output Current	10 amp (resistive) at 28 VDC or 120 VAC (higher ratings available)
5. Output Voltage	Either 120 VAC or 24 VAC
6. Sensors	Matched thermistors, (1°C over range from 0°C to + 100°C) in a metal housing with high temperature teflon leads
7. Differential Turnoff Offset	Typically 4°F $\pm$ 2° @ 100°F (can be custom adjusted by a resistor change)
8. Differential Turnon Offset	Typically 20°F $\pm$ 2° @ 100°F (can be custom adjusted by a resistor change)
9. Operating Temperature Range	Controller chassis: 0°F to 140°F
Sensors: -40°F to 300°F
10. Tracking Accuracy	$\pm$ 5°F over entire operating range
11. Isolation Protection	1500 V
12. Size	Basic Module about 4" x 4" x 3½"
13. Weight	Less than 2 lb.
14. Multichannel Priority	24 VAC interconnect logic
15. Mounting	Mount on "J" box or on wall or pump housing
16. Collector freeze protect (differential signal "on" typically; remote signal also available)	At 40°F $\pm$ 5°
17. Manual "on" Button	
18. Operating Light	100,000 hr. LED illuminates to indicate operation
19. Distribution Channel and Auxiliary Heater Control	For 75-172, 75-173 configuration
20. Multi-Tank Control	For 75-175 configuration

SOLID STATE SOLAR HOT WATER CONTROLLER

Model 77-171

Solid-State Solar Hot Water Controller

Description

The model 77-171 is a solid-state differential thermostat capable of fully controlling a solar hot water heating system. The unit is designed for a lifetime of maintenance free service, and incorporates freeze and boil protect circuitry.

Air and Water Probes

Air probes are available for clamp or screw mounting.

Water probes have 1/2" NPC thread, in lengths from 2 3/4" to 28".

115 VAC input, wire nut connection or 6' line cord

Specifications

Input Voltage	Either 120 VAC $\pm$ 10V or 24 VAC $\pm$ 4V.
Input Power	3 watts, no load.
Control Relay	SPDT, 10A. (resistive) at 28 VDC or 120 VAC. Higher ratings available.
Output Voltage	Either 120 VAC or 24 VAC.
Sensors	Matched thermistors, ($\pm$ 1°C over range from 0°C to +100°C) in a metal housing, with high temperature teflon leads.
Differential Turn-off Offset	Typically 4°F $\pm$ 2° @100°F, (can be adjusted by a resistor change).
Differential Turn-on Offset	Typically 20°F $\pm$ 2° @ 100°F, (can be adjusted by a resistor change).
Temperature Range	Controller chassis: -40°F to 140°F Sensors: -40°F to +300°F
Tracking Accuracy	$\pm$ 5°F over entire operating range.
Isolation Protection	1500 V
Size	4" $\times$ 4" $\times$ 3 1/2"
Weight	2 lbs.
Mounting	Mounts on 4" $\times$ 4" "J" box.

Wiring Diagram

Contact Solar Control Corporation
5595 Arapahoe Road
Boulder, CO 80302

for information on drawings which were unavailable for
publishing.

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BOULDER COLORADO

COPI IDENT NO 52060

SHEET

DOC NO: 10111

DATE

634

DR. ROBERT BACHMAN

171 62, 63 and 64 10/11/17

76-71

PREPARED BY D AUGUSTO

DRAWING BREAKDOWN

PAGE 2 OF 2

DATE _____

PROJECT 171 CONTROLLER (NASA)NUMBER 76-999

SIZE	DRAWING NUMBER	DRAWING LEVEL								DOCUMENT TITLE	EXPECTED RELEASE DATE	REMARKS
		1	2	3	4	5	6	7	8			
D	2816-A ✓	X								ΔT CONTROLLER ASSY	2/23/77	
C	2777-C			X						PWB AT	2/22/77	
C	2801-B		X							PWA AT	2/14/77	
D	2802			X						SILKSCREEN (PWA)	2/11/77	
C	2776-A									SCHEMATIC ΔT CONTROLLER	12/13/76	
C	2803									WIRING DIAGRAM 171	2/23/77	
	2804									" " 172		
C	2805A									" " 173	2/23/77	
	2806									" " 174		
D	2807									" " 175		
D	2817 ✓	X								MOD. CHASSIS BOX	2/23/77	
A	2816-LPL									PARTS LIST		
C	2790-A ✓	X								INTERNAL WIRING	3/7/77	
C	2764-B	X								ΔT CONTROLLER PROBE	12/10/76	
C	2763 ✓	X								PROBE HOUSING	12/4/76	
D	2835 ✓	X								BASE, BOX, 171 CONTROLLER	3/31/77	
A	2839 ✓									ΔT Test Procedure	4/4/77	
C	2876									Test Fixture	5/24/77	
C	2886 ✓									Relay Assembly	6/8/77	
										Prepared for:		
										SOLAR CONTROL CORP.		
										5595 ARAPAHOE ROAD		
										BOULDER COLORADO		

REVISION		DATE	APPROVED
1	1		
2	2		
3	3		
4	4		
5	5		
6	6		
7	7		
8	8		
9	9		
10	10		

ZIA ASSOCIATES INC. COLORADO	
171 AT CONTROLLER	
Installation	
2593	

171 ΔT CONTROLLER FIELD INSTALLATION DIAGRAM

TEST
BUTTON

RELAY WIRES

NC	RED / BLACK
COMMON	RED
NO	RED / WHITE
NC	BROWN / BLACK
COMMON	BROWN
NO	BROWN / WHITE
NC	ORG / BLACK
COMMON	ORG
NO	ORG / WHITE

TERM'S

1 BLU

2 YEL

FROM 24V AC
TRANSFORMER

3 AUX, OUTPUT

4 COLLECTOR PROBE

5 COMMON

6 STORAGE PROBE

4" X 4"
OUTLET BOX

1 SUPPLIED WITH ITEMS
2 OPTION-4 REPLACE RELAY #5X820 (ITEM 2) WITH RELAY #5X817
3 OPTION-5 TRANSFORMER INCLUDED IN ASSY.
4 FOR USE IN MODIFIED HONEYWELL BOX ONLY

REVISIONS			
ITEM	DESCRIPTION	DATE	APPROVED
A	DELETED ITEMS 7, 8, 9 INCREASED LENGTH OF CRT BOARD UNGR. RELAY	3/14/77	<i>[Signature]</i>

WIRE:					
20"	18 GA.	PVC	600V		ORANGE
11	17	11	11	11	RED
11	16	11	11	11	BAN
11	16	11	11	11	VELL
11	16	11	11	11	GRN
11	16	11	11	11	BLK
11	16	11	11	11	WHT

	I	10	[I]	COVER			MILITARY
	I	9		NUT, HEX	#6-32		
	I	8		STAND OFF		H.H. SMITH #297	
	I	7		B+ SCREW	#6-32-I		
	2	6	AD4MABS	POP RIVET			LBM
	I	5	2B-7	CHASSIS BOX, MND			
	I	4		D.H. SCREW	#6-32-7/8		
	I	3	2B01	1714T PWA			
	I	2	5X220	RELAY [2]			DAYTON WPA GEAR HONEY WELL
	I	1	AT20CAH23	TRANSFORMER [3]			
S/L	ITEM NO.	CODE IDENT.	PART NO.	DESCRIPTION	STOCK SIZE	WARRANTY DESCRIPTION	RATERAL SPECIFICATION

QTY PER PART		GOOD QUANTITY NUMBERED PARTS THROWN		PARTS LIST		EVER DATA NUMBERED PARTS APPROVED	
CONTRACT NO		APPROVED		DATE		ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED		PAPER BY <i>Samuel</i>		PS <i>20</i>		COLORADO	
DIMENSIONS ARE IN INCHES		DESIGNER					
TOLERANCES		GROUP ENG <i>20</i>		CHECKED		171 ΔT CONTROL	
XX .XX .XX						TOP ASSY	
XX .00 .010 .015							
BREAK ALL SHARP EDGES .005/.015		Prepared for					
MFG 12 15							
UNLESS NOTED OTHERWISE, FINISH		POLAR CONTROL CORP.		SIZE		CODE IDENT NO	
SURF STANDARDS 2000		100-101		D		52060	
BRASS PER PART		100-101		USED		2816	
SURFACE FINISHES		COLORADO					
EXCEPT AS NOTED							
APPLICATION							
PART NO		NEXT ASSY		USED ON			
SHEET NO		75-424					
MULTIPLE SHEETS							
REVISION							
SHEET NO							

2816	A	A
------	---	---

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

1. MATERIAL: 062 GLASS EPOXY 2 OZ SINGLE SIDE
2. TIN LEAD PER MIL-STD-275
3. FOIL SIDE SHOWN
4. SILKSCREEN PER ARTWORK 2800

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
B	CHANGED TERMINAL DESCRIPTIONS	2/28/77	DA
E	LENGTHENED BOARD ADDED PADS #3 AND #4	4/2/77	jal
D	Shear Marks Moved slightly Inward Changed Mounting note from 5/8" to #28	4/27/77	D.S.

SHEAR MARK TYP.
10 FLC.

DRILL CHART

REVISION	SHEET NO	PART NO	NEXT ASSY	USED ON	APPLICATION
1	2801	171			

ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE DESIGNATION ELEC DWS	MATERIAL SPECIFICATION
QTY PER ASSY			ODD DASH NUMBERED PARTS SHOWN	PARTS LIST	EVEN DASH NUMBERED PARTS OPPOSITE	
CONTRACT NO			APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED			PREP BY	4/2/77	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES TOLERANCES .XX .XXX .X" = .02 = .010 = .1"			DESIGNER	1/2/77	171 AT CONTROLLER	
BREAK ALL SHARP EDGES .005/.015 MIL-STD 12, 15 USASI Y32.16, B46.1, Y14.5 SHOP STANDARDS 2060 THREADS PER H-28 SURFACE FINISH 125 EXCEPT AS NOTED			GROUP ENG		PWB DRILL CHART	
CHECKED					SIZE	CODE IDENT NO
					C	52060
					2777	REV D
					SCALE 2/1	WT
					SHEET 1 OF 1	

1. TO DISABLE FADER PROTECT: CLIP OUT CR6
2. TO DISABLE BOM PROTECT: CLIP OUT CR5

TBI
TERMINAL STRIP

OPTION -1 (LED)

OPTION -2 (AUX FREEZE OUTPUT)

OPTION -3 (15 OPTIONS -1 & 2 TOGETHER)

			REVISION			
		I	SHEET NO	501	2816	76-934
MULTIPLE SHEETS REVISION STATUS				PART NO	NEXT ASS'Y	USED ON
				APPLICATION		

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

CONTRACT NO.		APPROVED	DATE	 ZIA ASSOCIATES INC. BOULDER, COLORADO 171 AT CON... PWA SIL... 52060
UNLESS OTHERWISE SPECIFIED		DESIGNER		
DIMENSIONS ARE IN INCHES		GROUP ENG		
TOLERANCES		CHK		
REVISION SHEET NO. 1 of 2		APPLICATION		D 52060

1. CRYSTAL BALL FOR BOOK CONTROL OPTION
2. CRYSTAL BALL FOR BOOK CONTROL OPTION
3. CRYSTAL BALL FOR BOOK CONTROL OPTION
4. CRYSTAL BALL FOR BOOK CONTROL OPTION
5. CRYSTAL BALL FOR BOOK CONTROL OPTION

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY PER ASSY		ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION HYPODEX PPM/ALUMINUM 2000 FOR	ELECTRONIC COMPONENTS
000 DASH NUMBERED PARTS SHOWN		PARTS LIST		EVEN DASH NUMBERED PARTS OPPOSITE				
CONTRACT NO		APPROVED		DATE		ZIA ASSOCIATES INC		
UNLESS OTHERWISE SPECIFIED		DESIGNER		J. Dalton		3/23/77		BOULDER COLORADO
DIMENSIONS ARE IN INCHES TOLERANCES .XX .XXX X" = .02 = .010 = 1"		GROUP ENG		CHECKED		171 Wiring Diagram		
BREAK ALL SHARP EDGES .006/.015 MIL STD 12, 15 USARI Y22, 16, 846.1, Y14.5 SHOP STANDARDS 2060 THREADS PER N-38 SURFACE FINISH 125 EXCEPT AS NOTED		Prepared for:		SOLAR CONTROL CORP.		8595 ARAPAHOE ROAD FOURTEEN COLORADO		
REVISION		SIZE		CODE IDENT NO		2803		
I SHEET NO		C		52060		2803		
MULTIPLE SHEETS REVISION STATUS		PART NO		NEXT ASSY		USED ON		
APPLICATION								

GENERAL NOTE: UNLESS OTHERWISE SPECIFIED.

REVISIONS			
LT	DESCRIPTION	DATE	APPROVED

ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION <small>(REFERENCE IDENTIFICATION FILE NO)</small>	MATERIAL SPECIFICATION
QTY PER ASBY						
ODD DASH NUMBERED PARTS SHOWN						
EVEN DASH NUMBERED PARTS OPPOSITE						
CONTRACT NO			APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED			PREP BY <i>SW</i>	9/1/77	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES			DESIGNER			
TOLERANCES			GROUP ENG			
.XX ±.02			CHECKED			
.XXX ±.010			Prepared for:			
K ±.1"			SOLAR CONTROL CORP.	SIZE C	CODE IDENT NO 52060	REV NC
BREAK ALL SHARP EDGES .005/.015			5595 ARAPAHOE ROAD	SCALE NONE	WT	
MIL-STD 12.15			BOULDER COLORADO	SHEET 1 OF 1		
USASI Y32.16, 846.1, Y14.5						
SHOP STANDARDS 2060						
THREADS PER N-29						
SURFACE FINISH 125						
EXCEPT AS NOTED						

REVISION	SHEET NO	PART NO	NEXT ASBY	USED OR	APPLICATION
	76-934				
MULTIPLE SHEETS REVISION STATUS					

172 WIRING DIAGRAM
171 CONTROLLER

2804

REV NC

2804

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADDED "171 CONTROLLER" DESIGNATION	5/30/77	JAL

QTY PER ASSY	ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION SPECIFICATION REFERENCE	MATERIAL SPECIFICATION
000 DASH NUMBERED PARTS SHOWN				PARTS LIST			
				EVEN DASH NUMBERED PARTS OPPOSITE			

CONTRACT NO		APPROVED		DATE	
UNLESS OTHERWISE SPECIFIED		J. Dutton		2/23/77	
DIMENSIONS ARE IN INCHES		DESIGNER			
TOLERANCES		GROUP ENG J. S. PROWERS		3/10/77	
XX .02		XXX .010		Z" .1"	
BREAK ALL SHARP EDGES .005/.015		CHECKED			
MIL-STD 12, 15		Prepared for			
USASI Y32.16, B46.1, Y14.5		SOLAR CONTROL CORP		SIZE	
SHOP STANDARDS		5575 ARAPAHO ROAD		CODE IDENT NO	
THREADS PER N-28		BOULDER		C 52060	
SURFACE FINISH 125 EXCEPT AS NOTED		COLORADO		2805	
				A	

REVISION	SHEET NO	PART NO	NEXT ASSY	USED ON	APPLICATION
	1			76-934	

MULTIPLE SHEETS
REVISION STATUS

ZIA ASSOCIATES INC			
BOULDER COLORADO			
173 Wiring Diagram			
SCALE	NONE	WT	
SHEET 1 OF 1			

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

SYMLOG 21642-1

① 1940年12月10日，毛泽东在《论政策》中提出，在统一战线中，要实行发展进步势力，争取中间势力，孤立顽固势力的政策。

REVISIONS			
REV	DESCRIPTION	DATE	BY
A	CHANGE DIMENSION		
B	CHANGE OF DIM 1.50		
C	CHANGE LOCATION OF 1.50 HOLE

				-1 MOD. CHASSIS BOX					
		ITEM NO	CODE IDENT	PART NO	DESCRIPTION	STOCK SIZE	MATERIAL DESCRIPTION		MATERIAL SPECIFICATION
								REFERENCE DRAWING(S) FILE NO.	
QTY PER ASST		QTY EACH NUMBERED PARTS SHOWN				PARTS LIST		EVEN EACH NUMBERED PARTS SPECIFIC	
		CONTRACT NO		APPROVED		DATE		ZIA ASSOCIATES INC.	
		UNLESS OTHERWISE SPECIFIED		PRY BY <i>Sammy J.W.</i>		7/2/64		BOUADER COLORADO	
		DIMENSIONS ARE IN INCHES		DESIGNER		171 CONTROLLER		MODIFIED	
		TOLERANCES		GROUP ENG		S. SPANWALL		CHASSIS BOX	
		.001		.010		.015			
		.003		.010		.015			
		BREAT ALL SHARP EDGES		ROUND R13					
		W. 610 12. 15							
		CHASSIS 722.15, 240. 1, 110.5							
		W/OP STANDARDS		1000					
		THROUGHS PAN IN 20							
		SURFACE FINISH LVS		✓					
		EXCEPT AS NOTED							
		REVISION		Prepared for:					
		SHEET NO		501		2814		76-934	
		PART NO		NEXT ASST		USE ON			
		APPLICATION							
		SOLAR CONTROL CORP.		DISE		CODE IDENT NO		K/P	
		5102 AIRPACER BOARD		B		2 5066D		2817	
		EVALUATOR		COLORADO		SCALE		2 1/2"	
								SHEET 1 OF 1	

APPLICATION			REVISIONS			
PART NO	NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
			B.	CHANGED FORECAST & ADDED	4/4/77	DL
			C	ADDED WIRE	9/11/77	DL
			D	R14 WAS 15 6.98K 100	4/4/77	DL
			E	R19, 20 were 4.7 K	4/27/77	D. S.
			F	REMOVED ON NEW FORM	9/29/77	DL

Prepared for:

SOLAR CONTROL CORP.

5595 ARAPAHOE ROAD
BOULDER COLORADO

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES		RELIABILITY	ZIA ASSOCIATES INC. BOULDER COLORADO		
.XX	.XXX	MAT'L & PROC			
±	±.010	QTY/ENG			
CONTRACT NO		DESIGNER			
		CHECKED			
		PREP BY	171 PARTS LIST		
EMC			SIZE	CODE IDENT NO	2816 - PL/F
WEIGHTS			A	52060	
STRESS			SCALE	NA	SHEET 1/5
THERMAL

FROM	TO	LUG
RLY1-A	PWA-E1	---
RLY1-B	PWA-E2	---
RLY1-1	9"RED/BLK LEAD	---
RLY1-2	9"OR/BLK LEAD	---
RLY1-3	9"BR/BLK LEAD	---
RLY1-4	9"RED/WH LEAD	---
RLY1-5	9"OR/WH LEAD	---
RLY1-6	9"BR/WH LEAD	---
RLY1-7	9"RED LEAD	---
RLY1-8	9"ORANGE LEAD	---
RLY1-9	9"BR LEAD	---
T1-BLUE	AC TERMINAL	SPADE
T2-YELLOW	AC TERMINAL	SPADE
T3-BLACK	---	---
T4-WHITE	---	---

REVISION	SHEET NO	171
1	---	---
MULTIPLE SHEETS	REVISION STATUS	APPLICATION
PART NO	NEXT ASSY	USED ON

ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE DIMENSIONS (LX WX H)	MATERIAL SPECIFICATIONS
QTY PER ASSY						
ODD DASH NUMBERED PARTS SHOWN						
PARTS LIST						
EVEN DASH NUMBERED PARTS OPPOSITE						
CONTRACT NO			APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED			PREP BY	9/7/72	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES			DESIGNER		171 AT CONTROLLER	
TOLERANCES			GROUP ENG		INTERNAL WIRING	
.XX .XXX X"			CHECKED			
.02 .010 .01"			Prepared for:			
BREAK ALL SHARP EDGES .005/.015			SOLAR CONTROL CORP.	SIZE	CODE IDENT NO	ASW
MIL-STD 12.15			5595 ARAPAHOE ROAD	C	52060	2790 A
USASI Y32.14, 844.1, Y14.5			BOULDER COLORADO	SCALE	2/1	WT
SHOP STANDARDS 2200						
THREADS PER AS-20						
SURFACE FINISH 125						
EXCEPT AS NOTED						
SHEET 1 OF 1						

2790 A

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

- 1 FENWAL ELECTRONICS FRAMINGHAM, MASS.
- 2 POT PROBE INTO HOUSING WITH CASTALL 301 RESIN. CURE WITH RT-7 CATALYST AT 25°C FOR 24 HRS.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADD DET-503	2/1/72	Samuel
B	ADD DESCRIPTION TO DETAIL A ADD NOTE 2.	3/30/72	pd

DETAIL A
PRE - STRIP DIM. TYP.

THERMISTOR DETAIL

1	-	6		UUT-35-J1	THERMISTOR				
-	1	5		UUT-43-J1	THERMISTOR				
1	1	4			HEAT SHRINK	3/16 X 5/8			
1	1	3			HEAT SHRINK	3/32 X 3/8			
+	1	2		2763-1	HOUSING				
T	1	1			TWISTED PAIR TEFLON INSUL WIRE	22 GA X 24"			
503	501		ITEM NO.	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE IDENTIFICATION ETC. NO.	MATERIAL SPECIFICATION

CONTRACT NO		APPROVED		DATE		ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED		PREP BY Samuel J.W.		2/1/72		BOULDER COLORADO	
DIMENSIONS ARE IN INCHES TOLERANCES .XX .XX .XX .XX .02 .010 .010 .010		DESIGNER		GROUP ENG		CHECKED	
BREAK ALL SHARP EDGES .005/.015 MIL-STD 12, 15 USASI Y32.16, B46.1, Y14.5 SHOP STANDARDS 2040 THREADS PER N-28 SURFACE FINISH 125 EXCEPT AS NOTED		Prepared for:		SOLAR CONTROL CORP.		5575 ACAPANOE ROAD COLORADO	
REVISION 503		SHEET NO 501		SIZE C		CODE IDENT NO 52060	
MULTIPLE SHEETS REVISION STATUS		APPLICATION		2764		REV B	

2764 B

2713

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

1. .50 FLANGE BEND FROM MAIN BODY OR MAKE SEPARATELY WITH FLANGES AND SPOT WELD ON.

REVISIONS			
LT#	DESCRIPTION	DATE	APPROVED

BB

ITEM		CODE	REVISION	PART NO	DESCRIPTION	STOCK SIZE	QUANTITY	APPROVED	DATE
1		001	1	001	BASE BOX	16 GA	1		
2		002	1	002	FLANGE	16 GA	1		
3		003	1	003	FLANGE	16 GA	1		
4		004	1	004	FLANGE	16 GA	1		
5		005	1	005	FLANGE	16 GA	1		
6		006	1	006	FLANGE	16 GA	1		
7		007	1	007	FLANGE	16 GA	1		
8		008	1	008	FLANGE	16 GA	1		
9		009	1	009	FLANGE	16 GA	1		
10		010	1	010	FLANGE	16 GA	1		
11		011	1	011	FLANGE	16 GA	1		
12		012	1	012	FLANGE	16 GA	1		
13		013	1	013	FLANGE	16 GA	1		
14		014	1	014	FLANGE	16 GA	1		
15		015	1	015	FLANGE	16 GA	1		
16		016	1	016	FLANGE	16 GA	1		
17		017	1	017	FLANGE	16 GA	1		
18		018	1	018	FLANGE	16 GA	1		
19		019	1	019	FLANGE	16 GA	1		
20		020	1	020	FLANGE	16 GA	1		
21		021	1	021	FLANGE	16 GA	1		
22		022	1	022	FLANGE	16 GA	1		
23		023	1	023	FLANGE	16 GA	1		
24		024	1	024	FLANGE	16 GA	1		
25		025	1	025	FLANGE	16 GA	1		
26		026	1	026	FLANGE	16 GA	1		
27		027	1	027	FLANGE	16 GA	1		
28		028	1	028	FLANGE	16 GA	1		
29		029	1	029	FLANGE	16 GA	1		
30		030	1	030	FLANGE	16 GA	1		
31		031	1	031	FLANGE	16 GA	1		
32		032	1	032	FLANGE	16 GA	1		
33		033	1	033	FLANGE	16 GA	1		
34		034	1	034	FLANGE	16 GA	1		
35		035	1	035	FLANGE	16 GA	1		
36		036	1	036	FLANGE	16 GA	1		
37		037	1	037	FLANGE	16 GA	1		
38		038	1	038	FLANGE	16 GA	1		
39		039	1	039	FLANGE	16 GA	1		
40		040	1	040	FLANGE	16 GA	1		
41		041	1	041	FLANGE	16 GA	1		
42		042	1	042	FLANGE	16 GA	1		
43		043	1	043	FLANGE	16 GA	1		
44		044	1	044	FLANGE	16 GA	1		
45		045	1	045	FLANGE	16 GA	1		
46		046	1	046	FLANGE	16 GA	1		
47		047	1	047	FLANGE	16 GA	1		
48		048	1	048	FLANGE	16 GA	1		
49		049	1	049	FLANGE	16 GA	1		
50		050	1	050	FLANGE	16 GA	1		
51		051	1	051	FLANGE	16 GA	1		
52		052	1	052	FLANGE	16 GA	1		
53		053	1	053	FLANGE	16 GA	1		
54		054	1	054	FLANGE	16 GA	1		
55		055	1	055	FLANGE	16 GA	1		
56		056	1	056	FLANGE	16 GA	1		
57		057	1	057	FLANGE	16 GA	1		
58		058	1	058	FLANGE	16 GA	1		
59		059	1	059	FLANGE	16 GA	1		
60		060	1	060	FLANGE	16 GA	1		
61		061	1	061	FLANGE	16 GA	1		
62		062	1	062	FLANGE	16 GA	1		
63		063	1	063	FLANGE	16 GA	1		
64		064	1	064	FLANGE	16 GA	1		
65		065	1	065	FLANGE	16 GA	1		
66		066	1	066	FLANGE	16 GA	1		
67		067	1	067	FLANGE	16 GA	1		
68		068	1	068	FLANGE	16 GA	1		
69		069	1	069	FLANGE	16 GA	1		
70		070	1	070	FLANGE	16 GA	1		
71		071	1	071	FLANGE	16 GA	1		
72		072	1	072	FLANGE	16 GA	1		
73		073	1	073	FLANGE	16 GA	1		
74		074	1	074	FLANGE	16 GA	1		
75		075	1	075	FLANGE	16 GA	1		
76		076	1	076	FLANGE	16 GA	1		
77		077	1	077	FLANGE	16 GA	1		
78		078	1	078	FLANGE	16 GA	1		
79		079	1	079	FLANGE	16 GA	1		
80		080	1	080	FLANGE	16 GA	1		
81		081	1	081	FLANGE	16 GA	1		
82		082	1	082	FLANGE	16 GA	1		
83		083	1	083	FLANGE	16 GA	1		
84		084	1	084	FLANGE	16 GA	1		
85		085	1	085	FLANGE	16 GA	1		
86		086	1	086	FLANGE	16 GA	1		
87		087	1	087	FLANGE	16 GA	1		
88		088	1	088	FLANGE	16 GA	1		
89		089	1	089	FLANGE	16 GA	1		
90		090	1	090	FLANGE	16 GA	1		
91		091	1	091	FLANGE	16 GA	1		
92		092	1	092	FLANGE	16 GA	1		
93		093	1	093	FLANGE	16 GA	1		
94		094	1	094	FLANGE	16 GA	1		
95		095	1	095	FLANGE	16 GA	1		
96		096	1	096	FLANGE	16 GA	1		
97		097	1	097	FLANGE	16 GA	1		
98		098	1	098	FLANGE	16 GA	1		
99		099	1	099	FLANGE	16 GA	1		
100		100	1	100	FLANGE	16 GA	1		

ZIA ASSOCIATES INC.	
BASE BOX 171	
CONTROLLER	
REV	2835
D	33060

171 ΔT		DATE		APPROVED	

CONSISTS OF:

1) COVER SHEET

2) SHEETS 1 of 2
 2 of 2

3) TITLE PAGE

ZIA ASSOCIATES INC.		COLORADO	
76-171 ΔT DIFFERENTIAL TEMP.			
CONTROLLER, TEST PROCEDURE			
D.J.		2839	
L.J.		N/A	
		COVER

Note

For SPDT Omit 2,3,5,6,8,9

For DPDT Omit 2,5,8

For 3PDT Omit No wires

16 GA. 10"

PIN	COLOR	STRIP	CNTS
1	RED	BLACK	NC
2	BROWN	"	"
3	ORG	"	"
4	RED	WHITE	NO
5	BROWN	"	"
6	ORG	"	"
7	RED	NO	COMM.
8	BROWN	"	"
9	ORG	"	"

REVISION	SHEET NO
1	1

MULTIPLE SHEETS
REVISION STATUS

PART NO. NEXT ASSY. USED ON
APPLICATION

ITEM NO.	CODE IDENT	PART NO.	NOMENCLATURE	STOCK SIZE
QTY PER ASSY. 000 DASH NUMBERED PARTS SHOWN PARTS LIST				
CONTRACT NO.			APPROVED	DATE
UNLESS OTHERWISE SPECIFIED			PREP BY DOUG R.	
DIMENSIONS ARE IN INCHES			DESIGNER	
TOLERANCES			GROUP ENG	
XX ± .02			CHECKED D. S.	6/4/77
XXX ± .010				
X' ± 1"				
BREAK ALL SHARP EDGES .005/.015				
MIL-STD 12, 15				
USASI Y32.16, B46.1, Y14.5				
SHOP STANDARDS 2060				
THREADS PER N-28				
SURFACE FINISH 125				
EXCEPT AS NOTED ✓				
ZIA ASSOCIATES INC.			171 AT Controls Relay Assembly	
SIZE C	CODE IDENT NO 52060	2886		
SCALE	WT	LIMIT 1

SOLARS .A. SOLID STATE SOLAR SYSTEM MONITOR

Model 77-180

Solid State Solar System Monitor

Description

The model 77-180 is a solid state temperature and system function monitor that provides the homeowner with accurate outdoor, indoor, collector and storage temperature readings.

The outdoor temperature is continuously indicated by a 0.3 inch liquid crystal display. Collector and storage temperatures may be selected by depressing the appropriate button. The control thermostat provides room temperature as well as two stage signals to the home's solar and back-up heating system.

The solar heating system's current mode of operation is indicated by three light emitting diodes which give a bright red indication of solar collecting, solar distribution, or back-up heating function.

The Solarstat uses less than 10 watts at 24 VAC and is compatible with all conventional HVAC equipment.

Specifications

Input voltage	24 VAC $\pm$ 20%.
Input power	10 watts maximum.
Temperature sensors	Diodes, linear from -40° to $+199^{\circ}$ F.
Displays	Temperature—0.3 inch liquid crystal, 3 digits plus (-) sign. Mode of operation—3 light emitting diodes.
Display range	Temperature— -40° to $+199^{\circ}$ F.
Accuracy	$\pm 0.5\%$ one count on least significant digit.
Measurement points	Outdoor, collector, storage and room.
Thermostat	Two stage heating. Optional: two stage heating, one stage cooling and fan on/off.
Solarstat operating temperature	32° to 120° F.
Size	8" x 7 $\frac{1}{4}$ " x 2 $\frac{1}{8}$ ".
Weight	2 lbs.

APPLICATION			REVISIONS			
PART NO	NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES .XX ± .XXX ±1° ± .010 ±1°		RELIABILITY MATL & PROC GROUP ENG DESIGNER CHECKED PREP BY	ZIA ASSOCIATES INC. BOULDER COLORADO
CONTRACT NO			DRAWING BREAKDOWN, SOLAR-STAT (NASA)
EMC			SIZE A
WEIGHTS			CODE IDENT NO 52060
STRESS			SCALE
THERMAL			SHEET 1 OF 2

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES

XX XXX X
010 .1

CONTRACT NO.

REVISION	
DATE	
DESCRIPTION	
BY	
CHECKED	
APPROVED	

DOUG R

ZIA ASSOCIATES INC.

BOLDER

COLORADO

SOLARSTAT FIELD
INSTALLATION DIAGRAM

CONTRACT NO.
50000

2594

SOLARSTAT FIELD INSTALLATION DIAGRAM

SOLARSTAT REAR TERMINATIONS

"J" CONNECTOR	INTERFACE
J1	24 V AC
J2	24 V AC
J3	GROUND
J4	STORAGE PROBE
J5	STORAGE PROBE NEG.
J6	COLLECTOR PROBE
J7	COLLECTOR PROBE NEG.
J8	NORMAL PROBE
J9	NORMAL PROBE NEG.
J10	SOLAR COLLECTING RELAY- 24 V AC OR POS DC
J11	SOLAR COLLECTING RELAY- 24 V AC OR NEG DC
J12	SOLAR HEATING RELAY 24 V AC OR POS DC
J13	SOLAR HEATING RELAY 24 V AC OR NEG DC
J14	CONVENTIONAL HEATING RELAY-24 V AC OR POS DC
J15	CONVENTIONAL HEATING RELAY-24 V AC OR NEG DC

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

1. FINISH: IRRIDITE, GOLD PAINT

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADD NOTE 1	4/2/77

	SIZE	QTY
A	.249 .255	2
B	.212 .218	3
C	#6-32-UNC	5
D	.50	1
E	.156 DIA. .38X.45X.5	2

ITEM NO.		CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
QTY PER ASSY		000 DASH NUMBERED PARTS SHOWN		PARTS LIST		EVEN DASH NUMBERED PARTS OPPOSITE	
CONTRACT NO				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				DESIGNER		BOULDER COLORADO	
DIMENSIONS ARE IN INCHES				GROUP ENG		FRONT PANEL	
TOLERANCES				CHECKED		SOLARSTAT	
XX .02				XXX .010	X* .1		
BREAK ALL SHARP EDGES 005/.015				Prepared for:			
WH. STD 12, 15				SOLAR CONTROL CORP.	SIZE	CODE IDENT NO	
USASI Y32.16, B46.1, Y14.5				5595 ARAPAHOE ROAD	C	52060	2791 A
SHOP STANDARDS 2060				BOULDER COLORADO	SCALE	1/1	WT
THREADS PER H-28							
SURFACE FINISH 125							
EXCEPT AS NOTED							

REVISION	SHEET NO	PART NO	NEXT ASSY	USED OR	APPLICATION
-1	2890	76-937			

MULTIPLE SHEETS
REVISION STATUS

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTANCE IN OHMS & CAPACITANCE IN μF .
2. U10 Y5 SMT 16A HIGH VOLTAGE OUTPUT O.C. HEX INV.
3. NUMBERS IN PARENTESIS ARE BOARD INTERCONNECTIONS
4. IS NEAREST TERMINAL BOARD

C	R11 WAS 100K J NCS REVISED R21, 22, 23, CR1, 2, 3, PUT IN OTHER LEAD	4/26/77	D.J.
D	R20 WAS 82.2K R9 WAS 10K	5/13/77	JAL

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADDED VALUE TO R19 ADDED "SCHEMATIC" TO TITLE BLOCK	3/30/77	JAL
B	R18 WAS 27K 1518K, R19 WAS 5K 1533K R20 WAS 27K 1518K, ADD NOTE 3 & 4 CR1, CR2, CR3 ESP7 DELAYED. ADD R23, R24, R25, 330K	4/2/77	JAL

QTY PER ASSY	TEMP NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
CONTRACT NO				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				DESIGNER	DATE	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES				GROUP ENG. J. SPANGLS	DATE	SOLAR/AT DIGITAL TEMP DISPLAY	
TOLERANCES				CHECKED	DATE	SCHEMATIC	
EX. .02 .010 .1"				DATE	DATE		
BREAK ALL SHARP EDGES				SOLAR CONTROL CORP		SIZE	CODE IDENT NO
MIL STD 12.15				SOLAR/AT DIGITAL TEMP DISPLAY		C	52060
USASI Y32.16 B46.1 Y14.5				SOLAR/AT DIGITAL TEMP DISPLAY		2772	REV.
SHOP STANDARDS				SOLAR/AT DIGITAL TEMP DISPLAY		2772	0
THREADS PER N28				SOLAR/AT DIGITAL TEMP DISPLAY		2772	0
SURFACE FINISH 125				SOLAR/AT DIGITAL TEMP DISPLAY		2772	0
EXCEPT AS NOTED				SOLAR/AT DIGITAL TEMP DISPLAY		2772	0

4-RW 2/1/77	1	REVISION
	1	SHEET NO

PART NO	NEXT ASSY	USED ON

APPLICATION

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED
 1. MATERIAL - 0.63 GLASS EPOXY 2 OZ COPPER
 2. ALL HOLES PLATED THRU
 3. TIN/LEAD PER MIL-STD 275

REVISIONS			
NO.	DESCRIPTION	DATE	BY
3	REVISED L23	7/2/66	✓

ZIA ASSOCIATES INC.
 BOULDER, COLORADO
 A 6052

3 #26 18 #44 6 #65 1 #26 38 #65 8 #65 15 #65
 33 #65

ITEM NO.		CODE IDENT	PART NO.	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE DESIGNATION ELEC. ENG.	MATERIAL SPECIFICATION
QTY PER ASSY		ODD DASH NUMBERED PARTS SHOWN			PARTS LIST		
CONTRACT NO.		APPROVED		DATE	ZIA ASSOCIATES INC.		
UNLESS OTHERWISE SPECIFIED		PREP BY			BOULDER COLORADO		
DIMENSIONS ARE IN INCHES TOLERANCES XX .02 XXX .010 X* .1*		DESIGNER			PWB - DRILL CHART		
BREAK ALL SHARP EDGES MIL STD 12, 13 USASI Y32 16, B46 1, 114 5 SHOP STANDARDS 2060 THREADS PER INCH SURFACE FINISH 175 EXCEPT AS NOTED		GROUP ENG. J. SPADWIS		5/2/66	SERIES 1, SERIAL 1		
REVISION		CHECKED			SIZE CODE IDENT NO.		
1 SHEET NO.		Prepared for			C 52060 2750		
MULTIPLE SHEETS REVISION STATUS		PART NO.		USED ON	REV B		
APPLICATION		EQUIPMENT			SCALE WT SHEET 1 OF 1		

Technical drawing of a component, likely a LED. The drawing shows a rectangular component with a rounded end. A dimension line indicates a length of .69. Below the component, the text "LED 1-3" and "MV5053" is printed.

SECTION A A

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVERSED DIRECTION OF "B" ARROWS ADDED VALUE TO R19	3/10/77	gml
B	REVERSED NOTATION OF DL 207 THREE PLACES R18 WAS 2 IN 15 33K R18 WAS 2.7K 15 18K C3 WAS .05UF 15 01UF	4/2/77	gml
FLAT ON BOARD			
C	R11 WAS 100K	5/13/77	gml

				PWA			
		ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION STANDARD SPECIFICATION
QTY PER ASST		QDD DASH NUMBERED PARTS SHOWN				PARTS LIST	
		CONTRACT NO				ZIA ASSOCIATES INC.	
		UNLESS OTHERWISE SPECIFIED				SOLARSTAT COLORADO	
		DIMENSIONS ARE IN INCHES				SOLARSTAT	
		TOLERANCES				PWA READOUT	
		XX .003 N"					
		.02 .010 .1"					
		STAKE ALL SHARP EDGES .006/.015					
		DIN 478 12, 15					
		STAKE 132.10, 144.1, 114.5					
		SHOP STANDARDS 1000					
		TOLERANCES PER A-36					
		SURFACE FINISH 125					
		CHECKED AS NOTED ✓					
REVISION		APPROVED				DATE	
1 SHEET NO		PREP BY				7/29/71	
501 2788 76-937		DESIGNED					
		GROUP ENG				3/14/71	
		CHECKED					
		Prepared for					
MULTIPLE SHEETS REVISION STATUS		SOLAR CONTROL CORP.				SIX CODE IDENT NO	
		EYES AIRSPACE ROAD				C 52040	
		COULDES COLORADO				2796 C	
		APPLICATION					

APPLICATION			REVISIONS		
PART NO	NEXT ASS Y	USED ON	LTR	DESCRIPTION	DATE
			A	ADDED DESCRIPTION TO R19	3/30/77
			B	DELETE CR 8, CR 9, CR 10 ADD R29, R30, R31 3.3K CHANGE R20 FROM 27K TO 82K CHANGE R26, 27, 28 FROM 72PK TO 72PK R100 R18 WAS 27K IS 18K R8 WAS 56K IS 33K	4/2/77
			D	CHANGE R24 TO 150K Add R32 150K CHANGE R9 FROM 10K TO 20K	
			C	R11 WAS 100K IS 75K J NOS REVISED R21, 22, 23 CR1, 2, 3 PUT IN OTHER LEAD	1/26/77

Prepared for:

SOLAR CONTROL CORP.

5595 ARAPAHOE ROAD
BOULDER COLORADO

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES .XX ± .XXX X° ±1° ± .010 ±1°		RELIABILITY		ZIA ASSOCIATES INC. BOULDER COLORADO
		MATL & PRCC		
		GROUP ENG		
		DESIGNER		
		CHECKED		
CONTRACT NO		PREP BY	SW.	PARTS LIST SOLAR STAT
EMC		SIZE	A	
WEIGHTS		CODE IDENT NO	52060	
STRESS			2796 & 2794-PL	
THERMAL		SCALE	NA	
				CHEET 1/14

ZIA ASSOCIATES INC. (SOLARSTAT)

DISPLAY

DWG. NO. 2794-2796

BOULDER COLORADO

CODE IDENT NO. 52060 SHEET 2 OF 9 REV. P

REFERENCE DESIGNATOR	DESCRIPTION	TOTAL QTY.	MFG. CODE	MFG. PART NO.
RESISTOR, 1/2 WATT, 5% FIXED COMP.				
R1	100 Ω	1		
R2, R3, R4, R5	560 Ω	4		
R6, R10	1M	2		
R11	75K	1		
R8, R15, R12	33K	3		
R18	18K	1		
R19	220K	1		
R7	68K	1		
R16, R17	1K	2		
R21, R22, R23	1.2K	3		
R29, R30, R31, R13	3.3K	4		
R24, R27, R28	TRIMPOT, 100 Ω PCB MOUNT	3	Beckman	72PX R100
R9	20K	1	11	72LPR10K
R20, R32	2W 5% 150 Ω	2

ZIA ASSOCIATES INC.

DWG. NO. 6187-21176 PL

BOULDER COLORADO

CODE IDENT NO. 52060SHEET 304 REV. 0

REFERENCE DESIGNATOR	DESCRIPTION	TOTAL QTY.	MFG. CODE	MFG. PART NO.
CAPACITOR, DISC CERAMIC				
C1, C2, C6	.0022 μ F	3	Mallory	GP 222
C5, C8	.01 μ F	2	SPRAGUE	TG-S10
C3	.1 μ F	1	"	225P
ZIA PART NO. 2873 HEAT SINK				
P.C. card NO. ²⁷⁶⁶ -B		1		
P.C. card NO. ²⁷⁶⁵ -B		1		
CAPACITOR, ELECTROLYTIC (ALUM.)				
C9	250 μ F/50 500D	1	SPRAGUE	500D 2576 050FF2
C4	1/35 TANTALUM	1	Mallory	TOC105K035EL
C10	400/50 500D	1	SPRAGUE	500D 4076 050FK7
LED1, LED2, LED3	MV 5053	3	MONSANTO	
CR11	ZENER	1	JEDEC	2N4400
CR1, CR2, CR3	DIODE	3	JEDEC	1N4001
CR4, CR5	RECTIFIER DIODE	2	JEDEC	1N4004
CR6, CR7	ZENER, 12VOLT	2	JEDEC	1N759A
CR8, CR9, CR10	DIODE ^{constant current}	3	SILICONIX	ES07
Q1	PNP TRANSISTOR	1	JEDEC	2N2907
Q2, Q3, Q4	NPN "	3	"	2N2222

REFERENCE DESIGNATOR	DESCRIPTION	TOTAL QTY.	MFG. CODE	MFG. PART NO.
INTEGRATED CKT, DIGITAL				
U2, U3, U1	7 SEG. LED DISPLAY	3	LITRONIX	DL-702
U5	BCD TO 7 SEGMENT	1	FAIRCHILD	9368 DC
U6	A/D DIGITAL CHIP	1	SILICONIX	LD110
U10	HEX BUFFER INV.	1	TI	SN7416N
INTEGRATED CKT, LINEAR				
U7	A/D ANALOG CHIP	1	SKICONIX	LD111
U8	VOLTAGE REG.	1	NATIONAL	LM 341P-5.0
U9	TIMER 555	1	SIGNETICS	NE555V
V10	VOLTAGE REG	1	NATIONAL	LM 78L08ACH
SW1, SW2	SPDT, MOM. CONTACT	2	C&K	8121
	PWB, SENSOR	1	ZIA	2766A
	PWB, READOUT	1	ZIA	2765A
DIP 14 PIN	SOCKET	3		
Terminal Bd 9 Term	BEAU	1	Beau Vertron	72709-50-C
Terminal Bd 6 Term	BEAU	1	Beau Vertron	72706-50-C
FLEX CABLE	20 CONDUCTOR	1	ANSLEY	FSM-31A-20

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

- 1 IDEAL INDUSTRIES, INC., SYCAMORE, ILLINOIS.
- 2 POT DIODE ASSY. INTO HOUSING WITH CASTALL 301 RESIN. CURE WITH RT7 CATALYST FOR 24 HRS. AT 25°C
- 3 FOR DIODE PROBES, USE GREEN TWISTED PAIR

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADD DESCRIPTION TO DETAIL A ADD NOTE 2.	7/24/77	SK
B	Wire Color added	4/5/79	SK
C	ITEMS 38 & 39 SILES CHANGED SOLDER INSTRUCTIONS ADDED	9/10/77	SK

DETAIL A
PRE-STRIP DIM. TYP.

WIRING DETAIL

SOLDER TWO DIODES TOGETHER
SOLDER 1/4 END TO BACK DIODE
PLACE ITEM 3
WRAP 1/2 TURN OF 1/4 STRIPPED WIRE ON DIODE
WIRE. PULL TIGHT TO GLASS AND SOLDER
TRM. ADD ITEM 4. SHRINK. POT.

1	6	43-830	NEG. WIRE LABEL		NOTE 1
2	5	IN914	SIGNAL DIODE		
1	4		HEAT SHRINK	5/2 X 3/4	
1	3		HEAT SHRINK	1/6 X 5/8	
1	2	2763-1	HOUSING		
1	1		TWISTED PAIR TEFLON INSUL WIRE	22 GAX24"	NOTE 3
501	ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE
QTY PER ASSY	ODD DASH NUMBERED PARTS SHOWN			PARTS LIST	
	CONTRACT NO			APPROVED	
	UNLESS OTHERWISE SPECIFIED			DATE	
	DIMENSIONS ARE IN INCHES			DESIGNER	
	TOLERANCES			GROUP ENG	
	.XX .XXX .X"			CHECKED	
	.02 .010 .1"			Prepared for:	
	BREAK ALL SHARP EDGES .005/.015			SIZE	
	MIL-STD 12.15			CODE IDENT NO	
	USASI Y32.16, B46.1, Y14.5			2797	
	SHOP STANDARDS 2060			REV	
	THREADS PER INCH			C	
	SURFACE FINISH 125			SCALE NONE	
	EXCEPT AS NOTED			BY	

REVISION	SHEET NO	PART NO	NEXT ASS'Y	USED ON
1	501	76-937		
MULTIPLE SHEETS REVISION STATUS				
APPLICATION				

CONTRACT NO		APPROVED		DATE	
UNLESS OTHERWISE SPECIFIED		PREP BY		7/77	
DIMENSIONS ARE IN INCHES		DESIGNER			
TOLERANCES		GROUP ENG		7/79	
.XX .XXX .X"		CHECKED			
.02 .010 .1"		Prepared for:			
BREAK ALL SHARP EDGES .005/.015		SOLAR CONTROL CORP		SIZE	
MIL-STD 12.15		BOULDER ARAPAHOE ROAD		CODE IDENT NO	
USASI Y32.16, B46.1, Y14.5		COLORADO		52060	
SHOP STANDARDS 2060				2797	
THREADS PER INCH				REV	
SURFACE FINISH 125				C	
EXCEPT AS NOTED				SCALE NONE	
				BY	

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADD USE CODE	3/30/77	gac
B	NUMBERS REVISED. SPARES REMOVED 4/26/77		D. J.
C	CHANGED CONNECTORS J3,4,7,8,9	7/28/77	D.R.

"J" CONNECTOR	INTERFACE
J1	24 VAC
J2	24 VAC LO
J3	GROUND
J4	STORAGE PROBE
J5	STORAGE PROBE NEG
J6	COLLECTOR PROBE
J7	COLLECTOR PROBE NEG
J8	NORMAL PROBE
J9	NORMAL PROBE NEG
J10	SOLAR COLLECTING RELAY-24VAC OR POS DC
J11	SOLAR COLLECTING RELAY-24VAC OR NEG DC
J12	SOLAR HEATING RELAY-24VAC OR POS DC
J13	SOLAR HEATING RELAY-24VAC OR NEG DC
J14	CONVENTIONAL HEATING RELAY-24VAC OR POS DC
J15	CONVENTIONAL HEATING RELAY-24VAC OR NEG DC

* RECOMMENDED FOR OUTDOOR TEMPERATURE

ITEM NO.		CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION	
QTY PER ASST		ORD DASH NUMBERED PARTS SHOWN			PARTS LIST			EVER DASH NUMBERED PARTS OFFSHORE
CONTRACT NO				APPROVED	DATE	ZIA ASSOCIATES INC.		
UNLESS OTHERWISE SPECIFIED				PREP BY	3/1/77	BOULDER COLORADO		
DIMENSIONS ARE IN INCHES				DESIGNER		WIRING DIAGRAM		
TOLERANCES				GROUP ENG		HOOK UP INSTRUCTIONS		
.XX ±.02 .XXX ±.010 .X" ±.1"				CHECKED				
BREAK ALL SHARP EDGES .006/.015				Prepared for:				
MIL-STD 12.15				SOLAR CONTROL CORP.	SIZE	CODE IDENT NO		
GRAPH 132.16. 044.1. 114.5				5595 ARAPAHOE ROAD	C	52060	2798	
GROUP STANDARDS 2000				BOULDER COLORADO				
THREADS PER N-28								
SURFACE FINISH 175 EXCEPT AS NOTED								
REVISION		SHEET NO		APPLICATION				
1		76-937						
MULTIPLE SHEETS		NEXT ASS'T		USED OR				
REVISION STATUS								

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

Artwork Number 2837

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

Counterbore holes this side

QTY PER ASSY		ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION NOMENCLATURE QTY PER ASSY	MATERIAL SPECIFICATION
		CONTRACT NO			APPROVED	DATE	ZIA ASSOCIATES INC.	
		UNLESS OTHERWISE SPECIFIED			PREP BY	4-4-77	BOULDER, COLORADO	
		DIMENSIONS ARE IN INCHES			DESIGNER		FRONT PANEL	
		TOLERANCES			GROUP ENG		SILKSCREEN,	
		.XX .XXX X"			CHECKED		SOLARSTAT	
		BREAK ALL SHARP EDGES .005/.015					SIZE CODE IDENT NO	
		MIL-STD 12.15					C 52060 2838	
		USASI Y32.16, B46.1, Y14.5					SCALE WT	
		SHOP STANDARDS					SHEET 1 OF 1	
		THREADS PER N-38						
		SURFACE FINISH 125 EXCEPT AS NOTED						
REVISION		SHEET NO			APPLICATION			
1		2788 Solarstat						
MULTIPLE SHEETS		PART NO NEXT ASSY USED ON						
REVISION STATUS

2837
Front Panel, Airway, Silenced, Colorado

8884

11A: 11A
SILENCED
FRONT PANEL
SILENCED

ZIA ASSOCIATES INC.		
BOULDER COLORADO		
SIZE D	CODE IDENT NO 52060	2837
SCALE		SHEET OF

[illegible]

TO: FRANKS

INTEGRITY

021 ZIA ASSOCIATES INC

NASA Solarstat Test Procedure

2866

REC
A

15

N/A

SOLARSTAT

Test Procedure

I. Equipment Needed

- A. 3½ Digit Digital Voltmeter ($\pm 1\%$ accuracy)
- B. 24 volt at 1 amp transformer
- C. Three dual diode temperature probes
- D. Approximately one quart ice-water bath (32°F)
- E. Approximately one quart hot water bath (150°F)
- F. 0° to 200°F thermometer ($\pm 2\%$ accuracy)

II. Procedure

- A. Connect the 24 volt transformer secondary leads to the terminal block screws J1 (Hi) and J2 (ground). (Refer to Drawing Number 2799 for terminal locations.)
- B. Connect the three temperature probes to the terminal block screws J4 and J5, J6 and J7, and J8 and J9.
- C. Center the three variable resistors on the bottom printed circuit board.
- D. Connect the negative (-) (blk) Digital voltmeter lead to the negative (-) side of the 400 micro farad capacitor (C_{10}).
- E. Connect the 24 volt transformer primary leads to a 110 volt-AC source. Allow two minutes before proceeding.
- F. Using the Digital voltmeter positive (+) (red) lead, verify the following voltages: (refer to Drawing number 2794A for component location on sensor (lower) board, and 2795C for locations on the readout (upper) board)
 - a. U6 pin 6 -- $+5\text{V} \pm .20$
 - b. U6 pin 11 -- $-12\text{V} \pm 1.2\text{V}$
 - c. U7 pin 16 -- $+12\text{V} \pm 1.2\text{V}$
 - d. U7 pin 15 -- $+1.44 \pm .07\text{V}$
 - e. U7 pin 10 -- $+8\text{V} \pm .3\text{V}$

- G. Remove the Digital voltmeter connection.
- H. Place the three temperature probes and thermometer in the ice water bath. Allow five minutes before proceeding.
- I. Verify 32°F on the thermometer.
- J. While observing the LED temperature display, adjust R_{26} for a display of 32°F .
- K. While pressing the left hand push button, adjust R_{27} for a display of 32°F .
- L. While pressing the right hand push button, adjust R_{28} for a display of 32°F .
- M. Transfer the three temperature probes and thermometer to the hot water bath. Allow five minutes before proceeding.
- N. Note the thermometer reading.
- O. Adjust R_9 for a temperature display equal to the thermometer reading.
- P. Verify the same display reading (± 1 degree) when the left and right hand push buttons are pressed.
- Q. Repeat steps H through P until all three temperature displays match the thermometer readings for the ice water bath and hot water bath ± 1 degree.
- R. Jumper the 24V from J1 and J2 to J10 and J11. The solar collecting LED should light. (left) Jumper J1 and J2 to J12 and J13. The solar heating (center) LED should light. Finally, jumper J1 and J2 to J14 and J15. The conventional heating (right) LED should light.

REVISION			DATE		APPROVED	
REVISED	BY	USED ON	DATE		DATE

2 HOLES # 25
 M'T'L: ALUMINUM $\frac{3}{32}$ THK
 FINISH: FLAT BLACK
 LACQUER

ASSEMBLE UNDER 5V REGULATOR BETWEEN
 BOARDS WITH $\frac{5}{16}$ SIDE TOWARD EDGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES		RELIABILITY	ZIA ASSOCIATES INC. SOLARSTAT HEAT SINK
XX	XX	XX	
±.010	±.010	±.010	
±.010	±.010	±.010	
±.010	±.010	±.010	
CONTRACT NO.		OWNER <i>K.R. Wendt</i>	54
DATE		DATE	
U.S. GOVERNMENT PRINTING OFFICE 1978-740-193/127 REGION NO. 4		2873	65