DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150628

PRELIMINARY DESIGN PACKAGE FOR RS600 MICROPROCESSOR CONTROL SUBSYSTEM

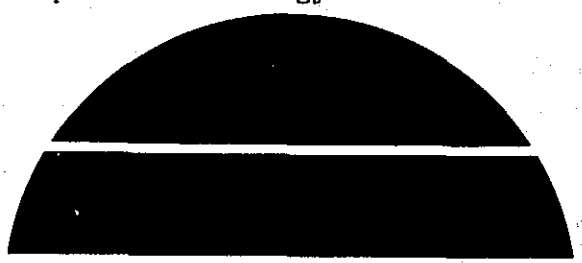
Prepared from documents provided by

Rho Sigma, Inc.
11922 Valerio Street
No. Hollywood, California 91605

Under Contract NAS8-32256 with

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

For the U. S. Department of Energy



U.S. Department of Energy

Solar Energy

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
DOE/NASA CR-150528		

4. TITLE AND SUBTITLE	5. REPORT DATE
Preliminary Design Package for RS600 Microprocessor Control Subsystem	January 1978
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT #
9. PERFORMING ORGANIZATION NAME AND ADDRESS Rho Sigma, Inc. 11922 Valerio Street No. Hollywood, California 91605	10. WORK UNIT, NO.
	11. CONTRACT OR GRANT NO. NAS8-32256
12 SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546	13. TYPE OF REPORT & PERIOD COVERED Contractor Report
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

This work was done under the technical management of Mr. James Hankins, George C. Marshall Space Flight Center, Alabama.

16. ABSTRACT

Rho Sigma, under NASA/MSFC Contract NAS8-32256, is developing three identical microprocessor control subsystems which could be used in heating, heating and cooling, and/or hot water systems for single family, multi-family, or commercial applications. The controller is to incorporate a low cost, highly reliable (all solid state) microprocessor which can be easily reprogrammed.

This report contains the information necessary for the evaluation of the preliminary design of the subsystem. Included are the Verification Plan, Hazard Analysis, Specifications and other information helpful in the evaluation of the preliminary design.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Solar System Controller Programmable Microprocessor Controller	Unclassified-Unlimited William A. Brooksbank, Jr. WILLIAM A. BROOKSBANK, JR. Mgr, Solar Heating and Cooling Projects Ofc

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	14	NTIS

TABLE OF CONTENTS

VERIFICATION PLAN

Rho Sigma will verify that the controller subsystem meets the performance specification by test with simulated inputs duplicating an actual test structure.

In order to provide a verification of a "real world" system control situation, it is requested that a system design of the type currently under development for NASA by IBM be provided. Rho Sigma has no hard factual data of temperature points (number and range), flows or valve/damper operations that are to be controlled. It is invisioned that these controllers should be tested under realist conditions.

Thermistor inputs will be simulated with precision variable resistors so that the temperature inputs can be changed to match the different test conditions.

Flow meter inputs will be simulated by pulse generators so that the flows can be varied and different conditions matched.

The outputs will be monitored with a simulated load matching that of the test conditions. In this manner, Rho Sigma will be able to demonstrate that the controller is solving the state equations for the heat transfer loops and controlling the outputs according to these equations.

VERIFICATION CROSS REFERENCE MATRIX

Performance Requirement	Verification Phase			Remarks
	D	C	A	
Control Capability	2	4	4	
Microprocessor/ Memory	2	4	4	
Environment	1	1	4	
Sensor/Inputs	2	4	4	
Control Outputs	2	4	4	
Internal Clock	2	4	4	
Physical	3	3	3	
Power	2	4	4	
Diagnostics	2	2	4	

I. DRAWING LIST REQUIRED FOR SUBSYSTEM DEFINITION

	DRAWING TITLE	DRAWING NUMBER
1.	Assembly - RS 600 MP	10000
2.	Chassis	10020
3.	CPU Assembly	10040
4.	CPU Logic Diagram	10041
5.	Prom Board Assembly	10060
6.	Prom Board Logic Diagram	20061
7.	Input Card Assembly	10080
8.	Input Card Logic Diagram	10081
9.	Counter Card Assembly	10100
10.	Counter Card Logic Diagram	10101
11.	A/D Card Assembly	10120
12.	A/D Card Logic Diagram	10121
13.	Clock Card Assembly	10140
14.	Clock Card Logic Diagram	10141
15.	Output card Assembly	10160
16.	Output Card Logic Diagram	10161
17.	D/A Card Assembly	10180
18.	D/A Card Logic Diagram	10181
19.	Power Supply Assembly	10200

II. Description and rational for proposed special handling, installation, and maintenance tools:

a) None required for Rho.Sigma's Model RS 600 MP Controller

III. Hazards Analysis:

a) The Model RS 600 MP is a controller which operates on a low D.C. voltage. 115 VAC will be supplied to generate this D.C. voltage and the solid state output relays can be used to switch 115 VAC. In the case of the 115 VAC input, the input will be fused and wired in an acceptable U.L. manner. The output relays will be separated from the low voltage section by a barrier strip and will match U.L. recommendations.

IV. List of data that Rho Sigma recommends to be used to accomplish prototype design review:

a) Rho Sigma needs the data on a typical multi-zoned, advanced, state of the art, heating/cooling solar home including the state equations that must be implemented.

V. Proposed Government furnished instrumentation delivery dates:

a) No Government furnished instrumentations.

VI. Type I and 2 documents to be approved.

a) Not applicable.

PRELIMINARY SPECIFICATIONS RS - 600

1. INPUTS

a. Analog D/A - 12 Bit

1. 8 Differential
2. 16 Single ended
3. Expandable 16 Differential Channels, 32 single ended
4. Voltage Range
   a. 0-5VDC (TBD)
   b. Input impedence - 1 meg. min.
5. Monitored Signals (Typ.)
   a. Temperature - thermistor 10K @ 25°C - Accuracy 1°F Range of 0 to 250°F
   b. Insolation - Photocell Pyronmeter .5V @ 300 Btu/ft^2/hr.

b. Discrete Inputs

1. 8 Discretes
2. Expandable to 16
3. Signal
   Low = 0 - .4VDC
   High = 2.4 to 5VDC

c. Flow Meters

1. 4 Channel
2. Pulse inputs Ø Hz to 10 KHZ
3. Pulse level low 0 - .4V
   high 2.4 to 5VDC

RS - 600 Cont'd

d. Keyboard
   1. Selects function for monitoring inputs
      a. Temperature ^{o}F, or ^{o}C all same
      b. Insolation
      c. Discretes
      d. Time
   2. Sets Time
   3. Sets specified constants

e. Input Power
   105 - 130 VAC 60 Hz
   150 Watts (outputs not included)

2. OUTPUTS

a. Display - 6 Place
   1. Converted Data
      a. Channel - 2 Place
      b. Data - 4 Place
      c. 4 Set of Units
         1. Time
         2. Temperature
         3. GPM
         4. Insolation Btu/ft^2/Hr.
      d. Time Hour: Min.

b. Solid State Relay
   1. Optical Isolated
   2. 10 Amps rating (AC @ 120 VAC)
   3. 1-8 Expandable to 24
   4. Light indicate coutput on = output
   5. Switch Override

RS - 600 Cont'd

c. Digital to Analog Converter
   1. 1-4 Outputs
   2. 0-10VDC or $\pm$ 5VDC (PBD)
   3. 8 Bit Accuracy
   4. Light indicates output - dim to bright
   5. Switch Override (Full on/off)

d. Relay Outputs
   1. 4 Expandable to 8
   2. 5 Amp Contact
   3. Light indicate state - on high
   4. Switch Override

3. COMPUTER FUNCTIONS

a. Convert input data to required units.
   1. Thermister inputs to temperature ^{o}F or ^{o}C (Tn)
   2. Photocell to Insolation (I) (Btu/ft^2)
   3. Flow rates counts to GPM or GPH
   4. 365 Day Clock Time to nearest second

b. Solve general equations
   Output = F (Tn, Time, Flow, Discrete, etc.)
c. Calculate real time
d. Built in Diagnostic (PBD)

4. PHYSICAL SIZE
a. 30 X 20 X 8½ Enclosure (nema-12)
b. Approx. wt. - 65 Lbs.

5. ENVIRONMENT

Controller will operate from 0° to 120°F and from 0 to 95% RH without condensation.

6. WARRANTY

The subsystem shall have a one year warranty on parts and labor, with liability limited to repair or replacement.

December 28, 1976

MODEL 600 MP CONTROLLER

INPUTS

32 - ANALOG
16 - Discrete
4 - PULSE TRAINS
52

OUTPUTS

4 - D/A
24 - SOLID STATE
10 A RELAY
8 - RELAY 5 A CONTACTS
36

FUNCTIONS

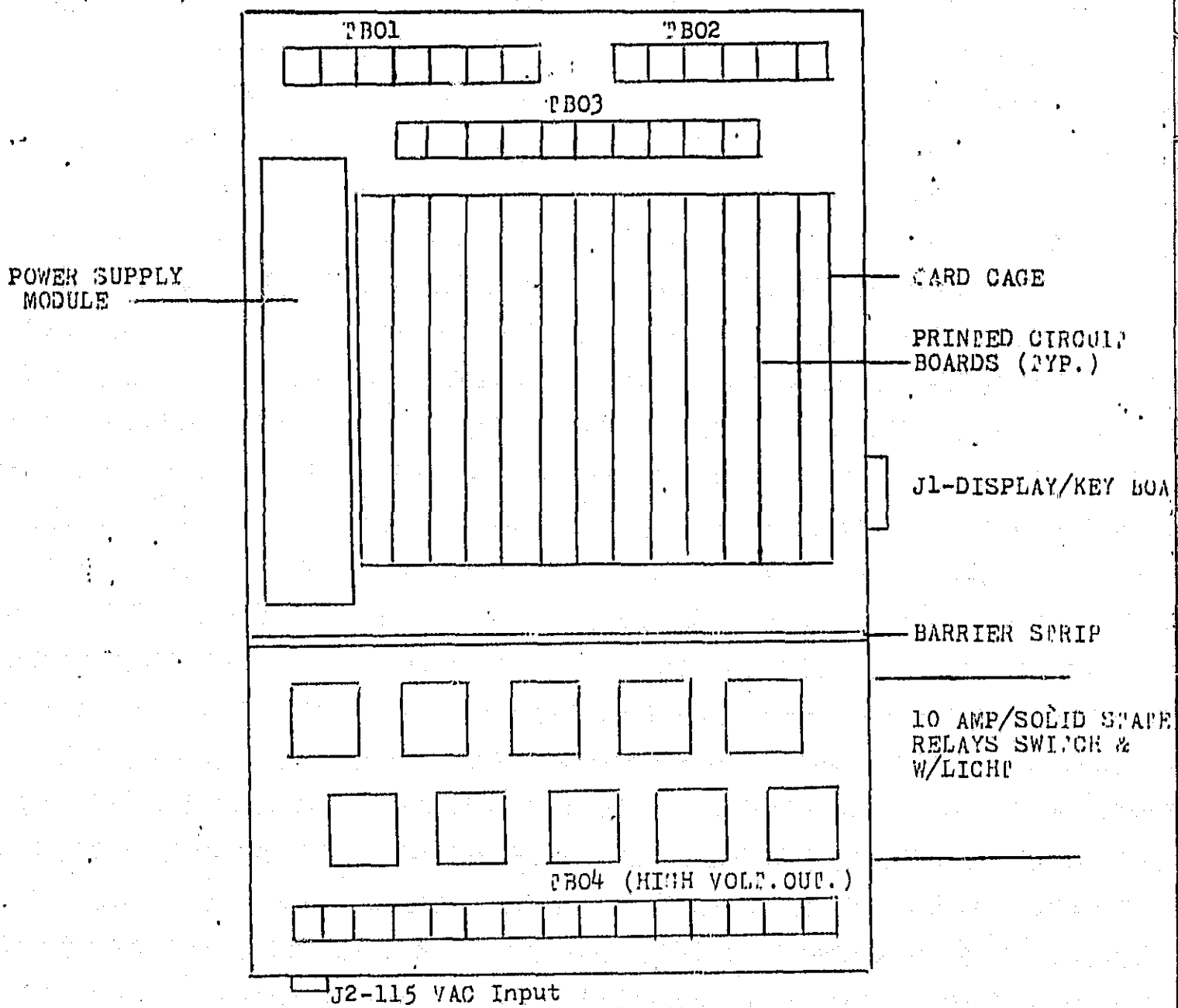
EQ. WITH APPROX. 10 TERMS
OPERATORS
or
and
nand
nor
>
>
=
(())
Typ. Equation: $TA1 > (TA2 + 10^{0})$

DISPLAY

1. INPUTS
   CONVERTED DATA
   °F, GPM, SW CLOSURE, TIME

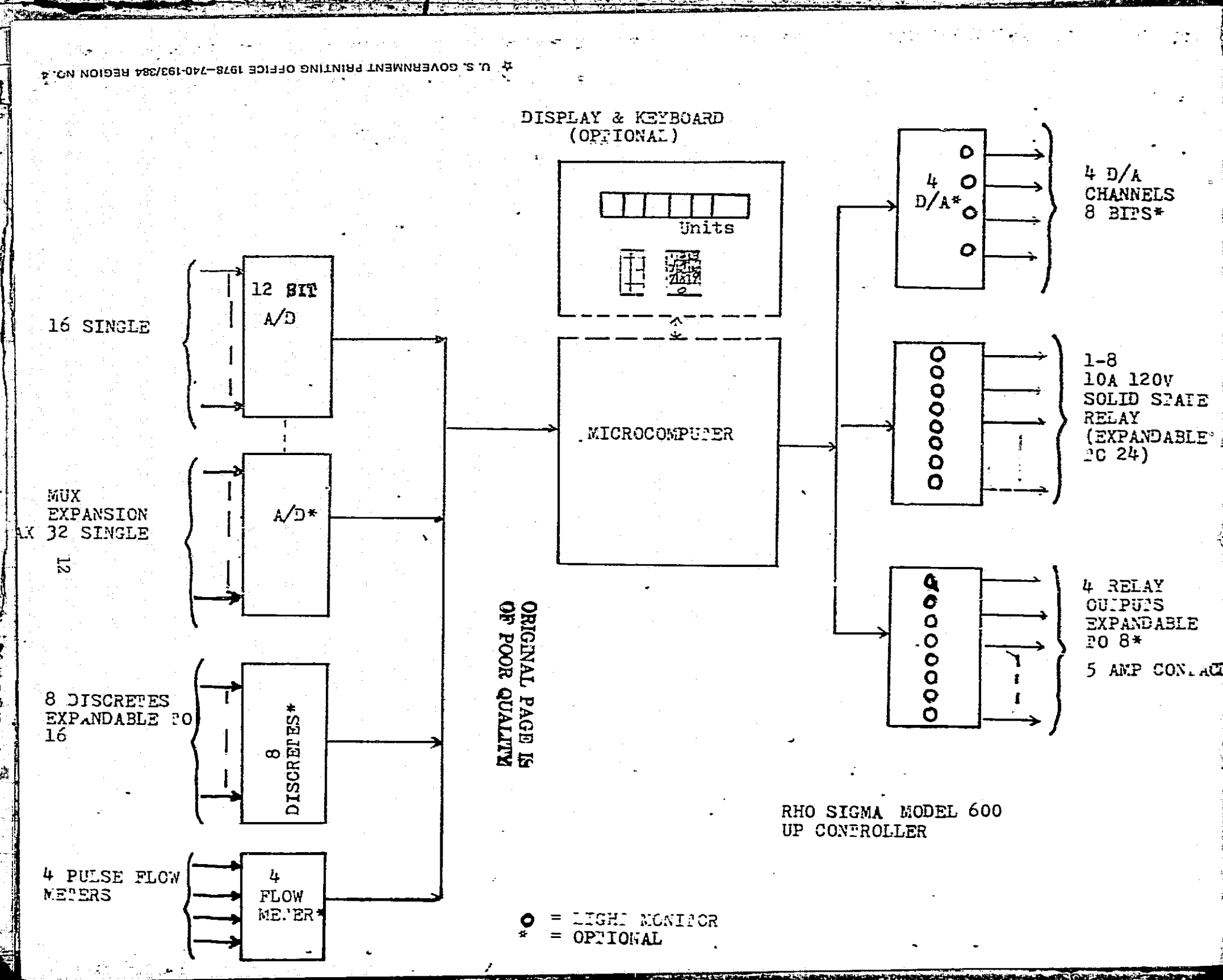
2. OUTPUTS
   SWITCHES 0/1
   PROPORTIONAL 0 → 10

3. CONSTANTS CHANGEABLE
   a) PREDEFINED CONSTANT
      △ TEMP
      △ TIME
      △ FL..



CASE SIZE = 18.5 X 26 X 8.5

RS 600 MP CONTROLLER



ORIGINAL PAGE IS
OF POOR QUALITY