



CANBERRA

**M0848
REV. -**

**OPERATION AND
MAINTENANCE MANUAL**

ADM-616A

**DIGITAL RATEMETER
WITH SMART PROBES**

**FOR
CORNELL UNIVERSITY
WILSON LABORATORY**

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Printed in the United States of America.



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Prepared By: *[Signature]*

DATE: 12/18/00

Engineering Approval: *[Signature]*

DATE: 12-18-00

QA Approval: *[Signature]*

DATE: 12-19-00

LETTER	DESCRIPTION	DATE	APPROVED

REVISIONS

OPERATION & MAINTENANCE
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REVISION -

LIST OF EFFECTIVE PAGES

(Change number "0" indicates an original page.)

PAGE NO.	CHANGE NO.
I-II	0
i-iii	0
1-1 through 6-1	0

RECORD OF CHANGES

MANUAL M0848

REVISION -

<u>CHANGE NO.</u>	<u>DATE</u>	<u>TITLE OR BRIEF DESCRIPTION</u>	<u>ENTERED BY</u>
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SECTION 1

DESCRIPTION

The manual provides instruction on the operation of Aptec-NRC's (formerly Nuclear Research Corporation) ADM-616A Digital Ratemeter. The ADM-616A is a microprocessor controlled digital ratemeter, designed to power, control, and process data from various types of Aptec-NRC radiation detectors.

The ADM-616A ratemeter is housed in a stainless steel, EMI qualified NEMA-12 wall mounted enclosure and consists of two major assemblies; an electronic enclosure assembly which houses electronics, lights and power supplies; and a termination enclosure assembly which houses some electronics and terminal blocks for customer interface.

The ADM-616A can operate with both area and process monitor type detectors for the measurement of many types of both low and high intensity radioactivity, including: gamma rays, X-rays, alpha particles, beta particles, and neutrons.

The ADM-616A can operate up to three (3) Aptec-NRC Area Monitor type detectors and Process Monitor type preamplifiers from the ADM-600 series probes. Detectors are connected to the three military style connectors located on the bottom of the ADM-616A's Electronic Enclosure Assembly. The connectors are identified PROBE 1, PROBE 2, and PROBE 3. The ADM-616A provides all detector power and control signals required for operation. The Area Monitor type detectors consist of detectors designed for open area detection of gamma or neutron radiation. The Process Monitor type detectors consist of detectors designed to be mounted in fluid or gas flow streams such as ventilation ducts, stacks and liquid piping systems.

For typical area monitor operation the ADM-616A is provided with configurable Smart Probe firmware. This firmware allows the customer to change the number and type of probes used on the ADM-616A. Process monitor applications typically require dedicated firmware for a specific configuration, and is not compatible with Smart Probe operation.

When switched on, the ADM-616A displays its basic configuration settings. If the settings are not changed in two seconds, the ADM-616A retains the displayed configuration. If the ADM-616A is configured for local operation, it reads the attached Smart Probe detectors and downloads calibration and scaling parameters from the detectors. If configured for remote operation, the ADM-616A tries to establish a communications link the local ratemeters. For each attached detector, the ratemeter provides radiation intensity displays, alarms set points, and other control and readout functions.

2.2.3 RELAY, COMM, DIGITAL INPUT, AND ANALOG OUTPUT SIGNALS

Each ADM-616A provides terminal block connections on its Customer Interface Panel for relays, RS485 communications, digital inputs, and analog outputs. Connections are shown in Table 2-1.

CUSTOMER INTERFACE PANEL				POWER ENTRY
TB1	TB2	TB3	TB4	TB51
1 K1A NO	1 K1B NO	1 K3A NO	1 K3B NO	1 120VAC LINE
2 K1A COM	2 K1B COM	2 K3A COM	2 K3B COM	2 120VAC NEUTRAL
3 K1A NC	3 K1B NC	3 K3A NC	3 K3B NC	3 GROUND
4 K2A NO	4 K2B NO	4 K4A NO	4 K4B NO	1 AMP MAX.
5 K2A COM	5 K2B COM	5 K4A COM	5 K4B COM	60 HZ, 1 PH
6 K2A NC	6 K2B NC	6 K4A NC	6 K4B NC	
7 K5A NO	7 K5B NO	7 RS485-1 POS	7 K6A NO	
8 K5A COM	8 K5B COM	8 RS485-1 NEG	8 K6A COM	
9 K5A NC	9 K5B NC	9 RS485-1 GND	9 K6A NC	
10 VOUT1+	10 RS485-3 POS	10 RS485-2 POS	10 VOUT2+	
11 VOUT1-	11 RS485-3 NEG	11 RS485-2 NEG	11 VOUT2-	
12 VOUT3+	12 RS485-3 GND	12 RS485-2 GND	12 VOUT4+	
13 VOUT3-	13 DIG1	13 DIG2	13 VOUT4-	
14 VIN1+	14 DIGITAL GROUND	14 DIGITAL GROUND	14 VIN2+	
15 VIN1-	15 DIG3	15 DIG4	15 VIN2-	

NOTES:

- ALL REKEY CONTACTS ARE DPDT, RATED AT 120 VAC, 5 AMPS, EXCEPT K6 IS SPDT. ALL RELAYS ARE NORMALLY ENERGIZED, DE-ENERGIZE ON ALARM. CONTACTS ARE SPECIFIED IN THE DE-ENERGIZED STATE.

K1 - HIGH ALARM CHANNEL 1	K4 - HIGH ALARM COMMON
K2 - HIGH ALARM CHANNEL 2	K5 - FAIL ALARM COMMON
K3 - HIGH ALARM CHANNEL 3	K6 - ALERT ALARM COMMON
- DIG1 IS INPUT FOR EXTERNAL RESET WHEN SWITCHED TO GROUND.
- DIG2 IS INPUT TO SELECT TEST RATE ON CHANNEL 1 WHEN SWITCHED TO GROUND.
- DIG3 IS INPUT TO SELECT TEST RATE ON CHANNEL 2 WHEN SWITCHED TO GROUND.
- DIG4 IS INPUT TO SELECT TEST RATE ON CHANNEL 3 WHEN SWITCHED TO GROUND.
- TB1 - TB4 ARE BARRIER STRIPS W/ #6-32 SCREWS, MATING CONNECTORS ARE #6 LUGS.

PROBE CONNECTIONS		
PROBE 1	PROBE 2	PROBE 3
A +5V	A +5V	A +5V
B ANALOG GROUND	B ANALOG GROUND	B ANALOG GROUND
C EE CLOCK1	C EE CLOCK2	C EE CLOCK3
D /LO ENABLE1	D /LO ENABLE2	D /LO ENABLE3
E /HI ENABLE1	E /HI ENABLE2	E /HI ENABLE3
F EE ENABLE1	F EE ENABLE2	F EE ENABLE3
G /EVENT1	G /EVENT2	G /EVENT3
H EVENT1	H EVENT2	H EVENT3
J DIGITAL GROUND	J DIGITAL GROUND	J DIGITAL GROUND
K ANALOG INPUT 1	K ANALOG INPUT 2	K ANALOG INPUT 3
L -15VDC	L -15VDC	L -15VDC
M +15VDC	M +15VDC	M +15VDC

NOTES:

- PROBE CONNECTORS ARE MS3110E14-12P; MATES WITH MS3116F14-12S.
- PROBE CABLE WIRING IS PIN TO PIN FOR MOST PROBES WHEN USING 12 CONDUCTOR CABLING.
- AREA MONITOR PROBES DO NOT REQUIRE PINS H, J, AND K, ALLOWING 9 CONDUCTOR CABLE TO BE USED.

TABLE 2-1: ADM-616A SIGNAL DEFINITIONS

The ADM-616A has four serial communications ports, one RS-232 port and three isolated RS-485 ports. The RS-232 port is used to connect to a TAM-100 or to access factory Debug mode. The RS-485 ports are used to connect to another ADM-616A, ADM-606M, or ADM-606, where one is a local unit controlling probes and the other is a remote display unit. The RS-485 ports can also be accessed by a computer running Aptec-NRC provided data acquisition software or customer written programs. See Section 3 for serial communications protocol.

A receptacle for connecting to the ADM-616A's RS-232 communication port 1 is provided on the front panel. Connections to a computer are made using Communications Cable part number 805756-001.

Relay operation and ratings are as described in Table 2-1.

Four digital inputs (CMOS 0-5 V) are available on the Customer Interface Panel. See Table 2-1 for definitions.

Four 0-5 VDC analog outputs are available. See Table 2-1 for connections. See Section 3 for explanation of analog output range and equations to determine appropriate output levels.

SECTION 3

OPERATION

3.1 OPERATIONAL OVERVIEW

This section provides detailed instructions on the operation of an ADM-616A Digital Ratemeter when attached to one, two, or three "Smart Probe" radiation detectors. At power ON the ADM-616A automatically recognizes each attached "Smart Probe" and adjusts its displays, controls, and behavior according to the type and number of attached probes.

The ADM-616A ratemeter can simultaneously operate one, two, or three probes depending on the application's requirements. The ADM-616A supports the operation of the "Smart Probe" types listed in the table below. Also noted in the table are limitations for connecting the probes to the ADM-616A, and cable types required.

ADM-616A PROBE TYPES			
PROBE TYPE	MODEL	DISPLAY	NOTES
Gamma, G-M	GP-100, GP-110	GP	Used on any port
Neutron	NP-100	NP	Used on any port
Beta	BP-100	BP	Used on any port
X-ray	XP-100	XP	Used on any port
Gamma High Sensitivity	uREM-100	uR	Used on any port
Alpha and Beta	ABP-100	A+Beta, Alpha, Beta	Requires special cable to connect to PROBE1 and PROBE2
Gamma, Scintillation	GSP-100	GSP	Used on any port
Alpha	AP-100	AP	Used on any port
Alpha	MD-35	PM	Used on any port
Ion Chamber	IP-100	IP	Used on any port
Alpha Air Monitor	PAM-100	PM	Detector to PROBE1, Sampler to PROBE3
Nickel-63 Detector	NI-63C	Nickel 63	Used PROBE1 only; PROBE2, PROBE3 cannot be used for other probes.

The ADM-616A formats its displays according to the type of probes.

3.2 OPERATIONAL DISPLAYS

The ADM-616A displays information on a 4 line by 20 character vacuum fluorescent display.

In the default display, the top three lines are Dose Rates or Count Rates, depending on the probe. The bottom line of the display is used to display status and failure messages that will alternate if condition(s) exists that requires notification of the operator. Otherwise, the bottom line is blank.

When viewing a single rate (1, 2, or 3), the top line is always the rate for the probe. The second line of the display is used to display a bar graph, or status and failure messages that will alternate with the bar graph if a condition exists that requires notification of the operator.

The right most character on the top line is used to display special characters to indicate alarm conditions. These characters are:

- a. "H" flashing indicates a High Alarm on the displayed channel.
- b. "A" flashing indicates an Alert Alarm on the displayed channel.
- c. "D" flashing indicates a Dose Alarm on the displayed channel.
- d. "?" flashing indicates an Alarm on an undisplayed channel.

Alarm set point displays follow the same format as the single rate displays. The exceptions are that the bar graph does not alternate with status messages, and there are no alarm characters on the top line.

3.2.1 RATE DISPLAY FORMAT

The following is an example of the ADM-616A default display with three probes attached. Probe 1 is a GP-100 Gamma Probe, Probe 2 is an XP-100 X-Ray Probe, and Probe 3 is an NP-100 Neutron Probe. It also shows alarm symbols in the far right of each line. In the example Rate 2 is in Alert alarm, displaying a flashing "A." Meanwhile, Rate 1 and Rate 3 indicate that they are not causing the alarm by displaying a flashing "?."

1.00E+0mR/h	GP Rt1?
1.00E+2CPM	XP Rt2A
1.00E-1mRe/h	NP Rt3?

The single channel display for Rate 1 is reached by pressing the (↑) button from the three channel default display above.

<p>1.00E+0mR/h GP Rt1? ■■■■■</p>

The single channel display for Rate 2 is reached by pressing the (↑) button from the Rate 1 display above.

<p>1.00E+2CPM XP Rt2A ■■■■■■■■■</p>

The single channel display for Rate 3 is reached by pressing the (↑) button from the Rate 2 display above.

<p>1.00E-1mRe/h NP Rt3? ■■</p>

Pressing the (↑) button again will return to the default display.

3.2.2 STATUS MESSAGES

Status messages are used to indicate conditions within the ADM-616A that would not normally cause an alarm condition. These conditions are:

MESSAGE	PURPOSE
Battery Power	ADM-616A is operating from internal batteries (optional).
Battery Voltage Low	Battery power low, approximately 10 minutes remaining.

3.2.3 FAILURE MESSAGES AND INDICATORS

The ADM-616A notifies the operator of failure modes that may occur during use. The table below lists types of failures and how they are indicated. See Section 4 for instructions on trouble shooting.

FAILURE MODE	DISPLAY MESSAGE	LAMP	RELAY	LATCHING
Probe 1, 2, 3 No Count Failure	YES	FAIL	K5	NO
Probe 1, 2, 3 Ext. EEPROM Failure	YES	FAIL	K5	YES
Failure Reading Det. Scale Factors	YES	FAIL	K5	YES
Internal EPROM (CRC) Failure	YES	FAIL	K5	YES
Backup RAM Failure	YES	FAIL	K5	YES
Internal EEPROM Failure	YES	FAIL	K5	YES
Power Down Halt Failure	YES	FAIL	K5	YES
Background Watchdog Failure	YES	FAIL	K5	YES
Low Sample Flow (PAM-100)	YES	FAIL	K5	YES

If the ADM-616A's self tests fail or data stored in the probe is not read by the ADM-616A correctly, the ADM-616A will indicate a fail condition. Fail conditions are indicated by lighting the Fail lamp, setting the fail relay to the alarm state, and indicating a failure message on the bottom line of the display. The failure message shows the type of failure that occurred. Multiple failure messages cycle on the bottom line of the display along with status messages.

3.2.4 INDICATORS

The indicator lamps are used to indicate a Normal or Alarm condition on any one of the channels active the ADM-616A. These conditions are indicated as marked on the lamps:

INDICATOR	PURPOSE
NORM (GREEN)	Indicates Normal operation of all channels.
ALERT (AMBER)	Indicates Alert Alarm on one or more channels.
FAIL (WHITE)	Indicates a Fail condition on ADM-616A or an attached probe.
FLASHING RED (HIGH)	Indicates High Alarm on one or more channels.

The ADM-616A includes an audible alarm on the front panel that will sound in the event of a High, Alert, or Fail alarm condition.

3.3 KEY SWITCH

The ADM-616A provides a three-position key switch to access ON/OFF control of the instrument and to access "locked out" functions from the KEYPAD position. The key must be used to change the key switch's position. The key may be removed while in the ON position thereby locking out access to operations conducted from the KEYPAD position.

3.3.1 OFF POSITION

With the key switch in the OFF position, the ADM-616A microprocessor and digital circuitry are de-energized. The internal AC to DC Converter remains energized as long as AC power is applied to the ADM-616A, but internal batteries are not charged.

3.3.2 KEYPAD POSITION

With the key switch in the KEYPAD position, the ADM-616A is switched on and all operations are accessible by the operator. The key cannot be removed while the key switch is in this position.

3.3.3 ON POSITION

With the key switch in the ON position the unit is switched on and only limited operations are accessible by the operator. In

this position, the key can be removed and the unit will continue to operate. This provides security against unauthorized tampering such as changing the alarm set points.

3.4 KEYPAD

The six-button keypad is used for changing the displayed mode, setting operating modes, entering information, and resetting alarm conditions. The keypad contains the following switches:

- a. RESET
- b. CHECK SOURCE,
- c. TEST,
- d. MODE,
- e. SET,
- f. (↑), or (INC), provides increment action.

3.4.1 RESET

The RESET button is used to mute the horn when an alarm condition exists and reset latched High, Alert, and Fail alarms when the cause for the alarm is no longer present. RESET can also be used to return to the default display from any other top level display when the key switch is in the KEYPAD position.

3.4.2 CHECK SOURCE

The CHECK SOURCE feature is not currently supported on the ADM-616A.

3.4.3 TEST

The TEST button can be activated while the key switch is in the KEYPAD or ON position. The TEST switch is used to test the ADM-616A lamps and horn. Pressing TEST causes the HIGH, ALERT, NORM, and FAIL lamps to light and the horn to sound.

3.4.4 MODE

The MODE button selects the displayed higher level functions such as alarm set points. In conjunction with the SET button, the MODE button will access other system configuration parameters as filter mode, SCA status, and other scale factor settings

3.4.5 SET

The SET button is used in conjunction with the (↑) button to enter data such as alarm set points. During a data entry mode, one digit will blink. The (↑) switch is used to increment the digit value. Once the desired value is reached, the SET switch is pushed to store the digit. This sequence is continued until all the digits of the desired number are entered.

The SET button can also be used simultaneously with other buttons to perform special functions.

3.4.6 (↑) OR (INC)

The (↑) button, also referred to as (INC), provides for incrementing of digits and is used in conjunction with the SET button to enter data such as alarm set points. During a data entry mode, one digit will blink. The (↑) button is used to toggle the digit values 0 through 9. Once the desired value is reached, the SET button is pushed to store the digit. This sequence is continued until all the digits of the desired value are entered.

The (↑) button is also used to select the desired channel for viewing. Pressing (↑) at the rate display will scroll the display through the three channels. When a channel's parameter is to be changed, the channel is selected in this way before pressing MODE to select the parameter to be changed.

As discussed above, (↑), with MODE or SET, provides access to important ADM-616A setup procedures.

3.5 DISPLAY MODES FOR LOCAL ADM-616A WITH SMART PROBES

The ADM-616A is typically used as a local display and control unit for up to three Aptec-NRC Smart probes. This section describes the displays available with the various probes. The displays available vary depending on the probe(s) connected. Consult the flow charts in Section 6 for which displays are available with which probes.

3.5.1 SYSTEM CHECK OUT AND POWER ON

Before connecting a probe to an ADM-616A the steps outlined in this section must be performed.

- a. Place the ADM-616A key switch in the OFF position.
- b. Connect the Probe(s) to probe port(s) PROBE 1, PROBE 2, and PROBE 3 on the ADM-616A, starting with PROBE 1.

- c. Place the internal toggle switch in the ON position.
- d. Switch on the ADM-616A by placing the key switch in the KEYPAD or ON position.
- e. The ADM-616A requires approximately fifteen seconds to initialize and perform self and probe diagnostics. During this period the ADM-616A display shows "Please Wait."
- f. The ADM-616A will display the current configuration, local or remote, and number of probes.
- g. View the rate(s) for Probe 1, Probe 2, and Probe 3, if attached.

3.5.2 SETTING OR CHANGING CONFIGURATION

To configure the ADM-616A as a local unit, press RESET while the current configuration is displayed at start-up. Press SET to toggle local or remote operation. Press (↑) to increment the number of probes. Press MODE to save the configuration and begin normal operation.

3.5.3 DISPLAYS AND FUNCTIONS AVAILABLE IN KEYPAD POSITION

The following is a list of displays available on the ADM-616A when the key switch is in the KEYPAD position. Some display modes are common to all probes while others are probe dependent. See the operating section for the specific probe to determine which displays are valid for that probe.

	AVAILABLE MODE DESCRIPTION: LOCAL KEY SWITCH IN KEYPAD POSITION	MANUAL SECTION
a.	Meter Configuration Display, local/remote, 1, 2, 3 probes	3.5.2
b.	View rate in mR/h, mRem/h, cpm, or $\mu\text{Ci/cc}$ for each probe.	3.5.6
c.	View Auxiliary Rates, ABP-100.	3.5.7
d.	View Specialized Isotope List, ABP-100, PAM-100	3.5.8
e.	View and clear Dose or Sum in mR, mRem, cts.	3.5.9
f.	View and adjust "HIGH" alarm set point.	3.5.10
g.	View and adjust "ALERT" alarm set point.	3.5.11
h.	View and adjust "DOSE" or "SUM" alarm set point.	3.5.12

	AVAILABLE MODE DESCRIPTION: LOCAL KEY SWITCH IN KEYPAD POSITION	MANUAL SECTION
i.	Activate Survey mode.	3.5.13
j.	Activate Scaler mode	3.5.14
k.	View Sample Flow Rate (PAM-100 only)	3.5.15
l.	View and clear Total Sample Flow (PAM-100 only)	3.5.16
m.	View and adjust Date and Time	3.5.17
n.	View battery voltage (optional).	3.5.18
o.	View and adjust Unit ID.	3.5.19
p.	Perform lamp tests.	3.5.20
q.	Perform probe calibration.	3.5.21
r.	View and adjust filter mode settings.	3.5.22
s.	View and adjust User Scale Factor (PAM-100 Flow Scale Factor).	3.5.23
t.	Nickel-63 Detector displays: 1. Nickel 63 Detector (TEST, Calibration) 2. Take Sample or Background 3. View and adjust High Alarm set point 4. View and adjust Alert Alarm set point 5. Unit ID	3.5.24

Note: With the key switch in the KEYPAD position, operating modes do not automatically switch back to the default display unless the mode's function is executed or the RESET button is pressed.

3.5.4 DISPLAYS AND FUNCTIONS AVAILABLE IN ON POSITION

The following is a list of displays available on the ADM-616A when the key switch is in the ON position. With the key switch in the ON position the unit is switched on and only limited operations are accessible by the operator. In this position, the key can be removed and the unit will continue to operate. This provides security against unauthorized tampering such as changing the alarm set points, detector status, filter parameters and unit ID. Some display modes are common to all probes while others are probe dependent. See the operating section for the specific probe to determine which displays are valid for that probe.

	AVAILABLE MODE DESCRIPTION: LOCAL KEY SWITCH IN ON POSITION	MANUAL SECTION
a.	View rate in mR/h, mRem/h, cpm, $\mu\text{Ci/cc}$, for each probe.	3.5.6
b.	View Auxiliary Rates, ABP-100, PAM-100, GSP-100	3.5.7
c.	View Specialized Isotope List	3.5.8
d.	View Dose or Sum in mR, mRem, cts.	3.5.9
e.	View "HIGH" alarm set point.	3.5.10
f.	View "ALERT" alarm set point.	3.5.11
g.	View "DOSE" or "SUM" alarm set point.	3.5.12
h.	Activate Survey mode.	3.5.13
i.	Activate Scaler mode	3.5.14
j.	View Sample Flow Rate (PAM-100 only)	3.5.15
k.	View Total Sample Flow (PAM-100 only)	3.5.16
l.	View Date and Time	3.5.17
m.	View battery voltage.	3.5.18
n.	View Unit ID.	3.5.19
o.	Perform lamp tests.	3.5.20

NOTE: With the key switch in the ON position operating modes switch to the default display after approximately 10 seconds.

3.5.6 RATE DISPLAY

The ADM-616A measures and displays Dose Rates (mR/h, mRem/h), Count Rates (cpm), or concentration ($\mu\text{Ci/cc}$) as appropriate for the attached probe.

3.5.7 AUXILIARY RATE DISPLAY

The Auxiliary Rate Displays are either measured rates or rates calculated from one or more measured rates and any appropriate scale factors. These rates may be values that are not directly measured by the ADM-616A, but are a composite values that can be measured.

3.5.8 SPECIALIZED DISPLAYS

The Specialized Displays are displayed in $\mu\text{Ci}/\text{cm}^2$ for the AP-100 and ABP-100, and in $\mu\text{Ci}/\text{cc}$ for the MD-35 Alpha Probe and MD-35 with PAM-100.

For the ABP-100 there are lists of five Alpha isotopes and Beta four isotopes. The lists of isotopes are accessed by pressing the (!) switch from the first specialized displays for the net Alpha and Beta count rates.

ABP-100 ISOTOPE LISTS	
ALPHA ISOTOPES	BETA ISOTOPES
Th-232	Sr-90
Ra-226	Pm-147
Am-241	C-14
U-238	Tc-99
Pu-239	

The PAM-100 Specialized Display gives a list of 5 isotopes for alpha particulate monitoring and displays values in $\mu\text{Ci}/\text{cc}$. The list is accessed by pressing the (!) switch from the first specialized display for the net Alpha count rate.

PAM-100 ISOTOPE LIST
Ra-226
Pu-239
Th-232
Am-241
U-238

3.5.9 ACCUMULATION AND ACCUMULATION DISPLAY

The ADM-616A calculates and displays the total accumulated dose or count sum since the dose or sum was last cleared. This value is stored in non-volatile memory and is not lost after the ADM-616A has been powered off for an extended period of time. This accumulated value can be viewed by pressing the MODE switch once from the rate display.

The value is cleared from the Accumulation display. Press and hold both the SET button and then the (!) button while the Accumulation display is present. After approximately four seconds, the display will indicate "CLEAR DOSE." Continue holding the buttons until the accumulation value is zeroed. Release the buttons.

3.5.10 HIGH ALARM OPERATION, DISPLAY AND SET PROCEDURE

The ADM-616A indicates a High alarm condition when the rate reading meets or exceeds the High alarm set point. The alarm condition is latching and will remain on until the rate reading goes below the alarm set point and the user presses the RESET button. Pressing the RESET button while the alarm condition still exists will mute the horn for this alarm condition.

A high alarm condition is indicated by the High alarm relay being in its alarm state, High lamp being lit, sounding of the horn, and a flashing "H" in the top right position of the ADM-616A's display. The alarm condition will also be communicated over the serial communication links to any monitoring device(s). The Normal lamp on the front panel will extinguish during this condition if it were present before the High alarm condition.

High Alarm values are entered by pressing the MODE switch until the High Alarm Set Point is displayed. Press SET to select the digits to be changed and (!) to change the digits. Press SET until all the digits have been selected, then the ADM-616A will return to the default display. The High Alarm can only be changed with the key switch in the KEYPAD position.

3.5.11 ALERT ALARM OPERATION, DISPLAY AND SET PROCEDURE

The ADM-616A indicates an Alert alarm condition when the rate reading meets or exceeds the Alert alarm set point. The alarm condition is latching and will remain on until the rate reading goes below the alarm set point and the user presses the RESET button. Pressing the RESET button while the alarm condition still exists will mute the horn for this alarm condition.

An Alert Alarm condition is indicated the Alert alarm relay being in its alarm state, the Alert lamp being lit, sounding of the horn, and a flashing "A" in the top right position of the ADM-616A's display. The alarm condition will also be communicated over the communication serial links to any monitoring device(s). The Normal lamp on the front panel will extinguish during this condition if it were present before the Alert alarm condition. A high alarm indication of a flashing "H" will take priority over the flashing "A" if present.

Alert Alarm values are entered by pressing the MODE switch until the High Alarm Set Point is displayed. Press SET to select the digits to be changed and (↑) to change the digits. Press SET until all the digits have been selected, then the ADM-616A will return to the default display. The Alert Alarm can only be changed with the key switch in the KEYPAD position.

3.5.12 ACCUMULATION ALARM OPERATION, DISPLAY AND SET PROCEDURE

The ADM-616A indicates a Dose or count Sum alarm condition when the Dose or count Sum accumulation meets or exceeds the Dose or Sum alarm set point. The alarm condition is latching and will remain on until the reading is cleared and the user presses the RESET button.

A Dose or Sum Alarm condition is indicated by a flashing "D" in the top right position of the ADM-616A's display. The alarm condition will also be communicated over the communication serial links to any monitoring device(s). The Normal lamp on the front panel will extinguish during this condition if it were present before the Dose or Sum alarm condition. A High or Alert Alarm indication of a flashing "H" or "A" will take priority over the flashing "D" if present.

Dose or Sum Alarm values are entered by pressing the MODE switch until the Dose or Sum Alarm Set Point is displayed. Press SET to select the digits to be changed and (↑) to change the digits. Press SET until all the digits have been selected, then the ADM-616A will return to the default display. The Dose or Sum Alarm can only be changed with the key switch in the KEYPAD position.

3.5.13 SURVEY MODE

The ADM-616A can be used to make multiple survey entries and view these entries later. The survey mode is only available when the ADM-616A is used with probes that display in dose rate or count rate. For example, the GP-100 Gamma Probe and NP-100 Neutron Probe take surveys in mR/h and mRem/h and GSP-100 Gamma probes and BP-100 Beta probes take surveys in cpm.

In survey mode, the ADM-616A measures the average dose rate or count rate. The average is measured over a period of two minutes.

3.5.14 SCALER MODE

The scaler mode provides a summing function similar to the Accumulation display. However, in scaler mode the summing function occurs over a user selectable period. This allows accurate objective recording to be made without any mental averaging of

displayed count rates by the operator. For example, if smear samples from suspected contaminated areas are to be evaluated, a one minute scaler could be made of each smear sample.

3.5.15 SAMPLE FLOW RATE (PAM-100 ONLY)

Sample Flow Rate is displayed for the PAM-100 only and is measured in SCFH.

3.5.16 TOTAL SAMPLE FLOW (PAM-100 ONLY)

Total Sample Flow is displayed for the PAM-100 only and is measured in SCF. The Total Sample Flow value is cleared from this display. Press and hold both the SET button and then the (↑) button while this display is present. After approximately four seconds, the display will indicate "CLEAR Total Flow." Continue holding the buttons until the value is zeroed. Release the buttons.

3.5.17 DATE AND TIME DISPLAY AND SET PROCEDURES

The ADM-616A has an internal real time clock that can be set from the front panel. The format is yyyy/mm/dd hh:mm and is year 2000 compliant. The Date and Time display indicates the current setting of the Date and Time.

Press SET to select the digits to be changed and (↑) to change the digits. The ADM-616A date and time are set in the following sequence: month, day, year, hour, and minutes. The first two digits of the year are selected by the ADM-616A to be either 19 or 20, depending on the value of the third digit. If the third digit is 9, the first two digits are 19. Otherwise, the first two digits are 20. Press SET until all the digits have been selected, then the ADM-616A will return to the default display. The Date and Time can be changed only with the key switch in the KEYPAD position.

3.5.18 BATTERY VOLTAGE

The Battery Voltage display indicates the condition of the internal lead-acid batteries that provide back up power and allow limited portable use. The value is displayed in Volts DC (e.g., 26.4 VDC). While the ADM-616A is operating from AC power, this display indicated the DC voltage supplied by the AC to DC converter.

3.5.19 "UNIT ID" DISPLAY AND SET PROCEDURE

The ADM-616A maintains a Unit ID for identification. The Unit ID must be set correctly for the ADM-616A to communicate over the serial communications links to any monitoring device(s). Monitoring devices request information by Unit ID number, and if the ADM-616A does not have a matching Unit ID, it will not respond to the requests.

The Unit ID display indicates the current setting of the Unit ID number. Press SET to select the digits to be changed and (↑) to change the digits. Press SET until all the digits have been selected, then the ADM-616A will return to the default display. The Unit ID can be changed only with the key switch in the KEYPAD position.

3.5.20 PERFORM LAMP TESTS

Pressing the TEST switch puts the ADM-616A into lamp test mode. This mode activates all lamps and is exited upon release of the TEST switch. The Lamp test can be performed with the key switch in either the ON or KEYPAD positions.

3.5.21 PERFORM PROBE CALIBRATION

The Aptec-NRC Area monitor smart probes (mR/h or mRem/h units displayed) are calibrated by placing the detector in an appropriate radiation field and following calibration procedures. The ADM-616A is entered into calibration mode by simultaneously pressing the SET and (↑) buttons while the key is in KEYPAD position. The SET and (↑) are then used to enter the proper calibration information.

3.5.22 VIEW AND ADJUST FILTER MODE SETTINGS

Filter Mode adjustments are made by depressing SET and MODE simultaneously when the ADM-616A is operating with any direct-count (i.e., not Time-To-Count G-M Detector). Pushing the (↑) button toggles through the filter modes and pushing the SET button accepts the filter mode that is displayed on the top line. The Filter Modes are:

- a. Unfiltered.
- b. Time Mode, adjustable from 00:00 to 10:00 minutes.
- c. Statistics Mode, 10%.
- d. Statistics Mode, 3%.
- e. Statistics Mode, 1%.
- f. Exponential Mode (not recommended for use).

This Filter Mode display shows the current filtering mode, Time, Statistics, or Exponential and the associated setting for the

current filtering mode, if enabled. It displays "Filter Disabled" if no filtering is enabled. Note that this is a "locked out" display.

Pressing the SET button from the Filter Mode Display enters the unit into the Filter Mode Set Procedure. At this point the operator is prompted to press the SET or the (↑) buttons associated with the desired filter mode.

Press SET to accept the displayed filter mode without any changes and pressing MODE returns to the Default display. Pressing the (↑) button from the Filter Mode Set Procedure display gives the operator the options of Time, Statistics, Exponential and no filter. The available modes and their selection procedures are listed below.

If the MODE button is pressed before the SET button in the following subsections, then the change is canceled and the filter status returns to the original unchanged status.

3.5.22.1 UNFILTERED MODE

Press the (↑) button from the Filter Mode Set Procedure display select the unfiltered mode (no filter mode) option. Press SET to accept the displayed filter mode and MODE to return to the Rate display.

3.5.22.2 TIME MODE FILTERING

Press the (↑) button from the Filter Mode Set Procedure display to select the Time Mode Filtering Procedure. At this point the operator must select the filtering time. If the currently displayed filtering time is desired or if a filtering time other than the displayed time is desired, press the SET button to select it. The desired acquisition time can then be selected using the SET and (↑) switches. The MODE button is pressed again to return the display to the Rate display.

3.5.22.3 STATISTICS MODE FILTERING

Press the (↑) button from the Filter Mode Set Procedure display into the Statistics Mode Filtering Set Procedure. The (↑) button can then be pressed to toggle among the available percent accuracy selections, 1%, 3% or 10%. The SET button is then pressed to accept the displayed filter status. The MODE button is pressed again to return the display to the Rate display.

3.5.23 VIEW AND ADJUST USER SCALE FACTOR (PAM-100 ONLY)

The ADM-616A provides a User Scale Factor for use with the PAM-100. With the PAM-100 the User Scale Factor is used as the Flow Rate Scale Factor.

The ADM-616A uses the Flow Rate Scale Factor to calibrate the air sample flow rate from the PAM-100, correcting for variations from one PAM-100's flow meter to the next. This variable must be adjusted whenever a different PAM-100 is connected to the ADM-616A.

The Scale Factor View Mode is entered by actuating the MODE switch from the Filter Mode Display. This Scale Factor display shows the current Scale Factor. At this point the operator is prompted to actuate the SET switch to select the scale factor set procedure. Using SET and (↑) switches, the User Scale Factor can be changed.

3.5.24 NICKEL-63 DETECTOR DISPLAYS

The Nickel 63 Detector is treated differently than most other Smart probes. The default display, after the configuration display, is not a rate display like for other probes. Instead it displays the message "Nickel 63 Detector" on both lines of the display. Lamp test mode, calibration mode, and AUX relay functions may be accessed from this display. These functions are accessed as described previously. The lamp test function provides a display that indicates the μCi count the detector is currently indicating.

Press MODE once from the Nickel 63 display to access the Sample/Background mode. The top line displays the last sample taken in μCi and the bottom line displays the last background taken in cps. Pressing (↑) will cause an initial background sample to be taken if one has not been taken previously, or cause a new background sample if one has been previously stored.

Pressing SET will cause a sample count to be taken after a 30-second delay time. When the one minute counting time has elapsed, the Sample Average is displayed. The Sample Average is adjusted for background counts if a background average has been stored. Press MODE to return to the Sample/Background display. Sample or Background readings can be aborted before the one minute time by pressing MODE to pause the count then SET to exit the count mode.

After a sample count has been taken, the net μCi (sample - background) reading is compared to the High and Alert set points and those alarms are set as appropriate. When an alarm is found, pressing RESET clears the alarm and the unit is ready for the next sample or background count.

Press MODE from the Sample/Background display to view and adjust High Alarm set point, followed by the Alert Alarm set point,

and Unit ID displays. These displays are the same as for other probes described earlier, except the units are in microcuries (μCi).

3.5.25 PRINCIPLES OF FILTER OPERATION

3.5.25.1 DATA FILTERING ALGORITHMS

The ADM-616A acquires signal data from nuclear radiation monitoring detectors, filters the data to reduce the effects of the randomness of the data, and compares the results to preset limits for the determination of FAIL, ALERT, and HIGH alarm status.

To implement this procedure, the ADM-616A accumulates digital pulses in a counter. The counter is 16 bits long and therefore can accumulate up to 65,535 counts. The contents of the counter is read every 10 milliseconds and accumulated. Thus, the maximum count rate that can be accommodated without overflow is $65,535 \times 100 = 6,553,500$ counts per second (393,210,000 counts per minute). For the maximum count rate specified for the ADM-616A of 10,000,000 CPM, the input counter will never experience an overflow condition, so accuracy of count is assured.

The counter contents that is read every 10 millisecond is summed in an accumulator for a two second period and then stored in memory. Each two-second accumulation is similarly stored in memory in a buffer with sufficient memory space to store 10 minutes of acquired data (300 accumulations). The buffer is ring configured so that the 301st accumulation replaces the first accumulation, the 302nd replaces the second, etc., in a continuing fashion.

The ADM-616A filters the accumulated data in a fashion that is user selectable. The two modes available are known as TIME mode and STATISTICS mode.

3.5.25.2 TIME MODE FILTERING

Time mode filtering is a conventional digital technique common to most digital instruments. The time mode uses a filtering technique, sometimes called boxcar filtering, which takes the mean value of a fixed number of the accumulation samples mentioned above. The time mode in the ADM-616A offers time intervals for filter averages from two seconds to ten minutes in two second increments. Thus, for a one minute filter, thirty 2-second accumulations are averaged to obtain the mean value. After thirty sample accumulations are obtained, the subsequent averages are obtained by dropping the oldest sample accumulation and adding the next new accumulation sample. Thus, the signal output will represent a sliding boxcar average of thirty sample accumulations. A three minute filter operates identically, but with ninety sample

accumulations included in the average. A ten minute average is also identical, but uses 300 sample accumulations in the average.

The decision whether or not to initiate an alarm is made after each two-second accumulation is obtained and the appropriate mean value calculated.

The statistical accuracy of the computed mean will be a function of the count rate being measured. One minute filtering will yield one percent accuracy if the count rate averages 10,000 CPM; three percent accuracy if the count rate averages 1,000 CPM; or 10 percent accuracy if the count rate averages 100 CPM.

Three minute filtering will yield one percent accuracy if the count rate averages 3,333 CPM, three percent accuracy if the count rate averages 333 CPM; or ten percent if the count rate averages 33 CPM.

Ten minute filtering will yield one percent accuracy if the count rate averages 1,000 CPM, three percent accuracy if the count rate averages 100 CPM; or ten percent if the count rate averages 10 CPM.

An alarm is tripped if the current mean value of the filtered data is above the alarm trip point setting. For example, if the filter is set for one minute filtering, the alarm will be tripped if the total sum of the thirty 2-second sample accumulations is higher than the alarm set point in CPM. For a set point of 1,000 CPM an alarm will be sounded as soon as the current thirty sample boxcar of sample accumulations adds to 1,000 or more.

If, in the example cited, the average signal rate is 300 CPM, then, on average, each two-second sample contains about 10 counts. Adding twenty-nine of these samples yields 290 counts. If the next sample has greater than $(1,000 - 290)$, that is, 710 counts, the alarm will be sounded after one two-second update is obtained. Lower count rates would require correspondingly longer times to trip the alarm.

Selection of the filtering time setting involves a trade off between accuracy and speed of response. It is important to note that the data contained in a short burst of counts, even if not sufficient to activate the alarm, is not lost. It is averaged into the period corresponding to the time setting; i.e., the area under a chart recorder curve presentation (corresponding to total counts) will be the same as it would be if the count rate were an instantaneous representation.

3.5.25.3 STATISTICS MODE FILTERING

The ADM-616A has another filter algorithm which can be selected. One, three, or ten percent statistical accuracy can be

selected in this algorithm. The ADM-616A collects data counts in two-second sample accumulations as described above. The method of computing the mean value, however, is different.

In the one percent mode, each two-second sample accumulation is summed, beginning with the most recent sample, until a total count of 10,000 is reached (10,000 is required for one percent accuracy) or until the entire boxcar ring buffer is included. In the three and ten percent modes, each two-second sample accumulation is summed until a total count of 1,000 or 100, respectively, is reached. For low count rates many sample accumulations are required. For high count rates only a few samples are required.

3.6 DISPLAY MODES FOR REMOTE ADM-616A

The ADM-616A can be used as a remote display and control unit for one, two, or three Aptec-NRC Local Display and Control Units, including ADM-616A, ADM-606M, and ADM-606 via the RS-485 port 1, or one TAM-100 Unit via the RS-232 port.

If only one local ADM-606, ADM-606M, or ADM-616A is connected to the remote ADM-616A, the local unit may have up to three probes connected. Probes will be displayed in the same order as on the local unit. The Unit ID of the local and remote units must be the same and can be set from 0001 to 9999.

If more than one Local Display and Control unit is connected to remote ADM-616A, only one probe may be connected to each local unit. The remote unit's ID must be set to 0001. The local units must have their Unit ID's set to 0001 and 0002 for two local units, or 0001, 0002, and 0003 for three local units. These ID's will determine the order that the remote unit will display the detector information.

Alternately, the ADM-616A can be used as a remote display unit for one ADM-616A, ADM-606, or TAM-100 via the RS-232 port. The conditions for a single local unit, described previously in this section, apply when using the RS-232 port to communicate with a TAM-100.

This section outlines the displays available with the various Local Displays connected. Consult the flow charts at the end of this section for which displays are available with which probes.

3.6.1 SYSTEM CHECK OUT AND POWER ON

Before connecting a Local Display and Control Unit to the ADM-616A the steps outlined in this section must be performed.

- a. Place the ADM-616A key switch in the OFF position.
- b. Connect the Local Display and Control Unit(s) to the proper COMM port on the ADM-616A.
- c. Switch on the ADM-616A by placing the key switch in the KEYPAD or ON position.
- d. The ADM-616A requires approximately fifteen seconds to initialize and perform self diagnostics and determine operating mode. During this period the ADM-616A display shows "Please Wait."
- e. The ADM-616A will display the current configuration, local or remote, and number of probes.

- f. View the rate for Probe 1, Probe 2, and Probe 3, if attached by pressing the (↑) switch.

3.6.2 SETTING OR CHANGING CONFIGURATION

To configure the ADM-616A as a remote unit, press RESET while the current configuration is displayed at start-up. Press SET to toggle local or remote operation. Press (↑) to increment the number of probes. Press MODE to save the configuration and begin normal operation.

3.6.3 DISPLAYS AND FUNCTIONS AVAILABLE IN THE KEYPAD POSITION

The following is a list of displays available on the ADM-616A when the key switch is in the KEYPAD position. Some display modes are common to all probes while others are probe dependent. See the flow charts in Section 6 for the specific probe to determine which displays are valid for that probe.

	AVAILABLE MODE DESCRIPTION: REMOTE KEY SWITCH IN KEYPAD POSITION	MANUAL SECTION
a.	View rate in mR/h, mRem/h, cpm, $\mu\text{Ci/cc}$, for each probe.	3.5.6
b.	View Auxiliary Rates, ABP-100	3.5.7
c.	View Specialized Isotope List, ABP-100, PAM-100, TAM-100	3.5.8
d.	View and clear Dose or Sum in mR, mRem, cts.	3.5.9
e.	View and adjust "HIGH" alarm set point.	3.5.10
f.	View and adjust "ALERT" alarm set point.	3.5.11
g.	View and adjust "DOSE" or "SUM" alarm set point.	3.5.12
h.	View Sample Flow Rate (PAM-100 only)	3.5.15
i.	View and clear Total Sample Flow (PAM-100 only)	3.5.16
j.	View and adjust Date and Time	3.5.17
k.	View battery voltage.	3.5.18
l.	View and adjust Unit ID.	3.5.19
m.	Perform lamp tests.	3.5.20

Note: With the key switch in the KEYPAD position, operating modes do not automatically switch back to the default display unless the mode's function is executed or the RESET button is pressed.

3.6.4 DISPLAYS AND FUNCTIONS AVAILABLE IN THE ON POSITION

The following is a list of displays available on the ADM-616A when the key switch is in the ON position. Some display modes are common to all probes while others are probe dependent. See the flow charts in Section 6 for the specific probe to determine which displays are valid for that probe.

	AVAILABLE MODE DESCRIPTION REMOTE KEY SWITCH IN ON POSITION	MANUAL SECTION
a.	View rate in mR/h, mRem/h, cpm, $\mu\text{Ci/cc}$, for each probe.	3.5.6
b.	View Auxiliary Rates, ABP-100	3.5.7
c.	View Specialized Isotope List, ABP-100, PAM-100, TAM-100	3.5.8
d.	View Dose or Sum in mR, mRem, cts.	3.5.9
e.	View "HIGH" alarm set point.	3.5.10
f.	View "ALERT" alarm set point.	3.5.11
g.	View "DOSE" or "SUM" alarm set point.	3.5.12
h.	View Sample Flow Rate (PAM-100 only)	3.5.15
i.	View Total Sample Flow (PAM-100 only)	3.5.16
j.	View Date and Time	3.5.17
k.	View battery voltage.	3.5.18
l.	View Unit ID.	3.5.19
m.	Perform lamp tests.	3.5.20

NOTE: With the key switch in the ON position operating modes switch to the default display after approximately 10 seconds.

3.7 ANALOG OUTPUTS

The ADM-616A provide four 0-5 Volt analog outputs, one for each probe channel, and one unused. Each voltage output represents the present rate from its associated probe channel as indicated in Equation 3-1 below. The 0-5 Volt outputs represent six decades of activity, starting at a rate of 1.00E-1, to a maximum rate of 1.00E+5.

$$V_{out1} \text{ (VDC)} = \frac{5}{6} \log \left[\frac{Rate1}{0.1} \right]$$

$$V_{out2} \text{ (VDC)} = \frac{5}{6} \log \left[\frac{Rate2}{0.1} \right]$$

$$V_{out3} \text{ (VDC)} = \frac{5}{6} \log \left[\frac{Rate3}{0.1} \right]$$

Equation 3-1:

3.8 SERIAL COMMUNICATIONS PROTOCOL

The ADM-616A can be connected to a computer that can poll the ADM-616A for real time data and status information, alter alarm set points, reset alarms, initiate test modes, and many other features. This is achieved through the RS-485 ports provided on the Customer Interface Panel. The computer must send commands as defined by the ADM-616A communications protocol.

3.8.1 SERIAL COMMUNICATIONS

The ADM-616A Ratemeters includes three RS-485 ports for interfacing to a host computer or terminal. Most of the information and functions available at the front panel are also available on the serial link. The information and functions available include:

- a. Dose Rate
- b. Dose
- d. High Alarm Set Point
- e. Alert Alarm Set Point
- f. Dose Alarm Set Point
- g. Status (i.e., alarms, failures, key position)
- h. Set point changes.
- i. Check Source Mode.
- j. Clear Dose, Reset latched Alarms.

3.8.2 COMMUNICATIONS PROTOCOL

Any of the items from the previous section can be acquired from (or sent to) the ADM-616A by connecting either a terminal or Personal Computer with an RS-485 port. Refer to ADM-616A Operation & Maintenance Manual Section 3 for pin definitions of the unit's COMM connector. The ADM-616A normally communicates at 2400 baud, 8 data bits, no parity, and 1 stop bit. The baud rate may be lowered for special applications at customer request.

The ADM-616A serial communications protocol uses four basic commands with list of options for each. The basic commands are:

ASCII	#	Description
'P'	25	Send requested values
'Q'	26	Send Historical values
'R'	27	Load values (Alarm Set points)
'S'	28	Miscellaneous commands: Clear Dose, check source

3.8.3 DATA REQUESTS -- P COMMAND

3.8.3.1 FORMAT FOR P COMMAND DATA REQUEST

A data request command string can be sent by the host computer to request any one, or all, of the available items. The request command string is composed of the following characters:

<u>LAYOUT OF BYTES IN REQUEST STRING</u>		<u>BYTE #</u>
'CR'	Carriage return	1 (^M)
'LF'	Line feed	2 (^J)
'P'	Request Command	3
----	Unit ID (1 to 4 decimal digits)	4 to 7
'SPACE'	Delimiter	?
----	Request item bytes	????
'SPACE'	Delimiter	?
--	Check Sum	??
'}'	Terminator	?

3.8.3.2 REQUEST ITEMS FOR P COMMAND

Request item bytes are represented by single ASCII characters given in the table below. Any or all of the items can be requested in a single command. The items are listed in the command string without spaces in between.

ASCII DESCRIPTION

'0' -> Status group

'1' -> Rate Filtered (Chan 1)
'2' -> Rate Unfiltered (Chan 1)
'3' -> Rate Curie (Chan 1)
'4' -> Dose (Chan 1)

'5' -> Rate Alarm: High (Chan 1)
'6' -> Rate Alarm: Alert (Chan 1)
'7' -> Dose Alarm (Chan 1)

'8' -> Rate Filtered (Chan 2)
'9' -> Rate Unfiltered (Chan 2)
'A' -> Rate Curie (Chan 2)
'B' -> Dose (Chan 2)
'C' -> Rate Alarm: High (Chan 2)
'D' -> Rate Alarm: Alert (Chan 2)
'E' -> Dose Alarm (Chan 2)

'F' -> Total Acq# & Strikes (Chan 1)
'G' -> Total Acq# & Strikes (Chan 2)
'H' -> Total Acq# & Strikes (Chan 3)

'I' -> Dose Curie (Chan 1)
'J' -> Dose Curie (Chan 2)

'K' -> Clear New Data flag
'L' -> Clear Modified Alarm Set point flag

'V' 31 -> Rate Filtered (Chan 3)
'W' 32 -> Rate Unfiltered (Chan 3)
'X' 33 -> Rate Curie (Chan 3)
'Y' 34 -> Dose (Chan 3)
'Z' 35 -> Rate Alarm: High (Chan 3)
'a' 36 -> Rate Alarm: Alert (Chan 3)
'b' 37 -> Dose Alarm (Chan 3)
'c' 38 -> Dose Curie (Chan 3)

'p' 51 -> Rate Filtered (Chan 1x2)
'q' 52 -> Rate Unfiltered (Chan 1x2)
'r' 53 -> Rate Curie (Chan 1x2)
's' 54 -> Dose (Chan 1x2)
't' 55 -> Rate Alarm: High (Chan 1x2)
'u' 56 -> Rate Alarm: Alert (Chan 1x2)
'v' 57 -> Dose Alarm (Chan 1x2)
'w' 58 -> Dose Curie (Chan 1x2)

3.8.3.2.1 FLAGS AFFECTED BY REQUEST ITEMS

The New Data flag is set every two seconds by the ADM-616A to signal that new data is available for the host computer. The ADM-616A acquires data over a two second period and updates the data available at the end of that two-second period. When the new data is available, the flag is set as one of the Status Bytes described later. The flag is cleared by use of the *P* command item *K*. The user may wish to only poll the ADM-616A for status bytes until the New Data flag is set.

The Modified Alarm Set Point flag is set at power up and whenever the Alarm Set Points are modified locally at the ADM-616A. If set points are being read by the host computer, the host computer need only download set points when this flag is set in the Status Bytes. The flag is cleared using the *P* command item *L*.

3.8.3.3 P COMMAND REQUEST STRING FORMAT

Request strings to the ADM-616A are formatted as in the following example:

```
INPUT:  ^M^JP0001 01456 60}
```

This string represents a request for all available data items where:

```
^M = Carriage Return  
^J = Line Feed  
P = Request command  
0001 = Unit ID, set at front panel of ADM-616  
    = Space  
01456 = Requests items 0, 1, 4, 5, 6  
    = Space  
60 = Check Sum  
} = Terminator character
```

The Check Sum at the end of the string is determined by Exclusive OR-ing (XOR) the Hex values of all the ASCII character in the string, including the Carriage Return and Line Feed at the beginning, and the SPACE before the Check Sum at the end. The resultant 2 digit Hex value is represented by 2 ASCII characters for those digits. Some versions of ADM-616A software do not require the check sum be present, but all will return a check sum with the response string.

3.8.3.4 RESPONSE STRINGS FOR P COMMAND

The ADM-616A sends data in response to the P command in the following general format:

<u>LAYOUT OF BYTES IN OUTPUT STRING</u>		<u>BYTE #</u>
'CR'	Carriage return	1
'LF'	Line feed	2
-	String Error Code (SPACE=OK)	3
----	Unit ID (1 to 4 decimal digits)	4 to 7
'SPACE'	Delimiter	?
----	Request items	
----	List: Rates, Sum Alarm Set points (items separated by spaces)	????
--	Check Sum: 2 Hex chars	??
'}'	Terminator:	?

3.8.3.5 RESPONSE STRING FORMAT

Output strings from the ADM-616A are sent to the computer in the following format.

OUTPUT: ^M^J P1 01456 0100002 499-1 979+1 200+2 100+2 11}

This output string is a sample response to the input string of Section 3.8.3.3 and represents the following:

^M	Carriage Return
^J	Line Feed
SPACE	error code or space indicates response packet
P1 01456	echo of request packet, leading zeroes of ID are omitted
2100000002	Status Bytes (ADM-606/616, New Data Ready, No Alarms, Keypad Enabled)
499-1	4.99E-1 mR/h, Gamma Dose Rate
979+1	9.79E+1 mR, Gamma Dose
200+2	2.00E+2 mR/h, Gamma High Alarm
100+2	1.00E+2 mR/h, Gamma Alert Alarm
11	Check Sum, determined as in request string
}	Terminator Character

STATUS BYTES

Status bytes give information about what is happening at the local ADM-616A, such as alarm conditions, set point changes, hardware failures, and key switch position. Each Status byte is sent as a single ASCII character that represents the hex value of that byte.

BYTE	Description	Description of Data Bits
1	Model ID:	0 -> Detector (local) unit 1 -> Control Room (Remote) unit
2	Status Bits	BIT0: 1 -> New Data Ready BIT1: 2 -> Alarm Set points modified
3	Channel 1 Alarms	BIT0: 1 -> Channel 1 High BIT1: 2 -> Channel 1 Alert BIT2: 4 -> Channel 1 Dose BIT3: 8 -> Channel 1 Rate of Rise
4	Channel 2 alarms	BIT0: 1 -> Channel 2 High BIT1: 2 -> Channel 2 Alert BIT2: 4 -> Channel 2 Dose BIT3: 8 -> Channel 2 Rate of Rise
5	Channel 3 alarms	BIT0: 1 -> Channel 3 High BIT1: 2 -> Channel 3 Alert BIT2: 4 -> Channel 3 Dose BIT3: 8 -> Channel 3 Rate of Rise
6	Channel 1X2 alarms	BIT0: 1 -> Channel 3 High BIT1: 2 -> Channel 3 Alert BIT2: 4 -> Channel 3 Dose BIT3: 8 -> Channel 3 Rate of Rise
7	Sample Flow & Stack Flow	BIT0: 1 -> Low Sample Flow BIT1: 2 -> High Sample Flow BIT2: 4 -> Low Stack Flow BIT3: 8 -> High Stack Flow
8	Vacuum Alarms	BIT0: 1 -> Low Vacuum BIT1: 2 -> High Vacuum
9	ADM-616 Failure Code	BIT0: 1 -> Hardware Failure* BIT1: 2 -> No Count Failure BIT2: 4 -> Check Source Alarm

BYTE	Description	Description of Data Bits
10	ADM-616 Hardware Status	BIT0: 1 -> AC Power Failure BIT1: 2 -> Key Switch enabled BIT2: 4 -> Check Source mode BIT3: 8 -> Calibrate mode 10-> Test 1 Mode 14-> Test 2 Mode 18-> Test Exit Mode
11	Remote ADM-600 Failure Code	BIT1: 2 -> ROM/RAM error BIT4: A -> Detector Link Failure
12	Remote ADM-600 Hardware Status	BIT0: 1 -> AC Power Failure BIT1: 2 -> Key Switch enabled BIT3: 4 -> Check Source Mode BIT4: 8 -> Calibrate Mode

*NOTE: Hardware Failure Byte includes the following:
 A. ROM/RAM Failure
 B. Internal EEPROM Failure
 C. External EEPROM Failure
 D. Background Watchdog Failure
 E. Power Down Interrupt

Several of the Status Bytes encode multiple, and possibly simultaneous, conditions at the ADM-616A. Each condition is internally represented by a single bit in the given byte. Each possible combination represents a specific set of conditions.

The described conditions for each byte include the hex values that those conditions add to the byte when it exists. The sum of these values determines which conditions exist. See the following example:

Status Bytes received: 2333300006

Byte 1 = 0: 2 = ADM-606/616A Detector Unit

Byte 2 = 3: 1 = New Data Ready 1 + 2 = 3
 2 = Alarm Set Points Modified

Byte 3 = 3: 1 = Channel 1 High alarm 1 + 2 = 3
 2 = Channel 1 Alert Alarm

Byte 4 = 3: 1 = Channel 2 High alarm 1 + 2 = 3
 2 = Channel 2 Alert Alarm

Byte 5 = 3: 1 = Channel 3 High alarm 1 + 2 = 3
 2 = Channel 3 Alert Alarm

Byte 6 = 0: 0 = Channel 1x2 No alarm

Byte 7 = 0: 0 = No Flow Alarms

Byte 8 = 0: 0 = No Vacuum Alarms

Byte 9 = 0: 0 = No Hardware Failures

Byte10 = 6: 2 = Keyswitch enabled 2 + 4 = 6
 4 = Check Source mode active

Bytes 11 and 12 are special case bytes that are only used when a host computer is connected to a remote ADM-606 or ADM-616A which is communicating with the local ADM-616A detector unit.

3.8.4 HISTORY REQUESTS -- Q COMMAND

The History Request - Q command feature is not currently supported on the ADM-616A.

3.8.5 UPLOAD COMMANDS -- R COMMANDS

3.8.5.1 FORMAT FOR R COMMAND UPLOADS

An Upload (i.e., install values) command string can be sent by the host computer to perform any one of the available items. The request command string is composed of the following characters:

<u>LAYOUT OF BYTES IN REQUEST STRING</u>		<u>BYTE #</u>	
'CR'	Carriage return	1	(^M)
'LF'	Line feed	2	(^J)
'R'	Upload Command	3	
----	Unit ID (1 to 4 decimal digits)	4 to 7	
'SPACE'	Delimiter	8	
-	Command item byte	9	
'SPACE'	Delimiter	10	
--	Check Sum	12	
'}'	Terminator	13	

3.8.5.2 COMMAND ITEMS FOR R COMMAND

Upload items are represented by a single ASCII character that indicates which value is being uploaded and the value itself. Only one value may be uploaded with each command string. The following are the values that may be uploaded:

ASCII DESCRIPTION

```
'5' -> Install Channel 1 High Alarm Set point ###+##
'6' -> Install Channel 1 Alert Alarm Set point ###+##
'7' -> Install Channel 1 Dose Alarm Set point ###+##

'C' -> Install Channel 2 High Alarm Set point ###+##
'D' -> Install Channel 2 Alert Alarm Set point ###+##
'E' -> Install Channel 2 Dose Alarm Set point ###+##

'Z' -> Install Channel 3 High Alarm Set point ###+##
'a' -> Install Channel 3 Alert Alarm Set point ###+##
'b' -> Install Channel 3 Dose Alarm Set point ###+##

't' 55 -> Install Channel 1x2 High Alarm Set point ###+##
'u' 56 -> Install Channel 1x2 Alert Alarm Set point ###+##
'v' 57 -> Install Channel 1x2 Dose Alarm Set point ###+##

'y' 60 -> Date & Time: 'mmddy hhmms'
```

3.8.5.3 R COMMAND UPLOAD STRING FORMAT

Upload strings to the ADM-616A are formatted as in the following example:

```
INPUT: ^M^JR0001 5 100+2 67}
```

This string represents an upload of the Gamma High Alarm set point where:

```
^M = Carriage Return
^J = Line Feed
R = Request command
0001 = Unit ID, set at front panel of ADM-616
     = Space
5 = Upload Channel 1 High Alarm Set Point
   = Space
100+2 = 1.00E+2 mR/h High Alarm Set Point Value
      = Space
67 = Check Sum
   } = Terminator character
```

3.8.5.4 R COMMAND RESPONSE STRING

R command response strings have similar formats, depending on which command is sent. A typical response to the previous command example would be as follows:

```
^M^JR1 5 Done 35}
```

where

```
^M = Carriage Return
^J = Line Feed
1 = Unit ID
  = Space
5 = Upload Command sent
  = Space
Done = Command executed
    = Space
35 = Check Sum, determined as in request string
} = String Terminator
```

3.8.6 MISCELLANEOUS COMMANDS -- S COMMANDS

The Miscellaneous Commands include such functions as clearing accumulated dose, clearing total counts (strikes), and engaging check source if applicable.

3.8.6.1 FORMAT FOR S COMMANDS

A Miscellaneous command string can be sent by the host computer to perform any one of the available items. The request command string is composed of the following characters:

<u>LAYOUT OF BYTES IN REQUEST STRING</u>		<u>BYTE #</u>	
'CR'	Carriage return	1	(^M)
'LF'	Line feed	2	(^J)
'S'	Misc. Command	3	
----	Unit ID (1 to 4 decimal digits)	4 to 7	
'SPACE'	Delimiter	8	
-	Command item byte	9	
'SPACE'	Delimiter	10	
--	Check Sum	12	
'}'	Terminator	13	

3.8.6.2 ITEMS FOR S COMMAND

Miscellaneous items are represented by a single ASCII character that indicates which function is to be performed. Only one item may be sent with each command string. The following are the values that may be uploaded:

<u>ASCII</u>	<u>Description</u>
'00'	-> Enter Terminal Debug mode
'1'	-> Clear Chan 1 Dose
'2'	-> Clear Chan 2 Dose
'3'	-> Clear Chan 1 & 2 Dose
'4'	-> Clear Chan 3 Dose
'7'	-> Check Source Request
'8'	-> Clear Alarms
'9'	-> Clear Sample Total Flow
'A'	-> Test 1
'B'	-> Test 2
'C'	-> Test Exit
'F'	-> Clear Stack Total Flow
'G'	-> Clear Particulate Total Flow
'O'	-> Clear Chan 1 Total Strike Counts
'P'	-> Clear Chan 2 Total Strike Counts
'Q'	-> Clear Chan 1 & 2 Total Strike Counts (& # of Acq periods)
'R'	-> Clear Chan 3 Total Strike Counts

3.8.6.3 S COMMAND STRING FORMAT

The S command string always has the same basic format, changing only for which type of command is sent. The format is as follows:

```
^M^JS0001 1 64}
```

This string represents a command to clear the Gamma Dose where:

```
^M = Carriage Return
^J = Line Feed
S = Request command
0001 = Unit ID, set at front panel of ADM-616A
= Space
1 = Clear Channel 1 Dose
= Space
64 = Check Sum
} = Terminator character
```

3.8.6.4 S COMMAND RESPONSE STRING

S command response strings have similar formats, depending on which command is sent. A typical response to the previous command example would be as follows:

```
^M^JS1 1 Done 00}
```

where

```
^M = Carriage Return  
^J = Line Feed  
   = error code or space  
1  = Unit ID  
   = Space  
1  = Clear Dose Command sent  
   = Space  
Done = Command executed  
     = Space  
00  = Check Sum, determined as in request string  
}   = String Terminator
```

SECTION 4

OPERATOR MAINTENANCE

4.1 GENERAL

Preventive maintenance consists of routine checks of the equipment before and after each use and every 365 days. Routine checks include cleaning, dusting and storing items not in use.

Problems requiring maintenance during routine checks should be referred to maintenance.

4.2 LEAD-ACID BATTERY MAINTENANCE

The ADM-616A uses lead acid batteries for optional backup power. To insure that the batteries remain charged, the unit must be operated from an AC power source for 24 hours every three months. The unit does not require any other items to be connected and must be turned on for the 24-hour period. This is not necessary if the unit is used regularly, every day or other day connected to AC power.

4.3 ROUTINE MAINTENANCE CHECKS

- Check fuses in fuse holder.
- Check J1, J2, J3 and COMM2 connectors on the rear of the unit and COMM connector on the front of the unit to ensure contacts are free of foreign material.
- Check probe cable connectors to ensure contacts are straight and free of foreign material.
- Check for broken display window.
- Check membrane switch for cracks.
- Check key switch to ensure that it is securely mounted to the panel and that the key turns to OFF, KEYPAD, and ON positions.

4.4 TROUBLESHOOTING PROCEDURES

In the event that a problem occurs during the operation of the ADM-616A, the following list of symptoms and corrective actions should be observed:

- A. DISPLAY is BLANK when unit is ON.
- Check that 120 VAC power is connected.
 - Check the toggle switch on inside panel is ON.
 - Check fuse on the inside panel.
- B. IMPROPER or NO ALARM indications during normal operation.
- Check and/or reset alarm set points.
- C. Local ADM-616A fails to recognize external probe.
- Make sure ADM-616A is configured for local operation, and the correct number of probes is selected, one probe selected uses PROBE1 only, two probes use PROBE1 and PROBE2, three probes use PROBE1, PROBE2, and PROBE3.
 - Make sure ADM-616A was turned OFF before the probe was attached. Connecting a probe while ADM-616A is turned ON may cause damage to either the probe or ADM-616A.
 - Inspect connectors for foreign material and make sure cable pins are straight.
 - If fault remains, connect another probe, if available, to the ADM-616A.
 - If no fault is observed, return the original probe to the factory.
 - If fault still exists, try another probe cable.
 - If fault still exists, consult the Hardware and Maintenance manual or return the ADM-616A to the factory for repair.
- D. Remote ADM-616A fails to recognize local ADM-606, ADM-616A, or TAM-100.
- Check that local unit is active.
 - Check that local unit is configured with the proper Unit ID per section 3.6.
 - Check that wiring to the COMM port is correct per Section 2.2.4 of this manual.

The inspections, tests, and corrective action listed should be performed. If normal operation cannot be restored, or if the observed malfunction is not on the list, consult the ADM-616A Hardware & Maintenance Manual M0846 or return the ADM-616A to the factory for repair.

SECTION 5

SPECIFICATIONS

HOUSING:	NEMA 12 Stainless Steel Enclosure
OPERATING TEMPERATURE:	-10° to +50° Celsius
WEIGHT:	Approximately 25 pounds
INPUT POWER:	120 VAC +10%, -13%; 47 to 63 HZ
AC FUSE:	250 VAC, 3/4 amps
DETECTOR INTERFACE:	Provides power, control and counting circuitry for three detector channels
USER INTERFACE:	<ul style="list-style-type: none">•Keypad: six-position keypad•Key Switch: three-position to provide unit ON, OFF and KEYPAD mode lock out feature•Display: vacuum fluorescent alphanumeric, 4 rows of 20 characters•Horn for alarm indication
ALARM INDICATORS:	<ul style="list-style-type: none">•ALARM LAMPS: High, Alert, Normal & Fail•RELAYS: 5 DPDT relays and 1 SPDT relay
COMMUNICATIONS:	<ul style="list-style-type: none">•One RS232C port•Three isolated RS485 ports
ANALOG INPUTS:	<ul style="list-style-type: none">•Eight voltage inputs (4 through 8 configurable for 4-20 milliamp, 7 and 8 configurable as isolated (optional))
ANALOG OUTPUTS:	<ul style="list-style-type: none">•Four 0-5 V (non-isolated)
DIGITAL INPUTS AND OUTPUTS:	<ul style="list-style-type: none">•Four digital lines configurable as inputs or outputs (CMOS compatible voltage levels)
MEMORY BACKUP:	<ul style="list-style-type: none">•Lithium battery for history files data retention•EEPROM for storage of system parameters

SECTION 6

DRAWINGS AND PARTS LISTS

<u>DESCRIPTION</u>	<u>DRAWING NO.</u>
Outline & Installation, ADM-616A	D810117-001

DISPLAY FLOW CHARTS

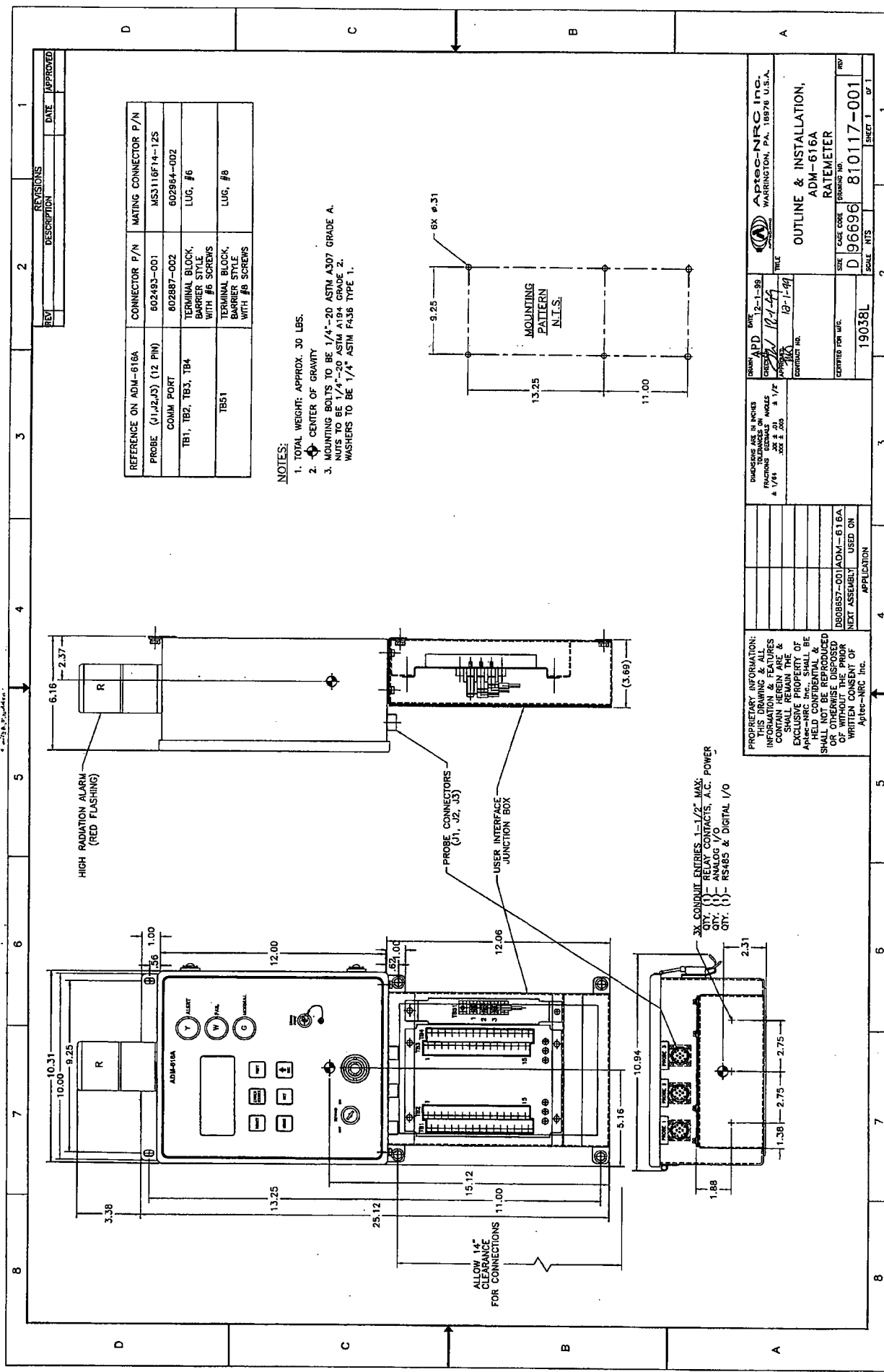
The following drawings are display flow charts for the ADM-616A, for both local and remote display operation, with key switch in KEYPAD and ON positions.

Display Flow Chart, Local Meter, Key in KEYPAD position	D810957-001
Display Flow Chart, Local Meter, Key in ON position	D810957-002
Display Flow Chart, Remote Meter, Key in KEYPAD position	D810957-003
Display Flow Chart, Remote Meter, Key in ON position	D810957-004
Display Flow Chart, NI-63C Nickel-63 Detector	D810957-005

CONFIGURATION DRAWINGS

The following drawings contain jumper settings, hardware modifications from the standard assembly drawing in the Hardware & Maintenance Manual, and EEPROM settings required for the ADM-616A to function as described in this manual.

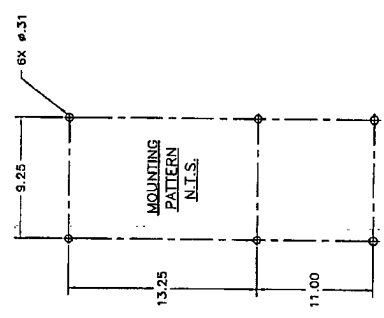
Assembly, Modification, Ratemeter	B808995-001
Parts List, Assembly, Modification, Ratemeter	PL808995-001
EEPROM Parameter Configuration Drawing	B808994-001



REV	DESCRIPTION	DATE	APPROVED

REFERENCE ON ADM-616A	CONNECTOR P/N	MATING CONNECTOR P/N
PROBE (J1, J2, J3) (12 PIN)	602493-001	MS3116F14-12S
CONN PORT	602887-002	602964-002
TB1, TB2, TB3, TB4	TERMINAL BLOCK, BARRIER STYLE WITH #6 SCREWS	LUG, #6
TB51	TERMINAL BLOCK, BARRIER STYLE WITH #8 SCREWS	LUG, #8

- NOTES:
- TOTAL WEIGHT: APPROX. 30 LBS.
 - ⊕ CENTER OF GRAVITY
 - MOUNTING BOLTS TO BE 1/4"-20 ASTM A307 GRADE A. NUTS TO BE 1/4"-20 ASTM A194 GRADE 2. WASHERS TO BE 1/4" ASTM F436 TYPE 1.



3X CONDUIT ENTRIES 1-1/2" MAX.
 QTY. () - RELAY CONTACTS, A.C. POWER
 QTY. () - ANALOG I/O
 QTY. () - RS485 & DIGITAL I/O

APTEC-NRG INC. WARRINGTON, PA. 18976 U.S.A.

OUTLINE & INSTALLATION, ADM-616A RATEMETER

DATE: 12-1-89
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]
 CONTRACT NO. 19-1-89

DESIGNERS ARE IN CHARGE OF DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED FRACTIONS DENOMINATORS SHALL BE 1/8" OR 1/16" DECIMALS SHALL BE TO 3 DECIMALS

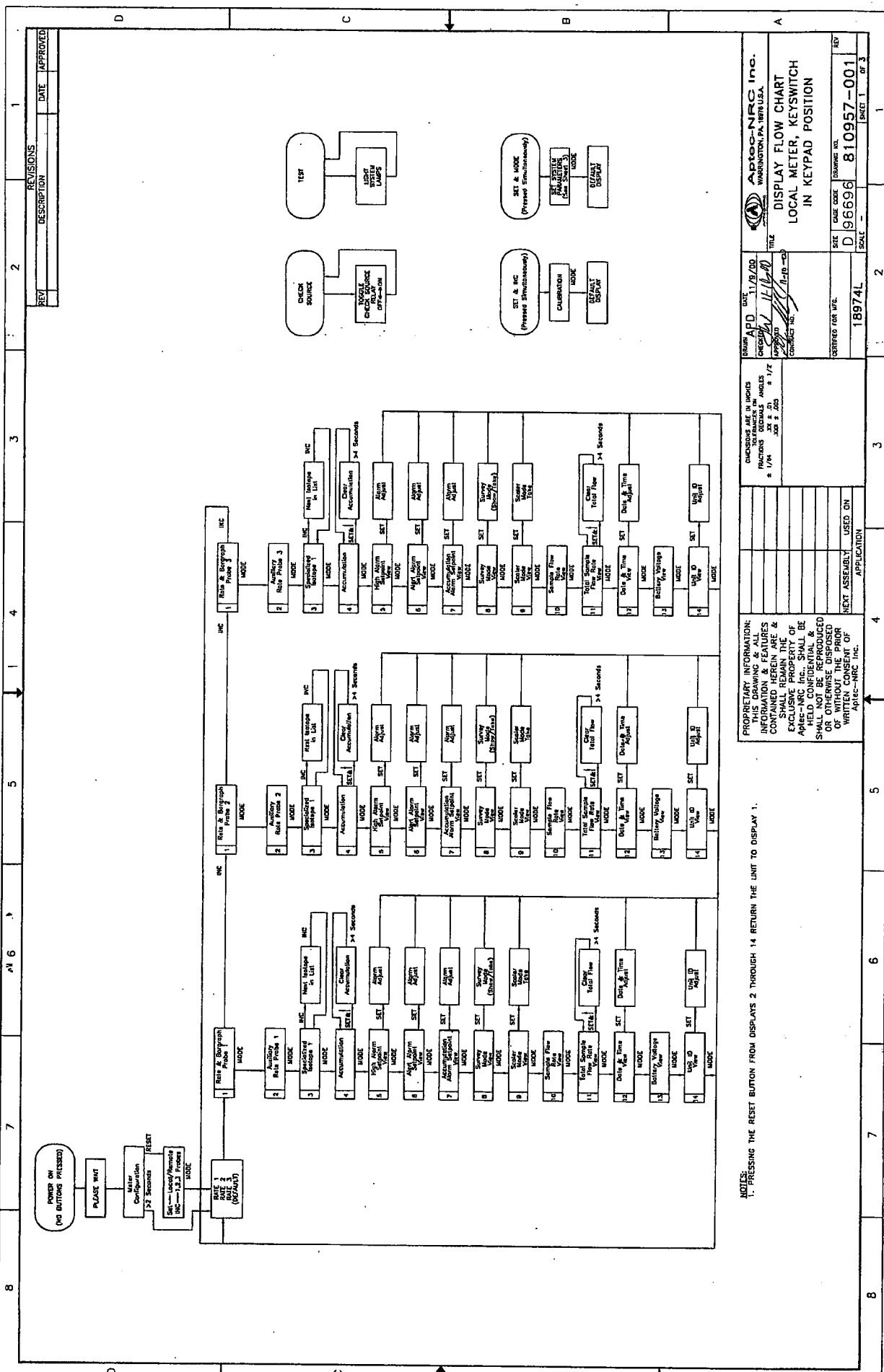
PROPRIETARY INFORMATION: THIS DRAWING & ALL INFORMATION CONTAINED HEREIN ARE THE EXCLUSIVE PROPERTY OF APTEC-NRG INC. AND SHALL BE HELD CONFIDENTIAL & SHALL NOT BE REPRODUCED OR OTHERWISE DISPOSED OF WITHOUT THE PRIOR WRITTEN CONSENT OF APTEC-NRG INC.

ADDRESS: 001 ADM-616A
 USED ON NEXT ASSEMBLY

APPROVED FOR U.S. 19038L

SCALE: NTS

SHEET 1 OF 1



REV	DESCRIPTION	DATE	APPROVED

REVISIONS

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

DRAMA APD DATE 11/19/00
 CUSTOMER 11/19/00
 PROJECT 11/19/00
 CONTRACT NO. 11-19-00

FILE
 DISPLAY FLOW CHART
 LOCAL METER, KEYSWITCH
 IN KEYPAD POSITION

SCALE 1 OF 3

18974L

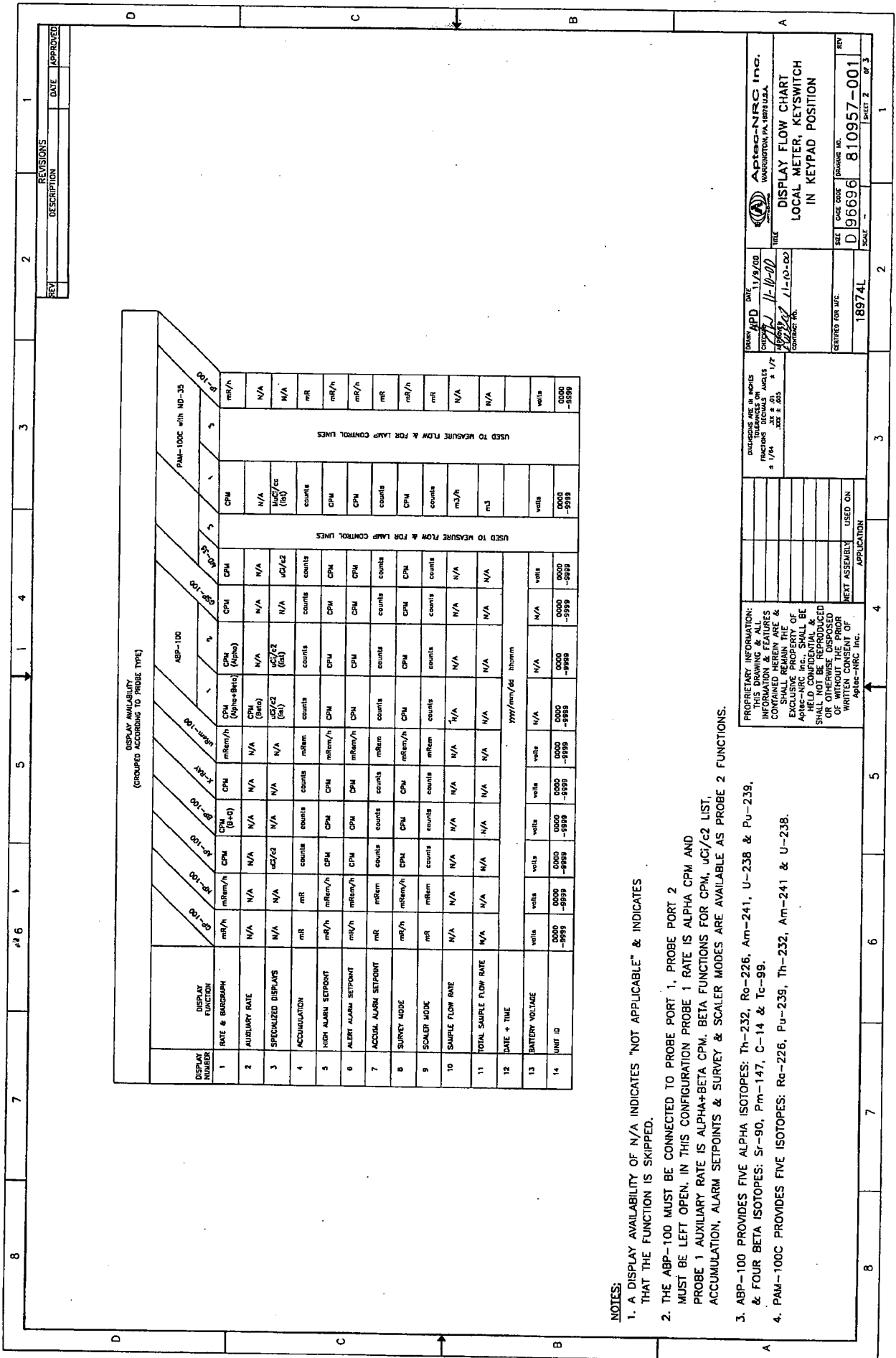
810957-001

Aptec-NRC Inc.
 WASHINGTON, PA 15388 USA

PROPRIETARY INFORMATION:
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NOTES:
 1. PRESSING THE RESET BUTTON FROM DISPLAYS 2 THROUGH 14 RETURN THE UNIT TO DISPLAY 1.

USED ON APPLICATION



- NOTES:**
- A DISPLAY AVAILABILITY OF N/A INDICATES "NOT APPLICABLE" & INDICATES THAT THE FUNCTION IS SKIPPED.
 - THE ASP-100 MUST BE CONNECTED TO PROBE PORT 1, PROBE PORT 2 MUST BE LEFT OPEN. IN THIS CONFIGURATION PROBE 1 RATE IS ALPHA CPM AND PROBE 1 AUXILIARY RATE IS ALPHA+BETA CPM. BETA FUNCTIONS FOR CPM, uCi/c2 LIST, ACCUMULATION, ALARM SETPOINTS & SURVEY & SCALER MODES ARE AVAILABLE AS PROBE 2 FUNCTIONS.
 - ASP-100 PROVIDES FIVE ALPHA ISOTOPES: Th-232, Ro-226, Am-241, U-238 & Pu-239, & FOUR BETA ISOTOPES: Sr-90, Pm-147, C-14 & Tc-99.
 - PAM-100C PROVIDES FIVE ISOTOPES: Ro-226, Pu-239, Th-232, Am-241 & U-238.

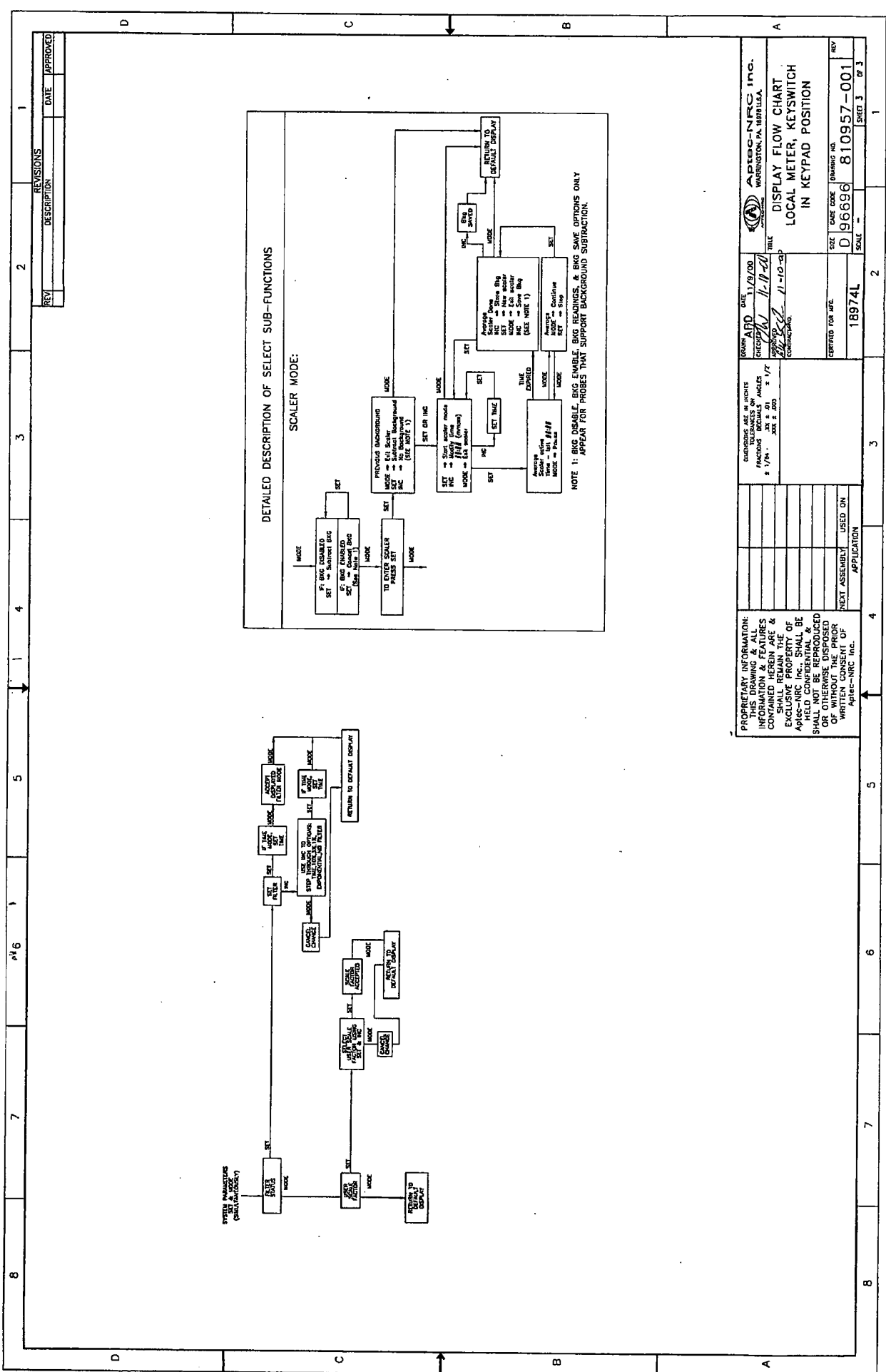
Aptec-NRG Inc.
 INVESTMENT PRODUCTS
 DISPLAY FLOW CHART
 LOCAL METER, KEYSWITCH
 IN KEYPAD POSITION

DRAWING NO. 18974L
 DATE 1/19/00
 CHECKED BY [Signature]
 DESIGNED BY [Signature]
 SCALE 1/1" = 1'-0"

SIZE D 96696
 DRAWING NO. 810957-001
 SHEET 2 OF 3

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 CONTAINED HEREIN ARE & SHALL REMAIN THE EXCLUSIVE PROPERTY OF APTEC-NRG INC. NO PART SHALL BE REPRODUCED OR OTHERWISE DISPOSED OF WITHOUT THE PRIOR WRITTEN CONSENT OF APTEC-NRG INC.

NEXT ASSEMBLY USED ON APPLICATION



REV	DESCRIPTION	DATE	APPROVED

1 2 3 4 5 6 7 8

APRES-NRC INC.
 WASHINGTON, PA 15381, U.S.A.

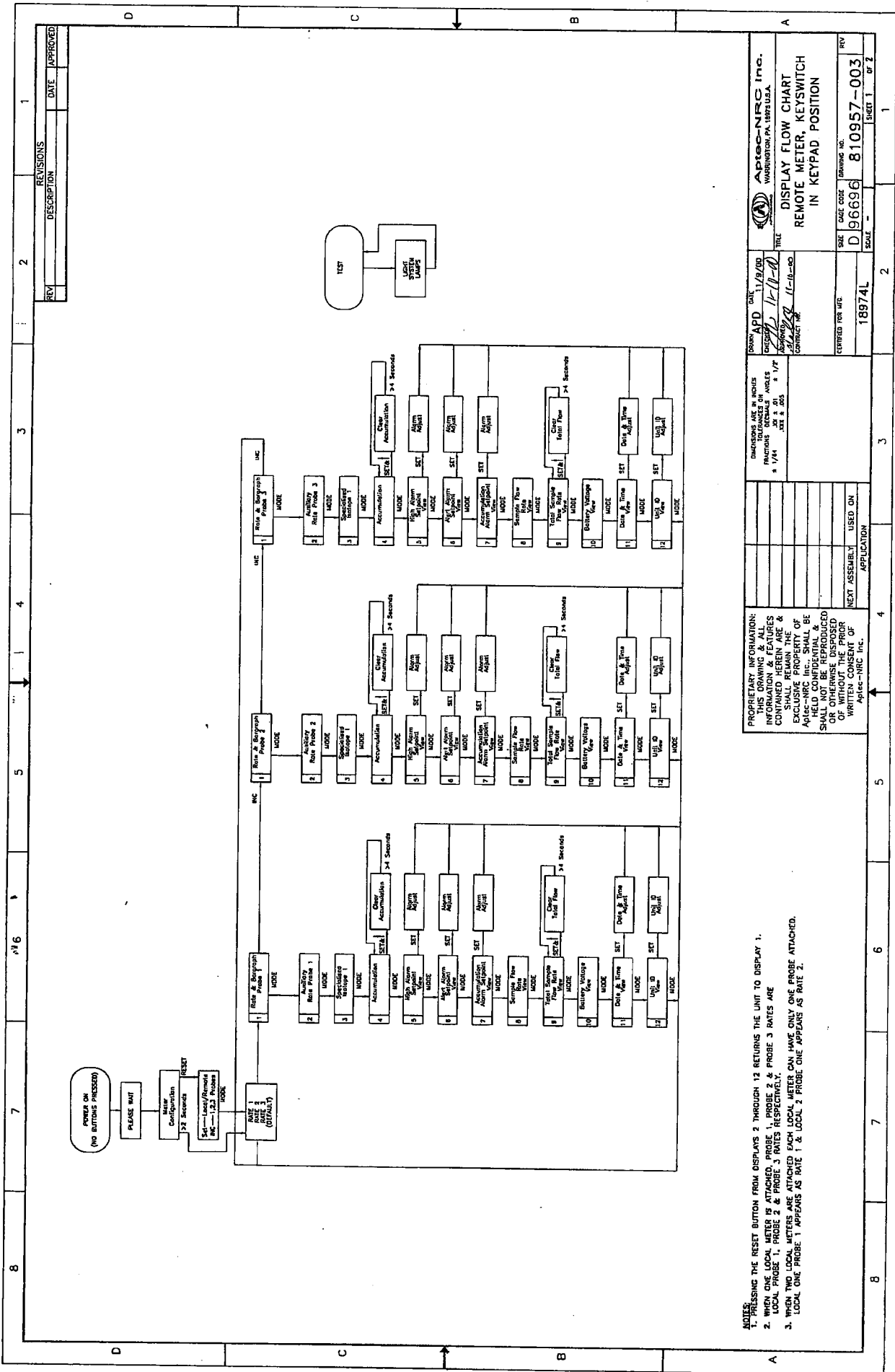
DATE: 1/2/80
 DESCRIPTION: DISPLAY FLOW CHART LOCAL METER, KEYSWITCH IN KEYPAD POSITION
 SCALE: 1:10-00

18974L
 DRAWING NO. 810957-001
 SHEET 3 OF 3

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UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
 FRACTIONS SHALL BE IN DECIMALS
 .XX ± .01 ± 1/2
 .XX ± .01 ± 1/4
 .XX ± .005

REV	DESCRIPTION	DATE	APPROVED



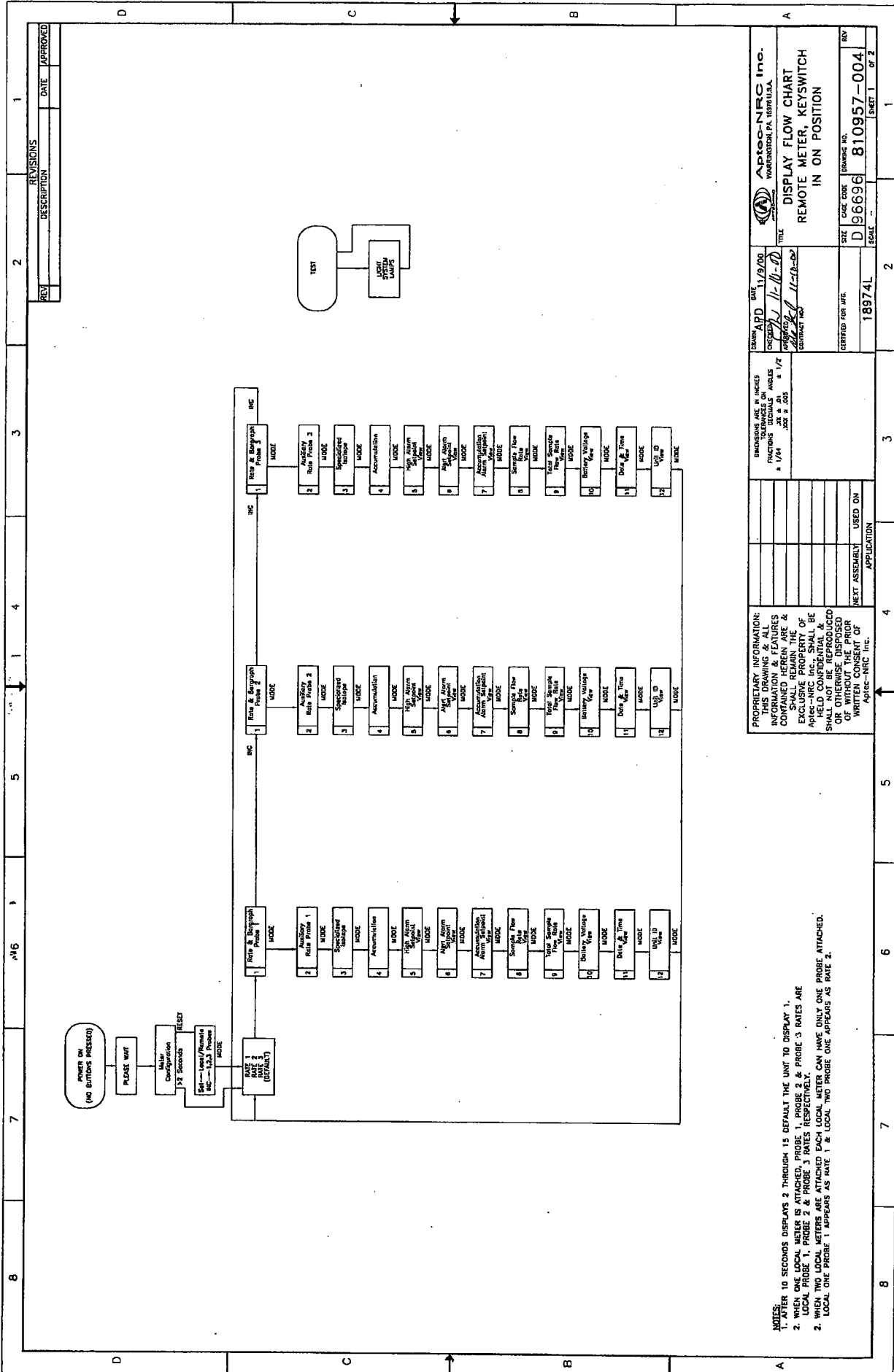
- NOTES:
1. PRESSED THE RESET BUTTON FROM DISPLAYS 2 THROUGH 12 RETURNS THE UNIT TO DISPLAY 1.
 2. WHEN ONE LOCAL METER IS ATTACHED, PROBE 1, PROBE 2 & PROBE 3 RATES ARE LOCAL. PROBE 1, PROBE 2 & PROBE 3 RATES RESPECTIVELY.
 3. WHEN TWO LOCAL METERS ARE ATTACHED EACH LOCAL METER CAN HAVE ONLY ONE PROBE ATTACHED. LOCAL ONE PROBE 1 APPEARS AS RATE 1 & LOCAL 2 PROBE ONE APPEARS AS RATE 2.

PROPRIETARY INFORMATION:
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DIMENSIONS ARE IN INCHES
 FRACTIONS DECIMALS
 1/4" .25" 1/2" .50" 3/8" .375"
 1/8" .125" 5/16" .3125"

APRES-INC. WASHINGTON, PA. 15374
 DISPLAY FLOW CHART
 REMOTE METER, KEYSWITCH
 IN KEYPAD POSITION

DATE: 11/12/80
 EXCESS: 11-11-80
 CONTRACT NO: 11-16-80
 18974L
 810957-003
 SHEET 1 OF 2



NOTES:
 1. AFTER 10 SECONDS DISPLAYS 2 THROUGH 15 DEFAULT THE UNIT TO DISPLAY 1.
 2. WHEN ONE LOCAL METER IS ATTACHED, PROBE 1, PROBE 2 & PROBE 3 RATES ARE LOCAL, PROBE 1, PROBE 2 & PROBE 3 RATES RESPECTIVELY.
 2. WHEN TWO LOCAL METERS ARE ATTACHED EACH LOCAL METER CAN HAVE ONLY ONE PROBE ATTACHED.
 3. LOCAL ONE PROBE 1 APPEARS AS RATE 1 & LOCAL TWO PROBE ONE APPEARS AS RATE 2.

REV	DESCRIPTION	DATE	APPROVED

DRAWN	APP	DATE	11/9/00
DESIGNED			
CHECKED			

INDICATING AND ANALOGIC FRACIONS DISPLAYS ON # 1/4 # 1/2 # 3/4 # 1	SCALE	18974L
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APTEC-NRC INC. WARRINGTON, PA 18980, USA	TITLE	DISPLAY FLOW CHART REMOTE METER, KEYSWITCH IN ON POSITION
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SIZE	CODE	DRAWING NO.	REV
D	96696	810957-004	

SCALE	18974L	SHEET	1	OF	2
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ZONE	LTR	DESCRIPTION	DATE	APPROVED
A		ECN# 12412-03	10-5-79	

1. APPLICATION: CORNELL AREA MONITOR, SMART PROBES

2. DESCRIPTION:
 THIS DOCUMENT AND ASSOCIATED PARTS LIST PROVIDE INFORMATION FOR THE ASSEMBLY AND CONFIGURATION OF AN ADM-616A, PART NUMBER 808995-001 RATEMETER.

3. ACTIONS:
 1) BUILD RATEMETER, ITEM #1, ON ASSOCIATED PARTS LIST.
 2) PURCHASE/ASSEMBLY ADDITIONAL PARTS ON ASSOCIATED PARTS LIST.
 3) MODIFY RATEMETER, ITEM #1, AS DESCRIBED IN TABLE 1.
 (ONLY MODIFICATIONS INDICATED BY AN "X" IN MOD. REQUIRED COLUMN ARE TO BE PERFORMED.)
 4) CONFIGURE RATEMETER PER SPECIFIED SETTING INDICATED IN TABLES 2, 3 & 4.
 5) COMPLETE SERIAL NUMBER TAG, PL ITEM #2, WITH INFORMATION PROVIDED IN TABLE 5.

4. SPECIFIC APPLICATION:
 1) NON-ISOLATED VOLTAGE OUTPUTS.

TABLE 1:
 HARDWARE MODIFICATIONS
 * ONLY MODIFICATIONS WITH AN "X" IN THE MODIFICATION (MOD.) COLUMN ARE TO BE PERFORMED

* MOD. REQUIRED	DESCRIPTION OF ACTION REQUIRED	FUNCTION
1. X	TERMINATION ENCLOSURE DB04883-005, INSTALL C805241-007	PROVIDE: 4 NON-ISOLATED 0-5V OUTPUT
2.	PLACE 704443-001 ASSY ON JP24 PROBE INT CCA WITH BODY AWAY FROM FRONT	REDUCES AC CHECK SOURCE TRANSIENTS

1. APPLICATION: CORNELL AREA MONITOR, SMART PROBES

2. DESCRIPTION:

THIS DOCUMENT AND ASSOCIATED PARTS LIST PROVIDE INFORMATION FOR THE ASSEMBLY AND CONFIGURATION OF AN ADM-616A, PART NUMBER 808995-001 RATEMETER.

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 5) COMPLETE SERIAL NUMBER TAG, PL ITEM #2, WITH INFORMATION PROVIDED IN TABLE 5.

4. SPECIFIC APPLICATION:
 1) NON-ISOLATED VOLTAGE OUTPUTS.

SEE SEPARATE PARTS LIST: PL808995-001

DATE	6-22-98	DRN	MM
CHECKED	9-30-99	APPROVED	9-30-99
CONTRACT NO. 18974L			
CERTIFIED FOR MFG.			
DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED. FRACTIONS DECIMAL ANGLES ± 1/64 .XXX ± .005 .XXX ± .005			
CORNELL			
ADM-616			
NEXT ASSEMBLY USED ON			
APPLICATION			
SCALE	NONE	SHEET	1 OF 4
SIZE	B	CAGE CODE	96696
DRWING NO.	808995-001		
REV.	A		
TITLE ASSEMBLY, RATEMETER MODIFICATION, RATEMETER			
INDUSTRIES NUCLEAR RESEARCH CORPORATION WARRINGTON, PA. 18976 U.S.A.			

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WRITTEN CONSENT OF NUCLEAR RESEARCH CORPORATION.

ZONE	TR	DESCRIPTION	DATE	APPROVED
1				

2

3

4

TABLE 2:
RATEMETER JUMPER POSITIONS
JUMPER POSITION NP INDICATES NO JUMPER PRESENT

CIRCUIT CARD ASSEMBLY	REF.	SPECIFIED SETTING	DESCRIPTION		ASSOC. SIGNAL
			1-2	2-3	
CCA, CPU (804368)	J1	NP	A18	N/A(VBATT)	A17
	J2	1-2	2.5V ref	N/A	EVENT1
	J3	1-2	2.5V ref	N/A	EVENT2
	J4	1-2	2.5V ref	N/A	EVENT3
	J5	2-3	R2 OUT(U15)	RXD2(5V)	UB(S7)
CCA, I/O (802052)	J1	2-3	LIT-LEVEL +5V	ANALIN7	CH6(U9)
	J2	NP	+5V	N/A	ANALIN5
	J3	NP	15V SENSE	N/A	ANALIN6
	J4	NP	GROUND	N/A	ANALIN4
	J5	NP	ANAL 4	N/A	ANALIN8
	J6	NP	GROUND	N/A	LIT-LEVEL
	J7	1-2	+5V	GROUND	RN4 I/OIN
CCA, MOTHER- BOARD (802058)	J10	NP	INPUT/	EXPAN1	SPARE1
	J11	NP	INPUT/	EXPAN2	SPARE2
	J12	NP	OUT1	EXPAN3	SPARE3
	J13	NP	OUT2	EXPAN4	SPARE4
	J14	1-2	TXD1	EXPAN5	SPARE5
	J15	1-2	RXD1	EXPAN6	SPARE6

TABLE 2, CONTINUED:
RATEMETER JUMPER POSITIONS
JUMPER POSITION NP INDICATES NO JUMPER PRESENT

CIRCUIT CARD ASSEMBLY	REF.	SPECIFIED SETTING	DESCRIPTION		ASSOC. SIGNAL
			1-2	2-3	
CCA, POWER SUPPLY ISOLATOR (804371)	J1	2-3	MPS + MPS	/CSOUT5Q3	DRAIN12
	J2	1-2	MPS	/CSOUT4Q7	DRAIN8
	J3	1-2	MPS	/CSOUT5Q0	DRAIN9
	J4	1-2	MPS	/CSOUTQ1	DRAIN10
	J5	1-2	MPS	/CSOUTQ2	DRAIN11
	J6	2-3	MPS	/CSOUT4Q0	DRAIN1
	J7	2-3	MPS	/CSOUT4Q1	DRAIN2
	J8	2-3	MPS	/CSOUT4Q2	DRAIN3
	J9	2-3	MPS	/CSOUT4Q3	DRAIN4
	J10	2-3	MPS	/CSOUT4Q4	DRAIN5
	J11	1-2	MPS	/CSOUT4Q5	DRAIN6
	J12	1-2	MPS	/CSOUT4Q6	DRAIN7
	J13	NP	(1/3)+2.4V	N/A	ANALIN3
	J14	1-2	ISO GND	IOUT1	"IOUT1" P1--49
	J15	NP	GND_I	N/A	N/A
	J16	1-2	ISO GND	IOUT2	"IOUT2" P1--99
	J17	NP	GND_1	N/A	N/A
	J18	1-2	ISO GND	IOUT3	"IOUT3" P1--50
	J19	NP	GND_I	N/A	N/A

CONTINUED

DRAWN <i>MM</i> 9-30-99		CHECKED <i>HW</i> 9-30-99		APPROVED <i>[Signature]</i> 9-30-99		CONTRACT NO.	
DIMENSIONS ARE IN INCHES FRACTIONS DECIMAL ANGLES ± 1/64 .XX±.01 ± 1/2 .XXX ±.005		CERTIFIED FOR MFG.		SCALE		DRAWING NO.	
CORNELL		ADM-616		808995-001		REV. A.	
NEXT ASSEMBLY		USED ON		18974L		SHEET 2 OF 4	
APPLICATION							

NUCLEAR RESEARCH CORPORATION
INDUSTRIES
WARRINGTON, PA. 18978 U.S.A.

ASSEMBLY,
MODIFICATION, RATEMETER

4	2	3	1
REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
			APPROVED

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REF.	JUMPER POSITION	DESCRIPTION		ASSOC. SIGNAL
		1-2	2-3	
JP1	1-2	RIBBON	HEADER	+24V
JP2	1-2	RIBBON	GROUND	GROUND
JP3	1-2	+24V	GROUND	RN1 (DRIVER)
JP4	2-3	ANALOUT1	ANALOUT2	ISO ANAL2
JP5	2-3	ANALOUT1	ANALOUT3	ISO ANAL3
JP6	2-3	ANALOUT2	ANALOUT4	ISO ANAL4
JP7	1-2	RS4851GND	GROUND	TB3-9
JP8	1-2	RS4851NEG	AC COMMON	TB3-8
JP9	1-2	RS4851POS	AC COMMON	TB3-7
JP10	1-2	RS4851GND	IOUT1+	RS1GND/IOUT1
JP11	1-2	RS4852GND	IOUT2+	RS2GND/IOUT2
JP12	1-2	RS4853GND	IOUT3+	RS3GND/IOUT3
JP13	NP	R1	N/A	VIN1
JP14	NP	R2	N/A	VIN2
JP15	1-2	GANC	DIGG	IB4-9
JP16	1-2	GACOM	DIGG	TB4-8
JP17	1-2	GANO	DIGS	TB4-7

CONTINUED

TABLE 4: CUSTOMER INTERFACE CCA (805247) JUMPER AND RESISTOR POSITIONS JUMPER POSITION NP INDICATES NO JUMPER PRESENT				
REF.	JUMPER POSITION	DESCRIPTION		ASSOC. SIGNAL
		1-2 (IN)	2-3	
J18	NP	+24V	AC LINE	4B COM
J19	NP	+24V	AC LINE	6A COM
J20	1-2	RIBBON	HEADER	AC LINE
J21	1-2	RIBBON	HEADER	AC COMMON
J22	NP(N/A)	N/A	N/A	N/A
J23	1-2	GROUND	+15V	VIN1-(S5)
J24	1-2	GROUND	+15V	VIN2-(S6)
S1	OUT(OPEN)	N/A	N/A	OUT1
S2	OUT(OPEN)	N/A	N/A	OUT2
S3	OUT(OPEN)	N/A	N/A	OUT3
S4	OUT(OPEN)	N/A	N/A	OUT4
S5	OUT(OPEN)	N/A	N/A	VIN1
S6	OUT(OPEN)	N/A	N/A	VIN2

TABLE 5: SERIAL NUMBER TAG INFORMATION	
DESCRIPTION:	RATEMETER (P/N:808995-001)
MODEL:	ADM-616A
SERIAL NUMBER:	RM-(YEAR CODE)(WEEK CODE)(UNIT NUMBER IN WEEK CODE)

DRAWN	M.M.	DATE	6-22-98	
CHECKED	J.L.	9-30-99		
APPROVED	[Signature]	9-30-99		
CONTRACT NO.				
CERTIFIED FOR MFG.				
CORNELL				
ADM-616				
USED ON				
NEXT ASSEMBLY				
APPLICATION				
18974L				
SCALE	B	CAGE CODE	96696	DRAWING NO.
				808995-001
				REV. A
				SHEET 4 OF 4

INDUSTRIES	CORPORATION	WARRINGTON, PA. 18978 U.S.A.		
TITLE			ASSEMBLY, RATEMETER	
MODIFICATION, RATEMETER				

4	3	2	1										
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<p>DESCRIPTION:</p> <p>THIS DOCUMENT LISTS FACTORY SETTINGS OF PARAMETERS WHICH MUST BE STORED IN EEPROM FOR EACH RATEMETER IN THE RADIATION MONITORING SYSTEM. THE EEPROM IS LOCATED ON THE RATEMETER'S I/O CCA. THE PARAMETERS MUST BE SET CORRECTLY TO ENSURE PROPER SYSTEM OPERATION. THIS INFORMATION SHOULD BE VERIFIED IF THE RATEMETER FAILS ANY ROUTINE TESTING, AND SET AND VERIFIED IF THE RATEMETER'S I/O CCA IS REPLACED.</p> <p>PROCEDURE:</p> <ol style="list-style-type: none"> 1) IDENTIFY FROM PAGE 2, THE CORRECT EEPROM PARAMETERS FOR YOUR APPLICATION. 2) FOLLOW THE INSTRUCTIONS IN THE RATEMETER HARDWARE MANUAL FOR VERIFYING AND SETTING THE EEPROM PARAMETERS. <p>NOTES:</p> <ol style="list-style-type: none"> 1) EEPROM MEMORY LOCATIONS ARE SPECIFIED IN HEXIDECIMAL. 2) UNSPECIFIED MEMORY LOCATIONS (" - ") SHOULD NOT BE MODIFIED. THE VALUES STORED IN UNSPECIFIED LOCATIONS WILL VARY UNDER PROGRAM CONTROL DEPENDING ON CURRENT SETTINGS SUCH AS ALARM SETPOINTS, UNIT ID, ETC. 													
<p>DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS: $\pm 1/64$ $\pm 1/32$.XXX $\pm .005$</p>		<p>DATE 9-30-99 CHECKED [Signature] 9-30-99 APPROVED [Signature] 9-30-99 CONTRACT NO. 18974L</p>											
<p>SCALE 18974L</p>		<p>SIZE B CAGE CODE 96696 DRAWING NO. 808994-001</p>											
<p>APPLICATION</p>		<p>REV. 1 of 3</p>											
<p>NUCLEAR RESEARCH CORPORATION WARRINGTON, PA. 18976 U.S.A.</p>		<p>TITLE EEPROM PARAMETER CONFIGURATION DRAWING</p>											

4	3	2	1																								
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NOTICE

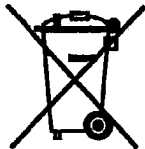
Note: This notice does not apply to software products, which may be provided on tape, floppy disk, or CD-ROM.

Information Concerning Disposal of This Equipment

Electrical and electronic equipment contain hazardous substances that, if disposed of improperly, can have a negative effect on the environment and on human health.

Users / owners of this equipment have the responsibility to ensure that this equipment does not pose a threat to the environment or to humans when it becomes obsolete and requires disposal.

The symbol below, also found on your CANBERRA equipment, indicates that this equipment should not be disposed of in unsorted municipal waste.



Therefore, following the provisions of COUNCIL DIRECTIVE 2002/96/EC on waste electrical and electronic equipment (WEEE), we ask that you contact your nearest CANBERRA office for instructions on the proper disposal of this equipment.

Warranty

Canberra (we, us, our) warrants to the customer (you, your) that for a period of ninety (90) days from the date of shipment, software provided by us in connection with equipment manufactured by us shall operate in accordance with applicable specifications when used with equipment manufactured by us and that the media on which the software is provided shall be free from defects. We also warrant that (A) equipment manufactured by us shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment of such equipment, and (B) services performed by us in connection with such equipment, such as site supervision and installation services relating to the equipment, shall be free from defects for a period of one (1) year from the date of performance of such services.

If defects in materials or workmanship are discovered within the applicable warranty period as set forth above, we shall, at our option and cost, (A) in the case of defective software or equipment, either repair or replace the software or equipment, or (B) in the case of defective services, reperform such services.

LIMITATIONS

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EXCLUSIONS

Our warranty does not cover damage to equipment which has been altered or modified without our written permission or damage which has been caused by abuse, misuse, accident, neglect or unusual physical or electrical stress, as determined by our Service Personnel.

We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our Service Personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows, or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

We are not responsible for damage sustained in transit. You should examine shipments upon receipt for evidence of damage caused in transit. If damage is found, notify us and the carrier immediately. Keep all packages, materials and documents, including the freight bill, invoice and packing list.

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