INSTRUCTION MANUAL

0872E3 Ice Detector

February 2011

WARRANTY AND ASSISTANCE

This equipment is warranted by CAMPBELL SCIENTIFIC (CANADA) CORP. ("CSC") to be free from defects in materials and workmanship under normal use and service for **twelve (12) months** from date of shipment unless specified otherwise. ***** **Batteries are not warranted.** ***** CSC's obligation under this warranty is limited to repairing or replacing (at CSC's option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CSC. CSC will return such products by surface carrier prepaid. This warranty shall not apply to any CSC products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CSC is not liable for special, indirect, incidental, or consequential damages.

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TABLE OF CONTENTS

APPENDICES

TABLE OF FIGURES

1 INTRODUCTION

This technical manual provides operation and field level maintenance information for the 0872E3 Ice Detector manufactured by Goodrich Sensor Systems. The 0872E3 consists of four functional assemblies: a Main circuit card assembly (CCA), an Output Interface CCA, a Filter assembly, and a Strut and Probe assembly. The CCAs and all electrical connections are contained within the 0872E3s housing. Access to these items is made through a large, hinged cover that is secured to the housing with captive screws.

The 0872E3 detects ice accumulation on an ultrasonic axially vibrating tube and communicates the associated frequency changes through an RS-232 or digital current loop data link. The 0872E3 is mounted on a pole (Figure 1) and is designed to operate continuously in an outdoor environment. The 0872E3 requires only period recalibration; no other maintenance is normally required.

Additional technical information on theory of operation and detailed communication requirements is contained in Appendix C (Specification Drawing 0872E3).

LIST OF ACRONYMS

CCA	Circuit Card Assembly
Bit	Built-In Test
EPROM	Electrically Programmable Read Only Memory
ESD	Electrostatic Discharge
FRU	Field Replacement Unit
IDS	Ice Detection Sensor

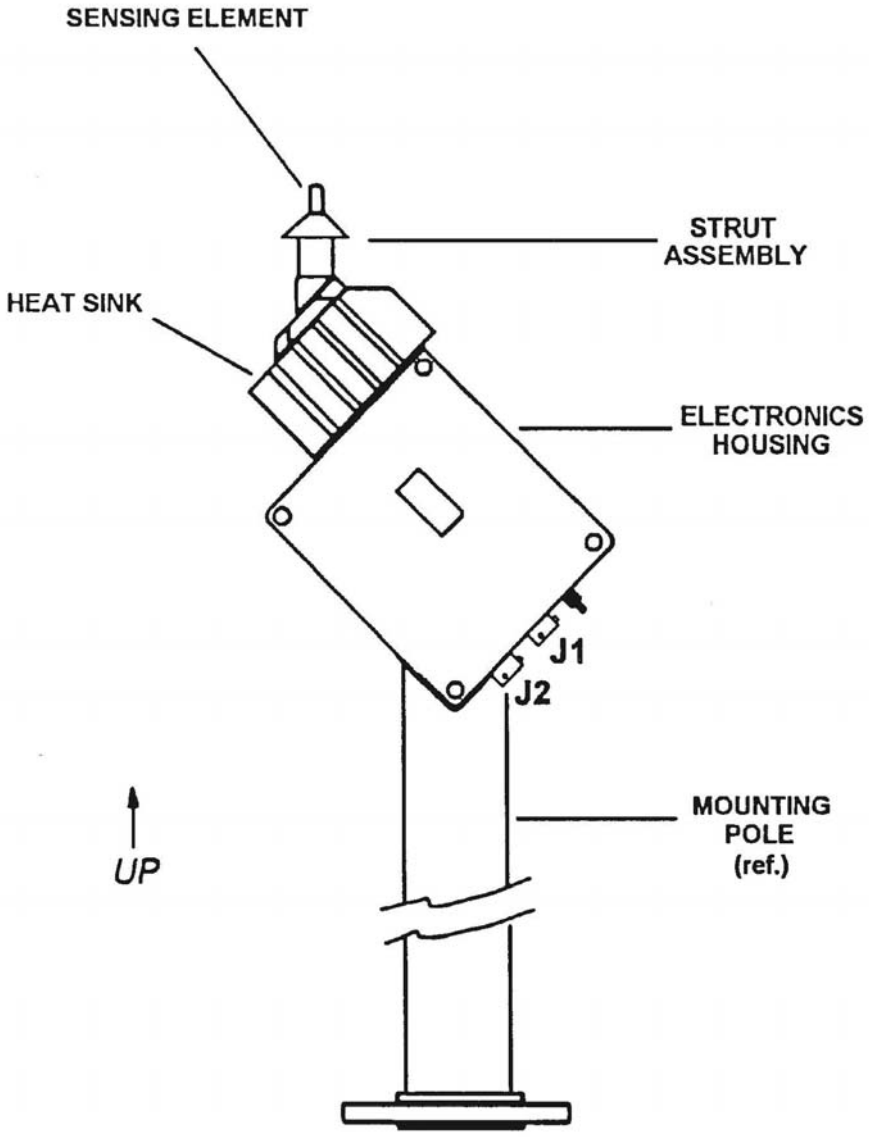


Figure 1. Model 0872E3 Ice Detector

2 SPECIFICATION

Power Requirements: 115 VAC, ±10%, 60Hz
Power Consumption:
Sensing Mode: 10 Watts (0.087 Amps)
De-icing Mode: 385 Watts (3.35 Amps)

Output Format: RS-232, or RS232 Current Loop (300 BAUD)
RS232 Configuration: 8 Data Bits, 1 Stop Bit, No Parity, Full Duplex, Configured as Data Terminal Equipment (DTE)

Output Commands: (see appropriate Section for more information)
Send Data: Z1
De-ice: Z3XX, where XX is time in seconds (maximum = 60 sec)
Extended Diagnostics: Z4
Field Calibration: F5

Measurement Range: 0 – 2.5 mm (0 – 0.10 inches) of Ice
Minimum Measurement Threshold: 0.13 mm (0.005 inches) of Ice
Resolution: ± 4Hz

Environmental Limitations:
Operating Temperature: -50°C to +50°C
Operating Humidity Limits: 74% RH @ 35°C to 100% RH @ 25° C
Wind: Steady - up to 55.5km (30 knots), Gust - up to 85.2km (46 knots)
Rain: 76.2mm (3") per hr with 55.5km (30 knots) winds
Freezing Rain: Ice accretion to 25.4mm (1”) with a 37km (20 knot) wind, at a rate of 12.7mm (1/2”) per hour
Ingress Protection: IPX4

Maximum Cable Length: 30 meters
Mating Connectors:
Connector 1 (J1): PT06J-12-13S
Connector 2 (J2): PT06J-12-10S
Cable Type:
0872E3CBL1-L (J1): 3 conductor, 16 AWG, Super Vu-Tron III jacket
0872E3CBL2-L (J2): Multiconductor, 2- pair, 22 AWG, Shielded, Santoprene jacket

Weight: 5.7 Kg (12.55 lbs)
Dimensions:
Electrical Housing: 230mm by 200mm by 110mm (L x W x D)
Sensing Element & Heat Sink: 164mm by 173mm by 110mm (Overall L x W x D)

Compliant Standards: CE and TUV (C / US)

3 INSTALLATION

3.1 Location

The 0872E3 should be mounted to a sturdy pole located away from buildings or other obstacles that could shadow the sensing element from freezing rain. The 0872E3 should be installed so that the sensing probe is a minimum 36 inches above the ground. The 0872E3 MNT mounting bracket (shown in Figure 2 below) is ideal for mounting the 0872E3 to the pole.

3.2 Mounting

1. Position the 0872E3 on mounting pole with the sensing probe pointing upward. Tighten band clamps (shown in photo below)

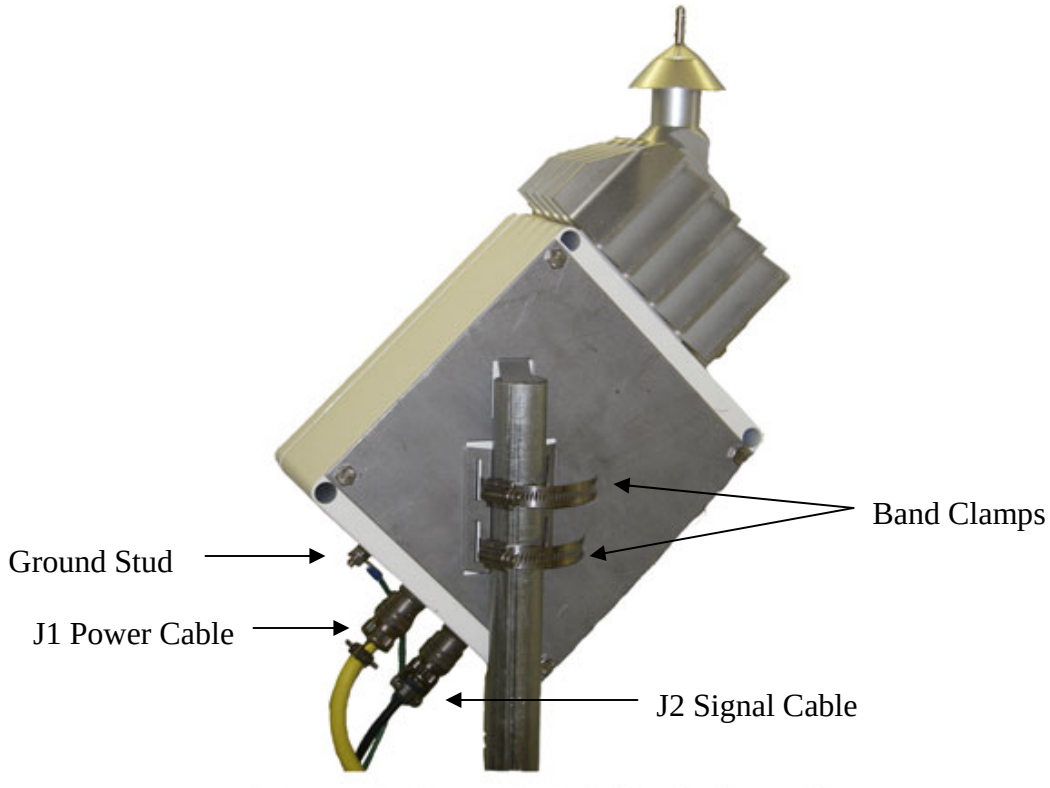


Figure 2. Mounting

2. Remove one ground stud nut.
3. Position ground wire on ground stud.
4. Replace and tighten ground stud nut.
5. Connect cables to connectors J1(IDS) and J2(IDS).
6. Remove protective tube from strut and probe.

3.3 Wiring

Ice Detector Connections	Wire Colour	Description	120 VAC Supply
J1 (pin A)	Black	120 VAC Line	Line
J1 (pin B)	White	120 VAC Neutral	Neutral
J1 (pin C)	Green	120 VAC Ground	Ground
Ground Stud	Green	Ground	Earth Ground

			Datalogger Connections
J2 (pin B)	Green	RS-232 Rx	C1
J2 (pin A)	White	RS-232 Tx	C2
J2 (pin C)	Black	RS-232 Signal Gnd	G
J2	Clear	Shield	G

4 OPERATIONAL CHECK USING DATALOGGER

Before deploying this unit in the field, please perform this quick Operational Check to verify its integrity.

The operational check can be performed using the following steps:

1. With the unit removed from the packaging, connect the power and communications cables.
2. Connect the unit to the datalogger using the wiring diagram provided in this manual.
3. After verifying that everything is connected correctly, remove the protective sleeve and probe cover, then apply power to the unit and the datalogger.
4. Using Loggernet or similar connection software, load the following program into the datalogger.

```
'Declare Public Variables

Public Frequency as String
Public IDS_Status as String
Public Heating as String

'Main Program
BeginProg
SerialOpen (Com1,300,0,0,10000)

	Scan (30,Sec,0,0)

		'Send command for frequency data
	SerialOut (Com1,"Z1","",0,100)
	Delay (0,5,Sec)
	'Clear buffer
	SerialFlush (Com1)
	'Accept data
	SerialIn (Frequency,Com1,100,0,100)

	'Send diagnostic command
	SerialOut (Com1,"Z4","",0,100)
	Delay (0,15,Sec)
	'Clear buffer
	SerialFlush (Com1)
	'Accept data
	SerialIn (IDS_Status,Com1,100,0,100)

	'Send command to de-ice strut & probe for 2 seconds
	SerialOut (Com1,"Z302","",0,100)
	Delay (0,5,Sec)
	'Clear buffer
	SerialFlush (Com1)
	'Accept data
	SerialIn (Heating,Com1,100,0,100)

	NextScan
EndProg
```

5. Using the numeric screens in Loggernet, add the public variables to the display. To do this, click and drag public to the upper left cell in the display. This will paste all three public strings into the view. It will take up to 30 seconds to see results.
6. The following is the expected results for an operational unit. If you receive these results, the unit is ready for field installation.

Frequency	*ZPxxxxxyy
IDS_Status	ZP E3 – IDS passes extended checks
Heating	ZDOK51

*xxxxx is frequency (39970 – 40030 Hz) and yy is the Checksum.

5 PROGRAMMING EXAMPLE FOR CR1000

```
'Declare Public Variables
Public MainString As String * 30
Public Freq_Str As String
Public Frequency As Float
Public CSum As String
Public Status As String
Public Ice          'Default units are in inches
Public Ice_mm       'Ice accumulation in millimeters
Public T109
Public HeatTime

Const Threshold = 0.02 'The icing threshold be be changed based on requirements.
'Note: The recommended min threshold for de-icing is 0.02 inches of ice, and the max is 0.16 inches of ice.

'Define Data Tables
DataTable (IceAcc,True,-1)
  Sample (1,Ice_mm,IEEE4)
  Sample (1,Ice,IEEE4)
EndTable

'Main Program
BeginProg
  SerialOpen (Com1,300,0,0,1000)
  Scan (10,Sec,0,0)

    'Clear buffer before sending commands
    SerialFlush (Com1)

    'Send serial out command to request frequency information
    SerialOut (Com1,"Z1","",0,0)

    'Send serial in command to read information form datalogger buffer.
    SerialIn (MainString,Com1,100,0,100)

    'The following instructions is used to parse the received string.
    Freq_Str = Left (MainString,11)
    Freq_Str = Right (Freq_Str,5)
    Status = Left (MainString,6)
    Status = Right (Status,3)
    CSum = Left (MainString,13)
    CSum = Right (CSum,2)
    Frequency = Freq_Str

    'Formula used to convert the Frequency into Ice Thickness (inches).
    Ice = -0.00015*Frequency + 6

    'Convert ice accumulation from inches to millimeters
    Ice_mm = Ice * 25.4

    'Used to make sure we do not have negative Ice thicknesses in data
    If Ice < 0 Then Ice = 0
    If Ice_mm < 0 Then Ice_mm = 0

    'Measure Temperature Sensor to make sure the temperature is less than 5 degrees Celsius
    Therm109 (T109,1,1,Vx1,0,_60Hz,1.0,0)

    'Check to see the temperature is less than 5 degrees Celsius & ice is greater than threshold.  If so, turn on heaters
```

```
   'long enough to remove any ice accumulation.
   If T109 <= 5 AND Ice >= Threshold Then
     HeatTime = 214.29 * Ice + 5.7142
     HeatTime = INT (HeatTime)

     'If the heat time is calculated higher than 45 seconds, heat for only 45 seconds.
     'NOTE: The heater time is limited to 45 seconds based on the time required to melt
     '      the recommended maximum allowable icing of 4mm (0.16 inches) on the sensing element.
     If HeatTime > 45 Then HeatTime = 45

     'Store icing event data. Calling "IceAcc" table is temperature dependant.
     CallTable IceAcc

     'Heat sensing element for prescribed time calculated in "HeatTime" variable
     SerialOut (Com1,"Z3"+HeatTime,"",0,100)
   EndIf

  NextScan
EndProg
```

1 APPENDIX A

1.1 SAFETY SUMMARY

1.1.1 Definitions

The following definitions apply to WARNINGS and CAUTIONS found throughout this publication.

1.1.2 Warning

An operation or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury, death, or long term health hazards to personnel.

1.1.3 Caution

An operating or maintenance procedure, practice, statement, etc., which, if not strictly observed, could result in damage/destruction of equipment or loss of mission effectiveness.

1.1.4 Warning

The ground stud must **ALWAYS** be connected to a ground cable when connecting J1(IDS) or applying power to the unit.

1.1.5 General Precautions

The following are general safety precautions that are not related to any specific procedure and therefore do not appear elsewhere in this procedure. These are recommended precautions that personnel shall understand and apply during many phases of operation and maintenance.

1.1.6 Cleaners/Chemicals

Keep in approved safety containers and in minimum quantities. Some cleaners / chemicals may have an affect on skin, eyes and respiratory tract. Observe manufacturer's WARNING labels and current safety directives. Use only in authorized areas. Discard soiled cleaning cloths into safety cans. Unless otherwise indicated in the text, use as described in this manual should not result in any immediate health concerns. Consult the local Bioenvironmental Engineer for specific protective equipment and ventilation requirements.

1.1.7 Compressed Air

Use of compressed air can create an environment of propelled foreign particles. Air pressure not to exceed 15 psi and used with effective chip guarding and personal protective equipment.

1.1.8 Keep Away From Live Circuits

Operating personnel must at all times observe safety regulations. Do not replace components or make adjustments inside the equipment with the voltage supply turned on.

1.1.9 Do Not Service or Adjust Alone

Do not attempt internal service or adjustment unless another person capable of rendering aid and resuscitation is present.

1.1.10 Resusitation

Personnel working with or near dangerous voltage shall be trained in modern methods of resuscitation. Information and training sources may be obtained from the Director of Base Medical Services.

1.1.11 Electrostatic Discharge (ESD)

Certain circuit card assemblies and their components are susceptible to electrostatic discharge/ damage. Care must be exercised during handling/repair of these items. Use electrostatic discharge (ESD) precautionary procedures.

1.1.12 Environmental Limitations

The 0872E3 is designed for outdoor use in areas that receive inclement weather. Its operation limit is as follows:

Environmental Conditions	*Operational Test Limit*
High Temperature	50°C
Low Temperature	- 50°C
Humidity	74% RH @ 35°C to 100% RH @ 25° C
Wind (Steady)	to 30 kts

Wind (Gust)	to 46 kts
Rain	3"/hr with 30 kts wind
Freezing Rain	Ice accretion to 1 inch with 20 kt wind at a rate of 1/2 inch per hour
Dust	Exposure to dust laden environment
Low Pressure	to 15.7 in Hg
Ingress Protection	IPX4

1.2 Operation

Apply power to the 0872E3. Wait 30 seconds minimum, then perform the following sequence of commands to ensure proper operation of the unit.

Command	Response	Wait (minimum)
Z1	Zpxxxxxyy	5 sec
Z4	ZP E3	15 sec
Z302	ZDOK51	5 sec

*xxxxx is frequency (39970-40030 Hz) and yy is the checksum

1.3 System Operation

Ice is sensed due to the effect of mass loading on the probe. As ice bonds to the probe the probe mass increases and its natural frequency decreases. The sensor outputs a normalized frequency (corresponding to the ice accretion level) that has been averaged over one minute. The 0872E3 will respond when interrogated by the host system with one of the four different requests described below:

Z1 – SEND FREQUENCY DATA
Z3 – DE-ICE STRUT AND PROBE
Z4 – PERFORM EXTENDED DIAGNOSTICS
F5 – PERFORM FIELD CALIBRATION

1.4 Data Link

The 0872E3 is interrogated once per minute by the host system. The host system sends ASCII characters to the 0872E3 and awaits the appropriate response. Control characters and control procedures are

compatible with ANSI X3.28 and ANSI X3.66, respectively. The data format consists of the following:

- 1 Start Bit
- 8 Data Bits
- 1 Stop Bit
- No Parity
- 300 Baud
- Full Duplex
- Serial Asynchronous
- Configured as Data Terminal Equipment (DTE)

Either RS-232 or digital current loop interface can be used to communicate with the 0872E3.

1.5 System Commands

****note: all system commands must be in upper case.**

Z1 – Typing Z1 commands the 0872E3 to "Send Routine Data". The expected output from the 0872E3 is:

ZPXXXXXCC Normal Operation
ZDXXXXXCC De-icing Cycle

"XXXXX" is the probe frequency (averaged over one minute) and "CC" is the checksum.
The probe frequency must be between 38,400 and 41,500 Hz. Three failure response outputs are also possible after a Z1 command:

ZF1XXXXXCC Probe Failure
ZF2XXXXXCC Heater Failure
ZF3XXXXXCC Electronics Failure

Z3 – Typing "Z3XX" Commands the 0872E3 to turn the strut and probe heaters on for "XX" seconds, where "XX" is a two digit number between 01 and 60. The expected output for the 0872E3 is:

ZDOK51 Confirmation of Heater Activation

If a heater failure is detected of if "XX" is not a valid input, the 0872E3 will not acknowledge the "Z3" request.

WARNING

Probe will become hot during and shortly after heater activation. Sever burns may result if probe is contacted during this time.

CAUTION

Heater activation during test must not exceed 5 seconds if the ambient temperature is greater that 5°C or damage to the probe may result.

Z4 – Typing "Z4" commands the 0872E3 to perform extended diagnostics. The possible outputs from the 0872E3 are:

ZP E3 0872E3 Passes
ZD D7 0872E3 in De-ice Mode
ZF1 EA Probe Failure
ZF2 EB Heater Failure
ZF3 EC Electronics Failure

F5 – Typing **"F5"** commands the 0872E3 to re-calibrate the probe frequency. The 0872E3 responds with:

Recalibrate? Y or N

Responding with "Y" will recalibrate the nominal probe frequency to 40,000 Hz. Responding with "N" or no response within 10 seconds will cancel the F5 request.

****note: Probe calibration should only be done under the conditions specified in Paragraph 1.8.7 (Field Calibration).**

1.6 Failure Detection

The 0872E3 continuously monitors the following functions:

- Power Supply Voltage
- Memory and Storage Checksums
- Probe Frequency within Operating Range
- Timing
- I/O Port Operation

In addition, the heater control circuit is checked once every ten hours and whenever a Z3 or Z4 command is received.

All failures are logged into a non-volatile RAM circuit and can be read out at the factory using a RS-232 data request. After factory repair, this data is cleared from the non-volatile RAM memory.

1.7 Probe Frequency Variation

It is normal for the 0872E3 frequency (returned after a "Z1" command) to vary slightly due to the effects of temperature, even in non-icing conditions. The frequency can vary up to 15 Hz due to changing ambient temperature. Greater frequency variation is possible during, and shortly after, the heaters have been activated. The frequency will return to normal as the probe cools.

1.8 Electrical Design

1.8.1 Electrical Input Requirements

The ice detector utilizes 115 VAC (103.5 to 126.5 VRMS), 50 to 60 hertz input power. Normal operation continues for power interruptions of less that 10 milliseconds. Power interruptions greater than 10 milliseconds will cause the 0872E3 to go into a reset condition. Under this condition, the 0872E3 will resume operation automatically after the power is reapplied, going through the power-up test sequence.

1.8.2 Power Consumption

Power consumption under the stated supply voltage conditions are shown below:

Mode	Maximum Power Consumption
Monitoring	10 Watts
Detection (no heater power)	10 Watts
De-Icing	385 Watts
Failure	10 Watts

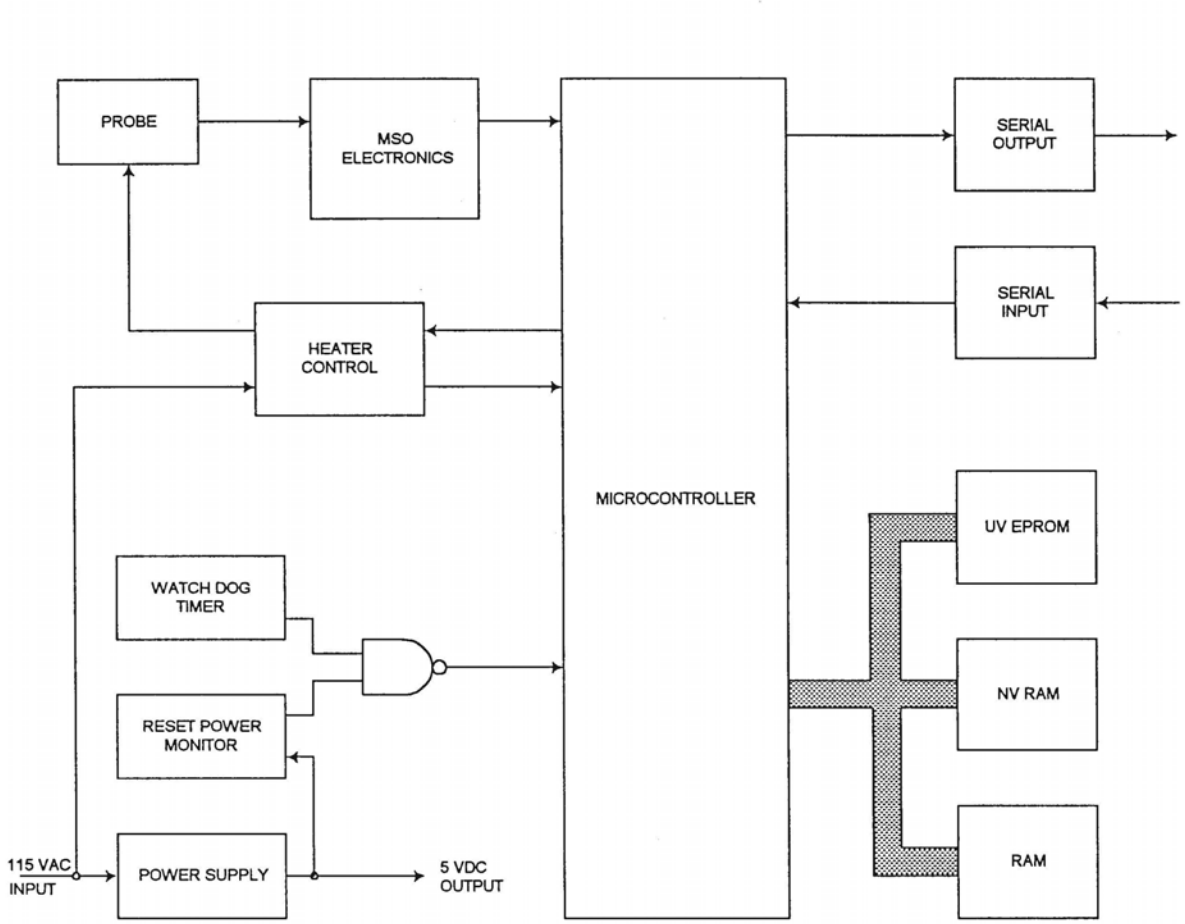


Figure 3. Electrical Block Diagram

Internal Electronics Block	Function
Microcontroler	Performs the ice detection and BIT functions
Heater Control	Activates probe/strut de-icing
Watch Dog Timer/Reset Power Monitor	Monitors internal power supply voltages and power disruptions. Checks microcontroller for operation
Solid-State Power Supply	Provides +5 VDC to unit
Serial Output	Provides RS-232 and digital current pulse
Serial Input	Receives RS-232 and digital current pulse
EPROM/NV-RAM/RAM	Various memories needed for operation of microcontroller

1.9 Maintenance

1.9.1 Maintenance Concept

The maintenance concept for the 0872E3 consists of:

- BIT detecting and isolating a 0872E3 fault to one of three subassemblies.
- Replacement of the faulty subassembly (with 0872E3 attached to the mounting pole).
- Return failed subassembly to Campbell Scientific Canada for repair

1.9.2 Calibration and Preventative Maintenance

The sensor is designed to require no adjustments, alignments, scheduled maintenance, or preventative maintenance. A field calibration feature is included in the design, but the calibration is not performed on a scheduled basis.

****note: probe calibration should only be done under the conditions specified in Paragraph 1.8.7 (Field Calibration).**

1.9.3 Fault Isolation

Failures can be broken into two categories: BIT detected failures, and those that BIT does not detect (non BIT failures).

1.9.3.1 BIT Detected Failures

ZF1 Probe Failure

If a ZF1 failure is indicated in response to the Z1 or Z4 command, proceed as follows:

1. Perform steps 1-6 of paragraph 1.8.5.3 (removal of strut and probe assembly) to electrically disconnect probe from Main CCA.
2. Connect a functional strut and probe assembly to J3(MAIN) and J4(MAIN) on the Main CCA. Install select capacitor (for

the functional strut at C7. The test strut and probe assembly can be temporarily placed on top of the 0872E3 housing.
3. Turn power to the 0872E3 “On” and wait for 30 seconds. Issue the Z4 command. If the ZF1 failure code is still indicated, replace the Main CCA. If the failure is not longer indicated, replace the strut and probe assembly.

ZF2 Heater Failure

If a ZF2 failure is indicated in response to the Z1 or Z4 command, or if a “no response” condition occurs after issuing the Z3 command, proceed as follows:

1. Perform steps 1-6 of paragraph 1.8.5.3 (removal of strut and probe assembly) to electrically disconnect probe from Main CCA.
2. Check resistance between J4(S/P)-1 and J4(S/P)-2 using an ohmmeter. Resistance must be 42 ± 5 ohms. If resistance is within range, replace Main CCA. If resistance is out of range, replace strut and probe assembly.

ZF3 Electronic Failure

If a Zf3 failure is indicated in response to the Z1 or Z4 command, replace the Main CCA. No further troubleshooting is required.

1.9.3.2 Non BIT Failures

If the sensor fails to respond to commands, proceed as follows:

1. Verify AC power is on and main J1(IDS) and J2(IDS) connectors are connected to the IDS.
2. Switch to RS-232 mode. If the 0872E3 communicates in RS-232 mode, but not is current loop mode, replace the Output Interface CCA. If the 0872E3 fails to communicate in either mode, continue with step 3.
3. Switch AC power off. Disconnect connector J1(IDS). Using an ohmmeter, measure the resistance between connector J1(IDS)-A and J1(IDS)-B. If resistance is less than 200 ohms, replace Main CCA. If not, loosen four cover screws and open cover. Remove plastic guard covering J1(MAIN) terminal block by depressing three white clips on each side of guard. Measure resistance between J12(MAIN) pins 1 and 2. If resistance is less than 200 ohms, replace Filter Assembly. If greater than 200 ohms, replace Main CCA.

1.9.4 Removal of 0872E3

Most repairs can be accomplished without removing the 0872E3 from the mounting pole. If removal is required, proceed as follows:

1. Switch 115 VAC power to 0872E3 off.
2. Place protective tube over strut and probe.
3. Disconnect connectors J1(IDS) and J2(IDS). Place ESD protective caps over connectors.
4. Remove ground nut and wire from ground stud. Put nut back on finger tight.
5. Loosen mounting bolts and remove unit from mounting pole.

1.9.5 Disassembly

1.9.5.1 Removal of Output Interface CCA

Refer to Figure 3 for removal of Output Interface CCA.

WARNING

Remove power to unit prior to opening sensor cover or injuries could result from electrical shock.

CAUTION

This is a Class 1 ESDS item. ESD precautions must be taken prior to opening sensor cover or equipment damage could result.

1. Switch 115 VDC power to the 0872E3 off. Disconnect J1(IDS).
2. Loosen captive screws on sensor cover.
3. Open sensor cover. Cover is hinged to housing. (Pull cover up, then back to open.)
4. Carefully disconnect J1(I/O) and J2(I/O) plugs from Output Interface CCA.
5. Remove green ground wire from case.
6. Remove Output Interface CCA by gently pulling off from Main CCA.

1.9.5.2 Removal of Main CCA

Refer to Figures 3 and 4 for removal of Main CCA.

WARNING

Remove power to unit prior to opening sensor cover or injuries could result from electrical shock.

CAUTION

This is a Class 1 ESDS item. ESD precautions must be taken prior to opening sensor cover or equipment damage could result.

1. Switch 115 VAC power to 0872E3 off. Disconnect J1(IDS).
2. Loosen captive screws on sensor cover.
3. Open sensor cover. Cover is hinged to housing (pull cover up, then back to open.)
4. Remove Output Interface CCA per paragraph 1.9.5.1.
5. Remove plastic terminal block cover mounted on snap-on standoffs.
6. Remove terminal screws #1, #2, and #3 with a flat-tip screwdriver. The lugs on these wires are closed-ended.
7. Carefully remove select capacitor C7. Deprress latch and pull capacitor straight upward. (This capacitor will be reinstalled on the replacement CCA.)
8. Carefully disconnect J2(MAIN), J3(MAIN), and J4(MAIN) plugs from main CCA.
9. Remove two remaining wires from terminal block (see Figures 3 and 4).
10. Remove Main CCA mounting screws.
11. Remove Main CCA from sensor housing.

1.9.5.3 Removal of Strut and Probe Assembly from Heat Sink

Refer to Figure 3 for removal of strut and probe assembly from heat sink.

WARNING

Remove power to unit prior to opening sensor cover or injuries could result from electrical shock.

CAUTION

This is a Class 1 ESDS item. ESD precautions must be taken prior to opening sensor cover or equipment damage could result.

****note: Strut and probe replacement can be done at any ambient temperature, however, the unit should be field calibrated only when the ambient temperature is between -10°C and +10°C (see paragraph 1.8.7).**

1. Switch 115VAC power to 0872E3 off. Disconnect J1(IDS).
2. Place protective tube over strut and probe.
3. Loosen captive bolts on sensor cover.
4. Open sensor cover. Cover is hinged to housing (pull cover up, then back to open).
5. Carefully remove select capacitor C7. Depress latch and pull capacitor straight out.
6. Carefully disconnect connectors P3(I/O) and P4(I/O) from J3(MAIN) and J4(MAIN). Remove black grommet from hole in top of housing. **NOTE: Some early units have a small amount of silicone RTV sealing the hole in the housing in place of the grommet. The RTV should be carefully removed prior to strut removal so that the connectors can be routed through the housing and heat sink**.
7. Remove four strut mounting screws securing strut to heat sink.
8. Remove strut and probe assembly from heat sink. Carefully feed connectors through the housing and heat sink as the strut is removed.
9. Remove and examine strut and probe O-ring.

1.9.5.4 Removal of Programmed EPROM

WARNING

Remove power to unit prior to opening sensor cover or injuries could result from electrical shock.

CAUTION

This is a Class 1 ESDS item. ESD precautions must be taken prior to opening sensor cover or equipment damage could result.

1. Switch 115VAC power to 0872E3 off. Disconnect J1(IDS).
2. Loosen captive bolts on sensor cover.
3. Open sensor cover. Cover is hinged to housing (pull cover up, then back to open.)
4. Remove Output Interface CCA per paragraph 5.5.1.
5. The EEPROM is located in the lower left corner of the Main CCA. It is distinguished from other components by the socket eject levers used to secure and remove the component from the socket. Push tabs on socket eject levers outward to lift and remove EPROM from Main CCA.

1.9.5.5 Removal of Filter Assembly

Refer to Figures 3 and 4 for removal of Filter Assembly.

WARNING

Remove power to unit prior to opening sensor cover or injuries could result from electrical shock.

CAUTION

This is a Class 1 ESDS item. ESD precautions must be taken prior to opening sensor cover or equipment damage could result.

1. Switch 115VAC power to 0872E3 off. Disconnect J1(IDS) and J2(IDS).
2. Loosen captive bolts on sensor cover.
3. Open sensor cover. Cover is hinged to housing (pull cover up, then back to open).
4. Remove jam nut securing J1(IDS) connector to housing.
5. Disconnect wires from line filter at terminal block J1(MAIN), terminals 1 and 2.
6. Disconnect green/yellow wire (originating at line filter) from ground stud.
7. Remove two shoulder nuts securing line filter to housing.
8. Remove J1(IDS) connector and line filter from housing.

1.9.6 Assembly

Refer to Figures 3 and 4 for installation of FRUs.

1.9.6.1 Installation of Main CCA

1. Ensure that 115VAC power to 0872E3 is off and J1(IDS) is disconnected.
2. Install Select Capacitor C7 into replacement Main CCA.
3. Position Main CCA into housing with terminal block to the bottom side (ground lug side) of the housing.
4. Install Main CCA mounting screws.
5. Install latching electrical connectors J2(MAIN), J3(MAIN) and J4(MAIN).
6. Position wires on terminal block and tighten terminal screws.
    - Blue wire to terminal #1
    - White wire from terminal #1 to terminal #4
    - Brown wire to terminal #2
    - Black wire from terminal #2 to terminal #5
    - Green wire (from ground stud) to terminal #3
7. Torque terminal block screws to 9 in-lbs.
8. Snap lastic terminal block cover in place.
9. Install Output Interface CCA per paragraph 1.9.5.1.
10. Position cover on housing.
11. Torque cover mounting screws to 28 in-lbs.
12. Perform “System Verification” (paragraph 1.8.8).

1.9.6.2 Installation of Output Interface CCA

1. Ensure that 115VAC power to 0872E3 is off.
2. Align four plastic standoffs with corresponding holes on Main CCA and snap in place.
3. Install green ground wire to internal ground stud.
4. Install plugs J1(I/O) and J2(I/O) in receptacles on Output Interface CCA.
5. Perform “System Verification” (paragraph 1.8.8).

1.9.6.3 Installation of Strut and Probe Assembly

1. Ensure that 115VAC power to 0872E3 is off and J1(IDS) is disconnected.
2. Replacement select capacitor is provided with the spare strut and probe assembly. Install select capacitor into Main CCA location C7.
3. Install O-ring in channel in strut. Feed probe and heater wires through heat sink into housing.
4. Carefully position strut and probe assembly on heat sink taking care not to pinch any wires.

5. Secure strut and probe assembly to heat sink with four screws. Torque to 12 in-lbs.
6. Connect probe electrical connectors P3(I/O) and P4(I/O) at J3(MAIN) and J4(MAIN).
7. Route wires through grommet and press grommet into hole in top of hole (about two-thirds of grommet should be inside hole).
8. Position cover on housing.
9. Torque cover mounting screws to 28 in-lbs.
10. Remove protective tube from strut and probe.
11. Perform "System Verification" (paragraph 1.8.8).

1.9.6.4 Installation of Programmed EPROM

1. Ensure that 115VAC power to 0872E3 is off and J1(IDS) is disconnected.
2. Orient replacement EPROM so that the notch faces the same direction as other integrated circuits on the CCA. Push EPROM evenly into socket until it is fully seated and eject levers clamp into place. **NOTE: It may be necessary to squeeze the eject levers together slightly to fully seat the EPROM.**
3. Install Output Interface CCA per paragraph 1.8.6.2
4. Perform steps 10 and 11 of paragraph 1.8.6.1 (Installation of Main CCA).
5. Perform "System Verification" (paragraph 1.8.8).

1.9.6.5 Installation of Filter Assembly

Refer to Figures 3 and 4 for installation of filter assembly.

1. Install line filter onto housing studs so that side of filter with two leads faces down
2. Secure line filter to housing using lockwasher and shoulder nut (two places). Torque to 8 in-lbs.
3. Remove jam nut from connector. Insert connector through D-hole in housing and secure with jam nut. NOTE: Ensure connector O-ring remains in the groove. Torque jam nut to 80 in-lbs.
4. Perform "System Verification" (paragraph 1.8.8).

1.9.7 Field Calibration

Field Calibration of the 0872E3 may be required after replacement of the Strut and Probe Assembly or Main CCA. Field calibration should be invoked if the "Z1" frequency of a clean and dry probe at 0 ± 10°C is less than 39970 Hz or greater than 40030 Hz. Calibration should not be performed under any of the following conditions:

- Temperature is greater than 10°C or less than -10°C.
- Freezing rain or snow has accreted on the sensing probe.
- Liquid water or other contaminants are visible on the probe.
- Within 20 minutes of a "Z3" (de-ice) command.
- Z1 or Z4 commands indicate a fail condition

1.9.7.1 Calibration Procedure

1. Insure temperature is 0 ± 10°C and the probe is clean and dry.
2. Type "F5".
3. Type "Y" when prompted.
4. Wait one minute.
5. Type "Z1". The 0872E3 should respond with "ZPXXXXXYY". "XXXXX" represents the probe frequency and should be between 39995 and 40005.

1.9.8 System Verification

1. Ensure connectors J1(IDS) and J2(IDS) are attached to the 0872E3 and 115VAC power to the 0872E3 is on.
2. Type "Z1". The 0872E3 should respond with "ZPXXXXXYY". "XXXXX" represents the probe frequency. If probe is clean and dry and the ambient temperature is 0° ± 10°C, the probe frequency should be between 39970 and 40030.
3. Type "Z4". The 0872E3 should respond with "ZP E3".
4. Type "Z302". The 0872E3 should respond with "ZDOK51".

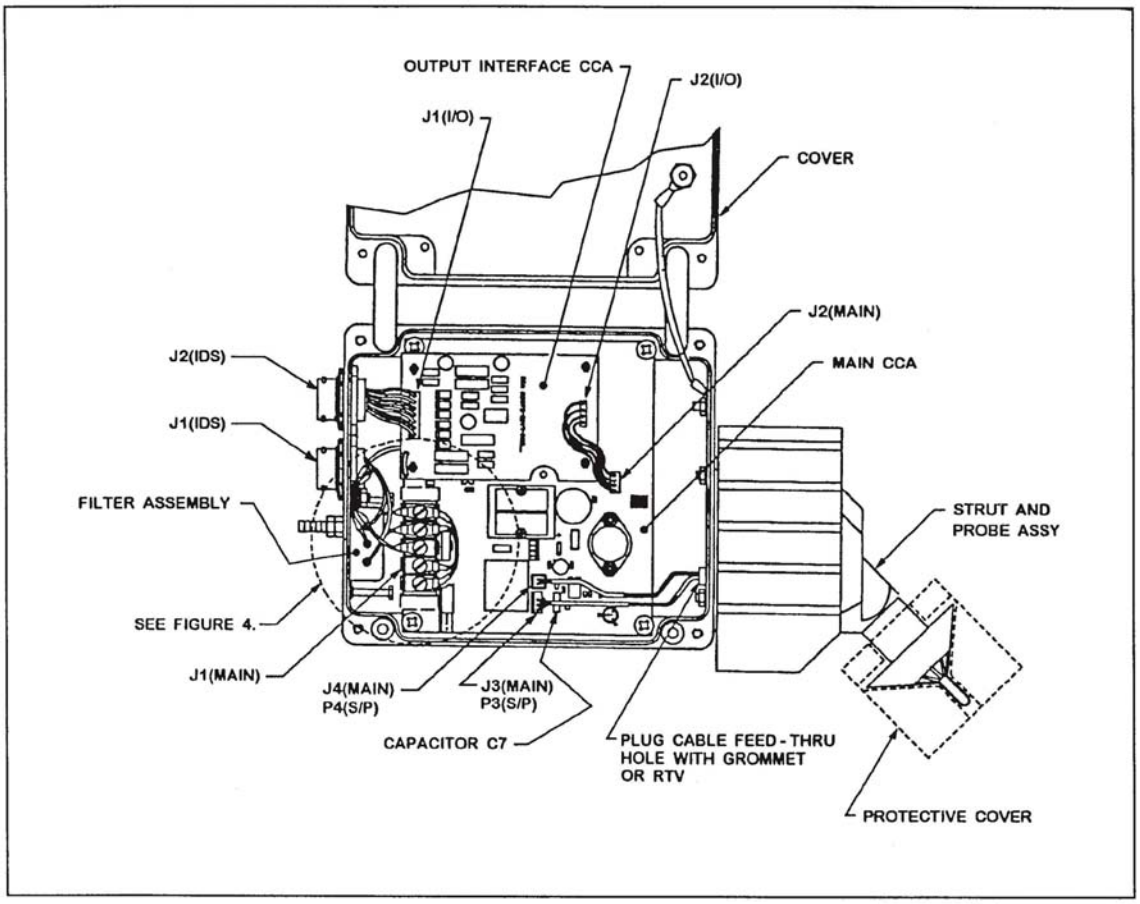


Figure 4. Assembly Drawing

FIELD REPLACEABLE ASSEMBLIES

Item Name	Manufacturer's Part Number	CAGE Code
Main CCA	00872-0150-0003	59885
Output Interface CCA	00872-0149-0002	59885
Strut and Probe Assembly	00872-0286-0002	59885
Filter Assembly	00872-0325-0001	59885
Programmed EPROM	00872-0151-0003	59885

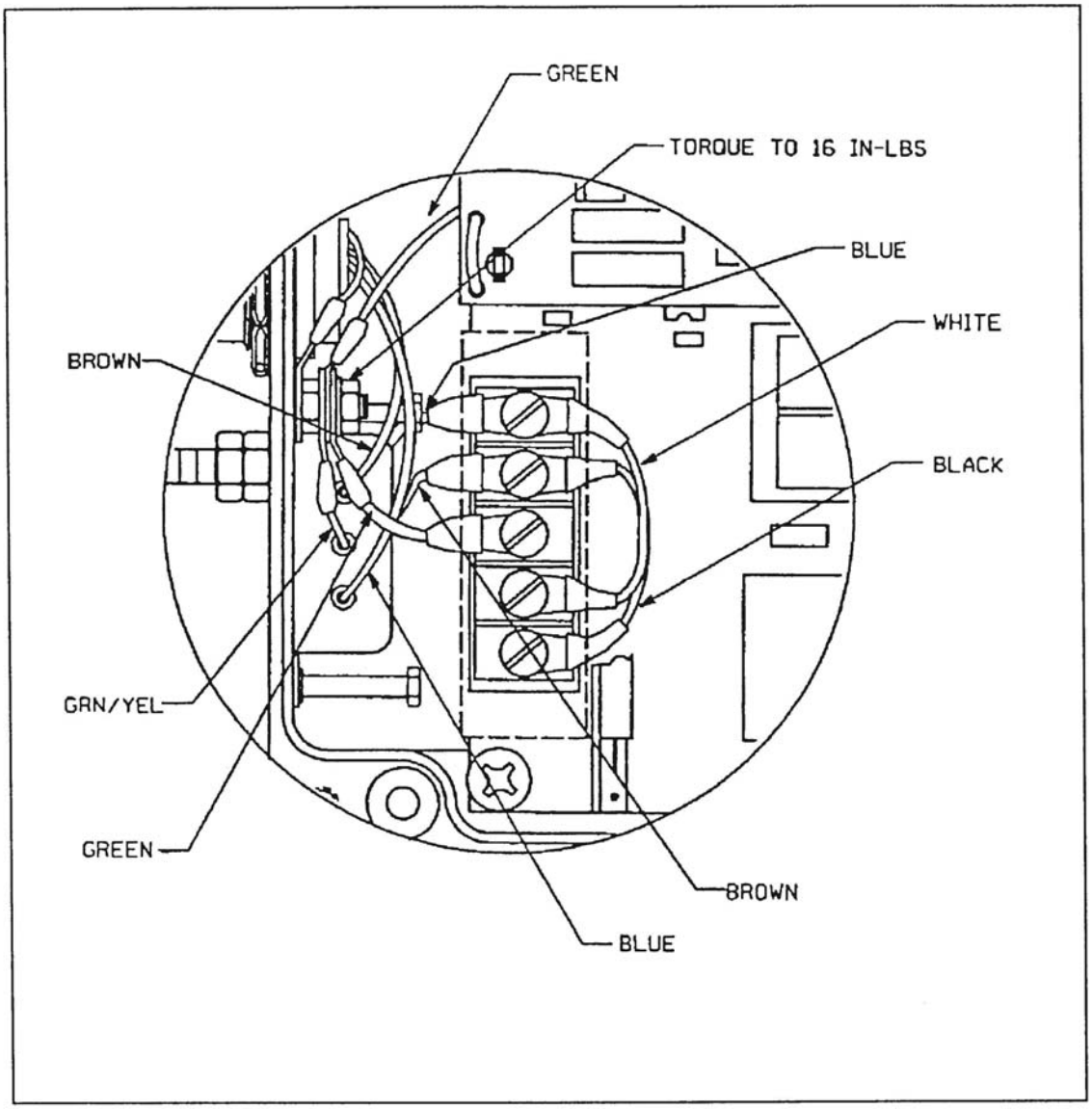


Figure 5. Detail Assembly Drawing

1.9.9 Output Interface Circuit

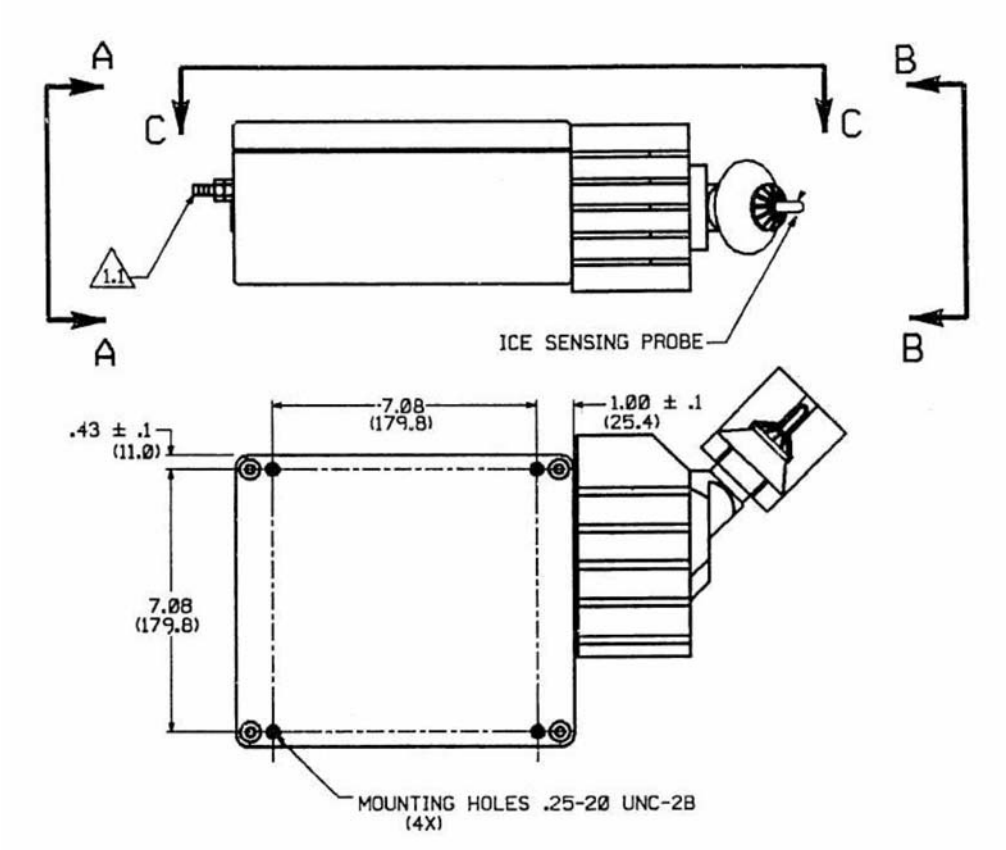
The Output Interface CCA contains all the necessary electronics to convert the RS-232 signal from the Main CCA to a current pulse output. Standard RS-232 output is also available.

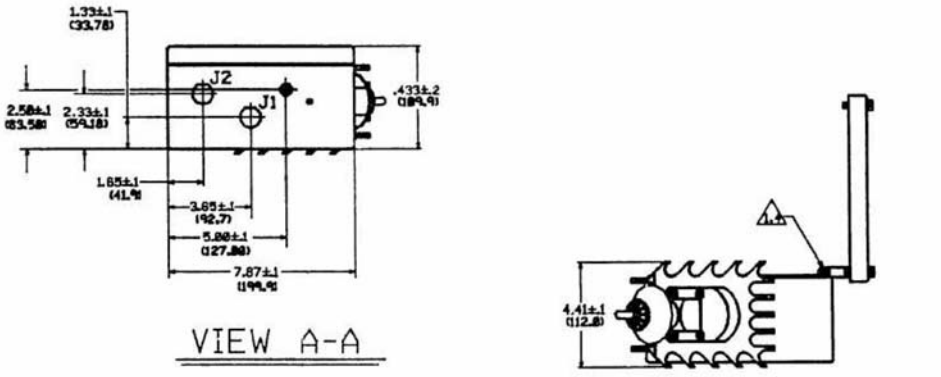
1.9.10 Electrical Connections

Electrical Connections to the 0872E3 are made at the two main unit connectors located on the outside of the hosuing. Connector J1(IDS) connects power to the 0872E3. J2(IDS) connects the RS-232 and current loop signal lines to the 0872E3.

J1(IDS) Power Connector	
Pin	Description
A	115 VAC Hot
B	115 VAC Neutral
C	Case Ground

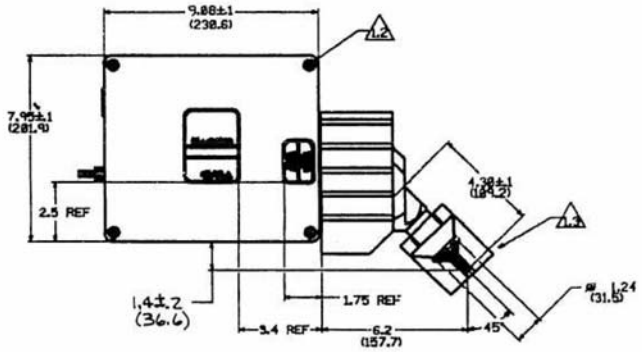
J2(IDS) Power Connector	
Pin	Description
A	RS-232Tx
B	RS-232Rx
C	RS-232 Signal Gnd.
D	Unused
E	Unused
F	Current Loop Rx+
G	Current Loop Rx-
H	Current Loop Tx+
J	Current Loop Tx-
K	Unused


A
B
C
C
1.1
A
B
ICE SENSING PROBE
7.08
(179.8)
1.00 ± .1
(25.4)
.43 ± .1
(11.0)
7.08
(179.8)
MOUNTING HOLES .25-20 UNC-2B
(4X)



VIEW A-A

VIEW B-B



VIEW C-C

2 APPENDIX B

2.1 FCC Compliancy Statement

AMADOR PRODUCT SERVICE
TEST REPORT #W4338

AMADOR PRODUCT SERVICE

1 TEST SUMMARY

Test Report #:	W4338
Company:	Rosemount Aerospace
Requester:	Rick Schwartz
Phone:	612 892 4260
Test Date(s):	25 July 1994
Equipment Under Test:	Freezing Rain Sensor
General Test Summary:	The Model 0872E3 Freezing Rain Sensor was tested for conformance to the FCC Part 15 electromagnetic emission requirements for an Unintentional Radiator. The testing was performed at AMADOR's Wild River Lab Large Test Site.
Original Grant or Permissive Change:	Neither, FCC Class B Verification.
Verification/Certification Status:	The Model 0872E3 Freezing Rain Sensor has been verified as being compliant with the FCC Class B Rules for a digital device.
Modifications Necessary for Compliance:	None.

Tested By:	*Report Written By:*	*Approval/NVLAP Signatory:*
G. E. Sutley	G. E. Sutley	J. P. Peltier 29 Jun 94

Figure 6. FCC Compliancy Statement

2.2 EC Declaration Certificate

EC DECLARATION OF CONFORMITY

Rosemount Aerospace, Inc. a wholly-owned subsidiary of the Goodrich Corporation, operating as Goodrich Sensors and Integrated Systems

of 14300 Judicial Road; Burnsville MN 55306

declares that:

Ice Detector Model No. **0872F1 Mod 1** and
Ice Detector Model No. **0872E3 Mod 1** and
Ice Detector Model No. **0872C3 Mod 1**

in accordance with the following Directives

2004/108/EC Directive

has been designed and manufactured to the following specifications:

EN 61326: 1997 Electrical Equipment for Measurement, Control and Laboratory Use. - EMC Requirements. Includes:
Amendment A1: 1998
Amendment A2: 2001
Amendment A3: 2003

Rosemount Aerospace, Inc. hereby declares that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with the requirements of the above referenced Directives as qualified per test reports NC708354.

Ice Detector Manager – Darren Jackson

Darren Jackson

Date 3-9-09

Quality Assurance – Bill Burkhart

Bill Burkhart

Date 3-12-09

CE 08

TRANSMITTAL OF TECHNICAL DATA (EAR)
These commodities, technology, or software are controlled by the U.S. Export Administration Regulations (EAR). Diversion contrary to U. S. law is prohibited.
ECCN: 7E994.

3 APPENDIX C

3.1 0872E3 Specification Drawing

REV. B | SH 1 | DWG NO 0872E3

PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY.
BY _____ DATE _____

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE

CAUTION: ELECTROSTATIC SENSITIVE DEVICE

REMOVE ELECTROSTATIC PROTECTION AT USE OR IN PROTECTED AREA.
RE-USE PACKAGING MATERIALS FOR THE UNSERVICEABLE ITEM. SEE
MIL-HDBK-263 FOR PROTECTIVE HANDLING OR TESTING MEASURES FOR THIS ITEM.

REV																						
SHEET	43	44	45	46	47	48	49	50														
REV																						
SHEET	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
REV STATUS OF SHEETS			REV	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	B	C	A	A	—
			SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125

—TOLERANCES—

DECIMALS: X ± .1, XX ± .02, XXX ± .010
FRACTIONS: ± 1/32
ANGLES: ± 2°

DO NOT SCALE PRINT

CONTRACT NO.

DR. 94 04 28
CHK'D 94 08 03
APP'D. 94 08 03
APP'D. GOVT.

ROSEMOUNT AEROSPACE INC.
BURNSVILLE, MINNESOTA

TITLE
SENSOR, ICE DETECTOR

SIZE	CAGE CODE	DRAWING NO.
A	59885	0872E3

SCALE: — WT. — SHEET 1 OF 18

DWG NO 0872E3 | SH 2 | REV. B

REVISION STATUS

REV.	PAGE	PARA.	CHANGE DESCRIPTION	ECO NO.	APP	DATE
A	1-18	–	DWG RELEASE	038111	[illegible]	6/1/94
B	1 3 15 16		In ESD Caution statement chg. DOD- HDBK To: MIL-HDBK; Spec. 2.1 -- Fr: Rosemount, To: Rosemount Aerospace Inc. Add +/- to. to .43, 1.00 dim. View A-A, View B-B, View C-C --- add +/- tol. to dims.	038576	RAS	940818
C	16		In View C-C change dim. from: 1.50 (38.1) To: 1.4 +/-.2 (36.6).	038687	RAS	940818

ROSEMOUNT AEROSPACE INC.
BURNSVILLE MINNESOTA

DR. SLS 94/04/28	SIZE A	CAGE CODE 59885	DRAWING NO. 0872E3		
ISSUE BLS 9/94	SCALE: –	WT: –	SHEET 2		

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

1.0 SCOPE

This specification establishes the performance design and test requirements for the Ice Detection Sensor (IDS) to be used by the Canadian Atmospheric Environment Service (AES).

2.0 APPLICABLE DOCUMENTS

In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding requirement.

2.1 AES DOCUMENTS

S009 Statement of Work for Rosemount Aerospace Inc. Ice Detection Sensor

2.2 RMTAERO DOCUMENTS

D9420132 Acceptance Test Procedure - Model 0872E3
D9320557 Burn-In Test Procedure - Model 0872E3

3.0 DESIGN REQUIREMENTS

3.1 PERFORMANCE

The IDS shall be capable of detecting freezing rain whenever ice has accreted to 0.005 inches on the probe. The IDS shall output the probe frequency that has been normalized over a one minute period using the data communications link as described in the following paragraphs. The output probe frequency shall have a resolution of 1 Hz. After a deice cycle the IDS shall be capable of detecting ice after a cool down period of 5 minutes nominal and 15 minutes maximum.

3.1.1 INSTALLATION

The IDS shall be mounted on a pole such that the sensing probe is pointing vertically up.

3.1.2 COMMUNICATION REQUIREMENTS

The IDS will be interrogated once per minute by the host system. The host system will send ASCII characters to the IDS and will wait for the appropriate response. The communication link will consist of an standard RS-232C datalink or a modification of an AES designed digital current loop (See Appendix A.) Control characters and control procedures shall be compatible with ANSI X3.28 and ANSI X 3.66 respectively. The data format shall consist of the following:

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.	
DR. [illegible]	7/94	A	59885	0872E3	
ISSUE [illegible]	7/20/94	SCALE:	WT.	SHEET 3	

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

Data format:

- 1 Start bit
- 8 Data bits
- 1 Stop bit
- No Parity
- 300 Baud
- Full Duplex
- Serial Asynchronous
- Configured as Data Terminal Equipment (DTE)

There are four interrogation request modes:

Request	Description
Z1	Send Routine Data
Z3XX	Perform Deice Cycle
Z4	Perform Extended Diagnostics
F5	Field Calibration

3.1.2.1 RESPONSE TO Z1 REQUEST

The IDS shall send the following data in response to a Z1 request. Z1 requests will be exercised once per minute.

Message to Z1 Request - Example: ZP 40000

Byte	Description	Value
1	Start of Transmission	STX
2	Carriage Return	CR
3	Line Feed	LF
4	Sensor ID	Z
5	Sensor Status	P/F/D (See Note 1)
6	Failure Code	X (See Note 2)
7-11	Probe Frequency	XXXXX (See Note 3)
12-13	Checksum	YY (See Note 4)
14	End of Transmission	ETX
15	Carriage Return	CR
16	Line Feed	LF

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.
DR. SCS 4/94		A	59885	0872E3
ISSUE 25	7/6/94	SCALE: —	WT. —	SHEET 4

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

Note 1 - The Sensor status is a single byte representing pass (P), fail (F), or deice (D). Pass (P) shall indicate that the IDS is fully operational. Fail (F) shall indicate the internal diagnostics of the IDS has detected a failure. Deice (D) shall indicate that the IDS is in the deice mode. When the IDS reports a "D", the actual probe frequency will continue to be reported. When the IDS reports an "F", the reported frequency will be invalid.

Note 2 - The Failure Code will be blank when the IDS reports a sensor status of "P" or "D". When the sensor status reports an "F", the Failure Code shall be as follows:

1 - Probe Frequency Failure: $\leq$38,400 Hz or $\geq$41,500 Hz
2 - Probe/strut Heater Failure
3 - Electronics Failure

Note 3 - The reported probe frequency shall be the probe frequency that has been averaged over the previous one minute and normalized to 40,000 Hz. The following formula shall be used:

Normalized Frequency = One Minute Average Frequency + (40,000 — Stored calibration frequency)

The last part of the equation provides an offset to the actual probe frequency and allows for correcting minor drifting of the probe frequency due to aging.

Note 4 - The checksum shall be the sum of all bytes preceding the checksum byte using modulo 256 to calculate the value of the checksum.

3.1.2.2 Response to Z3XX Request

The Z3 request for deice shall be accompanied by a two byte suffix; i.e. Z3XX. The numerical values of XX shall be between 01 and 60 and represent the amount of time, in seconds, that the sensor is to turn on it's deice heaters. Numerical values greater than 60 seconds will be ignored by the IDS.

Message Response to Z3XX Poll - Example: ZDOK

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.	
DR. SLS	8/3/94	A	59885	0872E3	
ISSUE SLS	8/3/94	SCALE: —	WT. —	SHEET 5	

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor ID	Z
5	Sensor Status	D
6-7	Deice Acknowledgement	OK (Note 1)
B-9	Checksum	YY
10	End of transmission	ETX
11	Carriage return	CR
12	Line feed	LF

Note 1. Deice acknowledgement, "OK", shall be sent only after the Z3XX command is received and the heaters are turned on.

3.1.2.3 Response to Z4 Request

This response sends the results of the sensor extended diagnostics routine.

Message Response to Z4 Poll - Example: ZF2

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor ID	Z
5	Sensor Status	P/F/D (Note 1)
6	Failure Code	X (Note 2)
7-8	Checksum	YY (Note 3)
9	End of transmission	ETX
10	Carriage return	CR
11	Line feed	LF

Note 1. The IDS status is a single byte representing pass or fail, "P" or "F" of the sensor's extended diagnostics or deice, "D", when the sensor is in the deice mode.

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.
DR. SLS	4/94	A	59885	0872E3
ISSUE SLS	7/20/94	SCALE: —	WT. —	SHEET 6

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

Note 2. The Failure Code will be blank, " ", when the sensor status is "P" or "D". When the sensor status is an "F", the Failure Code shall be as follows:

"1" - Probe Failure
"2" - Prove Deicing Heater Failure
"3" - Electronics Failure

Note 3. The checksum should be calculated using the modulo 256 summation of all bytes preceding the checksum byte.

3.1.2.4 Response to F5 Request

The IDS shall respond to a F5 request with the following:

"Recalibrate? Y or N"

The IDS shall respond at the completion of the recalibration cycle with the message that shows the effort has been successfully completed and with the recalibration frequency.

Message Response to F5 Poll - Example: ZP 39998

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor ID	Z
5	Sensor Status	P/F/D
6	Failure Code	X
7-11	Calibration Frequency	XXXXX (Note 1)
11-13	Checksum	YY
14	End of transmission	ETX
15	Carriage return	CR
16	Line feed	LF

Note 1. Bytes 7-11 represent the frequency to which the sensor is calibrated. This frequency is used to obtain the normalized frequency as described in Paragraph 3.1.2.1, Note 3.

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.	
DR. [illegible]	4/94	A	59885	0872E3	
ISSUE [illegible]	7/20/94	SCALE: —	WT. —	SHEET 7	

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

Note 2. Sensor re-calibration using the F5 request may be performed on an "as required" basis. The probe must be clean and free of ice and other foreign matter before performing the re-calibration. The ambient temperature shall be $0 \pm 10°C$ at the time of the recalibration.

3.2 POWER REQUIREMENTS

The IDS shall operate from 115 ± 10 VAC, 60 ± 5 Hz, single phase power. The basic electronic system shall require a maximum of 10 Watts. Heaters shall be provided to remove ice from the probe and shall require a maximum 385 watts during the deicing mode. The deice function shall be upon command of the host system. External and internal ground studs shall be supplied as specified in paragraph 3.6.

3.3 SELF TEST

The system shall be capable of performing three classes of tests: (1) continuous self-testing that runs automatically, (2) self-test every 10 hours to check heater continuity, and (3) specific tests plus sensor dialogue that are run on demand in response to an external command (See paragraph 3.4). The operation of the self-testing software shall not interfere with the collection, processing, storage or reporting of data. Tests that are run on demand shall be designed to be performed locally to isolate problems when an actual or perceived failure has occurred.

The continuous self-test shall be designed to detect any out of tolerance conditions. Internal power supplies of the IDS shall be continuously monitored for proper operation. The continuous self-test shall test the following for failure and out of tolerance conditions as required to meet a 95% confidence factor:

- Heater continuity
- Probe Frequency
- External RAM
- Non-volatile Calibration Checksum
- I/O Port Operation
- Power Supply Voltage
- Software Cycle Timing

A watchdog timer/power monitor circuit shall be incorporated into the design of the IDS to monitor the operation of the microcontroller. In normal operation, the microcontroller circuit will input a pulse into the watch dog timer circuit approximately every second. If the watch dog does not receive this pulse, it shall cause the microprocessor to go into a reset condition, which will re-initialize the microcontroller. The power monitor circuit shall cause the microcontroller to reset any time the internal 5.0 VDC power supply voltage drops below and then rises above 4.65 VDC.

All detected failures shall be logged into a non-volatile RAM circuit for failure analysis at a repair facility at a later time. Any logged failure(s) shall be capable of being cleared from the non-volatile RAM by an appropriate method.

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

3.4 EXTENDED BIT

Additional on command diagnostic capabilities shall be provided for those faults that cannot be detected by the internal self test. These additional tests consist of ROM checksum and heater control circuit checks. These additional functions shall be performed through commands of the host system (Z4 Command).

Any detected failures shall be logged into a non-volatile RAM circuit and be removable as described in paragraph 3.3.

3.5 LOGISTICS

3.5.1 MAINTAINABILITY

3.5.1.1 MEAN TIME TO REPAIR

The IDS shall demonstrate at the Field Replaceable Unit (FRU) level, a mean time to repair (MTTR) which is less than 30 minutes at a 95% confidence level. The MTTR shall include the time required to fault detect, fault isolate, remove and replace the faulty FRU and perform a checkout and any necessary calibration of the subsystem.

3.5.1.2 SERVICEABILITY

All modules, circuit boards, or other components shall be readily-accessible. External connectors and fasteners shall be readily accessible to allow for easy field replacement of the unit.

3.5.1.3 CALIBRATION AND PREVENTIVE MAINTENANCE

The IDS shall be designed to eliminate or minimize the need for equipment adjustments, alignments, and calibrations. Preventive maintenance, as required, shall not be necessary more frequently than every 180 days. This includes any servicing that may be needed to clean the sensor probe.

3.5.2 RELIABILITY

3.5.2.1 REQUIRED MTBF

The IDS shall have an MTBF in excess of 33,333 hours, while operating in a ground fixed environment. This reliability prediction shall be based on MIL-HDBK-217 and shall assume an ambient operating temperature of 40°C for the calculations.

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

3.5.2.2 DERATING OF ELECTRONIC PARTS AND MATERIALS

In the application of electronic parts and materials, the parts and materials selected shall be used within their electrical ratings and environmental capabilities. Derating shall be accomplished as necessary to assure the required equipment reliability within the specified operating conditions. Parts derating guidelines or requirements shall be based on MIL-HDBK-217.

3.6 EQUIPMENT SAFETY

Commercial power input shall be in accordance with National Fire Protection Association (NFPA) 70. The design and construction of the equipment, shall insure that all external parts, surfaces, and shields are at ground potential at all times during normal operation.

A grounding stud on the electrically conductive chassis shall serve as the common tie point for static and safety grounding. The path from the tie point to ground shall be continuous and permanent, shall have ample carrying capacity to safely conduct any fault currents that may be imposed upon it, shall have impedance sufficiently low to limit the potential above ground, and shall have sufficient mechanical strength to minimize possibility of ground disconnection.

Access covers shall be attached or hinged in such a manner as to insure that they are at the same ground potential as the equipment whether in a closed or open position.

3.7 DESIGN AND CONSTRUCTION

3.7.1 FUNGUS-INERT MATERIAL

Only inherently fungus-inert materials shall be used except that the other materials may be used in hermetically sealed assemblies or other specifically approved items.

3.7.2 ELECTRICAL CONNECTORS

The IDS shall incorporate the following electrical connectors as shown on sheet 16, view A-A.

J1: Power Connector, Bendix PT07SE-12-3P

Pin	Description
A	115 VAC Power Input
B	115 VAC Neutral (Power Return)
C	Case Ground (Safety)

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.
DR. SLS	4/4/4	A	59885	0872E3
ISSUE SLS	7/20/94	SCALE: —	WT. —	SHEET 10

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

J2: Signal Connector, Bendix PT07SE-12-10P

Pin	Description
A	RS232Tx
B	RS232 Rx
C	RS232 Signal Ground
D	Unused
E	Unused
F	Current Loop Rx_+
G	Current Loop Rx_-
H	Current Loop Tx_+
J	Current Loop Tx_-
K	Unused

3.7.3 CSA REQUIREMENTS

The IDS shall be designed and constructed for certification to Canadian Electrical Code, Part 1. Each IDS shall be tested for dielectric strength, J1 pins 1 and 2 to J1 pin 3 (case ground) at 1414 VDC for one minute.

3.7.4 INTERCHANGEABILITY

Provisions shall be made for design tolerances such that items having the dimensions and characteristics permitted by the item specification may be used as replacements without selection or departure from the specified equipment. When the item specification provides more than one characteristic or tolerance, the item having the broadest characteristics and tolerances that will fulfill the equipment performance requirements shall be used. However, delays in development or production caused by procurement time required for such items may be avoided by substitution of readily available acceptable items of higher quality.

3.7.5 ELECTROSTATIC DISCHARGE REQUIREMENT

The IDS shall not require special ESD handling requirements when all covers are in place. If the IDS uses ESD sensitive devices, appropriate ESD warning labels shall be affixed to the outside of the unit, easily visible to maintenance personnel.

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

3.7.6 EXTERNAL FINISHES

The IDS shall have corrosion resistant external finishes to the environmental conditions as specified in paragraph 3.8.1. As a minimum, the strut, heatsink and all portions of the strut shall be clear anodized per MIL-A-8625, Type III, Class 2; the sensing probe shall be electroless nickel plated per MIL-C-26074B, Class I, Grade B; the housing shall be finished with 2 coats of gloss acrylic white paint over a chemical conversion coat per MIL-C-5541, Class 3.

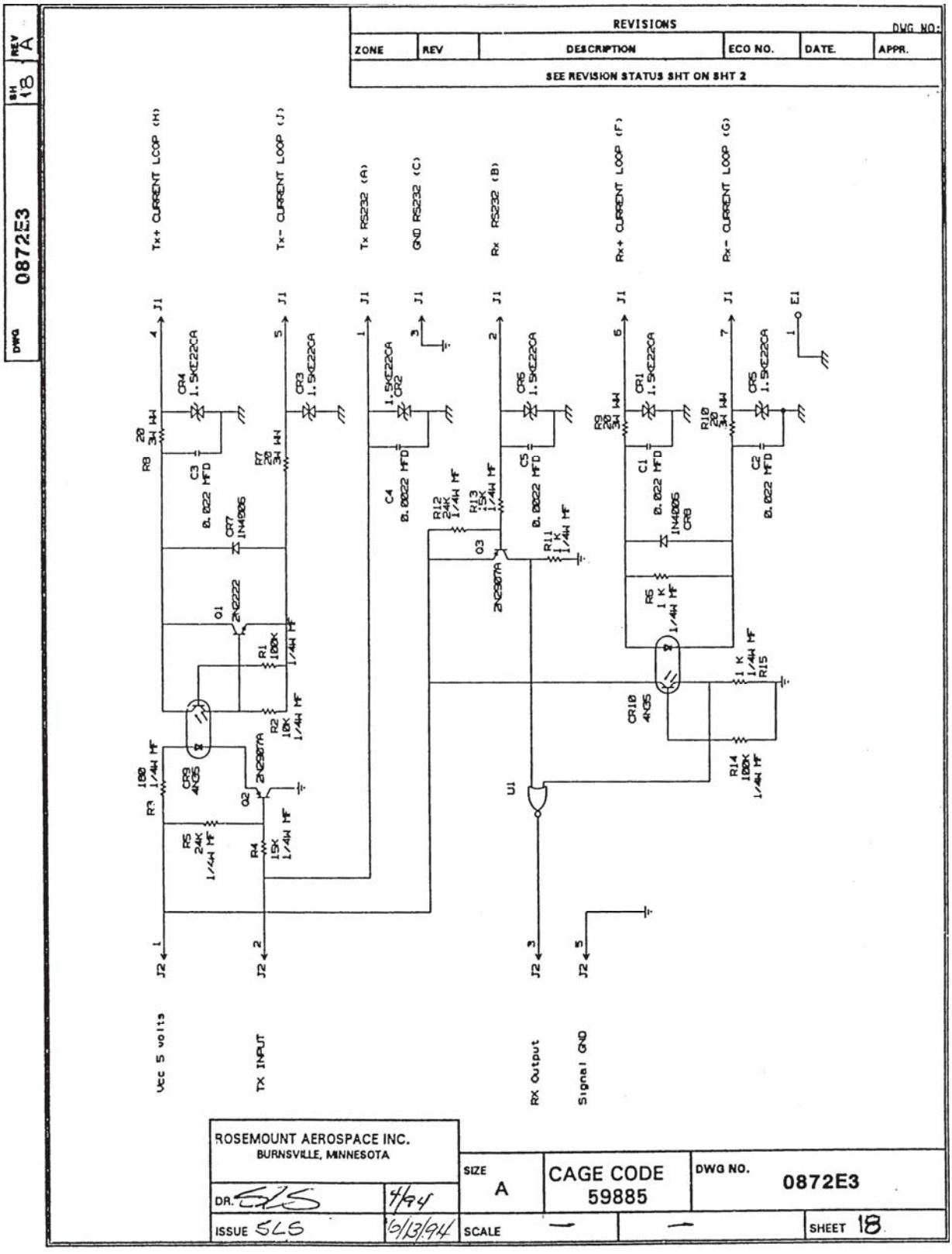
3.7.7 CURRENT LOOP COMMUNICATION

The IDS shall incorporate a current loop communication port in addition to the standard RS-232C communication port. The current loop shall be per Appendix A. Any deviation from this design shall require the approval of AES.

3.8 ENVIRONMENTAL CONDITIONS

3.8.1 OPERATIONAL ENVIRONMENT

The IDS shall be designed, fabricated, and tested to withstand the environmental conditions anticipated at any site encountered in Canada. The IDS shall be designed to operate in those environments 24 hours a day, 365 days a year. Table A is a detailed listing of the maximum environmental requirement that the IDS shall be fully capable of operating in.


DWG 0872E3
SH 18
REV A
REVISIONS
DWG NO:
ZONE
REV
DESCRIPTION
ECO NO.
DATE.
APPR.
SEE REVISION STATUS SHT ON SHT 2
Tx+ CURRENT LOOP (H)
Tx- CURRENT LOOP (J)
Tx RS232 (A)
GND RS232 (C)
Rx RS232 (B)
Rx+ CURRENT LOOP (F)
Rx- CURRENT LOOP (G)
Vcc 5 volts
TX INPUT
RX Output
Signal GND
ROSEMOUNT AEROSPACE INC.
BURNSVILLE, MINNESOTA
DR. SLS 4/94
ISSUE SLS 6/13/94
SIZE A
CAGE CODE 59885
DWG NO. 0872E3
SCALE
SHEET 18

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

DWG NO 0872E3 SH 13 REV. A

Table A - Environment Limits

Environmental Conditions	Operational Test Limit
High Temperature	50°C
Low Temperature	-50°C
Humidity	74% RH 35°C to 100%RH @ 25°c
Wind (Steady)	to 30 kts
Wind (Gust)	to 46 kts
Rain	to 3"/hr with 30 kts wind
Freezing Rain	ice accretion to 1 inch with 20 kt wind at a rate of ½ inch per hour
Dust	Exposure to dust laden environment
Insolation (Sunshine)	Heat build up when exposed to 90 watts/ft^2 at 50°C
Low Pressure	to 15.7 in. Hg
Electromagnetic Interference	Exposure to airport environment In addition, the IDS shall meet the requirements of paragraph 3.8.2
Salt fog	Exposure normal to coastal marine environment
Vibration (Handling)	Exposure normal to transit handling procedures via common carrier 3-5 Hz with acceleration of 1G
Vibration (Handling Shock)	Up to 22 inch drop (in shipping container)

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.
DR. SLS	4/94	A	59885	0872E3
ISSUE SLS	9/14/94	SCALE: —	WT. —	SHEET 13

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

3.8.2 EMI EMISSION/PROTECTION REQUIREMENTS

3.8.2.1 DOC EMISSION REQUIREMENTS

The IDS shall meet the CSA type approval requirements for "Electromagnetic Emissions from Data Processing Equipment and Electronic Office Machines" CSA Document Number C108.8-M2983 or the Federal Communications Commission (FCC) type approval requirements for Part 15, Subpart B of the Code or Federal Regulations for Class A Digital Devices. Type approval testing is required and the IDS must be certified as compliant with the above requirements.

3.8.2.2 PROTECTION REQUIREMENTS

The IDS shall meet the susceptability requirements of MIL-STD-461C, Part 7 and Part 10, "Electromagnetic Interference Characteristics, Requirements for Equipment" as follows:

CS01	Conducted Susceptibility, Power Leads, 30 Hz - 50 KHz
CS02	Conducted Susceptibility, Power and Interconnecting Control Leads, 0.05 - 400 MHz
CS06	Conducted Susceptibility, Spikes, Power Leads
UM05	Requirements for Commercial Electrical Equipment and Electromechanical Equipment (Group 1), paragraph 3.2.3 Radiated Susceptibility.

The IDS shall be tested to show compliance to the above requirements.

4.0 NAMEPLATE INFORMATION

The following information shall be contained as a minimum on the nameplate:

ICE DETECTION SENSOR
MODEL 0872E3
SERIAL NUMBER XXXX

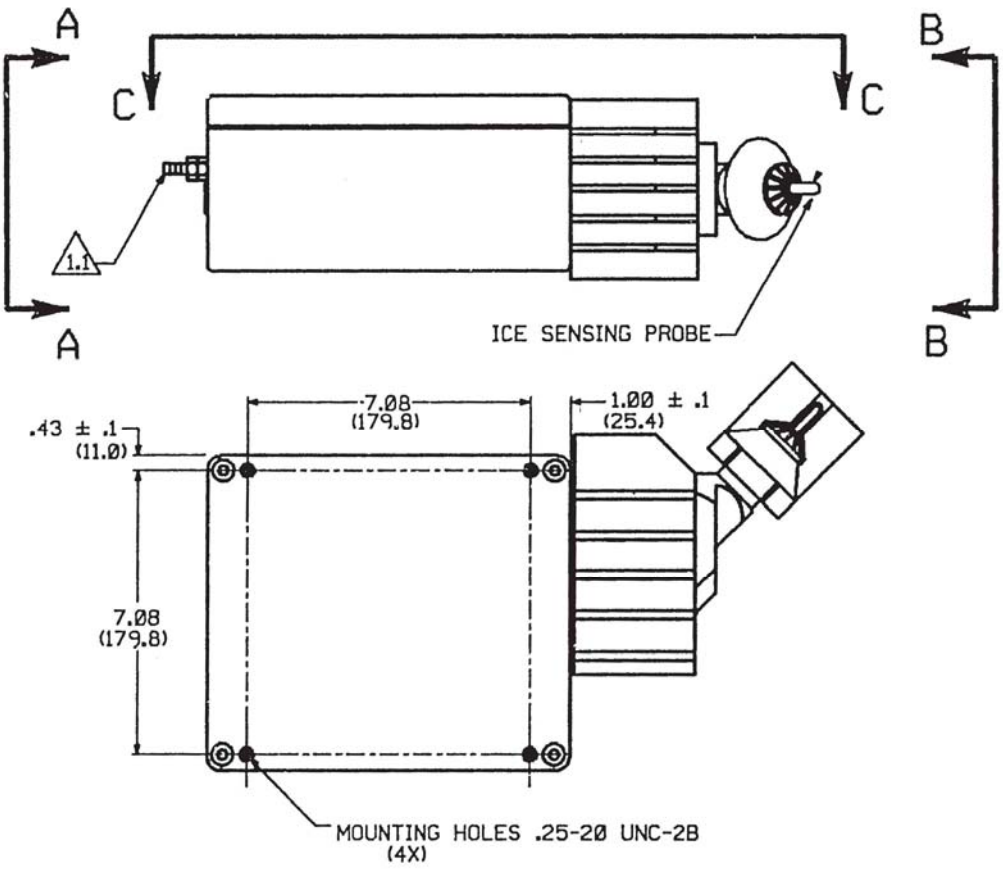
CAGE CODE 59885
ROSEMOUNT AEROSPACE INC
BURNSVILLE, MN 55306

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE	CAGE CODE	DRAWING NO.	
DR. [illegible]	8/3/94	A	59885	0872E3	
ISSUE [illegible]	9/13/94	SCALE: —	WT. —	SHEET 14	

SH 15

DWG NO 0872E3

REVISIONS (ALL SHEETS ARE SAME REV)				
REV	DESCRIPTION	CHG NO	APPD	DATE
	SEE REV STATUS SHT 2			



1.5 CAUTION - ELECTROSTATIC SENSITIVE DEVICE, REMOVE ELECTROSTATIC PROTECTION AT USE OR IN PROTECTIVE AREA. REUSE PACKAGING MATERIALS FOR THE UNSERVICEABLE ITEM. SEE MIL-HDBK-283 FOR PROTECTIVE HANDLING OR TESTING MEASURES FOR THIS ITEM. THIS IS A CLASS 1 ESDS ITEM, WHEN THE COVER IS OPEN.

1.4 COVER HINGES ON THIS SIDE OF HOUSING.

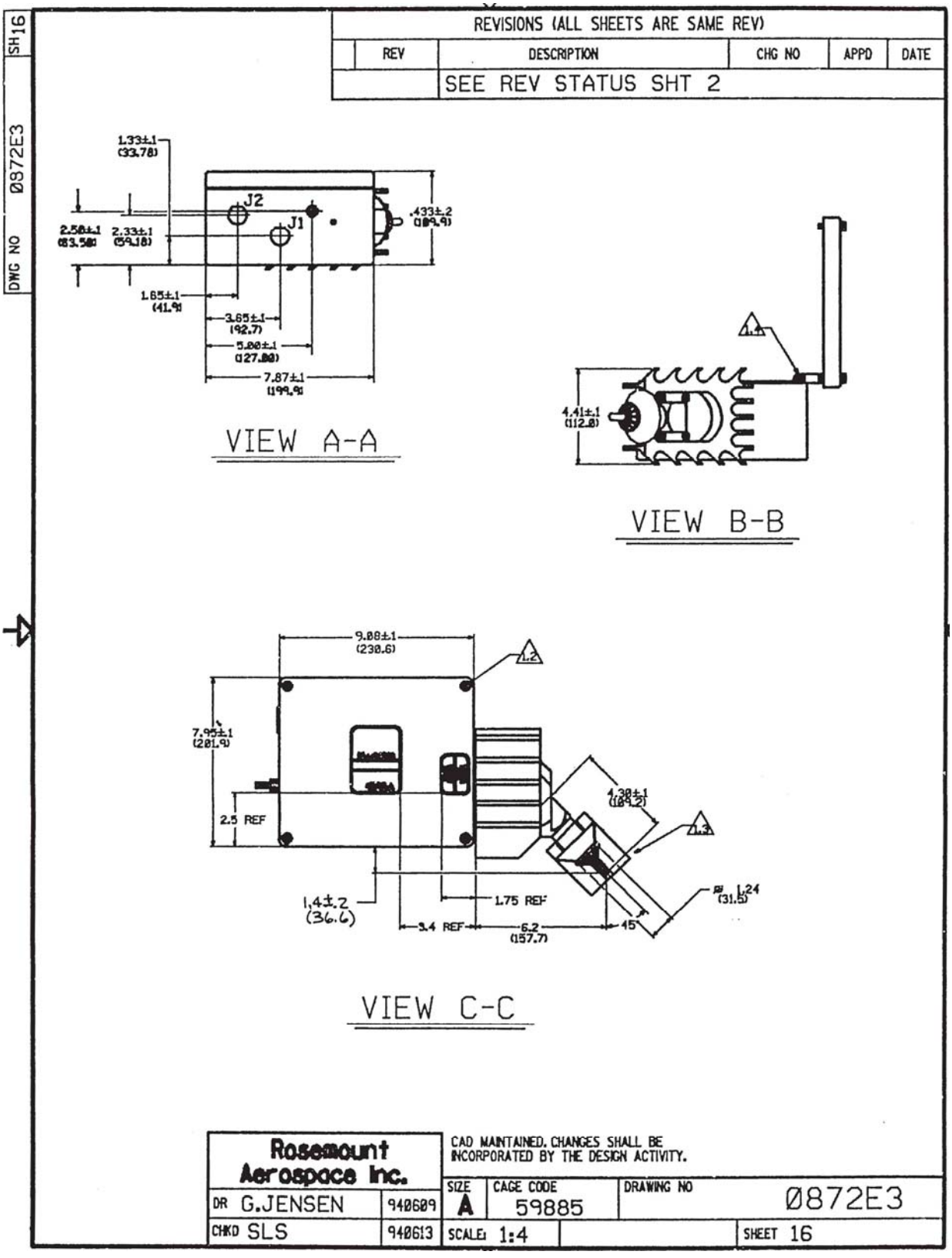
1.3 STRUT AND PROBE PROTECTIVE COVERS MUST BE REMOVED AT INSTALLATION. (RETAIN FOR SHIPMENT OF UNSERVICEABLE ITEM).

1.2 TORQUE M-6 COVER MOUNTING SCREWS TO 28.0 IN-LBS.

1.1 EXTERNAL GROUNDING WIRE TO BE ATTACHED BETWEEN TWO EXITING NUTS. TORQUE SHOULD NOT EXCEED 7.0 FT-LBS (84 IN-LBS).

NOTES: UNLESS OTHERWISE SPECIFIED

Rosemount Aerospace Inc.		CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.			
DR JEM	930806	SIZE A	CAGE CODE 59885	DRAWING NO 0872E3	
CHKD SLS	930613	SCALE: 1:4			SHEET 15

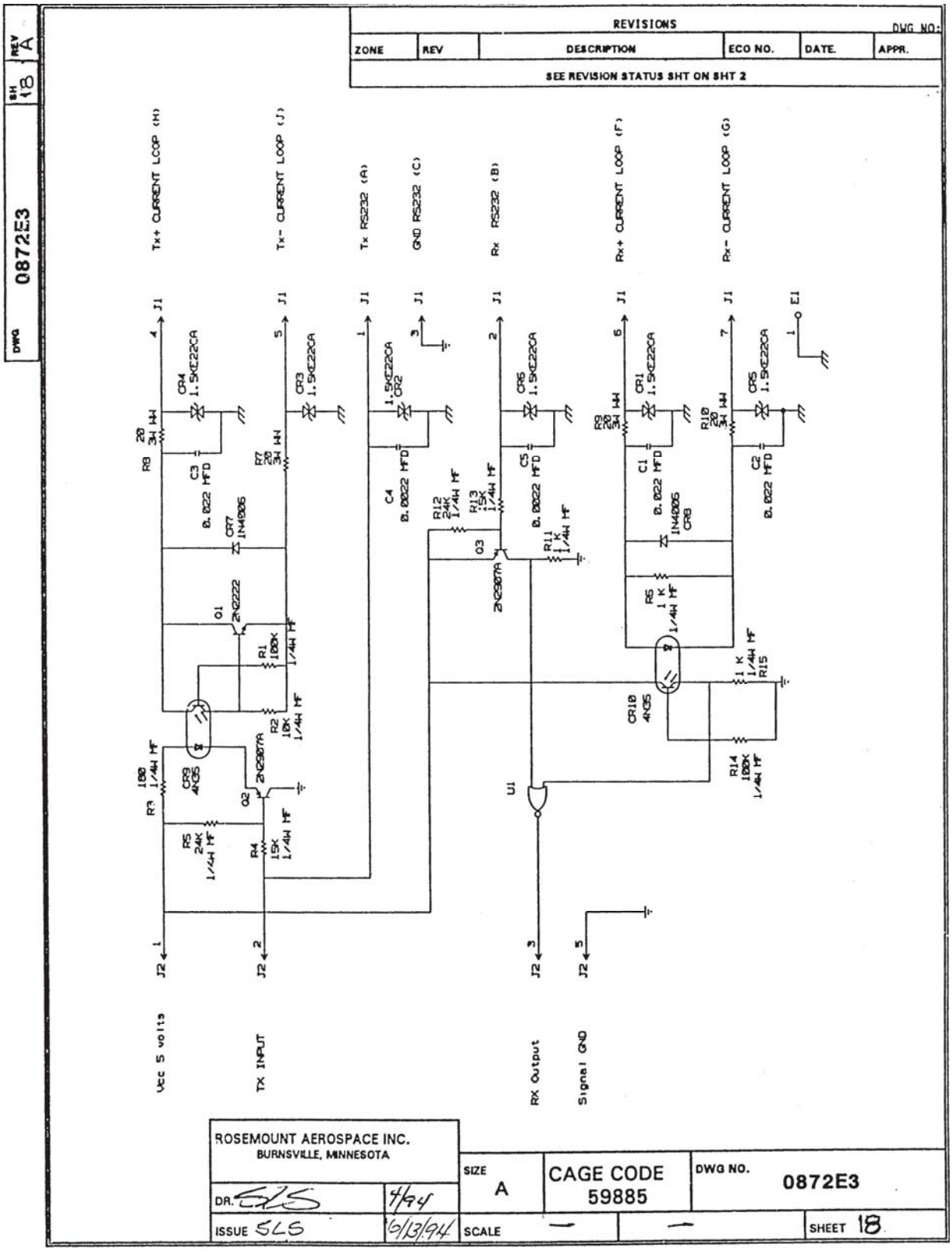

SH16
DWG NO 0872E3
REVISIONS (ALL SHEETS ARE SAME REV)
REV
DESCRIPTION
CHG NO
APPD
DATE
SEE REV STATUS SHT 2
J2
J1
VIEW A-A
VIEW B-B
VIEW C-C
Rosemount Aerospace Inc.
DR G.JENSEN 940609
CHKD SLS 940613
CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.
SIZE A
CAGE CODE 59885
DRAWING NO 0872E3
SCALE: 1:4
SHEET 16

REVISIONS				
REV.	DESCRIPTION	CHG. NO.	APP'D	DATE
	SEE REVISION STATUS SHEET 2			

DWG NO 0872E3 SH 17 REV. A

APPENDIX A

ROSEMOUNT AEROSPACE INC. BURNSVILLE MINNESOTA		SIZE A	CAGE CODE 59885	DRAWING NO. 0872E3
DR. SCS	4/5/94			
ISSUE SCS	7/20/94	SCALE: —	WT. —	SHEET 17


DWG 0872E3
SH 18
REV A
REVISIONS
DWG NO:
ZONE
REV
DESCRIPTION
ECO NO.
DATE.
APPR.
SEE REVISION STATUS SHT ON SHT 2
Tx+ CURRENT LOOP (H)
Tx- CURRENT LOOP (J)
Tx RS232 (A)
GND RS232 (C)
Rx RS232 (B)
Rx+ CURRENT LOOP (F)
Rx- CURRENT LOOP (G)
Vcc 5 volts
TX INPUT
RX Output
Signal GND
ROSEMOUNT AEROSPACE INC.
BURNSVILLE, MINNESOTA
DR. SLS 4/94
ISSUE SLS 6/13/94
SIZE A
CAGE CODE 59885
DWG NO. 0872E3
SCALE — —
SHEET 18