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Digital ThermArray System
Installation Guide

EPM0036 B

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1 INTRODUCTION

RST's ThermArray System provides precise thermal gradient information for geotechnical, geothermal, and marine applications. The system consists of numerous digital thermal data acquisition nodes distributed along one or more linear cable segments, typically spaced at uniform intervals.

FIGURE 1-1 THERMARRAY CONNECTED TO THE ULTRA RUGGED FIELD PC²

1.1 THERMARRAY COMPONENTS

The ThermArray system consists of multiple components.

- ThermArray Nodes: Each node is an individually addressed and individually calibrated digital temperature sensor which is moulded directly onto the ThermArray string.
- ThermArray String: The ThermArray string is a waterproof, low-temperature cable which provides power and digital data access to the ThermArray nodes. It includes waterblock filling and is composed of a high-strength, anti-stretch Kevlar® for precise and durable positioning.

1.2 Associated Products

The RS485 adaptor is required for RS232 serial port communication. Refer to Section 3 for further information.

2 Installation

The ThermArray system may be used in numerous applications. Installation of the ThermArray system will differ per site specifications.

The ThermArray string will need to be gently uncoiled prior to installation. Take care to prevent damage to the ThermArray string and nodes when installing in harsh site conditions or when in contact with materials such as soil and rocks.

A weight or rope may be attached to the deep threaded hole within the terminal assembly to assist the installation.

NOTE: Counter the buoyancy when installing the ThermArray System in a water-filled borehole or other upright submerged sites.
The weight required to counter the buoyancy will be equal to the weight of the water volume being displaced.

3 RS485 Adaptor

The RS485 adaptor is required for equipment built with a RS232 port.

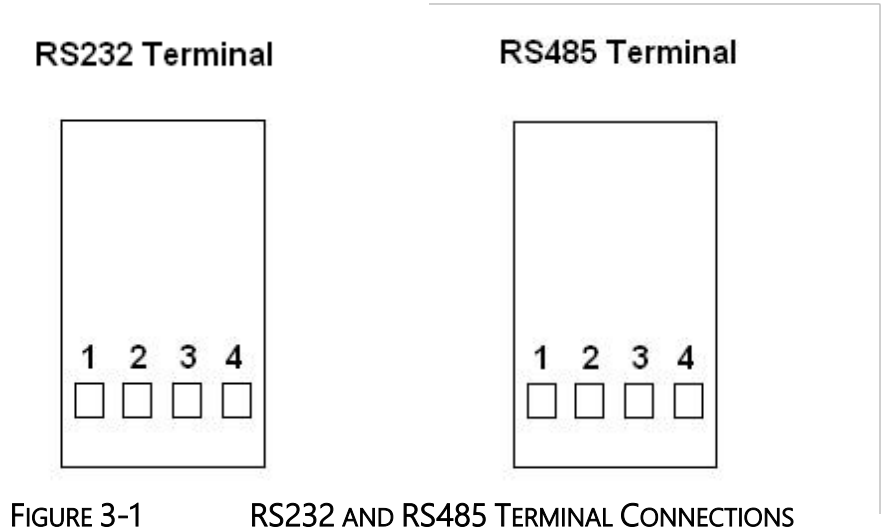


Figure 3-1 RS232 and RS485 Terminal Connections

The RS232 COM port settings are Baud 115200, 8 data bits, no parity, and 1 stop bit. The RS485 port baud is factory fixed. Refer to Figure 3-1 for RS232 and RS485 terminal connections.

3.1 ADAPTOR INSTALLATION

Refer to the following tables for terminal connections.

TABLE 3-1 RS232 TERMINAL CONNECTIONS FOR LOGGER CONNECTION

CR800/CR1000				RS232 Adapter Interface	Description
SW12V				1 (Red)	Power (7-12 V)
C2	C4	C6	C8	2 (Green)	RS232 Rx
C1	C3	C5	C7	3 (White)	RS232 Tx
G				4 (Black)	Ground (RS232 9-pin D-Sub pin 5) & Power Ground

TABLE 3-2 RS232 TERMINAL CONNECTIONS FOR COMPUTER CONNECTION

Computer RS232 Port	RS232 Adapter Interface	Description
12V	1 (Red)	Power (7-12 V)
Rx (RS232 9-pin D-Sub pin 2)	2 (Green)	RS232 Rx
Tx (RS232 9-pin D-Sub pin 3)	3 (White)	RS232 Tx
Ground (RS232 9-pin D-Sub pin 5) & Power Ground	4 (Black)	Ground

TABLE 3-3 RS485 TERMINAL CONNECTIONS

RS485 Adapter Interface	ThermArray String	Description
1 (Red)	Red	Power
2 (Green)	Green	RS485 Communications – A
3 (White)	White	RS485 Communications – B
4 (Black)	Black	Ground

4 RS485 COMMANDS

Various commands can be used to retrieve information from connected instruments when the RS485 adaptor is connected to a computer running communication software.

Temperature readings from the ThermArray node may be retrieved using two command sequences. One command is sent to take a reading and one command is sent to retrieve the reading.

4.1 TTT COMMAND

The TTT command will cause the ThermArray node to take a temperature reading and store it in its memory. Only the most current reading is stored. The stored reading is maintained until power is removed from the ThermArray node or a new reading is taken.

TTT DeviceAddress CR	=	Entered command
TTT DeviceAddress CR	=	Returned string
Where:		
TTT	=	Command to be processed
DeviceAddress	=	Address of ThermArray node in "**decimal**" format
CR	=	Carriage return, hex 0x0D, command termination character

4.2 TRT COMMAND

The TRT command will cause a group of ThermArray nodes to take a temperature reading.

TRT (DeviceNum) Addr1 Addr2 … AddrN CR	=	Command to be processed
TRT (DeviceNum) Addr1 Addr2 …AddrN (: Error#) CR	=	Returned string
Where:		
DeviceNum	=	The number of ThermArray nodes that will be taking a temperature reading. DeviceNum can be omitted if only one node is to be read
Addr1…AddrN	=	The address of each ThermArray node that will be taking a temperature reading. The addresses are in hex format.
(: Error#)	=	The nodes position in the address list will be displayed in the returned string if a communication error occurs with a node.

4.3 GTT COMMAND

The GTT command will cause the ThermArray node to send the latest temperature reading. If the TTT has not been processed, the entries in the returned reading defaults to 0 (zero). The entries are comma separated.

GTT DeviceAddress CR	=	Entered command
GTT DeviceAddress, Temperature, Resistance, ADReading CR	=	Returned string

Where:

GTT	=	Command to be processed
DeviceAddress	=	Address of ThermArray node in "**decimal**" format
Temperature	=	Temperature read at ThermArray node
Resistance	=	Resistance of thermistor
CR	=	Carriage return, hex 0x0D, command termination character

4.4 MODE

The MODE command is a special command used to switch the functionality of the adapter. For ThermArray mode, use the following command to ensure the correct configuration:

MODE 1**CR**

The adapter should respond with "RST Thermarray" to indicate proper communication. Lack of response indicates a communication problem.

4.5 BAUD

The BAUD command is a special command used to change the RS232 COM port baud rate. The adaptor will need to be switched into a different mode in order to use the BAUD command. The following lists the sequence required to change the baud rate.

1. MODE 1**CR**,
2. BAUD<baud rate>**CR**,
3. The supported <baud rate> is either 115200 or 9600.

5 SERVICE AND REPAIR

The product contains no user-serviceable parts. Contact RST for product service not covered in this manual.

Refer to the inside title page of this manual for RST's contact information.

Appendix A THERMARRAY SPECIFICATIONS

TABLE A-1 THERMARRAY NODE SPECIFICATIONS

Item	Description
Temperature Range	-20 to 50ºC
Resolution	0.01 C
Accuracy	0.07 C
Time Constant	20 seconds
Power Supply Voltage	7-13V DC
Current per Node	0.8 mA
Acquisition Time	0.5 seconds
Node Length	30 mm
Node Diameter	15 mm

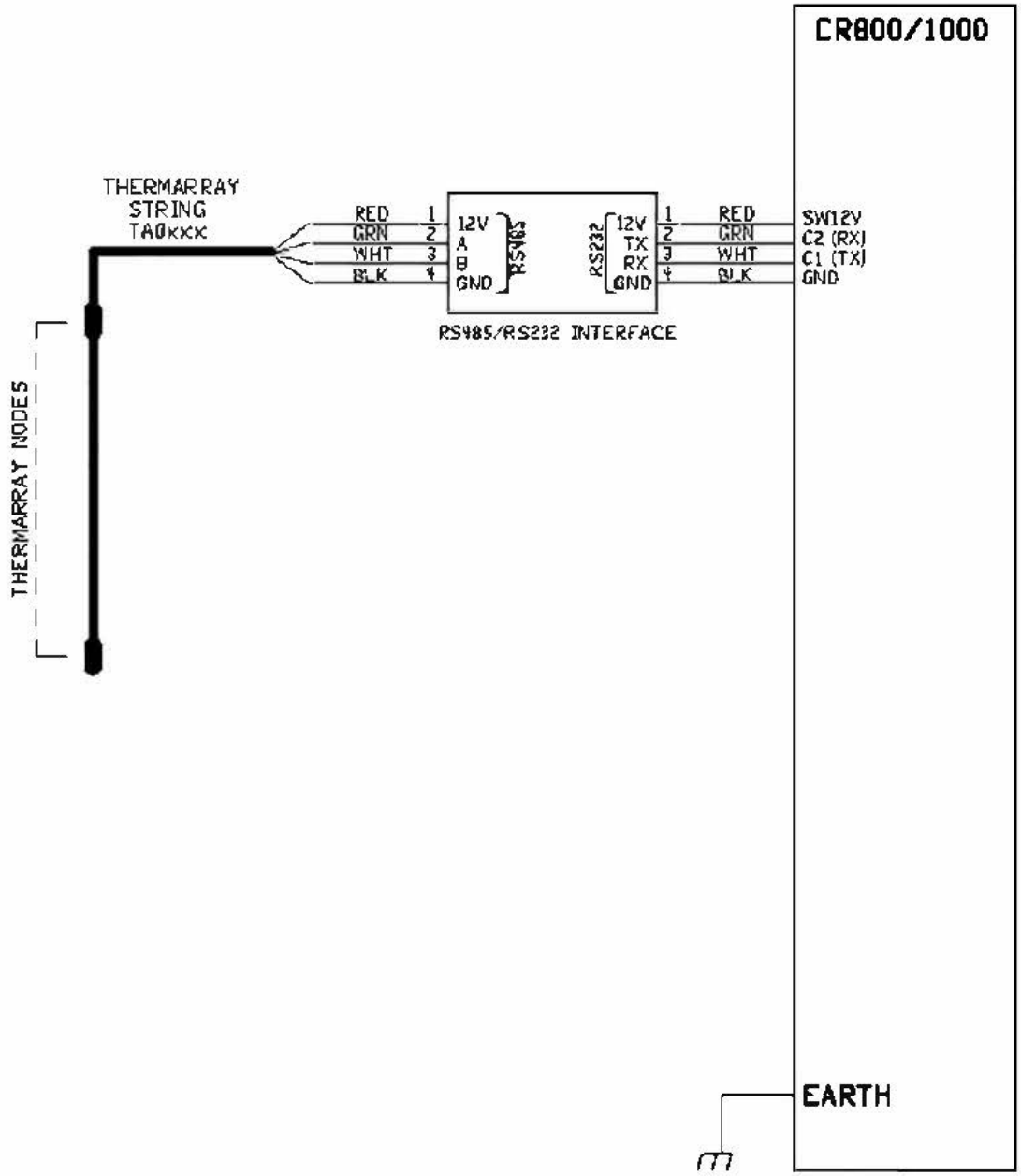
TABLE A-2 THERMARRAY CABLE SPECIFICATIONS

Item	Description
Conductors	4
Diameter	7 mm
Breaking Strength	5 kN
Maximum Segment Length	500 m
Minimum Node Spacing	100 mm
Mechanical Terminal	6 mm x 1 mm threaded

TABLE A-3 THERMARRAY TERMINAL SPECIFICATIONS

Item	Description
Maximum Nodes	256
Input Power	6V DC

Appendix B THERMARRAY WIRING DEMO TO CR800/CR1000 LOGGERS



Co.	RST INSTRUMENTS LTD		
Title	THERMARRAY DATA LOGGER		
Board	WIRING DEMO		Rev. A
Date: 2014/03/20	CHKD	APPRVD	DRAWN BY: CB

Appendix C SAMPLE CR800/CR1000 PROGRAM

```
'Thermarray Demo
'11-Aug-2015, CWB
'To monitor one Thermarray String with 10 nodes

SequentialMode

Public pTemp, batt_volt

Const nPoints0425 = 10 'number of points in thermarray string
Public tArray0425temp(nPoints0425), tArray0425res(nPoints0425)
Dim tArray0425sn(nPoints0425) = {3156,3157,3158,3159,3160,3161,3162,3163,3164,3165} 'thermarray node serial numbers

Sub ReadThermArray (tempArray(50), resArray(50), snArray(50), pointsToMeasure, ComPort)
  Dim t, temp As string * 40, parse(4) As String * 10,chan

  SerialOut(ComPort,"Mode 1" + CHR(13),"",0,0) 'ensure RS232/485 adapter is in correct mode
  Delay(0,1000,mSec)
  For t = 1 To pointsToMeasure  'number of points to measure
    SerialFlush(ComPort)
    Delay(0,10,mSec)
    chan = snArray(t) 'node serial number
    SerialOut(ComPort,"TTT " + chan + CHR(13),"",0,0) 'take reading
    Delay (0,350,mSec)
  Next t 'next node

  Delay(0,1500,mSec) 'processing delay

  For t = 1 to pointsToMeasure
    SerialFlush(ComPort)
    Delay(0,10,mSec)
    chan = snArray(t)
    SerialOut(ComPort,"GTT " + chan + CHR(13),"",0,0) 'get reading
    SerialIn(temp,ComPort,100,CHR(13),40)
    Delay(0,250,mSec)
    SplitStr(parse(),temp,",",4,0) 'parse returned measurement string
    tempArray(t) = parse(2)
    resArray(t) = parse(3)
  Next t 'next node

EndSub

DataTable (Thermarray_Demo, -1, -1)
  Sample (1,batt_volt,FP2)
  Sample (1,pTemp,FP2)
  Sample (nPoints0425,tArray0425temp(),IEEE4) 'node temperature
  Sample (nPoints0425,tArray0425res(),IEEE4) 'node resistance
EndTable

BeginProg
  Scan(1,Min,0,0) 'Scan Interval - 1 Minute (Adjust as necessary)

    PanelTemp(pTemp,_60Hz) 'measure data logger temperature
    Battery(batt_volt) 'measure data logger battery voltage

    '**********Thermarray**********
    SerialOpen(Com1,115200,0,10000,100) 'open serial port
    SW12(1)  'power on to thermarray string
    Delay(0,2000, mSec) 'power up delay

    ReadThermArray (tArray0425temp(),tArray0425res(),tArray0425sn(),nPoints0425,Com1)'measure thermarray string

    SerialClose(Com1) 'close serial port
    SW12(0) 'power OFF thermarray string

    CallTable Thermarray_Demo

  NextScan
EndProg
```