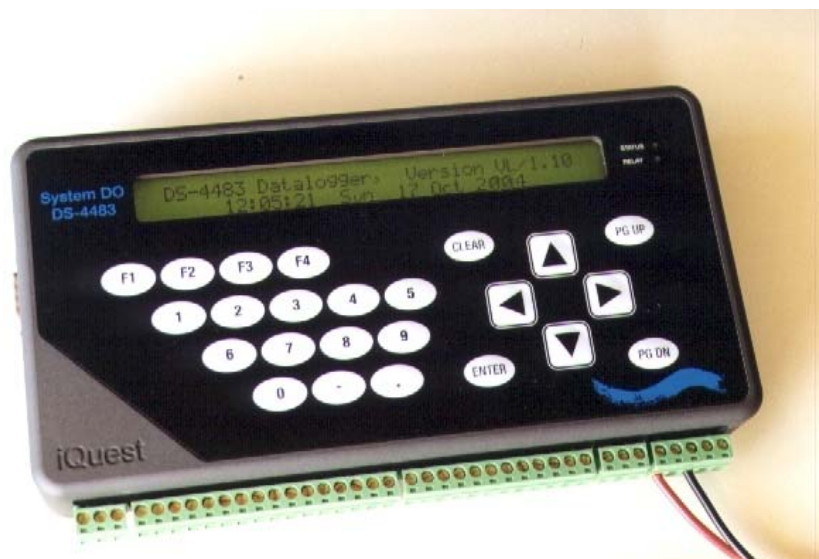


DS-4483

User Guide

**For Software
Version: 4.06**

Requires Firmware
Version: VL/2.17+



Revision History:

Issue 1	01 October 1998	Sections 1-10, Appendix A-D, References 1-4
Issue 2	02 February 2004	Updated contact details
Issue 3	11 August 2005	Updated formatting to standard iQuest style

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Owing to the wide variety of possible applications of this product, you must satisfy yourself as to its suitability to your specific application.

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DS-4483 OVERVIEW

1 Introduction

The DS-4483 is one of the System DO[®] range of process control and telemetry products. This particular product encompasses datalogging features integrated with telemetry communications, keypad and display for localised system configuration, and the ability to support control applications.

Part 1 of this Manual relates to the hardware configuration of the DS-4483. Please note that warranty is void if the unit is opened. All hardware configuration options are software controlled.

Part 2 of this Manual relates to software configuration of the unit. Configurations associated with specific application programmes will be summarised as separate documents.

The DS-4483 has been designed and constructed using the latest in technology appropriate to the unit being used in harsh outdoor and industrial environments. It is distinguished by being able to be fully software configured:

- Programmability
- Range of instrumentation I/O options
- Communications

The communication interface comprises of 3 serial ports.

- RS232 communications
- Radio telephone telemetry
- SDI-12 Instrumentation

By fitting an external PSTN line interface, the unit can be connected to a telephone line.

The DS-4483 is fully Y2K compliant.

2 Physical Description

4 x Digital Inputs -	Non isolated (two are also high speed counter inputs)
4 x Digital Outputs -	Non isolated (two sinking, two sourcing)
8 x Analogue Inputs -	Non isolated (12-bit resolution, range selectable up to 0-5V max)
3 x Analogue Outputs -	Configured as excitation outputs 0-5V, 12 bit resolution.
1 x Relay Output -	Single relay provides a clean changeover contact rated at 10A. Typically used as a radiotelephone control switch.

Power supply for the DS-4483 is a nominal 12V D.C. (usually 13.8V from a charged battery system). A high efficiency switch mode regulator supplies onboard requirements. The power supply is monitored internally and can be read as a scaled voltage via the comm ports or internal programme.

Onboard temperature measurement – this can also be read as a scaled 0.0°C – 100.0°C range.

Full Real Time Clock / Calendar. This is software trimmable to achieve very high accuracy.

Pluggable screw terminals provide the connection points for the DS-4483 I/O, and power supply. A RJ45 connector is used for the radio port and a DB9 connector used for the RS232 communications port. The configuration of the connectors is summarised in Section 10.

The radio port is an unbalanced line with separate RX, TX and Audio lines. The TX key is open drain pull down with protection. The Busy input is active high (5-12V +ve input). An optional external DIN Rail mount module allows direct connection to a standard telephone line for PSTN or cellular phone access.

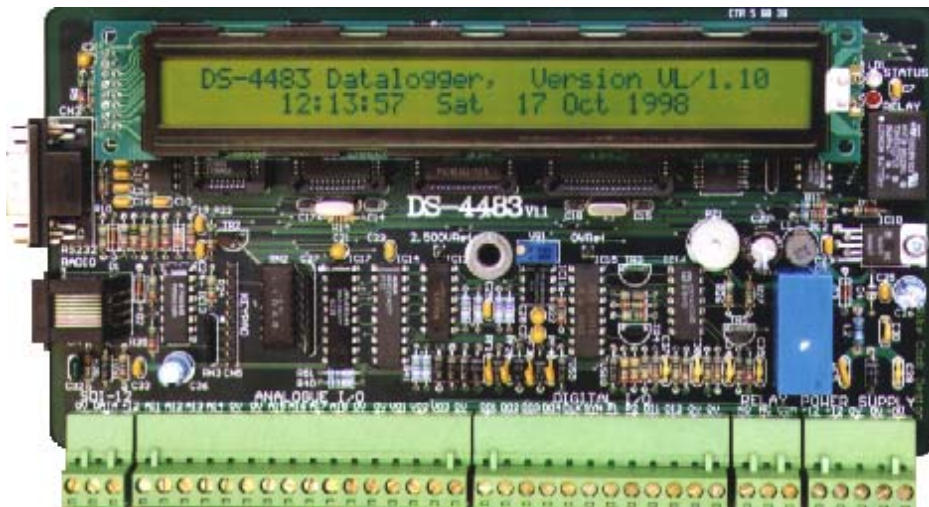
LED Indicators- Status. A bi-colour LED showing unit status. Normally green.
Becomes red if an error has occurred.
Relay Output. A red LED that is lit when the internal control relay is ON.

Physical Size: 226mm x 117mm x 36mm (nominal) - all I/O connections on bottom edge of the unit. Mounting holes (M4) are provided on the base of the unit for mounting direct to a gear plate. Optional mounting plates are available with "ear tags" to facilitate front mounting on a gear plate.

Case: The case is constructed from a special corrosion-resistant aluminium (aluminum) alloy that is hard anodized. This gives a high degree of mechanical strength and EMF shielding.

3 Circuitry Overview

Fig.1 illustrates the major circuitry on the DS-4483 board.



Communication and Configuration

These sections of circuitry contain the UART, port configuration, and driver circuitry. The communication ports are dealt with in more detail in the Sections 4 and 10.

Modem (Radio/PSTN)

This circuitry contains modem circuitry complete with buffering circuitry, transmit key switch and channel busy for radio. For PSTN use, an external interface module is required.

RS232

One DTE configured RS232 communication port is provided on the DS-4483 for interfacing with suitably equipped serial data radios, portable PC's or external modems.

PSU

The power supply circuit features a switch-mode voltage regulator as well as a precision 2.5V master analogue reference.

The power supply also contains watchdog circuitry to automatically reactivate the processor should some event or interference stop execution of either a user program or the system executive.

Processing "Core"

The processing core consists of a high performance Dallas DS87C550 micro-controller, real time clock, static RAM and large capacity flash memories for program and data storage. Full speed processor clock is 33.1176MHz.

Digital Outputs

The four digital outputs are short-circuit protected. They are configured as two pairs, one pair (DO1, DO2) sinking to 0V, the second pair (DO3, DO4) sourcing to +12V.

Digital Inputs

The digital inputs operate with either a clean contact activation to 0V or a 5 - 12V DC signal.

Analogue Inputs

The analogue inputs are 12-bit resolution. Range spans are set by software The input range is 0-5V max.

The inputs can be used as individual single ended channels, or treated as paired differential channels.

4 Basic Specifications

- SIZE:** 226mm ($8\frac{7}{8}$ ") x 117mm ($4\frac{5}{8}$ ") x 36mm ($1\frac{7}{16}$ ")
- MASS:** 1250g (2.76lb)
- POWER SUPPLY:** Nominal 12V DC. Max 15V DC continuous. Over-voltage and reverse polarity protected with self-resetting fusing.
- CURRENT CONSUMPTION:** 76mA at 13.8V dc input, no outputs activated, normal operating mode (fully awake). Sleep current 4-19mA depending on sensor configuration. Maximum 202mA with LCD backlight at 100%.
- I/O ISOLATION:** None, except control relay contacts which are 32V AC / 50V DC
- COMMUNICATIONS:**
 1. Non-isolated RS232 at 300 - 38400 baud DTE Configuration (DB9 connector).
 2. Non-isolated Modem Interface
 Either 300,600 or 1200 baud CCITT V23 FSK or V22 DPSK at 1200 baud (RJ45 connector)
 Modem Audio Levels: Transmit: 430mV p-p into 10K
 Nominal (software adjust -8dBm to +7dBm)
 Receive: 300mV p-p into 10K
 3. SDI-12 compliant communication at 1200 baud. (Pluggable terminal header)
- ENVIRONMENTAL:** Ambient 0°C - 70°C, (32°F - 158°F) 20% - 95% R.H (non-condensing)

DS-4483 CONFIGURATION

1 Hardware Connections and Setup

All external field connections are via pluggable header block connectors.

The order of the connections is as follows:

SDI-12	ANALOGUE I/O	DIGITAL I/O	RELAY	PWR SUPPLY
0V DATA +12	AI1 AI2 AI3 AI4 0V AI5 AI6 AI7 AI8 0V 0V VO1 VO2 VO3 0V	DO1 DO2 DO3 DO4 CLK SYN P1 P2 DI1 DI2 0V	NO NC COM	+12 +12 0V 0V 0V

1.1 Power Supply

The 12V D.C power supply connects via a 5 pin connector. The two +12V pins are commoned together as are the three 0V pins.

1.2 Relay

The relay can be used as NO (normally open) or NC (normally closed). The rating of this relay is 10A at 32VDC. It is typically used for controlling a radio.

Internal circuitry minimises the relay current consumption by applying full current to pull the relay in, then reducing to a low hold in value.

1.3 Digital I/O

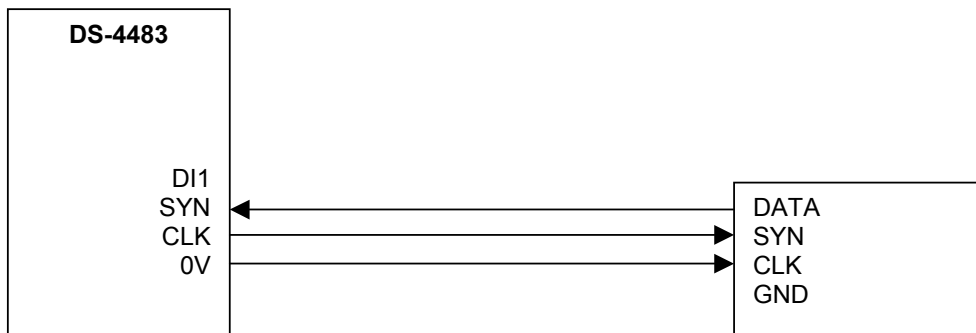
There are four digital inputs and four digital outputs. All I/O points are non-isolated and are referenced to the unit's 0V rail.

The inputs are activated by providing either a clean contact to 0V, or alternatively a 0–5V or 0–12V signal with respect to the unit 0V rail. These inputs are designated DI1, DI2 (standard digital inputs) and P1, P2 which also feature a high speed (5kHz) counter mode as well as being digital inputs.

1.4 CLK, SYN

These outputs are used for connection to synchronous serial instruments. CLK is the data clock signal and SYN is used to synchronise the attached instrument prior to clocking the data stream into the DS-4483.

Note: When using such instruments, the DI1 input must be used as the data input.



1.5 Analogue I/O

All of the analogue I/O are terminated on a 16 pin connector. There are eight analogue inputs (AI1 AI8), three analogue outputs (V01 ... V03) and five common terminations. All commons are internally connected to the -ve (0V) supply terminals.

The analogue inputs are software configurable to a set of ranges from 0-1V up to 0-5V as well as -2.5V to +2.5V. External resistors may be needed to scale or condition certain signal types, eg. 0 -10V, 4 - 20mA. Refer to Section 3.4.

The analogue inputs can be configured in single-ended mode or differential mode. The structure of the inputs is as follows:

Single-ended Mode

Channel	AI1	AI2	AI3	AI4	AI5	AI6	AI7	AI8
1	+							
2		+						
3			+					
4				+				
5					+			
6						+		
7							+	
8								+

Differential Mode

Channel	AI1	AI2	AI3	AI4	AI5	AI6	AI7	AI8
1	+	-						
2			+	-				
3					+	-		
4							+	-
5	-	+						
6			-	+				
7					-	+		
8							-	+

In single-ended mode, input signal voltages are referred to ground. In differential mode, the voltage difference between the two channels is measured.

1.6 SDI-12

The SDI-12 port consists of a ground connection (0V), a protected bi-directional serial data line (DATA) and 12V output power to the sensor(s) (+12). It is important to ensure that the terminations are correct before applying power to the sensor.

The data line is a bi-directional, three-state, data transfer line. Table 1 shows the logic and voltage levels for the transmission of serial data for the SDI-12 standard. The data line uses negative logic.

Condition	Binary state	Voltage Range
Marking	1	-0.5 to 1.0 volts
Spacing	0	3.5 to 5.5 volts
Transition	undefined	1.0 to 3.5 volts

Table 1. Logic and voltage levels for serial data

Details on the SDI-12 serial/digital interface are summarised in Appendix A.

2 LED Functions

Two indication LED's are fitted to the DS-4483. These are as follows:

STATUS: A bi-colour LED that normally flashes green at a 1Hz rate to indicate normal processing activity. It also flashes red if there are any internal errors logged in the unit such as divide by zero, or watchdog reset. If the DS-4483 is in low power mode, this LED is off.

RELAY: A red LED that is illuminated when the control relay is operated.

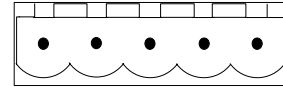
DS-4483 INSTALLATION

1 Power Supply Options

A five pin connector is used for the DC power supply. The internal power supply utilises a switch mode regulator for maximum efficiency.

The power supply is protected against both over voltage or reverse polarity connection. This is achieved by incorporating ultra-fast acting protection devices and a self-resetting semiconductor fuse.

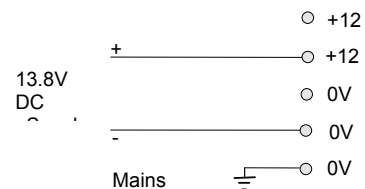
+12 +12 0V 0V 0V



Note: All three 0V terminals are commoned together and linked to the case.

◆ DC Supply without battery backup

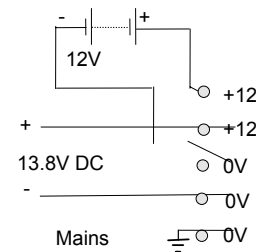
DC Supply - nominal 13.8V
Connect across terminals +12 and 0V



◆ DC Supply with Gelcell Battery backup

DC Supply - nominal 13.8V
Connect across terminals +12 and 0V

Gelcell battery (12V max 6.5Ahr) connected across terminals +12 and 0V as illustrated.



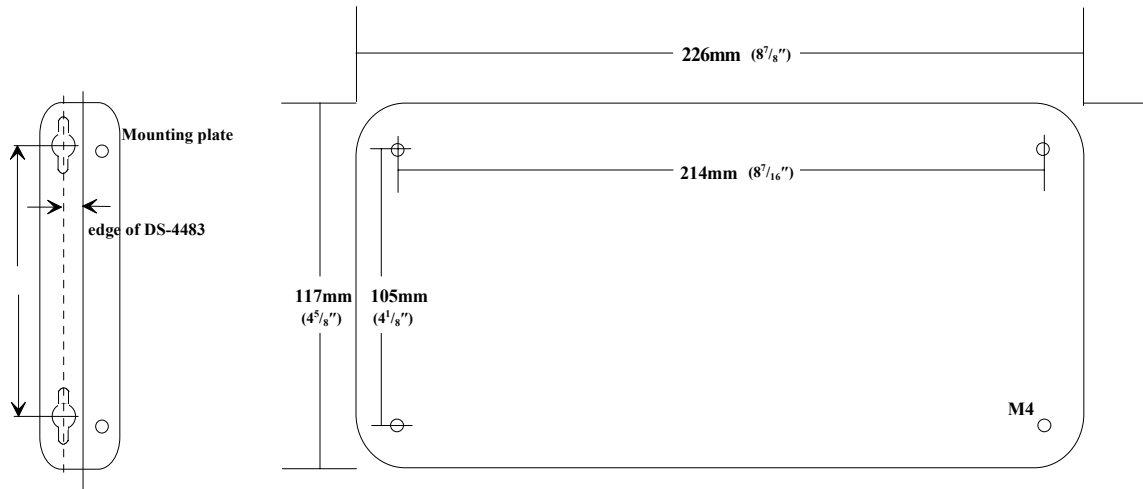
2 Earthing

It is strongly recommended that the DS-4483 is connected to a solid mains earth via a short lead to one of the 0V terminals as shown above.

Please note that the power supply 0V, analogue and digital I/O 0V's are internally linked.

3 Mounting

Mounting details for the DS-4483 are illustrated below. The correct mounting screws to the base of the unit are M4. Maximum thread available 6mm ($\frac{1}{4}$ ").



The mounting plates are supplied extra. The slots in the mounting plates are 3.5mm in width.

4 Analogue Sink/Divider Network

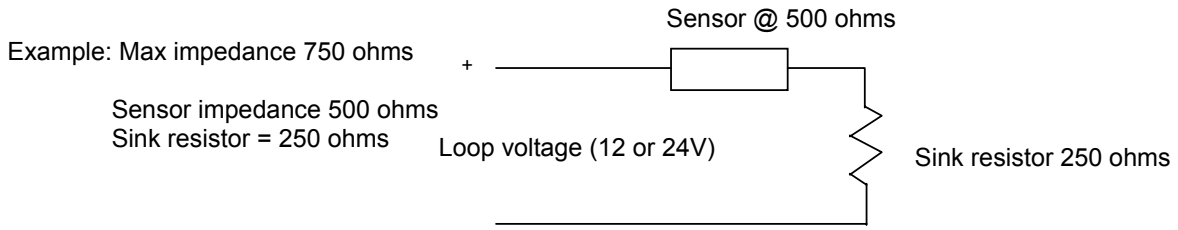
The DS-4483 analogue inputs are internally ranged for a maximum raw range of 0 – 5V. The ranges can be software configured for any range within this, e.g.:

- 0.2 – 1V for 4 - 20mA
- 0.4 – 2V for 4 - 20mA
- 0 – 1V
- 0 – 2.5V
- 0 – 5V
- 1 – 5V for 4-20mA

If a current range is required (eg 4 –20mA), an external sink resistor will need to be installed. The value of this will be:

INPUT	ANALOGUE INPUT RANGE	RESISTOR
4-20mA	0.2 – 1V	50 ohms
4-20mA	0.4 – 2V	100 ohms
4-20mA	1 – 5V (Std range)	250 ohms

Under normal circumstances, use the highest ranges possible (1 – 5V) unless the sink resistor's impedance will cause the total loop impedance to become out of specification as specified on the transducer/sensor.



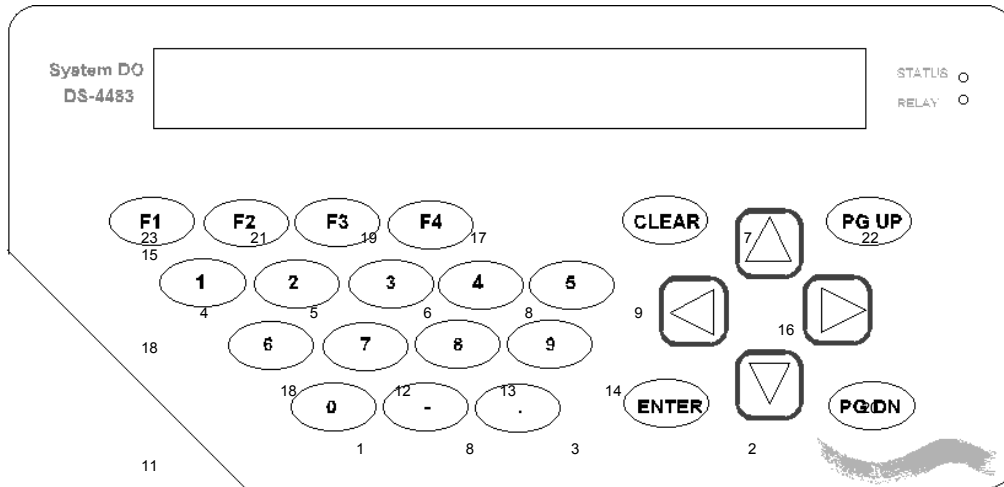
5 LCD Display & Keypad

The DS-4483 is supplied with a 24 key embossed tactile keypad and 2 x 40 LCD display. These can be used for viewing stored data or configuring the unit.

When powered up without an application programme, the LCD should display data similar to the example shown below. The LCD backlight will be off.

DS-4483, Vers: VL/2.17, S/No: AL1-0205
 Addr: 1 11:53:49 Fri, 05 Aug, 2005

This keypad produces various key codes in d6 (one of the reserved database locations). Please refer to Reference Section 1 for details. For clarity the keypad layout and its associated d6 key codes is shown here.



The unit does not support an external keypad.

DS-4483 COMMUNICATIONS

1 Radio Communications

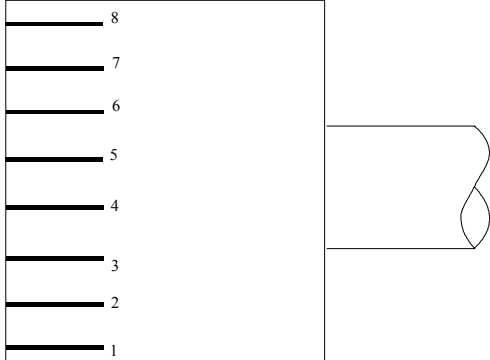
The DS-4483 provides a choice of a high performance radio/telephone modem terminated in an unbalanced line with RX and TX Audio.

Both ports default to System DO® protocol mode at power up. If using other communication protocols, programming must account for switching the ports to the required protocol after a power down.

1.1 Radio/Telephone Modem Interface

RJ45 PCB Socket on DS-4483

	Radio	PSTN	Pins Up, Tag Down
8	GND (Common)	GND (Common)	8
7	Busy +	Ring Detect	7
6	TX Key (PTT)	On Hook	6
5	GND (Common)	GND (Common)	5
4	TX Audio (Out)	TX Audio (Out)	4
3	RX Audio (In)	RX Audio (In)	3
2	GND (Common)	GND (Common)	2
1	+12V (Out)	+12V (Out)	1



The radio port is an unbalanced line with separate RX and TX audio designed for direct connection to most modern radio telephones that offer an external interface port. The relative transmit audio level is configurable in software over a 16dBm range (0-15 with the factory default being set to 7).

Modem Port Audio Line Specification:

- Modulation (Radio) : CCITT V.23 FSK with selectable phase compensation.
Baud rates 300, 600 or 1200
- Modulation (PSTN) : CCITT V.22 DPSK. (Baud rate 1200) or
CCITT V.22bis QAM (Baud rate 2400)
- Transmit Line Output Impedance: 60 ohms
- Transmit Level (into 10K, relative gain = 7) 420mV p-p at 1300Hz
- Receive Line Input Impedance: 40K ohms
- Receive Level (nominal) 300mV p-p (maximum 1.4V p-p)
- Receiver AGC Range 41dB

The TX Key (PTT) line is an open drain pull-down output with over-voltage protection set at 15V. The Busy Input is active high at the hardware level (between 5V and 12V input), although the actual polarity defining "BUSY" is configurable in software, allowing the use of radios with either an active low or active high channel busy signal.

Two optional external DIN rail mount modules allow a choice of interfacing with 600ohm line devices or alternatively a standard telephone line for PSTN or cellular phone access.

The radio/telephone modem port pins designations are:

- | | | |
|-----------------|---|----------------|
| 1. +12V Out | Supply to external interfaces as required | (Wire: Grey) |
| 2. Common | 0V Common for Power Supply | (Wire: Brown) |
| 3. RXD | Receive Audio In (nominal 300mV p-p) | (Wire: Yellow) |
| 4. TXD | Transmit Audio Out (default 420mV p-p into 10K) | (Wire: Green) |
| 5. Common | 0V Common for Audio | (Wire: Red) |
| 6. TX Key (PTT) | Open drain pull down to common when active | (Wire: Black) |
| 7. Busy + | Busy Input. 5V-12V dc when radio busy. | (Wire: Orange) |
| 8. Common | 0V common for Control Lines | (Wire: Blue) |

Note: Commons are all linked together on board the DS-4483.

Refer to Appendix B for pin out details for interfacing to different radios.

2 RS232 Port

The RS232 Port can be used for connection to a PC or a radio fitted with a RS232 data port. It is a DTE configured port identical to that found on IBM compatible PC's. The RS232 port pinouts are shown below, as well as standard null modem cable connections. The port may be configured for the full range of baud rates and framing via the user program.

The pinout configuration of the RS232 port is:

Pin 1 - Not used Pin 2 - Receive Data in (RXD) Pin 3 - Transmit Data out (TXD) Pin 4 - Data Terminal Ready out (this is linked active permanently) Pin 5 - Ground Pin 6 - Not used Pin 7 - Request to Send out (RTS) Pin 8 - Clear to Send in (CTS) Pin 9 - Factory diagnostic input – do not connect

The standard cable to connect an IBM PC compatible computer to these ports should be wired as shown.

DS-4483 RS232 PORT	COMPUTER RS232 PORT	
	DB9 TYPE	DB25 TYPE
Pin 2 (RXD) -----	Pin 3 (TXD)	Pin 2 (TXD)
Pin 3 (TXD) -----	Pin 2 (RXD)	Pin 3 (RXD)
Pin 5 (GND) -----	Pin 5 (GND)	Pin 7 (GND)
* Pin 7 (RTS) -----	Pin 8 (CTS)	Pin 5 (CTS)
* Pin 8 (CTS) -----	Pin 7 (RTS)	Pin 4 (RTS)

Note: The RTS/CTS lines are not required unless the port is used in a way that requires the handshaking lines externally e.g.: when connected to a serial printer and the port is used in ASCII mode.

APPENDIX A: SDI-12 Instrumentation

1 What is SDI-12?

SDI-12 stands for serial/digital interface at 1200 baud. It is a standard to interface battery powered data recorders with micro-processor based sensors designed for environmental data acquisition (EDA). EDA is accomplished by means of a sensor, or sensors, and a data recorder which collects and saves the data. SDI-12 is a standard communications protocol which provides a means to transfer measurements taken by an intelligent sensor to a data recorder. An intelligent sensor typically takes a measurement, makes computations based on the raw sensor reading, and outputs the measured data in engineering units. For example, an SDI-12 pressure sensor may take a series of pressure measurements, average them, and then output pressure in psi, inches of mercury, bars, millibars, or torrs. The sensor's micro-processor makes the computations, converts sensor readings into the appropriate units, and uses the SDI-12 protocol to transfer data to the recorder.

SDI-12 is a multi-drop interface that can communicate with multi-parameter sensors. Multi-drop means that more than one SDI-12 sensor can be connected to a data recorder. The SDI-12 bus is capable of having ten sensors connected to it. Having more than ten sensors, however, is possible. Some SDI-12 users connect more than ten sensors to a single data recorder.

Multi-parameter means that a single sensor may return more than one measurement. For example, some water quality sensors return temperature, conductivity, dissolved oxygen, pH, turbidity, and depth.

2 Advantages of SDI-12

A serial-digital interface is a logical choice for interfacing microprocessor-based sensors with a data recorder. This has advantages for sensors and data recorders.

- Unique and complex self calibration algorithms can be done in microprocessor-based sensors.
- Sensors can be interchanged without reprogramming the data recorder with calibration or other information.
- Power is supplied to sensors through the interface.
- Hybrid circuit and surface mount technologies make it practical to include the power supply regulator, a microprocessor, and other needed circuitry in small sensor packages.
- Sensors can use low cost EEPROMs (electrically erasable programmable read only memory) for calibration coefficients and other information instead of internal trimming operations.
- The use of a standard serial interface eliminates significant complexity in the design of data recorders.
- Data recorders can be designed and produced independently of future sensor development.
- SDI-12 data recorders interface with a variety of sensors.
- SDI-12 sensors interface with a variety of data recorders.
- Personnel trained in SDI-12 will have skills to work with a variety of SDI-12 data recorders and SDI-12 sensors.

3 SDI-12 Electrical Interface

The SDI-12 electrical interface uses the SDI-12 bus to transmit serial data between SDI-12 data recorders and sensors. The SDI-12 bus is the cable that connects multiple SDI-12 devices. This is a cable with three conductors:

- 1) a serial data line
- 2) a ground line
- 3) a 12-volt line

In the following specifications, all values not indicating specific limits, have an allowable tolerance of $\pm 10\%$ of the value. The SDI-12 bus is capable of having at least 10 sensors connected to it.

3.1 Serial Data Line

The data line is a bi-directional, three-state, data transfer line. Table 1 shows the logic and voltage levels for the transmission of serial data for the SDI-12 standard. The data line uses negative logic.

Condition	Binary state	Voltage range
marking	1	-0.5 to 1.0 volts
spacing	0	3.5 to 5.5 volts
transition	undefined	1.0 to 3.5 volts

Table 1. Logic and voltage levels for serial data

Voltage Transitions

During normal operation, the data line voltage slew rate must not be greater than 1.5 volts per microsecond.

3.2 Ground Line

The ground line must be connected to the circuit ground and the earth ground at the data recorder. The sensor circuit ground also must be connected to the ground line, but not normally to its own earth ground. If it is necessary to connect the sensor circuitry to earth ground, a heavy (12 AWG or larger) ground wire should be connected between the sensor earth ground and the data recorder earth ground for lightning protection.

The ground conductor should be large enough to keep the voltage drop between the data recorder and all sensors less than 0.5 volts during the maximum combined sensor current drain.

3.3 12 Volt-Line

The data recorder (or the external power supply) provides between 9.6 volts and 16 volts to the 12-volt line, with respect to ground, as measured under a maximum sensor load of 0.5 amperes. SDI-12 does not require the data recorder to be the source of power to the 12-volt line. Sensors connected to the 12-volt line must not have inductive loads. SDI-12 does not require voltage limiting for transient protection in the sensor. Transient protection is, however, recommended. See appendix A for suggested circuits for transient protection.

Note: This information is taken from :

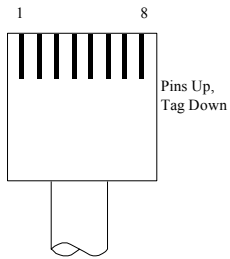
SDI-12 Serial-Digital Interface Standard for Microprocessor-Based Sensors,
Version 1.3 - July 18, 2005

Prepared By
SDI-12 Support Group
(Technical Committee)
135 East Center
Logan, Utah

APPENDIX B: Radio Cable Connections

1 Cable Interface to Salcom 11-38 and TR-460

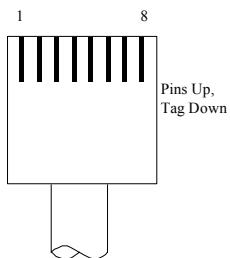
RJ45 TO DS-4483



	DS-4483 RJ45	Color	Salcom DB15 (M)
RXD	3	YELLOW	2
TXD	4	GREEN	3
COMMON	5	RED	1
TX KEY	6	BLACK	5
Busy +	7	ORANGE	7
COMMON	8	BLUE	1

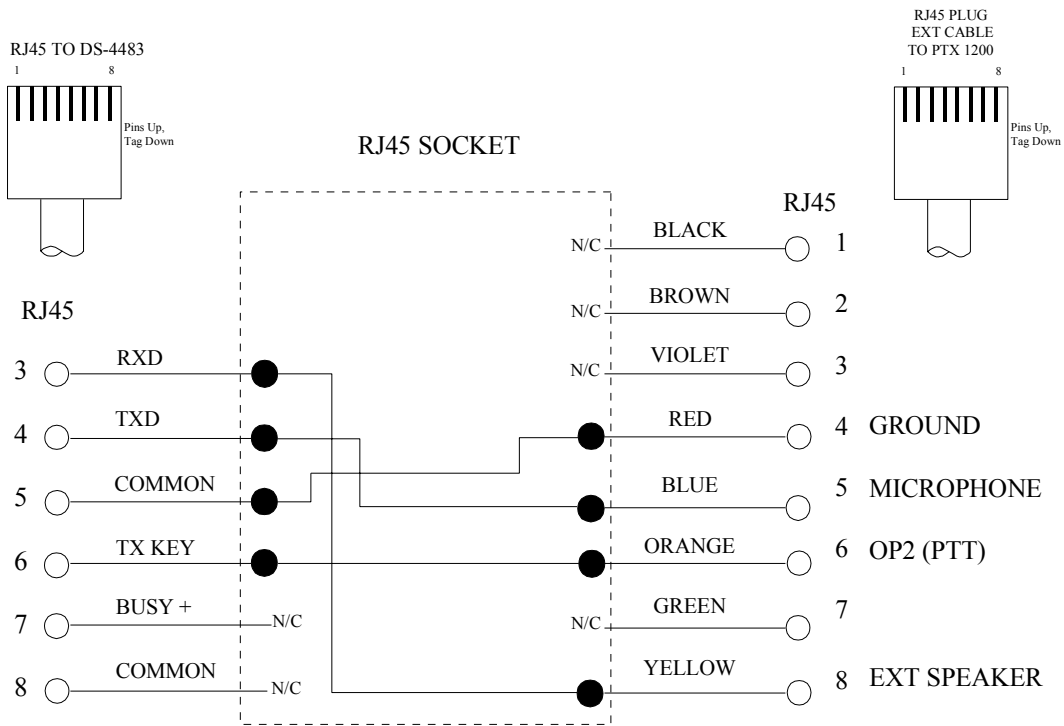
2 Cable Interface to Maxon DM-2850W

RJ45 TO DS-4483

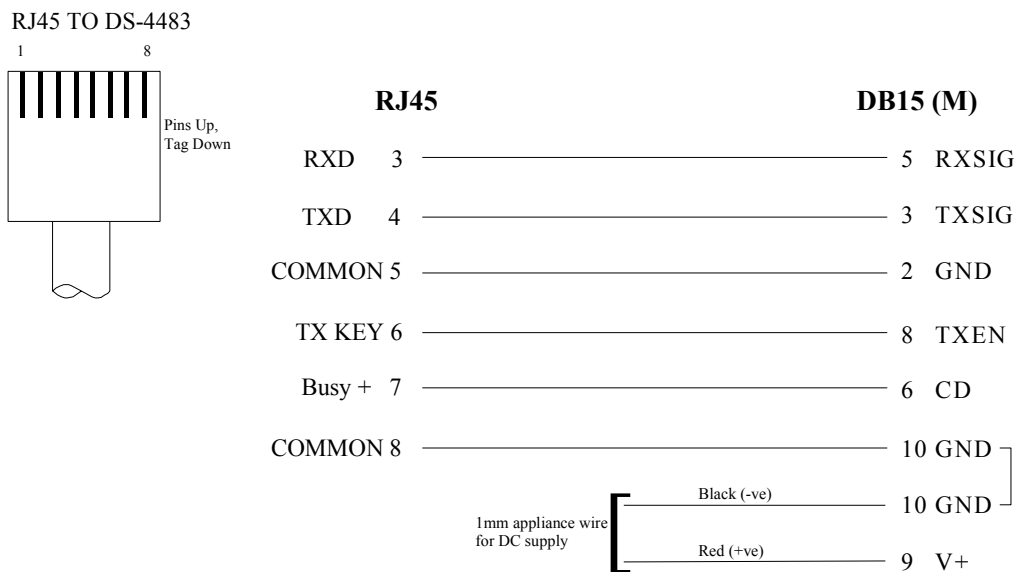


	RJ45	Color	DB9 (F)
RXD	3	YELLOW	2
TXD	4	GREEN	1
COMMON	5	RED	4
TX KEY	6	BLACK	3
Busy +	7	ORANGE	6
COMMON	8	BLUE	4
1mm appliance wire for DC supply			4
			5

3 Cable Interface to Motorola PTX1200

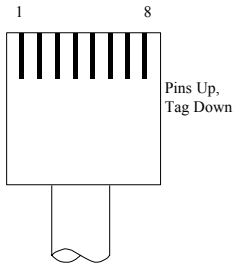


4 Cable Interface to Trio TS-450SR Radio



5 Cable Interface to Philips PRM80 Series Radio

RJ45 TO DS-4483



**DS - 4483
RJ45**

**RADIO
DB 15 (F)**

COMMON 2	BROWN	3	OV (SIGNAL)
RXD 3	YELLOW	10	RX AUDIO OUT
TXD 4	GREEN	6	TX AUDIO IN
COMMON 5	RED	3	OV (SIGNAL)
TX KEY 6	BLACK	8	PTT
Busy + 7	ORANGE	13	CONTROL
COMMON 8	BLUE	3	OV (SIGNAL)