Technology for Productivity

ENI Products

USER MANUAL

PROFIBUS-DP Interface
for Elite Family
Plasma Generators

QUALITY ISO 9001 SYSTEM

This product is manufactured at an MKS Instruments' ISO-9001:2000-Quality-System-compliant facility.

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Manual Order Number: 1037458
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Product and Applications information also available on the Internet at:

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Chapter 1

Interface Description

Introduction

The ENI generator PROFIBUS (Fieldbus) interface offers a communications interface for sensor-actuator devices. Data transfer between a PROFIBUS master and PROFIBUS slave is achieved through a sophisticated protocol that is based on the RS-485 physical layer. Excellent error correction and data transfer rates (up to 12 MBaud) make the PROFIBUS interface a very useful and reliable sensor-actuator device.

Hardware Layout

The Elite PROFIBUS interface hardware consists of four logical sections.

Section 1

This section is responsible for communications between the smart interface board and the control board. A customized communication protocol is used to transfer the generator information and receive generator commands.

Section 2

Two microprocessors and one memory module constitute the “brains” of the interface board. The first microprocessor controls data transfer between PROFIBUS and the generator’s control board. The second microprocessor is a specialized processor that implements the Data Link Layer of PROFIBUS. It handles transmission details, such as encoding/decoding, bit stuffing, baud rate detection and message buffering.

Section 3

This section is the physical interface to PROFIBUS. It is electrically isolated to 1500 V DC from sections 1 and 2 and is the RS-485 interface.

Section 4

This section is the fiber optic interface to the Matching Network.

User Interface

The user interface is located on the rear of the generator. It has one PROFIBUS connector that is a 9-pin sub-D and an eight-section address and setup DIP switch. DIP switches 1 through 7 configure the generator's PROFIBUS address. The value is in binary format with position 1 being the Least Significant Bit (LSB) of the address. There are 128 possible settings for the station address. A binary "1" is represented by a switch being in the ON position, and a binary "0" by the switch in the OFF position.

DIP switch 8 is used to enable the bootloader application for software downloads to the on board FLASH device. For normal communications (PROFIBUS data from/to control board to/from interface board) the switch should be in the OFF position.

The MOD LED (yellow) provides information to the user about the status of the interface board software. When the MOD LED blinks at a constant rate of approximately 1 s, the software has detected a valid baud rate. It is connected or waiting connection to the bus. Otherwise, the MOD LED blinks at a much slower rate indicating that the software is searching for a signal.

The NET LED (green) is a bus connection indicator. PROFIBUS communications is active when the NET LED is solidly ON. There is no data exchange with the master when the NET LED is OFF.

To connect to the bus, the board uses a female 9-pin sub-D connector as described in *PROFIBUS Standards*, part three.

Configuration of PROFIBUS Communications for Normal Operation

- **First**, turn off the generator**.** Make sure that the PROFIBUS master card in the PC computer is correctly initialized and check the connectors, terminations and bus cable for correct configuration.
- **Second**, ensure that bootloader mode is disabled by turning OFF DIP switch 8 on the PROFIBUS interface board.
- **Third**, turn on the generator.

Chapter 2

Configuring the PROFIBUS Board

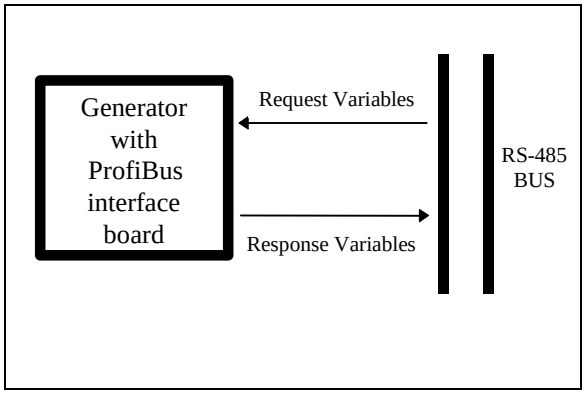
The configuration of the PROFIBUS interface board is done automatically during power up of the generator.

Data Format

The data that are transferred to/from the PROFIBUS interface are referred to in this document as *data variables.* Furthermore, *data variables* are divided into *request variables* and *response variables*.

Request variables are the data transferred **from** the PROFIBUS interface **to** the generator (HOST → ENI).

Response variables are the data transferred **to** the PROFIBUS interface **from** the generator (ENI → HOST). See Figure 1.



Direction of Data Flow
Figure 1

Request Variables (Download Bytes HOST → ENI)

Table 1 describes the applicability of the request variables to the Elite generator.

Byte #	Variable Contents
Offset	
0	COMMAND #
1	DATA BYTE (LSB) (bits 0-7)
2	DATA BYTE (MID) (bits 8-15)
3	DATA BYTE (MSB) (bits 16-23)

Request Variables
Table 1

Command Byte Description

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
0 Null	Null - Command - Do nothing	0	0
1 RF off	Turns off RF output. Read back with command 162.	0	1 (CSR only)
2 RF on	Turns on RF output. Read back with command 162.	0	1 (CSR only)
3 Regulation mode	Sets the regulation mode. Send one data byte, indicating the desired regulation mode: • 6 = Forward power (Pforward) regulation • 7 = Load power (Preal) regulation • 8 = External (V Bias) regulation **Note:** You cannot change regulation mode while RF power is on. Read back with command 154.	1	1 (CSR only)

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
8 Set point	Specifies the output set point level for the selected regulation mode (set with command 3). Send two data bytes, least significant byte first, representing the set point level in watts. • Accepts a value of 0 to nominal power. Read back with command 164.	2	1(CSR only)
13 Tuner control	Sets the tuner control if the generator is connected to a matchwork unit through the matching interface. This command will not work with other matching networks unless they are electrically compatible and are connected through the Matching Interface connector. Send one data byte: • 0 = Manual • 1 = Automatic (Generator Controlled Match) • 2 = Match Automatic **Note 1:** A matchwork unit must be connected to the generator. **Note 2:** Changing the matchwork from Match Automatic to Manual tuning will set the capacitors to the last position they were tuned to (in the Auto Mode) if RF is On. **Note 3:** When the matchwork is in Match Auto Tuning, the match presets will track the current capacitor position when RF is On. Read back with command 163.	1	1 (CSR only)
14 Active control mode	Sets the generator's active control mode. Send one data byte: • 2 = Host (serial/ProfiBus) control • 6 = Local control through Front Panel or RS-232. Read back with command 155.	1	1 (CSR only)

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
17 Frequency tuning parameters	**NOT CURRENTLY IMPLEMENTED** **Commands Status = 0x63 (99)**	3	1 (CSR only)
18 RF frequency	**NOT CURRENTLY IMPLEMENTED** **Commands Status = 0x63 (99)**	3	1 (CSR only)
24 Save presets	Saves the current operation parameters to EEPROM as a preset with the given number (0 to 5). **NOT CURRENTLY IMPLEMENTED** **Commands Status = 0x63 (99)**	1	1 (CSR only)
25 Restore presets	Restores the current operation parameters to EEPROM as preset with the given number (0 to 5). **NOT CURRENTLY IMPLEMENTED** **Commands Status = 0x63 (99)**	1	1 (CSR only)

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
27 Set pulsing	Sets the desired pulsing. Send one data byte. • 0 = Pulsing off • 1 = Internal pulsing • 2 = External pulsing See also commands 93 and 96. Read back with command 177.	1	1 (CSR only)
31 Set RF-on ramping rise time	**NOT CURRENTLY IMPLEMENTED** **Commands Status = 0x63 (99)**	2	1 (CSR only)
32 Set RF-on ramping fall time	**NOT CURRENTLY IMPLEMENTED** **Commands Status = 0x63 (99)**	2	1 (CSR only)
93 Set pulsing frequency	Sets the RF pulsing frequency. Send three data bytes, least significant byte first, representing the pulsing frequency in Hertz. • Accepts a value of 1 to 1000 (1 Hz to 1000 Hz). **Note:** Ensure the value does not exceed the specified maximum pulse frequency of the generator See also commands 27 and 96. Read back with command 193.	3	1 (CSR only)
96 Set pulsing duty cycle	Sets the RF pulsing duty ON time in increments of 1%. This value can range from 1% to 99%. • Minimum On or Off time is 20 uSec. See also commands 27 and 93. Read back with command 196.	2	1 (CSR only)
111 Initialize capacitors	Moves capacitors of a connected Matchwork unit to the minimum position (position zero). This command will not work with other matching networks unless they are electrically compatible and are connected through the Matching Interface connector.	0	1 (CSR only)

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
112 Move load capacitor position	Moves the load capacitor motor of a connected Matchwork unit to the specified position. This command will not work with other matching networks unless they are electrically compatible and are connected through the Matching Interface connector. Send two data bytes to move the load motor to its new position. • Accepts a value of 0 to 999 Read back with command 175.	2	1 (CSR only)
119 PROFIBUS reset/explicit fault clear	Clears PROFIBUS fault and error code register. Send one data byte. **Note:** Only if PROFIBUS is installed	0	1 (CSR only)
122 Move series cap position	Moves the series capacitor motor of a connected <> unit to a specified position. This command will not work with other matching networks unless they are electrically compatible and are connected through the Matching Interface connector. Send two data bytes to move the series motor to its new position. • Accepts a value of 0 to 999 Read back with command 175.	2	1 (CSR only)
128 Supply type	Reports the generator type; returns 5 ASCII characters (for example, ABCDE).	0	5 data bytes 5 ASCII characters
129 Supply size	Reports the output capacity of the generator; returning packet contains 5 ASCII characters (for example, _1350).	0	5 data bytes 5 ASCII characters
130 Report software version	Reports the version of the software. The returning packet contains 5 ASCII characters. This command is used in conjunction with command 198 to obtain the version/revision number of the software (for example, C3STD. **Note:** This is the Indicator of the Software Package	0	5 data bytes 5 ASCII characters

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
131 Report motor movement	Reports the match network motor movement when the generator is connected to a Matchwork unit through the matching interface. This command will not work with other matching networks unless they are electrically compatible and are connected through the Matching Interface connector. Returns one data byte: • 0 = Match network's motors stopped • 1 = Match network's motors running	0	1
151 Report ramping rise and fall times	Returns 0x00 **NOT CURRENTLY IMPLEMENTED**	0	4
154 Report regulation mode	Reports regulation mode. The controller returns one data byte representing the regulation mode: • 6 = Forward power (Pforward) regulation • 7 = Load power (Preal) regulation • 8 = External (V Bias) regulation Set with command 3.	0	1
155 Report control mode	Reports the control mode. The controller returns one data byte representing the control mode: • 2 = Host • 6 = Local (Front Panel) Set with command 14.	0	1

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
162 Report process status	Reports process status. The controller returns the following packet arranged as follows. 1st status byte (bit flags): • 0 = Reserved • 1 = Match tuned • 2 = Recipe run is active **(Always 0)** • 3 = Reserved • 4 = Reserved • 5 = Output power (0 = Off, 1 = On) • 6 = RF on requested (0 = Off, 1 = On) • 7 = Set point status (0 = Within tolerance, 1 = Out of tolerance) 2nd status byte (bit flags): • 0 = End of target life**(Always 0)** • 1 = Reserved • 2 = Reserved • 3 = Overtemperature • 4 = Reserved • 5 = Reserved • 6 = Match tune timeout • 7 = Interlock open 3rd status byte (bit flags): • 0 = Reserved • 1 = Reserved • 2 = Reserved • 3 = Unassigned • 4 = Reserved • 5 = Out of set point **(Always 0)** • 6 = Reserved • 7 = Reserved 4th status byte (bit flags): • 0 = Reserved • 1 = Reserved • 2 = PROFIBUS error • 3 = Reserved • 4 = Reserved • 5 = Extended fault status • 6 = Reserved • 7 = CEX is locked (0 = Unlocked, 1 = Locked) **(bit 7 always 0)**	0	4

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
163 Report tuning control	Reports matching control when the generator is connected to a Matchwork unit through the matching interface. This command will not work with other matching networks unless they are electrically compatible and are connected through the Matching Interface connector. Returns one data byte: • 0 = Manual control • 1 = Automatic (Generator Controlled Match) • 2 = Match Automatic Set with command 13.	0	1
164 Report set point/regulation mode	Reports output set point level (set with command 8) and the active regulation mode (set with command 3). The controller returns three data bytes: • Bytes 1 and 2 represent the set point value. • Byte 3 reports the regulation mode: - 6 = Forward power regulation (Pforward) - 7 = Load power regulation (Preal)	0	3
165 Report forward power	Reports a snapshot of forward power level at that instant. The controller returns two data bytes representing the forward power in watts (LSB first).	0	2
166 Report reflected power	Reports a snapshot of reflected power level at that instant. The controller returns two data bytes representing the reflected power in watts (LSB first).	0	2
167 Report delivered power	Reports a snapshot of delivered power level at that instant. The controller returns two data bytes. Both bytes represent delivered power (LSB first).	0	2
170 Report reflected power limit	Reports reflected power limit. The controller returns two data bytes representing the value in watts.	0	2
175 Report capacitor positions	Reports current load and series motor positions. The controller returns four data bytes, least significant byte first. • Bytes 1 and 2 report the current load position (0 to 999) • Bytes 3 and 4 report the current series position (0 to 999). Set with commands 112 and 122 or by using the automatic tune process.	0	4

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
177 Report pulsing	Reports pulsing settings. The controller returns one data byte. • 0 = Pulsing off • 1 = Internal pulsing • 2 = External pulsing • 3 = External pulsing inverted Set with command 27.	0	1
178 Report RF frequency	Reports RF frequency in Hertz. Note: Returns fixed 13560 Set with command 18.	0	4
187 Report frequency tuning parameters	Returns fixed 13560 for bytes 1 and 2; 0x00 data for remaining bytes. **NOT CURRENTLY IMPLEMENTED**	0	3
193 Report pulsing frequency	Reports the RF pulsing frequency. The controller returns three data bytes, least significant byte first, representing the pulse frequency in Hertz. Set with command 93.	0	3
196 Report pulsing duty cycle	Reports duty cycle in percent of on-time per cycle. The controller returns two data bytes, least significant byte first, representing the duty cycle in the percent of on-time per cycle. Set with command 96.	0	2
198 Report software revision level	Returns 0x00 data. **NOT CURRENTLY IMPLEMENTED**	0	4 data bytes 4 ASCII characters
205 Report run time	Returns 0x00 data. **NOT CURRENTLY IMPLEMENTED**	0	4

Command	**Description**	**Number of Host Data Bytes**	**Number of Response Data Bytes**
223 Report error code register	Retrieves the error code. Refer to Error Code Listing Page	0	1
231 Report unit serial number	Returns 0x00 data. **NOT CURRENTLY IMPLEMENTED**	0	4

Error Code Listings:

Command 223 (Report Error Code) Return	**Meaning**
0	No Fault
1	RF Overheat
2	
3	
4	
5	
6	
7	
8	
9	Link Integrity*
10	
11	
12	
13	
14	
15	
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21	
22	
23	
24	
25	
26	
27	
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29	
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31	
32	

*A link integrity fault is generated if the communication link between the profibus board and generator controller boards becomes inactive. The fault is self-clearing.

Response Variables (Upload Bytes ENI → HOST)

These data are returned to the PROFIBUS master from the generator.

Byte #	Variable Contents
0	STATUS FLAGS (first byte)
1	STATUS FLAGS (second byte)
2	DELIVERED POWER (LOW)
3	DELIVERED POWER (HIGH)
4	FORWARD POWER (LOW)
5	FORWARD POWER (HIGH)
6	REFLECTED POWER (LOW)
7	REFLECTED POWER (HIGH)
8	DATA BYTE (LSB)
9	DATA BYTE
10	DATA BYTE
11	DATA BYTE
12	DATA BYTE (MSB)
13	DATA FIELD DEFINITION

Response Variables

Table 2

NOTE: PROFIBUS WILL TRANSMIT LEAST SIGNIFICANT BYTES FIRST. THE DATA BYTES (#8-#12) CONTAIN INFORMATION DEFINED BY BYTE #13.

Status Flag Bit Definition for Bytes 0,1

Status Byte	Bit Position	Description	Definition	
0	8	CONTROL MODE	=00 USER	
	9	CONTROL MODE	=10 PROFIBUS (REMOTE)	
	10	SET POINT STATUS OK	=0 (Setpoint Not Reached)	=1 (Setpoint Reached)
	11	RESERVED	N/A	N/A
	12	END OF TARGET LIFE (EOTL)	=0 (No EOTL)	=1 (EOTL)
	13	ACTIVE TOGGLE BIT	Toggles on Internal Data Transaction	
	14	BUS FAULT	Not implemented	
	15	RESERVED	N/A	N/A
1	0	RESERVED	N/A	N/A
	1	OVERTEMPERATURE	=0 (No Overtemp)	=1 (Overtemp)
	2	INTERLOCK STATE	=0 (Interlock Closed)	=1 (Interlock Open)
	3	RESERVED	N/A	N/A
	4	RESERVED	N/A	N/A
	5	CONTACTOR STATE	=0 (Contactor Closed)	=1 (Contactor Not Closed)
	6	RESERVED	N/A	N/A
	7	OUTPUT ON	=0 (Output Off)	=1 (Output On)

Fault/Status Bit Definitions

Table 3

Active Toggle Bit

The Active Toggle Bit is a handshake flag. It will toggle from a 0 to a 1, or from a 1 to a 0, each time the generator recognizes an incoming telegram. This bit is used to tell the master that the generator has received a message and is ready for another. It will also indicate to the master that the generator is present on the bus.

Command Status Response (CSR)

Host Port CSR codes	
Value	**Description**
0	Command accepted
1	Command rejected because the unit is in the wrong control mode
2	Command rejected because RF output is on
4	Command rejected because the data sent is out of range
5	Reserved
7	Command rejected because active fault(s) exist in the generator
9	Command rejected because the data byte count is incorrect
19	Reserved
50	Command rejected because the frequency is out of range
51	Command rejected because the duty cycle is out of range
99	Command not implemented

Table 4

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Chapter 3

Interface Board Installation

1. To install the PROFIBUS interface:
2. Power down the generator.
3. Install the interface board into the generator Board must seat firmly on top of J18 connector (Elite board).
4. Power up the generator and and take note of DS1 LED. One half of the led (green) will blink at 1 second rate. This led signifies that FPGA is configured. The second half of DS1 (red) will be on once communication is established with the main board.
5. Set DIP switch position so that address 16 is enabled. Bits 0 –3 are set to off position., bit 4 is set to on, and remaining bits 5 –8 are off.
6. Enter the **PBS** command.
7. Validate profichip address is 16 and that profichip state is equal to ‘WAIT_PRM’.
8. Validate that profibus LEDs (DS2) are in the following state:

   Amber: Blinks at 1 second rate.

   Green: Off

Chapter 4

.GSD File

The .GSD file defines slave.

```
#Profibus_DP
;---- Device names ----
Vendor_Name            = "MKS,ENI"
Model_Name             = "MKS/ENI RF 4by14"
Revision               = "V1.0"       ;11/03/08
;---- Ident numbers ----
Ident_Number           = 0xFFCB
Protocol_Ident         = 0            ;PROFIBUS_DP
Station_Type           = 0            ;DP-Slave
FMS_supp               = 0             ;The Device isn't FMS/DP Composite
;---- Release version numbers ----
Hardware_Release       = "V1.1"
Software_Release       = "V2.6"       ;E1050_S11 V2.6
;---- Supported baudrates ----
9.6_supp               = 0            ;Not Supported
19.2_supp              = 0            ;Not Supported
93.75_supp              = 1
187.5_supp             = 1
500_supp               = 1
1.5M_supp              = 1
3M_supp                = 1
6M_supp                = 1
12M_supp               = 1
;----Max time responder ----
;MaxTsdr_9.6           = 40
;MaxTsdr_19.2          = 65
MaxTsdr_93.75          = 200
```

```
MaxTsdr_187.5          = 360
MaxTsdr_500            = 360
MaxTsdr_1.5M           = 980
MaxTsdr_3M             = 250
MaxTsdr_6M             = 350
MaxTsdr_12M            = 550
;---- Other Info ------ Only Pins 3, 5, and 8 are connected
Redundancy             = 0            ; The system supports no Redundancy
Repeater_Ctrl_Sig       = 0                   ; Not connected
24V_Pins                = 0                   ; Not connected
;--- DP Slaves Related Key Word ----
Freeze_Mode_supp       = 1            ;Freeze Mode supported
Sync_Mode_supp         = 1            ;Sync mode supported
Auto_Baud_supp         = 1            ;Unit does Auto Baud
Set_Slave_Add_supp     = 0            ;No Changeable Set_slave_address
User_Prm_Data_Len      = 0            ;No User Prm Data
Min_Slave_Intervall    = 1            ;(0.1 msec) Smallest allowable time between polls.
;                                     ;  Time base: 100 usec
;----Modular Info ----
Modular_Station        = 0            ; 0 = Compact DP-Station
Max_Module             = 1            ;Number of modules supported by this definition
Max_Input_Len          = 14           ;Data Byte count from Slave  to Master
Max_Output_Len         = 4            ;Data Byte count from Master to Slave
Max_Data_Len           = 18           ;Sum of max in & max out
;
;--------"<Name>"                    ,Output,Input
Module = "4 Byte Out, 14 Byte In" 0x1D,0x23
EndModule
```

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Chapter 5

Interconnection Between Generator and Matchwork

In order for the Generator to control the Matchwork, the Generator and the Matchwork need to be connected to each other via a Dual Fiber Optic Communication Cable (care needs to be taken that the Cable is damage in routing).

One side of that Dual Fiber Optic Link is connected to the Generator (it is located on the ProfiBus Interface card set of connectors. The Other side is connected to the Matchwork Analog Fiber Optic Connection location.

Once this connection is done the Matchwork has to be powered up via its 24V Bias connection, for the Generator to control it.

Note: On reboot the Matchwork will default both capacitors to position zero.

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Appendix A

PROFIBUS Electrical Characteristics

Topology

Linear bus, terminated at both ends, stubs less than or equal to 0.3 m^3, no branches.

Note: *In contrast to the EIA RS-485 recommendations, it is good practice to allow longer stubs if the total of the capacitance of all stubs (Cstges) does not exceed the following values:*

Cstges less than or equal to 0.6 nF @ 500 kbit/s
Cstges less than or equal to 1.0 nF @ 187.5 kbit/s
Cstges less than or equal to 3.0 nF @ 93.75 kbit/s
(Cstges less than or equal to 15 nF @ 9.6 and 19.2 kbit/s.)

It shall be taken into consideration that the total line length includes the sum of the stub lengths.

Medium

Shielded Twisted Pair with the following characteristics:

Parameter	Line A (pin 3)	Line B (pin 8)
Impedance	100 to 130 Ω (f > 100 kHz)	135 to 165 Ω (f = 3 to 20 MHz)
Capacitance	< 60 pF/m	< 30 pF/m
Resistance	-	< 110 Ω / km
Wire Gauge	> 0.53 mm	> 0.64 mm
Conductor Area	> 0.22 mm^2 (24 AWG)	> 0.34 mm^2

Line Length

Less than or equal to 1200 m, depending on the data rate (ref. EIA RS-485).

Number of Stations

32 (master stations, slave stations or repeaters).

Data Rates

- (9.6, 19.2) or 93.75 kBaud for line lengths less than or equal to 1200 m.
- 187.5 kBaud for line lengths less than or equal to 600 m.
- 500 kBaud for line lengths less than or equal to 200 m.

Appendix B

Hardware Specifications

Pin Definitions for 9-pin PROFIBUS Connector

Pin #	Description	Voltage (V)			Current (mA)		
		Min.	Typical	Max.	Min.	Typical	Max.
1	Digital Ground	-	0	-	-	-	-
2	NC	-	-	-	-	-	-
3	RxD/TxD Data Positive (A)	+4.75	+5.00	+5.25	-	60	-
4	Ready to Send	+4.50	+5.00	+5.50	-	4.0	-
5	Digital Ground	-	0	-	-	-	-
6	Positive Digital Rail	+4.75	+5.00	+5.25	100	300	600
7	NC	-	-	-	-	-	-
8	RxD/TxD Data Negative (B)	+4.75	+5.00	+5.25	-	60	-
9	NC	-	-	-	-	-	-

User Connector Definition

Table 5

Temperature Range

Absolute limits

Min. (^{o}C)	Max. (^{o}C)
0	70

Temperature Range

Table 6

Maximum Cable Length per PROFIBUS Segment

Baud Rate (Baud)	9.6 k	19.2 k	93.75 k	187.5 k	500 k	1.5 M	12 M
Line A Length (m)	1200	1200	1200	1000	400	200	100

Maximum Cable Length

Table 7

Appendix C

References

For further reading and assistance, refer to the following documents:

Siemens SINEC DP Programming Interface Description, Siemens AG Copyright 1995.

Siemens DP-5412/MS-DOS, Windows, Version 1.00, Installation Guide Siemens AG Copyright 1995.

DIN 19 245 PROFIBUS Standard, PROFIBUS Nutzerorganisation e. V., Copyright 1989-1993.

1000-008, DCG-50/100 DC Plasma Generator, Operations Manual, MKS Instruments, Inc., Copyright 1995.

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