DIGIbus PROTOCOL

Application Document

CONTENTS

This document covers the DIGIbus protocol, which is used for two-way communications between third party devices and the programmable range of DPM products. The main body of this document covers the protocol itself, while the appendices give register information for each DPM product.

The protocol is the property of DPM (Pty) Ltd, but may be implemented in third party systems for the exclusive use of communicating with the DPM range of products.

SECTION 1: DIGIbus PROTOCOL

The protocol is a simple master-slave system, with the third party system acting as the master unit and the DPM units acting as slaves. The master unit sends a binary frame to the DPM units.

If the unit number, CRC byte and parity are all received and are OK then the unit returns the same frame with new data and sets the to/from bit. If there are any errors, the DPM unit does not return anything.

1.1 SERIAL HARDWARE SETUP:

Baud: 2400, 4800, 9600, 19200
Data: 8 data bits
Parity: Odd parity
Stop: 1 stop bit

1.2 SERIAL FRAME FORMAT:

The serial frame has a fixed length of nine bytes. Bit eight of each byte is used as a synchronisation bit and is only on at the start and end of the frame.

Each byte is in a binary format and is defined as follows:

GURDDDD!E

G = 7654 3210 ----------Start-Byte----------
. . . . x 0 = normal, 1 = reset (reset unit only)
. . . . . . x . 0 = byte size data, 1 = word size data
. . . . . x . . 0 = message to unit, 1 = message from unit
. . . . x . . . 0 = RAM, 1 = EEPROM
. . . x . . . . 0 = low (0->127), 1 = high (128->255) memory area
. . x . . . . . 0 = read, 1 = write
. 0 . . . . . 0 = must be off (start)
x . . . . . 0 = data, 1 = control (start & end byte)

U = Unit number 0..99, $00..$63 hex, 0 = All units.
The unit number must be set the same in the DPM menu.

R = Register number 0..127, $00..$7F hex
If the register number > 127 then set bit four in the start byte (High memory) and subtract 128 or $80 from the register number to be sent.

D = The DPM uses 24 bit binary values (3 bytes) including a sign bit. Negative numbers are stored in 24 bit two's complement. There is no decimal point, this is used on the display only. However, when data bytes are sent to the unit, each byte must be converted from eight to six bits. Bit number zero to six stay the same while bit seven and eight are cleared. The bit seven and eight from the three bytes are moved to the fourth byte.

Example: Byte B1 is the least significant byte, B3 is the most significant byte.

Packing values from binary to data:

BINARY B1 = $BA (Binary = 10111010)
B2 = $DC (Binary = 11011100)
B3 = $FE (Binary = 11111110)

PACKED D1 = $3A (Binary = 00111010)
D2 = $1C (Binary = 00011100)
D3 = $3E (Binary = 00111110)
D4 = $3E (Binary = 00111110)

Unpacking values from data to binary:

PACKED D1 = $3A (Binary = 00111010)
D2 = $1C (Binary = 00011100)
D3 = $3E (Binary = 00111110)
D4 = $3E (Binary = 00111110)

BINARY B1 = $BA (Binary = 10111010)
B2 = $DC (Binary = 11011100)
B3 = $FE (Binary = 11111110)

If there is no data, fill the four bytes with binary zero .

! = CRC Error check code, XOR all bytes except the CRC and the end byte:
CRC = G xor U xor R xor D xor D xor D xor D
The CRC is only 7 bits, bit 8 must be 0.

E = End of frame code = Hex $C0, Dec 192, bit 7 and 8 are set.

1.3 RS485 CONTROL:

If you are using a Model 7000 communication converter with a RS485 bus, the Request To Send line is normally used to control the line RX/TX. Your program must change the RTS status before transmitting. Furthermore, all DPM products have the communications address default set to 0. This must be a value other than 0 if more than 1 DPM product is used in the system.

SECTION 2: APPLICATION EXAMPLES

EXAMPLE #1 - To get the analogue display value from a Model 4001.

Send >> 92 00 0C 00 00 00 00 1E C0

Start bits : $92 = 10010010 : Start of frame, read, high memory, word size data
Unit num : $00 = Address 00 : Hexidecimal (addressing unit no. 0)
Register # : $0C = $8C - $80 : High memory area, subtract $80.
Data sent : $00 = Fill with zero
CRC : $1E = ($92 xor $00 xor $0C xor $00 xor $00 xor $00 xor $00) : Mask off bit 7 and 8
End byte : $C0

Unit returns >> 96 00 0C 06 3F 3F 3C 20 C0

Start bits : $96 = 10010110 : Start, read, high, word, from unit
Unit num : $00 = Unit no. 0 responding
Register # : $0C = $8C - $80 : High memory area
Data : $06 $3F $3F $3C : Packed
$06 $FF $FF : Unpacked
$FFFF06 : Hexadecimal
-250 : Decimal
CRC : $20 = ($96 xor $00 xor $0C xor $06 xor $3F xor $3F xor $3C) : Mask off bit 7 amd 8
End byte : $C0

EXAMPLE #2 - To set the setpoint #1 value to 1234 on a Model 4001.

Send >> B2 00 24 12 04 00 03 03 C0

Start bits : $B2 = 10110010 : Start of frame, write, high mem, word
Unit num : $00 = Address 00 : Addressing unit no. 0
Register # : $24 = $A4 - $80 : High memory area, subtract $80
Data sent : $12 $04 $00 $03 : Packed
$D2 $04 $00 : Unpacked
$4D2 : Hexadecimal
+1234 : Decimal
CRC : $03 = ($B2 xor $00 xor $24 xor $12 xor $04 xor $00 xor $03) : Mask off bit 7 and 8
End byte : $C0

Unit returns >> B6 00 24 12 04 00 03 07 C0

Start bits : $B6 = 10110110 : Start, write, high, word, from unit
Unit num : $00 = Unit no. 0 responding
Register # : $24 = $A4 - $80 : High memory area
Data : $12 $04 $00 $03 : Packed
CRC : $07 = ($B6 xor $00 xor $24 xor $12 xor $04 xor $00 xor $03) Mask off bit 7 and 8
End byte : $C0

IMPORTANT NOTE:

After you have changed any setup values, you must reset the unit.

PC Send >> A1 00 00 00 00 00 00 21 C0

Start byte = $A1 (10100001) : Start, write, reset

Unit returns >> The unit will not return any message.

APPENDIX A – REGISTERS FOR MODEL 4001 / 5001 / 5001-T / 5600 / 8001 / 8001-T

Reg.	Size	Range	Description
$50	1 byte	0,1,2,3,4,5,6	Function selection: process, frequency, process X frequency, count up, count down, digital totaliser, analogue integrator
$53	1 byte	0,1	Frequency type: Hz, RPM
$54	1 byte	0,1,2,3	Frequency averaging: Std, 0.5, 1.1, 4.5 seconds
$B6	3 bytes	-199999->199999	Frequency scaler (2 decimal places included)
$B9	3 bytes	-199999->199999	Counter scaler (2 decimal places included)
$52	1 byte	0,1,2	Display selection: process, frequency, p x f
$8C	3 bytes	-199999->199999	Process display value
$82	3 bytes	-199999->199999	Frequency display value
$85	3 bytes	-199999->199999	Counter display value
$8F	3 bytes	-199999->199999	Peak hold value
$A4	3 bytes	-199999->199999	Alarm 1 setpoint value
$A7	3 bytes	-199999->199999	Alarm 2 setpoint value
$AA	3 bytes	-199999->199999	Alarm 3 setpoint value
$AD	3 bytes	-199999->199999	Alarm 4 setpoint value
$25	1 byte	XXXX XXXX	Alarm 1,2,3,4 normally open / normally closed, Use first four bits for alarm 1 to 4 respectively Alarm 1,2,3,4 high / low, Use last four bits for alarm 1 to 4 respectively
$5A	1 byte	0->255	Alarm 1 delay (seconds)
$5B	1 byte	0->255	Alarm 2 delay (seconds)
$5C	1 byte	0->255	Alarm 3 delay (seconds)
$5D	1 byte	0->255	Alarm 4 delay (seconds)
$C3	1 byte	0->127	Alarm 1 hysteresis value
$C4	1 byte	0->127	Alarm 2 hysteresis value
$C5	1 byte	0->127	Alarm 3 hysteresis value
$C6	1 byte	0->127	Alarm 4 hysteresis value
$5E	1 byte	0,1,2	Analog output type 0 = 0-10V, 1 = 0–20mA, 2 = 4-20mA
$CF	3 bytes	-199999->199999	Analog output zero value
$D2	3 bytes	-199999->199999	Analog output scale value
$5F	1 byte	0->99	Communication Address
$60	1 byte	0,1,2,3	Communication baud rate
$61	1 byte	0,1,2	Key lock level

APPENDIX B – REGISTERS FOR MODEL 4003

Reg.	Size	Range	Description
$50	1 byte	0,1	Input type 0 = TC, 1 = RTD
$51	1 byte	0->7	Thermocouple: J, K, N, S, R, -T, +T, W5 RTD: 0 = PT100, 1 = Ni100
$52	1byte	0,1,2	Display type selection : 0 = °C, 1 = °F, 2 = K
$53	1 byte	0,1	Broken TC read hi or low
$55	1 byte	0,1,2,3	Display decimal point
$86	3 bytes	-1999->1999	Display value
$8C	3 bytes	-1999->1999	Peak hold value
$A4	3 bytes	-1999->1999	Alarm 1 setpoint value
$A7	3 bytes	-1999->1999	Alarm 2 setpoint value
$AA	3 bytes	-1999->1999	Alarm 3 setpoint value
$AD	3 bytes	-1999->1999	Alarm 4 setpoint value
$58	1 byte	0,1	Alarm 1 type Hi / Low
$59	1 byte	0,1	Alarm 2 type Hi / Low
$5A	1 byte	0,1	Alarm 3 type Hi / Low
$5B	1 byte	0,1	Alarm 4 type Hi / Low
$5C	1 byte	0000XXXX	Alarm 1,2,3,4 normally open / normally closed, Use first four bits for alarm 1 to 4 respectively
$5E	1 byte	0->255	Alarm 1 delay (seconds)
$5F	1 byte	0->255	Alarm 2 delay (seconds)
$60	1 byte	0->255	Alarm 3 delay (seconds)
$61	1 byte	0->255	Alarm 4 delay (seconds)
$C2	1 byte	0->127	Alarm 1 hysteresis value
$C5	1 byte	0->127	Alarm 2 hysteresis value
$C8	1 byte	0->127	Alarm 3 hysteresis value
$CB	1 byte	0->127	Alarm 4 hysteresis value
$62	1 byte	0,1,2	Analog output type 0 = 0-10V, 1 = 0–20mA, 2 = 4-20mA
$CE	3 bytes	-1999->1999	Analog output zero value
$D1	3 bytes	-1999->1999	Analog output scale value
$63	1 byte	0->99	Communication Address
$64	1 byte	0,1,2,3	Communication baud rate
$65	1 byte	0,1,2	Key lock level

APPENDIX C – REGISTERS FOR MODEL 5002

Reg.	Size	Range	Description
$51	1 byte	0,1,2	Input type 0 = binary, 1 = gray code, 2 = BCD
$53	1 byte	0,1	Input logic 0 = negative, 1 = positive
$54	1 byte	0,1	Input BCD type 0 = parallel, 1 = multiplexed
$56	1 byte	0,1	0 = Model 5002, 1 = Model 4002
$55	1 byte	0,1,2,3,4	Display decimal point
$8C	3 bytes	-199999->999999	Display value
$86	3 bytes	-199999->999999	Peak hold value
$A4	3 bytes	-199999->999999	Alarm 1 setpoint value
$A7	3 bytes	-199999->999999	Alarm 2 setpoint value
$AA	3 bytes	-199999->999999	Alarm 3 setpoint value
$AD	3 bytes	-199999->999999	Alarm 4 setpoint value
$59	1 byte	0000XXXX	Alarm 1,2,3,4 high / low, Use first four bits for alarm 1 to 4 respectively
$5A	1 byte	0000XXXX	Alarm 1,2,3,4 normally open / normally closed, Use first four bits for alarm 1 to 4 respectively
$5B	1 byte	0->255	Alarm 1 delay (seconds)
$5C	1 byte	0->255	Alarm 2 delay (seconds)
$5D	1 byte	0->255	Alarm 3 delay (seconds)
$5E	1 byte	0->255	Alarm 4 delay (seconds)
$D4	1 byte	0->127	Alarm 1 hysteresis value
$D5	1 byte	0->127	Alarm 2 hysteresis value
$D6	1 byte	0->127	Alarm 3 hysteresis value
$D7	1 byte	0->127	Alarm 4 hysteresis value
$5F	1 byte	0,1,2	Analog output type 0 = 0-10V, 1 = 0–20mA, 2 = 4-20mA
$CE	3 bytes	-199999->999999	Analog output zero value
$D1	3 bytes	-199999->999999	Analog output scale value
$60	1 byte	0->99	Communication Address
$61	1 byte	0,1,2,3	Communication baud rate
$62	1 byte	0,1,2	Key lock level

APPENDIX D – REGISTERS FOR MODEL 4004 / 5004

Reg.	Size	Range	Description
$8C	3 bytes	-199999->199999	Load cell value
$83	3 bytes	-199999->199999	Speed value (2 decimal places included)
$8F	3 bytes	-199999->199999	Belt rate in kg/m, kg/h, t/h
$80	3 bytes	0->199999	Totaliser value
$57	1 byte	0->127	Display resolution step
$58	1 byte	0,1,2,3	Load cell averaging factor: (0, 1, 2 or 4 seconds)
$54	1 byte	0,1,2,3	Frequency averaging (Std, 0.5, 1.1, 4.5 seconds)
$86	3 bytes	-199999->199999	Peak hold value
$A4	3 bytes	-199999->199999	Alarm 1 setpoint value
$A7	3 bytes	-199999->199999	Alarm 2 setpoint value
$AA	3 bytes	-199999->199999	Alarm 3 setpoint value
$AD	3 bytes	-199999->199999	Alarm 4 setpoint value
$59	1 byte	0000XXXX	Alarm 1,2,3,4 high / low, Use first four bits for alarm 1 to 4 respectively
$5A	1 byte	0000XXXX	Alarm 1,2,3,4 normally open / normally closed, Use first four bits for alarm 1 to 4 respectively
$5B	1 byte	0->255	Alarm 1 delay (seconds)
$5C	1 byte	0->255	Alarm 2 delay (seconds)
$5D	1 byte	0->255	Alarm 3 delay (seconds)
$5E	1 byte	0->255	Alarm 4 delay (seconds)
$D4	1 byte	0->127	Alarm 1 hysteresis value
$D5	1 byte	0->127	Alarm 2 hysteresis value
$D6	1 byte	0->127	Alarm 3 hysteresis value
$D7	1 byte	0->127	Alarm 4 hysteresis value
$5F	1 byte	0,1,2	Analog output type 0 = 0-10V, 1 = 0–20mA, 2 = 4-20mA
$CE	3 bytes	-199999->199999	Analog output zero value
$D1	3 bytes	-199999->199999	Analog output scale value
$60	1 byte	0->99	Communication Address
$61	1 byte	0,1,2,3	Communication baud rate
$62	1 byte	0,1,2	Key lock level

APPENDIX E – REGISTERS FOR MODEL 5012

Reg.	Size	Range	Description
$52	1 byte	0->6	Input type: frequency1, frequency2, count, quad, clock, event, rate & totaliser
$56	1 byte	0,1,2,3	Frequency averaging (Std, 0.5, 1.1, 4.5 seconds)
$57	1 byte	0,1	Counter mode 0 = up, 1 = down
$5A	1 byte	0,1,2,3,4	Counter scaler (2 decimal places included)
$BC	3 bytes	-199999->199999	Counter factor
$BF	3 bytes	-199999->199999	Counter/ quadrature reset value
$B9	3 bytes	-199999->199999	Quadrature preset value
$58	1 byte	0,1,2,3,4	Frequency1, frequency2, rate decimal point
$59	1 byte	0,1,2,3,4	Count, quadrature, totaliser, event decimal point
$94	3 bytes	-199999->199999	Display value: frequency1, frequency2, rate
$97	3 bytes	-199999->199999	Display value: counter, quadrature, totaliser, event, clock
$9A	3 bytes	-199999->199999	Peak hold value
$AA	3 bytes	-199999->199999	Alarm 1 setpoint value
$AD	3 bytes	-199999->199999	Alarm 2 setpoint value
$B0	3 bytes	-199999->199999	Alarm 3 setpoint value
$B3	3 bytes	-199999->199999	Alarm 4 setpoint value
$20	1 byte	XXXX0000	Alarm 1,2,3,4 high / low, Use last four bits for alarm 1 to 4 respectively
$5B	1 byte	0000XXXX	Alarm 1,2,3,4 normally open / normally closed, Use first four bits for alarm 1 to 4 respectively
$5C	1 byte	0->255	Alarm 1 delay (seconds)
$5D	1 byte	0->255	Alarm 2 delay (seconds)
$5E	1 byte	0->255	Alarm 3 delay (seconds)
$5F	1 byte	0->255	Alarm 4 delay (seconds)
$C2	1 byte	0->127	Alarm 1 hysteresis value
$C5	1 byte	0->127	Alarm 2 hysteresis value
$C8	1 byte	0->127	Alarm 3 hysteresis value
$CB	1 byte	0->127	Alarm 4 hysteresis value
$60	1 byte	0,1,2	Analog output type 0 = 0-10V, 1 = 0–20mA, 2 = 4-20mA
$CE	3 bytes	-199999->199999	Analog output zero value
$D1	3 bytes	-199999->199999	Analog output scale value
$61	1 byte	0->99	Communication Address
$62	1 byte	0,1,2,3	Communication baud rate
$63	1 byte	0,1,2	Key lock level

APPENDIX F – REGISTERS FOR MODEL 9000 / 9240

Num.	Size	Range	Description
$69	3 bytes	0->255	Address of the virtual display register
$A4	3 bytes	-199999->199999	Alarm 1 setpoint value
$A7	3 bytes	-199999->199999	Alarm 2 setpoint value
$58	1 byte	0,1	Alarm 1 type Hi / Low
$59	1 byte	0,1	Alarm 2 type Hi / Low
$5C	1 byte	000000XX	Alarm 1,2 normally open / normally closed, Use first two bits for alarm 1 to 2 respectively
$5E	1 byte	0->255	Alarm 1 delay (seconds)
$5F	1 byte	0->255	Alarm 2 delay (seconds)
$C2	1 byte	0->127	Alarm 1 hysteresis value
$C5	1 byte	0->127	Alarm 2 hysteresis value
$62	1 byte	0,1,2	Analog output type 0 = 0-10V, 1 = 0–20mA, 2 = 4-20mA
$CE	3 bytes	-199999->199999	Analog output zero value
$D1	3 bytes	-199999->199999	Analog output scale value