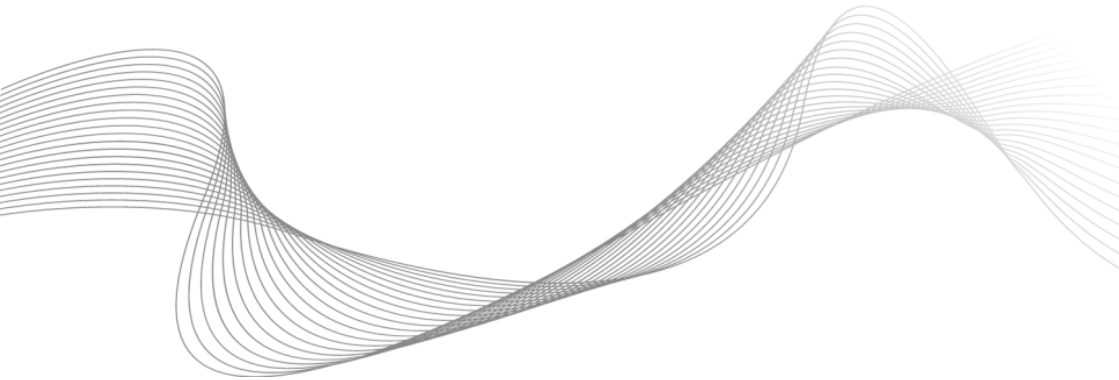
COTEK



AD-1500 Communication Protocol

Revision 1.7

1 Jun 2022

Table of Content

1. AD MODBUS

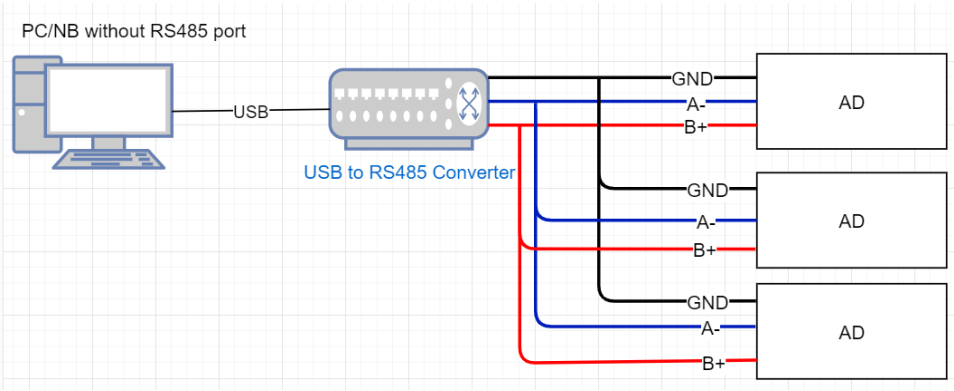
2. AD PMBUS

3. COTEK STANDARD PROTOCOL

1. AD MODBUS

1-1. Overview

AD series use MODBUS protocol with RS-485 physical layer for communication.
Transmission mode of MODBUS protocol is supported only by MODBUS-RTU (MODBUS-ASCII is not supported). MODBUS use the single master / multi-slave communication method. In MODBUS protocol, only the master device sends the query, and the slave device specified (unicasted) by master device return the response.
In the case of queries to all slave devices (broadcast), each slave device performs query processing but does not return the response. If the slave device receives the incorrect query frame, the slave device discards the query and waits for the next query.
AD operates as a MODBUS slave device.
By MODBUS communication, it is possible to monitor the operation status and to change various settings of AD.



Wiring / connection of communication system

1-2. Modbus protocol

Communication on a Modbus network is initiated by a master with a query to a slave. After receiving and processing the query, the slave returns a reply to the master. The master can address individual slaves or uses a special broadcast address (0x00) to initiate a broadcast message to all slaves. No response is returned to broadcast requests.

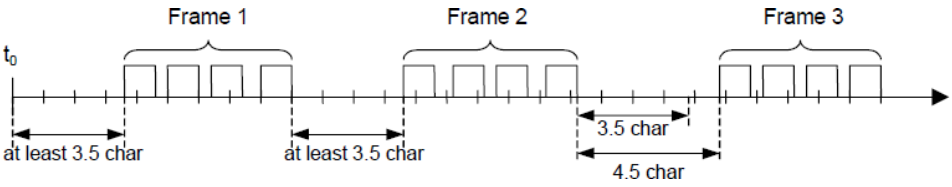
The AD only supports Modbus RTU. ASCII mode is not supported.. A Modbus register is always 2 bytes of data (MSB first) even if the command table in chapter 4 specifies only 1 byte (# bytes column). In this case, MSB byte will always be 0.

1-3. Modbus Physical Communication

Physical Interface	Comments
RS485 Half-duplex (Standard with different Setting)	Default Baud Rate: 19200 baud, none parity, 1 stop bit
UART (TTL level, Optional)	Default Baud Rate: 19200 baud, none parity, 1 stop bit
RS232 (Optional)	Default Baud Rate: 19200 baud, none parity, 1 stop bit

1-4. Modbus Message RTU Framing

In RTU mode, messages (request or response) frames are separated by a silent interval of at least 3.5 character times. Each character is 11 bits (1 start, 8 bits data, 1 bit parity and 1 stop). 2 stops bits is required if no parity is used.



MODBUS message

Start	Address	Function	Data	CRC Check	End
≥ 3.5 char	8 bits	8 bits	N x 8 bits	16 bits	≥ 3.5 char

Modbus RTU Message Frame

The entire message frame must be transmitted as a continuous stream of characters. If a silent interval of more than 1.5 character times occurs between 2 characters, the frame is declared incomplete and should be discarded by the receiver.

For baud rates greater than 19200 Bps, fixed values for the 2 timers should be used: it is recommended to use a value of 750µs for the inter-character time-out (t1.5) and a value of 1.750ms for inter-frame delay (t3.5).

The CRC field is appended as the last field of the message. The LSB is appended first followed by the MSB. The CRC calculation is started by first pre-loading a 16 bits register to all 1s.

1-5. Modbus Register

Function Description	Function Code
Read Coils	0X01
Read Holding Registers	0X03
Read Input Registers	0X04
Write Single Coil	0X05
Write Single Register	0X06

1-6. Modbus Function Code Read Coils Registers (0x01)

The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1= ON and 0= OFF. The LSB of the first data byte contains the output addressed in the query. The other coils follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

Request Frame:

	length	Description
Slave Address	1 Byte	0XA0 (Default Address)
Function Code	1 Byte	0x01
Starting Address MSB	1 Byte	0x00
Starting Address LSB	1 Byte	0x00 to 0xFF
Quantity of Coils MSB	1 Byte	0x00
Quantity of Coils LSB	1 Byte	0x01 to 0x7B (number of word to read)
CRC LSB	1 Byte	
CRC MSB	1 Byte	

Response Frame:

	length	Description
Slave Address	1 Byte	XA0 (AD Default Address)
Function Code	1 Byte	x01
Byte count	1 Byte	* N (N = Quantity of Register in Request)
Register Value	N*2 Bytes	Data
CRC LSB	1 Byte	
CRC MSB	1 Byte	

1-7. Read Coils Registers

FUNC CODE	Starting Address	Description	Write number of byte	CMD AND RESPONSE	Value
1	0X0001	Read the power ON/Off status	2	A0 01 00 01 00 01 B5 7B A0 01 02 00 00 04 25	1: power on 0: power off

1-8. Modbus Function Code Read Holding Registers (0x03)

This function code is used to read the contents of a contiguous block of holding registers in a remote device. The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero. Therefore registers numbered 1-4 are addressed as 0-3

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Request Frame:

	length	Description
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x03
Starting Address MSB	1 Byte	0x00
Starting Address LSB	1 Byte	0x00 to 0xFF
Quantity of Register MSB	1 Byte	0x00
Quantity of Register LSB	1 Byte	0x01 to 0x7B (number of word to read)
CRC LSB	1 Byte	
CRC MSB	1 Byte	

Response Frame:

	length	Description
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x03
Byte count	1 Byte	2 * N (N = Quantity of Register in Request)
Register Value	N*2 Bytes	Data
CRC LSB	1 Byte	
CRC MSB	1 Byte	

1-9. Read Holding Registers

FUNC CODE	Starting Address	Description	number of word to read	CMD AND RESPONSE	Value
3	0X0001	Read the Setting output voltage(SV?)	1	A0 03 00 01 00 01 CC BB A0 03 00 01 04 B0 0E 0F	0x04B0 =1200 12.00 V
	0X0002	Read the Setting output current (SI?)	1	A0 03 00 02 00 01 3C BB A0 03 00 02 30 D4 E9 24	0X30D4 = 12500 125.00A
	0X0003	Read the Connect type (CONTYPE?)	1	A0 03 00 03 00 01 6D 7B A0 03 00 03 00 00 AC BB	0X0000 = 0
	0X0004	Read master or slave id(ID?)	1	A0 03 00 04 00 01 DC BA A0 03 00 04 00 00 1D 7A	0X0000 = 0
	0X0006	Read Modbus ID	1	A0 03 00 06 00 01 7D 7A A0 03 00 06 00 00 BC BA	0X0000 = 0
	0X0007	Read PMBUS ID	1	A0 03 00 07 00 01 2C BA A0 03 02 00 50 05 A1	0X01~0X7F (Default 0x50)
	0X0008	Read POWER SOFTSTART	1	A0 03 00 08 00 01 1C B9 A0 03 02 00 19 C4 57	
	0X0009	Read SV SOFTSTART	1	A0 03 00 09 00 01 4D 79 A0 03 02 00 06 85 9F	
	0X000A	Read Vref SOFTSTART	1	A0 03 00 0A 00 01 BD 79 A0 03 02 00 24 05 86	
	0X000B	Read SI	1	A0 03 00 0B 00 01 EC B9	

		SOFTSTART		A0 03 02 00 06 85 9F	
	0x000C	Read Control Mode	1	A0 03 00 0C 00 01 5D 78 A0 03 02 00 01 C4 5D	0:local mode 1:remote mode
	0x000D	Read Power ON Rule	1	A0 03 00 0D 00 01 0C B8 A0 03 02 00 02 84 5C	0~2

1-10. Modbus Function Code Read Input Registers (0x04)

This function code is used to read from 1 to 125 contiguous input registers in a remote device. The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero. Therefore input registers numbered 1-16 are addressed as 0-15.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Request Frame:

	length	Description
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x04
Register Address MSB	1 Byte	0x00
Register Address LSB	1 Byte	0x00 to 0xFF
Register Value MSB	1 Byte	0x00
Register Value LSB	1 Byte	0x01 to 0x7B (number of word to read)
CRC LSB	1 Byte	
CRC MSB	1 Byte	

Response Frame:

	length	*Description*
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x04
Byte count	1 Byte	2 * N (N = Quantity of Register in Request)
Register Value	N * 2 Bytes	Data
CRC LSB	1 Byte	
CRC MSB	1 Byte	

1-11. Read Input Register (R)

FUNC CODE	Starting Address	Description	number of word to read	Command and Response	Example calculation of value
4	0x0030	Real time output voltage (RV?)	1	A0 04 00 30 00 01 28 B4 A0 04 00 30 04 DB AB EF	0X04DB = 1243 12.43V
	0X0031	Real time output current (RI?)	1	A0 04 00 31 00 01 79 74 A0 04 00 31 04 B7 FA 02	0X04B7 = 1207 12.07A
	0x0032	Response output power(RP?)	1	A0 04 00 32 00 01 89 74 A0 04 00 32 00 96 C8 DA	0X0096 = 150 150W
	0x0033	Temperature of NTC1 on PFC(NTC1?)	1	A0 04 00 33 00 01 D8 B4 A0 04 00 33 FF EC 19 49	0XFFEC (It is negative number) 0XFFFF-0XFFEC=0X13 -20℃
	0x0034	Temperature of NTC2 on PFC(NTC2?)	1	A0 04 00 34 00 01 69 75 A0 04 00 34 00 1E 28 BD	0X001E = 30 30℃
	0x0035	Temperature of NTC3 on PFC(NTC3?)	1	A0 04 00 35 00 01 38 B5 A0 04 00 35 00 1E 79 7D	0X001E = 30 30℃
	0x0036	Temperature of NTC1 on	1	A0 04 00 36 00 01 C8 B5	0X0022 = 34

		DD(NTC4?)		A0 04 00 36 00 22 89 6C	34℃
	0x0037	Temperature of NTC2 on DD(NTC5?)	1	A0 04 00 37 00 01 99 75 A0 04 00 37 00 3A D8 A6	0X003A = 58 58℃
	0X0038	Real time environment temperature (RAMB?)	1	A0 04 00 38 00 01 A9 76 A0 04 00 38 0F 2B 2D 59	0X0F3A = 3898 38.98℃
	0X0039	Response error code Primary side error code(ERR1?)	1	A0 04 00 39 00 01 F8 B6 A0 04 00 39 00 00 39 76	0X0000 = 0
	0X003A	Response error code secondary error code(ERR2?)	1	A0 04 00 3A 00 01 08 B6 A0 04 00 3A 00 00 C9 76	0X0000 = 0
	0X003B	Response voltage rate(VRATE?)	1	A0 04 00 3B 00 01 59 76 A0 04 00 3B 04 B0 9B C2	0X04B0 = 1200 12.00V
	0X003C	Response current rate(IRATE?)	1	A0 04 00 3C 00 01 E8 B7 A0 04 00 3C 30 D4 3D 28	0X30D4 = 12500 125.00A
	0X003D	Response fan speed(RFSP?)	Response fan speed	A0 04 00 3D 00 01 B9 77 A0 04 00 3D 00 00 78 B7	0X0000 = 0 0 RPM
	0X003E	read primary bus voltage(VBUS?)	1	A0 04 00 3E 00 01 49 77 A0 04 00 3E 01 7D 49 06	0X017E = 382 382V
	0X003F	read primary AC input voltage(VAC?)	1	A0 04 00 3F 00 01 18 B7 A0 04 00 3F 5D E0 E0 6F	0X5DDD = 24029

					240.29V
	0X0040	read primary AC input current voltage(IAC?)	1	A0 04 00 40 00 01 29 6F A0 04 00 40 02 80 E8 6F	0X0280 = 640 6.40A
	0X0041	AC in type 0: input is AC 1: input is DC (VINT?)	1	A0 04 00 41 00 01 78 AF A0 04 00 41 00 01 78 AF	0X0001 = 1 0:AC 1:DC
	0X0043	Real Time Power Rating (RRATE?)	1	A0 04 00 43 00 01 D9 6F A0 04 02 00 64 05 02	
	0X0060	Read Output voltage rate information (INFO2)	1	A0 04 00 60 00 01 28 A5 A0 04 02 12 C0 08 19	0X04B0 1200 12.00V
	0X0061	Read Manufacture company information(INFO0)	8	A0 04 00 61 00 08 B9 63 A0 04 10 43 6F 74 65 6B 31 32 33 34 35 36 37 38 39 30 41 8C BD	43 6F 74 65 6B 31 32 33 34 35 36 37 38 39 30 41 Cotek12345 67890A
	0X0062	Read Model name information(INFO1)	8	A0 04 00 62 00 08 49 63 A0 04 10 41 44 31 35 30 30 2D 31 32 56 2D 31 32 35 41 20 95 90	41 44 31 35 30 30 2D 31 32 56 2D 31 32 35 41 20 AD1500-12 V-125A
	0X0063	Read Revision information (INFO3)	8	A0 04 00 63 00 08 18 A3 A0 04 10 32 32 30 37 2E	32 31 30 38 30 35 2D 49

				32 20 20 20 20 20 20 20 20 20 00 25 E2	4E 54 45 52 41 54 45 00 210805_INTERATE
	0X0064	Read Date of MFG (INFO4)	8	A0 04 00 64 00 08 A9 62 A0 04 10 32 30 32 31 31 31 30 39 20 20 20 20 20 20 20 D0 95	32 30 32 31 30 33 31 39 20 20 20 20 20 20 20 20210319
	0X0065	Read Serial number(INFO5)	8	A0 04 00 65 00 08 F8 A2 A0 04 10 54 32 31 43 35 30 30 30 30 35 30 00 00 00 00 00 09 84	31 32 33 34 35 36 37 38 39 30 31 32 33 34 35 36 1234567890123456
	0X0066	Read Country of MFG(INFO6)	8	A0 04 00 66 00 08 08 A2 A0 04 10 00 6F 74 65 6B 2D 54 61 69 77 61 6E 20 20 20 20 3C EA	43 6F 74 65 6B 2D 54 61 69 77 61 6E 20 20 20 20 Cotek-Taiwan

1-12. Modbus Function Code Write Coils Registers (0x05)

This function code is used to write a single output to either ON or OFF in a remote device. The requested ON/OFF state is specified by a constant in the request data field. A value of FF 00 hex requests the output to be ON. A value of 00 00 requests it to be OFF. All other values are illegal and will not affect the output.

Request Frame:

	length	Description
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x05
Starting Address MSB	1 Byte	0x00
Starting Address LSB	1 Byte	0x00 to 0xFF
Quantity of Coils MSB	1 Byte	0x00
Quantity of Coils LSB	1 Byte	0x01 to 0x7B (number of word to read)
CRC LSB	1 Byte	
CRC MSB	1 Byte	

Response Frame:

	length	Description
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x05
Byte count	1 Byte	2 * N (N = Quantity of Register in Request)
Register Value	N * 2 Bytes	Data
CRC LSB	1 Byte	
CRC MSB	1 Byte	

FUNC CODE	Starting Address	Desc	Write number of byte	CMD AND RESPONSE	Value
5	0X0001	force to remote control & setting power ON/Off (POWER x)	2	Power on A0 01 00 03 00 01 A1 7B A0 06 00 03 00 01 A1 7B Power off A0 01 00 03 00 00 60 BB A0 06 00 03 00 00 60 BB	1: power on 0: power off
	0x0002	Reset to Default	2	A0 05 00 02 00 01 B4 BB A0 05 00 02 00 01 B4 BB	

1-13. Modbus Function Code Write Single Registers (0x06)

This function code is used to write a single holding register in a remote device. The Request PDU specifies the address of the register to be written. Registers are addressed starting at zero. Therefore register numbered 1 is addressed as 0. The normal response is an echo of the request, returned after the register contents have been written.

Request Frame:

	length	Description
Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x06
Register Address MSB	1 Byte	0x00
Register Address LSB	1 Byte	0x00 to 0xFF
Register Value MSB	1 Byte	0x00 to 0xFF
Register Value LSB	1 Byte	0x00 to 0xFF

CRC LSB	1 Byte	
CRC MSB	1 Byte	

Response Frame:

Slave Address	1 Byte	0XA0 (AD Default Address)
Function Code	1 Byte	0x06
Register Address MSB	1 Byte	0x00
Register Address LSB	1 Byte	0x00 to 0xFF
Register Value MSB	1 Byte	0x00 to 0xFF
Register Value LSB	1 Byte	0x00 to 0xFF
CRC LSB	1 Byte	
CRC MSB	1 Byte	

1-14. Write Single Register

FUNC CODE	Starting Address	Desc	Write number of byte	CMD AND RESPONSE	Value
6	0X0001	Setting output voltage	2	A0 06 00 01 04 B0 C2 0F A0 06 00 01 04 B0 C2 0F	Set 12.00V 1200(DEC)=0 X04B0(HEX)
	0X0002	Setting output current	2	A0 06 00 02 03 E8 31 C5 A0 06 00 02 03 E8 31 C5	Set 10.00A 1000(DEC)=0 X03E8(HEX)
	0X0003	CONTYPE x	1	A0 06 00 03 00 00 60 BB A0 06 00 03 00 00 60 BB	0X00~0X01
	0X0004	SET MODBUS ID	1	A0 06 00 04 00 A0 D1 02	0X01~0XFA(

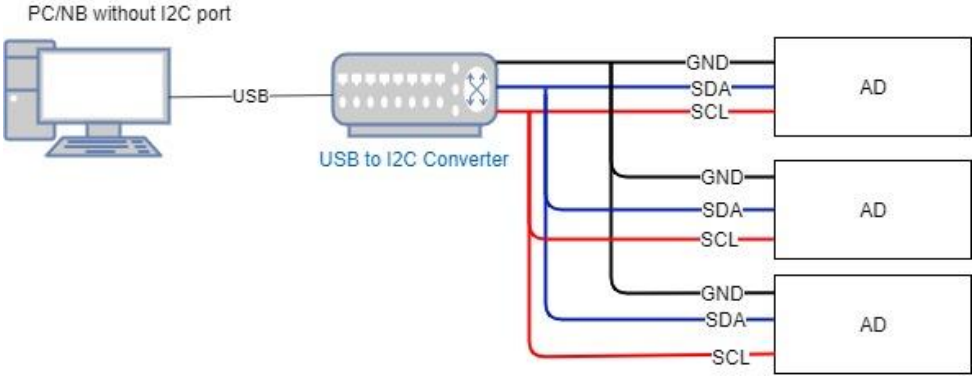
		(0X01~0XFA)		A0 06 00 04 00 A0 D1 02	Default 0XA0)
	0X0005	SET PMBUS ID(0X01~0X7F)	1	A0 06 00 05 00 50 80 86 A0 06 00 05 00 50 80 86	0X01~0X7F(Default 0X50)
	0X0008	SET POWER SOFTSTART	2	A0 06 00 08 00 19 D0 B3 A0 06 00 08 00 19 D0 B3	0X0000~0X0 1F4
	0X0009	SET SV SOFTSTART	2	A0 06 00 09 00 06 C0 BB A0 06 00 09 00 06 C0 BB	0X0000~0X0 3E8
	0X000A	Vref SOFTSTART	2	A0 06 00 0A 00 24 B0 A2 A0 06 00 0A 00 24 B0 A2	0X0000~0X0 3E8
	0X000B	SET SI SOFTSTART	2	A0 06 00 0B 00 06 61 7B A0 06 00 0B 00 06 61 7B	0X0000~0X2 710
	0x000C	SET CONTROL MODE	1	A0 06 00 0C 00 01 91 78 A0 06 00 0C 00 01 91 78	0:LOCAL MODE 1:REMOTE
	0X000D	SET POWER ON RULE	1	A0 06 00 0D 00 01 C0 B8 A0 06 00 0D 00 01 C0 B8	0X00~0X02

2. AD PMBUS

2-1. Overview

PMBus is a cost effective, two-wire interface that is an extension of the SMBus standard, which is built from the I2C protocol. Similar to SMBus, PMBus requires a minimum of two wires for communication, including the clock signal, SMBCLK, and data signal, SMBDAT.

2-2. Wiring / connection of communication system



2-3. PMBUS Addressing

Device	Slave Address	Address Bits (MSB to LSB)							
AD	0x50	1	0	1	0	0	0	0	R/W

2-4. PMBUS Clock Speed

AD supports I^2C clock speed up to 100 KHz. Faster speed can be used if signal rise time for SDAand SCL meet I^2C specification.

2-5. PMBus Data Format

The module receives and reports data in LINEAR format.

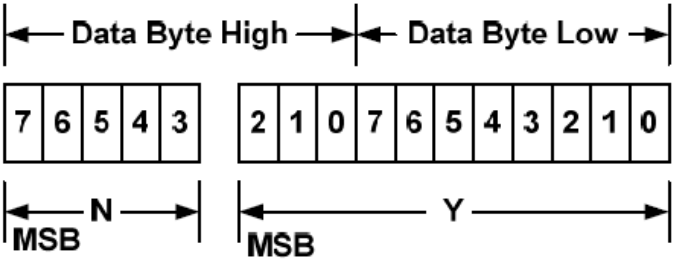
The Linear Data Format is typically used for commanding and reporting the parameters such as (but not only) the following:

- Output Current,
- Input Voltage,
- Output Voltage,
- Operating Temperatures,

The Linear Data Format is a two bytes value with:

- An 11 bit, two's complement mantissa and
- A 5 bit, two's complement exponent (scaling factor).

The format of the two data bytes is illustrated below:



The relation between Y, N and the "real world" value is:

$X = Y \cdot 2N$

Where, as described above:

X is the "real world" value;

Y is an 11 bit, two's complement integer; and N is a 5 bit, two's complement integer.

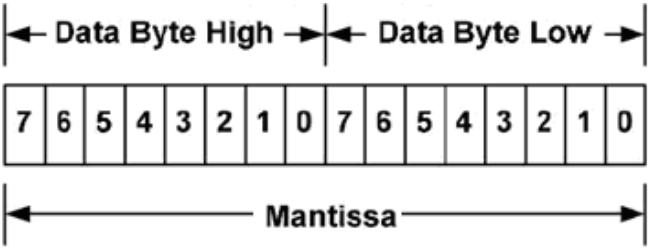
Devices that use the Linear format must accept and be able to process any value of N.

The Exponent of the data words is fixed at a reasonable value for the command.

The detail exponent and resolution of main parameter is summarized as below:

Exponent Resolution

For commands that report the output voltage, the module supports the linear data format consisting of a two bytes value with a 16-bit, unsigned mantissa, and a fixed exponent of -12. The format of the two data bytes as shown below:



The equation can be written as:

Vout = Mantissa x 2^{-12}

2-6. Supported PMBus Commands

Cmd Code	Command Name	Type	# bytes	Default	Comments
0x01	OPERATION	R/W-E	1	0x00	0x80: Turn ON, 0x00: Turn OFF
0x10	WRITE_ PROTECT	R/W-E	1	0x80	Write protected at power up by default 0x80: Disable all writes except WRITE_PROTECT 0x00: Enable writes to all commands **Needs to be 0x00 to enable write commands**
0x16	RESTORE_USE	W-E	1		Reset to Default

	R_ALL				
0x20	VOUT_MODE	RO	1		Use linear format mode, may vary from different model, N=-8 (1/256v), used by all commands related to output voltage
0x21	VOUT_COMMAND	R/W-E	2		linear format, 0x6400 for 100v model, based on VOUT_MODE exponent
0x78	STATUS_BYTE	RO	1		Summary of most critical faults
0x79	STATUS_ WORD	RO	2		Summary of unit's fault condition
0x88	READ_VIN	RO	2		linear format
0x8B	READ_VOUT	RO	2		linear format
0X8C	READ_IOUT	RO	2		linear format
0X8D	READ_TEMPERATURE_1	RO	2		linear format, °C
0X8E	READ_TEMPERATURE_2	RO	2		linear format, °C
0X8F	READ_TEMPERATURE_3	RO	2		linear format, °C
0X90	READ_FAN_SPEED_1	RO	2		linear format, RPM
0X98	PMBUS_ REVISION	RO	1	0x00	Table 25. PMBus Revision Data Byte Contents Bits [7:5] / Part I Revision / Bits [3:0] / Part II Revision 0000 / 1.0 / 0000 / 1.0 0001 / 1.1 / 0001 / 1.1 0002 / 1.2 / 0002 / 1.2
0X99	MFR_ID	RO	16		Write protected
0X9A	MFR_MODEL	RO	16		Write protected
0X9B	MFR_REVISION	RO	16		Write protected
0X9C	MFR_	RO	16		Write protected

	LOCATION				
0X9D	MFR_DATE	RO	16		Write protected
0X9E	MFR_SERIAL	RO	16		Write protected
0XD0	Operation Mode	R/W-E	1		Write protected 0:local mode 1:remote mode
0XD1	SLAVE ID	R/W-E	1		Write protected Device ID for PMBUS
0XD2	Power softstart	R/W-E	2	50	Write protected 50~1000 ms
0XD3	SV softstart	R/W-E	2	6	Write protected 10~1000 ms
0XD4	Vref softstart	R/W-E	2	36	Write protected 10~1000 ms
0XD5	SI softstart	R/W-E	2	60	Write protected 10~1000 ms
0XD6	Power on rule	R/W-E	1	0	Write protected 0~2
0XD7	Current setting	R/W-E	2		Write protected

STATUS_BYTE (0x78)

This command returns an abbreviated status for fast reads.

Bit #	Status Bit Name	Description
7	Not Used	
6	Not Used	
5	VOUT_OV_FAULT	An output overvoltage fault has occurred
4	Not Used	
3	Not Used	
2	TEMPERATURE	A temperature fault or warning has occurred
1	CML	A communications, memory or logic fault has occurred
0	NONE_OF_THE_ABOVE	A fault or warning not listed in bits [7:1] has occurred

STATUS_WORD (0x79)

Command returns the general status information used to indicate

subsequent status to be read for moredetail.

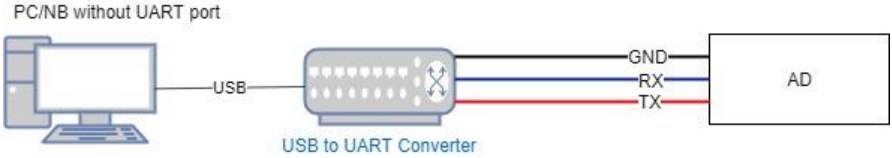
Bit #	Status Bit Name	Description
15	VOUT	An output voltage fault or warning has occurred
14	IOUT/POUT	An output current or output power fault or warning has occurred
13	INPUT	An input voltage, input current, or input power fault or warning has occurred
12	MFR_SPECIFIC	A manufacturer specific fault or warning has occurred
11	POWER_GOOD#	The POWER_GOOD signal, if present, is negated[1]
10	FANS	A fan or airflow fault or warning has occurred
9	OTHER	A bit in STATUS_OTHER is set
8	UNKNOWN	A fault type not given in bits [15:1] of the STATUS_WORD has been detected
7	BUSY	A fault was declared because the device was busy and unable to respond.
6	OFF	This bit is asserted if the unit is not providing power to the output, regardlessof the reason, including simply not being enabled.
5	VOUT_OV_FAULT	An output overvoltage fault has occurred
4	IOUT_OC_FAULT	An output overcurrent fault has occurred
3	VIN_UV_FAULT	An input under voltage fault has occurred
2	TEMPERATURE	A temperature fault or warning has occurred
1	CML	A communications, memory or logic fault has occurred
0	NONE_OF_THE_ABOVE	A fault or warning not listed in bits [7:1] has occurred

3. COTEK STANDARD PROTOCOL

3-1. Overview

Compatible with versions after 2219.5 (INFO3?)

3-2. Wiring / connection of communication system



3-3. COTEK Standard Physical Communication

Physical Interface	Comments
RS485 Half-duplex (Standard with different Setting)	Default baud rate: 19200 baud, even parity, 1 stop bit
UART (TTL level, Optional)	Default baud rate: 19200 baud, even parity, 1 stop bit
RS232 (Optional)	Default baud rate: 19200 baud, even parity, 1 stop bit

3-4. COTEK Standard Protocol

FOR USER ITEM	ELEMENT	Reference
SV xx.xx	Setting local or remote mode output voltage	
SI xxx.xx	Setting local or remote mode output current	
POWER x	x = 0: force to remote control & setting power Off	Ref.1
	x = 1: force to remote control & setting power On	
REMS	0: operation in Local mode	Ref.2
	1: operation in Remote mode	
	2: operation in charger mode	
	3: operation in programmable mode	
REMS?	response REMS setting	
MODID?	READ Modbus & Cotek STD ID	
MODID xxx	SET Modbus & Cotek STD ID	
PMID?	READ PMBUS ID	
PMID xxx	SET PMBUS ID	
RV?	Real time output voltage	
RI?	Real time output current	
RP?	Response output power	
SI?	Output current command (no matter operation in local / remote	
SV?	Output voltage command(no matter operation in local / remote	
NTC4?	x = 1: response secondary NTC1 value	
NTC5?	x = 2: response secondary NTC2 value	
NTC1?	x = 3: response Primary NTC1 value	
NTC2?	x = 4: response Primary NTC2 value	

NTC3?	x = 5: response Primary NTC3 value	
RAMB?	Real time environment temperature	
ERR1?	Response error code Primary side error code	Ref.3
ERR2?	Response error code secondary error code	Ref.4
STUS?	Status of Power	Ref.5
RRATE?	Real Time Power Rating	
SFT?	power softstart ask	
SFT	power softstart 50~1000 ms	
VSLE?	sv softstart	
VSLE	sv softstart 10~1000 ms	
VRSL?	vref softstart	
VRSL	vref softstart 10~1000 ms	
ISLE?	si softstart	
ISLE	si softstart 10~1000 ms	
FOR USER ITEM	**MACHINE PARAMETER**	
RATE?	Response Voltage / current rating	
VRATE?	Response rated voltage	
IRATE?	Response rated current	
INFO 0?	Manufacture company information	
INFO 1?	Model name information	
INFO 2?	Output voltage rate information	
INFO 3?	Revision information (20xx.x)	
INFO 4?	Date of MFG	
INFO 5?	Serial number	
INFO 6?	Country of MFG	
INFO 7?	Part Number	

ID-NAME xxxx	(16 word) Setting ID name (by user define)	
ID-NAME?	(16 word) Read ID name (by user define)	
RFSP1?	Response fan1 speed	
RFSP2?	Response fan2 speed	
SAVE	Write parameter to eeprom	
CONTYPE x	x = 0 : Setting connect type is series	Reserved or Coming Soon!
	x = 1 : Setting connect type is parallel	
CONTYPE?	Response connect type	
ID x	x = 0 : Setting master	
	x = 1 ~ 7 : Setting slave 1 ~ 7	
ID?	Response master or slave 1~7	
*RST	UER SETTING RESET TO DEFAULT	
POR?	Read POWER ON RULE 0~2	Ref.6
POR	Set POWER ON RULE	
RESSN?	Read all Devices Serial Number	
SETIDS	Set ID with Serial Number	

FOR USER ITEM	PFC	
VAC?	read primary AC input voltage	
VINT?	AC in type 0: input is AC 1: input is DC	

Ref.1	**POWER x**	
	0	setting power "off" and force to remote control
	1	setting power "on" and force to remote control

Ref.2	**REMS x**	
	0	Setting operation in Local mode
	1	Setting operation in Remote mode
	2	Setting operation in Charger mode (Reserved or coming soon!)
	3	Setting operation in Programmable mode (Reserved or coming soon!)

Ref.3	**ERR1?**			
	bit	**Decimal**	**ERROR**	**LED Status**
	0	1	Communication Fail	Power_Fail
	1	2	Primary side PFC stage build bus time out(P_PFC_TOUT)	Power_Fail
	2	4	Primary side Rectifier stage build bus time out(P_REC_TOUT)	Power_Fail
	3	8	Primary side Bus Over Voltage Protect(P_BUS_OVP)	Power_Fail
	4	16	Primary side Grid Over	AC_Fail

			Load Protect(P_GOLP)	
	5	32	Primary side Grid Over Current Protect(P_GOCP)	AC_Fail
	6	64	Primary side Grid Under Voltage Protect(P_GUVP)	AC_Fail
	7	128	Primary side Grid Over Voltage Protect(P_GOVP)	AC_Fail
	8	256	Hardware fault (P_Hw)	AC_Fail
	9	512	PFC OCP(P_OC)	AC_Fail

	ERR2?			
	bit	**Decimal**	**ERROR Content**	**LED State**
Ref.4	0	1	Primary side NTC1 over temperature protection (P_OTP_NTC1)	OTP/UTP FAIL
	1	2	Primary side NTC2 over temperature protection (P_OTP_NTC2)	OTP/UTP FAIL
	2	4	Primary side NTC3 over temperature protection (P_OTP_NTC3)	OTP/UTP FAIL
	3	8	NTC4 Over Temperature protection (D_OTP_NTC4)	OTP/UTP FAIL
	4	16	NTC5 Over Temperature protection (D_OTP_NTC5)	OTP/UTP FAIL
	5	32	Ambient Over Temperature protection (AMB_OTP)	OTP/UTP FAIL

	6	64	Ambient Under Temperature protection (AMB_UTP)	OTP/UTP FAIL
	7	128	Output Power Over load protection (D_OLP)	OLP FAIL
	8	256	Over Load protection (D_OPP)	OLP FAIL
	9	512	Over voltage protection (by Ti internal compare) (D_OVP_S)	OVP FAIL
	10	1024	Vafter	
	11	2048	Vrmt	
	12	4096	Hardware fail (D_Hw)	OVP FAIL
	13	8192	FAN_FAIL (F_Err)	FAN WARNING
	14	16384	EEPROM Fail	

Ref.5	**STUS**	Status of output
	0	power off
	1	power on

	0 **OR** **(Parallel Connection)**	REMS =1 , "1" = Enable , "0" = Disable , if EN+&- is 1=ON				
		Time sequence	1	2	3	4
		CMD (POWER)	0	1	0	1
		EN+&-	0	0	1	1
		Output status	OFF	**ON**	**ON**	**ON**

<table>
<tr><td rowspan="8">REF6</td><td></td><td colspan="5">When REMS =0 , CMD will not function, no matter if Power 0/1</td></tr>
<tr><td rowspan="5">1
AND
(Series Connection)</td><td>Time sequence</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>CMD (POWER)</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>EN+&-</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Output status</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td colspan="5">REMS =1 , "1" = Enable , "0" = Disable , if EN+&- is 1=ON</td></tr>
<tr><td rowspan="6">2</td><td colspan="5">REMS =1 , "1" = Enable , "0" = Disable , if EN+&- is 1=ON</td></tr>
<tr><td>Time sequence</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>CMD (POWER)</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>EN+&-(don’t care)</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Output status</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td colspan="5">When REMS =0 , CMD will not function, no matter if Power 0/1</td></tr>
</table>

3-5. COTEK STANDARD PROTOCOL WITH ID

ID address format

Address	Command	Termination code
N N N	Refer to COTEK Standard Protocol	CR LF
3 BYTE	N BYTE	2BYTE

Address:

1. Address from 001~250
2. Address 000 Global broadcast, the device will not respond after receiving, ,but will execute according to the command

Communication Protocol:

1. Per COTEK Standard Protocol

EXAMPLE

PC request AD		
160	RV?	\r\n
AD Response to PC		
160	12.00	\r\n