DAE Instrument Corp.

DEM Meter
Basic Communication
Modbus Reference

General Information

The **Basic Communication** type of **DEM** series of energy meters (to be known simply as DEM henceforth) has an RS485 communications port built into the meter for use with communicating with a PC computer. The primary use of this type of meter is for automatic meter reading from a remote PC.

The DEM uses the Modbus/RTU protocol. The communications interface is RS485. The baud rate is selectable from 1200 to 9600 bauds using Modbus. The data format is 8 bits, no parity, 1 stop bit. The address of the DEM can be read from the LED display during its power up sequence.

All numerical data returned by the DEM is in integer form.

Reading is be done using function code 3, while writing is done through function code 16. Some parameters need to be written to using a special sequence of commands. All numerical values are in decimal unless otherwise specified or appended with an 'h' or prepended with a '0x', in which case the data is in hexadecimal.

When a command is in error, the DEM will not respond; the host PC doing the reading will time out. The DEM should be given at least 100 milliseconds to respond and should have a maximum latency of 400 milliseconds, this is the guaranteed time in which the DEM should respond, if this time is exceeded, the host PC should issue a time out.

A command is in error in any of these conditions:

1. The function code is not supported.

2. The data is malformed or out of range.

3. The CRC is wrong.

Register Tables

Function Code	Address	Size	Modscan	Description	Range / Unit	Unit
3, 16	0	2 words	03:0001	Total Energy	0~9,999,999	0.01 kWh
3, special*	48	1 word	n.a.	Device Address	1~254	---
3, special*	55	1 word	n.a.	Baud Rate	0 = 9600, 1 = 4800, 2 = 2400, 3 = 1200	---

Notes:

* Modscan directly supports function code 3 for reading, for writing with function code 16, please see Notes on Modscan

* n.a. = not applicable

* Both the **Device Address** and **Baud Rate** are not standard Modbus commands, they both need a special sequence of commands in order to write to. Please see their respective write commands for specifics.

Message Frames

Read Total Energy (   )

Format

Input

- DEM Address = 1~254

Query

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1~254	3	0	0	0	2	ZL	ZH

Reply

DEM Address	Function Code	Byte Count	Read Word 1		Read Word 2		CRC	
			high	low	high	low	low	high
1~254	3	4	EP-1	EP-2	EP-3	EP-4	ZL	ZH

Output

- Total Energy = (EP-3 x 16,777,216 + EP-4 x 65,536 + EP-1 x 256 + EP-2) x 0.01 kWh

Example

Input

- DEM Address = 1

Query

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1	3	0	0	0	2	196	11

Reply

DEM Address	Function Code	Byte Count	Read Word 1		Read Word 2		CRC	
			high	low	high	low	low	high
1	3	4	81	173	0	39	59	52

Output

- Total Energy = (0 x 16,777,216 + 39 x 65,536 + 81 x 256 + 173) x 0.01 kWh

Write Total Energy (　　　　)

Format

Input

- DEM Address = 1~254
- Total Energy = 0.00~99,999.99 kWh

Query

- EP-3 = (Total Energy / 0.01 kWh) div 16,777,216
- EP-4 = ((Total Energy / 0.01 kWh) mod 16,777,216) div 65,536
- EP-1 = ((Total Energy / 0.01 kWh) mod 65,536) div 256
- EP-2 = (Total Energy / 0.01 kWh) mod 256

DEM Address	Function Code	Register Address		Number of Registers		Byte Count	Write Data		Write Data		CRC	
		high	low	high	low		high	low	high	low	low	high
1~254	16	0	0	0	2	4	EP-1	EP-2	EP-3	EP-4	ZL	ZH

Reply

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1~254	16	0	0	0	2	ZL	ZH

Output

- none

Example

Input

- DEM Address = 1
- Total Energy = 37196.23 kWh

Query

- EP-3 = (37196.23 kWh / 0.01 kWh) div 16,777,216 = 0
- EP-4 = ((37196.23 kWh / 0.01 kWh) mod 16,777,216) div 65,536 = 56
- EP-1 = ((37196.23 kWh / 0.01 kWh) mod 65,536) div 256 = 193
- EP-2 = (37196.23 kWh / 0.01 kWh) mod 256 = 199

DEM Address	Function Code	Register Address		Number of Registers		Byte Count	Write Data		Write Data		CRC	
		high	low	high	low		EP-1	EP-2	EP-3	EP-4	low	high
1	16	0	0	0	2	4	193	199	0	56	126	124

Reply

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1	16	0	0	0	2	65	200

Output

- none

Read Device Address

This command reads the DEM Modbus slave address. Note that in order to this parameter, you should already know the DEM address in the first place, so this command seems redundant. This command is useful for when you don't already know the existing address of the DEM and wishes to query to the DEM by using the broadcast address to compel the DEM to reply with its actual device address regardless of its current device address. But note that this will only work properly when there is a one to one connection between the host PC and the DEM, there must not be any other DEM on the same RS485 bus network; otherwise the other slave devices may also respond to the broadcasted command and the replies from the various devices will collide.

The device address may also be read from the LED display during a power on reset, but it is when it is not allowed to de-power the meters that this command may come into use.

Format

Input

- DEM Address = 1~254

Query

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1~254	3	0	5	0	1	ZL	ZH

Reply

DEM Address	Function Code	Byte Count	Read Word		CRC	
			high	low	low	high
1~254	3	2	GRP	ADR	ZL	ZH

Output

- Group (GRP) = 1~255 (reserved)
- Address (ADR) = 1~254

Example

Input

- DEM Address = 255 (broadcast)

Query

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
255	3	0	5	0	1	129	213

Reply

DEM Address	Function Code	Byte Count	Read Word		CRC	
			high	low (ADR)	low	high
255	3	2	1	78	16	52

Output

- Address (ADR) = 78

Write Device Address

Writing the **Device Address** is a three step process. First, the writing process is enabled. Second, the actual device address is written. Third, the writing process is affirmed and disabled. These three steps must be performed in an uninterrupted sequence without any intervening commands or it will not work. Some software such as Modscan will not be able to execute this command because they poll continuously and will insert read commands in between.

Note that after this command is executed, the DEM should be accessed from the new address. It will no longer respond to the old address unless the new address is the same as the old address.

Note also that the register address is 48 which is the same as that for the **Write Grace Period**, this is not a typo. The **Write Device Address** command will not conflict with the **Write Grace Period** in writing to the same location precisely because of the additional enable and affirm/disable steps.

Format

Input

- DEM Address = 1~254
- New Device Address (NDA) = 1~254

Query / Reply (Enable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1~254	5	0	48	0	0	ZL	ZH

Query (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		Byte Count	Write Data		CRC	
		high	low	high	low		high	low	low	high
1~254	16	0	48	0	1	2	NDA	0	ZL	ZH

Reply (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1~254	16	0	48	0	1	ZL	ZH

Query / Reply (Affirm Then Disable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1~254	5	0	48	255	0	ZL	ZH

Output

- none

Example

Input

- DEM Address = 1
- New Device Address (NDA) = 95

Query / Reply (Enable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1	5	0	48	0	0	205	197

Query (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		Byte Count	Write Data		CRC	
		high	low	high	low		high (NDA)	low	low	high
1	16	0	48	0	1	2	95	0	154	80

Reply (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1	16	0	48	0	1	1	198

Query / Reply (Affirm Then Disable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1	5	0	48	255	0	140	53

Output

- none

Write Baud Rate

Writing the **Baud Rate** is a three step process. First, the writing process is enabled. Second, the actual baud rate is written. Third, the writing process is affirm and disabled. These three steps must be performed in an uninterrupted sequence without any intervening commands or it will not work. Some software such as Modscan will not be able to execute this command because they poll continuously and will insert read commands in between.

Note that after this command is executed, the DEM should be accessed with the new baud rate. It will no longer respond using the old baud rate, unless of course the new and the old baud rates are the same.

Format

Input

- DEM Address = 1~254
- Baud Rate = 9600/4800/2400/1200
- Baud Rate Index (BRI) = {9600 => 0, 4800 => 1, 2400 => 2, 1200 => 3}

Query / Reply (Enable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1~254	5	0	55	0	0	ZL	ZH

Query (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		Byte Count	Write Data		CRC	
		high	low	high	low		high	low	low	high
1~254	16	0	55	0	1	2	BRI	0	ZL	ZH

Reply (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1~254	16	0	55	0	1	ZL	ZH

Query / Reply (Affirm Then Disable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1~254	5	0	55	255	0	ZL	ZH

Output

- none

Example

- DEM Address = 1
- Baud Rate = 1200
- Baud Rate Index (BRI) = 3

Query / Reply (Enable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1	5	0	55	0	0	124	4

Query (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		Byte Count	Write Data		CRC	
		high	low	high	low		high (BRI)	low	low	high
1	16	0	55	0	1	2	3	0	162	231

Reply (Device Address)

DEM Address	Function Code	Register Address		Number of Registers		CRC	
		high	low	high	low	low	high
1	16	0	55	0	1	176	7

Query / Reply (Affirm Then Disable Writing)

DEM Address	Function Code	Register Address		Write Data		CRC	
		high	low	high	low	low	high
1	5	0	55	255	0	61	244

Output

- none

CRC Computation

The DEM conforms to the Modbus/RTU protocol and thus uses CRC16 for its error checking. The computed CRC is appended to the end of the message with the LSB first and then the MSB. Below is the pseudo code for computing the CRC as used by the standard Modbus/RTU. The pseudo code is written in the Ruby language and can be directly used as such.

Definition

```ruby
def get_crc (*byte_array)
    sum = 0xFFFF
    byte_array.each do |byte|
      sum ^= byte
      8.times do
        carry = (1 == sum & 1)
        sum = 0x7FFF & (sum >> 1)
        sum ^= 0xA001 if carry
    end
  end
  return [sum & 0xFF, sum >> 8]
end
```

Usage

```ruby
>> crc = get_crc(1,3,0,141,0,5)
=> [21, 226]          <---- [CRC low byte, CRC high byte]
```

Notes on Modscan

This is not a manual of Modscan, but only a short note describing its manual commands capability.

Most users are familiar with Modscan's ability to read and continuously poll a designated device using Modbus commands 1 to 4. But in addition, Modscan also has the ability to issue other commands as well.

For the DEM, function code 5 and 16 needs to be issued as well. To issue them, first make sure that the connection has already been established and running then go to the menu and run the dialog box "User Defined Command String" from [Setup->Extended->User Msg] as shown in the screen captures below:
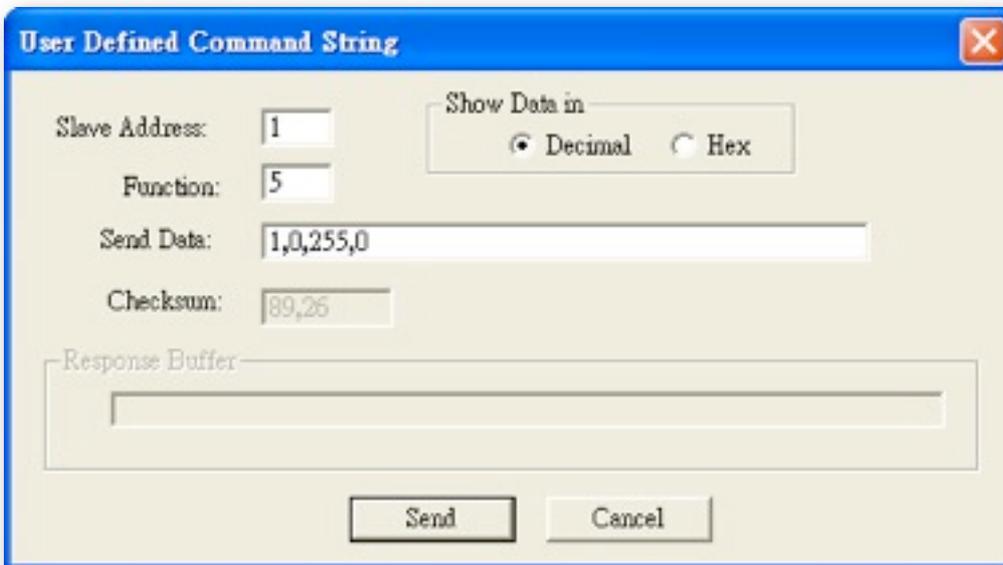
Revision History

Revision	Date	Section	Change
1.4e	2013/6/25	Read Device Address Example pg 5	Changed DEM address from 1 to 255.