Universal Measuring Device

DNP3.0 User's Manual

(Distributed Network Protocol)

The information contained in this document is believed to be accurate at the time of publication, however, Zilug assumes no responsibility for any errors which may appear here and reserves the right to make changes without notice. Please ask the local representative for latest product specifications before ordering.

Please read this manual carefully before installation, operation and maintenance of the ZMP8800+ series meter. The following symbols in this manual are used to provide warning of danger or risk during the installation and operation of the meters.

Electric Shock Symbol: Carries information about procedures which must be followed to reduce the risk of electric shock and danger to personal health.

Safety Alert Symbol: Carries information about circumstances which if not considered may result in injury or death.

Prior to maintenance and repair, the equipment must be de-energized and grounded. All maintenance work must be performed by qualified, competent accredited professionals who have received formal training and have experience with high voltage and current devices. Zilug shall not be responsible or liable for any damages or injuries caused by improper meter installation and/or operation.

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1. Overview

Structure Model

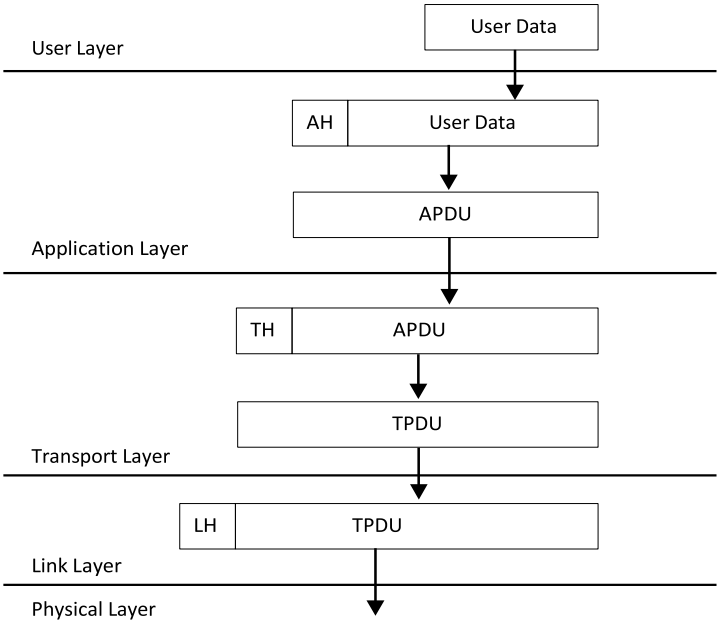


Figure 1: Each Layer of the relationship between the data unit

This document describes the DNP V3.00 communications protocol employed by ZMP8800+ Series Power Meter. This protocol can be selected for the serial communication port which can consist of RS485 and network on TCP/IP. It is assumed that the reader is familiar with the DNP V3.00 protocol and serial and network communications in general. This DNP3 is a reduced set of the Distributed Network Protocol Version 3.00, and it gives enough functionality to get critical measurement from the ZMP8800+ Series Power Meter. The DNP3 supports class0 object only. No event generation is supported .This DNP3 is always act as a slave device.

2. Physical Layer

The physical layer supported by DNP3 must transmit or receive data in serial mode or by TCP/IP. The data unit transferred will be 8 bits in length.

The port in serial mode must be asynchronous half-duplex RS-485.

The data format supporting 8 bit data, 1 start bit, 1 stop bit, no parity.

The baud rate can be set to any supported value in serial mode.

3. Data Link Layer

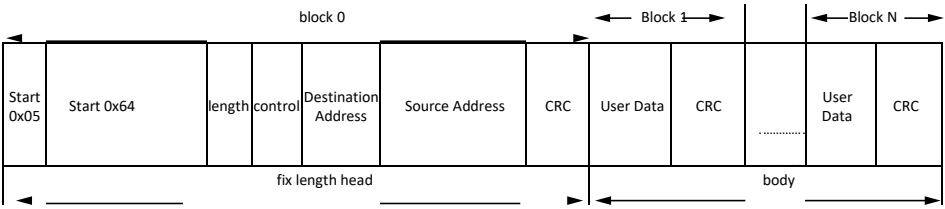
The ZMP8800+ Series Power Meter always acts as a Slave device .The device address can be set from 0 to 65534. The link layer comply with the stand FT3 frame format. The fixed length user data field is behind the fixed head. The link layer supports Reset Link, Reset User and Read Link Status. In order to ensure the stability of communication, it is recommended that you should better reset the link and reset the user before communicate with the ZMP8800+ Series Power Meter.

The function code supported as follows:

Reset Link (0X00), Reset User (0X01), Link Status (0X09).

FT3 Frame Format：

An FT3 frame is defined as a fixed length header block followed by optional data blocks. Each block has a 16-bit CRC appended to it. The header fields consist of 2 start octets, 1 octet length, 1 octet control, a destination address, a source address and a 16-bit CRC appended to it.



4. Transport Layer

The pseudo-transport layer segments application layer messages into multiple data link frames. For each frame, it inserts a single byte function code that indicates if the data link frame is the first frame of the message, the last frame of a message, or both (for single frame messages). The function code also includes a rolling frame sequence number which increments with each frame and allows the receiving transport layer to detect dropped frames.

5. Application Layer

The ZMP8800+ Series Power Meter implementation supports a subset of the objects and application layer function codes. The ZMP8800+ Series Power Meter will neither accept nor send multiple fragment application layer messages. The ZMP8800+ Series Power Meter's fragment size is fixed at 2k bytes.

Each application layer fragment begins with an application layer header followed by one object header or object header and data combinations. The application layer header contains an application control code and an application function code. The application control code contains an indication if the fragment is one of a multi-fragment message, contains an indication if an application layer confirmation is requested for the fragment, contains an indication if the fragment was unsolicited, and contains a rolling application layer sequence number. The application layer sequence number allows the receiving application layer to detect fragments that are out of sequence, or dropped fragments.

In the ZMP8800+ Series Power Meter, the Dnp3 supports the **Read** function, the **Direct Operate** function and the **Direct Operate Unconfirmed** function.

- **The Read function (0X01)**

  The read function is the basic code used for requesting data objects from an Outstation. Here this function is used for reading the measurement data from the Power Meter. Learning more about the measurement data, please refer to the Data Address Table. In this function, the qualifier could be selected contain **0X00, 0X01, 0X06**.

  The qualifier **0X00** refers that there two bytes called Range followed by, one is the start address want to request, the second is the stop address, and this Range would be from 0 to 255.

  The qualifier **0X01** indicates that the followed Range there are four bytes, the first two is the Start Address want to be request, the last two is the Stop Address, the two bytes consist of two 8-bit binary number, the low byte first, that the address Range would be from 0 to 65535.

The qualifier **0X06** means read all data from the object with its respective variations which would be list in the queue.

More about the message please see Message Layout, the detailed examples.

- **The Direct Operate function (0X05)**

The function is selects and sets or operates the specified outputs, the status of the control points will be responded. Here this function is intended for resetting the energy counters and the demand counters. These actions are mapped to Objects 12 Variations 1, point 1 and point 2, there are seen as a control relay. The relay must be operated On in 0 millisecond , and released Off in 1 millisecond .The qualifiers 0X17 and 0X28 are supported for writing the energy reset and demand reset. The examples will be shown in Message Layout.

- **The Direct Operate function (0X06)**

The function is selects and sets or operates the specified outputs but do not send a response to the request. Here this function is intended for switching the DNP3 protocol to Modbus protocol using the same communication port. This switching is seen as a control relay mapped into Object 12 Variation 1 and point 0 in the ZMP8800+ series Power Meter. The relay must be operated with qualifier 0X17, code 3, count 0, with 0 millisecond On and 1millisecond Off. After sending the request the current communication port will be changed to the Modbus protocol only. The example will be shown in the Message Layout.

6. Error Reply

When meet the can't recognize request , the unknown Object ,the unknown variation, the point unsupported, the unsupported function code , the unsupported qualifier, the unsupported range, the buffer overflow or any other exception error, an error reply will be generate from the ZMP8800+ series Power Meter to send to the requester station. The Internal Indicator field will reflect the type of error.

7. Profile

1) Device Function

Slave

2) Maximum Data Link Frame Size

Transmitted 292

Received 292

3) Maximum Application Fragment Size

Transmitted 2048

Received 2048

4) Transport Multi-Fragment

Supported

5) Data Link Layer Confirmation

Supported

6) Application Layer Confirmation

Supported

7) Application Layer Function

Request

Supported 0X01, Read

Qualifier, 0X00, 0X01, 0X06.

Response

Supported 129, Read Response

Qualifier, 0X00

Supported Error Internal Indicator Response

8) DATA OBJECT LIBRARY

a) ANALOG INPUT OBJECT 30

Variation: 4, 16-BIT WITHOUT FLAG

Variation: 5, 32-BIT FLOAT WITH FLAG

b) COUNTER OBJECT DEFINITIONS 20

Variation: 5, 32-BIT WITHOUT FLAG

c) CONTROL RELAY OUTPUT BLOCK Object 12

Variation: 1, static digital output control

8. Data Address Table

Point Descriptions

The following tables describe the DNP V3.0 data objects provided by the ZMP8800+ series Power Meter. The object, variation, and point numbers are specified for each parameter, as well as the application layer function codes which may be used to operate on the parameter.

Description:

Object		Variation	32-BIT FLOAT WITH FLAG
30		5	
Object		Variation	16-BIT WITHOUT FLAG
30		4	
Object		Variation	32-BIT FLOAT WITH FLAG
60		1	
Object		Variation	32-BIT WITHOUT FLAG
20		5	
Object		Variation	CONTROL RELAY OUTPUT BLOCK
12		1	

Address Table:

Object	Point	Variation	Name	Format	Range	Multiplier	Units	Description
30	0	1	Frequency (F)	FLOAT		1.0	Hz	Frequency
30	1	1	Phase Voltage V1	FLOAT		1.0	V	Voltage A
30	2	1	Phase Voltage V2	FLOAT		1.0	V	Voltage B
30	3	1	Phase Voltage V3	FLOAT		1.0	V	Voltage C
30	4	1	Average Phase Voltage Vlnavg.	FLOAT		1.0	V	Phrase Voltage Avg.
30	5	1	Line Voltage V12	FLOAT		1.0	V	Voltage A-B
30	6	1	Line Voltage V23	FLOAT		1.0	V	Voltage B-C
30	7	1	Line Voltage V31	FLOAT		1.0	V	Voltage C-A
30	8	1	Average Line Voltage Vllavg.	FLOAT		1.0	V	Line Voltage Avg.
30	9	1	Neutral Line Voltage Vn	FLOAT		1.0	V	Neutral Voltage
30	10	1	Current I1	FLOAT		1.0	A	Current A
30	11	1	Current I2	FLOAT		1.0	A	Current B
30	12	1	Current I3	FLOAT		1.0	A	Current C
30	13	1	Average Current Iavg	FLOAT		1.0	A	Current Average
30	14	1	Neutral Line Current In (calculated)	FLOAT		1.0	A	Neutral Current Calculated
30	15	1	Neutral Line Current In (Measured)	FLOAT		1.0	A	Neutral Current Measured
30	16	1	Phase Power P1	FLOAT		1.0	W	Pa
30	17	1	Phase Power P2	FLOAT		1.0	W	Pb
30	18	1	Phase Power P3	FLOAT		1.0	W	Pc
30	19	1	System Power Ptot	FLOAT		1.0	W	Total Active Power
30	20	1	Phase Reactive Power Q1	FLOAT		1.0	Var	Qa
30	21	1	Phase Reactive Power Q2	FLOAT		1.0	Var	Qb
30	22	1	Phase Reactive Power Q3	FLOAT		1.0	Var	Qc
30	23	1	System Reactive Power Qtot	FLOAT		1.0	Var	Total Reactive Power
30	24	1	Phase Apparent Power S1	FLOAT		1.0	VA	Sa
30	25	1	Phase Apparent Power S2	FLOAT		1.0	VA	Sb
30	26	1	Phase Apparent Power S3	FLOAT		1.0	VA	Sc
30	27	1	System Apparent Power Stot	FLOAT		1.0	VA	Total Apparent Power
30	28	1	Phase Power Factor PF1	FLOAT		1.0	None	PFa
30	29	1	Phase Power Factor PF2	FLOAT		1.0	None	PFb
30	30	1	Phase Power Factor PF3	FLOAT		1.0	None	PFc
30	31	1	System Power Factor PFtot	FLOAT		1.0	None	Total Power Factor
30	32	1	Voltage Unbalance Factor U_unbl	FLOAT		1.0	%	Voltage Unbalance
30	33	1	Current Unbalance Factor I_unbl	FLOAT		1.0	%	Current Unbalance
30	34	1	Current I1 - Harmonic - THD	FLOAT		1.0	%	Total Harmonic Distortion I1
30	35	1	Current I2 - Harmonic - THD	FLOAT		1.0	%	Total Harmonic Distortion I2
30	36	1	Current I3 - Harmonic - THD	FLOAT		1.0	%	Total Harmonic Distortion I3

30	37	1	Voltage V1 - Harmonic - THD	FLOAT		1.0	%	Total Harmonic Distortion V1
30	38	1	Voltage V2 - Harmonic - THD	FLOAT		1.0	%	Total Harmonic Distortion V2
30	39	1	Voltage V3 - Harmonic - THD	FLOAT		1.0	%	Total Harmonic Distortion V3

Object	Point	Variation	Name	Format	Range	Multiplier	Units	Description
20	0	5	Import Active Energy Tariff1	UNIT32	0-999999999	0.1	W hr	
20	1	5	Import Reactive Energy Tariff1	UNIT32	0-999999999	0.1	Var hr	
20	2	5	Export Active Energy Tariff1	UNIT32	0-999999999	0.1	W hr	
20	3	5	Export Reactive Energy Tariff1	UNIT32	0-999999999	0.1	Var hr	
20	4	5	Apparent Energy Tariff1	UNIT32	0-999999999	0.1	VA hr	
20	5	5	Import Active Energy Tariff2	UNIT32	0-999999999	0.1	W hr	
20	6	5	Import Reactive Energy Tariff2	UNIT32	0-999999999	0.1	Var hr	
20	7	5	Export Active Energy Tariff2	UNIT32	0-999999999	0.1	W hr	
20	8	5	Export Reactive Energy Tariff2	UNIT32	0-999999999	0.1	Var hr	
20	9	5	Apparent Energy Tariff2	UNIT32	0-999999999	0.1	VA hr	
20	10	5	Import Active Energy Tariff3	UNIT32	0-999999999	0.1	W hr	
20	11	5	Import Reactive Energy Tariff3	UNIT32	0-999999999	0.1	Var hr	
20	12	5	Export Active Energy Tariff3	UNIT32	0-999999999	0.1	W hr	
20	13	5	Export Reactive Energy Tariff3	UNIT32	0-999999999	0.1	Var hr	
20	14	5	Apparent Energy Tariff3	UNIT32	0-999999999	0.1	VA hr	
20	15	5	Import Active Energy Tariff4	UNIT32	0-999999999	0.1	W hr	
20	16	5	Import Reactive Energy Tariff4	UNIT32	0-999999999	0.1	Var hr	
20	17	5	Export Active Energy Tariff4	UNIT32	0-999999999	0.1	W hr	
20	18	5	Export Reactive Energy Tariff4	UNIT32	0-999999999	0.1	Var hr	
20	19	5	Apparent Energy Tariff4	UNIT32	0-999999999	0.1	VA hr	
20	20	5	Import Active Energy Total	UNIT32	0-999999999	0.1	W hr	
20	21	5	Import Reactive Energy Total	UNIT32	0-999999999	0.1	Var hr	
20	22	5	Export Active Energy Total	UNIT32	0-999999999	0.1	W hr	
20	23	5	Export Reactive Energy Total	UNIT32	0-999999999	0.1	Var hr	
20	24	5	Apparent Energy Total	UNIT32	0-999999999	0.1	VA hr	

Object	Point	Variation	Name	Format	Range	Multiplier	Units	Description
12	0	1	DNP3 to MODBUS	None	1	1	None	Responds to Function 0x06 (Direct Operate No Ack) Qualifier Code 0x17 Control Code 0x03 Count 0 On 0 milisecond Off 1 milisecond
12	1	1	Reset Energy	None	1	1	None	Responds to Function 0x05 Qualifier Code 0x17 or 0x28 Control Code 0x03 Count 0 On 0 milisecond Off 1 milisecond
12	2	1	Reset Statistic	None	1	1	None	Responds to Function 0x05 Qualifier Code 0x17 or 0x28 Control Code 0x03 Count 0 On 0 milisecond Off 1 milisecond

9. DNP3 Message Layout

The following table is the abbreviation and explain.

DestL	The destination address low byte
DestH	The destination address high byte
SorcL	The source address low byte
SorcH	The source address high byte
CRCL	The Cyclic Redundancy Checksum low byte
CRCH	The Cyclic Redundancy Checksum high byte
x	The transport layer data sequence number
y	The application layer data sequence number
IIN1	The first byte of Internal Indicator
IIN2	The second byte of Internal Indicator

Link Layer Frames:

Reset Link:

Request	05	64	05	C0	DestL	DestH	SorcL	SorcH	CRCL	CRCH
Response	05	64	05	00	SorcL	SorcH	DestL	DestH	CRCL	CRCH

Reset User:

Request	05	64	05	C1	DestL	DestH	SorcL	SorcH	CRCL	CRCH
Response	05	64	05	00	SorcL	SorcH	DestL	DestH	CRCL	CRCH

Link Status:

Request	05	64	05	C9	DestL	DestH	SorcL	SorcH	CRCL	CRCH
Response	05	64	05	0B	SorcL	SorcH	DestL	DestH	CRCL	CRCH

Error Reply:

Response	05	64	0A	44	DestL	DestH	SorcL	SorcH	CRCL	CRCH
	Cx	Cy	81	IIN1	IIN2	CRCL	CRCH			

Application Layer Frames:
Reset Energy:
Qualifier 0X17:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	18	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	05	0C	01	17	01	01	03	00	00	00	00	00	01	00	CRCL	CRCH
	00	00	00	CRCL	CRCH													
Response	05	64	1A	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	0C	01	17	01	01	03	00	00	00	00	00	CRCL	CRCH
	01	00	00	00	00	CRCL	CRCH											

Qualifier 0X28:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	1A	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	05	0C	01	28	01	00	01	00	03	00	00	00	00	00	CRCL	CRCH
	01	00	00	00	00	CRCL	CRCH											
Response	05	64	1C	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	0C	01	28	01	00	01	00	03	00	00	00	CRCL	CRCH
	00	00	01	00	00	00	00	CRCL	CRCH									

Reset Statistic:
Qualifier 0X17:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	18	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	05	0C	01	17	01	01	03	00	00	00	00	00	01	00	CRCL	CRCH
	00	00	00	CRCL	CRCH													
Response	05	64	1A	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	0C	01	17	01	02	03	00	00	00	00	00	CRCL	CRCH

	01	00	00	00	00	CRCL	CRCH										

Qualifier 0X28:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	1A	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	05	0C	01	28	01	00	02	00	03	00	00	00	00	00	CRCL	CRCH
	01	00	00	00	00	CRCL	CRCH											
Response	05	64	1C	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	0C	01	28	01	00	02	00	03	00	00	00	CRCL	CRCH
	00	00	01	00	00	00	00	CRCL	CRCH									

Switch to Modbus:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	18	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	06	0C	01	17	01	00	03	00	00	00	00	00	01	00	CRCL	CRCH
	00	00	00	CRCL	CRCH													

Read Data:

Qualifier 0X00 and Object 0x1E and Variation 0x04:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	0B	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	01	1E	04	00	00	07	CRCL	CRCH								
Response	05	64	1F	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	1E	04	00	00	07	Data0 L	Data0 H	Data1 L	Data1 H	Data2 L	Data2 H	CRCL	CRCH
	Data3 L	Data3 H	Data4 L	Data4 H	Data 5L	Data5 H	Data6 L	Data6 H	Data7 L	Data7 H	CRCL	CRCH						

Qualifier 0X00 and Object 0x1E and Variation 0x05:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	0D	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	01	1E	05	00	03	07	CRCL	CRCH								
Response	05	64	28	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	1E	05	00	03	07	Flag3	Data3 Byte1	Data3 Byte2	Data3 Byte3	Data3 Byte4	Flag4	CRCL	CRCH
	Data4 Byte1	Data4 Byte2	Data4 Byte3	Data4 Byte4	Flag5	Data5 Byte1	Data5 Byte2	Data5 Byte3	Data5 Byte4	Flag6	Data6 Byte1	Data6 Byte2	Data6 Byte3	Data6 Byte4	Flag7	Data7 Byte1	CRCL	CRCH
	Data7 Byte2	Data7 Byte3	Data7 Byte4	CRCL	CRCH													

Qualifier 0X01 and Object 0x1E and Variation 0x04:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	0F	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	01	1E	04	01	00	00	0A	00	CRCL	CRCH						
Response	05	64	3D	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	1E	04	01	00	00	0A	00	Data0 L	Data0 H	Data1 L	Data1 H	CRCL	CRCH
	Data2 L	Data2 H	Data3 L	Data3 H	Data4 L	Data4 H	Data5 L	Data5 H	Data6 L	Data6 H	Data7 L	Data7 H	Data8 L	Data8 H	Data9 L	Data9 H	CRCL	CRCH
	Data10 L	Data10 H	CRCL	CRCH														

Qualifier 0X00 and Object 0x14 and Variation 0x05:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	0D	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	01	14	05	00	03	07	CRCL	CRCH								
Response	05	64	23	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	1E	05	00	03	07	Data3 Byte1	Data3 Byte2	Data3 Byte3	Data3 Byte4	Data4 Byte1	Data4 Byte2	CRCL	CRCH
	Data4 Byte3	Data4 Byte4	Data5 Byte1	Data5 Byte2	Data5 Byte3	Data5 Byte4	Data6 Byte1	Data6 Byte2	Data6 Byte3	Data6 Byte4	Data7 Byte1	Data7 Byte2	Data7 Byte3	Data7 Byte4	CRCL	CRCH		

Read Class 0:

Qualifier 0X06 and Object 0x3C and Variation 0x01:

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Request	05	64	0B	C4	DestL	DestH	SorcL	SorcH	CRCL	CRCH								
	Cx	Cy	01	3C	01	06	CRCL	CRCH										
Response	05	64	D7	44	SorcL	SorcH	DestL	DestH	CRCL	CRCH								
	Cx	Cy	81	IIN1	IIN2	1E	05	00	00	27	00	Flag0	Data0 Byte1	Data0 Byte2	Data0 Byte3	Data0 Byte4	CRCL	CRCH
	Flag1	Data1 Byte1	Data1 Byte2	Data1 Byte3	Data1 Byte4	Flag2	Data2 Byte1	Data2 Byte2	Data2 Byte3	Data2 Byte4	Flag3	Data3 Byte1	Data3 Byte2	Data3 Byte3	Data3 Byte4	Flag4	CRCL	CRCH
	Data4 Byte1	Data4 Byte2	Data4 Byte3	Data4 Byte4	...	...	...	...	...	...	...	...	...	...	...	...	CRCL	CRCH
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CRCL	CRCH
	Data39 Byte3	Data39 Byte4	CRCL	CRCH														