

E-Series DNP3 Slave Device Profile



CONTROL MICROSYSTEMS

SCADA products... for the distance

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I SCADAPack E-Series DNP3 Slave Device Profile

<p>DNP3 DEVICE PROFILE DOCUMENT</p>	<p><i>February 2008 Revision 10</i></p>																																				
<p>Vendor Name: Control Microsystems Inc.</p>																																					
<p>Device Name: SCADAPack E-Series</p>																																					
<p>Highest DNP Level Supported:</p> <p>For Requests Level 2 For Responses Level 2</p>	<p>Device Function:</p> <ul style="list-style-type: none"> • Master √ Slave + Peer-to-Peer (see Note*1) 																																				
<p>Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):</p> <table border="0"> <tr> <td>Group 10, Var 1</td> <td>(Write to Binary Output)</td> </tr> <tr> <td>Group 22 Var 5</td> <td>(32-bit Ctr Chg Event w/Time)</td> </tr> <tr> <td>Group 22 Var 6</td> <td>(16-bit Ctr Chg Event w/Time)</td> </tr> <tr> <td>Group 30 Var 5</td> <td>(Short Float Analog In)</td> </tr> <tr> <td>Group 32, Var 3</td> <td>(32-bit Ana Chg Evt w/Time)</td> </tr> <tr> <td>Group 32, Var 4</td> <td>(16-bit Ana Chg Evt w/Time)</td> </tr> <tr> <td>Group 32, Var 5</td> <td>(Short Float Analog Chg Evt)</td> </tr> <tr> <td>Group 32, Var 7</td> <td>(Float Analog Chg Evt w/Time)</td> </tr> <tr> <td>Function Code 14</td> <td>(Warm Restart)</td> </tr> <tr> <td>Group 40, Var 1</td> <td>(32-bit Analog Output Status)</td> </tr> <tr> <td>Group 40, Var 3</td> <td>(Short Float Analog Output Status)</td> </tr> <tr> <td>Group 41, Var 1</td> <td>(32-bit Analog Output Block)</td> </tr> <tr> <td>Group 41,Var 3</td> <td>(Short Float Analog Output Block)</td> </tr> <tr> <td>Group 70, Var 1</td> <td>(File Identifier)</td> </tr> <tr> <td>Group 110</td> <td>(Octet String)</td> </tr> <tr> <td>Group 112,113</td> <td>(Virtual Terminal) see Note *10</td> </tr> <tr> <td>Function Code 15</td> <td>(Initialize Data for Counters)</td> </tr> <tr> <td>Qualifiers 00 & 01</td> <td>(8 & 16-bit start/stop point indexes)</td> </tr> </table>		Group 10, Var 1	(Write to Binary Output)	Group 22 Var 5	(32-bit Ctr Chg Event w/Time)	Group 22 Var 6	(16-bit Ctr Chg Event w/Time)	Group 30 Var 5	(Short Float Analog In)	Group 32, Var 3	(32-bit Ana Chg Evt w/Time)	Group 32, Var 4	(16-bit Ana Chg Evt w/Time)	Group 32, Var 5	(Short Float Analog Chg Evt)	Group 32, Var 7	(Float Analog Chg Evt w/Time)	Function Code 14	(Warm Restart)	Group 40, Var 1	(32-bit Analog Output Status)	Group 40, Var 3	(Short Float Analog Output Status)	Group 41, Var 1	(32-bit Analog Output Block)	Group 41,Var 3	(Short Float Analog Output Block)	Group 70, Var 1	(File Identifier)	Group 110	(Octet String)	Group 112,113	(Virtual Terminal) see Note *10	Function Code 15	(Initialize Data for Counters)	Qualifiers 00 & 01	(8 & 16-bit start/stop point indexes)
Group 10, Var 1	(Write to Binary Output)																																				
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Maximum Data Link Frame Size (octets):		Maximum Application Fragment Size (octets):		
Transmitted <u>249</u> Received (must be 292)		Transmitted <u>2048</u> (if >2048, must be configurable) Received <u>2048</u> (must be > 249)		
Maximum-Data-Link Re-tries:		Maximum Application Layer Re-tries:		
<ul style="list-style-type: none"> • None • Fixed at _____ <input checked="" type="checkbox"/> Configurable, range <u>0</u> to <u>255</u>		<ul style="list-style-type: none"> • None <input checked="" type="checkbox"/> Configurable, range <u>0</u> to <u>255</u> (Fixed is not permitted) see Note*2		
Requires Data Link Layer Confirmation:				
<ul style="list-style-type: none"> • Never • Always • Sometimes If 'Sometimes', when? _____ <input checked="" type="checkbox"/> Configurable If 'Configurable', how? by settings; see Note*3				
Requires Application Layer Confirmation:				
<ul style="list-style-type: none"> • Never • Always (not recommended) <input checked="" type="checkbox"/> When reporting Event Data (Slave devices only) <input checked="" type="checkbox"/> When sending multi-fragment responses (Slave devices only) • Sometimes If 'Sometimes', when? _____ • Configurable If 'Configurable', how? _____ 				
Timeouts while waiting for:				
Data Link Confirm	• None	• Fixed at ____	• Variable	<input checked="" type="checkbox"/> Configurable
Complete Appl. Fragment	• None	• Fixed at ____	• Variable	<input checked="" type="checkbox"/> Configurable
Application Confirm	• None	• Fixed at ____	• Variable	<input checked="" type="checkbox"/> Configurable
Complete Appl. Response	<input checked="" type="checkbox"/> None	• Fixed at ____	• Variable	• Configurable
Others				
Attach explanation if 'Variable' or 'Configurable' was checked for any timeout see Note*4				

<p>Sends/Executes Control Operations: (see Note*6)</p> <p>WRITE Binary Outputs SELECT/OPERATE DIRECT OPERATE DIRECT OPERATE - NO ACK</p> <p>Count > 1 Pulse On Pulse Off Latch On Latch Off</p> <p>Queue Clear</p> <p>Attach explanation if 'Sometimes' or 'Configurable' was checked for any operation. see Note*5</p>	<ul style="list-style-type: none"> • Never • Never • Never • Never <ul style="list-style-type: none"> • Never • Never • Never • Never • Never <ul style="list-style-type: none"> √ Never √ Never 	<ul style="list-style-type: none"> √ Always √ Always √ Always √ Always <ul style="list-style-type: none"> √ Always √ Always √ Always √ Always √ Always <ul style="list-style-type: none"> • Always √ Always 	<ul style="list-style-type: none"> • Sometimes • Sometimes • Sometimes • Sometimes <ul style="list-style-type: none"> • Sometimes • Sometimes • Sometimes • Sometimes • Sometimes <ul style="list-style-type: none"> • Sometimes • Sometimes 	<ul style="list-style-type: none"> • Configurable • Configurable • Configurable • Configurable <ul style="list-style-type: none"> • Configurable • Configurable • Configurable • Configurable • Configurable <ul style="list-style-type: none"> • Configurable • Configurable
<p>FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:</p>				
<p>Expects Binary Input Change Events:</p> <ul style="list-style-type: none"> • Either time-tagged or non-time-tagged for a single event • Both time-tagged and non-time-tagged for a single event • Configurable (attach explanation) 				
<p>FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</p>				
<p>Reports Binary Input Change Events when no specific variation requested: (Class Poll or Obj 2 Var 0 read)</p> <ul style="list-style-type: none"> • Never • Only time-tagged • Only non-time-tagged <p>√ Configurable to send both, one or the other (attach explanation)</p>	<p>Reports time-tagged Binary Input Change when no specific variation requested: (Class Poll or Obj 2 Var 0 read)</p> <ul style="list-style-type: none"> • Never <p>√ Binary Input Change With Time √ Binary Input Change With Relative Time √ Configurable (attach explanation)</p>			

Sends Unsolicited Responses: <ul style="list-style-type: none"> • Never √ Configurable (attach explanation) • Only certain objects • Sometimes (attach explanation) √ ENABLE/DISABLE UNSOLICITED Function codes supported 	Sends Static Data in Unsolicited Responses: <ul style="list-style-type: none"> √ Never • When Device Restarts • When Status Flags Change No other options are permitted.
Default Counter Object/Variation: <ul style="list-style-type: none"> • No Counters Reported • Configurable (attach explanation) √ Default Object <u> 20 </u> Default Variation <u> 5 </u> • Point-by-point list attached 	Counters Roll Over at: <ul style="list-style-type: none"> • No Counters Reported • Configurable (attach explanation) • 16 Bits √ 32 Bits • Other Value <u> </u> • Point-by-point list attached
Sends Multi-Fragment Responses: <ul style="list-style-type: none"> √ Yes • No 	

1 DNP3 Device Profile Document NOTES

SCADAPack E-Series RTUs

DNP3 Device Profile Document NOTES

Note*1

The SCADAPack E-Series RTU will support DNP3 Slave device functions to Level 2 as described by the DNP3 Subset Definitions, and selected additional objects and function codes from the DNP3 standard. Peer-to-Peer device functions allow generation of DNP requests from a SCADAPack E-Series RTU to other DNP Slave devices. The supported Peer-to-Peer device requests are described in the Peer-to-Peer Interoperability table (below). These requests are a subset of DNP3 Level 2 Master requests, with support for selected additional objects and function codes.

Note*2

Application retries are applicable to Peer requests from an RTU where a matching response is not received to a request after the *Complete Application Fragment Timeout*. Unsolicited response retries occur no more often than the *Minimum Unsolicited Event Transmit Delay Time* which is a configurable RTU parameter.

Note*3

Data Link Layer Confirmation is configurable for the following cases:

NEVER -never sends data link layer confirm

SOMETIMES-sends data link layer confirm for multi-frame fragments
 ALWAYS -always sends data link layer confirm

The *DLL Confirm* mode can be set via RTU configuration software.

Note*4

Configurable timeouts can be set via RTU configuration software. Value units are indicated for each parameter (eg. mS, S, Min) and are generally entered in the range 0-65535. *Data link confirm timeouts* are individually configurable for each DNP communication port on the RTU. A single *application layer confirm timeout* and *complete application fragment timeout* applies for the entire RTU. Peer-to-Peer requests may individually vary the *complete application fragment timeout* for each request to a peer device.

Note*5

If a user application executing on the RTU has control of particular physical output points, a configurable interlock point must be activated for a DNP3 control request to successfully control the point. Otherwise DNP3 control block status code 5 (Already Active) is returned in the DNP3 response.

Note*6

Control operations described in the device profile are for Slave operation (ie. Executes Control Operations). The following information is applicable to Peer-to-Peer control requests generated by an RTU to another device (ie. Sends Control Operations):

Sends Control Operations:

WRITE Binary Outputs	<i>Configurable</i>
SELECT/OPERATE	<i>Configurable</i>
DIRECT OPERATE	<i>Configurable</i>
DIRECT OPERATE - NO ACK	<i>Configurable</i> (not recommended)

[Obj 12 Var 1]

Count > 1	<i>Never</i>
Pulse On	<i>Never</i> (not currently supported)
Pulse Off	<i>Never</i>
Latch On	<i>Configurable</i>
Latch Off	<i>Configurable</i>

Queue	<i>Never</i>
Clear Queue	<i>Never</i>

Configurable options are on a per request basis and are defined in the RTU user application.

Note*7

In response to an event class poll request or Obj 2 Var 0 read request, the RTU will send one type of binary event as set by the RTU Event Object configuration parameters. RTU configuration software allows configuration for each event object type (i.e binary, analog, float). The event objects available are those supported by the RTU as defined by the Device Profile.

Note*8

The RTU Event Object configuration can be set for:

- Binary Input Change With Time (Obj 2 Var 2 will be sent), or
- Binary Input Change With No Time (only Obj 2 Var 1 will be sent), or
- Binary Input Change With Relative Time

When the RTU *Binary Event Object* configuration is set for Obj 2 Var 2, all binary input events will be sent with an absolute time. When the RTU *Binary Event Object* configuration is set for Obj 2 Var 3, all binary events transmitted will be Binary Input Change with Relative Time events (preceded by an Obj 51 Var 1 CTO object).

Note*9

All DNP data points configured for access by a SCADA system can be optionally assigned an event class, and be deemed to *trigger* unsolicited response generation, or be *buffered*. The event configurations are selectable on a point by point basis via RTU configuration software.

Note*10

The following Virtual Terminal Virtual Port numbers are used by SCADAPack E-Series RTUs:

- **0** = **ISaGRAF** (VT events reported in response message)
- **10..19** = **Port0 .. Port9** RTU Physical ports, when port is enabled as DNP VT Service (VT events reported in poll response or unsolicited response)
- **20** = **Remote Command Line** (VT events reported in response message)

Virtual Terminal event objects from physical ports are always assigned to DNP3 event Class 3, and can be unsolicited (if enabled with FC=20) or polled.

1.1 INTEROPERABILITY TABLE (SLAVE) - Part 1

SCADAPack E-Series RTUDNP3 Device Profile Document

INTEROPERABILITY TABLE (SLAVE) - Part 1

Object Group	Object Variation	Object Name / Description	(slave parses)		(slave responds with)	
			Request Func Code	Request Qual (hex)	Response Func Code	Response Qual (hex)
1	0*	Binary Input - All Variations	1	00,01,06	129	00,01
1	1	Binary Input	1	00,01, 06***	129	00,01
1	2	Binary Input Status	1	00,01, 06***	129	00,01
2	0**	Binary Input Change Event- All Var	1	06,07,08	129	28
2	1	Binary Input Change without time	1	06,07,08	129,130	17,28
2	2	Binary Input Change with time	1	06,07,08	129,130	17,28
2	3	Binary Input Chg with relative time	1	06,07,08	129,130	17,28
10	0*	Binary Output - All Variations	1	00,01,06	129	00,01
10	1	Binary Output	2	00,01	129	00,01
10	2	Binary Output Status	1	00,01, 06***	129	00,01
12	1	Control Relay Output Block	3,4,5,6	17,28	129	Echo of req
20	0*	Binary Counter - All Variations	1 7,8,9,10 15	00,01,06 +++ 00,01,06	129 129 129	00,01 00,01
20	1	32-bit Binary Counter	1 2 7,8,9,10	00,01, 06*** 00,01 +++	129 129 129	00,01
20	2	16-bit Binary Counter	1 2 7,8,9,10	00,01, 06*** 00,01 +++	129 129 129	00,01
20	5	32-bit Binary Counter without flag	1 2 7,8,9,10	00,01, 06*** 00,01 +++	129 129 129	00,01
20	6	16-bit Binary Counter without flag	1 2 7,8,9,10	00,01, 06*** 00,01 +++	129 129 129	00,01
21	0	Frozen Counter - All Variations	1 1++	06 + 00,01	129 129	
21	1	32-bit Frozen Counter	1++	00,01	129	
21	2	16-bit Frozen Counter	1++	00,01	129	
21	9	32-bit Frozen Counter without flag	1++	00,01	129	
21	10	16-bit Frozen Counter without flag	1++	00,01	129	
22	0**	Counter Change Event –All Var	1	06,07,08	129	28

22	1	32-bit Counter Change Event	1	06,07,08	129,130	17,28
22	2	16-bit Counter Change Event	1	06,07,08	129,130	17,28
22	5	32-bit Counter Chg Event w/Time	1	06,07,08	129,130	17,28
22	6	16-bit Counter Chg Event w/Time	1	06,07,08	129,130	17,28

* Default Variation for static object is returned (i.e. as per user configuration – point based).

** Default Variation for event object is returned (i.e. as per user configuration - system).

*** Variation returned for qualifier 06 request is as per user configuration – point based (same as for var 0)

+ Qualifier Code not supported. *Parse only* support.

++ Object not implemented. *Parse only* support.

+++ Function Codes not supported. *Parse only* support.

1.2 INTEROPERABILITY TABLE (SLAVE) - Part 2

SCADAPack E-Series RTUDNP3 Device Profile Document

INTEROPERABILITY TABLE (SLAVE) - Part 2

Object Group	Object Variation	Object Name / Description	(slave parses)		(slave responds with)	
			Request Func Code	Request Qual (hex)	Response Func Code	Response Qual (hex)
30	0*	Analog Input - All Variations	1	00,01,06	129	00,01
30	1	32-bit Analog Input	1	00,01, 06***	129	00,01
30	2	16-bit Analog Input	1	00,01, 06***	129	00,01
30	3	32-bit Analog Input without flag	1	00,01, 06***	129	00,01
30	4	16-bit Analog Input without flag	1	00,01, 06***	129	00,01
30	5	Short Floating Point Analog Input	1	00,01, 06***	129	00,01
32	0**	Analog Change Event - All Var	1	06,07,08 ^	129	28
32	1	32-bit Analog Chg Evnt without Time	1	06,07,08	129,130	17,28
32	2	16-bit Analog Chg Evnt without Time	1	06,07,08	129,130	17,28
32	3	32-bit Analog Chg Event with Time	1	06,07,08	129,130	17,28
32	4	16-bit Analog Chg Event with Time	1	06,07,08	129,130	17,28
32	5	Short Floating Point Ana Chg Evnt	1	06,07,08	129,130	17,28
32	7	Short Flt Pt Ana Chg Event w/ Time	1	06,07,08	129,130	17,28
40	0*	Analog Output Status - All Variations	1	00,01,06	129	00,01
40	1	32-bit Analog Output Status	1	00,01, 06***	129	00,01
40	2	16-bit Analog Output Status	1	00,01, 06***	129	00,01
40	3	Short Floating Pnt Ana Outp Status	1	00,01, 06***	129	00,01
41	1	32-bit Analog Output Block	3,4,5,6	17,28	129	echo of req
41	2	16-bit Analog Output Block	3,4,5,6	17,28	129	echo of req
41	3	Short Floating Pnt Ana Output Block	3,4,5,6	17,28	129	echo of req
50	1	Time and Date	1,2	07 (qty=1)	129	07 (qty=1)
51	1	Time and Date CTO			129,130	07 (qty=1)
51	2	Unsynchronised Time and date CTO				
52	2	Time Delay Fine			129	07 (qty=1)
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1,20,21	06,07,08		
60	3	Class 2 Data	1,20,21	06,07,08		
60	4	Class 3 Data	1,20,21	06,07,08		
70	1	File Identifier	2	1B	129	1B

80	1	Internal Indications	1,2	00 (index=7)	129	00
110	Length	String Octet	1,2	00,01	129	00,01
112	Length	Virtual Terminal Output Block	2	00,17		
113	Length	Virtual Terminal Event Data	1 20, 21	00,17 06	129, 130	17
No	Object	Cold Restart	13		129 (obj 52 var 2)	07 (qty=1)
No	Object	Warm Restart	14		129 (obj 52 var 2)	07 (qty=1)
No	Object	Delay Measurement	23		129 (obj 52 var 2)	07 (qty=1)

- + Qualifier Code not supported. *Parse only* support.
- ++ Object not implemented. *Parse only* support.
- * Default Variation for static object is returned (i.e. as per user configuration – point based).
- ** Default Variation for event object is returned (i.e. as per user configuration - system).
- *** Variation returned for qualifier 06 request is as per user configuration – point based (same as for var 0)
- ^ Qualifier 07 and 08 will not return float events (for obj 30 var 0 READ requests)

1.3 INTEROPERABILITY TABLE (PEER-to-PEER)

SCADAPack E-Series RTU

DNP3 Device Profile Document

INTEROPERABILITY TABLE (PEER-to-PEER)

Object Group	Object Variation	Object Name	Request Func Code	Request Qual (hex)
1	0	Binary Input – All variations	1	00,01
1	1	Binary Input	1	00,01
1	2	Binary Input Status	1	00,01
10	0	Binary Output - All variations	1	00,01
10	1	Binary Output	2	00,01
10	2	Binary Output Status	1	00,01
12	1	Control Relay Output Block see Note*7	3,4,5,6	28
20	0	Binary Counter – All variations	1	00,01
20	1	32-bit Binary Counter	1	00,01
20	2	16-bit Binary Counter	1	00,01
20	5	32-bit Binary Counter without flag	1	00,01
20	6	16-bit Binary Counter without flag	1	00,01
21	0	Frozen Counter – All variations	1	00,01
21	1	32-bit Frozen Counter	1	00,01
21	2	16-bit Frozen Counter	1	00,01
21	9	32-bit Frozen Counter without flag	1	00,01
21	10	16-bit Frozen Counter without flag	1	00,01
30	0	Analog Input – All variations	1	00,01
30	1	32-bit Analog Input	1	00,01
30	2	16-bit Analog Input	1	00,01
30	3	32-bit Analog Input without flag	1	00,01
30	4	16-bit Analog Input without flag	1	00,01
30	5	Short Floating Point Analog Input	1	00,01
40	0	Analog Output Status – All variations	1	00,01
40	1	32-bit Analog Output Status	1	00,01

(peer may request)+

40	2	16-bit Analog Output Status	1	00,01
40	3	Short Floating Point Analog Output Status	1	00,01
41	1	32-bit Analog Output Block	3,4,5,6	28
41	2	16-bit Analog Output Block	3,4,5,6	28
41	3	Short Floating Point Analog Output Block	3,4,5,6	28
50	1	Time and Date	1,2	07 (qty=1)

+ peer generation of these requests is user selectable