



Modbus RTU-CSP - Protocol Description

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1 General

This description applies for the software versions as from:
CSP2-Fx Software Version MAIN V02.09.00
CSP2-Lx Software Version MAIN V02.09.00

2 CSP Parameters for Modbus

For the Modbus Protocol several parameters have to be set which are relevant for the communication between the control system (SCADA) and the device. The parameters and their setting possibilities or value ranges are shown in the table below.

No.	Designation	Setting Possibilities Value Range (min/max values)	Parameter Details
1	Parity	even/odd/none	Bit in the transmission frame
2	Stop bit	1/2	Bit in the transmission frame
3	Baudrate	1200/2400/4800/9600/19200	Transmission rate in Bits per second.
4	Timeout in ms	50ms – 1000ms	Reaction time for the Slave to have responded to a Query. After this time has elapsed, the Master can send a new Query.
5	t call (Comm.-break over in ms)	200ms-10min	After this time has elapsed, a break in communication is assumed and indication „SCADA Comm. Active“ is reset
6	Slave id	1-256	Each device has its own address which is used when approached by the control system (SCADA).

Table 2.1: CSP Modbusparameter

3 CSP Specific Modbus Function Codes

For reading out data from the *CSP protection device* or to carry out commands, the services listed in the table, also called »Function Codes«, are supported.

Function-code	Designation	Description
3	Read Holding Registers	There are single or several data words read as from a specific data word address. Only status addresses and parameter addresses can be read.
4	Read Input Registers	There are single or several data words read as from a specific data word address. Only measuring values can be read. .
6	Load Register	Exactly one data word is written.
8	Loopback Test.	Test function for the communication system
16	Load Multiple Registers	There are single or several data words written as from a specific data word address.

Table 3.1: CSP Funktionscodes

On the following pages the Modbus functions are described in detail:

Funktion-Code 3/4:

Message

Slave adresse	3/4	Register adress HI	Register adress LO	Register number HI	Register number LO	Check-sum HI	Check-sum LO
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Response

Slave adresse	3/4	Byte number	Register 0 HI	Register 0 LO	...	Check-sum HI	Check-sum LO
---------------	-----	-------------	---------------	---------------	-----	--------------	--------------

Register adress ($HI*256 + LO$)

The data word address from where reading should start.

Register number ($HI*256 + LO$)

Number of data words to be read.

Byte number

Number of subsequent Bytes containing data words.

Register

Data words read out of the device (Highbyte and Lowbyte).

Permitted value range : Register number < 256

Funktion Code 6:

Message

Slave adress	6	Register adress HI	Register adress LO	Register data HI	Register data LO	Check-sum HI	Check-sum LO
--------------	---	--------------------	--------------------	------------------	------------------	--------------	--------------

Response

Slave adress	6	Register adress HI	Register adress LO	Register data HI	Register data LO	Check-sum HI	Check-sum LO
--------------	---	--------------------	--------------------	------------------	------------------	--------------	--------------

Register adress ($HI*256 + LO$)

Data word address to be written

Register data

Value of the data word to be written (Highbyte and Lowbyte).

Permitted value range : Register number < 256

Funktion Code 8:

Message

Slave adresse	8	Data Diag Code HI 0x00	Data Diag Code LO 0x00	Test data	Test data	Check-sum HI	Check-sum LO
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Response

Slave adresse	8	Data Diag Code HI	Data Diag Code LO	Test data	Test data	Check-sum HI	Check-sum LO
---------------	---	-------------------	-------------------	-----------	-----------	--------------	--------------

Data Diag Code HI (high), Data Diag Code LO (Low)

Diagnostic Code (subfunction of function 8) for testing the communication system. The Diagnostic Code „Return Query Data“ (0x00, 0x00) is being supported.

Test Data

By using the Diagnostic Code 0x00 0x00, the transmitted data is send back to the Master unchanged.

Function Code 16:

Message

Slave adress	16	Register adress HI	Register adress LO	Register number HI	Register number LO	Byte number	Register 0 HI	Register 0 LO	...	Check-sum HI	Check-sum LO
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Response

Slave adress	16	Register adress HI	Register adress LO	Register number HI	Register number LO	Check-sum HI	Check-sum LO
--------------	----	--------------------	--------------------	--------------------	--------------------	--------------	--------------

Register adress (HI*256 + LO)

Data word address as from where writing should start.

Register number (HI*256 + LO)

Number of data words to be written.

Byte number

Number of subsequent Bytes to contain data words.

Register

Data words read out of the device (Highbyte und Lowbyte).

Permitted value range : Register number < 256

4 Supported MODBUS- Error Messages

In the general Modbus RTU Protocol the theme Exception Response Telegrams is already shortly dealt with. A table with code examples is shown there and for the *CSP* we want to supply more information on these. The table below contains just the actual used codes. In case the device has recognised an error it can react in the following way:

Exeption Code	Designation	Description
1	Illegal Function	The message received includes a function code which is not supported by the Slave.
2	Illegal Data Adress	Access was sought on a data word address not included in the data module.
3	Illegal Data Value	A value was attempted to be written which the Slave recognised to be invalid.
4	Slave Device Failure	An unknown error has occured which cannot be specified more closely.

The response given by the *CSP* in a failure case has the following format:

Slave address	80h + Function Code	Exeption Code	Check-sum HI	Check-sum LO
---------------	---------------------	---------------	--------------	--------------

In the second Byte of the response the Function Code is sent with the highest set Bit. This is equivalent to an addition by 80h. The third Byte includes the Exception Code of the error message.

5 Parameters

Default setting of parameters for the transmission protocol Modbus RTU			Default Settings
No.	Designation	Value Range (min/max values)	
1	Parity	even/odd/none	Even
2	Stop bit	1/2	1
3	Baudrate	1200/2400/4800/9600/19200	9600
4	Timeout in ms	50ms – 1000ms	900
5	t call (Comm.-break over in ms)	200ms – 600000ms	240000
6	Slave id	1-256	1

5.1 Notes for the SCADA-System

The following times have to be considered by the control system and are to be fixed adjusted in the CSP :
The dwell times (t_D) before start of a telegram must at least be set to 3.5 characters.

3.5 characters 9600 Baud = 4 ms

3.5 characters 19200 Baud = 2 ms

Start of a new telegram is expected when the dwell time (t_D) is > 3.5 characters.

When a break is > 1.5 characters (intermittent time), the telegram is aborted and the start of a new telegram expected.

A continuous data flow is guaranteed, when the intermittent time is < 1.5 characters. At a Baudrate of 9600 Baud the intermittent time is 1.7 ms or 0.85 ms at 19200 Baud.

The fact that the probability of disruptions during transmission of a telegram increases with its length has to be taken into duly consideration and thus a query to the Slave should be possibly such that the response telegram is not much longer than 32 Byte.

6 Appendix - Data Point Lists

If the Format Code is not specified in the data point list, please see the Format CodeTable at the end of this description for formatting the relevant measuring values. Very often, though, formatting of the measuring values is included in the data point list.

6.1 Feeder ratings

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit	Comment	Device type		
		Start Register address	End Register address						CSP2-F3	CSP2-F5	CSP2-L
Feeder ratings	Nominal frequency fn	10000		4	F2		Hz		X	X	X
	Current transformer primary (CT prim)	10001	10002	4	F2		A		X	X	X
	Current transformer secondary (CT sec)	10003		4	F2		A		X	X	X
	Current transformer direction (CT dir)	10004		4	F2		grad		X	X	X
	Earth current transformer primary (ECT prim)	10005		4	F2		A		X	X	X
	Earth current transformer secondary (ECT sec)	10006		4	F2		A		X	X	X
	Earth current transformer direction (ECT dir)	10007		4	F2		grad		X	X	X
	Voltage transformer primary (VT prim)	10008	10009	4	F3		V		X	X	X
	Voltage transformer secondary (VT sec)	10010		4	F2		V		X	X	X
	Voltage transformer connection (VT con)	10011		4	F10		enumeration		X	X	X
					F10	0	no Voltage transfor				
						1	STAR,				
						2	DELTA,				
						3	V_CONNECT				
	Voltage transformer location (VT loc)	10012		4	F11		enumeration		X	X	X
					F11	0	BUSBAR				
						1	LINE				
	Earth voltage transformer connection (EVT con)	10013		4	F12		enumeration		X	X	X
					F12	0	BROKEN_DELTA				
						1	GEO_SUMME				
						2	NOT_AVAIL				
	Earth voltage transformer primary (EVT pri)	10014	10015	4	F3		V		X	X	X
	Earth voltage transformer primary	10016		4	F2		V		X	X	X

		Decimal								Device		
		Decimal								type		
Main groups	sub group/name	Start Register address	End Register address	Function Code	Format Code	Bitmask/Range	Unit	Comment	CSP2-F3	CSP2-F5	CSP2-L	
	(EVT sec)											

6.2 Measuring Values

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit	Step	Device type		
		Start Register address	End Register address						CSP2-F3	CSP2-F5	CSP2-L
Measurement values											
Current values	Phase current IL1	11000	11001	4	F6		A		X	X	X
	Phase current IL2	11002	11003	4	F6		A		X	X	X
	Phase current IL3	11004	11005	4	F6		A		X	X	X
	Earth current Ie	11006	11007	4	F6		A		X	X	X
	Negative phase sequence current I2	11008	11009	4	F6		A		X	X	
	Thermal capacity ϑ	11010	11011	4	F6		%		X	X	X
Voltage values	Phase to neutral voltage UL1	11012	11013	4	F6		V		X	X	X
	Phase to neutral voltage UL2	11014	11015	4	F6		V		X	X	X
	Phase to neutral voltage UL3	11016	11017	4	F6		V		X	X	X
	Phase to phase voltage U12	11018	11019	4	F6		V		X	X	X
	Phase to phase voltage U23	11020	11021	4	F6		V		X	X	X
	Phase to phase voltage U31	11022	11023	4	F6		V		X	X	X
	Residual voltage Ue	11024	11025	4	F6		V		X	X	X
Frequency and power values	Frequencyf	11026	11027	4	F7		Hz		X	X	X
	3 phase active power P	11028	11030	4	F8		kW		X	X	
	3 phase reactive power Q	11031	11033	4	F8		kVAR		X	X	
	Power factor $\cos\phi$	11034		4	F7		Cos phi		X	X	
Differential current values	Differential current Id L1	11035	11036	4	F6		A				X
	Differential current Id L2	11037	11038	4	F6		A				X
	Differential current Id L3	11039	11040	4	F6		A				X
Stabilizing current values	Stabilizing current Is L1	11041	11042	4	F6		A				X
	Stabilizing current Is L2	11043	11044	4	F6		A				X
	Stabilizing current Is L2	11045	11046	4	F6		A				X
Harm. stabilizing factor values	Harm. stabilizing factor m L1	11047	11048	4	F6		1				X

		Decimal							Device		
									type		
Main groups	sub group/name	Start Register address	End Register address	Function Code	Format Code	Bitmask/Range	Unit	Step	CSP2-F3	CSP2-F5	CSP2-L
	Harm. stabilizing factor m L2	11049	11050	4	F6		1				X
	Harm. stabilizing factor m L3	11051	11052	4	F6		1				X
Statistical data											
Energy	Positive active energy Wp+	11500	11502	4	F8		kWh		X	X	
	Negative active energy Wp-	11503	11505	4	F8		kWh		X	X	
	Positive reactive energy Wq+	11506	11508	4	F8		kVARh		X	X	
	Negative reactive energy Wq-	11509	11511	4	F8		kVARh		X	X	
Current maximal and average values	Current average value Il1 avg	11512	11513	4	F6		A		X	X	X
	Current average value Il2 avg	11514	11515	4	F6		A		X	X	X
	Current average value Il3 avg	11516	11517	4	F6		A		X	X	X
	Current max. value Il1 max	11518	11519	4	F6		A		X	X	X
	Current max. value Il2 max	11520	11521	4	F6		A		X	X	X
	Current max. value Il3 max	11522	11523	4	F6		A		X	X	X
Voltage average values	Phase to neutral voltage average value UL1 avg	11524	11525	4	F6		V		X	X	X
	Phase to neutral voltage average value UL2 avg	11526	11527	4	F6		V		X	X	X
	Phase to neutral voltage average value UL3 avg	11528	11529	4	F6		V		X	X	X
	Phase to phase voltage average value U12 avg	11530	11531	4	F6		V		X	X	X
	Phase to phase voltage average value U23 avg	11532	11533	4	F6		V		X	X	X
	Phase to phase voltage average value U31 avg	11534	11535	4	F6		V		X	X	X
Voltage maximal values	Phase to neutral voltage maximal value UL1 max	11536	11537	4	F6		V		X	X	X
	Phase to neutral voltage maximal value UL2 max	11538	11539	4	F6		V		X	X	X
	Phase to neutral voltage maximal value UL3 max	11540	11541	4	F6		V		X	X	X
	Phase to phase voltage maxi-	11542	11543	4	F6		V		X	X	X

		Decimal							Device		
									type		
Main groups	sub group/name	Start Register address	End Register address	Function Code	Format Code	Bitmask/Range	Unit	Step	CSP2-F3	CSP2-F5	CSP2-L
	mal value U12 max										
	Phase to phase voltage maximal value U23 max	11544	11545	4	F6		V		X	X	X
	Phase to phase voltage maximal value U31 max	11546	11547	4	F6		V		X	X	X
Frequency maximal and average values	Frequency average value f avg	11548	11549	4	F7		Hz		X	X	X
	Frequency maximal value f max	11550	11551	4	F7		Hz		X	X	X
Active power maximal and average values	Positive active power average value P+ avg	11552	11553	4	F6		kW		X	X	
	Negative active power average value P- avg	11554	11555	4	F6		kW		X	X	
	Positive active power max. value P+ max	11556	11557	4	F6		kW		X	X	
	Negative active power max. value P- max	11558	11559	4	F6		kW		X	X	
Reactive power maximal and average values	Positive reactive power average value Q+ avg	11560	11561	4	F6		kVAR		X	X	
	Negative reactive power average value Q- avg	11562	11563	4	F6		kVAR		X	X	
	Positive reactive power maximal value Q+ max	11564	11565	4	F6		kVAR		X	X	
	Negative reactive power average value Q- max	11566	11567	4	F6		kVAR		X	X	
Differential current max. value	Differential current max. value dI1 max	11568	11569	4	F6		A				X
	Differential current max. value dI2 max	11570	11571	4	F6		A				X
	Differential current max. value dI3 max	11572	11573	4	F6		A				X
Stabilizing current max. value	Stabilizing current max. value Is L1 max	11574	11575	4	F6		A				X
	Stabilizing current max. value IsL2 max	11576	11577	4	F6		A				X

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit	Step	Device type		
		Start Register address	End Register address						CSP2-F3	CSP2-F5	CSP2-L
	Stabilizing current max. value IsL3 max	11578	11579	4	F6		A				X
Harm. stabilizing factor max. value	Harm. stabilizing factor max. value m L1 max	11580	11581	4	F6		1				X
	Harm. stabilizing factor max. value m L2 max	11582	11583	4	F6		1				X
	Harm. stabilizing factor max. value m L3 max	11584	11585	4	F6		1				X
Service for SG (SG=Switchgear)											
	Number of operating cycles via AR AR tot.	11700	11701	4	F3		1		X	X	X
	Number of operating cycles SG1 Op.SG1	11702	11703	4	F3		1		X	X	X
	Number of operating cycles SG2 Op.SG2	11704	11705	4	F3		1		X	X	X
	Number of operating cycles SG3 Op.SG3	11706	11707	4	F3		1		X	X	X
	Number of operating cycles SG4 Op.SG4	11708	11709	4	F3		1		X	X	X
	Number of operating cycles SG5 Op.SG5	11710	11711	4	F3		1		X	X	X
	Operating hours h	11712	11713	4	F3		h		X	X	X
	Sum (Σ) of short circuit currents cleared by SG1 Σ I SWG1	11714	11715	4	F6		kA		X	X	X
	Sum (Σ) of short circuit currents cleared by SG2 Σ I SWG2	11716	11717	4	F6		kA			X	

6.3 Messages

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
Switchgear 1 to 5		16000	16002	3	F20 (register 0, 1, 2)							
	Switchgear 1 (SG1)				F20 (register 0)	0x0003	bit0 & bit1		Position switchgear 1 bit0 & bit1 00: Diff 01: Off 10: On 11: Failure position	X	X	X
						0x0004	bit		unused	X	X	X
						0x0008	bit		Switchgear 1 removed	X	X	X
						0x0010	bit		Switchgear 1 failure	X	X	X
						0x0020	bit		Control time switchgear 1	X	X	X
						0x0040	bit		unused			
						0x0080	bit		unused			
	Switchgear 2 (SG2)					0x0300	bit8 & bit9		Position switchgear 2 bit0 & bit1 00: Diff 01: Off 10: On 11: Failure position	X	X	X
						0x0400	bit		unused	X	X	X
						0x0800	bit		Switchgear 2 removed	X	X	X
						0x1000	bit		Switchgear 2 failure	X	X	X
						0x2000	bit		Control time switchgear 2	X	X	X
						0x4000	bit		unused	X	X	X
						0x8000	bit		unused			
	Switchgear 3 (SG3)				(register 1)	0x0003	bit0 & bit1		Position switchgear 3 bit0 & bit1 00: Diff 01: Off 10: On 11: Failure position	X	X	X
						0x0004	bit		unused	X	X	X
						0x0008	bit		Switchgear 3 removed	X	X	X
						0x0010	bit		Switchgear 3 failure	X	X	X
						0x0020	bit		Control time switchgear 3	X	X	X
						0x0040	bit		unused	X	X	X
						0x0080	bit		unused			
	Switchgear 4 (SG4)					0x0300	bit8 & bit9		Position switchgear 4 bit0 & bit1 00: Diff 01: Off 10: On	X	X	X

										Device		
										type		
Main groups	sub group/name	Start Register address	End Register address	Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	CSP2-F3	CSP2-F5	CSP2-L
									11: Failure position			
						0x0400	bit		unused	X	X	X
						0x0800	bit		Switchgear 4 removed	X	X	X
						0x1000	bit		Switchgear 4 failure	X	X	X
						0x2000	bit		Control time switchgear 4	X	X	X
						0x4000	bit		unused	X	X	X
						0x8000	bit		unused			
	Switchgear 5 (SG5)				(register 2)	0x0003	bit0 & bit1		Position switchgear 5 bit0 & bit1 00: Diff 01: Off 10: On 11: Failure position	X	X	X
						0x0004	bit		unused	X	X	X
						0x0008	bit		Switchgear 5 removed	X	X	X
						0x0010	bit		Switchgear 5 failure	X	X	X
						0x0020	bit		Control time switchgear 5	X	X	X
						0x0040	bit		unused	X	X	X
						0x0080	bit		unused			
						0x0100 to 0x8000			unused			
Devicetyp and language		16100		3	F21							
	Devicetyp				F21	0x00FF			0:- 1: reserved 2: <i>CSP2-F3</i> 3: <i>CSP2-F5</i> 4: <i>CSP2-L</i> 5: reserved	X	X	X
	Language					0xFF00			1: English 2: German 3: Spanish 4: Portuguese	X	X	X

										Device		
										type		
Main groups	sub group/name	Start Register address	End Register address	Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	CSP2-F3	CSP2-F5	CSP2-L
Software version		16101	16102	3	F22 (register 0, 1)							
					F22 (register 0)	0x00FF	Main Minor			X	X	X
						0xFF00	Main Major			X	X	X
					(register 1)	0x00FF	DSP Minor			X	X	X
						0xFF00	DSP Major			X	X	X
Hardware version		16103		3	F23							
					F23	0x00FF	Hardware Minor			X	X	X
						0xFF00	Hardware Major			X	X	X
Time and date (only read)		16104	16106	3	F24 (register 0, 1, 2)							
					F24 (register 0, 1)	DWORD first	ms of the day from 0.00 (midnight)			X	X	X
					(register 2)	WORD sec	Days since 1990			X	X	X
Device Status		16107	16108	3	F25 (register 0, 1)							
	System OK				F25 (register 1)	0x0001	bit		0: System faulty 1: System OK	X	X	X
	Self supervision OK					0x0002	bit		0: Fault dedect by self-supervision 1: Self-supervision OK	X	X	X
	Key Switch Local/Remote					0x0004	bit		0: Switching allowed locally only 1: Switching allowed only by way of SCADA system or digital inputs	X	X	X
	Operating mode					0x0008	bit		0: inactive 1: active	X	X	X
	Calibration mode					0x0010	bit		0: inactive 1: active	X	X	X
	Commissioning mode					0x0020	bit		0: inactive 1: active	X	X	X

										Device		
										type		
Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	CSP2-F3	CSP2-F5	CSP2-L
		Start Register address	End Register address									
	Parameter setting mode					0x0040	bit		0: inactive 1: active	X	X	X
	Information blocking					0x0080	bit		0: Information readable 1: Information not readable, blocked	X	X	X
	Protection ready					0x0100	bit		0: Protection not ready 1: Protection ready	X	X	X
	Active protection parameter Set					0x1E00	bit 9 & bit10 & bit11 & bit12		0000b = reserved, 0001b = Protection parameter set 1 active, 0010b = Protection parameter set 2 active, 0011b = Protection parameter set 3 active, 0100b = Protection parameter set 4 active, 0101b – 1111b = reserved	X	X	X
	Acknowledgement					0x2000	bit		0: Acknowledgement not necessary 1: Acknowledgement necessary (with trip for release of control system)	X	X	X
	Self-supervision current-measuring					0x4000	bit		{planned} 0: Current recording o.k. 1: Current recording defective	X	X	X
	Self-supervision voltage measuring					0x8000	bit		{planned} 0: Voltage recording o.k. 1: Voltage recording defective	X	X	X
	Self-supervision field of rotation				(register 0)	0x0001	bit		{planned} 0: r.h. field of rotation 1: l.h. field of rotation	X	X	X
	Device Start					0x0002	bit		0: Device not yet ready for operation 1: Device ready for operation	X	X	X
	LED Test					0x0004	bit		0: LED Test inactive 1: LED Test active	X	X	X
	Signal relay test					0x0008	bit		0: Relay test inactive 1: Relay test active	X	X	X

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
	Overflow pos. active energy					0x0010	bit		0:- 1: Energy meter overflow	X	X	
	Overflow neg. active energy					0x0020	bit		0:- 1: Energy meter overflow	X	X	
	Overflow pos. reactive energy					0x0040	bit		0:- 1: Energy meter overflow	X	X	
	Overflow neg. reactive energy					0x0080	bit		0:- 1: Energy meter overflow	X	X	
						0x0100 to 0x8000			unused			
Read status bits for release of switching devices		16109		3	F26							
	Status bit for external control order CB1 off (Ext CB 1 OFF)				F26	0x0001	bit		0: - 1: CB 1 was switched off via digital input function (Ext CB 1 OFF)	X	X	X
						0x0002 to 0x0080			unused			
	Status release marker for extern. Control order (Ext CB 1 on)					0x0100	bit		0: CB 1 not released 1: CB1 can be switched on via digital input function (Ext CB 1 on).	X	X	X
						0x0200 to 0x8000			unused			
Status bits output functions for controlling signal relays via scada		16110		3	F27							
	Status bit to the output function "SCADA:Cmd out1"				F27	0x0001	bit		0: not set 1: set	X	X	X
	Status bit to the output function "SCADA:Cmd out2"					0x0002	bit		0: not set 1: set	X	X	X

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
	Status bit to the output function "SCADA:Cmd_out3					0x0004	bit		0: not set 1: set	X	X	X
	Status bit to the output function "SCADA:Cmd_out4					0x0008	bit		0: not set 1: set	X	X	X
	Status bit to the output function "SCADA:Cmd_out5					0x0010	bit		0: not set 1: set	X	X	X
	Status bit to the output function "SCADA:Cmd_out6					0x0020	bit		0: not set 1: set	X	X	X
	Status bit to the output function "SCADA:Cmd_out7					0x0040	bit		0: not set 1: set	X	X	X
						0x0080 to 0x8000			unused	X	X	X
Status of the digital inputs		16111		3	F28							
	Digital input 11				F28	0x0001	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 12					0x0002	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 13					0x0004	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 14					0x0008	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 15					0x0010	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 16					0x0020	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 17					0x0040	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 18					0x0080	bit		0: inaktiv 1: aktiv	X	X	X

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
	Digital input 19					0x0100	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 20					0x0200	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 21					0x0400	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 22					0x0800	bit		0: inaktiv 1: aktiv	X	X	X
	Digital input 23					0x1000	bit		0: inaktiv 1: aktiv		X	
	Digital input 24					0x2000	bit		0: inaktiv 1: aktiv		X	
	Digital input 25					0x4000	bit		0: inaktiv 1: aktiv		X	
	Digital input 26					0x8000	bit		0: inaktiv 1: aktiv		X	
Protection in general		16200	16201	3	F29 (register 0, 1)							
	General protection alarm (General alarm)				F29 (reister 1)	0x0001	bit		0: no alarm 1: protection alarm	X	X	X
	General protection trip (General trip)					0x0002	bit		0: no trip 1: protection trip	X	X	X
	Phase fault forward (Ph-fault forw.)					0x0004	bit		0: no phase fault in forward direction 1: phase fault in forward direction	X	X	X
	Phase fault backward (Ph-fault backw.)					0x0008	bit		0: no phase fault in backward direction 1: phase fault in backward direction	X	X	X
	Earth fault forward (E-fault forw.)					0x0010	bit		0: no earth fault in forward direction 1: earth fault in forward direction	X	X	X
	Earth fault backward (E-fault backw.)					0x0020	bit		0: no earth fault in backward direction 1: earth fault in backward direction	X	X	X

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
									1: earth fault in backward direction			
	SCIFO Fault (Prot.sig.Fail)					0x0040	bit		0: No Fibre Optic fault 1: Fibre Optic fault			X
						0x0080	bit		unused			
	Alarm in L1 (Alarm: L1)					0x0100	bit		0: no protection alarm in Phase L1 1: protection alarm in Phase L1	X	X	X
	Alarm in L2 (Alarm: L2)					0x0200	bit		0: no protection alarm in Phase L2 1: protection alarm in Phase L2	X	X	X
	Alarm in L3 (Alarm: L3)					0x0400	bit		0: no protection alarm in Phase L3 1: protection alarm in Phase L3	X	X	X
	Alarm in N (Alarm: N)					0x0800	bit		0: no protection alarm in phase neutral 1: alarm in phase neutral	X	X	X
	Trip in L1 (Trip: L1)					0x1000	bit		0: no protection trip in phase L1 1: protection trip in phase L1	X	X	X
	Trip in L2 (Trip: L2)					0x2000	bit		0: no protection trip in phase L2 1: protection trip in phase L2	X	X	X
	Trip in L3 (Trip: L3)					0x4000	bit		0: no protection trip in phase L3 1: protection trip in phase L3	X	X	X
	Trip in N (Trip: N)					0x8000	bit		0: no protection trip in phase neutral 1: protection trip in phase neutral	X	X	X
	Local CBF (Local CBF)				(register 0)	0x0001	bit		0: no local circuit breaker failure 1: local circuit breaker failure	X	X	X
	Extern. CBF (Trip: Ext.CBF)					0x0002	bit		0: no external circuit breaker failure 1: external circuit breaker failure	X	X	X
						0x0004-0x0040	bits		unused			
	Switching device fail (Switchgea.fail)					0x0080	bit		0: no defect on a switching device 1: malfunction in one of the switch-	X	X	X

										Device		
										type		
Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	CSP2-F3	CSP2-F5	CSP2-L
		Start Register address	End Register address									
									ing elements			
	Interlocking (Interlock)					0x0100	bit		0: switching command accepted 1: switching command could not be carried out, interlocking condition failed	X	X	X
	Emergency-off (Emergency off)					0x0200	bit		0: no CB-off by Emergency-off 1: CB-off by Emergency-Off	X	X	X
						0x0400 to 0x8000			unused			
Protectionfunctions 1		16202	16203	3	F30 (register 0, 1)							
Over, short-circuit current steps	Function l> (Function l>)				F30 (register 1)	0x0001	bit		0: not activated 1: ready	X	X	X
	Function l>> (Function l>>)					0x0002	bit		0: not activated 1: ready	X	X	X
	Function l>>> (Function l>>>)					0x0004	bit		0: not activated 1: ready	X	X	
	Alarm l> (Alarm: l>)					0x0008	bit		0:- 1: Alarm l> - Step	X	X	X
	Alarm l>> (Alarm: l>>)					0x0010	bit		0:- 1: Alarm l>> - Step	X	X	X
	Alarm l>>> (Alarm: l>>>)					0x0020	bit		0:- 1: Alarm l>>> - Step	X	X	
	Trip l> (Trip: l>)					0x0040	bit		0:- 1: Trip l> - Step	X	X	X
	Trip l>> (Trip: l>>)					0x0080	bit		0:- 1: Trip l>> - Step	X	X	X
	Trip l>>> (Trip: l>>>)					0x0100	bit		0:- 1: Trip l>>> - Step	X	X	

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
Earth current steps	Function le> (Function le>)					0x0200	bit		0: not activated 1: ready	X	X	X
	Function le>> (Function le>>)					0x0400	bit		0: not activated 1: ready	X	X	X
	Alarm le> (Alarm: le>)					0x0800	bit		0:- 1: Earth current Alarm le> - Step	X	X	X
	Alarm le>> (Alarm: le>>)					0x1000	bit		0:- 1: Earth current Alarm le>> - Step	X	X	X
	Trip le> (Trip: le>)					0x2000	bit		0:- 1: Earth current trip le> - Step	X	X	X
	Trip le>> (Trip: le>>)					0x4000	bit		0:- 1: Earth current trip le>> - Step	X	X	X
Negative phase sequence (I 2) step	Function I2> (Function I2>)					0x8000	bit		0: not activated 1: ready	X	X	
	Function I2>> (Function I2>>)				(register 0)	0x0001	bit		0: not activated 1: ready	X	X	
	Alarm I2> (Alarm: I2>)					0x0002	bit		0:- 1: Alarm NPS I2> - Step	X	X	
	Alarm I2>> (Alarm: I2>>)					0x0004	bit		0:- 1: Alarm NPS I2>> - Step	X	X	
	Trip I2> (Trip: I2>)					0x0008	bit		0:- 1: Trip NPS I2> - Step	X	X	
	Trip I2>> (Trip: I2>>)					0x0010	bit		0:- 1: Trip NPS I2>> - Step	X	X	
Thermal replica	Function theta> (Function ϑ)					0x0020	bit		0: not activated 1: ready	X	X	X
	Alarm theta> (Alarm: ϑ)					0x0040	bit		0:- 1: Alarm thermal replica	X	X	X
	Trip theta> (Trip ϑ)					0x0080	bit		0:- 1: Trip thermal replica	X	X	X

										Device		
										type		
Main groups	sub group/name	Start Register address	End Register address	Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	CSP2-F3	CSP2-F5	CSP2-L
Control circuit supervision	Function CCS (Function CCS)					0x0100	bit		0: not activated 1: ready	X	X	X
	Alarm CCS (Alarm: CCS)					0x0200	bit		0:- 1: Control circuit supervision, defect in one of the selected control circuits	X	X	X
Fuse Failure (VT) supervision	Function fuse failure (Function FF)					0x0400	bit		0: not activated 1: ready	X	X	X
	Alarm fuse failure (Alarm: FF)					0x0800	bit		0:- 1: Voltage transformer supervision, voltage transformer defective	X	X	X
Line differential protection	Function Idiff> (Fct. Idiff>)					0x1000	bit		0: not activated 1: ready			X
	Trip Idiff> (Trip:Idiff>)					0x2000	bit		0:- 1: Trip Idiff> .-.step			X
	Function Idiff>> (Fct. Idiff>>)					0x4000	bit		0: not activated 1: ready			X
	Trip Idiff>> (Trip:Idiff>>)					0x8000	bit		0:- 1: Trip Idiff>> .-.step			X
Protectionfunctions 2		16204	16205	3	F31 (register 0, 1)							
Under- and over-voltage steps	Function U< (Function U<)				F31 (register 1)	0x0001	bit		0: not activated 1: ready	X	X	X
	Function U<< (Function U<<)					0x0002	bit		0: not activated 1: ready	X	X	X
	Function U> (Function U>)					0x0004	bit		0: not activated 1: ready	X	X	X
	Function U>> (Function U>>)					0x0008	bit		0: not activated 1: ready	X	X	X
	Alarm U< (Alarm: U<)					0x0010	bit		0:- 1: Alarm undervoltage U<	X	X	X
	Alarm U<< (Alarm: U<<)					0x0020	bit		0:- 1: Alarm undervoltage U<<	X	X	X

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
	Alarm U> (Alarm: U>)					0x0040	bit		0:- 1: Alarm undervoltage U>	X	X	X
	Alarm U>> (Alarm: U>>)					0x0080	bit		0:- 1: Alarm undervoltage U>>	X	X	X
	Trip U< (Trip: U<)					0x0100	bit		0:- 1: Trip undervoltage U<	X	X	X
	Trip U<< (Trip: U<<)					0x0200	bit		0:- 1: Trip undervoltage U<<	X	X	X
	Trip U> (Trip: U>)					0x0400	bit		0:- 1: Trip undervoltage U>	X	X	X
	Trip U>> (Trip: U>>)					0x0800	bit		0:- 1: Trip undervoltage U>>	X	X	X
Residual voltage steps	Function Ue> (Function Ue>)					0x1000	bit		0: not activated 1: ready	X	X	X
	Function Ue>> (Function Ue>>)					0x2000	bit		0: not activated 1: ready	X	X	X
	Alarm Ue> (Alarm: Ue>)					0x4000	bit		0:- 1: Alarm residual voltage Ue>	X	X	X
	Alarm Ue>> (Alarm: Ue>>)					0x8000	bit		0:- 1: Alarm residual voltage Ue>>	X	X	X
	Trip Ue> (Trip: Ue>)				(register 0)	0x0001	bit		0:- 1: Trip residual voltage Ue>	X	X	X
	Trip Ue>> (Trip: Ue>>)					0x0002	bit		0:- 1: Trip residual voltage Ue>>	X	X	X
Frequency steps	Function f1 (Function f1)					0x0004	bit		0: not activated 1: ready	X	X	
	Function f2 (Function f2)					0x0008	bit		0: not activated 1: ready	X	X	
	Function f3 (Function f3)					0x0010	bit		0: not activated 1: ready	X	X	

										Device		
										type		
Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	CSP2-F3	CSP2-F5	CSP2-L
		Start Register address	End Register address									
	Function f4 (Function f4)					0x0020	bit		0: not activated 1: ready	X	X	
	U< Freq. block (U< block. freq.)					0x0040	bit		0:- 1: Frequency blocked by sep. undervoltage recording	X	X	
	Alarm f1 (Alarm: f1)					0x0080	bit		0: - 1: Alarm frequency step 1	X	X	
	Alarm f2 (Alarm: f2)					0x0100	bit		0: - 1: Alarm frequency step 2	X	X	
	Alarm f3 (Alarm: f3)					0x0200	bit		0: - 1: Alarm frequency step 3	X	X	
	Alarm f4 (Alarm: f4)					0x0400	bit		0:- 1: Alarm frequency step 4	X	X	
	Trip f1 (Trip: f1)					0x0800	bit		0:- 1: Trip frequency step 1	X	X	
	Trip f2 (Trip: f2)					0x1000	bit		0:- 1: Trip frequency step 2	X	X	
	Trip f3 (Trip: f3)					0x2000	bit		0:- 1: Trip frequency step 3	X	X	
	Trip f4 (Trip: f4)					0x4000	bit		0:- 1: Trip frequency step 4	X	X	
						0x8000			unused			
Protectionfunctions 3		16206	16207	3	F32 (register 0, 1)							
Power and reverse power steps	Function Pr> (Function Pr>)				F32 (register 1)	0x0001	bit		0: not activated 1: ready	X	X	
	Function Pr>> (Function Pr>>)					0x0002	bit		0: not activated 1: ready	X	X	
	Function P> (Function P>)					0x0004	bit		0: not activated 1: ready	X	X	
	Function P>> (Function P>>)					0x0008	bit		0: not activated 1: ready	X	X	
	Alarm Pr> (Alarm: Pr>)					0x0010	bit		0:- 1: Alarm reverse power Pr> - step	X	X	

Main groups	sub group/name	Decimal		Function Code	Format Code	Bitmask/Range	Unit/description	Step	Comment/description	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
	Alarm Pr>> (Alarm: Pr>>)					0x0020	bit		0:- 1: Alarm reverse power Pr>> - step	X	X	
	Alarm P> (Alarm: P>)					0x0040	bit		0:- 1: Alarm power P> - step	X	X	
	Alarm P>> (Alarm: P>>)					0x0080	bit		0:- 1: Alarm power P>> - step	X	X	
	Trip Pr> (Trip: Pr>)					0x0100	bit		0:- 1: Trip reverse power Pr> - step	X	X	
	Trip Pr>> (Trip: Pr>>)					0x0200	bit		0:- 1: Trip reverse power Pr>> - step	X	X	
	Trip P> (Trip: P>)					0x0400	bit		0:- 1: Trip power P> - step	X	X	
	Trip P>> (Trip: P>>)					0x0800	bit		0:- 1: Trip power P>> - step	X	X	
Automatic reclosing	Function AR (Function AR)					0x1000	bit		0: not activated 1: ready	X	X	X
	Short time AR CB on execute (AR(ST):CB on)					0x2000	bit		0:- 1: CB-ON execute by short term AR	X	X	X
	Long-term AR CB on execute (AR(LT):CB on)					0x4000	bit		0:- 1: CB-ON execute by long term AR	X	X	X
	AR blocking (AR:blocked)					0x8000	bit		0:- 1: AR is blocked	X	X	X
	AR successful (AR:successful)				(register0)	0x0001	bit		0:- 1: AR was successful	X	X	X
	AR unsuccessful (AR:unsuccessful)					0x0002	bit		0:- 1: AR was unsuccessful	X	X	X
	AR is in progress (AR in progress)					0x0004	Bit		0: - 1: AR in progress	X	X	X
						0x0008 to 0x8000			unused	X	X	

6.4 Commands

Main groups	sub group/ name	Dezimal		Function Code	Format Code	Bitmask / Range	Unit	Step	Comment	Device type		
		Start Register address	End Register address							CSP2-F3	CSP2-F5	CSP2-L
Switching device control	Control switchgear 1 (Ctrl.by SCADA.)	30000		6	F2	0x03	bit		00b: no action 01b: Switching command switchgear 1 off 10b: Switching command switchgear 1 on 11b: reserved	X	X	X
	Control switchgear 2 (Ctrl.by SCADA.)	30001		6	F2	0x03	bit		00b: no action 01b: Switching command switchgear 2 off 10b: Switching command switchgear 2 on 11b: reserved	X	X	X
	Control switchgear 3 (Ctrl.by SCADA.)	30002		6	F2	0x03	bit		00b: no action 01b: Switching command switchgear 3 off 10b: Switching command switchgear 3 on 11b: reserved	X	X	X
	Control switchgear 4 (Ctrl.by SCADA.)	30003		6	F2	0x03	bit		00b: no action 01b: Switching command switchgear 4 off 10b: Switching command switchgear 4 on 11b: reserved	X	X	X
	Control switchgear 5 (Ctrl.by SCADA.)	30004		6	F2	0x03	bit		00b: no action 01b: Switching command switchgear 5 off 10b: Switching command switchgear 5 on 11b: reserved	X	X	X
Output control		30100		6	F50							
Unsafty output command for signal relays via SCADA	Command for switching signal relays via SCADA (SCADA:Cmd out 1)				F50	0x0003	bit		00b : No reaction 01b : Setting the command output 1 10b : Resetting the command output 1 11b : reserved	X	X	X
	Command for switching signal relays via SCADA (SCADA:Cmd out 2)					0x000C	bit		00b : No reaction 01b : Setting the command output 2 10b : Resetting the command output 2 11b : reserved	X	X	X
	Command for switching signal relays via SCADA (SCADA:Cmd out 3)					0x0030	bit		00b : No reaction 01b : Setting the command output 3 10b : Resetting the command output 3 11b : reserved	X	X	X

										Device		
										type		
Main groups	sub group/ name	Start Register address	End Register address	Function Code	Format Code	Bitmask / Range	Unit	Step	Comment	CSP2-F3	CSP2-F5	CSP2-L
	Command for switching signal relais via SCADA (SCADA:Cmd out 4)					0x00C0	bit		00b : No reaction 01b : Setting the command output 4 10b : Resetting the command output 4 11b : reserved	X	X	X
	Command for switching signal relais via SCADA (SCADA:Cmd out 5)					0x0300	bit		00b : No reaction 01b : Setting the command output 5 10b : Resetting the command output 5 11b : reserved	X	X	X
	Command for switching signal relais via SCADA (SCADA:Cmd out 6)					0x0C00	bit		00b : No reaction 01b : Setting the command output 6 10b : Resetting the command output 6 11b : reserved	X	X	X
	Command for switching signal relais via SCADA (SCADA:Cmd out 7)					0x3000	bit		00b : No reaction 01b : Setting the command output 7 10b : Resetting the command output 7 11b : reserved	X	X	X
Release for Circuit-breaker CB1		30101		6	F51							
	Release marker (Rel:Ext CB1 on) for the switch command via digital function (Ext CB1 on) for circuit breaker CB1				F51	0x0001	bit		0: not released 1: Release for the digital input with the function "Ext CB1 on"	X	X	X
Resetting and acknowledgement commands, parameter set switch-over		30102		6	F52							
	Acknowledgement (Device Reset)				F52	0x0001	bit		0: No reaction 1: Resetting the display/signal relays	X	X	X
						0x0002			unused			

										Device		
										type		
Main groups	sub group/ name	Start Register address	End Register address	Function Code	Format Code	Bitmask / Range	Unit	Step	Comment	CSP2-F3	CSP2-F5	CSP2-L
	command to change the activate protection set via SCADA ("Parameterset 1") ("Parameterset 2") ("Parameterset 3") ("Parameterset 4")					0x003c	bit		Date to activate one of the protection sets: 0001b = Protection parameter set 1 active, 0010b = Protection parameter set 2 active, 0011b = Protection parameter set 3 active, 0100b = Protection parameter set 4 active,	X	X	X
						0x0040	bit		unused			
						0x0080	bit		unused			
	Resetting the statistic value of the short-circuit currents					0x0100	bit		0: No reaction 1: Resetting	X	X	X
	Resetting the statistic value AR switching cycles					0x0200	bit		0: No reaction 1: Resetting	X	X	X
	Resetting the statistic value switching cycles					0x0400	bit		0: No reaction 1: Resetting	X	X	X
	Resetting statistic value energy meter					0x0800	bit		0: No reaction 1: Resetting	X	X	
	Resetting value thermal replica					0x1000	bit		0: No reaction 1: Resetting	X	X	X
	Resetting the operating hours					0x2000	bit		0: No reaction 1: Resetting	X	X	X
						0x4000 to 0x8000			unused			
Transfer new time setting		32000	32002	16	F53							
	Milliseconds				F53	DWORD first	ms of the day from 0.00 (midnight).			X	X	X
	Date					WORD sec	Days since 01.01.1990			X	X	X

6.5 Explanations to the Format Code

Annotation to the data point lists : For many Modbus addresses the Format Code with its associated format is already included in the data point list and therefore not listed in the table below.

When transmitting several Registers, the order of the respective values in the Response or Query is stated in the column „Format Code“. It has to be observed that Register 0 is the first one and all further Registers then follow accordingly.

Format code	Value/Bitmask	Description	Unit
F1	0-65535	unsigned integer	
F2	unsigned short		
F3	unsigned long		Top valued word of the »long value« is saved in the first Register (Register 0), lowest valued word of the »long value« is saved in the second Register (Register 1). Example : 123456789 saved as 123456789
F4	char name[32]	Description	Description
F5	signed long	Measuring value	Measuring value
F6	unsigned long value, 3 Decimal digits	Measuring value	Top valued word of the »long value« is saved in the first Register (Register 0) , lowest valued word of the »long value« is saved in the second Register (Register 1). Example: 123456.789 saved as 123456.789
F7	signed short, 3 Decimal digits	Measuring value	Top valued word of the »long value« is saved in the first Register (Register 0), lowest valued word of the »long value« is saved in the second (Register 1). Example: 123456.789 saved as 123456.789
F8	3 Register	Measuring value as unsigned long and factor as unsigned short	Top valued word of the »long value« is saved in the first Register (Register 0), lowest valued word of the »long value« is saved in the second Register (Register 1). In the third Register the factor Power = Measuring Value * Factor is stated.
F9	unsigned byte		
F10 / F11 / F12	enumeration		

This description is temporary. It is subject to continuous further processing (without prior notice). In case of questions please contact:



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