Doepke

Dupline

Bus System

Modbus Reference Manual for DKG 20, DKG 21-GSM and DSI 1

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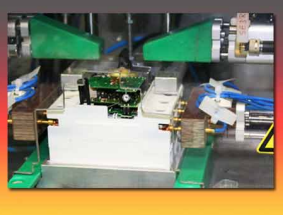


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Modbus Reference Manual
for DKG 20, DKG 21-GSM and DSI 1

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Chapter 1 Introduction

1.1 General

The product portfolio of the Dupline bus system already comprehends several components which allow a variety of applications. Nevertheless there always are requirements for expanding the system with HMI or SCADA products to observe and operate connected electrical loads.

For this reason we made the system accessible for many third-party manufacturers but also for our in-house visualisation by means of a standard protocol: the Modbus I RTU protocol opens Dupline to the automation world.

Currently two components offer an interface with the Modbus protocol: the DKG 20 resp. DKG 21-GSM channel generators and the plug connector interface DSI 1. Since the connection to the bus differs between both, they also provide different access possibilities. The supported Modbus telegrams herein are listed completely.

1.2 About this Document

This document describes the Modbus RTU I interfaces of the Dupline components DKG 20, DKG 21-GSM and DSI 1. In addition it shall provide assistance for configuration and for the possibilities that the devices offer.

If you have furthermore questions or suggestions, please don't hesitate to use our support, either via e-mail under support@doepke.de or by phone under +49 4931 1806-888.

1.3 Abbreviations and Terms

Abbreviation	Description
Configuration	Adaptation of device's settings to the current application: Some components as „objects“ in ProLine or devices, need settings which determine the device's configuration.
Dupline +	Dupline signal conductor (+)
Dupline -	Dupline signal conductor (-)
Encoding	Assignment of the Dupline address to a component: When encoding, the Dupline component gets an address (e.g. B5) which enables the device to exchange data with other device.
Firmware	Process or operating system: This „software“ most often is located on fixed programmed, intelligent devices as e.g. DKG 1. It makes basic functionality available.
HMI	Human Machine Interface: Previously called „Men Machine Interface („MMI“), today also called „SCADA“ (see „SCADA“).
Modbus	Protocol for data exchange via serial interfaces; „Modbus I RTU“, the basic protocol, has been standardised by Messrs. Gould Electronics.
SCADA	Supervisory Control And Data Acquisition: Software or device that offers the possibility to display and/or to modify process signals.

Abbreviation	Description
Touch Screen Panel	Touch and control panel: Screen which enables commands to be input by directly touching the screen surface.

1.4 Related Dokuments

Reference	Description	
[1]	ProLine Configuration Software for the Dupline Bus System - User Manual	59 00 126
[2]	ProLine^{NG} Configuration Software for the Dupline Bus System - User Manual	59 00 142
[3]	Dupline System-Katalog (Carlo Gavazzi GmbH)	CAT DUP GER 13 06/00
[4]	Modbus over serial Line Specification and implementation guide Information under www.modbus.org or www.modbus-ida.org	

Chapter 2 DSI 1

2.1 General

The DSI 1 allows the data exchange using the standardised Modbus protocol. This is a master-slave communication on command level where the DSI 1 always is a slave and only communicates on request from master. As a selection of all defined Modbus commands (“Function codes” = “F-Codes”) the DSI 1 is able to handle F-Code 3 (read register) and 16 (write register).

2.2 Configuration

2.2.1 DSI 1 Settings

The DSI 1 possesses a block with four DIP switches for the set-up of communication parameters. When altering the settings during operation, it most likely is necessary to restart all participating devices.

Switch 1: **Setting of the Modbus slave address**
In systems with two DSI 1 or where one of the two addresses already has been assigned to another participant, this switch allows choosing another address.
Position “**OFF**”: the DSI 1 has slave address **1**
Position “**ON**”: the DSI 1 has slave address **2**

Switch 2: **Setting of the Modbus communication speed**
With this it is possible to adapt the transmission speed of the DSI 1 to that of the master or to minimize possible communication faults by lowering the transmission speed.
Position “**OFF**”: **9600** bit/s
Position “**ON**”: **19200** bit/s

Switch 3: **Setting of the transmission mode**
This switch allows suppression of data writes to the Dupline bus. This might be of advantage if operating stations have read but no write access.
Position “**OFF**”: The connected operating station only has **read** access.
Position “**ON**”: The connected operating station has **read** and **write** access.

Switch 4: **Without function**

Additional fixed parameters are:

Parameter	Value
Data length	8 Bit
Parity	None
Stop bits	1

2.2.2 Communication Parameters

To some extent, the DSI 1 works with fixed parameters (see table). Please observe that the adjustable value of „Time Before Send“ in DSC 3-P or DSCconf EX varies dependent on the version DSI firmware:

Version	Time Before Send
up to 084/06 and ZPR0160-02	5 ms
084/07 and ZPR0160	15 ms

2.3 Read Commands

2.3.1 FC03: Reading Digital Values A1 to P8

Function Code	Description
03 **READ**	• Reads status of digital output values from bus. • Reading of 16 registers at a time is allowed. • Value: 0 or 1
Notes:	• -

Request by the master:

The Modbus master has to send the following telegram for requesting all digital address values A1 to P8:

Byte #	1	2	3	4	5	6	7	8
Data	01	03	00	00	00	10	xx	xx

Byte #	
1	Modbus slave address of DSI 1 (“1”)
2	Function code “read register” (“3”)
3 & 4	Start register (“0”)
5 & 6	Number of registers to read (16 words = 10_{hex})
7 & 8	Checksum

Reply by the DSI 1:

Byte #	1	2	3	4	5	6	7	...	33	34	35	36	37
Data	01	03	20	00	00	00	00	...	00	00	00	xx	xx

Reg #	Byte #	
	1	Modbus slave address of DSI 1 (“1”)
	2	Function code “read register” (“3”)
	3	Number of data bytes (16 words = 32 bytes = 20_{hex})
1	**4**	Data of Dupline channels B8..B1
	5	Data of Dupline channels A8..A1
2	**6**	Data of Dupline channels D8..D1
	7	Data of Dupline channels C8..C1
	...	
8	**18**	Data of Dupline channels P8..P1
	19	Data of Dupline channels O8..O1
9	**20**	Always 00
	21	Always 00
	...	
16	**34**	Always 00
	35	Always 00
	36 & 37	Checksum

2.3.2 FC03: Reading AnaLink Values A1 to P8

Function Code	Description
03 **READ**	• Reads status of analog input values from bus. • Reading from start address 80h. • Reading of up to 16 registers (32 bytes) at a time is allowed. • Value: 0 (0%) to 255 (100%)
Notes:	• The maximum number of data to read is 16 words (32 bytes). Thus several telegrams are necessary to retrieve all AnaLink values of the Dupline bus, • The DSI 1 does not react on requests fom master with more than 16 words.

Request by the master:

As AnaLink values start at offset 80_{hex}, the Modbus master has to send the following telegram with a start register value for requesting the first 16 data words:

Byte #	1	2	3	4	5	6	7	8
Data	01	03	00	80	00	10	xx	xx

Byte #	
1	Modbus slave address of DSI 1 (“1”)
2	Function code “read register” (“3”)
3 & 4	Start register (AnaLink value A1 = 80_{hex})
5 & 6	Number of registers to read (16 words = 10_{hex})
7 & 8	Checksum

Reply by DSI 1:

Byte #	1	2	3	4	5	6	7	...	34	35	36	37
Data	01	03	20	00	12	00	34	...	00	56	xx	xx

Reg #	Byte #	
	1	Modbus slave address of DSI 1 (“1”)
	2	Function code “read register” (“3”)
	3	Number of data bytes (16 words = 32 bytes = 20_{hex})
1	**4**	Always 00
	5	Data of Dupline AnaLink channel A1 (here: 12_{hex})
2	**6**	Always 00
	7	Data of Dupline AnaLink channel A2 (here: 34_{hex})
	...	
16	**34**	Always 00
	35	Data of Dupline AnaLink channel B8 (here: 56_{hex})
	36 & 37	Checksum

For further reading of AnaLink data C1 to P8 the procedure described above has to be repeated with the start registers 90_{hex}, $A0_{hex}$ to $F0_{hex}$. An overview about the start registers and byte offsets for AnaLink signals can be found in the table in chapter 2.3.3 “Address Table for AnaLink Signals”.

Example: Reading channels A7, G3 and J8

For reading these channels, the master sends the following request telegram:

Byte #	1	2	3	4	5	6	7	8
Data	01	03	00	00	00	10	xx	xx

The DSI 1, for instance, sends the following (here abridged) answer:

Byte #	1	2	3	4	5	6	7	8	9	10	11	12	...
Data	01	03	20	00	40	00	00	00	00	00	04	80	...

Registers 1, 4 and 5 respectively the bytes 5, 11 und 12 are important - their values have to be interpreted as follows:

Reg #	Byte #	
1	**5**	Data of Dupline channels A8..A1 Value: $40_{hex} = 64_{dez} = 01000000_{bin}$

The binary value is allocated as follows:

Bit #	7	6	5	4	3	2	1	0
Channel	A8	A7	A6	A5	A4	A3	A2	A1
Value	0	1	0	0	0	0	0	0

It is obvious that channel A7 is set while all other channels of group A are set to zero.

Reg #	Byte #	
4	**11**	Data of Dupline channels G8..G1 Value: $04_{hex} = 4_{dez} = 00000100_{bin}$ If proceeding analog to the first value, we see that G3 is an active channel while all other channels are not active.
5	**12**	Data of Dupline channels J8..J1 Value: $80_{hex} = 128_{dez} = 10000000_{bin}$ Only channel J8 is set here.

Example: Reading AnaLink channel A4 (temperature sensor DTS 1)

This channel is delivered within the reply telegram following the request of the first 16 registers. The value is related to the measuring range of the DTS from -30°C to +60°C, i.e. a total of 90°C referring to 256 register units (90°C : 256 = 0.352°C per unit).

Reg #	Byte #	
12	**27**	Data of the Dupline AnaLink channel A7 Value: $99_{hex} = 153_{dez}$ Calculation: $= 153 \times 0{,}352 - 30°C = 23{,}79°$

Other measuring ranges lead to different unit values.

2.3.3 Address Table for AnaLink Signals

Following table shows the address assignment for AnaLink values, where

ALink	The AnaLink-channel (A1 to P8)
SR	The start register (hexadecimal value), which has to specified at the beginning of the request telegram
Byte #	The byte position in telegram at which the AnaLink is present.

ALink	SR	ALink	SR	ALink	SR	ALink	SR	ALink	SR	ALink	SR	ALink	SR	ALink	SR	Byte #
A1		C1		E1		G1		I1		K1		M1		O1		5
A2		C2		E2		G2		I2		K2		M2		O2		7
A3		C3		E3		G3		I3		K3		M3		O3		9
A4	80	C4	90	E4	A0	G4	B0	I4	C0	K4	D0	M4	E0	O4	F0	11
A5		C5		E5		G5		I5		K5		M5		O5		13
A6		C6		E6		G6		I6		K6		M6		O6		15
A7		C7		E7		G7		I7		K7		M7		O7		17
A8		C8		E8		G8		I8		K8		M8		O8		19
B1		D1		F1		H1		J1		L1		N1		P1		21
B2		D2		F2		H2		J2		L2		N2		P2		23
B3		D3		F3		H3		J3		L3		N3		P3		25
B4	80	D4	90	F4	A0	H4	B0	J4	C0	L4	D0	N4	E0	P4	F0	27
B5		D5		F5		H5		J5		L5		N5		P5		29
B6		D6		F6		H6		J6		L6		N6		P6		31
B7		D7		F7		H7		J7		L7		N7		P7		33
B8		D8		F8		H8		J8		L8		N8		P8		35

2.4 Write Commands

2.4.1 FC16: Writing Digital Values A1 to P8

Function Code	Description
16 **WRITE**	• Writing a 1 will start the configured function on that channel as if a transmitter has been activated. • Address range from 100_{hex} to 107_{hex}. • Writing of 1 to 8 registers possible.
Notes:	• Writing the state of a channels means performing an „OR“-action with the current state of that channel. This means that writing a “0” value does not have any affects but sending an “1” value always activates the channel. • Due to the snap-shot type state change on the Dupline bus, it is not possible to change AnaLink values.

Request by the master:

For writing all channels of the Dupline bus, the master has to send following telegram:

Byte #	1	2	3	4	5	6	7	8	9	...	20	21	22	23	24	25
Data	01	10	01	00	00	08	10	00	00	...	00	00	00	00	xx	xx

Reg #	Byte #	
	1	Modbus slave address of DSI 1 (“1”)
	2	Function code “write register” ($16_{dez} = 10_{hex}$)
	3 & 4	Start register (100_{hex})

	5 & 6	Number of registers (8 words = 08_{hex})
	7	Number of data bytes (8 words = 16 bytes = 10_{hex})
1	**8**	Data of Dupline channels B8..B1
	9	Data of Dupline channels A8..A1
2	**10**	Data of Dupline channels D8..D1
	11	Data of Dupline channels C8..C1
	...	
2	**22**	Data of Dupline channels P8..P1
	23	Data of Dupline channels O8..O1
	24 & 25	Checksum

Reply by DSI 1:

If the command has been executed successfully, the DSI 1 answers as follows:

Byte #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Data	**01**	**10**	**00**	**00**	**00**	**10**	**xx**	**xx**

Byte #	
1	Modbus slave address of DSI 1 (“1”)
2	Function code “write register” ($16_{dez} = 10_{hex}$)
3 & 4	Start register (100_{hex})
5 & 6	Number of registers (8 words = 08_{hex})
7 & 8	Checksum

Example: Writing channels B2, E7 and I4

If the channel B2 shall be activated, the corresponding bit in the group has to be set. The allocation is as follows:

Bit #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Channel	B8	B7	B6	B5	B4	B3	B2	B1
Value	0	0	0	0	0	0	1	0

The bit value 00000010_{bin} corresponds to 02_{dez} respectively 02_{hex}. Data for group B (B1..B8) is located in byte #8, register #1.

Following values can be calculated for other groups in the same way:

E7:$01000000_{bin} = 64_{dez} = 40_{hex}$; byte #13, register #3

I4:$00001000_{bin} = 08_{dez} = 08_{hex}$; byte #17, register #5

Thus, the telegram for setting of the values has following layout:

Byte #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**...**
Daten	01	10	01	00	00	08	10	02	00	00	00	00	40	00	00	...

Byte #	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Daten	00	08	00	00	00	00	00	00	xx	xx

2.5 Conversion Table for Switching Signals

Following table summarizes the position of channel groups within read or write telegrams:

Group	Byte # (read)	Byte # (write)	Group	Byte # (read)	Byte # (write)
A	5	9	I	13	17
B	4	8	J	12	16
C	7	11	K	15	19
D	6	10	L	14	18
E	9	13	M	17	21

Group	Byte # (read)	Byte # (write)	Group	Byte # (read)	Byte # (write)
F	8	12	N	16	20
G	11	15	O	19	23
H	10	14	P	18	22

Chapter 3 DKG 20/DKG 21-GSM

3.1 General

The channel generators DKG 20 and DKG 21-GSM are the control centres of the Dupline bus and thus have complete access to all data of the bus. Since they also implement the central logic of a Dupline bus system, there is additional process data which can be read resp. changed, e.g. network status, time switch values or timer settings. The DKG thereby solely acts as a Modbus slave.

3.2 Configuration

The changeable parameters for the serial COM2 interface of a DKG solely can adjusted by means of the menu item ***<Edit><Communication Setup>*** in the ProLine^{NG} configuration software:

- Modbus slave address resp. Device address (1..32)
- Communication speed (2,400..115,000 Baud)

You'll find a complete ProLine^{NG} reference in [2].

Additional fixed parameters are:

Parameter	Value
Data length	8 Bit
Parity	None
Stop bits	1
Wait to Send	40 ms

The COM1 interface of DKG 2x also supports all mentioned Modbus functions but is adjusted to a fixed communication speed of 115,000 baud.

3.3 Read Commands

3.3.1 FC01: Read Single Forced Channel Output State

Function Code	Description
01 **READ**	• Reads information previously written by a Modbus command for transmission on Dupline • Number of registers: 1 • Register values: – 0: Off – 1: On
Notes:	• The value read does not reflect the state of the Dupline address but the latest value set via Modbus. This means that e. g. the last Modbus write command „01“ could have reset the channel while the acknowledged state is a „01“. • For reading the actual states of Dupline addresses please use function code 02 (beginning with address 0600hex).

Register Address			Register 8bit				
Dec	**Hex**						
1280	500	A1		00 = OFF			Bit
1281	501	A2		01 = ON			Bit
..	..	..					
1407	57F	P8					Bit

Request (example):

01	**01**	**0500**	**00**	**01**	**FD06**
					checksum
				number registers	
			dummy		
		address to be read (500hex = 1280dec)			
	function code				
Modbus slave address					

Response (example):

01	**01**	**02**	**00**	**01**	**783C**
					checksum
				data byte 2 (status „ON“)	
			data byte 1 (dummy)		
		number data bytes delivered			
	function code				
Modbus slave address					

3.3.2 FC02: Read Single Channel Input State

Function Code	Description
02 **READ**	• Reads output state as set by input modules. • Number of registers: 1 • Register values: – 00: Off – 01: On
Notes:	• This function code retrieves the physical state of the Dupline address. This might be set e. g. by a push-button but also by a Modbus write command.

Register Address			Register 8bit				
Dec	**Hex**						
1536	600	A1		00 = OFF			Bit
1537	601	A2		01 = ON			Bit
..	..	..					
1663	67F	P8					Bit

Example: see **Chapter 3.3.1** on **Page 14**.

3.3.3 FC03: Read Multiple Channel Output States

Function Code	Description
03 **READ**	• Reads the output status of multiple channels as set by input modules. • Number of registers: 1..8 • Register values: – 0: Off – 1: On
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit				
Dec	**Hex**		**High**	**Low**			
0	0		B8..B1	A8..A1			Digital
1	1		D8..D1	C8..C1			Digital
..	..		..	..			
6	6		N8..N1	M8..M1			Digital
7	7		P8..P1	O8..O1			Digital

3.3.4 FC03: Read Multiple Channel Input States

Function Code	Description
03 **READ**	• Reads input state („pull-down“) as set by input modules. • Number of registers: 1..8 • Register values: – 0: Off – 1: On
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit				
Dec	**Hex**		**High**	**Low**			
16	10		B8..B1	A8..A1			Digital
17	11		D8..D1	C8..C1			Digital
..	..		..	..			
22	16		N8..N1	M8..M1			Digital
23	17		P8..P1	O8..O1			Digital

3.3.5 FC03: Read AnaLink Values

Function Code	Description
03 **READ**	• Reads AnaLink values of multiple channels. • Number of registers: 1..32 • Register values: – FFFFh: Invalid channel function (not „Analog Sensor“) or invalid Sensorwert – 0001h..00FFh: Analog value to be scaled.
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit				
Dec	**Hex**		**High**	**Low**			
256	100	A1	0	0..255			AnaLink
257	101	A2	0	0..255			AnaLink
..	..		..	..			
382	17E	P7	0	0..255			AnaLink
383	17F	P8	0	0..255			AnaLink

3.3.6 FC03: Read DTZ 4 Counter Values

Function Code	Description
03 **READ**	• Reads one or more counter values. • Number of registers: 1..32 • Register values: – Data format: BCD – Value range: 0..99
Notes:	• Counter values only are valid if the counter value transmission has been activated in the configuration of DKG. • No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function). • When using the maximum data range of 32 bits the word-wise data format is „High - Low“.

Register Address			Register 16bit		Register 16bit		
Dec	**Hex**	**Counter**	**High**	**Low**	**High**	**Low**	
512	200	0	0..99	0..99	0..99	0..99	Counter
514	202	1	0..99	0..99	0..99	0..99	Counter
..	..		..	..			
764	2FC	126	0..99	0..99	0..99	0..99	Counter
766	2FE	127	0..99	0..99	0..99	0..99	Counter

3.3.7 FC03: Read Multiplexed Analog Input Table

Function Code	Description
03 **READ**	• Reads Dupline multiplexed analog values • Reading of 1 to 32 registers possible • Adresses A1..A4 hold the current multiplex address. The remaining bits hold the digital transmit information from channel A5..B8 • Registers 0300h to 037Fh: **BCD values** • Registers 0400h to 047Fh: **Binary values**
Notes:	• Values are supported **only by DKG with device address 1..31** (firmware version 1.20/1.21). • No answer will be sent – if Analog-MUX transmission has been configured – if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**	**Mux**	**High**	**Low**		
784	310	0	HI	LO	CD-0	Input Table
785	311	1	HI	LO	CD-1	Input Table
786	312	2	HI	LO	CD-2	Input Table
787	313	3	HI	LO	CD-3	Input Table
...	...	...	HI	LO	...	Input Table

Register Address			Register 16bit		Value	
Dec	Hex	Mux	High	Low		
799	31F	F	HI	LO	CD-F	Input Table
800	320	0	HI	LO	EF-0	Input Table
...	...	...	HI	LO	...	Input Table
815	32F	F	HI	LO	EF-F	Input Table
816	330	0	HI	LO	GH-0	Input Table
...	...	...	HI	LO	...	Input Table
831	33F	F	HI	LO	GH-F	Input Table
832	340	0	HI	LO	IJ-0	Input Table
...	...	...	HI	LO	...	Input Table
847	34F	F	HI	LO	IJ-F	Input Table
848	350	0	HI	LO	KL-0	Input Table
...	...	...	HI	LO	...	Input Table
863	35F	F	HI	LO	KL-F	Input Table
864	360	0	HI	LO	MN-0	Input Table
...	...	...	HI	LO	...	Input Table
879	36F	F	HI	LO	MN-F	Input Table
880	370	0	HI	LO	OP-0	Input Table
...	...	...	HI	LO	...	Input Table
895	37F	F	HI	LO	OP-F	Input Table

3.3.8 FC03: Read Channel Output Status

Function Code	Description
03 **READ**	• Reads information previously written by a Modbus command for transmission on Dupline. • Maximum number of registers: 1..8 • Register values: – 0: Off – 1: On
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit				
Dec	Hex		High	Low			
4096	1000		B8..B1	A8..A1			Digital
4097	1001		D8..D1	C8..C1			Digital
..	..		..	..			
4102	1006		N8..N1	M8..M1			Digital
4103	1007		P8..P1	O8..O1			Digital

3.3.9 FC03: Read Forced Channel Output Status

Function Code	Description
03 **READ**	• Reads information for transmission on the Dupline bus which has previously been written by a Modbus **force** (see 3.4.1 and 3.4.4) command. • Number of registers: 1..8 • Register values: – 0: Off – 1: On
Notes:	• Values are supported **only by DKG with device address 1..31** (firmware version 1.20/1.21). • No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit				
Dec	**Hex**		**High**	**Low**			
4112	1010		B8..B1	A8..A1			Digital
4113	1011		D8..D1	C8..C1			Digital
..	..		..	..			
4118	1016		N8..N1	M8..M1			Digital
4119	1017		P8..P1	O8..O1			Digital

3.3.10 FC03: Read Multiplexed Analog Output Table

Function Code	Description
03 **READ**	• Reads multiplexed analog output values written to the bus • Number of registers: 1..32 • Adresses A1..A4 hold the current multiplex address. The remaining bits hold the digital transmit information from channel A5..B8 • Registers 1300h to 137Fh **BCD** values • Registers 1400h to 147Fh **BINARY** values
Notes:	• Values are supported **only by DKG with device address 1..31** (firmware version 1.20/1.21). • No answer will be sent – if Analog-MUX transmission has been configured – if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**	**Mux**	**High**	**Low**		
4880	1310	0	HI	LO	CD-0	Output Table
4881	1311	1	HI	LO	CD-1	Output Table
4882	1312	2	HI	LO	CD-2	Output Table
4883	1313	3	HI	LO	CD-3	Output Table
...	...	...	HI	LO	...	Output Table
4895	131F	F	HI	LO	CD-F	Output Table
4896	1320	0	HI	LO	EF-0	Output Table
...	...	...	HI	LO	...	Output Table
4911	132F	F	HI	LO	EF-F	Output Table
4912	1330	0	HI	LO	GH-0	Output Table
...	...	...	HI	LO	...	Output Table
4929	133F	F	HI	LO	GH-F	Output Table
4930	1340	0	HI	LO	IJ-0	Output Table
...	...	...	HI	LO	...	Output Table
4943	134F	F	HI	LO	IJ-F	Output Table
4944	1350	0	HI	LO	KL-0	Output Table
...	...	...	HI	LO	...	Output Table
4959	135F	F	HI	LO	KL-F	Output Table
4960	1360	0	HI	LO	MN-0	Output Table
...	...	...	HI	LO	...	Output Table
4975	136F	F	HI	LO	MN-F	Output Table
4976	1370	0	HI	LO	OP-0	Output Table
...	...	...	HI	LO	...	Output Table
4990	137F	F	HI	LO	OP-F	Output Table

3.3.11 FC03: Read Radio Modem Substation Status

Function Code	Description
03 **READ**	• Delivers information about the presence of substations in radio modem network • Data delivered only by radio modem central station • Reading of 2 registers • 32 bits indicating the presence of a radio modem substation • Register 2000h, MSB = Substation no 00 (central = 00), LSB = Substation no 15 • Register 2001h, MSB = Substation no 16, LSB = Substation no 31
Notes:	• Status values only are valid channel generator is configured as radio modem central.

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
8192	2000		HI	LO	(Sub-)Stations 0..15	Status
8193	2001		HI	LO	Substations 16..31	Status

3.3.12 FC03: Read RS485 Network Slave Status

Function Code	Description
03 **READ**	• Delivers information about the presence of slaves in an RS485 channel generator network • Reading of 2 registers • 32 bits indicating the presence of slaves in the Network • Register 2002h, MSB = Slave no 00 (master = 00), LSB = Slave no 15 • Register 2003h, MSB = Slave no 16, LSB = Slave no 31
Notes:	• Status values only are valid channel generator is configured as network master.

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
8194	2002		HI	LO	Master/Slaves 0..15	Status
8195	2003		HI	LO	Slaves 16..31	Status

3.3.13 FC03: Read Channel Generator's Internal Time/Date

Function Code	Description
03 **READ**	• Reads generators internal 24-hour clock • Format: hh.mm, ss, DoW, MM, DD, YYYY • Day of Week (DoW): 1 (Monday) ..7 (Sunday) • The Data format is BCD
Notes:	• All **4** Registers must be read **simultaneously**.

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
8208	2010		HH	MM	Hours / Minutes	
8209	2011		SS	DoW	Seconds/Day of Week	
8210	2012		MM	DD	Month / Day	
8211	2013		YY	YY	Year	

3.3.14 FC03: Read AnaLink Channels' Setpoint Values

Function Code	Description
03 **READ**	• Read AnaLink channels' setpoint values, as configured or as set by a previous Modbus write command. • Legal Values lie in the range from 0 to 255, and must be scaled according to the type of analink signal. • Responds only, if channel is configured for AnaLink channel type. • 4 Registers per Setup. • Number of registers: 4..32
Notes:	• No answer will be sent – if the channel has not been configured to be a sensor (AnaLink value); – if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
16384	4000		HI	LO	A1 Limit 1 Low	Setup
16385	4001		HI	LO	A1 Limit 1 High	Setup
16386	4002		HI	LO	A1 Limit 2 Low	Setup
16387	4003		HI	LO	A1 Limit 2 High	Setup
16388	4004		HI	LO	A2 Limit 1 Low	Setup
..	..		..	..	..	
16892	41FC		HI	LO	P8 Limit 1 Low	Setup
16893	41FD		HI	LO	P8 Limit 1 High	Setup
16894	41FE		HI	LO	P8 Limit 2 Low	Setup
16895	41FF		HI	LO	P8 Limit 2 High	Setup

3.3.15 FC03: Read Real-time Switches' Set-up Values

Function Code	Description
03 **READ**	• Reads times and days of time switch channels as configured or as set by a previous Modbus write-command. • 16 registers per time switch. • Number of registers: 1..32 • Hours and minutes in BCD • Switch times with value FFh are not active. • Days: – MSB: Holiday – LSB: starting with Monday
Notes:	• No answer will be sent – if one of the requested channels is not configured as time switch. – if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
24576	6000	A1	hour	min	ON-time 1	Setup
24577	6001	A1	hour	min	OFF-time 1	Setup
24578	6002	A1	xxx	days	Day select 1	Setup
24579	6003	A1	xxx	xxx	don't care	Setup
24580	6004	A1	hour	min	ON-time 2	Setup
24581	6005	A1	hour	min	OFF-time 2	Setup
24582	6006	A1	xxx	days	Day select 2	Setup
24583	6007	A1	xxx	xxx	don't care	Setup
24584	6008	A1	hour	min	ON-time 3	Setup
24585	6009	A1	hour	min	OFF-time 3	Setup
24586	600A	A1	xxx	days	Day select 3	Setup
24587	600B	A1	xxx	xxx	don't care	Setup
24588	600C	A1	hour	min	ON-time 4	Setup
24589	600D	A1	hour	min	OFF-time 4	Setup
24590	600E	A1	xxx	days	Day select 4	Setup
24591	600F	A1	xxx	xxx	don't care	Setup
24592	6010	A2	hour	min	ON-time 1	Setup
..	..		..	..	..	
26608	67F0	P8	hour	min	ON-time 1	Setup
..	..		..	..	..	
26620	67FC	P8	hour	min	ON-time 4	Setup
26621	67FD	P8	hour	min	OFF-time 4	Setup
26622	67FE	P8	xxx	days	Day select 4	Setup
26623	67FF	P8	xxx	xxx	don't care	Setup

3.3.16 FC03: Read Pulse Counters' Logging Date Tag

Function Code	Description
03 READ	• Read pulse counters logging date tag • Date and month in BCD.
Notes:	• Values are only available in conjunction with the Dupline Online service and corresponding hardware. • If date and/or time contain the value 00h, no logging has been performed. • No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Log Time	
Dec	**Hex**		**High**	**Low**		
49152	C000		Month	Date	00:00	Log Date
49153	C001		Month	Date	00:30	Log Date
49154	C002		Month	Date	01:00	Log Date
49155	C003		Month	Date	01:30	Log Date
..	..		..	..	..	
49198	C02E		Month	Date	23:00	Log Date
49199	C02F		Month	Date	23:30	Log Date

3.3.17 FC03: Read Pulse Counters' Latched (Frozen) Values

Function Code	Description
03 READ	• Reads the values of frozen counters (see **Chapter 3.4.11** on **Page 32**). • Data format: BCD from 0 to 9999 • Number of registers: 1..32
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit			
Dec	**Hex**		**High**	**Low**		
49408	C100	A1	Hi	Lo		Pulse count
49409	C101	A2	Hi	Lo		Pulse count
49410	C102	A3	Hi	Lo		Pulse count
49411	C103	A4	Hi	Lo		Pulse count
..	..		..	..	..	
49534	C17E	P7	Hi	Lo		Pulse count
49535	C17F	P8	Hi	Lo		Pulse count

3.3.18 FC03: Read Pulse Counters' Logged Values

Function Code	Description
03 **READ**	• Reads pulse counters' logged values. • Data format: BCD from 0 to 9999 • 128 registers per half hour log • Number of registers: 1..32
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Log at	
Dec	**Hex**		**High**	**Low**	**(hour)**	
52248	D000	A1	Hi	Lo	00:00	Pulse count
52249	D001	A2	Hi	Lo	00:00	Pulse count
52210	D002	A3	Hi	Lo	00:00	Pulse count
..	..		..	..	..	
53375	D07F	P8	Hi	Lo	00:00	Pulse count
53376	D080	A1	Hi	Lo	00:30	Pulse count
..	..		..	..	..	
53503	D0FF	P8	Hi	Lo	00:30	Pulse count
53504	D100	A1	Hi	Lo	01:00	Pulse count
..	..		..	..	..	
65408	FF80	A1	Hi	Lo	23:30	Pulse count
..	..		..	..	..	
65535	FFFF	P8	Hi	Lo	23:30	Pulse count

3.4 Write Commands

3.4.1 FC05: Force Single Dupline Output Statel

Function Code	Description
05 **WRITE**	• Forces the input state of a Dupline channel. • FC01 delivers the latest state forced • Number of registers: 1 • Register values: – 0: Off (release function) – 1 and higher: On (start function and keep channel activated)
Notes:	• This write command enforces the status of the Dupline address, depending on the configured function. If e. g. a toggle switch function is regarded, the first ON-command will switch the address permanently on. In this state, a change by input signals (e.g. a push-button) is not possible. To turn off the address again, an off command and then an additional On command is first to send. Only after the final sending of an off command, the address can be operated manually again. • To set the Dupline address states in the way of input signals (e. g. push-buttons), please use the function code 05 (starting at address 3000hex).

Register Address			Register 8bit				
Dec	**Hex**						
5376	1500	A1		00 = OFF			Bit
5377	1501	A2		01 = ON			Bit
..	..	..					
5503	157F	P8					Bit

Request (example):

01	05	1500	FF	00	8836
					checksum
				dummy	
			command		
		address to be written (1500hex = 5376dec)			
	function code				
Modbus slave address					

Response (example):

01	05	1500	FF	00	8836
					Checksum
				data byte 2 (status „ON“)	
			data byte 1 (dummy)		
		address written (1500hex = 5376dec)			
	function code				
Modbus slave address					

3.4.2 FC05: Activate Single Dupline Channel

Function Code	Description
05 **WRITE**	• Triggers a Dupline channel. • Number of registers: 1 • Register values: – 0: allowed, but without function – 1 or higher: On (start function on this channel)
Notes:	• This command influences the „pull-down“ signal as if it would be an input module (sender). Thus the switching behaviour of the channel depends on the type of configured object in ProLine^{NG}.

Register Address			Register 8bit				
Dec	**Hex**						
12288	3000	A1		00 = OFF			Bit
12289	3001	A2		01 = ON			Bit
..	..	..					
12295	307F	P8					Bit

Example: see **Chapter 3.4.1** on **Page 26**.

3.4.3 FC05: Reset Single Multiplex Counter

Function Code	Description
05 **WRITE**	• Resets a single counter value by writing a „1“. • Number registers: 1 • Value: – 0: does nothing – 1: resets the counter value
Notes:	• -

Register Address			Register 8bit				
Dec	**Hex**						
49152	C000	0	Hi	Lo			Bit
49153	C001	1	Hi	Lo			Bit
49154	C002	2	Hi	Lo			Bit
49155	C003	3	Hi	Lo			Bit
..	..	..	..	..			..
49278	C07E	126	Hi	Lo			Bit
49279	C07F	127	Hi	Lo			Bit

3.4.4 FC06: Force Multiple Channel Output States.

Function Code	Description
06 **WRITE**	• Forces the output states of multiple Dupline channels. • Number of registers: 1 • Register values: – 0: Off (release function) – 1: On (start function and keep channel activated)
Notes:	• The switching behaviour of the channel depends on the type of the object configured in ProLine^{NG}.

Register Address			Register 8bit				
Dec	**Hex**						
4096	1000		B8..B1	A8..A1			Digital
4097	1001		D8..D1	C8..C1			Digital
..	..		..				
4103	1007		P8..P1	O8..O1			Digital

3.4.5 FC16: Trigger Output States of Multiple Channels

Function Code	Description
16 **WRITE**	• Triggers the output states of multiple Dupline channels. • Number of registers: 1..8 • Register values: – 0: Off (reset channel output) – 1: On (start function and keep channel activated)
Notes:	• The switching behaviour of the channel depends on the type of the object configured in in the channel generator. • No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 8bit				
Dec	**Hex**						
4096	1000		B8..B1	A8..A1			Digital
4097	1001		D8..D1	C8..C1			Digital
..	..		..				
4103	1007		P8..P1	O8..O1			Digital

3.4.6 FC16: Force Output States of Multiple Channels.

Function Code	Description
16 **WRITE**	• Forces the output state of multiple channels (as master function). • Number of registers: 1..8 • Register values: – 0: Off (reset channel output) – 1: On (start function and keep channel activated)

Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 8bit				
Dec	**Hex**						
4112	1010		B8..B1	A8..A1			Digital
4113	1011		D8..D1	C8..C1			Digital
..	..		..				
4119	1017		P8..P1	O8..O1			Digital

3.4.7 FC16: Write Multiplexed Analog Output Table

Function Code	Description
16 **WRITE**	• Writes Multiplexed-Analog-Values for output to the bus. • Number of registers: 1..32 • Registers 1300h to 137Fh: **BCD** values • Registers 1400h to 147Fh: **Binary** values
Notes:	• Values are supported **only by DKG with device address 1..31** (firmware version 1.20/1.21). • The DKG only reacts if Analog-MUX transmission has been configured. • No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**	**Mux**	**High**	**Low**		
4880	1310	0	HI	LO	CD-0	Output Table
4881	1311	1	HI	LO	CD-1	Output Table
4882	1312	2	HI	LO	CD-2	Output Table
4883	1313	3	HI	LO	CD-3	Output Table
...	...	...	HI	LO	...	Output Table
4895	131F	F	HI	LO	CD-F	Output Table
4896	1320	0	HI	LO	EF-0	Output Table
...	...	...	HI	LO	...	Output Table
4911	132F	F	HI	LO	EF-F	Output Table
4912	1330	0	HI	LO	GH-0	Output Table
...	...	...	HI	LO	...	Output Table
4929	133F	F	HI	LO	GH-F	Output Table
4930	1340	0	HI	LO	IJ-0	Output Table
...	...	...	HI	LO	...	Output Table
4943	134F	F	HI	LO	IJ-F	Output Table
4944	1350	0	HI	LO	KL-0	Output Table
...	...	...	HI	LO	...	Output Table

Register Address			Register 16bit		Value	
Dec	Hex	Mux	High	Low		
4959	135F	F	HI	LO	KL-F	Output Table
4960	1360	0	HI	LO	MN-0	Output Table
...	...	...	HI	LO	...	Output Table
4975	136F	F	HI	LO	MN-F	Output Table
4976	1370	0	HI	LO	OP-0	Output Table
...	...	...	HI	LO	...	Output Table
4990	137F	F	HI	LO	OP-F	Output Table

3.4.8 FC16: Set Channel Generator's Internal Time/Date

Function Code	Description
16 **WRITE**	• Writes generators internal 24-hour clock • Format: hh.mm, ss, DoW, MM, DD, YYYY • Day of Week (DoW): 1 (Monday) ..7 (Sunday) • Data format: BCD
Notes:	• All **4** registers must be written simultaneously. • No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	Hex		High	Low		
8192	2000		HH	MM	Hours / Minutes	Setup
8193	2001		SS	DoW	Seconds/Day of Week	Setup
8194	2002		MM	DD	Month / Day	Setup
8195	2003		YY	YY	Year	Setup

3.4.9 FC16: Write AnaLink Channels' Limit Values

Function Code	Description
16 **WRITE**	• Writes the limit values for one or multiple analog sensor objects. • Allowed values: 0...255 (observe scaling!) • 4 registers per sensor. • Number of registers: 1..32
Notes:	• No answer will be sent – if the channel has not been configured as sensor (AnaLink value); – if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
16384	4000		HI	LO	A1 Limit 1 Low	Setup
16385	4001		HI	LO	A1 Limit 1 High	Setup
16386	4002		HI	LO	A1 Limit 2 Low	Setup
16387	4003		HI	LO	A1 Limit 2 High	Setup
16388	4004		HI	LO	A2 Limit 1 Low	Setup
..	..		..	..	..	
16892	41FC		HI	LO	P8 Limit 1 Low	Setup
16893	41FD		HI	LO	P8 Limit 1 High	Setup
16894	41FE		HI	LO	P8 Limit 2 Low	Setup
16895	41FF		HI	LO	P8 Limit 2 High	Setup

3.4.10 FC16: Write Real-time Switches' Set-up Values

Function Code	Description
16 **WRITE**	• Writes the switching times and holiday settings of time switches. • 16 registers per time switch. • Number of registers: 1..32 • Hour and Minutes in BCD • To disable an on or off setting, write FFh to the „hour“ byte. • Days: – MSB: Holiday – LSB: starting with Monday
Notes:	• No answer will be sent – if the channel has not been configured as time switch; – if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 16bit		Value	
Dec	**Hex**		**High**	**Low**		
24576	6000	A1	hour	min	ON-time 1	Setup

Register Address			Register 16bit		Value	
Dec	Hex		High	Low		
24577	6001	A1	hour	min	OFF-time 1	Setup
24578	6002	A1	xxx	days	Day select 1	Setup
24579	6003	A1	xxx	xxx	don't care	Setup
24580	6004	A1	hour	min	ON-time 2	Setup
24581	6005	A1	hour	min	OFF-time 2	Setup
24582	6006	A1	xxx	days	Day select 2	Setup
24583	6007	A1	xxx	xxx	don't care	Setup
24584	6008	A1	hour	min	ON-time 3	Setup
24585	6009	A1	hour	min	OFF-time 3	Setup
24586	600A	A1	xxx	days	Day select 3	Setup
24587	600B	A1	xxx	xxx	don't care	Setup
24588	600C	A1	hour	min	ON-time 4	Setup
24589	600D	A1	hour	min	OFF-time 4	Setup
24590	600E	A1	xxx	days	Day select 4	Setup
24591	600F	A1	xxx	xxx	don't care	Setup
24592	6010	B1	hour	min	ON-time 1	Setup
..	..		..	..	..	
26608	67F0	P8	hour	min	ON-time 1	Setup
..	..		..	..	..	
26620	67FC	P8	hour	min	ON-time 4	Setup
26621	67FD	P8	hour	min	OFF-time 4	Setup
26622	67FE	P8	xxx	days	Day select 4	Setup
26623	67FF	P8	xxx	xxx	don't care	Setup

3.4.11 FC16: Reset and Freeze Pulse Counter.

Function Code	Description
16 **WRITE**	• The reset command clears all pulse counters. • The freeze command latches the actual counter-values so they may be read by the Function Code 3 (see **Chapter 3.3.6** on **Page 17**). • Only when value is AA55h, the commands are executed. • Number of registers: 1
Notes:	• No answer will be sent if the maximum number of registers or the register range has been overrun (illegal function).

Register Address			Register 8bit				
Dec	Hex		High	Low			
40960	A000		AAh	55h			Reset
40961	A001		AAh	55h			Freeze

Doepke

Schaltgeräte GmbH
Stellmacherstraße 11
26506 Norden
Telefon: +49 4931 1806-0
Telefax: +49 4931 1806-101
E-Mail: info@doepke.de
www.doepke.de

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