EWELLIX

MAKERS IN MOTION

REFERENCE AND PROGRAMMING MANUAL
SCU CONTROL UNIT

RS232 interface SCU control unit

Contents

⚠ WARNING

Read this manual before installing, operating or maintaining this actuator. Failure to follow safety precautions and instructions could cause actuator failure and result in serious injury, death or property damage.

1.0 Introduction

This chapter contains information regarding the structure and the organization of the operation manual which simplifies use of the operation manual and makes it possible to obtain rapid access to desired information.

1.1 Content

This operation manual contains a description of the RS232 serial interface of the SCU control unit. Please note that the RS232 interface is an option with the SCU control unit and must be ordered on the basis of the type key.

1.1.1 Validity scope

The information in this operation manual concern the serial interface for the SCU control unit with the following identification:

- Manufacturer: Ewellix
- Product name: SCU control unit with serial RS232 interface
- Type designation: SCUxx-xxxxx1-xxxx
- Year of manufacture: after 2007 with Firmwave version V2B0
- CE identification: in accordance with technical documentation

1.1.2 Target group

This manual is intended for development engineers who have the necessary professional knowledge to be able to develop control software for the operation of this product.

1.2 Presentation conventions

In this operation manual we employ certain abbreviations and markings to identify text sections or advice.

1.2.1 Safety advice

WARNING:

Safety advice to notify of danger of irreparable damage to equipment and persons based on hazard analyses. This includes advice as regards protective measures and any required special training and personal protective gear.

Such advice is indicated as follows:

⚠ WARNING

The hazard source is indicated.
Description of possible consequences!

- Measures that can be taken to prevent the hazard.

CAUTION:

Safety advice regarding remaining hazards that may still be present due to inadequate functioning of protective measures against damage to equipment and persons. Advice regarding any required special training and personal protective gear.

Such advice is indicated as follows:

⚠ CAUTION

The hazard source is indicated.
Description of possible consequences!

- Measures that can be taken to prevent the hazard.

1.2.2 Other advice

Advice regarding important and/or useful additional information to be taken into consideration during maintenance work.

Such advice is indicated as follows:

ADVICE:

Advice text is identified.

1.2.3 Code examples

The code examples given in the manual are in C++ and serve as clarification.

The code examples are set off using normal software formatting:

```
unsigned short HelloWorld()
{
//@todo
}
```

1.2.4 Cross-references

Cross-references to sections in other areas of the operation manual are bracketed. They contain the corresponding header text and page number.

Cross-references are indicated as follows:

(↳ **1.2.4 Cross-references, page 5**).

1.2.5 Referencing of diagram details

Details in diagrams are sequentially lettered clockwise and correspondingly referenced in the text.

2.0 Safety

Safety advice in this manual is differentiated according to applicability as follows.

- **General safety advice**
  Such safety advice applies in general and is to be taken into consideration on replacement of any assembly group. They are given in the section General Safety Advice.
- **Special safety advice**
  Such safety advice is only relevant for some assembly groups. This type of advice is found in the replacement description for the assembly group concerned.

2.1 General safety advice

With maintenance work please take the following safety advice into consideration:

⚠ WARNING

Maintenance work with live units.
Electrical shock!

- Switch off the unit prior to carrying out any maintenance work and take out the mains plug.

⚠ WARNING

Squashing of or damage to cables.
Electrical shock!

- Please pay attention to correct cable strain relief and cable routing on installing assembly groups.

⚠ CAUTION

Unintentional movement of work bench.
Damage to exposed device parts!

- Prior to starting maintenance work set all locking brakes.

⚠ CAUTION

Use of unsuitable tools or materials.
Damage / defective operation of the device!

- Please only use original parts and the specified special tool.

3.0 Technical overview

The basic technical characteristics of the serial interface are given in this chapter.

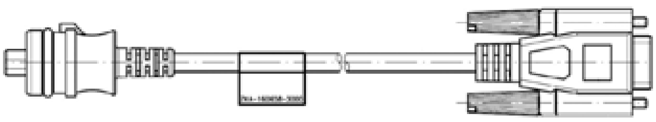
NOTE

If the remote user does not provide a mains supply according to medical standards (safety according to ENE60601-1) the final application has to be grounded to ensure a correct operation of RS232 interface.

3.1 Connection cable

Recommended connection cable: ZKA-160658-3000

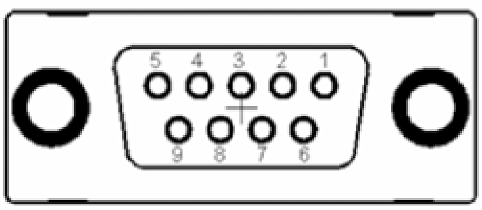
Fig. 1



3.2 Physical layer

- Electrical characteristics in accordance with RS232 definition
- Half duplex
- Bi-directional
- Baud rate: With standard control units the baud rate is set to 38400.
  With customized control units the baud rate may be set to the following values: 9600, 19200, 38400.
- Plug: 9-pole SUB-D (female)
- The control lines are not used. However, DTR and RTS must be switched on as permanently active because they supply the RS232 converter in the control unit.
  Instead of the DTR and RTS signals a separate power source of 5.5…15
  VDC/30mA can be connected (+ on pin 4 DTR or pin 7 RTS and – on pin 5 GND)
- Connection allocation:

Fig. 2



2. RxD
3. TxD
4. DTR
5. GND
7. RTS

3.3 Data link layer

- One start bit
- 8 data bits (LSB first)
- One stop bit
- No parity bit
- No handshake

3.4 Network layer

- Point to point connection (only two participants)
- The control unit functions as slave and replies to the requests of the master (e.g. PC program)
- The slave replies to each request from the master
- Maximum request delay: 2 000 ms
- Maximum delay between individual telegram bytes: 1 000 ms
- When the control is operated with batteries and the parameterization is set to <Low Power> = Enabled and the controller is set at low power mode, the controller can be set to remote mode in holding the circuit RXD during min. 100 ms at status “space” (Level > +3 V) (from FW V2B1).
- When the control is operated with batteries and the parameterization is set to <Low Power> = Enabled and the remote mode is activated, but there is no command, the controller does not go to low power mode. If the communication is interrupted at this status the controller sets to low power mode (from FW V2B1).

3.5 Transport layer

3.5.1 Telegram structure

Request:	<X><Y>[<P1><P2>…<Pn>]<C1><C2>
Reply:	<X><Y>[<P1><P2>…<Pn>]<C1><C2>
Request:	<X><Y>[<P1><P2>…<Pn>]<C1><C2>
Reply:	<X><Y>[<P1><P2>…<Pn>]<C1><C2>

[ ] :	optional
<X> :	Major Kommando Nummer (1Byte)
<Y> :	Minor Kommando Nummer (1Byte)
<P1>…<Pn> :	Parameter Bytes (Intel Little Endian Format, LS Byte... MS Byte)
<C1> :	Low Byte der 16 Bit Telegramm Checksumme
<C2> :	High Byte of 16 Bit Telegramm Checksumme

The checksums are calculated using the standard algorithm CCITT CRC-16. The polynomial for the algorithm is CRC16 = x^16 + x^12 + x^5 + 1. The start value is 0.

Each reply includes an ACK byte, which contains the device status. Many replies contain the parameter ctp in P1/P2. This defines the number of the following data bytes. Each reply that contains more than 1 data byte uses a ctp for the definition of data length.

A telegram can be described as follows:

Request:	<X><Y>[<P1><P2>…<Pn>]<C1><C2>
Reply:	<X><Y><ACK>[<<ctp1><ctp2>=n><P><P4>…<Pn+2>]<C1><C2>

4.0 Communication protocol

4.1 Command set

The following commands are available after mains on or in battery operation:

- The remote function is activated with the RO command.
- The remote function is deactivated with the RA command.
- To maintain the remote function, the RC command must be executed in a repeated cycle at least every 1 000 ms. Each additional remote command (RG, RT, RC, RE, RS, except for RO, RA) must be executed in a repeated cycle at least every 500 ms.
- The RG, RT, RC, RE and RS commands are only available if the remote function is activated.

The control lines DTR and RTS must be permanently switched on so that the RS232 converter is supplied and communication with the SCU is possible.

Table 1

Cmd <X>Y>	Name	Query parameter						Reply parameter					Description
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4	Pn	
RG	Remote data get	data_ID [0]	data_ID [1]	–	–	–	–	ACK, **e	ctp1	ctp2	1. Data byte	n-2. Data byte	Data transfer from SCU P2 to Pn as reply only if P1 = ACK
RT	Remote data tranfer	ctp1	ctp2	data_ID [0]	data_ID [1]	1. Data byte	n-4. Data byte	ACK, **e	–	–	–	–	Data transfer to SCU. Only data_Ids 3xxx are permitted (RemoteData)!
RC	Remote cyclic	ctp1	ctp2	Index of cyclicObj	1. Byte write data of cyclicObj	2. Byte write data of cyclicObj	n-3. Byte write data of cyclicObj	ACK, **e	ctp1	ctp2	1. Byte read data of cyclicOBj	n-3. Byte read data of cyclicObj	Must be sent at least every 500 ms so that the SCU remains in Remote-Mode (WDT). With P3 = -1 no data are transferred, otherwise P3 is the index for cyclicObj, which defines the query/reply data P3=0: cyclicObj with dataID=3001 P2 to Pn is in the reply only if P1 = ACK
RE	Remote execute function	fnc_ID	para_ID [0]	para_ID [1]	–	–	–	ACK, **e	–	–	–	–	Execution of a function. P1 is the index in the function list. P2/3 are additional function parameters, note. Note the definitions of fnc_ID and para_ID.
RS	Remote stop function	fnc_ID	para_ID [0]	–	–	–	–	ACK, **e	–	–	–	–	Stops a function. P1 is the index in the function list. P2/3 are additional function parameters, note. Note definitions of fnc_ID and para_ID.
RO	Remote mode open	Safety ID	para_ID [0]	–	–	–	–	ACK, **e	–	–	–	–	Safety_ID = 0: If a communication timeout (0.5 s) occurs, all movements are terminated, that is, no movement will be started. If a communication timeout occurs, only the RC, RA and RO commands are available. Safety_ID = 1: If a communication timeout (0.5 s) occurs, all movements are terminated. Safety ID = 2: If a communication timeout (0,5 s) occurs, only remote motion is terminated. (for FWV2B3)
RA	Remote mode abort	–	–	–	–	–	–	ACK, **e	–	–	–	–	Set the SCU is in normal mode (without reset).

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4.2 Communication error and acknowledge codes

Table 2

Code	Hax	Dec	Name	Description
ACK	06	6	Command acknowledged	Query accepted
CSE	80	128	Checksum error	Error in the telegram checksum
PDE	81	129	Parameter data error	Error in the telegram data bytes
PCE	82	130	Parameter count error	Incorrect counter level of the telegram data bytes
ICE	83	131	Invalid command error	Unknown command code
PE	84	132	Permission error	Command not possible with SCU mode/state

Table 3

Code	Value	Description
ctp	Dyn	Number of following telegram bytes
data_ID	Dyn	Index in data list (↳ **Table 4, page 12**)
fnc_id	Dyn	Index for function list (↳ **Table 5, page 15**)
para_id	Dyn	Additional parameters depend on function (↳ **Table 6, page 15**)

4.3 Abbreviations used

4.4 Data list

The specific settings and the status of the control unit can be queried via the data list (RG command). Both individual values and entire blocks can be queried. The values with collection index 3 000 can be described with the RT command.

Table 4

Primary collection index	Secondary collection index	Data index	Name	Data type	Comment
0000		0001	Firmware info Name Version CS	STRING	Size = 31 byte
		0002	Configuration info Name Version CS	STRING	Size = 36 byte
	0010	0011	Actual_Position Actuator 1	INT32	Unit: Encoder flank (count)
		0012	Actual_Position Actuator 2	INT32	
		0013	Actual_Position Actuator 3	INT32	
		0014	Actual_Position Actuator 4	INT32	
		0015	Actual_Position Actuator 5	INT32	
		0016	Actual_Position Actuator 6	INT32	
	0020		Actual_State_Binary Inputs 1...4	UINT8	Logic level Bit 0: binary input 1 (0 = not active/ 1 = active) Bit 1: binary input 2 (0 = not active/ 1 = active) Bit 2: binary input 3 (0 = not active/ 1 = active) Bit 3: binary input 4 (0 = not active/ 1 = active) Input level Bit 4: binary input 1 (0 = not active/ 1 = active) Bit 5: binary input 2 (0 = not active/ 1 = active) Bit 6: binary input 3 (0 = not active/ 1 = active) Bit 7: binary input 4 (0 = not active/ 1 = active)
	0030	0031	Actual_State_Analogue_Input_1	UINT16	Data: 0...600 Resolution 0.01V Range: 0…6.00V
		0032	Actual_State_Analogue_Input_2	UINT16	
		0033	Actual_State_Analogue_Input_3	UINT16	
		0034	Actual_State_Analogue_Input_4	UINT16	
	0040		Actual_State_Keys	UINT32	Bit 0: K1 … Bit 19: K20 Bit 20 … Bit 31 not used (0 = open / 1 = closed)
	0060	0061	Number_cycle_off_on_off_Relay_in A1	UINT32	
		0062	Number_cycle_off_on_off_Relay_in A2	UINT32	
		0063	Number_cycle_off_on_off_Relay_in A3	UINT32	
		0064	Number_cycle_off_on_off_Relay_in A4	UINT32	
		0065	Number_cycle_off_on_off_Relay_in A5	UINT32	
		0066	Number_cycle_off_on_off_Relay_in A6	UINT32	

Primary collection index	Secondary collection index	Data index	Name	Data type	Comment
0000	0070	0071	Number_cycle_off_on_off_ Relay_out A1	UINT32	
		0072	Number_cycle_off_on_off_ Relay_out A2	UINT32	
		0073	Number_cycle_off_on_off_ Relay_out A3	UINT32	
		0074	Number_cycle_off_on_off_ Relay_out A4	UINT32	
		0075	Number_cycle_off_on_off_ Relay_out A5	UINT32	
		0076	Number_cycle_off_on_off_ Relay_out A6		
	0080	0081	Number_Actuator error A1	UINT32	count 2 byte: number of actuator error 1 byte: number of peak current occurrence 1 byte: number of short circuit occurrence
		0082	Number_Actuator error A2	UINT32	
		0083	Number_Actuator error A3	UINT32	
		0084	Number_Actuator error A4	UINT32	
		0085	Number_Actuator error A5	UINT32	
		0086	Number_Actuator error A6	UINT32	
		008F	Number_Total_Over_Current	UINT32	
	0090	0091	Cumulated_Stroke A1	UINT32	Unit: Encoder flank
		0092	Cumulated_Stroke A2	UINT32	
		0093	Cumulated_Stroke A3	UINT32	
		0094	Cumulated_Stroke A4	UINT32	
		0095	Cumulated_Stroke A5	UINT32	
		0096	Cumulated_Stroke A6	UINT32	
	00A0	00A1	Current A1	UINT16	Data: 0...1000 Unit: fixed-point 0.1A Range: 0..100A
		00A2	Current A2	UINT16	
		00A3	Current A3	UINT16	
		00A4	Current A4	UINT16	
		00A5	Current A5	UINT16	
		00A6	Current A6	UINT16	
	00B0	00B1	Max_Current A1	UINT16	Data: 0...1000 Unit: fixed-point 0.1A Range: 0..100A
		00B2	Max_Current A2	UINT16	
		00B3	Max_Current A3	UINT16	
		00B4	Max_Current A4	UINT16	
		00B5	Max_Current A5	UINT16	
		00B6	Max_Current A6	UINT16	
		00BF	Max_Total_Current	UINT16	
		00C0	Max_Temp_Rectifier_FET	UINT8	Unit: ADC value. 0...255
		00C1	Number_Over_Temp_ Rectifier_FET	UINT32	
	00D0	00D1	Error_Code 1 (last recent)	UINT32	For structure see chapter **4.6 SCU error code**
		00D2	Error_Code 2 (History 1)	UINT32	
		00D3	Error_Code 3 (History 2)	UINT32	
		00D4	Error_Code 4 (History 3)	UINT32	
		00D5	Error_Code 5 (History 4)	UINT32	
	00E0	00E1	Actuator status 2 A1	UINT8	Bit 0; Initialization (0 = not initialized / 1 = initialized) Bit 1; Release flag for retraction (0 = no release / 1 = release) Bit 2; Release Flag for extension (0 = no release/ 1= release) Bit 3 to Bit 7 not used
		00E2	Actuator status 2 A2	UINT8	
		00E3	Actuator status 2 A3	UINT8	
		00E4	Actuator status 2 A4	UINT8	
		00E5	Actuator status 2 A5	UINT8	
		00E6	Actuator status 2 A6	UINT8	
	00F0	00F1	Speed A1	UINT16	If speed select relative: Unit: % Range: 0..100
		00F2	Speed A2	UINT16	
		00F3	Speed A3	UINT16	
		00F4	Speed A4	UINT16	
		00F5	Speed A5	UINT16	
		00F6	Speed A6	UINT16	

Primary collection index	Secondary collection index	Data index	Name	Data type	Comment
0000	0100		Battery Mains	UINT8	Bit 0 0/1: Mains not connected/connected Bit 1 0/1: Battery disconnected/connected Bit 2 0/1: Charging control on/off Bit 3 0/1: Charging process inactive / active
	0110		Binary Output Status	UINT8	Bit 0 0/1: Binary Output 1 off/on Bit 1 0/1: Binary Output 1 off/on
	0120		LED HS	UINT8	Bit 0 0/1: LED1 hand switch off/on Bit 1 0/1: LED2 hand switch off/on
	0130		LED LB	UINT8	Bit 0 0/1: LED1 locking box off/on Bit 1 0/1: LED2 locking box off/on … Bit 7 0/1: LED8 locking box off/on
		0140	Buzzer	UINT8	Bit 0 0/1: Buzzer off/on
		0150	Sensor Supply	UINT8	Bit 0 0/1: Sensor Supply off/on
		0162	Lock Status	UINT16	Bit 0 0/1: Function 0 unlocked/ locked Bit 1 0/1: Function 1 unlocked/ locked ... Bit 9 0/1: Function 10 unlocked/ locked
		0164	Battery voltage	UINT16	Unit: Fixed-point 0,1V Range: 0... 40,0 V
		0165	Locking Box detected	UINT8	0..2 locking box
		0166	User	UINT8	User 1..4
	0170	0171	Actuator Status 1 A 1	UINT8	Bit 0 0/1 drive unavailable/drive available Bit 1 0/1: signal limit_in_out inactive/aktive Bit 2 0/1: signal switch 1 inactive/active Bit 3 0/1: signal switch 2 inactive/active Bit 4 0/1: motion inactive/active Bit 5 0/1: in position not reached/reached Bit 6 0/1: out position Bit 7 0/1 Stroke not done/done
		0172	Actuator Status 1 A 2	UINT8	
		0173	Actuator Status 1 A 3	UINT8	
		0174	Actuator Status 1 A 4	UINT8	
		0175	Actuator Status 1 A 5	UINT8	
		0176	Actuator Status 1 A 6	UINT8	
1000	1010	1011-1016	Conversion factor A 1-6	FLOAT	
2000		2001	UserPositionData A 1	STRUCT	Structure definition according to **7.0 Structure definitions, page 23**: ACTUATOR_POSITIONS
		2002	UserPositionData A 2	STRUCT	
		2003	UserPositionData A 3	STRUCT	
		2004	UserPositionData A 4	STRUCT	
		2005	UserPositionData A 5	STRUCT	
		2006	UserPositionData A 6	STRUCT	
Remote data items Stored in volatile register. Initialized after reset with preset values.					
3000		3001	CyclicObj 1	UINT16[12]	With the CyclicObj definition the data transferred to and from the SCU with each RC command can be determined. The data indices set in the first 6 bytes (para[0..5] define the data to be sent to the SCU, (write data) and the data indices set in the last 6 bytes (para[6..11]) define the data that will be returned by the SCU (read data). A data index of –1 means no data transfer. All data can be read by the SCU, but only data with the indices 3xxx can be written. Default value: –1
		3002	CyclicObj 2	UINT16[12]	
		3003	CyclicObj 3	UINT16[12]	
		3004	CyclicObj 4	UINT16[12]	
		3005	CyclicObj 5	UINT16[12]	
	3010	3011-301A	Remote Speed F1-10	UINT16	Default value: function speed from configuration. If speed select relative: Unit: % Range: 0..100 If speed select absolute: Unit: Encoder flank/ s Range: 0..1000
	3020	3021-3026	Remote Position A1-6	INT32	Default value: memory 1 / user 3026 1 position of UserPositionData (DynamicConfiguration) Unit: Encoder flank

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4.5 Function list

Table 5

Func-ID	Value (dez.)	Used by command	Description	Para_ID[x]
F1...F10	0...9	RE, RS	Motion function (depends on parameterization)	Para_ID[0] according to Tab 4-1 Para_ID[1] = –1
F11	10	RE, RS	Buzzer (from FW V2B1)	Para_ID[0] = –1 Para_ID[1] = –1
F17	16	RE, RS	Binary Output 1 (from FW V2B1)	Para_ID[0] = –1 Para_ID[1] = –1
F18	17	RE, RS	Binary Output 2 (from FW V2B1)	Para_ID[0] = –1 Para_ID[1] = –1
F20	19	RE, RS	Emergency stop (from FW V2B1)	Para_ID[0] = –1 Para_ID[1] = –1
F21	20	RE, RS	Operating unit Led1 (from FW V2B1)	Para_ID[0] = –1 Para_ID[1] = –1
F22	21	RE, RS	Operating unit Led2 (from FW V2B1)	Para_ID[0] = –1 Para_ID[1] = –1

Parameter depends on function:

Table 6

Used for func_ID	Para_ID[1]	Value (dez.)	Description
F1-F10 (only with RE command)	motion_direction	0-9	0: Undefined direction (no motion) 1: Move to position In 2: Move to position Out 3: Move to position Mem1 4: Move to position Mem2 5: Move to position Mem3 6: Move to position Mem4 7: Move to position Intermediate In 8: Move to position Intermediate Out 9: Move to Remote Position
F1-F10 (only with RS command)	motion_stop	0-1	0: Fast Start/stop (start/stop ramp not considered) 1: Soft Start/stop (start/stop ramp considered)

The unused parameters in the telegram structure are to be set to –1 (unused_para).

The function of F1 – F10 is established in the control unit parameterization. A function can be assigned from one to six drives. If more than one drive is assigned to a function the drives may be coordinated among themselves:

- Simultaneous running in the same or opposite direction (simultaneous starting / stopping, but no position synchronization)
- Synchronized simultaneous running in the same direction or in the opposite direction (controlled position synchronization)

The second case can also be parameterized with a constant difference between the drives.

4.6 SCU Error code

Table 7

Bit in error field	Cause	Condition for appearance	Reaction
Bit 1	CRC error with ROM test. Faulty ROM	–	Motions are stopped and the control unit carries out a reset.
Bit 2	Error with RAM test. Faulty RAM.	–	Motions are stopped and the control unit carries out a reset.
Bit 3	Error with CPU test. Faulty CPU.	–	Motions are stopped and the control unit carries out a reset.
Bit 4	STACK overrun detected.	–	Motions are stopped (fast stop) and the control unit carries out a reset.
Bit 5	Program sequence error. Watchdog reset.	–	Motions are stopped (fast stop) and the control unit carries out a reset.
Bit 6	Error with hand switch test. Short detected in hand switch.	Only if hand switch is parameterized as “safe”	Motions are stopped (fast stop)
Bit 7	Error with binary inputs. Short detected between binary inputs.	Only if binary inputs are parameterized as safe and no analogue input is parameterized.	Motions are stopped (fast stop)
Bit 8	Error with relay and FET tests. Faulty relay or FET.	Test performed at start of motion.	Motion not executed.
Bit 9	–	–	–
Bit 10	Error with communication with MoveEnable controller. No reply from MoveEnable controller.	–	Motions stopped (fast stop).
Bit 11	Error with MoveEnable output test. The MoveEnable controller output is incorrect.	–	Motions stopped (fast stop).
Bit 12	Overtemperature detected at rectifier or FET.	–	Motions stopped (fast stop).
Bit 13	Switching off due to excessive discharge of battery	–	Motions stopped (fast stop). Control unit switches itself off.
Bit 14	Total current is exceeded	If motion in process.	Motions stopped (fast stop). Bit reset in the next motion.
Bit 15: Drive 1 Bit 16: Drive 2 Bit 17: Drive 3 Bit 18: Drive 4 Bit 19: Drive 5 Bit 20: Drive 6	Error with drive	Peak current Short circuit current Sensor monitor Over current (if not limit position) Time out (if not limit position)	Drive stopped (fast stop). Bit reset on next motion.
Bit 21	Position difference between drives too great (synchronized parallel run)	Only if synchronized parallel run is parameterized.	Motion not started or if motion in progress the motion is stopped (fast stop). Bit reset on next motion.
Bit 22	Remote communication time out	–	Depending on the safety ID
Bit 23	–	–	–
Bit 24	Locking box I²C communication error	Only if locking box safe parameterized	Motions not performed or stopped
Bit 25	RAM copy of EEPROM configuration data indicates incorrect CRC on	–	Motions not performed or stopped
Bit 26	RAM copy of EEPROM user data indicates incorrect CRC on	–	Motions not performed or stopped
Bit 27	EEPROM locking box data indicates incorrect CRC on	–	Motions not performed or stopped
Bit 28	RAM copy of EEPROM dynamic data indicate incorrect CRC on	–	Motions not performed or stopped
Bit 29	RAM copy of EEPROM calibration data indicate incorrect CRC on	–	Motions not performed or stopped
Bit 30	RAM copy of EEPROM HW settings indicates incorrect CRC on	–	Motions not performed or stopped
Bit 31	IO Test	Is performed if no motion is active.	Motions not performed
Bit 32	IDF operating system error	–	Motions not performed or stopped

4.7 Control of drives

Control of individual drives occurs via functions F1-F10. A function is activated via the RE command and thus one or more drives started. Each RE command must be stopped with an RS, even if the drive is stopped after reaching the end position.

4.7.1 Function definition

Please obtain the function definitions from the parameterization documentation for the control unit.

4.7.2 Setting of motion parameters

The motion parameters of speed and target position can be set via the indices 3011 to 301A or 3021 to 3026. The speed applies to the selected function, the target position is connected with individual drives. Motion is started with the RE command and parameter 9.

Speed is to be given in percentages (0-100%) or increments. This depends on the parameterization of the control unit. For standard control units the speed is set in percentages.

The lower threshold on which a drive is set into motion depends on the type of drive and load. The speed can be changed during motion. The control unit adjusts the speed according to the soft start ramp.

4.8 Read-out of information

Operating states and information can be read from the control unit via the RG command.

Values can be queried individually or blockwise.

4.8.1 Position data

The indices 0011 to 0016 will return current position. The grouping index 0010 returns the position of all 6 possible 6 drives. The position can be calculated in mm from the values of end position and hub length.

5.0 Communication examples

5.1 Example: Move to position and read current position with SCP11 parameterization

With the SCP11 parameterization all drives are set for individual operation. Drive 1 is assigned to function 1, drive 2 to function 2 and so on. In this way the drives can be controlled individually using functions 1-6.

ROUTINE:

- Communication mode open with RO (Safety ID)
- Set remote position of drive 1
- Start movement of drive 1
- Read status of drive 1. Check if movement is activated.
- Read current position of drive 1
- During the entire routine a cyclically repeated RC command communication must occur at least every 500 ms. The RC communication functions as a watchdog. If the RC communication should fail, the SCU will stop all drives in motion and deactivate the remote mode.
- Before the first command is sent to the SCU an RC communication must also have taken place (activation of remote mode)
- Communication mode closed with RA

Table 8

Periodic RC communication without any data transfer in this case (without CyclObj)

Cmd	Name	Request parameter						Reply parameter			
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4
RO	Remote Mode open	00	–	–	–	–	–	ACK, **E	–	–	–

– – – Safe communication mode open

Cmd	Name	Request parameter						Reply parameter						
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4	P5	P6	P7
RC	Remote cyclic	01	00	–1	–	–	–	ACK, **E	–	–	–	–	–	–

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Table 9

Setting of remote speed of drive 1 to value 100h with RT command (data index 3011)

Cmd	Name	Request parameter						Reply parameter				
		P1	P2	P3	P4	P5	P6	P1	P2	P3	P4	Pn
RT	Remote data transfer	04	00	11	30	01	00	ACK, **E	–	–	–	

Table 10

Drive to the Remote Position with actuator 1 without start/stop ramp. Starts with the RE command (Data index 0)

Cmd	Name	Request parameter						Reply parameter				
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4	Pn
RE	Remote execute function	00	09	–1	–	–	–	ACK, **E	–	–	–	–

Table 11

Request status of drive 1 with RG command (Data index 0171)

Cmd	Name	Request parameter						Reply parameter						
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4	P5	P6	P7
RG	Remote data get	71	01	–	–	–	–	ACK, **E	01	00	status			

Status bit 4 is set so long as the motion is active.

Table 12

Request current position of drive 1 with RG command (data index 0011)

Cmd	Name	Request parameter						Reply parameter						
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4	P5	P6	P7
RG	Remote data get	11	00	–	–	–	–	ACK, **E	04	00	1. Data byte	2. Data byte	3. Data byte	4. Data byte

Cmd	Name	Request parameter						Reply parameter			
		P1	P2	P3	P4	P5	Pn	P1	P2	P3	P4
RA	Remote Mode abord	–	–	–	–	–	–	ACK, **E	–	–	–

Close communication mode

6.0 Code examples

6.1 Checksum calculation

The checksum is determined using the standard CCITT CRC16 algorithm. The polynomial is CRC16 = x16 + x12 + x5 + 1, the starting value is 0.

The calculation of the CRC checksum makes heavy use of the processor. In order to reduce this a CRC table should ideally be used.

Table 13

Code example 1: CRC table

```
static const unsigned short CRC_TABLE[256] = {
   0x0000     0x1021 0x2042 0x3063 0x4084 0x50A5 0x60C6 0x70E7
   0x8108     0x9129 0xA14A 0xB16B 0xC18C 0xD1AD 0xE1CE 0xF1EF
   0x1231     0x0210 0x3273 0x2252 0x52B5 0x4294 0x72F7 0x62D6
   0x9339     0x8318 0xB37B 0xA35A 0xD3BD 0xC39C 0xF3FF 0xE3DE
   0x2462     0x3443 0x0420 0x1401 0x64E6 0x74C7 0x44A4 0x5485
   0xA56A     0xB54B 0x8528 0x9509 0xE5EE 0xF5CF 0xC5AC 0xD58D
   0x3653     0x2672 0x1611 0x0630 0x76D7 0x66F6 0x5695 0x46B4
   0xB75B     0xA77A 0x9719 0x8738 0xF7DF 0xE7FE 0xD79D 0xC7BC
   0x48C4     0x58E5 0x6886 0x78A7 0x0840 0x1861 0x2802 0x3823
   0xC9CC     0xD9ED 0xE98E 0xF9AF 0x8948 0x9969 0xA90A 0xB92B
   0x5AF5     0x4AD4 0x7AB7 0x6A96 0x1A71 0x0A50 0x3A33 0x2A12
   0xDBFD     0xCBDC 0xFBBF 0xEB9E 0x9B79 0x8B58 0xBB3B 0xAB1A
   0x6CA6     0x7C87 0x4CE4 0x5CC5 0x2C22 0x3C03 0x0C60 0x1C41
   0xEDAE     0xFD8F 0xCDEC 0xDDCD 0xAD2A 0xBD0B 0x8D68 0x9D49
   0x7E97     0x6EB6 0x5ED5 0x4EF4 0x3E13 0x2E32 0x1E51 0x0E70
   0xFF9F     0xEFBE 0xDFDD 0xCFFC 0xBF1B 0xAF3A 0x9F59 0x8F78
   0x9188     0x81A9 0xB1CA 0xA1EB 0xD10C 0xC12D 0xF14E 0xE16F
   0x1080     0x00A1 0x30C2 0x20E3 0x5004 0x4025 0x7046 0x6067
   0x83B9     0x9398 0xA3FB 0xB3DA 0xC33D 0xD31C 0xE37F 0xF35E
   0x02B1     0x1290 0x22F3 0x32D2 0x4235 0x5214 0x6277 0x7256
   0xB5EA     0xA5CB 0x95A8 0x8589 0xF56E 0xE54F 0xD52C 0xC50D
   0x34E2     0x24C3 0x14A0 0x0481 0x7466 0x6447 0x5424 0x4405
   0xA7DB     0xB7FA 0x8799 0x97B8 0xE75F 0xF77E 0xC71D 0xD73C
   0x26D3     0x36F2 0x0691 0x16B0 0x6657 0x7676 0x4615 0x5634
   0xD94C     0xC96D 0xF90E 0xE92F 0x99C8 0x89E9 0xB98A 0xA9AB
   0x5844     0x4865 0x7806 0x6827 0x18C0 0x08E1 0x3882 0x28A3
   0xCB7D     0xDB5C 0xEB3F 0xFB1E 0x8BF9 0x9BD8 0xABBB 0xBB9A
   0x4A75     0x5A54 0x6A37 0x7A16 0x0AF1 0x1AD0 0x2AB3 0x3A92
   0xFD2E     0xED0F 0xDD6C 0xCD4D 0xBDAA 0xAD8B 0x9DE8 0x8DC9
   0x7C26     0x6C07 0x5C64 0x4C45 0x3CA2 0x2C83 0x1CE0 0x0CC1
   0xEF1F     0xFF3E 0xCF5D 0xDF7C 0xAF9B 0xBFBA 0x8FD9 0x9FF8
   0x6E17     0x7E36 0x4E55 0x5E74 0x2E93 0x3EB2 0x0ED1 0x1EF0
};
```

Code example 2 is an example of CRC checksum determination using the table. The 2 bytes returned must be connected to the command.

Table 14

Code example 3: Calculation of checksum using the table

```
unsigned short CalculateChecksum (const unsigned char* pAdr, int len)
{
   if (len < 0)
   {
       ASSERT(FALSE);
       return 0;
   }
   unsigned short crc = 0;
   while (len--)
   {
       crc = static_cast<unsigned short>(CRC_TABLE[((crc >> 8) ^ *pAdr++) & 0xFF] ^ (crc << 8));
   }
   return crc;
}
```

Table 14

Code example 4: Check of checksum result

```
bool CheckResponseChecksum(const CArray<unsigned char>& responseData, bool
suppressTimeoutError)
{
   CArray<unsigned char> tempData;
   unsigned char crcByte1;
   unsigned char crcByte2;
   DWORD bytesRead;
   tempData.Append(responseData);
   if (!ReadFile(m_hComm, &crcByte1, 1, &bytesRead, NULL) || (bytesRead !=1))
   {
       if(!GetLastError()) {
              // case time out
              if(!suppressTimeoutError)
              AfxMessageBox(IDS_READ_ERROR_CRC);
       }
       else {
              Disconnect();
              AfxMessageBox(IDS_READ_ERROR);
       }
   }
   if (!ReadFile(m_hComm, &crcByte2, 1, &bytesRead, NULL) || (bytesRead !=1))
   {
       if(!GetLastError()) {
              // case time out
              if(!suppressTimeoutError)
              AfxMessageBox(IDS_READ_ERROR_CRC);
       }
       else {
              Disconnect();
              AfxMessageBox(IDS_READ_ERROR);
       }
   }
   tempData.Add(crcByte2);
   tempData.Add(crcByte1);
   if (CalculateChecksum(tempData.GetData(), static_cast<int>(tempData.Get-Size())) != 0)
   {
       AfxMessageBox(IDS_READ_ERROR_CRC_INVALID);
       return false;
   }
   else
   {
   return true;
   }
}
```

7.0 Structure definitions

```
struct ACTUATOR_POSITIONSstruct {
   INT32 Position_Memory_1[USER_1;
   INT32 Position_Memory_2[USER_1];
   INT32 Position_Memory_3[USER_1];
   INT32 Position_Memory_4[USER_1];
   INT32 Position_Intermediate_In[USER_1];
   INT32 Position_Intermediate_Out[USER_1];

   INT32 Position_Memory_1[USER_2;
   INT32 Position_Memory_2[USER_2];
   INT32 Position_Memory_3[USER_2];
   INT32 Position_Memory_4[USER_2];
   INT32 Position_Intermediate_In[USER_2];
   INT32 Position_Intermediate_Out[USER_2];

   INT32 Position_Memory_1[USER_3;
   INT32 Position_Memory_2[USER_3];
   INT32 Position_Memory_3[USER_3];
   INT32 Position_Memory_4[USER_3];
   INT32 Position_Intermediate_In[USER_3];
   INT32 Position_Intermediate_Out[USER_3];

   INT32 Position_Memory_1[USER_4;
   INT32 Position_Memory_2[USER_4];
   INT32 Position_Memory_3[USER_4];
   INT32 Position_Memory_4[USER_4];
   INT32 Position_Intermediate_In[USER_4];
   INT32 Position_Intermediate_Out[USER_4];
   INT32 Position_Virtual_Limit_In;
   INT32 Position_Virtual_Limit_Out;
   };
ACTUATOR_POSITIONS positions[ACTUATOR_COUNT];
```

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