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SERS ..V02/3/4 und WSERS...V01

PB-DP

Stepping motor power amplifier board with position control and Profibus-DP interface

Profibus-DP specific additions to the 'SERS installation and programming manual' for SERS with RS232 interface

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1. General notes
1.1 Short overview

- The stepper motor control SERS...PB-DP is a 1-axis position control with Profibus-DP interface.
- The file ‘**sers07B9.gsd**‘ (delivered together with the SERS...PB-DP control on floppy disc or on the STÖGRA-CD or download at the STÖGRA homepage http://www.stoegra.de) contains the corresponding ‘node‘ – information for the Profibus-Master
- Protocol mode: “extended binary mode 22/12Byte I/O”
  The WSERS/SERS control also supports the old protocol modes “ASCII-character mode” and “binary mode 8/12 Byte I/O”
- Write and Read of Profibus datas must be conistent (for Siemens-Simatic-controls use system function units SFC14 and SFC15 – read / write consistente datas)
- When using Siemens ontrols (e.g. from the Simatic series) Bytes must be alternated within a word, and words must be alternated within double words
  Example: the control word (double word) with bytes no 1 - 2 - 3 - 4 must be written at Siemens controls in following order: 4 – 3 – 2 - 1
- Available functions and commands of the SERS...PB-DP are identically to the functions and commands of the position control SERS with RS232/RS485 interface.

1.2 Manual notes

On the following pages the "installation and programming manual" for the SERS with RS232/RS485 interface will be named **SERS-manual**.

The assignment of the 9-pole D-Sub-connector is according to the Profibus-DP-standard

1.3 GSD-File and Protocol mode

Actual protocol mode at the provided file ‘**sers07B9.gsd**‘:

- **"SERP binary 22/12 Byte I/O" → extended binary mode with consistent data transmission and 22 Byte in the Output section and 12 Byte in the Input section**

2. Profibus-DP protocol in the SERS-PB-DP Extended binary mode (22/12 Byte I/O)

2.1 Overview

Transmitting data to the SERS...PB-DP via 22 Byte in the Output section:
Byte 1 until 4 : **Control Word**
Byte 5 until 6 : **Operation Code (Opcode)**
Byte 7 until 10 : **Operand**
Byte 11 until 14 : **Acceleration**
Byte 15 until 18 : **Velocity**
Byte 19 until 22 : **Position command value**

Receiving data from the SERS...PB-DP via 12 Byte in the Input section:
Byte 1 until 2 : **Status**
Byte 3 until 6 : **Result** (from a parameter value request before)
Byte 7 until 10 : **Actual Position**
Byte 11 until 12 : **Inputs**

2.2 Control Word

The Control Word in the Output section is triggering the actions defined below after **being changed**. "STOP" will be evaluated always (also without change of control word). "START_PROGRAMM" will be evaluated statically (without change of control word) if Parameter P1023 = 1

Bit 0: SLOW_NEGATIVE Jog edge 0 to 1 → jog slow negative, 0 to 1 → stop
Bit 1: SLOW_POSITIVE Jog edge 0 to 1 → jog slow positive, 0 to 1 → stop
Bit 2: FAST_NEGATIVE Jog edge 0 to 1 → jog fast negative, 0 to 1 → stop
Bit 3: FAST_POSITIVE Jog edge 0 to 1 → jog fast positive, 0 to 1 → stop
Bit 4: HOMING edge 0 to 1 → start homing
Bit 5: PHASE_CURRENT_ON 1 = ON, 0 = OFF
Bit 6: STOP 1 = Stop active, 0 = motor travel possible
Bit 7: START_PROGRAMM edge 0 to 1 → start running program in SERS
Bit 8: START_POSITIONING edge 0 to 1 → start Positioning job
Bit 9: OUTPUT 1 1 = ON (only if no running program is active / P0=0 !)
Bit 10: OUTPUT 2 1 = ON (only if no running program is active / P0=0 !)
Bit 11: OUTPUT 3 1 = ON (only if no running program is active / P0=0 !)
Bit 12: OUTPUT 4 1 = ON (only if no running program is active / P0=0 !)
Bit 13: RESET_ERROR edge 0 to 1 → P11=0
Bit 14: RESET_WARNING edge 0 to 1 → P12=0
Bit 15: EXECUTE_OPCODE edge 0 to 1 → "Opcode" will be executed
Bit 16: START_POSITIONING_TOGGLE at change of this bit will Start Positioning
Bit 17: ABSOLUTE 1 = set absolute positioning mode (P1014=2)
0 = set relative positioning mode (P1014=0), if absolute positioning mode was active before. Relative positioning modes (P1014=1, P1014=3) will not be changed, if any relative positioning mode was active before
Bit 18: POLYNOM 1 = activates the Polynom positioning mode (command WP)
Bit 19: POLYNOM_TERM 1 = termination of Polynom / last Polynom section (WPT)
Bit 20: PARAMETER_ACCEPT the parameter "acceleration", "velocity" and “position command value" in bytes 11 until 22 will be used in case of a start positioning via the Control Word (bit 8 or bit 16).
Bit 21 bis 31: reserved

2.3 Operation Code (Opcode)

- The Opcode is executed when Bit 15 in the Control word changed from "0" to “1".
- Both Bytes of the Opcode need to be transmitted time consistent, to prevent a non valid Opcode (for Siemens-Simatic-controls: system function module SFC14 and SFC15 – read / write consistent datas)
- Depending on the operation an operand is needed. This operand must be valid , before Bit 15 in the Control is set = “1”.
- After executing the transmitted Opcode the SERS...DP-PB will send an acknowledge at "Bit 8: HANDSHAKE" in the Status word of the data-Input-sector (Bit 8 = “1”)
- Before sending a new Opcode the master needs to set when Bit 15 in the Control word =”0”, and after that wait until the Handshake Bit is reset to "0" by the SERS.
- The most important Opcodes, for a SERS-drive used without operational program, are “Parameter assignment" and "Parameter request".

Following table shows all Opcodes with **binary** code.
The "c" Bit is used for formatting purposes for the internal listing of operational programs. If 'c' = "1" , then the Opcode in the listing is in a new line. If not using (programming) operational programs set always "c" = "0".
"p" bits: parameter numbers (identifiers) - parameter with the address (ppp pppp pppp).
(e.g.: 011 1111 0010 binary = "1010" decimal for parameter P1010)
"n" Bits: number of decimal places (referred to operand)
"e" Bits: event number for conditions used at conditional commands - see next page
"b" Bits: Inputs when using the conditional command "IF IN..."
"l" Bits: Label numbers in an operational program.
"X": accumulator for using the arithmetical functions in an operational program

Command	Opcode, binary	Explanation
Addition	0000 cppp pppp pppp	X = X + (ppp pppp pppp)
	0000 c111 nnnn nnnn	X = X + operand
Subtraction	0001 cppp pppp pppp	X = X - (ppp pppp pppp)
	0001 c111 nnnn nnnn	X = X - operand
Multiplication	0010 cppp pppp pppp	X = X * (ppp pppp pppp)
	0010 c111 nnnn nnnn	X = X * operand
Division	0011 cppp pppp pppp	X = X / (ppp pppp pppp)
	0011 c111 nnnn nnnn	X = X / operand
AND	0100 cppp pppp pppp	X = X & (ppp pppp pppp)
	0100 c111 nnnn nnnn	X = X & operand
OR	0101 cppp pppp pppp	X = X | (ppp pppp pppp)
	0101 c111 nnnn nnnn	X = X | operand
EXCL OR	0110 cppp pppp pppp	X = X ^ (ppp pppp pppp)
	0110 c111 nnnn nnnn	X = X ^ operand
Accu assignment	0111 cppp pppp pppp	X = (ppp pppp pppp)
	0111 c111 nnnn nnnn	X = operand
Parameter assignment	**1000 cppp pppp pppp**	**(ppp pppp pppp) = operand**
	1001 cppp pppp pppp	(ppp pppp pppp) = operand only 16bit
	1010 cppp pppp pppp	(ppp pppp pppp) = X
Parameter request	**1011 cppp pppp pppp**	**operand = (ppp pppp pppp)**

Conditional command	1101 ceee eeee eeee	if (eee eeee eeee) (e.g. IF 100)
	1101 c111 bbbb bbbb	if (bbbb bbbb) (e.g. IF IN 12)
	1110 ceee eeee eeee	if !(eee eeee eeee) (e.g. IF !11)
	1110 c111 bbbb bbbb	if !(bbbb bbbb) (e.g. IF !IN12)
Jump	1111 c000 llll llll	GOTO llll llll (e.g. GOTO 5)
Subroutine	1111 c001 llll llll	GOSUB llll llll (e.g. GOSUB 5)
Label	1111 c010 llll llll	Label llll llll (e.g. L5)
Program Start	1111 c011 llll llll	RUN llll llll (e.g. RUN 5)
Text	1111 c100 llll llll	Text with text length llll llll
NOT	1111 c111 0000 0000	X = !X
Negation	1111 c111 0000 0001	X = -X
	1111 c111 0000 0010	no operation
Start	1111 c111 0000 0011	E
Stop	1111 c111 0000 0100	S
Home	1111 c111 0000 0101	H
Return	1111 c111 0000 0110	RETURN
Program end	1111 c111 0000 0111	PE
End	1111 c111 1111 1111	END

Event numbers ("e") – for conditional commands if (eee eeee eeee)

Event no.	event true
0	Program running
1	Input 1 is active
2	Input 2 is active
3	Input 3 is active
4	Input 4 is active
5	Input 5 is active
6	Input 6 is active
7	Input 7 is active
8	Input 8 is active
11	Error - P11 <> 0
12	Warning - P12 <> 0
100	Counter C1 - P100 > 1
101	Counter C2 - P101 > 1
102	Counter C3 - P102 > 1
336	motor is not moving – positioning ready, drive is in position
1015	motor is accelerating
1016	motor is moving with constant speed
1042	software limit position overflow
1047	X > 0
1101	Marker M1 <> 0
1102	Marker M2 <> 0
1103	Marker M3 <> 0
1201	Output O1 active
1202	Output O2 active
1203	Output O3 active
1204	Output O4 active

The event numbers correspond to the Parameter numbers !
E.g. event "336" = Parameter P336

Running (operational) programs in SERS ... PB-DP controls:

Writing / transmitting a new running program into a SERS ... PB-DP, is initiated by the parameter assignment ’P0=2’.
Attention: ’P0=2’ is a parameter assignment with a 16-bit operand !

→ OPCODE 1010 0000 0000 0000 = 90 00 (HEX) and operand 00 00 00 02 (HEX)

All other parameter assignments are with 32-bit operands

→ OPCODE 1000 .... = 8... ... ...

All commands included in above OPCODE-list may be used in a running program.

The definition of a running program initiated by ’P0=2’ must be terminated by the parameter assignment ’P0=0’ (end of running program definition)

→ OPCODE 1000 0000 0000 0000 = 80 00 (HEX) and operand 00 00 00 00 (HEX)

Via the control word Bit 7 the running program can be started.
Bit 9 in the status word indicates if a running program is operating or stopped.

Bemerkung:

Das Schreiben und Übertragen von Ablaufprogrammen kann auch über die RS232-Schnittstelle mit der mitgelieferten SERS-Programmier-/Parameteriersoftware für Windows-PCs mit RS232-Schnittstelle gemacht werden.

In der Regel ist diese Möglichkeit praktikabler, da einfacher und schneller zu Realisieren.
Das Starten und Beobachten des Ablaufprogramms kann dann wieder über die Profibus-Schnittstelle vorgenommen werden (über Kontrollwort bzw. Statuswort).

2.4 Operand

Values in binary format

The number of decimal places is defined with the parameter number (in the Opcode) and the scaling of the parameter. Values are assigned and stored in binary format without decimal places. E.g. the position "360.6" degree at rotational scaling has to be assigned and also is indicated as "3606000", because this parameter at this scaling includes 4 decimal places.
When using arithmetical functions with constants, then the decimal places have to be indicated in the Opcode in the field "nnnn nnnn", because constants do not have a standard scaling.

The scalings can be selected via the parameters P44, P76 and P160 (see general **"manual SERS"** - for SERS with RS232-interface - page 54)

Following table shows all Parameters with decimal places:

Parameter	number of decimal places
41	depending on selected scaling
42	depending on selected scaling
47 (W)	depending on selected scaling
51	depending on selected scaling
91 (V)	depending on selected scaling
103	depending on selected scaling
108	2 100% = 1.00
123	depending on selected scaling
138 (A)	depending on selected scaling
1003	depending on selected scaling
1005	2 100% = 1.00
1006	2 100% = 1.00
1007	2 100% = 1.00
1008	2 100% = 1.00
1012	depending on selected scaling
1018	depending on selected scaling
1019	depending on selected scaling
1020	depending on selected scaling
1024	depending on selected scaling
1026	depending on selected scaling
1030	depending on selected scaling
1037	depending on selected scaling
1039	depending on selected scaling
1040	depending on selected scaling
1041	depending on selected scaling
1044	depending on selected scaling
1046	2 100% = 1.00
1047 (X)	depending calculation result
1052	depending on selected scaling
1053	depending on selected scaling
1054	3
1080... (R0...)	depending assigned parameter
1100 (D)	1

All other parameters are not scaled (without decimal places).

2.5 Status

The Status word includes following Bit definitions (similar to DRIVECOM profile):

Bit position and definition

Bit 0: READY_TO_SWITCH_ON	is always 1
Bit 1: SWITCHED_ON	1: motor phase current is ON, 0: OFF
Bit 2: OPERATION_ENABLED	1: motor phase current is ON, 0: OFF
Bit 3: FAULT	1: a SERS error ocurred (P11 <> 0)
Bit 4: SETPOINT_ACKNOWLEDGE	1: next Polynom section is expected (P1123=1)
Bit 5: QUICK_STOP	is always 0
Bit 6: SWITCH_ON_DISABLED	is always 0
Bit 7: WARNING	1: a SERS warning ocurred (P12 <> 0)
Bit 8: HANDSHAKE	1: SERS executed last Opcode, or Start_Positioning or Start_Program executed
Bit 9: REMOTE	1: running program not active, 0: active (P0=0)
Bit 10: TARGET_REACHED	1: motor stops (reached position), 0: motor moving
Bit 11: INTERNAL_LIMIT_ACTIVE	1: software limit switch overflow (P1042=1)
Bit 12: HOMING_ATTAINED	1: homing procedure successfull
Bit 13: FOLLOWING_ERROR	1: error load angle – only for SERS with option E50
Bit 14: ACCELERATING_PHASE	1: motor is accelerating (P1015 <> 0)
Bit 15: CONSTANT_PHASE	1: motor runs with constant velocity (P1016 <> 0)

2.6 Result

"result" of the last interrogation - after sending the Opcode "request" - value of the interrogated parameter value.
– indicated as binary value.

2.7 Position

"position" contains the actual position (P51) – binary value.

2.8 Inputs

"Inputs" contains the status of the digital inputs I1 until I8 and the optoisolated inputs Stop, Homing switch, Limit switch positive and limit switch negative.

Bit 0: input 1	Bit 8: Limit switch negative
Bit 1: input 2	Bit 9: Limit switch positive
Bit 2: input 3	Bit 10: Stop switch
Bit 3: input 4	Bit 11: Homing switch
Bit 4: input 5	Bit 12: Intern
Bit 5: input 6	Bit 13: Intern
Bit 6: input 7	Bit 14: Intern
Bit 7: input 8	Bit 15: Intern

2.9 Function principle extended binary mode

1. Write (assignment) and read (request) parameters:
The Opcode for writing and reading parameters has to be written in bytes 5 and 6. In case of writing or reading parameters, additionally the value to be assigned to the parameter needs to be written in the Operand (bytes 7 until 10). A change from "0" to "1" of Bit 15 in the Control Word will indicate the SERS, that there is a new OPCODE with Operand to be executed.
After executing the OPCODE the SERS will set the Handshake Bit (Status Word bit 8) to "1".
Before writing a new Opcode into the SERS, the Bit 15 in the Control Word must be set to "0" and it needs be waited for the Handshake Bit (Status word bit 8) to be reset to "0". When reading (requesting) parameters, the result of the request (the parameters value) can be read in the "result" in Byte 3 until 6 in the Input section (the result is valid when Handshake Bit = 1)

2. Positioning
The values "acceleration", "velocity" and "position command value" have to written in bytes 11 until 22. Bits 17 until 19 in the Control Word define the mode of positioning (standard point to point positioning or Polynom driving, relative or absolute mode → for point to point positioning jobs Bits 18 and 19 = "0").
Bit 20 in the Control Word tells the SERS to use the values in bytes 11 until 22 (acceleration, velocity, position command value) as new positioning parameters (by Bit 20 = "1").
In case of Bit 20 ="0" the values from the last positioning job, respectively the values actually set in the SERS are used.
An edge from "0" to "1" of Bit 8 in the Control Word results in starting the positioning job.
Alternatively a change of Bit 16 (Toggle bit) starts the positioning job – additionally the Bit 8 in the Control Word must be set permanently.
The Handshake Bit 8 in the Status Word follows the Bit 8 (Start_Positioning) respectively the Togglebit Bit 16 in the Control Word (when setting Bit Start_Positioning to "1", the SERS also will set the Handshake Bit in the status word to "1", when resetting Bit Start_Positioning to "0", the SERS also will reset the Handshake Bit to "0").
Once the motor started moving, Bit 10 in the Status word will be set = "0", and after reaching its set position, Bit 10 will be set ="1" again.
During Polynom driving the SERS indicates via Bit 4 in the status word that it excepts the definition of the next polynom section. The final decelerating ramp (Parameter B - P1096 - definition and scaling as parameter A – P138) can be defined via OPCODE only.

NOTES on the HANDSHAKE BIT in the Status word:
The Handshake Bit 8 in the Status word will be set / reset in case of following actions:
- Execute Opcode, after control word Bit 15 ="1" / "0" (e.g. writing of parameters)
- Start Positioning, after control word Bit 8 ="1" / "0"
- Start Programm, after control word Bit 7 ="1" / "0"

In case in the PLC program (in the Profibus Master PLC) are running program modules parallel to each other, (e.g. interupt controled), then it may happen, that the Handshake Bit is set by one action in one module (e.g. after writing a parameter by execute_opcode), and reset by another action in a different module (e.g. Start_Positioning, when in a PLC subroutine / module, Bit 15 in the control word of the SERS is reset, after succesfull starting the positioning job).
For receiving a reliable evalutation of the Handshake Bit, when setting up a program in the PLC (Profibus-Master), each single procedure (write opcode, start positioning, start program) needs to be executed consequent and sequentially, regarding the Handshake Bit, without any time overlap with another procedure.

3. Diagnostics

The diagnostics of the Profibus-protocol in the SERS...PB-DP is realised as follows:

X1 X2 X3 X4 X5 X6 Z1 D1 E1 E2 W1 W2

Bytes **X1** until **X6** are specified in the Profibus-DP standard.
Bytes **Z1** until **W2** are written by the SERS...PB-DP.

Z1 indicates the quantity of the following Bytes (inclusive Z1) - always '06' if there is a diagnostics message.

D1 indicates a diagnostics error number - see list below.

E1 corresponds to the High-Byte of the 16-Bit parameter P11 (SERS-drive error).
E2 corresponds to the Low-Byte of 16-Bit Parameters P11 (SERS-error).
W1 corresponds to the High-Byte of the 16-Bit Parameter P12 (SERS-warning).
W2 corresponds to the Low-Byte of the 16-Bit Parameter P12 (SERS-warning).

Diagnostics error numbers (Byte **D1**)
Hex-Wert (Dezimal)

1	(1)	: to big
2	(2)	: to small
3	(3)	: not valid
4	(4)	: invalid output
5	(5)	: EEPROM storage full
6	(6)	: EEPROM acknowledge timeout
7	(7)	: EEPROM no acknowledge
8	(8)	: EEPROM no page begin
9	(9)	: run decimal constant to small
A	(10)	: decimal constant to big
B	(11)	: unknown if event
C	(12)	: admission refused
D	(13)	: Parameter not existing
E	(14)	: adc expected
F	(15)	: end of text expected
10	(16)	: input text only in pgm mode
11	(17)	: text to long
12	(18)	: [decimal constant pgm psave] expected
13	(19)	: * permitted only at P1 or z
14	(20)	: data or z expected
15	(21)	: command expected
16	(22)	: programming mode not active
17	(23)	: if expected
18	(24)	: if event expected
19	(25)	: goto or gosub or GT or GS expected
1A	(26)	: goto or gosub expected
1B	(27)	: goto expected
1C	(28)	: goto decimal constant expected
1D	(29)	: gosub expected
1E	(30)	: gosub decimal constant expected
1F	(31)	: [return RT run rs rf] expected
20	(32)	: return expected
21	(33)	: [decimal constant list ls lf] expected

22	(34)	: = or ? expected
23	(35)	: [decimal constant on off] expected
24	(36)	: decimal constant or n expected
25	(37)	: decimal constant expected
26	(38)	: run expected
27	(39)	: [new, neg, not] expected
28	(40)	: new or neg expected
29	(41)	: list expected
2A	(42)	: quit expected
2B	(43)	: off expected
2C	(44)	: program still running
2D	(45)	: pgm expected
2E	(46)	: Programming mode not active
2F	(47)	: del expected
30	(48)	: data expected
31	(49)	: change: only constant allowed
32	(50)	: decimal constant or pos expected
33	(51)	: pos expected
34	(52)	: psave expected
35	(53)	: [tr tron troff] expected
36	(54)	: program not running
37	(55)	: troff expected
38	(56)	: ver expected
39	(57)	: 1, 2, 3 or 4 expected
3A	(58)	: pos or possave expected
3B	(59)	: lp expected
3C	(60)	: possave expected
3D	(61)	: data or parameter expected
3E	(62)	: semicolon not allowed
3F	(63)	: not expected
40	(64)	: not known status
41	(65)	: program start not possible when service switch is ON
42	(66)	: programmstart not possible, error P11
43	(67)	: stop switch is active
44	(68)	: stop switch is open
45	(69)	: not valid program existing
46	(70)	: drive must stand still
47	(71)	: unknown destination
48	(72)	: destination not valid
49	(73)	: Stack overflow
4A	(74)	: unknown Opcode, forgot return ?
4B	(75)	: unknown fxxx Opcode
4C	(76)	: invalid Opcode for destination address
4D	(77)	: unknown f7xx Opcode
4E	(78)	: limit switch open
4F	(79)	: drive not enabled (OFF)
50	(80)	: unknown positioning mode
51	(81)	: drive must run constant or stand still
52	(82)	: invalid EEPROM mode value
53	(83)	: label already defined: L
54	(84)	: position difference to big

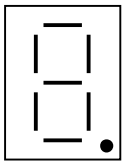
55	(85)	: new position to big
56	(86)	: new position to small
57	(87)	: new residual position to short
58	(88)	: compare position 1 is to big
59	(89)	: compare Position 1 is to small
5A	(90)	: compare Position 2 is to big
5B	(91)	: compare Position 2 is to small
5C	(92)	: new modulo value is to big
5D	(93)	: not writable, during drive is positioning
5E	(94)	: solder bridge is set wrong for this range
5F	(95)	: negative software limit position is bigger than positive position
60	(96)	: exponent to big
61	(97)	: exponent to small
62	(98)	: calculation result is to big
63	(99)	: calculation result is to small
64	(100)	: calculation result is to big to be displayed
65	(101)	: calculation result is to small to be displayed
66	(102)	: division through 0
67	(103)	: bus stopbit is active
68	(104)	: subindex not existing
69	(105)	: value can not be written (read only parameter)
6A	(106)	: value can not be read
6B	(107)	: Polynom with backlash not allowed
6C	(108)	: Missing Polynom data for next section
6D	(109)	: Wait expected
6E	(110)	: <=0 expected
6F	(111)	: =0 expected
70	(112)	: 0 expected
71	(113)	: 0 or 1 expected
72	(114)	: > expected
73	(115)	: 1 expected
74	(116)	: = expected
75	(117)	: 3 expected
76	(118)	: Polynom end to short for deceleration (false definition of polynom section)
77	(119)	: A to small
78	(120)	: A to big
79	(121)	: V to small
7A	(122)	: V to big
7B	(123)	: Polynom data reload not possible
7C	(124)	: RS232 buffer overflow
7C	(125)	: load angle error

In case of an error (SERS parameter P11<>0) or a warning (P12 <>0) a diagnostics message will be created (bytes Z1 until W2 <> 0).
The diagnostics message may be reset by resetting the error / warning via the control word.
In case the error or the warning is still active, the diagnostics message also stays active.

Reading / evaluating the diagnosis with bei Siemens-Simatic-controls can be done with system function module SFC13.

4. 7-Segment display

the 7 Segment display shows the actual status of the SERS



Elements of indication :
7 segments

Error and status indications are indicated by constantly illuminated characters.

Warnings are indicated by blinking characters.

Indication	description	comment
-	initialisation phase	indicated 1 second after power-on-reset
0	Profibus interface on SERS recognized	no external Profibus connection
1	Baudrate found	Profibus connection exists
2	Waiting for configuration telegram	yet no correct configuration telegram received, or wrong slave address
3	Profibus datas are exchanged	motor current can be switched on
4	no Profibus interface at SERS found	internal SERS hardware error
5	phase current of motor is ON positioning jobs can be executed	
7	checksum error of dates in E^2Prom	adjust standard parameters (factory default) by writing parameter P1004=3
8	error over temperature - from 85 °C (± 10%) on the power amplifier	check cooling of SERS – forced draft (fan and 24 VDC in ELK) o.k. ?
9	error under voltage	check power supply
8 (blinking)	warning over temperature 75 °C (± 10%) at the power amplifier stage	check cooling of SERS – forced draft (fan and 24 VDC in ELK) o.k. ?
9 (blinking)	warning under voltage	check power supply
A (blinking)	warning position overflow – positioning job is reaching position limit	- Parameter W (P47) to big - check positioning mode (for endless positioning → P1014=1)
C	Limit switch is open	check limit switches at machine and limit switch inputs of SERS
E	shortcircuit in motor or at power amplifier board	when installing the motor check phase connections
F	error step angle control - the motor could not follow the position command value (only with option step angle control) – see P1029	- check encoder connections - acceleration to high - external load to big (not enough motor torque)
F (blinking)	warning step angle control – description as F – see P1029	see comment for F
H (blinking)	warning program error – executable program stopped because of an error in the program	check parameters and labels in program (use SERS-software for debugging)
L (blinking)	Warning software limit switch	The actual position exceeded the limit position stored in P1040 or P1041

Reset of an error with 'P11=0' (or set control word Bit 13 = “1”)

Reset of a warning with 'P12=0' (or set control word Bit 14 = “1”)

5. Examples

5.1 Example: Positioning and writing parameters in the extended binary mode (22/12 Byte I/O)

1. Adjusting scaling of position data to linear scaling : P76=1
2. Adjusting of the feeding constant (assignment 1 motor revolution to [mm]) : P123=5 (mm)
3. Permanent saving of the parameter into the SERS E^2Prom with command : P1004=2
4. Adjusting of the positioning velocity : V=1000 (rpm)
5. Adjusting of the positioning acceleration : A=2000 (rad/s^2)
6. Selecting position command value: W=15 (mm)
7. Switching on motor phase current via the control word
8. Starting the positioning job via the control word
9. Starting again the positioning job

1. **P76=1**

Adjusting of linear scaling for all position data (position command value, actual position value, backlash, feeding constant, ..) → all values in [mm] by taking into account the parameter P121 until P123 – gear head ratio and feeding constant)

a) calculating and writing of the **OPCODE**
→ OPCODE for assignment of P76 :
→ binary 1000 000 0100 1010 (binary 0100 1010 = decimal 76)
byte 6 5
→ Hex-value for OPCODE for the assignment of P76: 80 4C
byte 6 5
→ writing the OPCODE 80 4C into the Profibus OUT-section into bytes 6 and 5

b) calculating and writing of the **Operand**:
Value (Operand) = 1
→ Changing to HEX-value → 00 00 00 01
→ Operand bytes 7 - 10 : byte 10 9 8 7
→ Writing the operand into the Profibus OUT-section into bytes 7 until 10
Note: Byte 7 is the lowest value byte and byte 10 is the highest value byte in the 32-Bit operand (double word)

c) executing the OPCODE (writing the parameter) by setting bit 15 in the control word
→ control word bit 15 = 1 (edge from "0" to "1") starts execution of the OPCODE)
→ after 2 to 4ms the SERS will set the handshakebit bit 8 in the status word to "1"
→ afterwards set bit 15 = 0 in the control word
→ 2 to 4ms afterwards the SERS will reset the handshakebit bit 8 in the status word to "0"

Remarks:
The cycle times of most of the Profibus-Master controls (e.g. PLC) relatively long, what allows to ignore the evaluation of the handshakebit in the status word → set and reset of bit 15 in the control word with a delay of 2ms will be sufficient. Another 2ms afterwards the next parameter (OPCODE) may be written (bit 15 in the control word may be set).

	control word	OPCODE	operand	
byte no.	1 2 3 4	5 6	7 8 9 10	
a) + b)	00 00 00 00	**4C 80**	01 00 00 00	(write OPCODE and Operand - P76=1)
c)	00 **8**0 00 00	4C 80	01 00 00 00	(execute OPCODE)
c)	00 **0**0 00 00	4C 80	01 00 00 00	(reset OPCODE - bit 15 to zero)

2. **P123=5**

e.g. in case of a spindle with 5mm pitch (1 motor revolution → linear movement of 5mm)

a) calculating the OPCODE as under 1. → OPCODE = 80 7B (HEX-value)

b) calculating the operand:

→ value=5 , P123 is a scaled value (because of P76=1 → in [mm] with 4 decimal places – see SERS-manual P76 page 54)

→ value=5.0000 → **value=50000** → operand = C3 50 (HEX-value)

c) set control word bit 15 and reset it (possibly control via handshakebit bit 8 in the status word) for executing the OPCODE

	control word	OPCODE	operand	
byte no.	1 2 3 4	5 6	7 8 9 10	
a) + b)	00 00 00 00	**7B 80**	50 C3 00 00	(OPCODE and operand – P123=5.0000)
c)	00 **8**0 00 00	7B 80	50 C3 00 00	(OPCODE execute)
c)	00 **0**0 00 00	7B 80	50 C3 00 00	(OPCODE Bit 15 reset to zero)

3. **P1004=2**

Permanent saving of the parameters adjusted at 1. and 2. into the E^2PROM of the SERS.
Calculating the OPCODE and the operand and executing the OPCODE as at 1.

	control word	OPCODE	operand	
byte no.	1 2 3 4	5 6	7 8 9 10	
	00 00 00 00	**EC 83**	02 00 00 00	(OPCODE and Operand – P1004=2)
	00 **8**0 00 00	EC 83	02 00 00 00	(OPCODE execute)
	00 **0**0 00 00	EC 83	02 00 00 00	(OPCODE Bit 15 reset to zero)

4. **V=1000 (U/min)**

Setting the positioning speed V in the Profibus OUT-section bytes 15 until 18

a) calculating the value to be set:

V (P91), at rotational scaling for speed values (P44=2 – standard setting), includes 4 decimal places (see SERS-manual parameter P44) → V=1000.0000 → writing V=10000000 (the decimal places are written without decimal point !)

→ changing into HEX-value → 80 96 98 00

→ bytes 15 - 18 : byte 15 16 17 18

→ writing the HEX-value into the Profibus OUT-section into the bytes 15 until 18

remarks: byte 15 is the lowest value byte and byte 18 is the highest value byte within the 32-bit value

5. **A=2000 (rad/s^2)**

Setting the positioning acceleration A in the Profibus OUT-section bytes 11 until 14

a) calculating the values to be set:

A (P138), at rotational scaling (P138=2 – standard setting), includes 3 decimal places (see SERS-manual P160) → A=2000.000 → write A=2000000 (the decimal places are written without the decimal point !)

→ change into HEX-value → 80 84 1E 00

→ bytes 11 - 14 : byte 11 12 13 14

→ writing the HEX-value into the Profibus OUT-section into the bytes 11 until 14

remarks: byte 11 is the lowest value byte and byte 14 is the highest value byte within the 32-bit value

6. **W=15 (mm)**

Setting the position command value in the Profibus OUT-section bytes 19 until 22

a) Calculating the value to be set:

W (P47), at linear scaling (P76=1, adjusted at 1.), includes 4 decimal points
(see SERS-manual parameter P76) → W=15.0000 → write W=150000
(the decimal places are written without the decimal point !)
→ change into HEX-value → F0 49 02 00
→ bytes 19 - 22 : Byte 19 20 21 22
→ write the HEX-value into the Profibus OUT-section into bytes 19 until 22
remarks: byte 11 is the lowest value byte and byte 14 is the highest value byte within the 32-bit value

Negative position command values are indicated by writing the complement by 2 value of the 32-bit value (example: **-** 0,0001 mm → **-** 1 → is written as HEX-value FF FF FF FF)

7. **Switching on motor phase current**

Switching on motor phase current via → control word bit 5 = 1

8. **Start positioning job**

Setting the positioning mode and start the positioning job

a) positioning mode: in the example "relative positioning" is used – the motor shall move the indicated value "W" (= distance) relative to the actual position.
→ control word bit 17 = 0 (in case of absolute positioning bit 17 = 1 must be set)

b) start positioning job
→ control word bit 20 = 1 (use values A, V, W in bytes 11 until 22 for the positioning job) and bit 8 = 1 (edge from "0" to "1" in bit 8 starts the positioning)

c) wait for bit 10 in the status word (TARGET_REACHED) – the SERS will set bit 10 = 0 after starting the positioning job (2 to 4ms after setting bit 8 in the control word)
Then bit 8 in the control word may be reset to "0".
After reaching the position the SERS will set bit 10 = 1 in the status word.

Remarks: Reset bit 8 in the control word may be done also later.

	control word	OPCODE	operand	accelerat. A	velocity V	position W
byte no.	1 2 3 4	5 6	7 8 9 10	11 12 13 14	15 16 17 18	19 20 21 22
A,V,W	20 00 00 00	00 00	00 00 00 00	80 84 1E 00	80 96 98 00	F0 49 02 00
bit 20=1	20 00 **1**0 00	00 00	00 00 00 00	80 84 1E 00	80 96 98 00	F0 49 02 00
start pos.	20 0**1** 10 00	00 00	00 00 00 00	80 84 1E 00	80 96 98 00	F0 49 02 00
	20 0**0** 10 00	00 00	00 00 00 00	80 84 1E 00	80 96 98 00	F0 49 02 00

9. **Start positioning job again**

Starting the positioning job again with the same values for A, V, W
→ Set bit 8 in the control word (edge from "0" to "1" starts the positioning job again – bit 20 in the control word and values A, V, W are still set !)

start pos.	20 0**1** 10 00	00 00	00 00 00 00	80 84 1E 00	80 96 98 00	F0 49 02 00

General notes:

Points 1. to 3. are necessary only once for most applications.

These parameters are defined and saved permanently into the E^2PROM of the SERS.
Of course these values can be redefined any time.

For writing any other SERS-parameter please follow the principle as shown in the above example under 1. to 3.

5.2 Example: Polynom driving with extended binary mode (22/12 Byte I/O)

A velocity profile consisting of 3 sections can be programmed as follows
(the values in the example are based on rotational scaling):

Initial status:

Control Word (Byte 1 - 4) = 0;
Opcode (Byte 5 - 6) = 0;
Operand (Byte 7 - 10) = 0;
Acceleration (Byte 11 - 14) e.g. = 1000000 (decimal); acceleration = 1000.000 rad/s^2
Velocity (Byte 15 - 18) e.g. = 30000000 (decimal); 3000.0000 rpm
Position command value (Byte 19 - 22) e.g. = 3600000 (decimal); 360.0000 degree

1. section Start:

Acceleration = 1500000 (decimal)
Velocity = 20000000 (decimal)
Position command value = 7200000 (decimal)
Control word = 0x00150120 (Hex) (Byte4 = 00, Byte3 = 15, Byte2 = 01 , Byte1 = 20)
Start relative Polynom section (relative positioning in polynom driving mode)
Bit 8 (START_POSITIONING) and Bit 15 (START_POSITIONING_TOGGLE) are set both for the first start.

Waiting until, Profibus-buffer is accepted and evaluated by the SERS:
→ Wait, until Handshake =1 (Status Word, Bit 8: HANDSHAKE)

Waiting, until the next data (definition of next polynom section) can be loaded:
→ Wait, until SETPOINT_ACKNOWLEDGE = 1 (Status Word, Bit 4)

2. section write and start (will be started right after the end of the first section):

Acceleration = 1800000 (decimal)
Velocity = 25000000 (decimal)
Position command value = 3600000 (decimal)
Control Word = 0x00140120 (Hex) start relative Polynom section, Togglebit (Bit 15) is changed

Wait, until Handshake =1 (Status Word, Bit 8: HANDSHAKE)

Wait until data are accepted (will be only at end of first polynom section):
Wait, until SETPOINT_ACKNOWLEDGE = 1 (Status Word, Bit 4)

Last section write and start:

Acceleration = 2000000 (decimal)
Velocity = 12000000 (decimal)
Position command value = 7200000 (decimal)
Control Word = 0x001D0120 start last Polynom section

After Handshake = 1 (Status Word, Bit 8: HANDSHAKE) → reset handshake bits, for not causing a new start and for releasing the execution of new commands via "Opcode":

Set Control Word = 0

6. Typical parameters to be set

For most applications there are only few basic parameters to be set. A detailed description of the below listed basic parameters can be found in the general manual **"SERS manual"** (for SERS drives with RS232-interface) chapter 4.7 page 41 to 71. All other additional parameter implemented in the SERS (described in the SERS manual) can be used for many different special functions.

1. Phase current parameter **P1010** (to be adjusted always depending on the connected motor)
   - e.g. for 4A phase current → P1010=4000 (in [mA])
2. Scaling mode
   a) **P76** – scaling position data → all position data (position command value, actual position, feeding constant, backlash, …)
   → e.g. for linear systems (e.g. spindle applications) P76 = 1 must be set
   b) **P44** – scaling velocity data → all velocity values (positioning, homing, jog mode)
   → e.g. at linear systems (e.g. spindle applications) for indicating the values in [mm/min] P44 = 1 must be set
   b) **P160** – scaling acceleration data → all acceleration data (positioning, homing, jog mode)

   The scaling for position data, velocity data and acceleration data may be set to different values (e.g. position data linear in [mm] – P76=1 – and velocity data in [rpm] – P44=2 or P44=66)
3. Parameter of the mechanics
   a) feeding constant **P123** (scaled value – depending on P76)
   b) gear ratio constants **P121** and **P122** (not scaled values)
4. Homing parameter (P41, P42 and P1003 are scaled values)
   a) general adjustments for homing parameter **P147** (e.g. homing direction)
   b) velocity homing **P41** and **P1003** and acceleration homing **P42**
5. Jog / manual drive parameter (all jog parameter are scaled parameter)
   a) jog velocity slow and fast **P019** and **P1020**
   b) jog acceleration **P1018**
6. Stop (deceleration) ramp in case of error or at active STOP → **P1030** (scaled value)
   When an error occurs (e.g. limit switch open) or the Stop-input gets active (external or (Stop-Bit in the control word), then the motor decelerates always with a ramp defined P1030 (independent whether the drive is positioning, homing or in jog mode at the moment)
7. Permanent saving of all changed parameter into the SERS E^2PROM by writing the parameter P1004 → **P1004=2** (not scaled value)

All parameters are pre-adjusted. So some of the parameter listed above, are adjusted with values suitable for many applications already:

P1010=6000 [mA] for SERS 06.. versions (for SERS 02... → 2800, for SERS 12... → 8000)
P76=2, P44=2, P160=2 (all scaled rotational, P121 until P123 are not used then)
P147=4 (homing to the input "homing switch" in positive direction)
P42=500 [rad/s^2], P41=1000 [rpm], P1003=100 [rpm]
P1018=500 [rad/s^2], P1019=30 [rpm], P1020=150 [rpm]
P1030=4000 [rad/s^2]