

## Application Note Serial Link for L180 digital servo drive





### Record of Manual Revision

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aPT	27 <sup>th</sup> September 00	HJO	Preliminary Issue for Review	All

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Critical evaluation of the manual is welcomed. Your comments will assist us in future product documentation.

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# 1 SERIAL LINK

## 1 SERIAL LINK

### 1.1 DIALOGUE PROTOCOL

This protocol is used to exchange data between computer and single L180 servo drive via RS232.

**Transmit format:**



Figure 1: Protocol format

Table 1: Protocol description

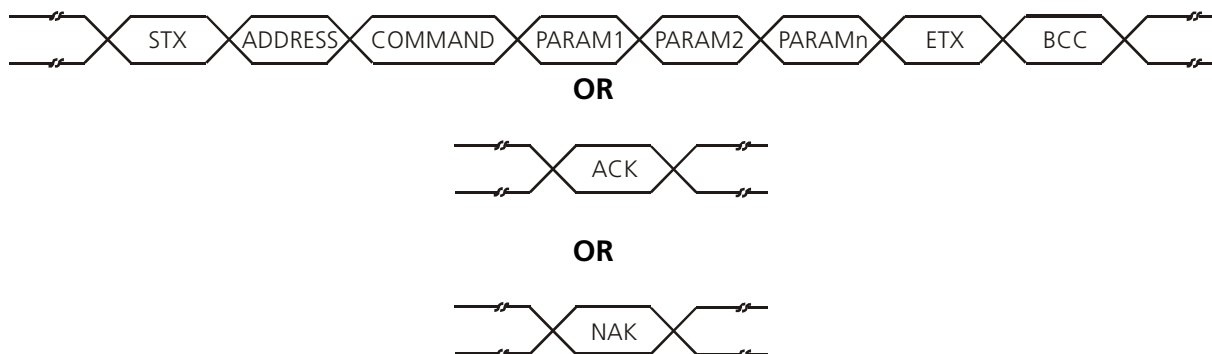
	Description
STX	Start of text.
ADDRESS	Axis address. The drive Address is fixed to 1 (=> ASCII 49).
COMMAND	Command to execute.
PARAM1	Drive parameter address or command complement. For the address, address value + 48
PARAM2..n	Optional parameters. If data's, 4 digits hexadecimal value.
ETX	End of text.
BCC	Block check 8 bit: <STX > XOR <ADDRESS> XOR ....XOR <ETX>

The decimal parameter value must be transferred into a four digit hexadecimal value. The ASCII equivalent of each digit of the hexadecimal value must be transmitted to the drive, for instance 10200 => 27D8<sub>h</sub> => {50}{55}{68}{56}. The same ASCII code format is received from the drive.

Table 2: Commands

COMMAND	ASCII	DESCRIPTION	REQUIRED PROTOCOL PARAMETERS
R	82	Read parameter	address
W	87	Write parameter	address + parameter
CH	67; 72	Reset hardware	-
ST	83; 84	Store in FLASH	-

### Receive format :



The answers are different depending on received command:

Write parameter :

Transmission : <Axis Address> <Write> <Parameter Address> <Data>

Answer : ACK if order understood and executed

NAK if BCC wrong and No Axis OK

Read parameter :

Transmission : <Axis Address> <Read> <Parameter Address>

Answer : <Axis Address> <Read> <Parameter Address> <Data>

NAK if BCC wrong and No Axis OK

### 1.1.1 DIALOGUE EXAMPLES

Command	Drive answer
Read parameter no 11 {02}{49}{82}{59}{03}{90}	Parameter no 11 = 27 = (1B)h {02}{49}{82}{59}{48}{48}{49}{66}{03}{41}
Write 127 to the parameter no 28 {02}{49}{87}{76}{48}{48}{55}{70}{03}{86}	ACK {06}
Store parameters in FLASH {02}{50}{83}{84}{03}{52}	-

## 2 APPENDIX

### 2 APPENDIX

#### 2.1 PARAMETER LIST

Table 3: Parameter List

Addr.	Save	R / W	Unit	Range	Description	Example
0	Enter B	R/W	-	1...6	Pair of motor Poles	
1	Enter	R/W	$\frac{1}{2^{16}} \text{ turns}$	8000h...7FFFh	Resolver shift angle	16384    ¼ turn
2	Save	R/W	-	0,1	Motor Thermostat n.o. or n.c.	
3		R/W	$\frac{1}{7FFF_h} \cdot I_{\max,drive}$	0...7FFFh	Maximum motor current	with I <sub>max,drive</sub> = 20 ARMS, 19988    12.2 Arms
4	Save	R/W	$\frac{1}{7FFF_h} \cdot I_{\max,drive}$	0...3FFFh	Nominal motor current	with I <sub>max,drive</sub> = 20 ARMS, 10322    6.3 ARMS
5	Save	R/W	ms	0...7FFFh	I <sup>2</sup> t motor, limited to maximal drive I <sup>2</sup> t	12534    12534 ms
6	Enter	R/W	V/A	1...7FFFh	Current loop Proportional gain (Kp)	
7	Enter	R/W	V/As	0...7FFFh	Current loop Integral gain (Ki)	
8	Enter	R/W	Vs/A	0...7FFFh	Current loop Differential gain (Kd)	
9	Enter	R/W	$\frac{0.1 \text{electr. deg r.}}{1000 \text{ rpm}}$	0...50	Phase advance	12    1.2° electrical degree at 1000 RPM
10	Enter	R/W	$\frac{1}{7FFF_h} \cdot I_{\max,drive}$	-1,0...7FFFh	AUTO/MANUAL mode, External I-limit	with I <sub>max,drive</sub> = 20 Arms, 5161    3.2 Arms
11	-	-	-	-	-	-
12	Enter	R/W	$\frac{1}{8000 h}$	6000h...A000h	Adjust factor of sine and cosine magnitude	35234    Factor 1.075
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	Save	R/W	ppr, puls per revolution	1..2048	Encoder resolution, 1025..2048 : Extrapolated resolution	234    234 pulse by revolution
18	S	R/W	-	0..6	Encoder marker pulse width 0: ¼ period channel A, gated . 1: ½ period channel A, gated . 2: 1 period channel A, gated . 4: ¼ period channel A, gated . 5: ½ period channel A, gated . 6: 1 period channel A, gated .	
19	Enter	R/W	$\frac{1}{2^{16}} \text{ turns}$	8000..7FFFh	Encoder marker pulse position	8192    1/8 turns
20	Enter	R/W	As/rad	1..7FFFh	Speed loop Proportional gain	
21	Enter	R/W	A/rad	0..7FFFh	Speed loop Integral gain	
22	Enter	R/W	A/rad s	0..7FFFh	Speed loop Differential gain	
23	Save	R/W	0.925 rpm	-8191...8191	Maximum speed (for 10V input)	3200    2960 RPM
24	Save	R/W	-	0...3	End limit switches n.o. or n.c.	
25	Save	R/W	-	0..3	Direction stop	

Table 4: Parameter List

Addr.	Save	R / W	Unit	Range	Description	Example
26	Enter	R/W	-	0,1	Speed or Current loop control 0: Speedloop 1: Currentloop	
27	Enter	R/W	-	0,1	Digital or Analogue command 0: Digital 1: Analog	
28	Enter	R/W	$\frac{1}{7FFF_h} \cdot V_{max}$ $\frac{1}{7FFF_h} \cdot I_{max,drive}$	-255..255	Analogue command offset with speedloop control Analogue command offset with currentloop control	with Vmax = 3000 rpm, 22 2 RPM with Imax,drive = 10 Arms, 33 0.01 A
29	Enter	R/W	55.6 RPM/s	0,1..7FFFh	Command Slope 0 : No ramp	100 556 RPM/s 0 No ramp
30	Save	R/W	-	0,2	Monitoring Relay Rdy/Ala/Ena 0 : Relay-Ready (Alarm inverted) 1 : Relay-Alarm	
31	-	-	-	-	-	-
32	Enter	R/W	ms	0..32000	Watchdog software communication	
33	Save	R/W	-	0..FFFFh	Alarm latch	
				Bit	Description	
				0	Latch alarm 7 (over or under voltage alarm)	
				2	Latch alarm d (earth fault)	
				4	Latch alarm 2 (I2t) (V2005	
6	Latch alarm b (over speed)					
34	Enter	R/W	revolu./4096	0..256	Encoder dead window	5 dead window = 5 REV/4096
35	-	-	-	-	-	-
36	-	-	-	-	-	-
37	-	-	-	-	-	-
38	-	-	-	-	-	-
39	-	-	-	-	-	-
40	-	-	-	-	-	-
41	Enter	R/W	-	-	Scope parameter	-
42	Enter	R/W	-	-	Scope parameter	-
43	Enter	R/W	-	-	Scope parameter	-
44	Enter	R/W	-	-	Scope parameter	-
45	Enter	R/W	-	-	Scope parameter	-
46	Enter	R/W	-	-	Scope options	-
47	-	-	-	-	-	-
48	-	-	-	-	-	-
49	-	-	-	-	-	-

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Table 5: Parameter List

Addr.	Save	R / W	Unit	Range	Description	Example
50	Enter	R/W	0.925/4 rpm $\frac{\sqrt{2}}{7FFF_h} \cdot I_{max, drive}$	8000..7FFFh 8000..7FFFh	Digital command with speedloop control Digital command with currentloop control	13838 3200 RPM with I <sub>max</sub> , drive = 20 Arms, 6226 3.8 ARMS
51	Enter	R/W	-	0...255	Status display 7 segment value 0 : Internal status, other values : bit 7 = DP, bit 6..0 = SEG A..G	146 DP + SEGMENT_F + SEGMENT_C
52		R/W	revolution	0..FFFFh	Motor revolutions counter	-
53	-	-	-	-	-	-
54	-	-	-	-	-	-
55	-	-	-	-	-	-
56	-	-	-	-	-	-
57	-	-	-	-	-	-
58	-	-	-	-	-	-
59	-	-	-	-	-	-
60	-	R/W	-	-	Internal register	-
61	-	R/W	-	-	Internal register	-
62	-	R/W	-	-	Internal register	-
63	-	R/W	-	-	Internal register	-
64	-	R			Status register	

Bit		Description	Drive display
0		Fault Int : Over or under voltage of DC Bus	
1	FO_N	Powermodule fault (over current, over temperature)	
2	FO_UP		
3	FO_VP		
4	FO_WP		
5			
6		-	
7			
8		Thermostat motor	
9	V6 OK		
10		End-switch 1	
11		End-switch 2	
12		-	
13		AUTO/MANUAL, External I-limit	
14		-	
15		enable/disable	0 / 1

Table 6: Parameter List

Addr.	Save	R / W	Unit	Range	Description	Example
65	-	R	-	-	Alarm register	
			<b>Bit</b>		<b>Description</b>	<b>Drive display</b>
			0		Fault Int : Over or under voltage alarm	7
			1		Powermodule fault	6
			2		-	-
			3		Internal over temperature (>80°C)	4
			4		I2t (only if latched)	2
			5		Resolver fault	5
			6		Over Speed	b
			7		Motor link fault	C
			8		Thermostat motor	3
			9			
			10			
			11			
			12			
			13		Software watchdog	9
			14		Firmware not OK	F
			15		Parameters not OK	E
66	-	R	°C	-	Heatsink temperature	32 32 °C
67	-	R	$\frac{2\sqrt{2}}{7FFF_h} \cdot I_{max, drive}$	8000h..7FFFh	Instantaneous motor current	with I <sub>max, drive</sub> = 20 ARMS 7241 12.5 A <sub>peak</sub>
68	-	R	0.925 rpm	8000h..7FFFh	Instantaneous motor speed	2667 2467 RPM
69	-	R	$\frac{1}{2^{16}} turns$	0..FFFFh	Resolver position within a revolution	4096 1/16 turn
70	-	R	-	-	-	-
71	-	R	-	-	Axis address	-
72	-	R	-	-	Monitor Version	-
73	-	R	-	-	Firmware Version	-
74	-	R	-	-	FPGA Version	-
75	-	R	-	-	-	-
76	-	R	-	-	-	-
77	-	R	-	-	-	-
78	-	R	-	-	-	-
79	-	R	-	-	-	-
80	-	R	-	-	-	-
81	-	R	-	-	-	-
82	-	R	-	-	Fan switch on temperature	40 Fan switch on at 40°C, switch off at 35°C
83	-	R	-	-	Control Unit ID	-
84	-	R	-	-	Commutation dead time	-
85	-	R	-	-	Options 2	-

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Table 7: Parameter List

Addr.	Save	R / W	Unit	Range	Description	Example
86	-	R	Arms	-	Maximum drive current (I <sub>max</sub> , drive)	20 20 ARMS
87	-	R	Arms	-	Nominal continuous drive current	10 10 ARMS
88	-	R	ms	-	Maximum drive I <sup>2</sup> t	-
89	-	R	-	-	Power modules	-
90	-	R	V <sub>rms</sub>	-	Line voltage input	400 400 V <sub>rms</sub>
91	-	R	-	-	Options 1	-
92	-	R	-	-	Hardware version	-
93	-	R	-	-	Delivery date	3099 week 30 in 1999
94	-	R	-	-	Customer	-
95	-	R	-	-	Serial Number	-
96	-	R	-	-	Firmware abilities	-
97	-	R	$\frac{-10}{7\text{FFF}_h} \text{V}$	8000..7FFFh	external analog command 10V	-
98	-	R	$\frac{2.5}{7\text{FFF}_h} \text{V}$	8000..7FFFh	external analog command 2.5V	-
99	-	R	parameter 50	8000...7FFFh	Internal digital command	-
100	-	R	-	-	Scope values	-
...	-	R	-	-	Scope values	-
179	-	R	-	-	Scope values	-
180	-	R	-	-	Resolver Sine	-
181	-	R	-	-	Resolver Cosine	-
182	-	R	$\frac{2\sqrt{2}}{7\text{FFF}_h} \cdot I_{\text{max, drive}}$	8000..7FFFh	Current Command	-
183	-	R	-	-	-	-
184	-	R	-	-	-	-
185	-	R	$\frac{2\sqrt{2}}{7\text{FFF}_h} \cdot I_{\text{max, drive}}$	8000..7FFFh	Phase U current	-
186	-	R	$\frac{2\sqrt{2}}{7\text{FFF}_h} \cdot I_{\text{max, drive}}$	8000..7FFFh	Phase V current	-
187	-	R	$\frac{2\sqrt{2}}{7\text{FFF}_h} \cdot I_{\text{max, drive}}$	8000..7FFFh	Phase W current	-
188	-	R	-	-	-	-
	-	R	-	-	-	-
189	-	R	-	-	-	-
190	-	R	-	-	-	-
191	-	R	-	-	-	-
192	-	R	-	-	I <sup>2</sup> t threshold	-
193	-	R	-	-	Instant I <sup>2</sup> t	-

### 2.2 ASCII-CODE

Table 8: ASCII-CODE non printable

Dez	Oct	Hex	Code	Description
0	0	0x00	NUL	Null prompt
1	1	0x01	SOH	Start of heading
2	2	0x02	STX	Start of text
3	3	0x03	ETX	End of Text
4	4	0x04	EOT	End of transmission
5	5	0x05	ENQ	Enquiry
6	6	0x06	ACK	Acknowledge
7	7	0x07	BEL	Bell
8	10	0x08	BS	Backspace
9	11	0x09	HT	Horizontal tab
10	12	0x0A	LF	Line feed
11	13	0x0B	VT	Vertical tab
12	14	0x0C	FF	Form feed
"	"	"	NP	New page
13	15	0x0D	CR	Carriage return
14	16	0x0E	SO	Shift out
15	17	0x0F	SI	Shift in
16	20	0x10	DLE	Data link escape
17	21	0x11	DC1	X-ON
18	22	0x12	DC2	
19	23	0x13	DC3	X-Off
20	24	0x14	DC4	
21	25	0x15	NAK	No acknowledge
22	26	0x16	SYN	Synchronous idle
23	27	0x17	ETB	End transmission blocks
24	30	0x18	CAN	Cancel
25	31	0x19	EM	End of medium
26	32	0x1A	SUB	Substitute
27	33	0x1B	ESC	Escape
28	34	0x1C	FS	File separator
29	35	0x1D	GS	Group separator
30	36	0x1E	RS	Record separator
31	27	0x1F	US	Unit separator
127	177	0x7F	DEL	Delete or rubout

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Table 9: ASCII-CODE printable

Dez	Oct	Hex	Zeichen
32	40	0x20	
33	41	0x21	!
34	42	0x22	"
35	43	0x23	#
36	44	0x24	\$
37	45	0x25	%
38	46	0x26	&
39	47	0x27	'
40	50	0x28	(
41	51	0x29	)
42	52	0x2A	*
43	53	0x2B	+
44	54	0x2C	,
45	55	0x2D	-
46	56	0x2E	.
47	57	0x2F	/
48	60	0x30	0
49	61	0x31	1
50	62	0x32	2
51	63	0x33	3
52	64	0x34	4
53	65	0x35	5
54	66	0x36	6
55	67	0x37	7
56	70	0x38	8
57	71	0x39	9
58	72	0x3A	:
59	73	0x3B	;
60	74	0x3C	<
61	75	0x3D	=
62	76	0x3E	>
63	77	0x3F	?
64	100	0x40	@
65	101	0x41	A
66	102	0x42	B
67	103	0x43	C
68	104	0x44	D
69	105	0x45	E
70	106	0x46	F
71	107	0x47	G
72	110	0x48	H
73	111	0x49	I

Table 10: Parameter List

Dez	Oct	Hex	Zeichen
74	112	0x4A	J
75	113	0x4B	K
76	114	0x4C	L
77	115	0x4D	M
78	116	0x4E	N
79	117	0x4F	O
80	120	0x50	P
81	121	0x51	Q
82	122	0x52	R
83	123	0x53	S
84	124	0x54	T
85	125	0x55	U
86	126	0x56	V
87	127	0x57	W
88	130	0x58	X
89	131	0x59	Y
90	132	0x5A	Z
91	133	0x5B	[
92	134	0x5C	\
93	135	0x5D	]
94	136	0x5E	^
95	137	0x5F	_
96	140	0x60	`
97	141	0x61	a
98	142	0x62	b
99	143	0x63	c
100	144	0x64	d
101	145	0x65	e
102	146	0x66	f
103	147	0x67	g
104	150	0x68	h
105	151	0x69	i
106	152	0x6A	j
107	153	0x6B	k
108	154	0x6C	l
109	155	0x6D	m
110	156	0x6E	n
111	157	0x6F	o
112	160	0x70	p
113	161	0x71	q
114	162	0x72	r
115	163	0x73	s

Table 11: Parameter List

Dez	Oct	Hex	Zeichen
116	164	0x74	t
117	165	0x75	u
118	166	0x76	v
119	167	0x77	w
120	170	0x78	x
121	171	0x79	y
122	172	0x7A	z
123	173	0x7B	{
124	174	0x7C	
125	175	0x7D	}
126	176	0x7E	~

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