

XDM-13, XDM-14 – numeric panel display



XDM-13, XDM-14, XDM-14A



XDM-14C

XDM-13/14 numeric display with 14mm digit height can display four figure numbers. Simple interface allows easy interconnection with almost any control system or PLC.

Four interface dependent modifications are available:

- XDM-13, parallel interface, logic inputs,
- XDM-14, synchronous serial interface, logic inputs,
- XDM-14A, asynchronous serial RS-232 or RS-422/RS-485 interface,
- XDM-14C, asynchronous serial RS-232 or RS-422/RS-485 interface.

Type	Order number	Modification
XDM-13	EI5393.00	parallel interface, TTL logic inputs (5V)
	EI5393.10	parallel interface, 12V logic inputs
	EI5393.20	parallel interface, 24V logic inputs
XDM-14	EI5394.00	synchronous serial interface, TTL logic inputs (5V)
	EI5394.10	synchronous serial interface, 12V logic inputs
	EI5394.20	synchronous serial interface, 24V logic inputs
XDM-14A	EI5394.30	asynchronous serial interface, RS-232
	EI5394.40	asynchronous serial interface, RS-422/485
XDM-14A/T (TECO)	EI5394.301	asynchronous serial interface, RS-232, protocol TECO-ID
	EI5394.401	asynchronous serial interface, RS-422, protocol TECO-ID
XDM-14C	EI5394.70	asynchronous serial interface, RS-232
	EI5394.80	asynchronous serial interface, RS-422/485
XDM-14C/T (TECO)	EI5394.701	asynchronous serial interface, RS-232, protocol TECO-ID
	EI5394.801	asynchronous serial interface, RS-422, protocol TECO-ID

Description

Fig. 1 shows individual modification block schematics. XDM-13 has parallel interface. Digits has to be entered in BCD code individually. XDM-14 has synchronous interface with clock, data, strobe signals, that should be simulated by PLC. XDM-14A has asynchronous RS-422/485 or RS-232 serial interface with an ASCII protocol im-

plemented. XDM-14A/T (TECO version) TECO operator panel system ID protocol implemented. Display is enclosed in plastic box for panel installation. There is a removable screw terminal on rear cover.

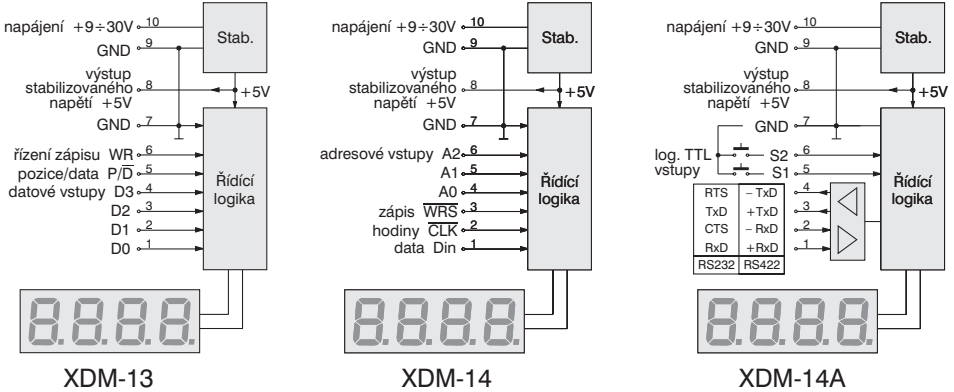


Fig. 1. XDM-13/14 block schematics

Specifications

Voltage/Power 9 ÷ 30 V / max 3 W
 5V output (terminal 8) 5 V ± 5%
 max. load 200 mA
 Operation temperature range -10 ÷ 50 °C

log.1 typ 3 V 12 V 24 V
 log.1 max 5.5 V 18 V 30 V
 Inp. current log.1 typ. 0.15 mA 2 mA 2 mA

XDM-13/14 input levels:

	.00	.10	.20
EI5393/EI5394			
log.0 max	0.8 V	3 V	5 V
log.1 min	2.4 V	8 V	15 V

XDM-14A

Transfer rate 300 ÷ 57600 Bd
 Format 8 bit
 Parity E/O/N selectable
 S1, S2 input filters 10 ms

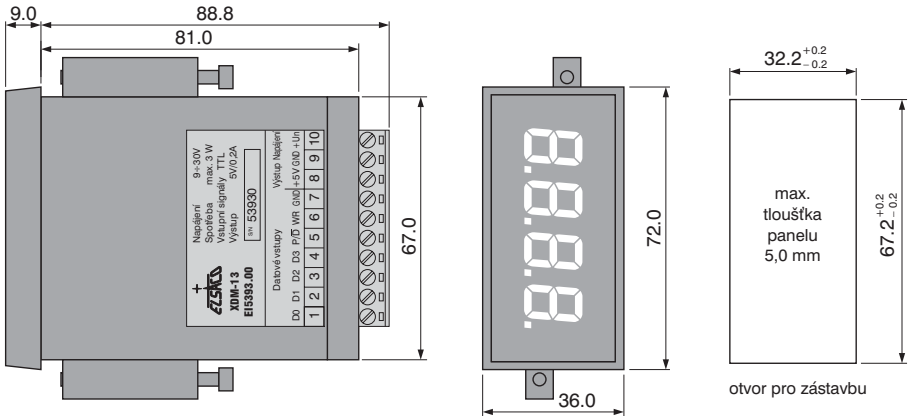


Fig. 2. Dimensions and inlet size

XDM-13 connection and control

Figure 3 shows typical XDM-13 typical connection. D0÷D3 data and P/D switch signals are common for all displays, but every one needs its own WR signal.

See fig. 4 for writing sequence. At first, position of digit is written and then a data are written on this position. WR rising edge defines writing moment. It is not necessary to write in left right order since position 0 (as shown on figure 4) or write all digits.

Position 0÷3 is set on D0÷D3 signals and P/D is 1 when writing position. Position 4 selects dot register.

D3	D2	D1	D0	P/D	digit position
0	0	0	0	1	0
0	0	0	1	1	1
0	0	1	0	1	2
0	0	1	1	1	3
0	1	0	0	1	dots

After setting position a digit is written according to this table:

D3	D2	D1	D0	P/D	digit shown		
					set 0	set 1	set 6
0	0	0	0	0	0	0	0
0	0	0	1	0	1	1	1
0	0	1	0	0	2	2	2
0	0	1	1	0	3	3	3
0	1	0	0	0	4	4	4
0	1	0	1	0	5	5	5
0	1	1	0	0	6	6	6
0	1	1	1	0	7	7	7
1	0	0	0	0	8	8	8
1	0	0	1	0	9	9	9
1	0	1	0	0	-	-	A
1	0	1	1	0	E	=	b
1	1	0	0	0	H	C	C
1	1	0	1	0	L]	d
1	1	1	0	0	P	°	E
1	1	1	1	0	dark	dark	F

With a dot register selected, D0 controls dot t0, ...D3 dot t3. Any count of dots can be lit, log 1 on D0÷D3 and P/D signals, means the dot is lit off. D0÷D3 and P/D signals must be stable at least 0 ms before and 50 ms after WR rising edge.

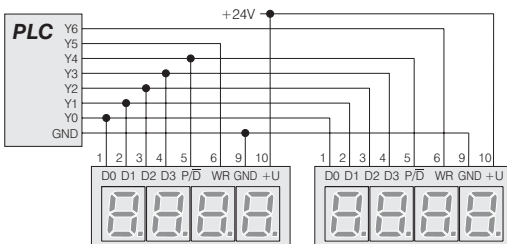


Fig. 3. XDM-13 to PLC connection

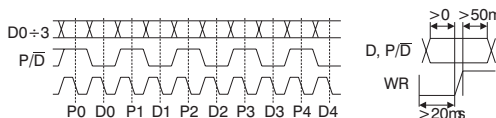


Fig. 4. XDM-13 writing sequence

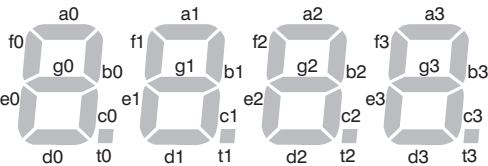


Fig. 5. Segment position

All segments lit on after power on.

Character set selection

Selection mode entered by writing in according position

D3	D2	D1	D0	P/D	position
1	1	1	1	1	character set

Then a character set selection follows

D3	D2	D1	D0	P/D	set
0	0	0	1	1	0 – basic
0	0	1	0	1	1 – thermometer
1	0	0	0	0	6 – hexadecimal

The set 0 is default and always set after power on. Character set switching is possible between position writes, then symbols from different character sets can be displayed concurrently.

Watch-Dog display

There is a watchdog timer included in display. Predefined warning message can be displayed, when display is not refreshed.

D3	D2	D1	D0	P/D	WD display position
1	0	0	0	1	0
1	0	0	1	1	1
1	0	1	0	1	2
1	0	1	1	1	3
1	1	0	0	1	dots
1	1	1	0	1	WD timeout

WD time-out message is set as usual messages, selected position is only changed. Timer timeout is set in its position as 0÷15 binary number in 0.25 sec. steps. Thus a $15 \times 0,25 = 3,75$ s maximum time is possible. WD function can be

switched off by writing 0 (D0÷D3=0). After power on, WD function is switched off, and message is predefined as “four dashes”.

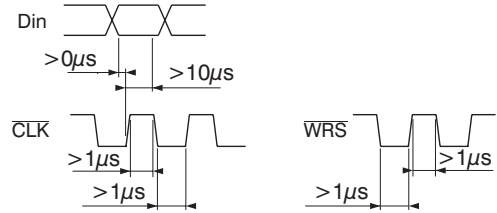
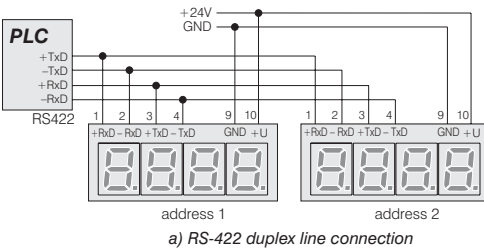
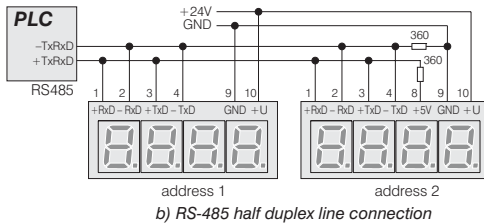


Fig. 6. XDM-14 signal timing

XDM-14 connection and control



a) RS-422 duplex line connection



b) RS-485 half duplex line connection

Fig. 7. Connection XDM-14A RS-422/485 to the PLC

Fig. 7 shows two XDM-14 connection. There are Din, Clk and WRS common signals and displays are individually addressed. The address is set on A0÷A2 connectors. Open input stands for log. 0,

+5V stands for log.1. Up to 8 displays can be connected to single control unit.

Communication

Starts with 2 WRS pulses. Then two B1,B2 head bytes follow. There are A0-A2 bits in the B1 byte. Their value defines display addressed. One WRS pulse follows. Then a four (B3÷B6) bytes follow, with content of display figures. The first the right figure (digit) is transmitted. See fig. 5 for segment depiction. See fig. 10 for communication record in time. Din is sampled with Clk rising edge. High level is CLK quiescent state.

Figure 10 shows data set-up and hold time. WRS must have a 1ms width at least. Clk signal must have high level when transmitting WRS pulses.

	7	6	5	4	3	2	1	0
1. byte (B1)	1	1	0	0	0	A2	A1	A0
	address							
2. byte (B2)	1	0	0	0	0	1	0	0
3. byte (B3)	a3	b3	c3	d3	e3	f3	g3	t3
4. byte (B4)	a2	b2	c2	d2	e2	f2	g2	t2
5. byte (B5)	a1	b1	c1	d1	e1	f1	g1	t1
6. byte (B6)	a0	b0	c0	d0	e0	f0	g0	t0

XDM-14A, XDM-14C connection and control

Address and communication parameters are saved in an internal EEPROM (saved even while power off) of display with asynchronous interface. Fig. 9 show display connection through RS-232 interface. One display can be connected to a single RS-232 interface, In practice, we can connect a few displays (its RxD input) to one PLC

TxD output. Then the only one way communication is possible and PLC is not able to check functionality of connected displays.

Display with RS-422/485 interface may be connected in two ways. If control device is equipped by full-duplex RS-422 line, four-lines connection is recommended – see fig. 8a). PLC transmitter is

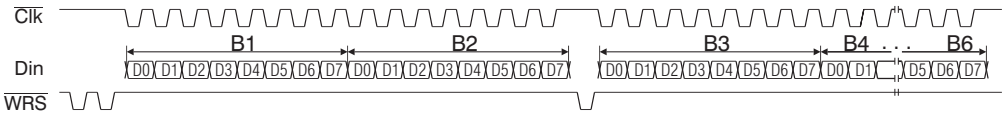


Fig. 10. XDM-14 write sequence

always active. It may subsequently send commands to all connected displays. Displays send its responses to the receive pair of PLC. After response a transmitters enters a high impedance state, and line pair needs termination resistors to be defined.

The second way is two-wires (half-duplex) connection – see picture 8b). After command receive, the display send response to the same line. PLC transmitter needs correct output control – it has to enter a high impedance state after transmission. Termination for defined line state is required, on both sides the better. Fig 8b) shows termination on receiver.

Communication protocol

Simple ASCII protocol (ADAM like) is used, communication model is master-slave. Display always figures as a slave.

Common message format is:

[delimiter] [address] [command] [data] [checksum] CR

where:

delimiter – unique initial character (not used in message body – eg. @, \$)

address – two-digit hexadecimal ASCII address (00÷FF)

command – determines required action

data – necessary data appropriate for specific command, numbers are hexadecimal in ASCII format

checksum – It is a two-digit modulo 256 sum of all the characters in message except this checksum and trailing CR character when checksum in protocol is turned on. For example message \$07M<CR> will be \$07MD8<CR> with checksum ($24h + 30h + 37h + 4Dh$) mod $100h = D8h$.

CR – carriage return character 0DH, determines the end of message.

Configuration

There are default values set for all parameters after display assembly. Before operation start parameter configuration may be required. It can be performed from PC with terminal program (e.g.

Norton Term95 or Hyperterm). Displays with RS-232 interface can be connected directly to serial PC COM – as shown in fig. 8 a). Displays with

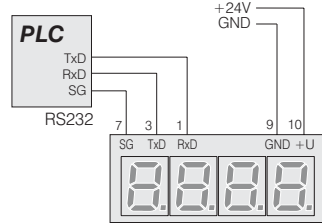
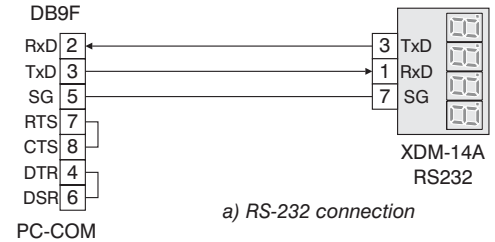
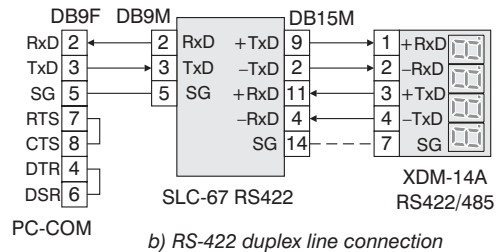


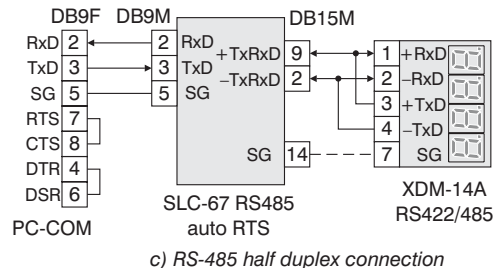
Fig. 9. XDM-14A RS-232 connection



a) RS-232 connection



b) RS-422 duplex line connection



c) RS-485 half duplex connection

Fig. 8. XDM-14A to PC connection

RS-422/485 interface must be connected through interface converter – e.g. ELSACO SLC-21 – see fig. 8b) or fig. 8c). Temporarily a direct connection can be used – see fig.

For 1,5 sec after power on, the display is waiting entry command to configuration mode. Communication parameters are 2400 Bd, 8 bit, no parity, module address 00. For switching to configuration mode display must receive three <ESC> characters subsequently. Procedure to entry to configuration mode follows:

- Connect the display to PC according to fig. 8
- Run terminal application on PC, set communication parameters 2400Bd, 8 bits without parity, 1 stop bit
- turn on display
- press ESC key on PC keyboard as long as „:“ character (colon) appears on display

Display reports configuration mode enter by sending „:“ character (colon). Since now display will write all the received characters to its EEPROM. The characters received are not echoed. Configuration mode ends when „!“ (exclamation mark) received.

If (after power on) display doesn't receive three <ESC> chars, it comes to normal operation mode after 1,5 sec.

When in configuration mode, next commands can be used:

- ? / module send its name and *firmware version (e.g. /XDM-14A*19990120)
- ?? display send ?<EEPROM content>, i.e. all the commands, saved in its EEPROM. After every <CR> a <LF> will be added to be readable on terminal.

Any command can be used for configuration. In configuration mode received characters are not echoed nor answered. Received characters are immediately written to EEPROM. Saved configuration will be executed while leaving configuration mode.

- ! display sets default parameters (clears EEPROM configuration) and leaves configuration mode.
- * display leaves configuration mode without changes in EEPROM.

When power off occurs in configuration mode, configuration is lost and display must be configured properly again.

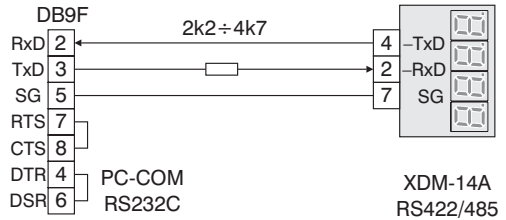


Fig. 11. XDM-14A temporary RS-422 connection to the RS-232 COM port PC

Communication commands

Interface setup

%aa`nn`ttccff<CR>

`aa` current module address. The default address is 00.

`nn` new module address (01 ÷ FF). After execution, the address of display is nn, and aa address is released.

`tt` response delay in ms. Allowed value is 00 ÷ FE, which means 0 ÷ 254 ms. This parameter allows response to be delayed. It may be important on half duplex lines (as RS-485), e.g. to switch direction of communication on line converters, repeaters, modems, etc. Setting tt=FF disables response completely. Default value is tt=0A, that means 10 ms.

`cc` baudrate code:

01	300 Bd	06	9600 Bd
02	600 Bd	07	19200 Bd
03	1200 Bd	08	38400 Bd
04	2400 Bd	09	57600 Bd
05	4800 Bd		

`ff` 8 configuration bits

bit 7 – not used

bit 6 – checksum: 0 disabled, 1 enabled.

If checksum was enabled, checksum byte must be used in commands and also will be inserted in responses.

bit 5 – parity – 0 disabled, 1 enabled.

bit 4 – parity type – 0 odd, 1 even. If bit 5 = 0, bit 4 has no meaning.

bits 3 ÷ 0 – not used.

Response:

!`nn`<CR> OK.

?`aa`<CR> error, command not executed.

If command was received correctly, execution comes immediately and then a response will be sent. Thus a response will be sent with new communication parameters, excluding baud rate.

Baud rate is changed only when executed from EEPROM at start up.

Soft WatchDog setting

Soft WD allows to check lost of communication. If in a predefined time, there is no command received, four dashes will be displayed instead of number.

`%aaWnnnn<CR>`

`aa` module address

`nnnn` WD time in msec as hex number.

E.g.: `07D0` set WD time to 2s, `0000` disables WD function.

Response

`!aa<CR>` OK.

`?aa<CR>` error, command not executed

Firmware version

`$aaF<CR>`

`aa` module address

Response

`!aayyyymmdd<CR>`

e.g. `!0119991207<CR>`

Module name

`$aaM<CR>`

`aa` module address

Response:

`!aaXDM-15<CR>`

Interface parameters request

`$aa2<CR>`

`aa` module address

Response:

`!aatccff<CR>` O.K

where `tt`, `cc` and `ff` are corresponding parameters as written by line parameters set-up `%aa...` setup command

`?aa<CR>` error

Configuration reading

`$aaE<CR>`

`aa` module address

Response:

`!:xx. .xx<CR>`

`xx. .xx` determines EEPROM content, saved in configuration mode. Up to 240 characters may be sent. EEPROM content includes `<CR>` and `!` characters too, if configuration mode was exited correctly.

Pause

Command allows to stop module for a predefined time. In this state module does not interpret commands. It usually may be used in configurati-

on – it allows for example to display text message after power up.

`$aaWtt<CR>`

`aa` module address

`tt` time in 0.01 sec

Response:

`!aa<CR>` O.K.

`?aa<CR>` error

Restart and initialization from EEPROM

`$aaX<CR>`

`aa` module address

Response:

none

Display a number / text on XDM-14A

`„aaT<number><CR>`

`aa` module address

`<number>` = number to be displayed, e.g. 123.4. Generally every ASCII character, which has a 7-segment representation, may be used.

It is always necessary to sent all characters – one per each controlled digit. Exception is „.“ (dot) – it is as additional character and it is interpreted as decimal point after digit. If only dot may be displayed on appropriate position, space character and dot must be send.

Also binary map of segments may be used. It must be written as \ (backslash) and ASCII hexadecimal byte. Segment depiction:

bit	7	6	5	4	3	2	1	0
segment	a	b	c	d	e	f	g	t

E.g. command `"01T\92\92\92\92<CR>` displays three horizontal lines on 4 digits indicator (lights segments a, d, g).

Response:

`!aa<CR>` O.K.

`?aa<CR>` error, command not executed

Display a number / text on XDM-14C

`„aaT<number><CR>`

`aa` module address

`<number>` = number to be displayed, sequenced for all displays, e.g. 0123.456.789.012.345, see fig. Generally, you can enter any ASCII character interpreted on seven-segment display. But you must always enter all 16 characters. The only exception is „.“ character, interpreted as a dot after number. If you want to lit th only dot, you

must enter a space in an according figure. Be aware of text strings, which are similar to commands.

You can enter a binary image of seven-segment display by sending a backslash followed by hexadecimal byte. As for XDM-14A, see above.

Response

!aa<CR> O.K.

?aa<CR> error, command not executed

Input read

„aaI<CR>

aa module address

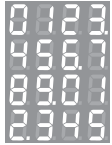
Response:

?aa<CR> error

!aabnnmm<CR> O.K, while

b bit2=0 – reset performed, bit0 and bit1 contain actual S1 and S2 level

nn, mm edge count modulo 256, nn for S2 inputs detected, mm for S1 inputs detected. Thus a short keypress is detected even outside communication.



Example of configuration

Connect the XDM-14A to PC-COM port according to fig. 8 or 11 depending on interface. On PC run the terminal application (e.g. TERM95.EXE). Set baudrate to 2400 Bd, format 8N1 – 8 bit, no parity, 1 stop and turn off handshake (for TERM95 in menu Settings – Line), if it is possible, set echo and CR to CRFL conversion (for TERM95 in menu Settings – Terminal Settings...).

Turn on the display and instantly press ESC up to : (colon) appears on display. Now display is in configuration mode. Set next configuration commands (cursive is comment only):

%00w2000<enter>

WatchDog 8 sec

"00THELP<enter>

initial text after power up

%00020A0600<enter>

address 02, response time 10 ms, baudrate 9600 Bd without parity

! save configuration and return to operational mode.

Now set the terminal baudrate to 9600 Bd and send commands:

\$02E<enter>

module send saved configuration

„02T123.45 <enter>

module displays number 123.45

After about 8 sec displayed number goes off – WatchDog time is expired.



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