XDM-15..39
modular large size numeric displays

Numeric displays XDM-15..39 with display height from 56 up to 180 mm are designed to indicate numeric data. Simple way of use allows to be applied with every control system and PLC.

Displays are provided as separate modules or mounted in frame with rubber seal, designed to be built into panel. Displays 56, 76 and 101 mm are also provided enclosed in anodized aluminium case.
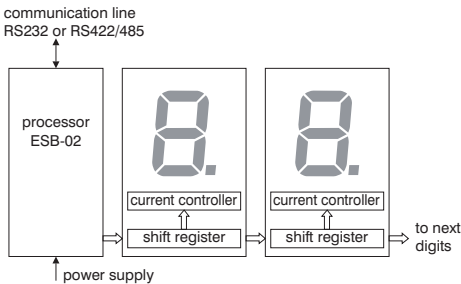
Complete displays:
- XDM-15/25/35, digit height 56 mm
- XDM-16/26/36, digit height 76 mm
- XDM-17/27/37, digit height 101 mm
- XDM-28/38, digit height 127 mm
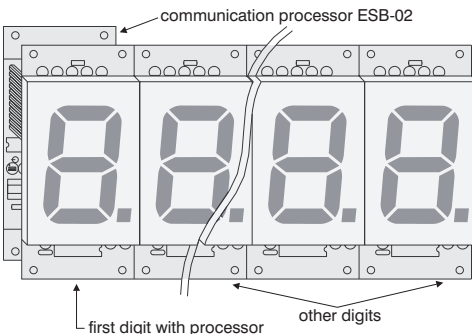- XDM-29, digit height 180 mm

Overview

Modular indicators allow to assemble displays with various number of digits. Communication processor – controller ESB-02 is the base of display, separate indicators is connected to them in chain – see picture 1. Controller processes commands received from serial line and generates control signals for indicators. Each indicator contains data shift register and eight regulated current outputs for each segment. Current regulators are controled from communication controller, so also display brightnees may be controled via serial line. Communication controller is always mounted on back of first (left) digit indicator (pic. 2). Controller has serial interface RS232 or RS422/485 (depends on modification). Communication protocol is simple ASCII (ADAM like). It allows to indicate numbers and others symbols or to separately control each segment.

Displays XDM-xx/T (modification TECO) have implemented protocol ID of PLC Tecomat operating panels. Modbus RTU protocol are alternative on special order.

Technical specification

Power supply
displays 56, 76, 101, 180 mm	12÷27 V
displays 127 mm	20÷30 V

Power consumption per digit
(all segment lights)	80÷200 mA

Working temperature limits   -10 ÷ 50 °C

Serial line
|	
speed	300÷57600 Bd
format	8 bit
parity	adjustable E/O/N

Display connection

Unenclosed displays

Power voltage and serial line are connected directly to communication processor ESB-02. Connectors are on inner board side – see picture 3. Power is connected via 2-pins connector XC4 (HS-02 type), before connecting make sure the polarity is correct. Serial line is connected via dual line 10-pins XC1 (PFL-10 type), interface is according to modification RS232 or RS422/485. Pin assignment is in the next table:


Picture. 1. Display block scheme.

Pic. 2. Mechanical design of XDM-15.
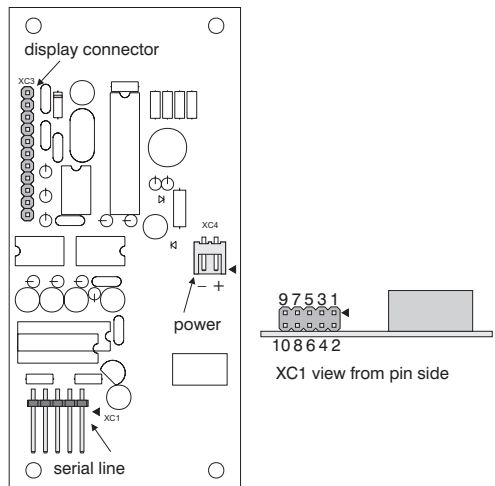
Pic. 3. Connectors of ESB-02 communication processor and pin numbering.

pin PFL-10	interface		note
	RS232	RS422	
1		+RxD	data to display
2		−RxD	
3	RxD		data to display
4	RTS		transmitter control
5	TxD		display response
6	not connected		
7		+TxD	display response
8		−TxD	
9	SG	SG	signal ground
10	+5V	+5V	for line terminator

Display with RS232 interface connection ilustrates picture 4. In duplex communication only one display may be connected to the line.
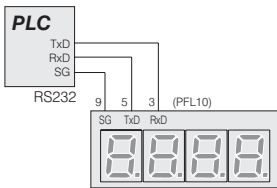
Pic. 4. Connection of display with RS232 interface to control system .
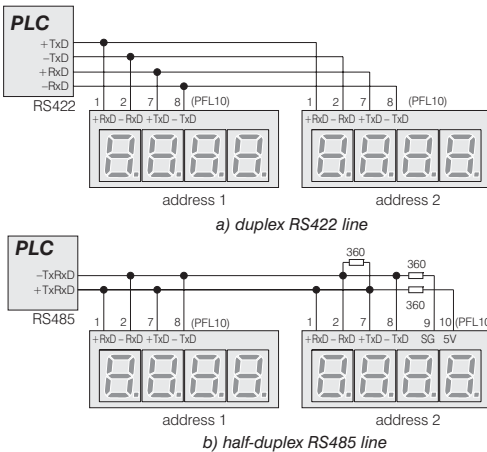
*Pic. 5. Connection of display with RS422/485 interface to control system.*

It is also possible to connect a few displays (its RxD input) to one PLC TxD output. In this case only one way communication takes place and PLC is not able to check functionality of connected displays.

Display with RS422/485 interface may be connected in two ways. If control device is equiped by full-duplex RS422 line, four-lines connection is recomended – see picture 5a). In PLC, transmitter is active all the time. It may subsequently send commands to all connected displays. Displays send responses to the receive line of PLC. Since after response transmitters goes to high impedaancy output state, innactive state of this line must be taken care of.

Second way is two-wires (half-duplex) connection – see picture 5b). After sending command display sends response to the same line. PLC transmitter must be correctly controlled – high impedancy output must be set after send command. Communication line must be terminated – best on both sides. Termination on display side is on picture 5b).
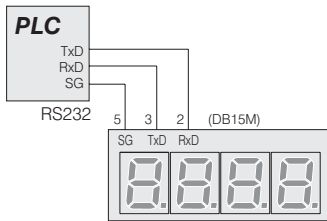
Enclosed displays

Displays in case are equipped with DSUB type connector DB15M. Inner connection demonstrates picture 7, pin description determines next table:
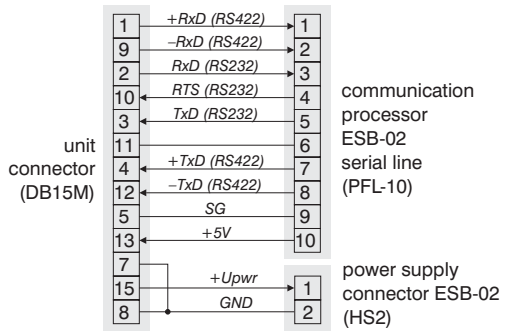

Pic. 6. Inner display connection of ESB-02 and DB15 connector.

pin DB15M	interface RS232	interface RS422	notes
1		+RxD	data to display
2	RxD		data to display
3	TxD		display response
4		+TxD	display response
5	SG	SG	signal ground
7	GND	GND	power ground
8	GND	GND	power ground
9		−RxD	data to display
10	RTS		transmit control
12		−TxD	display response
13		+5V	5V for terminating
15	Unap	Unap	Power voltage

Obr. 7. Connection of display with RS232 interface to control system.

a) duplex RS422 line

b) half-duplex RS485 line
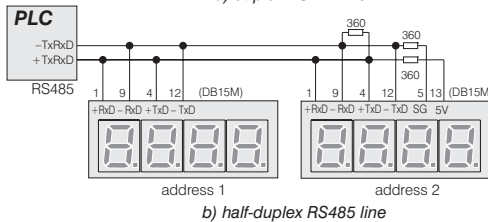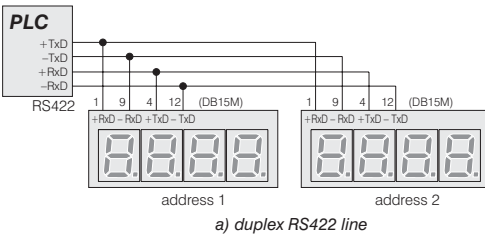
Pic. 8. Connection of display with RS422/485 interface to control system.

Display connection is analogic to unenclosed displays, only connector pin essignment is different. Picture 7 shows RS232 interface, picture 8 RS422/485 interface. Power voltage is not presented on pictures, it is to be connected to Unap and GND pins.

Communication protocol

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

Common message format is as follows:

[delimiter][address][command][data][chs]CR

where:

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

address - double digit hexadecimal ASCII address identifier (00÷FF)

command - determines required action

data - neccessary data appropriate for specific command, numbers are hexadecimal in ASCII form

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

CR - carriage return character 0DH, delimits the end of message.

Configuration

New modules have all the parameters set to default values. Parameters may be changed before using of display. Configuration can be adjusted from PC with terminal program (as Norton Term95 or Hyperterm). Displays with RS232 interface may be connected directly to
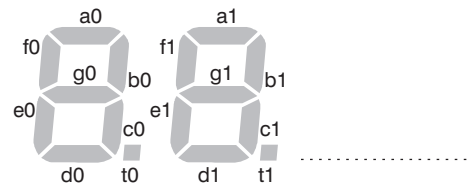
Pic. 9. Segment labeling.

serial PC COM – necessary connection demonstrates pic. 10a). Displays with RS422/485 inteface must be connected through inteface adapter – e.g. ELSACO SLC-21 – see pic. 10b) or 10c). Temporarily may be used direct connection – picture 11. Schematics assume enclosed displays with DB15 connector.

After turning on power display is 1,5 sec waiting for configuration mode entry command. Communication parameters are set to 2400 Bd, 8 bit, no parity, module address 00. Display must receive three <ESC> characters continuously to be switched to configuration mode. So procedure to entry to configuration mode is following:

- Connect the display to PC according to pictures 10 or 11
- Run terminal apllication on PC, set communication parameters 2400 Bd, 8 bits no parity, 1 stop bit
- turn on display power and instantly..
- press persistently ESC key on PC keyboard until ":" character (colon) appears on display

Entering to configuration mode display reports by sending ":" character (colon). From this moment display will write all the received characters to its EEPROM. Received characters are not echoed. Configuration mode is finished by receiving "!" (exclamation mark).

If (after power up) display did not receive three <ESC> chars, it goes after 1,5 sec to normal operation mode.
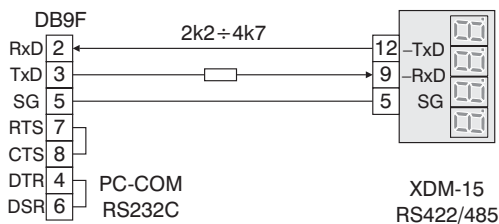
Immediately after entering configuration mode next commands may be also used:

- **?/** display sends /module name and *firmware version (e.g. **/XDM-17*19990120**)
- **??** display sends **?<EEPROM contens>**, i.e. all the commands, saved in its EEPROM. After every **<CR>** will be added **<LF>**, to be readable on terminal.
- **!** display loads manufacturer's default parameters (clears EEPROM configuration) and leaves configuration mode.
- ***** display leaves configuration mode without changes in EEPROM.

Every command may be used as configuration command. In configuration mode received characters are not echoed nor answered. Re-

a) RS232 line connection

b) duplex RS422 line connection

c) half-duplex RS485 connection
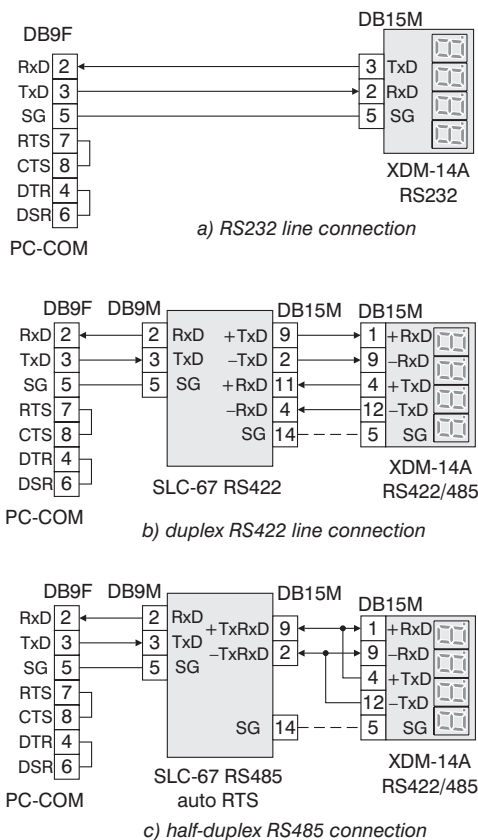
Pic. 10. XDM-15 to PC connection.

Pic. 11. XDM-15 RS422 to RS232 PC COM temporary connection.

ceived characters are immediately written to EEPROM. Saved configuration commands will be executed every time before entering normal operation mode.

If power down happens in configuration mode, configuration will be damaged and display must be configured properly again.

Communication commands

`%aannttccff<CR>`

aa current module address. In manufacturer's default configuration address is 00.

nn new module address (01÷FF). After command execution module will be accessible on address **nn**, address **aa** will be released.

tt response delay in ms. Allowed value is 00÷FE, that means 0÷254 ms. This parameter makes possible to delay response. It may be important on half duplex lines (as RS485), e.g. to switch direction of communication on line convertors, 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 is 8 bits with unique signification:

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, this bit has no meaning.

bity 3÷0 – not used.

Response:

`!nn<CR>` - OK.

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

If command was received correctly, execution comes immediately and then will be sent response. So response will be sent with new communication parameters, excluding baud rate. Baud rate is changed only by executing from EEPROM at start up.

Soft WatchDog

Soft WD allows to check lost of communication. If within time, defined in command, no command is received, 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.

Fimware version

`$aaF<CR>`

aa module address

Response

`!aayyyymmdd<CR>`
e.g. `!0119991207<CR>`

Module name

`$aaM<CR>`

aa module address

Response:

`!aaXDM-15<CR>`

Line parameters request

`$aa2<CR>`

aa module address

Response:

`!aattccff<CR>` - O.K
where **tt**, **cc** and **ff** are parameters corresponding to parameters of Line parameters setup command `%aa...`

`?aa<CR>` - chyba

Configuration read

`$aaE<CR>`

aa module address

Response:

`!:xx..xx<CR>`
xx..xx shows EEPROM content, saved in configuration mode. Up to 240 characters may be sent. EEPROM contens includes also `<CR>` chars nad trailing `!`, if configuration mode was exited correctly.

Pause

Command sets module to stand by for defined time. In this state module does not interpret commands. It is usually used in configuration – 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

Number of digits setup

`"aaWn<CR>`
  aa module address
  n = number of controlled digits, allowed
       value is 0÷9, A÷F,
       1÷F means number of digits 1 to 15,
       0 means 16 digits.

Display a number / text

`"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.
Always it is necessary sent all characters – one
per each controlled digit. Exception is "." (dot)
– it is additional character and it is interpreted
as decimal point after digit. If only dot shall be
displayed on appropriate position, space char-
acter and dot must be send.

Also binary map of segments may be used. It
must be written as \ (backslash) and ASCII hex-
adecimal byte. Segment assigment is follow-
ing:

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<CR>` dis-
plays three horizontal lines on 4 digits indicator
(lights segments a, d, g).

Response
  `!aa<CR>` - O.K.
  `?aa<CR>` - error

Brightness setting

`"aaJn<CR>`
  aa module address
  n   required brightness, allowed values are
       0÷9, A÷F.

0 - minimum brightness
F - maximum brightness

code	char	code	char	code	char	code	char
20H		3DH	=	51H	q	67H	g
22H	"	3EH	>	52H	r	68H	h
23H	≡	3FH	?	53H	S	69H	i
27H	'	41H	A	54H	t	6AH	j
2BH		42H	b	55H	U	6CH	l
2DH	–	43H	C	59H	Y	6DH	M
2EH	.	44H	d	5AH	Z	6EH	n
30H	0	45H	E	5BH	[	6FH	o
31H	1	46H	F	5DH	]	70H	p
32H	2	47H	G	5EH	°	71H	q
33H	3	48H	H	5FH	_	72H	r
34H	4	49H	I	60H	'	73H	S
35H	5	4AH	J	61H	A	74H	t
36H	6	4CH	L	62H	b	75H	u
37H	7	4DH	M	63H	c	79H	y
38H	8	4EH	n	64H	d	7AH	Z
39H	9	4FH	O	65H	E		
3CH	<	50H	P	66H	f		

Other characters will be displayed as .

Pic. 12. Viewable characters

Example of configuration

Connect the display to PC-COM port depend-
ing on interface type according to pic. 10 or 11.
On PC run the terminal application (e.g.
TERM95.EXE). Set baudrate to 2400 Bd, for-
mat 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 CRLF
conversion (for TERM95 in menu Setings – Ter-
minal Setings...).

Turn on the display and instantly press ESC un-
til : (colon) appears on terminal. Now display is
in configuration mode. Set next configuration
commands (cursive is comment only):
  `%00W2000`<enter>
       WatchDog 8 sec
  `"00W5`<enter>
       display with 5 digits
  `"00JF`<enter>
       maximal brightness

`"00THELP`<enter>

initial text after power up

`%00020A0600`<enter>

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

`!` *save configuration and return to operational mode.*

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

`$02E`<enter>

module sends saved configuration

`"02T123.45` <enter>

module displays number 123.45

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