

General description

MT-10T7/MT-10T8/MT-10T9 LCD display modules are composed of LSI controller and LCD panel. The display modules are capable of displaying 10 character locations (digit + dot). MT-10T7/MT-10T8 display module appearance is shown in Fig. 1/ Fig. 2, MT-10T9 display module appearance is shown in Fig. 3. Any segment of any character location can be set on/off independently of other segments. The structural scheme of displays is shown in Fig. 4. Data registers in LSI are divided into two nibbles: SGx(L) and SGx(H). Write of data to the character location is performed in two clock periods: first to the low nibble and then to the high nibble. The low nibble is in charge of segments g, e, d, and a, while the high nibble is responsible for segments h, b, c, and f (see Fig. 5). Write of 'H' highlights a corresponding segment, and write of 'L' extinguishes it.

MT-10T8/MT-10T9 display modules come with the backlight. Two backlight types are available: yellow-green (wavelength, $\lambda=570$ nm) and amber (wavelength, $\lambda=595$ nm). Display contrast depends on the display module supply voltage.

Contrast adjustment is performed by connecting an external resistor to V_0 pin (Fig.6). $R_{ext} = 0$ – MAX contrast, $R_{ext} = \infty$ (no resistor) – MIN contrast.

The dimensions of MT-10T7/MT-10T8 display modules are shown in Fig. 9, while the dimensions of MT-10T9 display module are shown in Fig. 10.

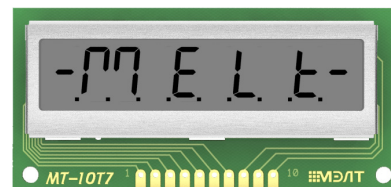


Fig. 1.

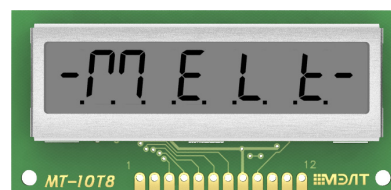


Fig. 2.



Fig. 3.

The structural scheme of displays

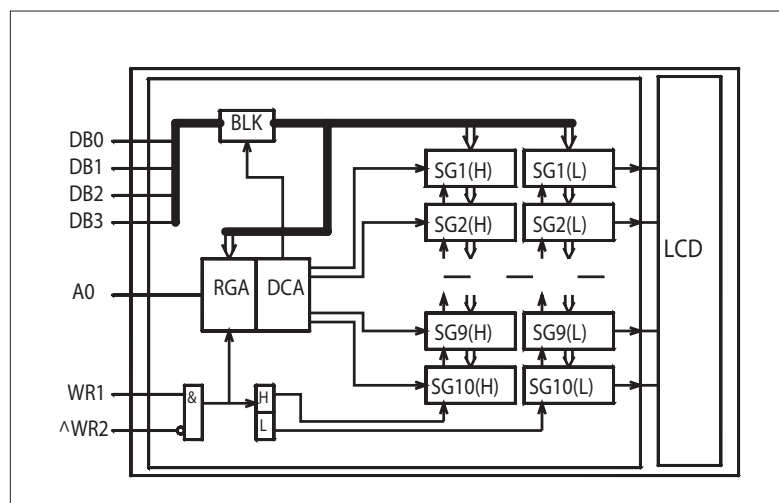


Fig. 4.

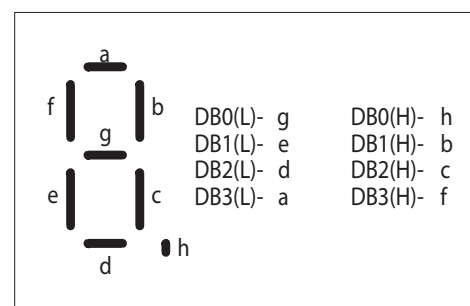


Fig. 5.

■ Contrast adjustment

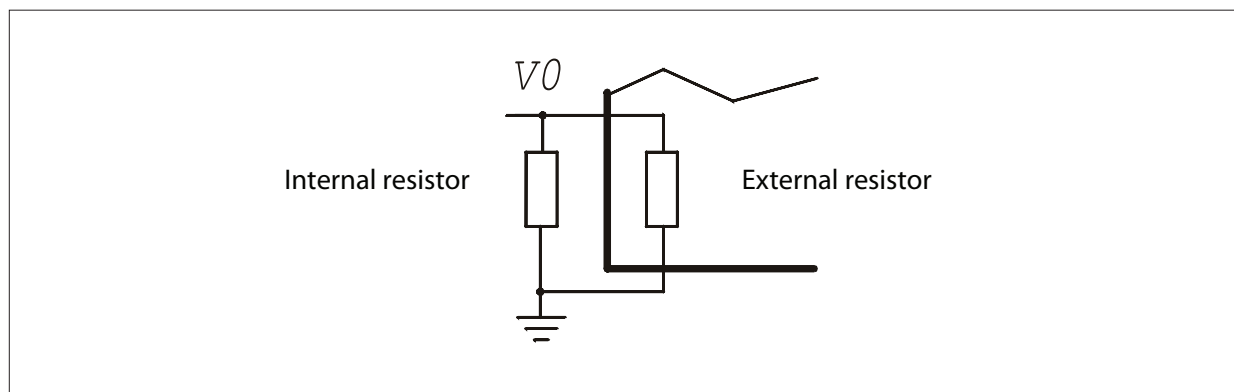


Fig. 6.

■ DC characteristics of the display module MT-10T7, MT-10T8

Table 1. DC characteristics.

Item	Symbol	Min.	Typ.	Max.	Units
Supply voltage	U_{CC}	3	–	5	V
Consumption current	I_{CC}	–	30	–	μA
Input "High" Voltage	U_{IH}	2,4	–	$U_{CC}+0,6$	V
Input "Low" Voltage	U_{IL}	-0,6	–	0,8	V
Max. Direct current of the backlight	U_{FM}	–	–	60	mA
Direct Voltage (at DC of 40 mA), V Wavelength 570/595 nm	U_F	4,15/3,7	4,35/3,9	4,55/4,1	V

Table 2. Dynamic characteristics of the display module.

Item	Symbol	Min.	Max.	Units
Preset time	t_{SAD}	0	–	ns
Hold time	t_{HAD}	100	–	ns
Write signal duration	t_{WR}	100	–	ns
Waiting time between WR	t_p	200	–	ns
WRx signal modification delay	t_{HW}	50	–	ns
Pulse rise time	t_R	0	50	ns
Pulse fall time	t_F	0	50	ns

■ DC characteristics of the display module MT-10T9

Table 3. DC characteristics.

Item	Symbol	Min.	Typ.	Max.	Units
Supply voltage	U_{CC}	3	–	5	V
Consumption current	I_{CC}	–	30	–	μA
Input "High" Voltage	U_{IH}	2,4	–	$U_{CC}+0,6$	V
Input "Low" Voltage	U_{IL}	-0,6	–	0,8	V
Max. Direct current of the backlight	I_{FM}	–	–	120	mA
Direct Voltage (at DC of 90 mA) Wavelength 570/595 nm	U_F	2,0/1,8	2,05/1,95	2,2/2,0	V

Table 4. Dynamic characteristics of the display module.

Item	Symbol	Min.	Max.	Units
Preset time	t_{SAD}	0	–	ns
Hold time	t_{HAD}	100	–	ns
Write signal duration	t_{WR}	100	–	ns
Waiting time between WR	t_p	200	–	ns
WRx signal modification delay	t_{HW}	50	–	ns
Pulse rise time	t_R	0	50	ns
Pulse fall time	t_F	0	50	ns

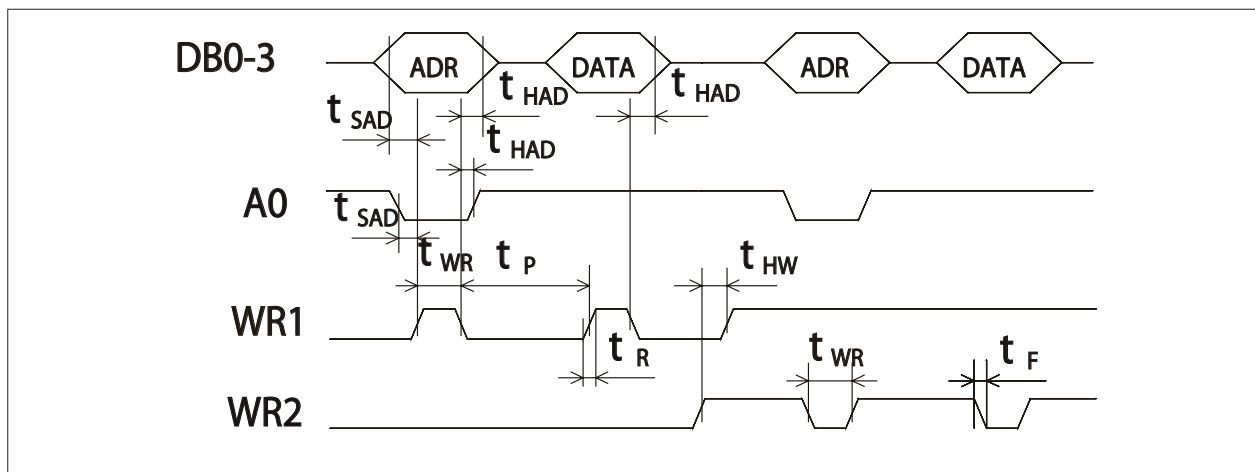


Fig. 7.

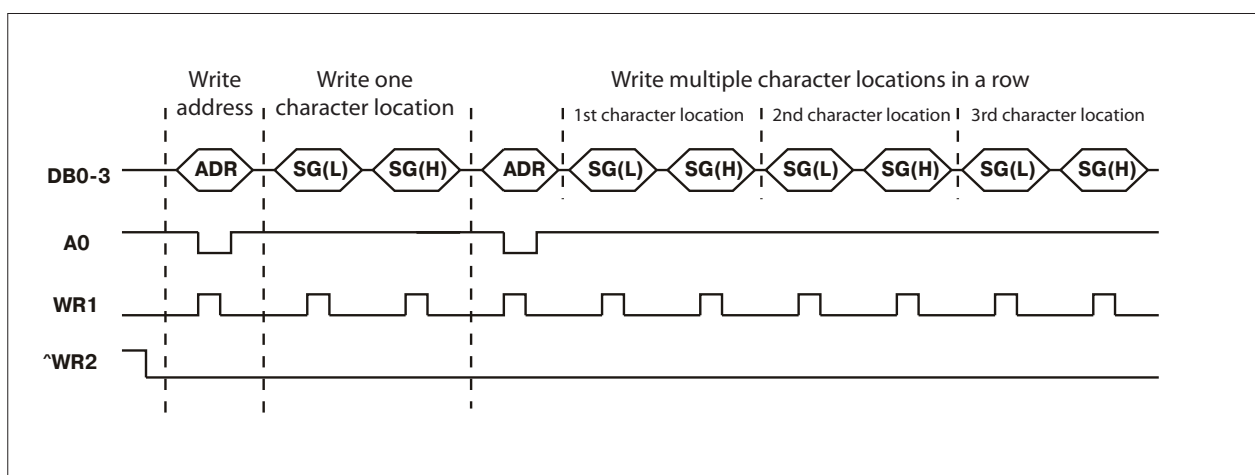


Fig. 8.

■ Description of instructions

Table 5. Addresses of display module registers.

Character location	1	2	3	4	5	6	7	8	9	10	
item	Sg1	Sg2	Sg3	Sg4	Sg5	Sg6	Sg7	Sg8	Sg9	Sg10	Lockout
Address, (HEX)	00	01	02	03	04	05	06	07	08	09	0F

Table 6. Truth Table.

Signal	Write to Address Register		Write to Data Register Storage		Data storage	
A0	0		1		X	
^WR2	0	1	0	1	1	X
WR1	1	0	1	0	X	0
DB0-3	Address		Data		X	

■ Description of LCD display module interface

First, an address of the appropriate character location is set on the bus. This address is then written to Address Register (AR) at the low signal level at A0 input with the corresponding signal at WRx input (see Table 2). WR1 and ^WR2 inputs latch on-bus information in internal static-type resistors. Within LSI those inputs are connected according to WR1 & ^WR2 circuit. Therefore, data will be written only if WR1="H" and ^WR2="L" simultaneously. This solution enables execution of CS function (crystal select) subject to the plenty of displays on the bus, or subject to other devices on the bus.

When writing the character location address, the nibble indicator is reset to SGx(L). The data is written to the low nibble at the high signal level at A0 input with the signal at WRx input. On the same signal, the data nibble indicator switches to SGx(H) with the same character location address maintained. The process of data write to the high nibble SGx(H) is similar to that to the low nibble SGx(L). After writing the second nibble, the address register contents are incremented, and data can be written to the next character location without writing the address.

0Fh is the bus lockout trigger address. Write of DB0="L" to 0Fh causes lockout of address and data write to LSI for 30 WRx signals. The bus is unlocked by writing DB0="H" to 0Fh.

At power on, SGx register contents are indefinite. Thus, when turning power on the registers should be cleared. The trigger status is undefined too; therefore the bus should be unlocked prior to displaying information. To unlock the bus, write DB0="H" to 0Fh

■ MT-10T7 and MT-10T8 dimensions

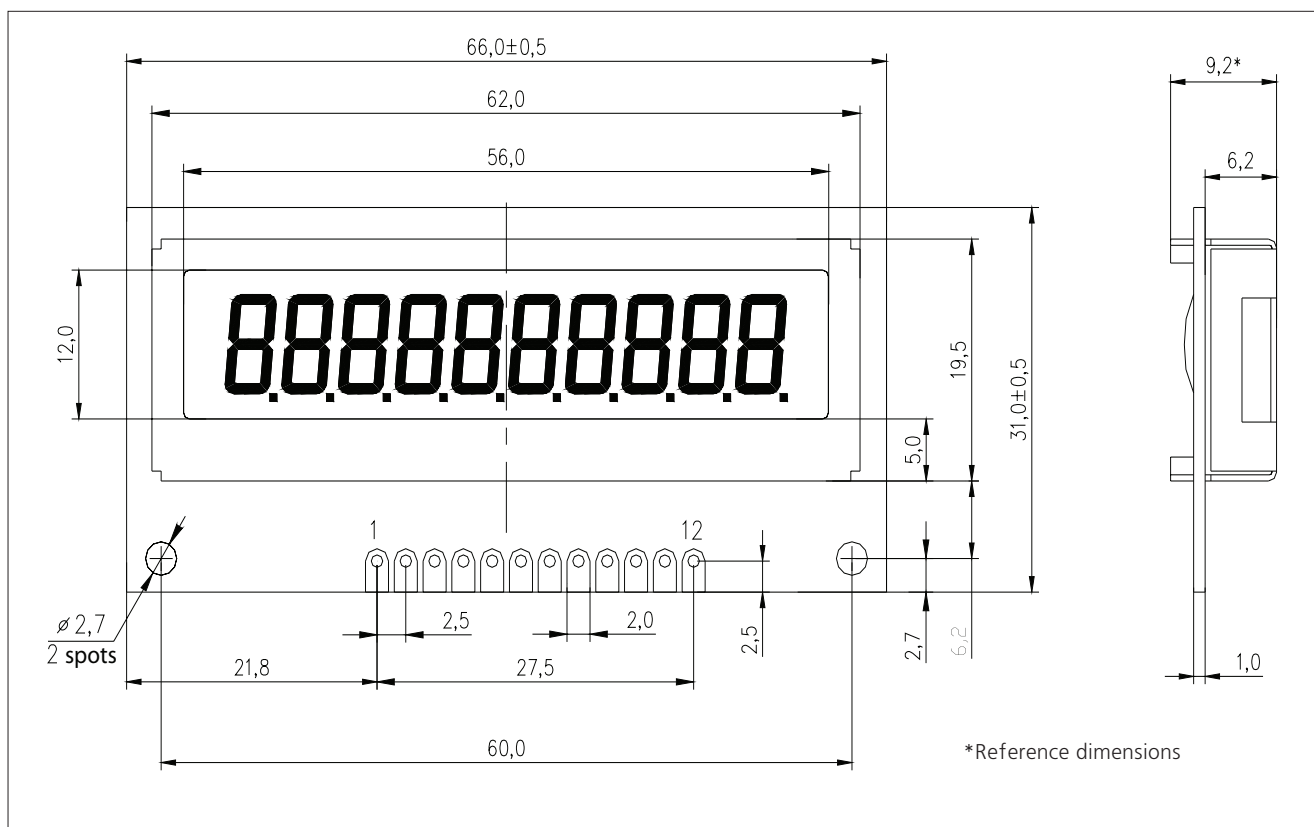


Fig. 9.

Dimensions deviation limits $\pm 0,3$.

Character size:
 height – 8 mm;
 width – 4 mm.

Table 7. Pinout.

Pin	Symbol	Pin assignment
1	A0	Select address/data: A0="L" – address, A0="H" – data
2	\wedge WR2	Write to display. Active level "L"
3	WR1	Write to display. Active level "H"
4	DB3	Data bus
5	DB2	Data bus
6	DB1	Data bus
7	DB0	Data bus
8	GND	Common pin. Ground.
9	V0	Contrast adjustment
10	+E	Display power supply
11	+LED	Used in MT-10T8 display (backlight power supply)
12	-LED	Used in MT-10T8 display

■ MT-10T9 dimensions

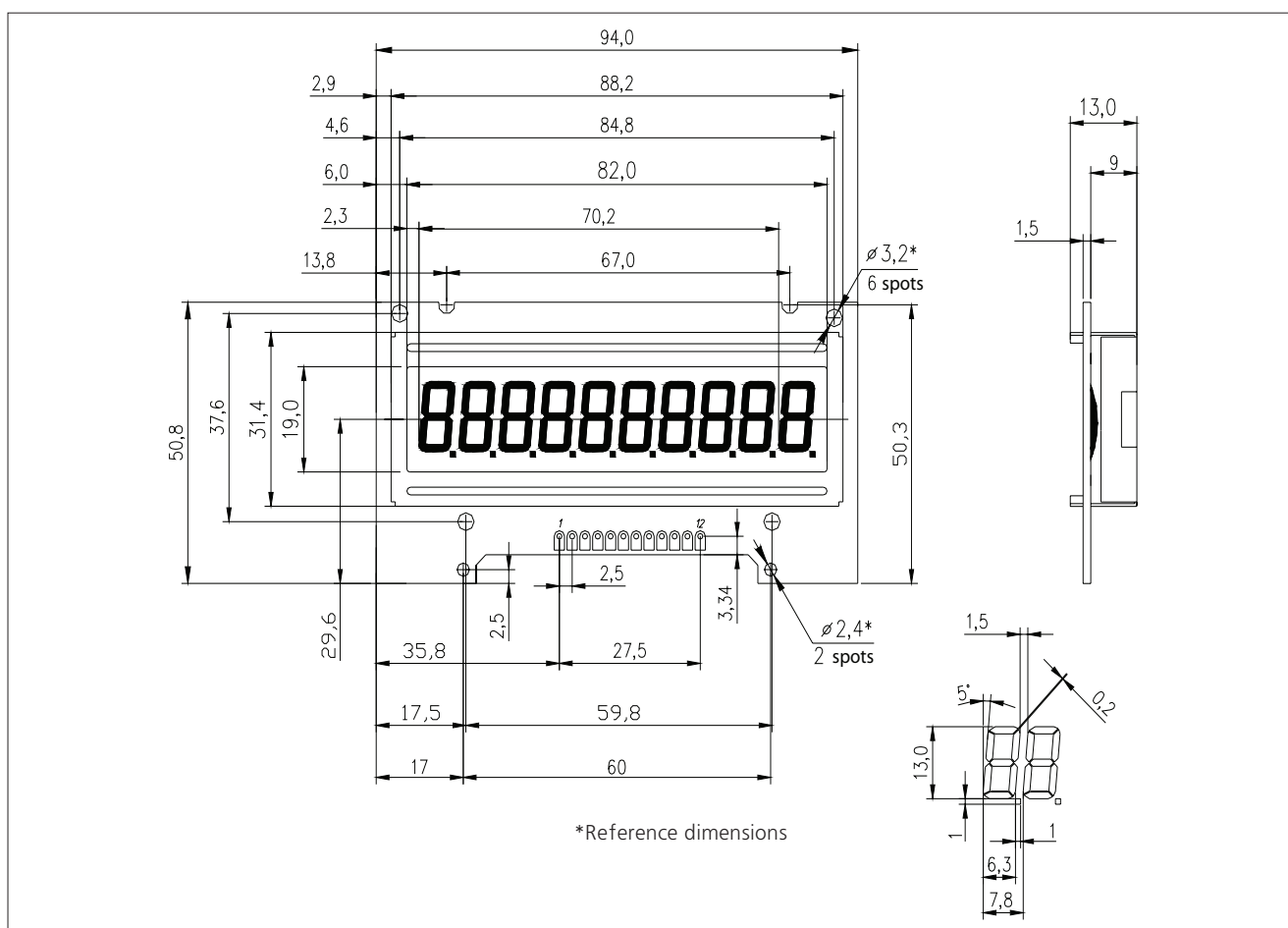


Fig. 10.

Dimensions deviation limits $\pm 0,3$.

Table 8. Pinout.

Pin	Symbol	Pin assignment
1	A0	Select address/data: A0="L" – address, A0="H" – data
2	^WR2	Write to display. Active level "L"
3	WR1	Write to display. Active level "H"
4	DB3	Data bus
5	DB2	Data bus
6	DB1	Data bus
7	DB0	Data bus
8	GND	Common pin. Ground.
9	V0	Contrast adjustment
10	+E	Display power supply
11	+LED	Used in MT-10T8 display (backlight power supply)
12	-LED	Used in MT-10T8 display

■ Revision history

Document version	Date	Alterations	Page
1.0	09/07/2013	Revision 1	



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