

## Data sheet

status Product specification

date of issue July 1990

# LTN111

## Liquid crystal display

T-41-39

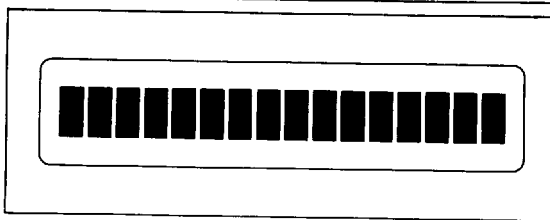
### MODULE DESCRIPTION

The LTN111 is a 5 x 7 dot, 16-character, 1-line dot matrix LCD module, with driver and controller LSI IC mounted on a single printed circuit board. The LSI controller incorporates a ROM-based character generator with a 160 characters and RAM display data with 8 characters. The module is capable of generating 160 fixed and 8 write by programme characters. The LTN111 operates from an extensive instruction set: display clear, cursor home, display ON/OFF, cursor ON/OFF, character blink, cursor shift and display shift.

### QUICK REFERENCE DATA

Outline dimensions	80 x 36 x 12 mm
Viewing area	64.5 x 13.8 mm
Character format	5 x 7 dots and cursor
Character size	3.07 x 6.56 mm
Dot size (spacing 0.08 mm)	0.55 x 0.75 mm
Mass	≈ 25 g
Drive method	MUX 1:16
Supply voltage	+5 V
Power consumption	7.5 mW
Illumination mode	reflective/trans- flective
Front surface	glossy
Character generator	built in
Data interface	parallel 4 or 8 bits

### DISPLAY MODE



7Z22322

Fig.1 16-character, 1-line LCD module.

### TYPE DEPENDENT DATA

TYPE	ILLUMINATION MODE	VIEWING DIRECTION	TO BE USED WITH EL BACKLIGHT
LTN111R-10	reflective	6 o'clock	-
LTN111F-10	transflective	6 o'clock	LXL111-G
LTN111R-50	reflective	12 o'clock	-
LTN111F-50	transflective	12 o'clock	LXL111-G



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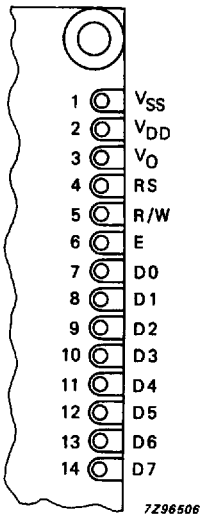


Fig.3 Pin configuration.

### PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1	V <sub>SS</sub>	ground
2	V <sub>DD</sub>	power supply (logic)
3	V <sub>O</sub>	contrast adjustment voltage
4	RS	register select
5	R/W	read/write
6	E	enable
7	D0	I/O data LSB
8	D1	I/O data 2nd bit
9	D2	I/O data 3rd bit
10	D3	I/O data 4th bit
11	D4	I/O data 5th bit
12	D5	I/O data 6th bit
13	D6	I/O data 7th bit
14	D7	I/O data MSB

### Notes to pin description

1. Contrast is adjusted by varying the voltage V<sub>O</sub> between 0 and 5 V.
2. D7 doubles as busy flag.
3. When the module is interfaced with a microprocessor with 4-bit parallel outputs, pins D0 to D3 are not used.

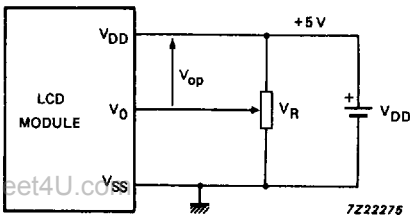


Fig.4 Power supply.

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## RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage	$V_{DD}$	-0.3	-	7.0	V
LCD drive voltage ( $V_{DD}-V_O$ )	$V_{Op}$	0	-	9.0	V
Input voltage	$V_I$	-0.3	-	$V_{DD}+0.3$	V
Storage temperature	$T_{stg}$	-25	-	+70	°C
Operating ambient temperature	$T_{amb}$	0	-	+50	°C

## OPERATING CHARACTERISTICS

 $T_{amb} = 25\text{ °C}$ ;  $V_{DD} = 5\text{ V}$ ; all voltages refer to  $V_{SS}$ ; unless otherwise specified

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage (logic)	$V_{DD}-V_{SS}$	4.75	5.0	5.25	V
Contrast adjustment voltage	$V_O$	-	0.6	-	V
Temperature compensation of $V_O$	$TC$	-	-14	-	mV/°C
LOW level input voltage	$V_{IL}$	-0.3	-	0.6	V
HIGH level input voltage	$V_{IH}$	2.2	-	$V_{DD}$	V
LOW level output voltage $-I_{OL} = 1.2\text{ mA}$	$V_{OL}$	-	-	0.4	V
HIGH level output voltage $-I_{OH} = 0.205\text{ mA}$	$V_{OH}$	2.4	-	-	V
Input leakage current	$I_I$	-	-	1.0	µA
Internal oscillating frequency	$f_{OSC}$	-	250	-	kHz
Supply current (logic)	$I_{DD}$	-	1.5	2.0	mA
Power dissipation	$P_d$	-	7.5	10.0	mW

## TIMING CHARACTERISTICS

 $T_{amb} = 0\text{ to }50\text{ °C}$ ,  $V_{DD} = 5\text{ V} \pm 5\%$ , unless otherwise specified.

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Enable cycle time	$t_{cyc}$	1000	-	-	ns
Enable pulse width	$t_W$	450	-	-	ns
Rise time	$t_r$	-	-	25	ns
Fall time	$t_f$	-	-	25	ns
Register select set-up time	$t_{rsu}$	140	-	-	ns
Read and write set-up time	$t_{su}$	140	-	-	ns
Data set-up time	$t_{dsu}$	195	-	-	ns
Data delay time	$t_d$	-	-	320	ns
Address hold time	$t_{AH}$	10	-	-	ns
Data hold time write	$t_{WH}$	10	-	-	ns
Data hold time read	$t_{RH}$	20	-	-	ns

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## ELECTRO-OPTICAL CHARACTERISTICS

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ,  $V_{DD} = V_{DD\text{ typ}}$ ,  $\alpha = 10^{\circ}$ ,  $\phi = \phi_{opt}$ , unless otherwise specified

PARAMETER	SYMBOL	CONDITIONS	TYP.	MAX.	UNIT
Response times	$t_{on}$	$T_{amb} = 0\text{ }^{\circ}\text{C}$	380	760	ms
		$T_{amb} = 25\text{ }^{\circ}\text{C}$	110	220	ms
		$T_{amb} = 50\text{ }^{\circ}\text{C}$	45	90	ms
	$t_{off}$	$T_{amb} = 0\text{ }^{\circ}\text{C}$	470	940	ms
		$T_{amb} = 25\text{ }^{\circ}\text{C}$	110	220	ms
		$T_{amb} = 50\text{ }^{\circ}\text{C}$	45	90	ms
Viewing Angles (contrast ratio CR > 3)	$\alpha_{opt}$ $\alpha_{2-\alpha_1}$	reflective types	30	–	$^{\circ}$
			30	–	$^{\circ}$
	$\alpha_{opt}$ $\alpha_{2-\alpha_1}$	transflective types reflective operation	30 25	–	$^{\circ}$ $^{\circ}$
	$\alpha_{2-\alpha_1}$	transflective types transmissive operation	30 20	–	$^{\circ}$ $^{\circ}$

For definitions of response times, viewing angles and contrast ratio refer to notes 1 to 3

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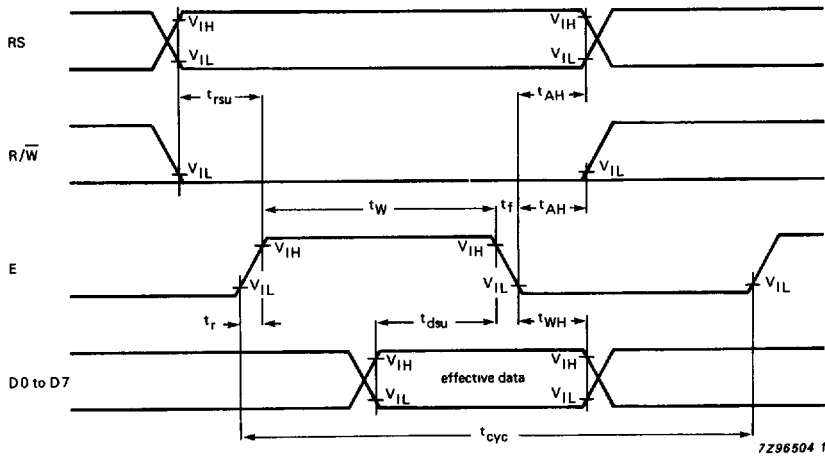


Fig.5 Timing waveforms (write operation).

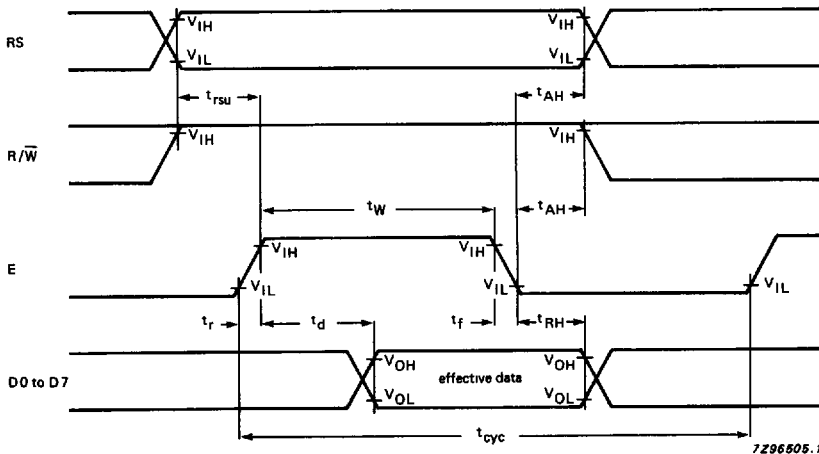


Fig.6 Timing waveforms (read operation).

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Table 1 Instruction set

INSTRUCTION	ADDRESSES										
	RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0	
Display clear	0	0	0	0	0	0	0	0	0	1	
Cursor home	0	0	0	0	0	0	0	0	1	*	
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	
Display on/off control	0	0	0	0	0	0	1	D	C	B	
Cursor display shift	0	0	0	0	0	1	S/C	R/L	*	*	
Function set	0	0	0	0	1	DL	1	0	*	*	
CG RAM address set	0	0	0	1	A <sub>CG</sub>						
DD RAM address set	0	0	1	A <sub>DD</sub>							
Busy flag/address read	0	1	BF	AC							
CG RAM/DD RAM data write	1	write data									
CG RAM/DD RAM data read	1	1	read data								

**Notes:** I/D = 1:increment  
 S = 1:display shift  
 D = 1:display on  
 C = 1:cursor on  
 B = 1:character at cursor position blinks  
 S/C = 1:display shift  
 R/L = 1:right shift  
 DL = 1:8 bits  
 BF = 1:during internal operation

I/D = 0:decrement  
 S = 0:display freeze  
 D = 0:display off  
 C = 0:cursor off  
 B = 0:character at cursor position does not blink  
 S/C = 0:cursor move  
 R/L = 0:left shift  
 DL = 0:4 bits  
 BF = 0:end of internal operation

Table 2 Display position and DD RAM address (HEX)

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Digit

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00H	01H	02H	03H	04H	05H	06H	07H	08H	09H	0AH	0BH	0CH	0DH	0EH	0FH

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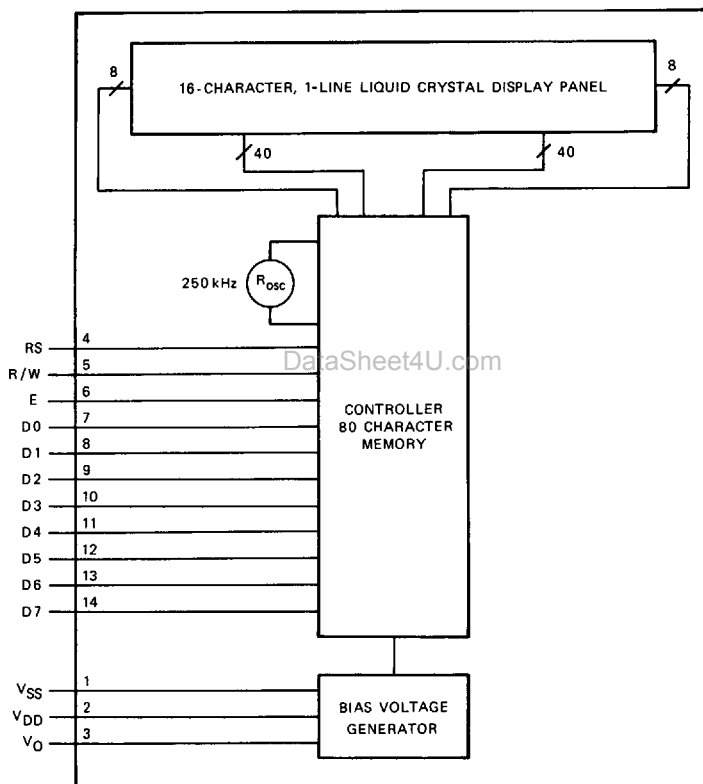


Fig.7 Functional block diagram.



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**Table 3** Input codes vs character pattern

4-bit Lower	Higher	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
	CG RAM (1)													
xxxx0000	(1)		0	1	2	3	4	5	6	7	8	9	A	B
xxxx0001	(2)		!	@	#	\$	%	&	'	(	)	*	+	,
xxxx0010	(3)		"	#	2	3	4	5	6	7	8	9	A	B
xxxx0011	(4)		#	3	0	5	c	s	.	7	t	e	e	.
xxxx0100	(5)		#	4	0	T	d	t	.	1	t	t	#	.
xxxx0101	(6)		%	5	E	U	e	u	.	=	7	7	1	s
xxxx0110	(7)		8	6	F	U	f	u	9	h	c	a	3	2
xxxx0111	(8)		'	7	G	W	g	w	7	#	7	7	7	7
xxxx1000	(1)		(	8	H	X	h	x	.	4	0	1	0	7
xxxx1001	(2)		)	9	I	Y	i	y	9	7	7	7	7	7
xxxx1010	(3)		*	#	1	2	3	4	5	6	7	8	9	7
xxxx1011	(4)		+	#	K	K	(	7	7	7	7	7	7	7
xxxx1100	(5)		,	<	L	#	1	1	1	1	7	7	7	7
xxxx1101	(6)		-	=	M	I	m	)	3	7	7	7	7	7
xxxx1110	(7)		.	>	N	^	n	7	7	7	7	7	7	7
xxxx1111	(8)		/	?	0	_	0	7	7	7	7	7	7	7

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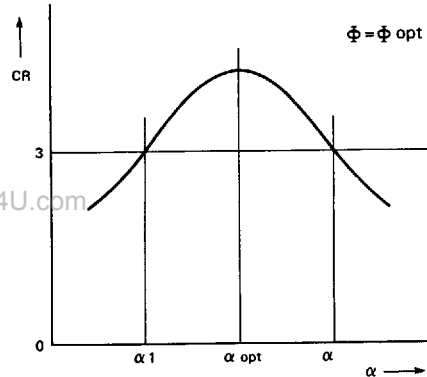
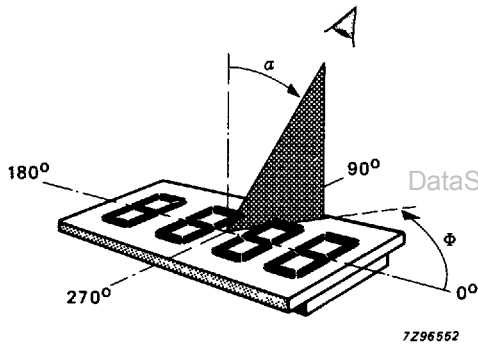
**Note 1** Definition of contrast ratio (CR).

$$\text{in positive image mode: CR} = \frac{B_{\text{off}}}{B_{\text{on}}}$$

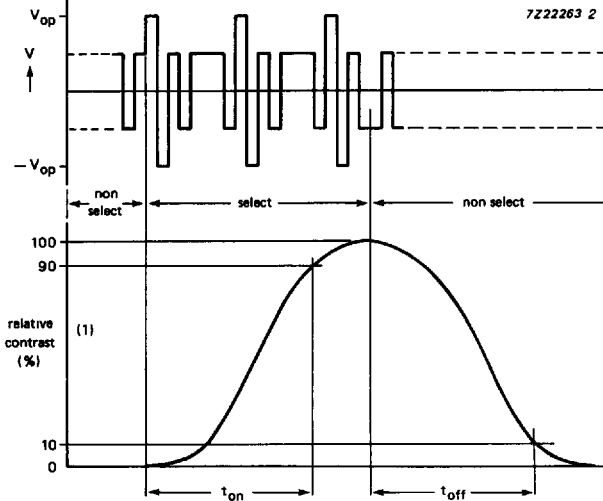
$$\text{in negative image mode: CR} = \frac{B_{\text{on}}}{B_{\text{off}}}$$

$B_{\text{on}}$  is the brightness of selected segments  
 $B_{\text{off}}$  is the brightness of non-selected segments

**Note 2** Definition of viewing angles  $\alpha$  and  $\phi$ .



**Note 3** Definition of response times.



1) measured at  $\alpha = 10^\circ$