

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16228 FGH-PW

Product Specification

Version: 3

09/Oct/2008

GENERAL SPECIFICATION

MODULE NO. :

DEM 16228 FGH-PW

CUSTOMER P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	05.05.2008
1	ADD VERSION	08.05.2008
2	ADD VERSION	19.09.2008
3	CHANGE PCB DRAWING AND DESCRIPTION	09.10.2008

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DATE: 09.10.2008

APPROVED BY: MH

DATE: 09.10.2008

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1. FUNCTIONS & FEATURES

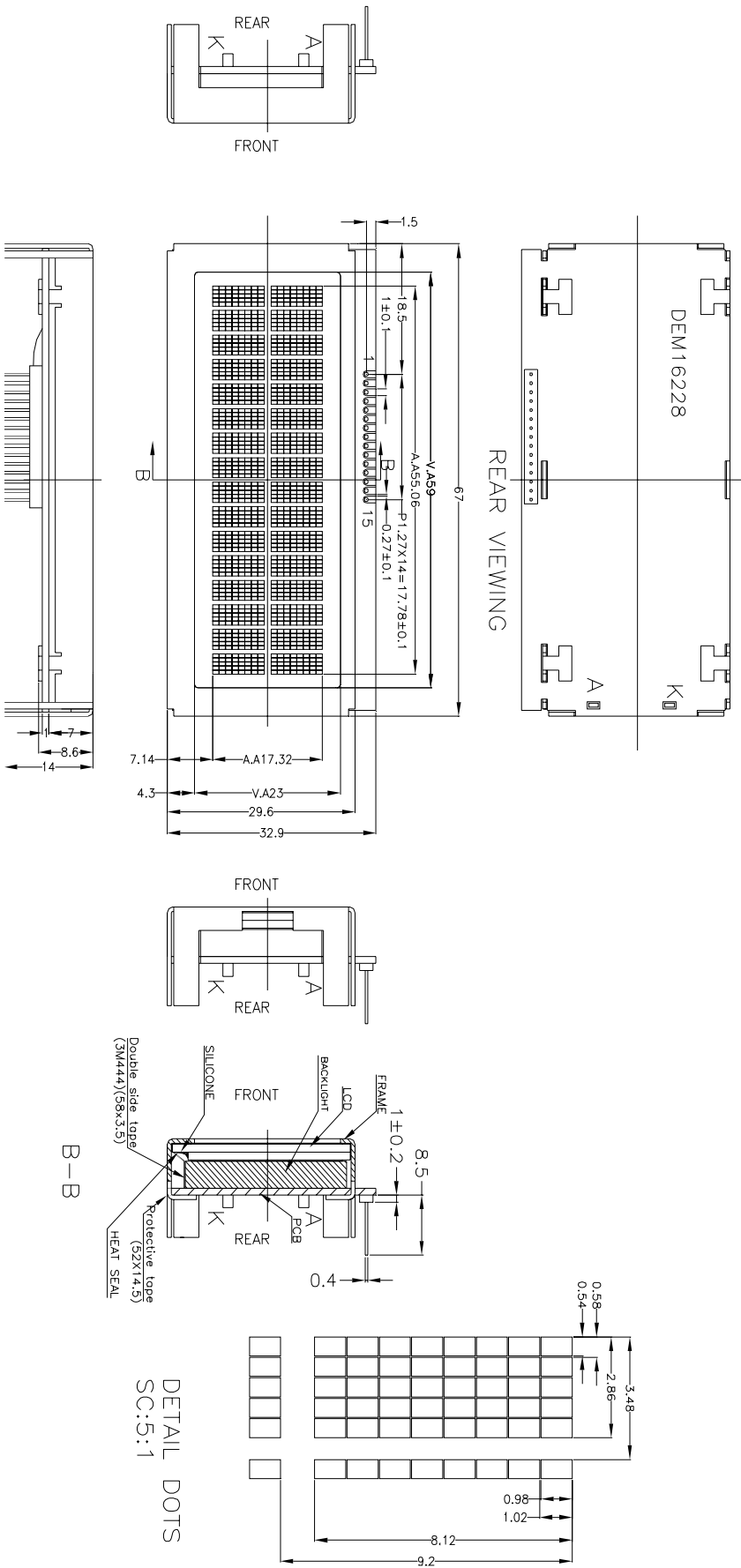
MODULE NAME	LCD TYPE
DEM 16228 FGH-PW	FSTN Transflective Positive Mode

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- V_{LCD} Adjustable For Best Contrast(V_0-V_{SS}) : 4.6 Volt (typ.)
- Display Format : 16 x 2 Characters (5 x 8 dots, Format: 208 Kinds)
- Internal Memory : CGROM (19,840bits)
: CGRAM (64 * 8 bits)
: DDRAM (80 * 8 bits for 80 Digits)
- CGROM : CGROM of the ST7070-0B-01
- Operating Temperature : -20°C to +70°C
- Storage Temperature : -30°C to +80°C

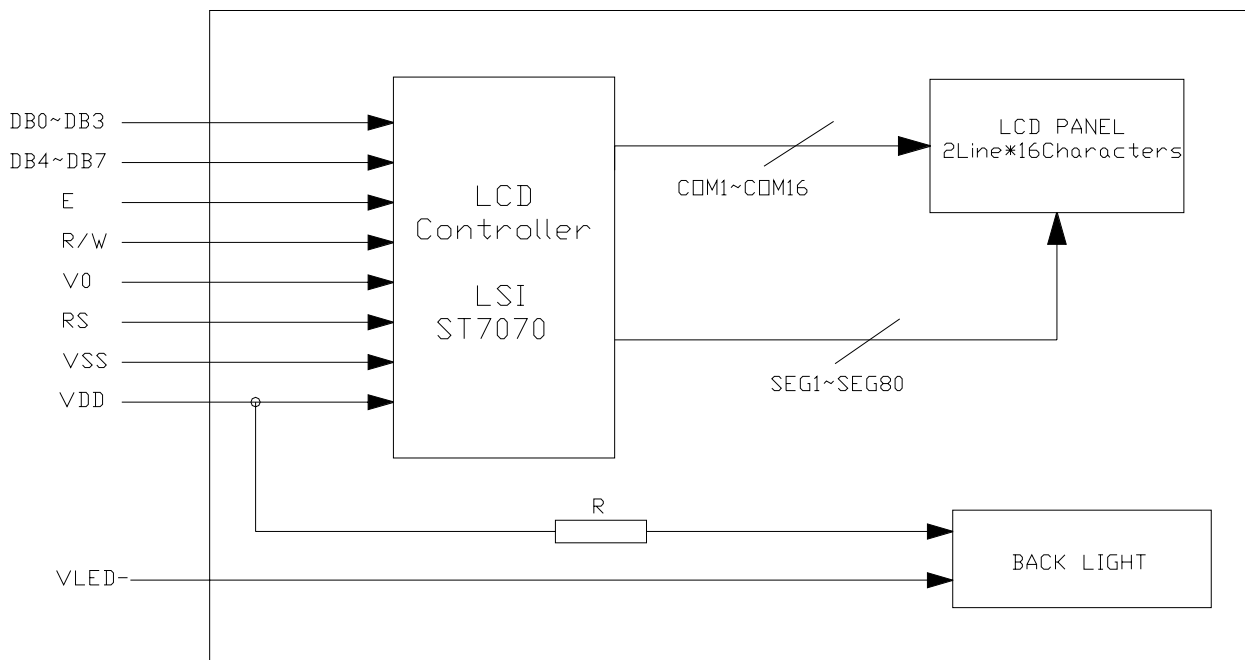
2. MECHANICAL SPECIFICATIONS

- Outline Dimension : 67.00 x 32.90 mm
- Viewing-Area : 59.00 x 23.00 mm
- Character Pitch : 3.48 x 9.20 mm
- Character Size : 2.86 x 8.12 mm
- Character Font : 5 x 8 dots
- Dot Size : 0.54 x 0.98 mm
- Dot Pitch : 0.58 x 1.02 mm

3. EXTERNAL DIMENSIONS



4. BLOCK DIAGRAM

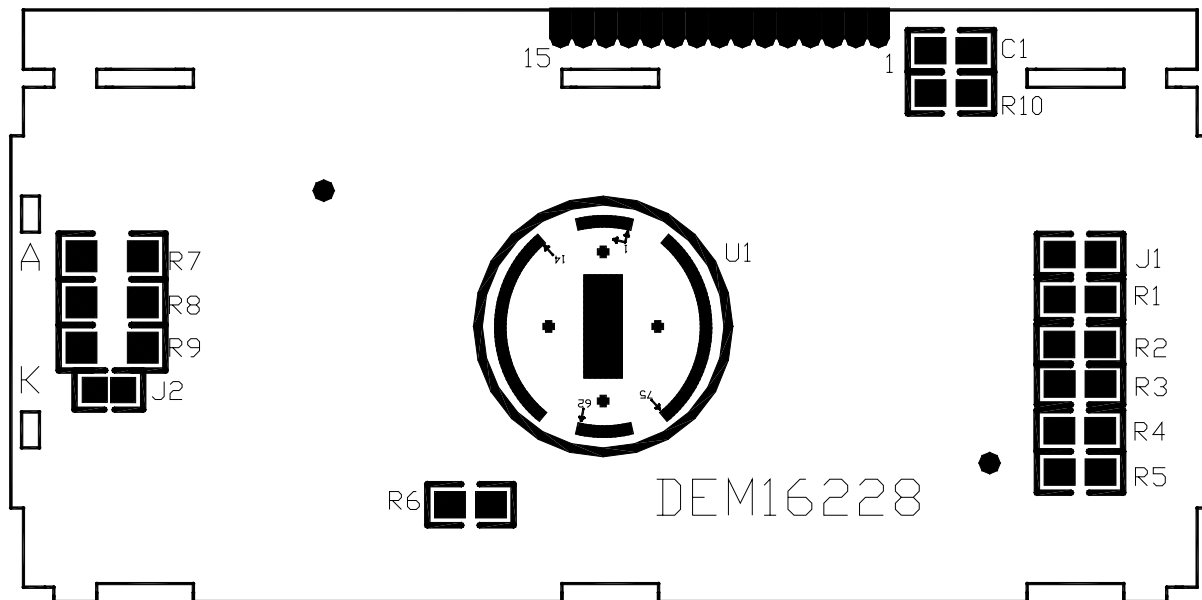


5. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	VLED-	Control the BKL to GND
2	VSS	Signal ground for LCM(GND)
3	V _{DD}	Power supply for logic(+5V) for LCM
4	V0	Contrast adjust
5	RS	Register select signal
6	R/W	Read/write select signal
7	E	Operation (data read/write) enable signal
8~11	DB0~DB3	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
12~15	DB4~DB7	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU.

6. PCB DRAWING AND DESCRIPTION

6.1. PCB Drawing



Note: The PCB drawing just for reference!

6.2 DESCRIPTION:

6-1-1. The J1 is metal-bezel GND to module GND

Note: In application module, J1= 0 ohm.

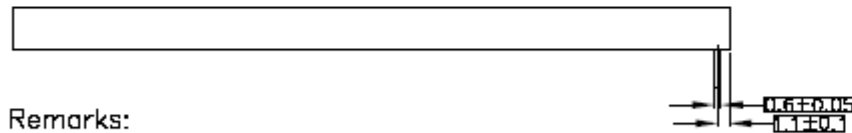
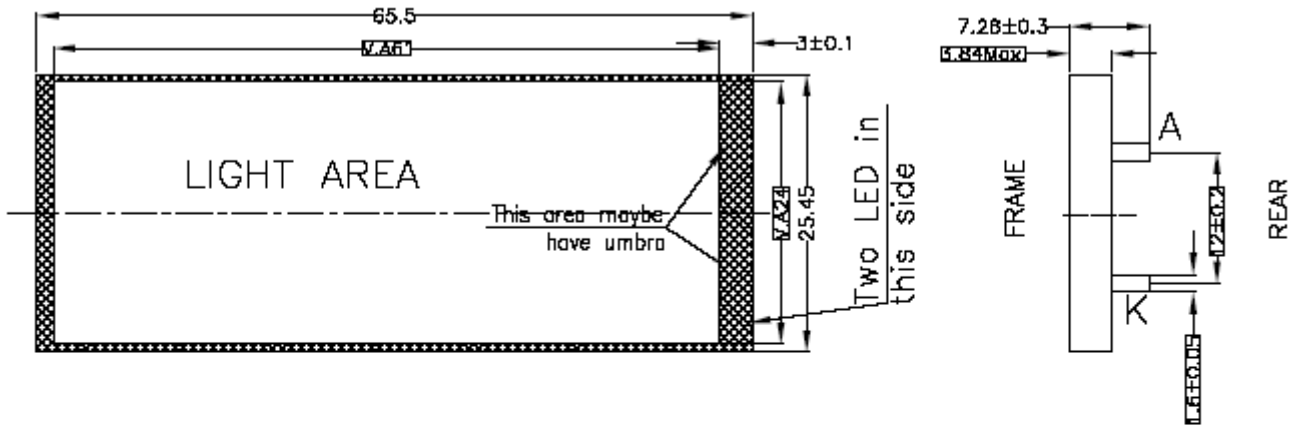
6-1-3.The LED resistor should be bridged when the J2 is closed.

Note: In application module, R8=68 ohm, R7=R9=open, J2=open.

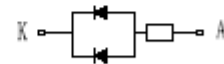
7. BACKLIGHT ELECTRONICS/OPTICAL SPECIFICATIONS

Electronics/Optical Specifications:

	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Forward Voltage	V_f	3.2	3.5	3.8	V	$I_f=30\text{ mA}$
Forward Current	I_f		30		mA	
Power Dissipation	P_d			0.11	W	$I_f= 2*15\text{ mA}$
Reverse Voltage	V_R			5.0	V	
Reverse Current	I_R			$2*0.1$	mA	
Luminous Intensity	I_v	100	200	300	cd/m ²	$I_f= 2*15\text{ mA}$
Luminous Uniformity		70			%	$I_f= 2*15\text{ mA}$
Color Chromaticity	X	0.26	0.29	0.32		$I_f=20\text{mA}$ $T_a=25^\circ\text{C}$ Each chip
	Y	0.26	0.29	0.32		
		SYMBOL		RATINGS		
Operating Temperature			T_{opr}	-20°C to $+70^\circ\text{C}$		
			T_{sty}	-30°C to $+80^\circ\text{C}$		



CIRCUIT DIAGRAM



- Remarks:
- 1.Unmarked tolerance is ± 0.3 ;
 - 2.The material comply with RoHS;
 - 3.Color:White;
 - 4.Lifetime>50000hours.

8. DISPLAY DATA RAM (DDRAM)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	← DDRAM ADDRESS
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	

9. MAXIMUM ABSOLUTE POWER RATINGS (Ta=25°C)

Item	Symbol	Standard value	Unit
Power supply voltage	V _{DD}	-0.3~+5.5	V
LCD driver voltage	V _{LCD}	V _{SS} +7.0~V _{SS} -0.3	V
Input voltage	V _{IN}	-0.3~V _{DD} +0.3	V
Operating temperature	T _{opr}	-20~+70	°C
Storage temperature	T _{stg}	-30~+80	°C

*Voltage greater than above may damage to the Circuit.

$$V_{DD} > V_1 > V_2 > V_3 > V_4 > V_5$$

10. ELECTRICAL CHARACTERISTICS

10-1 DC Characteristics

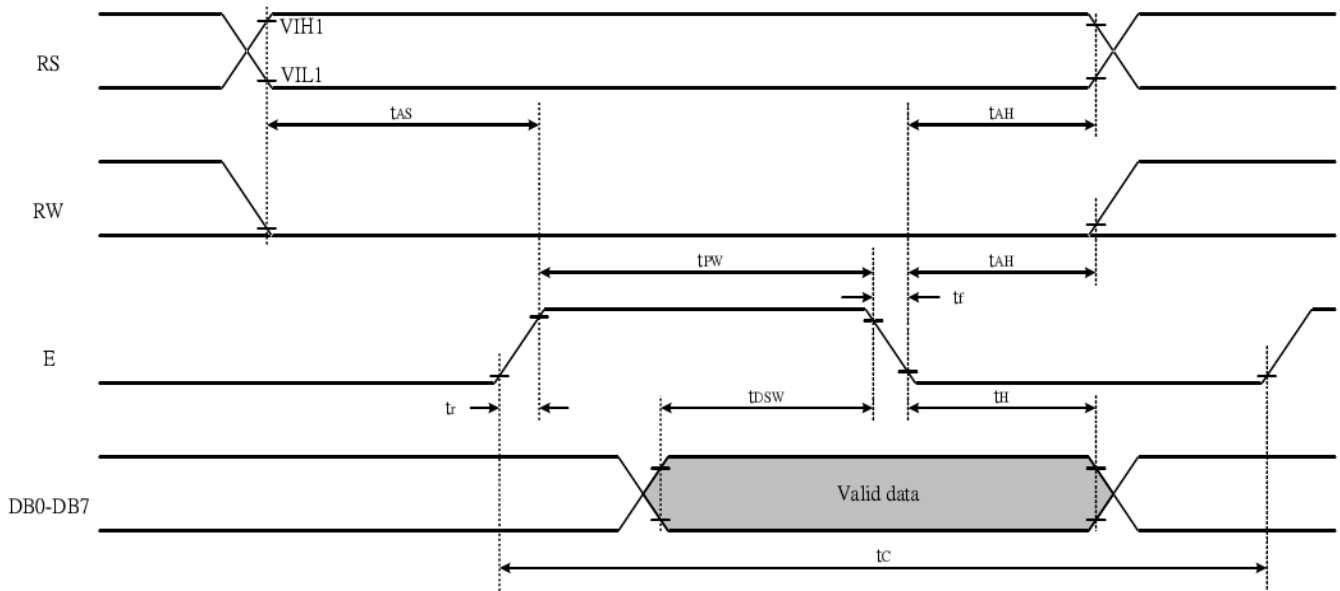
V_{DD}=5.0V, Ta= -20°C ~ +70°C

Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V _{DD}	4.5	5	5.5	-----	V
LCD Driving Voltage	V _{LCD}	4.3	4.6	4.9	V ₀ -V _{SS}	V
Supply Current	I _{DD}	----	0.3	----	V _{DD} =5V, fosc=270kHz	mA

10-2 AC Characteristics

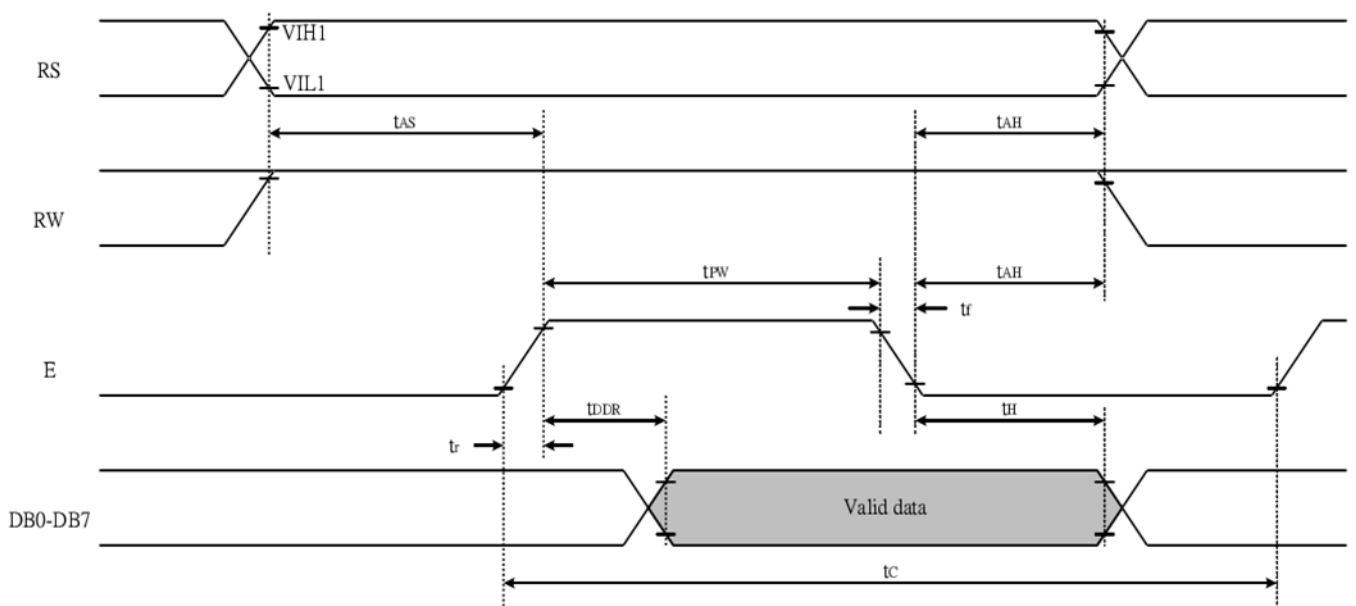
10-2-1 Write mode

Characteristic	Symbol	Min	Type	Max	Unit	Test PIN
Enable Cycle Time	t_C	40	---	---	ns	E
Enable Pulse Time	T_{PW}	40	---	---	ns	E
Enable Rise/Fall Time	T_R, T_F	---	---	25	ns	E
Address Setup Time	T_{AS}	0	---	---	ns	R/W,RS,E
Address Hold Time	T_{AH}	10	---	---	ns	R/W,RS,E
Data Setup Time	T_{DSW}	20	---	---	ns	DB0~DB7
Data Hold Time	T_H	10	---	---	ns	DB0~DB7



10-2-2 Read Mode

Characteristic	Symbol	Min	Type	Max	Unit	Test PIN
Enable Cycle Time	t_C	1200	---	---	ns	E
Enable Pulse Time	T_{PW}	480	---	---	ns	E
Enable Rise/Fall Time	T_R, T_F	---	---	25	ns	E
Address Set-up Time	T_{AS}	0	---	---	ns	R/W,RS,E
Address Hold Time	T_{AH}	10	---	---	ns	R/W,RS,E
Data Set-up Time	T_{DDR}	---	---	320	ns	DB0~DB7
Data Hold Time	T_H	10	---	---	ns	DB0~DB7



11. CONTROL AND DISPLAY COMMAND

Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Execution time (fosc=270KHz)	Remark
EXT=0 or 1												
Clear Display	0	0	0	0	0	0	0	0	0	1	1.52ms	Write"20H" to DDRAM. And set DDRAM address to "00H" from AC
Return home	0	0	0	0	0	0	0	0	1	x	0ms	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Display on/off	0	0	0	0	0	0	1	D	C	P	37us	D=1: entire display on C=1: cursor on B=1: cursor position on
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	37us	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.
function Set	0	0	0	0	1	DL	N	EXT	x	x	37us	DL: interface data is 8/4 bits N: number of line is 2/1
Read busy flag& address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	0us	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	37us	Write data into internal RAM (DDRAM/CGRAM)
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	37us	Read data from internal RAM (DDRAM /CGRAM)
EXT= 0												
Entry mode Set	0	0	0	0	0	0	0	1	I/D	S	37us	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	37us	Set CGRAM address in address counter
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	37us	Set DDRAM address in address counter
EXT= 1												
Bias resistor select	0	0	0	0	0	0	0	1	Rb1	Rb0	37us	Used internal resistor only provide 1/5 bias mode . Rb[1:0]=00 External Resistor Rb[1:0]=01~11 Internal Resistor
COM ,SEG direction select	0	0	0	1	0	0	C1	C2	S1	S2	37us	C1 : com1~8 com8~1 C2 : com9~16 com16~9 S1 : seg1~40 seg40~1 S2 : seg41~80 seg80~41
Set display data length	0	0	1	L6	L5	L4	L3	L2	L1	L0	37us	To specify the number of data bytes(3SPI mode)

Note:

Be sure the ST7070 is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7070. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

12. STANDARD CHARACTER PATTERN (ST7070-0B-01)

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)	○		0	Q	P	\	P	*	S	Z	-	9	E	O	P
0001	(2)	◆	!	1	A	Q	a	9	.	0	。	7	7	4	3	9
0010	(3)	▶	"	2	B	R	b	r	~	0	↑	イ	ウ	×	P	0
0011	(4)	⊂	#	3	C	S	c	s	-	3	↓	ウ	テ	E	E	8
0100	(5)	A	\$	4	D	T	d	t	..	0	、	E	T	P	H	Q
0101	(6)	A	%	5	E	U	e	u	^	±	*	7	6	1	0	0
0110	(7)	A	&	6	F	V	f	v		W	ヲ	カ	ニ	ヨ	P	Z
0111	(8)	A	'	7	G	W	g	w		W	7	7	又	ウ	9	π
1000	(1)	A	(8	H	X	h	x	\	W	イ	ウ	ネ	U	J	X
1001	(2)	A)	9	I	Y	i	y	-	I	0	7	7	U	7	Y
1010	(3)	A	*	:	J	Z	j	z	#	W	E	コ	ハ	U	J	7
1011	(4)	A	+	;	K	L	k	l	<	-	*	7	E	0	*	A
1100	(5)	E	,	<	L	*	I	I	0	*	7	0	7	7	0	A
1101	(6)	E	-	=	M	I	m	7	!	0	ユ	Z	ハ	U	U	7
1110	(7)	E	.	>	N	^	n	7	!	0	ヨ	E	ホ	7	h	7
1111	(8)	E	/	?	O	_	o	7	\$	Z	ウ	ウ	マ	7	0	■

13. LCD MODULES HANDLING PRECAUTIONS

- Please remove the protection foil of polarizer before using.
- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD module.
 - Tools required for assembly, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions
When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

14. OTHERS

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
 - Exposed area of the printed circuit board
 - Terminal electrode sections