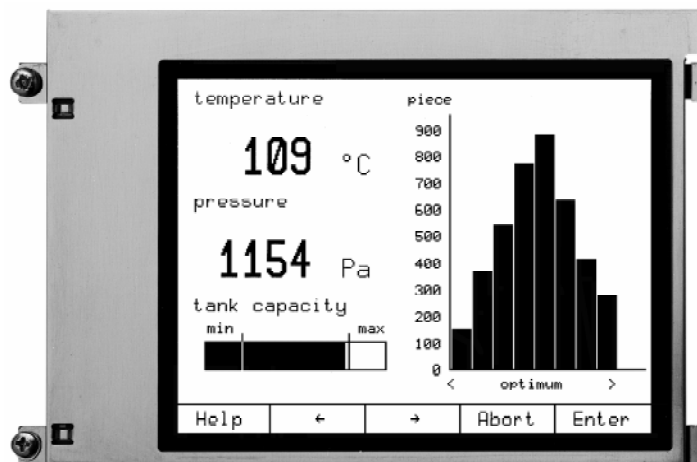


**LIQUID  
CRYSTAL  
GRAPHIC  
*display modules***



# Introduction to Hitachi Flat Panel Display Activities

Hitachi is one of the world's leading Liquid Crystal Display manufacturers, providing various technologies to meet the growing demand for advanced display devices. Due to continuous investment in research, design and production, Hitachi has established the following production facilities and product groups:

## Mobara Works, Japan

- High resolution colour TFT displays with sizes up to 13.3" (34 cm) and resolutions up to XGA. The latest Super TFT technology featuring 140 degree viewing angle without colour change puts Hitachi in a leading position for this technology.
- High resolution colour STN displays with sizes up to 15.5" (39 cm) and resolutions up to XGA. Hitachi's new Hi-addressing driving technology improves display uniformity and will enable fast speed products to be developed.
- Monochrome and colour Poly-Silicon displays in 1" size with VGA resolution. These products are ideal for projection and virtual imaging systems.

## Kaohsiung Works, Taiwan

- Medium and high resolution monochrome STN LCD modules with sizes from 2.5 " (5 cm) to 10.4" (26 cm) diagonal and resolutions from one eighth VGA to full VGA. All latest products feature excellent contrast, fast speed and high brightness. Several products have an integrated controller and RAM for ease of use.
- Medium resolution colour STN LCD modules with high contrast ratio.
- Character LCD modules based on TN and STN LCD technologies with fully integrated controllers and backlighting
- Full custom display module design and production capability. Close cooperation with our customers and continuous strive for technical improvement have made Hitachi one of the main supplier for customized graphic LCD modules.

In addition to the above manufacturing plants, Hitachi's LCD activities are supported by the following :

- Five research laboratories developing new materials, new technologies and new processes for enhanced display performance.
- Internal manufacturing of key components used in LCD module production. Being one of the world's leading manufacturers of LCD drivers allows Hitachi to design most advanced products with a high grade of flexibility.

By combining the above technological capabilities with a strong commitment to our customers in Europe, Hitachi is able to offer you leading products and outstanding support.

For further information or a product presentation please feel free to contact any of our sales offices or distributors.

# HITACHI

**Graphics Liquid Crystal Display Modules**

<b>Graphics LCD Module Overview</b> .....	4
<b>Module Structures</b> .....	6
<b>Medium Size Displays</b> .....	8
LMG6381QHGE.....	10
LMG7380QHFC.....	12
LMG6400PLGR.....	14
LMG6401PLGE.....	16
LMG6402PLFR.....	18
LMG7400PLFC.....	20
LMG7401PLBC.....	22
LMG7402PLFF.....	24
LMG7420PLFC-X.....	26
<b>Quarter VGA Displays</b> .....	28
SP14Q001.....	30
SP14Q002.....	32
LMG7520RPFC.....	34
<b>VGA Display Family</b> .....	36
LMG5278XUFC-00T.....	38
LMG7550XUFC.....	40

**CFL Inverters**

<b>CFL Backlight</b> .....	42
<b>CFL Inverter</b> .....	44
INVC132.....	45
INVC186.....	46
INVC191.....	47
INVC196.....	48
INVC304.....	49
INVC378.....	50
INVC444.....	51
INVC445.....	52
INVC473.....	53

**Support Tools**

<b>Starter Kits</b> .....	55
<b>Spare CFL Tubes</b> .....	55
<b>Low Cost Controller Board</b> .....	56

**LCM Handling Precautions**.....58**LCM Test Conditions**

<b>Environmental Conditions</b> .....	64
<b>Appearance Standard</b> .....	64
<b>Definition of Optical Data</b> .....	65

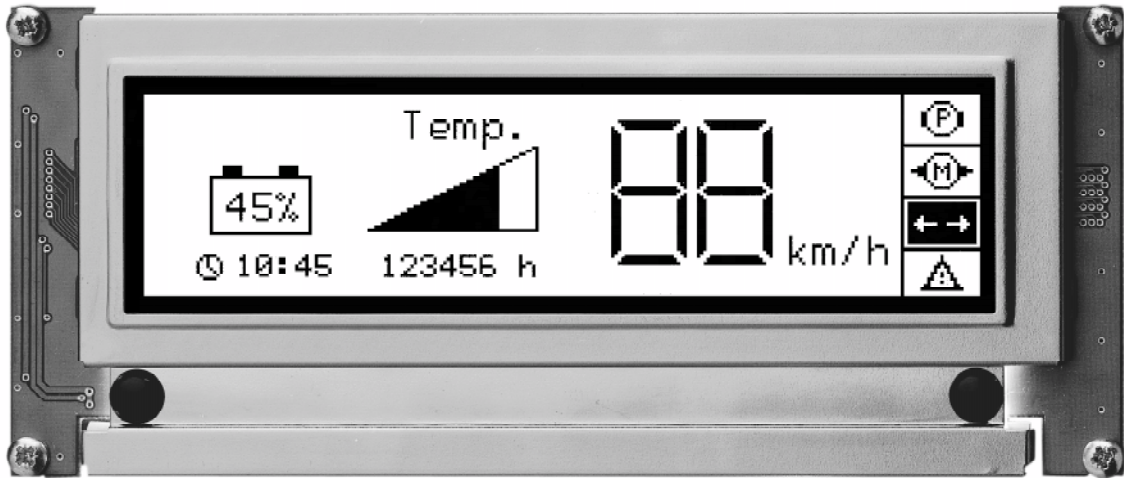
**LCM Lot Marking**.....66**LCM Part Numbering**.....67**Hitachi Sales Offices**.....106**Hitachi Distributors**.....108

## Notes:

1. This catalog may wholly or partially be subject to change without notice
2. This catalog neither ensures the enforcement of any industrial properties on other rights, nor sanctions the enforcement right thereof
3. All rights on this catalog are reserved. It is not permitted to reproduce or duplicate, in any form the whole or a part of this catalog without Hitachi's permission

# GRAPHICS LCD MODULES

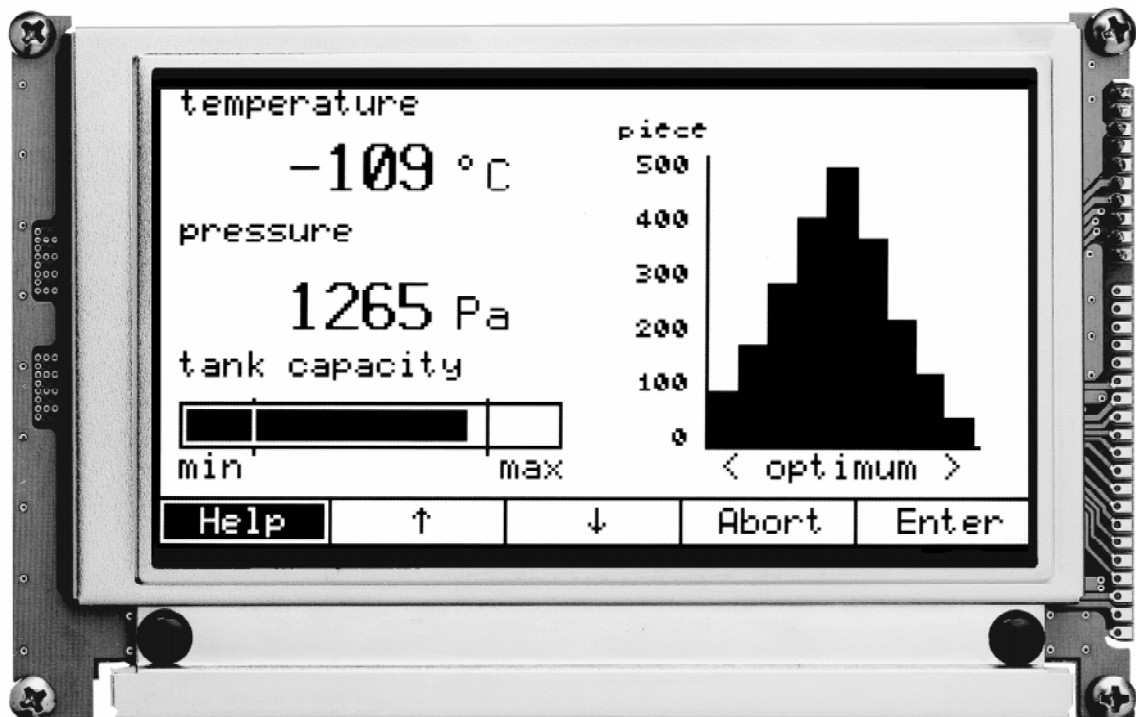
Resolution	Part Name	Display Type	Display Colour	Backlight Type	Module Dimensions H * W * D [mm]	Viewing Area H * W [mm]
<b>256*64</b>	LMG6381QHGE	Transflective STN	Blue on Grey	EL	160*68*9.5	126.3*37.0
<b>NEW</b>	LMG7380QHFC	Transmissive FSTN	Black on White	CFL	160*68*11	124*34
<b>240*128</b>	LMG6400PLGR	Reflective STN	Blue on Grey	None	159.4*101*9.5	126*71
	LMG6401PLGE	Transflective STN	Blue on Grey	EL	159.4*101*9.5	126*71
	LMG6402PLFR	Reflective STN	Black on Grey	None	159.4*101*9.5	126*71
	LMG7400PLFC	Transmissive FSTN	Black on White	CFL	159.4*101*11	126*71
	LMG7401PLBC	Transmissive STN	Blue on White	CFL	159.4*101*11	126*71
	LMG7402PLFF	Transflective FSTN	Black on Grey	CFL	159.4*101*11	126*71
	LMG7420PLFC-X	Transmissive FSTN	Black on White	CFL	159.4*101*11	126*71
<b>320*240</b>	SP14Q001	Transmissive STN	Blue on White	CFL	167.1*109*11	120*90
	<b>NEW</b> SP14Q002	Transmissive FSTN	Black on White	CFL	167.1*109*11	120*90
	<b>NEW</b> LMG7520RPFC	Transmissive FSTN	Black on White	CFL	129.6*92.6*7.5	100*75.5
<b>640*480</b>	LMG5278XUFC-00T	Transmissive FSTN	Black on White	CFL	257.5*174*7	200*152
	<b>NEW</b> LMG7550XUFC	Transmissive FSTN	Black on White	CFL	264*183*8.5	215.2*162.4



LMG7380QHFC

# HITACHI

Dot Size H * W [mm]	Dot Pitch H * W [mm]	Duty Ratio	Viewing Direction [o'clock]	Controller (Suitable )	Part Name	Page
0.44*0.44	0.47*0.47	64	6	HD61830	LMG6381QHGE	10
0.44*0.44	0.47*0.47	64	6	T6963C	LMG7380QHFC	12
0.47*0.47	0.50*0.50	128	6	HD61830B	LMG6400PLGR	14
0.47*0.47	0.50*0.50	128	6	HD61830B	LMG6401PLGE	16
0.47*0.47	0.50*0.50	128	6	HD61830B	LMG6402PLFR	18
0.47*0.47	0.50*0.50	128	6	HD61830B	LMG7400PLFC	20
0.47*0.47	0.50*0.50	128	6	HD61830B	LMG7401PLBC	22
0.47*0.47	0.50*0.50	128	6	HD61830B	LMG7402PLFF	24
0.47*0.47	0.50*0.50	128	6	T6963C	LMG7420PLFC-X	26
0.345*0.345	0.36*0.36	240	6	4 Bit Type (MSM6255)	SP14Q001	30
0.345*0.345	0.36*0.36	240	6	4 Bit Type (MSM6255)	SP14Q002	32
0.285*0.285	0.30*0.30	240	6	4 Bit Type (MSM6255)	LMG7520RPFC	34
0.27*0.27	0.30*0.30	242	12	4 Bit Type Dual Scan	LMG5278XUFC-00T	38
0.3*0.3	0.33*0.33	242	12	4 Bit Type Dual Scan	LMG7550XUFC	40



LMG7420PLFC-X

# HITACHI

**HITACHI LCD MODULE STRUCTURES**

Hitachi offers various technologies for connecting together the LCD, drivers and PCB to form an LCD Module (LCM). The following section gives an introduction on the different LCM structures.

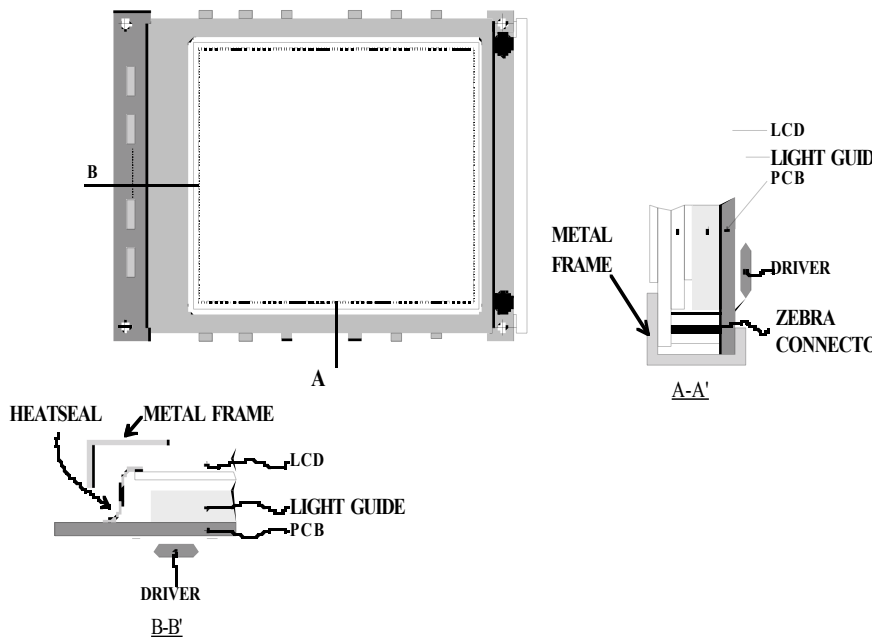
**Elastomer Connector**

The QFP drivers are mounted on a rigid PCB. Contact pads for each driver output line on the PCB are aligned with the LCD terminals and connected by an elastomer stripe positioned between the two parts. As the elastomer stripe consists of horizontally alternating layers of conducting and non-conducting material it conducts between each pad and its relevant LCD terminal but not between adjacent pads. The elastomer is held in position by a metal frame which maintains the pressure necessary for good connection. This technology is suitable for dot pitches greater than 0.3 mm.

**Heat Seal Cable Connector**

The QFP drivers are mounted on a rigid PCB. Contact pads on the PCB are aligned with the LCD terminals and a flexible film cable is bonded with a heat seal process to both parts to form the connection.

Many of Hitachi's standard LCM combine elastomer connectors and heat seal film cable connectors as shown in Fig.1.



*Fig. 1*

**Straight Tape Carrier Package (TCP)**

The newest generation of liquid crystal displays use driver with tape carrier packages (TCP).

The driver chip is mounted on a flexible film cable whose output pins are then bonded on the glass terminal with a heat seal process. On the input side the tape is bonded to a small PCB whose function is to connect all segment and common drivers and carry the output connectors.

Hitachi is a major manufacturer of LCD driver chips and so offers a variety of TCP standard packages allowing high flexibility in display design. TCP drivers have a large number of output pins (80, 160 or higher) allowing high resolution displays to be made with fewer drivers to reduce costs.

Hitachi's new standard LCM employ a straight TCP structure and backlight within a metal frame. Compared to the conventional structure where the frame is required to keep the connection between drivers and LCD, for TCP structure the frame has only a supporting and protecting function and can easily modified.

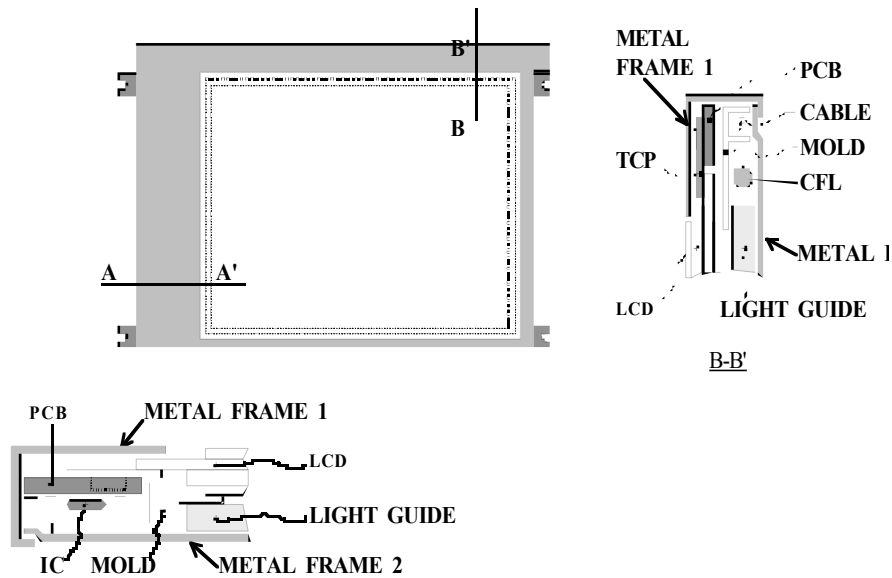


Fig. 2

**Bent Tape Carrier Package (TCP)**

Another package technology which even allows more compact design is Bent Tape Carrier Package. Compared to straight TCP the flexible film cable is bent around the glass with the driver. The input side of the tape is then bonded to a small PCB on the back of the LCD. Thus the fringe of the module is determined by the terminal width and the bending radius of the film cable.

Bent TCP packages are more expensive and more difficult to handle in the manufacturing process than straight TCP at present. Bent TCP drivers are mainly used for customized LCM in applications which require a very small fringe such as personal digital assistants (PDA), personal communications assistants (PCA) or other handheld devices. Also here Hitachi offers a wide range of standard packages which allow flexible and optimized design of such custom LCM.

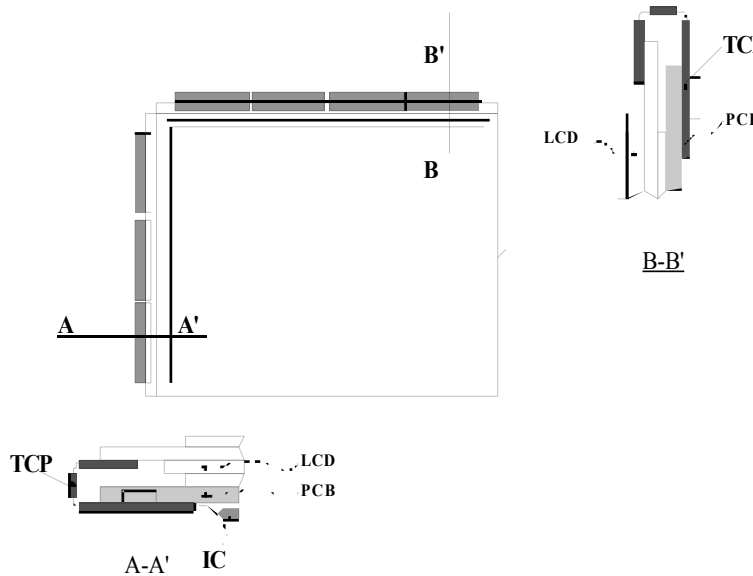


Fig. 3.



**MEDIUM SIZE DISPLAYS OVERVIEW**

**LMG74xx Series**

LMG74xx is a series of monochrome STN LCD modules with a resolution of 240 x 128 dots. It employs the newest generation of liquid crystal material thus providing an excellent contrast which together with a brightness of 80 cd/sqm renders an outstanding image quality.

The LMG74xx series is available in three different display modes, Film STN transmissive, STN transmissive and Film STN transreflective.

ITEM	LMG7400PLFC	LMG7401PLBC	LMG7402PLFF	LMG7420PLFC-X	UNIT
Display Type	Black and White Transmissive Film STN	Blue and White Transmissive STN	Black and White Transreflective Film STN	Black and White Transmissive Film STN	-
Controller	HD61830B			T6963C	-
Resolution	240 x 128				dots
Size	5.6				inch
Dot Size	0.44 x 0.44				mm
Dot Pitch	0.47 x 0.47				mm
External Dimensions	159.4 x 101 x 11				mm
Active Display Area	126 x 71				mm
Backlight	1 Tube				-
Brightness	80				cd/m <sup>2</sup>
Contrast	18:1				-
Response Time (Rise)	160				ms
Response Time (Fall)	110				ms
Operating Temperature	0 - + 50				°C
Storage Temperature	-20 - + 60				°C
CFL Tube Life Time	10.000 typ.				hrs

All displays have a built-in controller and display memory thus allowing for easy interfacing to a microcontroller. The most commonly used transmissive mode is available with two different controller options, built-in Hitachi HD61830B or built-in Toshiba T6963C. Main difference between the two controllers is that the HD61830B has two separate modes for displaying graphics and text while the T6963T can overlay both modes to display text and graphics simultaneously.

LMG74xx series and LMG64xx series are mechanically compatible and all LMG640x types having the HD61830B built-in are also electrically compatible to the LMG740x types.

In addition the LMG74xx series offers the following features

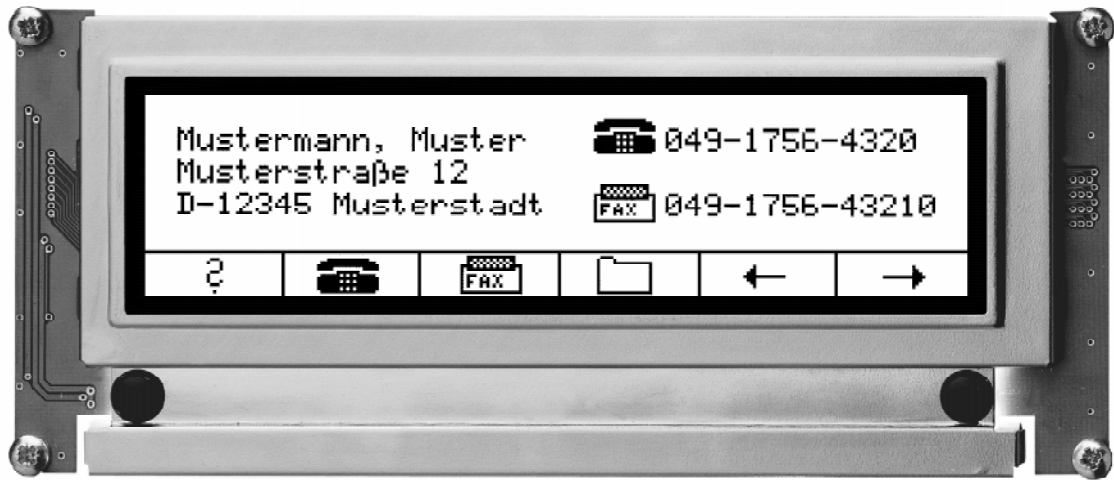
- High contrast ratio of 18:1 based on new LC and polariser materials
- High brightness of 90 cd /sqm based on new high efficiency CFL backlight and light guide
- Anti-glare hard coat surface
- Easy exchange of CFL tube

**LMG7380QHFC**

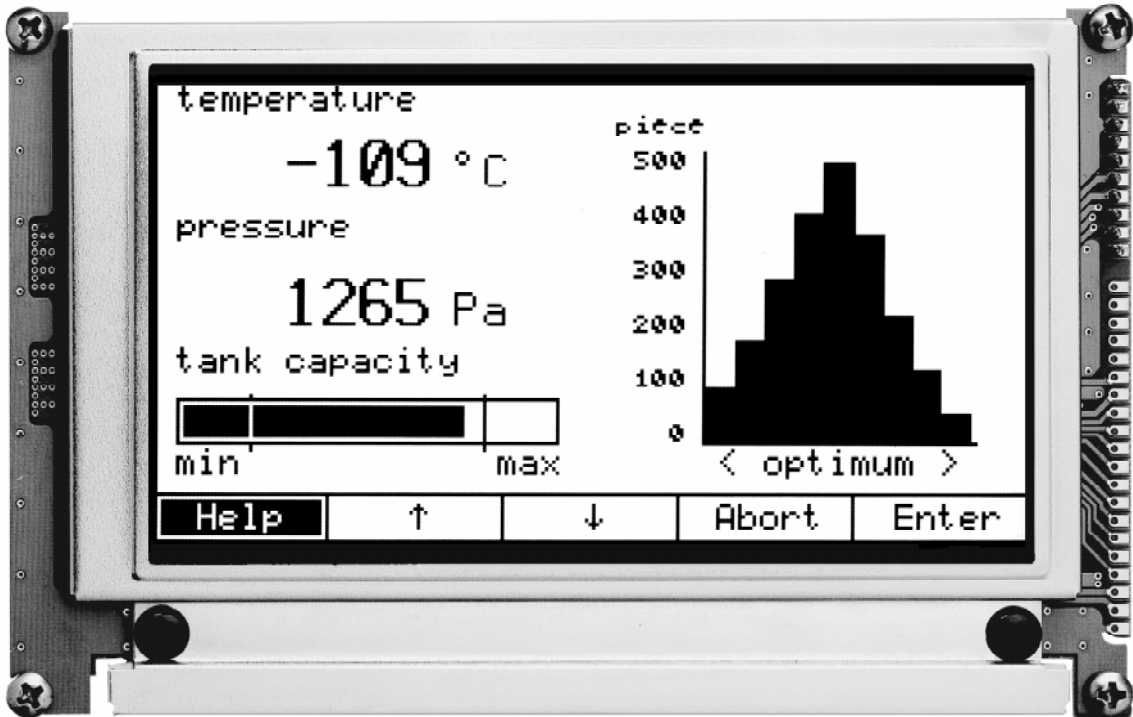
The LMG7380QHFC is a monochrome STN LCD module with a resolution of 256 x 64 dots. It employs the same technology as LMG74xx series thus offering the following features:

- High contrast ratio of 18:1 based on new LC and polariser materials
- High brightness of 100 cd /sqm based on new high efficiency CFL backlight and light guide
- Anti-glare hard coat surface
- Easy exchange of CFL tube

The LMG7380QHFC has a built in LCD controller Toshiba T6369 and display memory which allows easy interfacing to a microcontroller. In addition it is mechanically compatible to the LMG6381QHGE.



LMG7380QHFC



LMG7420PLFC

## FEATURES

- ◆ Blue on Grey STN Type
- ◆ Transflective Mode

- ◆ Low Power EL Backlight
- ◆ Built in LCD Controller HD61830

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	160*68*9.5	mm
Viewing Area	126.3*37.0	mm
Resolution	256*64	dots
Dot Size	0.44*0.44	mm
Dot Pitch	0.47*0.47	mm
Weight	115	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	3.0	-	-
Brightness	-	-	-	10	-	cd/m <sup>2</sup>
Viewing Direction	-	-	-	6	-	o'clock
Viewing Angle	∅2 - ∅1	K=1.4, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	250	400	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	300	450	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	7	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	22	V
Input Voltage	V <sub>I</sub>	-	V <sub>SS</sub>	V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 4,5	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 4,5	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS	-	Ground
A2	VDD	-	Power supply for logic
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Display data
A15	Not CS	-	Chip select
A16	Not RES	-	Reset
A17	VEE	-	Power supply for LCD
A18-A20	NC	-	No connection
E1-E2	VEL	-	Power supply for EL driving

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-12.5	-13.0	-13.5	V
Supply Current	I <sub>DD</sub>	-	-	35	-	mA
	I <sub>EE</sub>	-	-	2	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level, Note 2	0.8*V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level, Note 2	0	-	0.2*V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	-	-	-	-	Hz
Duty Ratio	-	-	-	1/64	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/64, T=0°C, ∅=10°, Note 3	-	16.2	-	V
		Duty=1/64, T=25°C, ∅=10°, Note 3	-	15.3	-	V
		Duty=1/64, T=40°C, ∅=10°, Note 3	-	14.7	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	F <sub>EL</sub> =400Hz	-	100	-	V <sub>rms</sub>
Backlight Lamp Frequency	f <sub>BL</sub>	-	-	400	-	Hz
Backlight Lamp Current	I <sub>BL</sub>	V <sub>EL</sub> =100V <sub>rms</sub> , F <sub>EL</sub> =400Hz	-	-	100	mA <sub>rms</sub>

## TIMING CHARACTERISTICS

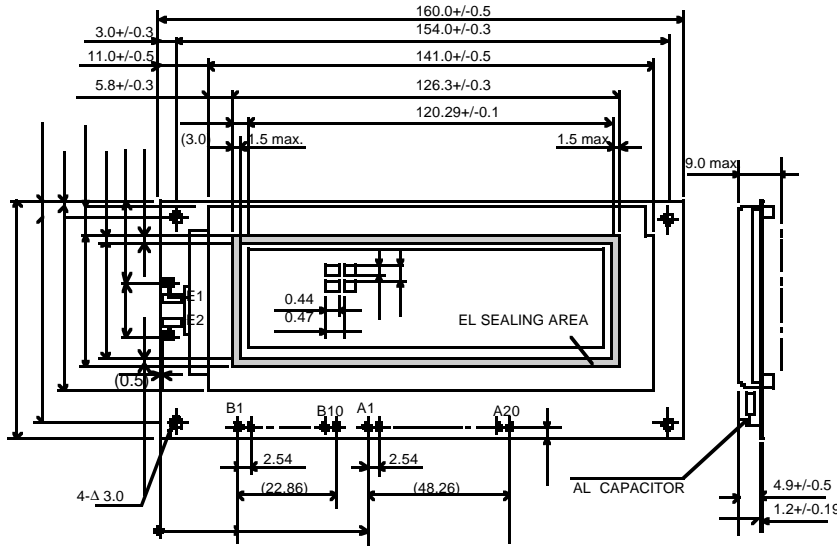
Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1000	-	-	ns
Enable pulse width (High level)	t <sub>WEH</sub>	450	-	-	ns
Enable pulse width (Low level)	t <sub>WEL</sub>	450	-	-	ns
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time	t <sub>AS</sub>	140	-	-	ns
Data set up time	t <sub>DSW</sub>	225	-	-	ns
Data delay time	t <sub>DDR</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Address hold time	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## INVERTER AND CONNECTORS

Recommended Inverter	Connector
NEC NEL-D32-48	No special connector required

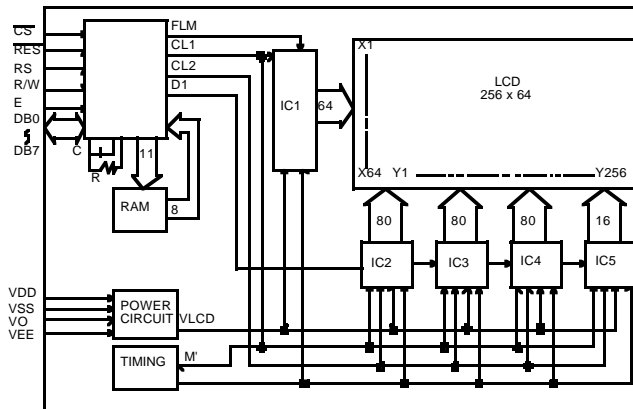
- Note1: Definition of optical data, see page 84
- Note 2: Applied to DB0-DB7, NotCS, E, R/W, RS
- Note 3: Recommended LC driving voltage may fluctuate about +/- 0.5V by each module
- Note 4: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 5: Storage at -20°C < 48 hr.

**MECHANICAL DIMENSIONS**

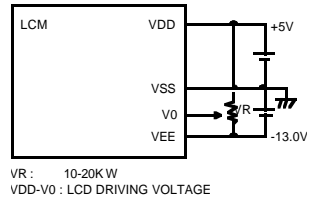


NOTE: PADS A1-A20 SHOULD NOT BE USED  
USE PADS B1-B10 FOR INTERFACE

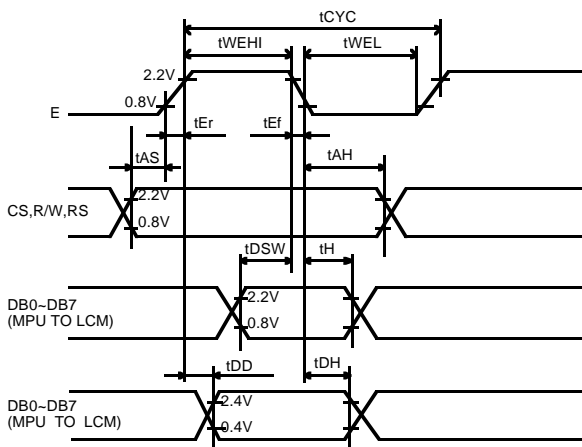
**BLOCK DIAGRAM**



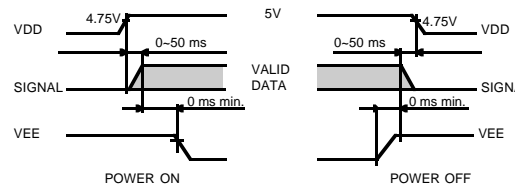
**POWER SUPPLY**



**INTERFACE TIMING DIAGRAM**



**POWER UP TIMING DIAGRAM**



## FEATURES

- ◆ Black on White Film STN Type
- ◆ Transmissive Mode
- ◆ High Brightness CFL Backlight

- ◆ High Contrast LC Material
- ◆ Mechanical Compatibility to LMG63xx series
- ◆ Built-in LCD Controller T6963C

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	160*68*12	mm
Viewing Area	124.3*34	mm
Resolution	256*64	dots
Dot Size	0.44*0.44	mm
Dot Pitch	0.47*0.47	mm
Weight	190	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	20	-	-
Brightness	-	T=25°C, IL=5mA, Note 8	70	90	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	(160)	-	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	(110)	-	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	20.5	V
Input Voltage	V <sub>I</sub>	-	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 7	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic circuit
A3	V0	-	Power supply for LCD drive
A4	C/D	-	WR=Low and C/D=High for Status read, C/D=Low for Data Read
A5	Not WR	-	DW=Low for Data Write
A6	Not RD	-	RD=Low for Data read
A7-A14	DB0 - DB7	-	Display data
A15	Not CE	-	Chip enable (CE must be low)
A16	Not RET	-	Reset
A17	VEE (-15V)	-	Power supply for LCD drive
A18	Not DISP OFF	-	NC for Display ON, GND for Display OFF
A19	F/S	-	Character font selection (F/S=High for 6x8 font, F/S=Low for 8x8 font)
A20	Reverse	-	Display mode reverse

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	GND	-	CFL Ground
2	NC	-	No connection
3	NC	-	No connection
4	HV	-	Power supply for CFL

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-15.5	-15.0	-14.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	11.0	14.0	mA
	I <sub>EE</sub>	Note 2	-	1.9	4.0	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 4	-	75	-	Hz
Duty Ratio	-	-	-	1/64	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/64, T=0°C, ∅=10°, Note 3	-	16.2	-	V
		Duty=1/64, T=25°C, ∅=10°, Note 3	-	15.0	-	V
		Duty=1/64, T=40°C, ∅=10°, Note 3	-	14.3	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	360	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	30	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	2.5	5.0	5.5	mA
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	(1000)	-	-	V

## TIMING CHARACTERISTICS

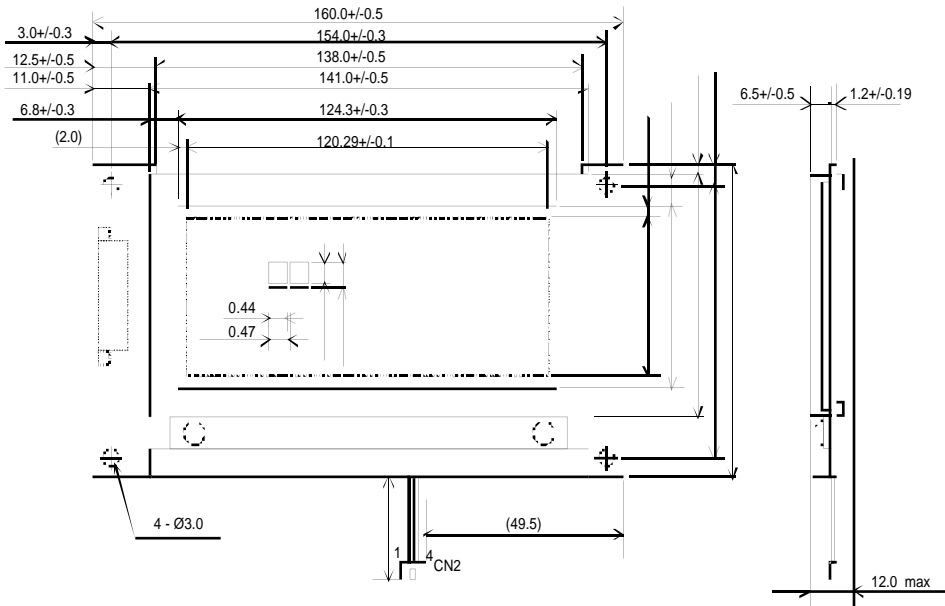
Item	Symbol	Min	Typ	Max	Unit
C/D set up time	t <sub>CDS</sub>	100	-	-	ns
C/D hold time	t <sub>CHD</sub>	10	-	-	ns
Not CE, Not RD, Not WR pulse width	Not t <sub>CE</sub> , Not t <sub>RD</sub> , Not t <sub>WR</sub>	80	-	-	ns
Data set up time	t <sub>DS</sub>	80	-	-	ns
Data hold time	t <sub>DH</sub>	40	-	-	ns
Access time	t <sub>ACC</sub>	-	-	150	ns
Output hold time	t <sub>OH</sub>	10	-	50	ns

## INVERTER AND CONNECTORS

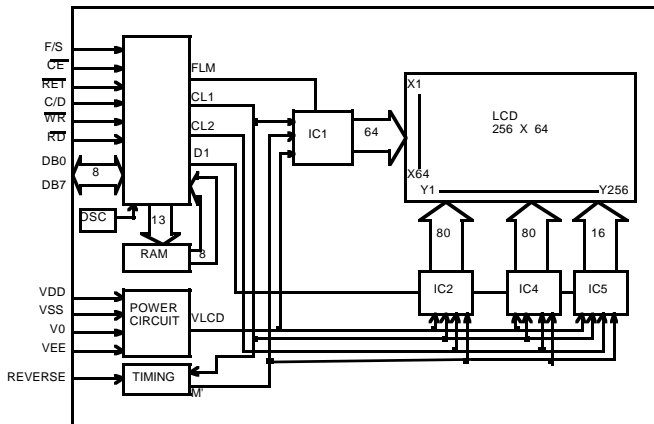
Recommended Inverter	Starter Kit
HITACHI INVC191	START7380
Data Connector	Data Housing Connector
JAE LZ-20P-SL-SMT-E3000	-
Lamp Connector	Lamp Housing Connector
mitsumi M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 1: Definition of optical data, see page 84
- Note 2: f<sub>FRAME</sub>=75Hz, V<sub>DD</sub>-V<sub>O</sub>=15.8V, T<sub>a</sub>=25°C
- Note 3: Recommended LCD driving may fluctuate about +- 1.0V by each module.
- Note 4: Need to make sure of flickering and rippling of display when setting the FRAME frequency in your set.
- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 6: Higher starting voltage of CFL and higher LCD driving voltage are needed while operating at 0°C. The lifetime of CFL will be reduced at 0°C
- Note 7: Storage at -20°C < 48 hr, Storage at 60°C < 168 hr
- Note 8: Measurement after 10 minutes of CFL operating. Brightness control: 100%
- Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

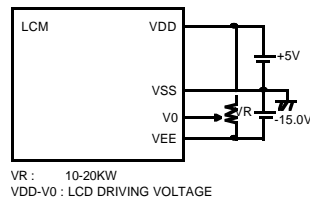
**MECHANICAL DIMENSIONS**



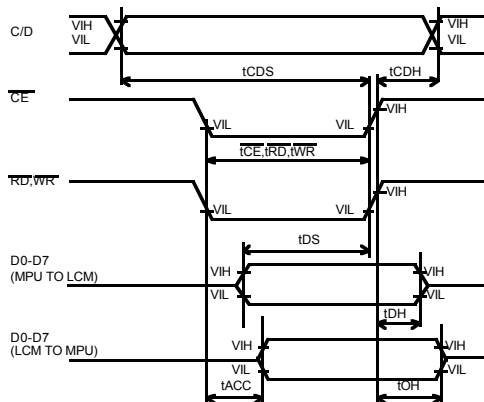
**BLOCK DIAGRAM**



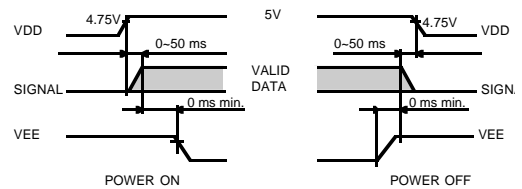
**POWER SUPPLY**



**INTERFACE TIMING DIAGRAM**



**POWER UP TIMING DIAGRAM**



## FEATURES

- ◆ Blue on Grey STN Type
- ◆ Reflective Mode

- ◆ Built-in LCD Controller HD61830B

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*9.5	mm
Viewing Area	126*71	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	160	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	(3.0)	-	-
Brightness	-	-	-	-	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=1.4, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	250	400	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	300	450	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	7	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	22	V
Input Voltage	V <sub>I</sub>	-	V <sub>SS</sub>	V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 4,5	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 4,5	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Display data
A15	Not CS	-	Chip select
A16	Not RES	-	Reset
A17	VEE (-15.0V)	-	Power supply for LCD drive
A18-A20	NC	-	No connection

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	6.0	-	mA
	I <sub>EE</sub>	Note 2	-	4.0	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	-	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=40°C, ∅=10°, Note 3	-	15.4	-	V

## TIMING CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1000	-	-	ns
Enable pulse width (High level)	t <sub>WEH</sub>	450	-	-	ns
Enable pulse width (Low level)	t <sub>WEL</sub>	450	-	-	ns
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time of CS, R/W, RS	t <sub>AS</sub>	140	-	-	ns
Set up time of Input Data	t <sub>DIS</sub>	225	-	-	ns
Data delay time	t <sub>DD</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Hold time of CS, R/W, RS	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## CONNECTORS

Connector	
No special connector required	-

Note1: Definition of optical data, see page 84

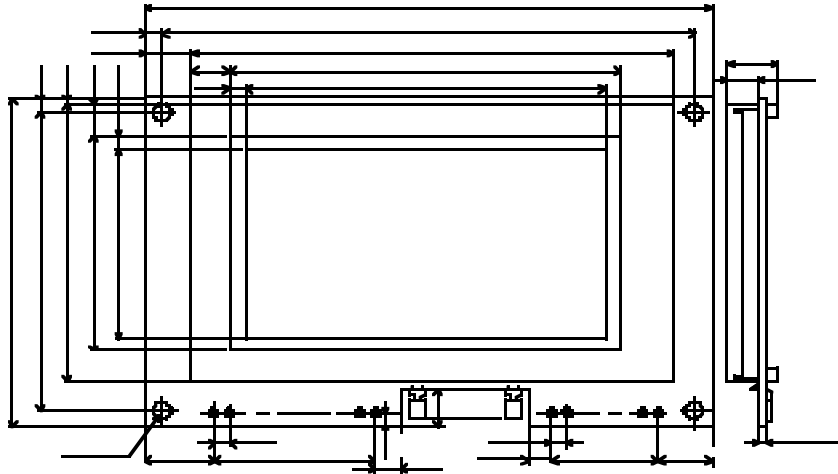
Note 2: f<sub>FLM</sub>=75Hz, V<sub>DD</sub>-V<sub>0</sub>=15.8V, D=GND(V<sub>SS</sub>)

Note 3: Recommended LC driving voltage may fluctuate about +- 0.5V by each module

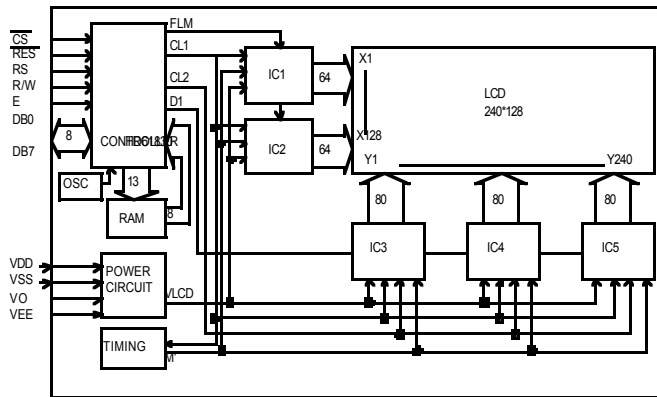
Note 4: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.

Note 5: Storage at -20°C < 48 hr.

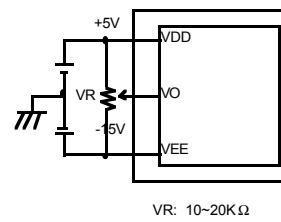
**MECHANICAL DIMENSIONS**



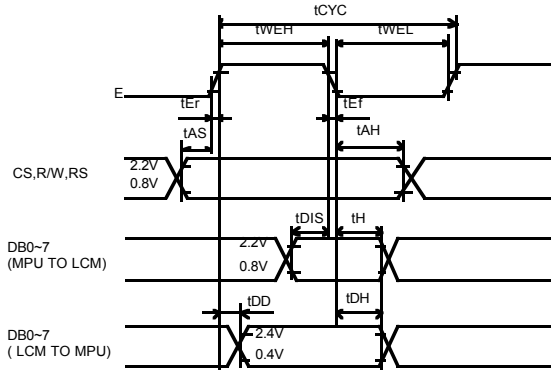
**BLOCK DIAGRAM**



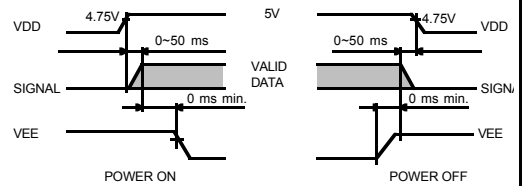
**POWER SUPPLY**



**INTERFACE TIMING DIAGRAM**



**POWER UP TIMING DIAGRAM**





## FEATURES

- ◆ Blue on Grey STN Type
- ◆ Transflective Mode

- ◆ Low Power EL Backlight
- ◆ Built-in LCD Controller HD61830B

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*9.5	mm
Viewing Area	126*71	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	160	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	(3.0)	-	-
Brightness	-	-	-	10	-	cd/m <sup>2</sup>
Viewing Direction	-	-	-	6	-	o'clock
Viewing Angle	∅2 - ∅1	K=1.4, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	250	400	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	300	450	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	7	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	22	V
Input Voltage	V <sub>I</sub>	-	V <sub>SS</sub>	V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 4,5	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 4,5	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Data bus
A15	Not CS	-	Chip select
A16	Not RES	-	Reset
A17	VEE (15.0V)	-	Power supply for LCD drive
A18-A20	NC	-	No connection
E1-E2	VEL	-	Power supply for EL driving

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	6.0	-	mA
	I <sub>EE</sub>	Note 2	-	4.0	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	-	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=40°C, ∅=10°, Note 3	-	15.4	-	V
Backlight Tile Voltage	V <sub>EL</sub>	f <sub>EL</sub> =400Hz	-	100	-	Vrms
Backlight Lamp Frequency	f <sub>EL</sub>	-	-	400	-	Hz
Backlight Tile Current	I <sub>EL</sub>	V <sub>EL</sub> =100Vr ms, f <sub>EL</sub> =400Hz	-	-	160	mA

## TIMING CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1000	-	-	ns
Enable pulse width (High level)	t <sub>WEH</sub>	450	-	-	ns
Enable pulse width (Low level)	t <sub>WEL</sub>	450	-	-	ns
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time of CS, R/W, RS	t <sub>AS</sub>	140	-	-	ns
Set up time of Input Data	t <sub>DIS</sub>	225	-	-	ns
Data delay time	t <sub>DD</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Hold time of CS, R/W, RS	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## CONNECTORS

Connector	
No special connector required	

Note1: Definition of optical data, see page 84

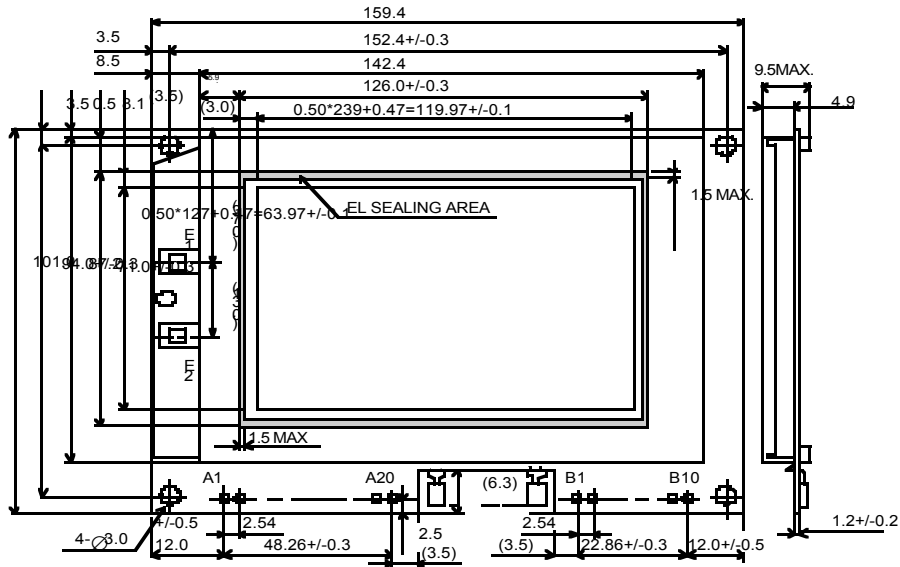
Note 2: f<sub>FLM</sub>=75Hz, V<sub>DD</sub>-V<sub>O</sub>=15.8V, D=GND(V<sub>SS</sub>)

Note 3: Recommended LC driving voltage may fluctuate about +- 0.5V by each module

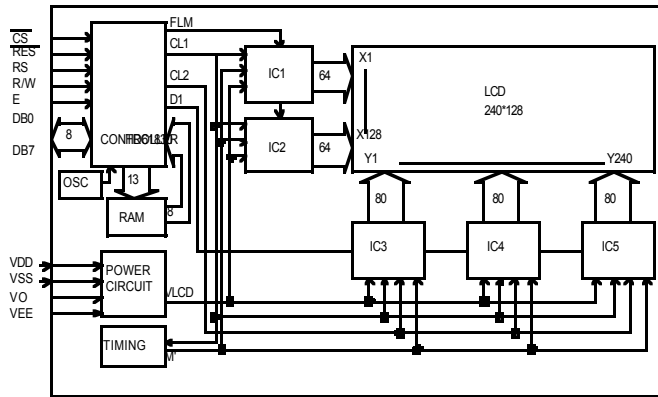
Note 4: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.

Note 5: Storage at -20°C < 48 hr.

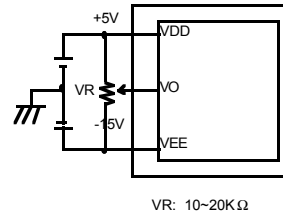
### MECHANICAL DIMENSIONS



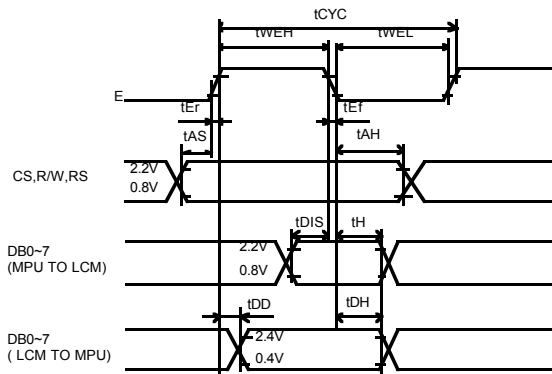
### BLOCK DIAGRAM



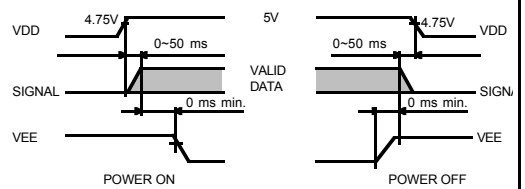
### POWER SUPPLY



### INTERFACE TIMING DIAGRAM



### POWER UP TIMING DIAGRAM



## FEATURES

- ◆ Black on Grey Film STN Type
- ◆ Reflective Mode

- ◆ Built-in LCD Controller HD61830B

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*9.5	mm
Viewing Area	126*71	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	150	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	(3.0)	-	-
Brightness	-	-	-	-	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=1.4, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	250	400	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	300	450	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	7	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	22	V
Input Voltage	V <sub>I</sub>	-	V <sub>SS</sub>	V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 4,5	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 4,5	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Data bus
A15	CS	-	Chip select
A16	RES	-	Reset
A17	VEE (15.0V)	-	Power supply for LCD drive
A18-A20	NC	-	No connection

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	6.0	-	mA
	I <sub>EE</sub>	Note 2	-	4.0	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	-	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=40°C, ∅=10°, Note 3	-	15.4	-	V

## TIMING CHARACTERISTICS

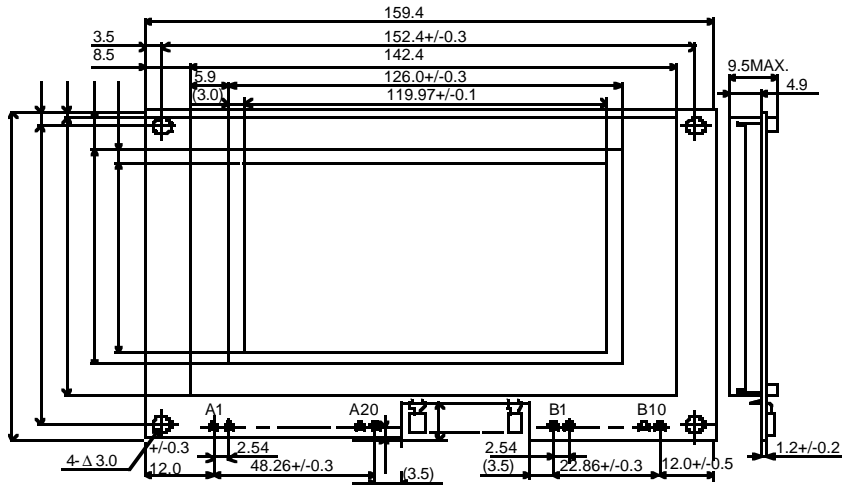
Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1000	-	-	ns
Enable pulse width (High level)	t <sub>WEH</sub>	450	-	-	ns
Enable pulse width (Low level)	t <sub>WEL</sub>	450	-	-	ns
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time of CS, R/W, RS	t <sub>AS</sub>	140	-	-	ns
Set up time of Input Data	t <sub>DIS</sub>	225	-	-	ns
Data delay time	t <sub>DD</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Hold time of CS, R/W, RS	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## CONNECTORS

Connector
No special connector required

- Note1: Definition of optical data, see page 84
- Note 2: f<sub>FLM</sub>=75Hz, V<sub>DD</sub>-V<sub>0</sub>=15.8V, D=GND(VSS)
- Note 3: Recommended LC driving voltage may fluctuate about +- 0.5V by each module
- Note 4: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 5: Storage at -20°C < 48 hr.

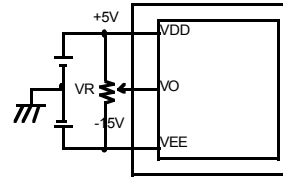
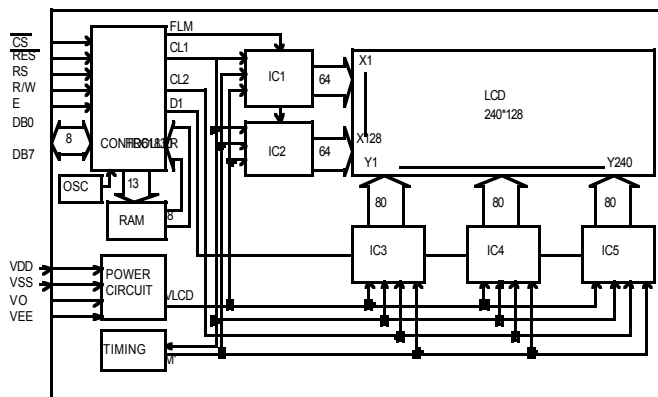
**MECHANICAL DIMENSIONS**



NOTE: PIN B1 - B10 SHOULD NOT BE USED  
USE PIN A1 - A20 FOR INTERFACE

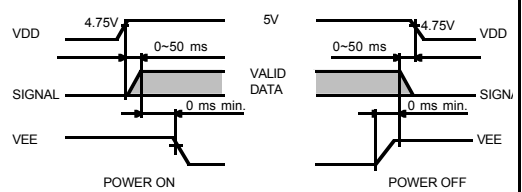
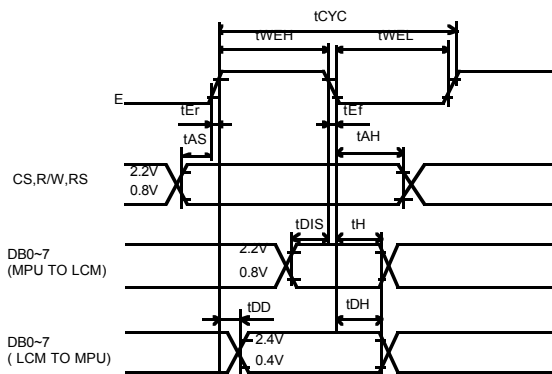
**BLOCK DIAGRAM**

**POWER SUPPLY**



**INTERFACE TIMING DIAGRAM**

**POWER UP TIMING DIAGRAM**



## FEATURES

- ◆ Black on White Film STN Type
- ◆ Transmissive Mode
- ◆ High Brightness CFL Backlight

- ◆ High Contrast LC Material
- ◆ Built-in LCD Controller HD61830B

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*11	mm
Viewing Area	123*68	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	180	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	18	-	-
Brightness	-	T=25°C, IL=5mA, Note 8	70.0	90.0	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	(160)	(210)	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	(110)	(160)	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	20.5	V
Input Voltage	V <sub>I</sub>	-	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 7	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic circuit
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Display data
A15	Not CS	-	Chip select
A16	RES	-	Reset
A17	VEE (-15V)	-	Power supply for LCD drive
A18	Not Disp OFF	-	NC for Display ON, GND for Display OFF
A19-A20	NC	-	No connection

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	GND	-	CFL Ground
2	NC	-	No connection
3	NC	-	No connection
4	HV	-	Power supply for CFL

- Note 1: Definition of optical data, see page 84  
 Note 2: f<sub>FRAME</sub>=75Hz, V<sub>DD</sub>-V<sub>0</sub>=15.7V, T<sub>a</sub>=25°C  
 Note 3: Recommended LCD driving may fluctuate about +/- 1.0V by each module.  
 Note 4: Need to make sure of flickering and rippling of display when setting the FRAME Frequency in your set.

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DP</sub>	Note 2	-	9.7	12.0	mA

	I <sub>FE</sub>	Note 2	-	2.5	4.0	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8*V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2*V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 4	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>0</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=40°C, ∅=10°, Note 3	-	15.4	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	360	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	30	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	2.5	5.0	5.5	mA
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	(1000)	-	-	V

## TIMING CHARACTERISTICS

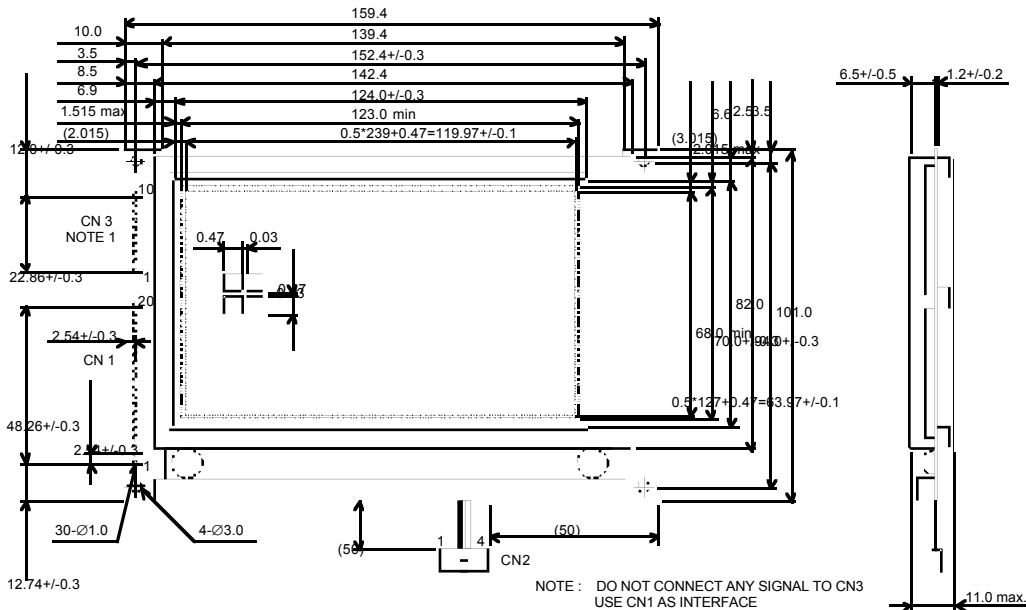
Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1.0	-	-	us
Enable pulse width (High level)	t <sub>WEH</sub>	0.45	-	-	us
Enable pulse width (Low level)	t <sub>WEL</sub>	0.45	-	-	us
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time of CS, R/W, RS	t <sub>AS</sub>	140	-	-	ns
Set up time of Input Data	t <sub>DIS</sub>	225	-	-	ns
Data delay time	t <sub>DD</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Hold time of CS, R/W, RS	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## INVERTER AND CONNECTORS

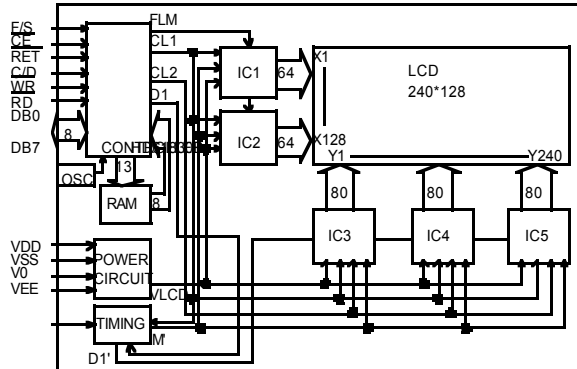
Recommended Inverter	Starter Kit
HITACHI INVC191	STARTLMG74xx
Lamp Connector	Lamp Housing Connector
MITSUMI M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.  
 Note 6: Higher starting voltage of CFL and higher LCD driving voltage are needed while operating at 0°C. The lifetime of CFL will be reduced at 0°C  
 Note 7: Storage at -20°C < 48 hr, T<sub>a</sub> at 60°C < 168 hr  
 Note 8: Measurement after 10 minutes of CFL operating. Brightness control 100%  
 Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

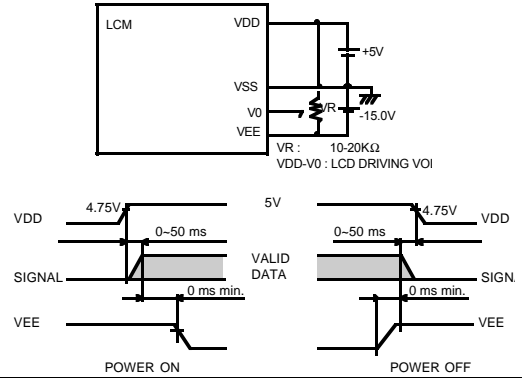
**MECHANICAL DIMENSIONS**



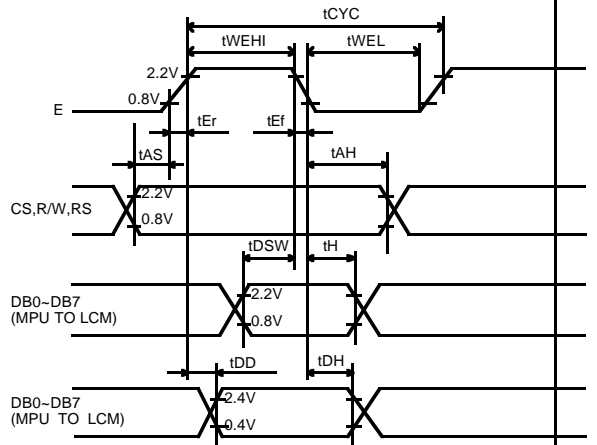
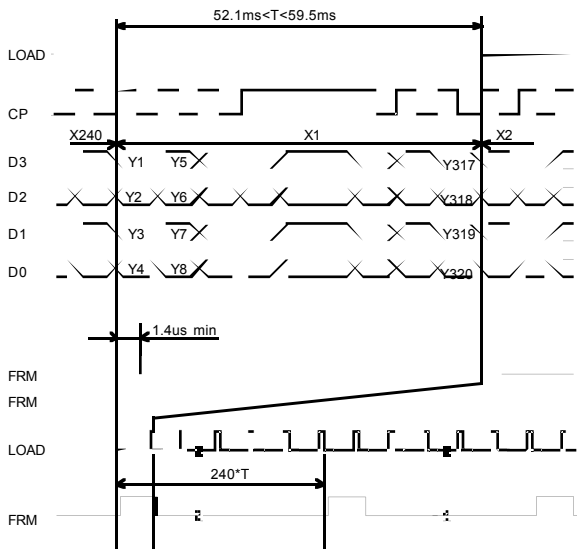
**BLOCK DIAGRAM**



**POWER SUPPLY / POWER UP TIMING DIAGRAM**



**INTERFACE TIMING DIAGRAM**



## FEATURES

- ◆ Blue on White STN Type
- ◆ Transmissive Mode
- ◆ High Brightness CFL Backlight

- ◆ High Contrast LC Material
- ◆ Built-in LCD Controller HD61830B

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*11	mm
Viewing Area	123*68	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	180	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	(18)	-	-
Brightness	-	T=25°C, IL=5mA, Note 8	(60.0)	(80.0)	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	(160)	(210)	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	(110)	(160)	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	20.5	V
Input Voltage	V <sub>I</sub>	-	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 7	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic circuit
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Display data
A15	Not CS	-	Chip select
A16	Not RET	-	Reset
A17	VEE (-15V)	-	Power supply for LCD drive
A18	Not DISP OFF	-	NC for Display ON, GND for Display OFF
A1- A20	NC	-	No connection

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	GND	-	CFL Ground
2	NC	-	No connection
3	NC	-	No connection
4	HV	-	Power supply for CFL

- Note 1: Definition of optical data, see page 84  
 Note 2: f<sub>FRAME</sub>=75Hz, V<sub>DD</sub>-V<sub>0</sub>=15.8V, T<sub>a</sub>=25°C  
 Note 3: Recommended LCD driving may fluctuate about +/- 1.0V by each module.  
 Note 4: Need to make sure of flickering and rippling of display when setting the FRAME Frequency in your set.

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	9.7	12.0	mA
	I <sub>EE</sub>	Note 2	-	2.5	4.0	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 4	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=40°C, ∅=10°, Note 3	-	15.4	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	360	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	30	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	2.5	5.0	5.5	mA
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	(1000)	-	-	V

## TIMING CHARACTERISTICS

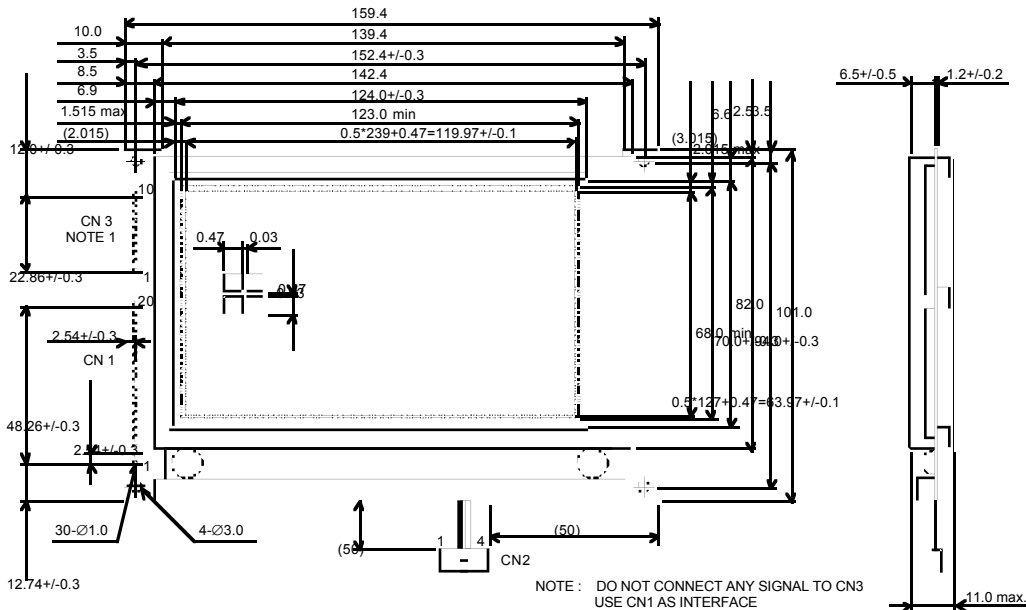
Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1.0	-	-	us
Enable pulse width (High level)	t <sub>WEH</sub>	0.45	-	-	us
Enable pulse width (Low level)	t <sub>WEL</sub>	0.45	-	-	us
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time of CS, R/W, RS	t <sub>AS</sub>	140	-	-	ns
Set up time of Input Data	t <sub>DIS</sub>	225	-	-	ns
Data delay time	t <sub>DD</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Hold time of CS, R/W, RS	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## INVERTER AND CONNECTORS

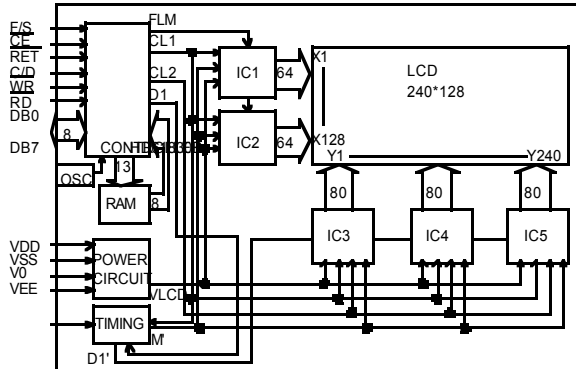
Recommended Inverter	Starter Kit
HITACHI INVVC191	START74xx
Lamp Connector	Lamp Housing Connector
MITSUMI M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.  
 Note 6: Higher starting voltage of CFL and higher LCD driving voltage are needed while operating at 0°C. The lifetime of CFL will be reduced at 0°C  
 Note 7: Storage at -20°C < 48 hr, T<sub>a</sub> at 60°C < 168 hr  
 Note 8: Measurement after 10 minutes of CFL operating. Brightness control 100%  
 Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

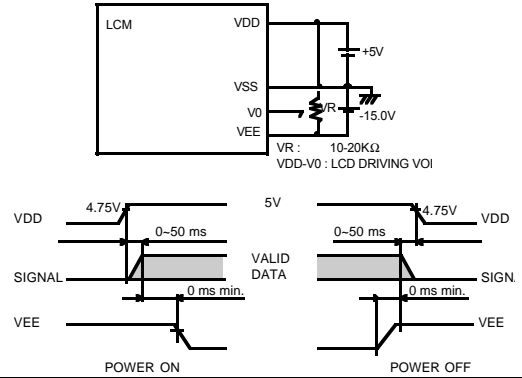
### MECHANICAL DIMENSIONS



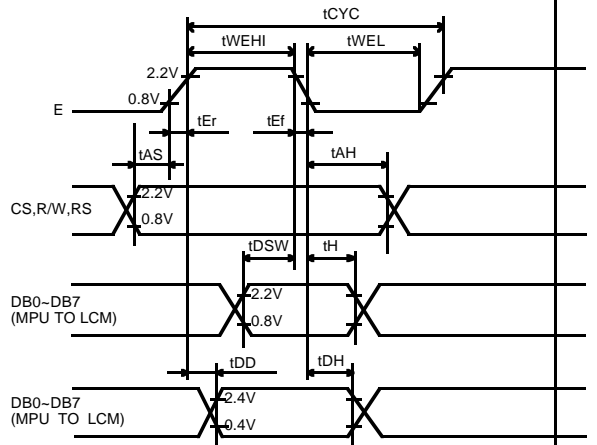
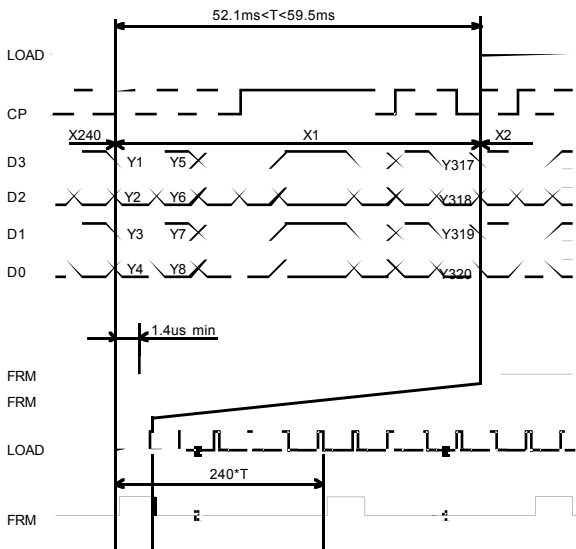
### BLOCK DIAGRAM



### POWER SUPPLY / POWER UP TIMING DIAGRAM



### INTERFACE TIMING DIAGRAM





## FEATURES

- ◆ Black on Grey Film STN
- ◆ Transflective Mode
- ◆ High Brightness CFL Backlight

- ◆ High Contrast LC Material
- ◆ Built-in LCD Controller HD61830B

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*11	mm
Viewing Area	123*68	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	180	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	(18)	-	-
Brightness	-	T=25°C, IL=5mA, Note 8	(60.0)	(80.0)	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	(160)	(210)	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	(110)	(160)	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	20.5	V
Input Voltage	V <sub>I</sub>	-	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 7	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic circuit
A3	V0	-	Power supply for LCD drive
A4	RS	-	Register select
A5	R/W	-	Read / Write
A6	E	-	Enable
A7-A14	DB0 - DB7	-	Display data
A15	Not CS	-	Chip select
A16	Not RET	-	Reset
A17	VEE (-15V)	-	Power supply for LCD drive
A18	Not DISP OFF	-	NC for Display ON, GND for Display OFF
A1- A20	NC	-	No connection

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	GND	-	CFL Ground
2	NC	-	No connection
3	NC	-	No connection
4	HV	-	Power supply for CFL

- Note 1: Definition of optical data, see page 84  
 Note 2: f<sub>FRAME</sub>=75Hz, V<sub>DD</sub>-V<sub>0</sub>=15.8V, T<sub>a</sub>=25°C  
 Note 3: Recommended LCD driving may fluctuate about +/- 1.0V by each module.  
 Note 4: Need to make sure of flickering and rippling of display when setting the FRAME Frequency in your set.

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	9.7	12.0	mA
	I <sub>EE</sub>	Note 2	-	2.5	4.0	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 4	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=40°C, ∅=10°, Note 3	-	15.4	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	360	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	30	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	2.5	5.0	5.5	mA
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	(1000)	-	-	V

## TIMING CHARACTERISTICS

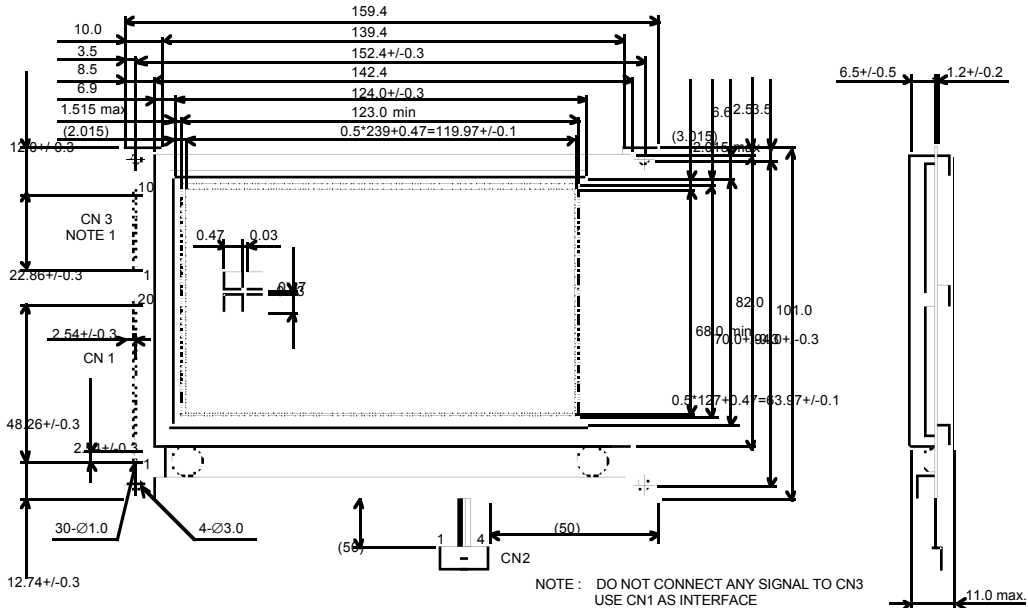
Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t <sub>CYC</sub>	1.0	-	-	us
Enable pulse width (High level)	t <sub>WEH</sub>	0.45	-	-	us
Enable pulse width (Low level)	t <sub>WEL</sub>	0.45	-	-	us
Enable rise time	t <sub>Er</sub>	-	-	25	ns
Enable fall time	t <sub>Ef</sub>	-	-	25	ns
Set up time of CS, R/W, RS	t <sub>AS</sub>	140	-	-	ns
Set up time of Input Data	t <sub>DIS</sub>	225	-	-	ns
Data delay time	t <sub>DD</sub>	-	-	225	ns
Hold time of Data	t <sub>H</sub>	10	-	-	ns
Hold time of CS, R/W, RS	t <sub>AH</sub>	10	-	-	ns
Data hold time	t <sub>DH</sub>	20	-	-	ns

## INVERTER AND CONNECTORS

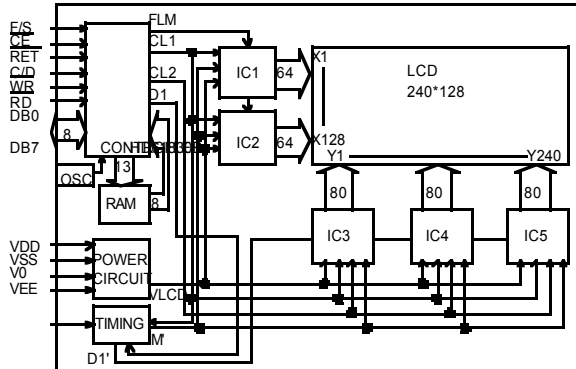
Recommended Inverter	Starter Kit
HITACHI INVVC191	START74xx
Lamp Connector	Lamp Housing Connector
MITSUMI M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.  
 Note 6: Higher starting voltage of CFL and higher LCD driving voltage are needed while operating at 0°C. The lifetime of CFL will be reduced at 0°C  
 Note 7: Storage at -20°C < 48 hr, T<sub>a</sub> at 60°C < 168 hr  
 Note 8: Measurement after 10 minutes of CFL operating. Brightness control 100%  
 Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

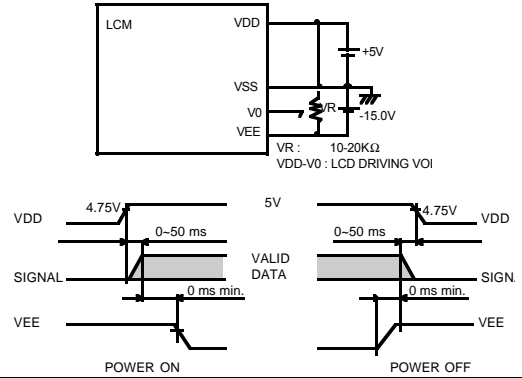
MECHANICAL DIMENSIONS



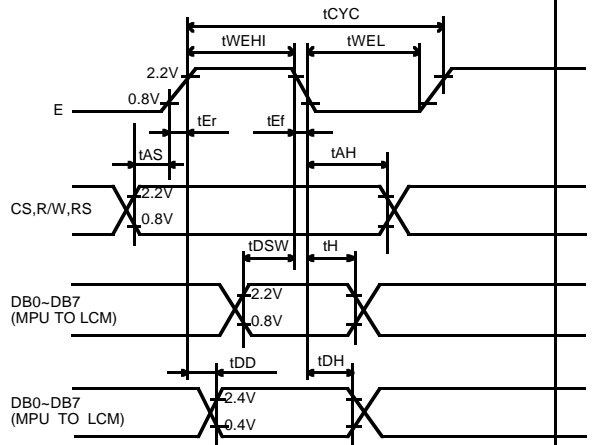
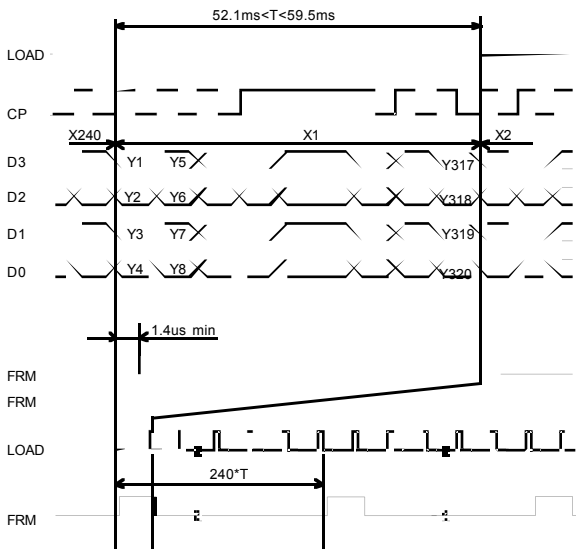
BLOCK DIAGRAM



POWER SUPPLY / POWER UP TIMING DIAGRAM



INTERFACE TIMING DIAGRAM



## FEATURES

- ◆ Black on White STN TYPE
- ◆ Transmissive Mode
- ◆ High Brightness CFL Backlight

- ◆ High Contrast LC Material
- ◆ Built-in LCD Controller T6963C

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	159.4*101*11	mm
Viewing Area	123*68	mm
Resolution	240*128	dots
Dot Size	0.47*0.47	mm
Dot Pitch	0.5*0.5	mm
Weight	180	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	18	-	-
Brightness	-	T=25°C, IL=5mA, Note 8	60.0	80.0	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	160	210	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	110	160	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	20.5	V
Input Voltage	V <sub>I</sub>	-	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 7	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
A1	VSS (0V)	-	Ground
A2	VDD (+5V)	-	Power supply for logic circuit
A3	V0	-	Power supply for LCD drive
A4	C/D	-	Not WR=Low and C/D=High for Command Write, C/D= Low for Data Write, Not RD = Low and C/D=High for Status Read, C/D = Low for Data Read
A5	Not WR	-	DW=Low for Data Write
A6	Not RD	-	RD=Low for Data read
A7-A14	DB0 - DB7	-	Display data
A15	Not CE	-	Chip enable (Not CE must be Low)
A16	Not RET	-	Reset
A17	VEE (-15V)	-	Power supply for LCD drive
A18	Not DISP OFF	-	NC for Display ON, GND for Display OFF
A19	F/S	-	Character font selection (F/S=High for 6x8 font, F/S=Low for 8x8 font)
A20	Reverse	-	Display mode reverse

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	GND	-	CFL Ground
2	NC	-	No connection
3	NC	-	No connection
4	HV	-	Power supply for CFL

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-14.5	-15.0	-15.5	V
Supply Current	I <sub>DD</sub>	Note 2	-	11.7	14.0	mA
	I <sub>EE</sub>	Note 2	-	2.5	4.0	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level	0.8* V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level	0	-	0.2* V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 4	-	75	-	Hz
Duty Ratio	-	-	-	1/128	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/128 T=0°C, ∅=10°, Note 3	-	16.9	-	V
		Duty=1/128 T=25°C, ∅=10°, Note 3	-	15.8	-	V
		Duty=1/128 T=50°C, ∅=10°, Note 3	-	15.2	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	360	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	30	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	2.5	5.0	5.5	mA
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	(1000)	-	-	V

## TIMING CHARACTERISTICS

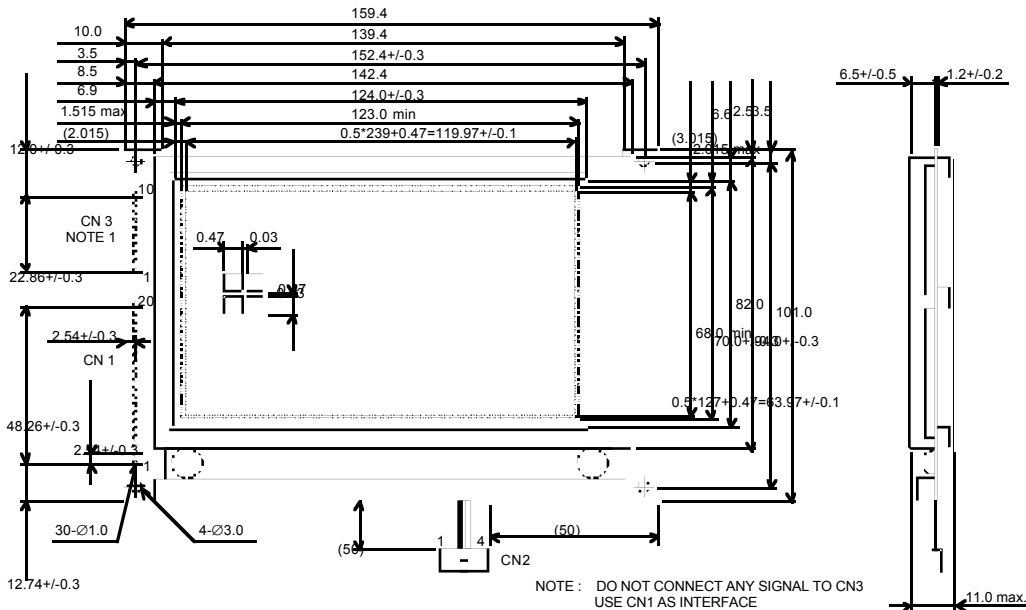
Item	Symbol	Min	Typ	Max	Unit
C/D set up time	t <sub>CDS</sub>	100	-	-	ns
C/D hold time	t <sub>CHD</sub>	10	-	-	ns
Not CE, Not RD, Not WR pulse width	Not t <sub>CE</sub> , Not t <sub>RD</sub> , Not t <sub>WR</sub>	80	-	-	ns
Data set up time	t <sub>DS</sub>	80	-	-	ns
Data hold time	t <sub>DH</sub>	40	-	-	ns
Access time	t <sub>ACC</sub>	-	-	150	ns
Output hold time	t <sub>OH</sub>	10	-	50	ns

## INVERTER AND CONNECTORS

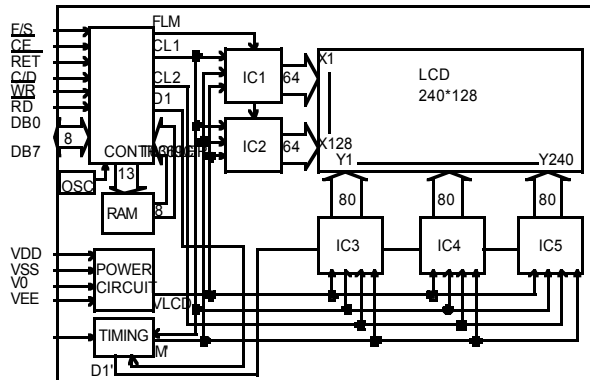
Recommended Inverter	Starter Kit
HITACHI INV6191	START74xx
Lamp Connector	Lamp Housing Connector
MITSUMI M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 1: Definition of optical data, see page 84
- Note 2: f<sub>FRAME</sub>=75Hz, V<sub>DD</sub>-V<sub>0</sub>=15.8V, T<sub>a</sub>=25°C
- Note 3: Recommended LCD driving may fluctuate about +/- 1.0V by each module.
- Note 4: Need to make sure of flickering and rippling of display when setting the FRAME Frequency in your set.
- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 6: Higher starting voltage of CFL and higher LCD driving voltage are needed while operating at 0°C. The lifetime of CFL will be reduced at 0°C
- Note 7: Storage at -20°C < 48 hr, T<sub>a</sub> at 60°C < 168 hr
- Note 8: Measurement after 10 minutes of CFL operating. Brightness control: 100%
- Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

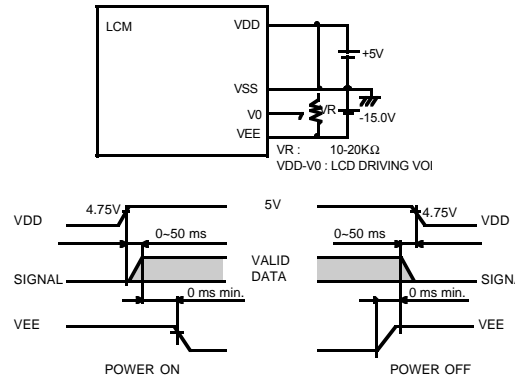
**MECHANICAL DIMENSIONS**



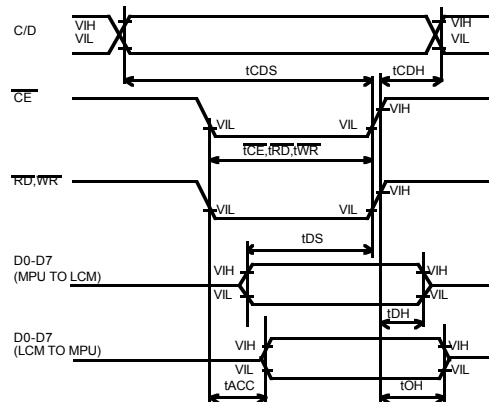
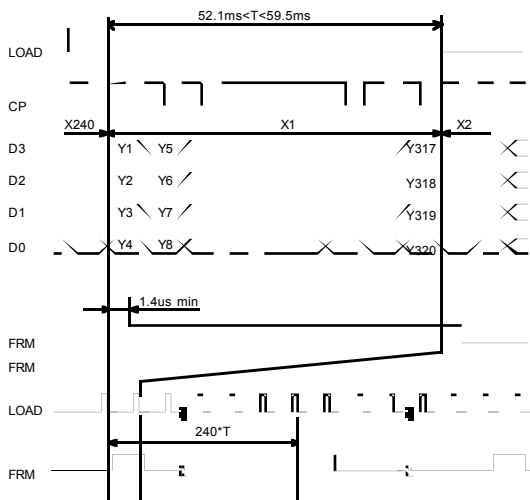
**BLOCK DIAGRAM**



**POWER SUPPLY / POWER UP TIMING DIAGRAM**



**INTERFACE TIMING DIAGRAM**



**QUARTER VGA RESOLUTION DISPLAYS OVERVIEW**

ITEM	SP14Q001 (Replaces LMG6911RPBC-00T)	SP14Q002 (Replaces LMG6912RPFC-00T)	LMG7520RPFC	UNIT
Display Type	Blue and White Transmissive STN	Black and White Transmissive Film STN	Black and White Transmissive Film STN	-
Resolution	320 x 240			dots
Size	5.7	5.7	4.7	inch
Dot Size	0.345 x 0.345	0.33 x 0.33	0.285x0.285	mm
Dot Pitch	0.36 x 0.36	0.36 x 0.36	0.3 x 0.3	mm
External Dimensions	167.1 x 109 x 11	167.1 x 109 x 11	129.6 x 92.6 x 7.5	mm
Active Display Area	120 x 91	120 x 91	100 x 75.5	mm
Backlight	1 CFL Tube			°C
Brightness	90	90	100	cd/m <sup>2</sup>
Contrast	12 : 1	20 : 1	20 : 1	-
Response Time (Rise)	160	160	160	ms
Response Time (Fall)	110	110	110	ms
Operating Temperature	0 - + 50			°C
Storage Temperature	-20 - + 60			°C
CFL Tube Life Time	20.000 typ			hrs

**SP14Q00x Series**

The SP14Q00x series of 5.7" Quarter VGA Monochrome LCD modules is another representative of Hitachi's newest generation LCD technology combining high contrast and high brightness. Both transmissive Film STN and transmissive STN types are available. Reflective and transmissive versions are available on request from a minimum order quantity of 3000 pcs.

The SP14Q00x series offers the following advanced features :

- High contrast ratio of up to 20:1 based on new LC material and high aperture technology
- High brightness of 90 cd/sqm based on new high efficiency cold fluorescent lamp and light guide
- Extremely wide viewing angle
- Easily replaceable long lifetime CFL tube
- Anti-glare hard coat surface

The SP14Q00x series is controllerless and various LCD controllers may be used. Suitable controllers are HITACHI HD64645/HD64646, OKI MSM6255/MSM6355, Seiko SED1350 or Yamaha YGV610B which allows to display up to 15 grey levels.

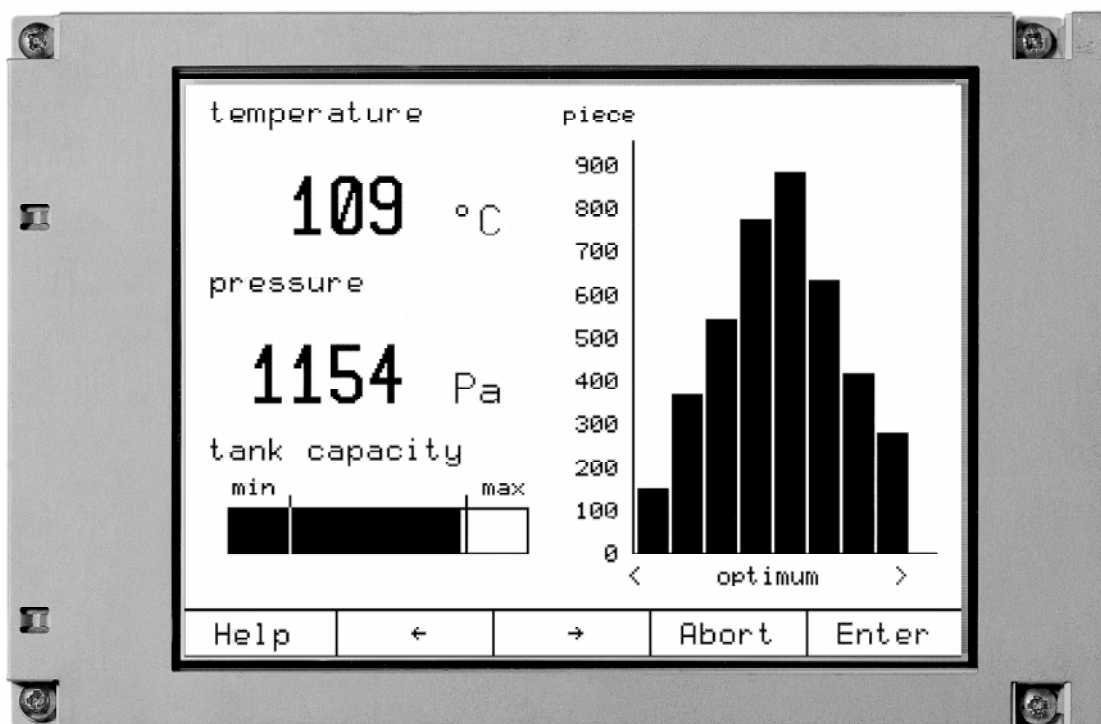
**LMG7520RPFC**

The LMG7520RPFC is a 4.7" Quarter VGA Monochrome LCD module with the following advanced features

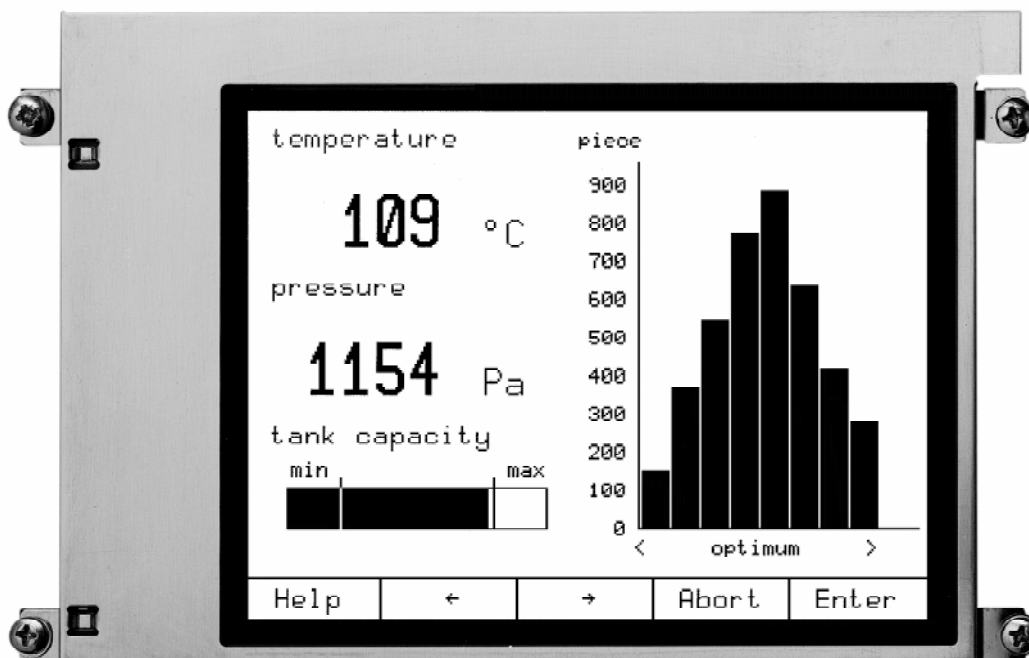
- Very compact external dimensions and low weight due to the use of the latest TCP driver technology
- High contrast ratio of 20:1 based on new LC materials combined with an improved aperture ratio
- High brightness of 100 cd /sqm based on new high efficiency CFL backlight and light guide
- Anti-glare hard coat surface

Since LMG7520RPFC is fully electrically compatible to the SP14Q00x series the same controllers can be used for interfacing.

Both display modules employ a new long life CFL tube providing 20.000 hrs half brightness lifetime.



SP14Q002



LMG7520RPFC

## FEATURES

- ◆ Blue on White STN Type
- ◆ Transmissive Mode

- ◆ High Brightness Long Lifetime CFL Backlight
- ◆ High Contrast LC Material

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	167.0*109*8.5	mm
Viewing Area	120*89	mm
Resolution	320*240	dots
Dot Size	0.345*0.345	mm
Dot Pitch	0.36*0.36	mm
Weight	160	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	12	-	-
Brightness	-	T=25°C, Note 7	-	80.0	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	120	-	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	150	-	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	27.5	V
Input Voltage	V <sub>I</sub>	Note 2	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 5,6	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1-4	D0 - D3	H/L	Display data
5	Not DISP OFF	H/L	High for ON / Low for OFF
6	FRAME	H	First Line Marker
7	NC	-	Do not connect
8	LOAD	H->L	Data latch
9	CP	H->L	Data shift
10	VDD	-	Power supply for logic circuit
11	VSS	-	Ground
12	VEE	-	Power supply for LC drive circuit
13	V0	-	Operating voltage for LC driving
14	FGND	-	Front panel ground

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	VCFL	-	Power supply for CFL
2	NC	-	No connection
3	NC	-	No connection
4	VCFL	-	CFL Ground

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-20.9	-22.0	-23.1	V
Supply Current	I <sub>DD</sub>	Note 3	-	6	-	mA
	I <sub>EE</sub>	Note 3	-	5	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level, Note 2	0.8* VDD	-	VDD	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level, Note 2	0	-	0.2* VDD	V
Frame Frequency	f <sub>FLM</sub>	-	70	75	80	Hz
Duty Ratio	-	-	-	1/240	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>0</sub>	Duty=1/240 T=0°, ∅=10°, Note 4	-	23.5	-	V
		Duty=1/240 T=25°C, ∅=10°, Note 4	-	22.3	-	V
		Duty=1/240 T=40°C, ∅=10°, Note 4	-	21.6	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	300	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	-	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	4	5	6	mA <sub>RMS</sub>
Lamp Start Voltage	V <sub>S</sub>	T=25°C	(1000)	-	-	V
Backlight Lamp Lifetime	T <sub>L</sub>	T=25°C	15.000	20.000	-	hrs

## TIMING CHARACTERISTICS

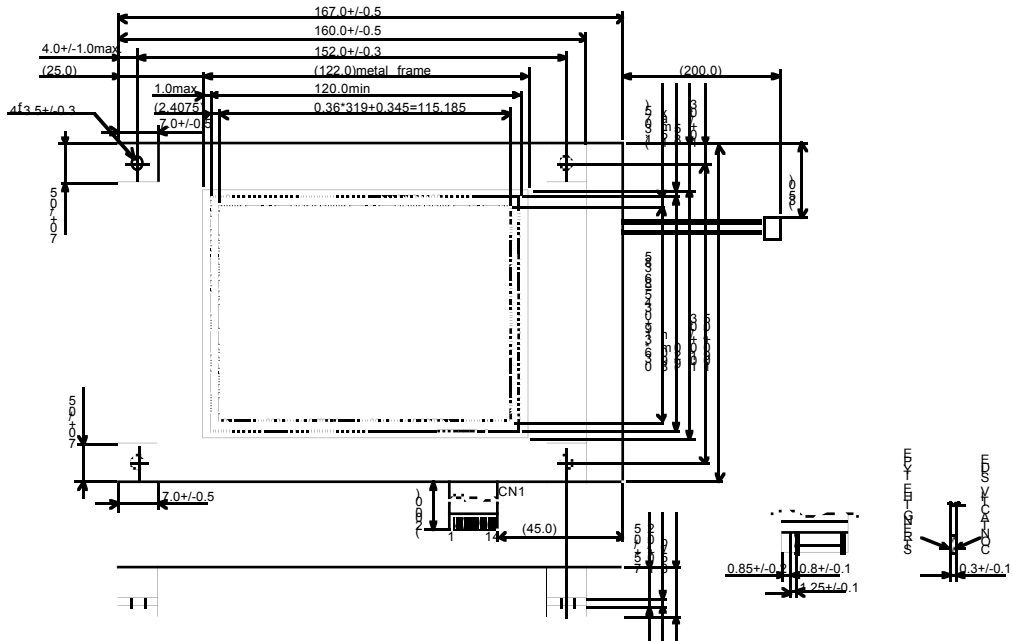
Item	Symbol	Min	Typ	Max	Unit
Clock frequency	f <sub>CP</sub>	-	-	6.5	MHz
Clock pulse width	tw	63	-	-	ns
Rise, Fall time	t <sub>r</sub> , t <sub>f</sub>	-	-	20	ns
Data set up time	t <sub>DSU</sub>	50	-	-	ns
Data hold time	t <sub>DHD</sub>	50	-	-	ns
LOAD set up time	t <sub>LSU</sub>	80	-	-	ns
LOAD -> Clock time	t <sub>LC</sub>	80	-	-	ns
FRAME set up time	t <sub>setup</sub>	100	-	-	ns
FRAME hold time	t <sub>hold</sub>	100	-	-	ns
LOAD pulse width	t <sub>wc</sub>	125	-	-	ns

## INVERTER AND CONNECTORS

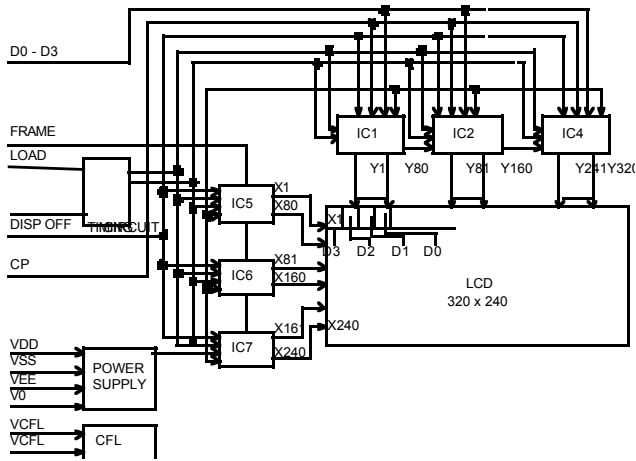
Recommended Inverter	Starter Kit
HITACHI INVC132, INVC196	START691x
Lamp Connector	Lamp Housing Connector
JAE IL-G-4S-S3C23	-

- Note 1: Definition of optical data, see page 84
- Note 2: Applied to NotDISP.OFF, FRAME, LOAD, CP, D0-D3
- Note 3: FRAME=75Hz, D0-D3=0.1.0.1...VDD-VEE=23.7V, T=25°C
- Note 4: Recommended LC driving voltage may fluctuate about +/-1.0V by each module
- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 6: Storage at -20°C < 48 hr, at 60°C < 168 hr
- Note 7: Measurement after 10 minutes of CFL operating. Brightness control at 100 %

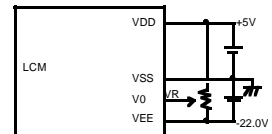
# MECHANICAL DIMENSIONS



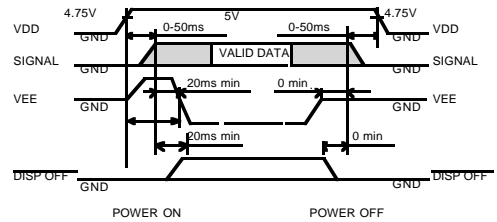
# BLOCK DIAGRAM



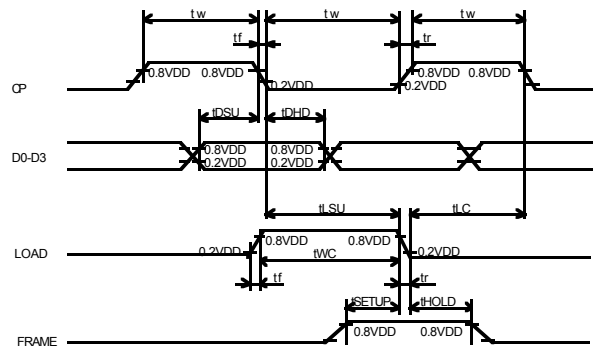
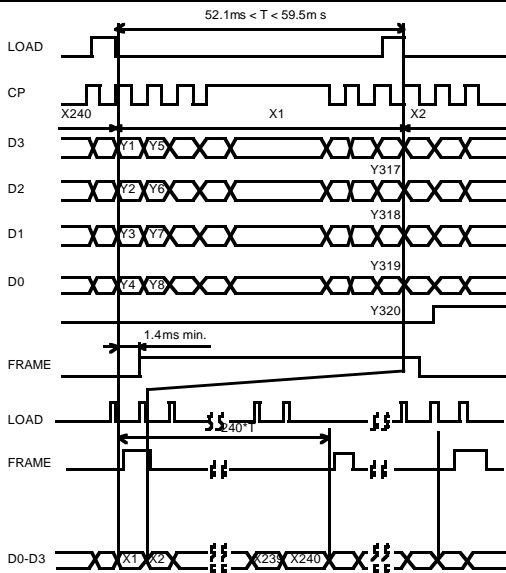
# POWER SUPPLY / POWER UP TIMING DIAGRAM



NOTE 1: IT IS RECOMMENDED TO ADD FUS (1 A) TO VDD LINE  
 NOTE 2: VR = 10kΩ



# INTERFACE TIMING DIAGRAM





## FEATURES

- ◆ Black on White Film STN Type
- ◆ Transmissive Mode

- ◆ High Brightness CFL Backlight
- ◆ High Contrast LC Material

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	167.0*109*8.5	mm
Viewing Area	120*89	mm
Resolution	320*240	dots
Dot Size	0.345*0.345	mm
Dot Pitch	0.36*0.36	mm
Weight	160	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	20	-	-
Brightness	-	T=25°C, Note 7	-	80.0	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	120	-	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	150	-	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	27.5	V
Input Voltage	V <sub>I</sub>	Note 2	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 5,6	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1-4	D0 - D3	H/L	Display data
5	Not DISP OFF	H/L	High for ON / Low for OFF
6	FRAME	H	First Line Marker
7	NC	-	Do not connect
8	LOAD	H->L	Data latch
9	CP	H->L	Data shift
10	VDD	-	Power supply for logic circuit
11	VSS	-	Ground
12	VEE	-	Power supply for LC drive circuit
13	V0	-	Operating voltage for LC driving
14	FGND	-	Front panel ground

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	VCFL	-	Power supply for CFL
2	NC	-	No connection
3	NC	-	No connection
4	VCFL	-	CFL Ground

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-20.9	-22.0	-23.1	V
Supply Current	I <sub>DD</sub>	Note 3	-	6	-	mA
	I <sub>EE</sub>	Note 3	-	5	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level, Note 2	0.8* VDD	-	VDD	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level, Note 2	0	-	0.2* VDD	V
Frame Frequency	f <sub>FLM</sub>	-	70	75	80	Hz
Duty Ratio	-	-	-	1/240	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>0</sub>	Duty=1/240 T=0°, ∅=10°, Note 4	-	23.0	-	V
		Duty=1/240 T=25°C, ∅=10°, Note 4	-	22.0	-	V
		Duty=1/240 T=40°C, ∅=10°, Note 4	-	21.0	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	300	-	Vrms
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	-	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	4	5	6	mA <sub>rms</sub>
Lamp Start Voltage	V <sub>S</sub>	T=25°C	1000	-	-	V
Backlight Lamp Lifetime	T <sub>L</sub>	T=25°C	15.000	20.000	-	hrs

## TIMING CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
Clock frequency	f <sub>CP</sub>	-	-	6.5	MHz
Clock pulse width	tw	63	-	-	ns
Rise, Fall time	t <sub>r</sub> , t <sub>f</sub>	-	-	20	ns
Data set up time	t <sub>DSU</sub>	50	-	-	ns
Data hold time	t <sub>DHD</sub>	50	-	-	ns
LOAD set up time	t <sub>LSU</sub>	80	-	-	ns
LOAD -> Clock time	t <sub>LC</sub>	80	-	-	ns
FRAME set up time	t <sub>setup</sub>	100	-	-	ns
FRAME hold time	t <sub>hold</sub>	100	-	-	ns
LOAD pulse width	t <sub>wc</sub>	125	-	-	ns

## INVERTER AND CONNECTORS

Recommended Inverter	Starter Kit
HITACHI INVC132, INVC196	START691x
Lamp Connector	Lamp Housing Connector
JAE IL-G-4S-S3C23	-

- Note 1: Definition of optical data, see page 84
- Note 2: Applied to NotDISP.OFF, FRAME, LOAD, CP, D0-D3
- Note 3: FRAME=75Hz, D0-D3=0.1.0.1...VDD-VEE=23.7V, T=25°C
- Note 4: Recommended LC driving voltage may fluctuate about +/-1.0V by each module
- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 6: Storage at -20°C < 48 hr, at 60°C < 168 hr
- Note 7: Measurement after 10 minutes of CFL operating. Brightness control at 100 %



## FEATURES

- ◆ Black on White STN Type
- ◆ Transmissive Mode
- ◆ High Brightness Long Lifetime CFL Backlight

- ◆ Improved Contrast through Smaller Dot Gap and New LC Material

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	129.6*92.6*7.5	mm
Viewing Area	100*75.5	mm
Resolution	320*240	dots
Dot Size	0.285*0.285	mm
Dot Pitch	0.3*0.3	mm
Weight	110	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	-	20	-	-
Brightness	-	T=25°C, IL=5mA, Note 7	80.0	100.0	-	cd/m <sup>2</sup>
Viewing Direction	-	-	6			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	-	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	110	-	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	160	-	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	27.5	V
Input Voltage	V <sub>I</sub>	Note 2	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 5,6	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	FRAME	H	First Line Marker
2	LOAD	H->L	Data latch
3	CP	H->L	Data shift
4	VDD	-	Power supply for logic
5	VSS	-	GND
6	VEE	-	Power supply for LC
7-10	D0-D3	H/L	Display data
11	Not DISP OFF	H/L	High for ON / Low for OFF
12	NC	-	No connection

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	HV	-	Power supply for CFL
2	NC	-	No connection
3	NC	-	No connection
4	GND	-	CFL Ground

- Note 1: Definition of optical data, see page 84  
 Note 2: Applied to Not DISP OFF, FRAME, LOAD, CP, D0-D3  
 Note 3: f<sub>FRAME</sub>=75Hz, D0-D3=0.1.0.1...VDD-VEE=23.0V, T=25°C  
 Note 4: Recommended LC driving voltage may fluctuate about +1.0V by each module

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	3.0	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-	-22.0	-	V
Supply Current	I <sub>DD</sub>	Note 3	-	8.0	-	mA
	I <sub>EE</sub>	Note 3	-	6.0	-	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level, Note 2	0.8* VDD	-	VDD	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level, Note 2	0	-	0.2* VDD	V
Frame Frequency	f <sub>FLM</sub>	Note 8	70	-	(140)	Hz
Duty Ratio	-	-	-	1/240	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/240 T=10°, ∅=10°, Note 4	-	24.1	-	V
		Duty=1/240 T=25°C, ∅=10°, Note 4	-	23.0	-	V
		Duty=1/240 T=40°C, ∅=10°, Note 4	-	21.6	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	300	-	V <sub>rms</sub>
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	-	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	4	5	6	mA <sub>rms</sub>
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	(1000)	-	-	V

## TIMING CHARACTERISTICS

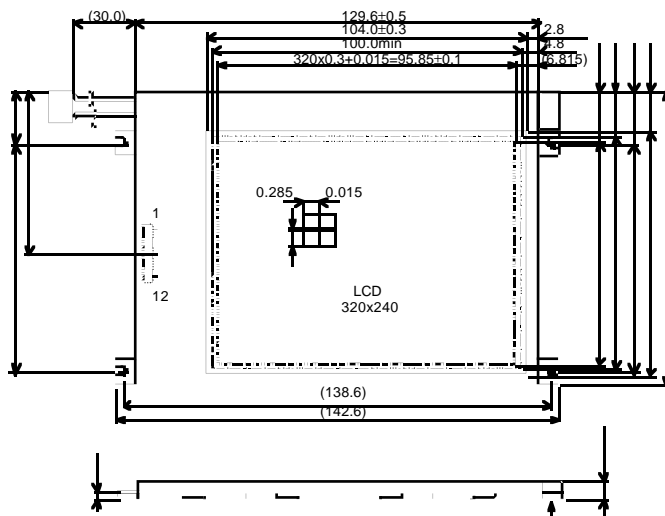
Item	Symbol	Min	Typ	Max	Unit
Clock frequency	f <sub>CP</sub>	-	-	6.5	MHz
Clock pulse width	t <sub>W</sub>	63	-	-	ns
Rise, Fall time	t <sub>r</sub> , t <sub>f</sub>	-	-	20	ns
Data set up time	t <sub>DSU</sub>	50	-	-	ns
Data hold time	t <sub>DHD</sub>	50	-	-	ns
LOAD set up time	t <sub>LSU</sub>	80	-	-	ns
LOAD -> Clock time	t <sub>LC</sub>	80	-	-	ns
FRAME set up time	t <sub>setup</sub>	100	-	-	ns
FRAME hold time	t <sub>hold</sub>	100	-	-	ns
LOAD pulse width	t <sub>wc</sub>	125	-	-	ns

## INVERTER AND CONNECTORS

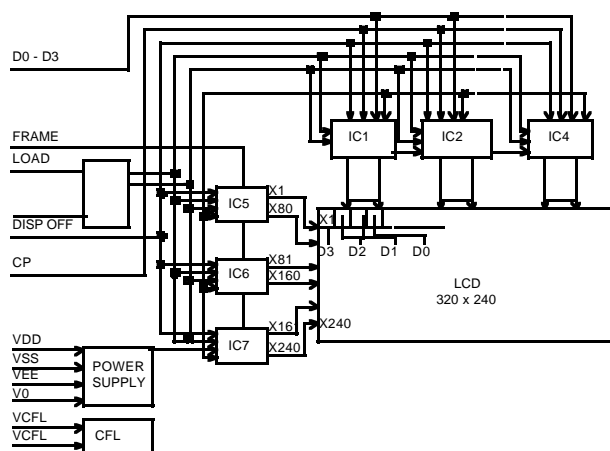
Recommended Inverter	Starter Kit
HITACHI INVC304	START7520
Data Connector	Data Housing Connector
MOLEX 52103-1217	510-1500
Lamp Connector	Lamp Housing Connector
mitsumi M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.  
 Note 6: Storage at -20°C < 48 hr, at 60°C < 168 hr  
 Note 7: Measurement after 10 minutes of CFL operating. Brightness control at 100%  
 Note 8: Need to make sure of flickering and rippling of display when setting the FRAME Frequency in your set.  
 Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

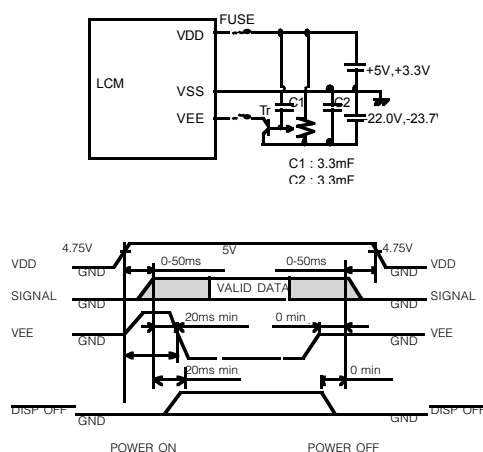
**MECHANICAL DIMENSIONS**



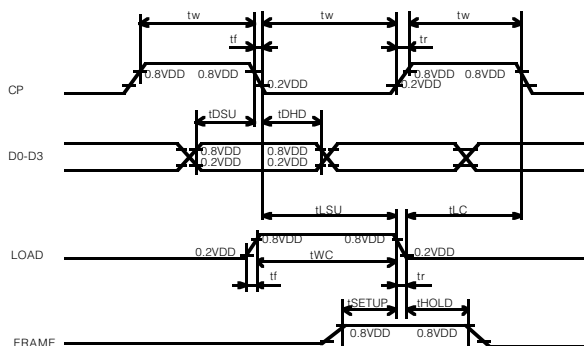
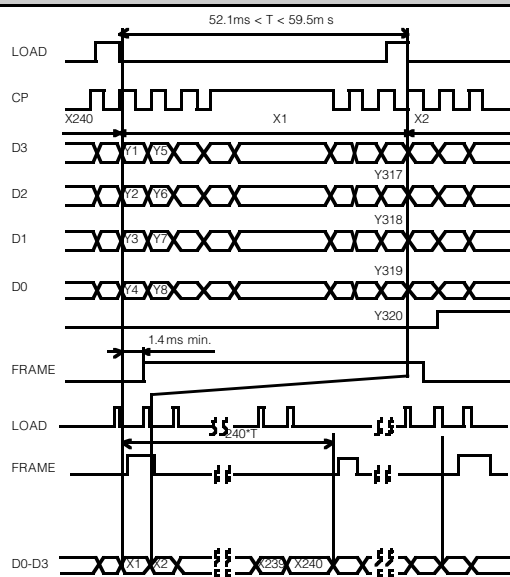
**BLOCK DIAGRAM**



**POWER SUPPLY / POWER UP TIMING DIAGRAM**



**INTERFACE TIMING DIAGRAM**



**VGA RESOLUTION DISPLAYS OVERVIEW**

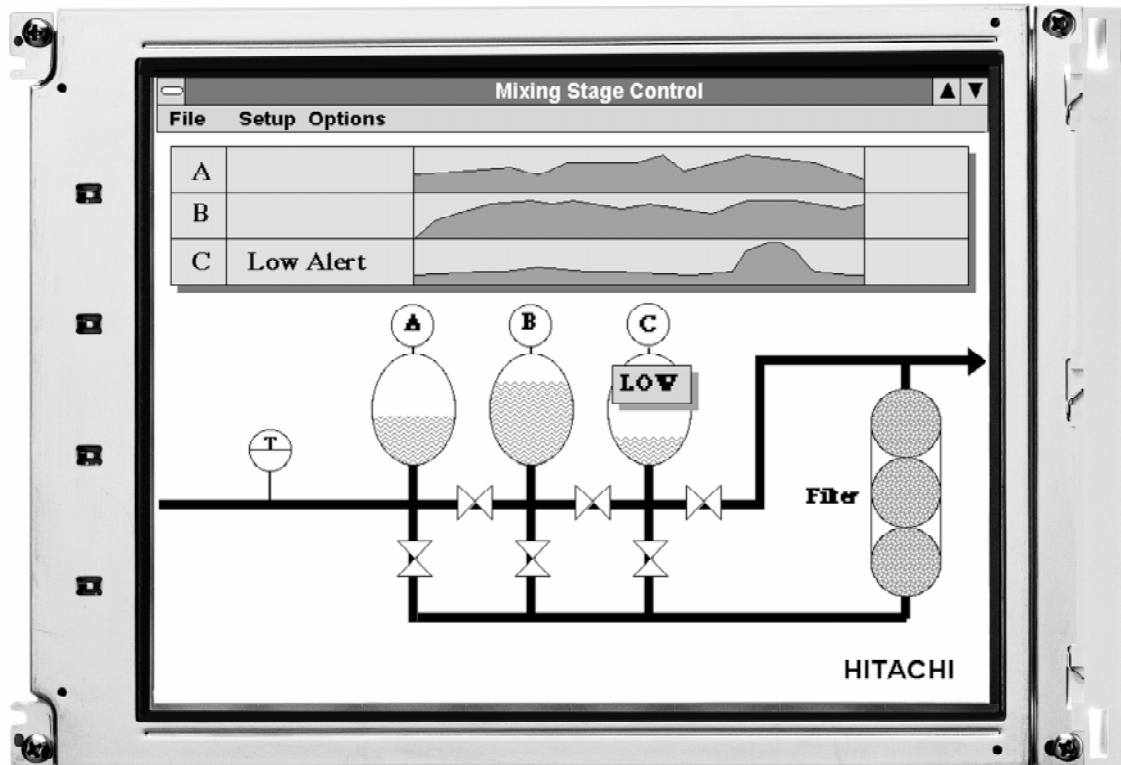
ITEM	LMG5278XUFC00T	LMG7550XUFC	UNIT
Display Type	Black and White Film STN Transmissive		-
Resolution	640 x 480		dots
Size	9.4	10.4	inch
Dot Size	0.27 x 0.27	0.3 x 0.3	mm
Dot Pitch	0.3 x 0.3	0.33 x 0.33	mm
External Dimensions	258 x 174 x 6.7	274 x 183 x 9	mm
Active Display Area	200 x 152	215.2 x 162.4	mm
Backlight	CFL (1Tube)		-
Brightness	60	100	cd/m <sup>2</sup>
Contrast	18 : 1		-
Response Time (Rise)	160		ms
Response Time (Fall)	110		ms
Power Consumption	1.8	2	W
Operating Voltage	3.3/5	3.3/5	V
Operating Temperature	0 - +50		°C
Storage Temperature	-20 - + 60		°C
CFL Lifetime	typ.10.000		hrs

**Features**

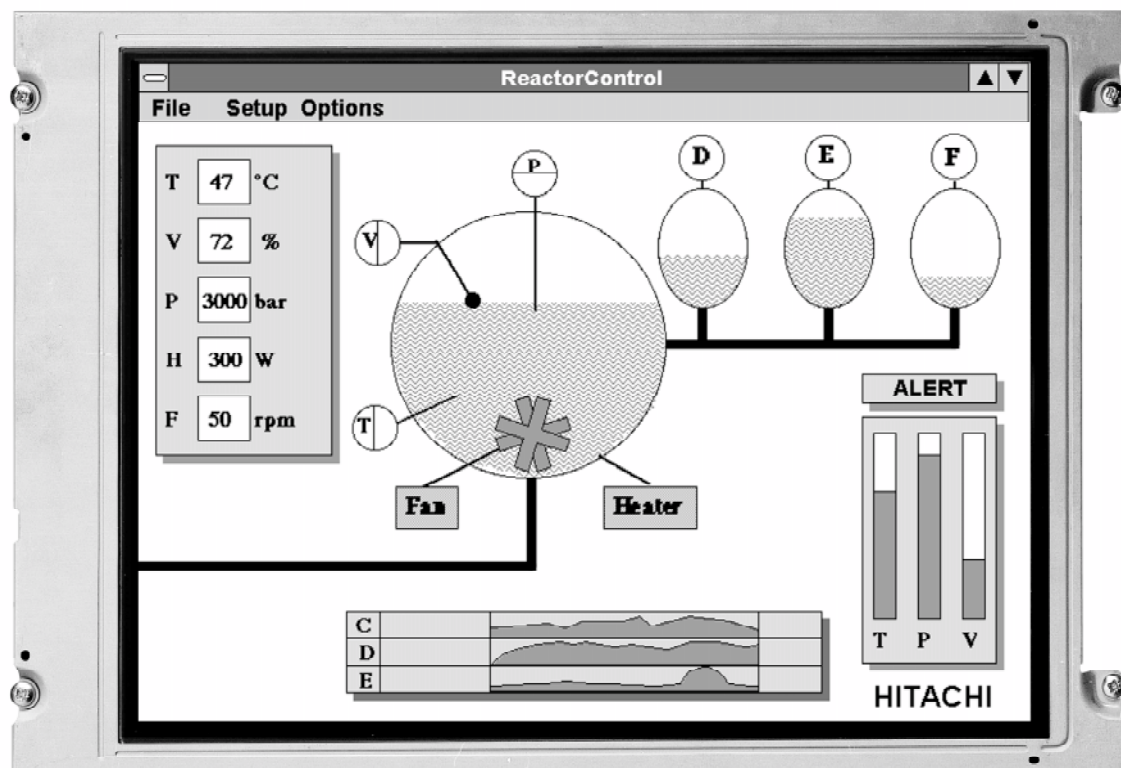
All VGA displays employ film compensated STN technology with the newest high contrast LC material

- High Contrast Ratio of 18 : 1
- High Brightness up to 100 cd/sqm
- Wide Viewing Angle
- Fast Response Time of 270 ms (Rise and Fall Time)

In addition, all VGA displays are fully electrically compatible to each other thus allowing to use the same interface for different display size.



LMG5278XUFC-00T (9.4")



LMG7550XUFC (10.4")

**HITACHI**

## FEATURES

- ◆ Black on White Film STN Type
- ◆ Transmissive Mode
- ◆ High Brightness CFL Backlight

- ◆ High Contrast LC Material
- ◆ Wide Viewing Angle

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	257.5*174*7	mm
Viewing Area	196*148	mm
Resolution	640*480	dots
Dot Size	0.27*0.27	mm
Dot Pitch	0.3*0.3	mm
Weight	350	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	14	18	-	-
Brightness	-	T=25°C, Note 9	40.0	60.0	-	cd/m <sup>2</sup>
Viewing Direction	-	-	12			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	160	210	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	110	160	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	27.5	V
Input Voltage	V <sub>I</sub>	Note 2	-0.3	0.3+V <sub>DD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 7	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	FRAME	H	First Line Marker
2	LOAD	H->L	Data Latch
	CP	H->L	Data Shift
4	Not DISP OFF	H/L	High for ON / Low for OFF
5	VDD	-	Power Supply for Logic
6	VSS	-	Ground
7	VEE	-	Power Supply for LC
8-11	UD0 - UD3	H/L	Display Data (Upper Half)
12-15	LD0 - LD3	H/L	Display Data (Lower Half)

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	GND	-	CFL Ground
2	NC	-	No connection
3	NC	-	No connection
4	HV	-	Power supply for CFL

- Note 1: Definition of optical data, see page 84
- Note 2: Applied to NotDISP.OFF, FRAME, LOAD, CP, UD0-UD3, LD0-LD3
- Note 3: FRAME=140Hz, UD0-UD3=0.1.0.1...LD0-LD3=1.0.1.0..VDD-VEE=22.7V,T=25°C
- Note 4: Recommended LC driving voltage may fluctuate about +/-1.0V by each module
- Note 5: A higher starting voltage will be needed for CFL at 0°C. Lifetime of CFL is reduced at 0°C.

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	T=25°C	3.0	3.3/5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	T=25°C	-	-22.0	-	V
Supply Current	I <sub>DD</sub>	Note 3, 3.3V/5V	-	22/20	32/30	mA
	I <sub>EE</sub>	Note 3, 3.3V/5V	-	20/18	27/25	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level, Note 2	0.8*V <sub>DD</sub>	-	V <sub>DD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level, Note 2	0	-	0.2*V <sub>DD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 8	120	130	140	Hz
Duty Ratio	-	-	-	1/242	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/242 T=0°C, Note 4	-	23.9	-	V
		Duty=1/242 T=25°C, Note 4	-	22.7	-	V
		Duty=1/242 T=45°C, Note 4	-	21.6	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	360	-	V <sub>rms</sub>
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	30	70	85	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	2.5	5.0	5.5	mArms
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 10	1000	-	1500	V

## TIMING CHARACTERISTICS

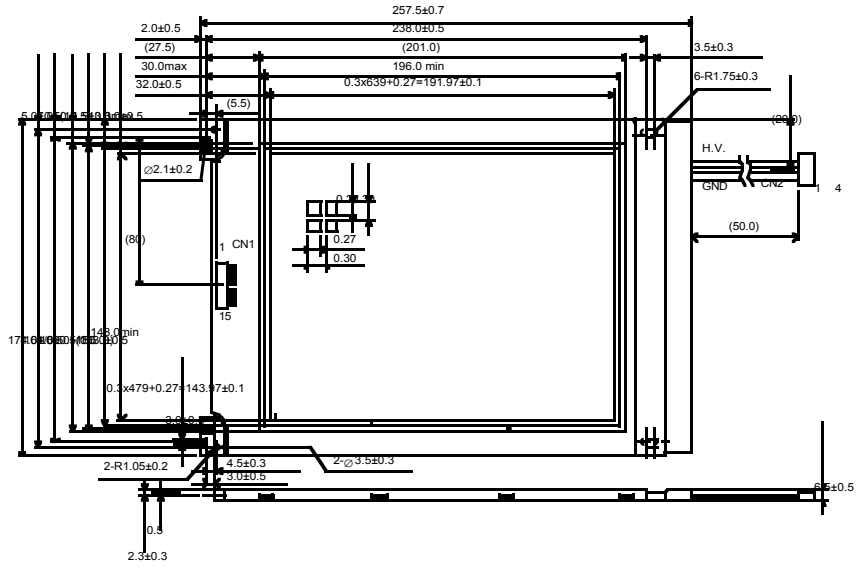
Item	Symbol	Min	Typ	Max	Unit
Clock frequency	f <sub>CP</sub>	-	-	6.5	MHz
Clock pulse width	t <sub>W</sub>	63	-	-	ns
Rise, Fall time	t <sub>r</sub> , t <sub>f</sub>	-	-	20	ns
Data set up time	t <sub>DSU</sub>	50	-	-	ns
Data hold time	t <sub>DHD</sub>	50	-	-	ns
LOAD set up time	t <sub>LSU</sub>	80	-	-	ns
LOAD->Clock time, 3.3V	t <sub>LC</sub>	120	-	-	ns
LOAD->Clock time, 5.0V	t <sub>LC</sub>	80	-	-	ns
FRAME set up time	t <sub>setup</sub>	100	-	-	ns
FRAME hold time	t <sub>hold</sub>	100	-	-	ns
LOAD pulse width	t <sub>WC</sub>	125	-	-	ns

## INVERTER AND CONNECTORS

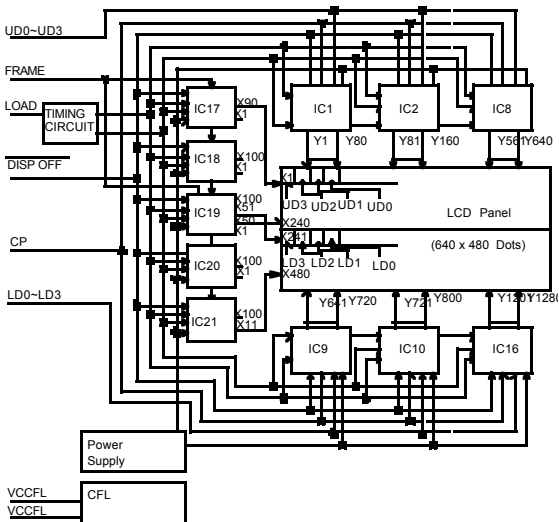
Recommended Inverter	Starter Kit
HITACHI INVC378, INVC218	START5278
Data Connector	Data Housing Connector
MOLEX 53261-1510	51021-1500
Lamp Connector	Lamp Housing Connector
MITSUBISHI M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.
- Note 7: Storage at -25°C < 48 hr, at 60°C < 168 hr
- Note 8: Need to make sure of flickering and rippling of display when setting the Frame Frequency in your set
- Note 9: Measurement after 10 minutes of CFL operating. Brightness control at 100%
- Note 10: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.

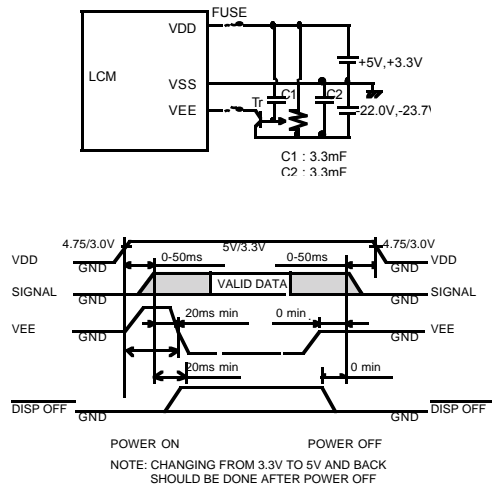
**MECHANICAL DIMENSIONS**



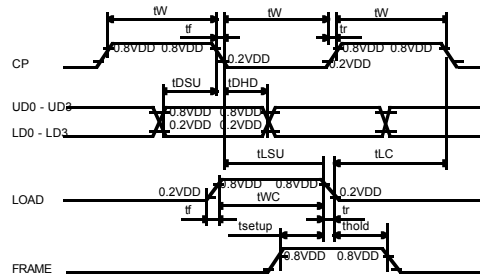
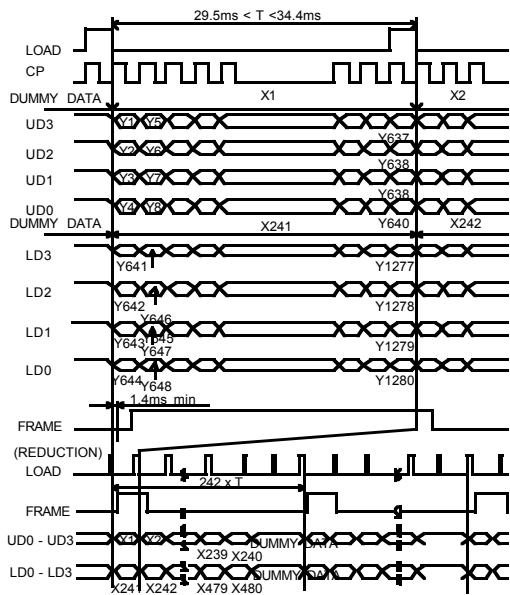
**BLOCK DIAGRAM**



**POWER SUPPLY / POWER UP TIMING DIAGRAM**



**INTERFACE TIMING DIAGRAM**





## FEATURES

- ◆ Black on White Film STN Type
- ◆ Transmissive Mode

- ◆ High Brightness CFL Backlight
- ◆ High Contrast LC Material

## MECHANICAL DATA

Item	Value	Unit
Module Dimensions	274*183*9	mm
Viewing Area	215.2*162.4	mm
Resolution	640*480	dots
Dot Size	0.3*0.3	mm
Dot Pitch	0.33*0.33	mm
Weight	450	g

## OPTICAL DATA

Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast Ratio	K	∅=10°, Q=0°, Note 1	(10)	(18)	-	-
Brightness	-	T=25°C, IL=5mA, Note 7	(80)	(100)	-	cd/m <sup>2</sup>
Viewing Direction	-	-	12			o'clock
Viewing Angle	∅2 - ∅1	K=2, Note 1	30	40	-	degree
Response Time (Rise)	t <sub>R</sub>	∅=10°, Q=0°, Note 1	-	160	-	ms
Response Time (Fall)	t <sub>F</sub>	∅=10°, Q=0°, Note 1	-	110	-	ms

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	0	6.5	V
Supply Voltage (LC Drive)	V <sub>DD</sub> - V <sub>EE</sub>	-	0	27.5	V
Input Voltage	V <sub>I</sub>	Note 2	-0.3	0.3+V <sub>VDD</sub>	V
Operating Temperature	T <sub>OP</sub>	Note 5,6	0	50	°C
Storage Temperature	T <sub>ST</sub>	Note 5,6	-20	60	°C

## DATA INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	FRAME	H	First Line Marker
2	LOAD	H->L	Data latch
3	CP	H->L	Data shift
4	Not DISP OFF	H/L	High for ON / Low for OFF
5	VDD	-	Power supply for logic
6	VSS	-	GND
7	VEE	-	Power supply for LC
8-11	UD0 - UD3	H/L	Display data (upper half)
12-15	LD0 - LD3	H/L	Display data (lower half)

## CFL INTERFACE PIN ASSIGNMENT

Pin No	Symbol	Level	Function
1	HV	-	Power supply for CFL
2	NC	-	No connection
3	NC	-	No connection
4	GND	-	CFL Ground

- Note 1: Definition of optical data, see page 84  
 Note 2: Applied to NotDISP.OFF, FRAME, LOAD, CP,LD0-LD3, UD0-UD3  
 Note 3: fFRAME=140Hz, UD0-UD3=0.1.0.1...LD0-LD3=1.0.1.0...VDD-V0=22.7V,T=25°C  
 Note 4: Recommended LCD driving may fluctuate about +/-1.0V by each module

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V <sub>DD</sub> - V <sub>SS</sub>	-	4.75	5.0	5.25	V
Supply Voltage (LC Drive)	V <sub>EE</sub> - V <sub>SS</sub>	-	-	-	-	V
Supply Current	I <sub>DD</sub>	Note 3	-	(25.0)	(30.0)	mA
	I <sub>EE</sub>	Note 3	-	(19.0)	(30.0)	mA
Input Voltage (High Level)	V <sub>IH</sub>	High Level, Note 2	0.7*V <sub>VDD</sub>	-	V <sub>VDD</sub>	V
Input Voltage (Low Level)	V <sub>IL</sub>	Low Level, Note 2	0	-	0.3*V <sub>VDD</sub>	V
Frame Frequency	f <sub>FLM</sub>	Note 8	(69)	-	(110)	Hz
Duty Ratio	-	-	-	1/244	-	-
Recommended LC Drive Voltage	V <sub>DD</sub> - V <sub>O</sub>	Duty=1/244 T=0°C, Note 4	-	(23.9)	-	V
		Duty=1/244 T=25°C, Note 4	-	(22.7)	-	V
		Duty=1/244 T=40°C, Note 4	-	(21.6)	-	V
Backlight Lamp Voltage	V <sub>BL</sub>	T=25°C	-	(430)	-	V <sub>rms</sub>
Backlight Lamp Frequency	f <sub>BL</sub>	T=25°C	(50)	-	(70)	kHz
Backlight Lamp Current	I <sub>BL</sub>	T=25°C	4	4.5	6	mArms
Lamp Start Voltage	V <sub>S</sub>	T=25°C, Note 9	1000	-	-	V

## TIMING CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
Clock frequency	f <sub>CP</sub>	-	-	6.5	MHz
Clock pulse width	t <sub>W</sub>	63	-	-	ns
Rise, Fall time	tr, tf	-	-	20	ns
Data set up time	t <sub>DSU</sub>	50	-	-	ns
Data hold time	t <sub>DHD</sub>	50	-	-	ns
LOAD set up time	t <sub>LSU</sub>	80	-	-	ns
LOAD->Clock time, 3.3V	t <sub>LC</sub>	120	-	-	ns
LOAD->Clock time, 5.0V	t <sub>CL</sub>	80	-	-	ns
FRAME set up time	t <sub>SETUP</sub>	100	-	-	ns
FRAME hold time	t <sub>HOLD</sub>	100	-	-	ns
LOAD pulse width	t <sub>WC</sub>	125	-	-	ns

## INVERTER AND CONNECTORS

Recommended Inverter	Starter Kit
HITACHI INVC304	START7550
Data Connector	Data Housing Connector
MOLEX 53261-1510	51021-1500
Lamp Connector	Lamp Housing Connector
mitsumi M63M83-04	M61M73-04, M60-04-30-114P or M60-04-30-134P

- Note 5: Background colour of the LCD changes depending on temperature. Between 40-50°C optical characteristics of the LCD like contrast and viewing angle change but the display remains readable.  
 Note 6: Storage at -20°C < 48 hr, at 60°C < 168 hr  
 Note 7: Measurement after 10 minutes of CFL operating. Brightness control at 100%  
 Note 8: Need to make sure of flickering and rippling of display when setting the Frame Frequency in your set  
 Note 9: Starting discharge voltage is increased when LCM is operating at lower temperature. Please check the characteristics of inverter before applying.



**COLD CATHODE FLUORESCENT LAMP BACKLIGHT**

Some Hitachi LCD modules have built-in Cold Cathode Fluorescent Lamp (CFL) backlight. This backlight type offers high brightness, high efficiency combined with low cost and a long lifetime.

Fig.1 shows the typical structure of a CFL backlight. The cold cathode fluorescent tube is placed at the edge of an acrylic lightguide into which the light is coupled. To increase the coupling efficiency a reflector foil is wrapped around the opposite side of the tube. A reflector foil at the bottom of the light guide reflects the light to the top side. In order to equalize the uneven brightness distribution the bottom of the lightguide is covered with a reflection dot pattern with the pattern density increasing towards the opposite side of the CFL. The brightness homogeneity is then further increased by a diffuser foil on the top of the light guide.

In some cases additional prisma foils are used to focus the light towards the top side. These foils increase the brightness while narrowing the spatial brightness distribution.

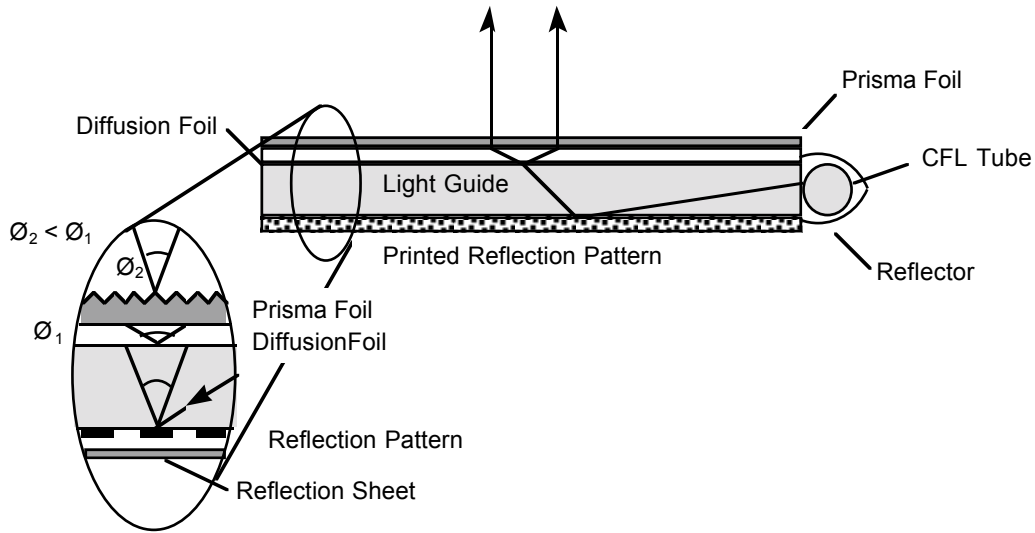


Fig. 1

Lifetime and brightness of a CFL depend strongly on the operating conditions. The following gives some typical values for these dependencies.

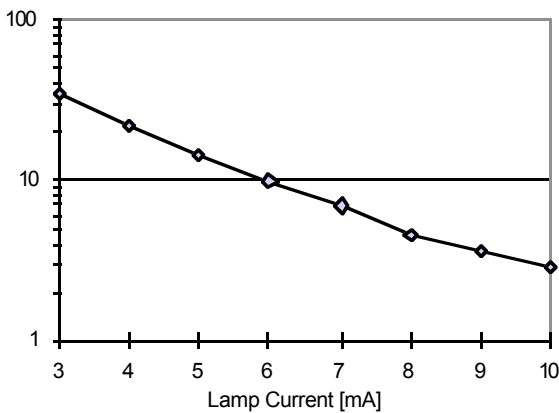


Fig. 2

**Lifetime versa Lamp Current**

The lifetime of a CFL backlight is typically between 10.000 and 20.000 hours depending on the operating conditions. Main parameters influencing the lifetime are temperature and lamp current. As shown in Fig. 2 the lifetime reduces with higher current passing through the CFL tube. It is therefore possible to increase the lifetime by driving the CFL with a current lower than specified.

**Brightness versa Lamp Current**

As shown in Fig. 3 the lamp current is also determining the brightness of the CFL.

Reducing the current from 6 mA to 4 mA will double the lifetime but at the same time reduce brightness by around 25 percent.

Another method to increase lifetime without sacrificing brightness is to dim or switch off the CFL backlight while the display is not used for some time.

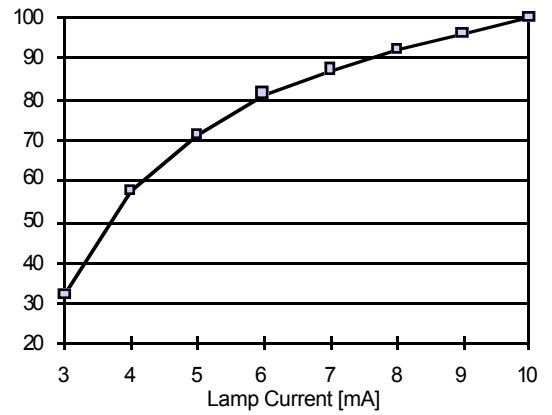


Fig. 3

**Life Time versa Ambient Temperature**

Besides the lamp current the tube lifetime is strongly depending on the temperature as shown in Fig. 4.

Operation at lower temperatures may therefore significantly reduce the lifetime of the CFL. Especially frequent on switching and longer operation of the CFL at negative temperatures may cause a lifetime reduction to several hundred hours.

The CFL tube should therefore not be switched on at negative ambient temperatures.

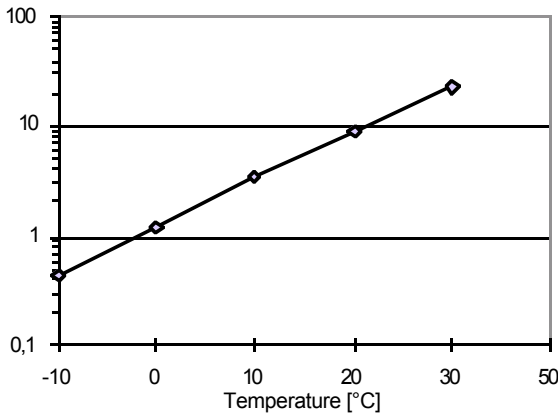


Fig. 4

**Ignition Voltage versa Lamp Length**

Another effect which does influence the characteristics of the CFL at lower temperatures is the temperature dependency of the ignition voltage (Fig. 5). As a result of the increased ignition voltage the CFL may not be switched on at negative temperatures.

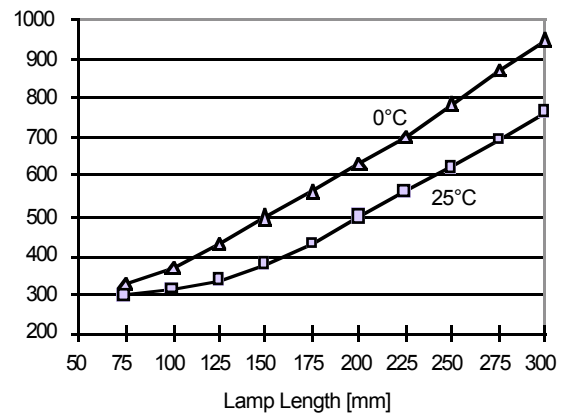


Fig. 5

## INVERTERS FOR COLD CATHODE FLUORESCENT LAMP

An effective backlighting system depends not only on the choice of the CFL tube but also on the DC/AC inverter which provides high voltage necessary for ignition and operation of the CFL tube. To this end Hitachi has designed a range of inverters which are adjusted ideally to the CFL tubes used in its LCD modules.

### INVERTER AVAILABILITY

CFL inverters from Hitachi are available for the following LCD modules :

Inverter Part Number	Suitable Displays
INVC132	SP14Q00x, LMG691x <sup>1</sup>
INVC186	SP14Q00x, LMG532x, LMG691x <sup>1</sup>
INVC191	LMG532x, LMG74xx, LMG7380QHFC
INVC196	SP14Q00x, LMG532x, LMG691x <sup>1</sup>
INVC218 <sup>1</sup>	Replaced by INVC378
INVC304 <sup>1</sup>	LMG7550XUFC, LMG7520RPFC
INVC329 <sup>1</sup>	LMG9520x <sup>1</sup>
INVC378	LMG527x
INVC444	LMG7550XUFC, LMG7520RPFC
INVC445	LMG7550XUFC, LMG7520RPFC
INVC473	LMG7550XUFC, LMG7520RPFC

Display Part Name	Suitable Inverter
LMG532x <sup>1</sup>	INVC191, INVC132, INVC186, INVC196
LMG527x	INVC378, INVC218 <sup>1</sup>
LMG691x <sup>1</sup>	INVC132, INVC186, INVC196
LMG7380QHPC	INVC191
LMG74xx	INVC191
LMG7520RPFC	INVC444, INVC445, INVC473, INVC304 <sup>1</sup>
LMG7550XUFC	INVC444, INVC445, INVC473, INVC304 <sup>1</sup>
LMG9520x <sup>1</sup>	INVC329 <sup>1</sup>
SP14Q00x	INVC132, INVC186, INVC196

<sup>1</sup> Part obsolete, do not use for new designs

Inverters from other manufacturers may be suitable as well. However, when choosing an inverter the following points should be observed to ensure that the full lifetime will be achieved.

The lamp current should not exceed the value given in the Hitachi specification. Driving the CFL with higher current will reduce the lifetime. Also the lamp frequency should be within the specified margins. Too low frequency will result in reduced inverter efficiency. The ignition voltage should not stay below the specified value. Besides possible lifetime reduction, low ignition voltage will cause problems when switching on the CFL at lower temperatures.

### PRECAUTIONS FOR USE

Losses on the output leads due to stray capacities may significantly reduce the inverter efficiency. The following recommendations should be observed in order to obtain maximum lamp brightness. Use UL1330 equivalent for the inverter output leads. Keep the length of output leads under 100 mm. Avoid binding high voltage and low voltage leads together. Avoid placing leads near the shield or any large grounded area

### INVERTER RELIABILITY DATA

The following general test conditions apply to all Hitachi inverters.

Item	Test Conditions
Low Temperature Operation	10°C, 12V, 100% Output, 500 hrs
High Temperature Operation	50°C, 12V, 100% Output, 500 hrs
Low Temperature Stock	-20°C, 500 hrs
High Temperature Stock	70°C, 500 hrs
High Temperature/High Humidity	50°C, 95% RH, 12V, 100% Output, 50 cycles
Cyclic Temperature Operation	10°C to 25°C to 50°C, 1 hr each, 12 V, 100% Output, 50 cycles
Thermal Shock	-20°C to +70°C, 0.5 hrs each, 50 cycles
Vibration Test	3G, 30-200 Hz, 0.5 hrs, XYZ axis
Impact Test	50G, XYZ axis

# INVC132

This Inverter is designed and adjusted for cold fluorescent lamps used in the LMG691x and SP14Q00x series of STN liquid crystal display modules.

## FEATURES

- ◆ Very small and low power consumption design
- ◆ External On/Off switching of backlight
- ◆ Dimmable from 100 down to 60 percent with variable resistor
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	103 x 20	mm
Weight	15.0 max	g
Output Power	1.3 nominal	W
Efficiency	50 min	%
Mean Time Between Failure (MTBF)	60.000min	hrs

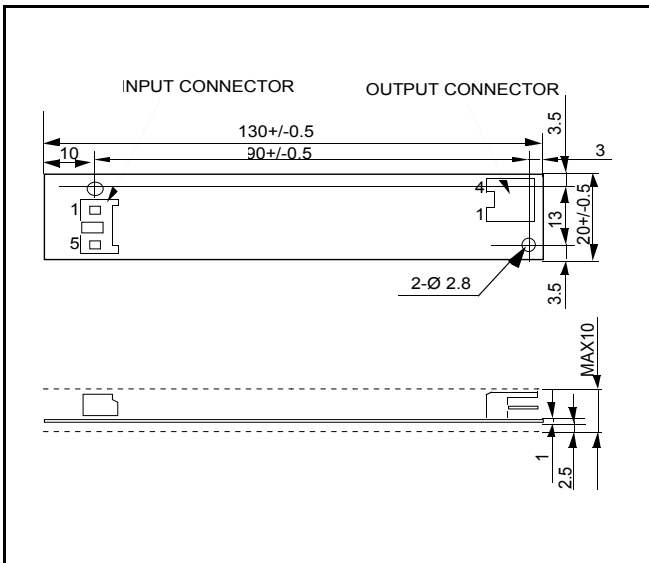
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	7.0	18.0	V
Operating Temperature	$T_{OP}$	-	10	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	8.0	12.0	17.0	V
Input Current	$I_{IN}$	12V, $T=25^{\circ}C$	0.15	0.20	0.35	A
Rush Current	$I_S$	12V, $T=25^{\circ}C$	-	-	1.0	A
Lamp Current	$I_L$	12V, $T=25^{\circ}C$	4.0	5.0	5.5	mA
Lamp Power	$P_L$	12V, $T=25^{\circ}C$	-	1.25	-	W
Frequency	$f_L$	12V, $T=25^{\circ}C$	60	70	80	kHz
Dimming Range	-	12V, $T=25^{\circ}C$	-	65	-	%
Startup Characteristics	10°C +/- 1°C, DC 8.0V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

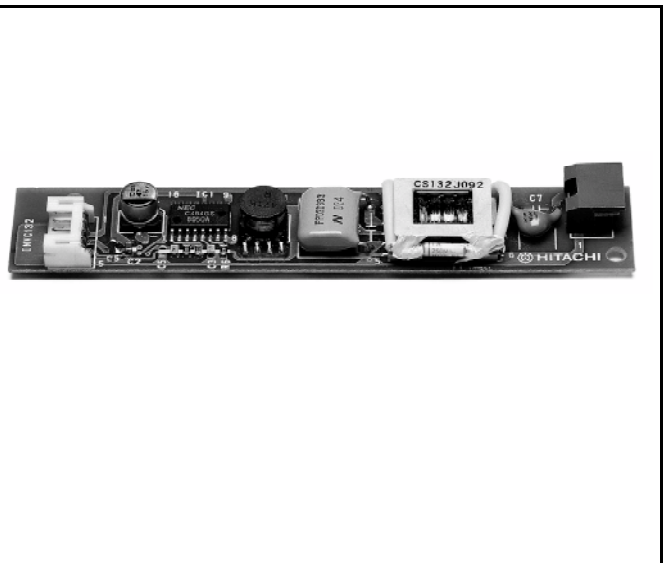
Input Connector	Input Housing Connector
JST S5B-PH-K-S	PHR-5
Output Connector	Output Housing Connector
JAE IL-G-4P-S3L2E	IL-G-4S-S3C2

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	GND	-
2	VCC	-
3	ON/OFF	Low for ON, open for OFF
4	BR1	Dimming through variable resistor 2.5kOhm
5	BR2	Brightness max at 0 kOhm, min at 2.5 kOhm

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFLGND	Ground
2	NC	-
3	NC	-
4	CFL HV	High voltage output



# INVC186 (Low cost version of INVC132)

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG691x STN liquid crystal display modules.

## FEATURES

- ◆ Low cost
- ◆ 12 V input voltage
- ◆ Very small and low power consumption design
- ◆ External On/Off switching of backlight
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	90x20x12.5	mm
Weight	13.5 max	g
Output Power	1.4 nominal	W
Efficiency	65 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

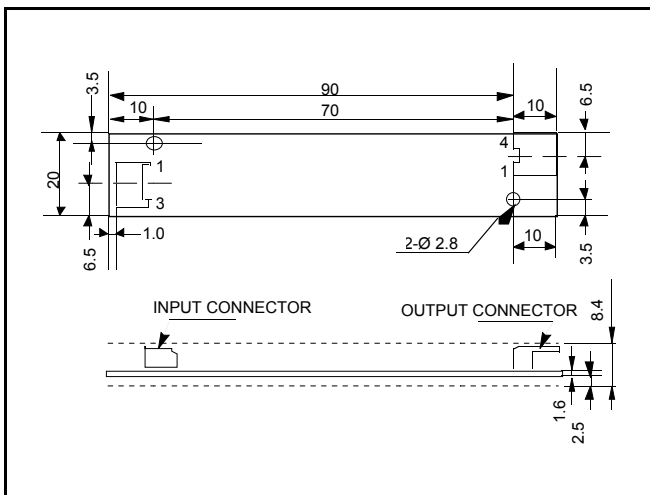
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	-	14.50	V
Operating Temperature	$T_{OP}$	-	-	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	10.8	12.0	13.2	V
Input Current	$I_{IN}$	12V, $T=25^{\circ}C$	0.11	0.16	0.21	A
Rush Current	$I_S$	12V, $T=25^{\circ}C$	-	-	1.0	A
Lamp Current	$I_L$	12V, $T=25^{\circ}C$	4.0	5.0	6.0	mA
Lamp Power	$P_L$	12V, $T=25^{\circ}C$	-	1.4	-	W
Frequency	$f_L$	12V, $T=25^{\circ}C$	65	75	85	kHz
Startup Characteristics	5°C +/- 1°C, DC 10.8.V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

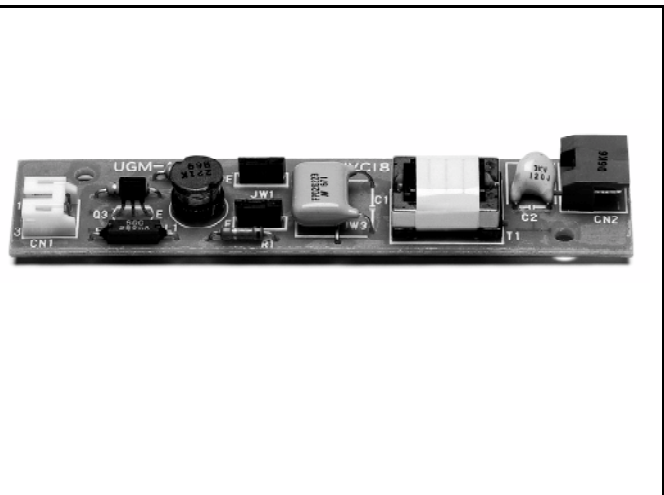
Input Connector	Input Housing Connector
JST S3B-PH-K-S	PHR-3
Output Connector	Output Housing Connector
JAE IL-G-4P-S3L2E	IL-G-4S

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL ON/OFF	On at 0V, Off at 12V or open
2	GND	-
3	Vin	12V +/- 10°C

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL HV	High voltage output
2	NC	-
3	GND	-
4	CFL GND	Ground



# INVC191

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG5320XUFC, LMG74xx, LMG7380 STN liquid crystal display modules.

## FEATURES

- ◆ Very small, very thin and low power consumption design
- ◆ Adaptable to a wide range of input voltages
- ◆ External On/Off switching of backlight
- ◆ Dimmable from 100 down to 50 percent with a variable resistor
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	95 x 15	mm
Weight	11.0 max	g
Output Power	1.35 nominal	W
Efficiency	60 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

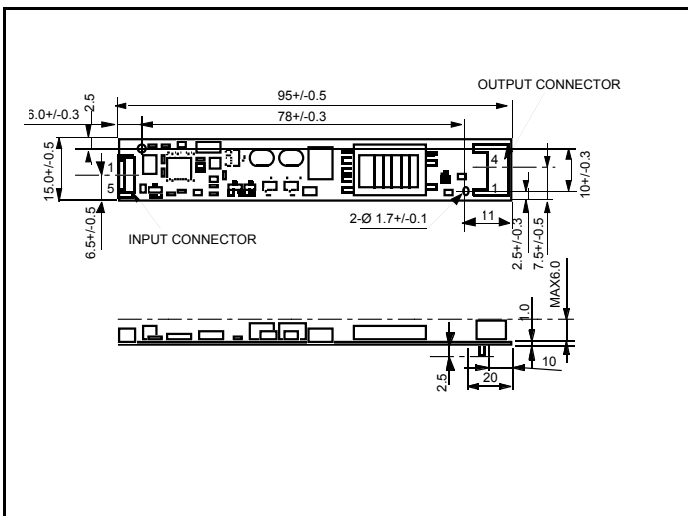
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	-	18.0	V
Operating Temperature	$T_{OP}$	-	5	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	7.0	12.0	17.0	V
Input Current	$I_{IN}$	12V, $T=25^{\circ}C$	0.13	0.18	0.23	A
Rush Current	$I_S$	12V, $T=25^{\circ}C$	-	-	1.0	A
Lamp Current	$I_L$	12V, $T=25^{\circ}C$	3.5	4.2	4.9	mA
Lamp Power	$P_L$	12V, $T=25^{\circ}C$	-	1.35	-	W
Frequency	$f_L$	12V, $T=25^{\circ}C$	50	65	80	kHz
Dimming Range	-	12V, $T=25^{\circ}C$	-	100-50	-	%
Startup Characteristics	10°C +/- 1°C, DC 7.0V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

Input Connector	Input Housing Connector
MOLEX 53261-0510	51021-0500
Output Connector	Output Housing Connector
MITSUMI M60-04-30-134P	M60-04

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	VCC	7 - 17V
2	GND	-
3	CFL ON/OFF	OFF at Open, ON at Low (V=0.8V, I=2mA)
4	BR1	Dimming through variable resistor 5kOhm
5	BR2	Brightness max at 0 kOhm, min at 2.5 kOhm

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL HV	High voltage output
2	NC	-
3	NC	-
4	CFL HV	High voltage output



# INVC196 (Low cost version of INVC132)

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG691x STN liquid crystal display modules.

## FEATURES

- ◆ Low cost
- ◆ 5V input voltage
- ◆ Very small and low power consumption design
- ◆ External On/Off switching of backlight
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	90x20x12.5	mm
Weight	13.5 max	g
Output Power	1.35 nominal	W
Efficiency	70 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

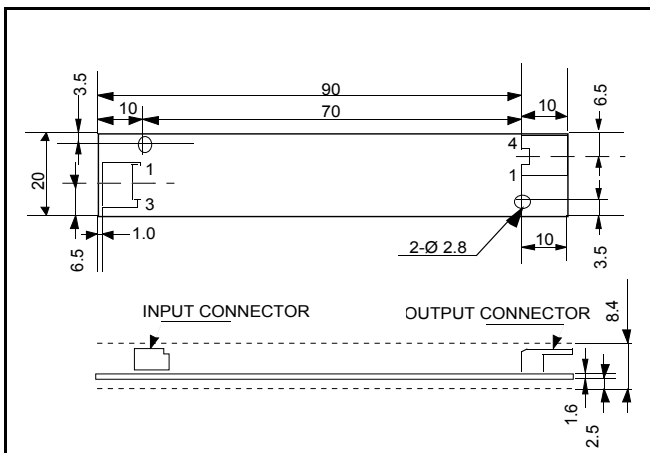
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	-	6.0	V
Operating Temperature	$T_{OP}$	-	5	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	4.5	5.0	5.5	V
Input Current	$I_{IN}$	12V, $T=25^{\circ}C$	0.31	0.36	0.41	A
Rush Current	$I_S$	12V, $T=25^{\circ}C$	-	-	1.0	A
Lamp Current	$I_L$	12V, $T=25^{\circ}C$	4.0	5.0	6.0	mA
Lamp Power	$P_L$	12V, $T=25^{\circ}C$	-	1.35	-	W
Frequency	$f_L$	12V, $T=25^{\circ}C$	65	75	85	kHz
Dimming Range	-	12V, $T=25^{\circ}C$	-	-	-	%
Startup Characteristics	5°C +/- 1°C, DC 4.5V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

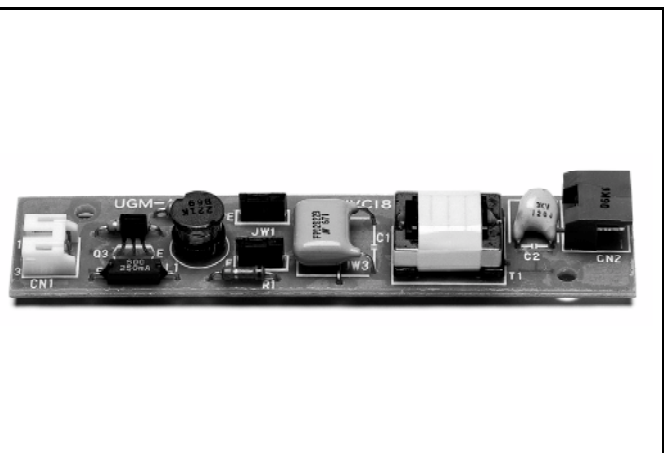
Input Connector	Input Housing Connector
JST S3B-PH-K-S	PHR-3
Output Connector	Output Housing Connector
JAE IL-G-4P-S3L2E	IL-G-4S

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL ON/OFF	On: at 0V, Off at 5V or open
2	GND	-
3	Vin	5V +/- 10°C

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL HV	High voltage output
2	NC	-
3	GND	-
4	CFL GND	Ground



This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG7550RPFC and LMG7520RPFC STN liquid crystal display modules.

## FEATURES

- ◆ Very small, very thin and low power consumption design
- ◆ Adaptable to a wide range of input voltages (7-19 V)
- ◆ External On/Off switching of backlight
- ◆ External adjustment of two maximum brightness levels
- ◆ Dimmable from 100 down to 60 percent with a variable resistor

## GENERAL DATA

Item	Value	Unit
Module Dimensions	110x13x8	mm
Weight	10.0 max	g
Output Power	2.4 nominal	W
Efficiency	65 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

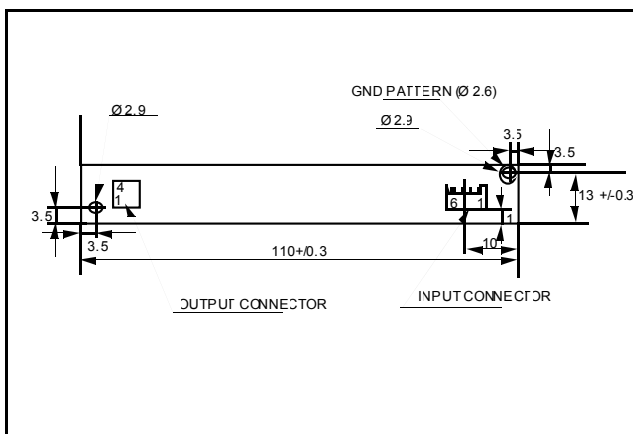
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	6.0	21.0	V
Operating Temperature	$T_{OP}$	-	0	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	7.0	12.0	19.0	V
Input Current	$I_{IN}$	12V, T=25°C;	0.26	0.31	0.36	A
Rush Current	$I_S$	12V, T=25°C	-	-	2.0	A
Lamp Current	$I_L$	12V, T=25°C;	4.0	5.0	6.0	mA
Lamp Power	$P_L$	12V, T=25°C;	-	2.4	-	W
Frequency	$f_L$	12V, T=25°C	60	70	80	kHz
Dimming Range	-	12V, T=25°C	-	100-50	-	%
Startup Characteristics	0°C +/- 1°C, DC 7.0V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

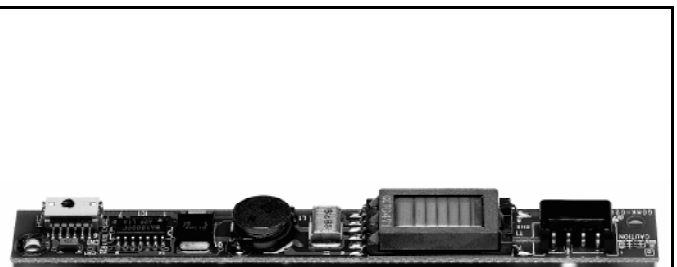
Input Connector	Input Housing Connector
HIROSE DF13-6P-1.25H	DF13-6S-1.25C
Output Connector	Output Housing Connector
MITSUMI M60-04-30-134P	M60-04

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	VCC	7V-19V
2	GND	-
3	CFL ON/OFF	Open or High = OFF, Low (V<0.8V) = ON
4	BR1	Dimming through variable resistor 10kOhm
5	BR2	Brightness max at 0 Ohm, min at 10kOhm
6	H / L	Lamp Current 5mA at Open, 6mA at Low

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL GND	Ground
2	NC	-
3	NC	-
4	CFL HV	High voltage output



# INVC378 (New Fully Compatible Replacement for INVC218)

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG5278XUFC STN liquid crystal display modules.

## FEATURES

- ◆ Very small, very thin and low power consumption design
- ◆ Adaptable to a wide range of input voltages
- ◆ External On/Off switching of backlight
- ◆ Dimmable from 100 down to 60 percent with a variable resistor
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	130 x 18	mm
Weight	15.0 max	g
Output Power	1.7 nominal	W
Efficiency	65 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

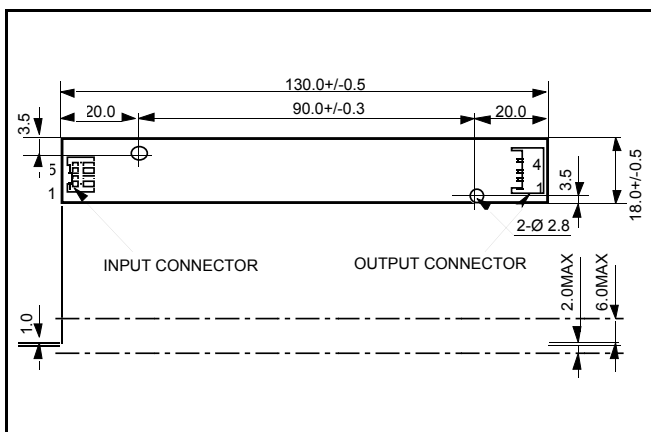
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	-	18.0	V
Operating Temperature	$T_{OP}$	-	5	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	8.0	12.0	17.0	V
Input Current	$I_{IN}$	12V, T=25°C	0.15	0.20	0.25	A
Rush Current	$I_S$	12V, T=25°C	-	-	1.0	A
Lamp Current	$I_L$	12V, T=25°C	3.7	4.2	4.7	mA
Lamp Power	$P_L$	12V, T=25°C	-	1.7	-	W
Frequency	$f_L$	12V, T=25°C	50	65	80	kHz
Dimming Range	-	12V, T=25°C	-	100-60	-	%
Startup Characteristics	10°C +/- 1°C, DC 8.0V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

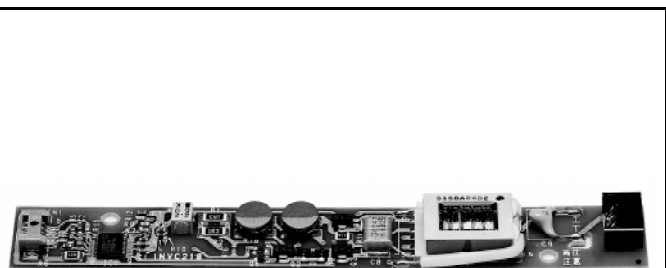
Input Connector	Input Housing Connector
JAE IL-Z-5PL-SMTY	IL-Z-5S-S125C3
Output Connector	Output Housing Connector
MITSUMI M60-04-30-134P	M60-04

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	GND	-
2	VCC	8V - 17V
3	CFL ON/OFF	OFF at Open, ON at Low (V<0.8V, I=2mA)
4	BR1	Dimming through variable resistor 5kOhm
5	BR2	Brightness max at 0 kOhm, min at 2.5 kOhm

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL HV	High voltage output
2	NC	-
3	NC	-
4	CFL HV	High voltage output



# INVC444 (New Fully Compatible Replacement for INVC304)

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG7550RPFC and LMG7520RPFC STN liquid crystal display modules.

## FEATURES

- ◆ Very small, very thin and low power consumption design
- ◆ Adaptable to a wide range of input voltages (7-19 V)
- ◆ External On/Off switching of backlight
- ◆ External adjustment of two maximum brightness levels
- ◆ Dimmable from 100 down to 60 percent with a variable resistor

## GENERAL DATA

Item	Value	Unit
Module Dimensions	110x13x8	mm
Weight	10.0 max	g
Output Power	2.4 nominal	W
Efficiency	65 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

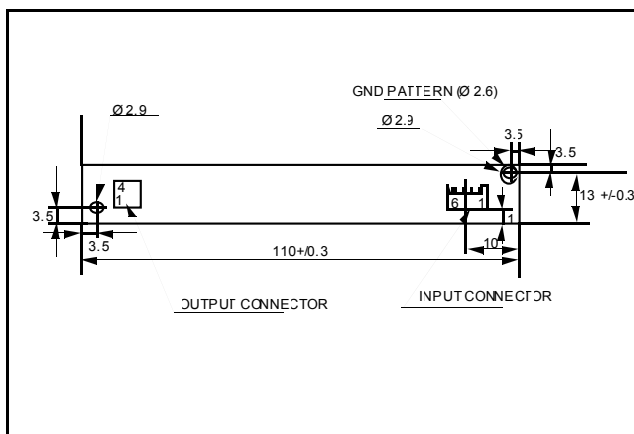
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	6.0	21.0	V
Operating Temperature	$T_{OP}$	-	0	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	7.0	12.0	19.0	V
Input Current	$I_{IN}$	12V, T=25°C;	0.26	0.31	0.36	A
Rush Current	$I_S$	12V, T=25°C	-	-	2.0	A
Lamp Current	$I_L$	12V, T=25°C;	4.0	5.0	6.0	mA
Lamp Power	$P_L$	12V, T=25°C;	-	2.4	-	W
Frequency	$f_L$	12V, T=25°C	60	70	80	kHz
Dimming Range	-	12V, T=25°C	-	100-50	-	%
Startup Characteristics	0°C +/- 1°C, DC 7.0V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

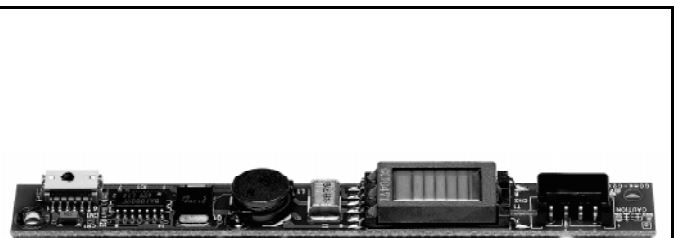
Input Connector	Input Housing Connector
HIROSE DF13-6P-1.25H	DF13-6S-1.25C
Output Connector	Output Housing Connector
MITSUMI M60-04-30-134P	M60-04

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	VCC	7V-19V
2	GND	-
3	CFL ON/OFF	Open or High = OFF, Low (V<0.8V) = ON
4	BR1	Dimming through variable resistor 10kOhm
5	BR2	Brightness max at 0 Ohm, min at 10kOhm
6	H / L	Lamp Current 5mA at Open, 6mA at Low

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL GND	Ground
2	NC	-
3	NC	-
4	CFL HV	High voltage output



# INVC445 (Low cost version of INVC444)

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG7550RPFC and LMG7520RPFC STN liquid crystal display modules.

## FEATURES

- ◆ Low cost
- ◆ 12V input voltage
- ◆ Very small, very thin and low power consumption design
- ◆ External On/Off switching of backlight
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	90x20x12.5	mm
Weight	13.5 max	g
Output Power	1.4 nominal	W
Efficiency	65 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

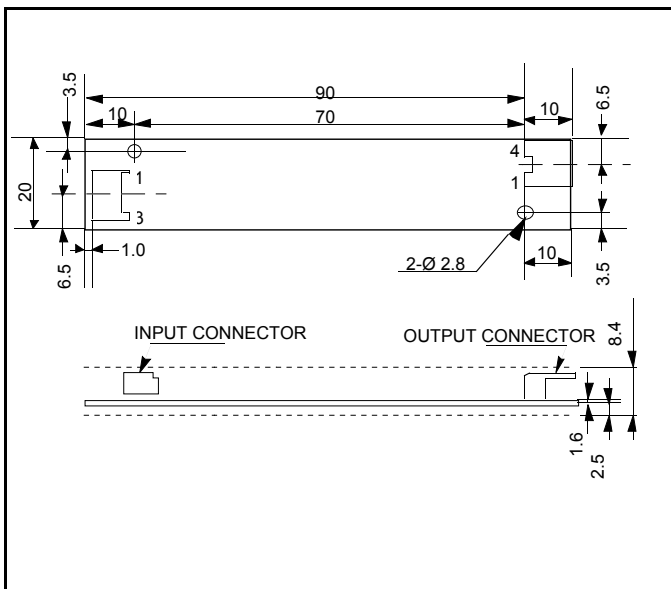
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	-	14.50	V
Operating Temperature	$T_{OP}$	-	0	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	10.8	12.0	13.2	V
Input Current	$I_{IN}$	12V, $T=25^{\circ}C$	0.15	0.2	0.25	A
Rush Current	$I_S$	12V, $T=25^{\circ}C$	-	-	1.0	A
Lamp Current	$I_L$	12V, $T=25^{\circ}C$	4.0	5.0	6.0	mA
Lamp Power	$P_L$	12V, $T=25^{\circ}C$	-	1.4	-	W
Frequency	$f_L$	12V, $T=25^{\circ}C$	65	75	85	kHz
Startup Characteristics	5°C +/- 1°C, DC 10.8.V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

Input Connector	Input Housing Connector
JST S3B-PH-K-S	JST PHR-3
Output Connector	Output Housing Connector
MITSUMI	MITSUMI M60-04-30-134P

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL ON/OFF	On at low (0.8V min) , Off at open
2	GND	-
3	Vin	12V +/- 10%

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL HV	Connect to lamp high voltage side
2	NC	-
3	NC	-
4	CFL GND	Connect to lamp low voltage side

# INVC473 (Low cost version of INVC444)

This Inverter is designed and adjusted for cold fluorescent lamp used in the LMG7550RPFC and LMG7520RPFC STN liquid crystal display modules.

## FEATURES

- ◆ Low cost
- ◆ 5V input voltage
- ◆ Very small, very thin and low power consumption design
- ◆ External On/Off switching of backlight
- ◆ Low noise

## GENERAL DATA

Item	Value	Unit
Module Dimensions	90x22x12.5	mm
Weight	13.5 max	g
Output Power	1.4 nominal	W
Efficiency	65 min	%
Mean Time Between Failure (MTBF)	60.000 min	hrs

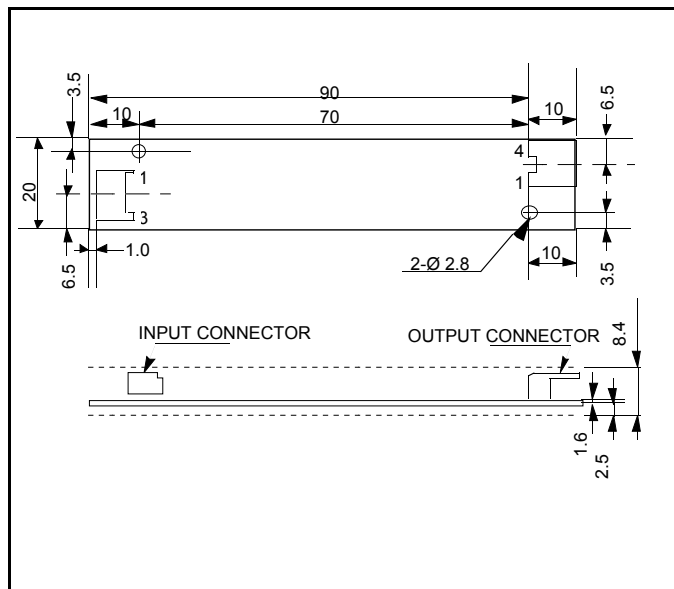
## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit
Input Voltage	$V_{MAX}$	-	-	6.0	V
Operating Temperature	$T_{OP}$	-	0	50	°C
Storage Temperature	$T_{ST}$	-	-20	70	°C
Humidity	-	-	-	90	% RH

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	$V_{IN}$	-	4.5	5.0	5.5	V
Input Current	$I_{IN}$	12V, $T=25^{\circ}C$	-	0.48	-	A
Rush Current	$I_S$	12V, $T=25^{\circ}C$	-	-	1.0	A
Lamp Current	$I_L$	12V, $T=25^{\circ}C$	4.0	5.0	6.0	mA
Lamp Power	$P_L$	12V, $T=25^{\circ}C$	-	1.4	-	W
Frequency	$f_L$	12V, $T=25^{\circ}C$	65	75	85	kHz
Startup Characteristics	5°C +/- 1°C, DC 10.8.V					

## MECHANICAL DIMENSIONS



## INPUT AND OUTPUT CONNECTORS

Input Connector	Input Housing Connector
JST S3B-PH-K-S	JST PHR-3
Output Connector	Output Housing Connector
MITSUMI	MITSUMI M60-04-30-134P

## INPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL ON/OFF	On at low (0.8V min) , Off at open
2	GND	-
3	Vin	5V +/- 10%

## OUTPUT CONNECTOR PIN ASSIGNMENT

Pin No	Symbol	Comment
1	CFL HV	Connect to lamp high voltage side
2	NC	-
3	NC	-
4	CFL GND	Connect to lamp low voltage side

## STARTER KITS

In order to enable purchasers of a LCD module to set up fast and easily a working prototype of their display system, Hitachi has prepared Starter Kits for several of its LCD modules.

### Starter Kit Contents

These starter kits contain:

- a comprehensive instruction leaflet with module and inverter details, handling precautions, lists of driver chip suppliers and connector manufacturer addresses throughout Europe.
- the relevant inverter board.
- input connector(s) for data input to the module.
- input connector to the inverter with flying leads.

### Starter Kit Availability

The following starter kits for flat panel display modules are available:

Display Part Name	Starter Kit Part Name
SP14Q00x series	START691x
LMG7520RPFC	START7520
LMG7380QHFC	START7380
LMG5278XUFC-00T	START5278
LMG7550XUFC	START7550
LMG74xx series	START74xx

## CFL TUBES

Most Hitachi LCD modules allow the easy exchange of the CFL backlight tube. Spare CFL tubes with attached cable and connector are available for the following displays :

Display Part Name	CFL Part Name
LMG9520RPCC A	CFL LMG9520-A
LMG6911RPFC-00T	6911-00T CFL
LMG6912RPFC-00T	6911-00T CFL
LMG7380QHFC	7380 CFL
LMG5278XUFC-00T	5278-00T CFL
LMG7550XUFC	7550 CFL
LMG74xx series	74xx CFL



## LOW COST CONTROLLER BOARD

In order to enable purchasers of a Hitachi LCD module to easily set up an evaluation system of their display, Hitachi offers a controller board which can interface its whole range of medium size colour and monochrome displays.

The board is based on the Yamaha YGV610B LCD controller and can drive

- 8 bit colour single scan LCD modules with 16 out of 512 colours
- 4 bit monochrome LCD modules from 128 x 128 pixels to 640 x 240 pixels with 16 greyscales
- 8 bit monochrome dual scan LCD modules up to 640 x 480 pixels with 16 greyscales

### System Input

The board is designed such that a number of host MCU/MPU can be interfaced. Primarily the Hitachi H8/300H family and the Hitachi SuperH SH1 family will be supported. In order to facilitate easy development and testing the design of the board allows to plug it onto the evaluation board for Hitachi SH series microcontrollers. In addition, interfacing to the Motorola 68x family and Intel 80x86 family is also possible.

### System Output

The controller board will be able to control monochrome displays up to 640 x 480 pixel with 16 greyscales and colour displays up to 640 x 240 pixel with 16 out of 512 colours.

In particular the following Hitachi displays can be interfaced:

- VGA Monochrome Displays (LMG5278XUFC-00T, LMG7550XUFC)
- Quarter VGA Displays (LMG691x, LMG7520RPFC, SP14Q00x)

### Software

Together with the controller board comes an ANSI-C library containing initialization routines for the different displays as well as basic graphics routines like

- Color setting foreground and background
- Set/ reset of pixels
- Drawing of lines, rectangles and circles
- Displaying characters in two different fonts

This library is made available as source code to enable portability across various host MCU/MPU. Based on some demonstration programs which are included the customer will be able display text and graphics within a very short time.



The mechanical layout of the controller board LCMEVB-001 is shown to scale in Fig.1. Outer dimensions are 80 x 90 mm.

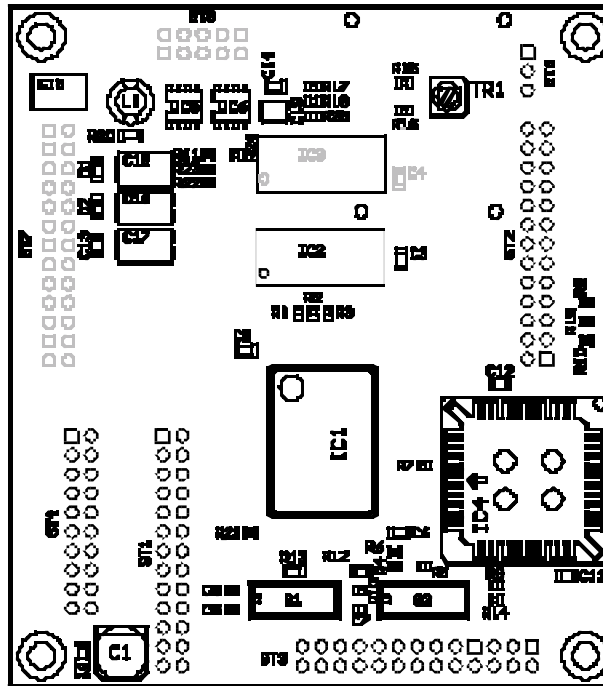


Fig. 1

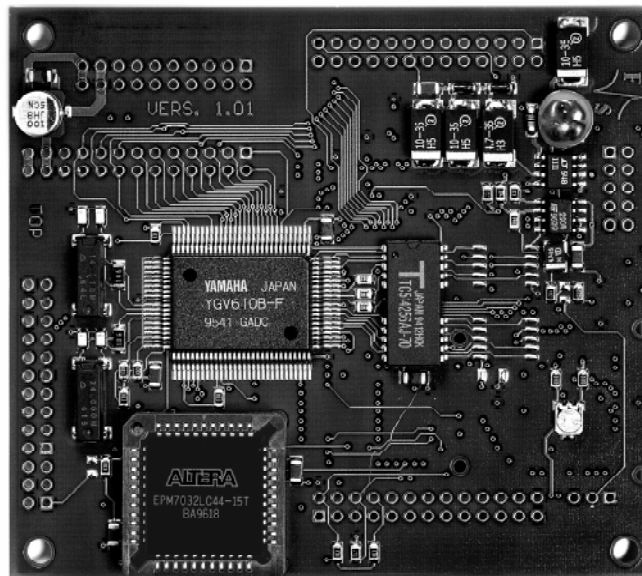


Photo LCMEVB-001

## 1. Liquid Crystal Display

The LCD is composed of glass and polarizer. Please pay attention to the following items when handling.

- (1) Please keep the temperature within the specified range for use and storage. Polarizer degradation, bubble generation or polarizer peel-off may occur at high temperature and high humidity.
- (2) Do not touch, push or rub the exposed polarizers with anything harder than an HB hardness (glass, tweezers, etc.).
- (3) N-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers and reflectors. These adhesives will be damaged by such chemicals as acetone, toluene, ethanol and isopropylalcohol.
- (4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzine. Do not scrub hard to avoid damaging the display surface.
- (5) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause deformation or color fading.
- (6) Avoid contact with oil and fats.
- (7) Condensation on the surface and contact terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperatures they must be warmed up in a container before coming in contact with room temperature air.
- (8) Do not put or attach anything on the display area to avoid leaving marks on.
- (9) Do not touch the display area with bare hands. This will stain the display area and degrade insulation between terminals.
- (10) As glass is fragile, it tends to become cracked or chipped during handling especially on the edges. Please avoid dropping or jarring.

## 2. Liquid Crystal Display Module

### 2.1 Installing LCD Modules

The holes in the printed circuit board are used to mount the LCM. Attend to the following items when installing the LCM.

- (1) Cover the surface with a transparent protective plate to protect the polarizer and LCD glass.
- (2) When assembling the LCM into other equipment, the spacer to be fit between the LCM and the fitting plate should have enough height to avoid causing any stress to the module surface. Refer to the individual specifications for measurements. The measurement tolerance should be +/- 0.1 mm.

### 2.2 Handling LCD Modules

Since the LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- (1) Do not alter, modify or change the shape of the tab on the metal frame.
- (2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- (3) Do not damage or modify the pattern wiring on the printed circuit board.
- (4) Absolutely do not modify the conductive rubber strip (elastomere connector) or touch it with another subject.
- (5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- (6) Do not drop, bend or twist LCM.

### 2.3 Avoiding Electrostatic Discharge

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- (1) Make certain that you are grounded when handling LCM.
- (2) Before removing LCM from its packing case or incorporating it into a set, be sure that the module and your body have the same electric potential.
- (3) When soldering the terminal of LCM, make certain that the AC power source for the soldering iron does not leak.
- (4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potential to minimize as much as possible any transmission of electro-magnetic waves produced by sparks coming from the commutator of the motor.
- (5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- (6) To reduce the generation of static electricity, be careful that the air in the work is not too dried. (A relative humidity of 50%-60% is recommended.)

## 2.4 Soldering Precautions

- (1) Observe the following when soldering lead wire, connector cable, etc., to the LCM

Soldering iron temperature: 280°C +/- 10°C

Soldering time: 3 - 4 sec.

Solder: eutectic-solder

If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation. (This does not apply in the case of a non-halogen type of flux). It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

- (2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
- (3) When removing the electroluminescent panel from the PC board, be sure that the solder has completely melted first. If you try to pull the components apart before the solder is completely melted, the soldered pad on the PC board could be damaged.

## 3. Operation Precautions

- (1) Viewing angle varies with the change of liquid crystal driving voltage (V0). Adjust V0 to show the best contrast.
- (2) Driving an LCD in the voltage above the limit shortens its life.
- (3) Response time is greatly delayed at temperature below the operating temperature range. The display area becomes dark blue at temperature above this range. However, this does not mean the LCD is out of order; it will recover when it returns to the specified temperature range.
- (4) If the display is pushed hard during operation, the display will become abnormal. However, it will return to normal operation after being turned off and on.
- (5) Condensation on the terminal can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C, 50% RH.
- (6) When turning the power on / off input each signal after the positive/negative voltage becomes stable.

## 4. Storage Precautions

- (1) When storing LCDs as spares for some years, the following precautions are necessary:
- (2) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.
- (3) Store them in a dark place; do not expose to sunlight or fluorescent light. Keep the temperature between 0°C and 35°C.
- (4) The polarizer surface should not come in contact with any other object. (We advise you to store them in the container in which they were shipped).
- (5) Environmental conditions:

- (a) Humidity

Observe the following conditions both in storage and in operations.

Below 40°C humidity should stay at 85% RH or less

Above 40°C humidity should not exceed maximum absolute humidity of 40°C 85% RH

- (b) Exposure to high humidity and temperature

Do not leave them for more than 168 hrs.at 40°C

Do not leave them for more than 168 hrs.at 60°C.

As for X-type LCM, should not be left for more than 48 hrs. at -20°C.

## 5. Handling Precautions for Electroluminescent Panels

### 5.1 Selecting Electroluminescent Panels

- (1) The electroluminescent panel is inserted between the liquid crystal display (LCD) and printed circuit board of a liquid crystal module (LCM). Therefore it is essential to select an electroluminescent panel that is insulated on both the PC board side and the LCD side. It is especially important to make sure that the electroluminescent panel is insulated on the PC board side, as the wiring of the through-hole portion is exposed.
- (2) It is recommended that you use an electroluminescent panel with insulated. If the ends of the electroluminescent panels are exposed, a short might occur with the liquid crystal module, resulting in damage to the module.
- (3) Select the electroluminescent panel that has the right size for each liquid crystal module. There is a recommended size for each standard Hitachi liquid module. Information on panel sizes is available on request.

### 5.2 Installing Electroluminescent Panels

- (1) The gaps at either end of the Liquid Crystal Display Module through which the electroluminescent panel is inserted are made of conductive rubber (interconnectors). When inserting the electroluminescent panel, be especially careful not to move the conductive rubber. Do not push the rubber with the edge of the panel, as the rubber might be moved from its proper position. This could damage the connection between the LCD and the PC Board, resulting in a display failure.
- (2) Since high voltage is applied to the feeder terminal of the electroluminescent panel, be careful to install the panel such that the feeder terminal does not touch the front panel or the PC board. ( The voltage is high in comparison with that applied to the C-MOS drive circuit used in the liquid crystal. module.) If the feeder terminal is touching the front panel or PC board when the lighting voltage is applied to the panel, the drive circuit and LCD will fail. There is also the possibility that other circuits (e.g. controller on the set side, MPU, etc.) may be adversely affected by the passage of voltage through the interface.
- (3) Install the electroluminescent panel such that the luminous part coincides with the window frame (effective display area) of the LCM front panel. The distance between the window frame of the front panel and the conductive rubber (dimension a in Fig. 2) varies with each liquid crystal module, but an average is about 2.0 mm. When determining the position where the electroluminescent panel is to be installed, be careful not to move the conductive rubber with the panel.
- (4) Observe the following standards when soldering the electroluminescent panel to the PC board.

Soldering iron temperature:	280°C +/- 10°C
Soldering time:	3 - 4 sec.
Solder:	eutectic solder

If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering gun.

- (5) When removing the electroluminescent panel from the PC board, be sure that the solder has completely melted first. If you try to pull the components apart before the solder is completely melted, the soldered pad on the PC board could be damaged.

### 5.3 Driving Electroluminescent Panels

- (1) The luminance and life time of an electroluminescent panel vary depending on the drive voltage and frequency. Therefore, it is recommended that you select the drive circuit suggested by the electroluminescent panel manufacturer. Using the recommended product will assure the optimum brightness and working life of the electroluminescent panel.

## 6. Safety

- (1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- (2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

**1. Environmental Conditions**

Item	Operating		Storage		Remarks
	Min	Max	Min	Max	
Ambient Temperature	Refer to individual specifications				
Humidity	max 85%RH				T < 40°C
	below max absolute humidity of 40°C 85%RH				T > 40°C
Vibration	-	4.9 m/s <sup>2</sup> (0.5G)	-	19.6 m/s <sup>2</sup> (2G)	
Shock	-	29.4 m/s <sup>2</sup> (3G)	-	490 m/s <sup>2</sup> (2G)	xyz direction
Vibration	-	2.45 m/s <sup>2</sup> (0.25G)	-	11.76 m/s <sup>2</sup> (1.2G)	f = 5Hz-100Hz (except resonance frequency)
Shock	-	29.4 m/s <sup>2</sup>	-	490 m/s <sup>2</sup> (50G)	xyz direction
Corrosive gases	No corrosive gases				

**2. Appearance Standard**

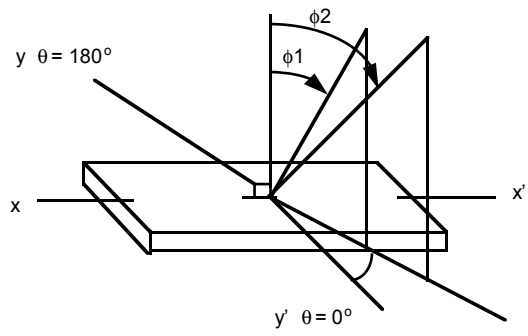
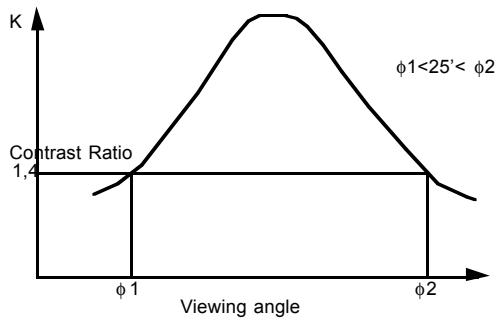
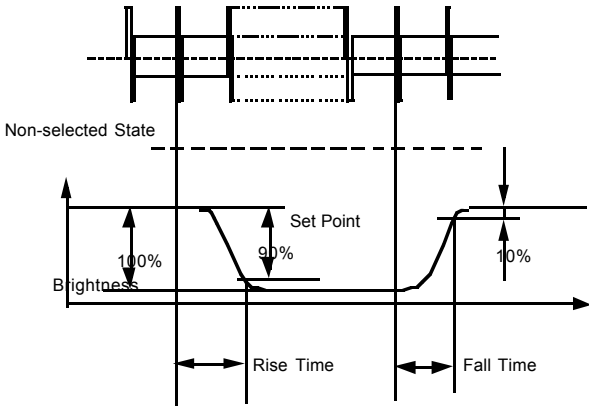
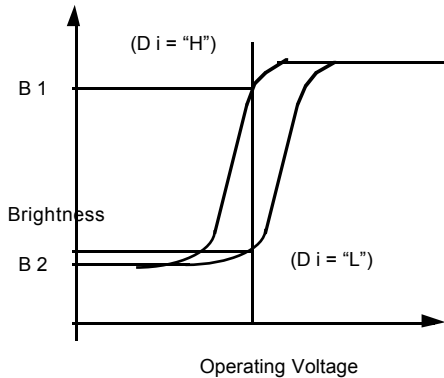
**1. Appearance Inspections Condition**

Visual inspections under single 20W fluorescent lamp with eyes to LCD distance 25 cm and lamp to LCD distance 25 - 30 cm. Viewing angle should be smaller than 45°.

**2. Appearance Standard**

No	Items			Applied Area
1	Scratches	Distinguished ones are not acceptable (To be judged by HITACHI limit sample)		Display
2	Dents			
3	Wrinkles in Polarizer			
4	Bubbles	Average diameter (mm)	Max. accept. number	
		1.0 < D	0	
		0.5 < D ≤ 1.0	1	
		0.3 < D ≤ 0.5	5	
		D ≤ 0.3	Ignore	
5	Stains, foreign materials	Filamentous		
		Length (mm)	Thickness (mm)	
		Ignore	0.02 ≥	Ignore
		2.0 ≥	0.03 ≥	4
		1.0 ≥	0.06 ≥	None
		Round		
		Average diameter (mm)	Max. accept. number	
		D < 0.25	Ignore	
		0.25 ≤ D ≤ 0.35	4	
		0.35 ≤ D	None	
Those can be wiped off easily are acceptable				
6	Interference fringe	Distinguished ones are not acceptable (To be judged by HITACHI limit sample)		Display
7	Non-display	There should be none		
8	Chipped glass	If it has nothing to do with function, ignore		PCB
9	Dimensions	Refer to individual acceptance specifications		Module
10	Dark spots	Average diameter (mm)	Max. accept. number	Display
		0 < 0.1	Ignore	
		0.1 ≤ D < 0.3	3	

### 3. Definition of Optical Data

Definition of $q$ and $f$	Definition of viewing angle $\phi_1$ and $\phi_2$
	
Definition of Optical Response (Rise/Fall Time)	Definition of Contrast $K$
	<p> <math display="block">K = \frac{\text{Brightness on selected dot}(\text{B})}{\text{Brightness on non-selected dot}(\text{B})}</math> </p> 

**LOT MARKING****1. Signification of Lot Number**

Lot Numbers of Hitachi LCD modules consist of four digits with the first digit for the year, the second and third digit for the month and the fourth digit for the week.

**Year Mark**

Year	Figure
1987	7
1988	8
1989	9
1990	0
1991	1
1992	2
1993	3

**Week Mark**

Week (Day)	Figure
21 - 27	1
28 - 3	2
4 - 10	3
11 - 17	4
18 - 20	5

**Month Mark**

Month	Figure	Month	Figure
Jan.	01	Jul.	07
Feb.	02	Aug.	08
Mar.	03	Sept.	09
Apr.	04	Oct.	10
May	05	Nov.	11
Jun.	06	Dec.	12

For example the lot number 4051 indicates that the display was manufactured between 21-27 May 1994.

**2. Position of Lot Number**

The lot number is indicated on the printed circuit board or in some cases on the metal frame on the back of the display module

## PART NUMBERING

Original Part Numbering Convention (used until October 1996 for new display introductions) for Monochrome STN and Colour-STN Liquid Crystal Displays.

e.g. **LMG 7380 QH F C xxx**

1            2            3 4 5 6

### 1. Display Type

LMG = Liquid Crystal Graphics Module

### 2. Serial Number ( 4 digit )

### 3. Resolution ( 2 digit )

1st digit defines horizontal resolution, 2nd digit defines vertical resolution

Type	Number of Dots	Type	Number of Dots
A	8	N	200
B	16	P	240
C	20	Q	256
D	24	R	320
E	32	S	360
F	40	T	400
G	48	U	480
H	64	V	540
J	80	W	600
K	100	X	640
L	128	Y	740
M	160	Z	1152

### 4. Colour Mode and Type

Type	S	H	Y	B	G	W	F	C
Mode	Grey		Yellow	Blue	New Grey	Black/White		Colour
Feature	Normal Temp	Wide Temp				Double Layer	Film	

### 5. Viewing Mode

Type	R	F	L	E	C
Mode	Reflective	Transflective	LED	EL	CFL
	Backlight				

### 6. Options ( 3 digit )



## PART NUMBERING

The following explains the part numbering convention (implemented for new displays introduced from October 1996) for Monochrome STN and Colour-STN Liquid Crystal Displays.

e.g. **S P 14 Q 001 - xxx**  
1 2 3 4 5 6

### 1. Display Type

S = Super Twisted Nematic Graphic Liquid Crystal Display

### 2. Module Type

Type	Mode	Backlight
X	Colour	Yes
A	Colour	No
P	Monochrome	Yes
R	Monochrome	No

### 3. Screen Diagonal Size (cm)

e.g. 287mm → 29, 68.7mm → 07, 14.2cm → 14

### 4. Display Resolution

Type	Display Type	Resolution
Y	Super XGA	1024 x 768 <Y
X	XGA	800 x 600 < X < 1024 x 768
S	Super VGA	640 x 480 < S < 800 x 600
V	VGA	480 x 320 < V < 640 x 480
H	Half VGA	320 x 240 < H < 480 x 320
Q	Quarter VGA	240 x 128 < Q < 320 x 240
N	-	128 x 64 < N < 240 x 128
M	-	M < 128 x 64

### 5. Serial Number ( 3 digit )

### 6. Options ( 3 digit )

**HEADQUARTERS****Northern Europe**

HITACHI EUROPE LTD  
Whitebrook Park, Lower Cookham Road,  
Maidenhead, Berkshire, SL6 8YA  
Tel.: +44 1628 585 000;  
Fax: +44 1628 778 322

**Central/Southern Europe**

HITACHI EUROPE GMBH  
Dornacher Str. 3, D-85622 Feldkirchen  
Postfach 201; D-85619 Feldkirchen  
Tel.: +49 89 9 91 80-0  
Fax: +49 89 9 29 30 00, 9 29 30 01

**SALES OFFICES****Denmark**

HITACHI EUROPE LTD  
Egebækvej 98; DK-2850 Nærum  
Tel.: +45 45 80 77 11  
Fax: +45 45 80 77 54

HITACHI EUROPE GMBH  
Dornacher Str. 3; D-85622 Feldkirchen  
Tel.: +49 89 9 91 80-0  
Fax: +49 89 9 91 80-266

**Eire**

HITACHI EUROPE LTD  
3rd Floor, Odeon House, Eyre Square  
Galway, Ireland  
Tel.: +35 39 156 20 20  
Fax: +35 39 156 20 14

**Italy**

HITACHI EUROPE GMBH  
Via Tommaso Gulli 39, I-20147 Milano  
Tel.: +39 2 48 78 61  
Fax: +39 2 48 78 63 91

**Finland**

HITACHI EUROPE LTD  
Tap House, Tapiolan Keskustorni 11 KRS  
02100 Espoo, Helsinki, Finland  
Tel.: +358 9455 2488  
Fax: +358 9455 2152

Via F. D'Ovidio 97, I-00135 Roma  
Tel.: +39 6 82 00 18 24  
Fax: +39 6 82 00 18 25

**France**

HITACHI EUROPE (France) SA  
18 rue Grange Dame Rose; BP 134  
F-78148 Velizy Cedex  
Tel.: +33 1 34 63 05 00  
Fax: +33 1 34 65 34 31

**Norway**

HITACHI EUROPE LTD  
P.O. Box 153; Østre Strandvei 4B  
N-3482 Tofte  
Tel.: +47 32 79 51 11  
Fax: +47 32 79 52 30

**North Germany/Benelux**

HITACHI EUROPE GMBH  
Am Seestern 18, D-40547 Düsseldorf  
Postfach 11 05 36, D-40505 Düsseldorf  
Tel.: +49 211 52 83-0  
Fax: +49 211 52 83-779

**Spain**

HITACHI EUROPE GMBH  
c/Buganvilla, 5; E-28036 Madrid  
Tel.: +34 1 7 67 27 82, -92  
Fax: +34 1 3 83 85 11

**Central Germany**

HITACHI EUROPE GMBH  
Friedrich-List-Str. 42; D-70771 Leinfelden-  
Echterdingen  
Tel.: +49 711 99085-5  
Fax: +49 711 99085-75

**Sweden**

HITACHI EUROPE LTD  
Box 1062; S-16421 Kista, Stockholm  
Tel.: +46 87 51 00 35  
Fax: +46 87 51 50 73

**United Kingdom**

HITACHI EUROPE LTD  
76 Castle Street, Hinckley;  
Leicestershire LE10 1DD  
Tel.: +44 1455 61 88 88 / 61 85 01  
Fax: +44 1455 61 87 26

**South Germany/Austria/Switzerland**

HITACHI EUROPE LTD  
Victoria House, 49 Clarendon Road; Watford

Herts WD1 1HP  
Tel.: +44 1923 24 02 11  
Fax: +44 1923 24 17 82

HITACHI EUROPE LTD  
Rutland Square House; Rutland Square  
Edinburgh EH1 2BB  
Tel.: +44 131 2 28 22 81  
Fax: +44 131 2 21 01 22

**South Africa**

HITACHI LTD  
Johannesburg Liaison Office  
7th Floor, Nedbank Gardens  
33 Bath Avenue, Rosebank 2196  
Rep. of South Africa  
Tel.: +27 11 442 9080  
Fax: +27 11 442 9745

**NISSEI SANGYO GMBH** (Nissei Sangyo is a subsidiary of Hitachi Ltd.)

---

**Germany**

Nissei Sangyo GmbH (Deutschland)  
Dornacher Str. 3e, D-85622 Feldkirchen  
Tel.: +49 89 9 91 30-0  
Fax: +49 89 9 29 11 85

Nissei Sangyo GmbH  
Kurfürstendamm 115b; D-10711 Berlin  
Tel: +49 30 893681-0  
Fax: +49 30 89 11 031

**Hungary**

East-West Business Center, Rákóczi út 1-3  
H-1088 Budapest  
Tel.: +36 (1) 2 66 66 58; Fax: +36 (1) 2 66-49 27

**France**

Nissei Sangyo France SARL  
Immeuble Ariane; 18 rue Grange Dame Rose  
F-78140 Velizy Cedex  
Tel.: +33 1 30 70 69 70  
Fax: +33 1 34 65 77 28

**United Kingdom**

Nissei Sangyo Co., Ltd.  
Whitebrook Park, Lower Cookham Road,  
Maidenhead, Berkshire, SL6 8YA  
Tel.: +44 1628 585 000  
Fax. +44 1628 778 322

**Austria**

Steiner Electronic Vertrieb GmbH  
Egererstraße 18, A-3013 Tullnerbach  
Tel.: +43 2 233 5 53 66-0  
Fax: +43 2 233 5 53 60

Elbatex GmbH  
Eitnergasse 6; A-1231 Wien  
Tel.: +43 1 86 64 20  
Fax: +43 1 86 64 22 01

**Belgium**

SEI/Sonetech Belgium  
Limburg Stirum 243, B-2, B-1780 Wommel  
Tel.: +32 2 460 07 47  
Fax: +32 2 460 02 71

**Czech Republic**

Macro Group  
Ceskomalinska 20; CZ-16000 Praha 6  
Tel.: +42 2 311 21 82  
Fax: +42 2 243 103 35

**Denmark**

Farnell Electronic Services  
Smedeholm 13 A; DK-2730 Herlev  
Tel.: +45 44 85 75 00  
Fax: +45 44 85 75 30

Jacob Hatteland Denmark A/S  
Tindbjergvej 18; DK-8600 Silkeborg  
Tel.: +45 70 10 22 11  
Fax: +45 86 83 63 83

Bondy Elmatok A/S  
Ostervej 11; DK-5540 Ullerslev  
Tel.: +45 65 35 14 46  
Fax: +45 65 35 15 75

**Eastern Europe**

Elbatex Ges.m.b.H.  
Eitnergasse 6; A-1231 Wien  
Tel.: +43 1 86 64 20  
Fax: +43 1 86 64 22 01

( offices in Hungary, Poland, Bulgaria,  
Czech Republic, Slovakia, Russia, Ukraine )

**Egypt**

Computek  
23 Amer St., Dokki/Cairo, Egypt  
Tel.: +202 36 02 234  
Fax: +202 36 14 576

**Finland**

Computer 2000 Finland OY  
Fintronic Ind. Components  
Pyyntitie 3; SF-02230 Espoo  
Tel.: +358 088 73 31  
Fax: +358 088 73 33 43

Farnell Electronic Services  
P.O.Box 25; SF-00581 Helsinki  
Tel.: +358 047 66 60  
Fax: +358 047 66 63 29

**France**

CCI Electronique  
12, Allée de la Vierge, Silic 577,  
F-94653 Rungis Cedex  
Tel.: +33 1 41 80 70 00  
Fax: +33 1 46 75 32 07

SCAIB  
6, Rue Ambroise Croizat,  
F-91127 Palaiseau Cedex  
Tel.: +33 1 69 19 89 00  
Fax: +33 169 19 89 20

Omnitech-Sertronique SA  
C.A. De Montheard; 11, Rue Edgar Brandt  
F-720 16 Le Mans Cedex  
Tel.: +33 16 43 86 74 74  
Fax: +33 16 43 86 74 86

Tekelec Airtronic  
5, Rue Carle Vernet;  
F-92315 Sevres Cedex  
Tel.: +33 1 46 23 22 64  
Fax: +33 1 46 23 25 83

**Germany**

CED Ditronic GmbH  
Julius-Hölder-Str. 42; D-70597 Stuttgart  
Postfach 70 01 59; D-70571 Stuttgart  
Tel.: +49 711 72 001-0  
Fax: +49 711 72 89 780

Data Modul AG  
Landsberger Str. 318-320  
D-80687 München  
Tel.: +49 89 5 60 17-0  
Fax: +49 89 5 60 17-119

MSC Vertriebs GmbH  
Headquarters  
Industriestr. 16, D-76297 Stutensee  
Postfach 13 80, D-76291 Stutensee  
Tel.: +49 7249 910-0  
Fax: +49 7249 79 93

Neumüller Fenner Elektronik GmbH  
Mehlbeerenstr. 2, D-82024 Taufkirchen  
Postfach 1252, D-82019 Taufkirchen  
Tel.: +49 89 61 44 99-0  
Fax: +49 89 61 44 99-80

Sasco  
Hermann-Oberth-Str. 16, D-85640 Putzbrunn  
Postfach 11 55, D-85636 Putzbrunn  
Tel.: +49 89 46 11-0  
Fax: +49 89 46 11-270

#### Greece

Pouliadis Associates Corp.  
Headquarters  
Aristotelous 3, Syngrou 150  
GR-17671 Athens  
Tel.: +301 9 24 20 72  
Fax: +301 9 24 10 66

#### Hungary

Macro Budapest KFT.  
Etele út 68.; H-1115 Budapest  
Tel.: +36 1 203 02 77  
Fax: +36 1 203 57 02

#### Israel

RDT Components Ltd.  
Atidim Advanced Technologies Park  
PO Box 58013; Neve Sharet  
IL-61580 Tel Aviv  
Tel.: +972 3 64 50 707  
Fax: +972 3 64 92 413

#### Italy

CED SPA  
Via A. Volta, 54; I-20090 Cusago (MI)  
Tel.: +39 2 90 33 61  
Fax: +39 2 90 39 0757

Claitron SPA  
Viale Fulvio Testi 280, I-20126 Milano  
Tel.: +39 2 66 14 91  
Fax: +39 2 66 10 56 66

Eurodis Fanton SRL  
Via O. Simoni 8  
I-40011 Anzola dell'Emilia (Bologna)  
Tel.: +39 51 73 50 15  
Fax: +39 51 73 50 13

#### Netherlands

SEI/Sonotech Nederland BV  
Takkebijsters 2, NL-4817 BL Breda  
Tel.: +31 76 57 22 333  
Fax: +31 76 57 22 395

#### Norway

Jakob Hatteland Electronics AS  
N-5578 Nedre Vats  
Tel.: +47 53 76 30 00  
Fax: +47 53 76 53 39

Ericsson Standard Components A/S  
Postboks 34; N-1361 Billingstadsletta 18  
Tel.: +47 66 84 18 10  
Fax: +47 66 84 19 09

#### Portugal

Amitron-Arrow, LDA  
Quinta Grande lote 20 Alfragide  
P-2700 Amadora  
Tel.: +351 1 471 48 06  
Fax: +351 1 471 08 02

#### South Africa

T.E.C. Timeous Electronic Components  
P.O.Box 15435; Farrarmere; Johannesburg  
Tel.: +27 11 425 41 93/4  
Fax: +27 11 425 41 95

HiQ Electronics  
P.O.Box 1586  
Amazintoti; Durban 4125  
Tel.: +27 31 903 78 14  
Fax: +27 31 903 69 80

#### Spain

Amitron Arrow SA  
Albasanz, 75; E-28037 Madrid  
Tel.: +34 1 30 43 040  
Fax: +34 1 32 72 472  
ADM Electronica S.A.  
C/Tomas Breton, 50; E-28045 Madrid  
Tel.: +34 1 530 41 21  
Fax: +34 1 530 01 64

#### Sweden

GB Topcomp Electronics  
S-16481 Kista, Stockholm  
Tel.: +46 87 57 53 00  
Fax: +46 87 57 53 53

Ericsson Standard Components AB  
S-16481 Kista; Stockholm  
Tel.: +46 87 57 49 00  
Fax: +46 87 52 92 65

Jakob Hatteland Electronic AB  
Box 3009  
S-163 03 Spånga  
Tel.: +46 8 445 75 00  
Fax: +46 8 364 686

#### Switzerland

Fenner Elektronik AG  
Gewerbestr. 10; CH-4450 Sissach  
Tel.: +41 61 975 00 00  
Fax: +41 61 971 56 08

**Turkey**

Inter Mühendislik Danismanlik ve Ticaret  
Hasircibasi Caddesi 55; TR-Istanbul  
Tel.: +90 216 34 99 400  
Fax: +90 216 34 99 430

**United Kingdom**

Abacus Polar Ltd.  
Cherry Court Way  
Leighton Buzzard LU7 8YY, UK  
Tel.: +44 1525 37 70 93  
Fax: +44 1525 85 80 01

Arrow-Jermyn Electronics  
St. Martins Business Centre  
Cambridge Road  
Bedford MK42 0LF, UK  
Tel.: +44 1234 27 00 27  
Fax: +44 1234 214 674

Eurodis Bytech Ltd.  
12a Cedar Wood; Chineham Business Park  
Crockford Lane; Basingstoke  
Hampshire RG24 0WD, UK  
Tel.: +44 1256 70 72 22; Fax: +44 1256 70 71 62

Farnell Dialogue  
Edinburgh Way; Harlow  
Essex CM20 2DF, UK  
Tel.: +44 1279 44 29 71  
Fax: +44 1279 44 34 17

Farnell Electronic Components Ltd.  
Canal Road; Leeds LS12 2TW; UK  
Tel.: +44 1132 63 63 11  
Fax: +44 1132 63 34 11

Macro Group  
Burnham Lane, Slough  
Berkshire SL1 6LN, UK  
Tel.: +44 1628 60 43 83  
Fax: +44 1628 66 68 73

MMD Limited  
3 Bennet Court; Bennet Road; Reading;  
Berkshire RG2 0QX; UK  
Tel.: +44 1734 63 37 80  
Fax: +44 1734 63 38 99

GD Technik  
Tudor House; 24 High Street  
Twyford  
Berks RG 10 9 AG  
Tel.: +44 1734 34 22 77  
Fax: +44 1734 34 28 96