SH-2 (SH7145) CPU Board with 320×240 dots LCD Controller

CPU-323L

Instruction Manual
(Second Edition)
07/15/2011

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■ Safety Precautions

In order to prevent physical harm and property damage to those using and/or installing this circuit board device (the “Product”), the manual describes below the necessary safety precautions.

●The severity of harm and damage caused by incorrect usage or installation stemming from ignoring the directions herein are indicated by the following symbols and warnings.

Danger	This symbol indicates that the possibility of death or serious injury is imminent.
Warning	This symbol indicates that death or serious injury is possible.
Caution	This symbol indicates that minor injury or damage to only property is possible.

●The types of necessary precautions are classified according to the following symbols. (The symbols below are an example)

This symbol indicates "Prohibited" actions.

This symbol indicates "Mandatory" actions.

⚠ Danger

Do not breathe in or swallow the liquid crystal if the LCD is damaged and leaking. If the liquid crystal is sticking to your hands or clothes, wipe with alcohol etc., and wash thoroughly with water.

⚠ Warning

Always use a rated power supply device as per this manual.
Other devices may cause burnout and fire.

When installing, select a well-ventilated and dry area with no risk of water spillage. Otherwise, electrocution, electrical leakage, burnout, or fires may result.

■ Installation and Software Design Precautions

This section covers the precautions when installing the Product (CPU-323L and accompanying LCD panel and touch panel)

Installing the LCD and the PCB

- In order to protect the polarization plate and LCD, place the guard plate on the panel whenever possible.
- Avoid applying external pressure on the LSI when installing.
- Be careful not to warp or contort the LCD panel and PCB.
- When designing your product, assure that the size of the window frame is within the effective display area.
- When using a frame beyond the effective display area for the external appearance of your product, any non-uniform appearance of the product is beyond the scope of the warranty.
- It is possible that there is a burr on the frame edge of the LCD module.
  When designing your product, be careful of any contact with cables so as to prevent damage to the cable insulation.

Static Electricity Precautions

- As CMOS-IC is used in the device, take proper measures to deal with static electricity when handling.
- Consider grounding for workers handling the device. For example, the use of an anti-static wrist strap/mat is recommended.

Handling Precautions

- Avoid placing in areas with high humidity for long periods of time. Be particularly careful of high humidity when the temperature is over 40 degrees Celsius.
- As the LCD polarization plate is easily damaged, be careful when handling. Avoid contact with hard objects.
- When cleaning the LCD surface, wipe lightly with a soft cloth (chamois leather, absorbent cotton etc.) and a drop of petroleum benzene.

- When saliva or a drop of water remains on the LCD polarization plate for a long time, deformation, discoloration, staining, or fading may occur. Wipe away quickly.
- As the LCD contains glass, chipping and cracking can occur when dropped or hit with a hard object.
- When testing, avoid condensation in the device in order to avoid staining of the polarization plate.

Operating Precautions

- The LCD controller mounted on this CPU board is a type that forwards configuration data from the flash memory inside the device to the SRAM.

  After powering on, it starts quickly after disengaging the reset. However, the hard fill starts soon after powering on. When designing software, ensure that it checks the completion of the hard fill in the hard fill register before allowing read-write access.
- Use of the Product in non-intended, off-specification conditions can cause a decrease in lifespan and a deterioration of visual quality. Always use within specifications.
- Use of the Product in conditions below the rated temperature can cause deterioration of visual quality and/or the formation of air bubbles. Use of the Product in non-intended, off-specification temperatures, can lead to an irreversible change in LCD characteristics. Always use within specifications.
- When the display is subjected to a strong push, a warning light comes on. However, it will return back to normal when left for a while, or if it is rebooted.
- D.C. application causes deterioration of the LCD. Be particularly careful with the connection of the CN6 (interface connector to the LCD), to make sure the contact is complete and not partial.

Storage Precautions

- Store the LCD in a cool, dry place. When keeping the LCD in long-term storage, place in a dark area away from sunlight and fluorescent lighting.
- When storing the LCD and PCB individually, make sure the polarization plate or LSI does not come in contact with other objects.

■ Warranty and Disclaimer

Warranty

- From a manufacturing standpoint, in order to warrant the functionality and reliability of the Product, Kenic System (the "Company") may issue a delivery specification to the purchaser of the Product (the "Customer"). The warranty covers the items outlined in the delivery specification.
- Any modifications to the Product by the Customer will not be covered by the warranty.

Disclaimer

The Customer agrees that the Company shall not be held liable for accidents and damages caused by the Product under the following circumstances.

- Use of the Product in conditions not specified in this instruction manual (the "Manual").
- Breakdown or damage to the Product caused by third-party products not approved and provided by the Company.
- Maintenance and repair work using parts not approved by the Company.
- The Customer did not follow the precautions or operating instructions as set forth in the Manual.
- Use of the Product in situations where the power source, installation environment, and other conditions are beyond the specifications as outlined in the Manual.
- Accidents and damages caused by natural disasters such as fires, earthquakes, floods, and lightning storms.

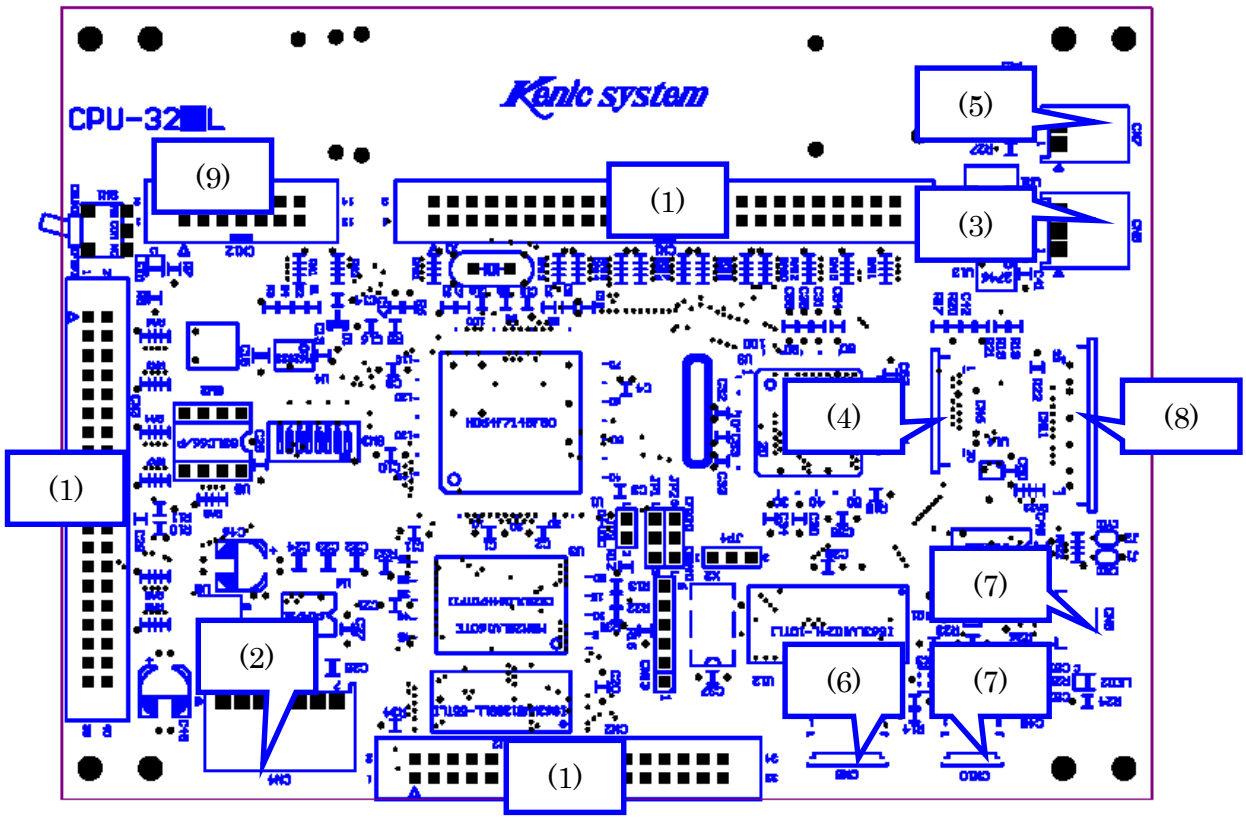
※Component specifications and external appearance may change without notice. However, if previously agreed to installation dimensions and electrical interface need to be changed due to unforeseen circumstances, the Company will contact the Customer to resolve the issue.

■ Overview and Features of the Product

1. List of Accessories

Flexible cable for LCD connection　　For CN11 (33pin × 80mm)
Assembly cable for backlight power supply connection
LED backlight power supply　　"KSLBC-3(D2)"　with on-board.
Assembly cable for power supply

2. Name and Function for the Circuit Board Connectors



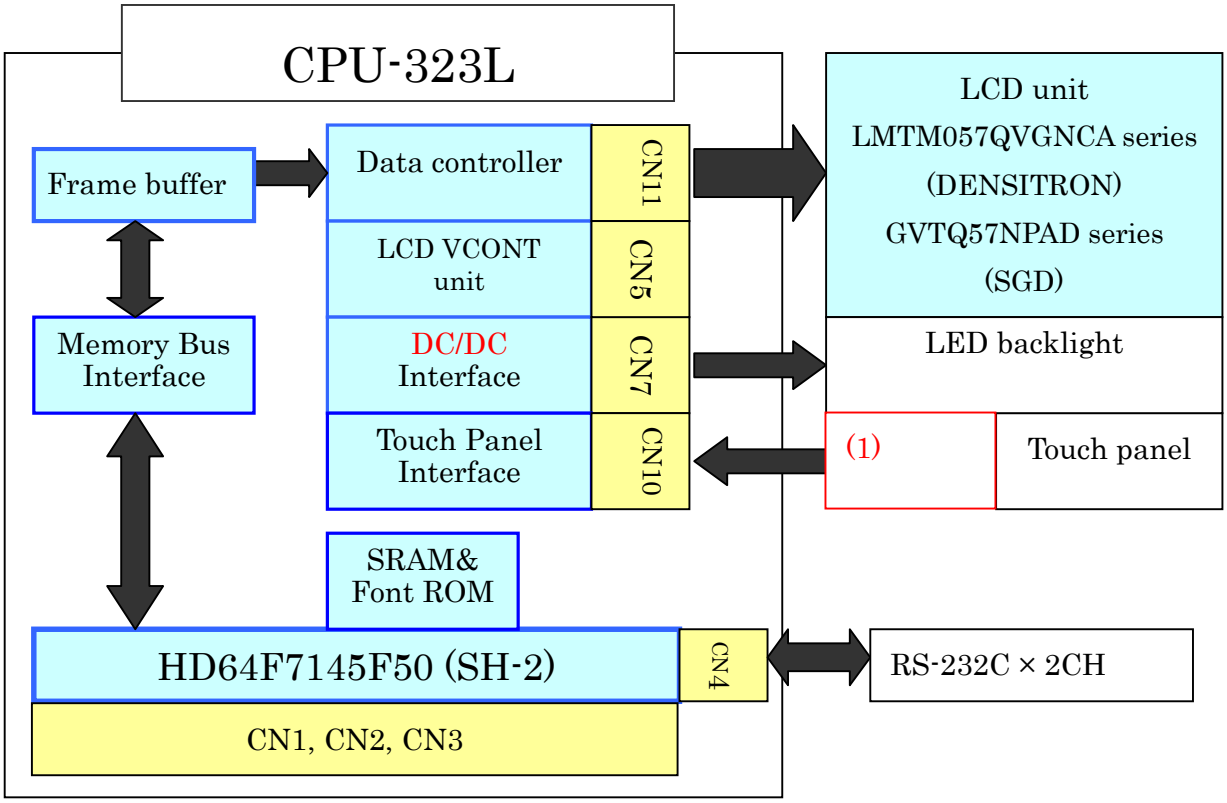
(1)　CN1, CN2, CN3:　System expansion connectors for the CPU I/O or bus signals. (Almost any connector can be used, such as a flat cable connector, pin header, etc.)

(2) CN4: Connector for RS-232C and +5V power supply.
(3) CN5: Connector for volume connection, and for contrast control. It doesn't use usually.
(4) CN6: Connector for STN LCD (No use).
(5) CN7: Connector for backlight inverter ON/OFF signal connection for LCD.
(6) CN8: Write connector for touch panel controller (KS-R8TPC).
(7) CN9, 10: Connector for touch panel.
(8) CN11: Connector for LCD.
(9) CN12: Connector for H-UDI.

3. Intended Purpose of Product

The CPU-323L is a unit which unified an exclusive controller board for color TFT LCD display module of the "LMTM057QVGNCA series" manufactured by DENSITRON, and the "GVTQ57NPAD series" manufactured by SGD. The CPU-323L can display horizontality 320 pixels × verticality 240 pixels × 64 colors.

Please refer to the following block diagram.



"(1)" is a touch panel connection substrate (model : CPU361L-TBS).
The substrate needs to connect the touch panel.

4. Main Feature

- As the SH-2 (HD64F7145F50) CPU by Renesas Technology is included as standard equipment, it is possible for the Customer's entire system to be completed with this single board.
- As the remaining I/O and bus signal have been extracted to a 2.54mm-pitch universal pattern, it is possible to directly install pin headers and flat cable connectors.
- Two RS-232C lines are included as standard equipment.
- 64 colors can be designated per pixel individually.
  Additionally, there is a complete, one-to-one correlation between the mapping coordinates of the pixels and addresses as seen from the Customer's CPU.
- There is no lag for write to from the CPU at intervals of 200ns or longer.
  There is no lag for read out at intervals of 400ns or longer.
  Even under DMA with SH-2, there is plenty of latitude for access.
- Touch position data from the touch panel can be directly read out as 8-bit data.
- It is possible to set two different inverted color blink controls (two patterns).
- Full-screen wipe is supported by the hardware.
  It is possible to specify the color for wiping.
- As the CS0 area can be switched from the Flash-ROM area to the SRAM area using short pin, it is possible to debug by E10A, ICE, etc.
- As EEPROM is included, it is possible to hold data for memory.
- DC/DC power supply for the LCD backlight (LED backlight) is standard equipment.
- Compact and lightweight, the Product dimensions are 144mm×104.6mm (not including protruding cables).

Specifications differ depending on the target controller. For details, refer to the LCD Controller IC manual.

■ Basic Specification 2

1. Electrical Specifications

——— LCD Section ———

- Intended LCD module: LMTM057QVGNCA series (DENSITRON)
  GVTQ57NPAD series (SGD)
- Intended LCD controller: KS3224-LD29 (Kenic system)
- Intended touch panel: The above LCD is included as standard equipment.
- Intended touch panel controller: KS-R8TPC (Kenic system)
- Intended backlight power supply: KSLBC-3(D2) (Kenic system)
- Color representation: 64 colors

——— CPU Section ———

- CPU: HD64F7145F50 (Renesas)
- SRAM: IS62WV5128BLL-55TLI (ISSI) etc.
- Flash-ROM: S29AL016D90TFI01 (SPANSION) etc.
- EEPROM: 93LC66-I/P-G (Microchip): mountable
- Chinese character fonts: JIS level-1, JIS level-2 (16dot font)
- RS-232C: 2CH already mounted.

——— I/O Specifications ———

- CN1 For expansion bus: D0~D31, WAIT, NMI, CS0~3, WRL, WRH, WDTOVF, RD
- CN2 For expansion bus: A0~A21, CK, MRESET, RESET, WRHH, WRHL, BACK, BREQ, PA16
- CN3 For generic I/O: PE0~7, PF0~7, PA2, 5, 8, 9, 20, 21, PB2, 3, 4, 5, PE14, 15

——— Others ———

- Power supply Specifications

5V single supply	2.0A MAX
Rated voltage of CPU board	5V±0.25V
Consumption current of CPU board	300mA

*Not including LCD and backlight power supplies.

- Operating environment　0 ℃~50 ℃ (CPU board only)
  Refer to starter kit manual for operating temperature range when including LCD.
- External dimensions and weight
  144 × 104.6 × 12mm
  (not including protruding cables)
  About　75g

2. Specifications for short pins, switches, etc.

(1) JP1　For selecting CS0 area
Shorting between No. 1 and No. 2: CS0 is set in Flash-ROM area.
Shorting between No. 2 and No. 3: CS0 is set in SRAM area.
Caution)　To avoid damage, do not set in the same area as CS1.

(2) JP2　For selecting CS1 area
Shorting between No. 1 and No. 2: CS1 is set in SRAM area.
Shorting between No. 2 and No. 3: CS1 is set in Flash-ROM area.
Caution)　To avoid damage, do not set in the same area as CS0.

(3) JP3　For H-UDI
When open, it is the setting for H-UDI.
When short, CPU operates normally.

(4) JP4　For selecting LCD clock
Shorting between No. 1 and No. 2: selecting X'tal.

(5) J1　For switching the X axis data of the touch panel.
When short, the X axis data of the touch panel is reversed.

(6) J2　For switching the Y axis data of the touch panel.
When short, the Y axis data of the touch panel is reversed.

(7) SW1　For switching modes
When switched towards a lit LED1, CPU changes to boot mode.
When switched towards an unlit LED1, CPU operates normally.

(8) SW2　Reset switch
When pressing SW2, set the RESET pin for the CPU, LCD controller, etc. LOW.

(9) SW3　8-bit DIP switch
Connected to the CPU I/O ports PF0～7.

3. CN1 Signal Table (Connector not mounted)

Pin number	Name of signal	Function
1,2	VCC	Pin for power. +5V supply pin.
3,4	VCC	Pin for power. +3.3V supply pin.
5	/WAIT	WAIT of CPU. This pin is connected by open drain from LCD controller.
6	NMI	NMI of CPU
7	D0	Data bus of CPU.
8	D1	
9	D2	
10	D3	
11	D4	
12	D5	
13	D6	
14	D7	
15	D8	
16	D9	
17	D10	
18	D11	
19	D12	
20	D13	
21	D14	
22	D15	
23	D16	
24	D17	
25	D18	
26	D19	
27	D20	
28	D21	
29	D22	
30	D23	
31	D24	
32	D25	
33	D26	
34	D27	
35	D28	
36	D29	
37	D30	
38	D31	
39	CS2	CS2 of CPU
40	CS3	CS3 of CPU
41	CS0	CS0 of CPU
42	CS1	CS1 of CPU
43	WRL	WRL of CPU
44	WRH	WRH of CPU
45	WDTOVF	WDTOVF of CPU
46	RD	RD of CPU
47,48,49,50	GND	Pin for power. Ground connection pin.

Compatible connectors: Almost any 2.54-pitch, 50-pin pin headers and flat cable connectors.

4. CN2 Signal Table (Connector not mounted)

Pin number	Name of signal	Function
1,2	VCC	Pin for power. +3.3V supply pin.
3	PA16	CPU I/O port PA16
4	CK	CK of CPU
5	MRESET	MRESET of CPU
6	RESET	RESET of CPU
7	WRHH	WRHH of CPU
8	WRHL	WRHL of CPU
9	A0	Address bus of CPU.
10	A1	
11	A2	
12	A3	
13	A4	
14	A5	
15	A6	
16	A7	
17	A8	
18	A9	
19	A10	
20	A11	
21	A12	
22	A13	
23	A14	
24	A15	
25	A16	
26	A17	
27	A18	
28	A19	
29	A20	
30	A21	
31	BACK	BACK of CPU
32	BREQ	BREQ of CPU
33,34	GND	Pin for power. Ground connection pin.

Compatible connectors: Almost any 2.54-pitch, 34-pin pin headers and flat cable connectors.

5. CN3 Signal Table (Connector not mounted)

Pin number	Name of signal	Function
1,2	VCC	Pin for power. +3.3V supply pin.
3	PE0	CPU I/O port PFXX
4	PE1	
5	PE2	
6	PE3	
7	PE4	
8	PE5	
9	PE6	
10	PE7	
11,12	GND	Pin for power. Ground connection pin.
13	PF0	CPU I/O port PFXX
14	PF1	
15	PF2	
16	PF3	
17	PF4	
18	PF5	
19	PF6	
20	PF7	
21,22	AVSS	Analog GND
23,24	AVCC	Analog VCC (+3.3V)
25,26	VCC	Pin for power. +3.3V supply pin.
27	PA2	CPU I/O port PA2
28	PE14	CPU I/O port PE14
29	PA5	CPU I/O port PA5
30	PE15	CPU I/O port PE15
31	PA21	CPU I/O port PA21
32	PB2	CPU I/O port PB2
33	PA20	CPU I/O port PA20
34	PB3	CPU I/O port PB3
35	PA9	CPU I/O port PA9
36	PB4	CPU I/O port PB4
37	PA8	CPU I/O port PA8
38	PB5	CPU I/O port PB5
39,40	GND	Pin for power. Ground connection pin.

Compatible connectors: Almost any 2.54-pitch, 40-pin pin headers and flat cable connectors.

6. CN4 Signal Table for RS-232C Connector

Pin number	Name of signal	Function
1	VCC	Power supply pin +5V
2	TxD0	RS-232C sending zero time line
3	TxD1	RS-232C sending line (in conjunction with program download)
4	RxD0	RS-232C receiving zero time line
5	RxD1	RS-232C receiving line (in conjunction with program download)
6	GND	RS-232C signal ground
7	GND	Power supply pin 0V

Connector used: S7B-XH-A (LF) (SN) (JST Mfg. Co., Ltd.)

Compatible connector: XHP-7 (JST Mfg. Co., Ltd.)

7. CN5 Signal Table for External Contrast Volume Connector

Pin number	Name of signal	Function
1	VR+	Pin for volume.
2	VRC	Brush pin for volume. Voltage input or PWM input is also possible.
3	VR-	Pin for volume.

Connector used: S3B-XH-A (LF) (SN) (JST Mfg. Co., Ltd.)

Compatible connectors: XHP-3 (JST Mfg. Co., Ltd.)

8. CN6, 11 Signal Table for LCD Connector

CN6 (for STN)		
Pin number	Name of signal	Function
1		This connector is no use.
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16, 17		
18, 19, 20		

Connector used: 08-6210-033-340-800A+ (ELCO)

Compatible FPC cable: 0.5mm pitch, 20-pin. No compatible product on the market.

CN11 (for TFT)		
Pin number	Name of signal	Function
1	GND	GND pin
2	CLK	Data sampling clock signal
3	Hsync	Horizontal sync signal (negative polarity)
4	Vsync	Vertical sync signal (negative polarity)
5	GND	GND pin
6	R0	Red data signal (LSB)
7	R1	Red data signal
8	R2	Red data signal
9	R3	Red data signal
10	R4	Red data signal
11	R5	Red data signal (MSB)
12	GND	GND pin
13	G0	Green data signal (LSB)
14	G1	Green data signal
15	G2	Green data signal
16	G3	Green data signal
17	G4	Green data signal
18	G5	Green data signal (MSB)
19	GND	GND pin
20	B0	Blue data signal (LSB)
21	B1	Blue data signal
22	B2	Blue data signal
23	B3	Blue data signal
24	B4	Blue data signal
25	B5	Blue data signal (MSB)
26	GND	GND pin
27	ENAB	Horizontal display position signal (positive polarity)
28,29	VCC	Power input (+3.3V)
30	R/L	Horizontal inverse signal (L: normal, H: flip horizontal)
31	U/L	Vertical inverse signal (H: normal, L: flip vertical)
32	V/Q	VGA/QVGA switch signal (H: VGA, L: QVGA) It is LOW fixation. The LCD side of DENSITORN is NC.
33	GND	GND pin

Connector used: 08-6210-033-340-800A+ (ELCO)

Compatible FPC cable: 0.5mm pitch, 33-pin. No compatible product on the market.

9. CN7 Signal Table for Backlight inverter ON/OFF signal connector

Pin number	Name of signal	Function
1	C	Collector of photo coupler
2	E	Emitter of photo coupler

Connector used: S2B-XH-A (LF) (SN) (JST Mfg. Co., Ltd.)

Compatible connectors: XHP-2 (JST Mfg. Co., Ltd.)

10. CN8 Signal Table for Touch Panel Controller Write Connector.

Pin number	Name of signal	Function
1	VCC	+3.3V power supply pin
2	TPRES	This pin is already connected to /RES pin of KS-R8TPC
3		No connection
4	MODE	This pin is already connected to MODE pin of KS-R8TPC
5	P4-5	This pin is already connected to P4-5 pin of KS-R8TPC
6	P3-7	This pin is already connected to P3-7 pin of KS-R8TPC
7	GND	GND pin

Connector used: 53261-0771 (Molex)

11. CN9 Signal Table for Touch Panel Connector

Pin number	Name of signal	Function
1	XR	Touch panel signal XR
2	YU	Touch panel signal YU
3	XL	Touch panel signal XL
4	YL	Touch panel signal YL

Connector used: 04FFS-SP-TF (LF) (SN) (JST Mfg. Co., Ltd.)

12. CN10 Signal Table for Touch Panel Connector

Pin number	Name of signal	Function
1	XL	Touch panel signal XL
2	YU	Touch panel signal YU
3	XR	Touch panel signal XR
4	YL	Touch panel signal YL
5	NC	No connection

Connector used: 53261-0571 (Molex)

Compatible connector: 51021-0500 (Molex)

13. CN12 Signal Table for H-UDI Connector

Pin number	Name of signal	Function
1	TCK	H-UDI connection
2	GND	
3	TRST	
4	GND	
5	TDO	
6	GND	
7	ASEBRKAK	
8	NC	
9	TMS	
10	GND	
11	TDI	
12	GND	
13	RESET	
14	GND	

Connector used: XG4C-1431 (Omron)

14. Address Map

**The on board CPU is preset so as to operate by mode2 (MD0=0 MD1=1).*

**The Chinese character ROM area, external RAM area, and LCD controller areas have not been decoded in the CS space.*

** For more details, refer to the HITACHI SH7145 series hardware manual.*

0000 0000H 0003 FFFFH	ROM with built-in CPU	
	Free (Reserved for CPU)	
0020 0000H 0027 FFFFH	Chinese character ROM	CS0 area
	Image	
0040 0000H 0047 FFFFH	External RAM	CS1 area
	Image	
0080 0000H 0081 DFFFH	Frame buffer for LCD controller	CS2 area
	Free	
0081 FFFBH 0081 FFFFH	Various registers for LCD controller	
	Image	
00C0 0000H 00FF FFFFH	Free space	CS3 area

15. Selection and Preparation of Peripheral Parts

(1) Selection of the main power supply device

Power-supply voltage: 5V±0.25V
Consumption current: 2.0A　MAX
Boot speed: within 300mS
Ripple noise: within 150mV

** Much of this is consumed by the LED backlight power supply.*

(2) Connection of each unit

Refer to the starter kit manual for connecting each of the units.
Use only the minimum length necessary for cables. Unnecessarily long cables may cause a decrease in transmission speeds and/or introduce noise.

(3) Powering on the Product

Before powering on, carefully check all connections first. Loose connections may cause damage to parts.

16. Technical Documentation about the Product

Technical information about the Product is continually updated and posted on the Kenic system website. Please feel free to browse at the URL below.

http://www.kenic.co.jp/w/