



深圳市拓普微科技开发有限公司

SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

# LM1075RCW

## LCD Module User Manual

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Rev.	Descriptions	Release Date
0.1	New release	2015-06-05

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# 1. Basic Specifications

## 1.1 Display Specifications

- 1) LCD Display Mode : FSTN, Positive, Transflective
- 2) Display Color : Display Data = "1" : Dark Gray (\*1)  
: Display Data = "0" : Light White (\*2)
- 3) Viewing Angle : 6H
- 4) Driving Method : 1/128 duty, 1/12 bias
- 5) Backlight : White LED backlight

Note:

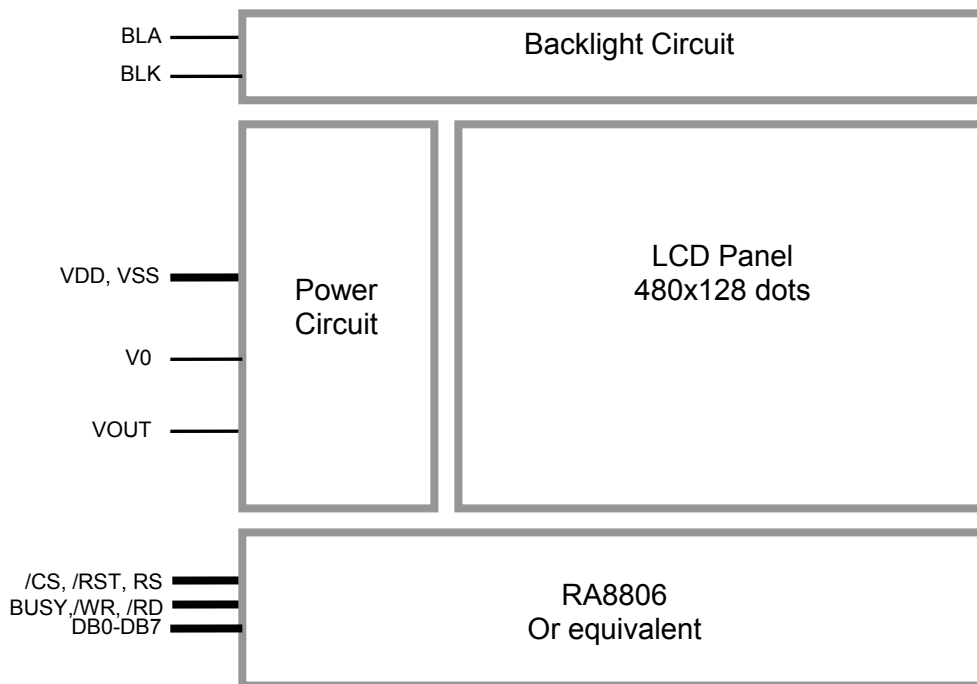
\*1. Color tone may slightly change by Temperature and Driving Condition.

\*2. The Color is defined as the inactive / background color

## 1.2 Mechanical Specifications

- 1) Outline Dimension : 180.0 x 62.0 x 11.0MAX  
see attached Outline Drawing for details

## 1.3 Block Diagram



## 1.4 Interface Description

### 1.4.1 Terminal Functions

Pin No.	Pin Name	I/O	Descriptions(80 mode)
1	VOOUT	Power	Power Booster Output for V0
2	V0	Power	LCD Contrast Reference Input
3	VSS	Power	0V Power Supply
4	VDD	Power	Positive Power Supply
5	BUSY	Input	Wait signal, if there is no read write activity, /WAIT will be in HZ state
6	NC	--	No connection (leave open)
7	/CS	Input	Chip Select Signal /CS=LOW: Data IO is enable /CS1=HIGH: Data IO is disable
8	RS	Input	Register Select A0=HIGH: data on DB0 to DB7 is display data A0=LOW: data on DB0 to DB7 is control data
9	/WR	Input	Write enable input, active LOW
10	/RD	Input	Read enable input, active LOW
11	DB0	I/O	8-bit bi-directional data bus
:	:		
18	DB7		
19	/RST	Input	Reset Signal: /RST = L, Reset the LCD Module /RST = H, Normal Running
20	NC	--	No connection (leave open)
21	BLA	Power	Positive Power Supply for LED backlight
22	BLK	Power	Negative Power Supply for LED backlight
23	BLA	Power	Positive Power Supply for LED backlight
24	BLK	Power	Negative Power Supply for LED backlight
25	BLA	Power	Positive Power Supply for LED backlight
26	BLK	Power	Negative Power Supply for LED backlight

## 2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	$V_{DD}$	0	+3.6	V	$V_{SS} = 0V$
Input Voltage	$V_{IN}$	$V_{SS}-0.3$	$V_{DD}+0.3$	V	$V_{SS} = 0V$
Operating Temperature	$T_{OP}$	-20	70	°C	No Condensation
Storage Temperature	$T_{ST}$	-30	80	°C	No Condensation

Cautions:

Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## 3. Electrical Characteristics

### 3.1 DC Characteristics

$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	$V_{DD}$	-	3.3	-	V	VDD
Input High Voltage	$V_{IH}$	$0.8 \times V_{DD}$	-	VDD	V	Input pins
Input Low Voltage	$V_{IL}$	VSS	-	$0.1 \times V_{DD}$	V	Input pins
Operating Current	$I_{DD}$	-	22.7	56.8	mA	VDD

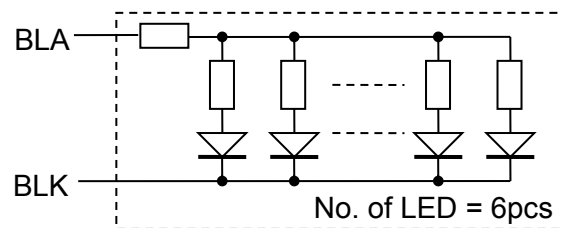
### 3.2 LED Backlight Circuit Characteristics

$BLK=0V, I_{f_{BLA}}=52.5mA, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Forward Voltage	$V_{f_{BLA}}$	-	3.3	-	V	BLA
Forward Current	$I_{f_{BLA}}$	-	52.5	120	mA	BLA

Cautions:

Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



### 3.3 AC Characteristics

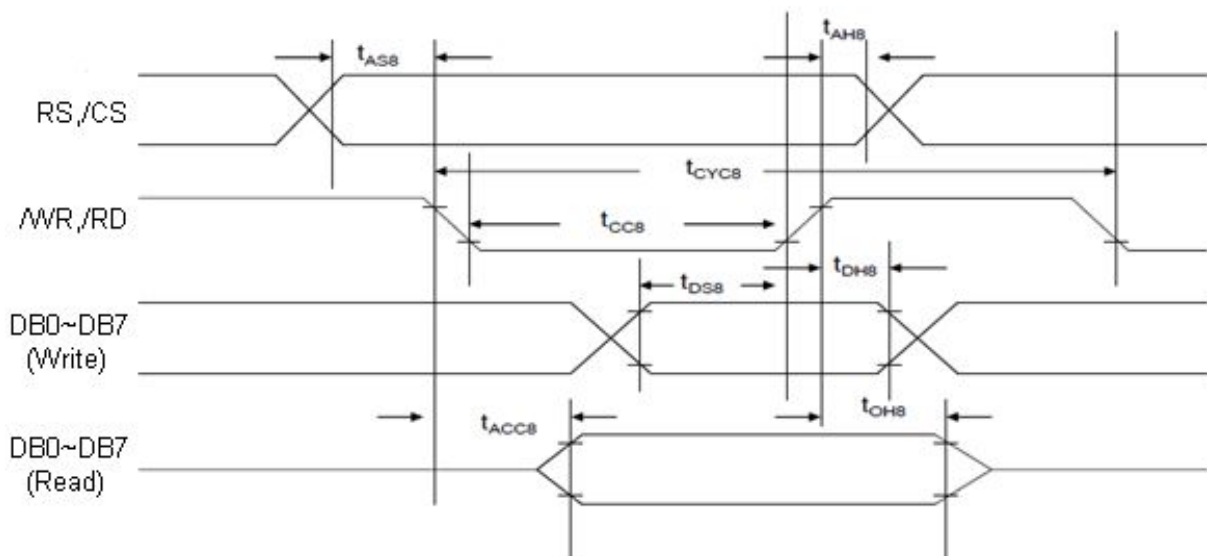
#### 3.3.1 8080 Mode

V<sub>SS</sub>=0V, V<sub>DD</sub>=3.3V, T<sub>OP</sub> =25°C, System clock =6MHz

Item	Symbol	MIN.	TYP.	MAX.	Unit
Address hold time	t <sub>AH8</sub>	26	-	-	ns
Address setup time	t <sub>AS8</sub>	3	-	-	ns
System cycle time	t <sub>CYC8</sub>	434	-	-	ns
Strobe pulse width	t <sub>CC8</sub>	65	-	-	ns
Data setup time	t <sub>DS8</sub>	39	-	-	ns
Data hold time	t <sub>DH8</sub>	26	-	-	ns
Data output access time	t <sub>ACC8</sub>	3	-	14	ns
Data Output hold time	t <sub>OH8</sub>	3	-	7	ns

Note:

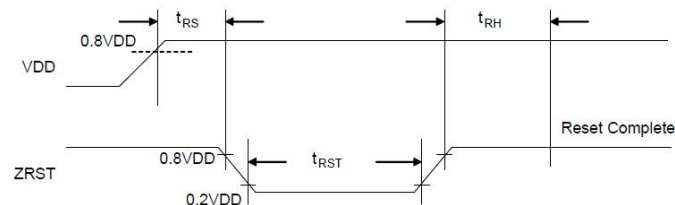
- \*1. Input signal rise/fall time should be less than 20ns
- \*2. Please see the RA8806 data sheet for details



### 3.4 Reset Timing

V<sub>SS</sub>=0V, V<sub>DD</sub>=3.3V, T<sub>OP</sub>=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset setup time	t <sub>RS</sub>	1.3	-	-	ms
Reset hold time	t <sub>RH</sub>	1.3	-	-	ms
Reset active time	t <sub>RST</sub>	222	-	-	us



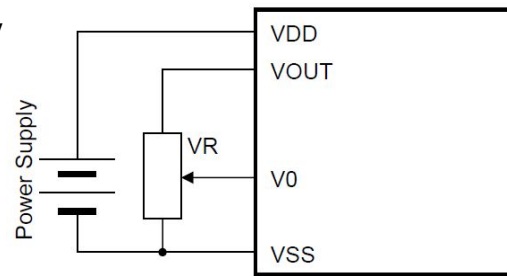
## 4. Function Specifications

### 4.1 Adjusting the Display Contrast

A Variable-Voltage-Resistor must be connected to the LCD module for providing a reference to V0.

Adjusting the VR will result the change of LCD display Contrast.

The recommended value of VR is 25k to 50k.



### 4.2 Resetting the LCD module

The LCD module should be initialized by hardware reset, using /RST terminal.

### 4.3 Display Pixel Map

1,1 (D7)	2,1 (D6)	3,1 (D5)	4,1 (D4)	5,1 (D3)	---	---	476,1 (D4)	477,1 (D3)	478,1 (D2)	479,1 (D1)	480,1 (D0)
1,2 (D7)	2,2 (D6)	3,2 (D5)	4,2 (D4)	5,2 (D3)	---	---	476,2 (D4)	477,2 (D3)	478,2 (D2)	479,2 (D1)	480,2 (D0)
1,3 (D7)	2,3 (D6)	3,3 (D5)	4,3 (D4)	5,3 (D3)	---	---	476,3 (D4)	477,3 (D3)	478,3 (D2)	479,3 (D1)	480,3 (D0)
:	:	:	:	:	:	:	:	:	:	:	:
1,126 (D7)	2,126 (D6)	3,126 (D5)	4,126 (D4)	5,126 (D3)	---	---	476,126 (D4)	477,126 (D3)	478,126 (D2)	479,126 (D1)	480,126 (D0)
1,127 (D7)	2,127 (D6)	3,127 (D5)	4,127 (D4)	5,127 (D3)	---	---	476,127 (D4)	477,127 (D3)	478,127 (D2)	479,127 (D1)	480,127 (D0)
1,128 (D7)	2,128 (D6)	3,128 (D5)	4,128 (D4)	5,128 (D3)	---	---	476,128 (D4)	477,128 (D3)	478,128 (D2)	479,128 (D1)	480,128 (D0)

- \*1. Based on the top view of the LCD module, the 1, 1 (x, y) pixel is the upper-left pixel; the 480, 128 (x, y) pixel is the lower-right pixel.
- \*2. For the details of memory mapping please refer to RA8806 datasheet.

### 4.4 Control Data and Command

The LCD module setting is controlled by the internal Register Values.

The Register Address should be addressed when RS=1 and Register Value should be issued when RS=0.

A full command sequence should be as follow.

Steps	/RD	/WR	RS	Data (DB0~ DB7)
1 <sup>st</sup>	1	0	1	Register Address
2 <sup>nd</sup>	1	0	0	Register Value

## 4.5 Command Summary

Reg. Add	Reg. Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Descriptions
--	STATUS	R	MBUSY	SBUSY	SLEEP	--	--	WAKE_STS	KS_STS	TP_STS	<b>MBUSY: Memory Write Busy Flag</b> 1=Busy when write font or clear RAM; 0=not busy <b>SBUSY: Scan Busy Flag</b> 1=Busy when driver scan logic is not idle; 0=not busy <b>SLEEP: Sleep state</b> 1= In Sleep mode; 0=In Normal mode <b>WAKE_STS: Wakeup Status Bit</b> Same as REG[0FH] Bit2 <b>KS_STS: Key Status Bit</b> Same as REG[0FH] Bit1 <b>TP_STS: Tp Status Bit</b> Same as REG[0FH] Bit0
00h	WLCR	R/W	PWR	LINER	SR	--	CG	DP	BK	DV	<b>PWR : Power Mode</b> 1=In Sleep Mode; 0=In Normal Mode <b>LINER: linear Decode Mode</b> 1=User-defined ROM mapping rule; 0=GIG5/GB ROM mapping rule <b>SR : Software Reset</b> 1=reset all register (except DDRAM); 0=normal operation <b>CG : Display mode selection</b> 1=Character Mode; 0=Graphic Mode <b>DP : Display on off control</b> 1=normal display; 0=display off <b>BK : Full screen blinking control</b> 1=blinking (blink time is set by REG 80H); 0=normal; <b>DV : Full screen inverse control</b> 1=Inverse Full Screen; 0=Normal
01h	MISC	R/W	NO_FLICKER	CKN	BUSY_LEV	INT_LEV	XCK_SEL1	XCK_SELO	SDIR	CDIR	<b>NO_FLICKER : Eliminating Flicker</b> 1=enable, scan will auto-pending when busy; 0=disable <b>CKN : Clock Output in pin CLK_OUT</b> 1=The pin indicates SLEEP state of STATUS REG; 0=The pin output internal system clock <b>BUSY_LEV : Busy Polarity(for "BUSY" pin)</b> 1=Set Active High; 0=Set Active Low <b>INT_LEV: Interrupt Polarity (for "INT" pin)</b> 1=Set Active High; 0=Set Active Low <b>XCK_SEL[1:0] : Driver Clock Selection</b> 00=CLK/8; 01=CLK/4(Default); 10=CLK/2; 11=CLK The CLK means system clock <b>SDIR:SEG Scan Direction</b> 1=SEG order is 319~0; 0=SEG order is 0~319 <b>CDIR: COM Scan Direction</b> 1=COM order is 239~0; 0=COM order is 0~239
03h	ADSR	R/W	SCR_PEND	--	--	--	BIT_INV	SCR_DIR	SCR_HV	SCR_LEN	<b>SCR_PEND : scroll Function Pending</b> 1=Scroll function pending; 0=Scroll function keep active <b>BIT_INV : Set driver data output BIT Order</b> 1=inverse order (BIT7 to BIT0, BIT6 to BIT1, and so on); 0=Normal order <b>SCR_DIR : Scroll Direction</b> When SCR_HV=1, 1= Bottom -> Top; 0= Top -> Bottom When SCR_HV=0, 1=Right -> Left; 0=Left -> Right <b>SCR_HV : Scroll Horizontal/Vertical Selection</b> 1= Common Scrolling(Vertical); 0= Segment Scrolling(Horizontal) <b>SCR_LEN : Scroll Enable</b> 1=Scroll function enable; 0=Scroll function disable
0FH	INTR	R/W	--	WAKI_EN	KEYI_EN	TPI_EN	TP_ACT	WAK_STS	KEY_STS	TP_STS	<b>WAKI_EN : Wakeup Interrupt Mask</b> 1=enable ; 0=disable <b>KEYI_EN : Key-Scan Interrupt Mask</b> 1=enable ; 0=disable <b>TPI_EN : Touch Panel Interrupt Mask</b> 1=Generate interrupt output if TP was detected; 0=disable <b>TP_ACT : Touch Panel Event (only read)</b> 1=TP is touched;0=TP is not touched <b>WAK_STS : Wakeup Interrupt Status bit</b> 1=Indicate wake-up event happen from Sleep mode 0=Indicate no wake-up happen User must write 0 to clear the status bit <b>KEY_STS : Key-Scan Interrupt Status bit</b> 1=Key-Scan Detect Key input; 0=Key-Scan don't Delete key input User must write 0 to clear the status bit <b>TP_STS : Touch Panel Detect Status bit</b> 1= TP touched; 0=TP untouched User must write 0 to clear the status bit



## Register Table Summary (cont')

Reg. Add	Reg. Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Descriptions
10h	WCCR	R/W	CUR_INC	FULL_OFS	BIT_REV	BOLD	T90DEG	CUR_EN	CUR_BLK		<b>CUR_INC : Auto-increase Cursor Position in reading/writing DDRAM operation</b> 1=disable; 0=enable <b>FILL_OFS: Full-size and Half-size Character Alignment</b> 1=Full-size alignment in Full-size and Half-size mixed mode; 0=disable <b>BIT_REV : Reversed Data Write mode</b> 1= inversely; 0= directly <b>BOLD : Set Bold font (char mode only)</b> 1=bold; 0=normal <b>T90DEG : Font Rotate mode (Font rotated 90 degree)</b> 1=enable; 0=normal <b>CUR_EN : Cursor display control</b> 1=on; 0=off <b>CUR_BLK : Cursor blink control</b> 1=blinking; 0=normal (Blink time is determined by REG 80H)
11h	CHWI	R/W	CURH3	CURH2	CURH1	CURH0	ROWH3	ROWH2	ROWH1	ROWH0	<b>CURH[3:0] : Cursor Height (Vertical direction, horizontal is fix)</b> 0000b : Cursor height 1pixel 0001b : Cursor height 2 pixels ..... 1111b : Cursor height 16 pixels <b>ROWH[3:0] : Char Line Gap</b> 0000b : Char LineGap 1pixel 0001b : Char LineGap 2 pixels ..... 1111b : Char LineGap 16 pixels
12h	MAMR	R/W	CUR_HV	DISPMD2	DISPMD1	DISPMD0	L_MIX1	L_MIX0	MW_MD1	MW_MD0	<b>CUR_HV : Cursor Auto Shifting Direction(only Graphic Mode)</b> 1= Vertical then Horizontal; 0= Horizontal then Vertical <b>DISPMD[2:0] : Display Layer and Display Mode Selection</b> 001=page1 only(default); 010=page2 only; 011=combine two layer; 000=gray scale mode 110=extended mode1, 111=extended mode2 <b>L_MIX[1:0] : two layer mode setting</b> 00=OR; 01=XOR; 10=NOR; 11=AND <b>MW[1:0] : Layer Read/Write Selection</b> 00=CGRAM(512Byte); 01=page1; 10=page2; 11=page1 & page2 at the same time
20h	AWRR	R/W			AWR5	AWR4	AWR3	AWR2	AWR1	AWR0	<b>AWR[5:0]: Active Window Right Position -&gt;Segment-Right</b> Default Value:27h
21h	DWRR	R/W			DWW5	DWW4	DWW3	DWW2	DWW1	DWW0	<b>DWW[5:0] : Display Window Width Position -&gt; Segment-Width</b> Segment-Width = (Segment Number / 8) – 1 Default Value:27h
30h	AWBR	R/W	AWB7	AWB6	AWB5	AWB4	AWB3	AWB2	AWB1	AWB0	<b>AWT[7:0] : Active Window Bottom Position-&gt;Common-Bottom</b> Default Value: efh
31h	DWHR	R/W	DWH7	DWH6	DWH5	DWH4	DWH3	DWH2	DWH1	DWH0	<b>DWH[7:0] : Display Window Bottom Position-&gt;Common-Height</b> Common-Height = LCD Common Number – 1 Default Value: efh
40h	AWLR	R/W			AWL5	AWL4	AWL3	AWL2	AWL1	AWL0	<b>AWL[5:0] : Active Window Left Position-&gt; Segment-Left</b> Default Value:00h
50h	AWTR	R/W	AWT7	AWT6	AWT5	AWT4	AWT3	AWT2	AWT1	AWT0	<b>AWT[7:0] : Active Window Top Position -&gt; Common- Top</b> Default Value:00h
60h	CURX	R/W			CURX5	CURX4	CURX3	CURX2	CURX1	CURX0	<b>CURX[5:0] : Cursor Position of Segment /CGRAM address[4:0]</b>
61h	BGSG	R/W			BGSG5	BGSG4	BGSG3	BGSG2	BGSG1	BGSG0	<b>BGSG[5:0] : Segment Start Position of Scrolling Mode</b>

## Register Table Summary (cont')

Reg. Add	Reg. Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Descriptions
62h	EDSG	R/W	--	--	EDSG5	EDSG4	EDSG3	EDSG2	EDSG1	EDSG0	<b>EDSG[5:0] : Segment End Position of Scrolling Mode</b>
70h	CURY	R/W	CURY7	CURY6	CURY5	CURY4	CURY3	CURY2	CURY1	CURY0	<b>RC7-RC0 : Cursor Position of Common /CGRAM address[8:5]</b>
71h	BGCM	R/W	BGCM7	BGCM6	BGCM5	BGCM4	BGCM3	BGCM2	BGCM1	BGCM0	<b>BGCM[7:0] : Common Start Position of Scrolling Mode</b>
72h	EDCM	R/W	EDCM7	EDCM6	EDCM5	EDCM4	EDCM3	EDCM2	EDCM1	EDCM0	<b>EDCN[7:0] : Common Ending Position of Scrolling Mode</b>
80h	BTMR	R/W	BLKT7	BLKT6	BLKT5	BLKT4	BLKT3	BLKT2	BLKT1	BLKT0	<b>BLKT[7:0] : Cursor Blink Time and Scroll Time</b> Blinking Time = Bit[7:0] x (Frame width) Frame width = 1 / Frame Rate
90h	ITCR	R/W	ITC7	ITC6	ITC5	ITC4	ITC3	ITC2	ITC1	ITC0	<b>ITC[7:0] : Idle Time Setting, In count of system clock</b> FR_time = COM_NO x (SEG_NO / 4 + ITC) / XCK FR_time = 1 / Frame Rate
A0h	KSCR1	R/W	KEY_EN	KEY4X8	KSAMP1	KSAMP0	LKEY_EN	KF2	KF1	KF0	<b>KSCR1[7] : Key Scan Enable</b> 1=enable, 0=disable <b>KSCR1[6] : Key Scan Enable</b> 1 : 4x8 Matrix(KOUT[3:0] is used, KOUT[7:4] please keep floating) 0 : 8x8 Matrix(KOUT[7:0] is used) <b>KSCR1[5:4] : Key Scan Data Sampling Times</b> 00: 4, 01: 8, 10: 16, 11:32 <b>KSCR1[3] : Long Time Key Function</b> 1=enable, 00=disable <b>KSCR1[2:0] : Key Scan Freq</b>
A1h	KSCR2	R/W	KWAK_EN	--	--	--	LKEY_T1	LKEY_T0	KEYNO1	KEYNO0	<b>KSCR2[7] : Key Scan Wakeup Function</b> 1=enable, 0=disable <b>KSCR2[3:2] : Long Key Timing Adjustment</b> <b>KSCR2[1:0] : Number of Key Hit</b>
A2h	KSDR0	R	KSD07	KSD06	KSD05	KSD04	KSD03	KSD02	KSD01	KSD00	<b>KSDR0[7:0] : Key Strobe Data</b>
A3h	KSDR1	R	KSD17	KSD16	KSD15	KSD14	KSD13	KSD12	KSD11	KSD10	<b>KSDR1[7:0] : Key Strobe Data</b>
A4h	KSDR2	R	KSD27	KSD26	KSD25	KSD24	KSD23	KSD22	KSD21	KSD20	<b>KSDR2[7:0] : Key Strobe Data</b>
B0h	MWCR	W	MWD7	MWD6	MWD5	MWD4	MWD3	MWD2	MWD1	MWD0	<b>MWD[7:0] : The Data is written to memory under the cursor position</b>
B1h	MRCR	R	MRD7	MRD6	MRD5	MRD4	MRD3	MRD2	MRD1	MRD0	<b>MRD[7:0] : The Data is Read from memory under the cursor position</b>
C0h	TPCR1	R/W	TP_EN	TP_SMP2	TP_SMP1	TP_SMP0	TPWAK_EN	ACK2	ACK1	ACK0	<b>TPCR1[7] : Touch Panel Enable</b> 1=enable, 0=disable <b>TPCR1[6:4] : Touch Panel Sample Time adjustment</b> <b>TPCR1[3] : Touch Panel Wake-Up</b> 1=enable, 0=disable <b>TPCR1[2:0] : Touch Panel ADC Convert Speed</b>
C1h	TPXR	R	TPX9	TPX8	TPX7	TPX6	TPX5	TPX4	TPX3	TPX2	<b>TPXR[7:0] : Touch Panel X Data Bit[9:2]</b>
C2h	TPYR	R	TPY9	TPY8	TPY7	TPY6	TPY5	TPY4	TPY3	TPY2	<b>TPYR[7:0] : Touch Panel Y Data Bit[9:2]</b>

## Register Table Summary (cont')

C3h	TPZR	R	--	--	--	--	TPY1	TPY0	TPX1	TPX0	TPZR[3:2] : Touch Panel Y Data Bit[1:0] TPZR[1:0] : Touch Panel X Data Bit[1:0]
C4h	TPCR2	R/W	MTP_MD	--	--	--	--	--	MTP_PH1	MTP_PH2	TPCR2[7] : TP Manual Mode 1=manual mode, 0=auto mode TPCR2[1:0] : TP manual mode Options
E0h	PNTR	R/W	PND7	PND6	PND5	PND4	PND3	PND2	PND1	PND0	PND[7:0] : Data Written to DDRAM when REGF0H Bit3=1
F0h	FNCR	R/W	ISO8859_EN	--	--	--	MCLR	ASC	ASC_SEL1	ASC_SELO	ISO8859_EN : ISO8859 Mode 1=disable; 0=enable MCLR : Memory Clear function 1=enable fill data of REG E0H to DDRAM under Active Window area; 0=no action; ASC : Font ROM range select 1=decode as ASCII; 0=auto treat as ASCII or GB ASC_SEL[1:0] : ASCII Block Selection 00=map to ASCII block 1; 01=map to ASCII block 2; 10=map to ASCII block 3; 11=map to ASCII block 4
F1h	FVHT	R/W	FH1	FH0	FV1	FV0	1	1	1	1	FH1~FV0 : Font Horizontal Size 00=1x; 01=2x; 10=3x; 11=4x FV1~FV0 : Font Vertical Size 00=1x; 01=2x; 10=3x; 11=4x

### Note:

- \*1. It is suggested to check the BUSY before sending the Control Data.
- \*2. For the details, please refer to RA8806 Data sheet.

## 5. Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. dropping from high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free from twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module without power supply.
16. IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
17. LCD module reliability may be reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module