

**LC86F1216A****8-Bit Single Chip Microcontroller with  
16K-Byte ROM and 1220-Byte RAM On Chip****Preliminary****Overview**

The LC86F1216A is an 8-bit single chip microcontroller with the following on-chip functional blocks:

- CPU: Operable at a minimum bus cycle time of 0.5μs
  - On-chip Flash EEPROM capacity: 144 Kbytes
  - On-chip RAM capacity: 1222 bytes
  - Dot matrix liquid crystal display controller / driver
  - 16-bit timer/counter (or two channels × 8-bit timer)
  - 16-bit timer/PWM (or two channels × 8-bit timer)
  - Serial interface circuit

All of the above functions are fabricated on a single chip.

**Features**

- (1)Flash EEPROM:
  - 64K × 8 bits: (program/data area) + 64K × 8 bits (data area)
  - 16K × 8 bits: (program area)
- (2) Mask ROM:
  - 4K × 8 bits: (4K: BIOS program area)
- (3) Random Access Memory (RAM):
  - 512 × 8 bits (calculation area) + 512 × 8 bits
  - 198 × 8 bits (display area)

## (4) Bus Cycle Time

Bus Cycle Time	Cycle Time	System Clock Oscillation	Oscillation Frequency	Voltage	Notes
0.5μs	1.0μs	Ceramic	6MHz	3.15–3.85V	OCR7 = 1
3.8μs	7.5μs	External RC	600kHz		OCR7 = 1
93μs	183μs	X'tal	32.768kHz		OCR7 = 1

*Note: Bus cycle time means cycle time of reading ROM. OCR7: Bit 7 of the oscillation control register*

## (5) Ports

- Input / Output Ports: 2 ports (16 terminals)
- Input port: 1 port (4 terminals)

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- (6) Dot matrix liquid crystal display controller / driver
- Display duty: 1/33 duty
  - Display bias: 1/5 bias
  - LCD power supply (max. 6V)
  - LCD driver (max. 1584 dots capability)
    - Common output ports: 33 ports
    - Segment output ports: 48 ports
  - Externally boosted clock
- (7) Serial interfaces
- Synchronous 8-bit serial interface × 2 (with 8-bit baud rate generator)
- (8) Timers
- Timer 0 (TOH/TOL)
    - 16-bit timer/counter
  - Timer 1 (T1H/T1L)
    - 16-bit timer/PWM
- (9) Interrupts
- 13 sources 10 vectored interrupts
- (10) Sub-routine stack level
- A maximum of 128 levels (stack is built in the internal RAM)
- (11) 3 oscillation circuits
- External RC oscillation circuit / CF oscillation circuit / X'tal oscillation circuit
- (12) Power voltage
- VDD = 3.15V – 3.85V
- (13) Shipping form
- Chip or SQFP144
- (14) Flash memory
- Erasing block unit size: 128 bytes
  - Erasing / writing voltage range: 3.15V – 5.5V
  - Maximum number of erase-write cycle: 50,000 times (Ta = +25°C) (with memory management program)

**Note**

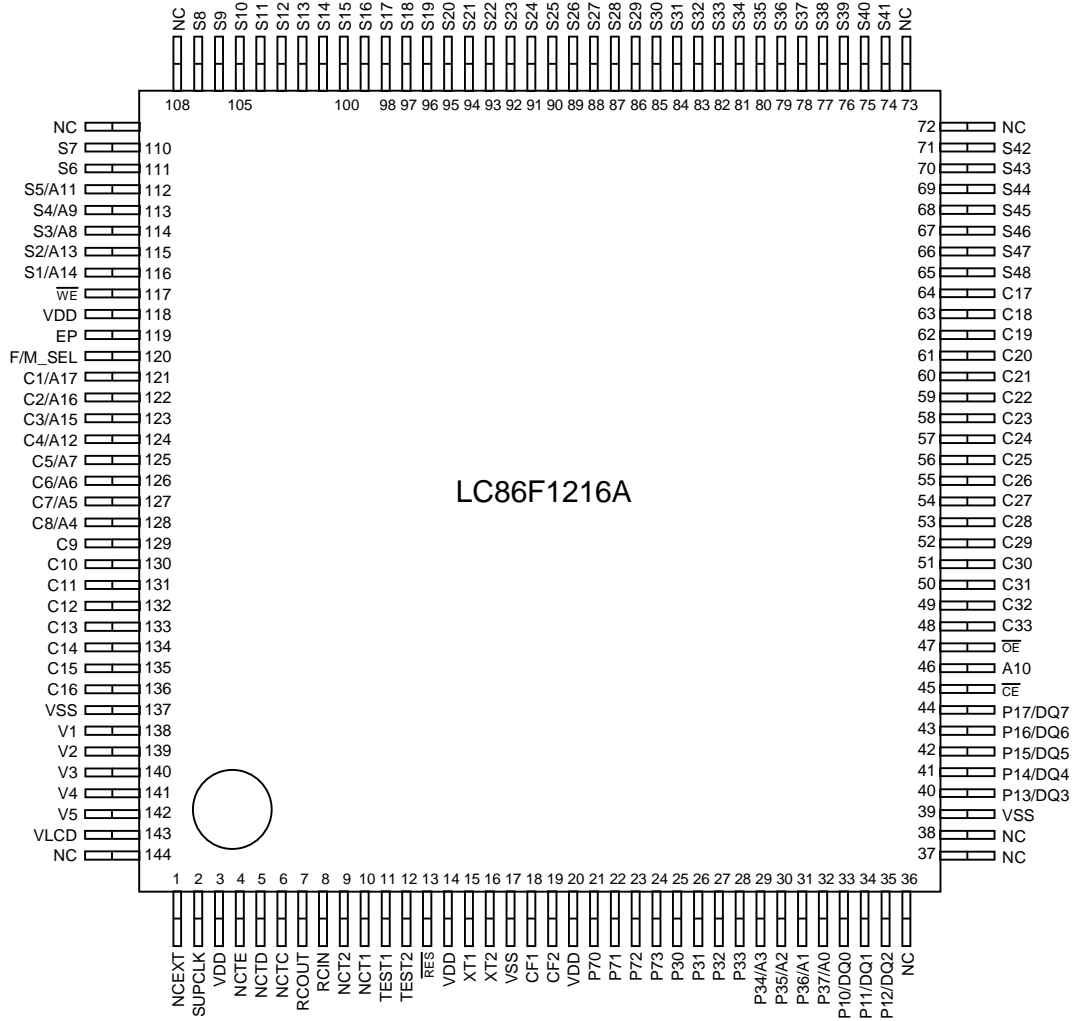
*The microcontroller will malfunction if the power supply voltage is less than the specified operable supply voltage. To prevent a malfunction, the low voltage detect circuit should be connected externally, and the voltage should always be set to the proper level. If the power supply voltage becomes lower than the voltage which is detected by the low voltage detect reset IC, then the microcontroller should be reset to restore stable operation. Use the low voltage detect reset IC which detects the lowest specification voltage of the power supply.*

*We cannot ensure the integrity of the block data, if the microcontroller is reset while writing to the flash memory. Therefore, in such a case, we recommend disabling any flash writing operation by user's program when the voltage decreases to a level just above the voltage which is detected by the low voltage detect reset IC.*

# LC86F1216A

## Pin Assignment

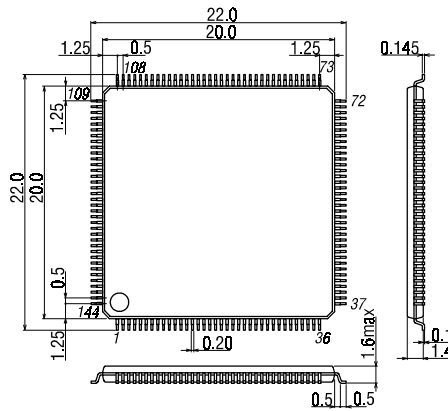
SQFP144



## Package Dimension

(unit : mm)

3214



SANYO : SQFP-144

Pad Assignment

	S8		103		
	S9		102		
	S10		101		
	S11		100		
	S12		99		
	S13		98		
	S14		97		
	S15		96		
	S16		95		
	S17		94		
	S18		93		
	S19		92		
	S20		91		
	S21		90		
	S22		89		
	S23		88		
	S24		87		
	S25		86		
	S26		85		
	S27		84		
	S28		83		
	S29		82		
	S30		81		
	S31		80		
	S32		79		
	S33		78		
	S34		77		
	S35		76		
	S36		75		
	S37		74		
	S38		73		
	S39		72		
	S40		71		
	S41		70		
S7			104	69	S42
S6			105	68	S43
S5/A11			106	67	S44
S4/A9			107	66	S45
S3/A8			108	65	S46
S2/A13			109	64	S47
S1/A14			110	63	S48
WE			111	62	C17
VDD			112	61	C18
EP			113	60	C19
F/M_SEL			114	59	C20
C1/A17			115	58	C21
C2/A16			116	57	C22
C3/A15			117	56	C23
C4/A12			118	55	C24
C5/A7			119	54	C25
C6/A6			120	53	C26
C7/A5			121	52	C27
C8/A4			122	51	C28
C9			123	50	C29
C10			124	49	C30
C11			125	48	C31
C12			126	47	C32
C13			127	46	C33
C14			128	45	OE
C15			129	44	A10
C16			130	43	CE
VSS			131	42	P17/DQ7
V1			132	41	P16/DQ6
V2			133	40	P15/DQ5
V3			134	39	P14/DQ4
V4			135	38	P13/DQ3
V5			136	37	VSS
VLCD			137	36	VSS
	1		35		
NEXT			34		
SUPCLK			33		
VDD			32		
NCTE			31		
NCTD			30		
NCTC			29		
RCOUT			28		
RCIN			27		
NCT2			26		
NCT1			25		
TEST1			24		
TEST2			23		
RES			22		
VDD			21		
XT1			20		
XT2			19		
VSS			18		
CF1			17		
CF2			16		
VDD			15		
P70			14		
P71			13		
P72			12		
P73			11		
P30			10		
P31			9		
P32			8		
P33			7		
P34/A3			6		
P35/A2			5		
P36/A1			4		
P37/A0			3		
P10/DQ0			2		
P11/DQ1			1		
P12/DQ2			0		

## Pad Name and Coordinates Table

PAD No.	Pin Name	X-cord	Y-cord	SQFP-144	PAD No.	Pin Name	X-cord	Y-cord	SQFP-144	PAD No.	Pin Name	X-cord	Y-cord	SQFP-144
1	NCEXT	-2965	-3540	1	47	C32	3333	-698	49	93	S18	-1139	3539	97
2	SUPCLK	-2791	-3540	2	48	C31	3333	-524	50	94	S17	-1313	3539	98
3	VDD	-2617	-3540	3	49	C30	3333	-350	51	95	S16	-1486	3539	99
4	NCTE	-2443	-3540	4	50	C29	3333	-176	52	96	S15	-1660	3539	100
5	NCTD	-2269	-3540	5	51	C28	3333	-2	53	97	S14	-1834	3539	101
6	NCTC	-2096	-3540	6	52	C27	3333	171	54	98	S13	-2008	3539	102
7	RCOUT	-1922	-3540	7	53	C26	3333	345	55	99	S12	-2182	3539	103
8	RCIN	-1748	-3540	8	54	C25	3333	519	56	100	S11	-2356	3539	104
9	NCT2	-1574	-3540	9	55	C24	3333	693	57	101	S10	-2530	3539	105
10	NCT1	-1400	-3540	10	56	C23	3333	867	58	102	S9	-2703	3539	106
11	TEST1	-1226	-3540	11	57	C22	3333	1041	59	103	S8	-2877	3539	107
12	TEST2	-1052	-3540	12	58	C21	3333	1215	60	104	S7	-3333	2992	110
13	RES#	-879	-3540	13	59	C20	3333	1388	61	105	S6	-3333	2818	111
14	VDD	-705	-3540	14	60	C19	3333	1562	62	106	S5/A11	-3333	2644	112
15	XT1	-531	-3540	15	61	C18	3333	1736	63	107	S4/A9	-3333	2470	113
16	XT2	-357	-3540	16	62	C17	3333	1910	64	108	S3/A8	-3333	2296	114
17	VSS	-183	-3540	17	63	S48	3333	2084	65	109	S2/A13	-3333	2122	115
18	CF1	-9	-3540	18	64	S47	3333	2258	66	110	S1/A14	-3333	1949	116
19	CF2	165	-3540	19	65	S46	3333	2432	67	111	WE#	-3333	1749	117
20	VDD	338	-3540	20	66	S45	3333	2605	68	112	VDD	-3333	1549	118
21	P70	512	-3540	21	67	S44	3333	2779	69	113	EP	-3333	1375	119
22	P71	686	-3540	22	68	S43	3333	2953	70	114	F/MSEL	-3333	1202	120
23	P72	860	-3540	23	69	S42	3333	3127	71	115	C1/A17	-3333	1010	121
24	P73	1034	-3540	24	70	S41	2860	3539	74	116	C2/A16	-3333	836	122
25	P30	1208	-3540	25	71	S40	2686	3539	75	117	C3/A15	-3333	662	123
26	P31	1382	-3540	26	72	S39	2512	3539	76	118	C4/A12	-3333	488	124
27	P32	1556	-3540	27	73	S38	2339	3539	77	119	C5/A7	-3333	314	125
28	P33	1729	-3540	28	74	S37	2165	3539	78	120	C6/A6	-3333	140	126
29	P34/A3	1903	-3540	29	75	S36	1991	3539	79	121	C7/A5	-3333	-34	127
30	P35/A2	2077	-3540	30	76	S35	1817	3539	80	122	C8/A4	-3333	-207	128
31	P36/A1	2251	-3540	31	77	S34	1643	3539	81	123	C9	-3333	-381	129
32	P37/A0	2425	-3540	32	78	S33	1469	3539	82	124	C10	-3333	-555	130
33	P10/DQ0	2599	-3540	33	79	S32	1295	3539	83	125	C11	-3333	-729	131
34	P11/DQ1	2773	-3540	34	80	S31	1122	3539	84	126	C12	-3333	-903	132
35	P12/DQ2	2946	-3540	35	81	S30	948	3539	85	127	C13	-3333	-1077	133
36	VSS	3333	-2756	39	82	S29	774	3539	86	128	C14	-3333	-1251	134
37	VSS	3333	-2582	39	83	S28	600	3539	87	129	C15	-3333	-1425	135
38	P13/DQ3	3333	-2408	40	84	S27	426	3539	88	130	C16	-3333	-1598	136
39	P14/DQ4	3333	-2234	41	85	S26	252	3539	89	131	VSS	-3333	-1772	137
40	P15/DQ5	3333	-2061	42	86	S25	78	3539	90	132	V1	-3333	-1946	138
41	P16/DQ6	3333	-1887	43	87	S24	-95	3539	91	133	V2	-3333	-2120	139
42	P17/DQ7	3333	-1713	44	88	S23	-269	3539	92	134	V3	-3333	-2294	140
43	CE#	3333	-1539	45	89	S22	-443	3539	93	135	V4	-3333	-2468	141
44	A10	3333	-1365	46	90	S21	-617	3539	94	136	V5	-3333	-2642	142
45	OE#	3333	-1191	47	91	S20	-791	3539	95	137	VLCD	-3333	-2815	143
46	C33	3333	-872	48	92	S19	-965	3539	96					

## Terminal Function

Terminal	Pin No.	Pad No.	Input/ Output	Function Description																		
VSS	17,39,137	17,36-37,131	-	·Negative power supply																		
VDD	3,14,20,118	3,14,20,112	-	·Positive power supply																		
VLCD	143	137	-	·Positive power supply (power supply for LCD driver)																		
V1-5	138-142	132-136	-	·Power supply for LCD driver																		
PORT3	25-32	25-32	I/O	·8 bit I/O port (Output format: CMOS with pull-up resistor: P30-P37) ·I/O programmable for each bit individually ·Used for switch input ·Key interrupt input																		
PORT1	33-35 40-44	33-35 38-42	I/O	·8 bit I/O port (Output format: CMOS: P16, P17 Nch-OD: P10, P11, P12, P13, P14, P15) (pull-up resistor: P10 - P17) ·I/O programmable for each bit individually ·Other functions																		
				<table border="1"> <thead> <tr> <th>Terminal</th> <th>Serial</th> </tr> </thead> <tbody> <tr> <td>P10</td> <td>Serial OUT0</td> </tr> <tr> <td>P11</td> <td>Serial IN0</td> </tr> <tr> <td>P12</td> <td>Serial Clock0</td> </tr> <tr> <td>P13</td> <td>Serial OUT1</td> </tr> <tr> <td>P14</td> <td>Serial IN1</td> </tr> <tr> <td>P15</td> <td>Serial Clock1</td> </tr> <tr> <td>P16</td> <td>Buzzer output</td> </tr> <tr> <td>P17</td> <td>Timer1 output (PWM output)</td> </tr> </tbody> </table>	Terminal	Serial	P10	Serial OUT0	P11	Serial IN0	P12	Serial Clock0	P13	Serial OUT1	P14	Serial IN1	P15	Serial Clock1	P16	Buzzer output	P17	Timer1 output (PWM output)
Terminal	Serial																					
P10	Serial OUT0																					
P11	Serial IN0																					
P12	Serial Clock0																					
P13	Serial OUT1																					
P14	Serial IN1																					
P15	Serial Clock1																					
P16	Buzzer output																					
P17	Timer1 output (PWM output)																					
PORT7	21-24	21-24	I	·4bit input port (pull-up resistor: P70 - P73) ·External interrupt function ·Input only																		
C01-C33	121-136 64-48	115-130 62-46	O	·LCD controller Common output terminals																		
S01-S48	116-110 107-74 71-65	110-63	O	·LCD controller Segment output terminals																		
SUPCK	2	2	O	·Externally boosted clock output terminal																		
CF1	18	18	I	·Input terminal for ceramic resonator																		
CF2	19	19	O	·Output terminal for ceramic resonator																		
XT1	15	15	I	·Input terminal for 32.768kHz X'tal																		
XT2	16	16	O	·Output terminal for 32.768kHz X'tal																		
RCIN	8	8	I	·Input terminal for RC oscillation Connect R between RCIN and RCOU, and C between RCIN and VSS.																		
RCOU	7	7	O	·Output terminal for RC oscillation Connect R between RCOU and RCIN.																		
RES	13	13	I	·Reset terminal																		
TEST1	11	11	-	·Test terminal Leave open circuit.																		
TEST2	12	12	-	·Test terminal Leave open circuit.																		

Continued.

**LC86F1216A**

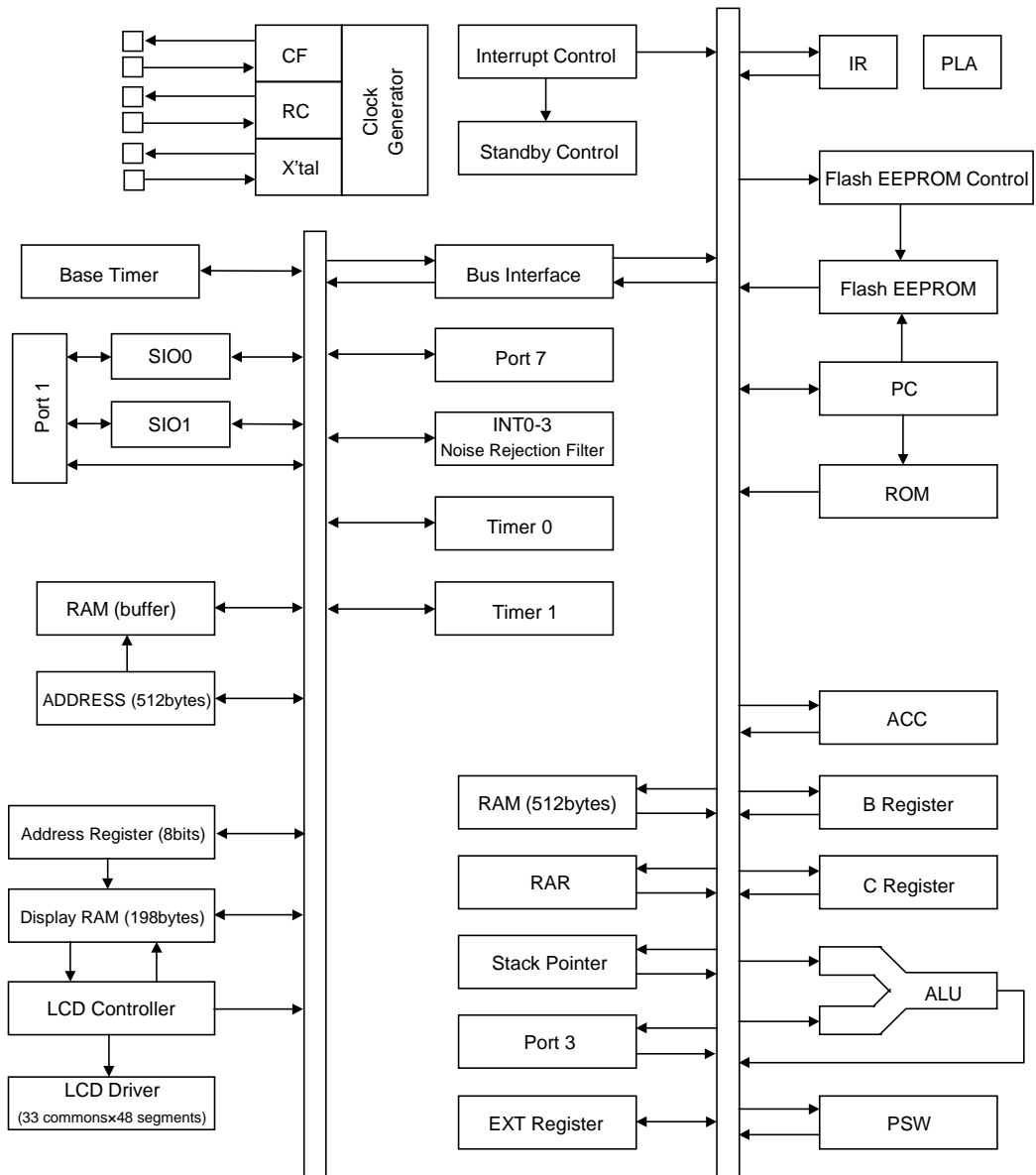
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Terminal	Pin No.	Pad No.	Input/ Output	Function Description
NCT1, NCT2, NCTC, NCTD, NCTE	10,9, 6,5 4	10,9 6,5 4	-	·Test terminal    Leave open circuit.
$\overline{CE}$ , $\overline{OE}$ , $\overline{WE}$	45,47,117	43,45	I	·Memory test terminal    Pull up to VDD.
EP, A10	119,46	113,44	I	·Memory test terminal    Leave open circuit.
F/M_SEL	120	114	I	·Connect to VDD.
NC	36,37,38, 72,73,108, 109,144		-	·Unused terminal    Leave open circuit.
NCEXT	1	1	I	·Test terminal Connect this terminal to VSS.

**\*Initial Port Status**

Terminal	Input/Output	Pull-up Resistor Status
Port1	I	Programmable pull-up resistor: OFF
Port3	I	Programmable pull-up resistor: OFF

System Block Diagram





1. Absolute Maximum Ratings at Ta=+25°C, VSS=0V

Parameter	Symbol	Pins	Conditions	Ratings			Unit		
				VDD[V]	Min.	Typ.		Max.	
Supply voltage	VDDMAX	VDD			-0.3	to	+6.0	V	
Input voltage	VI(1)	Port 71, 72, 73 RES			-0.3	to	VDD+0.3		
	VI(2)	VLCD			-0.3	to	+6.5		
Output voltage	VO(1)	C1 to C33 S1 to S48			-0.3	to	VLCD+0.3		
	VO(2)	TEST1, TEST2, SUPCK			-0.3	to	VDD+0.3		
Input/output voltage	VIO(1)	Port 1, 3 Port 70 TEST1			-0.3	to	VDD+0.3		
High level output current	Peak output current	IOPH(1)	Port 1, 3 TEST1, TEST2, SUPCK	·CMOS output ·For each pin	-4			mA	
	Total output current	ΣIOAH(1)	Port 3 C1 to C33, S1 to S48 TEST1, TEST2, SUPCK	Total of all pins	-25				
		ΣIOAH(2)	Port 1	Total of all pins	-25				
Low level output current	Peak output current	IOPL(1)	Port 1, 3 TEST1, TEST2, SUPCK	For each pin			20		
		IOPL(2)	Port 70	For each pin			15		
	Total output current	ΣIOAL(1)	Port 1	Total of all pins				40	
		ΣIOAL(2)	TEST1, TEST2, SUPCK	Total of all pins				40	
		ΣIOAL(3)	Port 70	Total of all pins				15	
		ΣIOAL(4)	C1 to C33, S1 to S48	Total of all pins				30	
ΣIOAL(5)	Port 70	Total of all pins				15			
Maximum power consumption	Pdmax	SQFP144	Ta = 0°C to +50°C				400	mW	
Operating temperature range	Topr				0		+50	°C	
Storage temperature range	Tstg				-55		+125		

2. Recommended Operating Range at Ta=0°C to +50°C, VSS=0V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				VDD[V]	Min.	Typ.		Max.
Operating supply voltage range	VDD(1)	VDD	$98\mu\text{s} \leq t_{\text{CYC}} \leq 400\mu\text{s}$		3.15		3.85	V
Hold voltage	VHD	VDD	RAM and register data are kept in HOLD mode.		2.0		3.85	
LCD voltage	VLCD	VLCD		3.15-3.85	VDD		6.0	
High level input voltage	VIH(1)	·Port 1, 3 ·Port 72, 73 (schmitt)	Output disable	3.15-3.85	0.7VDD		VDD	
	VIH(2)	·P70 port input/interrupt ·P71 $\overline{\text{RES}}$ (schmitt)	Output N-ch Tr.: OFF	3.15-3.85	0.7VDD		VDD	
Low level input voltage	VIL(1)	·Port 1, 3 ·Port 72, 73 (schmitt)	Output disable	3.15-3.85	VSS		0.3VDD	
	VIL(2)	·P70 port input/interrupt ·P71 $\overline{\text{RES}}$ (schmitt)	Output N-ch Tr.: OFF	3.15-3.85	VSS		0.3VDD	
Operation cycle time	tCYC			3.15-3.85	0.98		400	$\mu\text{s}$

## 3. Electrical Characteristics at Ta=0°C to +50°C, VSS=0V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				VDD[V]	Min.	Typ.		Max.
High level input current	I <sub>IH</sub> (1)	Port 1, 3	·Output disable ·Pull-up MOS Tr.: OFF ·VIN=VDD (including OFF state leak current of output Tr.)	3.15–3.85			1	μA
	I <sub>IH</sub> (2)	Port 7 without pull-up MOS Tr.	·Output N-ch Tr.: OFF ·VIN=VDD (including OFF state leak current of output Tr.)	3.15–3.85			1	
	I <sub>IH</sub> (3)	$\overline{RES}$	VIN=VDD	3.15–3.85			1	
	I <sub>IH</sub> (4)	$\overline{CE}$ , $\overline{OE}$ , $\overline{WE}$	VIN=VDD	3.15–3.85			1	
Low level input current	I <sub>IL</sub> (1)	Port 1,3	·Output disable ·Pull-up MOS Tr.: OFF ·VIN=VSS (including OFF state leak current of output Tr.)	3.15–3.85	-1			
	I <sub>IL</sub> (2)	Port 7 without pull-up MOS Tr.	·Output N-ch Tr.: OFF ·VIN=VSS (including OFF state leak current of output Tr.)	3.15–3.85	-1			
	I <sub>IL</sub> (3)	$\overline{RES}$	VIN=VSS	3.15–3.85	-1			
	I <sub>IL</sub> (4)	A10, EP, F/M_SEL $\overline{CE}$ , $\overline{OE}$ , $\overline{WE}$	VIN=VSS	3.15–3.85	-1			
High level output voltage	V <sub>OH</sub> (1)	Port 0, 1, 3: CMOS output TEST1, TEST2, SUPCK	I <sub>OH</sub> =-0.1mA	3.15–3.85	VDD-0.5			V
Low level output voltage	V <sub>OL</sub> (1)	Port 1,3 TEST1, TEST2, SUPCK	·I <sub>OL</sub> =1mA ·I <sub>OL</sub> at any single pin is not over 1mA.	3.15–3.85			0.4	
	V <sub>OL</sub> (2)	Port 70	I <sub>OL</sub> =0.5mA	3.15–3.85			0.4	
Pull-up MOS Tr. resistance	R <sub>pu</sub>	Port 1, 3, Port 7	V <sub>OH</sub> =0.9VDD	3.15–3.85	20	60	120	kΩ
Pull-down MOS Tr. resistance	R <sub>pd</sub>	A10, EP, F/M_SEL	V <sub>OL</sub> =0.1VDD	3.15–3.85	25	50	100	
Hysteresis voltage	V <sub>HIS</sub>	Port 1, 3 Port 7 $\overline{RES}$	Output disable	3.15–3.85		0.1VDD		V
Pin capacitance	CP	All pins	·f=1MHz ·Every other terminal is connected to VSS. ·Ta=+25°C	3.15–3.85		10		pF

4. Serial Input/Output Characteristics at Ta=0°C to +50°C, VSS=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			Unit	
					Min.	Typ.	Max.		
Serial clock	Input clock	Cycle	tCKCY(1)	SCK0, SCK1	Refer to figure 5.	3.15-3.85	2		tCYC
		Low level pulse width	tCKL(1)				1		
		High level pulse width	tCKH(1)				1		
	Output clock	Cycle	tCKCY(2)	SCK0, SCK1	Refer to figure 5.	3.15-3.85	2		
		Low level pulse width	tCKL(2)					1/2tCYC	
		High level pulse width	tCKH(2)					1/2tCYC	
Serial input	Data set-up time	tICK	·SI0, SI1 ·SB0, SB1	·Data set-up to SCK0 and SCK1	3.15-3.85	0.4		μs	
	Data hold time	tCKI		·Refer to figure 5.	3.15-3.85	0.4			
Serial output	Output delay time (Using external clock)	tCKO(1)	·SO0, SO1 ·SB0, SB1	·Data hold from SCK0 and SCK1 ·Refer to figure 5.	3.15-3.85			7/12tCYC +1	μs
	Output delay time (Using internal clock)	tCKO(2)	·SO0, SO1 ·SB0, SB1	·Data hold from SCK0 and SCK1 ·Refer to figure 5.	3.15-3.85			1/3tCYC +1	

5. Pulse Input Conditions at Ta=0°C to +50°C, VSS=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			Unit
					Min.	Typ.	Max.	
High/low level pulse width	tPIH(1)	·INT0, INT1	·Interrupt acceptable ·Timer 0-countable ·Refer to figure 6.	3.15-3.85	1			tCYC
	tPIL(1)	·INT2/T0IN						
	tPIH(2)	·INT3/T0IN	·Interrupt acceptable ·Timer 0-countable	3.15-3.85	2			
	tPIL(2)	(1/1 is selected for noise rejection clock.) ·Refer to figure 6.						
tPIH(3)	·INT3	·Interrupt acceptable	3.15-3.85	128				
tPIL(3)	(1/64 is selected for noise rejection clock.) ·Refer to figure 6.							
	tPIL(4)	·RES	·Reset acceptable	3.15-3.85	200			μs

6. Sample Current Consumption Characteristics at Ta=0°C to +50°C, VSS=0V

The sample current consumption characteristics are the measurement result of Sanyo provided evaluation board.  
The currents through the output transistors and the pull-up MOS transistors are ignored.

• Flash Memory Operation

Parameter	Symbol	Pins	Conditions	Ratings			Unit		
				OCR7	VDD[V]	Min.		Typ.	Max.
Current consumption during normal operation (Note 1)	IDDOP(6)	VDD	·FmCF=6MHz by ceramic resonator ·FsX'tal=32.768kHz by X'tal ·System clock: CF oscillation ·RC oscillation stops.	1	3.15-3.85		8	20	mA
	IDDOP(7)			0			2.0	4	
	IDDOP(8)			1			2.5	5	
	IDDOP(9)			0		3.15-3.85		200	
	IDDOP(10)	1		450	75				
			·FmCF=0Hz (No oscillation) ·FsX'tal=32.768kHz by X'tal ·System clock: RC oscillation				0	0	μA

• BIOS Program Operation

Parameter	Symbol	Pins	Conditions	Ratings			Unit			
				OCR7	VDD[V]	Min.		Typ.	Max.	
Current consumption during writing to flash memory (Note 1)	IDDOP(11)	VDD	·FmCF=6MHz by ceramic resonator ·FsX'tal=32.768kHz by X'tal ·System clock: CF oscillation ·RC oscillation stops.	1	3.15-3.85		8	15	mA	
	IDDOP(12)			0		3.15-3.85		4.5		10
				1				5		12
			·FmCF=0Hz (No oscillation) ·FsX'tal=32.768kHz by X'tal ·System clock: RC oscillation							

\*OCR7: Bit 7 of the oscillation control register

• BIOS Program Operation

Parameter	Symbol	Pins	Conditions	Ratings			Unit		
				OCR7	VDD[V]	Min.		Typ.	Max.
Current consumption in HALT mode <i>(Note 1)</i>	IDDHALT(1)	VDD	·HALT mode ·FmCF=6MHz by ceramic resonator ·FsX'tal=32.768kHz by X'tal ·System clock: CF oscillation ·RC oscillation stops. ·Refer to figure 7.	1	3.15-3.85		2.5	5	mA
	IDDHALT(2)		·HALT mode	0	3.15-3.85		250	600	μA
	IDDHALT(3)		·FmCF=0Hz (No oscillation) ·FsX'tal=32.768kHz by X'tal ·System clock: RC oscillation ·Refer to figure 7.	1			350	700	
	IDDHALT(4)		·HALT mode	0	3.15-3.85		15	50	μA
	IDDHALT(5)		·FmCF=0Hz (No oscillation) ·FsX'tal=32.768kHz by X'tal ·System clock: X'tal ·RC oscillation stops. ·Refer to figure 7.	1			20	70	
Current consumption in HOLD mode <i>(Note 1)</i>	IDDHOLD(1)	VDD	·HOLD mode ·Refer to figure 7.		3.15-3.85		0.05	30	

• Flash Memory Operation

Parameter	Symbol	Pins	Conditions	Ratings			Unit		
				OCR7	VDD[V]	Min.		Typ.	Max.
Current consumption in HALT mode <i>(Note 1)</i>	IDDHALT(6)	VDD	·HALT mode ·FmCF=6MHz by ceramic resonator ·FsX'tal=32.768kHz by X'tal ·System clock: CF oscillation ·RC oscillation stops. ·Refer to figure 7.	1	3.15-3.85		2.5	5	mA
	IDDHALT(7)		·HALT mode	0	3.15-3.85		200	50	μA
	IDDHALT(8)		·FmCF=0Hz (No oscillation) ·FsX'tal=32.768kHz by X'tal ·System clock: RC oscillation ·Refer to figure 7.	1			400	80	
	IDDHALT(9)		·HALT mode	0	3.15-3.85		15	50	μA
	IDDHALT(10)		·FmCF=0Hz (No oscillation) ·FsX'tal=32.768kHz by X'tal ·System clock: X'tal ·RC oscillation stops. ·Refer to figure 7.	1			20	70	

Note 1: The current through the output transistors, the pull-up MOS transistors, and the bleeder resistors for the display power supply are ignored.

## 7. LCD Driver Characteristics at Ta=0°C to +50°C, VSS=0V

Parameter	Symbol	Pins, Conditions	Ratings			Unit	
			VDD[V]	Min.	Typ.		Max.
Voltage drop between Vx and Ci (x: 1-5) (i: 1-33)	VD1	-.15μA (only on Ci terminal) -LCD: ON -1/5 bias -V5=VDD	3.3			120	mV
Voltage drop between Vx and Ci (x: 1-5) (i: 1-33)	VD2	+.15μA (only on Ci terminal) -LCD: ON -1/5 bias -V5=VDD	3.3	-120			
Voltage drop between Vx and Si (x: 1-5) (i: 1-48)	VD3	-.15μA (only on Si terminal) -LCD: ON -1/5 bias -V5=VDD	3.3			120	
Voltage drop between Vx and Si (x: 1-5) (i: 1-48)	VD4	+.15μA (only on Si terminal) -LCD: ON -1/5 bias -V5=VDD	3.3	-120			
V4 output voltage	VV4	-LCD clock frequency=0Hz -LCD: ON	3.3	0.75VDD	0.8VDD	0.85VDD	V
V3 output voltage	VV3	-1/5 bias -V5=VDD	3.3	0.55VDD	0.6VDD	0.65VDD	
V2 output voltage	VV2	-Refer to figure 9.	3.3	0.35VDD	0.4VDD	0.45VDD	
V1 output voltage	VV1		3.3	0.15VDD	0.2VDD	0.25VDD	

## Sample LCD Power Supply Characteristics at Ta=0°C to +50°C, VSS=0V

The sample current consumption characteristics are the measurement result of Sanyo provided evaluation board.

Parameter	Symbol	Pins, Conditions	Ratings			Unit	
			VDD[V]	Min.	Typ.		Max.
LCD Power supply	ILCD1	-LCD: ON -1/5 bias -VLCD=VDD -V1-V5: open -Refer to figure 8.	20kΩmode 3.3	15	29	60	μA

VCCR: LCD contrast control register

- Notes:
- Since the circuit pattern affects the oscillation frequency, place the oscillation-related parts as close to the oscillation pins as possible with the shortest possible pattern length.
  - When using the ceramic resonator or the X'tal, please contact with the oscillator manufacturer for the circuit parameters.

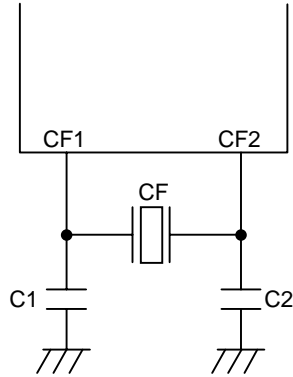


Figure 1 Ceramic Oscillation Circuit.

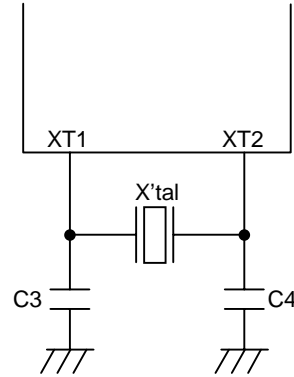


Figure 2 X'tal Oscillation Circuit.

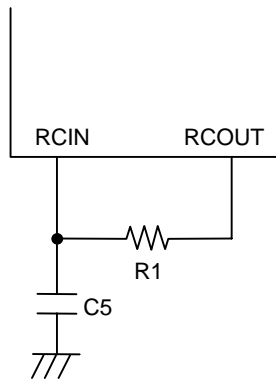


Figure 3 RC Oscillation Circuit.



## Recommended Oscillation Circuit and Characteristics

The oscillation circuit characteristics in the table below are based on the following conditions:

- Recommended circuit parameters are verified by an oscillator manufacturer using a Sanyo provided oscillation evaluation board.
- The characteristics are the results of the evaluation with the recommended circuit parameters connected externally.

Recommended Oscillation Circuit Parameters and Characteristics (Ta = 0°C to +50°C)

Frequency	Manufacturer	Oscillator	Recommended circuit parameter	Operating supply voltage range	Oscillation stabilizing time (*)	
					Typ.	Max.
6MHz	MURATA MANUFACTURING CO., LTD.	CSA6.00MG	C1=33pF C2=33pF	3.15-3.85V	TmsCF	
					0.02ms	0.2ms
32.768kHz	CITIZEN WATCH CO., LTD.	CFS-308	C3=20pF C4=20pF	3.15-3.85V	TssX'tal	
					1.00s	3.00s

(\*) Note: The oscillation stabilizing time period is the time until the oscillation becomes stable after the VDD becomes higher than the minimum operating voltage.

The oscillation circuit characteristics may differ by applications. For further assistance, please contact with the oscillator manufacturer with the following notes in your mind.

- Since the oscillation frequency precision is affected by wiring capacity of the application board, etc., adjust the oscillation frequency on the production board.

Since the oscillation circuit characteristics are affected by the noise, wiring capacity, etc., refer to the following notices.

- The distance between the clock I/O terminal and external parts should be as short as possible.
- The capacitors' VSS should be allocated close to the microcontroller's GND terminal and be away from other GND.
- The signal lines with rapid state changes or the signal line with large amplitude such as middle withstand voltage port or LCD driver output should be allocated away from the clock oscillation circuit.
- The signal lines with large current should be allocated away from the oscillation circuit.

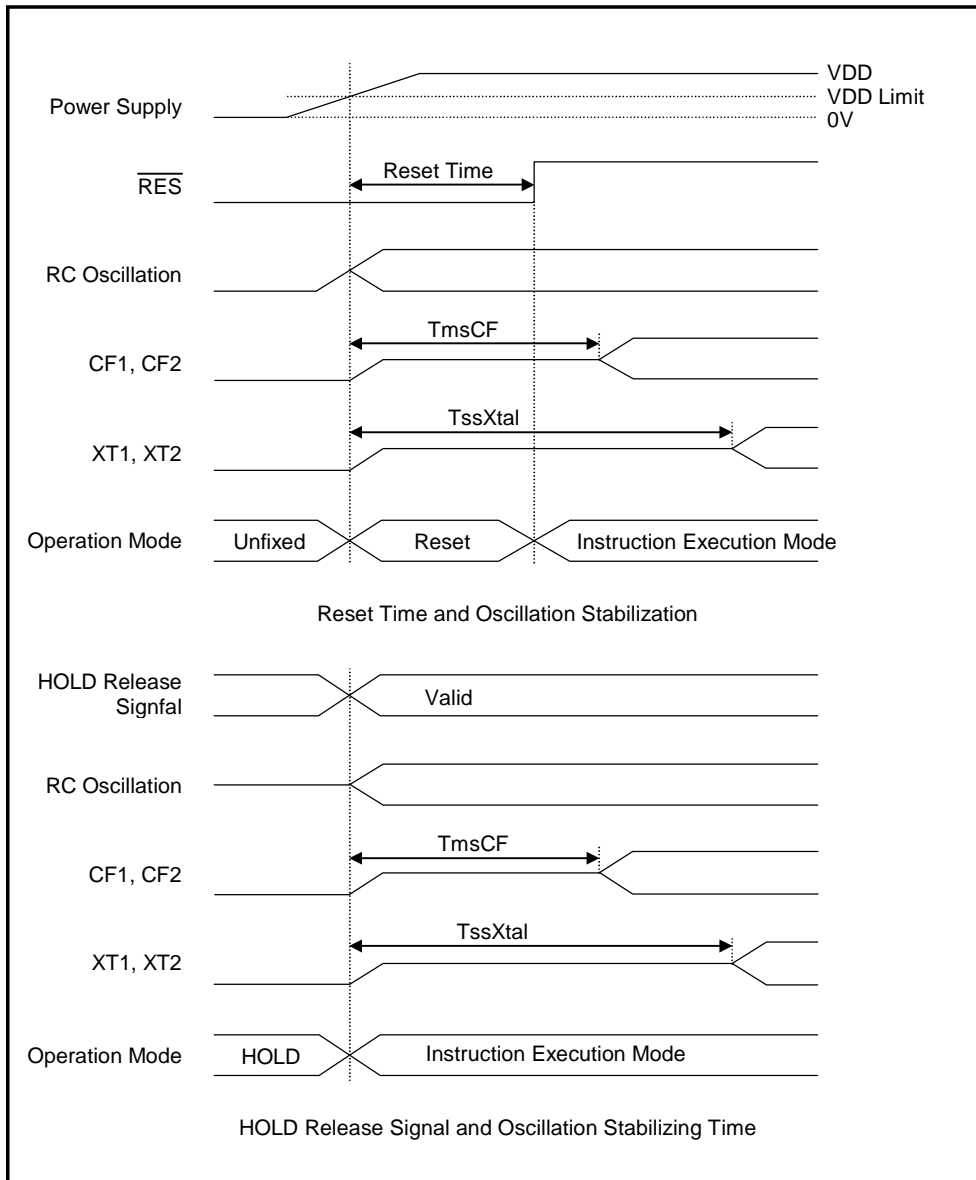


Figure 3 Oscillation Stabilizing Time.

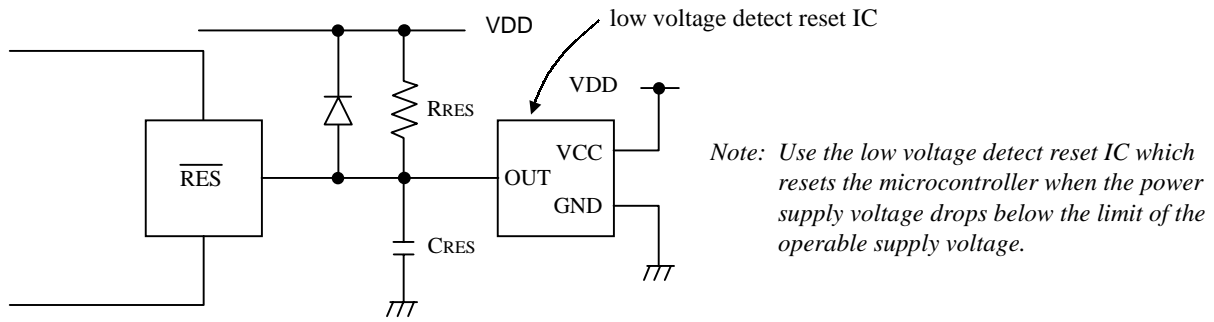
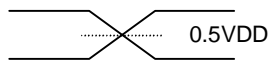


Figure 4 Reset Circuit.



AC Timing Measurement Point

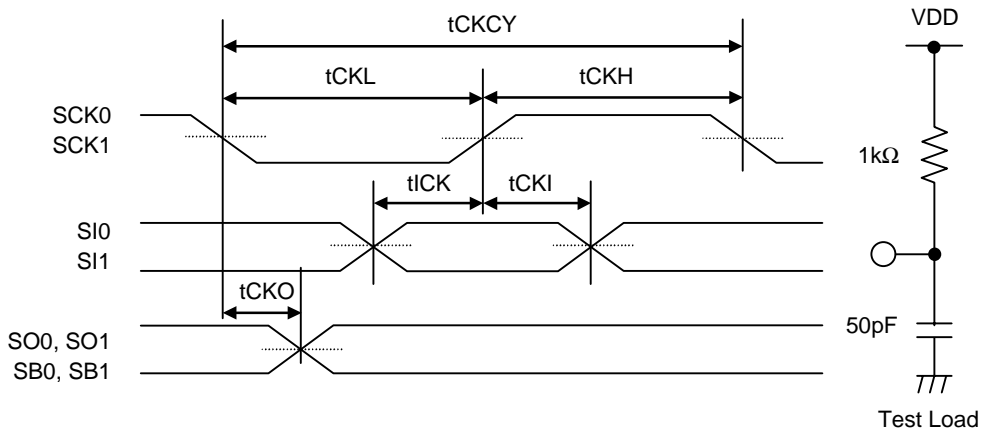


Figure 5 Serial Input Test Condition.

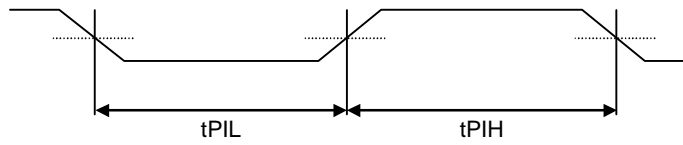


Figure 6 Pulse Input Timing Condition.

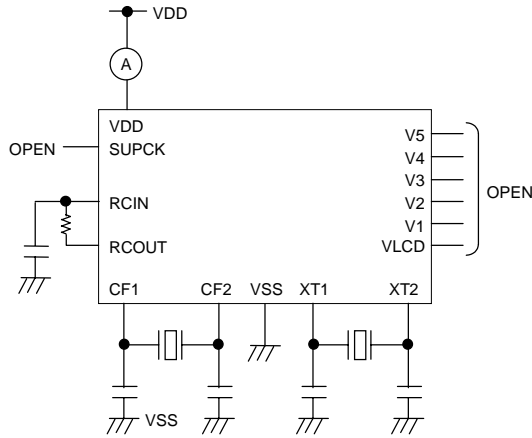


Figure 7 Current Consumption Measurement Circuit.

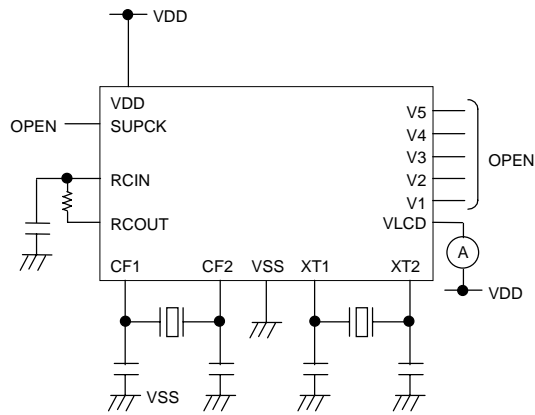


Figure 8 LCD Current Measurement Circuit.

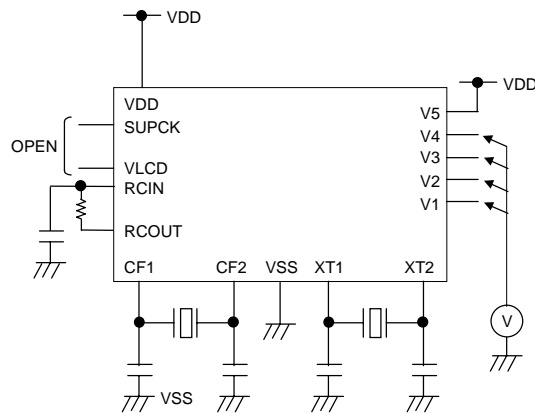


Figure 9 V1 - V4 Terminal Output Voltage Measurement Circuit.

- Evaluation Sample

The evaluation sample of LC86F1216 is provided in QIC144 (package). Take note that the package size will be a little different from the one made in mass-production.

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