



STK55C641 Specification

1. FEATURES :

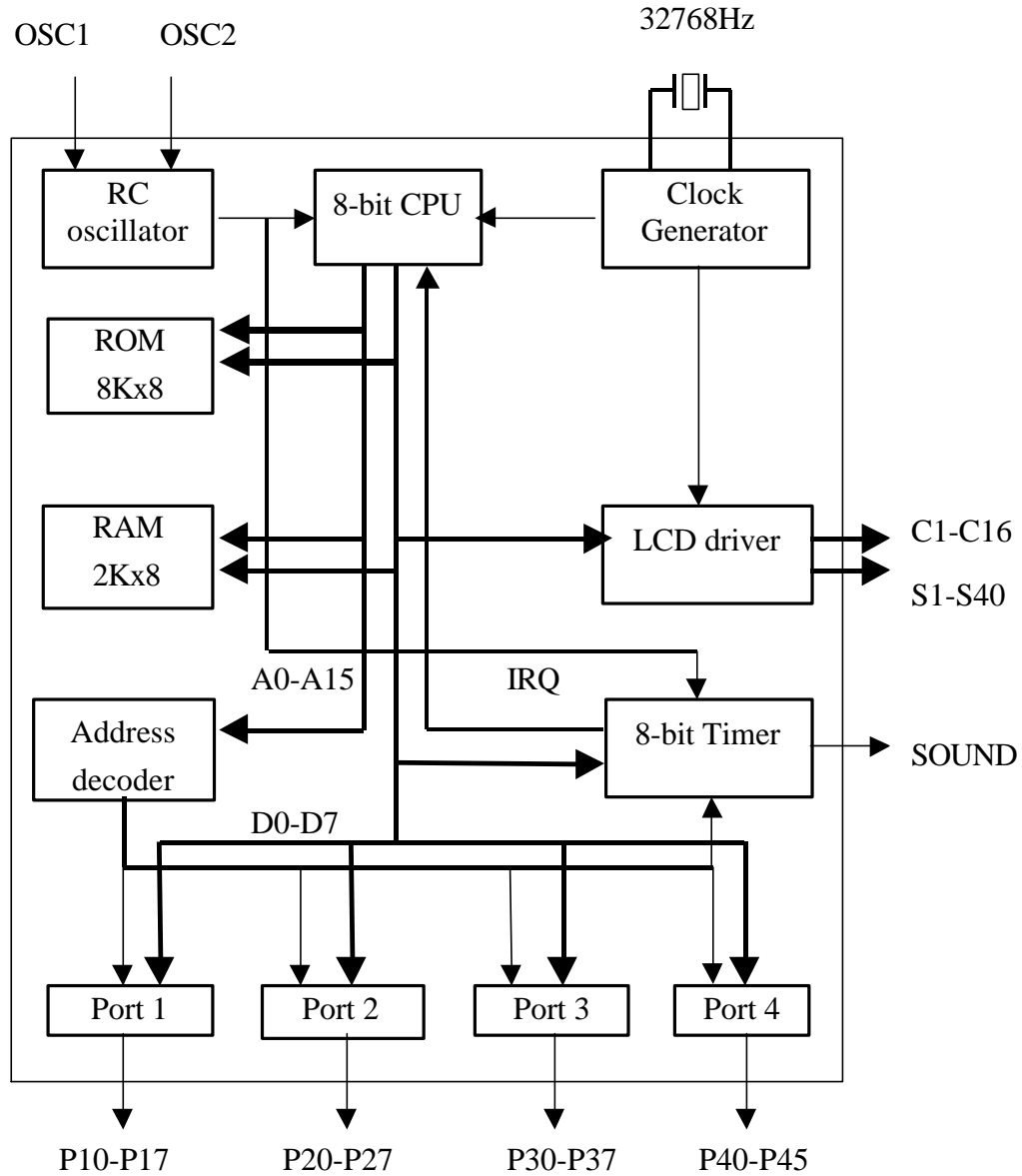
- * Operating voltage : 2.5V - 6V.
- * Maximum CPU operating frequency : 4MHz at 5V and 1.5MHz at 2.5V
- * Dual oscillators :
 - 32.768 KHz crystal oscillator for LCD display and watch timer.
 - RC oscillator for system clock.
- * 40 segments and 16 commons output for LCD driver.
 - 1/5 bias, 1/16 duty and 64Hz frame frequency.
 - 1/4 bias, 1/8 duty and 128Hz frame frequency.
- * I/O port.
 - 30 I/O pins.
 - Port 1 with selectable interrupt.
- * Built in 2K bytes RAM (including LCD storage area).
- * Built in 8K bytes ROM for program.
- * One 8-bit timer with 8 predefined input clock.
- * Five interrupt sources :
 - NMI - 64 Hz interrupt
 - IRQ1 - Stopwatch timer interrupt
 - IRQ2 - Fix-time timer interrupt
 - IRQ3 - Timer interrupt
 - IRQ4 - External interrupt
- * Code option :
 - Built-in 150K OHM pull-up resistors for I/O port.
 - 1/8 duty or 1/16 duty.

2. APPLICATION :

- * Data bank
- * Calculator
- * Hand-held game
- * Small instrument
- * Toy



3. BLOCK DIAGRAM:





4. PIN DESCRIPTION : (Total 100 pads)

Pin name	I/O	Function description
COM1-COM16	O	LCD common output pins
SEG1...SEG40	O	LCD segment output pins
VLCD	I	LCD voltage input
VR	I	LCD contrast control
CLK256	O	256 Hz clock output
P10-P17	I/O	8-bit I/O pins for port 1
P20-P27	I/O	8-bit I/O pins for port 2
P30-P37	I/O	8-bit I/O pins for port 3
P40-P45	I/O	6-bit I/O pins for port 4
OSC1	I	Main system oscillator input pin for chip
OSC2	O	Main system oscillator output pin for resistor
XOSC1	I	32.768K Hz crystal oscillator input
XOSC2	O	32.768K Hz crystal oscillator output
SOUND	O	Audio output
/RES	I	System reset
/TEST	I	Test pin. Keep floating or connect to Vdd
VDD		Power input
VSS1, VSS2		Signal ground

5. ADDRESS ARRANGEMENT

Please note that A14-A15 are not cared in hardware. So, following memory areas are mapping in the same location.

0000-3FFF, 4000-7FFF, 8000-BFFF, C000-FFFF.

1) RAM

0000-007F for LCD output data storage.

Memory address	Pin for 1/16 duty	Pin for 1/8 duty
0000-0004	COM1	COM1
0008-000C	COM2	COM2
0010-0014	COM3	COM3
0018-001C	COM4	COM4
0020-0024	COM5	COM5



<u>Memory address</u>	<u>Pin for 1/16 duty</u>	<u>Pin for 1/8 duty</u>
0028-002C	COM6	COM6
0030-0034	COM7	COM7
0038-003C	COM8	COM16
0040-0044	COM9	
0048-004C	COM10	
0050-0054	COM11	
0058-005C	COM12	
0060-0064	COM13	
0068-006C	COM14	
0070-0074	COM15	
0078-007C	COM16	

The LSB of low byte - SEG1.

The MSB of high byte - SEG40.

The middle bits are in the order.

0080-00FF for zero page area.

0100-01FF for stack and data page area.

0200-07FF for data area.

2) ROM

E000-FFFF for program area.

FFFF, FFFE - IRQ vector.

FFFD, FFFC - RES vector.

FFFB, FFFA - NMI vector.

3) Others

1000 To enter stand-by mode. Write only.

* Write this address, the CPU will be hold with LCD state no change.

* When in stand-by mode, the NMI and IRQ will wake up the CPU.

| 1001 To enter sleep mode. Write only.

= 1 Sleep mode 1

= 2 Sleep mode 2

All other values are prohibited. Do not write any other value to this register.



In sleep mode 1, both of the main system oscillator and 32.768KHz sub-system oscillator will be stopped. So, all function are stopped and only external interrupt can wake up this chip. The LCD display will be turn off while getting into sleep mode 1. In sleep mode 2, only main system oscillator will be stopped. So, the following functions will still keep working.

- * The LCD will be kept on.
- * The watch timer and fix-time timer will keep going.
- * The NMI, port 1, watch timer and fix-time timer interrupt will wake up this chip.
- * CPU will keep working if clock source is 32.768K Hz.

1002 Watch timer control register. Write only.

- Bit 0 : = 0 Set watch timer interrupt at 10 Hz
 = 1 Set watch timer interrupt at 100 Hz
- 1 : = 0 Set fix-time timer interrupt at 2 Hz
 = 1 Set fix-time timer interrupt at 1 Hz
- 2 : = 0 Normal operation.
 = 1 Reset and stop stopwatch timer.
- 3 : = 0 Stop stopwatch register without reset.
 = 1 Start stopwatch timer.
- 4 : = 0 CPU clock is system clock.
 = 1 CPU clock is 32.768K Hz.
- 7-5 : Reserved.

The default value for each bit is zero. Bit 2 will be cleared to zero automatically after stopwatch timer reset.

1003 IRQ flag register. Read & write.

Read function :

- Bit 0 : = 1 Stopwatch timer interrupt, IRQ1.
- 1 : = 1 Fix-time timer interrupt, IRQ2.
- 2 : = 1 Timer interrupt, IRQ3.
- 3 : = 1 External interrupt, IRQ4.

Write function :

- Bit 0 : = 0 Clear stopwatch timer interrupt.
- 1 : = 0 Clear fix-time timer interrupt.
- 2 : = 0 Clear timer interrupt.
- 3 : = 0 Clear external interrupt.

Note : Please do not use the STZ \$1003 to clear all the interrupts at the same time.



Also, please do not use the read-modify-write instruction to clear interrupt flag. For example, LDA #1 and TRB \$1003 to clear the IRQ1. Because some other interrupts may be lost if clear interrupt with above method. Following procedures are suggested.

```
LDA    $1003
AND    #1
BEQ    CheckIRQ2
EOR    #$0FF
STA    $1003    ;clear IRQ1
.
```

1004 Port 1 data. Read & write.

1005 Set port 1 bit function. Write only.

- * An '1' in this register will set the corresponding pin of port 1 as an output pin.
- * The default value for each bit is zero. A pull-up resistor can be added to the pin by code option. But the pull-up resistor will be disabled if the output state is low.

1006 Port 2 data. Read & write.

1007 Set port 2 bit function. Write only.

- * An '1' in this register will set the corresponding pin of port 2 as an output pin.
- * The default value for each bit is zero. A pull-up resistor can be added to the pin by code option. But the pull-up resistor will be disabled if the output state is low.

1008 Port 3 data. Read & write.

1009 Set port 3 bit function. Write only.

- * An '1' in this register will set the corresponding pin of port 3 as an output pin.
- * The default value for each bit is zero. A pull-up resistor can be added to the pin by code option. But the pull-up resistor will be disabled if the output state is low.

100A Port 4 data. Read & write.

100B Set port 4 bit function. Write only.



- * An '1' in this register will set the corresponding pin of port 4 as an output pin.
- * The default value for each bit is zero. A pull-up resistor can be added to the pin by code option. But the pull-up resistor will be disabled if the output state is low.

100C Set port 1 bit interrupt function. Write only.

- * An '1' in this register will set the interrupt function of the corresponding pin of port 1 to be enable. That is, an interrupt will be generated if a low level is detected in the pin.
- * The default value for each bit is zero.

100D Timer 1 data. Read & write.

- * Before writing \$100D, the program should select timer clock (\$100E) first.
- * After timer 1 been enabled, the timer will start to count down. When timer counts to zero, the timer will count from the initial value and IRQ3 will happen.
- * The time elapse = (\$100D)/timer clock

100E Timer 1 clock select. Write only.

- Bit 2-0 : = 000 System clock/2
- = 001 System clock/4
- = 010 System clock/8
- = 011 System clock/16
- = 100 System clock/32
- = 101 System clock/64
- = 110 System clock/128
- = 111 System clock/256
- 7-3 : Reserved

The default value is unknown.

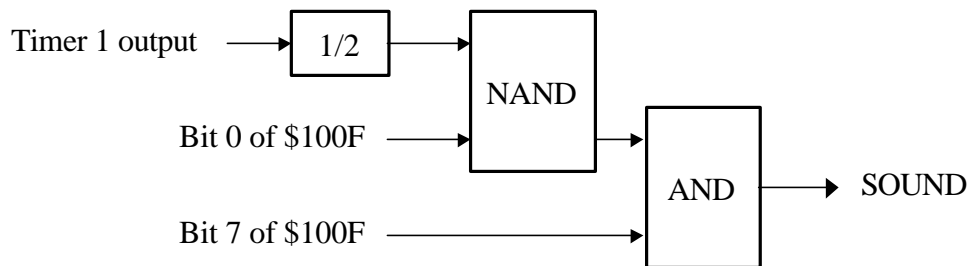
100F Control register. Write only.

- Bit 0 : = 0 Disable timer 1 output to SOUND pin.
- = 1 Enable timer 1 output to SOUND pin.
- 1 : = 0 Disable timer 1 interrupt.
- = 1 Enable timer 1 interrupt.
- 2 : = 0 Disable NMI.
- = 1 Enable NMI.
- 3 : = 0 Disable timer 1.
- = 1 Enable timer 1.



- 4 : = 0 LCD off.
= 1 LCD on.
- 5 : = 0 Disable watch timer interrupt.
= 1 Enable watch timer interrupt.
- 6 : = 0 Disable fix-time timer interrupt.
= 1 Enable fix-time timer interrupt.
- 7 : = 0 Disable sound output.
= 1 Enable sound output.

* The default value for each bit is zero.



1010 Stopwatch timer value. Read only.

Bit 3-0 : 1/100 sec data in BCD value.

7-4 : 1/10 sec data in BCD value.

4) The reset status of CPU

If the /RES is keep low more than two system clocks, then the CPU will be reset. After reset, the interrupt mask flag is set, the decimal mode is cleared and the program counter will be loaded with the reset vector from address \$FFFC and \$FFFD. So, after initial procedure the firmware should do a 'CLI' instruction. Otherwise, the CPU will not acknowledge any interrupt.

5) Interrupt Sources

* There are five interrupt sources :

- NMI - 64 Hz interrupt.
- IRQ1 - Stopwatch timer interrupt.
- IRQ2 - Fix-time timer interrupt.
- IRQ3 - Timer interrupt.
- IRQ4 - Port 1 interrupt.



- * The interrupt function of CPU is disabled after reset. A CLI instruction must be added after initialize this chip otherwise the CPU will not acknowledge any IRQ.
- * All interrupts will wake up CPU from standby mode.
- * NMI, IRQ1, IRQ2 and IRQ4 will wake up CPU from sleep mode 2.
- * Only IRQ4 will wake up CPU from sleep mode 1.
- * If want to accept IRQ in the middle of NMI loop, please reset the IRQ disable flag of the CPU before IRQ signal come.
- * When port 1 is in input mode and pin interrupt enable, a low signal from pin will generate IRQ4.

6. ABSOLUTE MAXIMUM RATINGS

Operating temperature 0 to 70
 Storage temperature -65 to 150
 Supply voltage 7 V
 Input voltage -0.6 to Vdd+0.6 V

7. ELECTRICAL CHARACTERISTIC :

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage	Vdd		2.5	3.0	6	V
Main system frequency	Øsys	Vdd=2.5V	-	1	1.5	Mhz
		Vdd=2.7V			2	Mhz
		Vdd=3V			2.5	Mhz
		Vdd=3.5V			3	Mhz
		Vdd=4V			3.5	Mhz
		Vdd>=4.5V			4	Mhz
Crystal frequency	Øcry			32768		Hz
Operating current	Idd	Vdd=5V, Øsys=1Mhz		1		mA
Standby current	Istdby	Vdd=5V, Øsys=1Mhz		.8		mA
Sleep mode 1 current	Islp1	Vdd=5V, LCD off			1	µA
Sleep mode2 current	Islp2	Vdd=2.5V, Vlcd=4V		40		µA
(LCD on)		Vdd=3V, Vlcd=5V		60		µA
		Vdd=3.5V, Vlcd=6V		80		µA
		Vdd=Vlcd=2.5V		16		µA
		Vdd=Vlcd=3V		25		µA

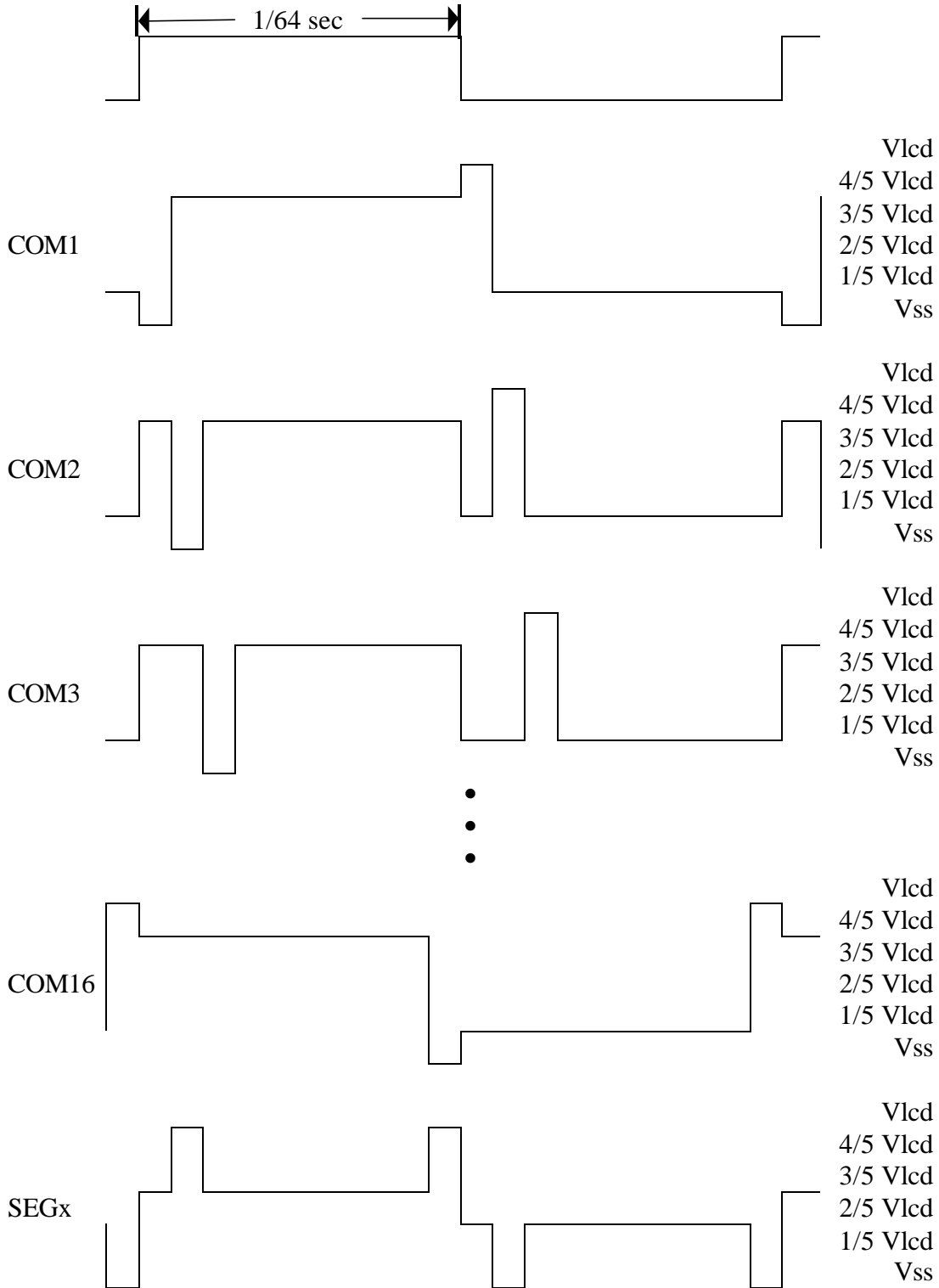


Parameter	Symbol	Condition	Min	Typ.	Max	Unit
		Vdd=Vlcd=3.5V		35		μA
		Vdd=Vlcd=4V		45		μA
		Vdd=Vlcd=4.5V		70		μA
		Vdd=Vlcd=5V		75		μA
Sleep mode2 current		Vdd=2.5V		2		μA
(LCD off)		Vdd=3V		3		μA
		Vdd=3.5V		5		μA
		Vdd=4V		6		μA
		Vdd=4.5V		7		μA
		Vdd=5V		9		μA
Input high voltage	Vih	Vdd=5.0V	2.0			V
Input low voltage	Vil	Vdd=5.0V	-0.6		0.8	V
Input high leakage current	Iih	Vih=Vdd			-1	μA
Input low leakage current	Iil	Vil=0			1	μA
Output high voltage (For SEGx and COMx)	Voh1	Ioh=-30 μA	Vlcd- 0.2		Vlcd	V
Output low voltage (for SEGx and COMx)	Vol1	Iol=40 μA	0		0.2	V
Output high voltage (for other pins)	Voh2	Ioh=-2mA	Vdd- 0.4		Vdd	V
Output low voltage (for other pins)	Vol2	Iol=2mA	0		0.4	V

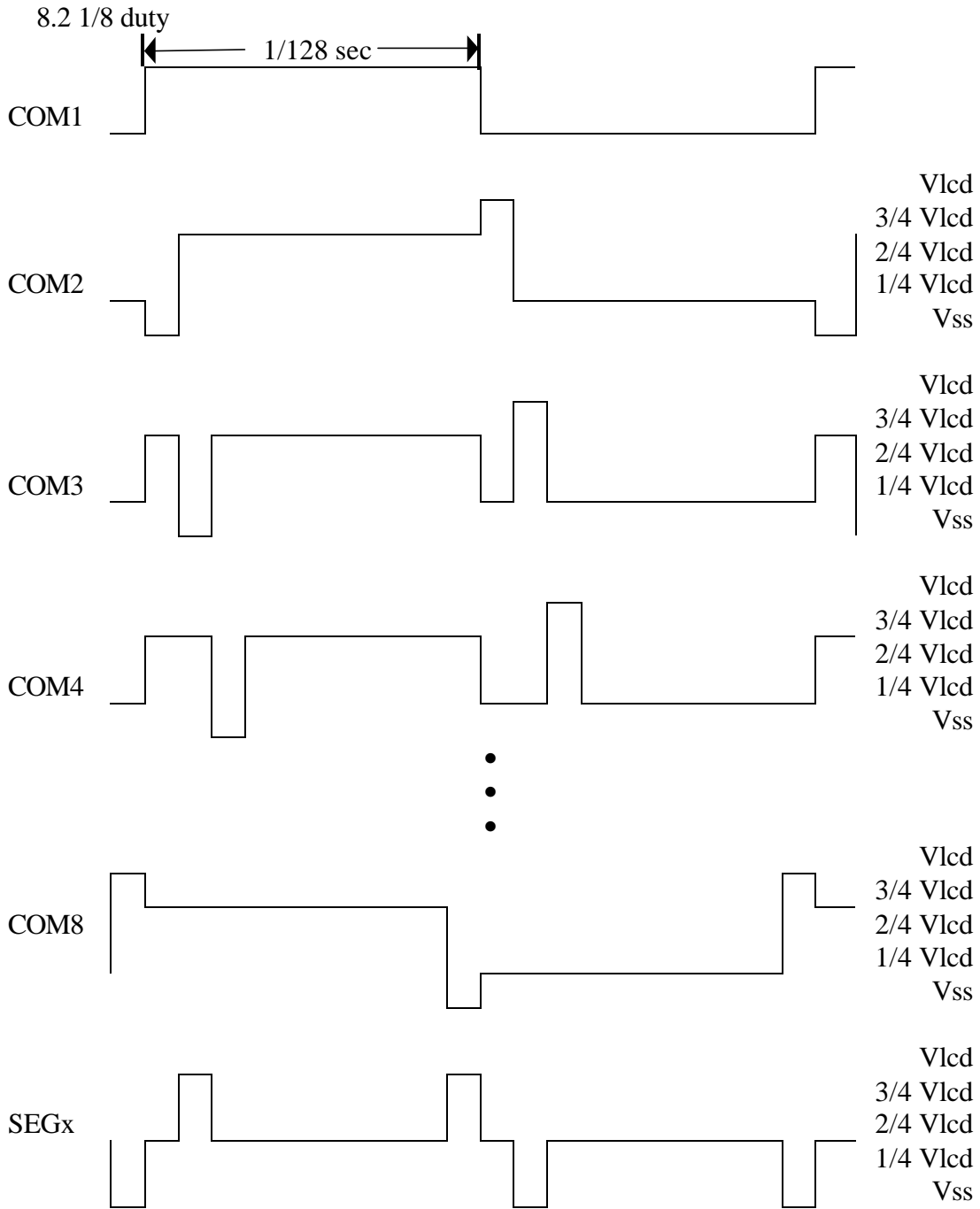


8. LCD WAVEFORM :

8.1 1/16 duty



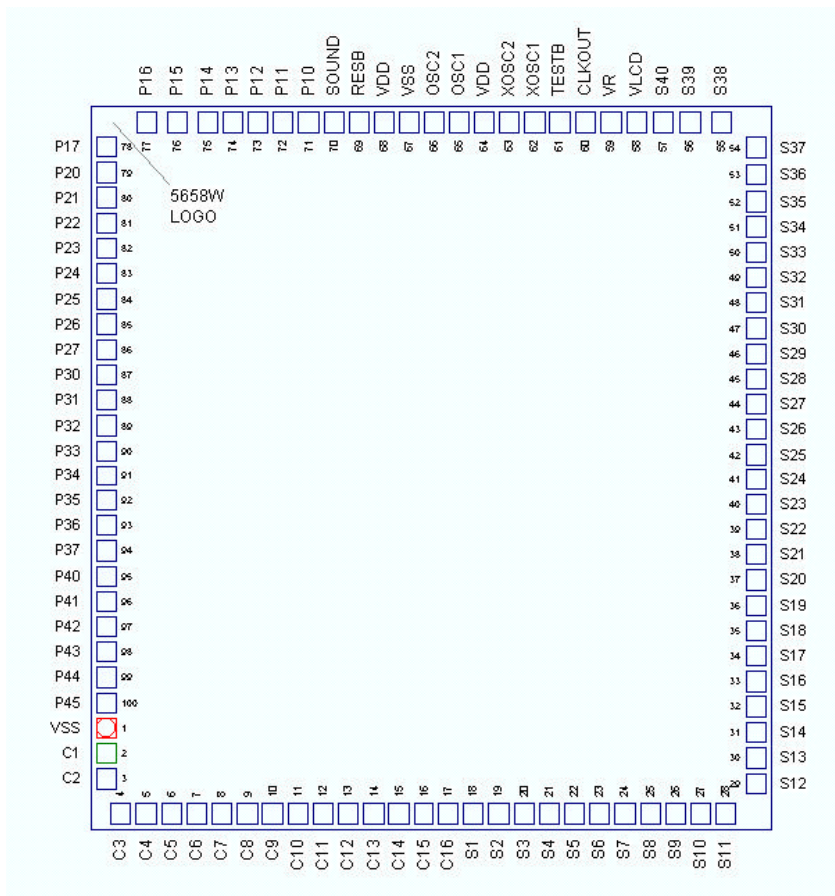
There are two LCD matrix DOTs active at (SEGx,COM2) and (SEGx,COM16)



There are two LCD matrix DOTs active at (SEGx,COM2) and (SEGx,COM8)



9. PAD LOCATION :



Chip size : 3090 x 3280

Unit : μM

PAD-No	Name	X	Y	PAD-No	Name	X	Y
1	VSS	69.94	459.36	51	S34	3020.06	2735.10
2	C1	69.94	344.68	52	S35	3020.06	2849.78
3	C2	69.94	230.00	53	S36	3020.06	2971.98
4	C3	133.12	70.94	54	S37	3020.06	3094.18
5	C4	247.80	70.94	55	S38	2864.38	3209.06
6	C5	362.48	70.94	56	S39	2723.57	3209.06
7	C6	477.16	70.94	57	S40	2601.37	3209.06
8	C7	591.84	70.94	58	VLCD	2481.05	3209.06
9	C8	706.52	70.94	59	VR	2363.55	3209.06
10	C9	821.20	70.94	60	CLKOUT	2246.05	3209.06
11	C10	935.88	70.94	61	TESTB	2131.37	3209.06
12	C11	1050.56	70.94	62	XOSC1	2016.69	3209.06
13	C12	1165.24	70.94	63	XOSC2	1902.01	3209.06



PAD-No	Name	X	Y	PAD-No	Name	X	Y
14	C13	1279.92	70.94	64	VDD	1787.33	3209.06
15	C14	1394.60	70.94	65	OSC1	1672.65	3209.06
16	C15	1509.28	70.94	66	OSC2	1557.97	3209.06
17	C16	1623.96	70.94	67	VSS	1443.29	3209.06
18	S1	1738.64	70.94	68	VDD	1328.61	3209.06
19	S2	1853.32	70.94	69	RESB	1213.93	3209.06
20	S3	1968.00	70.94	70	SOUND	1099.25	3209.06
21	S4	2082.68	70.94	71	P10	984.57	3209.06
22	S5	2197.36	70.94	72	P11	869.89	3209.06
23	S6	2312.04	70.94	73	P12	755.21	3209.06
24	S7	2426.72	70.94	74	P13	640.53	3209.06
25	S8	2541.40	70.94	75	P14	525.85	3209.06
26	S9	2656.08	70.94	76	P15	387.67	3209.06
27	S10	2770.76	70.94	77	P16	249.49	3209.06
28	S11	2885.44	70.94	78	P17	69.94	3097.00
29	S12	3020.06	206.50	79	P20	69.94	2982.32
30	S13	3020.06	324.00	80	P21	69.94	2867.64
31	S14	3020.06	441.50	81	P22	69.94	2752.96
32	S15	3020.06	556.18	82	P23	69.94	2638.28
33	S16	3020.06	670.86	83	P24	69.94	2523.60
34	S17	3020.06	785.54	84	P25	69.94	2408.92
35	S18	3020.06	900.22	85	P26	69.94	2294.24
36	S19	3020.06	1014.90	86	P27	69.94	2179.56
37	S20	3020.06	1129.58	87	P30	69.94	2064.88
38	S21	3020.06	1244.26	88	P31	69.94	1950.20
39	S22	3020.06	1358.94	89	P32	69.94	1835.52
40	S23	3020.06	1473.62	90	P33	69.94	1720.84
41	S24	3020.06	1588.30	91	P34	69.94	1606.16
42	S25	3020.06	1702.98	92	P35	69.94	1491.48
43	S26	3020.06	1817.66	93	P36	69.94	1376.80
44	S27	3020.06	1932.34	94	P37	69.94	1262.12
45	S28	3020.06	2047.02	95	P40	69.94	1147.44
46	S29	3020.06	2161.70	96	P41	69.94	1032.76
47	S30	3020.06	2276.38	97	P42	69.94	918.08

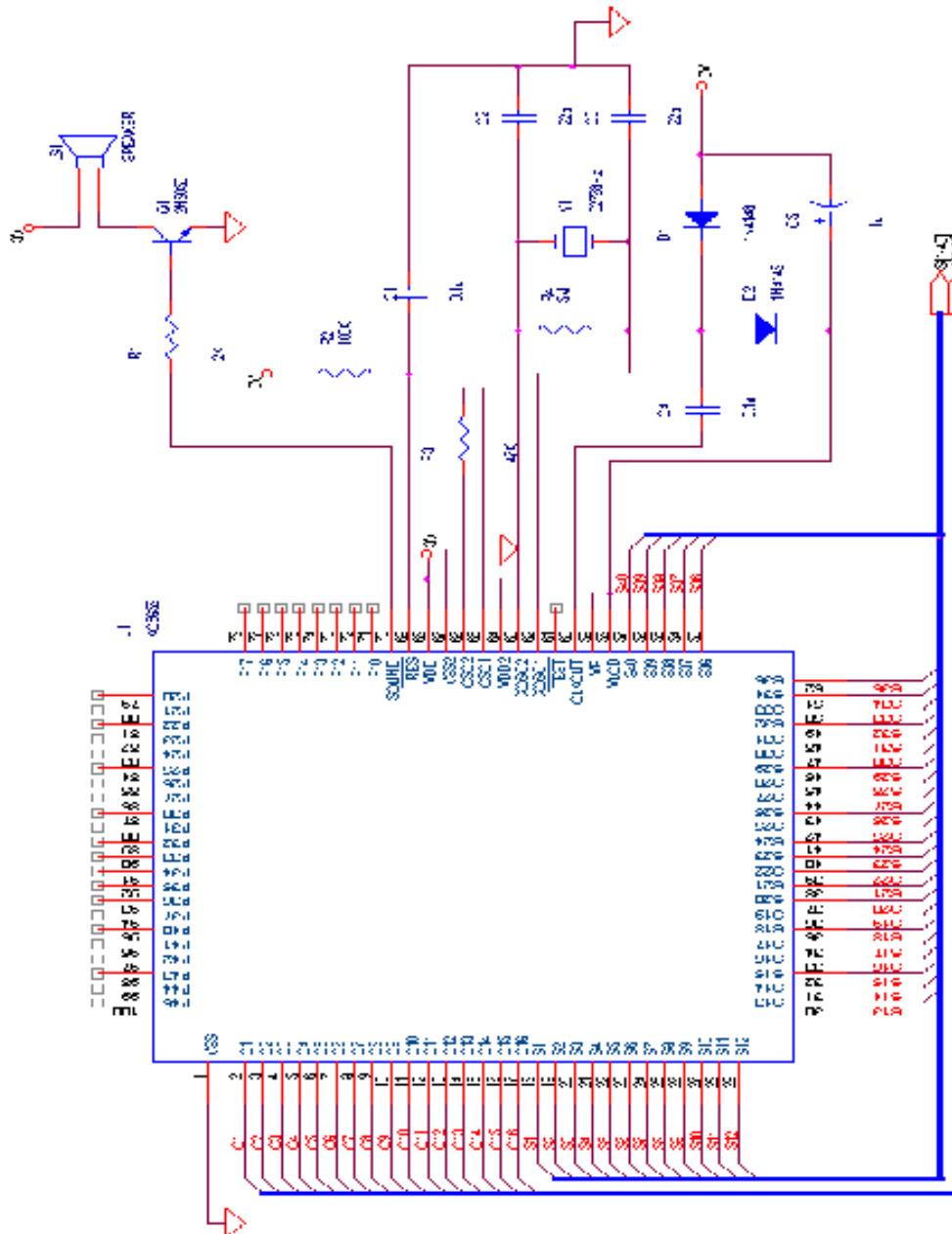


PAD-No	Name	X	Y	PAD-No	Name	X	Y
48	S31	3020.06	2391.06	98	P43	69.94	803.40
49	S32	3020.06	2505.74	99	P44	69.94	688.72
50	S33	3020.06	2620.42	100	P45	69.94	574.04



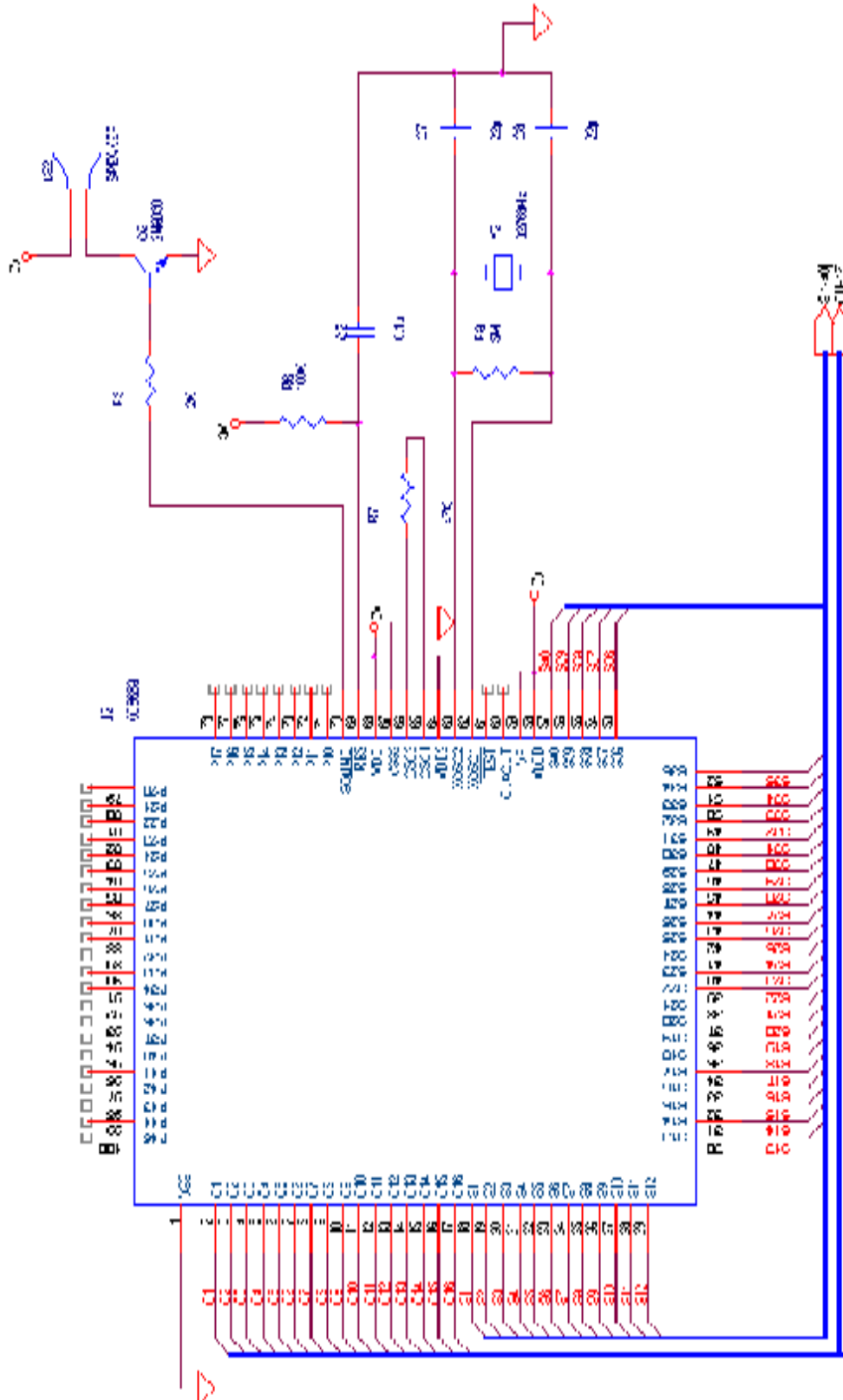
10. APPLICATION CIRCUIT :

10.1 For 5V LCD panel :



10.2 For 3V LCD panel :

Title	Application circuit for STK55C641
Size	Document number
	STK55C641
Date	Version
	1.00



File	A:\Embedded\st55c641.psd		
Doc. no.	Doc. no.	Doc. no.	Doc. no.
Rev.	7	ST55C641	Rev. 7
Date	01/03/2000	01/03/2000	Date



Syntek Semiconductor Co., Ltd.

Customer Information Sheet for STK55C641 000112

1. Customer's Name : _____

2. Project title : _____

* 3. Syntek part number : _____

4. Package ----- () Chip () QFP

5. Options :

Oscillator type ---- () RC () XTAL

LCD duty----- () 1/8 duty, 1/4 bias () 1/16 duty, 1/5 bias

	P o r t 1								P o r t 2								P o r t 3								P o r t 4							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	5	4	3	2	1	0		
Pull-up																																

6. Customer code :

Code form ----- () EPROM () file _____

Checksum ----- E000-EFFF _____H

F000-FFFF _____H

E000-FFFF _____H

7. Operating conditions :

All the operating conditions listed below are for Syntek reference. Syntek will not guaranty on these values. Please refer to data book or contact Syntek for the guaranty values.

Operating voltage : _____ - _____ V Voltage doubler : () Yes () No

Operating current : _____ mA Operating frequency : _____ Hz

Sleep current :

Mode 1: _____ μ A (LCD Off)

Mode 2 : _____ μ A (For LCD On) _____ μ A (For LCD Off)

Others :



Customer : _____ Salesman : _____ Date : __/__/__

Note : The items marked with '*' will be filled by Syntek.