



STK55C321 SPECIFICATION

1. CHIP FEATURES :

- | * Operating voltage 2.5V - 4.0V.
- | * Maximum operating frequency is 3.5MHz at 4V.
- | * Operating current under 1.3mA at 770KHz, 4V.
- * 40 segments and 8 commons out for LCD driver.
 - 1/4 duty and 244Hz frame frequency.
 - 1/8 duty and 122Hz frame frequency.
- * 2 bi-directional I/O port.
 - 8 pins for port 1.
 - 4 pins with selectable interrupt for port 2.
 - 4 pins without interrupt for port 2.
- * Built in 192 bytes RAM (including LCD storage area).
- * Built in 10K bytes ROM.
- * Selectable (system clock/16384) interrupt by NMI.
- * Timer and port 2 interrupt by IRQ.
- * SOUND output from CPU or two independent 16-bit counter.
- * 256 sound volumes for channel 1. 8 sound volumes for channel 2.
- * Code options :
 - 1/3 bias or 1/4 bias for LCD driver.
 - 1/4 duty or 1/8 duty for LCD driver.
 - Pull-up resistors for I/O pin.
 - RC or CRYSTAL oscillator.
 - System clock = OSC clock or OSC clock/2.

2. APPLICATION :

- * Hand-held game

**3. PIN DESCRIPTION :**

Pin name	I/O	Function description
COM1-COM8	O	Output pins for driving the common pins on the LCD panel.
SEG1-SEG40	O	Output pins for driving the segment pins on the LCD panel
SOUND1	O	Output pins for sound generator 1
SOUND2	O	Output pins for sound generator 2
P10-P17	I/O	8 bit bi-directional pins for port 1
P20-P27	I/O	8 bit bidirectional pins for port 2
OSC1	I	Oscillator input pin for chip
OSC2	O	Oscillator output pin for resistor
OSC3	O	Oscillator output pin for capacitor
/TEST	I	Test pin. Keep floating or connect to Vdd
/RES	I	Chip reset
V4	I	Bias supply voltage pin to drive the LCD
VDD		Power input
VSS		Signal ground

Note: The substrate should be connected to VSS or floating.

4. ADDRESS ARRANGEMENT :**1) RAM**

0000-003F for LCD output data storage area 1.

Memory address	Pin for 1/8 duty	Pin for 1/4 duty
0000-0004	COM1	COM1
0008-000C	COM2	COM2
0010-0014	COM3	COM3
0018-001C	COM4	COM8
0020-0024	COM5	
0028-002C	COM6	
0030-0034	COM7	
0038-003C	COM8	

0040-007F for LCD output data storage area 2.

Memory address	Pin for 1/8 duty	Pin for 1/4 duty
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0040-0044	COM1	COM1
0048-004C	COM2	COM2
0050-0054	COM3	COM3
0058-005C	COM4	COM8
0060-0064	COM5	
0068-006C	COM6	
0070-0074	COM7	
0078-007C	COM8	

* The LSB of low byte - SEG1.

The MSB of high byte - SEG40.

The middle bits are in the order.

The un-specified area between 0000-007F are general purpose RAM.

00C0-00FF for zero and stack page area.

* 0000-00FF are the same location with 0100-01FF.

* The data or stack can be stored in this area, but be careful not to make conflict.

2) ROM

D800-FFFF for program area.

FFFF,FFFE - IRQ vector.

FFFD,FFFC - RES vector.

FFFB,FFFA - NMI vector.

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

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

3) Other



0080 To enter stand-by mode. Write only.

- * Write this address, will make CPU into stand-by mode.
- * CPU will be hold with LCD state no change.
- * When in stand-by mode, the NMI or IRQ will wake up the CPU. After doing the interrupt routine, the program must access this address to enter stand-by again.

0081 To enter power-down mode. Write only.

Bit 0 : = 0 Disable power-down mode wake up timer.(default)

= 1 Enable power-down mode wake up timer.

1 : = 1 Into power-down mode.

In power-down mode, the oscillator will be stopped & LCD will be off. After wake up, bit 1 will be cleared to zero and programmer have to clear bit 0. If the wake up timer is enable, an oscillator warm-up time (defined by \$008B & 008C before entering power-down mode) will be added before CPU been waked up and the IRQ1 flag will be set after wake up.

0082 Set frame frequency. Write only.

Bit 0 : = 0 System clock/8192 for 1/8 duty.(default)

System clock/4096 for 1/4 duty.

= 1 System clock/4096 for 1/8 duty.

System clock/2048 for 1/4 duty.

0083 IRQ flag register. Read & write.

* Read Bit 0 : if 1, there is timer interrupt, IRQ1.

Bit 1 : if 1, there is port 2 interrupt, IRQ2.

Write Bit 0 : if 0, clear IRQ1 flag.

Bit 1 : if 0, clear IRQ2 flag.

* When in IRQ routine, clear this register before resetting the IRQ disable flag of the CPU. Or, it will go into IRQ loop infinitely.

* Disable port 2 interrupt function before clear IRQ1 flag.

0084 Port 1 data. Read & write.



0085 Set port 1 bit function. Write only.

- * An '0' in this register will set the corresponding pin of port 1 as an output pin.
- * The default value for each bit is one. 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.

0086 Port 2 data. Read & write.

0087 Set port 2 bit function. Write only.

- * An '0' in this register will set the corresponding pin of port 2 as an output pin.
- * The default value for each bit is one. 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.

0088 Set port 2 bit interrupt function. Write only.

Bit 3-0 : Set interrupt function.

7-4 : Reserved.

- * An '0' in this register will set the interrupt function of the corresponding pin of port 2 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 one.

0089 Set low byte of sound generator 1 frequency divider. Write only.

008A Set high byte of sound generator 1 frequency divider. Write only.

- * Program sequence should be low byte first then high byte.
- * $\text{Output frequency} = \text{system clock} / [(\$008A) \times 256 + (\$0089) + 1] / 2$

008B Timer data. Read & write.

- * Before writing \$008B, the program should select timer clock (\$008C) first.
- * After \$008B been written, the timer will start to count down. When timer



counts to zero, IRQ1 will happen.

* The time elapse = [(\$008B)+1]/timer clock

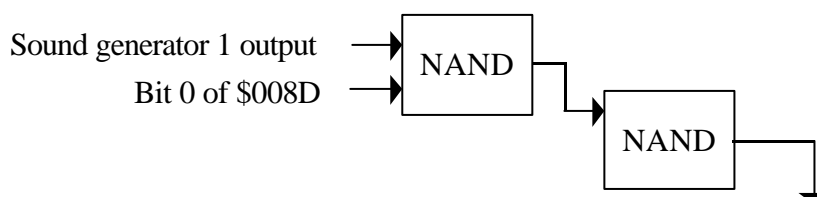
008C Timer clock select for different interrupt time range. Write only. (default unknown)

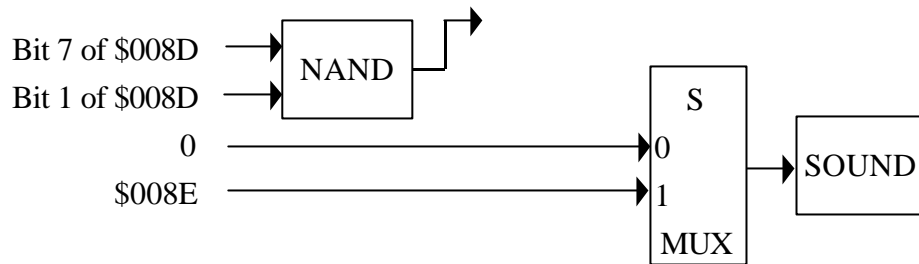
Bit 2-0 : = 000 System clock/2
 = 001 System clock/8
 = 010 System clock/32
 = 011 System clock/128
 = 100 System clock/512
 = 101 System clock/2048
 = 110 System clock/8192
 = 111 System clock/32768

008D Control register. Write only.

Bit 0 : = 0 Disable sound generator 1.
 = 1 Output sound generator 1 to SOUND1 pin.
Bit 1 : = 0 Disable bit 7 of port \$008D.
 = 1 Output bit 7 of port \$008D to SOUND1 pin.
Bit 2 : = 0 Disable NMI.
 = 1 Enable NMI.
Bit 4 : = 0 LCD off.
 = 1 LCD on.
Bit 5 : = 0 Disable timer.
 = 1 Enable timer.
Bit 6 : = 0 Select LCD data area from 0000-003F.
 = 1 Select LCD data area from 0040-007F.
Bit 7 : = 0 Set sound output to low.
 = 1 Set sound output to high.

Bit default value is zero. Bit 4 will be reset to zero while getting into power-down mode.





008E Define sound volume. Write only.(default unknown)

Bit 7-0 : define the volume of SOUND1 pin.

0090 Write function : Set low byte of sound generator 2 frequency divider.

Read function : Read pseudo random counter low byte value.

0091 Set high byte of sound generator 2 frequency divider. Write only.

* The value of bit 7 don't care.

* When load divider value, low byte first then high byte. After high byte is written, the new value will be loaded to counter.

0092 Set sound generator 2 clock. Write only. (Default unknown)

Bit 0-2 : = 000 System clock

= 001 System clock/4

= 010 System clock/16

= 011 System clock/64

= 100 System clock/256

= 101 System clock/1024

= 110 System clock/4096

= 111 System clock/16384

Bit 7-5 : Define volume of SOUND2 pin.

0093 Set sound generator 2 function. Write only.

Bit 0 : = 0 Sound generator 2 works in mode 0.

= 1 Sound generator 2 works in mode 1.

1 : = 0 Reset sound generator 2 counter.



= 1 Enable sound generator 2 counter.

2 : = 0 Disable sound generator 2 output to SOUND2 pin.

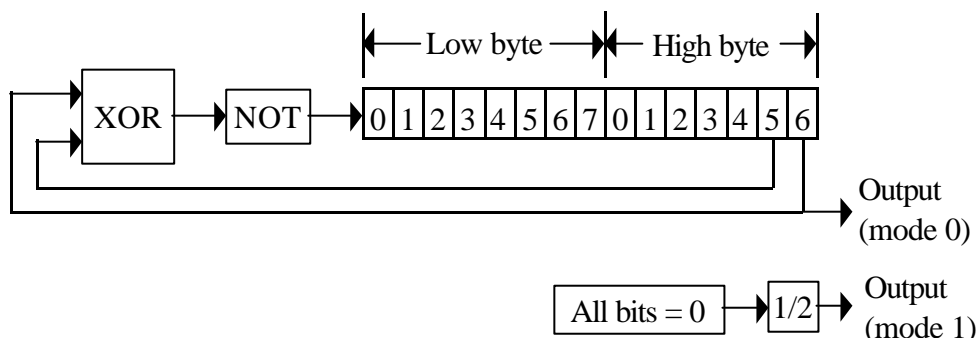
= 1 Enable sound generator 2 output to SOUND2 pin.

The default value is zero.

In mode 0, sound generator 2 work as a 15-bit pseudo random noise generator.

The shift direction is from LSB to MSB. The values of \$0090 and \$0091 don't care.

In mode 1, sound generator 2 work as a 15-bit pseudo random counter. Its initial value is defined by \$0090 and \$0091. A pulse will be output while 0000H is encountered and the initial value will be reloaded. The output pulse will be divided by two to output a square wave to SOUND2 pin.



4) Interrupts

* There are three interrupt sources :

NMI - Fix frequency (system frequency/16384) interrupt.

IRQ1 - Timer interrupt.

IRQ2 - External interrupt by port 2.

* Only IRQ2 will wake up CPU from power-down mode, but all interrupts will wake up CPU from standby mode.

* If \$0081 bit 0 is set to 1, an oscillator warm-up time (defined by \$008B & \$008C) will be added before CPU been waked up. After wake up, programmer should clear this bit.

* After CPU wake up from power-down mode, programmer should turn on LCD



again.

- * If want to accept IRQ in the middle of NMI loop, please reset the IRQ disable flag of the CPU before IRQ signal comes.
- * In the IRQ routine, the program decide from the port \$0083 which interrupt (timer or port 2) happens.
- * When port 2 in input mode and pin interrupt enable, a low signal from pin will generate IRQ2.

5) Reset states

Register	Initial value after reset
0080	-
0081	-
0082	uuuuuuu0
0083	00000000
0084	states on pins
0085	11111111
0086	states on pins
0087	11111111
0088	uuuu1111
0089	uuuuuuuu
008A	uuuuuuuu
008B	uuuuuuuu
008C	uuuuuuuu
008D	00000000
008E	uuuuuuuu
0090	uuuuuuuu
0091	uuuuuuuu
0092	uuuuuuuu
0093	uuuuu000

Note : u -- unknown

5. ABSOLUTE MAXIMUM RATINGS :

Operating temperature 0 to 70



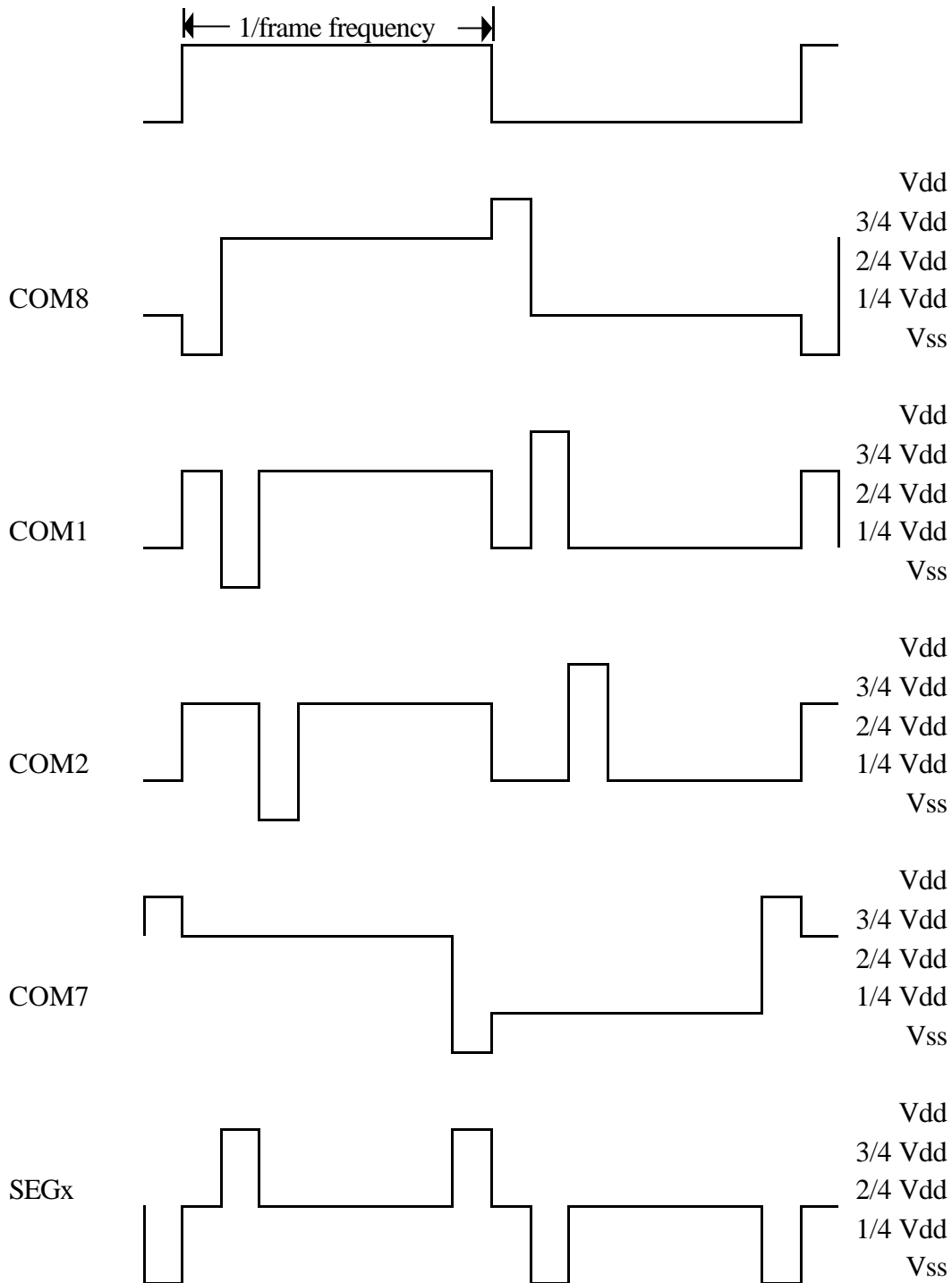
Storage temperature -65 to 150
 Supply voltage 7 V
 Input voltage -0.6 to Vdd+0.6 V

6. ELECTRICAL CHARACTERISTIC :

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage	Vdd		2.5	3.0	4.0	V
Main system frequency	Øsys	Vdd=2.5V		0.8	2	Mhz
		Vdd=3V			2.7	Mhz
		Vdd=4.0V			3.5	Mhz
Crystal frequency	Øcry			32768		Hz
Operating current	Idd	Vdd=4V, Øsys=1Mhz		2		mA
Power-down current	I _{down}	Vdd=2.5V		0.2		µA
		Vdd=3.0V		0.3		µA
		Vdd=3.5V		0.8		µA
		Vdd=4.0V		2		µA
		Vdd=4.5V		8		µA
		Vdd=4.8V		25		µA
		Vdd=5.0V		80		µA
		Vdd=5.25V		220		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=-30µA	Vdd- 0.2		Vdd	V
Output low voltage (for SEGx and COMx)	Vol1	Iol=40µA	0		0.2	V
Output high voltage (for other pins)	Voh2	Ioh=-2mA	Vdd- 0.4		Vdd	V



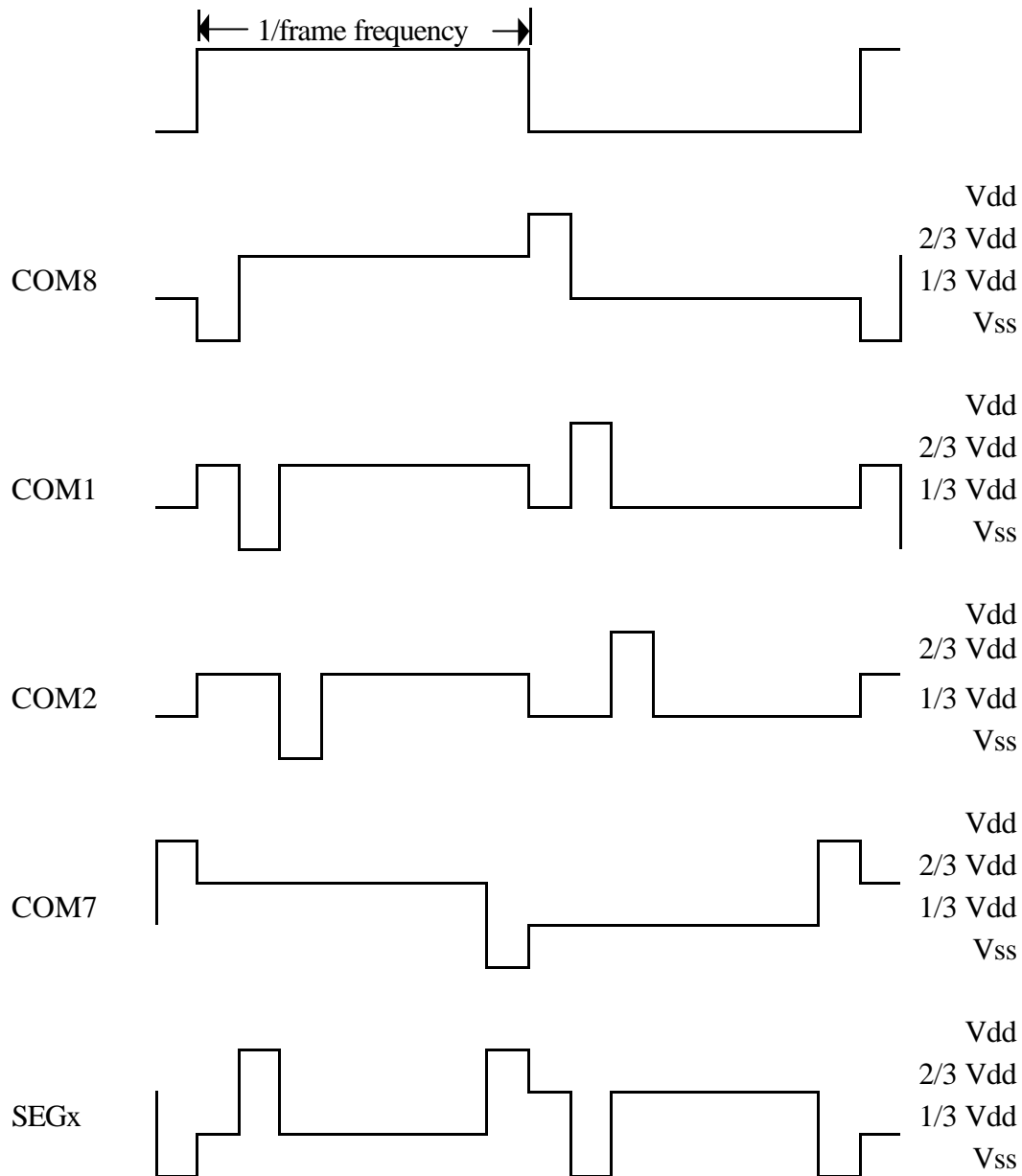
Output low voltage (for other pins)	Vol2	Iol=2mA	0	0.4	V
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**7. LCD WAVEFORM :****7.1 1/4 Bias, 1/8 Duty**

There are two LCD matrix DOTs active at (SEGx,COM1) and (SEGx,COM7)



7.2 1/3 Bias, 1/8 Duty



There are two LCD matrix DOTs active at (SEGx,COM1) and (SEGx,COM7)



Syntek Semiconductor Co., Ltd.

Customer Information Sheet for STK55C321

970926

1. Customer's Name : _____

2. Project title : _____

* 3. Syntek part number : _____

4. Package ----- () Chip () 80-pin QFP

5. Options :

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

CPU freq. ----- () =Oscillator freq. () =1/2(oscillator
freq.)

LCD duty ----- () 1/8 () 1/4

LCD bias ----- () 1/4 () 1/3

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

6. Customer code :

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

Checksum ----- 9800-9FFF _____H

A000-AFFF _____H

B000-BFFF _____H

9800-BFFF _____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 Operating frequency : _____ Hz

Operating current : _____ mA Sleep current : _____ μ A

Others :

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



STK55C321

Syntek Semiconductor Co.,Ltd.

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