

**Features**

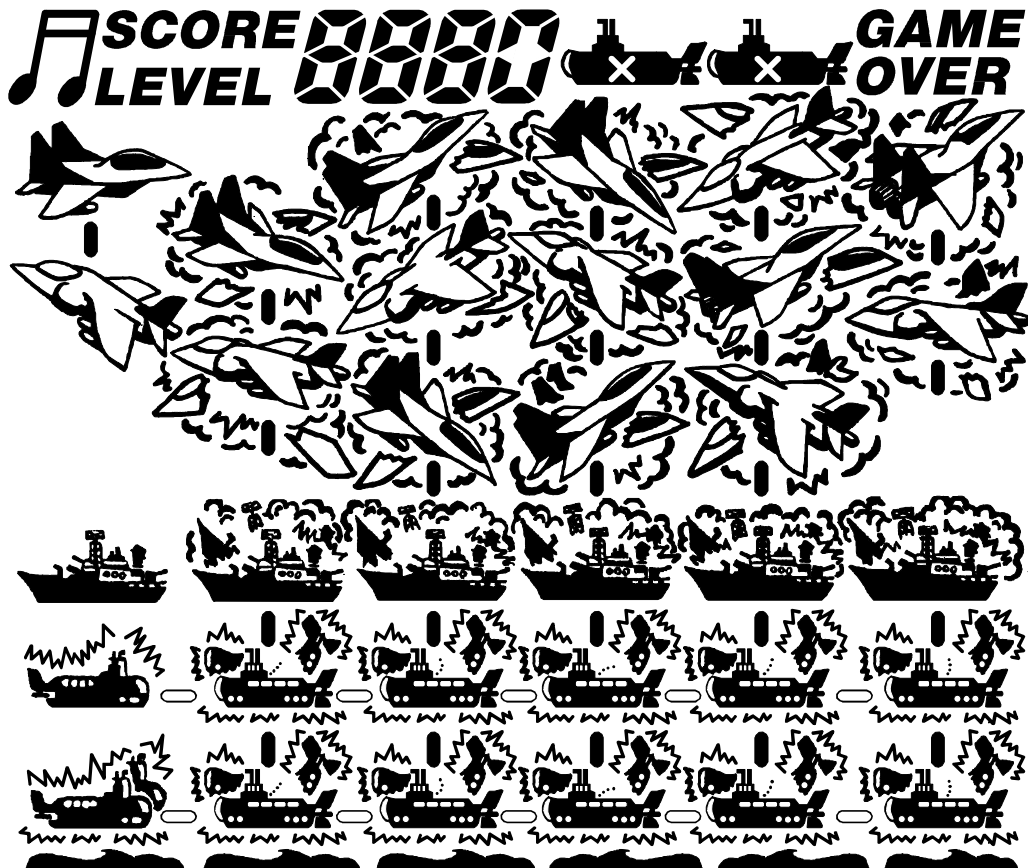
- 1/3 bias, 1/4 duty, 32x4 pattern, 3.0V LCD driver
- Built-in sound generator
- RC oscillator
- Auto power off mode

**General Description**

HT113FA is a submarine war LCD game designed by HOLTEK. In the game, the player's submarine tries to fight back against the bombs and torpedoes fired from the enemy's bombers, warships and submarines. To dodge the attack,

the player can use the up, down, left and right shift keys to move the submarine. Also, the player can fight back by firing missiles and torpedoes.

**LCD Pattern**



## Functional Description

### Key description

- **RESET**  
When this key is pressed, the game is re-initiated and all the records are cleared to zero. When the ON/OFF and RESET keys are pressed at the same time, and then the RESET key is released, all the pattern dots are shown on the screen until the ON/OFF key is released. This function is for LCD testing.
- **MUTE**  
This key is pressed to alternately put the music in the OFF or ON modes.
- **START/PAUSE**  
This key can function differently depending on the following three conditions. First, the START/PAUSE key is a restart key. When the game is over, pressing this key re-starts the game. At this time, the highest game level and score achieved are still saved. Next, it functions as a continue key. After the game is over, pressing the START/PAUSE and UP keys at the same time continues the game from the level previously achieved. Nonetheless, the score is cleared to zero. Finally, the START/PAUSE key is a pause key. When the game is in progress, pressing this key pauses the game and the score and game level are alternately displayed on the LCD. To continue the game, press the START/PAUSE key again. At this time, the MUTE, ON/OFF and START/PAUSE are in effect.
- **ON/OFF**  
This key is pressed to alternately turn the power off or on. When the game is in the PAUSE mode, pressing the ON/OFF key switches the power off. To turn on the power, re-press the ON/OFF key. At this time, the game still remains in the PAUSE mode.
- **MISSILE**  
When this key is pressed, a missile is fired.
- **TORPEDO**  
When this key is pressed, a torpedo is fired.

- **LEFT**  
When this key is pressed, the player's submarine moves to the left.
- **RIGHT**  
When this key is pressed, the player's submarine moves to the right.
- **UP**  
When this key is pressed, the player's submarine moves up.
- **DOWN**  
When this key is pressed, the player's submarine moves down.

### Operational description

- Press the ON/OFF key to turn the power on. Then, the game goes into the DEMO mode. To play the game, press the START/PAUSE key. At this time, the highest game level and score achieved are displayed on the LCD. The game comes into play immediately after the game level 1-1 and the initial zero score are shown. Notice that when the game is in progress, the START/PAUSE key functions as the PAUSE key until the game is over.
- After the music is initiated, the player's submarine first appears at the lowest right corner of the LCD. Then, the player's submarine moves to the left twice successively and lets off a "TU" sound. The game goes into a battle state.
- The game is divided into nine levels and each level consists of three rounds. The total number of games is 27. In the first round, the enemy's attack comes from the bombers only. In the second round, the attack, comes not only from the bombers but also from the warships. Finally, in the third round, all the enemy's attacks, namely the bombers, warships and submarines, are included. Each time a level is completed and the next level starts to play, the moving speed of the enemy's attack increases. In other words, the difficulty of the game increases with its level. The higher the level, the more difficult the game becomes.

- Three chances are offered to the player in each round. When the player's submarine is hit by the enemy three times, GAME OVER is shown on the LCD and the game goes into the DEMO mode. At this time, if the START/PAUSE key is not pressed within 2 minutes, power is automatically turned off. The record of being hit is cleared to zero whenever the hitting number is less than three and a new round begins.
- The player's submarine can only fire one shot at a time. Only when the player's torpedo hits its target or the target disappears can another torpedo or missile be fired. In addition, various sounds accompany with the firing. A picture of an explosion and a sound are generated whenever the enemy's or the player's submarine gets hit. When the player's missile or torpedo hits the enemy's, a "TU" sound is derived. In addition, a jubilant music is played each time a round is completed. When the player's submarine gets hit three times and the game is over, a sad music is played. However, no sounds are generated if the MUTE key is pressed. To re-initiate the sounds, press the MUTE key again.
- Each time the player hits the enemy and scores are added, the highest score recorded is compared with the present score. The highest score is replaced when the current score is greater than the recorded score. Otherwise, the recorded score is maintained. The highest score and game level achieved are reserved as long as the RESET key is not pressed or the batteries are not removed.
- The moving range of the player's submarine is limited to the upper and lower waterways. The player can use the up, down, left and right shift keys to move the submarine.
- When the player's submarine gets hit, a submarine picture is shown at the upper right side of the LCD to specify the submarine has been hit once. Another picture of submarine is added when the player's submarine is being hit again. However, the third hit of the player's submarine ends the game and displays GAME OVER at the upper right side of the LCD.
- The enemy's bombers can appear from either

the left or the right side. Each direction is further divided into the upper and lower routes. The Following is the code for the individual routes:

- The first route is: A1 → B2 → C2 → E2 → D5 → F2
- The second route is: A1 → B2 → C8 → E8 → D5 → F2
- The third route is: F5 → D2 → E5 → C5 → B5 → A3
- The fourth route is: F5 → D8 → E5 → C5 → B5 → A3

Given this, the maximum number of bombers appearing on the LCD is four. The warships emerge at the right side and then move to the left side. As for the enemy's submarines, they appear in the upper waterway or sometimes in the lower waterway. The submarines then move upward and downward. However, the submarines will automatically disappear after moving to and fro without being attacked.

- The enemy's bombs have two directions of flight, namely vertically down and slanting downward:
  - The routes for vertical flights are:
    - The first route: B3 → B6 → B9 → B13
  - The second route: C3 → C6 → C9 → C12 → C16
  - The third route: E3 → E6 → E9 → E12 → E16
  - The fourth route: D3 → D6 → D9 → D12 → D16
  - The fifth route: F3 → F6 → F9 → F12
  - The routes of the slanting flights are:
    - The first route: A2 → B6 → C9 → E12 → E16
  - The second route: C9 → E12 → E16
  - The third route: B3 → C6 → E9 → D12 → D16
  - The fourth route: E9 → D12 → D16
  - The fifth route: C3 → E6 → D9 → F9 → F12
  - The sixth route: E3 → D6 → F9 → F12
  - The seventh route: F6 → D9 → E12 → E16
  - The eighth route: D9 → E12 → E16
  - The ninth route: D3 → E6 → C9 → B9 → B13
  - The tenth route: E6 → C9 → B9 → B13

- The eleventh route: C6 → B9 → B13
- The enemy's bombs drop vertically.
- The enemy submarine fires torpedoes from left to right.
- After all the nine levels are completed, the game is re-initiated from level 7-1. However, the score is continually incremented until a score of 9990 is reached. When 9990 is the current score, the system will record it as the highest score. Then the score is cleared to zero.

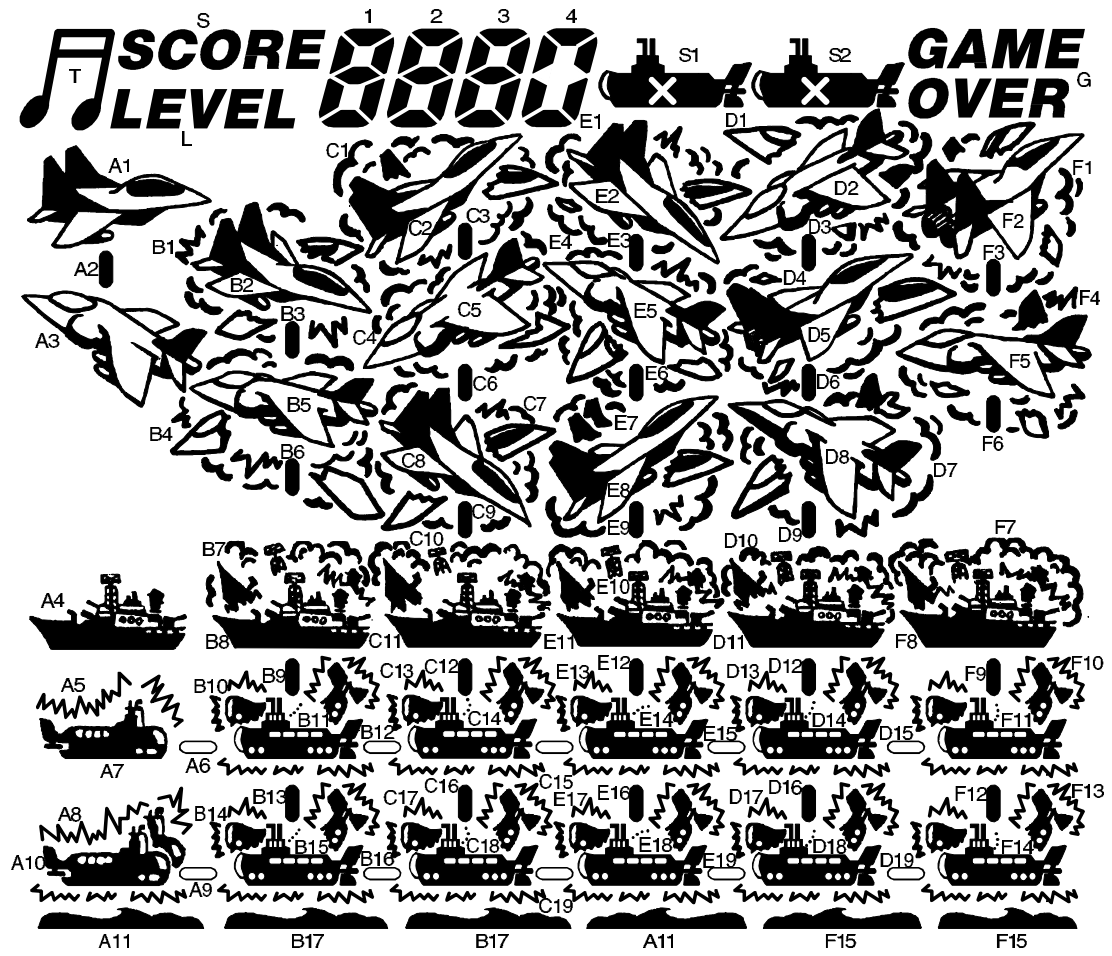
**Counting methods**

- 20 points are awarded when the enemy's bombers or warships are hit in the upper waterway.
- 10 points are awarded when the enemy's bombers or warships are hit in the lower waterway.
- 10 points are awarded when the enemy's submarine is hit by a torpedo.
- 5 points are awarded when a round is completed and the player's submarine has not been hit.

**Sound effects**

- Music when a game begins
- Sound when the player's submarine arrives (three times)
- Howling sound when the bomber appears
- Sound when the bomber drops a bomb
- Sound when the submarine fires a missile
- Sound when the submarine fires a torpedo
- Music when scores are added
- Music when a round is completed
- Explosion sound
- Sound when two bombs hit each other
- Sound when a game is over

LCD Display Label

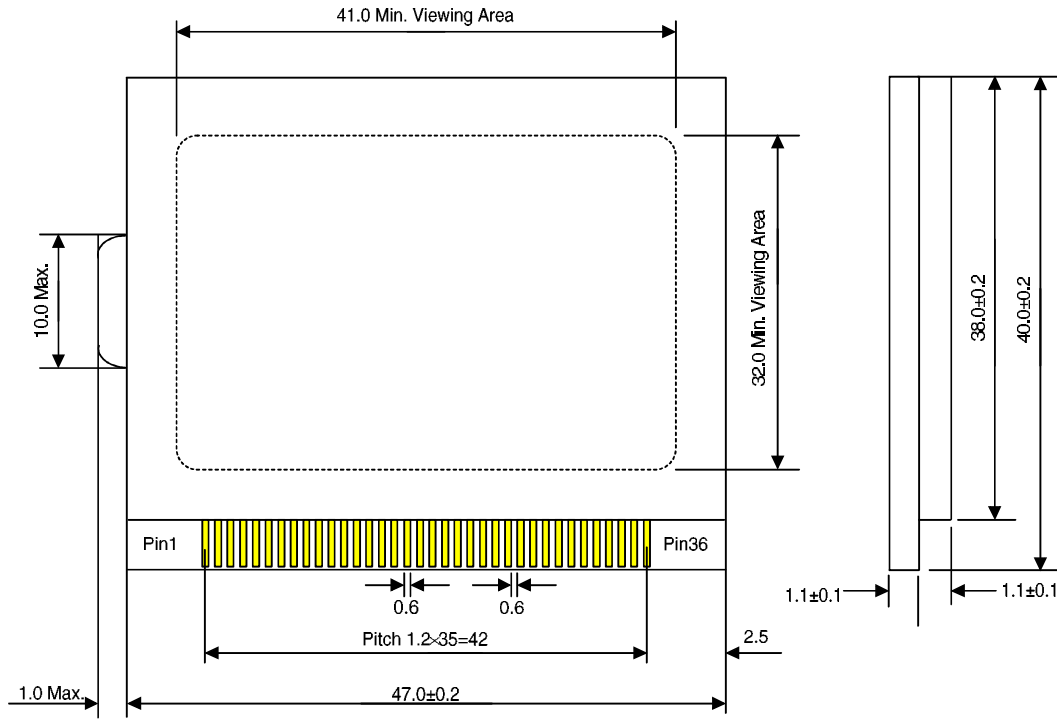


**LCD Pattern Contrast Table**

<b>Pad No.</b>	<b>Pin No.</b>	<b>COM0</b>	<b>COM1</b>	<b>COM2</b>	<b>COM3</b>	<b>SEGMENT</b>
65	1	2A	2G	2D	C9	SEG31
64	2	2F	2E	C3	C6	SEG30
63	3	1B	1C	C1	C5	SEG29
62	4	1A	1G	1D	C2	SEG28
61	5	1F	1E	C4	C8	SEG27
60	6	S	L	C7	C14	SEG26
59	7	T	B1	C10	C19	SEG25
58	8	A1	B2	C11	C17	SEG24
57	9	A2	B3	B6	C16	SEG23
56	10	A3	B4	C12	C13	SEG22
55	11	A4	B5	C15	C18	SEG21
54	12	A5	B7	B12	B16	SEG20
53	13	A7	B8	B9	B14	SEG19
52	14	A8	A6	B10	B11	SEG18
51	15	A10	A9	B15	B13	SEG17
50	16	A11	E18	E14	E9	SEG16
49	17	B17	E16	E12	E11	SEG15
48	18	E17	E13	E10	E6	SEG14
47	19	E19	E15	E7	E5	SEG13
46	20	D18	D14	D11	E8	SEG12
45	21	F15	D17	D15	F5	SEG11
44	22	D19	F9	F8	F4	SEG10
43	23	F14	F11	F7	F2	SEG9
42	24	F13	F12	F10	F1	SEG8
41	25	G	D16	F6	F3	SEG7
40	26	S2	D2	D13	D5	SEG6
39	27	S1	D1	D12	D4	SEG5
38	28	4-0	D3	D10	D6	SEG4
37	29	3B	3C	D7	E1	SEG3
36	30	3A	3G	3D	E2	SEG2
35	31	3F	3E	D8	E3	SEG1
34	32	2B	2C	D9	E4	SEG0
8	33	COM0	—	—	—	COM0
7	34	—	COM1	—	—	COM1
6	35	—	—	COM2	—	COM2
5	36	—	—	—	COM3	COM3

**LCD Package Outline**

Unit : mm



**Specifications:**

Display type: Tn

Viewing direction: 6.00

Polarizer mode: Reflective/Positive

Drive method: 1/4 duty, 1/3 bias

Operating voltage: 3.0V

Operating temperature : 0°C to +50°C

Storage temperature: -20°C to +60°C

Connector: Zebra





**Pad Coordinates**

 Unit :  $\mu\text{m}$ 

<b>Pad No.</b>	<b>X</b>	<b>Y</b>	<b>Pad No.</b>	<b>X</b>	<b>Y</b>
1	-1192.10	1305.20	34	1261.10	-1122.30
2	-1192.10	1169.80	35	1261.10	-979.80
3	-1196.70	1019.80	36	1261.10	-836.30
4	-1261.10	873.70	37	1261.10	-693.80
5	-1261.10	731.20	38	1261.10	-550.30
6	-1261.10	587.70	39	1261.10	-407.80
7	-1261.10	445.20	40	1261.10	-264.30
8	-1261.10	301.70	41	1261.10	-121.80
9	-1261.10	159.20	42	1261.10	21.70
10	-1261.10	15.70	43	1261.10	164.20
11	-1261.10	-126.80	44	1261.10	307.70
12	-1261.10	-270.30	45	1261.10	450.20
13	-1261.10	-412.80	46	1261.10	593.70
14	-1261.10	-556.30	47	1261.10	736.20
15	-1261.10	-698.80	48	1261.10	879.70
16	-1261.10	-842.30	49	1261.10	1022.20
17	-1261.10	-984.80	50	1261.10	1165.70
18	-1261.10	-1128.30	51	1261.10	1311.20
19	-876.70	-1331.40	52	1001.00	1331.40
20	-719.70	-1331.40	53	858.50	1331.40
21	-542.10	-1241.00	54	715.00	1331.40
22	-406.70	-1241.00	55	572.50	1331.40
23	-276.30	-1241.00	56	429.00	1331.40
24	-140.90	-1241.00	57	286.50	1331.40
25	-10.50	-1241.00	58	143.00	1331.40
26	124.90	-1241.00	59	0.50	1331.40
27	284.90	-1331.40	60	-143.00	1331.40
28	427.40	-1331.40	61	-285.50	1331.40
29	570.90	-1331.40	62	-429.00	1331.40
30	713.40	-1331.40	63	-571.50	1331.40
31	856.90	-1331.40	64	-715.00	1331.40
32	999.40	-1331.40	65	-857.50	1331.40
33	1261.10	-1265.80	66	-990.50	1331.40

**Absolute Maximum Ratings\***

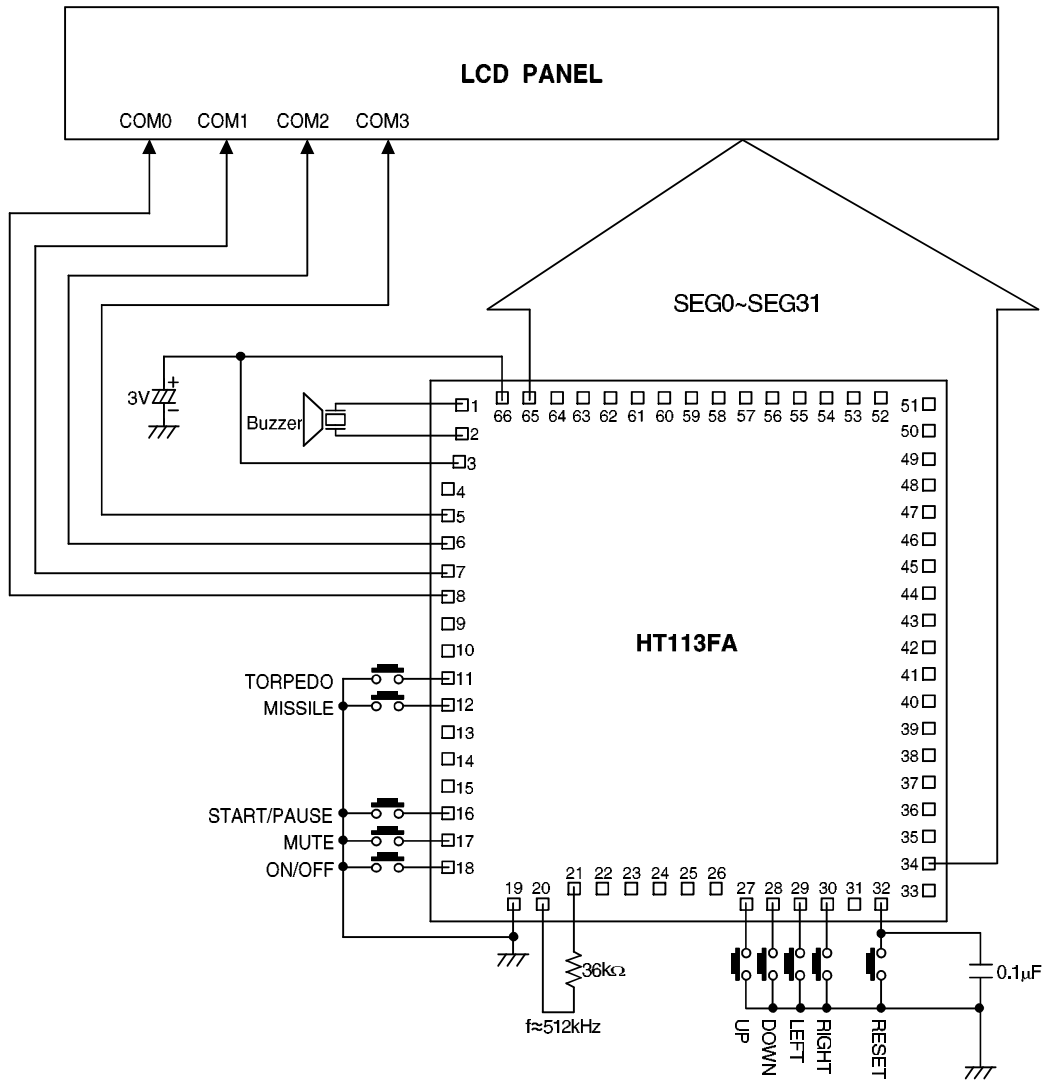
Supply Voltage .....  $V_{DD}-0.3V$  to  $5.5V$       Input Voltage.....  $V_{SS}-0.3V$  to  $V_{DD}+0.3V$   
 Storage Temperature.....  $-50^{\circ}C$  to  $125^{\circ}C$       Operating Temperature.....  $0^{\circ}C$  to  $70^{\circ}C$

\*Note: These are stress ratings only. Stresses exceeding the range specified under “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.

**Electrical Characteristics**
 $T_a=25^{\circ}C$ 

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		$V_{DD}$	Conditions				
$V_{DD}$	Operating Voltage	—	—	2.4	3	3.3	V
$I_{DD}$	Operating Current	3V	No load, $f_{SYS}=512kHz$	—	300	500	$\mu A$
$V_{LCD}$	LCD Supply Voltage	3V	—	—	3	—	V
$f_{SYS}$	Operating Frequency	3V	$R=36k\Omega$	—	512	—	kHz

Application Circuits



Note: The IC substrate should be connected to VSS in the PCB layout artwork.