



**GENERAL DESCRIPTION**

C1929 is a CMOS analog watch LSI with three functions (hour, minute, second) and 3-HAND LCD display, designed for a 1/6-duty multiplexing LCD. The analog LCD panel has 120 segments (20 segment outputs and 6 common outputs ).

It operates at a single battery supply and the time base is generated from a 32,768 Hz crystal oscillator.

**FUNCTIONS**

- Single 1.5V battery operation
- 32,768Hz crystal oscillator built-in
- 3 functions: Hour, Minute, Second
- 1 switch operation
- Time setting: Minute and Hour setting
- 1/6-duty multiplex LCD drive

**FEATURES**

- One-chip CMOS construction
- Lower power consumption
- Built-in voltage doubler, voltage triple circuits
- Trimmer capacitor included

**ABSOLUTE MAXIMUM RATINGS**

(T<sub>2</sub> = 25 °C)

Parameter	Symbol	Limits
Supply Voltage (V <sub>DD1</sub> - V <sub>SS</sub> )	V <sub>DS1</sub>	- 0.3V to +2.0V
Supply Voltage (V <sub>DD2</sub> - V <sub>SS</sub> )	V <sub>DS2</sub>	- 0.3 V to +4.0V
Supply Voltage (V <sub>DD3</sub> - V <sub>SS</sub> )	V <sub>DS3</sub>	- 0.3 V to +6.0V
Operating Temperature	Topr	-10°C to +60°C
Storage Temperature	Tstg	-55°C to +125°C

**DC ELECTRICAL CHARACTERISTICS**

(T<sub>2</sub> = 25°C, V<sub>SS</sub> = 0V, V<sub>DD</sub> = 1.5V unless otherwise specified.)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Operating Voltage	V <sub>DD1</sub>	1.2	1.5	1.7	V	-
	V <sub>DD2</sub>	2.4	3.0	3.4	V	-
	V <sub>DD3</sub>	3.6	4.5	5.1	V	-
Supply Current	I <sub>DD</sub>	-	1.5	2.5	µA	Without load
Input High Voltage	V <sub>IH</sub>	V <sub>DD</sub> - 0.3	-	V <sub>DD</sub>	V	-
Input Low Voltage	V <sub>IL</sub>	V <sub>SS</sub>	-	V <sub>SS</sub> + 0.3	V	-
Switch Activation Current	I <sub>SW</sub>	0.1	0.5	3.0	µA	V <sub>IH</sub> = V <sub>DD</sub>
Oscillator Start Voltage	V <sub>OSC</sub>	-	-	1.45	V	Within 5 Sec
Oscillator Stop Voltage	V <sub>OSP</sub>	-	-	1.15	V	-
Oscillator Frequency	F <sub>OSC</sub>	-	32,768	-	Hz	-
DC-DC Conversion Frequency	F <sub>CON</sub>	-	1,024	-	Hz	C12 = CD2 = CD3 = 0.1µF
LCD Frequency	F <sub>D</sub>	-	43	-	Hz	-
Oscillator Capacitor	C <sub>IN</sub>	-	16.9	-	pF	-
	C <sub>OUT</sub>	-	18.9	-	pF	-
Switch Debouncing Time	T <sub>deb</sub>	-	-	31.25	mSec	-

**FUNCTIONAL DESCRIPTION**

**1. Function Mode**

1.1. Initial Set

The initial state is shown in Fig. 1.

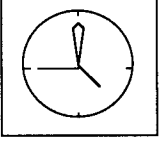
Initial State	Time	Display
Base Watch Mode	(AM) 00:00 00	

Fig. 1

1.2. Operation Mode

1.2.1 Normal Operation Mode

The normal mode will be displayed with three hands (hour, minute, second). The second hand is advanced at a 1 Hz rate, the minute is advanced at a 60-seconds rate, and the hour hand is advanced at a rate of 6, 18, 30, 42 and 54 minutes.

1.2.2 Time Setting Mode

When SW switch is depressed for less than 1 second, the minute hand advances a step once a depressing SW and the second hand returns to "0".

If SW switch is depressed for more than 1-2 seconds, the minute hand advances at a 8 Hz rate and the second hand remaining "0", whereas the hour hand advances according to the minute hand.

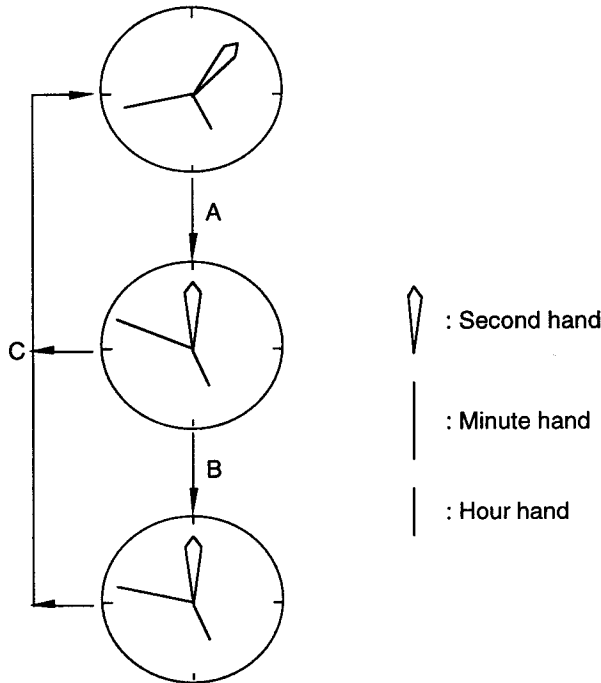


Fig. 2 Switch Setting Operation

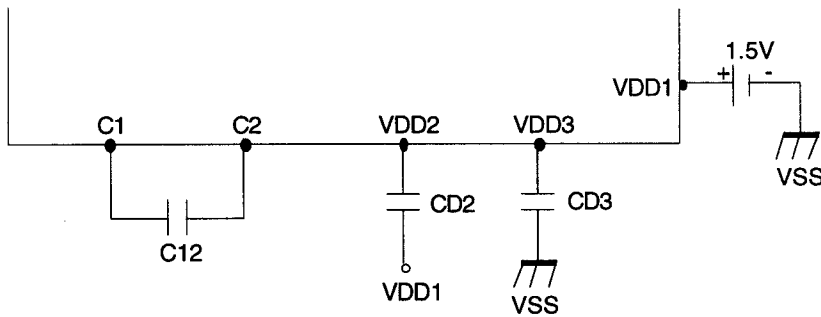
- A. Depressing SW switch for less than 1 second will make the minute hand advanced +1 and the Second hand returned to "0".
- B. Depressing SW switch for more than 1-2 seconds will make the minute hand advanced at a 8 Hz rate and the Second hand stayed at "0".
- C. SW switch is released.

2. Test Mode

T1	T2	T3	AC	SW	Function
0	0	0	0	-	Normal
Clock	-	-	0	-	Test 256 Hz drive
-	Clock	-	0	-	Test 8 Hz drive
Clock	0	1	0	Clock	Minute display & TEST
Clock	1	1	0	Clock	Hour display & TEST
-	-	0	1	-	Initial SET
-	-	1	1	-	LCD TEST

3. Voltage Tripler

The battery voltage (1.5V) can be doubled and tripled by connecting external capacitors CD2, CD3 and C12 to the on-chip voltage doubler and triple as shown in Fig. 3.

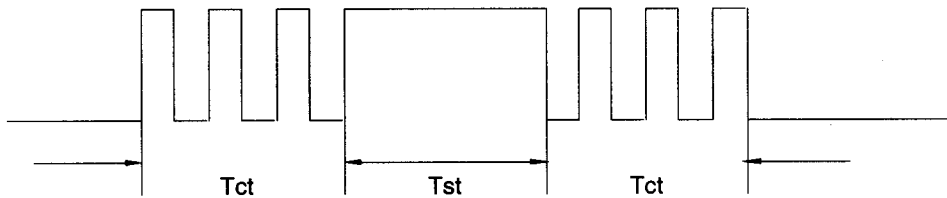


VSS = 0V  
 VDD1 = 1.5V  
 VDD2 = 3.0V  
 VDD3 = 4.5V  
 CD3 = CD2 = C12 = 0.1 μF

Fig. 3 Voltage Tripler

4. Debounce Circuit

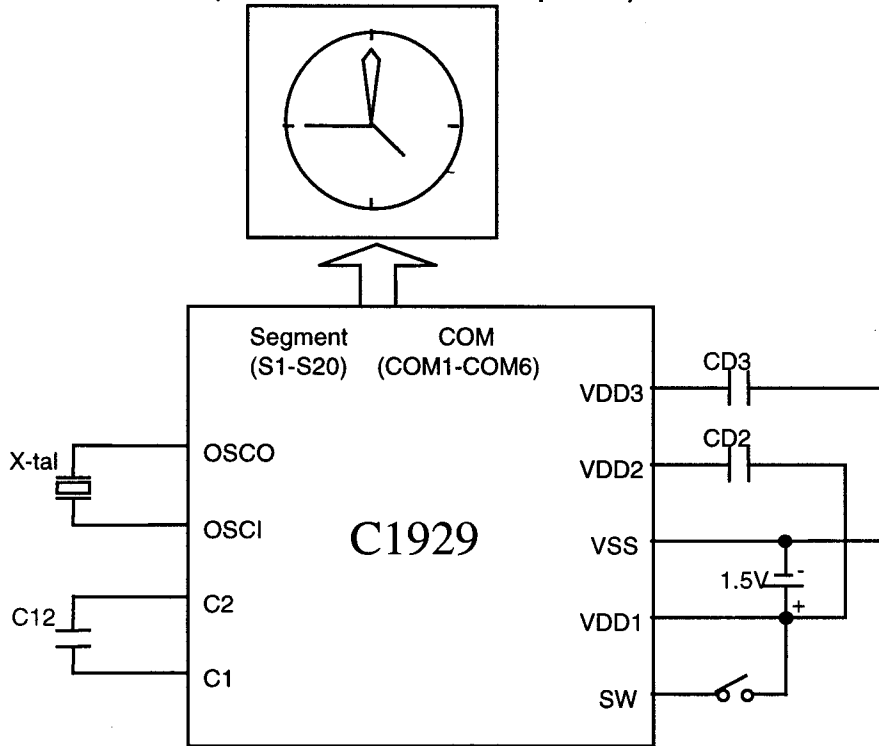
The built-in debounce circuit provided for the switch can prevent possible error caused by the bouncing of the switch as shown in Fig. 4.



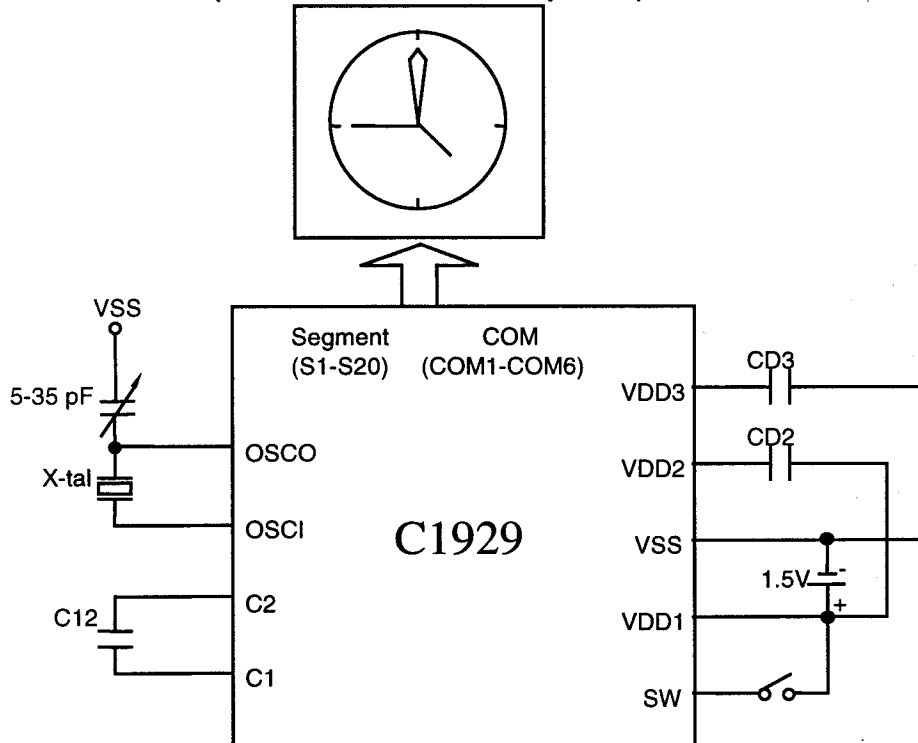
$T_{ct} \leq 33.3$  msec. (maximum switch bouncing time)  
 $T_{st} \leq 60$  msec. (minimum stable time)

Fig. 4 Bouncing

APPLICATION CIRCUIT (with Internal Trimmer Capacitor)



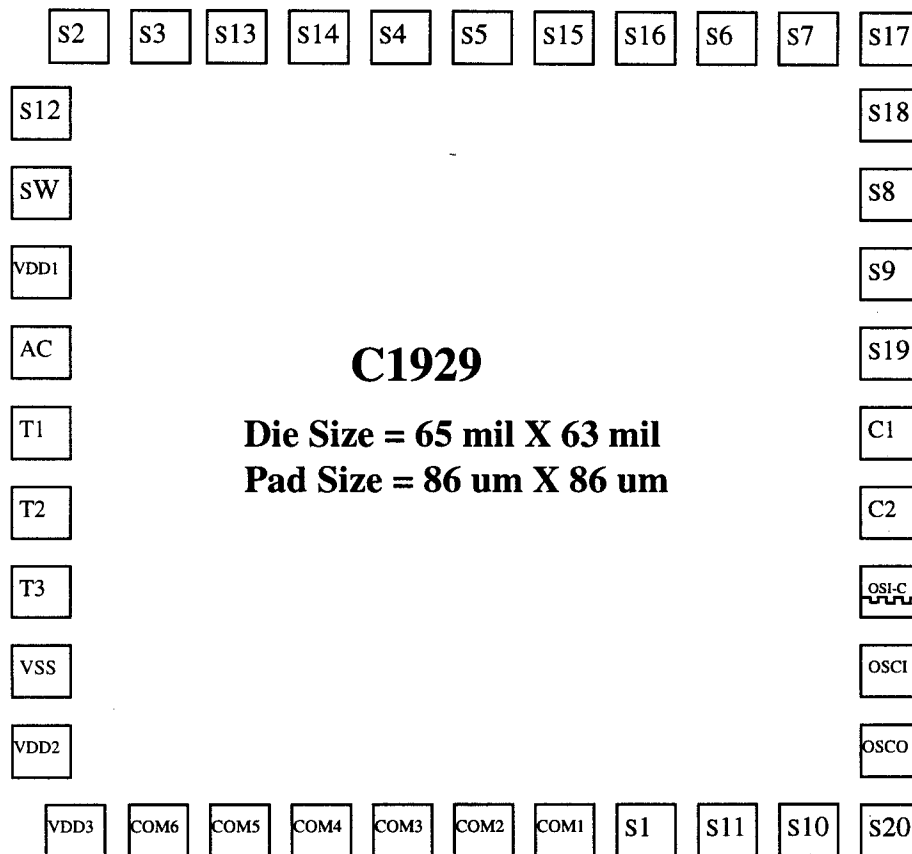
APPLICATION CIRCUIT (with External Trimmer Capacitor)



- NOTE:** In the above two diagrams,
1. C12 = CD2 = CD3 = 0.1  $\mu$ F and Quartz Crystal Parameter  
 Fp = 32,768 Hz  
 CL = 10 pF  
 C1 = 4.0 pF  
 Co = 2.0 pF  
 Rs = 35 K $\Omega$   
 Q = 35,000
  2. Substrate must be floating or connected to VSS.

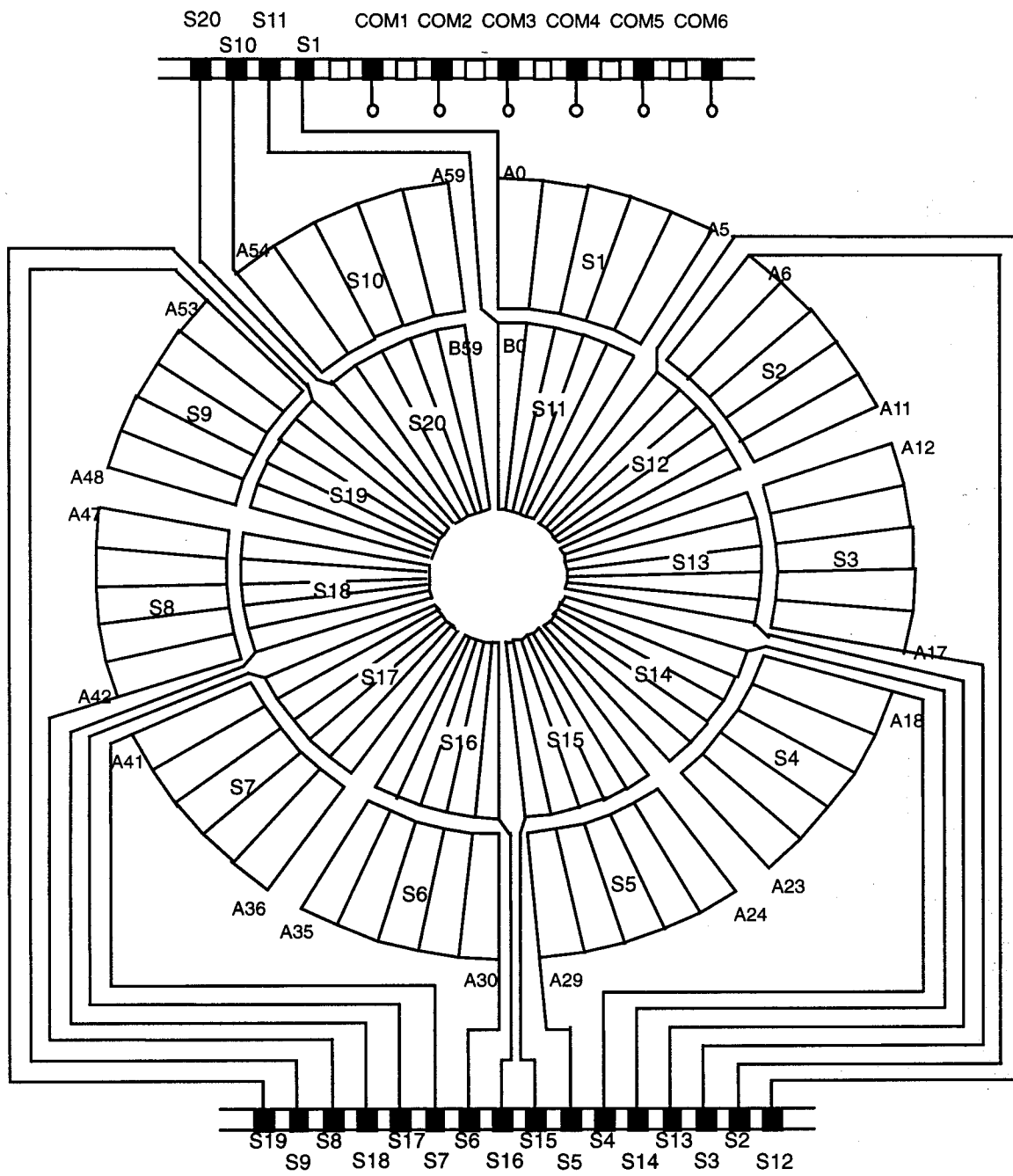
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## PAD DIAGRAM

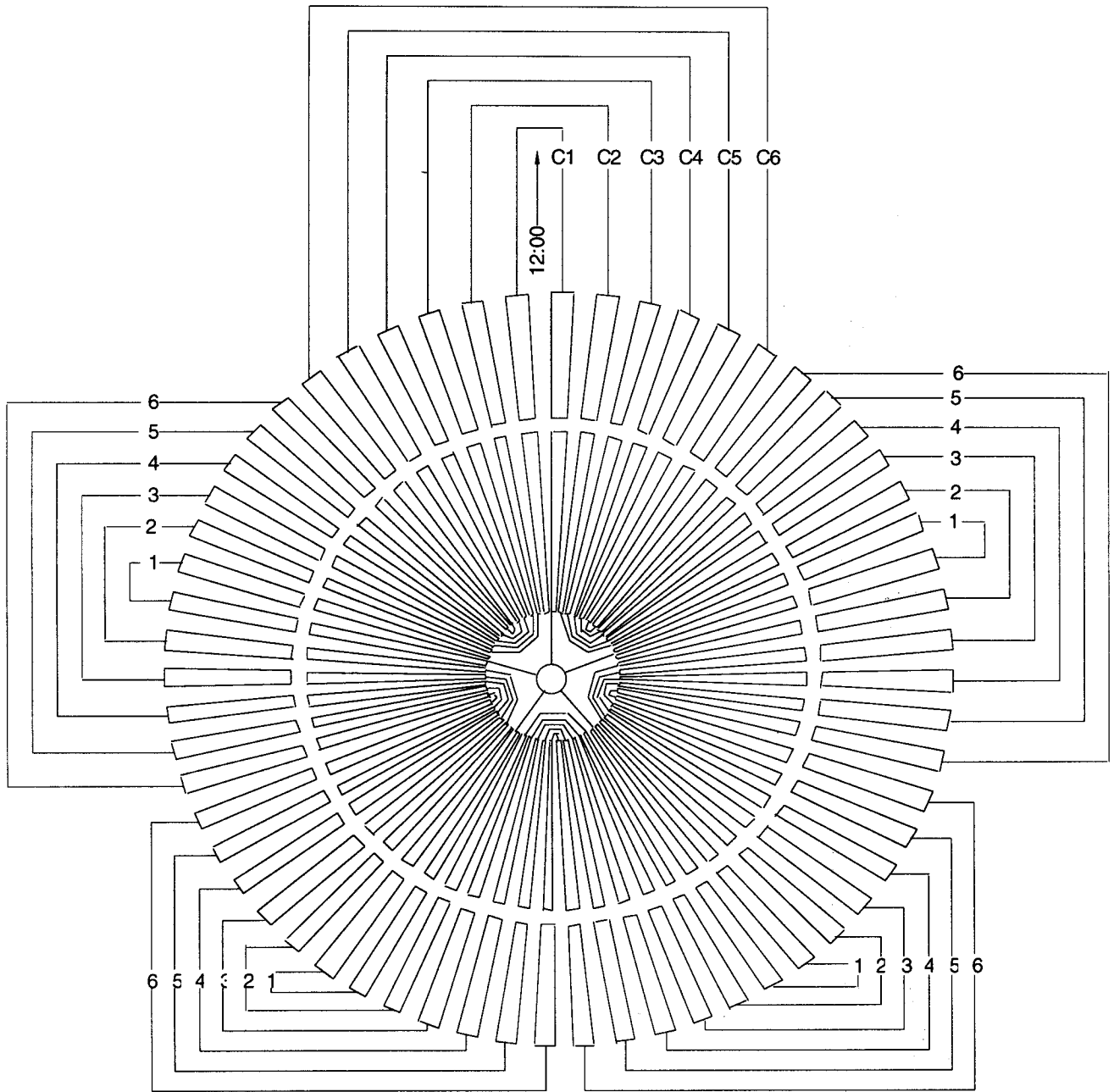
The Co-ordinate of Low Left Corner for Each Pad

VDD3( 129.3, -704.2)	S20 (1485.7, -704.2)	S17 (1485.7, 618.1)	S2 (147.7, 618.1)
COM6( 265.3, -704.2)	OSCO(1485.7, -571.9)	S7 (1353.7, 618.1)	S12 (79.3, 486.0)
COM5( 401.3, -704.2)	OSCI(1485.7, -439.6)	S6 (1219.7, 618.1)	SW (79.3, 354.0)
COM4( 537.3, -704.2)	OSI-C (1485.7, -307.3)	S16 (1085.7, 618.1)	VDD1 (79.3, 221.9)
COM3( 673.3, -704.2)	C2 (1485.7, -175.0)	S15 (951.7, 618.1)	AC (79.3, 89.6)
COM2( 809.3, -704.2)	C1 (1485.7, -42.7)	S5 (817.7, 618.1)	T1 (79.3, -42.7)
COM1( 945.3, -704.2)	S19 (1485.7, 89.6)	S4 (683.7, 618.1)	T2 (79.3, -175.0)
S1 (1081.3, -704.2)	S9 (1485.7, 221.9)	S14 (549.7, 618.1)	T3 (79.3, -307.3)
S11 (1217.3, -704.2)	S8 (1485.7, 354.1)	S13 (415.7, 618.1)	VSS (79.3, -439.6)
S10 (1353.3, -704.2)	S18 (1485.7, 486.1)	S3 (281.7, 618.1)	VDD2 (79.3, -571.6)

LCD FORMAT



Segments Connection



Backplanes Connection

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Pad Name	COM1	COM2	COM3	COM4	COM5	COM6
COM6						COM6
COM5					COM5	
COM4				COM4		
COM3			COM3			
COM2		COM2				
COM1	COM1					
S1	A0	A1	A2	A3	A4	A5
S11	B0	B1	B2	B3	B4	B5
S10	A59	A58	A57	A56	A55	A54
S20	B59	B58	B57	B56	B55	B54
S19	B48	B49	B50	B51	B52	B53
S9	A48	A49	A50	A51	A52	A53
S8	A47	A46	A45	A44	A43	A42
S18	B47	B46	B45	B44	B43	B42
S17	B36	B37	B38	B39	B40	B41
S7	A36	A37	A38	A39	A40	A41
S6	A35	A34	A33	A32	A31	A30
S16	B35	B34	B33	B32	B31	B30
S15	B24	B25	B26	B27	B28	B29
S5	A24	A25	A26	A27	A28	A29
S4	A23	A22	A21	A20	A19	A18
S14	B23	B22	B21	B20	B19	B18
S13	B12	B13	B14	B15	B16	B17
S3	A12	A13	A14	A15	A16	A17
S2	A11	A10	A9	A8	A7	A6
S12	B11	B10	B9	B8	B7	B6