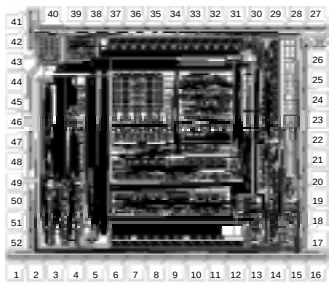
SIX DIGITS MULTIPLEXED LCD WATCH CMOS IC WITH ALARM AND CHRONOGRAPH



chip topography

DESCRIPTION

The SC3788 is a 6 digits and 6 functions watch CMOS LCD circuit with an alarm and chronograph function. It can directly drive 6 digits 1/2 duty multiplexed LCD and display Hours, Minutes, Seconds, Month, Data and Day of the Week. The user's option enables 12 hour or 24 hour format. The SC3788 is typically used in wristwatch and suitable for many other watch applications.

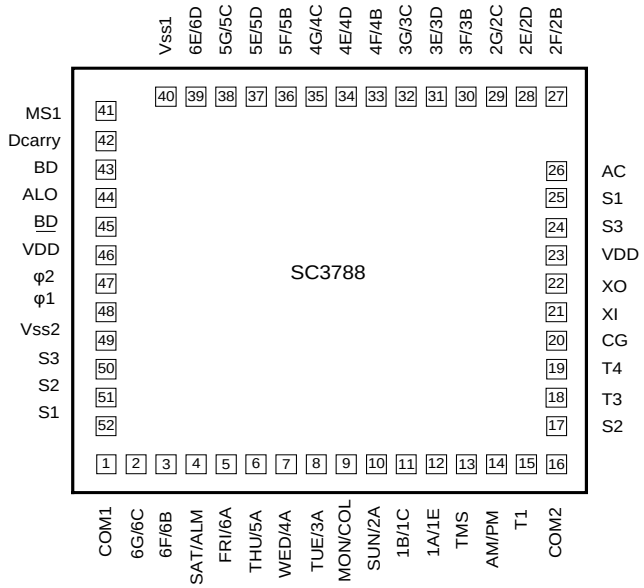
FEATURES

* Power supply voltage: 3V
* 32768 Hz quartz crystal frequency
* On-chip oscillator
* On-chip voltage reducer
* 3 buttons operation
* Alarm output drive external melody
* Piezo direct drive
* Direct interface to 1/2-duty multiplexed LCD with 6 digits and 11 flags (7 days flags, AM/PM flag, chime and alarm flag)
* Colon display
* Low power dissipation

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C, V_{DD} = 0V)

Characteristic	Symbol	Value	Unit
Supply Voltage (1) Vss1	V_{SS1}	-2.0 ~ 0.2	V
Supply Voltage (2) Vss2	V_{SS2}	-4.0 ~ 0.2	V
Input Voltage range	V_{IN}	V_{SS2} - 0.3 ~ V_{DD} + 0.3	V
Operating Temperature range	Topr	-20 ~ 60	°C
Storage Temperature range	Tstg	-40 ~ 70	°C

PAD ASSIGNMENT



ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25°C, VDD=0V, Vss2=-3.0V, Fosc=32768Hz)

Parameter	Symbol	Test conditions		Min	Typ	Max	Unit
Operating Voltage (1)	Vss1			-1.25	-1.55	-1.8	V
Operating Voltage (2)	Vss2			-2.4	-3.0	-3.5	V
Current consumption	I_{SUP}		Time mode and load	--	--	1.3	μA
Output current (1)	I_{OH1}	Vss2= -3.0V	V_{OH1}=-0.05V	--	--	-3.0	μA
(COM1, COM2)	I_{OL1}		V_{OL1}=-2.95V	3.0	--	--	
Output current (2)	I_{OH2}	Vss2= -3.0V	V_{OH2}=-0.05V	--	--	-0.15	μA
(Segment)	I_{OL2}		V_{OL2}=-2.95V	0.15	--		
Output current (3)	I_{OH3}	Vss2= -1.25V	V_{OH3}=-0.10V	--	--	-12	μA
(φ1)	I_{OL3}		V_{OL3}=-1.15V	12	--		
Output current (4)	I_{OH}	Vss2= -3.0V	V_{OH4}=-1.50V	--	--	-70	μA
(Dcarry, MSI)	I_{OL}		V_{OL4}=-1.50V	10	--		

(To be continued)

(Continued)

Parameter	Symbol	Test conditions		Min	Typ	Max	Unit
Input current (1)	I_{IH1}	Vss1= -1.5V	V_{IH1}=-1.50V	0.08	--	2.00	μA
(S_1, S_2, S_3)	I_{IL1}		V_{IL1}=-1.50V	-0.10	--		
Input current (2)	I_{IH2}	Vss2= -3.0V	V_{IH2}=0V	--	--	60	μA
(T_1, T_2, T_3, T_4, AC INPUT)	I_{IL2}		V_{IL2}=-3.0V	--	--	--	
Osc starting voltage	V_{STA}					-2.4	V
Alarm output current (ALO-)	I_{AL}	V_{OH}=-1.50V; Vss2=-3.0V				-500	μA
Alarm output current	I_{OHB}	Vss2= -3.0V	V_{OH}=-1.50V			-4.0	mA
(BD, BD-)	I_{OLB}		V_{OL}=-1.50V	4.0			

PAD DESCRIPTION

Pad No.	Symbol	I/O	Function
1	COM1	O	LCD Drive Output
2	6G/6C	O	LCD Drive Output
3	6F/6B	O	LCD Drive Output
4	SAT/ALM	O	LCD Drive Output
5	FRI/6A	O	LCD Drive Output
6	THU/5A	O	LCD Drive Output
7	WED/4A	O	LCD Drive Output
8	TUE/3A	O	LCD Drive Output
9	MON/COL	O	LCD Drive Output
10	SUN/2A	O	LCD Drive Output
11	1B/1C	O	LCD Drive Output
12	1A/1E	O	LCD Drive Output
13	TMS		
14	AM/PM	O	LCD Drive Output
15	T1	I	Test Input 1
16	COM2	O	LCD Drive Output
17	S2*	I	Switch 2
18	T3	I	Test Input 3
19	T4	I	Test Input 4
20	CG	I	Oscillator Input
21	XI	I	Oscillator Input

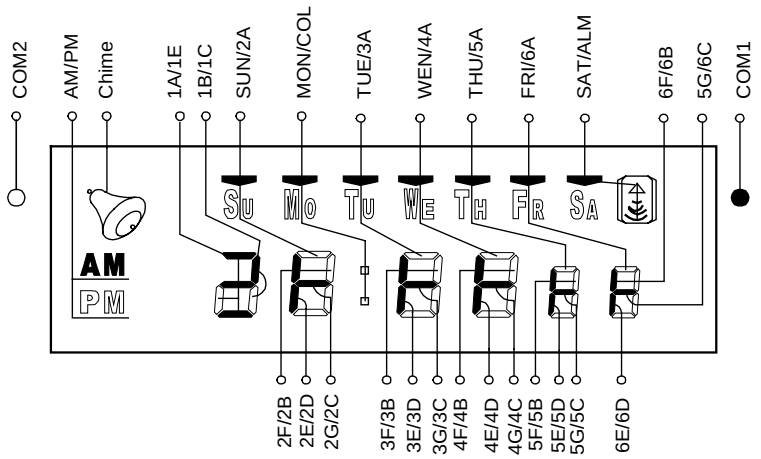
(To be continued)

(Continued)

Pad No.	Symbol	I/O	Function
22	XO	O	Oscillator Output
23	VDD*	--	Positive Power Supply (0V)
24	S3*	I	Switch 3
25	S1*	I	Switch 1
26	AC	I	All Clear
27	2F/2B	O	LCD Drive Output
28	2E/2D	O	LCD Drive Output
29	2G/2C	O	LCD Drive Output
30	3F/3B	O	LCD Drive Output
31	3E/3D	O	LCD Drive Output
32	3G/3C	O	LCD Drive Output
32	4F/4B	O	LCD Drive Output
34	4E/4D	O	LCD Drive Output
35	4G/4C	O	LCD Drive Output
36	5F/5B	O	LCD Drive Output
37	5E/5D	O	LCD Drive Output
38	5G/5C	O	LCD Drive Output
39	6E/6D	O	LCD Drive Output
40	VSS1	--	Negative Power Supply (-1.55V)
41	MS1	O	Signal to Select Melody
42	DCARRY	O	Signal to Advance the Day
43	BD	O	Alarm Output
44	ALO	O	Signal to Drive Melody
45	$\overline{BD}$	O	Alarm Output
46	VDD*	--	Positive Power Supply (0V)
47	$\Phi 2$	O	Voltage Doubler Outputs (256Hz, d.f. = 50%)
48	$\Phi 1$	O	Voltage Doubler Outputs (256Hz, d.f. = 50%)
49	VSS2	--	Negative Power Supply (-3.0V)
50	S3*	I	Switch 3
51	S2*	I	Switch 2
52	S1*	I	Switch 1

* Note: S1,S2,S3,VDD terminals have two pads on both sides of the chip.

LCD DISPLAY

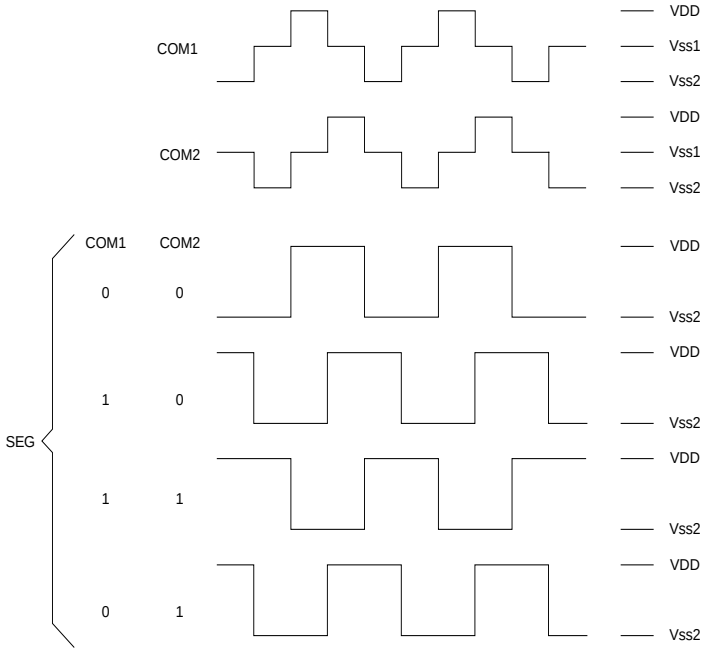


PAD NAME	2F/2B	2E/2D	2G/2C	3F/3B	3E/3D	3G/3C	4F/4B
COM1	2F	2E	2G	3F	3E	3G	4F
COM2	2B	2D	2C	3B	3D	3C	4B
PAD NAME	4E/4D	4G/4C	5F/5B	5E/5D	5G/5C	6E/6D	AM /PM
COM1	4E	4G	5F	5E	5C	6E	AM
COM2	4D	4C	5B	5D	5G	6D	PM
PAD NAME	Chime	1A/1E	1B/1C	SUN /2A	MON /COL	TUE /3A	WED /4A
COM1	--	1A	1B	SUN	MON	TUE	WED
COM2	TMS	1E	1C	2A	COL	3A	4A
PAD NAME	THU/ 5A	FRI/ 6A	SAT/ ALM	6F/6B	6G/6C		
COM1	THU	FRI	SAT	6F	6G		
COM2	5A	6A	ALM	6B	6C		

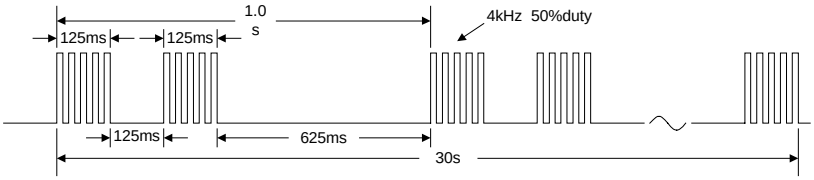
LCD PANEL WAVEFORM

Multiplex drive with ternary voltage: VDD, Vss1, Vss2,

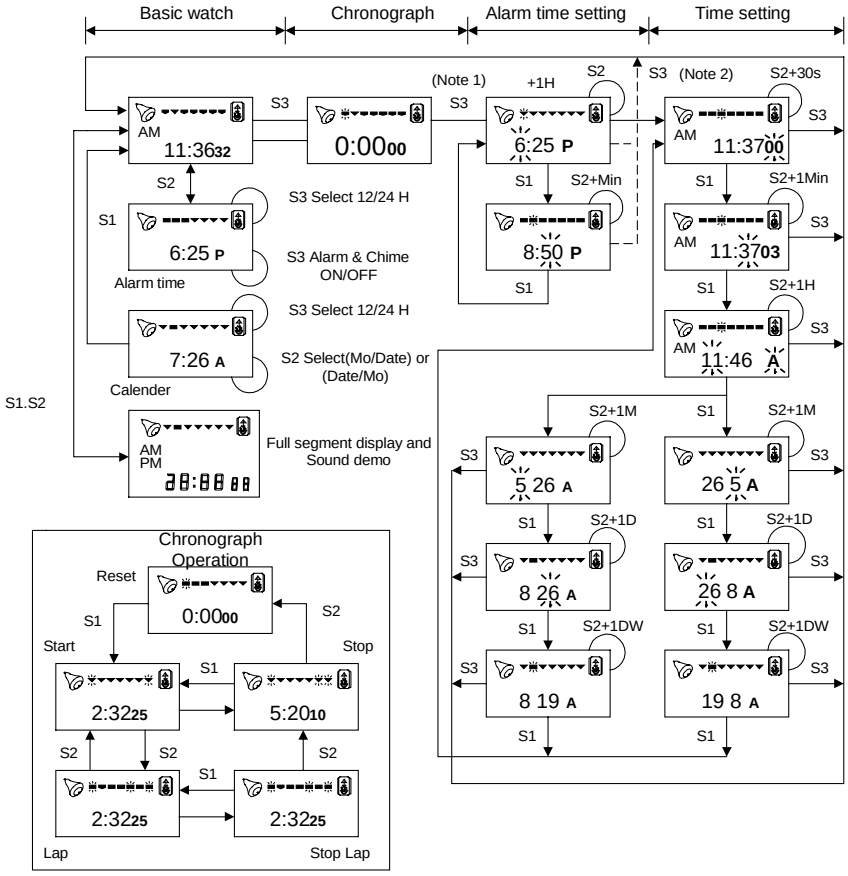
Frame frequency: 32Hz



ALARM OUTPUT WAVEFORM



SETTING SEQENCE AND SWITCH OPERATION

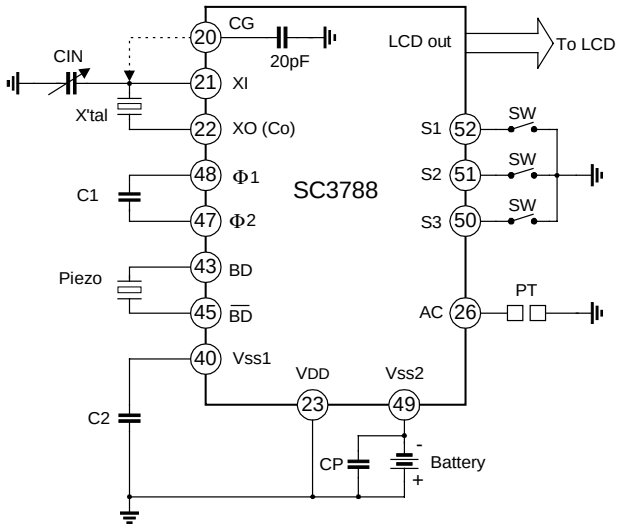


Note:

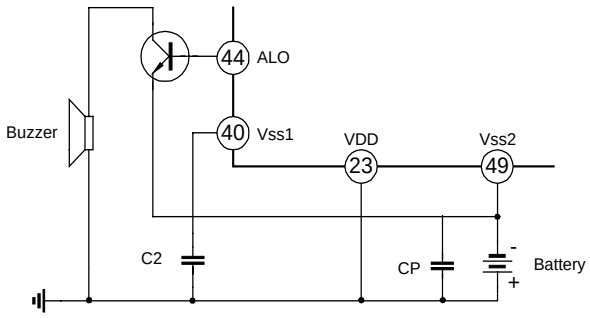
1. In basic watch or chronograph mode, when S3 switch depressed continuously for 1-2 second, the mode changes to alarm time setting.
2. In alarm time setting mode, after S1 or S2 switch is operated, the mode changes back to basic watch mode.
3. Depressing S2 switch for time setting:
   a. +1 advance per pushing
   b. when S2 switch depressed continuously for 1—2 second, the digit will be advanced +8 per second.
4. ⁙ mark is shown that the digits or marks are flashing at 2 Hz.
5. In chronograph and alarm setting modes, 7-day flags show the following respectively:

chronograph mode (Su), alarm set mode (Mo), time set (Tu), Lap (Thu), Stop (Fr) and 1/100 sec (Sa).

APPLICATION CIRCUIT



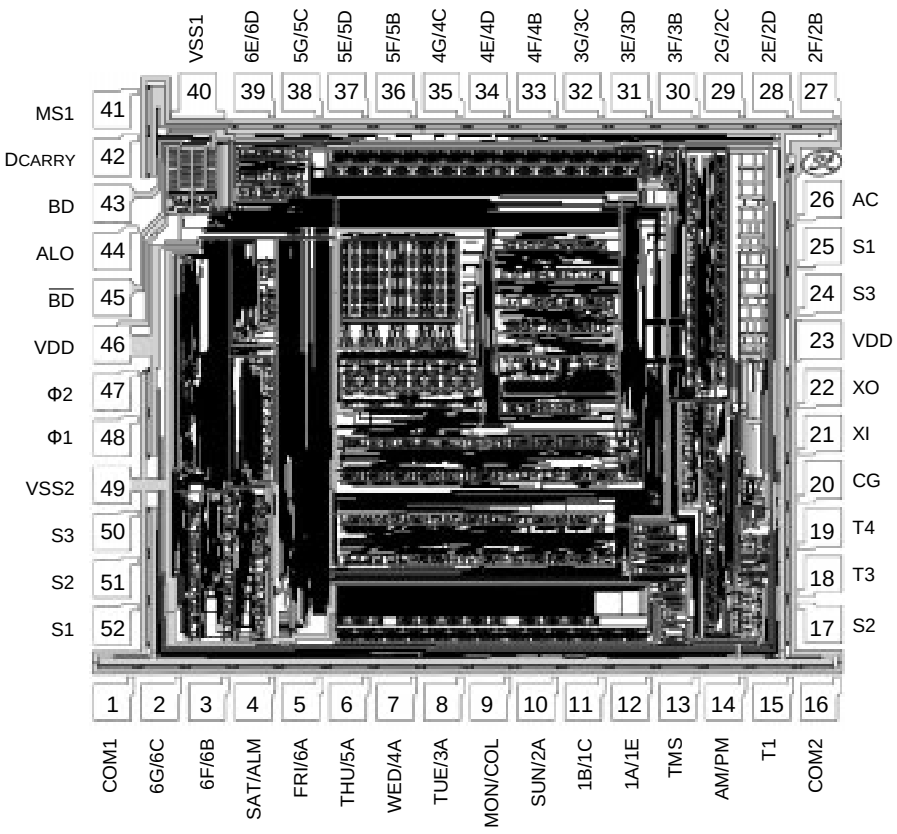
DRIVING ELECTROMAGNETIC SPEAKER BY BIPOLAR TRANSISTOR



Tr : NPN transister

Buzzer : Electromagnetic speaker

CHIP TOPOGRAPHY



Chip size: 2.37 x 2.08 (mm^2)

PAD COORDINATES (Unit: μm)

PAD NO.	Symbol	X	Y	PAD NO.	Symbol	X	Y
1	COM1	-1050	-910	27	2F/2B	1040	590
2	6G/6C	-920	-910	28	2E/2D	900	910
3	6F/6B	-780	-910	29	2G/2C	760	910
4	SAT/ALM	-640	-910	30	3F/3B	620	910
5	FBI/6A	-500	-910	31	3E/3D	480	910
6	THU/5A	-360	-910	32	3G/3C	340	910
7	MED/3A	-220	-910	33	4F/4B	200	910
8	TUE/3A	-80	-910	34	4E/4D	60	910
9	MON/COL	60	-910	35	4G/4C	-80	910
10	SUN/2A	200	-910	36	5F/5B	-220	910
11	1B/1C	340	-910	37	5E/5D	-360	910
12	1A/1E	480	-910	38	5G/5C	-500	910
13	TMS	620	-910	39	6E/6D	-640	910
14	AM/PM	765	-910	40	VSS1	-800	910
15	T1	900	-910	41	MSI	-1060	855
16	COM2	1045	-910	42	Dcarry	-1060	715
17	S2	1060	-680	43	BD	-1060	575
18	T3	1060	-530	44	ALD	-1060	435
19	T4	1060	-390	45	BD	-1060	295
20	CG	1060	-250	46	VDD	-1060	155
21	XI	1060	-110	47	ϕ2	-1060	15
22	XO	1060	30	48	ϕ1	-1060	-125
23	VDD	1060	170	49	Vss2	-1060	-265
24	S3	1060	310	50	S3	-1060	-405
25	S1	1060	450	51	S2	-1060	-545
26	AC	1060	590	52	S1	-1060	-685

Note: The original point of the coordinate is the die center.