愛高實業(香港)有限公司
HICO INDUSTRIAL (HK) LIMITED

PRODUCT SPECIFICATION

TRAINER

Product Code:	HCS-T012-1
Version:	1.2
Date:	April 8, 2003

Hong Kong 香港

22nd Floor, Delta House, 3 On Yiu Street, Siu Lek Yuen, Shatin, N. T., Hong Kong
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GENERAL DESCRIPTION

The TRAINER is a single-chip micro-controller that is preprogrammed for digital watch applications. Features with 10-lap memories Chronograph, 2 linked Countdown Timer, and 5 Daily Alarms, it could be a useful tool for daily exercise.

FEATURES

- Real Time Clock
  - Hour, Minute, Second
  - 12 or 24 hour display format by user option
  - Hourly chime
- Dual Time Clock
  - Time display of another city
- Auto Calendar
  - Year, Month, Day, Day of Week
  - Auto leap year adjustment from 2000 to 2049
  - Auto setting on Day of Week
- Schedule Alarms
  - Five independent schedule alarms with adjustable Hour, Minute, Month and Day
  - Distinctive alert signal for each alarm
- Countdown Timers
  - Two countdown timers with 16 preset time duration ranging from 0 to 120 minutes
  - Linked operation
  - Alert signal when countdown to zero
- Chronograph
  - Count up to 23 hours 59 minutes 59.99 seconds with 1/100 second resolution
  - Memories for 10 lap time
- Operates with 3 volts battery
- Operates with 3 buttons
- Beep tone alerts for key operations

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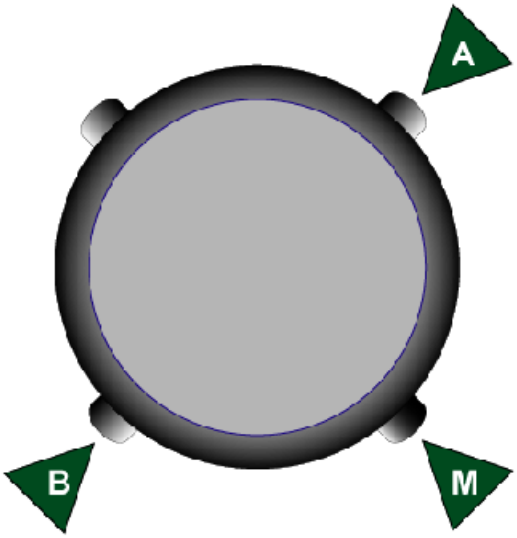
LCD PATTERN

- **Operating Voltage:** **4.5V**
- **Duty Cycle:** **1/5**
- **Bias:** **1/3**
- **Viewing Direction:** **6H**
- **Connection:** **Top and Bottom**

KEYBOARD



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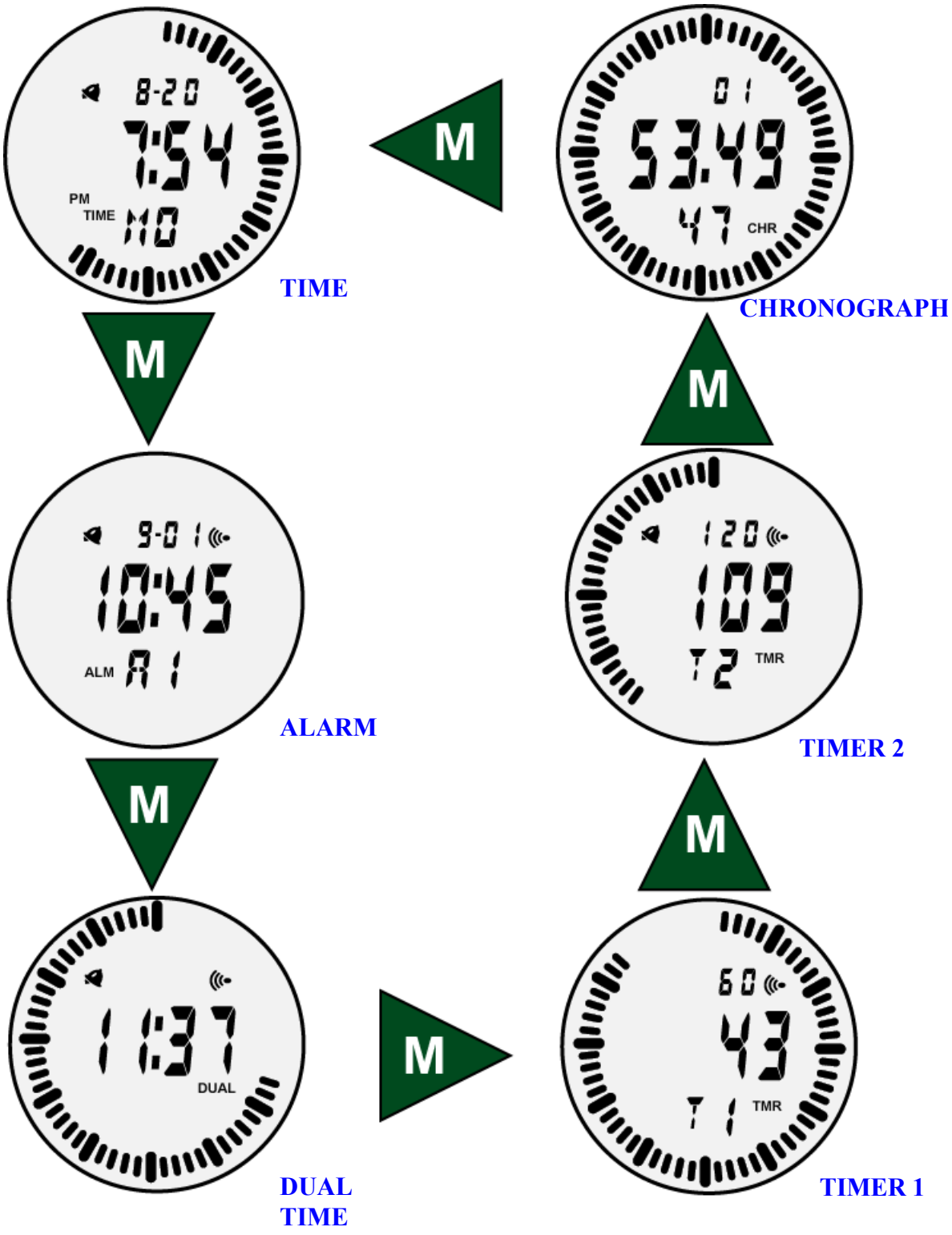
FUNCTIONAL FLOWCHART



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FUNCTIONAL DESCRIPTIONS

1. Button

Operating Mode	Button	Press once	Press and Hold
Time Mode	A	Enable/Disable Hourly Chime	-----
	B	12/24 Hours Display	Single/Full Second Ring Display
	M	Enter to Alarm Mode	Enter Time Setting
Alarm Mode	A	Change Alarm	-----
	B	Toggle Alarm ON/OFF	Test Alert Tone
	M	Enter to Dual Mode	Enter Alarm Setting
Dual Mode	A	Dual Hour increment	-----
	B	Dual Hour decrement	-----
	M	Enter to Timer 1 Mode	----
Timer 1	A	Start Timer (at Stopped state) Stop Timer (at Running state)	-----
	B	Reload/Change Preset value	-----
	M	Enter to Timer 2 Mode	-----
Timer 2	A	Start Timer (at Stopped state) Stop Timer (atn Running state)M	-----
	B	Reload/Change Preset value	-----
	M	Enter to Timer 2 Mode	-----
Chronograph Mode	A	Start Chrono (at Stopped state) Stop Chrono (at Running state)	-----
	B	Lap Record (at Running state) Lap Recall (at Stopped state)	Reset Chrono
	M	Enter to Time Mode	-----
Other Setting Modes	A	Adjust selected digits	Fast scrolling
	B	Select next digit	-----
	M	Exit Setting Mode	-----

- Beep sound will be played when pressing any button
- Press 3 buttons simultaneously will reset the MCU

2. Auto Return

- Real Time Clock will be resumed if no key operation for 1 minute in any operating mode except the following:
  - Countdown Timer at running state
  - Chronograph at running state

3. Fast Scrolling

- In any setting mode, press and hold [A] for more than 2 seconds will activate Fast Scrolling function. Current selected digits will be adjusted at a rate of 5 steps per second until [A] is released.

4. Alert Signals

- Alert signals will be played based on the following priority:
  - Timer 1, Timer 2, Alarm 1, Alarm 2, Alarm 3, Alarm 4, Alarm 5, Chime

5. System Defaults

- System Defaults will be initialized upon system startup

MODE	ELEMENT	SETTING
Real Time	Time	12:00:00 AM
	Date	Wednesday 2003-01-01
	Display format	12-hour
	Hourly chime	Disabled
Dual Time	Time	12:00:00 AM
Schedule Alarms	Time	12:00 AM
	Date	None
	Alert	Disabled
Chronograph	Total Time	0 hour 0 minutes 00.00 second
	LAP	All cleared
	Status	Stopped
Countdown Timers	Time	Zero
	Status	Stopped

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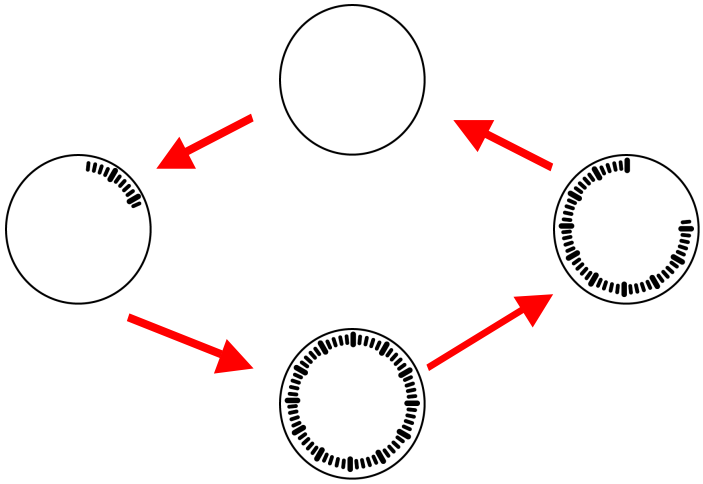
OPERATIONAL INSTRUCTIONS

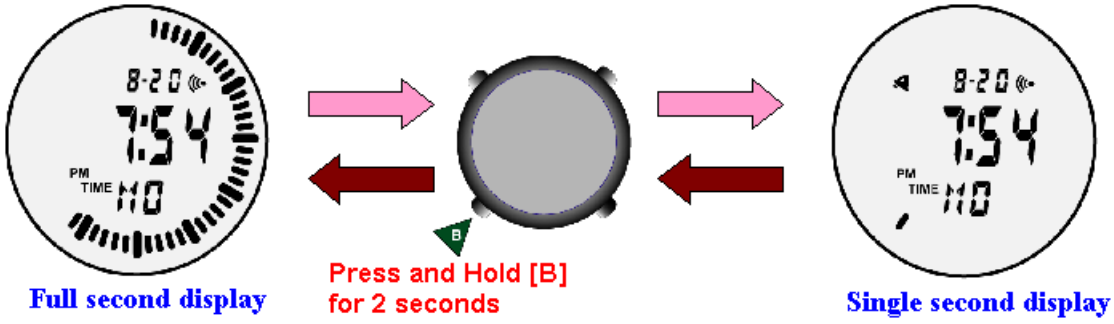
1. Real Time Clock

- Basic display
  - e.g. Monday 2001-8-20 07:54:36 PM

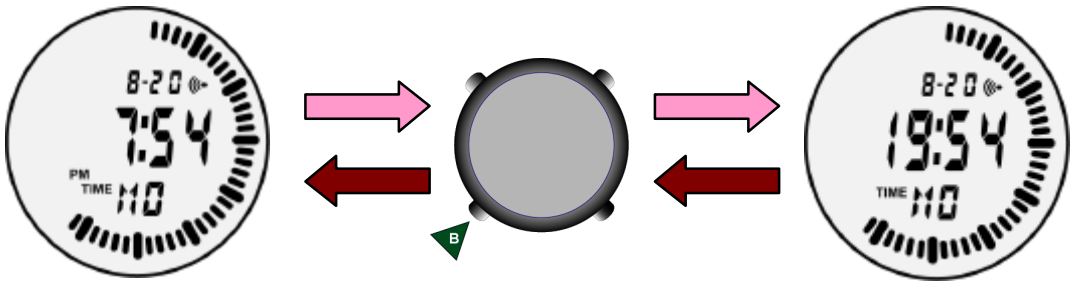
  - SECOND will be shown on the outer circle based on the following sequence:



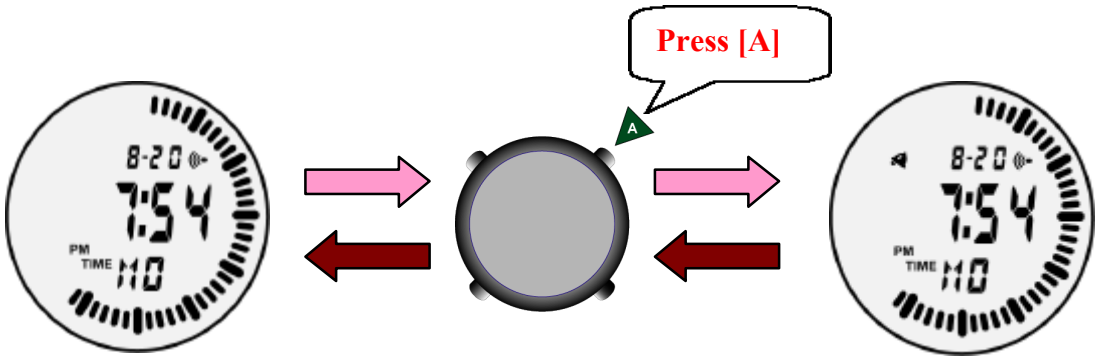
  - Select SECOND display method:



- Select 12/24-hour display system



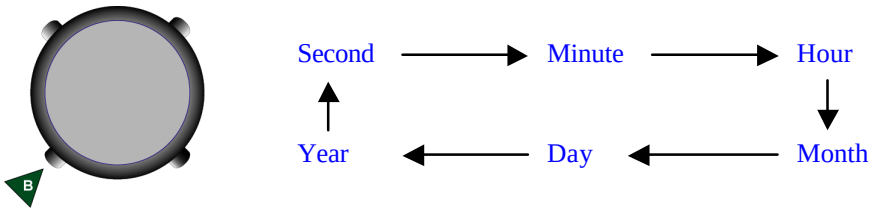
- Enable or Disable Hourly chime



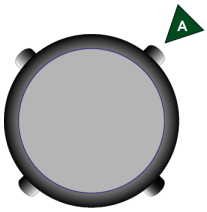
- Adjusting the Time and Calendar
  - Activate Time and Calendar setting

- On entry, display will show as follows with segments in outer circle blinking for adjusting the Second:

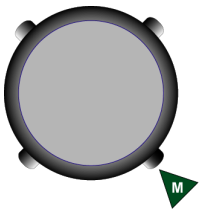
- Use [B] to select the blinking digits according to the following sequence:



- Use [A] to adjust the blinking digits



- Use [M] to confirm setting

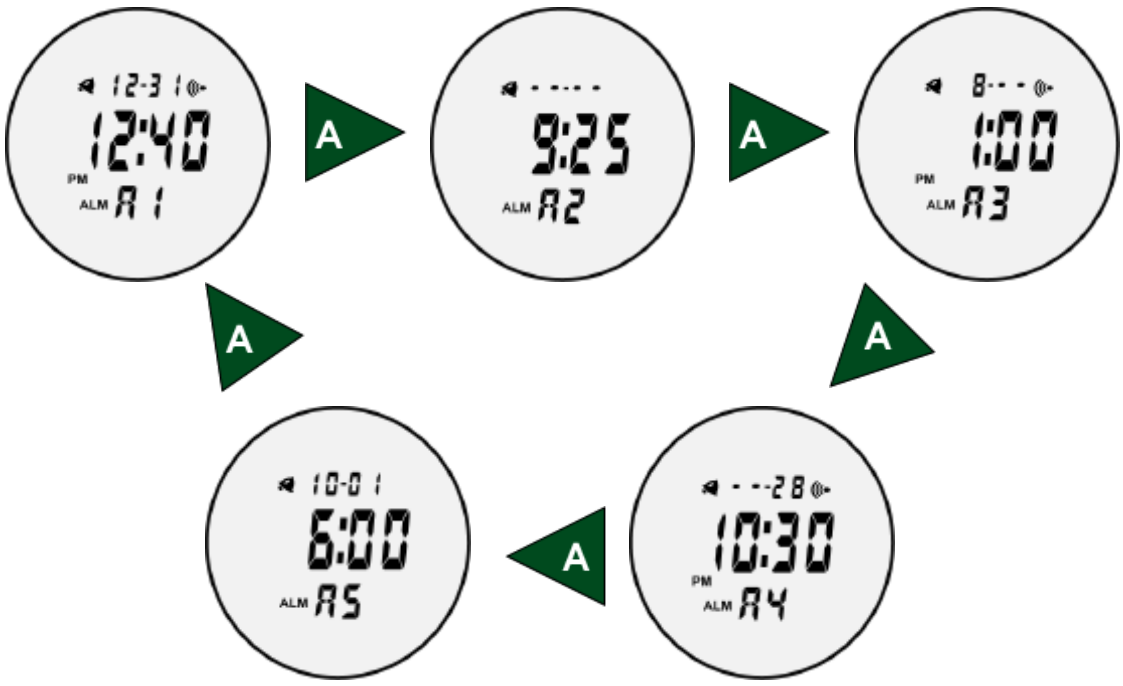


- On exit, the Day of Week will be adjusted automatically.

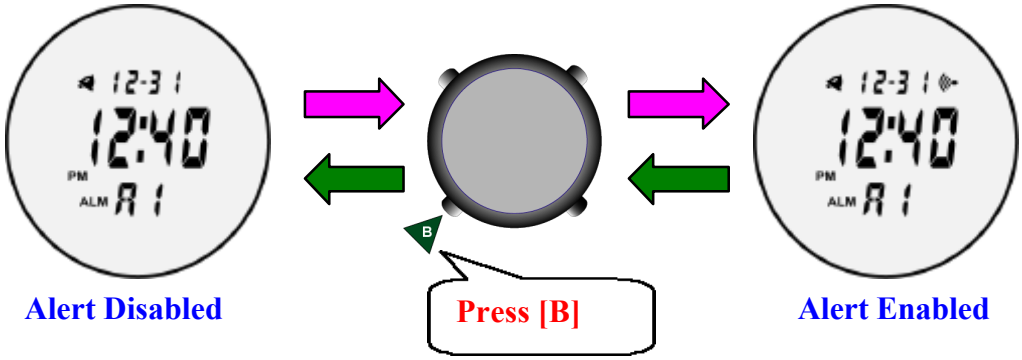
2. Schedule Alarm

- Basic display
  - e.g. Alarm 1: alert enabled on December 31 12:40 PM

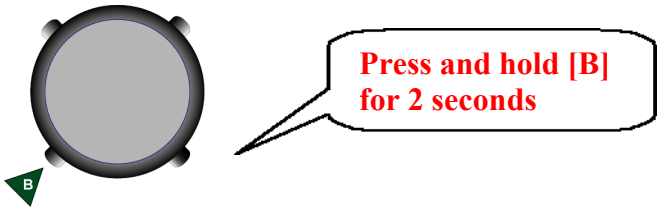
- Operating the Schedule Alarm
  - All Schedule Alarms are operated identically with only difference in the alert tone.
  - The Alarms can be adjusted to alert at the desired time with the following options:
    - Daily (both Month & Day set to '-')
    - Monthly at specific day (Month set to '-' with Day set to desired day)
    - For specific month (Month set to desired month with day set to '-')
    - At specific date
  - To display Alarm 1 to Alarm 5



- To enable/disable the alert

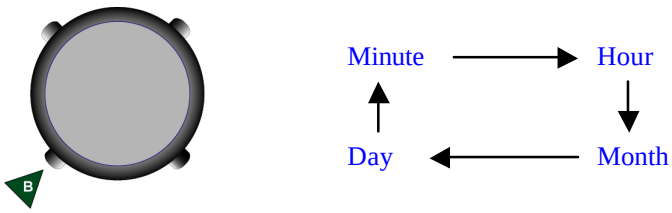


- Test the alert tone

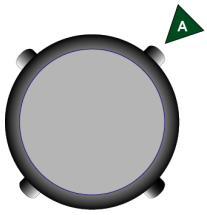


- Adjusting the Alarm
  - Activate the setting

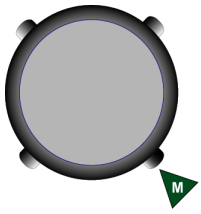
  - Use [B] to select the blinking digits according to the following sequence:



- Use [A] to adjust the blinking digits



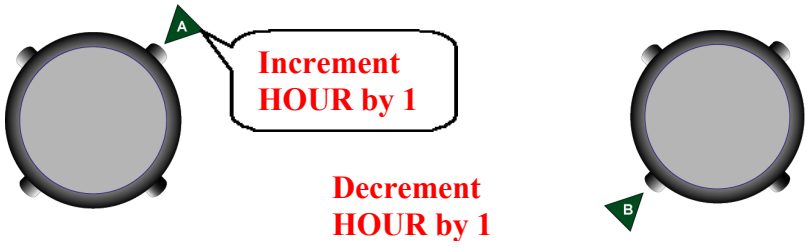
- Use [M] to confirm the setting and exit



3. Dual Time Clock

- Basic display
  - e.g. 03:14:45 PM

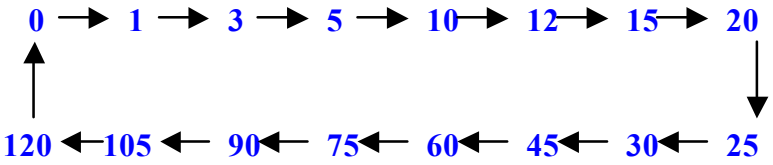
- Adjusting the Dual Time
  - Only HOUR can be adjusted. MINUTE and SECOND are synchronized with the Real Time Clock.
  - Use [A] and [B] to increase and decrease the HOUR respectively.



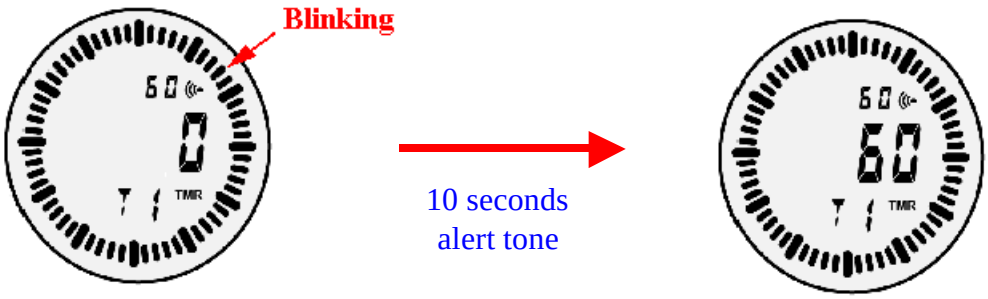
4. Countdown Timer

- Basic display
  - e.g. Timer 1 set to 60 minutes, time remaining is 59 minutes 41 seconds

- Operating the Timer
  - Both Timer 1 and Timer 2 are operated identically. The only difference is the tone of the timeout alert.
  - Use [B] while timer stopped to select the time duration in minutes with the following sequence:



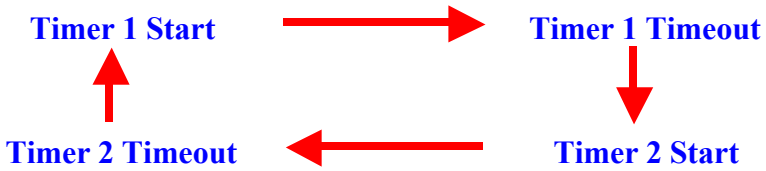
  - Use [A] to start/stop the counting
  - Upon counting down to zero, the Timer will be stopped automatically. Alert signal will be sounded for 10 seconds with all the segments on the outer circle blinking.



Timer count down to zero

Timer value reloaded

- Linked operation
  - Timer 1 and Timer 2 can be linked to operate in series, i.e. another will start counting from the preset time duration immediately after the timeout of another timer.



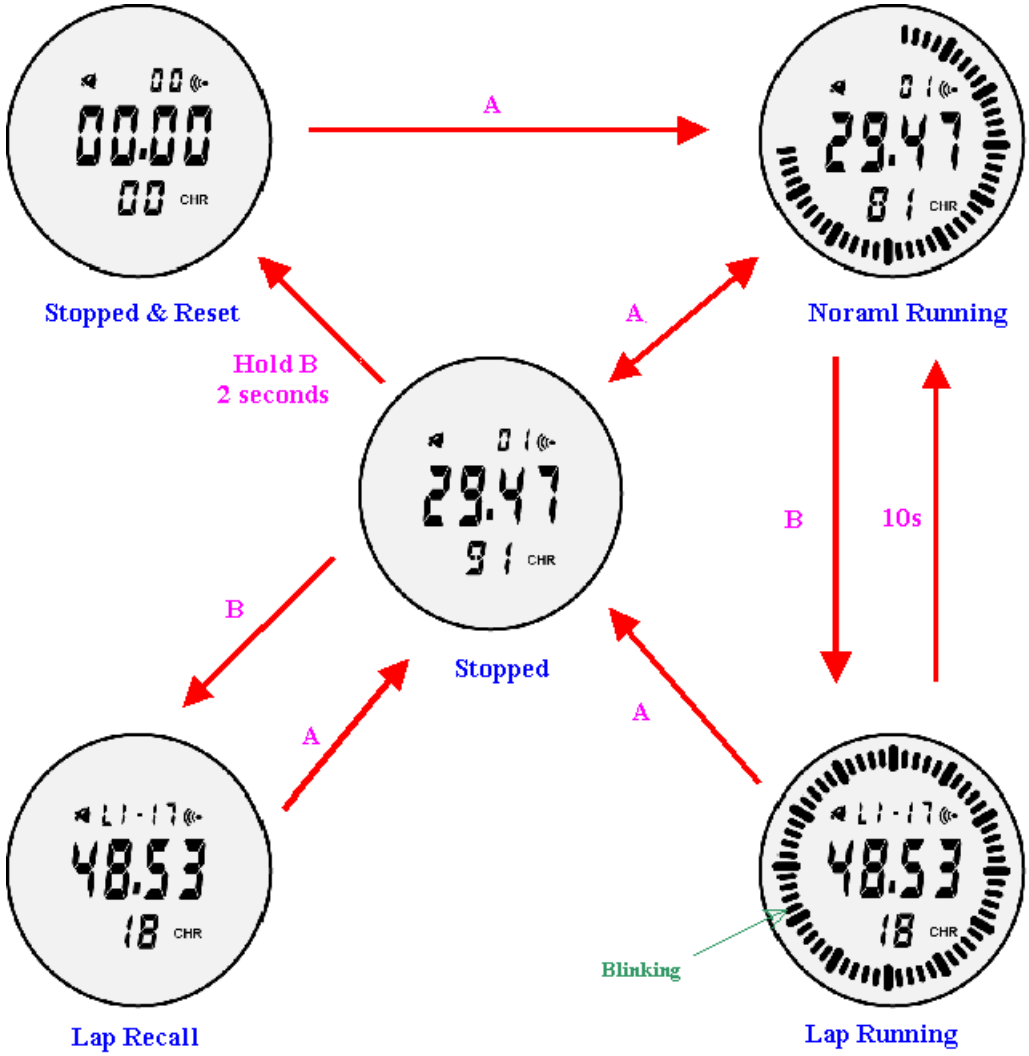
The loop will be repeated endlessly until user stops the timer.

  - Procedures to initiate linked operation:
    1. Stopped both timers
    2. Set non-zero time duration in both timers
    3. Start Timer 1

  - Procedures to cancel linked operation:
    1. Stopped both timers

5. Chronograph

- Operating the Chronograph



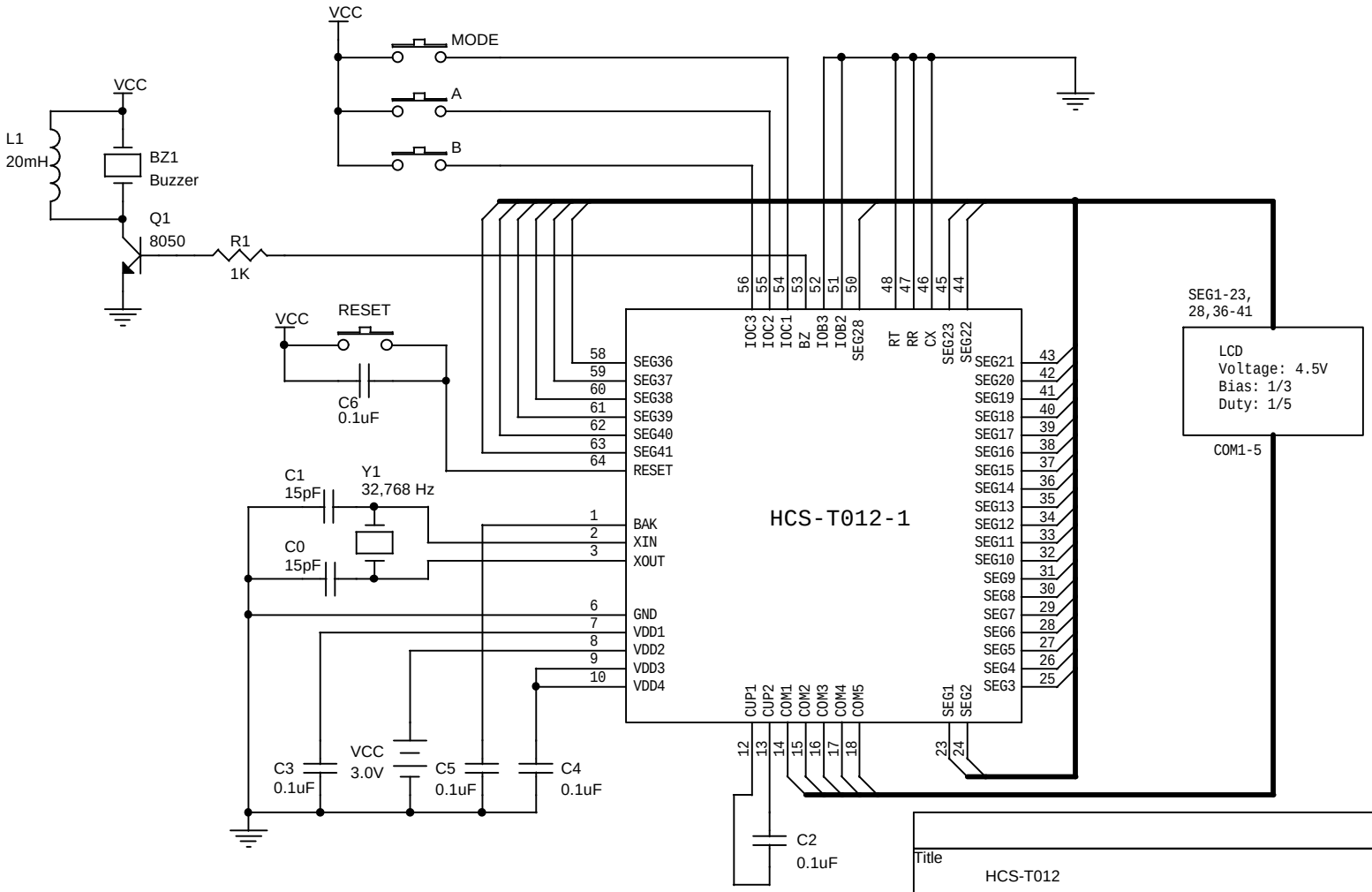
- Maximum count is 23 hours 59 minutes 59.99 seconds. When maximum count is reached, counting will continue with time reset to zero.

- Ten LAP records (L0 to L9) can be stored in the internal memory. When all the records are occupied, new LAP entry will overwrite the 10th record.

- Maximum Lap record for each lap is 23 hours 59 minutes 59.99 seconds. When maximum is reached, the record will start from zero again.

- In LAP Recall, press [B] will retrieve LAP records sequentially.

- If no Lap Record has been stored previously, Lap Recall function will be disabled.



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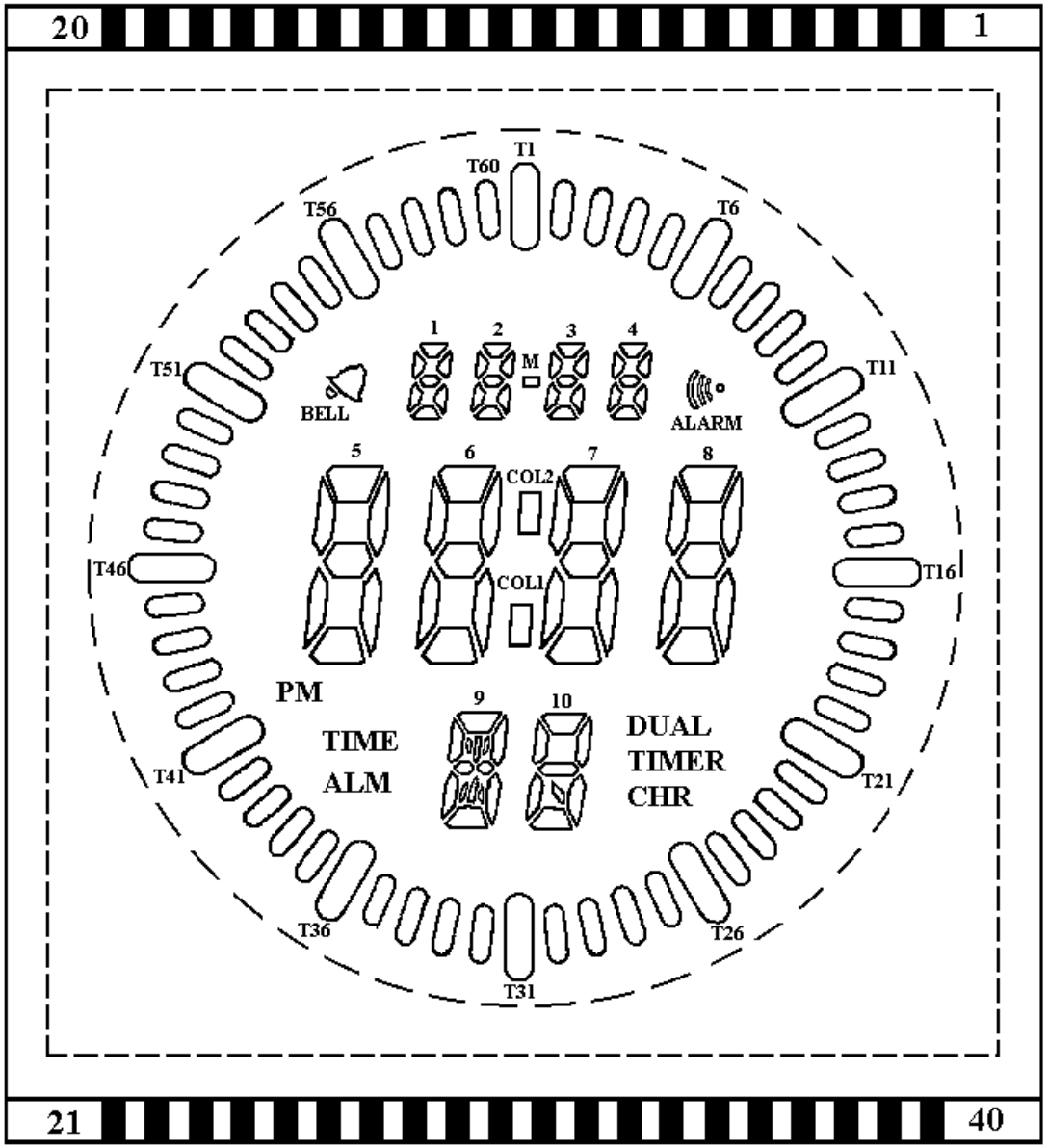
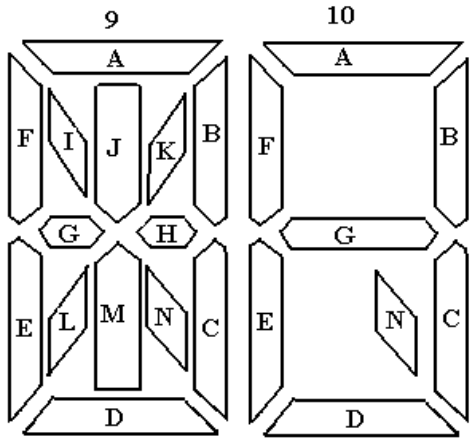
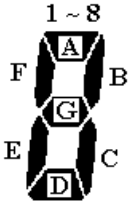
Size: A	Document Number: HCS-T012-1	Rev: 0
Date: Monday, December 30, 2002	Sheet 1 of 1	







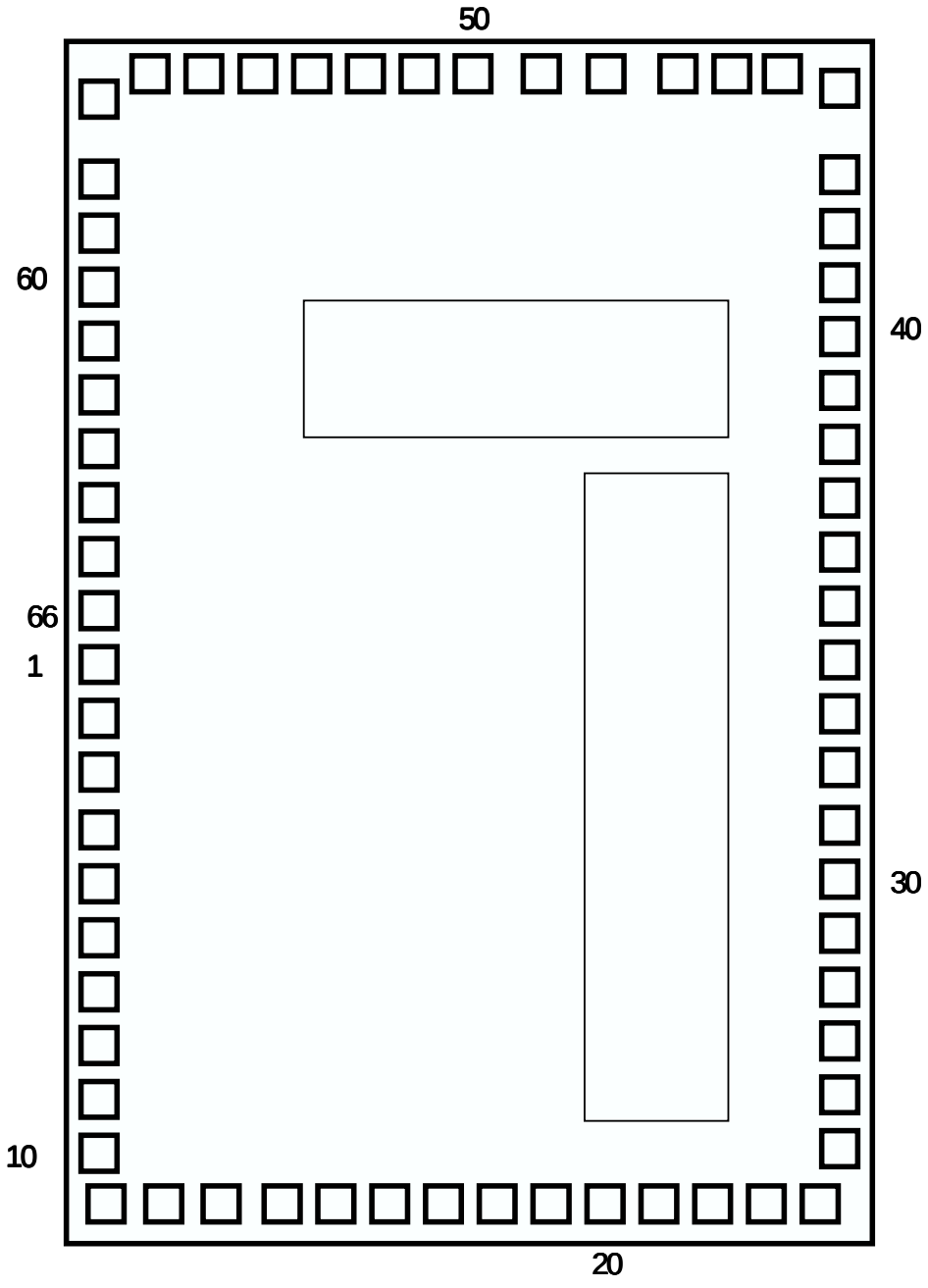
- Operating Voltage: 4.5V
- Duty Cycle: 1/5
- Bias: 1/3
- Viewing Direction: 6H

HCS-T012 TRAINER

17-Sep-02

PAD NO.	**LSI PAD NO.**	**LSI NAME**	COM1	COM2	COM3	COM4	COM5
1	14	COM1	COM1	--	--	--	--
2	15	COM2	--	COM2	--	--	--
3	16	COM3	--	--	COM3	--	--
4	17	COM4	--	--	--	COM4	--
5	23	SEG1	T13	T14	ALARM	4B	4C
6	24	SEG2	T12	T11	4A	4G	4D
7	25	SEG3	T8	T9	T10	4F	4E
8	26	SEG4	T7	T6	T5	3B	3C
9	27	SEG5	T3	T4	3A	3G	3D
10	28	SEG6	T2	T1	T60	3F	3E
11	29	SEG7	T58	T59	M	2B	2C
12	30	SEG8	T57	T56	2A	2G	2D
13	31	SEG9	T53	T54	T55	2F	2E
14	32	SEG10	T52	T51	T50	1B	1C
15	33	SEG11	T48	T49	1A	1G	1D
16	34	SEG12	T47	T46	BELL	1F	1E
17	14	COM1	COM1	--	--	--	--
18	15	COM2	--	COM2	--	--	--
19	16	COM3	--	--	COM3	--	--
20	18	COM5	--	--	--	--	COM5
21	35	SEG13	T45	5F	PM	5E	COL2
22	36	SEG14	T43	T44	5D	5G	5A
23	37	SEG15	T42	T41	TIME	5C	5B
24	38	SEG16	T39	T40	ALM	6E	6F
25	39	SEG17	T38	T37	6D	6G	6A
26	40	SEG18	T35	T36	COL1	6C	6B
27	18	COM5	--	--	--	--	COM5
28	17	COM4	--	--	--	COM4	--
29	41	SEG19	9E	9F	--	T33	T34
30	42	SEG20	9L	9G	9I	T32	9D
31	43	SEG21	9M	9J	9A	T31	9N
32	44	SEG22	9H	9B	9K	T30	9C
33	45	SEG23	10E	10F	10A	T29	10D
34	50	SEG28	10C	10G	10B	T28	10N
35	58	SEG36	T26	T27	CHR	7E	7F
36	59	SEG37	T25	T24	7D	7G	7A
37	60	SEG38	T22	T23	TMR	7C	7B
38	61	SEG39	T21	T20	DUAL	8E	8F
39	62	SEG40	T18	T19	8D	8G	8A
40	63	SEG41	T17	T16	T15	8C	8B

PAD DIAGRAM (HCS-T012-1)



The substrate of the chip should be connected to the GND.

PAD COORDINATE

No	Name	X	Y	No	Name	X	Y
1	BAK	72.50	1229.50	34	SEG12(K12)	1677.50	1244.50
2	XIN	72.50	1114.50	35	SEG13(K13)	1677.50	1359.50
3	XOUT	72.50	999.50	36	SEG14(K14)	1677.50	1474.50
4	CFIN	72.50	884.50	37	SEG15(K15)	1677.50	1589.50
5	CFOUT	72.50	769.50	38	SEG16(K16)	1677.50	1704.50
6	GND	72.50	654.50	39	SEG17	1677.50	1819.50
7	VDD1	72.50	539.50	40	SEG18	1677.50	1934.50
8	VDD2	72.50	424.50	41	SEG19	1677.50	2049.50
9	VDD3	72.50	309.50	42	SEG20	1677.50	2175.00
10	VDD4	72.50	194.50	43	SEG21	1677.50	2300.00
11	CUP0	89.50	72.50	44	SEG22	1677.50	2477.00
12	CUP1	204.50	72.50	45	SEG23	1558.50	2507.50
13	CUP2	319.50	72.50	46	SEG24/IOA1/CX	1430.45	2507.50
14	COM1	434.50	72.50	47	SEG25/IOA2/RR	1305.00	2507.50
15	COM2	549.50	72.50	48	SEG26/IOA3/RT	1164.50	2507.50
16	COM3	669.50	72.50	49	SEG27/IOA4/RH	1024.00	2507.50
17	COM4	789.50	72.50	50	SEG28/IOB1/ELC	881.50	2507.50
18	COM5	909.50	72.50	51	SEG29/IOB2/ELP	766.50	2507.50
19	COM6	1029.50	72.50	52	SEG30/IOB3/BZB	651.50	2507.50
20	COM7	1149.50	72.50	53	SEG31/IOB4/BZ	536.50	2507.50
21	COM8	1269.50	72.50	54	SEG32/IOC1/KI1	421.50	2507.50
22	COM9	1389.50	72.50	55	SEG33/IOC2/KI2	306.50	2507.50
23	SEG1(K1)	1509.50	72.50	56	SEG34/IOC3/KI3	191.50	2507.50
24	SEG2(K2)	1629.50	72.50	57	SEG35/IOC4/KI4	72.50	2477.00
25	SEG3(K3)	1677.50	197.50	58	SEG36/IOD1	72.50	2300.00
26	SEG4(K4)	1677.50	322.50	59	SEG37/IOD2	72.50	2175.00
27	SEG5(K5)	1677.50	439.50	60	SEG38/IOD3	72.50	2049.50
28	SEG6(K6)	1677.50	554.50	61	SEG39/IOD4	72.50	1934.50
29	SEG7(K7)	1677.50	669.50	62	SEG40	72.50	1819.50
30	SEG8(K8)	1677.50	784.50	63	SEG41	72.50	1704.50
31	SEG9(K9)	1677.50	899.50	64	RESET	72.50	1589.50
32	SEG10(K10)	1677.50	1014.50	65	INT	72.50	1474.50
33	SEG11(K11)	1677.50	1129.50	66	TEST	72.50	1359.50

GND= 0V

Name	Symbol	Range	Unit
Maximum Supply Voltage	VDD1	-0.3 to 5.5	V
	VDD2	-0.3 to 5.5	V
	VDD3	-0.3 to 8.5	V
	VDD4	-0.3 to 8.5	V
Maximum Input Voltage	Vin	-0.3 to VDD1/2+0.3	V
Maximum output Voltage	Vout1	-0.3 to VDD1/2+0.3	V
	Vout2	-0.3 to VDD3+0.3	V
	Vout3	-0.3 to VDD4+0.3	V
Maximum Operating Temperature	Topg	-20 to +70	℃
Maximum Storage Temperature	Tstg	-25 to +125	℃

POWER CONSUMPTION

at Ta=-20℃ to 70℃,GND= 0V

Name	Sym.	Condition	Min.	Typ.	Max.	Unit
HALT mode	I_{HALT1}	Only 32.768KHz Crystal oscillator operating, without loading. Ag mode, VDD1=1.5V, BCF = 0		2		uA
	I_{HALT2}	Only 32.768KHz Crystal oscillator operating, without loading. Li mode, VDD2=3.0V, BCF = 0		2		uA
STOP mode	I_{STOP}				1	uA

Note : When RC oscillator function is operating, the current consumption will depend on the frequency of oscillation.

ALLOWABLE OPERATING CONDITIONS

at Ta=-20℃ to 70℃,GND= 0V

Name	Symb.	Condition	Min.	Max.	Unit
Supply Voltage	VDD1		1.2	5.25	V
	VDD2		2.4	5.25	V
	VDD3		2.4	8.0	V
	VDD4		2.4	8.0	V
Oscillator Start-Up Voltage	VDDB	Crystal Mode	1.3		V
Oscillator Sustain Voltage	VDDB	Crystal Mode	1.2		V
Supply Voltage	VDD1	Ag Mode	1.2	1.65	V
Supply Voltage	VDD2	EXT-V, Li Mode	2.4	5.25	V
Input “H” Voltage	Vih1	Ag Battery Mode	VDD1-0.7	VDD1+0.7	V
Input “L” Voltage	Vil1		-0.7	0.7	V
Input “H” Voltage	Vih2	Li Battery Mode	VDD2-0.7	VDD2+0.7	V
Input “L” Voltage	Vil2		-0.7	0.7	V
Input “H” Voltage	Vih3	OSCIN at Ag	0.8xVDD1	VDD1	V
Input “L” Voltage	Vil3	Battery Mode	0	0.2xVDD1	V
Input “H” Voltage	Vih4	OSCIN at Li Battery	0.8xVDD2	VDD2	V
Input “L” Voltage	Vil4	Mode	0	0.2xVDD2	V
Input “H” Voltage	Vih5	CFIN at Li Battery	0.8xVDD2	VDD2	V
Input “L” Voltage	Vil5	or EXT-V Mode	0	0.2xVDD2	V
Input “H” Voltage	Vih6	RC Mode	0.8xVDDO	VDDO	V
Input “L” Voltage	Vil6		0	0.2xVDDO	V
Operating Freq	Fopg1	Crystal Mode	32		KHZ
	Fopg2	RC Mode	10	1000	KHZ
	Fopg3	CF Mode	1000	3580	KHz

INTERNAL RC FREQUENCY RANGE

Option Mode	BAK	Min.	Typ.	Max.
250KHz	1.2V~1.5V	300KHz	350KHz	400KHz
	2.4V~5.0V	200KHz	250KHz	300KHz
500KHz	1.2V~1.5V	550KHz	650KHz	750KHz
	2.4V~5.0V	400KHz	500KHz	600KHz

ELECTRICAL CHARACTERISTICS

at#1:VDD1=1.2V(Ag);

at#2:VDD2=2.4V(Li):

at#3:VDD2=4V(Ext-V);

Input Resistance

Name	Symb.	Condition	Min.	Typ.	Max.	Unit
"L" Level Hold Tr(IOC)	Rllh1	Vi=0.2VDD1,#1	10	40	100	Kohm
	Rllh2	Vi=0.2VDD2,#2	10	40	100	Kohm
	Rllh3	Vi=0.2VDD2,#3	5	20	50	Kohm
IOC Pull-Down Tr	Rmad1	Vi=VDD1,#1	200	500	1000	Kohm
	Rmad2	Vi=VDD2,#2	200	500	1000	Kohm
	Rmad3	Vi=VDD2,#3	100	250	500	Kohm
INT Pull-up Tr	Rintu1	Vi=VDD1,#1	200	500	1000	Kohm
	Rintu2	Vi=VDD2,#2	200	500	1000	Kohm
	Rintu3	Vi=VDD2,#3	100	250	500	Kohm
INT Pull-Down Tr	Rintd1	Vi=GND,#1	200	500	1000	Kohm
	Rintd2	Vi=GND,#2	200	500	1000	Kohm
	Rintd3	Vi=GND,#3	100	250	500	Kohm
RES Pull-Down R	Rres1	Vi=GND or VDD1,#1	5	20	50	Kohm
	Rres2	Vi=GND or VDD2,#2	5	20	50	Kohm
	Rres3	Vi=GND or VDD2,#3	5	20	50	Kohm

DC Output Characteristics

Name	Symb.	Condition	Port	Min.	Typ.	Max.	Unit
Output ”H” Voltage	Voh1c	Ioh=-200uA,#1	COM5~9 SEG1~41	0.8	0.9	1.0	V
	Voh2c	Ioh=-1mA,#2		1.5	1.8	2.1	V
	Voh3c	Ioh=-3mA,#3		2.5	3.0	3.5	V
Output ”L” Voltage	Vol1c	Iol=400uA,#1		0.2	0.3	0.4	V
	Vol2c	Iol=2mA,#2		0.3	0.6	0.9	V
	Vol3c	Iol=6mA,#3		0.5	1.0	1.5	V

Segment Driver Output Characteristics

Name	Symb.	Condition	For	Min.	Typ.	Max.	Unit.
Static Display Mode							
Output ”H” Voltage	Voh1d	Ioh=-1uA,#1	SEG-n	1.0			V
	Voh2d	Ioh=-1uA,#2		2.2			V
	Voh3d	Ioh=-1uA,#3		3.8			V
Output ”L” Voltage	Vol1d	Iol=1uA,#1				0.2	V
	Vol2d	Iol=1uA,#2				0.2	V
	Vol3d	Iol=1uA,#3				0.2	V
Output ”H” Voltage	Voh1e	Ioh=-10uA,#1	COM-n	1.0			V
	Voh2e	Ioh=-10uA,#2		2.2			V
	Voh3e	Ioh=-10uA,#3		3.8			V
Output ”L” Voltage	Vol1e	Iol=10uA,#1				0.2	V
	Vol2e	Iol=10uA,#2				0.2	V
	Vol3e	Iol=10uA,#3				0.2	V
1/2 Bias Display Mode							
Output ”H” Voltage	Voh12f	Ioh=-1uA,#1,#2	SEG-n	2.2			V
	Voh3f	Ioh=-1uA,#3		3.8			V
Output ”L” Voltage	Vol12f	Iol=1uA,#1,#2				0.2	V
	Vol3f	Iol=1uA,#3				0.2	V
Output ”H” Voltage	Voh12g	Ioh=-10uA,#1,#2	COM-n	2.2			V
	Voh3g	Ioh=-10uA,#3		3.8			V
Output ”M” Voltage	Vom12g	Iol/h=+/-10uA,#1,#2	COM-n	1.0		1.4	V
	Vom3g	Iol/h=+/-10uA,#3		1.8		2.2	V
1/3 Bias display Mode							

Output ”H” Voltage	Voh12h	Ioh=-1uA,#1,#2	SEG-n	3.4			V
	Voh3h	Ioh=-1uA,#3		5.8			V
Output ”M1” Voltage	Vom1h	Iol/h=+/-10uA,#1,#2		1.0		1.4	V
	Vom13h	Iol/h=+/-10uA,#3		1.8		2.2	V
Output ”M2” Voltage	Vom22h	Iol/h=+/-10uA,#1,#2		2.2		2.6	V
	Vom23h	Iol/h=+/-10uA,#3		3.8		4.2	V
Output ”L” Voltage	Vol12h	Iol=1uA,#1,#2				0.2	V
	Vol3h	Iol=1uA,#3				0.2	V
Output ”H” Voltage	Voh12i	Ioh=-10uA,#1,#2	COM-n	3.4			V
	Voh3i	Ioh=-10uA,#3		5.8			V
Output ”M1” Voltage	Vom12i	Iol/h=+/-10uA,#1,#2		1.0		1.4	V
	Vom13i	Iol/h=+/-10uA,#3		1.8		2.2	V
Output ”M2” Voltage	Vom22i	Iol/h=+/-10uA,#1,#2		2.2		2.6	V
	Vom23i	Iol/h=+/-10uA,#3		3.8		4.2	V
Output ”L” Voltage	Vol12i	Iol=10uA,#1,#2				0.2	V
	Vol3i	Iol=10uA,#3				0.2	V
1/4 Bias display Mode							
Output ”H” Voltage	Voh12j	Ioh=-1uA,#1,#2	SEG-n	4.6			V
Output ”M2” Voltage	Vom22j	Iol/h=+/-10uA,#1,#2		2.2		2.6	V
Output ”L” Voltage	Vol12j	Iol=1uA,#1,#2				0.2	V
Output ”H” Voltage	Voh12k	Ioh=-10uA,#1,#2	COM-n	4.6			V
Output ”M1” Voltage	Vom12k	Iol/h=+/-10uA,#1,#2		1.0		1.4	V
Output ”M3” Voltage	Vom22k	Iol/h=+/-10uA,#1,#2		3.4		3.8	V
Output ”L” Voltage	Vol12k	Iol=10uA,#1,#2				0.2	V