GENERAL DESCRIPTION

The TM8713 is an embedded high-performance 4-bit microcomputer with LCD/LED driver. It contains all the necessary functions, such as 4-bit parallel processing ALU, ROM, RAM, I/O ports, timer, clock generator, dual clock operation, EL panel driver, LCD driver, look-up table, watchdog timer and key matrix scanning circuitry in a signal chip.

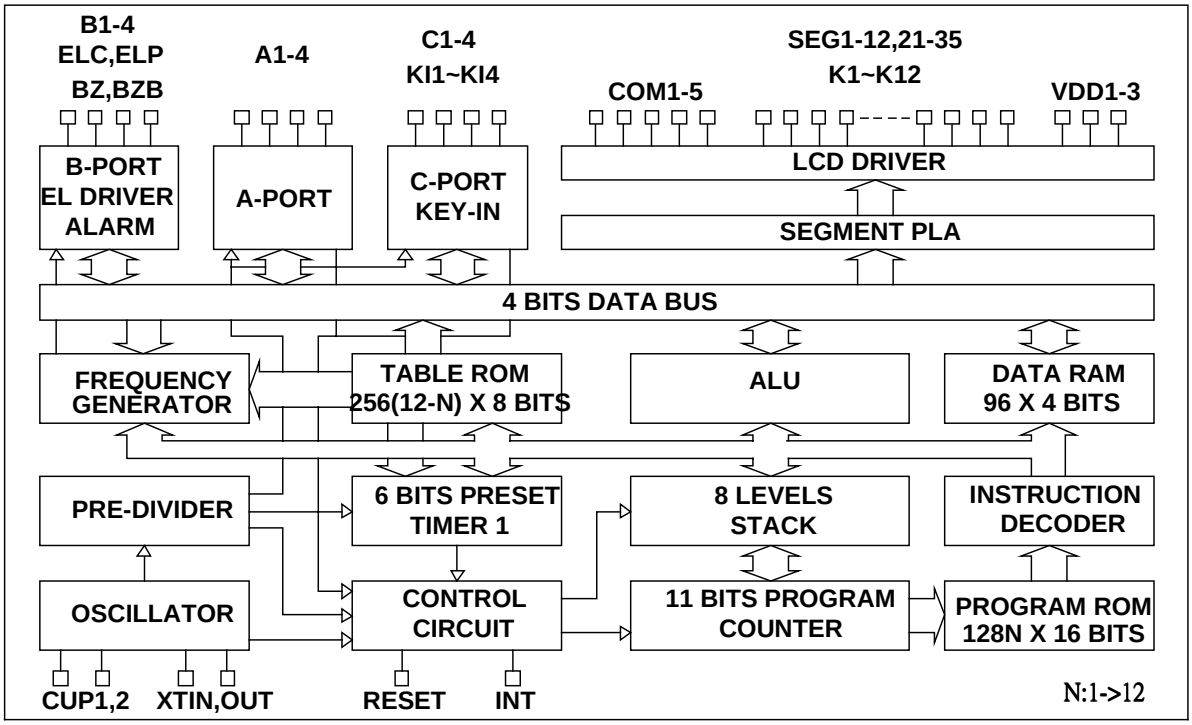
FEATURES

1. Low power dissipation.
2. Powerful instruction set (135 instructions).
   - Binary addition, subtraction, BCD adjust, logical operation in direct and index addressing mode.
   - Single bit manipulation (set, reset, decision for branch).
   - Various conditional branch.
   - 16 working registers and manipulation.
   - Table look-up.
   - LCD driver data transfer.
3. LCD/LED driver output.
   - 5 common outputs and 27 segment outputs (up to drive 135 LCD/LED segments).
   - 1/2 Duty, 1/3 Duty, 1/4 Duty or 1/5 Duty for both LCD/LED drivers is selected by MASK option.
   - 1/2 Bias or 1/3 Bias for LCD driver is selected by MASK option.
   - Single instruction to turn off all segments.
   - Segment outputs(SEG1~12,21~35) could be defined as CMOS or P_open drain type output by mask option.
4. Memory capacity.
   - ROM capacity 1536 x 16 bits.
   - RAM capacity 96 x 4 bits.
5. Input/output ports.
   - Port IOA 4 pins (with internal pull-low), muxed with SEG24~27.
   - Port IOB 4 pins (with internal pull-low), muxed with SEG28~31.
   - Port IOC 4 pins (with internal pull-low / low-level-hold), muxed with SEG32 ~ SEG35.
     IOC port had built-in input signal chattering prevention circuitry.
6. 8 level subroutine nesting.
7. Interrupt function.
   - External factors 3 (INT pin, Port IOC & KI input).
   - Internal factors 2 (Pre-Divider, Timer1).
8. Built-in EL panel driver.

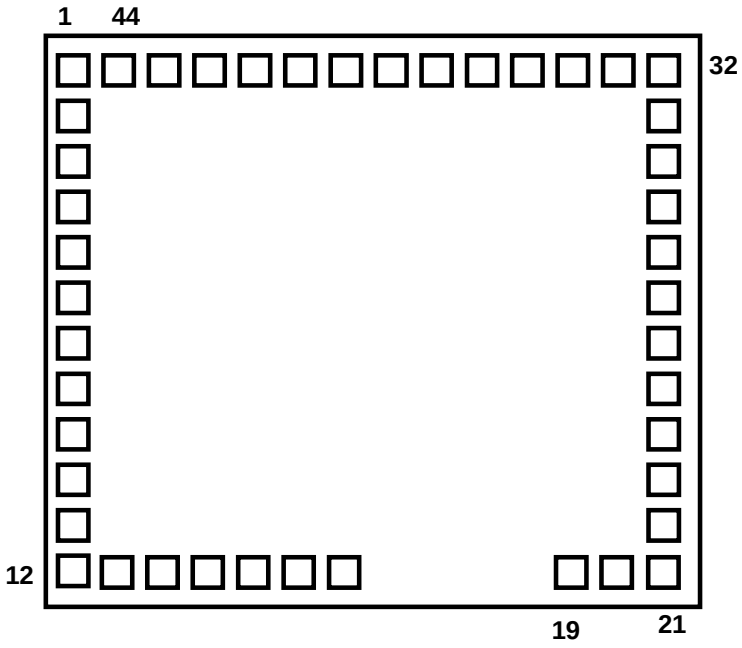
- ELC, ELP (Muxed with SEG28, SEG29).

9. Built in Alarm, clock or single tone melody generator.
   - BZB, BZ (Muxed with SEG30, SEG31).
10. Built in key matrix scanning function.
    - K1~K12 (Shared with SEG1~SEG12).
    - KI1~KI4 (Muxed with SEG32~SEG35).
11. One 6-bit programmable timer with programmable clock source.
12. Watch dog timer.
13. Built-in Voltage doubler, halver, tripler charge pump circuit.
14. Dual clock operation.
    - slow clock oscillation can be defined as X'tal or external RC type oscillator by mask option.
    - fast clock oscillation can be defined as internal R or external R type oscillator by mask option.
15. HALT function.
16. STOP function.

BLOCK DIAGRAM



PAD DIAGRAM



The substrate of chip should be connected to GND.

PAD COORDINATE

No	Name	X	Y	No	Name	X	Y
1	BAK	77.50	1399.10	23	SEG9(K9)	1602.50	344.70
2	XIN	77.50	1269.10	24	SEG10(K10)	1602.50	464.10
3	XOUT	77.50	1154.10	25	SEG11(K11)	1602.50	579.10
4	GND	77.50	1039.10	26	SEG12(K12)	1602.50	694.10
5	VDD1	77.50	924.10	27	SEG21	1602.50	809.10
6	VDD2	77.50	809.10	28	SEG22	1602.50	924.10
7	VDD3	77.50	694.10	29	SEG23	1602.50	1039.10
8	CUP1	77.50	579.10	30	SEG24/IOA1	1602.50	1154.10
9	CUP2	77.50	464.10	31	SEG25/IOA2	1602.50	1269.10
10	COM1	77.50	349.10	32	SEG26/IOA3	1602.50	1399.10
11	COM2	77.50	224.50	33	SEG27/IOA4	1472.50	1399.10
12	COM3	77.50	77.50	34	SEG28/IOB1/ELC	1357.50	1399.10
13	COM4	207.50	77.50	35	SEG29/IOB2/ELP	1242.50	1399.10
14	COM5	322.50	77.50	36	SEG30/IOB3/BZB	1127.50	1399.10
15	SEG1(K1)	437.50	77.50	37	SEG31/IOB4/BZ	1012.50	1399.10
16	SEG2(K2)	552.50	77.50	38	SEG32/IOC1/KI1	897.50	1399.10
17	SEG3(K3)	667.50	77.50	39	SEG33/IOC2/KI2	782.50	1399.10
18	SEG4(K4)	782.50	77.50	40	SEG34/IOC3/KI3	667.50	1399.10
19	SEG5(K5)	1366.80	77.50	41	SEG35/IOC4/KI4	552.50	1399.10
20	SEG6(K6)	1481.80	77.50	42	RESET	437.50	1399.10
21	SEG7(K7)	1602.50	77.50	43	INT	322.50	1399.10
22	SEG8(K8)	1602.50	224.50	44	TEST	207.50	1399.10

PIN DESCRIPTION

Name	I/O	Description
BAK	P	Power Back-up pin(+). . At Li Mode, connect a 0.1u capacitor to GND.
VDD1,2,3	P	LCD supply voltage and positive supply pins. . In Ag power mode, connect positive power to VDD1. . In Li or ExtV power mode, connect positive power to VDD2.
RESET	I	Input pin for external reset request signal, built-in internal pull-down resistor. . Reset cycle time can be defined as “PH15/2” or “PH12/2” by mask option. . Reset Type can be defined as “Level reset” or “Pulse reset” by mask option.
INT	I	Input pin for external interrupt request signal. . Falling edge or rising edge triggered is defined by mask option. . Internal pull-down or pull-up resistor is defined by mask option.
TESTA	I	Test signal input pin.
CUP1,2	O	Switching pins for supply the LCD driving voltage to the VDD1,2,3 pins. . Connect the CUP1 and CUP2 pins with non-polarized electrolytic capacitor when chip operated in 1/2 or 1/3 bias mode. . In no BIAS mode application, leave these pins opened
XIN XOUT	I O	Time base counter frequency (clock specified. LCD alternating frequency. Alarm signal frequency) or system clock oscillation. . 32KHz Crystal oscillator. . In FAST ONLY mode option, connect an external resistor could compose a RC oscillator.
COM1~5	O	Output pins for driving the common pins of the LCD or LED panel.
SEG1-12,21-35	O	Output pins for driving the LCD or LED panel segment.
IOA1-4	I/O	Input / Output port A.
IOB1-4	I/O	Input / Output port B.
IOC1-4	I/O	Input / Output port C.
ELC/ELP	O	Output port for EL driver.
BZB/BZ	O	Output port for alarm, clock or single tone melody generator
K1~16	O	Output port for key matrix scanning.(Shared with SEG1~SEG16)
KI1~4	I	Input port for key matrix.
GND	P	Negative supply voltage.

ABSOLOUTE MAXIMUM RATINGS

(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
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
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.

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

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
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

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=VDD3,#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=VDD3,#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	SEG1~12 SEG13~35	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

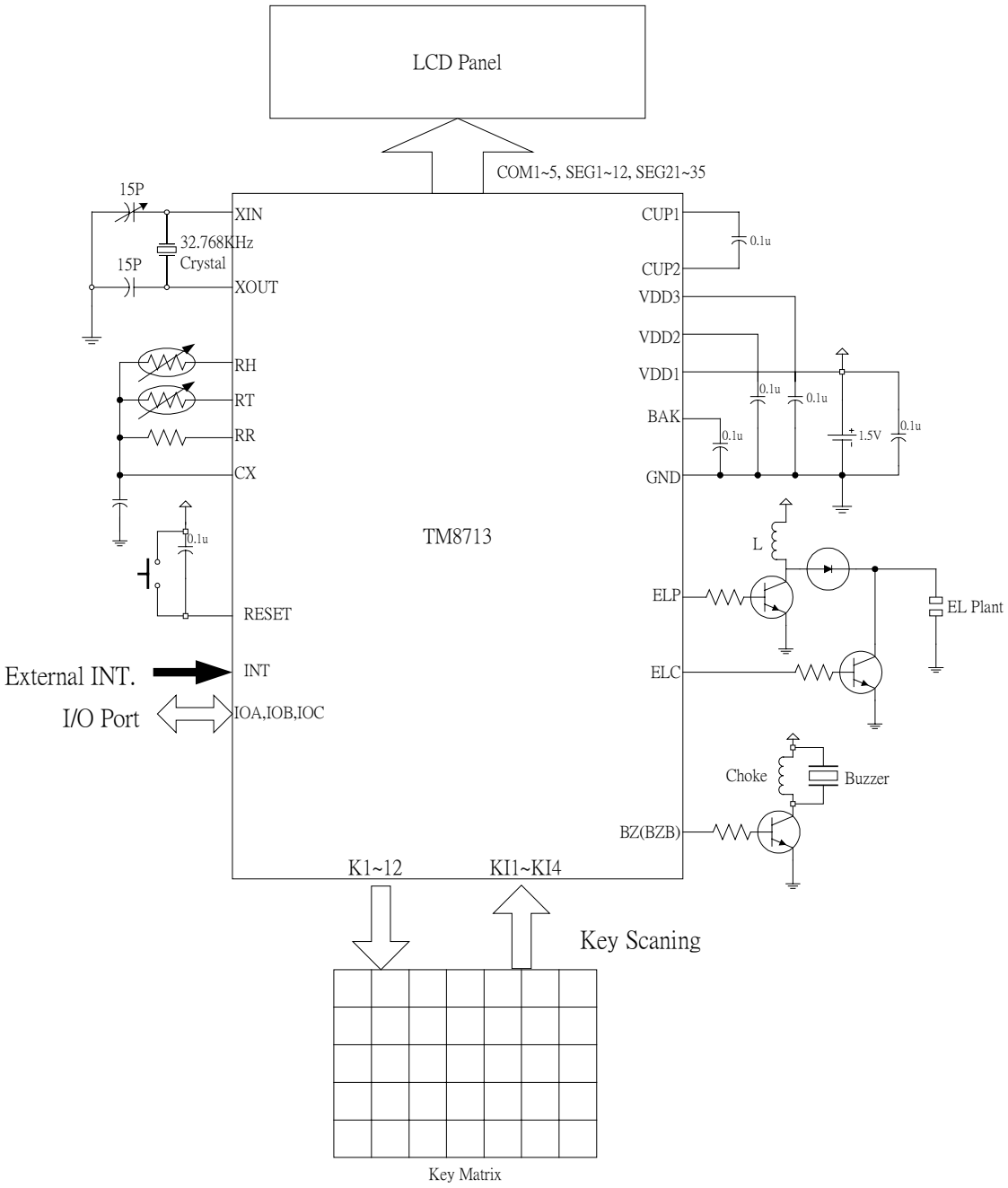
Segment Driver Output Characteristics

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		1.0		1.4	V
	Vom3g	Iol/h=+/-10uA,#3		1.8		2.2	V
Output ”L” Voltage	Vol12g	Iol=10uA,#1,#2				0.2	V
	Vol3g	Iol=10uA,#3				0.2	V
1/3 Bias display Mode							
Output ”H” Voltage	Voh12i	Ioh=-1uA,#1,#2	SEG-n	3.4			V
	Voh3i	Ioh=-1uA,#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=1uA,#1,#2				0.2	V
	Vol3i	Iol=1uA,#3				0.2	V

Output ”H” Voltage	Voh12j	Ioh=-10uA,#1,#2	COM-n	3.4			V
	Voh3j	Ioh=-10uA,#3		5.8			V
Output ”M1” Voltage	Vom12j	Iol/h=+/-10uA,#1,#2		1.0		1.4	V
	Vom13j	Iol/h=+/-10uA,#3		1.8		2.2	V
Output ”M2” Voltage	Vom22j	Iol/h=+/-10uA,#1,#2		2.2		2.6	V
	Vom23j	Iol/h=+/-10uA,#3		3.8		4.2	V
Output ”L” Voltage	Vol12j	Iol=10uA,#1,#2				0.2	V
	Vol3j	Iol=10uA,#3				0.2	V

TYPICAL APPLICATION CIRCUIT

This application circuit is simply an example, and is not guaranteed to work.



Ag power mode, 1/3 Bias, 1/5 Duty