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**TM8722**

***DATA SHEET***

***Rev 1.4***

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## AMENDMENT HISTORY

Version	Date	Description
1.0	Oct, 2003	New release
1.1	Nov, 2003	修正 page 6,9
1.2	Apr, 2004	P6.新增 Allowable Operating Frequency.
1.3	Dec, 2016	Delete P.13 the Static data from Segment Driver Output Characteristics
1.4	Jul, 2023	P.14 Application circuit 1.5V -> 3V

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## GENERAL DESCRIPTION

The TM8722 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, Resistance to Frequency Converter(RFC), EL panel driver, LCD driver, look-up table, watchdog timer and key matrix scanning circuitry in a signal chip.

## FEATURE

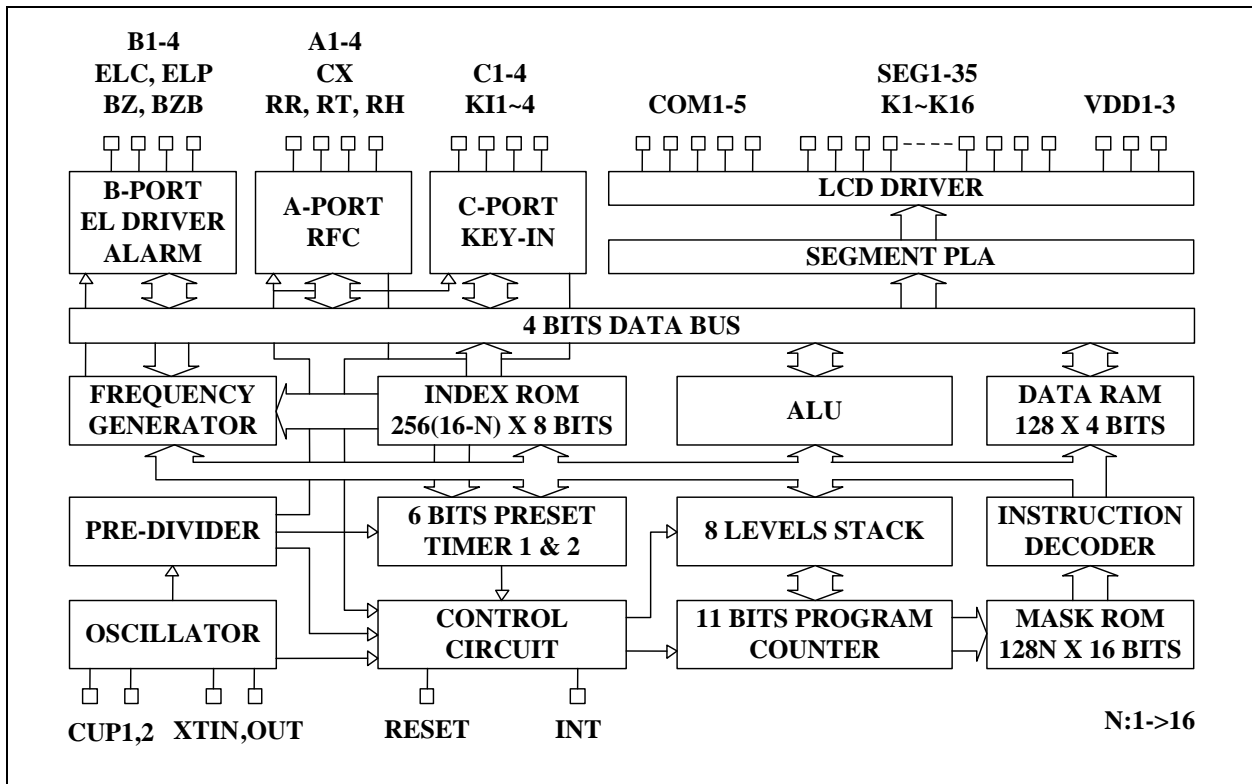
1. Low power dissipation.
2. Powerful instruction set (143 instructions).
  - Binary addition, subtraction, BCD adjust, logical operation in direct and index addressing mode.
  - Single-bit manipulation (set, reset, decision for branch).
  - Various conditional branch.
  - 16 working registers and manipulation.
  - Table look-up.
  - LCD driver data transfer.
3. Memory capacity.
  - ROM capacity     2048 x 16 bits.
  - RAM capacity     128 x 4 bits.
4. LCD/LED driver output.
  - 5 common outputs and 35 segment outputs (up to drive 175 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.
  - All segment outputs could be defined as CMOS or P\_open drain output type by mask option.
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 SEG32~35.  
IOC port had built in the input signal chattering prevention circuitry.
6. 8 level subroutine nesting.

7. Interrupt function.
  - External factors 3 (INT pin, Port IOC & KI input).
  - Internal factors 4 (Pre-Divider, Timer1, Timer2 & RFC).
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 R to F Converter circuit.
  - CX, RR, RT, RH (Muxed with SEG24~SEG27).
11. Built in key matrix scanning function.
  - K1~K16 (Shared with SEG1~SEG16).
  - KI1~KI4 (Muxed with SEG32~SEG35).
12. Two 6-bit programmable timer with programmable clock source.
13. Watch dog timer.
14. Built-in Voltage doubler, halver, tripler charge pump circuit.
15. 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.
16. HALT function.
17. STOP function.

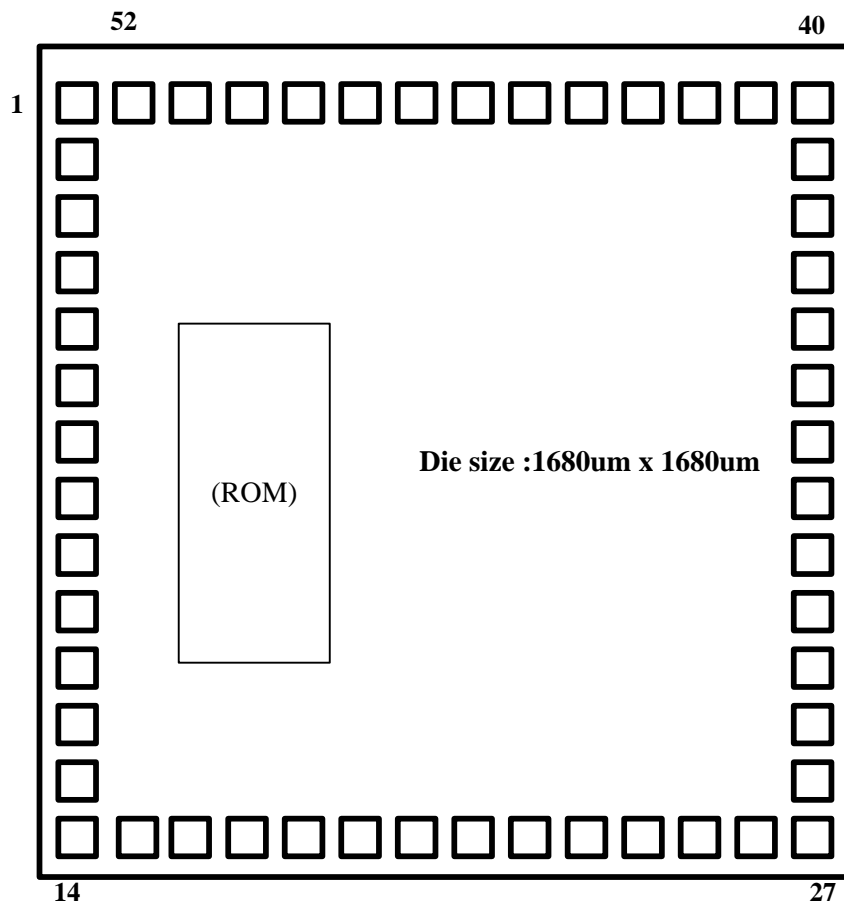
## APPLICATION

- Timer/Calendar/Calculator/Thermometer

## 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	77.5	1602.5	27	SEG13/K13	1602.5	77.5
2	XIN	77.5	1472.5	28	SEG14/K14	1602.5	207.5
3	XOUT	77.5	1357.5	29	SEG15/K15	1602.5	322.5
4	GND	77.5	1242.5	30	SEG16/K16	1602.5	437.5
5	VDD1	77.5	1127.5	31	SEG17	1602.5	552.5
6	VDD2	77.5	1012.5	32	SEG18	1602.5	667.5
7	VDD3	77.5	897.5	33	SEG19	1602.5	782.5
8	CUP1	77.5	782.5	34	SEG20	1602.5	897.5
9	CUP2	77.5	667.5	35	SEG21	1602.5	1012.5
10	COM1	77.5	552.5	36	SEG22	1602.5	1127.5
11	COM2	77.5	437.5	37	SEG23	1602.5	1242.5
12	COM3	77.5	322.5	38	SEG24/IOA1/CX	1602.5	1357.5
13	COM4	77.5	207.5	39	SEG25/IOA2/RR	1602.5	1472.5
14	COM5	77.5	77.5	40	SEG26/IOA3/RT	1602.5	1602.5
15	SEG1/K1	207.5	77.5	41	SEG27/IOA4/RH	1472.5	1602.5
16	SEG2/K2	322.5	77.5	42	SEG28/IOB1/ELC	1357.5	1602.5
17	SEG3/K3	437.5	77.5	43	SEG29/IOB2/ELP	1242.5	1602.5
18	SEG4/K4	552.5	77.5	44	SEG30/IOB3/BZB	1127.5	1602.5
19	SEG5/K5	667.5	77.5	45	SEG31/IOB4/BZ	1012.5	1602.5
20	SEG6/K6	782.5	77.5	46	SEG32/IOC1/KI1	897.5	1602.5
21	SEG7/K7	897.5	77.5	47	SEG33/IOC2/KI2	782.5	1602.5
22	SEG8/K8	1012.5	77.5	48	SEG34/IOC3/KI3	667.5	1602.5
23	SEG9/K9	1127.5	77.5	49	SEG35/IOC4/KI4	552.5	1602.5
24	SEG10/K10	1242.5	77.5	50	RESET	437.5	1602.5
25	SEG11/K11	1357.5	77.5	51	INT	322.5	1602.5
26	SEG12/K12	1472.5	77.5	52	TEST	207.5	1602.5



## PIN DESCRIPTION

Name	I/O	Description
BAK	P	Positive Back-up voltage. At Li power Mode, connect a 0.1u capacitor to GND.
VDD1, 2, 3	P	LCD supply voltage, and positive supply voltage. • In Ag 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.
INT	I	Input pin for external INT 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		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 mode, connect an external resistor could compose the RC oscillator (mask option). • In SLOW mode, connect an external resistor could compose the RC oscillator (mask option).
COM1~5	O	Output pins for driving the common pins of the LCD or LED panel.
SEG1-35	O	Output pins for driving the LCD or LED panel segment.
IOA1-4	I/O	Input/ Output port A. (Muxed with SEG24~SEG27)
IOB1-4	I/O	Input/Output port B. (Muxed with SEG28~SEG31)
IOC1-4	I/O	Input/Output port C. (Muxed with SEG32~SEG35)
CX RR/RT/RH	I O	1 input pin and 3 output pins for RFC application. (Muxed with SEG24~SEG27)
ELC/ELP	O	Output port for EL panel driver. (Muxed with SEG28, SEG29)
BZB/BZ	O	Output port for alarm, clock or single tone melody generator. (Muxed with SEG30~SEG31)
K1~K16	O	Output port for key matrix scanning. (Shared with SEG1~SEG16)
KI1~4	I	Input port for key matrix scanning. (Muxed with SEG32~SEG35)
GND	P	Negative supply voltage.

## ABSOLUTE MAXIMUM RATINGS

GND=0V

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

## POWER CONSUMPTION

at Ta= -20°C to 70°C, GND=0V

Name	Sym.	Condition	Min.	Typ.	Max.	Unit
HALT mode	IHALT1	Only 32.768KHz Crystal oscillator operating, without loading. Ag mode, VDD1=1.5V, BCF=0		2	5	uA
	IHALT2	Only 32.768 KHz Crystal oscillator operating, without loading. Li mode, VDD2=3.0V, BCF=0		2	5	
STOP mode	ISTOP				1	

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

## ALLOWABLE OPERATING CONDITIONS

at Ta= -20°C to 70°C, GND=0V

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

## ALLOWABLE OPERATING FREQUENCY

at Ta=-20°C to 70°C, GND= 0V

Condition	Max, Operating Frequency
BAK=1.5V (VDD1)	800 KHz
BAK=3V (VDD2)	4 MHz

## 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	KΩ
	Rllh2	Vi=0.2VDD2, #2	10	40	100	
	Rllh3	Vi=0.2VDD2, #3	5	20	50	
IOA/B/C Pull-Down Tr	Rmad1	Vi=VDD1, #1	200	500	1000	
	Rmad2	Vi=VDD2, #2	200	500	1000	
	Rmad3	Vi=VDD2, #3	100	250	500	
INT Pull-up Tr	Rintu1	Vi=VDD1, #1	200	500	1000	
	Rintu2	Vi=VDD2, #2	200	500	1000	
	Rintu3	Vi=VDD2, #3	100	250	500	
INT Pull-Down Tr	Rintd1	Vi=GND, #1	200	500	1000	
	Rintd2	Vi=GND, #2	200	500	1000	
	Rintd3	Vi=GND, #3	100	250	500	
RES Pull-Down R	Rres1	Vi=GND or VDD1, #1	10	40	100	
	Rres2	Vi=GND or VDD2, #2	10	40	100	
	Rres3	Vi=GND or VDD2, #3	10	40	100	

### DC Output Characteristics

Name	Symb.	Condition	Port	Min.	Typ.	Max.	Unit
Output “H” Voltage	Voh1c	Ioh=-200uA, #1	SEG1~35	0.8	0.9	1.0	V
	Voh2c	Ioh=-1mA, #2		1.5	1.8	2.1	
	Voh3c	Ioh=-3mA, #3		2.5	3.0	3.5	
Output “L” Voltage	Vol1c	Iol=400uA, #1		0.2	0.3	0.4	
	Vol2c	Iol=2mA, #2		0.3	0.6	0.9	
	Vol3c	Iol=6mA, #3		0.5	1.0	1.5	

**SEGMENT DRIVER OUTPUT CHARACTERISTICS**

Name	Symb.	Condition	For	Min.	Typ.	Max.	Unit.	
1/2 Bias Display Mode								
Output "H" Voltage	Voh12f	Ioh=-1uA, #1, #2	SEG-n	2.2			V	
	Voh3f	Ioh=-1uA, #3		3.8				
Output "L" Voltage	Vol12f	Iol=1uA, #1, #2	SEG-n			0.2		
	Vol3f	Iol=1uA, #3				0.2		
Output "H" Voltage	Voh12g	Ioh=-10uA, #1, #2	COM-n	2.2				
	Voh3g	Ioh=-10uA, #3		3.8				
Output "M" Voltage	Vom12g	Iol/h=+/-10uA, #1, #2	COM-n	1.0		1.4		
	Vom3g	Iol/h=+/-10uA, #3		1.8		2.2		
Output "L" Voltage	Vol12g	Iol=10uA, #1, #2	COM-n			0.2		
	Vol3g	Iol=10uA, #3				0.2		
1/3 Bias display Mode								
Output "H" Voltage	Voh12i	Ioh=-1uA, #1, #2	SEG-n	3.4				V
	Voh3i	Ioh=-1uA, #3		5.8				
Output "M1" Voltage	Vom12i	Iol/h=+/-10uA, #1, #2	SEG-n	1.0		1.4		
	Vom13i	Iol/h=+/-10uA, #3		1.8		2.2		
Output "M2" Voltage	Vom22i	Iol/h=+/-10uA, #1, #2	SEG-n	2.2		2.6		
	Vom23i	Iol/h=+/-10uA, #3		3.8		4.2		
Output "L" Voltage	Vol12i	Iol=1uA, #1, #2	SEG-n			0.2		
	Vol3i	Iol=1uA, #3				0.2		
Output "H" Voltage	Voh12j	Ioh=-10uA, #1, #2	COM-n	3.4				
	Voh3j	Ioh=-10uA, #3		5.8				
Output "M1" Voltage	Vom12j	Iol/h=+/-10uA, #1, #2	COM-n	1.0		1.4		
	Vom13j	Iol/h=+/-10uA, #3		1.8		2.2		
Output "M2" Voltage	Vom22j	Iol/h=+/-10uA, #1, #2	COM-n	2.2		2.6		
	Vom23j	Iol/h=+/-10uA, #3		3.8		4.2		
Output "L" Voltage	Vol12j	Iol=10uA, #1, #2	COM-n			0.2		
	Vol3j	Iol=10uA, #3				0.2		

## TYPICAL APPLICATION CIRCUIT

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

