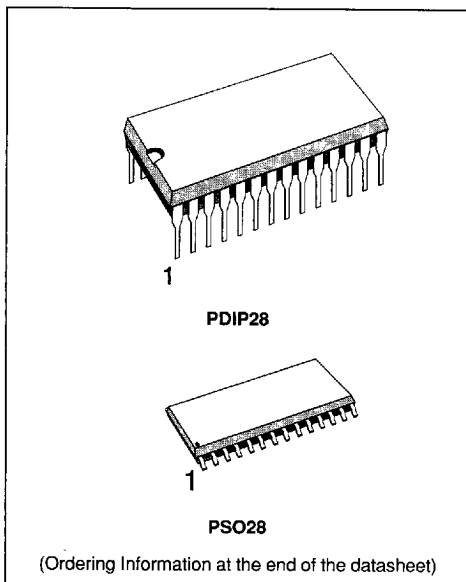


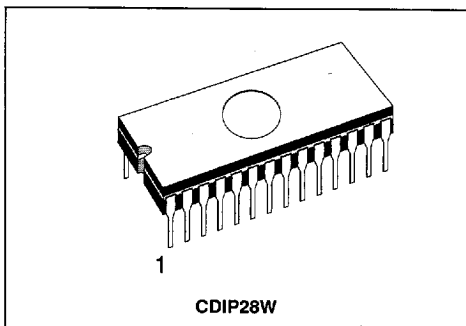
8-BIT EPROM HCMOS MCUs WITH A/D CONVERTER, EEPROM & AUTORELOAD TIMER

PRELIMINARY DATA

- 3.0 to 6.0V Supply Operating Range
- 8 MHz Maximum Clock Frequency
- -25 to +85°C Operating Temperature Range
- Run, Wait & Stop Modes
- 5 different interrupt vectors
- Look-up table capability in ROM
- User EPROM: 3868 bytes
- Data ROM: User selectable size (in program EPROM)
- Data RAM: 128 bytes
- EEPROM: 128 bytes
- PDIP28, PSO28 (ST62T94) packages
- CDIP28W (ST62E94) packages
- 21 fully software programmable I/O as:
 - Input with pull-up resistor
 - Input without Pull-up resistor
 - Input with interrupt generation
 - Open-drain or push-pull outputs
 - Analog Inputs
- 8 I/O lines can sink up to 20mA for direct LED or TRIAC driving
- 8 bit counter with a 7-bit programmable prescaler (Timer1)
- 8 bit Autoreload timer with 7-bit programmable prescaler (AR Timer)
- Digital Watchdog
- 8 bit A/D Converter with up to analog inputs
- 8 bit Synchronous Peripheral Interface (SPI)
- On-chip clock oscillator (Quartz or Ceramic)
- Power-on Reset
- Clock output
- 9 powerful addressing modes



EPROM PACKAGES



The ST62E94 is the EPROM version; ST62T94 is the OTP version; both are fully compatible with ST6294 ROM version.

Figure 1. ST62E94/T94 Pin Configuration

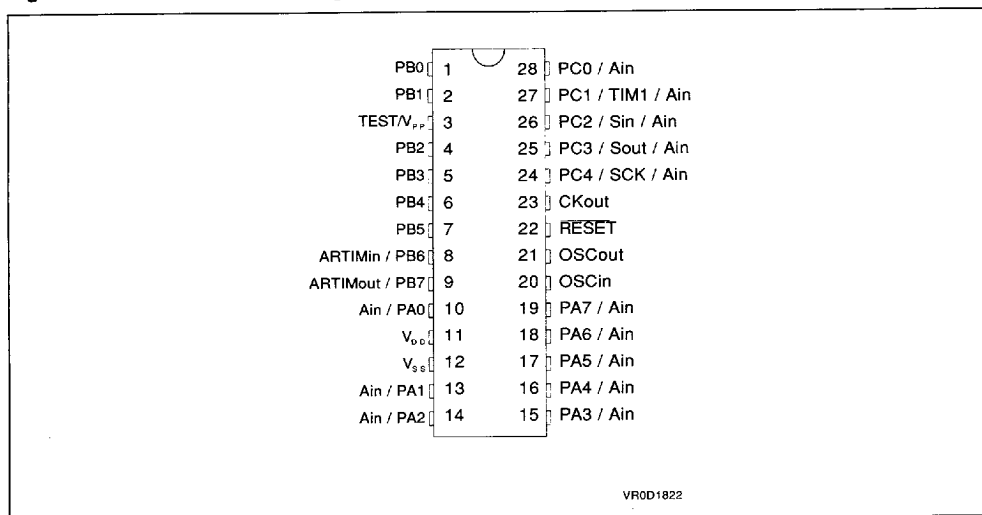
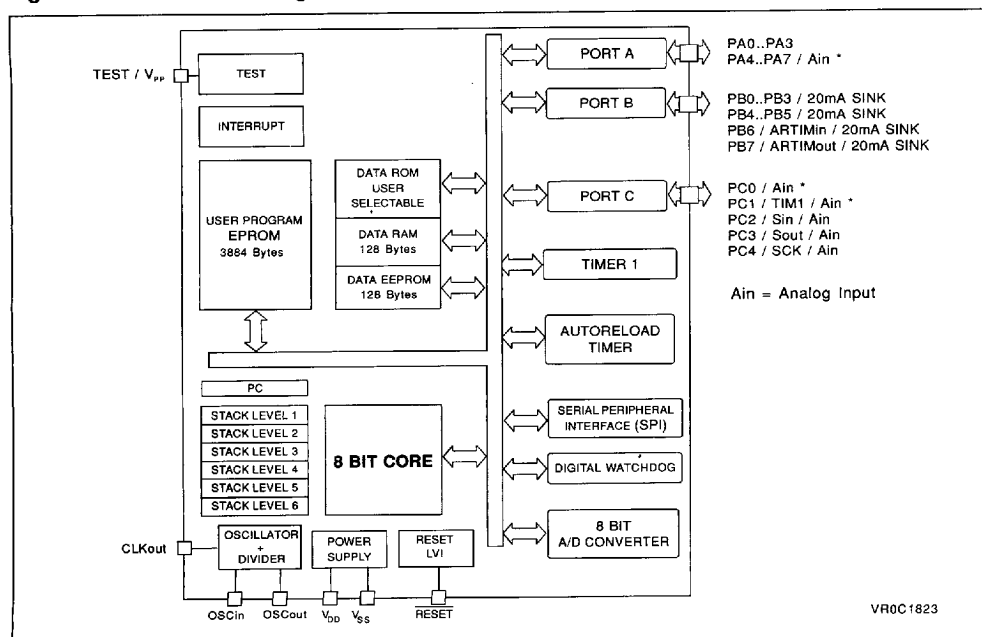


Figure 2. ST62E94 Block Diagram



GENERAL DESCRIPTION

The ST62E94, T94 microcontrollers are members of the 8-bit HCMOS ST62xx family, a series of devices oriented to low-medium complexity applications.

They are the EPROM and OTP versions of the ST6294 device. EPROM are suited for development. OTPs are suited for prototyping, preseries, low to mid volume series and inventory optimization for customer having several applications using the same MCU. All ST62xx members are based on a building block approach: a common core is surrounded by a combination of on-chip peripherals (macrocells).

The macrocells of the ST62E94, T94 are: the timer peripheral that includes an 8-bit counter with a 7-bit software programmable prescaler (Timer1), the 8-bit Auto-reload Timer with 7 bit programmable prescaler (AR Timer), the 8-bit A/D Converter with up to 13 analog inputs (A/D inputs are alternate functions of I/O pins), the Digital Watchdog (DWD) and an 8-bit Serial synchronous Peripheral Interface (SPI). In addition, these devices offer 128 bytes of EEPROM for non volatile data storage.

The ST62E94, T94 are a version of the ST62E65, T65 specifically tailored to be used in telephone set applications. The only difference is that a CKOUT pin is provided instead of the NMI input pin.

PIN DESCRIPTION

VDD and VSS. Power is supplied to the MCU using these two pins. VDD is power and VSS is the ground connection.

OSCI_n and OSCOUT. These pins are internally connected with the on-chip oscillator circuit. A quartz crystal, a ceramic resonator or an external clock signal can be connected between these two pins in order to allow the correct operation of the MCU with various stability/cost trade-offs. The frequency at OSCI_n and OSCOUT is internally divided by 1, 2 or 4 by a software controlled divider. The OSCI_n pin is the input pin, the OSCOUT pin is the output pin.

RESET. The active low **RESET** pin is used to restart the microcontroller to the beginning of its program.

TEST. The TEST must be held at VSS for normal operation (an internal pull-down resistor selects normal operating mode if TEST pin is not connected).

CKOUT. This clock pin outputs the oscillator frequency divided by 2 ($f_{osc}/2$). This function can be disabled by software to reduce power consumption.

PC1/TIM1/Ain. This pin can be used as a Port C I/O bit, as Timer 1 I/O pin or as analog input for the on-chip A/D converter. If programmed to be the Timer 1 pin, in input mode it is connected to the prescaler and acts as external timer clock or as control gate for the internal timer clock. In the output mode the timer pin outputs the data bit when a time out occurs.

To use this pin as Timer 1 output a dedicated bit in the TIMER 1 Status/Control Register must be set. To use this pin as input pin the I/O pin has to be programmed as input. The analog mode should be programmed to use the line as an analog input.

PB6/ARTIMin, PB7/ARTIMout. These pins are either Port B I/O bits or the Input and Output pins of the Auto-reload Timer. To be used as timer input function PB6 has to be programmed as input with or without pull-up. A dedicated bit in the AR TIMER Mode Control Register sets PB7 as timer output function.

PA0-PA7. These 8 lines are organized as one I/O port (A). Each line may be configured under software control as input with or without internal pull-up resistor, interrupt generating input with pull-up resistor, analog input, open-drain or push-pull output.

PB0-PB3, PB4, PB5. These 6 lines are organized as one I/O port (B). Each line may be configured under software control as input with or without internal pull-up resistor, interrupt generating input with pull-up resistor, open-drain or push-pull output. In output mode these lines can also sink 20mA for direct LED and TRIAC driving.

PC0-PC4. These 5 lines are organized as one I/O port (C). Each line may be configured under software control as input with or without internal pull-up resistor, interrupt generating input with pull-up resistor, analog input for the A/D converter, open-drain or push-pull output. PC2-PC4 can also be used as respectively Data in, Data out and Clock I/O pins for the on-chip SPI to carry the synchronous serial I/O signals.

THE READER IS ASKED TO REFER TO THE DATASHEET OF THE ST6294 DEVICE FOR FURTHER DETAILS.

EPROM/OTP DESCRIPTION

The ST62E94 is the EPROM version of the ST6294 product. It is intended for use during the development of an application and for pre-production and small volume production. ST62T94 OTP has the same characteristics. It includes EPROM memory instead of the ROM memory and so the program can be easily modified by the user with the ST62E6x EPROM programming tools from SGS-THOMSON.

From a user point of view (with the following exceptions) the ST62E94, T94 products have exactly the same software and hardware features as the ROM version. An additional mode is used to configure the part for programming of the EPROM, this is set by a +12.5V voltage applied to the TEST/V_{PP} pin. The programming of the ST62E94, T94 is described in the User Manual of the EPROM Programming Board.

Note also the Low Voltage option of ROM devices can not be emulated on EPROM or OTP devices

ROM Option Emulation

The ROM mask options that can be selected by the user in the ROM devices can be selected on the EPROM/OTP devices by an EPROM CODE byte that can be programmed with the ST62E6x EPROM programming tools available from SGS-THOMSON. This EPROM CODE byte is automatically read, and the selected options enabled, when the chip reset is activated.

The Option byte is written during programming either by using the PC menu (PC driven Mode) or automatically (stand-alone mode).

EPROM Programming Mode

An additional mode is used to configure the part for programming of the EPROM, this is set by a 12.5V voltage applied to the TEST/V_{PP} pin. The programming of the ST62E94, T94 is described in the User Manual of the EPROM Programming board.

EPROM ERASING

The EPROM of the windowed package of the ST62E94 may be erased by exposure to Ultra Violet light.

The erasure characteristic of the ST62E94 is such that erasure begins when the memory is exposed to light with a wave lengths shorter than approximately 4000Å. It should be noted that sunlights and some types of fluorescent lamps have wave-lengths in the range 3000-4000Å. It is thus recommended that the window of the ST62E94 packages be covered by an opaque label to prevent unintentional erasure problems when testing the application in such an environment.

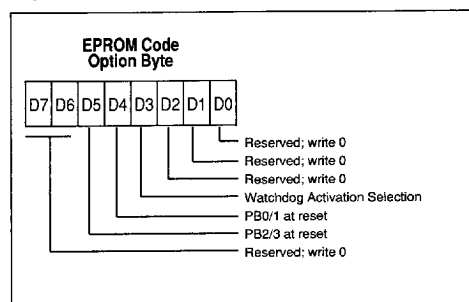
The recommended erasure procedure of the ST62E94 EPROM is the exposure to short wave ultraviolet light which have a wave-length 2537Å. The integrated dose (i.e. U.V. intensity x exposure time) for erasure should be a minimum of 15W-sec/cm². The erasure time with this dosage is approximately 15 to 20 minutes using an ultraviolet lamp with 12000μW/cm² power rating. The ST62E94 should be placed within 2.5cm (1inch) of the lamp tubes during erasure.

Table 1. ST62E94/T94 OTP Memory Map

Device Address	Description
0000h-007Fh	Reserved
0080h-0F9Fh	User Program ROM 3856 Bytes
0FA0h-0FEFh 0FF0h-0FF7h 0FF8h-0FFBh 0FFCh-0FFDh 0FFEh-0FFFh	Reserved Interrupt Vectors Reserved NMI Vector User Reset Vector

Note. Reserved Areas should be filled with FFh

Figure 3. EPROM Code Option Byte



D7-D6. These bits are not used.

D5. This bit selects the configuration of the ports PB2 and PB3 during reset. If set to zero, PB2 and PB3 are configured with pull-up during reset. If set to one, PB2 and PB3 are configured as high impedance ports.

D4. Same as D5 for PB0 and PB1.

D3. This bit selects the on-chip Watchdog activation. If cleared to zero this bit selects the software activation, if set to one, it selects the hardware activation option.

D2-D0. Must be cleared to zero.

D1. Must be set to zero.

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

This product contains devices to protect the inputs against damage due to high static voltages, however it is advised to take normal precaution to avoid application of any voltage higher than maximum rated voltages.

For proper operation it is recommended that V_I and V_O must be higher than V_{SS} and smaller V_{DD} . Reliability is enhanced if unused inputs are connected to an appropriated logic voltage level (V_{DD} or V_{SS}).

Power Considerations. The average chip-junction temperature, T_J , in Celsius can be obtained from :

$$T_J = T_A + P_D \times R_{thJA}$$

Where : T_A = Ambient Temperature.

R_{thJA} = Package thermal resistance (junction-to ambient).

P_D = $P_{int} + P_{port}$.

P_{int} = $I_{DD} \times V_{DD}$ (chip internal power).

P_{port} = Port power dissipation (determined by the user).

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage	-0.3 to 7.0	V
V_I	Input Voltage	$V_{SS} - 0.3$ to $V_{DD} + 0.3^{(1)}$	V
V_O	Output Voltage	$V_{SS} - 0.3$ to $V_{DD} + 0.3^{(1)}$	V
I_O	Current Drain per Pin Excluding V_{DD} , V_{SS}	10	mA
I_{INJ+}	Pin Injection current (positive), All I/O, $V_{DD} = 4.5V$	+5	mA
I_{INJ-}	Pin Injection current (negative), All I/O, $V_{DD} = 4.5V$	-5	mA
I_{VDD}	Total Current into V_{DD} (source)	50	mA
I_{VSS}	Total Current out of V_{SS} (sink)	50	mA
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature	-60 to 150	°C

Notes :

- Stresses above those listed as "absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

- (1) Within these limits, clamping diodes are guarantee to be not conductive. Voltages outside these limits are authorised as long as injection current is kept within the specification.

THERMAL CHARACTERISTIC

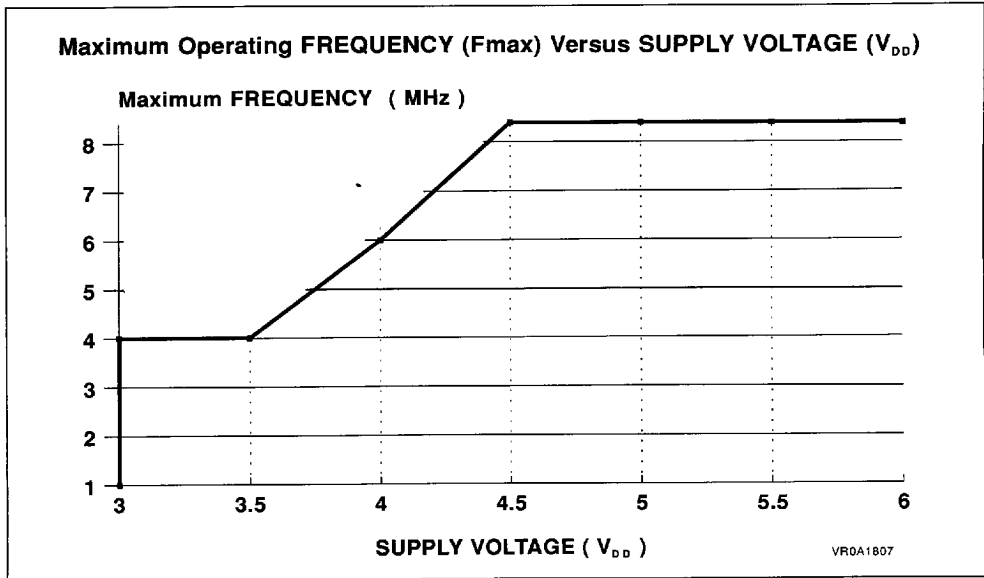
Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
R_{thJA}	Thermal Resistance	PDIP28			55	°C/W
		PSO28			75	

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
T _A	Operating Temperature	8 Suffix Version 1 Suffix Version	-25 0		85 70	°C
V _{DD}	Operating Supply Voltage	f _{OSC} = 4MHz f _{INT} = 4MHz f _{OSC} = 8MHz f _{INT} = 8MHz	3.0 4.5		6.0 6.0	V V
f _{INT}	Internal Frequency ⁽³⁾	V _{DD} = 3V V _{DD} = 4.5V	0 0		4.0 8.0	MHz MHz
I _{INJ+}	Pin Injection Current (positive) Digital Input ⁽¹⁾ Analog Inputs ⁽²⁾	V _{DD} = 4.5 to 5.5V			+5	mA
I _{INJ-}	Pin Injection Current (negative) Digital Input ⁽¹⁾ Analog Inputs	V _{DD} = 4.5 to 5.5V			-5	mA

Notes :

1. A current of ± 5mA can be forced on each pin of the digital section without affecting the functional behaviour of the device. For a positive current injected into one pin, a part of this current (~ 10%) can be expected to flow from the neighbouring pins.
2. If a total current of +1 mA is flowing into the single analog channel or if the total current flowing into all the analog inputs is of 1mA, all the resulting conversions are shifted by +1 LSB. If a total positive current is flowing into the single analog channel or if the total current flowing into all the analog inputs is of 5mA, all the resulting conversions are shifted by +2 LSB.
3. An oscillator frequency above 1MHz is recommended for reliable A/D results.



The shaded area is outside the device operating range, device functionality is not guaranteed.

DC ELECTRICAL CHARACTERISTICS(T_A = -25 to +85°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
V _{IL}	Input Low Level Voltage All inputs				V _{DD} × 0.3	V
V _{IH}	Input High Level Voltage All inputs		V _{DD} × 0.7			V
V _{OL}	Low Level Output Voltage	V _{DD} =5V I _{OL} = 10μA, All I/O pins CKOUT			0.1	V
		I _{OL} = 5.0mA, Standard I/O CKOUT			0.8	
		I _{OL} = 10mA, Port B			0.8	
		I _{OL} = 20mA, Port B			1.3	
V _{OH}	High Level Output Voltage	V _{DD} =5V I _{OH} = -10μA	4.9			V
		I _{OH} = -5.0mA	3.5			
		I _{OH} = -1.5mA, V _{DD} =3V	2.0			
I _{PU}	Input Pull-up Current Input Mode with Pull-up Port A, B, C	V _{IN} = V _{SS} , V _{DD} =3.0-6V			100	μA
I _{IL} I _{IH}	Input Leakage Current ⁽¹⁾	V _{IN} = V _{SS} V _{IN} = V _{DD}			1.0	μA
I _{DD}	Supply Current in RESET Mode	V _{RESET} =V _{SS} , f _{OSC} =4MHz V _{DD} <3.8V V _{DD} <6.0V			0.70 1.25	mA
	Supply Current in RUN Mode ⁽²⁾	V _{DD} =6.0V, f _{INT} =8MHz All peripherals on ⁽¹⁾			6.6	mA
		V _{DD} =3.8V, f _{INT} =4MHz All peripherals on ⁽¹⁾			1.50	mA
		V _{DD} =3.8V, f _{INT} =1MHz f _{OSC} =4MHz Peripherals disabled ⁽²⁾			0.65	mA
	Supply Current in WAIT Mode ⁽³⁾	V _{DD} =6.0V, f _{INT} =8MHz Peripherals disabled ⁽³⁾			1.30	mA
		V _{DD} =3.8V, f _{INT} =4MHz Peripherals disabled ⁽³⁾			0.35	
	Supply Current in STOP Mode	V _{DD} =6.0V			20	μA

Notes :

1. A/D Converter running; EEPROM enabled; Timer 1 and AR Timer running; CKOUT pin enabled. When the EEPROM is in write cycle, an additional 300μA must be added to I_{DDmax}
2. A/D Converter in Stand-by; EEPROM in Stand-by; CKOUT pin disabled
3. A/D Converter in Stand-by; EEPROM in Stand-by; CKOUT pin disabled; Timer 1 and AR Timer stopped
4. Hysteresis voltage between switching levels

AC ELECTRICAL CHARACTERISTICS(T_A = -25 to +85°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
f _{OSC}	Oscillator Frequency	V _{DD} = 3.0V V _{DD} = 4.5V			4 8	MHz
t _{OH}	High to Low Transition Time	Port A, B, C, CKOUT C _L =100pF		40		ns
t _{OL}	Low to High Transition Time	Port A, B, C, CKOUT C _L =100pF		40		
t _{SU}	Oscillator Start-up Time	C _{L1} = C _{L2} = 22pF V _{DD} =5V		5	10	ms
t _{REC}	Supply Recovery Time ⁽¹⁾		100			
T _{WR}	Minimum Pulse Width (V _{DD} = 5V) RESET pin, NMI pin		100 100			ns
T _{WEE}	EEPROM Write Time	T _A = 25°C One Byte		5	10	ms
Endurance	EEPROM WRITE/ERASE Cycle	Q _A Lot Acceptance	300,000			cycles
Retention	EEPROM Data Retention	T _A = 25°C	10			years
C _{IN}	Input Capacitance	All Inputs Pins			10	pF
C _{OUT}	Output Capacitance	All Outputs Pins			10	pF

Note:1. Period for which V_{DD} has to be connected at 0V to allow internal Reset function at next power-up.

I/O PORT CHARACTERISTICS(T_A = -25 to +85°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
V _{IL}	Input Low Level Voltage	I/O Pins			0.3x V _{DD}	V
V _{IH}	Input High Level Voltage	I/O Pins	0.7x V _{DD}			V
V _{OL}	Low Level Output Voltage	V _{DD} = 5.0V I _{OL} = 10μA , All I/O Pins, CKOUT I _{OL} = 5mA , Standard I/O, CKOUT I _{OL} = 10mA , Port B I _{OL} = 20mA , Port B			0.1 0.8 0.8 1.3	V
V _{OH}	High Level Output Voltage	I _{OH} = - 10μA I _{OH} = - 5mA, V _{DD} = 5.0V I _{OH} = - 1.5mA, V _{DD} = 3.0V	V _{DD} -0.1 3.5 2.0			V
I _{IL} I _{IH}	Input Leakage Current I/O Pins (pull-up resistor off)	V _{in} = V _{DD} or V _{SS} V _{DD} = 3.0V V _{DD} = 5.5V		0.1 0.1	1.0 1.0	μA
R _{PU}	Pull-up Resistor	V _{in} = 0V; All I/O Pins	50	100	200	KΩ

SPI CHARACTERISTICS(T_A = -25 to +85°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
f _{CL}	Clock Frequency at SCK				500	kHz
t _{SV}	Data Set up time on Sin			TBD		
t _H	Data hold time on Sin			TBD		
t _{TS}	Delay Transmission started on Sin	8MHz	0	Note 1		μs

Note :

1. Minimum time: 0μs
Maximum time: 1 instruction cycle

TIMER1 CHARACTERISTICS
(T_A = -25 to +85°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
t _{RES}	Resolution		$\frac{12}{f_{INT}}$			s
f _{IN}	Input Frequency on TIM1 Pin				$\frac{f_{INT}}{8}$	MHz
t _w	Pulse Width at TIM1 Pin	V _{DD} = 3.0V V _{DD} ≥ 4.5V	1 125			μs ns

AR TIMER CHARACTERISTICS
(T_A = -25 to +85°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
t _{RES}	Resolution		$\frac{1}{f_{INT}}$			s
f _{ARin}	Input Frequency on ARTIMin pin	STOP Mode RUN and WAIT Modes			2 $\frac{f_{INT}}{4}$	MHz MHz
t _w	Pulse Width at ARTIMin Pin	V _{DD} = 3.0V V _{DD} ≥ 4.5V	125 125			ns ns

A/D CONVERTER CHARACTERISTICS(T_A = -25 to +85°C unless otherwise specified)

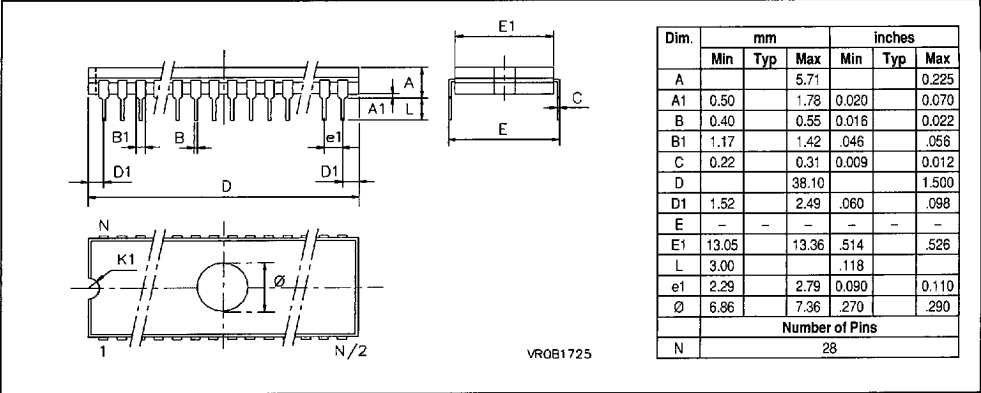
Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Res	Resolution ⁽¹⁾			8		Bit
A _{TOT}	Total Accuracy ⁽¹⁾	f _{osc} > 1.2MHz f _{osc} > 32kHz			±2 ±4	LSB
t _c ⁽²⁾	Conversion Time	f _{osc} = 8MHz		70		μs
V _{AN}	Conversion Range		V _{SS}		V _{DD}	V
ZIR	Zero Input Reading	Conversion result when V _{in} = V _{SS}	00			Hex
FSR	Full Scale Reading	Conversion result when V _{in} = V _{DD}			FF	Hex
AD _I	Analog Input Current During Conversion	V _{DD} = 4.5V			1.0	μA
AC _{IN} ⁽³⁾	Analog Input Capacitance			2	5	pF
ASI	Analog Source Impedance				30	KΩ
SSI	Analog Reference Supply Impedance				2	KΩ

Notes:

1. Noise at V_{DD}, V_{SS} < 10mV
2. With oscillator frequencies less than 1MHz, the A/D Converter accuracy is decreased.
3. Excluding Pad Capacitance.
4. ASI can be increased as long as the load of the A/D Converter input capacitor is ensured before conversion start.

PACKAGE MECHANICAL DATA

Figure 4. 28-Lead Frit Seal Ceramic Dual in Line Package, 600-Mil Width



ORDERING INFORMATION

ORDERING INFORMATION TABLE

Sales Type	OTP/EPROM	I/O	Additional Features	Temperature Range	Package
ST62T94B8	OTP 4K Bytes	21	CKOUT Pin	-25° to + 85°C	PDIP28
ST62T94M8					PSO28
ST62E94F1	EPROM 4K Bytes	21	CKOUT Pin	0 to + 70°C	CDIP28