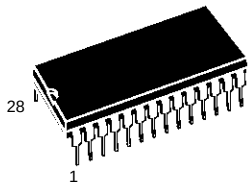
SGS-THOMSON MICROELECTRONICS

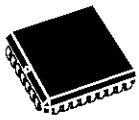
M28C64C
M28C64X

PARALLEL ACCESS 64K (8K x 8) EEPROM

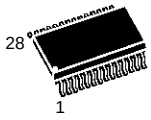
- FAST ACCESS TIME: 150ns
- SINGLE 5V ± 10% SUPPLY VOLTAGE
- LOW POWER CONSUMPTION
- FAST WRITE CYCLE
  - 32 Bytes Page Write Operation
  - Byte or Page Write Cycle: 5ms
- ENHANCED END OF WRITE DETECTION
  - Ready/Busy Open Drain Output (for M28C64C product only)
  - Data Polling
  - Toggle Bit
- PAGE LOAD TIMER STATUS BIT
- HIGH RELIABILITY SINGLE POLYSILICON, CMOS TECHNOLOGY
  - Endurance >100,000 Erase/Write Cycles
  - Data Retention >40 Years
- JEDEC APPROVED BYTEWIDE PIN OUT



PDIP28 (P)



PLCC32 (K)



SO28 (MS)
300 mils

TSOP28 (N)
8 x13.4mm

DESCRIPTION

The M28C64C is an 8K x 8 low power Parallel EEPROM fabricated with SGS-THOMSON proprietary single polysilicon CMOS technology. The device offers fast access time with low power dissipation and requires a 5V power supply.

The circuit has been designed to offer a flexible microcontroller interface featuring both hardware and software handshaking mode with Ready/Busy, Data Polling and Toggle Bit. The M28C64C supports 32 byte page write operation.

Table 1. Signal Names

A0 - A12	Address Input
DQ0 - DQ7	Data Input / Output
$\overline{W}$	Write Enable
$\overline{E}$	Chip Enable
$\overline{G}$	Output Enable
$R\overline{B}$	Ready / Busy
V_{CC}	Supply Voltage
V_{SS}	Ground

Figure 1. Logic Diagram

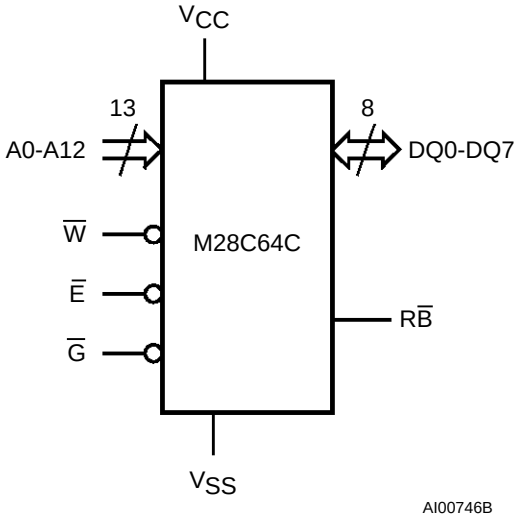
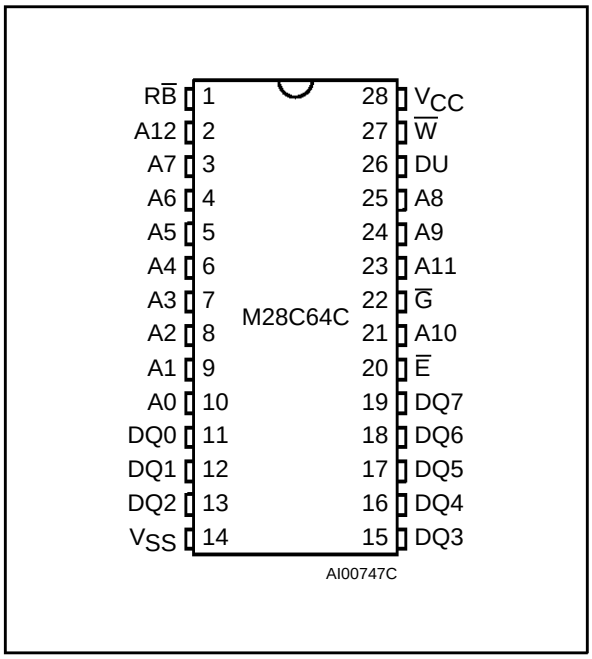
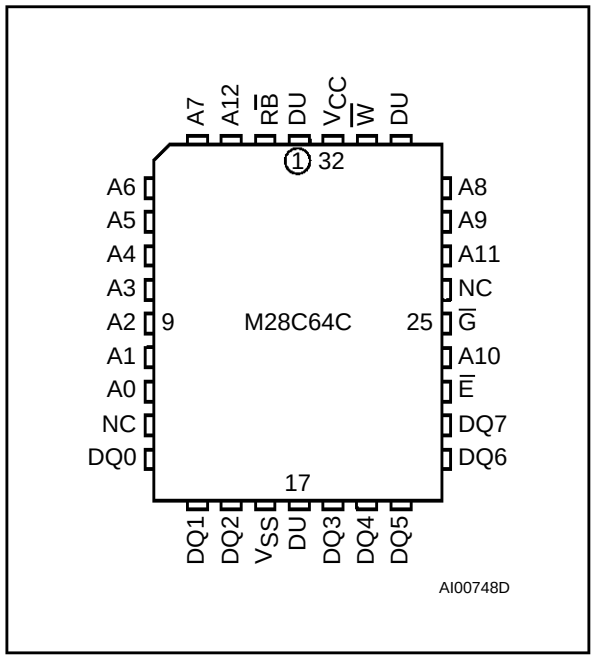


Figure 2A. DIP Pin Connections



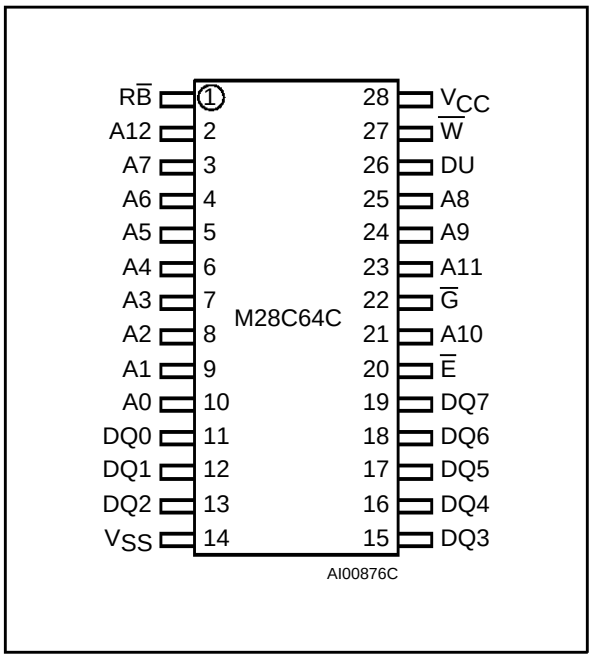
Warning: DU = Don't Use

Figure 2B. LCC Pin Connections



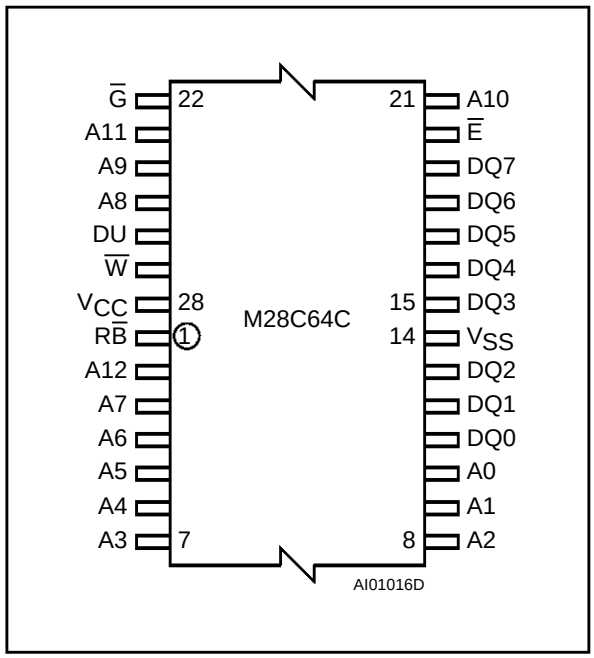
Warning: NC = Not Connected, DU = Don't Use

Figure 2C. SO Pin Connections



Warning: DU = Don't Use

Figure 2D. TSOP Pin Connections



Warning: DU = Don't Use

PIN DESCRITPION

Addresses (A0-A12). The address inputs select an 8-bit memory location during a read or write operation.

Chip Enable ($\overline{E}$). The chip enable input must be low to enable all read/write operations. When Chip Enable is high, power consumption is reduced.

Output Enable ($\overline{G}$). The Output Enable input controls the data output buffers and is used to initiate read operations.

Table 2. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
T_A	Ambient Operating Temperature	– 40 to 125	°C
T_{STG}	Storage Temperature Range	– 65 to 150	°C
V_{CC}	Supply Voltage	– 0.3 to 6.5	V
V_{IO}	Input/Output Voltage	– 0.3 to V_{CC} +0.6	V
V_I	Input Voltage	– 0.3 to 6.5	V
V_{ESD}	Electrostatic Discharge Voltage (Human Body model)	2000	V

Note: Except for the rating "Operating Temperature Range", stresses above those listed in the Table "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the SGS-THOMSON SURE Program and other relevant quality documents.

Table 3. Operating Modes

Mode	$\overline{E}$	$\overline{G}$	$\overline{W}$	DQ0 - DQ7
Read	V_{IL}	V_{IL}	V_{IH}	Data Out
Write	V_{IL}	V_{IH}	V_{IL}	Data In
Standby / Write Inhibit	V_{IH}	X	X	Hi-Z
Write Inhibit	X	X	V_{IH}	Data Out or Hi-Z
Write Inhibit	X	V_{IL}	X	Data Out or Hi-Z
Output Disable	X	V_{IH}	X	Hi-Z

Note: X = V_{IH} or V_{IL}

Data In/ Out (DQ0 - DQ7). Data is written to or read from the M28C64C through the I/O pins.

Write Enable ($\overline{W}$). The Write Enable input controls the writing of data to the M28C64C.

Ready/Busy ($R\overline{B}$). Ready/Busy is an open drain output that can be used to detect the end of the internal write cycle.

OPERATION

In order to prevent data corruption and inadvertent write operations during power-up, a Power On Reset (POR) circuit resets all internal programming cicuitry. Access to the memory in write mode is allowed after a power-up as specified in Table 6.

Read

The M28C64C is accessed like a static RAM. When $\overline{E}$ and $\overline{G}$ are low with $\overline{W}$ high, the data addressed is presented on the I/O pins. The I/O pins are high impedance when either $\overline{G}$ or $\overline{E}$ is high.

Write

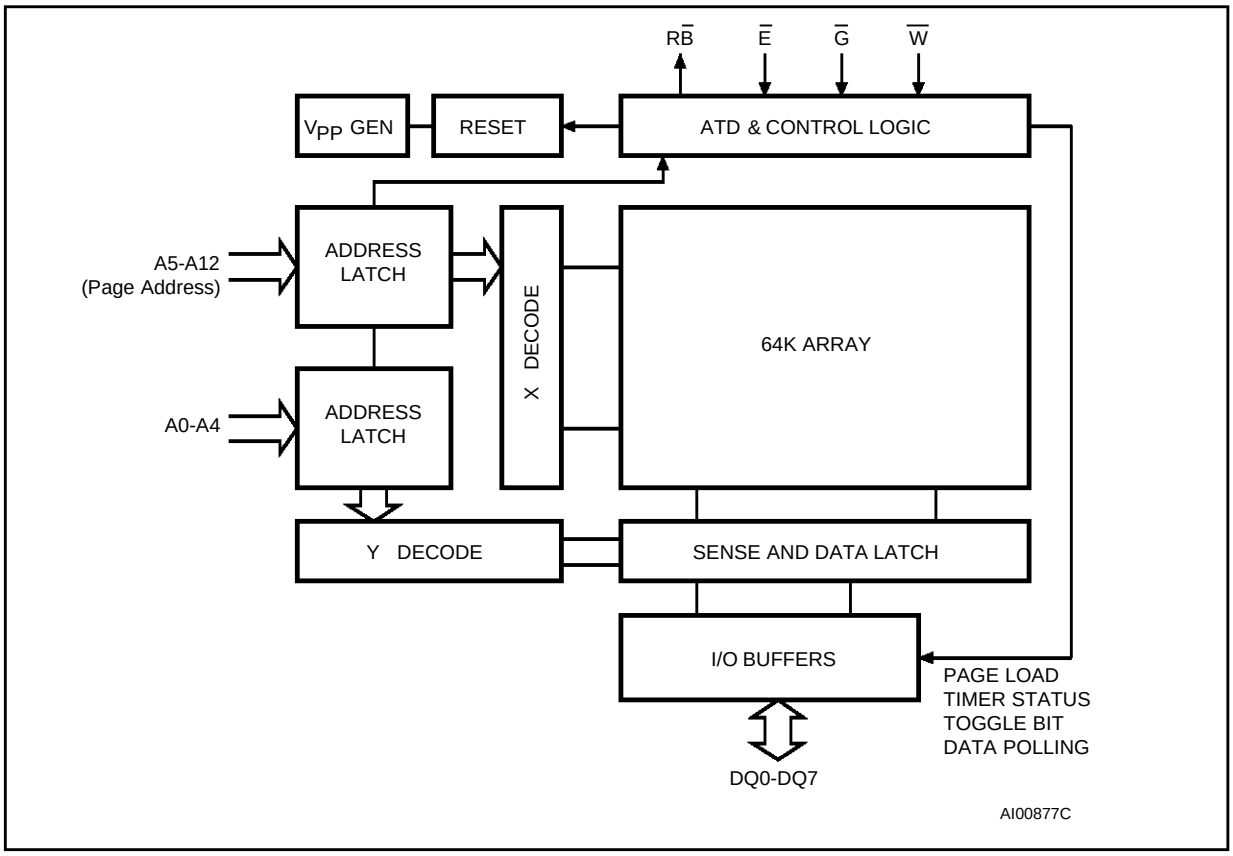
Write operations are initiated when both $\overline{W}$ and $\overline{E}$ are low and $\overline{G}$ is high. The M28C64C supports both $\overline{E}$ and $\overline{W}$ controlled write cycles. The Address is latched by the falling edge of $\overline{E}$ or $\overline{W}$ which ever occurs last and the Data on the rising edge of $\overline{E}$ or $\overline{W}$ which ever occurs first. Once initiated the write operation is internally timed until completion.

Page Write

Page write allows up to 32 bytes to be consecutively latched into the memory prior to initiating a programming cycle. All bytes must be located in a single page address, that is A5 - A12 must be the same for all bytes. The page write can be initiated during any byte write operation.

Following the first byte write instruction the host may send another address and data up to a maximum of 100µs after the rising edge of $\overline{E}$ or $\overline{W}$ which ever occurs first (t_{BLC}). If a transition of $\overline{E}$ or $\overline{W}$ is not detected within 100µs, the internal programming cycle will start.

Figure 3. Block Diagram



Microcontroller Control Interface

The M28C64C provides two write operation status bits and one status pin that can be used to minimize the system write cycle. These signals are available on the I/O port bits DQ7 or DQ6 of the memory during programming cycle only, or as the RB signal on a separate pin.

Figure 4. Status Bit Assignment

DQ7	DQ6	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
DP	TB	PLTS	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z

DP = Data Polling
TB = Toggle Bit
PLTS = Page Load Timer Status

Data Polling bit (DQ7). During the internal write cycle, any attempt to read the last byte written will produce on DQ7 the complementary value of the previously latched bit. Once the write cycle is finished the true logic value appears on DQ7 in the read cycle.

Toggle bit (DQ6). The M28C64C offers another way for determining when the internal write cycle is completed. During the internal Erase/Write cycle, DQ6 will toggle from "0" to "1" and "1" to "0" (the first read value is "0") on subsequent attempts to read any address in the memory. When the internal cycle is completed the toggling will stop and the device will be accessible for a new Read or Write operation.

Page Load Timer Status bit (DQ5). In the Page Write mode data may be latched by E or W up to 100µs after the previous byte. Up to 32 bytes may be input. The Data output (DQ5) indicates the status of the internal Page Load Timer. DQ5 may be read by asserting Output Enable Low (t_{PLTS}). DQ5 Low indicates the timer is running, High indicates time-out after which the write cycle will start and no new data may be input.

Ready/Busy pin. The RB pin provides a signal at its open drain output which is low during the erase/write cycle, but which is released at the completion of the programming cycle.

AC MEASUREMENT CONDITIONS

Input Rise and Fall Times	≤ 20ns
Input Pulse Voltages	0.4V to 2.4V
Input and Output Timing Ref. Voltages	0.8V to 2.0V

Note that Output Hi-Z is defined as the point where data is no longer driven.

Figure 5. AC Testing Input Output Waveforms

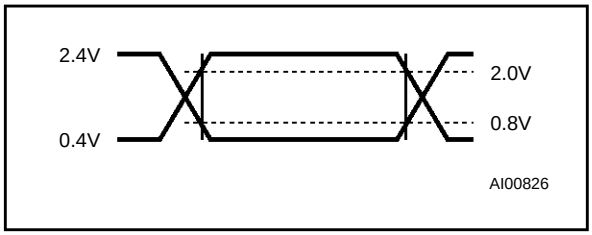


Figure 6. AC Testing Equivalent Load Circuit

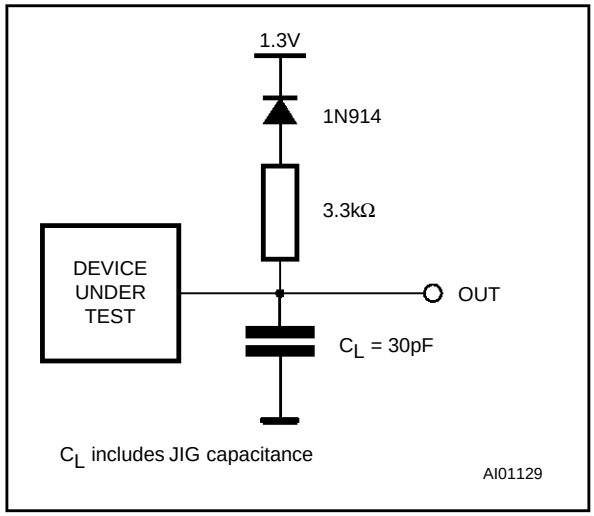


Table 4. Capacitance (1) (T_A = 25 °C, f = 1 MHz)

Symbol	Parameter	Test Condition	Min	Max	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V		6	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V		12	pF

Note: 1. Sampled only, not 100% tested.

Table 5. Read Mode DC Characteristics (T_A = 0 to 70°C or –40 to 85°C, V_{CC} = 4.5V to 5.5V)

Symbol	Parameter	Test Condition	Min	Max	Unit
I_{LI}	Input Leakage Current	0V ≤ V_{IN} ≤ V_{CC}		10	µA
I_{LO}	Output Leakage Current	0V ≤ V_{IN} ≤ V_{CC}		10	µA
I_{CC} (1)	Supply Current (TTL and CMOS inputs)	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL} , f = 5 MHz		30	mA
I_{CC1} (1)	Supply Current (Standby) TTL	$\overline{E}$ = V_{IH}		2	mA
I_{CC2} (1)	Supply Current (Standby) CMOS	$\overline{E}$ > V_{CC} –0.3V		100	µA
V_{IL}	Input Low Voltage		– 0.3	0.8	V
V_{IH}	Input High Voltage		2	V_{CC} +0.5	V
V_{OL}	Output Low Voltage	I_{OL} = 2.1 mA		0.4	V
V_{OH}	Output High Voltage	I_{OH} = –400 µA	2.4		V

Note: 1. All I/O's open circuit.

Table 6. Power Up Timing (1) (T_A = 0 to 70°C or –40 to 85°C, V_{CC} = 4.5V to 5.5V)

Symbol	Parameter	Min	Max	Unit
t_{PUR}	Time Delay to Read Operation	1		µs
t_{PUW}	Time Delay to Write Operation	10		ms

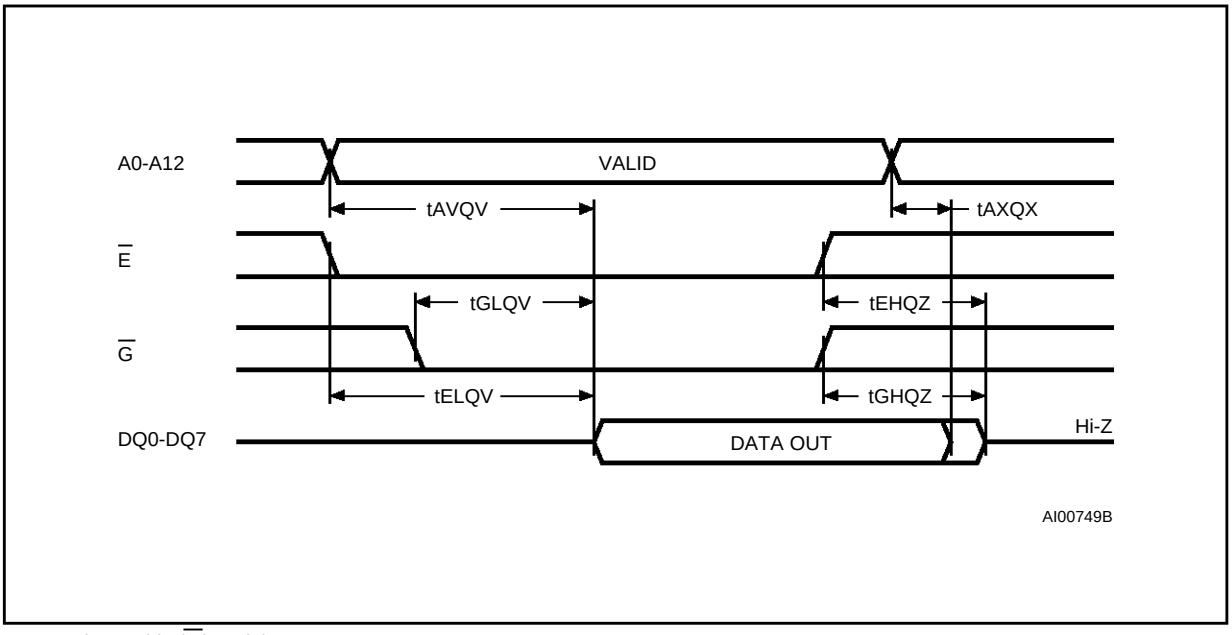
Note: 1. Sampled only, not 100% tested.

Table 7. Read Mode AC Characteristics
(T_A = 0 to 70°C or –40 to 85°C, V_{CC} = 4.5V to 5.5V)

Symbol	Alt	Parameter	Test Condition	M28C64C						Unit
				-150		-200		-250		
				min	max	min	max	min	max	
t_{AVQV}	t_{ACC}	Address Valid to Output Valid	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL}		150		200		250	ns
t_{ELQV}	t_{CE}	Chip Enable Low to Output Valid	G = V_{IL}		150		200		250	ns
t_{GLQV}	t_{OE}	Output Enable Low to Output Valid	$\overline{E}$ = V_{IL}		75		100		110	ns
t_{EHQZ} (1)	t_{DF}	Chip Enable High to Output Hi-Z	$\overline{G}$ = V_{IL}	0	50	0	60	0	65	ns
t_{GHQZ} (1)	t_{DF}	Output Enable High to Output Hi-Z	$\overline{E}$ = V_{IL}	0	50	0	60	0	65	ns
t_{AXQX}	t_{OH}	Address Transition to Output Transition	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL}	0		0		0		ns

Note: 1. Output Hi-Z is defined as the point at which data is no longer driven.

Figure 7. Read Mode AC Waveforms



Note: Write Enable ($\overline{W}$) = High

Table 8. Write Mode AC Characteristics
(T_A = 0 to 70°C or –40 to 85°C, V_{CC} = 4.5V to 5.5V)

Symbol	Alt	Parameter	Test Condition	Min	Max	Unit
t_{AVWL}	t_{AS}	Address Valid to Write Enable Low	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IH}	0		ns
t_{AVEL}	t_{AS}	Address Valid to Chip Enable Low	$\overline{G}$ = V_{IH}, $\overline{W}$ = V_{IL}	0		ns
t_{ELWL}	t_{CES}	Chip Enable Low to Write Enable Low	$\overline{G}$ = V_{IH}	0		ns
t_{GHWL}	t_{OES}	Output Enable High to Write Enable Low	$\overline{E}$ = V_{IL}	0		ns
t_{GHEL}	t_{OES}	Output Enable High to Chip Enable Low	$\overline{W}$ = V_{IL}	0		ns
t_{WLEL}	t_{WES}	Write Enable Low to Chip Enable Low	$\overline{G}$ = V_{IH}	0		ns
t_{WLAX}	t_{AH}	Write Enable Low to Address Transition		150		ns
t_{ELAX}	t_{AH}	Chip Enable Low to Address Transition		150		ns
t_{WLDV}	t_{DV}	Write Enable Low to Input Valid	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IH}		1	µs
t_{ELDV}	t_{DV}	Chip Enable Low to Input Valid	$\overline{G}$ = V_{IH}, $\overline{W}$ = V_{IL}		1	µs
t_{WLWH}	t_{WP}	Write Enable Low to Write Enable High		150		ns
t_{ELEH}	t_{WP}	Chip Enable Low to Chip Enable High		150		ns
t_{WHEH}	t_{CEH}	Write Enable High to Chip Enable High		0		ns
t_{WHGL}	t_{OEH}	Write Enable High to Output Enable Low		10		ns
t_{EHGL}	t_{OEH}	Chip Enable High to Output Enable Low		10		ns
t_{EHWH}	t_{WEH}	Chip Enable High to Write Enable High		0		ns
t_{WHDX}	t_{DH}	Write Enable High to Input Transition		0		ns
t_{EHDX}	t_{DH}	Chip Enable High to Input Transition		0		ns
t_{WHWL}	t_{WPH}	Write Enable High to Write Enable Low		200		ns
t_{WHWH}	t_{BLC}	Byte Load Repeat Cycle Time		0.35	50	µs
t_{WHRH}	t_{WC}	Write Cycle Time			5	ms
t_{WHRL}	t_{DB}	Write Enable High to Ready/Busy Low	Note 1		220	ns
t_{EHRL}	t_{DB}	Chip Enable High to Ready/Busy Low	Note 1		220	ns
t_{DVWH}	t_{DS}	Data Valid before Write Enable High		50		ns
t_{DVEH}	t_{DS}	Data Valid before Chip Enable High		50		ns

Note: 1. With a 3.3 kΩ external pull-up resistor.

Figure 8. Write Mode AC Waveforms - Write Enable Controlled

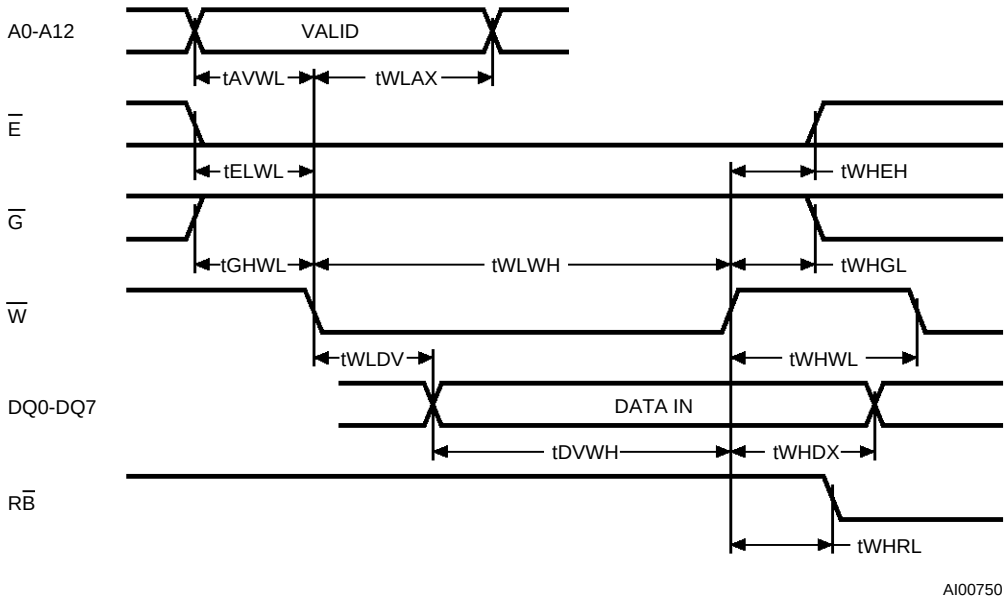


Figure 9. Write Mode AC Waveforms - Chip Enable Controlled

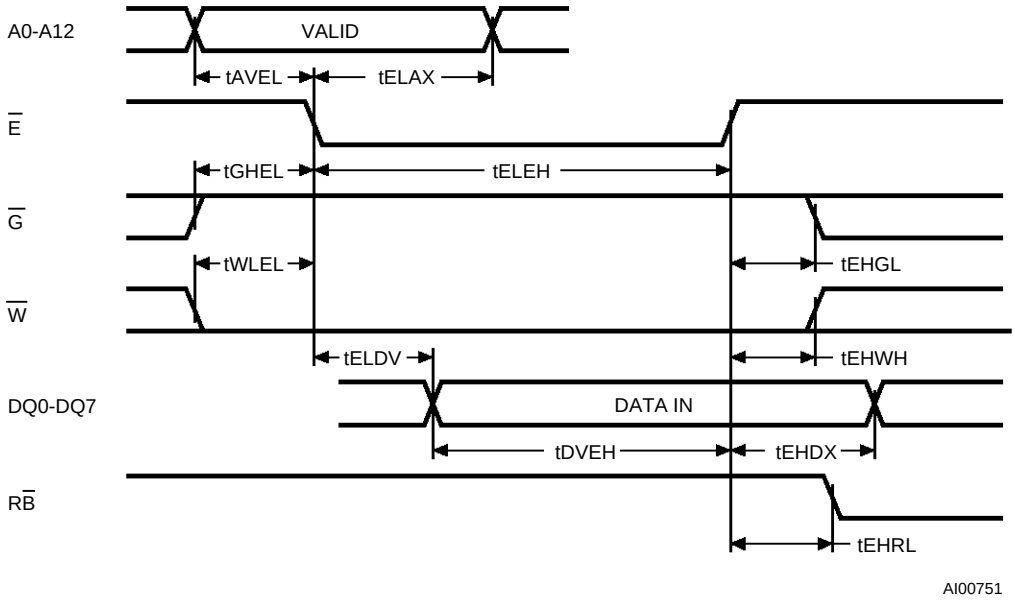


Figure 10. Page Write Mode AC Waveforms - Write Enable Controlled

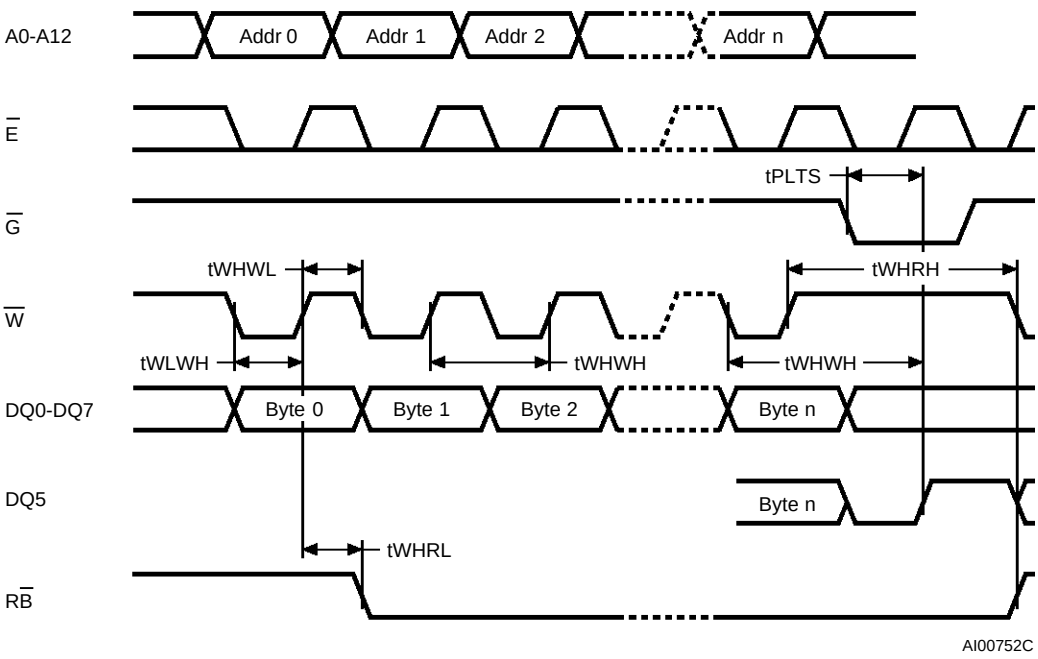


Figure 11. Data Polling Waveform Sequence

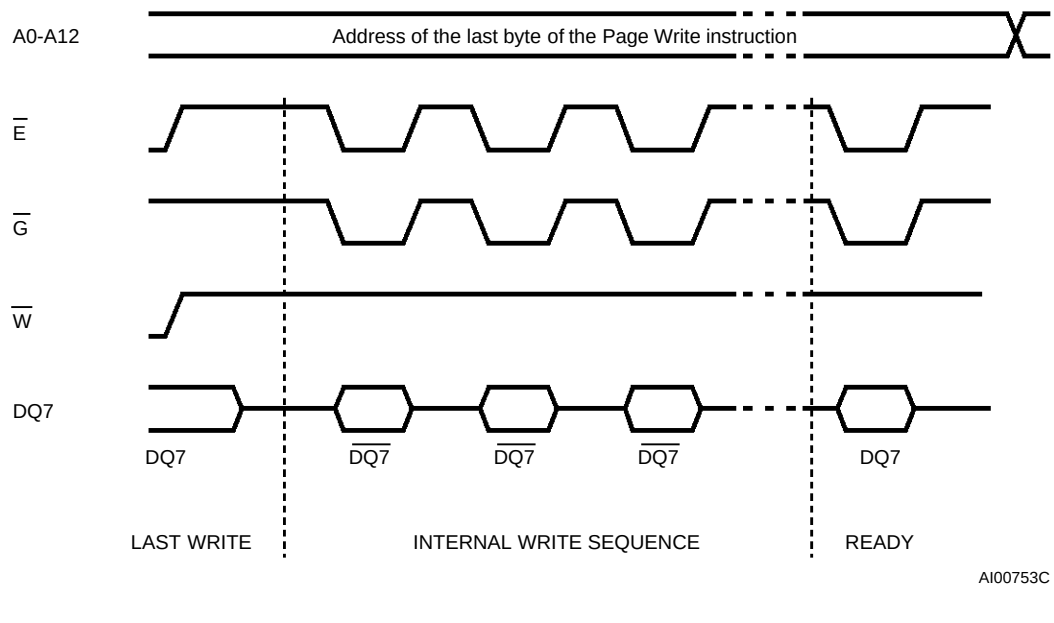
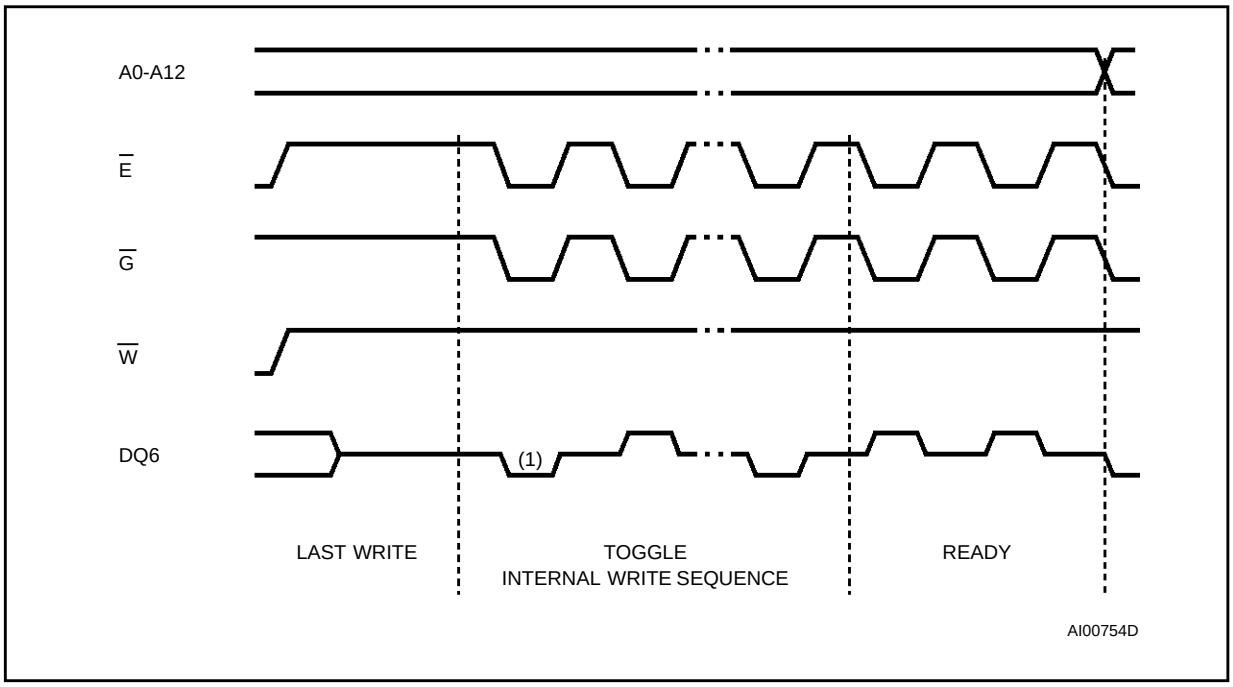


Figure 12. Toggle Bit Waveform Sequence



Note: 1. First Toggle bit is forced to '0'

ORDERING INFORMATION SCHEME

Example: M28C64C -150 K 1

Version	Speed		Package	Temperature Range
C RB available	-150	150 ns	P PDIP28	1 0 to 70 °C
X RB not bonded (pin NC)	-200	200 ns	K PLCC32	6 –40 to 85 °C
	-250	250 ns	MS SO28 300 mils	
			N TSOP28 8 x 13.4mm	

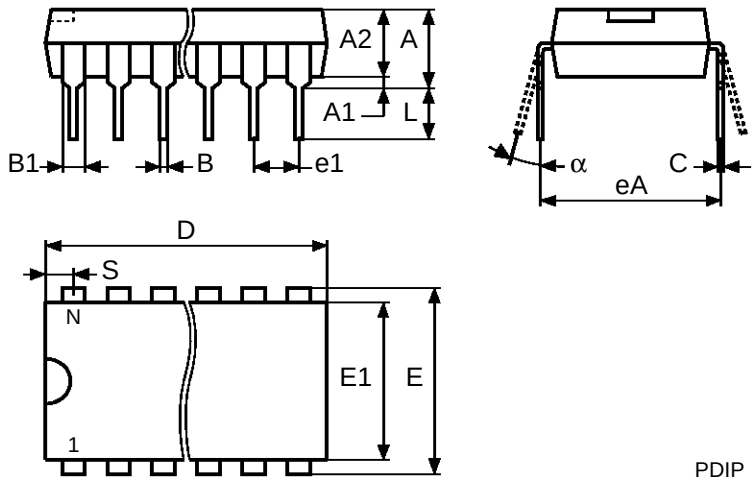
For a list of available options (Speed, Package, Temperature Range, etc...) refer to the current Memory Shortform catalogue.

For further information on any aspect of this device, please contact the SGS-THOMSON Sales Office nearest to you.

PDIP28 - 28 pin Plastic DIP, 600 mils width

Symb	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A		3.94	5.08		0.155	0.200
A1		0.38	1.78		0.015	0.070
A2		3.56	4.06		0.140	0.160
B		0.38	0.56		0.015	0.021
B1		1.14	1.78		0.045	0.070
C		0.20	0.30		0.008	0.012
D		34.70	37.34		1.366	1.470
E		14.80	16.26		0.583	0.640
E1		12.50	13.97		0.492	0.550
e1	2.54	–	–	0.100	–	–
eA		15.20	17.78		0.598	0.700
L		3.05	3.82		0.120	0.150
S		1.02	2.29		0.040	0.090
α		0°	15°		0°	15°
N	28			28		

PDIP28



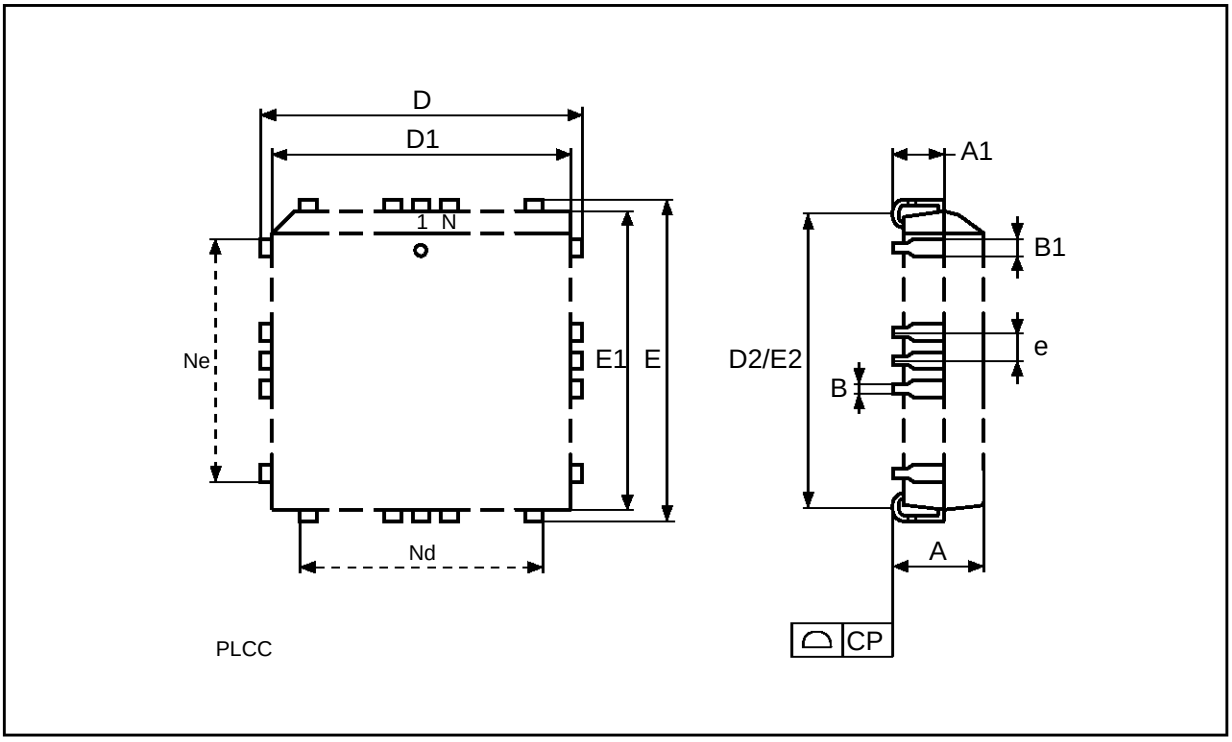
PDIP

Drawing is not to scale

PLCC32 - 32 lead Plastic Leaded Chip Carrier, rectangular

Symb	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A		2.54	3.56		0.100	0.140
A1		1.52	2.41		0.060	0.095
B		0.33	0.53		0.013	0.021
B1		0.66	0.81		0.026	0.032
D		12.32	12.57		0.485	0.495
D1		11.35	11.56		0.447	0.455
D2		9.91	10.92		0.390	0.430
E		14.86	15.11		0.585	0.595
E1		13.89	14.10		0.547	0.555
E2		12.45	13.46		0.490	0.530
e	1.27	–	–	0.050	–	–
N	32			32		
Nd	7			7		
Ne	9			9		
CP			0.10			0.004

PLCC32

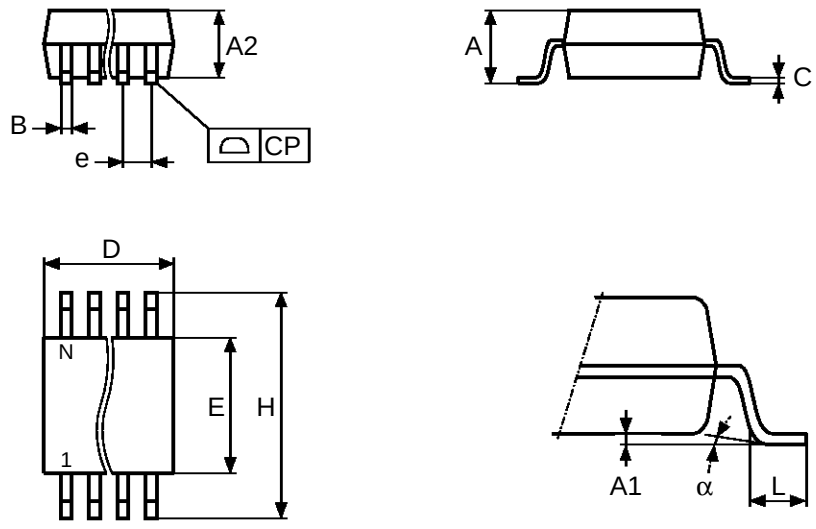


Drawing is not to scale

SO28 - 28 lead Plastic Small Outline, 300 mils body width

Symb	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A		2.46	2.64		0.097	0.104
A1		0.13	0.29		0.005	0.011
A2		2.29	2.39		0.090	0.094
B		0.35	0.48		0.014	0.019
C		0.23	0.32		0.009	0.013
D		17.81	18.06		0.701	0.711
E		7.42	7.59		0.292	0.299
e	1.27	–	–	0.050	–	–
H		10.16	10.41		0.400	0.410
L		0.61	1.02		0.024	0.040
α		0°	8°		0°	8°
N	28			28		
CP			0.10			0.004

SO28



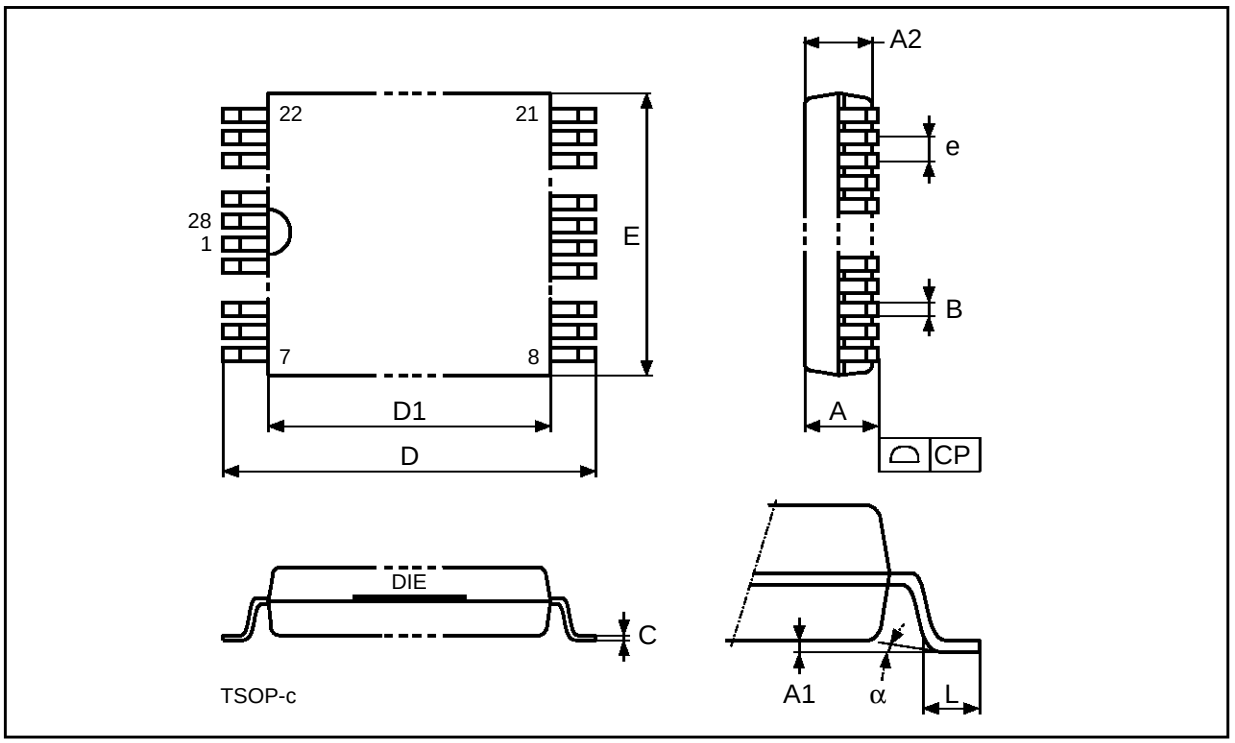
SO-b

Drawing is not to scale

TSOP28 - 28 lead Plastic Thin Small Outline, 8 x 13.4mm

Symb	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A			1.25			0.049
A1			0.20			0.008
A2		0.95	1.15		0.037	0.045
B		0.17	0.27		0.007	0.011
C		0.10	0.21		0.004	0.008
D		13.20	13.60		0.520	0.535
D1		11.70	11.90		0.461	0.469
E		7.90	8.10		0.311	0.319
e	0.55	–	–	0.022	–	–
L		0.50	0.70		0.020	0.028
α		0°	5°		0°	5°
N	28			28		
CP			0.10			0.004

TSOP28



Drawing is not to scale