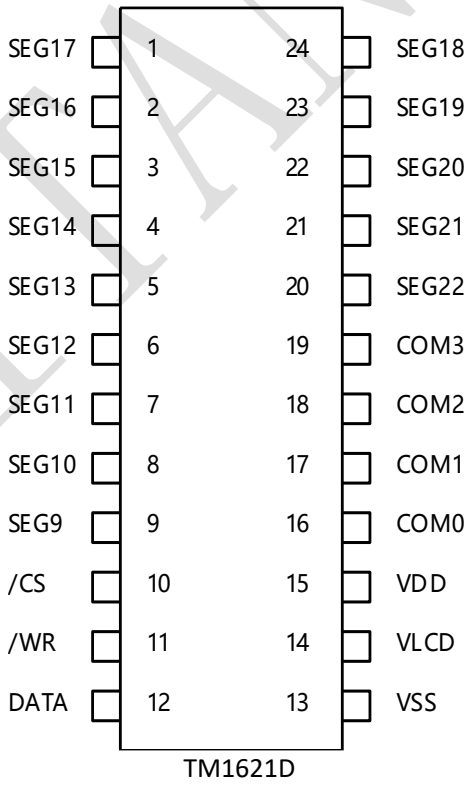
Characteristic Description

TM1621D is a 56-point, memory-mapped and multifunctional LCD driver. The software configuration features of TM1621D make it suitable for many LCD applications, including LCD modules and display subsystems. Communication timing between the main controller and TM1621D is simple, and TM1621D also has a power saving command to reduce system power consumption.

Functional Characteristics

- The working voltage is 2.4~ 5.2V
- Embedded 256KHz RC oscillator
- 1/2 or 1/3 bias and 1/2, 1/3 or 1/4 duty cycle can be selected
- On-chip time base frequency source
- Power saving commands can be used to reduce power consumption
- A 14x4 LCD driver
- An embedded 14x4 bit display RAM memory
- Three-wire serial interface
- On-chip LCD driving frequency source
- Software configuration features
- Data mode and command mode instructions
- Two data access modes
- The VLCD pin is provided for adjusting the LCD operating voltage
- Package form: SOP24.QSOP24

Pin Information



TM1621D

Pin Description

Pin number	Pin name	I/O	Function description
10	/CS	I	Chip select input connected with a pull-up resistor. When /CS is at high level, the data and command for writing TM1621D are invalid, and the serial interface circuit is reset. When /CS is low and used as input, the data and command for writing TM1621D are valid
11	/WR	I	WRITE pulse input, connected with a pull-up resistor. At the rising edge of the /WR signal, the DATA on the data line is written to TM1621D.
12	DATA	I/O	Serial data input/output with external pull-up resistor
13	VSS	I	Negative power supply, ground
14	VLCD	I	LCD power input
15	VDD	I	Positive power supply
16~19	COM0~COM3	O	LCD common output port
1~9 20~24	SEG9~SEG22	O	LCD segment output port

In the dry season or dry environment, it is easy to produce a large amount of static electricity, and electrostatic discharge may damage the integrated circuit. TitanMicro Electronics recommends taking all appropriate preventive measures for the integrated circuit. Improper operation and welding may cause ESD damage or performance degradation, and the chip cannot work normally.

Absolute Maximum Rating Range

Parameter		Range	Unit
VDD	Logic supply voltage	VSS-0.3~VSS+5.5	V
VIN	Logic input voltage	VSS-0.3~VDD+0.3	V
Topr	operating temperature range	-25~+75	℃
Tstg	Storage temperature range	-50~+120	℃
ESD	Human body mode (HBM)	4000	V
	Machine mode (MM)	400	V

DC Electrical Parameters

Symbol	Describe	Test condition		Minimum value	Typical value	Maximum value	Unit
		V_{DD}	Condition				
VDD	Working voltage			2.4		5.2	V
IDD	Working current	3V	Without load On-chip RC oscillator		150	300	uA
		5V			300	600	uA
IDD	Working current	3V	Crystal oscillator without load		60	120	uA
		5V			120	240	uA
IDD	Working current	3V	Without load External clock source		100	200	uA
		5V			200	400	uA
ISTB	Standby current	3V	Without load Power saving mode		0.1	5	uA
		5V			0.3	10	uA
VIL	Input low	3V	DATA,/WR,	0		0.6	V

	level voltage	5V	/CS	0		1.0	V
VIH	Input high level voltage	3V	DATA,/WR, /CS	2.4		3.0	V
		5V		4.0		5.0	V
IOL1	DATA	3V	VOL=0.3V	0.5	1.2		mA
		5V	VOL=0.5V	1.3	2.6		mA
IOH1	DATA	3V	VOH=2.7V	-0.4	-0.8		mA
		5V	VOH =4.5V	-0.9	-1.8		mA
IOL2	Leakage current of LCD common port	3V	VOL=0.3V	80	150		uA
		5V	VOL=0.5V	150	250		uA
IOH2	Common port source current of LCD	3V	VOH=2.7V	-80	-120		uA
		5V	VOH=4.5V	-120	-200		uA
IOL3	Leakage current of LCD segment pin	3V	VOL=0.3V	60	120		uA
		5V	VOL=0.5V	120	200		uA
IOH3	Source current of LCD segment pin	3V	VOH=2.7V	-40	-70		uA
		5V	VOH=4.5V	-70	-100		uA
RPH	Pull up resistor	3V	DATA,/WR, /CS	40	80	150	Kohm
		5V		30	60	100	Kohm

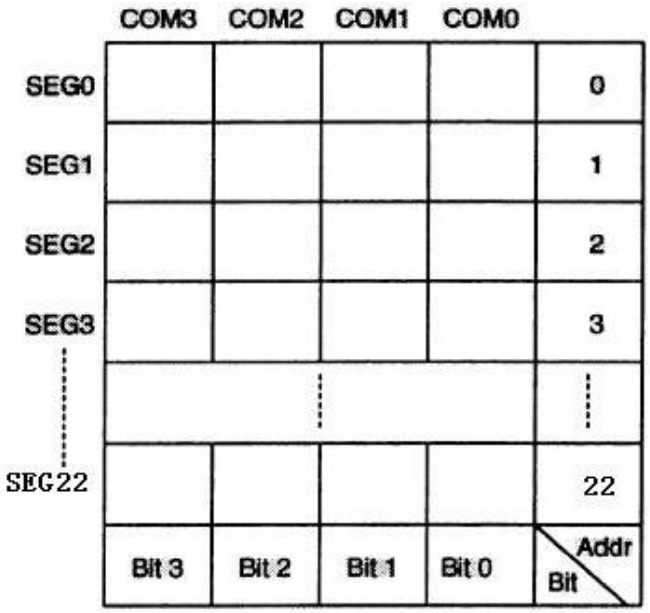
Ac Electrical Characteristics

Symbol	Describe	Test condition		Minimum value	Typical value	Maximum value	Unit
		V_{DD}	Condition				
fSYS1	System clock	3V	On-chip RC oscillator		256		KHz
		5V			256		KHz
fSYS2	System clock	3V	Crystal oscillator		32.768		KHz
		5V			32.768		KHz
fSYS3	System clock	3V	External clock source		256		KHz
		5V			256		KHz
fLCD	LCD clock		On-chip RC oscillator		fSYS1/1024		Hz
			Crystal oscillator		fSYS2 /128		Hz
tCOM	COM clock cycle		n: Number of COM		n/ fLCD		s
fCLK	Serial data clock	3V				300	KHz
		5V				500	KHz
tDD	Output delay time of DATA pin	3V				2	u s
		5V				1	us

System Structure

1. Display Memory (RAM)

Static display memory (RAM) stores the displayed data in the format of 23x4 bits, but only the display memory corresponding to SEG9~SEG22 is useful. The RAM data is directly mapped to the LCD driver.



RAM map

2. System Oscillator

TM1621D system clock is used to generate LCD driving clock. On-chip RC oscillator (256KHz) generates clock source. Executing SYS DIS command can stop the system clock and LCD bias generator from working. SYS DIS command is only applicable to on-chip RC oscillator. When the system clock stops working, LCD will display blank. The LCD OFF command is used to turn off the LCD bias generator. When the LCD bias generator is turned off, the SYS DIS command can be used to reduce the power consumption of the system. At this time, SYS DIS is a power saving command. TM1621D is in SYS DIS state when the system starts to power up.

3. LCD Driver

TM1621D is a 56(14x4) LCD driver, which can be configured with 1/2 or 1/3 LCD driver bias and 2, 3 or 4 common ports by software. This feature makes TM1621D suitable for various LCD applications occasions. The LCD driving clock is generated by frequency division of the system clock, and the frequency value of the LCD driving clock is kept at 256Hz. See the following table for commands related to LCD driver.

Name	Command code	Function description
LCD OFF	**100**00000010X	Turn off LCD output
LCD ON	**100**00000011X	Turn on LCD output
BIAS&COM	**100**0010abXcX	c=0: 1/2 bias can be selected c=1: 1/3 bias can be selected ab=00: 2 public ports can be selected ab=01: 3 public ports can be selected ab=10: 4 public ports can be selected

Bold 100 is "**100**", indicating the command mode type. If successive commands are executed, the pattern type codes of other commands except the first command will be ignored. The LCD OFF command disables the LCD bias generator, thus turning off the LCD display. The LCD ON command enables the LCD bias generator to turn on the LCD display. BIAS&COM is a command related to LCD module, which can make TM1621D compatible with most LCD modules.

4. Command Format

TM1621D can be set by software. Two modes of commands can configure TM1621D and transmit data displayed by LCD. The configuration mode of TM1621D is called command mode, and the type code is 100. Command modes include a system configuration command, a system frequency selection command, an LCD configuration command and an operation command. The following table is the data and command mode type code table.

Operation	Mode	Type code
WRITE	Data	101
COMMAND	Command	100

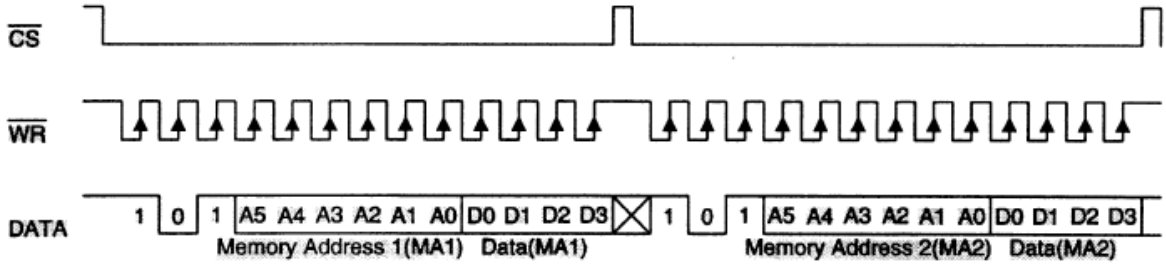
The mode command should be run before data or command transmission. If continuous commands are executed, the command mode code is **100**, which will be ignored. When the system is in discontinuous command mode or discontinuous address data mode, pin /CS should be set to "1", and the previous operation mode will be reset. When pin /CS returns "0", the new operation mode type code should be run first.

5. Interface

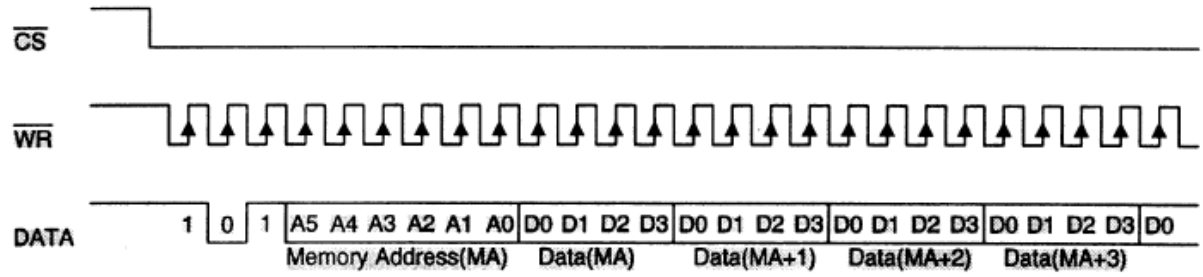
TM1621D has only three pins for interface. Pin /CS is used to initialize the serial interface circuit and end the communication between the main controller and TM1621D. When pin /CS is set to "1", the data and commands between the main controller and TM1621D are invalid and initialized. Before generating mode command or mode conversion, the serial interface of TM1621D must be initialized with a high level pulse. Pin DATA is a serial DATA input/output pin, and reading/writing data and writing commands are performed through pin data. The pin /WR is the write clock input pin, and the DATA, address and command on the pin data are written into TM1621D at the rising edge of the /WR signal.

6. Timing Diagram

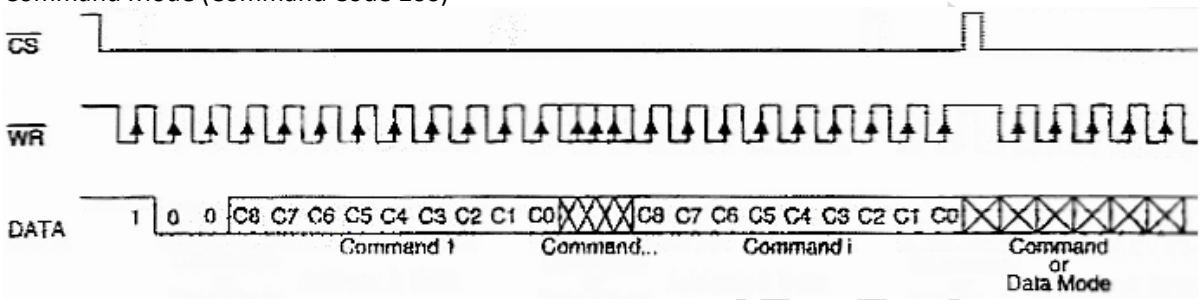
WRITE Mode (Command Code **101**)



WRITE Mode (Write Continuous Address)



Command Mode (Command Code **100**)



Command Overview

Command name	Command code	D/C	Function description	Reset the default at power-on
WRITE	**101** a5a4a3a2a1a0d0d1d2d3	D	Write data to RAM	
SYS DIS	**100**00000000X	C	Turn off the system oscillator and LCD bias generator	Y
SYS EN	**100**00000001X	C	Turn on the system oscillator	
LCD OFF	**100**00000010X	C	Turn off the LCD bias generator	Y
LCD ON	**100**00000011X	C	Turn on the LCD bias generator	
XTAL 32K	**100**000101XXX	C	System clock source crystal oscillator	
RC 256K	**100**000110XXX	C	System clock source on-chip RC oscillator	Y
BIAS1/2	**100**0010abX0X	C	LCD 1/2 bias option ab=00:2 public ports ab=01:3 public ports ab=10:4 public ports	
BIAS 1/3	**100**0010abX1X	C	LCD 1/3 bias option ab=00:2 public ports ab=01:3 public ports ab=10:4 public ports	
TOPT	**100**11100000X	C	Test mode	
TNORMAL	**100**11100011X	C	Normal mode	Y

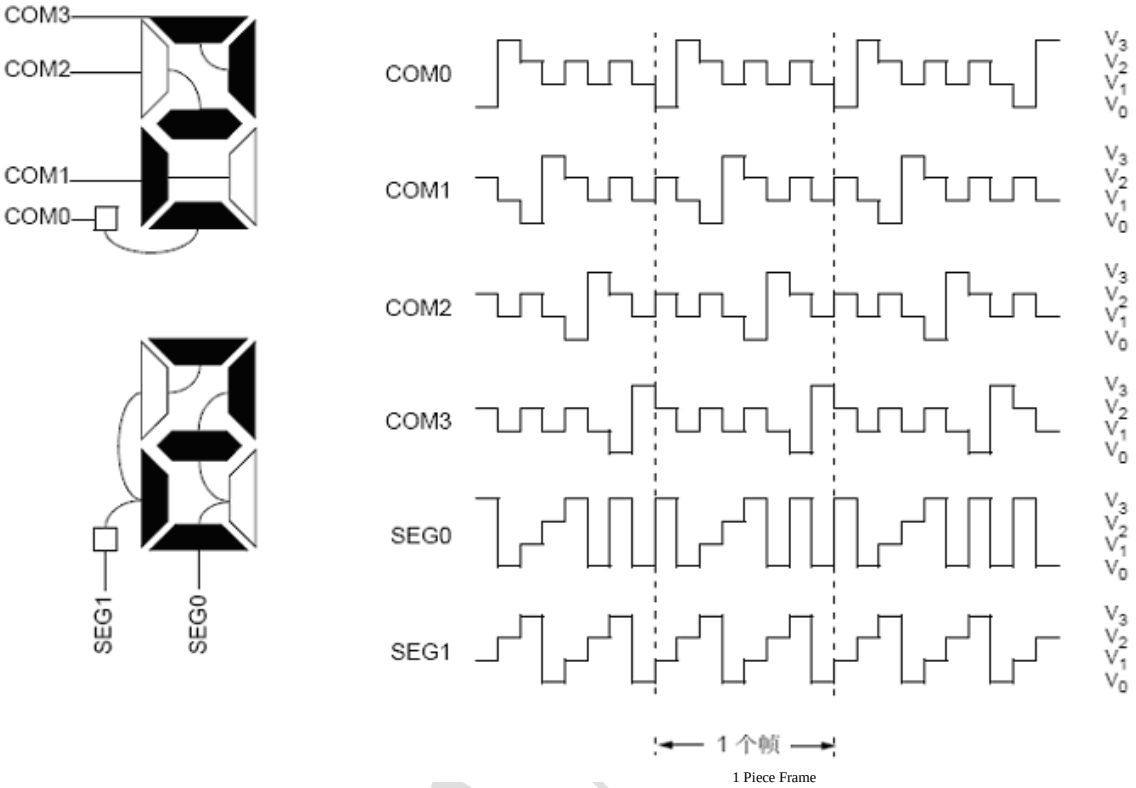
Note: X: 0 or 1; A5 ~ A0: RAM address; D3 ~ d0: RAM data

D/C data/Command Mode

All bold numbers, namely 101 and 100, are mode command codes. 100 is the command mode type code. If continuous commands are run, the mode type codes of other commands will be ignored except the first command. It is recommended to initialize TM1621D with the main controller after power-on reset, because if power-on reset fails, TM1621D will not work normally.

Pin Drive Waveform

Give the waveform of "2" driven by 1/4 multiplexing and 1/3 bias voltage:



V3=VDD (VDD is the LCD supply voltage)

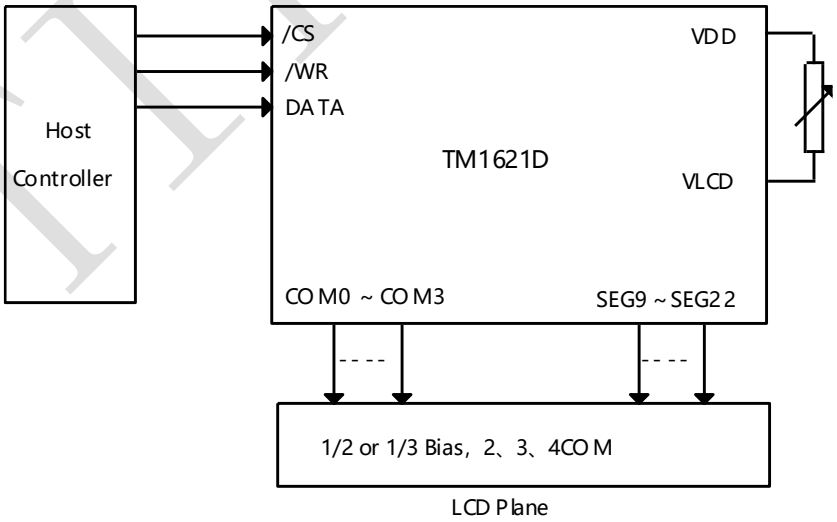
V2=2/3VDD

V1=1/3VDD

V0=0

Peripheral Application Block Diagram

The main controller and TM1621D form a display system, as shown in the following figure.

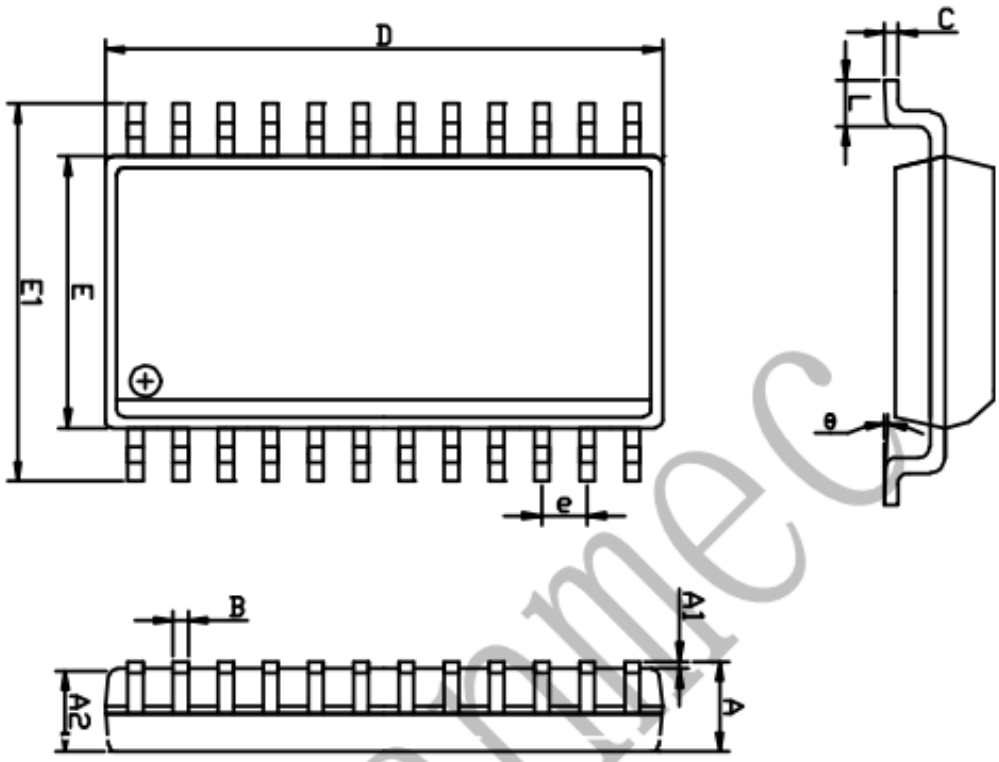


Note: 1. The voltage of VLCD pin must be smaller than that of VDD pin.

2. The VR resistor is used to adjust the display gray scale of LCD screen. When VDD=5V and VLCD=4V, VR is generally 15KΩ (±20%).

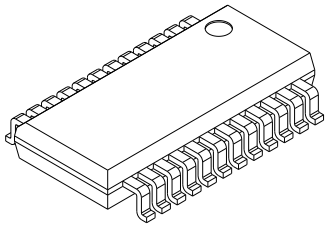
Package Outline Drawing

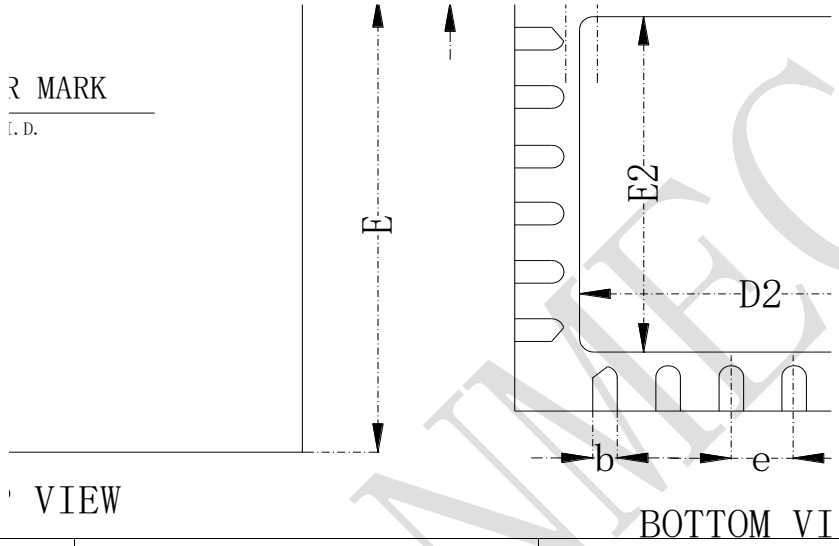
SOP24



Symbol	Dimensions In Millimenters		Dimensions In Inches	
	Min	Max	Min	Max
A	2.280	2.630	0.090	0.104
A1	0.100	0.300	0.004	0.012
A2	2.180	2.330	0.086	0.092
B	0.350	0.510	0.014	0.020
C	0.204	0.360	0.008	0.014
D	15.200	15.600	0.598	0.614
E	7.400	7.600	0.291	0.299
E1	10.000	10.650	0.394	0.419
e	1.270(TYP)		0.050(TYP)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

QSOP24





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.50	1.80	0.059	0.070
A1	0.102	0.249	0.004	0.009
A2	1.40	1.55	0.055	0.061
b	0.2	0.3	0.007	0.011
c	0.2TYP		0.007TYP	
D	8.585	8.738	0.337	0.344
E	3.86	3.998	0.151	0.157
E1	5.842	6.198	0.23	0.244
e	0.635TYP		0.025TYP	
L	0.406	0.889	0.015	0.035
θ	4° TYP		4° TYP	