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Micron Serial NOR Flash Memory

1.8V, Multiple I/O, 4KB, 32KB, 64KB, Sector Erase

MT25QU128ABA

Features

- SPI-compatible serial bus interface
- Single and double transfer rate (STR/DTR)
- Clock frequency
 - 166 MHz (MAX) for all protocols in STR
 - 90 MHz (MAX) for all protocols in DTR
- Dual/quad I/O commands for increased throughput up to 90 MB/s
- Supported protocols in both STR and DTR
 - Extended I/O protocol
 - Dual I/O protocol
 - Quad I/O protocol
- Execute-in-place (XIP)
- PROGRAM/ERASE SUSPEND operations
- Volatile and nonvolatile configuration settings
- Software reset
- Additional reset pin for selected part numbers
- Dedicated 64-byte OTP area outside main memory
 - Readable and user-lockable
 - Permanent lock with PROGRAM OTP command
- Erase capability
 - Bulk erase
 - Sector erase 64KB uniform granularity
 - Subsector erase 4KB, 32KB granularity
- Security and write protection
 - Volatile and nonvolatile locking and software write protection for each 64KB sector
 - Nonvolatile configuration locking
 - Password protection
 - Hardware write protection: nonvolatile bits (BP[3:0] and TB) define protected area size
 - Program/erase protection during power-up
 - CRC detects accidental changes to raw data
- Electronic signature
 - JEDEC-standard 3-byte signature (BA18h)
 - Extended device ID: two additional bytes identify device factory options
- JESD47H-compliant
 - Minimum 100,000 ERASE cycles per sector
 - Data retention: 20 years (TYP)

Options

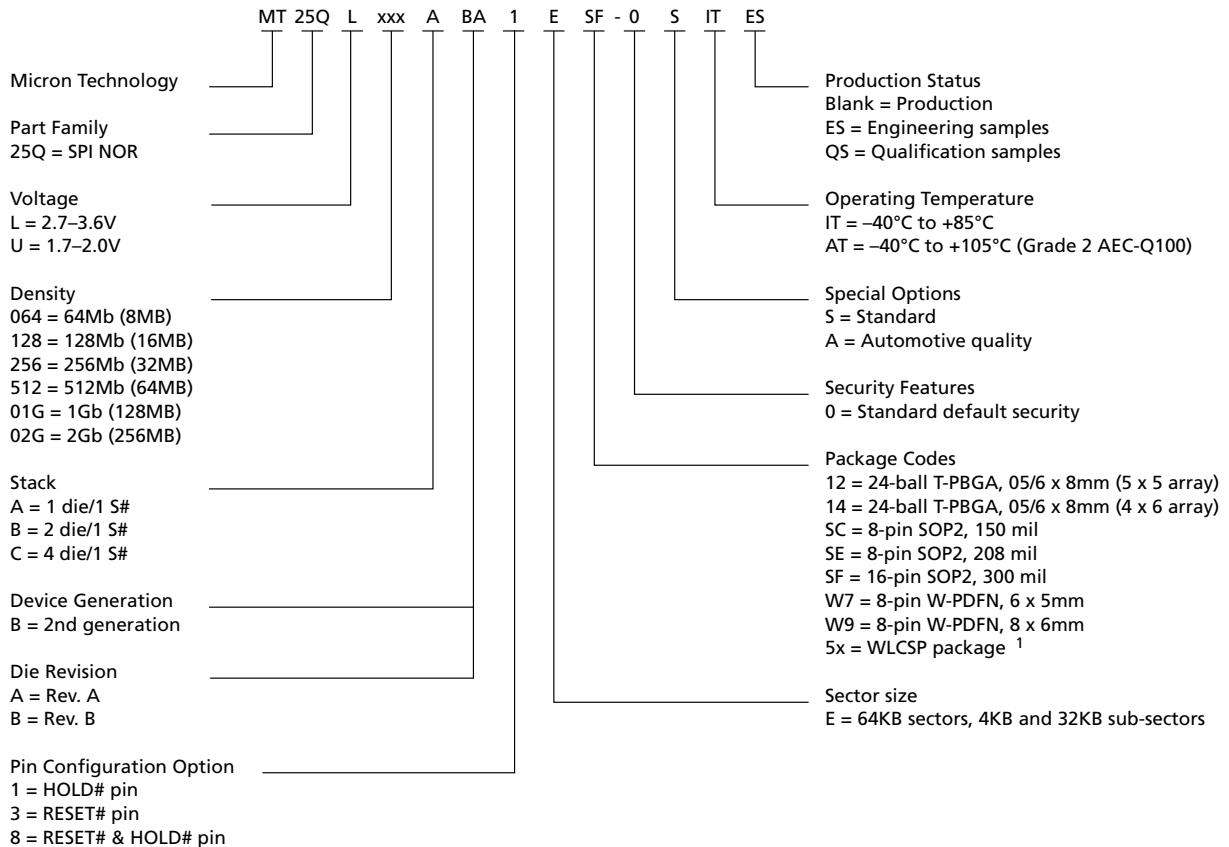
- Voltage
 - 1.7–2.0V
- Density
 - 128Mb
- Device stacking
 - Monolithic
- Device generation
- Die revision
- Pin configuration
 - RESET# and HOLD#
- Sector Size
 - 64KB
- Packages – JEDEC-standard, RoHS-compliant
 - 24-ball T-PBGA, 05/6mm x 8mm (5 x 5 array) 12
 - 24-ball T-PBGA 05/6mm x 8mm (4 x 6 array) 14
 - Wafer level chip-scale package, 15 balls, 9 active balls (XFWLBGA 0.5P) 54
 - 8-pin SOP2, 208 mils body width (SO8W) SE
 - 16-pin SOP2, 300 mils body width (SO16W) SF
 - W-PDFN-8 6mm x 5mm (MLP8 6mm x 5mm) W7
 - W-PDFN-8 8mm x 6mm (MLP8 8mm x 6mm) W9
- Standard security 0
- Special options
 - Standard S
 - Automotive A
- Operating temperature range
 - From –40°C to +85°C IT
 - From –40°C to +105°C AT

Marking

Part Number Ordering

Micron Serial NOR Flash devices are available in different configurations and densities. Verify valid part numbers by using Micron's part catalog search at www.micron.com. To compare features and specifications by device type, visit www.micron.com/products. Contact the factory for devices not found.

Figure 1: Part Number Ordering Information



Note: 1. WLCSP package codes, package size, and availability are density-specific. Contact the factory for availability.



Contents

Device Description	8
Device Logic Diagram	9
Advanced Security Protection	9
Signal Assignments – Package Code: 12	10
Signal Assignments – Package Code: 14	11
Signal Assignments – Package Code: SE, W7, W9	12
Signal Assignments – Package Code: SF	12
Signal Descriptions	13
Package Dimensions – Package Code: 12	14
Package Dimensions – Package Code: 14	15
Package Dimensions – Package Code: SE	16
Package Dimensions – Package Code: SF	17
Package Dimensions – Package Code: W7	18
Package Dimensions – Package Code: W9	19
Memory Map – 128Mb Density	20
Status Register	21
Block Protection Settings	22
Flag Status Register	23
Internal Configuration Register	24
Nonvolatile Configuration Register	25
Volatile Configuration Register	26
Supported Clock Frequencies	27
Enhanced Volatile Configuration Register	29
Security Registers	30
Sector Protection Security Register	31
Nonvolatile and Volatile Sector Lock Bits Security	32
Volatile Lock Bit Security Register	32
Device ID Data	33
Serial Flash Discovery Parameter Data	34
Command Definitions	35
Software RESET Operations	40
RESET ENABLE and RESET MEMORY Commands	40
READ ID Operations	41
READ ID and MULTIPLE I/O READ ID Commands	41
READ SERIAL FLASH DISCOVERY PARAMETER Operation	42
READ SERIAL FLASH DISCOVERY PARAMETER Command	42
READ MEMORY Operations	43
READ MEMORY Operations Timings	43
WRITE ENABLE/DISABLE Operations	50
READ REGISTER Operations	51
WRITE REGISTER Operations	52
CLEAR FLAG STATUS REGISTER Operation	54
PROGRAM Operations	55
PROGRAM Operations Timings	56
ERASE Operations	59
SUSPEND/RESUME Operations	61
PROGRAM/ERASE SUSPEND Operations	61
PROGRAM/ERASE RESUME Operations	61
ONE-TIME PROGRAMMABLE Operations	63
READ OTP ARRAY Command	63



128Mb, 1.8V Multiple I/O Serial Flash Memory Features

PROGRAM OTP ARRAY Command	63
QUAD PROTOCOL Operations	64
ENTER or RESET QUAD INPUT/OUTPUT MODE Command	64
CYCLIC REDUNDANCY CHECK Operations	66
State Table	68
XIP Mode	69
Activate or Terminate XIP Using Volatile Configuration Register	69
Activate or Terminate XIP Using Nonvolatile Configuration Register	69
Confirmation Bit Settings Required to Activate or Terminate XIP	70
Terminating XIP After a Controller and Memory Reset	70
Power-Up and Power-Down	71
Power-Up and Power-Down Requirements	71
Power Loss and Interface Rescue	73
Recovery	73
Power Loss Recovery	73
Interface Rescue	73
Initial Delivery Status	74
Absolute Ratings and Operating Conditions	75
DC Characteristics and Operating Conditions	77
AC Characteristics and Operating Conditions	79
AC Reset Specifications	81
Program/Erase Specifications	84
Revision History	85
Rev. H - 07/16	85
Rev. G - 06/16	85
Rev. F - 12/15	85
Rev. E - 10/15	85
Rev. D - 9/15	85
Rev. C - 7/15	85
Rev. B - 7/14	86
Rev. A - 3/14	86

List of Figures

Figure 1: Part Number Ordering Information	2
Figure 2: Block Diagram	8
Figure 3: Logic Diagram	9
Figure 4: 24-Ball T-BGA, 5 x 5 (Balls Down)	10
Figure 5: 24-Ball TBGA, 4 x 6 (Balls Down)	11
Figure 6: 8-Pin, SOP2 or W-PDFN (Top View)	12
Figure 7: 16-Pin, Plastic Small Outline – SO16 (Top View)	12
Figure 8: 24-Ball T-PBGA (5 x 5 ball grid array) – 6mm x 8mm	14
Figure 9: 24-Ball T-PBGA (24b05) – 6mm x 8mm	15
Figure 10: 8-Pin SOP2 (SO8W) – 208 Mils Body Width	16
Figure 11: 16-Pin SOP2 – 300 mils Body Width	17
Figure 12: W-PDFN-8 (MLP8) – 6mm x 5mm	18
Figure 13: W-PDFN-8 (MLP8) – 8mm x 6mm	19
Figure 14: Internal Configuration Register	24
Figure 15: Sector and Password Protection	30
Figure 16: RESET ENABLE and RESET MEMORY Command	40
Figure 17: READ ID and MULTIPLE I/O READ ID Commands	41
Figure 18: READ SERIAL FLASH DISCOVERY PARAMETER Command – 5Ah	42
Figure 19: READ – 03h	43
Figure 20: FAST READ – 0Bh	44
Figure 21: DUAL OUTPUT FAST READ – 3Bh	44
Figure 22: DUAL INPUT/OUTPUT FAST READ – BBh	45
Figure 23: QUAD OUTPUT FAST READ – 6Bh	45
Figure 24: QUAD INPUT/OUTPUT FAST READ – EBh	46
Figure 25: QUAD INPUT/OUTPUT WORD READ – E7h	46
Figure 26: DTR FAST READ – 0Dh	47
Figure 27: DTR DUAL OUTPUT FAST READ – 3Dh	47
Figure 28: DTR DUAL INPUT/OUTPUT FAST READ – BDh	48
Figure 29: DTR QUAD OUTPUT FAST READ – 6Dh	48
Figure 30: DTR QUAD INPUT/OUTPUT FAST READ – EDh	49
Figure 31: WRITE ENABLE and WRITE DISABLE Timing	50
Figure 32: READ REGISTER Timing	51
Figure 33: WRITE REGISTER Timing	53
Figure 34: CLEAR FLAG STATUS REGISTER Timing	54
Figure 35: PAGE PROGRAM Command	56
Figure 36: DUAL INPUT FAST PROGRAM Command	57
Figure 37: EXTENDED DUAL INPUT FAST PROGRAM Command	57
Figure 38: QUAD INPUT FAST PROGRAM Command	58
Figure 39: EXTENDED QUAD INPUT FAST PROGRAM Command	58
Figure 40: SUBSECTOR and SECTOR ERASE Timing	60
Figure 41: BULK ERASE Timing	60
Figure 42: PROGRAM/ERASE SUSPEND or RESUME Timing	62
Figure 43: READ OTP Command	63
Figure 44: PROGRAM OTP Command	64
Figure 45: XIP Mode Directly After Power-On	69
Figure 46: Power-Up Timing	72
Figure 47: AC Timing Input/Output Reference Levels	76
Figure 48: Reset AC Timing During PROGRAM or ERASE Cycle	82
Figure 49: Reset Enable and Reset Memory Timing	82
Figure 50: Serial Input Timing	82



Figure 51: Write Protect Setup and Hold During WRITE STATUS REGISTER Operation (SRWD = 1)	83
Figure 52: Hold Timing	83
Figure 53: Output Timing	83

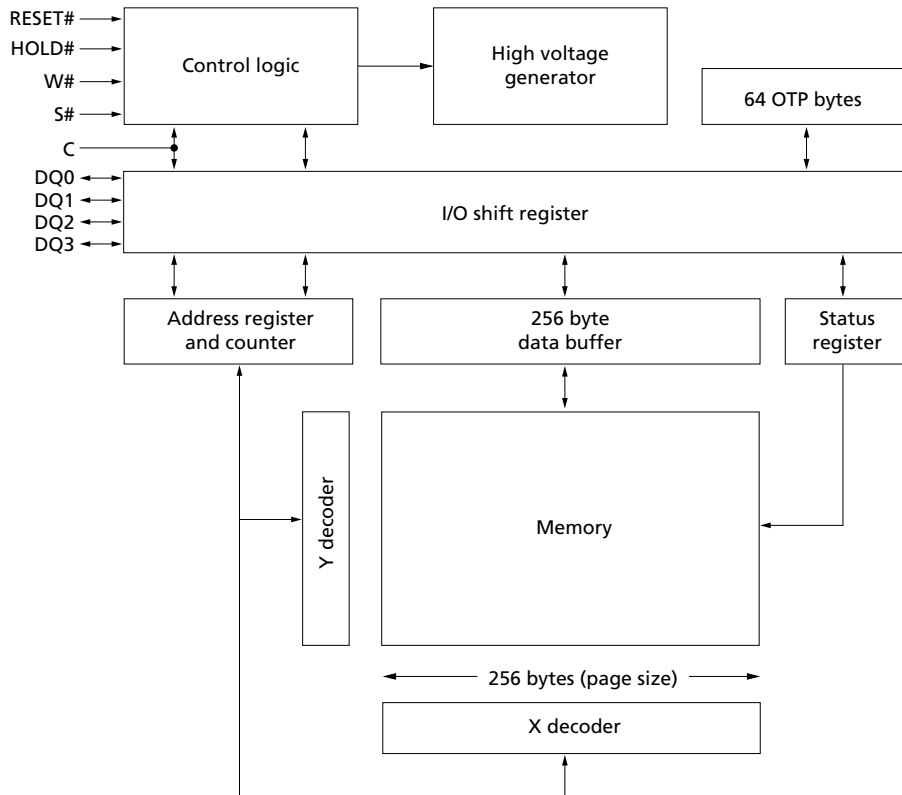
List of Tables

Table 1: Signal Descriptions	13
Table 2: Memory Map	20
Table 3: Status Register	21
Table 4: Protected Area	22
Table 5: Flag Status Register	23
Table 6: Nonvolatile Configuration Register	25
Table 7: Volatile Configuration Register	26
Table 8: Sequence of Bytes During Wrap	26
Table 9: Clock Frequencies – STR (in MHz)	27
Table 10: Clock Frequencies – DTR (in MHz)	28
Table 11: Enhanced Volatile Configuration Register	29
Table 12: Sector Protection Register	31
Table 13: Global Freeze Bit	31
Table 14: Nonvolatile and Volatile Lock Bits	32
Table 15: Volatile Lock Bit Register	32
Table 16: Device ID Data	33
Table 17: Extended Device ID Data, First Byte	33
Table 18: Command Set	35
Table 19: RESET ENABLE and RESET MEMORY Operations	40
Table 20: READ ID and MULTIPLE I/O READ ID Operations	41
Table 21: READ MEMORY Operations	43
Table 22: WRITE ENABLE/DISABLE Operations	50
Table 23: READ REGISTER Operations	51
Table 24: WRITE REGISTER Operations	52
Table 25: CLEAR FLAG STATUS REGISTER Operation	54
Table 26: PROGRAM Operations	55
Table 27: ERASE Operations	59
Table 28: SUSPEND/RESUME Operations	61
Table 29: OTP Control Byte (Byte 64)	64
Table 30: ENTER and RESET QUAD PROTOCOL Operations	65
Table 31: CRC Command Sequence on Entire Device	66
Table 32: CRC Command Sequence on a Range	67
Table 33: Operations Allowed/Disallowed During Device States	68
Table 34: XIP Confirmation Bit	70
Table 35: Effects of Running XIP in Different Protocols	70
Table 36: Power-Up Timing and V_{WI} Threshold	72
Table 37: Absolute Ratings	75
Table 38: Operating Conditions	75
Table 39: Input/Output Capacitance	75
Table 40: AC Timing Input/Output Conditions	76
Table 41: DC Current Characteristics and Operating Conditions	77
Table 42: DC Voltage Characteristics and Operating Conditions	77
Table 43: AC Characteristics and Operating Conditions	79
Table 44: AC RESET Conditions	81
Table 45: Program/Erase Specifications	84

Device Description

The MT25Q is a high-performance multiple input/output serial Flash memory device. It features a high-speed SPI-compatible bus interface, execute-in-place (XIP) functionality, advanced write protection mechanisms, and extended address access. Innovative, high-performance, dual and quad input/output commands enable double or quadruple the transfer bandwidth for READ and PROGRAM operations.

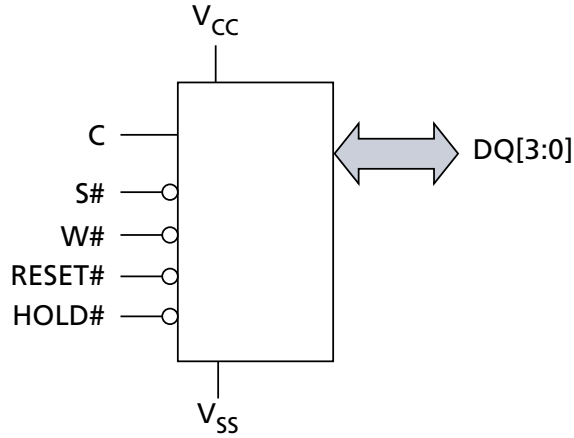
Figure 2: Block Diagram



Note: 1. Each page of memory can be individually programmed, but the device is not page-erasable.

Device Logic Diagram

Figure 3: Logic Diagram



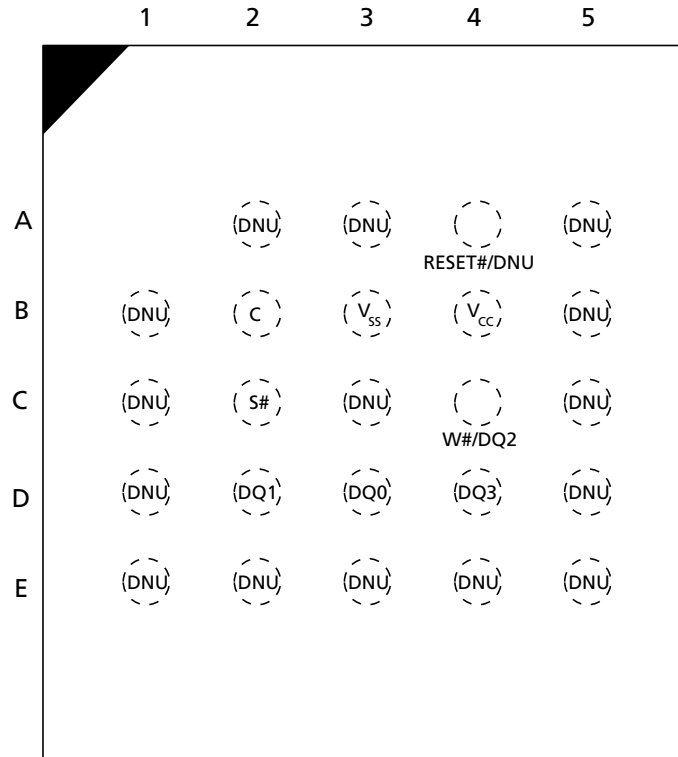
- Notes:
1. Depending on the selected device (see Part Numbering Ordering Information), DQ3 = DQ3/RESET# or DQ3/HOLD#.
 2. A separate RESET pin is available on dedicated part numbers (see Part Numbering Ordering Information).

Advanced Security Protection

The device offers an advanced security protection scheme where each sector can be independently locked, by either volatile or nonvolatile locking features. The nonvolatile locking configuration can also be locked, as well password-protected. See Block Protection Settings and Sector and Password Protection for more details.

Signal Assignments – Package Code: 12

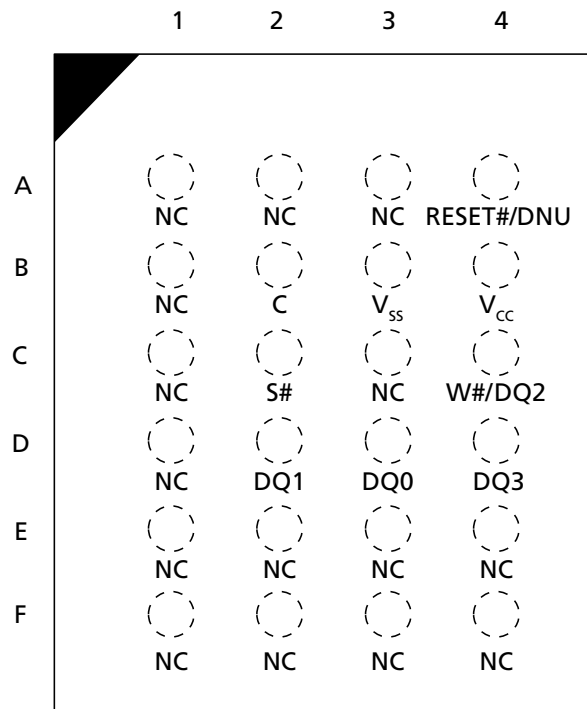
Figure 4: 24-Ball T-BGA, 5 x 5 (Balls Down)



- Notes:
1. RESET# or HOLD# signals can share Ball D4 with DQ3, depending on the selected device (see Part Numbering Ordering Information). When using single and dual I/O commands on these parts, DQ3 must be driven high by the host, or an external pull-up resistor must be placed on the PCB, in order to avoid allowing the HOLD# or RESET# input to float.
 2. Ball A4 = RESET# or DNU, depending on the part number. This signal has an internal pull-up resistor and may be left unconnected if not used.

Signal Assignments – Package Code: 14

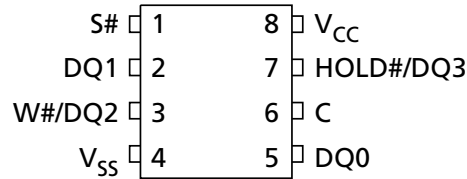
Figure 5: 24-Ball TBGA, 4 x 6 (Balls Down)



- Notes:
1. RESET# or HOLD# signals can share Ball D4 with DQ3, depending on the selected device (see Part Numbering Ordering Information). When using single and dual I/O commands on these parts, DQ3 must be driven high by the host, or an external pull-up resistor must be placed on the PCB, in order to avoid allowing the HOLD# or RESET# input to float.
 2. Ball A4 = RESET# or DNU, depending on the part number. This signal has an internal pull-up resistor and may be left unconnected if not used.

Signal Assignments – Package Code: SE, W7, W9

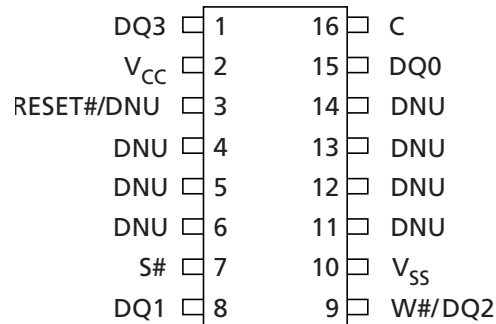
Figure 6: 8-Pin, SOP2 or W-PDFN (Top View)



- Notes:
1. RESET# or HOLD# signals can share Pin 7 with DQ3, depending on the selected device (see Part Numbering Ordering Information). When using single and dual I/O commands on these parts, DQ3 must be driven high by the host, or an external pull-up resistor must be placed on the PCB, in order to avoid allowing the HOLD# or RESET# input to float.
 2. On the underside of the W-PDFN package, there is an exposed central pad that is pulled internally to V_{SS}. It can be left floating or can be connected to V_{SS}. It must not be connected to any other voltage or signal line on the PCB.

Signal Assignments – Package Code: SF

Figure 7: 16-Pin, Plastic Small Outline – SO16 (Top View)



- Notes:
1. RESET# or HOLD# signals can share Pin 1 with DQ3, depending on the selected device (see Part Numbering Ordering Information). When using single and dual I/O commands on these parts, DQ3 must be driven high by the host, or an external pull-up resistor must be placed on the PCB, in order to avoid allowing the HOLD# or RESET# input to float.
 2. Pin 3 = RESET# or DNU, depending on the part number. This signal has an internal pull-up resistor and may be left unconnected if not used.

Signal Descriptions

The signal description table below is a comprehensive list of signals for the MT25Q family devices. All signals listed may not be supported on this device. See Signal Assignments for information specific to this device.

Table 1: Signal Descriptions

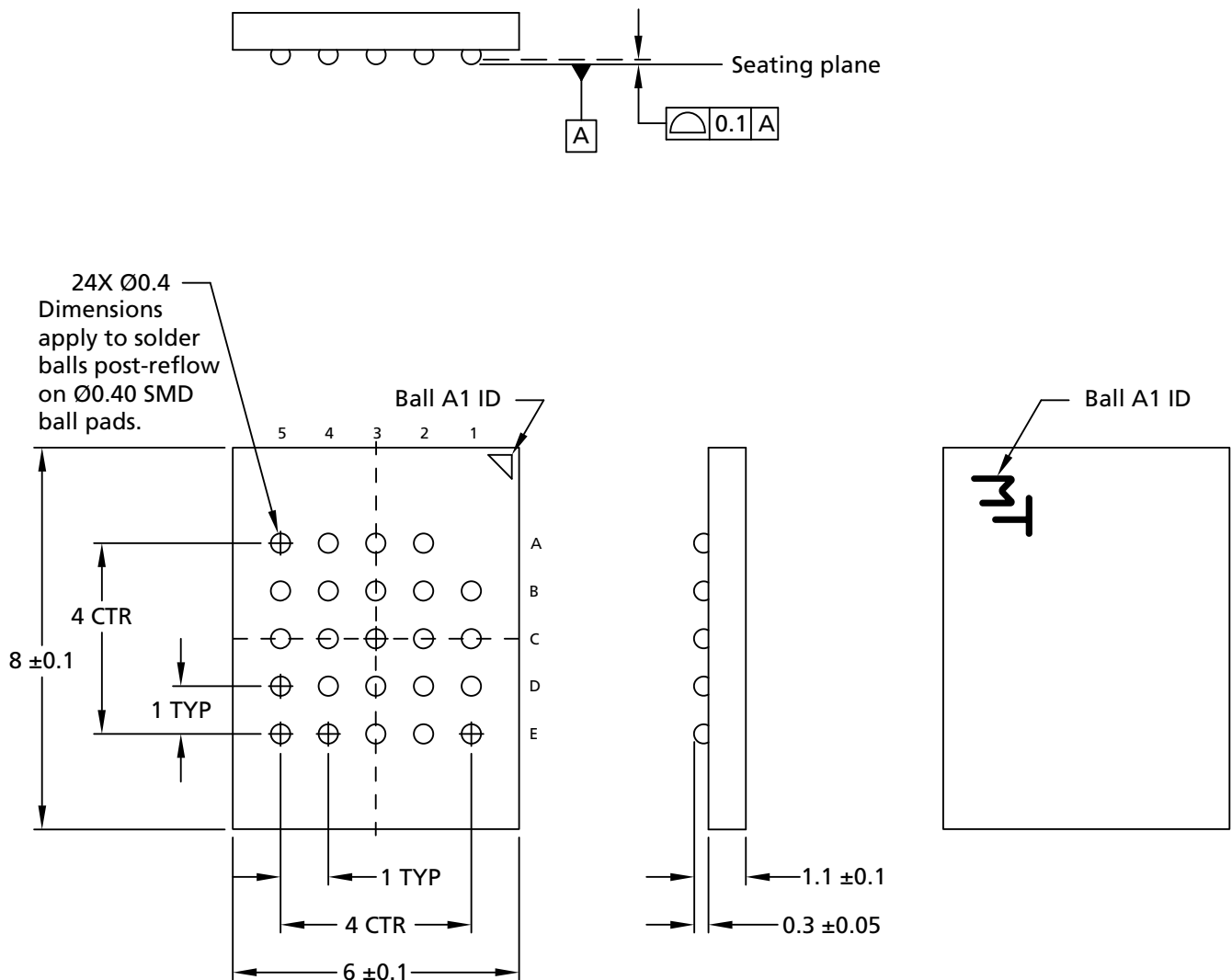
Symbol	Type	Description
S#	Input	<p>Chip select: When S# is driven HIGH, the device will enter standby mode, unless an internal PROGRAM, ERASE, or WRITE STATUS REGISTER cycle is in progress. All other input pins are ignored and the output pins are tri-stated. On parts with the pin configuration offering a dedicated RESET# pin, however, the RESET# input pin remains active even when S# is HIGH.</p> <p>Driving S# LOW enables the device, placing it in the active mode.</p> <p>After power-up, a falling edge on S# is required prior to the start of any command.</p>
C	Input	<p>Clock: Provides the timing of the serial interface. Command inputs are latched on the rising edge of the clock. In STR commands or protocol, address and data inputs are latched on the rising edge of the clock, while data is output on the falling edge of the clock. In DTR commands or protocol, address and data inputs are latched on both edges of the clock, and data is output on both edges of the clock.</p>
RESET#	Input	<p>RESET#: When RESET# is driven LOW, the device is reset and the outputs are tri-stated. If RESET# is driven LOW while an internal WRITE, PROGRAM, or ERASE operation is in progress, data may be lost. The RESET# functionality can be disabled using bit 4 of the nonvolatile configuration register or bit 4 of the enhanced volatile configuration register.</p> <p>For pin configurations that share the DQ3 pin with RESET#, the RESET# functionality is disabled in QIO-SPI mode.</p>
HOLD#	Input	<p>HOLD: Pauses serial communications with the device without deselecting or resetting the device. Outputs are tri-stated and inputs are ignored. The HOLD# functionality can be disabled using bit 4 of the nonvolatile configuration register or bit 4 of the enhanced volatile configuration register.</p> <p>For pin configurations that share the DQ3 pin with HOLD#, the HOLD# functionality is disabled in QIO-SPI mode or when DTR operation is enabled.</p>
W#	Input	<p>Write protect: Freezes the status register in conjunction with the enable/disable bit of the status register. When the enable/disable bit of the status register is set to 1 and the W# signal is driven LOW, the status register nonvolatile bits become read-only and the WRITE STATUS REGISTER operation will not execute. During the Extended-SPI protocol with QOFR and QIOFR instructions, and with QIO-SPI protocol, this pin functions as an input/output (DQ2 functionality). This signal does not have internal pull-ups, it cannot be left floating and must be driven, even if none of W#/DQ2 function is used.</p>
DQ[3:0]	I/O	<p>Serial I/O: The bidirectional DQ signals transfer address, data, and command information.</p> <p>When using legacy (x1) SPI commands in extended I/O protocol (XIO-SPI), DQ0 is an input and DQ1 is an output. DQ[3:2] are not used.</p> <p>When using dual commands in XIO-SPI or when using DIO-SPI, DQ[1:0] are I/O. DQ[3:2] are not used.</p> <p>When using quad commands in XIO-SPI or when using QIO-SPI, DQ[3:0] are I/O.</p>
V _{CC}	Supply	Core and I/O power supply.

Table 1: Signal Descriptions (Continued)

Symbol	Type	Description
V _{SS}	Supply	Core and I/O ground connection.
DNU	–	Do not use. Must be left floating.
NC	–	No connect. Not internally connected.

Package Dimensions – Package Code: 12

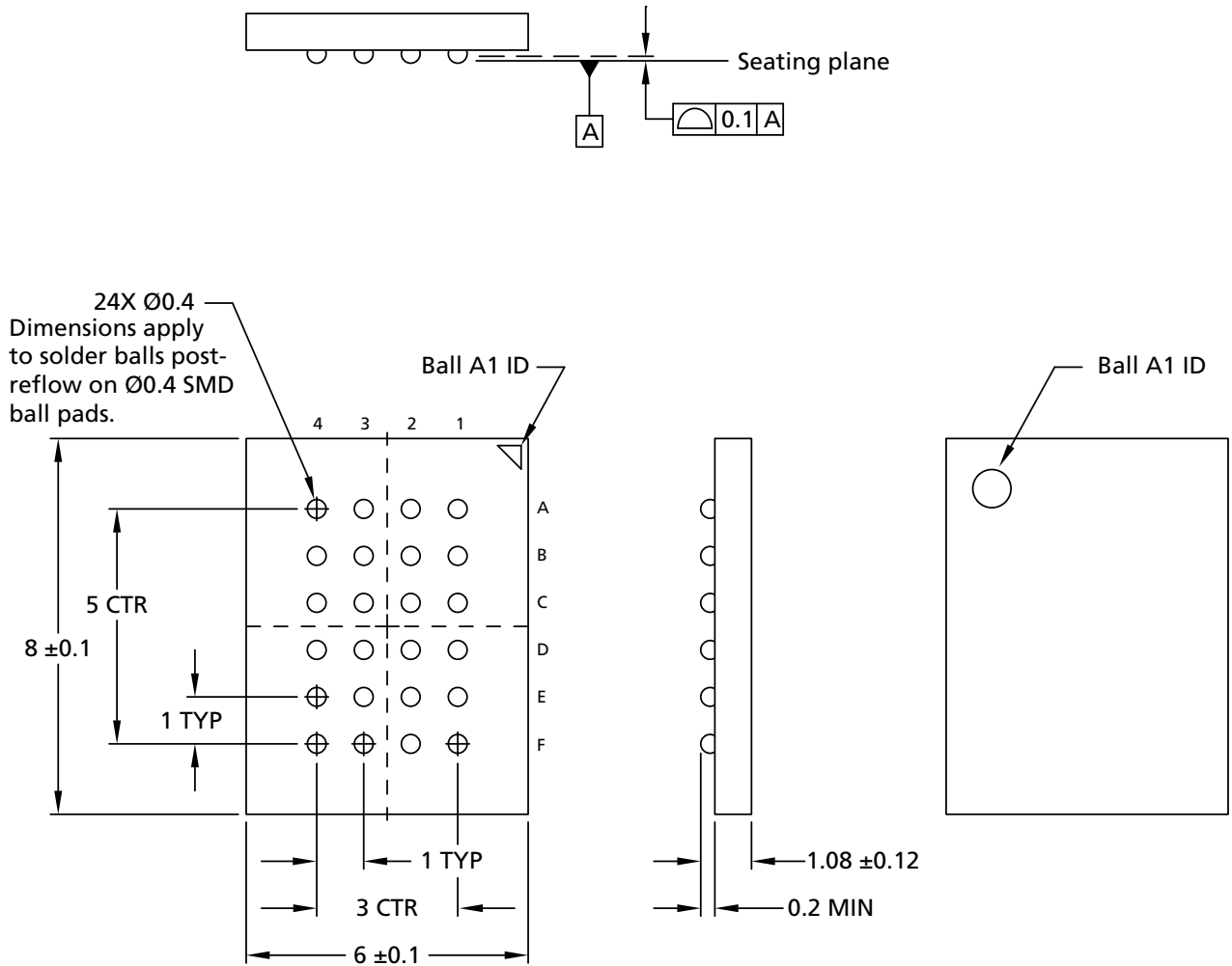
Figure 8: 24-Ball T-PBGA (5 x 5 ball grid array) – 6mm x 8mm



- Notes: 1. All dimensions are in millimeters.
2. See Part Number Ordering Information for complete package names and details.

Package Dimensions – Package Code: 14

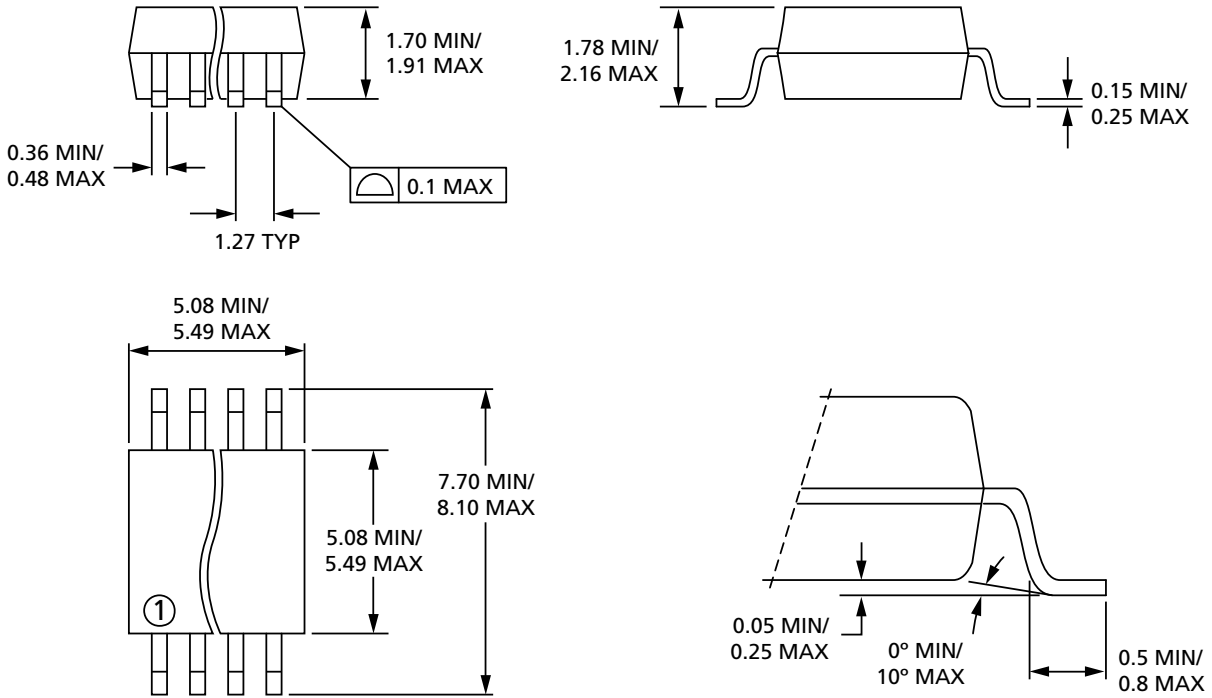
Figure 9: 24-Ball T-PBGA (24b05) – 6mm x 8mm



- Notes:
1. All dimensions are in millimeters.
 2. See Part Number Ordering Information for complete package names and details.

Package Dimensions – Package Code: SE

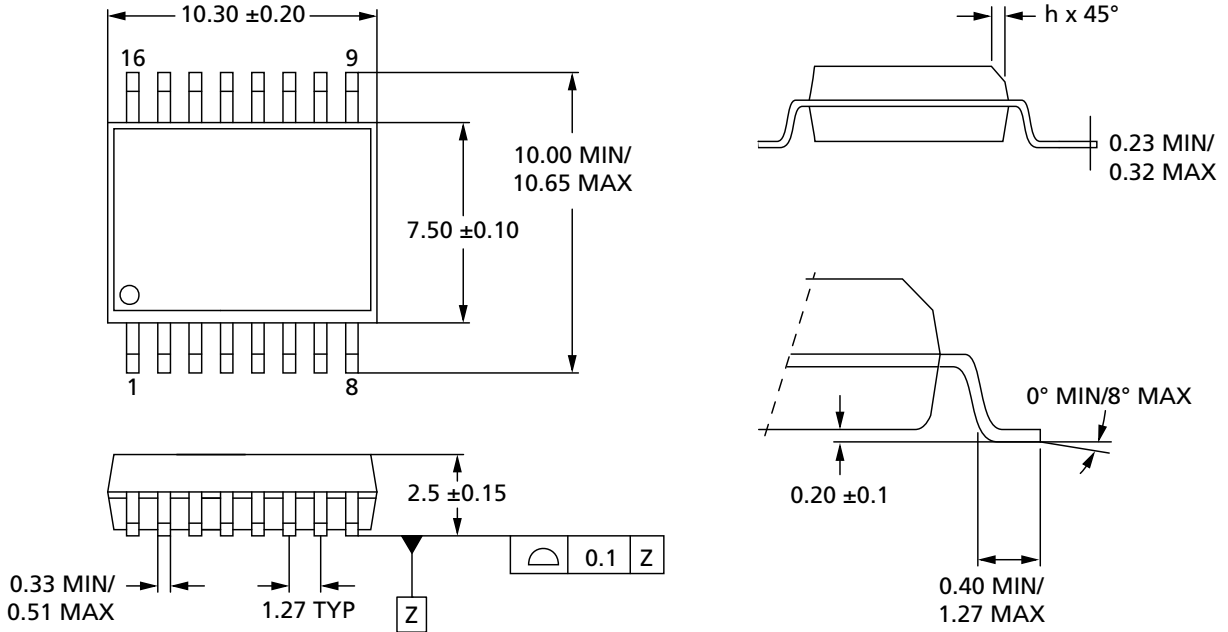
Figure 10: 8-Pin SOP2 (SO8W) – 208 Mils Body Width



- Notes: 1. All dimensions are in millimeters.
 2. See Part Number Ordering Information for complete package names and details.

Package Dimensions – Package Code: SF

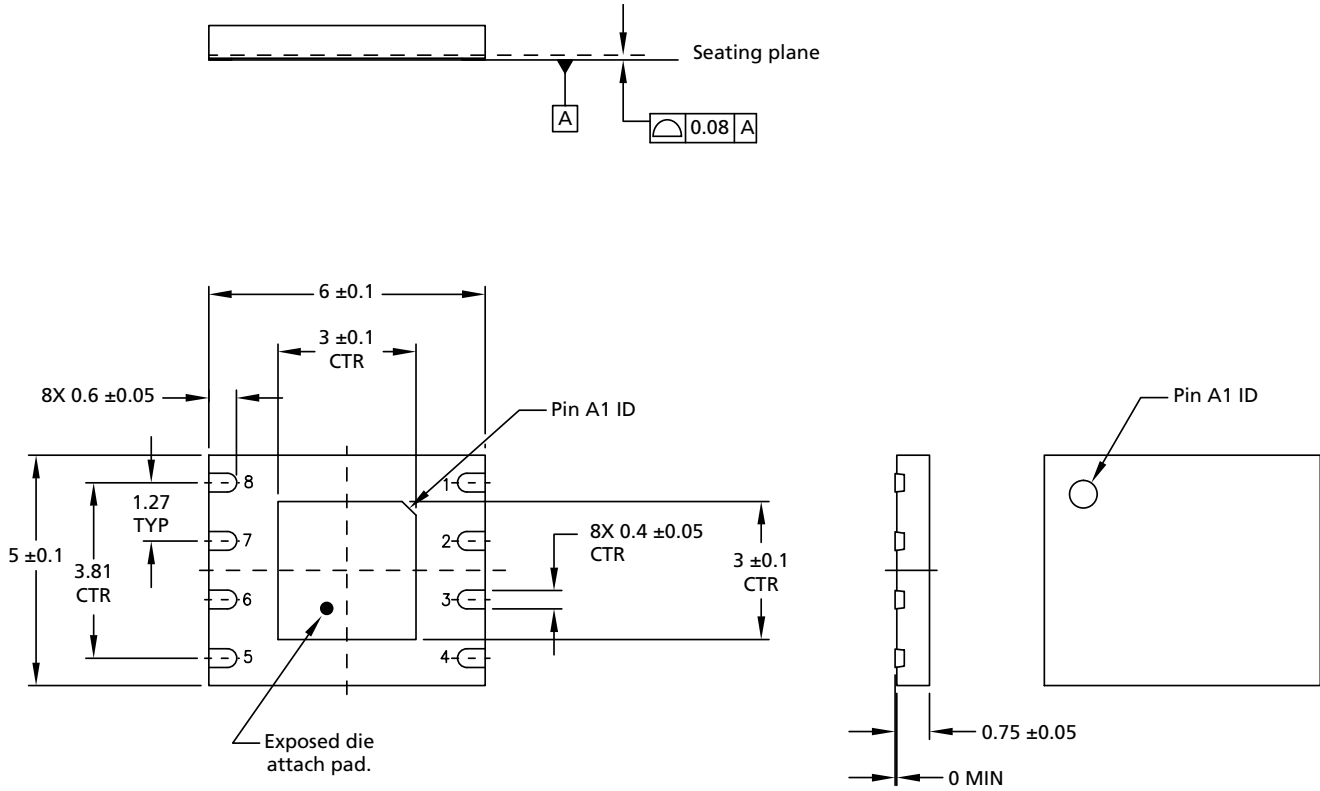
Figure 11: 16-Pin SOP2 – 300 mils Body Width



- Notes:
1. All dimensions are in millimeters.
 2. See Part Number Ordering Information for complete package names and details.

Package Dimensions – Package Code: W7

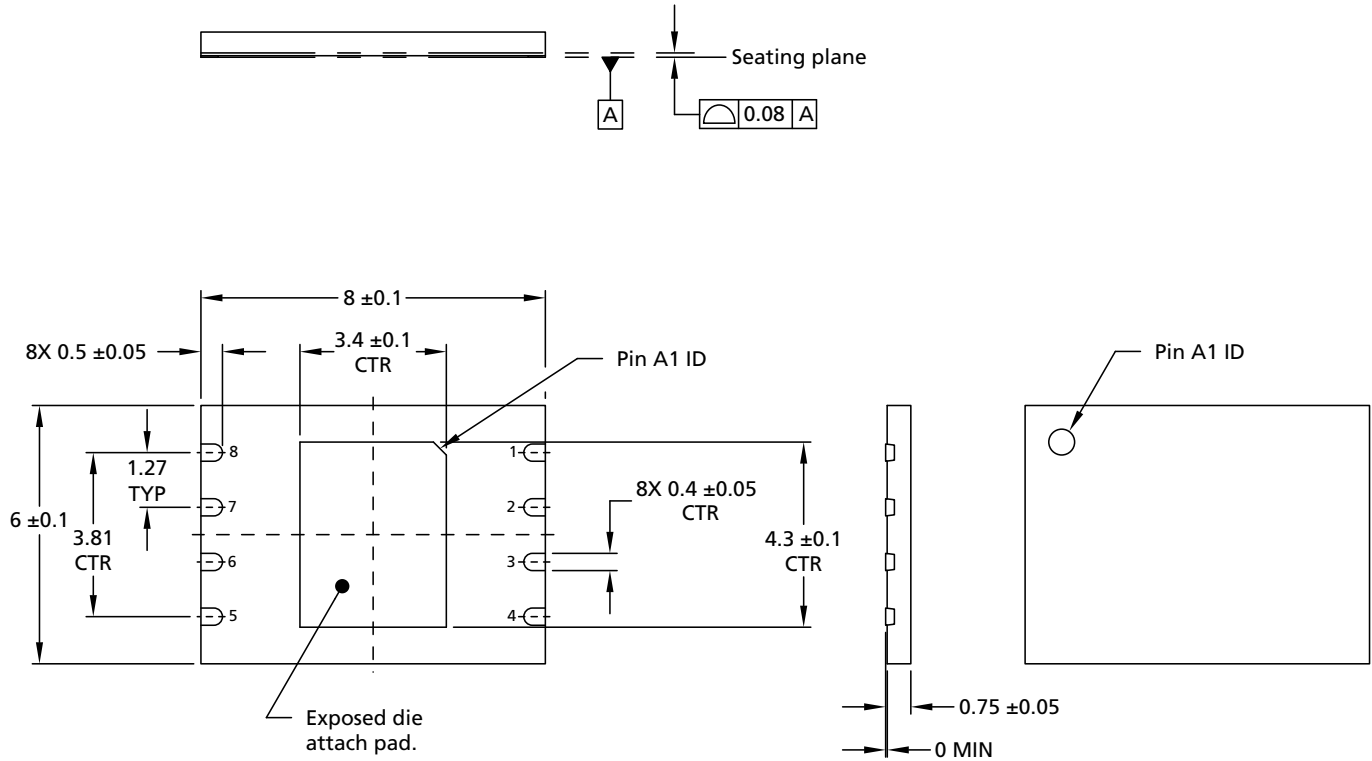
Figure 12: W-PDFN-8 (MLP8) – 6mm x 5mm



- Notes:
1. All dimensions are in millimeters.
 2. See Part Number Ordering Information for complete package names and details.

Package Dimensions – Package Code: W9

Figure 13: W-PDFN-8 (MLP8) – 8mm x 6mm



- Notes: 1. All dimensions are in millimeters.
2. See Part Number Ordering Information for complete package names and details.



Memory Map – 128Mb Density

Table 2: Memory Map

Sector	Subsector (32KB)	Subsector (4KB)	Address Range	
			Start	End
255	511	4095	00FF F000h	00FF FFFFh
		⋮	⋮	⋮
		4088	00FF 8000h	00FF 8FFFh
	510	4087	00FF 7000h	00FF 7FFFh
		⋮	⋮	⋮
		4080	00FF 0000h	00FF 0FFFh
⋮	⋮	⋮	⋮	⋮
127	255	2047	007F F000h	007F FFFFh
		⋮	⋮	⋮
		2040	007F 8000h	007F 8FFFh
	254	2039	007F 7000h	007F 7FFFh
		⋮	⋮	⋮
		2032	007F 0000h	007F 0FFFh
⋮	⋮	⋮	⋮	⋮
63	127	1023	003F F000h	003F FFFFh
		⋮	⋮	⋮
		1016	003F 8000h	003F 8FFFh
	126	1015	003F 7000h	003F 7FFFh
		⋮	⋮	⋮
		1008	003F 0000h	003F 0FFFh
⋮	⋮	⋮	⋮	⋮
0	1	15	0000 F000h	0000 FFFFh
		⋮	⋮	⋮
		8	0000 8000h	0000 8FFFh
	0	7	0000 7000h	0000 7FFFh
		⋮	⋮	⋮
		0	0000 0000h	0000 0FFFh

Note: 1. See Part Number Ordering Information, Sector Size – Part Numbers table for options.

Status Register

Status register bits can be read from or written to using READ STATUS REGISTER or WRITE STATUS REGISTER commands, respectively. When the status register enable/disable bit (bit 7) is set to 1 and W# is driven LOW, the status register nonvolatile bits become read-only and the WRITE STATUS REGISTER operation will not execute. The only way to exit this hardware-protected mode is to drive W# HIGH.

Table 3: Status Register

Bit	Name	Settings	Description	Notes
7	Status register write enable/disable	0 = Enabled (default) 1 = Disabled	Nonvolatile control bit: Used with W# to enable or disable writing to the status register.	–
5	Top/bottom	0 = Top (default) 1 = Bottom	Nonvolatile control bit: Determines whether the protected memory area defined by the block protect bits starts from the top or bottom of the memory array.	–
6, 4:2	BP[3:0]	See Protected Area tables	Nonvolatile control bit: Defines memory to be software protected against PROGRAM or ERASE operations. When one or more block protect bits is set to 1, a designated memory area is protected from PROGRAM and ERASE operations.	1
1	Write enable latch	0 = Clear (default) 1 = Set	Volatile control bit: The device always powers up with this bit cleared to prevent inadvertent WRITE, PROGRAM, or ERASE operations. To enable these operations, the WRITE ENABLE operation must be executed first to set this bit.	–
0	Write in progress	0 = Ready (default) 1 = Busy	Volatile status bit: Indicates if one of the following command cycles is in progress: WRITE STATUS REGISTER WRITE NONVOLATILE CONFIGURATION REGISTER PROGRAM ERASE	2

- Notes:
1. The BULK ERASE command is executed only if all bits = 0.
 2. Status register bit 0 is the inverse of flag status register bit 7.



Block Protection Settings

Table 4: Protected Area

Status Register Content					Protected Area
Top/Bottom	BP3	BP2	BP1	BP0	64KB Sectors
0	0	0	0	0	None
0	0	0	0	1	255:255
0	0	0	1	0	255:254
0	0	0	1	1	255:252
0	0	1	0	0	255:248
0	0	1	0	1	255:240
0	0	1	1	0	255:224
0	0	1	1	1	255:192
0	1	0	0	0	255:128
0	1	0	0	1	255:0
0	1	0	1	0	255:0
0	1	0	1	1	255:0
0	1	1	0	0	255:0
0	1	1	1	0	255:0
0	1	1	1	1	255:0
1	0	0	0	0	None
1	0	0	0	1	0:0
1	0	0	1	0	1:0
1	0	0	1	1	3:0
1	0	1	0	0	7:0
1	0	1	0	1	15:0
1	0	1	1	0	31:0
1	0	1	1	1	63:0
1	1	0	0	0	127:0
1	1	0	0	1	255:0
1	1	0	1	0	255:0
1	1	0	1	1	255:0
1	1	1	0	0	255:0
1	1	1	0	1	255:0
1	1	1	1	0	255:0
1	1	1	1	1	255:0
1	1	1	1	0	255:0
1	1	1	1	1	255:0

Flag Status Register

Flag status register bits are read by using READ FLAG STATUS REGISTER command. All bits are volatile and are reset to zero on power up.

Status bits are set and reset automatically by the internal controller. Error bits must be cleared through the CLEAR STATUS REGISTER command.

Table 5: Flag Status Register

Bit	Name	Settings	Description
7	Program or erase controller	0 = Busy 1 = Ready	Status bit: Indicates whether one of the following command cycles is in progress: WRITE STATUS REGISTER, WRITE NONVOLATILE CONFIGURATION REGISTER, PROGRAM, or ERASE.
6	Erase suspend	0 = Clear 1 = Suspend	Status bit: Indicates whether an ERASE operation has been or is going to be suspended.
5	Erase	0 = Clear 1 = Failure or protection error	Error bit: Indicates whether an ERASE operation has succeeded or failed.
4	Program	0 = Clear 1 = Failure or protection error	Error bit: Indicates whether a PROGRAM operation has succeeded or failed. It indicates, also, whether a CRC check has succeeded or failed.
3	Reserved	0	Reserved
2	Program suspend	0 = Clear 1 = Suspend	Status bit: Indicates whether a PROGRAM operation has been or is going to be suspended.
1	Protection	0 = Clear 1 = Failure or protection error	Error bit: Indicates whether an ERASE or PROGRAM operation has attempted to modify the protected array sector, or whether a PROGRAM operation has attempted to access the locked OTP space.
0	Reserved	0	Reserved

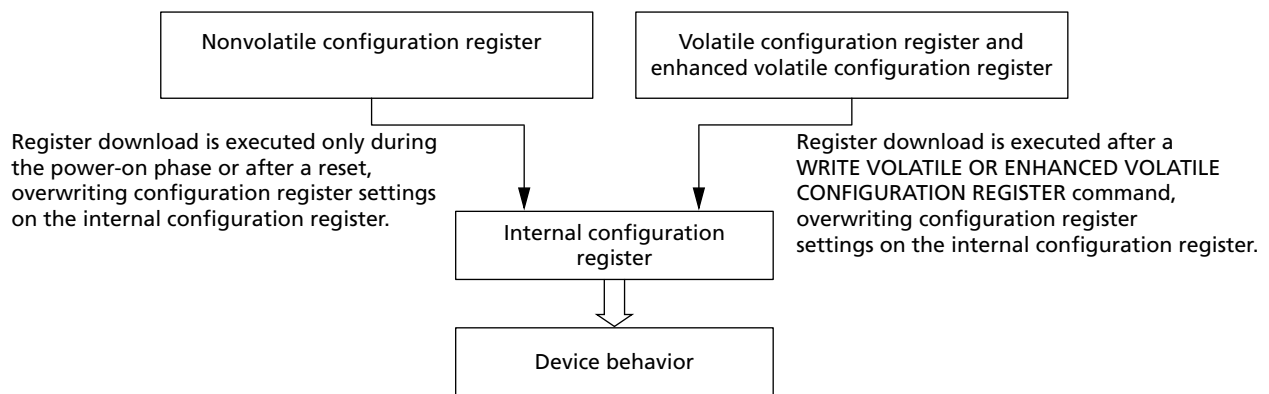
Internal Configuration Register

The memory configuration is set by an internal configuration register that is not directly accessible to users.

The user can change the default configuration at power up by using the WRITE NON-VOLATILE CONFIGURATION REGISTER. Information from the nonvolatile configuration register overwrites the internal configuration register during power on or after a reset.

The user can change the configuration during operation by using the WRITE VOLATILE CONFIGURATION REGISTER or the WRITE ENHANCED VOLATILE CONFIGURATION REGISTER commands. Information from the volatile configuration registers overwrite the internal configuration register immediately after the WRITE command completes.

Figure 14: Internal Configuration Register



Nonvolatile Configuration Register

This register is read from and written to using the READ NONVOLATILE CONFIGURATION REGISTER and the WRITE NONVOLATILE CONFIGURATION REGISTER commands, respectively. A register download is executed during power-on or after reset, overwriting the internal configuration register settings that determine device behavior.

Table 6: Nonvolatile Configuration Register

Bit	Name	Settings	Description	Notes
15:12	Number of dummy clock cycles	0000 = identical to 1111 0001 = 1 0010 = 2 . . 1101 = 13 1110 = 14 1111 = Default	Sets the number of dummy clock cycles subsequent to all FAST READ commands (See the Command Set Table for default setting values).	1
11:9	XIP mode at power-on reset	000 = XIP: Fast read 001 = XIP: Dual output fast read 010 = XIP: Dual I/O fast read 011 = XIP: Quad output fast read 100 = XIP: Quad I/O fast read 101 = Reserved 110 = Reserved 111 = Disabled (Default)	Enables the device to operate in the selected XIP mode immediately after power-on reset.	
8:6	Output driver strength	000 = Reserved 001 = 90 Ohms 010 = Reserved 011 = 45 Ohms 100 = Reserved 101 = 20 Ohms 110 = Reserved 111 = 30 Ohms (Default)	Optimizes the impedance at $V_{CC}/2$ output voltage.	
5	Double transfer rate protocol	0 = Enabled 1 = Disabled (Default)	Set DTR protocol as current one. Once enabled, all commands will work in DTR.	
4	Reset/hold	0 = Disabled 1 = Enabled (Default)	Enables or disables HOLD# or RESET# on DQ3.	
3	Quad I/O protocol	0 = Enabled 1 = Disabled (Default)	Enables or disables quad I/O command input (4-4-4 mode).	2
2	Dual I/O protocol	0 = Enabled 1 = Disabled (Default)	Enables or disables dual I/O command input (2-2-2 mode).	2
1	Reserved	0	Reserved	
0	Reserved	0	Reserved	

- Notes:
1. The number of cycles must be set to accord with the clock frequency, which varies by the type of FAST READ command (See Supported Clock Frequencies table). Insufficient dummy clock cycles for the operating frequency causes the memory to read incorrect data.
 2. When bits 2 and 3 are both set to 0, the device operates in quad I/O protocol.