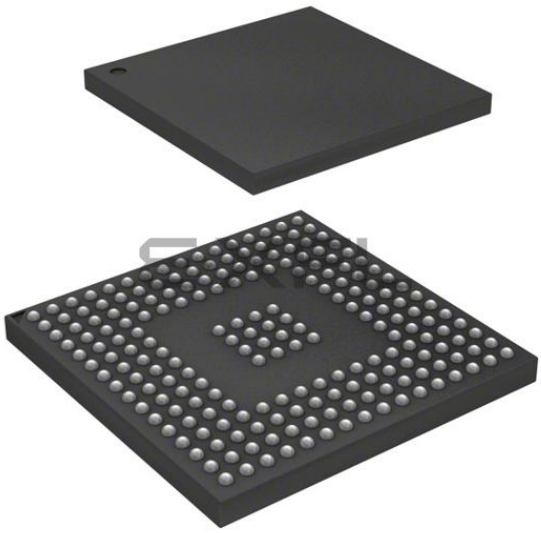

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Program Memory Type	FLASH
EEPROM Size	-
RAM Size	128K x 8
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Data Converters	A/D 64x10b
Oscillator Type	Internal
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Mounting Type	Surface Mount
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Supplier Device Package	208-BGA (17x17)
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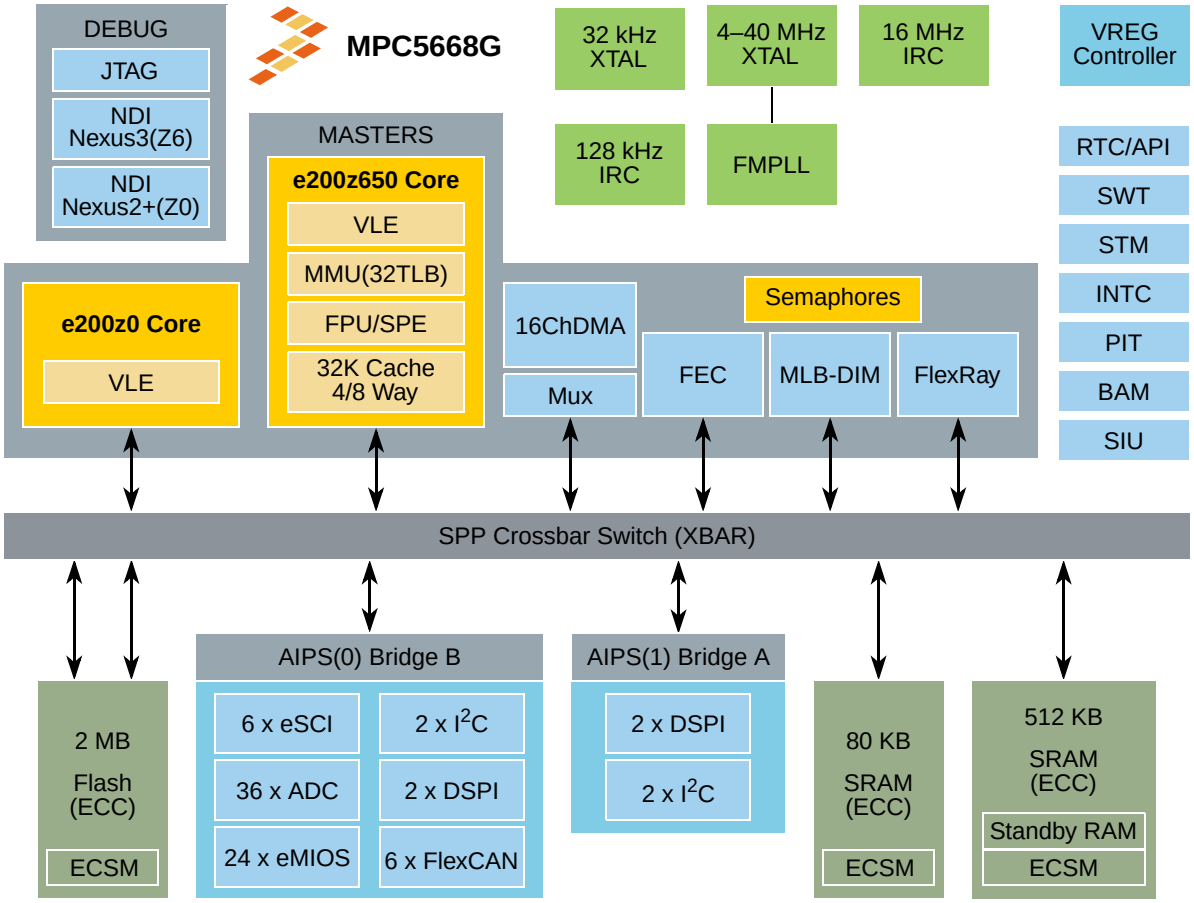
2 MPC5668x Block Diagrams

Figure 1 shows a top-level block diagram of the MPC5668G device.

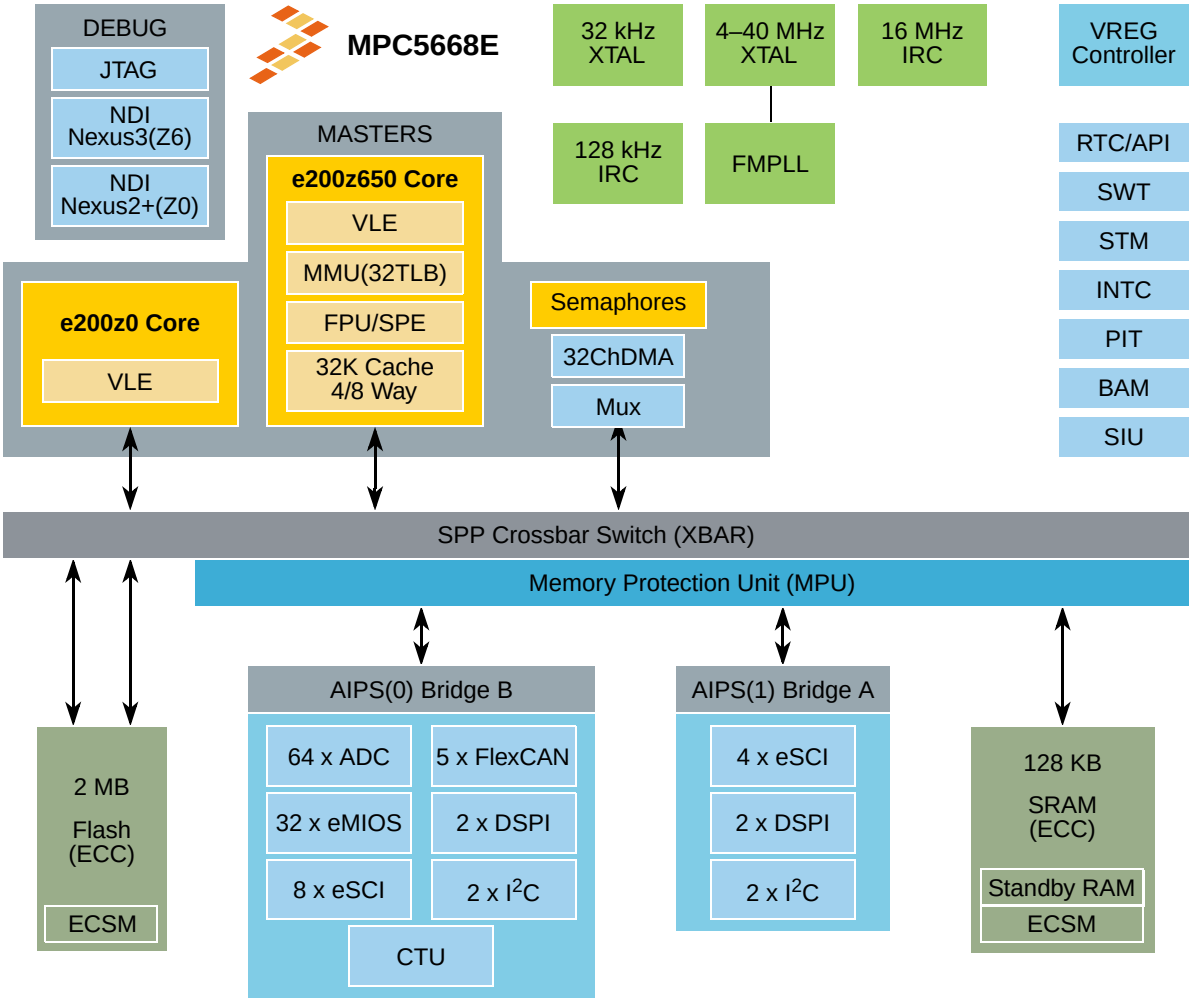


LEGEND

ADC	– Analog to Digital Converter	**I²C**	– Inter IC Controller
BAM	– Boot Assist Module	**INTC**	– Interrupt Controller
DSPI	– Serial Peripherals Interface	**JTAG**	– Joint Test Action Group interface
ECC	– Error Correction Code	**MLB-DIM**	– Media Local Bus Device Interface Module
ECSM	– Error Correction Status Module	**NDI**	– Nexus Debug Interface
eMIOS	– Timed Input Output	**PIT**	– Periodic Interrupt Timer
eDMA	– Enhanced Direct Memory Access controller	**RTC**	– Real Time Clock
eSCI	– Serial Communications Interface	**SIU**	– System Integration
FEC	– Fast Ethernet Controller	**STM**	– System Timer Module
FlexCAN	– Controller Area Network controller	**SWT**	– Software Watchdog Timer
FlexRay™	– FlexRay Bus Controller	**VREG**	– Voltage Regulator
FMPLL	– Frequency Modulated Phase Locked Loop		

Figure 1. MPC5668G Block Diagram

Figure 2 shows a top level block diagram for the MPC5668E device.



LEGEND

ADC	– Analog to Digital Converter	**I²C**	– Inter IC Controller
BAM	– Boot Assist Module	**INTC**	– Interrupt Controller
CTU	– Cross Triggering Unit	**JTAG**	– Joint Test Action Group interface
DSPI	– Serial Peripherals Interface controller	**MPU**	– Memory Protection Unit
ECC	– Error Correction Code	**NDI**	– Nexus Debug Interface
ECSM	– Error Correction Status Module	**PIT**	– Periodic Interrupt Timer
eDMA	– Enhanced Direct Memory Access controller	**RTC**	– Real Time Clock
eMIOS200	– Timed Input Output	**SIU**	– System Integration
eSCI	– Serial Communications Interface	**STM**	– System Timer Module
FlexCAN	– Controller Area Network controller	**SWT**	– Software Watchdog Timer
FMPLL	– Frequency Modulated Phase Locked Loop	**VREG**	– Voltage Regulator

Figure 2. MPC5668E Block Diagram

3 Pin Assignments

3.1 208-ball MAPBGA Pin Assignments

Figure 3 shows the 208-ball MAPBGA pin assignments.

Figure 3. MPC5668x 208-ball MAPBGA (full diagram)

3.2 256-ball MAPBGA Pin Assignments

Figure 4 shows the 256-ball MAPBGA pin assignments.

256 MAPBGA Ball Map

(as viewed from top through the package)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
A	V_{SS}	PD0	PG1	PC12	PC9	PC7	PC2	PB13	PB10	PB8	RESET	V_{DDSYN}	XTAL	EXTAL	V_{SSSYN}	V_{SS}	A
B	PD2	PD1	PG0	PC11	PC10	PC8	PC3	PB14	PB11	V_{RC}	V_{RCCTL}	PB9	PB2	PB0	V_{DDA}	V_{RH}	B
C	PD3	PD4	PD14	PC14	PC13	PC5	PC6	PC1	PB15	PB12	PB6	PB4	PB3	PB1	V_{SSA}	V_{RL}	C
D	PD5	PD6	PD15	V_{DD}	PC15	V_{DDE1}	V_{SS}	PC4	PC0	V_{DD}	PB7	PB5	PA10	PA12	PA0	PA14	D
E	PD7	PD8	PE0	PE1	MDO0	V_{DDENEX}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	PA11	PA9	PA1	PA15	E
F	PD9	PD10	PE3	PE2	MDO1	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	PA13	PA8	PA3	PA2	F
G	PD11	PD12	PE4	V_{SS}	MDO2	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	PA7	PA5	PA4	G
H	PD13	PF0	PE5	V_{DD}	MDO3	MDO4	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{RCSEL}	PG2	PG6	PA6	H
J	PF1	PF2	TDI	PE8	MDO6	MDO5	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDE3}	PG3	PG7	PG11	J
K	PK1	PK2	JCOMP	V_{DDEMLB}	MDO7	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDENEX}	V_{SS}	V_{DD}	PG4	PG8	PG12	K
L	PK0	PE7	TMS	V_{DDE2}	MDO8	V_{SS}	V_{DDENEX}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DD33}	PG5	PG9	PG13	L
M	PF4	PE6	TDO	PE9	MDO9	MDO10	MDO11	MSEO1	MSEO0	MCKO	EVTI	EVTO	TEST	PF13	PG10	PG14	M
N	PF6	PF3	PE10	PE11	V_{DD}	PE15	PE14	PH9	PH11	V_{DDE4}	PH15	PJ10	V_{SS}	PF12	PH3	PG15	N
P	PF8	PF5	TCK	PE12	PE13	PK10	PH8	PH10	PH12	PH13	PH14	PJ11	PF15	PF14	PH4	PH1	P
R	PF10	PF7	PF11	PK4	PK6	PK8	PJ0	PJ2	PJ4	PJ6	PJ9	PJ12	PJ14	PH5	PH6	PH2	R
T	V_{SS}	PF9	PK3	PK5	PK7	PK9	PJ1	PJ3	PJ5	PJ7	PJ8	PJ13	PJ15	PH0	PH7	V_{SS}	T
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

Figure 4. MPC5668x 256-ball MAPBGA (full diagram)

Table 2. MPC5668x Signal Properties (continued)

Pin Name[1]	Supported Functions[2]	GPIO (PCR) Num[3]	PA[4]	Description	I/O Type	Volt-age	Pad Type[5]	Status		Package Pin Locations	
								During Reset[6]	After Reset[7]	208 BGA	256 BGA
PE14	PE[14] SCL_A PCS_D[2]	78	00 01 10 11	Port E GPIO I^2C_A Serial Clock DSPI_D Peripheral Chip Select —	I/O I/O O —	V_{DDE2}	SH	—	—	N7	N7
PE15	PE[15] SDA_A PCS_D[5]	79	00 01 10 11	Port E GPIO I^2C_A Serial Data DSPI_D Peripheral Chip Select —	I/O I/O O —	V_{DDE2}	SH	—	—	N6	N6
Port F (16)											
PF0	PF[0] SCK_A	80	00 01 10 11	Port F GPIO DSPI_A Serial Clock — —	I/O I/O — —	V_{DDE2}	MH	—	—	H2	H2
PF1	PF[1] SOUT_A	81	00 01 10 11	Port F GPIO DSPI_A Serial Data Out — —	I/O O — —	V_{DDE2}	MH	—	—	J1	J1
PF2	PF[2] SIN_A	82	00 01 10 11	Port F GPIO DSPI_A Serial Data In — —	I/O I — —	V_{DDE2}	SH	—	—	J2	J2
PF3	PF[3] PCS_A[0] PCS_B[5] PCS_C[4]	83	00 01 10 11	Port F GPIO DSPI_A Peripheral Chip Select DSPI_B Peripheral Chip Select DSPI_C Peripheral Chip Select	I/O I/O O O	V_{DDE2}	SH	—	—	N2	N2
PF4	PF[4] SCK_B PCS_A[1] PCS_C[2]	84	00 01 10 11	Port F GPIO DSPI_B Serial Clock DSPI_A Peripheral Chip Select DSPI_C Peripheral Chip Select	I/O I/O O O	V_{DDE2}	MH	—	—	M1	M1
PF5	PF[5] SOUT_B PCS_A[2] PCS_C[3]	85	00 01 10 11	Port F GPIO DSPI_B Serial Data Out DSPI_A Peripheral Chip Select DSPI_C Peripheral Chip Select	I/O O O O	V_{DDE2}	MH	—	—	P2	P2
PF6	PF[6] SIN_B PCS_A[3] PCS_C[5]	86	00 01 10 11	Port F GPIO DSPI_B Serial Data In DSPI_A Peripheral Chip Select DSPI_C Peripheral Chip Select	I/O I O O	V_{DDE2}	SH	—	—	N1	N1
PF7	PF[7] PCS_B[0] PCS_C[5] PCS_D[4]	87	00 01 10 11	Port F GPIO DSPI_B Peripheral Chip Select DSPI_C Peripheral Chip Select DSPI_D Peripheral Chip Select	I/O I/O O O	V_{DDE2}	SH	—	—	R2	R2

Table 2. MPC5668x Signal Properties (continued)

Pin Name[1]	Supported Functions[2]	GPIO (PCR) Num[3]	PA[4]	Description	I/O Type	Volt-age	Pad Type[5]	Status		Package Pin Locations	
								During Reset[6]	After Reset[7]	208 BGA	256 BGA
PF8	PF[8] SCK_C	88	00 01 10 11	Port F GPIO DSPI_C Serial Clock — —	I/O I/O — —	V_{DDE2}	MH	—	—	P1	P1
PF9	PF[9] SOUT_C	89	00 01 10 11	Port F GPIO DSPI_C Serial Data Out — —	I/O O — —	V_{DDE2}	MH	—	—	T2	T2
PF10	PF[10] SIN_C	90	00 01 10 11	Port F GPIO DSPI_C Serial Data In — —	I/O I — —	V_{DDE2}	SH	—	—	R1	R1
PF11	PF[11] PCS_C[0] PCS_D[5] PCS_A[4]	91	00 01 10 11	Port F GPIO DSPI_C Peripheral Chip Select DSPI_D Peripheral Chip Select DSPI_A Peripheral Chip Select	I/O I/O O O	V_{DDE2}	SH	—	—	R3	R3
PF12	PF[12] SCK_D	92	00 01 10 11	Port F GPIO DSPI_D Serial Clock — —	I/O I/O — —	V_{DDE3}	MH	—	—	N14	N14
PF13	PF[13] SOUT_D	93	00 01 10 11	Port F GPIO DSPI_D Serial Data Out — —	I/O O — —	V_{DDE3}	MH	—	—	M14	M14
PF14	PF[14] SIN_D	94	00 01 10 11	Port F GPIO DSPI_D Serial Data In — —	I/O I — —	V_{DDE3}	SH	—	—	P14	P14
PF15	PF[15] PCS_D[0] PCS_A[5] PCS_B[4]	95	00 01 10 11	Port F GPIO DSPI_D Peripheral Chip Select DSPI_A Peripheral Chip Select DSPI_B Peripheral Chip Select	I/O I/O O O	V_{DDE3}	SH	—	—	P13	P13
Port G (16)											
PG0	PG[0] PCS_A[4] PCS_B[3] AN[48]	96	00 01 10 11	Port G GPIO DSPI_A Peripheral Chip Select DSPI_B Peripheral Chip Select ADC Analog Input	I/O O O I	V_{DDE2}	SHA	—	—	B3	B3
PG1	PG[1] PCS_A[5] PCS_B[4] AN[49]	97	00 01 10 11	Port G GPIO DSPI_A Peripheral Chip Select DSPI_B Peripheral Chip Select ADC Analog Input	I/O O O I	V_{DDE2}	SHA	—	—	A3	A3

Table 2. MPC5668x Signal Properties (continued)

Pin Name[1]	Supported Functions[2]	GPIO (PCR) Num[3]	PA[4]	Description	I/O Type	Volt-age	Pad Type[5]	Status		Package Pin Locations	
								During Reset[6]	After Reset[7]	208 BGA	256 BGA
PG13	PG[13] eMIOS[2] FEC_TXD[1] AN[61]	109	00 01 10 11	Port G GPIO eMIOS Channel Ethernet Transmit Data ADC Analog Input	I/O I/O O I	V_{DDE3}	MHA	—	—	L16	L16
PG14	PG[14] eMIOS[1] FEC_TXD[2] AN[62]	110	00 01 10 11	Port G GPIO eMIOS Channel Ethernet Transmit Data ADC Analog Input	I/O I/O O I	V_{DDE3}	MHA	—	—	M16	M16
PG15	PG[15] eMIOS[0] FEC_TXD[3] AN[63]	111	00 01 10 11	Port G GPIO eMIOS Channel Ethernet Transmit Data ADC Analog Input	I/O I/O O I	V_{DDE3}	MHA	—	—	N16	N16
Port H (16)											
PH0	PH[0] eMIOS[31] FEC_COL	112	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Collision —	I/O I/O I —	V_{DDE3}	SH	—	—	T14	T14
PH1	PH[1] eMIOS[30] FEC_RX_DV	113	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Receive Data Valid —	I/O I/O I —	V_{DDE3}	SH	—	—	P16	P16
PH2	PH[2] eMIOS[29] FEC_TX_EN	114	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Transmit Enable —	I/O I/O O —	V_{DDE3}	MH	—	—	R16	R16
PH3	PH[3] eMIOS[28] FEC_RX_ER	115	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Receive Error —	I/O I/O I —	V_{DDE3}	SH	—	—	N15	N15
PH4	PH[4] eMIOS[27] FEC_RXD[0]	116	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Receive Data —	I/O I/O I —	V_{DDE3}	SH	—	—	P15	P15
PH5	PH[5] eMIOS[26] FEC_RXD[1]	117	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Receive Data —	I/O I/O I —	V_{DDE3}	SH	—	—	R14	R14
PH6	PH[6] eMIOS[25] FEC_RXD[2]	118	00 01 10 11	Port H GPIO eMIOS Channel Ethernet Receive Data —	I/O I/O I —	V_{DDE3}	SH	—	—	R15	R15

$$T_J = T_A + (R_{\theta JA} \times P_D) \quad \textit{Eqn. 1}$$

where:

T_A = ambient temperature for the package (^oC)

$R_{\theta JA}$ = junction to ambient thermal resistance ($^oC/W$)

P_D = power dissipation in the package (W)

The supplied thermal resistances are provided based on JEDEC JESD51 series of standards to provide consistent values for estimations and comparisons. The difference between the values determined on the single-layer (1s) board and on the four-layer board with two signal layers and a power and a ground plane (2s2p) clearly demonstrate that the effective thermal resistance of the component is not a constant. It depends on the construction of the application board (number of planes), the effective size of the board which cools the component, how well the component is thermally and electrically connected to the planes, and the power being dissipated by adjacent components.

Connect all the ground and power balls to the respective planes with one via per ball. Using fewer vias to connect the package to the planes reduces the thermal performance. Thinner planes also reduce the thermal performance. When the clearance between through vias leave the planes virtually disconnected, the thermal performance is also greatly reduced.

As a general rule, the value obtained on a single layer board is appropriate for the tightly packed printed circuit board. The value obtained on the board with the internal planes is usually appropriate if the application board has one oz. (35 micron nominal thickness) internal planes, the components are well separated, and the overall power dissipation on the board is less than 0.02 W/cm^2.

The thermal performance of any component depends strongly on the power dissipation of surrounding components. In addition, the ambient temperature varies widely within the application. For many natural convection and especially closed box applications, the board temperature at the perimeter (edge) of the package is approximately the same as the local air temperature near the device. Specifying the local ambient conditions explicitly as the board temperature provides a more precise description of the local ambient conditions that determine the temperature of the device.

At a known board temperature, the junction temperature is estimated using the following equation:

$$T_J = T_B + (R_{\theta JB} \times P_D) \quad \textit{Eqn. 2}$$

where:

T_J = junction temperature (^oC)

T_B = board temperature at the package perimeter ($^oC/W$)

$R_{\theta JB}$ = junction to board thermal resistance ($^oC/W$) per JESD51-8

P_D = power dissipation in the package (W)

When the heat loss from the package case to the air can be ignored, acceptable predictions of junction temperature can be made. The application board should be similar to the thermal test condition, with the component soldered to a board with internal planes.

Historically, the thermal resistance has frequently been expressed as the sum of a junction to case thermal resistance and a case to ambient thermal resistance:

$$R_{\theta JA} = R_{\theta JC} + R_{\theta CA} \quad \textit{Eqn. 3}$$

where:

$R_{\theta JA}$ = junction to ambient thermal resistance ($^oC/W$)

$R_{\theta JC}$ = junction to case thermal resistance ($^oC/W$)

$R_{\theta CA}$ = case to ambient thermal resistance ($^oC/W$)

$R_{\theta JC}$ is device related and cannot be influenced by the user. The user controls the thermal environment to change the case to ambient thermal resistance, $R_{\theta CA}$. For instance, the user can change the air flow around the device, add a heat sink, change the mounting arrangement on printed circuit board, or change the thermal dissipation on the printed circuit board surrounding the device. This description is most useful for packages with heat sinks where some 90% of the heat flow is through the case to the heat sink to ambient. For most packages, a better model is required.

A more accurate two-resistor thermal model can be constructed from the junction to board thermal resistance and the junction to case thermal resistance. The junction to case covers the situation where a heat sink will be used or where a substantial amount of heat is dissipated from the top of the package. The junction to board thermal resistance describes the thermal performance when most of the heat is conducted to the printed circuit board. This model can be used for either hand estimations or for a computational fluid dynamics (CFD) thermal model.

To determine the junction temperature of the device in the application after prototypes are available, the Thermal Characterization Parameter (Ψ_{JT}) can be used to determine the junction temperature with a measurement of the temperature at the top center of the package case using the following equation:

$$T_J = T_T + (\Psi_{JT} \times P_D) \qquad \textit{Eqn. 4}$$

where:

T_T = thermocouple temperature on top of the package (^oC)

Ψ_{JT} = thermal characterization parameter ($^oC/W$)

P_D = power dissipation in the package (W)

The thermal characterization parameter is measured per JESD51-2 specification using a 40-gauge type T thermocouple epoxied to the top center of the package case. The thermocouple should be positioned so that the thermocouple junction rests on the package. A small amount of epoxy is placed over the thermocouple junction and over about 1 mm of wire extending from the junction. The thermocouple wire is placed flat against the package case to avoid measurement errors caused by cooling effects of the thermocouple wire.

References:

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134
(408) 943-6900

MIL-SPEC and EIA/JESD (JEDEC) specifications are available from Global Engineering Documents at 800-854-7179 or 303-397-7956.

JEDEC specifications are available on the WEB at http://www.jedec.org.

1. C.E. Triplett and B. Joiner, “An Experimental Characterization of a 272 PBGA Within an Automotive Engine Controller Module,” Proceedings of SemiTherm, San Diego, 1998, pp. 47–54.
2. G. Kromann, S. Shidore, and S. Addison, “Thermal Modeling of a PBGA for Air-Cooled Applications,” Electronic Packaging and Production, pp. 53–58, March 1998.
3. B. Joiner and V. Adams, “Measurement and Simulation of Junction to Board Thermal Resistance and Its Application in Thermal Modeling,” Proceedings of SemiTherm, San Diego, 1999, pp. 212–220.

4.3 ESD Characteristics

Table 6. ESD Ratings[1, 2]

Characteristic	Symbol	Value	Unit
ESD for Human Body Model (HBM)		2000	V
HBM Circuit Description	R1	1500	Ohm
	C	100	pF
ESD for Field Induced Charge Model (FDCM)		750 (corner pins)	V
		250 (all other pins)	
Number of Pulses per pin: Positive Pulses (HBM) Negative Pulses (HBM)	 — —	 1 1	 — —
Interval of Pulses	—	1	second

1 All ESD testing is in conformity with CDF-AEC-Q100 Stress Test Qualification for Automotive Grade Integrated Circuits.

2 A device will be defined as a failure if after exposure to ESD pulses the device no longer meets the device specification requirements. Complete DC parametric and functional testing shall be performed per applicable device specification at room temperature followed by hot temperature, unless specified otherwise in the device specification.

4.4 VRC Electrical Specifications

Table 7. VRC Electrical Specifications

Spec	Characteristic	Symbol	Min	Max	Units
1	Current which can be sourced by V_{RCCTL}	I_V_{RCCTL}	6.25 µA	20 mA	—
2	Minimum Required Gain from external circuit: I_{DD} / I_V_{RCCTL} (@V_{DD} = 1.32 V)[1] –40°C 25°C 150°C	BETA	 50 50 50	 500	

1 Assumes “typical usage” currents which will vary with application.

4.5 DC Electrical Specifications

Table 8. DC Electrical Specifications

Spec	Characteristic	Symbol	Min	Max	Unit
1	Maximum Operating Temperature Range — Die Junction Temperature	T_J	–40.0	150.0	°C
2	3.3 V Clock Synthesizer Voltage[1]	V_{DDSYN}	3.0	3.6	V
3	3.3 V I/O Buffer Voltage[1]	V_{DD33}	3.0	3.6	V
4	3.3–5.0 V Voltage Regulator Reference Voltage[1] V_{RCSEL} = V_{SSA} V_{RCSEL} = V_{DDA}	V_{VRC}	 3.0 4.5	 3.6 5.5	V
5	3.3–5.0 V Analog Supply Voltage	V_{DDA}	maximum of 3.0 V or V_{VRC} – 0.1	5.5	V

Table 9. Operating Currents (continued)

Spec	Characteristic	Symbol	Typ[1] 25 °C Ambient	Max[1] –40–150 °C Junction	Unit
5	V_{DDSYN} Current V_{DD33} @ 3.0 V – 3.6 V Run mode Sleep mode – Optional[4] 4–40 MHz osc enabled w/ no clock – Optional[4] 4–40 MHz osc enabled w/ clock	I_{DDSYN}	 5 1 +150 +300	 10 20 +350 +400	 mA µA µA µA
6	V_{RC} Current (excluding I_{DD}, I_{DD33}, I_{DDSYN})[5] V_{RC} @ 3.135 V – 5.5 V Run mode Sleep mode – Optional[4] 16MIRC enabled	I_{RC}	 1 0 +40	 10 10 +60	 mA µA µA
7	V_{DD} Current V_{DD} @ 1.08 V – 1.32 V Run mode (Maximum @ 116 MHz)[6] Sleep mode – Optional[4] 128KIRC enabled – Optional[4] 16MIRC enabled – Optional[4] 32 kHz osc enabled – Optional[4] 4–40 MHz osc enabled w/ no clock – Optional[4] 4–40 MHz osc enabled w/ clock – Optional[4] 32 KB RAM – Optional[4] 64 KB RAM – Optional[4] 128 KB RAM	I_{DD}	 200 100 +5 +200 +5 +5 +150 +10 +20 +40	 340 900 +10 +220 +20 +20 +200 +150 +300 +600	 mA µA µA µA µA µA µA µA µA µA

1 Typ – Nominal voltage levels and functional activity. Max – Maximum voltage levels and functional activity.

2 Static state of pins is when input pins are disabled or not being toggled and driven to a valid input level, output pins are not toggling or driving against any current loads, and internal pull devices are disabled or not pulling against any current loads.

3 Dynamic current from pins is application-specific and depends on active pull devices, switching outputs, output capacitive and current loads, and switching inputs. Refer to Table 10 for more information.

4 Optional currents are values that should be added to their respective current specifications to obtain the actual value for that specification when the optional function is active. The plus sign (+) in the Typ and Max columns indicates these optional currents. For example, V_{DDSYN} in Sleep mode draws 1 .µA (typ). With the optional 4–40 MHz osc enabled w/ no clock, add 150 .µA for a total of 151 .µA (typ).

5 V_{RC} Current excluding the current supply to V_{DD33}, V_{DDSYN} and V_{DD} from V_{RC}.

6 Maximum supply current transition: 50mA per 20µS observation window.

4.8 Low Voltage Characteristics

Table 13. Low Voltage Monitors

Spec	Characteristic	Symbol	Min	Typical	Max	Unit
1	Power-on-Reset Assert Level[1]	V_{POR}	1.5	—	2.8	V
2	Low Voltage Monitor 3.3 V[2] Assert Level De-assert Level	 V_{LVI33A} V_{LVI33D}	 3.00 3.04	 3.05 3.12	 3.10 3.19	V
3	Low Voltage Monitor Synthesizer[3] Assert Level De-assert Level	 $V_{LVISYNA}$ $V_{LVISYND}$	 3.00 3.04	 3.05 3.12	 3.10 3.19	V
4	Low Voltage Monitor 3.0 V Low Threshold[1] VRCSEL = V_{SSA} Assert Level De-assert Level VRCSEL = V_{DDA} Assert Level De-assert Level	 $V_{LVI\_VDDA\_LOA}$ $V_{LVI\_VDDA\_LOD}$ $V_{LVI\_VDDA\_LOA}$ $V_{LVI\_VDDA\_LOD}$	 3.00 3.04 3.25 3.35	 3.05 3.12 3.35 3.45	 3.10 3.19 3.48 3.55	V
5	Low Voltage Monitor 5.0 V[1, 4] Assert Level De-assert Level	 $V_{LVI\_VDDA\_A}$ $V_{LVI\_VDDA\_D}$	 4.35 4.45	 4.475 4.575	 4.55 4.65	V
6	Low Voltage Monitor 5.0 V High Threshold[1, 5] Assert Level De-assert Level	 $V_{LVI\_VDDA\_HA}$ $V_{LVI\_VDDA\_HD}$	 4.50 4.50	 4.675 4.675	 4.80 4.80	V

1 Monitors V_{DDA}.

2 Monitors V_{DD33}.

3 Monitors V_{DDSYN}.

4 Disabled when $V_{RCSEL} = V_{SSA}$.

4.9 Oscillators Electrical Characteristics

Table 14. 3.3 V High Frequency External Oscillator

Spec	Characteristic	Symbol	Min	Max	Unit
1	Frequency Range	f_{ref}	4[1]	40	MHz
2	Duty Cycle of reference	t_{DC}	40	60	%
3	EXTAL Input High Voltage External crystal mode[2] External clock mode	V_{IHEXT}	 V_{XTAL} + 0.4 0.65 × V_{DDSYN}	 V_{DDSYN} + 0.3 V_{DDSYN} + 0.3	V
4	EXTAL Input Low Voltage External crystal mode[3] External clock mode	V_{ILEXT}	 V_{DDSYN} – 0.3 V_{DDSYN} – 0.3	 V_{XTAL} – 0.4 0.35 × V_{DDSYN}	V
5	XTAL Current[4]	I_{XTAL}	1	3	mA
6	Total On-chip stray capacitance on XTAL	C_{S_XTAL}	—	3	pF
7	Total On-chip stray capacitance on EXTAL	C_{S_EXTAL}	—	3	pF

Table 17. 5V Low Frequency (128 kHz) Internal RC Oscillator

Spec	Characteristic	Symbol	Range	Min	Typ	Max	Unit
1	Frequency before trim[1]	F_{ut128}	35%	83.2	128	172.8	kHz
2	Frequency after loading factory trim[2]	F_{t128}	7%	119.0	128	137.0	kHz
3	Application trim resolution[3]	T_{s128}	—	—	—	±2	%
4	Application frequency trim step[3]	F_{s128}	—	—	4	—	kHz
5	Startup Time	S_{t128}	—	—	—	100	µs

1 Across process, voltage, and temperature.

2 Across voltage and temperature.

3 Fixed voltage and temperature.

4.10 FMPLL Electrical Characteristics

Table 18. FMPLL Electrical Specifications[1]

Spec	Characteristic	Symbol	Min	Max	Unit
1	System Frequency[2]	f_{SYS}	—	116	MHz
2	PLL Reference Frequency Range	f_{REF}	4	40	MHz
3	PLL Frequency	f_{PLL}	$\frac{f_{vco(min)}}{(ERFD+1)}$		MHz
4	Loss of Reference Frequency [3]	f_{LOR}	100	2000	kHz
5	Self Clocked Mode Frequency	f_{SCM}	16	64	MHz
6	PLL Lock Time[4]	t_{LPLL}	—	400	µs
7	Duty Cycle of Reference	t_{DC}	40	60	%
8	Frequency un-LOCK Range	f_{UL}	–4.0	4.0	% f_{SYS}
9	Frequency LOCK Range	f_{LCK}	–2.0	2.0	% f_{SYS}
10	CLKOUT Period Jitter,[5] Measured at f_{SYS} Max Cycle-to-cycle Jitter	C_{Jitter}	–5	5	%f_{SYS}
11	CLKOUT Jitter at ≥ 50 µs period	C_{Jitter}	–250	250	ns
12	Peak-to-Peak Frequency Modulation Range Limit [6,7] (f_{SYS}Max must not be exceeded)	C_{mod}	0	4	%f_{SYS}
13	FM Depth Tolerance[8]	C_{mod_err}	–0.50	0.50	%f_{SYS}
14	VCO Frequency[9]	f_{VCO}	192	600	MHz
15	Modulation Rate Limits[10]	f_{MOD}	0.400	1	MHz

1 V_{DDSYN} = 3.0 V to 3.6 V, V_{SS} = V_{SSSYN} = 0 V, T_A = T_L to T_H.

4.14.6 Deserial Serial Peripheral Interface (DSPI)

Table 29. DSPI Timing

Spec	Characteristic	Symbol	116 MHz[1]		Unit
			Min. Value	Max. Value	
1	DSPI Cycle Time Master (MTFE = 0) Slave (MTFE = 0) Master (MTFE = 1) Slave (MTFE = 1)	t_{SCK}	 100 100 50 50	 — — — —	 ns ns ns ns
2	PCS to SCK Delay[2]	t_{CSC}	7	—	ns
3	After SCK Delay[3]	t_{ASC}	14	—	ns
4	SCK Duty Cycle	t_{SDC}	$0.4 \times t_{SCK}$	$0.6 \times t_{SCK}$	ns
5	Slave Access Time ($\overline{SS}$ active to SOUT valid)	t_A	—	25	ns
6	Slave SOUT Disable Time ($\overline{SS}$ inactive to SOUT High-Z or invalid)	t_{DIS}	—	25	ns
7	PCSx to $\overline{PCSS}$ time	t_{PCSC}	0	—	ns
8	$\overline{PCSS}$ to PCSx time	t_{PASC}	0	—	ns
9	Data Setup Time for Inputs Master (MTFE = 0) Slave Master (MTFE = 1, CPHA = 0)[4] Master (MTFE = 1, CPHA = 1)	t_{SUI}	 25 5 10 25	 — — — —	 ns ns ns ns
10	Data Hold Time for Inputs Master (MTFE = 0) Slave Master (MTFE = 1, CPHA = 0)[4] Master (MTFE = 1, CPHA = 1)	t_{HI}	 –4 7 12 –4	 — — — —	 ns ns ns ns
11	Data Valid (after SCK edge) Master (MTFE = 0) Slave Master (MTFE = 1, CPHA = 0) Master (MTFE = 1, CPHA = 1)	t_{SUO}	 — — — —	 8 28 15 8	 ns ns ns ns
12	Data Hold Time for Outputs Master (MTFE = 0) Slave Master (MTFE = 1, CPHA = 0) Master (MTFE = 1, CPHA = 1)	t_{HO}	 –7 2 1 –7	 — — — —	 ns ns ns ns

1 116 MHz timing specified at CL = 50 pF with SRC = 0b11.

2 The maximum value is programmable in DSPI_CTAR*n*[PSSCK] and DSPI_CTAR*n*[CSSCK].

3 The maximum value is programmable in DSPI_CTAR*n*[PASC] and DSPI_CTAR*n*[ASC].

4 This number is calculated assuming the SMPL_PT bit field in DSPI_MCR is set to 0b10.

1 The Controller can shut off MLBCLK to place MLB in a low-power state.

2 Pulse width variation is measured at 1.25 V by triggering on one edge of MLBCLK and measuring the spread on the other edge, measured in ns peak-to-peak (ns p-p).

3 The board must be designed to insure that the high-impedance bus does not leave the logic state of the final driven bit for this time period. Therefore, coupling must be minimized while meeting the maximum capacitive load listed.

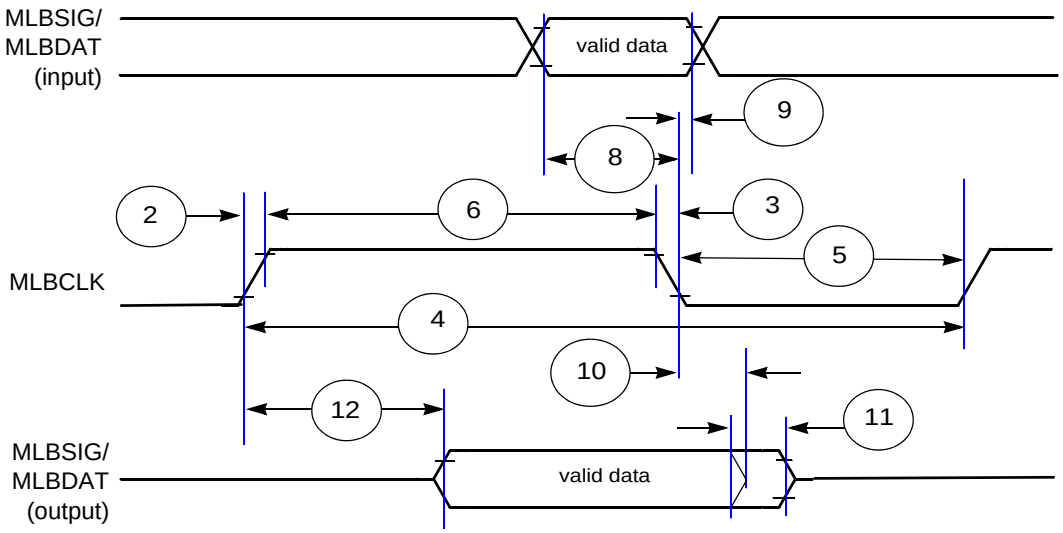


Figure 25. Media Local Bus (MLB) Timing

4.14.8 Fast Ethernet Interface

MII signals use CMOS signal levels compatible with devices operating at either 5.0 V or 3.3 V. Signals are not TTL compatible. They follow the CMOS electrical characteristics.

4.14.8.1 MII Receive Signal Timing (RXD[3:0], RX_DV, RX_ER, and RX_CLK)

The receiver functions correctly up to a RX_CLK maximum frequency of 25 MHz +1%. There is no minimum frequency requirement. In addition, the system clock frequency must exceed four times the RX_CLK frequency.

Table 33. MII Receive Signal Timing

Spec	Characteristic	Min	Max	Unit
M1	RXD[3:0], RX_DV, RX_ER to RX_CLK setup	5	—	ns
M2	RX_CLK to RXD[3:0], RX_DV, RX_ER hold	5	—	ns
M3	RX_CLK pulse width high	35%	65%	RX_CLK period
M4	RX_CLK pulse width low	35%	65%	RX_CLK period

4.14.8.3 MII Async Inputs Signal Timing (CRS and COL)

Table 35. MII Async Inputs Signal Timing[1]

Spec	Characteristic	Min	Max	Unit
M9	CRS, COL minimum pulse width	1.5	—	TX_CLK period

1 Output pads configured with SRC = 0b11.

Figure 28. MII Async Inputs Timing Diagram

4.14.8.4 MII Serial Management Channel Timing (MDIO and MDC)

The FEC functions correctly with a maximum MDC frequency of 2.5 MHz.

Table 36. MII Serial Management Channel Timing[1]

Spec	Characteristic	Min	Max	Unit
M10	MDC falling edge to MDIO output invalid (minimum propagation delay)	0	—	ns
M11	MDC falling edge to MDIO output valid (max prop delay)	—	25	ns
M12	MDIO (input) to MDC rising edge setup	10	—	ns
M13	MDIO (input) to MDC rising edge hold	0	—	ns
M14	MDC pulse width high	40%	60%	MDC period
M15	MDC pulse width low	40%	60%	MDC period

1 Output pads configured with SRC = 0b11.

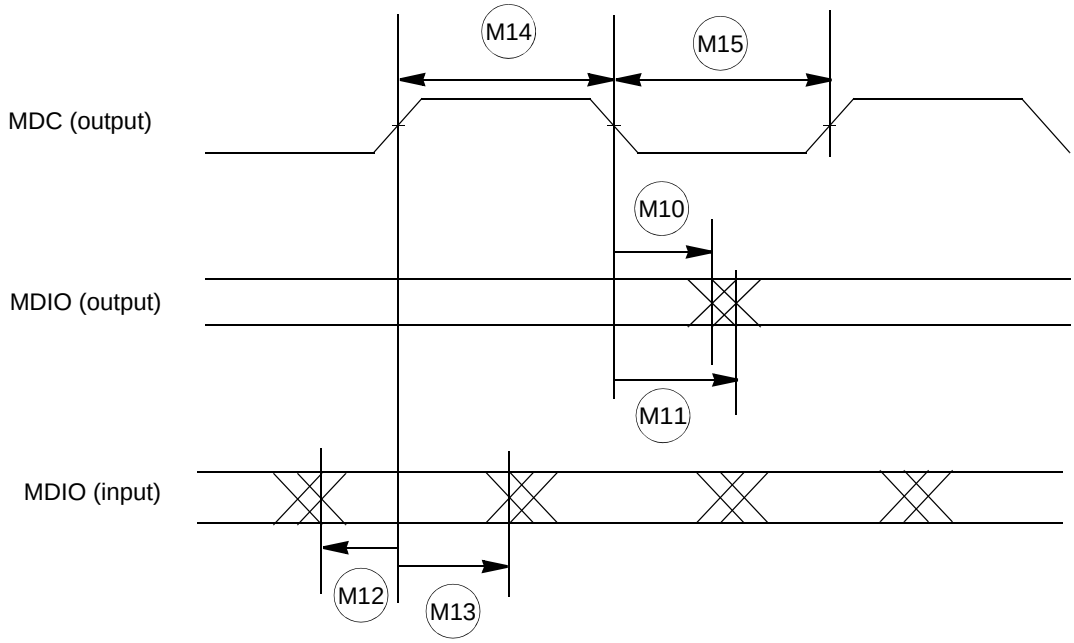
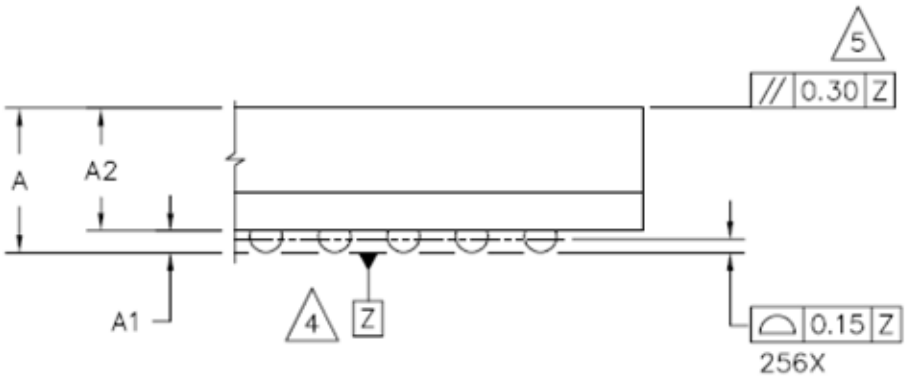


Figure 29. MII Serial Management Channel Timing Diagram



DETAIL K
ROTATED 90° CLOCKWISE

DIM	MIN	MAX
A	1.25	1.60
A1	0.27	0.47
A2	1.16 REF	
b	0.40	0.60
D	17.00 BSC	
E	17.00 BSC	
e	1.00 BSC	
S	0.50 BSC	

NOTES

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO DATUM PLANE Z.
4. DATUM Z (SEATING PLANE) IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. PARALLELISM MEASUREMENT SHALL EXCLUDE ANY EFFECT OF MARK ON TOP SURFACE OF PACKAGE.

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ARH98219A	REV: A
256 I/O STD MAP BGA, 17 X 17 PKG, 1.00 PITCH	CASE NUMBER: 1216B-01	15 JUL 2005
	STANDARD: NON-JEDEC	

Figure 33. 256 MAPBGA Package Detail

6 Revision History

Table 37 describes the changes made to this document between revisions.

Table 37. Revision History

Revision	Date	Description
0	April 2008	Preliminary release.
1	June 2008	Initial release: Advance Information.
2	Jan 2009	Release: Advance Information.
3	September 2009	Release: Advance Information, interim updates.
4	January 2011	Release: Technical Data, interim updates.
5	January 2011	Release: Technical Data, interim updates.
6	March 2011	Release: Technical Data, interim updates.

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