

CAB4A - DDR4 Register

32-Bit 1:2 Command/Address/Control Buffer and 1:4 Differential Clock Buffer

Check for Samples: [CAB4A](#)

FEATURES

- DDR4RCD01 JEDEC Compliant
- DDR4 RDIMM and LRDIMM up to DDR4-2400
- 32 Bits 1-to-2 Register Outputs
- 1-to-4 Differential Clock Buffer
- 1.2V Operation
- PLL with Internal Feedback
- Configurable Driver Strength
- Scalable Weak Driver
- Programmable Latency
- Output Driver Calibration
- Address Mirroring and Inversion
- DDR4 Full-Parity Operation
- On-Chip Programmable V_{REF} Generation
- CA Bus Training Mode
- I²C™ Interface Support
- Up to 16-Logical Ranks Support for 3DS RDIMMs and LRDIMMs
- Up to 4 Physical Ranks Support for RDIMMs and LRDIMMs

DESCRIPTION

The CAB4 is 32-bit 1:2 Command/Address/Control Buffer and 1:4 differential Clock Buffer designed for operation on DDR4 registered DIMMs with a 1.2 V VDD mode.

All inputs are pseudo-differential using external or internal voltage reference. All outputs are full swing CMOS drivers optimized to drive 15 to 50 Ω effective terminated traces in DDR4 RDIMM, LRDIMM and 3D-Stacked DIMM applications. The clock outputs, command/address outputs, control outputs, data buffer control outputs can be enabled in groups, and independently driven with different strengths to compensate for different DIMM net topologies. The DDR4 Register operates from a differential clock (CK_t and CK_c). Inputs are registered at the crossing of CK_t going HIGH, and CK_c going LOW. The input signals could be either re-driven to the outputs if one of the input signals DCS[n:0]_n is driven LOW or it could be used to access device internal control registers when certain input conditions are met.

The device is characterized in the operating temperature range from -40°C to 95°C.

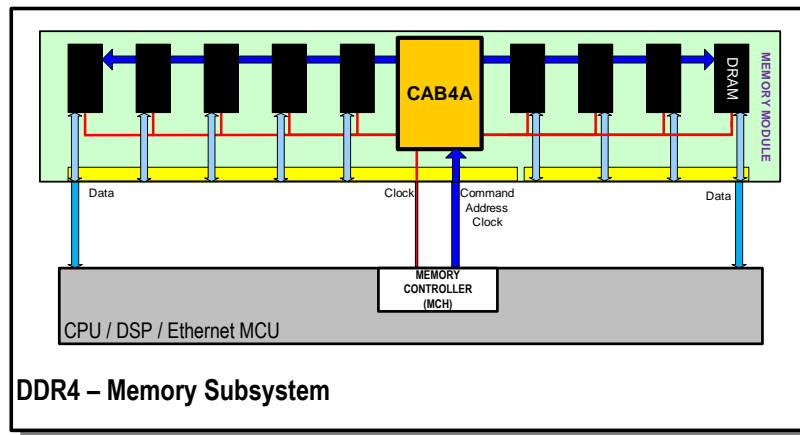


Figure 1. DDR4 - RDIMM Memory Subsystem



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

I²C is a trademark of NXP Semiconductors.

All other trademarks are the property of their respective owners.

FUNCTIONAL BLOCK DIAGRAM

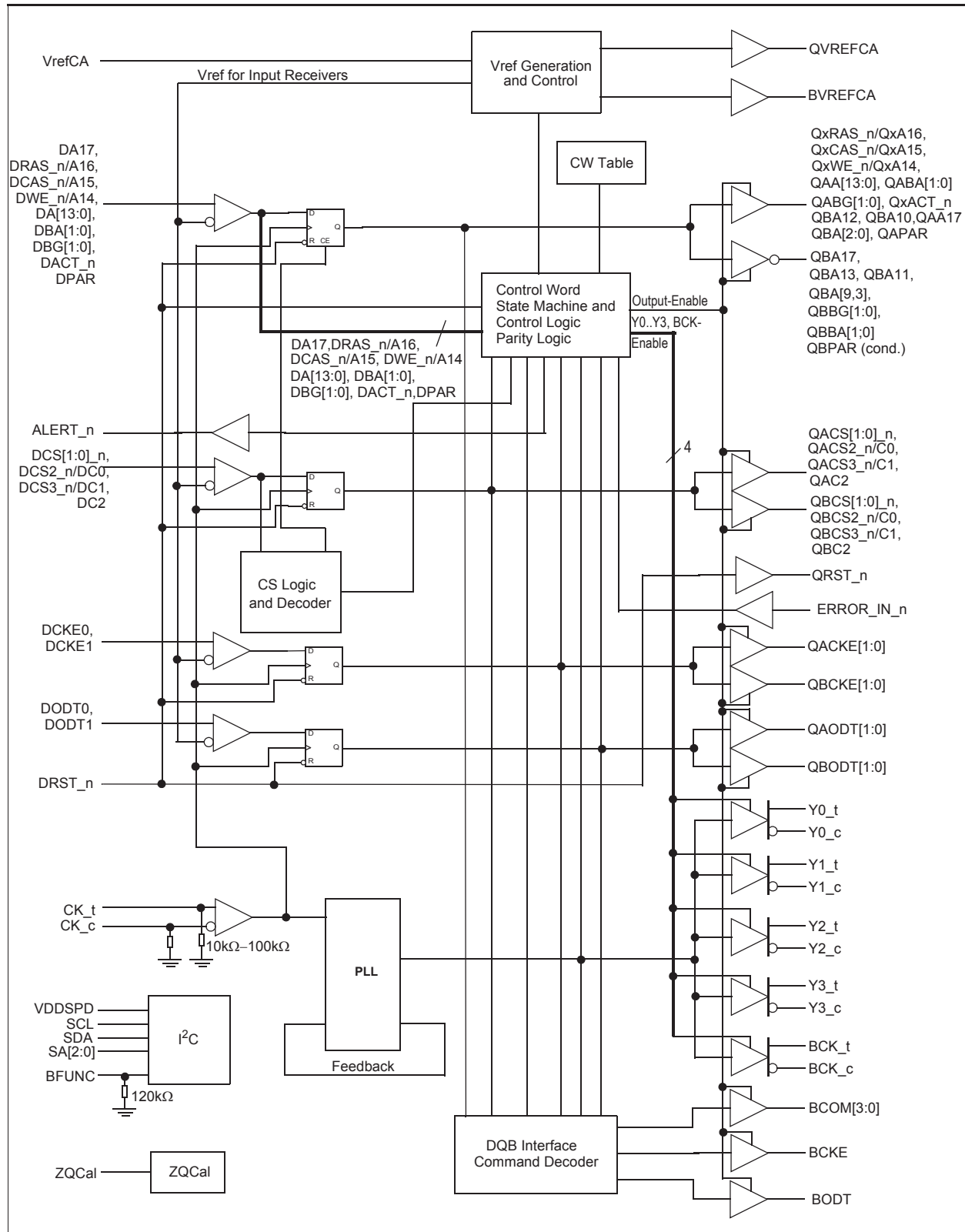


Table 1. TERMINAL FUNCTIONS

SIGNAL		TYPE	DESCRIPTION
GROUP	NAME		
Input Control bus	DCKE0/1 DODT0/1	CMOS ⁽¹⁾ VREF based	DRAM corresponding register function pins not associated with Chip Select.
	DCS0_n..DCS1_n		DRAM corresponding register Chip Select signals.
	DCS2_n..DCS3_n or DC0..DC1		DRAM corresponding register Chip Select signals. These pins initiate DRAM address/command decodes, and as such exactly one will be LOW when a valid address/command is present which should be re-driven. Some of these have alternative functions: <ul style="list-style-type: none"> • DCS2_n ↔ DC0 • DCS3_n ↔ DC1
	DC2		DRAM corresponding register Chip ID 2 signal.
Input Address and Command bus	DA0..DA13, DA17 DBA0..DBA1, DBG0..DBG1	CMOS ⁽¹⁾ VREF based	DRAM corresponding register inputs. In case of an ACT command some of these terminals have an alternative function: DRAM corresponding register command signals <ul style="list-style-type: none"> • DA14 ↔ DWE_n • DA15 ↔ DCAS_n • DA16 ↔ DRAS_n
	DA14..DA16 or DWE_n, DCAS_n, DRAS_n		
	DACT_n		DRAM corresponding register DACT_n signal.
Clock inputs	CK_t, CK_c	CMOS differential	Differential master clock input pair to the PLL with a 10 kΩ ~ 100 kΩ pull-down resistor.
Reset input	DRST_n	CMOS input	Active LOW asynchronous reset input. When LOW, it causes a reset of the internal latches and disables the outputs, thereby forcing the outputs to float.
Parity input	DPAR	CMOS ⁽²⁾ VREF based	Input parity is received on pin DPAR and should maintain even parity across the address and command inputs (see above), at the rising edge of the input clock.
Error Input	ERROR_IN_n	CMOS input	DRAM address parity and CRC Alert is connected to this input pin, which in turn is buffered and re-driven to the ALERT_n output of the register. Requires external pull-up resistor. ⁽³⁾
Data buffer control and communication outputs	BODT	CMOS ⁽³⁾	Data buffer on-die termination signal.
	BCKE		Data buffer clock enable signal for PLL power management.
	BCOM[3:0]		Register communication bus for data buffer programming and control access.
	BCK_t, BCK_c	CMOS differential	Differential clock output pair to the data buffer
	BVREFCA	VDD/2Reference Voltage	Output reference voltage for data buffer control bus receivers.

(1) These receivers use VREFCA as the switching point reference.

(2) These receivers use VREFCA as the switching point reference.

(3) CMOS: These outputs with rail to rail signal swing and programmable impedance are optimized for memory applications to drive DRAM inputs over a terminated transmission line.

Error_In_n: Internal Pull-up resistor can be turned on.

Table 1. TERMINAL FUNCTIONS (continued)

SIGNAL		TYPE	DESCRIPTION
GROUP	NAME		
Output Control Bus	QACKE0/1, QAODT0/1, QBCKE0/1, QBODT0/1	CMOS	Register output CKE and ODT signals.
	QACS0_n..QACS1_n, QBSC0_n..QBSC1_n		Register output Chip Select signals.
	QACS2_n..QACS3_n, QBSC2_n..QBSC3_n or QAC0..QAC1, QBC0..QBC1		Register output Chip Select signals. These pins initiate DRAM address/command decodes, and as such exactly one will be LOW when a valid address/command is present which should be re-driven. Some of these have alternative functions (Chip ID): <ul style="list-style-type: none"> QxCS2_n ↔ QxC0 QxCS2_n ↔ QxC0
	QAC2, QBC2		Register output Chip ID2 signals.
Output Address and Command bus	QAA0..QAA13, QAA17, QBA0..QBA13, QBA17, QABA0..QABA1, QBBA0..QBBA1, QAG0..QAG1, QBG0..QBG1	CMOS	Outputs of the register, valid after the specified clock count and immediately following a rising edge of the clock.
	QAA14..QAA16, QBA14..QBA16 or QAWEn, QACAS_n, QARAS_n, QBWE_n, QBCAS_n, QBRAS_n		Outputs of the register, valid after the specified clock count and immediately following a rising edge of the clock. In case of an ACT command some of these terminals have an alternative function: <ul style="list-style-type: none"> QxA14 ↔ QxWE_n QxA15 ↔ QxCAS_n QxA16 ↔ QxRAS_n
	QAACT_n, QBACT_n		Outputs of the register, valid after the specified clock count and immediately following a rising edge of the clock.
Vref output	QVREFCA	VDD/2 Reference voltage	Output reference voltage for DRAM receivers
Clock outputs	Y0_t..Y3_t, Y0_c..Y3_c	CMOS differential	Re-driven clocks
Reset output	QRST_n	CMOS	Re-driven reset. This is not an asynchronous output.
Parity outputs	QAPAR, QBPAR		Re-driven parity ⁽⁴⁾
Error out	ALERT_n	Open drain	When LOW, this output indicates that a parity error was identified associated with the address and/or command inputs when parity checking is enabled or that the ERROR_IN_n input was asserted, regardless of whether parity checking is enabled or not.
I ² C pins	SDA SCL SA[2:0] BFUNC VDDSPD	Open drain I/O CMOS input CMOS input CMOS input Power input	I ² C Data I ² C Clock I ² C Address signals Reserved ⁽⁵⁾ I ² C power input

(4) I²C inputs: These inputs are 2.5V inputs, except BFUNC which is a 1.2V input.

(5) BFUNC has an internal pull-down resistor of 120 kΩ to V.

Table 1. TERMINAL FUNCTIONS (continued)

SIGNAL		TYPE	DESCRIPTION
GROUP	NAME		
Miscellaneous pins	VREFCA	VCC/2Reference voltage	Input reference voltage for the CMOS inputs.
	VDD	Power input	Power supply voltage
	VSS	Ground input	Ground
	AVDD	Analog power	Analog supply voltage
	PVDD	Clock power	Clock logic and clock output driver power supply.
	PVSS	Clock ground	Clock logic and clock output driver ground.
	ZQCAL	Reference	Needs a calibration resistor of $240\Omega \pm 1\%$ to VSS.
	NU	Mechanical ball	Do not connect on PCB.
	RFU[3:0]	I/O	Reserved; must be left floating on DIMM and in DDR4 register.

REVISION HISTORY

Change document to production data.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CAB4AZNRR	ACTIVE	NFBGA	ZNR	253	2000	RoHS & Green	SNAGCU	Level-3-260C-168 HR	0 to 0	CAB4A6	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CAB4AZNRR	NFBGA	ZNR	253	2000	330.0	24.4	8.3	13.8	1.8	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

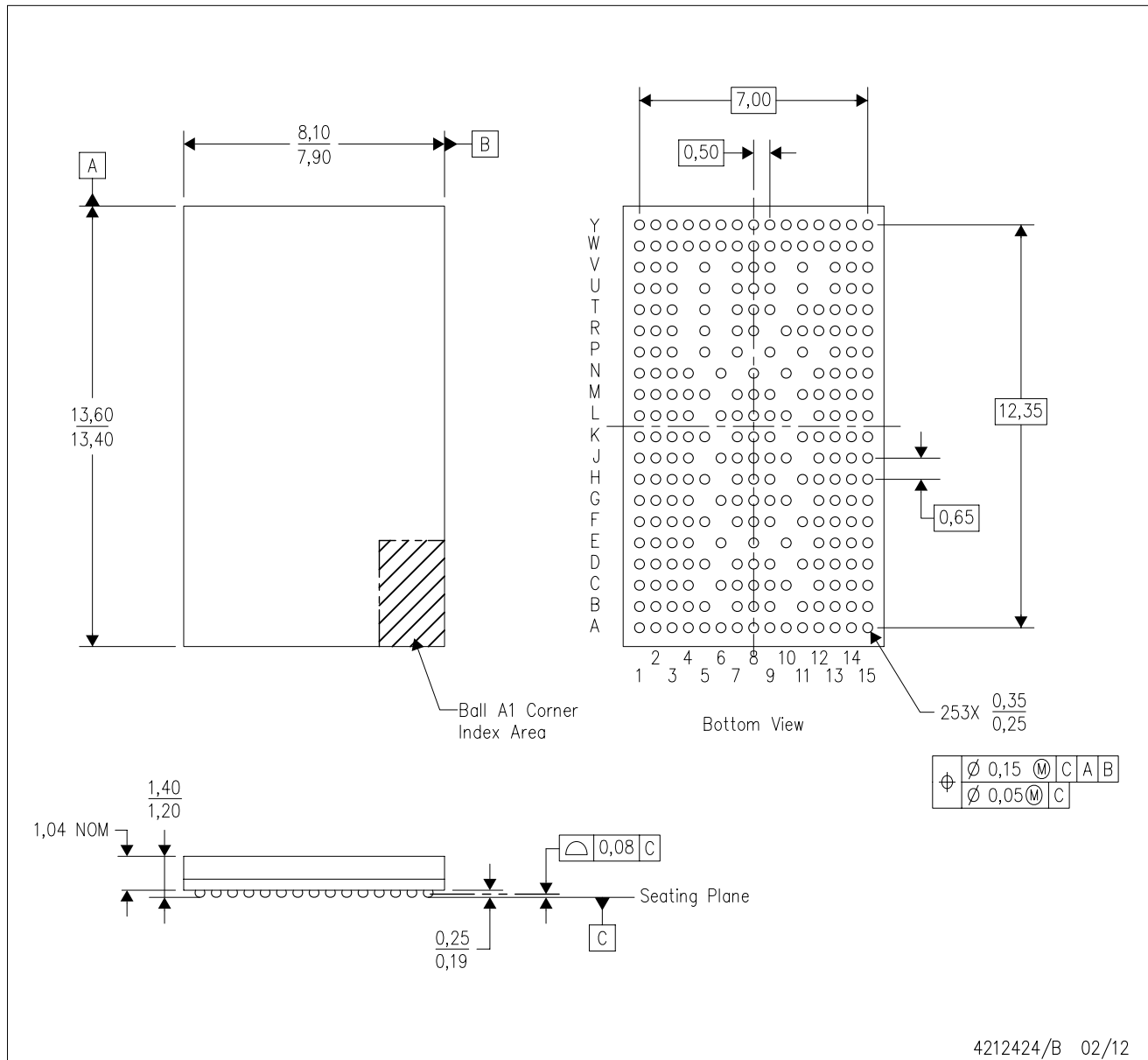


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CAB4AZNRR	NFBGA	ZNR	253	2000	367.0	367.0	38.0

ZNR (R-PBGA-N253)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. This package is Pb-free.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2020, Texas Instruments Incorporated