

SN74CBTU4411
11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER
1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS
 SCDS192 – APRIL 2005

- Supports SSTL_18 Signaling Levels
- Suitable for DDR-II Applications
- D-Port Outputs Are Precharged by Bias Voltage (V_{BIAS})
- Internal Termination for Control Inputs
- High Bandwidth (334 MHz Min)
- Low and Flat ON-State Resistance (r_{on}) Characteristics, ($r_{on} = 17 \Omega$ Max)
- Internal 400- Ω Pulldown Resistors
- Low Differential and Rising/Falling Edge Skew
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
 - 2000-V Human-Body Model (A114-B, Class II)
 - 1000-V Charged-Device Model (C101)

description/ordering information

The SN74CBTU4411 is a high-bandwidth, SSTL_18 compatible FET multiplexer/demultiplexer with low ON-state resistance (r_{on}). The device utilizes an internal charge pump to elevate the gate voltage of the pass transistor, providing a low and flat r_{on} . The low and flat r_{on} allows for minimal propagation delay and supports rail-to-rail signaling on data input/output (I/O) ports. The device also features very low data I/O capacitance to minimize capacitive loading and signal distortion on the data bus. Matched r_{on} and I/O capacitance among channels results in extremely low differential and rising/falling edge skew. This allows the device to show optimal performance in DDR-II applications.

The device is organized as an 11-bit 1-of-4 multiplexer/demultiplexer with a single switch-enable (\overline{EN}) input. When \overline{EN} is low, the switch is enabled and the H port is connected to one of the D ports. Ports D0 to D9 for the disabled channels are connected to V_{BIAS} through a 400 Ω resistor. DQS_EN determines the output voltage for the disabled D10 ports. When DQS_EN is low, this voltage is V_{BIAS} . When DQS_EN is high, the disabled D10 ports are connected to an internal voltage (V_{BIAS_DQS}) source, which is approximately equal to 0.7 V_{DD} .

When \overline{EN} is high, all the channels are disabled. Ports D0 to D9 are connected to V_{BIAS} . For the D10 port, the disabled output voltage is determined by the DQS_EN input. When DQS_EN is low, this voltage is V_{BIAS} . When DQS_EN is high, this voltage is V_{DD} .

The select (S0, S1) inputs control the data path of each multiplexer/demultiplexer. The \overline{EN} and TC inputs determine the internal termination for S0 and S1 inputs. When \overline{EN} is low, the termination is determined by the TC input. When both \overline{EN} and TC are low, termination resistors are disconnected from the S inputs. When \overline{EN} is low and TC is high, both pullup and pulldown resistors are connected to the S inputs. When \overline{EN} is high, only the pulldown termination resistors are connected to the S inputs, regardless of the voltage level at the TC input.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 85°C	LFBGA – GST	Tape and reel	SN74CBTU4411GSTR	CTU4411

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

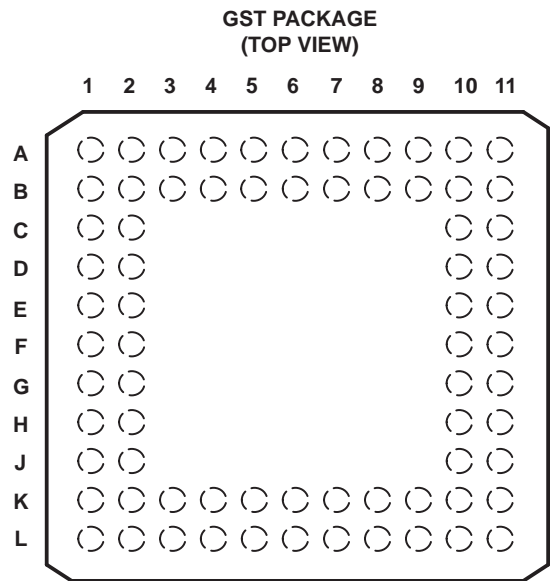
Copyright © 2005, Texas Instruments Incorporated

SN74CBTU4411

11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER

1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS

SCDS192 – APRIL 2005



terminal assignments

	1	2	3	4	5	6	7	8	9	10	11
A	S1	DQS_EN	V _{DD}	0D0	1D0	2D0	1D1	2D1	3D1	0D2	1D2
B	TC	S0	V _{DD}	GND	H0	3D0	0D1	H1	GND	H2	2D2
C	V _{REF}	$\overline{\text{EN}}$								0D3	3D2
D	V _{BIAS}	GND								H3	1D3
E	2D10	3D10								2D3	3D3
F	1D10	H10								GND	0D4
G	0D10	GND								H4	1D4
H	3D9	2D9								2D4	3D4
J	1D9	H9								1D5	0D5
K	0D9	GND	H8	0D8	H7	0D7	GND	H6	0D6	H5	2D5
L	3D8	2D8	1D8	3D7	2D7	1D7	3D6	2D6	1D6	V _{DD}	3D5

SN74CBTU4411
11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER
1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS
SCDS192 – APRIL 2005

FUNCTION TABLES

INPUTS				INPUT/OUTPUT Hn	FUNCTION
$\overline{\text{EN}}$	DQS_EN	S1	S0		
L	L	L	L	0Dn	Hn = 0Dn 1Dn, 2Dn, 3Dn connected to V _{BIAS}
L	L	L	H	1Dn	Hn = 1Dn 0Dn, 2Dn, 3Dn connected to V _{BIAS}
L	L	H	L	2Dn	Hn = 2Dn 0Dn, 1Dn, 3Dn connected to V _{BIAS}
L	L	H	H	3Dn	Hn = 3Dn 0Dn, 1Dn, 2Dn connected to V _{BIAS}
L	H	L	L	0Dn	H0–H9 = 0D0–0D9 1D0–1D9, 2D0–2D9, 3D0–3D9 connected to V _{BIAS} H10 = 0D10 1D10, 2D10, 3D10 connected to V _{BIAS} _DQS [†]
L	H	L	H	1Dn	H0–H9 = 1D0–1D9 0D0–0D9, 2D0–2D9, 3D0–3D9 connected to V _{BIAS} H10 = 1D10 0D10, 2D10, 3D10 connected to V _{BIAS} _DQS [†]
L	H	H	L	2Dn	H0–H9 = 2D0–2D9 0D0–0D9, 1D0–1D9, 3D0–3D9 connected to V _{BIAS} H10 = 2D10 0D10, 1D10, 3D10 connected to V _{BIAS} _DQS [†]
L	H	H	H	3Dn	H0–H9 = 3D0–3D9 0D0–0D9, 1D0–1D9, 2D0–2D9 connected to V _{BIAS} H10 = 3D10 0D10, 1D10, 2D10 connected to V _{BIAS} _DQS [†]
H	L	X	X	Z	0Dn, 1Dn, 2Dn, 3Dn connected to V _{BIAS}
H	H	X	X	Z	0D0–0D9, 1D0–1D9, 2D0–2D9, 3D0–3D9 connected to V _{BIAS} 0D10, 1D10, 2D10, 3D10 connected to V _{DD}

[†] V_{BIAS}_DQS is an internal voltage condition.

INPUTS		FUNCTION
$\overline{\text{EN}}$	TC	
L	L	Termination resistors disconnected from S inputs
L	H	Termination resistors connected with S inputs
H	X	Pulldown termination resistor connected and pullup termination resistor disconnected from the S inputs

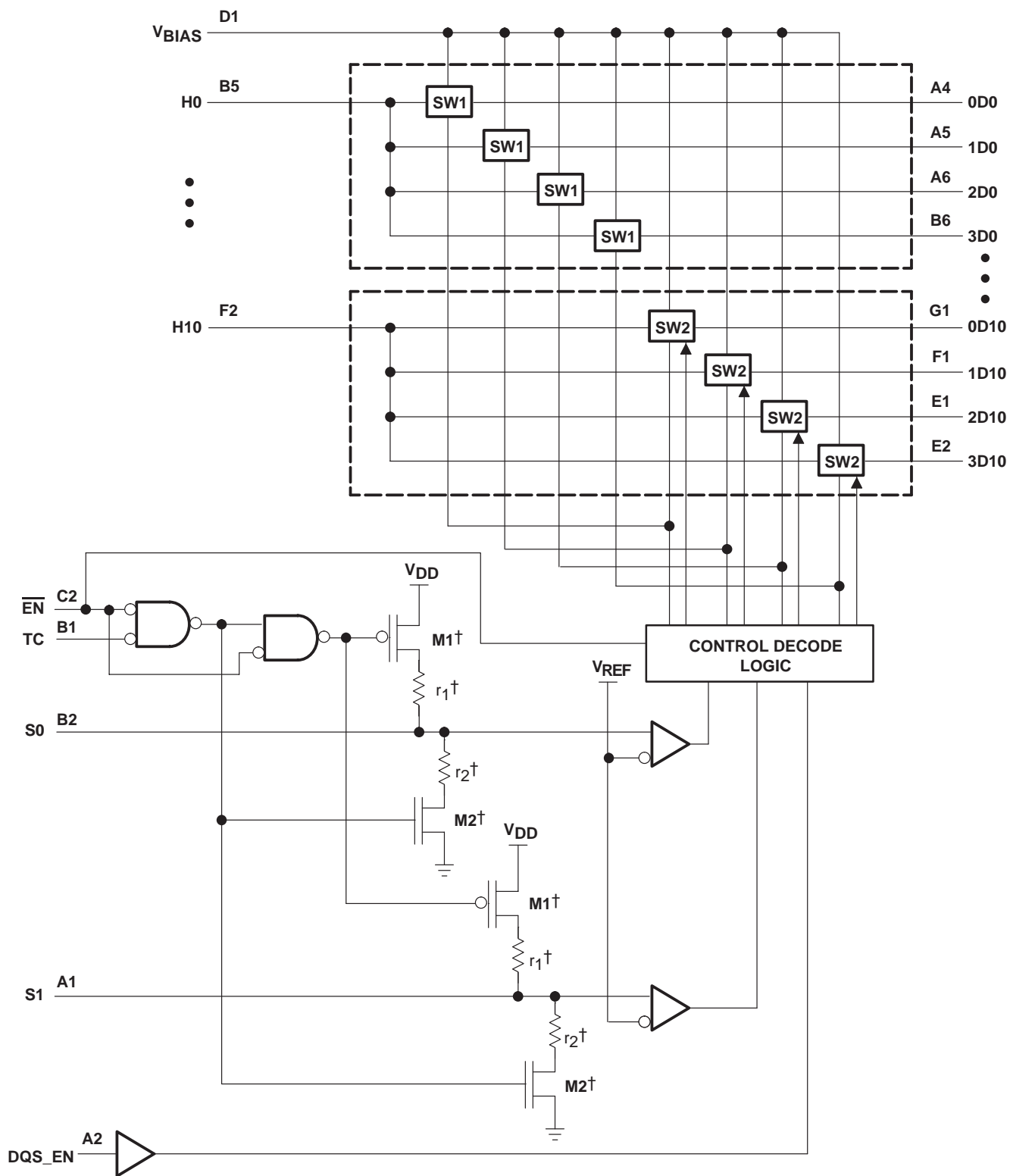
SN74CBTU4411

11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER

1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS

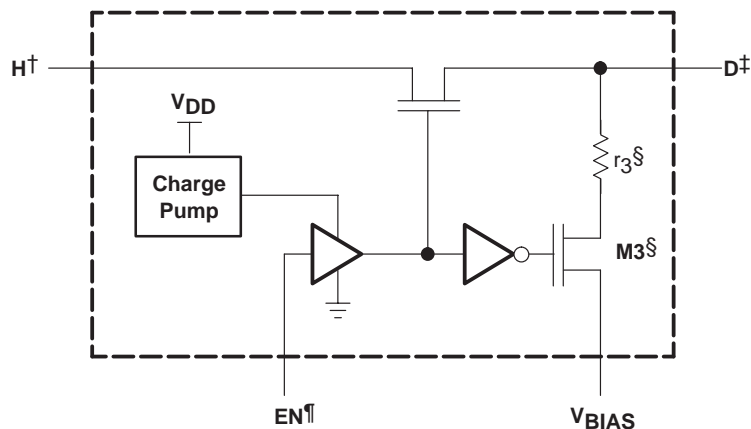
SCDS192 – APRIL 2005

logic diagram (positive logic)



† $r_1 + r_{on}(M1)$, $r_2 + r_{on}(M2) = 160\ \Omega$ Typical.

simplified schematic, each FET switch (SW1)



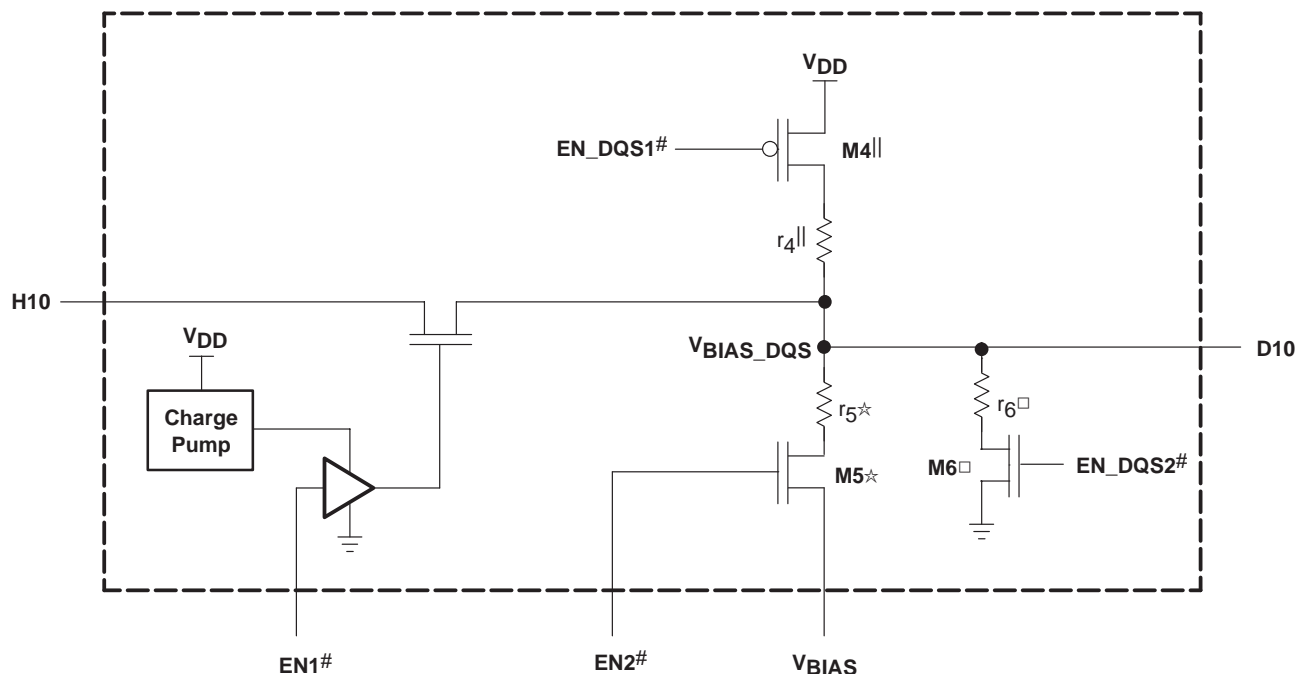
† Applicable for ports H0 through H9

‡ Applicable for ports D0 through D9

§ $r_3 + r_{on}(M3) = 400\ \Omega$ Typical.

¶ EN is the internal enable signal applied to the switch.

simplified schematic, each FET switch (SW2)



EN_DQS1, EN_DQS2, EN1, and EN2 are the internal enable signals applied to the switch.

|| $r_4 + r_{on}(M4) = 1\ \text{k}\Omega$ Typical.

☆ $r_5 + r_{on}(M5) = 400\ \Omega$ Typical.

□ $r_6 + r_{on}(M6) = 2.3\ \text{k}\Omega$ Typical.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{DD}	–0.5 V to 2.5 V
Control input voltage range, V_{IN} (see Notes 1 and 2)	–0.5 V to 2.5 V
Switch I/O voltage range, $V_{I/O}$ (see Notes 1, 2, and 3)	–0.5 V to 2.5 V
Control input clamp current, I_{IK} ($V_{IN} < 0$ or $V_{IN} > 0$)	±50 mA
I/O port clamp current, $I_{I/OK}$ ($V_{I/O} < 0$ or $V_{I/O} > 0$)	±50 mA
ON-state switch current, $I_{I/O}$ (see Note 4)	±100 mA
Continuous current through V_{DD} or GND terminals	±100 mA
Package thermal impedance, θ_{JA} (see Note 5)	TBD°C/W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltages are with respect to ground, unless otherwise specified.
 2. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 3. V_I and V_O are used to denote specific conditions for $V_{I/O}$.
 4. I_I and I_O are used to denote specific conditions for $I_{I/O}$.
 5. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 6)

		MIN	TYP	MAX	UNIT
V _{DD}	Supply voltage	1.7	1.8	1.9	V
V _{REF}	Reference supply voltage	0.49 V _{DD}	0.5 V _{DD}	0.51 V _{DD}	V
V _{BIAS}	BIAS supply voltage	0	0.3 V _{DD}	0.33 V _{DD}	V
V _{IH}	High-level control input voltage (S)	V _{REF} +250 mV			V
	High-level control input voltage ($\overline{\text{EN}}$, TC, DQS_EN)	0.65 V _{DD}			
V _{IL}	Low-level control input voltage (S)	V _{REF} –250 mV			V
	Low-level control input voltage ($\overline{\text{EN}}$, TC, DQS_EN)	0.35 V _{DD}			
V _{I/O}	Data input/output voltage	0		V _{DD}	V
T _A	Operating free-air temperature	0		85	°C

NOTE 6: All unused control inputs of the device must be held at V_{DD} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

SN74CBTU4411
11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER
1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS

SCDS192 – APRIL 2005

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T _A = 70 °C		T _A = 0 °C TO 85 °C			UNIT
			MIN	MAX	MIN	TYP†	MAX	
V _{IK} ‡	Control inputs§	V _{DD} = 1.7 V, I _{IN} = –18 mA					–1.8	V
V _{BIAS_DQS}	D10	V _{DD} = 1.7 V, DQS_EN = V _{DD}			1.1		1.275	V
V _{OH}	D10	V _{DD} = 1.7 V, DQS_EN = V _{DD} , $\overline{\text{EN}} = \text{V}_{\text{DD}}$, I _O = 100 µA			1.6		1.8	V
I _{IN}	Control inputs§	V _{DD} = 1.9 V, V _{IN} = V _{DD} or GND					±1	µA
I _{OZ} ¶		V _{DD} = 1.9 V, V _O = 0 to 1.9 V, V _I = 0, Switch OFF, V _{BIAS} open					±10	µA
I _{CC}		V _{DD} = 1.9 V, TC = GND, $\overline{\text{EN}} = \text{GND}$, S0, S1 = V _{IH} or V _{IL} , Switch ON or OFF			0.7		2.5	mA
		$\overline{\text{EN}} = \text{V}_{\text{DD}}$					500	µA
I _{CCD}		V _{DD} = 1.9 V, TC = GND, $\overline{\text{EN}} = \text{GND}$, I _O = 0, S0 or S1 input switching at 50% duty cycle, Data I/O are open					0.5	mA/MHz#
C _{in}	S port	V _{DD} = 1.9 V, TC = GND, $\overline{\text{EN}} = \text{GND}$, V _{IN} = V _{REF} ± 250 mV			2.5		3.5	pF
	$\overline{\text{EN}}$, TC, DQS_EN inputs	V _{DD} = 1.9 V, V _{IN} = 0 or 1.9 V			2.5			pF
C _{io(OFF)}	H port	V _{I/O} = 0.5 V _{DD} ± 0.4 V, Switch OFF, V _{BIAS} open					2.5	pF
C _{io(ON)}		V _{I/O} = 0.5 V _{DD} ± 0.4 V, Switch ON, V _{BIAS} = GND					4.6	pF
r _{on}		V _{DD} = 1.7 V, V _I = 0.5 V _{DD} ± 0.5 V, I _O = 10 mA			6	10	17	Ω
Δr _{on} (flat)★		V _{DD} = 1.7 V, DQS_EN = V _{DD} , I _O = 10 mA, V _I = 0.5 V _{DD} ± 0.25 V			1.5		3	Ω
		V _I = 0.5 V _{DD} ± 0.5 V			2.5		5	Ω
r _{term}	S port	V _{DD} = 1.7 V			110	160	210	Ω
r _{pulldown}	D0–D10	V _{DD} = 1.7 V, DQS_EN = GND			280	400	520	Ω
	D10	V _{DD} = 1.7 V, DQS_EN = V _{DD} , $\overline{\text{EN}} = \text{GND}$			1600	2300	3000	
r _{pullup}	D10	V _{DD} = 1.7 V, DQS_EN = V _{DD} , $\overline{\text{EN}} = \text{GND}$			700	1000	1300	Ω

V_{IN} and I_{IN} refer to control inputs. V_I, V_O, I_I, and I_O refer to data pins.

† All typical values are at V_{DD} = 1.8 V (unless otherwise noted), T_A = 25°C.

‡ V_{IK} refers to the clamp voltage due to the internal diode, which is connected from each control input to GND.

§ For the leakage current test on S0 and S1, $\overline{\text{EN}}$ and TC inputs are set to low.

¶ For I/O ports, the parameter I_{OZ} includes the input leakage current. I_{OZ} applies only to the H port.

The frequency of S0 and S1 inputs, for example, for a data I/O rate of 533 Mbit/s, with a burst of 4, the required frequency is for S0 or S1 input is ≅ 66 MHz (533/8). The total I_{CC} due to switching S0, S1 will be approximately 27 mA (66 MHz × 0.4 mA/MHz).

|| Measured by the voltage drop between the D and H terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (D or H) terminals.

★ Δr_{on}(flat) is the difference of maximum r_{on} and minimum r_{on} for a specific channel in a specific device.



SN74CBTU4411**11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER****1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS**

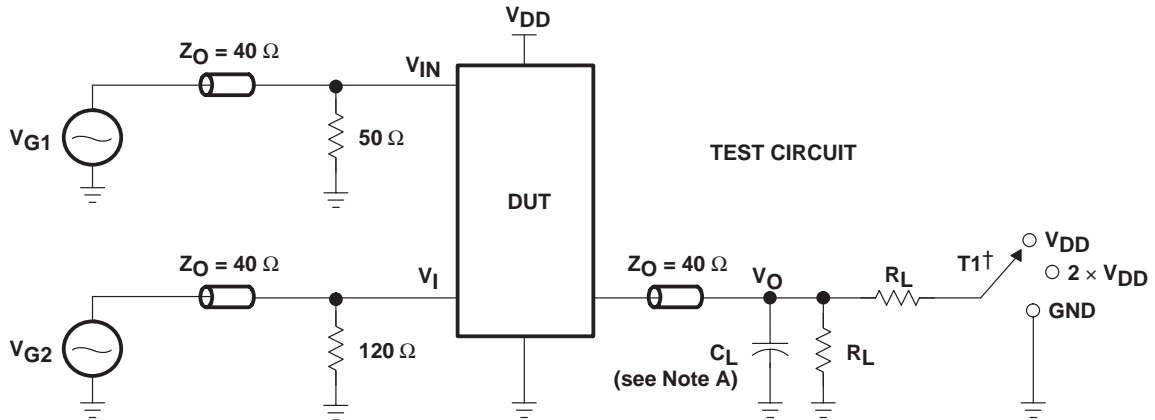
SCDS192 – APRIL 2005

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figures 1 and 2)

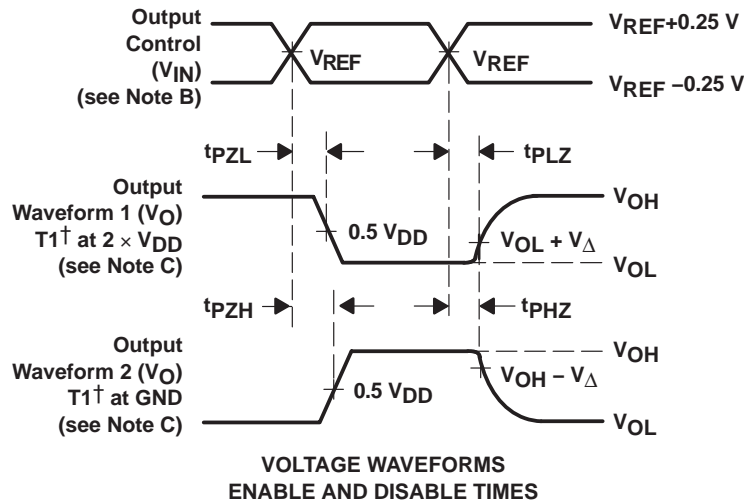
PARAMETER		FROM (INPUT)	TO (OUTPUT)	T _A = 70 °C		T _A = 0 °C TO 85 °C			UNIT
				MIN	MAX	MIN	TYP	MAX	
f _{max}	D or H port					334			MHz
	S port†					84			
t _{pd}		H or D	D or H			297			ps
t _{en} (t _{PZL} , t _{PZH})‡		S	D			750		2100	ps
t _{dis} (t _{PLZ} , t _{PHZ})‡		S	D			750		2100	ps
t _{osk}								85	ps
t _{esk}								40	ps
t _{start} §							20		μs

† $\overline{\text{EN}}$ = GND, TC = GND‡ V_{BIAS} = open§ t_{start} is the time required for the charge-pump circuit output voltage to reach a steady state value after V_{DD} is applied.

PARAMETER MEASUREMENT INFORMATION
(Enable and Disable Times)



TEST	V _{DD}	T1 [†]	R _L	V _I	C _L	V _Δ
t _{PLZ} /t _{PZL}	1.8 V ± 0.1 V	2 × V _{DD}	1 kΩ	GND	6 pF	0.125 V
t _{PHZ} /t _{PZH}	1.8 V ± 0.1 V	GND	1 kΩ	V _{DD}	6 pF	0.125 V



[†] T1 is an external terminal.

- NOTES: A. C_L includes probe and jig capacitance.
 B. Output control applies to select (S0, S1) inputs.
 C. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 D. All input pulses are supplied by generators having the following characteristics: Z_{OS} = 50 Ω, rising and falling edge rate is 1 V/ns.
 E. The outputs are measured one at a time, with one transition per measurement.
 F. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
 G. t_{PZL} and t_{PZH} are the same as t_{en}.

Figure 1. Test Circuit and Voltage Waveforms

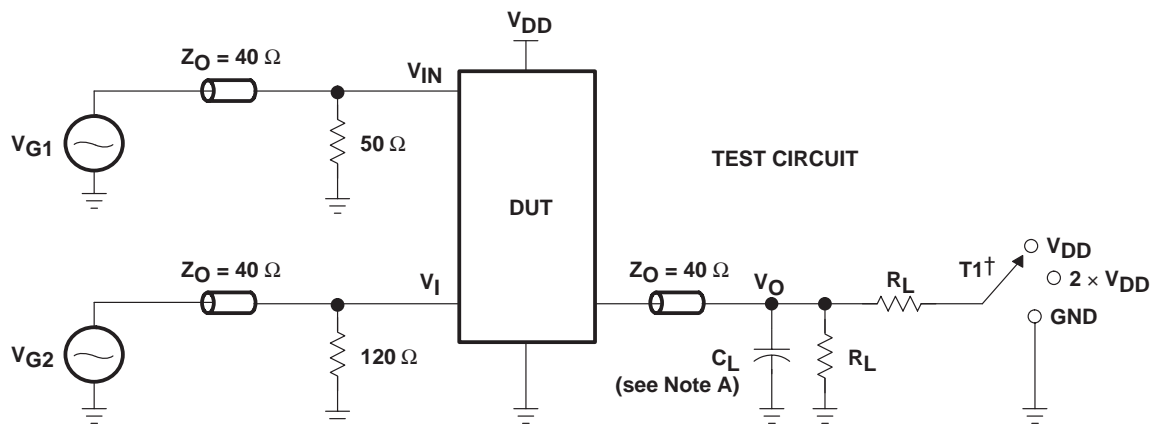
SN74CBTU4411

11-BIT 1-OF-4 FET MULTIPLEXER/DEMULTIPLEXER

1.8-V DDR-II SWITCH WITH CHARGE PUMP AND PRECHARGED OUTPUTS

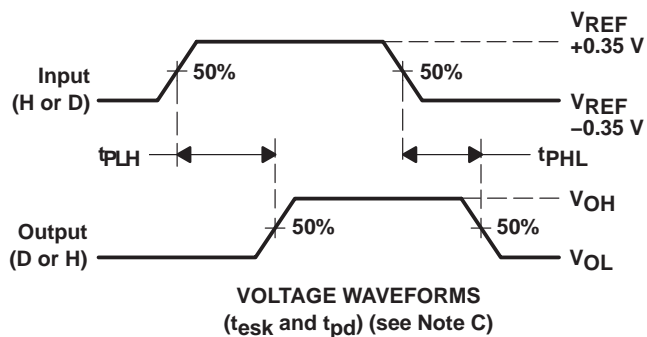
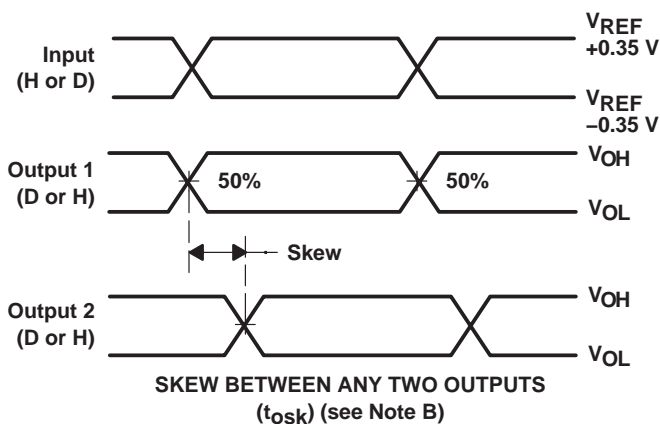
SCDS192 – APRIL 2005

PARAMETER MEASUREMENT INFORMATION (Skew and Propagation Delay Times)



TEST	V _{DD}	T1†	R _L	V _I	C _L
t _{pd}	1.8 V ± 0.1 V	V _{DD}	150 Ω	see Waveform	6 pF
t _{osk}	1.8 V ± 0.1 V	V _{DD}	150 Ω	see Waveform	6 pF
t _{esk}	1.8 V ± 0.1 V	V _{DD}	150 Ω	see Waveform	6 pF

† T1 is an external terminal.

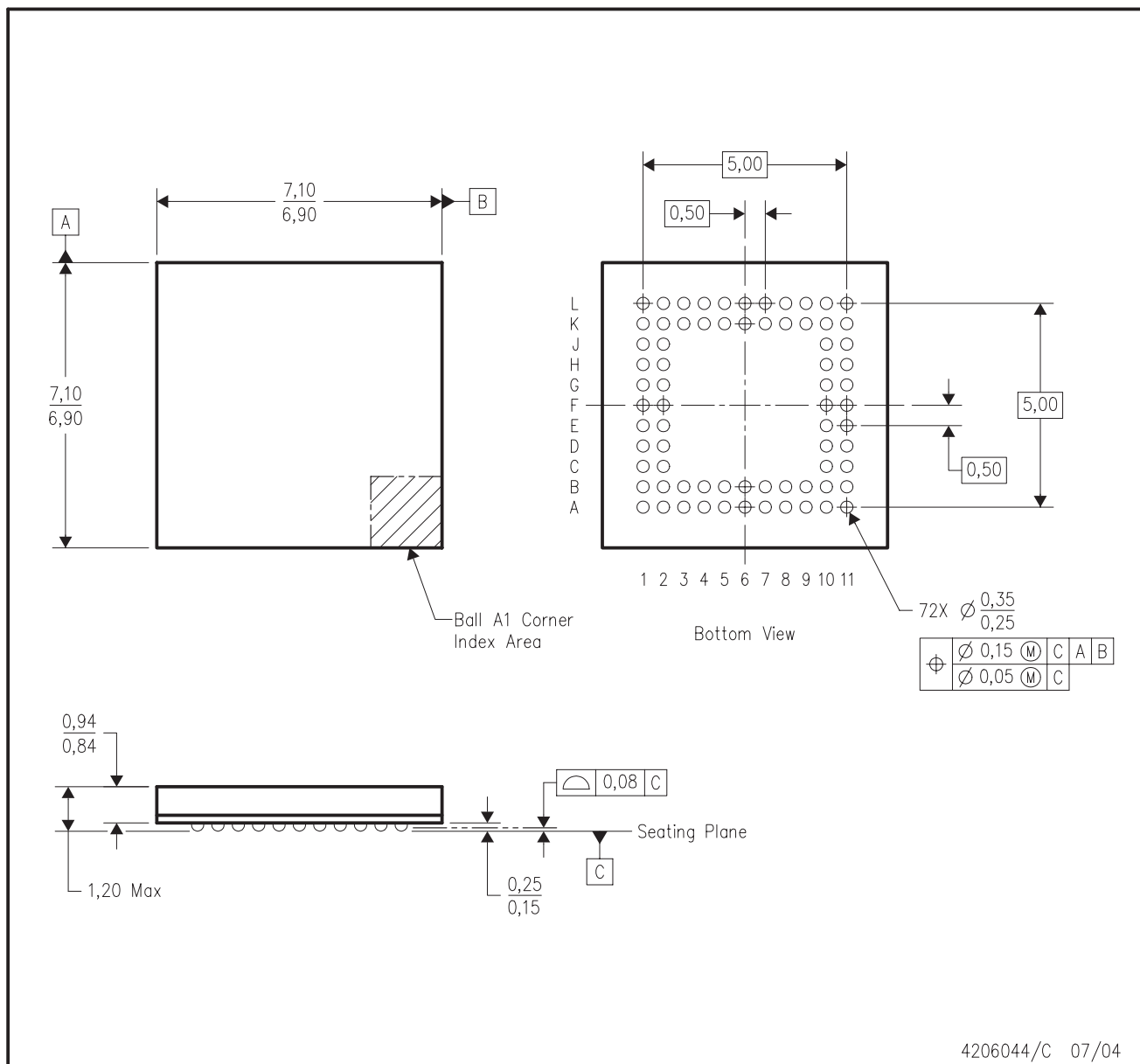


- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. t_{osk} is the difference in output voltage from channel to channel in a specific device.
 - C. t_{PLH} and t_{PHL} are the same as t_{pd} and t_{esk} = |t_{PLH} - t_{PHL}|
 - D. All input pulses are supplied by generators having the following characteristics: Z_{OS} = 50 Ω, rising and falling edge rate is 1 V/ns.
 - E. The outputs are measured one at a time, with one transition per measurement.

Figure 2. Test Circuit and Voltage Waveforms

ZST (S-PBGA-N72)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. JEDEC MO-225 registration is pending.
 - D. This package is lead-free. Refer to the 72 GST package (drawing 4206043) for tin-lead (SnPb).

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74CBTU4411GSTR	PREVIEW	BGA	GST	72	2000	TBD	Call TI	Call TI
SN74CBTU4411ZSTR	ACTIVE	BGA	ZST	72	2000	Pb-Free (RoHS)	SNAGCU	Level-3-260C-168 HR

⁽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.

OBSELETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

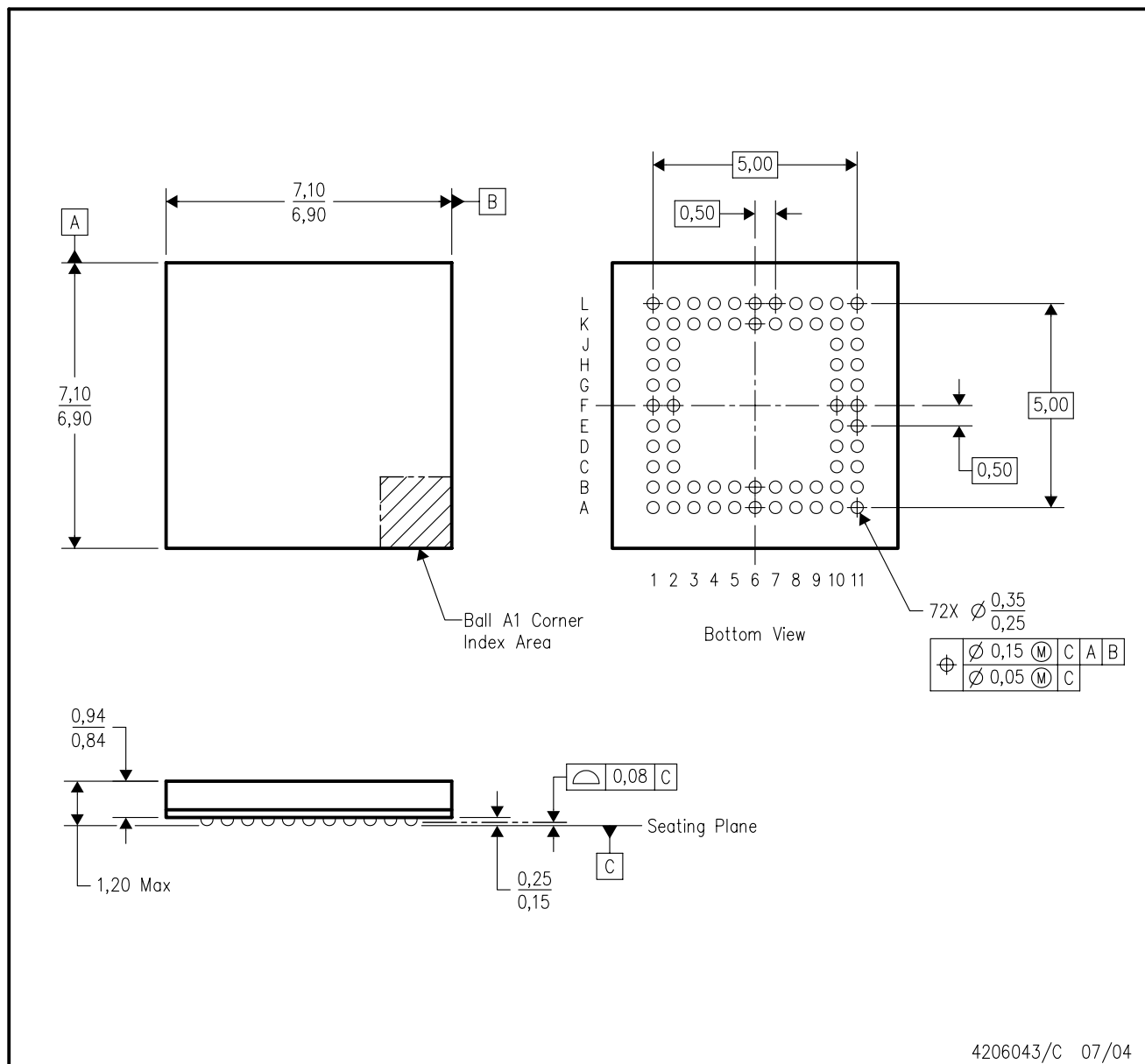
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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.

GST (S-PBGA-N72)

PLASTIC BALL GRID ARRAY

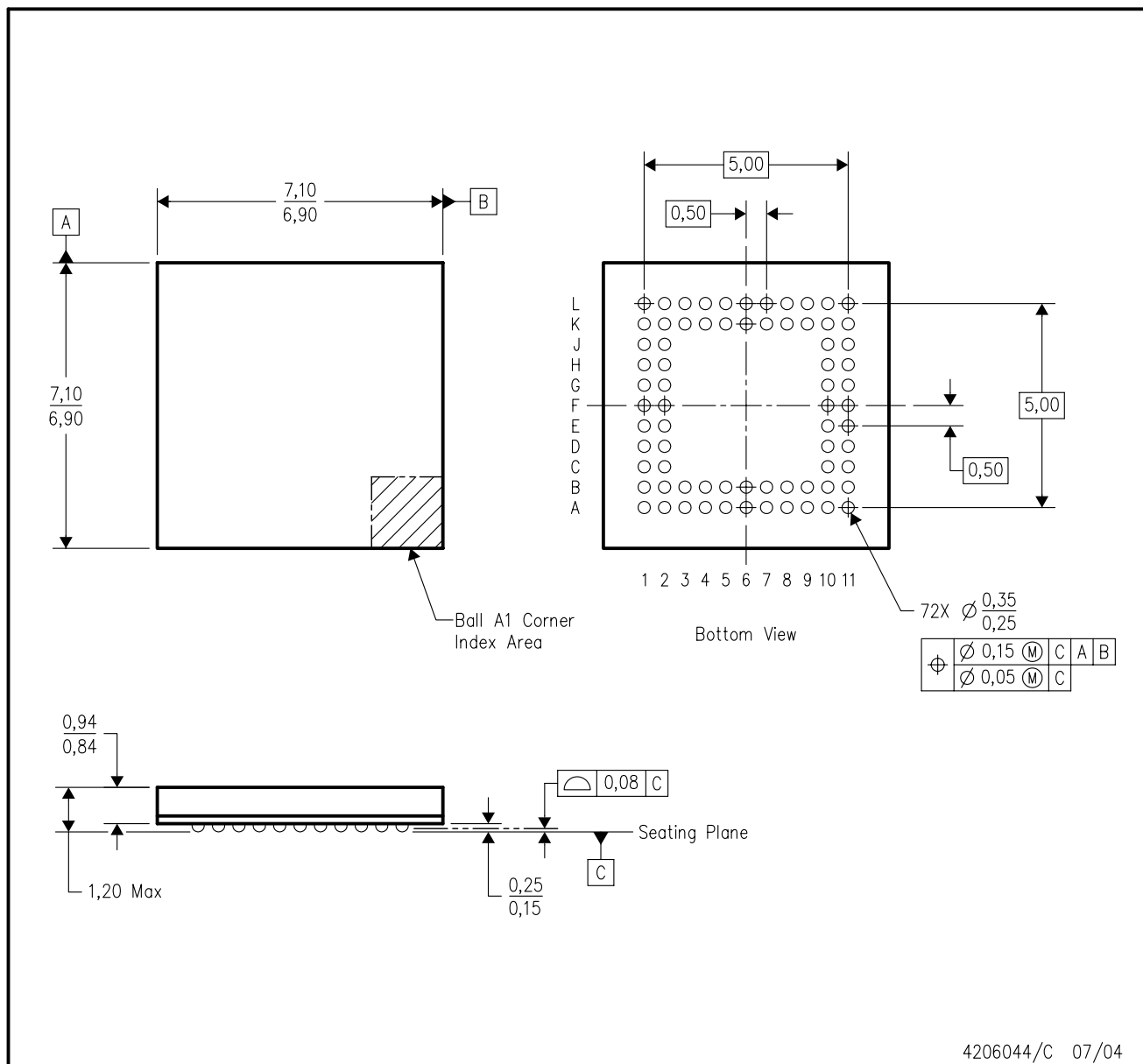


NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- JEDEC MO-225 registration is pending.
- This package is tin-lead (SnPb). Refer to the 72 ZST package (drawing 4206044) for lead-free.

ZST (S-PBGA-N72)

PLASTIC BALL GRID ARRAY



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - JEDEC MO-225 registration is pending.
 - This package is lead-free. Refer to the 72 GST package (drawing 4206043) for tin-lead (SnPb).

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

Copyright © 2005, Texas Instruments Incorporated