

SN74CB3Q3245

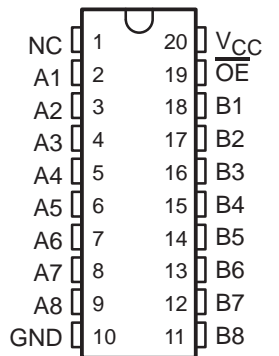
8-BIT FET BUS SWITCH

2.5-V/3.3-V LOW-VOLTAGE HIGH-BANDWIDTH BUS SWITCH

SCDS124B – JULY 2003 – REVISED NOVEMBER 2003

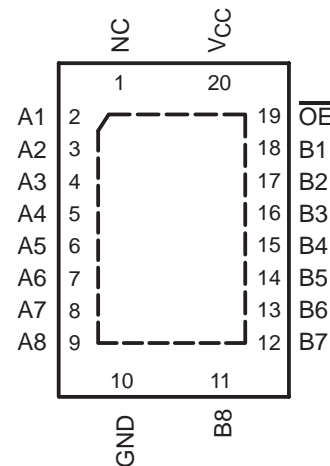
- High-Bandwidth Data Path (Up to 500 MHz†)
 - Equivalent to IDTQS3VH384 Device
 - 5-V Tolerant I/Os with Device Powered-Up or Powered-Down
 - Low and Flat ON-State Resistance (r_{on}) Characteristics Over Operating Range ($r_{on} = 4 \Omega$ Typical)
 - Rail-to-Rail Switching on Data I/O Ports
 - 0- to 5-V Switching With 3.3-V V_{CC}
 - 0- to 3.3-V Switching With 2.5-V V_{CC}
 - Bidirectional Data Flow, With Near-Zero Propagation Delay
 - Low Input/Output Capacitance Minimizes Loading and Signal Distortion ($C_{iO(OFF)} = 3.5$ pF Typical)
 - Fast Switching Frequency ($f_{OE} = 20$ MHz Max)
- † For additional information regarding the performance characteristics of the CB3Q family, refer to the TI application report, *CBT-C*, *CB3T*, and *CB3Q Signal-Switch Families*, literature number SCDA008.
- Data and Control Inputs Provide Undershoot Clamp Diodes
 - Low Power Consumption ($I_{CC} = 1$ mA Typical)
 - V_{CC} Operating Range From 2.3 V to 3.6 V
 - Data I/Os Support 0 to 5-V Signaling Levels (0.8-V, 1.2-V, 1.5-V, 1.8-V, 2.5-V, 3.3-V, 5-V)
 - Control Inputs Can be Driven by TTL or 5-V/3.3-V CMOS Outputs
 - I_{off} Supports Partial-Power-Down Mode Operation
 - 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)
 - Supports Both Digital and Analog Applications: PCI Interface, Differential Signal Interface, Memory Interleaving, Bus Isolation, Low-Distortion Signal Gating

DBQ, DGV, OR PW PACKAGE
(TOP VIEW)



NC – No internal connection

RGY PACKAGE
(TOP VIEW)



NC – No internal connection



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description/ordering information

The SN74CB3Q3245 is a high-bandwidth FET bus switch utilizing a charge pump to elevate the gate voltage of the pass transistor, providing a low and flat ON-state resistance (r_{on}). The low and flat ON-state resistance allows for minimal propagation delay and supports rail-to-rail switching on the data input/output (I/O) ports. The device also features low data I/O capacitance to minimize capacitive loading and signal distortion on the data bus. Specifically designed to support high-bandwidth applications, the SN74CB3Q3245 provides an optimized interface solution ideally suited for broadband communications, networking, and data-intensive computing systems.

The SN74CB3Q3245 is organized as an 8-bit bus switch with a single output-enable (\overline{OE}) input. When \overline{OE} is low, the bus switch is ON and the A port is connected to the B port, allowing bidirectional data flow between ports. When \overline{OE} is high, the bus switch is OFF and a high-impedance state exists between the A and B ports.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry prevents damaging current backflow through the device when it is powered down. The device has isolation during power off.

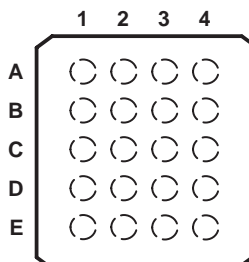
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	QFN – RGY	Tape and reel	SN74CB3Q3245RGYR	BU245
	SSOP (QSOP) – DBQ	Tape and reel	SN74CB3Q3245DBQR	CB3Q3245
	TSSOP – PW	Tube	SN74CB3Q3245PW	BU245
		Tape and reel	SN74CB3Q3245PWR	
	TVSOP – DGV	Tape and reel	SN74CB3Q3245DGVR	BU245
VFBGA – GQN	Tape and reel	SN74CB3Q3245GQNR	BU245	

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

GQN PACKAGE (TOP VIEW)



terminal assignments

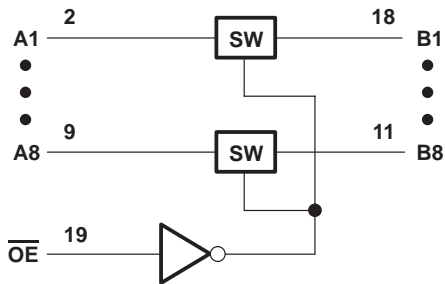
	1	2	3	4
A	A1	NC	V_{CC}	\overline{OE}
B	A3	B2	A2	B1
C	A5	A4	B4	B3
D	A7	B6	A6	B5
E	GND	A8	B8	B7

NC – No internal connection

FUNCTION TABLE

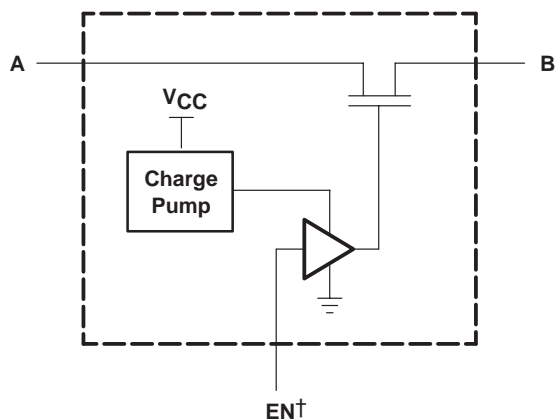
INPUT \overline{OE}	INPUT/OUTPUT A	FUNCTION
L	B	A port = B port
H	Z	Disconnect

logic diagram (positive logic)



Pin numbers shown are for the DBQ, DGV, PW, and RGY packages.

simplified schematic, each FET switch (SW)



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

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

Supply voltage range, V_{CC}	–0.5 V to 4.6 V
Control input voltage range, V_{IN} (see Notes 1 and 2)	–0.5 V to 7 V
Switch I/O voltage range, $V_{I/O}$ (see Notes 1, 2, and 3)	–0.5 V to 7 V
Control input clamp current, I_{IK} ($V_{IN} < 0$)	–50 mA
I/O port clamp current, $I_{I/OK}$ ($V_{I/O} < 0$)	–50 mA
ON-state switch current, $I_{I/O}$ (see Note 4)	±64 mA
Continuous current through V_{CC} or GND terminals	±100 mA
Package thermal impedance, θ_{JA} (see Note 5): DBQ package	68°C/W
(see Note 5): DGV package	92°C/W
(see Note 5): GQN package	78°C/W
(see Note 5): PW package	83°C/W
(see Note 6): RGY package	37°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.
6. The package thermal impedance is calculated in accordance with JESD 51-5.

recommended operating conditions (see Note 7)

		MIN	MAX	UNIT	
V_{CC}	Supply voltage	2.3	3.6	V	
V_{IH}	High-level control input voltage	$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	5.5	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2	5.5	
V_{IL}	Low-level control input voltage	$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0	0.7	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	0	0.8	
$V_{I/O}$	Data input/output voltage	0	5.5	V	
T_A	Operating free-air temperature	–40	85	°C	

NOTE 7: All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V _{IK}		V _{CC} = 3.6 V,	I _I = -18 mA			-1.8	V
I _{IN}	Control inputs	V _{CC} = 3.6 V,	V _{IN} = 0 to 5.5 V			±1	μA
I _{OZ} ‡		V _{CC} = 3.6 V,	V _O = 0 to 5.5 V, V _I = 0, Switch OFF, V _{IN} = V _{CC} or GND			±1	μA
I _{off}		V _{CC} = 0,	V _O = 0 to 5.5 V, V _I = 0			1	μA
I _{CC}		V _{CC} = 3.6 V,	I _{I/O} = 0, Switch ON or OFF, V _{IN} = V _{CC} or GND		1	2	mA
ΔI _{CC} §	Control inputs	V _{CC} = 3.6 V,	One input at 3 V, Other inputs at V _{CC} or GND			30	μA
I _{CCD} ¶		V _{CC} = 3.6 V,	A and B ports open, Control input switching at 50% duty cycle		0.30	0.35	mA/ MHz
C _{in}	Control inputs	V _{CC} = 3.3 V,	V _{IN} = 5.5 V, 3.3 V, or 0		2.5	3.5	pF
C _{io} (OFF)		V _{CC} = 3.3 V,	Switch OFF, V _{IN} = V _{CC} or GND, V _{I/O} = 5.5 V, 3.3 V, or 0		3.5	5	pF
C _{io} (ON)		V _{CC} = 3.3 V,	Switch ON, V _{IN} = V _{CC} or GND, V _{I/O} = 5.5 V, 3.3 V, or 0		9	11	pF
r _{on} #	V _{CC} = 2.3 V, TYP at V _{CC} = 2.5 V	V _I = 0,	I _O = 30 mA		4	8	Ω
		V _I = 1.7 V,	I _O = -15 mA		4.5	9	
	V _{CC} = 3 V	V _I = 0,	I _O = 30 mA		4	6	
		V _I = 2.4 V,	I _O = -15 mA		4	8	

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_{CC} = 3.3 V (unless otherwise noted), T_A = 25°C.

‡ For I/O ports, the parameter I_{OZ} includes the input leakage current.

§ This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.

¶ This parameter specifies the dynamic power-supply current associated with the operating frequency of a single control input (see Figure 2).

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

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	
f _{OE}	\overline{OE}	A or B		10		20	MHz
t _{pd} *†	A or B	B or A		0.12		0.20	ns
t _{en}	\overline{OE}	A or B	1.5	7.5	1.5	6.5	ns
t _{dis}	\overline{OE}	A or B	1	6.5	1	6.5	ns

|| Maximum switching frequency for control input (V_O > V_{CC}, V_I = 5 V, R_L ≥ 1 MΩ, C_L = 0)

*† The propagation delay is the calculated RC time constant of the typical ON-state resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero output impedance).

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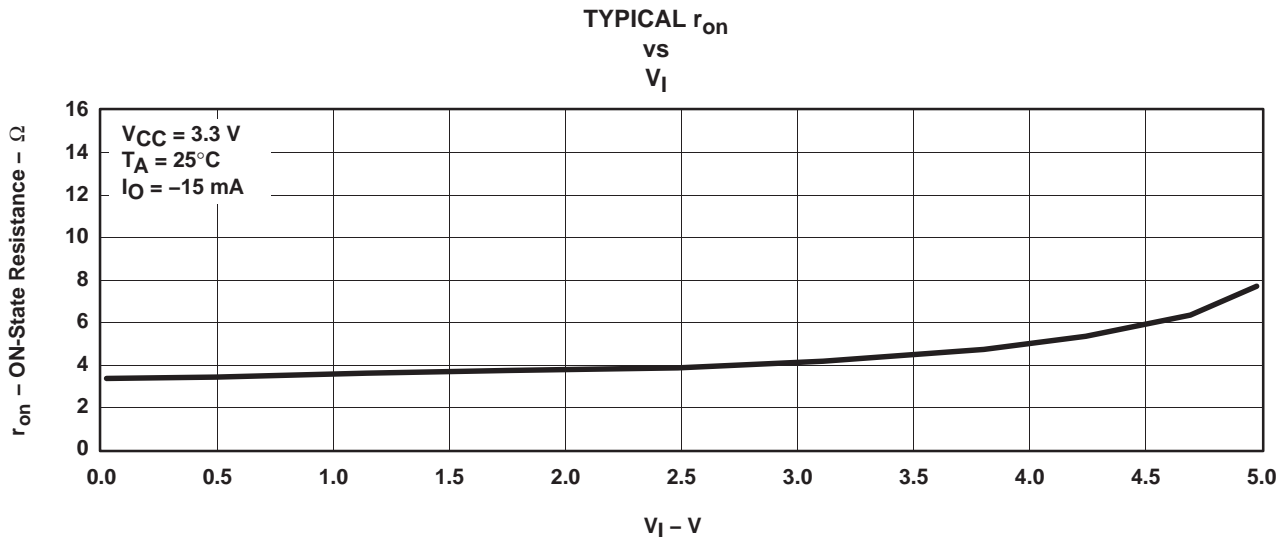


Figure 1. Typical r_{on} vs V_I , $V_{CC} = 3.3\text{ V}$ and $I_O = -15\text{ mA}$

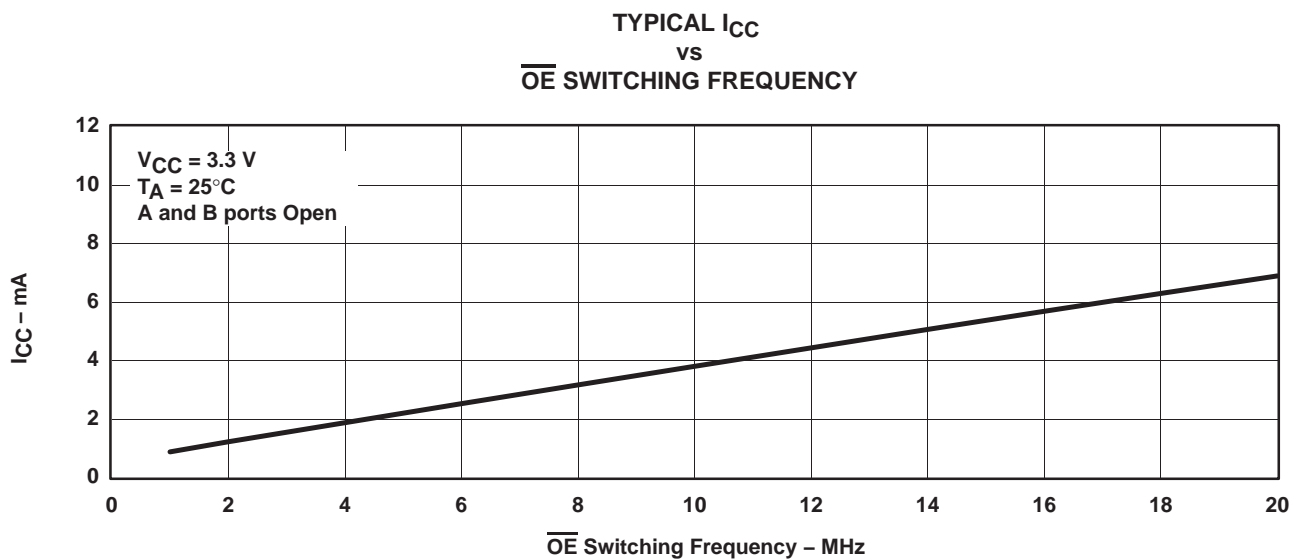
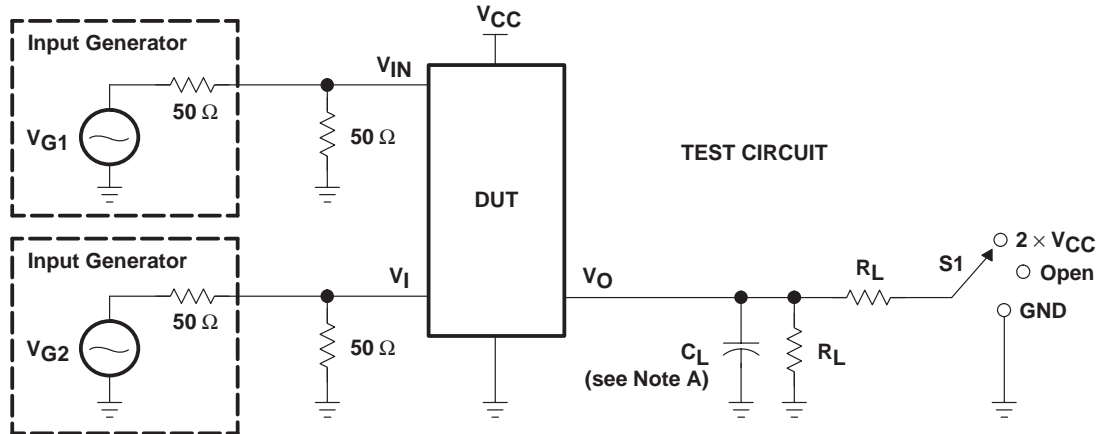


Figure 2. Typical I_{CC} vs \overline{OE} Switching Frequency, $V_{CC} = 3.3\text{ V}$

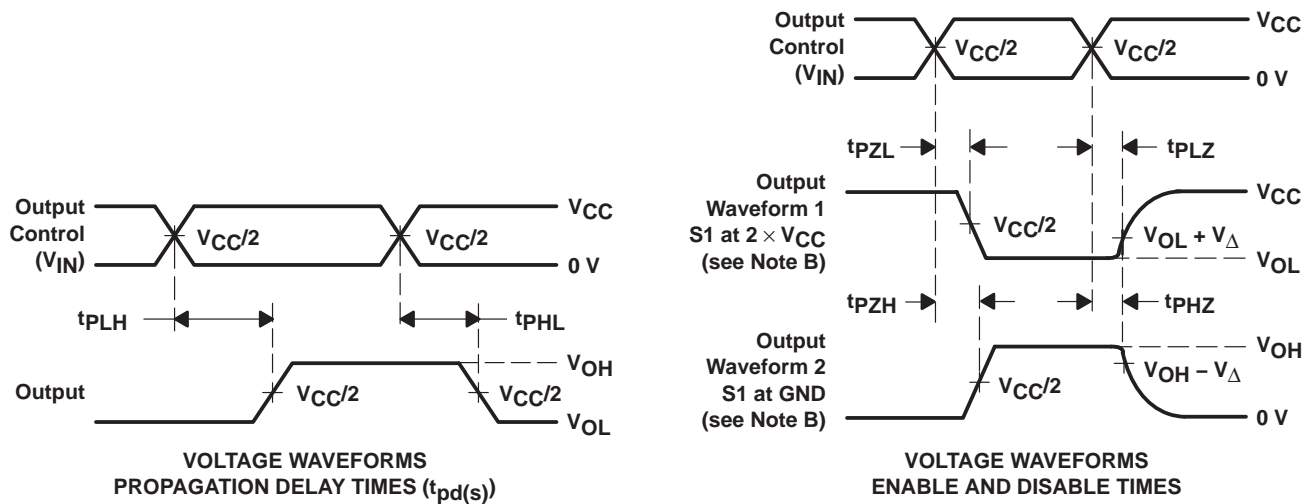
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PARAMETER MEASUREMENT INFORMATION



TEST	V _{CC}	S1	R _L	V _I	C _L	V _Δ
t _{pd} (s)	2.5 V ± 0.2 V	Open	500 Ω	V _{CC} or GND	30 pF	
	3.3 V ± 0.3 V	Open	500 Ω	V _{CC} or GND	50 pF	
t _{PLZ} /t _{PZL}	2.5 V ± 0.2 V	2 × V _{CC}	500 Ω	GND	30 pF	0.15 V
	3.3 V ± 0.3 V	2 × V _{CC}	500 Ω	GND	50 pF	0.3 V
t _{PHZ} /t _{PZH}	2.5 V ± 0.2 V	GND	500 Ω	V _{CC}	30 pF	0.15 V
	3.3 V ± 0.3 V	GND	500 Ω	V _{CC}	50 pF	0.3 V



- NOTES: A. C_L includes probe and jig capacitance.
 B. 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.
 C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
 D. The outputs are measured one at a time with one transition per measurement.
 E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
 F. t_{PZL} and t_{PZH} are the same as t_{en}.
 G. t_{PLH} and t_{PHL} are the same as t_{pd}(s). The t_{pd} propagation delay is the calculated RC time constant of the typical ON-state resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).
 H. All parameters and waveforms are not applicable to all devices.

Figure 3. Test Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74CB3Q3245DBQR	ACTIVE	SSOP/QSOP	DBQ	20	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74CB3Q3245DGVR	ACTIVE	TVSOP	DGV	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74CB3Q3245GQNR	ACTIVE	VFBGA	GQN	20	1000	None	SNPB	Level-1-240C-UNLIM
SN74CB3Q3245PW	ACTIVE	TSSOP	PW	20	70	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74CB3Q3245PWR	ACTIVE	TSSOP	PW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74CB3Q3245RGYR	ACTIVE	QFN	RGY	20	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
SN74CB3Q3245ZQNR	ACTIVE	VFBGA	ZQN	20	1000	Pb-Free (RoHS)	SNAGCU	Level-1-260C-UNLIM

⁽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⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

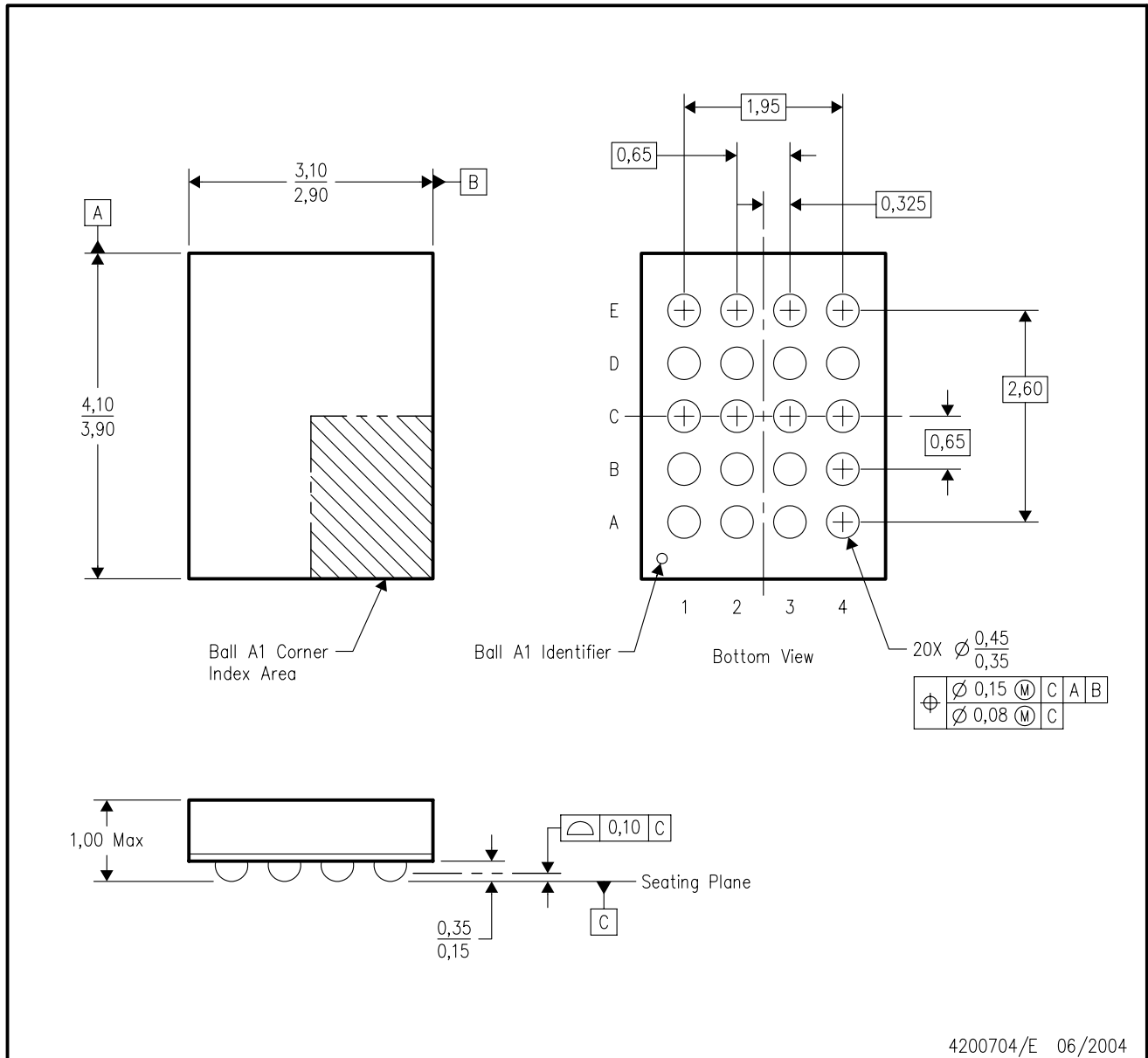
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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GQN (R-PBGA-N20)

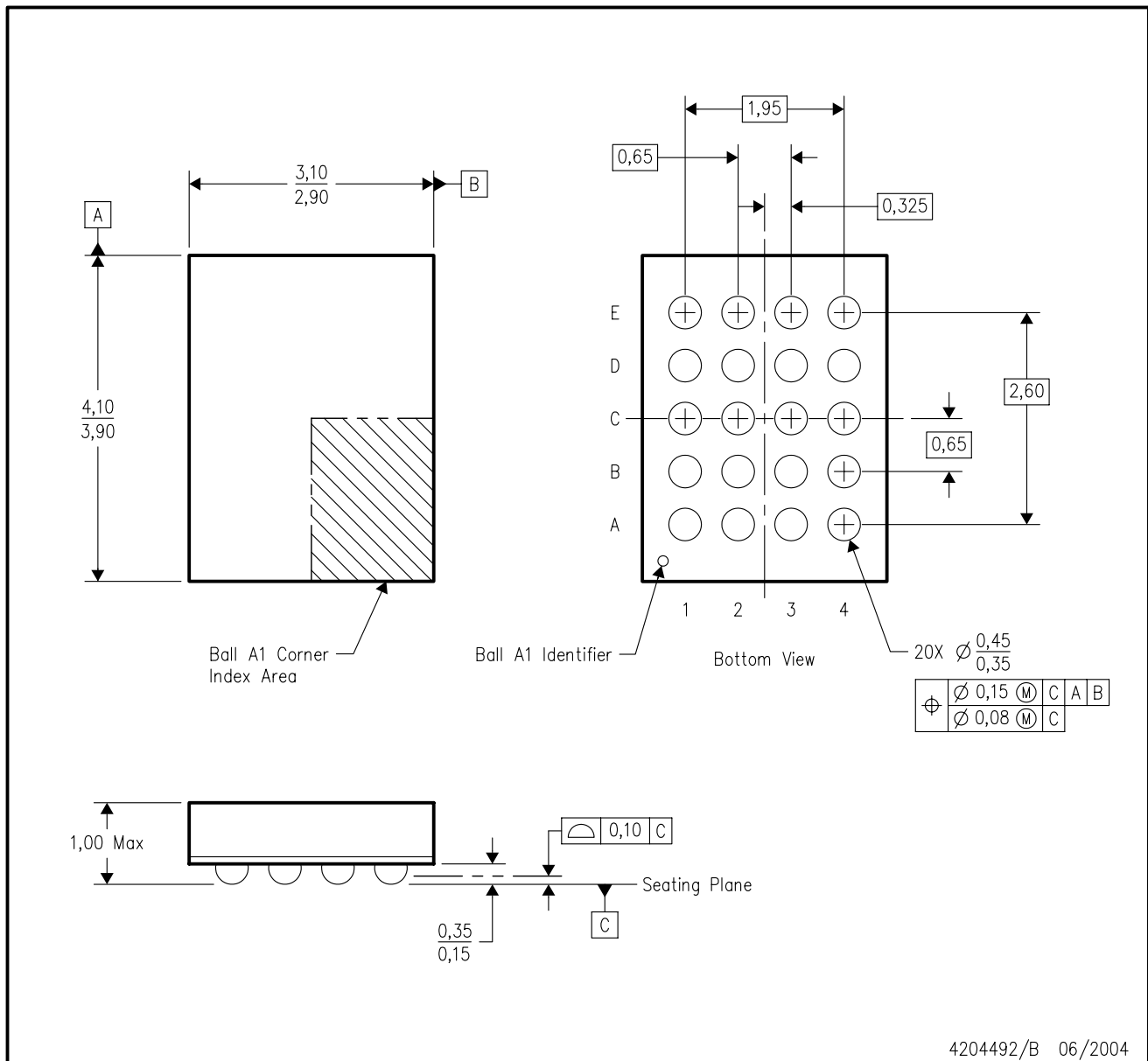
PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-225 variation BC.
 - D. This package is tin-lead (SnPb). Refer to the 20 ZQN package (drawing 4204492) for lead-free.

ZQN (R-PBGA-N20)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-225 variation BC.
 - D. This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead (SnPb).

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN

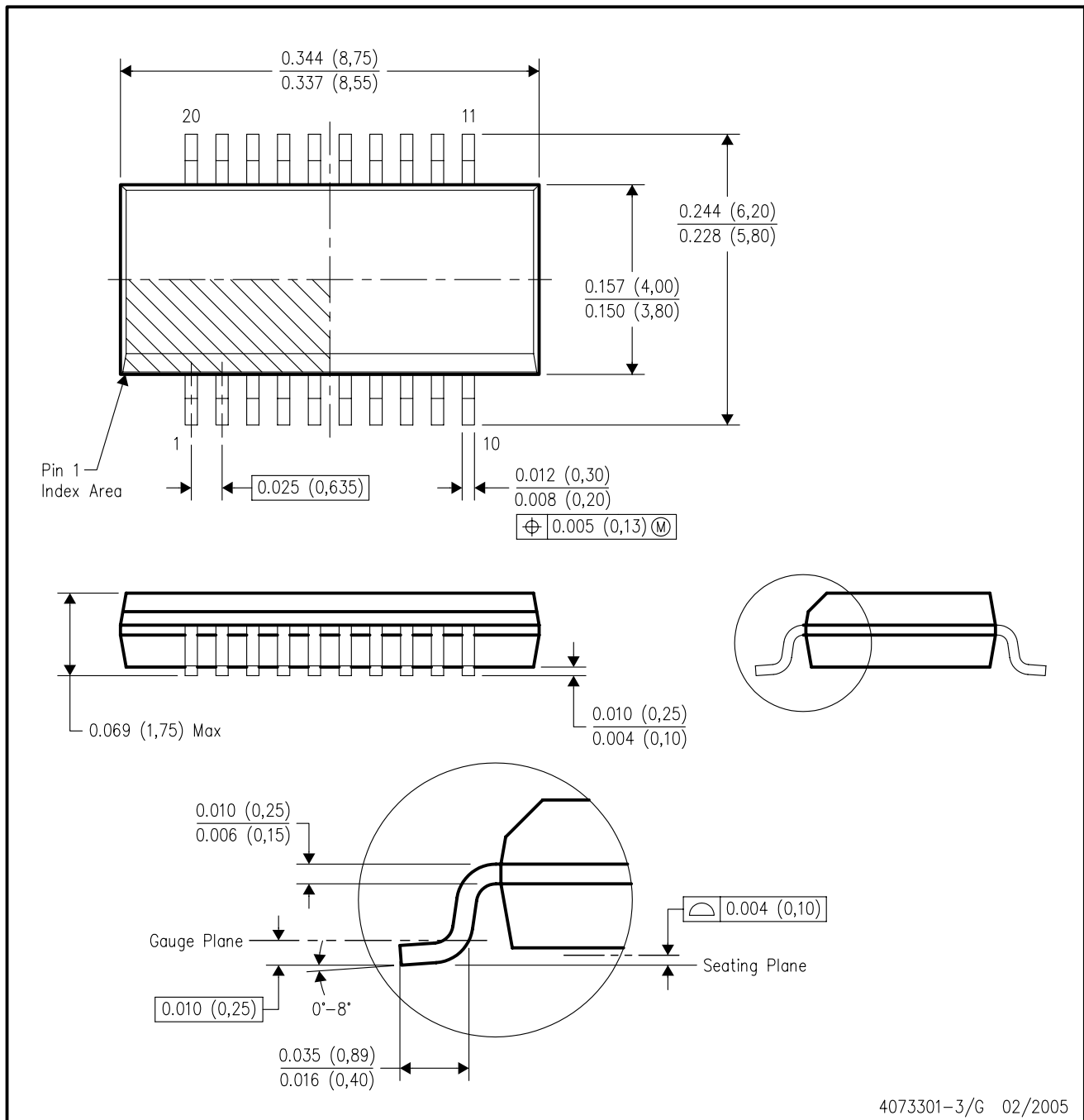


4073251/E 08/00

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

DBQ (R-PDSO-G20)

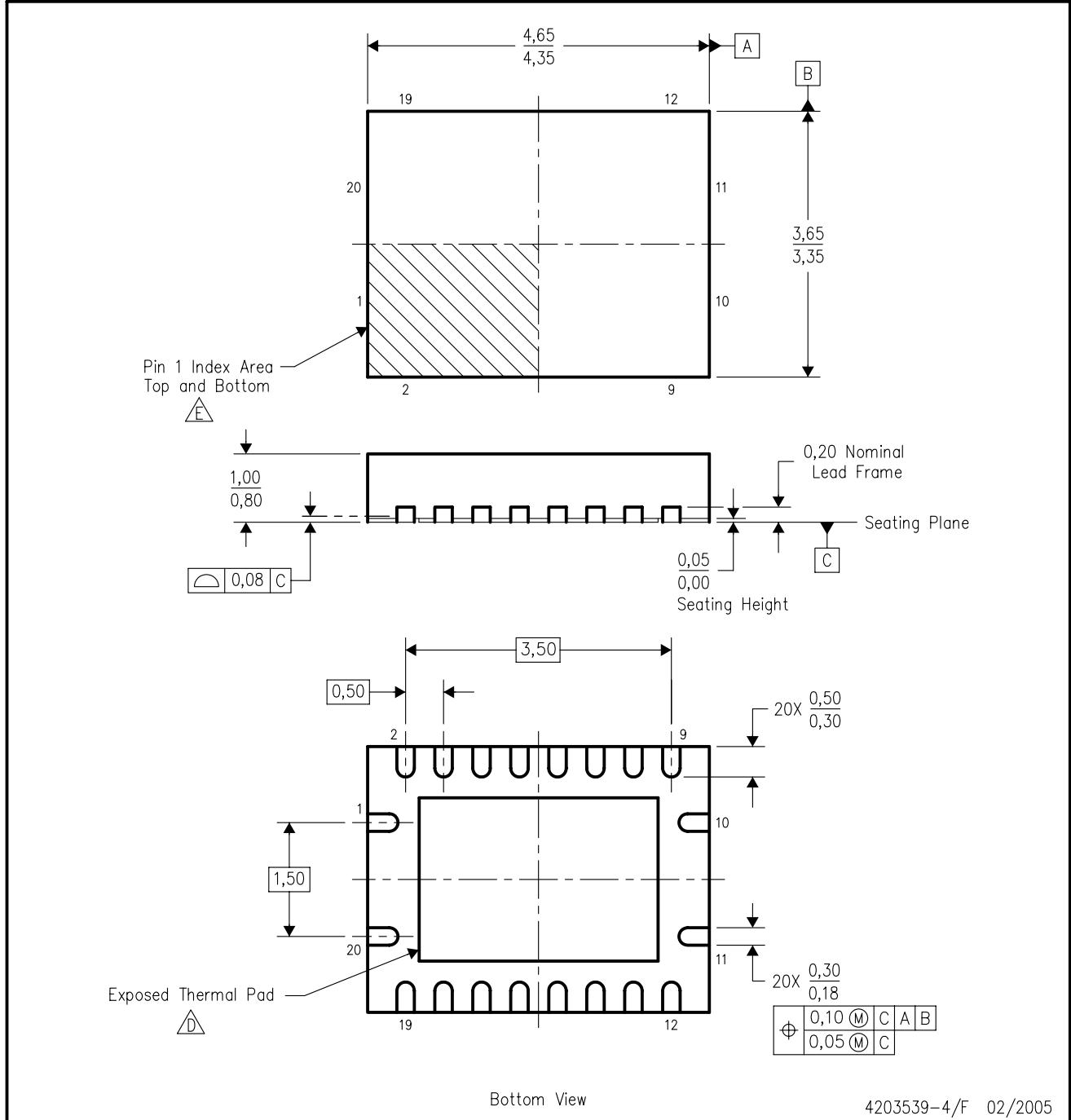
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15) per side.
 - D. Falls within JEDEC MO-137 variation AD.

RGY (R-PQFP-N20)

PLASTIC QUAD FLATPACK



- 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. QFN (Quad Flatpack No-Lead) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
 - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - F. Package complies to JEDEC MO-241 variation BC.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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