THE DATASHEET OF

CDCVF857DGGRG4

2.5-V PHASE-LOCKED-LOOP CLOCK DRIVER

FEATURES

- **Spread-Spectrum Clock Compatible**
- **Operating Frequency: 60 MHz to 220 MHz**
- **Low Jitter (Cycle-Cycle): ±35 ps**
- **Low Static Phase Offset: ±50 ps**
- **Low Jitter (Period): ±30 ps**
- **1-to-10 Differential Clock Distribution (SSTL2)**
- **Best in Class for $V_{OX} = V_{DD}/2$ ±0.1 V**
- **Operates From Dual 2.6-V or 2.5-V Supplies**
- **Available in a 40-Pin MLF Package, 48-Pin TSSOP Package, 56-Ball MicroStar Junior™ BGA Package**
- **Consumes < 100-μA Quiescent Current**
- **External Feedback Pins (FBIN, $\overline{\text{FBIN}}$) Are Used to Synchronize the Outputs to the Input Clocks**
- **Meets/Exceeds JEDEC Standard (JESD82-1) For DDRI-200/266/333 Specification**
- **Meets/Exceeds Proposed DDRI-400 Specification (JESD82-1A)**
- **Enters Low-Power Mode When No CLK Input Signal Is Applied or PWRDWN Is Low**

APPLICATIONS

- **DDR Memory Modules (DDR400/333/266/200)**
- **Zero-Delay Fan-Out Buffer**

DESCRIPTION

The CDCVF857 is a high-performance, low-skew, low-jitter, zero-delay buffer that distributes a differential clock input pair (CLK, $\overline{\text{CLK}}$) to 10 differential pairs of clock outputs (Y[0:9], $\overline{\text{Y[0:9]}}$) and one differential pair of feedback clock outputs (FBOUT, $\overline{\text{FBOUT}}$). The clock outputs are controlled by the clock inputs (CLK, $\overline{\text{CLK}}$), the feedback clocks (FBIN, $\overline{\text{FBIN}}$), and the analog power input (AVDD). When $\overline{\text{PWRDWN}}$ is high, the outputs switch in phase and frequency with CLK. When $\overline{\text{PWRDWN}}$ is low, all outputs are disabled to a high-impedance state (3-state) and the PLL is shut down (low-power mode). The device also enters this low-power mode when the input frequency falls below a suggested detection frequency that is below 20 MHz (typical 10 MHz). An input frequency detection circuit detects the low frequency condition and, after applying a >20-MHz input signal, this detection circuit turns the PLL on and enables the outputs.

When AV_{DD} is strapped low, the PLL is turned off and bypassed for test purposes. The CDCVF857 is also able to track spread spectrum clocking for reduced EMI.

Because the CDCVF857 is based on PLL circuitry, it requires a stabilization time to achieve phase-lock of the PLL. This stabilization time is required following power up. The CDCVF857 is characterized for both commercial and industrial temperature ranges.

AVAILABLE OPTIONS

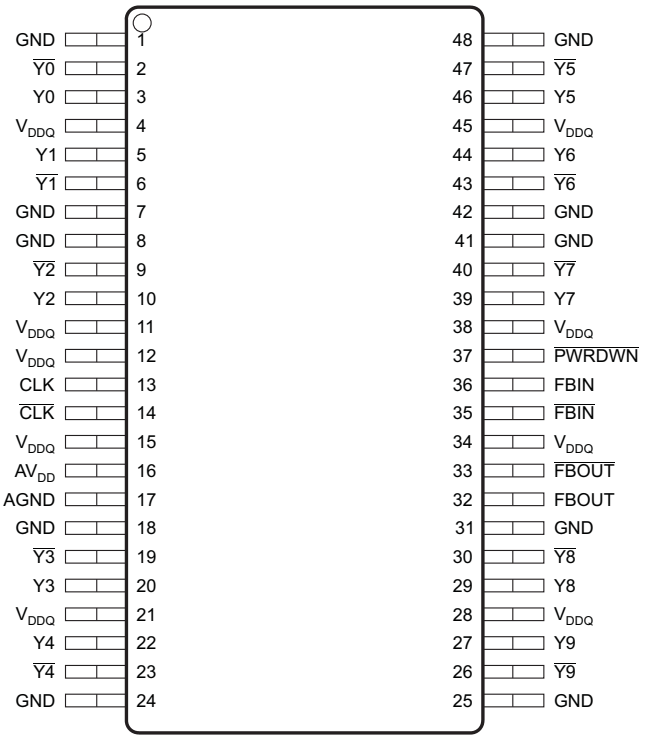
T_A	TSSOP (DGG)	40-Pin MLF	56-Ball BGA(1)
–40°C to 85°C	CDCVF857DGG	CDCVF857RTB	CDCVF857GQL
–40°C to 85°C		CDCVF857RHA	CDCVF857ZQL

(1) Maximum load recommended is 12 pf for 200 MHz. At 12-pf load, maximum T_A allowed is 70°C.

FUNCTION TABLE
(Select Functions)

INPUTS				OUTPUTS				PLL
AVDD	$\overline{\text{PWRDWN}}$	CLK	$\overline{\text{CLK}}$	Y[0:9]	$\overline{\text{Y[0:9]}}$	FBOUT	$\overline{\text{FBOUT}}$	
GND	H	L	H	L	H	L	H	Bypassed/off
GND	H	H	L	H	L	H	L	Bypassed/off
X	L	L	H	Z	Z	Z	Z	Off
X	L	H	L	Z	Z	Z	Z	Off
2.5 V (nom)	H	L	H	L	H	L	H	On
2.5 V (nom)	H	H	L	H	L	H	L	On
2.5 V (nom)	X	<20 MHz	<20 MHz	Z	Z	Z	Z	Off

DGG PACKAGE
(TOP VIEW)



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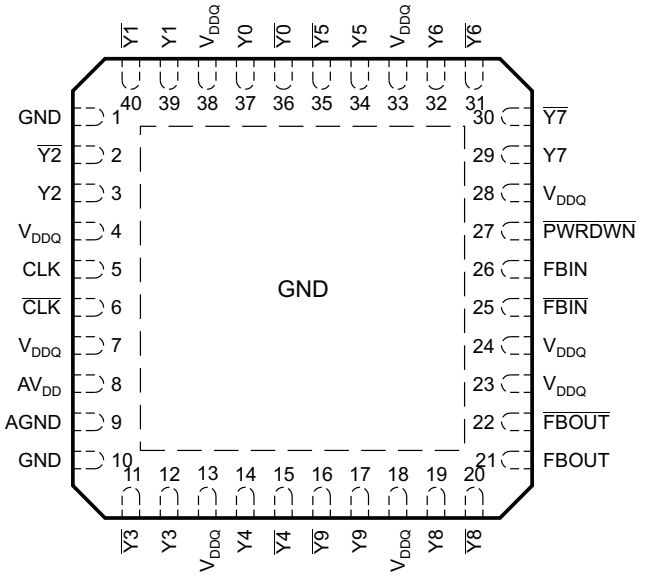
RHA/RTB PACKAGE
(TOP VIEW)



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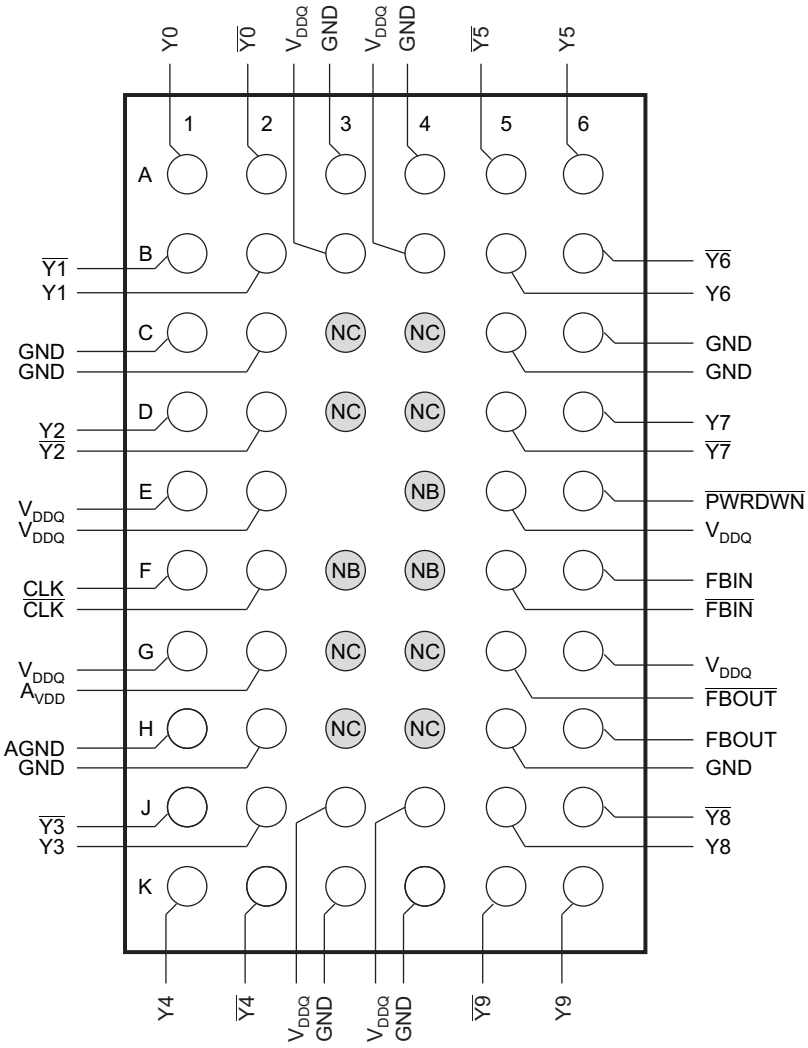
MicroStar Junior™ BGA (GQL/ZQL) PACKAGE
(TOP VIEW)



NB = No Ball
NC = No Connection

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FUNCTIONAL BLOCK DIAGRAM

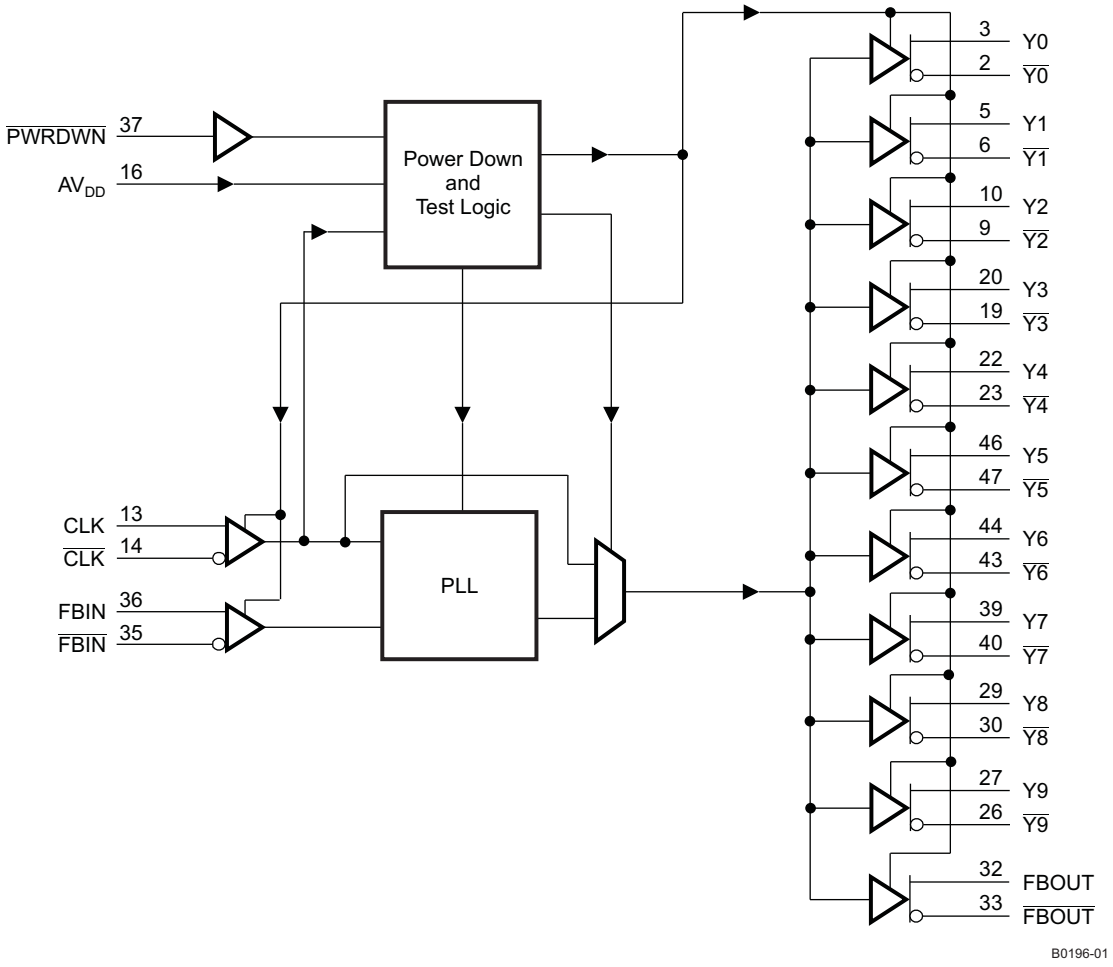


Table 1. TERMINAL FUNCTIONS

TERMINAL				I/O	DESCRIPTION
NAME	DGG	RHA/RTB	GQL/ZQL		
AGND	17	9	H1	–	Ground for 2.5-V analog supply
AV_{DD}	16	8	G2	–	2.5-V analog supply
CLK, $\overline{CLK}$	13, 14	5, 6	F1, F2	I	Differential clock input
$\overline{FBIN}$, FBIN	35, 36	25, 26	F5, F6	I	Feedback differential clock input
FBOUT, $\overline{FBOUT}$	32, 33	21, 22	H6, G5	O	Feedback differential clock output
GND	1, 7, 8, 18, 24, 25, 31, 41, 42, 48	1, 10	A3, A4, C1, C2, C5, C6, H2, H5, K3, K4	–	Ground
$\overline{PWRDWN}$	37	27	E6	I	Output enable for Y and $\overline{Y}$
V_{DDQ}	4, 11, 12, 15, 21, 28, 34, 38, 45	4, 7, 13, 18, 23, 24, 28, 33, 38	B3, B4, E1, E2, E5, G1, G6, J3, J4	–	2.5-V supply
Y0, $\overline{Y0}$	3, 2	37, 36	A1, A2	O	Buffered output copies of input clock, CLK, $\overline{CLK}$
Y1, $\overline{Y1}$	5, 6	39, 40	B2, B1	O	
Y2, $\overline{Y2}$	10, 9	3, 2	D1, D2	O	
Y3, $\overline{Y3}$	20, 19	12,11	J2, J1	O	
Y4, $\overline{Y4}$	22, 23	14, 15	K1, K2	O	
Y5, $\overline{Y5}$	46, 47	34, 35	A6, A5	O	
Y6, $\overline{Y6}$	44, 43	32, 31	B5, B6	O	
Y7, $\overline{Y7}$	39, 40	29, 30	D6, D5	O	
Y8, $\overline{Y8}$	29, 30	19, 20	J5, J6	O	
Y9, $\overline{Y9}$	27, 26	17, 16	K6, K5	O	

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted) (1)

V_{DDQ}, AV_{DD}	Supply voltage range		0.5 V to 3.6 V
V_I	Input voltage range (2) (3)		–0.5 V to V_{DDQ} + 0.5 V
V_O	Output voltage range (2) (3)		–0.5 V to V_{DDQ} + 0.5 V
I_{IK}	Input clamp current	$V_I < 0$ or $V_I > V_{DDQ}$	±50 mA
I_{OK}	Output clamp current	$V_O < 0$ or $V_O > V_{DDQ}$	±50 mA
I_O	Continuous output current	V_O = 0 to V_{DDQ}	±50 mA
I_{DDC}	Continuous current to GND or V_{DDQ}		±100 mA
T_{stg}	Storage temperature range		–65°C to 150°C

(1) 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.
(2) The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
(3) This value is limited to 3.6 V maximum.

THERMAL CHARACTERISTICS

$R_{\theta JA}$ for TSSOP (DGG) Package (1)			$R_{\theta JA}$ for MLF (RHA/RTB) Package		$R_{\theta JA}$ for BGA (GQL/ZQL) Package (2)	
Airflow	Low K	High K	Airflow	With 4 Thermal Vias	Airflow	High K
0 ft/min	89.1°C/W	70°C/W	0 ft/min	44.7°C/W	0 ft/min	132.2°C/W
150 ft/min	78.5°C/W	65.3°C/W	150 ft/min		150 ft/min	126.4°C/W

(1) The package thermal impedance is calculated in accordance with JESD 51.
(2) Connecting the NC-balls (C3, C4, D3, D4, G3, G4, H3, H4) to a ground plane improves the θ_{JA} to 114.8°C/W (0 airflow).

RECOMMENDED OPERATING CONDITIONS

				MIN	NOM	MAX	UNIT
	Supply voltage	V_{DDQ}	PC1600 – PC3200	2.3		2.7	V
		AVDD		V_{DDQ} – 0.12		2.7	
V_{IL}	Low-level input voltage	CLK, $\overline{CLK}$, FBIN, $\overline{FBIN}$				$V_{DDQ}/2$ – 0.18	V
		$\overline{PWRDWN}$		–0.3		0.7	
V_{IH}	High-level input voltage	CLK, $\overline{CLK}$, FBIN, $\overline{FBIN}$		VDDQ/2 + 0.18			V
		$\overline{PWRDWN}$		1.7		V_{DDQ} + 0.3	
	DC input signal voltage (1)			–0.3		V_{DDQ} + 0.3	V
V_{ID}	Differential input signal voltage (2)	DC	CLK, FBIN	0.36		V_{DDQ} + 0.6	V
		AC	CLK, FBIN	0.7		V_{DDQ} + 0.6	
V_{IX}	Input differential pair cross voltage (3) (4)			$V_{DDQ}/2$ – 0.2		$V_{DDQ}/2$ + 0.2	V
I_{OH}	High-level output current					–12	mA
I_{OL}	Low-level output current					12	mA
SR	Input slew rate			1		4	V/ns
T_A	Operating free-air temperature			–40		85	°C

(1) The unused inputs must be held high or low to prevent them from floating.
(2) The dc input signal voltage specifies the allowable dc execution of the differential input.
(3) The differential input signal voltage specifies the differential voltage |VTR – VCP| required for switching, where VTR is the true input level and VCP is the complementary input level.
(4) The differential cross-point voltage tracks variations of V_{CC} and is the voltage at which the differential signals must cross.

ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS		MIN	TYP (1)	MAX	UNIT
V_{IK}	Input voltage, all inputs	V_{DDQ} = 2.3 V, I_I = –18 mA				–1.2	V
V_{OH}	High-level output voltage	V_{DDQ} = min to max, I_{OH} = –1 mA		V_{DDQ} – 0.1			V
		V_{DDQ} = 2.3 V, I_{OH} = –12 mA		1.7			
V_{OL}	Low-level output voltage	V_{DDQ} = min to max, I_{OL} = 1 mA				0.1	V
		V_{DDQ} = 2.3 V, I_{OL} = 12 mA				0.6	
V_{OD}	Output voltage swing (2)	Differential outputs are terminated with 120 Ω, C_L = 14 pF (see Figure 3)		1.1		V_{DDQ} – 0.4	V
V_{OX}	Output differential cross-voltage (3)			$V_{DDQ}/2$ – 0.1	$V_{DDQ}/2$	$V_{DDQ}/2$ + 0.1	V
I_I	Input current	V_{DDQ} = 2.7 V, V_I = 0 V to 2.7 V				±10	µA
I_{OZ}	High-impedance-state output current	V_{DDQ} = 2.7 V, V_O = V_{DDQ} or GND				±10	µA
I_{DDPD}	Power-down current on V_{DDQ} + AV_{DD}	CLK and $\overline{CLK}$ = 0 MHz; $\overline{PWRDWN}$ = Low; Σ of I_{DD} and AI_{DD}			20	100	µA
AI_{DD}	Supply current on AV_{DD}	f_O = 170 MHz			6	8	mA
		f_O = 200 MHz			8	10	
C_I	Input capacitance	V_{DDQ} = 2.5 V, V_I = V_{DDQ} or GND		2	2.5	3.5	pF
I_{DD}	Dynamic current on V_{DDQ}	Without load	f_O = 170 MHz		120	140	mA
			f_O = 200 MHz		125	150	
		Differential outputs terminated with 120 Ω, C_L = 0 pF	f_O = 170 MHz		220	270	
			f_O = 200 MHz		230	280	
		Differential outputs terminated with 120 Ω, C_L = 14 pF	f_O = 170 MHz		280	330	
			f_O = 200 MHz		300	350	

(1) All typical values are at nominal V_{DDQ}.
(2) The differential output signal voltage specifies the differential voltage |VTR – VCP|, where VTR is the true output level and VCP is the complementary output level.
(3) The differential cross-point voltage tracks variations of V_{DDQ} and is the voltage at which the differential signals must cross.

ELECTRICAL CHARACTERISTICS (continued)

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

PARAMETER		TEST CONDITIONS	MIN	TYP (1)	MAX	UNIT
ΔC	Part-to-part input capacitance variation	V_{DDQ} = 2.5 V, V_I = V_{DDQ} or GND			1	pF
$C_{I(\Delta)}$	Input capacitance difference between CLK and $\overline{CLK}$, FBIN, and $\overline{FBIN}$	V_{DDQ} = 2.5 V, V_I = V_{DDQ} or GND			0.25	pF

TIMING REQUIREMENTS

over recommended ranges of supply voltage and operating free-air temperature

PARAMETER		MIN	MAX	UNIT
f_{CLK}	Operating clock frequency	60	220	MHz
	Application clock frequency	90	220	
	Input clock duty cycle	40%	60%	
	Stabilization time (PLL mode) (1)		10	µs
	Stabilization time (bypass mode) (2)		30	ns

(1) The time required for the integrated PLL circuit to obtain phase lock of its feedback signal to its reference signal. For phase lock to be obtained, a fixed-frequency, fixed-phase reference signal must be present at CLK and V_{DD} must be applied. Until phase lock is obtained, the specifications for propagation delay, skew, and jitter parameters given in the switching characteristics table are not applicable. This parameter does not apply for input modulation under SSC application.
(2) A recovery time is required when the device goes from power-down mode into bypass mode (AV_{DD} at GND).

SWITCHING CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH} (1)	Low-to-high level propagation delay time	Test mode/CLK to any output		3.5		ns
t_{PHL} (1)	High-to-low level propagation delay time	Test mode/CLK to any output		3.5		ns
$t_{jit(per)}$ (2)	Jitter (period), see Figure 7	100 MHz (PC1600)	–65		65	ps
		133/167/200 MHz (PC2100/2700/3200)	–30		30	
$t_{jit(cc)}$ (2)	Jitter (cycle-to-cycle), see Figure 4	100 MHz (PC1600)	–50		50	ps
		133/167/200 MHz (PC2100/2700/3200)	–35		35	
$t_{jit(hper)}$ (2)	Half-period jitter, see Figure 8	100 MHz (PC1600)	–100		100	ps
		133/167/200 MHz (PC2100/2700/3200)	–75		75	
$t_{slr(o)}$	Output clock slew rate, see Figure 9	Load: 120 Ω, 14 pF	1		2	V/ns
$t_{(\phi)}$	Static phase offset, see Figure 5	100/133/167/200 MHz	–50		50	ps
$t_{sk(o)}$	Output skew, see Figure 6	Load: 120 Ω, 14 pF; 100/133/167/200 MHz			40	ps

(1) Refers to the transition of the noninverting output.
(2) This parameter is assured by design but cannot be 100% production tested.

PARAMETER MEASUREMENT INFORMATION

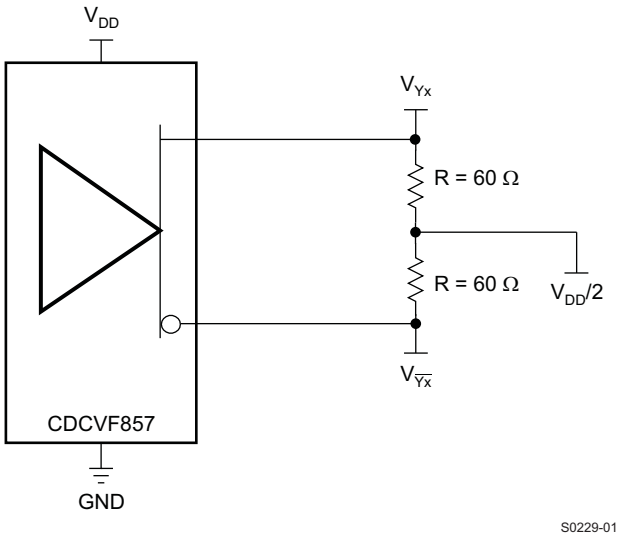


Figure 1. IBIS Model Output Load

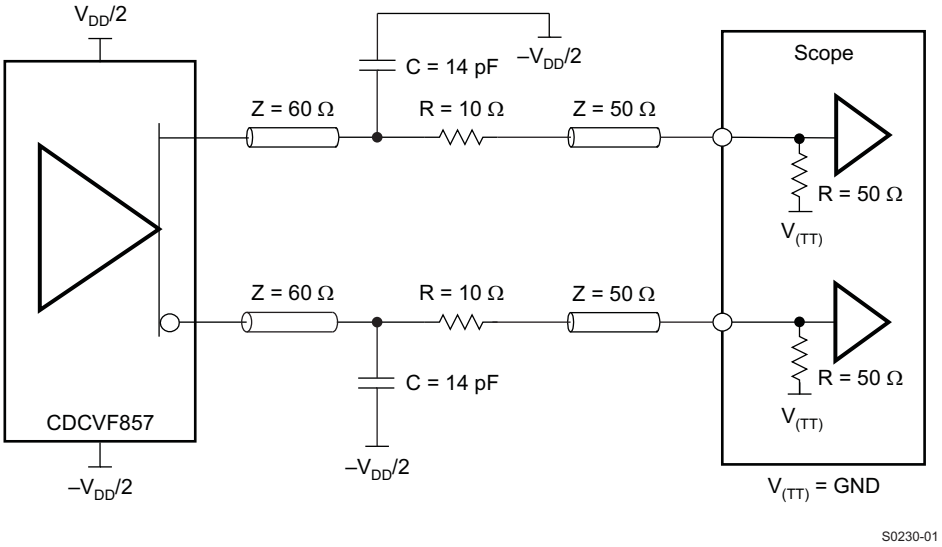


Figure 2. Output Load Test Circuit

PARAMETER MEASUREMENT INFORMATION (continued)

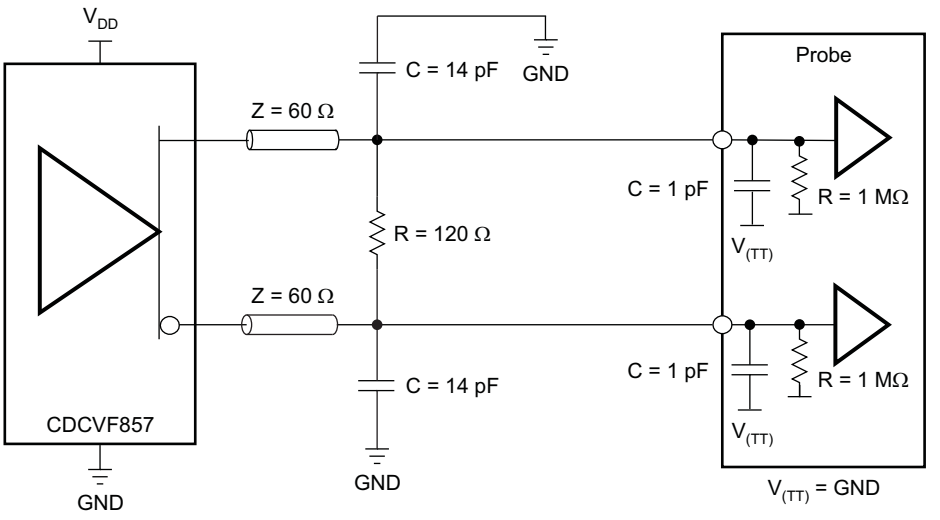


Figure 3. Output Load Test Circuit for Crossing Point

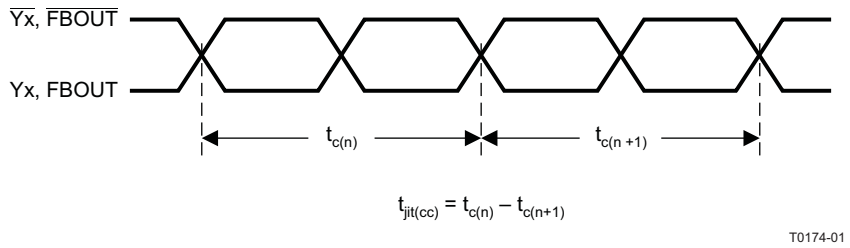


Figure 4. Cycle-to-Cycle Jitter

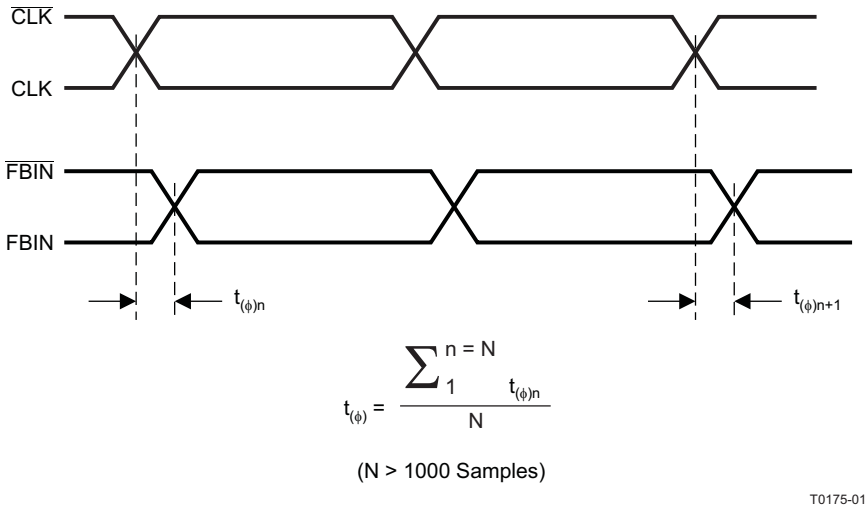


Figure 5. Phase Offset

PARAMETER MEASUREMENT INFORMATION (continued)

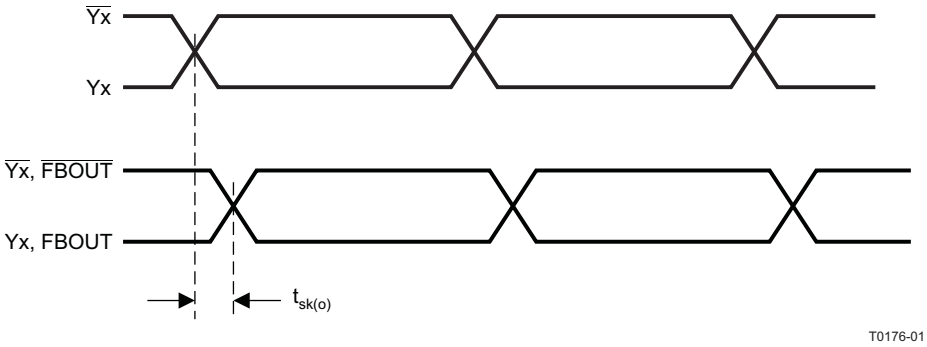
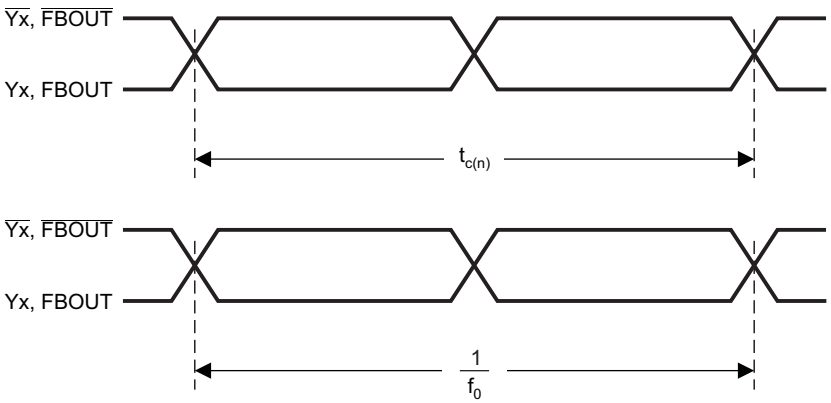


Figure 6. Output Skew



$$t_{jit(per)} = t_{c(n)} - \frac{1}{f_0}$$

f_0 = Average Input Frequency Measured at CLK/$\overline{CLK}$

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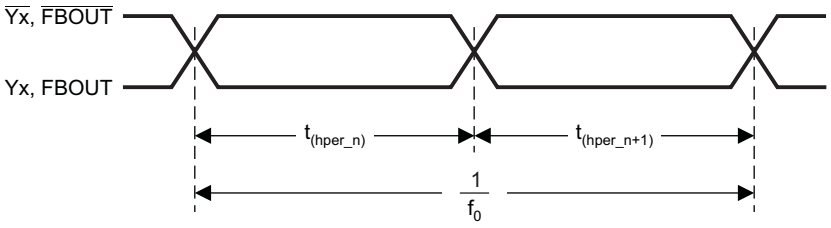
Figure 7. Period Jitter



$$t_{jit(hper)} = t_{(hper\_n)} - \frac{1}{2 \times f_0}$$

n = Any Half Cycle

f_0 = Average Input Frequency Measured at CLK/$\overline{CLK}$

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Figure 8. Half-Period Jitter

PARAMETER MEASUREMENT INFORMATION (continued)

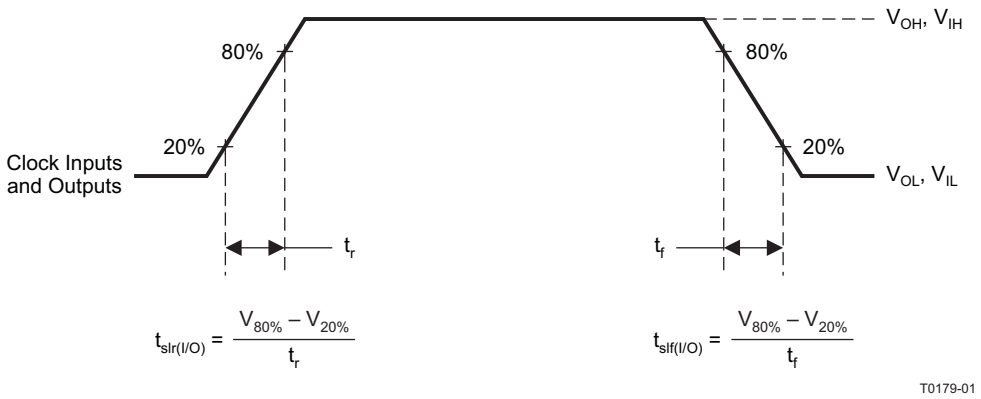
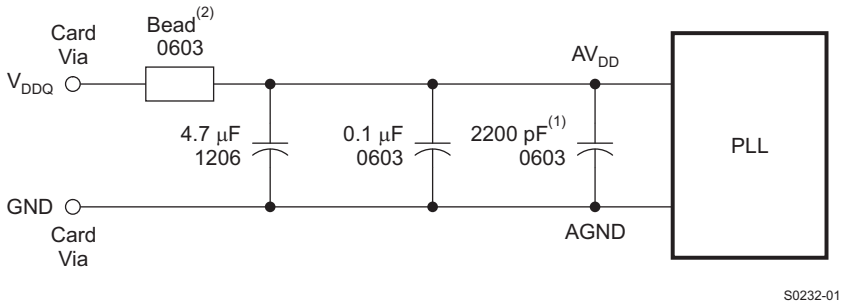


Figure 9. Input and Output Slew Rates



(1) Place the 2200-pF capacitor close to the PLL.

(2) Recommended bead: Fair-Rite P/N 2506036017Y0 or equilvalent (0.8 Ω dc maximum, 600 Ω at 100 MHz).

NOTE: Use a wide trace for the PLL analog power and ground. Connect PLL and capacitors to AGND trace and connect trace to one GND via (farthest from the PLL).

Figure 10. Recommended AV_{DD} Filtering

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CDCVF857DGG	ACTIVE	TSSOP	DGG	48	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CDCVF857	Samples
CDCVF857DGGG4	ACTIVE	TSSOP	DGG	48	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CDCVF857	Samples
CDCVF857DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CDCVF857	Samples
CDCVF857DGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CDCVF857	Samples
CDCVF857RHAT	ACTIVE	VQFN	RHA	40	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	CKVF857	Samples
CDCVF857RHATG4	ACTIVE	VQFN	RHA	40	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	CKVF857	Samples
CDCVF857ZQLR	LIFEBUY	BGA MICROSTAR JUNIOR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	CDCVF857	
HPA00126DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CDCVF857	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.

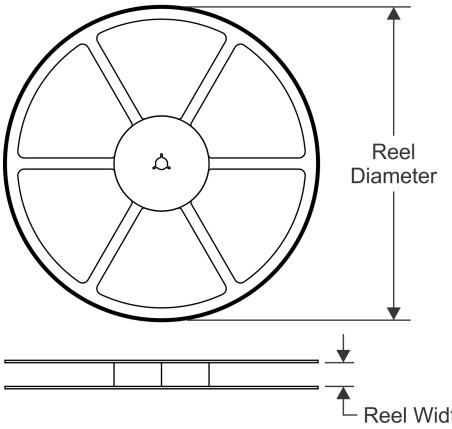
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

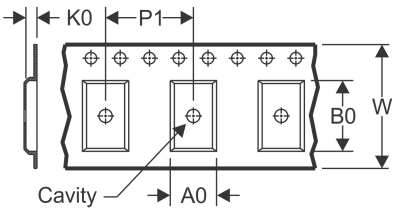
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

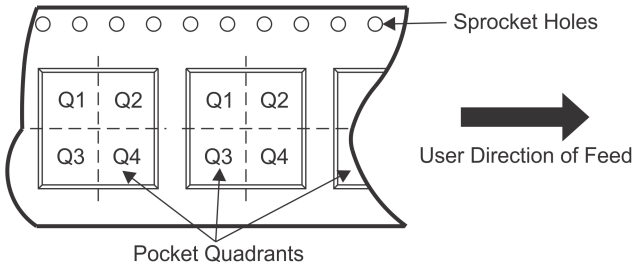


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

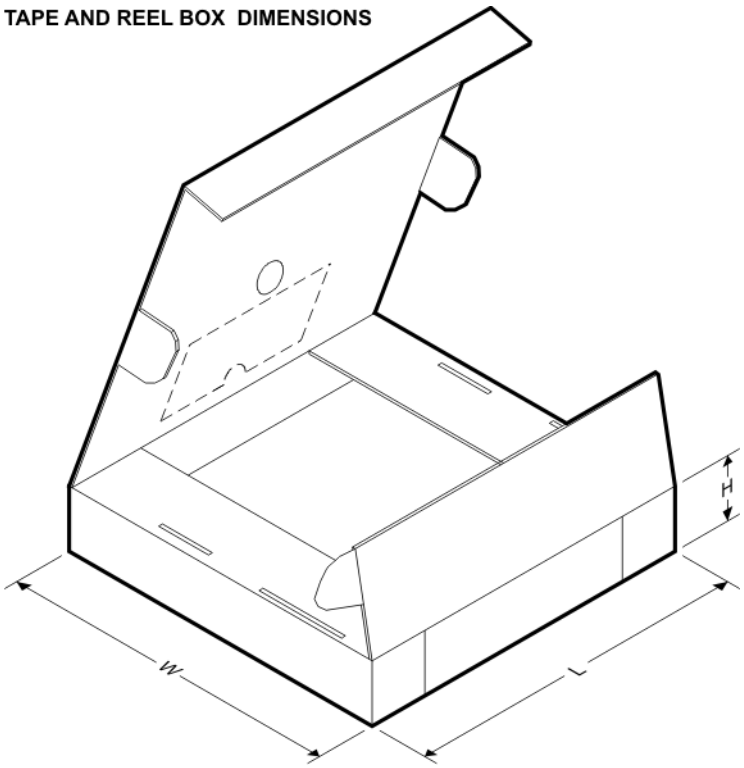
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CDCVF857DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
CDCVF857RHAT	VQFN	RHA	40	250	180.0	16.4	6.3	6.3	1.1	12.0	16.0	Q2
CDCVF857ZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	330.0	16.4	4.8	7.3	1.5	8.0	16.0	Q1

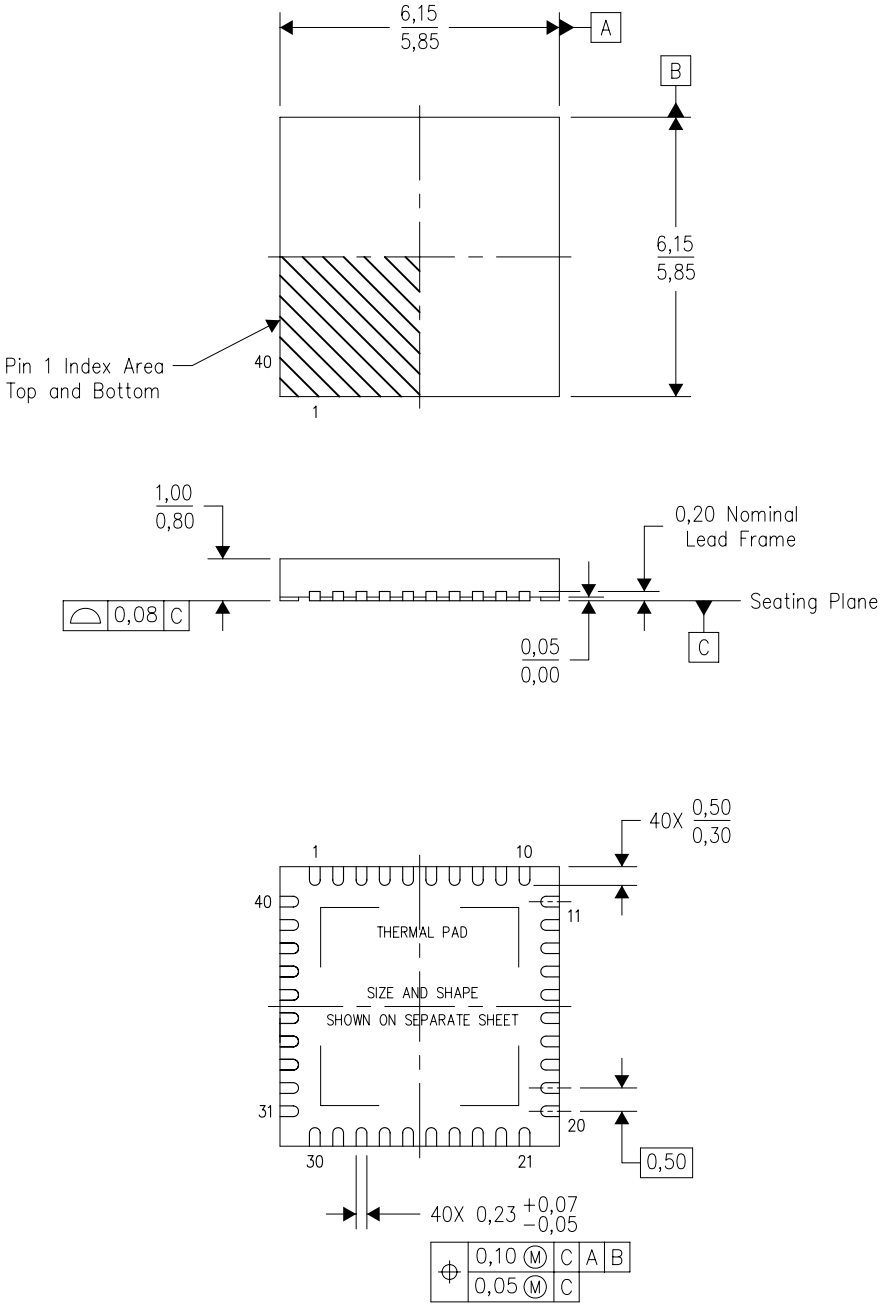
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCVF857DGGR	TSSOP	DGG	48	2000	367.0	367.0	45.0
CDCVF857RHAT	VQFN	RHA	40	250	210.0	185.0	35.0
CDCVF857ZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	350.0	350.0	43.0

RHA (S–PVQFN–N40) PLASTIC QUAD FLATPACK NO–LEAD



Bottom View

4204276/E 06/11

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.
D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
F. Package complies to JEDEC MO–220 variation VJJD–2.

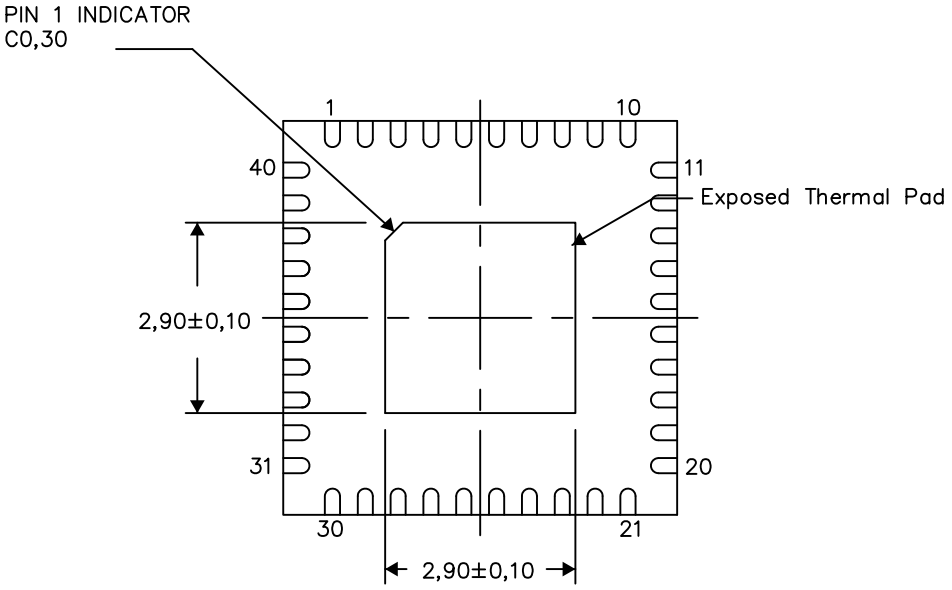
RHA (S–PVQFN–N40) PLASTIC QUAD FLATPACK NO–LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No–Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



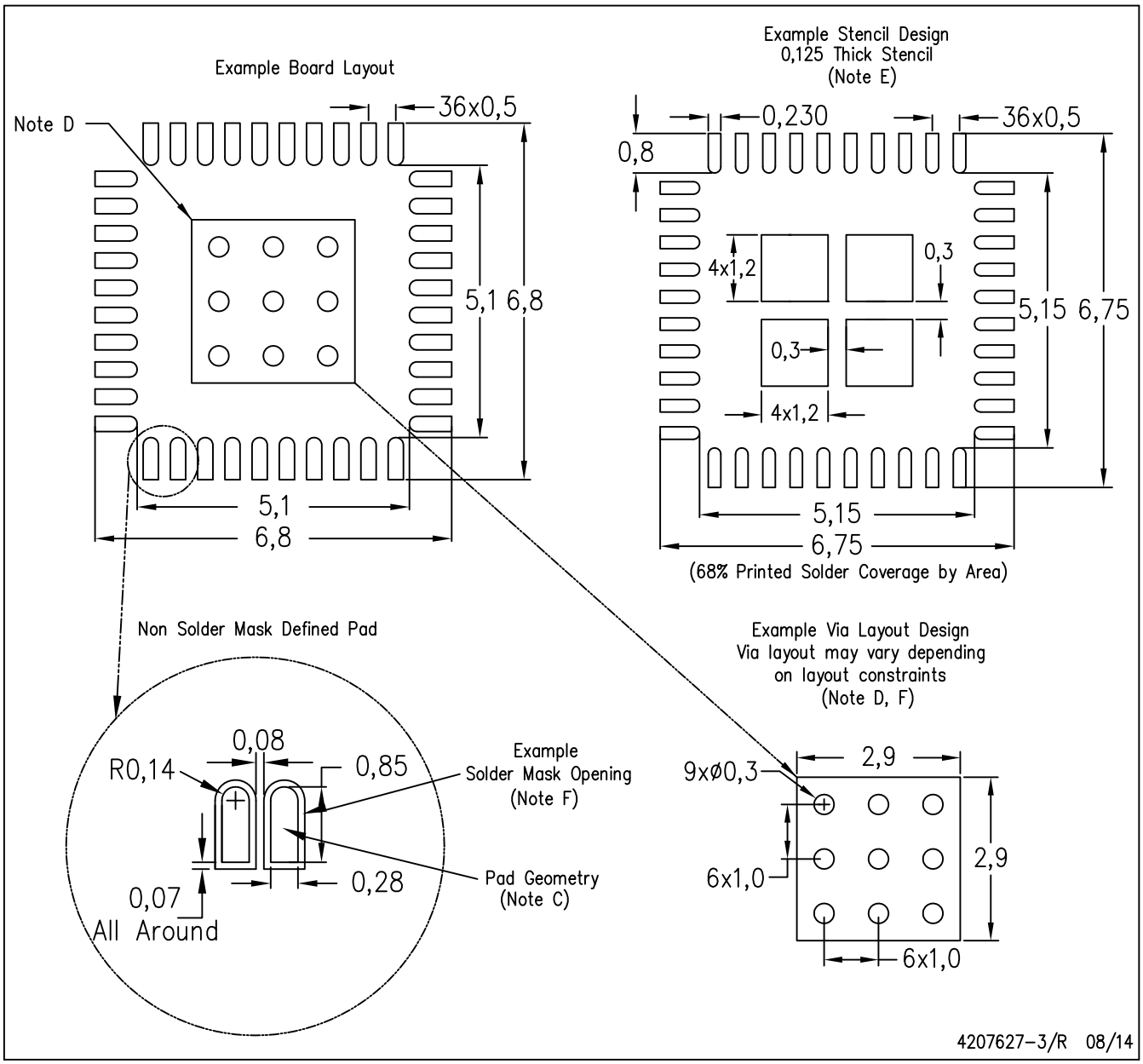
Bottom View

Exposed Thermal Pad Dimensions

4206355–3/X 08/14

NOTES: A. All linear dimensions are in millimeters

RHA (S–PVQFN–N40) PLASTIC QUAD FLATPACK NO–LEAD



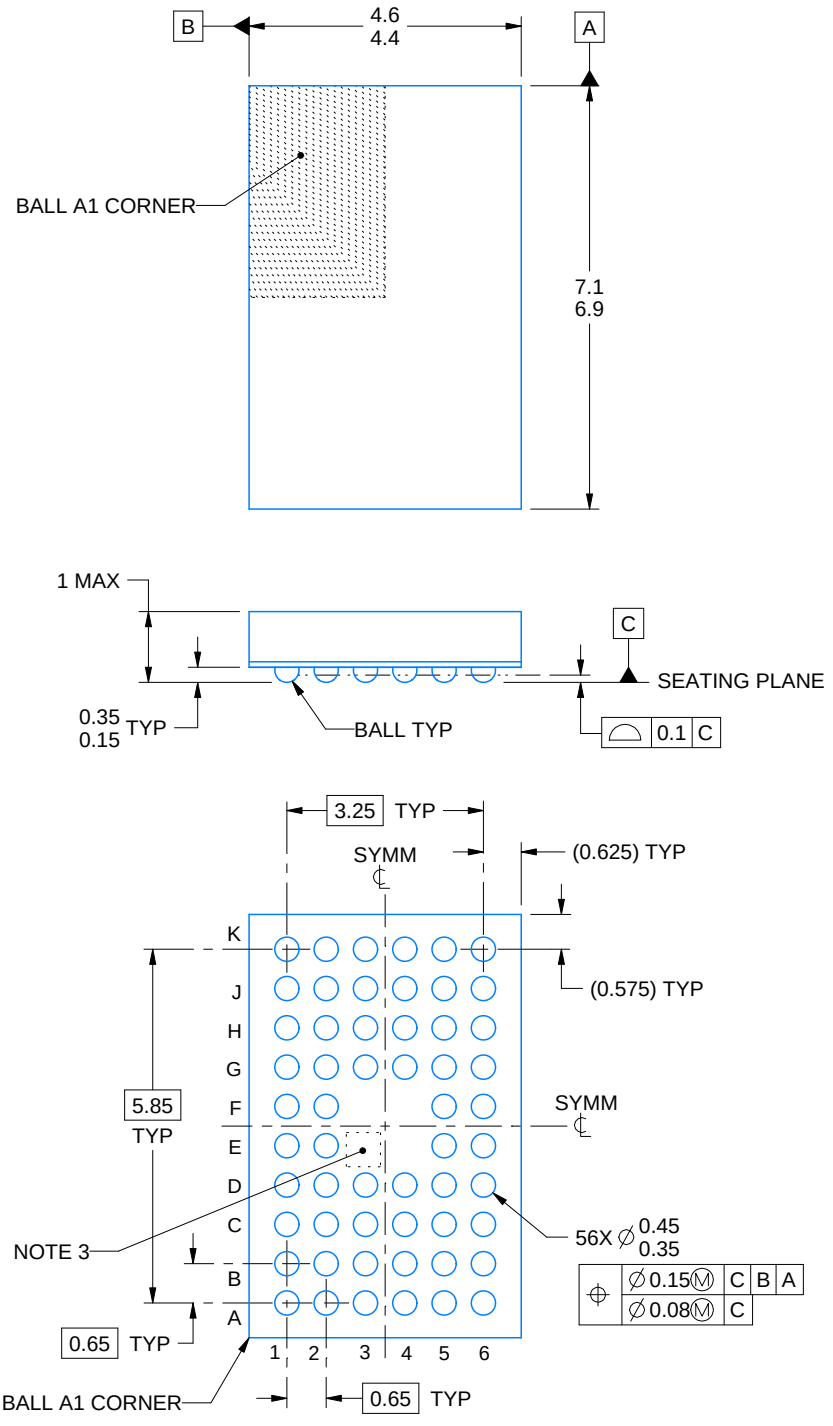
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat–Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <http://www.ti.com>.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
F. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

PACKAGE OUTLINE

ZQL0056A

JRBGA - 1 mm max height

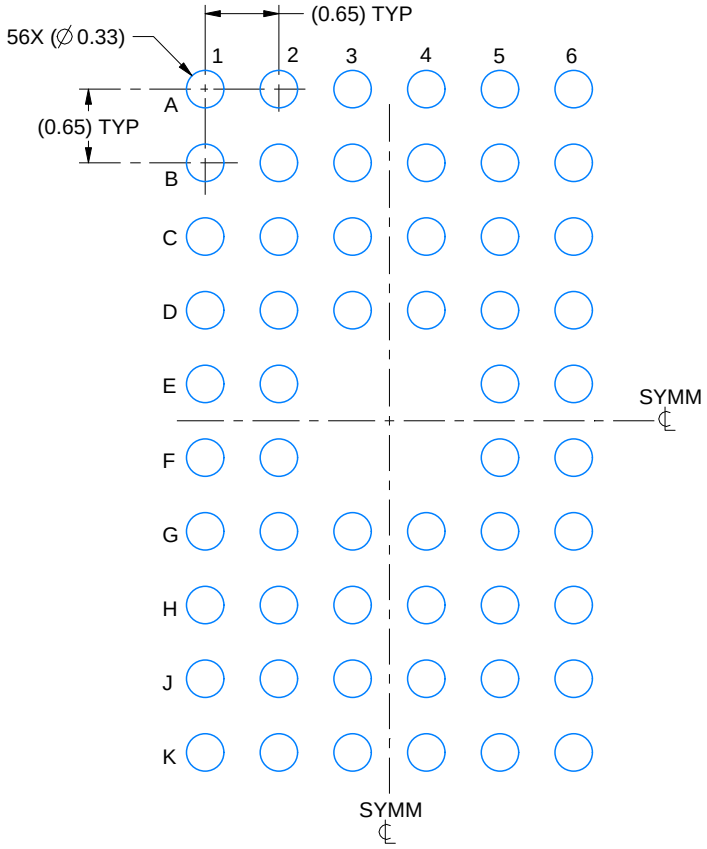
PLASTIC BALL GRID ARRAY



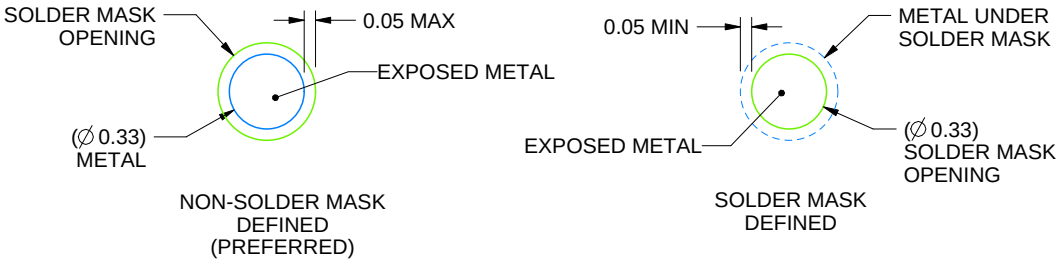
4219711/B 01/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. No metal in this area, indicates orientation.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

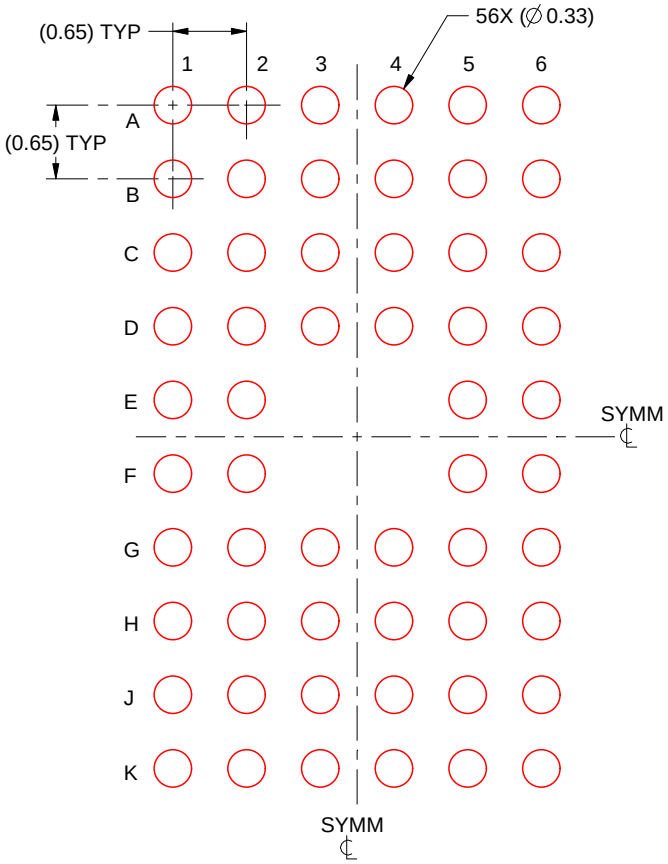


SOLDER MASK DETAILS
NOT TO SCALE

4219711/B 01/2017

NOTES: (continued)

4. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For information, see Texas Instruments literature number SPRAA99 (www.ti.com/lit/spraa99).



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

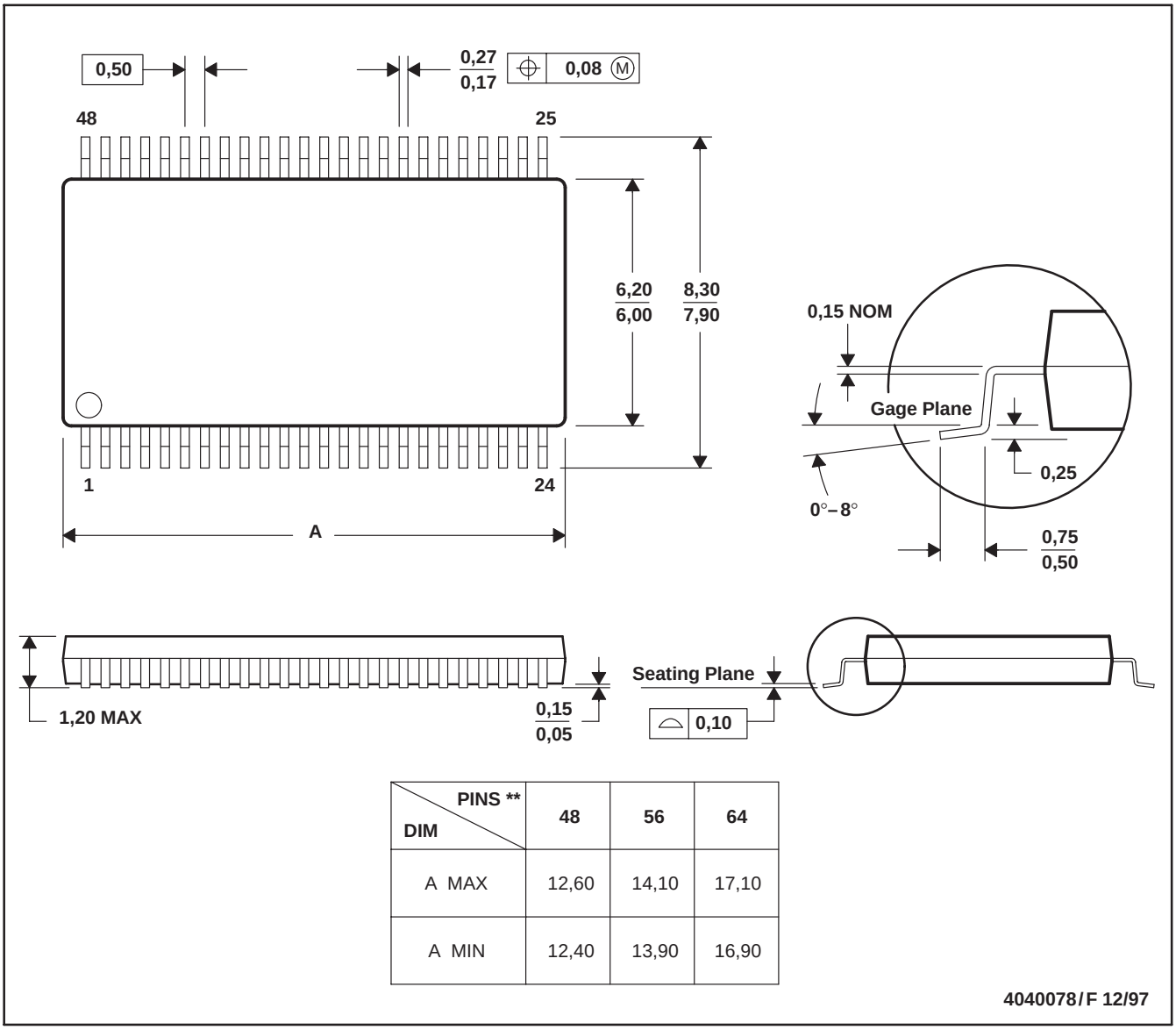
4219711/B 01/2017

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

DGG (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

48 PINS SHOWN



DIM \ PINS **	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

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

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