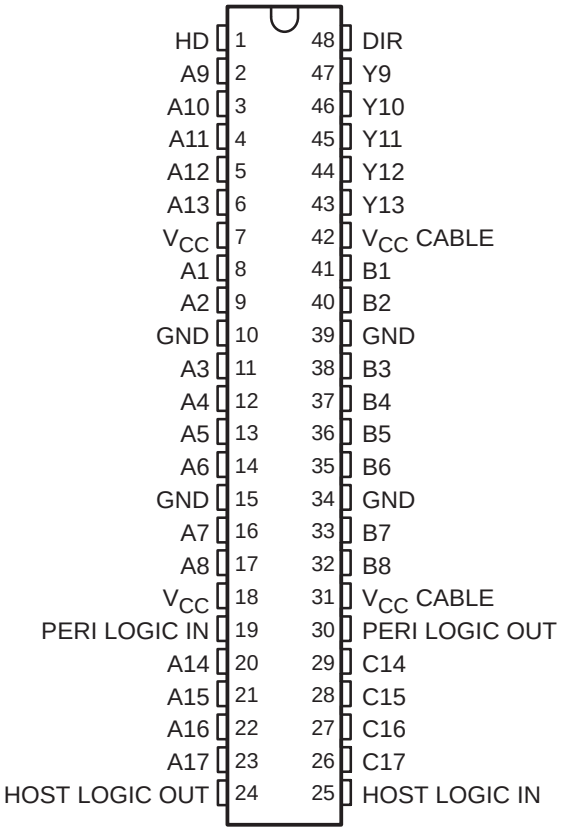
- **Auto-Power-Up Feature Prevents Printer Errors When Printer Is Turned On, But No Valid Signal Is at A9−A13 Pins**
- **1.4-kΩ Pullup Resistors Integrated on All Open-Drain Outputs Eliminate the Need for Discrete Resistors**
- **Designed for the IEEE Std 1284-I (Level-1 Type) and IEEE Std 1284-II (Level-2 Type) Electrical Specifications**
- **Flow-Through Architecture Optimizes PCB Layout**
- **I_{off} and Power-Up 3-State Support Hot Insertion**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection**
  - **±4 kV − Human-Body Model**
  - **±8 kV − IEC 61000-4-2, Contact Discharge (Connector Pins)**
  - **±15 kV − IEC 61000-4-2, Air-Gap Discharge (Connector Pins)**
  - **±15 kV − Human-Body Model (Connector Pins)**

DGG OR DL PACKAGE
(TOP VIEW)



description/ordering information

The SN74LVCE161284 is designed for 3-V to 3.6-V V_{CC} operation. This device provides asynchronous two-way communication between data buses. The control-function implementation minimizes external timing requirements.

This device has eight bidirectional bits; data can flow in the A-to-B direction when the direction-control input (DIR) is high and in the B-to-A direction when DIR is low. This device also has five drivers that drive the cable side, and four receivers. The SN74LVCE161284 has one receiver dedicated to the HOST LOGIC line and a driver to drive the PERI LOGIC line.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SSOP − DL	Tube	SN74LVCE161284DL	LVCE161284
		Tape and reel	SN74LVCE161284DLR	
	TSSOP − DGG	Tape and reel	SN74LVCE161284DGGR	LVCE161284

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

description/ordering information (continued)

The output drive mode is determined by the high-drive (HD) control pin. When HD is high, the outputs are in a totem-pole configuration, and in an open-drain configuration when HD is low. This meets the drive requirements as specified in the IEEE Std 1284-I (level-1 type) and IEEE Std 1284-II (level-2 type) parallel peripheral-interface specifications. Except for HOST LOGIC IN and peripheral logic out (PERI LOGIC OUT), all cable-side pins have a 1.4-kΩ integrated pullup resistor. The pullup resistor is switched off if the associated output driver is in the low state or if the output voltage is above V_{CC} CABLE. If V_{CC} CABLE is off, PERI LOGIC OUT is set to low.

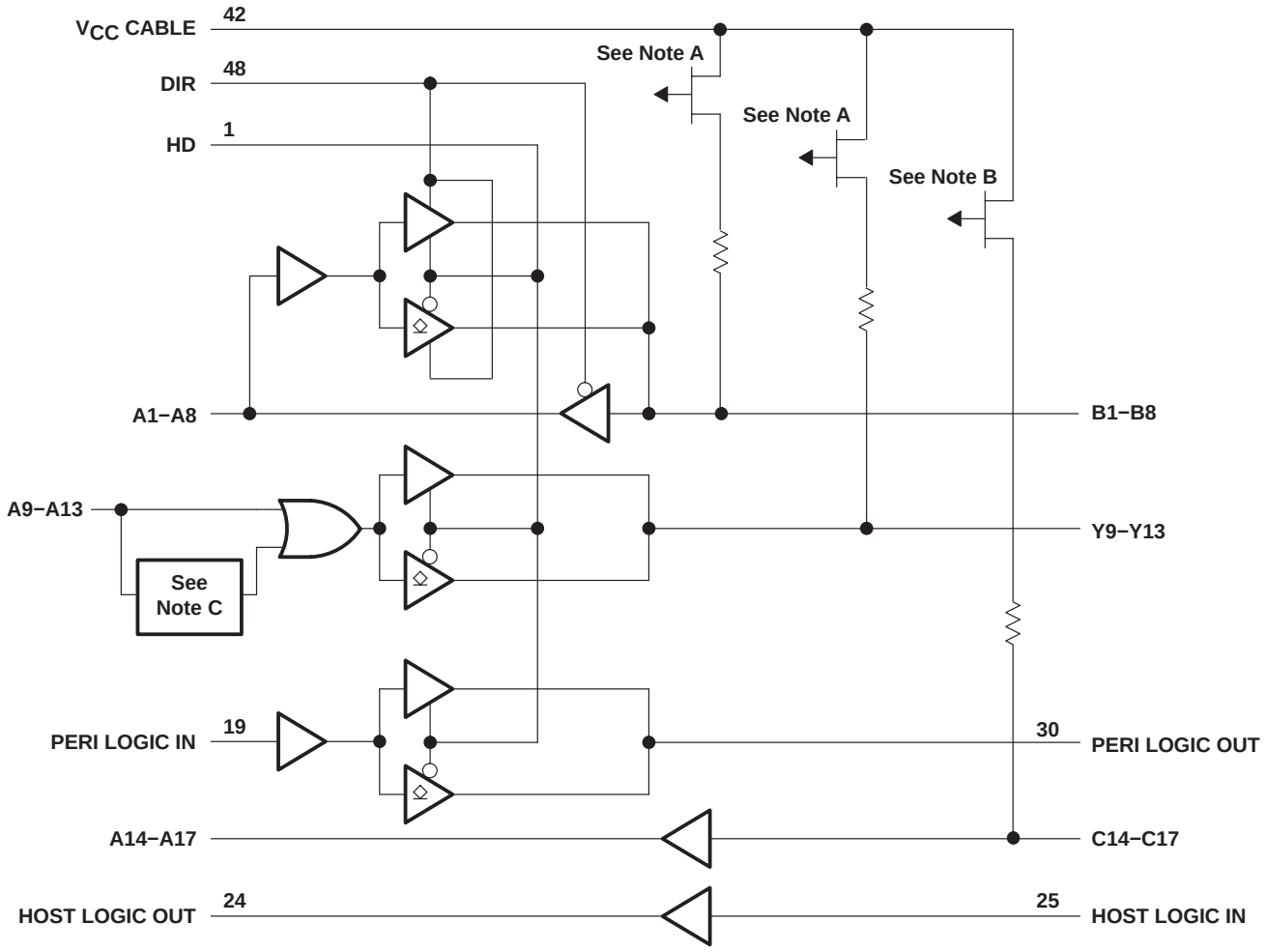
The device has two supply voltages. V_{CC} is designed for 3-V to 3.6-V operation. V_{CC} CABLE supplies the inputs and output buffers of the cable side only and is designed for 3-V to 3.6-V and for 4.7-V to 5.5-V operation. Even when V_{CC} CABLE is 3 V to 3.6 V, the cable-side I/O pins are 5-V tolerant.

The Y outputs (Y9−Y13) stay in the high state after power on until an associated input (A9−A13) goes high. When an associated input goes high, all Y outputs are activated, and noninverting signals of the associated inputs are driven through Y outputs. This special feature prevents printer-system errors caused by deasserting the BUSY signal in the cable at power on.

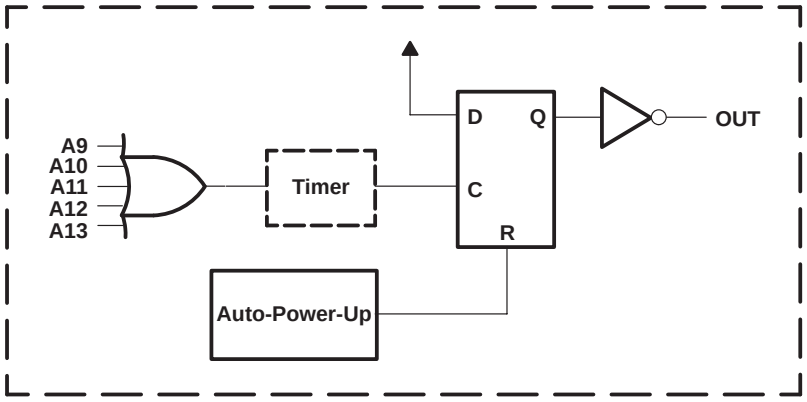
FUNCTION TABLE

INPUTS		OUTPUT	MODE
DIR	HD		
L	L	Open drain	A9−A13 to Y9−Y13 and PERI LOGIC IN to PERI LOGIC OUT
		Totem pole	B1−B8 to A1−A8 and C14−C17 to A14−A17
L	H	Totem pole	B1−B8 to A1−A8, A9−A13 to Y9−Y13, PERI LOGIC IN to PERI LOGIC OUT, and C14−C17 to A14−A17
H	L	Open drain	A1−A8 to B1−B8, A9−A13 to Y9−Y13, and PERI LOGIC IN to PERI LOGIC OUT
		Totem pole	C14−C17 to A14−A17
H	H	Totem pole	A1−A8 to B1−B8, A9−A13 to Y9−Y13, C14−C17 to A14−A17, and PERI LOGIC IN to PERI LOGIC OUT

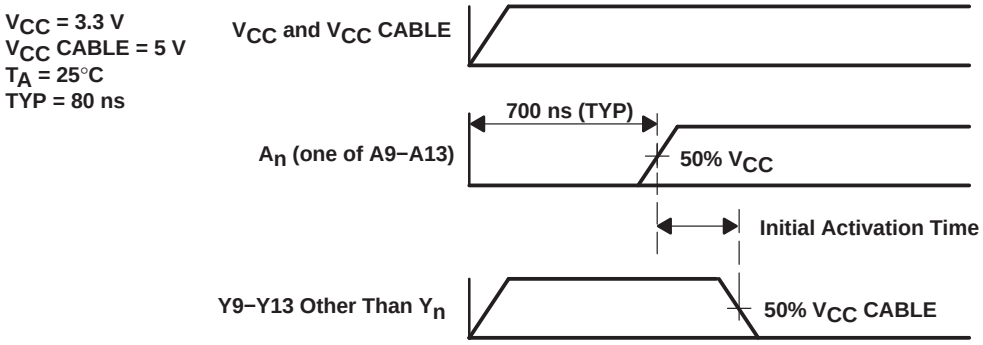
logic diagram



NOTES: A. The PMOS transistors prevent backdriving current from the signal pins to V_{CC} CABLE when V_{CC} CABLE is open or at GND. The PMOS transistor is turned off when the associated driver is in the low state.
B. The PMOS transistor prevents backdriving current from the signal pins to V_{CC} CABLE when V_{CC} CABLE is open or at GND.
C. Active input detection circuit forces Y9−Y13 to the high state after power-on, until one of the A9−A13 goes high (see Figure 1).



Active Input Detection Circuit



NOTE A: One of A9−A13 is switched as shown above, and the other four inputs are forced to low state.

Figure 1. Error-Free Circuit Timing

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

Supply voltage range: V_{CC} CABLE . . . . . −0.5 V to 7 V
V_{CC} . . . . . −0.5 V to 4.6 V
Input and output voltage range, V_I and V_O: Cable side (see Notes 1 and 2) . . . . . −2 V to 7 V
Peripheral side (see Note 1) . . . . . −0.5 V to V_{CC} + 0.5 V
Input clamp current, I_{IK} (V_I < 0) . . . . . −20 mA
Output clamp current, I_{OK} (V_O < 0) . . . . . −50 mA
Continuous output current, I_O: Except PERI LOGIC OUT . . . . . ±50 mA
PERI LOGIC OUT . . . . . ±100 mA
Continuous current through each V_{CC} or GND . . . . . ±200 mA
Output high sink current, I_{SK} (V_O = 5.5 V and V_{CC} CABLE = 3 V) . . . . . 65 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package . . . . . 70°C/W
DL package . . . . . 63°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. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The ac input-voltage pulse duration is limited to 40 ns if the amplitude is greater than −0.5 V.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V_{CC} CABLE	Supply voltage for the cable side, V_{CC} CABLE ≥ V_{CC}		3	5.5	V
V_{CC}	Supply voltage		3	3.6	V
V_{IH}	High-level input voltage	A, B, DIR, and HD	2		V
		C14−C17	2.3		
		HOST LOGIC IN	2.6		
		PERI LOGIC IN	2		
V_{IL}	Low-level input voltage	A, B, DIR, and HD		0.8	V
		C14−C17		0.8	
		HOST LOGIC IN		1.6	
		PERI LOGIC IN		0.8	
V_I	Input voltage	Peripheral side	0	V_{CC}	V
		Cable side	0	5.5	
V_O	Open-drain output voltage	HD low	0	5.5	V
I_{OH}	High-level output current	HD high, B and Y outputs		−14	mA
		A outputs and HOST LOGIC OUT		−4	
		PERI LOGIC OUT		−0.5	
I_{OL}	Low-level output current	B and Y outputs		14	mA
		A outputs and HOST LOGIC OUT		4	
		PERI LOGIC OUT		84	
T_A	Operating free-air temperature		0	70	°C

NOTE 4: All unused 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.

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

PARAMETER		TEST CONDITIONS	V_{CC}	V_{CC} CABLE	MIN	TYP†	MAX	UNIT
ΔV_t Hysteresis ($V_{T+} - V_{T-}$)	All inputs except the C inputs and HOST LOGIC IN		3.3 V	5 V	0.4			V
	HOST LOGIC IN				0.2			
	C inputs				0.8			
V_{OH}	HD high, B and Y outputs	I_{OH} = −14 mA	3 V	3 V	2.23			V
			3.3 V	4.7 V	2.4			
	HD high, A outputs, and HOST LOGIC OUT	I_{OH} = −4 mA	3 V	3 V	2.4			
		I_{OH} = −50 µA			2.8			
	PERI LOGIC OUT	I_{OH} = −0.5 mA	3.15 V	3.15 V	3.1			
			3.3 V	4.7 V	4.5			
V_{OL}	B and Y outputs	I_{OL} = 14 mA	3 V	3 V			0.77	V
	A outputs and HOST LOGIC OUT	I_{OL} = 50 µA					0.2	
		I_{OL} = 4 mA					0 4	
	PERI LOGIC OUT	I_{OL} = 84 mA					0.9	
I_I	C inputs	$V_I = V_{CC}$	3.6 V	3.6 V			50	µA
		V_I = GND (pullup resistors)					−3.5	mA
	All inputs except B or C inputs	$V_I = V_{CC}$ or GND	3.6 V	5.5 V			±1	µA
I_{OZ}	A1−A8	$V_O = V_{CC}$ or GND	3.6 V	5.5 V			±20	µA
	B outputs	$V_O = V_{CC}$ CABLE	3.6 V	5.5 V			50	µA
		V_O = GND (pullup resistors)	3.6 V	3.6 V			−3.5	mA
	Open-drain Y outputs	V_O = GND (pullup resistors)	3.6 V	3.6 V			−3.5	mA
I_{OZPU}	B and Y outputs	V_O = 5.5 V	0 to 1.5 V‡	0 to 1.5 V‡			350	µA
		V_O = GND					−5	mA
I_{OZPD}	B and Y outputs	V_O = 5.5 V	0 to 1.5 V‡	0 to 1.5 V‡			350	µA
		V_O = GND					−5	mA
I_{off}	Power-down input leakage, except A1−A8 or B1−B8 inputs	V_I or V_O = 0 to 3.6 V	0	0			100	µA
	Power-down output leakage, B1−B8 and Y9−Y13 outputs	V_I or V_O = 0 to 5.5 V					100	
I_{CC}		V_I = GND (12 × pullup)	3.6 V	3.6 V			45	mA
			3.6 V	5.5 V			70	
		$V_I = V_{CC}$, I_O = 0	3.6 V	3.6 V			0.8	
Z_O	B1-B8, Y9-Y13	I_{OH} = −35 mA	3.3 V	3.3 V		36		Ω
R pullup	B1-B8, Y9-Y13, C14-C17	V_O = 0 V (in high-impedance state)	3.3 V	3.3 V	1.15		1.65	kΩ

† Typical values are measured at T_A = 25°C.
‡ Connect the V_{CC} pin to the V_{CC} CABLE pin.

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

PARAMETER		TEST CONDITIONS	V_{CC}	V_{CC} CABLE	MIN	TYP†	MAX	UNIT
C_i	A9-A13, DIR, HD, PERI LOGIC IN	$V_I = V_{CC}$ or GND	3.3 V	5 V		6.5		pF
	HOST LOGIC IN					4		
C_{io}	A1-A8	$V_O = V_{CC}$ or GND	3.3 V	5 V		8		pF
	B1-B8					13		

† Typical values are measured at T_A = 25°C.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figures 2 and 3)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	MIN	TYP‡	MAX	UNIT
t_{PLH}	Totem pole	A1−A8	B1−B8	2		30	ns
t_{PHL}				2		30	
t_{PLH}	Totem pole	A9−A13	Y9−Y13	2		30	ns
t_{PHL}				2		30	
t_{PLH}	Totem pole	B1−B8	A1−A8	2		12	ns
t_{PHL}				2		12	
t_{PLH}	Totem pole	C14−C17	A14−A17	2		14	ns
t_{PHL}				2		14	
t_{PLH}	Totem pole	PERI LOGIC IN	PERI LOGIC OUT	2		16	ns
t_{PHL}				2		16	
t_{PLH}	Totem pole	HOST LOGIC IN	HOST LOGIC OUT	1		18	ns
t_{PHL}				1		18	
t_{slew}	Totem pole	B1−B8 and Y9−Y13 outputs		0.05		0.4	V/ns
t_{PZH}		HD	B1−B8, Y9−Y13, and PERI LOGIC OUT	2		30	ns
t_{PHZ}				2		25	
t_{en}−t_{dis}		DIR	A1−A8	2		25	ns
t_{PHZ}		DIR	B1−B8	2		25	ns
t_{PLZ}				2		25	
t_r, t_f	Open drain	A1−A13	B1−B8 or Y9−Y13	1		120	ns
$t_{sk(o)}$§		A1−A8 or B1−B8	B1−B8 or A1−A8		3	10	ns

‡ Typical values are measured at V_{CC} = 3.3 V, V_{CC} CABLE = 5 V, and T_A = 25°C.
§ Skew is measured at 1/2 (V_{OH} + V_{OL}) for signals switching in the same direction.

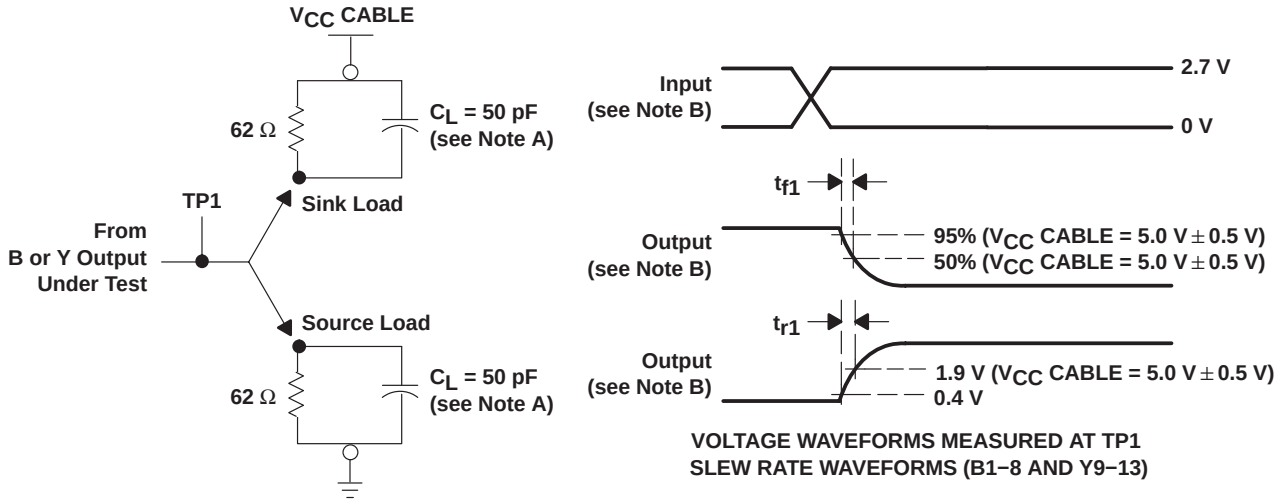
ESD protection

PIN	TEST CONDITIONS	TYP	UNIT
B1−B8, Y9−Y13, PERI LOGIC OUT, C14−C17, HOST LOGIC IN	HBM	±15	kV
	Contact discharge, IEC 61000-4-2	±8	
	Air-gap discharge, IEC 61000-4-2	±15	
DIR, HD, A1−A8, A9−A13, PERI LOGIC IN, A14−A17, HOST LOGIC OUT	HBM	±4	kV

operating characteristics, V_{CC} and V_{CC} CABLE = 3.3 V, C_L = 0, f = 10 MHz, T_A = 25°C

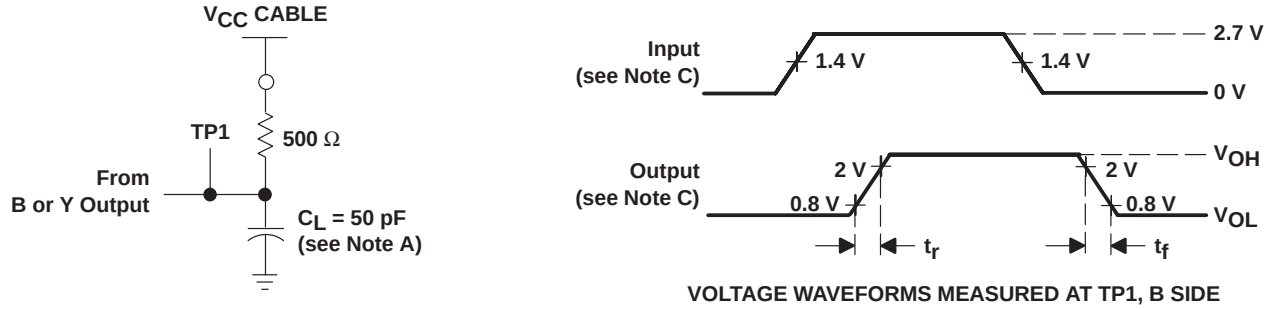
PARAMETER		FROM (INPUT)	TO (OUTPUT)	TYP	UNIT
C_{pd}	Power dissipation capacitance	A	B	15	pF
		A	Y	6	
		PERI LOGIC IN	PERI LOGIC OUT	10	
		B	A	33	
		C	A	29	
		HOST LOGIC IN	HOST LOGIC OUT	29	

PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS MEASURED AT TP1
SLEW RATE WAVEFORMS (B1−8 AND Y9−13)

SLEW RATE A-TO-B OR A-TO-Y LOAD (TOTEM POLE) OR PERI LOGIC IN TO PERI LOGIC OUT



VOLTAGE WAVEFORMS MEASURED AT TP1, B SIDE

A-TO-B LOAD OR A-TO-Y LOAD (OPEN DRAIN) OR PERI LOGIC IN TO PERI LOGIC OUT

NOTES: A. C_L includes probe and jig capacitance.

B. When V_{CC} CABLE is 3.3 V ± 0.3 V, slew rate is measured between 0.4 V and 0.9 V for the rising edge and between 2.4 V and 1.9 V for the falling edge. When V_{CC} CABLE is 5 V ± 0.5 V, slew rate is measured between 0.4 V and 1.9 V for the rising edge and between 95% V_{CC} CABLE and 50% V_{CC} CABLE for the falling edge.

$$t_{slew}\,\text{fall} = V_{CC}\left(\frac{95\% - 50\%}{t_{f1}}\right) \qquad t_{slew}\,\text{rise} = \left(\frac{1.9\ \text{V} - 0.4\ \text{V}}{t_{r1}}\right)$$

C. Input rise (t_r) and fall (t_f) times are 3 ns. Rise and fall times (open drain) are <120 ns.

D. The outputs are measured one at a time, with one transition per measurement.

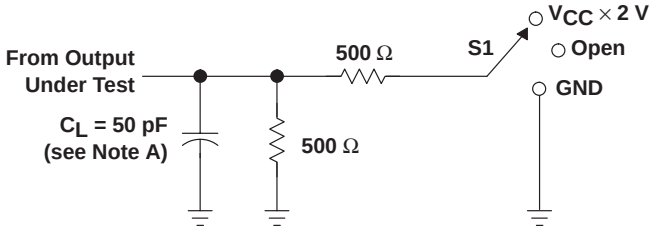
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.

F. t_{PZL} and t_{PZH} are the same as t_{en}.

G. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 2. Load Circuits and Voltage Waveforms

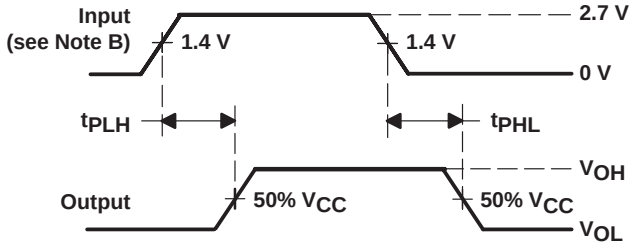
PARAMETER MEASUREMENT INFORMATION



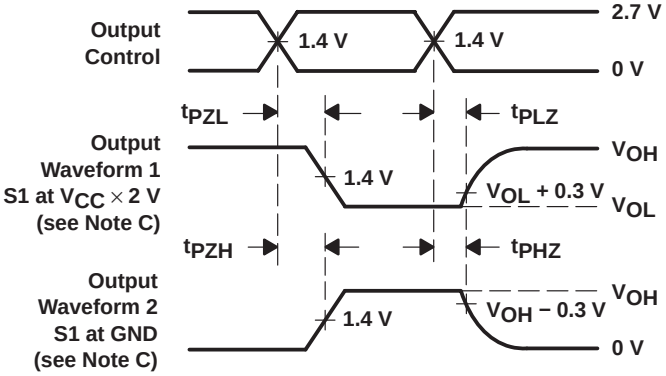
LOAD CIRCUIT

When Measuring the Cable Side, V_{CC} CABLE × 2 V

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC} × 2 V
t_{PHZ}/t_{PZH}	GND

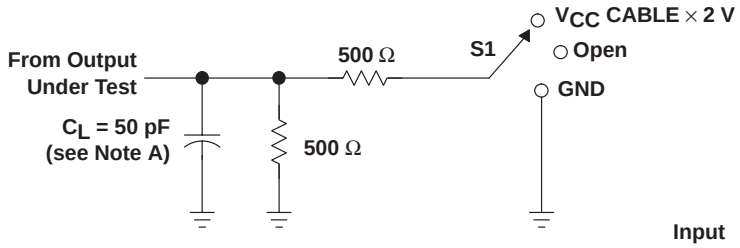


VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES (B to A)



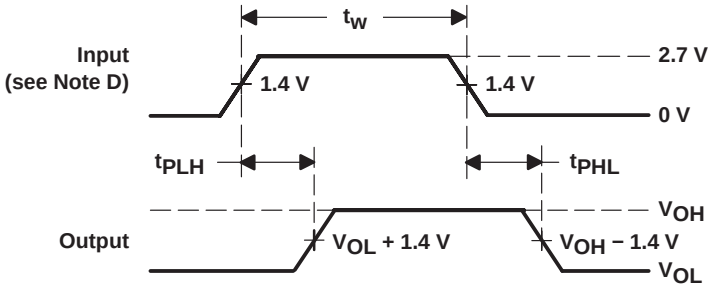
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

HOST LOGIC IN TO HOST LOGIC OUT OR B-TO-A LOAD (TOTEM POLE)



LOAD CIRCUIT

TEST	S1
t_{PLH}	Open
t_{PHL}	V_{CC} CABLE × 2 V
t_{PLZ}/t_{PZL}	V_{CC} CABLE × 2 V
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS MEASURED AT TP1
PROPAGATION DELAY TIMES (A to B)

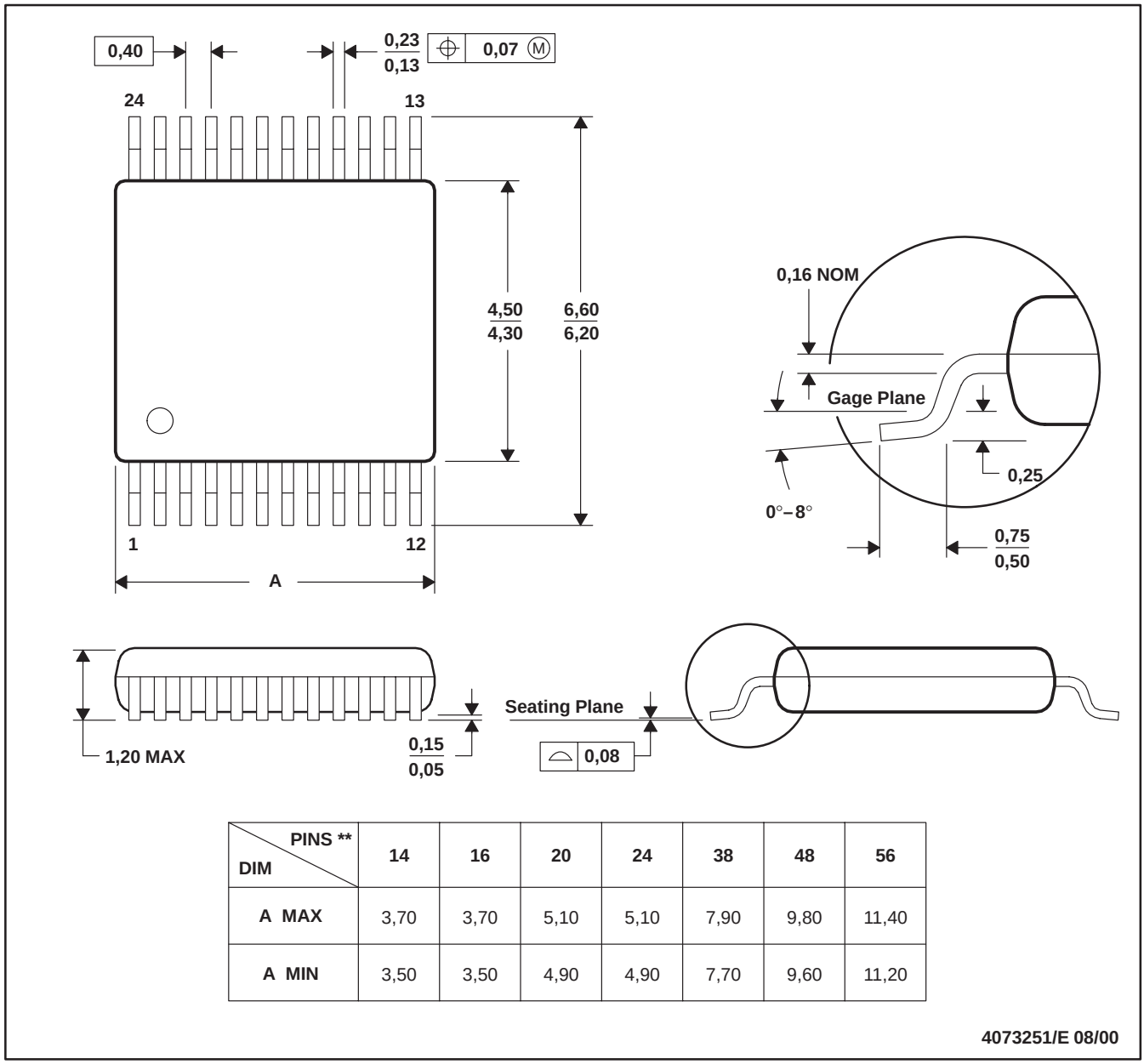
A-TO-B LOAD OR A-TO-Y LOAD (TOTEM POLE) OR PERI LOGIC IN TO PERI LOGIC OUT

NOTES: A. C_L includes probe and jig capacitance.
B. Input rise and fall times are 3 ns.
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. Input rise and fall times are 3 ns. Pulse duration is 150 ns < t_w < 10 μs.
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}.
H. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 3. Load Circuit and Voltage Waveforms

DGV (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

24 PINS SHOWN



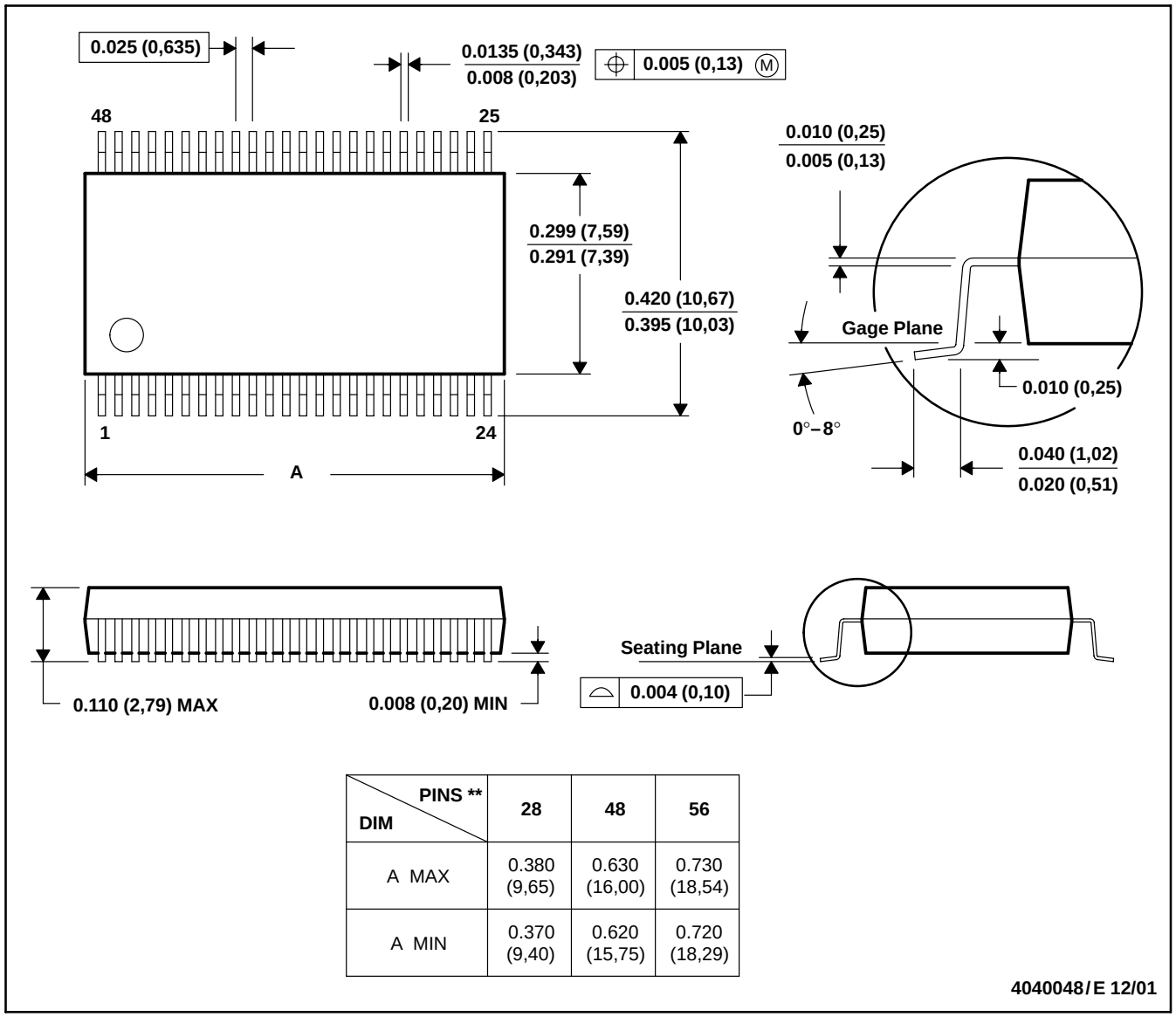
DIM \ PINS **	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

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

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

48 PINS SHOWN



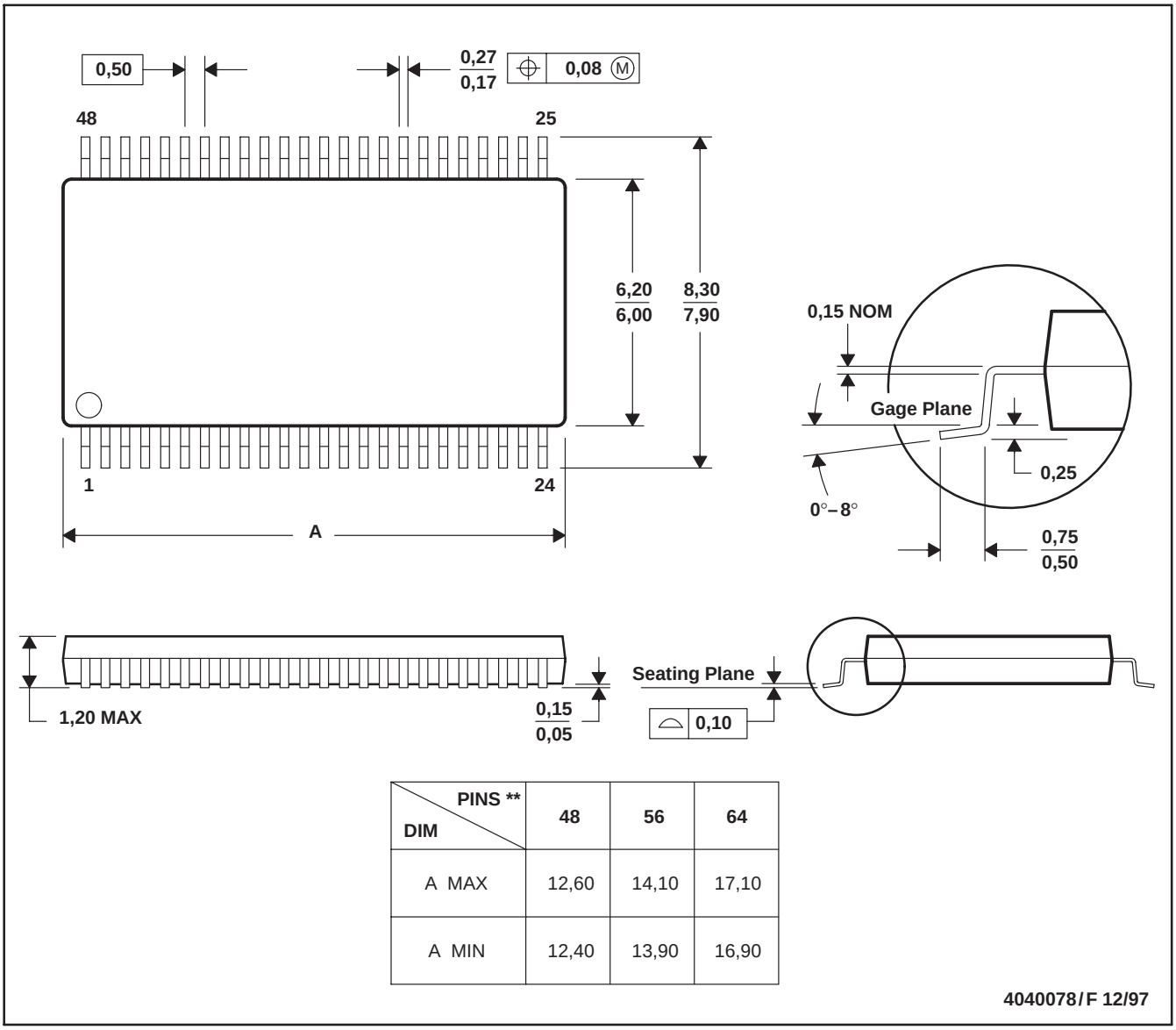
DIM \ PINS **	28	48	56
A MAX	0.380 (9,65)	0.630 (16,00)	0.730 (18,54)
A MIN	0.370 (9,40)	0.620 (15,75)	0.720 (18,29)

4040048/E 12/01

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).
D. Falls within JEDEC MO-118

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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