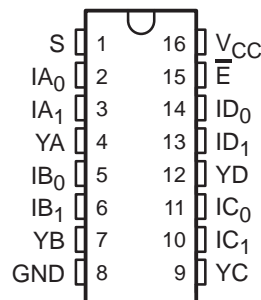


TS3L100 QUAD SPDT WIDE-BANDWIDTH LAN SWITCH WITH LOW ON-STATE RESISTANCE

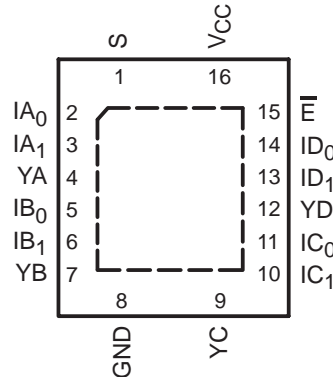
SCDS161 – MAY 2004

- Wide Bandwidth (BW = 350 MHz Min)
- Low Differential Crosstalk ($X_{TALK} = -68$ dB Typ)
- Low Power Consumption ($I_{CC} = 3$ μ A Max)
- Bidirectional Data Flow, With Near-Zero Propagation Delay
- Low ON-State Resistance ($r_{on} = 5$ Ω Typ)
- Rail-to-Rail Switching on Data I/O Ports (0 to V_{CC})
- V_{CC} Operating Range From 3 V to 3.6 V
- I_{off} Supports Partial-Power-Down Mode Operation
- Data and Control Inputs Have Undershoot Clamp Diodes
- 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)
- Suitable for Both 10 Base-T/100 Base-T Signaling

D, DBQ, DGV, OR PW PACKAGE
(TOP VIEW)



RGY PACKAGE
(TOP VIEW)



description/ordering information

The TI TS3L100 LAN switch is a 4-bit 1-of-2 multiplexer/demultiplexer with a single switch-enable (\bar{E}) input. When \bar{E} is low, the switch is enabled and the I port is connected to the Y port. When \bar{E} is high, the switch is disabled and the high-impedance state exists between the I and Y ports. The select (S) input controls the data path of the multiplexer/demultiplexer.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	QFN – RGY	Tape and reel	TS3L100RGYR	TK100
	SOIC – D	Tube	TS3L100D	TS3L100
		Tape and reel	TS3L100DR	
	SSOP (QSOP) – DBQ	Tape and reel	TS3L100DBQR	TK100
	TSSOP – PW	Tube	TS3L100PW	TK100
		Tape and reel	TS3L100PWR	
	TVSOP – DGV	Tape and reel	TS3L100DGV	TK100

† 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.

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2004, Texas Instruments Incorporated

TS3L100

QUAD SPDT WIDE-BANDWIDTH LAN SWITCH WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

description/ordering information (continued)

This device can be used to replace mechanical relays in LAN applications. This device has low r_{on} , wide bandwidth, and low differential crosstalk, making it suitable for 10 Base-T, 100 Base-T, and various other LAN applications.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} feature ensures that damaging current will not 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, \bar{E} 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.

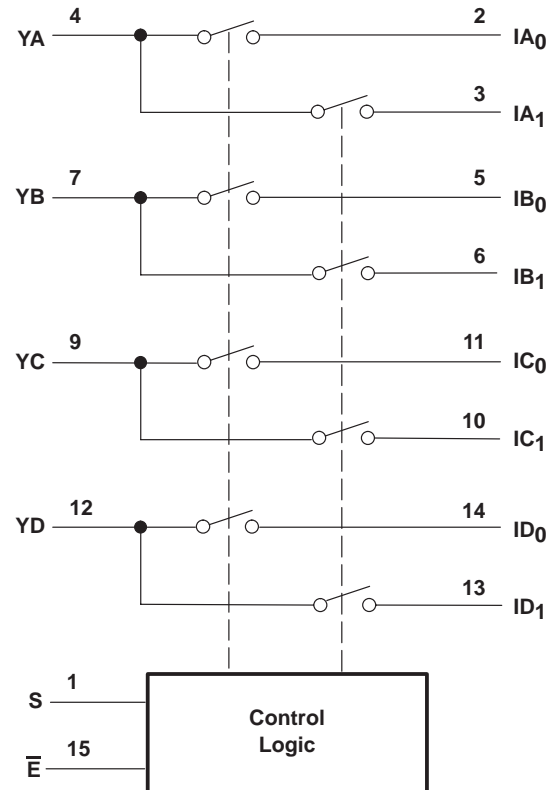
FUNCTION TABLE

INPUTS		INPUT/OUTPUT YX	FUNCTION
\bar{E}	S		
L	L	IX_0	$YX = IX_0$
L	H	IX_1	$YX = IX_1$
H	X	Z	Disconnect

PIN DESCRIPTIONS

PIN NAME	DESCRIPTION
$IAn-IDn$	Data I/Os
S	Select input
\bar{E}	Enable input
YA-YD	Data I/Os

logic diagram (positive logic)



TS3L100

QUAD SPDT WIDE-BANDWIDTH LAN SWITCH WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

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 4.6 V
Switch I/O voltage range, $V_{I/O}$ (see Notes 1, 2, and 3)	–0.5 V to 4.6 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)	±128 mA
Continuous current through V_{CC} or GND terminals	±100 mA
Package thermal impedance, θ_{JA} (see Note 5): D package	73°C/W
DB package	82°C/W
DBQ package	90°C/W
PW package	108°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	MAX	UNIT
V_{CC}	Supply voltage	3	3.6	V
V_{IH}	High-level control input voltage (\bar{E} , S)	2	V_{CC}	V
V_{IL}	Low-level control input voltage (\bar{E} , S)	0	0.8	V
T_A	Operating free-air temperature	0	70	°C

NOTE 6: 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.

TS3L100
QUAD SPDT WIDE-BANDWIDTH LAN SWITCH
WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

**electrical characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{IK}	\overline{E}, S	$V_{CC} = 3\text{ V}, I_{IN} = -18\text{ mA}$			-1.8	V
V_{hys}	\overline{E}, S			150		mV
I_{IH}	\overline{E}, S	$V_{CC} = 3.6\text{ V}, V_{IN} = V_{CC}$			± 1	μA
I_{IL}	\overline{E}, S	$V_{CC} = 3.6\text{ V}, V_{IN} = \text{GND}$			± 1	μA
I_{OZ}^{\ddagger}		$V_{CC} = 3.6\text{ V}, V_O = 0\text{ to }3.6\text{ V}, V_I = 0,$ Switch OFF			± 1	μA
I_{OS}^{\S}		$V_{CC} = 3.6\text{ V}, V_O = 0\text{ to }0.5 V_{CC}, V_I = 0,$ Switch ON	50			mA
I_{off}		$V_{CC} = 0, V_O = 0\text{ to }3.6\text{ V}, V_I = 0$			15	μA
I_{CC}		$V_{CC} = 3.6\text{ V}, I_{I/O} = 0,$ Switch ON or OFF		0.1	3	μA
ΔI_{CC}	\overline{E}, S	$V_{CC} = 3.6\text{ V},$ One input at $V_{CC} - 0.6\text{ V},$ Other inputs at V_{CC} or GND			750	μA
I_{CCD}		$V_{CC} = 3.6\text{ V},$ I and Y ports open, V_{IN} input switching 50% duty cycle			0.45	mA/MHz
C_{IN}	\overline{E}, S	$f = 1\text{ MHz}$		3		pF
C_{OFF}	I port	$V_I = 0, f = 1\text{ MHz},$ Outputs open, Switch OFF		5		pF
	Y port			10		
C_{ON}		$V_I = 0, f = 1\text{ MHz},$ Outputs open, Switch ON		17		pF
r_{on}		$V_{CC} = 3\text{ V}, V_I = 0\text{ V}, I_O = 48\text{ mA}$	5	7		Ω
		$V_I = 2\text{ V}, I_O = 15\text{ mA}$	10	15		
Δr_{on}		$V_I = 3\text{ V},$ Switch ON, $I_O = 15\text{ mA}$		1		Ω

$V_I, V_O, I_I,$ and I_O refer to I/O pins. V_{IN} refers to the control inputs.

† All typical values are at $V_{CC} = 3.3\text{ V}$ (unless otherwise noted), $T_A = 25^\circ\text{C}$.

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

§ The I_{OS} test is applicable to only one ON channel at a time. The duration of this test is less than one second.

**switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}, R_L = 100\ \Omega, C_L = 35\text{ pF}$ (unless otherwise noted) (see Figure 4)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	MAX	UNIT
t_{ON}	S	Y	1	7.5	ns
t_{OFF}	S	Y	1	3.5	ns

† All typical values are at $V_{CC} = 3.3\text{ V}$ (unless otherwise noted), $T_A = 25^\circ\text{C}$.

**dynamic characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	TYP†	UNIT
$X_{TALK}(\text{Diff})$	$R_L = 100\ \Omega, f = 10\text{ MHz},$ see Figure 8, $t_r = t_f = 2\text{ ns}$	-55	dB
X_{TALK}	$R_L = 100\ \Omega, f = 30\text{ MHz},$ see Figure 6	-68	dB
O_{IRR}	$R_L = 100\ \Omega, f = 30\text{ MHz},$ see Figure 7	-42	dB
BW	$R_L = 100\ \Omega,$ see Figure 5	350	MHz

† All typical values are at $V_{CC} = 3.3\text{ V}$ (unless otherwise noted), $T_A = 25^\circ\text{C}$.



TS3L100

QUAD SPDT WIDE-BANDWIDTH LAN SWITCH

WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

OPERATING CHARACTERISTICS

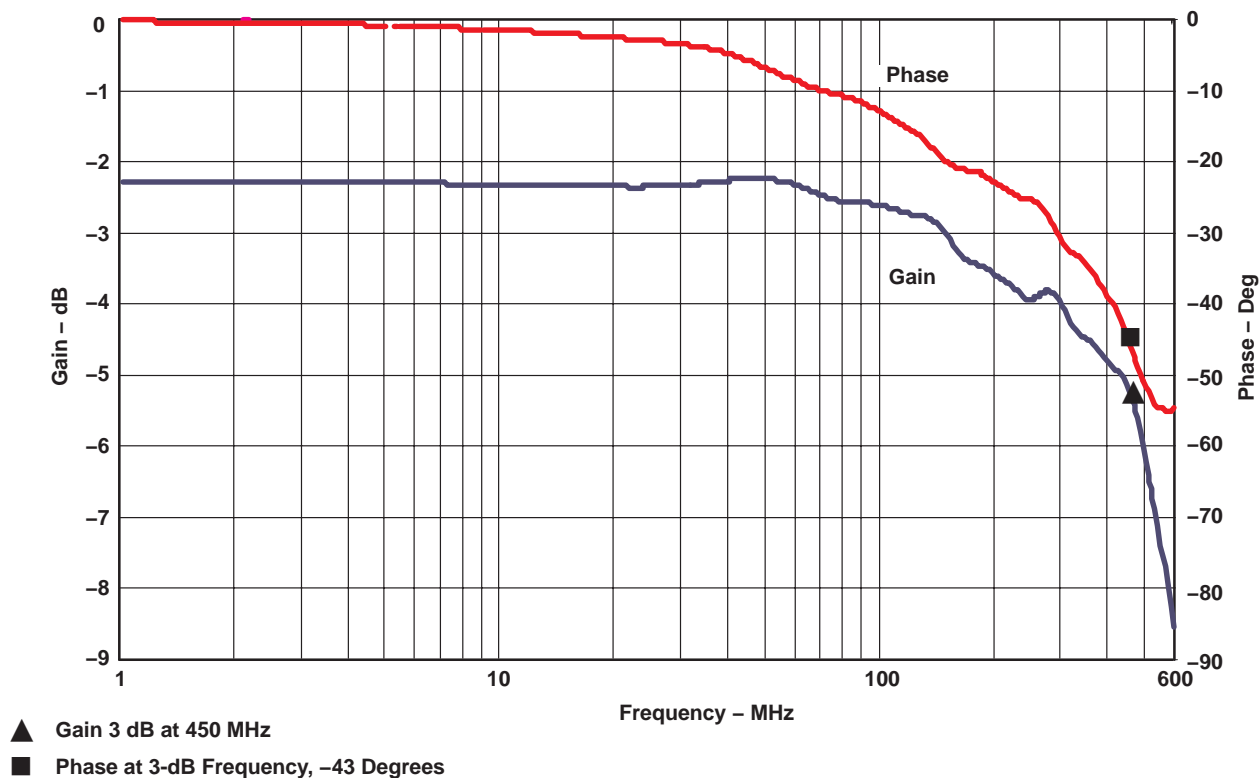


Figure 1. Gain/Phase vs Frequency

OPERATING CHARACTERISTICS

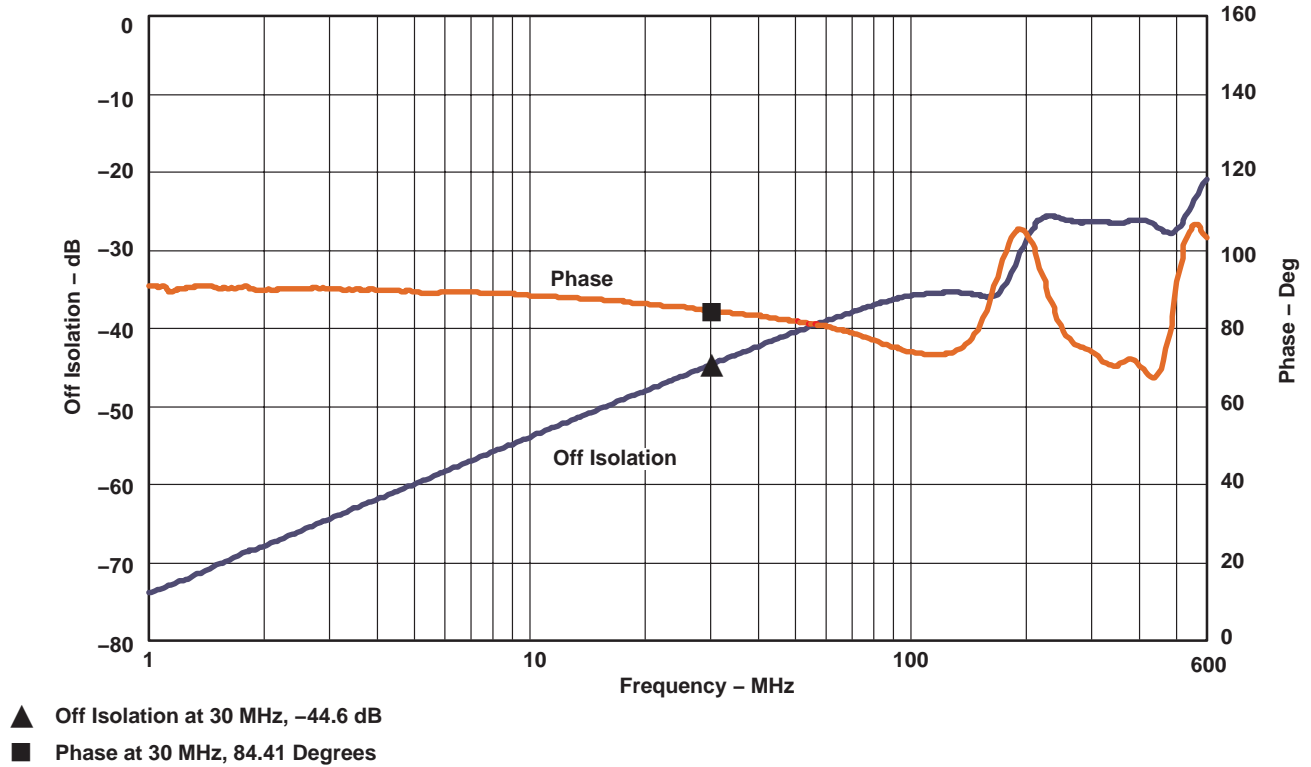


Figure 2. Off Isolation vs Frequency

TS3L100
QUAD SPDT WIDE-BANDWIDTH LAN SWITCH
WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

OPERATING CHARACTERISTICS

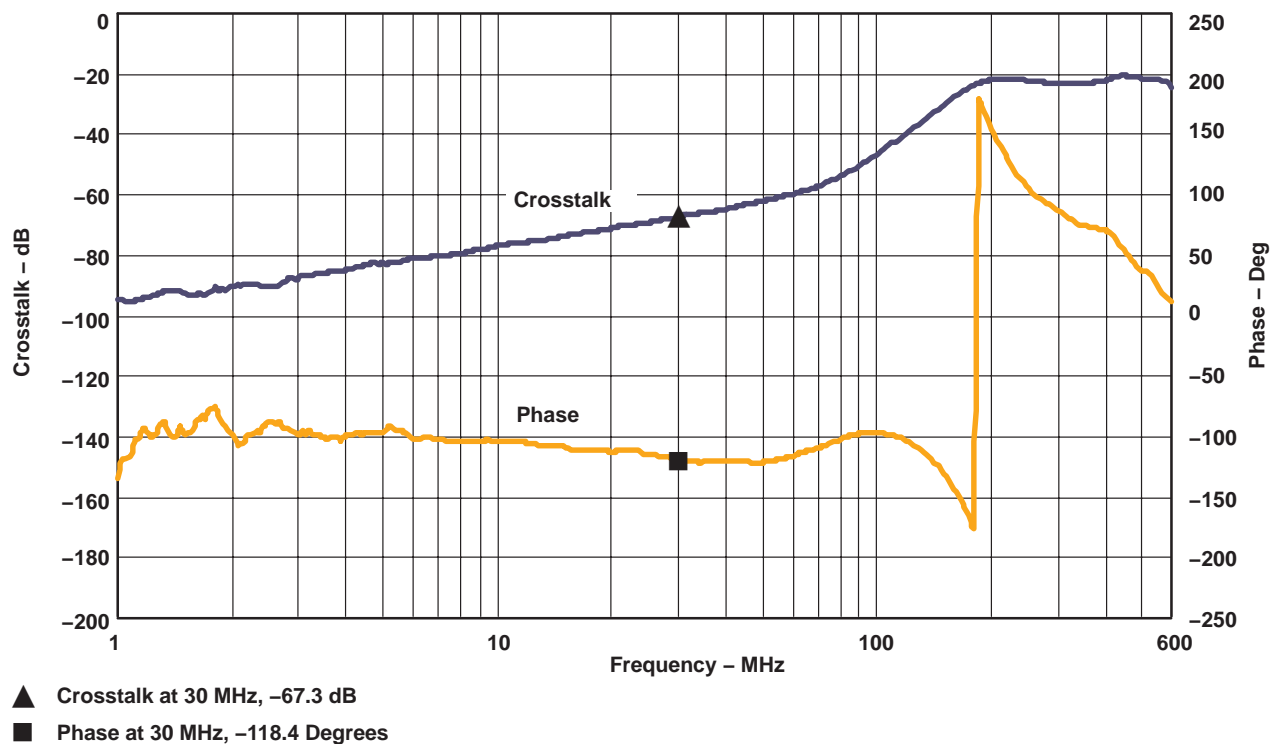
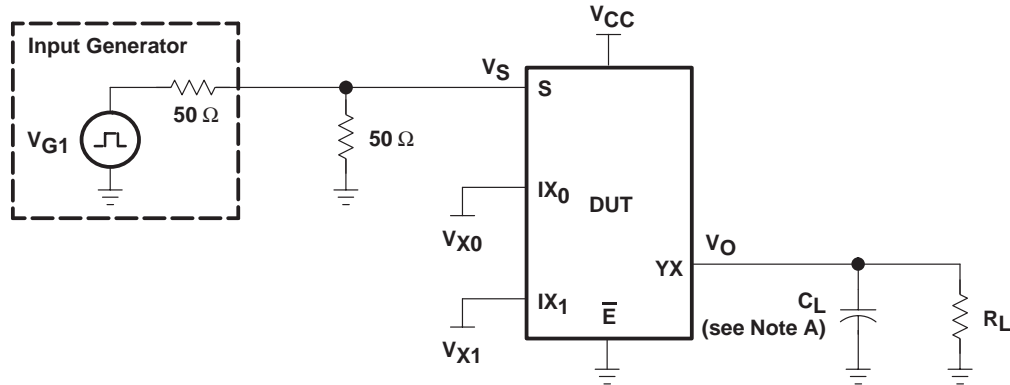
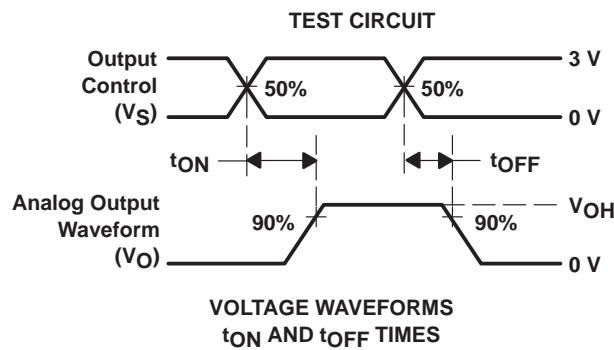


Figure 3. Crosstalk vs Frequency

PARAMETER MEASUREMENT INFORMATION



TEST	V _{CC}	R _L	C _L	V _{X0}	V _{X1}
t _{ON}	3.3 V ± 0.3 V	100 Ω	35 pF	GND	3 V
	3.3 V ± 0.3 V	100 Ω	35 pF	3 V	GND
t _{OFF}	3.3 V ± 0.3 V	100 Ω	35 pF	GND	3 V
	3.3 V ± 0.3 V	100 Ω	35 pF	3 V	GND



- NOTES: A. C_L includes probe and jig capacitance.
 B. 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.
 C. The outputs are measured one at a time, with one transition per measurement.

Figure 4. Test Circuit and Voltage Waveforms

TS3L100 QUAD SPDT WIDE-BANDWIDTH LAN SWITCH WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

PARAMETER MEASUREMENT INFORMATION

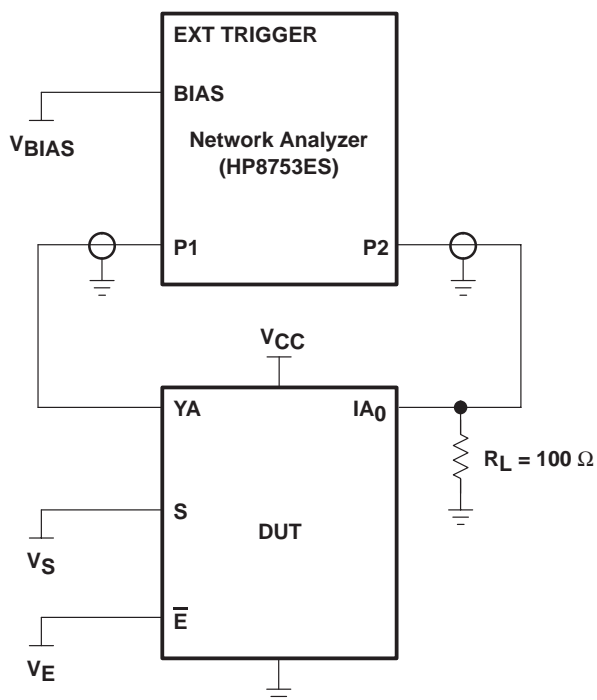


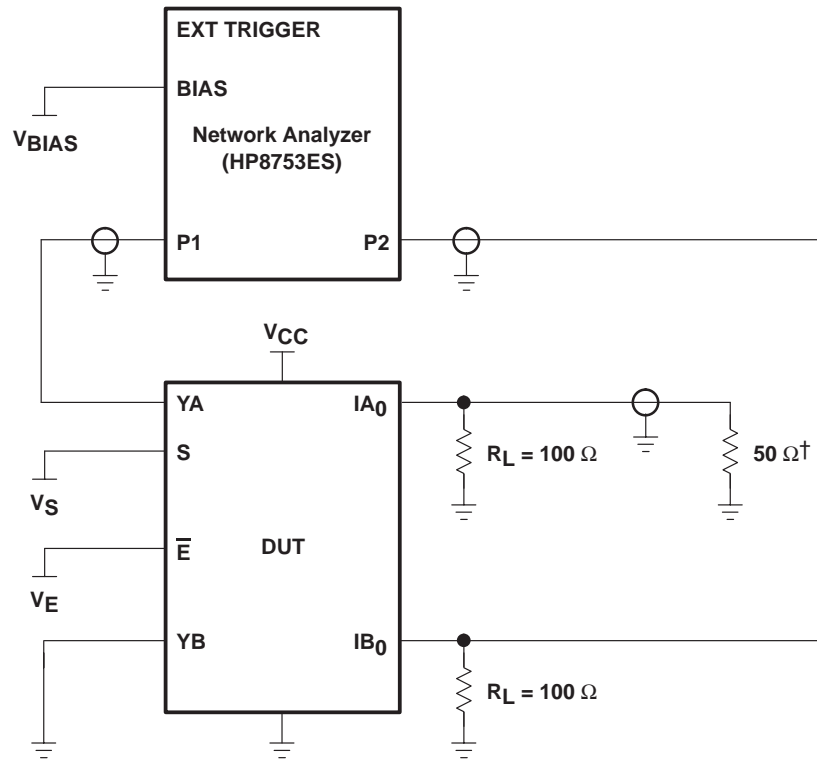
Figure 5. Test Circuit for Frequency Response (BW)

Frequency response is measured at the output of the ON channel. For example, when $V_S = 0$, $V_E = 0$, and YA is the input, the output is measured at IA₀. All unused analog I/O ports are left open.

HP8753ES setup

Average = 4
RBW = 3 kHz
 $V_{BIAS} = 0.35$ V
ST = 2 s
P1 = 0 dBm

PARAMETER MEASUREMENT INFORMATION



† A 50- Ω termination resistor is needed for the network analyzer.

Figure 6. Test Circuit for Crosstalk (X_{TALK})

Crosstalk is measured at the output of the nonadjacent ON channel. For example, when $V_S = 0$, $V_E = 0$, and YA is the input, the output is measured at IB_0 . All unused analog input (Y) ports are connected to GND and output (I) ports are connected to GND through 50- Ω pulldown resistors.

HP8753ES setup

Average = 4
 RBW = 3 kHz
 $V_{BIAS} = 0.35$ V
 ST = 2 s
 P1 = 0 dBm

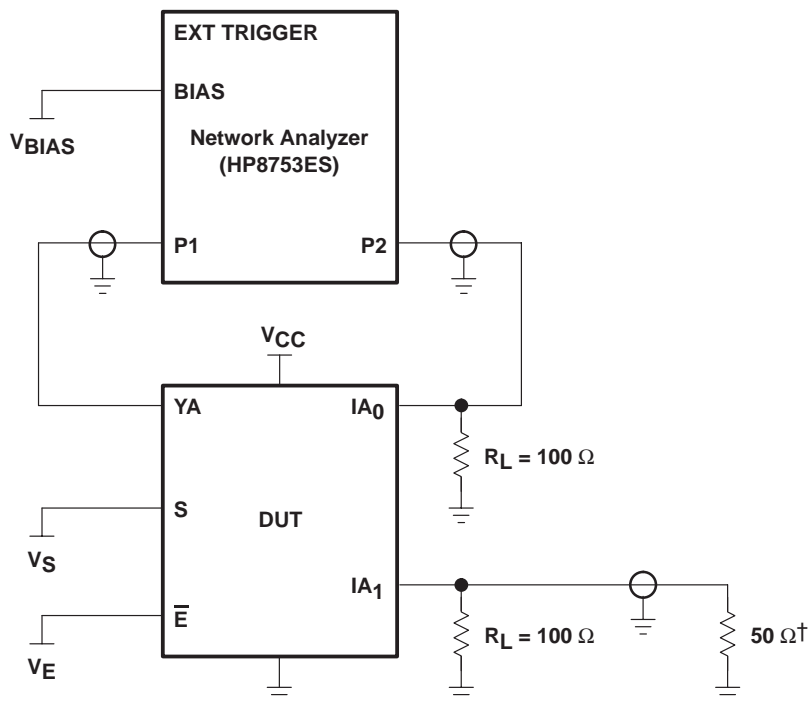
TS3L100

QUAD SPDT WIDE-BANDWIDTH LAN SWITCH

WITH LOW ON-STATE RESISTANCE

SCDS161 – MAY 2004

PARAMETER MEASUREMENT INFORMATION



† A 50-Ω termination resistor is needed for the network analyzer.

Figure 7. Test Circuit for Off Isolation (O_{IRR})

OFF isolation is measured at the output of the OFF channel. For example, when $V_S = V_{CC}$, $V_E = 0$, and YA is the input, the output is measured at IA_0 . All unused analog input (Y) ports are left open and output (I) ports are connected to GND through 50-Ω pulldown resistors.

HP8753ES setup

Average = 4
RBW = 3 kHz
 $V_{BIAS} = 0.35$ V
ST = 2 s
P1 = 0 dBm

PARAMETER MEASUREMENT INFORMATION

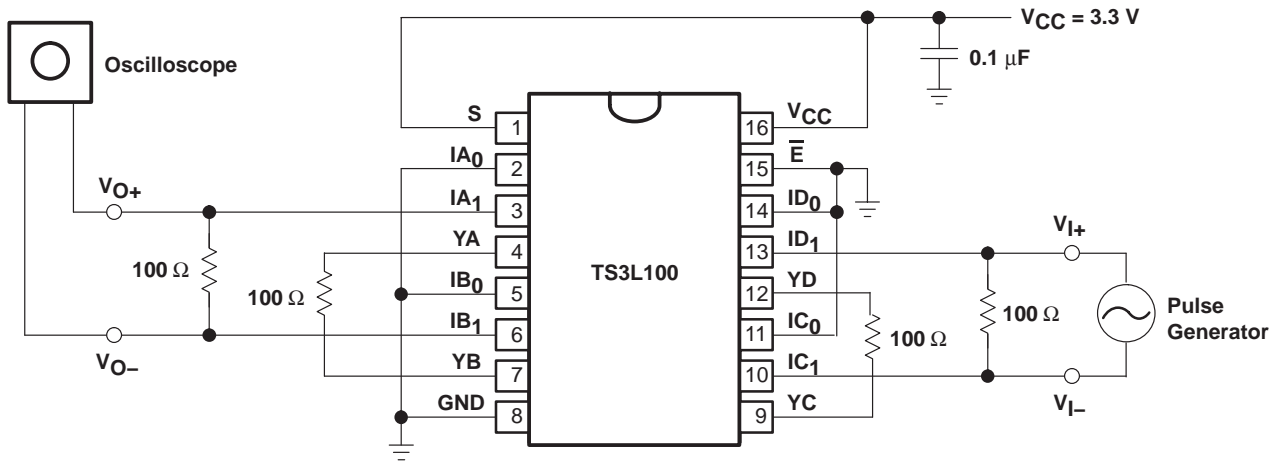


Figure 8. Differential Crosstalk Measurement

Differential crosstalk is a measure of coupling noise between a transmit and receive pair in the LAN application. Differential crosstalk depends on the edge rate, frequency, and load. This is calculated from the equation, $X_{TALK}(Diff) \text{ db} = 20 \log V_O(Diff)/V_I(Diff)$, where $V_O(Diff)$ is the differential output voltage and $V_I(Diff)$ is the differential input voltage.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

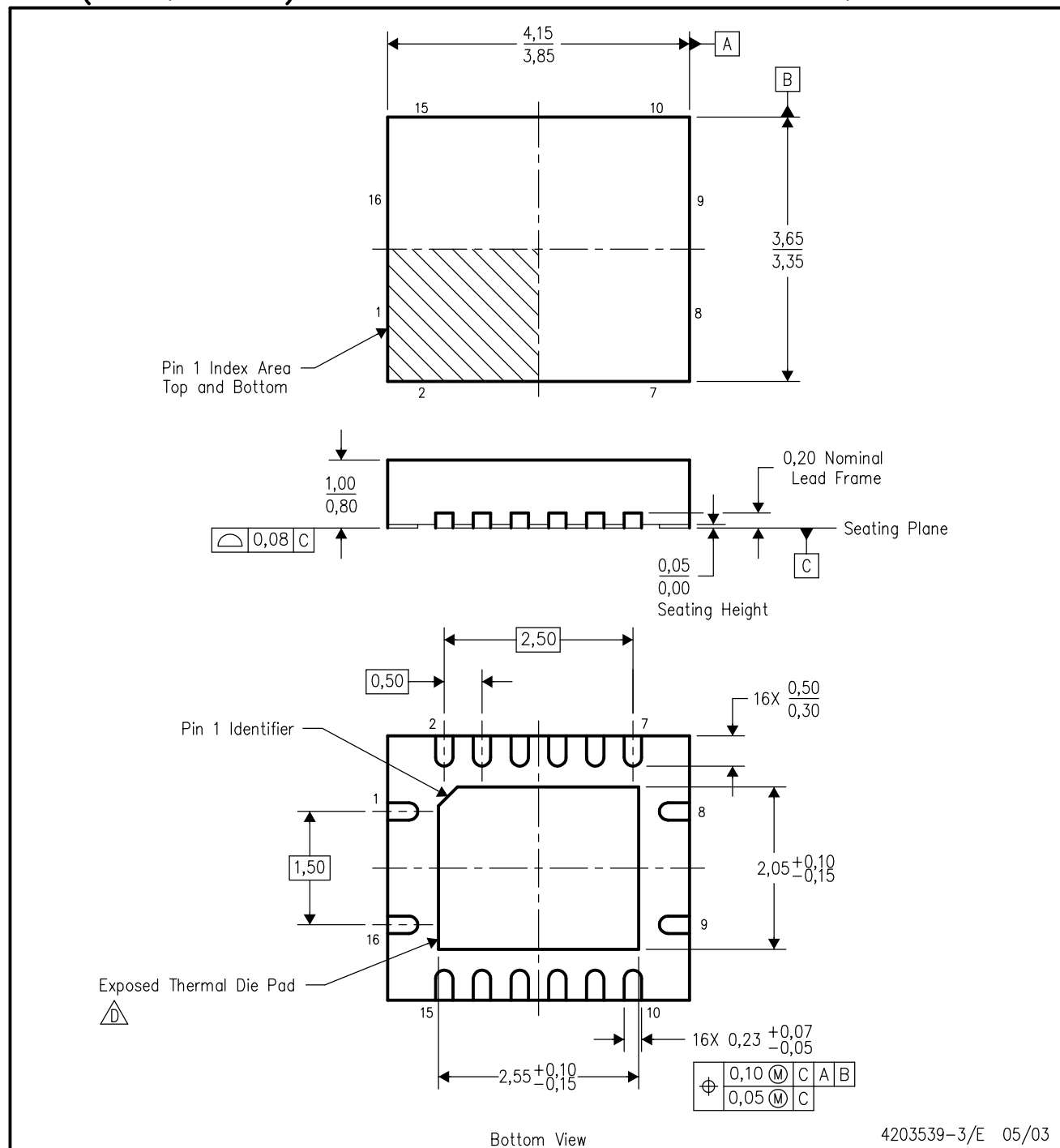
24 PINS SHOWN



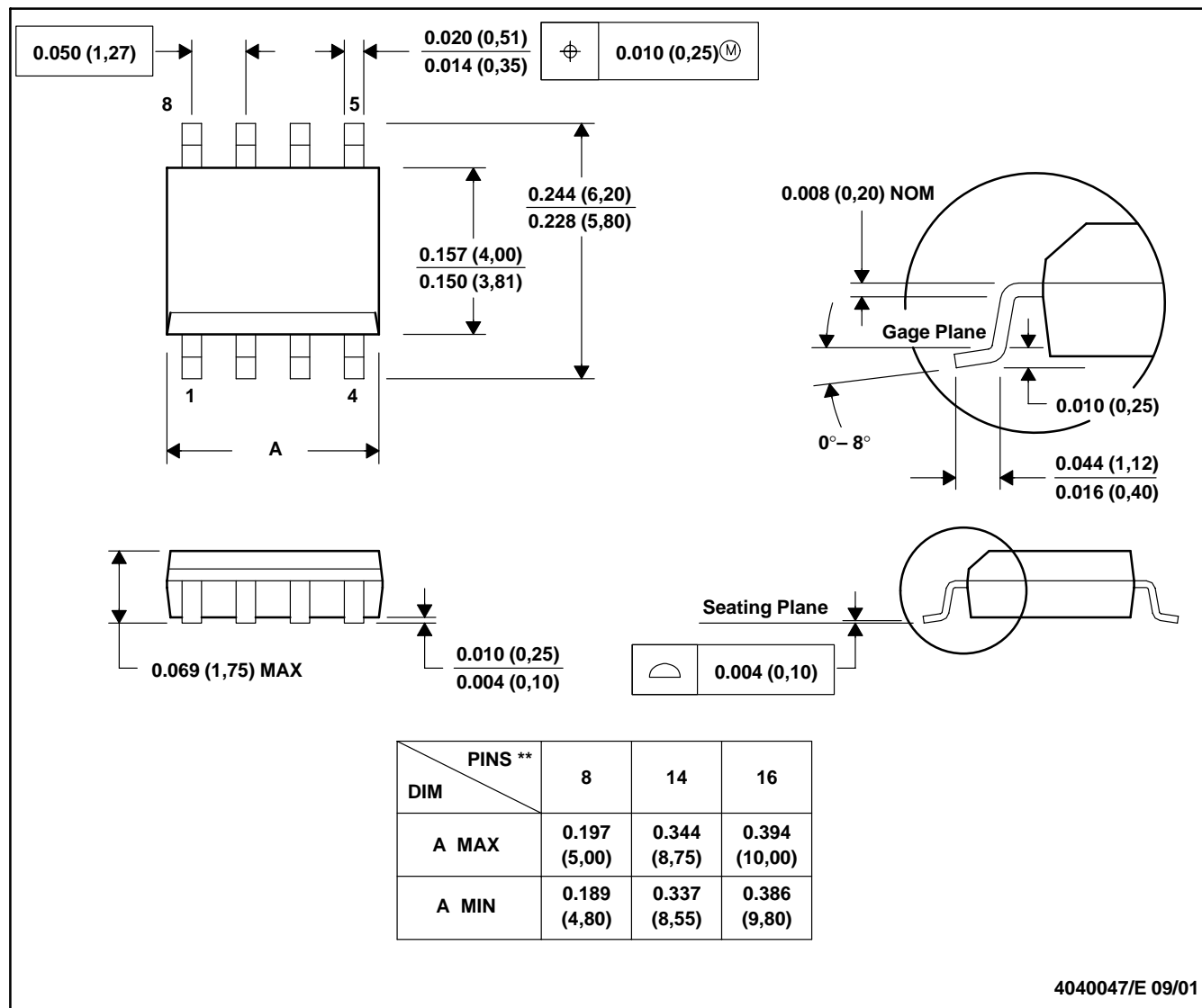
- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

RGY (R-PQFP-N16)

PLASTIC QUAD FLATPACK



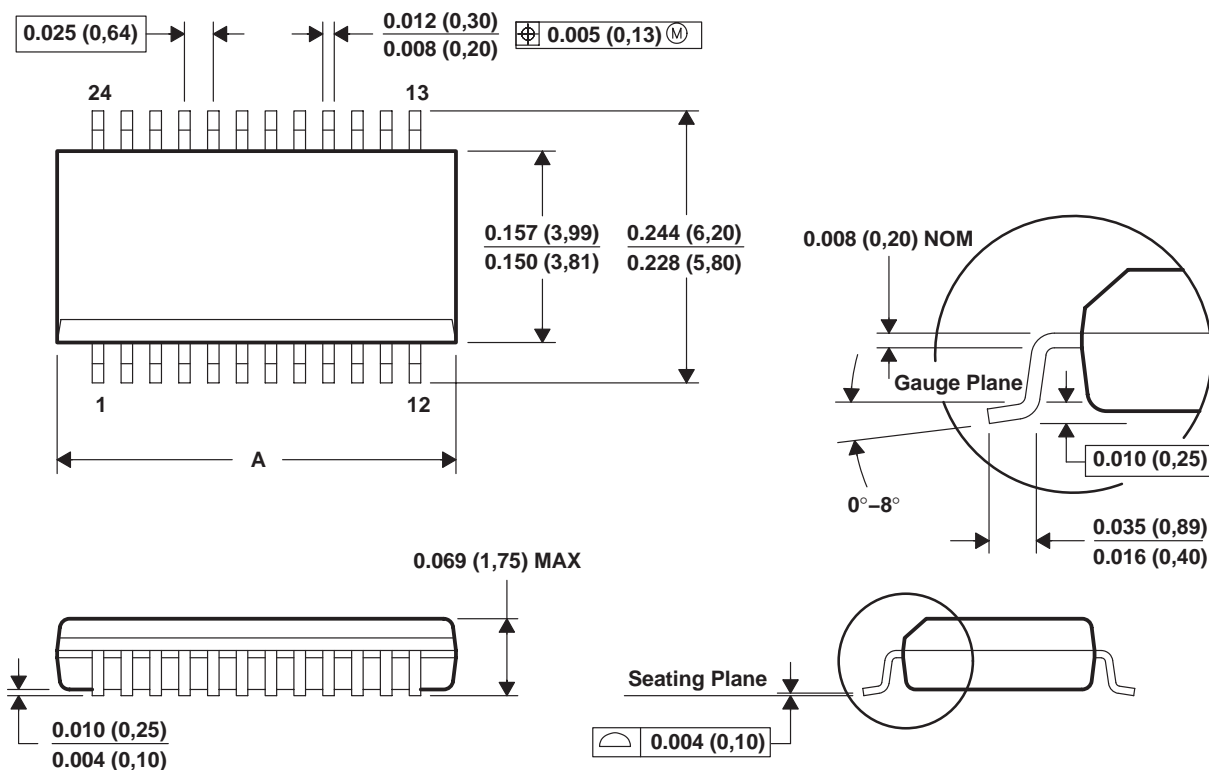
- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - D. The package thermal performance may be enhanced by bonding the thermal die pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected ground leads.
 - E. Package complies to JEDEC MO-241 variation BB.

D (R-PDSO-G)****PLASTIC SMALL-OUTLINE PACKAGE****8 PINS SHOWN**

- 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 MS-012

DBQ (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE



PINS **	16	20	24	28
DIM				
A MAX	0.197 (5,00)	0.344 (8,74)	0.344 (8,74)	0.394 (10,01)
A MIN	0.189 (4,80)	0.337 (8,56)	0.337 (8,56)	0.386 (9,80)
MO-137 VARIATION	AB	AD	AE	AF



4073301/F 02/2002

- 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-137.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- 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

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 © 2004, Texas Instruments Incorporated