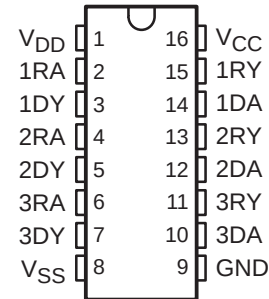


- Meets or Exceeds the Requirements of ANSI EIA/TIA-232-E and ITU V.28
- Designed to Support Data Rates Up to 120 kbits/s Over 3-m Cable
- ESD Protection Exceeds 5 kV on All Pins
- Flow-Through Design
- Wide-Driver Supply Voltage . . . ± 4.5 V to ± 15 V
- Functionally Interchangeable With Motorola MC145406 and Texas Instruments SN75C1406

DW OR N PACKAGE
(TOP VIEW)



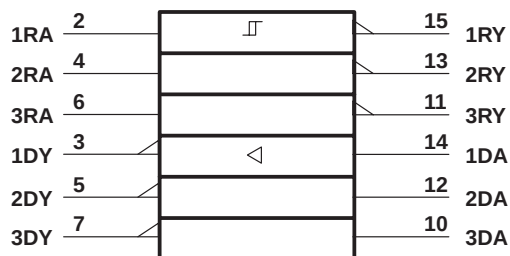
description

The TL145406 is a bipolar device containing three independent drivers and receivers that are used to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). The drivers and receivers of the TL145406 are similar to those of the SN75188 quadruple driver and SN75189A quadruple receiver, respectively. The pinout matches the flow-through design of the SN75C1406 to reduce the board space required and allow easy interconnection. The bipolar circuits and processing of the TL145406 provide a rugged low-cost solution for this function at the expense of quiescent power and external passive components relative to the SN75C1406.

The TL145406 complies with the requirements of the EIA/TIA 232-E and ITU (formerly CCITT) V.28 standards. These standards are for data interchange between a host computer and peripheral at signalling rates up to 20 kbit/s. The switching speeds of the TL145406 are fast enough to support rates up to 120 kbit/s with lower capacitive loads (shorter cables). Interoperability at the higher signalling rates cannot be assured unless the designer has design control of the cable and the interface circuits at both ends. For interoperability at signalling rates to 120 kbit/s, use of EIA/TIA-423-B (ITU V.10) and EIA/TIA-422-B (ITU V.11) standards are recommended.

The TL145406 is characterized for operation from 0°C to 70°C.

logic symbol†



logic diagram (positive logic)

Typical of each receiver



Typical of each driver



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.



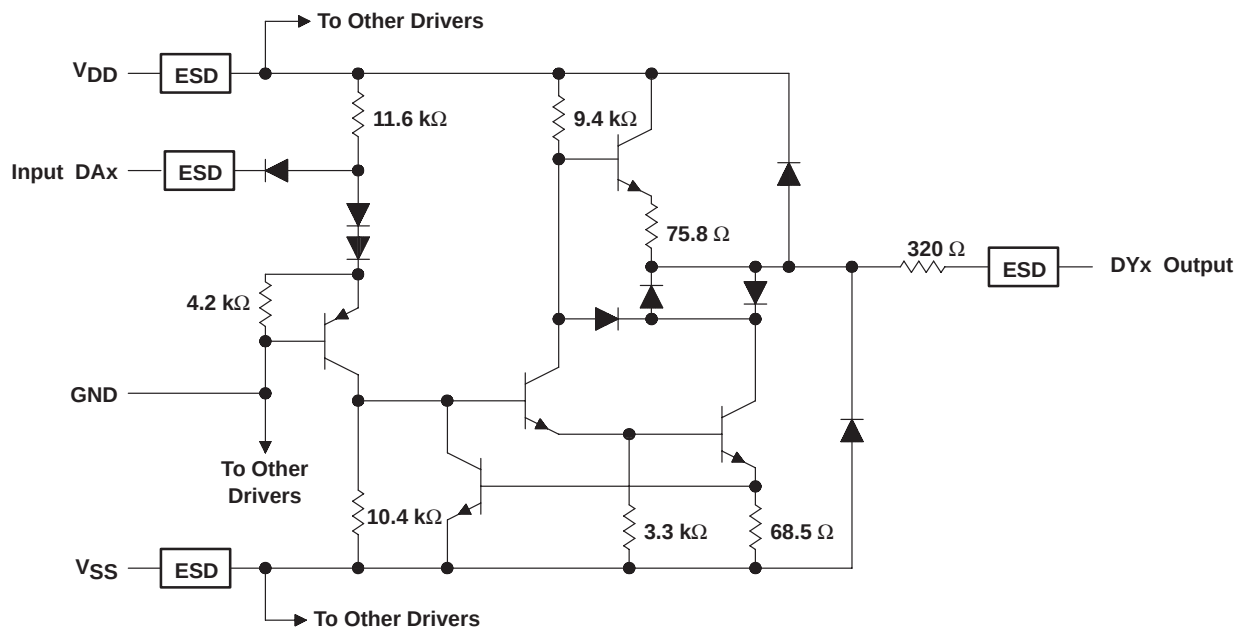
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

TL145406

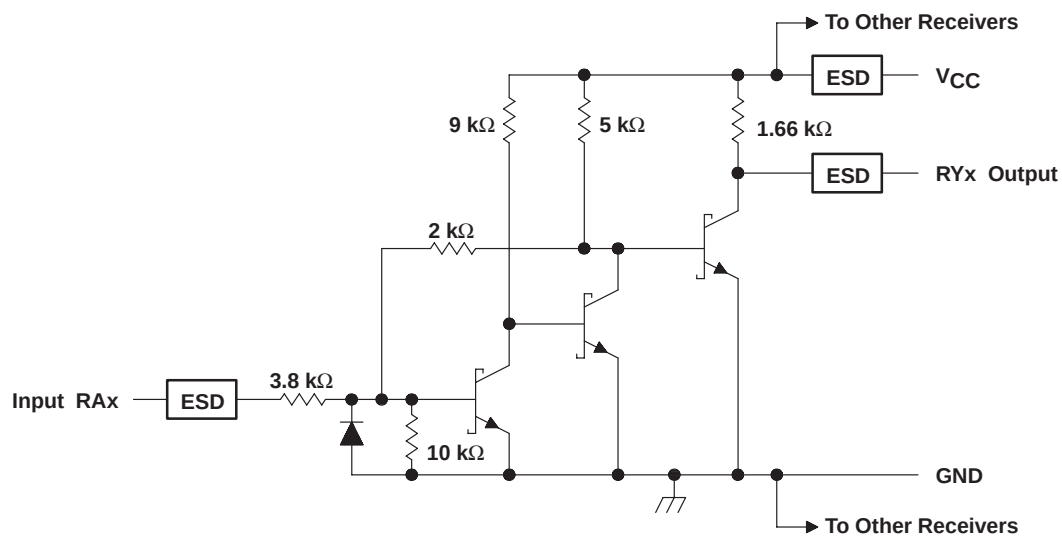
TRIPLE RS-232 DRIVERS/RECEIVERS

SLLS185A – DECEMBER 1994 – REVISED MARCH 1995

schematic (each driver)



schematic (each receiver)



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

Supply voltage, V_{CC} (see Note 1)	10 V
Supply voltage, V_{DD} (see Note 1)	15 V
Supply voltage, V_{SS} (see Note 1)	–15 V
Input voltage range: Driver	–15 V to 7 V
Receiver	–30 V to 30 V
Driver output voltage range	–15 V to 15 V
Receiver low-level output current	20 mA
Continuous total power dissipation	See Dissipation Rating Table
Operating free-air temperature range, T_A	0°C to 70°C
Storage temperature range, T_{stg}	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°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.

NOTE 1: All voltages are with respect to the network ground terminal.

DISSIPATION RATING TABLE[‡]

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A \leq 70^\circ\text{C}$ POWER RATING
DW	1256 mW	9.7 mW/°C	819 mW
N	1943 mW	14.9 mW/°C	1272 mW

[‡] Dissipation ratings are the inverse of the traditional junction-to-case thermal resistance ($R_{\theta JA}$).

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		7.5	9	15	V
Supply voltage, V_{SS}		–7.5	–9	–15	V
Supply voltage, V_{CC}		4.5	5	5.5	V
High-level input voltage, V_{IH} (driver only)		1.9			V
Low-level input voltage, V_{IL} (driver only)				0.8	V
High-level output current, I_{OH}	Driver			–6	mA
	Receiver			–0.5	
Low-level output current, I_{OL}	Driver			6	mA
	Receiver			16	
Operating free-air temperature, T_A		0		70	°C

TL145406

TRIPLE RS-232 DRIVERS/RECEIVERS

SLLS185A – DECEMBER 1994 – REVISED MARCH 1995

supply currents

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{DD} Supply current from V_{DD}	All inputs at 1.9 V, No load	$V_{DD} = 9\text{ V}, V_{SS} = -9\text{ V}$			15	mA
		$V_{DD} = 12\text{ V}, V_{SS} = -12\text{ V}$			19	
		$V_{DD} = 15\text{ V}, V_{SS} = -15\text{ V}$			25	
	All inputs at 0.8 V, No load	$V_{DD} = 9\text{ V}, V_{SS} = -9\text{ V}$			4.5	mA
		$V_{DD} = 12\text{ V}, V_{SS} = -12\text{ V}$			5.5	
		$V_{DD} = 15\text{ V}, V_{SS} = -15\text{ V}$			9	
I_{SS} Supply current from V_{SS}	All inputs at 1.9 V, No load	$V_{DD} = 9\text{ V}, V_{SS} = -9\text{ V}$			-15	mA
		$V_{DD} = 12\text{ V}, V_{SS} = -12\text{ V}$			-19	
		$V_{DD} = 15\text{ V}, V_{SS} = -15\text{ V}$			-25	
	All inputs at 0.8 V, No load	$V_{DD} = 9\text{ V}, V_{SS} = -9\text{ V}$			-3.2	mA
		$V_{DD} = 12\text{ V}, V_{SS} = -12\text{ V}$			-3.2	
		$V_{DD} = 15\text{ V}, V_{SS} = -15\text{ V}$			-3.2	
I_{CC} Supply current from V_{CC}	All inputs at 5 V, No load,	$V_{CC} = 5\text{ V}$		13.2	20	mA

DRIVER SECTION

electrical characteristics over recommended operating free-air temperature range, $V_{DD} = 9\text{ V}$, $V_{SS} = -9\text{ V}$, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OH} High-level output voltage	$V_{IL} = 0.8\text{ V}$, $R_L = 3\text{ k}\Omega$, See Figure 1		6	7.5		V
V_{OL} Low-level output voltage (see Note 2)	$V_{IH} = 1.9\text{ V}$, $R_L = 3\text{ k}\Omega$, See Figure 1		-7.5	-6		V
I_{IH} High-level input current	$V_I = 5\text{ V}$, See Figure 2				10	μA
I_{IL} Low-level input current	$V_I = 0$, See Figure 2				-1.6	mA
$I_{OS(H)}$ High-level short-circuit output current (see Note 3)	$V_{IL} = 0.8\text{ V}$, $V_O = 0$ or V_{SS} , See Figure 1		-4.5	-10	-19.5	mA
$I_{OS(L)}$ Low-level short-circuit output current	$V_{IH} = 2\text{ V}$, $V_O = 0$ or V_{DD} , See Figure 1		4.5	10	19.5	mA
r_O Output resistance (see Note 4)	$V_{CC} = V_{DD} = V_{SS} = 0$, $V_O = -2\text{ V}$ to 2 V		300			Ω

- NOTES: 2. The algebraic convention, where the more positive (less negative) limit is designated as maximum, is used in this data sheet for logic levels only (e.g., if -10 V is maximum, the typical value is a more negative voltage).
3. Output short-circuit conditions must maintain the total power dissipation below absolute maximum ratings.
4. Test conditions are those specified by EIA/TIA-232-E and as listed above.

switching characteristics, $V_{CC} = 5\text{ V}$, $V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH} Propagation delay time, low- to high-level output	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 15\text{ pF}$, See Figure 3			315	500	ns
t_{PHL} Propagation delay time, high- to low-level output				75	175	ns
t_{TLH} Transition time, low- to high-level output	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 15\text{ pF}$, See Figure 3			60	100	ns
	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 2500\text{ pF}$, See Figure 3 and Note 5			1.7	2.5	μs
t_{THL} Transition time, high- to low-level output	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 15\text{ pF}$, See Figure 3			40	75	ns
	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 2500\text{ pF}$, See Figure 3 and Note 6			1.5	2.5	μs

- NOTES: 5. Measured between -3 V and 3 V points of the output waveform (EIA/TIA-232-E conditions). All unused inputs are tied.
6. Measured between 3 V and -3 V points of the output waveform (EIA/TIA-232-E conditions). All unused inputs are tied.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

RECEIVER SECTION

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V _{IT+}	Positive-going threshold voltage	See Figure 5	T _A = 25°C	1.75	1.9	2.3	V
V _{IT−}	Negative-going threshold voltage		T _A = 0°C to 70 °C	1.55		2.3	
V _{hys}	Input hysteresis (V _{IT+} + − V _{IT−})			0.75	0.97	1.25	
V _{OH}	High-level output voltage	I _{OH} = −0.5 mA	V _{IH} = 0.75 V	2.6	4	5	V
			Inputs open	2.6			
V _{OL}	Low-level output voltage	I _{OL} = 10 mA, V _I = 3 V			0.2	0.45	V
I _{IH}	High-level input current	V _I = 25 V,	See Figure 5	3.6		8.3	mA
		V _I = 3 V,	See Figure 5	0.43			
I _{IL}	Low-level input current	V _I = −25 V,	See Figure 5	−3.6		−8.3	mA
		V _I = −3 V,	See Figure 5	−0.43			
I _{OS}	Short-circuit output current				−3.4	−12	mA

† All typical values are at $T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{ V}$, $V_{DD} = 9\text{ V}$, and $V_{SS} = -9\text{ V}$.

switching characteristics, $V_{CC} = 5\text{ V}$, $V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH} Propagation delay time, low- to high-level output	$C_L = 50\text{ pF}$, $R_L = 5\text{ k}\Omega$, See Figure 6		107	425	ns
t_{PHL} Propagation delay time, high- to low-level output			42	150	ns
t_{TLH} Transition time, low- to high-level output			175	400	ns
t_{THL} Transition time, high- to low-level output			16	60	ns

PARAMETER MEASUREMENT INFORMATION

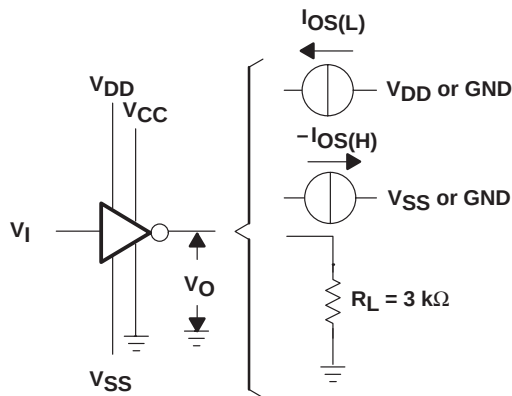


Figure 1. Driver Test Circuit for V_{OH} , V_{OL} , $I_{OS(H)}$, and $I_{OS(L)}$

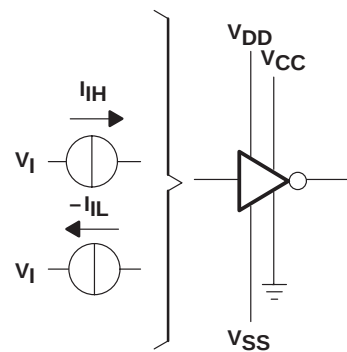
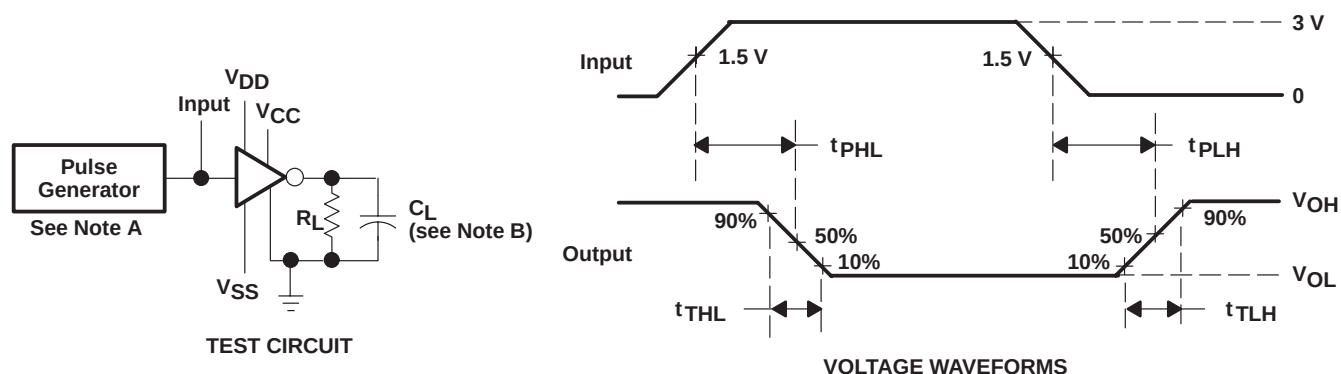


Figure 2. Driver Test Circuit for I_{IH} and I_{IL}

PARAMETER MEASUREMENT INFORMATION



NOTES: A. The pulse generator has the following characteristics: $t_W = 25 \mu s$, $PRR = 20 \text{ kHz}$, $Z_O = 50 \Omega$, $t_r = t_f < 50 \text{ ns}$.
B. C_L includes probe and jig capacitance.

Figure 3. Driver Test Circuit and Voltage Waveforms

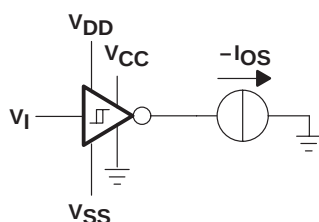


Figure 4. Receiver Test Circuit for I_{OS}

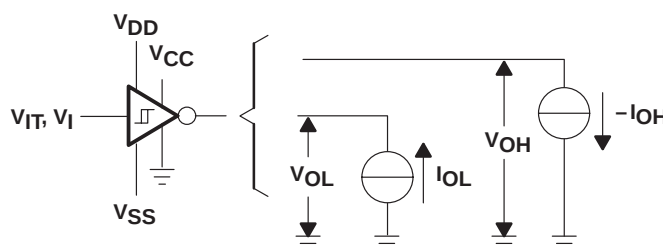
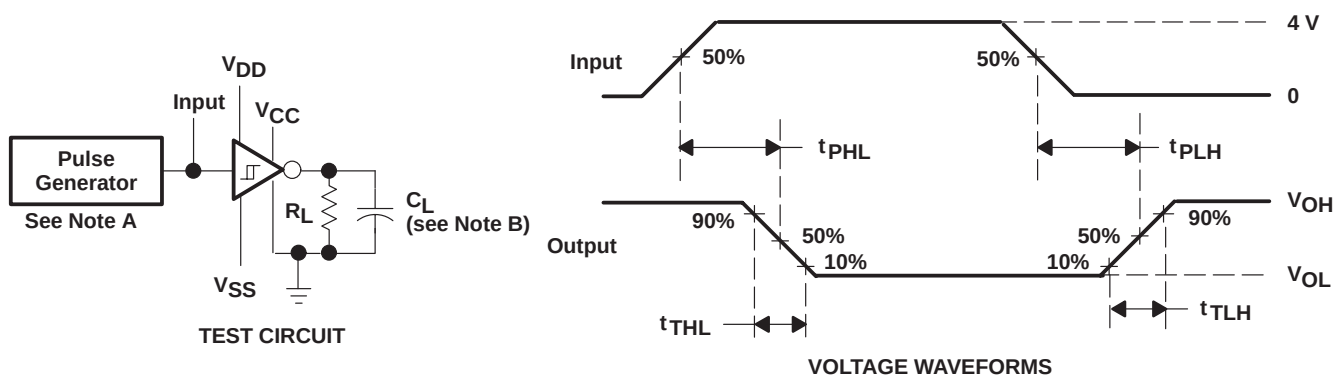


Figure 5. Receiver Test Circuit for V_{IT} , V_{OH} , and V_{OL}



NOTES: A. The pulse generator has the following characteristics: $t_W = 25 \mu s$, $PRR = 20 \text{ kHz}$, $Z_O = 50 \Omega$, $t_r = t_f < 50 \text{ ns}$.
B. C_L includes probe and jig capacitance.

Figure 6. Receiver Propagation and Transition Times

TYPICAL CHARACTERISTICS

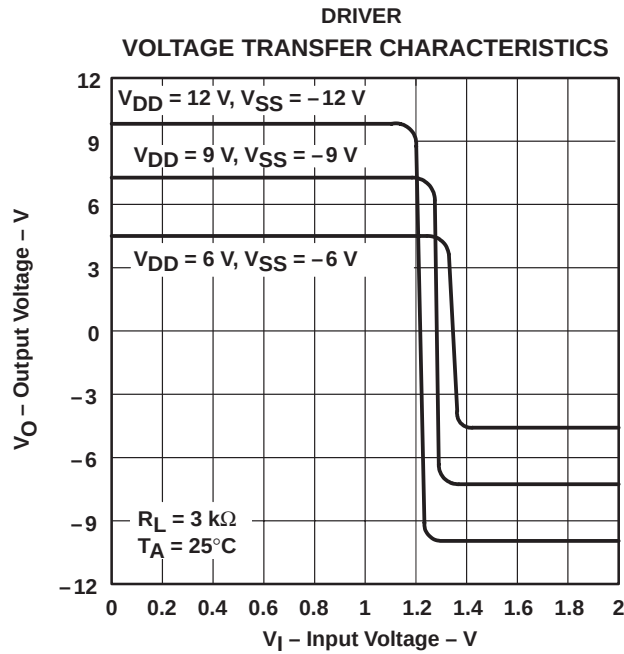


Figure 7

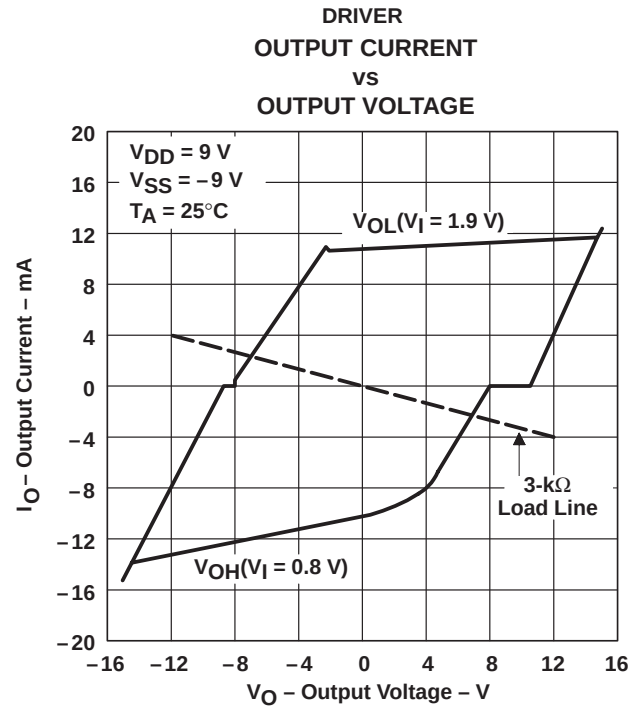


Figure 8

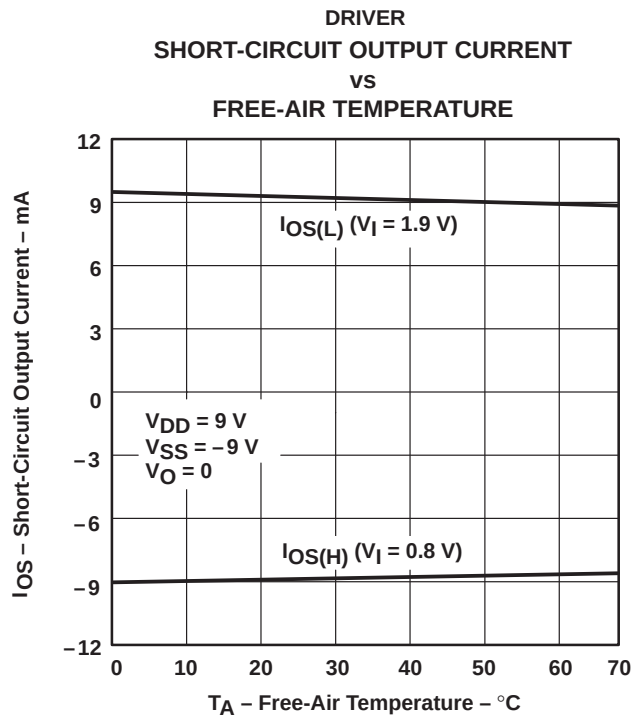


Figure 9

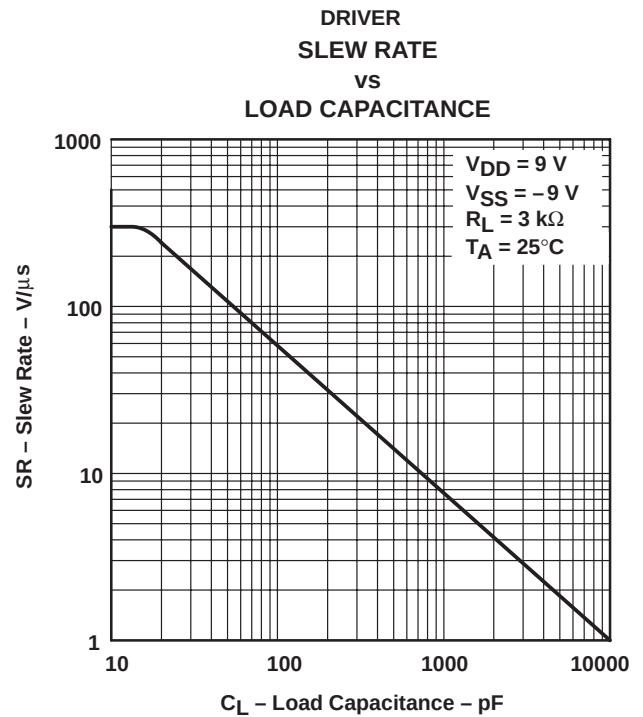


Figure 10

TYPICAL CHARACTERISTICS

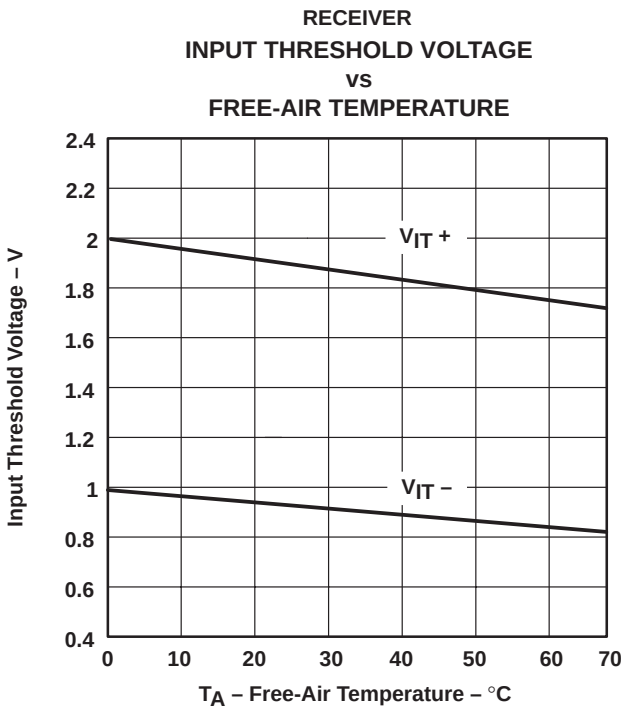


Figure 11

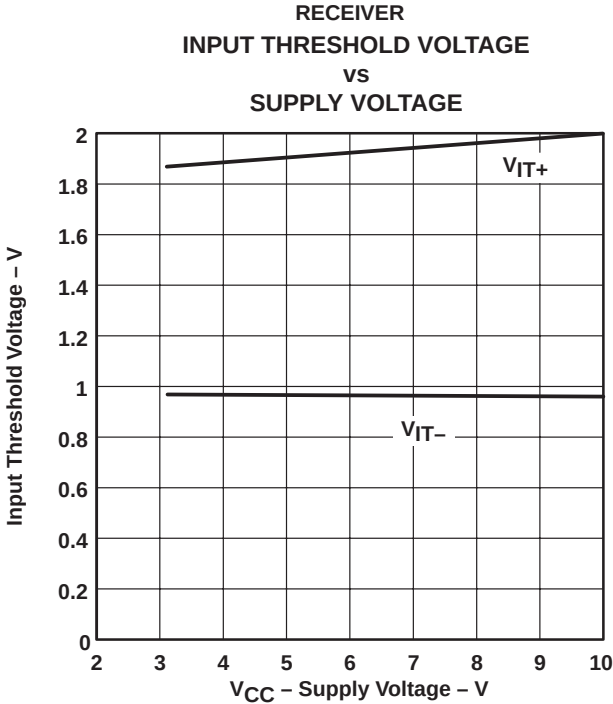
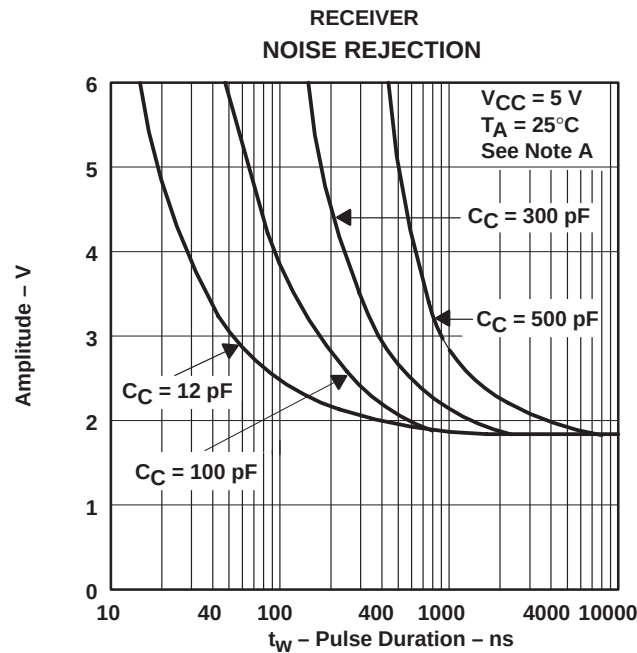


Figure 12



NOTE A: This figure shows the maximum amplitude of a positive-going pulse that, starting from 0, does not cause a change of the output level.

Figure 13

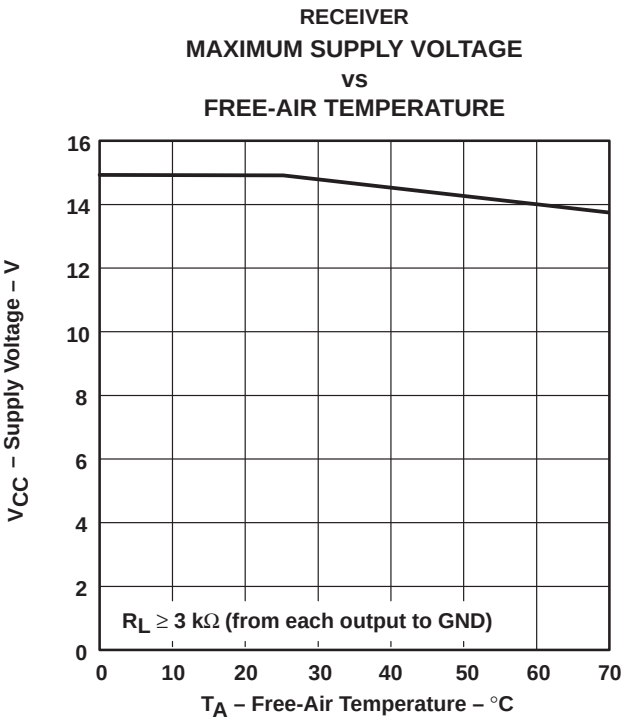


Figure 14

APPLICATION INFORMATION

Diodes placed in series with the V_{DD} and V_{SS} leads protect the TL145406 during the fault condition in which the device outputs are shorted to ± 15 V and the power supplies are at low. Diodes also provide low-impedance paths to ground (see Figure 15).

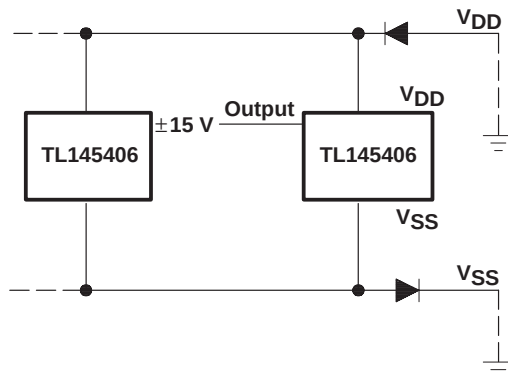


Figure 15. Power-Supply Protection to Meet Power-Off Fault Conditions of ANSI EIA/TIA-232-E

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

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

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.