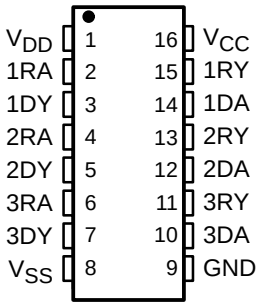
SLLS148C – MAY 1990 – REVISED MARCH 1997

- **Meet or Exceed the Requirements of ANSI EIA/TIA-232-E and ITU Recommendation V.28**
- **Very Low Power Consumption 5 mW Typ**
- **Wide Driver Supply Voltage Range ±4.5 V to ±15 V**
- **Driver Output Slew Rate Limited to 30 V/μs Max**
- **Receiver Input Hysteresis . . . 1000 mV Typ**
- **Push-Pull Receiver Outputs**
- **On-Chip Receiver 1-μs Noise Filter**
- **Functionally Interchangeable With Motorola MC145406 and Texas Instruments TL145406**

D, DW, OR N PACKAGE
(TOP VIEW)



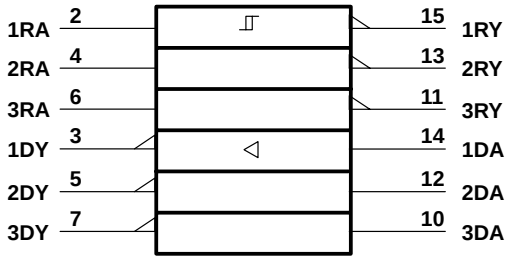
description

The SN75C1406 is a low-power BiMOS device containing three independent drivers and receivers that are used to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). This device is designed to conform to ANSI EIA/TIA-232-E. The drivers and receivers of the SN75C1406 are similar to those of the SN75C188 quadruple driver and SN75C189A quadruple receiver, respectively. The drivers have a controlled output slew rate that is limited to a maximum of 30 V/μs, and the receivers have filters that reject input noise pulses shorter than 1 μs. Both these features eliminate the need for external components.

The SN75C1406 is designed using low-power techniques in a BiMOS technology. In most applications, the receivers contained in these devices interface to single inputs of peripheral devices such as ACEs, UARTs, or microprocessors. By using sampling, such peripheral devices are usually insensitive to the transition times of the input signals. If this is not the case, or for other uses, it is recommended that the SN75C1406 receiver outputs be buffered by single Schmitt input gates or single gates of the HCMOS, ALS, or 74F logic families.

The SN75C1406 is characterized for operation from 0°C to 70°C.

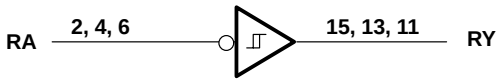
logic symbol



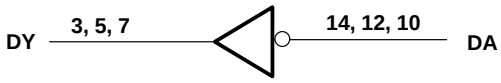
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram

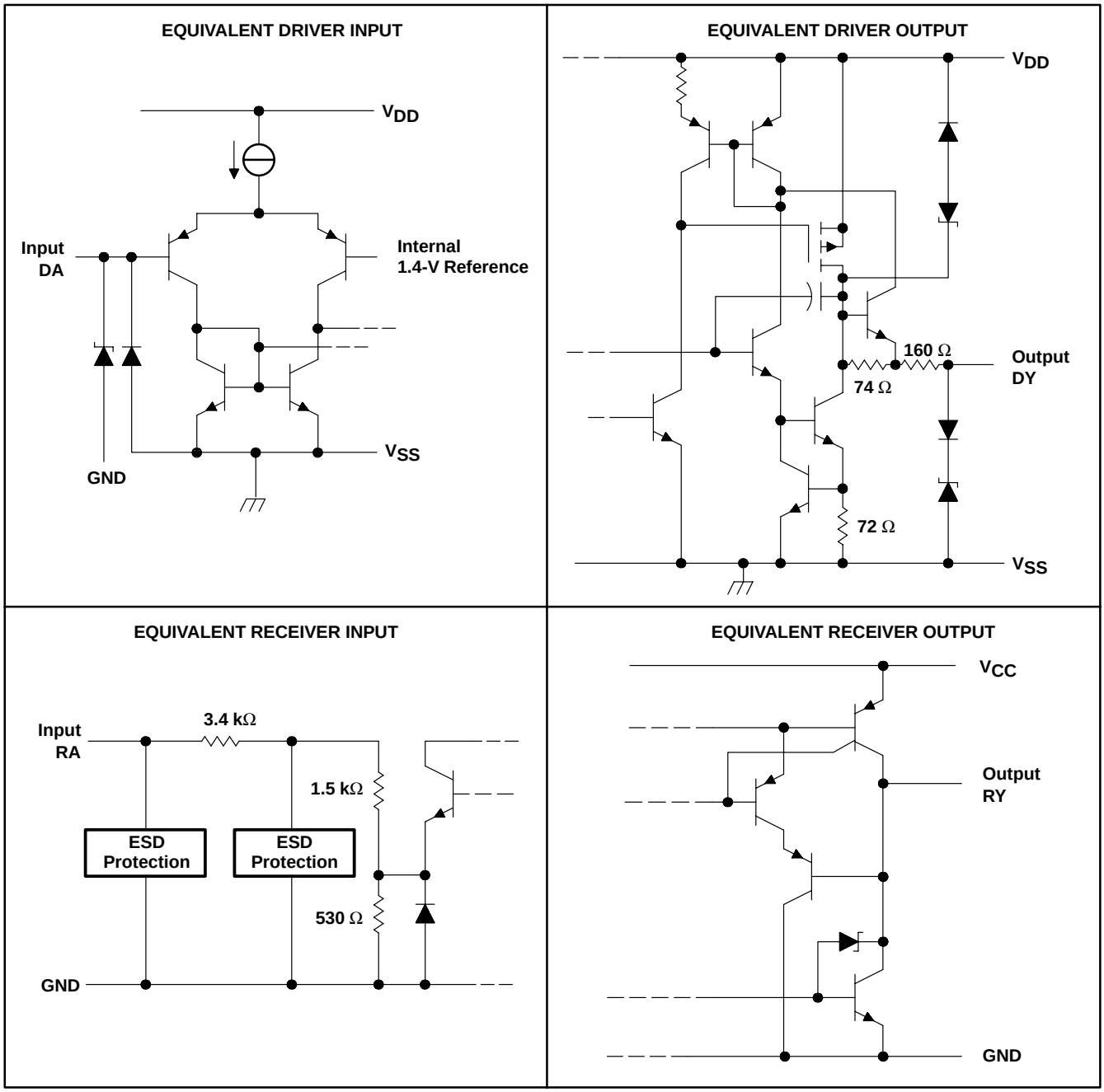
Typical of each receiver



Typical of each driver



schematics of inputs and outputs



All resistor values shown are nominal.

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

Supply voltage, V_{DD} (see Note 1) . . . . . 15 V
Supply voltage, V_{SS} . . . . . –15 V
Supply voltage, V_{CC} . . . . . 7 V
Input voltage range, V_I: Driver . . . . . V_{SS} to V_{DD}
Receiver . . . . . –30 V to 30 V
Output voltage range, V_O: Driver . . . . . (V_{SS} – 6 V) to (V_{DD} + 6 V)
Receiver . . . . . –0.3 V to (V_{CC} + 0.3 V)
Continuous total power dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: SN75C1406 . . . . . 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	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING
D	950 mW	7.6 mW/°C	608 mW
DW	1025 mW	8.2 mW/°C	656 mW
N	1150 mW	9.2 mW/°C	736 mW

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		4.5	12	15	V
Supply voltage, V_{SS}		–4.5	–12	–15	V
Supply voltage, V_{CC}		4.5	5	6	V
Input voltage, V_I	Driver	V_{SS}+2		V_{DD}	V
	Receiver			±25	
High-level input voltage, V_{IH}		2			V
Low-level input voltage, V_{IL}				0.8	V
High-level output current, I_{OH}				–1	mA
Low-level output current, I_{OL}				3.2	mA
Operating free-air temperature, T_A		0		70	°C

DRIVER SECTION

electrical characteristics over operating free-air temperature range, V_{DD} = 12 V, V_{SS} = –12 V, V_{CC} = 5 V ± 10% (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP†	MAX	UNIT
V_{OH}	High-level output voltage	V_{IH} = 0.8 V, See Figure 1	R_L = 3 kΩ,	V_{DD} = 5 V, V_{SS} = –5 V	4	4.5		V
				V_{DD} = 12 V, V_{SS} = –12 V	10	10.8		
V_{OL}	Low-level output voltage (see Note 2)	V_{IH} = 2 V, See Figure 1	R_L = 3 kΩ,	V_{DD} = 5 V, V_{SS} = –5 V		–4.4	–4	V
				V_{DD} = 12 V, V_{SS} = –12 V		–10.7	–10	
I_{IH}	High-level input current	V_I = 5 V,	See Figure 2				1	µA
I_{IL}	Low-level input current	V_I = 0,	See Figure 2				–1	
$I_{OS(H)}$	High-level short circuit output current‡	V_I = 0.8 V,	V_O = 0 or V_{SS},	See Figure 1	–7.5	–12	–19.5	mA
$I_{OS(L)}$	Low-level short circuit output current‡	V_I = 2 V,	V_O = 0 or V_{DD},	See Figure 1	7.5	12	19.5	mA
I_{DD}	Supply current from V_{DD}	No load, All inputs at 2 V or 0.8 V		V_{DD} = 5 V, V_{SS} = –5 V		115	250	µA
				V_{DD} = 12 V, V_{SS} = –12 V		115	250	
I_{SS}	Supply current from V_{SS}	No load, All inputs at 2 V or 0.8 V		V_{DD} = 5 V, V_{SS} = –5 V		–115	–250	µA
				V_{DD} = 12 V, V_{SS} = –12 V		–115	–250	
r_O	Output resistance	V_{DD} = V_{SS} = V_{CC} = 0, See Note 3	V_O = –2 V to 2 V,		300	400		Ω

† All typical values are at T_A = 25°C.
‡ Not more than one output should be shorted at a time.
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.
3. Test conditions are those specified by EIA/TIA-232-E.

switching characteristics at T_A = 25°C, V_{DD} = 12 V, V_{SS} = –12 V, V_{CC} = 5 V ± 10%

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output§	R_L = 3 kΩ to 7 kΩ, C_L = 15 pF, See Figure 3		1.2	3	µs
t_{PHL}	Propagation delay time, high- to low-level output§			2.5	3.5	µs
t_{TLH}	Transition time, low- to high-level output¶		0.53	2	3.2	µs
t_{THL}	Transition time, high- to low-level output¶		0.53	2	3.2	µs
t_{TLH}	Transition time, low- to high-level output#	R_L = 3 kΩ to 7 kΩ, C_L = 2500 pF, See Figure 3		1	2	µs
t_{THL}	Transition time, high- to low-level output#	R_L = 3 kΩ to 7 kΩ, C_L = 2500 pF, See Figure 3		1	2	µs
SR	Output slew rate	R_L = 3 kΩ to 7 kΩ, C_L = 15 pF, See Figure 3	4	10	30	V/µs

§ t_{PHL} and t_{PLH} include the additional time due to on-chip slew rate and are measured at the 50% points.
¶ Measured between 10% and 90% points of output waveform
# Measured between 3-V and –3-V points of output waveform (EIA/TIA-232-E conditions) with all unused inputs tied either high or low

RECEIVER SECTION

electrical characteristics over operating free-air temperature range, V_{DD} = 12 V, V_{SS} = –12 V, V_{CC} = 5 V ± 10% (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP†	MAX	UNIT
V_{IT+}	Positive-going input threshhold voltage	See Figure 5			1.7	2	2.55	V
V_{IT-}	Negative-going input threshhold voltage	See Figure 5			0.65	1	1.25	V
V_{hys}	Input hysteresis voltage (V_{IT+}–V_{IT-})				600	1000		mV
V_{OH}	High-level output voltage	V_I = 0.75 V, I_{OH} = –20 µA,		See Figure 5 and Note 4	3.5			V
		V_I = 0.75 V, I_{OH} = –1 mA, See Figure 5		V_{CC} = 4.5 V	2.8	4.4		
				V_{CC} = 5 V	3.8	4.9		
				V_{CC} = 5.5 V	4.3	5.4		
V_{OL}	Low-level output voltage	V_I = 3 V, I_{OL} = 3.2 mA,		See Figure 5		0.17	0.4	V
I_{IH}	High-level input current	V_I = 2.5 V			3.6	4.6	8.3	mA
		V_I = 3 V			0.43	0.55	1	
I_{IL}	Low-level input current	V_I = –2.5 V			–3.6	–5	–8.3	
		V_I = –3 V			–0.43	–0.55	–1	
$I_{OS(H)}$	High-level short-circuit output current	V_I = 0.75 V, V_O = 0,		See Figure 4		–8	–15	mA
$I_{OS(L)}$	Low-level short-circuit output current	V_I = V_{CC}, V_O = V_{CC},		See Figure 4		13	25	mA
I_{CC}	Supply current from V_{CC}	No load, All inputs at 0 or 5 V	V_{DD} = 5 V,	V_{SS} = –5 V		320	450	µA
			V_{DD} = 12 V,	V_{SS} = –12 V		320	450	

† All typical values are at T_A = 25°C.

NOTE 4: If the inputs are left unconnected, the receiver interprets this as an input low and the receiver outputs will remain in the high state.

switching characteristics at T_A = 25°C, V_{DD} = 12 V, V_{SS} = –12 V, V_{CC} = 5 V ± 10% (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	C_L = 50 pF, R_L = 5 kΩ, See Figure 6		3	4	µs
t_{PHL}	Propagation delay time, high- to low-level output			3	4	µs
t_{TLH}	Transition time, low- to high-level output‡			300	450	ns
t_{THL}	Transition time, high- to low-level output‡			100	300	ns
$t_{w(N)}$	Duration of longest pulse rejected as noise§	C_L = 50 pF, R_L = 5 kΩ	1		4	µs

‡ Measured between 10% and 90% points of output waveform

§ The receiver ignores any positive- or negative-going pulse that is less than the minimum value of $t_{w(N)}$ and accepts any positive- or negative-going pulse greater than the maximum of $t_{w(N)}$.

PARAMETER MEASUREMENT INFORMATION

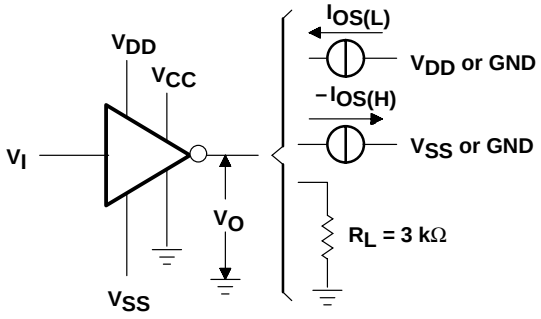


Figure 1. Driver Test Circuit
V_{OH}, V_{OL}, $I_{OS(L)}$, $I_{OS(H)}$

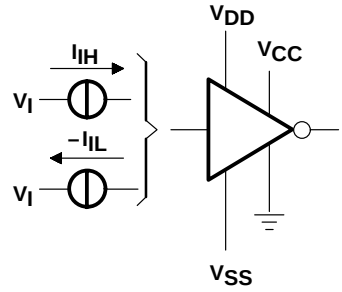
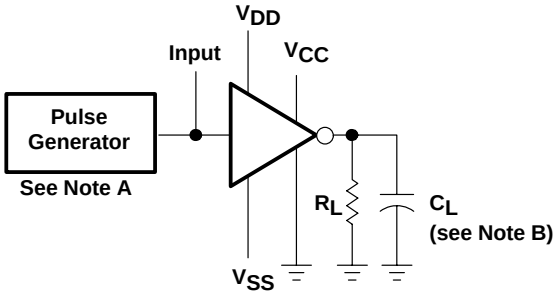
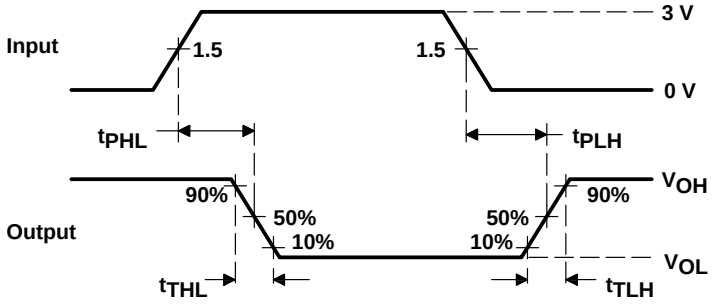


Figure 2. Driver Test Circuit, I_{IL}, I_{IH}



TEST CIRCUIT



VOLTAGE WAVEFORMS

NOTES: A. The pulse generator has the following characteristics: t_W = 25 µs, PRR = 20 kHz, Z_O = 50 Ω, $t_r = t_f$ < 50 ns.
B. C_L includes probe and jig capacitance.

Figure 3. Driver Test Circuit and Voltage Waveforms

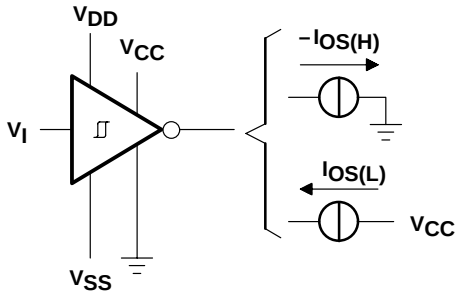


Figure 4. Receiver Test Circuit, $I_{OS(H)}$, $I_{OS(L}$

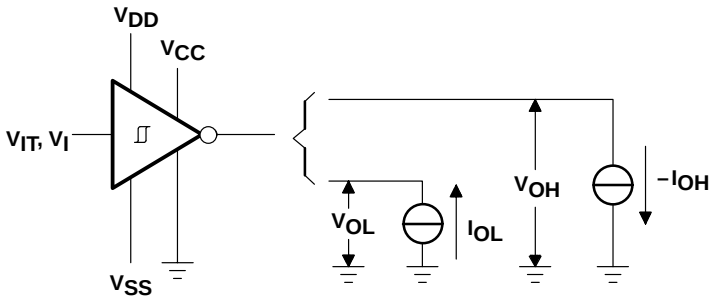
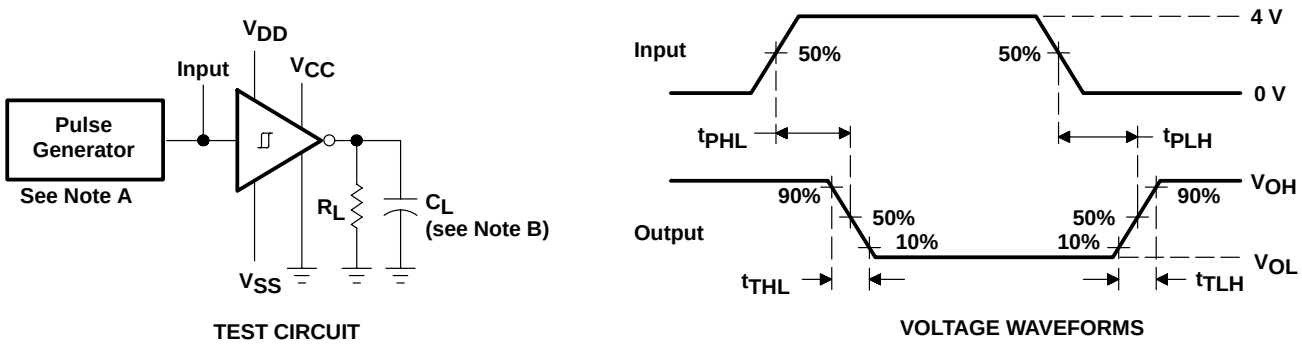


Figure 5. Receiver Test Circuit, V_{IT}, V_{OL}, V_{OH}

PARAMETER MEASUREMENT INFORMATION



NOTES: A. The pulse generator has the following characteristics: t_w = 25 µs, PRR = 20 kHz, Z_O = 50 Ω, $t_r = t_f$ < 50 ns.
B. C_L includes probe and jig capacitance.

Figure 6. Receiver Test Circuit and Voltage Waveforms

APPLICATION INFORMATION

The EIA/TIA-232-E specification is for data interchange between a host computer and a peripheral at signaling rates up to 20 kbps. Many EIA/TIA-232-E devices will operate at higher data rates with lower capacitive loads (short cables). For reliable operation at greater than 20 kbps, the designer needs to have control of both ends of the cable. By mixing different types of EIA/TIA-232-E devices and cable lengths, errors can occur at higher frequencies (above 20 kbps). When operating within the EIA/TIA-232-E requirements of less than 20 kbps and with compliant line circuits, interoperability is assured. For applications operating above 20 kbps, the design engineer should consider devices and system designs that meet the EIA/TIA-423-B requirements.

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