

8 MBd Low Input Current Optocoupler

Technical Data

HCPL-2300/HCPL-0300

Features

- **Guaranteed Low Thresholds:**
 $I_F = 0.5 \text{ mA}$, $V_F \leq 1.5 \text{ V}$
- **High Speed: Guaranteed 5 MBd over Temperature**
- **Versatile: Compatible with TTL, LSTTL and CMOS**
- **Efficient 820 nm AlGaAs LED**
- **Internal Shield for Guaranteed Common Mode Rejection**
- **Schottky Clamped, Open Collector Output with Optional Integrated Pull-Up Resistor**
- **Static and Dynamic Performance Guaranteed from -40°C to 85°C**
- **Safety Approval**
UL Recognized -3750 V rms for 1 minute
CSA Approved
IEC/EN/DIN EN 60747-5-2
Approved with $V_{IORM} = 630 \text{ V}_{\text{peak}}$
(Option 060)

Applications

- **Ground Loop Elimination**
- **Computer-Peripheral Interfaces**
- **Level Shifting**

- **Microprocessor System Interfaces**
- **Digital Isolation for A/D, D/A Conversion**
- **RS-232-C Interface**
- **High Speed, Long Distance Isolated Line Receiver**

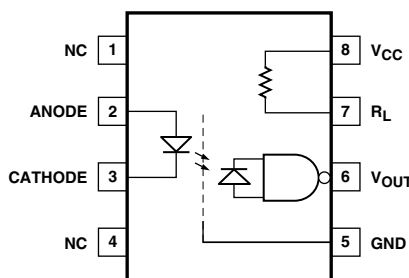
Description

The HCPL-2300/HCPL-0300 optocoupler combines an 820 nm AlGaAs photon emitting diode with an integrated high gain photon detector. This

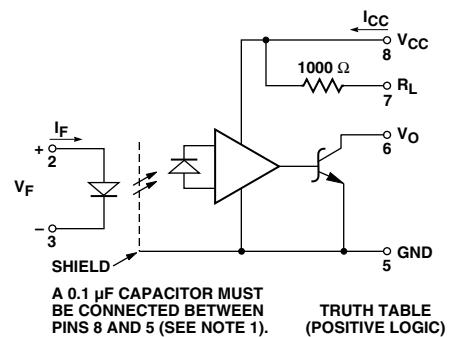
combination of Agilent designed and manufactured semiconductor devices brings new high performance capabilities to designers of isolated logic and data communication circuits.

The new low current, high speed AlGaAs emitter manufactured with a unique diffused junction, has the virtue of fast rise and fall times at low drive currents. Figure 6 illustrates the propagation delay vs. input current characteristic. These unique

Functional Diagram



Schematic



TRUTH TABLE
(POSITIVE LOGIC)

LED	OUTPUT
ON	L
OFF	H

A 0.1 pF bypass capacitor must be connected between pins 5 and 8.

CAUTION: It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

characteristics enable this device to be used in an RS-232-C interface with ground loop isolation and improved common mode rejection. As a line receiver, the HCPL-2300/HCPL-0300 will operate over longer line lengths for a given data rate because of lower I_F and V_F specifications.

The output of the shielded integrated detector circuit is an open

collector Schottky clamped transistor. The shield, which shunts capacitively coupled common mode noise to ground, provides a guaranteed transient immunity specification of 100 V/ μ s. The output circuit includes an optional integrated 1000 Ω pull-up resistor for the open collector. This gives designers the flexibility to use the internal resistor for pull-up to five volt logic or to use

an external resistor for connection to supply voltages up to 18 V (CMOS logic voltage).

The Electrical and Switching Characteristics of the HCPL-2300/HCPL-0300 are guaranteed over a temperature range of -40°C to 85°C. This enables the user to confidently design a circuit which will operate under a broad range of operating conditions.

Ordering Information

Specify part number followed by Option Number (if desired).

HCPL-2300# XXXX

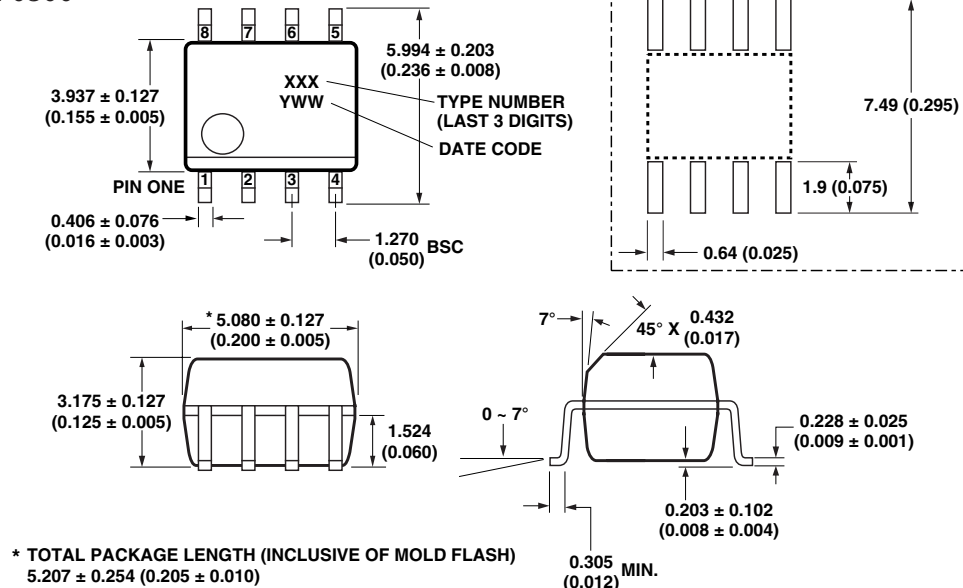
- 060 = IEC/EN/DIN EN 60747-5-2 $V_{IORM} = 630$ V_{peak} Option
- 300 = Gull Wing Surface Mount Lead Option
- 500 = Tape/Reel Package Option (1 K min)
- XXXE = Lead Free Option

Option data sheets available. Contact your Agilent sales representative or authorized distributor for information.

Remarks: The notation “#” is used for existing products, while (new) products launched since 15th July 2001 and lead free option will use “-”

Package Outline Drawings

Small Outline SO-8 Package HCPL-0300



IEC/EN/DIN EN 60747-5-2 Insulation Related Characteristics (HCPL-2300 Option 060 only)

Description	Symbol	Characteristic	Units
Installation classification per DIN VDE 0110/1.89, Table 1 for rated mains voltage ≤ 300 V rms for rated mains voltage ≤ 450 V rms		I-IV I-III	
Climatic Classification		55/85/21	
Pollution Degree (DIN VDE 0110/1.89)		2	
Maximum Working Insulation Voltage	V_{IORM}	630	V _{peak}
Input to Output Test Voltage, Method b* $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5 pC	V_{PR}	1181	V _{peak}
Input to Output Test Voltage, Method a* $V_{IORM} \times 1.5 = V_{PR}$, Type and sample test, $t_m = 60$ sec, Partial Discharge < 5 pC	V_{PR}	945	V _{peak}
Highest Allowable Overvoltage* (Transient Overvoltage, $t_{ini} = 10$ sec)	V_{IOTM}	6000	V _{peak}
Safety Limiting Values (Maximum values allowed in the event of a failure, also see Figure 11, Thermal Derating curve.) Case Temperature Input Current Output Power	T_S $I_{S,INPUT}$ $P_{S,OUTPUT}$	175 230 600	°C mA mW
Insulation Resistance at T_S , $V_{IO} = 500$ V	R_S	$\geq 10^9$	Ω

*Refer to the front of the optocoupler section of the current catalog, under Product Safety Regulations section, IEC/EN/DIN EN 60747-5-2, for a detailed description.

Note: Isolation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in application.

Absolute Maximum Ratings

(No Derating Required up to 55°C)

Storage Temperature, T_S -55°C to +125°C

Operating Temperature, T_A -40°C to +85°C

Lead Solder Temperature, max 260°C for 10 s
(1.6 mm below seating plane)

Average Forward Input Current - I_F 5 mA^[2]

Reverse Input Voltage, V_R 3.0 V

Supply Voltage, V_{CC} 0 V to 7.0 V

Pull-Up Resistor Voltage, V_{RL} -0.5 V to V_{CC}

Output Collector Current, I_O -25 to 25 mA

Input Power Dissipation, P_I 10 mW

Output Collector Power Dissipation, P_O 40 mW

Output Collector Voltage, V_O -0.5 V to 18 V

Infrared and Vapor Phase Reflow Temperature

(Option #300) see Fig. 1, Thermal Profile

Recommended Operating Conditions

Parameter		Symbol	Min.	Max.	Units
Input Voltage, Low Level		V_{FL}	-2.5	0.8	V
Input Current High Level	0°C to 85°C	I_{FH}	0.5	1.0	mA
	-40°C to 85°C		0.5	0.75	
Supply Voltage, Output		V_{CC}	4.75	5.25	V
Fan Out (TTL Load)		N		5	
Operating Temperature		T_A	-40	85	°C

DC Electrical Specifications

For $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$, $V_{FL} \leq 0.8\text{ V}$, unless otherwise specified.

All typicals at $T_A = 25^{\circ}\text{C}$ and $V_{CC} = 5\text{ V}$, unless otherwise specified. See note 1.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
High Level Output Current	I_{OH}		0.05	250	μA	$V_F = 0.8\text{ V}$, $V_O = 18\text{ V}$	4	
Low Level Output Voltage	V_{OL}		0.4	0.5	V	$I_F = 0.5\text{ mA}$ $I_{OL}(\text{Sinking}) = 8\text{ mA}$	3	
High Level Supply Current	I_{CCH}		4.0	6.3	mA	$I_F = 0\text{ mA}$, $V_{CC} = 5.25\text{ V}$		
Low Level Supply Current	I_{CCL}		6.2	10.0	mA	$I_F = 1.0\text{ mA}$, $V_{CC} = 5.25\text{ V}$		
Input Forward Voltage	V_F	1.0	1.3	1.5	V	$T_A = 25^{\circ}\text{C}$ $I_F = 1.0\text{ mA}$	2	
		0.85		1.65				
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$		-1.6		mV/ $^{\circ}\text{C}$	$I_F = 1.0\text{ mA}$		
Input Reverse Breakdown Voltage	BV_R	3.0			V	$I_R = 10\text{ }\mu\text{A}$		
Input Capacitance	C_{IN}		18		pF	$V_F = 0\text{ V}$, $f = 1\text{ MHz}$		
Internal Pull-up Resistor	R_L	680	1000	1700	Ω	$T_A = 25^{\circ}\text{C}$		

Switching Specifications

For $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, $0.5\text{ mA} \leq I_{FH} \leq 0.75\text{ mA}$;

For $0^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, $0.5\text{ mA} \leq I_{FH} \leq 1.0\text{ mA}$; With $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$, $V_{FL} \leq 0.8\text{ V}$, unless otherwise specified. All typicals at $T_A = 25^{\circ}\text{C}$ and $V_{CC} = 5\text{ V}$, $I_{FH} = 0.625\text{ mA}$, unless otherwise specified. See note 1.

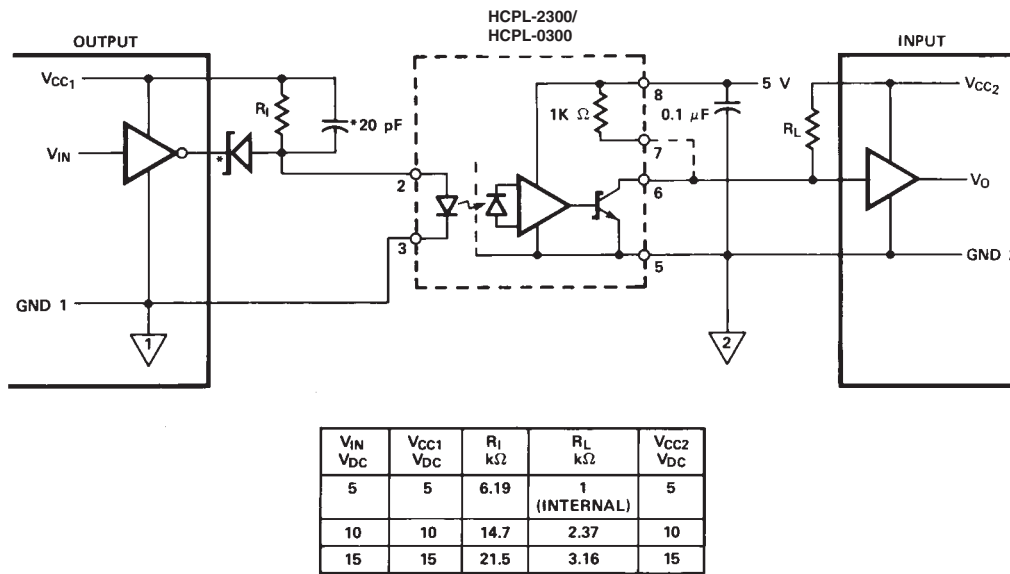
Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time to Logic High Output Level	t_{PLH}		95		ns	$C_P = 0\text{ pF}$	5, 6, 8	4, 8
			85	160		$C_P = 20\text{ pF}$	5, 8	
Propagation Delay Time to Logic Low Output Level	t_{PHL}		110		ns	$C_P = 0\text{ pF}$	5, 6, 8	5, 8
			35	200		$C_P = 20\text{ pF}$	5, 8	
Output Rise Time (10-90%)	t_r		40		ns	$C_P = 20\text{ pF}$	7, 8	8
Output Fall Time (90-10%)	t_f		20		ns			
Common Mode Transient Immunity at High Output Level	$ CM_H $	100	400		V/ μs	$V_{CM} = 50\text{ V (peak)}$, $V_O(\text{min.}) = 2\text{ V}$, $R_L = 560\text{ }\Omega$, $I_F = 0\text{ mA}$	9, 10	6
Common Mode Transient Immunity at Low Output Level	$ CM_L $	100	400		V/ μs	$V_{CM} = 50\text{ V (peak)}$, $V_O(\text{max.}) = 0.8\text{ V}$, $R_L = 560\text{ }\Omega$, $I_F = 0.5\text{ mA}$	9, 10	7

provides guaranteed minimum common mode immunity of 100 V/ μ s while maintaining the 2:1 dynamic range of I_F .

A recommended layout for use with an internal 1000 Ω resistor

or an external pull-up resistor and required V_{CC} bypass capacitor is given in Figure 19. V_{CC1} is used with an external pull-up resistor for output voltage levels (V_O) greater than or equal to 5 V. As illustrated in Figure 19, an

optional V_{CC} and GND trace can be located between the input and the output leads of the HCPL-2300/HCPL-0300 to provide additional noise immunity at the compromise of insulation capability (V_{I-O}).



*SCHOTTKY DIODE (HP 5082-2800, OR EQUIVALENT) AND 20 pF CAPACITOR ARE NOT REQUIRED FOR UNITS WITH OPEN COLLECTOR OUTPUT.

Figure 12. Recommended Shunt Drive Circuit for Interfacing between TTL/LSTTL/CMOS Logic Systems.

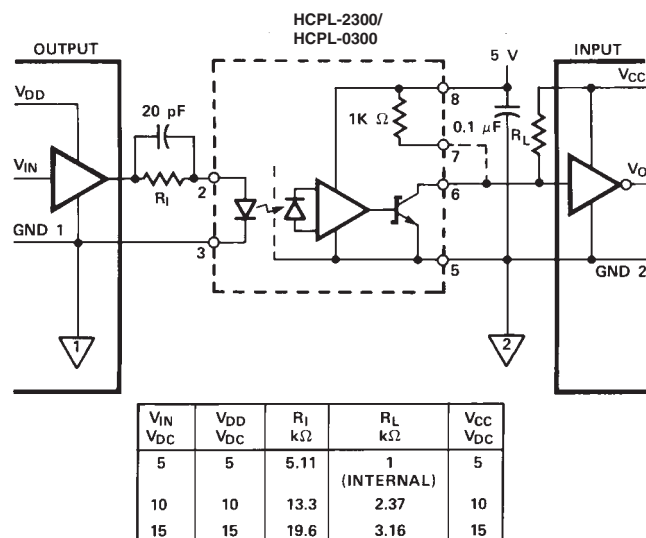


Figure 13. Active CMOS Series Drive Circuit.

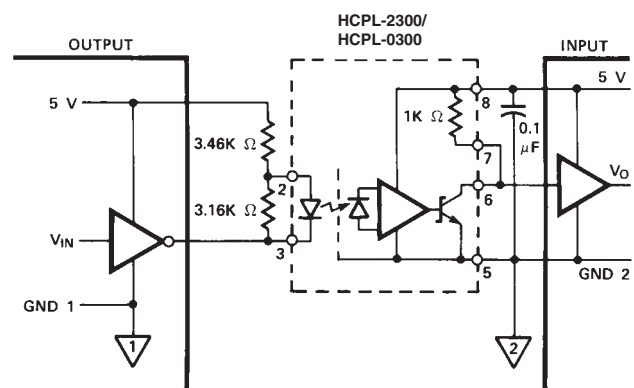


Figure 14. Series Drive from Open Collector TTL/LSTTL Units.

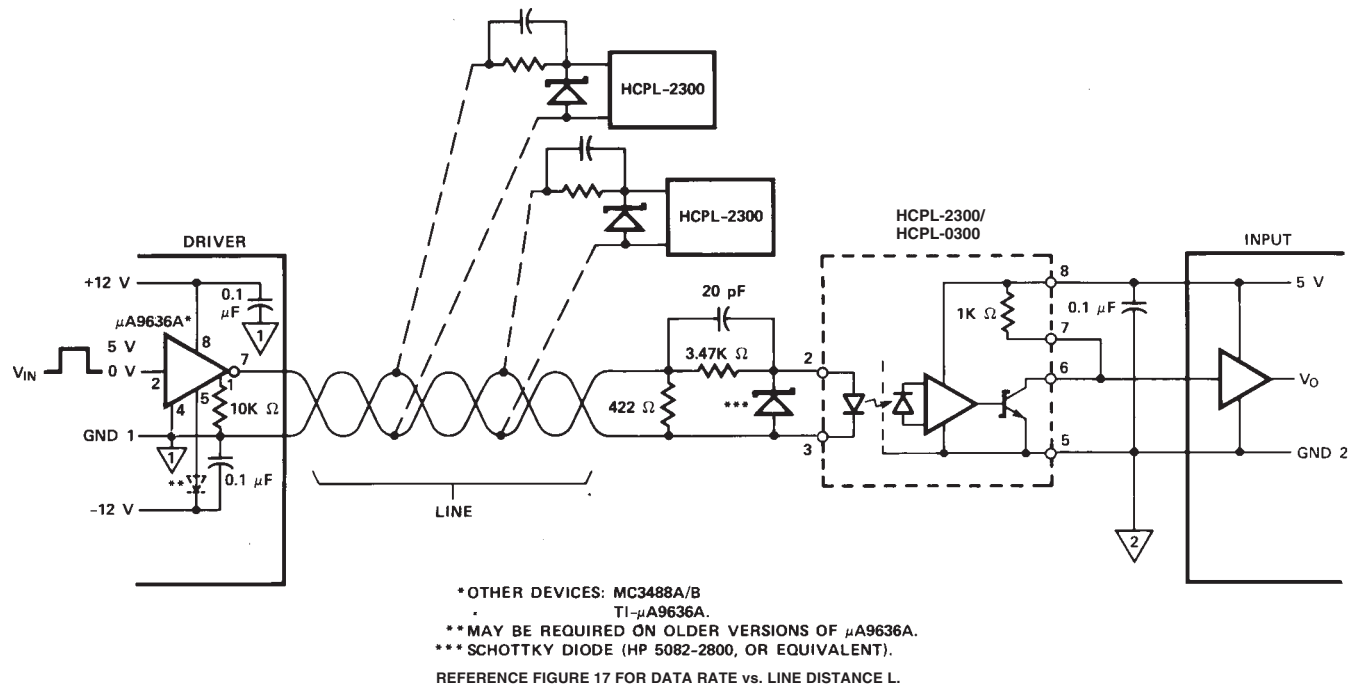


Figure 15. Application of HCPL-2300/HCPL-0300 as Isolated, Unbalanced Line Receiver(s).

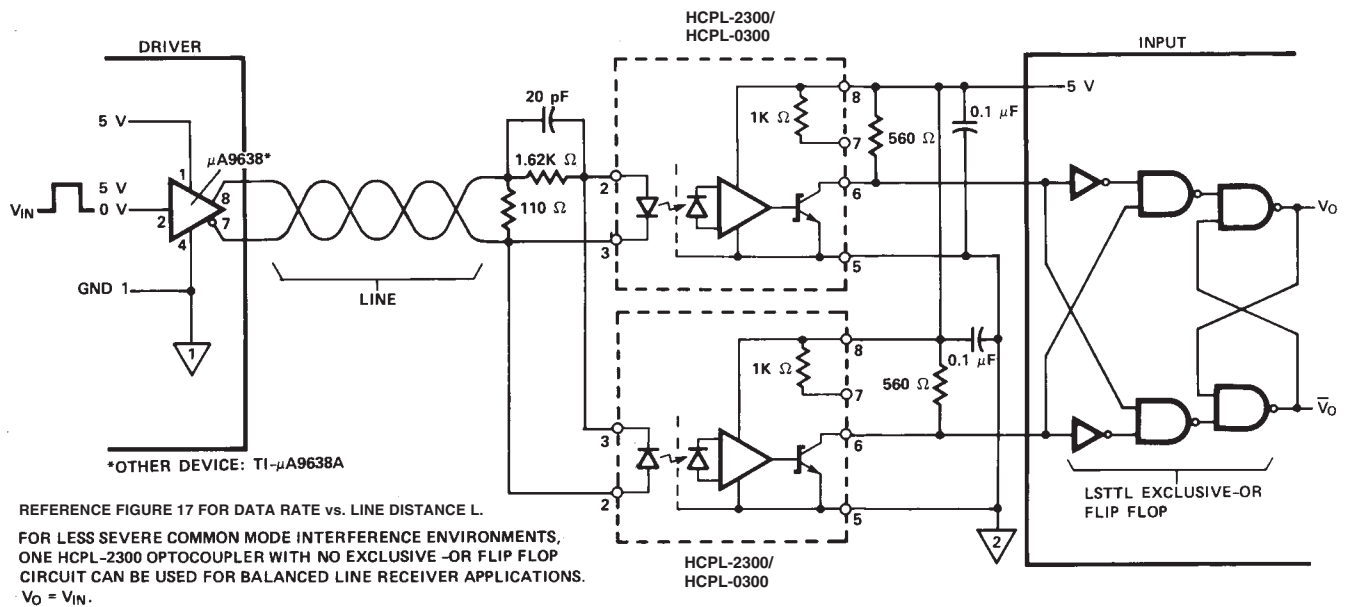


Figure 16. Application of Two HCPL-2300/HCPL-0300 Units Operating as an Isolated, High Speed, Balanced, Split Phase Line Receiver with Significantly Enhanced Common Mode Immunity.

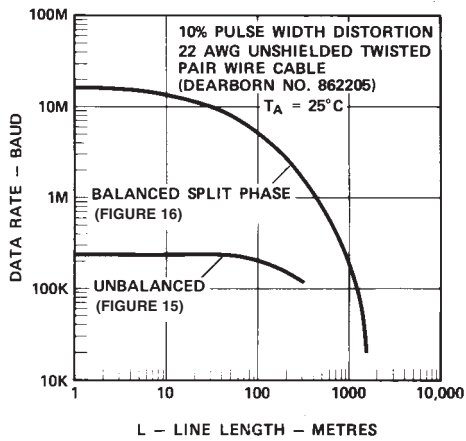


Figure 17. Typical Point to Point Data Rate vs. Length of Line for Unbalanced (Figure 15) and Balanced (Figure 16) Line Receivers Using HCPL-2300/HCPL-0300 Optocouplers.

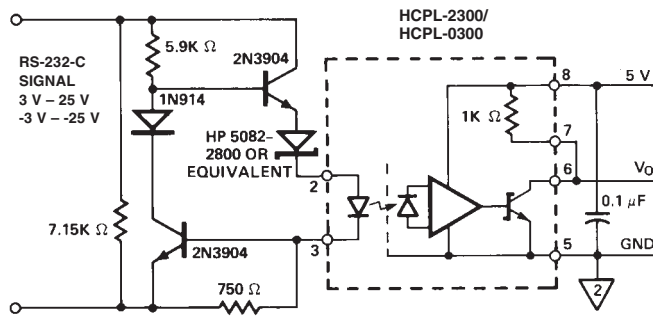
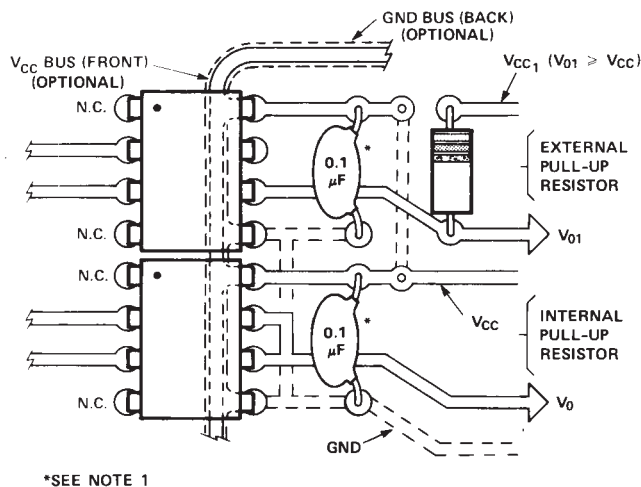


Figure 18. RS-232-C Interface Circuit with HCPL-2300/HCPL-0300. 0°C < T_A < 85°C.



*SEE NOTE 1

Figure 19. Recommended Printed Circuit Board Layout.

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Data subject to change.

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Obsoletes 5989-0284EN

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