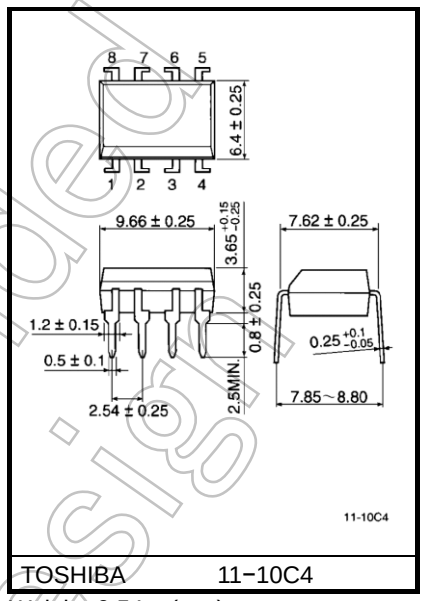
TOSHIBA Photocoupler GaAℓAs Ired & Photo−IC

TLP2601

Isolated Line Receiver
Simplex / Multiplex Data Transmission
Computer−Peripheral Interface
Microprocessor System Interface
Digital Isolation for A/D, D/A Conversion
Direct Replacement for HCPL−2601

Unit: mm



TOSHIBA 11−10C4

Weight: 0.54 g (typ.)

The TOSHIBA TLP2601 a photocoupler which combines a GaAℓAs IRed as the emitter and an integrated high gain, high speed photodetector.
The output of the detector circuit is an open collector, Schottky clamped transistor.
A Faraday shield integrated on the photodetector chip reduces the effects of capacitive coupling between the input LED emitter and the high gain stages of the detector. This provides an effective common mode transient immunity of 1000V/μs.

- Input current thresholds: I_F = 5mA (max)
- Isolation voltage: 2500Vrms (min)
- Switching speed: 10MBd
- Common mode transient immunity: 1000V/μs (min)
- Guaranteed performance over temp.: 0°C to 70°C
- UL Recognized: UL1577, file No. E67349
- cUL approved :CSA Component Acceptance Service No. 5A, File No.E67349

Truth Table (positive logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H

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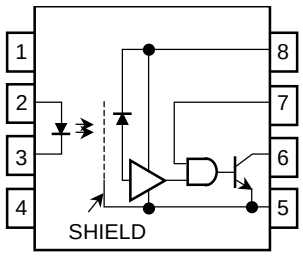
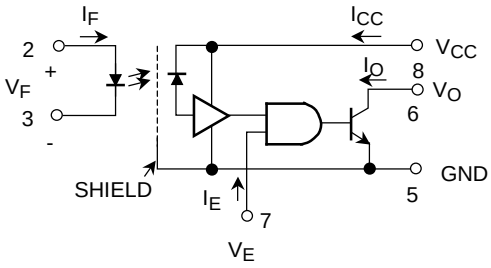
Pin Configuration (top view)



Schematic



A 0.01 to 0.1μF bypass capacitor must be connected between pins 8 and 5 (see Note 1)

Start of commercial production
1985-01

Recommended Operating Conditions

Characteristic	Symbol	Min	Typ.	Max	Unit
Input current, low level	I_{FL}	0	—	250	μA
Input current, high level	I_{FH}	6.3 (*)	—	20	mA
Supply voltage**, output	V_{CC}	4.5	—	5.5	V
High level enable voltage	V_{EH}	2.0	—	V_{CC}	V
Low level enable voltage	V_{EL}	0	—	0.8	V
Fan out (TTL load)	N	—	—	8	—
Operating temperature	T_{opr}	0	—	70	°C

Note: Recommended operating conditions are given as a design guideline to obtain expected performance of the device. Additionally, each item is an independent guideline respectively. In developing designs using this product, please confirm specified characteristics shown in this document.
(*) 6.3mA is a guard banded value which allows for at least 20% CTR degradation.
Initial input current threshold value is 5.0 mA or less.

**This item denotes operating ranges, not meaning of recommended operating conditions.

Absolute Maximum Ratings (no derating required)

Characteristic		Symbol	Rating	Unit
LED	Forward current	I_F	20	mA
	Reverse voltage	V_R	5	V
	Diode power dissipation	P_D	100	mW
	Diode power dissipation derating (Ta ≥70°C)	ΔP_D/°C	-1.8	mW/°C
	Junction Temperature	Tj	125	°C
Detector	Output current	I_O	25	mA
	Output voltage	V_O	−0.5 to 7	V
	Supply voltage (1 minute maximum)	V_{CC}	7	V
	Enable input voltage (not to exceed V_{CC} by more than 500mV)	V_E	5.5	V
	Output power dissipation	P_C	40	mW
	Output Power dissipation derating (Ta ≥ 70°C)	ΔP_C / °C	-0.7	mW / °C
	Junction Temperature	Tj	125	°C
Operating temperature range		Topr	−40 to 85	°C
Storage Temperature range		T_{stg}	−55 to 125	°C
Lead Solder Temperature (10 s)		T_{sol}	260	°C
Isolation voltage (R.H.≤ 60%, AC 1minute) (Note 10)		BV_S	2500	Vrms
			3540	V_{dc}

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

(**) 1.6mm below seating plane.

Electrical Characteristics (Ta = 0°C to 70°C unless otherwise noted)

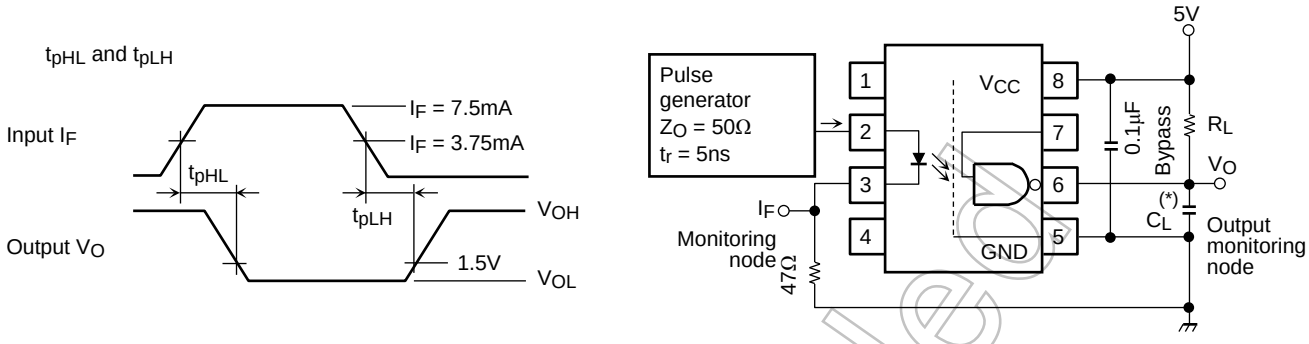
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
High level output current	I_{OH}	V_{CC} = 5.5V, V_O = 5.5V I_F = 250μA, V_E = 2.0V	—	1	250	μA
Low level output voltage	V_{OL}	V_{CC} = 5.5V, I_F = 5mA V_E = 2.0V, I_{OL}(sinking) = 13mA	—	0.4	0.6	V
High level supply current	I_{CCH}	V_{CC} = 5.5V, I_F = 0A, V_E = 0.5V	—	7	15	mA
Low level supply current	I_{CCL}	V_{CC} = 5.5V, I_F = 10mA, V_E = 0.5V	—	12	19	mA
Low level enable current	I_{EL}	V_{CC} = 5.5V, V_E = 0.5V	—	−1.6	−2.0	mA
High level enable current	I_{EH}	V_{CC} = 5.5V, V_E = 2.0V	—	−1	—	mA
High level enable voltage	V_{EH}	(Note 11)	2.0	—	—	V
Low level enable voltage	V_{EL}	—	—	—	0.8	
Input forward voltage	V_F	I_F = 10mA, Ta = 25°C	—	1.65	1.75	V
Input reverse breakdown voltage	BV_R	I_R = 10μA, Ta = 25°C	5	—	—	V
Input capacitance	C_{IN}	V_F = 0 V, f = 1MHz	—	45	—	pF
Input diode temperature coefficient	$\Delta V_F/\Delta T_A$	I_F = 10mA	—	−2.0	—	mV / °C
Input−output insulation leakage current	I_{I-O}	Relative humidity = 45% Ta=25°C, t = 5 second V_{I-O} = 3000Vdc, (Note 10)	—	—	1	μA
Resistance (input−output)	R_{I-O}	V_{I-O} = 500V, R.H.≤ 60% (Note 10)	5×10^{10}	10^{14}	—	Ω
Capacitance (input−output)	C_{I-O}	f = 1MHz (Note 10)	—	0.6	—	pF

(**) All typ.values are at V_{CC} = 5V, Ta = 25°C.

Switching Characteristics (Ta = 25°C, Vcc = 5 V)

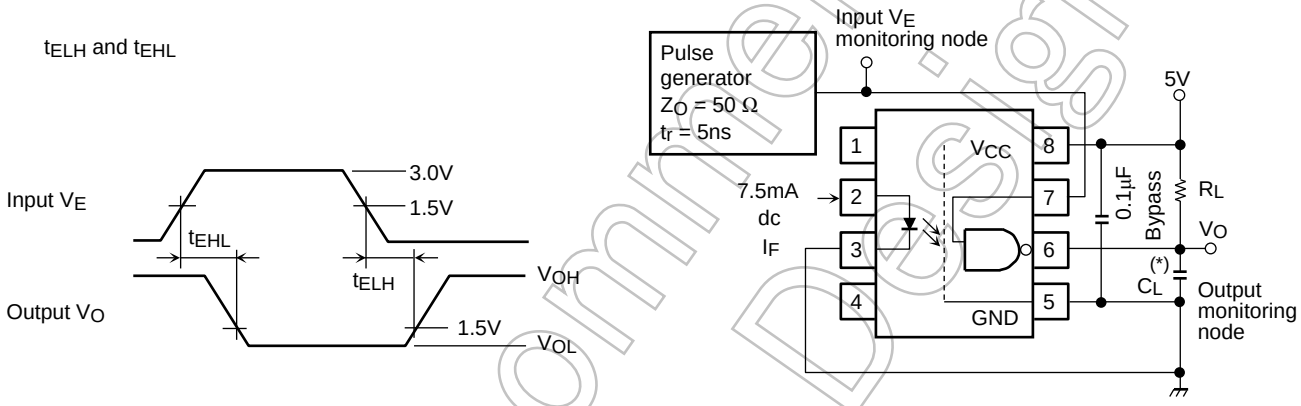
Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time to high output level	t_{pLH}	1	R_L = 350Ω, C_L = 15pF I_F = 7.5mA (Note 2), (Note 3), (Note 4)&(Note 5)	—	60	75	ns
Propagation delay time to low output level	t_{pHL}			—	60	75	ns
Output rise time (10−90%)	t_r			—	30	—	ns
Output fall time (90−10%)	t_f			—	30	—	ns
Propagation delay time of enable from V_{EH} to V_{EL}	t_{ELH}	2	R_L = 350Ω, C_L = 15pF I_F = 7.5mA V_{EH} = 3.0V V_{EL} = 0.5V (Note 6) & (Note 7)	—	25	—	ns
Propagation delay time of enable from V_{EL} to V_{EH}	t_{EHL}			—	25	—	ns
Common mode transient immunity at high output level	CM_H	3	V_{CM} = 400V R_L = 350Ω $V_{O(min)}$ = 2V I_F = 0mA, (Note 9)	1000	10000	—	V/μs
Common mode transient immunity at low output level	CM_L		V_{CM} = 400V R_L = 350Ω $V_{O(max)}$ = 0.8V I_F = 7.5mA, (Note 8)	−1000	−10000	—	V/μs

Test Circuit 1.



(*) C_L is approximately 15pF which includes probe and stray wiring capacitance.

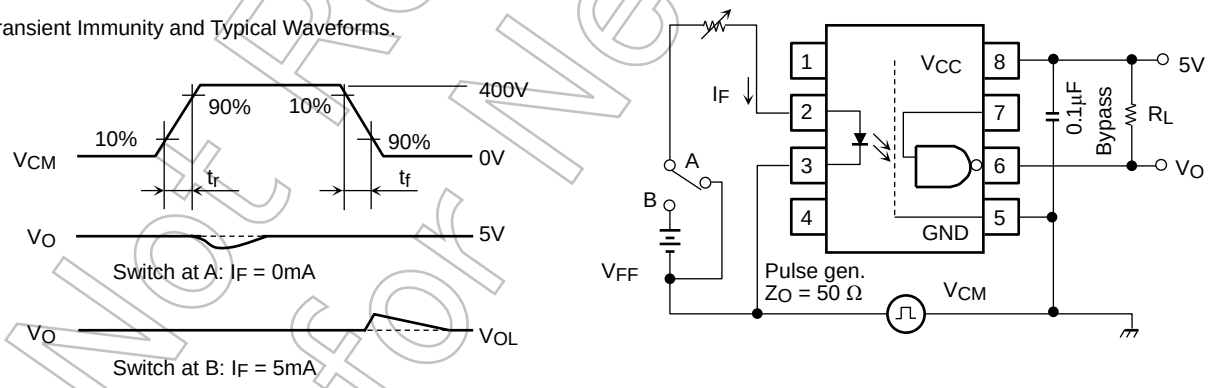
Test Circuit 2.



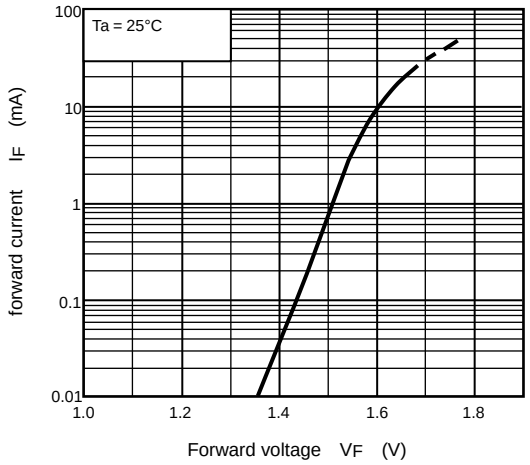
(*) C_L is approximately 15pF which includes probe and stray wiring capacitance.

Test Circuit 3.

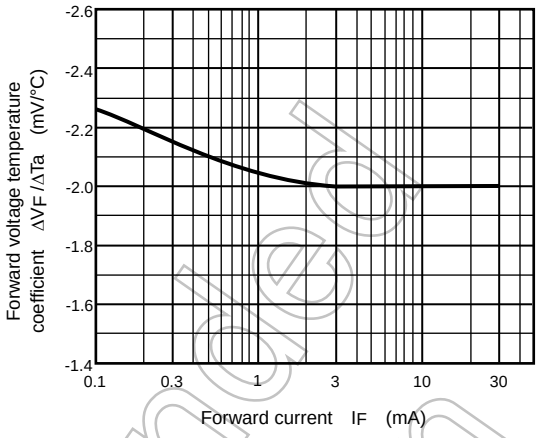
Transient Immunity and Typical Waveforms.



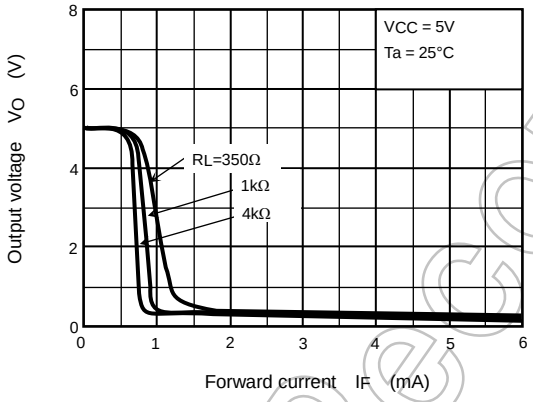
$I_F - V_F$



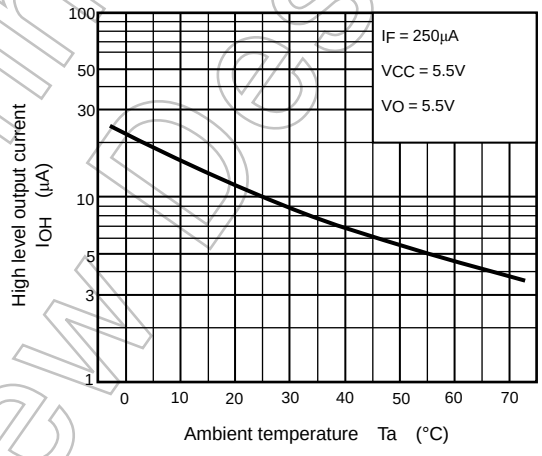
$\Delta V_F / \Delta Ta - I_F$



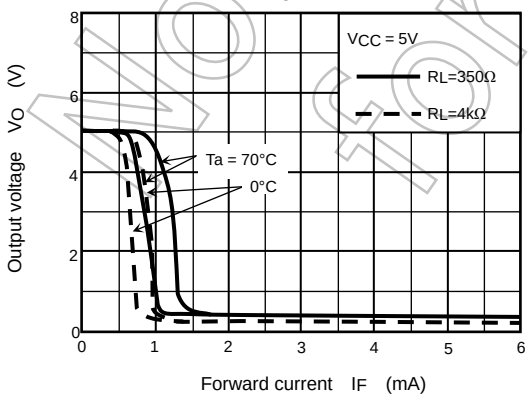
$V_O - I_F$



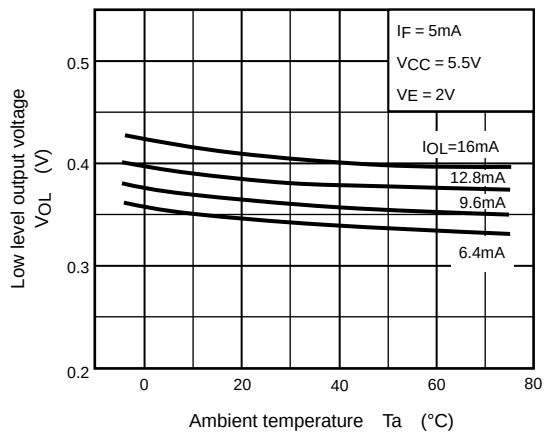
$I_{OH} - Ta$



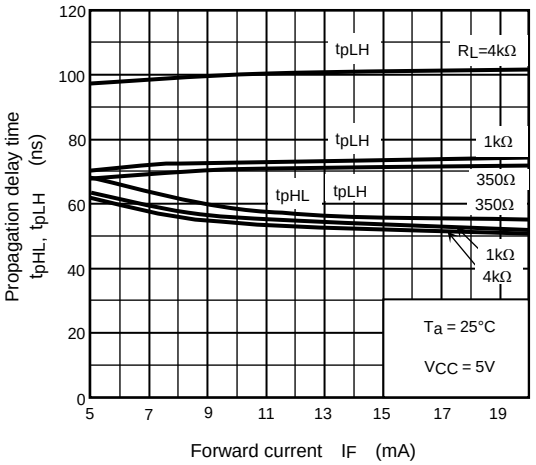
$V_O - I_F$



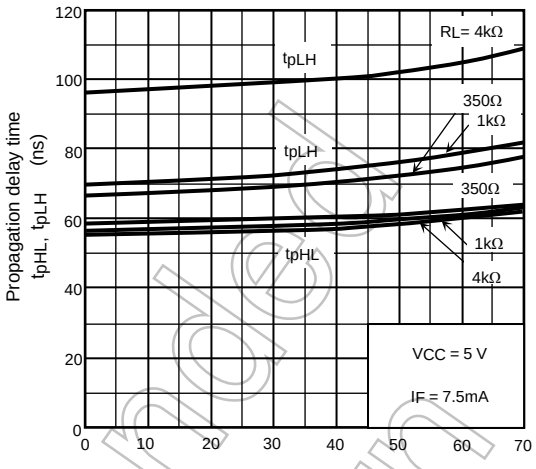
$V_{OL} - T_a$



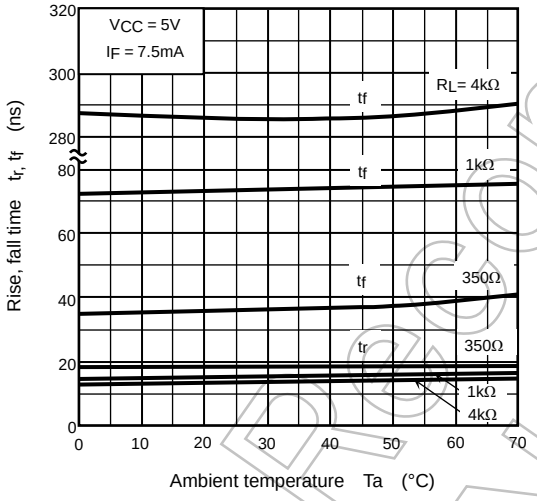
t_{pHL}, t_{pLH} – I_F



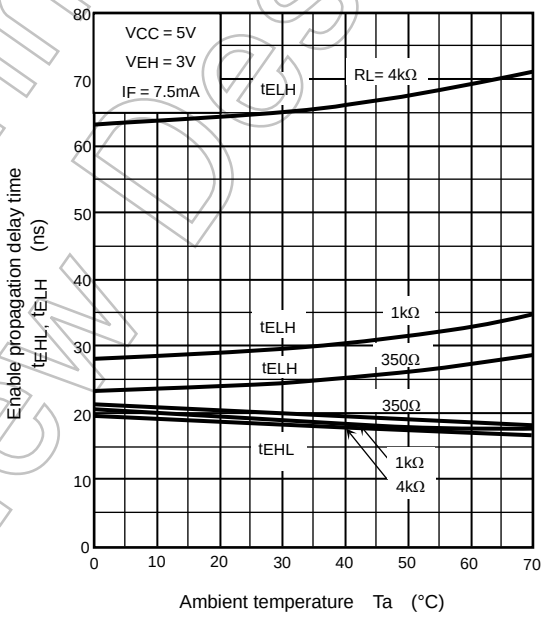
t_{pHL}, t_{pLH} – Ta



t_r, t_f – Ta



t_{EHL}, t_{ELH} – Ta



Notes

1. The V_{CC} supply voltage to each TLP2601 isolator must be bypassed by a 0.1μF capacitor of larger.This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.

2. t_{pHL} · Propagation delay is measured from the 3.75mA level on the low to high transition of the input current pulse to the 1.5V level on the high to low transition of the output voltage pulse.

3. t_{pLH} · Propagation delay is measured from the 3.75mA level on the high to low transition of the input current pulse to the 1.5V level on the low to high transition of the output voltage pulse.

4. t_f · Fall time is measured from the 10% to 90% levels of the high to low transition on the output pulse.

5. t_r · Rise time is measured from the 90% to 10% levels of the low to high transition on the output pulse.

6. t_{EHL} · Enable input propagation delay is measured from the 1.5V level on the low to high transition of the input voltage pulse to the 1.5V level on the high to low transition of the output voltage pulse.

7. t_{ELH} · Enable input propagation delay is measured from the 1.5V level on the high to low transition of the input voltage pulse to the 1.5V level on the low to high transition of the output voltage pulse.

8. CM_L · The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e. $V_{OUT} < 0.8V$).
   Measured in volts per microsecond (V / μs).

9. CM_H · The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the high state (i.e. $V_{OUT} > 2.0V$).
   Measured in volts per microsecond (V / μs).
   Volts/microsecond can be translated to sinusoidal voltages:

$$V / \mu s = \left(\frac{dv_{CM}}{dt}\right)_{Max.} = f_{CM}\, V_{CM}\ (p.p.)$$

   Example:
   $V_{CM} = 318V_{pp}$ when $f_{CM} = 1MHz$ using CM_L and $CM_H = 1000V / \mu s$ data sheet specified minimum.

10. · Device considered a two−terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together.

11. Enable input · No pull up resistor required as the device has an internal pull up resistor.

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