Photocouplers Optically Isolation Amplifiers

TLP7820

1. Applications

- Motor phase and rail current sensing
- Power inverter current and voltage sensing

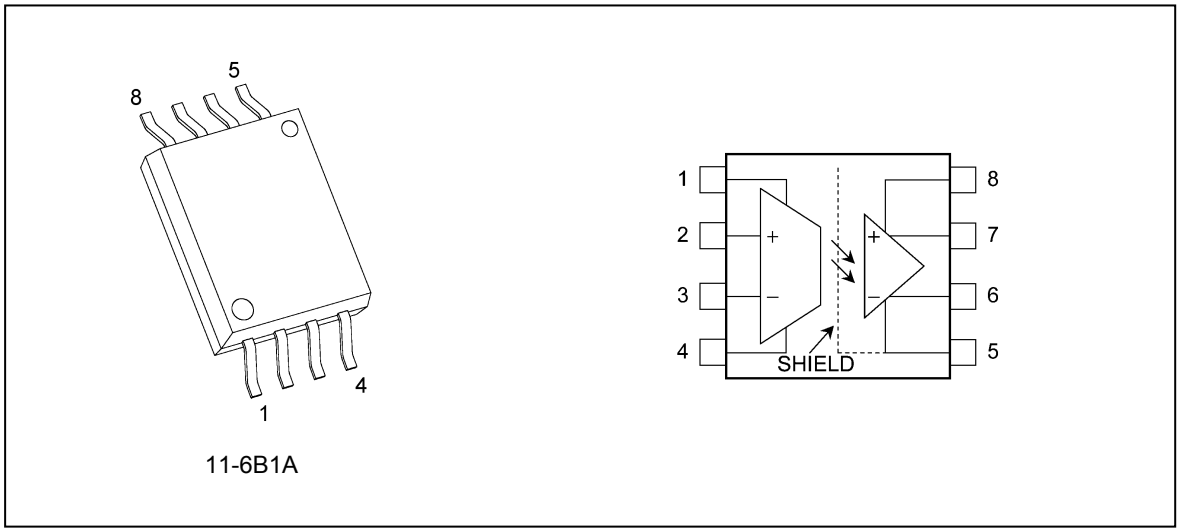
2. General

The TLP7820 of isolation amplifiers is designed for current sensing in electronic motor drives. In a typical implementation, motor currents flow through an external resistor and the resulting analog voltage drop is sensed by the TLP7820.

3. Features

(1) Output side supply voltage: 3 to 5.5 V
(2) Output side supply current: 6.2 mA (typ.)
(3) Operating temperature range: -40 to 105 ℃
(4) Common-mode transient immunity: 15 kV/μs (min)

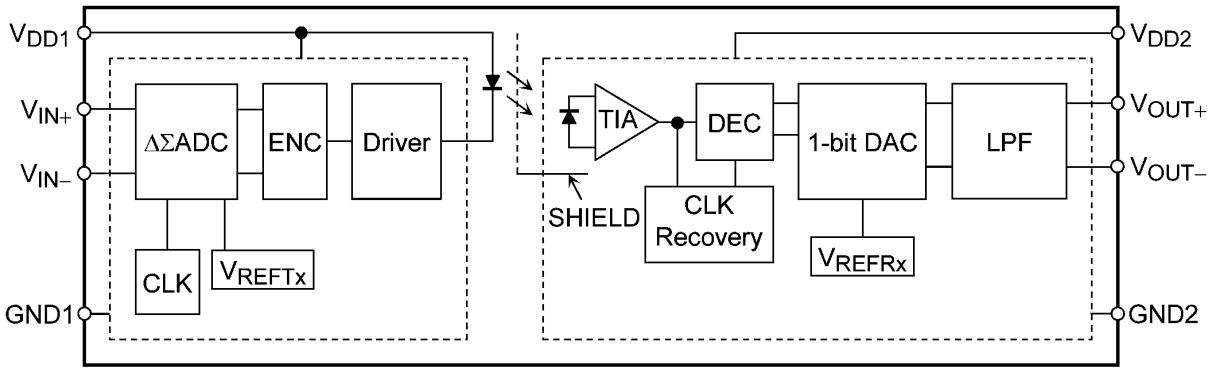
4. Packaging and Pin Assignment



4.1. Pin Assignment

Pin No.	Symbol	Description
1	V_{DD1}	Input side supply voltage
2	V_{IN+}	Positive input
3	V_{IN-}	Negative input
4	GND1	Input side ground
5	GND2	Output side ground
6	V_{OUT-}	Negative output
7	V_{OUT+}	Positive output
8	V_{DD2}	Output side supply voltage

5. Internal Circuit (Note)



Note: A 0.1-μF bypass capacitor must be connected between 1 and 4 pins and between 5 and 8 pins.

6. Principle of Operation

6.1. Mechanical Parameters

Characteristics	SO8L	Unit
Height	2.3 (Max)	mm
Creepage distances	8.0 (Min)	
Clearance	8.0 (Min)	
Internal isolation thickness	0.4 (Min)	

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Note	Rating	Unit
Supply Voltages		V_{DD1}, V_{DD2}		-0.5 to 6	V
Steady-state input voltages		V_{IN+}, V_{IN-}		-0.5 to 6	
Two-second transient input voltages		V_{IN+}, V_{IN-}		-6 to 6	
Output voltages		V_{OUT+}, V_{OUT-}		-0.5 to 6	
Operating temperature		T_{opr}		-40 to 105	°C
Storage temperature		T_{stg}		-55 to 125	
Lead soldering temperature	(10 s)	T_{sol}	(Note 1)	260	
Isolation voltage	AC, 60 s, R.H. ≤ 60 %	BV_S	(Note 2)	5000	Vrms

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.
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).

Note: Ceramic capacitors (0.1 μF) should be connected between 1 and 4 pins and between 5 and 8 pins to stabilize the operation. Otherwise, this photocoupler may not switch properly. The bypass capacitors should be placed as close as possible to each pin.

Note 1: ≥ 2 mm below seating plane.

Note 2: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

8. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Input side supply voltage	V_{DD1}		4.5	5	5.5	V
Output side supply voltage	V_{DD2}		3	—	5.5	
Analog input voltage	V_{IN+}, V_{IN-}	(Note 1), (Note 2)	-200	—	200	mV
Ambient temperature	T_a		-40	—	105	°C

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this datasheet should also be considered.

Note 1: FSR = ±300 mV

Note 2: When either V_{IN+} or V_{IN-} or both are equal to or greater than V_{DD1} - 2 V (e.g., if V_{DD1} = 5 V, when V_{IN+} and/or V_{IN-} are equal to or greater than 5 V - 2 V = 3 V), isolation amplifiers go into one of the test modes. Do not raise either V_{IN+} or V_{IN-} above this voltage to keep the device in functional mode.

9. Electrical Characteristics

9.1. DC Characteristics (Unless otherwise specified, T_a = -40 to 105 °C, V_{DD1} = 4.5 to 5.5 V, V_{DD2} = 3 to 5.5 V, V_{IN+} = -200 to 200 mV, V_{IN-} = 0 V)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Input offset voltage	V_{OS}		T_a = 25 °C	-0.6	0.9	2.4	mV
Input offset voltage drift vs ambient temperature	$\lvert dV_{OS}/dT_a \rvert$			—	2	6	μV/°C
Input offset voltage drift vs input side supply voltage	$\lvert dV_{OS}/dV_{DD1} \rvert$			—	120	—	μV/V
Gain (Rank B)	G_0	(Note 1)	T_a = 25 °C	8.16	8.2	8.24	V/V
Gain (Rank A)	G_1	(Note 1)	T_a = 25 °C	8.12	8.2	8.28	
Gain (None)	G_3	(Note 1)	T_a = 25 °C	7.95	8.2	8.44	
Gain drift vs ambient temperature	$\lvert dG/dT_a \rvert$			—	0.00012	—	V/V/°C
V_{OUT} non-linearity (±200 mV)	NL_{200}	(Note 2)	V_{IN+} = -200 to 200 mV, T_a = 25 °C	—	0.02	0.13	%
V_{OUT} non-linearity (±200 mV) drift vs ambient temperature	$\lvert dNL_{200}/dT_a \rvert$			—	0.00007	—	%/°C
V_{OUT} non-linearity (±100 mV)	NL_{100}	(Note 2)	V_{IN+} = -100 to 100 mV, T_a = 25 °C	—	0.01	0.06	%
High-level output voltage	V_{OH}		V_{IN+} = 400 mV, T_a = 25 °C	—	2.497	—	V
Low-level output voltage	V_{OL}		V_{IN+} = -400 mV, T_a = 25 °C	—	0.0009	—	
Input common-mode rejection ratio	$CMRR_{IN}$			—	80	—	dB
Input bias current	I_{IN+}		V_{IN+} = 0 V, T_a = 25 °C	-1	-0.055	—	μA
Input side supply current (V_{DD1})	I_{DD1}		V_{IN+} = 0 V	—	8.6	12	mA
Output side supply current (V_{DD2})	I_{DD2}		V_{IN+} = 0 V	—	6.2	10	
Equivalent input resistance	R_{IN}			—	78	—	kΩ

Note 1: See section 9.1.1. for gain rank values.

Note 2: The slope of the optimum line is derived by the method of least squares between differential input voltage (V_{IN+} - V_{IN-}) and differential output voltage (V_{OUT+} - V_{OUT-}). Nonlinearity is defined as a fraction of the half of the peak-to-peak value of differential output voltage deviation divided by the full-scale differential output voltage (OVR).

9.1.1. Gain Rank (Note) (Unless otherwise specified, T_a = 25 °C)

Rank	Gain Rank Marking	Gain (Min)	Gain (Typ.)	Gain (Max)	Unit
None (±3 %)	Blank, A, B	7.95	8.2	8.44	V/V
Rank A (±1 %)	A, B	8.12	8.2	8.28	
Rank B (±0.5 %)	B	8.16	8.2	8.24	

Note: The gain is defined as the slope of the optimum line derived by the method of least squares between differential input voltage (V_{IN+} - V_{IN-}) and differential output voltage (V_{OUT+} - V_{OUT-}) in the recommended voltage range.

Note: Specify both the part number and a rank in this format when ordering.
Example: Rank B: TLP7820(B

10. AC Characteristics (Note) (Unless otherwise specified, T_a = -40 to 105 °C, V_{DD1} = 4.5 to 5.5 V, V_{DD2} = 3 to 5.5 V)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
V_{OUT} bandwidth (-3 dB)	f_{-3dB}	V_{IN+} = 400 mV_{p-p} , sine wave	140	230	—	kHz
V_{IN} to V_{OUT} propagation delay time (10 %-10 %)	t_{pD10}	V_{IN+} = 0 to 200 mV/μs step C_L = 15 pF	—	1.9	2.3	μs
V_{IN} to V_{OUT} propagation delay time (50 %-50 %)	t_{pD50}		—	2.3	2.6	
V_{IN} to V_{OUT} propagation delay time (90 %-90 %)	t_{pD90}		—	2.8	3.3	
V_{OUT} rise time	t_r		—	1.7	—	
V_{OUT} fall time	t_f		—	1.7	—	
Common-mode transient immunity	CMTI	V_{CM} = 1 kV, T_a = 25 °C	15	20	—	kV/μs

Note: All typical values are at T_a = 25 °C.
C_L is approximately 15 pF which includes probe and stray wiring capacitance.

11. Isolation Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	(Note 1)	V_S = 0 V, f = 1 MHz	—	1.0	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60 %	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	5000	—	—	Vrms
			AC, 1 s in oil	—	10000	—	
			DC, 60 s in oil	—	10000	—	Vdc

Note 1: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

12. Characteristics Curves (Note)

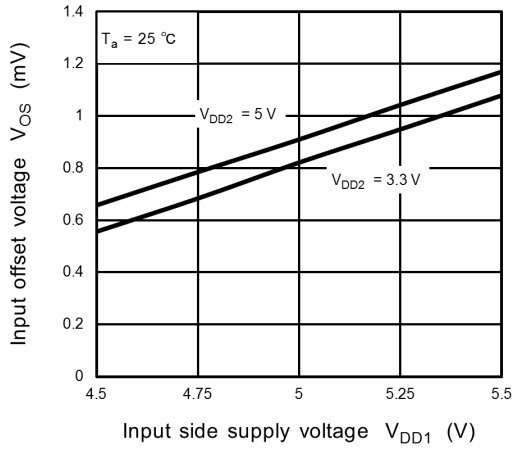


Fig. 12.1 V_{OS} - V_{DD1}

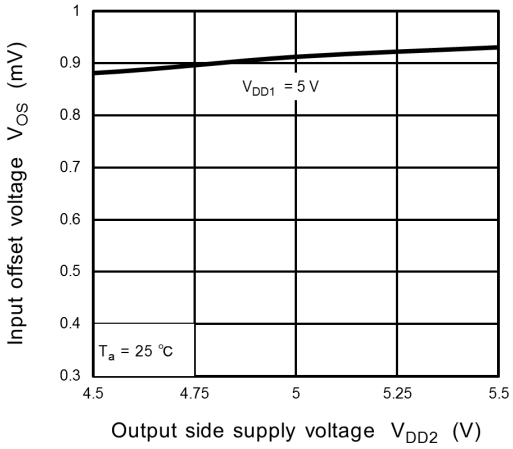


Fig. 12.2 V_{OS} - V_{DD2}

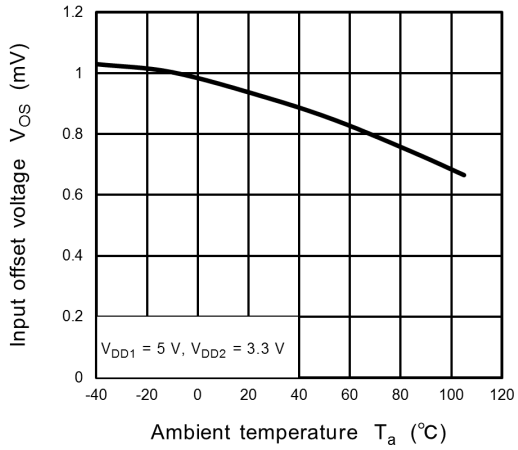


Fig. 12.3 V_{OS} - T_a

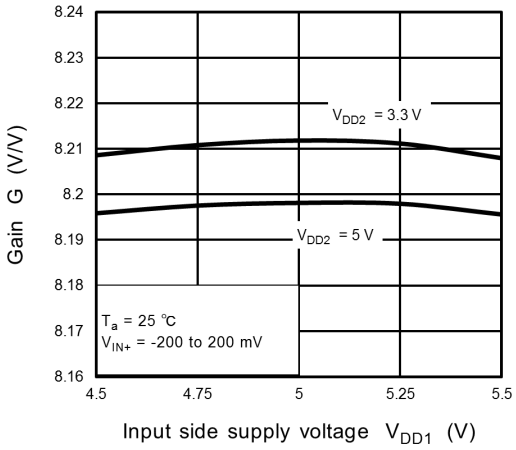


Fig. 12.4 G - V_{DD1}

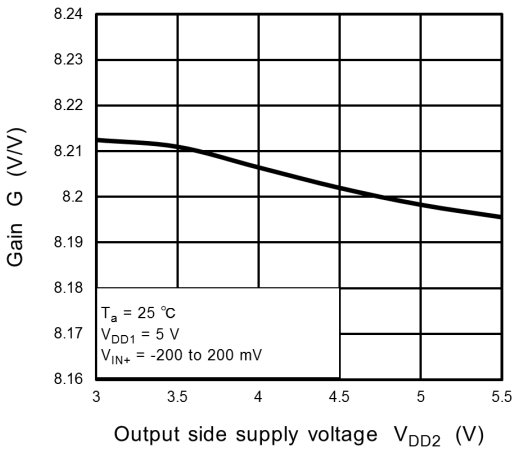


Fig. 12.5 G - V_{DD2}

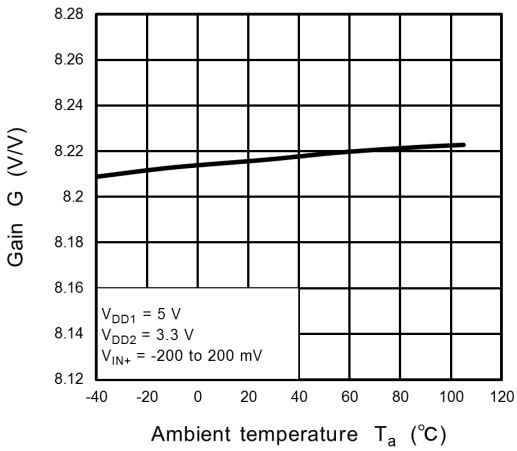


Fig. 12.6 G - T_a

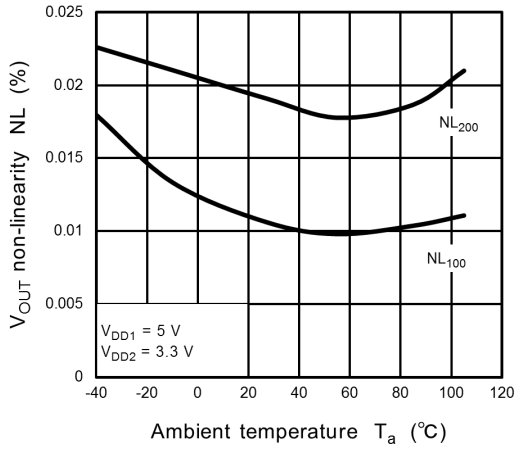


Fig. 12.7 NL - T_a

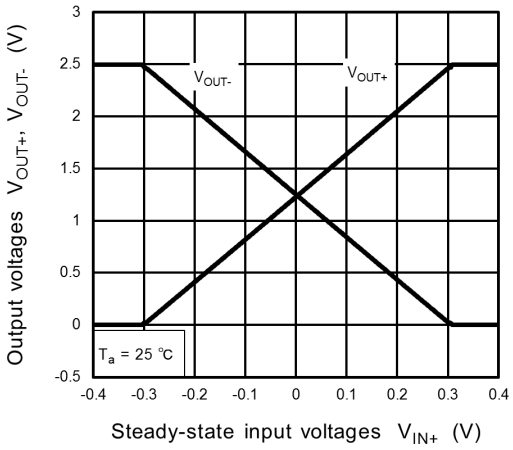


Fig. 12.8 V_{OUT} - V_{IN+}

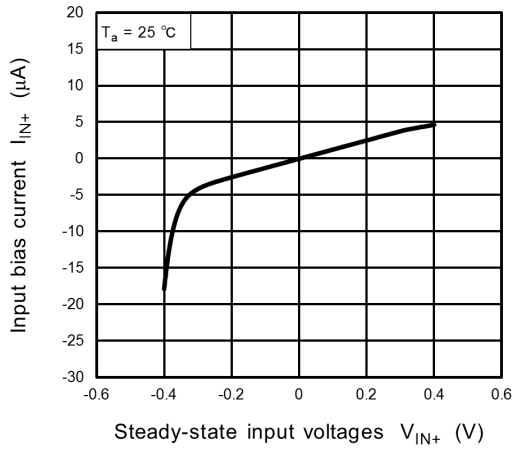


Fig. 12.9 I_{IN+} - V_{IN+}

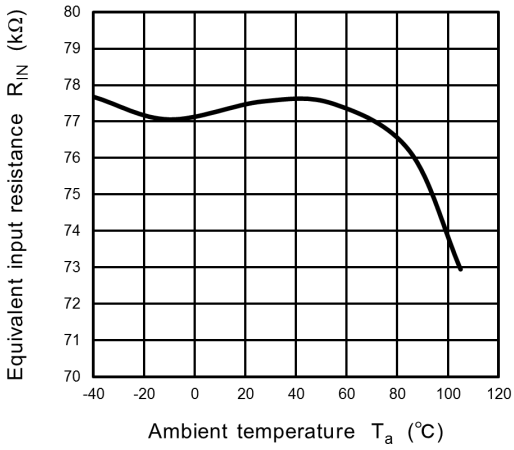


Fig. 12.10 R_{IN} - T_a

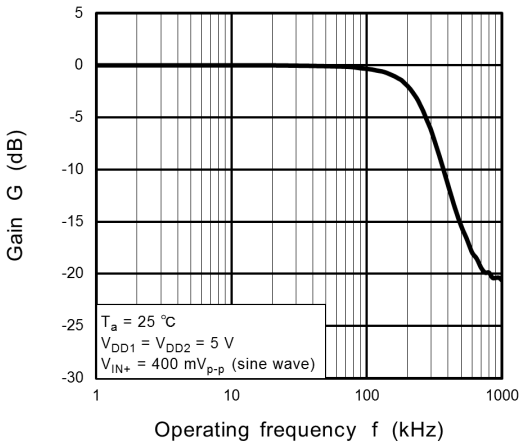


Fig. 12.11 G[dB] - f

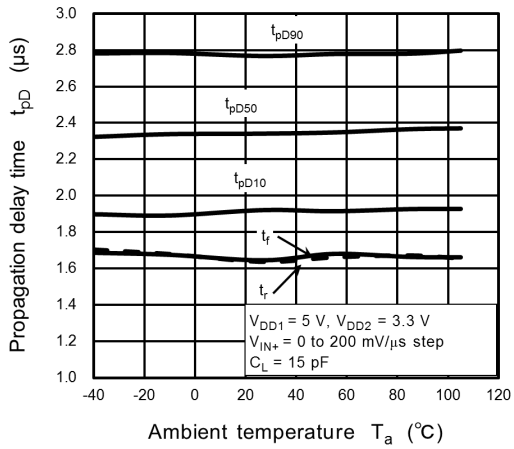


Fig. 12.12 Propagation delay time - T_a

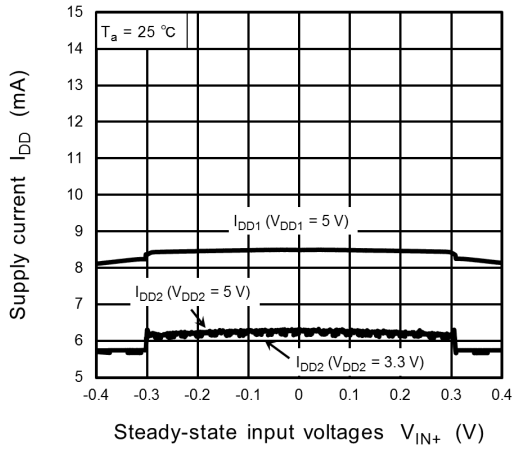
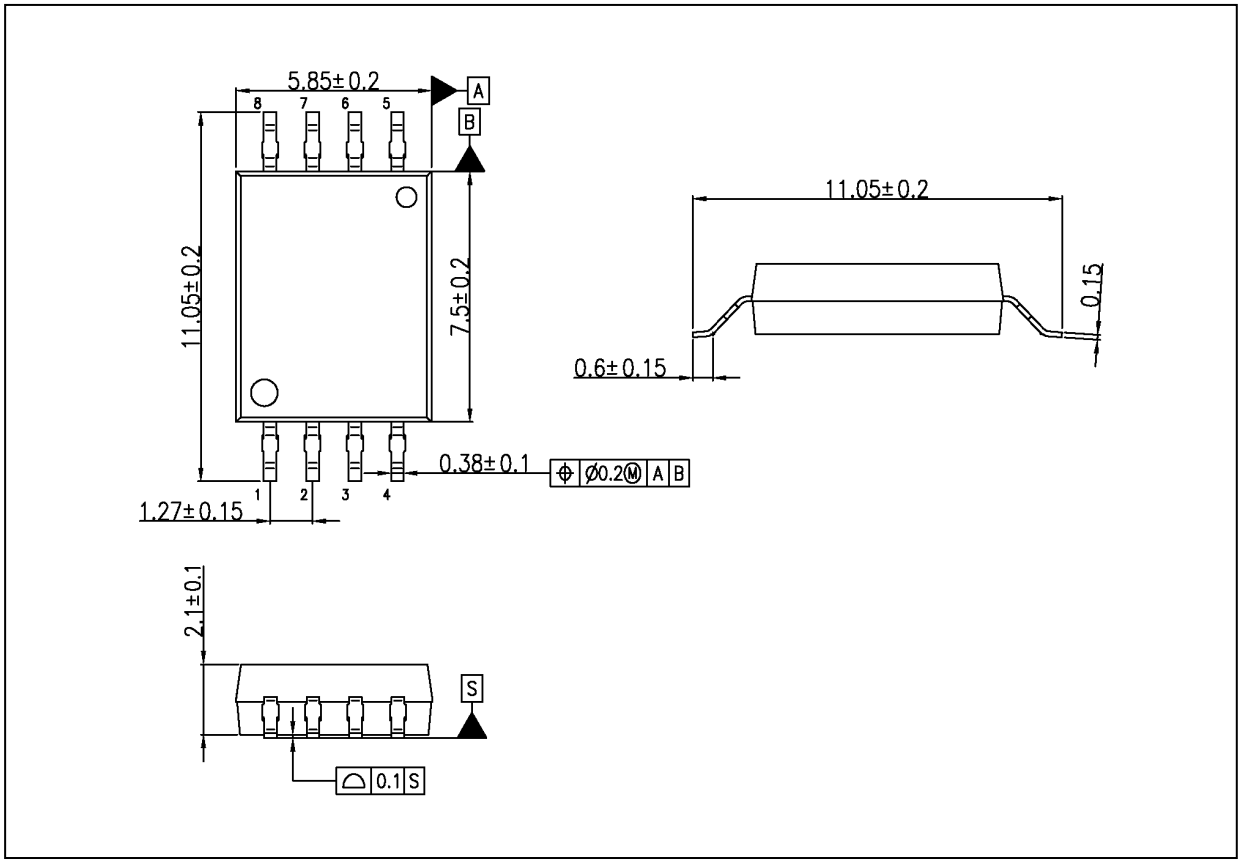


Fig. 12.13 I_{DD} - V_{IN+}

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.205 g (typ.)

Package Name(s)
TOSHIBA: 11-6B1A

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