±12KV ESD Protected, 10Mbps, Full Fail-safe, RS-485 Transceivers

Features

- **High Data Rates:**
  TPT75176B: 10Mbps @ 5V Supply
- **35ns Tx/Rx Propagation Delays;**
  10ns (Typ) Skew
- **Full Fail-safe (Open, Short, Terminated) Receivers**
- **Up to 128 Nodes on a Bus (1/4 unit load)**
- **Wide Supply Voltage 3.0V~5.5V**
- **Low Quiescent Supply Current: 3 mA**
- **Bus-Pin Protection:**
  - **±8 kV IEC-ESD Contact**
  - **±15 kV IEC-ESD Air-discharge**
- **Pb-Free**

Applications

- PROFIBUS® DP and FMS Networks
- SCSI “Fast 40” Drivers and Receivers
- Motor Controller/Position Encoder Systems
- Factory Automation
- Field Bus Networks
- Industrial/Process Control Networks

Description

3PEAK’s TPT75176A/B is enhanced RS485 which exceeds standard TIA/EIA-485-A with ±12kV ESD Protected, 3.0~5.5V powered, single transceiver for balanced communication. It also features the larger output voltage and higher data rate - up to 10Mbps - required by high speed PROFIBUS applications, and is offered in Industrial and Extended Industrial (-40°C to +125°C) temperature ranges.

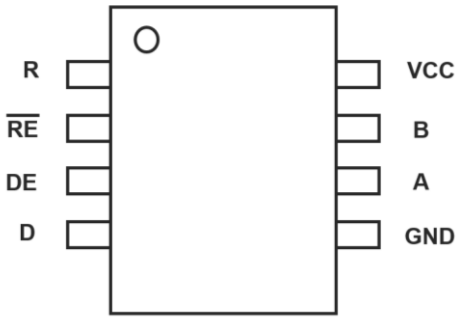
This transceiver requires a 3V~5.5V tolerance supply, and delivers at least a 2.1V differential output voltage on 5V supply condition. This translates into better noise immunity (data integrity), longer reach, or the ability to drive up to three 120Ω terminations in “star” or other non-standard bus topologies, at the exceptional 10Mbps data rate.

Receiver (Rx) inputs feature a “Full Fail-Safe” design, which ensures a logic high Rx output if Rx inputs are floating, shorted, or terminated but undriven. Rx outputs feature high drive levels (typically >25mA @ V_{OL} = 1V) to ease the design of optically isolated interfaces.

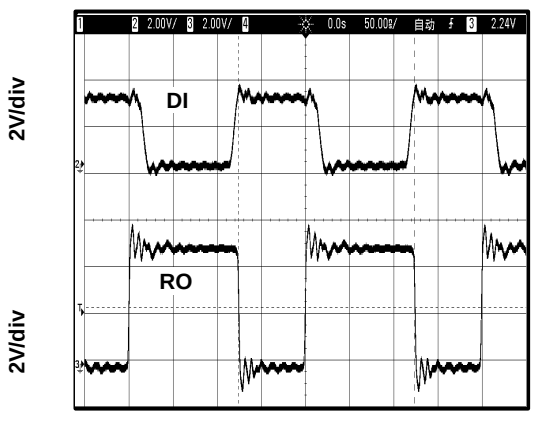
The TPT75176A/B is available in an SOP8, MSOP8 and DFN3X3-8L package, and is characterized from –40°C to 125°C.

Pin Configuration (Top View)

TPT75176A/B
8-Pin SOP/MSOP/DFN
-SO1R, -VS1R, DF6R



Loopback Test At 10Mbps/5V



Revision History

Date	Revision	Notes
2019/4/23	Rev. Pre 0.1	Definition Version 0
2019/7/29	Rev. Pre 0.2	Update ESD level
2019/10/22	Rev. 0	Final version

Order Information

Model Name	Order Number	Package	Transport Media, Quantity	Marking Information
TPT75176A	TPT75176A-SO1R	8-Pin SOP	Tape and Reel, 4,000	T176A
TPT75176A	TPT75176A-VS1R	8-Pin MSOP	Tape and Reel, 3,000	176A
TPT75176A	TPT75176A-DF6R	8-Pin DFN	Tape and Reel, 4,000	176A
TPT75176B	TPT75176B-SO1R	8-Pin SOP	Tape and Reel, 4,000	T176B
TPT75176B	TPT75176B-VS1R	8-Pin MSOP	Tape and Reel, 3,000	176B
TPT75176B	TPT75176B-DF6R	8-Pin DFN	Tape and Reel, 4,000	176B

Functional Table

DRIVER PIN FUNCTIONS

INPUT	ENABLE	OUTPUTS		DESCRIPTION
D	DE	A	B	
NORMAL MODE				
H	H	H	L	Actively drives bus High
L	H	L	H	Actively drives bus Low
X	L	Z	Z	Driver disabled
X	OPEN	Z	Z	Driver disabled by default
OPEN	H	H	L	Actively drives bus High

RECEIVER PIN FUNCTIONS

DIFFERENTIAL INPUT	ENABLE	OUTPUT	DESCRIPTION
$V_{ID} = V_A - V_B$	/RE	R	
NORMAL MODE			
$V_{IT+} < V_{ID}$	L	H	Receive valid bus High
$V_{IT-} < V_{ID} < V_{IT+}$	L	?	Indeterminate bus state
$V_{ID} < V_{IT-}$	L	L	Receive valid bus Low
X	H	Z	Receiver disabled
X	OPEN	Z	Receiver disabled
Open, short, idle Bus	L	H	Indeterminate bus state

Absolute Maximum Ratings

V_{DD} to GND.....-0.3V to +7V

Input Voltages DI, DE, RE.....-0.3V to (VCC + 0.3V)

Input/Output Voltages A, B..... -9V to +14V

A, B (Transient Pulse Through 100Ω, Note 1)..... ±100V

R_O..... -0.3V to (VCC +0.3V)

Short Circuit Duration A, B.....Continuous

ESD Rating..... See Specification Table

Recommended Operating Conditions Note 2

Supply Voltage.....3V~5.5V

Temperature Range.....-40°C to +125°C

Bus Pin Common Mode Voltage Range ..... -7V to +12V

Thermal Resistance, Θ_{JA} (Typical) 8-Pin SOP Package .....158°C/W

8-Pin MSOP Package ..... 210°C/W

Maximum Junction Temperature (Plastic Package) .....+150°C

Maximum Storage Temperature Range ..... -65°C to +150°C

Electrical Characteristics

Test Conditions: V_{CC} = 5V, Ta = 25°C (unless otherwise noted)

PARAMETER		CONDITIONS		MIN	TYP	MAX	UNITS
$\|V_{OD}\|$	Driver differential-output voltage magnitude	R_L = 54 Ω V_{CC} = 5V	See Figure 1A	2.3	2.5		V
		R_L = 54 Ω with V_A or V_B from –7 to +12 V, V_{CC} = 5V (RS-485)		2.2	2.4		
		R_L = 54 Ω with V_A or V_B from –7 to +12 V, V_{CC} = 3V (RS-485)		1.2	1.5		
$\Delta\|V_{OD}\|$	Change in magnitude of driver differential-output voltage	R_L = 54 Ω, C_L=50 pF, V_{CC} = 5V	See Figure 1A	-0.2	-0.002	0.2	V
$V_{OC(SS)}$	Steady-stage common-mode output voltage	Center of two 27 Ω load resistors	See Figure 1A		V_{CC}/2		V
ΔV_{OC}	Change in differential driver common-mode output voltage				0.05		V
$V_{OC(PP)}$	Peak-to-peak driver common-mode output voltage				0.5		
C_{OD}	Differential output capacitance				8		pF
V_{IT+}	Positive-going receiver differential-input voltage threshold	V_A or V_B from –5 to +7 V			-50	-10	mV
V_{IT-}	Negative-going receiver differential-input voltage threshold	V_A or V_B from –5 to +7 V		-200	-130		mV
V_{HYS}	Receiver differential-input voltage threshold hysteresis ($V_{IT+} - V_{IT-}$)				75		mV
V_{IH}	Logic Input High Voltage	DI, DE, $\overline{RE}$		2			V
V_{IL}	Logic Input Low Voltage	DI, DE, $\overline{RE}$				0.8	V
V_{OH}	Receiver high-level output voltage	I_{OH}= -8 mA		4			V
V_{OL}	Receiver low-level output voltage	I_{OL}= 8 mA				0.4	V
I_I	Driver input, driver enable and receiver enable input current	DI, DE, $\overline{RE}$		-2		2	μA
I_{OZ}	Receiver high-impedance output current	V_O = 0 V or V_{CC}, /RE at V_{CC}		-2		2	μA
$\|I_{OS}\|$	Driver short-circuit output current	|IOS| with V_A or V_B from –7 to +12 V			120	300	mA
I_{IN}	Bus input current(driver disabled)	V_{CC} = 4.5 to 5.5 V or V_{CC} = 0 V, DE at 0 V	VI= 12 V			1	mA
			VI= -7 V	-0.8			
I_{CC}	Supply current(quiescent)	Driver and receiver enabled	DE = V_{CC}, /RE = GND, No LOAD		2.2	5	mA
		Driver enabled, receiver disabled	DE = V_{CC}, /RE = V_{CC}, No LOAD		1.5	3	
		Driver disabled, receiver enabled	DE = GND, /RE = GND, No LOAD		0.5	1	
		Driver and receiver disabled	DE = GND, /RE = V_{CC}, D= V_{cc} No LOAD		0.1	0.5	

Switching Characteristics: TPT75176B

PARAMETER		CONDITIONS		MIN	TYP	MAX	UNITS
DRIVER							
f_{MAX}	Maximum Data Rate	V_{OD} ≥ ±1.5V, R_L = 54Ω, C_L = 100pF (Figure 4)				10	Mbps
t_r, t_f	Driver differential-output rise and fall times	R_L = 54 Ω, C_L=50pF	See Figure 2		36		ns
t_{PHL}, t_{PLH}	Driver propagation delay				35	45	
$t_{SK(P)}$	Driver pulse skew, |t_{PHL} – t_{PLH}|				5	10	
t_{PHZ}, t_{PLZ}	Driver disable time		See Figure 3		70	90	ns
t_{PHZ}, t_{PLZ}	Driver enable time	Receiver enabled			70	90	ns
		Receiver disabled			90	120	
RECEIVER							
t_r, t_f	Receiver output rise and fall times	C_L=15 pF	See Figure 5		20		ns
t_{PHL}, t_{PLH}	Receiver propagation delay time				35	50	
$t_{SK(P)}$	Receiver pulse skew, |t_{PHL} – t_{PLH}|				10	15	
t_{PHZ}, t_{PLZ}	Receiver disable time				45	60	ns
t_{PZL}, t_{PZH}	Receiver enable time	Driver enabled	See Figure 6		50	70	ns
		Driver disabled	See Figure 6		70	90	
ESD							
Human Body Model, per ANSI/ESDA/JEDEC JS-001 / ANSI/ESD STM5.5.1		RS-485 Pins (A, B)		±12			kV
		All Other Pins		±4			kV
CDM, per ANSI/ESDA/JEDEC JS-002		RS-485		±1.5			kV

Test Circuits and Waveforms

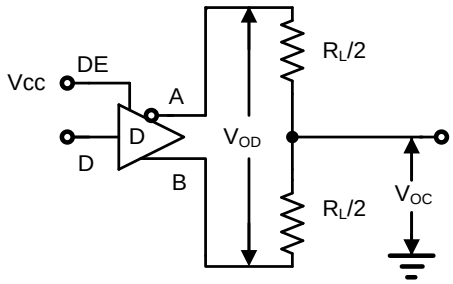


Figure 1A. VOD and VOC

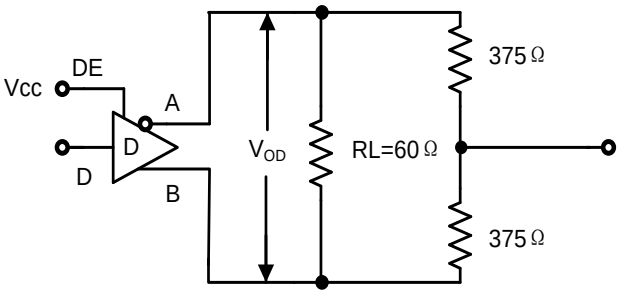


Figure 1B. VOD with Common Mode Load

Figure 1. DC Driver Test Circuits

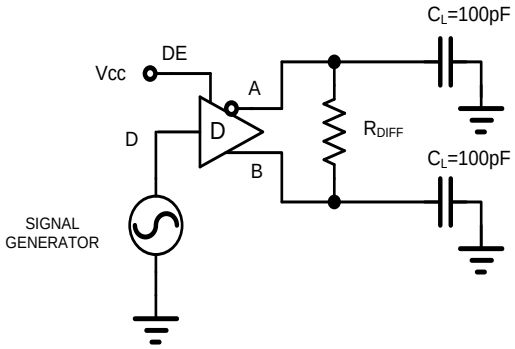


Figure 2A. Test Circuit

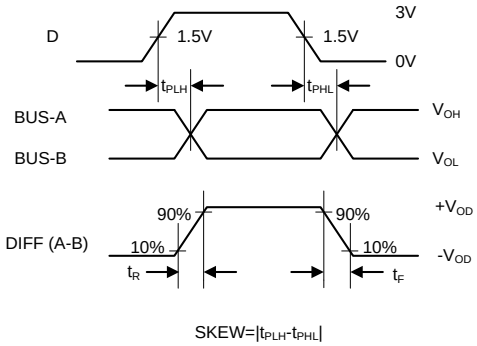
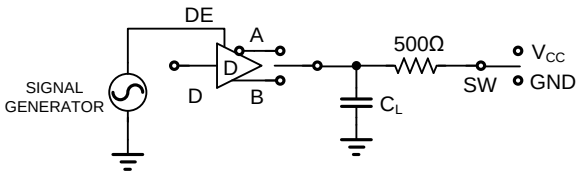


Figure 2B. Measurement Points

Figure 2. Driver Propagation Delay and Differential Transition Times



PARAMETER	OUTPUT	RE	DI	SW	CL (pF)
tPHZ	A/B	X	1/0	GND	15
tPLZ	A/B	X	0/1	VCC	15
tPZH	A/B	0	1/0	GND	100
tPZL	A/B	0	0/1	VCC	100
tPZH(SHDN)	A/B	1	1/0	GND	100
tPZL(SHDN)	A/B	1	0/1	VCC	100

Figure 3A. Test Circuit

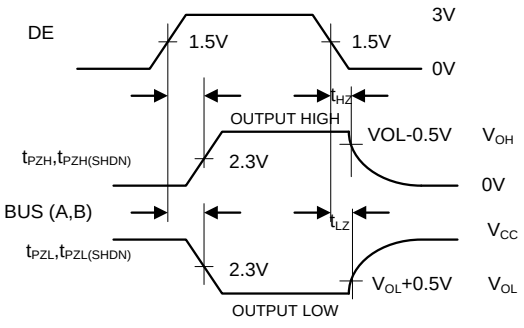


Figure 3B. Measurement Points

Figure 3. Driver Enable and Disable Times

Test Circuits and Waveforms (continue)

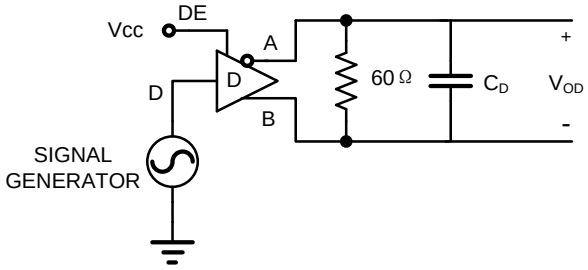


Figure 4A. Test Circuit

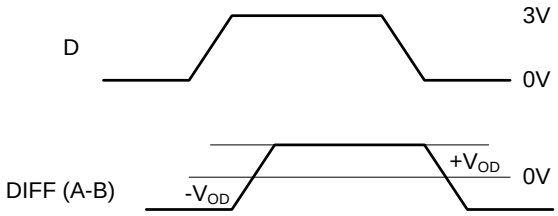


Figure 4B. Measurement Points

Figure 4. Driver Data rate

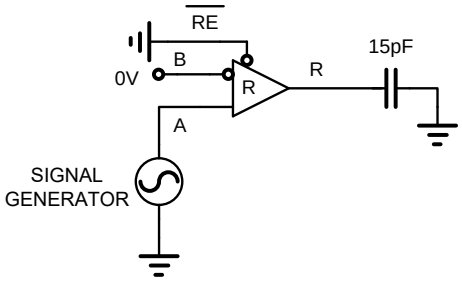


Figure 5A. Test Circuit

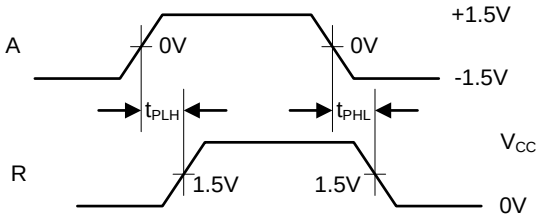
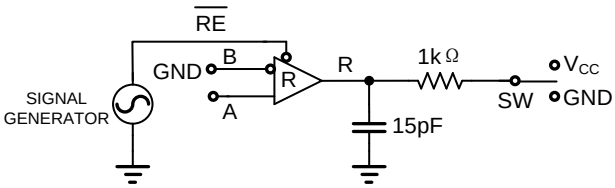


Figure 5B. Measurement Points

Figure 5. Receiver Propagation Delay and Data rate



PARAMETER	DE	A	SW
tPHZ	1	+1.5V	GND
tPLZ	1	-1.5V	VCC
tPZH	1	+1.5V	GND
tPZL	1	-1.5V	VCC
tPZH(SHDN)	0	+1.5V	GND
tPZL(SHDN)	0	-1.5V	VCC

Figure 6A. Test Circuit

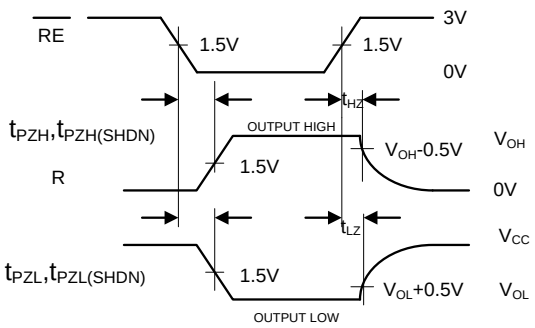
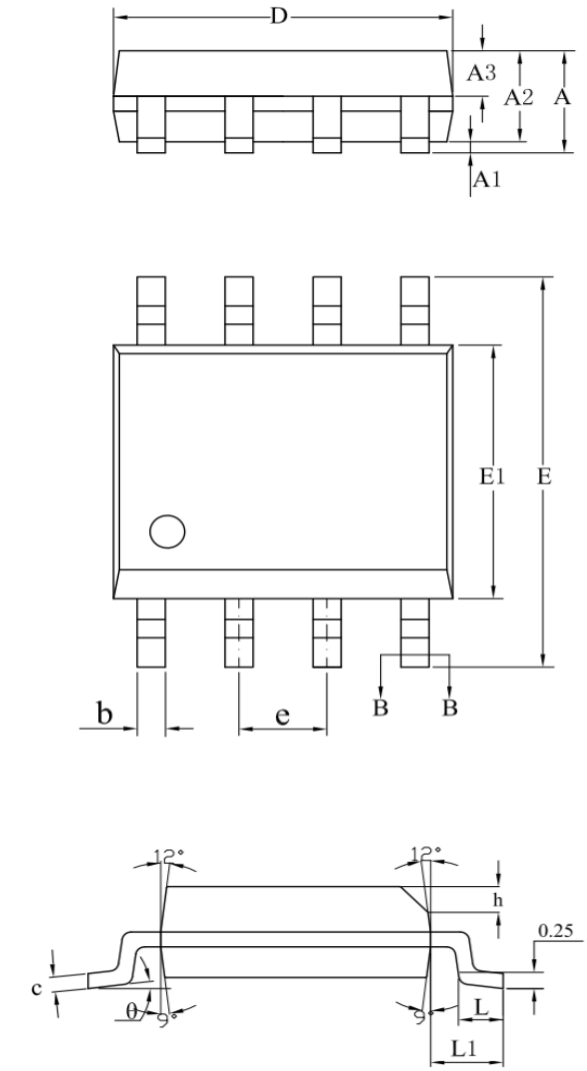


Figure 6B. Measurement Points

Figure 6. Receiver Enable and Disable Times

Package Outline Dimensions

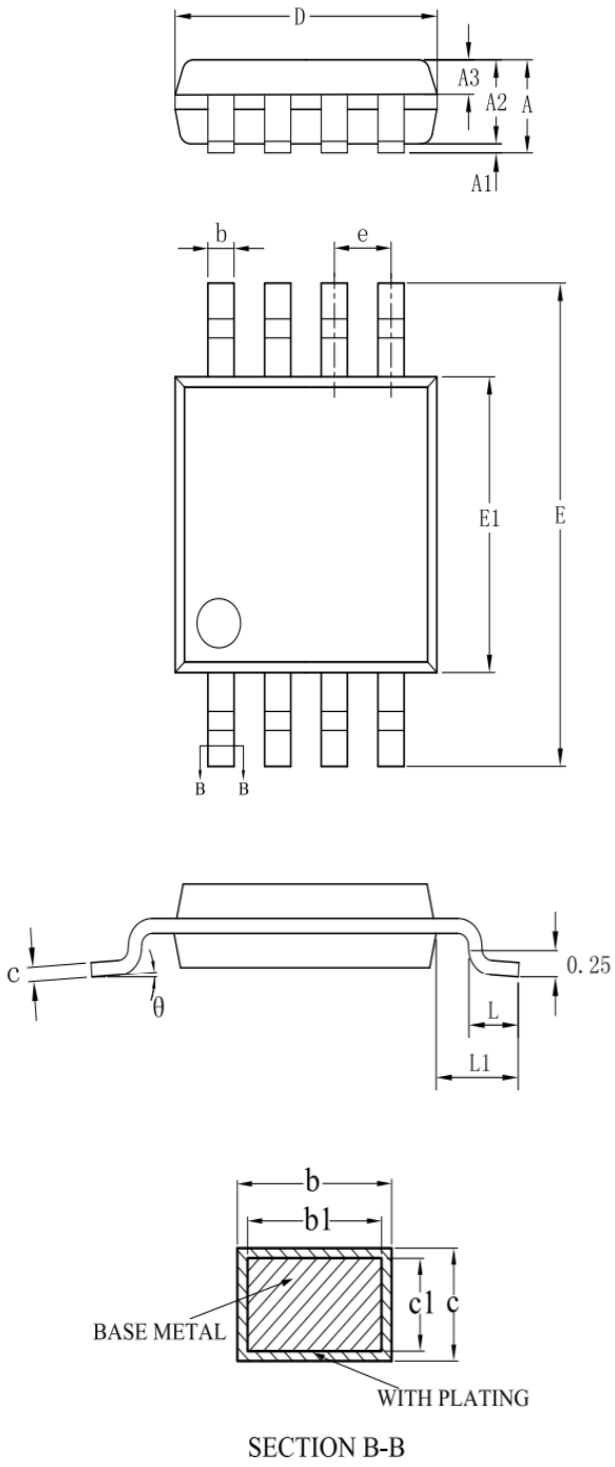
SO1R (SOP8)



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

Package Outline Dimensions

VS1R (MSOP8)

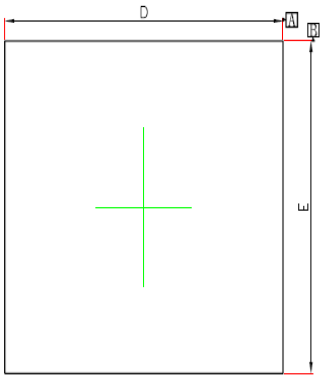


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.28	—	0.36
b1	0.27	0.30	0.33
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.65BSC		
L	0.40	—	0.70
L1	0.95REF		
θ	0	—	8°

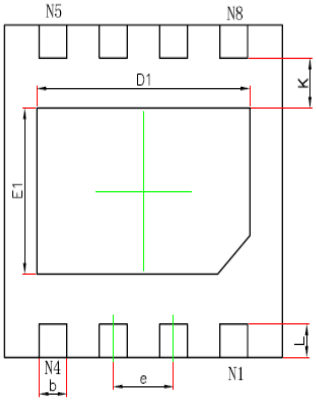
Package Outline Dimensions

DF6R (DFN3X3-8L)

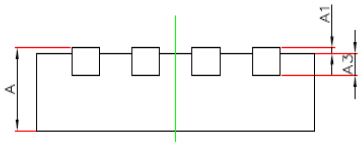
DFNWB3×3-8L-F(P0.65T0.75/0.85) PACKAGE OUTLINE DIMENSIONS



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	NOM.	Min.	NOM.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	3.000BSC.		0.118BSC.	
E	3.000BSC.		0.118BSC.	
D1	2.200	2.400	0.087	0.094
E1	1.400	1.600	0.055	0.063
k	0.250MIN.		0.010MIN.	
b	0.250	0.350	0.010	0.014
e	0.650TYP.		0.026TYP.	
L	0.224	0.376	0.009	0.015

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