Features

- Exceeds Requirements of EIA-485 Standard
- Hot Plug Circuitry - Tx and Rx Outputs Remain Three-State During Power-up/Power-down
- Data Rate: 500 Kbps
- Up to 256 Nodes on a Bus (1/8 unit load) at 500kbps
- Full Fail-safe Receiver (Open, Short, Terminated)
- Wide Supply Voltage 3V to 5.5V
- Bus-Pin Protection:
  - ±18 kV HBM ESD
  - ±15 kV IEC61000-4-2 Contact Discharge
  - ±18 kV IEC61000-4-2 Air Discharge
- –40°C to 125°C Operation Temperature Range

Description

The TPT487 are IEC61000 ESD protected, 3.0V to 5.5V powered transceivers that meet the RS-485 and RS-422 standards for balanced communication.

Transmitters in this family deliver exceptional differential output voltages into the RS-485 required 54Ω load. These 500kbps devices have very low bus currents so they present a true “1/8 unit load” to the RS-485 bus. This allows up to 256 transceivers on the network without using repeaters. Receiver (Rx) inputs feature a “Full Fail-Safe” design, which ensures a logic high Rx output if Rx inputs are floating, shorted, or on a terminated but undriven bus.

TPT487 is designed for half-duplex RS485, and support SOP8，MSOP8 and DFN3X3-8L package, which is characterized from –40°C to 125°C.

Applications

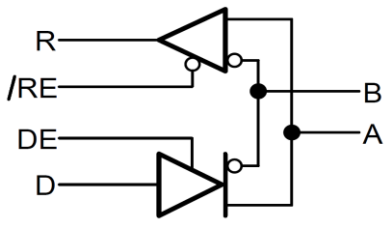
- Motor Drives
- Industrial Control
- Communication Infrastructure

Device Table

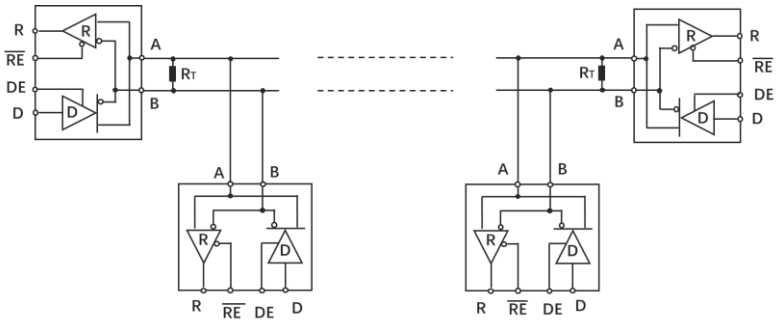
Part	Duplex	Enable	Data Rate	Nodes
TPT487	Half	Yes	500Kbps	256

Simplified Schematic

TPT487 Block Diagram



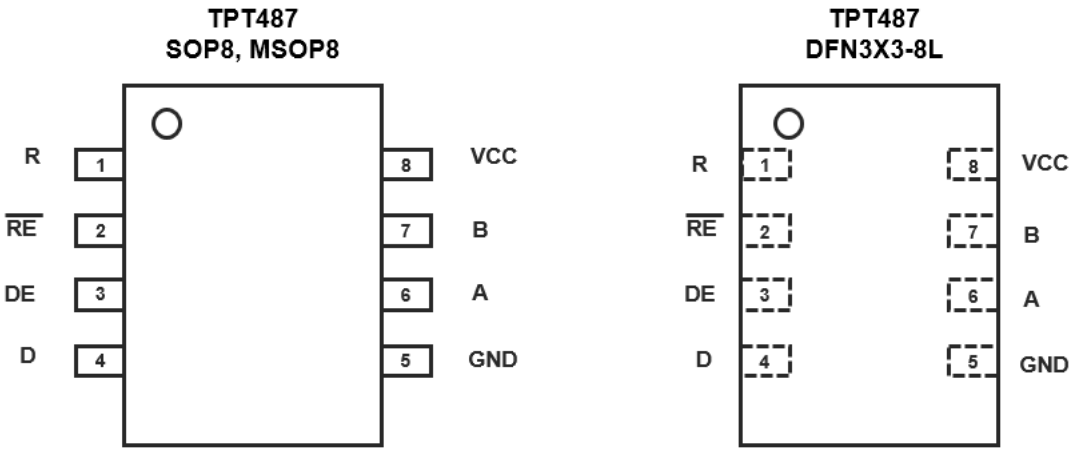
TPT487 Network



Revision History

Date	Revision	Notes
2019/1/14	Rev. Pre 0.1	Definition Version 0
2019/6/15	Rev. Pre 0.2	Update package information
2019/9/17	Rev. 0	Release version
2020/3/20	Rev. A	Update absolute rating

Pin Configuration and Functions



Pin No.	Pin Name	I/O	Description
1	R	Digital output	Receiver Output.
2	/RE	Digital input	Receiver Output Enable.
3	DE	Digital input	Driver Output Enable.
4	D	Digital input	Driver Input.
5	GND	Ground	Ground.
6	A	Bus input/output	Noninverting Receiver Input A and Noninverting Driver Output A.
7	B	Bus input/output	Inverting Receiver Input B and Inverted Driver Output B.
8	V_{CC}	Power	Power Supply.

Order Information

Model Name	Order Number	Package	MSL Level	Transport Media, Quantity	Marking Information
TPT487	TPT487L1-SO1R	8-Pin SOP	MSL1	Tape and Reel 4,000	T487
TPT487	TPT487-VS1R	8-Pin MSOP	MSL3	Tape and Reel 3,000	T487
TPT487	TPT487L1-DF6R	8-Pin DFN3X3	MSL1	Tape and Reel 4,000	T487

Functional Table

Driver Function Table

Input	Enable	Outputs	Outputs	Description
D	DE	A	B	
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 by default

Receiver Function Table

Input	Input	Output	Description
A-B	/RE	R	
>-50mV	L	H	Receive valid bus High
-200mV<Input<-50mV	L	?	Indeterminate bus state
<-200mV	L	L	Receive valid bus Low
X	H	Z	Receiver disabled
X	Open	Z	Receiver disabled in default
Open	L	H	Fail-safe high output
Short	L	H	Fail-safe high output
Idle(Terminated)	L	H	Fail-safe high output

X = don't care, Z = high impedance

Absolute Maximum Ratings

Parameters	Rating
V_{CC} to GND	-0.3V to +7V
Voltage at Logic pin: DI, DE, /RE, RO[Note 2]	-0.3V to V_{CC} + 0.3V
Voltage at Bus pin: A, B as receiver and idle	-15V to +15V
Voltage at Bus pin: A, B as driver	-8V to +13V
Operating Temperature Range	-40°C to 125°C
Storage Temperature Range	-65°C to 150°C
Maximum Junction Temperature	150°C
Lead Temperature (Soldering, 10 sec)	260°C

(1) Stresses beyond the *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*.

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	3.0		5.5	V
V_I	Input voltage at any bus terminal(1)	-7		12	V
V_{IH}	High-level input voltage (driver, driver enable, and receiver enable inputs)	2		V_{CC}	V
V_{IL}	Low-level input voltage (driver, driver enable, and receiver enable inputs)	0		0.8	V
V_{ID}	Differential input voltage	-7		12	V
R_L	Differential load resistance	54			Ω
T_A	Operating ambient temperature	-40		125	°C
T_J	Junction temperature	-40		150	°C

(1) The algebraic convention, in which the least positive (most negative) limit is designated as minimum is used in this data sheet.

ESD Rating

		Value	Unit
IEC-61000-4-2, Contact Discharge	Bus Pin	15	kV
IEC-61000-4-2, Air-Gap Discharge	Bus Pin	18	kV
HBM, per ANSI/ESDA/JEDEC JS-001 / ANSI/ESD STM5.5.1	Bus Pin	18	kV
	All Pin Except Bus Pin	4	kV
CDM, per ANSI/ESDA/JEDEC JS-002	All Pin	1.5	kV

Electrical Characteristics

Test Conditions: VCC = 5V, Over operating free-air temperature range (unless otherwise noted)

Parameter		Conditions		Min	Typ	Max	Units
Driver							
$\|V_{OD}\|$	Driver differential-output voltage magnitude , VCC=3.3V	RL = 60 Ω, -7V ≤ Vtest ≤ +12V	See Figure 1B	1.5	2.3		V
		RL = 54 Ω (RS-485)	See Figure 1A	1.5	2.2		
		RL = 100 Ω		2.0	2.6		
	Driver differential-output voltage magnitude , VCC=5.0V	RL = 60 Ω, -7V ≤V test ≤ +12V	See Figure 1B	2.0	3.5		
		RL = 54 Ω (RS-485)	See Figure 1A	2.0	3.4		
		RL = 100 Ω (RS-485)		2.7	3.9		
$\Delta\|V_{OD}\|$	Change in magnitude of driver differential-output voltage	RL = 54 Ω, CL=50pF	See Figure 1A	-50		50	mV
		RL = 100 Ω, CL=50pF	See Figure 1A	-50		50	
$V_{OC(SS)}$	Steady-stage common-mode output voltage	Center of two 27-Ω load resistors	See Figure 1A	1	VCC/2	3	V
ΔV_{OC}	Change in differential driver common-mode output voltage			-65		65	mV
$V_{OC(PP)}$	Peak-to-peak driver common-mode output				600		
$\|I_{OS}\|$	Driver short-circuit output current	$\|I_{OS}\|$ with A shorted to B			86	110	mA
		$\|I_{OS}\|$ with -7V ~ +12V		-220		220	
Receiver							
V_{IT+}	Positive-going receiver differential-input voltage threshold				-100	-15	mV
V_{IT-}	Negative-going receiver differential-input voltage threshold			-240	-150		mV
V_{HYS}(1)	Receiver differential-input voltage threshold hysteresis ($V_{IT+} - V_{IT-}$)				60		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	I_{OH}= -8 mA		4.0	VCC-0.3		V
V_{OL}	Receiver low-level	I_{OL}= 8 mA			0.2	0.4	V
I_{in}	DE=0, VCC=0 or VCC=5.5V (A,B)	VI=12V			30	120	μA
		VI=-7V		-100	-50		μA
RA, RB	Bus input impedance	VA=-7V, VB=12V or VA=12V ,		96			kΩ
I_{OZ}	Receiver high-impedance output	VO = 0 V or VCC, /RE at VCC		-1		1	μA
I_{OSR}	Receiver output short to ground	REN=0, DE=VCC			78	95	mA
Logic							
Iin	Input current (RE, DE,	4.5V<VCC<5.5V		-5		5	uA

Parameter		Conditions		Min	Typ	Max	Units
Supply							
I_{CC}	Supply current(quiescent)	Driver and receiver enabled	DE = VCC, /RE = GND, No LOAD		650	750	μA
		Driver enabled, receiver disabled	DE = /RE = V_{CC}, No LOAD		450	600	
		Driver disabled, receiver enabled	DE = GND, /RE = V_{CC}, No LOAD		450	600	
		Driver and receiver disabled	DE = GND, /RE = D= V_{cc} , No LOAD		0.5	2	

Switching CHARACTERISTICS

Parameter		Conditions		Min	Typ	Max	Units
DRIVER							
t_r, t_f	Driver differential-output rise and fall times	RL = 54 Ω, CL=50pF	See Figure 2		300		ns
t_{PHL}, t_{PLH}	Driver propagation delay			230	280	410	
$t_{SK(P)}$	Driver pulse skew, $\|t_{PHL} - t_{PLH}\|$					20	
t_{PHZ}, t_{PLZ}	Driver disable time	/RE = 0, /RE = VCC	See Figure 3		50	90	ns
t_{PZH}, t_{PZL}	Driver enable time	/RE = 0			200	450	ns
		/RE = VCC			2750	3200	
RECEIVER							
t_r, t_f	Receiver rise and fall times				28		
t_{PHL}, t_{PLH}	Receiver propagation delay time	CL=15 pF	See Figure 5		100	150	ns
$t_{SK(P)}$	Receiver pulse skew, $\|t_{PHL} - t_{PLH}\|$					25	
t_{PHZ}, t_{PLZ}	Driver disable time	/RE = 0, /RE = VCC	See Figure 6		20	65	ns
t_{PZL}	Receiver enable time	DE = VCC	See Figure 6		20	50	ns
t_{PZH}	Receiver enable time	DE = VCC	See Figure 6		127	200	ns
t_{PZL}, t_{PZH}	Receiver enable time	DE = 0	See Figure 6		2600	3200	ns

Test Circuits and Waveforms

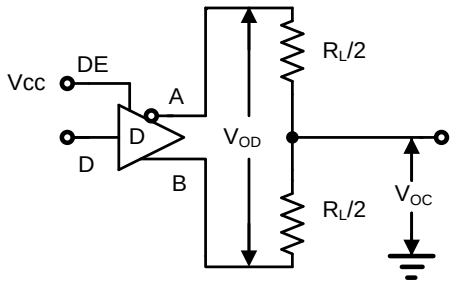


Figure 1A. V_{OD} and V_{OC}

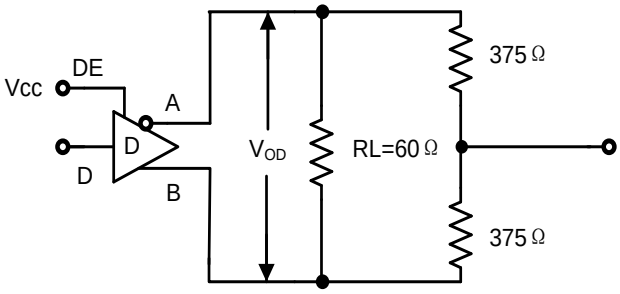


Figure 1B. V_{OD} with Common Mode Load

FIGURE 1. DC Driver Test Circuits

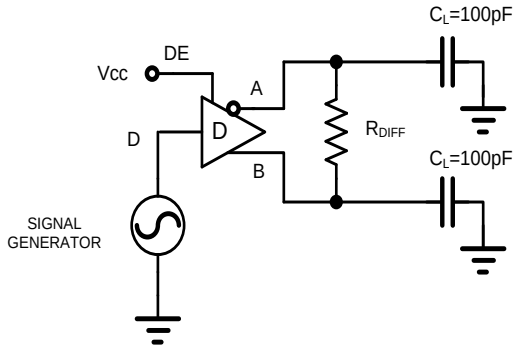


Figure 2A. Test Circuit

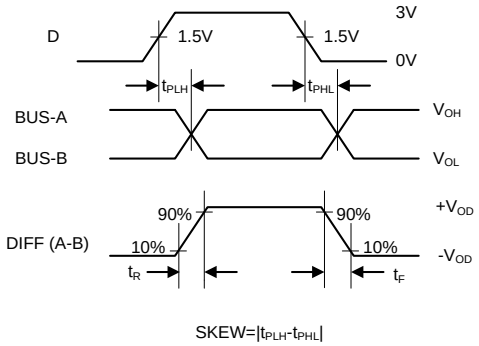
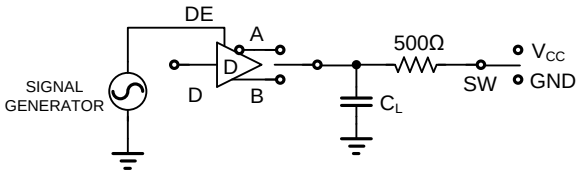


Figure 2B. Measurement Points

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

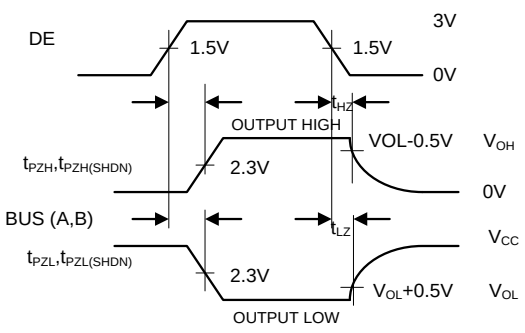


Figure 3B. Measurement Points

Figure 3. Driver Enable and Disable Times

Test Circuits and Waveforms (continue)

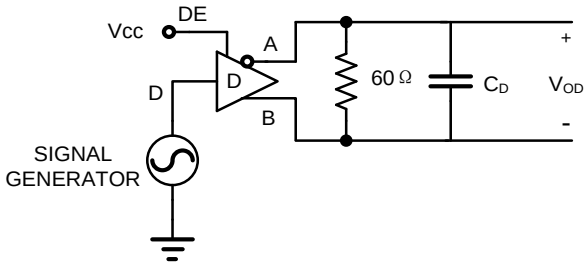


Figure 4A. Test Circuit

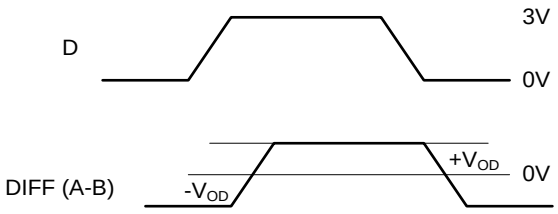


Figure 4B. Measurement Points

Figure 4. Driver Data rate

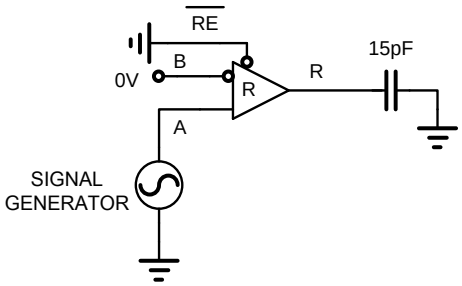


Figure 5A. Test Circuit

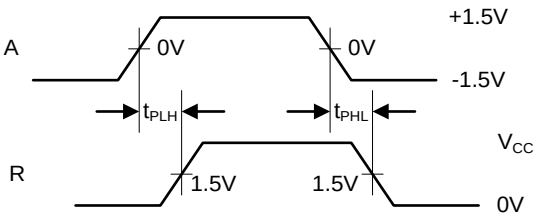
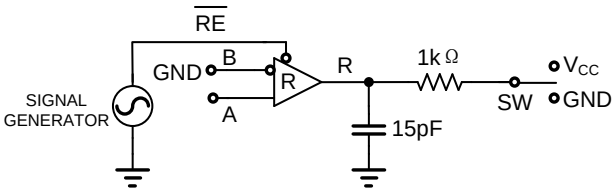


Figure 5B. Measurement Points

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

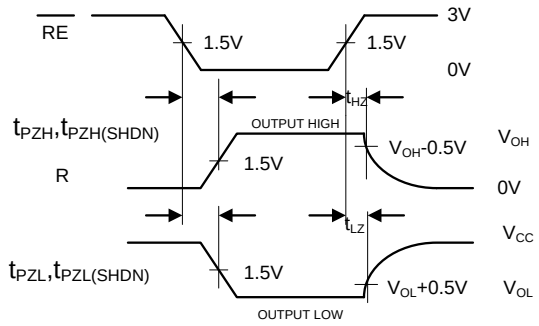
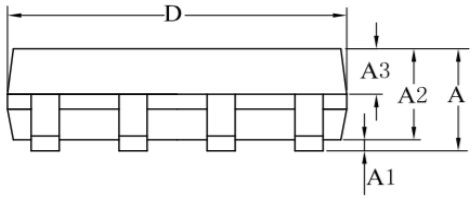


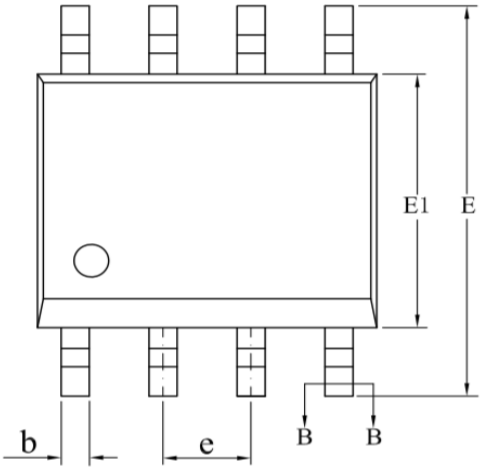
Figure 6B. Measurement Points

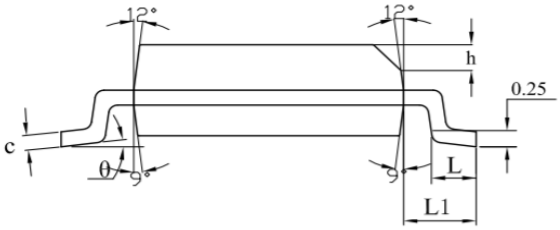
Figure 6. Receiver Enable and Disable Times

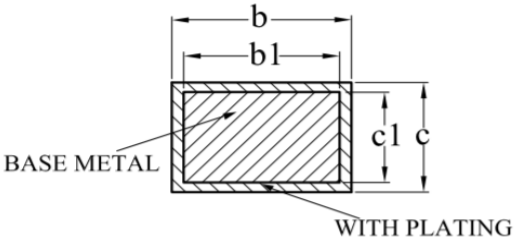
Package Outline Dimensions

SO1R (SOP8)







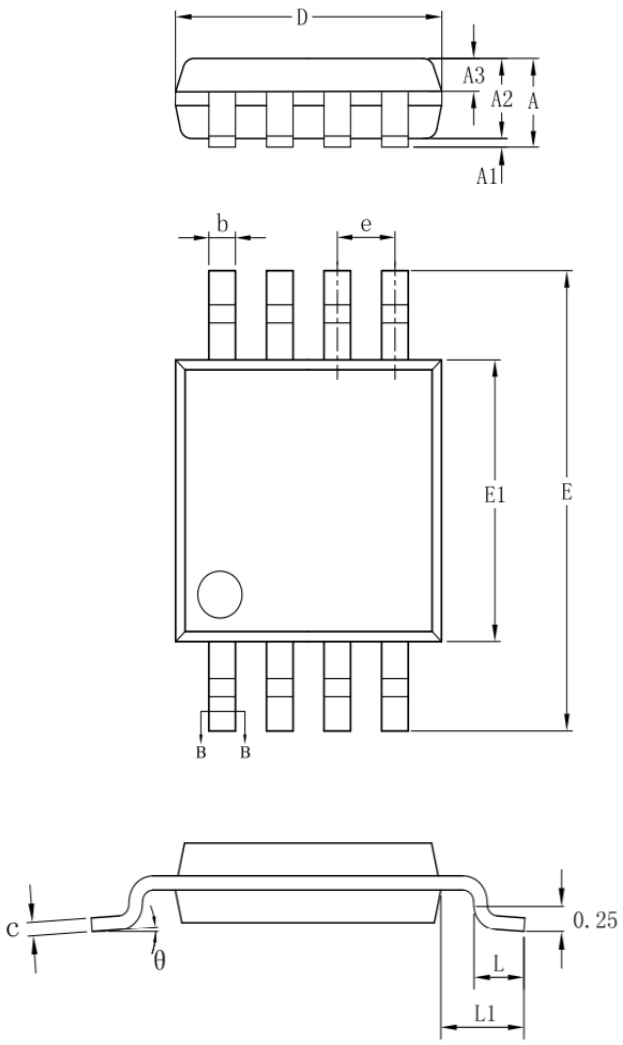


SECTION B-B

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)



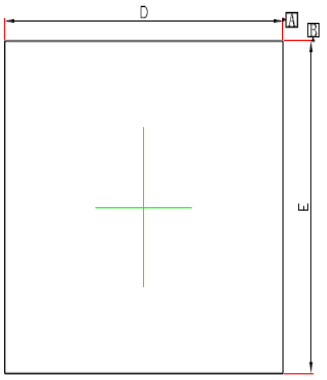
SECTION B-B

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°

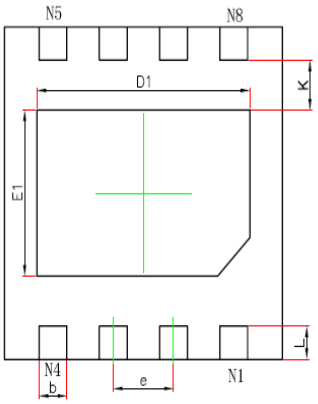
Package Outline Dimensions

DF6R (DFN3X3-8L)

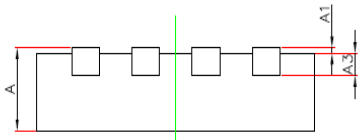
DFNWB3×3-8L-F(P0.65T0.75/0.85) PACKAGE OUTLINE DIMENSIONS



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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