

Features

- Supply Voltage: 3.3 V to 5.25 V
- High Gain Bandwidth Product: 4 GHz
- High Slew Rate: 1000 V/μs
- Low input voltage Noise: 1.25 nV /√Hz
- Offset Voltage: ±1.8 mV Maximum at 25 °C
- Stable when Gain > 7 V/V
- Quiescent Current: 9.8 mA
- Overload Recovery: 4.8 ns
- Package: DFN2X2-8
- –40°C to 125°C Operation Temperature Range
- AEC-Q100 Qualified for Automotive Applications, Grade 1: –40C to +125°C Ta

Applications

- Automotive Lidar
- Lab Equipment
- Automated Test Equipment
- OTDR
- Laser Distance Meter

Description

TPH2865Q is a high-speed, low noise operational amplifier with high-speed BJT inputs, suitable for high-speed applications.

The TPH2865Q has a gain-bandwidth product of 4 GHz, a slew rate of 1000 V/μs and only 4.8 ns is need for overload recovery, making it suitable for high-speed pulse applications.

The feedback pin (FB) of TPH2865Q decreases the distance of the feedback network connection between the input and output on the PCB, which benefits the achievement of high closed-loop bandwidth.

The DFN2X2-8 package with a wettable flank is provided for TPH2865Q, making the solder yield easy to check during the SMT.

Typical Application Circuit

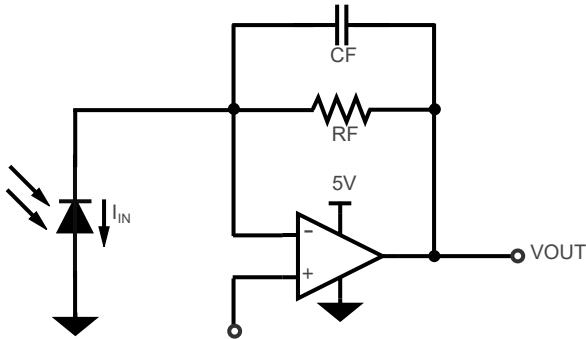


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Revision History

Date	Revision	Notes
2024-05-22	Rev.A.0	Initial version.
2024-07-05	Rev.A.1	<p>The following updates are all about the typo, the actual product remains unchanged.</p> <p>In Absolute Maximum Ratings:</p> <p>Changed the value of Differential Input Voltage from min: $(-V_S) - (+V_S)$, max: $(+V_S) - (-V_S)$ to min: , max: 1.</p> <p>Changed the value of Input Current: $+IN, -IN$ from min: -1 , max: +1 to min: -10 , max: +10.</p> <p>Changed the value of Output Short-Circuit Duration from min: , max: Infinite to min: -100 , max: +100.</p>

Pin Configuration and Functions

TPH2865Q
DFN2X2-8 Package
Top View

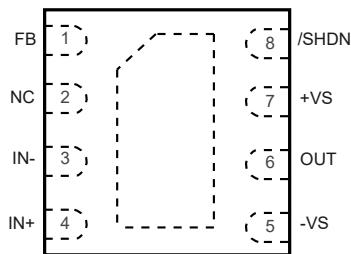


Table 1. Pin Functions: TPH2865Q

Pin No.	Name	I/O	Description
1	FB	Input	Feedback connection to the output of amplifier
2	NC		No connection
3	IN-	Input	Inverting input
4	IN+	Input	Noninverting input
5	-VS		Negative power supply
6	OUT	Output	Output
7	+VS		Positive power supply
8	/SHDN	Input	Shut down input, the device is shut down when the low-level input voltage is on the input; the device is active when the high-level input voltage is on the input. The device is active by default with an internal pull-up resistor.
Thermal pad			Connect the thermal pad to -VS

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, (+Vs) – (–Vs)		5.5	V
	Input Voltage	(–Vs) – 0.3	(+Vs) + 0.3	V
	Differential Input Voltage		1	V
	Input Current: +IN, –IN (2)	–10	+10	mA
	Output Short-Circuit Duration (3)	–100	+100	mA
T _J	Maximum Junction Temperature		150	°C
T _A	Operating Temperature Range	–40	125	°C
T _{STG}	Storage Temperature Range	–65	150	°C
T _L	Lead Temperature (Soldering 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

(2) The inputs are protected by ESD protection diodes to the power supply. If the input extends more than 300 mV beyond the power supply, the input current should be limited to less than 10 mA.

(3) A heat sink may be required to keep the junction temperature below the absolute maximum rating. This depends on the power dissipation of the application. Thermal resistance varies with the amount of PC board metal connected to the package.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Level	Unit
HBM	Human Body Model ESD	AEC-Q100-002	2	kV
CDM	Charged Device Model ESD	AEC-Q100-011	1.5	kV

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
V _s	Supply Voltage, (+Vs) – (–Vs)	3.3 (±1.65)		5.25 (±2.625)	V
T _A	Operating Temperature Range	–40		125	°C

Thermal Information

Package Type	θ _{JA}	θ _{JC(TOP)}	Unit
DFN2X2-8	72	114	°C/W

5-V, G=7 Stable, 4-GHz, High-speed Op Amp
Electrical Characteristics

All test conditions: $V_S = 5$ V, $V_{CM} = 2.5$ V, $T_A = 25^\circ\text{C}$, $G = 7\text{V/V}$, input common-mode biased at mid-supply, unless otherwise noted.

Parameter	Conditions	Min	Typ	Max	Unit	
Power Supply						
V_S	Supply Voltage Range	3.3		5.25	V	
I_Q	Quiescent Current per Amplifier		9.8	11	mA	
		$T_A = -40^\circ\text{C}$ to 125°C		13	mA	
$PSRR_+$	Positive Power-supply Rejection Ratio	80	87		dB	
		$T_A = -40^\circ\text{C}$ to 125°C	72		dB	
$PSRR_-$	Negative Power-supply Rejection Ratio	64	69		dB	
		$T_A = -40^\circ\text{C}$ to 125°C	60		dB	
Input Characteristics						
V_{OS}	Input Offset Voltage		-1.8	0.2	1.8	mV
		$T_A = -40^\circ\text{C}$ to 125°C	-3		3	mV
$V_{OS\text{TC}}$	Input Offset Voltage Drift	$T_A = -40^\circ\text{C}$ to 125°C		2		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current		-18	-11	-2	μA
I_{OS}	Input Offset Current		-4	1	4	μA
C_{IN}	Input Capacitance	Differential Mode		0.5		pF
		Common Mode		0.6		pF
R_{IN}	Input Resistance	Differential Mode		4		k Ω
		Common Mode		0.3		M Ω
Av	Open-Loop Voltage Gain		64	68		dB
V_{IH}	Common-mode input range (high)		4.4	4.6		V
		$T_A = -40^\circ\text{C}$ to 125°C		4.3		V
V_{IL}	Common-mode input range (Low)			1.1	1.3	V
		$T_A = -40^\circ\text{C}$ to 125°C		1.3		V
$CMRR$	Common Mode Rejection Ratio	$V_{CM} = \pm 0.5$ V referred to midsupply	75	110		dB

5-V, G=7 Stable, 4-GHz, High-speed Op Amp
Electrical Characteristics (continued)

All test conditions: $V_S = 5$ V, $T_A = 25^\circ\text{C}$, $R_L = 10$ k Ω , unless otherwise noted.

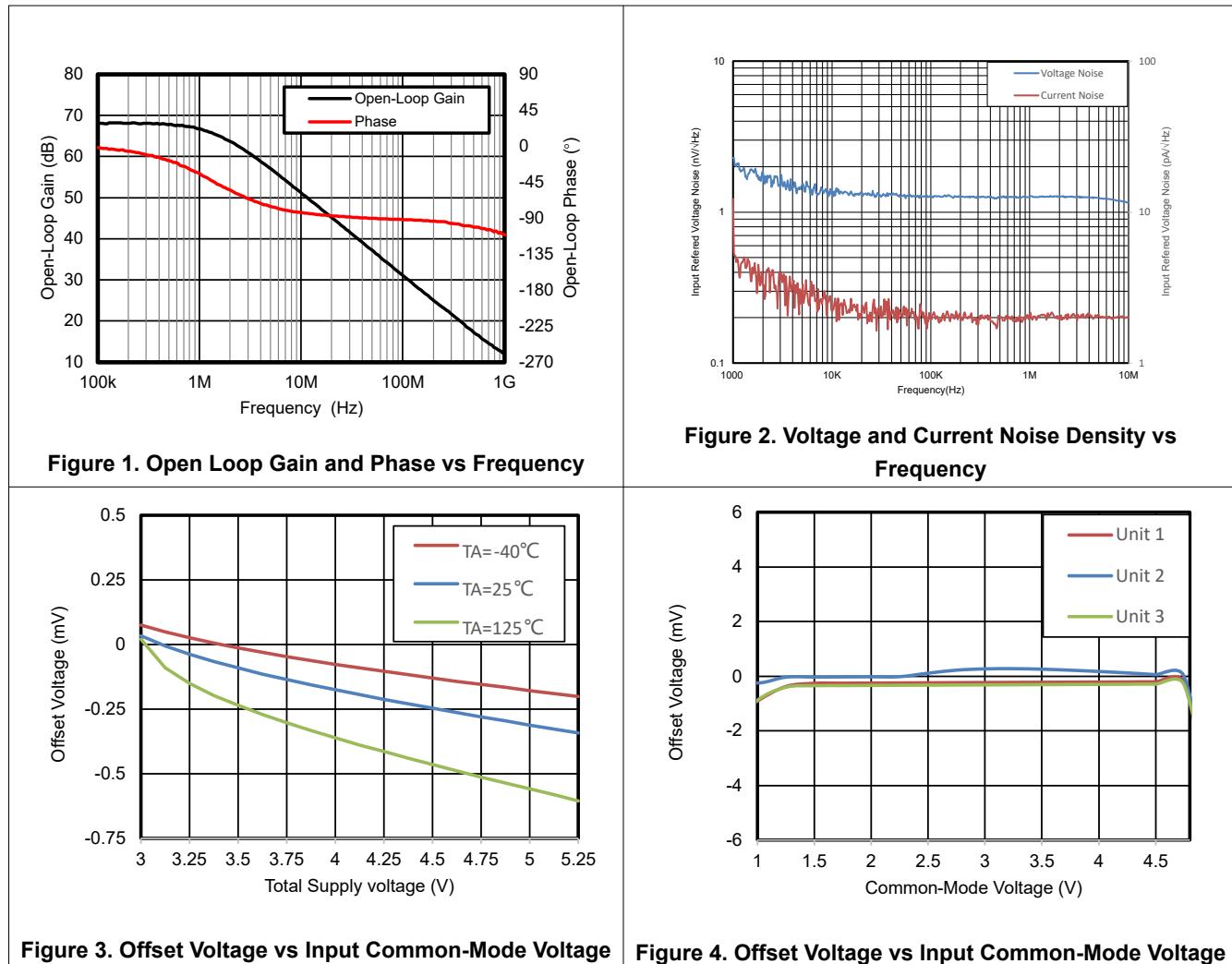
Parameter	Conditions	Min	Typ	Max	Unit
Output Characteristics					
Output Voltage Swing from Positive Rail	$I_{\text{OUT}} = 10$ mA		0.9	1.1	V
	$I_{\text{OUT}} = 10$ mA, $T_A = -40^\circ\text{C}$ to 125°C			1.2	V
	$V_S = 3.3$ V, $I_{\text{OUT}} = 10$ mA		0.9	1.1	V
	$V_S = 3.3$ V, $I_{\text{OUT}} = 10$ mA, $T_A = -40^\circ\text{C}$ to 125°C			1.2	V
Output Voltage Swing from Negative Rail	$I_{\text{OUT}} = 10$ mA		1.05	1.15	V
	$I_{\text{OUT}} = 10$ mA, $T_A = -40^\circ\text{C}$ to 125°C			1.2	V
	$V_S = 3.3$ V, $I_{\text{OUT}} = 10$ mA		1.05	1.15	V
	$V_S = 3.3$ V, $I_{\text{OUT}} = 10$ mA, $T_A = -40^\circ\text{C}$ to 125°C			1.2	V
I _{SC}	Output Short-Circuit Current	$V_S = 5$ V, Source	27	50	mA
		$V_S = 5$ V, Sink	40	94	mA
AC Specifications					
SSBW	Small-signal Bandwidth	$V_{\text{OUT}} = 100$ mV _{PP}		1.15	GHz
LSBW	Large-signal Bandwidth	$V_{\text{OUT}} = 2$ V _{PP}		433	MHz
GBW	Gain-Bandwidth Product			4	GHz
SR	Slew Rate	$V_{\text{OUT}} = 3$ V step		1000	V/ μ s
t _{OR}	Overload Recovery	2x output overdrive		4.8	ns
t _S	Settling Time, 0.1%			4.6	ns
	Settling Time, 0.001%			2600	ns
Noise Performance					
e _N	Input Voltage Noise Density	$f = 1$ MHz, $V_{\text{CM}} = 1$ V		1.28	nV/ $\sqrt{\text{Hz}}$
i _N	Input Current Noise	$f = 1$ MHz		2.5	pA/ $\sqrt{\text{Hz}}$
HD2	Second-order Harmonic Distortion	$f = 10$ MHz, $V_{\text{OUT}} = 2$ V _{PP}		83	dBc
		$f = 100$ MHz, $V_{\text{OUT}} = 2$ V _{PP}		55	dBc
HD3	Third-order Harmonic Distortion	$f = 10$ MHz, $V_{\text{OUT}} = 2$ V _{PP}		86	dBc
		$f = 100$ MHz, $V_{\text{OUT}} = 2$ V _{PP}		72	dBc
PD Performance					
	Disable Voltage Threshold	Amplifier OFF below this voltage	0.8	0.9	V
		Amplifier OFF below this voltage, $T_A = -40^\circ\text{C}$ to 125°C	0.7		V
	Enable Voltage Threshold	Amplifier ON above this voltage		1.1	V

5-V, G=7 Stable, 4-GHz, High-speed Op Amp

Parameter		Conditions	Min	Typ	Max	Unit
		Amplifier ON above this voltage, $T_A = -40^\circ\text{C}$ to 125°C			1.3	V
	Power-down Quiescent Current			224	255	μA
	Input PD bias Current			67	77	μA
		$T_A = -40^\circ\text{C}$ to 125°C			82	μA
	Turn-on Time Delay	Time to $V_{\text{OUT}} = 90\%$ of final value		17		ns
	Turn-off Time Delay			86		ns

Typical Performance Characteristics

All test conditions: $T_A = 25^\circ\text{C}$, $V_{S+} = 2.5\text{ V}$, $V_{S-} = -2.5\text{ V}$, $V_{IN+} = 0\text{ V}$, $R_F = 453\text{ }\Omega$, Gain = 7 V/V, $R_L = 200\text{ }\Omega$, and output load referenced to midsupply, unless otherwise noted.



Detailed Description

Overview

The TPH2865Q is a BJT, high-speed, voltage-feedback operational amplifier designed for high-speed pulse, high-speed data acquisition systems and other applications. It is available as a single op amp. The amplifier features a 4-GHz gain bandwidth, 1000-V/μs slew rate and broad voltage noise of 1.28 nV /√Hz, but it is not unity-gain stable and can be stable when the gain is larger than 7 V/V. The TPH2865Q power-supply range of +3.3 V to +5.25 V (± 1.65 V to ± 2.625 V).

Functional Block Diagram

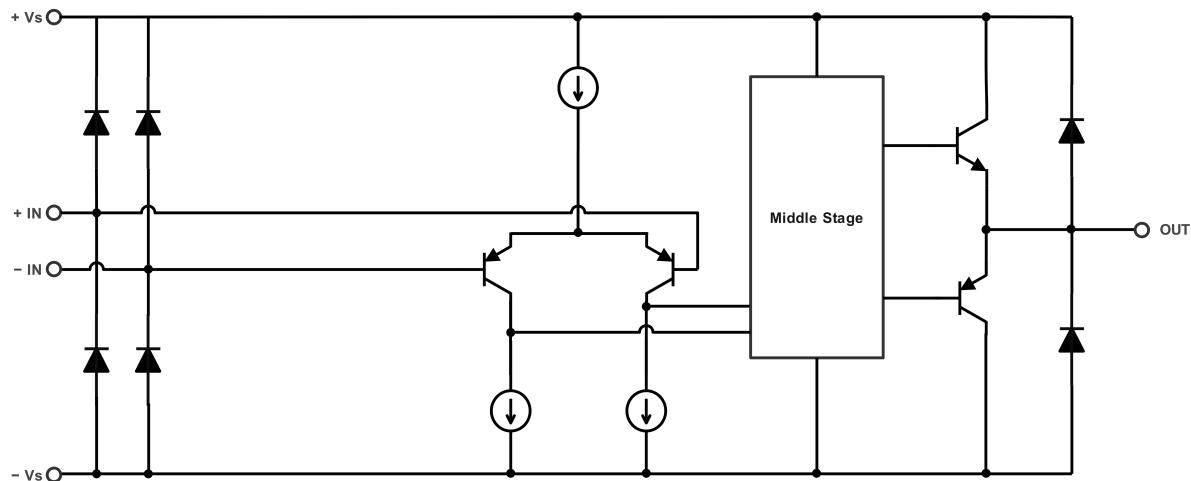


Figure 5. Functional Block Diagram

Feature Description

Operating Voltage

The TPH2865Q is designed for single supply operation from 3.3 V to 5.25 V or dual supply operation from ± 1.65 V to ± 2.625 V.

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

Transimpedance Amplifier Application

Figure 6 shows the device is configured in a transimpedance amplifier application. In the circuit shown in the following figure, the current source (shown as a photodiode) is connected between ground and the inverting input of the op-amp, the other input of the op-amp is connected to 2.5 V. The current of the photodiode is equal to the feedback current through RF due to the high gain of the op-amp. The DC gain of a transimpedance amplifier is determined by the equation shown in Figure 6. The CF is used to maintain the stability of the whole circuit.

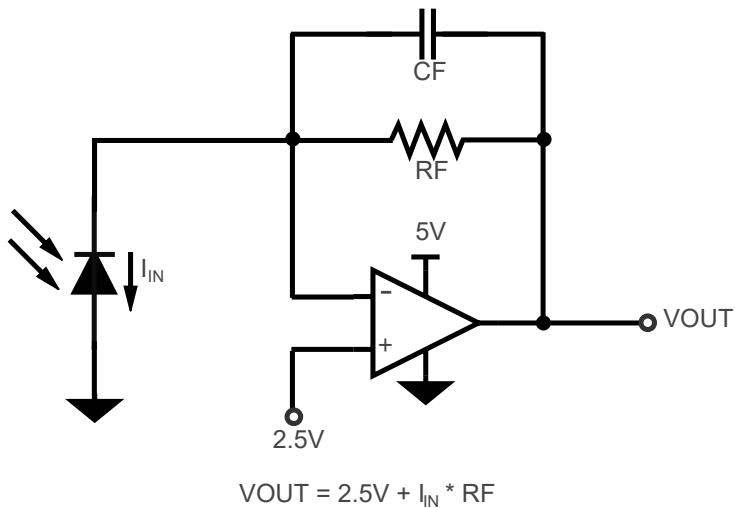
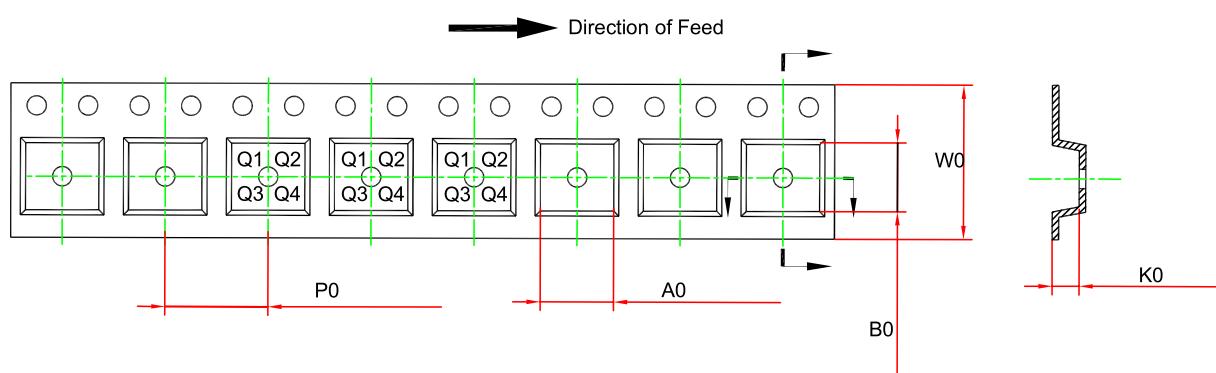
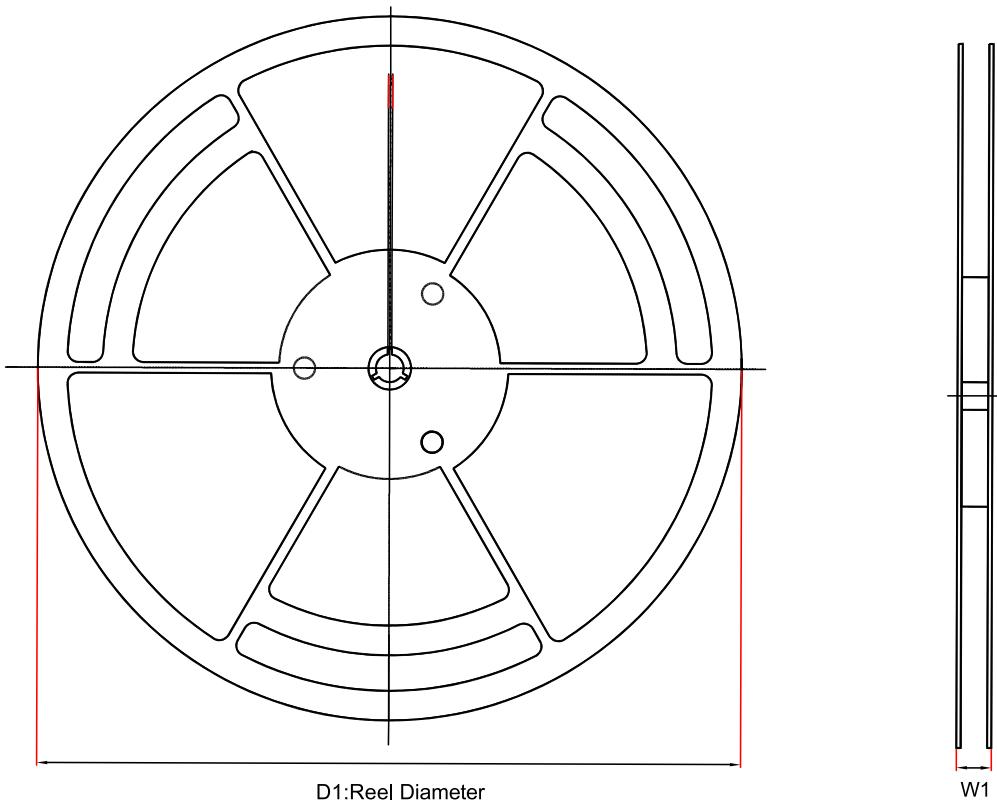


Figure 6. TIA(transimpedance amplifier) Application

Power Supply Recommendations

Place 0.1- μ F bypass capacitors close to the power supply pins to reduce coupling errors from the noisy or high-impedance power supplies.

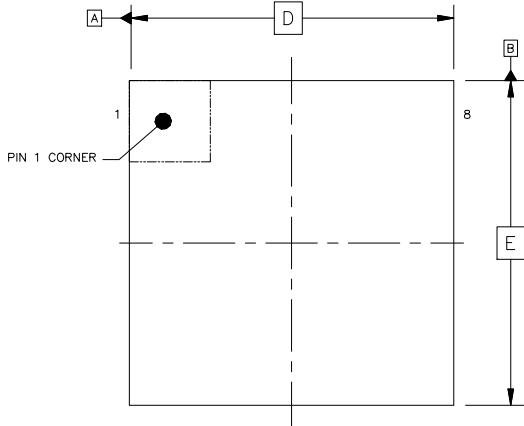
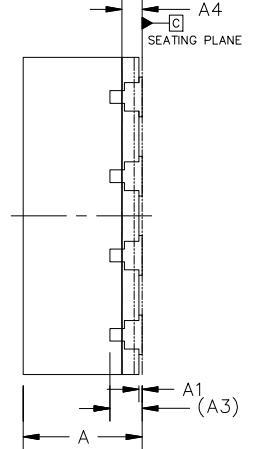
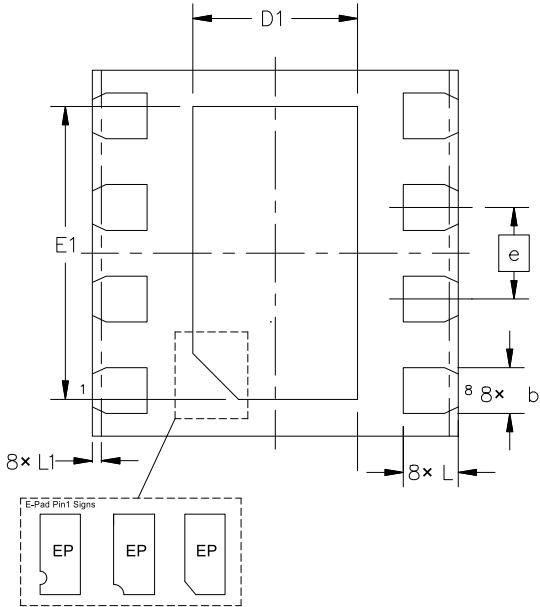
Tape and Reel Information



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPH2865Q-DFVR-S	DFN2X2-8	180	12.5	2.3	2.3	1.1	4	8	Q2

Package Outline Dimensions

DFN2X2-8-WET-H

Package Outline Dimensions		DFV(DFN2X2-8-WET-H)																																																																								
																																																																										
Top View		Side View																																																																								
		<table border="1"> <thead> <tr> <th rowspan="2">Symbol</th><th colspan="2">Dimensions In Millimeters</th><th colspan="2">Dimensions In Inches</th></tr> <tr> <th>MIN</th><th>MAX</th><th>MIN</th><th>MAX</th></tr> </thead> <tbody> <tr> <td>A</td><td>0.700</td><td>0.800</td><td>0.028</td><td>0.031</td></tr> <tr> <td>A1</td><td>0.000</td><td>0.050</td><td>0.000</td><td>0.002</td></tr> <tr> <td>A3</td><td colspan="2">0.203 REF</td><td colspan="2">0.008 REF</td></tr> <tr> <td>A4</td><td>0.080</td><td>0.180</td><td>0.003</td><td>0.007</td></tr> <tr> <td>b</td><td>0.200</td><td>0.300</td><td>0.008</td><td>0.012</td></tr> <tr> <td>D</td><td colspan="2">2.000 BSC</td><td colspan="2">0.079 BSC</td></tr> <tr> <td>D1</td><td>0.800</td><td>1.000</td><td>0.031</td><td>0.039</td></tr> <tr> <td>E</td><td colspan="2">2.000 BSC</td><td colspan="2">0.079 BSC</td></tr> <tr> <td>E1</td><td>1.500</td><td>1.700</td><td>0.059</td><td>0.067</td></tr> <tr> <td>e</td><td colspan="2">0.500 BSC</td><td colspan="2">0.020 BSC</td></tr> <tr> <td>L</td><td>0.250</td><td>0.350</td><td>0.010</td><td>0.014</td></tr> <tr> <td>L1</td><td>0.010</td><td>0.090</td><td>0.000</td><td>0.004</td></tr> </tbody> </table>				Symbol	Dimensions In Millimeters		Dimensions In Inches		MIN	MAX	MIN	MAX	A	0.700	0.800	0.028	0.031	A1	0.000	0.050	0.000	0.002	A3	0.203 REF		0.008 REF		A4	0.080	0.180	0.003	0.007	b	0.200	0.300	0.008	0.012	D	2.000 BSC		0.079 BSC		D1	0.800	1.000	0.031	0.039	E	2.000 BSC		0.079 BSC		E1	1.500	1.700	0.059	0.067	e	0.500 BSC		0.020 BSC		L	0.250	0.350	0.010	0.014	L1	0.010	0.090	0.000	0.004
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NOTES <ol style="list-style-type: none"> 1. Do not include mold flash or protrusion. 2. This drawing is subject to change without notice. 3. The many types of E-pad Pin1 signs may appear in the product. 																																																																										

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPH2865Q-DFVR-S	-40 to 125°C	DFN2X2-8	A30	MSL2	Tape and Reel,3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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TPH2865Q

5-V, G=7 Stable, 4-GHz, High-speed Op Amp

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