

Features

- Constant Voltage and Constant Current Control
- Supply Voltage: 3 V to 36 V
- Low Supply Current: Maximum 200 μA
- Precision Internal Reference
 - Voltage Control Loop: 1.21 V
 - Current Control Loop: 50/70/100/150/200 mV
- -40°C to 125°C Operation Temperature Range

Description

The TPA725x is a highly integrated solution for SMPS (Switching mode power supply) applications requiring voltage and current control loop.

The device integrates two op amps with open-drain output, a 1.21-V voltage reference, and a lower voltage reference for low-side current sensing circuit.

The device has a 200- μA supply current, which can be used in low-power applications.

Applications

- Power Module
- Adapter
- Led Lighting

Typical Application Circuit

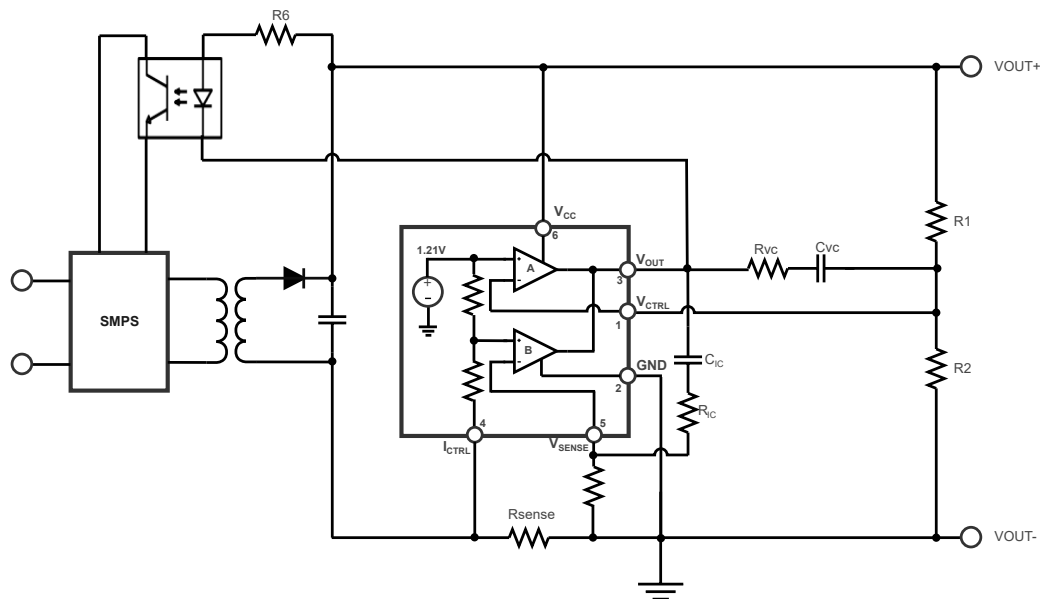


Figure 1. TPA725x in a Constant-Current and Constant-Voltage Battery Charger

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Revision History

Date	Revision	Notes
2023-08-20	Rev.A.0	Initial version.

Pin Configuration and Functions

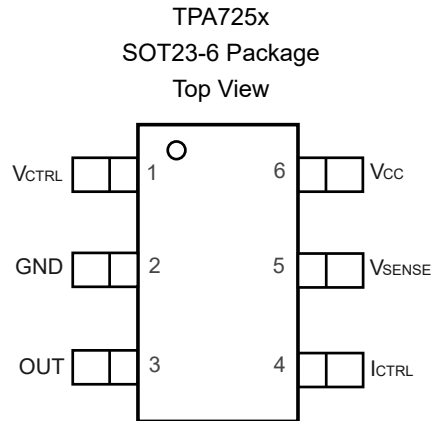


Table 1. Pin Functions: TPA725x

Pin		I/O	Description
No.	Name		
1	V _{CTRL}	I	Inverting input of the voltage loop op amp.
2	GND		Ground.
3	V _{OUT}	O	Common open-drain output of the two internal op amps.
4	I _{CTRL}	I	Non-inverting input of the current loop op amp.
5	V _{SENSE}	I	Inverting input of the current loop op amp.
6	V _{CC}		Power supply.

Constant Voltage and Constant Current Controller

Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter		Min	Max	Unit
	Supply Voltage, V_{CC}		40	V
	Voltage on input and output pin	-0.3	$V_{CC} + 0.3$	V
	Input Current: V_{CTRL} , I_{CTRL} , V_{SENSE} ⁽²⁾	-10	10	mA
	Output Short-Circuit Duration ⁽³⁾		Infinite	
T_J	Maximum Operating 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 each 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. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 ⁽²⁾	1	kV

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
V_S	Supply Voltage, V_{CC}	3		36	V
T_A	Operating Temperature Range	-40		125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-6	250	81	°C/W

Constant Voltage and Constant Current Controller
Electrical Characteristics

All test conditions: $T_A = 25^{\circ}\text{C}$, $V_{CC} = 5\text{ V}$, unless otherwise noted.

Parameter		Conditions	T _A	Min	Typ	Max	Unit
Power Supply							
V _{CC}	Supply Voltage Range			3		36	V
I _Q	Quiescent Current, No Load	V _{CC} = 36V			150	185	μA
			−40 to 125°C			200	μA
		V _{CC} = 5V			125	170	μA
			−40 to 125°C			200	μA
Voltage Control Loop							
GM _V	Transconduction Gain	Sink Current Only			8		mA/mV
V _{REF_V}	Voltage Reference for Voltage Control Loop			1.198	1.21	1.222	V
			−40 to 125°C	1.17		1.25	V
I _B	Input Bias Current		−40 to 125°C		200		pA
Current Control Loop							
GM _I	Transconduction Gain	Sink Current Only			6		mA/mV
V _{REF_I}	Voltage Reference for Current Control Loop, connect the V _{SENSE} Pin(Pin 5) to GND Pin(Pin 2), V _{REF_I} = Voltage on V _{SENSE} Pin(Pin 5) – Voltage on I _{CTRL} Pin(Pin 4).	TPA7255			50		mV
			−40 to 125°C				mV
		TPA7256		66	70	74	mV
			−40 to 125°C	63		77	mV
		TPA7257			100		mV
			−40 to 125°C				mV
		TPA7258			150		mV
			−40 to 125°C				mV
		TPA7259			200		mV
			−40 to 125°C				mV
	Current Out of Pin Ictrl			10	20	30	μA
			−40 to 125°C		25		μA
Current Control Loop							
V _{OL}	Low Output Voltage Level	I _{SINK} = 2 mA			100	200	mV
			−40 to 125°C			300	mV
I _{OS}	Output Short Circuit Current	Sink Current Only		15	25		mA
			−40 to 125°C	10			mA

Typical Performance Characteristics

Test chip is TPA7256, all test condition: $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

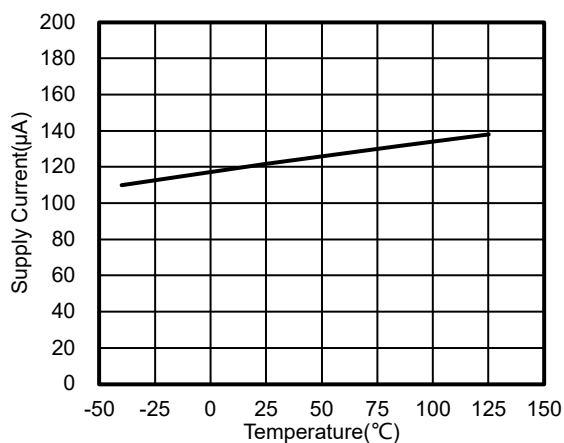


Figure 2. Supply Current vs Temperature

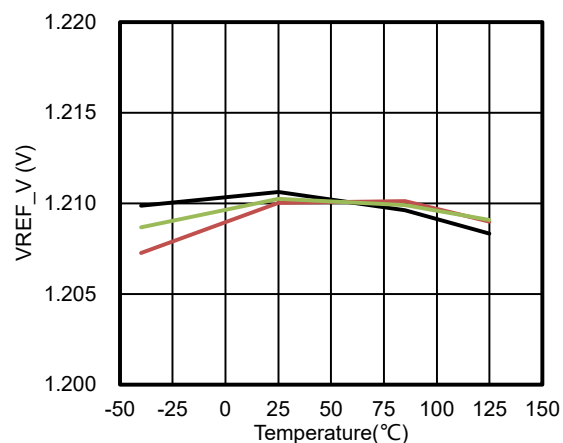


Figure 3. Reference for Voltage Loop vs Temperature

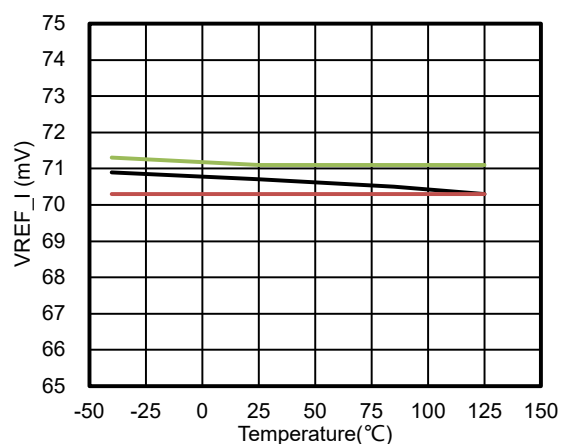


Figure 4. Reference for Current Loop vs Temperature

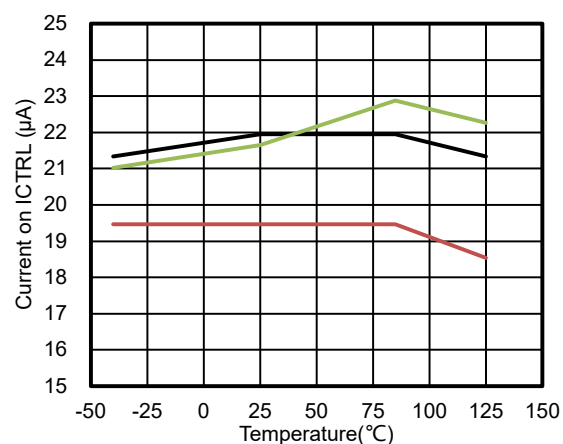


Figure 5. Current on ICTRL vs Temperature

Detailed Description

Overview

The device integrates two op amps with open-drain output, a 1.21-V voltage reference, and a lower voltage reference for low-side current sensing circuit.

Functional Block Diagram

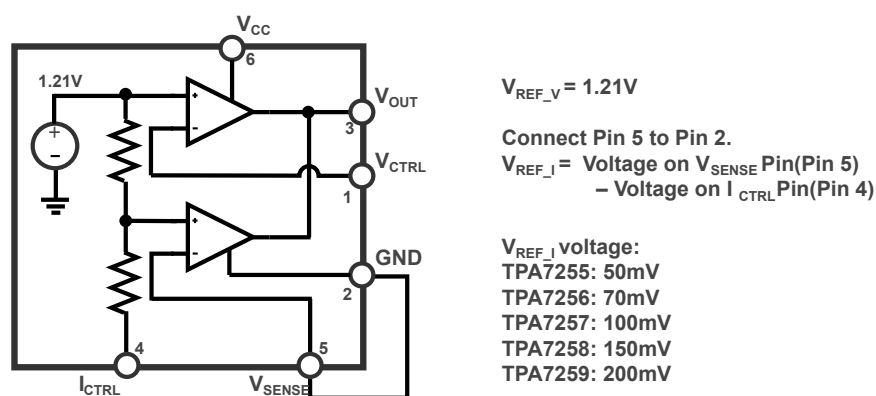


Figure 6. Functional Block Diagram

Feature Description

Operating Voltage

The device is designed for single-supply operation from 3 V to 36 V. The high-power supply voltage helps the device survive on the very noisy power supply.

Low Power Operation

The device has a 200-µA power supply, which is very useful in low-power applications.

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

Power Supply Recommendations

Place 0.1-μF bypass capacitors close to the power-supply pins for reducing coupling errors from the noisy or high impedance power supplies.

Typical Application

Figure 7 shows the typical application schematic.

Constant-Current and Constant-Voltage Battery Charger

The following figure shows the device configured in constant-current and constant-voltage battery charger.

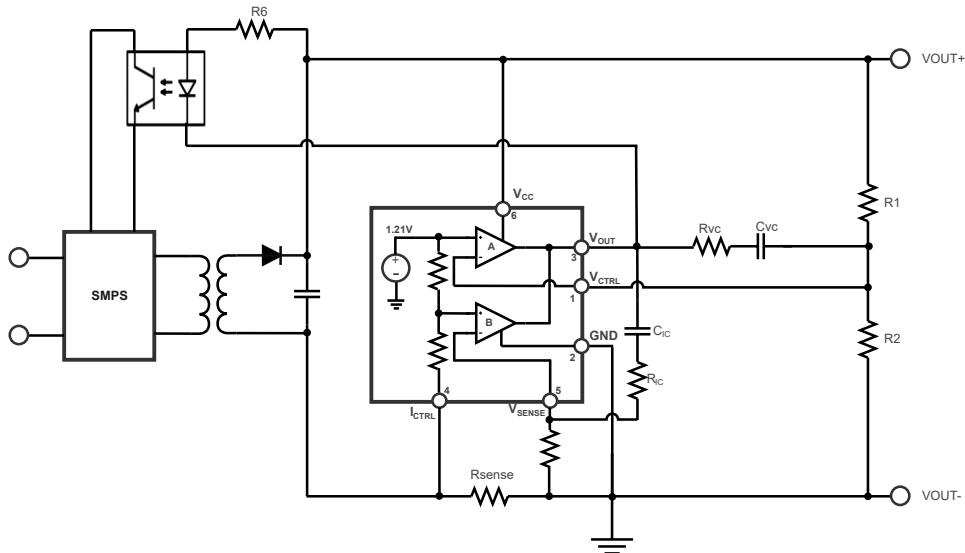


Figure 7. TPA725x in a Constant-Current and Constant-Voltage Battery Charger

The voltage control loop is controlled by the operational amplifier A and the resistor divider (R1, R2), the output voltage is given in the following equation.

$$V_{OUT} = V_{REF_V} \times \frac{R1 + R2}{R2} \quad (1)$$

Where V_{OUT} is the desired maximum output voltage, V_{REF_V} is the voltage reference for voltage control loop.

The current control loop is controlled via the operational amplifier B and the maximum output current is given by the following equation.

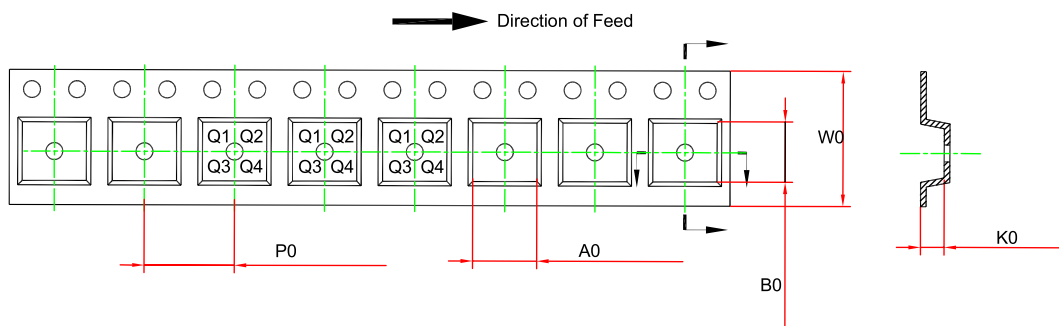
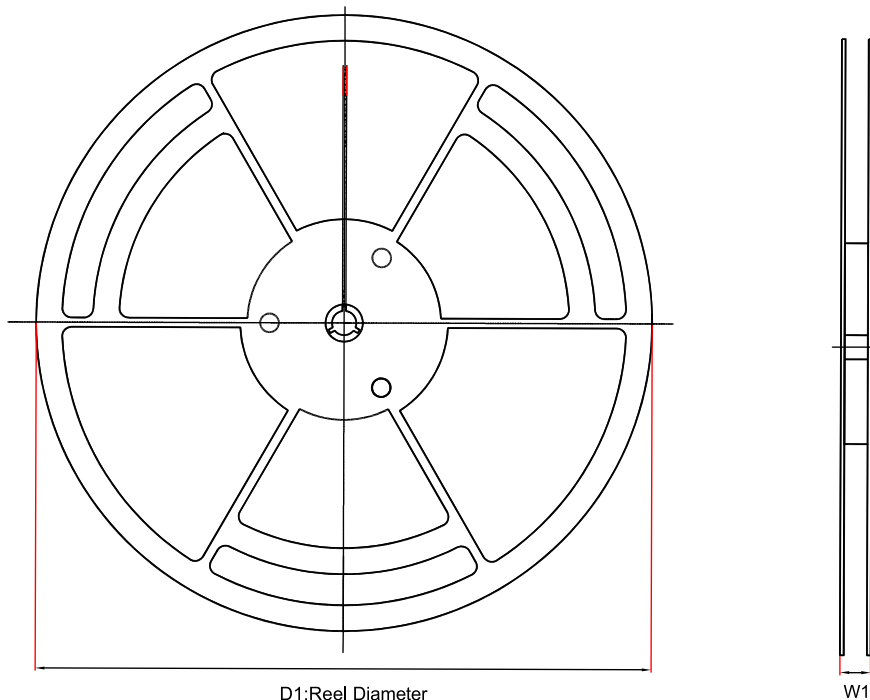
Constant Voltage and Constant Current Controller

$$I_{OUT} = \frac{V_{REF_I}}{R_{SENSE}} \quad (2)$$

Where I_{OUT} is the desired maximum output current, V_{REF_I} is the voltage reference for current control loop.

The open-drain outputs of the two operational amplifiers are connected to the opto-coupler, this makes an ORing function that ensures whenever the values of the current or the voltage reaches too high, the opto-coupler is activated.

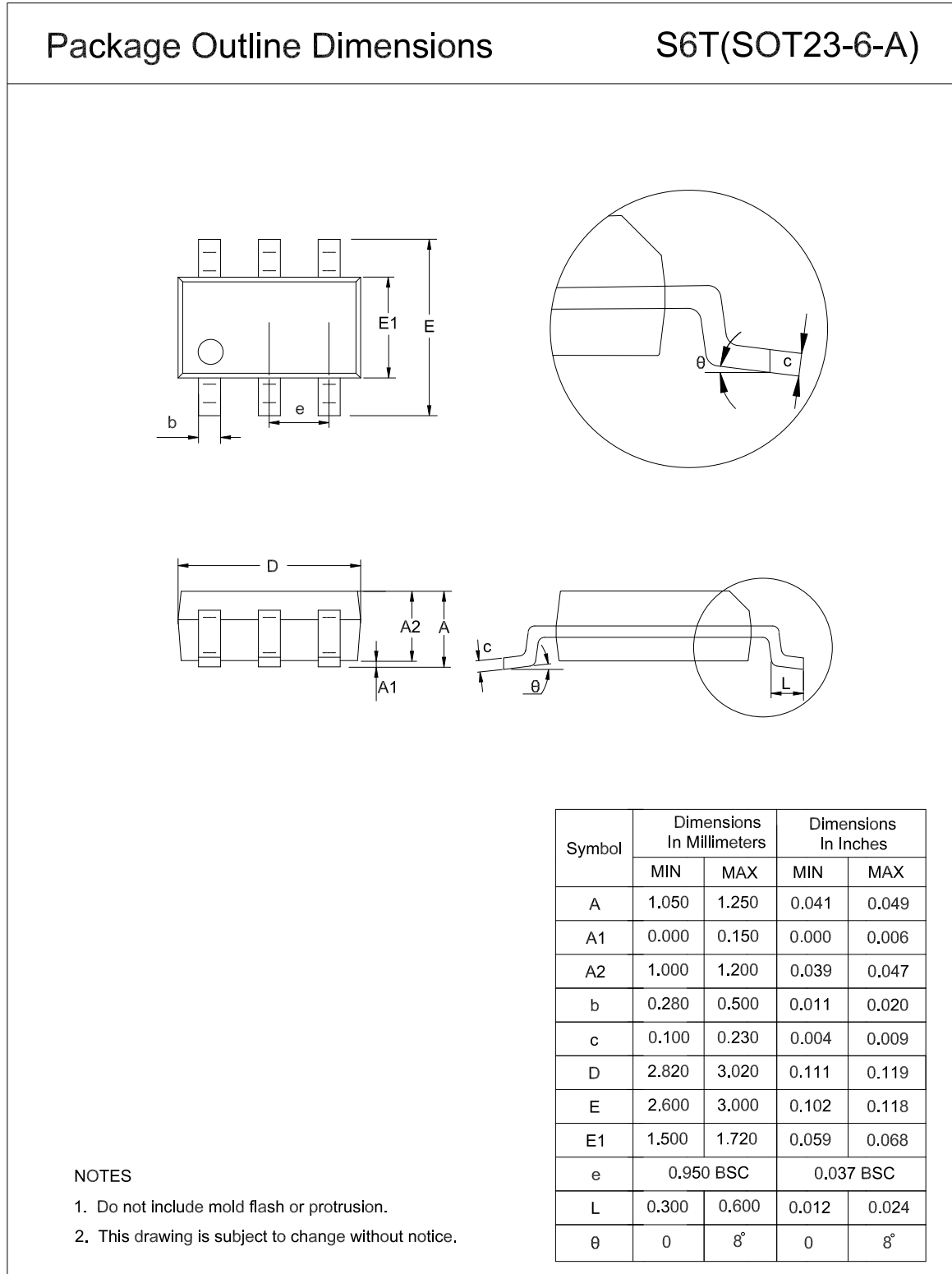
Tape and Reel Information



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA725x-S6TR	SOT23-6	180.0	12.0	3.3	3.2	1.4	4.0	8.0	Q3

Package Outline Dimensions

SOT23-6



Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA7255-S6TR ⁽¹⁾	-40 to 125°C	SOT23-6	755	3	Tape and Reel, 3000	Green
TPA7256-S6TR	-40 to 125°C	SOT23-6	756	3	Tape and Reel, 3000	Green
TPA7257-S6TR ⁽¹⁾	-40 to 125°C	SOT23-6	757	3	Tape and Reel, 3000	Green
TPA7258-S6TR ⁽¹⁾	-40 to 125°C	SOT23-6	758	3	Tape and Reel, 3000	Green
TPA7259-S6TR ⁽¹⁾	-40 to 125°C	SOT23-6	759	3	Tape and Reel, 3000	Green

(1) For future products, contact the 3PEAK factory for more information and samples.

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

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