

Programmable Current-Limited Load Switch

DESCRIPTION

ETA6281 is a load switch which provides full protection to systems and loads which may encounter large current conditions. ETA6281 offers a 70mΩ current-limited switch which can operate over an input voltage range of 2.1-6V. The current limit can be externally programmed by a precision resistor, ranging from 75mA to 2.2A. Current is prevented from flowing when the switch is off and the output voltage is higher than the input voltage. ETA6281 also features thermal shutdown protection which shuts off the switch to prevent damage to the part when a continuous over-current condition causes excessive heating. When the switch current reaches the current limit, the parts operate in a constant-current mode to prohibit excessive currents from causing damage. The ETA6281 will not turn off after a current limit fault, but will rather remain in the constant current mode indefinitely. The nFAULT output asserts low during over-current and reverse-voltage conditions.

ETA6281 is available in three types of package: SOT23-5, SOT23-6, DFN2x2-6.

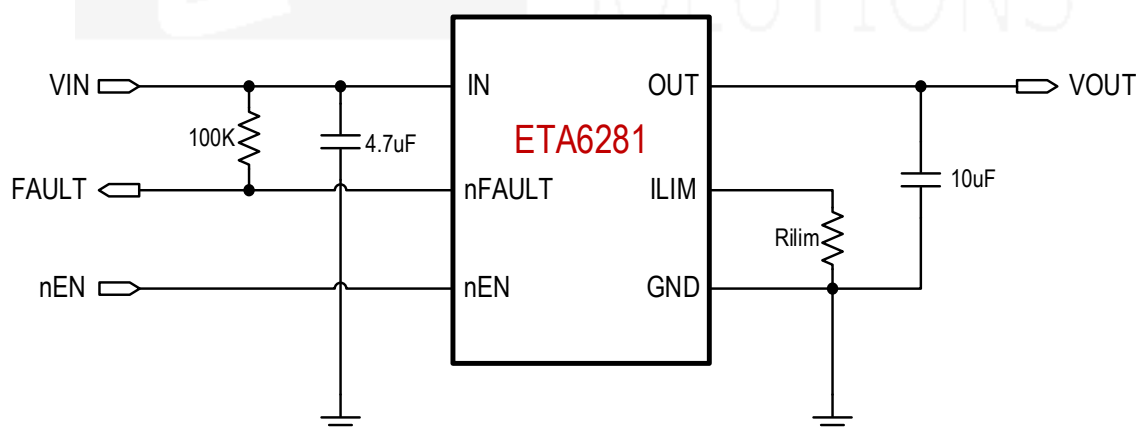
FEATURES

- ◆ Wide Input Voltage Range: 2.1V to 6V
- ◆ 7.5V Input Standoff Voltage
- ◆ 6.1V OVP
- ◆ Up to 2.2A Max Load Current
- ◆ Programmable Current Limit: 75mA to 2200mA
- ◆ Accurate Current Limit Threshold at 1.7A: +/-5%
- ◆ Fast Over Current Response
- ◆ Fault Flag Output: nFAULT Pin
- ◆ Reversed Input-Output Current Blocking
- ◆ Thermal Shutdown, UVLO Protection
- ◆ Tiny SOT23-5, SOT23-6, DFN2x2-6 Package

APPLICATIONS

- ◆ USB Ports and Hubs
- ◆ Digital TVs
- ◆ Set-Top Boxes
- ◆ VOIP Phones

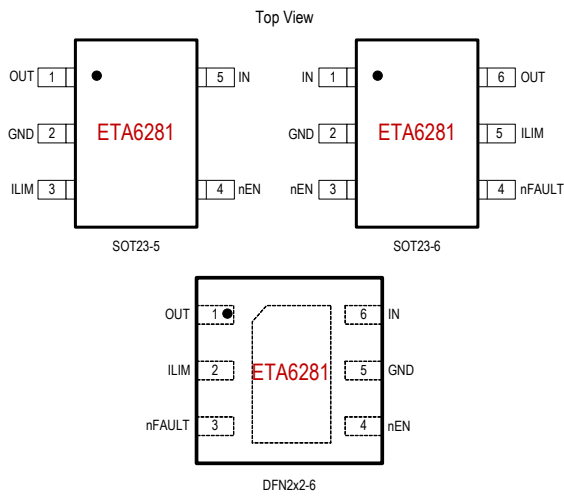
TYPICAL APPLICATION



ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA6281S2F	SOT23-5	HH YW	3000
ETA6281S2G	SOT23-6	HH YW	3000
ETA6281D2G	DFN2x2-6	HH YW	3000

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

IN, OUT Voltage to GND	-0.3V to 7.5V
All other pins Voltage to GND	-0.3V to 7.5V
nEN Voltage to IN.....	-7.5V to 0.3V
OUT to ground current	Internally limited
Operating Temperature Range.....	-40°C to 85°C
Storage Temperature Range.....	-55°C to 150°C
Thermal Resistance θ_{JC} θ_{JA}	
DFN2x2-6.....	30.....80.....°C/W
SOT23-6	90.....180..... °C/W
SOT23-5	110.....220.....°C/W
Lead Temperature (Soldering, 10sec).....	260°C

ELECTRICAL CHARACTERISTICS

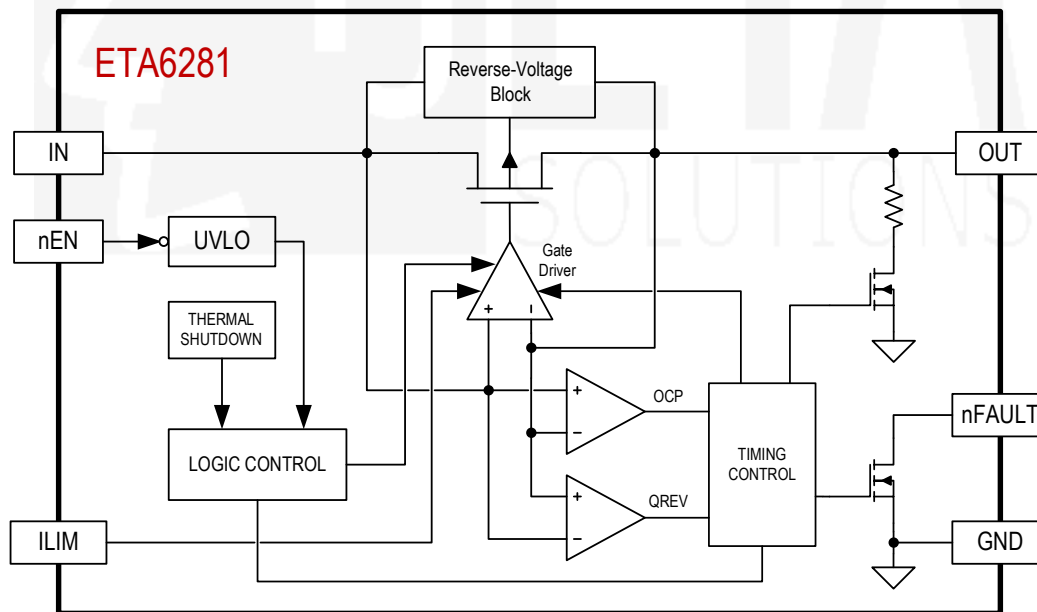
($V_{IN} = 5V$, unless otherwise specified. Typical values are at $T_A = 25^\circ C$.)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Standoff Voltage		7.5			V
Input Voltage Range		2.1		6	V
Input OVP			6.1		V
Input UVLO	Rising, Hysteresis=100mV		2.0		V
Input Supply Current	$R_{ILIM}=20K$		100		μA
Input Shutdown Current			0.9		μA
Power Switch On Resistance	$I_{SW} = 500mA$		70		m Ω
	$I_{SW} = 500mA$, $-40^\circ C \leq T_J \leq 120^\circ C$			130	m Ω
Current limit Threshold	$R_{ILIM}=6.8K$		1.0		A
	$R_{ILIM}=17K$		0.4		A
	$R_{ILIM}=3.4K$		2.0		A
Forward regulation voltage	Light Load		25		mV
Response time to Short-circuit			1		μs
Reverse Indication Threshold	$V_{OUT}-V_{IN}$		150		mV
Reverse Leakage Current	$V_{OUT}=5.5V, V_{IN}=0V$		0.5	2	μA
nEN Voltage Threshold	nEN Pin Rising, Disable IC	1			V
	nEN Pin Falling, Enable IC			0.4	V
nFAULT Output Low Voltage	$I_{nFAULT} = 1mA$		70	170	mV
Output Discharge resistance	$V_{nEN}=High$		300		Ω
nFAULT Output Leakage				1	μA
nFAULT Deglitch Time	De-assertion due to Over-current		9		ms
	De-assertion due to Reverse-Voltage		4.5		ms
Thermal Shutdown			160		$^\circ C$
Thermal Shutdown In Current Limit			135		$^\circ C$
Thermal Shutdown Hysteresis			15		$^\circ C$

PIN DESCRIPTION

PIN NAME	PACKAGE			DESCRIPTION
	SOT23-5	SOT23-6	DFN2x2-6	
IN	5	1	6	Power input. Bypass with a 4.7 μ F capacitor to GND
OUT	1	6	1	Current limit output. 10uF is recommended for output capacitor.
GND	2	2	5	Ground
ILIM	3	5	2	Current limit threshold setting pin. Connect a resistor (Rilim) from this pin to GND to set different current limit values.
nEN	4	3	4	Enable Input pin. Drive this pin low to enable, high to disable.
nFAULT	N/A	4	3	Fault flagging pin. Connect a pull up resistor to IN, when in FAULT conditions, this pin is asserted low.
EP	N/A	N/A	EP	Thermal pad. Used to sink the heat through the circuit board traces. Connect EP to GND on board.

FUNCTIONAL BLOCK DIAGRAM



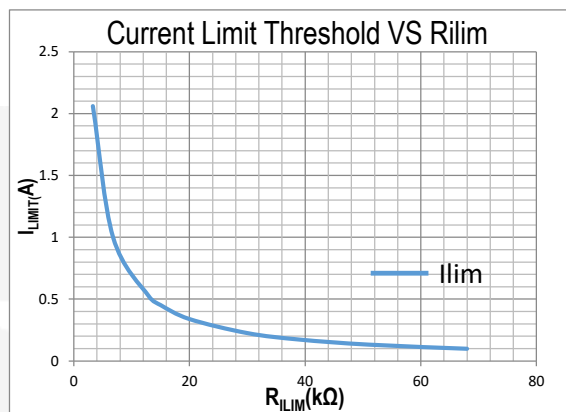
FUNCTIONAL DESCRIPTION

The ETA6281 is a load switch which provides full protection to systems and loads which may encounter large current conditions. ETA6281 offers a 70mΩ current-limited switch which can operate over an input voltage range of 2.1-6V. The current limit can be externally programmed by a precision resistor, ranging from 75mA to 2.2A. ETA6281 also features reverse voltage blocking, UVLO, and thermal shutdown to protect IC from overheating. An nFAULT flag output provides a pull-down signal to indicate fault conditions.

CURRENT LIMITING

The current limit ensures that the current through the switch doesn't exceed a maximum value while not limiting at less than a minimum value. The current at which the parts will limit is adjustable through the selection of an external resistor connected to ILIM pin.

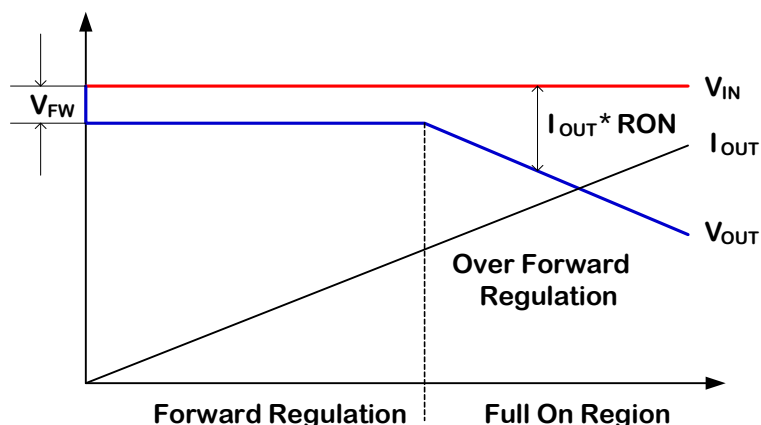
Rilim(kΩ)	Current Limit(A)
3.3	2.06
6.8	1.00
13	0.52
15	0.45
20	0.34
30	0.23
39	0.17
51	0.13
68	0.10



ETA6281 thermal cycles if an overload condition is present long enough to activate thermal limiting in any of the above cases. The device turns off when the junction temperature exceeds 135°C (typically) while in current limit. The device remains off until the junction temperature cools 15°C (typically) and then restarts

IN-OUT FORWARD VOLTAGE REGULATION and REVERSE-VOLTAGE BLOCKING

ETA6281 is integrated an advanced technology to get a perfect reverse protection function. When Output current is high enough, the different voltage between IN and OUT terminals is determined by I_{OUT}*R_{ON}. But when output current is low, OUT is regulated to be always lower than IN a small difference, V_{FW}. This will control V_{GS} of Power MOSFET small enough to handle output current with its V_{DS} not changed. And finally, there is not any reverse current at any condition since Power MOSFET will be in Cutoff when output current reaches zero.



This prevents damage to devices on the input side of the ETA6281 by preventing significant current from sinking into the input capacitance.

The nFAULT pin will not indicate the reverse condition until output voltage exceeds the input voltage by 150mV (typically) for TF_REV=4.5ms (typically).

nFAULT FLAG

The nFAULT open-drain output is asserted (active low) during an over-current, over temperature or reverse-voltage condition. The ETA6281 asserts the FAULT signal until the fault condition is removed and the device resumes normal operation. The nFAULT signal is de-asserted once device power is cycled or the enable is toggled and the device resumes normal operation. The ETA6281 is designed to eliminate false nFAULT reporting by using an internal delay "deglitch" circuit for over-current (9-ms typically) and reverse-voltage (4.5-ms typically) conditions without the need for external circuitry. This ensures that nFAULT is not accidentally asserted due to normal operation such as starting into a heavy capacitive load. The deglitching circuitry delays entering and leaving fault conditions. Over temperature conditions are not deglitched and assert the nFAULT signal immediately.

APPLICATION INFORMATION

INPUT OUTPUT CAPACITANCE

Input and output capacitance improve the performance of the device; the actual capacitance should be optimized for the particular application. For all applications, a 4.7μF or greater ceramic bypass capacitor between IN and GND is recommended as close to the device as possible for local noise de-coupling. This precaution reduces ringing on the input due to power-supply transients. Additional input capacitance may be needed on the input to reduce voltage overshoot from exceeding the absolute maximum voltage of the device during heavy transient conditions. This is especially important during bench testing when long, inductive cables are used to connect the evaluation board to the bench power-supply. Placing a high-value electrolytic capacitor on the output pin is recommended when large transient currents are expected on the output.

POWER DISSIPATION

During normal operation as a switch, the power dissipated in the part will depend upon the level at which the current limit is set. The maximum allowed setting for the current limit is 2A and this will result in a power dissipation of,

$$P=(ILIM)^2 \times R_{ON}=2^2 \times 0.09=360mW$$

assuming the part is in high temperature, the Ron increases to 90mohm.

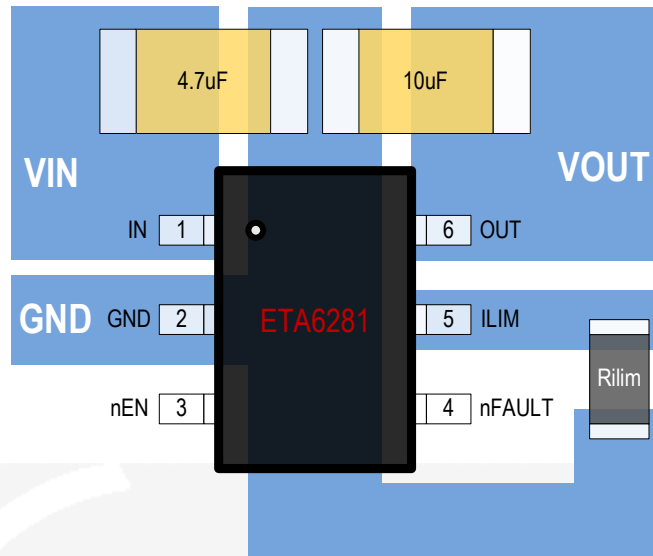
If the part goes into current limit the maximum power dissipation will occur when the output is shorted to 1V above ground. This is more power than the package can dissipate, but the thermal shutdown of the part will activate to protect the part from damage due to excessive heating. A short on the output will cause the part to operate in a constant current state dissipating a worst-case power of,

$$P_{(MAX)}=[VIN(max)-1] \times ILIM(max)=(6.1-1) \times 2=10.2W$$

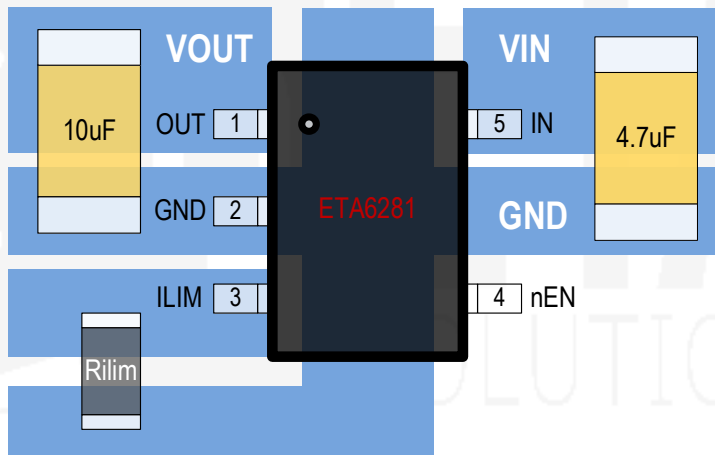
This large amount of power will activate the thermal shutdown and the part will cycle in and out of thermal shutdown so long as the nEN pin is active and the short is present.

PCB LAYOUT GUIDE

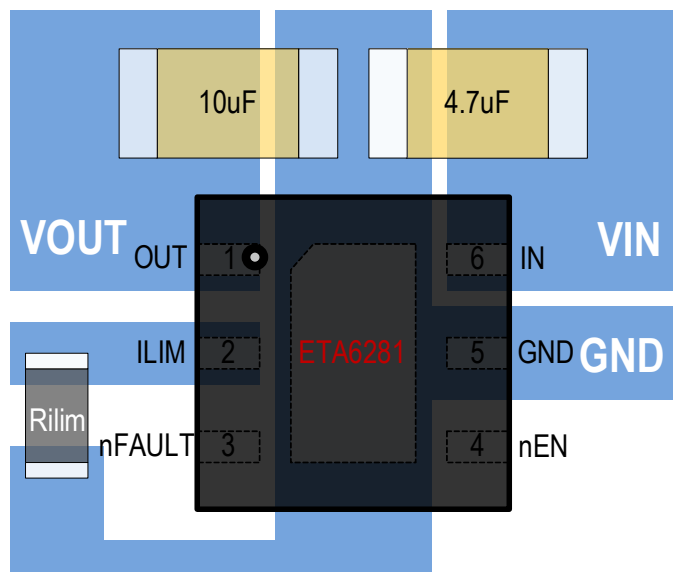
Package: SOT23-6



Package: SOT23-5

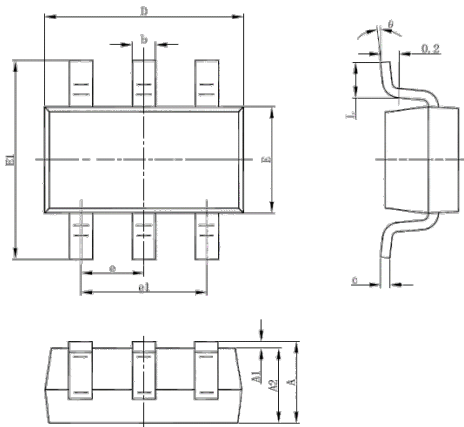


Package: DFN2x2-6



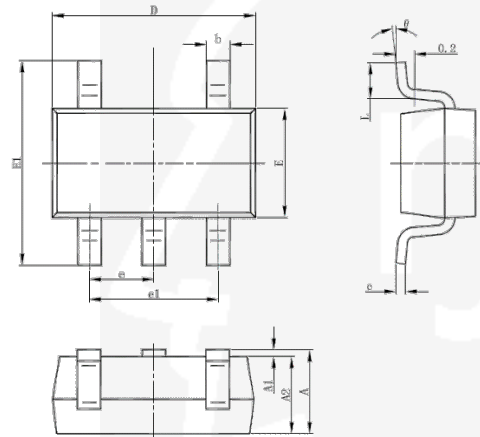
PACKAGE OUTLINE

Package: SOT23-6



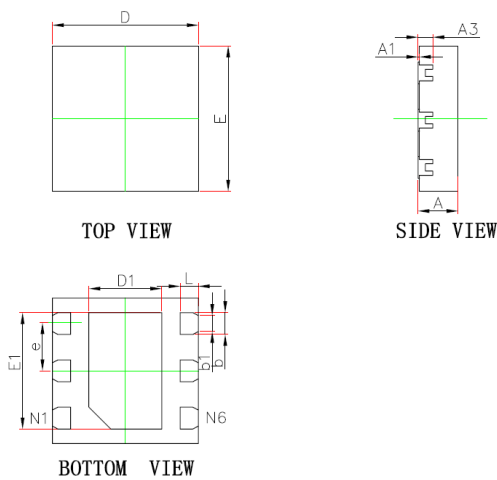
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Package: SOT23-5



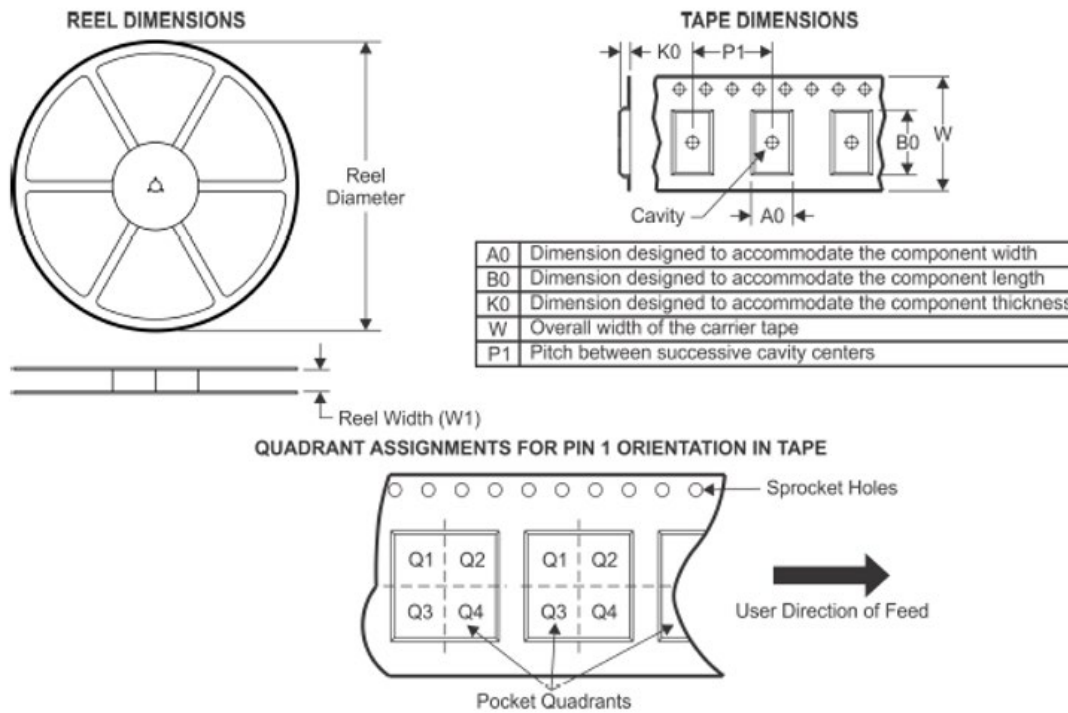
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Package: DFN2x2-6



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.	
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D1	0.900	1.100	0.035	0.043
E1	1.500	1.700	0.059	0.067
b	0.250	0.350	0.010	0.014
b1	0.220 REF.		0.009 REF.	
e	0.650 BSC.		0.026 BSC.	
L	0.174	0.326	0.007	0.013

TAPE AND REEL INFORMATION



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ETA6281S2G	SOT23-6	6	3000	180	9.5	3.17	3.23	1.37	4	8	Q3
ETA6281S2F	SOT23-5	5	3000	180	9.5	3.17	3.23	1.37	4	8	Q3
ETA6281D2G	DFN2x2-6	6	3000	180	9.5	2.3	2.3	1.1	4	8	Q1