20V Standoff, Li+ Battery PMU with 3A Charger and 2.4A Boost OTG

DESCRIPTION

ETA6912 is a switching Li-Ion battery charger capable of delivering up to 2.4A of charging current to the battery and also capable of delivering up to 2.4A in boost operation. ETA6912 includes a power path from IN to OUT, a buck charger, a 5V boost converter, and a charge status indication. The buck charger guarantees a 93.5% average efficiency at 2.4A charge current and the boost converter achieves 92% efficiency at 2.4A output when battery voltage is as low as 3.3V. It greatly increases the effective battery capacity for a battery powered system, such as power bank. With all these features, ETA6912 is an ideal all-in-one solution for Li+ battery charging, discharging applications.

ETA6912 is available in DFN3×3-10 package.

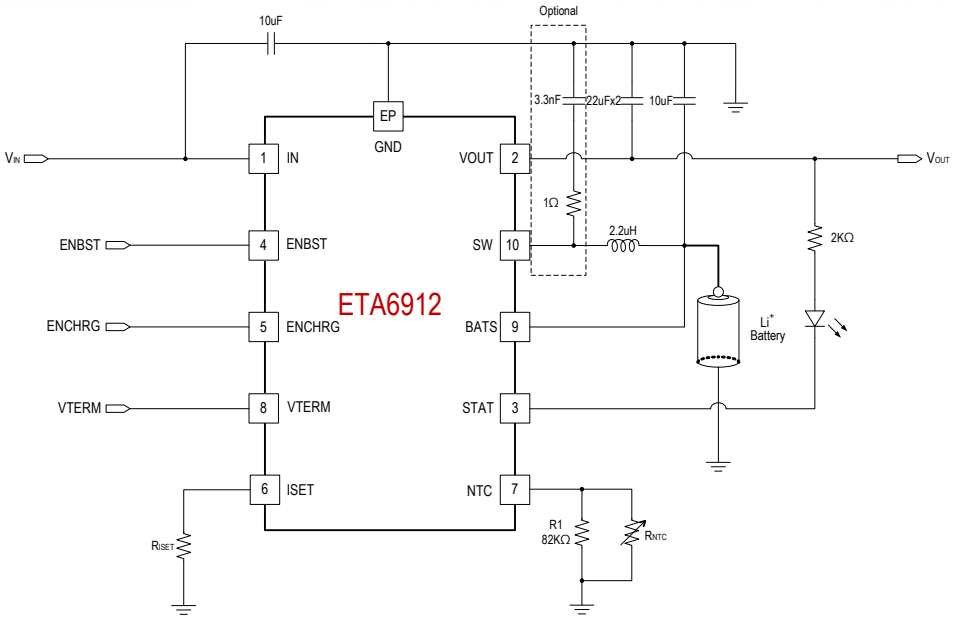
FEATURES

- 20V Input Standoff Voltage
- Bi-Directional Power Conversion with Single Inductor
- Power Path from IN to OUT
- ENBST and ENCHRG Function
- 4.2V/4.35V Optional Battery CV voltage
- Switching Charger
- 5V Synchronous Boost
- Up to 96% Efficiency
- No External Sense Resistor
- NTC Monitor
- Charge Status Indication
- Charge Current Programmable
- Pb Free, RoHS and REACH Compliant
- Halogen Free and “Green” Device

APPLICATIONS

- E-cigarette
- Power Bank
- Li+ Battery Powered System

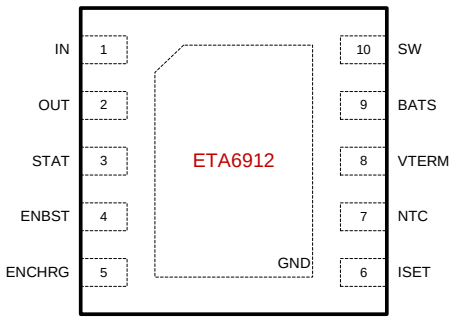
TYPICAL APPLICATION



ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA6912D3K	DFN3×3-10	ETA6912 YWW2L	5000

PIN CONFIGURATION



DFN3x3-10

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 Voltage.....–0.3V to 20V
BATS Voltage .....–0.3V to 9V
OUT Voltage .....–0.3V to 6V
All Other Pin Voltage.....V_{OUT}–0.3V to V_{OUT}+0.3V
SW, IN, 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}
DFN3×3-10	10	40 °C/W

Lead Temperature (Soldering, 10sec) .....260°C

ELECTRICAL CHARACTERISTICS

(V_{IN} = 5V, V_{BAT}=3.8V, L=2.2μH unless otherwise specified. Typical values are at TA = 25°C.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BUCK MODE					
Input Standoff Voltage		20			V
Input Voltage Range		4.5		6	V
Input UVLO Voltage	Rising, Hys=500mV		4.5		V
IN to OUT Rdson			95		mΩ
IN to OUT Input Current Limit			3.5		A
IN to OUT Hiccup Threshold Voltage	Falling. V_{IN}-V_{OUT}>500mV Rising, Hys=100mV		500		mV
Hiccup On Time			7		mS
Hiccup Off Time			350		mS
Input OVP Voltage	Hys=500mV		6.1		V
IN Operating Current as Buck	Switcher Enable, Switching		5		mA
	Switcher Enable, No Switching		500		μA
BATTERY CHARGER					
Battery CV Voltage	V_{TERM}=LOW	4.16	4.2	4.24	V
	V_{TERM}=HIGH	4.31	4.35	4.39	V
Charger Restart Threshold			-170		mV
Battery Pre-Condition Voltage	V_{BAT} Rising, Hys=200mV		3		V

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Pre-Condition Charge Current			230		mA
Fast Charge Current	R_{ISET}=45K		2.4		A
Charge Termination Current			10		%ICC
Charge Termination Blanking Time			12		S
BOOST MODE					
BAT OK Threshold	Rising within 50ms		3.2		V
	Falling		2.9		V
	Unlock Voltage		3.5		V
Output Voltage Range	I_{OUT}=0A	4.95	5.05	5.15	V
Output Cord Compensation	I_{OUT}=2.4A		150		mV
Quiescent Current at BAT Pin	Boost On		500		μA
Shutdown Supply Current at BAT Pin	ENBST=0		2		μA
Switching Frequency	V_{BAT}<4.4V		0.5		MHz
Output Current Limit	V_{BAT}=3.8V	2.4	2.8	3.2	A
Maximum Duty Cycle			95		%
High Side Pmos Rdson	I_{SW} =500mA		36		mΩ
Low Side Nmos Rdson	I_{SW} =500mA		26		mΩ
Short Circuit Hiccup Current			3		A
Over Current Detect Time			100		mS
From Short to Reboot Time			1		S
STAT					
STAT Output Low Voltage	I_{STAT}=10mA			0.2	V
LOGIC INPUT: ENBST, ENCHRG, VTERM					
Logic Input High		1.2			V
Logic Input Low				0.4	V
NTC IN CHARGING MODE					
Cold Threshold	Disable Charging, Rising		1.32		V
Hot Threshold	Disable Charging, Falling		0.56		V
NTC IN BOOST MODE					
Cold Threshold	Disable Boost, Rising		1.48		V
Hot Threshold	Disable Boost, Falling		0.44		V
THERMAL PROTECTION					
Charging Thermal Regulation Threshold			110		°C
Thermal Shutdown	Rising, Hys=30°C		160		°C

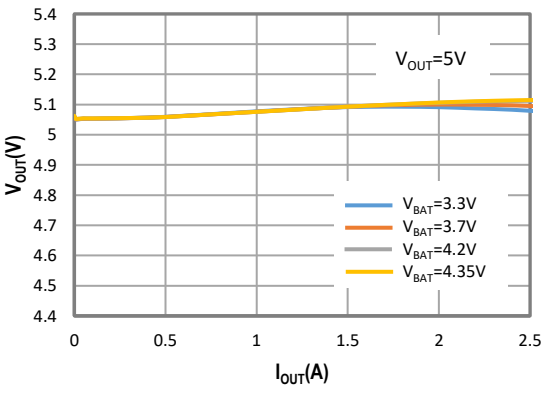
PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1	IN	DC input pin. Bypass with a 10uF capacitor from this pin to GND
2	OUT	USB 5.05V output during boost and charging input pin during charging. This is a power pin, bypass with 2*22uF capacitors from this pin to GND as close as possible.
3	STAT	Open-drain output, drive a LED to indicate the charge status.
4	ENBST	Enable pin for the boost. Drive this pin high to enable, low or floating to disable.
5	ENCHRG	Enable pin for the charger. Drive this pin high or floating to enable, low to disable.
6	ISET	Charge current programmable pin. The charge current is programmed by connecting a 1% resistor (R_{ISET})from ISET pin to GND pin. The charge current can be calculated by using the following formula: $$I_{CHRG}(A)=\frac{108000}{R_{ISET}(\Omega)}$$
7	NTC	Battery temperature monitoring pin. It sets the operating temperature range for the charging or boost process. Enable NTC by setting R1=82K, R_{NTC}=100K. Tie NTC pin to GND to disable NTC.
8	VTERM	Termination voltage selection pin. Drive this pin low, battery CV voltage is 4.2V; drive this pin high, battery CV voltage is 4.35V.
9	BATS	Battery voltage sense pin. Connect a separate sensing wire to the battery positive terminal to avoid voltage drop and achieve accurate battery CV charging. Bypass with a 10uF capacitor from this pin to GND as close as possible.
10	SW	Switching pin. Connect an inductor between this pin and BAT pin.
EP	GND	The substrate of the chip, connected to GND, and large area of ground trace for good thermal dissipation.

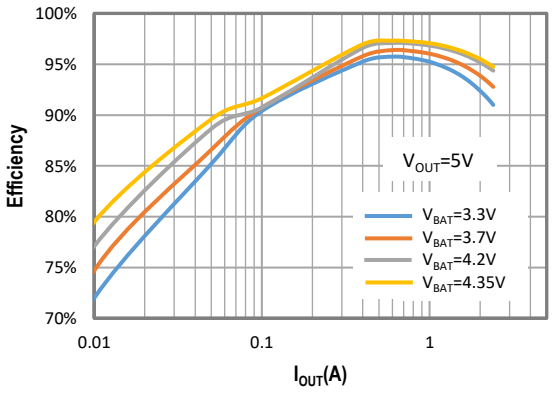
TYPICAL CHARACTERISTICS

(Typical values are at T_A = 25°C unless otherwise specified.)

Boost V_{OUT} Vs. I_{OUT}



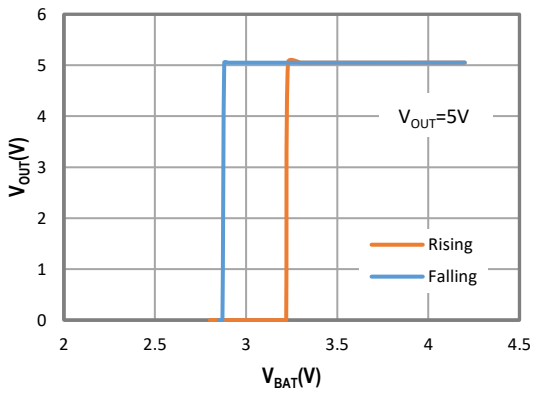
Boost Eff Vs. I_{OUT}



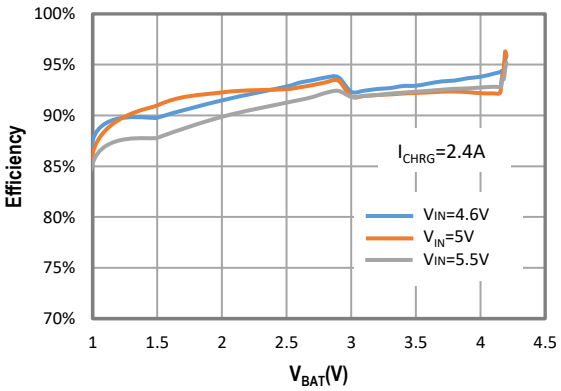
TYPICAL CHARACTERISTICS Cont'd

(Typical values are at T_A = 25°C unless otherwise specified.)

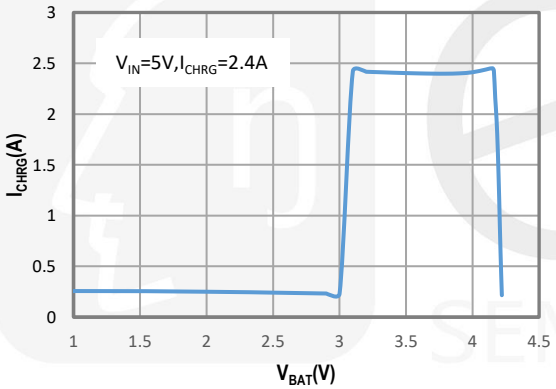
Boost UVLO



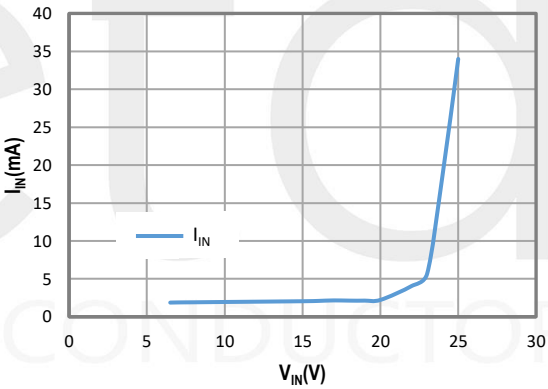
Charger Eff. Vs. V_{BAT}



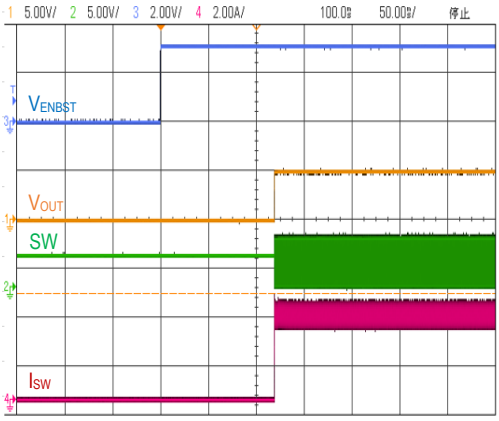
I_{CHRG} Vs. V_{BAT}



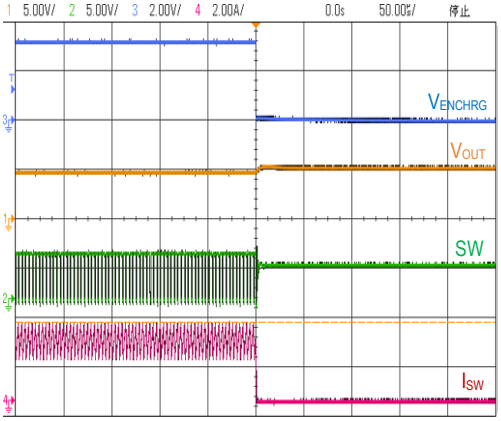
V_{IN} Standoff Voltage



Enable Boost



Disable Charger



APPLICATION INFORMATION

ETA6912 is a switching Li-Ion battery charger, which is capable of delivering 2.4A of charging current and can deliver up to 2.4A output current in boost operation.

Normal Charge Cycle

The ETA6912 initiates a charge cycle once the voltage at the IN pin rises above the UVLO threshold level. A 1% precision resistor needs to be connected from the ISET pin to ground. If the voltage at the BAT pin is less than 3V, the charger enters pre-condition charge mode. In this mode, the charge current is reduced to 230mA until the battery voltage is raised to a safe level for full current charging.

The charger switches to constant-current mode as the BAT pin voltage rises above 3V, and the charge current is programmed by R_{ISET}. When the final float voltage (4.2V/4.35V) is reached, the ETA6912 enters constant-voltage mode and the charge current begins to decrease until it drops to 1/10 of the programmable value and ends the charge cycle.

Charge Status Indicator

The ETA6912 uses a LED to indicate the charge status.

Table 1 Charge Status Indicator

State	LED
Charging	on
Charging Done	off

High Temperature Fold-back

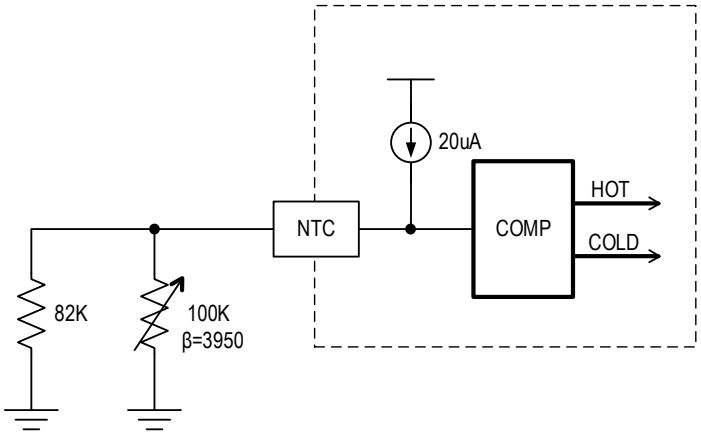
Build-in feedback circuitry mechanism can reduce the value of the programmed charge current once the die temperature tends to rise above 110°C, hence prevents the temperature from further increase and ensure device safe operation.

Automatic Recharge

After the termination of the charge cycle, the ETA6912 constantly monitors the BAT pin voltage and starts a new charge cycle when the battery voltage falls more than 170mV, keeping the battery at fully charged condition.

Battery Temperature Monitoring

When in charging or boost mode, the NTC pin outputs 20uA current to monitor the voltage of NTC pin, then detect the temperature of the battery. NTC function can be disabled by connecting NTC pin to GND.



In charging mode: When the voltage of NTC pin is 1.32V, it represents that the battery temperature is 0°C, then stop charging the battery. And when the voltage of NTC pin is 0.56V, it represents that the battery temperature is 45°C, then stop charging the battery.

In boost mode: When the voltage of NTC pin is 1.48V, it represents that the battery temperature is -15°C, then stop boost. And when the voltage of NTC pin is 0.44V, it represents that the battery temperature is 55°C, then stop boost.

Boost Operation

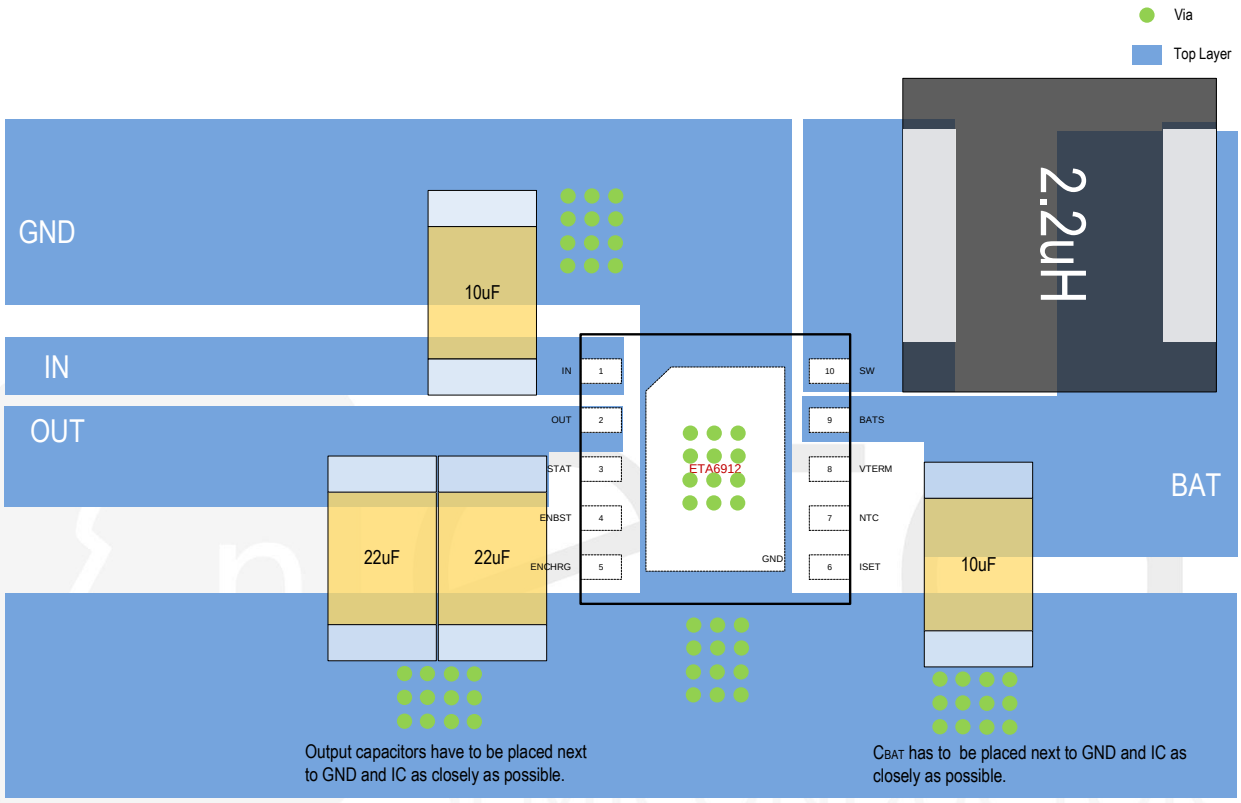
Generally, the boost is working in a fixed constant frequency PWM mode. But for ETA6912, at light load, the boost is working in power saving mode to improve the convert efficiency.

Output Short-Circuit Protection

Unlike most step-up converters, the ETA6912 allows for short circuits on the output. In the event of a short circuit, the device first turns off the high-side MOS when the sensed current reaches the current limit. When V_{OUT} drops below V_{IN}, the device then enters a linear charge period with the current limited same as with the start-up period. In addition, the thermal shutdown circuits disable switching if the die temperature rises above 160°C.

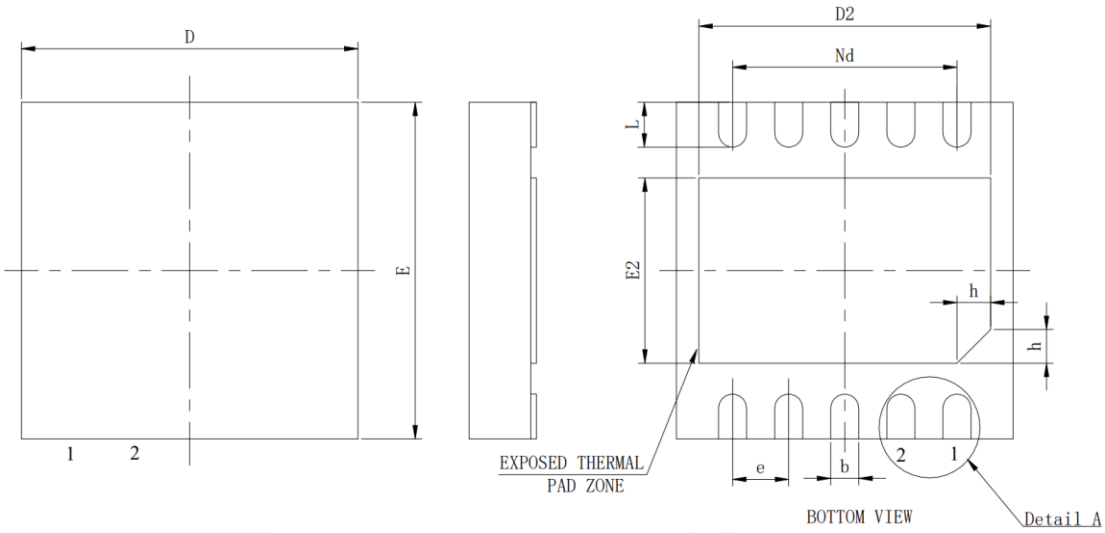
PCB GUIDELINE

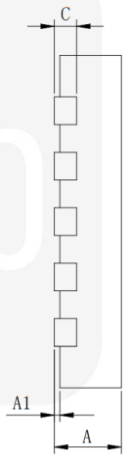
Keep the power devices as close to the chip as possible to achieve the smallest power loop area, which leads to the best EMI performance; C_{IN} is always placed nearest to IN and GND.



PACKAGE OUTLINE

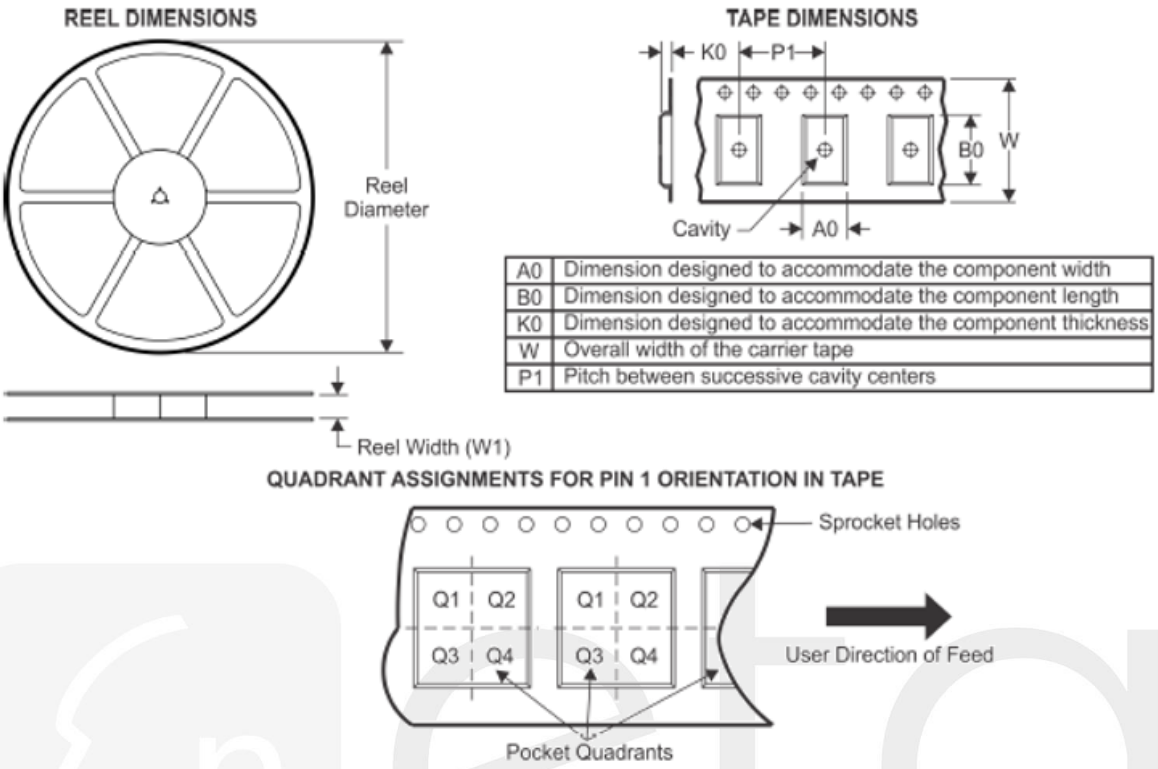
Package: DFN3×3-10





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 70	0.75	0. 80
A1	—	0.02	0. 05
b	0. 18	0.25	0. 30
c	0. 18	0.20	0. 25
D	2. 90	3. 00	3. 10
D2	2. 40	2. 50	2. 60
e	0. 50BSC		
Nd	2. 00BSC		
E	2. 90	3. 00	3. 10
E2	1. 45	1. 55	1. 65
L	0. 30	0.40	0. 50
h	0. 20	0. 25	0. 30

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
ETA6912D3K	DFN3*3*0.75-10	10	5000	329	12.8	3.3	3.3	1.1	8	12	Q1