BCT7915
Over-Voltage Protection Load Switch with Surge Protection

GENERAL DESCRIPTION

The BCT7915 OVP load switch features surge protection, an internal clamp circuit protects the device from surge voltages up to 110V.

The BCT7915 features an ultra-low 30.7mΩ(Typ.) R_{dson} nFET load switch. When input voltage exceeds the OVP threshold, the switch is turned off very fast to prevent damage to the protected downstream devices. The IN pin is capable of withstanding fault voltages up to $30V_{DC}$.

The default OVP threshold is 6.8V, the OVP threshold can be adjusted from 4V to 20V through external OVLO pin.

The device features an open-drain output ACOK,when VIN_UVLO < VIN < VIN_OVLO and the switch is on,ACOK will be driven low to indicate a good power input, otherwise it is high impedance.

This device features over-temperature protection that prevents itself from thermal damaging.

The BCT7915 is available in a RoHS compliant 1.8mm × 1.3mm QFNFC1.8X1.3-12L package.

FEATURES

- Highly reliable 1.8mm × 1.3mm QFNFC1.8X1.3-12L package
- Surge protection
  - IEC 61000-4-5: > 110V
- Integrated low R_{dson} nFET switch: typical 30.7mΩ
- 5A continuous current capability
- Default Over-Voltage Protection (OVP) threshold: 6.8V
- OVP threshold adjustable range: 4V to 20V
- Input maximum voltage rating: $30V_{DC}$
- Fast turn-off response: typical 50ns
- Over-Temperature Protection (OTP)
- Under-Voltage Lockout (UVLO)

APPLICATIONS

- Smartphones
- Tablets
- Charging Ports

ORDERING INFORMATION

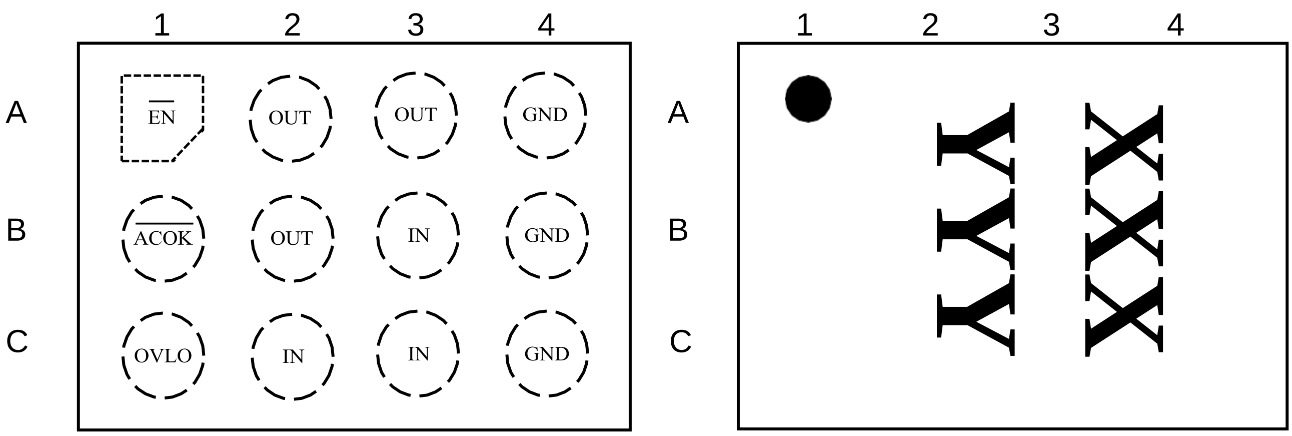
Order Number	Voltage	Package Type	Temperature Range	Marking	QTY/Reel
BCT7915EZC-TR	6.8V	QFNFC1.8x1.3-12L	-40°C to +85°C	VQR XXX	3000

Note:
1. "VQR" in Marking is product short code for BCT7915EZC-TR.
2. "XXX" in Marking will be appeared as the batch code.

PIN CONFIGURATION (TOP VIEW)

Pin Configuration (TOP VIEW)

Marking



XXX – Marking
YYY –batch code

Figure 1 Pin Configuration and Top Mark

PIN DESCRIPTION

BCT7915

Pin	Name	Function
A1	$\overline{\text{EN}}$	Enable pin, active low
B1	$\overline{\text{ACOK}}$	Power good flag, active-low, open-drain
C1	OVLO	OVP threshold adjustment pin
C2, C3, B3	IN	Switch input and device power supply
A2, A3, B2	OUT	Switch output
A4, B4, C4	GND	Device ground

FUNCTIONAL BLOCK DIAGRAM

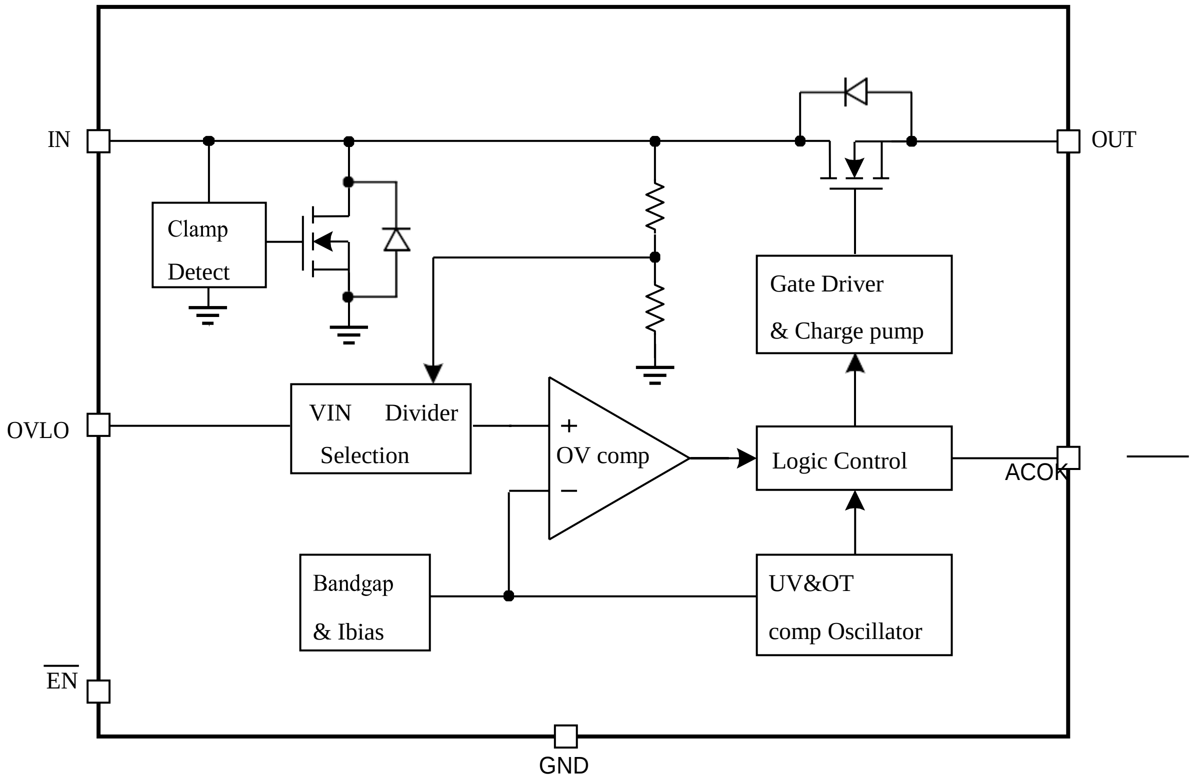


Figure 2 Functional Block Diagram

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (IN to GND) ....-0.3V to 29V
Other Pins(V_{OVLO}/ V_{ACOK} / V_{EN}).. -0.3V to 6V
Out Pin Voltage.. *29*V or V_{IN}+0.3V
Continuous Power Dissipation (TA = +70°C)：
QFNFC1.8x1.3-12L (derate 15.4mW/°C above +70°C)..................................1.23W
Maximum Continuous Current of switch IN-OUT...4.5A
Maximum Peak Current of switch IN-OUT(10ms) 7A
Operating Temperature Range ....-40°C to +85°C
Junction Temperature...+150°C
Storage Temperature Range ....-65°C to +150°C
Lead Temperature (soldering, 10s) ....+260°C
ESD Susceptibility（HBM） 2KV

Note 1:

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

TA = -40°C to 85°C unless otherwise noted. Typical values are guaranteed for V_{IN} = 5V, C_{IN} = 0.1µF, I_{IN}≤ 5A and TA = 25℃.

参数描述	参数	测试条件	DATASHEET			
			最小	典 型	最大	单位
Input clamp voltage	V_{IN_CLAMP}	I_{IN} = 10mA		30.8		V
Switch on resistance	R_{dson}	V_{IN} = 5V, I_{OUT} = 1A,		30.7		mΩ
Input quiescent current	I_Q	V_{IN} = 5V, V_{OVLO}=0V,I_{OUT} = 0A		65	130	uA
Input current at over-voltage condition	I_{IN_OVLO}	V_{IN} = 5V, V_{OVLO}=3V, V_{OUT} = 0V		60	120	
OVLO set threshold	V_{OVLO_TH}		1.16	1.20	1.24	V
OVP threshold adjustable range	V_{OVLO_RNG}		4		20	
External OVLO select threshold	$O_{VLO\ rising}$		0.19	0.26	0.33	
	Hysteresis			0.06		
OVLO pin leakage current	I_{OVLO}	V_{OVLO}=V_{OVLO_TH}	-0.2		0.2	uA
Protection						
OVP trip level V_{IN_OVLO}		V_{IN} rising	6.60	6.80	7.00	
		Hysteresis		0.14		
Shutdown temperature	T_{SDN}			150		℃
Shutdown temperature Hysteresis	T_{SDN_HYS}			20		
Output discharge resistance	R_{DCHG}	V_{OUT}=7V,V_{OVLO}=3V		50		Ω
Digital Logical Interface						
/ACOK output low voltage	V_{OL}	I_{SINK}=1mA		0.4		V
/ACOK leakage current	I_{LEAK_ACOK}	V_{IO}=5V,/ACOK de-asserted	-0.5		0.5	uA
/EN input high voltage	V_{IH}		1.2			V
/EN input low voltage	V_{IL}				0.5	
/EN leakage current	I_{LEAK_EN}	V_{EN} = 5V	0		2	uA
Timing Characteristics						
Debounce time	t_{DEB}	From V_{IN} > V_{IN_UVLO} to 10% V_{OUT}		15		ms
Start-up time	t_{START}	From V_{IN} > V_{IN_UVLO} to ACOK low		30		
Switch turn-on time	t_{ON}	R_L = 100Ω, C_L = 22uF, V_{OUT} from 10% V_{IN} to 90% V_{IN}		2		
Switch turn-off time	t_{OFF}	C_L = 0uF, R_L = 100Ω, V_{IN} > V_{IN_OVLO} to V_{OUT} stop rising, V_{IN} rise at 10V/s		50		ns

TIMING DIAGRAM

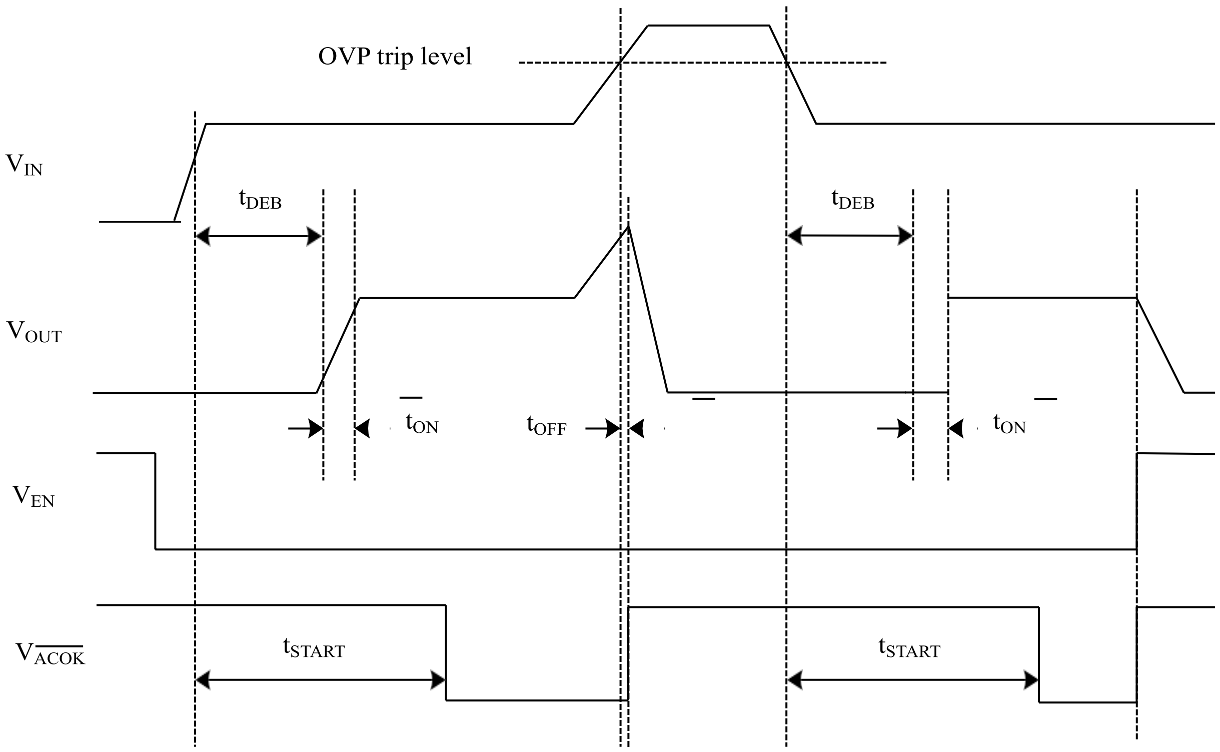


Figure 3 Timing diagram

TYPICAL APPLICATION CIRCUITS

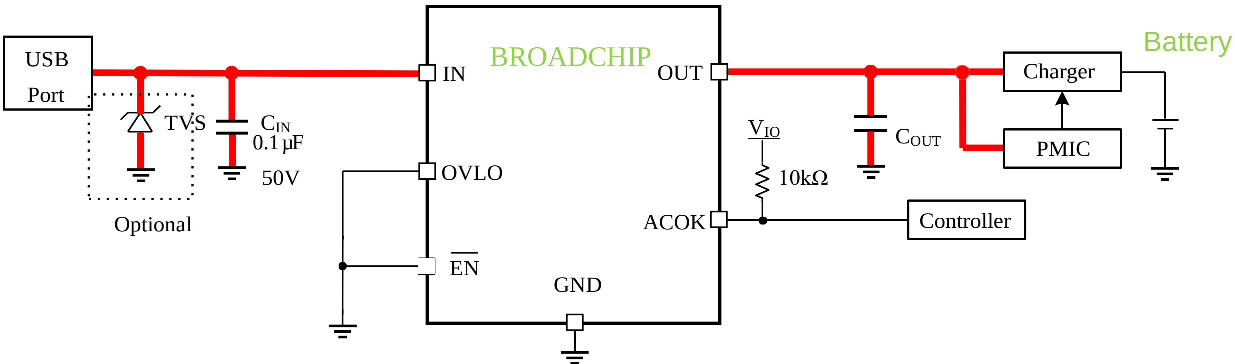


Figure 4 BCT7915 typical application circuit(using default OVP threshold)

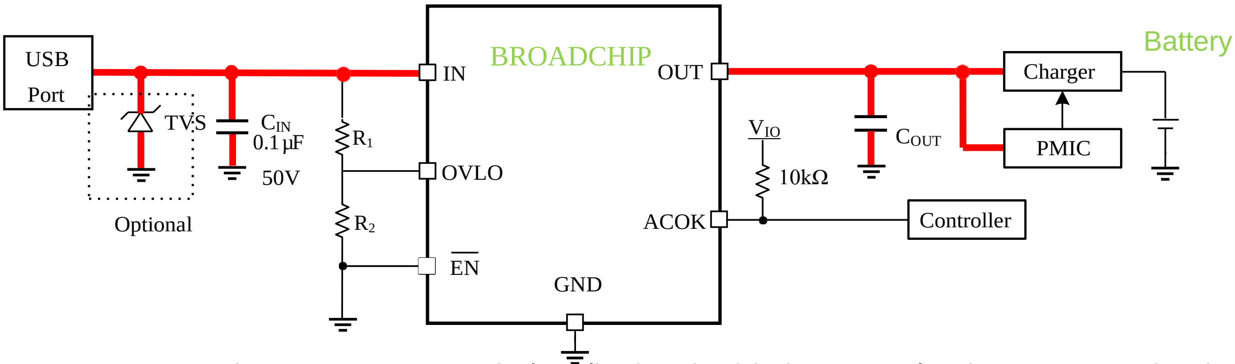


Figure 5 BCT7915 typical application circuit(using external resistors set OVP threshold)

Note:R1 and R2 are used for OVP threshold adjustment, to use default OVP threshold, connect OVLO to ground.

Notice for Typical Application Circuits:

1. If VBUS is required to pass surge voltage greater than 110V, external TVS is needed, the maximum clamping voltage of the TVS should be below 34V.
2. When the default OVP threshold is used, connect OVLO pin to GND directly or through a 0Ω resistor. OVLO pin cannot be left floating.
3. If R1 and R2 are used to adjust the OVP threshold, it is better to use 1% precision resistors to improve the OVP threshold precision.
4. If ACOK is not used, it can be left floating, or short to GND.
5. C_{IN} = 0.1μF is recommended for typical application, larger C_{IN} is also acceptable. The rated voltage of C_{IN} should be larger than the TVS maximum clamping voltage, if no TVS is applied and only BCT7915 is used, the rated voltage of C_{IN} should be 50V.
6. C_{OUT} = 1μF is recommended for typical application, larger C_{OUT} is also acceptable. The rated voltage of C_{OUT} should be larger than the OVP threshold. For example, if the OVP threshold is 6.80V, the rated voltage of C_{OUT} should be 10V or higher.

FUNCTIONAL DESCRIPTION

Device Operation

If the BCT7915 is enabled and the input voltage is between UVLO and OVP threshold, the internal charge pump begins to work after debounce time, the gate of the nFET switch will be slowly charged high till the switch is fully on. ACOK will be driven low about 30ms after V_{IN} valid, indicating the switch is on with a good power input. Ifthe input voltage exceeds the OVP trip level, the switch will be turned off in about 50ns. If EN is pulled high, or input voltage falls below UVLO threshold, or over-temperature happens, the switch will also be turned off.

Surge Protection

The BCT7915 integrates a clamp circuit to suppress input surge voltage. For surge voltages between V_{IN_OVLO} and V_{IN_CLAMP}, the switch will be turned off but the clamp circuit will not work. For surge voltages greater than V_{IN_CLAMP}, the internal clamp circuit will detect surge voltage level and discharge the surge energy to ground. The device can suppress surge voltages up to 110V.

Over-Voltage Protection

If the input voltage exceeds the OVP rising trip level, the switch will be turned off in about 50ns. The switch will remain off until VIN falls below the OVP falling trip level.

OVP Threshold Adjustment

If the default OVP threshold is used, OVLO pin must be grounded. If OVLO pin is not grounded, and by connecting external resistor divider to OVLO pin as shown in the typical application circuit, between IN and GND, the OVP threshold can be adjusted as following:

$$V_{IN\_OVLO} = \frac{R1+R2}{R_2} V_{OVLO\_TH}$$

For example, if we select $R_1 = 1M\Omega$ and $R_2 = 100k\Omega$, then the new OVP threshold calculated from the above formula is 13.2V. The OVP threshold adjustment range is from 4V to 20V. When the OVLO pin voltage V_{OVLO} exceeds V_{OVLO_SEL} (0.26V typical), V_{OVLO} is compared with the reference voltage V_{OVLO_TH} (1.2V typical) to judge whether input supply is over-voltage.

ACOK Output

The device features an open-drain output ACOK, it should be connected to the system I/O rail through a pull- up resistor. If the device is enabled and $V_{IN\_UVLO} < V_{IN} < V_{IN\_OVLO}$, ACOK will be driven low indicating the switch is on with a good power input. If OVP, UVLO, or OT occurs, or EN is pulled high, the switch will be turned off and ACOK will be pulled high.

USB On-The-Go (OTG) Operation

If V_{IN} = 0V and OUT is supplied by OTG voltage, the body diode of the load switch conducts current from OUT to IN and the voltage drop from OUT to IN is approximately 0.7V. When $V_{IN} > V_{IN\_UVLO}$, internal charge pump begins to open the load switch after debounce time (about 15ms). After switch is fully on, current is supplied through switch channel and the voltage drop from OUT to IN is minimum.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IN}	Input DC voltage	3		28	V
C_{IN}	Input capacitance		0.1		μF
C_{OUT}	Output load capacitance		1		μF

PCB LAYOUT CONSIDERATION

To make fully use of the performance of BCT7915, the guidelines below should be followed.

1. All the peripherals should be placed as close to the device as possible. Place the input capacitor C_{IN} on the top layer (same layer as the BCT7915) and close to IN pin, and place the output capacitor C_{OUT} on the top layer (same layer as the BCT7915) and close to OUT pin.

2. If external TVS is used, IN pin routing passes through the external TVS firstly, and then connect BCT7915.

3. Red bold paths on figure 4 and 5 are power lines that will flow large current, please route them on PCB as straight, wide and short as possible.

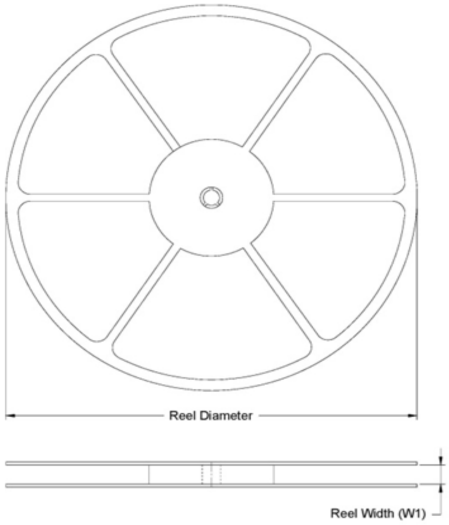
4. If R1 and R2 are used, route OVLO line on PCB as short as possible to reduce parasitic capacitance.

5. The power trace from USB connector to BCT7915 may suffer from ESD event, keep other traces away from it to minimize possible EMI and ESD coupling.

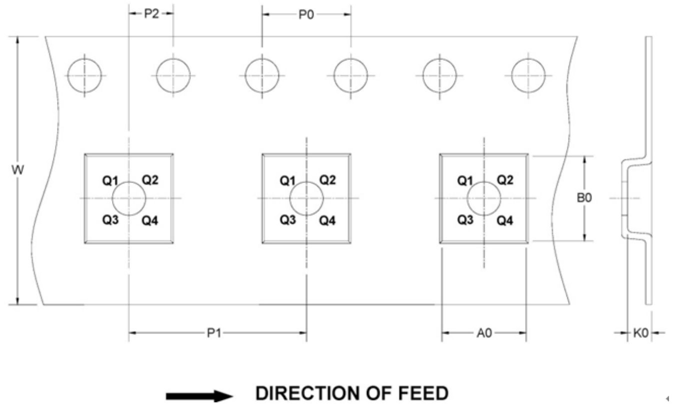
6. Use rounded corners on the power trace from USB connector to BCT7915 to decrease EMI coupling.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



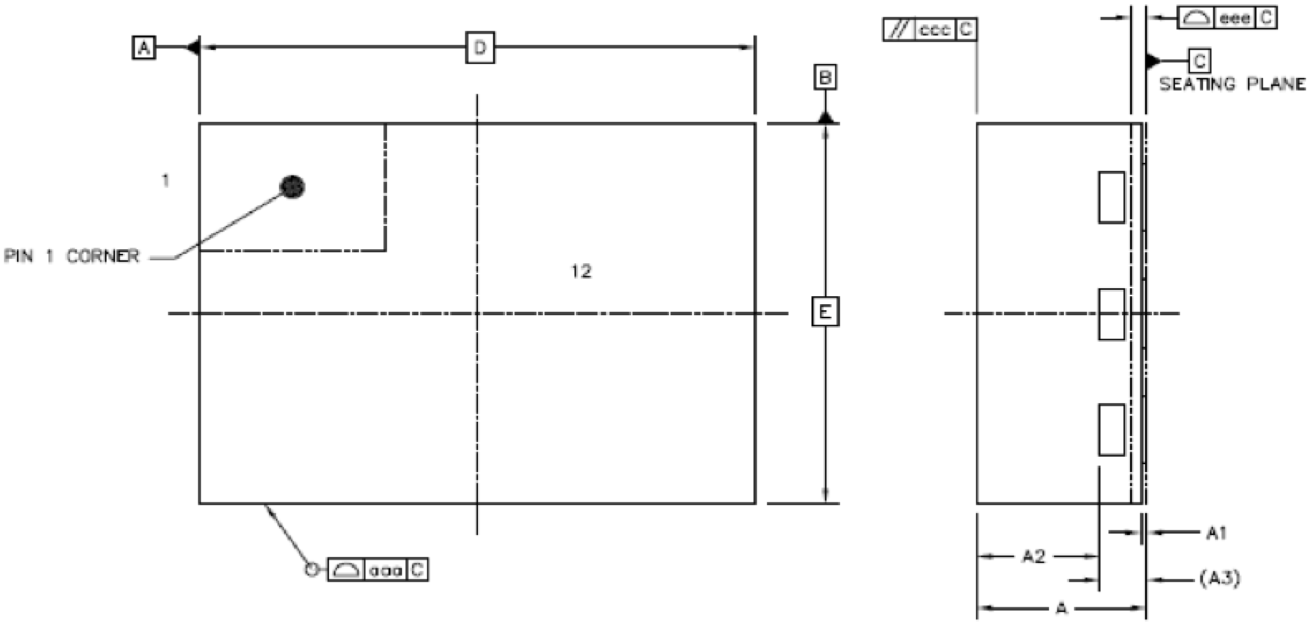
TAPE DIMENSIONS



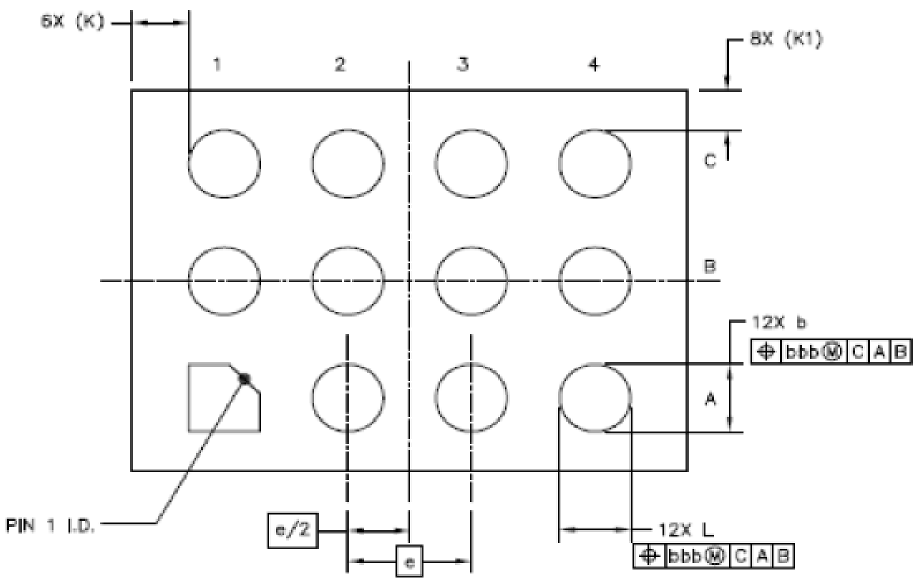
Reel Diameter	Unit: mm								Pin 1 Quadrant	Reel Q'ty
	Reel Width W1	A0	B0	K0	P0	P1	P2	W		
7"	9.5	1.5	2.02	0.74	4	4	2	8	Q2	3000

PACKAGE OUTLINE DIMENSIONS

QFNFC1.8X1.3-12L



TOP VIEW SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	Min	Nom	Max
A	0.5	0.55	0.6
A1	0	0.02	0.05
A2	---	0.4	---
A3	0.152REF		
b	0.18	0.23	0.28
D	1.8(BSC)		
E	1.3(BSC)		
e	0.4(BSC)		
L	0.18	0.23	0.28
K	0.185REF		
K1	0.135REF		
aaa	0.1		
ccc	0.1		
eee	0.05		
bbb	0.07		

QFNFC1.8X1.3-12L Surface Mount Package

单击下面可查看定价，库存，交付和生命周期等信息

[>>Broadchip(广芯电子)]