3A , 4.2V-20V Input , Multi-Cell buck-boost Switching Charger

GENERAL DESCRIPTION

PW4000 is a monolithic buck-boost charger that can operate over a wide input voltage range of 4.2V to 20V. The full chargevoltage and charge current can be programmable through external resistor. Low RDSON N-channel power switches reduce the solution complexity and improve the efficiency. The DC-DC converter utilizes proprietary single inductorcurrent-mode control to guarantee smooth transitionbetween buck and boost operation with better dynamic response and cycle-by-cycle current protection. Compensation is done internally onthe chip.The PW4000 operates in PFM mode at light load. In PFM mode, switching frequency is continuouslycontrolled in proportion to the load current, i.e. switch frequency is decreased when load current drops to boost power efficiency at light load by reducing switching-loss, minimizing the circuit.

The PW4000 can operate in charge mode if a logic High is on CE pin. In charge mode, if the VIN voltage is lower than battery voltage, it is a boost converter. When the VIN voltage is higher than battery voltage, it is a buck converter

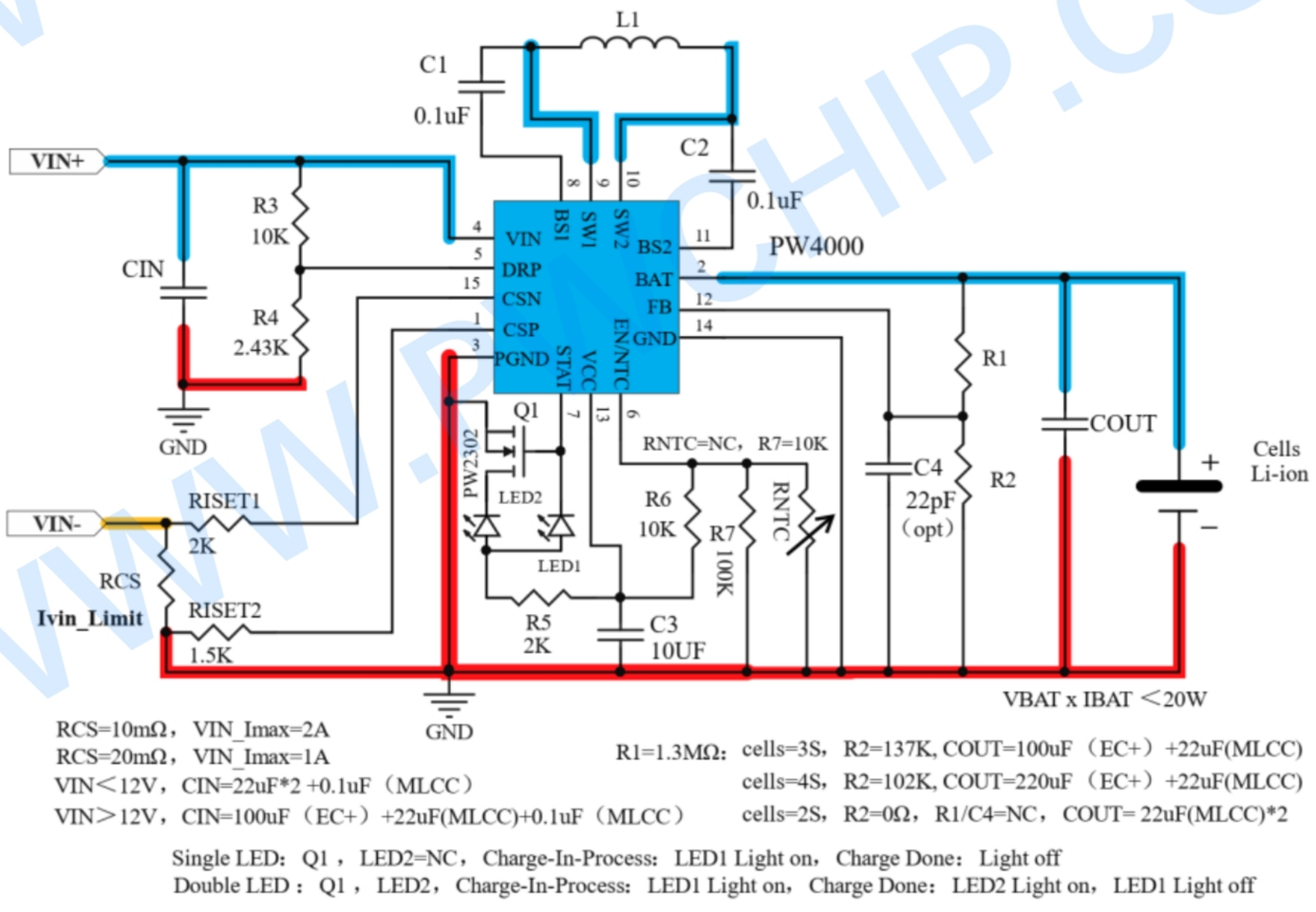
FEATURES

- Input range: 4.2V-20V
- 1 cell, 2cells, 3cells, 4cells battery charge
- FB pin selectable battery charge voltage
- 450kHz Switching frequency
- batteryshort protection
- thermal protection
- QFN 3 x 4-15L package
- Programmable charge current, up to 3A

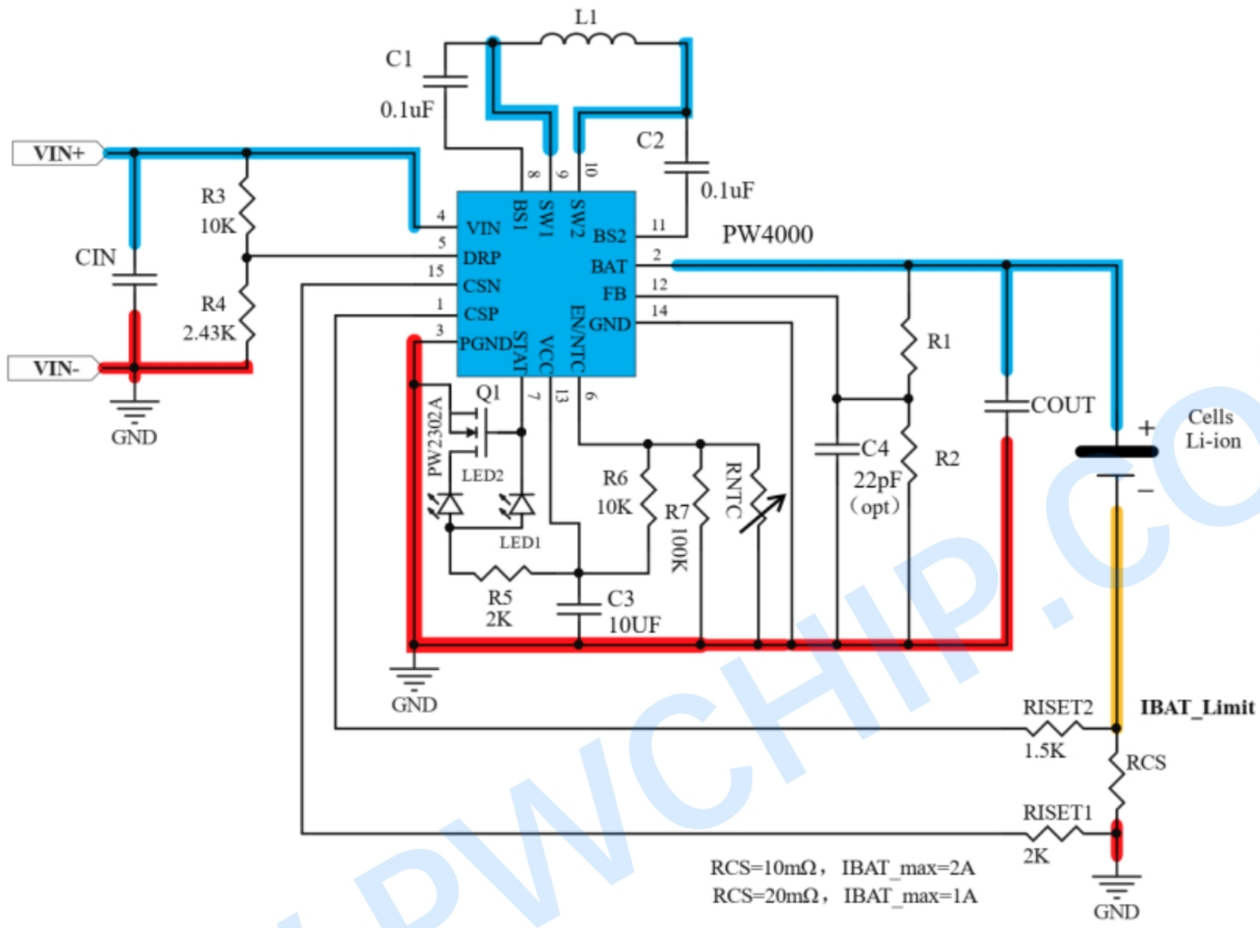
APPLICATIONS

- Cellular Telephones,
- PDA, MP3 Players, MP4 Players
- Digital Cameras
- Bluetooth Applications

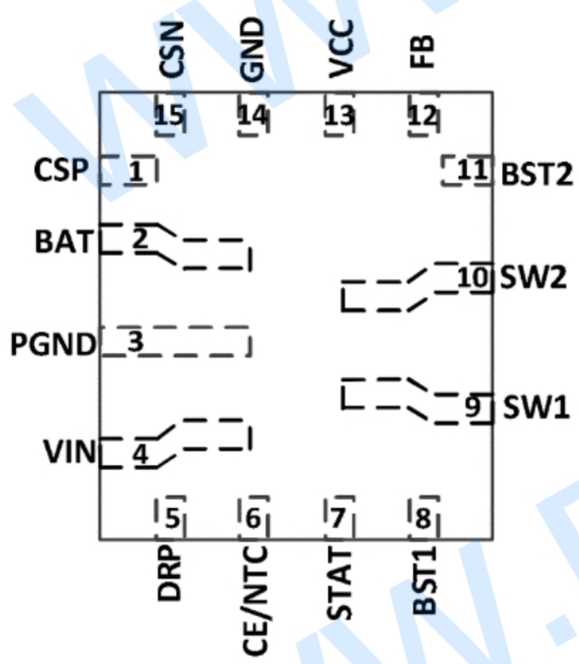
TYPICAL APPLICATION CIRCUIT



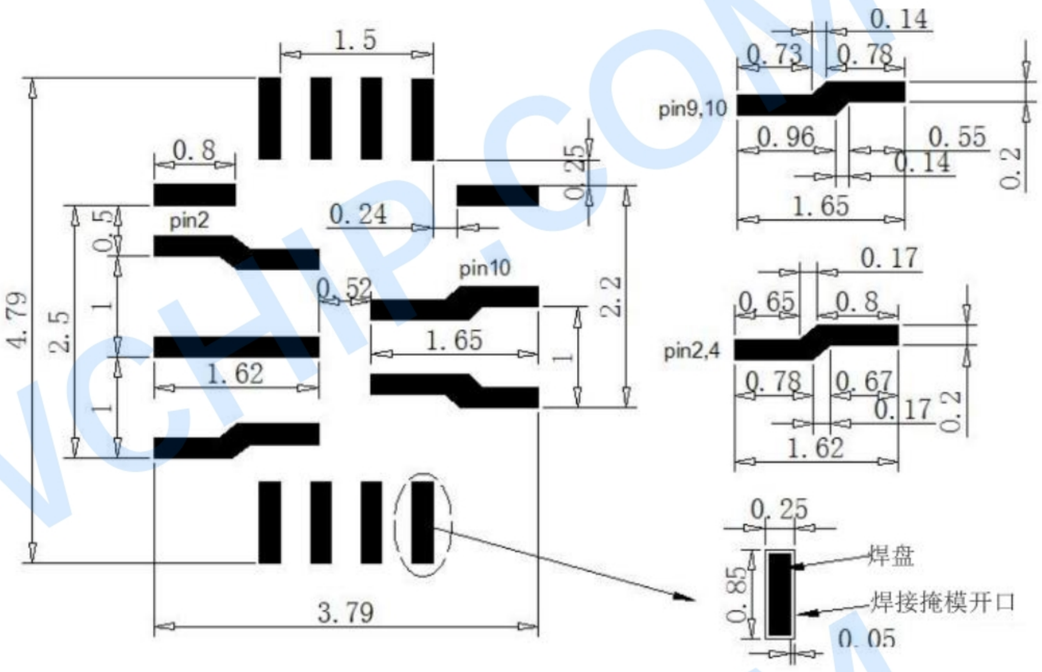
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PIN ASSIGNMENT/DESCRIPTION



QFN 3 x 4-15L

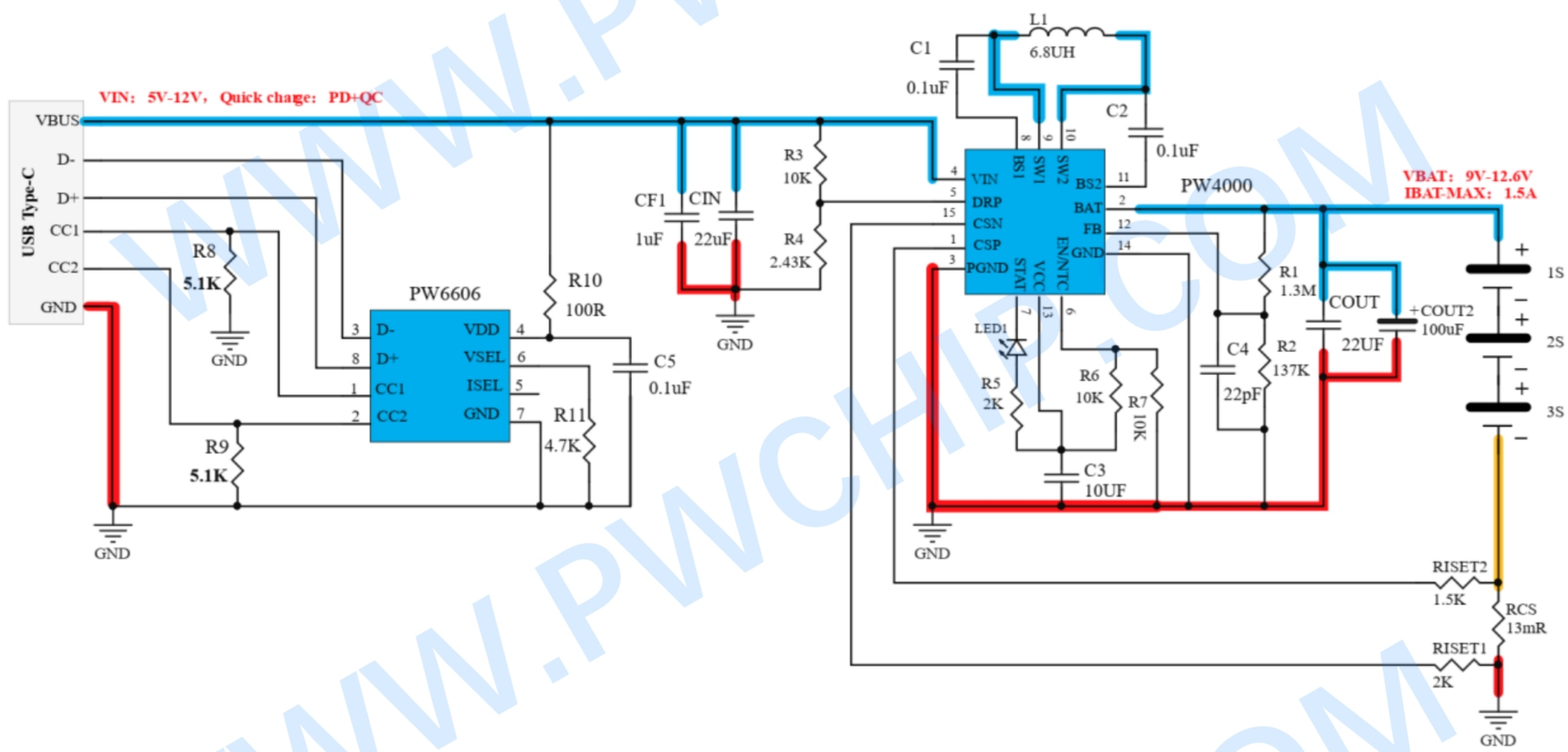


Pin Number	Pin Name	Function
1	CSP	Positive terminal of battery charge current sense
2	BAT	Battery positive pin
3	PGND	Power Ground.
4	VIN	Main supply pin, connect to adaptor.
5	DRP	VIN droop allowance program pin.
6	CE/NTC	This is a multi-purpose pin.1. Charge enable pin.2. Battery temperature protection pin.
7	STAT	Open-drain charge status output. Connect the STAT pin to a logic rail via 10kΩ resistor. The STAT pin indicates charger status. Connect a current limit resistor and a LED from VCC to this pin. Charge in progress: LOW Charge complete or charger in SLEEP mode: HIGH ,Charge suspend (fault response): 1Hz, 50% duty cycle pulses.
8	BST1	VIN side bootstrap supply pin for top switch. 0.1uF capacitor is connected between

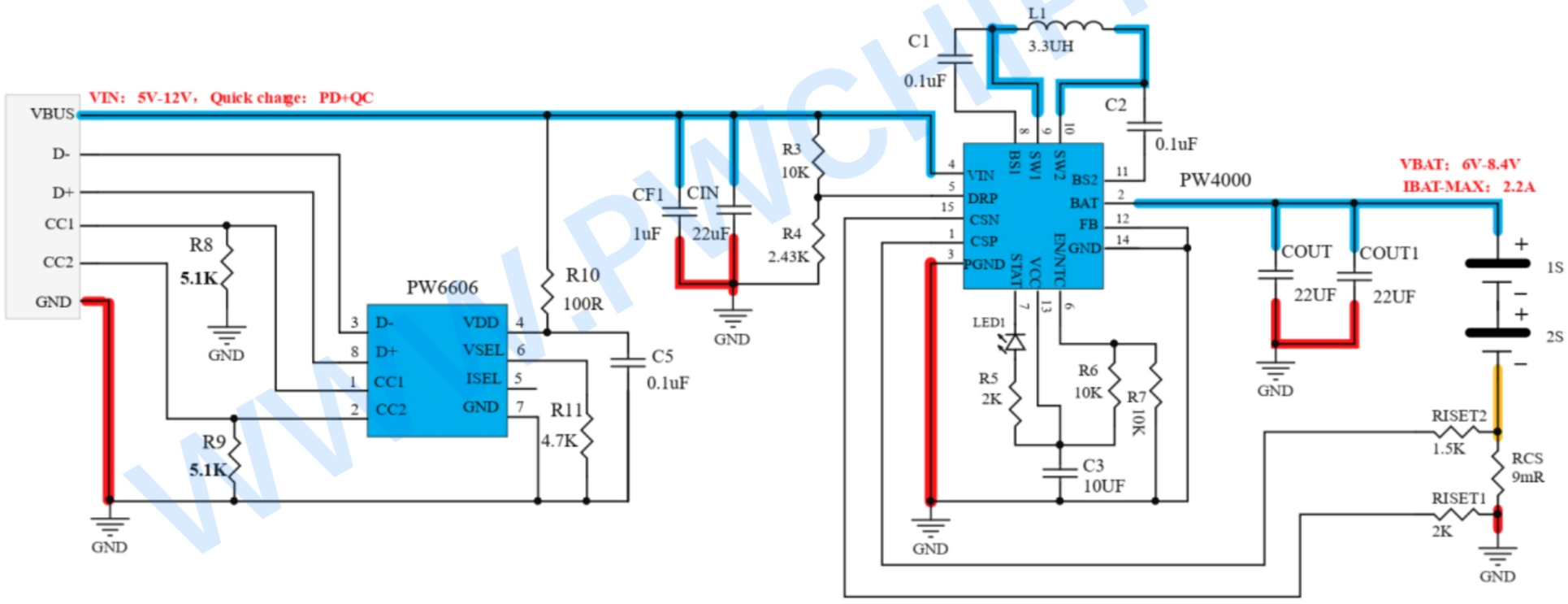
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		BST1 and SW1 pins.
9	SW1	VIN side power switching node. connect to SW2 with inductor
10	SW2	BAT side power switching node.
11	BST2	BAT side bootstrap supply pin for top switch. 0.1uF capacitor is connected between BST2 and SW2 pins.
12	FB	Battery float voltage configuration pin. VBAT=【(R1÷R2)+1】×1.2V VBAT range = 3V∽17V
13	VCC	5V LDO for power driver and internal circuit. Must be bypassed to GND with a minimum of 10uF ceramic capacitor for stable operation.
14	GND	Signal GND.
15	CSN	Negative terminal of battery charge current sense.

VIN：5V-12V，Quick charge：PD+QC VBAT：12.6V 1.5A



VIN：5V-12V，Quick charge：PD+QC VBAT：8.4V 2.2A



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Absolute Maximum Ratings (note)

Parameter		VALUE	Unit
VIN, BAT, SW1,SW2 PIN		-0.3-24	V
BST1-SW1, BST2-SW2		-0.3- 6.5	V
All Other Pins		-0.3- 6.5	V
HBM ESD Susceptibility		2000	V
Package Thermal Resistance	θJA	48	°C/W
	θJC	11	°C/W
Junction Temperature		-40-150	°C
Lead Temperature (Soldering, 10 sec.)		260	°C
Storage Temperature Range		-65 to 155	°C

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

ELECTRICAL CHARACTERISTICS

(TA=25°C, VIN=5V, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VBAT	VBAT voltage range		3.0		21	V
VCC	VCC output voltage		4.7	5.0	5.3	V
VCE	Charge enable Threshold		14.7%	16.7%	18.7%	VCC
VBAT	Floating BAT Voltage	VFB =GND	8.358	8.4	8.442	V
VBAT	Floating BAT Voltage	Set by divider resistor	3.0		17	V
VFB	BAT feedback voltage	External resistor divider	1.191	1.2	1.212	V
VREC	BAT Recharge threshold	VFB = GND	8.118	8.2	8.282	V
VRECFB	BAT recharge feedback threshold	External resistor divider	1.159	1.171	1.183	V
VIN_UVP	VIN UVP threshold	VIN rising	4.0	4.2	4.3	V
VIN_UVP	VIN UVP threshold	VIN falling	3.8	4.0	4.1	V
IVCC	VCC output current limit	VCC>2.7V		50		mA
IQ	Supply current in shut-down mode	VBAT=8V, CE=0V		3	5	μA
Fsw	Switch frequency		350	450	450	kHz
Toff_min	Switch minimum off time		80	100	120	ns
RdsbkTG	Bucktop switch on-resistance			20	28	mΩ
RdsbkBG	Buck bottom switchon-resistance			20	28	mΩ
RdsbstTG	Boost top switch on-resistance			20	28	mΩ
RdsbstBG	Boost bottom switch on-resistance			20	28	mΩ
ICC	CC mode charge current	RCS=10mΩ,RISET1=2K RISET2=1.5K	1.9	2	2.1	A
ITER	Charge termination current	RCS=10mΩ,RISET1=2K		10%		ICC

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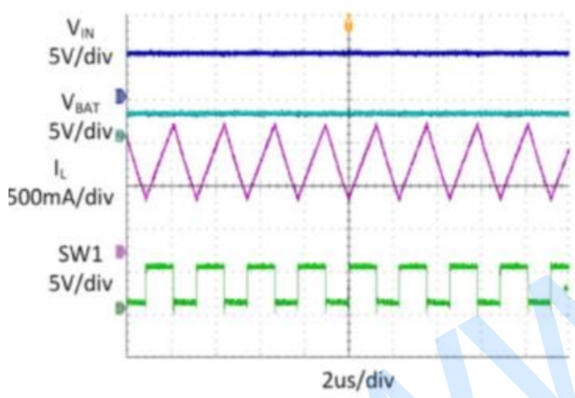
		RISET2=1.5K				
TFULL	Battery full charge deglitch time	ICC< ITER		500		ms
ITRI	Trickle mode charge current		10%	20%	30%	ICC
VTRI	Trickle mode battery threshold	VFB = GND	5.9	6.0	6.1	V
VTRIFB	Trickle mode feedback threshold			0.857		V
TTRI	Trickle charge time-out duration			55		min
Tchg_delay	VIN delay to start charging			150		ms
VDRP	DRP reference voltage for adaptive current limit		0.885	0.9	0.915	V
VUTP	Battery under temperature protection threshold		70.2%	72.2%	74.2%	Vcc
VOTP	Battery over temperature protection threshold		27.2%	29.2%	31.2%	Vcc
TSHUT	Thermal shutdown threshold			150		°C
TREC	Thermal recovery threshold			130		°C

Typical Performance Characteristics

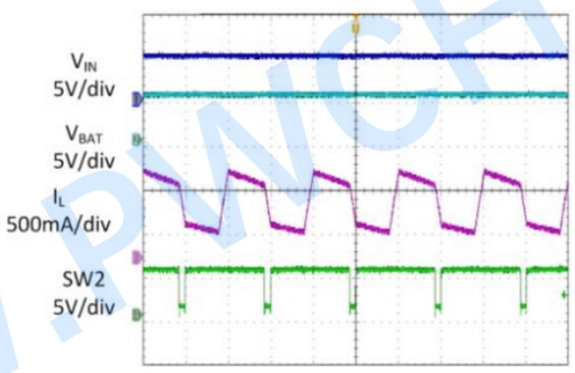
(TA=25°C, VIN=5V, L1 = 3.3μH, CIN= 22μF, COUT = 22μF, unless otherwise specified)

Tricklecharge

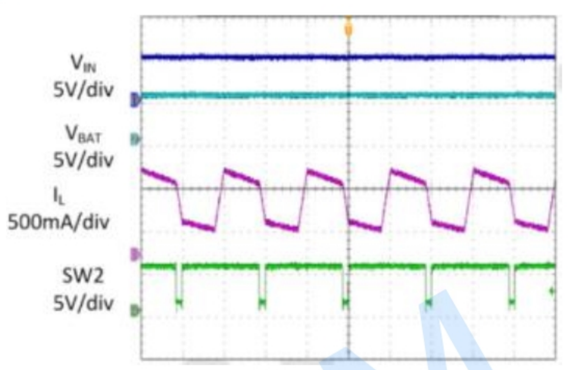
1 cell



2 cells

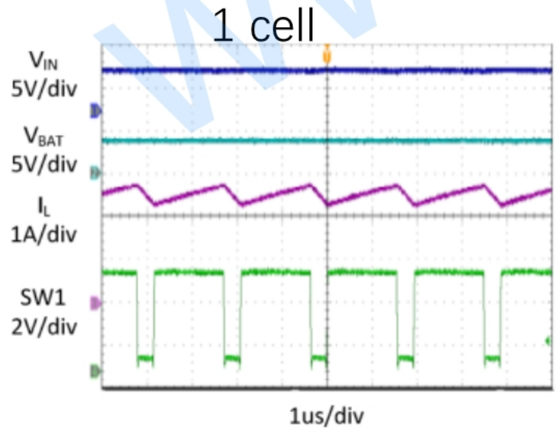


3 cells

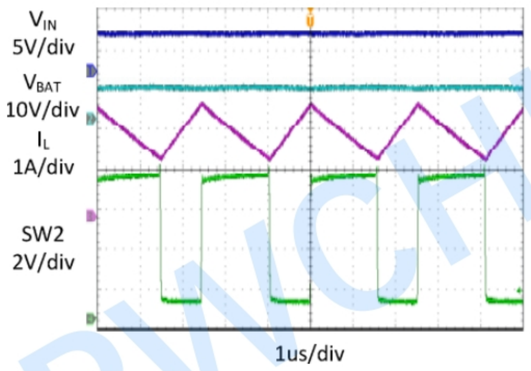


Constantcurrentcharge

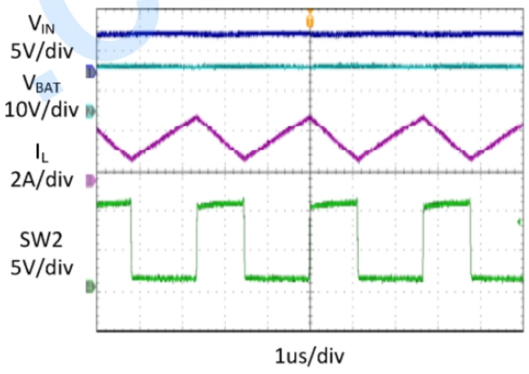
1 cell



2 cells

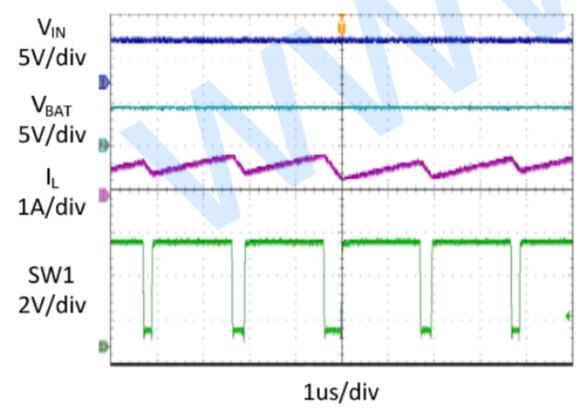


3 cells

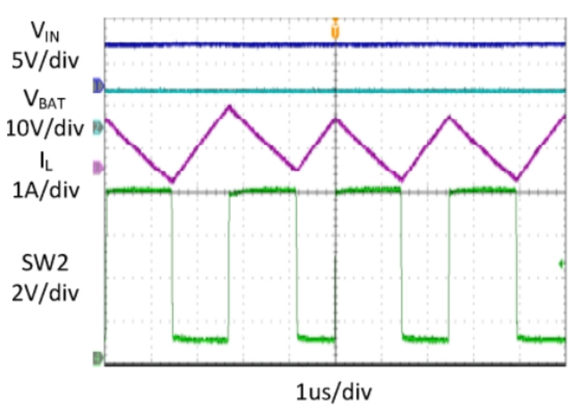


Constantvoltagecharge

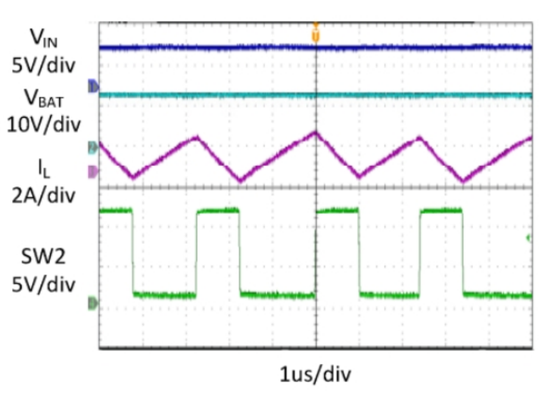
1 cell



2 cells



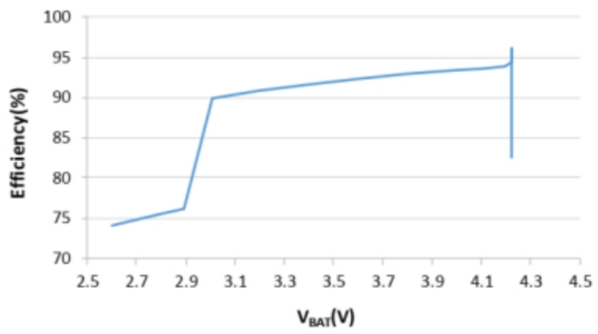
3 cells



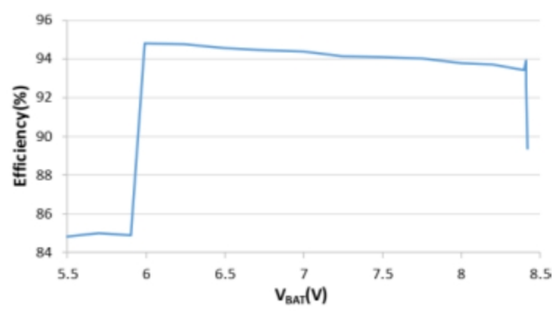
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Charge efficiency

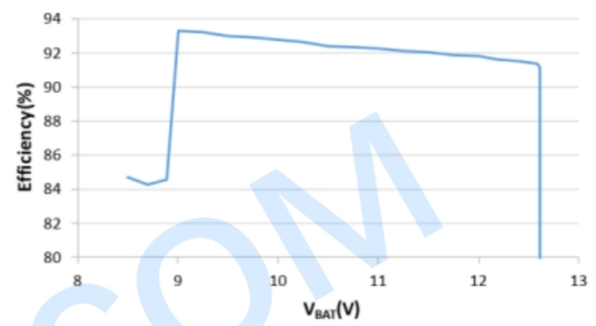
1 cell



2 cells

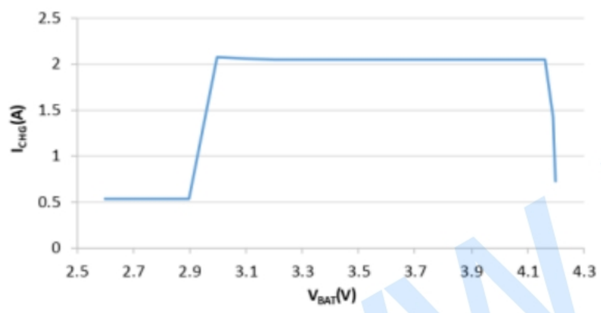


3 cells

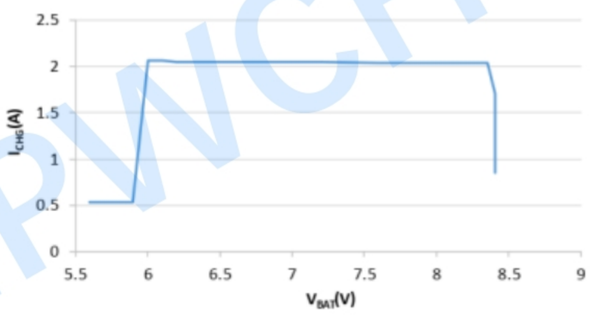


Charge efficiency

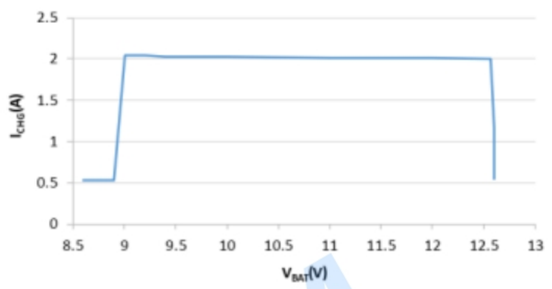
1 cell



2 cells



3 cells

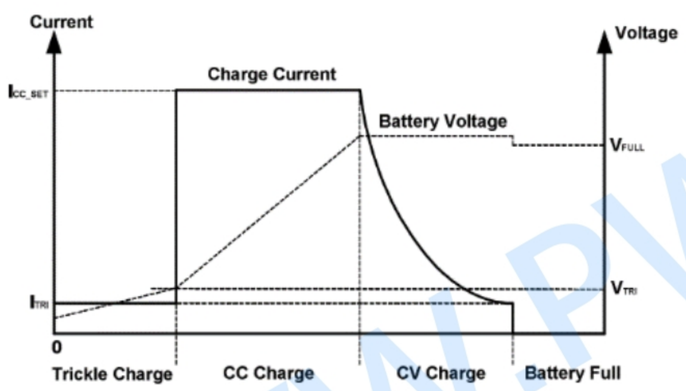


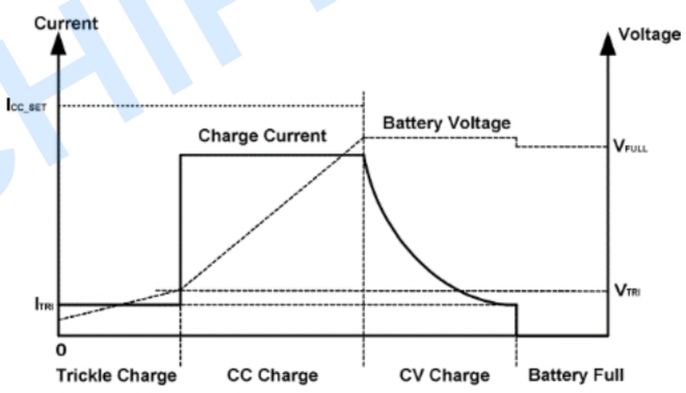
Function Description

The PW4000 is a buck boost converter targets HVDC fast charging system. The PW4000 supports 1 to 4 cells Li-ion battery, the full charge voltage and charge current can be programmed through external resistor. The PW4000 implements the Buck Boost converter with an H-bridge. The integrated low RDS(on) MOSFET minimizes physical footprint, maximizescharge efficiency. Built-in loop compensation simplifies the circuit and design. PFM is engaged to maintain high efficiency at light load current. PW4000 guarantees robustness with thermal protectionand battery under voltage lockout.

Charge mode

In charge mode, PW4000 regulates the battery current according to input voltage and battery voltage. It charges battery with three phases: trickle charge, constant current charge, constant voltage charge and charge termination. Figure 1 is a typical charge profile. Figure 2 is a charge profile with input current limit. When the input current is limited, the system decreases the charge current.





Trickle charge

The PW4000 charges the battery with ITRI when battery voltage is less than VTRI. If charging remains in TC mode beyond the trickle-charge time TTRI, charging terminates.

CC charge

When the battery is higher than VTRI, the device charges the battery with ICC if the input current is sufficient. When input current limit is hit, the device reduces the charge current automatically. The PW4000 can set the charge current through RISET1 and RISET2, we recommend RISET1/RISET2 is

around 4/3.The maximum charge current is up to 3A

$$(A)\quad ICC=(\ 10\times RISET1\ (K\Omega))\div RCS\ \ (m\Omega)$$

For 1A cc charge current, we recommend RISET1=2k, RISET2=1.5k, RCS=20mΩ;

For 2A cc charge current, we recommend RISET1=2k, RISET2=1.5k, RCS=10mΩ.

CV charge

When battery voltage equals to VBAT, the device regulates the battery voltage and reduces the charge current reduces automatically. The customer can select 2 cells or program the VBAT through FB pin. Connect FB to GND selects 2 cells. The VBAT can also be programmable by resistor divider connected to FB, when the PW4000 detect a resistor connect to this pin. We recommend the 1‰ accuracy resistor should be used in order to achieve the accuracy of full charge voltage.The full charge voltage configuration shows in

$$VBAT=【(R1\div R2)+1】\times 1.2V \qquad VBAT\ range = 3V\backsim 17V$$

Charge termination

If the battery voltage is higher than VFULL, and the charge current is less than charge termination current ITER for TFULL, the charge process terminates.

Auto recharge

Once the battery charge cycle completes, the charger remains off. A new charge cycle automatically begins when the battery voltage falls below the auto-recharge threshold VREC if the input adaptor is present. The idle mode to charge mode transition also restarts the charge cycle.

Charging status indication

The PW4000 has open-drain output for charge status. Connect a current limit resistor and a LED from VCC to this pin can. When charge is in progress, the STAT pin output LOW. When charge is completed or charger is in sleep mode, the STAT pin is output HIGH. When charge suspend at fault condition, the STAT pin blinks at 1Hz.

Dynamic input Current Tracking Scheme

PW4000 detects the VIN pin, if the VIN pin voltage is higher than VIN_UVP rising threshold for 150ms, the PW4000 starts charging with a limited charging current. When the adaptor is over load, the DRP pin drops below the internal reference 0.9V, PW4000 will decrease the charging current. We recommend the ratio of R3/R4 is around 4.1. The input voltage sense shows , choose R3, R4 to set the input voltage threshold.

$$V_{IN_ALLOWANCE}\ (V)=\ 【(R3\div R4)+1】\times V_{DRP}(V)$$

Thermal Control

We of the PW4000 rises above 150°C, the discharging process stops.

Shut-down Mode

The PW4000 shuts down when voltage at CE pin is below charge enable threshold. The entire regulator is off

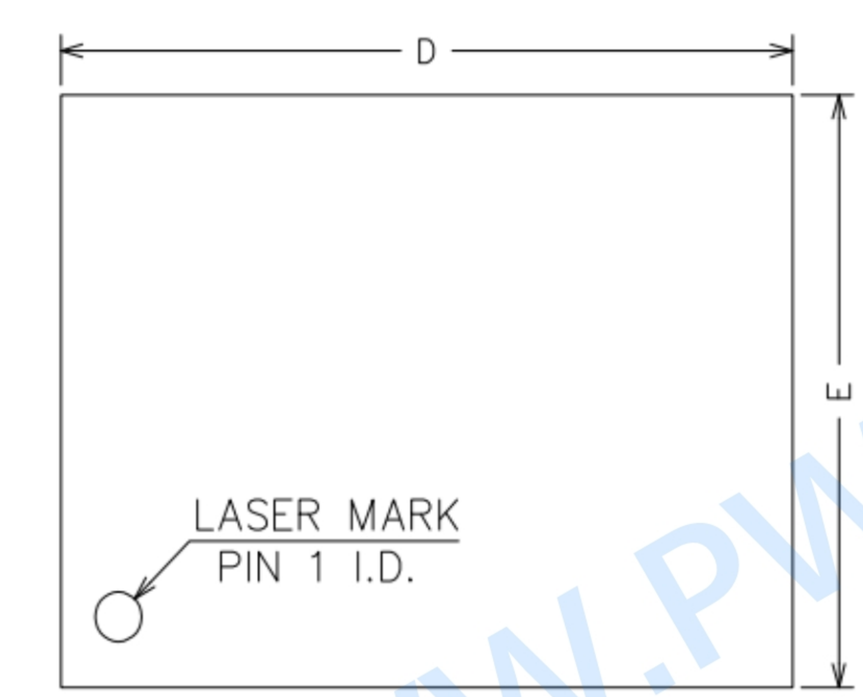
Battery temperature protection

For battery protection during charge mode, the device monitors the battery temperature through NTC pin. When the voltage of the NTC pin is outside the thresholds, the charge progress is suspended. In additional, STAT pin blinks at 1Hz to inform fault condition. Once temperature returns within thresholds, the charge is recovered.

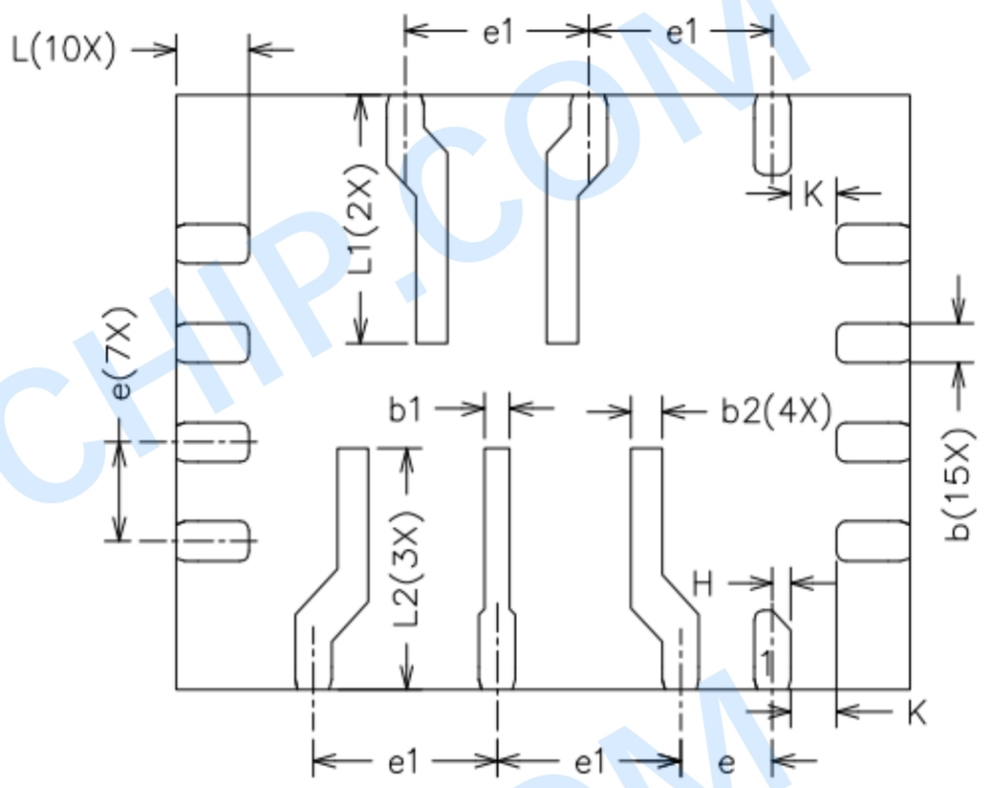
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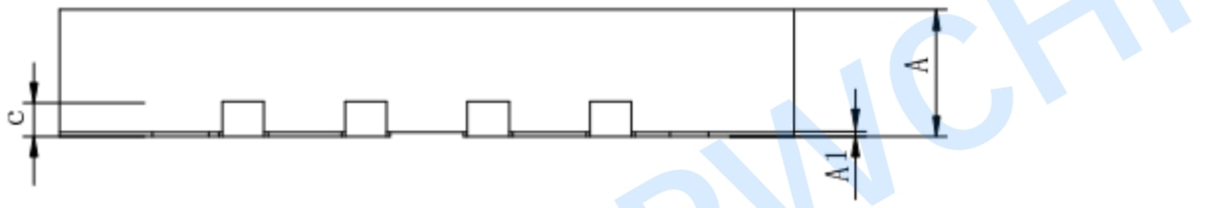
QFN3X4-15



TOP VIEW



BOTTOM VIEW



SIDE VIEW

	MIN	NOM	MAX
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
c		0.15REF	
b	0.15	0.20	0.25
b1	0.09	0.14	0.19
b2	0.12	0.17	0.22
D	3.90	4.00	4.10
E	2.90	3.00	3.10
e	0.40	0.50	0.60
e1	0.90	1.00	1.10
H		0.10REF	
K	0.15	0.25	0.35
L	0.30	0.40	0.50
L1	1.15	1.25	1.35
L2	1.12	1.22	1.32

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