36V Input, 3.5A output USB Charging Total Solution IC in QFN3x3-16

DESCRIPTION

The ETA2831 is a total solution IC specifically for high voltage USB charging applications. It includes a wide input range, high-efficiency, and high frequency DC-to-DC step-down switching regulator that is capable of delivering up to 4A of output current and a low side USB current limiting switch. The DC-DC in ETA2831 is a current mode converter with a fixed-frequency that is externally adjustable. There is also a cable resistance compensation feature that allows users to adjust the output voltage to compensate for the voltage drop due to cable resistance.

An OVP function protects the IC itself and its downstream system against input voltage surges. With this OVP function, the IC can stand off input voltage as high as 42V, making it an ideal solution for industrial applications such as smart meters as well as automotive applications. In automotive systems, power comes from the battery, with its voltage typically ranges between 9V and 24V. Including cold crank and double battery jump-starts, the minimum input voltage may be as low as 4V and the maximum up to 36V, This makes ETA2831 ideal for the automotive application.

There is also a low side current limiting USB switch in ETA2831. The current limit is internally set at 1A. Since the total output current limit of the DCDC can be externally adjusted with a resistor, this 1A USB switch provides flexible configurations for two-port USB charging system.

FEATURES

- **Wide Input Operating Range from 4V to 36V**
- **Standoff Input Voltage: 42V**
- **High Efficiency at 12V In 5V Out: Up to 91%:**
- **High Efficiency PFM mode at light load**
- **Capable of Delivering 3.5A output current**
- **Peak Output Current up to 4A**
- **Cable resistance compensation**
- **Adjustable Switching frequency**
- **Adjustable Output current limit**
- **Frequency dithering Option for low EMI available**
- Current Mode control
- Logic Control Shutdown
- Thermal shutdown and UVLO

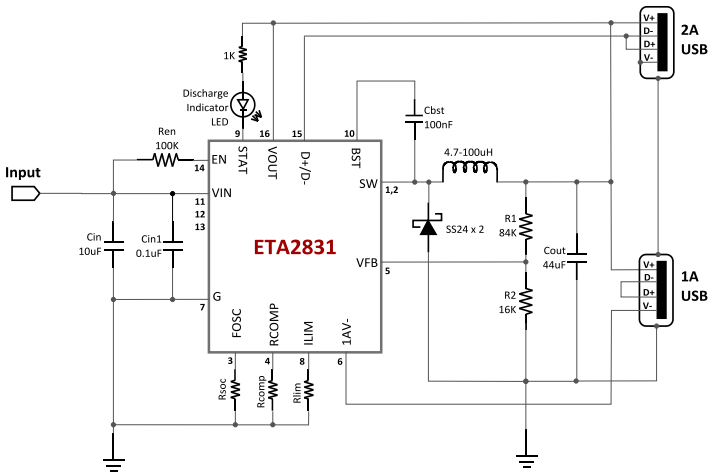
APPLICATIONS

- Car Charge ports
- Multi-cell Li-ion Battery Charger

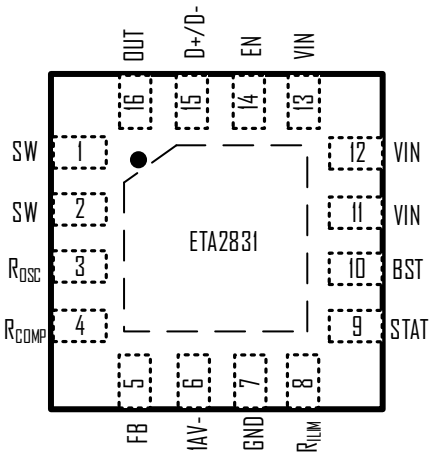
ORDERING INFORMATION

PART	PACKAGE	TOP MARK
ETA2831Q3Q-T	QFN3X3-16	ETA2831

TYPICAL APPLICATION



PIN CONFIGURATION



QFN3x3-16

ABSOLUTEMAXIMUM 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 42V
SW, EN Voltage .....–0.3V toVIN+0.3V
BST Voltage .....-0.3V to SW+6V
Other Pins Voltage.....-0.3V to +0.3V
SW to ground current.....Internally limited
Operating Temperature Range .....–40°C to 85°
Storage Temperature Range .....–55°C to 150°C
Thermal Resistance θ_{JA}
QFN3X3-16.....50 .....oC/W
Lead Temperature (Soldering, 10ssec) .....260°C
ESD HBM (Human Body Mode) 2KV
ESD MM (Machine Mode) 200V

ELECTRICAL CHACRACTERISTICS

(V_{IN} =12V, unless otherwise specified. Typical values are at TA = 25°C.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Standoff Voltage		42			V
Input Voltage Range		4		36	V
Input UVLO	Rising. Hysteresis=150mV		3.80		V
Input OVP	Rising. Hysteresis=1.5V		37.5		V
Input Supply Current	V_{FB}=0.85V. no switching		0.85	1	mA
Input Shutdown Current			6		μA
FB Voltage		0.776	0.800	0.824	V
FB Input Current		-1	0	1	μA
Switching Frequecy	R_{OSC}=200KΩ		500		KHZ
FoldBack Frequency	V_{FB}=0, R_{OSC}=200KΩ		125		KHZ
Maximum Duty Cycle	f_{OSC} < 600KHZ	90			%
High side Switch On Resistance	I_{SW}=200mA		100		mΩ
High side Switch Current Limit	R_{ILIM}=250KΩ		4		A
SW Leakage Current	VIN=12V,V_{SW}=0, EN= GND			10	μA
IAV- Drain Current Limit	V_{IAV-}=0.2V	1.05	1.2	1.35	A
IAV- Lower Side NMOS On Resistance	I_{IAV-}=1A		150		mΩ
IAV- Leakage Current	EN=GND	-1	0	1	μA
Short Circuit Hiccup time	ON		0.5		ms
	OFF		100		ms
EN Input Current	VIN=12V, V_{EN}=5		0.1	5	μA

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
EN Input Low Voltage	Rising, Hysteresis=100mV	0.8	1.05	1.4	V
$R_{DM}1$	D+/D- output impedance at Divider Mode	28	39	50	kΩ
$R_{DM}2$	D+/D- output impedance at Samsung Mode	9	13	17	kΩ
Thermal Shutdown	Rising, Hysteresis=30°C		150		°C

PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1,2	SW	Inductor Connection. Connect an inductor between SW and the regulator output.
3	R_{OSC}	Frequency Setting. Connect a resistor from this pin to GND to set the switching frequency.
4	R_{COMP}	Cable Resistance Compensation adjust pin. Connect a resistor from this pin to GND to compensate for voltage drop due to cord resistance
5	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set VOUT
6	1AV-	Negative terminal of the 1A port
7	GND	Ground
8	R_{ILIM}	Current Limit Setting. Connect a resistor from this pin to GND to set the current limit value.
9	STAT	Status display. It is low resistance when there is heavy load.
10	BST	Bootstrap pin. Connect a 100nF capacitor from this pin to SW
11,12,13	VIN	Supply Voltage. Bypass with a 10μF ceramic capacitor to GND
14	EN	Enable pin for the IC. Drive this pin high to enable the part, low to disable.
15	D+/D-	Connected to the D+ and D- line of USB connect, provide the correct voltage with attached portable equipment for USB Dedicated Charging Port (DCP) Emulator.
16	OUT	Output Voltage.

APPLICATION INFORMATION

Peripheral Capacitor and Inductor Selection

Table 1 .Recommended Peripherals

Frequency (KHZ)	Cin (uF)	Cout (uF)	L(μH)	VOUT (V)
150	10	22x2	68-100	5
300	10	22x2	6.8-22	5
500	10	22x2	4.7-10	5
1000	10	22x2	2.2-4.7	5
2000	10	22x2	1.0	5

Setting the Switching Frequency

The ETA2831 uses a constant frequency PWM architecture that can be programmed to switch from 100kHz to 2MHz by using a resistor tied from the R_{OSC} pin to ground. A table showing the necessary R_{OSC} value for a desired switching frequency is below.

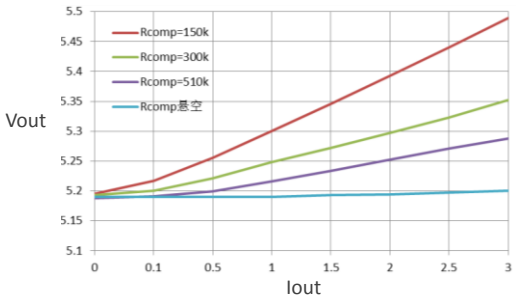
Table 2. SW Frequency vs R_{OSC} Value

ROSC(kΩ)	f(kHZ)
82	1000
100	857
150	574
220	400
330	282
390	241
470	200
680	140

Cable Resistance compensation

The ETA2831 has a cable cord resistance compensation feature to compensate the voltage drop due to cord resistance. The amount of added output voltage can be adjusted by an external resistor connected between RCOMP and GND pin.

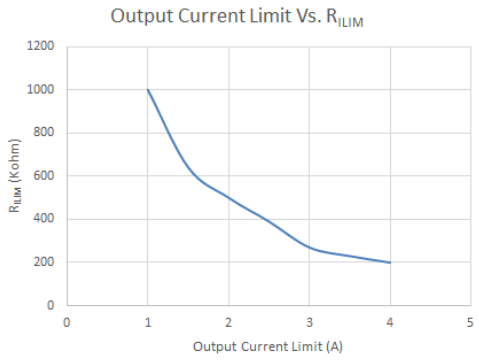
Iout	Rcomp=150k	Rcomp=300k	Rcomp=510k
0	5.195	5.193	5.188
0.1	5.217	5.201	5.191
0.5	5.256	5.221	5.2
1	5.3	5.248	5.216
1.5	5.346	5.272	5.234
2	5.393	5.297	5.252
2.5	5.44	5.323	5.271
3	5.489	5.352	5.288



Setting of Output Current Limit

Given the input voltage, inductor value and oscillation frequency, the output current limit can be set by external resistor connected to R_{ILIM} pin. Several typical current limit setting is listed in following table at Vin=12V, f=300KHz and L=6.8uH.

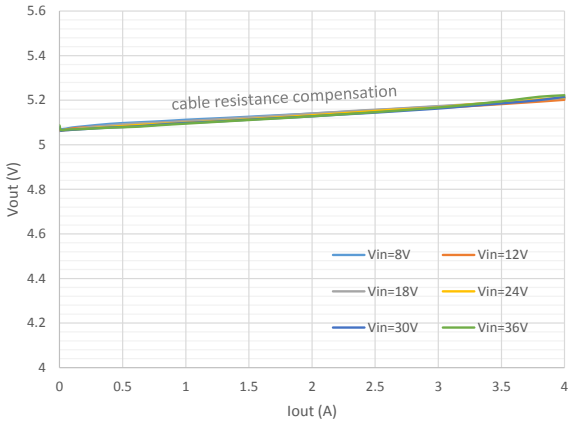
Output Current Limit (A)	**R_{ILIM} (K)**
1	1000
1.5	640
2	500
2.5	390
3	270
3.5	230
4	200



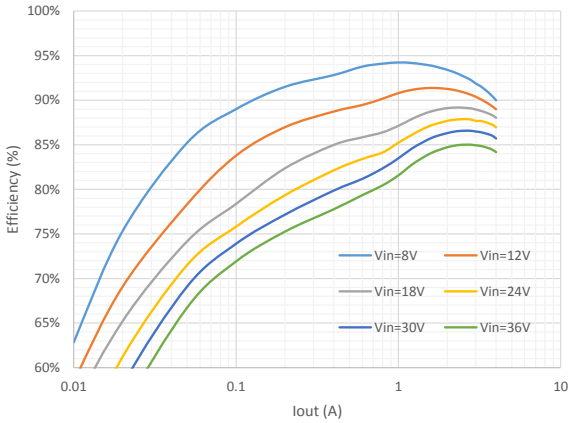
TYPICAL CHARACTERISTICS

(Vin=12V, Vout=5V, Rcomp=510ohm for cable resistance compensation, T_A=25°C, unless otherwise specified)

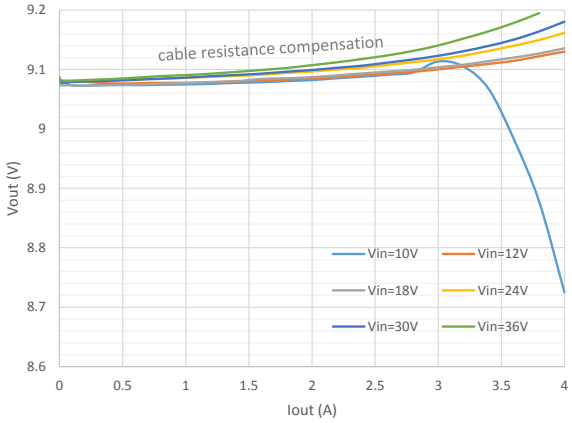
Vout Vs Iout
(Vout set to be 5V)



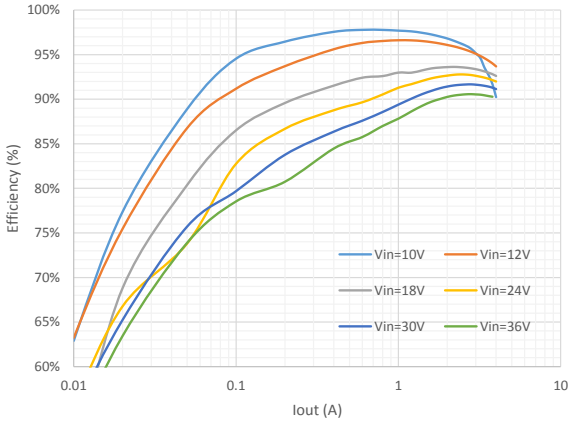
Efficiency Vs Iout
(Vout set to be 5V)



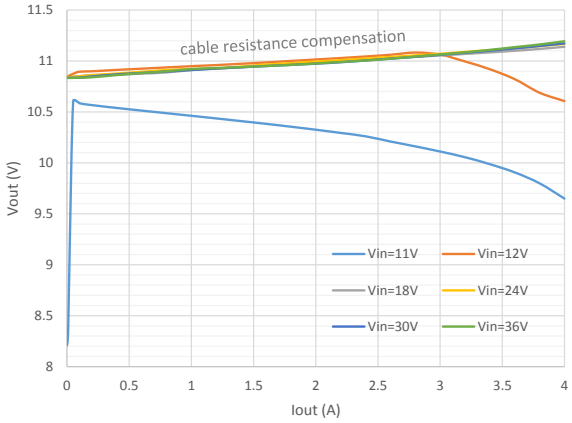
Vout Vs Iout
(Vout set to be 9V)



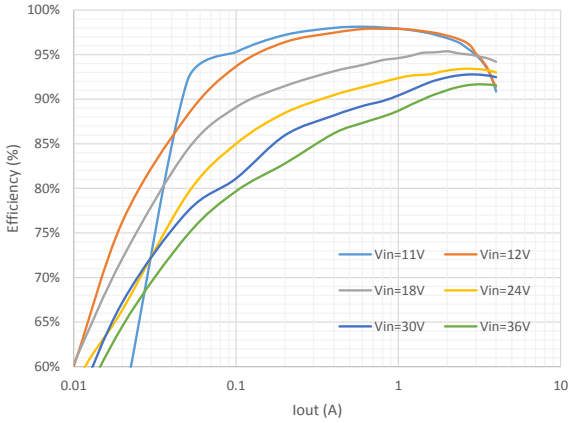
Efficiency Vs Iout
(Vout set to be 9V)

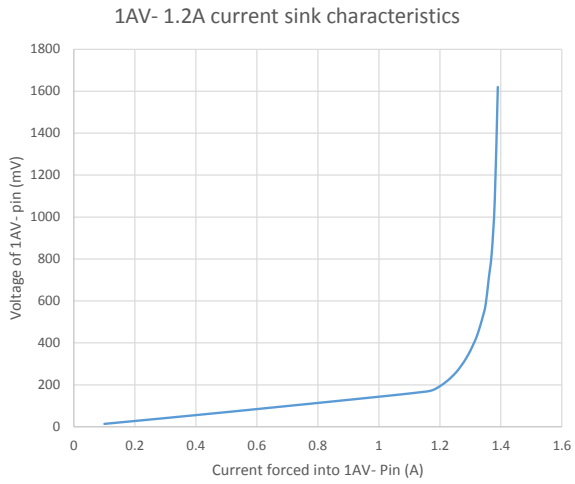


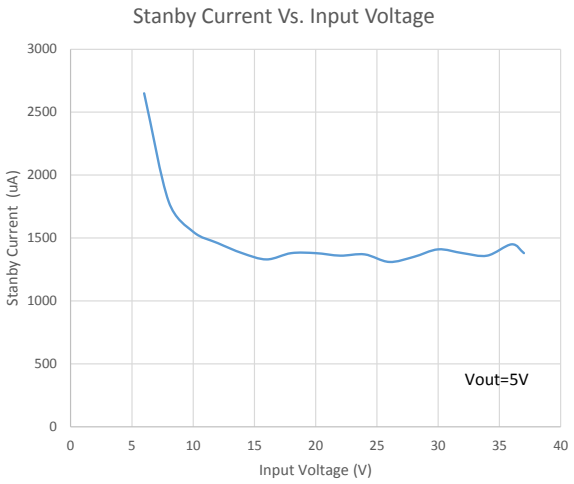
Vout Vs Iout
(Vout set to be 10.8V)



Efficiency Vs Iout
(Vout set to be 10.8V)

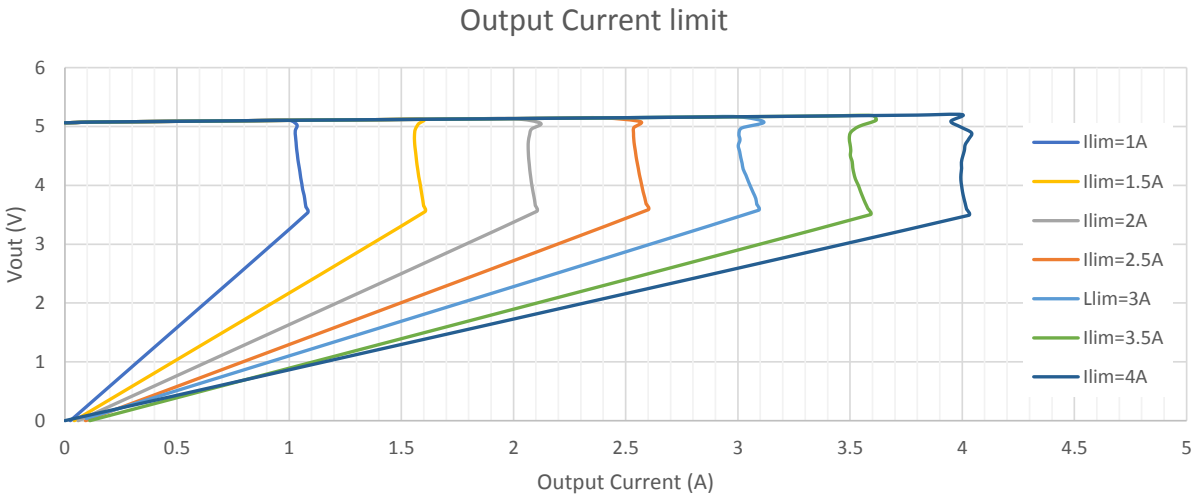






Output Current Limit Characteristic

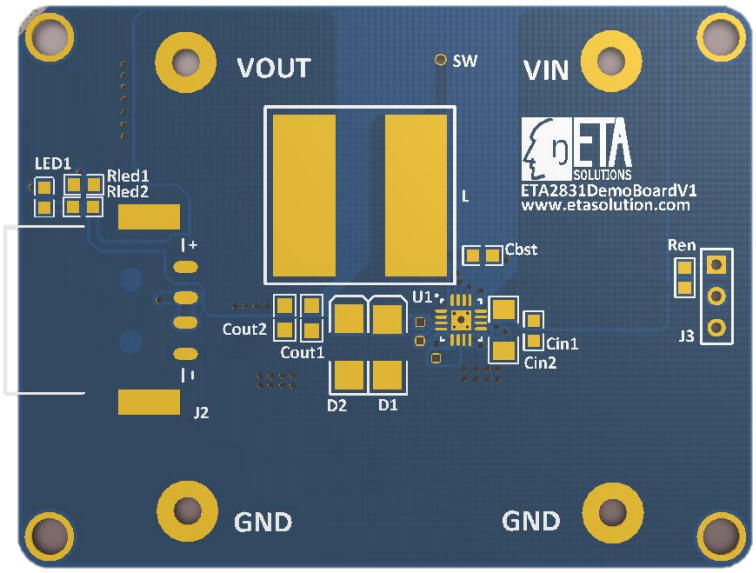
Vin=12V, Vout=5V, L=6.8uH, f=300KHz, Rcomp=510Kohm



Heat Consideration and PCB Guideline

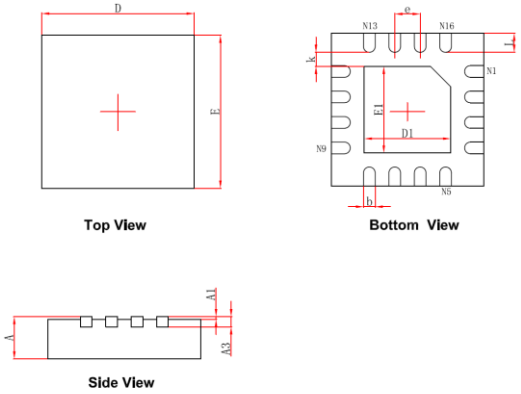
ETA2831 can deliver current up to 4A, and there will be a large amount of heat generated by the chip even though the efficiency is higher than 90% in most cases. Beside the ETA2831 itself, the 2 Schottky Diode (SBD) also generate a lot of heat. Please draw large heat sink area in PCB for ETA2831 and the 2 SBDs. In addition, 2 oz copper is recommended to be used on the PCB for better heat dissipation. Keeping SBDs and ETA2831 a little bit away from each other is also a good way to control the heat issue by having the heating source not too close to each other.

A picture of DEMO PCB is shown below. Please place the input capacitor (Cin1 and Cin2) as close to the chip as possible and placing this input capacitor is always the highest priority in drawing a PCB for ETA2831.



Package Outline

Package: QFN3*3_16



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	1.600	1.800	0.063	0.071
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.180	0.280	0.007	0.011
e	0.500TYP.		0.020TYP.	
L	0.324	0.476	0.013	0.019