

Single Inductor, 5A Battery Charger with 3A USB OTG, 0.1us True OVP

DESCRIPTION

ETA6986 is a switching Li-Ion battery charger capable of delivering up to 5A of charging current to the battery and also capable of delivering up to 3A in boost OTG operation. It employs a charge pump to achieve a very fast input OVP, a For charging, it uses a proprietary control scheme that eliminates the current sense resistor for constant current control, thereby improving efficiency and reducing costs. It can also output a 5V voltage in the reversed direction by boosting from the battery. Therefore, it only needs a single inductor to provide power bi-directionally. ETA6986 is truly an ideal solution controlled by MCU for battery charging and discharge applications, such as power banks, smart phones, and tablets with only one USB port that can be used for both charging battery and USB OTG function.

ETA6986 is in a tiny QFN3x3-20 package.

FEATURES

- ◆ Bi-Directional Power conversion with Single Inductor
- ◆ Input OVP with 0.1us reaction time
- ◆ Input standoff voltage up to 20V
- ◆ Switching Charger up to 5A
- ◆ 5V Synchronous Boost up to 3A
- ◆ Up to 95% Efficiency
- ◆ NTC thermistor input

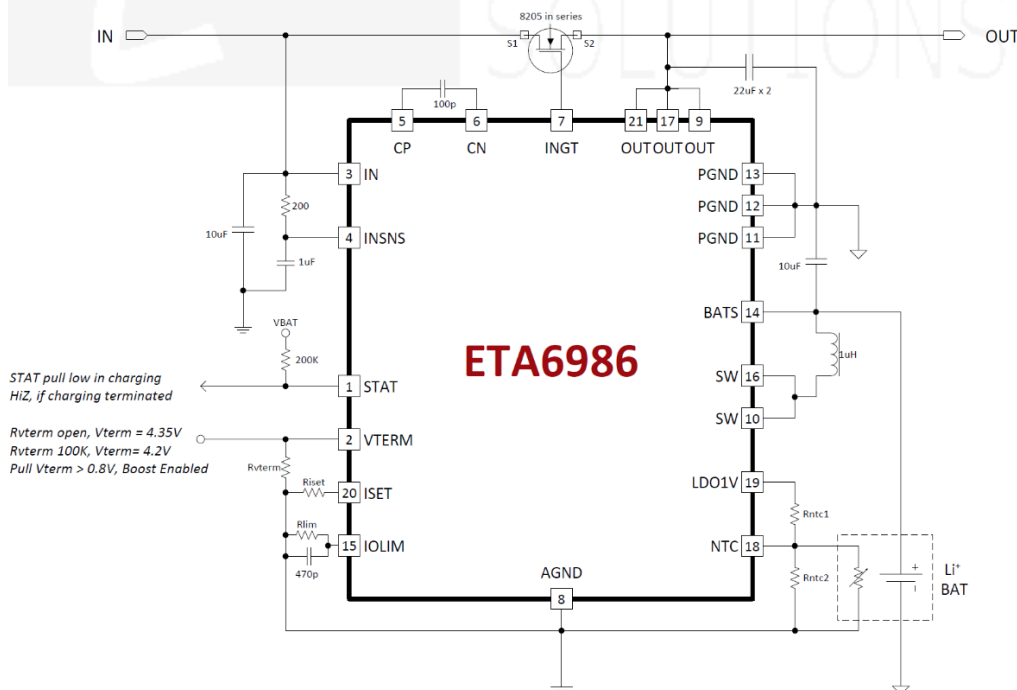
APPLICATIONS

- ◆ Power Bank
- ◆ Smart Phone / Tablet, MID

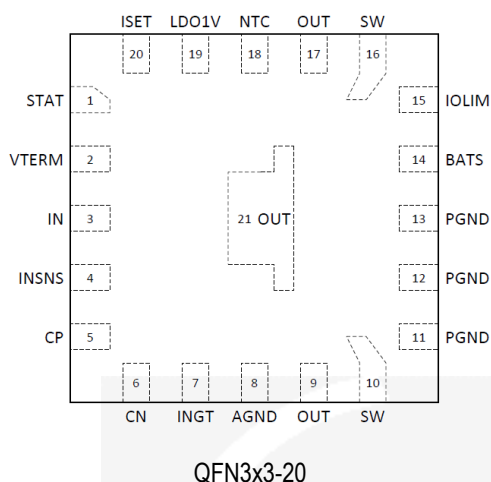
ORDERING INFORMATION

| PART | PACKAGE | TOP MARK |
|------------|-----------|------------------|
| ETA6986F3W | QFN3x3-20 | ETA6986 YWW2L |

TYPICAL APPLICATION



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.)

| | |
|--|--------------------------------------|
| OUT Voltage | -0.3V to 6V |
| IN, INGT Voltage | -0.3V to 20V |
| 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} | |
| QFN3X3-20..... | 2.....30.....°C/W |
| Lead Temperature (Soldering, 10ssec) | 260°C |
| ESD HBM (Human Body Mode) | 2KV |
| ESD MM (Machine Mode) | 200V |

ELECTRICAL CHARACTERISTICS

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

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------------------------|---|------|------|------|---------|
| BUCK MODE | | | | | |
| IN Standoff Voltage | | | | 20 | V |
| IN Range | | 4.5 | | 5.5 | V |
| IN UVLO Voltage | Rising, Hys=500mV | | 4.5 | | V |
| PUMP Hiccup threshold Voltage | Falling, $V_{in} - V_{out} < 300mV$ Rising, Hys=50mV | | 300 | | mV |
| PUMP Hiccup on time | | | 7 | | mS |
| PUMP Hiccup off time | | | 200 | | mS |
| PUMP frequency | | | 500 | | KHZ |
| PUMP Voltage | $V_{ingt} - V_{out}$ | | 3.5 | | V |
| INSNS Clamp Voltage | | | 6.4 | | V |
| INSNS OVP Voltage | Hys=300mV | | 6.0 | | V |
| IN Operating Current as BUCK | Switcher Enable, Switching | | 5 | | mA |
| | Switcher Enable, No Switching | | 500 | | μA |
| BATTERY CHARGER | | | | | |
| Battery CV Voltage | $R_{VTERM} = 50K, I_{BAT} = 0mA$, default | 4.16 | 4.2 | 4.24 | V |
| | $R_{VTERM} = open, I_{BAT} = 0mA$, default | 4.3 | 4.35 | 4.4 | V |
| Charger Restart Threshold | From DONE to Fast Charge | | -150 | | mV |
| Battery Pre-Condition Voltage | V_{BAT} Rising Hys=200mV | | 3 | | V |

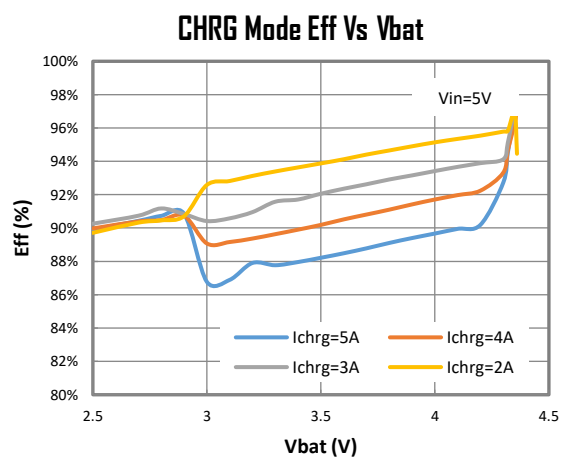
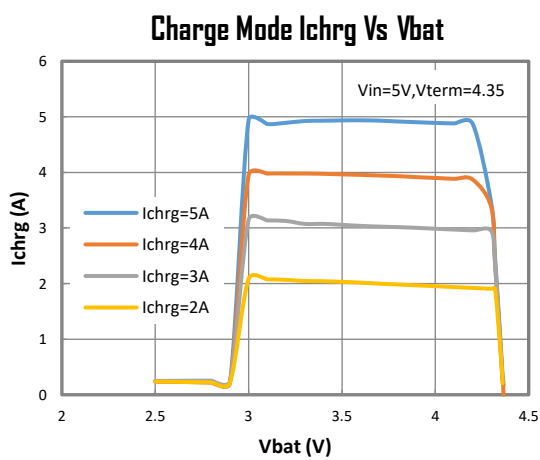
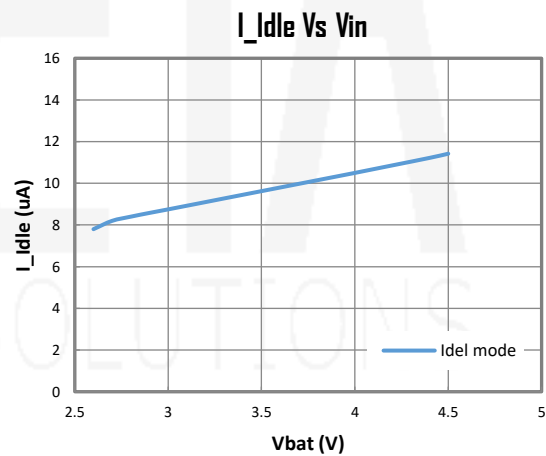
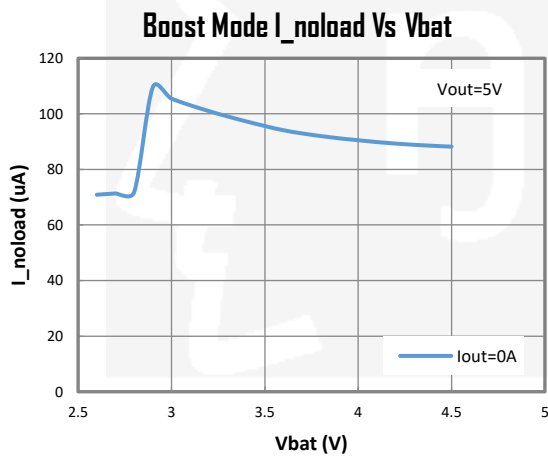
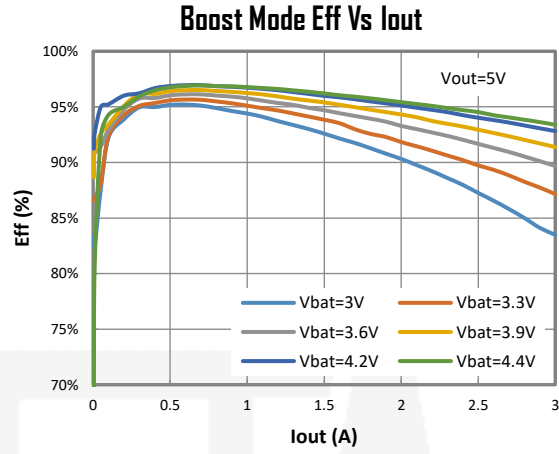
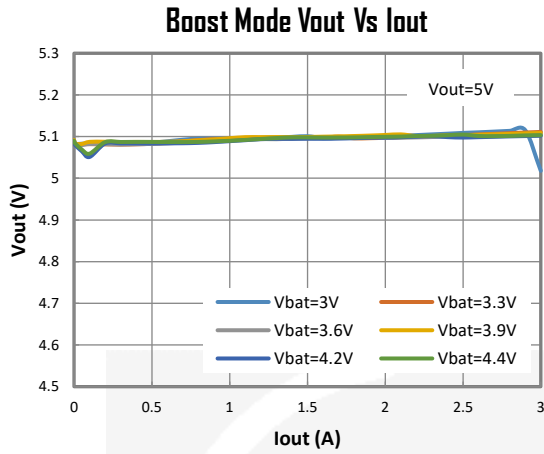
| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|---|-----|------|-----|--------------------|
| Pre-Condition Charge Current | | | 200 | | mA |
| Fast Charge Current | $R_{ISET} = 62K\Omega$ | | 3 | | A |
| Charge Termination Current | $R_{VICHRG} = 100K, C_{VICHRG} = 100pF$ | | 200 | | mA |
| Charge Termination Blanking time | | | 12 | | S |
| BOOST MODE | | | | | |
| BATT Ok Threshold | Rising, HYS=0.5 V | | 3.2 | | V |
| Output Voltage Range | | 5.0 | 5.05 | 5.1 | V |
| Quiescent Current At BATT | Boost On | | | 100 | μA |
| Shutdown Supply Current At BATT | Idle Mode | | | 30 | μA |
| Switching Frequency | $V_{BATT} < 4.4V$ | 0.8 | 1.0 | 1.2 | MHz |
| I _{out} Current Limit | | | 3.5 | | A |
| Maximum Duty Cycle | | | 90 | | % |
| Highside Pmos Rdson | $I_{SW} = 500mA$ | | 45 | | m Ω |
| Lowside Nmos Rdson | $I_{SW} = 500mA$ | | 40 | | m Ω |
| Short Circuit Hiccup Current | | | 4 | | A |
| Short Circuit Hiccup Timer | On Time | | 25 | | ms |
| | Off Time | | 750 | | |
| ISET, Vhold | | | | | |
| Vhold | Vout start to reduce charging current | | 4.65 | | V |
| ISET Voltage | | | 0.8 | | V |
| NTC THERMISTOR MONITOR | | | | | |
| NTC Threshold, Cold | Charger Suspended | | 52 | | %I _{DO1V} |
| NTC Threshold, Hot | Charger Suspended | | 13 | | %I _{DO1V} |
| NTC Threshold Hysteresis | | | 2 | | %I _{DO1V} |
| NTC Disable Threshold | Tie NTC to LDO1V | | | | |
| NTC Input Leakage | | | 0 | 5 | μA |
| LOGIC INPUT: VTERM for Boost Enabling | | | | | |
| Logic Input High | | 1.2 | | | V |
| Logic Input Low | | | | 0.4 | V |
| THERMAL PROTECTION | | | | | |
| Charging Thermal Regulation threshold | | | 85 | | $^{\circ}C$ |
| Thermal Shutdown | Rising, Hys=30 $^{\circ}C$ | | 160 | | $^{\circ}C$ |

PIN DESCRIPTION

| PIN # | NAME | DESCRIPTION |
|------------|-------|---|
| 1 | STAT | Charging status pin. Pull low when charge in progress and HiZ when charge finishes. |
| 2 | VTERM | Multi-functional pin. In charge mode (Vin is available), pulling VTERM pin below 0.2V sets the chip to have charge terminated at 4.2V and leaving it float (VTERM is set 0.3V internally if left float) sets the chip to have charge terminated at 4.35V. And if Vin is absent, pulling VTERM high will enable the boost mode that the chip works as step-up converter to make output maintaining a 5V voltage. |
| 3 | IN | Input OVP sense pins. Bypass with a 10uF capacitor from this pin to ground. |
| 4 | INSNS | Input sense pin. Internally clamped to 6.4V. Connect a resistor from INSNS to IN, and 1uF cap to Analog ground. |
| 5 | CP | Charging pump Cap's positive terminal |
| 6 | CN | Charging pump Cap's negative terminal |
| 7 | INGT | A gate driver pin to control the external NMOS power path. |
| 8 | AGND | Analog ground pin |
| 9, 17, 21 | OUT | USB 5V output during boost and charging input pin during charging. This is a power pin, bypass with 2x22uF MLCC caps to the pin and PGND as close as possible. |
| 10, 16 | SW | Switching Pin. Connect with an inductor between this pin and BATT. |
| 11, 12, 13 | PGND | Power Ground pin |
| 14 | BATS | Battery Voltage sense pin. Connect to the battery positive terminal with a separate sensing wire to avoid voltage drop to achieve accurate battery CV charging |
| 15 | IOLIM | Output current limit pin. This pin sets the output current limit in Boost mode. Connect a resistor (Rlim) and a cap (470pF) in parallel from this pin to Analog Ground. |
| 18 | NTC | Battery Temperature Monitoring input pin. It sets the valid temperature operating range for both battery charging and discharging. |
| 19 | LDO1V | 1V LDO output pin setting up a voltage reference for NTC resistor network. Bypass with a 22pF capacitor to Analog ground. |
| 20 | ISET | Buck Charging current setting pin. Connect a resistor between this pin and analog ground to set the current level. |

TYPICAL CHARACTERISTICS

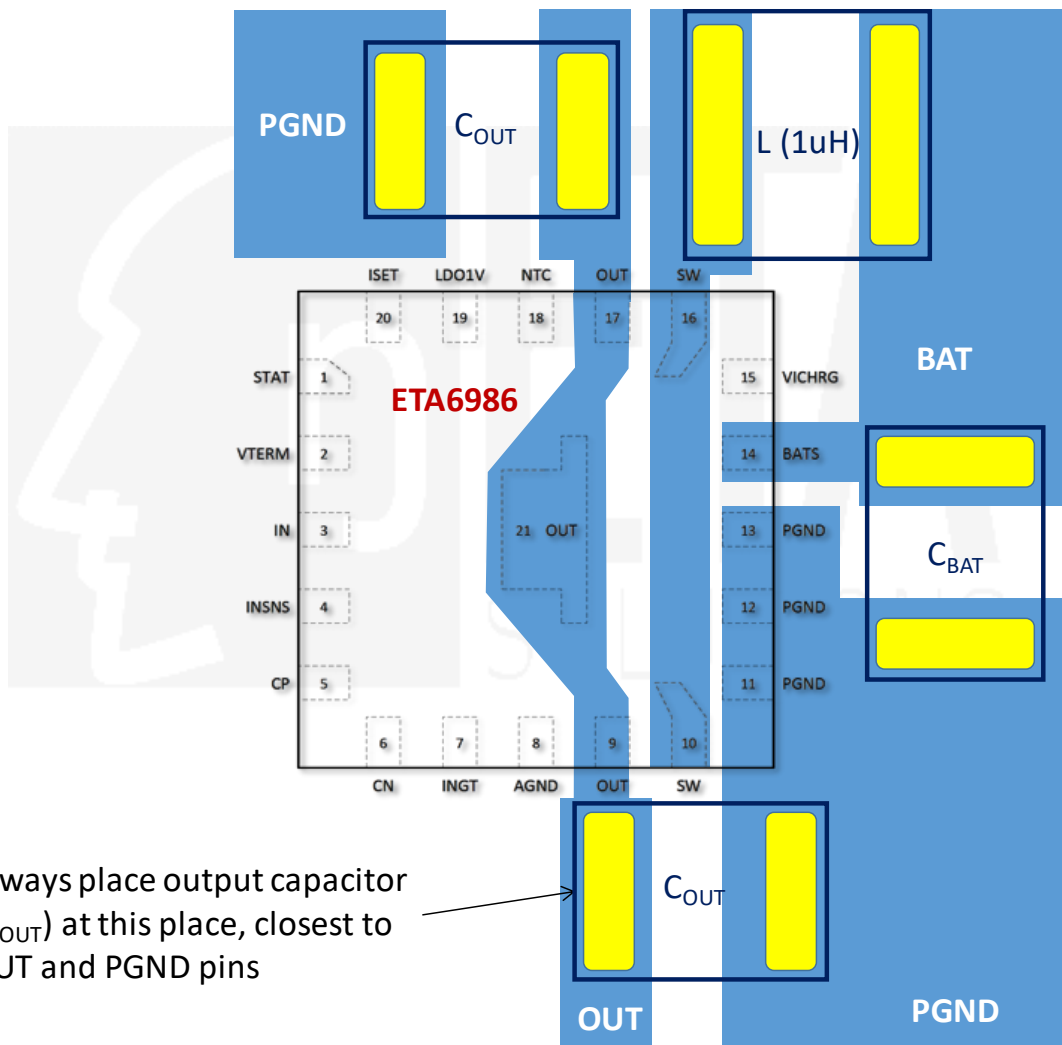
($V_{in}=5V$, $T_A=25^{\circ}C$, unless otherwise specified)



Application Support

Please contact local distributor or ETA solutions for detail engineering support.

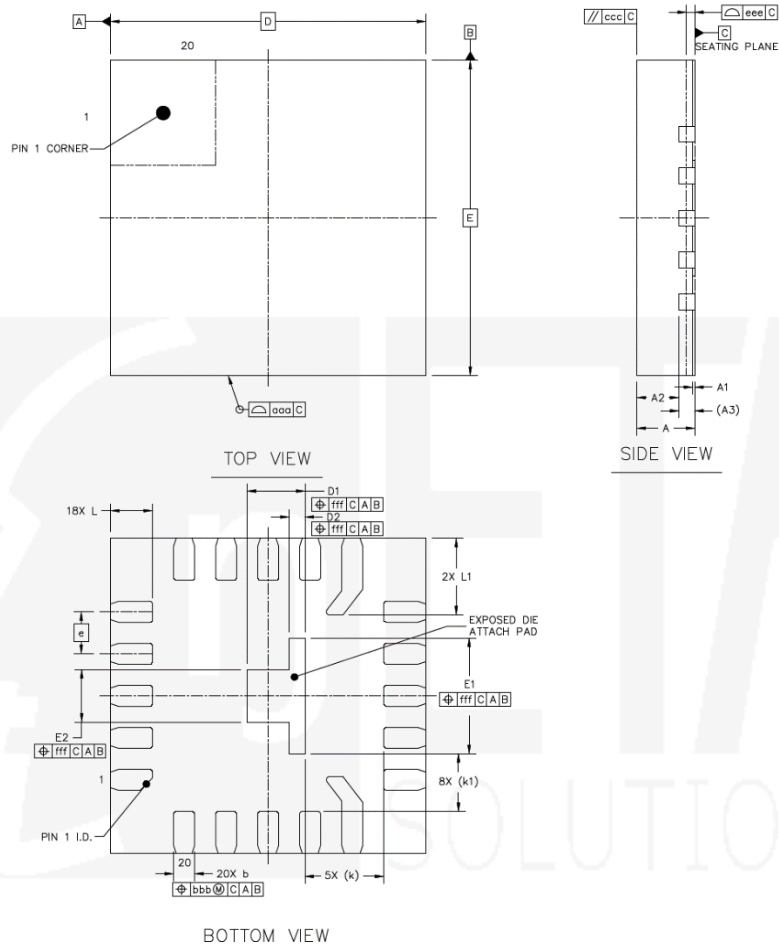
PCB Guidelines



Please try to place the C_{out} , L , and C_{bat} as suggested by the illustration above. The C_{out} has to be placed just next to the chip with shortest wire to the OUT and PGND pins. And SW wire goes underneath the chip and connected by a power inductor just next to the C_{out} . With the C_{in} placed beside and the shortest SW trace, a very tight and small power loop is achieved, so as to improve EMI characteristics.

Package Outline

Package: QFN3x3-20



| | SYMBOL | MIN | NOM | MAX | |
|--------------------------|--------|-----------|------|------|------|
| TOTAL THICKNESS | A | 0.5 | 0.55 | 0.6 | |
| STAND OFF | A1 | 0 | 0.02 | 0.05 | |
| MOLD THICKNESS | A2 | --- | 0.4 | --- | |
| L/F THICKNESS | A3 | 0.152 REF | | | |
| LEAD WIDTH | b | 0.15 | 0.2 | 0.25 | |
| BODY SIZE | X | D | | | |
| | Y | E | | | |
| LEAD PITCH | e | 0.4 BSC | | | |
| EP SIZE | X | D1 | 0.45 | 0.55 | 0.65 |
| | | D2 | 0.05 | 0.15 | 0.25 |
| | Y | E1 | 1 | 1.1 | 1.2 |
| | | E2 | 0.4 | 0.5 | 0.6 |
| LEAD LENGTH | L | 0.3 | 0.4 | 0.5 | |
| | L1 | 0.63 | 0.73 | 0.83 | |
| LEAD TO EXPOSED PAD EDGE | k | 0.75 REF | | | |
| | k1 | 0.55 REF | | | |
| PACKAGE EDGE TOLERANCE | aaa | 0.1 | | | |
| MOLD FLATNESS | ccc | 0.1 | | | |
| COPLANARITY | eee | 0.08 | | | |
| LEAD OFFSET | bbb | 0.1 | | | |