XM3205 Mobile Power Supply

GENERAL DESCRIPTION

The XM3205 is a PMU designed for mobile power supply.

FEATURES

- Built-in USB Switch with Current Limit
- LED Status Display: 4 LEDs
- Torch LED Driver: 50mA
- Precise Output Voltage: V_{OUT}=5.08V (±2.2%)
- High Output Current: 2.1A
- High Output Efficiency: 95%@I_{OUT}=1A, 92%@I_{OUT}=2A
- High Charge Current: 2A
- Low Quiescent Current: 30uA (TYP)
- Low Shutdown Current: < 1uA
- Automatic Load Detection
  - XM3205A: Automatic ON/OFF + User-key ON
  - XM3205B: User-key ON/OFF + Automatic OFF
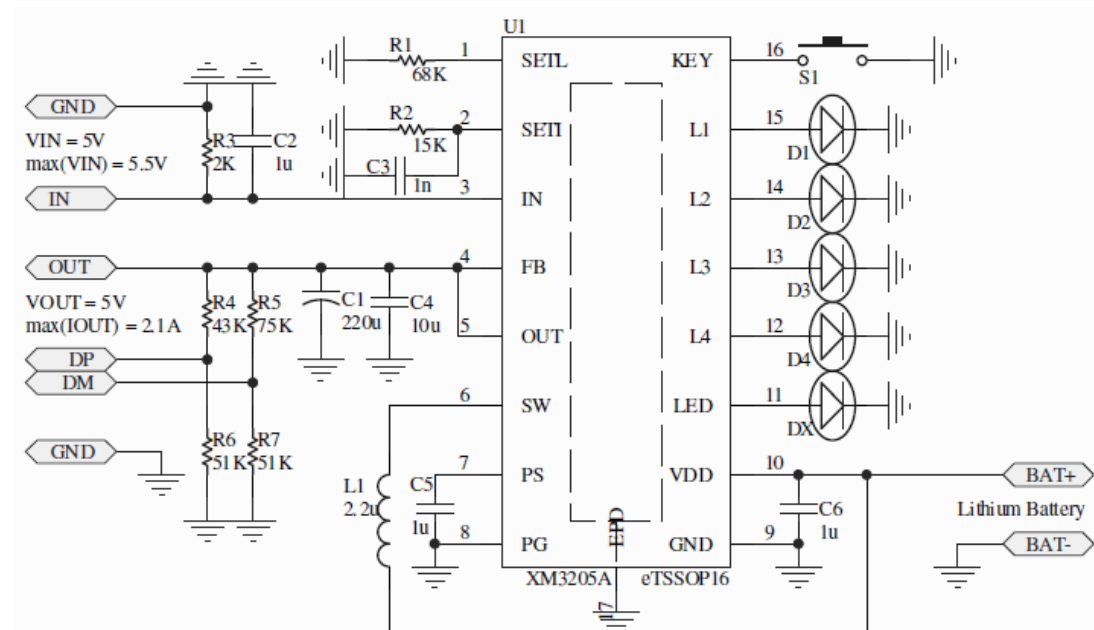
TYPICAL APPLICATION CIRCUIT

Figure 1: Typical application circuit of the XM3205

PIN CONFIGURATION

Package: eTSSOP16

| No.	Name	Description	No.	Name	Description
1	SETL	Output current adjustment pin	9	GND	Signal ground
2	SETI	Input current adjustment pin	10	VDD	Battery power
3	IN	Input USB power pin	11	LED	Torch LED
4	FB	Output feedback pin	12	L4	4th status display LED
5	OUT	Output USB power	13	L3	3rd status display LED
6	SW	Switch and inductor connection	14	L2	2nd status display LED
7	PS	Power reservoir	15	L1	1st status display LED
8	PG	Power ground	16	KEY	User key input pin

FUNCTIONAL BLOCK DIAGRAM
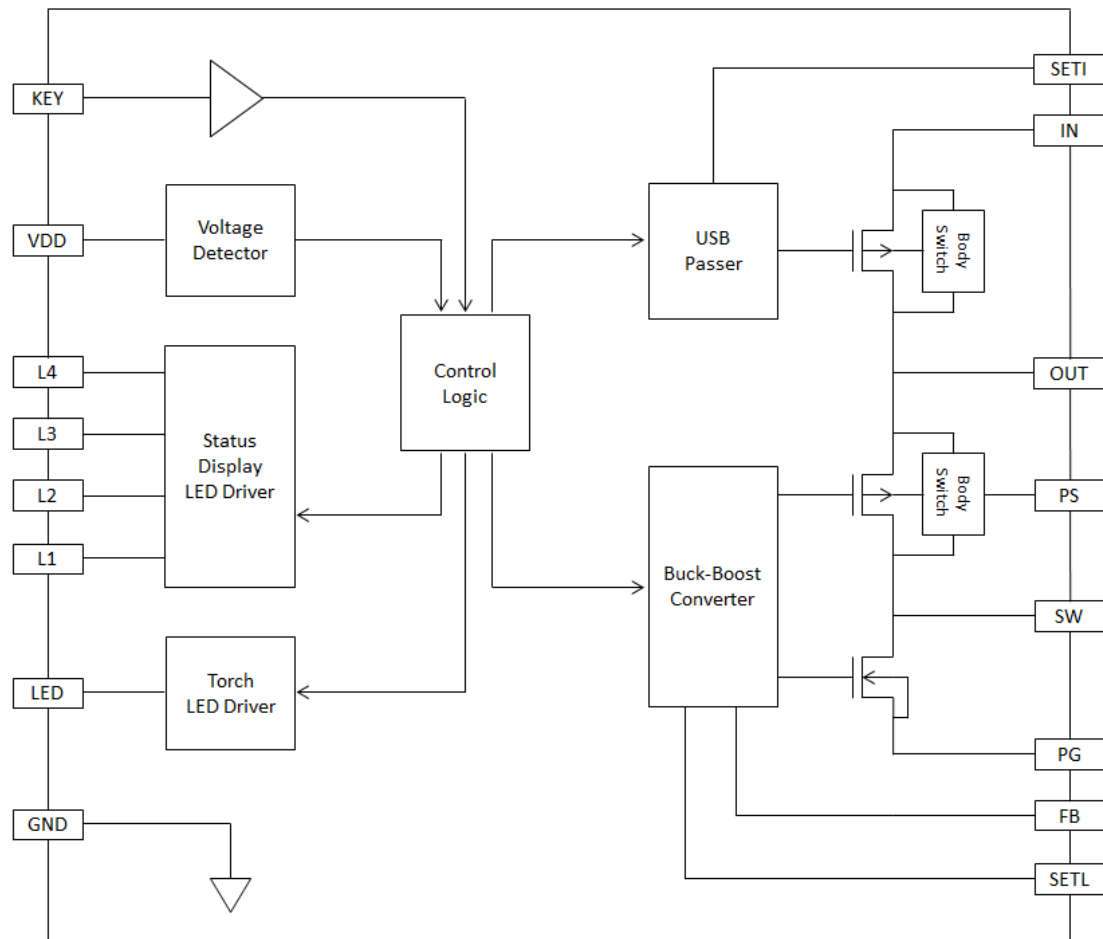
Figure 2: Functional block diagram of the XM3205

OPERATION

The XM3205 has five main building blocks: USB Switch, Lithium Battery Charger, Output USB Converter, Torch LED Driver and Status Display LED Driver.

USB Switch

The XM3205 has an USB switch circuit for passing power from the input USB port (V_{IN}) to the output USB port (V_{OUT}). When the input USB voltage rises across the undervoltage threshold V_{INLV} (4.6V) and does not exceed the overvoltage limit V_{INOV} (6.0V), the USB switch circuit will pass the input power to the output USB port. The output USB power will be used for charging the internal lithium battery as well as delivered to the load connected to the output USB port.

The USB switch circuit has a current limit for protecting the circuit. The current limit I_{CLAMP} can be adjusted by the resistor R_{SETI} connected to the SETI pin.

$$I_{CLAMP} = \frac{1.2V}{R_{SETI}} \times 17000$$

When charging occurs, the charge will keep the input current not exceeding I_{CHRG} (I_{CLAMP}x5/6) and the output USB voltage not lower than V_{OUTMIN} (4.7V). If the load draws more current from the output USB port, the charger will draw less current accordingly.

Battery Charger

The battery charger in the XM3205 is a DC-DC buck converter. Once input USB power is connected, the battery charger will start operation after the output USB voltage rises across the undervoltage threshold V_{OUTLV} (4.6V).

If the battery voltage V_{DD} is lower than the trickle charge threshold V_{TK} (2.9V), the charger will linearly pass 40mA (I_{TK}) from the output USB port to the battery. When the battery voltage is higher than V_{TK}, the DC-DC converter will start operation and convert power from the output USB port to the battery.

The charger will operate in constant current mode and keep the total current drawn from the input USB port not exceeding I_{CHRG}. If the load connected to the output USB port draws more current, the DC-DC converter will reduce current accordingly.

The target battery voltage is V_{PRESET} (4.2V). When the battery voltage reaches this level, the charger will operate in constant voltage mode. The battery voltage is kept constant while the charging current and the input current will drop gradually. Once the input current drop across the termination threshold I_{END}, the charger will stop charging and report the battery is full.

3

Torch LED

The XM3205 has an LED torch function. Once the user key is pressed for more than two seconds (long key), the torch is switched on. The driver will deliver 50mA current to the torch LED. If another long key event happens, the torch will be switched off. If the battery voltage is lower than 3.2V, the torch function is disabled.

Status Display LED

The XM3205 has four LED for displaying the voltage level of the battery and the status of the XM3205. The LED current of each branch is 3mA.

During discharge mode, all the LEDs are used to display the voltage level of the battery. When the user key is pressed for more than 30ms and less than two seconds (short key), the LED will be switched on (for five seconds) to display the voltage level.

During charge mode, the LED will be switched on in waving style to indicate charging occurs and display the voltage level. The waving frequency is 1Hz.

MODE	Battery Level	L1	L2	L3	L4
Discharge	VDD < 3.2V	Blink	OFF	OFF	OFF
(All OFF after 5s)	3.2V < VDD < 3.5V	ON	OFF	OFF	OFF
	3.5V < VDD < 3.7V	ON	ON	OFF	OFF
	3.7V < VDD < 3.9V	ON	ON	ON	OFF
	3.9V < VDD	ON	ON	ON	ON
Charge	VDD < 3.6V	Wave			
	3.6V < VDD < 3.8V	ON	Wave		
	3.8V < VDD < 4.0V	ON	ON	Wave	
	4.0V < VDD < 4.2V	ON	ON	ON	Wave
	VDD = 4.2V, I_{IN} < 0.4 I_{SET}	ON	ON	ON	ON
	4.0V < VDD (entering Charge mode)	ON	ON	ON	ON
Standby		OFF	OFF	OFF	OFF

Output USB Converter

The output USB converter is a DC-DC converter operating in boost mode. When a load is connected to the output USB port, the converter will switch on automatically and boost the output voltage to 5V. When the load is disconnected for eight seconds, the converter will switch off automatically. The converter can also be turn-on by pressing the user key. Every time a load is connected or a short key event

happens, the converter and the status display LED will be switched on to drive the output USB port and display the battery level.

Before boosting VDD voltage to OUT pin, the converter will first pass VDD voltage to OUT pin. Once OUT voltage reach VDD, the converter will start boosting. There is a current limit when passing the VDD voltage to OUT pin. The current limit can be adjusted by SETL pin.

$$I_{START} = \frac{1.4V}{R_{SETL}} \times 120000$$
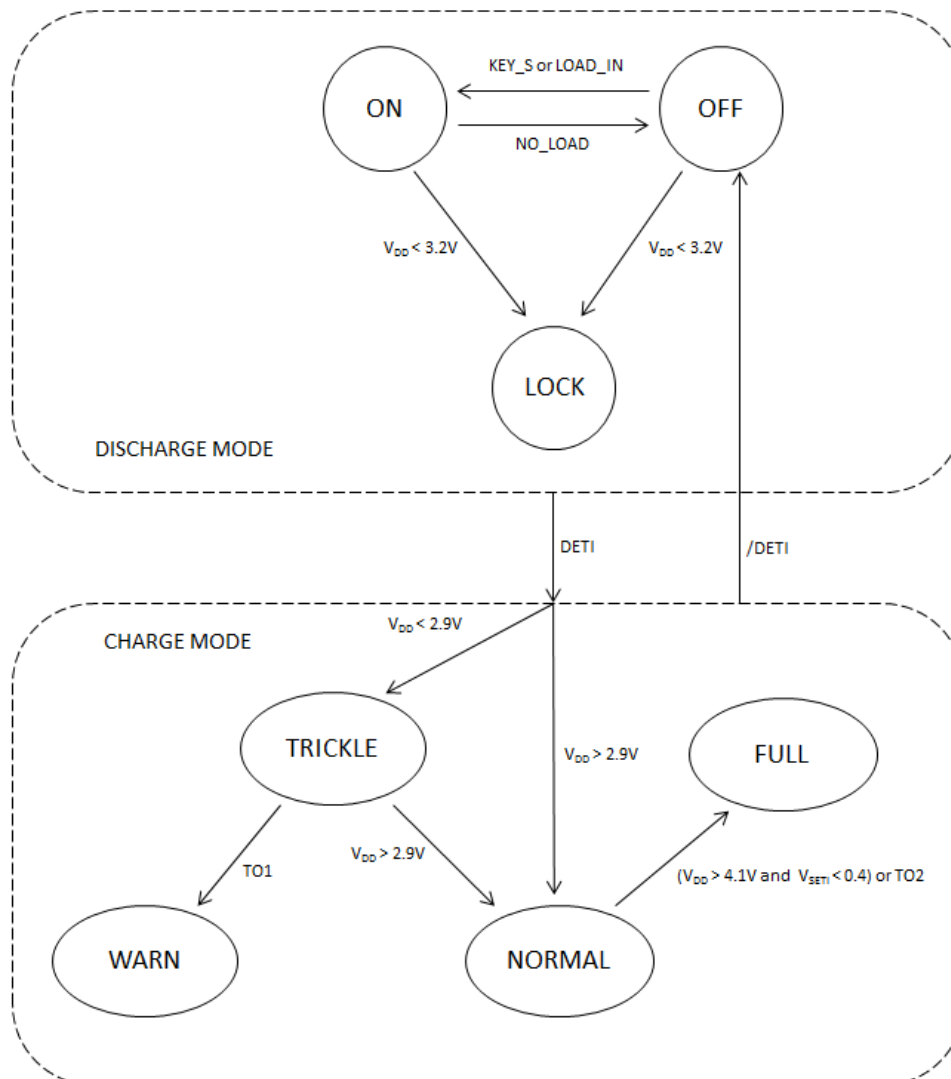
ABSOLUTE MAXIMUM RATINGS

Parameter	Limit
IN, OUT, VDD, FB, PS Supply Voltages	-0.3V to 6V
KEY, SETI, SETL, LED, L1, L2, L3 and L4 Voltages	-0.3V to V_{DD}
SW Voltage	-0.3V to PS
SW Sink and Source Current	5A
Operating Temperature	-40°C to 85°C
Junction Temperature	-40°C to 125°C
Storage Temperature	-65°C to 150°C
Soldering Temperature	300°C

ELECTRICAL CHARACTERISTICS (T_A=25°C, V_{IN}=5V and V_{DD}=3.6V)

Parameter	Symbol	Conditions	Limit			Unit
			MIN	TYP	MAX	
Overall						
Supply Voltage	V_{DD}		0		5	V
Supply Current	I_{DD}	Lockout Mode			1	uA
		Quiescent Mode		30	75	uA
		Active Mode			5	mA
Undervoltage Threshold	V_{DDUV}		2.8	2.9	3.0	V
KEY Pull-up Resistance	R_{KEY}			150		kΩ
USB Switch						
Input Voltage	V_{IN}		0		5.5	V
SETI Reference Voltage	V_{SETI}		1.1	1.2	1.3	V
Input Overvoltage Threshold (Rising)	V_{INOV+}			6.0		V
Input Overvoltage Threshold (Falling)	V_{INOV-}			5.74		V
Input Undervoltage	V_{INLV-}			4.42		V

Threshold (Falling)						
Input Undervoltage Threshold (Rising)	V_{INLV+}			4.60		V
Output Ready Threshold (Falling)	V_{OUTOK-}			4.42		V
Output Ready Threshold (Rising)	V_{OUTOK+}			4.60		V
MOSFET Resistance	R_{PASS}			80		mΩ
Current Clamp	I_{CLAMP}	R_{SETI}=15kΩ		1.4		A
Battery Charging						
Trickle Charge Threshold (Rising)	V_{TK+}			2.9		V
Trickle Charge Threshold (Falling)	V_{TK-}			2.81		V
Trickle Charge Current	I_{TK}			40		mA
Trickle Charge Timeout	t_{TK}			1.1		hrs
Normal Charge Current	I_{CHRG}	R_{SETI}=15 kΩ		1.16		A
Minimum Output Voltage	V_{OUTMIN}			4.7		V
Preset Voltage	V_{PRESET}		4.15	4.20	4.25	V
Termination Current	I_{END}	R_{SETI}=15 kΩ		0.46		A
Normal Charge Timeout	t_{NORMAL}			9		hrs
USB Output						
Output Voltage	V_{OUT}		4.96	5.08	5.20	V
Switching Frequency	f_{SW}			1.0		MHz
PFET Resistance	R_{PFET}			60		mΩ
NFET Resistance	R_{NFET}			60		mΩ
Switch-on Threshold	R_{LOAD}			800		Ω
Switch-off Threshold	I_{OFF}			10		mA
SETL Reference Voltage	V_{SETL}		1.35	1.4	1.45	V
Output Startup Current	I_{START}	R_{SETL}= 68kΩ		2.5		A
LED Torch and LED Display						
LED Current (Display)	I_{LED}			3		mA
LED Current (Torch)	I_{TORCH}			50		mA

STATE DIAGRAM – USB CONVERTER

```
         KEY_S or LOAD_IN
   ON  <------------------  OFF
       ------------------>
           NO_LOAD
   |                         |
 VDD<3.2V                 VDD<3.2V
   |                         |
   v                         v
        LOCK

DISCHARGE MODE
```

DETI | /DETI

```
CHARGE MODE
VDD < 2.9V
                              VDD > 2.9V
   TRICKLE                                FULL
   |        \                              ^
  TO1     VDD>2.9V                         |
   |          \                  (VDD>4.1V and VSETI<0.4) or TO2
   v           v                           |
  WARN      NORMAL  -----------------------
```

STATE DIAGRAM – TORCH LED

```
         KEY_L
   ON  <----------  OFF
       ---------->
         KEY_L
   |                  |
 VDD<3.2V          VDD<3.2V   VDD>3.2V
   |                  |
   v                  v
        LOCK
```

7
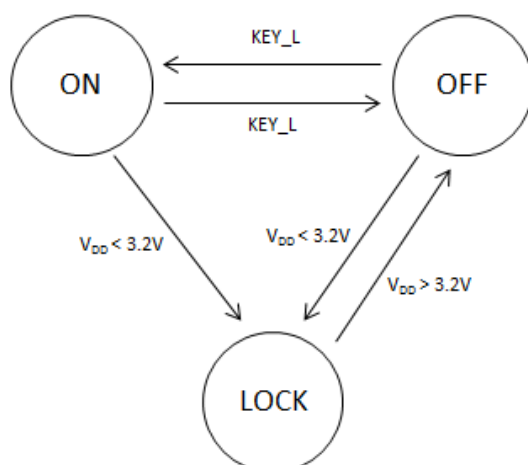
PACKAGE INFORMATION – eTSSOP16
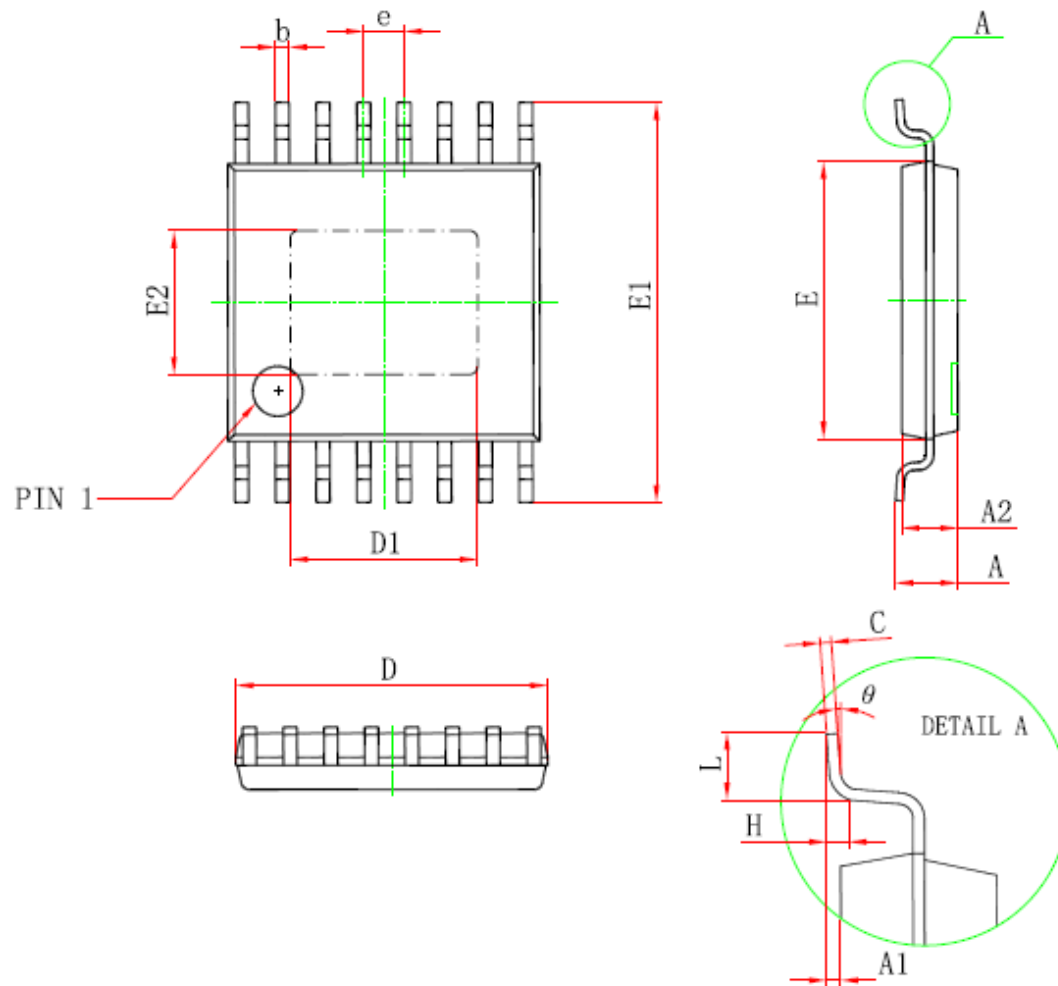
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	4.900	5.100	0.193	0.201
D1	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
E2	2.200	2.400	0.087	0.094
A		1.150		0.043
A2	0.800	1.000	0.031	0.039
A1	0.020	0.150	0.001	0.006
e	0.65（BSC)		0.026(BSC)	
L	0.500	0.700	0.02	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°