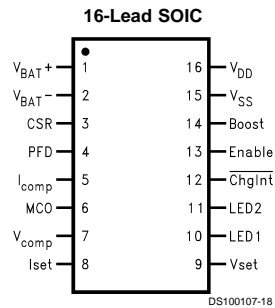




## Connection Diagram



**Top View**  
**Order Number LM3621M or LM3621M-3.0**  
**NSC Package Number M16A**

## Pin Description

| Pin No. | Symbol     | I/O | Description   |
|---------|------------|-----|---|
| 1       | $V_{BAT+}$ | I   | Battery pack high side sense input.   |
| 2       | $V_{BAT-}$ | I   | Battery pack low side sense input.  |
| 3       | CSR        | I   | <b>C</b> urrent <b>S</b> ense <b>R</b> esistor high side input.                                 |
| 4       | PFD        | O   | <b>P</b> ass <b>F</b> ET gate <b>D</b> rive output. (N-channel).                                |
| 5       | $I_{COMP}$ | I   | Compensation pin for current regulation loop.   |
| 6       | MCO        | O   | <b>M</b> odulation <b>C</b> ontrol <b>O</b> utput- analog control signal output                 |
| 7       | $V_{COMP}$ | I   | Compensation pin for voltage regulation loop.   |
| 8       | $I_{SET}$  | I   | Charge current adjust input pin (see application section).                                      |
| 9       | $V_{SET}$  | I   | Charge termination voltage control input ( $V_{SET} = HI$ for 4.2V or $V_{SET} = LO$ for 4.1V). |
| 10      | LED1       | O   | LED driver #1 output (open drain).  |
| 11      | LED2       | O   | LED driver #2 output (open drain).  |
| 12      | ChgInt     | I   | Charge current interrupt (active LO).   |
| 13      | Enable     | I   | Enable charge cycle control.  |
| 14      | Boost      | I   | Maximum output current boost control (max output current increased by 80%).                     |
| 15      | $V_{SS}$   | S   | IC common.  |
| 16      | $V_{DD}$   | S   | IC power supply.  |

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                             |   |
|-----------------------------|---|
| Supply Voltage, $V_{DD}$    | 6.0V  |
| All pins                    | $-0.3\text{ V} \leq V \leq V_{DD}+0.3\text{ V}$ |
| Power Dissipation           | 100 mW  |
| ESD Susceptibility (Note 2) | 2kV   |
| Junction Temperature        | 150°C   |
| Storage Temperature         | -65°C to +150°C                                 |

Lead Temperature, soldering

|                      |        |
|----------------------|--------|
| Vapor Phase (60 sec) | +215°C |
| Infrared (15 sec)    | +220°C |

## Operating Ratings

|                               |  |
|-------------------------------|--|
| Ambient Temperature Range     | $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ |
| Supply Voltage Range (Note 3) | $3.0\text{ V} \leq V_{DD} \leq 5.5\text{ V}$     |

## Electrical Characteristics

$V_{DD} = 4.2\text{ V}$  unless otherwise specified. Specifications with standard type face are for  $T_A = 25^\circ\text{C}$ , and those with **boldface type** apply over **full operating temperature range**.

| Symbol   | Parameter  | Conditions  | Min          | Typ  | Max          | Units         |
|--|--|---|--------------|------|--------------|---------------|
| $V_{OUT}$  | Battery Regulation Voltage (Note 4)                      | Charge termination voltage for $V_{SET} = \text{HI}$  | 4.18         | 4.2  | 4.22         | V             |
|  |  |   | <b>4.16</b>  |      | <b>4.24</b>  | V             |
|  |  | Charge termination voltage for $V_{SET} = \text{LO}$  | 4.08         | 4.1  | 4.12         | V             |
|  |  |   | <b>4.06</b>  |      | <b>4.14</b>  | V             |
|  |  | Battery conditioning (Hi-Z) charge mode, LM3621M-3.0  | 2.95         | 3.1  | 3.25         | V             |
|  |  | Battery conditioning (Hi-Z) charge mode, LM3621M      | 4.05         | 4.1  | 4.15         | V             |
|  |  | Monitor Mode float voltage for $V_{SET} = \text{HI}$  | <b>4.05</b>  | 4.09 | <b>4.13</b>  | V             |
| Monitor Mode float voltage for $V_{SET} = \text{LO}$ | <b>3.80</b>  | 3.85  | <b>3.90</b>  | V    |              |               |
| $V_{CSR}$  | Charge Current Regulation Voltage (Notes 5, 16)          | Fast Charge Mode                                      | <b>0.475</b> | 0.5  | <b>0.525</b> | V             |
|  |  | Conditioning (Hi-Z) Charge Mode                       | <b>0.04</b>  | 0.05 | <b>0.06</b>  | V             |
|  |  | Boost Mode  | <b>0.855</b> | 0.9  | <b>0.945</b> | V             |
| $V_{BAT-Det}$  | Battery Voltage Detection Threshold (Note 6)             | Overvoltage Fault Threshold for $V_{SET} = \text{HI}$ | <b>4.28</b>  | 4.40 | 4.50         | V             |
|  |  | Overvoltage Fault Threshold for $V_{SET} = \text{LO}$ | <b>4.18</b>  | 4.30 | 4.40         | V             |
|  |  | Battery Resistance Free Voltage Threshold             | 3.55         | 3.65 | 3.75         | V             |
|  |  | Conditioning (Hi-Z) Charge Mode Threshold             | 2.45         | 2.55 | 2.65         | V             |
|  |  |   | <b>2.40</b>  |      | <b>2.70</b>  | V             |
| $V_{CSR-Det}$  | Charge Current Voltage Detection Threshold (Notes 7, 16) | End of charge threshold                               |              | 40   |              | mV            |
|  |  | Over Current Fault Threshold                          | 0.95         | 1    | 1.05         | V             |
| $I_Q$  | Quiescent Current  | Standby Mode with $I_{OUT} = 0\text{ mA}$             |              | 3    | 5            | mA            |
| $I_{OUT}$  | MCO Output Source Current                                | $V_{MCO} = 1.0\text{ V}$                              |              |      | 20           | mA            |
| $V_{MCO}$  | Maximum MCO Output Voltage                               | $I_{OUT} = 1\text{ mA}, V_{DD} = 5.5\text{ V}$        |              | 4.9  |              | V             |
|  |  | $I_{OUT} = 1\text{ mA}, V_{DD} = 3.0\text{ V}$        |              | 2.9  |              | V             |
| GM-V   | V-Reg Loop Error Amp Transconductance                    |   |              | 0.1  |              | mA/V          |
| $I_{SLEW-V}$   | V-Reg Loop Error Amp Slew Current                        |   |              | 100  |              | $\mu\text{A}$ |
| GM-I   | I-Reg Loop Error Amp Transconductance                    |   |              | 1    |              | mA/V          |
| $I_{SLEW-I}$   | I-Reg Loop Error Amp Slew Current                        |   |              | 200  |              | $\mu\text{A}$ |
| $T_{HR}$   | 1 Hour Timer   |   | 55           | 60   | 65           | min           |

## Electrical Characteristics (Continued)

$V_{DD} = 4.2V$  unless otherwise specified. Specifications with standard type face are for  $T_A = 25^\circ C$ , and those with **boldface type** apply over **full operating temperature range**.

| Symbol        | Parameter   | Conditions                   | Min          | Typ  | Max          | Units   |
|---------------|---|------------------------------|--------------|------|--------------|---------|
| $I_{LKG-0}$   | Battery Load Current (Note 8)   | $V_{DD} = 0V$                |              | 1    | <b>10</b>    | $\mu A$ |
| $I_{LKG-MM}$  | Battery Load Current (Note 9)   | Monitor Mode                 |              | 1    | <b>10</b>    | $\mu A$ |
| $V_{BSD}$     | Maximum Allowed Battery Self-Discharge (Note 10)                        | $V_{SET} = HI$               | 70           | 110  | 150          | mV      |
|               |   | $V_{SET} = LO$               | 220          | 260  | 300          | mV      |
| $G_{CSR}$     | Fast Charge Current Regulation Adjustment Transfer Ratio (Notes 11, 12) | $V_{ISET} = 0.5V$            | 0.90         | 0.93 | 0.96         | V/V     |
| $I_{LED}$     | LED1 & LED2 Driver Sink Current   | $V_{LED1} = V_{LED2} = 1.5V$ | 20           |      |              | mA      |
| $V_{SUV}$     | Start Up Voltage (Note 13)  |                              |              | 3.4  |              | V       |
| $V_{UVR}$     | Under Voltage Reset (Note 14)   |                              |              | 2.2  |              | V       |
| $V_{PFD-MAX}$ | Maximum PFD Output Drive  | no DC load on PFD            | $V_{DD}-0.2$ |      |              | V       |
| $V_{PFD-MIN}$ | Minimum PFD Output Drive  | no DC load on PFD            |              |      | $V_{SS}+0.1$ | V       |
| $V_{IL}$      | Logic Input Low (Note 15)   |                              |              |      | 0.5          | V       |
| $V_{IH}$      | Logic Input High (Note 15)  |                              | $V_{DD}-0.5$ |      |              | V       |
| $I_{DIG}$     | Digital Input Leakage Current (Note 15)                                 |                              | -1           |      | 1            | $\mu A$ |

**Note 1:** Absolute Maximum Ratings indicates limits beyond which damage to the device may occur. Operating ratings indicate conditions for which the device is intended to be functional, but device parameter specifications may not be guaranteed under these conditions. For guaranteed specifications and test conditions, see the Electrical Characteristics.

**Note 2:** ESD rating is based on the human body model, 100 pF discharged through 1.5 k $\Omega$ .

**Note 3:** LM3621 requires a minimum  $V_{DD}$  of 3.4V to start-up. After start-up, the operating range is 3.0V to 5.5V.

**Note 4:**  $V_{OUT}$  is measured between  $V_{BAT+}$  and CSR.

**Note 5:**  $V_{CSR}$  is measured between CSR and  $V_{SS}$  (across the current sense resistor).

**Note 6:**  $V_{BAT-Det}$  is measured between  $V_{BAT+}$  and  $V_{BAT-}$ .

**Note 7:**  $V_{CSR-Det}$  is measured between CSR and  $V_{SS}$  (across the current sense resistor).

**Note 8:** This is the current drawn from the battery by the LM3621 when  $V_{DD} = 0V$ .

**Note 9:** This is the current drawn from the battery by the LM3621 when the charger is in Monitor Mode.

**Note 10:** This is the maximum battery voltage droop that is allowed before the charger initiates a fast charge mode to refresh the battery to its full charge capacity.

**Note 11:** The current regulation and detection levels can be set by applying a dc voltage adjusting between 0.1V to 1V to the  $I_{SET}$  pin without changing the value of the current sense resistor. To ensure proper operation, if the default current regulation and detection values are desired, then a capacitor of at least 100 pF should be connected from  $I_{SET}$  to  $V_{SS}$  (GND).

**Note 12:** Transfer ratio of  $V_{CSR}/V_{ISET}$  to adjust the fast charge current regulation level. See application section.

**Note 13:** Minimum  $V_{DD}$  supply voltage required at start-up.

**Note 14:** The LM3621 goes to a shutdown or reset state during "brown out" (i.e., when  $V_{DD} < V_{UVR}$ )

**Note 15:** Digital inputs are Enable, Boost,  $\overline{ChgInt}$  and  $V_{SET}$ . To ensure proper operation, never allow any unused input pin to be left open.

**Note 16:** No external voltage applied to  $I_{set}$  pin; a 100 pF capacitor is connected across  $I_{set}$  and  $V_{SS}$ .

## Definition of Terms

**$V_{OUT}$ :** Voltage measured between  $V_{BAT+}$  and CSR.

**$V_{CSR}$ :** Charging current sense voltage measured between CSR and  $V_{SS}$  (Gnd).

**$V_{BATTERY}$ :** Battery terminal voltage measured between  $V_{BAT+}$  and  $V_{BAT-}$ .

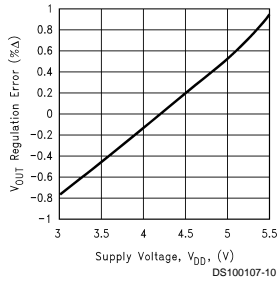
**ESR:** The equivalent series resistance of a battery. The ESR is the purely resistive component of a battery's impedance. Its value is usually determined by the battery construction.

**RFV:** The RFV (resistance free voltage, often called the float voltage) is the open circuit terminal voltage of a battery which is free from the ESR voltage drop error.

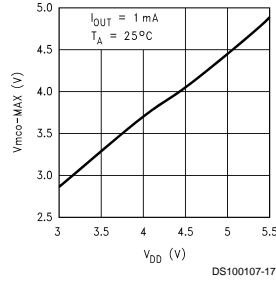
**$V_{ISET}$ :** External voltage applied to  $I_{SET}$  pin, measured between  $I_{SET}$  and  $V_{SS}$ , to override the default value of  $V_{CSR}$ .

**Typical Performance Characteristics** Unless otherwise specified,  $T_A = 25^\circ\text{C}$

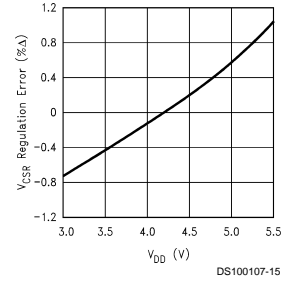
**Charge Termination Voltage Change vs  $V_{DD}$**



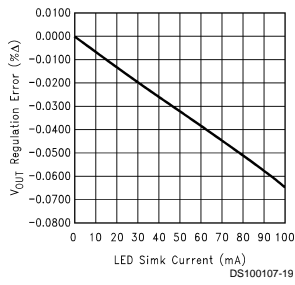
**Maximum MCO Output Voltage vs  $V_{DD}$**



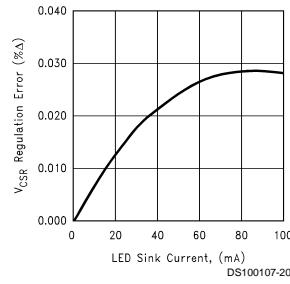
**Fast Charge Current Regulation Voltage vs  $V_{DD}$**



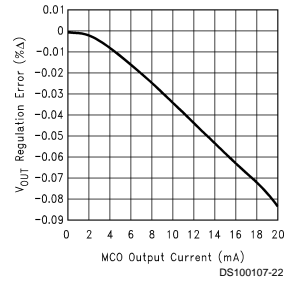
**Charge Termination Voltage Regulation vs LED1 or LED2 Sink Current**



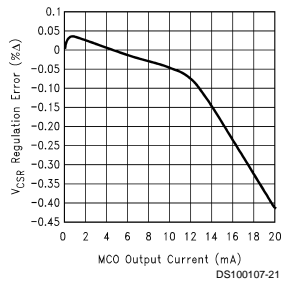
**Fast Charge Current Regulation vs LED1 or LED2 Sink Current**



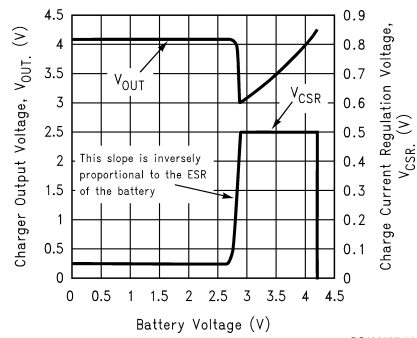
**Charge Termination Voltage Regulation vs MCO Output Current,  $I_{OUT}$**



**Fast Charge Current Regulation vs MCO Output Current,  $I_{OUT}$**



**Charger Output Voltage Current Regulation Voltage vs Battery Resistance Free Voltage**



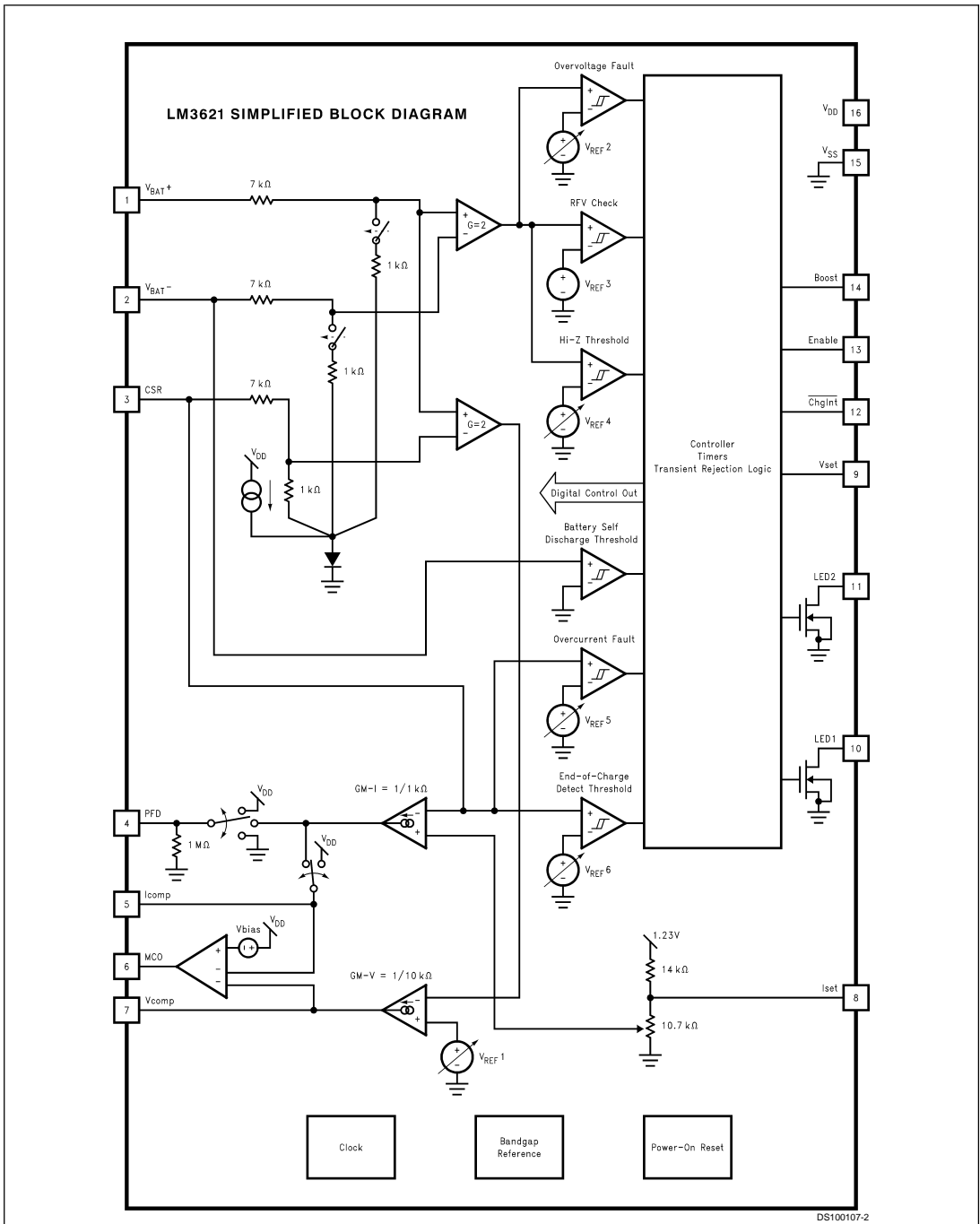
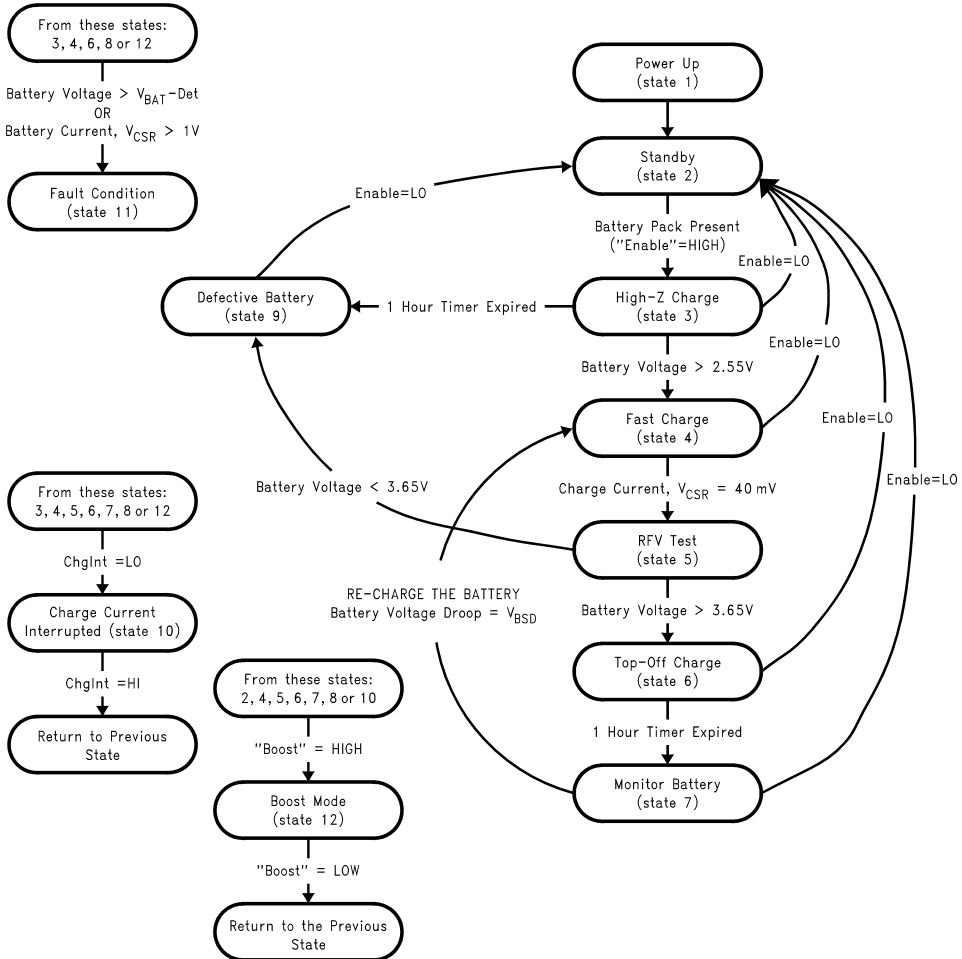


FIGURE 1. LM3621 Simplified Block Diagram



Note 17: State 8 is not used.

DS100107-3

FIGURE 2. LM3621 Charge State Diagram

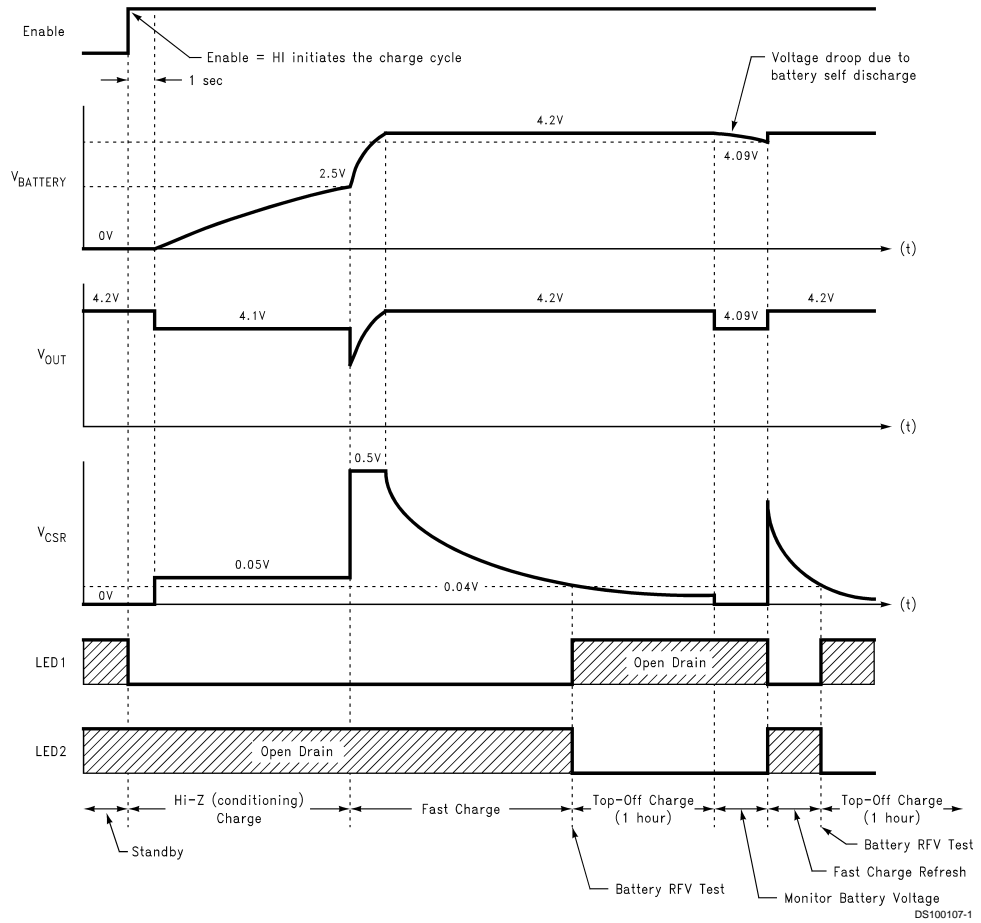


FIGURE 3. Typical Charge Cycle Waveform ( $V_{SET} = HI$ )



**TABLE 1. Truth Table for Operation of LED Drivers (LED1 and LED2)**

| Charge Mode         | Input Conditions                |   |                              |                              |   |          | LED Outputs        |                    |
|---------------------|---------------------------------|---|------------------------------|------------------------------|---|----------|--------------------|--------------------|
|                     | Pack Present?<br>(Enable = HI?) | Defective Pack<br>Detected?               | Boost Mode?<br>(Boost = HI?) | Battery Voltage<br>(Note 18) | Charge Current<br>Detect Voltage<br>(Note 19) | Timer    | LED1<br>Output     | LED2<br>Output     |
| Standby             | No                              | X   | No                           | X                            | X   | X        | Open<br>Drain      | Open<br>Drain      |
| Conditioning (Hi-Z) | Yes                             | NO  | X                            | < 2.55V                      | 0.05V   | < 1hour  | Low                | Open<br>Drain      |
| Conditioning (Hi-Z) | Yes                             | Yes, Shorted<br>Battery or No<br>Capacity | X                            | < 2.55V                      | 0.05V   | ≥ 1hour  | Pulse at<br>0.8 Hz | Open<br>Drain      |
| Fast Charge         | Yes                             | No  | No                           | ≥ 2.55V                      | > 40mV  | X        | Low                | Open<br>Drain      |
| Fast Charge         | Yes                             | Yes, Open<br>Battery or High<br>ESR       | No                           | RFV ≤ 3.65V                  | ≤ 40mV  | X        | Pulse at<br>0.8 Hz | Open<br>Drain      |
| Top-Off             | Yes                             | No  | No                           | = 4.2V                       | < 40 mV                                       | < 1 hour | Open<br>Drain      | Low                |
| Monitor             | Yes                             | No  | No                           | > 4.09V                      | 0   | ≥ 1 hour | Open<br>Drain      | Low                |
| Boost               | X                               | X   | Yes                          | X                            | X   | X        | Low                | Low                |
| Fault               | Yes                             | X   | X                            | ≥ 4.4V                       | X   | X        | Pulse at<br>0.8 Hz | Pulse at<br>0.8 Hz |
| Fault               | Yes                             | X   | X                            | X                            | ≥ 1V  | X        | Pulse at<br>0.8 Hz | Pulse at<br>0.8 Hz |

**Note 18:** Battery Voltage =  $V_{BAT+} - V_{BAT-}$ ,  $V_{SET} = HI$

**Note 19:** Voltage across the current sense resistor connected between CSR and  $V_{SS}$ .

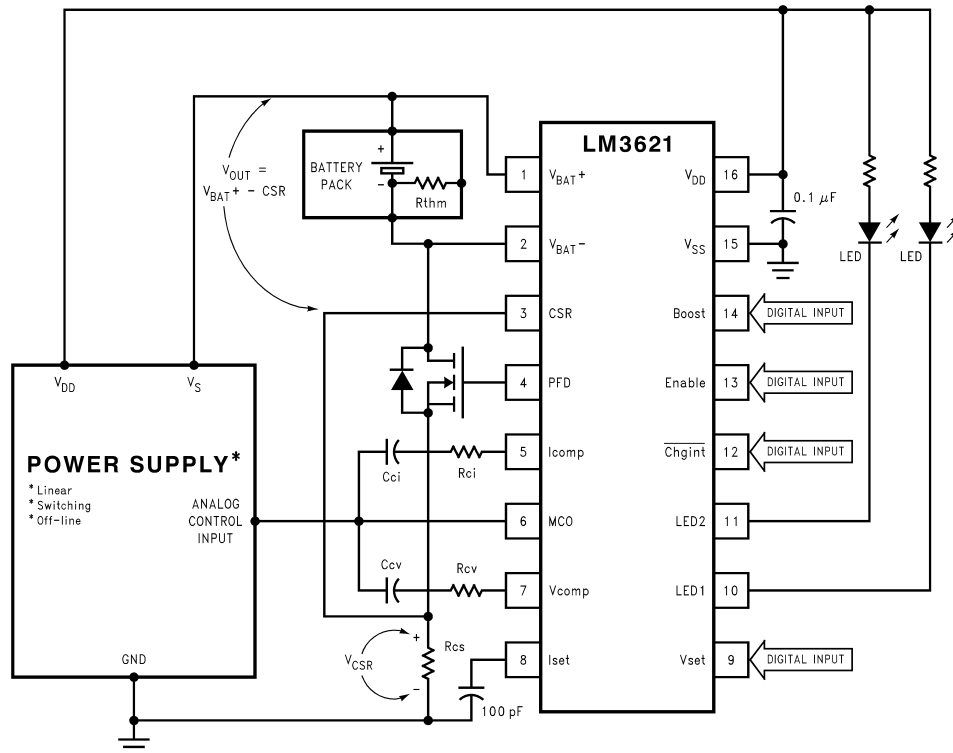


FIGURE 4. General Application Circuit

DS100107-4

## Application Information

### Battery Charger Operation Information

Figure 4 shows a general battery charger configuration using LM3621. The LM3621 provides all the necessary control functions for charging Lithium-Ion batteries precisely and safely. It features constant voltage and constant current mode operation. The on chip timer provides all critical timing functions to properly initialize the charging cycle, avoid over charging the battery above its maximum capacity level, and cut off charging to a defective battery. The LM3621 also provides the high accuracy of output voltage regulation without requiring a trim pot or precision resistors. A built-in power down switch prevents the battery from discharging through the LM3621.

### Input Supply Voltage

The voltage supply to LM3621 must never exceed 6.0V or catastrophic damage may occur to the IC. When power is first applied to the battery charger, the LM3621 will remain in a reset state until the voltage on the V<sub>DD</sub> pin exceeds 3.4V for at least one second. This ensures that the power source is stable before a charge cycle is initiated. Figure 2 shows the state diagram for the charge cycle operation. Once the LM3621 emerges from the reset state after power up, it will not go into the reset state again until the voltage on the V<sub>DD</sub> pin drops below approximately 2.2V. When the LM3621 is in

the reset state, the PFD (Pass FET Drive) pin is pulled low so that current is not allowed to flow into the load (e.g., Li+ battery). The LM3621 transitions from the reset state to standby mode when the conditions for a stable power source are met.

### Digital Control Inputs

The LM3621 has four digital input control pins: Enable, Boost, V<sub>SET</sub> and ChgInt. To ensure proper operation, never allow unused digital input pins to be left open circuited. Enable is used to initiate a charge cycle, Boost is used to increase the maximum regulation current output, V<sub>SET</sub> controls the maximum output voltage, and ChgInt is used to instantaneously interrupt (and resume) a charge cycle in progress.

### Current Boost Mode

This mode is activated when the "Boost" pin is pulled high. The charger increases the maximum output current equal to a V<sub>CSR</sub> level of 0.9V. This mode of operation is overridden by a charge interrupt signal.

### Charge Interrupt Control

Charging is interrupted with the digital input "ChgInt" pulled low. The PFD pin is pulled to ground turning off the series low pass FET. This is useful to prevent charging a battery if, for example, the ambient temperature is excessively high.

## Application Information (Continued)

### Programmable Charge Termination Voltage

The charging status for battery of graphite or coke anode is programmed with the digital input "V<sub>SET</sub>". V<sub>SET</sub> = LO for a charge termination voltage of 4.1V, a float voltage of 3.84V and over voltage detection threshold (V<sub>BAT</sub>-Det) of 4.3V. V<sub>SET</sub> = HI for a charge termination voltage of 4.2V, float voltage of 4.09V and V<sub>BAT</sub>-Det of 4.4V.

### Defective Pack Detection

The LM3621 automatically checks for defective battery. Whenever a defective pack is detected, the charging sequence is suspended and LED1 driver is pulsed at a rate of 0.8 Hz. A defective battery is indicated under three conditions: (1) when a battery fails to charge up to 2.55V within one hour, (2) when the battery ESR plus the contact resistance is excessive, and (3) when the pack is an open circuit.

### Step by Step Description of a Typical Charging Sequence. (Refer to Figure 3)

#### 1. Standby Mode

The LM3621 will remain in standby while the digital inputs to the Enable and Boost pins are low. Boost overrides Enable, and Boost mode may be activated at any time with two exceptions: (1) when a deeply discharged battery (i.e., V<sub>BAT</sub> / T<sub>ERY</sub> ≤ 2.5V) is attached to the charger or (2) when ChgInt has been activated during a normal charge cycle. Both LED drivers pull low during Boost mode. During standby, the charger's output voltage V<sub>OUT</sub> is regulated to either 4.2V or 4.1V depending on the state of the digital input to the V<sub>SET</sub> pin (V<sub>OUT</sub> = 4.2V when V<sub>SET</sub> = high or V<sub>OUT</sub> = 4.1V when V<sub>SET</sub> = low). PFD is low so the low side pass FET is off. The LED driver pins are high impedance (open drain). Table 1 shows the state of the LED drivers during various modes of operation.

#### 2. Charging Sequence Initialization

The LM3621 determines the presence or absence of a battery pack by the state of the "Enable" pin. Enable should be pulled low when the pack is not present. When a pack is inserted into the charger, Enable should go high to initiate the charging sequence.

After Enable is asserted with a battery connected to the charger, LED1 goes low and there is a one-second delay before current is allowed to flow into the battery. During this delay, the LM3621 checks the charge condition of the battery to determine if it is grossly overcharged or if it is deeply discharged. If the battery is grossly overcharged, PFD stays low keeping the low side pass FET off, and both LED drivers pulse at a frequency of 0.8 Hz to indicate a fault condition. If the battery is less than 2.55V, the LM3621 goes to the Hi-Z (battery conditioning) charge mode. During the Hi-Z charge mode, V<sub>OUT</sub> is regulated to 4.1V, and the voltage (V<sub>CSR</sub>) across the current sense resistor (R<sub>CS</sub>) is regulated to 50 mV. The LM3621 is capable of charging a battery that has

been discharged down to as low as 0V. This is accomplished by the fact that the "ON" resistance of the low side N-channel pass FET is modulated by the PFD output. This ensures that V<sub>CSR</sub> stays constant at 50 mV regardless of what the battery voltage is, and it prevents the charger's regulation loop from collapsing in the event that the charger's output is shorted. The LM3621 will remain in the Hi-Z Charge mode for a maximum of one hour. If the battery voltage does not increase to at least 2.55V by the end of the one-hour interval, then PFD goes low to turn off the low side pass FET and LED1 will pulse at 0.8 Hz to indicate a defective battery.

#### 3. Fast Charge Mode

The LM3621 will transition to Fast Charge mode whenever the battery voltage is above 2.55V. During Fast Charge mode LED1 stays low and LED2 stays open drain, and the LM3621 controls the charger to behave as a current limited, constant output voltage source to the battery. If the battery voltage is less than 4.2V (for V<sub>SET</sub> = HI), the LM3621 controls the charger to behave as a constant current source. V<sub>CSR</sub> is limited to 0.5V, so the maximum charge current delivered to the battery is equal to 0.5V / R<sub>CS</sub>. Once the battery voltage reaches 4.2V, the LM3621 controls the charger to behave as a constant voltage source, and V<sub>OUT</sub> is maintained at 4.2V. As the battery continues to charge up, the charge current will decrease. Correspondingly, V<sub>CSR</sub> will decrease as well.

The battery will continue to charge until V<sub>CSR</sub> has decreased to 40 mV, at which time PFD pulls low to interrupt the charge current for one second. At the end of the one second interval, the LM3621 checks to see if the battery's Resistance Free Voltage (RFV) is greater than 3.65V or less than 3.65V. If the battery's RFV is less than 3.65V, then the ESR of the battery is excessively high, PFD stays low to keep the charging sequence suspended and LED1 pulses at 0.8 Hz to indicate a defective battery. If the battery's RFV is greater than 3.65V, then the LM3621 transitions to Top-Off mode. At this transition, LED1 becomes open drain and LED2 pulls low indicating a fully charged battery.

#### 4. Top-Off Mode

During Top-Off mode, the battery is trickle charged for one hour. At the end of the one hour interval, PFD goes low to terminate charging (i.e., the charge current is interrupted), and the LM3621 transitions to Battery Monitor mode.

#### 5. Monitor Mode

During Monitor mode, V<sub>OUT</sub> drops to 4.09V (if V<sub>SET</sub> is high) or 3.84V (if V<sub>SET</sub> is low), and the battery is floating. The LM3621 typically draws less than 1 μA from the battery during Monitor mode. If the battery self discharges so that its voltage decreases to 4.09V (if V<sub>SET</sub> is high) or 3.84V (if V<sub>SET</sub> is low), then the LM3621 will transition back to Fast Charge mode to refresh the battery and charge it back up to its full capacity (Figure 2 & Figure 5). This process will continue until Enable goes low.

## Application Information (Continued)

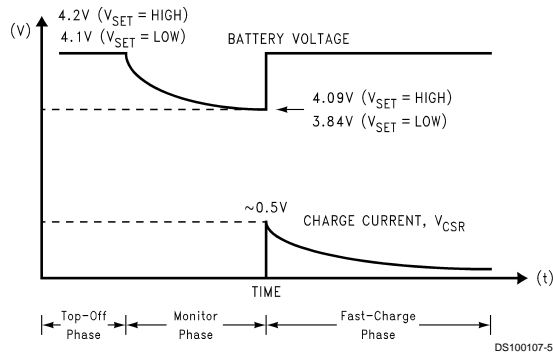


FIGURE 5. Battery Refresh

### Fault Protection

LM3621 provides redundant fault protection for a Li-Ion battery pack. If the charger's control loop is accidentally opened, the regulation voltage will begin to increase beyond the level that are safe for the battery. In order to protect the battery from a fault condition, PFD goes low to turn off the series pass FET whenever the voltage across the battery exceeds the over voltage detection threshold ( $V_{BAT-Det}$ ) or whenever  $V_{CSR}$  exceeds 1V. A fault condition also causes both of the LED drivers to pulse at 0.8 Hz. Enable must go low to cause the LM3621 to transition from the Fault State to Standby mode.

### Low Current Drain of Battery

If power is inadvertently removed from the battery charger, the voltage at the  $V_{DD}$  pin will collapse to the same potential as the  $V_{SS}$  pin. An internal switch will disconnect the circuitry of the LM3621 from the  $V_{BAT+}$  pin so that no more than 1 $\mu$ A (typical) of leakage current will be drawn from the battery.

### Adjustable Charge Current

The current sense resistor ( $R_{CS}$ ) converts the charging current to a voltage level,  $V_{CSR}$ . Applying an external voltage source ( $V_{EXT}$ ) to the  $I_{SET}$  pin will adjust the value of  $V_{CSR}$  for Fast Charge current regulation. Simultaneously the regulation level for Boost mode, Hi-Z Charge mode, End-of-Charge threshold and over current detect threshold will also be adjusted accordingly. The voltage at  $I_{SET}$  pin should be within the range of  $1V \geq V_{ISET} \geq 0.1V$ . The transfer functions of  $V_{CSR}$  to  $V_{ISET}$  are:

Fast Charge Mode,  $V_{CSR} = 0.933 \cdot V_{ISET}$

Hi-Z Mode,  $V_{CSR} = 0.083 \cdot V_{ISET}$

Boost Mode,  $V_{CSR} = 0.48 \cdot V_{ISET} + 0.65$

Over Current Threshold,  $V_{CSR} = 0.36 \cdot V_{ISET} + 0.79$

End-Of-Charge,  $V_{CSR} = 0.07 \cdot V_{ISET}$

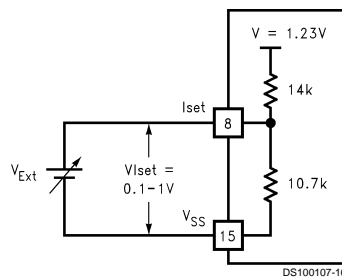
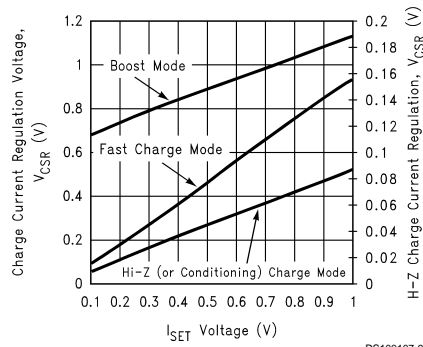


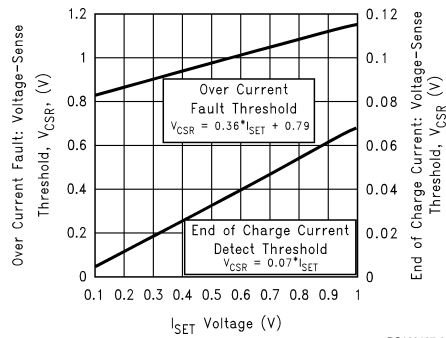
FIGURE 6. Adjusting  $V_{CSR}$  by applying  $V_{EXT}$  to  $I_{SET}$  pin

## Application Information (Continued)



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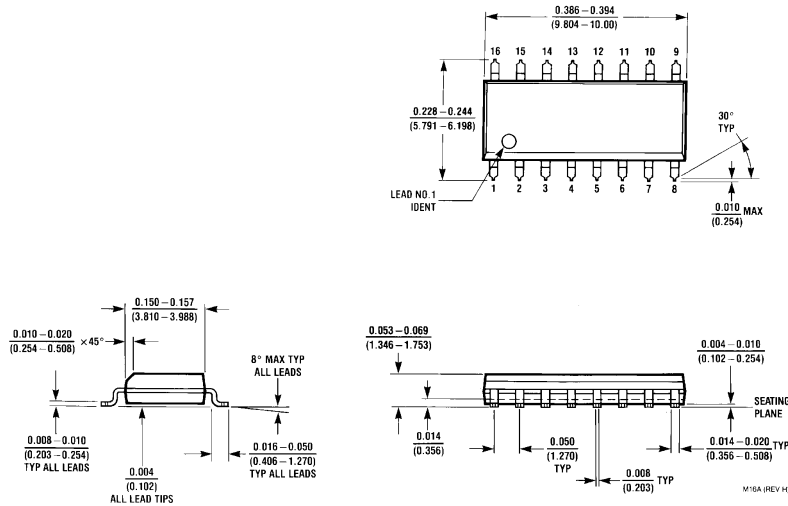
**FIGURE 7. Charge Current Regulation ( $V_{CSR}$ ) vs  $I_{SET}$  Voltage**



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**FIGURE 8. Charge Current Detection ( $V_{CSR}$ ) vs  $I_{SET}$  Voltage**

**Physical Dimensions** inches (millimeters) unless otherwise noted




**16-Lead SOIC Package**  
**Order Number LM3621M or LM3621M-3.0**  
**NSC Package Number M16A**

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