National Semiconductor

July 2000

LM3620
Lithium-Ion Battery Charger Controller

General Description

The LM3620 series of controllers are monolithic integrated circuits designed to control the charging and end-of-charge control for lithium-ion rechargeable batteries. The LM3620 is available in two versions for one or two cell charger applications. Each version provides the option of selecting the appropriate termination voltage for either coke or graphite anode lithium cells.

The LM3620 can operate from a wide range of DC input sources (4V to 30V). With no charger supply connected, the controller draws a quiescent current of only 10nA to minimize discharging of a connected battery pack.

The LM3620 consists of an operational transconductance amplifier, a bandgap voltage reference, a NPN driver transistor and precision voltage setting resistors. The output of the amplifier is made available to drive an external power transistor if higher drive currents are required.

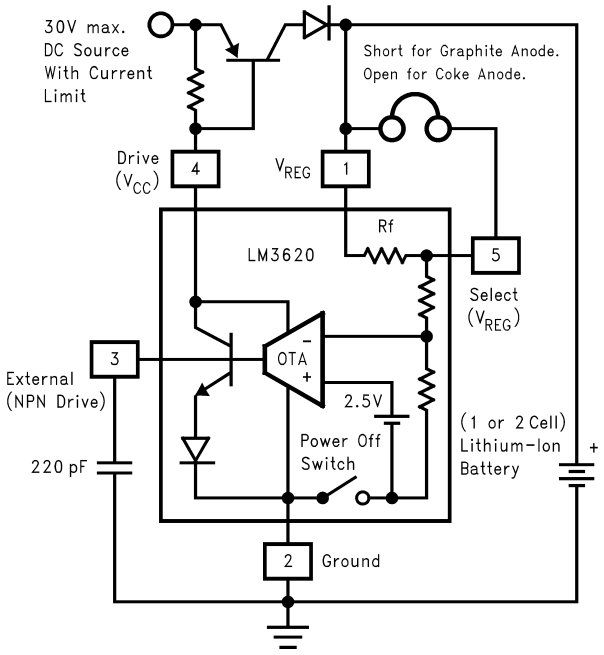
With a trimmed output voltage regulation of ±1.2% initial accuracy, the LM3620 provides a simple, precise solution for end-of-charge control of lithium-ion rechargeable cells.

The LM3620 is packaged in a miniature 5-lead SOT-23 surface mount package for very compact designs.

Features

- Voltage options for charging 1 or 2 cell stacks
- Adjustable output voltage for coke or graphite anodes
- Precision end-of-charge voltage control
- Wide input voltage range (4V to 30V)
- Low off state current (<10nA)
- Drive provided for external power stage
- Tiny SOT-23 package

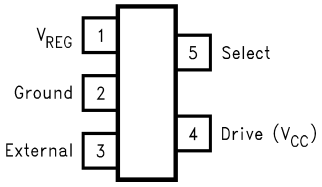
Typical Application



10084110

Connection Diagram

5-Lead SOT23-5 Surface Mount Package



10084101

Refer to the Ordering Information Table in this Data Sheet for Specific Part Number

See NS Package MF05A

Ordering Information

Device Order Number	Package Marking	Output Voltage	Initial Accuracy (25˚C)	Over Temperature Accuracy (0 to 70˚C)	Number of Cells	Supplied as
LM3620M5-4	D10B	4.1V/4.2V	1.2%	2%	1	1000 Unit increments on Tape and Reel
LM3620M5X-4	D10B	4.1V/4.2V	1.2%	2%	1	3000 Unit increments on Tape and Reel
LM3620M5-8	D11B	8.2V/8.4V	1.2%	2%	2	1000 Unit increments on Tape and Reel
LM3620M5X-8	D11B	8.2V/8.4V	1.2%	2%	2	3000 Unit increments on Tape and Reel

The small physical size of the SOT23-5 Package does not allow for the full part number marking. Devices will be marked with the designation shown in the column Package Marking.

The devices are shipped in tape-and-reel format. The standard quantity is 250 units on a reel (indicated by the letters “M5” in the part number), or 3000 units on a reel (indicated by the letters “M5X” in the part number).

Absolute Maximum Ratings (Note 1)

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

Input Voltage (V_{DRIVE})	35V
V_{EXT}	1.5V
Junction Temperature	150˚C
Storage Temperature	−65 to +150˚C
Lead Temp. Soldering	
Vapor Phase (60 sec.)	215˚C
Infrared (15 sec.)	220˚C
Power Dissipation (T_A = 25˚C) (Note 2)	300mW
ESD Susceptibility (Note 3)	2000V

Operating Ratings (Note 1)

Ambient Temp. Range	0˚C to 70˚C
Junction Temp. Range	0˚C to 125˚C
Thermal Resistance (Junction to Ambient, θ_{J-A})	280˚C/W
Input Voltage (V_{DRIVE})	4V to 30V

Electrical Characteristics

LM3620-4

V_{DRIVE} = 5V, I_{DRIVE} = 2mA. Limits with **boldface type** apply over the full operating ambient temperature range, 0˚C to +70˚C, limits with standard typeface apply for T_A = 25˚C.

Symbol	Parameter	Conditions	Typical	Limit	Units
V_{REG}	Regulated Output Voltage (pin 1 to ground)	Pin 5 shorted to pin 1 (graphite anode)	4.1	4.051/**4.018** 4.149/**4.182**	V(min) V(max)
		Pin 5 open (coke anode)	4.2	4.150/**4.116** 4.250/**4.284**	V(min) V(max)
	Regulated Output Voltage Tolerance	Either Pin 5 setting		±1.2/**±2.0**	%
V_{REG}/V_{DRIVE}	Supply Sensitivity	V_{REG} for 5V ≤ V_{DRIVE} ≤ 30V	100		µV/V(max)
I_Q	Quiescent Current	V_{REG} = 4.5V, V_{EXT} = 1.0V (Note 4)	400	**750**	µA(max)
I_{OFF}	Off State Current	V_{DRIVE} open circuited (Note 5)	10	**200**	nA(max)
I_{DRIVE}	Drive Pin Sink Current	V_{DRIVE} = 5.0V	20	**15**	mA(min)
$Gm_{(DRIVE)}$	Drive Pin Transconductance	$\Delta I_{DRIVE}/\Delta V_{REG}$ 2mA ≤ I_{DRIVE} ≤15mA	3		A/V
I_{EXT}	External Pin Source Current	V_{EXT} = 1V (Note 6)	3	**2.5**	mA(min)
$Gm_{(EXT)}$	External Pin Transconductance	$\Delta I_{EXT}/\Delta V_{REG}$, V_{EXT} = 1V 0mA ≤ I_{EXT} ≤ 2.5mA	0.8		A/V
R_{IN}	V_{REG} Input Resistance	Pin 1 to Ground. Circuit biased with V_{DRIVE} applied V_{DRIVE} open circuited	 46 42		 kΩ MΩ
R_F	Feedback Resistance	Pin 1 to Pin 5	1500		Ω

Electrical Characteristics (Continued)

LM3620-8

V_{DRIVE} = 5V, I_{DRIVE} = 2mA. Limits with **boldface type** apply over the full operating ambient temperature range, 0˚C to + 70˚C, limits with standard typeface apply for T_A = 25˚C.

Symbol	Parameter	Conditions	Typical	Limit	Units
V_{REG}	Regulated Output Voltage (pin 1 to ground)	Pin 5 shorted to pin 1 (graphite anode)	8.2	8.102/**8.036** 8.298/**8.364**	V(min) V(max)
		Pin 5 open (coke anode)	8.4	8.299/**8.232** 8.501/**8.568**	V(min) V(max)
	Regulated Output Voltage Tolerance	Either Pin 5 setting		±1.2/**±2.0**	%
V_{REG}/V_{DRIVE}	Supply Sensitivity	V_{REG} for 5V ≤ V_{DRIVE} ≤ 30V	200		µV/V(max)
I_Q	Quiescent Current	V_{REG} = 8.7V, V_{EXT} = 1.0V (Note 4)	400	**750**	µA(max)
I_{OFF}	Off State Current	V_{DRIVE} open circuited (Note 5)	10	**200**	nA(max)
I_{DRIVE}	Drive Pin Sink Current	V_{DRIVE} = 5.0V	20	**15**	mA(min)
$Gm_{(DRIVE)}$	Drive Pin Transconductance	$\Delta I_{DRIVE}/\Delta V_{REG}$ 2mA ≤ I_{DRIVE} ≤15mA	1.5		A/V
I_{EXT}	External Pin Source Current	V_{EXT} = 1V (Note 6)	3	**2.5**	mA(min)
$Gm_{(EXT)}$	External Pin Transconductance	$\Delta I_{EXT}/\Delta V_{REG}$, V_{EXT} = 1V 0mA ≤ I_{EXT} ≤ 2.5mA	0.4		A/V
R_{IN}	V_{REG} Input Resistance	Pin 1 to Ground. Circuit biased with V_{DRIVE} applied V_{DRIVE} open circuited	 110 42		 kΩ MΩ
R_F	Feedback Resistance	Pin 1 to Pin 5	2900		Ω

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: The maximum power dissipation must be derated at elevated temperatures and is limited by T_{JMAX} (maximum junction temperature), θ_{J-A} (junction-to-ambient thermal resistance) and T_A (ambient temperature). The maximum power dissipation at any temperature is: $PDiss_{MAX} = (T_{JMAX} - T_A)/\theta_{J-A}$ up to the value listed in the Absolute Maximum Ratings.

Note 3: Rating is for the human body model, a 100 pF capacitor discharged through a 1.5kΩ resistor into each pin.

Note 4: Quiescent current is all current flowing to ground when the voltage at the V_{REG} pin is forced to be above the nominal regulating voltage (V_{REG}).

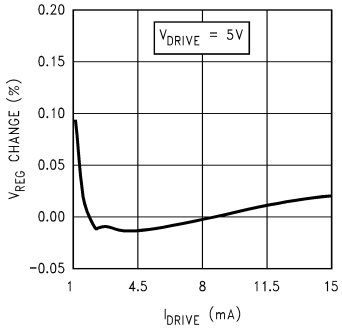
Note 5: Off current is all of the current flowing to ground including all leakage current that would be drawn from the battery connected to the V_{REG} terminal.

Note 6: When the External pin is being used as the driving source, it is recommended to keep the operating point of V_{EXT} ≤ 1V. If greater than 1V, the internal circuitry would bias I_{DRIVE} to conduct up to the current limit level continuously causing unnecessary power dissipation in the device.

Typical Performance Characteristics

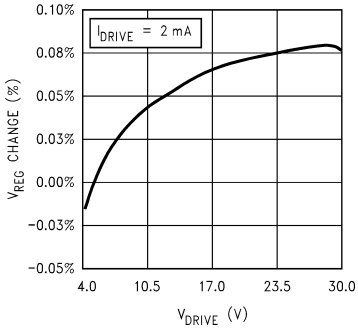
Unless otherwise specified, T_A = 25˚C.

LM3620M5-4
Normalized Regulation Voltage Change vs I_{DRIVE}



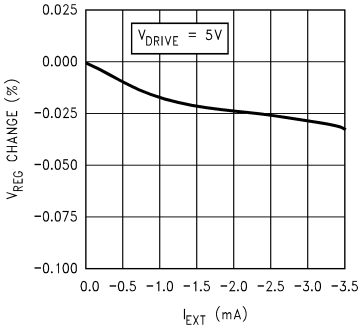
10084104

LM3620M5-4
Normalized Regulation Voltage Change vs V_{DRIVE}



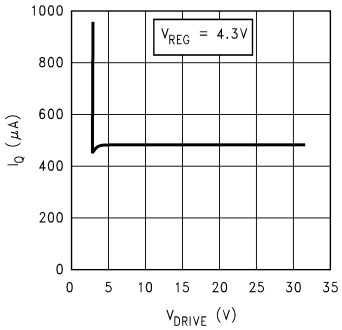
10084108

LM3620M5-4
Normalized Regulation Voltage Change vs I_{EXT}



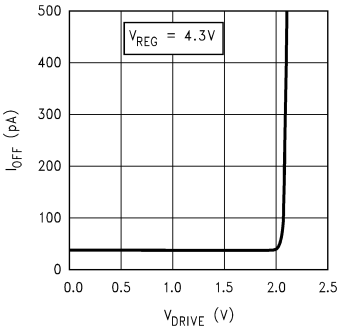
10084107

LM3620M5-4
Quiescent Current vs V_{DRIVE}



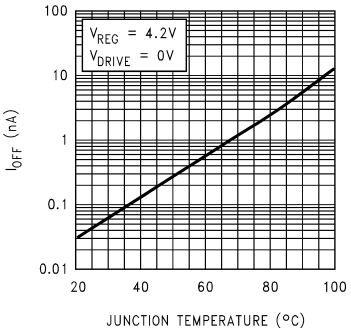
10084105

LM3620M5-4
Off State Current vs V_{DRIVE}



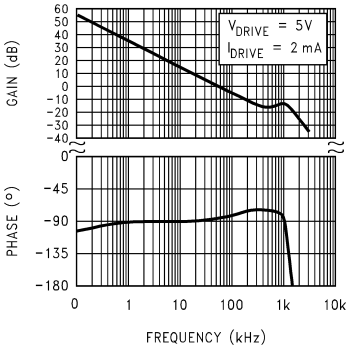
10084106

LM3620M5-4
Off State Current vs Temperature



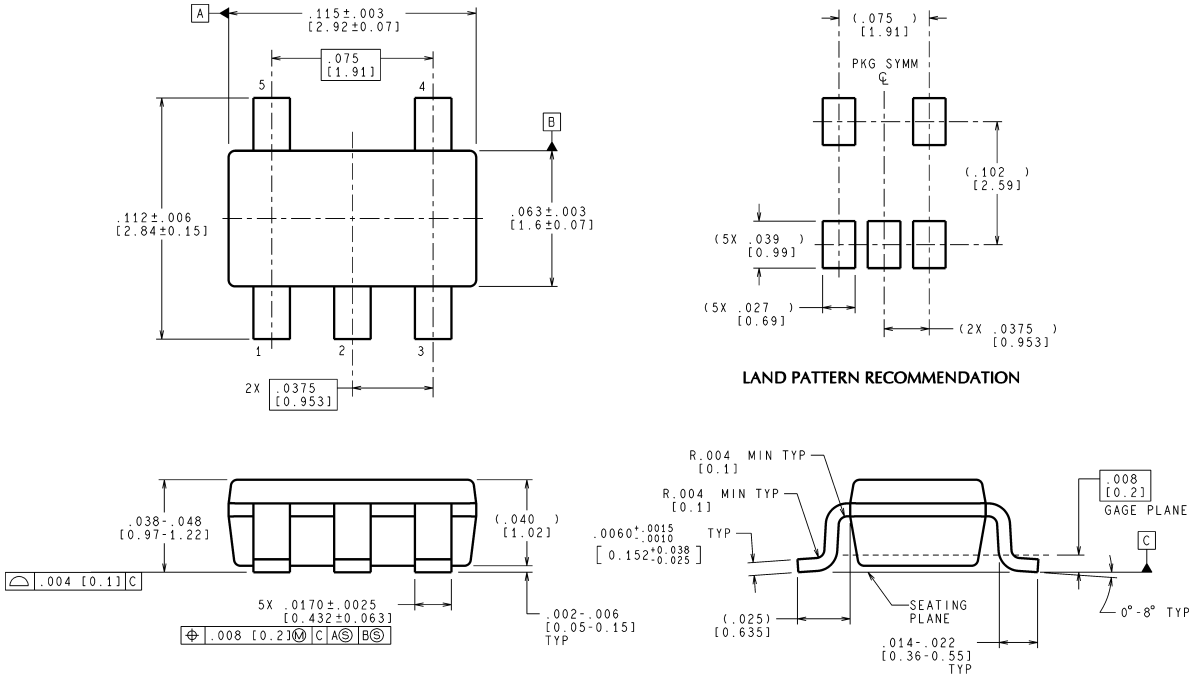
10084103

LM3620M5-4
Bode Plot ($\Delta V_{DRIVE}/\Delta V_{REG}$)



10084109

Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MF05A (Rev B)

SOT23-5 Package
5-Lead Small-Outline Package (M5)
For Ordering, Refer to Ordering Information Table
NS Package Number MF05A

National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

www.national.com

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560