CHANGE NOTIFICATION

Linear Technology Corporation
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April 09, 2013

PCN#: 040913

Dear Sir/Madam:

Subject: Notification of Change to LTC3854 Die and Datasheet

Please be advised that Linear Technology Corporation has made minor changes to the LTC3854 die and datasheet. A minor mask revision was made to improve application robustness and variance in soft start time. As a result of the change, the RUN/SS pin is clamped internally to 3.2V in the revised design vs. 4.8V in prior silicon. In applications where the RUN/SS pin is pulled up, up to 50uA is sourced into the pin. Normal active states are unaffected.

Product specifications are unaffected. Changes to the datasheet (attached) will be made to clarify the new RUN/SS pin characteristics. The die change was qualified by performing characterization over the full operation junction temperature range and through rigorous engineering evaluation across a broad range of application conditions. Optical comparison of old versus new masks and electronic error checking were performed to verify the changes. Samples of the revised die are available now upon request. The revised product has passed 1000 hours of high temperature operating life (HTOL) test before production release. Product built using the new die will be shipped with a datecode of approximately 1336.

Should you have any further questions, please feel free to contact me at 408-432-1900 ext. 2519, or by e-mail at NGirn@Linear.com. If I do not hear from you by May 10th, 2013, we will consider this change to be approved by your company.

Sincerely,

Naib Girn
Quality Assurance Manager

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_{IN} = 15V, V_{RUN} = 5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Main Control Loop							
V_{IN}	Operating Input Voltage Range			4.5		38	V
V_{FB}	Regulated Feedback Voltage	(Note 4); ITH Voltage = 1.2V	●	0.792	0.8	0.808	V
I_{FB}	Feedback Current	(Note 4)			±5	±50	nA
$V_{REFLNREG}$	Reference Voltage Line Regulation	V_{IN} = 6V to 38V (Note 4)			0.002	0.02	%/V
$V_{LOADREG}$	Output Voltage Load Regulation	(Note 4) Measured in Servo Loop; Δ_{ITH} Voltage = 0.7V to 1.2V	●		0.1	0.5	%
		Measured in Servo Loop; Δ_{ITH} Voltage = 1.2V to 2V	●		–0.1	–0.5	%
gm	Transconductance Amplifier gm	ITH = 1.2V; Sink/Source = 5µA (Note 4)			2.0		mmho
gm_{GBW}	Transconductance Amplifier GBW	ITH = 1.2V; (Guaranteed by Design)			3		MHz
I_Q	Input DC Supply Current						
	Normal Mode	(Note 5)			2	3	mA
	Shutdown	RUN = 0V			10	25	µA
UVLO	Undervoltage Lockout	V_{IN} Ramping Down; Measured at $INTV_{CC}$	●	3.0	3.5		V
$UVLO_{HYST}$	Undervoltage Lockout Hysteresis	V_{IN} Ramping Down then Up; Measured at $INTV_{CC}$			350		mV
V_{OVL}	Feedback Overvoltage Lockout	Measured at FB	●	0.86	0.88	0.90	V
I_{SENSE}	Sense Pins Source Current	V_{SENSE}– = V_{SENSE}+ = 3.3V			±0.5	±1	µA
DF_{MAX}	Maximum Duty Factor	In Dropout		97	98		%
$I_{RUN/SS}$	Soft-Start Charge Current	RUN/SS = 0V		0.6	1.25	2.0	µA
V_{RUN/SS_SD}	Shutdown Threshold	RUN/SS Pin Must be Taken Below this Value to Reset Part (or Put into Shutdown Mode)			0.4		V
V_{RUN/SS_ON}	Soft-Start Threshold	Soft-Start Mode (See Pin Description)			1.2		V
$V_{SENSE(MAX)}$	Maximum Current Sense Threshold	FB = 0.7V, V_{SENSE}– = 3.3V, V_{IN} = 6V		40	50	65	mV
TG R_{UP}	TG Driver Pull-Up On Resistance	TG High			2.5		Ω
TG R_{DOWN}	TG Driver Pull-Down On Resistance	TG Low			2.1		Ω
BG R_{UP}	BG Driver Pull-Up On Resistance	BG High			2.5		Ω
BG R_{DOWN}	BG Driver Pull-down On Resistance	BG Low			1.2		Ω
	TG Transition Time:	(Note 6)					
TG t_r	Rise Time	C_{LOAD} = 3300pF			25		ns
TG t_f	Fall Time	C_{LOAD} = 3300pF			25		ns
	BG Transition Time:	(Note 6)					
BG t_r	Rise Time	C_{LOAD} = 3300pF			25		ns
BG t_f	Fall Time	C_{LOAD} = 3300pF			25		ns
TG/BG t_{1D}	Top Gate Off to Bottom Gate On Delay Synchronous Switch-On Delay Time	C_{LOAD} = 3300pF Each Driver			30		ns
BG/TG t_{2D}	Bottom Gate Off to Top Gate On Delay Top Switch-On Delay Time	C_{LOAD} = 3300pF Each Driver			30		ns
$t_{ON(MIN)}$	Minimum On-Time	(Note 7)			75		ns
$INTV_{CC}$ Linear Regulator							
V_{INTVCC}	Internal V_{CC} Voltage	6V < V_{IN} < 38V		4.8	5.0	5.2	V
V_{LDO} INT	$INTV_{CC}$ Load Regulation	I_{CC} = 0 to 20mA			0.2	1.0	%
Oscillator							
f_{SW}	Switching Frequency			360	400	440	kHz

PIN FUNCTIONS

FB (Pin 1): Error Amplifier Feedback Input. This pin receives the remotely-sensed feedback voltage from an external resistor divider across the output.

ITH (Pin 2): Error Amplifier Output and Switching Regulator Compensation Point. The current comparator trip point increases with this control voltage.

RUN/SS (Pin 3): Run Control, Soft-Start. If the voltage on this pin is held below 0.4V, the part is in shutdown. If the pin is released the capacitance to ground at this pin sets the soft-start ramp rate. ~~An internal 1.25µA soft-start current is always charging this pin~~.

BOOST (Pin 4): Bootstrapped Supply to the Top Side Floating Driver. A low ESR capacitor is connected between the BOOST and SW pins and an external Schottky diode is tied between the BOOST and $INTV_{CC}$ pins. The voltage swing on the BOOST pin is $INTV_{CC}$ to (V_{IN} + $INTV_{CC}$).

TG (Pin 5): High Current Gate Drive for Top N-channel MOSFET. This is the output of floating driver with a voltage swing equal to $INTV_{CC}$ superimposed on the switch node voltage.

SW (Pin 6): Switch Node Connection to Inductor. The voltage swing on this pin is from a Schottky diode (external) forward voltage (when this diode is added across the N-channel synchronous MOSFET) below ground to V_{IN}.

GND (Pin 7): Small Signal and Power Ground. This is the high current ground for the gate driver. The internal signal ground is Kelvin connected to this pin for noise suppression.

BG (Pin 8): High Current Gate Drive for Bottom (Synchronous) N-channel MOSFET. The voltage swing at this pin is from ground to $INTV_{CC}$.

$INTV_{CC}$ (Pin 9): Output of the Internal 5V Low Dropout Regulator. The driver and control circuits are powered from this voltage. Must be decoupled to power ground with a minimum of 2.2µF low ESR ceramic capacitor (X5R or better).

V_{IN} (Pin 10): Main Supply Pin. A bypass capacitor should be tied between this pin and the signal ground pin.

$SENSE^-$ (Pin 11): The (–) Input to the Differential Current Comparator.

$SENSE^+$ (Pin 12): The (+) Input to the Differential Current Comparator. The ITH pin voltage and controlled offsets between the $SENSE^-$ and $SENSE^+$ pins in conjunction with R_{SENSE} (or R_{DCR}) set the peak current trip threshold.

SGND (Exposed Pad Pin 13): The exposed pad must be soldered to PCB ground for electrical contact and rated thermal performance.

An internal 1.25uA soft-start current charges up to 2V. When RUN/SS is pulled high, up to 50uA is sourced into this pin.

OPERATION

Main Control Loop

The LTC3854 is a constant-frequency, peak current mode step-down controller. During normal operation, the top MOSFET is turned on when the clock sets the RS latch, and is turned off when the main current comparator, I_{CMP}, resets the RS latch. The peak inductor current at which I_{CMP} resets the RS latch is controlled by the voltage on the ITH pin, which is the output of the error amplifier EA. The V_{FB} pin receives the voltage feedback signal, which is compared to the internal reference voltage by the EA. When the load current increases, it causes a slight decrease in V_{FB} relative to the 0.8V reference, which in turn causes the ITH voltage to increase until the average inductor current matches the new load current. After the top MOSFET has turned off, the bottom MOSFET is turned on until the beginning of the next cycle.

$INTV_{CC}$ Power

Power for the top and bottom MOSFET drivers and most other internal circuitry is derived from the $INTV_{CC}$ pin. An internal 5V low dropout linear regulator supplies $INTV_{CC}$ power from V_{IN}.

The top MOSFET driver is biased from a floating bootstrap capacitor C_B, which recharges during each off cycle through an external Schottky diode when the top MOSFET turns off. If the input voltage V_{IN} decreases to a voltage close to V_{OUT}, the loop may enter dropout and attempt to turn on the top MOSFET continuously. The dropout detector then forces the top MOSFET off for 1/10 of the clock period every fourth cycle to allow C_B to recharge.

In this case, up to 50uA is sourced into the pin.

Shutdown and Start-Up (RUN/SS)

The LTC3854 is shut down using the RUN/SS pin. Pulling this pin below 1.2V disables the controller and most of the internal circuitry, including the $INTV_{CC}$ regulator.

However, for RUN/SS>0.8V the internal bandgap is functional and the input current will be greater than the minimum shutdown current. To keep the part in a true shutdown mode the RUN/SS pin should be held below 0.4V. Releasing RUN/SS pin allows an internal 1.25µA current to pull up the pin and enable the controller. Alternatively, the RUN/SS pin may be externally pulled up or driven directly by logic. Be careful not to exceed the Absolute Maximum Rating of 6V on this pin.

The start-up of the controller's output voltage V_{OUT} is governed by the voltage on the RUN/SS pin until RUN/SS > 2V.

When the voltage on the RUN/SS pin is greater than 1.2V and less than 2V the LTC3854 regulates the V_{FB} voltage to 1.2V below the RUN/SS pin voltage. The RUN/SS pin programs the soft-start period through an external capacitor from the RUN/SS pin to GND. An internal 1.25µA pull-up current charges this capacitor creating a voltage ramp on the RUN/SS pin. As the RUN/SS voltage rises linearly from 1.2V to 2V, V_{OUT} rises smoothly from zero to the target output voltage. When the LTC3854 is in undervoltage lockout the external MOSFETs are held off.

Frequency of Operation

The LTC3854 operates at a fixed frequency of 400kHz.

Output Overvoltage Protection

An overvoltage comparator, OV, guards against transient overshoots (>10%) as well as other more serious conditions that may overvoltage the output. In such cases, the top MOSFET is turned off and the bottom MOSFET is turned on until the overvoltage condition is cleared.