DICE/DWF SPECIFICATION

RH3845MK DICE

Radiation Hardened High Voltage Synchronous Step-Down Controller

DESCRIPTION

The RH3845MK is a high voltage, synchronous, current mode controller for medium to high power, high efficiency supplies. It offers a wide 4V to 60V input range (7.5V minimum start-up voltage). An onboard regulator simplifies the biasing requirements by providing IC power directly from V_{IN}.

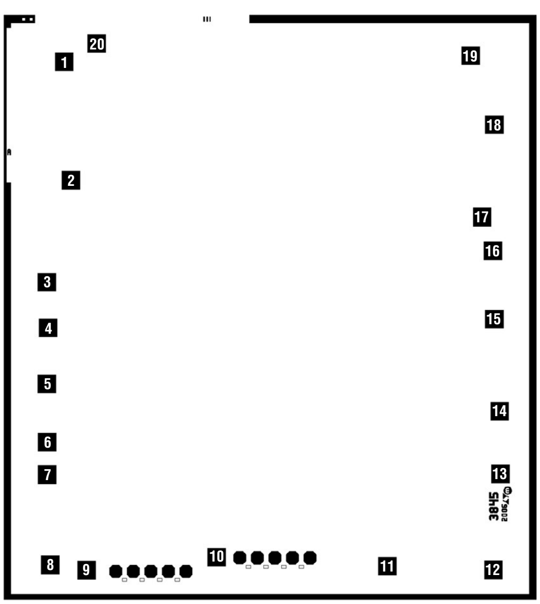
Additional features include an adjustable fixed operating frequency synchronizable to an external clock for noise sensitive applications, gate drivers capable of driving large N-channel MOSFETs, a precision undervoltage lockout, low shutdown current, short-circuit protection, and a programmable soft-start. Note that Burst Mode® operation, available in the LT3845, is not available in the RH3845 version.

ABSOLUTE MAXIMUM RATINGS

(Note 1)

V_{IN} 65V
BOOST 80V
BOOST to SW 24V
V_{CC}, MODE 24V
SENSE⁺, SENSE⁻ 40V
SENSE⁺ TO SENSE⁻ .... ±1V
SYNC, V_{FB}, AND C_{SS} 5V
$\overline{\text{SHDN}}$ Pin Current 1mA
Operating Junction Temperature Range ... –55°C to 125°C
Storage Temperature Range .... –65°C to 150°C

DICE PINOUT



113mils × 124mils,
Backside Metal: Alloyed Gold Layer
Backside Potential: GND

PAD FUNCTION

1. V_{IN}
2. $\overline{\text{SHDN}}$
3. C_{SS}
4. MODE
5. V_{FB}
6. V_C
7. SYNC
8. f_{SET}
9. GND
10. GND
11. GND
12. SENSE⁻
13. SENSE⁺
14. PGND
15. BG
16. V_{CC}
17. SW
18. TG
19. BOOST
20. GND

DIE CROSS REFERENCE

LTC® Finished Part Number	Order Part Number
RH3845MK	RH3845MK DICE
RH3845MK	RH3845MK DWF*

Please refer to LTC standard product data sheet for other applicable product information.
***DWF = DICE in wafer form.**

TABLE 1: DICE/DWF ELECTRICAL TEST LIMITS

Specifications are at T_A = 25°C, V_{IN} = 20V, V_{CC} = BOOST = 10V, $\overline{SHDN}$ = 2V, R_{SET} = 49.9kΩ, SENSE⁻ = SENSE⁺ = 10V, SGND = PGND, SW = 0V.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN} Minimum Start Voltage (Note 2)				7.5	V
V_{IN} UVLO Threshold (Falling)		3.6		4.0	V
V_{IN} Supply Current	V_{CC} > 9V			200	µA
V_{IN} Shutdown Current	$V_{\overline{SHDN}}$ = 0.3V			100	µA
BOOST Supply Current (Note 3)				2	mA
V_{CC} Supply Current				4.5	mA
$\overline{SHDN}$ Enable Threshold (Rising)		1.30		1.40	V
Reference Voltage		1.214		1.250	V
V_{FB} Input Bias Current				±100	nA
V_{FB} Error Amp Transconductance		350			µS
Error Amp Sink/Source Current		35			µA
MODE Pin Current (Note 4)				2	µA
Peak Current Limit Sense Voltage		90		120	mV
Soft-Start Charge Current		8		14	µA
Sense Pins Common-Mode Range		0		36	V
Sense Pins Input Current	$V_{SENSE(CM)}$ > 4V			400	µA
Reverse Protect Sense Voltage	V_{MODE} = 7.5V			120	mV
Reverse Current Sense Voltage Offset	V_{MODE} = V_{FB}			20	mV
Switching Frequency	R_T = 49.9k	270		360	kHz
Programmable Frequency Range		100		500	kHz

TABLE 2: ELECTRICAL CHARACTERISTICS

(Pre-Irradiation) Specifications are at $T_A = 25°C$, $V_{IN} = 20V$, V_{CC} = BOOST = 10V, $\overline{SHDN} = 2V$, $R_{SET} = 49.9k\Omega$, $SENSE^- = SENSE^+ = 10V$, SGND = PGND, SW = 0V.

PARAMETER	CONDITIONS	SUB-GROUP	$T_A = 25°C$ MIN	TYP	MAX	SUB-GROUP	$-55°C \le T_A \ge 125°C$ MIN	TYP	MAX	UNITS
V_{IN} Minimum Start Voltage (Note 2)		1			7.5	2, 3			7.5	V
V_{IN} UVLO Threshold (Falling)		1	3.6	3.8	4.0	2, 3	3.6	3.8	4.0	V
V_{IN} Supply Current	$V_{CC} > 9V$	1		130	200	2, 3			800	µA
V_{IN} Shutdown Current	$V_{\overline{SHDN}} = 0.3V$	1		65	100	2, 3			200	µA
BOOST Supply Current (Note 3)		1		1.4	2	2, 3			3.5	mA
V_{CC} Supply Current		1		3.8	4.5	2, 3			5.5	mA
V_{CC} Current Limit		1	–40	–150		2, 3	–40			mA
$\overline{SHDN}$ Enable Threshold (Rising)		1	1.30	1.35	1.4	2, 3	1.30		1.5	V
$\overline{SHDN}$ Hysteresis		1		140		2, 3	100		200	mV
Reference Voltage		1	1.214	1.232	1.250	2, 3	1.214		1.250	V
V_{FB} Input Bias Current		1		±20	±100	2, 3		±20		nA
V_{FB} Error Amp Transconductance		1	350	450		2, 3	340		540	µS
Error Amp Sink/Source Current		1	35	50		2, 3	20			µA
Peak Current Limit Sense Voltage		1	90	105	120	2, 3	85		125	mV
Soft-Start Charge Current		1	8	12	14	2, 3	8		16	µA
Sense Pins Common-Mode Range		1	0		36	2, 3	0		36	V
Sense Pins Input Current	$V_{SENSE(CM)} > 4V$	1		320	400	2, 3			500	µA
Reverse Protect Sense Voltage	$V_{MODE} = 7.5V$	1		108	120	2, 3			140	mV
Reverse Current Sense Voltage Offset	$V_{MODE} = V_{FB}$	1		15	20	2, 3			25	mV
Switching Frequency	$R_T = 49.9k$	1	270	300	360	2, 3	240		390	kHz
Programmable Frequency Range		1	100		500	2, 3	100		500	kHz
External Sync Frequency Range		1	100		600	2, 3	100		600	kHz
Non-Overlap Time TG to BG		1		250		2, 3				ns
Non-Overlap Time BG to TG		1		250		2, 3				ns
TG Minimum On-Time		1		400		2, 3				ns
TG Minimum Off-Time		1		300		2, 3				ns
TG, BG Drive On Voltage	$V_{CC} = 10V$	1	8	8.75		2, 3	8			V
TG, BG Drive Off Voltage		1			0.1	2, 3			0.1	V
TG, BG Drive Rise Time	$C_{TG} = C_{BG} = 3300pF$	1		45		2, 3				ns
TG, BG Drive Fall Time	$C_{TG} = C_{BG} = 3300pF$	1		45		2, 3				ns

TABLE 3: ELECTRICAL CHARACTERISTICS (Post-Irradiation) Specifications are at T_A = 25°C, V_{IN} = 20V, V_{CC} = BOOST = 10V, $\overline{SHDN}$ = 2V, R_{SET} = 49.9kΩ, $SENSE^-$ = $SENSE^+$ = 10V, SGND = PGND, SW = 0V.

PARAMETER	CONDITIONS	10KRADS (Si) MIN	10KRADS (Si) MAX	20KRADS (Si) MIN	20KRADS (Si) MAX	50KRADS (Si) MIN	50KRADS (Si) MAX	100KRADS (Si) MIN	100KRADS (Si) MAX	200KRADS (Si) MIN	200KRADS (Si) MAX	UNITS
V_{IN} Minimum Start Voltage (Note 2)			7.5		7.5		7.5		7.5		7.5	V
V_{IN} UVLO Threshold (Falling)			4		4		4		4		4	V
V_{IN} Supply Current	V_{CC} > 9V		200		200		200		200		200	µA
V_{IN} Shutdown Current	$V_{\overline{SHDN}}$ = 0.3V		100		100		100		100		100	µA
BOOST Supply Current (Note 3)			2		2		2		2		2	mA
V_{CC} Supply Current			4.5		4.5		4.5		4.5		4.5	mA
V_{CC} Current Limit		–40		–40		–40		–40		–40		mA
$\overline{SHDN}$ Enable Threshold (Rising)		1.30	1.5	1.30	1.5	1.30	1.5	1.30	1.5	1.30	1.5	V
$\overline{SHDN}$ Hysteresis		100	180	100	180	100	180	100	180	80	180	mV
Reference Voltage		1.214	1.250	1.210	1.246	1.208	1.244	1.204	1.240	1.187	1.223	V
V_{FB} Input Bias Current			±100		±150		±170		±300		±400	nA
V_{FB} Error Amp Transconductance		350		330		300		280		250		µS
Error Amp Sink/Source Current		35		35		35		35		30		µA
Peak Current Limit Sense Voltage		90	120	85	120	85	120	80	120	75	120	mV
Soft-Start Charge Current		8	16	8	16	6	16	5	16	4	16	µA
Sense Pins Common-Mode Range			36		36		36		36		36	V
Sense Pins Input Current	$V_{SENSE(CM)}$ > 4V		400		400		400		400		400	µA
Reverse Protect Sense Voltage	V_{MODE} = 7.5V		120		120		120		120		120	mV
Reverse Current Sense Voltage Offset	V_{MODE} = V_{FB}		20		20		20		20		20	mV
Switching Frequency	R_T = 49.9k	270	370	270	370	270	370	270	370	270	370	kHz
Programmable Frequency Range		100	500	100	500	100	500	100	500	100	500	kHz
Non-Overlap Time TG to BG			350		350		350		350		350	ns
Non-Overlap Time BG to TG			350		350		350		350		350	ns
TG Minimum On-Time			500		500		500		500		500	ns
TG Minimum Off-Time			350		350		350		360		360	ns
TG, BG Drive On Voltage	V_{CC} = 10V	8		8		8		8		8		V
TG, BG Drive Off Voltage			0.1		0.1		0.1		0.1		0.1	V
TG, BG Drive Rise Time	C_{TG} = C_{BG} = 3300pF		60		60		60		60		60	ns
TG, BG Drive Fall Time	C_{TG} = C_{BG} = 3300pF		60		60		60		60		60	ns

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability.

Note 2: V_{IN} voltages below the start-up threshold (7.5V) are only supported when the V_{CC} is externally driven above 6.5V.

Note 3: Supply current specification does not include switch drive currents. Actual supply currents will be higher.

Note 4: Connect the MODE pin to V_{FB} for pulse-skipping mode or V_{CC} for forced continuous mode. Burst Mode operation is not available in the RH3845 version of this part.

TABLE 4: ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUP
Final Electrical Test Requirements (Method 5004)	1*, 2, 3
Group A Test Requirements (Method 5005)	1, 2, 3
Group B and D for Class S, End Point Electrical Parameters (Method 5005)	1, 2, 3

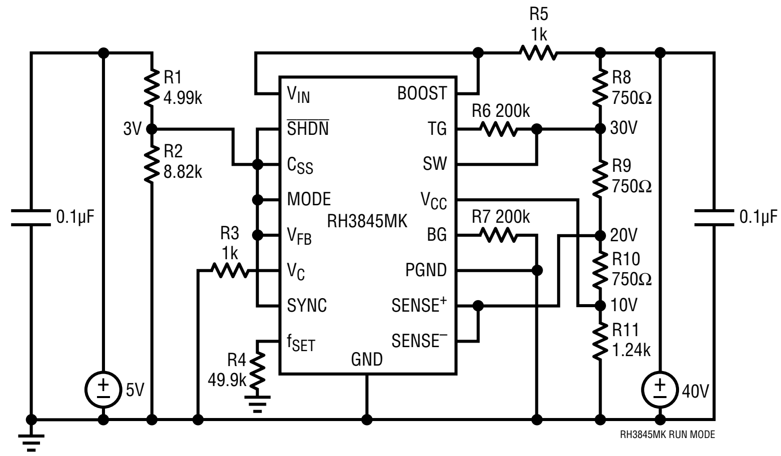
*PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

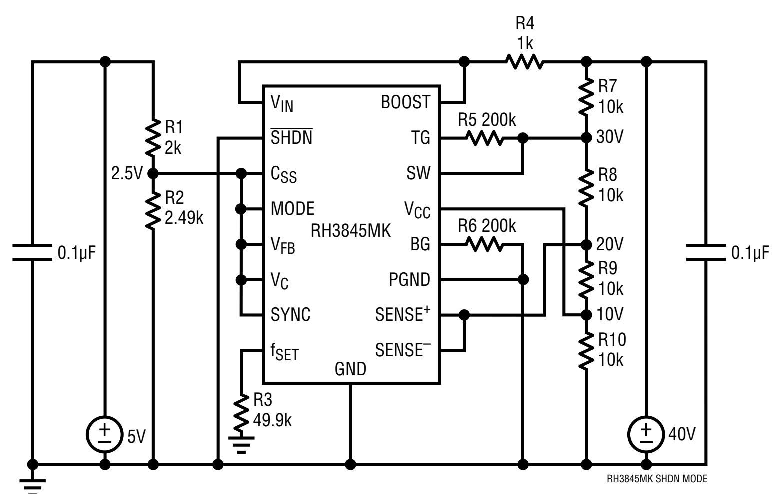
The PDA is specified as 5% based on failures from Group A, Subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of Group A, Subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent for the lot.

Linear Technology Corporation reserves the right to test to tighter limits than those given.

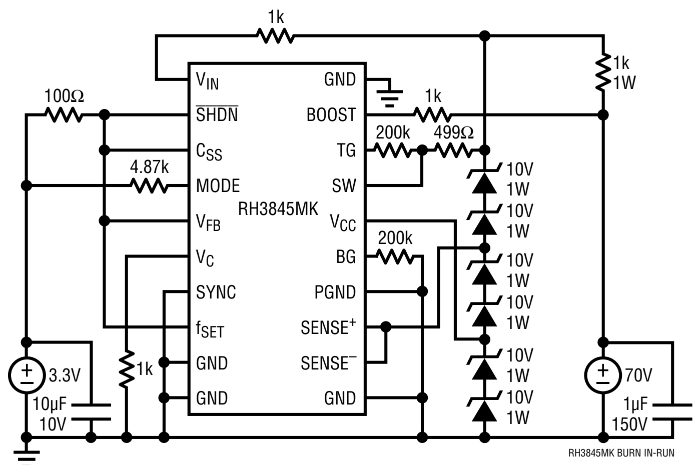
TOTAL DOSE BIAS CIRCUIT — RUN MODE



TOTAL DOSE BIAS CIRCUIT — SHUTDOWN MODE



BURN-IN CIRCUIT — RUN MODE

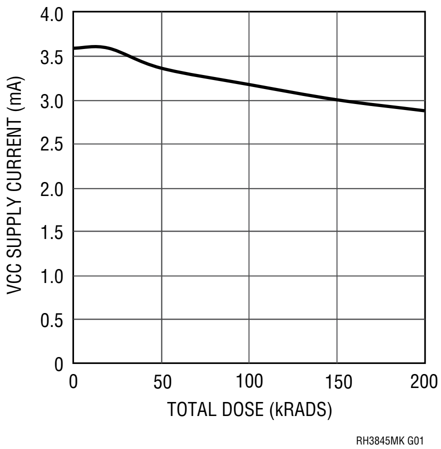


REVISION HISTORY (Revision history begins at Rev C)

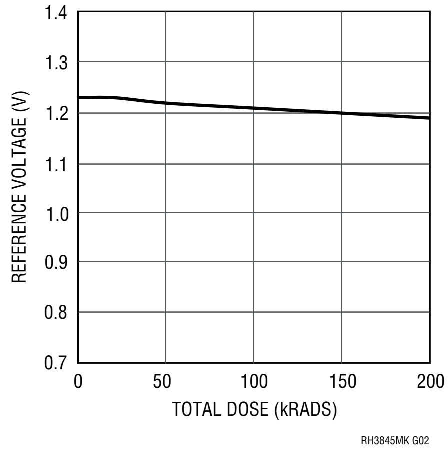
REV	DATE	DESCRIPTION	PAGE NUMBER
C	09/16	Removed V_{CC} Current Limit, corrected Reverse Current Sense Voltage Offset from 10mV to 20mV, corrected FB Bias Current from maximum 50nA to ±100nA	2, 3, 4

TYPICAL PERFORMANCE CHARACTERISTICS

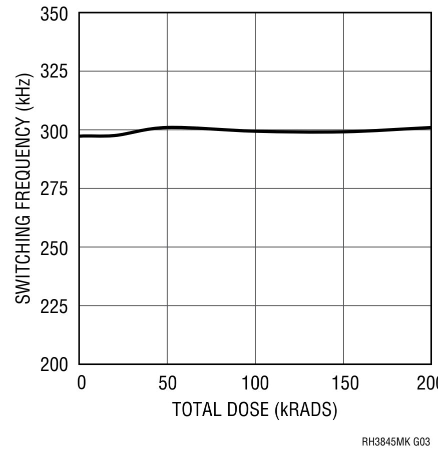
V_{CC} Supply Current vs TID



Feedback Voltage Reference vs TID



Operating Switching Frequency vs TID



Rad Hard die require special handling as compared to standard IC chips.

Rad Hard die are susceptible to surface damage because there is no silicon nitride passivation as on standard die. Silicon nitride protects the die surface from scratches by its hard and dense properties. The passivation on Rad Hard die is silicon dioxide that is much “softer” than silicon nitride.

LTC recommends that die handling be performed with extreme care so as to protect the die surface from scratches. If the need arises to move the die around from the chip tray, use a Teflon-tipped vacuum wand. This wand can be made by pushing a small diameter Teflon tubing onto the tip of a steel-tipped wand. The inside diameter of the Teflon tip should match the die size for efficient pickup. The tip of the Teflon should be cut square and flat to ensure good vacuum to die surface. Ensure the Teflon tip remains clean from debris by inspecting under stereoscope.

During die attach, care must be exercised to ensure no tweezers touch the top of the die.

Wafer level testing is performed per the indicated specifications for dice. Considerable differences in performance can often be observed for dice versus packaged units due to the influences of packaging and assembly on certain devices and/or parameters. Please consult factory for more information on dice performance and lot qualifications via lot sampling test procedures.

Dice data sheet subject to change. Please consult factory for current revision in production.

I.D.No. 66-13-3845

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LT 0916 REV C • PRINTED IN USA