PRERELEASE
Electrical Specifications Subject to Change

LTM4603/LTM4603-1

6A DC/DC µModule with PLL, Output Tracking and Margining

FEATURES

- **Complete Switch Mode Power Supply**
- **Wide Input Voltage Range: 4.5V to 20V**
- **6A DC Typical, 8A Peak Output Current**
- **0.6V to 5V Output Voltage**
- **Output Voltage Tracking and Margining**
- **Remote Sensing for Precision Regulation (LTM4603 Only)**
- **Typical Operating Frequency: 1MHz**
- **PLL Frequency Synchronization**
- **1.5% Regulation**
- **Current Foldback Protection (Disabled at Start-Up)**
- Pin Compatible with the LTM4601
- Pb-Free (e4) RoHS Compliant Package with Gold Finish Pads
- Ultrafast Transient Response
- Current Mode Control
- Up to 93% Efficiency at $5V_{IN}$, $3.3V_{OUT}$
- Programmable Soft-Start
- Output Overvoltage Protection
- Small Footprint, Low Profile (15mm × 15mm × 2.8mm) Surface Mount LGA Package

APPLICATIONS

- Telecom and Networking Equipment
- Servers
- Industrial Equipment
- Point of Load Regulation

DESCRIPTION

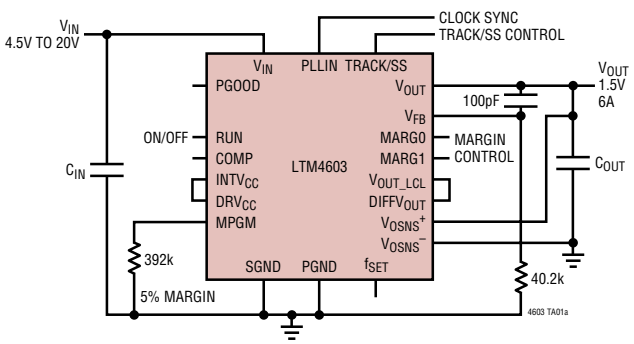
The LTM®4603 is a complete 6A step-down switch mode DC/DC power supply with onboard switching controller, MOSFETs, inductor and all support components. The µModule™ is housed in a small surface mount 15mm × 15mm × 2.8mm LGA package. Operating over an input voltage range of 4.5 to 20V, the LTM4603 supports an output voltage range of 0.6V to 5V as well as output voltage tracking and margining. The high efficiency design delivers 6A continuous current (8A peak). Only bulk input and output capacitors are needed to complete the design.

The low profile (2.8mm) and light weight (1.73g) package easily mounts on the unused space on the back side of PC boards for high density point of load regulation. The µModule can be synchronized with an external clock for reducing undesirable frequency harmonics and allows PolyPhase® operation for high load currents.

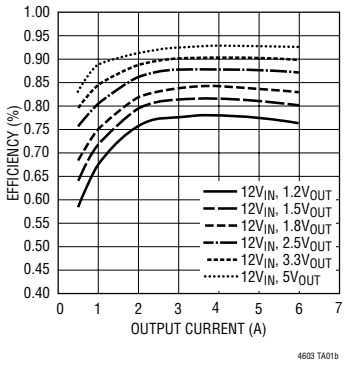
A high switching frequency and adaptive on-time current mode architecture deliver a very fast transient response to line and load changes without sacrificing stability. An onboard remote sense amplifier can be used to accurately regulate an output voltage independent of load current. The onboard remote sense amplifier is not available in the LTM4603-1. The LTM4603/LTM4603-1 are pin compatible with the 12A LTM4601/LTM4601-1.

TYPICAL APPLICATION

1.5V/6A Power Supply with 4.5V to 20V Input



Efficiency vs Load Current with $12V_{IN}$

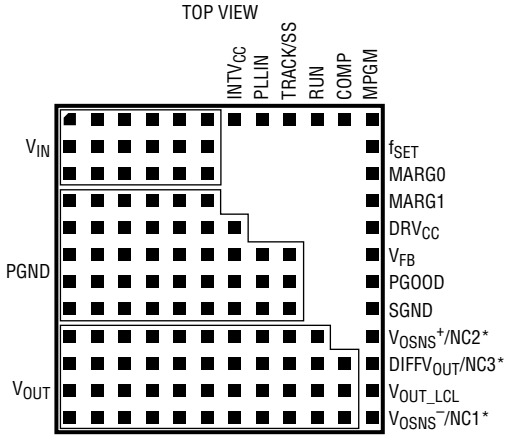


ABSOLUTE MAXIMUM RATINGS

(Note 1)

$INTV_{CC}$, DRV_{CC}, V_{OUT_LCL}, V_{OUT} ($V_{OUT} \leq 3.3V$ with Remote Sense Amp) ..... –0.3V to 6V
PLLIN, TRACK/SS, MPGM, MARG0, MARG1, PGOOD, f_{SET} ..... –0.3V to $INTV_{CC}$ + 0.3V
RUN ..... –0.3V to 5V
V_{FB}, COMP ..... –0.3V to 2.7V
V_{IN} ..... –0.3V to 20V
V_{OSNS}^+, V_{OSNS}^- ..... 0V to $INTV_{CC}$ – 1V
Operating Temperature Range (Note 2) ... –40°C to 85°C
Junction Temperature ..... 125°C
Storage Temperature Range..... –55°C to 125°C

PACKAGE/ORDER INFORMATION



LGA PACKAGE
118-LEAD (15mm × 15mm × 2.8mm)
T_{JMAX} = 125°C, θ_{JA} = 15°C/W, θ_{JC} = 6°C/W,
θ_{JA} DERIVED FROM 95mm × 76mm PCB WITH 4 LAYERS, WEIGHT = 1.7g
*LTM4603-1 Only

ORDER PART NUMBER	LGA PART MARKING
LTM4603EV#PBF	LTM4603V
LTM4603IV#PBF	LTM4603V
LTM4603EV-1#PBF	LTM4603V-1
LTM4603IV-1#PBF	LTM4603V-1

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the –40°C to 85°C temperature range, otherwise specifications are at T_A = 25°C, V_{IN} = 12V. Per typical application (front page) configuration.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$V_{IN(DC)}$	Input DC Voltage		●	4.5		20	V
$V_{OUT(DC)}$	Output Voltage	C_{IN} = 10µF ×2, C_{OUT} = 2×, 100µF/X5R/ Ceramic V_{IN} = 12V, V_{OUT} = 1.5V, I_{OUT} = 0A V_{IN} = 12V, V_{OUT} = 1.5V, I_{OUT} = 6A	●	1.478	1.5	1.522	V
Input Specifications							
$V_{IN(UVLO)}$	Undervoltage Lockout Threshold	I_{OUT} = 0A			3.2	4	V
$I_{INRUSH(VIN)}$	Input Inrush Current at Startup	I_{OUT} = 0A. V_{OUT} = 1.5V V_{IN} = 5V V_{IN} = 12V			 0.6 0.7		 A A
$I_{Q(VIN)}$	Input Supply Bias Current	V_{IN} = 12V, V_{OUT} = 1.5V, No Switching V_{IN} = 12V, V_{OUT} = 1.5V, Switching Continuous V_{IN} = 5V, V_{OUT} = 1.5V, No Switching V_{IN} = 5V, V_{OUT} = 1.5V, Switching Continuous Shutdown, RUN = 0, VIN = 12V			2.5 41.8 52.9 35		mA mA mA µA

ELECTRICAL CHARACTERISTICS

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SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$I_{S(VIN)}$	Input Supply Current	V_{IN} = 12V, V_{OUT} = 1.5V, I_{OUT} = 6A V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 6A V_{IN} = 5V, V_{OUT} = 1.5V, I_{OUT} = 6A			0.85 1.78 2.034		A A A
$INTV_{CC}$	V_{IN} = 12V, RUN > 2V	No Load		4.7	5	5.3	V
Output Specifications							
I_{OUTDC}	Output Continuous Current Range (See Output Current Derating Curves for Different V_{IN}, V_{OUT} and T_A)	V_{IN} = 12V, V_{OUT} = 1.5V		0		6	A
$\frac{V_{OUT(NOM)} - V_{OUT(\Delta LINE)}}{V_{OUT(NOM)}}$	Line Regulation Accuracy	V_{OUT} = 1.5V, I_{OUT} = 0A, V_{IN} = 4.5V to 20V, I_{OUT} = 0A to 6A	●			0.3	%
$\frac{V_{OUT(NOM)} - V_{OUT(\Delta LOAD)}}{V_{OUT(NOM)}}$	Load Regulation Accuracy	V_{OUT} = 1.5V V_{IN} = 5V V_{IN} = 12V	 ●			 1 1	 % %
$V_{OUT(AC)}$	Output Ripple Voltage	I_{OUT} = 0A, C_{OUT} = 2×, 100µF/X5R/Ceramic V_{IN} = 12V, V_{OUT} = 1.5V V_{IN} = 5V, V_{OUT} = 1.5V			 20 18		 mV_{P-P} mV_{P-P}
f_S	Output Ripple Voltage Frequency	I_{OUT} = 3A, V_{IN} = 12V, V_{OUT} = 1.5V			1000		kHz
$\Delta V_{OUT(START)}$	Turn-On Overshoot, TRACK/SS = 10nF	C_{OUT} = 2×, 100µF/X5R/Ceramic, V_{OUT} = 1.5V, I_{OUT} = 0A V_{IN} = 12V V_{IN} = 5V			 20 20		 mV mV
t_{START}	Turn-On Time, TRACK/SS = Open	C_{OUT} = 2×, 100µF/X5R/Ceramic, V_{OUT} = 1.5V, I_{OUT} = 6A Resisitive Load V_{IN} = 12V V_{IN} = 5V			 0.5 0.7		 ms ms
ΔV_{OUTLS}	Peak Deviation for Dynamic Load	Load: 0% to 50% to 0% of Full Load, C_{OUT} = 2 × 22µF/Ceramic, 470µF, 4V Sanyo POSCAP V_{IN} = 12V V_{IN} = 5V			 35 35		 mV mV
t_{SETTLE}	Settling Time for Dynamic Load Step	Load: 0% to 50% to 10% of Full Load V_{IN} = 12V			 25		 µs
I_{OUTPK}	Output Current Limit	C_{OUT} = 2×, 100µF/X5R/Ceramic V_{IN} = 12V, V_{OUT} = 1.5V V_{IN} = 5V, V_{OUT} = 1.5V			 8 8		 A A
Remote Sense Amp (LTM4603 Only, Not Supported in the LTM4603-1) (Note 3)							
V_{OSNS}^+, V_{OSNS}^- CM Range	Common Mode Input Voltage Range	V_{IN} = 12V, RUN > 2V		0		$INTV_{CC}$ – 1	V
$DIFFV_{OUT}$ Range	Output Voltage Range	V_{IN} = 12V, DIFF OUT Load = 100k		0		$INTV_{CC}$	V
V_{OS}	Input Offset Voltage Magnitude					1	mV
AV	Differential Gain				1		V/V
GBP	Gain Bandwidth Product				3		MHz
SR	Slew Rate				2		V/µs
R_{IN}	Input Resistance	V_{OSNS}^+ to GND			20		kΩ
CMRR	Common Mode Rejection Ratio				100		dB

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the –40°C to 85°C temperature range, otherwise specifications are at T_A = 25°C, V_{IN} = 12V. Per typical application (front page) configuration.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Control Stage							
V_{FB}	Error Amplifier Input Voltage Accuracy	I_{OUT} = 0A, V_{OUT} = 1.5V	●	0.594	0.6	0.606	V
V_{RUN}	RUN Pin On/Off Threshold			1	1.5	1.9	V
$I_{SS/TRACK}$	Soft-Start Charging Current	$V_{SS/TRACK}$ = 0V		–1.1	–1.4	–1.7	µA
$t_{ON(MIN)}$	Minimum On Time	(Note 4)			50	100	ns
$t_{OFF(MIN)}$	Minimum Off Time	(Note 4)			250	400	ns
R_{PLLIN}	PLLIN Input Resistance				50		kΩ
I_{DRVCC}	Current into DRV_{CC} Pin	V_{OUT} = 1.5V, I_{OUT} = 2.5A, Frequency = 1MHz, DRV_{CC} = 5V			18	25	mA
R_{FBHI}	Resistor Between V_{OUT} and V_{FB}			60.098	60.4	60.702	kΩ
V_{MPGM}	Margin Reference Voltage				1.18		V
V_{MARG0}, V_{MARG1}	MARG0, MARG1 Voltage Thresholds				1.4		V
PGOOD Output							
ΔV_{FBH}	PGOOD Upper Threshold	V_{FB} Rising		7	10	13	%
ΔV_{FBL}	PGOOD Lower Threshold	V_{FB} Falling		–7	–10	–13	%
$\Delta V_{FB(HYS)}$	PGOOD Hysteresis	V_{FB} Returning			1.5	3	%
V_{PGL}	PGOOD Low Voltage	I_{PGOOD} = 5mA			0.15	0.4	V

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 and lifetime.

Note 2: The LTM4603E is guaranteed to meet performance specifications from 0°C to 85°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls. The LTM4603I is guaranteed and tested over the –40°C to 85°C temperature range.

Note 3: Remote sense amplifier recommended for ≤3.3V output.

Note 4: 100% tested at wafer level only.