

## CHANGE NOTIFICATION



Linear Technology Corporation  
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June 28, 2013

Dear Sir/Madam:

PCN# 062813

**Subject: Notification of Change to LTC3612, LTC3614, LTC3615, LTC3616**

Please be advised that Linear Technology Corporation has made minor changes to the LTC3612, LTC3614, LTC3615/-1 and LTC3616 family of monolithic synchronous buck converters. A minor mask revision was made to improve application robustness and efficiency at low switching frequencies. The original production silicon turns off the low side switch too early in some applications, which leads to current flow in the body diode. The revised silicon avoids this limitation and improves efficiency in low frequency (<600 KHz) Burst Mode operation. Further, the external Soft Start function was improved to keep the output voltage in regulation during fast drops in input voltage.

In addition, in order to improve manufacturability, the specification for the minimum top switch current limit at 100% duty cycle will be reduced slightly for the LTC3612, LTC3614 and LTC3616 as shown in the attached redlined specifications. The LTC3615/LTC3615-1 specifications and datasheet are unchanged.

These changes were qualified by performing characterization over the full operating junction temperature range and through rigorous engineering bench evaluations. In addition, each product successfully completed 1000 hours of HTOL stress. Product built using the new die and tested to the updated specification will be shipped with a datecode of approximately 1348.

Should you have any further questions, please feel free to contact me at 408-432-1900 ext. 2077, or by email at [JASON.HU@LINEAR.COM](mailto:JASON.HU@LINEAR.COM). If I do not hear from you by August 29<sup>th</sup>, 2013, we will consider this change to be approved by your company.

Sincerely,

Jason Hu  
Quality Assurance Engineer

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{IN} = 3.3\text{V}$ ,  $RT/SYNC = SV_{IN}$ , unless otherwise specified (Note 2).

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	
$V_{IN}$	Operating Voltage Range		●	2.25	5.5	V	
$V_{UVLO}$	Undervoltage Lockout Threshold	$SV_{IN}$ Ramping Down $SV_{IN}$ Ramping Up	●	1.7	2.25	V	
$V_{FB}$	Feedback Voltage Internal Reference	(Notes 3, 4) $V_{TRACK/SS} = SV_{IN}$ , $V_{DDR} = 0\text{V}$ $0^\circ\text{C} < T_J < 85^\circ\text{C}$	●	0.594	0.6	0.606	V
		$-40^\circ\text{C} < T_J < 125^\circ\text{C}$	●	0.591		0.609	V
	Feedback Voltage External Reference (Note 7)	(Notes 3, 4) $V_{TRACK/SS} = 0.3\text{V}$ , $V_{DDR} = SV_{IN}$		0.289	0.3	0.311	V
		(Notes 3, 4) $V_{TRACK/SS} = 0.5\text{V}$ , $V_{DDR} = SV_{IN}$		0.489	0.5	0.511	V
$I_{FB}$	Feedback Input Current	$V_{FB} = 0.6\text{V}$	●		$\pm 30$	nA	
$\Delta V_{LINEREG}$	Line Regulation	$SV_{IN} = PV_{IN} = 2.25\text{V}$ to $5.5\text{V}$ (Notes 3, 4) $TRACK/SS = SV_{IN}$	●		0.2	%/V	
$\Delta V_{LOADREG}$	Load Regulation	ITH from $0.5\text{V}$ to $0.9\text{V}$ (Notes 3, 4)			0.25	%	
		$V_{ITH} = SV_{IN}$ (Note 5)			2.6	%	
$I_S$	Active Mode	$V_{FB} = 0.5\text{V}$ , $V_{MODE} = SV_{IN}$ (Note 6)		1100		$\mu\text{A}$	
	Sleep Mode	$V_{FB} = 0.7\text{V}$ , $V_{MODE} = 0\text{V}$ , ITH = $SV_{IN}$ (Note 5)		70	100	$\mu\text{A}$	
		$V_{FB} = 0.7\text{V}$ , $V_{MODE} = 0\text{V}$ (Note 4)		120	160	$\mu\text{A}$	
	Shutdown	$SV_{IN} = PV_{IN} = 5.5\text{V}$ , $V_{RUN} = 0\text{V}$		0.1	1	$\mu\text{A}$	
$R_{DS(ON)}$	Top Switch On-Resistance	$PV_{IN} = 3.3\text{V}$ (Note 10)		70		m $\Omega$	
	Bottom Switch On-Resistance	$PV_{IN} = 3.3\text{V}$ (Note 10)		45		m $\Omega$	
$I_{LIM}$	Top Switch Current Limit	Sourcing (Note 8), $V_{FB} = 0.5\text{V}$ Duty Cycle < 35% Duty Cycle = 100%		5.2 <del>3.7</del>	6	6.8	A
	Bottom Switch Current Limit	Sinking (Note 8), $V_{FB} = 0.7\text{V}$ , Forced Continuous Mode		-3	-4	-5	A
$g_{m(EA)}$	Error Amplifier Transconductance	$-5\mu\text{A} < I_{ITH} < 5\mu\text{A}$ (Note 4)		200		$\mu\text{S}$	
$I_{EAO}$	Error Amplifier Max Output Current	(Note 4)		$\pm 30$		$\mu\text{A}$	
$t_{SS}$	Internal Soft-Start Time	$V_{FB}$ from $0.06\text{V}$ to $0.54\text{V}$ , $TRACK/SS = SV_{IN}$		0.65	1	1.5	ms
$V_{TRACK/SS}$	Enable Internal Soft-Start	(Note 7)		0.62		V	
$t_{TRACK/SS\_DIS}$	Soft-Start Discharge Time at Start-Up			70		$\mu\text{s}$	
$R_{ON(TRACK/SS\_DIS)}$	TRACK/SS Pull-Down Resistor at Start-Up				200	$\Omega$	
$f_{OSC}$	Oscillator Frequency	$RT/SYNC = 370\text{k}$	●	0.8	1	1.2	MHz
	Internal Oscillator Frequency	$V_{RT/SYNC} = SV_{IN}$	●	1.8	2.25	2.7	MHz
$f_{SYNC}$	Synchronization Frequency			0.3	4	MHz	
$V_{RT/SYNC}$	SYNC Level High			1.2		V	
	SYNC Level Low				0.3	V	
$I_{SW(LKG)}$	Switch Leakage Current	$SV_{IN} = PV_{IN} = 5.5\text{V}$ , $V_{RUN} = 0\text{V}$		0.1	1	$\mu\text{A}$	
$V_{DDR}$	DDR Option Enable Voltage			$SV_{IN} - 0.3$		V	
$V_{MODE}$ (Note 9)	Internal Burst Mode Operation				0.3	V	
	Pulse-Skipping Mode			$SV_{IN} - 0.3$		V	
	Forced Continuous Mode			1.1	$SV_{IN} \cdot 0.58$	V	
	External Burst Mode Operation			0.45	0.8	V	

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## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{IN} = 3.3\text{V}$ ,  $\text{RT}/\text{SYNC} = \text{SV}_{IN}$  unless otherwise specified (Notes 1, 2, 11).

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	
$V_{IN}$	Operating Voltage Range		●	2.25	5.5	V	
$V_{UVLO}$	Undervoltage Lockout Threshold	$\text{SV}_{IN}$ Ramping Down	●	1.7		V	
		$\text{SV}_{IN}$ Ramping Up	●		2.25	V	
$V_{FB}$	Feedback Voltage Internal Reference	(Note 3) $V_{\text{TRACK}} = \text{SV}_{IN}$ , $V_{\text{DDR}} = 0\text{V}$ $0^\circ\text{C} < T_J < 85^\circ\text{C}$ $-40^\circ\text{C} < T_J < 125^\circ\text{C}$	●	0.594 0.591	0.6 0.606 0.609	V V V	
	Feedback Voltage External Reference (Note 7)	(Note 3) $V_{\text{TRACK}} = 0.3\text{V}$ , $V_{\text{DDR}} = \text{SV}_{IN}$		0.288	0.300	0.312	V
		(Note 3) $V_{\text{TRACK}} = 0.5\text{V}$ , $V_{\text{DDR}} = \text{SV}_{IN}$		0.488	0.500	0.512	V
$I_{FB}$	Feedback Input Current	$V_{FB} = 0.6\text{V}$	●		±30	nA	
$\Delta V_{\text{LINEREG}}$	Line Regulation	$\text{SV}_{IN} = \text{PV}_{IN} = 2.25\text{V}$ to $5.5\text{V}$ (Notes 3, 4) $\text{TRACK}/\text{SS} = \text{SV}_{IN}$	●		0.2	%/V	
$\Delta V_{\text{LOADREG}}$	Load Regulation	ITH from $0.5\text{V}$ to $0.8\text{V}$ (Notes 3, 4) $V_{\text{ITH}} = \text{SV}_{IN}$ (Note 5)			0.25 2.6	% %	
$I_S$	Active Mode Supply Current	$V_{FB} = 0.5\text{V}$ , $V_{\text{MODE}} = \text{SV}_{IN}$ (Note 6)		1100		μA	
	Sleep Mode Supply Current	$V_{FB} = 0.7\text{V}$ , $V_{\text{MODE}} = 0\text{V}$ , ITH = $\text{SV}_{IN}$ (Note 5)		75	100	μA	
		$V_{FB} = 0.7\text{V}$ , $V_{\text{MODE}} = 0\text{V}$ (Note 4)		130	175	μA	
	Shutdown Current	$\text{SV}_{IN} = \text{PV}_{IN} = 5.5\text{V}$ , $V_{\text{RUN}} = 0\text{V}$		0.1	1	μA	
$R_{\text{DS(ON)}}$	Top Switch On-Resistance	$\text{PV}_{IN} = 3.3\text{V}$ (Note 10)		35		mΩ	
	Bottom Switch On-Resistance	$\text{PV}_{IN} = 3.3\text{V}$ (Note 10)		25		mΩ	
$I_{\text{LIM}}$	Top Switch Current Limit	Sourcing (Note 8), $V_{FB} = 0.5\text{V}$ Duty Cycle < 35% Duty Cycle = 100%		7.5 <del>5.3</del> 5	9 10.5	A A	
	Bottom Switch Current Limit	Sinking (Note 8), $V_{FB} = 0.7\text{V}$ , Forced Continuous Mode		-6	-8 -11	A	
$g_{\text{m(EA)}}$	Error Amplifier Transconductance	$-5\mu\text{A} < I_{\text{ITH}} < 5\mu\text{A}$ (Note 4)		200		μS	
$I_{\text{EAO}}$	Error Amplifier Maximum Output Current	(Note 4)		±30		μA	
$t_{\text{SS}}$	Internal Soft-Start Time	$V_{FB}$ from $0.06\text{V}$ to $0.54\text{V}$ , $\text{TRACK}/\text{SS} = \text{SV}_{IN}$		0.65	1.2	1.9	ms
$V_{\text{TRACK}/\text{SS}}$	Enable Internal Soft-Start	(Note 7)		0.62		V	
$t_{\text{TRACK}/\text{SS\_DIS}}$	Soft-Start Discharge Time at Start-Up			60		μs	
$R_{\text{ON(TRACK}/\text{SS\_DIS})}$	TRACK/SS Pull-Down Resistor at Start-Up				200	Ω	
$f_{\text{OSC}}$	Oscillator Frequency	$\text{RT}/\text{SYNC} = 370\text{k}$	●	0.8	1	1.2	MHz
	Internal Oscillator Frequency	$V_{\text{RT}/\text{SYNC}} = \text{SV}_{IN}$	●	1.8	2.25	2.7	MHz
$f_{\text{SYNC}}$	Synchronization Frequency Range			0.3	4	MHz	
$V_{\text{RT}/\text{SYNC}}$	SYNC Input Threshold High			1.2		V	
	SYNC Input Threshold Low			.	0.3	V	
$I_{\text{SW(LKG)}}$	Switch Leakage Current	$\text{SV}_{IN} = \text{PV}_{IN} = 5.5\text{V}$ , $V_{\text{RUN}} = 0\text{V}$		0.1	1	μA	
$V_{\text{DDR}}$	DDR Option Enable Voltage			$\text{SV}_{IN} - 0.3$		V	
$V_{\text{MODE}}$ (Note 9)	Internal Burst Mode Operation				0.3	V	
	Pulse-Skipping Mode			$\text{SV}_{IN} - 0.3$		V	
	Forced Continuous Mode			1.1	$\text{SV}_{IN} \cdot 0.58$	V	
	External Burst Mode Operation			0.45	0.8	V	

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## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_J = 25^\circ\text{C}$ .  $V_{IN} = 3.3\text{V}$ ,  $RT/SYNC = SV_{IN}$  unless otherwise specified (Notes 1, 2, 11).

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	
$V_{IN}$	Operating Voltage Range		●	2.25	5.5	V	
$V_{UVLO}$	Undervoltage Lockout Threshold	$SV_{IN}$ Ramping Down $SV_{IN}$ Ramping Up	●	1.7	2.25	V	
$V_{FB}$	Feedback Voltage Internal Reference	(Note 3) $V_{TRACK} = SV_{IN}$ , $V_{DDR} = 0\text{V}$ $0^\circ\text{C} < T_J < 85^\circ\text{C}$ $-40^\circ\text{C} < T_J < 125^\circ\text{C}$	●	0.594 0.591	0.6 0.606 0.609	V	
	Feedback Voltage External Reference (Note 7)	(Note 3) $V_{TRACK} = 0.3\text{V}$ , $V_{DDR} = SV_{IN}$		0.275	0.300	0.325	V
		(Note 3) $V_{TRACK} = 0.5\text{V}$ , $V_{DDR} = SV_{IN}$		0.475	0.500	0.525	V
$I_{FB}$	Feedback Input Current	$V_{FB} = 0.6\text{V}$	●		±30	nA	
$\Delta V_{LINEREG}$	Line Regulation	$SV_{IN} = PV_{IN} = 2.25\text{V}$ to $5.5\text{V}$ (Notes 3, 4) $TRACK/SS = SV_{IN}$	●		0.2	%/V	
$\Delta V_{LOADREG}$	Load Regulation	ITH from $0.5\text{V}$ to $0.9\text{V}$ (Notes 3, 4) $V_{ITH} = SV_{IN}$ (Note 5)			0.25 2.6	% %	
$I_S$	Active Mode	$V_{FB} = 0.5\text{V}$ , $V_{MODE} = SV_{IN}$ (Note 6)		1100		$\mu\text{A}$	
	Sleep Mode	$V_{FB} = 0.7\text{V}$ , $V_{MODE} = 0\text{V}$ , ITH = $SV_{IN}$ (Note 5)		75	100	$\mu\text{A}$	
		$V_{FB} = 0.7\text{V}$ , $V_{MODE} = 0\text{V}$ (Note 4)		130	175	$\mu\text{A}$	
	Shutdown	$SV_{IN} = PV_{IN} = 5.5\text{V}$ , $V_{RUN} = 0\text{V}$		0.1	1	$\mu\text{A}$	
$R_{DS(ON)}$	Top Switch On-Resistance	$PV_{IN} = 3.3\text{V}$ (Note 10)		35		m $\Omega$	
	Bottom Switch On-Resistance	$PV_{IN} = 3.3\text{V}$ (Note 10)		25		m $\Omega$	
$I_{LIM}$	Top Switch Current Limit	Sourcing (Note 8), $V_{FB} = 0.5\text{V}$ Duty Cycle < 35% Duty Cycle = 100%		10.5 8.7 7.6	12 13.5	A A	
	Bottom Switch Current Limit	Sinking (Note 8), $V_{FB} = 0.7\text{V}$ , Forced Continuous Mode		-6	-8 -11	A	
$g_{m(EA)}$	Error Amplifier Transconductance	$-5\mu\text{A} < I_{ITH} < 5\mu\text{A}$ (Note 4)		200		$\mu\text{S}$	
$I_{EAO}$	Error Amplifier Maximum Output Current	(Note 4)		±30		$\mu\text{A}$	
$t_{SS}$	Internal Soft-Start Time	$V_{FB}$ from $0.06\text{V}$ to $0.54\text{V}$ , $TRACK/SS = SV_{IN}$		0.65	1.2	1.9	ms
$V_{TRACK/SS}$	Enable Internal Soft-Start	(Note 7)		0.62		V	
$t_{TRACK/SS\_DIS}$	Soft-Start Discharge Time at Start-Up			60		$\mu\text{s}$	
$R_{ON(TRACK/SS\_DIS)}$	$TRACK/SS$ Pull-Down Resistor at Start-Up				200	$\Omega$	
$f_{OSC}$	Oscillator Frequency	$RT/SYNC = 370\text{k}$	●	0.8	1	1.2	MHz
	Internal Oscillator Frequency	$V_{RT/SYNC} = SV_{IN}$	●	1.8	2.25	2.7	MHz
$f_{SYNC}$	Synchronization Frequency Range			0.3	4	MHz	
$V_{RT/SYNC}$	SYNC Level High			1.2		V	
	SYNC Level Low				0.3	V	
$I_{SW(LKG)}$	Switch Leakage Current	$SV_{IN} = PV_{IN} = 5.5\text{V}$ , $V_{RUN} = 0\text{V}$		0.1	1	$\mu\text{A}$	
$V_{DDR}$	DDR Option Enable Voltage			$SV_{IN} - 0.3$		V	
$V_{MODE}$ (Note 9)	Internal Burst Mode Operation				0.3	V	
	Pulse-Skipping Mode			$SV_{IN} - 0.3$		V	
	Forced Continuous Mode			1.1	$SV_{IN} \cdot 0.58$	V	
	External Burst Mode Operation			0.45	0.8	V	

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