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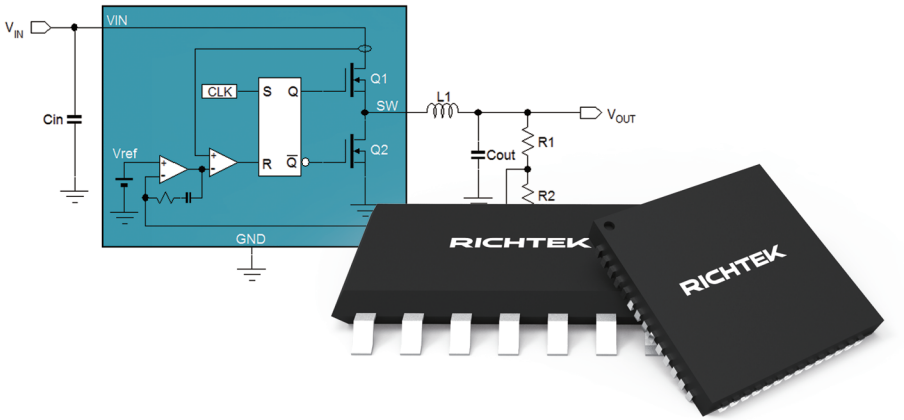
Buck Converters Selection Guide

Oct. 2017

Richtek Buck Converters Selection Guide



Richtek provides over 400 buck converters which power a wide range of applications, from battery operated hand-held equipment to computing, industrial and automotive applications.

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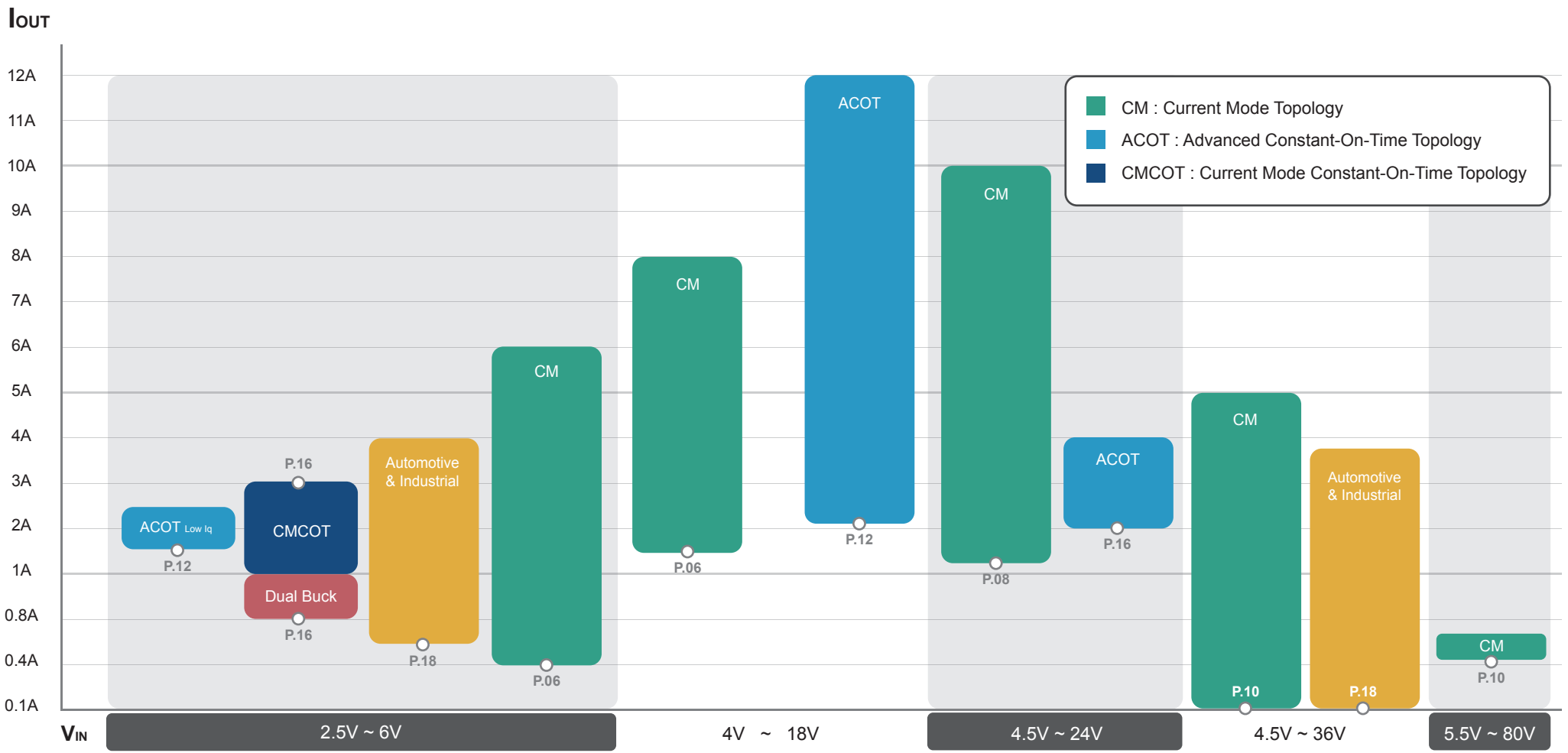
Richtek Buck Converter Product Portfolio



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Current Mode Buck Converters (Vin up to 6V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT8024	2.5V-5.5V	400mA	1.5MHz	√				SOT-23-5 / TSOT-23-5	→ Int. Comp. → Vref ±2% → 100% duty cycle → Fixed and Adj. Vout
RT8008	2.5V-5.5V	600mA	1.5MHz	√				SOT-23-5 / TSOT-23-5	
RT8009	2.5V-5.5V	600mA	1.25MHz	√				SOT-23-5 / TSOT-23-5	
RT8010	2.5V-5.5V	1A	1.5MHz	√				WDFN2x2-6	
RT8059	2.8V-5.5V	1A	1.5MHz	√				TSOT-23-5	
RT8064	2.7V-5.5V	2A	Adj. 200kHz-2MHz	√		√	√	WDFN3x3-8 / PSOP8	→ Ext. Comp. → 100% duty cycle → Vref ±2%
RT2652	2.7V-5.5V	2A	1.2MHz	√				WDFN3x3-10	→ Vref ±1%
RT8077	2.6V-5.5V	2A	Adj. 300kHz-2MHz	√				WDFN2x2-8	→ 100% duty cycle → Vref ±1.5%
RT8068A	2.7V-5.5V	3A	1MHz	√			√	WDFN3x3-10 / PSOP8	→ 100% duty cycle → Vref ±1%
RT5771C	2.7V-5.5V	3A	1MHz		√		√	WDFN3x3-10	
RT5771D	2.7V-5.5V	3A	1MHz	√			√	WDFN3x3-10	
RT8079	2.95V-6V	3A	Adj. 300kHz-2MHz	√		√	√	WQFN3x3-16	→ Industrial part → Ext. Sync. → Vref ±3%
RT8079A	2.95V-6V	3A	Adj. 300kHz-2MHz		√	√	√	WQFN3x3-16	
RT8065	2.7V-5.5V	3A	Adj. 200kHz-2MHz	√		√	√	WDFN3x3-8 / PSOP8	→ Ext. Comp. → 100% duty cycle → Vref ±2%
RT8070	2.7V-5.5V	4A	Adj. 200kHz-2MHz	√		√	√	WDFN3x3-8 / PSOP8	→ 100% duty cycle → Vref ±2%
RT8072	2.9V-5.5V	5A	Adj. 300kHz-2MHz	√		√	√	WDFN3x3-12 / PSOP8	→ Ext. Comp. → Vref ±2%
RT8073	2.9V-5.5V	6A	Adj. 300kHz-2MHz	√		√	√	WDFN3x3-12 / PSOP8	→ Ext. Comp. → Vref ±2%

Current Mode Buck Converters (Vin up to 18V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT8297A/B	4V-17V	1.5A	340kHz (A) 800kHz (B)		√		√	WDFN2x2-8	→ Int. Comp. → Vref ±1.5%
RT7251A/B	4V-17V	1.5A		√			√	WDFN2x2-8	
RT7250A/B	4V-17V	2A			√		√	PSOP-8	
RT7252A/B	4V-17V	2A		√			√	PSOP-8	
RT7247A	4.5V-18V	2A	340kHz		√	√		PSOP-8	→ Ext. Comp. → Vref ±1.5%
RT7247B	4.5V-18V	2A	1.2MHz		√	√		PSOP-8	
RT7247C	4.5V-18V	2A	800kHz		√	√		PSOP-8	

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Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT7237A	4.5V-18V	2A	340kHz	√		√		PSOP-8	→ Ext. Comp. → Vref ±1.5%
RT7237B		2A	1.2MHz	√		√			
RT7237C		2A	800kHz	√		√			
RT7297A		3A	340kHz		√	√			
RT7297B		3A	1.2MHz		√	√			
RT7297C		3A	800kHz		√	√			
RT7257A		3A	340kHz	√		√			
RT7257B		3A	1.2MHz	√		√			
RT7257C		3A	800kHz	√		√			
RT6296A	4.5V-17V	2A	500kHz	√				TSOT23-8	→ PSM/PWM threshold setting pin → Vref ±1%
RT6296B		2A	500kHz		√	√			
RT6296C		2A	1.4MHz		√	√			
RT6296E		2A	800kHz	√		√			
RT6296F		2A	500kHz	√			√		
RT7296A		3A	500kHz	√					
RT7296B		3A	500kHz		√	√			
RT7296C		3A	1.4MHz		√	√			
RT7296E		3A	800kHz	√		√			
RT7296F		3A	500kHz	√			√		
RT2856	4.5V-18V	6A	Adj. 200kHz-1.6MHz		√	√	√	WQFN3.5x3.5-14A	→ Industrial
RT7243		6A			√	√	√		→ Hiccup
RT7298A		6A		√		√	√		→ Latch off/ Hiccup
RT7298B		6A			√	√	√		→ Latch off/ Hiccup
RT7299B		8A			√	√	√		→ Latch off/ Hiccup

Current Mode Buck Converters (Vin up to 24V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT7262A	4.5V-21V	2A	500kHz		√	√	√	WDFN4x3-14L / PSOP-8	→ Ext. Sync. → Int. Comp. → Vref ±1.5%
RT7263A		3A			√	√	√		
RT7263E		3A		√		√	√		
RT7264A		4A			√	√	√		
RT7264E		4A		√		√	√		
RT8292A	4.5V-23V	2A	340kHz		√	√		PSOP-8	→ Ext. Comp. → Vref ±1.5%
RT8292B		2A	1.2MHz		√	√			

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Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT8295A	4.5V-23V	2A	340kHz	√		√		PSOP-8	→ Ext. Comp. → Vref ±1.5%
RT8295B		2A	1.2MHz	√		√			
RT8293A		3A	340kHz		√	√			
RT8293B		3A	1.2MHz		√	√			
RT8296A		3A	340kHz	√		√			
RT8296B		3A	1.2MHz	√		√			
RT8258	4.5V-24V	1.2A	700kHz		√			SOT-23-6 / TSOT-23-6	→ Asynchronous → Vref ±2%
RT8259		1.2A	1.4MHz		√				
RT8298		6A	600kHz Or 300kHz-1.5MHz with ext. sync		√		√	WDFN4x3-14L / PSOP-8	→ Ext. Sync. → Int. Comp. → Vref ±1.5% → 45mΩ HS MOS with driver for external low-side MOS
RT8298E		6A		√			√		
RT7258		8A			√		√		
RT7259		10A					√	WDFN4x3-14L	

Current Mode Buck Converters (Vin up to 36V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT6208	4.5V-36V	0.1A	Boundary Conduction Mode	√			√	SOT-23-6 / SOT-23-8	→ 25μA Iq → Adj. Ilim → Vref ±1%
RT6200		0.6A	1.2MHz		√			SOT-23-6	→ Asynchronous → Vref ±2%
RT7272A		3A	500kHz		√			PSOP-8	→ Adj. current limit → Ext. Comp.
RT7272B		3A	500kHz	√				PSOP-8	
RT8289	5.5V-32V	5A	500kHz		√			PSOP-8	→ Asynchronous
RT8279	5.5V-36V	5A	500kHz		√			PSOP-8	→ Asynchronous

Current Mode Buck Converters (Vin up to 80V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT6204	5.2V-60V	500mA	350kHz	√		√		PSOP-8	→ 80V max. rating → 0.8V-50V output
RT6210	5.2V-80V	500mA	350kHz	√		√		PSOP-8	→ 80V max. rating → 0.8V-72V output

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Low Quiescent Current ACOT Buck Converters (Vin up to 6V)

Part Number	Vin (V)	Quiescent Current	Current Rating	f_{SW}	PSM	Force-PWM	PGood	Package	Note
RT5784A/B	2.5V-6V	25μA	2A	1.5MHz	A	B	√	WDFN2x1.5-8J(FC)	
RT5785A/B	2.5V-6V	25μA	2A	1.5MHz	A	B	√	TSOT-28(FC)	
RT5795A	2.5V-5.5V	30μA	2A	2.7MHz	√		√	WDFN2x2-8S	

ACOT Buck Converters (Vin up to 18V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT6211A/B	4.5V-18V	1.5A	500kHz	A	B			SOT-23-6	
RT6212A/B		2A	500kHz	A	B			TSOT-23-6	
RT6213A/B		3A (peak)	500kHz	A	B			TSOT-23-6	
RT6214A/B		3A	500kHz	A	B		√	TSOT-23-6 / TSOT-23-8	
RT7285A	4.3V-18V	1.5A	500kHz	√				TSOT-23-6	→ A*: Hiccup UVP/OCP → B*: Constant current → C*: Hiccup UVP/OCP → D*: Constant current
RT7285B		1.5A	500kHz	√				TSOT-23-6	
RT7285C		1.5A	500kHz		√			SOT-23-6 / TSOT-23-6	
RT7285D		1.5A	500kHz		√			TSOT-23-6	
RT7294A		2.5A	500kHz	√				TSOT-23-6	
RT7294B		2.5A	500kHz	√				TSOT-23-6	
RT7294C		2.5A	500kHz		√			TSOT-23-6	
RT7294D		2.5A	500kHz		√			TSOT-23-6	
RT7295A		3.5A	500kHz	√				TSOT-23-6	
RT7295B		3.5A	500kHz	√				TSOT-23-6	
RT7295C		3.5A	500kHz		√			TSOT-23-6	
RT7295D		3.5A	500kHz		√			TSOT-23-6	
RT6222A/B		2.5A	500kHz	A	B			TSOT-23-6	
RT6222C/D		2A	1.4MHz	C	D			TSOT-23-6	
RT6224A/B		3A	500kHz	A	B			TSOT-23-6	
RT6224C		3A	1.4MHz	√				TSOT-23-6	
RT6224D		3A	1.4MHz		√			TSOT-23-6	
RT6232A/B		2A	500kHz	A	B	√	√	WDFN2x3-8	→ A&B: Hiccup UVP
RT6234A/B		3A	500kHz	A	B		√	WDFN2x3-8	

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Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT7279	4.5V-18V	2A	700kHz		√	√	√	TSSOP-14 / WDFN3x3-10	
RT7280		2A	700kHz	√		√	√	TSSOP-14 / WDFN3x3-10	→ TSSOP-14 : Latch-up UVP → WDFN3x3-10 : Hiccup UVP → PSOP-8 : Non UVP
RT7281		2A	700kHz		√	√		PSOP-8	
RT7274		2A	700kHz	√		√		PSOP-8	
RT7275		3A	700kHz		√	√	√	TSSOP-14 / WDFN3x3-10	
RT7276		3A	700kHz	√		√	√	TSSOP-14 / WDFN3x3-10	
RT7277		3A	700kHz		√	√		PSOP-8	
RT7278		3A	700kHz	√		√		PSOP-8	
RT7231		4A	650kHz		√	√	√	TSSOP-14 / WDFN3x3-10	
RT7232		4A	650kHz	√		√	√	TSSOP-14 / WDFN3x3-10	
RT7233		4A	650kHz		√	√		PSOP-8	
RT7234		4A	650kHz	√		√		PSOP-8	
RT6201A/B		4A	650kHz	A	B	√		PSOP-8	→ Hiccup UVP
RT2853A/B	4.5V-18V	3A	650kHz	A	B	√	√	WQFN3x3-16	→ Optional Hiccup UVP & latched UVP
RT2858B		3A	650kHz		√	√		PSOP-8	→ Hiccup UVP
RT2859A/B		3A	650kHz	A	B	√	√	WQFN3x3-16	→ Optional Hiccup UVP & latched UVP
RT2855A/B		4A	650kHz	A	B	√	√	WQFN3x3-16	→ Optional Hiccup UVP & latched UVP
RT6254A/B		4A	500kHz	A	B		√	TSOT-23-6 / TSOT-23-8	→ PGOOD : TSOT-23-8
RT6255A/B		5A	500kHz	A	B		√	TSOT-23-6 / TSOT-23-8	
RT6257A/B		6A	500kHz	A	B			TSOT-23-6	
RT7235		5A	650kHz		√	√	√	TSSOP-14 / WDFN3x3-10	→ TSSOP-14 : Latch-up UVP → WDFN3x3-10 : Hiccup UVP → PSOP-8 : Non UVP
RT7236		5A	650kHz	√		√	√	TSSOP-14 / WDFN3x3-10	
RT7239		5A	650kHz		√	√		PSOP-8	
RT7240		5A	650kHz	√		√		PSOP-8	
RT6202A/B		5A	650kHz	A	B	√		PSOP-8	
RT6206A		5.5A	650kHz		√	√	√	TSSOP-14 / WDFN3x3-10 / PSOP-8	
RT6206B		5.5A	650kHz	√		√	√	TSSOP-14 / WDFN3x3-10 / PSOP-8	
RT6207A/B		5A	650kHz	A	B	√	√	UQFN-13JL 2x3	→ Optional Hiccup UVP & latched UVP
RT6236A/B		6A	650kHz	A	B	√	√	UQFN-13JL 2x3	
RT6237A/B		7A	500kHz	A	B	√	√	UQFN-14L 2x3	
RT6238A/B		8A	500kHz	A	B	√	√	UQFN-14L 2x3	
RT6239A/B		9A	500kHz	A	B	√	√	UQFN-14L 2x3	
RT2810A/B		10A	500kHz	A	B	√	√	UQFN-16JL 3x3	
RT6242A/B		12A	300kHz-700kHz	A	B	√	√	UQFN-16JL 3x3	

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ACOT Buck Converters (Vin up to 24V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT6215E	4.5V-24V	2A	500kHz	√				TSOT23-8	
RT6217E	4.5V-24V	3A	500kHz	√				TSOT23-8	
RT6219A/B	5V-23V	4A	500kHz	A	B		√	WDFN-3x3-10	→ Latch-up & Hiccup UVP

CMCOT Buck Converters (Vin up to 6V)

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT8096A	2.5V-6V	1A	1.5MHz	√			√	SOT-23-5/6 / TSOT-23-5/6	→ A&B: fast transient → C&D: medium transient
RT8096B		1A	1.5MHz		√		√	SOT-23-5/6 / TSOT-23-5/6	
RT8096C		1A	1.5MHz	√			√	TSOT23-5/6	
RT5710A		1A	1.5MHz	√				WDFN2x2-6	
RT5710B		1A	1.5MHz		√			WDFN2x2-6	
RT5796A		1.5A	1MHz	√			√	SOT-23-5/6 / TSOT-23-5/6	
RT5796B		1.5A	1MHz		√		√	SOT-23-5/6 / TSOT-23-5/6	
RT5796C		1.5A	1MHz	√			√	TSOT23-5/6	
RT5711A		1.5A	1MHz	√				WDFN2x2-6	
RT5711B		1.5A	1MHz		√			WDFN2x2-6	
RT8097A	2.7V-6V	2A	1MHz	√			√	SOT23-5/6	→ Peak 3A
RT8097B		2A	1MHz		√		√	SOT23-5/6	→ Peak 3A
RT8097C		2A	1MHz	√			√	SOT23-5/6	→ Peak 3A
RT5712E		2A	1MHz	√				WDFN2x2-6	→ Peak 3A
RT5712F		2A	1MHz		√			WDFN2x2-6	→ Peak 3A
RT5797A		3A	1MHz	√			√	WDFN2x2-8 / WDFN2x2-8S	
RT5797B		3A	1MHz		√		√	WDFN2x2-8	

Dual Buck Converters

Part Number	Vin (V)	Current Rating	f_{SW}	PSM	Force-PWM	Ext. Soft-Start	PGood	Package	Note
RT8035	2.5V-5.5V	0.8A+ 0.8A	1.25MHz		√			WDFN3x3-10	→ Dual Buck
RT8020	2.5V-5.5V	1A+ 1A	1.5MHz		√			WDFN3x3-12	→ Dual Buck

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Automotive and Industrial Buck Converters

Part Number	Vin (V)	Current Rating	f_{SW}	Package	Note
RT2657BQ	2.7V-5.5V	0.6A	2.25MHz	WDFN-8L 3x3	→ AEC-Q100 Grade3
RT2101A	2.95V-6V	3A	Adj. 700kHz-2MHz	WQFN-16L 3x3	→ AEC-Q100 Grade2
RT8079A	2.95V-6V	3A	Adj. 300kHz-2MHz	WQFN-16L 3x3	→ Industrial/automotive
RT5701	2.5V-5.5V	4A	3MHz	TSSOP-14	→ I^2C control → AEC-Q100 Grade2

Automotive and Industrial Buck Converters (Vin up to 36V)

Part Number	Vin (V)	Vout range	Current Rating	Package	Note
RT6200	4.5V-36V	0.8V-15V	0.6A	SOT-23-6	→ 95% duty cycle → 0.35Ω PMOSFET → Ideal for generic low current supply
RT2875A/B		0.6V-24V	3A	TSSOP-14	→ AEC-Q100 Grade 2
RT2872		0.8V-30V	3A	PSOP-8	→ AEC-Q100 Grade 3
RT7272A		0.8V-30V	3A	PSOP-8	→ A: Force PWM B: PSM → Adj. current limit → Ext. compensation → Ideal for generic medium current supply
RT7272B		0.8V-30V	3A	PSOP-8	
RT2862A		0.8V-30V	3A	PSOP-8	→ Ext. compensation → Ideal for generic medium current supply
RT6208	4.75V-36V	V_{FB} = 0.8V	0.1A	SOT-23-6 / SOT-23-8	→ ±1% Vfb → Boundary Conduction Mode for high efficiency → Ideal for MCU supply
RT2808A	5.5V-36V	1.222V-26V	3A	PSOP-8	→ Asynchronous → Internal compensation
RT2805A		1.222V-26V	5A	PSOP-8	
RT8279		1.222V-26V	5A	PSOP-8	
RT6266	7.5V-36V	0.8V-5.5V	2.4A	PSOP-8	→ Asynchronous → Adj. load line compensation to compensate → for voltage drop in a USB cable → Adj. current limit → Ideal for 5V USB/Cigarette lighter output
RT6268	7V-36V	V_{FB} = 0.8V	3.7A	PSOP-8	

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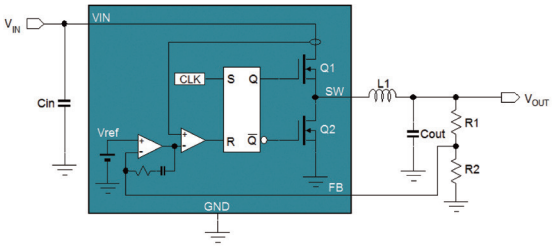
Overview

Buck converter definition



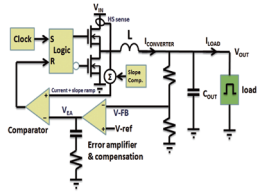
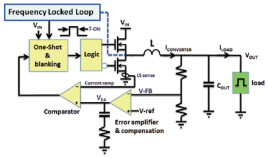
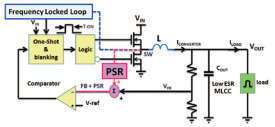
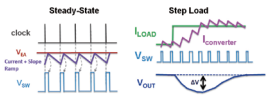
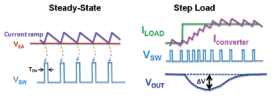
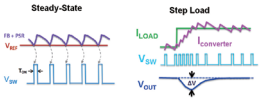
Buck converters are switch-mode step-down converters which can provide high efficiency and high flexibility at higher VIN/VOUT ratios and higher load current. Most Buck converters contain an internal high side MOSFET and synchronous rectifier MOSFET, which are in turn switched on and off via internal duty-cycle control circuit to regulate the average output voltage. The switching waveform is filtered via an external LC filter stage.

Buck converter features

Due to the fact that the MOSFETs are either ON or OFF, Buck converters dissipate very little power, and the duty-cycle control makes large VIN/VOUT ratios possible. The internal MOSFETs RDS(ON) mainly determines the current handling capabilities of the Buck converter, and the MOSFET voltage ratings determine the maximum input voltage. The switching frequency together with the external LC filter components will determine the ripple voltage on the output. Higher switching frequency buck converters can use smaller filter components, but switch losses will increase. Buck converters with Pulse Skipping Mode (PSM) will reduce their switching frequency at light load, thereby increasing light load efficiency, which can be important in applications with low power standby modes.

The Richtek DC/DC portfolio contains a wide range of Buck converters with different control topologies, including Current Mode (CM), Current Mode-Constant On Time (CMCOT) and Advanced Constant On Time (ACOT™) control topologies. Each topology is suitable for different applications and requirements. For example, Richtek unique ACOT™ family has extremely fast transient response compared to CM and CMCOT topologies, which makes it ideal for applications that exhibit very fast load transients, such as DDR, Core SoC, FPGA and ASIC supplies.

Comparison Table of Richtek Buck Topologies

Key features	CM Current Mode	CMCOT Current Mode Constant-On-Time	ACOT™ Advanced Constant-On-Time
Topology			
Steady-state & Step load			
V_{IN} / I_{OUT} range	→ 2.5Vin to 5.5Vin / up to 6A for low Vin and battery-powered applications → Up to 36Vin / up to 10A → Up to 60Vin for Industrial and 36Vin for Automotive applications	→ 2.5Vin to 5.5Vin / up to 3A	→ Up to 23Vin / up to 12A
Response to Load Steps	moderate	fast	extremely fast
Current Sense	current sense limits min. ON time	low side current sense	Not required
Min. ON Time	Larger, limits the min. achievable duty-cycle	Small min. On time allows small duty-cycles	Small min. On time allows small duty-cycles
Frequency	stable fixed f_{SW}	constant average f_{SW}	constant average f_{SW}
Stable with MLCC	V	V	V
Slope Compensation	V	not required	not required
Synchronized to ext. Clock	V	X	X
Richtek Designer™ simulation tool	Create your account and get your designs up and running in no time. (partial parts have been released)	Coming soon	Create your account and get your designs up and running in no time. (partial parts have been released)
Applications	For applications with steady load conditions. Also for industrial and automotive applications.	For applications with moderate load transients, or applications that require small minimum ON times (i.e. high switching frequency in combination with larger step-down ratios)	For applications with severe fast load transients , such as DDR, Core SoC, FPGA and ASIC supplies

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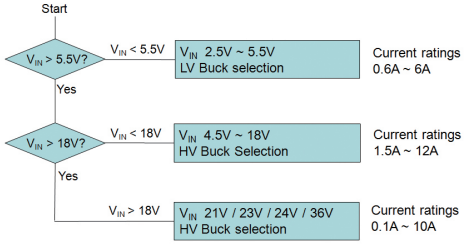
Buck Converter Selection Criteria

In order to select a suitable Buck converter for your application, some key criteria are important to be considered.

Application input voltage

Which upper bound of input voltage fits for your application best?

Richtek Buck converters can be divided into 3 main groups to fulfill different application requirements. Richtek LV Buck converters are suitable for running off single cell Li-Ion batteries as well as supplies from 5V rails. The 18V rated HV Buck converters are often used for applications that run from 12V. We also provide parts up to 36V input range for industrial supplies or automotive applications with large input voltage fluctuation.



Application current consumption

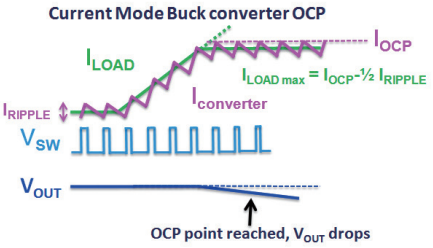
How to calculate the power loss and maximum application peak current?

When considering the Buck converter current rating, there are two factors to consider: The application average current consumption and the application peak current.

→ The application average current will determine the average heat in switching MOSFETs which is related to conduction losses and switching losses. Conduction losses are related to the internal MOSFET RDS(ON) : The MOSFET conduction losses are I2 * RDS(ON) ; Switching losses are mostly related to the current, the input voltage and the switching frequency. In most standard applications, the switching losses are roughly 30% of the total losses, but in applications with higher input voltage or high frequency, the switching losses can increase considerably. The application total power losses can be derived from the datasheet efficiency curve:

$$P_{LOSS} = \frac{(1-\eta)}{\eta}(V_{OUT} \cdot I_{OUT})$$

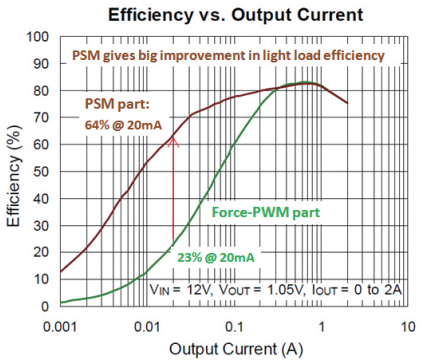
→ The device maximum rated current and over-current protection level must be considered when checking application peak load current. The difference between load current and inductor peak or valley current is ½ the inductor ripple current, so be sure to include this when checking the application maximum load current in relation to OCP current levels.

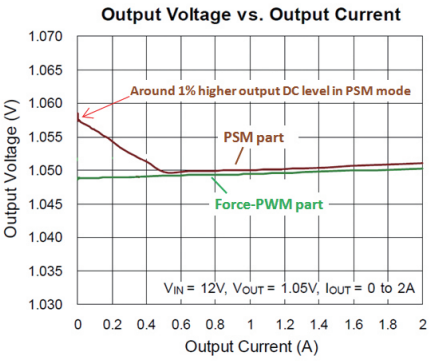


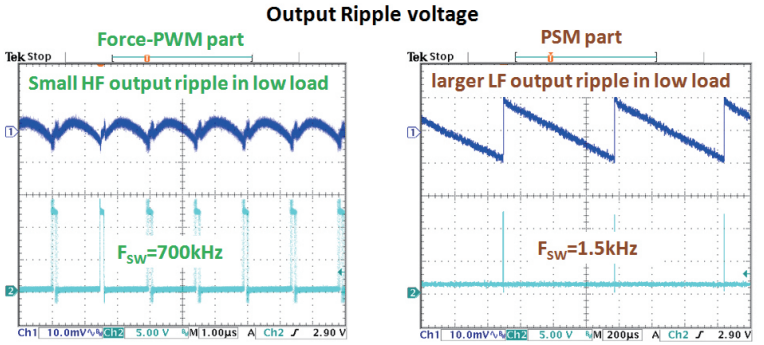
Light load efficiency

When to select Force-PWM mode or PSM mode?

For supply rails that need to be active in low power standby modes, it is desirable to make the Buck converter efficiency at light load as high as possible. Force-PWM Buck converters keep the switching frequency fixed over the entire load range while Pulse Skip Mode (PSM) will reduce switching frequency at light load, thereby improving light load efficiency since the majority of losses at light load are caused by switching loss.







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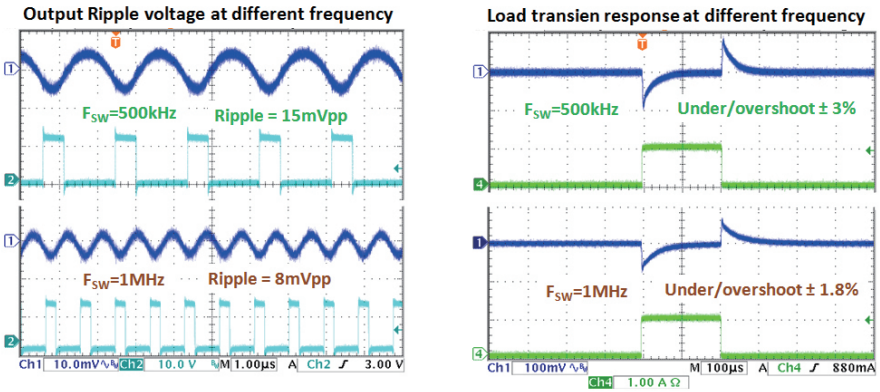
Switching frequency

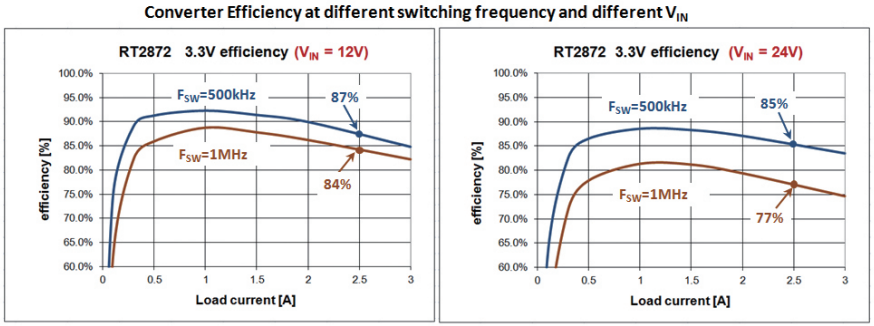
How to select suitable switching frequency?

Higher switching frequency makes it possible to use smaller inductor and capacitors, and improves the step load behaviour of the converter. However, it also increases switching losses and extends the EMI radiation frequency range. Higher switching frequency can also limit the maximum step-down ratio that can be achieved : The minimum duty-cycle is limited by the converter minimum ON time and the frequency:

$$\delta_{min} = t_{ON\ min} \cdot F_{SW}$$

In general, higher VIN applications should use lower switching frequency devices.





Low BOM cost

How to reduce BOM cost?

Choosing the right Buck topology together with the most optimal IC package can bring you cost savings on both passive components and IC cost. ACOT™ topology offers superior load transient response, making it possible to reduce the size of your output capacitors and still meet the load transient voltage undershoot requirement. Flip-Chip in TSOT-23-6 package offers lowest package cost, while maintaining good thermal performance and low RDS(ON) due to the absence of bonding wires.

IC package consideration

Which IC package is most suitable for your application?

Richtek Buck converters are available in many types of packages: from tiny CSP 1.3x2.1mm to cost effective TSOT-23-6 to larger TSSOP-14 thermally enhanced package.

SOP-8 (exposed pad) and DFN2x2 and DFN3x3 packages are often used in Buck converters: Their pin count ranges from 6 ~ 12 pins for extra functionality, and they offer good thermal performance due to exposed thermal pad. They are cost effective, making them a popular choice for many applications. It is possible to use these parts in single sided layout, but for better thermal and electrical performance multi-layer PCB layouts are recommended. TSSOP-14 or WDFN-14L 4x3 have larger thermal pads, which allow them to dissipate more power.

Other considerations

External soft-start

All Richtek Buck converters have a soft-start function. After enabling the converter, the duty-cycle is gradually increased to allow a smooth rising output voltage, which avoids inrush current due to sudden charging of the output capacitors. Converters with internal soft-start have a fixed soft-start time. If the application uses very large output capacitance or requires a specific soft-start time, it is better to select a converter with externally programmable soft-start; the soft-start time can be set by an external capacitor.

External compensation

Current mode converters need error amplifier compensation to ensure stable operation. The type-II compensation components determine the converter bandwidth and the phase boost frequency. Converters with external compensation have more flexibility in setting the desired bandwidth and phase margin with different types of output capacitors over a wider range of input and output voltage conditions.

Programmable frequency

Some converters have a programmable frequency function: The switching frequency can be set by means of an external resistor. This gives more flexibility in choosing the best switching frequency for the application; higher frequency to reduce ripple or component size or get better transient behavior, or lower frequency to improve efficiency or reduce higher harmonics.

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External sync input

Some current mode converters have an external sync input that allows the internal clock to be synchronized to an external clock signal. This makes it possible to set the switching frequency at a very precise value (for avoiding noise at sensitive frequency bands), and also make it possible to run several converters at the same frequency.

Low-Dropout mode or 100% duty-cycle mode

Many current mode Buck converters from the LV series have Low Dropout mode function: When the input voltage drops, these Buck converters gradually increase the duty-cycle and will continuously switch-on the high side MOSFET when the input voltage drops below the regulated output voltage. This function is especially suitable in battery powered applications, and can extend application operation time when the battery is almost depleted.

Power Good function

The Power Good function will monitor the Buck converter output signal and provide a means of telling the system when the output voltage is within a certain operating range. Power Good can be used for system initialization, fault detection or start-up sequence.

Over Current Protection

All Richtek Buck converters have Over Current Protection (OCP). When the inductor current exceeds the OCP level, the converter duty-cycle is limited. Further load increase will result in output voltage drop. However, there are different ways how the system behaves in overload condition:

→ Latch mode OCP: When during overload the output voltage drops below the Under Voltage Protection (UVP) point, the system shuts down and latches. The converter needs to be re-enabled or cycle the input voltage for restart. This protection ensures zero power after overload, but does not have auto restart.

→ Hiccup mode OCP: When during overload the output voltage drops below the UVP point, the system shuts down and initiates a restart with soft-start. Continuous overload will show continuous shut-down/restart cycle or hiccup mode. The advantage of hiccup mode is low average overload current, and guarantees auto restart after the overload is removed.

→ Non UVP: During overload the output voltage drops, but there is no UVP action. The system continues to run at OCP current level during overload. The output voltage recovers immediately after the overload is removed. But the continuous OCP current level can lead to increased temperature in longer term overload conditions.

Richtek Buck Product Family

ACOT product family

The proprietary ACOT control scheme not only features ultra-fast transient response but also improves upon legacy constant on-time architectures, achieving constant average frequency over line, load and output ranges to minimize interference and noise problems. The ACOT Buck converters are stable with and optimized for ceramic output capacitors without external components or external ripple injection scheme. The ACOT family includes latch-off, hiccup and constant current protection modes. Richtek has introduced the whole range of ACOT Buck converters up to 12A output current capacity and the input range is from 4.5V to 23V. The ACOT Buck converters are ideal for Set Top Boxes, industrial and commercial low power systems, computer peripherals and LCD Monitors and TVs.

Wide Input Voltage Range DC-DC power solutions for industrial, Automotive and LED lighting applications

Richtek offers comprehensive power conversion solutions for input voltages ranging up to 60V, suitable for a wide range of applications in the industrial, automotive, and professional lighting field. The key features for Buck converter parts in wide input range are: Robust control architectures for coping with noisy environments, PGOOD and adjustable Soft-start for power sequencing, thermally enhanced packages for operation in higher ambient temperatures, and fully stable with all ceramic input and output capacitors for extended operation life time. We also offer products qualified over -40°C to 85°C industrial temperature range as well as automotive AEC-Q100 standard qualified parts.

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