



1A, 76V, High-Efficiency MAXPower Step-Down DC-DC Converter

MAX5035

General Description

The MAX5035 easy-to-use, high-efficiency, high-voltage, step-down DC-DC converter operates from an input voltage up to 76V and consumes only 270µA quiescent current at no load. This pulse-width modulated (PWM) converter operates at a fixed 125kHz switching frequency at heavy loads, and automatically switches to pulse-skipping mode to provide low quiescent current and high efficiency at light loads. The MAX5035 includes internal frequency compensation simplifying circuit implementation. The device uses an internal low-on-resistance, high-voltage, DMOS transistor to obtain high efficiency and reduce overall system cost. This device includes undervoltage lockout, cycle-by-cycle current limit, hiccup mode output short-circuit protection, and thermal shutdown.

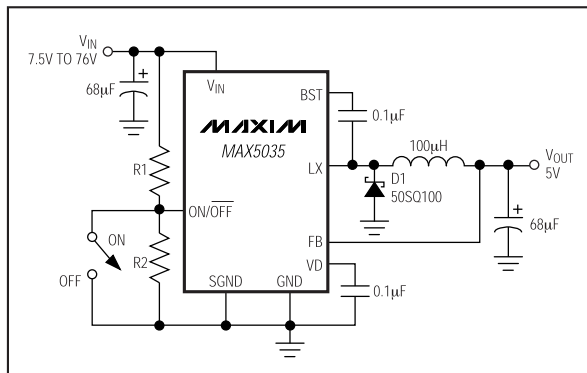
The MAX5035 delivers up to 1A output current. The output current may be limited by the maximum power dissipation capability of the package. External shutdown is included, featuring 10µA (typ) shutdown current. The MAX5035A/B/C versions have fixed output voltages of 3.3V, 5V, and 12V, respectively, while the MAX5035D features an adjustable output voltage from 1.25V to 13.2V.

The MAX5035 is available in space-saving 8-pin SO and 8-pin plastic DIP packages and operates over the automotive (-40°C to +125°C) temperature range.

Applications

- Automotive
- Consumer Electronics
- Industrial
- Distributed Power

Typical Operating Circuit



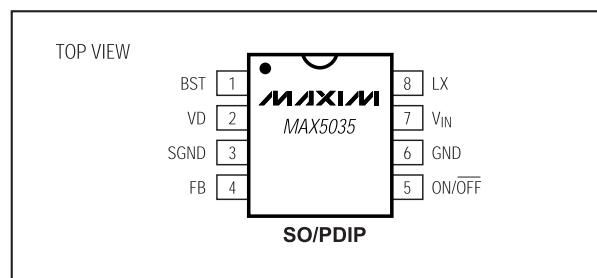
Features

- ♦ Wide 7.5V to 76V Input Voltage Range
- ♦ Fixed (3.3V, 5V, 12V) and Adjustable (1.25V to 13.2V) Versions
- ♦ 1A Output Current
- ♦ Efficiency Up to 94%
- ♦ Internal 0.4Ω High-Side DMOS FET
- ♦ 270µA Quiescent Current at No Load, 10µA Shutdown Current
- ♦ Internal Frequency Compensation
- ♦ Fixed 125kHz Switching Frequency
- ♦ Thermal Shutdown and Short-Circuit Current Limit
- ♦ 8-Pin SO and PDIP Packages

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	OUTPUT VOLTAGE (V)
MAX5035AUSA	0°C to +85°C	8 SO	3.3
MAX5035AUPA	0°C to +85°C	8 PDIP	
MAX5035AASA	-40°C to +125°C	8 SO	
MAX5035BUS A	0°C to +85°C	8 SO	5.0
MAX5035BUPA	0°C to +85°C	8 PDIP	
MAX5035BASA	-40°C to +125°C	8 SO	
MAX5035CUSA	0°C to +85°C	8 SO	12
MAX5035CUPA	0°C to +85°C	8 PDIP	
MAX5035CASA	-40°C to +125°C	8 SO	
MAX5035DUSA	0°C to +85°C	8 SO	ADJ
MAX5035DUPA	0°C to +85°C	8 PDIP	
MAX5035DASA	-40°C to +125°C	8 SO	

Pin Configuration



For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

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ABSOLUTE MAXIMUM RATINGS

(Voltages referenced to GND, unless otherwise specified.)

V _{IN}	-0.3V to +80V
SGND	-0.3V to +0.3V
LX	-0.8V to (V _{IN} + 0.3V)
BST	-0.3V to (V _{IN} + 10V)
BST (transient < 100ns)	-0.3V to (V _{IN} + 15V)
BST to LX	-0.3V to +10V
BST to LX (transient < 100ns)	-0.3V to +15V
ON/OFF	-0.3V to (V _{IN} + 0.3V)
VD	-0.3V to +12V
FB	
MAX5035A/MAX5035B/MAX5035C	-0.3V to +15V
MAX5035D	-0.3V to +12V

V _{OUT} Short-Circuit Duration	Indefinite
VD Short-Circuit Duration	Indefinite
Continuous Power Dissipation (T _A = +70°C)	
8-Pin PDIP (derate 9.1mW/°C above +70°C)	727mW
8-Pin SO (derate 5.9mW/°C above +70°C)	471mW
Operating Temperature Range	
MAX5035_U_	0°C to +85°C
MAX5035_A_	-40°C to +125°C
Storage Temperature Range	-65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (soldering, 10s)	+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS (MAX5035_U_)

(V_{IN} = +12V, V_{ON/OFF} = +12V, I_{OUT} = 0, T_A = 0°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C. See the Typical Application Circuit.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V _{IN}	MAX5035A	7.5		76.0	V
		MAX5035B	7.5		76.0	
		MAX5035C	15		76	
		MAX5035D	7.5		76.0	
Undervoltage Lockout	UVLO		5.2			V
Output Voltage	V _{OUT}	MAX5035A V _{IN} = 7.5V to 76V, I _{OUT} = 20mA to 1A	3.185	3.3	3.415	V
		MAX5035B V _{IN} = 7.5V to 76V, I _{OUT} = 20mA to 1A	4.85	5.0	5.15	
		MAX5035C V _{IN} = 15V to 76V, I _{OUT} = 20mA to 1A	11.64	12	12.36	
Feedback Voltage	V _{FB}	V _{IN} = 7.5V to 76V, MAX5035D	1.192	1.221	1.250	V
Efficiency	η	V _{IN} = 12V, I _{LOAD} = 0.5A, MAX5035A		86		%
		V _{IN} = 12V, I _{LOAD} = 0.5A, MAX5035B		90		
		V _{IN} = 24V, I _{LOAD} = 0.5A, MAX5035C		94		
		V _{IN} = 12V, V _{OUT} = 5V, I _{LOAD} = 0.5A, MAX5035D		90		
Quiescent Supply Current	I _Q	V _{FB} = 3.5V, V _{IN} = 7.5V to 76V, MAX5035A		270	440	μA
		V _{FB} = 5.5V, V _{IN} = 7.5V to 76V, MAX5035B		270	440	
		V _{FB} = 13V, V _{IN} = 15V to 76V, MAX5035C		270	440	
		V _{FB} = 1.3V, MAX5035D		270	440	
Shutdown Current	I _{SHDN}	V _{ON/OFF} = 0V, V _{IN} = 7.5V to 76V		10	45	μA
Peak Switch Current Limit	I _{LIM}	(Note 1)	1.30	1.80	2.50	A
Switch Leakage Current	I _{OL}	V _{IN} = 76V, V _{ON/OFF} = 0V, V _{LX} = 0V		1		μA
Switch On-Resistance	R _{DS(ON)}	I _{SWITCH} = 1A		0.40	0.80	Ω

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ELECTRICAL CHARACTERISTICS (continued) (MAX5035_U_ _)

($V_{IN} = +12V$, $V_{ON/OFF} = +12V$, $I_{OUT} = 0$, $T_A = 0^{\circ}C$ to $+85^{\circ}C$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}C$. See the Typical Application Circuit.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
PFM Threshold	I_{PFM}	Minimum switch current in any cycle	55	85	130	mA
FB Input Bias Current	I_B	MAX5035D	-150	+0.01	+150	nA
ON/OFF CONTROL INPUT						
ON/OFF Input-Voltage Threshold	$V_{ON/OFF}$	Rising trip point	1.53	1.69	1.85	V
ON/OFF Input-Voltage Hysteresis	V_{HYST}			100		mV
ON/OFF Input Current	$I_{ON/OFF}$	$V_{ON/OFF} = 0V$ to V_{IN}		10	150	nA
OSCILLATOR						
Oscillator Frequency	f_{OSC}		109	125	135	kHz
Maximum Duty Cycle	D_{MAX}	MAX5035D		95		%
VOLTAGE REGULATOR						
Regulator Output Voltage	V_D	$V_{IN} = 8.5V$ to $76V$, $I_L = 0$	6.9	7.8	8.8	V
Dropout Voltage		$7.5V \leq V_{IN} \leq 8.5V$, $I_L = 1mA$		2.0		V
Load Regulation	$\Delta V_D / \Delta I_{VD}$	0 to 5mA		150		Ω
PACKAGE THERMAL CHARACTERISTICS						
Thermal Resistance (Junction to Ambient)	θ_{JA}	SO package (JEDEC 51)		170		$^{\circ}C/W$
		DIP package (JEDEC 51)		110		
THERMAL SHUTDOWN						
Thermal-Shutdown Junction Temperature	T_{SH}			+160		$^{\circ}C$
Thermal-Shutdown Hysteresis	T_{HYST}			20		$^{\circ}C$

ELECTRICAL CHARACTERISTICS (MAX5035_A_ _)

($V_{IN} = +12V$, $V_{ON/OFF} = +12V$, $I_{OUT} = 0$, $T_A = T_J = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}C$. See the Typical Application Circuit.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}	MAX5035A	7.5		76.0	V
		MAX5035B	7.5		76.0	
		MAX5035C	15		76	
		MAX5035D	7.5		76.0	
Undervoltage Lockout	UVLO			5.2		V
Output Voltage	V_{OUT}	MAX5035A $V_{IN} = 7.5V$ to $76V$, $I_{OUT} = 20mA$ to $1A$	3.185	3.3	3.415	V
		MAX5035B $V_{IN} = 7.5V$ to $76V$, $I_{OUT} = 20mA$ to $1A$	4.825	5.0	5.175	
		MAX5035C $V_{IN} = 15V$ to $76V$, $I_{OUT} = 20mA$ to $1A$	11.58	12	12.42	
Feedback Voltage	V_{FB}	$V_{IN} = 7.5V$ to $76V$, MAX5035D	1.192	1.221	1.250	V

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ELECTRICAL CHARACTERISTICS (MAX5035_A_ _)

($V_{IN} = +12V$, $V_{ON/OFF} = +12V$, $I_{OUT} = 0$, $T_A = T_J = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}C$. See the *Typical Application Circuit.*) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Efficiency	η	$V_{IN} = 12V$, $I_{LOAD} = 0.5A$, MAX5035A		86		%
		$V_{IN} = 12V$, $I_{LOAD} = 0.5A$, MAX5035B		90		
		$V_{IN} = 24V$, $I_{LOAD} = 0.5A$, MAX5035C		94		
		$V_{IN} = 12V$, $V_{OUT} = 5V$, $I_{LOAD} = 0.5A$, MAX5035D		90		
Quiescent Supply Current	I_Q	$V_{FB} = 3.5V$, $V_{IN} = 7.5V$ to $76V$, MAX5035A		270	440	μA
		$V_{FB} = 5.5V$, $V_{IN} = 7.5V$ to $76V$, MAX5035B		270	440	
		$V_{FB} = 13V$, $V_{IN} = 15V$ to $76V$, MAX5035C		270	440	
		$V_{FB} = 1.3V$, MAX5035D		270	440	
Shutdown Current	I_{SHDN}	$V_{ON/OFF} = 0V$, $V_{IN} = 7.5V$ to $76V$		10	45	μA
Peak Switch Current Limit	I_{LIM}	(Note 1)	1.30	1.80	2.50	A
Switch Leakage Current	I_{OL}	$V_{IN} = 76V$, $V_{ON/OFF} = 0V$, $V_{LX} = 0V$		1		μA
Switch On-Resistance	$R_{DS(ON)}$	$I_{SWITCH} = 1A$		0.40	0.80	Ω
PFM Threshold	I_{PFM}	Minimum switch current in any cycle	55	85	130	mA
FB Input Bias Current	I_B	MAX5035D	-150	+0.01	+150	nA
ON/OFF CONTROL INPUT						
ON/OFF Input-Voltage Threshold	$V_{ON/OFF}$	Rising trip point	1.50	1.69	1.85	V
ON/OFF Input-Voltage Hysteresis	V_{HYST}			100		mV
ON/OFF Input Current	$I_{ON/OFF}$	$V_{ON/OFF} = 0V$ to V_{IN}		10	150	nA
OSCILLATOR						
Oscillator Frequency	f_{OSC}		105	125	137	kHz
Maximum Duty Cycle	D_{MAX}	MAX5035D		95		%
VOLTAGE REGULATOR						
Regulator Output Voltage	V_D	$V_{IN} = 8.5V$ to $76V$, $I_L = 0$	6.5	7.8	9.0	V
Dropout Voltage		$7.5V \leq V_{IN} \leq 8.5V$, $I_L = 1mA$		2.0		V
Load Regulation	$\Delta V_D / \Delta I_{VD}$	0 to 5mA		150		Ω
PACKAGE THERMAL CHARACTERISTICS						
Thermal Resistance (Junction to Ambient)	θ_{JA}	SO package (JEDEC 51)		170		$^{\circ}C/W$
		DIP package (JEDEC 51)		110		
THERMAL SHUTDOWN						
Thermal-Shutdown Junction Temperature	T_{SH}			+160		$^{\circ}C$
Thermal-Shutdown Hysteresis	T_{HYST}			20		$^{\circ}C$

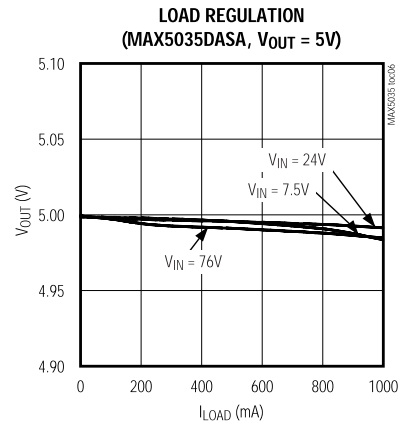
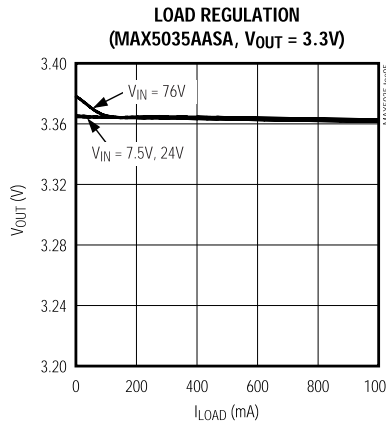
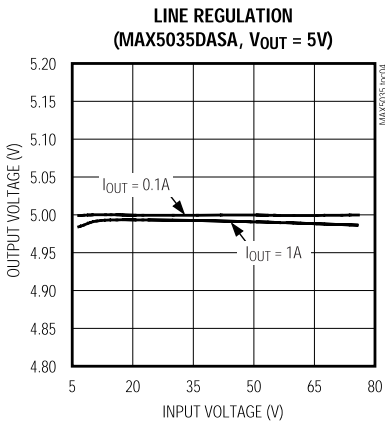
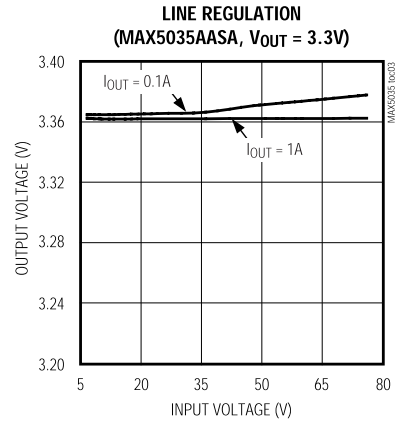
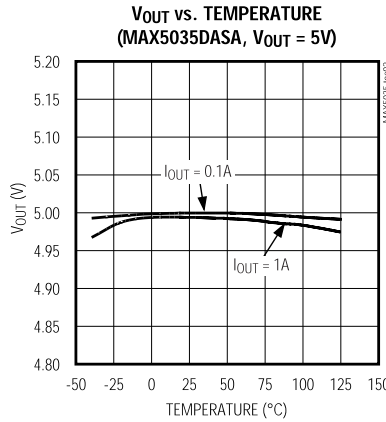
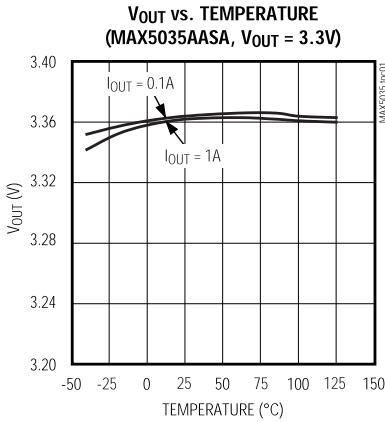
Note 1: Switch current at which current limit is activated.
Note 2: All limits at $-40^{\circ}C$ are guaranteed by design, not production tested.

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Typical Operating Characteristics

($V_{IN} = 12V$, $V_{ON/OFF} = 12V$, $T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}C$. See the *Typical Application Circuit*, if applicable.)



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