2S76M1K-XX 52kHz 2.1-amp PWM Buck DC/DC Converter

October 2010- revised June 2013

FEATURES

- Output voltages - 3.3V, 5V, 12 V and adjustable.
- Adjustable version output voltage range is within 1.23V to 37V.
- 52 kHz fixed switching frequency.
- Voltage mode non-synchronous PWM control.
- Thermal-shutdown and current-limit protection.
- On/Off shutdown control input.
- Short circuit protect (SCP).
- Wide output current – up to 2.1A
- Low power standby mode.
- Load regulation ~ 0.2 %, line regulation ~0.2%.

GENERAL DESCRIPTION

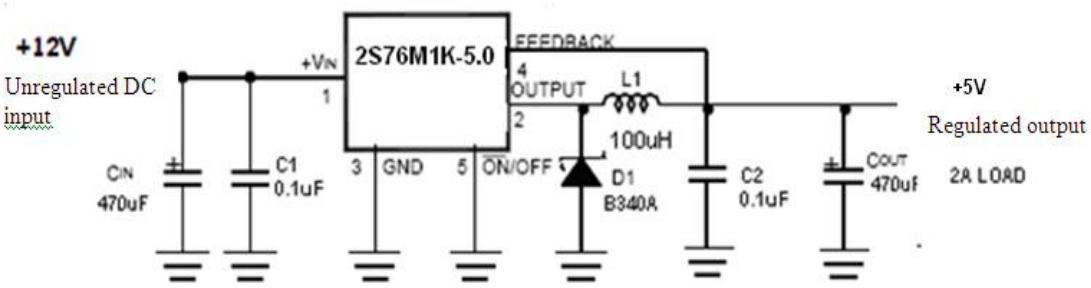
The 2S76M1K-XX series are monolithic ICs designed for a step-down DC/DC converter, capable of driving 2A load without an additional transistor. It saves a board space. The external shutdown function is controlled by a logic level and then the circuit comes into the standby mode. The internal compensation makes the feedback control with good line and load regulation characteristics without an external design. Regarding the protection functions – the thermal shutdown prevents circuit damage during the overtemperature operation and the current limit is against overcurrent operation of the output switch. If the case for the current limiting occurs and V_{FB} is down by 40% of the nominal output voltage, the switching frequency shall be reduced.

The fixed output voltage version includes 3.3V, 5V, 12V devices, while the adjustable version voltages range from 1.23V to 37V. The chips are available in standard 5-lead TO-220, TO-263 and 8-lead SOP packages. The 2S76M1K-XX has excellent load regulation and line regulation.

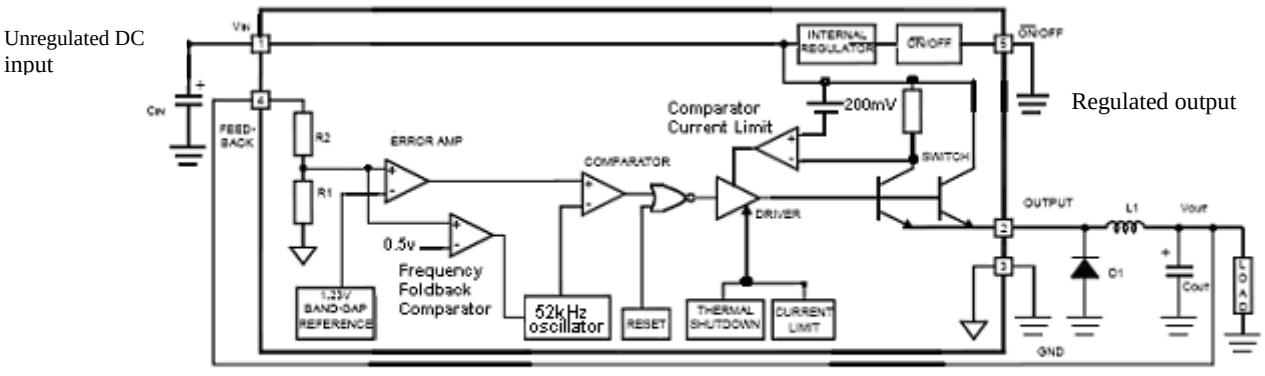
APPLICATIONS

- Simple high-efficiency step-down (buck) regulator
- Efficient pre-regulator for linear regulators
- On-card switching regulators
- Positive-to-negative converter (buck-boost)

TYPICAL APPLICATION (Fixed output voltage versions)



BLOCK DIAGRAM



For ADJ Version
R1 = Open, R2 =0Ω

PIN ASSIGNMENT

TO-220, TO-263:
1 - V_{IN}
2 - OUTPUT
3 - GND
4 - FEEDBACK (FB)
5 - $\overline{\text{ON/OFF}}$

8-lead SOP with an exposed pad connection to GND on the bottom of the package
1 - V_{IN}
2 - OUTPUT
3 – FEEDBACK (FB)
4 - $\overline{\text{ON/OFF}}$
5,6,7,8 - GND

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ABSOLUTE MAXIMUM RATING

Characteristics	Symbol	Rating	Units
Maximum supply voltage	V_{IN}	45	V
ON/OFF pin input voltage	$V_{ON/OFF}$	-0.3 to 40, ≤ Vin	V
FEEDBACK (FB) pin voltage	V_{FB}	-0.3 to 25, ≤ Vin	V
Output voltage to GND	V_{OUT}	-1	V
Power dissipation	P_D	Internally-limited	W
Minimum ESD rating HBM (C=100pF, R=1.5k)	ESD	2000	V
Storage temperature range	T_{ST}	-65°C to +150°C	°C
Maximum junction temperature	$T_{J,max}$	150°C	°C
Short-term surge	V_{IN}	60	V

OPERATING RATING

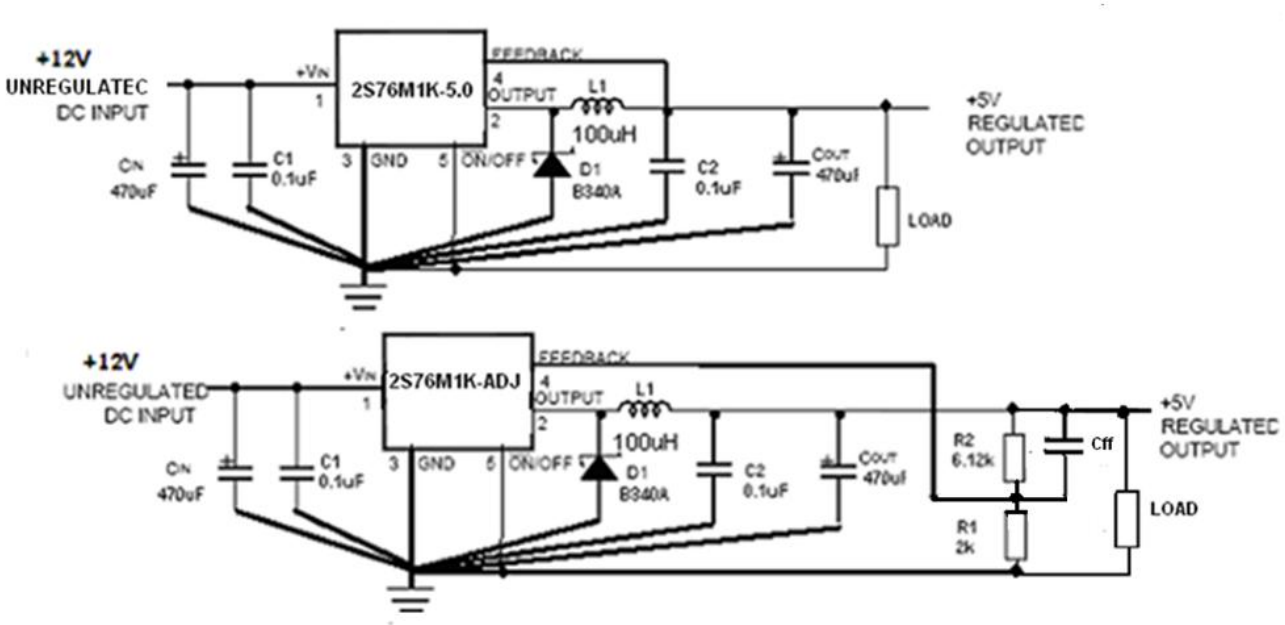
Temperature range	T_J	-40°C ≤ Tj ≤ +125°C	°C
Supply voltage	Vop	4.5 to 40	V
I_{LOAD}	I_{LOAD}	I_{LOAD} ≤ 2.1	A

ELECTRICAL CHARATERISTICS (Note 1)

Unless specified otherwise, V_{IN}=12V for the 3.3V, 5V and adjustable versions, I_{LOAD}=0.5A.
The *denotes the specifications, which apply over full operating temperature range T_J = -40 to +125°C.

SYMBOL	PARAMETER	CONDITIONS	*	Min	Typ	Max	Units
SYSTEM PARAMETERS **Test Circuit** Figure 1							
V_{OUT}	Output voltage 2S76M1K-3.3	5.1V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 2.1A		3.200	3.300	3.400	V
			*	3.168		3.432	
	2S76M1K-5.0	7V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 2.1A		4.85	5.00	5.15	V
			*	4.80		5.20	
	2S76M1K-12	15V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 2A		11.64	12.00	12.36	V
			*	11.52		12.48	
	2S76M1K-adj	7V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 2.1A		1.205	1.230	1.255	V
			*	1.193		1.267	
Line Reg	Line regulation	7.5V ≤ V_{IN} ≤ 40V, I_{LOAD} = 0.2A			0.2	0.5	%
Load Reg	Load regulation	10mA ≤ I_{LOAD} ≤ 2.1A, V_{IN} = 12V			0.2	0.5	%
η	Efficiency 2S76M1K-3.3	V_{IN}=12V, I_{LOAD}=2A			77		%
	2S76M1K-5.0	V_{IN}=12V, I_{LOAD} =2A			79		%
	2S76M1K-12	V_{IN}=18V, I_{LOAD} =2A			82		%
	2S76M1K- adj	V_{IN}=12V, I_{LOAD}=2A, V_{OUT}=5V			79		%
DEVICE PARAMETERS							
I_Q	Quiescent current	V_{FB}=12V force driver off			5	8	mA
I_{FB}	Feedback bias current	V_{FB}=1.3V (adjustable version only)		-50	-10		nA
			*	-100			nA
I_{STB}	Shutdown supply current	$V_{ON/OFF}$=5V, V_{IN}=40V			20	200	µA
			*			250	µA
F_{OSC}	Oscillator frequency			47	52	58	kHz
			*				
F_{SCP}	Oscillator frequency of Short circuit protect (SCP)	When V_{OUT}<40% from the nominal			19		kHz
$DC_{(Max)}$	Max. duty cycle	V_{FB}=0V force driver on	*	100			%
$DC_{(Min)}$	Min. duty cycle	V_{FB}=12V force driver off	*			0	%
CL	Current limit	Peak current. No outside circuit. V_{FB}=0V		2.5	3.5	4.5	A
			*	2.3		4.9	A
V_{SAT}	Saturation voltage	I_{OUT}=2A. No outside circuit. V_{FB}=0V			1.10	1.20	V
			*			1.35	V
I_L	Output leakage current	V_{OUT}=0V. No outside circuit. V_{FB}=12V		-300	-50		µA
I_{L1}	Output leakage current	V_{OUT}=-1V. No outside circuit. V_{FB}=12V		-30	-3		mA
V_{TH}	ON/OFF input threshold		*	0.6	1.3	2.0	V
Symbol Parameter							
I_H	ON/OFF input current	$V_{ON/OFF}$=2.5V		-5	-0.1	5	µA
I_L	ON/OFF input current	$V_{ON/OFF}$=0.5V		-1	-0.01	1	µA
T_{SD}	Thermal shutdown temperature	T_J	*		155		°C

TEST CIRCUIT AND LAYOUT GUIDELINES



$$V_{OUT} = V_{REF}(1+\frac{R_2}{R_1})$$

$$R_2 = R_1(\frac{V_{OUT}}{V_{REF}} - 1)$$

where V_{REF} = 1.23V, R1 between 1k and 5k

FIGURE 1.

For minimal inductance and ground loops, the wires indicated by **heavy lines should be wide printed circuit traces and kept as short as possible.** Keep the FEEDBACK wiring away from the inductor flux.
Cff~1 to 10nF – as option.

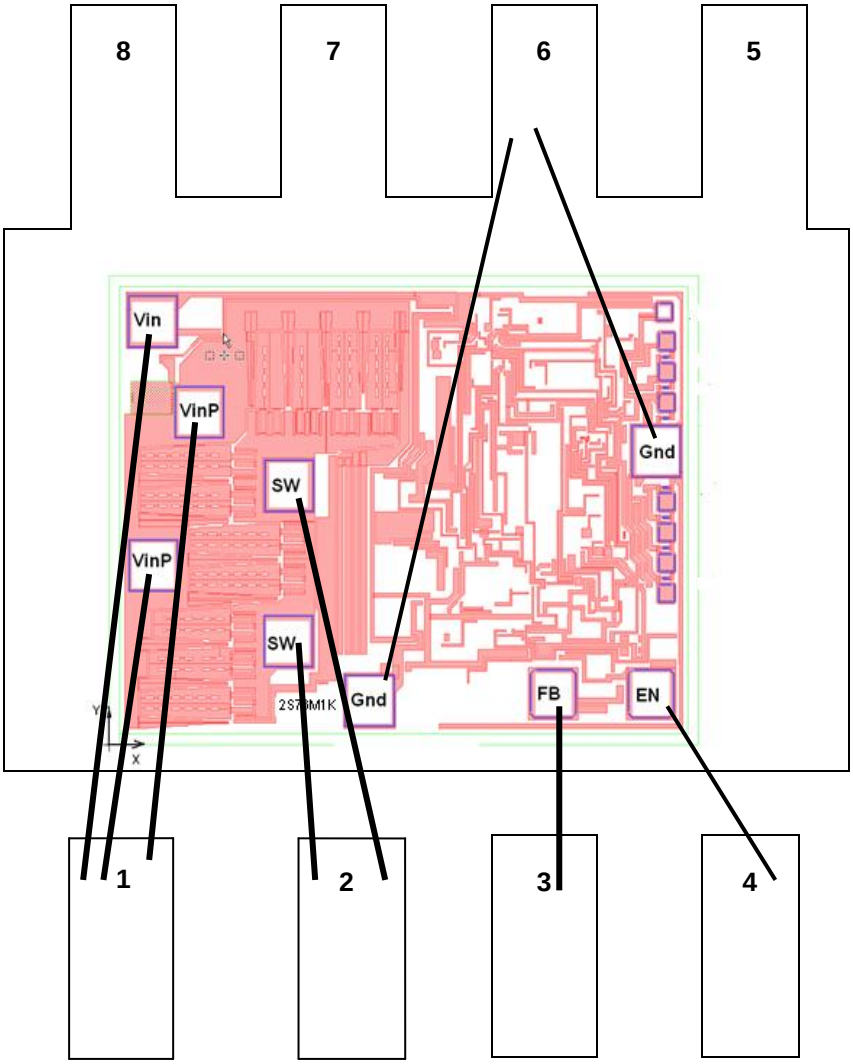
2S76M1K-XX PAD LOCATION

Chip size = 2.25 x 1.70 mm^2

Pad	Name	Pad coordinates (center)		Size
		X (µm)	Y (µm)	
1	Vin	165	1535	190*190
1	VinP	344	1205	190*190
1	VinP	167	650	190*190
2	SW	684	941	190*190
2	SW	684	375	190*190
3	Gnd	994	160	190*190
3	Gnd	2090	1066	190*190
4	FB	1696	185	176*176
5	EN	2071	186	179*179

2S76M1K-XX BONDING DIAGRAM

8-lead SOP Package

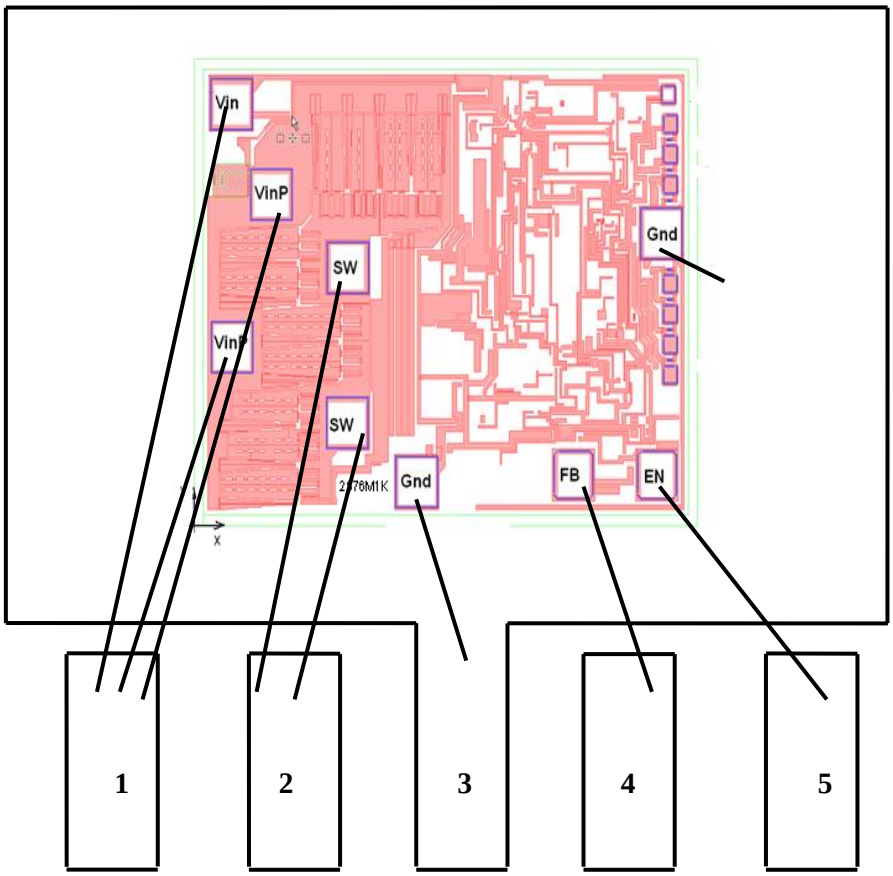


The wire diameter is 50μm

Pad	Name
1	V_{IN}
2	OUTPUT
3	FEEDBACK(FB)
4	$\overline{ON}$/0FF
5-8	GND

2S76M1K-XX BONDING DIAGRAM

TO-220, TO-263 Packages



The wire diameter is 50μm

Pad	Name
1	V_{IN}
2	OUTPUT
3	GND
4	FEEDBACK(FB)
5	$\overline{ON}$/0FF

The appearance complies with the requirements of the company standards.