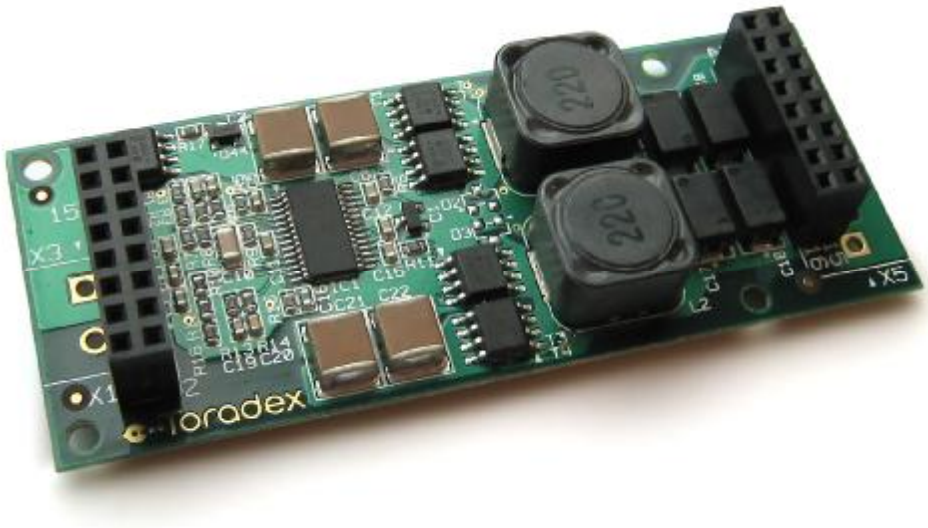
Firefly V 1.00

Datasheet



Firefly: standard version with PCB mount header

Revision History

Date	Doc. Rev.	Firefly Version	Changes
8-March-07	Rev. 1.0	V1.00	Initial

Content

1. Introduction

Firefly is a ready-to-use, very high efficiency, dual channel DC/DC converter.

The deployment of National Semiconductors LM5642 – a synchronous, dual phase buck converter - results in a reduced input current ripple.

2. Features

- Two synchronous buck channels preconfigured for 5V and 3.3V output voltage
- 9V to 36V input voltage range
- Input reverse polarity protection
- Reduced input current ripple due to 180° out of phase operation
- Independent enable/soft-start signals
- 250µA Shutdown current
- Up to 2.8A supply current per channel
- High efficiency up to 95%
- Output under voltage shutdown
- Output over voltage shutdown
- Thermal shutdown
- Short circuit and overload protection
- Small size with 4 mounting holes

Firefly can be assembled for two different connection types:

- The standard version with 2.54mm female headers allows to connect Firefly to other PCBs
- The optional version using screw terminals allows to hock up Firefly by wires.

3. Reference Documents

- LM5642 - High Voltage, Dual Synchronous Buck Converter: http://cache.national.com/ds/LM/LM5642.pdf

4. Functional Description

4.1. Block Diagram

Firefly is based on the LM5642, a synchronous, dual phase buck converter from National Semiconductor.

Firefly is available with two different connector types: the standard module version features two 2.54mm female headers for interconnection to a PCB, the optional version comes with screw terminals used for wires hock up.

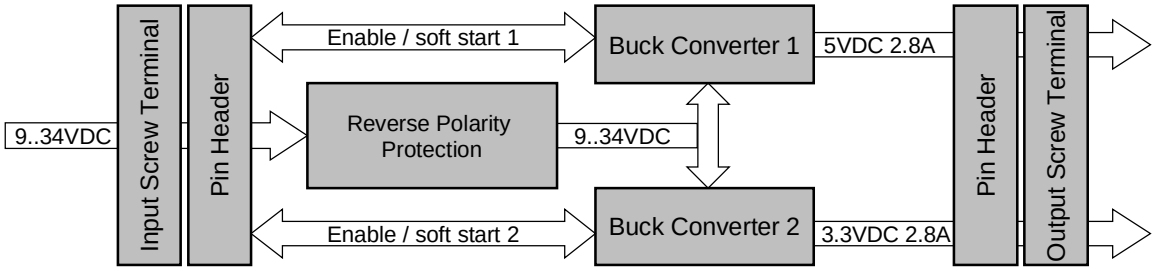


Fig. 1: Firefly Block Diagram

4.2. Enable / Soft-Start

Each power channel is controlled by a individual Enable/Soft-start signal.

Each of these two signals is internally connected to a 2.4µA current source and a 10nF capacitor. If the signal is pulled down to ground the channel wills remain in shut down mode. In case the signal is floating, the internal 2.4µA current source charges the soft-start capacitor. As the soft-start capacitor voltage ramps up, the duty cycle increases proportional to the soft-start ramp, causing the output voltage to ramp up. When the corresponding output voltage exceeds 81% (typical) of the target voltage, the regulator switches from soft-start to normal operating mode.

During soft-start period over-voltage protection and current limit remain in effect, but the under voltage protection feature is deactivated.

4.3. Reverse polarity protection

The input voltage is protected against reverse polarity. In case of reverse polarity a FET breaks up the connection between $-V_{IN}$ and the GND pins of the output connector X2.

If $-V_{IN}$ and GND are connected externally, the reverse polarity protection is by-passed and thus no longer active.

4.4. Thermal Shutdown

The deployed buck controller LM5642 will enter thermal shutdown if the die temperature exceeds 160°C. The top and bottom FETs of both channels will be turned off immediately. In addition, both soft-start capacitors will begin to discharge through separate 5.5µA current sinks. The voltage on both capacitors will settle to approximately 1.1V, where it will remain until the thermal shutdown condition has cleared.

The power controller will return to normal operating mode when the die temperature has fallen below 146°C. At this point the two soft-start capacitors will begin to charge with their 2.4µA current sources. This allows a controlled return to normal operation, similar to the soft-start during turn-on.

If the thermal shutdown condition clears before the voltage on the soft-start capacitors has fallen to 1.1V, the capacitors will first be discharged to 1.1V, and then immediately begin charging back up.

4.5. Output Over Voltage Protection

If the output voltage on either channel rises above 114% of its nominal value, over voltage protection (OVP) activates and both channels will latch off. When the OVP latch is set, the high side FET is immediately turned off and the low side FET is turned on to discharge the output capacitor through the inductor.

In order to reset the OVP fault condition, either the input voltage must be cycled, or both channels must be switched off (both Enable/soft-start pins must be pulled low).

4.6. Output Under Voltage Protection

If the output voltage on either channel falls below 80% of its nominal value for more than UV_DELAY, under voltage protection (UVP) activates. During UVP, both the high side and low side FET will be turned off.

To reset the UVP fault condition, either the input voltage must be cycled, or both channels must be switched off (both Enable/soft-start pins must be pulled low).

4.7. Output Current Limit

The output current is limited by the maximal high side current. Every time the high side FET is turned on, the current is measured. If the current exceeds maximal ratings the high side FET will be turned off after a minimal on time of 166ns. If the current remains too high for several cycles the output voltage will drop below 80% of nominal. This will activate UVP which then shuts down both cannels.

4.8. Output capacitor discharge

Each channel has an embedded 480Ω MOSFET with the drain connected to the switching point of the inductor. This MOSFET will discharge the output capacitor of its channel through the inductor if its channel is off, or the power controller enters a fault state.

5. Electrical Characteristics

5.1. Absolute Maximum Ratings

Symbol	Parameter	Value	Units
VIN	Input voltage	-36 to 36	V
IOUT	Output current per channel	3.5	A
TSTOR	Storage Temperature range	-40 to 125	°C
TOP	Operating Temperature range	-40 to 70	°C
VOUT_IDLE	Voltage on disabled channel output	6.0	V
VON/SS	Enable / soft-start voltage	-03 to 5.5	V

5.2. Operating Conditions

5.2.1 General Specifications

Symbol	Parameter	Min	Typical	Max	Units
	Efficiency		92	96	%
VOFF	Enable / soft-start signal: minimal channel off threshold range	-0.3		0.7	V
IENABLE/SS	Enable/soft-start source current	0.5	2.4	5	µA
TSS	Soft-start duration		14		ms

5.2.2 Input Specifications

Symbol	Parameter	Min	Typical	Max	Units
	Input voltage	9		34	V
	Input current (no load)		16		mA

5.2.3 Output Specifications Channel 1 (3.3V)

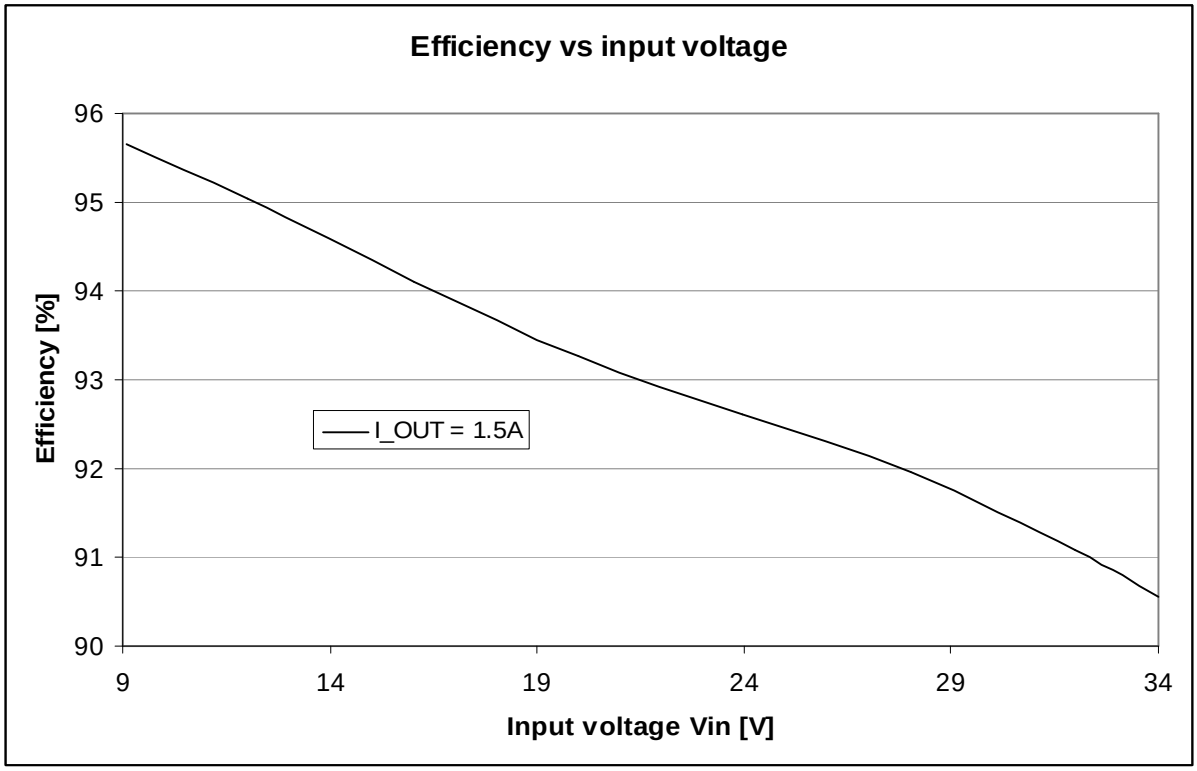
Symbol	Parameter	Min	Typical	Max	Units
VOUT 1	Output voltage	3.2	3.3	3.4	V
IOUT 1	Output current			2.8	A
VRIPPLE 1	Output ripple at IOUT I = 2A		≈35		mVpp
ΔvOUT1/vOUT 1	Dynamic regulation accuracy		≤1		%
ΔVOUT1/VOUT 1	Static regulation accuracy		0.05		%
ROUTPUT OFF	Output resistance if Channel is disabled	420	487	560	Ω
TTRANS 1	Output transient response (0 to 50% load)		1		ms
VUVP1	Under voltage protection latch threshold	2.4	2.663	2.924	V
VOVP1	Over voltage protection latch threshold	3.424	3.762	4.148	V
IOLP1	Over load protection threshold	3	3.3	3.5	A

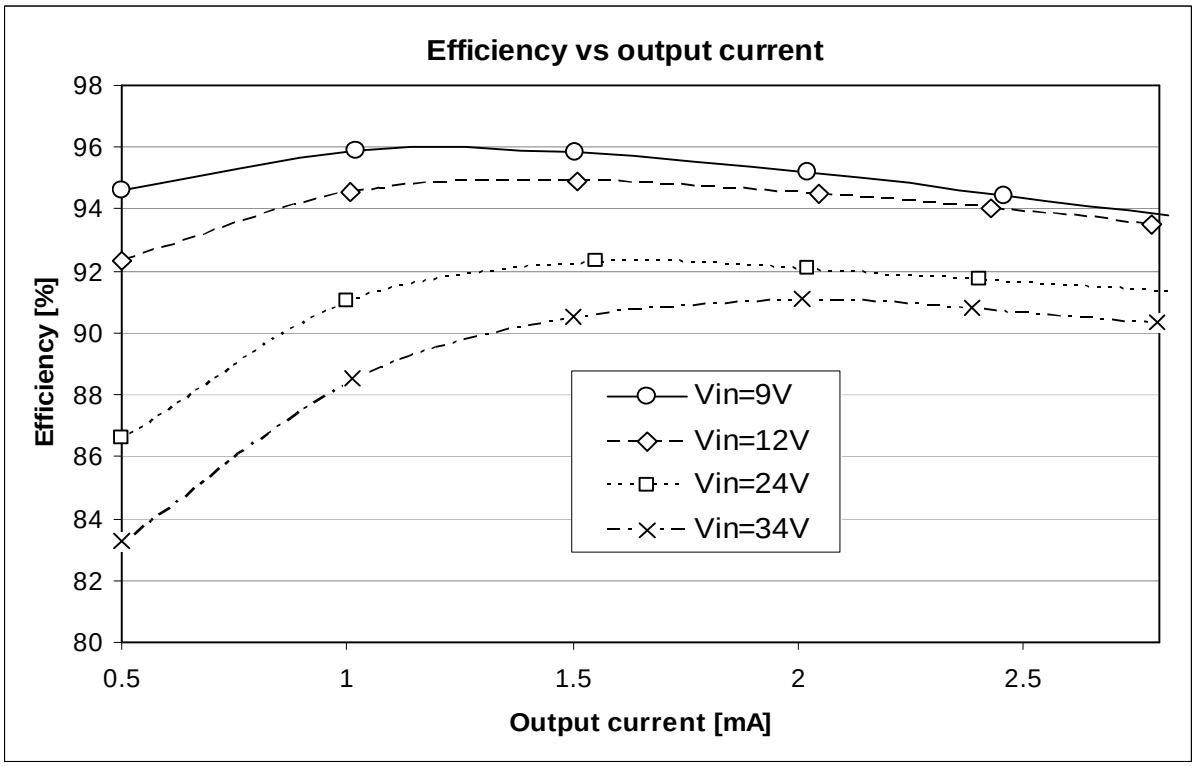
5.2.4 Output Specifications Channel 2 (5V)

Symbol	Parameter	Min	Typical	Max	Units
VOUT 2	Output voltage	4.85	5	5.15	V
IOUT 2	Output current			2.8	A
VRIPPLE 2	Output ripple at IOUT I = 2A		≈31		mVpp
ΔvOUT2/vOUT 2	Dynamic regulation accuracy		≤1		%
ΔVOUT2/VOUT 2	Static regulation accuracy		0.07		%
ROUTPUT OFF	Output resistance if Channel is disabled	420	487	560	Ω
TTRANS 2	Output transient response (0 to 50% load)		1.2		ms
VUVP 2	Under voltage protection latch threshold	3.638	4.035	4.429	V
VOVP 2	Over voltage protection latch threshold	5.19	5.7	6.283	V
IOLP 2	Over load protection threshold	3	3.3	3.5	A

6. Typical Performance Characteristics

6.1. Efficiency (Channel2)





7. Firefly Board Physical Drawings

7.1. Mechanical Drawing PCB Mount Headers

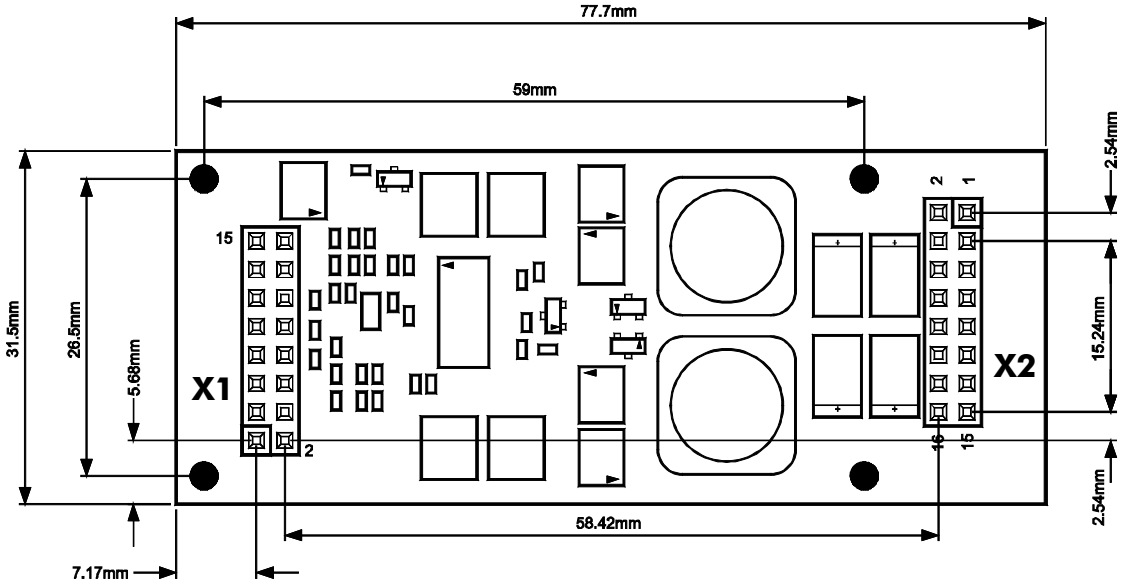


Fig. 2: Mechanical Drawing PCB mount header version (standard): top view

7.2. Mechanical Drawing Screw Terminals

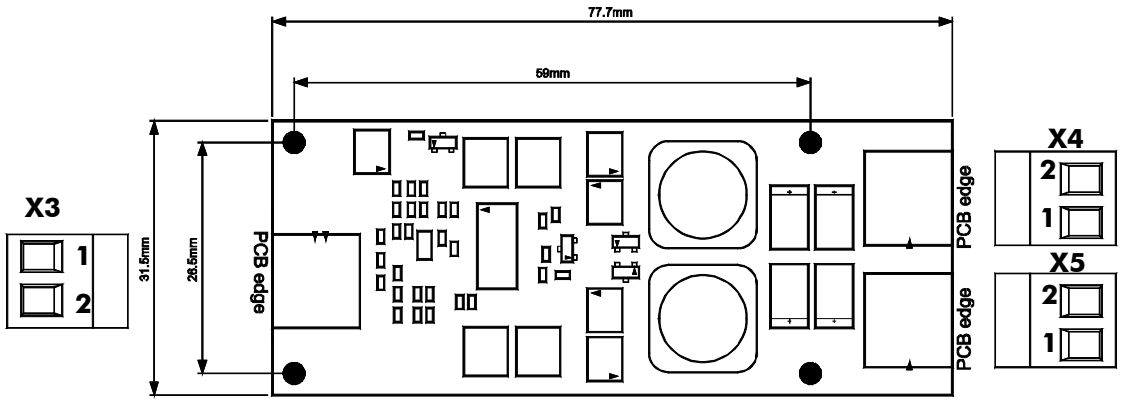


Fig. 2: Mechanical Drawing Screw terminal version (optional): top view

8. Firefly Connectors

8.1. Standard Version

8.1.1 Input Connector (X1)

Type: 2x8Pin Header Female, 2.54mm

Pin #	Signal Name
15,16	GND_IN
13,14	GND_IN
11,12	GND_IN *
9,10	Channel 1 (3.3V) Enable / Soft-start signal
7,8	Channel 2 (5V) Enable / Soft-start signal
5,6	V_IN
3,4	V_IN
1,2	V_IN

Remark: If $-V_{IN}$ is connected to GND_OUT (X2 pins5-12) the reverse polarity protection function is by-passed.

8.1.2 Output Connector (X2)

Type: 2x8Pin Header Female, 2.54mm

Pin #	Signal Name
15,16	V_OUT_5V
13,14	V_OUT_5V
11,12	GND_OUT
9,10	GND_OUT
7,8	GND_OUT
5,6	GND_OUT
3,4	V_OUT_3.3V
1,2	V_OUT_3.3V

8.2. Alternative Version

8.2.1 Screw Terminals (X3, X4, X5)

Part number: AUK TBH02D13

Pin #	Signal Name
X3:1	GND_IN
X3:2	Input Voltage V_IN
X4:1	GND_OUT
X4:21	V_OUT_3.3V
X5:1	GND_OUT
X5:2	V_OUT_5V

If $-V_{IN}$ is connected to GND_OUT (X4:1 or X41) Reverse polarity protection is by-passed.

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