

PFM Mode Step-Up DC/DC Converter With True Shutdown

FEATURES

- Adjustable Output Voltage up to 24V.
- 2.7V to 5.5V Input Range.
- Maximum 0.1 μ A Shutdown Current.
- Tiny Inductor and Capacitors are allowed.
- Space-Saving SOT-23-6 Package.

APPLICATIONS

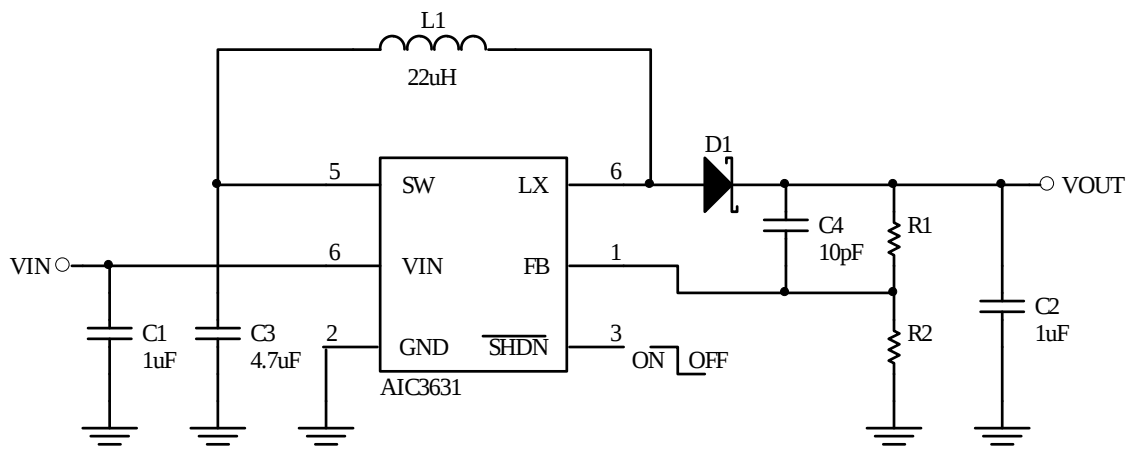
- LCD Bias
- LCM
- OLED Driver

DESCRIPTION

AIC3631 is a pulse-frequency modulation (PFM), step-up DC/DC Converter. The built-in high voltage N-channel MOSFET allows AIC3631 for step-up applications with up to 24V output voltage, as well as for Single Ended Primary Inductance Converter (SEPIC) and other low-side switching DC/DC converter.

The AIC3631 is available in a space-saving SOT-23-6 package.

TYPICAL APPLICATION CIRCUIT



Typical Application Circuit

ORDERING INFORMATION

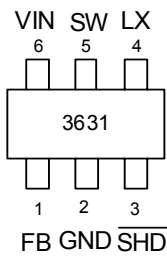
AIC3631 X XX XX

PACKING TYPE
TR: TAPE & REEL
BG: BAG

PACKAGE TYPE
G6: SOT-23-6

G: GREEN PACKAGE

Example: AIC3631GG6TR
→ in SOT-23-6 Green Package and
Tape & Reel Packing Type

ORDER NUMBER	PIN CONFIGURATION
AIC3631GG6 (SOT-23-6)	FRONT VIEW  Note: Pin1 is determined by orienting the package marking as shown.

SOT-23-6 Marking

Part No.	Marking
AIC3631GG6	3631G

ABSOLUTE MAXIMUM RATINGS

LX to GND	28V
FB to GND	6V
IN, SW, SHDN	6V
SW Pin RMS Current	0.6A
Operating Ambient Temperature Range T_A	-40°C to 85°C
Operating Maximum Junction Temperature T_J	125°C
Storage Temperature Range T_{STG}	-65°C to 150°C
Lead Temperature (Soldering 10 Sec.)	260°C
Thermal Resistance Junction to Case SOT-23-6	115°C/W
Thermal Resistance Junction to Ambient SOT-23-6	250°C/W

(Assume no Ambient Airflow, no Heatsink)

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

TEST CIRCUIT

Refer to "TYPICAL APPLICATION CIRCUIT".

■ ELECTRICAL CHARACTERISTICS

($V_{IN}=V_{SHDN}=3.6V$, SW=Open, $T_A=25^{\circ}C$, unless otherwise specified) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply Range	V _{IN}		2.7		5.5	V
Output Voltage Adjust Range	V _{OUT}				24	V
V _{IN} Undervoltage Lockout	UVLO	V _{IN} rising, 50mV hysteresis	2.33	2.5	2.65	V
Quiescent Current	I _{IN}	V _{FB} = 1.3V, No switching		30	50	μA
Shutdown Supply Current		V _{SHDN} = 0V		0.01	0.5	μA
ERROR AMPLIFIER						
Feedback Voltage	V _{FB}	At 0°C to 85°C, Note 1	1.2137	1.226	1.2383	V
FB Input Bias Current	I _{FB}	V _{FB} = 1.24V	-50		50	nA
Line Regulation		V _{IN} = 2.7V to 5.5V		0.1		%/V
Load Regulation		V _{OUT} = 15V, I _{LOAD} = 0 to 5mA		0.1		%/mA
OSCILLATOR						
Minimum LX Off-Time		V _{FB} > 1.1V		1		μS
		V _{FB} = 0.1V		5		
POWER SWITCH						
On-Resistance	R _{DS(ON)}	V _{IN} = 5V		0.6	1	Ω
Leakage Current	I _{LX(OFF)}	V _{LX} = 28V		0.1	2	μA
Switch Current Limit	I _{LX}		0.088	0.101	0.108	A
SOFT-START						
SW PMOS ON-Resistance		V _{IN} = 2.7V, I _{SW} = 100mA		1.5	2.5	Ω
SW PMOS Current Limit		V _{IN} = 3.6V, V _{SW} = 0V	0.7	0.85	1	A
SW PMOS Leakage Current		V _{IN} = 5.5V, V _{SW} = 0V			1	μA
SW PMOS Soft Start Time		V _{IN} = 2.7V, C _{SW} = 4.7μF		0.2	1	mS
CONTROL INPUT						
SHDN Input Low Voltage	V _{IL}				0.7	V
SHDN Input High Voltage	V _{IH}		1.5			V
SHDN Input Current	I _{SHDN}	V _{SHDN} = 0V		0.01	0.1	μA

Note 1: Specifications are production tested at $T_A=25^{\circ}C$. Specifications over the $0^{\circ}C$ to $85^{\circ}C$ operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

TYPICAL PERFORMANCE CHARACTERISTICS

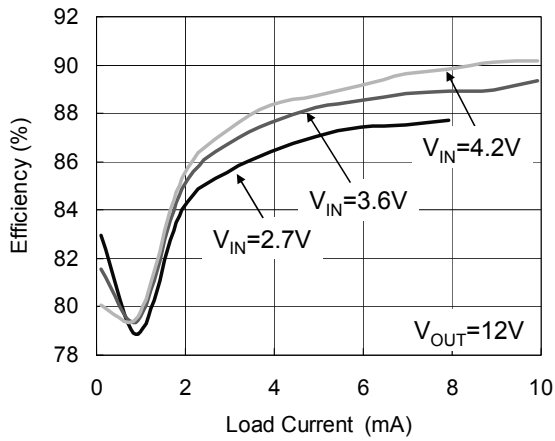


Fig. 1 Efficiency vs. Load Current

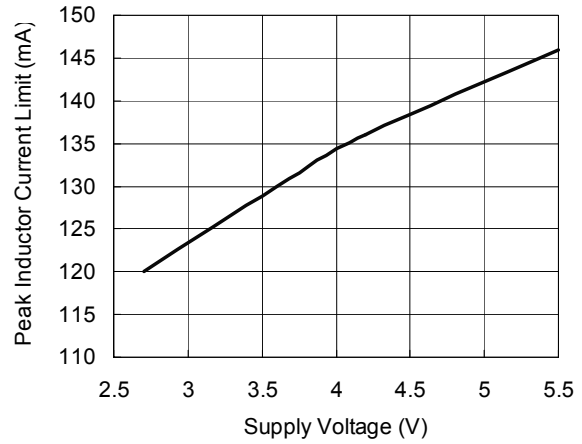


Fig. 2 Peak Inductor Current Limit vs. Supply Voltage

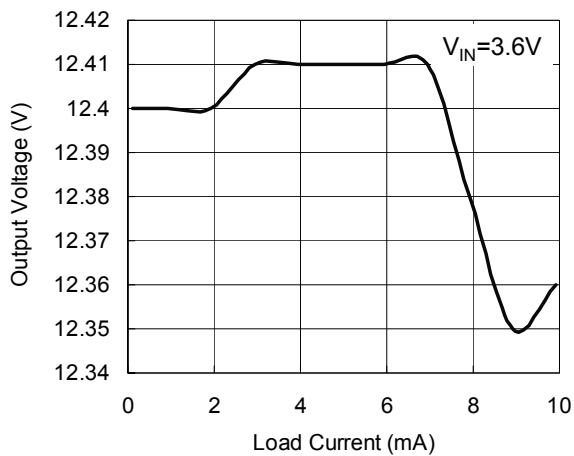


Fig. 3 Output Voltage vs. Load Current

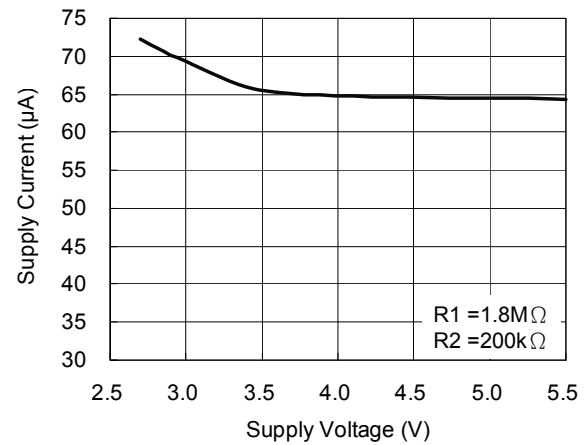


Fig. 4 Supply Current vs. Supply Voltage

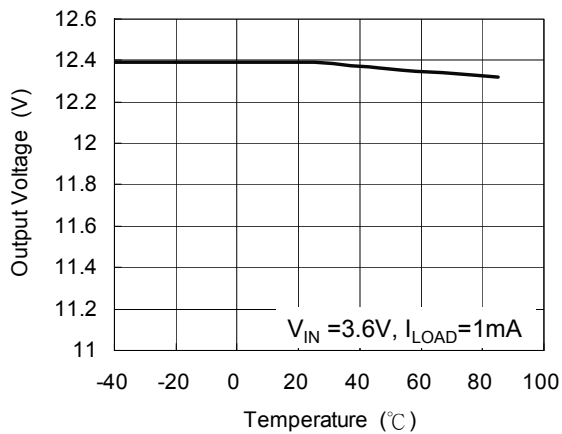


Fig. 5 Output Voltage vs. Temperature

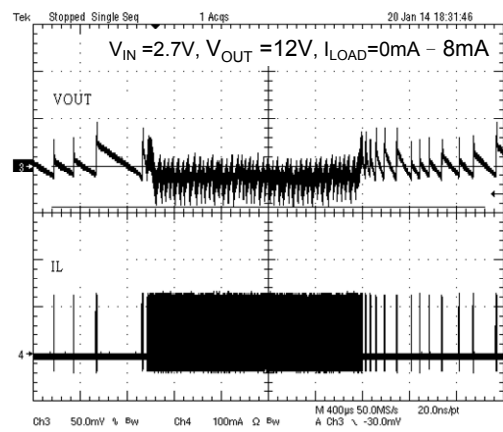
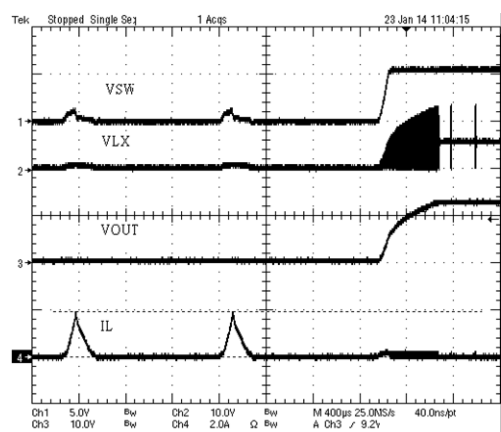
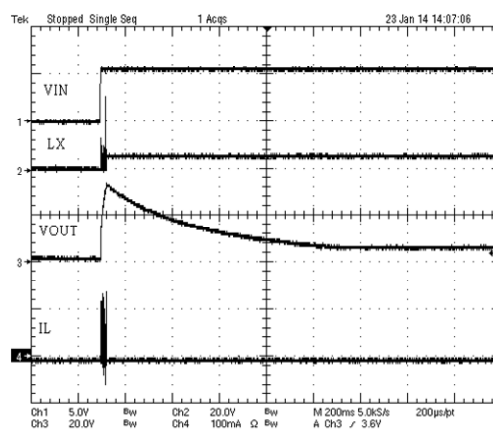
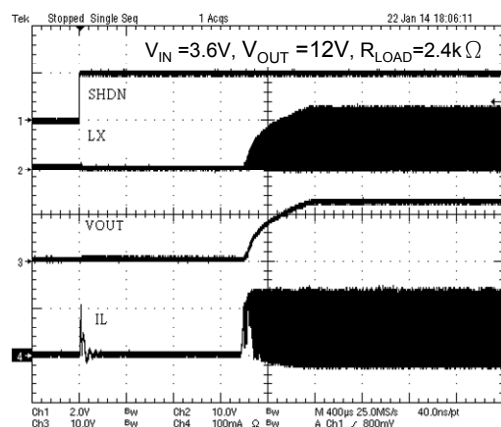


Fig. 6 Load Transient Response

■ TYPICAL PERFORMANCE CHARACTERISTICS(Continued)



■ APPLICATION INFORMATION

The AIC3631 is a step-up DC-DC converter. It is based on PFM control topology. At the beginning of each switching cycle, the main switch (NMOS) is turned on and the inductor current starts to ramp. When the sense current signal equals to the main switch current limit value, the main switch is turned off and the inductor current flows through diode to supply the output. The AIC3631 have true-shutdown feature which have an internal P-channel MOSFET connects from VIN pin to SW pin to protect main switch, diode and inductor during operation. The AIC3631 can operate with an input voltage from 2.7V to 5.5V and adjustable output voltage up to 24V.

Device Shutdown

When $\overline{\text{SHDN}}$ is set logic high, the AIC3631 is put into active mode operation. If $\overline{\text{SHDN}}$ is set logic low, the device is put into shutdown mode and consumes less than 0.5 μ A of current. At the shutdown mode, the internal P-channel switch will turn off and the output voltage of AIC3631 step-up converter will reduce to 0V.

Under-Voltage Lockout

Under-Voltage Lockout (UVLO) prevents the main switch from turning on until input voltage exceeds 2.5V typically. When the main switch turns on, if the input voltage drops below 2.4V typically, UVLO shuts off the main switch.

Adjustable Output Voltage

An external resistor divider is used to set the output voltage. The output voltage of the switching regulator (V_{OUT}) is determined by the following equation:

$$V_{\text{OUT}} = V_{\text{FB}} \times \left(1 + \frac{R_1}{R_2} \right)$$

Where V_{FB} is 1.226V reference voltage.

Short Circuit Protection

While the output is shorted to ground, the surge

current will flow through the internal P-channel MOSFET. If the surge current reaches the PMOS current limit, the internal P-channel switch will turn off and restart soft-start. This would protect the inductor and diode not been damage and make sure downstream circuits are safe.

Soft-Start

The AIC3631 have soft-start function it can prevent large inrush current during start-up period. During soft-start period, the internal P-channel switch will turn on slowly.

Over Voltage Protection

If the feedback resistor is floating or other situation is happened to make the output voltage over normal voltage, the AIC3631 will stops switching, and the output voltage will reduce to VIN voltage.

Inductor Selection

A 22 μ H inductor is recommended for most AIC3631 applications. It is important to ensure the inductor saturation current value exceeds the peak value of inductor current in application to prevent core saturation.

Diode Selection

Schottky diodes, with their low forward voltage drop and fast reverse recovery, are the ideal choices for AIC3631 applications. The forward voltage drop of an Schottky diode represents the conduction losses in the diode, while the diode capacitance (CT or CD) represents the switching losses. For diode selection, both forward voltage drop and diode capacitance need to be considered. In addition, the rating of selected Schottky diode should be able to handle the output voltage and the maximum peak diode current.

Capacitor Selection

The small size of ceramic capacitors makes them ideal for AIC3631 applications. When choosing the input and

output ceramic capacitors, low ESR/ESL X5R and X7R types are recommended because they retain their capacitance over wider ranges of voltage and temperature than other types. A $1\mu\text{F}$ input capacitor and a $1\mu\text{F}$ output capacitor are sufficient for most applications. The SW pin is suggested to connect a $4.7\mu\text{F}$ or greater bypass capacitor. A 10pF feed-forward capacitor connected between output and FB pin is recommended, it can improve stability for most applications.

PCB Layout Guidance

This is a considerably high frequency for DC-DC converters. PCB layout is important to guarantee satisfactory performance. It is recommended to make traces of the power loop, especially where the switching node is involved, as short and wide as possible. First of all, the inductor, input and output capacitor should be as close to the device as possible. Feedback and shutdown circuits should avoid the proximity of large AC signals involving the power inductor and switching node.

APPLICATION EXAMPLE

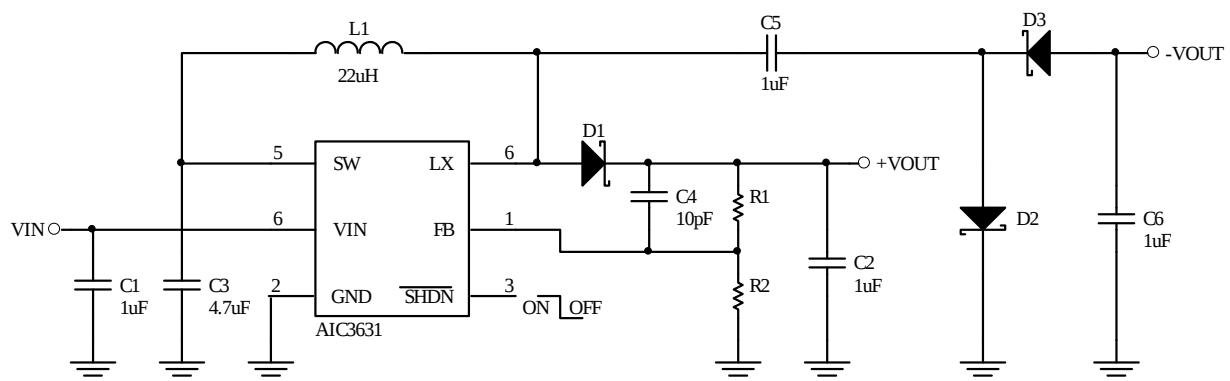
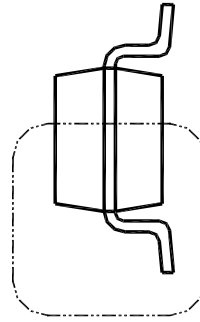
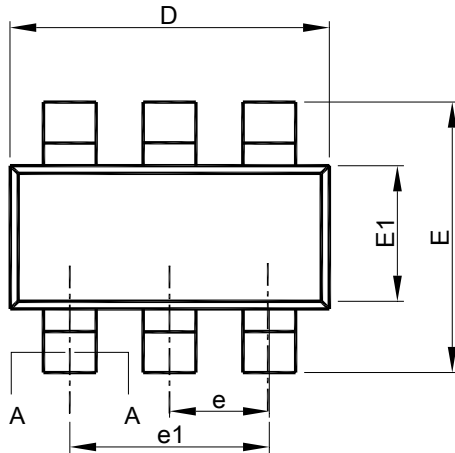


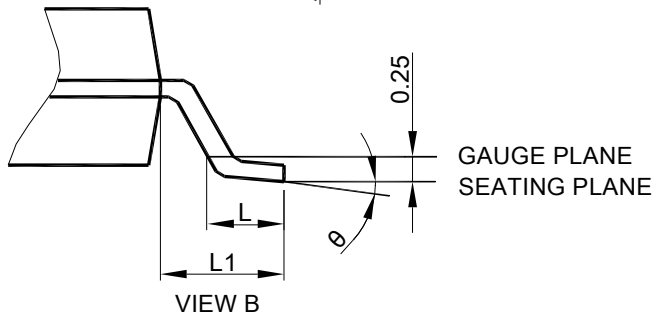
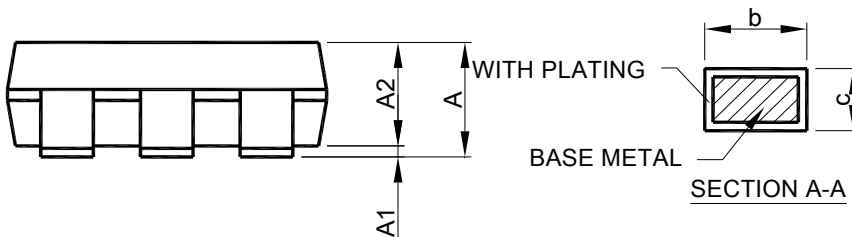
Fig. 10 Dual Output Application

■ PHYSICAL DIMENSIONS (unit: mm)

● SOT-23-6



SEE VIEW B



Note : 1. Refer to JEDEC MO-178AB.

2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.
3. Dimension "E1" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

SYMBOL	SOT-23-6	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

Note:

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