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Universal Input, Fixed Output 15V DC-to-DC Converter

IR 2100A
IR 2100K
IR 2101A
IR 2101K

General Description

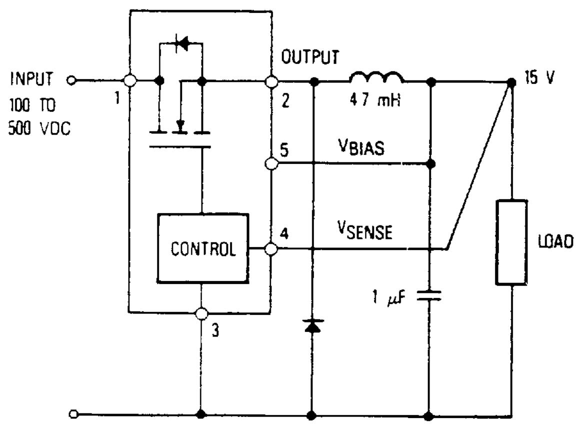
The IR2100 family of power integrated circuits allows the circuit designer to implement a bias supply or a small power supply with the simple addition of three components. The wide range of input voltages, the compact and inexpensive package as well as its performance enhance the appeal of this solution with respect to the various alternatives presently used.

The key to the device's features is a novel high voltage junction isolation power BI-MOS technology. The high blocking voltage capability was achieved with two dimensional charge control on the switching device. This results in a high quality, reliable and thermally stable structure.

Typical fields of application include switchmode power supplies, motor controllers, uninterruptible power systems, office machines, industrial controls, home appliances, battery chargers.

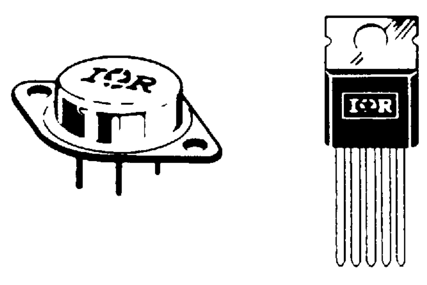
Features

- Wide Range of input voltages: 100V to 500V
- High Frequency: 125 kHz
- Only three external components needed
- ±1V line and load regulation
- Input "feedforward" for improved regulation
- Thermal protection with hysteresis
- Undervoltage lockout
- Wide bandwidth: 5 kHz
- Remote output sense
- Efficiency: 70% at 160 V, .15A
- Compact and economical package
- Grounded tab simplifies mounting and reduces radiated noise
- Low selfbias current (8 mA)



4 PIN TO-3
Similar to
TO-204AA

5 PIN TO-220
Similar to
TO-220



For dimensions refer to page J-20

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Absolute Maximum Ratings

	Parameter	IR2100	IR2101	Units
V_{in}	Supply Voltage Pin 1 to Pin 3	500	250	V
V_S, V_B	Sense and Bias Terminals Pins 4, 5, to Pin 3	20		V
I_{om}	Output Current (Peak) Pin 2	1		A
I_o	Output Current (Continuous) Pin 2	0.5		A
P_D	Maximum Power Dissipation Entire Package @ T_C = 25°C	10		W
	Operating Temperature Range (1)	−55 to 150		°C
	Storage Temperature Range	−55 to 150		°C
	Lead Temperature 0.063 in. (1.6 mm) from case	300 (10 seconds max)		°C

(1) Limited by thermal protection

Electrical Characteristics @ T_C = 25°C Unless Otherwise Specified. Test Circuit of Figure 1.

	Parameter	Type	Min.	Typ	Max.	Units	Test Conditions
V_{in}	Input Operating Voltage	IR2100	100		450	V	I_o = 0.1A
		IR2101	100		250		
V_o	Output Voltage	All	14	15	16	V	I_o = 0.05A to 0.5A, 100V ≤ V_{in} ≤ V_{in} max. Test circuit Figure 1
$R_{DS(on)}$	of Switching MOSFET	All		15		Ω	I_o = 0.2A, V_{in} = 150V, T_J = 25°C
I_Q	Selfbias Current	All		8		mA	V_{in} = 150V, I_o = 0.1A, Pin 5
$\Delta V_o/\Delta T_j$	Temperature Dependence of Output Voltage	All	−3		+2	mV/°C	I_o = 0.1A, V_{in} = 150V, −55 ≤ T_J ≤ 150°C
$\Delta V_o/\Delta V_{in}$	Line Regulation	All			1	mV/V	I_o = 0.1A, 100V ≤ V_{in} ≤ V_{in} max.
$\Delta V_o/\Delta I_o$	Load Regulation	All			0.05	V/A	V_{in} = 150V, 50 ≤ I_o ≤ 500 mA
η	Efficiency	All	40	50		%	V_{in} = 350V, I_o = 0.1A, IR2100 only
			60	70			V_{in} = 200V, I_o = 0.2A
V_{OS}	Turn-on Overshoot	All			16.5	V	V_{in} = 350V, I_o = 0.1A
					16.0		V_{in} = 200V, I_o = 0.1A
	Output Ripple	All		±0.05		V	V_{in} = 200V, I_o = 0.1A
f_s	Switching Frequency		110	125	135	kHz	V_{in} = 150V, I_o = 0.1A
$\Delta f/\Delta T_J$	Temperature Dependence of Switching Frequency			−100		Hz/°C	I_o = 0.1A, V_{in} = 150V, −55 ≤ T_j ≤ 150°C
$\Delta f/\Delta V_i$	Input Voltage Dependence of Switching Frequency			5		Hz/V	I_o = 0.1A, 100V ≤ V_{in} ≤ V_{in} max.
t_{s1}	Transient Response to Load Change			100		µs	V_{in} = 150V, I_o = 0.15A, Load change = 50 mA
t_{s2}	Transient Response to Line Change			200		µs	V_{in} = 250V, I_o = 0.1A, V_{in} change = 50V
V_{LO}	Undervoltage Lockout, Turn-On		80		90	V	I_o = 0.1A
V_{LO}	Undervoltage Lockout, Turn-Off		70		80	V	I_o = 0.1A
	Ripple Rejection			50		dB	V_{in} = 150V, I_o = 0.1A, 60 to 120 Hz
T_{sc}	Overtemp. Cut-off		125		145	°C	V_{in} = 150V, I_o = 0.1A
T_{sr}	Overtemp. Reset		85		105	°C	V_{in} = 150V

Thermal Resistance

		Type	Min.	Typ	Max.	Units	
R_{thJC}	Thermal Resistance,Junction-to-Case	ALL	—	—	2.5	°C/W	
R_{thCS}	Thermal Resistance, Junction-to-Sink	IR2100A	—	0 5	—	°C/W	Mounting surface flat, smooth, and greased
		IR2101A	—	0 5	—		
		IR2100K	—	0 2	—		
		IR2101K	—	0.2	—		
R_{thJA}	Thermal Resistance, Junction-to-Ambient	IR2100A	—	—	60	°C/W	Operation in free still air
		IR2101A	—	—	60		
		IR2100K	—	—	40		
		IR2101K	—	—	40		

APPLICATIONS CONSIDERATIONS

The circuit, as shown in Figure 1 and Figure 2, implements a Buck regulator operated in the continuous current conduction mode at a frequency of 125 kHz.

The block diagram and the open loop transfer function are shown in Figure 3. The gain and phase margins for two different output currents are plotted in Figures 4 and 5. A more detailed analysis can be found in Application Note AN 974.

An isolated supply can be generated by replacing the filter inductor with a "flyback" transformer, as shown in Figure 6. The loading of the secondary inserts a step in the current waveform at its discontinuity. Consequently the amount of isolated power must be limited to a share of the total power (isolated and non isolated) to avoid discontinuous current mode of operation. The regulation of the isolated supply depends on the stray leakage inductance of the transformer. A transformer design example can be found on Table I. For more details, please refer to Application Note 974.

Figure 7 shows how to connect the Sense and Bias pins to obtain higher output voltages, within the limitations of those pins.

Figure 8 shows a simple battery charger for off-line operation.

Suggested suppliers for the filter inductor are listed in Table II.

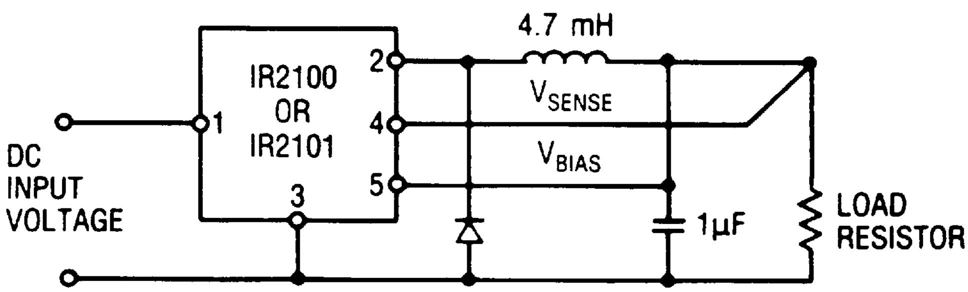

Fig. 1 — Test Circuit

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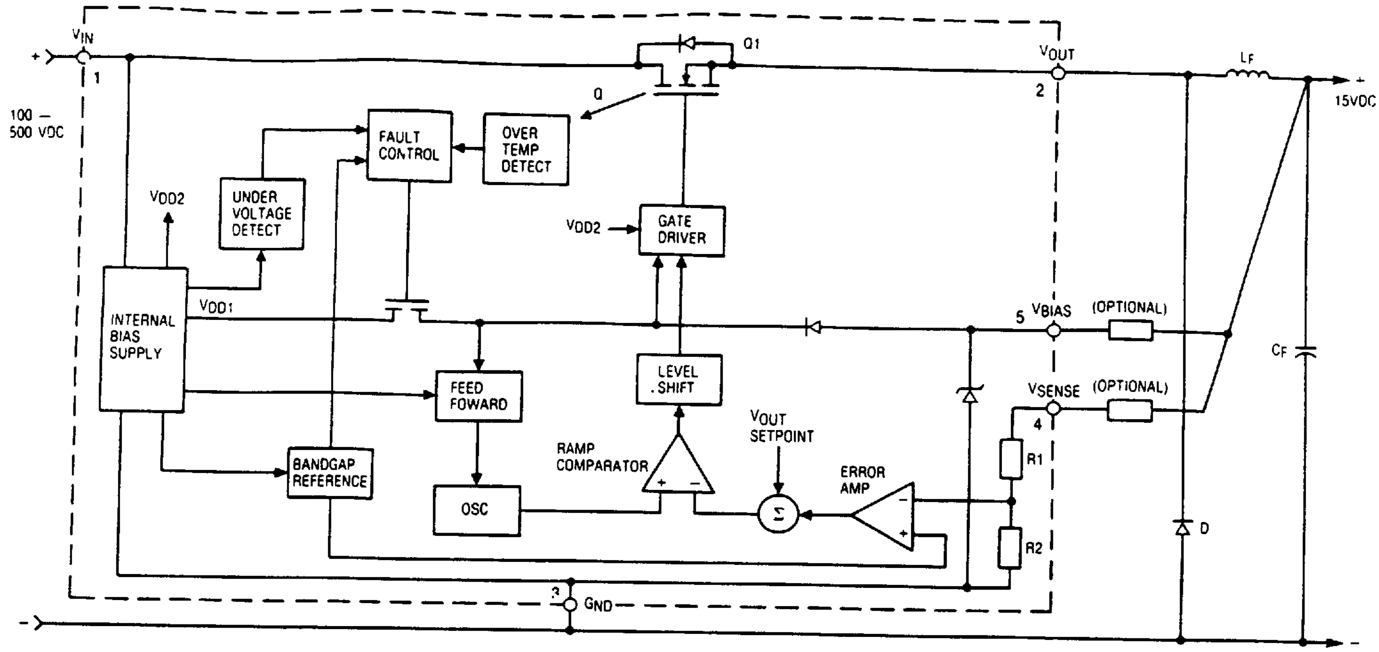
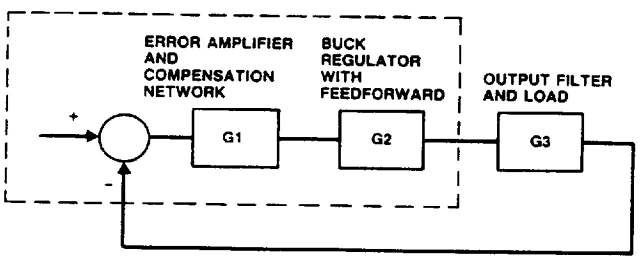


Fig. 2 — Simplified Block Diagram



$$G1 = \frac{K}{S}(1 + T_1S)(1 + T_2S) = \frac{257}{S}(1 + .12 \cdot 10^{-3}\,S)(1 + .06 \cdot 10^{-3}\,S)$$

$$G2 = 62.5$$

$$G3 = \frac{1}{1 + S\frac{L}{R} + S^2 LC}$$

FOR $L = 4.7\,mH$, $C = 1\,\mu F$

$$G3 = \frac{1}{1 + \frac{34.3}{R}S + S^2\, 4.7 \cdot 10^{-9}}$$

Fig. 3 — Block Diagram and Transfer Function

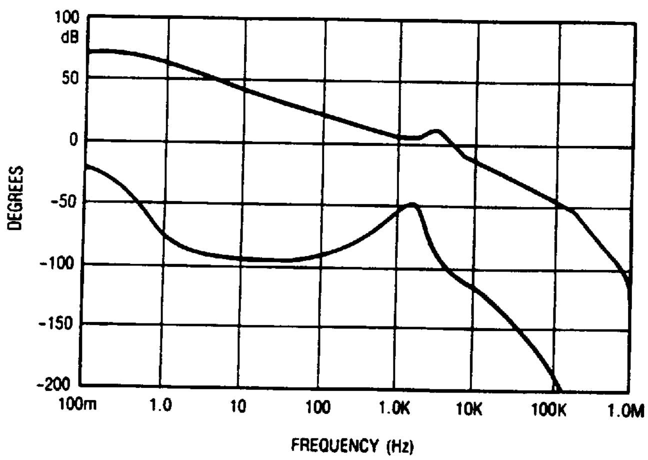


Fig. 4 — Open Loop Frequency Response 0.1A Load

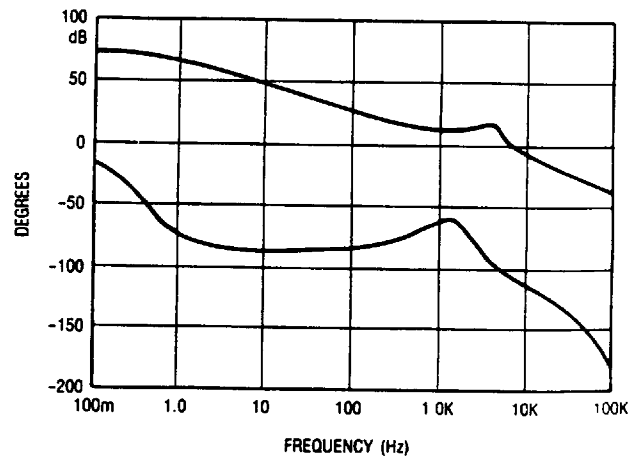


Fig. 5 — Open Loop Frequency Response 0.25A Load

Table I. Transformer Design Example

For a 5V isolated supply:
- Core: Ferroxcube 1811 PA 160-3B7
- Bobbin: Ferroxcube 1811 F1D
- Primary: 140 turns of #32 HPT (self leads)
- Secondary: 50 turns of #32 HPT (self leads)
- Insulation between primary and secondary: 0.005″ Mylar adhesive tape

Different turns ratio would of course, give different secondary voltages. For a 4.7 mH (± 10%) primary inductance the number of primary turns should not be changed.

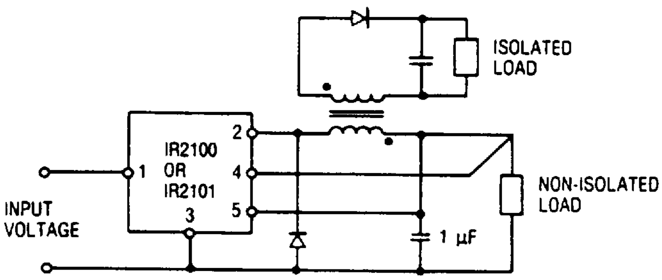


Fig. 6 — Isolated and Non-Isolated Supply

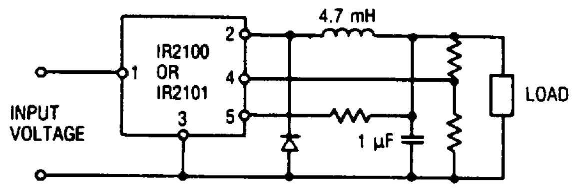


Fig. 7 — Circuit Configuration for Higher Output Voltages

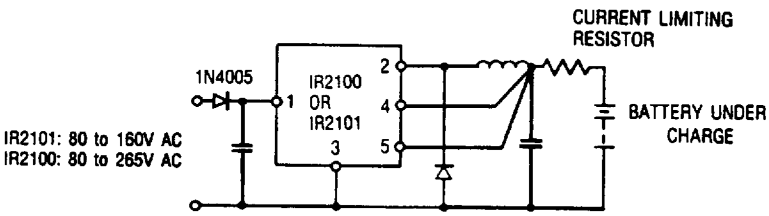
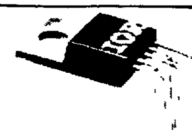


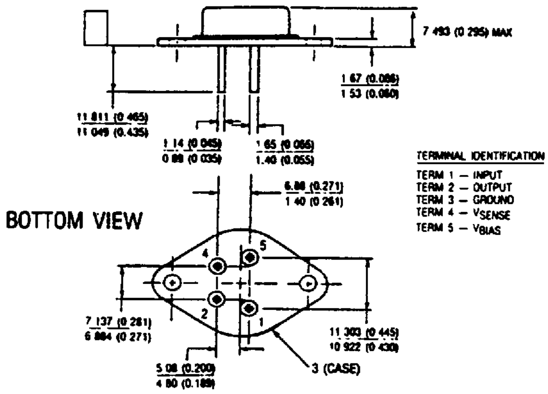
Fig. 8 — Battery Charger for Off-Line Operation

Table II. Complementary Components

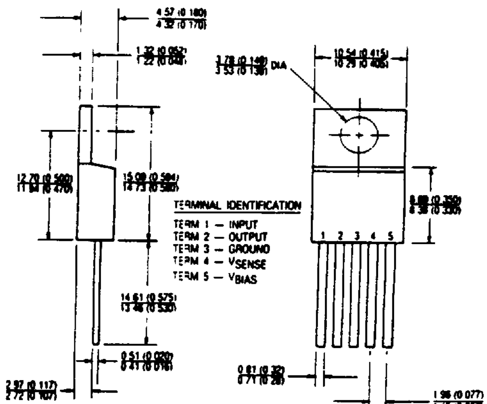
Component	Supplier	Part #
Diode	IR	10KF6
Capacitor	TBA	TBA
Inductor	TBA	TBA
Transformer	TBA	TBA

Table III: Ordering Information

Part Number	Voltage	Package	Photo
IR2100A	500V	5-leaded TO-220	
IR2101A	250V		
IR2100A-007	500V	5-leaded TO-220 Leadform Option -007	
IR2101A-007	250V		
IR2100A-008	500V	5-leaded TO-220 Leadform Option -008	
IR2101A-008	250V		
IR2100K	500V	4-leaded TO-3	
IR2101K	250V		



4 PIN TO-3



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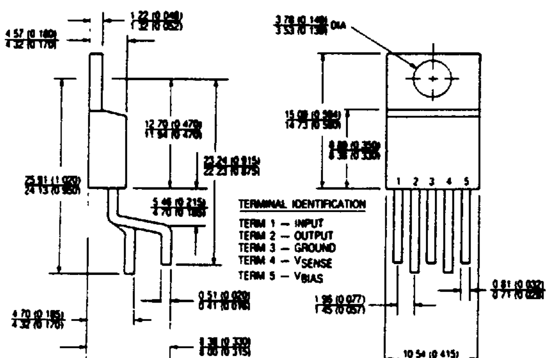

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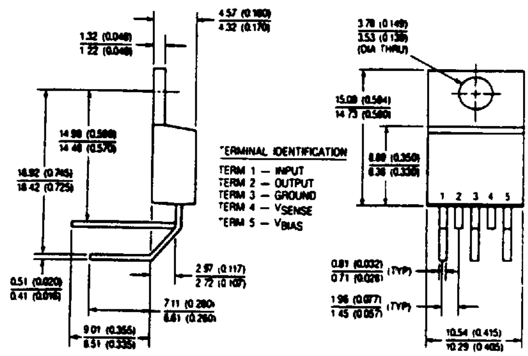

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