

INTELLIGENT HIGH SIDE MOSFET POWER SWITCH

Features

- PWM Current Limit for Short Circuit Protection
- Over-Temperature Protection
- Active Output Negative Clamp
- Reverse Battery Protection
- Broken Ground Protection
- Short to VCC Protection
- Low Noise Charge Pump
- Sleep Mode Supply Current
- 4kV ESD Protection On All Pins
- Logic Ground Isolated From Power Ground

General Description:

The IR6224 is a 5 terminal monolithic HIGH SIDE SWITCH with built in short circuit, over-temperature, ESD, inductive load turn off capability and diagnostic feedback.

The on-chip protection circuit goes into PWM mode, limiting the average current during short circuit if the drain current exceeds 5A. The protection circuit latches off the high side switch if the junction temperature exceeds 170°C and latches on after the junction temperature falls by 10°C. The drain to source voltage is actively clamped at 55V, improving its performance during turn off with inductive loads.

The on-chip charge pump high side driver stage is floating and referenced to the source of the power MOSFET. Thus the logic to power ground isolation can be as high as 50V. This allows operation with larger offset as well as controlling the switch during load energy recirculation or regeneration.

A diagnostic pin is provided for status feedback of short circuit, over temperature and open load detection.

| | |
|--------------|--------|
| $V_{CC(OP)}$ | 5v-50v |
| $R_{ds(on)}$ | 100mΩ |
| I_{lim} | 20A |
| $T_{j(sd)}$ | 170°C |
| E_{av} | 200mJ |

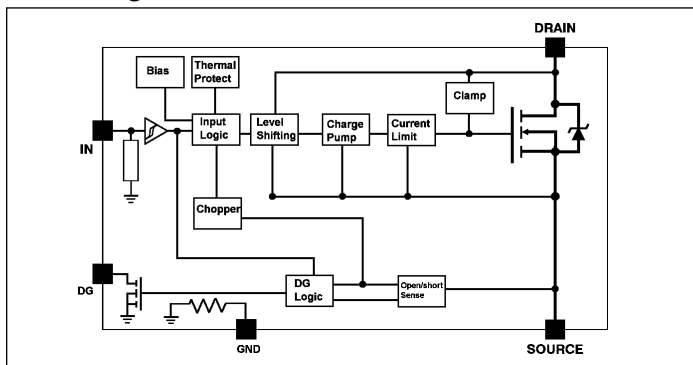
Applications

- Solenoid Driver
- DC Motor Driver

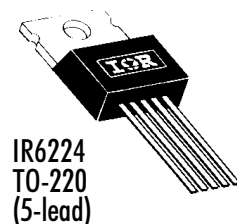
Truth Table

| Condition | In | Out | Dg |
|------------------|----|------------------|----|
| Normal | H | H | H |
| Normal | L | L | L |
| Output Open | H | H | H |
| Output Open | L | H | H |
| Shorted Output | H | Current-Limiting | L |
| Shorted Output | L | L | L |
| Over-Temperature | H | L | L |
| Over-Temperature | L | L | L |

Block Diagram



Available Packages



IR6224
TO-220
(5-lead)

Absolute Maximum Ratings

Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur. ($T_c = 25^\circ\text{C}$ unless otherwise specified.)

| | | | Minimum | Maximum | Units | Test Conditions |
|--------------|--|-----------|---------------|----------------|------------------|--|
| V_{cc} | Supply Voltage | Permanent | -0.3 | 50 | V | Pin 3 to Pin 1 (1), for 10 seconds |
| | | Reverse | -16 | — | | |
| V_{offset} | Logic to Power Ground Offset | | $V_{cc} - 50$ | $V_{cc} + 0.3$ | | |
| V_{in} | Input Voltage | | -0.3 | 30 | | |
| I_{in} | Input Current | | — | 10 | mA | |
| V_{out} | Output Voltage | | $V_{cc} - 50$ | $V_{cc} + 0.3$ | V | |
| I_{out} | Output Current | | Self-limited | | | |
| V_{dg} | Diagnostic Output Voltage | | -0.3 | 30 | V | |
| I_{dg} | Diagnostic Output Current | | — | 10 | mA | |
| E_{av} | Repetitive Avalanche Energy | | — | 200 | mJ | $I = 2\text{A}$ (2) |
| ESD1 | Electrostatic Discharge (Human Body Model) | | — | 4000 | V | $C = 100\text{ pF}$, $R = 1500\Omega$ |
| ESD2 | Electrostatic Discharge (Machine Model) | | — | 1000 | V | $C = 200\text{ pF}$, $R = 0\Omega$ |
| PD | Power Dissipation | | — | 28 | W | $T_{case} = 25^\circ\text{C}$ |
| T_{JOP} | Operating Junction Temperature Range | | -40 | Self-limited | | |
| T_{Stg} | Storage Temperature Range | | -40 | 175 | $^\circ\text{C}$ | |
| T_L | Lead Temperature (Soldering, 10 seconds) | | — | 300 | | |

NOTES: (1) with 15k Ω resistors in input and diagnostic

(2) maximum frequency depends on heatsink (rectangular waveform)

Static Electrical Characteristics

($T_c = 25^\circ\text{C}$ unless otherwise specified.)

| | | Minimum | Typical | Maximum | Units | Test Conditions | |
|--------------|-------------------------------------|---------|---------|---------|-------|--|--|
| V_{ccop} | Operating Voltage Range | | 5 | — | 50 | V | |
| I_{ccoff} | Sleep Mode Supply Current | | — | 40 | — | μA $V_{cc} = 24\text{V}$, $V_{in} = 0\text{V}$ | |
| I_{ccon} | Supply Current (Average) | | — | 3 | — | mA $V_{in} = 5\text{V}$ | |
| I_{ccac} | Supply Current (AC RMS) | | — | 20 | — | μA $V_{in} = 5\text{V}$ | |
| V_{ih} | High Level Input Threshold Voltage | | — | 2 | 2.5 | V | |
| V_{il} | Low Level Input Threshold Voltage | | 1 | 1.8 | — | | |
| I_{ion} | On-State Input Current | | 10 | — | 70 | μA | |
| I_{loff} | Off-State Input Current | | 1 | — | 30 | | $V_{in} = 3.5\text{V}$ |
| I_{oh} | Output Leakage Current | | — | 20 | — | | $V_{in} = 0.4\text{V}$ |
| I_{ol} | Output Leakage Current | | 0 | — | 10 | | $V_{out} = 6\text{V}$ |
| V_{dgl} | Low Level Diagnostic Output Voltage | | — | 0.3 | — | V $I_{dg} = 1.6\text{mA}$ | |
| I_{dgh} | Diagnostic Output Leakage Current | | 0 | — | 10 | μA $V_{dg} = 5\text{V}$ | |
| $R_{DS(on)}$ | On-State Resistance | | — | 80 | 100 | $\text{m}\Omega$ | $I_{out} = 1\text{A}$ |
| | | | — | 120 | — | | $V_{cc} = 5\text{V}$, $I_{out} = 1\text{A}$ |

Switching Electrical Characteristics

($V_{CC} = 14\text{V}$, Resistive Load (R_L) = 12 Ω , $T_c = 25^\circ\text{C}$.)

| | | Minimum | Typical | Maximum | Units | Test Conditions |
|---------------|----------------------------|---------|---------|---------|-------|------------------|
| t_c | Over-Current Cycle Time | | — | 5 | — | mS |
| D_c | Over-Current Duty Time | | — | 10 | — | % |
| t_{on} | Turn-On Delay Time to 90% | | — | — | 70 | μs |
| t_{off} | Turn-Off Delay Time to 10% | | — | — | 60 | |
| dv/dt_{on} | Slew Rate On | | — | 3 | — | V/ μs |
| dv/dt_{off} | Slew Rate Off | | — | 5 | — | |

Protection Characteristics

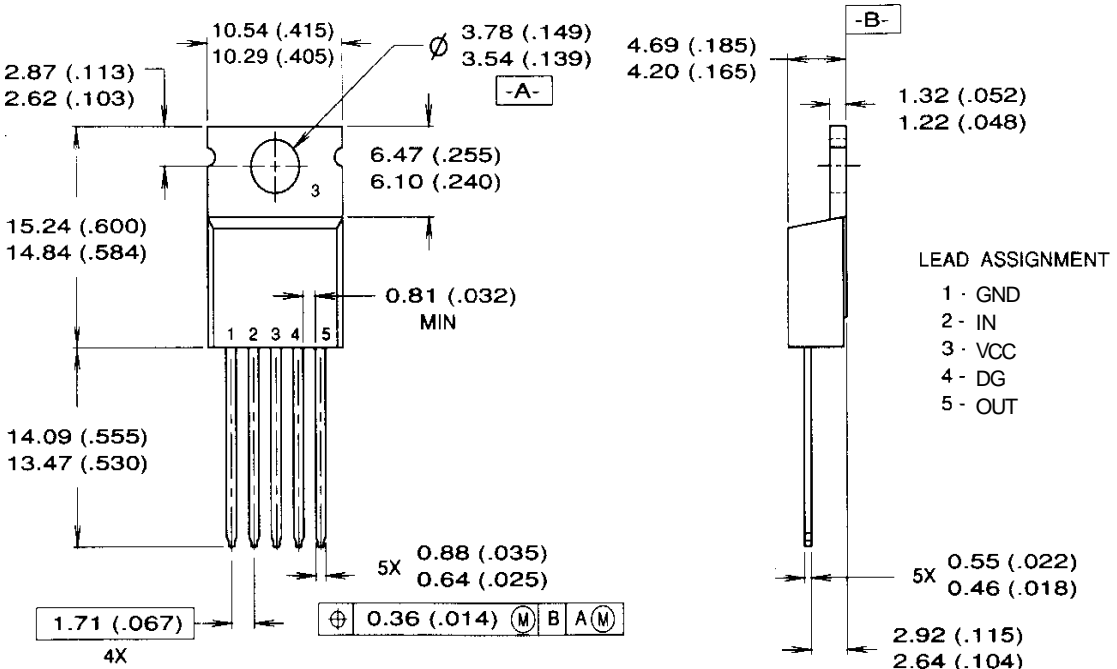
| | Minimum | Typical | Maximum | Units | Test Conditions | |
|--|---------|---------|---------|-------|-----------------|------------------|
| I_{lim} Internal Current Limit | — | 20 | — | A | | |
| V_{sc} Short Circuit Detection Voltage | — | 3.5 | — | V | | |
| V_{slh} Open Load Detection Voltage | — | 3.5 | — | | | |
| V_{cl1} Output Negative Clamp | 50 | 54 | — | | | $I_{out} = 10mA$ |
| V_{cl2} Output Negative Clamp | — | 56 | 62 | | | $I_{out} = 2A$ |

Thermal Characteristics

| | Minimum | Typical | Maximum | Units | Test Conditions |
|--|---------|---------|---------|-------|-----------------|
| T_{jcd} Thermal Shutdown Temperature | — | 170 | — | °C | |
| T_{hys} Thermal Hysteresis | — | 5 | — | | |
| R_{thjc} Thermal Resistance, Junction to Case | — | 3.5 | — | °C/W | |
| R_{thja} Thermal Resistance, Junction to Ambient | — | 50 | — | | |

IR6224

Case Outline — TO-220 (IR6224)



NOTES:

1. Dimensioning and tolerancing per ANSI Y14.5M, 1982
2. Controlling dimension: INCH
3. Dimensions shown are in millimeters (inches)
4. Heatsink and lead measurements do not include burrs.