# Anexo B: hoja de datos IR4426, IRG4PC50U.

International
IOR Rectifier

Data Sheet No. PD60177 Rev. E

## IR4426/IR4427/IR4428(S) & (PbF)

## DUAL LOW SIDE DRIVER

### Features

- Gate drive supply range from 6 to 20V
- CMOS Schmitt-triggered inputs
- Matched propagation delay for both channels
- Outputs out of phase with inputs (IR4426)
- Outputs in phase with inputs (IR4427)
- OutputA out of phase with inputA and OutputB in phase with inputB (IR4428)
- Also available LEAD-FREE

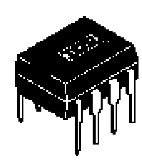
### Product Summary

| | |
|---|---|
| $I_O$+/- | 1.5A / 1.5A |
| $V_{OUT}$ | 6V - 20V |
| $t_{on/off}$ (typ.) | 85 & 65 ns |

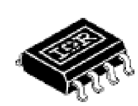
### Descriptions

The IR4426/IR4427/IR4428 (S) is a low voltage, high speed power MOSFET and IGBT driver. Proprietary latch immune CMOS technologies enable ruggedized monolithic construction. Logic inputs are compatible with standard CMOS or LSTTL outputs. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays between two channels are matched.

### Packages

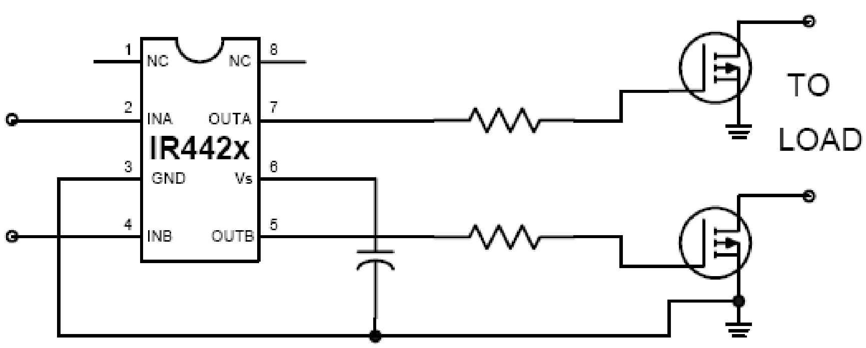


8 Lead PDIP



8 Lead SOIC

### Block Diagram



# IR4426/IR4427/IR4428(S) & (PbF)

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## Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to GND. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions.

| Symbol | Definition | | Min. | Max. | Units |
|---|---|---|---|---|---|
| $V_S$ | Fixed supply voltage | | -0.3 | 25 | V |
| $V_O$ | Output voltage | | -0.3 | $V_S$ + 0.3 | |
| $V_{IN}$ | Logic input voltage | | -0.3 | $V_S$ + 0.3 | |
| $P_D$ | Package power dissipation @ $T_A \leq +25°C$ | (8 Lead PDIP) | — | 1.0 | W |
| | | (8 lead SOIC) | — | 0.625 | |
| $Rth_{JA}$ | Thermal resistance, junction to ambient | (8 lead PDIP) | — | 125 | °C/W |
| | | (8 lead SOIC) | — | 200 | |
| $T_J$ | Junction temperature | | — | 150 | °C |
| $T_S$ | Storage temperature | | -55 | 150 | |
| $T_L$ | Lead temperature (soldering, 10 seconds) | | — | 300 | |

## Recommended Operating Conditions

The input/output logic timing diagram is shown in figure 1. For proper operation the device should be used within the recommended conditions. All voltage parameters are absolute voltages referenced to GND.

| Symbol | Definition | Min. | Max. | Units |
|---|---|---|---|---|
| $V_S$ | Fixed supply voltage | 6 | 20 | V |
| $V_O$ | Output voltage | 0 | $V_S$ | |
| $V_{IN}$ | Logic input voltage | 0 | $V_S$ | |
| $T_A$ | Ambient temperature | -40 | 125 | °C |

## DC Electrical Characteristics

$V_{BIAS}$ ($V_S$) = 15V, $T_A$ = 25°C unless otherwise specified. The $V_{IN}$, and $I_{IN}$ parameters are referenced to GND and are applicable to input leads: INA and INB. The $V_O$ and $I_O$ parameters are referenced to GND and are applicable to the output leads: OUTA and OUTB.

| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{IH}$ | Logic "0" input voltage (OUTA=LO, OUTB=LO) (IR4426)<br>Logic "1" input voltage (OUTA=HI, OUTB=HI) (IR4427)<br>Logic "0" input voltage (OUTA=LO), Logic "1" input voltage (OUTB=HI) (IR4428) | 2.7 | — | — | V | |

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# IR4426/IR4427/IR4428(S) & (PbF)

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## DC Electrical Characteristics cont.

$V_{BIAS}$ ($V_S$) = 15V, $T_A$ = 25°C unless otherwise specified. The $V_{IN}$, and $I_{IN}$ parameters are referenced to GND and are applicable to input leads: INA and INB. The $V_O$ and $I_O$ parameters are referenced to GND and are applicable to the output leads: OUTA and OUTB.

| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{IL}$ | Logic "1" input voltage (OUTA=HI, OUTB=HI) (IR4426)<br>Logic "0" input voltage (OUTA=LO, OUTB=LO) (IR4427)<br>Logic "I" input voltage (OUTA=HI), Logic "0" input voltage (OUTB=LO) (IR4428) | — | — | 0.8 | V | |
| $V_{OH}$ | High level output voltage, $V_{BIAS}$-$V_O$ | — | — | 1.2 | V | |
| $V_{OL}$ | Low level output voltage, $V_O$ | — | — | 0.1 | V | |
| $I_{IN+}$ | Logic "1" input bias current (OUT=HI) | — | 5 | 15 | μA | $V_{IN}$ = 0V (IR4426)<br>$V_{IN}$ = $V_S$ (IR4427)<br>$V_{INA}$ = 0V (IR4428)<br>$V_{INB}$ = $V_S$ (IR4428) |
| $I_{IN-}$ | Logic "0" input bias current (OUT=LO) | — | -10 | -30 | μA | $V_{IN}$ = $V_S$ (IR4426)<br>$V_{IN}$ = 0V (IR4427)<br>$V_{INA}$ = $V_S$ (IR4428)<br>$V_{INB}$ = 0V (IR4428) |
| $I_{QS}$ | Quiescent Vs supply current | — | 100 | 200 | μA | $V_{IN}$ = 0V or $V_S$ |
| $I_{O+}$ | Output high short circuit pulsed current | 1.5 | 2.3 | — | A | $V_O$ = 0V, $V_{IN}$ = 0 (IR4426)<br>$V_O$ = 0V, $V_{IN}$ = $V_S$ (IR4427)<br>$V_O$ = 0V, $V_{INA}$ = 0 (IR4428)<br>$V_O$ = 0V, $V_{INB}$ = $V_S$ (IR4428)<br>PW ≤ 10 μs |
| $I_{O-}$ | Output low short circuit pulsed current | 1.5 | 3.3 | — | A | $V_O$ = 15V, $V_{IN}$ = $V_S$ (IR4426)<br>$V_O$ = 15V, $V_{IN}$ = 0 (IR4427)<br>$V_O$ = 15V, $V_{INA}$ = $V_S$ (IR4428)<br>$V_O$ = 15V, $V_{INB}$ = 0 (IR4428)<br>PW ≤ 10 μs |

# IR4426/IR4427/IR4428(S) & (PbF)

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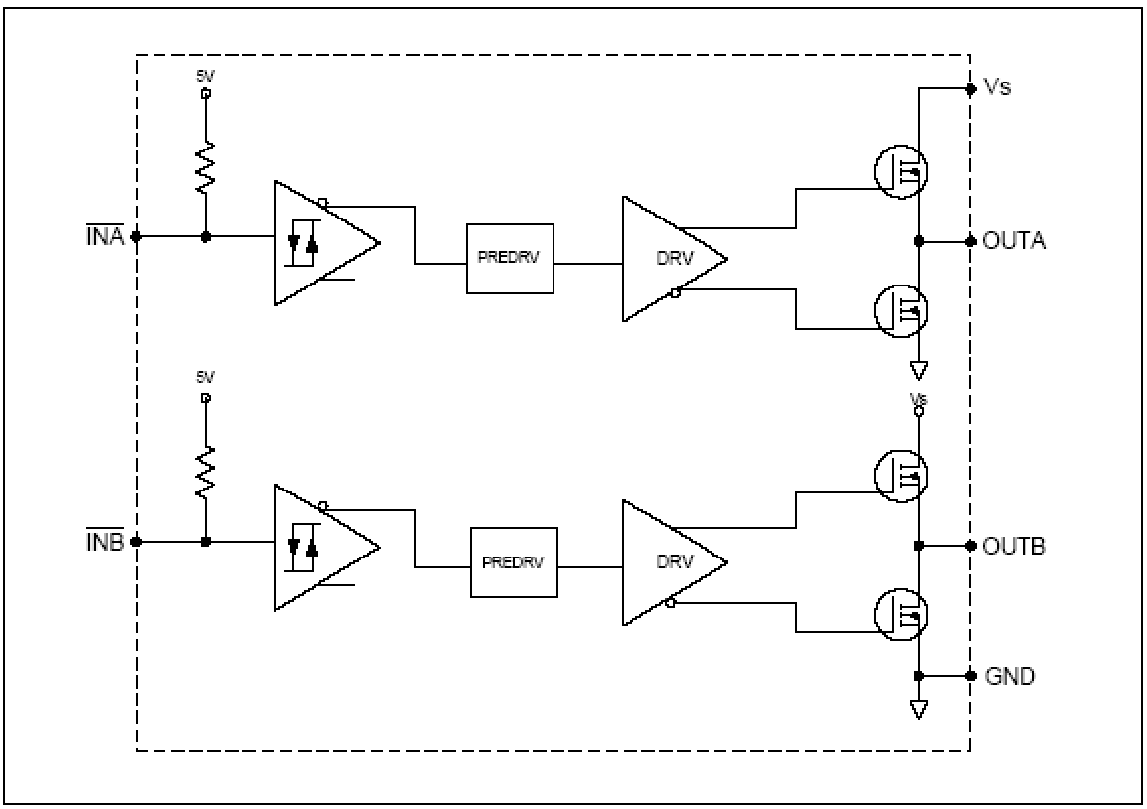
## AC Electrical Characteristics

$V_{BIAS}$ ($V_S$) = 15V, CL = 1000pF, $T_A$ = 25°C unless otherwise specified.

| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| **Propagation delay characteristics** | | | | | | |
| $t_{d1}$ | Turn-on propagation delay | — | 85 | 160 | ns | figure 4 |
| $t_{d2}$ | Turn-off propagation delay | — | 65 | 150 | | |
| $t_r$ | Turn-on rise time | — | 15 | 35 | | |
| $t_f$ | Turn-off fall time | — | 10 | 25 | | |

## Functional Block Diagram IR4426



# IR4426/IR4427/IR4428(S) & (PbF)

ADVANCE INFORMATION

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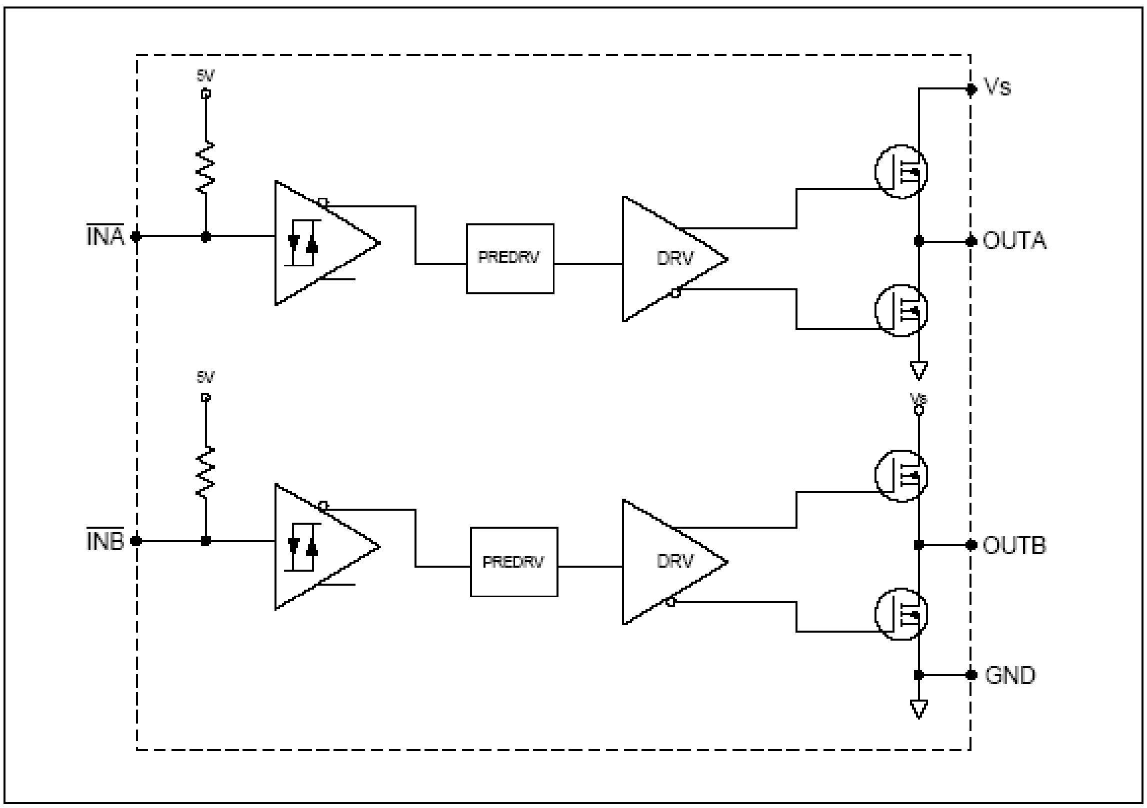
## AC Electrical Characteristics

$V_{BIAS}$ ($V_S$) = 15V, CL = 1000pF, $T_A$ = 25°C unless otherwise specified.

| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| **Propagation delay characteristics** | | | | | | |
| $t_{d1}$ | Turn-on propagation delay | — | 85 | 160 | ns | figure 4 |
| $t_{d2}$ | Turn-off propagation delay | — | 65 | 150 | | |
| $t_r$ | Turn-on rise time | — | 15 | 35 | | |
| $t_f$ | Turn-off fall time | — | 10 | 25 | | |

## Functional Block Diagram IR4426



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# IR4426/IR4427/IR4428(S) & (PbF)

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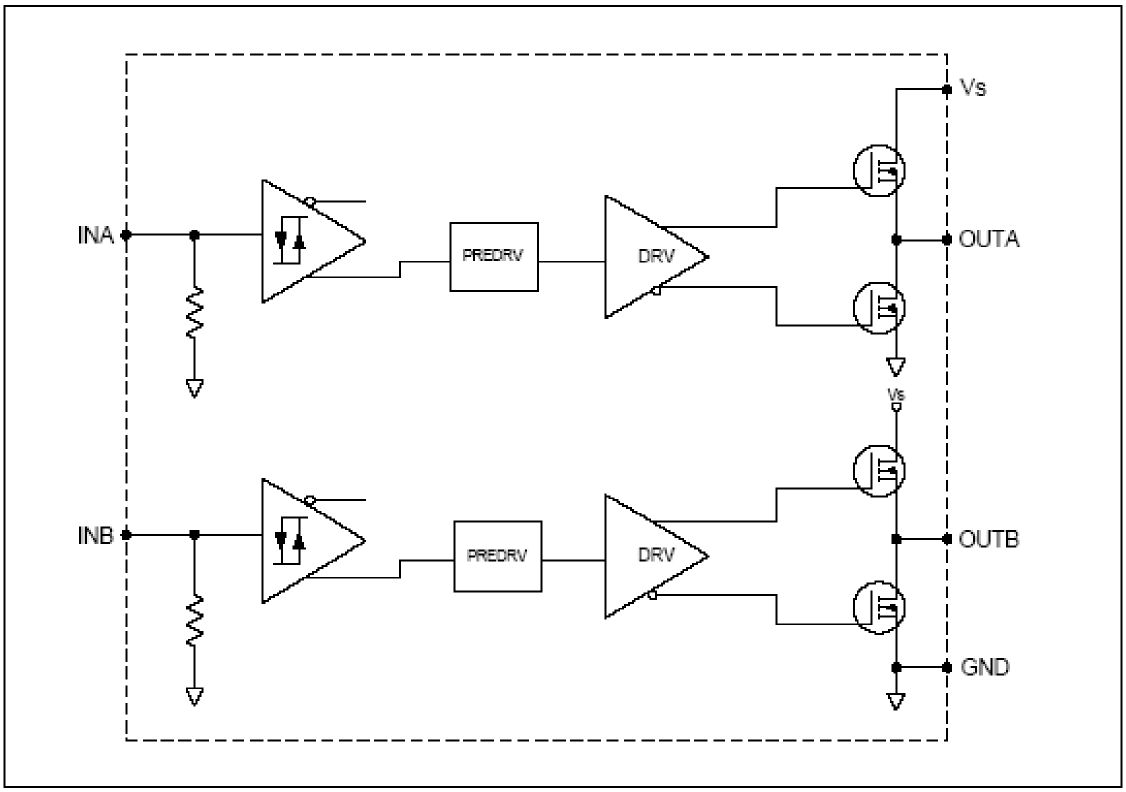
## Functional Block Diagram IR4427



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PD 91470F

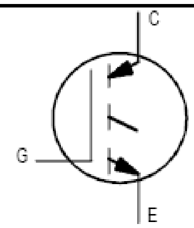
# IRG4PC50U

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT

## Features

- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-247AC package




n-channel

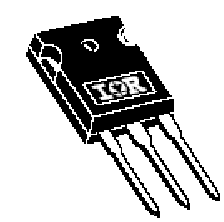
$V_{CES} = 600V$

$V_{CE(on)\,typ.} = 1.65V$

$@V_{GE} = 15V, I_C = 27A$

## Benefits

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBT's



TO-247AC

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 55 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 27 | |
| $I_{CM}$ | Pulsed Collector Current ① | 220 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 220 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ± 20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 20 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 200 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 78 | |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to + 150 | °C |
| | Soldering Temperature, for 10 seconds | 300 (0.063 in. (1.6mm from case ) | |
| | Mounting torque, 6-32 or M3 screw. | 10 lbf•in (1.1N•m) | |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | ---- | 0.64 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.24 | ---- | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | ---- | 40 | |
| Wt | Weight | 6 (0.21) | ---- | g (oz) |

# IRG4PC50U

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## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | ---- | ---- | V | $V_{GE}$ = 0V, $I_C$ = 250µA |
| $V_{(BR)ECS}$ | Emitter-to-Collector Breakdown Voltage ④ | 18 | ---- | ---- | V | $V_{GE}$ = 0V, $I_C$ = 1.0A |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | ---- | 0.60 | ---- | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0mA |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | ---- | 1.65 | 2.0 | V | $I_C$ = 27A, $V_{GE}$ = 15V |
| | | ---- | 2.0 | ---- | | $I_C$ = 55A, See Fig.2, 5 |
| | | ---- | 1.6 | ---- | | $I_C$ = 27A , $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | ---- | 6.0 | | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | ---- | -13 | ---- | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $g_{fe}$ | Forward Transconductance ⑤ | 16 | 24 | ---- | S | $V_{CE}$ ≥ 15V, $I_C$ = 27A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | ---- | ---- | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | ---- | ---- | 2.0 | | $V_{GE}$ = 0V, $V_{CE}$ = 10V, $T_J$ = 25°C |
| | | ---- | ---- | 5000 | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | ---- | ---- | ±100 | nA | $V_{GE}$ = ±20V |

## Switching Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge (turn-on) | ---- | 180 | 270 | nC | $I_C$ = 27A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | ---- | 25 | 38 | | $V_{CC}$ = 400V See Fig. 8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | ---- | 61 | 90 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | ---- | 32 | ---- | ns | $T_J$ = 25°C |
| $t_r$ | Rise Time | ---- | 20 | ---- | | $I_C$ = 27A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | ---- | 170 | 260 | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $t_f$ | Fall Time | ---- | 88 | 130 | | Energy losses include "tail" |
| $E_{on}$ | Turn-On Switching Loss | ---- | 0.12 | ---- | mJ | See Fig. 10, 11, 13, 14 |
| $E_{off}$ | Turn-Off Switching Loss | ---- | 0.54 | ---- | | |
| $E_{ts}$ | Total Switching Loss | ---- | 0.66 | 0.9 | | |
| $t_{d(on)}$ | Turn-On Delay Time | ---- | 31 | ---- | ns | $T_J$ = 150°C, |
| $t_r$ | Rise Time | ---- | 23 | ---- | | $I_C$ = 27A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | ---- | 230 | ---- | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $t_f$ | Fall Time | ---- | 120 | ---- | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | ---- | 1.6 | ---- | mJ | See Fig. 13, 14 |
| $L_E$ | Internal Emitter Inductance | ---- | 13 | ---- | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | ---- | 4000 | ---- | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | ---- | 250 | ---- | | $V_{CC}$ = 30V See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | ---- | 52 | ---- | | $f$ = 1.0MHz |

**Notes:**

① Repetitive rating; $V_{GE}$ = 20V, pulse width limited by max. junction temperature. ( See fig. 13b )

② $V_{CC}$ = 80%($V_{CES}$), $V_{GE}$ = 20V, L = 10µH, $R_G$ = 5.0Ω, (See fig. 13a)

③ Repetitive rating; pulse width limited by maximum junction temperature.

④ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

⑤ Pulse width 5.0µs, single shot.

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# IRG4PC50U

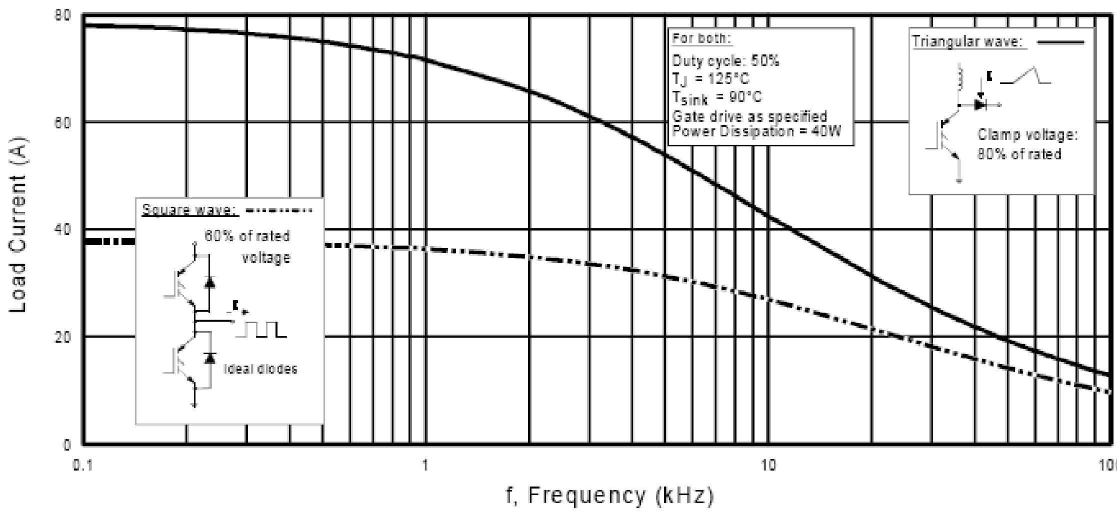


**Fig. 1** - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

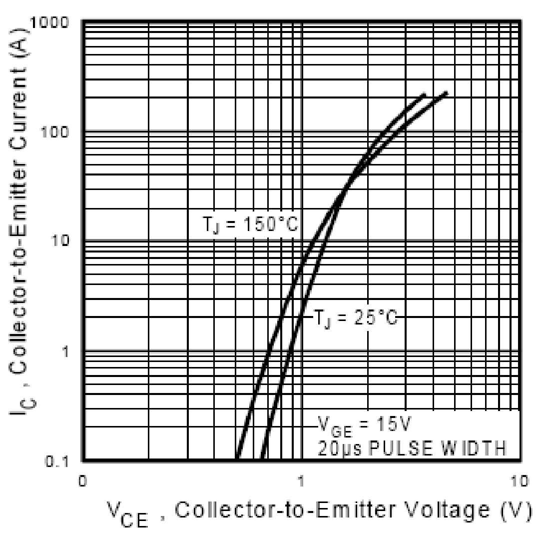


**Fig. 2** - Typical Output Characteristics

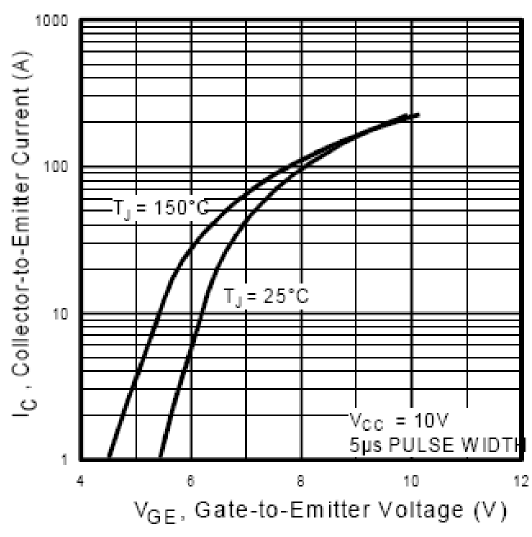


**Fig. 3** - Typical Transfer Characteristics

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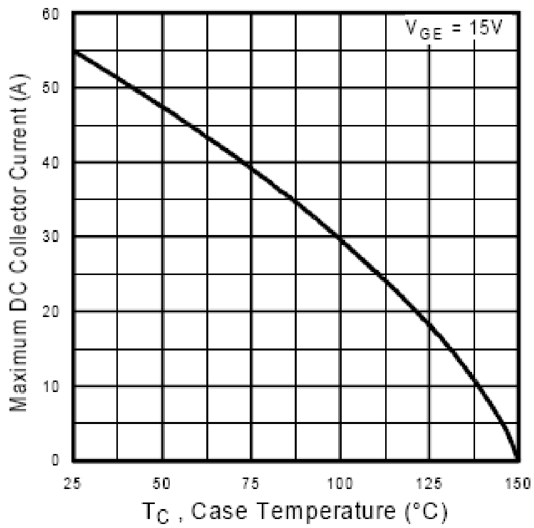


**Fig. 4** - Maximum Collector Current vs. Case Temperature

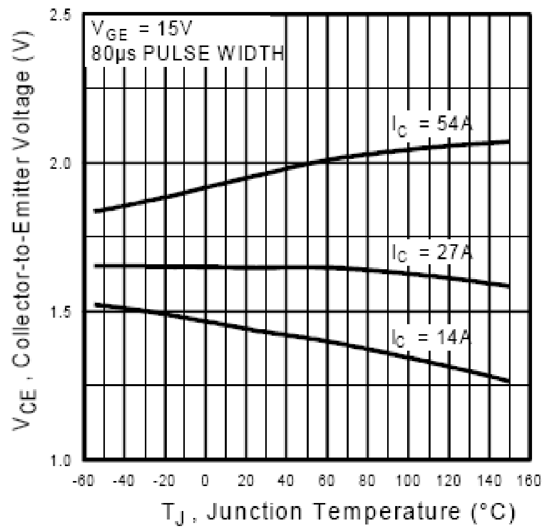


**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature

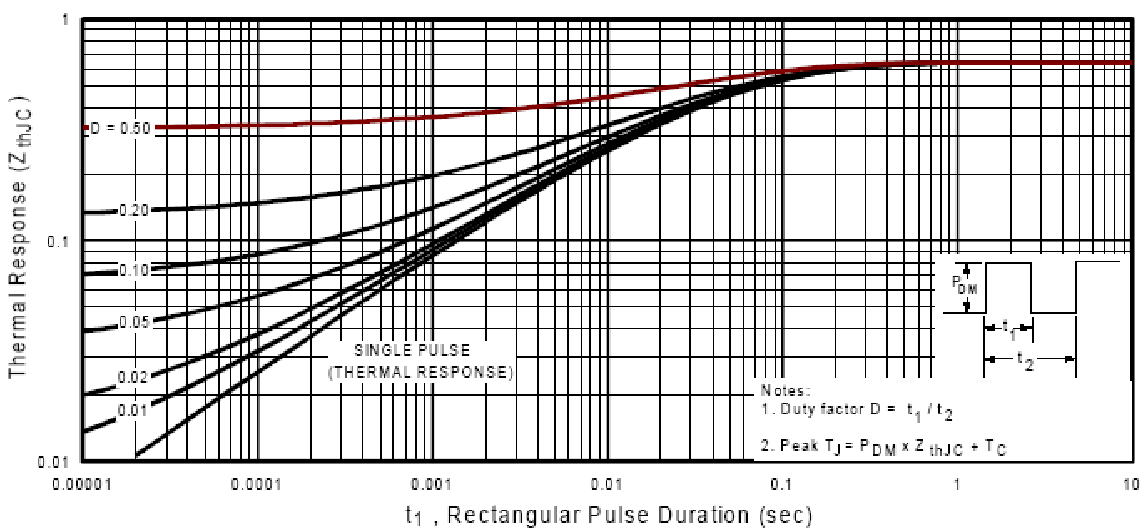


**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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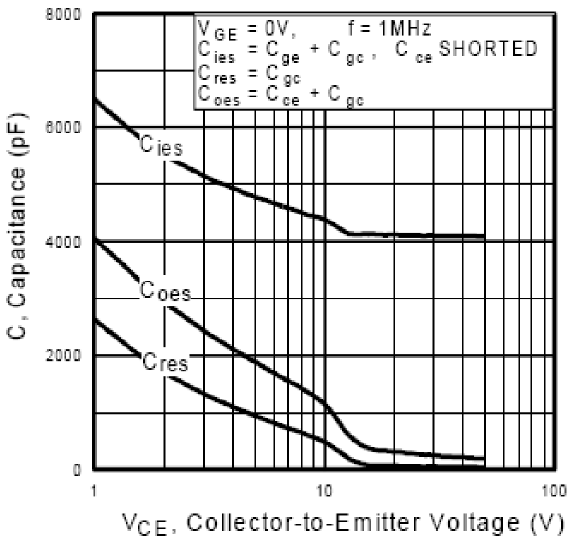


**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

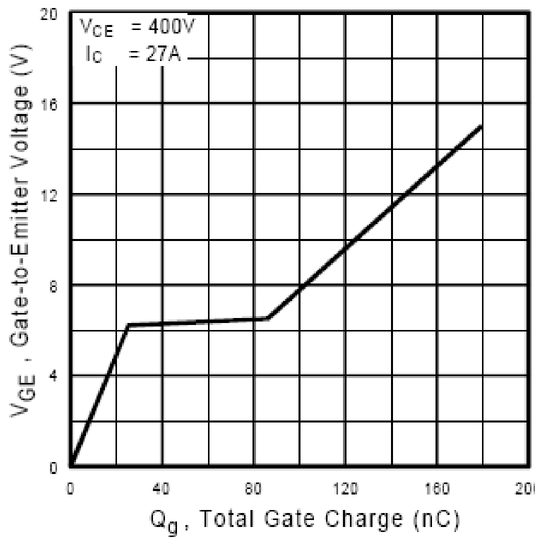


**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

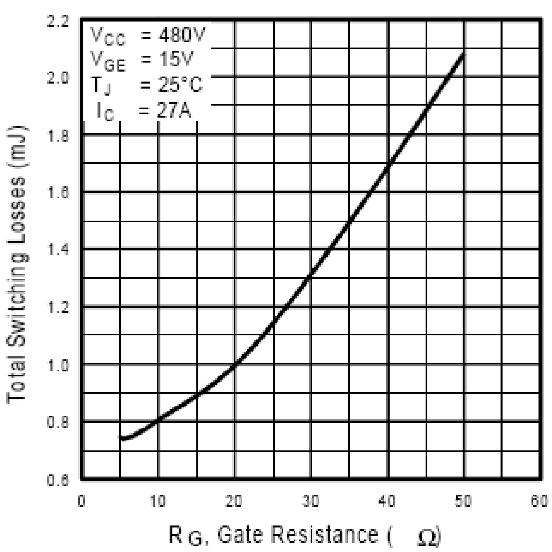


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

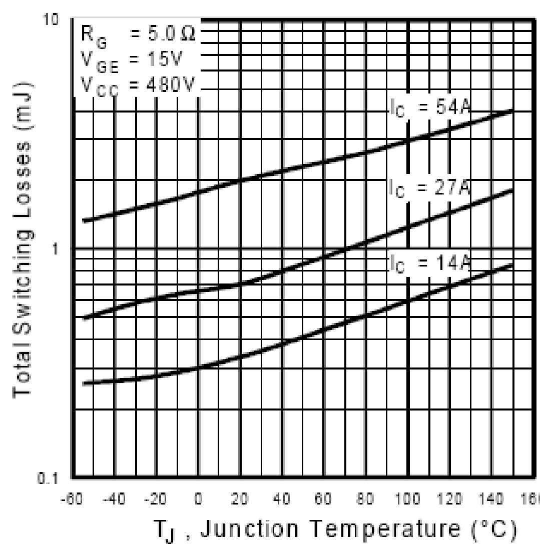


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

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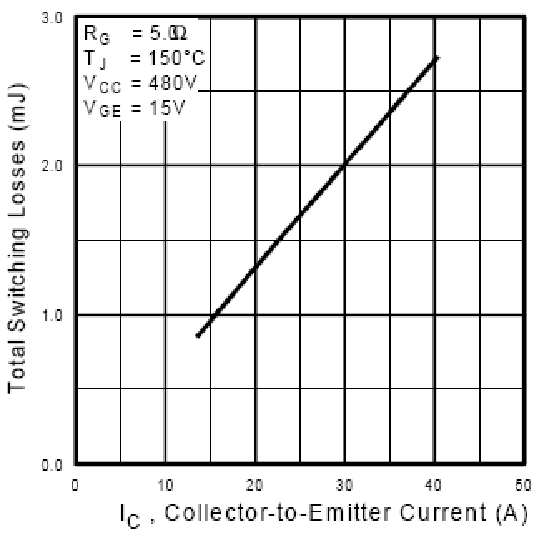


**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

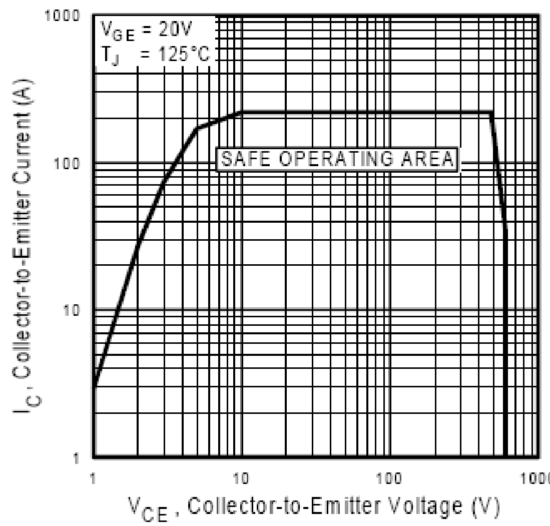


**Fig. 12** - Turn-Off SOA

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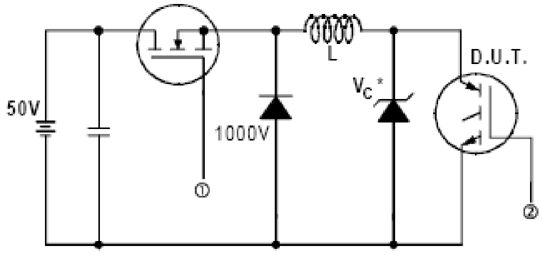


* Driver same type as D.U.T.; Vc = 80% of Vce(max)
* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated Id.

**Fig. 13a** - Clamped Inductive Load Test Circuit

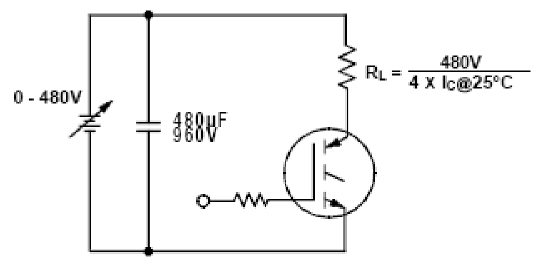


**Fig. 13b** - Pulsed Collector Current Test Circuit

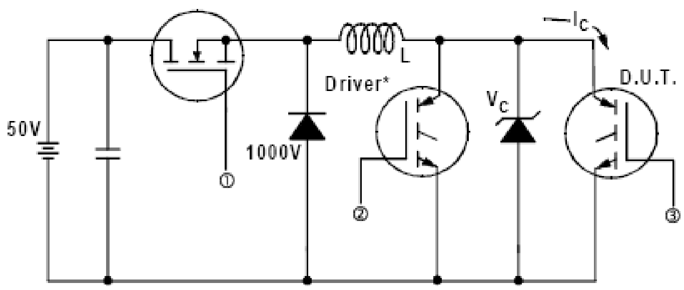


**Fig. 14a** - Switching Loss Test Circuit

* Driver same type as D.U.T., VC = 480V

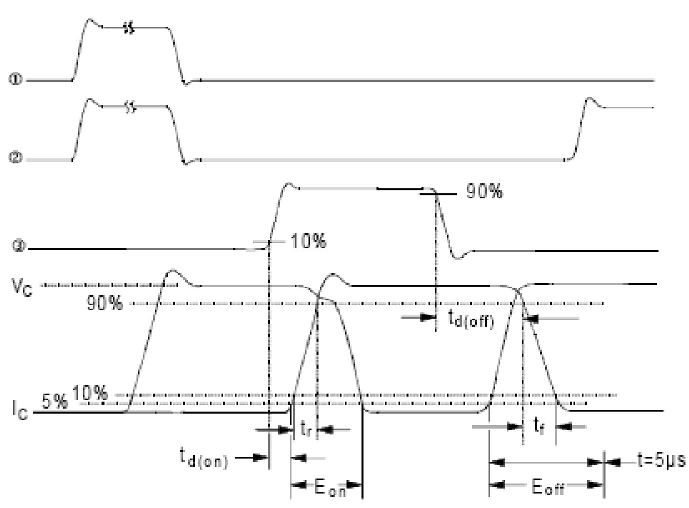


**Fig. 14b** - Switching Loss Waveforms