International
IOR Rectifier

PD - 95535

**SMPS MOSFET**

# IRFB23N15DPbF
# IRFS23N15DPbF
# IRFSL23N15DPbF

HEXFET® Power MOSFET

### Applications

- High frequency DC-DC converters
- Lead-Free

| $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|
| 150V | 0.090Ω | 23A |

### Benefits

- Low Gate-to-Drain Charge to Reduce Switching Losses
- Fully Characterized Capacitance Including Effective $C_{OSS}$ to Simplify Design, (See App. Note AN1001)
- Fully Characterized Avalanche Voltage and Current

TO-220AB IRFB23N15D | $D^2$Pak IRFS23N15D | TO-262 IRFSL23N15D

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 23 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V | 17 | |
| $I_{DM}$ | Pulsed Drain Current ① | 92 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ⑦ | 3.8 | W |
| $P_D$ @$T_C$ = 25°C | Power Dissipation | 136 | |
| | Linear Derating Factor | 0.9 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 30 | V |
| dv/dt | Peak Diode Recovery dv/dt ③ | 4.1 | V/ns |
| $T_J$ | Operating Junction and | -55 to + 175 | °C |
| $T_{STG}$ | Storage Temperature Range | | |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case ) | |
| | Mounting torqe, 6-32 or M3 screw⑥ | 10 lbf•in (1.1N•m) | |

### Typical SMPS Topologies

- Telecom 48V input DC-DC Active Clamp Reset Forward Converter

Notes ① through ⑦ are on page 11

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 150 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.18 | — | V/°C | Reference to 25°C, $I_D$ = 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.090 | Ω | $V_{GS}$ = 10V, $I_D$ = 14A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | — | 5.5 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 25 | µA | $V_{DS}$ = 150V, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 120V, $V_{GS}$ = 0V, $T_J$ = 150°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$ = 30V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS}$ = -30V |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $g_{fs}$ | Forward Transconductance | 11 | — | — | S | $V_{DS}$ = 25V, $I_D$ = 14A |
| $Q_g$ | Total Gate Charge | — | 37 | 56 | nC | $I_D$ = 14A |
| $Q_{gs}$ | Gate-to-Source Charge | — | 9.6 | 14 | | $V_{DS}$ = 120V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | 19 | 29 | | $V_{GS}$ = 10V, ④ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 10 | — | ns | $V_{DD}$ = 75V |
| $t_r$ | Rise Time | — | 32 | — | | $I_D$ = 14A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 18 | — | | $R_G$ = 5.1Ω |
| $t_f$ | Fall Time | — | 8.4 | — | | $V_{GS}$ = 10V ④ |
| $C_{iss}$ | Input Capacitance | — | 1200 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 260 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 65 | — | | $f$ = 1.0MHz⑥ |
| $C_{oss}$ | Output Capacitance | — | 1520 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 120 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 120V, $f$ = 1.0MHz |
| $C_{oss}$ eff. | Effective Output Capacitance | — | 210 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 120V ⑤ |

## Avalanche Characteristics

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $E_{AS}$ | Single Pulse Avalanche Energy② | — | 260 | mJ |
| $I_{AR}$ | Avalanche Current① | — | 14 | A |
| $E_{AR}$ | Repetitive Avalanche Energy① | — | 13.6 | mJ |

## Thermal Resistance

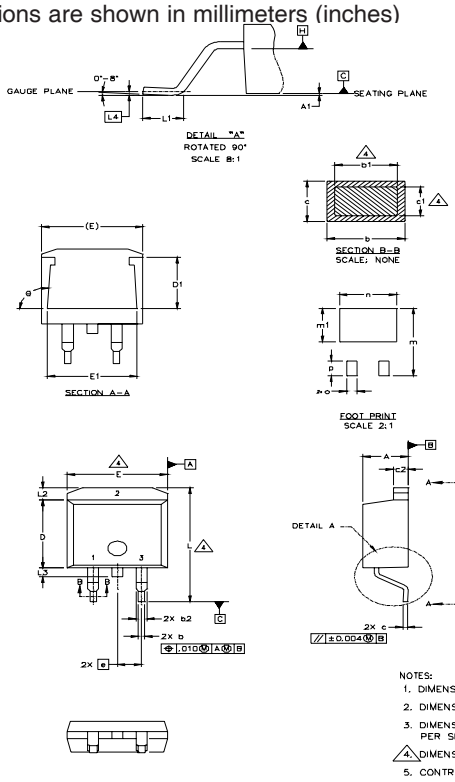
| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | — | 1.1 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface ⑥ | 0.50 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient⑥ | — | 62 | |
| $R_{\theta JA}$ | Junction-to-Ambient⑦ | — | 40 | |

## Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 23 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 92 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J$ = 25°C, $I_S$ = 14A, $V_{GS}$ = 0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | 150 | 220 | ns | $T_J$ = 25°C, $I_F$ = 14A |
| $Q_{rr}$ | Reverse RecoveryCharge | — | 0.8 | 1.2 | µC | di/dt = 100A/µs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

## D²Pak Package Outline

Dimensions are shown in millimeters (inches)




| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | .160 | .190 | |
| A1 | | 0.127 | | .005 | |
| b | 0.51 | 0.99 | .020 | .039 | |
| b1 | 0.51 | 0.89 | .020 | .035 | 4 |
| b2 | 1.14 | 1.40 | .045 | .055 | |
| c | 0.43 | 0.63 | .017 | .025 | |
| c1 | 0.38 | 0.74 | .015 | .029 | 4 |
| c2 | 1.14 | 1.40 | .045 | .055 | |
| D | 8.51 | 9.65 | .335 | .380 | 3 |
| D1 | 5.33 | | .210 | | |
| E | 9.65 | 10.67 | .380 | .420 | 3 |
| E1 | 6.22 | | .245 | | |
| e | 2.54 BSC | | .100 BSC | | |
| L | 14.61 | 15.88 | .575 | .625 | |
| L1 | 1.78 | 2.79 | .070 | .110 | |
| L2 | | 1.65 | | .065 | |
| L3 | 1.27 | 1.78 | .050 | .070 | |
| L4 | 0.25 BSC | | .010 BSC | | |
| m | 17.78 | | .700 | | |
| m1 | 8.89 | | .350 | | |
| n | 11.43 | | .450 | | |
| o | 2.08 | | .082 | | |
| p | 3.81 | | .150 | | |
| θ | 90° | 93° | 90° | 93° | |

LEAD ASSIGNMENTS

| HEXFET | IGBTs, CoPACK | DIODES |
|---|---|---|
| 1.– GATE | 1.– GATE | 1.– ANODE * |
| 2.– DRAIN | 2.– COLLECTOR | 2.– CATHODE |
| 3.– SOURCE | 3.– EMITTER | 3.– ANODE |

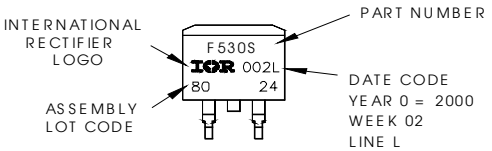
* PART DEPENDENT.

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

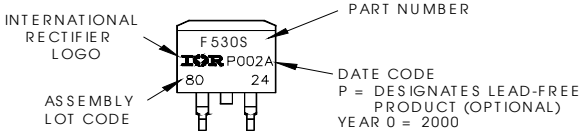
## D²Pak Part Marking Information (Lead-Free)

EXAMPLE: THIS IS AN IRF530S WITH
LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"

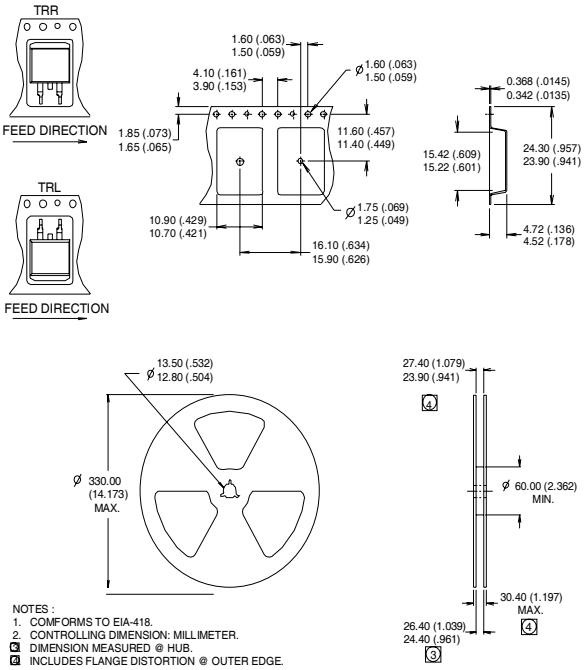
Note: "P" in assembly line
position indicates "Lead-Free"




OR



## D²Pak Tape & Reel Infomation




**Notes:**

① Repetitive rating; pulse width limited by max. junction temperature.

② Starting $T_J$ = 25°C, L = 2.7mH $R_G$ = 25Ω, $I_{AS}$ = 14A.

③ $I_{SD} \leq$ 14A, di/dt ≤ 240A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C

④ Pulse width ≤ 300μs; duty cycle ≤ 2%.

⑤ $C_{oss}$ eff. is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$

⑥ This is only applied to TO-220AB package

⑦ This is applied to D²Pak, when mounted on 1" square PCB ( FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.

Data and specifications subject to change without notice.

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