# HIGH-TEMPERATURE, 30V P-CHANNEL POWER MOSFET FAMILY

## FEATURES

- ▲ Minimum $BV_{DSS}$ =-35V.
- ▲ Allowed $V_{GS}$ range –5.5V to +5.5V.
- ▲ Operational beyond the -60°C to +230°C temperature range.
- ▲ Low $R_{DS(on)}$
  - XTR2N0325: 1.24 Ω @ 230°C
  - XTR2N0350: 0.56 Ω @ 230°C
- ▲ Maximum Peak $I_D$:
  - XTR2N0325: 6.1 A @ 230°C
  - XTR2N0350: 13.4 A @ 230°C
- ▲ On-time ($t_{d(on)}$+$t_r$):
  - XTR2N0325: 79 nsec @ 230°C
  - XTR2N0350: 88 nsec @ 230°C
- ▲ Off-time ($t_{d(off)}$+$t_f$):
  - XTR2N0325: 66 nsec @ 230°C
  - XTR2N0350: 71 nsec @ 230°C
- ▲ Ruggedized 3-lead TO257 and SMD packages.
- ▲ Also available as bare die.

## APPLICATIONS

- ▲ Reliability-critical, Automotive, Aeronautics & Aerospace, Down-hole.
- ▲ DC/DC converters, power switching, motor control, power inverters, power linear regulators, power supply.

## DESCRIPTION

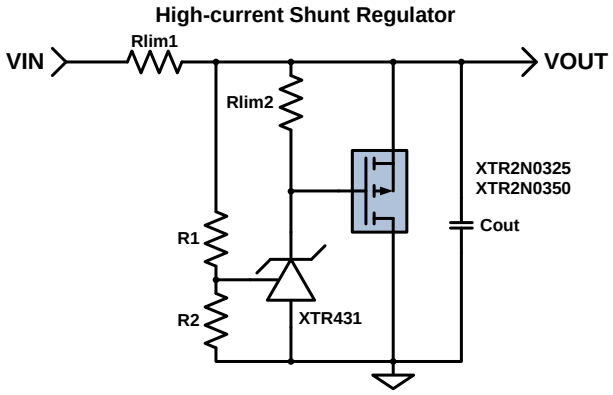
XTR2N0300 is a family of 30V P-channel power MOSFETs designed to reliably operate over a wide range of temperatures. Full functionality is guaranteed from -60°C to +230°C, though operation well below and above this temperature range is achieved.

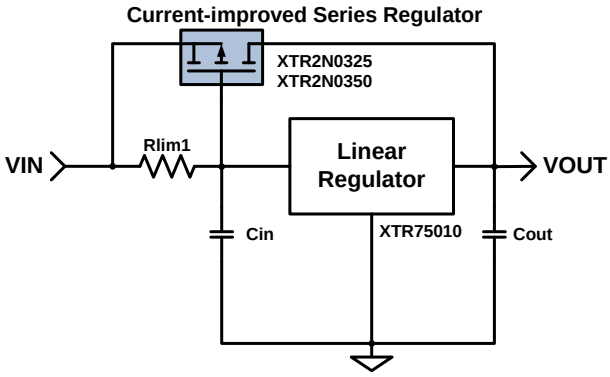
Fabricated on a Silicon-on-Insulator (SOI) process, XTR2N0300 family parts offer reduced leakage currents while providing high drain currents and low $R_{DS(on)}$. These features allow XTR2N0300 parts to be ideally suited for switching and linear applications.

XTR2N0300 family parts have been designed to reduce system cost and ease adoption by reducing the learning curve and providing smart and easy to use features.

Parts from the XTR2N0300 family are available in ruggedized 3-lead TO257, 8-lead side brazed DIP, 8-lead SOIC with ePAD, as well as SMD power packages upon demand. Parts are also available as tested bare die.

## PRODUCT HIGHLIGHT




## ORDERING INFORMATION

| X | TR | 2N | 03xx |
|---|---|---|---|
| Source: X = X-REL Semi | Process: TR = HiTemp, HiRel | Part family | Part number |

| Product Reference | Temperature Range | Package | Pin Count | Marking |
|---|---|---|---|---|
| **XTR2N0325-BD** | -60°C to +230°C | Bare die | | XTR2N0325 |
| **XTR2N0350-BD** | -60°C to +230°C | Bare die | | XTR2N0350 |
| **XTR2N0325-TD** | -60°C to +230°C | Tested bare die | | XTR2N0325 |
| **XTR2N0350-TD** | -60°C to +230°C | Tested bare die | | XTR2N0350 |
| **XTR2N0325-D** | -60°C to +230°C | Ceramic side Braze DIP | 8 | XTR2N0325 |
| **XTR2N0325-FE** | -60°C to +230°C | Gull-wing flat pack with ePad | 8 | XTR2N0325 |
| **XTR2N0325-T** | -60°C to +230°C | TO-257AA | 3 | XTR2N0325 |
| **XTR2N0350-T** | -60°C to +230°C | TO-257AA | 3 | XTR2N0350 |
| **XTR2N0325-M** | -60°C to +230°C | SMD-0.5 | 3 | XTR2N0325 |
| **XTR2N0350-M** | -60°C to +230°C | SMD-1 | 3 | XTR2N0350 |

**For some packages, MOQ may apply.**
**Other packages and packaging configurations possible upon request.**

## ABSOLUTE MAXIMUM RATINGS

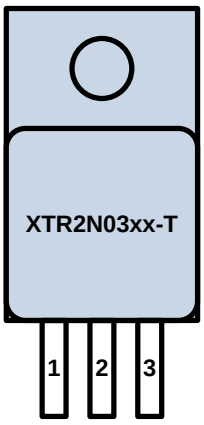
| | |
|---|---|
| Drain-source voltage | -35V to +2V |
| Gate-source voltage | ±6.0V |
| Storage temperature range | -70°C to +230°C |
| Operating junction temperature range | -70°C to +300°C |
| ESD classification | 2kV HBM MIL-STD-750 |

***Caution:*** *Stresses beyond those listed in "ABSOLUTE MAXIMUM RATINGS" may cause permanent damage to the device. These are stress ratings only and functionality of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to "ABSOLUTE MAXIMUM RATINGS" conditions for extended periods may permanently affect device reliability.*

## PRODUCT VARIANTS

### TO-257

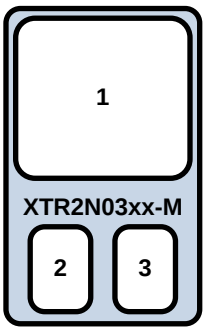
**Front view**




**1 DRAIN**
**2 SOURCE**
**3 GATE**

### SMD-0.5 / SMD-1

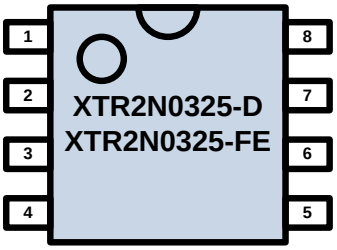
**Bottom view**




**1 SOURCE**
**2 GATE**
**3 DRAIN**

### DIP8 / CDFP8

**Top view**




**1, 2, 3 SOURCE**
**4 GATE**
**5, 6, 7, 8 DRAIN**
**ePAD of CDFP8 SOURCE**

## THERMAL CHARACTERISTICS

| Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **XTR2N03xx-T (TO257)** | | | | | |
| Thermal Resistance: J-C $R_{Th\_J\text{-}C}$ | | | 5 | | °C/W |
| Thermal Resistance: J-A $R_{Th\_J\text{-}A}$ | Still air. | | 50 | | °C/W |
| **XTR2N03xx-M (SMD-0.5 / SMD-1)** | | | | | |
| Thermal Resistance: J-C $R_{Th\_J\text{-}C}$ | | | 2 | | °C/W |
| Thermal Resistance: J-A $R_{Th\_J\text{-}A}$ | Still air. | | 45 | | °C/W |
| **XTR2N0325-D (DIP8)** | | | | | |
| Thermal Resistance: J-C $R_{Th\_J\text{-}C}$ | | | 20 | | °C/W |
| Thermal Resistance: J-A $R_{Th\_J\text{-}A}$ | Still air. | | 100 | | °C/W |
| **XTR2N0325-FE (DFP8 with exposed pad)** | | | | | |
| Thermal Resistance: J-C $R_{Th\_J\text{-}C}$ | Measured on ePAD. | | 7 | | °C/W |
| Thermal Resistance: J-A $R_{Th\_J\text{-}A}$ | ePAD thermally connected to 3cm² PCB copper | | 70 | | °C/W |

## RECOMMENDED OPERATING CONDITIONS

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Drain-source voltage<br>$V_{DS}$ | -30 | | 1.5 | V |
| Gate-source voltage<br>$V_{GS}$ | -5.5 | | +5.5 | V |
| Junction Temperature[1]<br>$T_C$ | -60 | | 230 | °C |

[1] Operation beyond the specified temperature range is achieved. The -60°C to +230°C range for the case temperature is considered for the case where $I_D \leq I_{D(DC)}$ for a given case temperature.

## XTR2N0325 SPECIFICATIONS

Unless otherwise stated, specification applies for -60°C<$T_j$<230°C.

| Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **DC Characteristics** | | | | | |
| Drain-source breakdown voltage<br>$BV_{DSS}$ | $V_{GS}$=0V, $I_{DS}$=-100µA | -35 | | | V |
| Static drain-source on-state resistance<br>$R_{DS(on)}$ | $V_{GS}$=-5V, $I_{DS}$=-100mA<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230° | | 0.48<br>0.85<br>1.24 | | Ω |
| Continuous drain current<br>$I_{D(DC)}$ | $V_{GS}$=-5V for TO-257<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230°C | | -2.3<br>-1.9<br>-1.5 | | A |
| Gate threshold voltage<br>$V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_{DS}$=-1mA<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230° | | -1.33<br>-1.02<br>-0.63 | | V |
| Temperature drift of gate threshold voltage<br>$\Delta V_{GS(TH)}/\Delta T_j$ | $V_{DS}$=$V_{GS}$, $I_{DS}$=-1mA | | 2.4 | | mV/°C |
| Off-state drain current<br>$I_{DSS}$ | $V_{DS}$=-30V, $V_{GS}$=0V<br>$T_C$=85°C<br>$T_C$=230°C | | -0.2<br>-30 | | µA |
| Gate Leakage current<br>$I_{GSS}$ | $V_{GS}$=±5V, $V_{DS}$=0V<br>$T_C$=85°C<br>$T_C$=230°C | | ±0.6<br>±170 | | nA |
| **AC Characteristics** | | | | | |
| Input capacitance<br>$C_{iss}$ | $V_{DS}$=-15V, $V_{GS}$=0V, f=1MHz | | 230 | | pF |
| Output capacitance<br>$C_{oss}$ | | | 71 | | pF |
| Reverse transfer capacitance<br>$C_{rss}$ | | | 24 | | pF |
| **Switching Characteristics** | | | | | |
| Pulsed drain current<br>$I_{DM}$ | $V_{DS}$=-20V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230°C | | -9.2<br>-7.6<br>-6.1 | | A |
| Total gate charge<br>$Q_g$ | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V | | TBD | | nC |
| Turn-on delay time<br>$t_{d(on)}$ | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 28 | | ns |
| Rise time<br>$t_r$ | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 51 | | |
| Turn-off delay time<br>$t_{d(off)}$ | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 43 | | |
| Fall time<br>$t_f$ | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 23 | | |

## XTR2N0350 SPECIFICATIONS

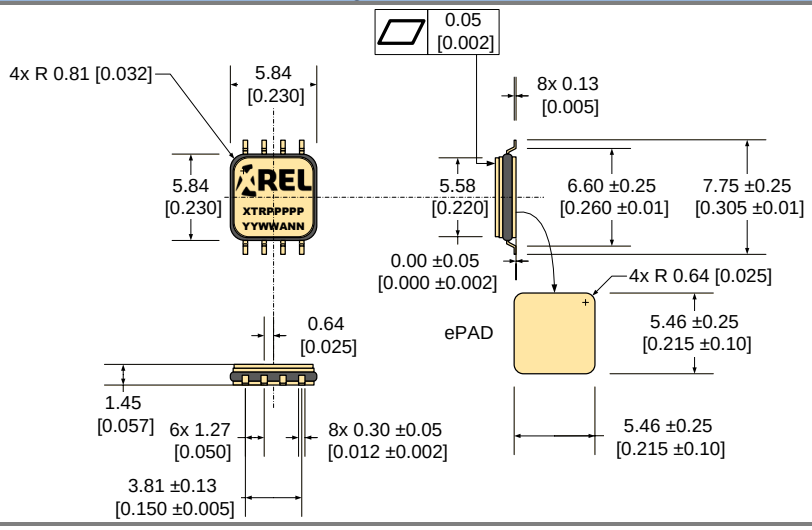
Unless otherwise stated, specification applies for -60°C<$T_j$<230°C.

| Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **DC Characteristics** | | | | | |
| Drain-source breakdown voltage **$BV_{DSS}$** | $V_{GS}$=0V, $I_{DS}$=-100µA | -35 | | | V |
| Static drain-source on-state resistance **$R_{DS(on)}$** | $V_{GS}$=-5V, $I_{DS}$=-100mA<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230°C | | <br>0.22<br>0.39<br>0.56 | | Ω |
| Continuous drain current **$I_{D(DC)}$** | $V_{GS}$=-5V for TO-25<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230°C | | <br>-5.1<br>-4.2<br>-3.3 | | A |
| Gate threshold voltage **$V_{GS(th)}$** | $V_{DS}$=$V_{GS}$, $I_{DS}$=-1mA<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230°C | | <br>-1.33<br>-1.02<br>-0.63 | | V |
| Temperature drift of gate threshold voltage **$\Delta V_{GS(TH)}/\Delta T_j$** | $V_{DS}$=$V_{GS}$, $I_{DS}$=-2.5mA | | 2.4 | | mV/°C |
| Off-state drain current **$I_{DSS}$** | $V_{DS}$=-30V, $V_{GS}$=0V<br>$T_C$=85°C<br>$T_C$=230°C | | <br>-0.45<br>-70 | | µA |
| Gate Leakage current **$I_{GSS}$** | $V_{GS}$=±5V, $V_{DS}$=0V<br>$T_C$=85°C<br>$T_C$=230°C | | <br>±0.8<br>±190 | | nA |
| **AC Characteristics** | | | | | |
| Input capacitance **$C_{iss}$** | $V_{DS}$=-15V, $V_{GS}$=0V, f=1MHz | | 530 | | pF |
| Output capacitance **$C_{oss}$** | | | 163 | | pF |
| Reverse transfer capacitance **$C_{rss}$** | | | 55 | | pF |
| **Switching Characteristics** | | | | | |
| Pulsed drain current **$I_{DM}$** | $V_{DS}$=-20V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms<br>$T_C$=-60°C<br>$T_C$=85°C<br>$T_C$=230°C | | <br>-20.2<br>-16.5<br>-13.4 | | A |
| Total gate charge **$Q_g$** | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V | | TBD | | nC |
| Turn-on delay time **$t_{d(on)}$** | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 31 | | ns |
| Rise time **$t_r$** | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 57 | | |
| Turn-off delay time **$t_{d(off)}$** | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 46 | | |
| Fall time **$t_f$** | $V_{DS}$=-15V, $V_{GS\ sweep}$=0 to -5V, d=0.2%, τ=1ms | | 25 | | |

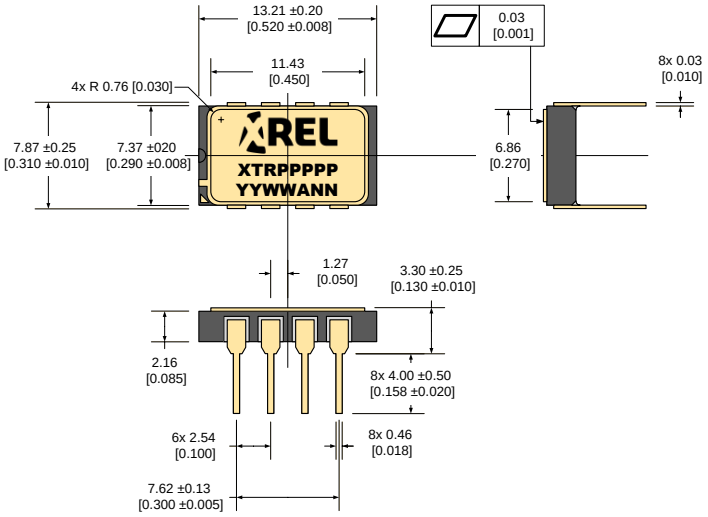
## PACKAGE OUTLINES

Dimensions shown in mm [inches]. Tolerance ±0.13 mm [±0.005 in] unless otherwise stated.

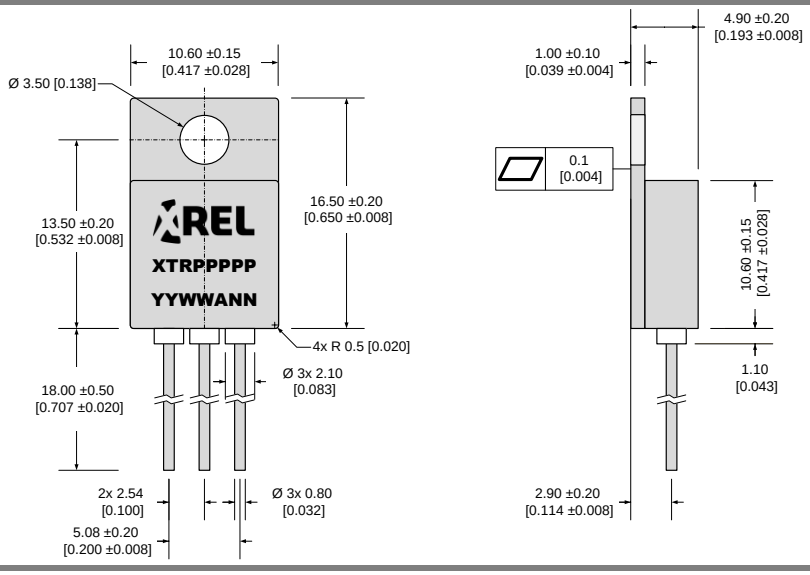
### Ceramic Gull-wing Flat Pack with ePad CDFP8



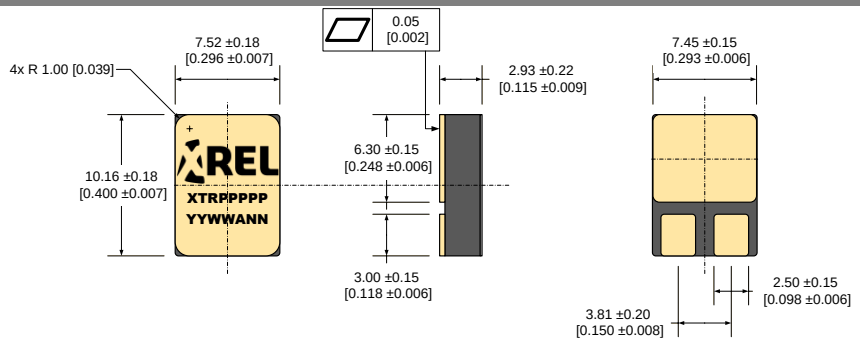

### Ceramic Side Brazed Dual In-line DIP8



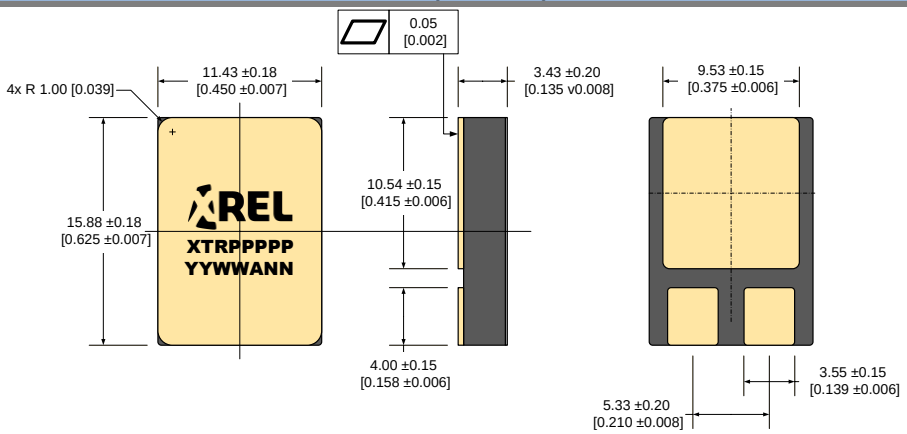

### Ceramic Seal TO-257AA (TO-220M)



**SMD-0.5 (TO-276AA)**




**SMD-1 (TO-276AB)**




| Part Marking Convention | |
|---|---|
| **Part Reference: XTRPPPPPP** | |
| **XTR** | X-REL Semiconductor, high-temperature, high-reliability product (XTRM Series). |
| **PPPPP** | Part number (0-9, A-Z). |
| **Unique Lot Assembly Code: YYWWANN** | |
| **YY** | Two last digits of assembly year (e.g. 12 = 2012). |
| **WW** | Assembly week (01 to 52). |
| **A** | Assembly location code. |
| **NN** | Assembly lot code (01 to 99). |

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