

### HIGH-TEMPERATURE, 40V N-CHANNEL POWER MOSFET FAMILY

#### FEATURES

- ▲ Minimum  $BV_{DSS} = 55V$ .
- ▲ Allowed  $V_{GS}$  range  $-5.5V$  to  $+5.5V$ .
- ▲ Operational beyond the  $-60^{\circ}C$  to  $+230^{\circ}C$  temperature range.
- ▲ Low  $R_{DS(on)}$ 
  - XTR2N0425: 525 m $\Omega$  @ 230 $^{\circ}C$
  - XTR2N0450: 270 m $\Omega$  @ 230 $^{\circ}C$
- ▲ Maximum  $I_D$ :
  - XTR2N0425: 5.1A @ 230 $^{\circ}C$
  - XTR2N0450: 11A @ 230 $^{\circ}C$
- ▲ On-time ( $t_{d(on)}+t_r$ ):
  - XTR2N0425: 70nsec @ 230 $^{\circ}C$
  - XTR2N0450: 90nsec @ 230 $^{\circ}C$
- ▲ Off-time ( $t_{d(off)}+t_f$ ):
  - XTR2N0425: 50nsec @ 230 $^{\circ}C$
  - XTR2N0450: 70nsec @ 230 $^{\circ}C$
- ▲ Ruggedized 3-lead TO257 and SMD packages.
- ▲ Also available as bare die.

#### DESCRIPTION

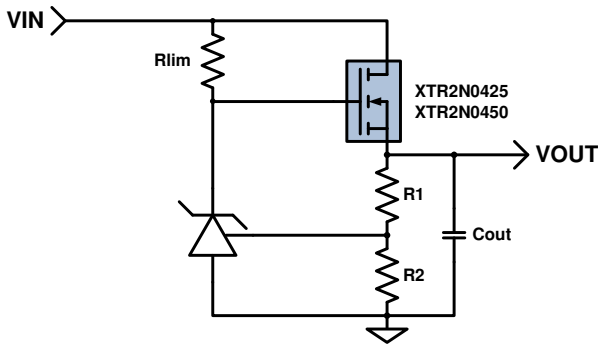
XTR2N0400 is a family of N-channel power MOSFETs designed to reliably operate over a wide range of temperatures. Full functionality is guaranteed from  $-60^{\circ}C$  to  $+230^{\circ}C$ , though operation well below and above this temperature range is achieved. Fabricated on a Silicon-on-Insulator (SOI) process, XTR2N0400 family parts offer reduced leakage currents while providing high drain currents a low  $R_{DS(on)}$ . These features allow XTR2N0400 parts to be ideally suited for switching applications. XTR2N0400 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 XTR2N0400 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.

#### APPLICATIONS

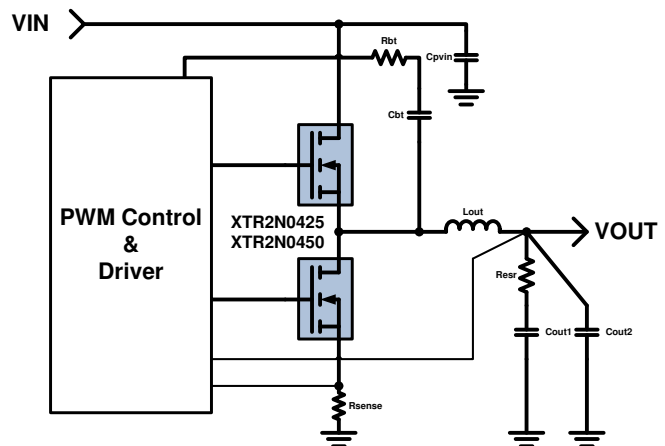
- ▲ Reliability-critical, Automotive, Aeronautics & Aerospace, Down-hole.
- ▲ DC/DC converters, power switching, motor control, power inverters, power linear regulators, power supply.

#### PRODUCT HIGHLIGHT

Power Series Regulator



Step-down DC-DC Converter



#### ORDERING INFORMATION



Product Reference	Temperature Range	Package	Pin Count	Marking
XTR2N0425-TD	$-60^{\circ}C$ to $+230^{\circ}C$	Tested bare die		XTR2N0425
XTR2N0450-TD	$-60^{\circ}C$ to $+230^{\circ}C$	Tested bare die		XTR2N0450
XTR2N0425-D	$-60^{\circ}C$ to $+230^{\circ}C$	Ceramic side Braze DIP	8	XTR2N0425
XTR2N0425-FE	$-60^{\circ}C$ to $+230^{\circ}C$	Gull-wing flat pack with ePAD	8	XTR2N0425
XTR2N0425-T	$-60^{\circ}C$ to $+230^{\circ}C$	TO-257AA	3	XTR2N0425
XTR2N0450-T	$-60^{\circ}C$ to $+230^{\circ}C$	TO-257AA	3	XTR2N0450
XTR2N0425-M	$-60^{\circ}C$ to $+230^{\circ}C$	SMD-0.5	3	XTR2N0425
XTR2N0450-M	$-60^{\circ}C$ to $+230^{\circ}C$	SMD-1	3	XTR2N0450

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

## ABSOLUTE MAXIMUM RATINGS

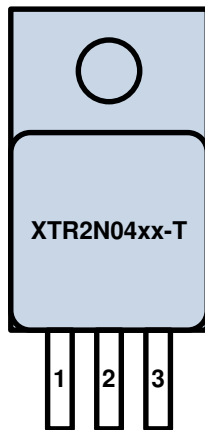
Drain-source voltage	-2V to +55V
Gate-source voltage	±6.0V
Storage temperature range	-70°C to +230°C
Operating junction temperature range	-70°C to +300°C
ESD classification	1kV HBM MIL-STD-883

**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

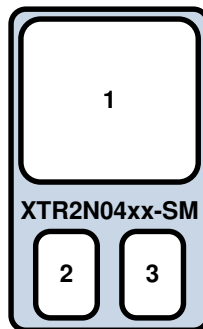
Front view



- 1 DRAIN
- 2 SOURCE
- 3 GATE

### SMD-0.5 / SMD-1

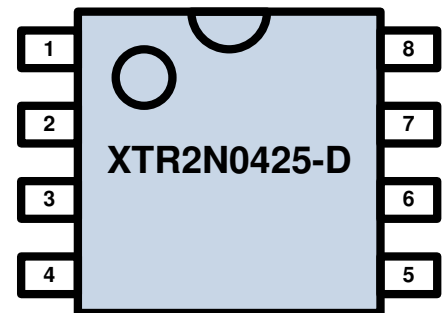
Bottom view



- 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
<b>XTR2N04xx-T (TO257)</b>					
Thermal Resistance: J-C $R_{Th\ J-C}$			5		°C/W
Thermal Resistance: J-A $R_{Th\ J-A}$	Still air.		50		°C/W
<b>XTR2N04xx-M (SMD-0.5 / SMD-1)</b>					
Thermal Resistance: J-C $R_{Th\ J-C}$			2		°C/W
Thermal Resistance: J-A $R_{Th\ J-A}$	Still air.		45		°C/W
<b>XTR2N0425-D (DIP8)</b>					
Thermal Resistance: J-C $R_{Th\ J-C}$			20		°C/W
Thermal Resistance: J-A $R_{Th\ J-A}$	Still air.		100		°C/W
<b>XTR2N0425-FE (DFP8 with exposed pad)</b>					
Thermal Resistance: J-C $R_{Th\ J-C}$	Measured on ePAD.		7		°C/W
Thermal Resistance: J-A $R_{Th\ J-A}$	ePAD thermally connected to 3cm <sup>2</sup> PCB copper		70		°C/W

**RECOMMENDED OPERATING CONDITIONS**

Parameter	Min	Typ	Max	Units
Drain-source voltage $V_{DS}$	-1.5		40	V
Gate-source voltage $V_{GS}$	-5.5		+5.5	V
Junction Temperature <sup>1</sup> $T_j$	-60		230	°C

<sup>1</sup> 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.

**XTR2N0425 SPECIFICATIONS**

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

Parameter	Condition	Min	Typ	Max	Units
<b>DC Characteristics</b>					
Drain-source breakdown voltage $BV_{DSS}$	$V_{GS}=0V, I_{DS}=100\mu A$	55			V
Static drain-source on-state resistance $R_{DS(on)}$	$V_{GS}=+5V, I_{DS}=100mA$ $T_C=-60^\circ C$ $T_C=85^\circ C$ $T_C=230^\circ C$		200 330 525		mΩ
Continuous drain current $I_{D(DC)}$	$V_{GS}=+5V$ for TO-257 $T_C=-60^\circ C$ $T_C=85^\circ C$ $T_C=230^\circ C$		2.1 1.8 1.2		A
Gate threshold voltage $V_{GS(th)}$	$V_{DS}=V_{GS}, I_{DS}=1mA$ $T_C=-60^\circ C$ $T_C=85^\circ C$ $T_C=230^\circ C$		1.77 1.38 0.92		V
Temperature drift of gate threshold voltage $\Delta V_{GS(th)}/\Delta T_j$	$V_{DS}=V_{GS}, I_{DS}=1mA$		-2.9		mV/°C
Off-state drain current $I_{DSS}$	$V_{DS}=40V, V_{GS}=0V$ $T_C=85^\circ C$ $T_C=230^\circ C$		0.01 10		μA
Gate Leakage current $I_{GSS}$	$V_{GS}=\pm 5V, V_{DS}=0V$ $T_C=85^\circ C$ $T_C=230^\circ C$		±0.6 ±130		nA
<b>AC Characteristics</b>					
Input capacitance $C_{iss}$	$V_{DS}=20V, V_{GS}=0V, f=1MHz$		480		pF
Output capacitance $C_{oss}$			65		pF
Reverse transfer capacitance $C_{rss}$			28		pF
<b>Switching Characteristics</b>					
Pulsed drain current $I_{DM}$	$V_{DS}=40V, V_{GS \text{ sweep}}=0$ to +5V, $d=0.2\%, \tau=1ms$ $T_C=-60^\circ C$ $T_C=85^\circ C$ $T_C=230^\circ C$		8.6 7.2 5.1		A
Total gate charge $Q_g$	$V_{DS}=40V, V_{GS \text{ sweep}}=0$ to +5V		4.5		nC
Turn-on delay time $t_{d(on)}$	$V_{DS}=20V, V_{GS \text{ sweep}}=0$ to +5V, $d=0.2\%, \tau=1ms$		25		ns
Rise time $t_r$			45		
Turn-off delay time $t_{d(off)}$	$V_{DS}=20V, V_{GS \text{ sweep}}=+5$ to 0V, $d=0.2\%, \tau=1ms$		35		
Fall time $t_f$			15		

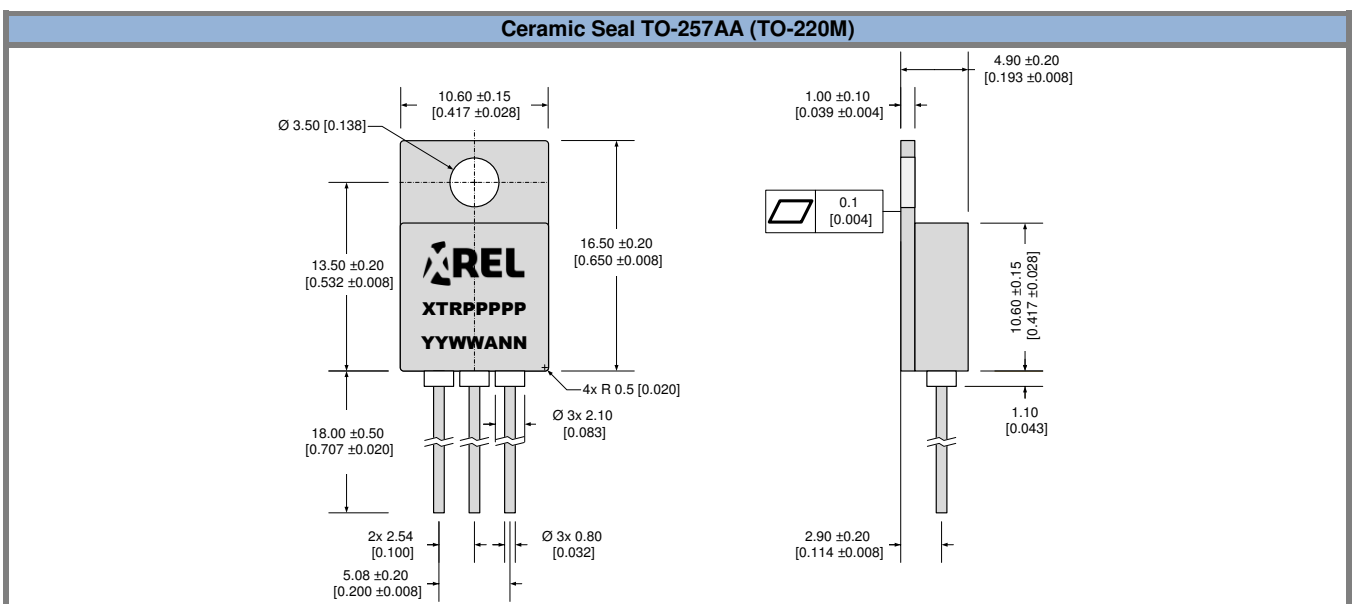
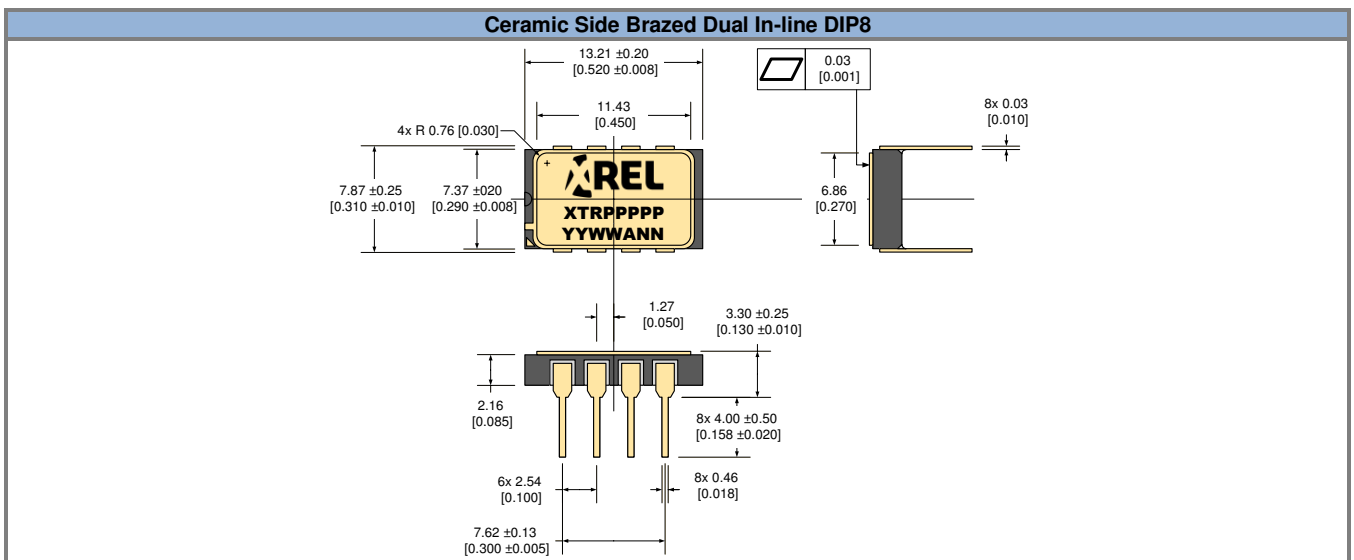
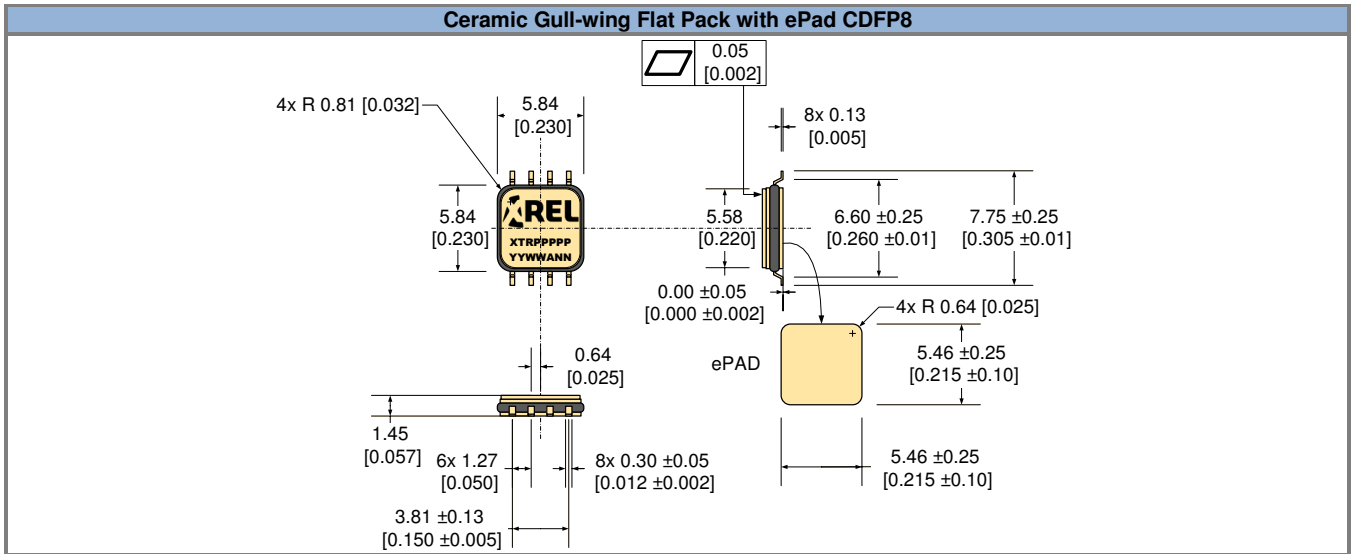
**XTR2N0450 SPECIFICATIONS**

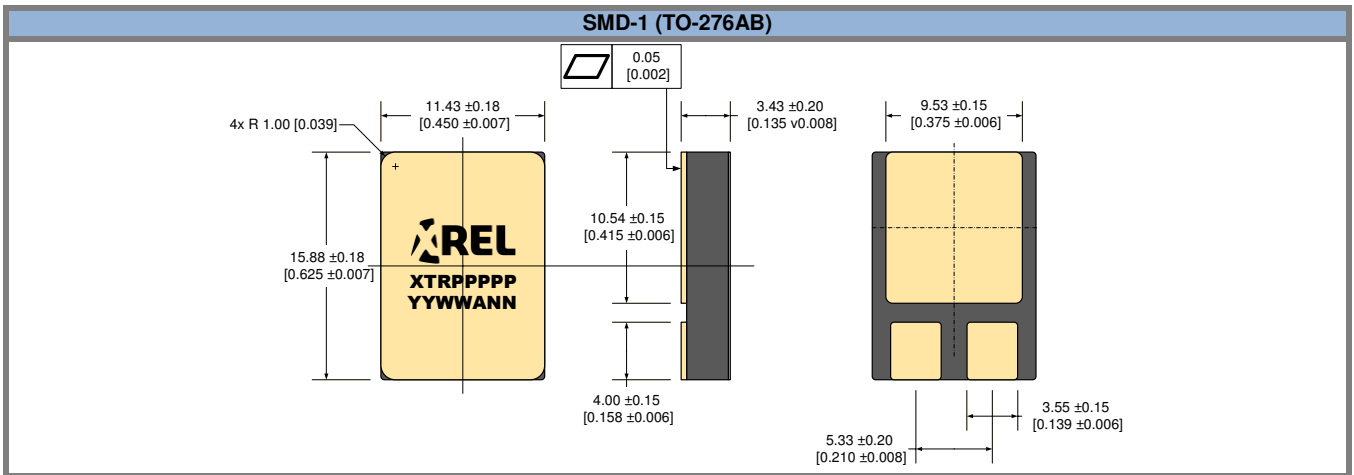
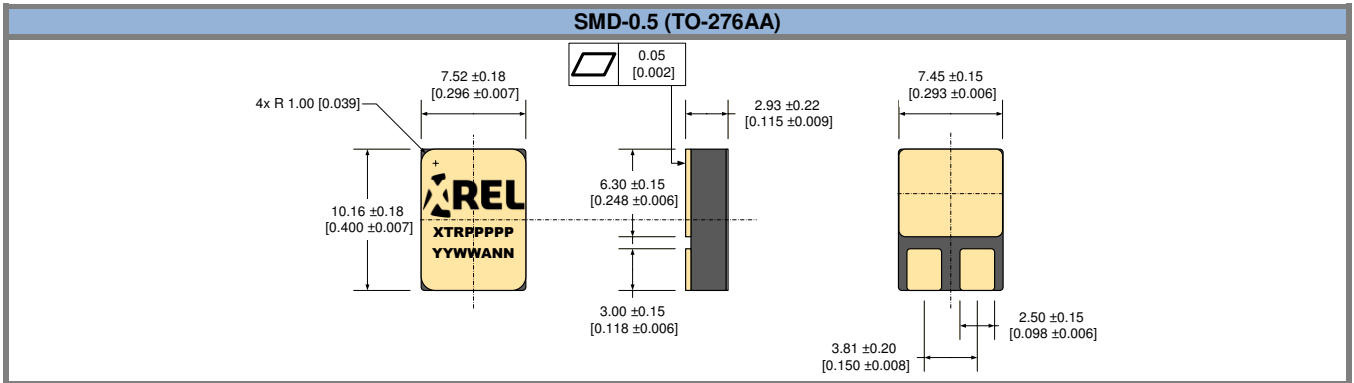
 Unless otherwise stated, specification applies for  $-60^{\circ}\text{C} < T_j < 230^{\circ}\text{C}$ .

Parameter	Condition	Min	Typ	Max	Units
<b>DC Characteristics</b>					
Drain-source breakdown voltage $BV_{DSS}$	$V_{GS}=0\text{V}, I_{DS}=100\mu\text{A}$	55			V
Static drain-source on-state resistance $R_{DS(on)}$	$V_{GS}=+5\text{V}, I_{DS}=100\text{mA}$ $T_C=-60^{\circ}\text{C}$ $T_C=85^{\circ}\text{C}$ $T_C=230^{\circ}\text{C}$		110 170 270		m $\Omega$
Continuous drain current $I_{D(DC)}$	$V_{GS}=+5\text{V}$ for TO-257 $T_C=-60^{\circ}\text{C}$ $T_C=85^{\circ}\text{C}$ $T_C=230^{\circ}\text{C}$		4.7 3.7 2.7		A
Gate threshold voltage $V_{GS(th)}$	$V_{DS}=V_{GS}, I_{DS}=1\text{mA}$ $T_C=-60^{\circ}\text{C}$ $T_C=85^{\circ}\text{C}$ $T_C=230^{\circ}\text{C}$		1.75 1.35 0.90		V
Temperature drift of gate threshold voltage $\Delta V_{GS(th)}/\Delta T_j$	$V_{DS}=V_{GS}, I_{DS}=1\text{mA}$		-2.9		mV/ $^{\circ}\text{C}$
Off-state drain current $I_{DSS}$	$V_{DS}=40\text{V}, V_{GS}=0\text{V}$ $T_C=85^{\circ}\text{C}$ $T_C=230^{\circ}\text{C}$		0.02 22		$\mu\text{A}$
Gate Leakage current $I_{GSS}$	$V_{GS}=\pm 5\text{V}, V_{DS}=0\text{V}$ $T_C=85^{\circ}\text{C}$ $T_C=230^{\circ}\text{C}$		$\pm 0.6$ $\pm 180$		nA
<b>AC Characteristics</b>					
Input capacitance $C_{iss}$	$V_{DS}=20\text{V}, V_{GS}=0\text{V}, f=1\text{MHz}$		1.1		nF
Output capacitance $C_{oss}$			150		pF
Reverse transfer capacitance $C_{rss}$			65		pF
<b>Switching Characteristics</b>					
Pulsed drain current $I_{DM}$	$V_{DS}=40\text{V}, V_{GS \text{ sweep}}=0$ to +5V, $d=0.2\%$ , $\tau=1\text{ms}$ $T_C=-60^{\circ}\text{C}$ $T_C=85^{\circ}\text{C}$ $T_C=230^{\circ}\text{C}$		19 15 11		A
Total gate charge $Q_g$	$V_{DS}=40\text{V}, V_{GS \text{ sweep}}=0$ to +5V		11		nC
Turn-on delay time $t_{d(on)}$	$V_{DS}=20\text{V}, V_{GS \text{ sweep}}=0$ to +5V, $d=0.2\%$ , $\tau=1\text{ms}$		40		ns
Rise time $t_r$	$V_{DS}=20\text{V}, V_{GS \text{ sweep}}=0$ to +5V, $d=0.2\%$ , $\tau=1\text{ms}$		50		
Turn-off delay time $t_{d(off)}$	$V_{DS}=20\text{V}, V_{GS \text{ sweep}}=+5$ to 0V, $d=0.2\%$ , $\tau=1\text{ms}$		40		
Fall time $t_f$	$V_{DS}=20\text{V}, V_{GS \text{ sweep}}=+5$ to 0V, $d=0.2\%$ , $\tau=1\text{ms}$		30		

## PACKAGE OUTLINES

Dimensions shown in mm [inches]. Tolerance  $\pm 0.13$  mm [ $\pm 0.005$  in] unless otherwise stated.





**Part Marking Convention**

<b>Part Reference: XTRPPPPPP</b>	
<b>XTR</b>	X-REL Semiconductor, high-temperature, high-reliability product (XTRM Series).
<b>PPPPP</b>	Part number (0-9, A-Z).
<b>Unique Lot Assembly Code: YYWWANN</b>	
<b>YY</b>	Two last digits of assembly year (e.g. 11 = 2011).
<b>WW</b>	Assembly week (01 to 52).
<b>A</b>	Assembly location code.
<b>NN</b>	Assembly lot code (01 to 99).

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