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°C to +230°C temperature range.
- ▲ Low $R_{DS(on)}$
  - o XTR2N0425: 560 mΩ @ 230°C
  - o XTR2N0450: 255 mΩ @ 230°C
- ▲ Maximum I_D:
  - o XTR2N0425: 4.7A @ 230°C
  - o XTR2N0450: 10.3A @ 230°C
- ▲ On-time ($t_{d(on)}$+t_r):
  - o XTR2N0425: 25nsec @ 230°C
  - o XTR2N0450: 30nsec @ 230°C
- ▲ Off-time ($t_{d(off)}$+t_f):
  - o XTR2N0425: 56nsec @ 230°C
  - o XTR2N0450: 68nsec @ 230°C
- ▲ Ruggedized 3-lead TO257, 8-lead side brazed DIP and 8-lead SOIC with ePAD.
- ▲ Also available as bare die.

APPLICATIONS

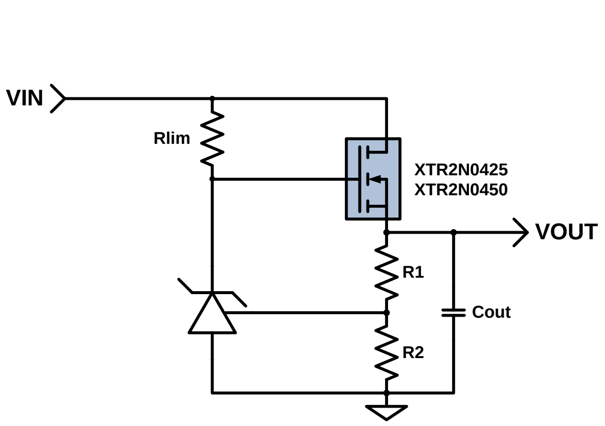
- ▲ Reliability-critical, Automotive, Aeronautics & Aerospace, Down-hole.
- ▲ DC/DC converters, power switching, motor control, power inverters, power linear regulators, power supply.

DESCRIPTION

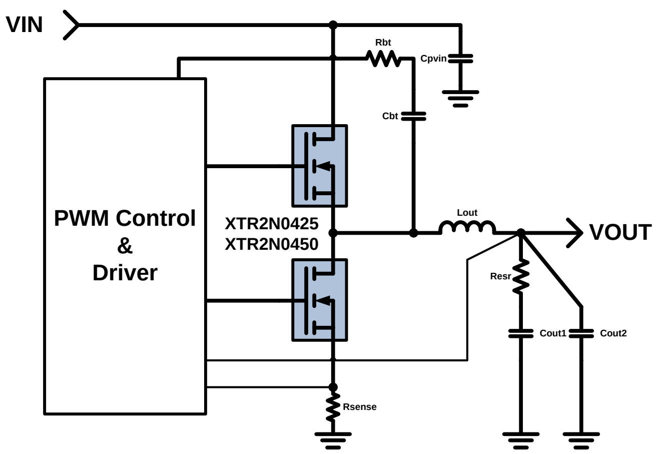
XTR2N0400 is a family of N-channel power MOSFETs designed to reliably operate over a wide range of temperatures. Full functionality is guaranteed from -60°C to +230°C, though operation well below and above this temperature range is achieved.
Fabricated on a Silicon-on-Insulator (SOI) process, XTR2N0400 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 and 8-lead SOIC with ePAD. Parts are also available as tested bare die.

PRODUCT HIGHLIGHT

Power Series Regulator



Step-down DC-DC Converter



ORDERING INFORMATION

X	TR	2N	04xx
Source: X = X-REL Semi	Process: TR = HiTemp, HiRel; R = HiRel	Part family	Part number

Product Reference	Temperature Range	Package	Pin Count	Marking
XTR2N0425-TD	-60°C to +230°C	Tested bare die		XTR2N0425
XTR2N0450-TD	-60°C to +230°C	Tested bare die		XTR2N0450
XTR2N0425-D	-60°C to +230°C	Ceramic side Braze DIP	8	XTR2N0425
XTR2N0425-FE	-60°C to +230°C	Gull-wing flat pack with ePad	8	XTR2N0425
XTR2N0425-T	-60°C to +230°C	TO-257AA	3	XTR2N0425
XTR2N0450-T	-60°C to +230°C	TO-257AA	3	XTR2N0450

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

ABSOLUTE MAXIMUM RATINGS

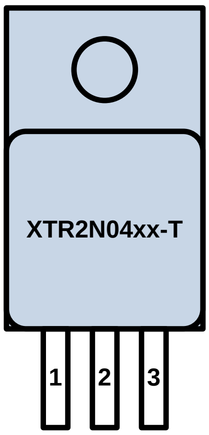
Drain-source voltage	-2V to +55V
Gate-source voltage	±6.0V
Storage temperature range	-70°C to +230°C
Operating junction temperature range	-70°C to +300°C
ESD classification	2kV HBM MIL-STD-750

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

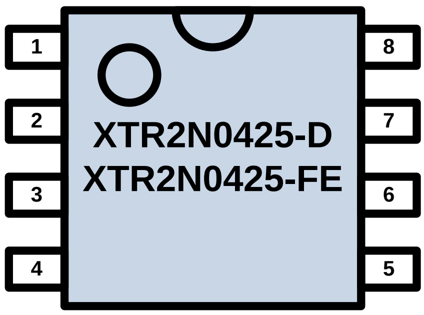
Front view



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

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
XTR2N04xx-T (TO257)					
Thermal Resistance: J-C R_{Th_J-C}			5		°C/W
Thermal Resistance: J-A R_{Th_J-A}	Still air.		50		°C/W
XTR2N0425-D (DIP8)					
Thermal Resistance: J-C R_{Th_J-C}			20		°C/W
Thermal Resistance: J-A R_{Th_J-A}	Still air.		100		°C/W
XTR2N0425-FE (DFP8 with exposed pad)					
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 3cm² 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[1] T_j	-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 $I_D \le I_{D(DC)}$ 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
DC Characteristics					
Drain-source breakdown voltage BV_{DSS}	V_{GS}=0V, I_{DS}=100µA	55			V
Static drain-source on-state resistance $R_{DS(on)}$	V_{GS}=+5V, I_{DS}=100mA T_C=-60°C T_C=85°C T_C=230°C		 230 360 560	 280 430 670	mΩ
Continuous drain current $I_{D(DC)}$	V_{GS}=+5V for TO-257 T_J=-60°C T_J=85°C T_J=230°C	 1.75 1.25 0.95	 2.2 1.6 1.2		A
Gate threshold voltage $V_{GS(th)}$	V_{DS}=V_{GS}, I_{DS}=1mA T_C=-60°C T_C=85°C T_C=230°C		 1.76 1.38 0.89		V
Temperature drift of gate threshold voltage $\Delta V_{GS(TH)}/\Delta T_j$	V_{DS}=V_{GS}, I_{DS}=1mA		-3.0		mV/°C
Off-state drain current I_{DSS}	V_{DS}=40V, V_{GS}=0V T_C=85°C T_C=230°C		 0.01 13	 0.5 60	µA
Gate Leakage current I_{GSS}	V_{GS}=±5V, V_{DS}=0V T_C=85°C T_C=230°C		 ±0.6 ±130	 ±5 ±1000	nA
AC Characteristics					
Input capacitance C_{iss}	V_{DS}=32V, V_{GS}=0V, f=1MHz		390		pF
Output capacitance C_{oss}			80		pF
Transfer capacitance C_{rss}			65		pF
Switching Characteristics					
Pulsed drain current I_{DM}	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, d=0.2%, τ=1ms T_C=-60°C T_C=85°C T_C=230°C	 7.0 5.0 3.8	 8.8 6.2 4.7		A
Total gate charge Q_g	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V		5.4		nC
Turn-on delay time $t_{d(on)}$	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		11		ns
Rise time t_r	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		14		
Turn-off delay time $t_{d(off)}$	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		29		
Fall time t_f	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		27		
Drain-Source Diode Characteristics					
Forward diode voltage V_{SD_1A}	V_{GS}=0V, I_{DS}=-1A T_C=-60°C T_C=85°C T_C=230°C		 1.10 0.97 0.89		V

XTR2N0450 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	55			V
Static drain-source on-state resistance **$R_{DS(on)}$**	V_{GS}=+5V, I_{DS}=100mA T_C=-60°C T_C=85°C T_C=230°C		105 165 255	130 200 310	mΩ
Continuous drain current **$I_{D(DC)}$**	V_{GS}=+5V for TO-257 T_J=-60°C T_J=85°C T_J=230°C	3.8 2.7 2.1	4.8 3.4 2.6		A
Gate threshold voltage **$V_{GS(th)}$**	V_{DS}=V_{GS}, I_{DS}=1mA T_C=-60°C T_C=85°C T_C=230°C		1.72 1.32 0.79		V
Temperature drift of gate threshold voltage **$\Delta V_{GS(TH)}/\Delta T_j$**	V_{DS}=V_{GS}, I_{DS}=1mA		-3.2		mV/°C
Off-state drain current **I_{DSS}**	V_{DS}=40V, V_{GS}=0V T_C=85°C T_C=230°C		0.02 30	1 150	µA
Gate Leakage current **I_{GSS}**	V_{GS}=±5V, V_{DS}=0V T_C=85°C T_C=230°C		±0.8 ±160	±5 ±1000	nA
AC Characteristics					
Input capacitance **C_{iss}**	V_{DS}=32V, V_{GS}=0V, f=1MHz		900		pF
Output capacitance **C_{oss}**			180		pF
Transfer capacitance **C_{rss}**			150		pF
Switching Characteristics					
Pulsed drain current **I_{DM}**	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, d=0.2%, τ=1ms T_C=-60°C T_C=85°C T_C=230°C	15.5 10.9 8.3	19.4 13.6 10.3		A
Total gate charge **Q_g**	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V		12.2		nC
Turn-on delay time **$t_{d(on)}$**	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		13		ns
Rise time **t_r**	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		17		
Turn-off delay time **$t_{d(off)}$**	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		35		
Fall time **t_f**	V_{DS}=20V, $V_{GS\ sweep}$=0 to +5V, R_D=47Ω, d=0.2%, τ=1ms		33		
Drain-Source Diode Characteristics					
Forward diode voltage **V_{SD_1A}**	V_{GS}=0V, I_{DS}=-1A T_C=-60°C T_C=85°C T_C=230°C		1.00 0.88 0.66		V

XTR2N0425 TYPICAL PERFORMANCE

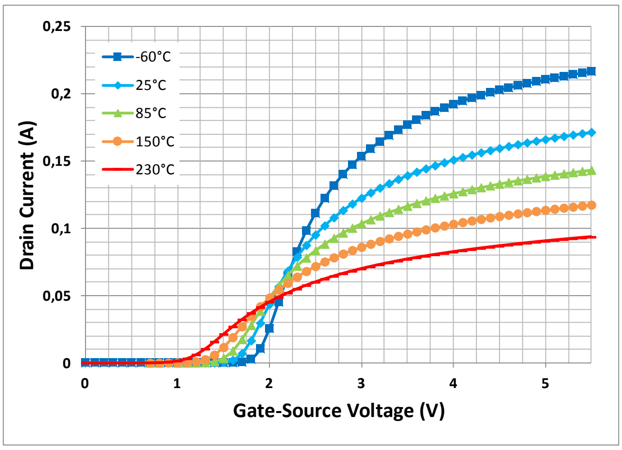


Figure 1. Drain Current (I_{DS}) vs Gate-Source Voltage for several case temperatures. V_{DS}=50mV.

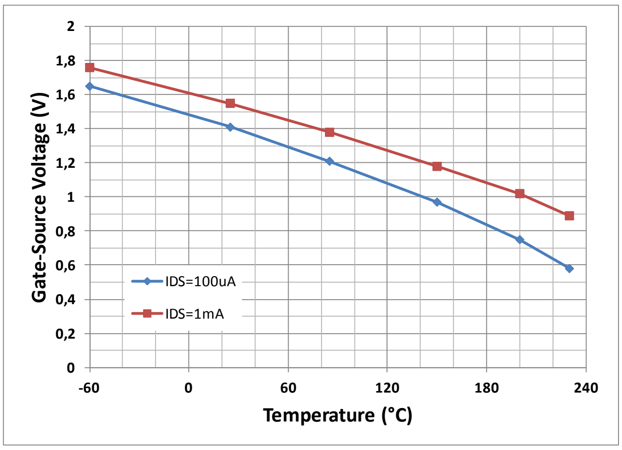


Figure 2. Gate-Source Threshold Voltage ($V_{GS(th)}$) vs Gate-Source Voltage for several case temperatures. V_{GS}= V_{DS}.

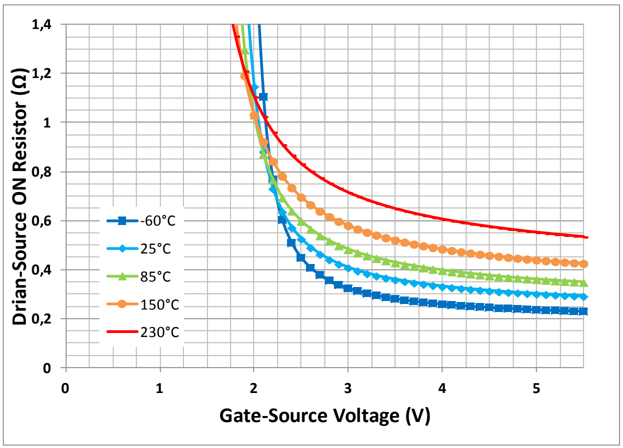


Figure 3. Drain-Source ON Resistance ($R_{DS(on)}$) vs Gate-Source Voltage for several case temperatures. V_{DS}=50mV.

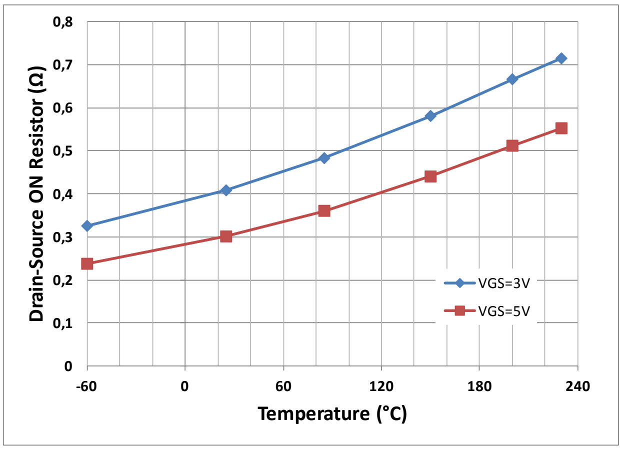


Figure 4. Drain-Source ON Resistance ($R_{DS(on)}$) vs Case Temperature. V_{DS}=50mV.

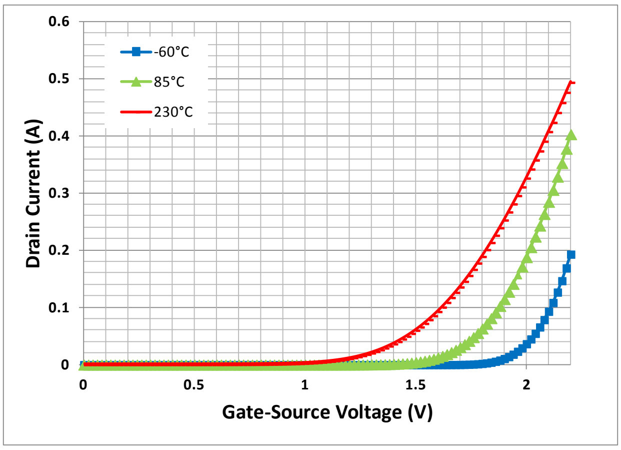


Figure 5. Drain Current (I_{DS}) vs Gate-Source Voltage for several case temperatures. V_{GS}=V_{DS}

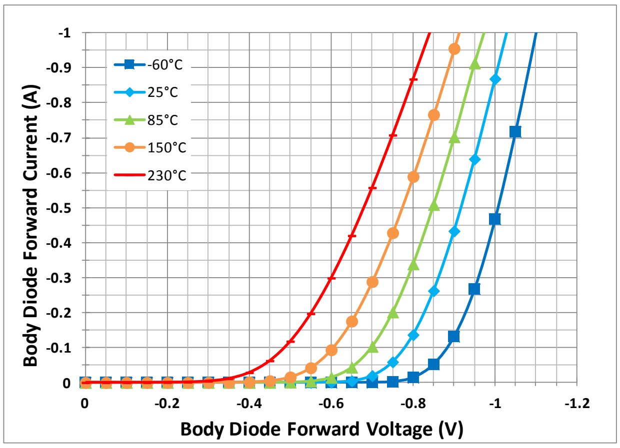


Figure 6. Body Diode Forward Current (I_{FD}) vs Forward Voltage for several case temperatures. V_{GS}=0V.

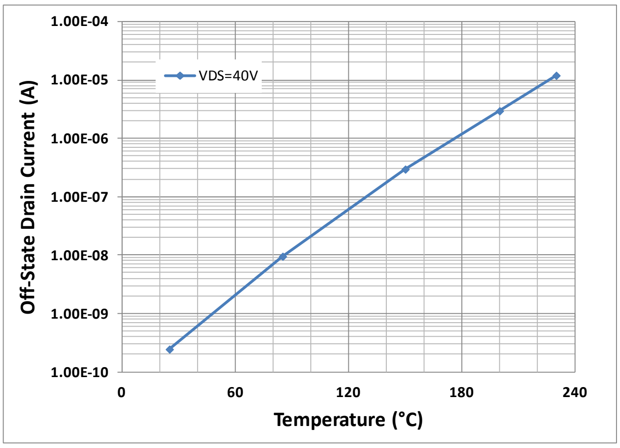


Figure 7. Off-State Drain Current (I_{DSS}) vs Case Temperature. V_{DS}=40V, V_{GS}=0V.

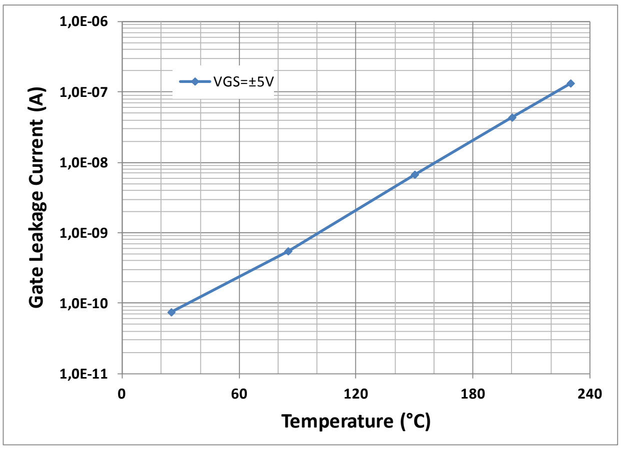


Figure 8. Gate Leakage Current (I_{GSS}) vs Case Temperature. V_{GS}=±5V, V_{DS}=0V.

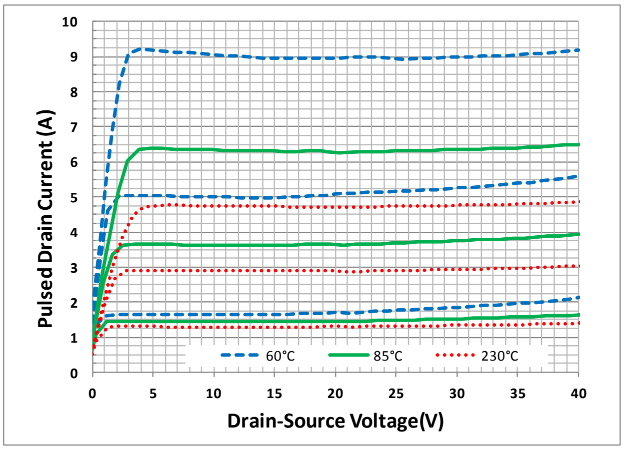


Figure 9. Pulsed Drain Current (I_{DM}) vs Drain-Source Voltage for several case temperatures. V_{GS}=3V, 4V and 5V.

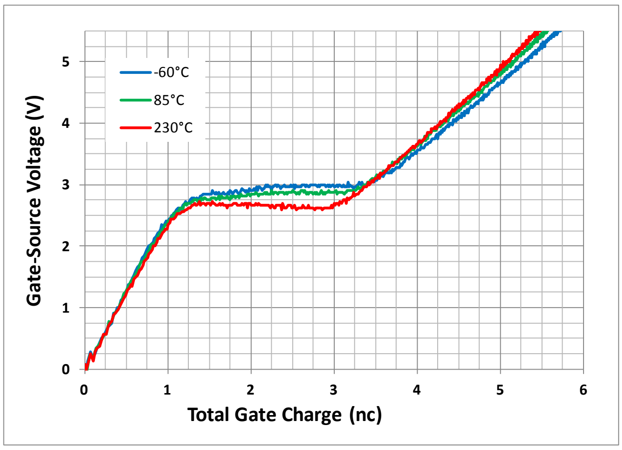


Figure 10. Total Gate Charge (Q_g) vs Gate-Source Voltage for several case temperatures. I_{DS}=900mA.

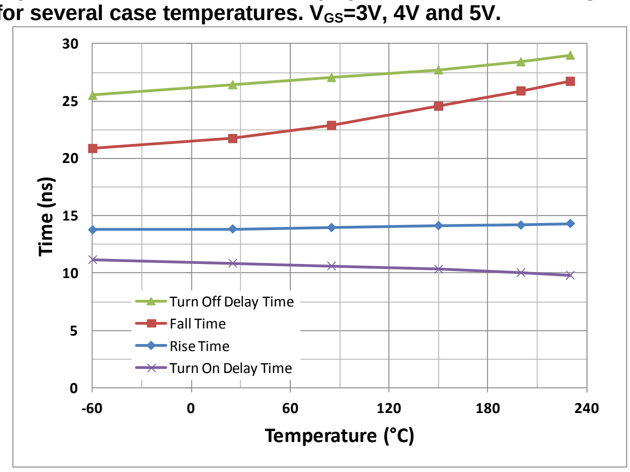


Figure 11. Timing Characteristics vs Case Temperature. V_{DS}=20V, $V_{GS\ sweep}$= 0 to 5V.

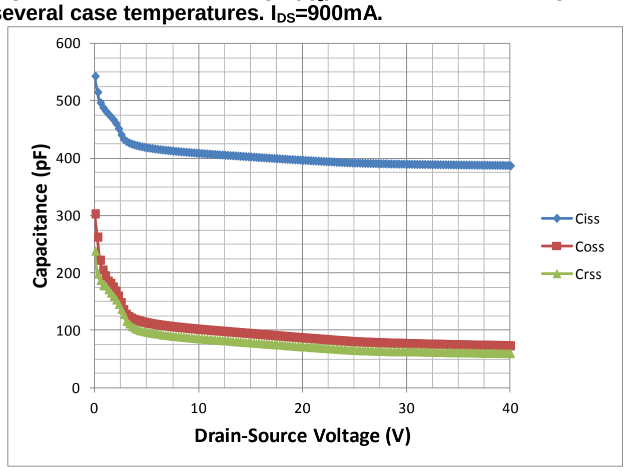


Figure 12. Capacitance vs Drain-Source Voltage at Tc=25°C.

XTR2N0450 TYPICAL PERFORMANCE

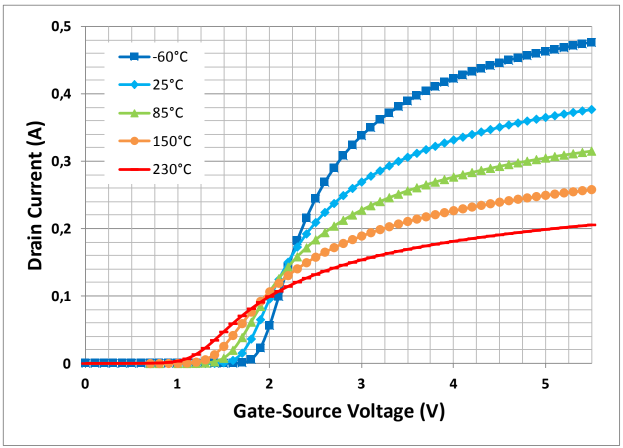


Figure 13. Drain Current (I_{DS}) vs Gate-Source Voltage for several case temperatures. V_{DS}=50mV.

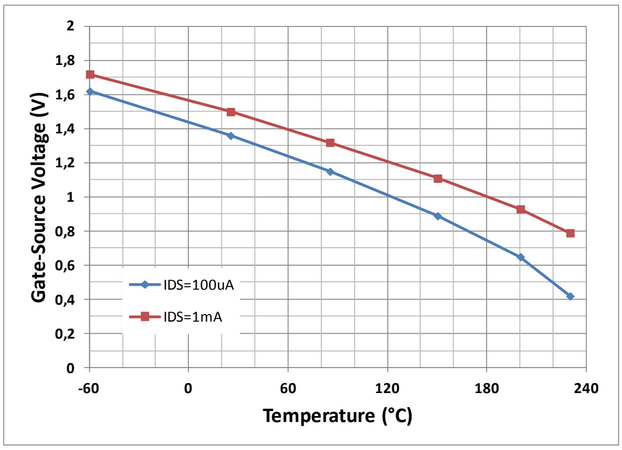


Figure 14. Gate-Source Threshold Voltage ($V_{GS(th)}$) vs Case Temperature. V_{GS}= V_{DS}.

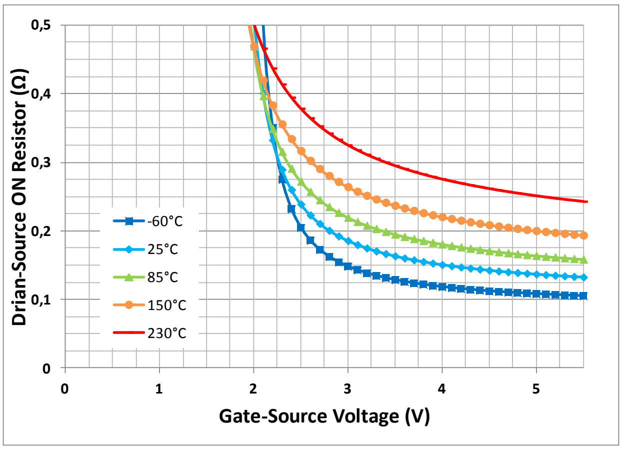


Figure 15. Drain-Source ON Resistance ($R_{DS(on)}$) vs Gate-Source Voltage for several case temperatures. V_{DS}=50mV.

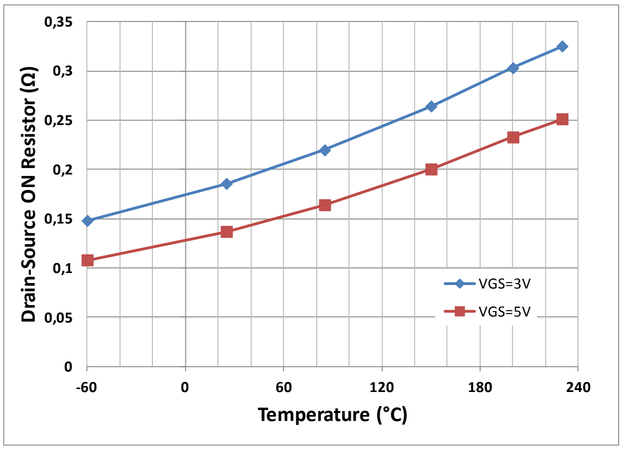


Figure 16. Drain-Source ON Resistance ($R_{DS(on)}$) vs Case Temperature. V_{DS}=50mV.

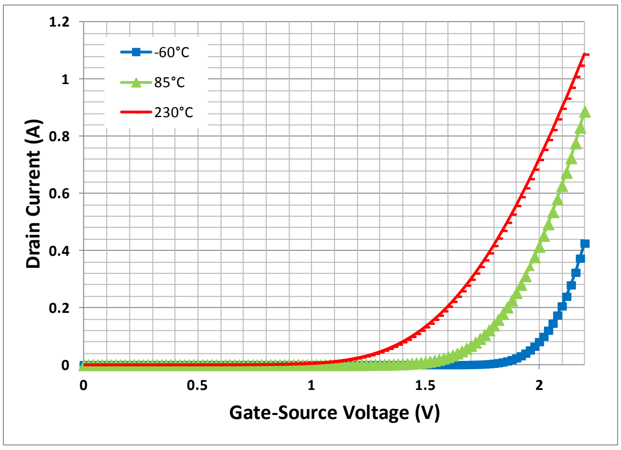


Figure 17. Drain Current (I_{DS}) vs Gate-Source Voltage for several case temperatures. V_{GS}=V_{DS}

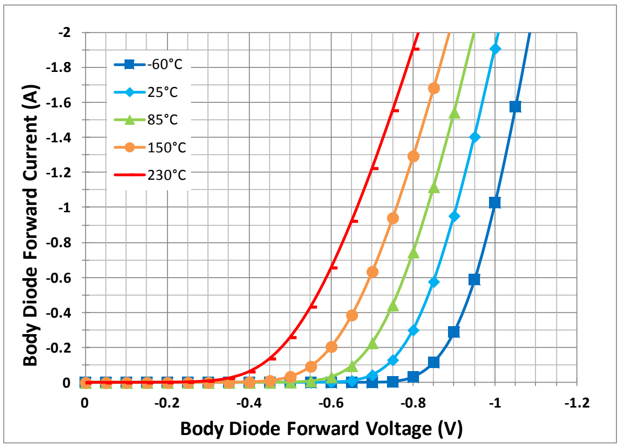


Figure 18. Body Diode Forward Current (I_{FD}) vs Forward Voltage for several case temperature. V_{GS}=0V.

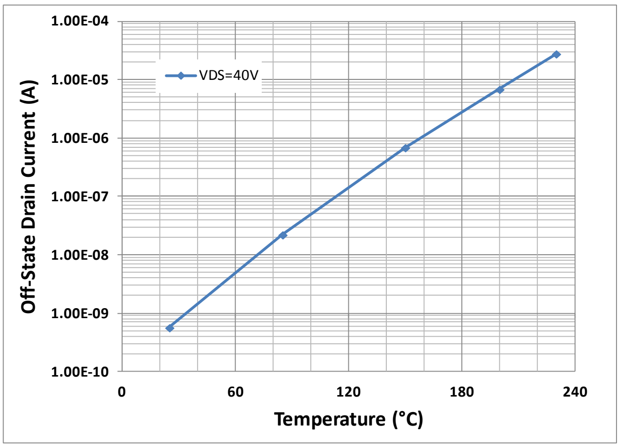


Figure 19. Off-State Drain Current (I_{DSS}) vs Case Temperature. V_{DS}=40V, V_{GS}=0V.

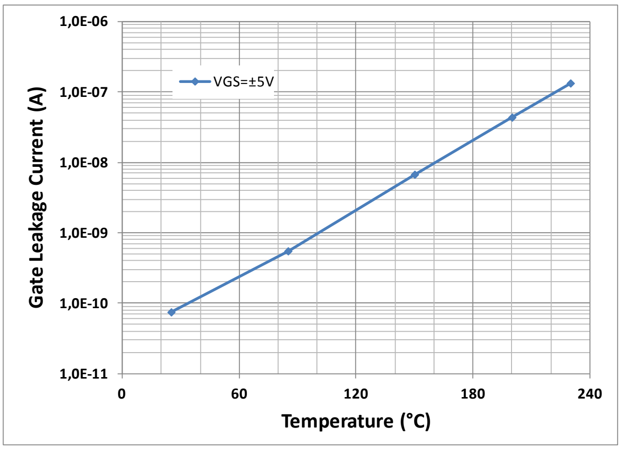


Figure 20. Gate Leakage Current (I_{GSS}) vs Case Temperature. V_{GS}=±5V, V_{DS}=0V.

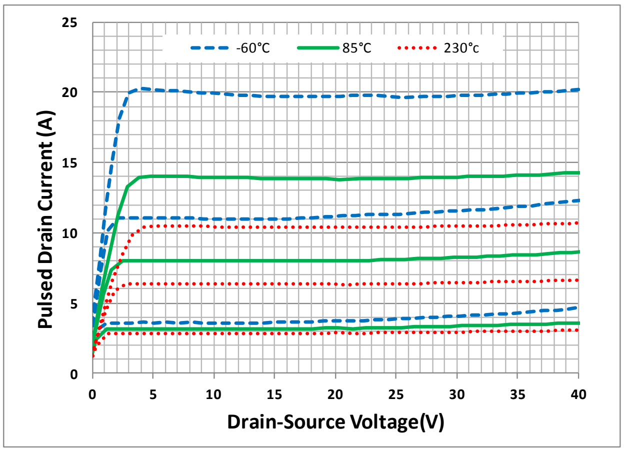


Figure 21. Pulsed Drain Current (I_{DM}) vs Drain-Source Voltage for several case temperatures. V_{GS}=3V, 4V and 5V.

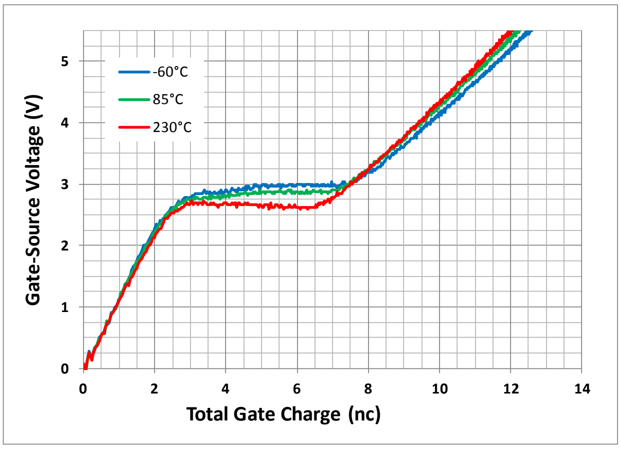


Figure 22. Total Gate Charge (Q_g) vs Gate-Source Voltage for several case temperatures. I_{DS}=900mA.

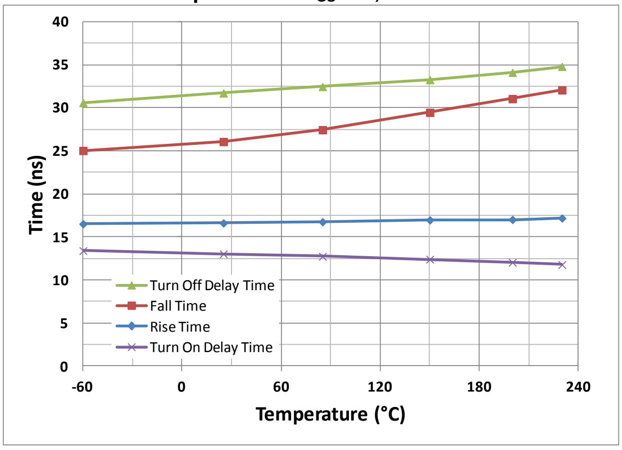


Figure 23. Timing Characteristics vs Case Temperature. V_{DS}=20V, $V_{GS\ sweep}$= 0 to 5V.

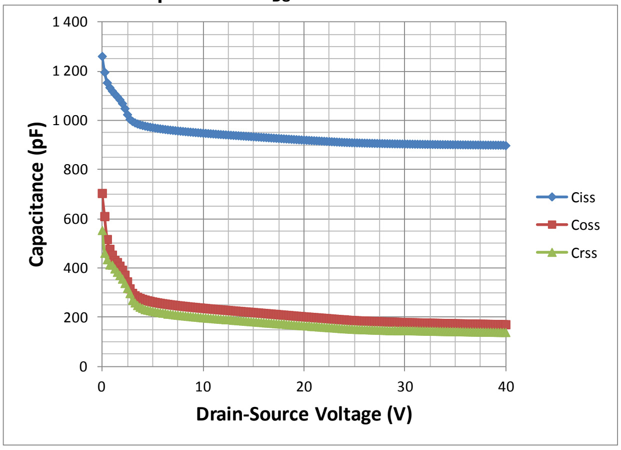


Figure 24. Capacitance vs Drain-Source Voltage at Tc=25°C.

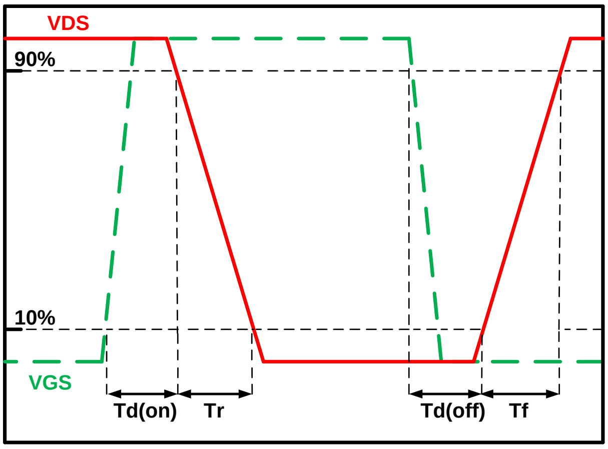
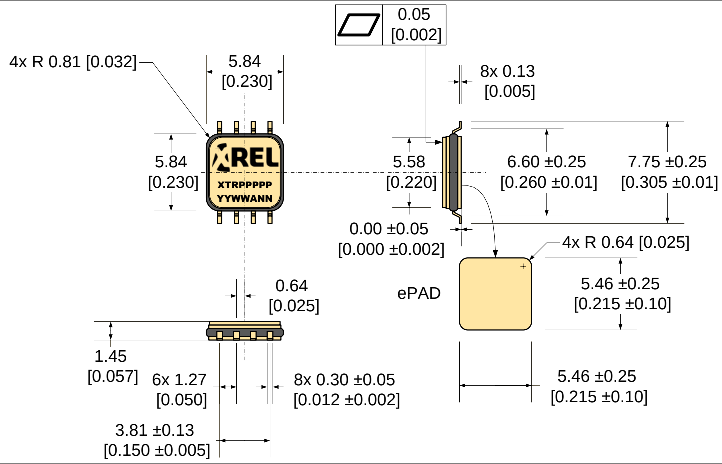


Figure 25. Timing diagram definition.

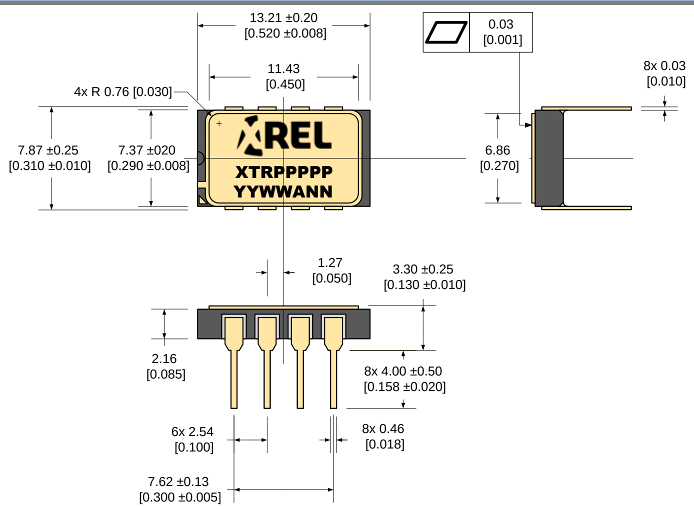
PACKAGE OUTLINES

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

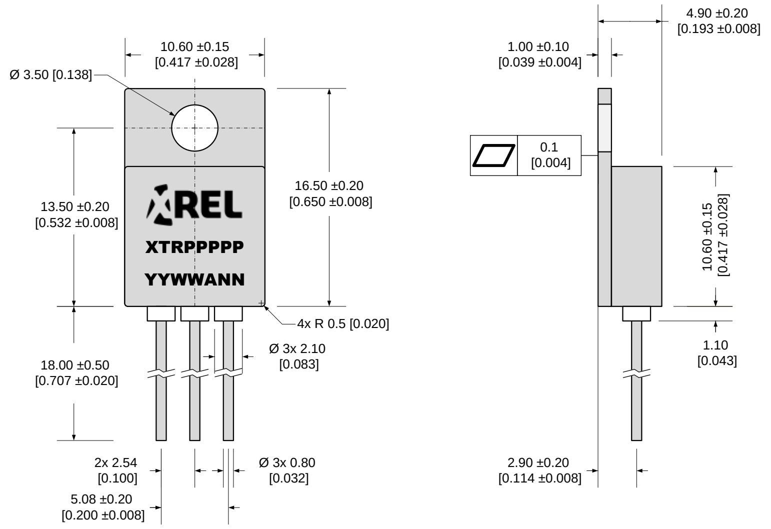
Ceramic Gull-wing Flat pack with ePad DFP8



Ceramic Side Brazed Dual In-line DIP8



TO-257AA (TO-220M)



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. 15 = 2015).
WW	Assembly week (01 to 52).
A	Assembly location code.
NN	Assembly lot code (01 to 99).

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