

## AUTOMOTIVE N-Channel 40V 175°C MOSFET

### FEATURES

- AEC-Q101 Qualified
- 100% UIS and R<sub>g</sub> Tested
- 175°C Operating Junction Temperature
- Wettable Flank Package
- RoHS Compliant
- Halogen-free according to IEC 61249-2-21

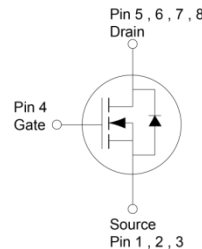
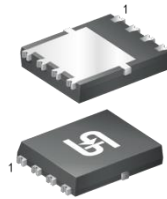
### APPLICATIONS

- 12V Automotive Systems
- Solenoid and Motor Control
- Automotive Transmission Control
- DC-DC Converters

PRODUCT SUMMARY		
PARAMETER	VALUE	UNIT
V <sub>DS</sub>	40	V
R <sub>DS(on)</sub> (max)	V <sub>GS</sub> = 10V	3.3
	V <sub>GS</sub> = 7V	5.1
Q <sub>g</sub>	87	nC



PDFN56U



Note: MSL 1 (Moisture Sensitivity Level) per J-STD-020

ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25°C unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V <sub>DS</sub>	40	V
Gate-Source Voltage	V <sub>GS</sub>	±20	V
Continuous Drain Current (Note 1)	I <sub>D</sub>	T <sub>C</sub> = 25°C	121
		T <sub>A</sub> = 25°C	21
Pulsed Drain Current	I <sub>DM</sub>	484	A
Single Pulse Avalanche Current (Note 2)	I <sub>AS</sub>	36	A
Single Pulse Avalanche Energy (Note 2)	E <sub>AS</sub>	194	mJ
Total Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25°C	107
		T <sub>C</sub> = 125°C	36
Total Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = 25°C	3.1
		T <sub>A</sub> = 125°C	1
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	- 55 to +175	°C

THERMAL RESISTANCE			
PARAMETER	SYMBOL	MAXIMUM	UNIT
Thermal Resistance – Junction to Case	R <sub>θJC</sub>	1.4	°C/W
Thermal Resistance – Junction to Ambient	R <sub>θJA</sub>	48	°C/W

**Thermal Performance Note:** R<sub>θJA</sub> is the sum of the junction-to-case and case-to-ambient thermal resistances. The case-thermal reference is defined at the solder mounting surface of the drain pins. R<sub>θJC</sub> is guaranteed by design while R<sub>θCA</sub> is determined by the user's board design. The R<sub>θJA</sub> limit presented here is based on mounting on a 1 in<sup>2</sup> pad of 2 oz copper.

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)						
PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$	$BV_{DSS}$	40	--	--	V
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	$V_{GS(TH)}$	1.8	2.5	3.8	V
Gate-Source Leakage Current	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$	$I_{GSS}$	--	--	$\pm 100$	nA
Drain-Source Leakage Current	$V_{GS} = 0\text{V}, V_{DS} = 40\text{V}$	$I_{DSS}$	--	--	1	$\mu\text{A}$
	$V_{GS} = 0\text{V}, V_{DS} = 40\text{V}$ $T_J = 125^\circ\text{C}$		--	--	100	
	$V_{GS} = 0\text{V}, V_{DS} = 40\text{V}$ $T_J = 175^\circ\text{C}$		--	--	500	
Drain-Source On-State Resistance (Note 3)	$V_{GS} = 10\text{V}, I_D = 21\text{A}$	$R_{DS(on)}$	--	2.2	3.3	m $\Omega$
	$V_{GS} = 10\text{V}, I_D = 21\text{A},$ $T_J = 125^\circ\text{C}$		--	3.8	5.7	
	$V_{GS} = 10\text{V}, I_D = 21\text{A},$ $T_J = 175^\circ\text{C}$		--	4.8	7.3	
	$V_{GS} = 7\text{V}, I_D = 17\text{A}$		--	2.5	5.1	
Forward Transconductance (Note 3)	$V_{DS} = 10\text{V}, I_D = 21\text{A}$	$g_{fs}$	--	68	--	S
<b>Dynamic</b> (Note 4)						
Total Gate Charge	$V_{GS} = 10\text{V}, V_{DS} = 20\text{V},$ $I_D = 21\text{A}$	$Q_g$	--	87	--	nC
Total Gate Charge	$V_{GS} = 7\text{V}, V_{DS} = 20\text{V},$ $I_D = 17\text{A}$	$Q_g$	--	64	--	
Gate-Source Charge		$Q_{gs}$	--	20	--	
Gate-Drain Charge		$Q_{gd}$	--	23	--	
Input Capacitance	$V_{GS} = 0\text{V}, V_{DS} = 20\text{V},$ $f = 1.0\text{MHz}$	$C_{iss}$	--	4917	--	pF
Output Capacitance		$C_{oss}$	--	484	--	
Reverse Transfer Capacitance		$C_{rss}$	--	276	--	
Gate Resistance	$f = 1.0\text{MHz}$	$R_g$	0.5	1.7	3.4	$\Omega$
<b>Switching</b> (Note 4)						
Turn-On Delay Time	$V_{GS} = 10\text{V}, V_{DS} = 20\text{V},$ $I_D = 21\text{A}, R_G = 2\Omega$	$t_{d(on)}$	--	10	--	ns
Rise Time		$t_r$	--	24	--	
Turn-Off Delay Time		$t_{d(off)}$	--	49	--	
Fall Time		$t_f$	--	23	--	
<b>Source-Drain Diode</b>						
Diode Forward Voltage (Note 3)	$V_{GS} = 0\text{V}, I_S = 21\text{A}$	$V_{SD}$	--	--	1	V
Reverse Recovery Time	$I_S = 21\text{A},$ $di/dt = 100\text{A}/\mu\text{s}$	$t_{rr}$	--	30	--	ns
Reverse Recovery Charge		$Q_{rr}$	--	20	--	nC

**Notes:**

1. Silicon limited current only.
2.  $L = 0.3\text{mH}, V_{GS} = 10\text{V}, V_{DD} = 25\text{V}, R_G = 50\Omega, I_{AS} = 36\text{A},$  Starting  $T_J = 25^\circ\text{C}$
3. Pulse test: Pulse Width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
4. Switching time is essentially independent of operating temperature.

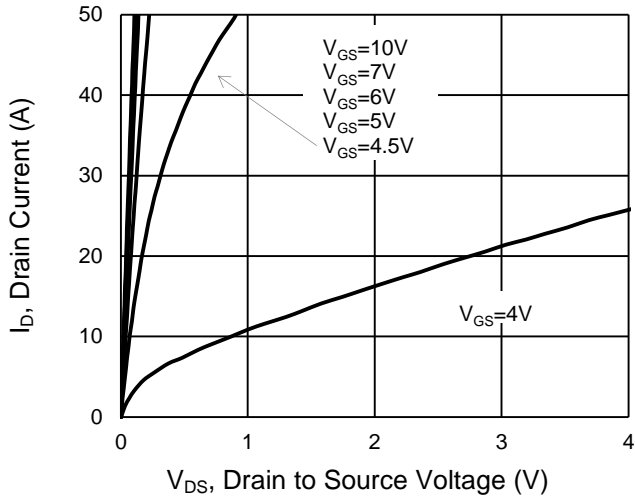
**ORDERING INFORMATION**

<b>ORDERING CODE</b>	<b>PACKAGE</b>	<b>PACKING</b>
TQM033NB04CR RLG	PDFN56U	2,500pcs / 13" Reel

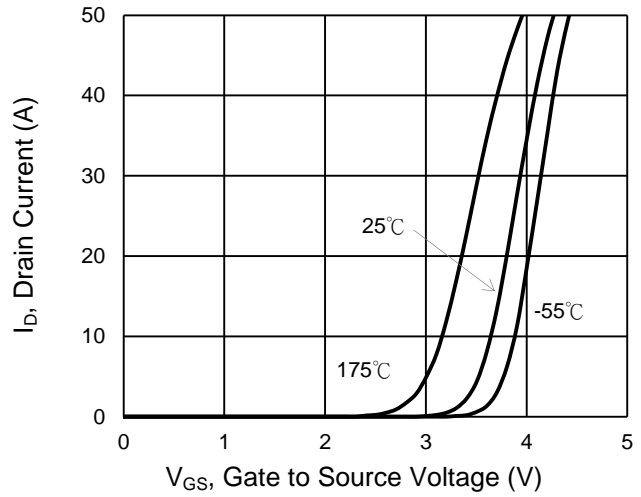
**CHARACTERISTICS CURVES**

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

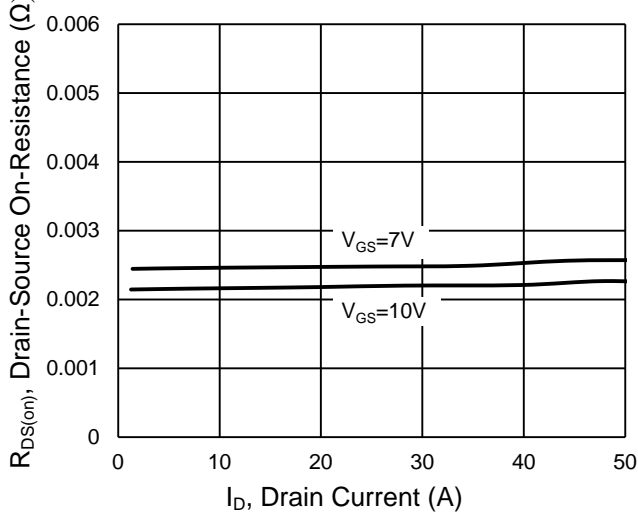
**Output Characteristics**



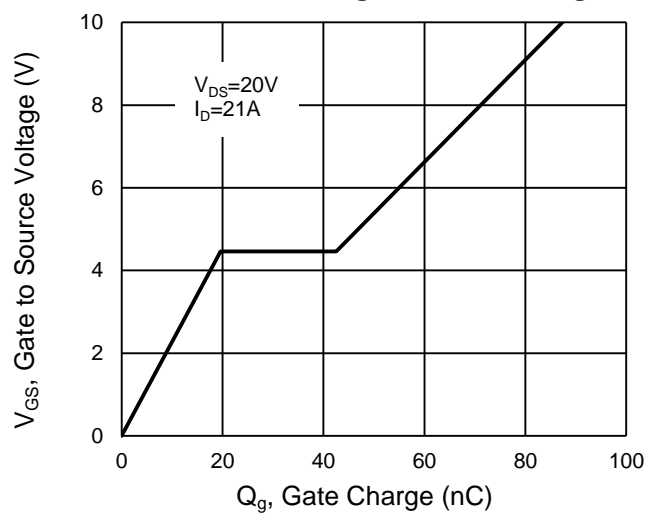
**Transfer Characteristics**



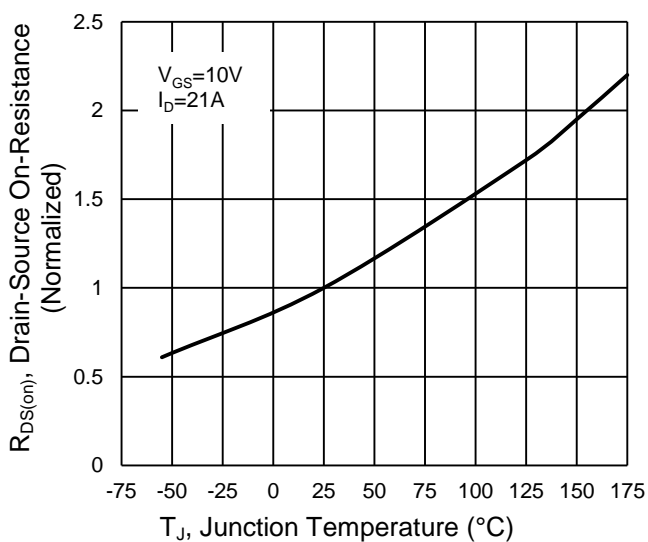
**On-Resistance vs. Drain Current**



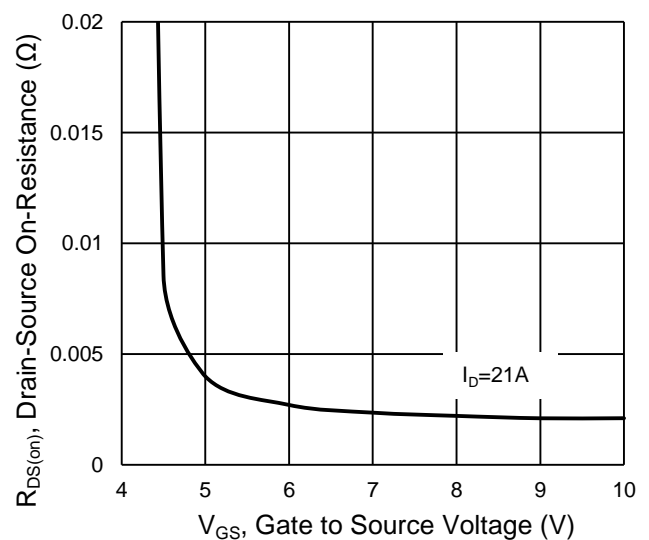
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**

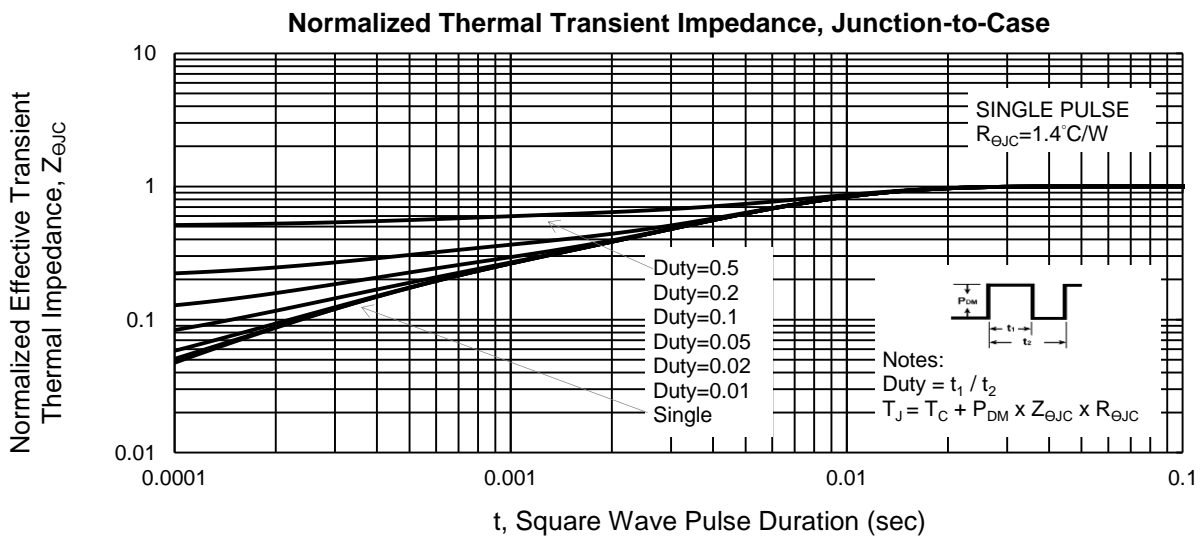
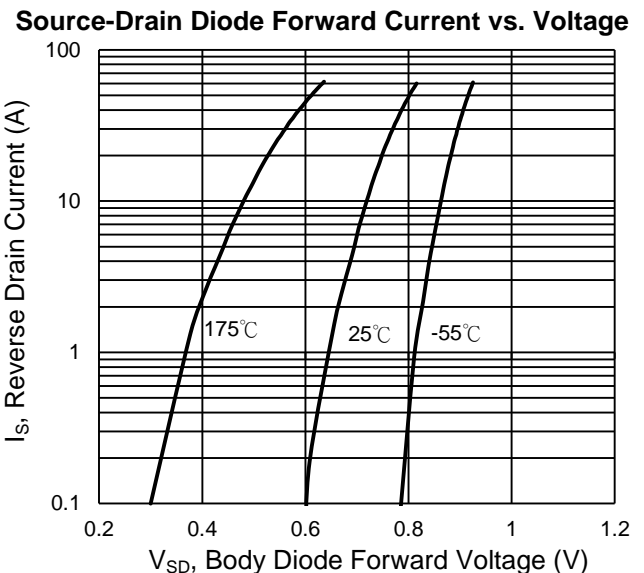
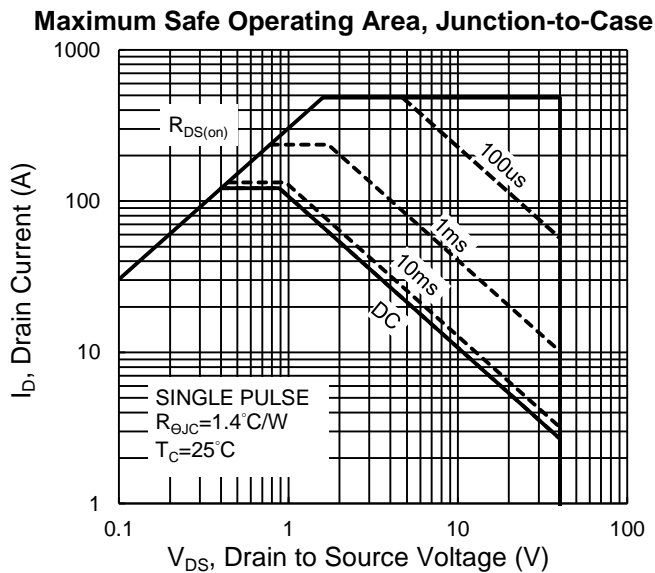
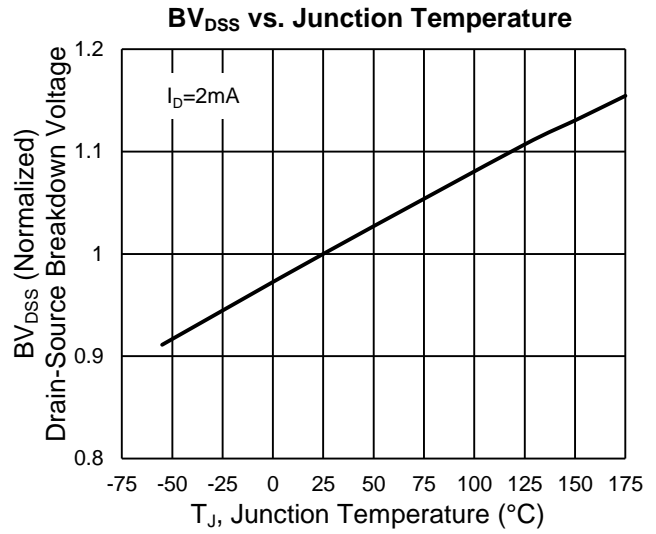
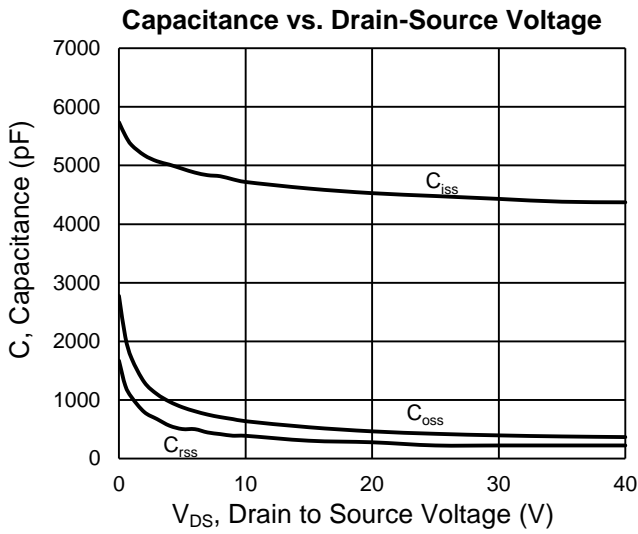


**On-Resistance vs. Gate-Source Voltage**



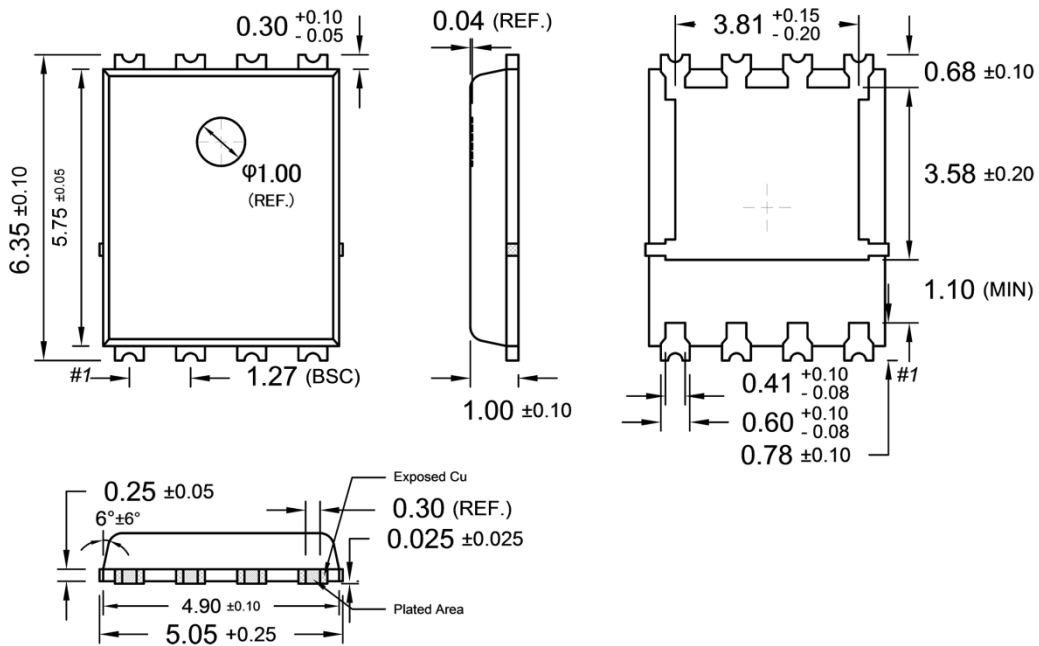
**CHARACTERISTICS CURVES**

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

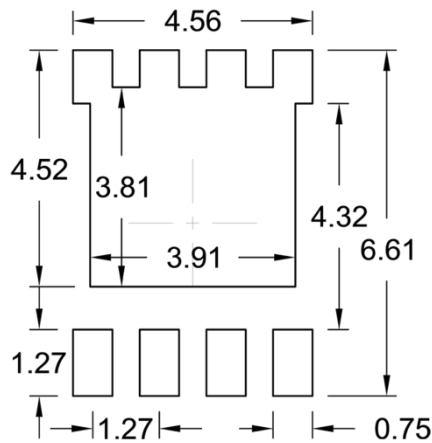


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

**PDFN56U**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



- Y** = Year Code
- WW** = Week Code (01~52)
- L** = Lot Code (1~9, A~Z)
- F** = Factory Code
- = AEC-Q101 Qualified

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