NDF10N60Z, NDP10N60Z

N-Channel Power MOSFET 600 V, 0.65 Ω

Features

- Low ON Resistance
- Low Gate Charge
- Zener Diode−protected Gate
- 100% Avalanche Tested
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	NDF10N60Z	NDP10N60Z	Unit
Drain−to−Source Voltage	V_{DSS}	600		V
Continuous Drain Current, $R_{\theta JC}$	I_D	10 (Note 2)		A
Continuous Drain Current T_A = 100°C, $R_{\theta JC}$	I_D	5.7 (Note 2)		A
Pulsed Drain Current, V_{GS} @ 10 V	I_{DM}	36 (Note 2)		A
Power Dissipation, $R_{\theta JC}$ (Note 1)	P_D	36	125	W
Gate−to−Source Voltage	V_{GS}	±30		V
Single Pulse Avalanche Energy, L = 6.0 mH, I_D = 10 A	E_{AS}	300		mJ
ESD (HBM) (JESD22−A114)	V_{esd}	3900		V
RMS Isolation Voltage (t = 0.3 sec., R.H. ≤ 30%, T_A = 25°C) (Figure 13)	V_{ISO}	4500		V
Peak Diode Recovery	dv/dt	4.5 (Note 3)		V/ns
Continuous Source Current (Body Diode)	I_S	10		A
Maximum Temperature for Soldering Leads	T_L	260		°C
Operating Junction and Storage Temperature Range	T_J, T_{stg}	−55 to 150		°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface mounted on FR4 board using 1″ sq. pad size, 1 oz cu
2. Limited by maximum junction temperature
3. $I_S \le 10$ A, di/dt ≤ 200 A/μs, V_{DD} = 80% BV_{DSS}

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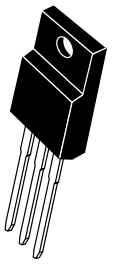
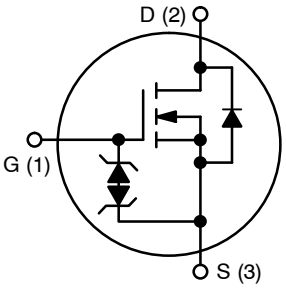
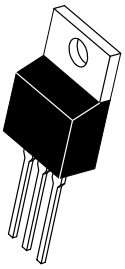
V_{DSS}	$R_{DS(ON)}$ (TYP) @ 5 A
600 V	0.65 Ω



TO−220FP
CASE 221D
STYLE 1

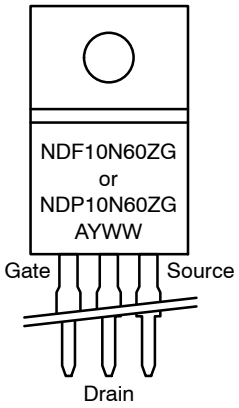
N−Channel





TO−220AB
CASE 221A
STYLE 5

MARKING DIAGRAM



A = Location Code
Y = Year
WW = Work Week
G = Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping
NDF10N60ZG	TO−220FP	50 Units/Rail
NDP10N60ZG	TO−220AB	In Development

THERMAL RESISTANCE

Parameter	Symbol	NDF10N60Z	NDP10N60Z	Unit
Junction−to−Case (Drain)	$R_{\theta JC}$	3.4	1.0	°C/W
Junction−to−Ambient Steady State (Note 4)	$R_{\theta JA}$	50	50	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic	Test Conditions		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain−to−Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA		BV_{DSS}	600			V
Breakdown Voltage Temperature Coefficient	Reference to 25°C, I_D = 1 mA		$\Delta BV_{DSS}/\Delta T_J$		0.6		V/°C
Drain−to−Source Leakage Current	V_{DS} = 600 V, V_{GS} = 0 V	25°C	I_{DSS}			1	μA
		150°C				50	
Gate−to−Source Forward Leakage	V_{GS} = ±20 V		I_{GSS}			±10	μA
ON CHARACTERISTICS (Note 5)							
Static Drain−to−Source On−Resistance	V_{GS} = 10 V, I_D = 5.0 A		$R_{DS(on)}$		0.65	0.75	Ω
Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 100 μA		$V_{GS(th)}$	3.0		4.5	V
Forward Transconductance	V_{DS} = 15 V, I_D = 10 A		g_{FS}		7.9		S
DYNAMIC CHARACTERISTICS							
Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz		C_{iss}		1425		pF
Output Capacitance			C_{oss}		150		
Reverse Transfer Capacitance			C_{rss}		35		
Total Gate Charge	V_{DD} = 300 V, I_D = 10 A, V_{GS} = 10 V		Q_g		47		nC
Gate−to−Source Charge			Q_{gs}		9.0		
Gate−to−Drain (“Miller”) Charge			Q_{gd}		26		
Gate Resistance			R_g		1.5		Ω
RESISTIVE SWITCHING CHARACTERISTICS							
Turn−On Delay Time	V_{DD} = 300 V, I_D = 10 A, V_{GS} = 10 V, R_G = 5 Ω		$t_{d(on)}$		15		ns
Rise Time			t_r		31		
Turn−Off Delay Time			$t_{d(off)}$		40		
Fall Time			t_f		23		
SOURCE−DRAIN DIODE CHARACTERISTICS (T_C = 25°C unless otherwise noted)							
Diode Forward Voltage	I_S = 10 A, V_{GS} = 0 V		V_{SD}			1.6	V
Reverse Recovery Time	V_{GS} = 0 V, V_{DD} = 30 V, I_S = 10 A, di/dt = 100 A/μs		t_{rr}		395		ns
Reverse Recovery Charge			Q_{rr}		3.0		μC

4. Insertion mounted
5. Pulse Width ≤ 380 μs, Duty Cycle ≤ 2%.

TYPICAL CHARACTERISTICS

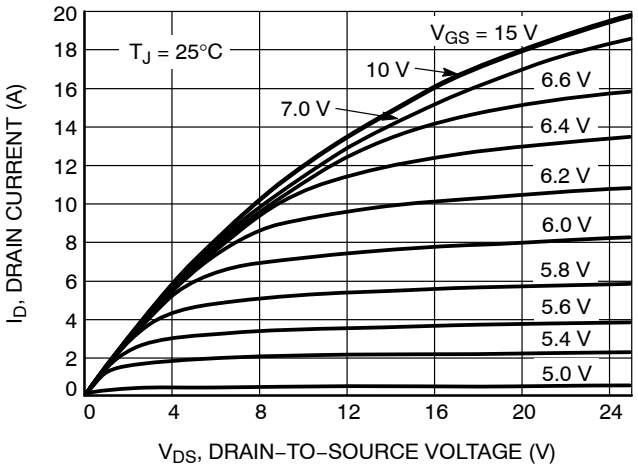


Figure 1. On−Region Characteristics

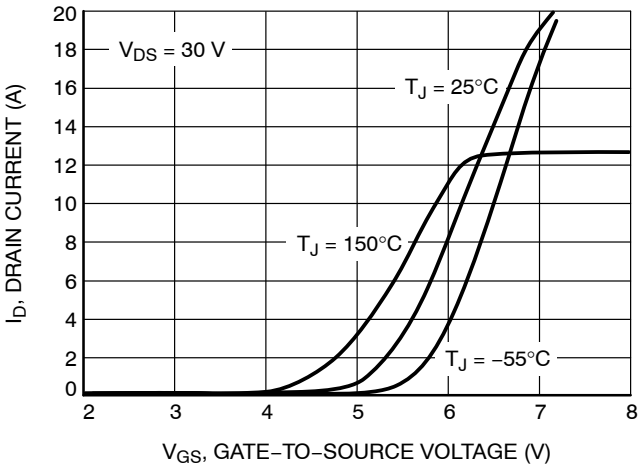


Figure 2. Transfer Characteristics

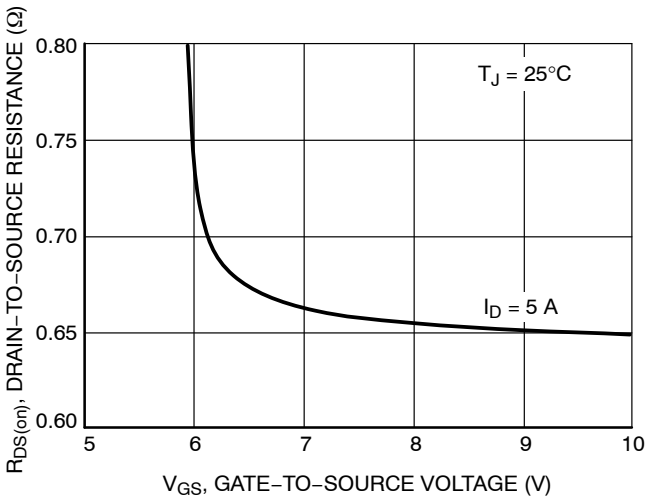


Figure 3. On−Resistance vs. Gate Voltage

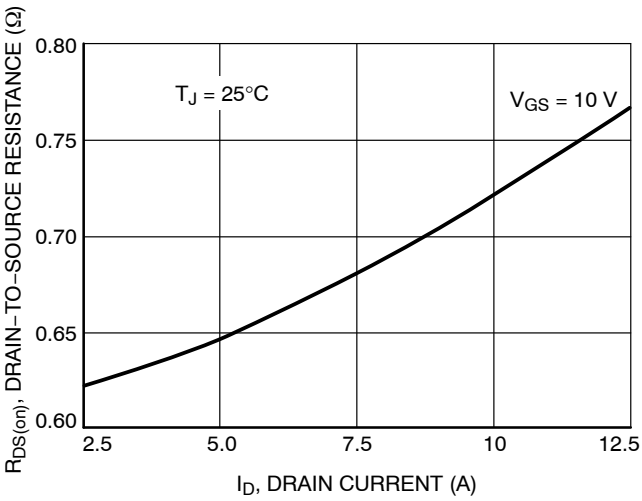


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

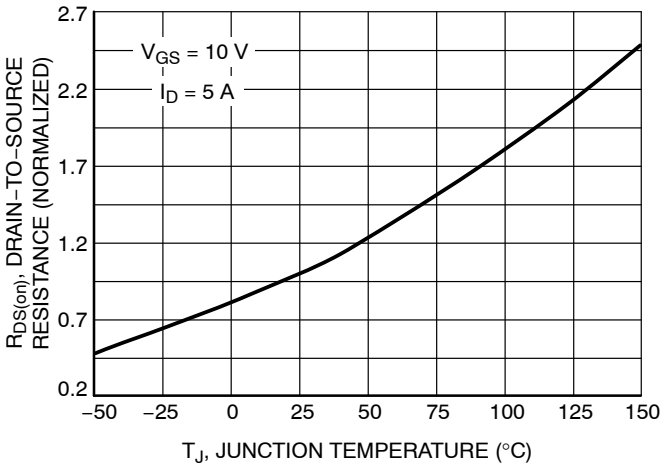


Figure 5. On−Resistance Variation with Temperature

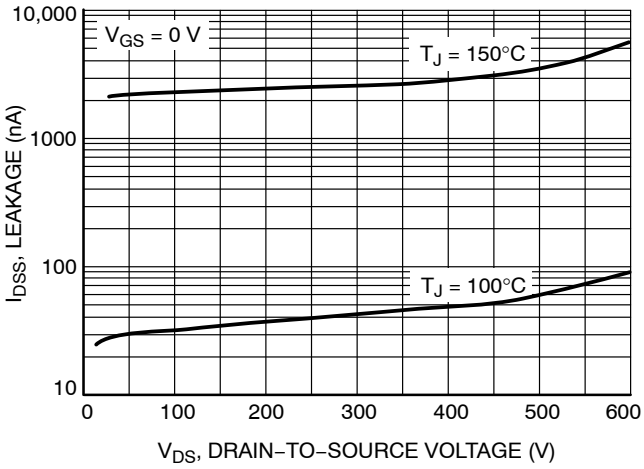


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

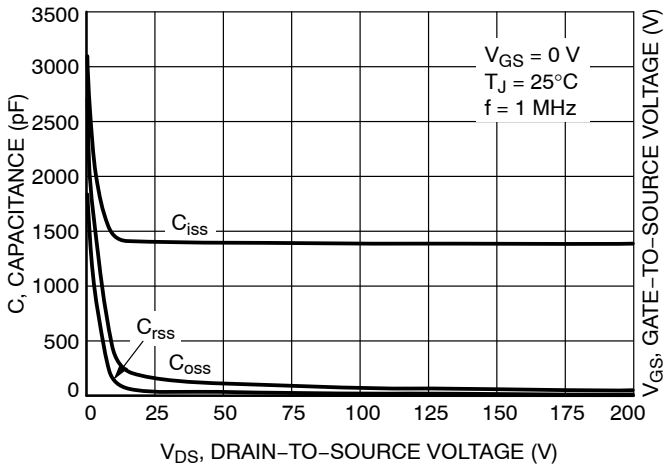


Figure 7. Capacitance Variation

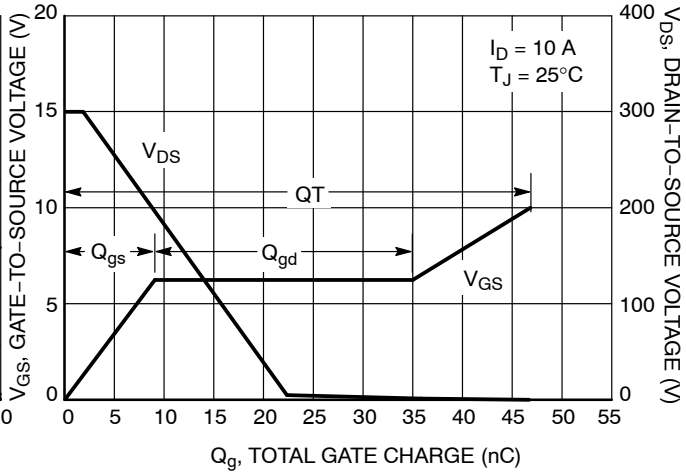


Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge

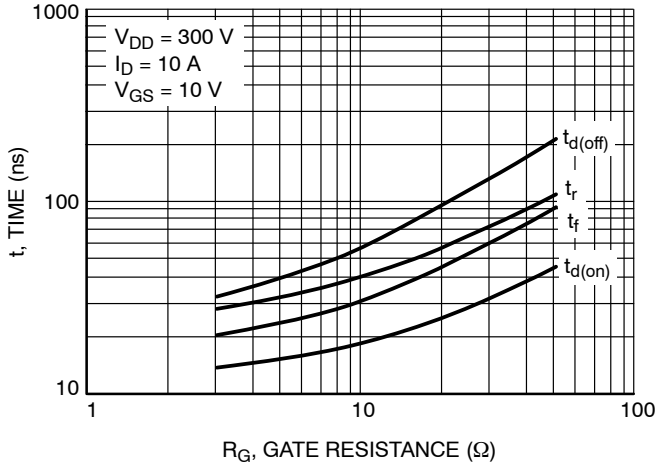


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

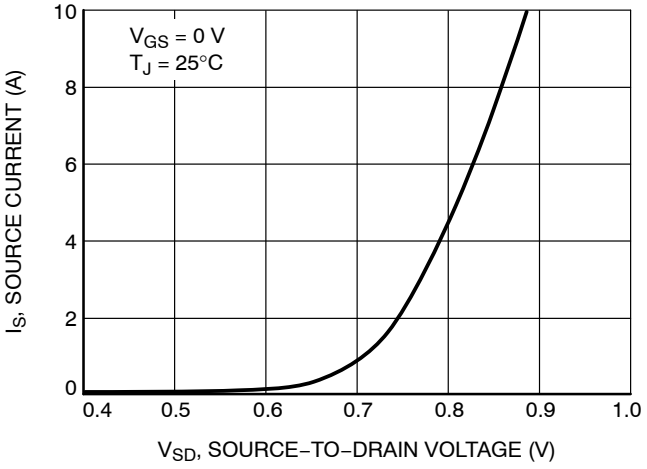
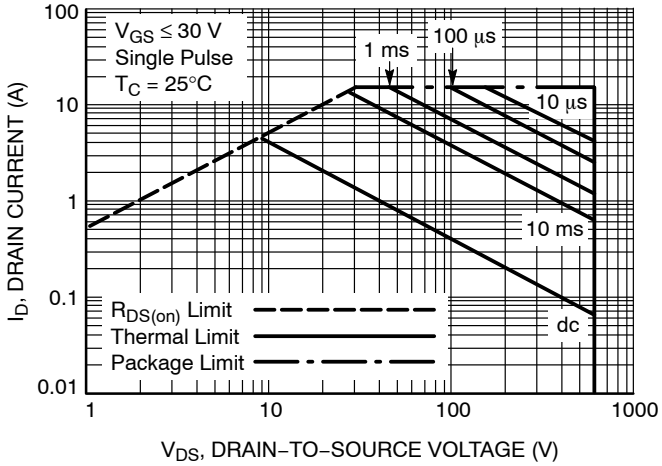


Figure 10. Diode Source Current vs. Forward Voltage



Mounted on 2″ sq. FR4 board (1″ sq. 2 oz. Cu 0.06″ thick single sided) with one die operating

Figure 11. Maximum Rated Forward Biased Safe Operating Area for NDF10N60Z

TYPICAL CHARACTERISTICS

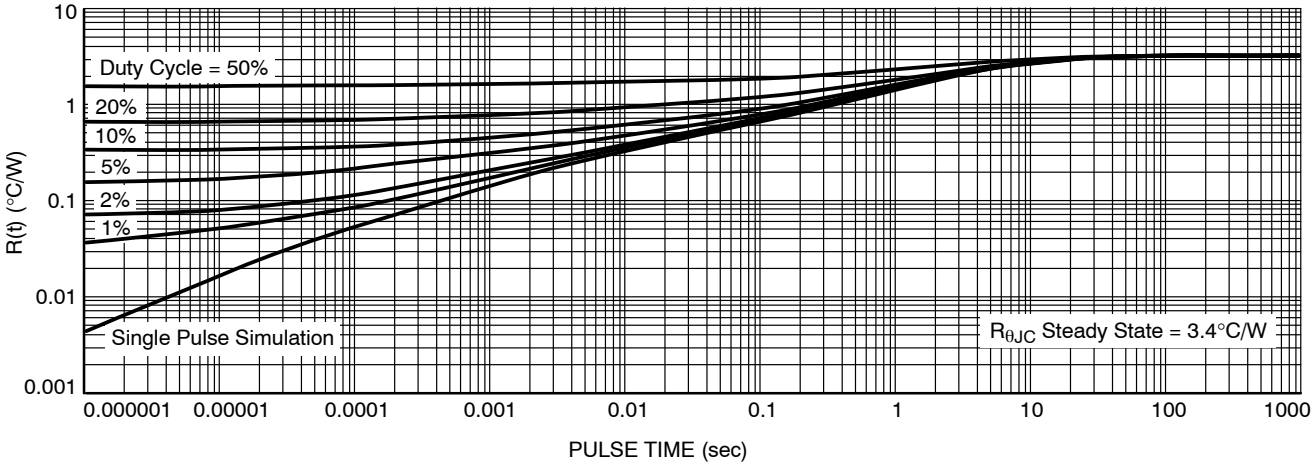


Figure 12. Thermal Impedance for NDF10N60Z

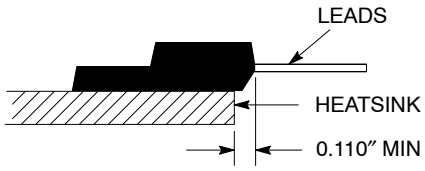


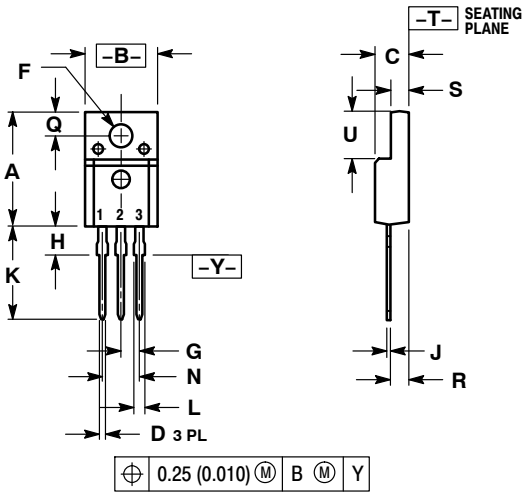
Figure 13. Mounting Position for Isolation Test

Measurement made between leads and heatsink with all leads shorted together.

*For additional mounting information, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

TO−220FP
CASE 221D−03
ISSUE K

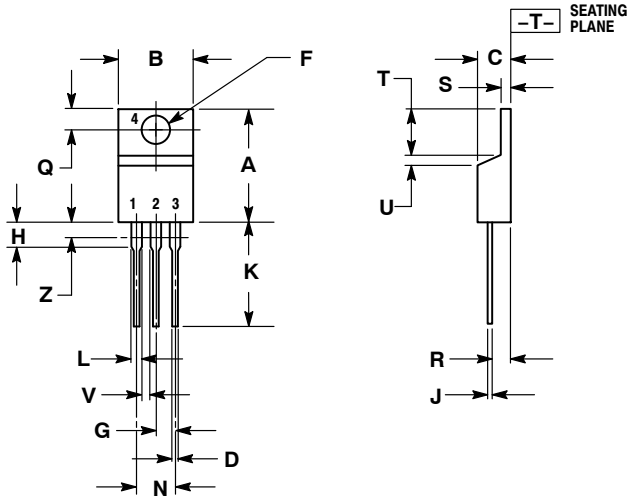


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D−01 THRU 221D−02 OBSOLETE, NEW STANDARD 221D−03.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88

STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE

TO−220AB
CASE 221A−09
ISSUE AE



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.161	3.61	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.014	0.025	0.36	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

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