TEMIC
Semiconductors

ND2012L/2020L

N-Channel Depletion-Mode MOSFET Transistors

Product Summary

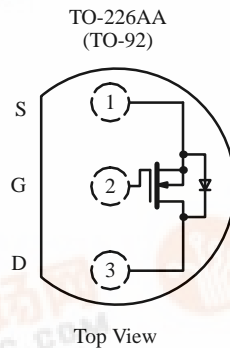| Part Number	$V_{(BR)DSV}$ Min (V)	$r_{DS(on)}$ Max (Ω)	$V_{GS(off)}$ (V)	I_D (A)
ND2012L	200	12	–1.5 to –4	0.16
ND2020L	200	20	–0.5 to –2.5	0.132

Features

- High Breakdown Voltage: 220 V
- Normally "On" Low r_{DS} Switch: 9 Ω
- Low Input and Output Leakage
- Low-Power Drive Requirement
- Low Input Capacitance

Benefits

- Full-Voltage Operation
- Low Offset Voltage
- Low Error Voltage
- Easily Driven Without Buffer
- High-Speed Switching

Applications

- Normally "On" Switching Circuits
- Current Sources/Limiters
- Power Supply, Converter Circuits
- Solid-State Relays
- Telecom Switches

TO-226AA
(TO-92)

Top View

Absolute Maximum Ratings ($T_A = 25^\circ$C Unless Otherwise Noted)

Parameter		Symbol	ND2012L	ND2020L	Unit
Drain-Source Voltage		V_{DS}	200	200	V
Gate-Source Voltage		V_{GS}	$\pm$ 30	$\pm$ 30	
Continuous Drain Current ($T_J = 150^\circ$C)	$T_A = 25^\circ$C	I_D	0.16	0.132	A
	$T_A = 100^\circ$C		0.1	0.083	
Pulsed Drain Current[a]		I_{DM}	0.8	0.8	
Power Dissipation	$T_A = 25^\circ$C	P_D	0.8	0.8	W
	$T_A = 100^\circ$C		0.32	0.32	
Maximum Junction-to-Ambient		R_{thJA}	156	156	$^\circ$C/W
Operating Junction and Storage Temperature Range		T_J, T_{stg}	–55 to 150		$^\circ$C

Notes
a.   Pulse width limited by maximum junction temperature.

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70197.
Applications information may also be obtained via FaxBack, request document #70612.

ND2012L/2020L
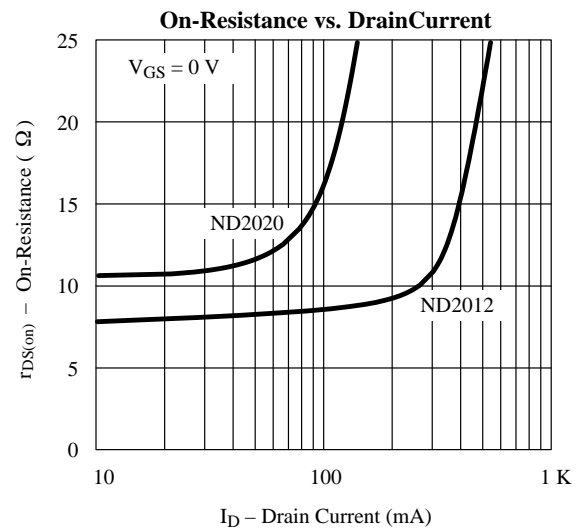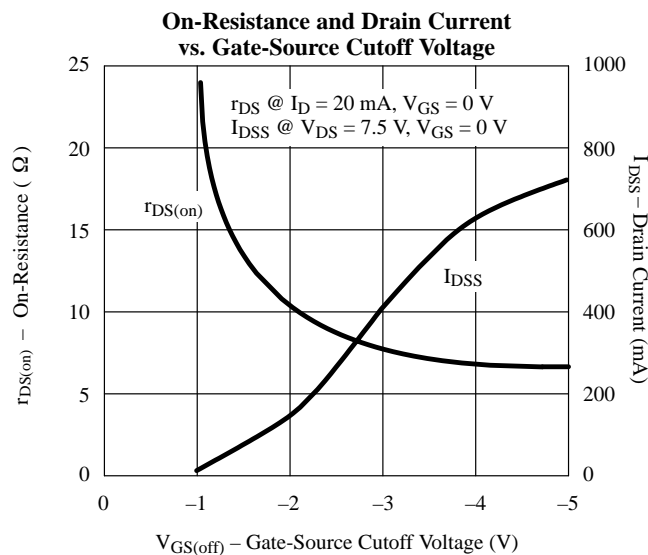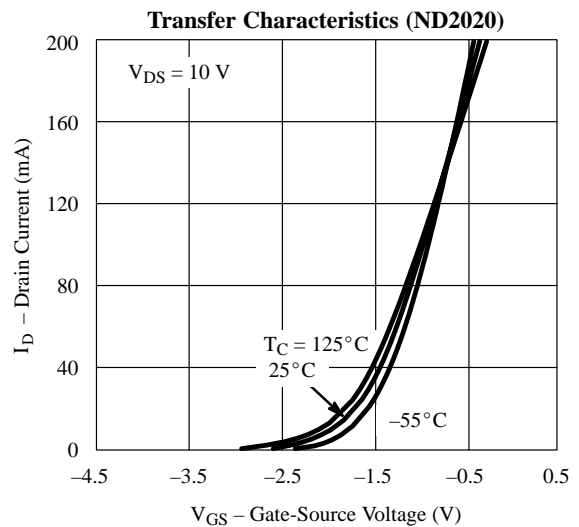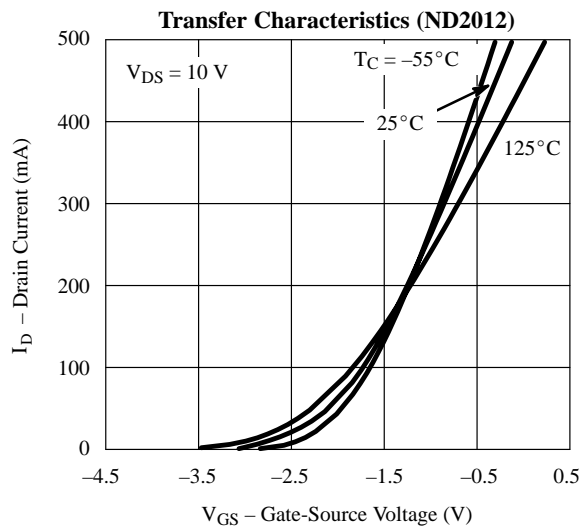
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Specifications[a]

Parameter	Symbol	Test Conditions	Typ[b]	ND2012L Min	ND2012L Max	ND2020L Min	ND2020L Max	Unit
Static								
Drain-Source Breakdown Voltage	$V_{(BR)DSV}$	$V_{GS} = -8$ V, $I_D = 10$ µA	220	200				V
		$V_{GS} = -5$ V, $I_D = 10$ µA	220			200		
Gate-Source Cutoff Voltage	$V_{GS(off)}$	$V_{DS} = 5$ V, $I_D = 10$ µA		-1.5	-4	-0.5	-2.5	
Gate-Body Leakage	I_{GSS}	$V_{DS} = 0$ V, $V_{GS} = \pm 20$ V			± 10		± 10	nA
		$T_J = 125°C$			± 50		± 50	
Drain Cutoff Current	$I_{D(off)}$	$V_{DS} = 160$ V, $V_{GS} = -8$ V			1			µA
		$T_J = 125°C$			200			
		$V_{DS} = 160$ V, $V_{GS} = -5$ V					1	
		$T_J = 125°C$					200	
Drain-Saturation Current[c]	I_{DSS}	$V_{DS} = 10$ V, $V_{GS} = 0$ V	300	30		30		mA
Drain-Source On-Resistance[c]	$r_{DS(on)}$	$V_{GS} = 2$ V, $I_D = 20$ mA	7					Ω
		$V_{GS} = 0$ V, $I_D = 20$ mA	8		12		20	
		$T_J = 125°C$	12.6		30		50	
Forward Transconductance[c]	g_{fs}	$V_{DS} = 7.5$ V, $I_D = 20$ mA	55					mS
Common Source Output Conductance[c]	g_{os}		75					µS
Dynamic								
Input Capacitance	C_{iss}	$V_{DS} = 25$ V, $V_{GS} = -5$ V, $f = 1$ MHz	35		100		100	pF
Output Capacitance	C_{oss}		10		20		20	
Reverse Transfer Capacitance	C_{rss}		2		5		5	
Switching[d]								
Turn-On Time	$t_{d(on)}$	$V_{DD} = 25$ V, $R_L = 1250$ Ω $I_D \cong 20$ mA, $V_{GEN} = -5$ V $R_G = 25$ Ω	20					ns
	t_r		20					
Turn-Off Time	$t_{d(off)}$		10					
	t_f		10					

Notes
a. $T_A = 25°C$ unless otherwise noted.
b.   For DESIGN AID ONLY, not subject to production testing.
c.   Pulse test: PW ≤ 300 µs duty cycle $\leq 2\%$.
d.   Switching time is essentially independent of operating temperature.

VDDQ20

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Typical Characteristics (25°C Unless Otherwise Noted)

Output Characteristics (ND2012)

Output Characteristics (ND2020)

Transfer Characteristics (ND2012)

Transfer Characteristics (ND2020)

On-Resistance and Drain Current vs. Gate-Source Cutoff Voltage

On-Resistance vs. DrainCurrent

Typical Characteristics (25°C Unless Otherwise Noted) (Cont'd)

Normalized On-Resistance vs. Junction Temperature

$V_{GS} = 0$ V
$I_D = 20$ mA

y-axis: $r_{DS(on)}$ – Drain-Source On-Resistance (Normalized)
x-axis: T_J – Junction Temperature (°C)

Forward Transconductance and Output Conductance vs. Drain Current

$V_{DS} = 7.5$ V
Pulse Test
80 ms, 1% Duty Cycle

g_{fs}
g_{os}

y-axis left: g_{fs} – Forward Transconductance (mS)
y-axis right: g_{os} – Output Conductance (μS)
x-axis: I_D – Drain Current (A)

Capacitance

$V_{GS} = -5$ V
f = 1 MHz

C_{iss}
C_{oss}
C_{rss}

y-axis: C – Capacitance (pF)
x-axis: V_{DS} – Drain-to-Source Voltage (V)

Load Condition Effects on Switching

$t_{d(on)}$
$V_{DD} = 25$ V
$V_{GS} = 0$ to -5 V
$R_G = 25$ Ω

t_f
$t_{d(off)}$
t_r

y-axis: t – Switching Time (ns)
x-axis: I_D – Drain Current (A)

Normalized Effective Transient Thermal Impedance, Junction-to-Ambient (TO-226AA)

Duty Cycle = 0.5
0.2
0.1
0.05
0.02
0.01
Single Pulse

Notes:

P_{DM}

t_1
t_2

1. Duty Cycle, $D = \dfrac{t_1}{t_2}$

2. Per Unit Base = $R_{thJA} = 156\,°C/W$

3. $T_{JM} - T_A = P_{DM} Z_{thJA}^{(t)}$

y-axis: Normalized Effective Transient Thermal Impedance
x-axis: t_1 – Square Wave Pulse Duration (sec)