



**THE DATASHEET OF  
NTMS4404NR2**



# NTMS4404N

## Power MOSFET

30 V, 12 A, Single N-Channel, SO-8



ON Semiconductor®

<http://onsemi.com>

### Features

- High Density Power MOSFET with Ultra Low  $R_{DS(on)}$  for Higher Efficiency
- Miniature SO-8 Surface Mount Package Saving Board Space
- $I_{DSS}$  Specified at Elevated Temperature
- Diode Exhibits High Speed, Soft Recovery

### Applications

- Power Management for Battery Power Products
- Portable Products
- Computers, Printers, PCMCIA Cards
- Cell Phones, Cordless Telephones

$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
30 V	9.7 m $\Omega$ @ 10 V	12 A
	15.5 m $\Omega$ @ 4.5 V	

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise stated)

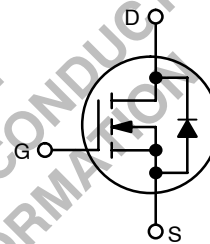
Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DSS}$	30	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$ 9.6	A
		$T_A = 70^\circ\text{C}$	7.6	
		$t_p \leq 10$ s	$T_A = 25^\circ\text{C}$	12
Power Dissipation (Note 1)	Steady State		$P_D$ 1.56	W
	$t_p \leq 10$ s		2.5	
Continuous Drain Current (Note 2)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$ 7.0	A
		$T_A = 70^\circ\text{C}$	5.6	
Power Dissipation (Note 2)		$T_A = 25^\circ\text{C}$	$P_D$ 0.83	W
Pulsed Drain Current	$t_p = 10$ $\mu\text{s}$ , DC = 2 %	$I_{DM}$ 50	A	
Operating Junction and Storage Temperature	$T_J$	-55 to 150	$^\circ\text{C}$	
	$T_{STG}$			
Source Current (Body Diode)	$I_S$	6.0	A	
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 20$ V, $V_{GS} = 5$ V, $I_{PK} = 7.25$ A, $L = 19$ mH, $R_G = 25$ $\Omega$ )	$E_{AS}$	500	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	80	$^\circ\text{C}/\text{W}$
Junction-to-Ambient - $t = 10$ s (Note 1)	$R_{\theta JA}$	50	
Junction-to-Ambient - Steady State (Note 2)	$R_{\theta JA}$	150	

1. Surface-mounted on FR4 board using 1 in sq. pad size (Cu area = 1.127 in sq. [1 oz] including traces)
2. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.412 in sq.)

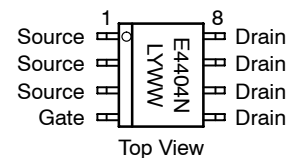
### N-Channel



### MARKING DIAGRAM/ PIN ASSIGNMENT



SO-8  
CASE 751  
STYLE 12



E4404N = Device Code  
L = Assembly Location  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping†
NTMS4404NR2	SO-8	2500/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NTMS4404N

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			25		mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 30\text{ V}$	$T_J = 25^\circ\text{C}$		1.0	$\mu\text{A}$
			$T_J = 100^\circ\text{C}$		5.0	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.0	2.2	3.0	V
Gate Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-5.0		mV/ $^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 12\text{ A}$		9.7	11.5	m $\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 6.0\text{ A}$		15.5	17.5	
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 12\text{ A}$		17.5		S

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 24\text{ V}$		1975	2500	pF
Output Capacitance	$C_{OSS}$			575	750	
Reverse Transfer Capacitance	$C_{RSS}$			180	300	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 24\text{ V}, I_D = 12\text{ A}$		50	70	nC
Threshold Gate Charge	$Q_{G(TH)}$			2.4		
Gate-to-Source Charge	$Q_{GS}$			7.5		
Gate-to-Drain Charge	$Q_{GD}$			16		

### SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 4)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 24\text{ V}, I_D = 12\text{ A}, R_G = 2.5\ \Omega$		15	25	ns
Rise Time	$t_r$			25	50	
Turn-Off Delay Time	$t_{d(OFF)}$			35	55	
Fall Time	$t_f$			15	30	

### SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 4)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 24\text{ V}, I_D = 6.0\text{ A}, R_G = 2.5\ \Omega$		20		ns
Rise Time	$t_r$			80		
Turn-Off Delay Time	$t_{d(OFF)}$			25		
Fall Time	$t_f$			15		

### DRAIN-SOURCE DIODE CHARACTERISTICS (Note 4)

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 6.0\text{ A}$	$T_J = 25^\circ\text{C}$	0.80	1.1	V
			$T_J = 125^\circ\text{C}$	0.65		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_{SD}/dt = 100\text{ A}/\mu\text{s}, I_S = 6.0\text{ A}$		40	55	ns
Charge Time	$t_a$			23		
Discharge Time	$t_b$			17		
Reverse Recovery Charge	$Q_{RR}$			0.05		

#### NOTES:

- Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

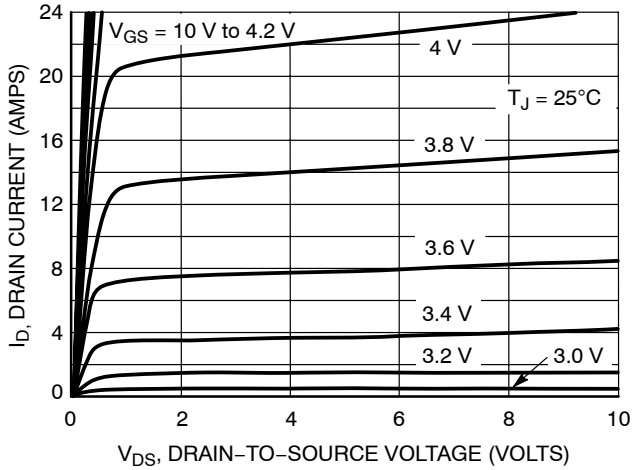


Figure 1. On-Region Characteristics

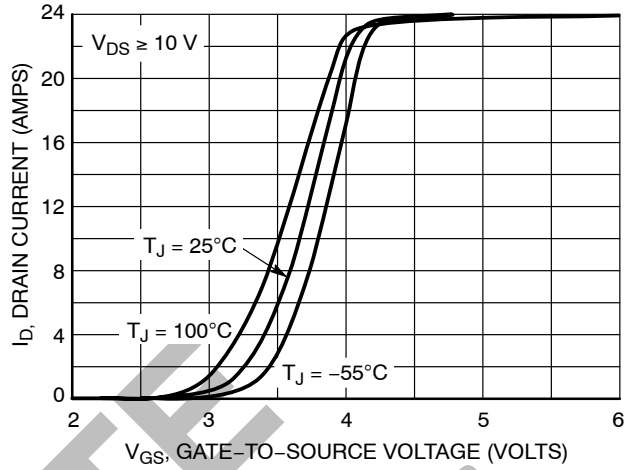


Figure 2. Transfer Characteristics

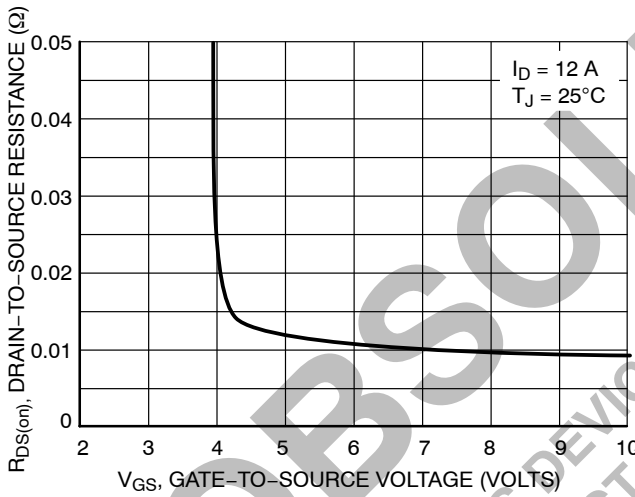


Figure 3. On-Resistance vs. Gate-to-Source Voltage

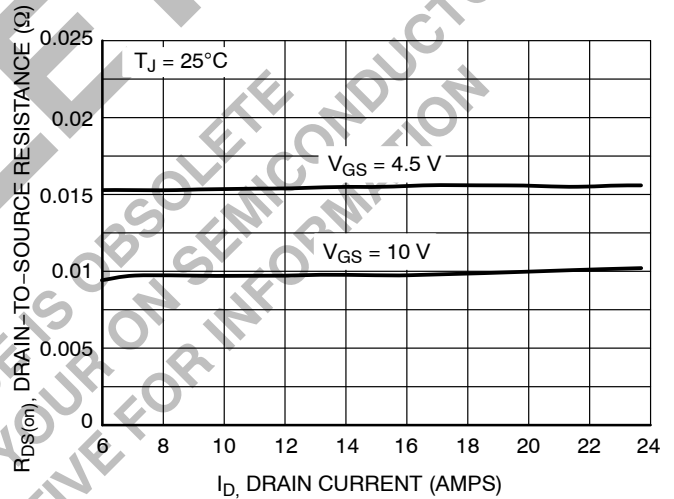


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

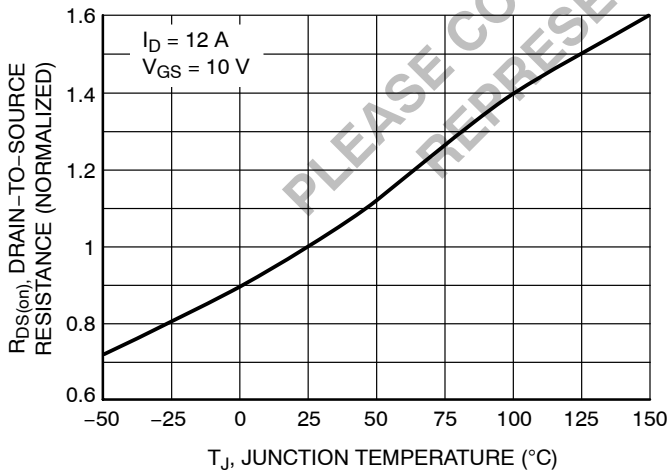


Figure 5. On-Resistance Variation with Temperature

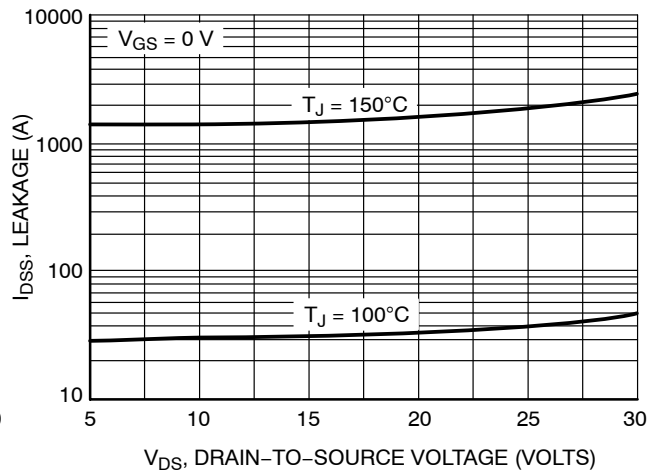
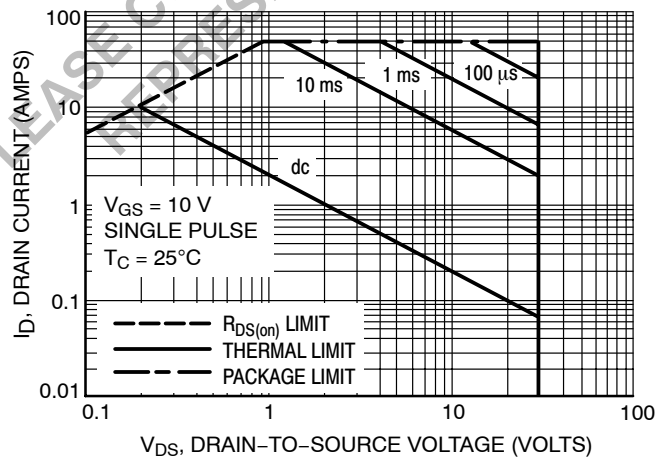
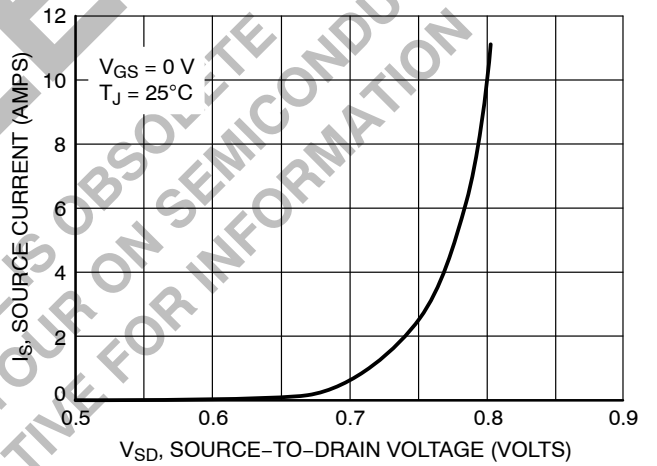
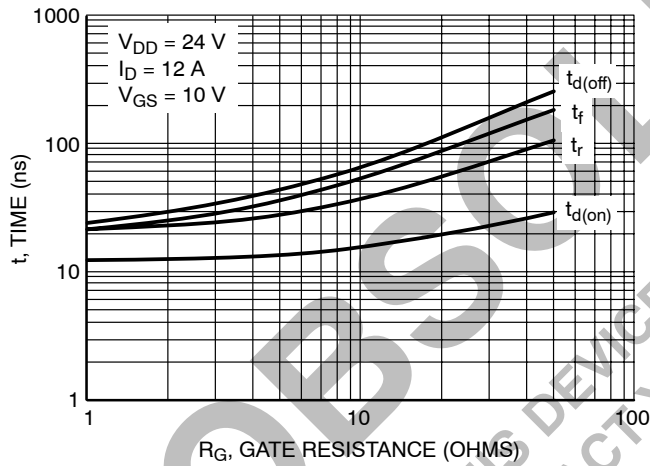
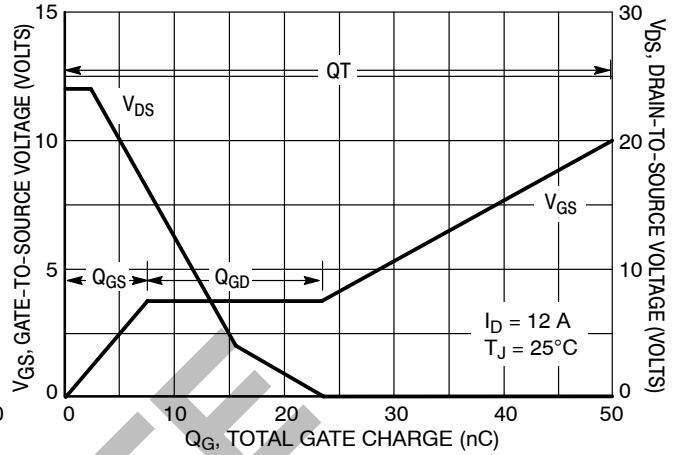
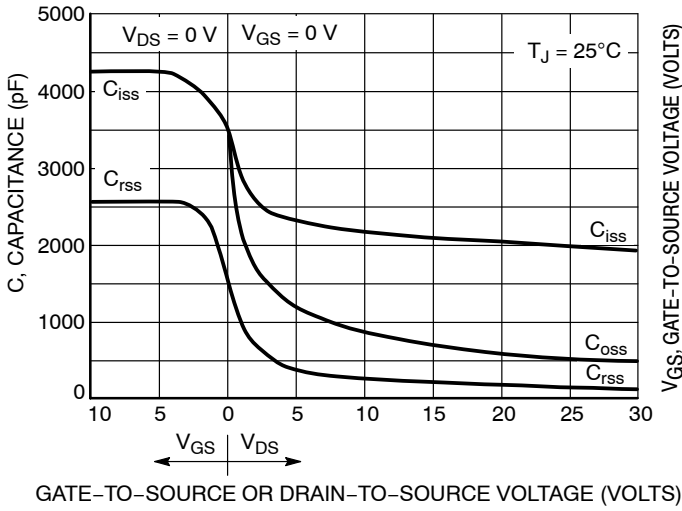


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES



NTMS4404N

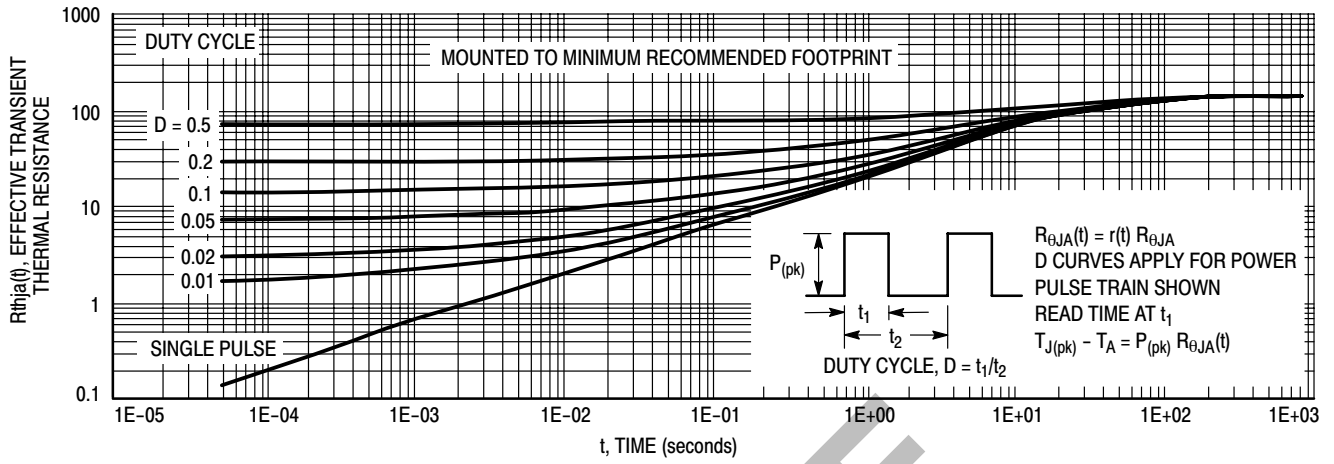


Figure 12. Thermal Response – Various Duty Cycles

OBSOLETE

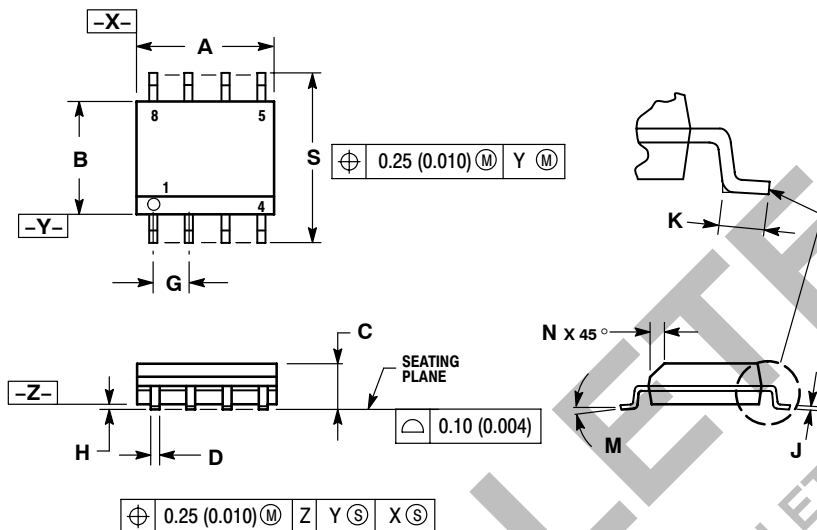
THIS DEVICE IS OBSOLETE

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# NTMS4404N

## PACKAGE DIMENSIONS

SOIC-8 NB  
CASE 751-07  
ISSUE AA



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

### STYLE 12:

1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

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