

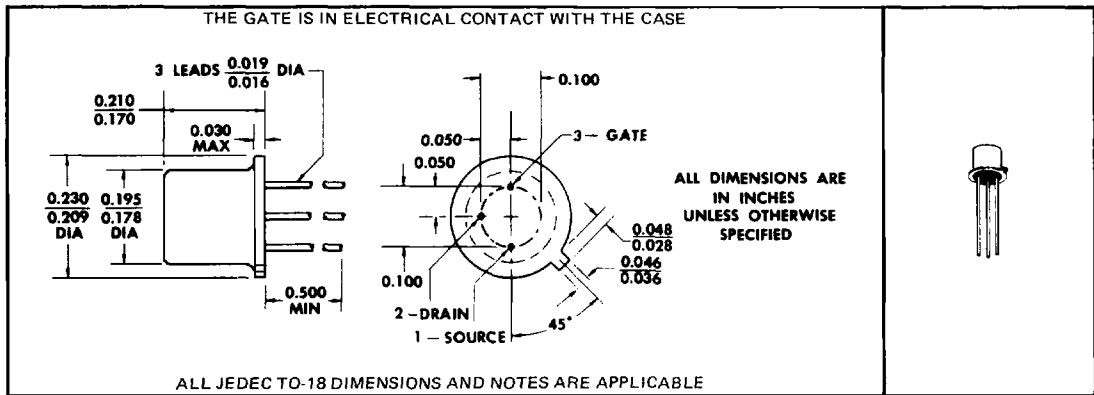
TYPES 2N4856 THRU 2N4861, 2N4856A THRU 2N4861A N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

BULLETIN NO. DL-S 7311911, JUNE 1973

SYMMETRICAL N-CHANNEL FIELD-EFFECT TRANSISTORS FOR HIGH-SPEED COMMUTATOR AND CHOPPER APPLICATIONS

- Low $r_{ds(on)}$. . . 25 Ω Max (2N4856, 2N4856A, 2N4859, 2N4859A)
- Low $I_{D(off)}$. . . 0.25 nA Max
- Low $r_{ds(on)}$ C_{iss} Product

*mechanical data



*absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

	2N4856	2N4859
Drain-Source Voltage	40 V	30 V
Drain-Gate Voltage	40 V	30 V
Reverse Gate-Source Voltage	-40 V	-30 V
Continuous Forward Gate Current	← 50 mA →	
Continuous Device Dissipation at (or below) 25°C Free-Air Temperature (See Note 1)	← 360 mW →	
Continuous Device Dissipation at (or below) 25°C Case Temperature (See Note 2)	← 1.8 W →	
Storage Temperature Range	-65°C to 200°C	
Lead Temperature 1/16 Inch from Case for 60 Seconds	← 300°C →	

NOTES: 1. Derate linearly to 200°C free-air temperature at the rate of 2.06 mW/°C.
2. Derate linearly to 200°C case temperature at the rate of 10.3 mW/°C.

USES CHIP JN52

*JEDEC registered data. This data sheet contains all applicable registered data in effect at the time of publication.

TYPES 2N4856 THRU 2N4861, 2N4856A THRU 2N4861A N-CANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

2N4856 THRU 2N4861

*electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	2N4856		2N4857		2N4858		2N4859		2N4860		2N4861		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$V_{(BR)GSS}$ Gate-Source Breakdown Voltage	$I_G = -1 \mu A, V_{DS} = 0$	-40		-40		-40		-30		-30		-30		V
I_{GSS} Gate Reverse Current	$V_{GS} = -20 V, V_{DS} = 0$		-0.25		-0.25		-0.25							nA
	$V_{GS} = -20 V, V_{DS} = 0, I_A = 150^\circ C$		-0.5		-0.5		-0.5							μA
	$V_{GS} = -15 V, V_{DS} = 0$							-0.25		-0.25		-0.25		nA
	$V_{GS} = -15 V, V_{DS} = 0, T_A = 150^\circ C$							-0.5		-0.5		-0.5		μA
$I_{D(off)}$ Drain Cutoff Current	$V_{DS} = 15 V, V_{GS} = -10 V$		0.25		0.25		0.25		0.25		0.25		0.25	nA
	$V_{DS} = 15 V, V_{GS} = -10 V, T_A = 150^\circ C$		0.5		0.5		0.5		0.5		0.5		0.5	μA
$V_{GS(off)}$ Gate-Source Cutoff Voltage	$V_{DS} = 15 V, I_D = 0.5 nA$	-4	-10	-2	-6	-0.8	-4	-4	-10	-2	-6	-0.8	-4	V
I_{DSS} Zero-Gate-Voltage Drain Current	$V_{DS} = 15 V, V_{GS} = 0$	50		20	100	8	80	50		20	100	8	80	mA
	See Note 3													
$V_{DS(on)}$ Drain-Source On-State Voltage	$I_D = 20 mA, V_{GS} = 0$		0.75						0.75					V
	$I_D = 10 mA, V_{GS} = 0$				0.5					0.5				
	$I_D = 5 mA, V_{GS} = 0$						0.5				0.5			
$r_{ds(on)}$ Small-Signal Drain-Source On-State Resistance	$V_{GS} = 0, I_D = 0, f = 1 kHz$		25		40		40		25		40		40	Ω
C_{iss} Common-Source Short-Circuit Input Capacitance	$V_{DS} = 0, V_{GS} = -10 V, f = 1 MHz$		18		18		18		18		18		18	pF
	See Figure 1													
C_{rss} Common-Source Short-Circuit Reverse Transfer Capacitance	$V_{DS} = 0, V_{GS} = -10 V, f = 1 MHz$		8		8		8		8		8		8	pF

*switching characteristics at 25°C free-air temperature

PARAMETER	TEST CONDITIONS	2N4856	2N4857	2N4858	UNIT
		2N4859	2N4860	2N4861	
$t_{d(on)}$ Turn-On Delay Time	$V_{DD} = 10 V, I_{D(on)} \uparrow = \begin{cases} 20 mA (2N4856, 2N4859) \\ 10 mA (2N4857, 2N4860) \\ 5 mA (2N4858, 2N4861) \end{cases}$	6	6	10	ns
t_r Rise Time	$V_{GS(on)} = 0, V_{GS(off)} = \begin{cases} -10 V (2N4856, 2N4859) \\ -6 V (2N4857, 2N4860) \\ -4 V (2N4858, 2N4861) \end{cases}$	3	4	10	ns
t_{off} Turn-Off Time	See Figure 1	25	50	100	ns

NOTE 3: This parameter must be measured using pulse techniques. $t_w \approx 100 ms$, duty cycle $\leq 10\%$.

†These are nominal values; exact values vary slightly with transistor parameters.

*JEDEC registered data

TYPES 2N4856 THRU 2N4861, 2N4856A THRU 2N4861A N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

2N4856A THRU 2N4861A

*electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	2N4856A	2N4857A	2N4858A	2N4859A	2N4860A	2N4861A	UNIT
		MIN MAX	MIN MAX	MIN MAX	MIN MAX	MIN MAX	MIN MAX	
$V_{(BR)GSS}$ Gate-Source Breakdown Voltage	$I_G = -1 \mu A, V_{DS} = 0$	-40	-40	-40	-30	-30	-30	V
I_{GSS} Gate Reverse Current	$V_{GS} = -20 V, V_{DS} = 0$	-0.25	-0.25	-0.25				nA
	$V_{GS} = -20 V, V_{DS} = 0, T_A = 150^\circ C$	-0.5	-0.5	-0.5				μA
	$V_{GS} = -15 V, V_{DS} = 0$				-0.25	-0.25	-0.25	nA
	$V_{GS} = -15 V, V_{DS} = 0, T_A = 150^\circ C$				-0.5	-0.5	-0.5	μA
$I_{D(off)}$ Drain Cutoff Current	$V_{DS} = 15 V, V_{GS} = -10 V$	0.25	0.25	0.25	0.25	0.25	0.25	nA
	$V_{DS} = 15 V, V_{GS} = -10 V, T_A = 150^\circ C$	0.5	0.5	0.5	0.5	0.5	0.5	μA
$V_{GS(off)}$ Gate-Source Cutoff Voltage	$V_{DS} = 15 V, I_D = 0.5 nA$	-4 -10	-2 -6	-0.8 -4	-4 -10	-2 -6	-0.8 -4	V
I_{DSS} Zero-Gate-Voltage Drain Current	$V_{DS} = 15 V, V_{GS} = 0, \text{ See Note 3}$	50	20 100	8 80	50	20 100	8 80	mA
$V_{DS(on)}$ Drain-Source On-State Voltage	$I_D = 20 mA, V_{GS} = 0$	0.75			0.75			V
	$I_D = 10 mA, V_{GS} = 0$		0.5			0.5		
	$I_D = 5 mA, V_{GS} = 0$			0.5			0.5	
$r_{ds(on)}$ Small-Signal Drain-Source On-State Resistance	$V_{GS} = 0, I_D = 0, f = 1 kHz$	25	40	60	25	40	60	Ω
C_{iss} Common-Source Short-Circuit Input Capacitance	$V_{DS} = 0, V_{GS} = -10 V, f = 1 MHz$	10	10	10	10	10	10	pF
C_{rss} Common-Source Short-Circuit Reverse Transfer Capacitance	$V_{DS} = 0, V_{GS} = -10 V, f = 1 MHz$	4	3.5	3.5	4	3.5	3.5	pF

4

*switching characteristics at 25°C free-air temperature

PARAMETER	TEST CONDITIONS	2N4856A	2N4857A	2N4858A	UNIT	
		2N4859A	2N4860A	2N4861A		
		TYP	MAX	TYP	MAX	
$t_{d(on)}$ Turn-On Delay Time	$V_{DD} = 10 V, I_{D(on)}^+ \left\{ \begin{array}{l} 20 mA (2N4856A, 2N4859A) \\ 10 mA (2N4857A, 2N4860A) \\ 5 mA (2N4858A, 2N4861A) \end{array} \right.$	5		6	8	ns
t_r Rise Time	$V_{GS(on)} = 0, \left\{ \begin{array}{l} -10 V (2N4856A, 2N4859A) \\ -6 V (2N4857A, 2N4860A) \\ -4 V (2N4858A, 2N4861A) \end{array} \right.$	3		4	8	ns
$t_{d(off)}$ Turn-Off Time	See Figure 1, $V_{GS(off)} \left\{ \begin{array}{l} -6 V (2N4856A, 2N4860A) \\ -4 V (2N4858A, 2N4861A) \end{array} \right.$	20		40	80	ns
t_r Rise Time	$V_{DD} = 10 V, I_{D(on)}^+ \left\{ \begin{array}{l} 12 mA (2N4856A, 2N4859A) \\ 6 mA (2N4857A, 2N4860A) \\ 3 mA (2N4858A, 2N4861A) \end{array} \right.$	2		3	4	ns
t_{on} Turn-On Time	$V_{GS(on)} = 0, \left\{ \begin{array}{l} -12 V (2N4856A, 2N4859A) \\ -7 V (2N4857A, 2N4860A) \\ -5 V (2N4858A, 2N4861A) \end{array} \right.$	5.5		6.5	8	ns
t_f Fall Time	See Figure 2, $V_{GS(off)} \left\{ \begin{array}{l} -12 V (2N4856A, 2N4859A) \\ -7 V (2N4857A, 2N4860A) \\ -5 V (2N4858A, 2N4861A) \end{array} \right.$	7		13	27	ns
$t_{d(off)}$ Turn-Off Time		10		18	31	ns

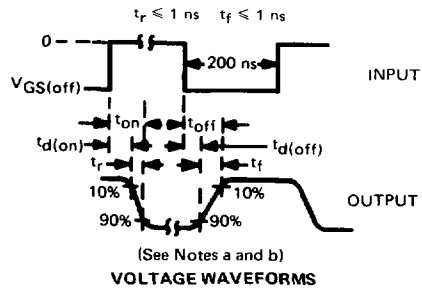
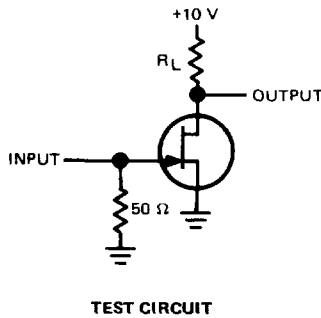
NOTE 3 This parameter must be measured using pulse techniques. $I_w = 100 ms$ duty cycle $\leq 10\%$.

* JEDEC registered data (typical data excluded).

† These are nominal values; exact values vary slightly with transistor parameters.

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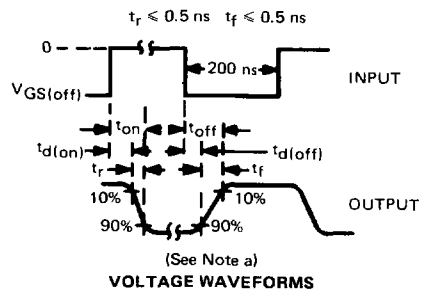
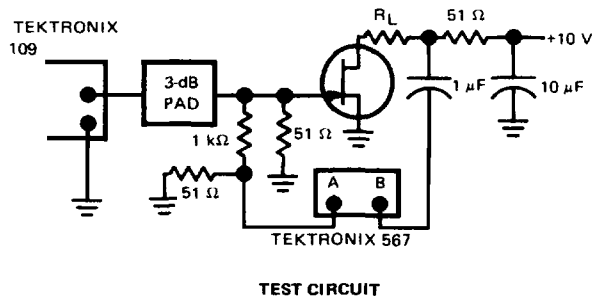
PARAMETER MEASUREMENT INFORMATION



TYPES	R _L	V _{GS(off)}
2N4856A, 2N4859A	464 Ω	-10 V
2N4857A, 2N4860A	953 Ω	-6 V
2N4858A, 2N4861A	1910 Ω	-4 V

- NOTES: a. The input waveforms are supplied by a generator with the following characteristics: Z_{out} = 50 Ω, duty cycle ≈ 2%.
b. Waveforms are monitored on an oscilloscope with the following characteristics: t_r ≤ 0.75 ns, R_{in} ≥ 1 MΩ, C_{in} ≤ 2.5 pF.

FIGURE 1



TYPES	R _L	V _{GS(off)}
2N4856, 2N4856A, 2N4859, 2N4859A	750 Ω	-12 V
2N4857, 2N4857A, 2N4860, 2N4860A	1.54 kΩ	-7 V
2N4858, 2N4848A, 2N4861, 2N4861A	3.16 kΩ	-5 V

- NOTE a: An equivalent generator and oscilloscope may be used. The oscilloscope must have a 50-Ω input impedance.

FIGURE 2