TYPES 2N3970 THRU 2N3972
N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

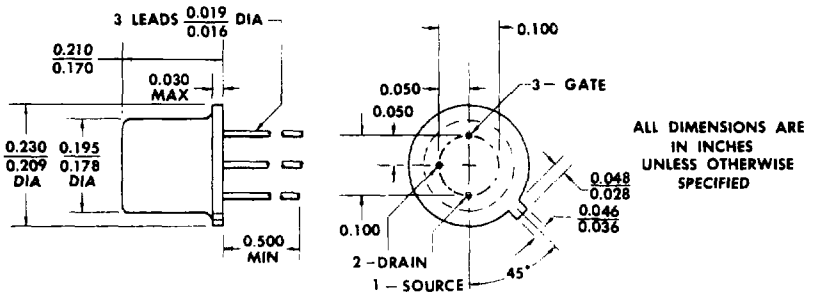
BULLETIN NO. DL-S 7311913, MARCH 1973

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

- Low $I_{D(off)}$ . . . 0.25 nA Max
- Low $r_{ds(on)}$ C_{iss} Product

***mechanical data**

THE GATE IS IN ELECTRICAL CONTACT WITH THE CASE



ALL JEDEC TO-18 DIMENSIONS AND NOTES ARE APPLICABLE

4

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

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

NOTE 1: Derate linearly to 200° C case temperature at the rate of 10.3 mW/° C.

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

USES CHIP JN52

TEXAS INSTRUMENTS
INCORPORATED
POST OFFICE BOX 5012 • DALLAS, TEXAS 75222

TYPES 2N3970 THRU 2N3972
N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

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

PARAMETER		TEST CONDITIONS	2N3970 MIN	2N3970 MAX	2N3971 MIN	2N3971 MAX	2N3972 MIN	2N3972 MAX	UNIT
$V_{(BR)GSS}$	Gate-Source Breakdown Voltage	$I_G = -1\ \mu A$, $V_{DS} = 0$	−40		−40		−40		V
I_{DGO}	Drain Reverse Current	$V_{DG} = 20$ V, $I_S = 0$		0.25		0.25		0.25	nA
		$V_{DG} = 20$ V, $I_S = 0$, $T_A = 150°C$		0.5		0.5		0.5	μA
$I_{D(off)}$	Drain Cutoff Current	$V_{DS} = 20$ V, $V_{GS} = -12$ V		0.25		0.25		0.25	nA
		$V_{DS} = 20$ V, $V_{GS} = -12$ V, $T_A = 150°C$		0.5		0.5		0.5	μA
$V_{GS(off)}$	Gate-Source Cutoff Voltage	$V_{DS} = 20$ V, $I_D = 1$ nA	−4	−10	−2	−5	−0.5	−3	V
I_{DSS}	Zero-Gate-Voltage Drain Current	$V_{DS} = 20$ V, $V_{GS} = 0$, See Note 2	50	150	25	75	5	30	mA
$V_{DS(on)}$	Drain-Source On-State Voltage	$V_{GS} = 0$, $I_D = 20$ mA		1					V
		$V_{GS} = 0$, $I_D = 10$ mA				1.5			
		$V_{GS} = 0$, $I_D = 5$ mA						2	
$r_{DS(on)}$	Static Drain-Source On-State Resistance	$V_{GS} = 0$, $I_D = 1$ mA		30		60		100	Ω
$r_{ds(on)}$	Small-Signal Drain-Source On-State Resistance	$V_{GS} = 0$, $I_D = 0$, $f = 1$ kHz		30		60		100	Ω
C_{iss}	Common-Source Short-Circuit Input Capacitance	$V_{DS} = 20$ V, $V_{GS} = 0$, $f = 1$ MHz, See Note 3		25		25		25	pF
C_{rss}	Common-Source Short-Circuit Reverse Transfer Capacitance	$V_{DS} = 0$, $V_{GS} = -12$ V, $f = 1$ MHz		6		6		6	pF

4

*switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	2N3970 TYP	2N3970 MAX	2N3971 TYP	2N3971 MAX	2N3972 TYP	2N3972 MAX	UNIT
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 10$ V, $I_{D(on)}$† = 20 mA (2N3970), 10 mA (2N3971), 5 mA (2N3972)		10		15		40	ns
t_r	Rise Time	$V_{GS(on)} = 0$,		10		15		40	ns
t_{off}	Turn-Off Time	See Figure 1, $V_{GS(off)}$ = −10 V (2N3970), −5 V (2N3971), −3 V (2N3972)		30		60		100	ns
t_r	Rise Time	$V_{DD} = 10$ V, $I_{D(on)}$† = 12 mA (2N3970), 6 mA (2N3971), 3 mA (2N3972)	2		3		4		ns
t_{on}	Turn-On Time	$V_{GS(on)} = 0$,	5.5		6.5		8		ns
t_f	Fall Time	See Figure 2, $V_{GS(off)}$ = −12 V (2N3970), −7 V (2N3971), −5 V (2N3972)	7		13		27		ns
t_{off}	Turn-Off Time		10		18		31		ns

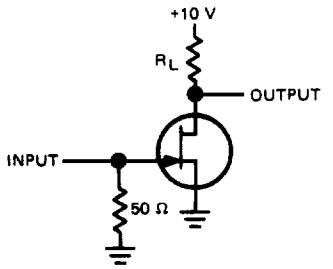
NOTES: 2. This parameter must be measured using pulse techniques. $t_w = 300\ \mu s$, duty cycle ≤ 3%.
3. This parameter must be measured with bias voltages applied for less than 5 seconds to avoid overheating.

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

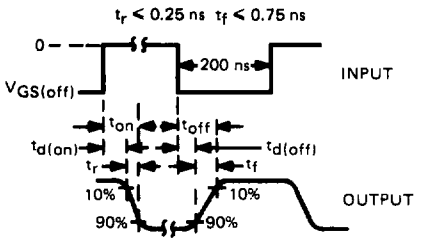
* JEDEC registered data (typical data excluded).

TEXAS INSTRUMENTS
INCORPORATED
POST OFFICE BOX 5012 • DALLAS, TEXAS 75222

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



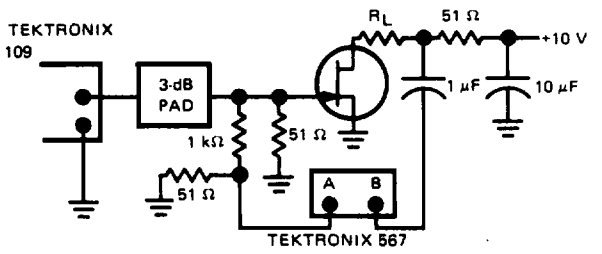
(See Notes a and b)
VOLTAGE WAVEFORMS

TYPE	R_L	$V_{GS(off)}$
2N3970	453 Ω	−10 V
2N3971	845 Ω	−5 V
2N3972	1.62 kΩ	−3 V

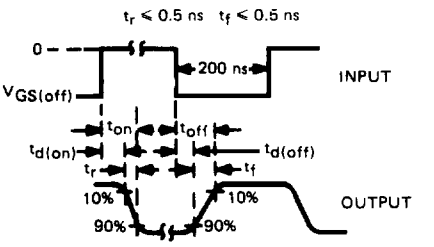
NOTES: a. The input waveforms are supplied by a generator with the following characteristics: Z_{out} = 50 Ω, duty cycle ≈ 2%.
b. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 0.4$ ns, R_{in} = 10 MΩ, C_{in} = 1.5 pF.

FIGURE 1

4



TEST CIRCUIT



(See Note a)
VOLTAGE WAVEFORMS

TYPE	R_L	$V_{GS(off)}$
2N3970	750 Ω	−12 V
2N3971	1.54 kΩ	−7 V
2N3972	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