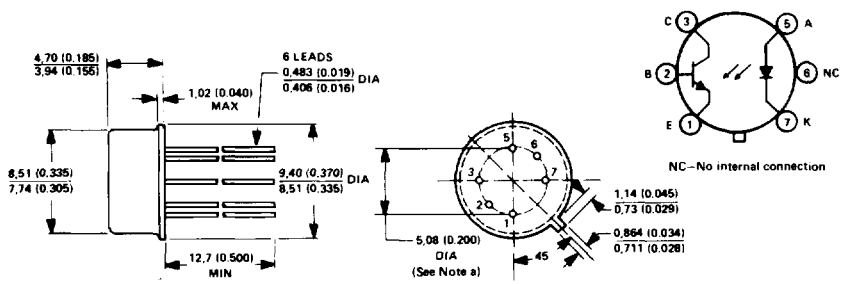
D3054, SEPTEMBER 1987

JEDEC REGISTERED DEVICES
GALLIUM ARSENIDE DIODE INFRARED SOURCE OPTICALLY COUPLED TO A HIGH-GAIN N-P-N SILICON PHOTOTRANSISTOR

- **Base Lead Provided for Conventional Transistor Biasing**
- **High Overall Current Gain . . . 1.5 Typ (4N24)**
- **High-Gain, High-Voltage Transistor . . . h_{FE} = 700 Typ (4N24), $V_{(BR)CEO}$ = 35 V Min**
- **High-Voltage Electrical Isolation . . . 1-kV Rating**
- **Stable over Wide Temperature Range**
- **Qualified to MIL-S-19500/486A**

*mechanical data

THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE CASE



NOTE: a. Leads having maximum diameter shall be within 0,18 mm (0.007 inch) of true position relative to a maximum-width tab when measured in the gaging plane between 1,371 mm (0.054 inch) and 1,397 mm (0.055 inch) below the seating plane.

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

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

Input-to-output voltage	±1 kV
Collector-base voltage	35 V
Collector-emitter voltage	35 V
Emitter-base voltage	4 V
Input diode reverse voltage	2 V
Input diode continuous forward current at (or below) 65°C free-air temperature (see Note 1)	40 mA
Continuous collector current	50 mA
Peak diode current (see Note 2)	1 A
Continuous transistor power dissipation at (or below) 25°C free-air temperature (see Note 3)	300 mW
Operating free-air temperature range	−55°C to 125°C
Storage temperature range	−55°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	240°C

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

NOTES: 1. Derate linearly to 125°C free-air temperature at the rate of 0.67 mA/°C.
2. This value applies for $t_w \leq 1\ \mu s$, PRR ≤ 300 pps.
3. Derate linearly to 125°C free-air temperature at the rate of 3 mW/°C.

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

PARAMETER		TEST CONDITIONS	4N22			4N23			4N24			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
*$V_{(BR)CBO}$	Collector-base breakdown voltage	I_C = 100 μA, I_E = 0, I_F = 0	35			35			35			V
*$V_{(BR)CEO}$	Collector-emitter breakdown voltage	I_C = 1 mA, I_B = 0, I_F = 0	35			35			35			V
*$V_{(BR)EBO}$	Emitter-base breakdown voltage	I_E = 100 μA, I_C = 0, I_F = 0	4			4			4			V
*I_R	Input diode static reverse current	V_R = 2 V			100			100			100	μA
†h_{FE}	Transistor static forward current transfer ratio	V_{CE} = 5 V, I_C = 10 mA, I_F = 0	200			300			400	700		
*$I_{C(on)}$	On-state collector current	V_{CE} = 5 V, I_B = 0, I_F = 2 mA	0.15			0.2			0.4			mA
		V_{CE} = 5 V, I_B = 0, I_F = 10 mA, T_A = −55°C	1			2.5			4			
		V_{CE} = 5 V, I_B = 0, I_F = 10 mA	2.5	4		6	8		10	15		
		V_{CE} = 5 V, I_B = 0, I_F = 10 mA, T_A = 100°C	1			2.5			4			
*$I_{C(off)}$	Off-state collector current	V_{CE} = 20 V, I_B = 0, I_F = 0			100			100			100	nA
		V_{CE} = 20 V, I_B = 0, I_F = 0, T_A = 100°C			100			100			100	μA
*V_F	Input diode static forward voltage	I_F = 10 mA, T_A = −55°C	1		1.5	1		1.5	1		1.5	V
		I_F = 10 mA	0.8		1.3	0.8		1.3	0.8		1.3	
		I_F = 10 mA, T_A = 100°C	0.7		1.2	0.7		1.2	0.7		1.2	
*$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C = 2.5 mA, I_B = 0, I_F = 20 mA			0.3							V
		I_C = 5 mA, I_B = 0, I_F = 20 mA						0.3				
		I_C = 10 mA, I_B = 0, I_F = 20 mA									0.3	
*r_{IO}	Input-to-output internal resistance	V_{in-out} = ±1 kV, See Note 4	10^{11}			10^{11}			10^{11}			Ω
*C_{io}	Input-to-output capacitance	V_{in-out} = 0, f = 1 MHz, See Note 4			5			5			5	pF

NOTE 4: These parameters are measured between all the input diode leads shorted together and all the phototransistor leads shorted together.

*switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	4N22			4N23			4N24			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
t_r	Rise time	V_{CC} = 10 V, $I_{F(on)}$ = 10 mA, R_L = 100 Ω, See Figure 1			15			15			20	μs
t_f	Fall time				15			15			20	μs

*JEDEC registered data
†The h_{FE} specification is a requirement of MIL-S-19500/486A and is not JEDEC registered.

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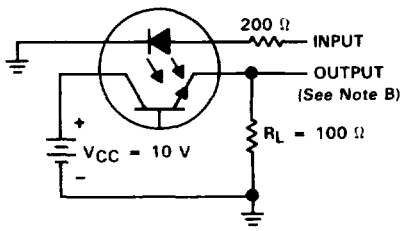
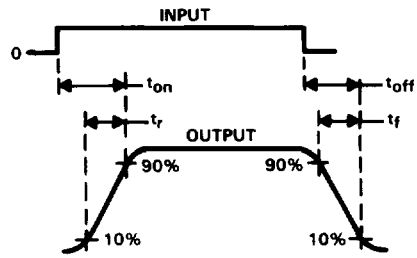
*PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

Adjust amplitude of input pulse for $I_{F(on)}$ = 10 mA



VOLTAGE WAVEFORMS

NOTES: A. The input waveform is supplied by a generator with the following characteristics: Z_{out} = 50 Ω, $t_r \leq 15$ ns, t_w = 100 μs, duty cycle = 1%.

B. *Waveforms are monitored on an oscilloscope with the following characteristics:* $t_r \leq 12$ *ns*, $R_{in} \geq 1$ MΩ, $C_{in} \leq 20$ pF.

* JEDEC registered data

FIGURE 1. SWITCHING TIMES

TYPICAL CHARACTERISTICS

4N22
COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

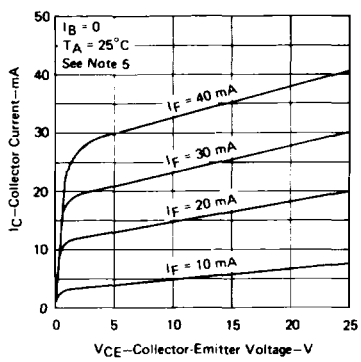


FIGURE 2

4N23
COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

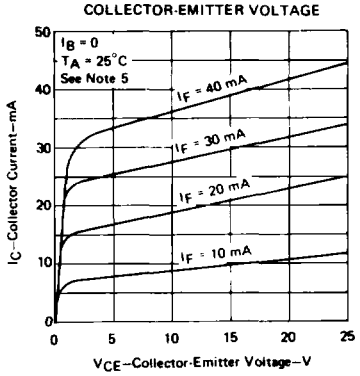


FIGURE 3

4N24
COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

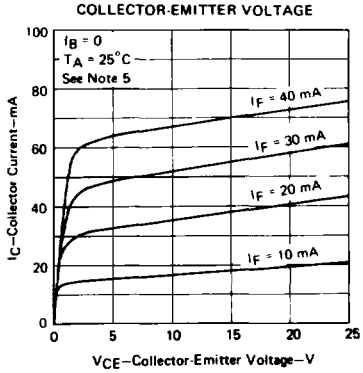


FIGURE 4

NOTE 5: This parameter was measured using pulse techniques, t_w = 100 μs, duty cycle = 1%.

TYPICAL CHARACTERISTICS

INPUT DIODE FORWARD CONDUCTION CHARACTERISTICS

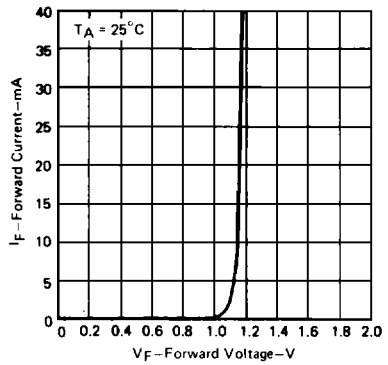
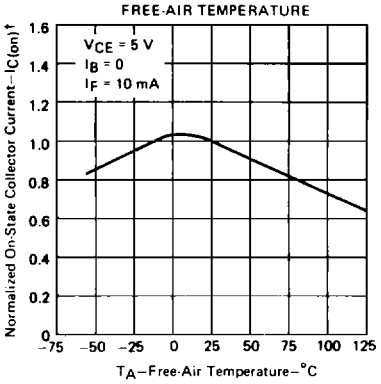


FIGURE 5

NORMALIZED ON-STATE COLLECTOR CURRENT†
vs
FREE-AIR TEMPERATURE



†Normalized to value at T_A = 25° C

FIGURE 6

PHOTOTRANSISTOR COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

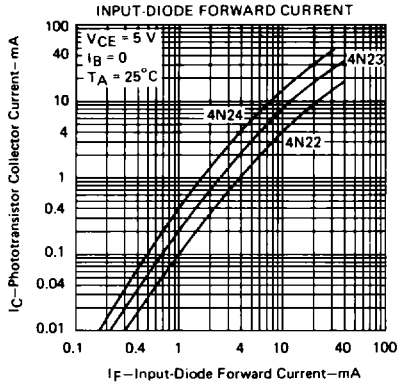


FIGURE 7

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

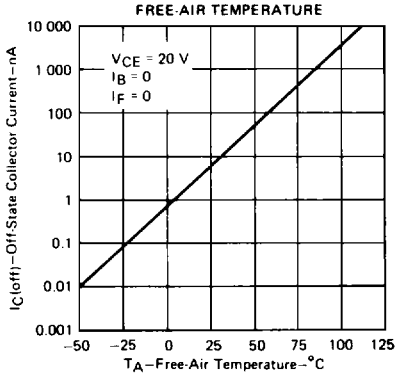


FIGURE 8

AVERAGE SWITCHING TIME
vs
LOAD RESISTANCE

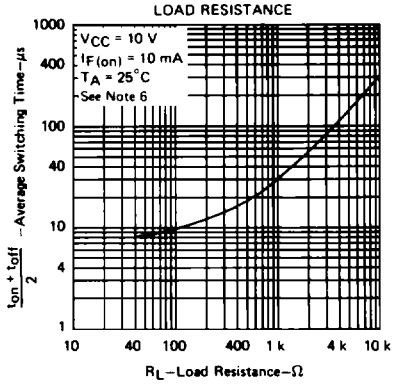


FIGURE 9

NOTE 6: This parameter was measured in the test circuit of Figure 1 with R_L varied between 40 Ω and 10 kΩ.

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