Indian Institute of Technology, Bombay

Aerospace Engineering

Ae 230 Modelling and Simulation Laboratory

Report

Experiment 1

Group 11

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1 Abstract

RAbstract

This section describes the experiment and how they develop concis way, with emphasis on results and important conclusions in a maximum of 160 words is described.

Keywords: Wind Tunnel, blah blah

2 Objectives

2.1 Aim

Objective described in Experiment Guide.

2.2 Specific objectives

- Specific objectives proposed by students .
- They are comprehensive and based on theoretical note, the procedure and the expected results of the experiment.

3 List of equipment

The list of equipment used in the experiment shown in Table 1.

Table 1: List of equipment

Equipment	**Sesión 1**			**Sesión 2**		
	Brand	**Model**	**Plate**	**Brand**	**Model**	**Plate**
Source DC Digital oscilloscope Signal generator Multifunction Meter Breadboard						

4 List of components

The list of components used in the experiment shown in Table 2.

Table 2: Lista de componentes

Component	Symbol	Face value	Measured value	Tolerance	Power
Resistor cerámico	R1	1 kΩ			0,25 W
Potenciómetro	Rp	5 kΩ			2 W
Capacitor electrolítico	C11	150 µF		-	-
Capacitor cerámico	C	100 nF		-	-
Diodo	1N4148				500 mW
Transistor BJT	2N2222A				1000 mW

5 Experimental Results and analysis of results

Yeah, but how

6 Conclusions

The recommended format is the APA bibliography . The following is an example :

References

[Apuntes, 2008] *http://www.apuntesdeelectronica.com/componentes/transistor-igbt.htm* consultado el 12/05/2013.

[Boylestad, 1998] Robert L. Boylestad, Louis Nashelsky (1998). *Electronic Devices and Circuit Theory*. New Jersey: Pearson Prentice Hall, 7th Edition.

A Appendices

Includes information sheets manufacturer of components used or any other information deemed necessary .

The following is a way to attach pages as PDFs sheets manufacturer, but there are many ways to attach the annexes as deemed necessary .

A.1 Transistor 2N2222A

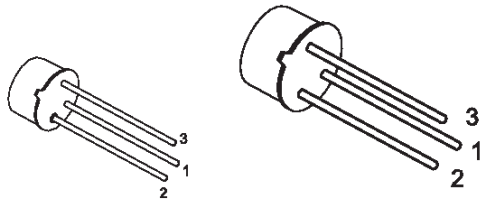
2N2219A
2N2222A

HIGH SPEED SWITCHES

DESCRIPTION

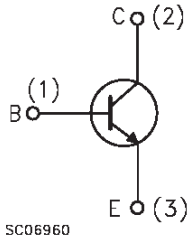
The 2N2219A and 2N2222A are silicon planar epitaxial NPN transistors in Jedec TO-39 (for 2N2219A) and in Jedec TO-18 (for 2N2222A) metal case. They are designed for high speed switching application at collector current up to 500mA, and feature useful current gain over a wide range of collector current, low leakage currents and low saturation voltage.

2N2219A approved to CECC 50002-100, 2N2222A approved to CECC 50002-101 available on request.



TO-18 **TO-39**

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-Base Voltage (I_E = 0)	75	V
V_{CEO}	Collector-Emitter Voltage (I_B = 0)	40	V
V_{EBO}	Emitter-Base Voltage (I_C = 0)	6	V
I_C	Collector Current	0.8	A
P_{tot}	Total Dissipation at $T_{amb} \leq 25\ ^oC$		
	for **2N2219A**	0.8	W
	for **2N2222A**	0.5	W
	at $T_{case} \leq 25\ ^oC$		
	for **2N2219A**	3	W
	for **2N2222A**	1.8	W
T_{stg}	Storage Temperature	-65 to 200	^oC
T_j	Max. Operating Junction Temperature	175	^oC

THERMAL DATA

		TO-39	TO-18	
$R_{thj\text{-}case}$	Thermal Resistance Junction-Case Max	50	83.3	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-Ambient Max	187.5	300	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cut-off Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V T_{case} = 150 °C			10 10	nA µA
I_{CEX}	Collector Cut-off Current (V_{BE} = -3V)	V_{CE} = 60 V			10	nA
I_{BEX}	Base Cut-off Current (V_{BE} = -3V)	V_{CE} = 60 V			20	nA
I_{EBO}	Emitter Cut-off Current (I_C = 0)	V_{EB} = 3 V			10	nA
$V_{(BR)CBO}$*	Collector-Base Breakdown Voltage (I_E = 0)	I_C = 10 µA	75			V
$V_{(BR)CEO}$*	Collector-Emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	40			V
$V_{(BR)EBO}$*	Emitter-Base Breakdown Voltage (I_C = 0)	I_E = 10 µA	6			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			0.3 1	V V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA	0.6		1.2 2	V V
h_{FE}*	DC Current Gain	I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 1 V I_C = 10 mA V_{CE} = 10 V T_{amb} = -55 °C	35 50 75 100 40 50 35		300	
h_{fe}*	Small Signal Current Gain	I_C = 1 mA V_{CE} = 10 V f = 1KHz I_C = 10 mA V_{CE} = 10 V f = 1KHz	50 75		300 375	
f_T	Transition Frequency	I_C = 20 mA V_{CE} = 20 V f = 100 MHz	300			MHz
C_{EBO}	Emitter Base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 100KHz			25	pF
C_{CBO}	Collector Base Capacitance	I_E = 0 V_{CB} = 10 V f = 100 KHz			8	pF
$R_{e(hie)}$	Real Part of Input Impedance	I_C = 20 mA V_{CE} = 20 V f = 300MHz			60	Ω

* Pulsed: Pulse duration = 300 µs, duty cycle ≤ 1 %

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
NF	Noise Figure	I_C = 0.1 mA V_{CE} = 10 V f = 1KHz R_g = 1KΩ		4		dB
h_{ie}	Input Impedance	I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V	2 0.25		8 1.25	kΩ kΩ
h_{re}	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V			8 4	10^{-4} 10^{-4}
h_{oe}	Output Admittance	I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V	5 25		35 200	µS µS
t_d**	Delay Time	V_{CC} = 30 V I_C = 150 mA I_{B1} = 15 mA V_{BB} = -0.5 V			10	ns
t_r**	Rise Time	V_{CC} = 30 V I_C = 150 mA I_{B1} = 15 mA V_{BB} = -0.5 V			25	ns
t_s**	Storage Time	V_{CC} = 30 V I_C = 150 mA I_{B1} = -I_{B2} = 15 mA			225	ns
t_f**	Fall Time	V_{CC} = 30 V I_C = 150 mA I_{B1} = -I_{B2} = 15 mA			60	ns
$r_{bb'}$ $C_{b'c}$	Feedback Time Constant	I_C = 20 mA V_{CE} = 20 V f = 31.8MHz			150	ps

* Pulsed: Pulse duration = 300 µs, duty cycle ≤ 1 %
** See test circuit