# UNIVERSIDAD DE GUADALAJARA

## CENTRO UNIVERSITARIO DE CIENCIAS EXACTAS E INGENIERÍAS


# Sistemas Fotónicos

## Reporte de Laboratorio

### 1: Modulación con Puente Wheatstone

Alumno:
**XXXX XXX XXX XXXX**
Código:
**2XXXXXXX24**
Sección:
**D03**

Profesor:
**Guillermo García Torales**

3 de marzo de 2020

# 1 Introducción

La introducción debe contener una explicación breve que relacione la problemática a resolver, el objetivo y los antecedentes del trabajo a realizar.

# 2 Marco teórico

Aquí se deberá añadir los fundamentos teóricos en los cuales se sustenta la práctica. debiendo colocar las referencias y ecuaciones apropiadas.

Por ejemplo: [1] [2] [3][4] nueva cita [5]
Ejemplo ecuación: ecuación en linea $a = b + c$
ecuación en una linea aparte

$$a = a + b$$

Ecuación numerada

$$L = \lim_{t \to c} \sin(\omega t) \tag{1}$$

$$a = b + c \tag{2}$$

A la ecuación numerada se le puede llamar usando (2)

# 3 Metodología y materiales

En esta sección se debe describir el procedimiento de cada una de las etapas relevantes de la práctica. Explicando el funcionamiento mediante una descripción detallada y basada en Figuras, calculos, tablas, gráficas, fotografias, simulaciones, etc.

1. Etapa 1

- Cálculos
- Diagramas
- Fotografías
- Tablas (Listas de materiales y equipo utilizado)

1. Etapa 2

- Cálculos
- Diagramas
- Fotografías
- Tablas (Listas de materiales y equipo utilizado)

FIGURAS

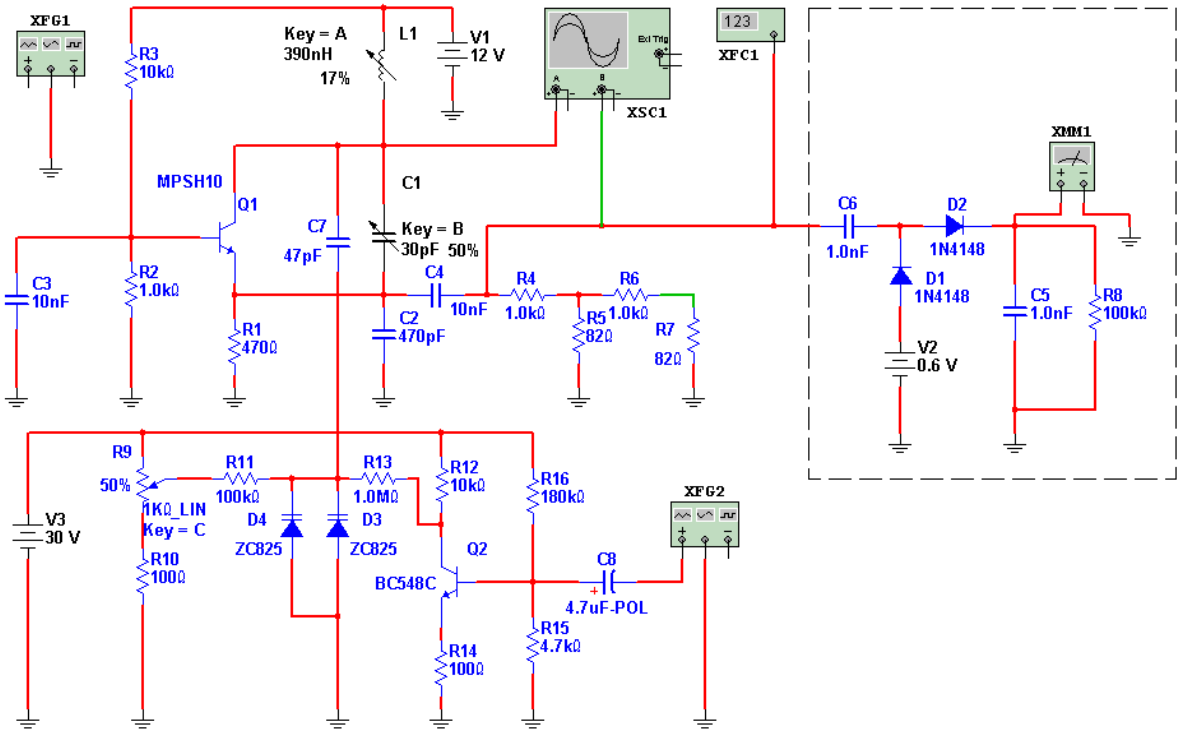



**Figura 1:** Descripción de la figura.

Todas las figuras deben ser descritas en el texto: por ejemplo, la figura 1 muestra

**Tabla 1: Lista de materiales**

| Cantidad | Descripción |
|---|---|
| 2 | Resistencias de 220Ω |
| 4 | Diodos 1N4007 (ver A.1) |
| 1 | Transistor 2N2222 (ver A.2) |

Tambien las tablas deben referenciarse en el texto 1

**Listing 1:** Ejemplo de código fuente en C

```c
#include <stdio.h>

// main prints "hello world" to standard output.
int main(int argc, char **argv) {
  printf("hello world\n");
  return 0;
}
```

**Listing 2:** Ejemplo de código fuente de arduino

```
/*
  AnalogReadSerial

  Reads an analog input on pin 0, prints the result to the Serial Monitor.
  Graphical representation is available using Serial Plotter (Tools > Serial
     Plotter menu).
```

```
  Attach the center pin of a potentiometer to pin A0, and the outside pins to
     +5V and ground.

  This example code is in the public domain.

  http://www.arduino.cc/en/Tutorial/AnalogReadSerial
*/

// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
  // print out the value you read:
  Serial.println(sensorValue);
  delay(1);        // delay in between reads for stability
}
```

# 4 Resultados

En los resultados se deberán incluir tablas y gráficas donde se registren las mediciones realizadas, así como su análisis en orden cero. Además se pueden mostrar fotografías del prototio funcionando. Se debe incluir una discusión sobre los resultados y explicar que es lo relevante de la técnica o medición realizada.

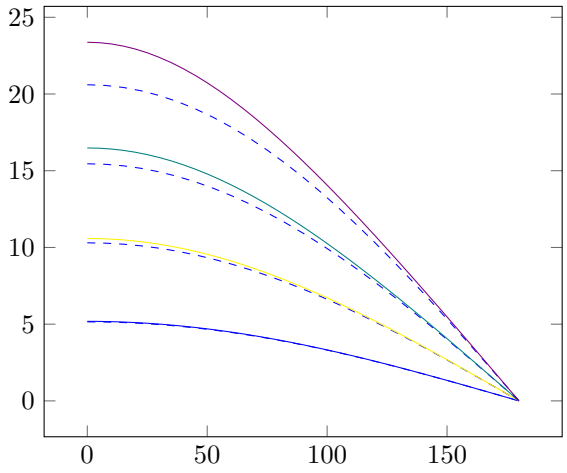



**Figura 2:** Descripción de la figura.

# 5 Conclusiones

En esta sección no se agrega nada nuevo, solo se vuelve a presentar de forma sucinta lo más sobresaliente. No escribir agradecimientos ni notas personales.

# A Hojas de datos

## A.1 Diodo rectificador 1N4007

# 1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007

**1N4004 and 1N4007 are Preferred Devices**

# Axial Lead Standard Recovery Rectifiers

This data sheet provides information on subminiature size, axial lead mounted rectifiers for general−purpose low−power applications.

**Features**

- Shipped in plastic bags, 1000 per bag
- Available Tape and Reeled, 5000 per reel, by adding a “RL” suffix to the part number
- Available in Fan−Fold Packaging, 3000 per box, by adding a “FF” suffix to the part number
- These devices are manufactured with a Pb−Free external lead finish only*

**Mechanical Characteristics**

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16 in. from case
- Polarity: Cathode Indicated by Polarity Band

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

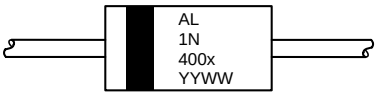
**ON Semiconductor®**

**http://onsemi.com**

**LEAD MOUNTED RECTIFIERS**
**50−1000 VOLTS**
**DIFFUSED JUNCTION**

**CASE 59−10**
**AXIAL LEAD**
**PLASTIC**

**MARKING DIAGRAM**




AL = Assembly Location
1N400x = Device Number
x = 1, 2, 3, 4, 5, 6 or 7
YY = Year
WW = Work Week

**ORDERING INFORMATION**

See detailed ordering and shipping information on page 3 of this data sheet.

**Preferred** devices are recommended choices for future use and best overall value.


**December, 2004 − Rev. 9**

Publication Order Number:
**1N4001/D**

## 1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007

**MAXIMUM RATINGS**

| Rating | Symbol | 1N4001 | 1N4002 | 1N4003 | 1N4004 | 1N4005 | 1N4006 | 1N4007 | Unit |
|---|---|---|---|---|---|---|---|---|---|
| *Peak Repetitive Reverse Voltage<br>Working Peak Reverse Voltage<br>DC Blocking Voltage | $V_{RRM}$<br>$V_{RWM}$<br>$V_R$ | 50 | 100 | 200 | 400 | 600 | 800 | 1000 | V |
| *Non−Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz) | $V_{RSM}$ | 60 | 120 | 240 | 480 | 720 | 1000 | 1200 | V |
| *RMS Reverse Voltage | $V_{R(RMS)}$ | 35 | 70 | 140 | 280 | 420 | 560 | 700 | V |
| *Average Rectified Forward Current (single phase, resistive load, 60 Hz, $T_A$ = 75°C) | $I_O$ | 1.0 | | | | | | | A |
| *Non−Repetitive Peak Surge Current (surge applied at rated load conditions) | $I_{FSM}$ | 30 (for 1 cycle) | | | | | | | A |
| Operating and Storage Junction Temperature Range | $T_J$<br>$T_{stg}$ | −65 to +175 | | | | | | | °C |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

**ELECTRICAL CHARACTERISTICS***

| Rating | Symbol | Typ | Max | Unit |
|---|---|---|---|---|
| Maximum Instantaneous Forward Voltage Drop, ($i_F$ = 1.0 Amp, $T_J$ = 25°C) | $v_F$ | 0.93 | 1.1 | V |
| Maximum Full−Cycle Average Forward Voltage Drop, ($I_O$ = 1.0 Amp, $T_L$ = 75°C, 1 inch leads) | $V_{F(AV)}$ | − | 0.8 | V |
| Maximum Reverse Current (rated DC voltage)<br>($T_J$ = 25°C)<br>($T_J$ = 100°C) | $I_R$ | <br>0.05<br>1.0 | <br>10<br>50 | μA |
| Maximum Full−Cycle Average Reverse Current, ($I_O$ = 1.0 Amp, $T_L$ = 75°C, 1 inch leads) | $I_{R(AV)}$ | − | 30 | μA |

*Indicates JEDEC Registered Data

## A.2 Transistor de switcheo 2N2222

SGS-THOMSON MICROELECTRONICS

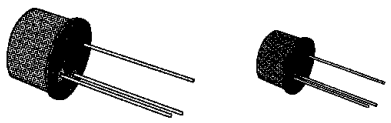
# 2N2218-2N2219 2N2221-2N2222

## HIGH-SPEED SWITCHES

**DESCRIPTION**

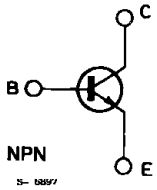
The 2N2218, 2N2219, 2N2221 and 2N2222 are silicon planar epitaxial NPN transistors in Jedec TO-39 (for 2N2218 and 2N2219) and in Jedec TO-18 (for 2N2221 and 2N2222) metal cases. They are designed for high-speed switching applications at collector currents up to 500 mA, and feature useful current gain over a wide range of collector current, low leakage currents and low saturation voltages.

2N2218/2N2219 approved to CECC 50002-100, 2N2221/2N2222 approved to CECC 50002-101 available on request.



TO-39 TO-18

**INTERNAL SCHEMATIC DIAGRAM**




**ABSOLUTE MAXIMUM RATINGS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CBO}$ | Collector-base Voltage ($I_E$ = 0) | 60 | V |
| $V_{CEO}$ | Collector-emitter Voltage ($I_B$ = 0) | 30 | V |
| $V_{EBO}$ | Emitter-base Voltage ($I_C$ = 0) | 5 | V |
| $I_C$ | Collector Current | 0.8 | A |
| $P_{tot}$ | Total Power Dissipation at $T_{amb} \leq 25$ °C | | |
| | for **2N2218** and **2N2219** | 0.8 | W |
| | for **2N2221** and **2N2222** | 0.5 | W |
| | at $T_{case} \leq 25$ °C | | |
| | for **2N2218** and **2N2219** | 3 | W |
| | for **2N2221** and **2N2222** | 1.8 | W |
| $T_{stg}$ | Storage Temperature | – 65 to 200 | °C |
| $T_j$ | Junction Temperature | 175 | °C |

January 1989 

## 2N2218-2N2219-2N2221-2N2222

### THERMAL DATA

| | | | 2N2218<br>2N2219 | 2N2221<br>2N2222 |
|---|---|---|---|---|
| $R_{th\ j\text{-}case}$ | Thermal Resistance Junction-case | Max | 50 °C/W | 83.3 °C/W |
| $R_{th\ j\text{-}amb}$ | Thermal Resistance Junction-ambient | Max | 187.5 °C/W | 300 °C/W |

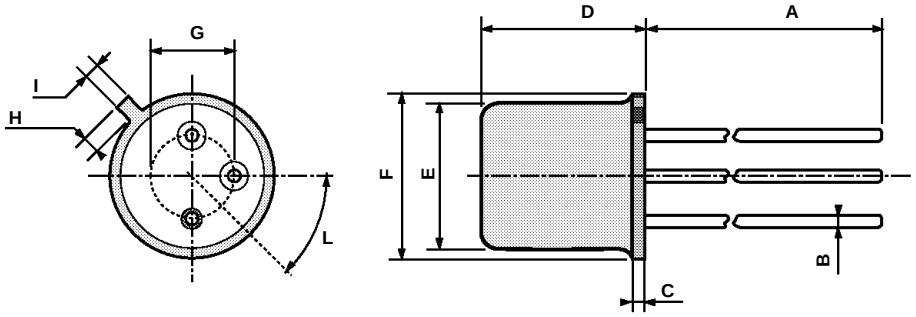
### ELECTRICAL CHARACTERISTICS ($T_{amb}$ = 25 °C unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current ($I_E$ = 0) | $V_{CB}$ = 50 V<br>$V_{CB}$ = 50 V $T_{amb}$ = 150 °C | | | 10<br>10 | nA<br>µA |
| $I_{EBO}$ | Emitter Cutoff Current ($I_C$ = 0) | $V_{EB}$ = 3 V | | | 10 | nA |
| $V_{(BR)\ CBO}$ | Colllector-base Breakdown Voltage ($I_E$ = 0) | $I_C$ = 10 µA | 60 | | | V |
| $V_{(BR)CEO}$* | Collector-emitter Breakdown Voltage ($I_B$ = 0) | $I_C$ = 10 mA | 30 | | | V |
| $V_{(BR)\ EBO}$ | Emittter-base Breakdown Voltage ($I_C$ = 0) | $I_E$ = 10 µA | 5 | | | V |
| $V_{CE\ (sat)}$* | Collector-emitter Saturation Voltage | $I_C$ = 150 mA $I_B$ = 15 mA<br>$I_C$ = 500 mA $I_B$ = 50 mA | | | 0.4<br>1.6 | V<br>V |
| $V_{BE\ (sat)}$* | Base-emitter Saturation Voltage | $I_C$ = 150 mA $I_B$ = 15 mA<br>$I_C$ = 500 mA $I_B$ = 50 mA | | | 1.3<br>2.6 | V<br>V |
| $h_{FE}$* | DC Current Gain | for **2N2218** and **2N2221**<br>$I_C$ = 0.1 mA $V_{CE}$ = 10 V<br>$I_C$ = 1 mA $V_{CE}$ = 10 V<br>$I_C$ = 10 mA $V_{CE}$ = 10 V<br>$I_C$ = 150 mA $V_{CE}$ = 10 V<br>$I_C$ = 500 mA $V_{CE}$ = 10 V<br>$I_C$ = 150 mA $V_{CE}$ = 1 V<br>for **2N2219** and **2N2222**<br>$I_C$ = 0.1 mA $V_{CE}$ = 10 V<br>$I_C$ = 1 mA $V_{CE}$ = 10 V<br>$I_C$ = 10 mA $V_{CE}$ = 10 V<br>$I_C$ = 150 mA $V_{CE}$ = 10 V<br>$I_C$ = 500 mA $V_{CE}$ = 10 V<br>$I_C$ = 150 mA $V_{CE}$ = 1 V | <br>20<br>25<br>35<br>40<br>20<br>20<br><br>35<br>50<br>75<br>100<br>30<br>50 | | <br><br><br><br>120<br><br><br><br><br><br>300 | |
| $f_T$ | Transition Frequency | $I_C$ = 20 mA $V_{CE}$ = 20 V<br>f = 100 MHz | 250 | | | MHz |
| $C_{CBO}$ | Collector-base Capacitance | $I_E$ = 0 $V_{CB}$ = 10 V<br>f = 100 kHz | | | 8 | pF |
| $R_{e(hie)}$ | Real Part of Input Impedance | $I_C$ = 20 mA $V_{CE}$ = 20 V<br>f = 300 MHz | | | 60 | Ω |

* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

## TO-18 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | 12.7 | | | 0.500 | |
| B | | | 0.49 | | | 0.019 |
| D | | | 5.3 | | | 0.208 |
| E | | | 4.9 | | | 0.193 |
| F | | | 5.8 | | | 0.228 |
| G | 2.54 | | | 0.100 | | |
| H | | | 1.2 | | | 0.047 |
| I | | | 1.16 | | | 0.045 |
| L | 45° | | | 45° | | |




0016043

## Referencias

[1] M. Rashid, M. Fernández, and V. Pozo, *Electrónica de potencia: circuitos, dispositivos y aplicaciones*. Pearson Educación, 2004. [Online]. Available: https://books.google.com.mx/books?id=5OXh2vdmCRsC

[2] R. Boylestad and C. Barraza, *Introducción al análisis de circuitos*. Pearson Educación, 2004.

[3] M. Rashid, *Circuitos microelectrónicos: análisis y diseño*. Thomson, 2002. [Online]. Available: https://books.google.com.mx/books?id=9AvaAAAACAAJ

[4] R. Boylestad, L. Nashelsky, and C. Barraza, *Electrónica, teoría de circuitos y dispositivos electrónicos*. Prentice-Hall Hispanoamericana, 2003. [Online]. Available: https://books.google.com.mx/books?id=hHVWXmr_RcYC

[5] S. Chapman, *Máquinas eléctricas (5a. ed.)*:, 2012. [Online]. Available: https://books.google.com.mx/books?id=-bmMDAAAQBAJ