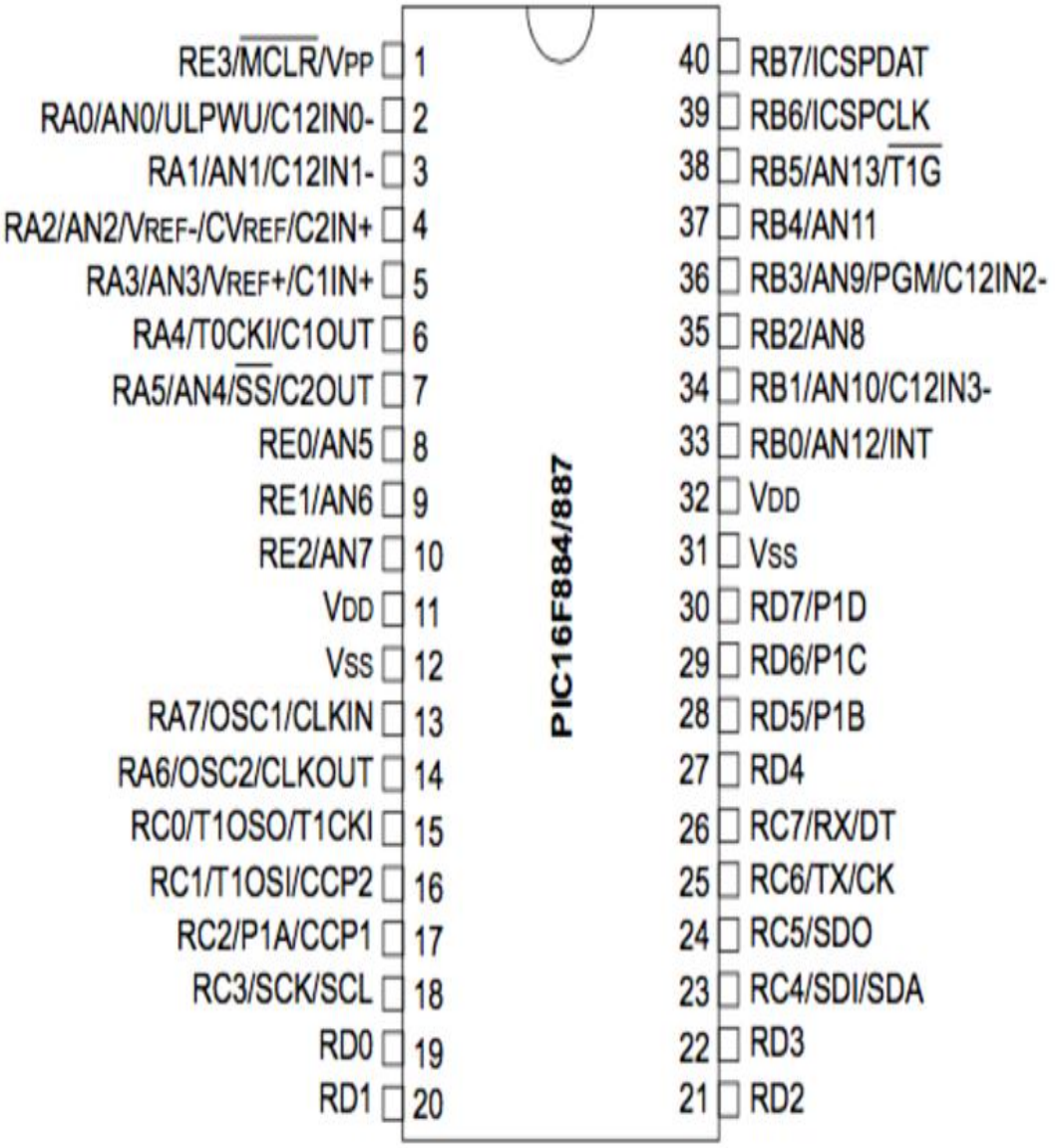
Appendix A

Data sheet of microcontroller PIC16F887:

Name	Number (DIP 40)	Function	Description
RE3/MCLR/Vpp	1	RE3	General purpose input Port E
		MCLR	Reset pin. Low logic level on this pin resets microcontroller.
		Vpp	Programming voltage
RA0/AN0/ULPWU/C12IN0-	2	RA0	General purpose I/O port A
		AN0	A/D Channel 0 input
		ULPWU	Stand-by mode deactivation input
		C12IN0-	Comparator C1 or C2 negative input
RA1/AN1/C12IN1-	3	RA1	General purpose I/O port A
		AN1	A/D Channel 1
		C12IN1-	Comparator C1 or C2 negative input
RA2/AN2/Vref-/CVref/C2IN+	4	RA2	General purpose I/O port A
		AN2	A/D Channel 2
		Vref-	A/D Negative Voltage Reference input
		CVref	Comparator Voltage Reference Output
		C2IN+	Comparator C2 Positive Input
RA3/AN3/Vref+/C1IN+	5	RA3	General purpose I/O port A
		AN3	A/D Channel 3
		Vref+	A/D Positive Voltage Reference Input
		C1IN+	Comparator C1 Positive Input
RA4/T0CKI/C1OUT	6	RA4	General purpose I/O port A
		T0CKI	Timer T0 Clock Input
		C1OUT	Comparator C1 Output
RA5/AN4/SS/C2OUT	7	RA5	General purpose I/O port A
		AN4	A/D Channel 4
		SS	SPI module Input (*Slave Select*)
		C2OUT	Comparator C2 Output
RE0/AN5	8	RE0	General purpose I/O port E
		AN5	A/D Channel 5
RE1/AN6	9	RE1	General purpose I/O port E
		AN6	A/D Channel 6
RE2/AN7	10	RE2	General purpose I/O port E
		AN7	A/D Channel 7
Vdd	11	+	Positive supply
Vss	12	-	Ground (GND)

Name	Number (DIP 40)	Function	Description
RA7/OSC1/CLKIN	13	RA7	General purpose I/O port A
		OSC1	Crystal Oscillator Input
		CLKIN	External Clock Input
RA6/OSC2/CLKOUT	14	OSC2	Crystal Oscillator Output
		CLKO	Fosc/4 Output
		RA6	General purpose I/O port A
RC0/T1OSO/T1CKI	15	RC0	General purpose I/O port C
		T1OSO	Timer T1 Oscillator Output
		T1CKI	Timer T1 Clock Input
RC1/T1OSO/T1CKI	16	RC1	General purpose I/O port C
		T1OSI	Timer T1 Oscillator Input
		CCP2	CCP1 and PWM1 module I/O
RC2/P1A/CCP1	17	RC2	General purpose I/O port C
		P1A	PWM Module Output
		CCP1	CCP1 and PWM1 module I/O
RC3/SCK/SCL	18	RC3	General purpose I/O port C
		SCK	MSSP module Clock I/O in SPI mode
		SCL	MSSP module Clock I/O in I^2C mode
RD0	19	RD0	General purpose I/O port D
RD1	20	RD1	General purpose I/O port D
RD2	21	RD2	General purpose I/O port D
RD3	22	RD3	General purpose I/O port D
RC4/SDI/SDA	23	RC4	General purpose I/O port A
		SDI	MSSP module *Data* input in SPI mode
		SDA	MSSP module *Data* I/O in I^2C mode
RC5/SDO	24	RC5	General purpose I/O port C
		SDO	MSSP module *Data* output in SPI mode
RC6/TX/CK	25	RC6	General purpose I/O port C
		TX	USART Asynchronous Output
		CK	USART Synchronous Clock
RC7/RX/DT	26	RC7	General purpose I/O port C
		RX	USART Asynchronous Input
		DT	USART Synchronous Data

Name	Number (DIP 40)	Function	Description
RD4	27	RD4	General purpose I/O port D
RD5/P1B	28	RD5	General purpose I/O port D
		P1B	PWM Output
RD6/P1C	29	RD6	General purpose I/O port D
		P1C	PWM Output
RD7/P1D	30	RD7	General purpose I/O port D
		P1D	PWM Output
Vss	31	-	Ground (GND)
Vdd	32	+	Positive Supply
RB0/AN12/INT	33	RB0	General purpose I/O port B
		AN12	A/D Channel 12
		INT	External Interrupt
RB1/AN10/C12INT3-	34	RB1	General purpose I/O port B
		AN10	A/D Channel 10
		C12INT3-	Comparator C1 or C2 Negative Input
RB2/AN8	35	RB2	General purpose I/O port B
		AN8	A/D Channel 8
RB3/AN9/PGM/C12IN2-	36	RB3	General purpose I/O port B
		AN9	A/D Channel 9
		PGM	Programming enable pin
		C12IN2-	Comparator C1 or C2 Negative Input
RB4/AN11	37	RB4	General purpose I/O port B
		AN11	A/D Channel 11
RB5/AN13/T1G	38	RB5	General purpose I/O port B
		AN13	A/D Channel 13
		T1G	Timer T1 External Input
RB6/ICSPCLK	39	RB6	General purpose I/O port B
		ICSPCLK	Serial programming Clock
RB7/ICSPDAT	40	RB7	General purpose I/O port B
		ICSPDAT	Programming enable pin


RE3/MCLR/VPP 1
RA0/AN0/ULPWU/C12IN0- 2
RA1/AN1/C12IN1- 3
RA2/AN2/VREF-/CVREF/C2IN+ 4
RA3/AN3/VREF+/C1IN+ 5
RA4/T0CKI/C1OUT 6
RA5/AN4/SS/C2OUT 7
RE0/AN5 8
RE1/AN6 9
RE2/AN7 10
VDD 11
VSS 12
RA7/OSC1/CLKIN 13
RA6/OSC2/CLKOUT 14
RC0/T1OSO/T1CKI 15
RC1/T1OSI/CCP2 16
RC2/P1A/CCP1 17
RC3/SCK/SCL 18
RD0 19
RD1 20
40 RB7/ICSPDAT
39 RB6/ICSPCLK
38 RB5/AN13/T1G
37 RB4/AN11
36 RB3/AN9/PGM/C12IN2-
35 RB2/AN8
34 RB1/AN10/C12IN3-
33 RB0/AN12/INT
32 VDD
31 VSS
30 RD7/P1D
29 RD6/P1C
28 RD5/P1B
27 RD4
26 RC7/RX/DT
25 RC6/TX/CK
24 RC5/SDO
23 RC4/SDI/SDA
22 RD3
21 RD2
PIC16F884/887

Appendix B

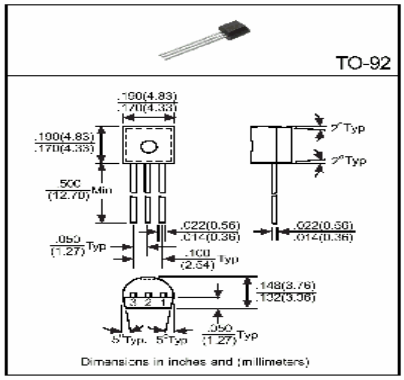
Data Sheet Of Transistor(Bc547)

DC COMPONENTS CO., LTD.
DISCRETE SEMICONDUCTORS

BC547

TECHNICAL SPECIFICATIONS OF NPN EPITAXIAL PLANAR TRANSISTOR

Description
Designed for use in driver stage of audio amplifier.



Pinning
1 = Collector
2 = Base
3 = Emitter

Absolute Maximum Ratings(T_A=25°C)

Characteristic	Symbol	Rating	Unit
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage	V_{CEO}	45	V
Emitter-Base Voltage	V_{EBO}	6	V
Collector Current	I_C	100	mA
Total Power Dissipation	P_C	500	mW
Junction Temperature	T_J	+150	°C
Storage Temperature	T_{STG}	-55 to +150	°C

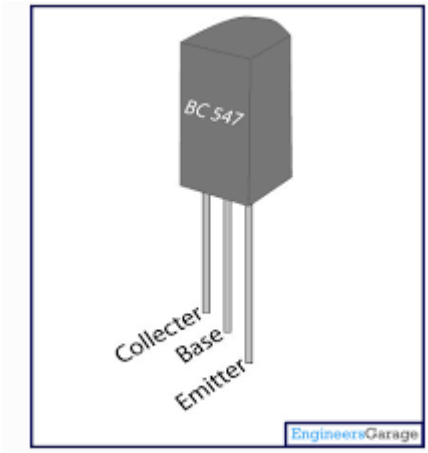
Electrical Characteristics
(Ratings at 25°C ambient temperature unless otherwise specified)

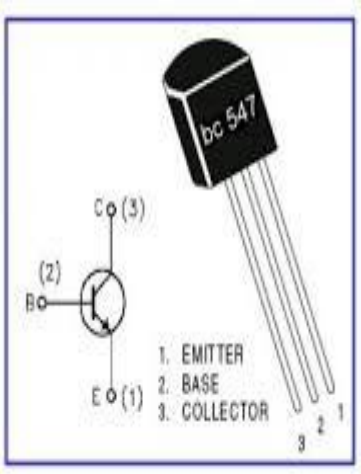
Characteristic	Symbol	Min	Typ	Max	Unit	Test Conditions
Collector-Base Breakdown Volatge	BV_{CBO}	50	-	-	V	I_C=100μA, I_E=0
Collector-Emitter Breakdown Voltage	BV_{CEO}	45	-	-	V	I_C=1mA, I_B=0
Emitter-Base Breakdown Volatge	BV_{EBO}	6	-	-	V	I_E=10μA, I_C=0
Collector Cutoff Current	I_{CBO}	-	-	15	nA	V_{CB}=30V, I_E=0
Collector-Emitter Saturation Voltage[1]	$V_{CE(sat)1}$	-	-	0.25	V	I_C=10mA, I_B=0.5mA
	$V_{CE(sat)2}$	-	-	0.6	V	I_C=100mA, I_B=5mA
Base-Emitter Saturation Voltage[1]	$V_{BE(sat)1}$	-	0.7	-	V	I_C=10mA, I_B=0.5mA
	$V_{BE(sat)2}$	-	0.9	-	V	I_C=100mA, I_B=5mA
Base-Emitter On Voltage	$V_{BE(on)1}$	0.58	-	0.7	V	I_C=2mA, V_{CE}=5V
	$V_{BE(on)2}$	-	-	0.77	V	I_C=10mA, V_{CE}=5V
DC Current Gain[1]	h_{FE}	110	-	800	-	I_C=2mA, V_{CE}=5V
Transition Frequency	f_T	-	300	-	MHz	I_C=10mA, V_{CE}=5V, f=100MHz
Output Capacitance	C_{ob}	-	-	4.5	pF	V_{CL}=10V, f=1MHz, I_E=0

(1)Pulse Test: Pulse Width ≤ 380μs, Duty Cycle ≤ 2%

Classification of h_{FE}

Rank	A	B	C
Range	110–220	200–450	420–800





Appendix C

Data Sheet of LM35

National Semiconductor

November 2000

LM35
Precision Centigrade Temperature Sensors

General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±¼°C typical
- Low impedance output, 0.1 Ω for 1 mA load

Typical Applications

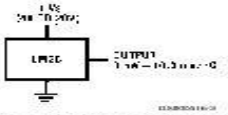
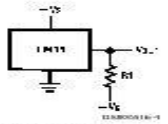


FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)

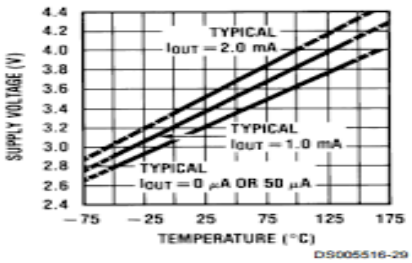


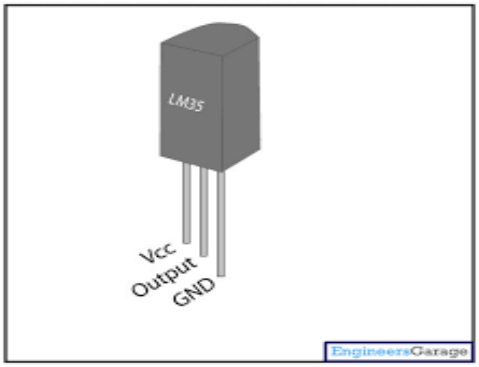
Choose $R_1 = -V_S/50\ \mu A$
V_{OUT} = +1,500 mV at +150°C
= +250 mV at +25°C
= −550 mV at −55°C

FIGURE 2. Full-Range Centigrade Temperature Sensor

 DS005516

Minimum Supply Voltage vs. Temperature





Appendix D

CODE

```
define RS RD2#
define EN RD3#
define D4 RD4#
define D5 RD5#
define D6 RD6#
define D7 RD7#
define led_r RC0#
define led_y RC1#
define led_b RC2#
define led_g RC3#
define pls_pin RC6#
define buz_pin RC7#
define red RC4#
define ir RC5#
define up RA2#
define dwn RA3#
define _XTAL_FREQ 8000000#
<include <xc.h#
"include "BM.h#
"include "lcd.h#
<include <string.h#
<include <stdio.h#
```

<include <stdlib.h#

ŧunsigned long ms = 0,sec=1,mn=1,hrs=0

ŧunsigned long loop_time_sync

ŧunsigned long loopnum = 0

ŧunsigned char mnf = 0, hrf = 0

diplay variables //

ŧ[char num[3],debug[4

const unsigned short numPts = 100; //number of data points taken within the wait time

unsigned char pts_cnt=0; // current sample number

saturated and desaturated hemoglobin adc values //

ŧunsigned int adcRead_oxi=0

unsigned int minVal = 1023; //minimum value taken

unsigned int maxVal = 0;   //maximum value taken

unsigned char max_spo2 = 0; // max value of spo2

ŧfloat rTop=0, rBot=0, rr=0, SpO2=0

unsigned char count = 0;//count for R Values array

leds control variables //

unsigned char red_stat=1, RedIr_done=0;   // status of the red led

movingAverage function's control variables //

ŧconst unsigned char avgWindowLen = 5

ŧfloat average[avgWindowLen],sum=0,SpO2_avg=0

ŧunsigned char pos=0

ŧ[unsigned int adc_br = 0,bchrs[24

ŧunsigned char schmittOn = 0,brp=0,bcnt=0,iter=0,brf=0,counter = 0

‘unsigned long brt=0

‘unsigned int prev_hrs = 0

‘unsigned char upf =0,dwnf=0

‘unsigned int ptr=0

‘unsigned long window = 0

Place/Copy this part in declaration section//