UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria de Barcelona Est

TRABAJO DE FINAL DE GRADO

Grado en Ingeniería Electrónica Industrial y Automática

SISTEMA DE GESTIÓN DOMÓTICA PARA OPTIMIZAR EL CONSUMO ENERGÉTICO DE UNA VIVIENDA

Anexos

Autor/a: Judit Pérez Pérez

Director/a: Manuel Andrés Manzanares Brotons

Convocatoria: Enero 2023

Índice

Índice de figuras

Índice de tablas

1. Utilización de los pines de la placa Arduino Mega 2560

Tabla 1: Comparación de los pines utilizados en el prototipo comercial *y el prototipo de pruebas. [Fuente propia]*

Pines del Arduino Mega		
nº	**Prototipo de ventas**	**Prototipo de prueba**
0 (RX)		x
1 (TX)		x
~2		x
~3		x
~4	CD74HC4067 MODO DEMULTIPLEXOR (S0)	LCD Keypad Shield (LCD D4)
~5	CD74HC4067 MODO DEMULTIPLEXOR (S1)	LCD Keypad Shield (LCD D5)
~6	CD74HC4067 MODO DEMULTIPLEXOR (S2)	LCD Keypad Shield (LCD D6)
~7	CD74HC4067 MODO DEMULTIPLEXOR (S3)	LCD Keypad Shield (LCD D7)
~8	CD74HC4067 MODO MULTIPLEXOR (S0)	LCD Keypad Shield (LCD RS)
~9	CD74HC4067 MODO MULTIPLEXOR (S1)	LCD Keypad Shield (Enable)
~10	CD74HC4067 MODO MULTIPLEXOR (S2)	LCD Keypad Shield (Backlight)
~11	CD74HC4067 MODO MULTIPLEXOR (S3)	x
~12	Buzzer (alarma)	x
~13	-	LED Amarillo Luz (conectado a un ~ reg. Intensidad de la luz)
14 (TX3)	Motor ventana 1 (Subir)	-
15 (RX3)	Motor ventana 1 (Bajar)	-
16 (TX2)	Motor ventana 2 (Subir)	-
17 (RX2)	Motor ventana 2 (Bajar)	-
18 (TX1)	Motor ventana 3 (Subir)	-
19 (RX1)	Motor ventana 3 (Bajar)	-
20 (SDA)	RTC SDA	-
21 (SCL)	RTC SCL	-
22	LCD Keypad Shield (LCD D7)	Reloj (CLK)
23	Teclado (rojo)	Teclado (rojo)
24	LCD Keypad Shield (LCD D6)	Reloj (DAT)
25	Teclado (naranja)	Teclado (naranja)
26	LCD Keypad Shield (LCD D5)	Reloj (RST)
27	Teclado (amarillo)	Teclado (amarillo)
28	LCD Keypad Shield (LCD D4)	LED Rojo Calefacción
29	Teclado (verde)	Teclado (verde)
30	LCD Keypad Shield (Enable)	LED Verde Calefacción
31	Teclado (azul)	Teclado (azul)
32	LCD Keypad Shield (LCD RS)	LED Rojo Grande Alarmas

33	Teclado (lila)	Teclado (lila)
34	Pulsador Manual/Auto	LED Verde Grande Alarmas
35	Teclado (gris)	Teclado (gris)
36	A3144 (Sensor Hall)	Pulsador Manual/Automático
37	Final de carrera superior (M1_Habitación1)	Relé (IN1)
38	A3144 (Sensor Hall)	Servomotor (Ventana)
39	Final de carrera inferior (M1_Habitación1)	Relé (IN2)
40	A3144 (Sensor Hall)	Servomotor (Toldo)
41	Final de carrera superior (M2_Habitación2)	Buzzer (alarma)
42	-	Sensor PIR
43	Final de carrera inferior (M2_Habitación2)	Sensor Temperatura/Humedad
~44	-	-
~45	Final de carrera superior (M3_Toldo)	-
~46	-	LED Verde Pequeño Alarmas
47	Final de carrera inferior (M3_Toldo)	Motor paso a paso (IN1)
48	Sensor Temperatura/Humedad	LED Rojo Pequeño Alarmas
49	74HC595 (pinDato)	Motor paso a paso (IN2)
50	Bluetooth RX	Bluetooth RX
51	74HC595 (pinRegistro)	Motor paso a paso (IN3)
52	Bluetooth TX	Bluetooth TX
53	74HC595 (pinClock)	Motor paso a paso (IN4)
A0	Botones del módulo LCD	LCD Keypad Shield (Buttons)
A1	Sensor de Gas Natural MQ-5	x
A2	-	x
A3	CD74HC4067 MODO MULTIPLEXOR (INPUT)	x
A4	CD74HC4067 MODO DEMULTIPLEXOR (INPUT)	x
A5	-	x
A6	Medir tensión	x
A7	ACS712	-
A8	LDR (fotorresistores) 1	Potenciómetro
A9	LDR (fotorresistores) 2	Sensor Luz Ambiental
A10	LDR (fotorresistores) 3	Sensor Nivel Agua
A11	LDR (fotorresistores) 4	-
A12	Sensor Nivel de Agua 1	-
A13	Sensor Nivel de Agua 2	-
A14	Sensor Nivel de Agua 3	-
A15	-	-

2. Variables creadas en el código del prototipo de pruebas

Tabla 2: Listado de las variables creadas en el código del prototipo de pruebas. [Fuente propia]

Variable	Tipo	Definición
currentMillis, previousMillis	unsigned long	Variable de milisegundos para retroceder de menú
interval	long	Intervalo de tiempo que se presiona el pulsador para retroceder de menú
currentMillis2, previousMillis2	unsigned long	Variable de milisegundos para entrar en el modo seguridad
interval2	long	Intervalo de tiempo que se presiona el pulsador para entrar en el modo seguridad
currentMillis3, previousMillis3	unsigned long	Variable de milisegundos para medir luz con el LDR
interval3	long	Intervalo de tiempo que tardará el sensor LDR en dar una medida de la luz
TECLA	char	Variable que corresponde a la tecla pulsada del teclado matricial 4x3
CLAVE	char	Variable de 6 bits que corresponde a los 6 caracteres pulsados del teclado
CLAVE_MAESTRA	char	Clave de acceso a la vivienda (en este caso es: "123456")
INDICE	byte	Variable que sirve para crear una variable de 6 bits para mostrarse en el LCD los 6 caracteres presionados del teclado
temp	float	Variable que indica la temperatura medida por el sensor DHT11
hum	float	Variable que indica la humedad medida por el sensor DHT11
luzAmbiente	int	Variable que indica la luz medida por el LDR (valor de 0 a 1023)
valor_luz	int	Intensidad de la luz que percibe el LDR (en porcentaje)
agua	int	Variable para saber si el sensor de nivel de agua detecta o no agua
estadoPir	int	Cuando sea '1' indicará que el sensor PIR está detectando movimiento
brillo	int	Variable que, mediante el potenciómetro, regula la intensidad de luz de un LED (valor de 0 a 1023)
estadoVentana	int	Cuando el valor sea de '1' indicará que la ventana está abierta, si es '0' estará cerrada

estadoToldo	int	Cuando el valor sea de '1' indicará que el toldo está abierto, si es '0' estará recogido
bluetooth	char	Variable que ejecuta las distintas funciones a partir de la aplicación móvil
Bright, Bup, Bdown, Bleft, Bselect	int	Variable con valor '1' mientras se presione el pulsador "right", "up", "down", "left" y "select" respectivamente
back	int	Variable con valor '1' cuando se haya mantenido presionado el pulsador "select" 3 segundos
menu	int	Número que corresponde al menú que se muestra en el LCD
ventanaMenu0	int	Número que corresponde a la ventana que se muestre en el LCD del menú 0
ventanaMenu1	int	Número que corresponde a la ventana que se muestre en el LCD del menú 1
numEstancias	int	Número que corresponde a las distintas estancias de la vivienda
estancia	string	Variable que corresponde al nombre de la estancia seleccionada
ventanaMenu2	int	Número que corresponde a la ventana que se muestre en el LCD del menú 2
numControl	int	Número que llama a las distintas funciones de control creadas
control	string	Variable que corresponde al nombre del control que se realiza
luz	boolean	Variable para cambiar el estado de la iluminación (LEDs)
calef	boolean	Variable para cambiar el estado de la calefacción (LED rojo y LED verde)
aire	boolean	Variable para cambiar el estado del aire acondicionado (ventilador)
ventana	boolean	Variable para cambiar el estado de la ventana (servomotor)
persiana	boolean	Variable para cambiar el estado de la persiana (motor paso a paso)
electro	boolean	Variable para cambiar el estado de los electrodomésticos (relé)
lluvia	boolean	Variable para cambiar el estado del toldo (servomotor)
manual	boolean	Indica el modo de funcionamiento, '0' si está en modo manual y '1' si está en modo automático
seguridad	boolean	Indica si el modo seguridad esta activado ('1') o no ('0')
consumo	float	Porcentaje de energía consumida (100% exceso de consumo y 0% sistema apagado

day, month, year	int	Indica la fecha actual (día, mes y año)
hour, minute, second	int	Indica la hora actual (horas, minutos y segundos)
modoSeguridad	int	Variable con valor '1' cuando se haya mantenido presionado el pulsador "manual/auto" 3 segundos
contraIncorrecta	int	Número de veces que se ha introducido la clave incorrectamente
alertaIntentoEntrar	int	Cuando sea '1' indicará que se ha introducido la clave incorrectamente 3 veces seguidas
alertaPosibleIncendio	int	Cuando sea '1' indicará una temperatura excesivamente elevada
alertaHumedadElevada	int	Cuando sea '1' indicará una humedad excesivamente elevada
alertaPosibleIntruso	int	Será '1' cuando el sensor PIR detecte movimiento cuando esté activado el modo seguridad
alarmas	int	Número de alarmas activadas

3. Código del prototipo de pruebas

```
//Librería para el display LCD
#include <LiquidCrystal.h>
//Librería para el real time clock
#include <ThreeWire.h>
#include <RtcDS1302.h>
//Librería para el teclado
#include <Keypad.h>
//Librería para el sensor de temperatura
#include <DHT.h>
#include <DHT_U.h>
//Librería para el motor paso a paso
#include <Stepper.h>
//Librería para el servomotor
#include <Servo.h>
//Librería para el módulo bluetooth HC05
#include <SoftwareSerial.h>


//LCD pin to Arduino
const int pin_RS = 8;
const int pin_EN = 9;
const int pin_d4 = 4;
const int pin_d5 = 5;
const int pin_d6 = 6;
const int pin_d7 = 7;

const int pin_BL = 10;

LiquidCrystal lcd( pin_RS,  pin_EN,  pin_d4,  pin_d5,  pin_d6,  pin_d7);

//Pulsador manual/automático
const int Bmanual = 36;
int pulsador = 0;

//Pulsador back y las variables necesarias para el timer
long previousMillis = 0;    //Variable del timer que nos permite retroceder
de menú
long interval = 2000;   //Intervalo de tiempo que queremos que se mantenga
presionado el botón
long previousMillis2 = 0;   //Variable del timer que nos permite entrar al
modo seguridad
long interval2 = 2000;  //Intervalo de tiempo que queremos que se mantenga
presionado el botón
long previousMillis3 = 0;   //Variable del timer que nos permite entrar al
modo seguridad
```

```
long interval3 = 2000;


//Conexiones Real-Time Clock
ThreeWire myWire(24,22,26); //IO,SCLK,CE
RtcDS1302<ThreeWire> Rtc(myWire);


//Conexiones teclado
const byte FILAS = 4;
const byte COLUMNAS = 3;
char keys[FILAS][COLUMNAS] = {
  {'1','2','3'},
  {'4','5','6'},
  {'7','8','9'},
  {'*','0','#'}
};

byte pinesFilas[FILAS] = {25,35,33,29};     //Cables lila,rojo,naranja,verde
byte pinesColumnas[COLUMNAS] = {27,23,31};  //Cables azul,gris,amarillo

Keypad teclado = Keypad(makeKeymap(keys), pinesFilas, pinesColumnas, FILAS,
COLUMNAS);

char TECLA;
char CLAVE[7];
char CLAVE_MAESTRA[7] = "123456";
byte INDICE = 0;


//Conexiones sensor Temperatura y Humedad + Variables necesarias de temp y
hum
int pinTemp = 43;
DHT dht(pinTemp, DHT11);
float temp, hum;

//Conexiones detector de luz ambiental
int sensorLuzAmbiente = A9;
int luzAmbiente;
int valor_luz;    //Luz en %

//Conexiones detector de agua
int sensorLluvia = A10;
int agua;

//Conexiones detector de presencia (Sensor PIR)
int sensorPir = 42;         // PIR Outpin
int estadoPir = 0;          // PIR status
```

```
//Conexiones de los LEDs
const int LedRojoCalef = 28;
const int LedVerdeCalef = 30;
const int LedAmarilloLuz = 13;
const int LedAlertaIntentoEntrar = 32;     //Led Rojo Grande --> Alarma
Intento Entrar (Fallo x3 contra casa)
const int LedAlertaPosibleIntruso = 34;    //Led Verde Grande --> Alarma
Posible Intruso (Sensor PIR)
const int LedAlertaHumedadElevada = 46;    //Led Verde Pequeño --> Alarma
Humedad Elevada
const int LedAlertaPosibleIncendio = 48;   //Led Rojo Pequeño --> Alarma
Posible Incendio

//Conexión del potenciómetro
const int pot = A8;
int brillo;   //Variable para la intensidad del LED

//Conexiones buzzer (alarma sonora)
const int Buzzer = 41;

//Conexiones de los Relés
#define fanOn 0       //Activar Relé, como los reles se activan con nivel
bajo o 0 por la lògica inversa
#define fanOff 1      //Desactivar Relé, como los reles se activan con nivel
alto o 1 por la lógica inversa
#define electroOn 0       //Activar Relé, como los reles se activan con
nivel bajo o 0 por la lògica inversa
#define electroOff 1      //Desactivar Relé, como los reles se activan con
nivel alto o 1 por la lógica inversa
const int fan = 37;    //Ventilador
const int electrodomestico = 39;

//Conexiones del motor paso a paso
Stepper motor1(2048, 47, 51, 49, 53);
int estadoPersiana = 0;

//Conexiones de los servomotores (Servo1 --> Ventanas     Servo2 --> Toldo)
Servo servoVentanas;
Servo servoToldo;
int estadoVentana = 0;
int estadoToldo = 0;
int val1;
int val2;


//Conexiones para el módulo bluetooth HC05
SoftwareSerial ModuloHC05 (52, 50);  //pin TXD, pin RXD del módulo --> RX1,
TX1 dell arduino Mega
char bluetooth;
```

```
//Variables para saber si se ha pulsado el BUTTON correspondiente
int Bright = 0;
int Bup = 0;
int Bdown = 0;
int Bleft = 0;
int Bselect = 0;

//Variables que aumentan (+1) cada vez que se presione el pulsador
correspondiente
int right = 0;
int up = 0;
int down = 0;
int left = 0;
int select = 0;
int back = 0;

//Variables para moverse entre pestañas
int menu = 0;
int ventanaMenu0 = 1;
int ventanaMenu1 = 1;
int numEstancias = 1;
String estancia;
int ventanaMenu2 = 1;
int numControl = 1;
String control;

//Variables ON/OFF del control
boolean luz = false;
boolean calef = false;
boolean aire = false;
boolean ventana = false;
boolean persiana = false;
boolean electro = false;
boolean lluvia = true;

boolean manual = false;
boolean seguridad = false;

float consumo = 0;


//Otras variables & ALARMAS
int day = 0;
int month = 0;
int year = 0;
int hour = 0;
int minute = 0;
int second = 0;
```

```
int modoSeguridad = 0;
int contraIncorrecta = 0;
int alertaIntentoEntrar = 0;
int alertaPosibleIncendio = 0;
int alertaHumedadElevada = 0;
int alertaPosibleIntruso = 0;
int alarmas = 0;


//Funciones creadas para el control del sistema
void printDateTime(const RtcDateTime& dt);
void contraPuerta();
void iluminacion();
void calefaccion();
void ventilador();
void ventanas();
void persianas();
void electrodomesticos();
void toldo();
void tempHum();
void lumLluvia();
//Funciones creadas para el módulo bluetooth
void bluetooth_B_iluminacion();
void bluetooth_C_iluminacion();
void bluetooth_D_calefaccion();
void bluetooth_E_calefaccion();
void bluetooth_F_ventilador();
void bluetooth_G_ventilador();
void bluetooth_H_control();
void bluetooth_I_infoSensores();
void bluetooth_J_ventanas();
void bluetooth_K_ventanas();
void bluetooth_N_persianas();
void bluetooth_O_persianas();
void bluetooth_P_alarmas();
void bluetooth_Q_electrodomesticos();
void bluetooth_R_electrodomesticos();
void bluetooth_T_toldo();
void bluetooth_U_toldo();

//Mirar si hay algo sobre led
void setup() {
  Serial.begin(9600);  //Inicia la comunicación serie

  //Inicializar el módulo bluetooth HC05
  ModuloHC05.begin(38400);    //Inicializa puerto serie por software
  pinMode(led, OUTPUT);
```

```
  //Inicializar el real-time clock
  Rtc.Begin();
  RtcDateTime compiled = RtcDateTime(__DATE__,__TIME__);
  printDateTime(compiled);

  //Inicializar el sensor de temperatura para medir la humedad y la
temperatura
  dht.begin();

  //Indicar el modo del sensor PIR
  pinMode(sensorPir, INPUT);

  //Indicar la velocidad del motor paso a paso: valores de 1,2 o 3
  motor1.setSpeed(5);

  //Attaches the servo on pin 38 to the servo object
  servoVentanas.attach(38);
  servoToldo.attach(40);

  //Indicar el modo de los pines de los LEDs (INPUT/OUTPUT)
  pinMode(LedRojoCalef, OUTPUT);
  pinMode(LedVerdeCalef, OUTPUT);
  pinMode(LedAmarilloLuz, OUTPUT);
  pinMode(LedAlertaIntentoEntrar, OUTPUT);
  pinMode(LedAlertaPosibleIntruso, OUTPUT);
  pinMode(LedAlertaHumedadElevada, OUTPUT);
  pinMode(LedAlertaPosibleIncendio, OUTPUT);

  pinMode(Bmanual, INPUT);    //Botón manual/automático
  pinMode(Buzzer, OUTPUT);    //Buzzer (alarma contra incorrecta)
  pinMode(fan, OUTPUT);       //Relé para el ventilador
  pinMode(electrodomestico, OUTPUT);   //Relé controlar el apagado/encedido
de los electrodomésticos según la hora del día

  //Inicializar el programa con los relés y los leds apagados (en rojo)
  digitalWrite(fan, fanOff);
  digitalWrite(electrodomestico, electroOff);
  digitalWrite(LedRojoCalef, HIGH);
  servoVentanas.write(0);

  lcd.begin(16, 2);   //Indicar las dimensiones del LCD
  lcd.setCursor(0,0); //Poner el cursor en la columna 0, fila 0
  lcd.print("Let's go!!");
  lcd.setCursor(0,1); //Poner el cursor en la columna 0, fila 1
  lcd.print("Version30");
  delay(2000);
  lcd.clear();
}
```

```
void loop() {

//-----------------------------------------------------------------------------
// Variables que indican el día, el mes, el año, la hora, los minutos y los
segundos
  RtcDateTime now = Rtc.GetDateTime();
  day = now.Day();
  month = now.Month();
  year = now.Year();
  hour = now.Hour();
  minute = now.Minute();
  second = now.Second();
//-----------------------------------------------------------------------------
  int x;
  x = analogRead(A0);             //Pulsadores analógicos del shield del LCD
  luzAmbiente = analogRead(A9);   //Variable del sensor LDR luz ambiente

  agua = analogRead(A10);         //Variable del detector de nivel de agua

  temp = dht.readTemperature();   //Variable Temperatura
  hum = dht.readHumidity();       //Variable Humedad

  consumo = electro * 64.5 + luz * 11.7 + calef * 14.9 + aire * 2.3 + 6.6;

  unsigned long currentMillis = millis();     //Variable de milisegundos
para retroceder de menú
  unsigned long currentMillis2 = millis();    //Variable de milisegundos
para entrar en el modo seguridad
  unsigned long currentMillis3 = millis();    //Variable de milisegundos
para medir luz con el LDR

  //Delay para que muestre el porcentaje de luminosidad cada 2 segundos.
  if (currentMillis3 - previousMillis3 > interval3)
  {
    previousMillis3 = currentMillis3;
    valor_luz = map(luzAmbiente, 0, 1023, 0, 100);
  }

//-----------------------------------------------------------------------------
//BLUETOOTH (código para la aplicación móvil)
  if (ModuloHC05.available()) {             //Llega algo por bluetooth?
    bluetooth = ModuloHC05.read();
    if (bluetooth == 'I')
    {
      bluetooth_I_infoSensores();
    }
    if (bluetooth == 'P'){
      bluetooth_P_alarmas();
    }
```

```
if (bluetooth == 'M'){
  manual = 0;
  seguridad = 0;
}
if (bluetooth == 'A'){
  manual = 1;
  seguridad = 0;
}
if (bluetooth == 'H'){
  bluetooth_H_control();
}
if (bluetooth == 'S'){
  seguridad = 1;
}
if ((bluetooth == 'B') && (manual == 0)){
  bluetooth_B_iluminacion();
}
if ((bluetooth == 'C') && (manual == 0)){
  bluetooth_C_iluminacion();
}
if ((bluetooth == 'D') && (manual == 0)){
  bluetooth_D_calefaccion();
}
if ((bluetooth == 'E') && (manual == 0)){
  bluetooth_E_calefaccion();
}
if ((bluetooth == 'F') && (manual == 0)){
  bluetooth_F_ventilador();
}
if ((bluetooth == 'G') && (manual == 0)){
  bluetooth_G_ventilador();
}
if ((bluetooth == 'J') && (manual == 0)){
  bluetooth_J_ventanas();
}
if ((bluetooth == 'K') && (manual == 0)){
  bluetooth_K_ventanas();
}
if ((bluetooth == 'N') && (manual == 0)){
  bluetooth_N_persianas();
}
if ((bluetooth == 'O') && (manual == 0)){
  bluetooth_O_persianas();
}
if ((bluetooth == 'Q') && (manual == 0)){
  bluetooth_Q_electrodomesticos();
}
if ((bluetooth == 'R') && (manual == 0)){
  bluetooth_R_electrodomesticos();
```

```
    }
    if ((bluetooth == 'T') && (manual == 0)){
      bluetooth_T_toldo();
    }
    if ((bluetooth == 'U') && (manual == 0)){
      bluetooth_U_toldo();
    }
    bluetooth == ' ';
  }

//---------------------------------------------------------------------------
  //Pulsadores del display (son analógicos A0)
  if (x < 20 && x >= 0) {  //Pulsador RIGHT
    Bright = 1;
    Bup = 0;
    Bdown = 0;
    Bleft = 0;
    Bselect = 0;
  }
  else if (x < 110 && x >= 90) {  //Pulsador UP
    Bright = 0;
    Bup = 1;
    Bdown = 0;
    Bleft = 0;
    Bselect = 0;
  }
  else if (x < 265 && x >= 245){  //Pulsador DOWN
    Bright = 0;
    Bup = 0;
    Bdown = 1;
    Bleft = 0;
    Bselect = 0;
  }
  else if (x < 420 && x >= 400){  //Pulsador LEFT
    Bright = 0;
    Bup = 0;
    Bdown = 0;
    Bleft = 1;
    Bselect = 0;
  }
  else if (x < 650 && x >= 630){  //Pulsador SELECT
    Bright = 0;
    Bup = 0;
    Bdown = 0;
    Bleft = 0;
    Bselect = 1;

    if (currentMillis - previousMillis > interval)
    {
```

```
      previousMillis = currentMillis;
      //Función que queremos que haga cuando se mantenga pulsado el botón
      back = 1;
    }

  }
  else if (x > 1020){  //Ningún pulsador presionado
    previousMillis = currentMillis;
    if (Bright == 1){
      Bright = 0;
      right++;
      if (menu == 1 && ventanaMenu1 == 1) numEstancias++;
      else if (menu == 2 && ventanaMenu2 == 1) numControl++;
      lcd.clear();
    }
    else if (Bup == 1){
      Bup = 0;
      up++;
      if (menu == 0) ventanaMenu0--;
      else if (menu == 1) ventanaMenu1--;
      else if (menu == 2) ventanaMenu2--;
      lcd.clear();
    }
    else if (Bdown == 1){
      Bdown = 0;
      down++;
      if (menu == 0) ventanaMenu0++;
      else if (menu == 1) ventanaMenu1++;
      else if (menu == 2) ventanaMenu2++;
      lcd.clear();
    }
    else if (Bleft == 1){
      Bleft = 0;
      left++;
      if (menu == 1 && ventanaMenu1 == 1) numEstancias--;
      else if (menu == 2 && ventanaMenu2 == 1) numControl--;
      lcd.clear();
    }
    else if (Bselect == 1){
      Bselect = 0;
      //Pulsador digital (Botón Back) --> Mantener pulsado el botón Select
      if (back == 1){
        back = 0;
        select--;
        lcd.clear();
      }
      else {
        select++;
        if (manual == 0){
```

```
          if (menu == 2 && numControl == 2) luz = !luz;
          else if (menu == 2 && numControl == 3) calef = !calef;
          else if (menu == 2 && numControl == 4) aire = !aire;
          else if (menu == 2 && numControl == 5) ventana = !ventana;
          else if (menu == 2 && numControl == 6) persiana = !persiana;
          else if (menu == 2 && numControl == 7) electro = !electro;
          else if (menu == 2 && numControl == 8) lluvia = !lluvia;
          lcd.clear();
        }
      }
      lcd.clear();
    }
  }


//---------------------------------------------------------------------------
  //Pulsador Manual / Automático /Seguridad
  //manual = 0 --> modo Manual
  //manual = 1 --> modo Automático
  //seguridad = 1 --> modo Seguridad
  if (digitalRead(Bmanual) == 1) {
    pulsador = 1;
    if (currentMillis2 - previousMillis2 > interval2)
    {
      previousMillis2 = currentMillis2;
      //Función que queremos que haga cuando se mantenga pulsado el botón
      modoSeguridad = 1;
    }
  }
  else {
    previousMillis2 = currentMillis2;
    if (pulsador == 1 && modoSeguridad == 0 && seguridad == 0){
      pulsador = 0;
      manual = !manual;
      lcd.setCursor(0,0);
      lcd.print("Sistema domotico");
      lcd.setCursor(0,1);
      lcd.print("Modo: ");
      lcd.setCursor(6,1);
      if (manual == 1) lcd.print("AUTOMATICO");
      else if (manual == 0) lcd.print("MANUAL    ");
      delay(3000);
      lcd.clear();
    }
    if (modoSeguridad == 1){
      pulsador = 0;
      modoSeguridad = 0;
      seguridad = !seguridad;
      lcd.setCursor(0,0);
```

```
      lcd.print("Sistema domotico");
      lcd.setCursor(0,1);
      lcd.print("Modo: ");
      lcd.setCursor(6,1);
      if (seguridad == 1) lcd.print("SEGURIDAD ");
      else if (seguridad == 0 && manual == 1) lcd.print("AUTOMATICO");
      else if (seguridad == 0 && manual == 0) lcd.print("MANUAL    ");
      delay(2000);
      lcd.clear();
    }
  }


//------------------------------------------------------------------------
  //Modo AUTOMÁTICO
  if (manual == 1){
    //Encender/Apagar luces segun la luz ambiente (Detector de luz
ambiental)
    if (luzAmbiente <= 70){
      digitalWrite(LedAmarilloLuz, HIGH);
      luz = true;
    }
    else if (luzAmbiente > 70){
      digitalWrite(LedAmarilloLuz, LOW);
      luz = false;
    }
    //Encender/Apagar la calefacción o el ventilador según temperatura
    if (temp > 28){
      digitalWrite(fan, fanOn);
      aire = true;
    }
    if (temp <= 28){
      digitalWrite(fan, fanOff);
      aire = false;
    }
    if (temp <= 17){
      digitalWrite(LedRojoCalef, LOW);
      digitalWrite(LedVerdeCalef, HIGH);
      calef = true;
    }
    if (temp > 17){
      digitalWrite(LedRojoCalef, HIGH);
      digitalWrite(LedVerdeCalef, LOW);
      calef = false;
    }
    //Abrir/Cerrar las ventanas según temperatura
    if (temp > 23 && temp <= 28){
      ventana = true;
      if (estadoVentana == 0){
```

```
      lcd.setCursor(0,0);
      lcd.print("Cambio ventanas ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("ABRIENDO");
      for(val1 = 0; val1 <= 180; val1++){
        servoVentanas.write(val1);
        delay(50);
      }
      estadoVentana = 1;
    }
  }
  if (temp <= 23){
    ventana = false;
    if (estadoVentana == 1){
      lcd.setCursor(0,0);
      lcd.print("Cambio ventanas ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("CERRANDO");
      for (val1 = 180; val1 >= 0; val1--){
        servoVentanas.write(val1);
        delay(50);
      }
      estadoVentana = 0;
    }
  }
  //Subir/Bajar persianas según la luz exterior
  if (luzAmbiente <= 70){
    persiana = true;
    if (estadoPersiana == 0){
      lcd.setCursor(0,0);
      lcd.print("Cambio persianas ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("SUBIENDO");
      motor1.step(2048);
      estadoPersiana = 1;
    }
  }
  if (luzAmbiente > 800){
    persiana = false;
    if (estadoPersiana == 1){
      lcd.setCursor(0,0);
      lcd.print("Cambio persianas ");
      lcd.setCursor(0,1);
```

```
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("BAJANDO ");
      motor1.step(-2048);
      estadoPersiana = 0;
    }
  }
  //Encender electrodomesticos
  if (second == 00){
    electro = true;
    digitalWrite(electrodomestico, electroOn);
  }
  else if (second > 10){
    electro = false;
    digitalWrite(electrodomestico, electroOff);
  }

  //Abrir/Recoger el toldo según si llueve o no y los rayos UVA
  if (agua > 20){
    //Si llueve, independientemente de los rayos UVA recogerá el toldo
    lluvia = true;
    if (estadoToldo == 1){
      lcd.setCursor(0,0);
      lcd.print("Cambio toldo    ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("RECOGER ");
      for (val2 = 100; val2 > 0; val2--){
        servoToldo.write(110);
        delay(50);
      }
      estadoToldo = 0;
      servoToldo.write(90);
    }
  }
  else if (agua <= 20 && luzAmbiente > 800){
    //Abrir toldo por alta intensidad de los rayos UVA
    lluvia = false;
    if (estadoToldo == 0){
      lcd.setCursor(0,0);
      lcd.print("Cambio toldo    ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("ABRIENDO");
      for (val2 = 0; val2 < 100; val2++){
        servoToldo.write(80);
        delay(50);
```

```
        }
        estadoToldo = 1;
        servoToldo.write(90);
      }
      else servoToldo.write(90);
    }
    //Encender luz segun la presencia de una persona (sensor PIR)
    //estadoPir = digitalRead(sensorPir);
    //if (estadoPir == 1) digitalWrite(LedVerdeCalef, HIGH);
    //else if (estadoPir == 0) digitalWrite(LedVerdeCalef, LOW);
  }

//----------------------------------------------------------------------------
  //Modo SEGURIDAD (Apaga todo y avisa si hay intruso)
  if (seguridad == 1){
    luz = false;           //Apagar iluminación de casa
    digitalWrite(LedAmarilloLuz, LOW);
    aire = false;          //Apagar aire acondicionado
    digitalWrite(fan, fanOff);
    calef = false;         //Apagar calefacción
    digitalWrite(LedRojoCalef, HIGH);
    digitalWrite(LedVerdeCalef, LOW);
    ventana = false;       //Cerrar ventanas
    if (estadoVentana == 1){
      lcd.setCursor(0,0);
      lcd.print("Cambio ventanas ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("CERRANDO");
      for (val1 = 180; val1 >= 0; val1--){
        servoVentanas.write(val1);
        delay(50);
      }
      estadoVentana = 0;
    }
    persiana = false;      //Bajar persianas
    if (estadoPersiana == 1){
      lcd.setCursor(0,0);
      lcd.print("Cambio persianas ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("BAJANDO ");
      motor1.step(-2048);
      estadoPersiana = 0;
    }
    lluvia = true;         //Recoger el toldo
    if (estadoToldo == 1){
```

```
      lcd.setCursor(0,0);
      lcd.print("Cambio toldo    ");
      lcd.setCursor(0,1);
      lcd.print("Estado: ");
      lcd.setCursor(8,1);
      lcd.print("RECOGER ");
      for (val2 = 100; val2 > 0; val2--){
        servoToldo.write(110);
        delay(50);
      }
      estadoToldo = 0;
      servoToldo.write(90);
    }
    //INTRUSO
    estadoPir = digitalRead(sensorPir);
    if (estadoPir == 1) digitalWrite(LedVerdeCalef, HIGH);
    else if (estadoPir == 0) digitalWrite(LedVerdeCalef, LOW);
  }

//---------------------------------------------------------------------------
  //ALARMAS
  if (contraIncorrecta >= 3){     //Alarma cuando se introduzca la contaseña
erróneamente 3 veces
    lcd.setCursor(0,0);
    lcd.print("PELIGRO: CONTRA ");
    lcd.setCursor(0,1);
    lcd.print("INCORRECTA X3   ");
    tone(Buzzer, 440);
    delay(2000);
    noTone(Buzzer);
    lcd.clear();
    contraIncorrecta = 0;
    if (alertaIntentoEntrar == 0){
      alarmas++;
      alertaIntentoEntrar = 1;
    }
  }
  if (temp > 40) {
    tone(Buzzer, 440);
    delay(2000);
    noTone(Buzzer);
    if (alertaPosibleIncendio == 0){
      alarmas++;
      alertaPosibleIncendio = 1;
    }
  }
  else if (temp <= 40){
    noTone(Buzzer);
    if (alertaPosibleIncendio == 1){
```

```
      alarmas--;
      alertaPosibleIncendio = 0;
    }
  }
  if (hum > 90) {
    tone(Buzzer, 440);
    delay(2000);
    noTone(Buzzer);
    if (alertaHumedadElevada == 0){
      alarmas++;
      alertaHumedadElevada = 1;
    }
  }
  else if (hum <= 90) {
    noTone(Buzzer);
    if (alertaHumedadElevada == 1){
      alarmas--;
      alertaHumedadElevada = 0;
    }
  }
  if (seguridad == 1 && estadoPir == 1) {
    tone(Buzzer, 440);
    delay(2000);
    noTone(Buzzer);
    if (alertaPosibleIntruso == 0){
      alarmas++;
      alertaPosibleIntruso = 1;
    }
  }
  else if (seguridad == 0){
    noTone(Buzzer);
    if (alertaPosibleIntruso == 1){
      alarmas--;
      alertaPosibleIntruso = 0;
    }
  }
  //LEDs ALARMAS
  if (alertaIntentoEntrar == 1) digitalWrite(LedAlertaIntentoEntrar, HIGH);
  else if (alertaIntentoEntrar == 0) digitalWrite(LedAlertaIntentoEntrar,
LOW);

  if (alertaPosibleIntruso == 1) digitalWrite(LedAlertaPosibleIntruso,
HIGH);
  else if (alertaPosibleIntruso == 0) digitalWrite(LedAlertaPosibleIntruso,
LOW);

  if (alertaHumedadElevada == 1) digitalWrite(LedAlertaHumedadElevada,
HIGH);
```

```
  else if (alertaHumedadElevada == 0) digitalWrite(LedAlertaHumedadElevada,
LOW);

  if (alertaPosibleIncendio == 1) digitalWrite(LedAlertaPosibleIncendio,
HIGH);
  else if (alertaPosibleIncendio == 1)
digitalWrite(LedAlertaPosibleIncendio, LOW);

//---------------------------------------------------------------------------
  //MENÚ 0  (Sistema domótico; Hora/día; Consumo actual)
  if (menu == 0){
    if (ventanaMenu0 == 1){
      lcd.setCursor(0,0);
      lcd.print("Sistema de      ");
      lcd.setCursor(0,1);
      lcd.print("control domotico");
    }
    else if (ventanaMenu0 == 2){
      select = 0;
      printDateTime(now);
    }
    else if (ventanaMenu0 == 3){
      select = 0;
      lcd.setCursor(0,0);
      lcd.print("Consumo actual  ");
      lcd.setCursor(0,1);
      lcd.print("Nivel:   ");
      lcd.setCursor(9,1);
      lcd.print(consumo);
      lcd.setCursor(14,1);
      lcd.print("  ");
    }
  }

//---------------------------------------------------------------------------
  //VentanaMenu0 --> Pestañas en el MENÚ 0 (3)
  if (ventanaMenu0 > 3) ventanaMenu0 = 1;
  else if (ventanaMenu0 < 1) ventanaMenu0 = 3;

  //VentanaMenu1 --> Pestañas en el MENÚ 1 (2)
  if (ventanaMenu1 > 2) ventanaMenu1 = 1;
  else if (ventanaMenu1 < 1) ventanaMenu1 = 2;

  //VentanaMenu2 --> Pestañas en el MENÚ 2 (3)
  if (ventanaMenu2 > 3) ventanaMenu2 = 1;
  else if (ventanaMenu2 < 1) ventanaMenu2 = 3;

//---------------------------------------------------------------------------
```

```
  //Si estamos en la ventana 1 del Menú 0 y pulsamos Bselet pasaremos al
Menú 1
  if (ventanaMenu0 == 1 && Bselect == 1 && select == 0){
    menu = 1;
    numEstancias = 1;
  }
  //Si estamos en la ventana 1 del Menú 1 y pulsamos Bselet pasaremos al
Menú 2
  if (ventanaMenu1 == 1 && Bselect == 1 && select == 1){
    menu = 2;
    numControl = 1;
  }
  //Si estamos en el Menú 1 y mantenemos pulsado Bselect pasaremos al Menú 0
  if (back == 1 && select == 1){
    menu = 0;
  }
  //Si estamos en el Menú 2 y mantenemos pulsado Bselect pasaremos al Menú 1
  if (back == 1 && select == 2){
    menu = 1;
    ventanaMenu2 = 1;
  }

//----------------------------------------------------------------------------
  //MENÚ 1 (Estancias; Alarmas; Recomendaciones)
  if (menu == 1){
    if (ventanaMenu1 == 1){
      lcd.setCursor(0,0);
      lcd.print("ESTANCIAS:      ");
      lcd.setCursor(0,1);
      lcd.print(estancia);
    }
    else if (ventanaMenu1 == 2){
      select = 1;
      lcd.setCursor(0,0);
      lcd.print("ALARMAS         ");
      lcd.setCursor(0,1);
      lcd.print("ACTIVAS: ");
      lcd.setCursor(9,1);
      if (alarmas > 0){
        lcd.print(alarmas);
        lcd.setCursor(10,1);
        lcd.print("      ");
      }
      else lcd.print("NINGUNA");
    }
  }

//----------------------------------------------------------------------------
//Límites de las variables
```

```
  if (select < 0) select = 0;
  if (select > 2) select = 2;
  if (menu < 0) menu = 0;
  if (menu > 2) menu = 2;

//---------------------------------------------------------------------------
  //numEstancias --> Diferentes estancias de la vivienda (10)
  if (numEstancias > 10) numEstancias = 1;
  else if (numEstancias < 1) numEstancias = 10;

  //Variable "estancias"
  if (numEstancias == 1) estancia = "General         ";
  else if (numEstancias == 2) estancia = "Vestibulo       ";
  else if (numEstancias == 3) estancia = "Cocina          ";
  else if (numEstancias == 4) estancia = "Salon-Comedor   ";
  else if (numEstancias == 5) estancia = "Distribuidor    ";
  else if (numEstancias == 6) estancia = "Habitacion 1    ";
  else if (numEstancias == 7) estancia = "Habitacion 2    ";
  else if (numEstancias == 8) estancia = "WC 1            ";
  else if (numEstancias == 9) estancia = "WC 2            ";
  else if (numEstancias == 10) estancia = "Terraza         ";


//---------------------------------------------------------------------------
  /*MENÚ 2 (Iluminación; Calefacción; Aire Acondicionado; Temp/Hum;
Ventanas;
  Persianas; Puerta Principal; Piscina; Electrodomésticos; Puerta Garaje;
)*/
  if (menu == 2){
    if (ventanaMenu2 == 1){
      lcd.setCursor(0,0);
      lcd.print(control);
      lcd.setCursor(0,1);
      if (numControl == 1){
        contraPuerta();
      }
      else if (numControl == 2){
        iluminacion();
      }
      else if (numControl == 3){
        calefaccion();
      }
      else if (numControl == 4){
        ventilador();
      }
      else if (numControl == 5){
        ventanas();
      }
      else if (numControl == 6){
```

```
        persianas();
      }
      else if (numControl == 7){
        electrodomesticos();
      }
      else if (numControl == 8){
        toldo();
      }
    }
    else if (ventanaMenu2 == 2)
    {
      select = 2;
      tempHum();
    }
    else if (ventanaMenu2 == 3)
    {
      select = 2;
      lumLluvia();
    }
  }

//----------------------------------------------------------------------------
  //numControl --> Que queremos controlar de la vivienda
  if (numControl > 8) numControl = 1;
  else if (numControl < 1) numControl = 8;

  //Variable "numControl"
  if (numControl == 1) control = "PUERTA PRINCIPAL     ";
  else if (numControl == 2) control = "ILUMINACION     ";
  else if (numControl == 3) control = "CALEFACCION     ";
  else if (numControl == 4) control = "AIRE ACOND.     ";
  else if (numControl == 5) control = "VENTANAS        ";
  else if (numControl == 6) control = "PERSIANAS       ";
  else if (numControl == 7) control = "ELECTRODOMESTICO";
  else if (numControl == 8) control = "TOLDO TERRAZA   ";

//----------------------------------------------------------------------------
}


//----------------------------------------------------------------------------
//Función del reloj en tiempo real
#define countof(a)(sizeof(a)/sizeof(a[0]))
void printDateTime(const RtcDateTime& dt)
{
  char fecha[17];
  snprintf_P(fecha, countof(fecha), PSTR("DIA: %02u/%02u/%04u "), dt.Day(),
dt.Month(), dt.Year());
```

```
  char hora[17];
  snprintf_P(hora, countof(hora), PSTR("HORA: %02u:%02u:%02u  "), dt.Hour(),
dt.Minute(), dt.Second());

  lcd.setCursor(0,0);
  lcd.print(fecha);
  lcd.setCursor(0,1);
  lcd.print(hora);
}

//-------------------------------------------------------------------------------
//Función del teclado (mostrar la clave de la puerta)   [numControl = 1]
void contraPuerta()
{
  lcd.setCursor(0,1);
  lcd.print("CONTRA: ");
  lcd.setCursor(INDICE+9,1);
  TECLA = teclado.getKey();

  if (TECLA)
  {
    CLAVE[INDICE] = TECLA;
    INDICE++;
    lcd.print(TECLA);
  }
  if (INDICE == 6)
  {
    if (!strcmp(CLAVE, CLAVE_MAESTRA))
    {
      delay(1000);
      lcd.setCursor(0,1);
      lcd.print("Key: CORRECTA   ");
      delay(1000);
      contraIncorrecta = 0;
      seguridad = 0;
      if (alertaIntentoEntrar == 1){
        alertaIntentoEntrar = 0;
        alarmas--;
      }
    }
    else
    {
      delay(1000);
      lcd.setCursor(0,1);
      lcd.print("Key: INCORRECTA ");
      contraIncorrecta++;
    }
    INDICE = 0;
    delay(2500);
```

```
    lcd.clear();
  }
}

//-----------------------------------------------------------------------------
//Control de la iluminación (sensor luz ambiental, LEDs)    [numControl = 2]
void iluminacion()
{
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);
  brillo = analogRead(pot)/4;

  if (luz == true){
    analogWrite(LedAmarilloLuz, brillo);
    lcd.print("ON      ");
  }
  else if (luz == false){
    analogWrite(LedAmarilloLuz, 0);
    lcd.print("OFF     ");
  }
}


//-----------------------------------------------------------------------------
-
//Control de la calefacción                                [numControl = 3]
//(sensor temperatura/humedad; LED que hace de resistencia)
void calefaccion()
{
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);
  if (calef == true){
      digitalWrite(LedRojoCalef, LOW);
      digitalWrite(LedVerdeCalef, HIGH);
      lcd.print("ON      ");
    }
  else if (calef == false){
      digitalWrite(LedRojoCalef, HIGH);
      digitalWrite(LedVerdeCalef, LOW);
      lcd.print("OFF     ");
  }
}


//-----------------------------------------------------------------------------
//Control del aire acondicionado                       [numControl = 4]
//(sensor temperatura/humedad; mini ventilador)
void ventilador()
{
```

```
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);
  if (aire == true){
      digitalWrite(fan, fanOn);
      lcd.print("ON      ");
    }
  else if (aire == false){
      digitalWrite(fan, fanOff);
      lcd.print("OFF     ");
  }
}


//-----------------------------------------------------------------------------
//Control de las ventanas                              [numControl = 5]
//(detector de temperatura/humedad, motor paso a paso)
void ventanas()
{
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);

  if (ventana == true){
    if (estadoVentana == 1){
      lcd.print("ABIERTA ");
    }
    else if (estadoVentana == 0){
      lcd.print("ABRIENDO");
      for(val1 = 0; val1 <= 180; val1++){
        servoVentanas.write(val1);
        delay(50);
      }
      lcd.print("ABIERTA ");
      estadoVentana = 1;
    }
  }
  else if (ventana == false){
    if (estadoVentana == 1){
      lcd.print("CERRANDO");
      for(val1 = 180; val1 >= 0; val1--){
        servoVentanas.write(val1);
        delay(50);
      }
      lcd.print("CERRADA ");
      estadoVentana = 0;
    }
    else if (estadoVentana == 0){
      lcd.print("CERRADA ");
    }
  }
```

```
}

//-----------------------------------------------------------------------------
//Control de las persianas                                   [numControl = 6]
//(sensor luz ambiental, servomotores)
void persianas()
{
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);

  if (persiana == true){
    if (estadoPersiana == 1){
      motor1.step(0);
      lcd.print("SUBIDA  ");
    }
    else if (estadoPersiana == 0){
      lcd.print("SUBIENDO");
      motor1.step(2048);
      lcd.print("SUBIDA  ");
      estadoPersiana = 1;
    }
  }
  else if (persiana == false){
    if (estadoPersiana == 1){
      lcd.print("BAJANDO ");
      motor1.step(-2048);
      lcd.print("BAJADA  ");
      estadoPersiana = 0;
    }
    else if (estadoPersiana == 0){
      motor1.step(0);
      lcd.print("BAJADA  ");
    }
  }
}


//-----------------------------------------------------------------------------
//Control de los electrodomésticos                             [numControl = 7]
//(relés, hora)
void electrodomesticos()
{
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);
  if (electro == true){
    digitalWrite(electrodomestico, electroOn);
    lcd.print("EN USO  ");
  }
  else if (electro == false){
```

```
    digitalWrite(electrodomestico, electroOff);
    lcd.print("APAGADO ");
  }
}


//------------------------------------------------------------------------
//Control del toldo de la terraza                    [numControl = 8]
//(detector de agua "Water Level Sensor")
void toldo()
{
  lcd.print("ESTADO: ");
  lcd.setCursor(8,1);
  if (lluvia == true){
    if (estadoToldo == 1){
      lcd.print("RECOGER ");
      for (val2 = 100; val2 > 0; val2--){
        servoToldo.write(110);
        delay(50);
      }
      estadoToldo = 0;
      servoToldo.write(90);
    }
    else if (estadoToldo == 0){
      lcd.print("RECOGIDO");
      servoToldo.write(90);
    }
  }
  else if (lluvia == false){
    if (estadoToldo == 1){
      lcd.print("ABIERTO ");
    }
    else if (estadoToldo == 0){
      lcd.print("ABRIENDO");
      for (val2 = 0; val2 < 100; val2++){
        servoToldo.write(80);
        delay(50);
      }
      estadoToldo = 1;
      servoToldo.write(90);
    }
  }
}


//-----------------------------------------------------------------------
//Función para visualizar las medidas del sensor de Temperatura y de Humedad
void tempHum()
{
```

```
  lcd.setCursor(0,0);
  lcd.print("Temp.:   ");
  lcd.setCursor(9,0);
  lcd.print(temp);
  lcd.setCursor(14,0);
  lcd.print((char)223);
  lcd.setCursor(15,0);
  lcd.print("C");
  lcd.setCursor(0,1);
  lcd.print("Humedad: ");
  lcd.setCursor(9,1);
  lcd.print(hum);
  lcd.setCursor(15,1);
  lcd.print("%");
}

//--------------------------------------------------------------------------
//Función para visualizar las medidas del fotorresistor y del sensor de
nivel de agua
void lumLluvia()
{
  lcd.setCursor(0,0);
  lcd.print("Llueve?:    ");
  lcd.setCursor(12,0);
  if (agua > 100) lcd.print("Si  ");
  else if (agua < 100) lcd.print("No  ");
  lcd.setCursor(0,1);
  lcd.print("Luz:        ");
  lcd.setCursor(12,1);
  lcd.print(valor_luz);
  lcd.setCursor(15,1);
  lcd.print("%");
}

//---------------------------------------------------------------------------
//Funciones para el módulo bluetooth
void bluetooth_B_iluminacion(){
  brillo = analogRead(pot)/4;
  luz = true;
  //analogWrite(LedAmarilloLuz, brillo);
  digitalWrite(LedAmarilloLuz, HIGH);
}
void bluetooth_C_iluminacion(){
  luz = false;
  digitalWrite(LedAmarilloLuz, LOW);
  //analogWrite(LedAmarilloLuz, 0);
}
void bluetooth_D_calefaccion(){
  calef = true;
```

```
  digitalWrite(LedRojoCalef, LOW);
  digitalWrite(LedVerdeCalef, HIGH);
}
void bluetooth_E_calefaccion(){
  calef = false;
  digitalWrite(LedRojoCalef, HIGH);
  digitalWrite(LedVerdeCalef, LOW);
}
void bluetooth_F_ventilador(){
  aire = true;
  digitalWrite(fan, fanOn);
}
void bluetooth_G_ventilador(){
  aire = false;
  digitalWrite(fan, fanOff);
}
void bluetooth_J_ventanas(){
  ventana = true;
  if (estadoVentana == 0){
    for(val1 = 0; val1 <= 180; val1++){
      servoVentanas.write(val1);
      delay(50);
    }
    estadoVentana = 1;
  }
}
void bluetooth_K_ventanas(){
  ventana = false;
  if (estadoVentana == 1){
    for(val1 = 180; val1 >= 0; val1--){
      servoVentanas.write(val1);
      delay(50);
    }
    estadoVentana = 0;
  }
}
void bluetooth_N_persianas(){
  persiana = true;
  if (estadoPersiana == 1){
    motor1.step(0);
  }
  else if (estadoPersiana == 0){
    motor1.step(2048);
    estadoPersiana = 1;
  }
}
void bluetooth_O_persianas(){
  persiana = false;
  if (estadoPersiana == 1){
```

```
    motor1.step(-2048);
    estadoPersiana = 0;
  }
  else if (estadoPersiana == 0){
    motor1.step(0);
  }
}
void bluetooth_Q_electrodomesticos(){
  electro = true;
  digitalWrite(electrodomestico, electroOn);
}
void bluetooth_R_electrodomesticos(){
  electro = false;
  digitalWrite(electrodomestico, electroOff);
}
void bluetooth_T_toldo(){
  lluvia = false;
  if (estadoToldo == 0){
    for (val2 = 0; val2 < 100; val2++){
      servoToldo.write(80);
      delay(50);
    }
    estadoToldo = 1;
    servoToldo.write(90);
  }
}
void bluetooth_U_toldo(){
  lluvia = true;
  if (estadoToldo == 1){
    for (val2 = 100; val2 > 0; val2--){
      servoToldo.write(110);
      delay(50);
    }
    estadoToldo = 0;
    servoToldo.write(90);
  }
}


void bluetooth_I_infoSensores(){
  ModuloHC05.print(temp);
  ModuloHC05.print(" ºC");
  ModuloHC05.print("|");
  ModuloHC05.print(hum);
  ModuloHC05.print(" %");
  ModuloHC05.print("|");
  ModuloHC05.print(valor_luz);
  ModuloHC05.print(" %");
  ModuloHC05.print("|");
```

```
  if (agua > 100) ModuloHC05.print("Sí");
  else if (agua < 100) ModuloHC05.print("No");
  ModuloHC05.print("|");
  ModuloHC05.print(consumo);
  ModuloHC05.print(" %");
  ModuloHC05.print("|");
}

void bluetooth_P_alarmas(){
  ModuloHC05.print(alertaIntentoEntrar);
  ModuloHC05.print("|");
  ModuloHC05.print(alertaPosibleIntruso);
  ModuloHC05.print("|");
  ModuloHC05.print(alertaHumedadElevada);
  ModuloHC05.print("|");
  ModuloHC05.print(alertaPosibleIncendio);
  ModuloHC05.print("|");
}

void bluetooth_H_control(){
  ModuloHC05.print(luz);          //Índice = 1
  ModuloHC05.print("|");
  ModuloHC05.print(calef);        //Índice = 2
  ModuloHC05.print("|");
  ModuloHC05.print(aire);         //Índice = 3
  ModuloHC05.print("|");
  ModuloHC05.print(ventana);      //Índice = 4
  ModuloHC05.print("|");
  ModuloHC05.print(persiana);     //Índice = 5
  ModuloHC05.print("|");
  ModuloHC05.print(electro);      //Índice = 6
  ModuloHC05.print("|");
  ModuloHC05.print(lluvia);       //Índice = 7
  ModuloHC05.print("|");
  ModuloHC05.print(manual);       //Índice = 8
  ModuloHC05.print("|");
  ModuloHC05.print(seguridad);    //Índice = 9
  ModuloHC05.print("|");
}
```

4. Programación de la aplicación móvil

4.1. Pantalla "USUARIO"

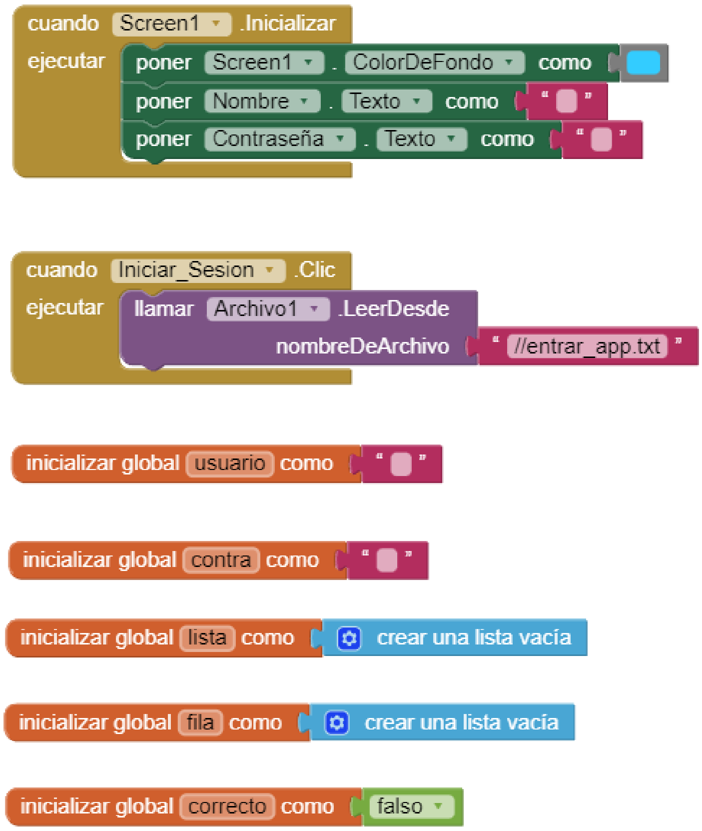


Figura 1: Programación de la pantalla "USUARIO" de la aplicación móvil, parte 1. [Fuente propia]

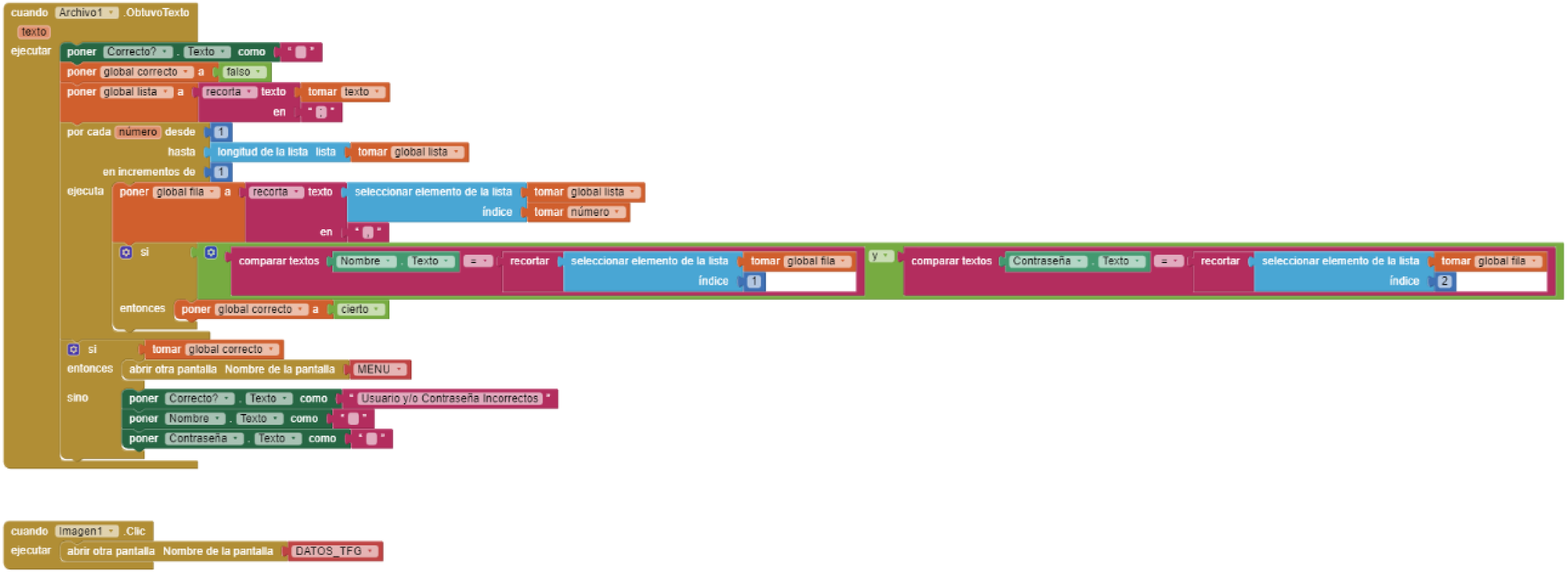


Figura 2: Programación de la pantalla "USUARIO" de la aplicación móvil, parte 2. [Fuente propia]

4.2. Pantalla “DATOS”

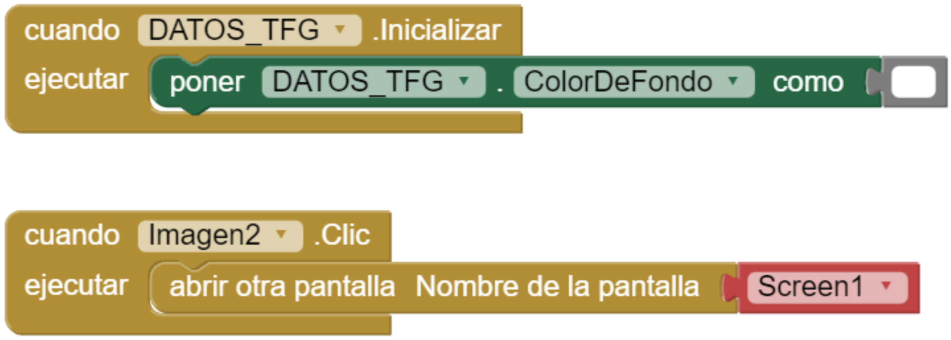


Figura 3: Programación de la pantalla “DATOS” de la aplicación móvil, parte 1. [Fuente propia]

4.3. Pantalla “MENU”

Figura 4: Programación de la pantalla “MENU” de la aplicación móvil, parte 1. [Fuente propia]

4.4. Pantalla “CONTROL”

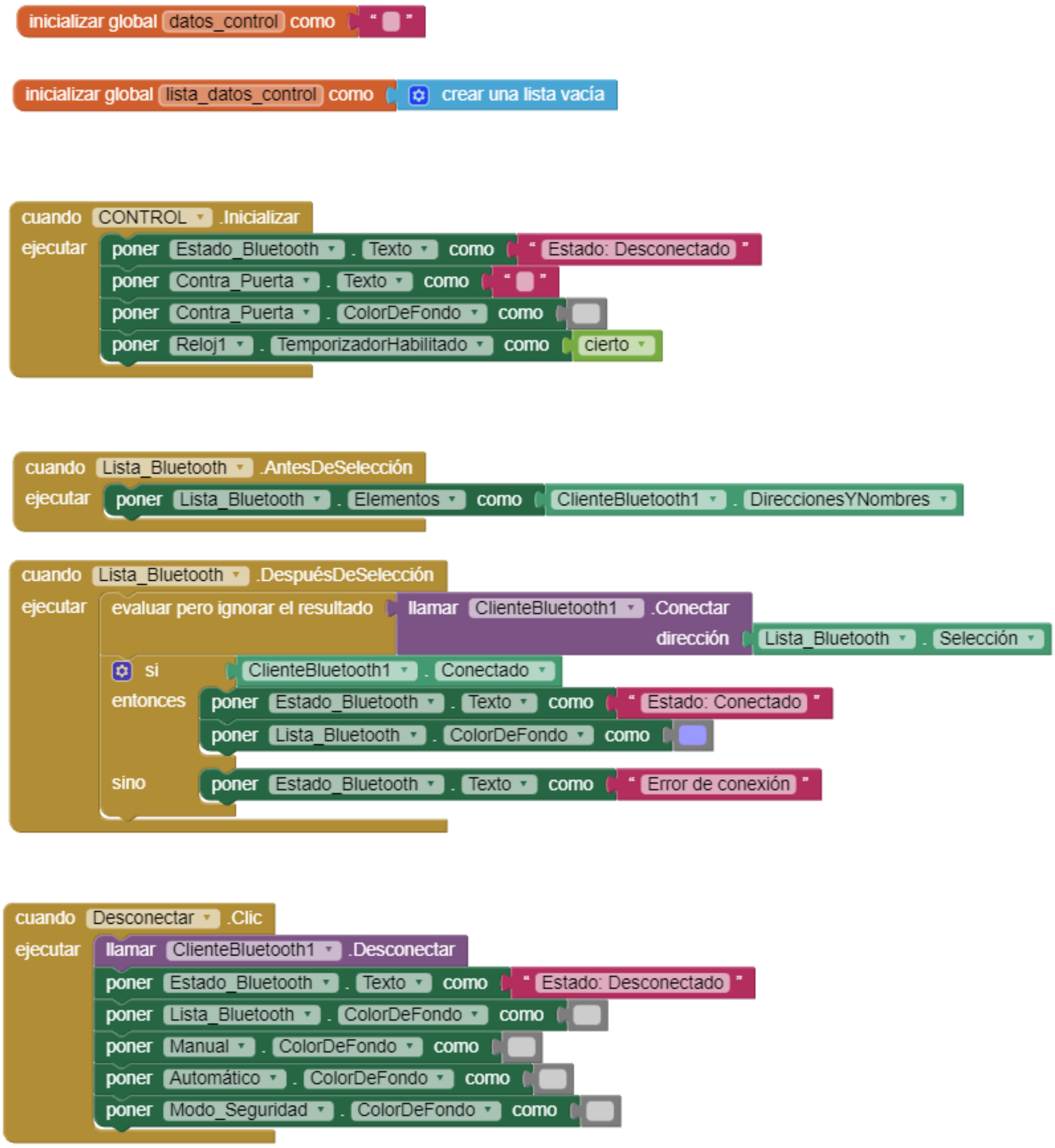


Figura 5: Programación de la pantalla “CONTROL” de la aplicación móvil, parte 1. [Fuente propia]

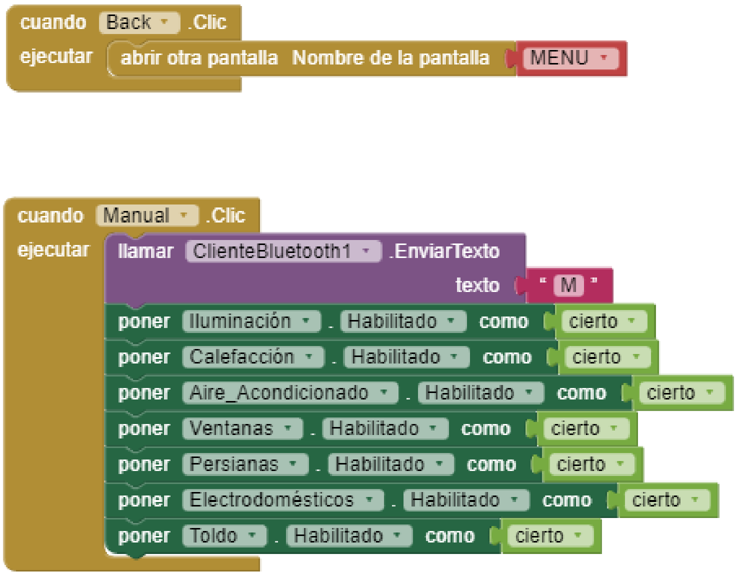


Figura 6 Programación de la pantalla "CONTROL" de la aplicación móvil, parte 2. [Fuente propia]

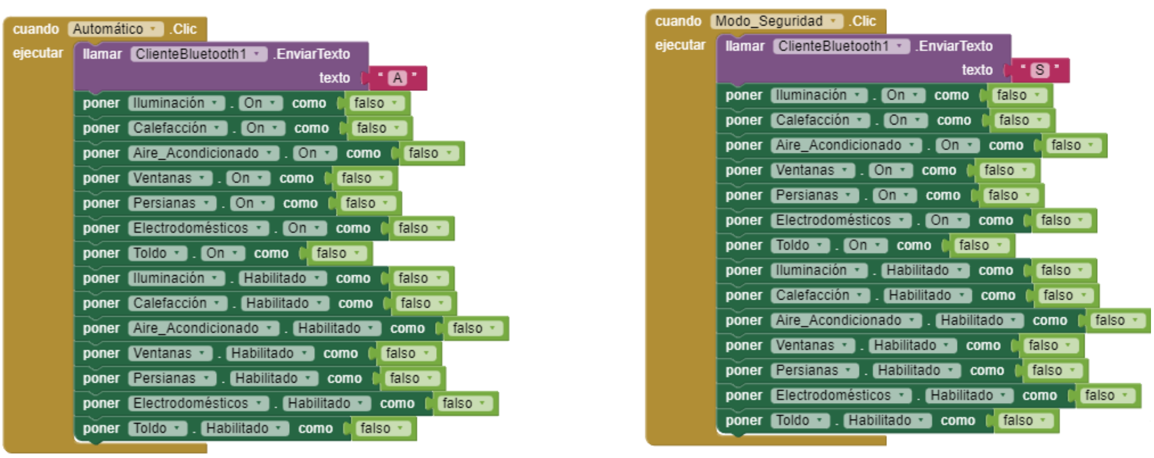


Figura 7: Programación de la pantalla "CONTROL" de la aplicación móvil, parte 3. [Fuente propia]

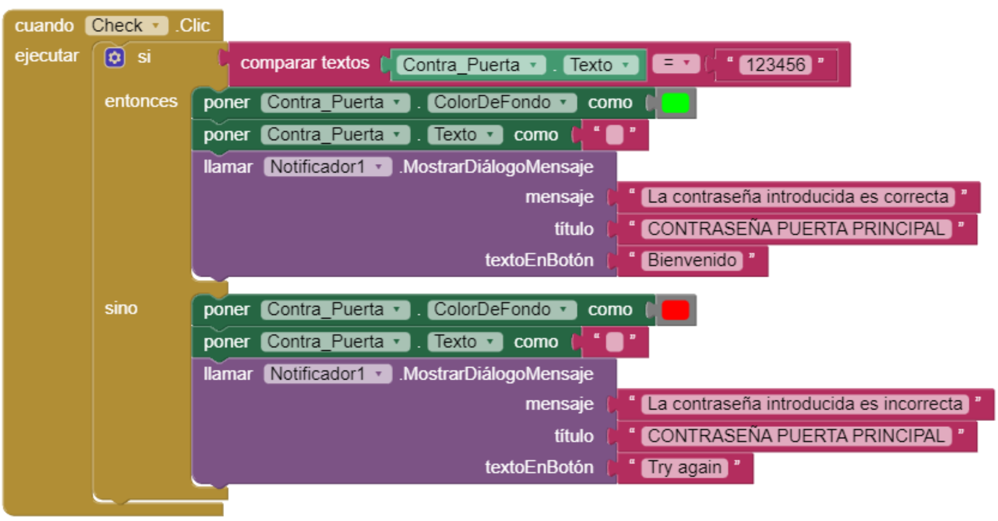


Figura 8: Programación de la pantalla "CONTROL" de la aplicación móvil, parte 4. [Fuente propia]

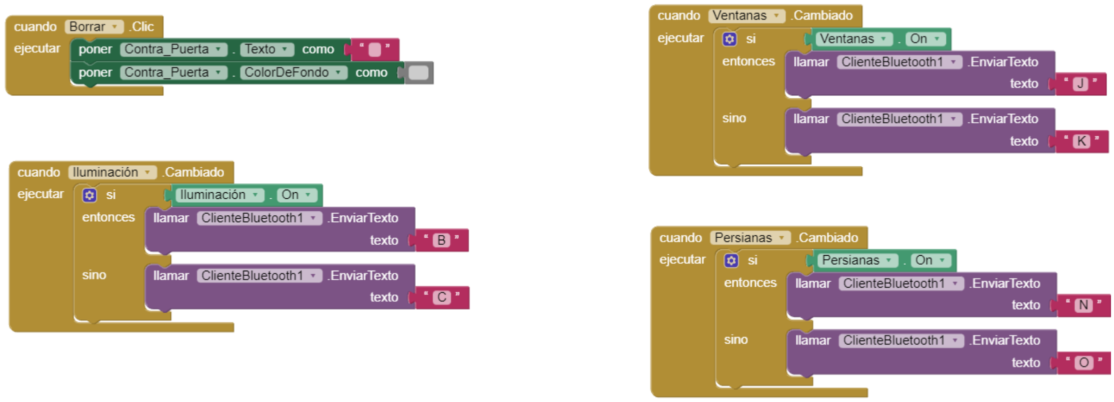


Figura 9: Programación de la pantalla "CONTROL" de la aplicación móvil, parte 5. [Fuente propia]

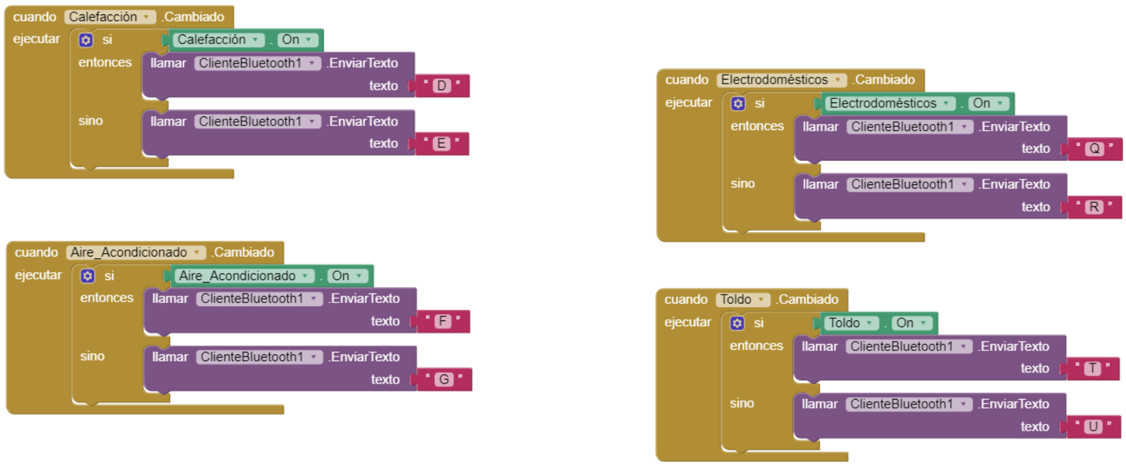


Figura 10: Programación de la pantalla "CONTROL" de la aplicación móvil, parte 6. [Fuente propia]

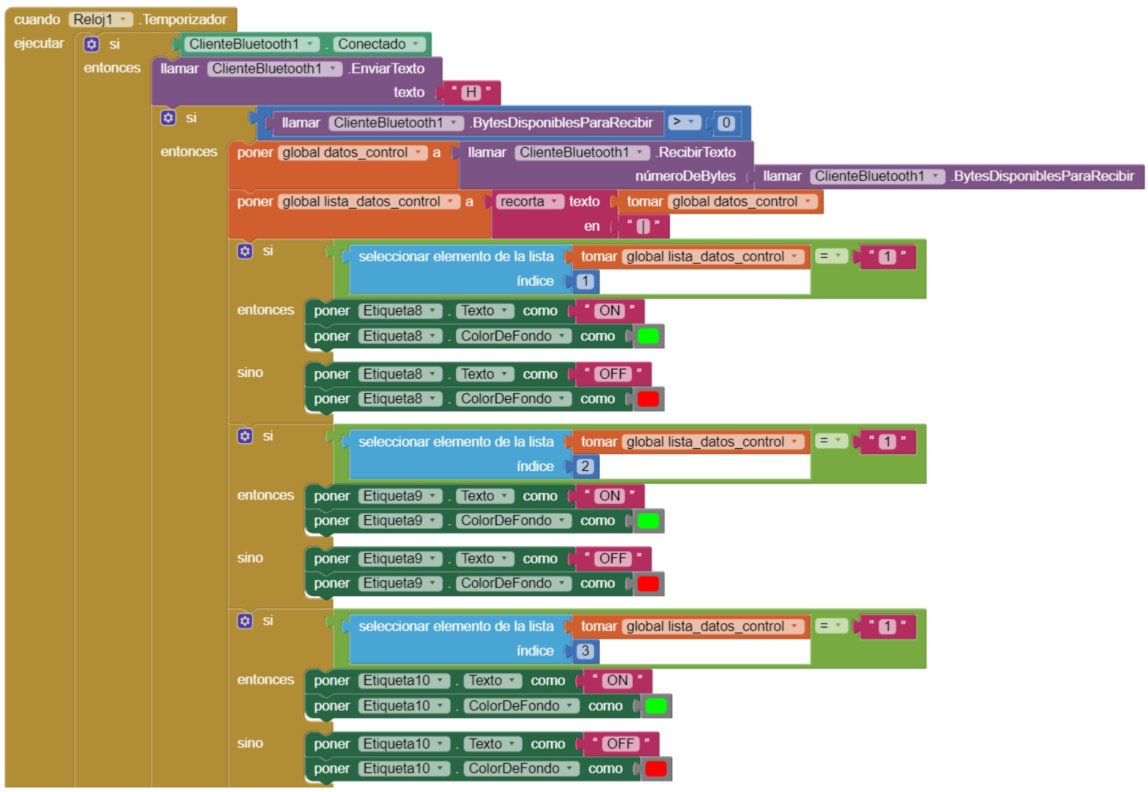


Figura 11: Programación de la pantalla "CONTROL" de la aplicación móvil, parte 7. [Fuente propia]

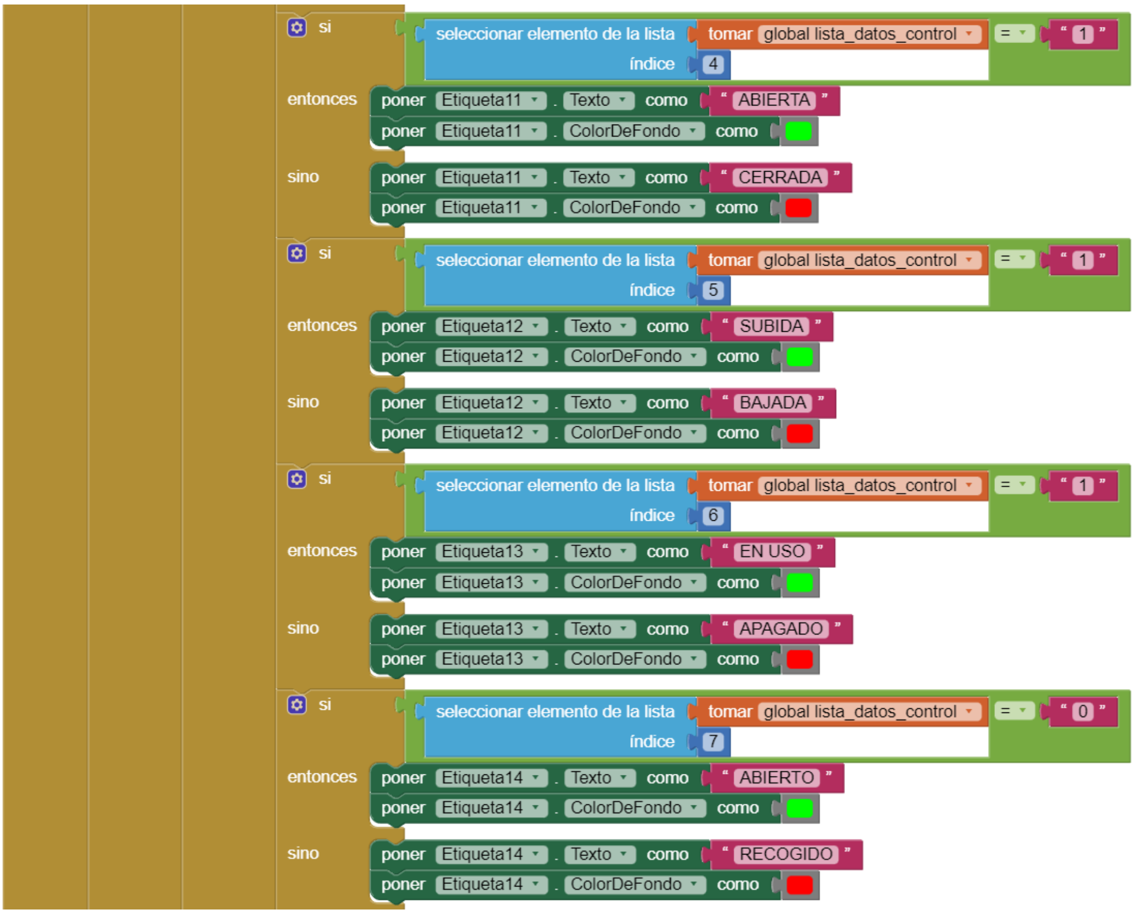


Figura 12: Programación de la pantalla “CONTROL” de la aplicación móvil, parte 8. [Fuente propia]

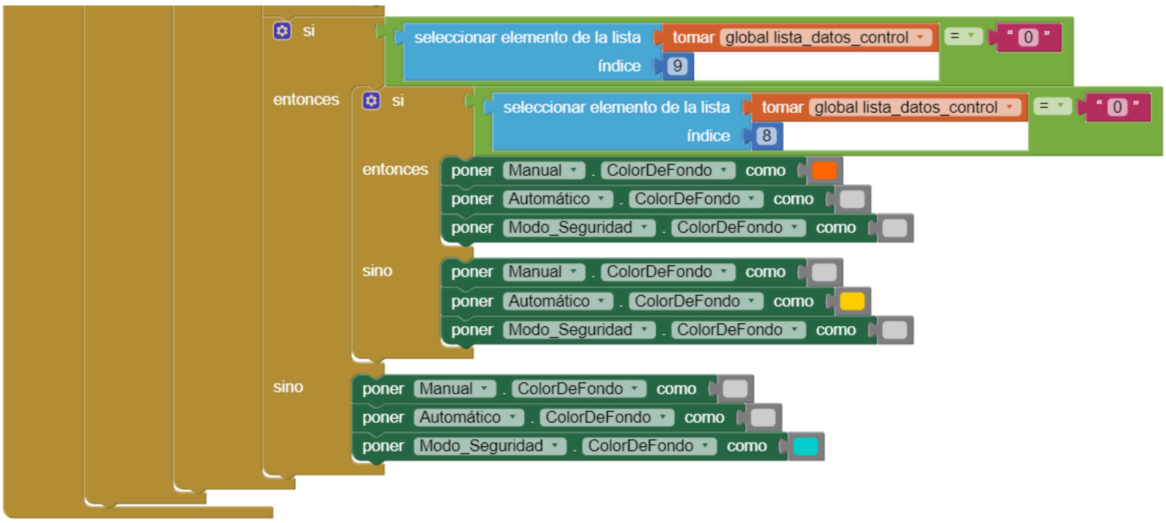


Figura 13: Programación de la pantalla “CONTROL” de la aplicación móvil, parte 9. [Fuente propia]

4.5. Pantalla "ALARMAS"

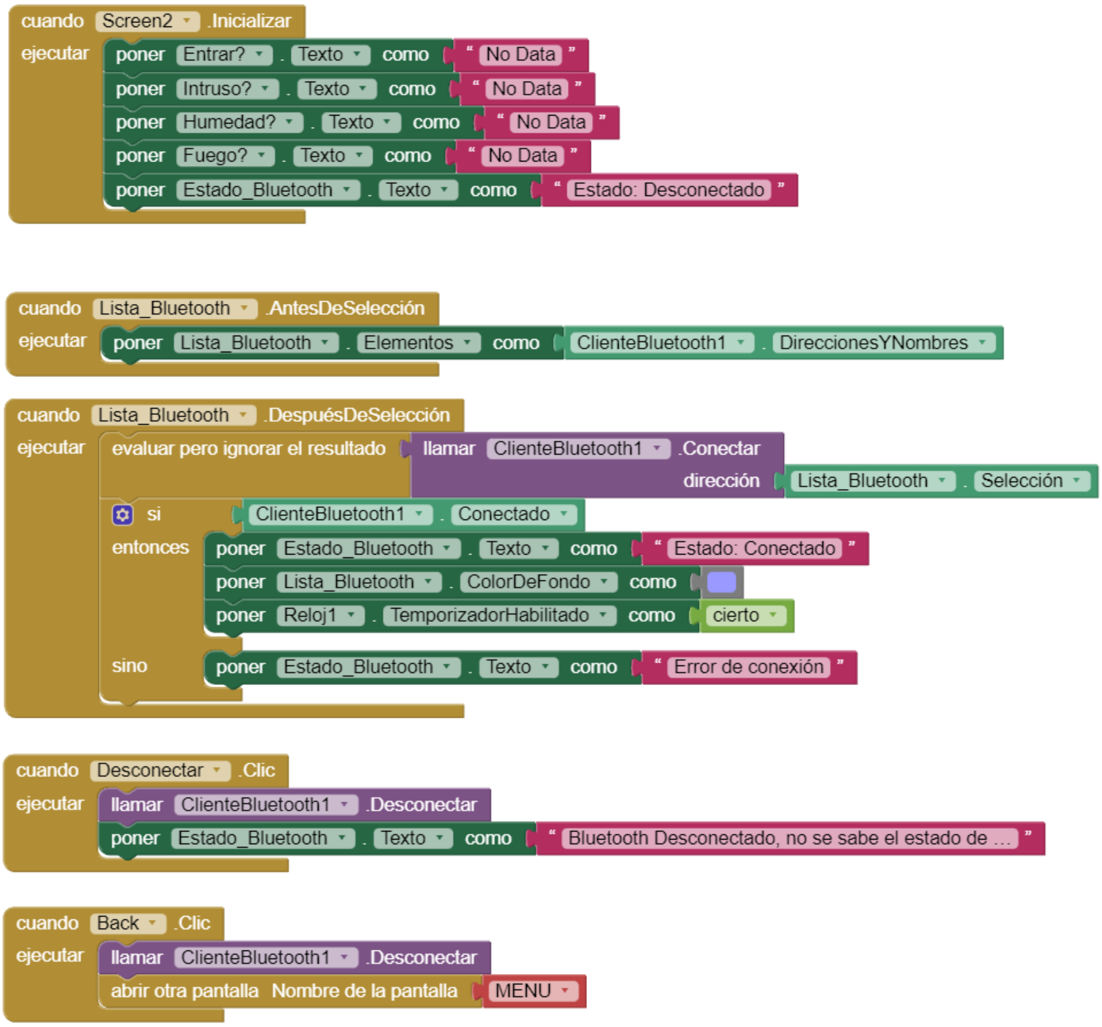


Figura 14: Programación de la pantalla "ALARMAS" de la aplicación móvil, parte 1. [Fuente propia]

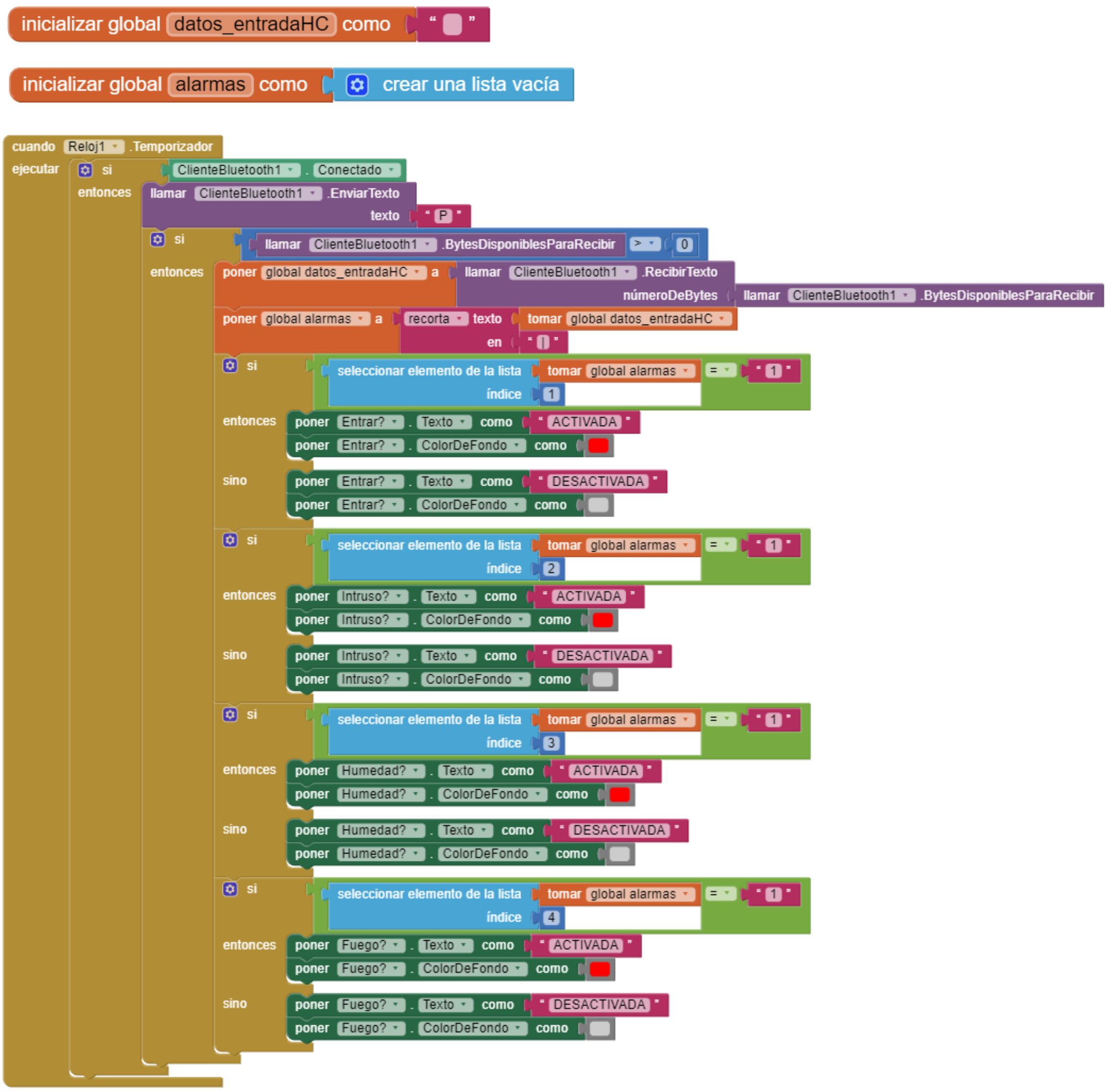


Figura 15: Programación de la pantalla "ALARMAS" de la aplicación móvil, parte 2. [Fuente propia]

Figura 16: Programación de la pantalla "ALARMAS" de la aplicación móvil, parte 3. [Fuente propia]

4.6. Pantalla "INFORMACIÓN"

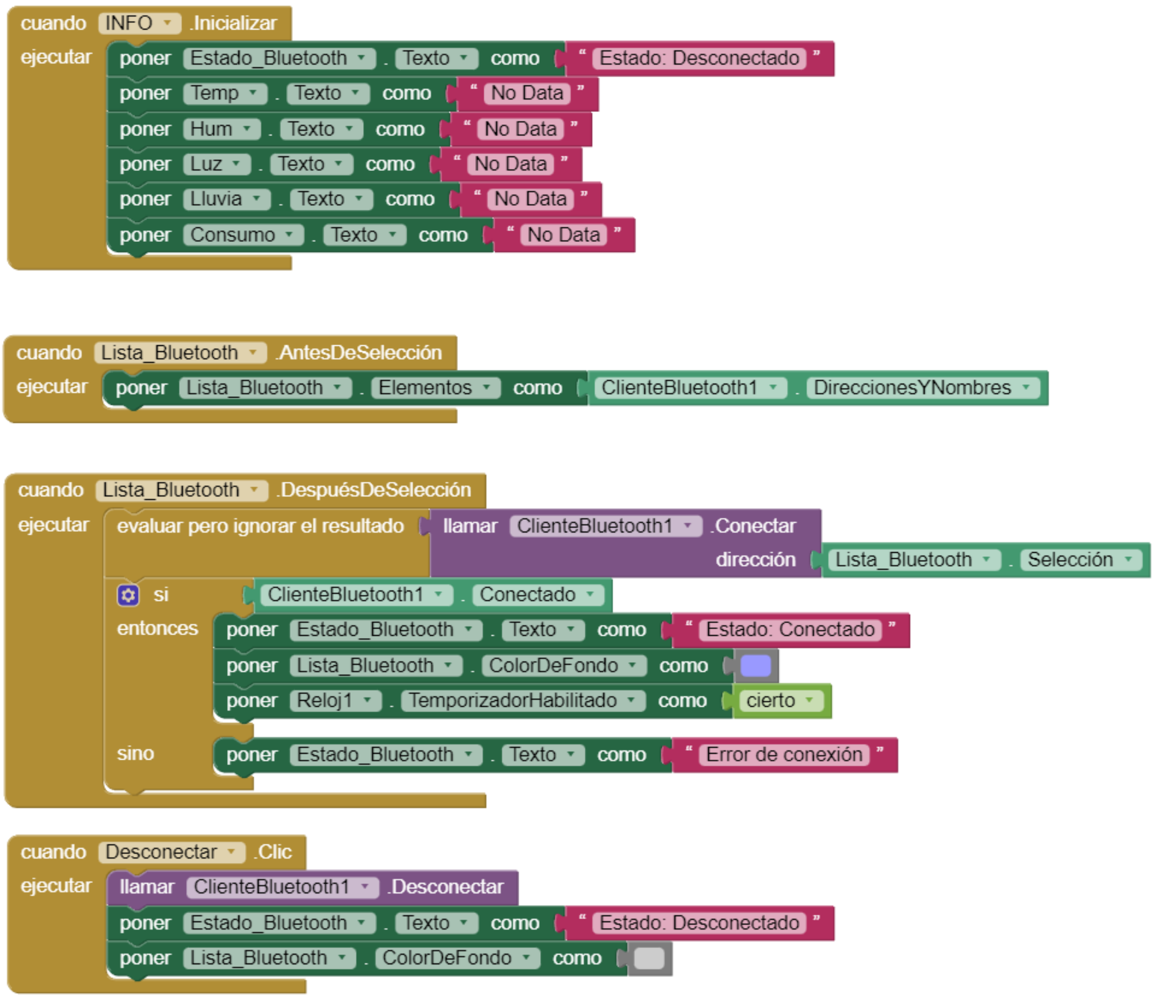


Figura 17: Programación de la pantalla "INFORMACIÓN" de la aplicación móvil, parte 1. [Fuente propia]

Figura 18: Programación de la pantalla "INFORMACIÓN" de la aplicación móvil, parte 2. [Fuente propia]

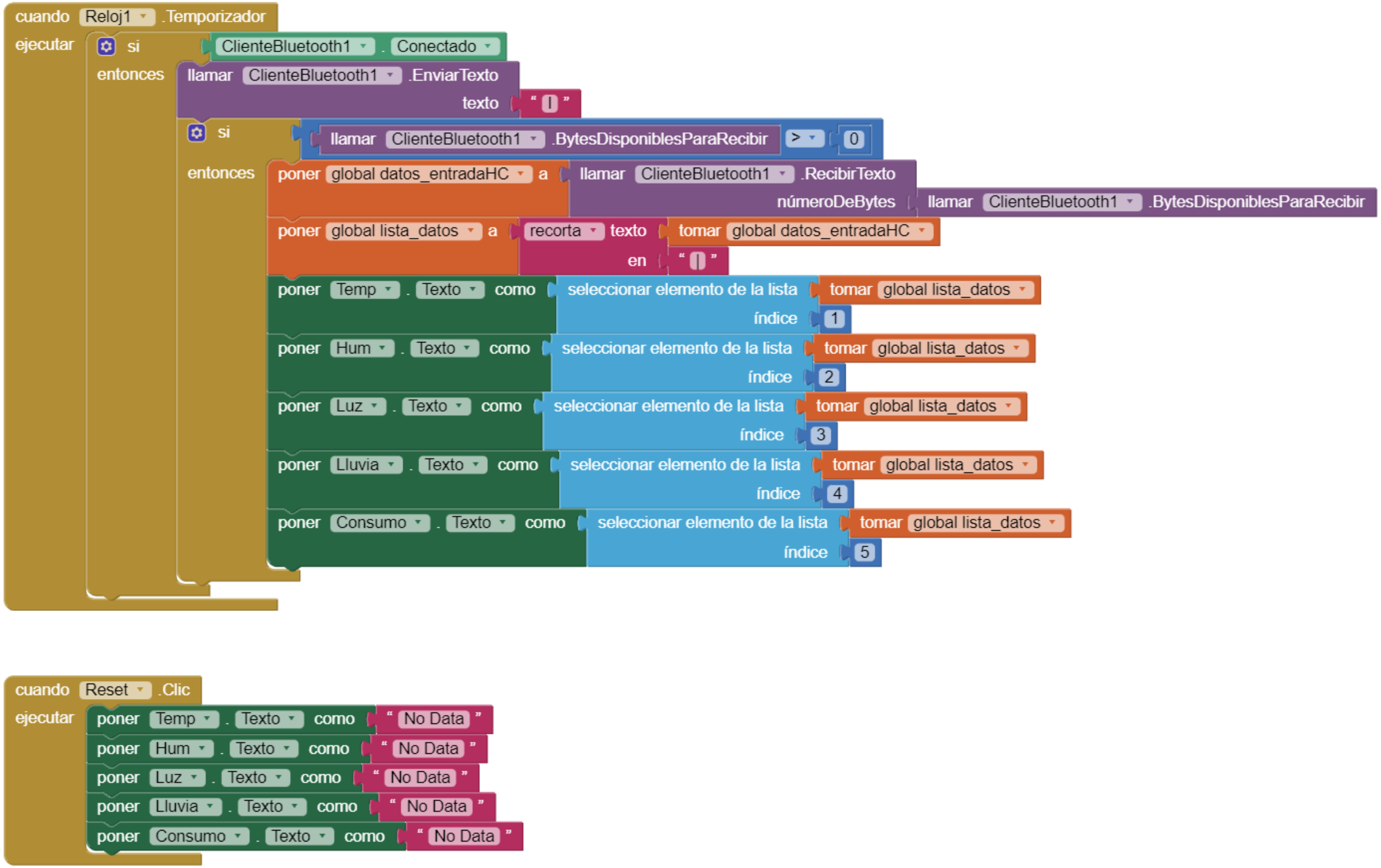


Figura 19: Programación de la pantalla "INFORMACIÓN" de la aplicación móvil, parte 3. [Fuente propia]

5. Distribución de los componentes en la vivienda

Tabla 3: Leyenda de los símbolos correspondientes a los dispositivos usados en el prototipo de ventas. [Fuente propia]

Tabla de símbolos		
Color	**Dispositivo**	**Símbolo**
Círculos (Sensores)		
Rosa	Sensor temperatura / humedad	● (rosa)
Amarillo	Detector de luz (LDR)	● (amarillo)
Naranja	Sensor PIR	● (naranja)
Verde	Sensor Hall	● (verde)
Azul	Sensor de nivel de agua	● (azul)
Lila	Sensor electromagnético	● (lila)
Marrón	Final de carrera	● (marrón)
Blanco	Detector humo	○
Rectángulos (Actuadores)		
Rosa	Calefacción	▬ (rosa)
Amarillo	Bombillas LED	▬ (amarillo)
Verde	Motores para ventanas	▬ (verde)
Lila	Aire acondicionado	▬ (lila)
Marrón	Motor tubular	▬ (marrón)
Blanco	Alarma	▭
Rombo (Módulo bluetooth y amplificador de señal)		
Azul	Bluetooth	◆ (azul)
Control		
Naranja	Mando de control	▬ (naranja)

5.1. Sensores

Figura 20: Distribución de los sensores usados en el prototipo comercial. [Fuente propia]

5.2. Actuadores

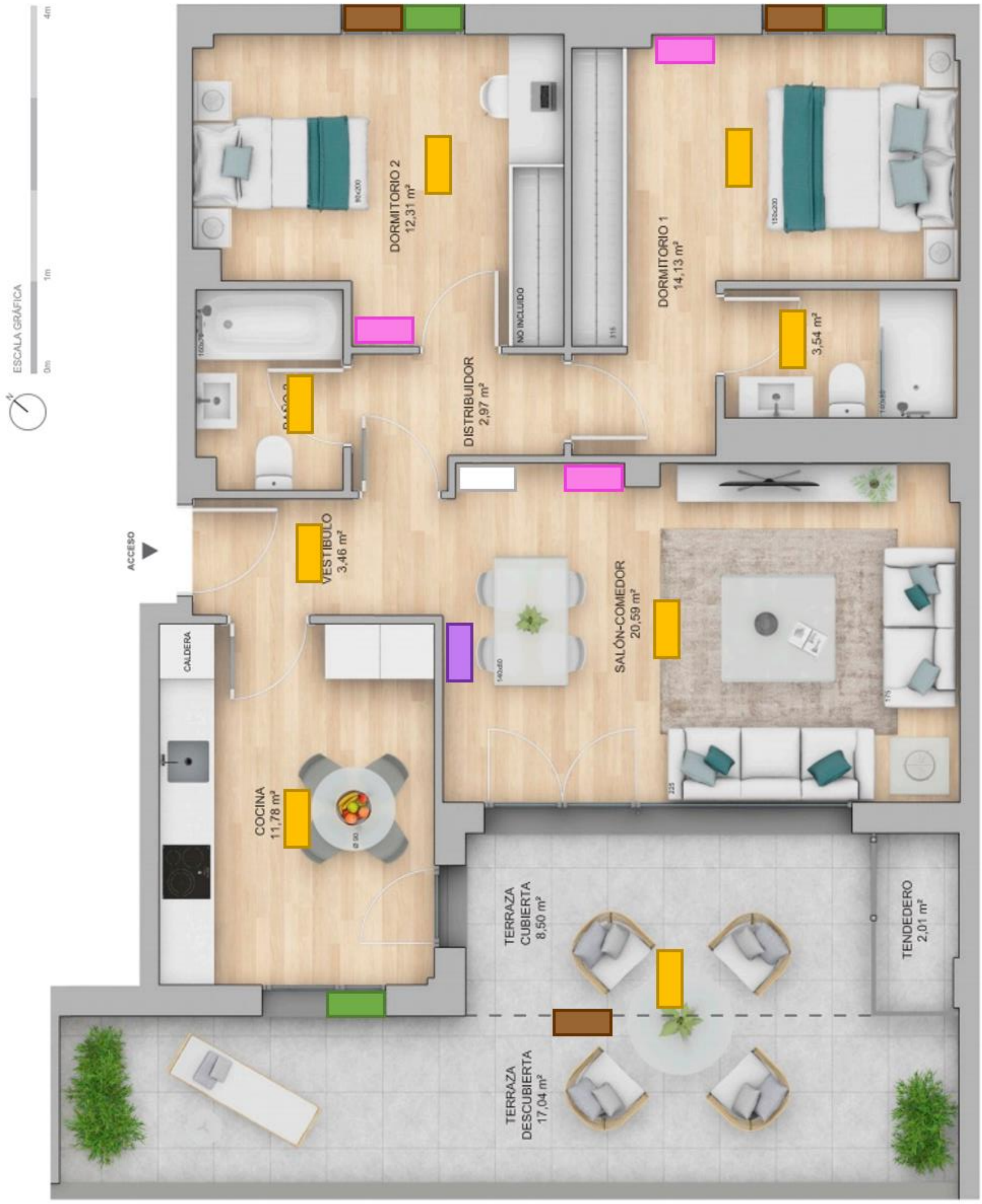


Figura 21: Distribución de los actuadores usados en el prototipo comercial. [Fuente propia]

5.3. Bluetooth y el mando de control

Figura 22: Ubicación del módulo bluetooth HC-12 y del mando de control del sistema domótico de la vivienda. [Fuente propia]

6. Datasheets de los componentes

PACKS COMPONENTES ELÉCTRICOS

Pack Detector de Movimiento PIR 360º Empotrable (4 un)

Parámetros técnicos	
Tensión:	220-240V AC
Frecuencia:	50-60 Hz
Clase Aislamiento Eléctrico:	II
Ángulo de Apertura:	360º
Uso:	Interior
Protección IP:	IP20
Material:	PC Ignífugo
Instalación:	Empotrable
Dimensiones:	Ø76x75 mm
Dimensiones de corte:	Ø59x60 mm
Alto:	75 mm
Diámetro:	Ø76 mm
Garantía:	5 Años.
Certificados:	CE & RoHS,UKCA

Descripción del producto

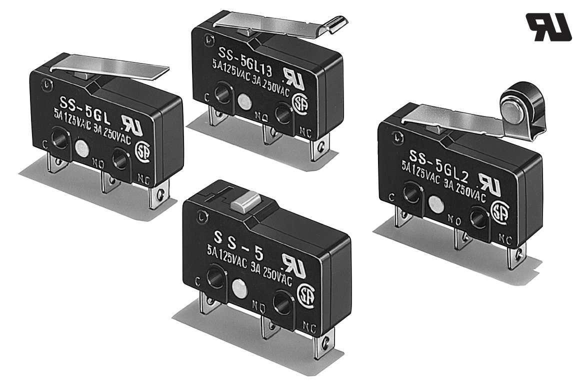
Detector de presencia empotrable de techo, con un ángulo de cobertura de 360º y un campo de detección de hasta 6 metros a una altura de 2-4 metros. Capaz de captar emisiones invisibles infrarrojas procedentes de cualquier fuente de calor sin emitir ningún tipo de radiación.
El detector activa su circuito de salida cuando una fuente de calor se mueve delante del interruptor y se desactiva una vez se deje de captar dicho calor, tras un tiempo de retardo regulable. Temporización y sensibilidad luminosa ajustables.
Angulo de Detección: 360°.
Distancia de Detección: 6 metros.
Tiempo Mínimo de Encendido: 10 segundos ±3 segundos.
Tiempo Máximo de encendido: 15 minutos ±2 minuto.
Altura de Instalación: 2 a 4 metros.
Velocidad de Detección: 0.6-1.5 m/s.
Cargas: 300W LED y 1200W Incandescencia.

SS

Subminiature Basic Switch

Subminiature Basic Switch Offers High Reliability and Security

- The OMRON's best-selling micro switches of a wide variety from 0.1A to 10.1A.
- A variety of models are available, with operating force ranging from low to high.
- Two split springs ensure a high stability and durability of 30,000,000 operations.
- 1 mm MIN Contact Gap Models available for Interlock applications



RoHS Compliant

Model Number Legend

SS-[1] [2] [3] [4] [5] [6]

1. Ratings
- 10 : 250 VAC 10.1A
- 5 : 125 VAC 5 A
- 01 : 30 VDC 0.1A

2. Actuator
- None : Pin plunger
- GL : Hinge lever
- GL111 : Long hinge lever
- GL13 : Simulated roller lever
- GL2 : Hinge roller lever
- GL02 : Hinge roller lever (Roller material: Stainless) heat-resistant

3. Maximum Operating Force (OF)
- None : 1.47 N {150 gf}
- -F : 0.49 N {50 gf} (0.1 A, 5 A)
- -E : 0.25 N {25 gf} (0.1 A)

Note. These values are for the pin plunger models.

4. Contact form
- None : SPDT
- -2 : SPST-NC
- -3 : SPST-NO

5. Terminals
- None : Solder terminals
- T : Quick-connect terminals (#110)
- D : PCB terminals

6. Heat resistance
- None : Standard (85°C)
- -T : Heat-resistant (120°C)

List of Models

●**Standard Models**

Actuator	Terminals	Contact Form	Maximum Operating Force (OF) \ Ratings	10.1 A	5 A	0.1 A
Pin plunger	Solder terminals	SPDT	1.47 N {150 gf}	**SS-10**	**SS-5**	**SS-01**
		SPST-NC		**SS-10-2**	**SS-5-2**	**SS-01-2**
		SPST-NO		**SS-10-3**	**SS-5-3**	**SS-01-3**
	Quick-connect terminals (#110)	SPDT		**SS-10T**	**SS-5T**	**SS-01T**
		SPST-NC		**SS-10-2T**	**SS-5-2T**	**SS-01-2T**
		SPST-NO		**SS-10-3T**	**SS-5-3T**	**SS-01-3T**
	PCB terminals	SPDT		**SS-10D**	**SS-5D**	**SS-01D**
		SPST-NC		**SS-10-2D**	**SS-5-2D**	**SS-01-2D**
		SPST-NO		**SS-10-3D**	**SS-5-3D**	**SS-01-3D**
	Solder terminals	SPDT	0.49 N {50 gf}	-	**SS-5-F**	**SS-01-F**
		SPST-NC		-	**SS-5-F-2**	**SS-01-F-2**
		SPST-NO		-	**SS-5-F-3**	**SS-01-F-3**
	Quick-connect terminals (#110)	SPDT		-	**SS-5-FT**	**SS-01-FT**
		SPST-NC		-	**SS-5-F-2T**	**SS-01-F-2T**
		SPST-NO		-	**SS-5-F-3T**	**SS-01-F-3T**
	PCB terminals	SPDT		-	**SS-5-FD**	**SS-01-FD**
		SPST-NC		-	**SS-5-F-2D**	**SS-01-F-2D**
		SPST-NO		-	**SS-5-F-3D**	**SS-01-F-3D**
	Solder terminals	SPDT	0.25 N {25 gf}	-	-	**SS-01-E**
		SPST-NC		-	-	**SS-01-E-2**
		SPST-NO		-	-	**SS-01-E-3**
	Quick-connect terminals (#110)	SPDT		-	-	**SS-01-ET**
		SPST-NC		-	-	**SS-01-E-2T**
		SPST-NO		-	-	**SS-01-E-3T**
	PCB terminals	SPDT		-	-	**SS-01-ED**
		SPST-NC		-	-	**SS-01-E-2D**
		SPST-NO		-	-	**SS-01-E-3D**

Separator (Sold Separately), Terminal Connector (Sold Separately) ➡ Refer to "**Basic Switch Common Accessories**"

Actuator	Terminals	Contact Form	Ratings Maximum Operating Force (OF)	10.1 A	5 A	0.1 A
Hinge lever 	Solder terminals	SPDT	0.49 N {50 gf}	SS-10GL	SS-5GL	SS-01GL
		SPST-NC		SS-10GL-2	SS-5GL-2	SS-01GL-2
		SPST-NO		SS-10GL-3	SS-5GL-3	SS-01GL-3
	Quick-connect terminals (#110)	SPDT		SS-10GLT	SS-5GLT	SS-01GLT
		SPST-NC		SS-10GL-2T	SS-5GL-2T	SS-01GL-2T
		SPST-NO		SS-10GL-3T	SS-5GL-3T	SS-01GL-3T
	PCB terminals	SPDT		SS-10GLD	SS-5GLD	SS-01GLD
		SPST-NC		SS-10GL-2D	SS-5GL-2D	SS-01GL-2D
		SPST-NO		SS-10GL-3D	SS-5GL-3D	SS-01GL-3D
	Solder terminals	SPDT	0.16 N {16 gf}	-	SS-5GL-F	SS-01GL-F
		SPST-NC		-	SS-5GL-F-2	SS-01GL-F-2
		SPST-NO		-	SS-5GL-F-3	SS-01GL-F-3
	Quick-connect terminals (#110)	SPDT		-	SS-5GL-FT	SS-01GL-FT
		SPST-NC		-	SS-5GL-F-2T	SS-01GL-F-2T
		SPST-NO		-	SS-5GL-F-3T	SS-01GL-F-3T
	PCB terminals	SPDT		-	SS-5GL-FD	SS-01GL-FD
		SPST-NC		-	SS-5GL-F-2D	SS-01GL-F-2D
		SPST-NO		-	SS-5GL-F-3D	SS-01GL-F-3D
	Solder terminals	SPDT	0.08 N {8 gf}	-	-	SS-01GL-E
		SPST-NC		-	-	SS-01GL-E-2
		SPST-NO		-	-	SS-01GL-E-3
	Quick-connect terminals (#110)	SPDT		-	-	SS-01GL-ET
		SPST-NC		-	-	SS-01GL-E-2T
		SPST-NO		-	-	SS-01GL-E-3T
	PCB terminals	SPDT		-	-	SS-01GL-ED
		SPST-NC		-	-	SS-01GL-E-2D
		SPST-NO		-	-	SS-01GL-E-3D
Long hinge lever 	Solder terminals	SPDT	0.39 N {40 gf}	SS-10GL111	SS-5GL111	SS-01GL111
		SPST-NC		SS-10GL111-2	SS-5GL111-2	SS-01GL111-2
		SPST-NO		SS-10GL111-3	SS-5GL111-3	SS-01GL111-3
	Quick-connect terminals (#110)	SPDT		SS-10GL111T	SS-5GL111T	SS-01GL111T
		SPST-NC		SS-10GL111-2T	SS-5GL111-2T	SS-01GL111-2T
		SPST-NO		SS-10GL111-3T	SS-5GL111-3T	SS-01GL111-3T
	PCB terminals	SPDT		SS-10GL111D	SS-5GL111D	SS-01GL111D
		SPST-NC		SS-10GL111-2D	SS-5GL111-2D	SS-01GL111-2D
		SPST-NO		SS-10GL111-3D	SS-5GL111-3D	SS-01GL111-3D
	Solder terminals	SPDT	0.12 N {12 gf}	-	SS-5GL111-F	SS-01GL111-F
		SPST-NC		-	SS-5GL111-F-2	SS-01GL111-F-2
		SPST-NO		-	SS-5GL111-F-3	SS-01GL111-F-3
	Quick-connect terminals (#110)	SPDT		-	SS-5GL111-FT	SS-01GL111-FT
		SPST-NC		-	SS-5GL111-F-2T	SS-01GL111-F-2T
		SPST-NO		-	SS-5GL111-F-3T	SS-01GL111-F-3T
	PCB terminals	SPDT		-	SS-5GL111-FD	SS-01GL111FD
		SPST-NC		-	SS-5GL111-F-2D	SS-01GL111-F-2D
		SPST-NO		-	SS-5GL111-F-3D	SS-01GL111-F-3D
	Solder terminals	SPDT	0.06 N {6 gf}	-	-	SS-01GL111-E
		SPST-NC		-	-	SS-01GL111-E-2
		SPST-NO		-	-	SS-01GL111-E-3
	Quick-connect terminals (#110)	SPDT		-	-	SS-01GL111-ET
		SPST-NC		-	-	SS-01GL111-E-2T
		SPST-NO		-	-	SS-01GL111-E-3T
	PCB terminals	SPDT		-	-	SS-01GL111-ED
		SPST-NC		-	-	SS-01GL111-E-2D
		SPST-NO		-	-	SS-01GL111-E-3D
Simulated roller lever 	Solder terminals	SPDT	0.49 N {50 gf}	SS-10GL13	SS-5GL13	SS-01GL13
		SPST-NC		SS-10GL13-2	SS-5GL13-2	SS-01GL13-2
		SPST-NO		SS-10GL13-3	SS-5GL13-3	SS-01GL13-3
	Quick-connect terminals (#110)	SPDT		SS-10GL13T	SS-5GL13T	SS-01GL13T
		SPST-NC		SS-10GL13-2T	SS-5GL13-2T	SS-01GL13-2T
		SPST-NO		SS-10GL13-3T	SS-5GL13-3T	SS-01GL13-3T
	PCB terminals	SPDT		SS-10GL13D	SS-5GL13D	SS-01GL13D
		SPST-NC		SS-10GL13-2D	SS-5GL13-2D	SS-01GL13-2D
		SPST-NO		SS-10GL13-3D	SS-5GL13-3D	SS-01GL13-3D
	Solder terminals	SPDT	0.16 N {16 gf}	-	SS-5GL13-F	SS-01GL13-F
		SPST-NC		-	SS-5GL13-F-2	SS-01GL13-F-2
		SPST-NO		-	SS-5GL13-F-3	SS-01GL13-F-3
	Quick-connect terminals (#110)	SPDT		-	SS-5GL13-FT	SS-01GL13-FT
		SPST-NC		-	SS-5GL13-F-2T	SS-01GL13-F-2T
		SPST-NO		-	SS-5GL13-F-3T	SS-01GL13-F-3T
	PCB terminals	SPDT		-	SS-5GL13-FD	SS-01GL13-FD
		SPST-NC		-	SS-5GL13-F-2D	SS-01GL13-F-2D
		SPST-NO		-	SS-5GL13-F-3D	SS-01GL13-F-3D
	Solder terminals	SPDT	0.08 N {8 gf}	-	-	SS-01GL13-E
		SPST-NC		-	-	SS-01GL13-E-2
		SPST-NO		-	-	SS-01GL13-E-3
	Quick-connect terminals (#110)	SPDT		-	-	SS-01GL13-ET
		SPST-NC		-	-	SS-01GL13-E-2T
		SPST-NO		-	-	SS-01GL13-E-3T
	PCB terminals	SPDT		-	-	SS-01GL13-ED
		SPST-NC		-	-	SS-01GL13-E-2D
		SPST-NO		-	-	SS-01GL13-E-3D

Separator (Sold Separately), Terminal Connector (Sold Separately) ➡ Refer to "**Basic Switch Common Accessories**"

Actuator	Terminals	Contact Form	Maximum Operating Force (OF) / Ratings	10.1 A	5 A	0.1 A
Hinge roller lever	Solder terminals	SPDT	0.49 N {50 gf}	SS-10GL2	SS-5GL2	SS-01GL2
		SPST-NC		SS-10GL2-2	SS-5GL2-2	SS-01GL2-2
		SPST-NO		SS-10GL2-3	SS-5GL2-3	SS-01GL2-3
	Quick-connect terminals (#110)	SPDT		SS-10GL2T	SS-5GL2T	SS-01GL2T
		SPST-NC		SS-10GL2-2T	SS-5GL2-2T	SS-01GL2-2T
		SPST-NO		SS-10GL2-3T	SS-5GL2-3T	SS-01GL2-3T
	PCB terminals	SPDT		SS-10GL2D	SS-5GL2D	SS-01GL2D
		SPST-NC		SS-10GL2-2D	SS-5GL2-2D	SS-01GL2-2D
		SPST-NO		SS-10GL2-3D	SS-5GL2-3D	SS-01GL2-3D
	Solder terminals	SPDT	0.16 N {16 gf}	-	SS-5GL2-F	SS-01GL2-F
		SPST-NC		-	SS-5GL2-F-2	SS-01GL2-F-2
		SPST-NO		-	SS-5GL2-F-3	SS-01GL2-F-3
	Quick-connect terminals (#110)	SPDT		-	SS-5GL2-FT	SS-01GL2-FT
		SPST-NC		-	SS-5GL2-F-2T	SS-01GL2-F-2T
		SPST-NO		-	SS-5GL2-F-3T	SS-01GL2-F-3T
	PCB terminals	SPDT		-	SS-5GL2-FD	SS-01GL2-FD
		SPST-NC		-	SS-5GL2-F-2D	SS-01GL2-F-2D
		SPST-NO		-	SS-5GL2-F-3D	SS-01GL2-F-3D
	Solder terminals	SPDT	0.08 N {8 gf}	-	-	SS-01GL2-E
		SPST-NC		-	-	SS-01GL2-E-2
		SPST-NO		-	-	SS-01GL2-E-3
	Quick-connect terminals (#110)	SPDT		-	-	SS-01GL2-ET
		SPST-NC		-	-	SS-01GL2-E-2T
		SPST-NO		-	-	SS-01GL2-E-3T
	PCB terminals	SPDT		-	-	SS-01GL2-ED
		SPST-NC		-	-	SS-01GL2-E-2D
		SPST-NO		-	-	SS-01GL2-E-3D

●Heat Resistant Models

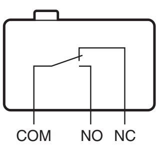
Actuator	Terminals	Contact Form	Maximum Operating Force (OF) / Ratings	10.1 A	5 A	0.1 A
Pin plunger	Solder terminals	SPDT	1.47 N {150 gf}	SS-10-T	SS-5-T	SS-01-T
	Quick-connect terminals (#110)			SS-10T-T	SS-5T-T	SS-01T-T
	PCB terminals			SS-10D-T	SS-5D-T	SS-01D-T
Hinge lever	Solder terminals		0.49 N {50 gf}	SS-10GL-T	SS-5GL-T	SS-01GL-T
	Quick-connect terminals (#110)			SS-10GLT-T	SS-5GLT-T	SS-01GLT-T
	PCB terminals			SS-10GLD-T	SS-5GLD-T	SS-01GLD-T
Long hinge lever	Solder terminals		0.39 N {40 gf}	SS-10GL111-T	SS-5GL111-T	SS-01GL111-T
	Quick-connect terminals (#110)			SS-10GL111T-T	SS-5GL111T-T	SS-01GL111T-T
	PCB terminals			SS-10GL111D-T	SS-5GL111D-T	SS-01GL111D-T
Simulated roller lever	Solder terminals		0.49 N {50 gf}	SS-10GL13-T	SS-5GL13-T	SS-01GL13-T
	Quick-connect terminals (#110)			SS-10GL13T-T	SS-5GL13T-T	SS-01GL13T-T
	PCB terminals			SS-10GL13D-T	SS-5GL13D-T	SS-01GL13D-T
Hinge roller lever (Roller material: stainless steel)	Solder terminals		0.49 N {50 gf}	SS-10GL02-T	SS-5GL02-T	SS-01GL02-T
	Quick-connect terminals (#110)			SS-10GL02T-T	SS-5GL02T-T	SS-01GL02T-T
	PCB terminals			SS-10GL02D-T	SS-5GL02D-T	SS-01GL02D-T

●1 mm MIN Contact Gap Models

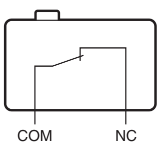
Actuator	Terminals	Contact Form	Maximum Operating Force (OF) / Ratings	10.1 A	5 A	0.1 A
Long hinge lever	Solder terminals	SPST-NO	0.54 N {55 gf}	-	SS-5FL111-3	-
	Quick-connect terminals (#110)			-	SS-5FL111-3T	-

Contact Form

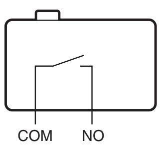
●SPDT



●SPST-NC



●SPST-NO



Contact Specifications

Item		SS-10 models	SS-5 models	SS-01 models	SS-5F models
Contact	Specification	Rivet		Crossbar	Rivet
	Material	Silver alloy	Silver	Gold alloy	Silver
	Gap (standard value)	0.5 mm		0.25 mm	1mm min.
Inrush current	NC	20 A max.		1 A max.	-
	NO	15 A max.	10 A max.	1 A max.	10 A max.
Minimum applicable load (reference value)*		5 VDC 160 mA		5 VDC 1 mA	5 VDC 160 mA

* Please refer to "**●Using Micro Loads**" in "**Precautions**" for more information on the minimum applicable load.

Separator (Sold Separately), Terminal Connector (Sold Separately) ➡ Refer to "**Basic Switch Common Accessories**"

Ratings

Model	Item / Rated voltage	Resistive load
SS-10 models	250 VAC	10.1 A
SS-5 models	125 VAC 250 VAC	5 A 3 A
SS-01 models	125 VAC	0.1 A
	30 VDC	0.1 A
SS-5F models	250 VAC	3 A
	30 VDC	5 A

Note. The above rating values apply under the following test conditions.
(1) Ambient temperature: 20±2°C
(2) Ambient humidity: 65±5%
(3) Operating frequency: 30 operations/min

Approved Safety Standards

Models shown in the "**List of Models**" are UL and CSA approved models.

Note. Note that heat resistant models are not standard approved models.

UL (UL1054)/CSA (CSA C22.2 No.55)

Rated voltage \ Model	SS-10	SS-5	SS-01	SS-5F
125 VAC 250 VAC	- 10.1 A	5 A 3 A	0.1 A -	- 3 A
30 VDC	-	-	0.1 A	5 A

Consult your OMRON sales representative for specific models with VDE standard approvals.

VDE (EN61058-1)

Rated voltage \ Model	SS-10	SS-5	SS-5F
250 VAC	10 A	5 A	3 A

Testing conditions: 5E4 (50,000 operations)
T85 (0°C to 85°C)

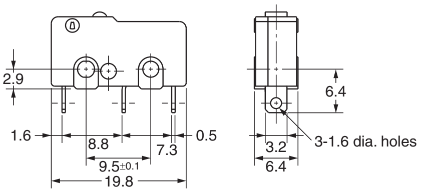
Characteristics

Item		Model	SS-10 models	SS-5 models	SS-01 models	SS-5F models
Permissible operating speed			0.1 mm to 1 m/s (for pin plunger models)			
Permissible operating frequency	Mechanical		400 operations/min			
	Electrical		60 operations/min			
Insulation resistance			100 MΩ min. (at 500 VDC with insulation tester)			
Contact resistance (initial value)		OF 1.47 N models	30 mΩ max.		50 mΩ max.	30 mΩ max.
		OF 0.49 N models	-	50 mΩ max.	100 mΩ max.	-
		OF 0.25 N models	-		150 mΩ max.	-
Dielectric strength *1	Between terminals of the same polarity		1,000 VAC 50/60 Hz for 1 min		600 VAC 50/60 Hz for 1 min	1,000 VAC 50/60 Hz for 1 min
	Between current-carrying metal parts and ground		1,500 VAC 50/60 Hz for 1 min			
	Between each terminals and non-current-carrying metal parts		1,500 VAC 50/60 Hz for 1 min			
Vibration resistance *2	Malfunction		10 to 55 Hz, 1.5 mm double amplitude			
Shock resistance	Durability	OF 1.47 N models	1,000 m/s² {approx. 100G} max.			
		OF 0.49 N models	500 m/s² {approx. 50G} max.			-
		OF 0.25 N models	500 m/s² {approx. 50G} max.			-
	Malfunction *2	OF 1.47 N models	300 m/s² {approx. 30G} max.			
		OF 0.49 N models	200 m/s² {approx. 20G} max.			-
		OF 0.25 N models	200 m/s² {approx. 20G} max.			-
Durability *3	Mechanical		10,000,000 operations min. (60 operations/min)	30,000,000 operations min. (60 operations/min)		100,000 operations min. (60 operations/min)
	Electrical		50,000 operations min. (30 operations/min)	200,000 operations min. (30 operations/min)		100,000 operations min. (30 operations/min)
Degree of protection			IEC IP40			
Degree of protection against electric shock			Class I			
Proof tracking index (PTI)			175			
Ambient operating temperature			-25°C to +85°C (at ambient humidity of 60% max.) (with no icing or condensation)			
Ambient operating humidity			85% max. (for +5°C to +35°C)			
Weight			Approx. 1.6g (pin plunger models)			

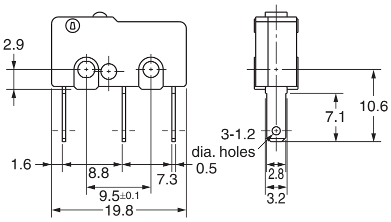
Note. The data given above are initial values.
*1. The values for dielectric strength shown are for models with a Separator (refer to "**Micro Switch Common Accessories**").
*2. The values are at Free Position and Total Travel Position values for pin plunger, and Total Travel Position value for lever. Close or open circuit of the contact is 1ms max.
*3. For testing conditions, consult your OMRON sales representative.

Terminals/Appearances (Unit: mm)

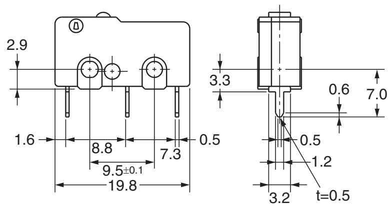
●Solder terminals



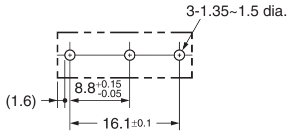
●Quick connect terminals (#110)



●PCB terminals

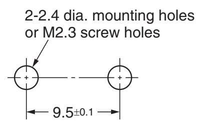


<PCB Mounting Dimensions (Reference)>



Note. SPST-NO terminal models do not have NC terminal.

Mounting Holes (Unit: mm)

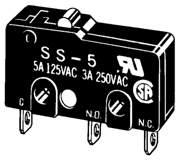


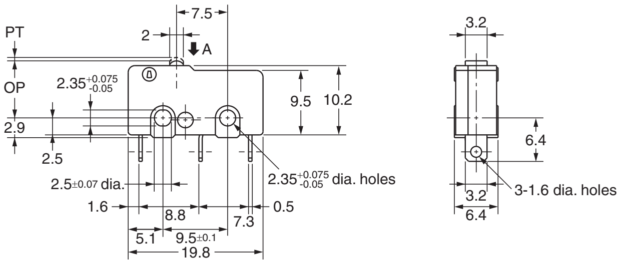
Dimensions (Unit: mm) and Operating Characteristics

The illustrations and drawings are for solder terminals models.

Refer to **"Terminals/Appearances"** of the previous page for details on models with quick connect terminals (#110) or PCB terminals.

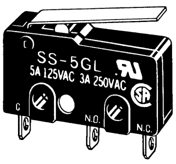
●Pin plunger
SS-10
SS-5 (-F)
SS-01 (-E, -F)

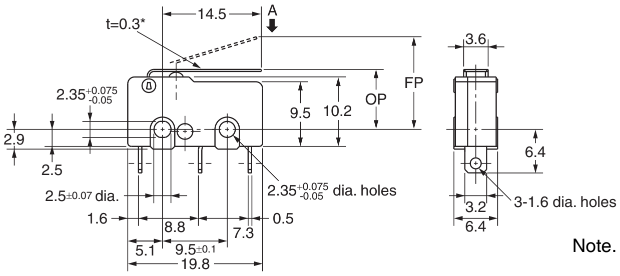




Operating Characteristics			SS-10	SS-5 SS-01	SS-5-F SS-01-F	SS-01-E
Operating Force	OF	Max.	1.47 N {150 gf}	1.47 N {150 gf}	0.49 N {50 gf}	0.25 N {25 gf}
Releasing Force	RF	Min.	0.25 N {25 gf}	0.25 N {25 gf}	0.04 N {4 gf}	0.02 N {2 gf}
Pretravel	PT	Max.	0.6 mm	0.5 mm	0.5 mm	0.5 mm
Overtravel	OT	Min.	0.4 mm	0.5 mm	0.5 mm	0.5 mm
Movement Differential	MD	Max.	0.12 mm	0.1 mm	0.1 mm	0.1 mm
Operating Position	OP		8.4±0.5 mm			

●Hinge lever
SS-10GL
SS-5GL (-F)
SS-01GL (-E, -F)



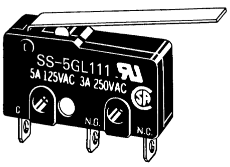


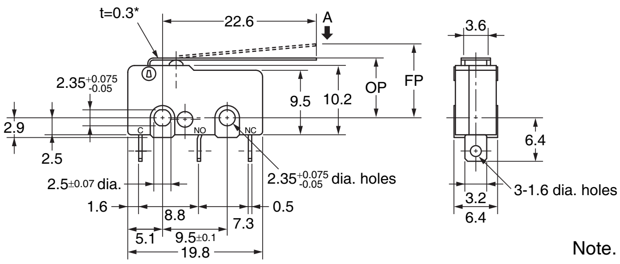
* Stainless-steel lever

Note. The indicated reference values of RF are for cases where the lever weight is not applied to the plunger.

Operating Characteristics			SS-10GL	SS-5GL SS-01GL	SS-5GL-F SS-01GL-F	SS-01GL-E
Operating Force	OF	Max.	0.49 N {50 gf}	0.49 N {50 gf}	0.16 N {16 gf}	0.08 N {8 gf}
Releasing Force	RF	Min.	0.06 N {6 gf}	0.06 N {6 gf}	0.02 N {2 gf}	0.01 N {1 gf} (reference value)
Overtravel	OT	Min.	1.0 mm	1.2 mm	1.2 mm	1.2 mm
Movement Differential	MD	Max.	1.0 mm	0.8 mm	0.8 mm	0.8 mm
Free Position	FP	Max.	13.6 mm			
Operating Position	OP		8.8±0.8 mm			

●Long hinge lever
SS-10GL111
SS-5GL111 (-F)
SS-01GL111 (-E, -F)
SS-5FL111-3





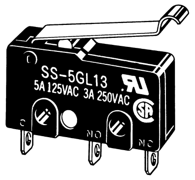
* Stainless-steel lever

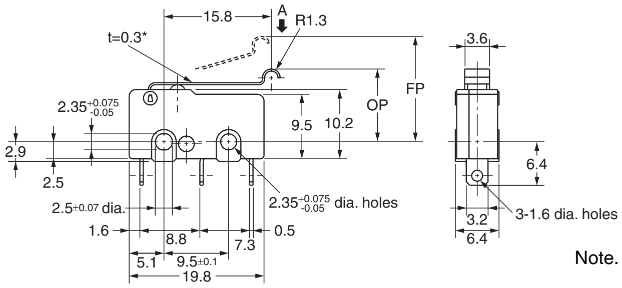
Note. The indicated reference values of RF are for cases where the lever weight is not applied to the plunger.

Operating Characteristics			SS-10GL111	SS-5GL111 SS-01GL111	SS-5FL111-3	SS-5GL111-F SS-01GL111-F	SS-01GL111-E
Operating Force	OF	Max.	0.39 N {40 gf}	0.39 N {40 gf}	0.54 N {55 gf}	0.12 N {12 gf}	0.06 N {6 gf}
Releasing Force	RF	Min.	0.03 N {3 gf}	0.03 N {3 gf}	0.01 N {1 gf}	0.02 N {2 gf} (reference value)	0.003 N {0.3 gf} (reference value)
Overtravel	OT	Min.	1.2 mm	1.2 mm	1.0 mm	1.2 mm	1.2 mm
Movement Differential	MD	Max.	1.2 mm	1.2 mm	3.0 mm	1.2 mm	1.2 mm
Free Position	FP	Max.	16.8 mm				
Operating Position	OP		8.8±1.5 mm				8.8±2 mm

Note 1. Unless otherwise specified, a tolerance of ±0.4 mm applies to all dimensions.
Note 2. The operating characteristics are for operation in the A direction (⬇).

●Simulated roller lever
SS-10GL13
SS-5GL13 (-F)
SS-01GL13 (-E, -F)



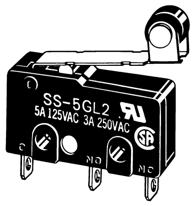


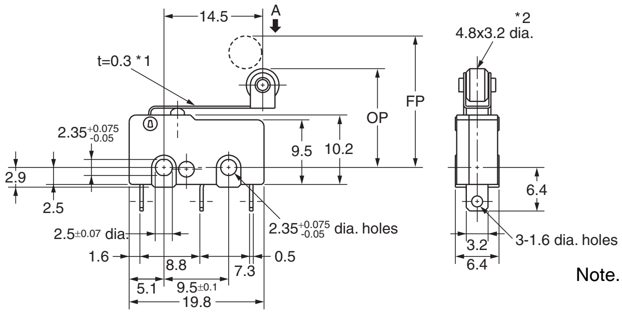
* Stainless-steel lever

Note. The indicated reference values of RF are for cases where the lever weight is not applied to the plunger.

Operating Characteristics \ Model			SS-10GL13	SS-5GL13 SS-01GL13	SS-5GL13-F SS-01GL13-F	SS-01GL13-E
Operating Force Releasing Force	OF RF	Max. Min.	0.49 N {50 gf} 0.06 N {6 gf}	0.49 N {50 gf} 0.06 N {6 gf}	0.16 N {16 gf} 0.02 N {2 gf}	0.08 N {8 gf} 0.01 N {1 gf} (reference value)
Overtravel Movement Differential	OT MD	Min. Max.	1.0 mm 1.0 mm	1.2 mm 0.8 mm	1.2 mm 0.8 mm	1.2 mm 0.8 mm
Free Position Operating Position	FP OP	Max.	15.5 mm 10.7±0.8 mm			

●Hinge roller lever
SS-10GL2
SS-5GL2 (-F)
SS-01GL2 (-E, -F)





*1. Stainless-steel lever
*2. Polyacetal resin roller

Note. The indicated reference values of RF are for cases where the lever weight is not applied to the plunger.

Operating Characteristics \ Model			SS-10GL2	SS-5GL2 SS-01GL2	SS-5GL2-F SS-01GL2-F	SS-01GL2-E
Operating Force Releasing Force	OF RF	Max. Min.	0.49 N {50 gf} 0.06 N {6 gf}	0.49 N {50 gf} 0.06 N {6 gf}	0.16 N {16 gf} 0.02 N {2 gf}	0.08 N {8 gf} 0.01 N {1 gf} (reference value)
Overtravel Movement Differential	OT MD	Min. Max.	1.0 mm 1.0 mm	1.2 mm 0.8 mm	1.2 mm 0.8 mm	1.2 mm 0.8 mm
Free Position Operating Position	FP OP	Max.	19.3mm 14.5±0.8mm			

Note 1. Unless otherwise specified, a tolerance of ±0.4 mm applies to all dimensions.
Note 2. The operating characteristics are for operation in the A direction (⬇).

Precautions

★Please refer to "Common Precautions" for correct use.

Cautions

●Soldering

- Complete the soldering at the iron tip temperature below 350°C within 5 seconds, and do not apply any external force for 1 minute after soldering. Soldering at an excessively high temperature or soldering for more than 5 seconds may deteriorate the characteristics of the Switch.
- Be sure to apply only the minimum required amount of flux. Switch may have contact failures if flux intrudes into the interior of the Switch.
- If the PCB terminal models are soldered in the solder bath, flux will permeate inside the Switch and cause contact failure. Therefore, manually solder the PCB terminal.

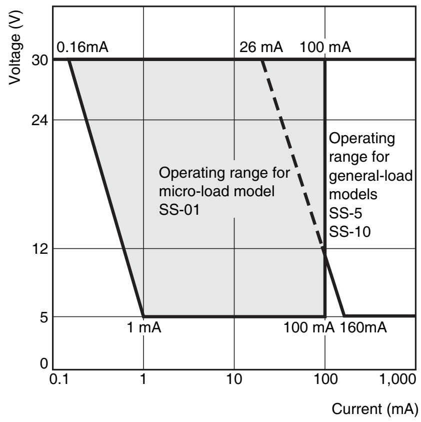
Correct Use

●Mounting

- Use M2.3 mounting screw with plane washers or spring washers to securely mount the Switch. Tighten the screws to a torque of 0.23 to 0.26 N·m {2.3 to 2.7 kgf·cm}.
- Mount the Switch onto a flat surface. Mounting on an uneven surface may cause deformation of the Switch, resulting in faulty operation or breakage in the housing.

●Using Micro Loads

Using a model for ordinary loads to open or close the contact of a micro load circuit may result in faulty contact. Use models that operate in the following range. However, even when using micro load models within the following operating range, if inrush current occurs when the contact is opened or closed, it may increase the contact wear and so decrease durability. Therefore, insert a contact protection circuit where necessary. The N-level reference value applies for the minimum applicable load. This value indicates the malfunction reference level for the reliability level of 60% (λ_{60}).
(JIS C5003)
The equation, $\lambda_{60}=0.5\times10^{-6}$/operation indicates that the estimated malfunction rate is less than $\frac{1}{2,000,000}$ operations with a reliability level of 60%.



SS

OMRON Corporation
ELECTRONIC AND MECHANICAL COMPONENTS COMPANY **Contact: www.omron.com/ecb**
Cat. No.B032-E1-14
0716(0207)(O)

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Omron:

SS-01GL13D SS-01GL-F SS-5-3T SS-5GL-F SS-10GLT SS-5-FT SS-10GL SS-01GL-ET SS-01D SS-10D SS-10T SS-10GL13T SS-3GLPD SS-3GLPT SS-3GLPB SS-5GL2D SS-5GL2T SS-01GL13 SS-5T SS-5D SS-5-F SS-01GL13P SS-01GLPT SS-5GL SS-3GPB SS-3GLP SS-3GPD SS-5D2 SS-3GL13P SS-01GLP SS-01GPD SS-01GPT SS-01GL13PD SS-01GL13PT SS-10 SS-01GL2-FD SS-5GLD SS-5GLT SS-10GL2T SS-5GL2 SS-01 SS-3GL13PT SS-3GL13PD SS-3GP SS-5GL13T SS-5 SS-01-FT SS-01GP SS-01GL SS-5GL13 SS-01-ED SS-01-FD SS-01GL-ED SS-01GL-FD SS-01GL13-ED SS-01GL13-FD SS-01GL2-ED SS-01D1 SS-01GLD1 SS-01-E SS-01-F SS-01GL-E SS-01GL13-E SS-01GL13-F SS-01GL2-E SS-01GL2-F SS-01GL2 SS-01T SS-01GL-FT SS-01GL13-ET SS-01GL13-FT SS-01GL2-FT SS-01GL2T SS-5-FD SS-5GL-FD SS-5GL13-FD SS-5GL13D SS-5GL2-FD SS-5GL-FD1 SS-5GLD1 SS-5GL13D1 SS-5GL2-FD1 SS-5GL2D1 SS-5GL-FD2 SS-5GLD2 SS-5GL13-FD2 SS-5GL13D2 SS-5GL2-FD2 SS-5GL2D2 SS-5GL13-F SS-5GL14-F SS-5GL14 SS-5GL2-F SS-5GL-FT SS-5GL13-FT SS-5GL14T SS-5GL2-FT SS-10GLD SS-10GL13D SS-10GL13

PDV-P9203

Light Dependent Resistor CdS Photocell

The PDV-P9203 is a light dependent resistor with sensitivity in the visible light region. The CdS photoresistor photocell is mounted on a 2-pin ceramic and the photocell surface is plastic encapsulated for moisture resistance.

Advanced Photonix's CdS Photocells are photoresistor cells for visible light measurement designed to sense light from 400 to 700 nm. Their resistance decreases as the light level increases with efficiency characteristics similar to the human eye. These Light Dependent Resistors (LDR) are available in a wide range of resistance values. They are available in a two leaded plastic-coated ceramic header or hermetically sealed TO metal can.

Applications

- Camera exposure
- Shutter controls
- Night light controls
- Audio Compressors
- Solar Street Lights
- Flame Detection

Features

- Visible Light Response
- Sintered Construction
- Two-leaded ceramic package
- Available in a Hermetically sealed package
- Available in a wide range of resistance values

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Voltage	V_R	-	150	V
Power Dissipation	-	9	90	mW
Operating Temperature	T_{OP}	-30	+75	°C
Storage Temperature	T_{STG}	-50	+75	°C
Package	2-pin Ceramic			

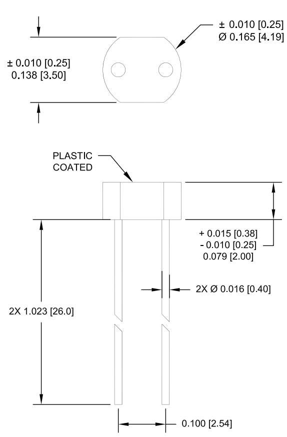
Typical Electro-Optical Specifications at T_A=23 °C

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Dark Resistance	After 10sec. @10Lux @ 2856°K	R_D	5	-	-	MΩ
Illuminated Resistance	10Lux @ 2856°K	R_{IL}	10	-	30	KΩ
Sensitivity	$\frac{\text{Log (R100) - Log (R10)**}}{\text{Log (E100) - Log (E10) ***}}$	S	-	0.90	-	Ω/Lux
Spectral Peak	-	λ_P	-	570	-	nm
Rise Time	10Lux @ 2856°K	T_R	-	60	-	ms
Fall Time	After 10Lux @ 2856°K	T_F	-	25	-	ms

**R100, R10: cell resistances at 100 Lux and 10 Lux at 2856 K respectively.
***E100, E10: luminances at 100 Lux and 10 Lux 2856 K respectively.

Mechanical Specifications

Units are in inches [mm]



Care and handling instructions

Your optoelectronic components are packaged and shipped in opaque, padded containers to avoid ambient light exposure and damage due to shock from dropping or jarring.

Care must be taken to avoid exposure to high ambient light levels, particularly from tungsten sources or sunlight.

- These components can be rendered inoperable if dropped or sharply jarred. The wire bonds are delicate and can become separated from the bonding pads when the component is dropped or otherwise receives a sharp physical blow.
- Most windows on photodiodes are either silicon or quartz. They should be cleaned with isopropyl alcohol and a soft (optical grade) pad.
- Photodiode exposure to extreme high or low storage temperatures can affect the subsequent performance. Maintain a non-condensing environment for optimum performance and lifetime.
- All devices are considered ESD sensitive. The photodiodes are shipped in ESD protective packaging. When unpacking and using these products, anti-ESD precautions should be observed.
- Photodiode packages and/or operation may be impaired if exposed to CHLOROETHENE, THINNER, ACETONE, TRICHLOROETHYLENE or any harsh chemicals.
- Optoelectronic components in plastic packages should be given special care. Clear plastic packages are more sensitive to environmental stress than those of black plastic. Storing devices in high humidity can present problems when soldering. Since the rapid heating during soldering stresses the wire bonds and can cause wire to bonding pad separation, it is recommended that devices in plastic packages to be baked for 24 hours at 85°C.
- The leads on the photodiode SHOULD NOT BE FORMED. If your application requires lead spacing modification, please contact Advanced Photonix Applications group at Techsupport@advancedphotonix.com before forming a product's leads. Product warranties could be voided.
- Most devices are provided with wire or pin leads for installation in circuit boards or sockets. Observe the soldering temperatures and conditions specified below:
  - Soldering Iron: Soldering 30 W or less
  - Temperature at tip of iron 300°C or lower.
  - Dip Soldering: Bath Temperature: 260±5°C.
  - Immersion Time: within 5 Sec.
  - Soldering Time: within 3 Sec.
  - Vapor Phase Soldering, Reflow Soldering: DO NOT USE

Legal Disclaimer

Information in this data sheet is believed to be correct and reliable. However, no responsibility is assumed for possible inaccuracies or omission. Specifications are subject to change without notice.

Data sheet acquired from Harris Semiconductor
SCHS209C

February 1998 - Revised July 2003

CD74HC4067, CD74HCT4067

High-Speed CMOS Logic 16-Channel Analog Multiplexer/Demultiplexer

Features

- **Wide Analog Input Voltage Range**
- **Low "ON" Resistance**
  - **V_{CC} = 4.5V . . . . 70Ω (Typ)**
  - **V_{CC} = 6V . . . . 60Ω (Typ)**
- **Fast Switching and Propagation Speeds**
- **"Break-Before-Make" Switching. . . . . 6ns (Typ) at 4.5V**
- **Available in Both Narrow and Wide-Body Plastic Packages**
- **Fanout (Over Temperature Range)**
  - **Standard Outputs . . . . 10 LSTTL Loads**
  - **Bus Driver Outputs . . . . 15 LSTTL Loads**
- **Wide Operating Temperature Range . . . -55°C to 125°C**
- **Balanced Propagation Delay and Transition Times**
- **Significant Power Reduction Compared to LSTTL Logic ICs**
- **HC Types**
  - **2V to 6V Operation**
  - **High Noise Immunity: N_{IL} = 30%, N_{IH} = 30% of V_{CC} at V_{CC} = 5V**
- **HCT Types**
  - **4.5V to 5.5V Operation**
  - **Direct LSTTL Input Logic Compatibility, V_{IL}= 0.8V (Max), V_{IH} = 2V (Min)**
  - **CMOS Input Compatibility, $I_I \leq 1\mu A$ at V_{OL}, V_{OH}**

Description

The CD74HC4067 and CD74HCT4067 devices are digitally controlled analog switches that utilize silicon-gate CMOS technology to achieve operating speeds similar to LSTTL, with the low power consumption of standard CMOS integrated circuits.

These analog multiplexers/demultiplexers control analog voltages that may vary across the voltage supply range. They are bidirectional switches thus allowing any analog input to be used as an output and vice-versa. The switches have low "on" resistance and low "off" leakages. In addition, these devices have an enable control which when high will disable all switches to their "off" state.

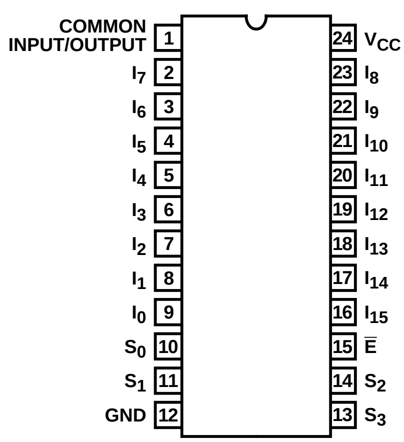
Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD74HC4067E	-55 to 125	24 Ld PDIP
CD74HC4067M	-55 to 125	24 Ld SOIC
CD74HC4067M96	-55 to 125	24 Ld SOIC
CD74HC4067SM96	-55 to 125	24 Ld SSOP
CD74HCT4067M	-55 to 125	24 Ld SOIC

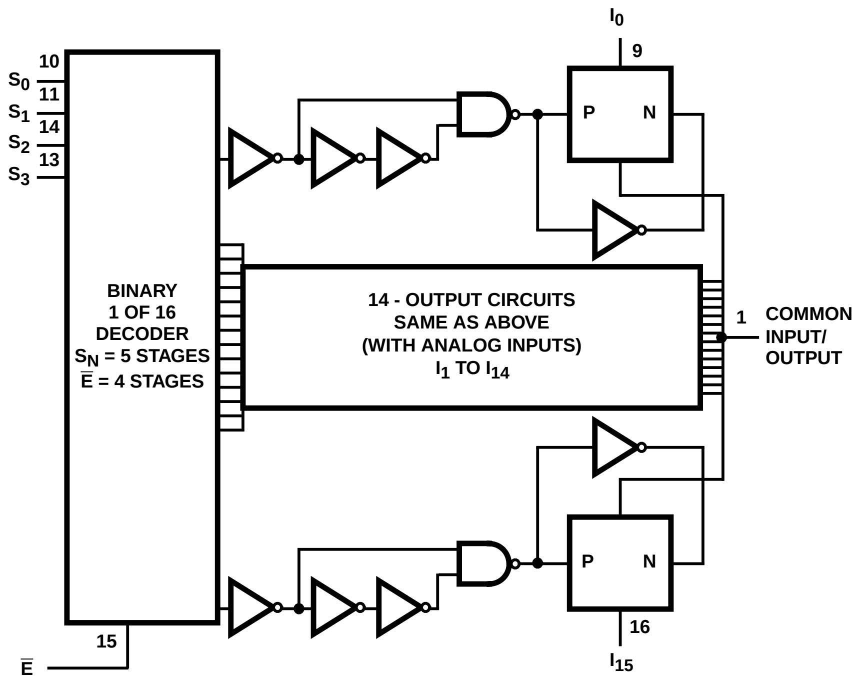
NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel.

Pinout

CD74HC4067 (PDIP, SOIC, SSOP)
CD74HCT4067 (SOIC)
TOP VIEW



Functional Diagram



TRUTH TABLE

S0	S1	S2	S3	$\overline{E}$	SELECTED CHANNEL
X	X	X	X	1	None
0	0	0	0	0	0
1	0	0	0	0	1
0	1	0	0	0	2
1	1	0	0	0	3
0	0	1	0	0	4
1	0	1	0	0	5
0	1	1	0	0	6
1	1	1	0	0	7
0	0	0	1	0	8
1	0	0	1	0	9
0	1	0	1	0	10
1	1	0	1	0	11
0	0	1	1	0	12
1	0	1	1	0	13
0	1	1	1	0	14
1	1	1	1	0	15

H= High Level
L= Low Level
X= Don’t Care

Absolute Maximum Ratings

DC Supply Voltage, V_{CC}
(Voltages Referenced to Ground) . . . . -0.5V to 7V
DC Input Diode Current, I_{IK}
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ . . . . ±20mA
DC Drain Current, I_O
For $-0.5V < V_O < V_{CC} + 0.5V$ . . . . ±25mA
DC Output Diode Current, I_{OK}
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ . . . . ±20mA
DC Output Source or Sink Current per Output Pin, I_O
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ . . . . ±25mA
DC V_{CC} or Ground Current, I_{CC} . . . . ±50mA

Operating Conditions

Temperature Range, T_A . . . . -55°C to 125°C
Supply Voltage Range, V_{CC}
HC Types . . . . .2V to 6V
HCT Types . . . . .4.5V to 5.5V
DC Input or Output Voltage, V_I, V_O . . . . 0V to V_{CC}
Input Rise and Fall Time
2V . . . . 1000ns (Max)
4.5V. . . . . 500ns (Max)
6V . . . . 400ns (Max)

Thermal Information

Thermal Resistance (Typical) θ_{JA} (°C/W)
E (PDIP) Package, Note 1 67
M (SOIC) Package, Note 2 46
SM (SSOP) Package, Note 2. 63
Maximum Junction Temperature (Plastic Package) . . . . 150°C
Maximum Storage Temperature Range . . . .-65°C to 150°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. The package thermal impedance is calculated in accordance with JESD 51-3.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V_I (V)	V_{IS} (V)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES												
High Level Input Voltage	V_{IH}	-	-	2	1.5	-	-	1.5	-	1.5	-	V
				4.5	3.15	-	-	3.15	-	3.15	-	V
				6	4.2	-	-	4.2	-	4.2	-	V
Low Level Input Voltage	V_{IL}	-	-	2	-	-	0.5	-	0.5	-	0.5	V
				4.5	-	-	1.35	-	1.35	-	1.35	V
				6	-	-	1.8	-	1.8	-	1.8	V
Maximum "ON" Resistance I_O = 1mA	R_{ON}	V_{CC} or GND	V_{CC} or GND	4.5	-	70	160	-	200	-	240	Ω
				6	-	60	140	-	175	-	210	Ω
		V_{CC} to GND	V_{CC} to GND	4.5	-	90	180	-	225	-	270	Ω
				6	-	80	160	-	200	-	240	Ω
Maximum "ON" Resistance Between Any Two Switches	ΔR_{ON}	-	-	4.5	-	10	-	-	-	-	-	Ω
				6	-	8.5	-	-	-	-	-	Ω
Switch "Off" Leakage Current 16 Channels	I_{IZ}	$\overline{E} = V_{CC}$	V_{CC} or GND	6	-	-	±0.8	-	±8	-	±8	µA
Logic Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	±0.1	-	±1	-	±1	µA

DC Electrical Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS V_I (V)	TEST CONDITIONS V_{IS} (V)	V_{CC} (V)	25°C MIN	25°C TYP	25°C MAX	-40°C TO 85°C MIN	-40°C TO 85°C MAX	-55°C TO 125°C MIN	-55°C TO 125°C MAX	UNITS
Quiescent Device Current I_O = 0mA	I_{CC}	V_{CC} or GND	-	6	-	-	8	-	80	-	160	µA
HCT TYPES												
High Level Input Voltage	V_{IH}	-	-	4.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V_{IL}	-	-	4.5	-	-	0.8	-	0.8	-	0.8	V
Maximum "ON" Resistance I_O = 1mA	R_{ON}	V_{CC} or GND	V_{CC} or GND	4.5	-	70	160	-	200	-	240	Ω
		V_{CC} to GND	V_{CC} to GND	4.5	-	90	180	-	225	-	270	Ω
Maximum "ON" Resistance Between Any Two Switches	ΔR_{ON}	-	-	4.5	-	10	-	-	-	-	-	Ω
Switch "Off" Leakage Current 16 Channels	I_{IZ}	$\overline{E}$ = V_{CC}	V_{CC} or GND	6	-	-	±0.8	-	±8	-	±8	µA
Logic Input Leakage Current	I_I	V_{CC} or GND (Note 3)	-	6	-	-	±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	-	6	-	-	8	-	80	-	160	µA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI_{CC} (Note 4)	V_{CC} -2.1	-	-	-	100	360	-	450	-	490	µA

NOTES:

3. Any voltage between V_{CC} and GND.
4. For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

INPUT	UNIT LOAD
S_0 - S_3	0.5
$\overline{E}$	0.3

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Specifications table, e.g., 360µA max at 25°C.

Switching Specifications Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C MIN	25°C TYP	25°C MAX	-40°C TO 85°C MIN	-40°C TO 85°C MAX	-55°C TO 125°C MIN	-55°C TO 125°C MAX	UNITS
HC TYPES											
Propagation Delay Time Switch In to Out	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
		C_L = 15pF	5	-	6	-	-	-	-	-	ns

Switching Specifications Input t_r, t_f = 6ns **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C MIN	25°C TYP	25°C MAX	-40°C TO 85°C MIN	-40°C TO 85°C MAX	-55°C TO 125°C MIN	-55°C TO 125°C MAX	UNITS
Switch Turn On $\overline{E}$ to Out	t_{PZH}, t_{PZL}	C_L = 50pF	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	69	-	83	ns
			6	-	-	47	-	59	-	71	ns
		C_L = 15pF	5	-	23	-	-	-	-	-	ns
Switch Turn On Sn to Out	t_{PZH}, t_{PZL}	C_L = 50pF	2	-	-	300	-	375	-	450	ns
			4.5	-	-	60	-	75	-	90	ns
			6	-	-	51	-	64	-	76	ns
		C_L = 15pF	5	-	25	-	-	-	-	-	ns
Switch Turn Off $\overline{E}$ to Out	t_{PHZ}, t_{PLZ}	C_L = 50pF	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	69	-	83	ns
			6	-	-	47	-	59	-	71	ns
		C_L = 15pF	5	-	23	-	-	-	-	-	ns
Switch Turn Off Sn to Out	t_{PHZ}, t_{PLZ}	C_L = 50pF	2	-	-	290	-	365	-	435	ns
			4.5	-	-	58	-	73	-	87	ns
			6	-	-	49	-	62	-	74	ns
		C_L = 50pF	5	-	21	-	-	-	-	-	ns
Input (Control) Capacitance	C_I	-	-	-	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 5, 6)	C_{PD}	-	5	-	93	-	-	-	-	-	pF
HCT TYPES											
Propagation Delay Time Switch In to Out	t_{PLH}, t_{PHL}	C_L = 50pF	4.5	-	-	15	-	19	-	22	ns
		C_L = 15pF	5	-	6	-	-	-	-	-	ns
Switch Turn On $\overline{E}$ to Out	t_{PZH}, t_{PZL}	C_L = 50pF	4.5	-	-	60	-	75	-	90	ns
		C_L = 15pF	5	-	25	-	-	-	-	-	ns
Switch Turn On Sn to Out	t_{PZH}, t_{PZL}	C_L = 50pF	4.5	-	-	60	-	75	-	90	ns
		C_L = 15pF	5	-	25	-	-	-	-	-	ns
Switch Turn Off $\overline{E}$ to Out	t_{PHZ}, t_{PLZ}	C_L = 50pF	4.5	-	-	55	-	69	-	83	ns
		C_L = 15pF	5	-	23	-	-	-	-	-	ns
Switch Turn Off Sn to Out	t_{PHZ}, t_{PLZ}	C_L = 50pF	4.5	-	-	58	-	73	-	87	ns
		C_L = 15pF	5	-	21	-	-	-	-	-	ns
Input (Control) Capacitance	C_I	-	-	-	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 5, 6)	C_{PD}	-	5	-	96	-	-	-	-	-	pF

NOTES:

5. C_{PD} is used to determine the dynamic power consumption, per package.
6. $P_D = C_{PD} V_{CC}^2 f_i + \Sigma (C_L + C_S) V_{CC}^2 f_o$ where f_i = input frequency, f_o = output frequency, C_L = output load capacitance, C_S = switch capacitance, V_{CC} = supply voltage.

Analog Channel Specifications $T_A = 25^oC$

PARAMETER	TEST CONDITIONS	V_{CC} (V)	HC/HCT	UNITS
Switch Frequency Response Bandwidth at -3dB (Figure 2)	Figure 4, Notes 7, 8	4.5	89	MHz
Sine Wave Distortion	Figure 5	4.5	0.051	%
Feedthrough Noise $\overline{E}$ to Switch	Figure 6, Notes 8, 9	4.5	TBE	mV
Feedthrough Noise S to Switch			TBE	mV
Switch "OFF" Signal Feedthrough (Figure 3)	Figure 7	4.5	-75	dB
Switch Input Capacitance, C_S		-	5	pF
Common Capacitance, C_{COM}		-	50	pF

NOTES:

7. Adjust input level for 0dBm at output, f = 1MHz.
8. V_{IS} is centered at $V_{CC}/2$.
9. Adjust input for 0dBm at V_{IS}.

Typical Performance Curves

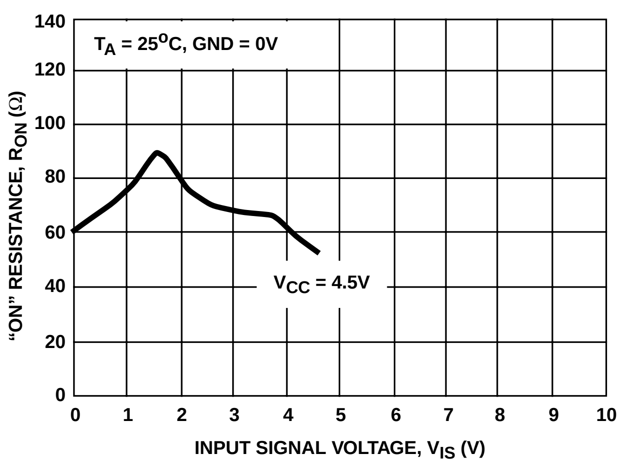


FIGURE 1. TYPICAL "ON" RESISTANCE vs INPUT SIGNAL VOLTAGE

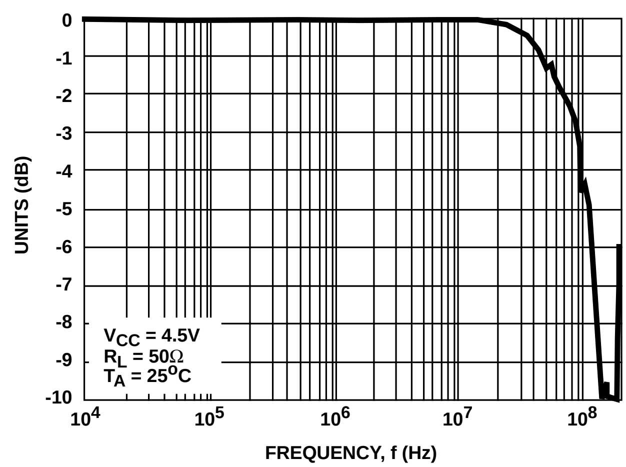


FIGURE 2. TYPICAL SWITCH FREQUENCY RESPONSE

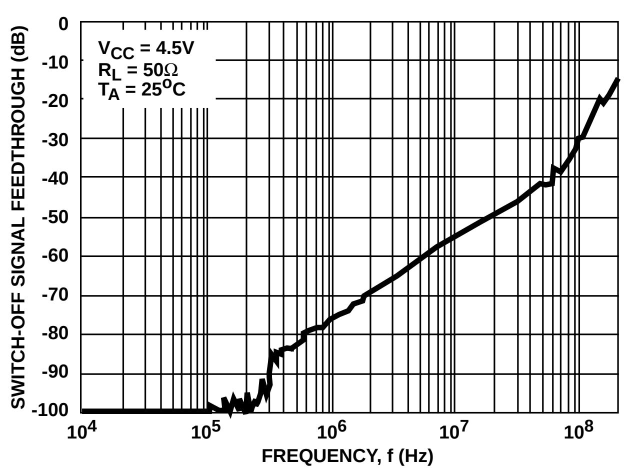


FIGURE 3. TYPICAL SWITCH-OFF SIGNAL FEEDTHROUGH vs FREQUENCY

Analog Test Circuits

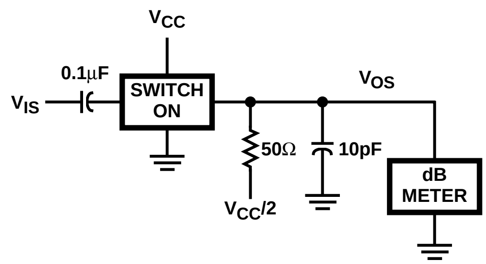


FIGURE 4. FREQUENCY RESPONSE TEST CIRCUIT

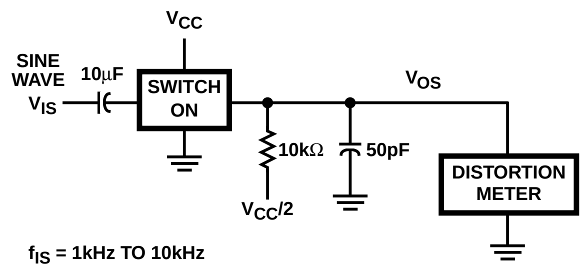


FIGURE 5. SINE WAVE DISTORTION TEST CIRCUIT

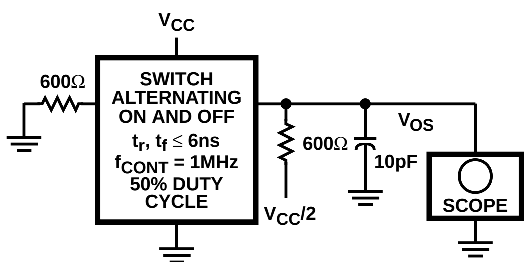


FIGURE 6. CONTROL-TO-SWITCH FEEDTHROUGH NOISE TEST CIRCUIT

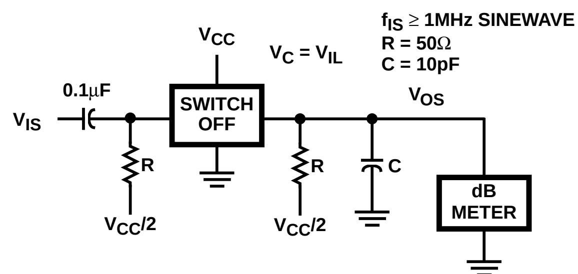


FIGURE 7. SWITCH OFF SIGNAL FEEDTHROUGH TEST CIRCUIT

Test Circuits and Waveforms

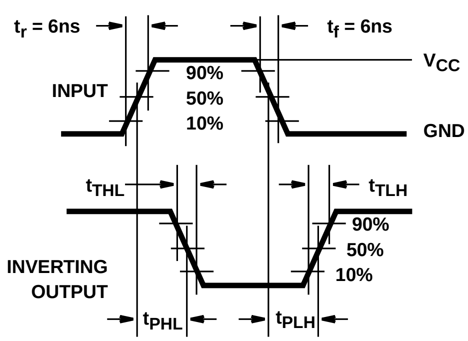


FIGURE 8. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

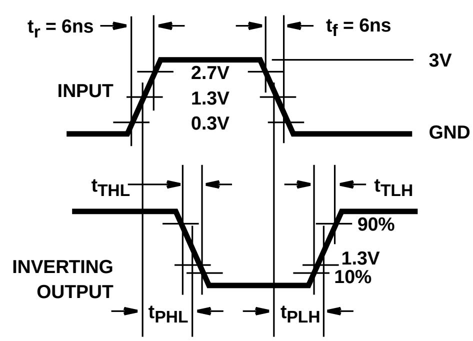


FIGURE 9. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD74HC4067M	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067M96	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067M96E4	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067M96G4	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067MG4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067SM96	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HP4067	Samples
CD74HC4067SM96E4	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HP4067	Samples
CD74HC4067SM96G4	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HP4067	Samples
CD74HCT4067M	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT4067M	Samples
CD74HCT4067ME4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT4067M	Samples
CD74HCT4067MG4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT4067M	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

[4] There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

[5] Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

[6] Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

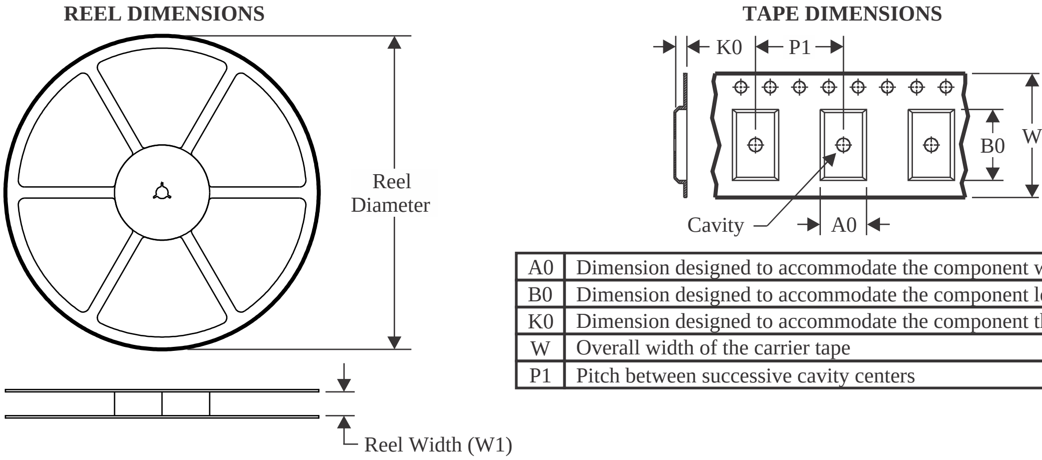
OTHER QUALIFIED VERSIONS OF CD74HCT4067 :

- Automotive : CD74HCT4067-Q1

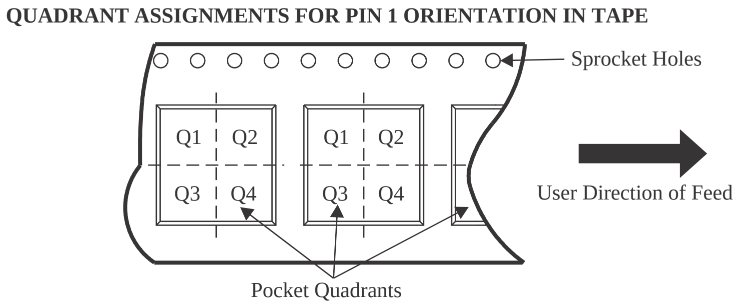
NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION



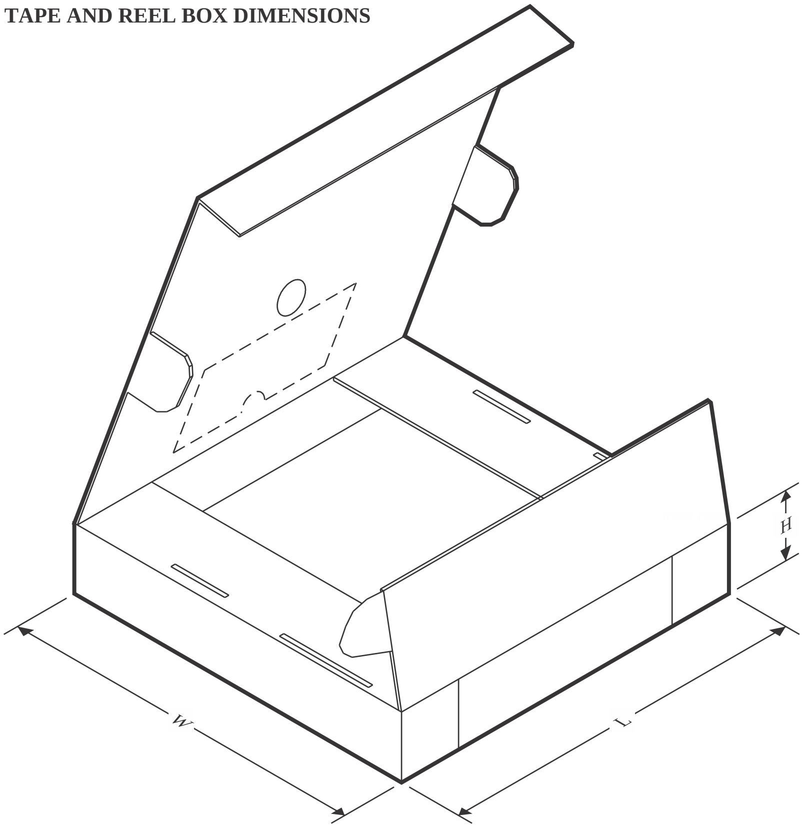
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74HC4067M96	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CD74HC4067M96	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CD74HC4067M96G4	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CD74HC4067SM96	SSOP	DB	24	2000	330.0	16.4	8.2	8.8	2.5	12.0	16.0	Q1

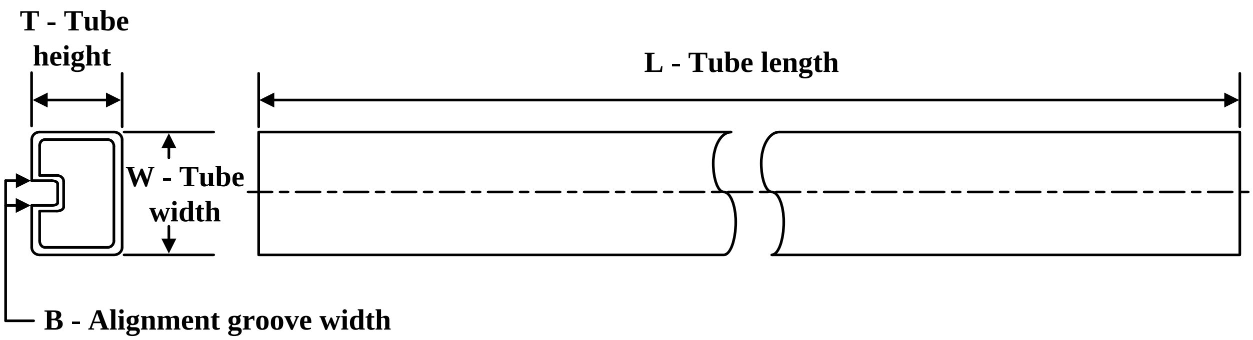
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HC4067M96	SOIC	DW	24	2000	364.0	361.0	36.0
CD74HC4067M96	SOIC	DW	24	2000	350.0	350.0	43.0
CD74HC4067M96G4	SOIC	DW	24	2000	350.0	350.0	43.0
CD74HC4067SM96	SSOP	DB	24	2000	356.0	356.0	35.0

TUBE

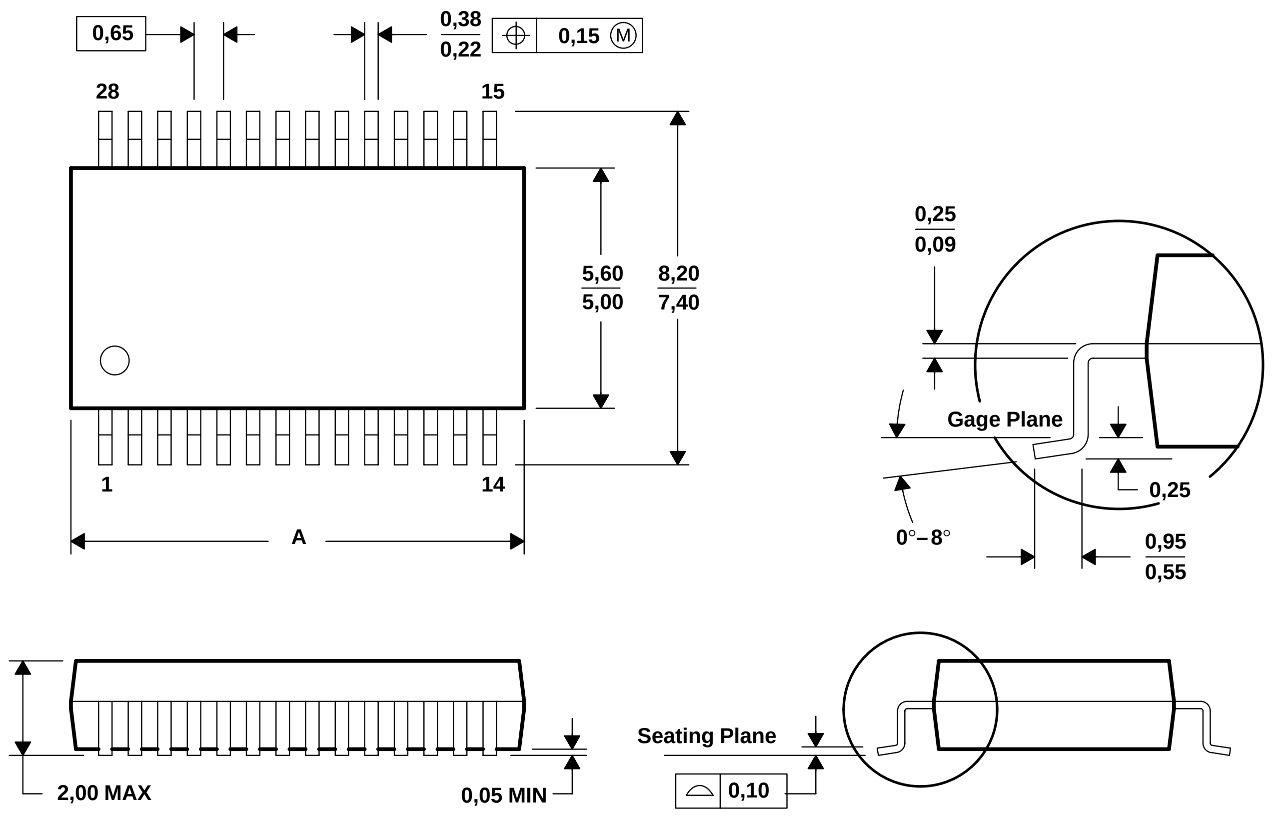


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD74HC4067M	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HC4067MG4	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HCT4067M	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HCT4067ME4	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HCT4067MG4	DW	SOIC	24	25	506.98	12.7	4826	6.6

DB (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN

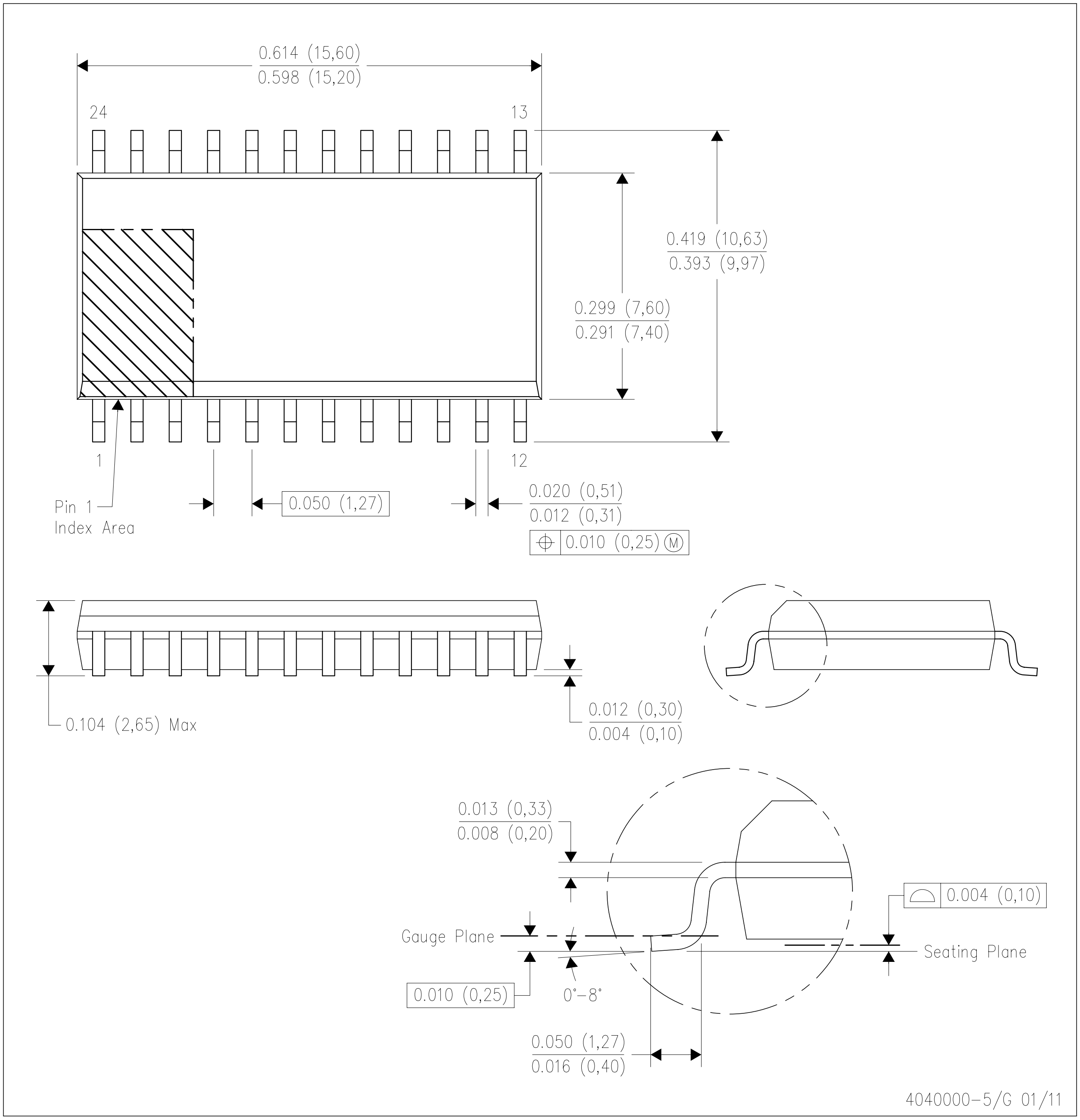


DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

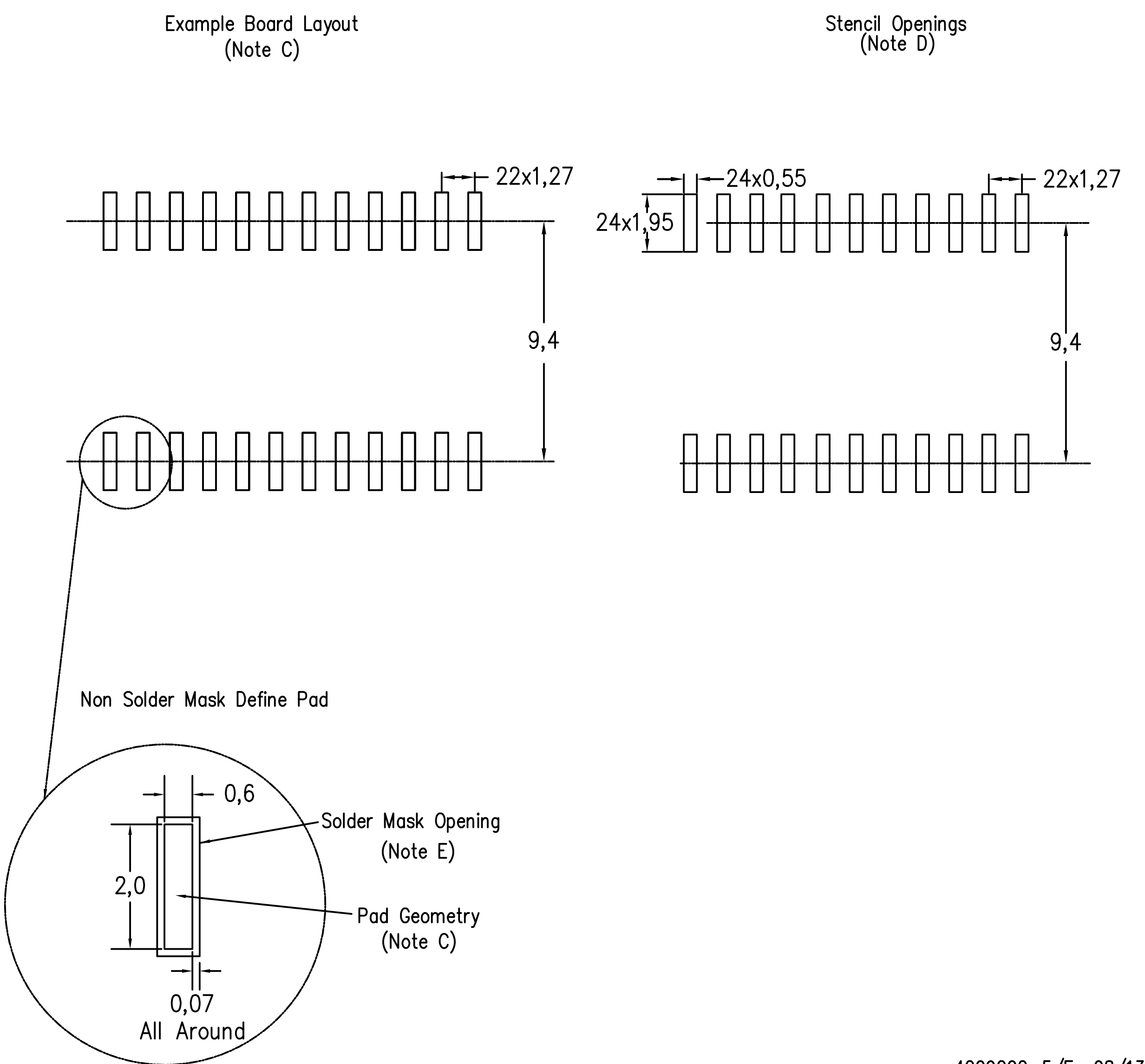
NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
- D. Falls within JEDEC MO-150

DW (R-PDSO-G24) PLASTIC SMALL OUTLINE



NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
- D. Falls within JEDEC MS-013 variation AD.

DW (R–PDSO–G24) PLASTIC SMALL OUTLINE



4209202–5/F 08/13

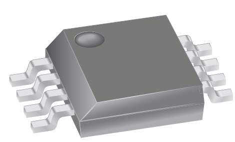
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Refer to IPC7351 for alternate board design.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

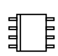
Fully Integrated, Hall Effect-Based Linear Current Sensor with 2.1 kVRMS Voltage Isolation and a Low-Resistance Current Conductor

Features and Benefits

- Low-noise analog signal path
- Device bandwidth is set via the new FILTER pin
- 5 µs output rise time in response to step input current
- 50 kHz bandwidth
- Total output error 1.5% at T_A= 25°C, and 4% at –40°C to 85°C
- Small footprint, low-profile SOIC8 package
- 1.2 mΩ internal conductor resistance
- 2.1 kV_{RMS} minimum isolation voltage from pins 1-4 to pins 5-8
- 5.0 V, single supply operation
- 66 to 185 mV/A output sensitivity
- Output voltage proportional to AC or DC currents
- Factory-trimmed for accuracy
- Extremely stable output offset voltage
- Nearly zero magnetic hysteresis
- Ratiometric output from supply voltage

Package: 8 pin SOIC (suffix LC)



Approximate Scale 1:1 

Description

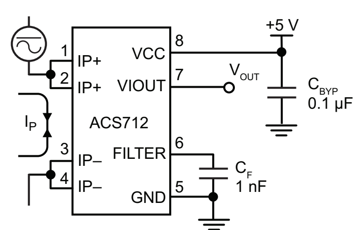
The Allegro® ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, automotive, commercial, and communications systems. The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switched-mode power supplies, and overcurrent fault protection.

The device consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilized BiCMOS Hall IC, which is programmed for accuracy after packaging.

The output of the device has a positive slope (>$V_{IOUT(Q)}$) when an increasing current flows through the primary copper conduction path (from pins 1 and 2, to pins 3 and 4), which is the path used for current sensing. The internal resistance of this conductive path is 1.2 mΩ typical, providing low power

Continued on the next page…

Typical Application



Application 1. The ACS712 outputs an analog signal, V_{OUT}. that varies linearly with the uni- or bi-directional AC or DC primary sensed current, I_P, within the range specified. C_F is recommended for noise management, with values that depend on the application.

Description (continued)

loss. The thickness of the copper conductor allows survival of the device at up to 5× overcurrent conditions. The terminals of the conductive path are electrically isolated from the sensor leads (pins 5 through 8). This allows the ACS712 current sensor to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques.

The ACS712 is provided in a small, surface mount SOIC8 package. The leadframe is plated with 100% matte tin, which is compatible with standard lead (Pb) free printed circuit board assembly processes. Internally, the device is Pb-free, except for flip-chip high-temperature Pb-based solder balls, currently exempt from RoHS. The device is fully calibrated prior to shipment from the factory.

Selection Guide

Part Number	Packing*	T_{OP} (°C)	Optimized Range, I_P (A)	Sensitivity, Sens (Typ) (mV/A)
ACS712ELCTR-05B-T	Tape and reel, 3000 pieces/reel	–40 to 85	±5	185
ACS712ELCTR-20A-T	Tape and reel, 3000 pieces/reel	–40 to 85	±20	100
ACS712ELCTR-30A-T	Tape and reel, 3000 pieces/reel	–40 to 85	±30	66

*Contact Allegro for additional packing options.

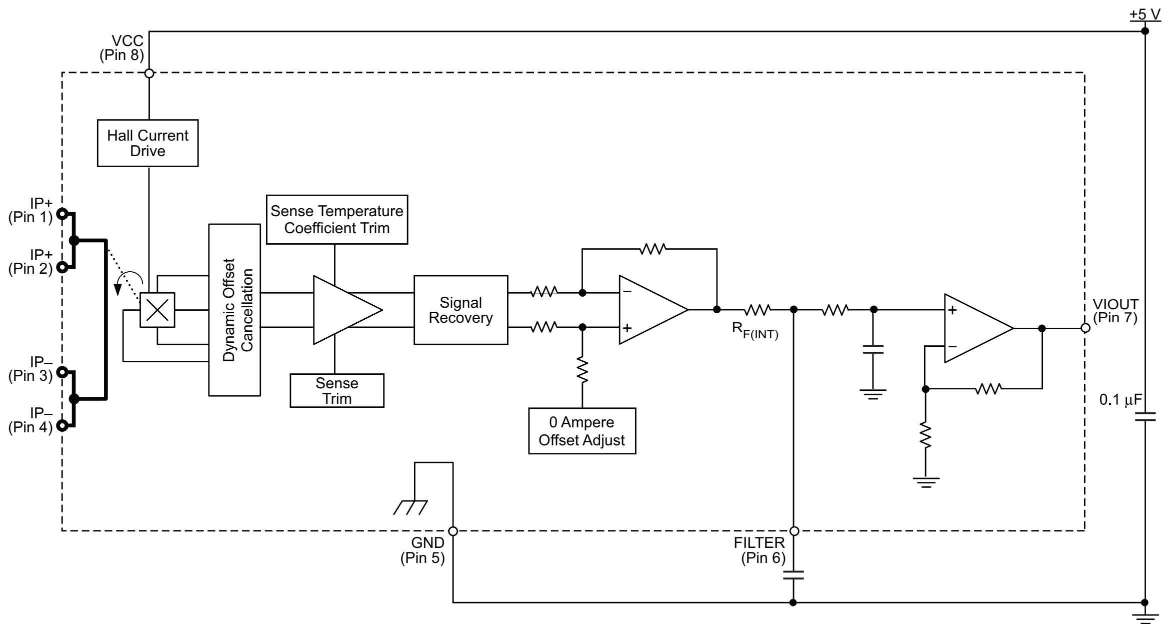
Absolute Maximum Ratings

Characteristic	Symbol	Notes	Rating	Units
Supply Voltage	V_{CC}		8	V
Reverse Supply Voltage	V_{RCC}		–0.1	V
Output Voltage	V_{IOUT}		8	V
Reverse Output Voltage	V_{RIOUT}		–0.1	V
Output Current Source	$I_{IOUT(Source)}$		3	mA
Output Current Sink	$I_{IOUT(Sink)}$		10	mA
Overcurrent Transient Tolerance	I_P	100 total pulses, 250 ms duration each, applied at a rate of 1 pulse every 100 seconds.	60	A
Maximum Transient Sensed Current	$I_R(max)$	Junction Temperature, $T_J < T_J(max)$	60	A
Nominal Operating Ambient Temperature	T_A	Range E	–40 to 85	ºC
Maximum Junction	$T_J(max)$		165	ºC
Storage Temperature	T_{stg}		–65 to 170	ºC

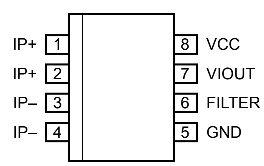
TÜV America
Certificate Number:
U8V 06 05 54214 010

Parameter	Specification
Fire and Electric Shock	CAN/CSA-C22.2 No. 60950-1-03 UL 60950-1:2003 EN 60950-1:2001

Functional Block Diagram



Pin-out Diagram



Terminal List Table

Number	Name	Description
1 and 2	IP+	Terminals for current being sensed; fused internally
3 and 4	IP–	Terminals for current being sensed; fused internally
5	GND	Signal ground terminal
6	FILTER	Terminal for external capacitor that sets bandwidth
7	VIOUT	Analog output signal
8	VCC	Device power supply terminal

COMMON OPERATING CHARACTERISTICS[1] over full range of T_{OP}, C_F = 1 nF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
ELECTRICAL CHARACTERISTICS						
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Supply Current	I_{CC}	V_{CC} = 5.0 V, output open	6	8	11	mA
Output Zener Clamp Voltage	V_Z	I_{CC} = 11 mA, T_A = 25°C	6	8.3	–	V
Output Resistance	R_{IOUT}	I_{IOUT} = 1.2 mA, T_A=25°C	–	1	2	Ω
Output Capacitance Load	C_{LOAD}	VIOUT to GND	–	–	10	nF
Output Resistive Load	R_{LOAD}	VIOUT to GND	4.7	–	–	kΩ
Primary Conductor Resistance	$R_{PRIMARY}$	T_A = 25°C	–	1.2	–	mΩ
RMS Isolation Voltage	V_{ISORMS}	Pins 1-4 and 5-8; 60 Hz, 1 minute, T_A=25°C	2100	–	–	V
DC Isolation Voltage	V_{ISODC}	Pins 1-4 and 5-8; 1 minute, T_A=25°C	–	5000	–	V
Propagation Time	t_{PROP}	I_P = I_P(max), T_A = 25°C, C_{OUT} = open	–	3	–	μs
Response Time	$t_{RESPONSE}$	I_P = I_P(max), T_A = 25°C, C_{OUT} = open	–	7	–	μs
Rise Time	t_r	I_P = I_P(max), T_A = 25°C, C_{OUT} = open	–	5	–	μs
Frequency Bandwidth	f	–3 dB, T_A = 25°C; I_P is 10 A peak-to-peak	50	–	–	kHz
Nonlinearity	E_{LIN}	Over full range of I_P	–	±1	±1.5	%
Symmetry	E_{SYM}	Over full range of I_P	98	100	102	%
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	V_{CC} × 0.5	–	V
Magnetic Offset Error	V_{ERROM}	I_P = 0 A, after excursion of 5 A	–	0	–	mV
Clamping Voltage	V_{CH}		Typ. –110	V_{CC} × 0.9375	Typ. +110	mV
	V_{CL}		Typ. –110	V_{CC} × 0.0625	Typ. +110	mV
Power-On Time	t_{PO}	Output reaches 90% of steady-state level, T_J = 25°C, 20 A present on leadframe	–	35	–	μs
Magnetic Coupling[2]			–	12	–	G/A
Internal Filter Resistance[3]	$R_{F(INT)}$			1.7		kΩ

[1]Device may be operated at higher primary current levels, I_P, and ambient, T_A, and internal leadframe temperatures, T_{OP}, provided that the Maximum Junction Temperature, T_J(max), is not exceeded.

[2]1G = 0.1 mT.

[3]$R_{F(INT)}$ forms an RC circuit via the FILTER pin.

COMMON THERMAL CHARACTERISTICS[1]

			Min.	Typ.	Max.	Units
Operating Internal Leadframe Temperature	T_{OP}	E range	–40	–	85	°C
					Value	Units
Junction-to-Lead Thermal Resistance[2]	$R_{\theta JL}$	Mounted on the Allegro ASEK 712 evaluation board			5	°C/W
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$	Mounted on the Allegro 85-0322 evaluation board, includes the power consumed by the board			23	°C/W

[1]Additional thermal information is available on the Allegro website.

[2]The Allegro evaluation board has 1500 mm^2 of 2 oz. copper on each side, connected to pins 1 and 2, and to pins 3 and 4, with thermal vias connecting the layers. Performance values include the power consumed by the PCB. Further details on the board are available from the Frequently Asked Questions document on our website. Further information about board design and thermal performance also can be found in the Applications Information section of this datasheet.

Allegro MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000
www.allegromicro.com

x05A PERFORMANCE CHARACTERISTICS T_{OP} = –40°C to 85°C[1], C_F = 1 nF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Optimized Accuracy Range	I_P		–5	–	5	A
Sensitivity[2]	$Sens_{TA}$	Over full range of I_P, T_A = 25°C	–	185	–	mV/A
	$Sens_{TOP}$	Over full range of I_P	178	–	193	mV/A
Noise	$V_{NOISE(PP)}$	Peak-to-peak, T_A= 25°C, 185 mV/A programmed Sensitivity, C_F=4.7 nF, C_{OUT} = open, 20 kHz bandwidth	–	45	–	mV
		Peak-to-peak, T_A = 25°C, 185 mV/A programmed Sensitivity, C_F = 47 nF, C_{OUT} = open, 2 kHz bandwidth	–	20	–	mV
		Peak-to-peak, T_A = 25°C, 185 mV/A programmed Sensitivity, C_F = 1 nF, C_{OUT} = open, 50 kHz bandwidth	–	75	–	mV
Electrical Offset Voltage	V_{OE}	I_P = 0 A	–40	–	40	mV
Total Output Error[3]	E_{TOT}	I_P =±5 A, T_A = 25°C	–	±1.5	–	%

[1]Device may be operated at higher primary current levels, I_P, and ambient temperatures, T_{OP}, provided that the Maximum Junction Temperature, $T_{J(max)}$, is not exceeded.
[2]At –40°C Sensitivity may shift as much 9% outside of the datasheet limits.
[3]Percentage of I_P, with I_P = 5 A. Output filtered.

x20A PERFORMANCE CHARACTERISTICS T_{OP} = –40°C to 85°C[1], C_F = 1 nF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Optimized Accuracy Range	I_P		–20	–	20	A
Sensitivity[2]	$Sens_{TA}$	Over full range of I_P, T_A = 25°C	–	100	–	mV/A
	$Sens_{TOP}$	Over full range of I_P	97	–	103	mV/A
Noise	$V_{NOISE(PP)}$	Peak-to-peak, T_A= 25°C, 100 mV/A programmed Sensitivity, C_F=4.7 nF, C_{OUT} = open, 20 kHz bandwidth	–	24	–	mV
		Peak-to-peak, T_A = 25°C, 100 mV/A programmed Sensitivity, C_F = 47 nF, C_{OUT} = open, 2 kHz bandwidth	–	10	–	mV
		Peak-to-peak, T_A = 25°C, 100 mV/A programmed Sensitivity, C_F = 1 nF, C_{OUT} = open, 50 kHz bandwidth	–	40	–	mV
Electrical Offset Voltage	V_{OE}	I_P = 0 A	–30	–	30	mV
Total Output Error[3]	E_{TOT}	I_P =±20 A, T_A = 25°C	–	±1.5	–	%

[1]Device may be operated at higher primary current levels, I_P, and ambient temperatures, T_{OP}, provided that the Maximum Junction Temperature, T_J(max), is not exceeded.
[2]At –40°C Sensitivity may shift as much 9% outside of the datasheet limits.
[3]Percentage of I_P, with I_P = 20 A. Output filtered.

x30A PERFORMANCE CHARACTERISTICS T_{OP} = –40°C to 85°C[1], C_F = 1 nF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Optimized Accuracy Range	I_P		–30	–	30	A
Sensitivity[2]	$Sens_{TA}$	Over full range of I_P, T_A = 25°C	–	66	–	mV/A
	$Sens_{TOP}$	Over full range of I_P	64	–	68	mV/A
Noise	$V_{NOISE(PP)}$	Peak-to-peak, T_A= 25°C, 66 mV/A programmed Sensitivity, C_F=4.7 nF, C_{OUT} = open, 20 kHz bandwidth	–	20	–	mV
		Peak-to-peak, T_A = 25°C, 66 mV/A programmed Sensitivity, C_F = 47 nF, C_{OUT} = open, 2 kHz bandwidth	–	7	–	mV
		Peak-to-peak, T_A = 25°C, 66 mV/A programmed Sensitivity, C_F = 1 nF, C_{OUT} = open, 50 kHz bandwidth	–	35	–	mV
Electrical Offset Voltage	V_{OE}	I_P = 0 A	–30	–	30	mV
Total Output Error[3]	E_{TOT}	I_P = ±30 A, T_A = 25°C	–	±1.5	–	%

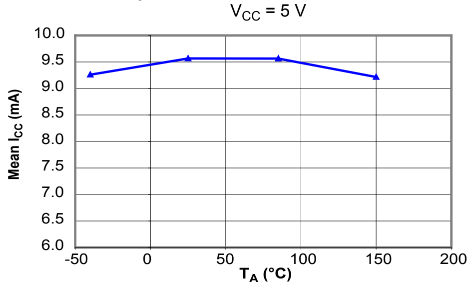
[1]Device may be operated at higher primary current levels, I_P, and ambient temperatures, T_{OP}, provided that the Maximum Junction Temperature, T_J(max), is not exceeded.
[2]At –40°C Sensitivity may shift as much 9% outside of the datasheet limits.
[3]Percentage of I_P, with I_P = 30 A. Output filtered.

Characteristic Performance

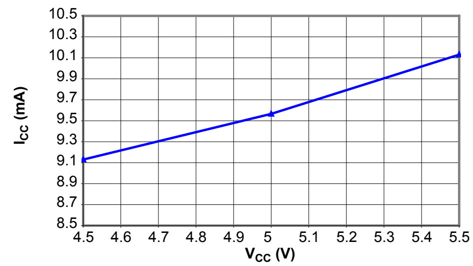
I_P = 5 A, Sens = 185 mV/A unless otherwise specified

Mean Supply Current versus Ambient Temperature

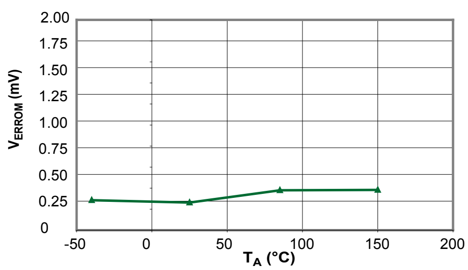
V_{CC} = 5 V



Supply Current versus Supply Voltage

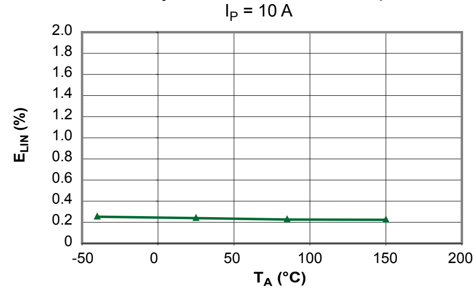


Magnetic Offset versus Ambient Temperature



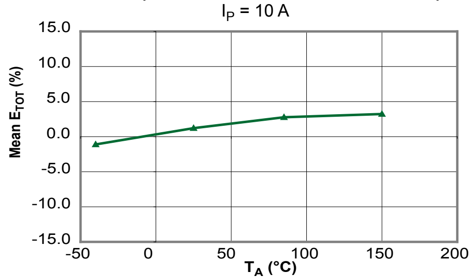
Nonlinearity versus Ambient Temperature

I_P = 10 A

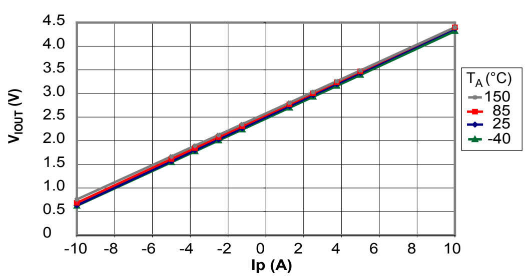


Mean Total Output Error versus Ambient Temperature

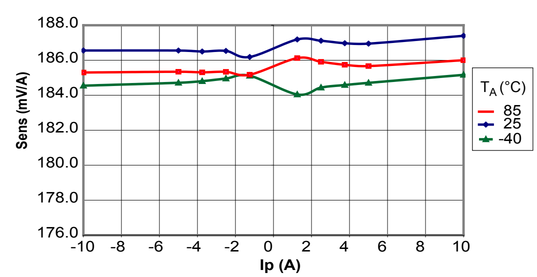
I_P = 10 A



Output Voltage versus Sensed Current



Sensitivity versus Sensed Current

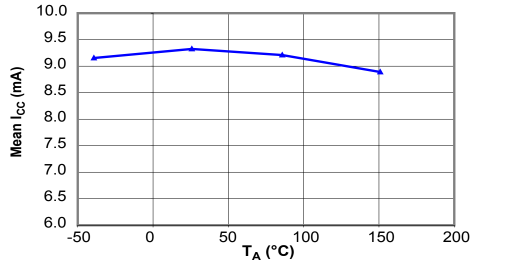


Characteristic Performance

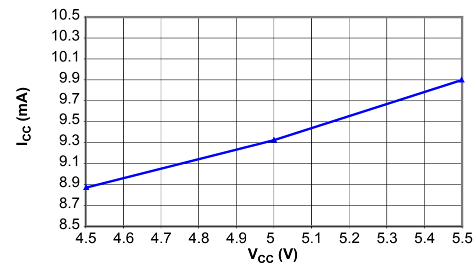
I_P = 30 A, Sens = 66 mV/A unless otherwise specified

Mean Supply Current versus Ambient Temperature

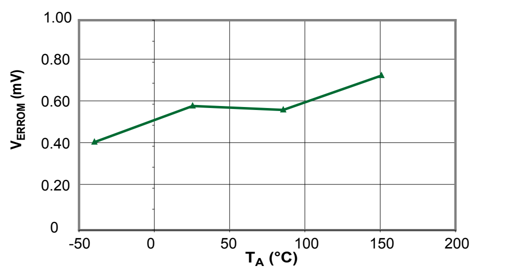
V_{CC} = 5 V



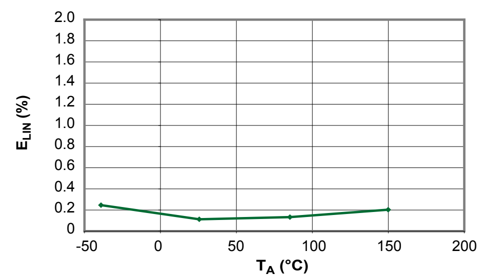
Supply Current versus Supply Voltage



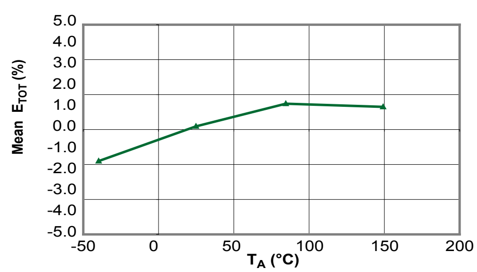
Magnetic Offset Current versus Ambient Temperature



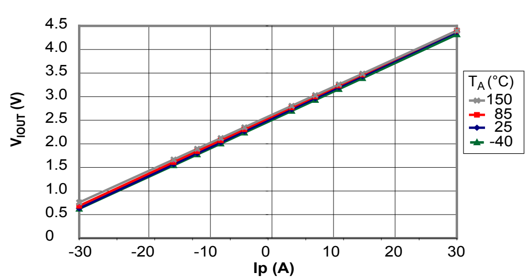
Nonlinearity versus Ambient Temperature



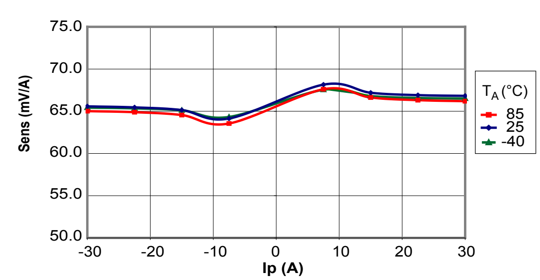
Mean Total Output Error versus Ambient Temperature



Output Voltage versus Sensed Current



Sensitivity versus Sensed Current



Allegro MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000
www.allegromicro.com

Definitions of Accuracy Characteristics

Sensitivity (Sens). The change in sensor output in response to a 1 A change through the primary conductor. The sensitivity is the product of the magnetic circuit sensitivity (G/A) and the linear IC amplifier gain (mV/G). The linear IC amplifier gain is programmed at the factory to optimize the sensitivity (mV/A) for the full-scale current of the device.

Noise (V_{NOISE}). The product of the linear IC amplifier gain (mV/G) and the noise floor for the Allegro Hall effect linear IC (≈1 G). The noise floor is derived from the thermal and shot noise observed in Hall elements. Dividing the noise (mV) by the sensitivity (mV/A) provides the smallest current that the device is able to resolve.

Linearity (E_{LIN}). The degree to which the voltage output from the sensor varies in direct proportion to the primary current through its full-scale amplitude. Nonlinearity in the output can be attributed to the saturation of the flux concentrator approaching the full-scale current. The following equation is used to derive the linearity:

$$100\left\{1-\left[\frac{\Delta \text{ gain} \times \% \text{ sat } (V_{IOUT\_full\text{-}scale\ amperes} - V_{IOUT(Q)})}{2\,(V_{IOUT\_half\text{-}scale\ amperes} - V_{IOUT(Q)})}\right]\right\}$$

where $V_{IOUT\_full\text{-}scale\ amperes}$ = the output voltage (V) when the sensed current approximates full-scale $\pm I_P$.

Symmetry (E_{SYM}). The degree to which the absolute voltage output from the sensor varies in proportion to either a positive or negative full-scale primary current. The following formula is used to derive symmetry:

$$100\left(\frac{V_{IOUT\_+\ full\text{-}scale\ amperes} - V_{IOUT(Q)}}{V_{IOUT(Q)} - V_{IOUT\_-full\text{-}scale\ amperes}}\right)$$

Quiescent output voltage ($V_{IOUT(Q)}$). The output of the sensor when the primary current is zero. For a unipolar supply voltage, it nominally remains at $V_{CC}/2$. Thus, V_{CC} = 5 V translates into $V_{IOUT(Q)}$ = 2.5 V. Variation in $V_{IOUT(Q)}$ can be attributed to the resolution of the Allegro linear IC quiescent voltage trim and thermal drift.

Electrical offset voltage (V_{OE}). The deviation of the device output from its ideal quiescent value of $V_{CC}/2$ due to nonmagnetic causes. To convert this voltage to amperes, divide by the device sensitivity, Sens.

Accuracy (E_{TOT}). The accuracy represents the maximum deviation of the actual output from its ideal value. This is also known as the total ouput error. The accuracy is illustrated graphically in the output voltage versus current chart at right.

Accuracy is divided into four areas:

- **0 A at 25°C.** Accuracy of sensing zero current flow at 25°C, without the effects of temperature.
- **0 A over Δ temperature.** Accuracy of sensing zero current flow including temperature effects.
- **Full-scale current at 25°C.** Accuracy of sensing the full-scale current at 25°C, without the effects of temperature.
- **Full-scale current over Δ temperature.** Accuracy of sensing full-scale current flow including temperature effects.

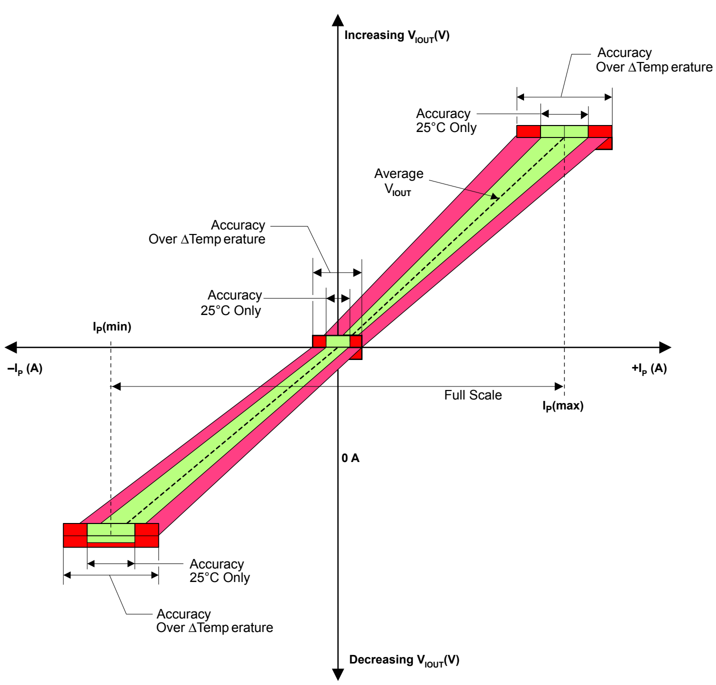
Ratiometry. The ratiometric feature means that its 0 A output, $V_{IOUT(Q)}$, (nominally equal to $V_{CC}/2$) and sensitivity, Sens, are proportional to its supply voltage, V_{CC}. The following formula is used to derive the ratiometric change in 0 A output voltage, $\Delta V_{IOUT(Q)RAT}$ (%).

$$100\left(\frac{V_{IOUT(Q)VCC} / V_{IOUT(Q)5V}}{V_{CC} / 5\text{ V}}\right)$$

The ratiometric change in sensitivity, $\Delta Sens_{RAT}$ (%), is defined as:

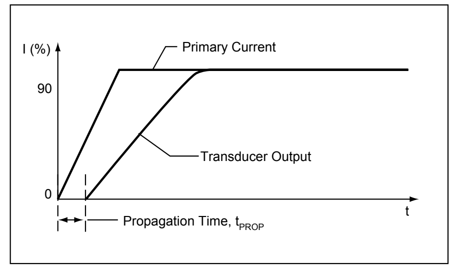
$$100\left(\frac{Sens_{VCC} / Sens_{5V}}{V_{CC} / 5\text{ V}}\right)$$

Output Voltage versus Sensed Current
Accuracy at 0 A and at Full-Scale Current

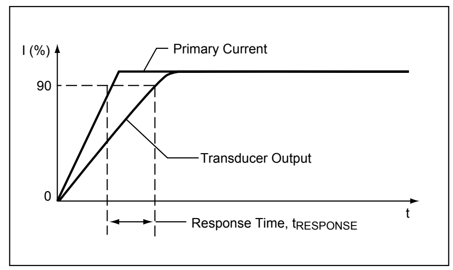


Definitions of Dynamic Response Characteristics

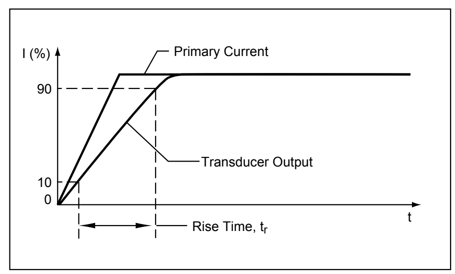
Propagation delay (t_{PROP}). The time required for the sensor output to reflect a change in the primary current signal. Propagation delay is attributed to inductive loading within the linear IC package, as well as in the inductive loop formed by the primary conductor geometry. Propagation delay can be considered as a fixed time offset and may be compensated.

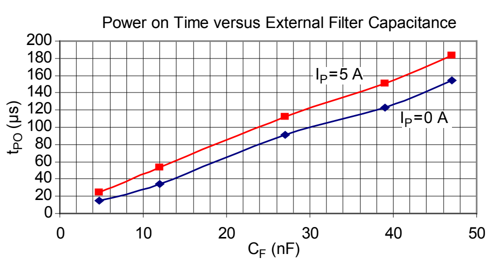


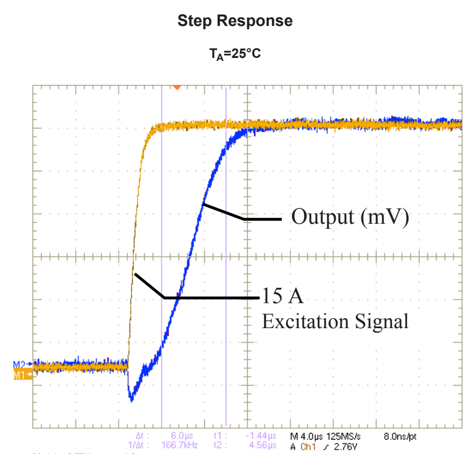
Response time ($t_{RESPONSE}$). The time interval between a) when the primary current signal reaches 90% of its final value, and b) when the sensor reaches 90% of its output corresponding to the applied current.

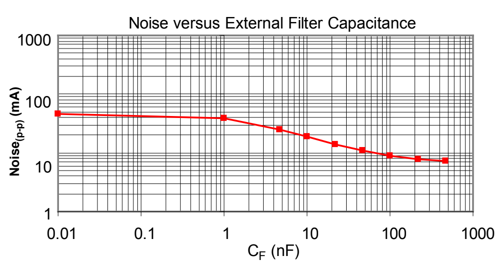


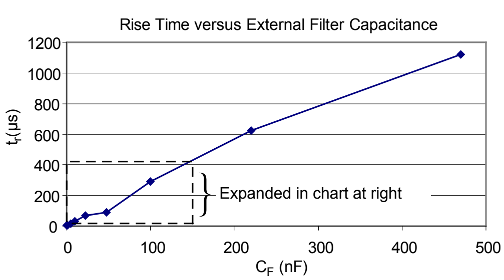
Rise time (t_r). The time interval between a) when the sensor reaches 10% of its full scale value, and b) when it reaches 90% of its full scale value. The rise time to a step response is used to derive the bandwidth of the current sensor, in which $f(-3\text{ dB}) = 0.35 / t_r$. Both t_r and $t_{RESPONSE}$ are detrimentally affected by eddy current losses observed in the conductive IC ground plane.



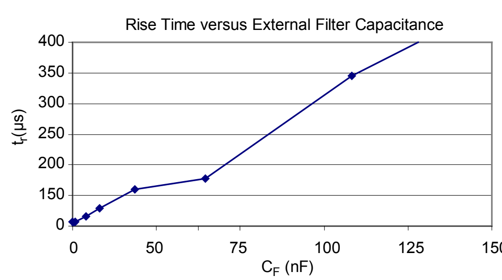








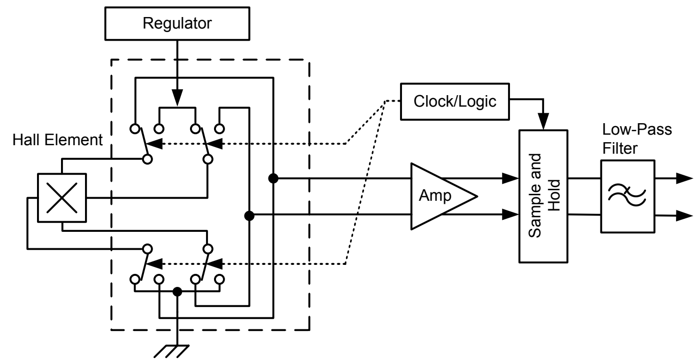
C_F (nF)	t_r (µs)
0	6.647
1	7.74
4.7	17.38
10	32.09087
22	68.15
47	88.18
100	291.26
220	623.02
470	1120



Chopper Stabilization Technique

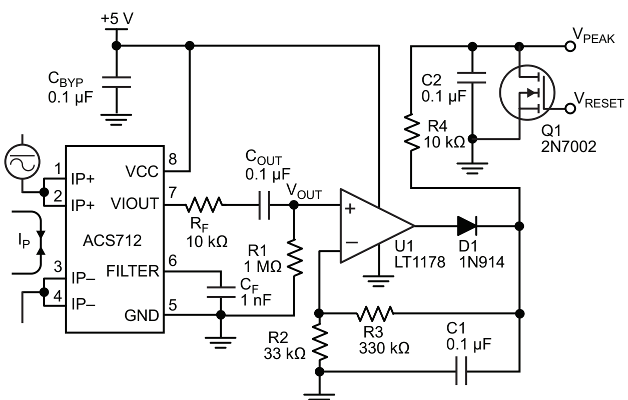
Chopper Stabilization is an innovative circuit technique that is used to minimize the offset voltage of a Hall element and an associated on-chip amplifier. Allegro patented a Chopper Stabilization technique that nearly eliminates Hall IC output drift induced by temperature or package stress effects. This offset reduction technique is based on a signal modulation-demodulation process. Modulation is used to separate the undesired dc offset signal from the magnetically induced signal in the frequency domain. Then, using a low-pass filter, the modulated dc offset is suppressed while the magnetically induced signal passes through the filter. As a result of this chopper stabilization approach, the output voltage from the Hall IC is desensitized to the effects of temperature and mechanical stress. This technique produces devices that have an extremely stable Electrical Offset Voltage, are immune to thermal stress, and have precise recoverability after temperature cycling.

This technique is made possible through the use of a BiCMOS process that allows the use of low-offset and low-noise amplifiers in combination with high-density logic integration and sample and hold circuits.

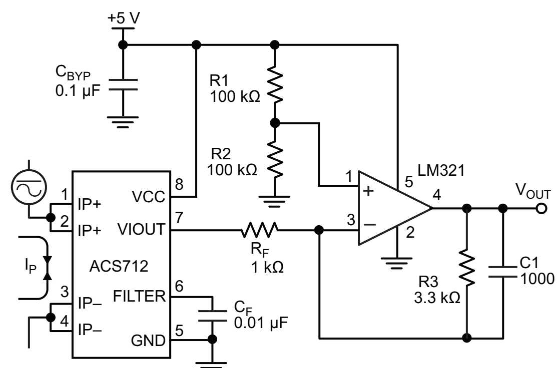


Concept of Chopper Stabilization Technique

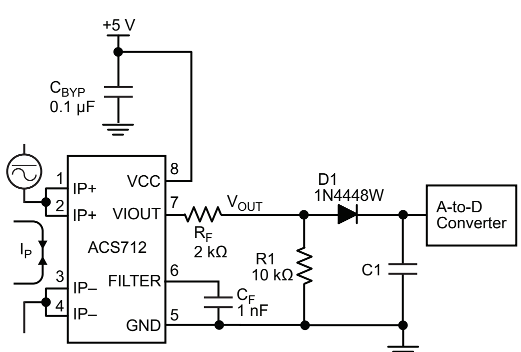
Typical Applications



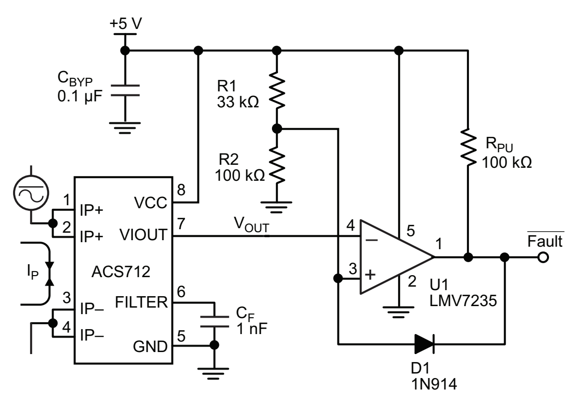
Application 2. Peak Detecting Circuit



Application 3. This configuration increases gain to 610 mV/A (tested using the ACS712ELC-05A).



Application 4. Rectified Output. 3.3 V scaling and rectification application for A-to-D converters. Replaces current transformer solutions with simpler ACS circuit. C1 is a function of the load resistance and filtering desired. R1 can be omitted if the full range is desired.



Application 5. 10 A Overcurrent Fault Latch. Fault threshold set by R1 and R2. This circuit latches an overcurrent fault and holds it until the 5 V rail is powered down.

Improving Sensing System Accuracy Using the FILTER Pin

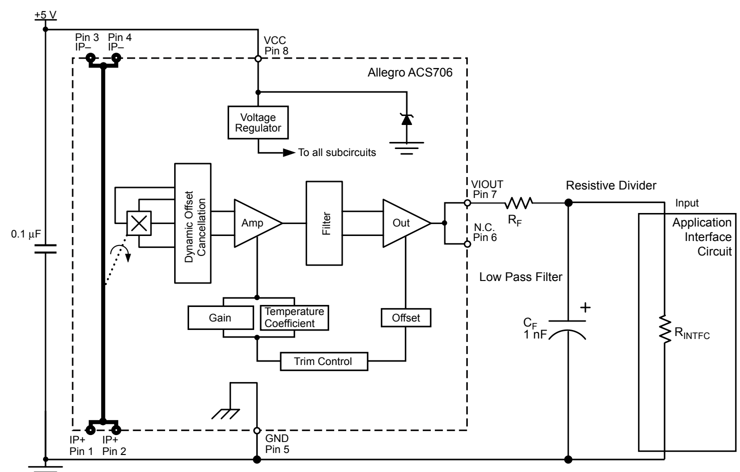
In low-frequency sensing applications, it is often advantageous to add a simple RC filter to the output of the sensor. Such a low-pass filter improves the signal-to-noise ratio, and therefore the resolution, of the sensor output signal. However, the addition of an RC filter to the output of a sensor IC can result in undesirable sensor output attenuation — even for dc signals.

Signal attenuation, ΔV_{ATT}, is a result of the resistive divider effect between the resistance of the external filter, R_F (see Application 6), and the input impedance and resistance of the customer interface circuit, R_{INTFC}. The transfer function of this resistive divider is given by:

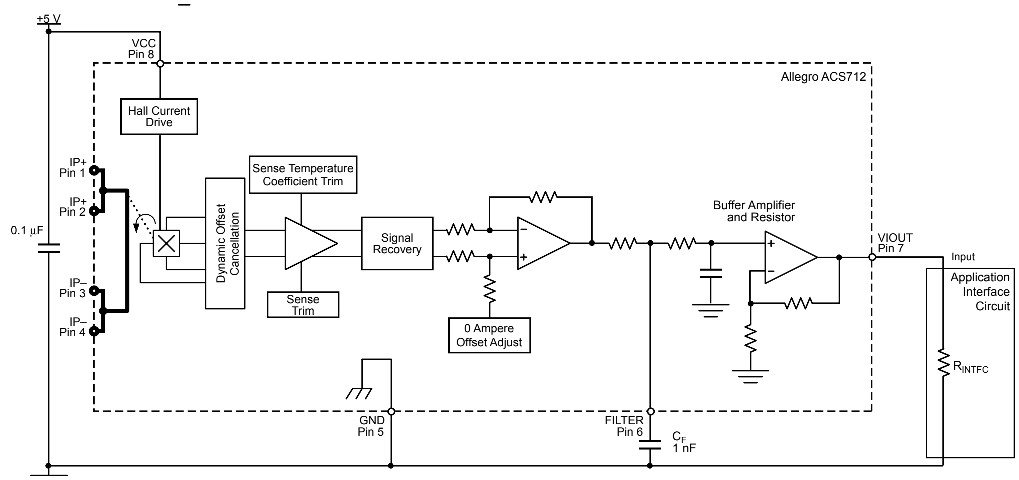
$$\Delta V_{ATT} = V_{IOUT}\left(\frac{R_{INTFC}}{R_F + R_{INTFC}}\right) .$$

Even if R_F and R_{INTFC} are designed to match, the two individual resistance values will most likely drift by different amounts over temperature. Therefore, signal attenuation will vary as a function of temperature. Note that, in many cases, the input impedance, R_{INTFC}, of a typical analog-to-digital converter (ADC) can be as low as 10 kΩ.

The ACS712 contains an internal resistor, a FILTER pin connection to the printed circuit board, and an internal buffer amplifier. With this circuit architecture, users can implement a simple RC filter via the addition of a capacitor, C_F (see Application 7) from the FILTER pin to ground. The buffer amplifier inside of the ACS712 (located after the internal resistor and FILTER pin connection) eliminates the attenuation caused by the resistive divider effect described in the equation for ΔV_{ATT}. Therefore, the ACS712 device is ideal for use in high-accuracy applications that cannot afford the signal attenuation associated with the use of an external RC low-pass filter.

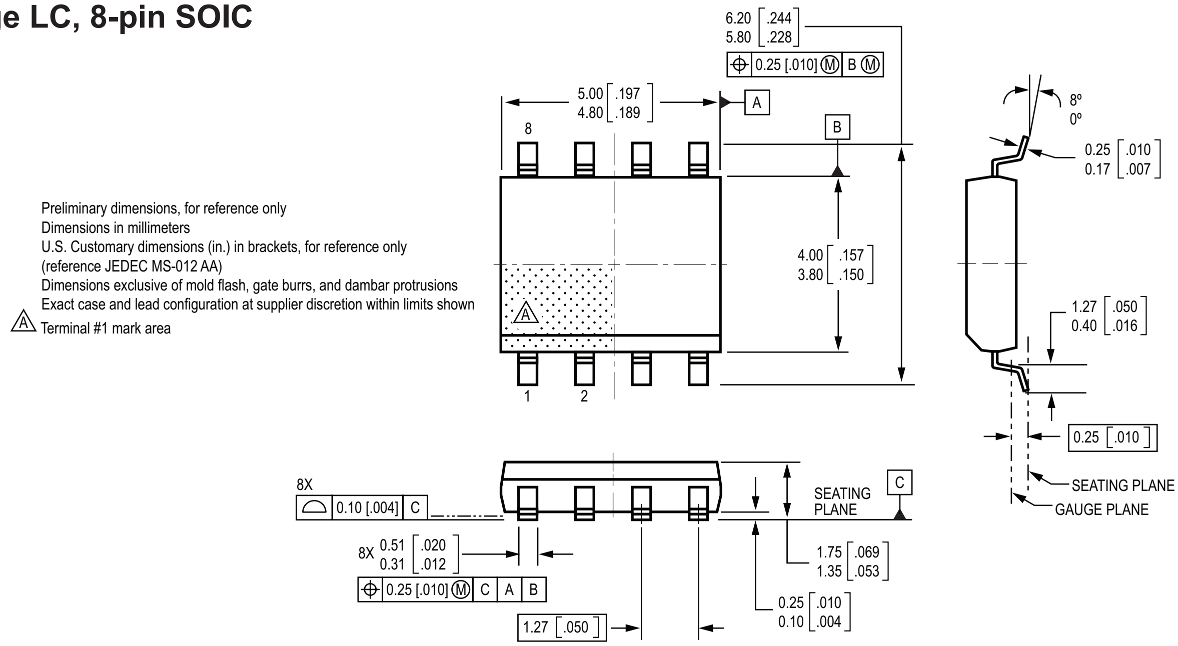


Application 6. When a low pass filter is constructed externally to a standard Hall effect device, a resistive divider may exist between the filter resistor, R_F, and the resistance of the customer interface circuit, R_{INTFC}. This resistive divider will cause excessive attenuation, as given by the transfer function for ΔV_{ATT}.



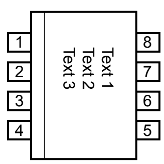
Application 7. Using the FILTER pin provided on the ACS712 eliminates the attenuation effects of the resistor divider between R_F and R_{INTFC}, shown in Application 6.

Package LC, 8-pin SOIC



Package Branding

Two alternative patterns are used



ACS712T *RLCPPP* *YYWWA*	ACS	Allegro Current Sensor
	712	Device family number
	T	Indicator of 100% matte tin leadframe plating
	R	Operating ambient temperature range code
	LC	Package type designator
	PPP	Primary sensed current
	YY	Date code: Calendar year (last two digits)
	WW	Date code: Calendar week
	A	Date code: Shift code

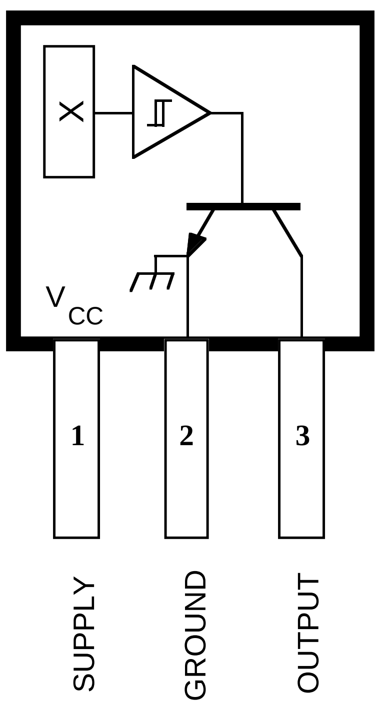
ACS712T *RLCPPP* *L...L* *YYWW*	ACS	Allegro Current Sensor
	712	Device family number
	T	Indicator of 100% matte tin leadframe plating
	R	Operating ambient temperature range code
	LC	Package type designator
	PPP	Primary sensed current
	L...L	Lot code
	YY	Date code: Calendar year (last two digits)
	WW	Date code: Calendar week

For the latest version of this document, go to our website at:
www.allegromicro.com

3141 THRU 3144

Data Sheet
27621.6B*

SENSITIVE HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION



Dwg. PH-003A

Pinning is shown viewed from branded side.

ABSOLUTE MAXIMUM RATINGS at T_A = +25°C

Supply Voltage, V_{CC} .... **28 V**

Reverse Battery Voltage, V_{RCC} .... **-35 V**

Magnetic Flux Density, B .... **Unlimited**

Output OFF Voltage, V_{OUT} .... **28 V**

Reverse Output Voltage, V_{OUT} .... **-0.5 V**

Continuous Output Current, I_{OUT} ...... **25 mA**

Operating Temperature Range, T_A

Suffix ‘E–’ .... **-40°C to +85°C**

Suffix ‘L–’ .... **-40°C to +150°C**

Storage Temperature Range,

T_S .... **-65°C to +170°C**

These Hall-effect switches are monolithic integrated circuits with tighter magnetic specifications, designed to operate continuously over extended temperatures to +150°C, and are more stable with both temperature and supply voltage changes. The unipolar switching characteristic makes these devices ideal for use with a simple bar or rod magnet. The four basic devices (3141, 3142, 3143, and 3144) are identical except for magnetic switch points.

Each device includes a voltage regulator for operation with supply voltages of 4.5 to 24 volts, reverse battery protection diode, quadratic Hall-voltage generator, temperature compensation circuitry, small-signal amplifier, Schmitt trigger, and an open-collector output to sink up to 25 mA. With suitable output pull up, they can be used with bipolar or CMOS logic circuits. The A3141– and A3142– are improved replacements for the UGN/UGS3140–; the A3144– is the improved replacement for the UGN/UGS3120–.

The first character of the part number suffix determines the device operating temperature range. Suffix ‘E–’ is for the automotive and industrial temperature range of -40°C to +85°C. Suffix ‘L–’ is for the automotive and military temperature range of -40°C to +150°C. Three package styles provide a magnetically optimized package for most applications. Suffix ‘–LT’ is a miniature SOT89/TO-243AA transistor package for surface-mount applications; suffix ‘–UA’ is a three-lead ultra-mini-SIP.

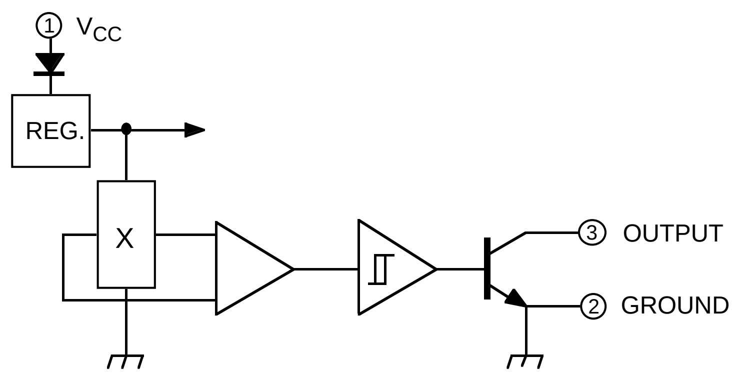
FEATURES and BENEFITS

- Superior Temp. Stability for Automotive or Industrial Applications
- 4.5 V to 24 V Operation … Needs Only An Unregulated Supply
- Open-Collector 25 mA Output … Compatible with Digital Logic
- Reverse Battery Protection
- Activate with Small, Commercially Available Permanent Magnets
- Solid-State Reliability
- Small Size
- Resistant to Physical Stress

Always order by complete part number, e.g., **A3141ELT** .

3141 THRU 3144
SENSITIVE HALL-EFFECT SWITCHES FOR HIGH-TEMP. OPERATION

FUNCTIONAL BLOCK DIAGRAM



Dwg. FH-005-2

ELECTRICAL CHARACTERISTICS at V_{CC} = 8 V over operating temperature range.

Characteristic	Symbol	Test Conditions	Limits Min.	Limits Typ.	Limits Max.	Units
Supply Voltage	V_{CC}	Operating	4.5	—	24	V
Output Saturation Voltage	$V_{OUT(SAT)}$	I_{OUT} = 20 mA, B > B_{OP}	—	175	400	mV
Output Leakage Current	I_{OFF}	V_{OUT} = 24 V, B < B_{RP}	—	<1.0	10	µA
Supply Current	I_{CC}	B < B_{RP} (Output OFF)	—	4.4	9.0	mA
Output Rise Time	t_r	R_L = 820 Ω, C_L = 20 pF	—	0.04	2.0	µs
Output Fall Time	t_f	R_L = 820 Ω, C_L = 20 pF	—	0.18	2.0	µs

MAGNETIC CHARACTERISTICS in gauss over operating supply voltage range.

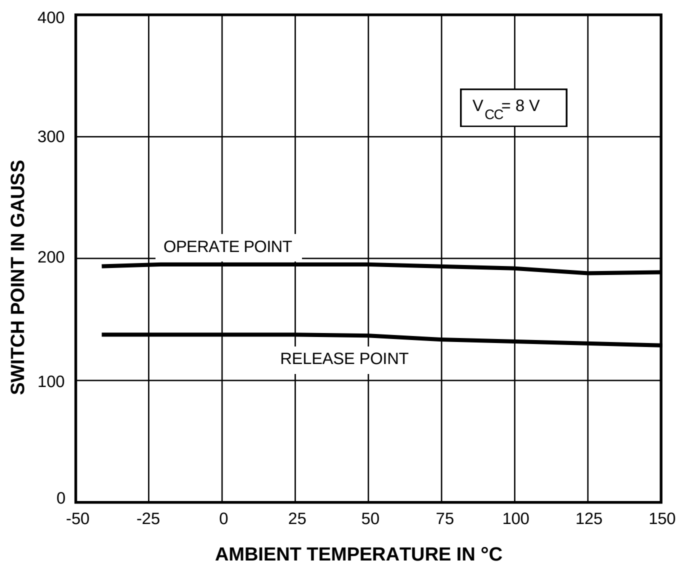
Characteristic		Part Numbers* A3141– Min.	Typ.	Max.	A3142– Min.	Typ.	Max.	A3143– Min.	Typ.	Max.	A3144– Min.	Typ.	Max.
B_{OP}	at T_A = 25°C	50	100	160	130	180	230	220	280	340	70	—	350
	over operating temp. range	30	100	175	115	180	245	205	280	355	35	—	450
B_{RP}	at T_A = 25°C	10	45	130	75	125	175	165	225	285	50	—	330
	over operating temp. range	10	45	145	60	125	190	150	225	300	25	—	430
B_{hys}	at T_A = 25°C	20	55	80	30	55	80	30	55	80	20	55	—
	over operating temp. range	20	55	80	30	55	80	30	55	80	20	55	—

NOTES: Typical values are at T_A = +25°C and V_{CC} = 8 V.
B_{OP} = operate point (output turns ON); B_{RP} = release point (output turns OFF); B_{hys} = hysteresis (B_{OP} - B_{RP}).
1 gauss (G) is exactly equal to 0.1 millitesla (mT).
*Complete part number includes a suffix to identify operating temperature range (E- or L-) and package type (-LT or -UA).

115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

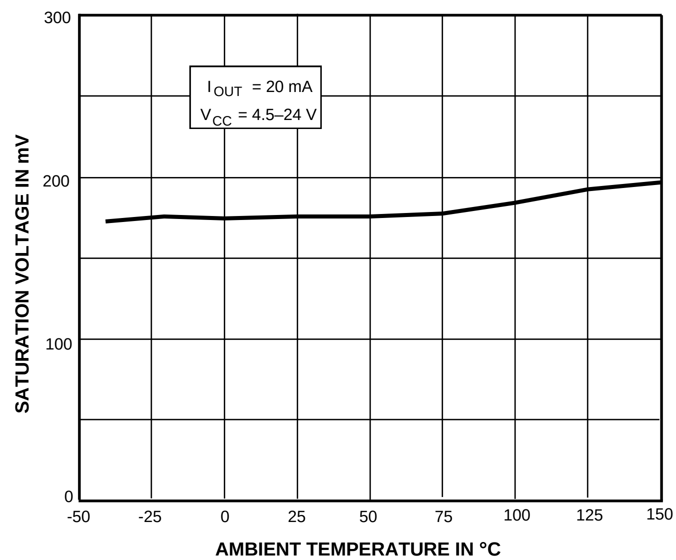
TYPICAL OPERATING CHARACTERISTICS

A3142– SWITCH POINTS



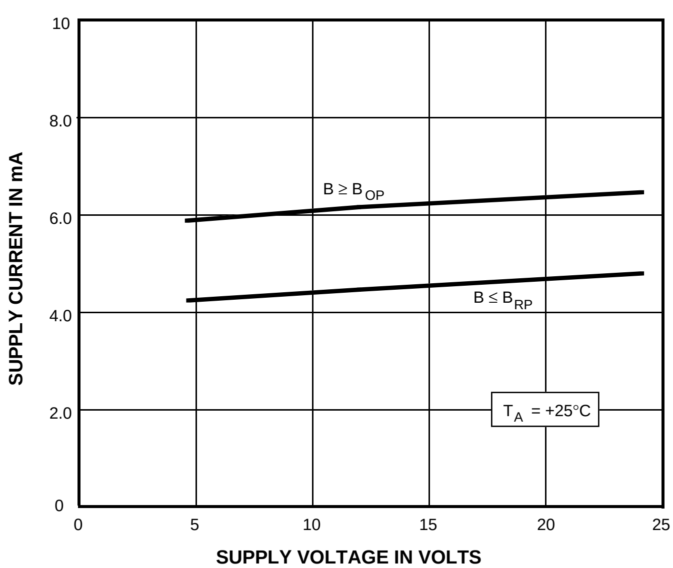
Dwg. GH-044

OUTPUT SATURATION VOLTAGE



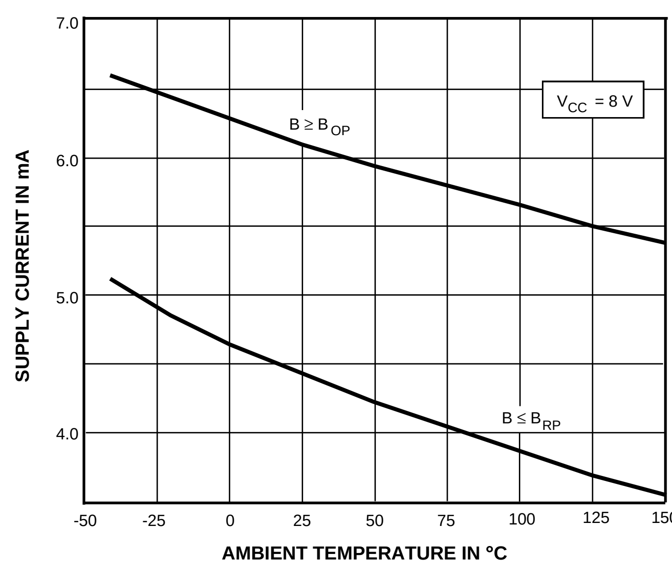
Dwg. GH-040-1

SUPPLY CURRENT



Dwg. GH-041-1

SUPPLY CURRENT



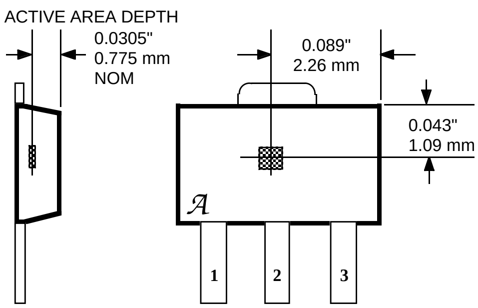
Dwg. GH-039-1

* Complete part number includes a suffix denoting operating temperature range (E- or L-) and package type (-LT, -U, or -UA).

SENSOR LOCATIONS

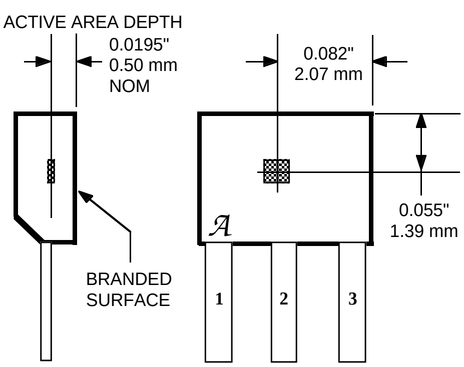
(±0.005” [0.13 mm] die placement)

Suffix “LT”



Dwg. MH-008-2D

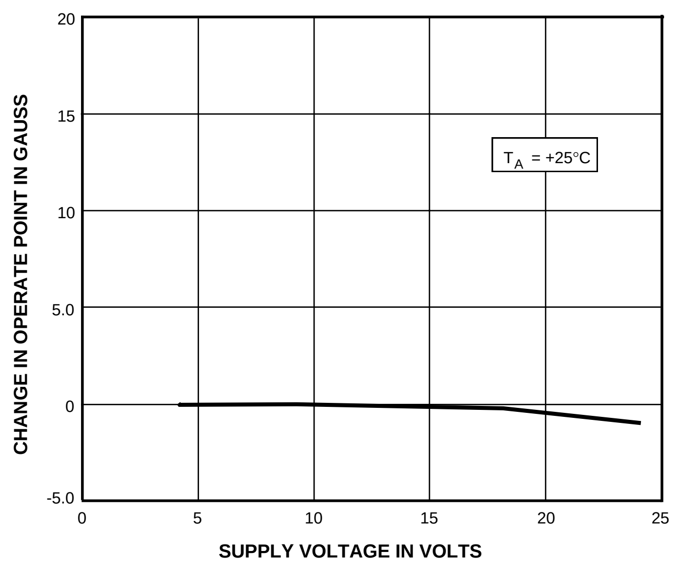
Suffix “UA”



Dwg. MH-011-10A

TYPICAL OPERATING CHARACTERISTICS (cont.)

CHANGE IN OPERATE POINT



Dwg. GH-042-1

OPERATION

The output of these devices (pin 3) switches low when the magnetic field at the Hall sensor exceeds the operate point threshold (B_{OP}). At this point, the output voltage is $V_{OUT(SAT)}$. When the magnetic field is reduced to below the release point threshold (B_{RP}), the device output goes high. The difference in the magnetic operate and release points is called the hysteresis (B_{hys}) of the device. This built-in hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

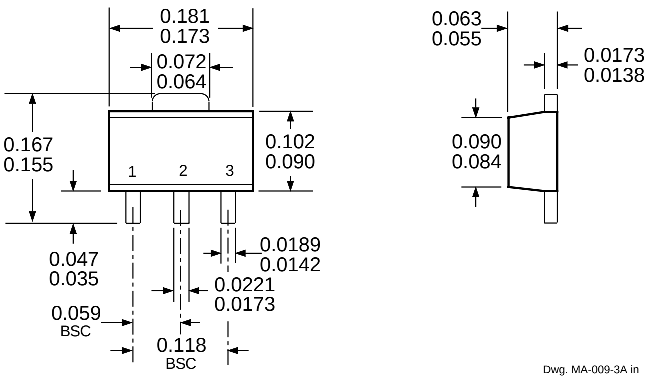
Extensive applications information for Hall-effect sensors is available in:
• *Hall-Effect IC Applications Guide*, Application Note 27701;
• *Hall-Effect Devices: Soldering, Gluing, Potting, Encapsulating, and Lead Forming*, Application Note 27703.1;
• *Soldering of Through-Hole Hall-Sensor Dervices*, Application Note 27703; and
• *Soldering of Surface-Mount Hall-Sensor Devices*, Application Note 27703.2.

All are provided in *Allegro Electronic Data Book*, AMS-702. or at
www.allegromicro.com

115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

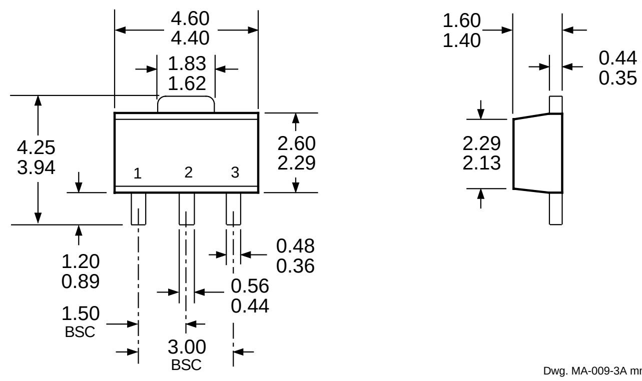
PACKAGE DESIGNATOR 'LT'
(SOT89/TO-243AA)

Dimensions in Inches
(for reference only)

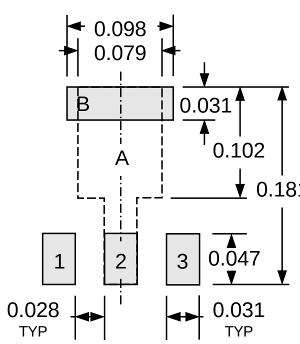


Dwg. MA-009-3A in

Dimensions in Millimeters
(controlling dimensions)

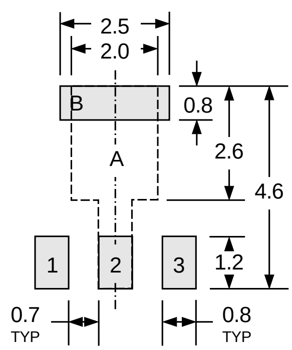


Dwg. MA-009-3A mm



Pads 1, 2, 3, and A — Standard SOT89 Layout
Pads 1, 2, 3, and B — Low-Stress Version
Pads 1, 2, and 3 only — Lowest Stress, But Not Self Aligning

Dwg. MA-012-3 in



Pads 1, 2, 3, and A — Standard SOT89 Layout
Pads 1, 2, 3, and B — Low-Stress Version
Pads 1, 2, and 3 only — Lowest Stress, But Not Self Aligning

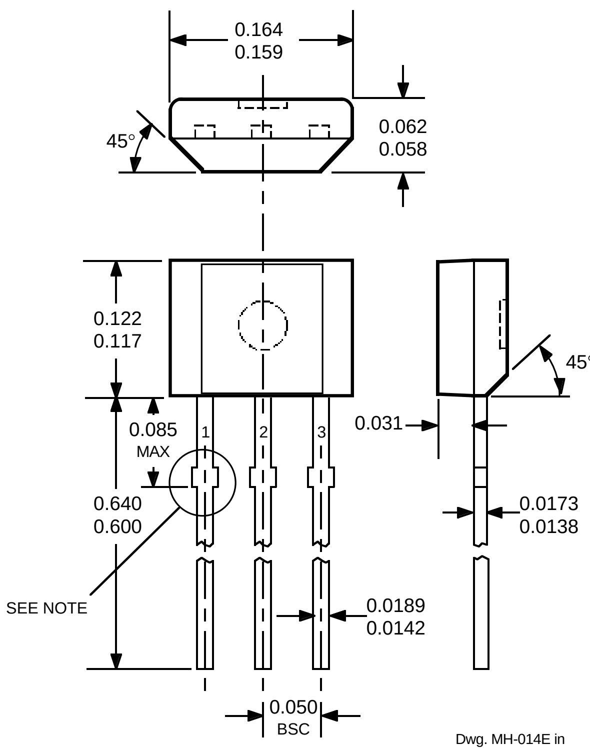
Dwg. MA-012-3 mm

NOTES:
1. Exact body and lead configuration at vendor's option within limits shown.
2. Supplied in bulk pack (500 pieces per bag) or add "TR" to part number for tape and reel.
3. Only low-temperature (≤240°C) reflow-soldering techniques are recommended for SOT89 devices.

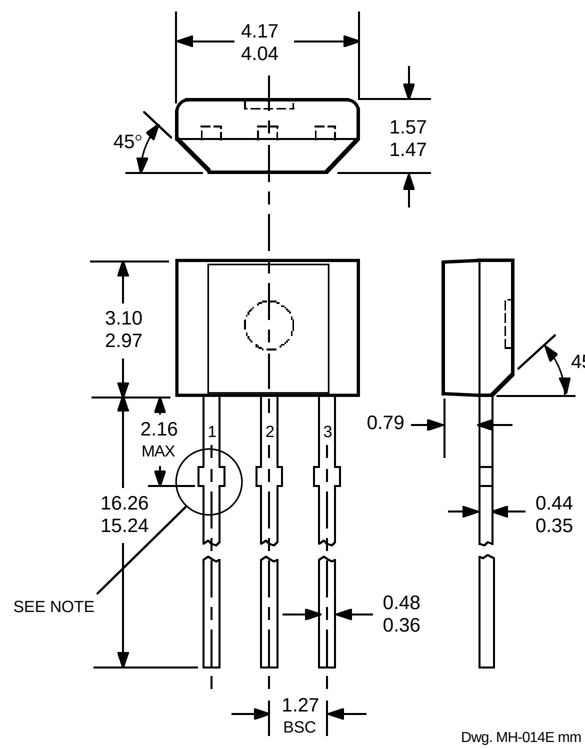
3141 THRU 3144
SENSITIVE HALL-EFFECT SWITCHES FOR HIGH-TEMP. OPERATION

PACKAGE DESIGNATOR 'UA'

Dimensions in Inches
(controlling dimensions)

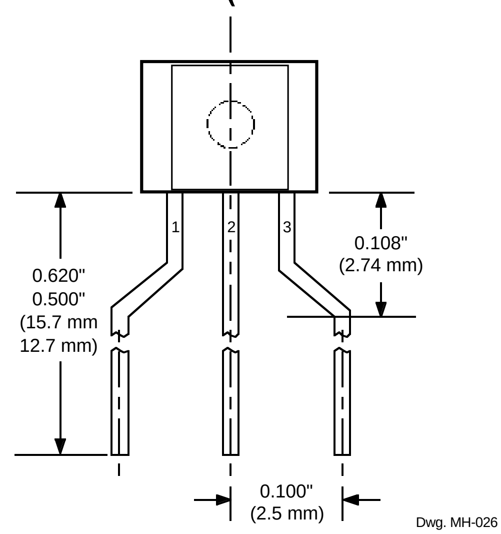


Dimensions in Millimeters
(for reference only)



NOTES:
1. Tolerances on package height and width represent allowable mold offsets. Dimensions given are measured at the widest point (parting line).
2. Exact body and lead configuration at vendor's option within limits shown.
3. Height does not include mold gate flash.
4. Recommended minimum PWB hole diameter to clear transition area is 0.035" (0.89 mm).
5. Where no tolerance is specified, dimension is nominal.
6. Supplied in bulk pack (500 pieces per bag).

Radial Lead Form (order A314xxUA-LC)



NOTE: Lead-form dimensions are the nominals produced on the forming equipment. No dimensional tolerance is implied or guaranteed for bulk packaging (500 pieces per bag).

Allegro MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

HALL-EFFECT SENSORS

UNIPOLAR HALL-EFFECT DIGITAL SWITCHES

Partial Part Number	Operate Point (G) Over Oper. Voltage & Temp. Range	Release Point (G) Over Oper. Voltage & Temp. Range	Hysteresis (G) Over Oper. Voltage & Temp. Range	Oper. Temp.	Packages	Replaces and Comments
A3121x	220 to 500	80 to 410	60 to 150	E, L	LT, UA	3019, 3113, 3119
A3122x	260 to 430	120 to 360	70 to 140	E, L	LT, UA	
A3123x	230 to 470	160 to 330	70 to 140	E, L	LT, UA	
A3141x	30 to 175	10 to 145	20 to 80	E, L	LT, UA	3040, 3140
A3142x	115 to 245	60 to 190	30 to 80	E, L	LT, UA	
A3143x	205 to 355	150 to 300	30 to 80	E, L	LT, UA	
A3144x	35 to 450	25 to 430	>20	E, L	LT, UA	3020, 3120
A3161E	<160 (Typ 130)	>30 (Typ 110)	5 to 80	E	LT, UA	2-wire operation
A3163E	<160 (Typ 98)	>30 (Typ 79)	5 to 40	E	LT, UA	2-wire
A3240x	<50 (Typ 35)	>5 (Typ 25)	Typ 10	E, L	LH, LT, UA	chopper stabilized
A3250x	<50 to >350	_	5 to 35	J, L	UA	programmable, chopper stabilized
A3251x	<50 to >350	_	5 to 35	J, L	UA	programmable, chopper stabilized
A3361E	<125	>40	5 to 30	E	LH, LT, UA	2-wire, chopper stabilized, output normally high
A3362E	<125	>40	5 to 30	E	LH, LT, UA	2-wire, chopper stabilized, output normally low

MICROPOWER OMNIPOLAR HALL-EFFECT DIGITAL SWITCHES

Partial Part Number	Operate Points (G) Over Oper. Voltage & Temp. Range	Release Points (G) Over Oper. Voltage & Temp. Range	Hysteresis (G) Over Oper. Voltage & Temp. Range	Oper. Temp.	Packages	Average Supply Current (μA)
A3209E	>-60, <60	<-5, >5	Typ 7.7	E	LH, UA	<425 (Typ 145)
A3210E	>-60, <60	<-5, >5	Typ 7.7	E	LH, UA	<60 (Typ 8.8)
A3212E	>-55, <55	<-10, >10	Typ. 8	E	LH, UA	<10 (Typ 4.2)

BIPOLAR HALL-EFFECT DIGITAL SWITCHES

Partial Part Number	Operate Point (G) Over Oper. Voltage & Temp. Range	Release Point (G) Over Oper. Voltage & Temp. Range	Hysteresis (G) Over Oper. Voltage & Temp. Range	Oper. Temp.	Packages	Replaces and Comments
UGx3132	<95 (Typ 32)	>-95 (Typ -20)	>30 (Typ 52)	K, L, S	LT, UA	3030, 3130, 3131
UGx3133	<75 (Typ 32)	>-75 (Typ -20)	>30 (Typ 52)	K, L, S	LT, UA	
UGx3134	-40 to 50	-50 to 40	5 to 55	E, L	LT, UA	
A3260x	<30 (Typ 10)	>-30 (Typ -10)	Typ 20	E, L	LH, LT, UA	2 wire, chopper stabilized

Notes: 1) Typical data is at T_A = +25°C and nominal operating voltage.
2) “x” = Operating Temperature Range [suffix letter or (prefix)]: S (UGN) = -20°C to +85°C, E = -40°C to +85°C, J = -40°C to +115°C, K (UGS) = -40°C to +125°C, L (UGL) = -40°C to +150°C.

The products described herein are manufactured under one or more of the following U.S. patents: 5,045,920; 5,264,783; 5,442,283; 5,389,889; 5,581,179; 5,517,112; 5,619,137; 5,621,319; 5,650,719; 5,686,894; 5,694,038; 5,729,130; 5,917,320; and other patents pending.

Allegro MicroSystems, Inc. reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the performance, reliability, or manufacturability of its products. Before placing an order, the user is cautioned to verify that the information being relied upon is current.

Allegro products are not authorized for use as critical components in life-support appliances, devices, or systems without express written approval.

The information included herein is believed to be accurate and reliable. However, Allegro MicroSystems, Inc. assumes no responsibility for its use; nor for any infringements of patents or other rights of third parties that may result from its use.

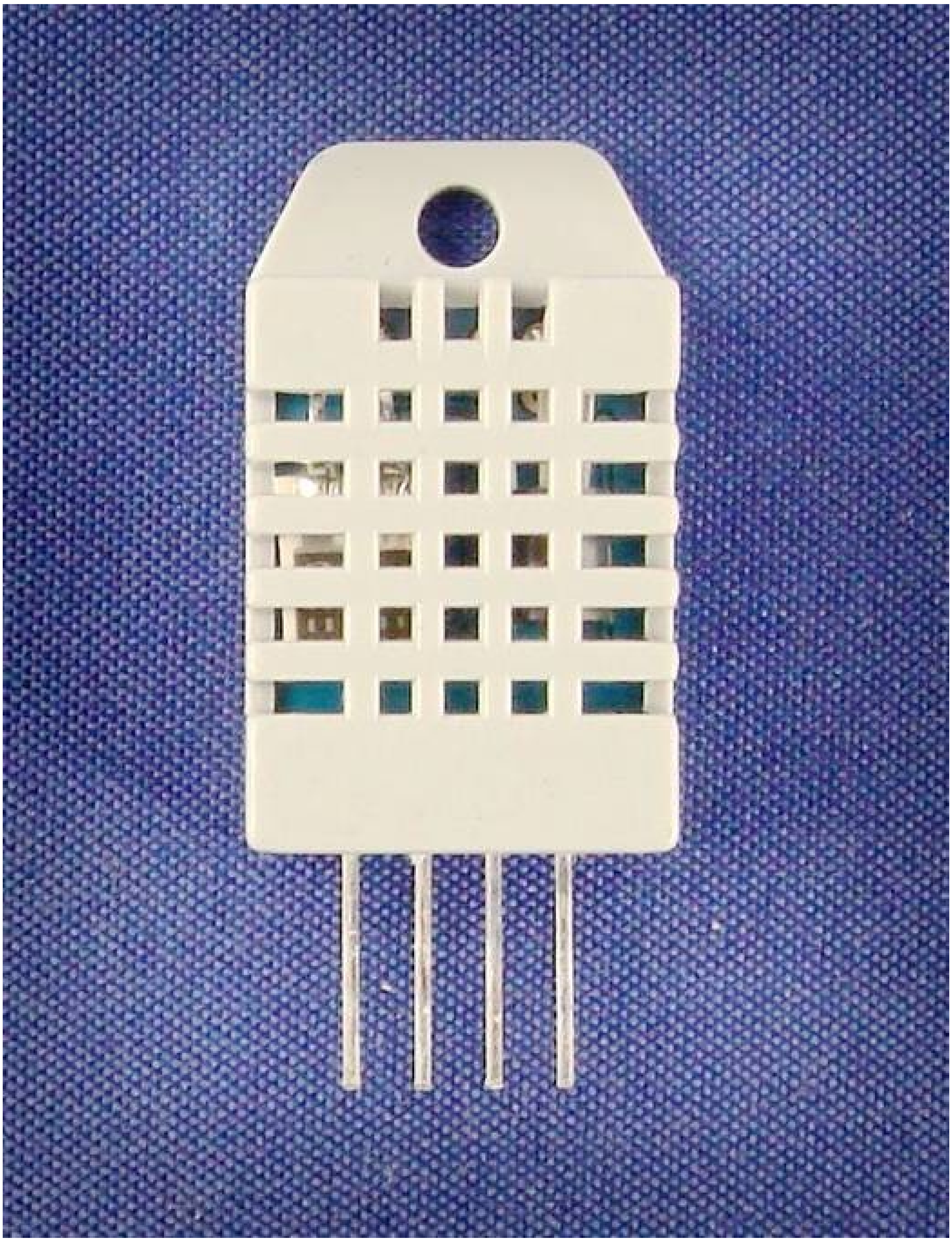
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

Aosong Electronics Co.,Ltd

Your specialist in innovating humidity & temperature sensors

Digital-output relative humidity & temperature sensor/module

DHT22 (DHT22 also named as AM2302)



Capacitive-type humidity and temperature module/sensor

Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn

Aosong Electronics Co.,Ltd

Your specialist in innovating humidity & temperature sensors

1. Feature & Application:

* Full range temperature compensated * Relative humidity and temperature measurement
* Calibrated digital signal *Outstanding long-term stability *Extra components not needed
* Long transmission distance * Low power consumption *4 pins packaged and fully interchangeable

2. Description:

DHT22 output calibrated digital signal. It utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability.Its sensing elements is connected with 8-bit single-chip computer.

Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP memory, when the sensor is detecting, it will cite coefficient from memory.

Small size & low consumption & long transmission distance(20m) enable DHT22 to be suited in all kinds of harsh application occasions.

Single-row packaged with four pins, making the connection very convenient.

3. Technical Specification:

Model	DHT22
Power supply	3.3-6V DC
Output signal	digital signal via single-bus
Sensing element	Polymer capacitor
Operating range	humidity 0-100%RH; temperature -40~80Celsius
Accuracy	humidity +-2%RH(Max +-5%RH); temperature <+-0.5Celsius
Resolution or sensitivity	humidity 0.1%RH; temperature 0.1Celsius
Repeatability	humidity +-1%RH; temperature +-0.2Celsius
Humidity hysteresis	+-0.3%RH
Long-term Stability	+-0.5%RH/year
Sensing period	Average: 2s
Interchangeability	fully interchangeable
Dimensions	small size 14*18*5.5mm; big size 22*28*5mm

4. Dimensions: (unit----mm)

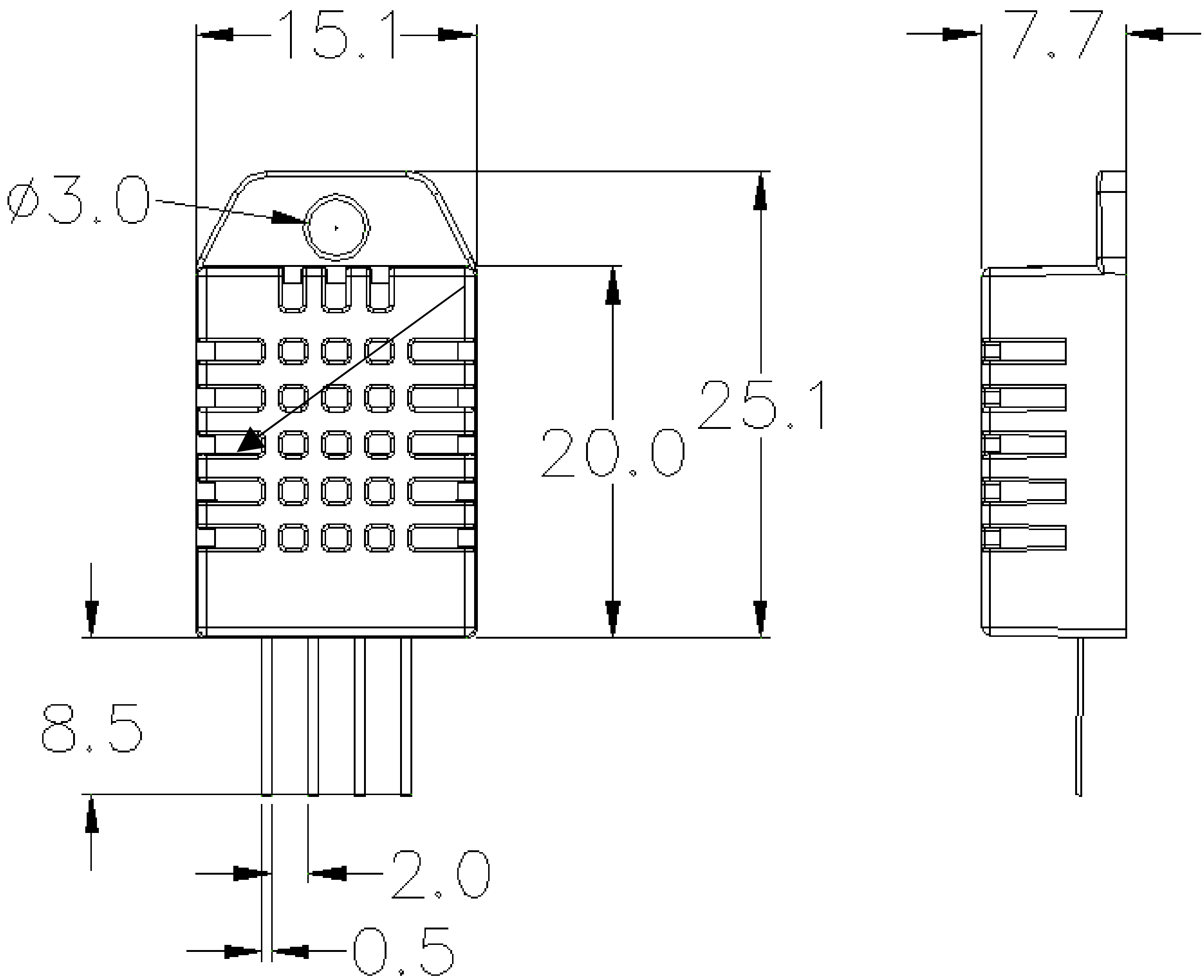
1) Small size dimensions: (unit----mm)

Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn

Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn



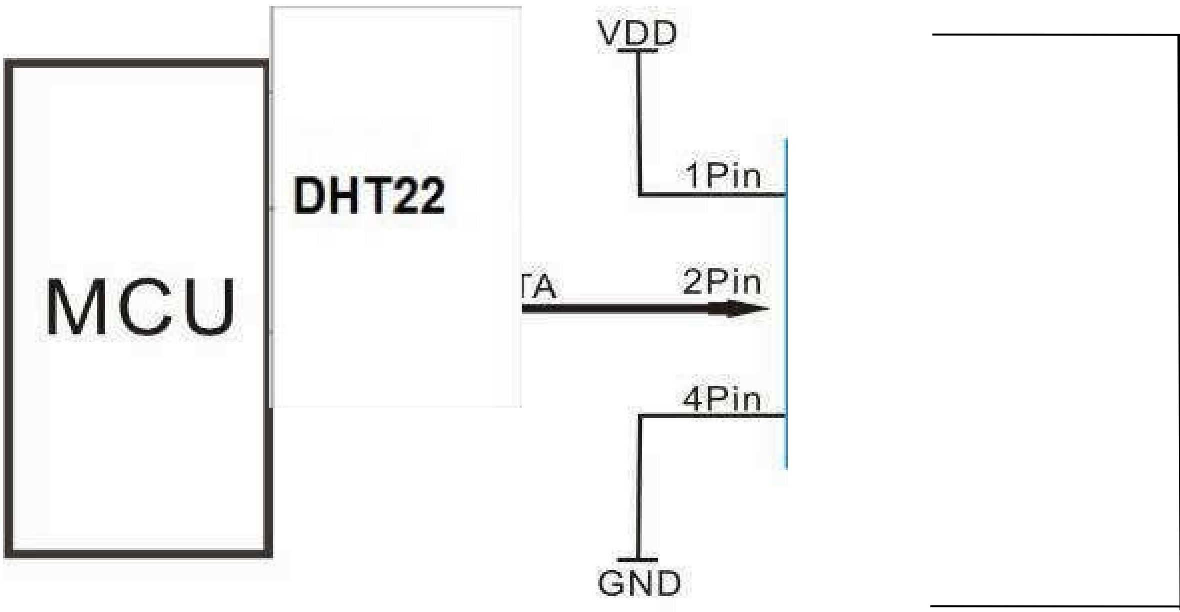
Pin sequence number: 1 2 3 4 (from left to right direction).

Pin	Function
1	VDD----power supply
2	DATA--signal
3	NULL
4	GND

Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn

5. Electrical connection diagram:



3Pin---NC, AM2302 is another name for DHT22

6. Operating specifications:

(1) Power and Pins

Power's voltage should be 3.3-6V DC. When power is supplied to sensor, don't send any instruction to the sensor within one second to pass unstable status. One capacitor valued 100nF can be added between VDD and GND for wave filtering.

(2) Communication and signal

Single-bus data is used for communication between MCU and DHT22, it costs 5mS for single time communication.

Data is comprised of integral and decimal part, the following is the formula for data.

DHT22 send out higher data bit firstly!

DATA=8 bit integral RH data+8 bit decimal RH data+8 bit integral T data+8 bit decimal T data+8 bit check-sum

If the data transmission is right, check-sum should be the last 8 bit of "8 bit integral RH data+8 bit decimal RH data+8 bit integral T data+8 bit decimal T data".

When MCU send start signal, DHT22 change from low-power-consumption-mode to running-mode. When MCU finishs sending the start signal, DHT22 will send response signal of 40-bit data that reflect the relative humidity

Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn

and temperature information to MCU. Without start signal from MCU, DHT22 will not give response signal to MCU. One start signal for one time's response data that reflect the relative humidity and temperature information from DHT22. DHT22 will change to low-power-consumption-mode when data collecting finish if it don't receive start signal from MCU again.

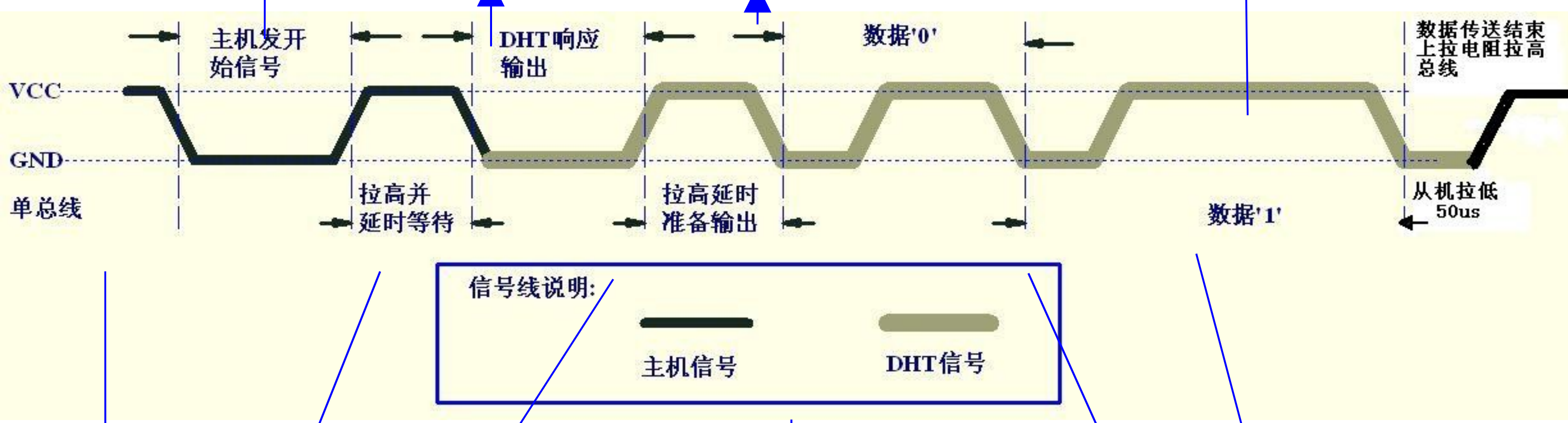
1) Check bellow picture for overall communication process:

Host computer send out start signal.

Sensor send out response signal.

Output data: 1bit"0"

Data transmission finished, and RL pull up bus's voltage for next transmission



Pull up and wait response from sensor

Host's signal

Sensor's signal

Output data: 1bit "1"

Sensor pull down bus's voltage

Pull up voltage and get ready for sensor's output.

Single-bus output

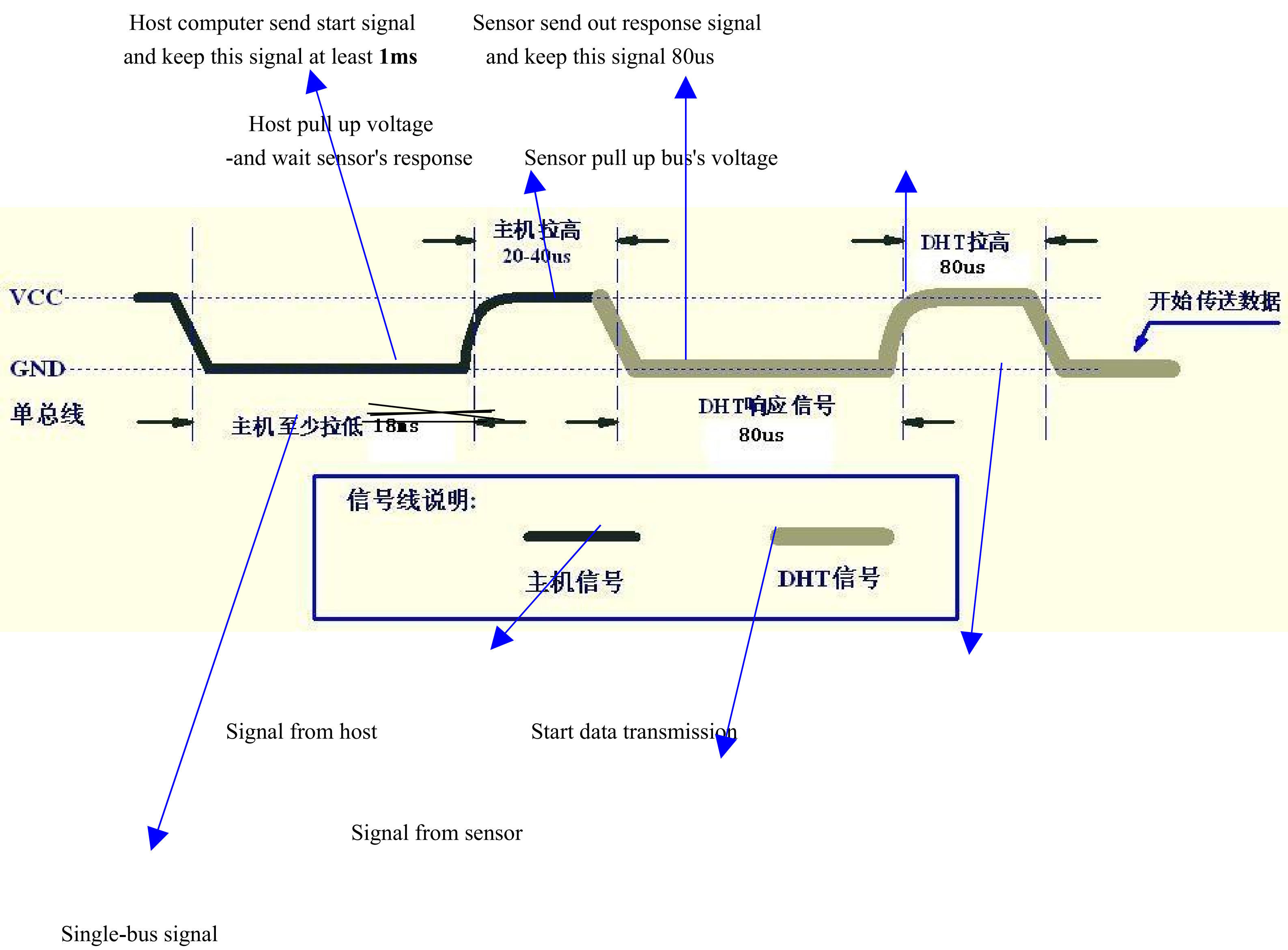
2) Step 1: MCU send out start signal to DHT22

Data-bus's free status is high voltage level. When communication between MCU and DHT22 begin, program of MCU will transform data-bus's voltage level from high to low level and this process must beyond at least 1ms to ensure DHT22 could detect MCU's signal, then MCU will wait 20-40us for DHT22's response.

Check bellow picture for step 1:

Thomas Liu (Business Manager)

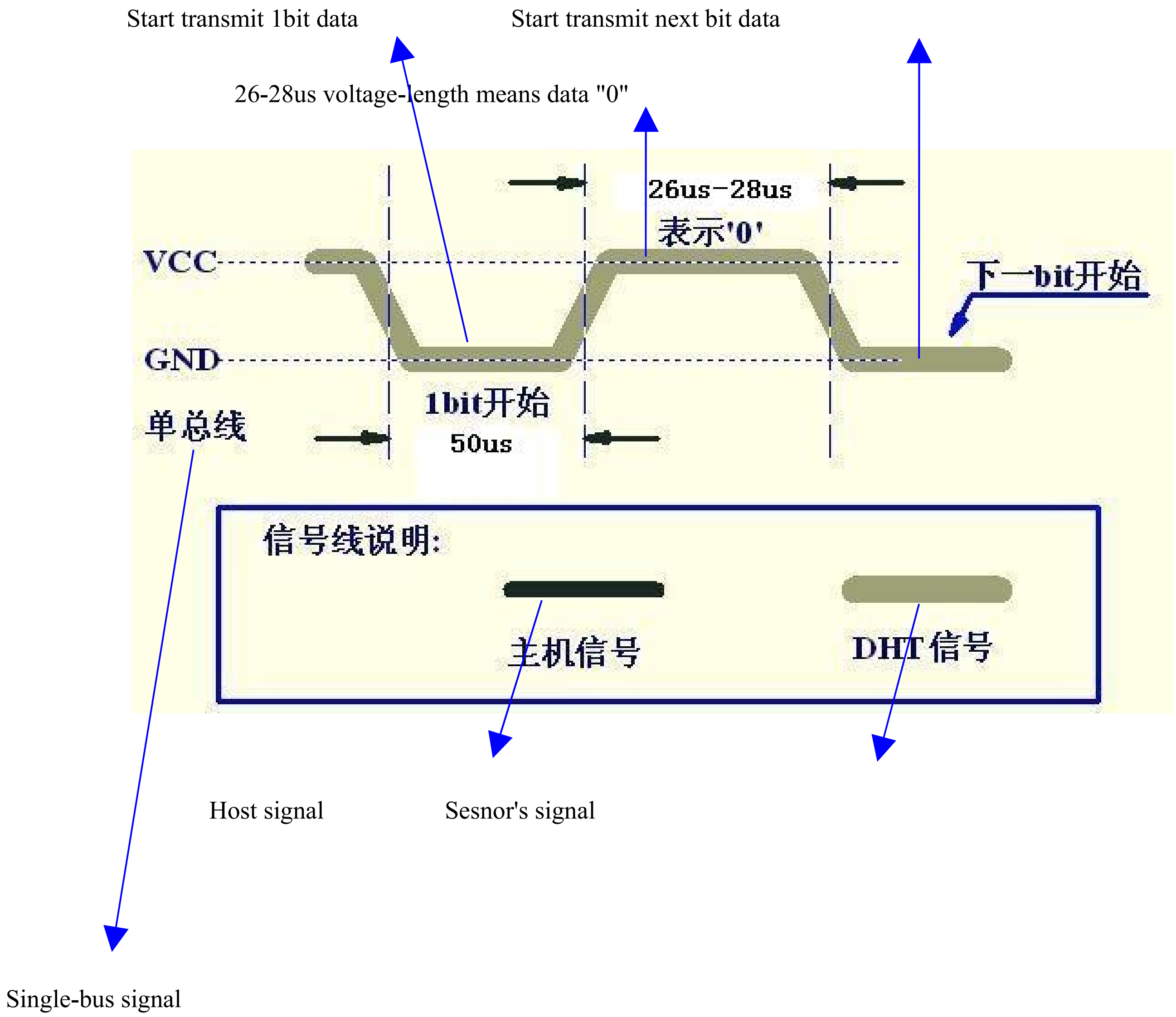
Email: thomasliu198518@yahoo.com.cn



Step 2: DHT22 send response signal to MCU

When DHT22 detect the start signal, DHT22 will send out low-voltage-level signal and this signal last 80us as response signal, then program of DHT22 transform data-bus's voltage level from low to high level and last 80us for DHT22's preparation to send data.

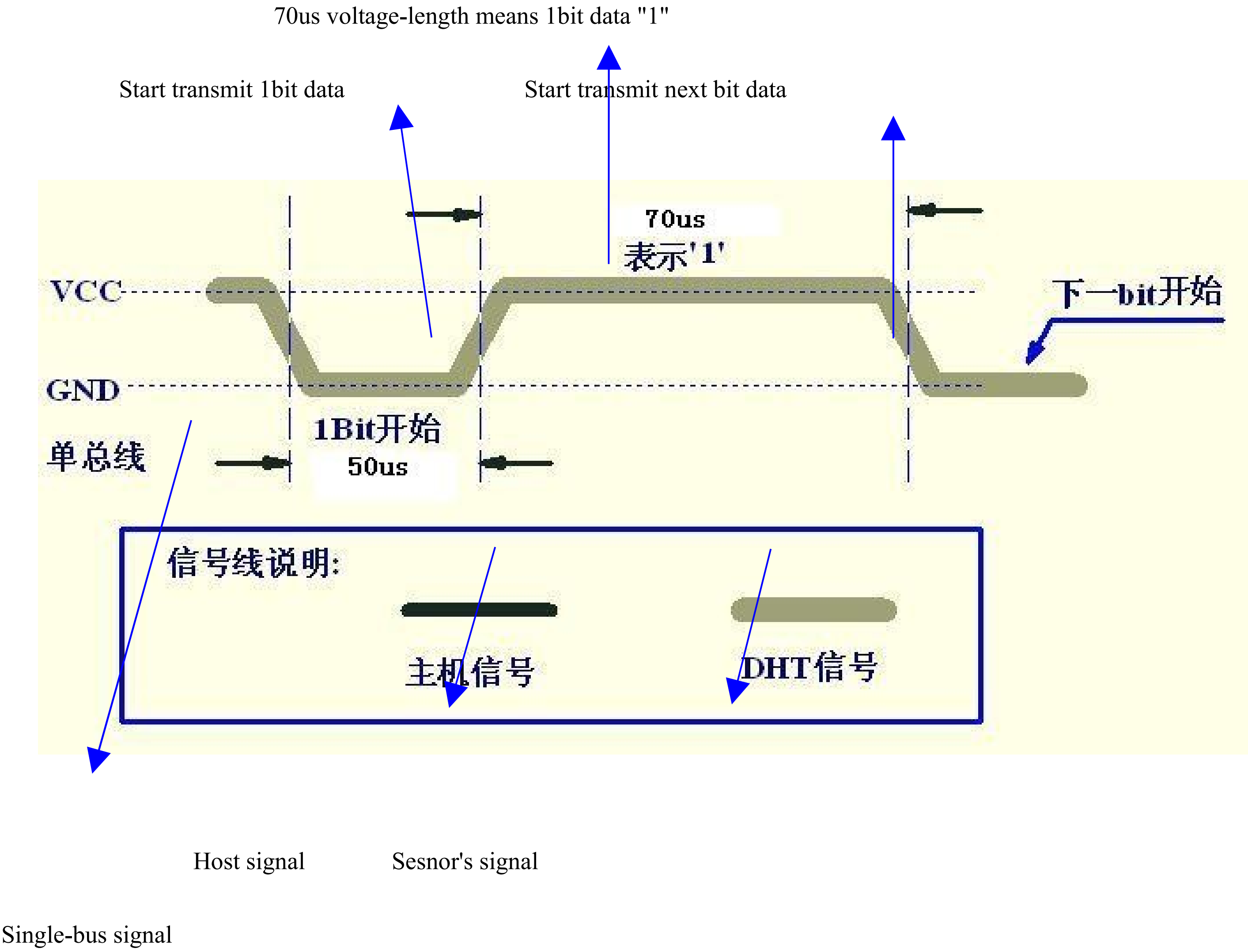
Check bellow picture for step 2:



Step 3: DHT22 send data to MCU

When DHT22 is sending data to MCU, every bit's transmission begin with low-voltage-level that last 50us, the following high-voltage-level signal's length decide the bit is "1" or "0".

Check bellow picture for step 3:



If signal from DHT22 is always high-voltage-level, it means DHT22 is not working properly, please check the electrical connection status.

7. Electrical Characteristics:

Item	Condition	Min	Typical	Max	Unit
Power supply	DC	3.3	5	6	V
Current supply	Measuring	1		1.5	mA
	Stand-by	40	Null	50	uA
Collecting period	Second		2		Second

*Collecting period should be : >2 second.

Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn

8. Attentions of application:

(1) Operating and storage conditions

We don't recommend the applying RH-range beyond the range stated in this specification. The DHT22 sensor can recover after working in non-normal operating condition to calibrated status, but will accelerate sensors' aging.

(2) Attentions to chemical materials

Vapor from chemical materials may interfere DHT22's sensitive-elements and debase DHT22's sensitivity.

(3) Disposal when (1) & (2) happens

Step one: Keep the DHT22 sensor at condition of Temperature 50~60Celsius, humidity <10%RH for 2 hours;

Step two: After step one, keep the DHT22 sensor at condition of Temperature 20~30Celsius, humidity >70%RH for 5 hours.

(4) Attention to temperature's affection

Relative humidity strongly depend on temperature, that is why we use temperature compensation technology to ensure accurate measurement of RH. But it's still be much better to keep the sensor at same temperature when sensing.

DHT22 should be mounted at the place as far as possible from parts that may cause change to temperature.

(5) Attentions to light

Long time exposure to strong light and ultraviolet may debase DHT22's performance.

(6) Attentions to connection wires

The connection wires' quality will effect communication's quality and distance, high quality shielding-wire is recommended.

(7) Other attentions

* Welding temperature should be bellow 260Celsius.
* Avoid using the sensor under dew condition.
* Don't use this product in safety or emergency stop devices or any other occasion that failure of DHT22 may cause personal injury.

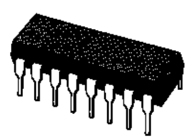
Thomas Liu (Business Manager)

Email: thomasliu198518@yahoo.com.cn

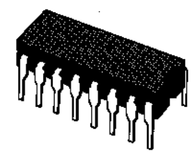
M54HC595
M74HC595

8 BIT SHIFT REGISTER WITH OUTPUT LATCHES (3 STATE)

- HIGH SPEED
  f_{MAX} = 55 MHz (TYP.) AT V_{CC} = 5 V
- LOW POWER DISSIPATION
  I_{CC} = 4 µA (MAX.) AT T_A = 25 °C
- HIGH NOISE IMMUNITY
  V_{NIH} = V_{NIL} = 28 % V_{CC} (MIN.)
- OUTPUT DRIVE CAPABILITY
  15 LSTTL LOADS FOR QA TO QH
  10 LSTTL LOADS FOR QH'
- SYMMETRICAL OUTPUT IMPEDANCE
  $|I_{OH}|$ = I_{OL} = 6 mA (MIN.) FOR QA TO QH
  $|I_{OH}|$ = I_{OL} = 4 mA (MIN.) FOR QH'
- BALANCED PROPAGATION DELAYS
  t_{PLH} = t_{PHL}
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2 V TO 6 V
- PIN AND FUNCTION COMPATIBLE
  WITH LSTTL 54/74LS595

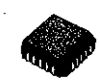


B1R
(Plastic Package)



F1R
(Ceramic Package)

M1R
(Micro Package)



C1R
(Chip Carrier)

ORDER CODES :

M54HC595F1R M74HC595M1R
M74HC595B1R M74HC595C1R

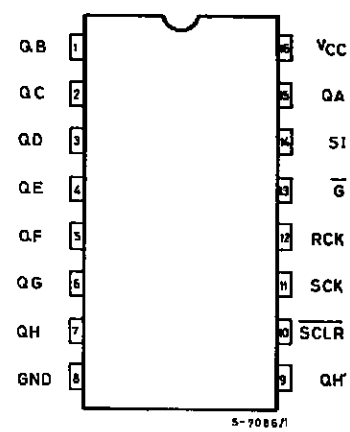
DESCRIPTION

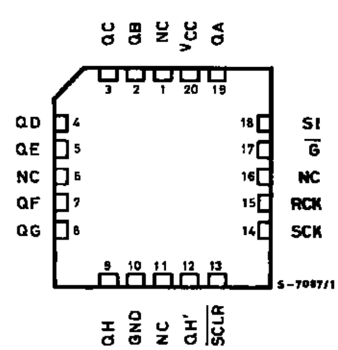
The M54/74HC595 is a high speed CMOS 8-BIT SHIFT REGISTERS/OUTPUT LATCHES (3-STATE) fabricated in silicon C^2MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has 8 3-STATE outputs. Separate clocks are provided for both the shift register and the storage register.

The shift register has a direct-overriding clear, serial input, and serial output (standard) pins for cascading. Both the shift register and storage register use positive-edge triggered clocks. If both clocks are connected together, the shift register state will always be one clock pulse ahead of the storage register.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

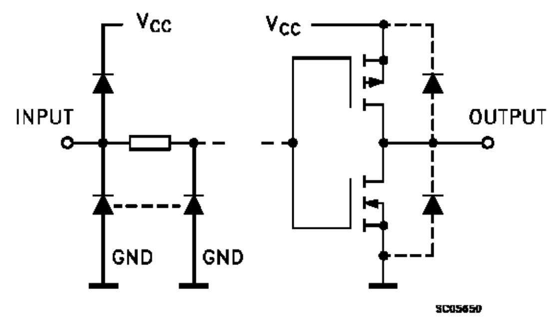
PIN CONNECTIONS (top view)





NC =
No Internal
Connection

INPUT AND OUTPUT EQUIVALENT CIRCUIT

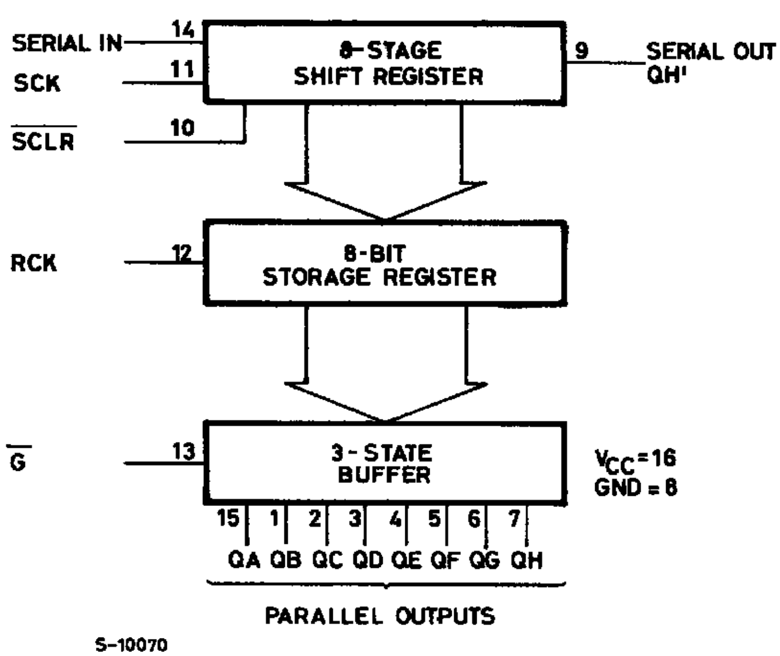


TRUTH TABLE

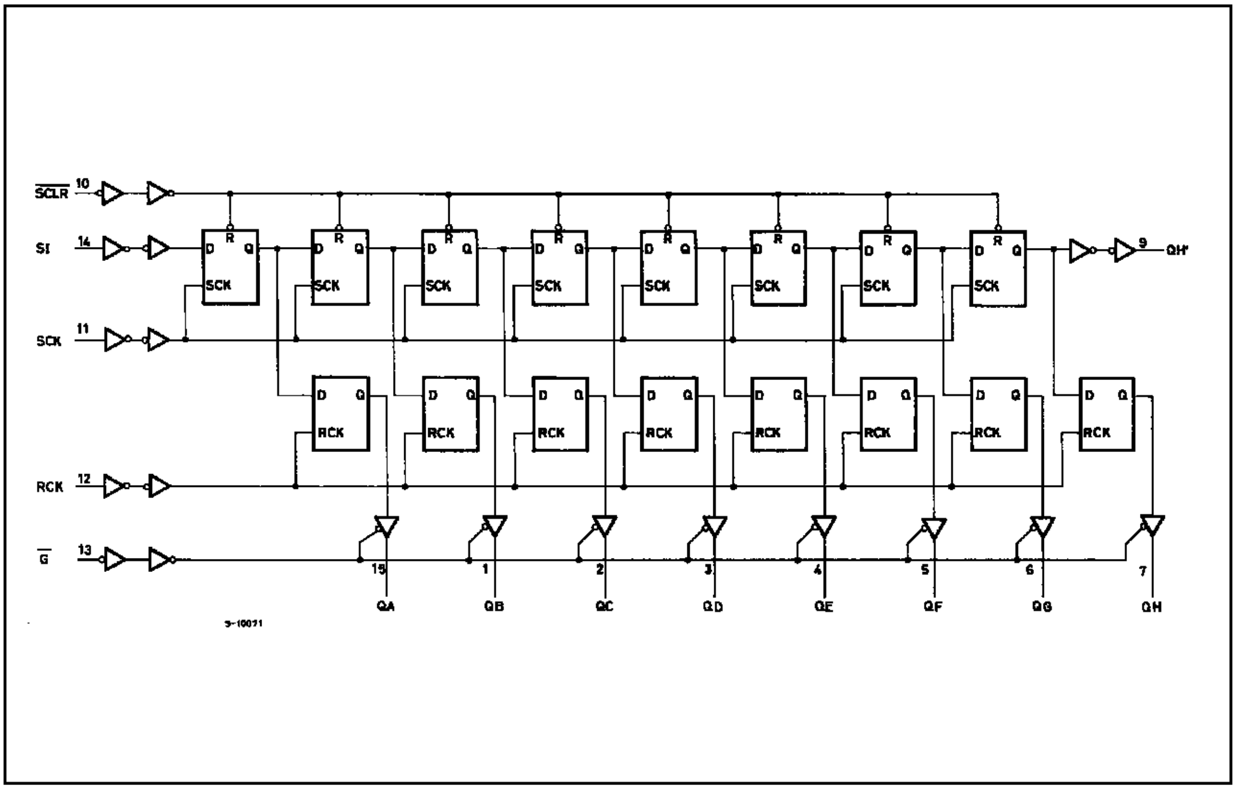
INPUTS					OUTPUT
SI	SCK	$\overline{SCLR}$	RCK	$\overline{G}$	
X	X	X	X	H	QA THRU QH OUTPUTS DISABLE
X	X	X	X	L	QA THRU QH OUTPUTS ENABLE
X	X	L	X	X	SHIFT REGISTER IS CLEARED
L	↑	H	X	X	FIRST STAGE OF S.R. BECOMES "L" OTHER STAGES STORE THE DATA OF PREVIOUS STAGE, RESPECTIVELY
H	↑	H	X	X	FIRST STAGE OF S.R. BECOMES "H" OTHER STAGES STORE THE DATA OF PREVIOUS STAGE, RESPECTIVELY
X	↓	H	X	X	STATE OF S.R IS NOT CHANGED
X	X	X	↑	X	S.R. DATA IS STORED INTO STORAGE REGISTER
X	X	X	↓	X	STORAGE REGISTER STATE IS NOT CHANGED

X: DON'T CARE

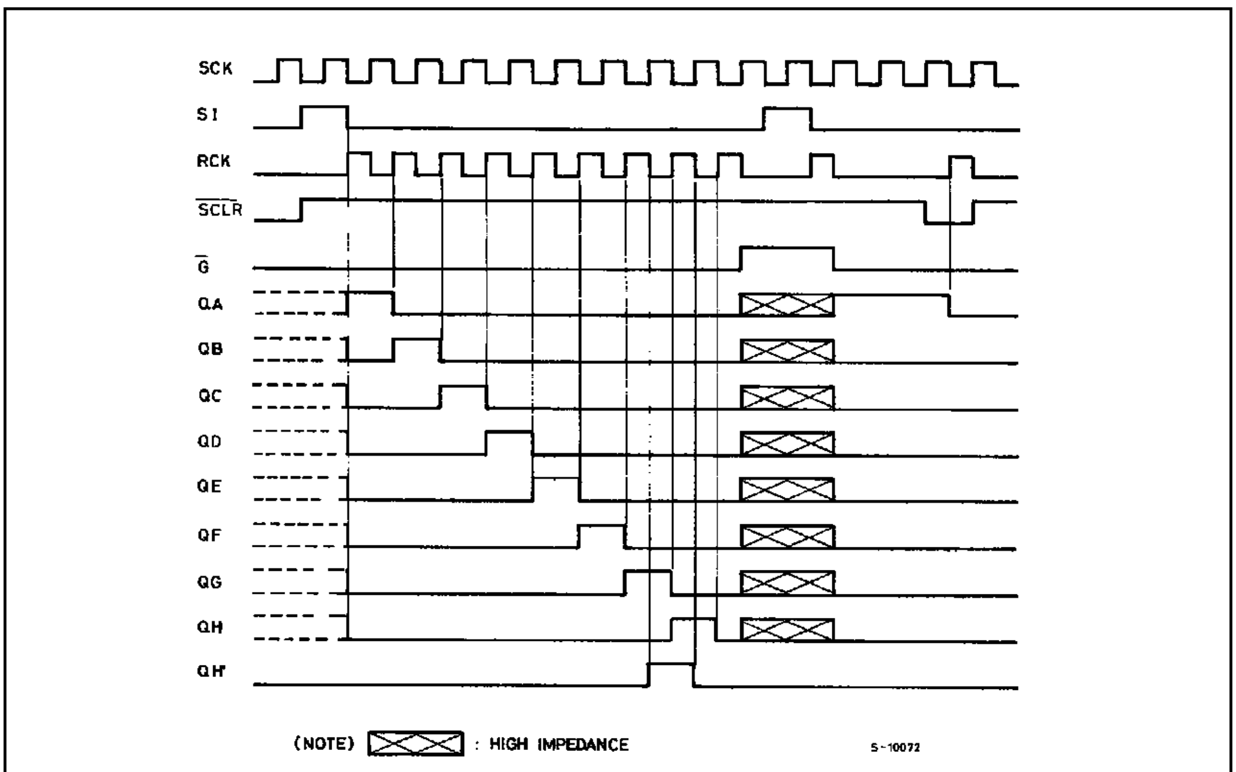
LOGIC DIAGRAM



LOGIC DIAGRAM



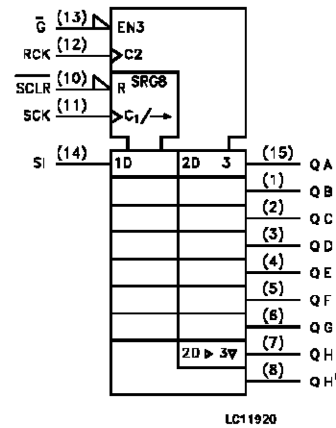
TIMING CHART



PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 15	QA to QH	Data Outputs
9	QH'	Serial Data Outputs
10	$\overline{SCLR}$	Shift Register Clear Input
11	SCK	Shift Register Clock Input
13	$\overline{G}$	Output Enable Input
14	SI	Serial Data Input
12	RCK	Storage Register Clock Input
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

IEC LOGIC SYMBOL



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7	V
V_I	DC Input Voltage	-0.5 to V_{CC} + 0.5	V
V_O	DC Output Voltage	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Current Per Output Pin QA-QH	± 35	mA
I_O	DC Output Current Per Output Pin QH'	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 70	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	-65 to +150	^oC
T_L	Lead Temperature (10 sec)	300	^oC

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.
(*) 500 mW: ≅ 65 ^oC derate to 300 mW by 10mW/^oC: 65 ^oC to 85 ^oC

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		2 to 6	V
V_I	Input Voltage		0 to V_{CC}	V
V_O	Output Voltage		0 to V_{CC}	V
T_{op}	Operating Temperature: **M54HC** Series **M74HC** Series		-55 to +125 -40 to +85	^oC ^oC
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2 V	0 to 1000	ns
		V_{CC} = 4.5 V	0 to 500	
		V_{CC} = 6 V	0 to 400	

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)			T_A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0			1.5			1.5		1.5		V
		4.5			3.15			3.15		3.15		
		6.0			4.2			4.2		4.2		
V_{IL}	Low Level Input Voltage	2.0					0.5		0.5		0.5	V
		4.5					1.35		1.35		1.35	
		6.0					1.8		1.8		1.8	
V_{OH}	High Level Output Voltage (for QH' output)	2.0	V_I = V_{IH} or V_{IL}	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5			4.4	4.5		4.4		4.4		
		6.0			5.9	6.0		5.9		5.9		
		4.5		I_O=-4.0 mA	4.18	4.31		4.13		4.10		
		6.0		I_O=-5.2 mA	5.68	5.8		5.63		5.60		
V_{OH}	High Level Output Voltage (for QA to QH outputs)	2.0	V_I = V_{IH} or V_{IL}	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5			4.4	4.5		4.4		4.4		
		6.0			5.9	6.0		5.9		5.9		
		4.5		I_O=-6.0 mA	4.18	4.31		4.13		4.10		
		6.0		I_O=-7.8 mA	5.68	5.8		5.63		5.60		
V_{OL}	Low Level Output Voltage (for QH' output)	2.0	V_I = V_{IH} or V_{IL}	I_O= 20 µA		0.0	0.1		0.1		0.1	V
		4.5				0.0	0.1		0.1		0.1	
		6.0				0.0	0.1		0.1		0.1	
		4.5		I_O= 4.0 mA		0.17	0.26		0.33		0.40	
		6.0		I_O= 5.2 mA		0.18	0.26		0.33		0.40	
V_{OL}	Low Level Output Voltage (for QA to QH outputs)	2.0	V_I = V_{IH} or V_{IL}	I_O= 20 µA		0.0	0.1		0.1		0.1	V
		4.5				0.0	0.1		0.1		0.1	
		6.0				0.0	0.1		0.1		0.1	
		4.5		I_O= 6.0 mA		0.17	0.26		0.33		0.40	
		6.0		I_O= 7.8 mA		0.18	0.26		0.33		0.40	
I_I	Input Leakage Current	6.0	V_I = V_{CC} or GND				±0.1		±1		±1	µA
I_{OZ}	3 State Output Off State Current	6.0	V_I = V_{IH} or V_{IL} V_O = V_{CC} or GND				±0.5		±5		±10	µA
I_{CC}	Quiescent Supply Current	6.0	V_I = V_{CC} or GND				4		40		80	µA

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input t_r = t_f = 6 ns)

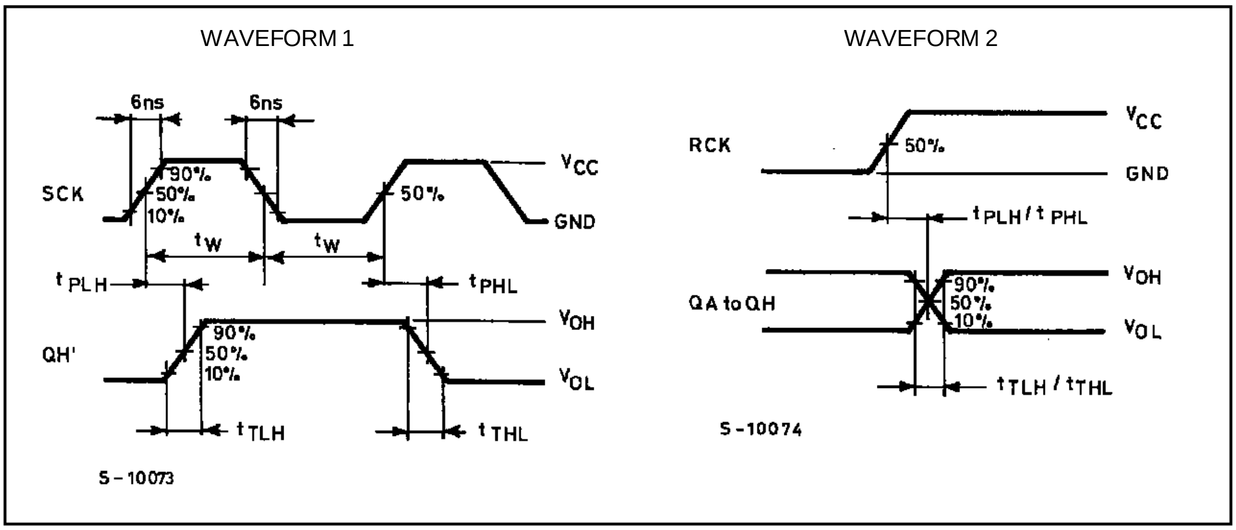
Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	C_L (pF)		T_A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time (Qn)	2.0	50			25	60		75		90	ns
		4.5				7	12		15		18	
		6.0				6	10		13		15	
t_{TLH} t_{THL}	Output Transition Time (QH')	2.0	50			30	75		95		115	ns
		4.5				8	15		19		23	
		6.0				7	13		16		20	
t_{PLH} t_{PHL}	Propagation Delay Time (SCK - QH')	2.0	50			45	125		155		190	ns
		4.5				15	25		31		38	
		6.0				13	21		26		32	
t_{PLH} t_{PHL}	Propagation Delay Time (SCLR - QH')	2.0	50			60	175		220		265	ns
		4.5				18	35		44		53	
		6.0				15	30		37		45	
t_{PLH} t_{PHL}	Propagation Delay Time (RCK - Qn)	2.0	50			60	150		190		225	ns
		4.5				20	30		38		45	
		6.0				17	26		32		38	
		2.0	150			75	190		240		285	ns
		4.5				25	38		48		57	
		6.0				22	32		41		48	
t_{PZL} t_{PZH}	3 State Output Enable Time	2.0	50	R_L = 1 KΩ		45	135		170		205	ns
		4.5				15	27		34		41	
		6.0				13	23		29		35	
		2.0	150	R_L = 1 KΩ		60	175		220		265	ns
		4.5				20	35		44		53	
		6.0				17	30		37		45	
t_{PLZ} t_{PHZ}	3 State Output Disable Time	2.0	50	R_L = 1 KΩ		30	150		190		225	ns
		4.5				15	30		38		45	
		6.0				14	26		32		38	
f_{MAX}	Maximum Clock Frequency	2.0	50		6.0	17		4.8		4		ns
		4.5			30	50		24		20		
		6.0			35	59		28		24		
		2.0	150		5.2	14		4.2		3.4		ns
		4.5			26	40		21		17		
		6.0			31	45		25		20		
$t_{W(H)}$	Minimum Pulse Width (SCK, RCK)	2.0	50			17	75		95		110	ns
		4.5				6	15		19		22	
		6.0				6	13		16		19	
$t_{W(L)}$	Minimum Pulse Width (SCLR)	2.0	50			20	75		95		110	ns
		4.5				6	15		19		22	
		6.0				6	13		16		19	
t_s	Minimum Set-up Time (SI - CCK)	2.0	50			25	50		65		75	ns
		4.5				5	10		13		15	
		6.0				4	9		11		13	

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input t_r = t_f = 6 ns)

Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	C_L (pF)		T_A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_s	Minimum Set-up Time (SCK - RCK)	2.0	50			35	75		95		110	ns
		4.5				8	15		19		22	
		6.0				6	13		16		19	
t_s	Minimum Set-up Time ($\overline{SCRL}$ - RCK)	2.0	50			40	100		125		145	ns
		4.5				10	20		25		29	
		6.0				7	17		21		25	
t_h	Minimum Hold Time	2.0	50				0		0		0	ns
		4.5					0		0		0	
		6.0					0		0		0	
t_{REM}	Minimum Clear Remuval Time	2.0	50			15	50		65		75	ns
		4.5				3	10		13		15	
		6.0				3	9		11		13	
C_{IN}	Input Capacitance					5	10		10		10	pF
C_{PD} (*)	Power Dissipation Capacitance					184						pF

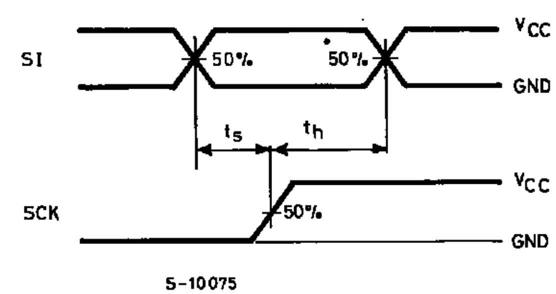
(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

SWITCHING CHARACTERISTICS TEST WAVEFORM

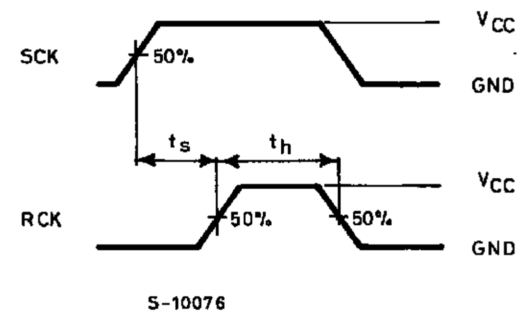


SWITCHING CHARACTERISTICS TEST WAVEFORM (continued)

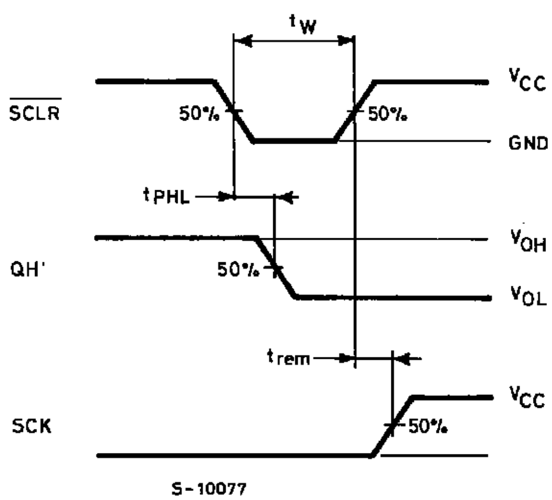
WAVEFORM 3



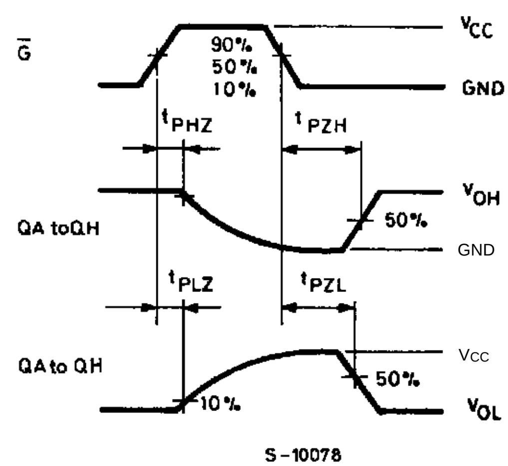
WAVEFORM 4



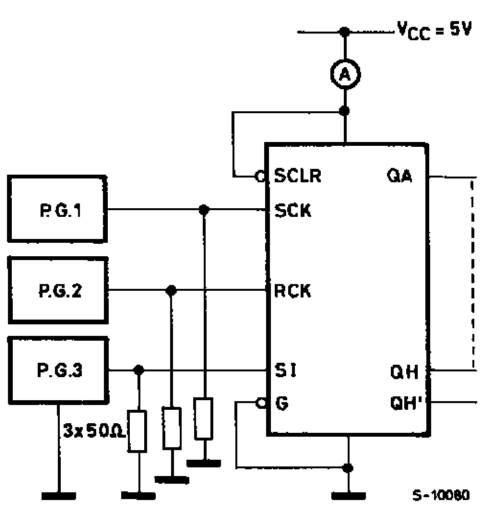
WAVEFORM 5



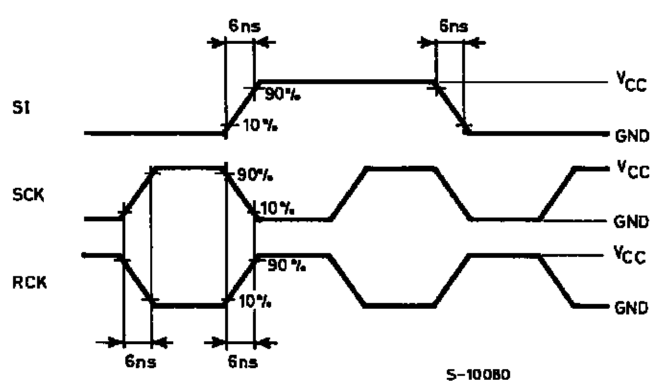
WAVEFORM 6



TEST CIRCUIT I_{CC} (Opr.)

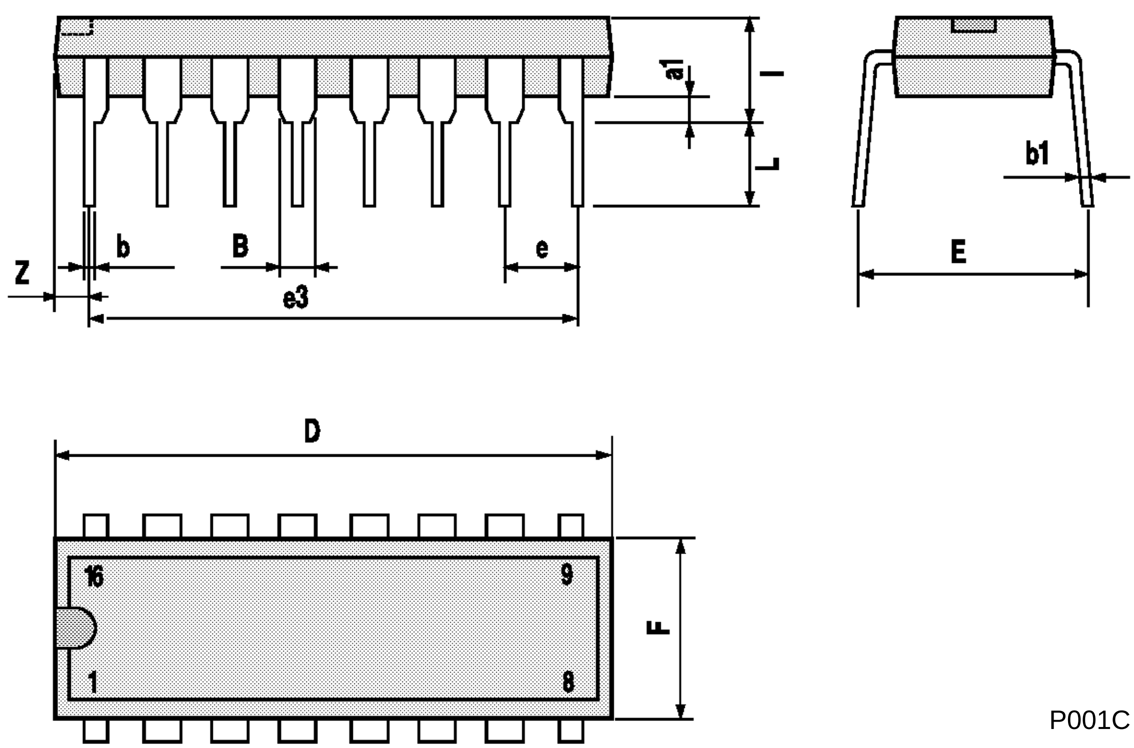


INPUT WAVEFORM



Plastic DIP16 (0.25) MECHANICAL DATA

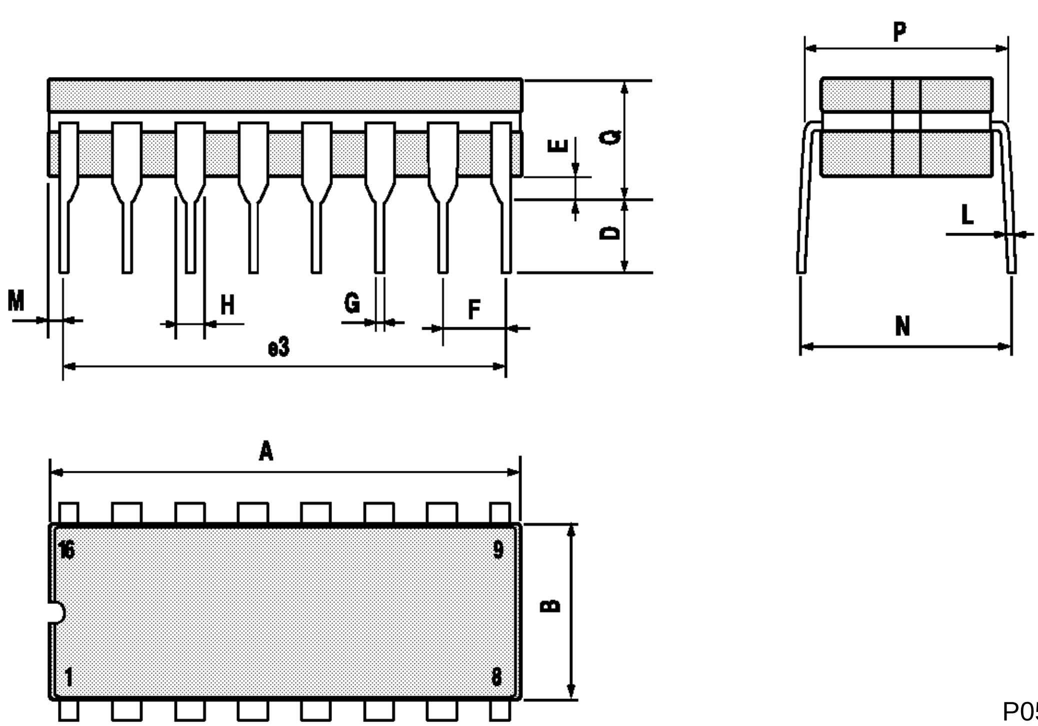
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

Ceramic DIP16/1 MECHANICAL DATA

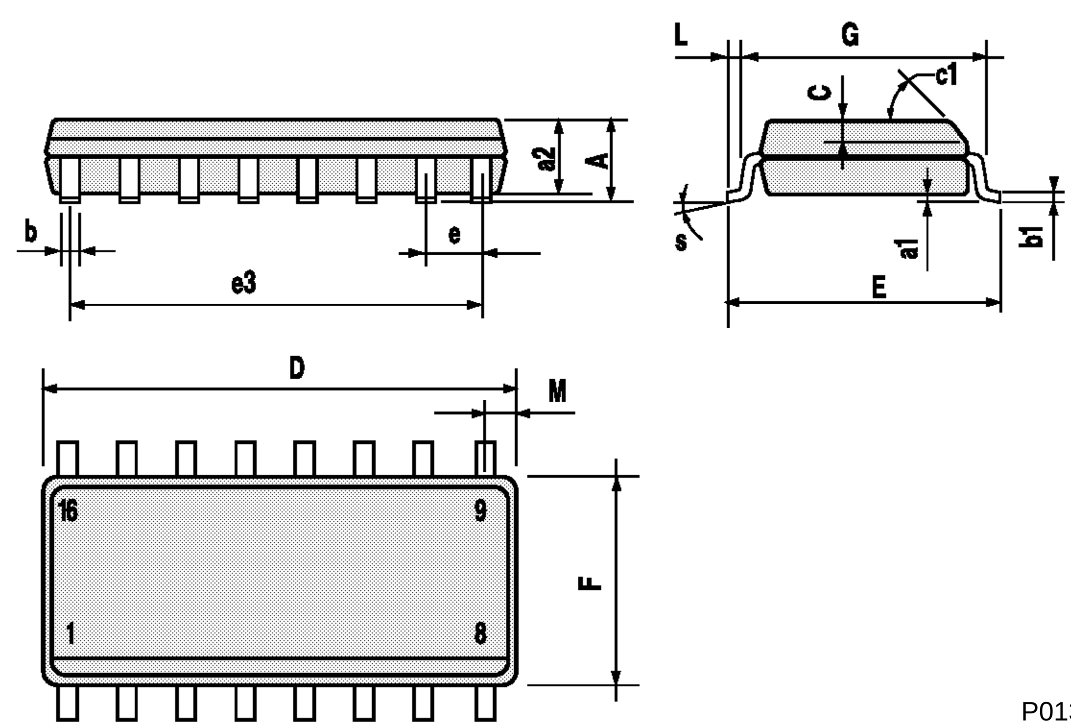
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053D

SO16 (Narrow) MECHANICAL DATA

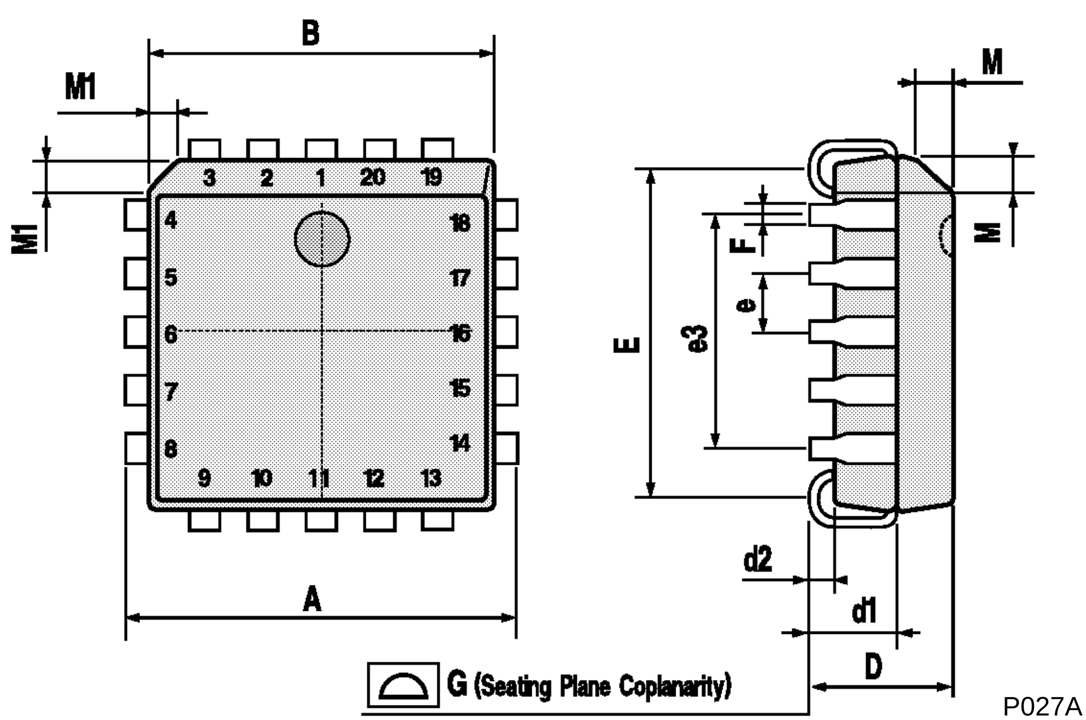
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



P013H

PLCC20 MECHANICAL DATA

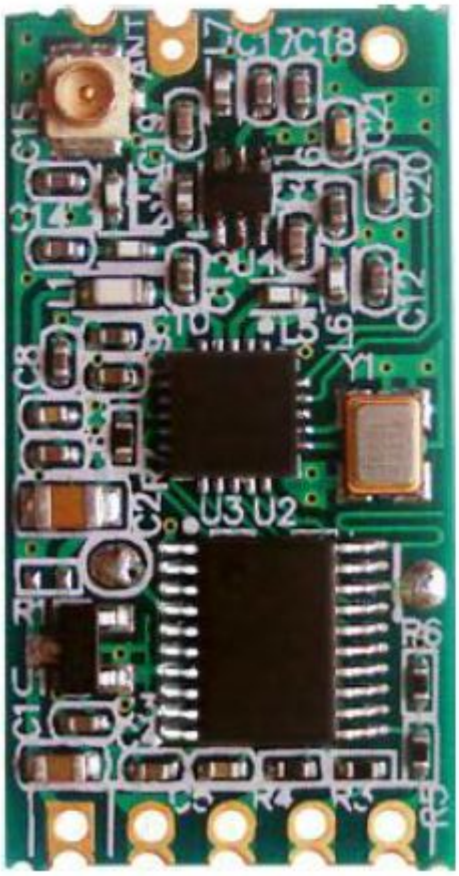
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



SGS-THOMSON MICROELECTRONICS

HC-12 Wireless Serial Port Communication Module

User Manual V1.18



Product Application

- Wireless sensor
- Community building security
- Robot wireless control
- Industrial remote control and telemetering
- Automatic data acquisition
- Container information management
- POS system
- Wireless acquisition of gas meter data
- Vehicle keyless entry system
- PC wireless networking

……

Document: 2012/10

Product Features

- Long-distance wireless transmission (1,000m in open space/baud rate 5,000bps in the air)
- Working frequency range (433.4-473.0MHz, up to 100 communication channels)
- Maximum 100mW (20dBm) transmitting power (8 gears of power can be set)
- Three working modes, adapting to different application situations
- Built-in MCU, performing communication with external device through serial port
- The number of bytes transmitted unlimited to one time
- Update software version through serial port

Product Introduction

HC-12 wireless serial port communication module is a new-generation multichannel embedded wireless data transmission module. Its wireless working frequency band is 433.4-473.0MHz, multiple channels can be set, with the stepping of 400 KHz, and there are totally 100 channels. The maximum transmitting power of module is 100mW (20dBm), the receiving sensitivity is -117dBm at baud rate of 5,000bps in the air, and the communication distance is 1,000m in open space.

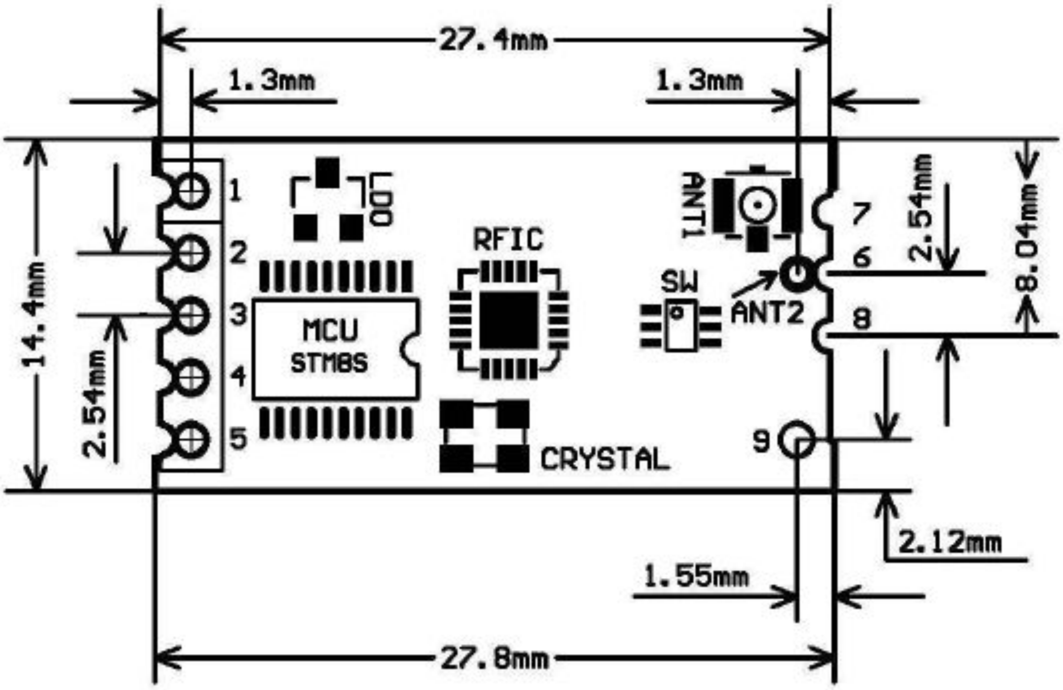
The module is encapsulated with stamp hole, can adopt patch welding, and its dimension is 27.8mm × 14.4mm × 4mm (including antenna cap, excluding spring antenna), so it is very convenient for customers to go into application system. There is a PCB antenna pedestal ANT1 on the module, and user can use external antenna of 433M frequency band through coaxial cable; there is also an antenna solder eye ANT2 in the module, and it is convenient for user to weld spring antenna. User could select one of these antennas according to use requirements.

There is MCU inside the module, and user don't need to program the module separately, and all transparent transmission mode is only responsible for receiving and sending serial port data, so it is convenient to use. The module adopts multiple serial port transparent transmission modes, and user could select them by AT command according to use requirements. The average working current of three modes FU1, FU2 and FU3 in idle state is 80μa, 3.6mA an 16mA respectively, and the maximum working current is 100mA (in transmitting state).

Product Configuration

Standard configuration of HC-12 module only contains one 433MHz-frequency-band wireless communication module with IPEX20279-001E-03 standard RF socket. The optional accessories are 433MHz-frequency-band spring antenna, IPEX-to-BNC coaxial cable and matching 433MHz-frequency-band omni-directional rubber antenna of BNC connector. User could purchase them according to use requirements.

Product Dimension



Definition of Pins

HC-12 module can adopt patch welding, or weld 2.54mm-spacing pin header, and directly insert it onto user's PCB. The module totally has nine pins and one RF antenna pedestal ANT1, and their definitions are as shown in the table below:

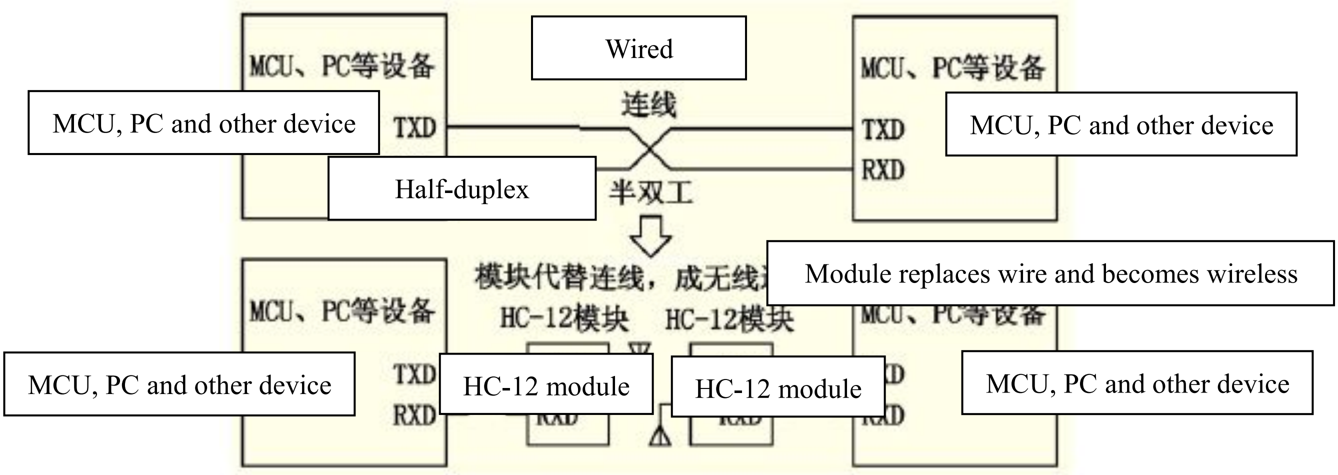
Pin	Definition	I/O direction	Note
1	VCC		Power supply input, DC3.2V-5.5V, with load capacity not less than 200mA. (Note: If the module is working in transmitting state for a long time, it is suggested that one 1N4007 diode should be connected in series when the power voltage is greater than 4.5V, to avoid heating of built-in LDO of module.)
2	GND		Common ground

3	RXD	Input, weak pull-up	URAT input port, TTL level; 1k resistance has been connected in series inside
4	TXD	Output	URAT output port, TTL level; 1k resistance has been connected in series inside
5	SET	Input, internal 10k pull-up resistance	Parameter setting control pin, valid for low level; 1k resistance has been connected in series inside
6	ANT	Input/output	433MHz antenna pin
7	GND		Common ground
8	GND		Common ground
9	NC		No connection, used in fixing, compatible with HC-11 module pin position
ANT1	ANT	Input/output	IPEX20279-001E-03 antenna socket
ANT2	ANT	Input/output	433MHz spring antenna solder eye

Pints 1-6 have two bonding pads respectively, and the outer half-hole bonding pad is used in patch welding. When the inner bonding pad ANT2 of Pin 6 is used in patch welding, the spring antenna can be welded with hands. The inner round-hole bonding pads of Pins 1-5 are used to weld 2.54mm-spacing pin header, and can be directly inserted onto user’s PCB socket.

Wireless serial port transparent transmission

(1) Simple introduction of working p principle



As shown in the above figure, HC-12 module is used in physical wiring when replacing half duplex communication. The left device sends serial port data to module, and after RXD port of left module receives the serial port data, it will automatically send the data into the air via radio wave. The right module can automatically receive the data, and restore, from TXD, the serial port data originally sent by the left device. It is the same from right to left. Only half duplex state is available between modules, and they cannot receive and send data at the same time.

(2) Serial port transparent transmission

HC-12 module has three serial port transparent transmission modes, expressed with FU1, FU2 and FU3 respectively. In the use, all modes are only responsible for receiving and sending serial port data rather than wireless transmission. The default working mode of system is in FU3 full-speed mode, and in this mode, the baud rate in this air can be automatically adjusted according to baud rate of serial port, and the communication distance will be the farthest at the low baud rate. Different modes cannot transmit data to each other, and user could select the optimal mode according to practical circumstances.

The modules are usually used in pairs, and transmit data by means of half duplex. Meanwhile, the transparent transmission mode, serial port baud rate, and wireless communication channel of two paired modules shall be set to be the same. The default setting is FU3, 9,600bps (8-dibit data, no check, one stop bit), CH001 (433.4MHz).

Use the number of bytes continuously sent to serial port of module unlimited to one time. However, considering ambient interference and other factors, if thousands of data size is sent continuously at a time, some number of bytes may be lost. Therefore, the upper computer shall have response and resending mechanism, to avoid information loss.

(3) Three serial port transparent transmission modes

When HC-12 module leaves the factory, its default serial port transparent transmission mode is FU3. Then the module is in full-speed state, and the idle current is about

16mA. In this mode, the module can automatically adjust the baud rate of wireless transmission in the air according to serial port baud rate, and the corresponding relationship is as shown in the table below:

Serial port baud rate	1,200bps	2,400bps	4,800bps	9,600bps	19,200bps	38,400bps	57,600bps	115,200bps
Baud rate in the air	5,000bps		15,000bps		58,000bps		236,000bps	

To get the farthest communication distance, the serial port baud rate can be set to be low. For short-time transmission of mass data, set the serial port baud rate to be high, but the communication distance will be reduced accordingly.

The receiving sensitivity of module at different baud rates in the air is as shown in the table below:

Baud rate in the air	5,000bps	15,000bps	58,000bps	236,000bps
Wireless receiving sensitivity	-117dBm	-112dBm	-107dBm	-100dBm

Generally, every time the receiving sensitivity is reduced by 6dB, the communication distance will be reduced by half.

When "SET" pin of module is at low level, the serial port transparent transmission mode can be set through AT command (see the introduction in the following chapter for details).

FU1 mode is relatively power saving mode, and the idle working current of this mode is about 3.6mA. In this mode, the module can also set eight types of serial port baud rate as shown in the above table, but the baud rate in the air is uniform, 250,000bps.
FU2 mode is power saving mode, and the idle working current of this mode is about 80μA. In this mode, the module only supports baud rates of 1,200bps, 2,400bps and 4,800bps, and the baud rate in the air is uniform, 250,000bps. If the module is set to be other serial port baud rate, the module cannot conduct communication normally.

Meanwhile, when the module is set to be FU2 mode in FU1 and FU3 mode, the baud rate exceeding 4,800bps will be automatically reduced to be 4,800bps. In FU2 mode, the sending time interval of data package cannot be too short; otherwise, the data will be lost. It is suggested that the sending time interval of data package should not be less than 1sec.

The following gives some characteristics reference values of various modes:

Mode	FU1	FU2	FU3	Remark
Idle current	3.6mA	80μA	16mA	Average value
Transmission time delay	15-25mS	500mS	4-80mS	Sending one byte
Loopback test time delay 1	31mS			Serial port baud rate 9,600, sending one byte
Loopback test time delay 2	31mS			Serial port baud rate 9,600, sending ten bytes

Note: Loopback test time delay means the duration from the time of, after conducting short circuit on TX and RX pins of one module and sending serial port data to the other module, starting to send serial port data to the other module to the time that the returned data appear at TX pin of the other module.

Module Parameter Setting AT Command

AT command is used to set the module parameters and switch the module functions, and after setting, it will be valid only after exiting from setting state. Meanwhile, modification of parameters and functions will not be lost in case of power failure.

(1) Command mode entering

The first way to enter: in normal use (energized), put Pin 5 “SET” in low level;

The second way to enter: disconnect power supply, first put Pin 5 “Set” in low level, and then energize it;

Either of the above two ways can make the module enter AT command mode; release it (not put pin “SET” in low level), and exit from the command mode. If the module function is changed after exiting from command mode, it will be switched to corresponding functional status.

In the second way, the module enters AT in the serial port format of 9,600, N, 1 constantly.

(2) Command instruction

①. AT

Test command.

e.g.:
Send “AT” command to module, and the module returns “OK”.

②AT+Bxxxx
Change the serial port baud rate. The baud rate can be set to be 1,200bps, 2,400bps, 4,800bps, 9,600bps, 19,200bps, 38,400bps, 57,600bps, and 115,200bps. The default value is 9,600bps.
e.g.: To set serial port baud rate of module to be 19,200bps, first send “AT+B19200” command to module, and the module returns “OK+B19200”.

③AT+Cxxxx
Change wireless communication channel, optional from 001 to 127 (for the wireless channel exceeding 100, the communication distance cannot be ensured). The default value of wireless channel is 001, and the working frequency is 433.4MHz. The channel stepping is 400KHz, and the working frequency of Channel 100 is 473.0MHz.
e.g.:
To set the module to work at Channel 21, first send “AT+C021” command to the module, and the module returns “COK+C021”. After exiting from the command mode, the module will work at Channel 21, and the working frequency is 441.4MHz.
Note: As the wireless receiving sensitivity of HC-12 module is relatively high, when the serial port baud rate is greater than 9,600bps, five adjacent channels shall be staggered to use. When the serial port baud rate is not greater than 9,600bps, in short-distance (within 10m) communication, also five adjacent channels shall be staggered to use.

④AT+FUx
Change serial port transparent transmission mode of module and three modes are available, namely, FU1, FU2 and FU3. The default mode of module is FU3, and only when serial port transparent transmission mode of two modules is set to be the same, can normal communication be available. For detailed introduction, please see the above “wireless serial port transparent transmission”.
e.g.:
Send “AT+FU1” to module, and the module returns “AT+0K”.

⑤AT+Px
Set transmitting power of module, x is optional from 1 to 8, and the corresponding transmitting power of module is as shown below:

x value	1	2	3	4	5	6	7	8
Transmitting power of module (dBm)	-1	2	5	8	11	14	17	20

The default value is 8, and the higher the transmitting power is, the farther the communication distance is. When the transmitting power level is set to be 1, the transmitting power is the minimum. Generally speaking, every time the transmitting power is reduced by 6dB, the communication distance will be reduced by half.
e.g.:
Send “AT+P5” command to module, and the module returns “OK+P5”. After exiting from the command code, the transmitting power of module is +11dBm.

⑥AT+Ry
Obtain single parameter of module, y is any letter among B, C, F and P, respectively representing: baud rate, communication channel, serial port transparent transmission mode, and transmitting power.
Example 1:
Send “AT+RB” to module, and if the module returns “OK+B9600”, it is inquired that the serial port baud rate of module is 9,600bps.
Example 2:
Send “AT+RC” command to module, and if the module returns “OK+RC001”, it is inquired that the communication channel of module is 001.
Example 3:
Send “AT+RF” command to module, and if the module returns “OK+FU3”, it is inquired that the module is working in serial port transparent transmission mode 3.
Example 4:
Send “AT+RP” command to module, and if the module returns “OK+RP: +20dBm”, it is inquired that the transmitting power of module is +20dBm.

⑦AT+RX
Obtain all parameters of module. Return serial port transparent transmission mode, serial port baud rate, communication channel, and transmitting power in order.
e.g.:
Send “AT+RX” command to module, and the module returns “OK+FU3\r\n OK+B9600\r\n OK+C001\r\n OK+RP: +20dBm\r\n”. (“\r\n” means return\newline)

⑧AT+Uxxx
Set data bits, check bit and stop bit of serial port communication. For check bit, N means no check, O means odd check, and E means even check. For stop bit, 1 means one stop bit, 2 means two stop bits, and 3 means 1.5 stop bits.
e.g.:
To send serial port format to be eight data bits, odd check, and one stop bit, please Send “AT+U8O1” to module, and the module returns “OK+U8O1”.

⑨AT+V
Inquire firmware version information of module.
e.g.:
Send “AT+V” command to module, and the module returns “HC-12_V1.1”.

⑩AT+SLEEP

After receiving the command, the module enters sleep mode after exiting from AT, the working current is about 22μA, and this mode doesn't allow serial port data transmission. Then enter AT setting state again, and the module will exit from sleep mode automatically.

e.g.:

When wireless data transmission is not needed, to save power, send "AT+SLEEP" command to module, and the module returns "OK+SLEEP".

⑾AT+DEFAULT

Set serial port baud rate, communication channel, and serial port transparent transmission mode to be default value.

e.g.:

Send "AT+DEFAULT" to module, and the module returns "OK+DEFAULT", and the default vale is restored. The serial port baud rate is 9,600bps, communication channel is C001, and serial port transparent transmission mode is FU3.

⑿AT+UPDATE

Put the module in the status of waiting for software update.

After sending the command, the module will not respond to command any more, until it is re-energized.

After sending the command, please close the serial port assistant, and turn on HC-1X updater to update the software. For detailed operating method, please refer to the following "software update" introduction.

3W Ultra-small Power Module

PM03/PM01/PM09/PM12

Version: V2.21 Date: Oct. 2018 Made by Shenzhen Hi-Link Electronic Co., Ltd

Catalogue

1. Ultra-small Power Module

3W ultra-small series of power module is a small volume, high efficiency module power supply designed by Hi-Link Electronics. With the global input voltage range, low temperature rise, low power consumption, high efficiency, high reliability, high security isolation and so on. Has been widely used in smart home, automation, communications equipment, instrumentation and other industries.

2. Product Model

MODEL	**Dimension** (mm)	**Output power** (W)	**Output voltage** (V)	**Output current** (mA)	Notes
HLK-PM03	34*20*15	3	3.3	1000	
HLK-PM01		3	5	600	
HLK-PM09		3	9	330	Need customize
HLK-PM12		3	12	250	

3. Product Features

1. Ultra-thin, ultra-small, the industry's smallest volume;
2. Global universal input voltage (90 ~ 245Vac);
3. Low-power, green, no-load loss <0.1W;
4. Low ripple, low noise;
5. Good output short circuit and overcurrent protection and self recovery;
6. High efficiency, high power density;
7. Input and output isolation voltage 3000Vac;
8. 100% full load aging and testing;
9. High reliability, long life design, continuous working time is greater than 100,000 hours;
10. Meet UL, CE requirements; product design to meet EMC and safety testing requirement;
11. Using high-quality environmentally friendly waterproof plastic potting, moisture, vibration, water and dust to meet IP65 standards;
12. Economic solutions, cost-effective

13. No external circuit to work

14. 1 year quality guarantee period.

4. Environmental Conditions

Project name	Technical indicators	Unit	Notes
Working temperature	-25—+60	℃	
Storage temperature	-40—+80	℃	
Relative humidity	5—95	%	
Thermal methods	Natural cooling		
Atmospheric pressure	80—106	Kpa	
Altitude	≤2000	m	
Vibration	Vibration coefficient 10~500Hz,2G10min./1cycle, 60min.each along X,Y,Z axes		Meet the second-class road transport requirement

5. Electrical Characteristics

5.1. Input characteristics

Project Name	Technical Requirements	Unit	Notes
Rated input voltage	90-245	Vac	
Input voltage range	85-264	Vac	Or 70-350Vdc
The maximum input current	≤0.2	A	
Input inrush current	≤10	A	
The maximum input voltage	≤270	Vac	

Input soft start	≤50	mS	
Input low voltage efficiency	Vin=110Vac，output full load≥69	%	
Input high voltage efficiency	Vin=220Vac，output full load≥70	%	
Long-term reliability	MTBF≥100，000	h	
External fuse recommended	0.5A/250Vac		slow blow

Note：Test at room temperature

5.2. Output characteristics (3.3V/1000mA)

Project Name	Technical Requirements	Unit	Notes
No-load rated output voltage	3.3±0.1	Vdc	
Full load rated output voltage	3.3±0.2	Vdc	
Short time maximum output current	≥1200	mA	
Long time maximum output current	≥1000	mA	
Voltage regulation	±0.2	%	
Load regulation	±0.5	%	
Output ripple and noise (mVp-p)	≤50 Rated input voltage, output full load. With 20MHz bandwidth oscilloscope, Load side 10uF and 0.1uF capacitance test.	mV	
Switch overshoot amplitude	(Rated input voltage, output plus 10% load) ≤5	%Vo	
Output over-current protection	Output the maximum load of 150-200%	A	
Output short circuit protection	Direct output when the normal short-circuit, short circuit removed automatically resume normal work		Undamaged machine

5.3. Output characteristics(5V/600mA)

Project Name	Technical Requirements	Unit	Notes
No-load rated output voltage	5.0±0.1	Vdc	
Full load rated output voltage	5.0±0.2	Vdc	
Short time maximum output current	≥800	mA	
Long time maximum output current	≥600	mA	
Voltage regulation	±0.2	%	
Load regulation	±0.5	%	
Output ripple and noise (mVp-p)	≤50 Rated input voltage, output full load. With 20MHz bandwidth oscilloscope, Load side 10uF and 0.1uF capacitance test.	mV	
Switch overshoot amplitude	(Rated input voltage, output plus 10% load) ≤5	%V_O	
Output over-current protection	Output the maximum load of 150-200%	A	
Output short circuit protection	Direct output when the normal short-circuit, short circuit removed automatically resume normal work		Undamaged machine

5.4. Output characteristics(9V/330mA)

Project Name	Technical Requirements	Unit	Notes
No-load rated output voltage	9.0±0.1	Vdc	
Full load rated output	9.0±0.2	Vdc	

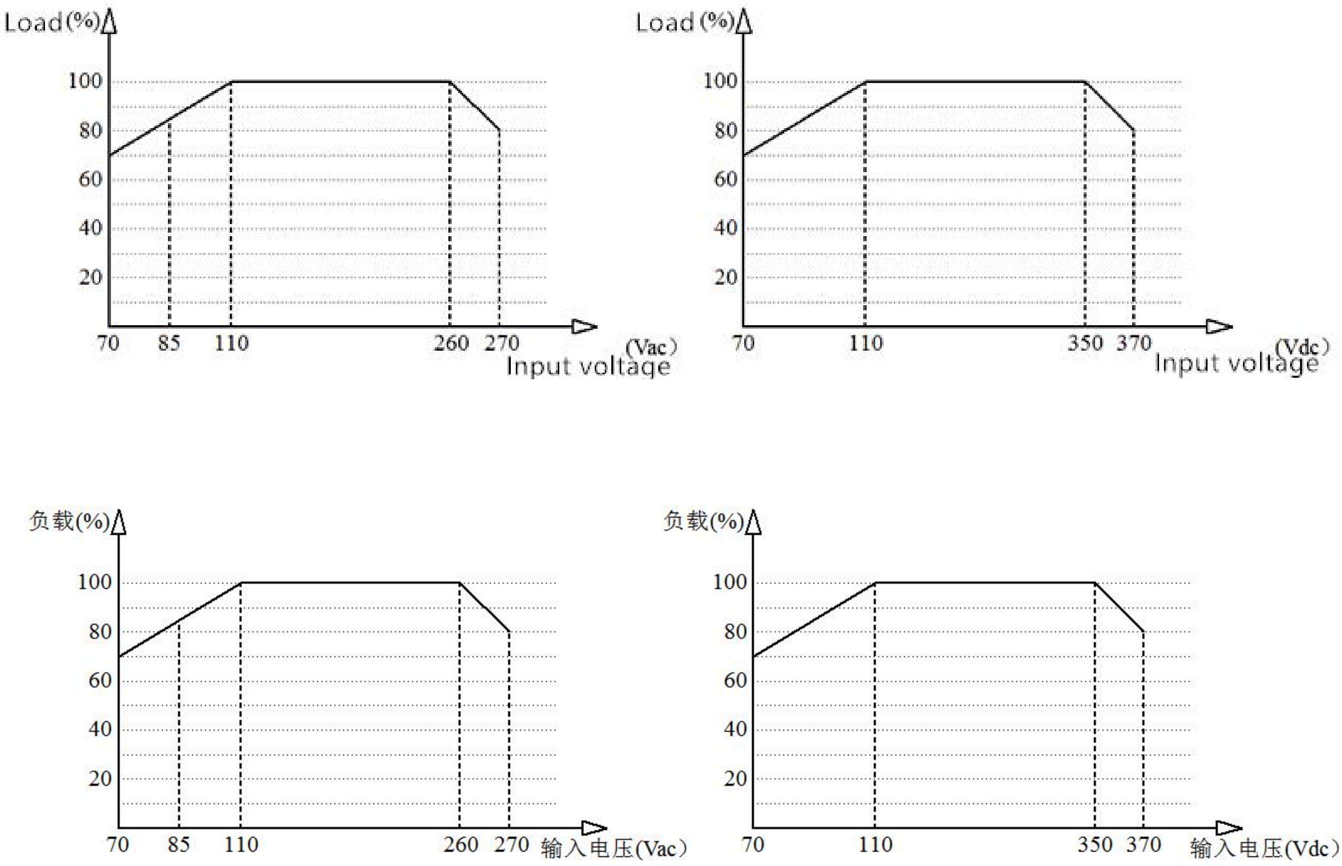
voltage			
Short time maximum output current	≥450	mA	
Long time maximum output current	≥330	mA	
Voltage regulation	±0.2	%	
Load regulation	±0.5	%	
Output ripple and noise (mVp-p)	≤70 Rated input voltage, output full load. With 20MHz bandwidth oscilloscope, Load side 10uF and 0.1uF capacitance test.	mV	
Switch overshoot amplitude	(Rated input voltage, output plus 10% load) ≤5	%Vo	
Output over-current protection	Output the maximum load of 110-150%	A	
Output short circuit protection	Direct output when the normal short-circuit, short circuit removed automatically resume normal work		Undamaged machine

5.5. Output characteristics(12V/250mA)

Project Name	Technical Requirements	Unit	Notes
No-load rated output voltage	12.0±0.1	Vdc	
Full load rated output voltage	12.0±0.2	Vdc	
Short time maximum output current	≥350	mA	
Long time maximum output current	≥250	mA	
Voltage regulation	±0.2	%	
Load regulation	±0.5	%	

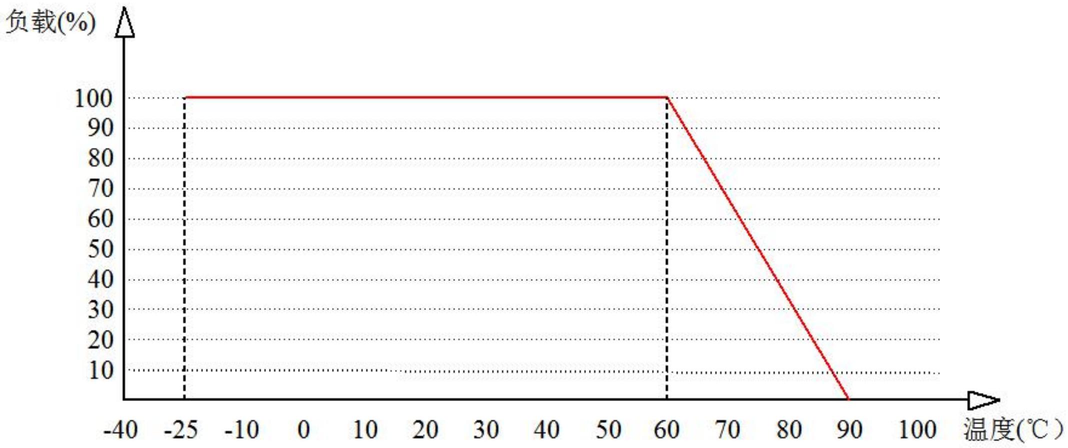
Output ripple and noise (mVp-p)	≤70 Rated input voltage, output full load. With 20MHz bandwidth oscilloscope, Load side 10uF and 0.1uF capacitance test.	mV	
Switch overshoot amplitude	(Rated input voltage, output plus 10% load) ≤5	%V_O	
Output over-current protection	Output the maximum load of 110-150%	A	
Output short circuit protection	Direct output when the normal short-circuit, short circuit removed automatically resume normal work		Undamaged machine

6. Input voltage and load characteristics

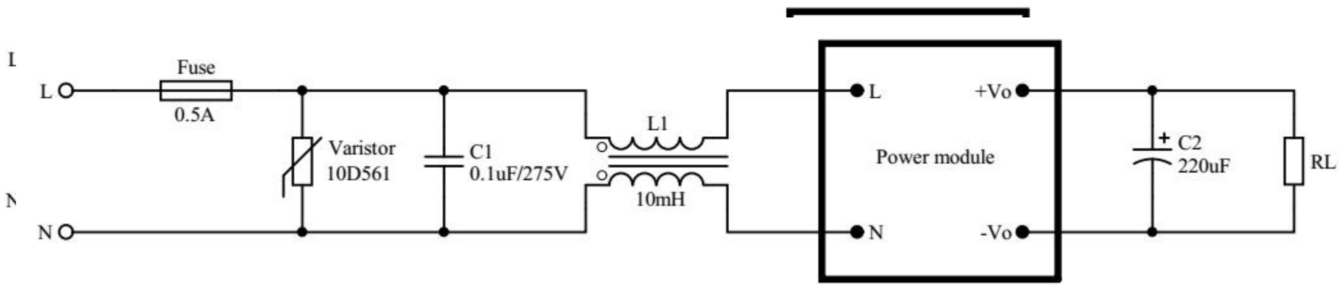


Input voltage and load characteristics curve

7. Working Environment Temperature And Load Characteristics

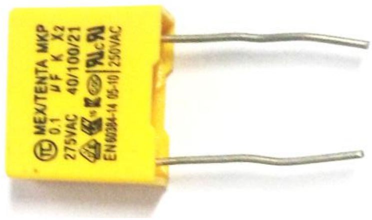


8. Typical Application Circuit



Input section

Component number/ Recommended device	Function	Value
Fuse	protect the circuit from damage when the module is abnormal.	0.5A/250Vac，slow blow
Varistor	Protect the module do not damaged in the accumulative surge	10D561K
C1/Safety capacitor	Filtering safety protection（EMC certification）	0.1uF/275Vac
L1/Common mode choke	EMI filtering	Sense value 10-15mH，current 70-500mA

 Safety capacitor	 Common mode choke

Note：

- Fuses and varistor for the basic protection circuit (Received).
- To pass certification, safety capacitor and common mode inductance can not be omitted.

Output section

Component number/ Recommended device	Function	Value
C2/ Filtering capacitor	Filtering，the output AC signal can be maintain within 30mV	Aluminum electrolytic capacitors，capacitance range 100-220uF，Pressure drop>75%
RL/ Load	Load	

Note：C2 filtering capacitor can bring down the output signal from the original 50mV to less than 30mV.

9. Safety Features

9.1. Certification

The product design meet UL, CE safety certification requirements. (Though the UL and CE certificates need to be done by client)

9.2. Safety and electromagnetic compatibility:

- Design of Input end fulfills the 0.5A security of UL certification；
- PCB board designed as double-sided copper clad plate, the material fireproof rating 94-V0 level；
- Safety standard in line with UL1012, EN60950, UL60950

- Insulation Voltage I/P-O/P:2500Vac
- Insulation Resistor I/P-O/P>100M Ohms/500Vdc 25℃ 70% RH
- Conductivity and Radiation meet EN55011, EN55022 (CISPR22)
- Electrostatic discharge IEC/EN 61000-4-2 level 4 8kV/15kV
- RF Radiation Immunity meet the standard IEC/EN 61000-4-3 (Check details in Application Notes)

9.3. Temperature safety design:

The maximum temperature rise of the power supply capacitor, main converter and other inner surfaces at room temperature does not exceed 90 ℃; the maximum temperature rise of the shell surface does not exceed 60 ℃.

10. Marking, Packaging, Transportation, Storage

10.1. Marking

10.1.1. Product marking

Place the product's unique bar code logo in the proper location on the product to ensure trace ability of each product's production date, product batch, and more. Its content in line with national standards, industry standards.

10.1.2. Package marking

Product box marked with the name of the manufacturer, site, zip code, product model, factory year, month, day;

Marked with "up", "moisture-proof" and "carefree" and other transport signs, all signs are in line with the provisions of GB 191.

10.2. Products

Products using special plastic boxes separated packaging, with anti-vibration function, and in line with the provisions of GB 3873.

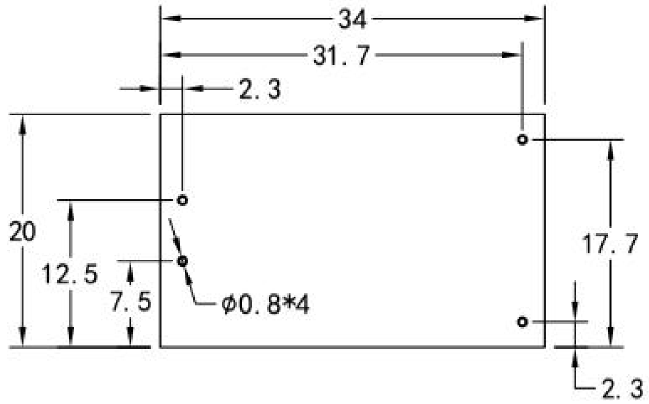
10.3. Packaging

Packaged products can be transported by any means of transportation, should be awning in transit, there should be no violent vibration, impact, etc.

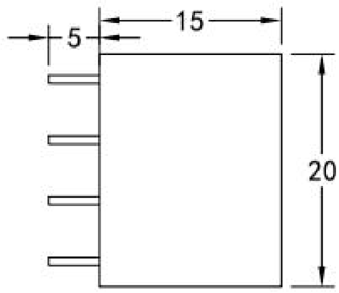
10.4. Storage

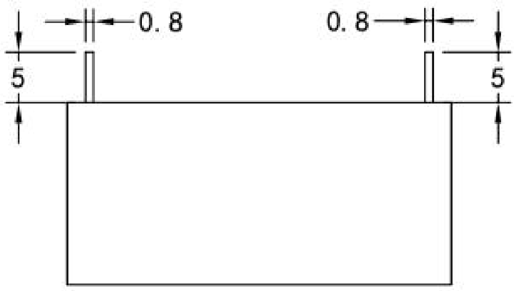
Product storage should be consistent with the provisions of GB 3873.

11. Overall Dimensions And Weight



Pin function	
1	AC
2	AC
3	-V0
4	+V0
Weight：20±1g	





Dimensions Variation:

1. Pin Spacing Variation
2. Pin Length Variation ±0.5mm
3. Pin Diameter Variation-0.2mm

单位：毫米（mm）