RANCANGAN *MONITORING* INTERFERENSI FREKUENSI PADA KOMUNIKASI *VHF AIR TO GROUND* BERBASIS *ARDUINO UNO* MENGGUNAKAN *RECEIVER* RTL-SDR R820T

TUGAS AKHIR

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PROGRAM STUDI DIPLOMA 3 TEKNIK NAVIGASI UDARA
POLITEKNIK PENERBANGAN SURABAYA
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TUGAS AKHIR

Diajukan sebagai Salah Satu Syarat untuk Mendapatkan Gelar Ahli Madya (A.Md.) pada Program Studi Diploma 3 Teknik Navigasi Udara

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PROGRAM STUDI DIPLOMA 3 TEKNIK NAVIGASI UDARA
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LEMBAR PERSETUJUAN

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ABSTRAK

RANCANGAN MONITORING INTERFERENSI FREKUENSI PADA KOMUNIKASI *VHF AIR TO GROUND BERBASIS* ARDUINO UNO MENGGUNAKAN *RECEIVER* RTL-SDR R820T

Oleh :
Arnila Maulidya Avianty
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Komunikasi VHF A/G sangat rentan terhadap interferensi frekuensi komunikasi di bandar udara. Karena dari gangguan frekuensi yang tidak terkendali ini dapat menggangu dalam pemberian pelayanan pemanduan lalu lintas udara. Sesuai Peraturan Menteri Perhubungan nomor : KM 27 Tahun 2005 tentang Pemberlakuan Standard Nasional Indonesia (SNI) 03-7097-2005 mengenai peralatan komunikasi darat udara berfrekuensi amat tinggi (*VHF-Air-Ground*) di bandar udara sebagai standard wajib.

Oleh karena itu perlu adanya alat yang dapat memantau frekuensi komunikasi VHF A/G. Perangkat yang digunakan untuk memantau frekuensi VHF A/G adalah *receiver* RTL-SDR R820T. *Receiver* tersebut merupakan *receiver wideband* dengan *range* frekuensi 24 MHz – 1700 MHz.

Selanjutnya *receiver* RTL-SDR R820T yang sudah terhubung ke laptop dapat masuk kedalam tahap pemrosesan *software*-nya. Dengan menggunakan *software* SDR# maka akan terlihat grafik spektrum frekuensi dan juga dapat mendengarkan audio-nya.

Kata Kunci : RTL-SDR R820T, *Software Defined Radio,* Arduino Uno

ABSTRACT

FREQUENCY INTERFERENCE MONITORING DESIGN ON VHF AIR TO GROUND COMMUNICATION BASED ON ARDUINO UNO USING RTL-SDR R820T RECEIVER

By:

Arnila Maulidya Avianty
NIT: 30218002

VHF A / G communications are very susceptible to communication frequency interference at airports. Because of this uncontrolled frequency disturbance it can interfere with the provision of air traffic guidance services. In accordance with the Minister of Transportation Regulation number: KM 27 of 2005 concerning the Enforcement of the Indonesian National Standard (SNI) 03-7097-2005 regarding very high frequency ground-to-air communication equipment (VHF-Air-Ground) at airports as a mandatory standard.

Therefore it is necessary to have a tool that can monitor the VHF A / G communication frequency. The device used to monitor VHF A / G frequencies is the RTL-SDR R820T receiver. The receiver is a wideband receiver with a frequency range of 24 MHz - 1700 MHz.

Then the RTL-SDR R820T receiver that is already connected to the laptop can enter the software processing stage. By using the SDR # software you will see a graph of the frequency spectrum and can also listen to the audio.

Keywords: *RTL-SDR R820T, Software Defined Radio, Arduino Uno*

PERNYATAAN DAN KEASLIAN HAK CIPTA

Saya yang bertanda tangan dibawah ini :

Nama	:	Arnila Maulidya Avianty
NIT	:	30218002
Program Studi	:	Diploma 3 Teknik Navigasi Udara
Judul Tugas Akhir	:	Rancangan *Monitoring* Interferensi Frekuensi Pada Komunikasi VHF *Air to Ground* Berbasis Arduino Uno Menggunakan RTL-SDR R820T

dengan ini menyatakan bahwa :

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Surabaya, 16 Agustus 2021
Yang membuat pernyataan

Arnila Maulidya Avianty
NIT. 30218002

MOTTO DAN PERSEMBAHAN

MOTTO :

"Dan bahwasanya seorang manusia tiada memperoleh selain apa yang telah diusahakannya" (An Najm : 39)

PERSEMBAHAN :

Persembahan Kepada :

Allah SWT yang telah melimpahkan Rahmat dan HidayahNya
Ayahanda Isnanto dan Ibunda Any Diah Ratnawati tercinta, untuk setiap do'a yang selalu dipanjatkan, serta dukungan di setiap langkahku, tanpa mereka aku bukanlah siapa-siapa. Para pembimbing yang telah membimbingku.
Semua pihak yang telah membantu dan mendukung dalam Penyusunan Tugas Akhir.

KATA PENGANTAR

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Ucapan terima kasih kami sampaikan kepada segenap pihak yang telah membantu selama proses penyusunan Tugas Akhir ini, terutama kepada :

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4. Ibu Dr. Yuyun Suprapto, S.SiT, MM selaku pembimbing I yang selalu memberi semangat, pemahaman, ilmu, dan dukungan moril dalam penyusunan Tugas Akhir.
5. Bapak Totok Warsito, S.SiT, MM selaku pembimbing II yang senantiasa memberi semangat, pemahaman, ilmu, dan dukungan moril dalam penyusunan Tugas Akhir.
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7. Seluruh rekan-rekan D3 Teknik Navigasi Udara Angakatan 11, atas kebersamaan, kekompakan dan kerjasamanya selama ini.
8. Teman-teman seangkatan dan adik-adik kelas, atas dukungan yang diberikan.

Penulis juga menyadari bahwa penulisan Tugas Akhir ini masih jauh dari sempurna. Oleh karena itu, penulis mengharapkan kritik dan saran membangun guna penyempuranaan rancangan ini kedepannya.

Surabaya, 16 Agustus 2021

Penulis

DAFTAR ISI

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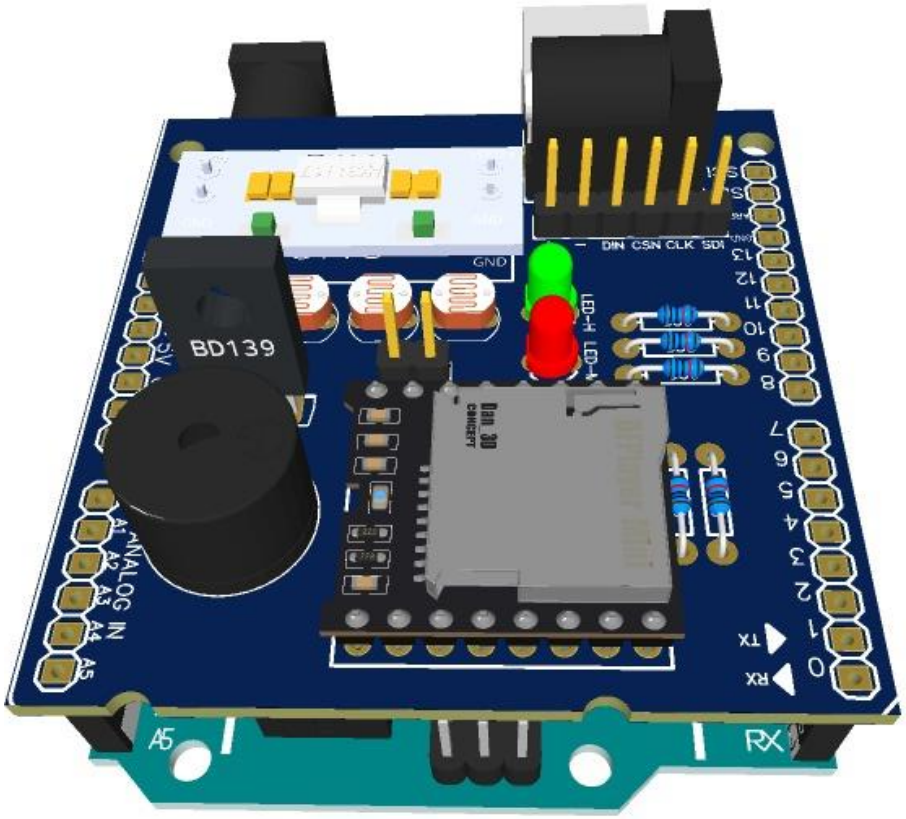
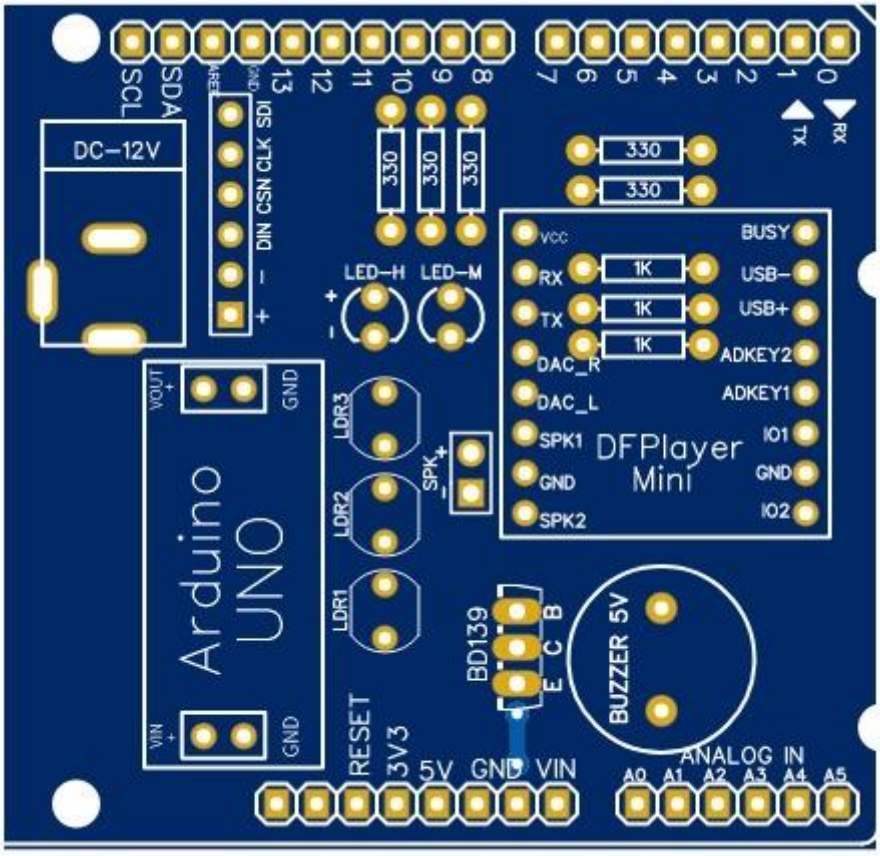
LAMPIRAN A

ARDUINO UNO



Arduino Uno


SCL
SDA
AREF
GND
13
12
11
10
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7
6
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4
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2
1
0
TX
RX
SDI
CLK
CSN
DIN
DC–12V
330
330
330
330
LED–H
LED–M
1K
1K
1K
VCC
RX
TX
DAC_R
DAC_L
SPK1
GND
SPK2
BUSY
USB–
USB+
ADKEY2
ADKEY1
IO1
GND
IO2
DFPlayer
Mini
VOUT
GND
Arduino
UNO
VIN
GND
LDR3
LDR2
LDR1
SPK
BD139
E C B
BUZZER 5V
RESET
3V3
5V
GND
VIN
ANALOG IN
A0 A1 A2 A3 A4 A5

LAMPIRAN B

Program Interferensi Sinyal

```
#include <MD_Parola.h>
#include <MD_MAX72xx.h>
#include <SPI.h>
#include "DFPlayer_Mini_Mp3.h"

#define HARDWARE_TYPE MD_MAX72XX::FC16_HW
#define MAX_DEVICES 4
#define CLK_PIN   11
#define DATA_PIN  12
#define CS_PIN    10

// HARDWARE SPI
//MD_Parola P = MD_Parola(HARDWARE_TYPE, CS_PIN, MAX_DEVICES);
// SOFTWARE SPI
MD_Parola P = MD_Parola(HARDWARE_TYPE, DATA_PIN, CLK_PIN,
CS_PIN, MAX_DEVICES);

uint8_t scrollSpeed = 50;    // default frame delay value
textEffect_t scrollEffect = PA_SCROLL_LEFT;
textPosition_t scrollAlign = PA_LEFT;
uint16_t scrollPause = 500; // in milliseconds

// Global message buffers shared by Serial and Scrolling functions
#define  BUF_SIZE  10
char curMessage[BUF_SIZE] = { "" };
```

```
char Unfriend[BUF_SIZE] = { "UNFRIEND" };
char Friend[BUF_SIZE] = { "FRIEND" };
bool newMessageAvailable = true;

#define BUZZ_PIN 3
#define LEDH_PIN 5
#define LEDM_PIN 6

#define LDR1_PIN A0
#define LDR2_PIN A1
#define LDR3_PIN A2

bool UnfrienDetect = false;
void setup()
{
  Serial.begin(9600);
  pinMode(BUZZ_PIN, OUTPUT);
  pinMode(LEDH_PIN, OUTPUT);
  pinMode(LEDM_PIN, OUTPUT);

  pinMode(LDR1_PIN, INPUT);
  pinMode(LDR2_PIN, INPUT);
  pinMode(LDR3_PIN, INPUT);

  P.begin();
  P.displayText(curMessage, scrollAlign, scrollSpeed, scrollPause, scrollEffect,
scrollEffect);
```

```
mp3_set_serial (Serial);  //set Serial for DFPlayer-mini mp3 module
  delay(1);  //wait 1ms for mp3 module to set volume
  mp3_set_volume (15);

  digitalWrite(LEDH_PIN, HIGH);
  digitalWrite(LEDM_PIN, HIGH);
  digitalWrite(BUZZ_PIN, LOW);
}

#define interval 1000
unsigned long previousmillis, previousmillisBlink, previousmillisAudio = 0;
bool Blink = false;
bool LastBlink;
bool REDON, GREENON = false;
bool LEDRON, LEDGON = false;
void loop()
{
  if (P.displayAnimate())
  { P.displayReset(); }

  unsigned long currentmillis = millis( );
  if(UnfrienDetect)
  {
    if(currentmillis - previousmillisBlink >= 500)
    {
      previousmillisBlink = currentmillis;
      if(Blink) { digitalWrite(BUZZ_PIN, HIGH); Blink = false; }
      else if(!Blink) { digitalWrite(BUZZ_PIN, LOW); Blink = true; }
```

```
}


   if(currentmillis - previousmillisAudio >= 10000)
   {
    previousmillisAudio = currentmillis;
    mp3_play (1);
   }


   if(LEDRON)
   {
    if(REDON)
    {
     digitalWrite(LEDH_PIN, LOW);
     digitalWrite(LEDM_PIN, HIGH); REDON = false;  LEDGON = false;
GREENON = false;
     strcpy(curMessage, Unfriend);
     Serial.println("ITS NOT FRIEND");
     Blink = true;
    }
   }
  }
  else if (!UnfrienDetect)
  {
   if(currentmillis - previousmillisAudio >= 10000)
   {
    previousmillisAudio = currentmillis;
    mp3_play (2);
   }
```

```
if(LEDGON)
   {
    if(GREENON)
    {
      digitalWrite(BUZZ_PIN, LOW);
      digitalWrite(LEDM_PIN, LOW);
      digitalWrite(LEDH_PIN, HIGH); GREENON = false; LEDRON = false;
REDON = false;
      strcpy(curMessage, Friend);
      Serial.println("ITS FRIEND");
    }
   }
  }


  if(currentmillis - previousmillis >= interval)
  {
   previousmillis = currentmillis;
   readLDR();
   if(UnfrienDetect)
   {
    Serial.print("#S|LOGTEST|[");
//     Serial.print(LDR1read); Serial.print(";");
//     Serial.print(LDR2read); Serial.print(";");
    Serial.print(Unfriend); Serial.println("]#");
   }
   else
   {
    Serial.print("#S|LOGTEST|[");
```

```
Serial.print(Friend); Serial.println("]#");
    }
  }
}

#define Interferensi 80
void readLDR()
{
  uint16_t LDR1read = analogRead(LDR1_PIN);
  uint16_t LDR2read = analogRead(LDR2_PIN);
  uint16_t LDR3read = analogRead(LDR3_PIN);

//  Serial.print(LDR1read); Serial.print(";");
//  Serial.print(LDR2read); Serial.print(";");
//  Serial.print(LDR3read);Serial.println();

  if(LDR1read >= 80 || LDR2read >= 80 || LDR3read >= 80)
  {
    UnfrienDetect = true;
    if(!LEDRON) { LEDRON = true; REDON = true; }
  }
  else
  {
    UnfrienDetect = false;
    if(!LEDGON) { LEDGON = true; GREENON = true; }
  }
}
```

LAMPIRAN C

Lampiran 1. Datasheet LDR

SUNROM TECHNOLOGIES
Your Source for Embedded Systems

Email: info@sunrom.com or sunrom@gmail.com
Visit us at http://www.sunrom.com

Document: Datasheet | Date: 28-Jul-08 | Model #: 3190 | Product's Page: www.sunrom.com/p-510.html

Light Dependent Resistor - LDR

Two cadmium sulphide(cds) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. Applications include smoke detection, automatic lighting control, batch counting and burglar alarm systems.

Applications

Photoconductive cells are used in many different types of circuits and applications.

Analog Applications

- Camera Exposure Control
- Auto Slide Focus - dual cell
- Photocopy Machines - density of toner
- Colorimetric Test Equipment
- Densitometer
- Electronic Scales - dual cell
- Automatic Gain Control – modulated light source
- Automated Rear View Mirror

Digital Applications

- Automatic Headlight Dimmer
- Night Light Control
- Oil Burner Flame Out
- Street Light Control
- Absence / Presence (beam breaker)
- Position Sensor

Electrical Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Cell resistance	1000 LUX 10 LUX	- -	400 9	- -	Ohm K Ohm
Dark Resistance	-	-	1	-	M Ohm
Dark Capacitance	-	-	3.5	-	pF
Rise Time	1000 LUX 10 LUX	- -	2.8 18	- -	ms ms
Fall Time	1000 LUX 10 LUX	- -	48 120	- -	ms ms
Voltage AC/DC Peak		-	-	320	V max
Current		-	-	75	mA max
Power Dissipation				100	mW max
Operating Temperature		-60	-	+75	Deg. C

Guide to source illuminations

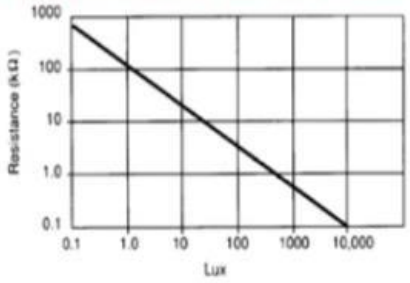
Light source Illumination	LUX
Moonlight	0.1
60W Bulb at 1m	50
1W MES Bulb at 0.1m	100
Fluorescent Lighting	500
Bright Sunlight	30,000

FIGURE 1 CIRCUIT SYMBOL

Sensitivity

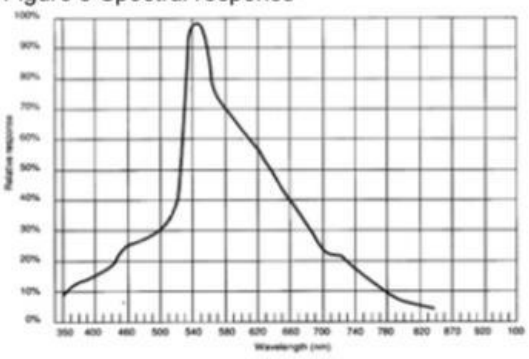
The sensitivity of a photodetector is the relationship between the light falling on the device and the resulting output signal. In the case of a photocell, one is dealing with the relationship between the incident light and the corresponding resistance of the cell.

FIGURE 2 RESISTANCE AS FUNCTION OF ILLUMINATION



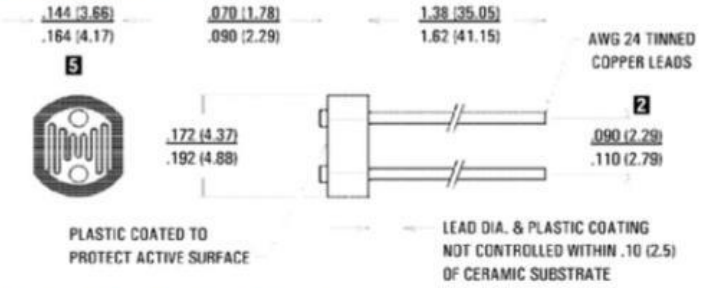
Spectral Response

Figure 3 Spectral response



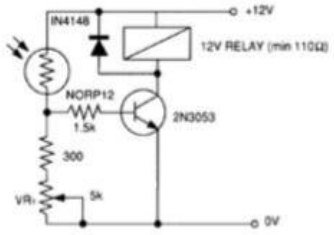
Like the human eye, the relative sensitivity of a photoconductive cell is dependent on the wavelength (color) of the incident light. Each photoconductor material type has its own unique spectral response curve or plot of the relative response of the photocell versus wavelength of light.

Dimensions



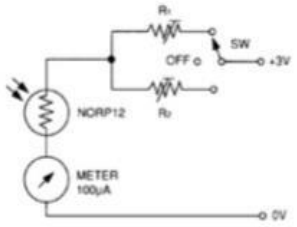
Typical Application Circuits

Figure 6 Sensitive light operated relay



Relay energised when light level increases above the level set by VR_1

Figure 9 Logarithmic law photographic light meter



Typical value R^1 = 100kΩ
R^2 = 200kΩ preset to give two overlapping ranges.
(Calibration should be made against an accurate meter.)

Lampiran 2. RTL-SDR R820T

PRELIMINARY VERSION

Rafael Micro

R820T

High Performance Low Power Advanced Digital TV Silicon Tuner

General Description

In heritage from Rafael Micro's state-of-the-art architecture, the R820T digital silicon tuner achieves the lowest power consumption and the smallest font factor. R820T offers unmatchable RF performance for all digital broadcast television standards including DVB-T, ATSC, DMB-T, ISDB-T,. With innovative AccuTune™ and TrueRF™ mechanisms, R820T provides superior performance in sensitivity, linearity, adjacent channel immunity, and image rejection. The chip embeds a smart power detector to optimize different input power scenarios as well as the spurious free dynamic range.

The R820T is a highly integrated silicon tuner that builds in low noise amplifier (LNA), mixer, fractional PLL, VGA, voltage regulator and tracking filter, eliminating the need for external SAW filters, LNA, balun, and LDO. Thanks the LNA architecture, R820T offers the lowest cost and high performance solution for digital TV application. On-chip LDO, high performance LNA, and small package enable R820T the perfect solution for both cost and font factor sensitive applications.

With proprietary GreenRF techniques, R820T achieves both high performance and the lowest power consumption which perfectly compliant with the worldwide trend. The R820T comes in a small and thin QFN RoHs compliant package.

Features

- Support all digital TV standards: DVB-T, ATSC, DTMB and ISDB-T.
- Lowest BOM cost WITHOUT external SAW filters, LNA, balun, LDO, and adjustable parts.
- Low cost Single-In Digital TV Application
- Compliant with EN 300 744, Nordig 2.2, D-BOOK 7.0, ARIB B21, ABNT 15604, ATSC A74 and GB20600-2006
- Compliant with EN-55020, EN55013 and FCC
- Ultra low power consumption < 178mA
- Single power supply 3.3V
- 2-wired I2C interface
- 24-pin 4x4 QFN lead-free package

Applications

- Terrestrial Digital TV
- Desktop/Laptop PCTV, Mini-card, and USB peripherals
- Set Top Box
- Portable Media Player
- Automobile TV

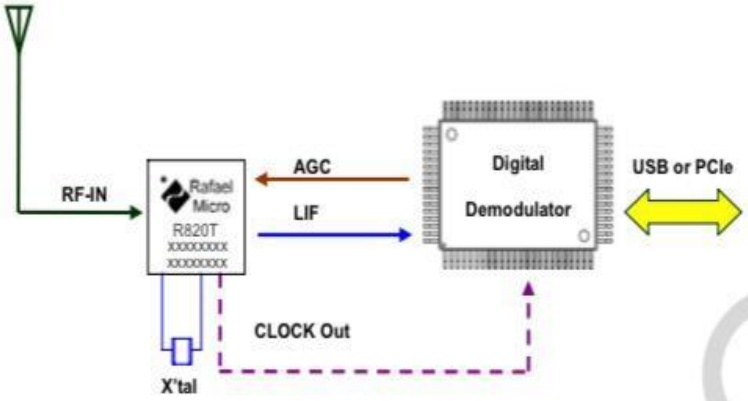
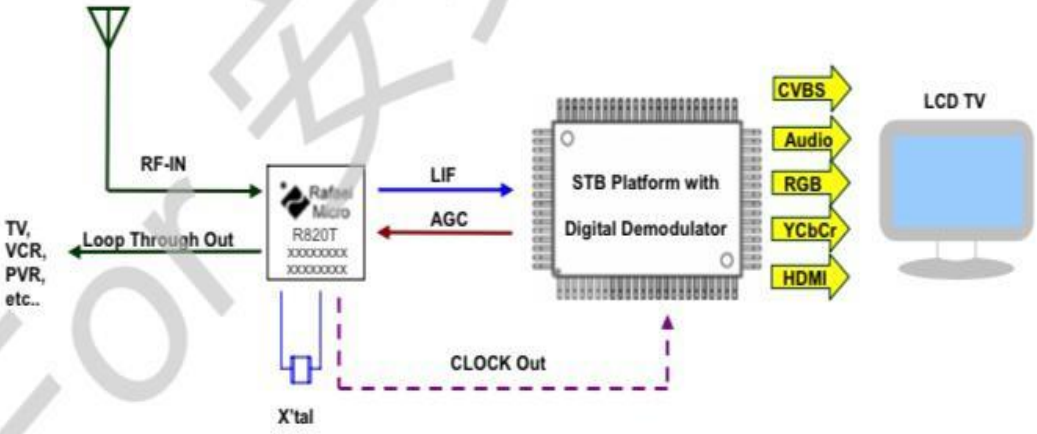
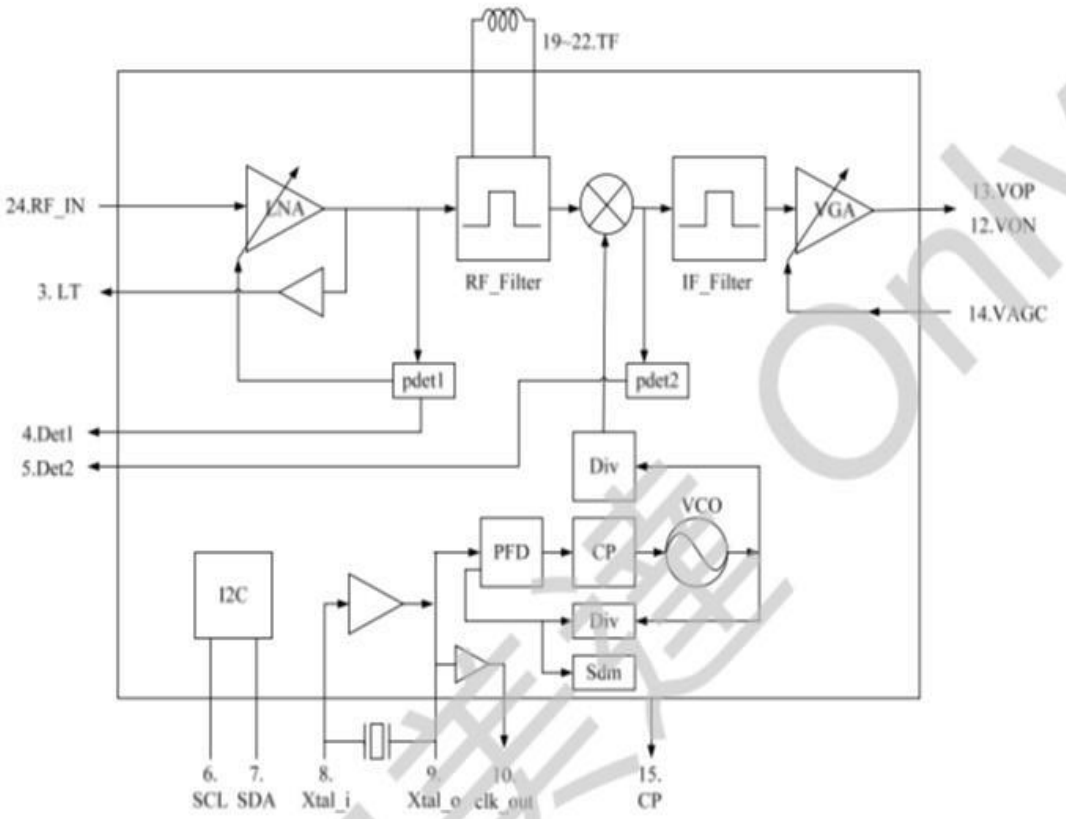


Figure B: Example of Set Top Box Applications



Functional Block Diagram

Figure D: Simplified R820T Block Diagram



■ Quick Reference Data

Typical figures

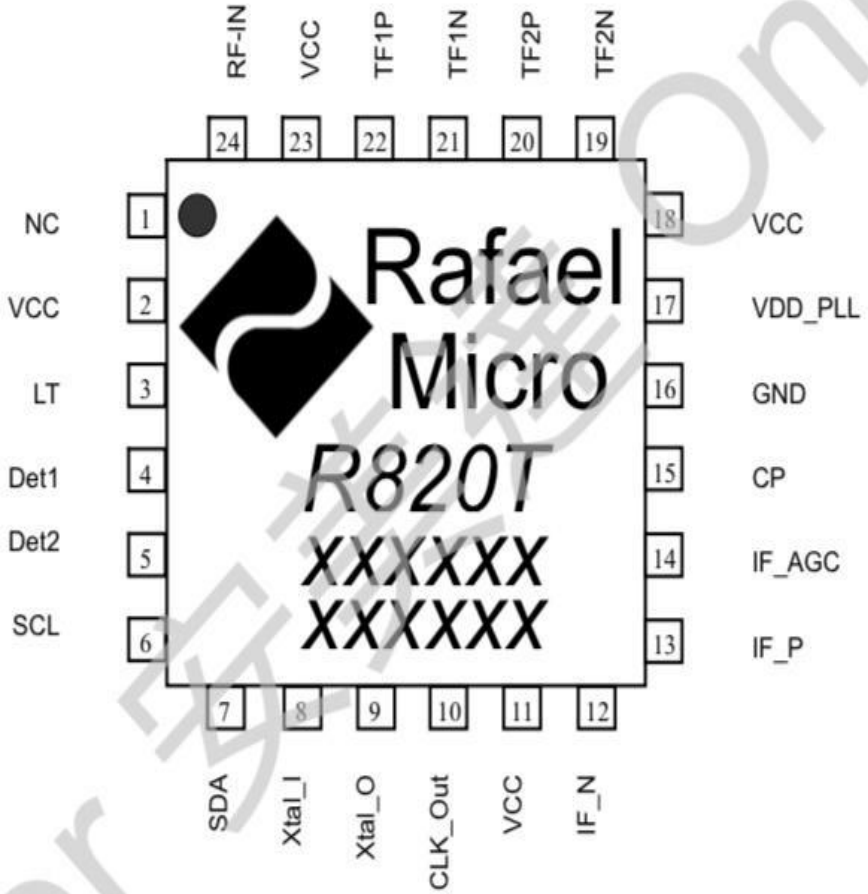
- Frequency range: 42 to 1002 MHz
- Noise figure : 3.5 dB @ RF_IN
- Phase noise: -98 dBc/Hz @ 10 kHz
- Current consumption: ＜178 mA @ 3.3V power supply
- Max input power: +10 dBm
- Image rejection: 65 dBc

note: [dBm]=[dBuV on 75Ω] -108.75dB

2 Pin Description

Pin Allocation

Figure 2-1 : Pin Allocation (note: E-Pad is GND)



Pin Assignment

Table 2-1 : Summary List of Pin Assignment

Pin Number	Symbol	Description
24	RF_In	RF Input
1	NC	Not Connect
2,11,18,23	VCC	Tuner 3.3V voltage input
3	LT	Loop through output
4,5	Detx	Power detector decoupling capacitor
6	SCL	I2C bus, clock input
7	SDA	I2C bus, data input/ output
8	Xtal_I	Crystal oscillator Input
9	Xtal_O	Crystal oscillator Output
10	CLK_Out	Clock output for sharing Crystal oscillator
12	IF_N	IF output
13	IF_P	IF output
14	IF_AGC	IF automatic gain control input
15	CP	PLL charge pump
17	VDD_PLL	PLL 2V supply output decoupling
19,20,21,22	TFxx	Tracking filter, the detail as Figure 2-1: Pin Allocation.
16	GND	Ground
0	GND	Exposed pad

4.3 IF Frequency

R820T receives RF signal and feed through internal low-noise amplifier, power detector, band-pass filter, and image rejection filter. The mixer down-converts the RF signal to a low-IF frequency, which depends on channel bandwidth in different applications. The standard IF filters are implemented for 6/7/8 MHz channel bandwidths.

.

Table 4-1 : IF Frequency Table

	TV Standard	Channel BW	Center Frequency
1	ATSC (Digital)	BW = 6MHz	Fcenter= 4.063MHz
2	DVB-T (Digital)	BW = 6MHz	Fcenter= 3.57MHz
3	DVB-T (Digital)	BW = 7MHz	Fcenter= 4.07MHz
4	DVB-T (Digital)	BW = 7MHz	Fcenter= 4.57MHz
5	DVB-T (Digital)	BW = 8MHz	Fcenter= 4.57MHz
7	ISDB-T (Digital)	BW = 6MHz	Fcenter = 4.063MHz
8	DTMB (Digital)	BW = 8MHz	Fcenter = 4.57MHz

7 Hardware Tolerance Specifications

To achieve better RF performance, hardware tolerance for tracking filter inductors and RF input inductors is highly recommended in the R820T reference design..

Table 7-1 : Value and specification of Tracking filter inductors and RF input inductors
(Reference Figure 4-1: Reference Application Schematic)

Reference	L (nH)	Tolerance	Q Min.	L, Q test frequency	Q at 100 MHz	Q at 300 MHz	Q at 500 MHz	S.R.F. Min.	DCR Max.
L3,	180	0.5 +/- 0.15	8	100 MHz	10	-	-	500 MHz	3.7 ohm
L7	100	0.5 +/- 0.15	8	100 MHz	10	12	-	700 MHz	2.6 ohm
L2,L6	150	0.5 +/- 0.15	8	100 MHz	10	-	-	550 MHz	3.2 ohm
L9	8.2	0.5 +/- 0.15	8	100 MHz	10	27	30	3600MHz	0.4 ohm

Lampiran 3. Datasheet DF Player

DFPLayer Mini

1. Summary

1.1 .Brief Instruction

DFPLayer Mini module is a serial MP3 module provides the perfect integrated MP3, WMV hardware decoding. While the software supports TF card driver, supports FAT16, FAT32 file system. Through simple serial commands to specify music playing, as well as how to play music and other functions, without the cumbersome underlying operating, easy to use, stable and reliable are the most important features of this module.

1.2 .Features

- Support Mp3 and WMV decoding
- Support sampling rate of 8KHz,11.025KHz,12KHz,16KHz,22.05KHz,24KHz,32KHz,44.1KHz,48KHz
- 24-bit DAC output, dynamic range support 90dB, SNR supports 85dB
- Supports FAT16, FAT32 file system, maximum support 32GB TF card
- A variety of control modes, serial mode, AD key control mode
- The broadcast language spots feature, you can pause the background music being played
- Built-in 3W amplifier
- The audio data is sorted by folder; supports up to 100 folders, each folder can be assigned to 1000 songs
- 30 levels volume adjustable, 10 levels EQ adjustable.

1.3 .Application

- Car navigation voice broadcast
- Road transport inspectors, toll stations voice prompts
- Railway station, bus safety inspection voice prompts
- Electricity, communications, financial business hall voice prompts
- Vehicle into and out of the channel verify that the voice prompts
- The public security border control channel voice prompts
- Multi-channel voice alarm or equipment operating guide voice
- The electric tourist car safe driving voice notices
- Electromechanical equipment failure alarm
- Fire alarm voice prompts
- The automatic broadcast equipment, regular broadcast.

2. Module Application Instruction

2.1. Specification Description

Item	Description
MP3Format	1、Support 11172-3 and ISO13813-3 layer3 audio decoding
	2、Support sampling rate (KHZ):8/11.025/12/16/22.05/24/32/44.1/48
	3、Support Normal、Jazz、Classic、Pop、Rock etc
UART Port	Standard Serial; TTL Level; Baud rate adjustable(default baud rate is 9600)
Working Voltage	DC3.2~5.0V; Type :DC4.2V
Standby Current	20mA
Operating Temperature	-40~+70
Humidity	5% ~95%

Table 2.1 Specification Description

3. Serial Communication Protocol

Serial port as a common communication in the industrial control field, we conducted an industrial level of optimization, adding frame checksum, retransmission, error handling, and other measures to significantly strengthen the stability and reliability of communication, and can expansion more powerful RS485 for networking functions on this basis, serial communication baud rate can set as your own, the default baud rate is 9600

3.1. Serial Communication Format

Support for asynchronous serial communication mode via PC serial sending commands
Communication Standard:9600 bps
Data bits :1
Checkout :none
Flow Control :none

Format: $S VER Len CMD Feedback para1 para2 checksum $O		
$S	Start byte 0x7E	Each command feedback begin with $, that is 0x7E
VER	Version	Version Information
Len	the number of bytes after "Len"	Checksums are not counted
CMD	Commands	Indicate the specific operations, such as play / pause, etc.
Feedback	Command feedback	If need for feedback, 1: feedback, 0: no feedback
para1	Parameter 1	Query high data byte
para2	Parameter 2	Query low data byte
checksum	Checksum	Accumulation and verification [not include start bit $]
$O	End bit	End bit 0xEF

For example, if we specify play NORFLASH, you need to send: 7E FF 06 09 00 00 04 FF DD EF
Data length is 6, which are 6 bytes [FF 06 09 00 00 04]. Not counting the start, end, and verification.

3.2 .Serial Communication Commands

1).Directly send commands, no parameters returned

CMD	Function Description	Parameters(16 bit)
0x01	Next	
0x02	Previous	
0x03	Specify tracking(NUM)	0-2999
0x04	Increase volume	
0x05	Decrease volume	
0x06	Specify volume	0-30
0x07	Specify EQ(0/1/2/3/4/5)	Normal/Pop/Rock/Jazz/Classic/Base
0x08	Specify playback mode (0/1/2/3)	Repeat/folder repeat/single repeat/ random

2.2 .Pin Description

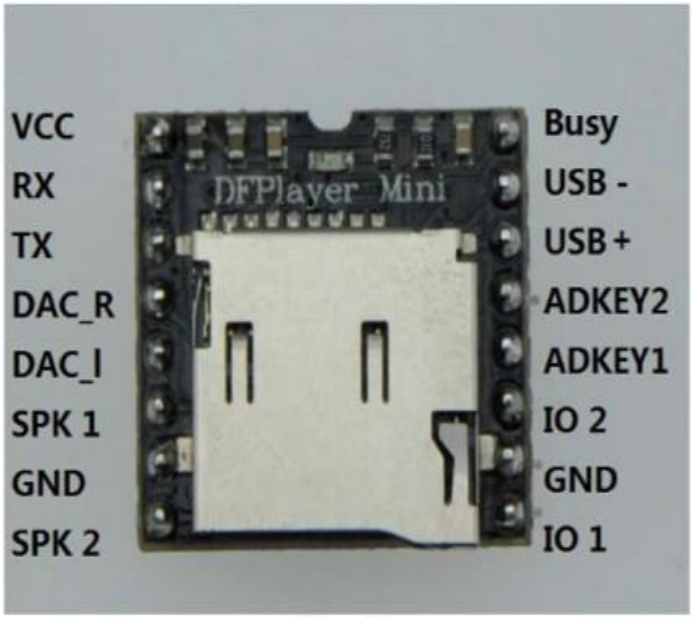


Figure 2.1

No	Pin	Description	Note
1	VCC	Input Voltage	DC3.2~5.0V;Type: DC4.2V
2	RX	UART serial input	
3	TX	UART serial output	
4	DAC_R	Audio output right channel	Drive earphone and amplifier
5	DAC_L	Audio output left channel	Drive earphone and amplifier
6	SPK2	Speaker-	Drive speaker less than 3W
7	GND	Ground	Power GND
8	SPK1	Speaker+	Drive speaker less than 3W
9	IO1	Trigger port 1	Short press to play previous（long press to decrease volume）
10	GND	Ground	Power GND
11	IO2	Trigger port 2	Short press to play next（long press to increase volume）
12	ADKEY1	AD Port 1	Trigger play first segment
13	ADKEY2	AD Port 2	Trigger play fifth segment
14	USB+	USB+ DP	USB Port
15	USB-	USB- DM	USB Port
16	BUSY	Playing Status	Low means playing \High means no

Table 2.2 Pin Description

Figure 3.1folder name

Figure 3.2 file name

3.5. Key Ports

We use the AD module keys, instead of the traditional method of matrix keyboard connection, it is to take advantage of increasingly powerful MCU AD functionality, Our module default configuration 2 AD port, 20 key resistance distribution, if used in strong electromagnetic interference or strong inductive, capacitive load of the occasion, please refer to our "Notes."

1).Refer diagram

Figure 3.3 ad key refer

2)、20 function keys allocation table

Key	Short Push	Long Push	Description
K1	Play Mode		Switch to interrupt / non interrupted
K2	Playback device switches		U/TF/SPI/Sleep
K3	Operating Mode		All cycle
K4	Play/Pause		
K5	Previous	Vol+	
K6	Next	Vol-	
K7	4	Repeat play tracking 4	Long push always to repeat play
K8	3	Repeat play tracking 3	Long push always to repeat play

K9	2	Repeat play tracking 2	Long push always to repeat play
K10	1	Repeat play tracking 1	Long push always to repeat play
K11	5	Repeat play tracking 5	Long push always to repeat play
K12	6	Repeat play tracking 6	Long push always to repeat play
K13	7	Repeat play tracking 7	Long push always to repeat play
K14	8	Repeat play tracking 8	Long push always to repeat play
K15	9	Repeat play tracking 9	Long push always to repeat play
K16	10	Repeat play tracking 10	Long push always to repeat play
K17	11	Repeat play tracking 11	Long push always to repeat play
K18	12	Repeat play tracking 12	Long push always to repeat play
K19	13	Repeat play tracking 13	Long push always to repeat play
K20	14	Repeat play tracking 14	Long push always to repeat play

4、Application Circuit

4.1 Serial Communication Connect

Module's serial port is 3.3V TTL level, so the default interface level is 3.3V. If the MCU system is 5V. It is recommended connect a 1K resistor in series.

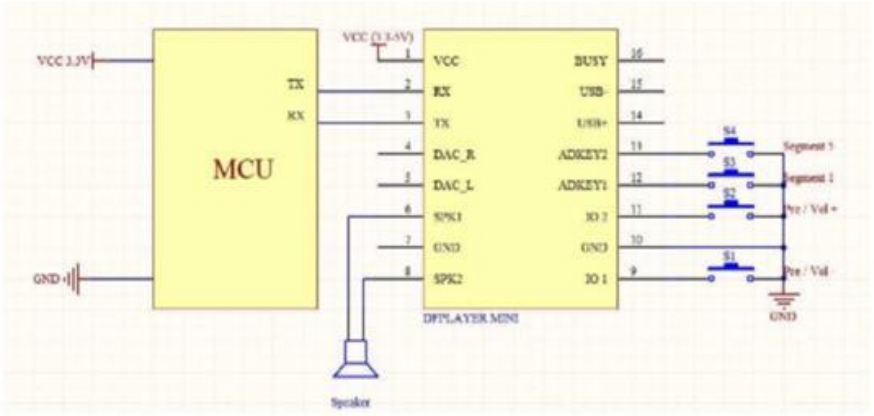


Figure 4.1 Serial Connect (3.3V)

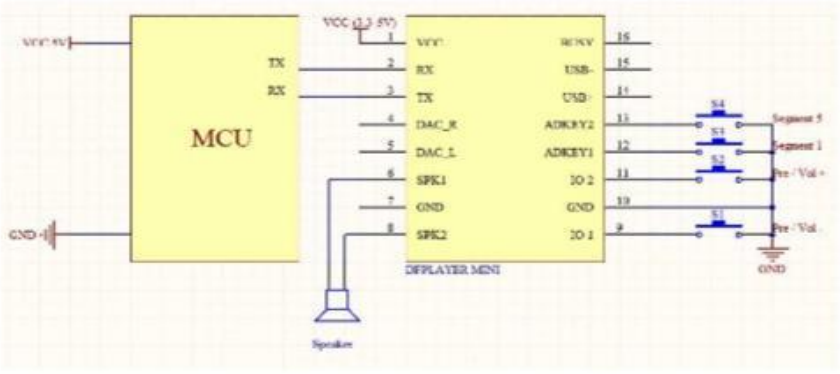


Figure 4.2 Serial Connect (5v)

4.2. Other Refer Diagram

Figure 4.3 headset connect module

Between the headset and the module can string a 100R resistor, make a limiting

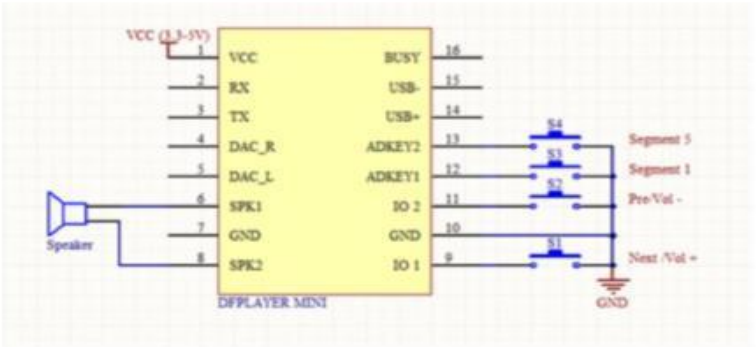


Figure 4.4 speaker connect module

DFPLayer Mini

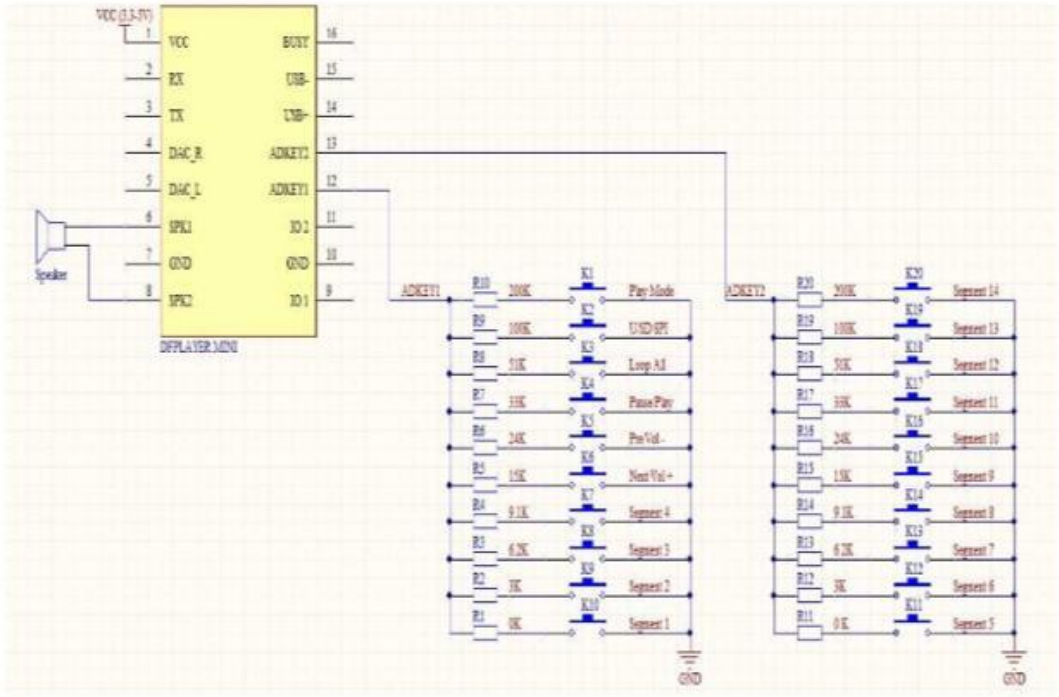


Figure 4.5 Ad key connect refer

5、MP3-TF-16P Size (unit: mm)

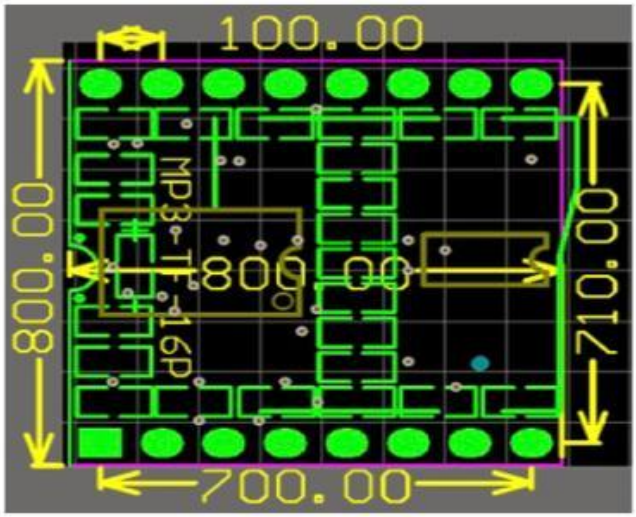


Figure 5.1 pcb size

Lampiran 4. Datasheet DF Player

maxim integrated™

MAX7219/MAX7221

Serially Interfaced, 8-Digit LED Display Drivers

General Description

The MAX7219/MAX7221 are compact, serial input/output common-cathode display drivers that interface microprocessors (µPs) to 7-segment numeric LED displays of up to 8 digits, bar-graph displays, or 64 individual LEDs. Included on-chip are a BCD code-B decoder, multiplex scan circuitry, segment and digit drivers, and an 8x8 static RAM that stores each digit. Only one external resistor is required to set the segment current for all LEDs. The MAX7221 is compatible with SPI™, QSPI™, and MICROWIRE™, and has slew-rate-limited segment drivers to reduce EMI.

A convenient 4-wire serial interface connects to all common µPs. Individual digits may be addressed and updated without rewriting the entire display. The MAX7219/MAX7221 also allow the user to select code-B decoding or no-decode for each digit.

The devices include a 150µA low-power shutdown mode, analog and digital brightness control, a scan-limit register that allows the user to display from 1 to 8 digits, and a test mode that forces all LEDs on.

For applications requiring 3V operation or segment blinking, refer to the MAX6951 data sheet.

Applications

Bar-Graph Displays
Industrial Controllers
Panel Meters
LED Matrix Displays

Features

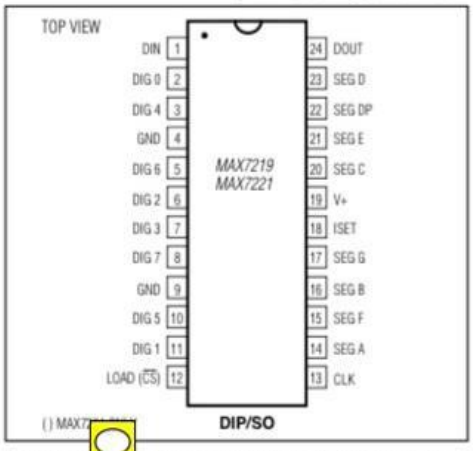
- ♦ 10MHz Serial Interface
- ♦ Individual LED Segment Control
- ♦ Decode/No-Decode Digit Selection
- ♦ 150µA Low-Power Shutdown (Data Retained)
- ♦ Digital and Analog Brightness Control
- ♦ Display Blanked on Power-Up
- ♦ Drive Common-Cathode LED Display
- ♦ Slew-Rate Limited Segment Drivers for Lower EMI (MAX7221)
- ♦ SPI, QSPI, MICROWIRE Serial Interface (MAX7221)
- ♦ 24-Pin DIP and SO Packages

Ordering Information

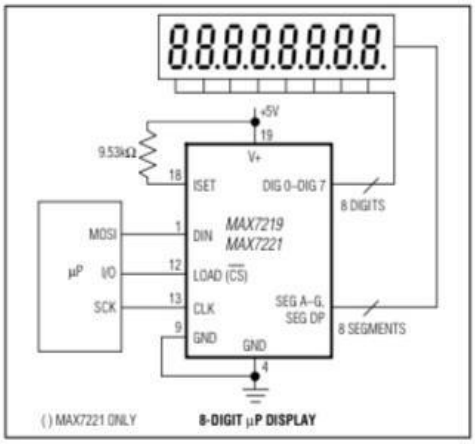
PART	TEMP RANGE	PIN-PACKAGE
MAX7219CNG	0°C to +70°C	24 Narrow Plastic DIP
MAX7219CWG	0°C to +70°C	24 Wide SO
MAX7219C/D	0°C to +70°C	Dice*
MAX7219ENG	-40°C to +85°C	24 Narrow Plastic DIP
MAX7219EWG	-40°C to +85°C	24 Wide SO
MAX7219ERG	-40°C to +85°C	24 Narrow CERDIP

Ordering Information continued at end of data sheet.
**Dice are specified at T_A = +25°C.*

Pin Configuration



Typical Application Circuit



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For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maximintegrated.com.

19-4452; Rev 4; 7/03

ABSOLUTE MAXIMUM RATINGS

Voltage (with respect to GND)
- V+ ..... -0.3V to 6V
- DIN, CLK, LOAD, $\overline{CS}$ ..... -0.3V to 6V
- All Other Pins ..... -0.3V to (V+ + 0.3V)

Current
- DIG 0–DIG 7 Sink Current 500mA
- SEG A–G, DP Source Current 100mA

Continuous Power Dissipation (T_A = +85°C)
- Narrow Plastic DIP (derate 13.3mW/°C above +70°C) 1066mW
- Wide SO (derate 11.8mW/°C above +70°C) 941mW
- Narrow CERDIP (derate 12.5mW/°C above +70°C) 1000mW

Operating Temperature Ranges (T_{MIN} to T_{MAX})
- MAX7219C_G/MAX7221C_G ..... 0°C to +70°C
- MAX7219E_G/MAX7221E_G ..... -40°C to +85°C

Storage Temperature Range ..... -65°C to +160°C

Lead Temperature (soldering, 10s) ..... +300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

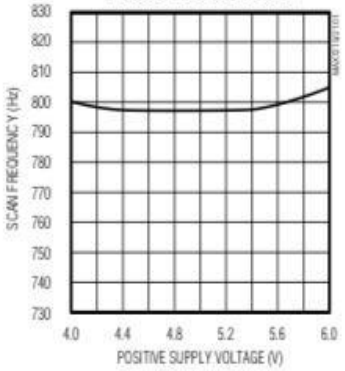
(V+ = 5V ±10%, R_{SET} = 9.53kΩ ±1%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage	V+		4.0		5.5	V
Shutdown Supply Current	I+	All digital inputs at V+ or GND, T_A = +25°C			150	µA
Operating Supply Current	I+	R_{SET} = open circuit			8	mA
		All segments and decimal point on, $I_{SEG\_}$ = -40mA		330		
Display Scan Rate	f_{OSC}	8 digits scanned	500	800	1300	Hz
Digit Drive Sink Current	I_{DIGIT}	V+ = 5V, V_{OUT} = 0.65V	320			mA
Segment Drive Source Current	I_{SEG}	T_A = +25°C, V+ = 5V, V_{OUT} = (V+ - 1V)	-30	-40	-45	mA
Segment Current Slew Rate (MAX7221 only)	$\Delta I_{SEG}/\Delta t$	T_A = +25°C, V+ = 5V, V_{OUT} = (V+ - 1V)	10	20	50	mA/µs
Segment Drive Current Matching	ΔI_{SEG}			3.0		%
Digit Drive Leakage (MAX7221 only)	I_{DIGIT}	Digit off, V_{DIGIT} = V+			-10	µA
Segment Drive Leakage (MAX7221 only)	I_{SEG}	Segment off, V_{SEG} = 0V			1	µA
Digit Drive Source Current (MAX7219 only)	I_{DIGIT}	Digit off, V_{DIGIT} = (V+ - 0.3V)	-2			mA
Segment Drive Sink Current (MAX7219 only)	I_{SEG}	Segment off, V_{SEG} = 0.3V	5			mA

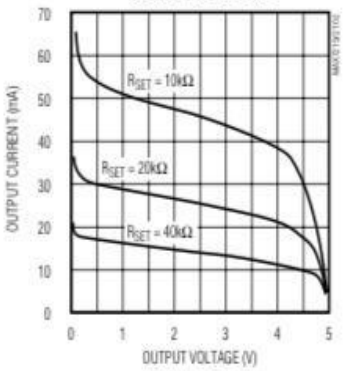
Typical Operating Characteristics

(V+ = +5V, T_A = +25°C, unless otherwise noted.)

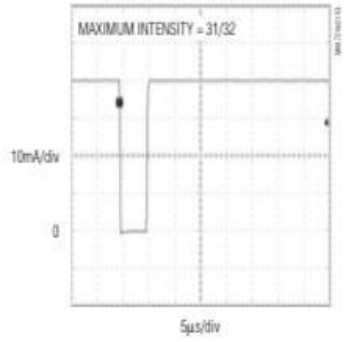
SCAN FREQUENCY vs. POSITIVE SUPPLY VOLTAGE



SEGMENT DRIVER OUTPUT CURRENT vs. OUTPUT VOLTAGE



MAX7219 SEGMENT OUTPUT CURRENT



MAX7221 SEGMENT OUTPUT CURRENT

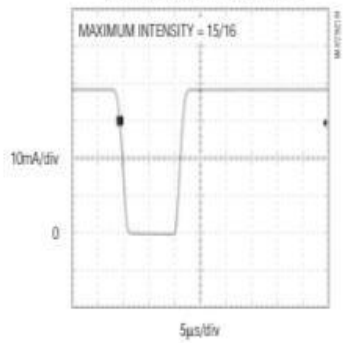


Table 2. Register Address Map

REGISTER	ADDRESS					HEX CODE
	D15–D12	D11	D10	D9	D8	
No-Op	X	0	0	0	0	0xX0
Digit 0	X	0	0	0	1	0xX1
Digit 1	X	0	0	1	0	0xX2
Digit 2	X	0	0	1	1	0xX3
Digit 3	X	0	1	0	0	0xX4
Digit 4	X	0	1	0	1	0xX5
Digit 5	X	0	1	1	0	0xX6
Digit 6	X	0	1	1	1	0xX7
Digit 7	X	1	0	0	0	0xX8
Decode Mode	X	1	0	0	1	0xX9
Intensity	X	1	0	1	0	0xXA
Scan Limit	X	1	0	1	1	0xXB
Shutdown	X	1	1	0	0	0xXC
Display Test	X	1	1	1	1	0xXF

Initial Power-Up

On initial power-up, all control registers are reset, the display is blanked, and the MAX7219/MAX7221 enter shutdown mode. Program the display driver prior to display use. Otherwise, it will initially be set to scan one digit, it will not decode data in the data registers, and the intensity register will be set to its minimum value.

Decode-Mode Register

The decode-mode register sets BCD code B (0-9, E, H, L, P, and -) or no-decode operation for each digit. Each bit in the register corresponds to one digit. A logic high selects code B decoding while logic low bypasses the decoder. Examples of the decode mode control-register format are shown in Table 4.

When the code B decode mode is used, the decoder looks only at the lower nibble of the data in the digit registers (D3–D0), disregarding bits D4–D6. D7, which sets the decimal point (SEG DP), is independent of the decoder and is positive logic (D7 = 1 turns the decimal point on). Table 5 lists the code B font.

When no-decode is selected, data bits D7–D0 correspond to the segment lines of the MAX7219/MAX7221. Table 6 shows the one-to-one pairing of each data bit to the appropriate segment line.

Table 3. Shutdown Register Format (Address (Hex) = 0xXC)

MODE	ADDRESS CODE (HEX)	REGISTER DATA							
		D7	D6	D5	D4	D3	D2	D1	D0
Shutdown Mode	0xXC	X	X	X	X	X	X	X	0
Normal Operation	0xXC	X	X	X	X	X	X	X	1

Table 4. Decode-Mode Register Examples (Address (Hex) = 0xX9)

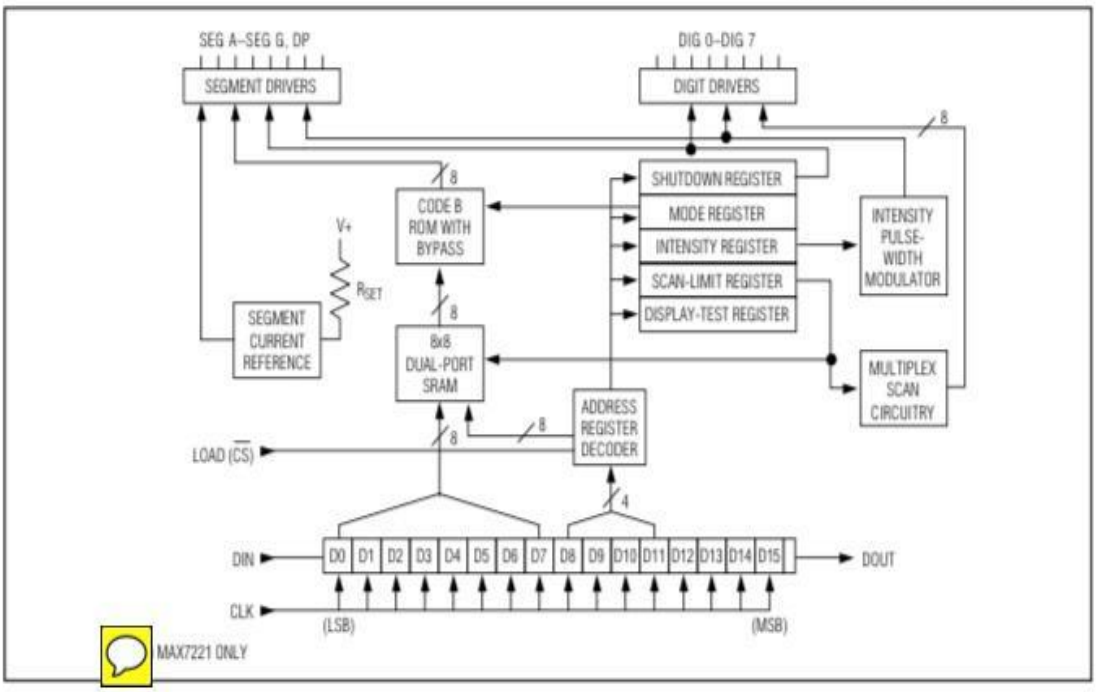
DECODE MODE	REGISTER DATA								HEX CODE
	D7	D6	D5	D4	D3	D2	D1	D0	
No decode for digits 7–0	0	0	0	0	0	0	0	0	0x00
Code B decode for digit 0 No decode for digits 7–1	0	0	0	0	0	0	0	1	0x01
Code B decode for digits 3–0 No decode for digits 7–4	0	0	0	0	1	1	1	1	0x0F
Code B decode for digits 7–0	1	1	1	1	1	1	1	1	0xFF

Serially Interfaced, 8-Digit LED Display Drivers

Pin Description

PIN	NAME	FUNCTION
1	DIN	Serial-Data Input. Data is loaded into the internal 16-bit shift register on CLK's rising edge.
2, 3, 5–8, 10, 11	DIG 0–DIG 7	Eight-Digit Drive Lines that sink current from the display common cathode. The MAX7219 pulls the digit outputs to V+ when turned off. The MAX7221's digit drivers are high-impedance when turned off.
4, 9	GND	Ground (both GND pins must be connected)
12	LOAD (MAX7219)	Load-Data Input. The last 16 bits of serial data are latched on LOAD's rising edge.
	$\overline{CS}$ (MAX7221)	Chip-Select Input. Serial data is loaded into the shift register while $\overline{CS}$ is low. The last 16 bits of serial data are latched on $\overline{CS}$'s rising edge.
13	CLK	Serial-Clock Input. 10MHz maximum rate. On CLK's rising edge, data is shifted into the internal shift register. On CLK's falling edge, data is clocked out of DOUT. On the MAX7221, the CLK input is active only while $\overline{CS}$ is low.
14–17, 20–23	SEG A–SEG G, DP	Seven Segment Drives and Decimal Point Drive that source current to the display. On the MAX7219, when a segment driver is turned off it is pulled to GND. The MAX7221 segment drivers are high-impedance when turned off.
18	ISET	Connect to V_{DD} through a resistor (R_{SET}) to set the peak segment current (Refer to *Selecting R_{SET} Resistor and Using External Drivers* section).
19	V+	Positive Supply Voltage. Connect to +5V.
24	DOUT	Serial-Data Output. The data into DIN is valid at DOUT 16.5 clock cycles later. This pin is used to daisy-chain several MAX7219/MAX7221's and is never high-impedance.

Functional Diagram



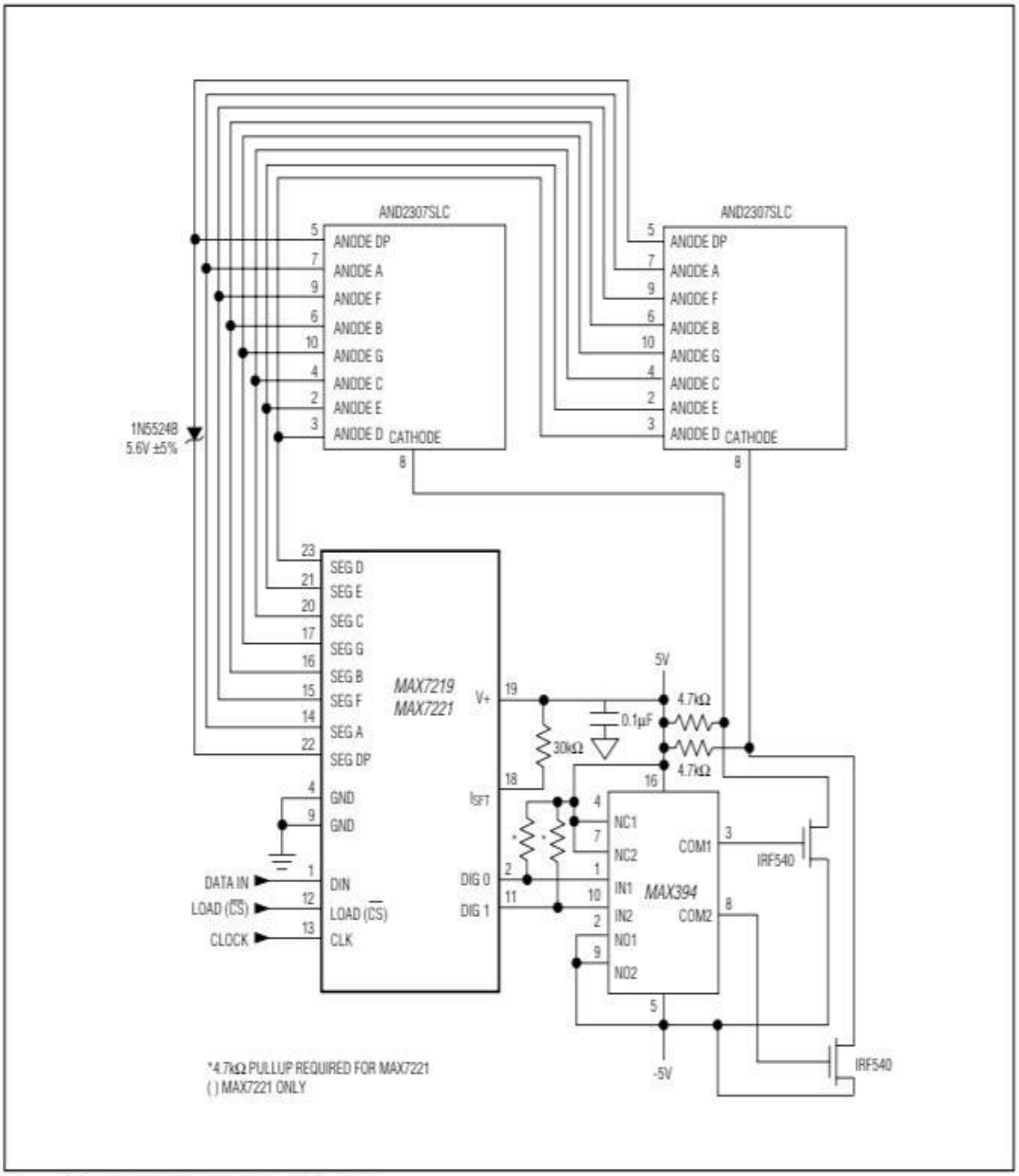


Figure 2. MAX7219/MAX7221 Driving 2.3in Displays

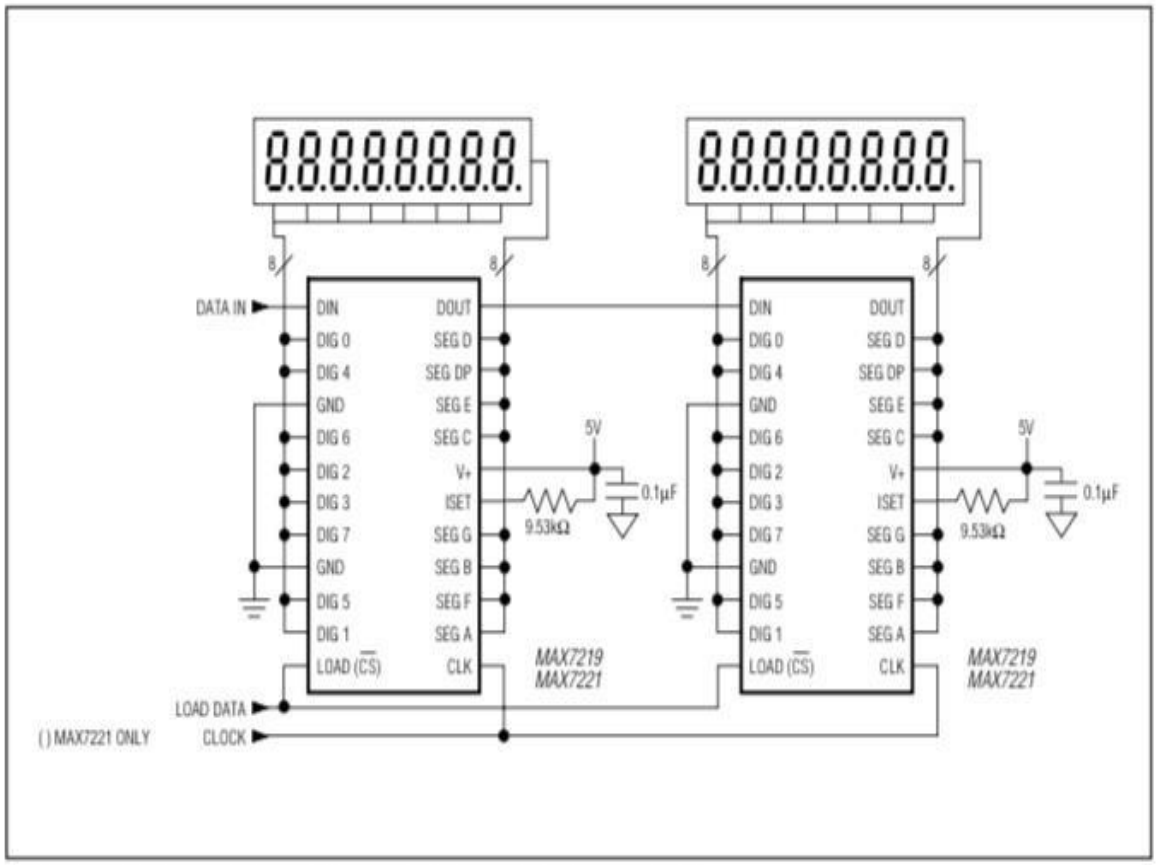


Figure 3. Cascading MAX7219/MAX7221s to Drive 16 Seven-Segment LED Digits