MONITORING SUHU DAN KELEMBABAN UDARA MENGGUNAKAN SENSOR DHT22 BERBASIS IOT (INTERNET OF THINGS)

LAPORAN TUGAS AKHIR

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PROGRAM STUDI D3 METROLOGI DAN INSTRUMENTASI
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
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PERNYATAAN ORISINALITAS

MONITORING SUHU DAN KELEMBABAN UDARA MENGGUNAKAN SENSOR DHT22 BERBASIS IOT (INTERNET OF THINGS)

LAPORAN PROJEK AKHIR 2

Saya mengakui bahwa tugas akhir ini adalah hasil keja saya sendiri. Kecuali beberapa kutipan dan ringkasan yang masing-masing di sebutkan sumbernya.

Medan, 29 Juli 2020

Elvidasari Sijabat
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PENGESAHAN LAPORAN PROJEK AKHIR 2

Judul	: Monitoring Suhu dan Kelembaban Udara Menggunakan Sensor DHT22 Berbasis IoT (Internet of Things)
Kategori	: Projek Akhir 2
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MONITORING SUHU DAN KELEMBABAN UDARA MENGGUNAKAN SENSOR DHT22 BERBASIS IOT (INTERNET OF THINGS)

ABSTRAK

Permintaan terhadap otomatisasi dan sistem intelejen sangat tinggi, itu sebabnya masyarakat menunjukkan ketertarikan terhadap perangkat pintar. Masyarakat dapat mengontrol atau memonitor suatu ruangan atau laboratorium melalui web atau aplikasi melalui telepon genggam dengan sistem Internet of Things (IoT). Sistem IOT (Internet of Things) sangat mempermudah masyarakat untuk dapat memantau dan mengakses suhu dan kelembaban udara pada suatu ruangan atau laboratorium dimana dan kapan pun. Dalam projek akhir ini telah dirancang alat utuk memonitoring suhu dan kelembaban udara. Pada alat ini digunakan sensor jenis DHT22 yang berfungsi sebagai pendeteksi suhu dan kelembababan udara dan digunakan NodeMCU ESP8266 yang berfungsi sebagai pengolah data sehingga hasil deteksi dapat ditampilkan pada layar smartphone atau PC agar pengguna dapat membaca langsung hasil pengukuran dari suhu dan kelebaban udara pada suata ruangan, dengan itu masyarakat dapat mengetahui berapa suhu dan kelembaban di ruangan tersebut serta mengetahui apakah suhu dan kelembaban udara di ruangan tersebut aman atau tidak.

Kata Kunci : Internet of Things (IOT), NodeMCU ESP8266, Sensor DHT22

TEMPERATURE AND HUMIDITY MONITORING USING CENCOR DHT22 WITH IOT(INTERNET OF THINGS) SYSTEM

ABSTRACT

The demand for automation and intelligence systems is very high, that's why people show interest in smart evices. The public can control or monitor a room or laboratory through a web or application via a mobile phone with the Internet of Things (IoT) system. The IoT (Internet of Things) system makes it very easy for people to be able to monitor and access temperature and humidity in a room or laboratory whenever and wherever. In this final project a tool has been designed to monitor temperature and humidity. In this tool, DHT22 sensor is used to detect air temperature and humidity and use NodeMCU ESP8266 which functions as a data processor so that detection results can be displayed on the screen of a smartphone or PC so that users can read the measurement results directly from the temperature and air pressure in the room, with that the community can find out what temperature and humidity in the room and find out whether the temperature and humidity of the room is safe or not.

Keywords: DHT22 Sensor, Internet of Things (IoT), NodeMCU ESP8266

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Medan, 29 Juli 2020

Elvidasari Sijabat

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BAB I

PENDAHULUAN

1.1 LatarBelakang

Saat ini, permintaan terhadap otomatisasi dan sistem intelejen sangat tinggi, itu sebabnya masyarakat menunjukkan ketertarikan terhadap perangkat pintar. Contohnya,masyarakat dapat mengkontrol atau memonitor alat-alat rumah tangga mereka melalui web atau aplikasi melalui telepon genggam.Internet of Things (IoT) yang dapat membuat alat-alat atau perangkat keras tersebut dapat berkomunikasi, bertukar data, dan saling mengendalikan melalui web atau aplikasi telepon genggam.Suhu dan kelembaban udara di lingkungan pun dapat dimonitor melalui web dengan menggunakan (IoT) agar udara di lingkungan tersebut tetap sehat dan terjaga.Menurut data dari medicalogy.com kelembaban udara (relative humidity) adalah satuan untuk menyatakan jumlah uap air yang terkandung pada udara.Semakin banyak uap air yang dikandung dalam udara, maka semakin lembab udara tersebut.Kelembaban udara dinyatakan dalam persen (%) dan rentang kelembaban udara dalam ruangan (indoor) yang dianggap ideal adalah 40%-60% tergantung dimana Anda tinggal. Biasanya angka 45% dianggap sebagai angka yang paling ideal bagi kelembaban udara indoor.Jika kelembaban udara di ruangan tersebut rendah maka beresiko menyebabkan munculnya penyakit flu dan batuk, sedangkan jika kelembaban udara tinggi beresiko menyebabkan infeksi pernapasan yang lebih tinggi.Untuk suhu udara sendiri, suhu ideal untuk indoor adalah 20-29°C. Menurut cnnindonesia.com suhu yang berada diatas range ideal tersebut dapat meningkatkan resiko tekanan darah rendah dan memicu sakit jantung. Oleh karena itu Saya membuat suatu alat yang bisa memonitoring suhu dan kelembaban di ruangan atau rumah menggunakan sensor yang dapat langsung dipantau atau dimonitor oleh para penggunanya melalui tampilan antarmuka web agar mereka dapat mengetahui berapa suhu dan kelembaban di ruangan tersebut serta mengetahui apakah suhu dan kelembaban udara di ruangan tersebut aman atau tidak.

1.2 Rumusan Masalah

Berdasarkan uraian diatas, penulis tertarik untuk mengangkat permasalahan yang dihadapi masyarakat dengan memberikan sistem monitoring suhu dan kelembaban udara menggunakan sensor dengan sistem IoT(Internet of Things) dengan harapan masyarakat Indonesia mampu mengetahui keadaan suhu dan kelembaban udara pada suatu tempat melalui website. Harapan tersebut dapat terwujud melalui pembuatan Projek akhir 2 dengan dengan judul **“MONITORING SUHU DAN KELEMBABAN UDARA MENGGUNAKAN SENSOR DHT22 DENGAN SISTEM IOT (INTERNET OF THINGS) “.** Pada judul ini menggunakan power supply sebagai sumber tegangan keseluruhan sistem yang memberikan tegangan untuk mengendalikan sistem pada rangkaian serta menggunakan sensor yang berfungsi untuk membaca besarnya suhu dan kelembaban udara yang dihasilkan oleh alat monitoring sehingga hasilnya dapat dilihat dari web dengan tampilan aplikasi pada android.

1.3 Tujuan Penulisan

Penulisan laporan proyek ini adalah untuk :

1. Membuat dan mengetahui cara kerja alat dan bagaimana penerapan Internet of Things dalam memonitoring suhu dan kelembaban udara Berbasis NodeMCU ESP8266 .
2. Pengembangan kreatifitas mahasiswa dalam bidang ilmu instrumentasi pengontrolan dan elektronika sebagai bidang yang diketahui.
3. Sebagai salah satu syarat untuk dapat menyelesaikan program Diploma Tiga (D-III) Metrologi dan Instrumentasi FMIPA Universitas Sumatera Utara..

1.4 Batasan Masalah

Pembatasan masalah dalam tugas akhir ini mengacu pada Monitoring Suhu dan Kelembapan udara di ruangan atau rumah IoT(Internet of Things) menggunakan sensor Dht22 berbasis NodeMCU ESP8266 dengan batasan-batasan sebagai berikut:

1. NodeMCU ESP8266 hanya digunakan sebagai platform iot device yang dikemas dalam modul yang dikhususkan untuk mengakses modul sensor maupun modul

microcontroler lainnya, yang dapat dikendalikan atau monitoring melalui internet.

2. Sensor DHT22 digunakan untuk mendeteksi Suhu dan Kelembaban di ruangan miniatur.
3. Perangkat keras (hardware) yang digunakan NodeMCU ESP8266, DHT22, Power supply dan PC.
4. Display atau penampil nilai data menggunakan PC (Personal Computer).

1.5 Sistematika Penulisan

Untuk mempermudah pembahasan dan pemahaman maka penulis membuat sistematika pembahasan bagaimana sebenarnya prinsip kerja alat ukur digital dengan menggunakansensor Dht22 berbasis NodeMCU ESP8266 maka penulis menulis laporan ini sebagai berikut:

BAB I PENDAHULUAN

Pada bab ini berisikan mengenai latar belakang, rumusan masalah, Tujuan penulisan, batasan masalah, serta sistematika penulisan.

BAB II DASAR TEORI

Bab ini berisi tentang teori dasar yang digunakan sebagai bahan acuan projek tugas akhir, serta komponen yang perlu diketahui untukmempermudah dalam memahami sistem kerja alat ini.

BAB III PERANCANGAN DAN PEMBUATAN

Pada bagian ini akan dibahas perancangan dari alat, yaitu diagram blok dari rangkaian, skematik dari masing-masing rangkaian dan diagram alir dari program yang akan diisikan ke NodeMCU ESP8266.

BAB IV PENGUJIAN DAN ANALISA

Pada bab ini akan dibahas hasil analisa dari rangkaian dan sistem kerja alat, penjelasan mengenai program-program yang digunakan untuk mengaktifkan rangkaian, penjelasan mengenai program yang diisikan ke NodeMCU ESP8266.

BAB V KESIMPULAN DAN SARAN

Bab ini merupakan penutup yang meliputi tentang kesimpulan daripembahasan yang dilakukan dari tugas akhir ini serta saran apakah rangkaian ini dapat dibuat lebih efisien dan dikembangkan perakitannya pada suatu metode lain yang mempunyai sistem kerja yangsama.

BAB II

LANDASAN TEORI

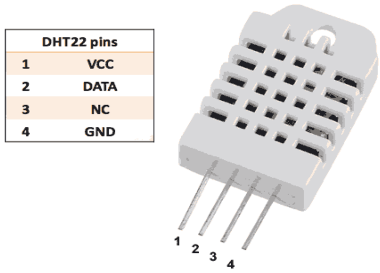
2.1 Sensor

Pengertian Sensor adalah transduser yang berfungsi untuk mengolah variasi gerak, panas, cahaya atau sinar, magnetis, dan kimia menjadi tegangan serta arus listrik. Sensor sendiri adalah komponen penting pada berbagai peralatan.Sensor juga berfungsi sebagai alat untuk mendeteksi dan juga untuk mengetahui magnitude. Transduser sendiri memiliki arti mengubah, resapan dari bahasa latin traducere Bentuk perubahan yang dimaksud adalah kemampuan merubah suatu energi kedalam bentuk energi lain. Energi yang diolah bertujuan untuk menunjang daripada kinerja piranti yang menggunakan sensor itu sendiri. Sensor sendiri sering digunakan dalam proses pendeteksi untuk proses pengukuran.

Sensor yang sering menjadi digunakan dalam berbagai rangkaian elektronik antara lain sensor cahaya tau sinar atau pun sensor suhu,serta sensor tekanan. Dari pengertian sensor yang telah saya jabarkan diatas wajar jika alat tersebut menjadi alat yang banyak diminati oleh berbagai pabrikan elektronik. Salah satu pabrikan yang tengah gencar menggunakan sensor pada produk mereka adalah pabrikan handphone dengan model touch screen. Sensor tekanan pada berbagai handphone sekarang ini membutuhkan adanya dukungan dari sensor tekanan. Selain pada gadget dengan teknologi canggih tersebut, sensor tekanan juga biasa diaplikasikan kepada berbagai alat elektronik lain seperti kalkulator serta remot. Adanya tekanan pada tombol-tombol pada kalkulator ataupun remot bekerja dengan mengubah daya tekan tersebut menjadi daya atau sinyal listrik.Dengan pengertian sensor beserta kinerja dari sensor tekanan diatas dapat diambil kesimpulan bahwa sensor memiliki banyak andil pada berbagai teknologi.Pada sensor suhu sendiri terdapat empat jenis sensor yang sering dipakai yaitu thermocouple, resistance temperature detectore, IC sensor dan termistor.Pada komponen thermocouple terdapat dua komponen transduser panas dan juga dingin. Kedua transedur tersebut berfungsi untuk membandingkan objek serta untuk mendapatkan hasil akan suhu dari objek. Platina menjadi pilihan utama pada komponen resistence temperature detectore karena memiliki tahanan suhu, stabilitas, kelinearan, reproduktifitas, serta stabilitas.Termistor merupakan resistor yang tahan terhadap panas, serta IC sensor sensor suhu dengan rangkaian yang menggunakan chipsilikon guna mendeteksi tingkat suhu yang terdapat pada objek.

2.1 Sensor DHT22

DHT22 menggunakan teknik pengumpulan sinyal digital eksklusif dan teknologi penginderaan kelembaban dan dapat mensuplai sinyal digital yang dikalibrasi.Ukuran kecil & konsumsi rendah & jarak transmisi yang panjang (20 meter) memungkinkan AM2303 sesuai dengan semua jenis aplikasi yang keras.Tegangan daya seharusnya antara 3.3V dan 6V DC.Bila daya disuplai ke sensor, jangan mengirim instruksi apapun sampai detik berlalu tanpa status yang tidak stabil.Satu kapasitor 100nF dapat ditambahkan antara VDD dan GND untuk penyaringan gelombang.



Gambar 2.1 Sensor DHT22

Sensor yang di gunakan untuk mengetahui nilai suhu dan kelembaban adalah sensor DHT22, untuk dapat digunakan pada arduino sensor DHT22 memebutuhkan beberapa komponen untuk pengkondisian tegangan yang masuk ke dalam sensor berupa resistor. Pada alat yang dibuat digunakan sebuah modul sensor DHT22 yang sudah siap digunakan pada bord arduino uno. Sensor DHT22 terdiri dari 2 buah sensor didalamnya yaitu sensor kelembaban yang berupa *capacitive-type humidity* untuk pengukur kelembaban sensor ini bekerja berdasarkan perubahan kapasistas kapasitor apabila ada objek yang berada dalam daerah deteksinya yaitu adanya molekul air di udara dan sebuah *temperature module* untuk mengatur suhu yang terbuat dibuat dari campuran bahan semikonduktor yang dapat menghasilkan hambatan interistik yang akan berubah terhadap temperature. Cara kerja dari sensor DHT22, bahan semikonduktor pada sensor suhu dan kelembaban membaca nilai suhu dna kelembaban kemudian data dikirimkan ke wemos dalam bentuk digital secara beriringan, waktu pengiriman data antara data suhu dan kelembaban sangatlah singkat yaitu kurang dari 40ms, sehingga pembacaan akan terlihat seperti bersamaan. Untuk dapat mengirim data digital pengkuruan pertama mikro kontroler

2.1.1 Suhu

Suhu adalah besaran yang menyatakan derajat panas atau dingin suatu benda. Secara mikropis suhu menunjukan energi yang dimiliki oleh suatu zat. Setiap atom dalam suatu benda selalu berada dalam keadaan bergerak, baik itu perpindahan ataupun gerakan ditempat yang berupa getaran. Semakin besar energi atom penyusun suatu benda, maka semakin besar pula suhu benda tersebut. Alat ukur yang digunakan untuk mengukur besaranya suhu adalah thermometer. Mengacu pada SI, satuan suhu adalah Kelvin (K), akan tetapi ada skala-skala lain yang digunakan selain Kelvin, yaitu Celcius, Fahrenheit dan Rankine. Di Indonesia, skala yang umum digunakan untuk mengukur suhu adalah skala Celcius, pada skala Celcius 0°C adalah titik dimana air membentuk dan 100°C adalah titik didih air pada tekanan 1 atmosfer. Skala Celcius dan Kelvin memiliki tingkatan kenaikan skala yang sama, kenaikan 1 °C sama dengan kenaikan suhu 1 K, yang membedakan hanyalah titik 0 skala. Saat skala Celcius menunjukan 0 °C maka pada skala Kelvin bernilai 273 K (atau 273.15 untuk lebih tepatnya) sehingga untuk mengkonversikan nilai Celcius ke skala Kelvin hanya perlu menambahakan 273 (atau 273.15 untuk lebih tepatnya).

2.1.2 Kelembaban

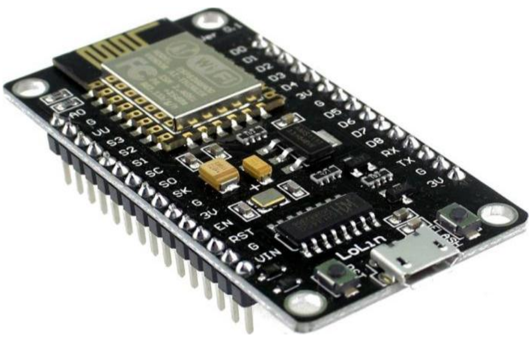
Kelembaban udara adalah jumlah uap air di udara (atmosfer). Kelembaban sendiri adalah konsentrasi uap air di udara. Angka konsentrasi ini dapat di ekspresikan dalam kelembaban *absolut* dan kelembaban spesifik atau kelembaban *relative*. Alat yang digunakan ntuk mengukur kelembaban disebut dengan *hygrometer*. Kelembaban udara adalah tingkat kebasahan udara karena dalam udara, air selalu terkandung dalam bentuk uap air. Kandungan uap air dalam udara hangat lebih banyak dari kandungan uap air dalam udara dingin. Perubahan tekanan parsial uap air di udara berhubungan dengan perubahan suhu. Konsentrasi air di udara pada tingkat permukaan laut mencapai 3% pada suhu 30% dan tidak berubah 0.5% pada 0 °C. Kelembaban udara dapat dinyatakan sebagai kelembaban udara *absolut* dan kelembaban dengan massa uap air atau tekanannya per satuan *volume* (Kg/m3).

Sedangkan kelembaban *relative* adalah perbandingan antara uap air yang ada di udara dengan jumlah uap air maksimum yang dapat ditampung oleh udara tersebut pada volume yang sama (Naiggolan dan Yusuf, 2013).

2.2 NodeMCU ESP8266

2 2.1 Pengenalan NodeMCU ESP8266

NodeMcu merupakan sebuah opensource platform IoT dan pengembangan Kityang menggunakan bahasa pemrograman Lua untuk membantu programmer dalam membuat prototype produk IoT atau bisa dengan memakai sketch dengan arduino IDE. Pengembangan Kitini didasarkan pada modul ESP8266, yang mengintegrasikan GPIO, PWM (Pulse Width Modulation), IIC , 1-Wire dan ADC (Analog to Digital Converter) semua dalam satu board. Keunikan dari Nodemcu yaitu Boardnya yang berukuran sangat kecil yaitu panjang 4.83cm, lebar 2.54cm, dan dengan berat 7 gram. Tapi walaupun ukurannya yang kecil,board ini sudah dilengkapi dengan fitur wifi dan firmwarenya yang bersifat opensource.Penggunaan NodeMcu lebih menguntungkan dari segi biaya maupun efisiensi tempat,karena NodeMcu yang ukurannya kecil, lebih praktis dan harganya jauh lebih murah dibandingkan dengan Arduino Uno. Arduino Uno sendiri merupakan salah satu jenis mikrokontroler yang banyak diminati dan memiliki bahasa pemrograman C++ sama seperti NodeMcu, namun Arduino Uno belum memiliki modul wifi dan belum berbasis IoT. Untuk dapat menggunakan wifi Arduino Uno memerlukan perangkat tambahan berupa wifi shield.NodeMcu merupakan salah satu produk yang mendapatkan hak khusus dari Arduino untuk dapat menggunakan aplikasi Arduino sehingga bahasa pemrograman yang digunakan sama dengan board Arduino pada umumnya.



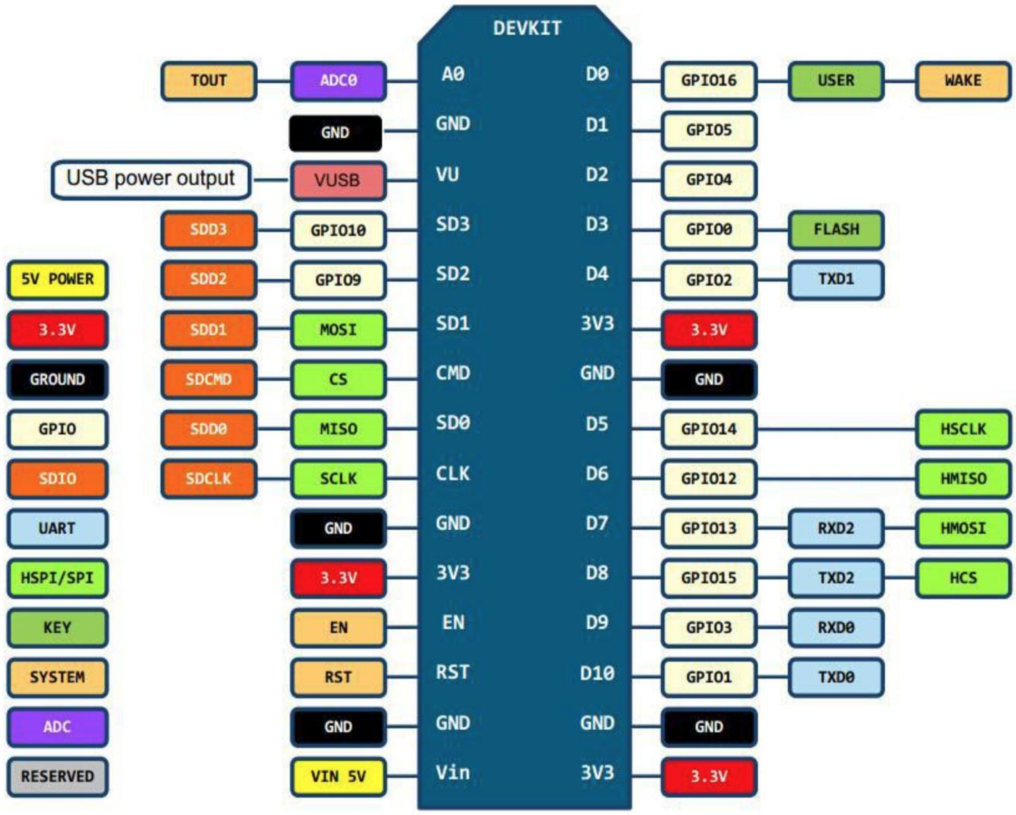
Gambar 2.2 Board NodeMcu

Spesifikasi yang dimiliki oleh NodeMCU sebagai berikut :

1. Board ini berbasis ESP8266 serial WiFi SoC (Single on Chip) dengan onboard USB to TTL, Wireless yang digunakan adalah IEE 802.11b/g/n.
2. 2 tantalumcapsitir 100 micro farad dan 10 micro farad.
3. 3.3v LDO regulator.
4. Blue led sebagai indikator.
5. Cp2102 usb to UART bridge.
6. Tombol reset, port usb, dan tombol flash.
7. Terdapat 9 GPIO yang didalamnya ada 3 pin PWM, 1 x ADC channel, dan pin RX TX.
8. 3 pin ground.
9. S3 dan S2 sebagai pin GPIO.
10. SI MOSI (Master Output Slave Input) yaitu jalur data dari master dan masuk ke dalam slave, sc cmd/sc.
11. SO MISO (Master Slave Input) yaitu jalur data keluar dari slave dan masuk kedalam master.
12. SK yang merupakan SCLK dari master ke slave yang berfungsi sebagai clock.
13. Pin Vin sebagai muatan tegangan.
14. Built in 32-bit MCU.

2.3.2 Konfigurasi Pin NodeMCU ESP8266

Rangkaian NodeMCU ESP8266-12E ini adalah sebuah otak dan sistem kendali rangkaian alat *monitoring* suhu dan kelembaban menggunakan web secara *online* berbasis ESP8266. Pengembangan Kitini didasarkan pada modul ESP8266, yang mengintegrasikan GPIO, PWM (Pulse Width Modulation), IIC , 1-Wire dan ADC (Analog to Digital Converter) semua dalam satu board.



Gambar 2.2.2 Susunan Pin NodeMCU ESP8266

Dari gambar diatas dapat dilihat masing-masing pin NodeMCU ESP8266 sebagai berikut :

1. RST : berfungsi sebagai modul
2. ADC : Analog Digital Converter. Rentang tegangan masukan 0-1v, dengan skup nilai digital 0-1024
3. EN: Chip Enable, Active High
4. IO16 : GPIO16, dapat digunakan membangunkan chipset dari mode deep sleep
5. IO14 : GPIO14; HSPI_CLK
6. IO12 : GPIO12; HSPI_MISO
7. IO13 : GPIO13; HSPI_MOSI;UART0_CTS
8. VCC: Catu daya 3,3V (VDD)
9. CSO: Chip selection
10. MISO : Slave output, Main input
11. IO9 :GPIO9

12. IO10 GBIO10
13. MOSI : Main output slave input
14. SCLK : Clock
15. GND : Ground
16. IO15 : GPIO15; MTDO; HSPICS; UART0_RTS
17. IO2 : GPIO2;UART1_TXD
18. IOO : GPIO0
19. IO4 : GPIO4
20. IO5 : GPIO5
21. RXD : UART0_RXD; GPIO3
22. TXD : UART0_TXD;GPIO1

2.3 Modul Step Down DC-DC Converter LM2596

Modul stepdown lm2596 adalah modul yang memiliki IC LM2596 sebagai komponen utamanya.IC LM2596 adalah sirkuit terpadu / integrated circuit yang berfungsi sebagai Step-Down DC converterdengan currentrating 3A. Terdapat beberapa varian dari IC seri ini yang dapat dikelompokkan dalam dua kelompok yaitu versi adjustableyang tegangan keluarannya dapat diatur, dan versi fixed voltage outputyang tegangan keluarannya sudah tetap / fixed.

Gambar 2.3 DC-DC Converter LM2596

Modul ini memiliki spesifikasi :

1. Module Properties: non-isolated step-down module (buck)
2. Rectification: non-synchronous rectification
3. Input voltage:4.5-35V
4. OutputVoltage :1.25-30V (adjustable)

5. Outputcurrent: rated current 2A, Recommended less than2A,13W
6. Efficiency: Up to 92% (The higher the outputvoltage, the higher the Efficiency)
7. Switching frequency: 150KHz
8. Minimum pressure: 2V
9. Operating Temperature: Industrial(-40°c to +85°c) (outputpowerdari10W atau kurang)
10. Full load temperature rise: 40°c
11. Load regulation: ± 0.5%12.Voltage regulation: ± 0.5%

2.4 Arduino IDE

IDE (Integrated Development Environment) atau secara bahasa mudahnya merupakan lingkungan terintegrasi yang digunakan untuk melakukan pengembangan. Disebut sebagai lingkungan karena melalui software inilah Arduino dilakukan pemrograman untuk melakukan fungsi-fungsi yang dibenamkan melalui sintaks pemrograman. Arduino menggunakan bahasa pemrograman sendiri yang menyerupai bahasa C. Bahasa pemrograman Arduino (*Sketch*) sudah dilakukan perubahan untuk memudahkan pemula dalam melakukan pemrograman dari bahasa aslinya.IC mikrokontroler Arduino telah ditanamkan suatu program bernama *Bootlader* yang berfungsi sebagai penengah antara *compiler* Arduino dengan mikrokontroler. IDE yang diperuntukan untuk membuat perintah atau source code, melakukan pengecekan kesalahan, kompilasi, upload program, dan menguji hasil kerja arduino melalui serial monitor.

Menu menu yang ada pada sketch Arduino IDE:

1. Verify berfungsi untuk melakukan checking kode yang kamu buat apakah sudah sesuai dengan kaidah pemrograman yang ada atau belum
2. Upload berfungsi untuk melakukan kompilasi program atau kode yang kamu buat menjadi bahsa yang dapat dipahami oleh mesih alias si Arduino.
3. New berfungsi untuk membuat Sketch barud.
4. Open berfungsi untuk membukasketchyang pernah kamu buat dan membuka kembali untuk dilakukan editing atau sekedar upload ulang ke Arduino.
5. Save berfungsi untuk menyimpan Sketchyang telah kamu buat.

6. Serial Monitor berfungsi untuk membuka serial monitor. Serial monitor disini merupakan jendela yang menampilkan data apa saja yang dikirimkan atau dipertukarkan antara arduino dengan sketch pada port serialnya.

2.5 Website

Website merupakan kumpulan halaman web yang saling terhubung dan file-filenya saling terkait. Web terdiri dari halaman dan kumpulan halaman yang dinamakan homepage. Homepage berada pada posisi teratas, dengan halaman-halaman terkait berada di bawahnya. Biasanya setiap halaman di bawa homepage disebut child page, yang berisi hyperlink ke halaman lain dalam web. Penggunaan website memungkinkan untuk mengawasi suhu dan kelembabapan secara Real-Time sehingga langsungdapat mengetahui ruangan atau rumah terkondisi yang sedang terjadi di situs atau aplikasi. Laporan diperbarui terus menerus sehingga suhu dan kelembaban dapat selalu terlihat dalam monitor. Website awalnya merupakan suatu layanan sajian informasi yang menggunakan konsep hyperlink, yang memudahkan surfer atau pengguna internet melakukan penelusuran informasi di internet. Informasi yang disajikan dengan web menggunakan konsep multimedia, informasi dapat disajikan dengan menggunakan banyak media, seperti teks, gambar, animasi, suara, atau film. Web server adalah sebuah aplikasi server yang melayani permintaan HTTP atau HTTPS dari browser dan mengirimkan kembali dalam bentuk halaman halaman web. Halaman-halaman web yang dikirim oleh web server biasanya berupa file-file HTML dan CSS yang nantinya akan diparsing atau ditata oleh browser sehingga menjadi halaman-halaman web yang bagus dan mudah dibaca. Pengunaan paling umur server web adalah untuk menempatkan *situs* web, namun pada prakteknya pengunaan diperluas sebagai tempat penyimpanan data ataupun menjalankan sebuah aplikasi kelas bisnis. Fungsi utama sebuah web server adalah untuk mentrasfer berkas atas permintaan pengguna melalui *protocol* komunikasi yang telah ditentukan. Disebabkan sebuah pengguna melalui *protocol* komunikasi yang telah ditentukan. Disebabkan sebuah halaman web dapat terdiri atas berkas teks, gambar, video, dan lainnya permanfaatan web server berfungsi untuk mentrasfer seluruh aspek pemberkasan dalam sebuah halaman web yang terkait, termasuk didalam teks gambar, video, atau lain

2.6 Internet Of Things (IoT)

Internet of things IoT adalah sebuah istilah yang dimaksudkan dalam penggunaan internet yang lebih besar, mengadopsi komputasi uang bersifat mobile dan konektivitas kemudian menggabungkannya kedalam kesehari-harian dalam kehidupan. IoT berkaitan dengan DoT (Distruption of Things) dan sebagai pengantar perubahan atau transformasi penggunaan internet dari sebelumnya Internet of People menjadi internet of M2M (maching-to-maching). Sedangkan Ciot adalah singkatan dari collaborativeInternet of things adalah sebuah hubungan dari dua point solusi menjadi tiga poin secara cerdas, sebagai contohnya adalah iWatch salah satu smartwatch tidak hanya mengelola kesehatan dan kebugaran tetapi juga dapat menyesuaikan suhu ruangan pada AC mobil. Internet of things (IoT) adalah istilah yang menggambarkan bagaimana berbagai perangkat di sekitar selain bisa terhubung ke internet, juga dapat berkomunikasi dengan tablet,komputer/laptop, dan smartphone. Adalah Kevin Ashton yang pertama mencetusistilah IoTpada tahun 1999. Ashton pencetus standar global untuk RFID itu sudah lama membayangkan bahwa internet dapat terhubung ke dunia fisik melalui berbagai sensor yang dibenamkan di perangkat tertentu, mengumpulkan data untuk dikirimkan ke database atau server. Penerapan IoT dalam beberapa tahun kedepan akan terlihat dalam aspek smart home tidak perlu melalui kontak fisik untuk menyalakan sesuatu didalam rumah, hanya dengan internet dan interface bisa mempermudah penggunanya. Sedangkan menurut Casagras (Coordination and support action for global RFID-releted activities and standarisation) mendefinisikan internet of things sebagai sebuah infrastruktur jaringanglobal, yang menggabungkan benda-benda fisik dan virtual melalui eksploitasi dan capture dan kemampuan komunikasi. Infrastruktur terdiri dari jaringan yang telah ada internet berikut pengembangan jaringannya. Semua ini akan menawarkan identifikasi objek, sensor dan kemampuan koneksi sebagai dasar untuk pengembangan layanan dan aplikasi kooperatif yang independen. Dan juga ditandai dengan tingkat otonom dan capture yang tinggi, event transfer, konektivitas jaringan dan interoperabilitas.

2.6.1 BLYNK

Blynk adalah platform untuk aplikasi OS Mobile (iOS dan Android) yang bertujuan untuk kendali module Arduino, Raspberry Pi, ESP8266, WEMOS D1, dan module sejenisnya melalui Internet.Aplikasi ini merupakan wadah kreatifitas untuk membuat antarmuka grafis untuk proyek yang akan diimplementasikan hanya dengan metode drag and drop widget. Penggunaannya sangat mudah untuk mengatur semuanya dan dapat dikerjakan dalam waktu kurang dari 5 menit. Blynk tidak terikat pada papan atau module tertentu. Dari platform aplikasi inilah dapat mengontrol apapun dari jarak jauh, dimanapun kita berada dan waktu kapanpun. Dengan catatan terhubung dengan internet dengan koneksi yang stabil dan inilah yang dinamakan dengan sistem Internet of Things (IOT).

Aplikasi Blynk memiliki 3 komponen utama.yaitu Aplikasi, Server, dan Libraries. Blynk server berfungsi untuk menangani semua komunikasi diantara smartphone dan hardware. Widget yang tersedia pada Blynk diantaranya adalah Button, Value Display.

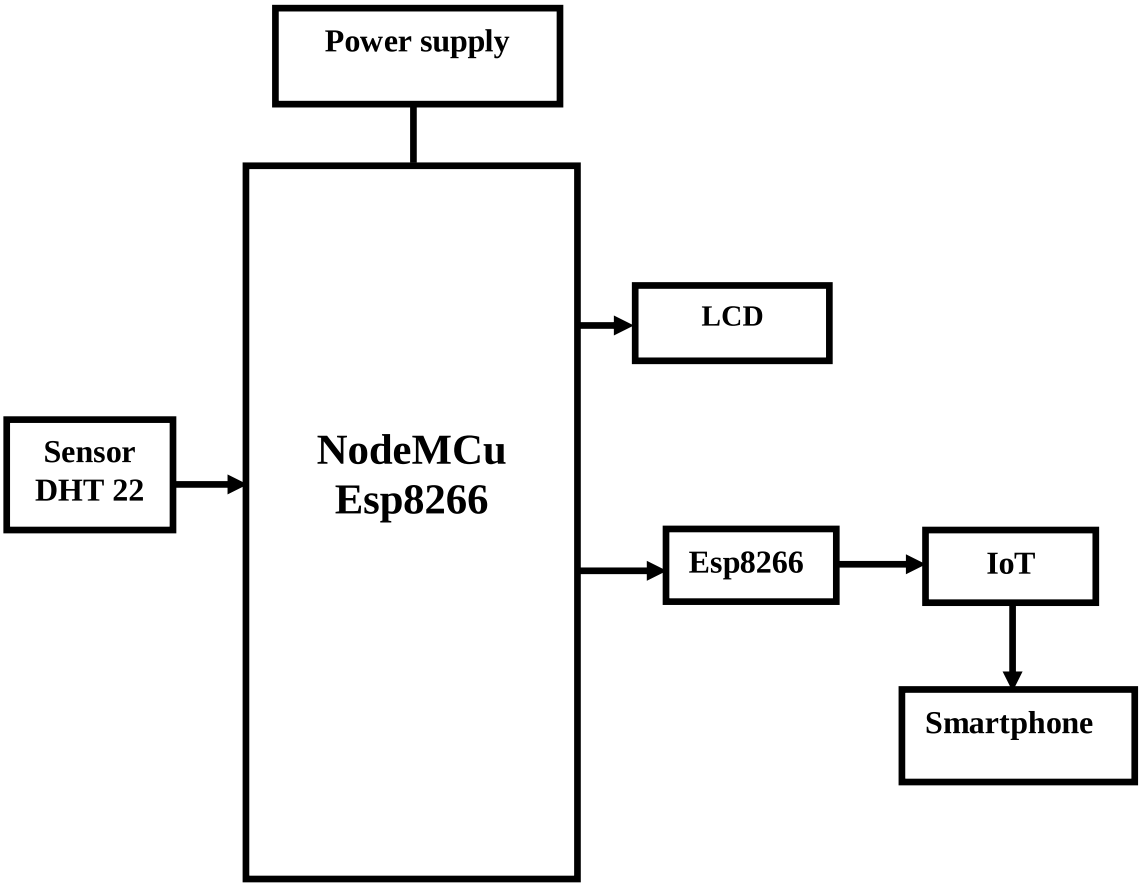
2.7 LCD (Liquid Crystal Dislay)

LCD adalah singkatan dari liquid crystal display, yaitu panel penampil yang dibuat dari bahan Kristal cair. Kristal dengan sifat-sifat khusus yang menampilkan warna lengkap yang berasal dari efek pantulan/transmisi cahaya degan panjang gelombang pada sudut lihat tertentu, merupakan salah satu rekayaan penting yang menunjang kebutuhan akan peralatan elektronik serba tipis dang ringan. Pada dasarnya, secara garis efek cahaya pada bahan penyusun LCD dapat dideskripsikan sebagai berikut: operasi PDLC (polymer dispersed liquid crystal) pada keadaan transparan (pixel kiri) dan pada keadaaan hamburan (pixel kanan). Pada keadaan transparan, tegangan dikenakan pada pixel, oleh karenanya mengarahkan Kristal cair dalam droplet/titik kecil dan menciptakan indek sesuai kondisi dimana n_o sesuai n_p. pada keadaan hamburan, sumbu simetris pada droplet secara tidak diorientasikan, menciptakan indek tidak sesuai n antara droplet dan matrik pengkapsulan. Untuk dapat menghubungkan LCD dengan mikrokontroler, PORT pada LCD perlu dihubungkan dengan PORT yang sesuai dengan PORT pada mikrokontroler. .

BAB III

METODE PENELITIAN

3.1 Diagram Blok Rangkaian

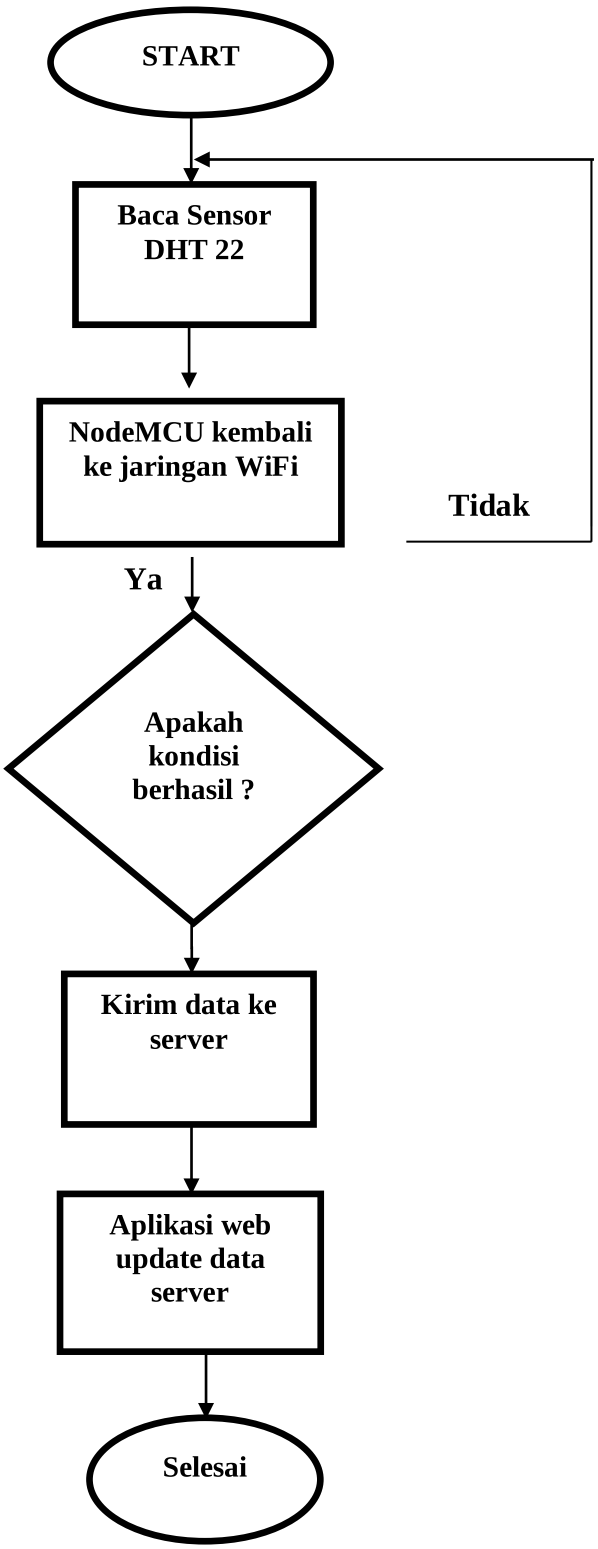


Gambar 3.1 Diagram Blok Rangkaian

3.1.1 Fungsi-fungsi Diagram Blok

1. Blok Power Supply sebagai pemberi tegangan ke seluruh system
2. Blok sensor DHT22 sebagai pendeteksi Kelembaban
3. Blok Nodemcu esp8266 sebagai pengolah data dan pemberitahuan
4. Blok LCD sebagai pemberitahuan melalui tampilan layar
5. Blok esp sebagai konect to smartphone via iot

3.2 Flowchart System



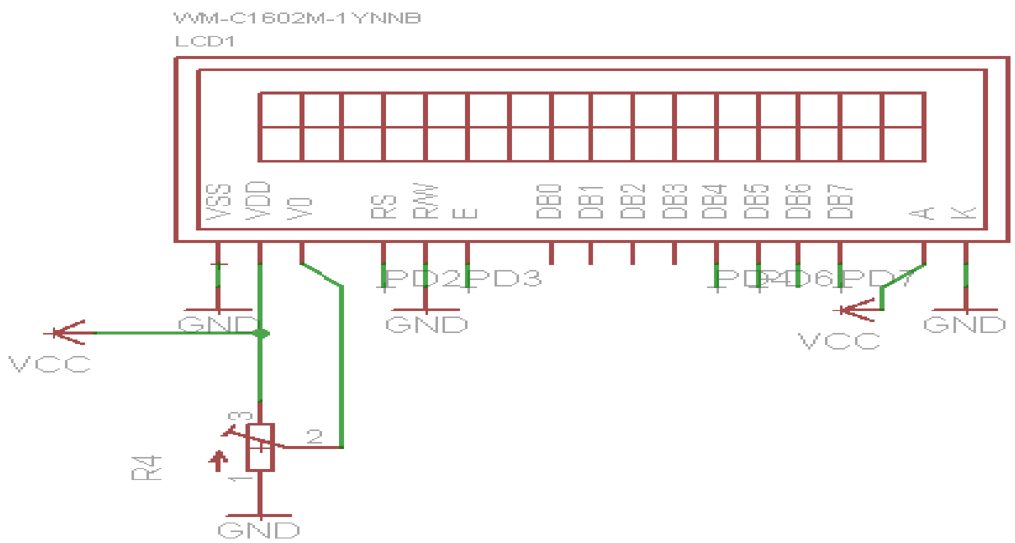
Gambar 3.2 *Flowchart* Sistem

Keterangan Diagram Alir (Flowchart) :

1. Pertama-tama program dirancang untuk inisialisasi port, inisilaisasi port berfungsi untuk mendefinisikan pin-pin I/O mikrokontroler yang akan digunakan dalam rangkaian.
2. Berikan perintah untuk membaca suhu dan kelembaban udara ke DHT 22.
3. Di baca penginderaan suhu dan kelembaban udara yang dikirim oleh DHT 22.
4. Tampilkan hasil pengukuran ke LCD dan Android
5. Kemudian beri perlakuan dingin atau panas untuk memonitoring suhu dan kelembaban sesuai keinginan dengan keadaan baik dan sehat.

3.3 Rangkaian LCD

Display LCD adalah sebuah display yang memberikan informasi sistem, berupa status atau data hasil olahan. Display yang digunakan adalah LCD 16x2, yaitu display 2x16 karakter. Karakter yang dapat ditampilkan LCD M16x2 adalah M16x2adalah karakter ASCII. Display LCD memperoleh data melalui kontroler ATMEGA328. Dalam hal ini, display LCD digunakan untuk menampilkan posisi x, posisi y, dan posisi z pada suatu bidang.Berikut rangkaian LCD:



Gambar 3.3 Rangkaian LCD

Pin – pin LCD 16×2 dan keterangannya

Keterangan :

GND : catu daya 0Vdc

VCC : catu daya positif

Constrate : untuk kontras tulisan pada LCD

RS atau Register Select :

High : untuk mengirim data

Low : untuk mengirim instruksi

R/W atau Read/Write

High : mengirim data

Low : mengirim instruksi

Disambungkan dengan LOW untuk pengiriman data ke layar

E (enable) : untuk mengontrol ke LCD latar

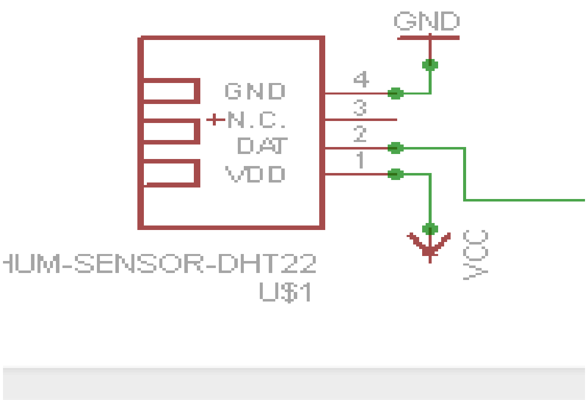
Backlight – : disambungkan ke GND untuk menyalakan lampu latar ketika bernilai LOW, LCD tidak dapat diakses

D0 – D7 = Data Bus 0 – 7

Backlight + : disambungkan ke VCC untuk menyalakan lampu

3.4 Perancangan Hardware

3.4.1 Rangkaian Sensor DHT 22

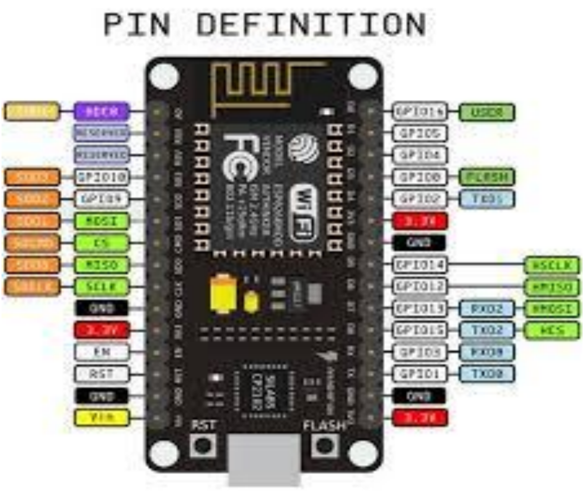


Gambar 3.4 Rangkaian Sensor DHT 22

Prinsip kerja rangkaian sensor di atas akan dijelaskan Sensor Suhu dan kelembapan DHT 22 berfungsi untuk mendeteksi keberadaan suhu dan kelembapan yang berasal dari gas mudah terbakar di udara. Pada dasarnya sensor ini terdiri dari tabung aluminium yang dikelilingi oleh silikon dan di pusatnya ada elektroda yang terbuat dari aurum di mana ada element pemanasnya. Ketika terjadi proses pemanasan, kumparan akan dipanaskan sehingga SnO2 keramik menjadi semikonduktor atau sebagai penghantar sehingga melepaskan elektron dan ketika suhu dan kelembapan dideteksi oleh sensor dan mencapai aurum elektroda maka output sensor DHT 22 akan menghasilkan tegangan analog. Sensor DHT 22 ini memiliki 6 buah masukan yang terdiri dari tiga buah power supply (Vcc) sebasar +5 volt untuk mengaktifkan heater dan sensor, Vss (Ground), dan pin keluaran dari sensor tersebut.

3.4.2 Rangkaian Mikrokontroller Nodemcu esp8266

Mikrokontroller ATMega328 memiliki 3 buah PORT utama yaitu PORTB, PORTC, dan PORTD dengan total pin *input/output* sebanyak 23 pin. Komponen pada mikrokontroller menggunakan *pin header* dan konektor yang bertujuan memudahkan pengguna untuk memasang, memindahkan komponen ke pin yang dibutuhkan. Skematik rangkaian keseluruhan pada mikrokontroller dapat dilihat pada gambar dibawah.



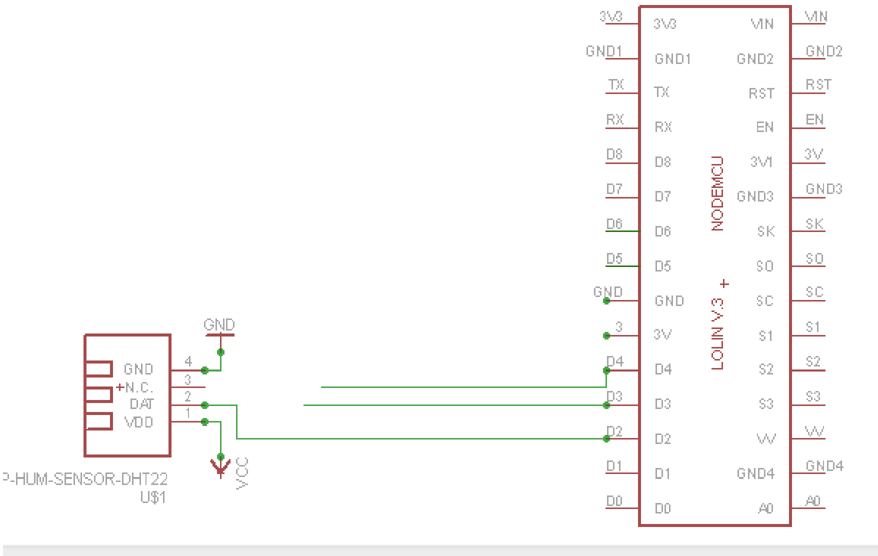
Gambar 3.4.2 Skematik Keseluruhan Rangkaian

Keterangan dari rangkaian diatas:

1. ARD1 adalah Nodemcu esp8266 yang berfungsi sebagai pusat sistim bekerja
2. J2 adalah soket penghubung ke LCD
3. J3 adalah soket penghubung ke LCD
4. J4 adalah soket penghubung ke GND Resistor Variabel
5. J5 adalah soket penghubung ke Resistor Variabel
6. J6 adalah soket penghubung ke VCC Resistor Variabel

3.4.3 Koneksi *sensor* DHT 22 dengan *mikrokontroller*

Sensor gas (DHT 22) Sensor alcohol (DHT 22) terdiri dari 4 kaki dengan spesifikasi VCC, DATA, NC dan GND. Dimana data dihubungkan ke Nodemcu esp8266 melalui pin 8, sedangkan VCC dengan tegangan 5V dan input *SIGNAL* ke pin analog A2. Koneksi DHT 22 dapat dilihat dibawah ini.

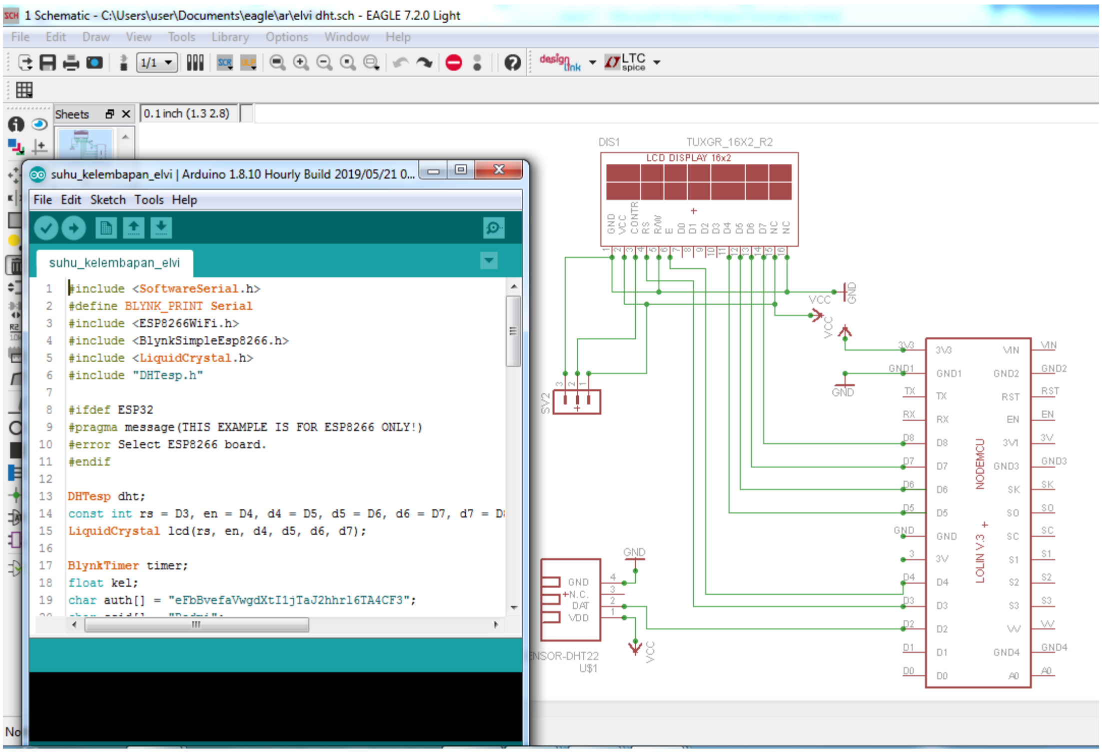


Gambar 3.4.3 Koneksi Sensor DHT 22 dengan *mikrokontroller* nodemcu

Sensor gas (DHT 22) terdiri dari 4 kaki dengan spesifikasi VCC, GND, SCL dan SDA. Dimana keempat pin tersebut terhubung ke Nodemcu esp8266 dengan Vin =5 V, gnd =gnd, SCL = Pin A2. Sensor alcohol (DHT 22) terdiri dari 4 kaki dengan spesifikasi VCC, DATA, NC dan GND. Dimana data dihubungkan ke Nodemcu esp8266 melalui pin A1 , sedangkan VCC dengan tegangan VCC

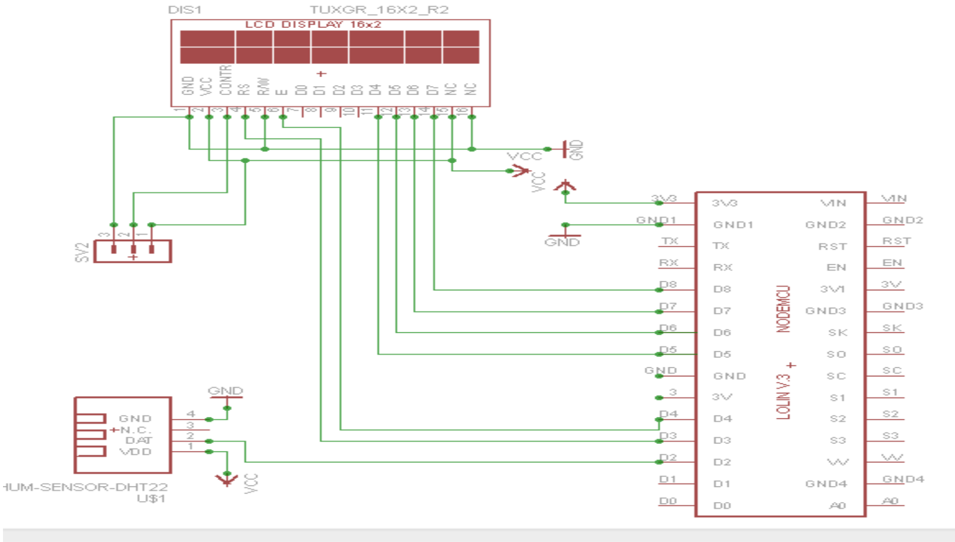
3.5 Perancangan Software

Perancangan perangkat lunak dimulai setelah perancangan perangkat keras dilakukan. Hal ini dilakukan karena perangkat lunak yang berfungsi untuk mengendalikan peralatan tersebut. Bahasa pemograman yang digunakan pada tugas akhir ini adalah bahasa C. Untuk mempermudah perancangan perangkat lunak maka terlebih dahulu dibuat algoritma dan *flow chart* untuk menggambarkan jalannya program secara keseluruhan terhadap sistem.

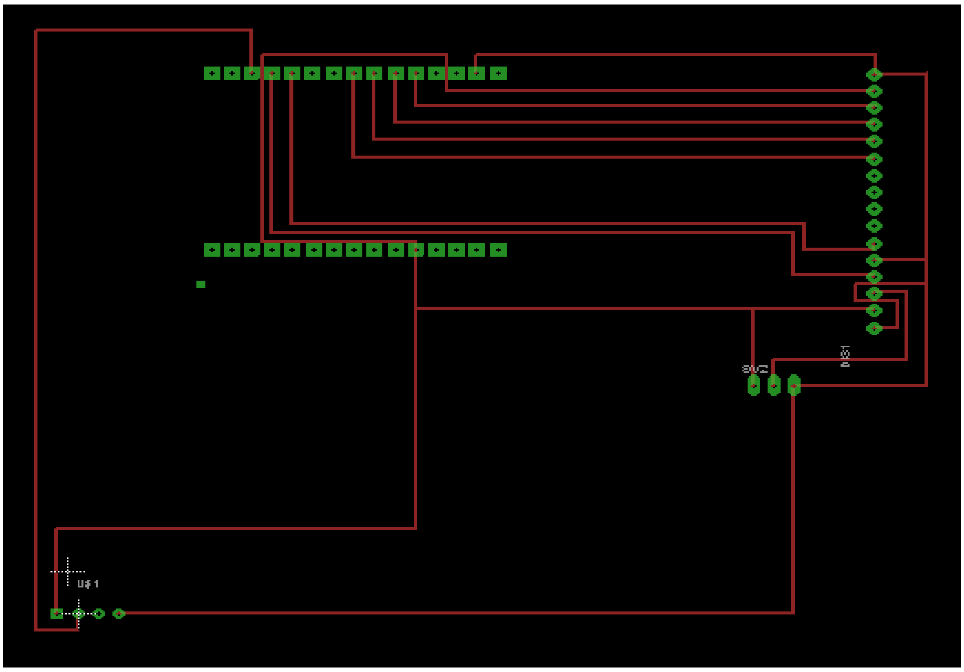


Gambar 3.5 Perancangan Sistem

Rangkain skematik keseluruhan sistem



Board system



Gambar 3.5.2 Board System

BAB VI

HASIL DAN PEMBAHASAN

4.1 Uraian Secara Umum

Alat pendeteksi kebakaran pada ruagan ini ini mengunakan VDC 5V. Alat ini akan mengeluarkan tampilan di *LCD* dengan tampilan suhu dan kelembaban udara pada suatu ruangan atau laboratorium dan suatu kantor.

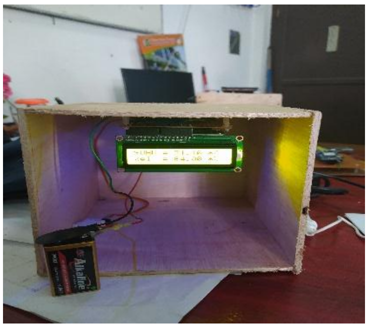
4.2 Hasil Pengukuran dan Pengujian Bagian-bagian Alat

Pengukuran merupakan suatu proses dimana alat yang dibuat bekerja dengan baik dan sesuai dengan teori yang ada. Ada beberapa pengujian alat yang dilakukan, yaitu: pengujian *tegangan*, LCD, *DHT 22 NodeMCu*,dan pegukuran secara keseluruhan.

4.3 Pengujian adaptor

Pengujian Baterai ini bertujuan untuk mengetahui tegangan yang dikeluarkan oleh PSA tersebut, dengan mengukur tegangan keluaran dari power supply menggunakan multimeter digital. Setelah dilakukan pengukuran maka diperoleh besarnya tegangan keluaran sebesar 5 volt. Dengan begitu dapat dipastikan apakah terjadi kesalahan terhadap rangkaian atau tidak jika diukur. Jika pada saat diukur dengan multimeter besar keluaran baterai tidak mencapai 3,3 V maka hal ini disebut wajar karena baterai sudah pernah dipakai sebelumnya..Halini bertujuan agar daya untuk tiap komponen dapat tersupply dengan baik, karna ketika daya kurang dalam tiap kompenen,maka akan terjadi kesalahan dalam proses kinerja alat.

Gambar hasil pengukuran dapat dilihat di bawah ini:



Gambar 4.1 Pengujian adaptor

4.3 Pengujian *LCD* (*Liquid Crystal Display)*

Pengujian ini bertujuan untuk mengetahui apakah *LCD* bekerja atau tidak sehingga dapat menampilkan karakter sesuai dengan yang diharapkan. Pengujian dilakukan dengan memprogram karakter atau tulisan yang ingin ditampilkan dan kemudian dicocokan dengan tampilan yang ada pada layar *LCD* tersebut.

Display karakter pada LCD diatur oleh pin EN, RS dan RW: Jalur EN dinamakan Enable. Jalur ini digunakan untuk memberitahu LCD bahwa anda sedang mengirimkan sebuah data. Untuk mengirimkan data ke LCD, maka melalui program EN harus dibuat logika low “0” dan set (high) pada dua jalur kontrol yang lain RS dan RW. Jalur RW adalah jalur control Read/ Write. Ketika RW berlogika low (0), maka informasi pada bus data akan dituliskan pada layar LCD. Ketika RW berlogika high ”1”,maka program akan melakukan pembacaan memori dari LCD. Sedangkan pada aplikasi umum pin RW selalu diberi logika low (0) Berdasarkan keterangan di atas maka kita sudah dapat membuat progam untuk menampilkan karaker pada display LCD. Adapun program yang diisikan ke mikrokontroller untuk menampilkan karakter pada display LCD adalah sebagai berikut:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
// Set the LCD address to 0x27 for a 16 chars and 2 line display
LiquidCrystal_I2C lcd(0x27, 16, 2);
void setup()
{
	// initialize the LCD
	lcd.begin();

	// Turn on the blacklight and print a message.
	lcd.backlight();
	lcd.print("Rizki Aswari!");
}

void loop()
{
	// Do nothing here...
}}
```

4.4 Pengujian Rangkaian Nodemcu

Pengujian pada rangkaian Nodemcu ini dapat dilakukan dengan menghubungkan rangkaian ini dengan multimeter sebagai pendeteksi sumber tegangan. Pada pengujian ini metode yang dipakai ialah dengan menguji melalui pin digital yang ada ada rangkaian nodemcu dengan menggunakan multimeter sebagai pendeteksi tegangan yang dihasilkan. Pada program uji arduino dimasukkan perintah "HIGH" dan "LOW" yang artinya menghidupkan dan mematikan pin yang diberi perintah "HIGH" dan "LOW" dan menghasilkan tegangan 3,3 volt pada multimeter. Pada Pin digital tegangan yang terdapat ialah sebesar 3,3 volt, maka dari itu pada saat pin digital diuji oleh multimeter maka hasil yang terdapat di multimeter haruslah sebesar 3,3 volt. Jika yang dihasilkan 3,3 volt maka Nodemcu tersebut dapat digunakan dan berfungsi dengan baik. Berikut data yang diperoleh dari hasil pengujian:

Tabel 4.1 Data Pengujian

Pin Digital	Perintah	Tegangan (Volt)
0	HIGH	3.3
1	LOW	0.0457
2	HIGH	3.3
3	LOW	004,9

Berikut Programnya:

```
*/
// the setup function runs once when you press reset or power
the board void setup() {
    // initialize digital pin LED_BUILTIN as an
     output. pinMode(0, OUTPUT);
     pinMode(1, OUTPUT);
     pinMode(2, OUTPUT);
     pinMode(3, OUTPUT);
}
// the loop function runs over and over again
forever void loop() {
     digitalWrite(0, HIGH);
     digitalWrite(1, LOW);
```

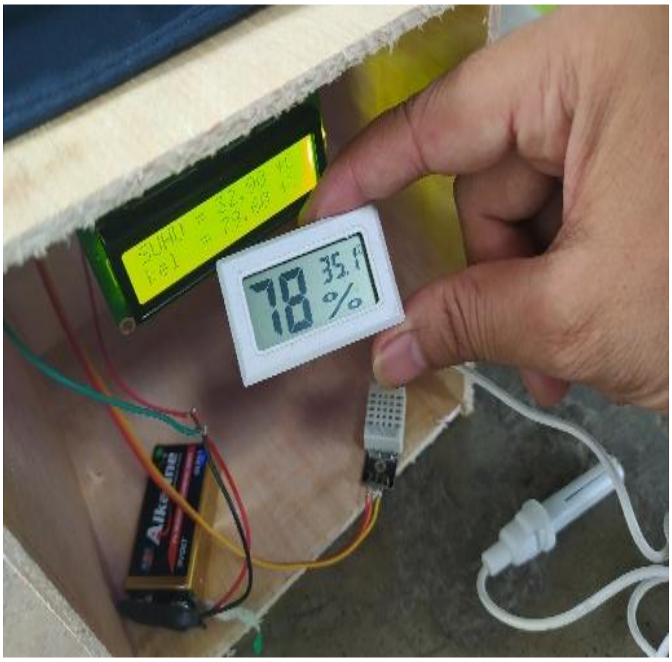
```
digitalWrite(2, HIGH);
digitalWrite(3, LOW);// turn the LED on (HIGH is the voltage level)// wait for a second
}
```

4.5 Pengukuran Rangkaian *sensor DHT 22*

Pengujian *sensor DHT 22* dilakukan untuk menentukan suhu dan kelembaban dari beberapa sampel pengujian dilakukan dengan memanaskan objek dan memanaskaanya dibawah sensor. Berikut titik pengukuran pada sensor *DHT 22* beserta tabel.

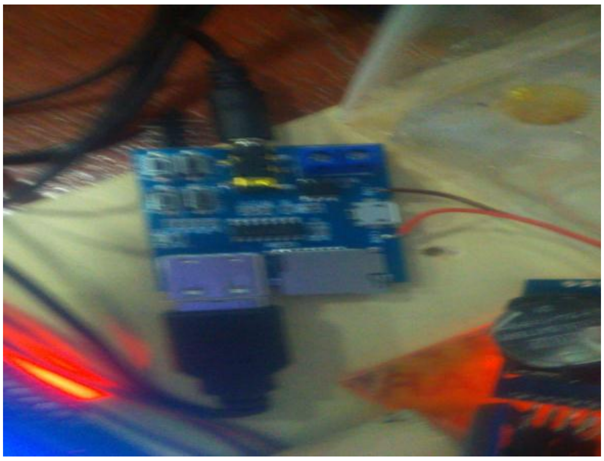
Tabel 4.2 Hasil pengukuran Sensor DHT 22

No	Suhu (˚C)	*Satndar Suhu (˚C)*	*Kelembapan(%)*	*Standar kelembapan(%)*	*Tempat Pengujian*
1	*30*	*29.54*	*50*	*50,08*	*Lab. Fisika*
2	*31,24*	*30,87*	*64*	*60,03*	*Kamar Tidur*
3	*32,36*	*31,82*	*75*	*70,14*	*Ruang 8208*
4	*32,85*	*32,01*	*78*	*80,06*	*Lab.Fisika*



Gambar 4.2 Pengujian dengan kalibrasi suhu dan Kelembaban

4.6 Pengujian Alat



KONECTION ALAT KE SMARTPHONE

1. **Connection esp8266 ke wifi**

Dilakukan dengan program:

Blynk Timer timer;

float kel;

char auth[] = "eFbBvefaVwgdXtI1jTaJ2hhrl6TA4CF3"; //Your Project authentication key

char ssid[] = "Redmi"; // Name of your network (HotSpot or Router name)

char pass[] = "Sipidong27"; // Corresponding Password

2. **Proses mengirim data ke smartphone**

Dilakukan dengan program:

float humidity = dht.getHumidity();

float temperature = dht.getTemperature();

Blynk.virtualWrite(V1,humidity);

Blynk.virtualWrite(V2,temperature);

3. **Tampilan smartphone aplikasi**

Dilakukan dengan program keseluruhan:

#include <SoftwareSerial.h>

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <LiquidCrystal.h>
#include "DHTesp.h"

#ifdef ESP32
#pragma message(THIS EXAMPLE IS FOR ESP8266 ONLY!)
#error Select ESP8266 board.
#endif

DHTesp dht;
const int rs = D3, en = D4, d4 = D5, d5 = D6, d6 = D7, d7 = D8;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

BlynkTimer timer;
float kel;
char auth[] = "eFbBvefaVwgdXtI1jTaJ2hhrl6TA4CF3";          //Your Project authentication
key
char ssid[] = "Redmi";                              // Name of your network (HotSpot or Router
name)
char pass[] = "Sipidong27";                              // Corresponding Password


void setup()
{
  Serial.begin(115200);
  Serial.println();
  Serial.println("Status\tHumidity (%)\tTemperature (C)\t(F)\tHeatIndex (C)\t(F)");
  String thisBoard= ARDUINO_BOARD;
  Serial.println(thisBoard);
   lcd.begin(16, 2);
  Serial.println();
  Blynk.begin(auth, ssid, pass);
```

```
  // Autodetect is not working reliable, don't use the following line
  // dht.setup(17);
  // use this instead:
  dht.setup(D2, DHTesp::DHT22); // Connect DHT sensor to GPIO 17
}
void loop()
{
  delay(dht.getMinimumSamplingPeriod());

  float humidity = dht.getHumidity();
  float temperature = dht.getTemperature();
   Blynk.virtualWrite(V1,humidity);
    Blynk.virtualWrite(V2,temperature);
    lcd.setCursor(0, 0);
  lcd.print("SUHU = ");
  lcd.print(temperature);
  lcd.print(" *C    ");
   lcd.setCursor(0, 1);
  lcd.print("kel  = ");
  lcd.print(humidity);
  lcd.print(" *%    ");

 Serial.println(humidity);
 Serial.print(" RH ");
 Serial.println(temperature);
 Serial.print(" *C ");
  Serial.print(dht.getStatusString());
  Serial.print("\t");
  Serial.print(humidity, 1);
  Serial.print("\t\t");
  Serial.print(temperature, 1);
  Serial.print("\t\t");
  Serial.print(dht.toFahrenheit(temperature), 1);
  Serial.print("\t\t");
  Serial.print(dht.computeHeatIndex(temperature, humidity, false), 1);
  Serial.print("\t\t");
```

```
  Serial.println(dht.computeHeatIndex(dht.toFahrenheit(temperature), humidity, true), 1);
   Blynk.run();
  timer.run();
  delay(2000);
}
```

HASIL KESELURUHAN

Setelah berhasil,makan hasil yang sama akan di tampilkan di lcd dan di smartphone dengan pengaturan waktu yang berbeda.

Gambar 4.7 Tampilan LCD dan Smartphone

Dari evaluasi hasil kerja alat dapat diambil beberapa kegunaan dari tugas akhir ini adalah untuk membantu dalam memonitoring suatu ruangan atau laboratorium agar tetap terjaga dan terkondisi suhu dan kelembabannya dengan baik. Piranti elektronik yang dibutuhkan dalam rangkaian sistem monitoring suhu dan kelembaban udara ini adalah NodeMCU ESP8266, Sensor DHT22, Power Supply, DC-DC Converter LM2596. Alat ini dibuat dengan merangkai piranti-piranti elektronik yang menjadi suatu sistem yang dapat mengatur suhu dan mengukur kelembaban udara pada suatu ruangan khusus yang menjadi inti digunakan penghuni rumah dan akan menampilkannya secara otomatis pada LCD dan Android dengan memberi perlakuan dingin(misalnya kipas atau Ac) atau panas(mematikan Ac dan Kipas atau menambah api unggun dengan tempat yang khusus untuk menghasilkan panas) sesuai kenyamanan kita. Manfaat alat ini adalah untuk :

1. Mempermudah dalam memonitoring suhu dan kelembaban suatu ruangan atau laboratorium dengan cara mengakses WEB pada tampilan android yang telah dibuat, dapat diakses dimanapun dan kapanpun tanpa ada batas jarak.
2. Sistem ini dapat melakukan monitoring suhu dan kelembaban dalam ruangan
yang dapat membantu penghuni rumah supaya dapat menyesuaikan dengan tingkat suhu dan kelembaban yang sehat.

BAB V
PENUTUP

5.1 Kesimpulan

Setelah melakukan tahap perancangan dan pembuatan sistem yang kemudian dilanjutkan dengan tahap pengujian dan analisa maka dapat diambil kesimpulan sebagai berikut :

1. Dari evaluasi hasil kerja alat dapat diambil beberapa kesimpulan dalam tugas akhir ini adalah : untuk membantu dalam memonitoring suatu ruangan atau laboratorium agar tetap terjaga dan terkondisi suhu dan kelembabannya dengan baik dengan perbandingan pengujian dengan standard kalibrasi

Berikut daftar Tabel 51. Perbandingan pengujian alat dengan standar

No	Suhu (˚C)	*Satndar Suhu (˚C)*	*Kelembapan(%)*	*Standar kelembapan(%)*	*Tempat Pengujian*
1	*30*	*29.54*	*50*	*50,08*	*Lab. Fisika*
2	*31,24*	*30,87*	*64*	*60,03*	*Kamar Tidur*
3	*32,36*	*31,82*	*75*	*70,14*	*Ruang 8208*
4	*32,85*	*32,01*	*78*	*80,06*	*Lab.Fisika*

2. Piranti elektronik yang dibutuhkan dalam rangkaian sistem monitoring suhu dan kelembaban udara ini adalah NodeMCU ESP8266, Sensor DHT22, Power Supply, DC-DC Converter LM2596. Alat ini dibuat dengan merangkai piranti-piranti elektronik yang menjadi suatu sistem yang dapat mengatur suhu dan mengukur kelembaban udara pada suatu ruangan dan akan menampilkannya secara otomatis pada LCD dan akan ditampilkan pada aplikasi android sesuai suhu dan kelembaban yang telah diujikan.

5.2 Saran

Setelah melakukan penulisan ini diperoleh beberapa hal yang dapat dijadikan saran untuk dapat dilakukan perancangan lebih lanjut yaitu:

1. Diperlukan rancangan yang lebih teliti lagi pada alat agar rangkaian ini dapat bekerja lebih sempurna.
2. Agar dilakukan peningkatan kemampuan pada alat ini, sehingga semakin cerdas dengan mengkombinasikan dengan komponen lain, sehingga sistem kerjanya akan lebih baik lagi.

DAFTAR PUSTAKA

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Gregorius, Agung. 2001. *Desain Web Interaktif Dengan Frontpage 2000 dan Dreamweaver 4*. PT Elex Media Komputindo. Jakarta.

Husni.2007.*Pemograman Database Berbasis WEB*.Graha Ilmu. Kamal City.

file:///C:/Users/Hewlett%20Packard/Downloads/SISTEM_MONITORING_SUHU_DAN_KELEMBABAN_RU.pdf.

file:///C:/Users/HP/Desktop/9225-20739-1-PB.pdf.

http://eprints.akakom.ac.id/4911/3/3_143310017_BAB_II.pdf.

https://www.sinauarduino.com/artikel/mengenal-arduino-software-ide/.

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file:///G:/TUGAS%20AKHIR/TUGAS%20AKHIR%202/e.%20BAB%20II.pdf

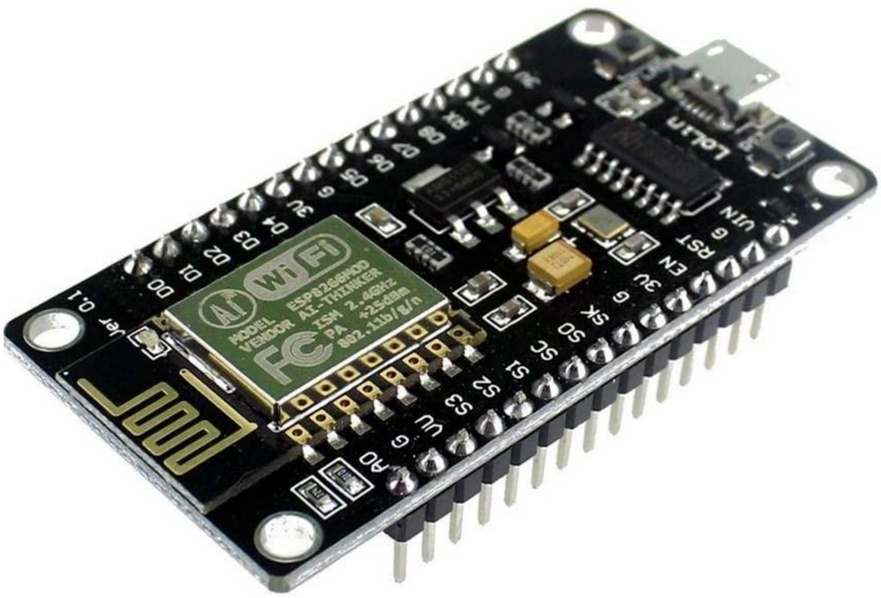
https://docplayer.info/172500066-Monitoring-suhu-dan-kelembaban-udara-menggunakan-sensor-dht22-dengan-sistem-iot-internet-of-things.html

http://repositori.usu.ac.id/bitstream/handle/123456789/21412/162411038.pdf?sequence=1&isAllowed=y

LAMPIRAN

User Manual V1.2

ESP8266 NodeMCU WiFi Devkit



The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained WiFi networking solution offering as a bridge from existing micro controller to WiFi and is also capable of running self-contained applications.

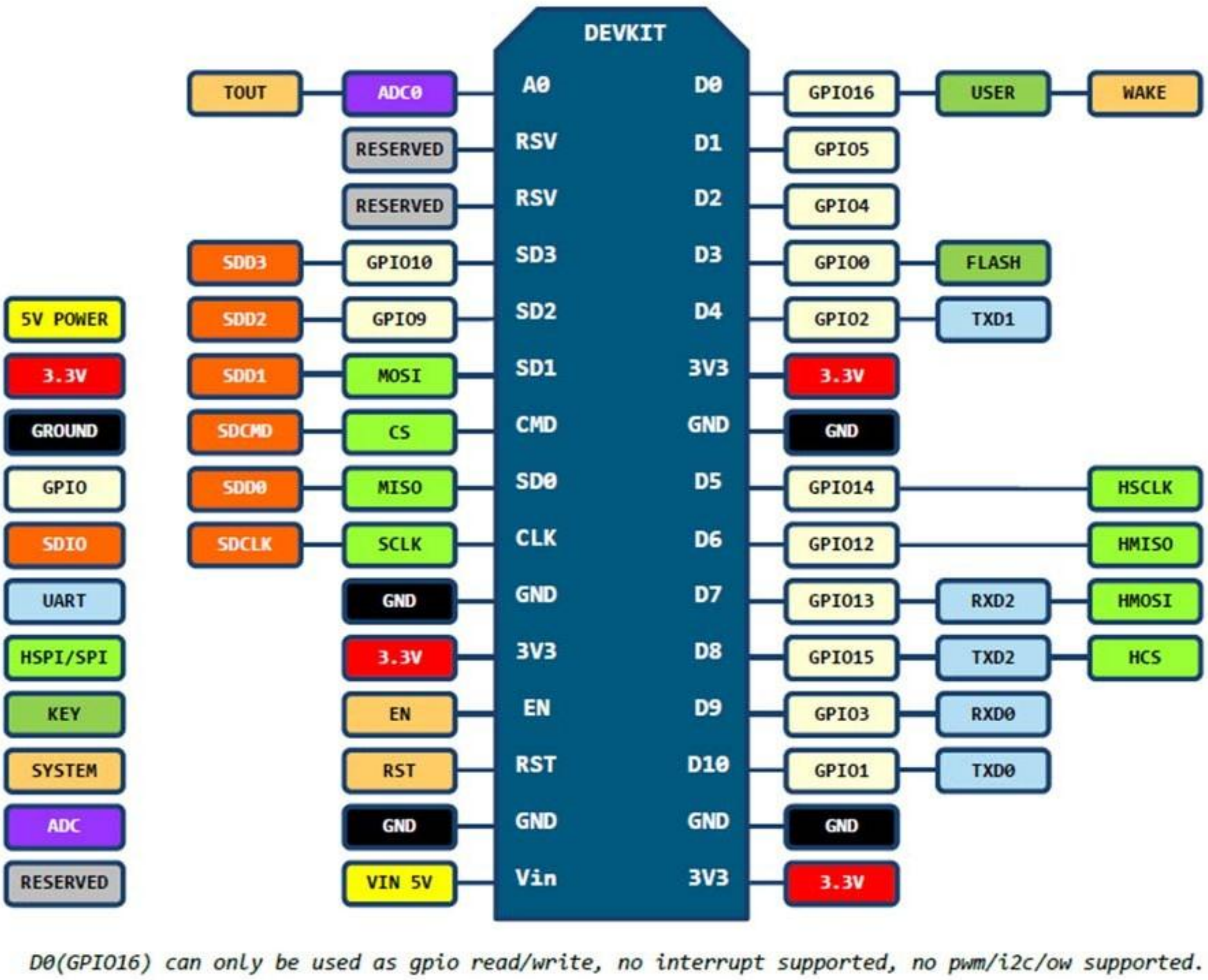
This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

Table of Contents

1. Specification:

- Voltage:3.3V.
- Wi-Fi Direct (P2P), soft-AP.
- Current consumption: 10uA~170mA.
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.
- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- Analog to Digital: 1 input with 1024 step resolution.
- +19.5dBm output power in 802.11b mode
- 802.11 support: b/g/n.
- Maximum concurrent TCP connections: 5.

2. Pin Definition:



3. Using Arduino IDE

The most basic way to use the ESP8266 module is to use serial commands, as the chip is basically a WiFi/Serial transceiver. However, this is not convenient. What we recommend is using the very cool Arduino ESP8266 project, which is a modified version of the Arduino IDE that you need to install on your computer. This makes it very convenient to use the ESP8266 chip as we will be using the well-known Arduino IDE. Following the below step to install ESP8266 library to work in Arduino IDE environment.

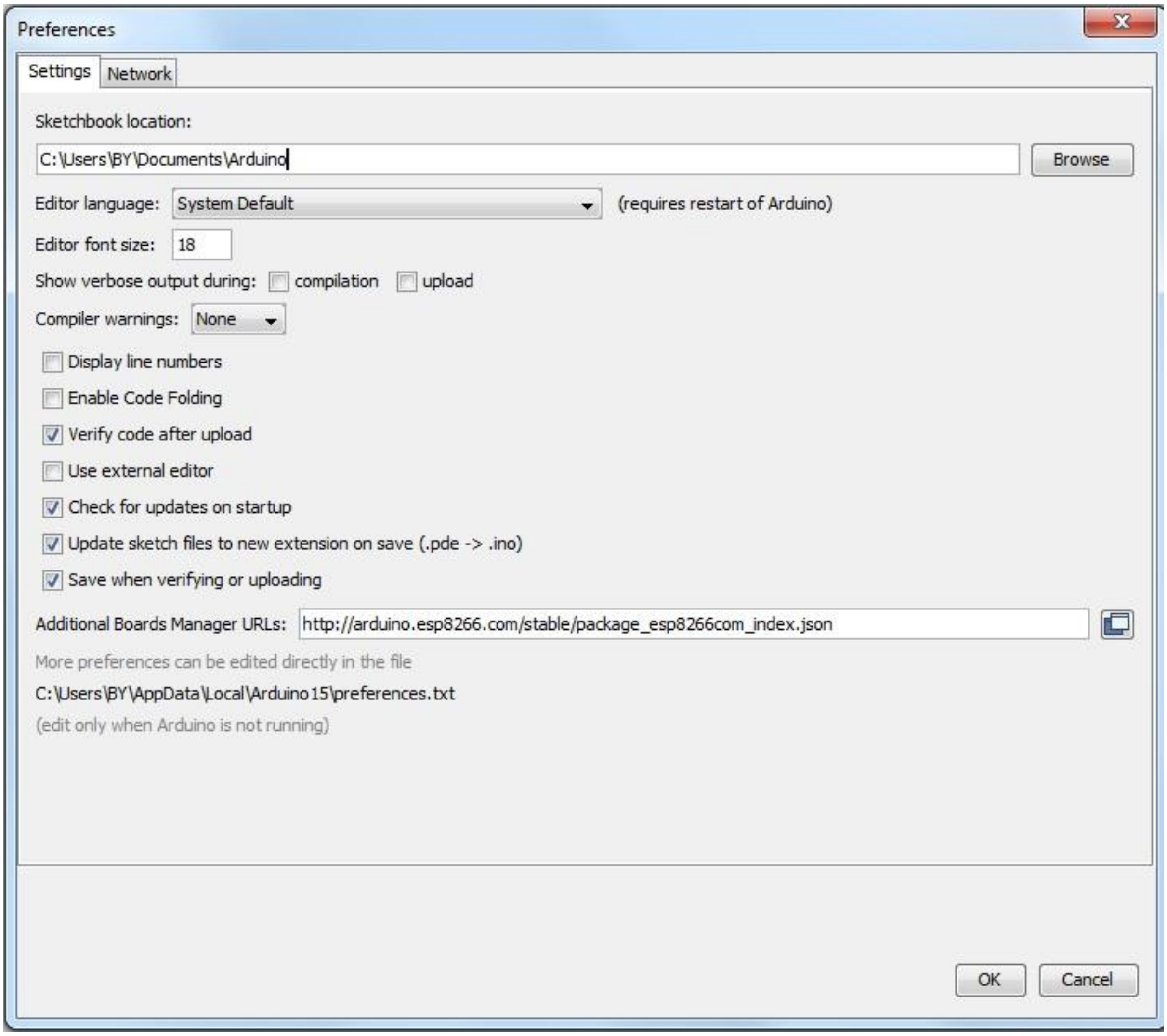
3.1 Install the Arduino IDE 1.6.4 or greater

Download Arduino IDE from Arduino.cc (1.6.4 or greater) - don't use 1.6.2 or lower version! You can use your existing IDE if you have already installed it.

You can also try downloading the ready-to-go package from the ESP8266-Arduino project, if the proxy is giving you problems.

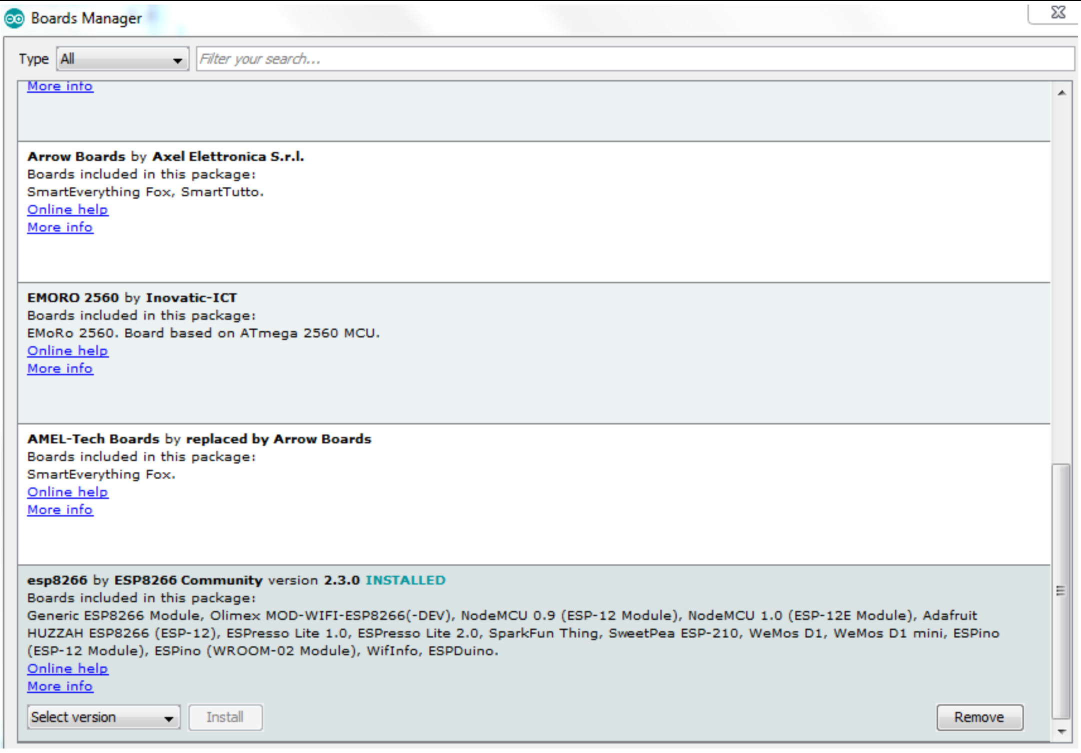
3.2 Install the ESP8266 Board Package

Enter ***http://arduino.esp8266.com/stable/package_esp8266com_index.json*** into *Additional Board Manager URLs*
field in the Arduino v1.6.4+ preferences.



Click ‘File’ -> ‘Preferences’ to access this panel.

Next, use the Board manager to install the ESP8266 package.

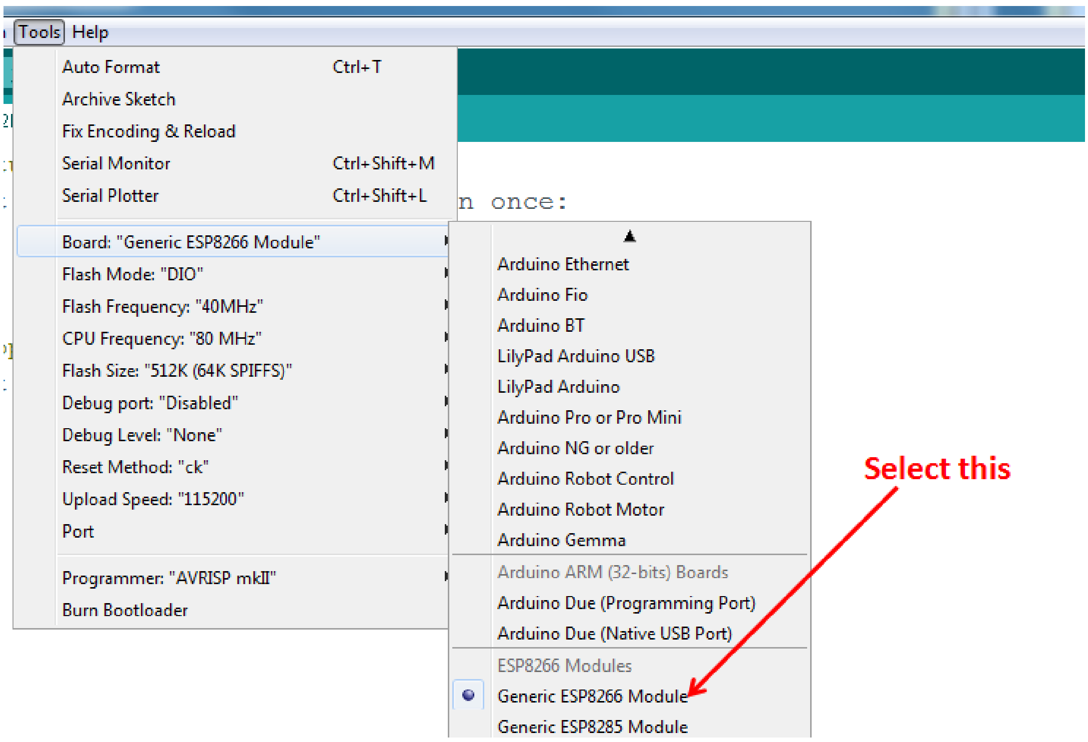


Click ‘Tools’ -> ‘Board:’ -> ‘Board Manager…’ to access this panel.

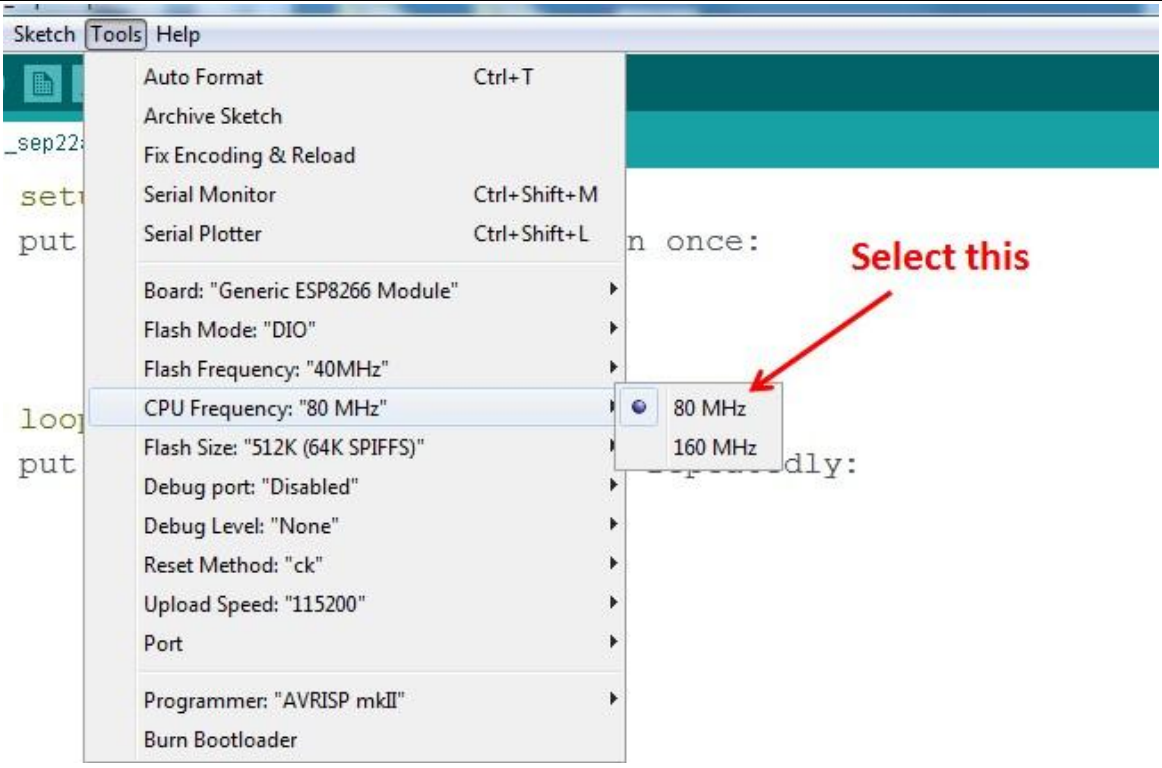
Scroll down to ‘ esp8266 by ESP8266 Community ’ and click “Install” button to install the ESP8266 library package. Once installation completed, close and re-open Arduino IDE for ESP8266 library to take effect.

3.3 Setup ESP8266 Support

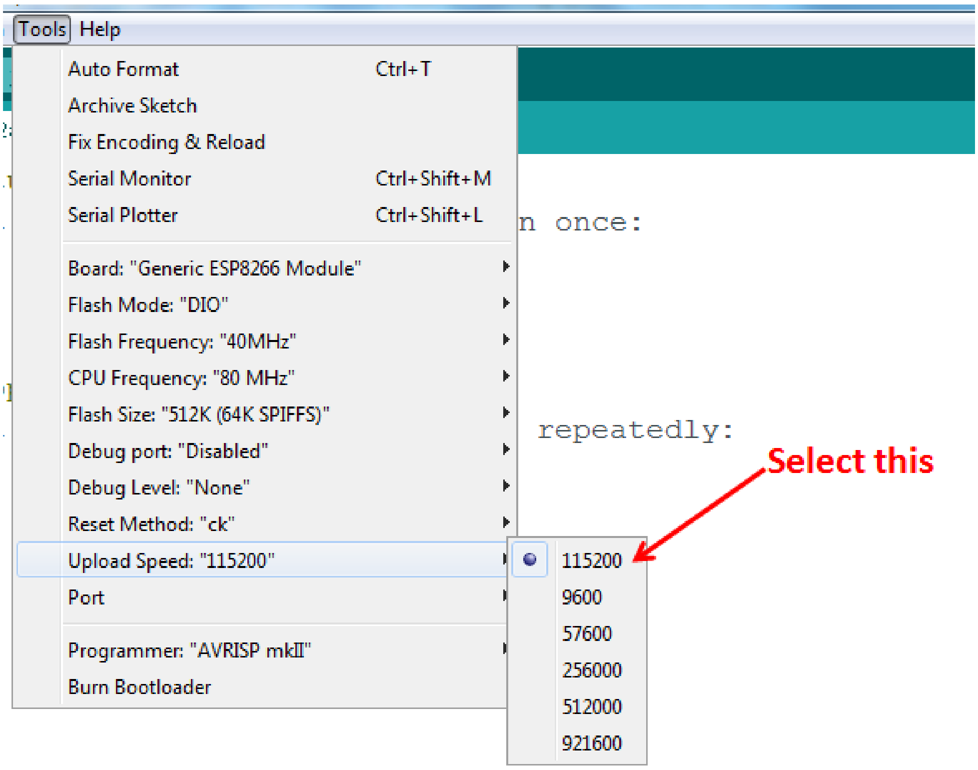
When you've restarted Arduino IDE, select ‘Generic ESP8266 Module’ from the ‘Tools’ -> ‘Board:’ dropdown menu.



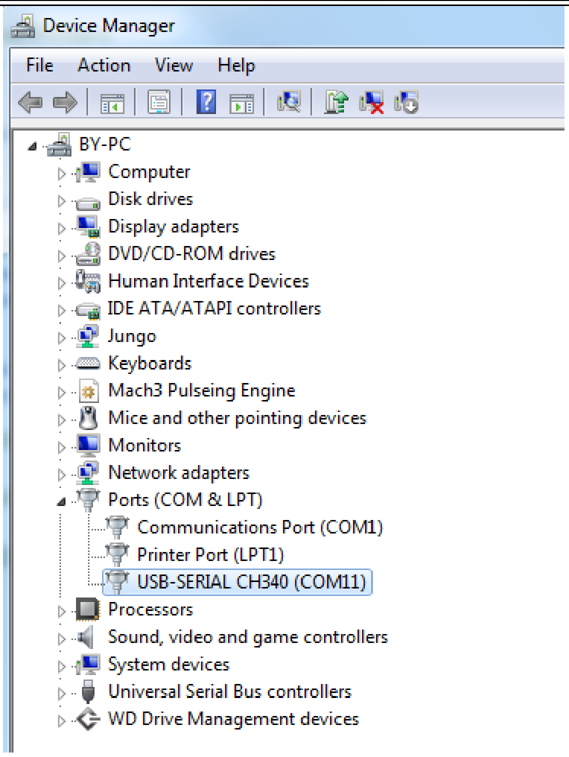
Select 80 MHz as the CPU frequency (you can try 160 MHz overclock later)

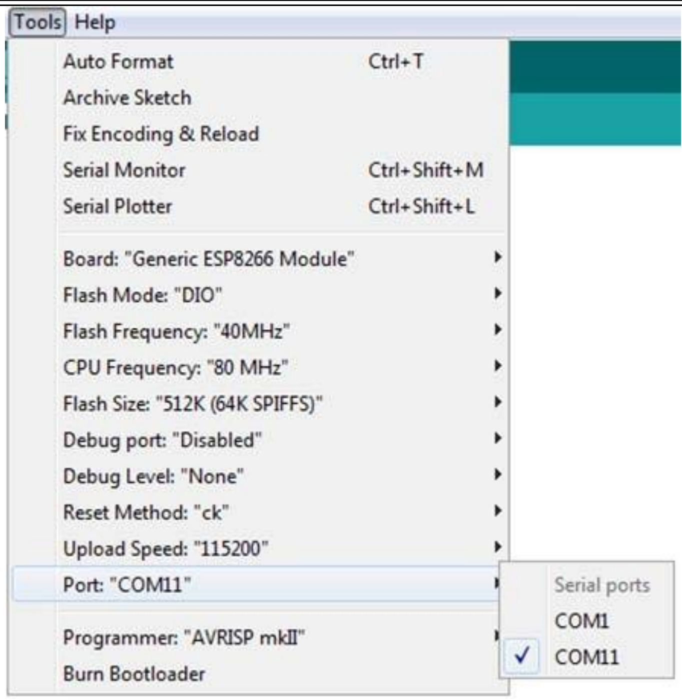


Select ‘115200’ baud upload speed is a good place to start - later on you can try higher speeds but 115200 is a good safe place to start.



Go to your Windows ‘Device Manager’ to find out which Com Port ‘USB-Serial CH340’ is assigned to. Select the matching COM/serial port for your CH340 USB-Serial interface.





Find out which Com Port is assign for CH340	Select the correct Com Port as indicated on 'Device Manager"

<u>Note: if this is your first time using CH340 " USB-to-Serial " interface, please install the driver first before proceed the above Com Port setting. The CH340 driver can be download from the below site:</u>

https://github.com/nodemcu/nodemcu-devkit/tree/master/Drivers

3.4 Blink Test

We'll begin with the simple blink test.

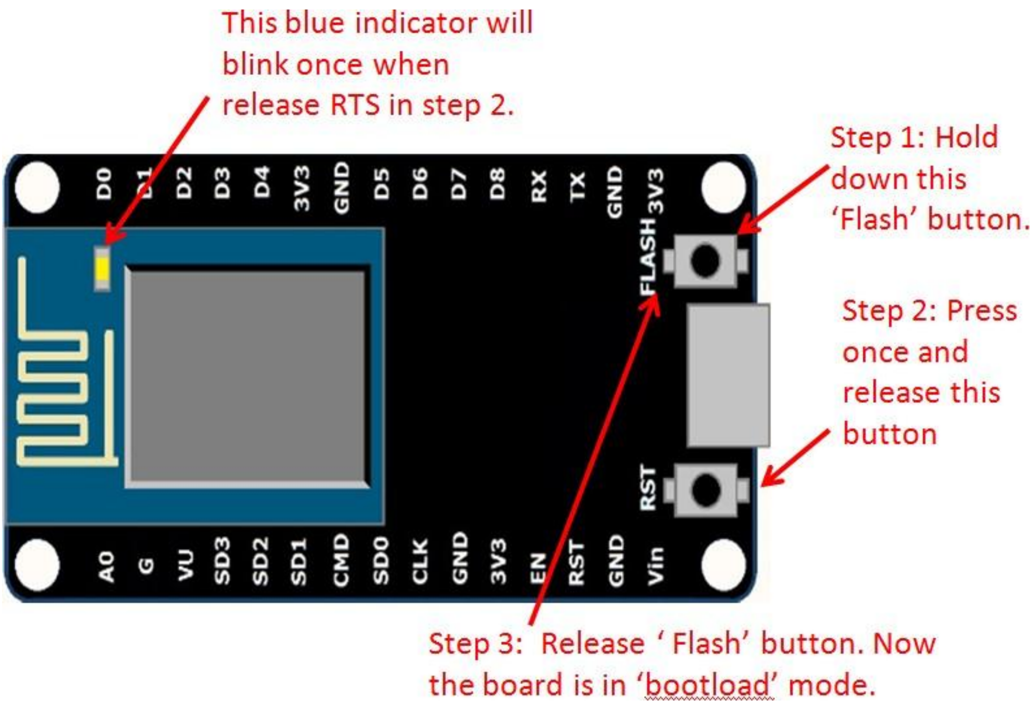
Enter this into the sketch window (and save since you'll have to). Connect a LED as shown in Figure3-1.

```
void setup() {
  pinMode(5, OUTPUT);    // GPIO05, Digital Pin D1
}

void loop() {
  digitalWrite(5, HIGH);
  delay(900);
  digitalWrite(5, LOW);
  delay(500);
}
```

Now you'll need to put the board into bootload mode. You'll have to do this before each upload. There is no timeout for bootload mode, so you don't have to rush!

- Hold down the 'Flash' button.
- While holding down ' Flash', press the 'RST' button.
- Release 'RST', then release 'Flash'

- When you release the 'RST' button, the blue indication will blink once, this means its ready to bootload.



Once the ESP board is in bootload mode, upload the sketch via the IDE, Figure 3-2.

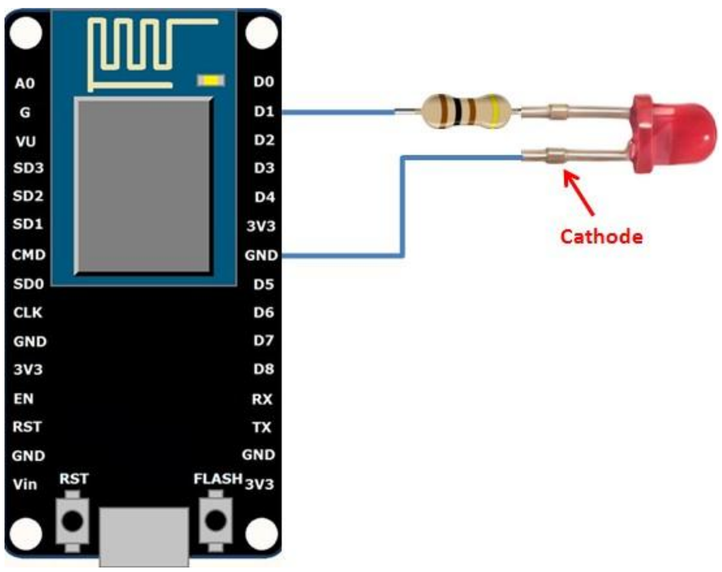


Figure3-1: Connection diagram for the blinking test

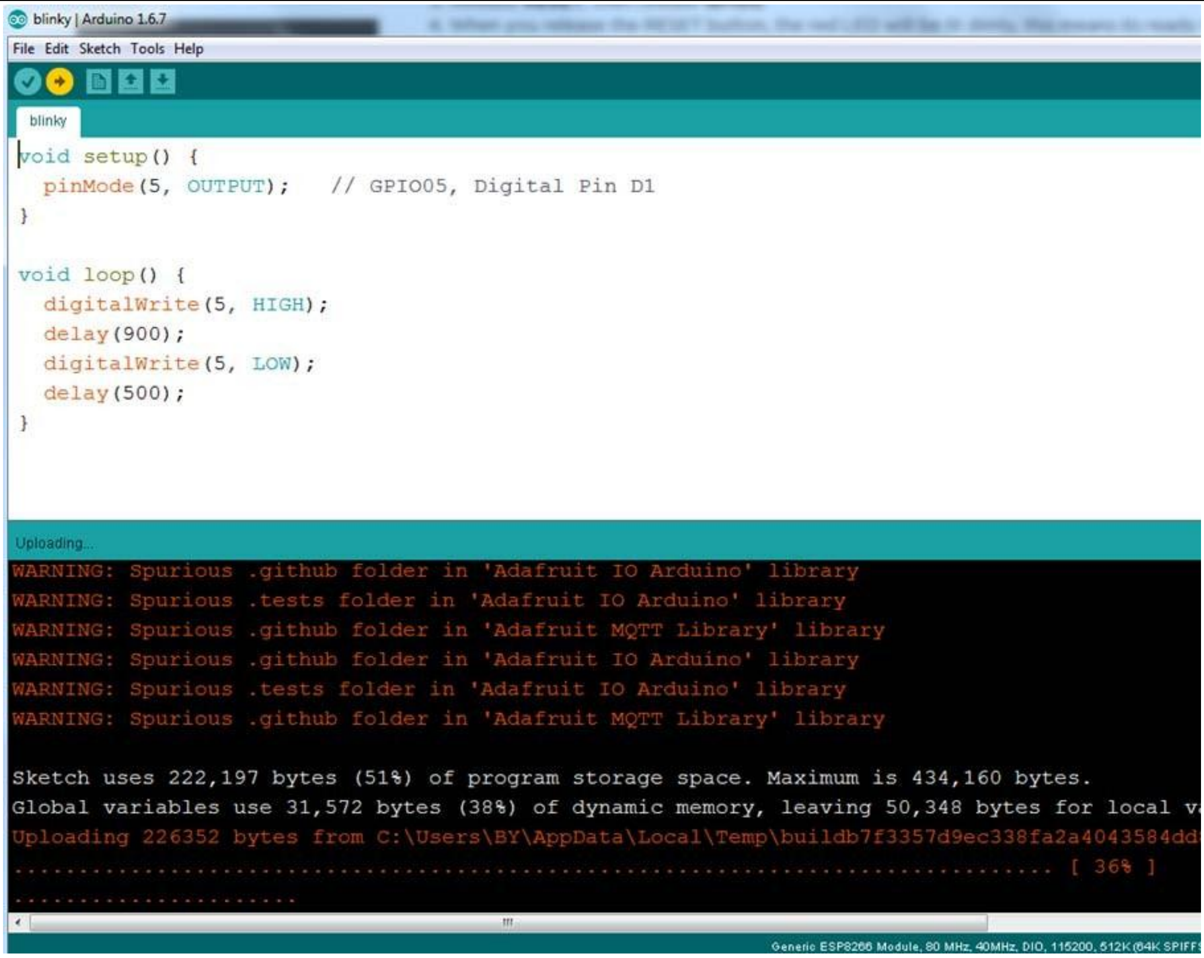


Figure 3.2: Uploading the sketch to ESP8266 NodeMCU module.

The sketch will start immediately - you'll see the LED blinking. Hooray!

3.5 Connecting via WiFi

OK once you've got the LED blinking, let's go straight to the fun part, connecting to a webserver. Create a new sketch with this code:

Don't forget to update:

const char* ssid = "yourssid";

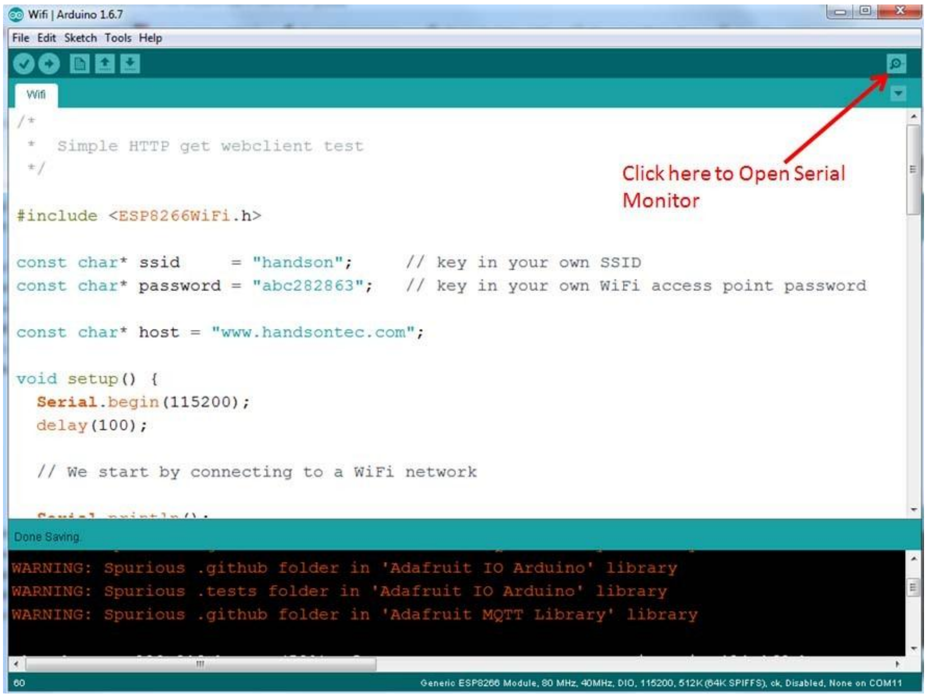
const char* password = "yourpassword";

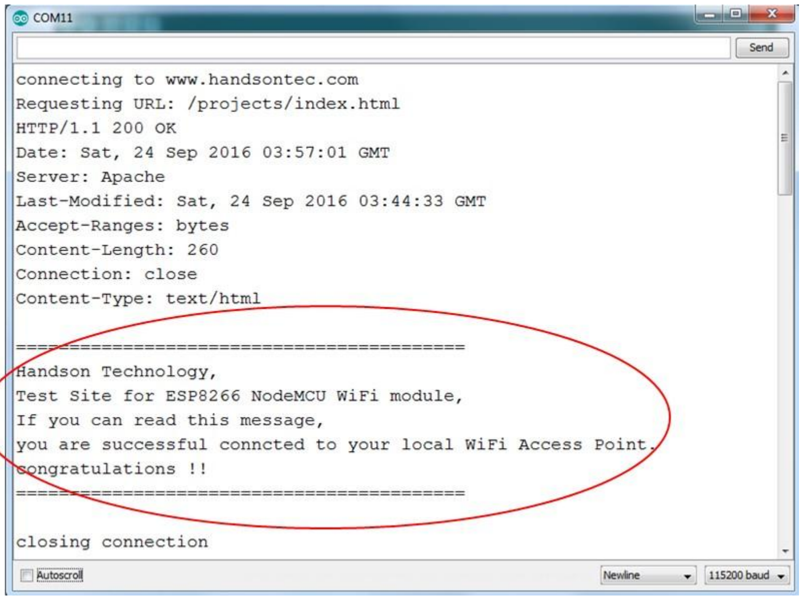
to your WiFi access point and password, then upload the same way: get into bootload mode, then upload code via IDE.

```
/*
 *  Simple HTTP get webclient test
 */

#include <ESP8266WiFi.h>

const char* ssid     = "handson";      // key in your own SSID
const char* password = "abc1234";      // key in your own WiFi access point
password
```

```
const char* host = "www.handsontec.com";

void setup() {
  Serial.begin(115200);
  delay(100);

  // We start by connecting to a WiFi network

  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

int value = 0;

void loop() {
  delay(5000);
  ++value;

  Serial.print("connecting to ");
  Serial.println(host);

  // Use WiFiClient class to create TCP connections
  WiFiClient client;
  const int httpPort = 80;
  if (!client.connect(host, httpPort)) {
    Serial.println("connection failed");
    return;
  }

  // We now create a URI for the request
  String url = "/projects/index.html";
  Serial.print("Requesting URL: ");
  Serial.println(url);

  // This will send the request to the server
  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");
  delay(500);

  // Read all the lines of the reply from server and print them to Serial
  while(client.available()){
    String line = client.readStringUntil('\r');
    Serial.print(line);
  }

  Serial.println();
  Serial.println("closing connection");
}
```

Open up the IDE serial console at 115200 baud to see the connection and webpage printout!





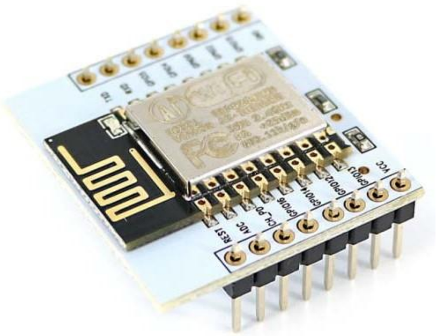
That's it, pretty easy right ! This section is just to get you started and test out your module.

4. Flashing NodeMCU Firmware on the ESP8266 using Windows

Why flashing your ESP8266 module with NodeMCU?

NodeMCU is a firmware that allows you to program the ESP8266 modules with LUA script. And you'll find it very similar to the way you program your Arduino. With just a few lines of code you can establish a WiFi connection, control the ESP8266 GPIOs, turning your ESP8266 into a web server and a lot more.

In this tutorial we are going to use another ESP8266 module with pin header adapter board which is breadboard friendly.

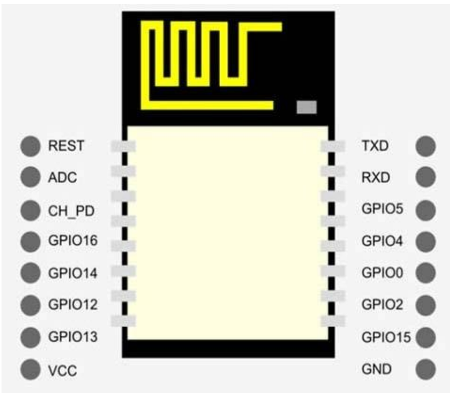


ESP8266 Module Breadboard Friendly with Header Connector

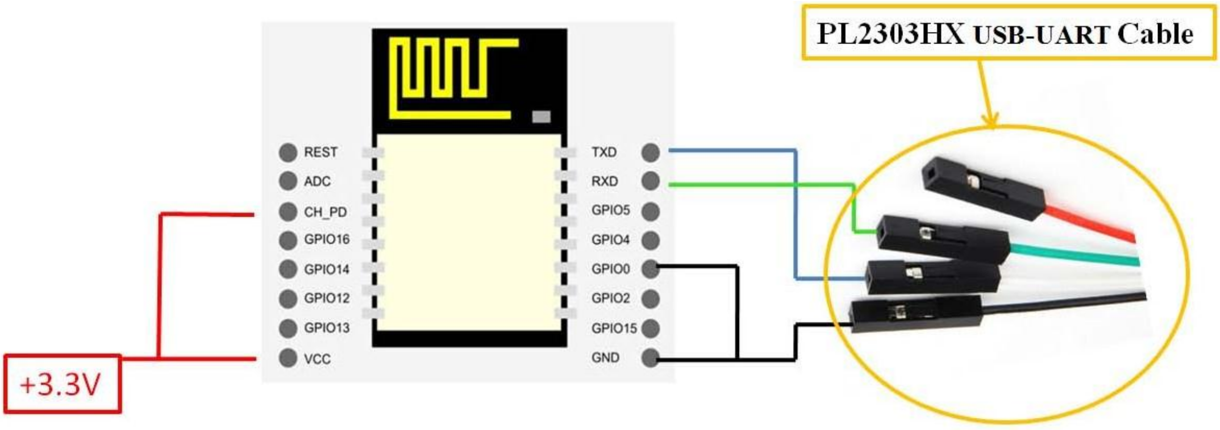
4.1 Parts Required:

- ESP8266 Module Breadboard Friendly
- PL2303HX USB-UART Converter Cable
- Some Male-to-Female Jumper Wires

4.2 Pin Assignment:



4.3 Wiring:



ESP8266 Pin	Description
CH_PD	Pull high, connect to Vcc +3.3V
Vcc	Power Supply +3.3V
TXD	Connect to RXD (white) of PL2303HX USB-Serial converter cable
RXD	Connect to TXD (Green) of PL2303HX USB-Serial converter cable
GPIO0	Pull low, connect to GND pin
GND	Power Supply ground

4.4 Downloading NodeMCU Flasher for Windows

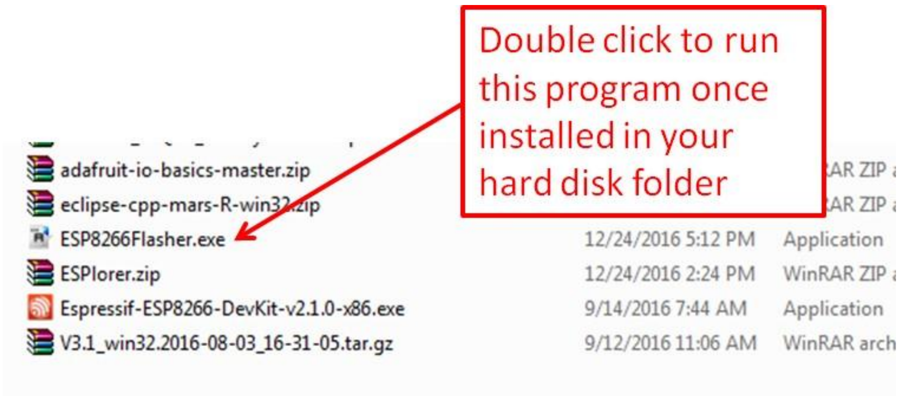
After wiring your circuit, you have to download the NodeMCU flasher. This is a .exe file that you can download using one of the following links:

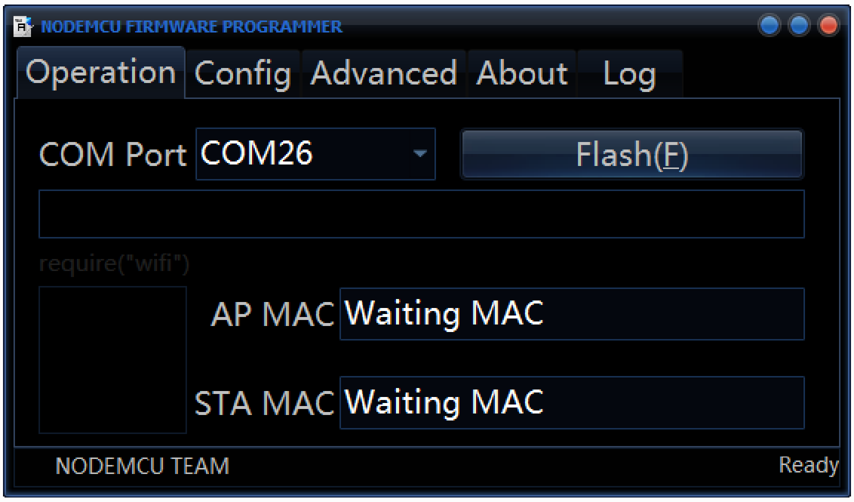
- Win32 Windows Flasher
- Win64 Windows Flasher

You can find all the information about NodeMCU flasher here.

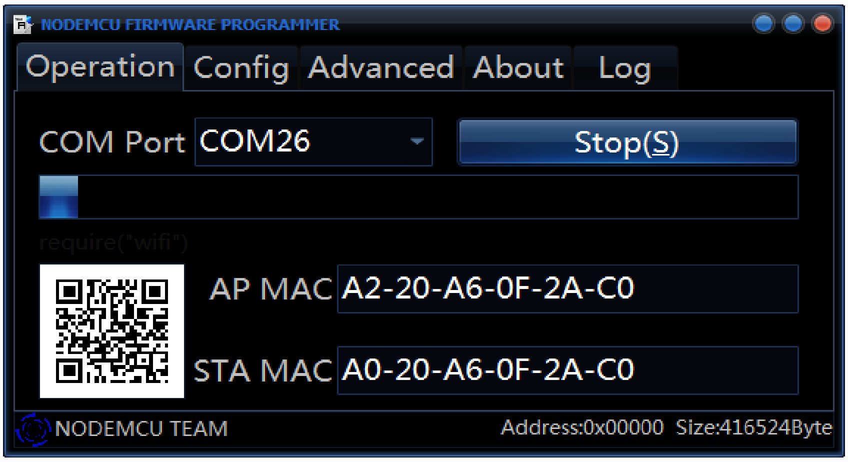
4.5 Flashing your ESP8266 using Windows

Open the flasher that you just downloaded and a window should appear (as shown in the following figure).

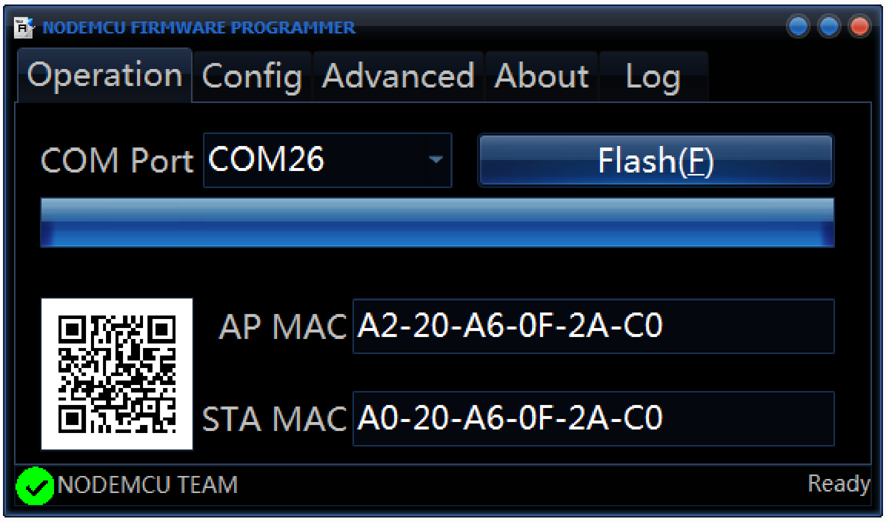




Press the button “Flash” and it should start the flashing process immediately, showing the Module MAC address if successful connected.



After finishing this flashing process, it should appear a green circle with a check icon at lower left corner.



Your ESP8266 module is now loaded with NodeMCU firmware.

5. Getting Started with the ESPlorer IDE

ESPlorer is an IDE (Integrated Development Environment) for ESP8266 devices. It’s a multi platform IDE, can be used in any OS environment, this simply means that it runs on Windows, Mac OS X or Linux.

Supported platforms:

- Windows(x86, x86-64)
- Linux(x86, x86-64, ARM soft & hard float)
- Solaris(x86, x86-64)
- Mac OS X(x86, x86-64, PPC, PPC64)

This software allows you to establish a serial communications with your ESP8266 module, send commands, and upload code and much more.

Requirements:

- You need to have JAVA installed in your computer. If you don’t have, go to this website: http://java.com/download, download and install the latest version. It requires JAVA (SE version 7 and above) installed.
- In order to complete the sample project presented in this Guide you need to flash your ESP8266 with NodeMCU firmware. Refer to chapter-4 in this guide on how to flash the NodeMCU firmware.

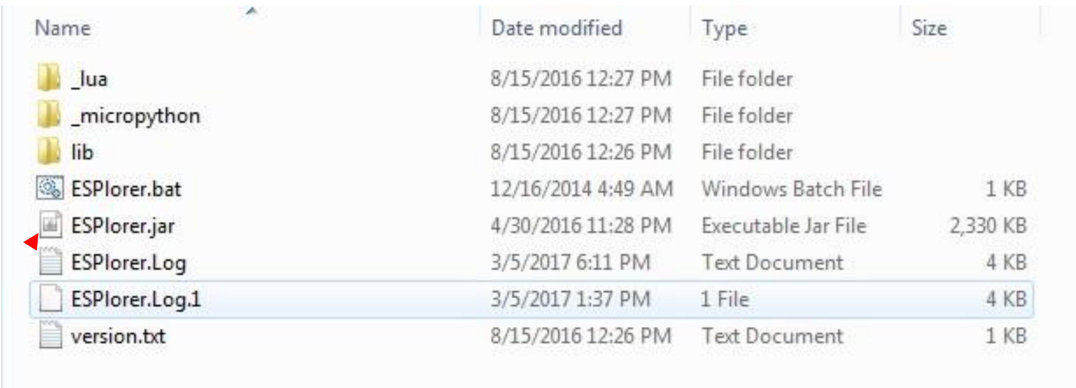
Main Resources:

- ESPlorer Homepage: http://esp8266.ru/esplorer/
- GitHub Repository: https://github.com/4refr0nt/ESPlorer

5.1 Installing ESPlorer

Now let’s download the ESPlorer IDE, visit the following URL: http://esp8266.ru/esplorer/#download

Grab the folder that you just downloaded. It should be named “ESPlorer.zip” and unzip it. Inside that folder you should see the following files:



Name	Date modified	Type	Size
_lua	8/15/2016 12:27 PM	File folder	
_micropython	8/15/2016 12:27 PM	File folder	
lib	8/15/2016 12:26 PM	File folder	
ESPlorer.bat	12/16/2014 4:49 AM	Windows Batch File	1 KB
ESPlorer.jar	4/30/2016 11:28 PM	Executable Jar File	2,330 KB
ESPlorer.Log	3/5/2017 6:11 PM	Text Document	4 KB
ESPlorer.Log.1	3/5/2017 1:37 PM	1 File	4 KB
version.txt	8/15/2016 12:26 PM	Text Document	1 KB

Execute the “ESPlorer.jar” file and the ESPlorer IDE should open after a few seconds (the “ESPlorer.jar” file is what you need to open every time you want to work with the ESPlorer IDE).

Note: If you're on Mac OS X or Linux you simply use this command line in your terminal to run the ESPlorer: sudo java –jar ESPlorer.jar.

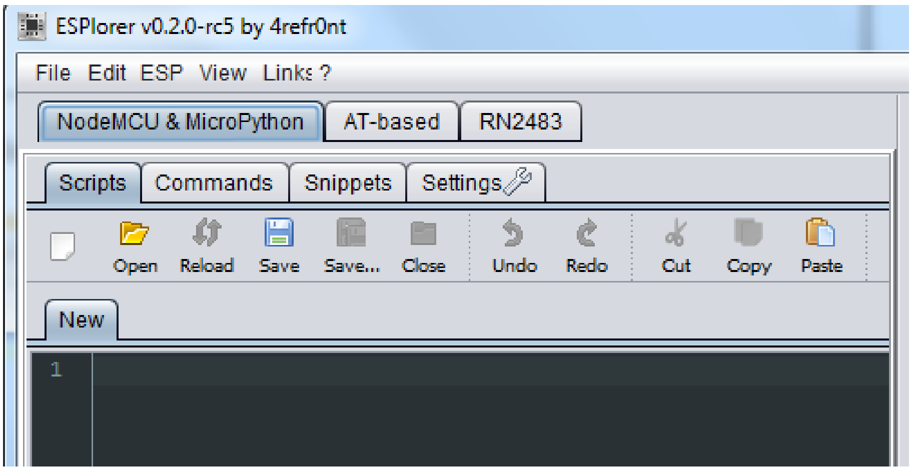
When the ESPlorer first opens, that's what you should see:

Here's a rundown of the features the ESPlorer IDE includes:

- Syntax highlighting LUA and Python code.
- Code editor color themes: default, dark, Eclipse, IDEA, Visual Studio.
- Undo/Redo editors features.
- Code Autocomplete (Ctrl+Space).
- Smart send data to ESP8266 (without dumb send with fixed line delay), check correct answer from ESP8266 after every lines.
- Code snippets.
- Detailed logging.
- And a lot more…

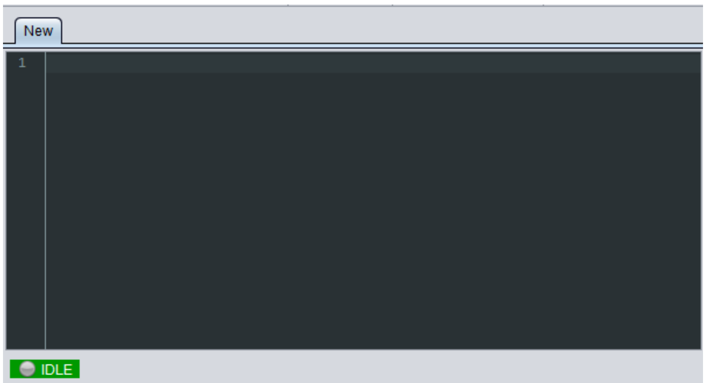
The ESPlorer IDE has a couple of main sections, let's break it down each one.

In the top left corner you can see all the regular options that you find in any software. Create a New file, Open a new file, Save file, Save file as, Undo, Redo, etc.

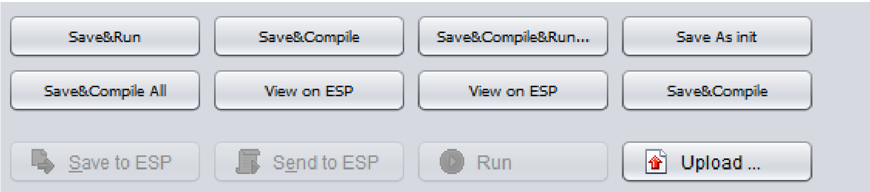


In the top right corner you have all the options you need to establish a serial communication (you're going to learn how to use them later in this Guide).

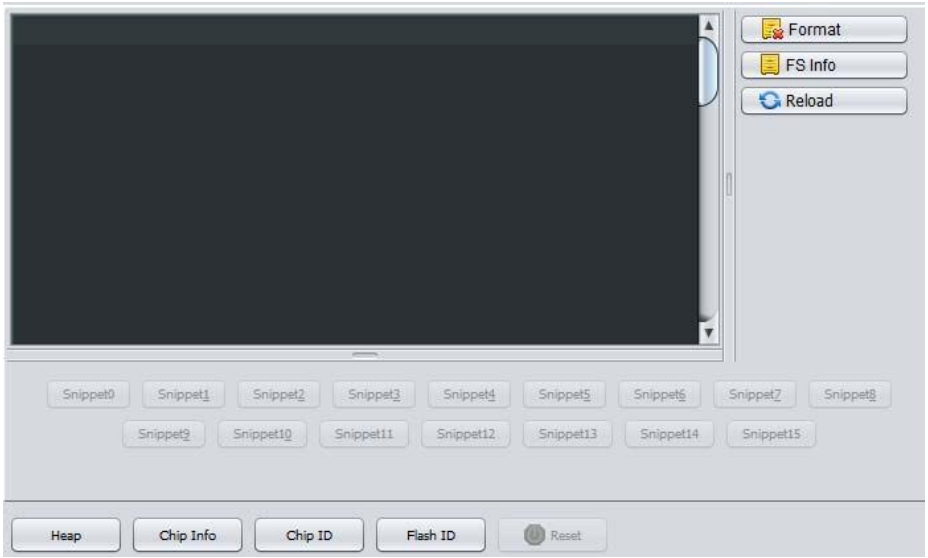
This next screenshot shows your Code Window, that's where you write your scripts (your scripts are highlighted with your code syntax).



Below the Code Window, you have 12 buttons that offer you all the functions you could possible need to interact with your ESP8266. Here's the ones you'll use most: "Save to ESP" and "Send to ESP".

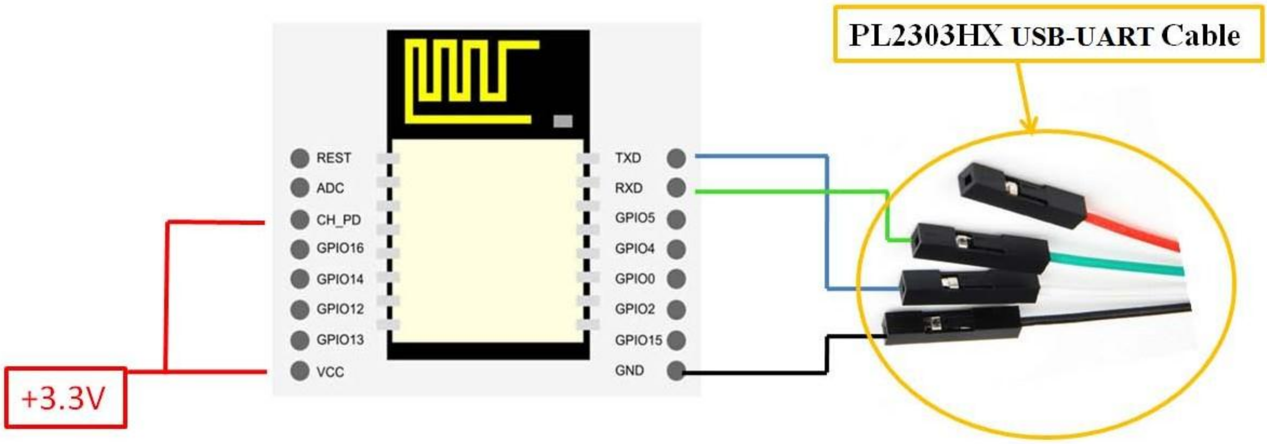


This screenshot shows the Output Window which tells you exactly what's going on in your ESP8266. You can see errors and use prints in your code to debug your projects.



5.2 Schematics

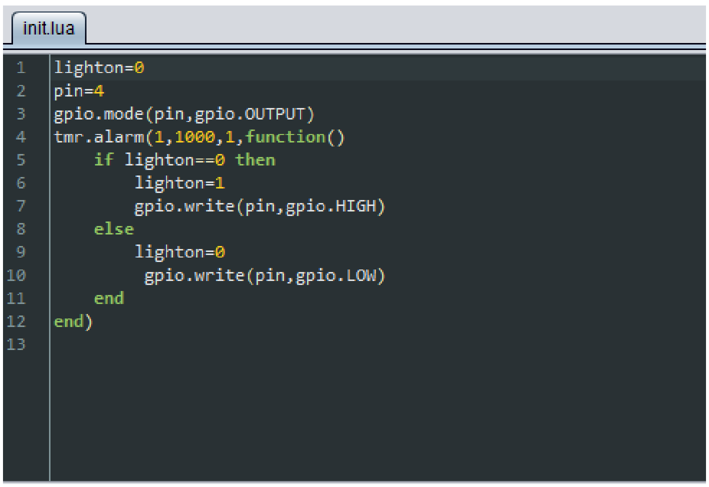
To upload code to your ESP8266, you should connect your ESP8266 to your PL2303HX USB-UART Programming Cable like the figure below:



5.3 Writing Your Lua Script

Below is your script to blink an LED.

```
lighton=0
pin=4
gpio.mode(pin,gpio.OUTPUT)
tmr.alarm(1,2000,1,function()
    if lighton==0 then
        lighton=1
        gpio.write(pin,gpio.HIGH)
    else
        lighton=0
         gpio.write(pin,gpio.LOW)
    end
end)
```

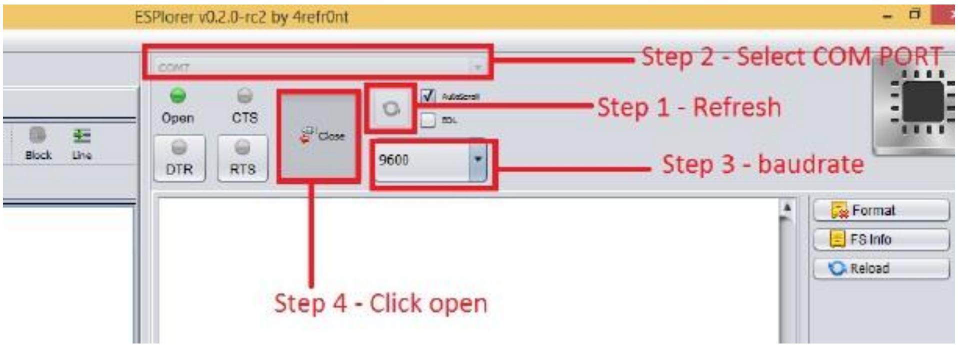


Right now you don’t need to worry how this code works, but how you can upload it to your ESP8266.

Having your ESP8266+PL2303HX Programmer connected to your computer, go to the ESPlorer IDE:

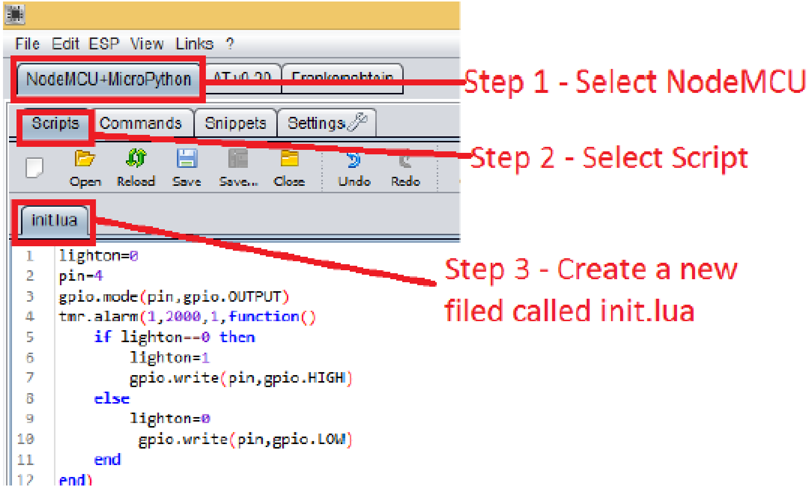
Look at the top right corner of your ESPlorer IDE and follow these instructions:

1. Press the Refresh button.
2. Select the COM port for your FTDI programmer.
3. Select your baudrate.
4. Click Open.

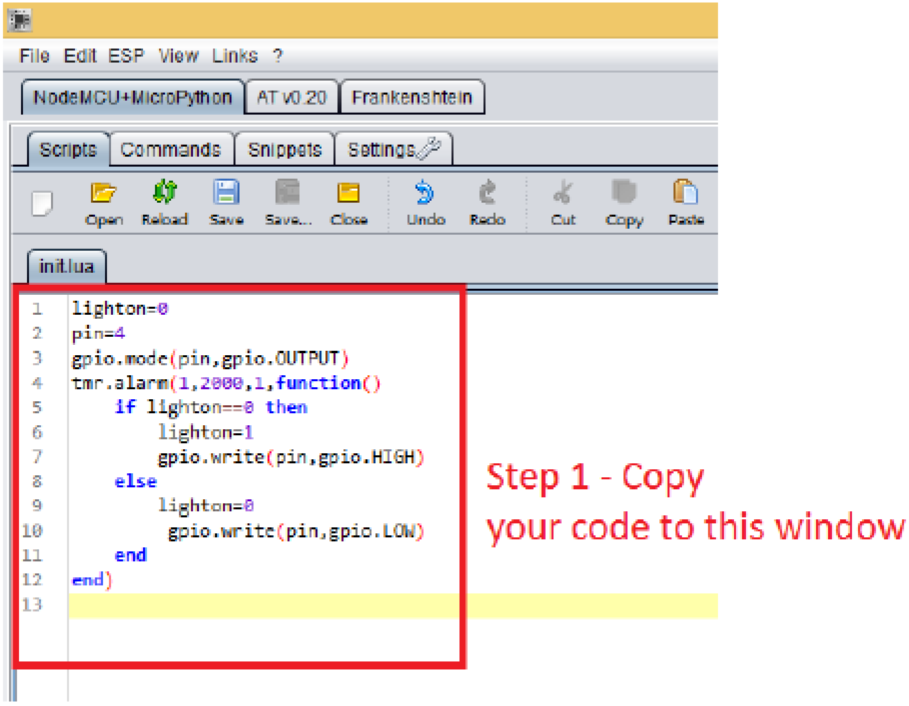


Then in the top left corner of your ESPlorer IDE, follow these instructions:

1. Select NodeMCU
2. Select Scripts
3. Create a new filled called “init.lua”



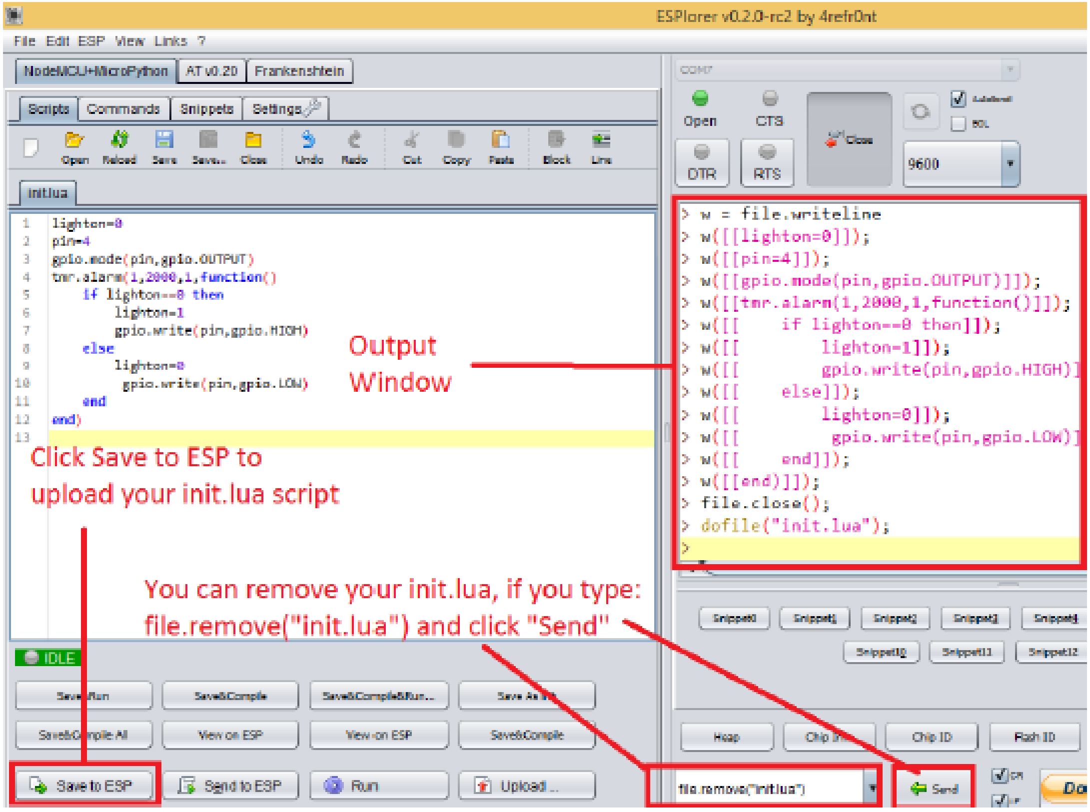
Copy your Lua script to the code window (as you can see in the Figure below):



The next step is to save your code to your ESP8266!

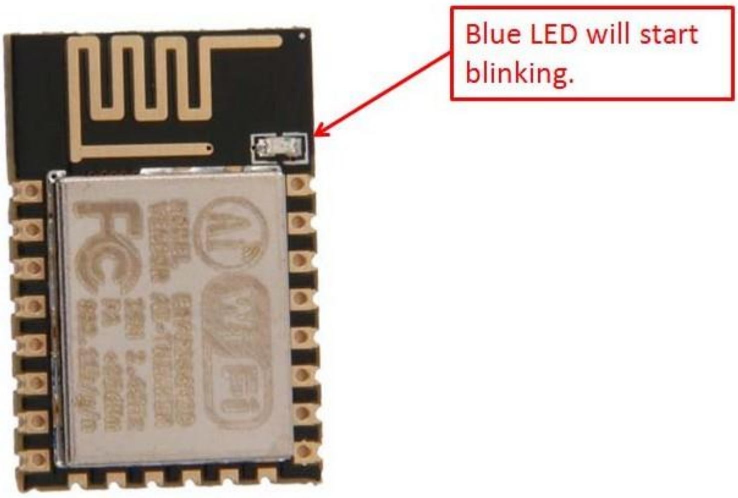
At the left bottom corner click the button “Save to ESP”.

In your output window, it should start showing exactly which commands are being sent to your ESP8266 and it should look similar to the Figure below.



Note: If you want to delete your "init.lua" file, you can do that easily. Simply type file.remove("init.lua") and press the button "Send" (see Figure above). Or you can type the command file.format() to remove all the files saved in your ESP8266. You can type any commands and send them to your ESP8266 through that window.

After uploading your code to your ESP8266, unplug your ESP8266 from your computer and power up the ESP8288 module.



Congratulations, you've made it! The blue LED at the upper right corner should be blinking every 2 seconds!

6. NodeMCU GPIO for Lua

The GPIO(General Purpose Input/Output) allows us to access to pins of ESP8266 , all the pins of ESP8266 accessed using the command GPIO, all the access is based on the I/O index number on the NoddMCU dev kits, not the internal GPIO pin, for example, the pin 'D7' on the NodeMCU dev kit is mapped to the internal GPIO pin 13, if you want to turn 'High' or 'Low' that particular pin you need to called the pin number '7', not the internal GPIO of the pin. When you are programming with generic ESP8266 this confusion will arise which pin needs to be called during programming, if you are using NodeMCU devkit, it has come prepared for working with Lua interpreter which can easily program by looking the pin names associated on the Lua board. If you are using generic ESP8266 device or any other vendor boards please refer to the table below to know which IO index is associated to the internal GPIO of ESP8266.

Nodemcu dev kit	ESP8266 Pin	Nodemcu dev kit	ESP8266 Pin
D0	GPIO16	D7	GPIO13
D1	GPIO5	D8	GPIO15
D2	GPIO4	D9	GPIO3
D3	GPIO0	D10	GPIO1
D4	GPIO2	D11	GPIO9
D5	GPIO14	D12	GPIO10
D6	GPIO12		

D0 or GPIO16 can be used only as a read and write pin, no other options like PWM/I2C are supported by this pin.

In our example in chapter 5 on blinking the blue LED, the blue LED in connected to GPIO2, it is defined as Pin4 (D4) in Lua script.

7. Web Resources:

- ESP8266 Lua Nodemcu WIFI Module
- ESP8266 Breadboard Friendly Module
- ESP8266 Remote Serial WIFI Module
- PL2303HX USB-UART Converter Cable

LM2596

3.0 A, Step-Down Switching Regulator

The LM2596 regulator is monolithic integrated circuit ideally suited for easy and convenient design of a step−down switching regulator (buck converter). It is capable of driving a 3.0 A load with excellent line and load regulation. This device is available in adjustable output version and it is internally compensated to minimize the number of external components to simplify the power supply design.

Since LM2596 converter is a switch−mode power supply, its efficiency is significantly higher in comparison with popular three−terminal linear regulators, especially with higher input voltages.

The LM2596 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in a standard 5−lead TO−220 package with several different lead bend options, and D^2PAK surface mount package.

The other features include a guaranteed ±4% tolerance on output voltage within specified input voltages and output load conditions, and ±15% on the oscillator frequency. External shutdown is included, featuring 80 μA (typical) standby current. Self protection features include switch cycle−by−cycle current limit for the output switch, as well as thermal shutdown for complete protection under fault conditions.

Features

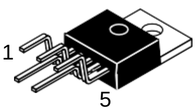
- Adjustable Output Voltage Range 1.23 V − 37 V
- Guaranteed 3.0 A Output Load Current
- Wide Input Voltage Range up to 40 V
- 150 kHz Fixed Frequency Internal Oscillator
- TTL Shutdown Capability
- Low Power Standby Mode, typ 80 μA
- Thermal Shutdown and Current Limit Protection
- Internal Loop Compensation
- Moisture Sensitivity Level (MSL) Equals 1
- Pb−Free Packages are Available

Applications

- Simple High−Efficiency Step−Down (Buck) Regulator
- Efficient Pre−Regulator for Linear Regulators
- On−Card Switching Regulators
- Positive to Negative Converter (Buck−Boost)
- Negative Step−Up Converters
- Power Supply for Battery Chargers

ON Semiconductor®

http://onsemi.com

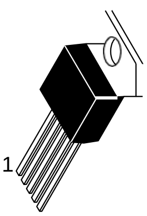


1

5

TO−220
TV SUFFIX
CASE 314B

Heatsink surface connected to Pin 3

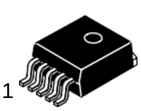


1

5

TO−220
T SUFFIX
CASE 314D

Pin
1. V_{in}
2. Output
3. Ground
4. Feedback
5. $\overline{ON}$/OFF



1

5

D^2PAK
D2T SUFFIX
CASE 936A

Heatsink surface (shown as terminal 6 in case outline drawing) is connected to Pin 3

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 23 of this data sheet.

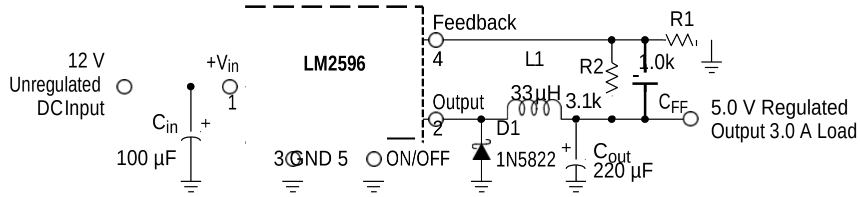
DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 23 of this data sheet.

November, 2008 − Rev. 0

Publication Order Number:
LM2596/D

Typical Application (Adjustable Output Voltage Version)



Block Diagram

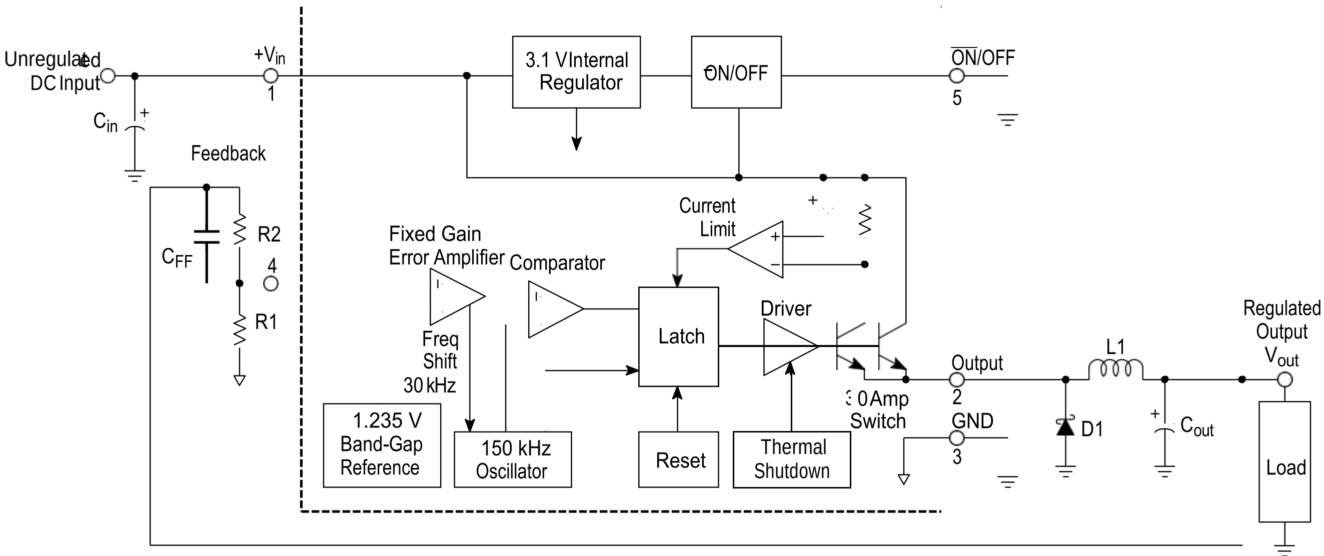


Figure 1. Typical Application and Internal Block Diagram

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Maximum Supply Voltage	V_{in}	45	V
$\overline{\text{ON}}$/OFF Pin Input Voltage	−	$-0.3\ V \le V \le +V_{in}$	V
Output Voltage to Ground (Steady−State)	−	−1.0	V
Power Dissipation			
Case 314B and 314D (TO−220, 5−Lead)	P_D	Internally Limited	W
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	65	°C/W
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	5.0	°C/W
Case 936A (D^2PAK)	P_D	Internally Limited	W
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	70	°C/W
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	5.0	°C/W
Storage Temperature Range	T_{stg}	−65 to +150	°C
Minimum ESD Rating (Human Body Model: C = 100 pF, R = 1.5 kfi)	−	2.0	kV
Lead Temperature (Soldering, 10 seconds)	−	260	°C
Maximum Junction Temperature	T_J	150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

PIN FUNCTION DESCRIPTION

Pin	Symbol	Description (Refer to Figure 1)
1	V_{in}	This pin is the positive input supply for the LM2596 step−down switching regulator. In order to minimize voltage transients and to supply the switching currents needed by the regulator, a suitable input bypass capacitor must be present (C_{in} in Figure 1).
2	Output	This is the emitter of the internal switch. The saturation voltage V_{sat} of this output switch is typically 1.5 V. It should be kept in mind that the PCB area connected to this pin should be kept to a minimum in order to minimize coupling to sensitive circuitry.
3	GND	Circuit ground pin. See the information about the printed circuit board layout.
4	Feedback	This pin is the direct input of the error amplifier and the resistor network R2, R1 is connected externally to allow programming of the output voltage.
5	$\overline{\text{ON}}$/OFF	It allows the switching regulator circuit to be shut down using logic level signals, thus dropping the total input supply current to approximately 80 μA. The threshold voltage is typically 1.6 V. Applying a voltage above this value (up to $+V_{in}$) shuts the regulator off. If the voltage applied to this pin is lower than 1.6 V or if this pin is left open, the regulator will be in the “on” condition.

OPERATING RATINGS (Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.)

Rating	Symbol	Value	Unit
Operating Junction Temperature Range	T_J	−40 to +125	°C
Supply Voltage	V_{in}	4.5 to 40	V

SYSTEM PARAMETERS

ELECTRICAL CHARACTERISTICS Specifications with standard type face are for T_J = 25°C, and those with boldface type apply over full Operating Temperature Range −40°C to +125°C

Characteristics	Symbol	Min	Typ	Max	Unit
LM2596 (Note 1, Test Circuit Figure 15)					
Feedback Voltage (V_{in} = 12 V, I_{Load} = 0.5 A, V_{out} = 5.0 V,)	V_{FB_nom}		1.23		V
Feedback Voltage (8.5 V ≤ V_{in} ≤ 40 V, 0.5 A ≤ I_{Load} ≤ 3.0 A, V_{out} = 5.0 V)	V_{FB}	1.193 **1.18**		1.267 **1.28**	V
Efficiency (V_{in} = 12 V, I_{Load} = 3.0 A, V_{out} = 5.0 V)	η	–	73	–	%
Characteristics	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Feedback Bias Current (V_{out} = 5.0 V)	I_b		25	100 **200**	nA
Oscillator Frequency (Note 2)	f_{osc}	135 **120**	150	165 **180**	kHz
Saturation Voltage (I_{out} = 3.0 A, Notes 3 and 4)	V_{sat}		1.5	1.8 **2.0**	V
Max Duty Cycle "ON" (Note 4)	DC		95		%
Current Limit (Peak Current, Notes 2 and 3)	I_{CL}	4.2 **3.5**	5.6	6.9 **7.5**	A
Output Leakage Current (Notes 5 and 6) Output = 0 V Output = −1.0 V	I_L		 0.5 6.0	 2.0 20	mA
Quiescent Current (Note 5)	I_Q		5.0	10	mA
Standby Quiescent Current ($\overline{ON}$/OFF Pin = 5.0 V ("OFF")) (Note 6)	I_{stby}		80	200 **250**	μA
$\overline{ON}$/OFF PIN LOGIC INPUT					
Threshold Voltage			1.6		V
V_{out} = 0 V (Regulator OFF)	V_{IH}	2.2 **2.4**			V
V_{out} = Nominal Output Voltage (Regulator ON)	V_{IL}			1.0 **0.8**	V
$\overline{ON}$/OFF Pin Input Current					
$\overline{ON}$/OFF Pin = 5.0 V (Regulator OFF)	I_{IH}	–	15	30	μA
$\overline{ON}$/OFF Pin = 0 V (regulator ON)	I_{IL}	–	0.01	5.0	μA

1. External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2596 is used as shown in the Figure 15 test circuit, system performance will be as shown in system parameters section.
2. The oscillator frequency reduces to approximately 30 kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.
3. No diode, inductor or capacitor connected to output (Pin 2) sourcing the current.
4. Feedback (Pin 4) removed from output and connected to 0 V.
5. Feedback (Pin 4) removed from output and connected to +12 V to force the output transistor "off".
6. V_{in} = 40 V.

TYPICAL PERFORMANCE CHARACTERISTICS (Circuit of Figure 15)

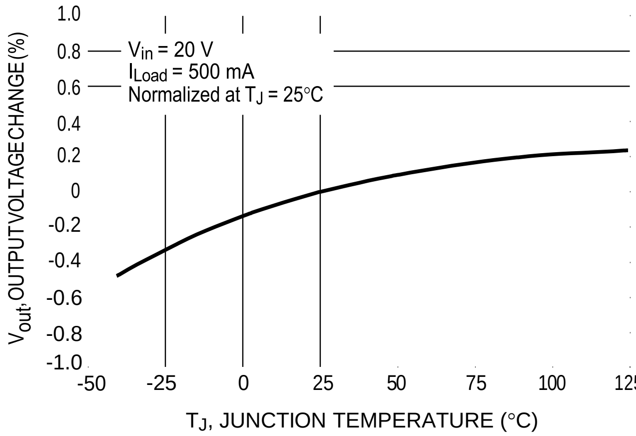


Figure 2. Normalized Output Voltage

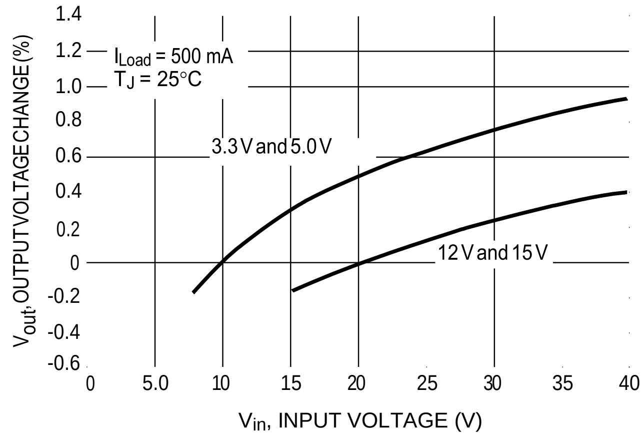


Figure 3. Line Regulation

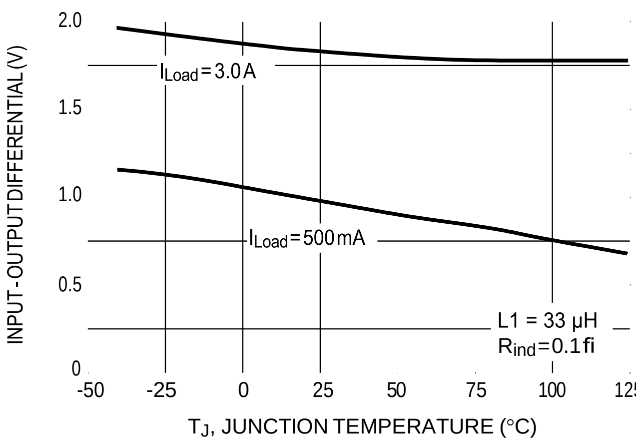


Figure 4. Dropout Voltage

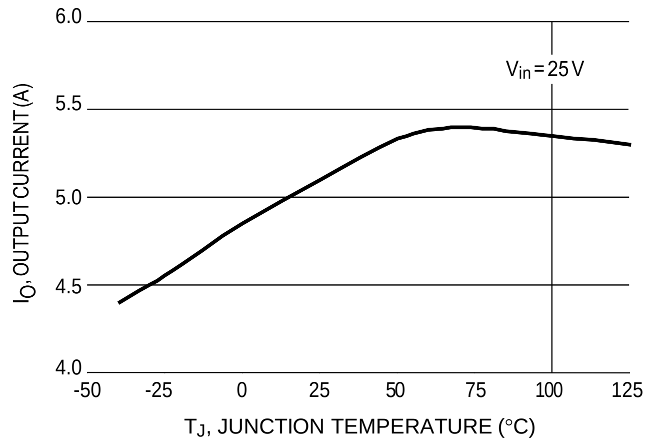


Figure 5. Current Limit

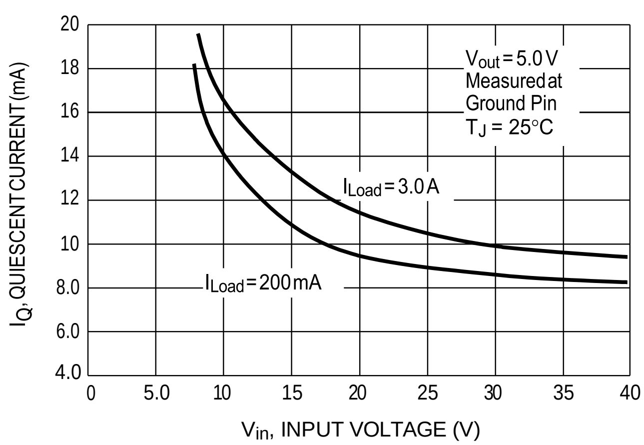


Figure 6. Quiescent Current

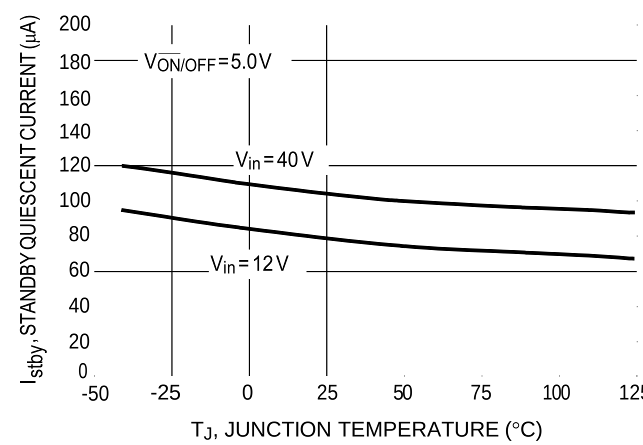


Figure 7. Standby Quiescent Current

TYPICAL PERFORMANCE CHARACTERISTICS (Circuit of Figure 15)

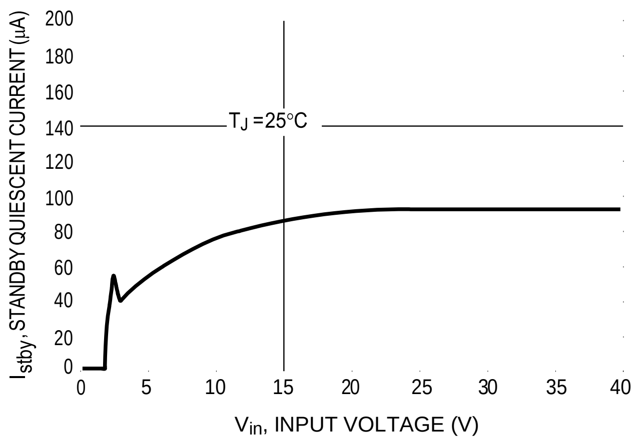


Figure 8. Standby Quiescent Current

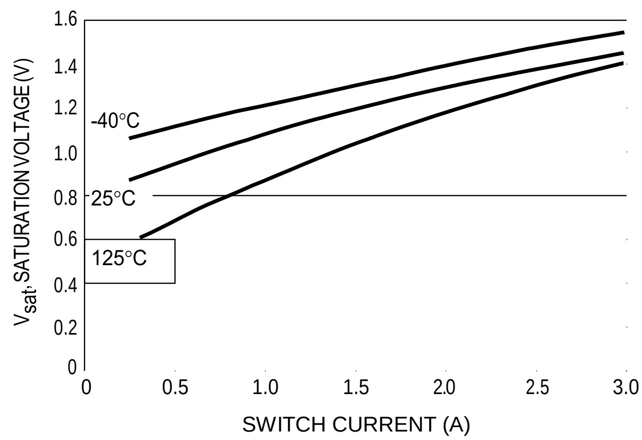


Figure 9. Switch Saturation Voltage

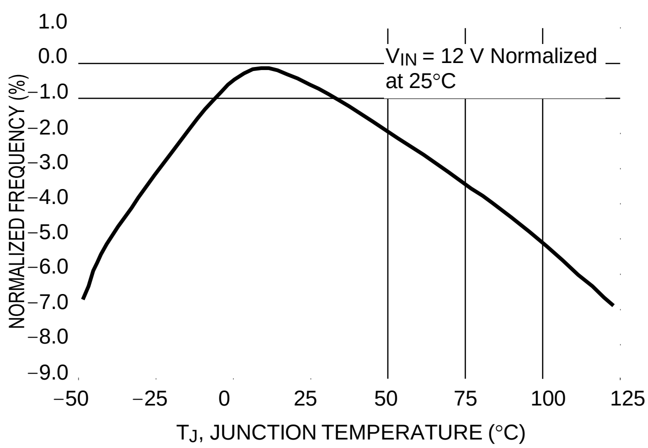


Figure 10. Switching Frequency

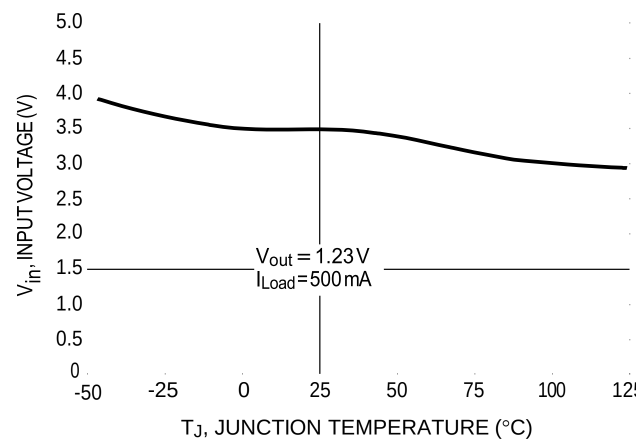


Figure 11. Minimum Supply Operating Voltage

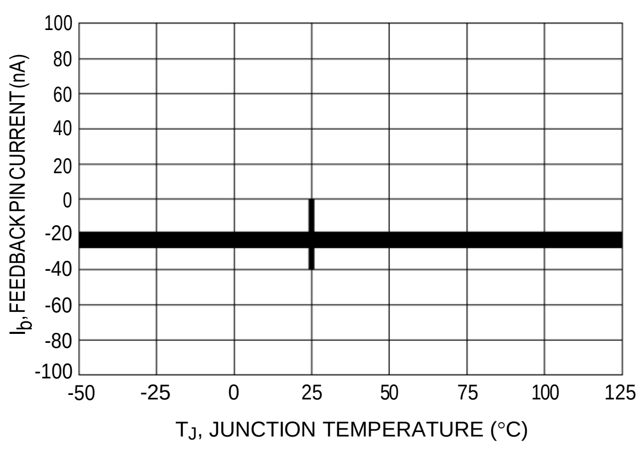


Figure 12. Feedback Pin Current

TYPICAL PERFORMANCE CHARACTERISTICS (Circuit of Figure 15)

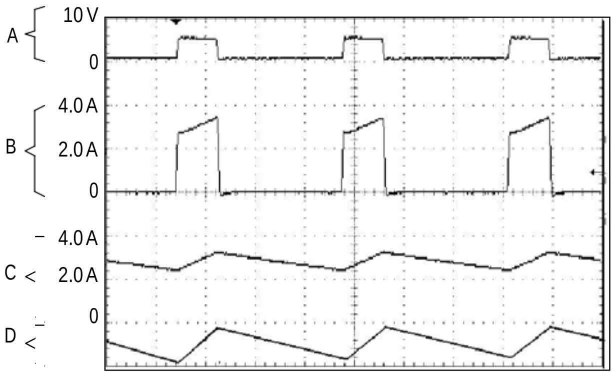


Figure 13. Switching Waveforms

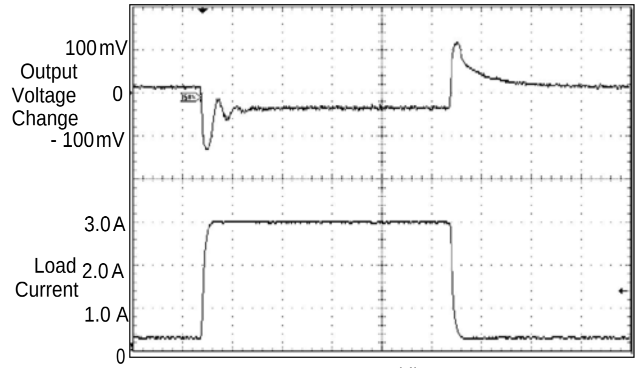
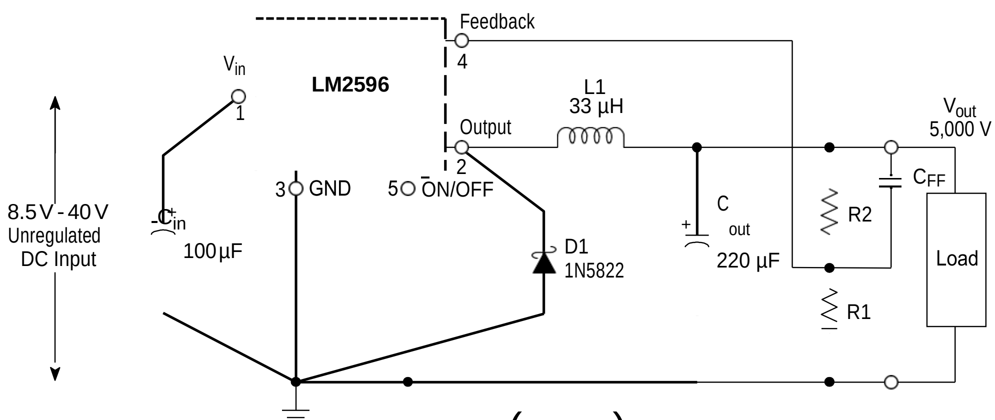


Figure 14. Load Transient Response

Vout = 5 V
A: Output Pin Voltage, 10 V/div
B: Switch Current, 2.0 A/div
C: Inductor Current, 2.0 A/div, AC−Coupled
D: Output Ripple Voltage, 50 mV/div, AC−Coupled

Horizontal Time Base: 5.0 µs/div

Adjustable Output Voltage Versions



$$V_{out} = V_{ref}\left(1.0 + \frac{R2}{R1}\right)$$

$$R2 = R1\left(\frac{V_{out}}{V_{ref}}\ 1.0\right)$$

Where V_{ref} = 1.23 V, R1
between 1.0 k and 5.0 k

Figure 15. Typical Test Circuit

PCB LAYOUT GUIDELINES

As in any switching regulator, the layout of the printed circuit board is very important. Rapidly switching currents associated with wiring inductance, stray capacitance and parasitic inductance of the printed circuit board traces can generate voltage transients which can generate electromagnetic interferences (EMI) and affect the desired operation. As indicated in the Figure 15, to minimize inductance and ground loops, the length of the leads indicated by heavy lines should be kept as short as possible.

For best results, single−point grounding (as indicated) or ground plane construction should be used.

On the other hand, the PCB area connected to the Pin 2 (emitter of the internal switch) of the LM2596 should be kept to a minimum in order to minimize coupling to sensitive circuitry.

Another sensitive part of the circuit is the feedback. It is important to keep the sensitive feedback wiring short. To assure this, physically locate the programming resistors near to the regulator, when using the adjustable version of the LM2596 regulator.

DESIGN PROCEDURE

Buck Converter Basics

The LM2596 is a "Buck" or Step−Down Converter which is the most elementary forward−mode converter. Its basic schematic can be seen in Figure 16.

The operation of this regulator topology has two distinct time periods. The first one occurs when the series switch is on, the input voltage is connected to the input of the inductor. The output of the inductor is the output voltage, and the rectifier (or catch diode) is reverse biased. During this period, since there is a constant voltage source connected across the inductor, the inductor current begins to linearly ramp upwards, as described by the following equation:

$$I_{L(on)} = \frac{(V_{IN} - V_{OUT})t_{on}}{L}$$

During this "on" period, energy is stored within the core material in the form of magnetic flux. If the inductor is properly designed, there is sufficient energy stored to carry the requirements of the load during the "off" period.

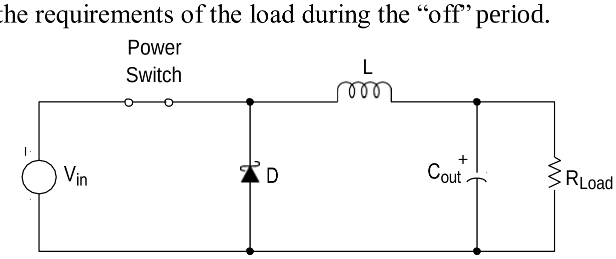


Figure 16. Basic Buck Converter

The next period is the "off" period of the power switch. When the power switch turns off, the voltage across the inductor reverses its polarity and is clamped at one diode voltage drop below ground by the catch diode. The current now flows through the catch diode thus maintaining the load current loop. This removes the stored energy from the inductor. The inductor current during this time is:

$$I_{L(off)} = \frac{(V_{OUT} - V_D)t_{off}}{L}$$

This period ends when the power switch is once again turned on. Regulation of the converter is accomplished by varying the duty cycle of the power switch. It is possible to describe the duty cycle as follows:

$$d = \frac{t_{on}}{T}$$, where T is the period of switching.

For the buck converter with ideal components, the duty cycle can also be described as:

$$d = \frac{V_{out}}{V_{in}}$$

Figure 17 shows the buck converter, idealized waveforms of the catch diode voltage and the inductor current.

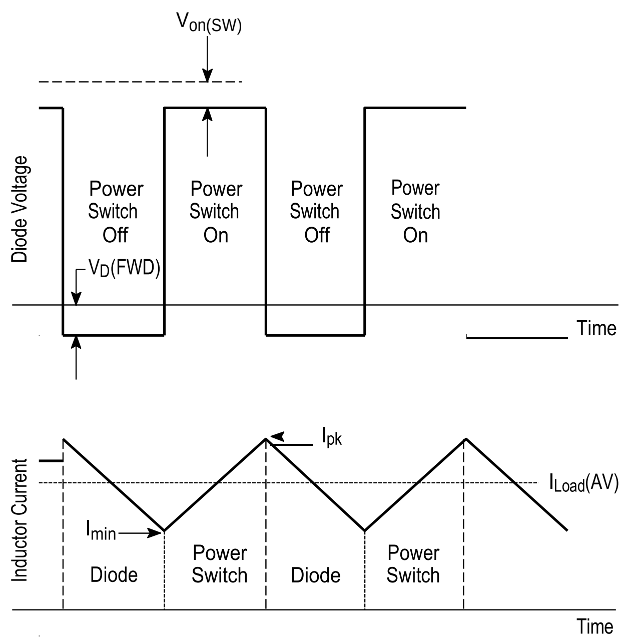


Figure 17. Buck Converter Idealized Waveforms

PROCEDURE (ADJUSTABLE OUTPUT VERSION: LM2596)

Procedure	Example
Given Parameters: V_{out} = Regulated Output Voltage $V_{in(max)}$ = Maximum DC Input Voltage $I_{Load(max)}$ = Maximum Load Current	**Given Parameters:** V_{out} = 5.0 V $V_{in(max)}$ = 12 V $I_{Load(max)}$ = 3.0 A
1. Programming Output Voltage To select the right programming resistor R1 and R2 value (see Figure 1) use the following formula: $V_{out} = V_{ref}\left(1.0 + \frac{R2}{R1}\right)$ where V_{ref} = 1.23 V Resistor R1 can be between 1.0 k and 5.0 kfi. (For best temperature coefficient and stability with time, use 1% metal film resistors). $R2 = R1\left(\frac{V_{out}}{V_{ref}} - 1.0\right)$	**1. Programming Output Voltage** (selecting R1 and R2) Select R1 and R2: $V_{out} = 1.23\left(1.0 + \frac{R2}{R1}\right)$ Select R1 = 1.0 kfi $R2 = R1\left(\frac{V_{out}}{V_{ref}} - 1.0\right) = \left(\frac{5\,V}{1.23\,V} - 1.0\right)$ R2 = 3.0 kfi, choose a 3.0k metal film resistor.
2. Input Capacitor Selection (C_{in}) To prevent large voltage transients from appearing at the input and for stable operation of the converter, an aluminium or tantalum electrolytic bypass capacitor is needed between the input pin $+V_{in}$ and ground pin GND This capacitor should be located close to the IC using short leads. This capacitor should have a low ESR (Equivalent Series Resistance) value. For additional information see input capacitor section in the “Application Information” section of this data sheet.	**2. Input Capacitor Selection (C_{in})** A 100 μF, 50 V aluminium electrolytic capacitor located near the input and ground pin provides sufficient bypassing.
3. Catch Diode Selection (D1) **A.** Since the diode maximum peak current exceeds the regulator maximum load current the catch diode current rating must be at least 1.2 times greater than the maximum load current. For a robust design, the diode should have a current rating equal to the maximum current limit of the LM2596 to be able to withstand a continuous output short. **B.** The reverse voltage rating of the diode should be at least 1.25 times the maximum input voltage.	**3. Catch Diode Selection (D1)** **A.** For this example, a 3.0 A current rating is adequate. **B.** For robust design use a 30 V 1N5824 Schottky diode or any suggested fast recovery diode in the Table 2.

PROCEDURE (ADJUSTABLE OUTPUT VERSION: LM2596) (CONTINUED)

Procedure	Example
4. Inductor Selection (L1) **A.** Use the following formula to calculate the inductor Volt x microsecond [V x µs] constant: $E \times T = (V_{IN} - V_{OUT} - V_{SAT}) \times \frac{V_{OUT} + V_D}{V_{IN} - V_{SAT} + V_D} \times \frac{1000}{150\ kHz} (V \times \mu s)$ **B.** Match the calculated E x T value with the corresponding number on the vertical axis of the Inductor Value Selection Guide shown in Figure 18. This E x T constant is a measure of the energy handling capability of an inductor and is dependent upon the type of core, the core area, the number of turns, and the duty cycle. **C.** Next step is to identify the inductance region intersected by the E x T value and the maximum load current value on the horizontal axis shown in Figure 18. **D.** Select an appropriate inductor from Table 3. The inductor chosen must be rated for a switching frequency of 150 kHz and for a current rating of 1.15 x I_{Load}. The inductor current rating can also be determined by calculating the inductor peak current: $I_{p(max)} = I_{Load(max)} + \frac{(V_{in} - V_{out})\, t_{on}}{2L}$ where t_{on} is the “on” time of the power switch and $t_{on} = \frac{V_{out}}{V_{in}} \times \frac{1.0}{f_{osc}}$	**4. Inductor Selection (L1)** **A.** Calculate E x T [V x µs] constant: $E \times T = (12 - 5 - 1.5) \times \frac{5 + 0.5}{12 - 5 + 0.5} \times \frac{1000}{150\ kHz} (V \times \mu s)$ $E \times T = (5.5) \times \frac{5.5}{7.5} \times 6.6 (V \times \mu s)$ **B.** E x T = 27 [V x µs] **C.** $I_{Load(max)} = 3.0$ A Inductance Region = L40 **D.** Proper inductor value = 33 µH Choose the inductor from Table 3.
5. Output Capacitor Selection (C_{out}) **A.** Since the LM2596 is a forward−mode switching regulator with voltage mode control, its open loop has 2−pole−1−zero frequency characteristic. The loop stability is determined by the output capacitor (capacitance, ESR) and inductance values. For stable operation use recommended values of the output capacitors in Table 1. Low ESR electrolytic capacitors between 220uFand 1500uF provide best results. **B.** The capacitors voltage rating should be at least 1.5 times greater than the output voltage, and often much higher voltage rating is needed to satisfy low ESR requirement	**5. Output Capacitor Selection (C_{out})** **A.** In this example is recommended Nichicon PM capacitors: 470 µF/35 V or 220 µF/35 V
6. Feedforward Capacitor (C_{FF}) It provides additional stability mainly for higher input voltages. For Cff selection use Table 1. The compensation capacitor between 0.6 nF and 40 nF is wired in parallel with the output voltage setting resistor R2, The capacitor type can be ceramic, plastic, etc..	**6. Feedforward Capacitor (C_{FF})** In this example is recommended feedforward capacitor 15 nF or 5 nF.

LM2596 Series Buck Regulator Design Procedures (continued)

Table 1. RECOMMENDED VALUES OF THE OUTPUT CAPACITOR AND FEEDFORWARD CAPACITOR
(I_{load} = 3 A)

Nichicon PM Capacitors								
V_{in} (V)	Capacity/Voltage Range/ESR (μF/V/mΩ)							
40	1500/35/24	1000/35/29	1000/35/29	680/35/36	560/25/55	560/25/55	470/35/46	470/35/46
26	1200/35/26	820/35	680/35/36	560/35/41	470/25/65	470/25/65	330/35/60	
22	1000/35/29	680/35/36	560/35/41	330/25/85	330/25/85	220/35/85		
20	820/35/32	470/35/46	470/25/65	330/25/85	330/25/85	220/35/85		
18	820/35/32	470/35/46	470/25/65	330/25/85	330/25/85	220/35/85		
12	820/35/32	470/35/46	220/35/85	220/25/111				
10	820/35/32	470/35/46	220/35/85					
V_{out} (V)	2	4	6	9	12	15	24	28
C_{FF} (nF)	**40**	**15**	**5**	**2**	**1.5**	**1**	**0.6**	**0.6**

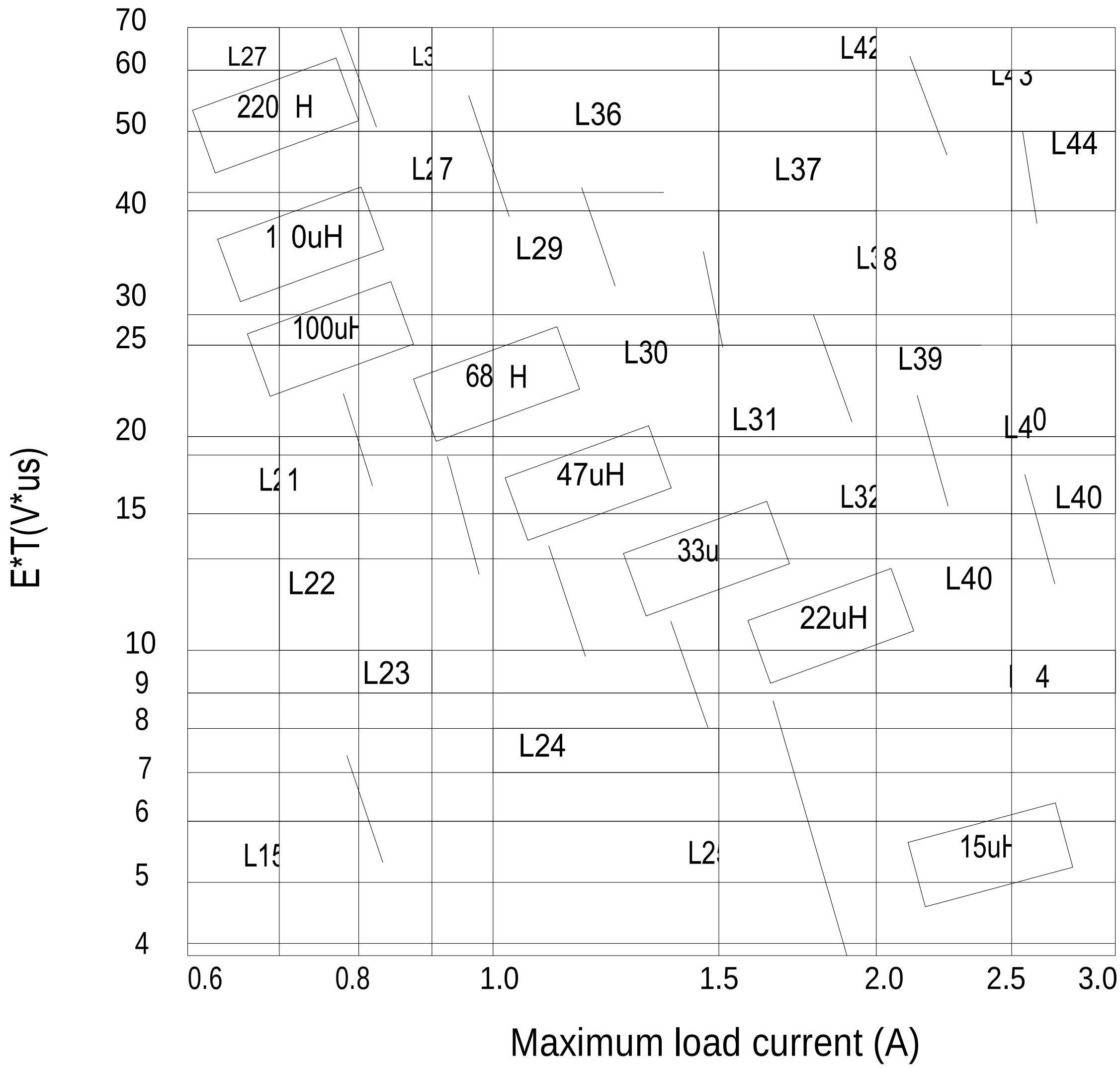


Figure 18. Inductor Value Selection Guides (For Continuous Mode Operation)

Table 2. DIODE SELECTION

<table>
<tr><th rowspan="3">V_R</th><th colspan="4">Schottky</th><th colspan="4">Fast Recovery</th></tr>
<tr><th colspan="2">3.0 A</th><th colspan="2">4.0 – 6.0 A</th><th colspan="2">3.0 A</th><th colspan="2">4.0 – 6.0 A</th></tr>
<tr><th>Through Hole</th><th>Surface Mount</th><th>Through Hole</th><th>Surface Mount</th><th>Through Hole</th><th>Surface Mount</th><th>Through Hole</th><th>Surface Mount</th></tr>
<tr><td>20 V</td><td>1N5820
MBR320P
SR302</td><td>SK32</td><td>1N5823
SR502
SB520</td><td></td><td rowspan="5">MUR320
31DF1
HER302

(all diodes rated to at least 100 V)</td><td rowspan="5">MURS320T3
MURD320
30WF10

(all diodes rated to at least 100 V)</td><td rowspan="5">MUR420
HER602

(all diodes rated to at least 100 V)</td><td rowspan="5">MURD620CT
50WF10

(all diodes rated to at least 100 V)</td></tr>
<tr><td>30 V</td><td>1N5821
MBR330
SR303
31DQ03</td><td>SK33
30WQ03</td><td>1N5824
SR503
SB530</td><td>50WQ03</td></tr>
<tr><td>40 V</td><td>1N5822
MBR340
SR304
31DQ04</td><td>SK34
30WQ04
MBRS340T3
MBRD340</td><td>1N5825
SR504
SB540</td><td>MBRD640CT
50WQ04</td></tr>
<tr><td>50 V</td><td>MBR350
31DQ05
SR305</td><td>SK35
30WQ05</td><td>SB550</td><td>50WQ05</td></tr>
<tr><td>60 V</td><td>MBR360
DQ06
SR306</td><td>MBRS360T3
MBRD360</td><td>50SQ080</td><td>MBRD660CT</td></tr>
</table>

NOTE: Diodes listed in bold are available from ON Semiconductor.

Table 3. INDUCTOR MANUFACTURERS PART NUMBERS

	Inductance (µH)	Current (A)	Schott		Renco		Pulse Engineering		Coilcraft
			Through Hole	Surface Mount	Through Hole	Surface Mount	Through Hole	Surface Mount	Surface Mount
L15	22	0.99	67148350	67148460	RL−1284−22−43	RL1500−22	PE−53815	PE−53815−S	DO3308−223
L21	68	0.99	67144070	67144450	RL−5471−5	RL1500−68	PE−53821	PE−53821−S	DO3316−683
L22	47	1.17	67144080	67144460	RL−5471−6	−	PE−53822	PE−53822−S	DO3316−473
L23	33	1.40	67144090	67144470	RL−5471−7	−	PE−53823	PE−53823−S	DO3316−333
L24	22	1.70	67148370	67148480	RL−1283−22−43	−	PE−53824	PE−53825−S	DO3316−223
L25	15	2.10	67148380	67148490	RL−1283−15−43	−	PE−53825	PE−53824−S	DO3316−153
L26	330	0.80	67144100	67144480	RL−5471−1	−	PE−53826	PE−53826−S	DO5022P−334
L27	220	1.00	67144110	67144490	RL−5471−2	−	PE−53827	PE−53827−S	DO5022P−224
L28	150	1.20	67144120	67144500	RL−5471−3	−	PE−53828	PE−53828−S	DO5022P−154
L29	100	1.47	67144130	67144510	RL−5471−4	−	PE−53829	PE−53829−S	DO5022P−104
L30	68	1.78	67144140	67144520	RL−5471−5	−	PE−53830	PE−53830−S	DO5022P−683
L31	47	2.20	67144150	67144530	RL−5471−6	−	PE−53831	PE−53831−S	DO5022P−473
L32	33	2.50	67144160	67144540	RL−5471−7	−	PE−53932	PE−53932−S	DO5022P−333
L33	22	3.10	67148390	67148500	RL−1283−22−43	−	PE−53933	PE−53933−S	DO5022P−223
L34	15	3.40	67148400	67148790	RL−1283−15−43	−	PE−53934	PE−53934−S	DO5022P−153
L35	220	1.70	67144170	−	RL−5473−1	−	PE−53935	PE−53935−S	−
L36	150	2.10	67144180	−	RL−5473−4	−	PE−54036	PE−54036−S	−
L37	100	2.50	67144190	−	RL−5472−1	−	PE−54037	PE−54037−S	−
L38	68	3.10	67144200	−	RL−5472−2	−	PE−54038	PE−54038−S	DO5040H−683ML
L39	47	3.50	67144210	−	RL−5472−3	−	PE−54039	PE−54039−S	DO5040H−473ML
L40	33	3.50	67144220	67148290	RL−5472−4	−	PE−54040	PE−54040−S	DO5040H−333ML
L41	22	3.50	67144230	67148300	RL−5472−5	−	PE−54041	PE−54041−S	DO5040H−223ML
L42	150	2.70	67148410	−	RL−5473−4	−	PE−54042	PE−54042−S	−
L43	100	3.40	67144240	−	RL−5473−2	−	PE−54043		-
L44	68	3.40	67144250	−	RL−5473−3	−	PE−54044		DO5040H−683ML

APPLICATION INFORMATION

EXTERNAL COMPONENTS

Input Capacitor (C_{in})

The Input Capacitor Should Have a Low ESR

For stable operation of the switch mode converter a low ESR (Equivalent Series Resistance) aluminium or solid tantalum bypass capacitor is needed between the input pin and the ground pin, to prevent large voltage transients from appearing at the input. It must be located near the regulator and use short leads. With most electrolytic capacitors, the capacitance value decreases and the ESR increases with lower temperatures. For reliable operation in temperatures below −25°C larger values of the input capacitor may be needed. Also paralleling a ceramic or solid tantalum capacitor will increase the regulator stability at cold temperatures.

RMS Current Rating of C_{in}

The important parameter of the input capacitor is the RMS current rating. Capacitors that are physically large and have large surface area will typically have higher RMS current ratings. For a given capacitor value, a higher voltage electrolytic capacitor will be physically larger than a lower voltage capacitor, and thus be able to dissipate more heat to the surrounding air, and therefore will have a higher RMS current rating. The consequence of operating an electrolytic capacitor beyond the RMS current rating is a shortened operating life. In order to assure maximum capacitor operating lifetime, the capacitor's RMS ripple current rating should be:

$$I_{rms} > 1.2 \times d \times I_{Load}$$

where d is the duty cycle, for a buck regulator

$$d = \frac{t_{on}}{T} = \frac{V_{out}}{V_{in}}$$

and $d = \dfrac{t_{on}}{T} = \dfrac{|V_{out}|}{|V_{out}| + V_{in}}$ for a buck—boost regulator.

Output Capacitor (C_{out})

For low output ripple voltage and good stability, low ESR output capacitors are recommended. An output capacitor has two main functions: it filters the output and provides regulator loop stability. The ESR of the output capacitor and the peak−to−peak value of the inductor ripple current are the main factors contributing to the output ripple voltage value. Standard aluminium electrolytics could be adequate for some applications but for quality design, low ESR types are recommended.

An aluminium electrolytic capacitor's ESR value is related to many factors such as the capacitance value, the voltage rating, the physical size and the type of construction. In most cases, the higher voltage electrolytic capacitors have lower ESR value. Often capacitors with much higher voltage ratings may be needed to provide low ESR values that, are required for low output ripple voltage.

Feedfoward Capacitor

(Adjustable Output Voltage Version)

This capacitor adds lead compensation to the feedback loop and increases the phase margin for better loop stability. For C_{FF} selection, see the design procedure section.

The Output Capacitor Requires an ESR Value That Has an Upper and Lower Limit

As mentioned above, a low ESR value is needed for low output ripple voltage, typically 1% to 2% of the output voltage. But if the selected capacitor's ESR is extremely low (below 0.05 fi), there is a possibility of an unstable feedback loop, resulting in oscillation at the output. This situation can occur when a tantalum capacitor, that can have a very low ESR, is used as the only output capacitor.

At Low Temperatures, Put in Parallel Aluminium Electrolytic Capacitors with Tantalum Capacitors

Electrolytic capacitors are not recommended for temperatures below −25°C. The ESR rises dramatically at cold temperatures and typically rises 3 times at −25°C and as much as 10 times at −40°C. Solid tantalum capacitors have much better ESR spec at cold temperatures and are recommended for temperatures below −25°C. They can be also used in parallel with aluminium electrolytics. The value of the tantalum capacitor should be about 10% or 20% of the total capacitance. The output capacitor should have at least 50% higher RMS ripple current rating at 150 kHz than the peak−to−peak inductor ripple current.

Catch Diode

Locate the Catch Diode Close to the LM2596

The LM2596 is a step−down buck converter; it requires a fast diode to provide a return path for the inductor current when the switch turns off. This diode must be located close to the LM2596 using short leads and short printed circuit traces to avoid EMI problems.

Use a Schottky or a Soft Switching Ultra−Fast Recovery Diode

Since the rectifier diodes are very significant sources of losses within switching power supplies, choosing the rectifier that best fits into the converter design is an important process. Schottky diodes provide the best performance because of their fast switching speed and low forward voltage drop.

They provide the best efficiency especially in low output voltage applications (5.0 V and lower). Another choice could be Fast−Recovery, or Ultra−Fast Recovery diodes. It has to be noted, that some types of these diodes with an abrupt turnoff characteristic may cause instability or EMI troubles.

A fast−recovery diode with soft recovery characteristics can better fulfill some quality, low noise design requirements. Table 2 provides a list of suitable diodes for the LM2596 regulator. Standard 50/60 Hz rectifier diodes, such as the 1N4001 series or 1N5400 series are **NOT** suitable.

Inductor

The magnetic components are the cornerstone of all switching power supply designs. The style of the core and the winding technique used in the magnetic component's design has a great influence on the reliability of the overall power supply.

Using an improper or poorly designed inductor can cause high voltage spikes generated by the rate of transitions in current within the switching power supply, and the possibility of core saturation can arise during an abnormal operational mode. Voltage spikes can cause the semiconductors to enter avalanche breakdown and the part can instantly fail if enough energy is applied. It can also cause significant RFI (Radio Frequency Interference) and EMI (Electro−Magnetic Interference) problems.

Continuous and Discontinuous Mode of Operation

The LM2596 step−down converter can operate in both the continuous and the discontinuous modes of operation. The regulator works in the continuous mode when loads are relatively heavy, the current flows through the inductor continuously and never falls to zero. Under light load conditions, the circuit will be forced to the discontinuous mode when inductor current falls to zero for certain period of time (see Figure 19 and Figure 20). Each mode has distinctively different operating characteristics, which can affect the regulator performance and requirements. In many cases the preferred mode of operation is the continuous mode. It offers greater output power, lower peak currents in the switch, inductor and diode, and can have a lower output ripple voltage. On the other hand it does require larger inductor values to keep the inductor current flowing continuously, especially at low output load currents and/or high input voltages.

To simplify the inductor selection process, an inductor selection guide for the LM2596 regulator was added to this data sheet (Figure 18). This guide assumes that the regulator is operating in the continuous mode, and selects an inductor that will allow a peak−to−peak inductor ripple current to be a certain percentage of the maximum design load current. This percentage is allowed to change as different design load currents are selected. For light loads (less than approximately 300 mA) it may be desirable to operate the regulator in the discontinuous mode, because the inductor value and size can be kept relatively low. Consequently, the percentage of inductor peak−to−peak current increases. This discontinuous mode of operation is perfectly acceptable for this type of switching converter. Any buck regulator will be forced to enter discontinuous mode if the load current is light enough.

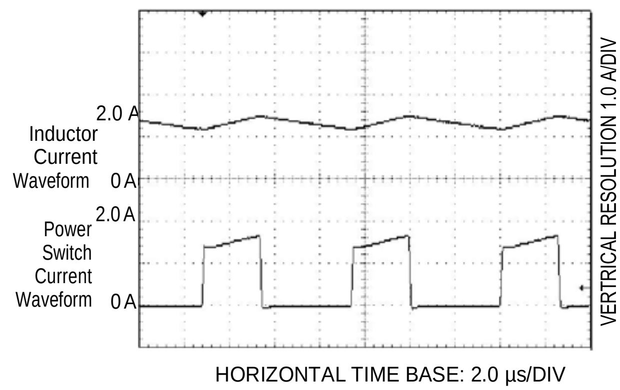


Figure 19. Continuous Mode Switching Current Waveforms

Selecting the Right Inductor Style

Some important considerations when selecting a core type are core material, cost, the output power of the power supply, the physical volume the inductor must fit within, and the amount of EMI (Electro−Magnetic Interference) shielding that the core must provide. The inductor selection guide covers different styles of inductors, such as pot core, E−core, toroid and bobbin core, as well as different core materials such as ferrites and powdered iron from different manufacturers.

For high quality design regulators the toroid core seems to be the best choice. Since the magnetic flux is contained within the core, it generates less EMI, reducing noise problems in sensitive circuits. The least expensive is the bobbin core type, which consists of wire wound on a ferrite rod core. This type of inductor generates more EMI due to the fact that its core is open, and the magnetic flux is not contained within the core.

When multiple switching regulators are located on the same printed circuit board, open core magnetics can cause interference between two or more of the regulator circuits, especially at high currents due to mutual coupling. A toroid, pot core or E−core (closed magnetic structure) should be used in such applications.

Do Not Operate an Inductor Beyond its Maximum Rated Current

Exceeding an inductor's maximum current rating may cause the inductor to overheat because of the copper wire losses, or the core may saturate. Core saturation occurs when the flux density is too high and consequently the cross sectional area of the core can no longer support additional lines of magnetic flux.

This causes the permeability of the core to drop, the inductance value decreases rapidly and the inductor begins to look mainly resistive. It has only the DC resistance of the winding. This can cause the switch current to rise very rapidly and force the LM2596 internal switch into cycle−by−cycle current limit, thus reducing the DC output load current. This can also result in overheating of the inductor and/or the LM2596. Different inductor types have different saturation characteristics, and this should be kept in mind when selecting an inductor.

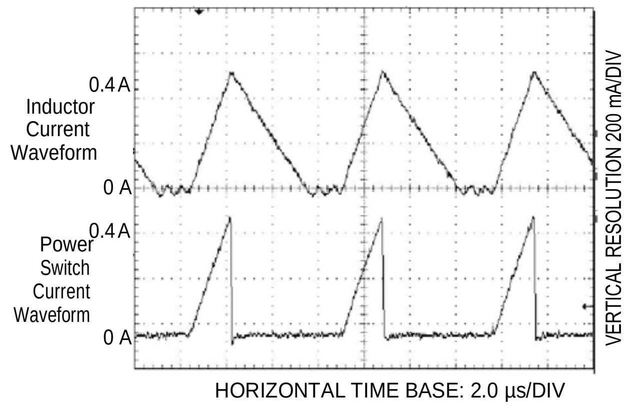


Figure 20. Discontinuous Mode Switching Current Waveforms

GENERAL RECOMMENDATIONS

Output Voltage Ripple and Transients

Source of the Output Ripple

Since the LM2596 is a switch mode power supply regulator, its output voltage, if left unfiltered, will contain a sawtooth ripple voltage at the switching frequency. The output ripple voltage value ranges from 0.5% to 3% of the output voltage. It is caused mainly by the inductor sawtooth ripple current multiplied by the ESR of the output capacitor.

Short Voltage Spikes and How to Reduce Them

The regulator output voltage may also contain short voltage spikes at the peaks of the sawtooth waveform (see Figure 21). These voltage spikes are present because of the fast switching action of the output switch, and the parasitic inductance of the output filter capacitor. There are some other important factors such as wiring inductance, stray capacitance, as well as the scope probe used to evaluate these transients, all these contribute to the amplitude of these spikes. To minimize these voltage spikes, low inductance capacitors should be used, and their lead lengths must be kept short. The importance of quality printed circuit board layout design should also be highlighted.

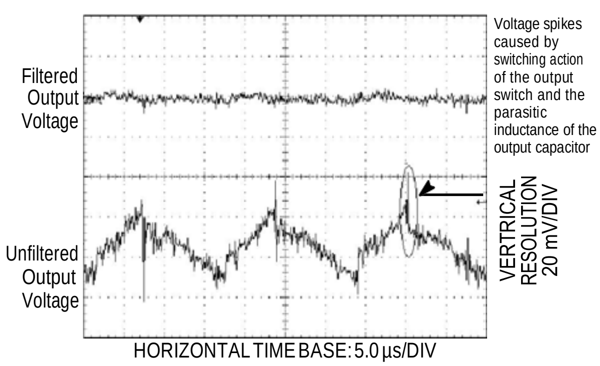


Figure 21. Output Ripple Voltage Waveforms

Minimizing the Output Ripple

In order to minimize the output ripple voltage it is possible to enlarge the inductance value of the inductor L1 and/or to use a larger value output capacitor. There is also another way to smooth the output by means of an additional LC filter (20 μH, 100 μF), that can be added to the output (see Figure 30) to further reduce the amount of output ripple and transients. With such a filter it is possible to reduce the output ripple voltage transients 10 times or more. Figure 21 shows the difference between filtered and unfiltered output waveforms of the regulator shown in Figure 30.

The lower waveform is from the normal unfiltered output of the converter, while the upper waveform shows the output ripple voltage filtered by an additional LC filter.

Heatsinking and Thermal Considerations

The Through−Hole Package TO−220

The LM2596 is available in two packages, a 5−pin TO−220(T, TV) and a 5−pin surface mount D^2PAK(D2T). Although the TO−220(T) package needs a heatsink under most conditions, there are some applications that require no heatsink to keep the LM2596 junction temperature within the allowed operating range. Higher ambient temperatures require some heat sinking, either to the printed circuit (PC) board or an external heatsink.

The Surface Mount Package D^2PAK and its Heatsinking

The other type of package, the surface mount D^2PAK, is designed to be soldered to the copper on the PC board. The copper and the board are the heatsink for this package and the other heat producing components, such as the catch diode and inductor. The PC board copper area that the package is soldered to should be at least 0.4 in^2 (or 260 mm^2) and ideally should have 2 or more square inches (1300 mm^2) of 0.0028 inch copper. Additional increases of copper area beyond approximately 6.0 in^2 (4000 mm^2) will not improve heat dissipation significantly. If further thermal improvements are needed, double sided or multilayer PC boards with large copper areas should be considered. In order to achieve the best thermal performance, it is highly recommended to use wide copper traces as well as large areas of copper in the printed circuit board layout. The only exception to this is the OUTPUT (switch) pin, which should not have large areas of copper (see page 8 ‘PCB Layout Guideline’).

Thermal Analysis and Design

The following procedure must be performed to determine whether or not a heatsink will be required. First determine:

1. $P_{D(max)}$ maximum regulator power dissipation in the application.
2. $T_{A(max)}$) maximum ambient temperature in the application.
3. $T_{J(max)}$ maximum allowed junction temperature (125°C for the LM2596). For a conservative design, the maximum junction temperature should not exceed 110°C to assure safe operation. For every additional +10°C temperature rise that the junction must withstand, the estimated operating lifetime of the component is halved.
4. R_{0JC} package thermal resistance junction−case.
5. R_{0JA} package thermal resistance junction−ambient.

(Refer to Maximum Ratings on page 2 of this data sheet or R_{0JC} and R_{0JA} values).

The following formula is to calculate the approximate total power dissipated by the LM2596:

$$P_D = (V_{in} \times I_Q) + d \times I_{Load} \times V_{sat}$$

where d is the duty cycle and for buck converter

$$d = \frac{t_{on}}{T} = \frac{V_O}{V_{in}},$$

I_Q (quiescent current) and V_{sat} can be found in the LM2596 data sheet,

V_{in} is minimum input voltage applied,

V_O is the regulator output voltage,

I_{Load} is the load current.

The dynamic switching losses during turn−on and turn−off can be neglected if proper type catch diode is used.

Packages Not on a Heatsink (Free−Standing)

For a free−standing application when no heatsink is used, the junction temperature can be determined by the following expression:

$$T_J = (R_{0JA})\,(P_D) + T_A$$

where $(R_{0JA})(P_D)$ represents the junction temperature rise caused by the dissipated power and T_A is the maximum ambient temperature.

Packages on a Heatsink

If the actual operating junction temperature is greater than the selected safe operating junction temperature determined in step 3, than a heatsink is required. The junction temperature will be calculated as follows:

$$T_J = P_D\,(R_{0JA} + R_{0CS} + R_{0SA}) + T_A$$

where R_{0JC} is the thermal resistance junction−case,
R_{0CS} is the thermal resistance case−heatsink,
R_{0SA} is the thermal resistance heatsink−ambient.

If the actual operating temperature is greater than the selected safe operating junction temperature, then a larger heatsink is required.

Some Aspects That can Influence Thermal Design

It should be noted that the package thermal resistance and the junction temperature rise numbers are all approximate, and there are many factors that will affect these numbers, such as PC board size, shape, thickness, physical position, location, board temperature, as well as whether the surrounding air is moving or still.

Other factors are trace width, total printed circuit copper area, copper thickness, single− or double−sided, multilayer board, the amount of solder on the board or even color of the traces.

The size, quantity and spacing of other components on the board can also influence its effectiveness to dissipate the heat.

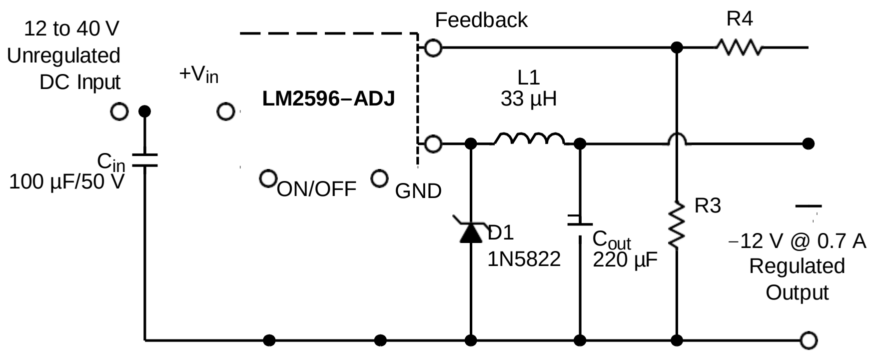


Figure 22. Inverting Buck−Boost Develops −12 V

ADDITIONAL APPLICATIONS

Inverting Regulator

An inverting buck−boost regulator using the LM2596−ADJ is shown in Figure 22. This circuit converts a positive input voltage to a negative output voltage with a common ground by bootstrapping the regulators ground to the negative output voltage. By grounding the feedback pin, the regulator senses the inverted output voltage and regulates it.

In this example the LM2596−12 is used to generate a −12 V output. The maximum input voltage in this case cannot exceed +28 V because the maximum voltage appearing across the regulator is the absolute sum of the input and output voltages and this must be limited to a maximum of 40 V.

This circuit configuration is able to deliver approximately 0.7 A to the output when the input voltage is 12 V or higher. At lighter loads the minimum input voltage required drops to approximately 4.7 V, because the buck−boost regulator topology can produce an output voltage that, in its absolute value, is either greater or less than the input voltage.

Since the switch currents in this buck−boost configuration are higher than in the standard buck converter topology, the available output current is lower.

This type of buck−boost inverting regulator can also require a larger amount of startup input current, even for light loads. This may overload an input power source with a current limit less than 5.0 A.

Such an amount of input startup current is needed for at least 2.0 ms or more. The actual time depends on the output voltage and size of the output capacitor.

Because of the relatively high startup currents required by this inverting regulator topology, the use of a delayed startup or an undervoltage lockout circuit is recommended.

Using a delayed startup arrangement, the input capacitor can charge up to a higher voltage before the switch−mode regulator begins to operate.

The high input current needed for startup is now partially supplied by the input capacitor C_{in}.

It has been already mentioned above, that in some situations, the delayed startup or the undervoltage lockout features could be very useful. A delayed startup circuit applied to a buck−boost converter is shown in Figure 27. Figure 29 in the “Undervoltage Lockout” section describes an undervoltage lockout feature for the same converter topology.

Design Recommendations:

The inverting regulator operates in a different manner than the buck converter and so a different design procedure has to be used to select the inductor L1 or the output capacitor C_{out}.

The output capacitor values must be larger than what is normally required for buck converter designs. Low input voltages or high output currents require a large value output capacitor (in the range of thousands of μF).

The recommended range of inductor values for the inverting converter design is between 68 μH and 220 μH. To select an inductor with an appropriate current rating, the inductor peak current has to be calculated.

The following formula is used to obtain the peak inductor current:

$$I_{peak} = \frac{I_{Load}\,(V_{in} + |V_O|)}{V_{in}} + \frac{V_{in} \times t_{on}}{2L_1}$$

where $t_{on} = \frac{|V_O|}{V_{in} + |V_O|} \times \frac{1.0}{f_{osc}}$, and $f_{osc} = 52$ kHz.

Under normal continuous inductor current operating conditions, the worst case occurs when V_{in} is minimal.

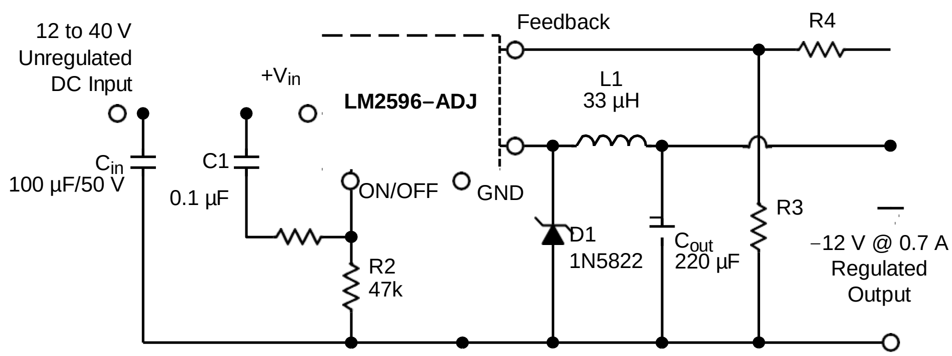
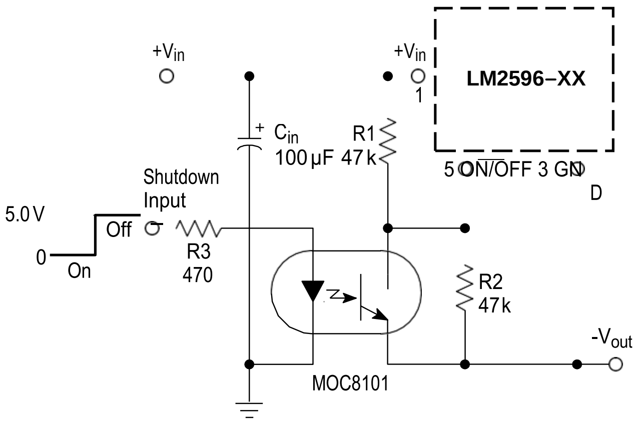
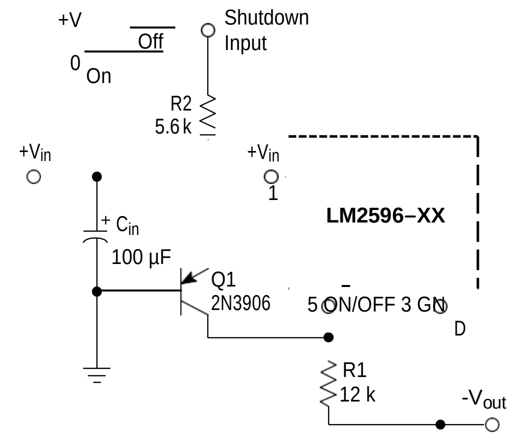


Figure 23. Inverting Buck−Boost Develops −12 V



NOTE: This picture does not show the complete circuit.

Figure 24. Inverting Buck−Boost Regulator Shutdown Circuit Using an Optocoupler



NOTE: This picture does not show the complete circuit.

Figure 25. Inverting Buck−Boost Regulator Shutdown Circuit Using a PNP Transistor

With the inverting configuration, the use of the $\overline{\text{ON}}$/OFF pin requires some level shifting techniques. This is caused by the fact, that the ground pin of the converter IC is no longer at ground. Now, the $\overline{\text{ON}}$/OFF pin threshold voltage (1.3 V approximately) has to be related to the negative output voltage level. There are many different possible shut down methods, two of them are shown in Figures 24 and 25.

Negative Boost Regulator

This example is a variation of the buck−boost topology and it is called negative boost regulator. This regulator experiences relatively high switch current, especially at low input voltages. The internal switch current limiting results in lower output load current capability.

The circuit in Figure 26 shows the negative boost configuration. The input voltage in this application ranges from −5.0 V to −12 V and provides a regulated −12 V output. If the input voltage is greater than −12 V, the output will rise above −12 V accordingly, but will not damage the regulator.

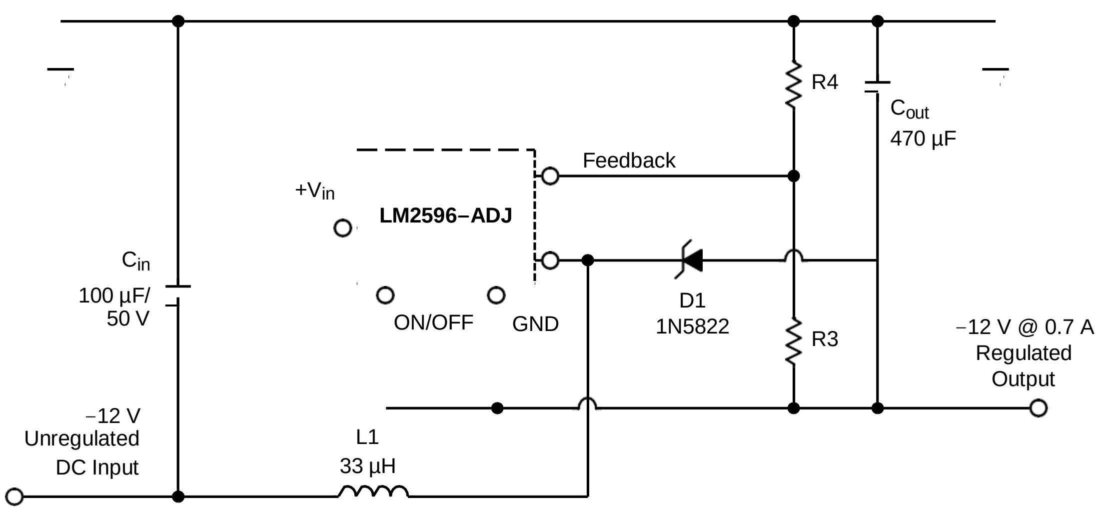


Figure 26. Negative Boost Regulator

Design Recommendations:

The same design rules as for the previous inverting buck−boost converter can be applied. The output capacitor C_{out} must be chosen larger than would be required for a what standard buck converter. Low input voltages or high output currents require a large value output capacitor (in the range of thousands of µF). The recommended range of inductor values for the negative boost regulator is the same as for inverting converter design.

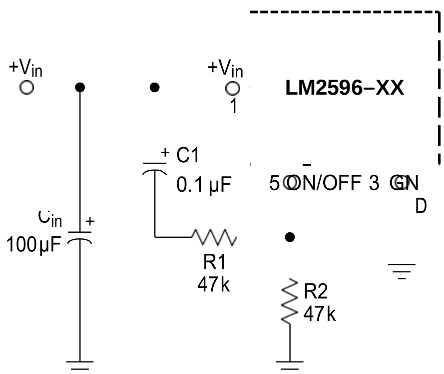
Another important point is that these negative boost converters cannot provide current limiting load protection in the event of a short in the output so some other means, such as a fuse, may be necessary to provide the load protection.

Delayed Startup

There are some applications, like the inverting regulator already mentioned above, which require a higher amount of startup current. In such cases, if the input power source is limited, this delayed startup feature becomes very useful.

To provide a time delay between the time when the input voltage is applied and the time when the output voltage comes up, the circuit in Figure 27 can be used. As the input voltage is applied, the capacitor C1 charges up, and the voltage across the resistor R2 falls down. When the voltage on the $\overline{\text{ON}}$/OFF pin falls below the threshold value 1.3 V, the regulator starts up. Resistor R1 is included to limit the maximum voltage applied to the $\overline{\text{ON}}$/OFF pin. It reduces the power supply noise sensitivity, and also limits the capacitor C1 discharge current, but its use is not mandatory.

When a high 50 Hz or 60 Hz (100 Hz or 120 Hz respectively) ripple voltage exists, a long delay time can cause some problems by coupling the ripple into the $\overline{\text{ON}}$/OFF pin, the regulator could be switched periodically on and off with the line (or double) frequency.



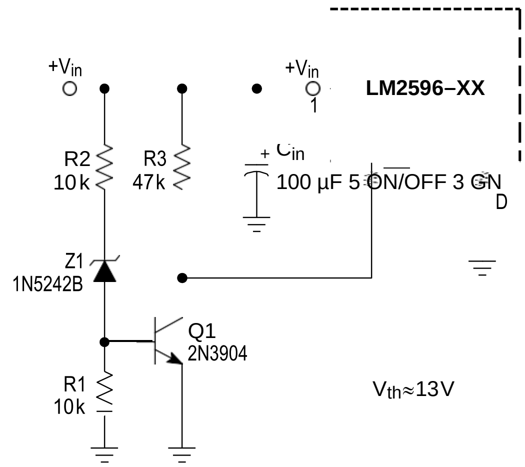
NOTE: This picture does not show the complete circuit.

Figure 27. Delayed Startup Circuitry

Undervoltage Lockout

Some applications require the regulator to remain off until the input voltage reaches a certain threshold level. Figure 28 shows an undervoltage lockout circuit applied to a buck regulator. A version of this circuit for buck−boost converter is shown in Figure 29. Resistor R3 pulls the $\overline{\text{ON}}$/OFF pin high and keeps the regulator off until the input voltage reaches a predetermined threshold level with respect to the ground Pin 3, which is determined by the following expression:

$$V_{th} = V_{Z1} + \left(1.0 + \frac{R2}{R1}\right) V_{BE}\,(Q1)$$



NOTE: This picture does not show the complete circuit.

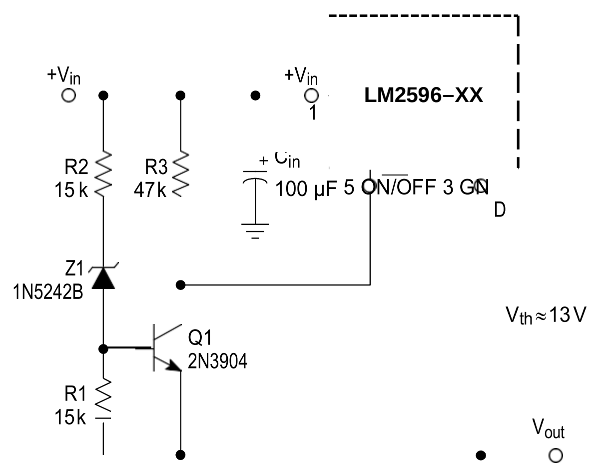
Figure 28. Undervoltage Lockout Circuit for Buck Converter

The following formula is used to obtain the peak inductor current:

$$I_{peak} = \frac{I_{Load}\,(V_{in} + |V_O|)}{V_{in}} + \frac{V_{in} \times t_{on}}{2L_1}$$

where $t_{on} = \frac{|V_O|}{V_{in} + |V_O|} \times \frac{1.0}{f_{osc}}$, and $f_{osc} = 52$ kHz.

Under normal continuous inductor current operating conditions, the worst case occurs when V_{in} is minimal.



NOTE: This picture does not show the complete circuit.

Figure 29. Undervoltage Lockout Circuit for Buck−Boost Converter

Adjustable Output, Low−Ripple Power Supply

A 3.0 A output current capability power supply that features an adjustable output voltage is shown in Figure 30.

This regulator delivers 3.0 A into 1.2 V to 35 V output. The input voltage ranges from roughly 3.0 V to 40 V. In order to achieve a 10 or more times reduction of output ripple, an additional L−C filter is included in this circuit.

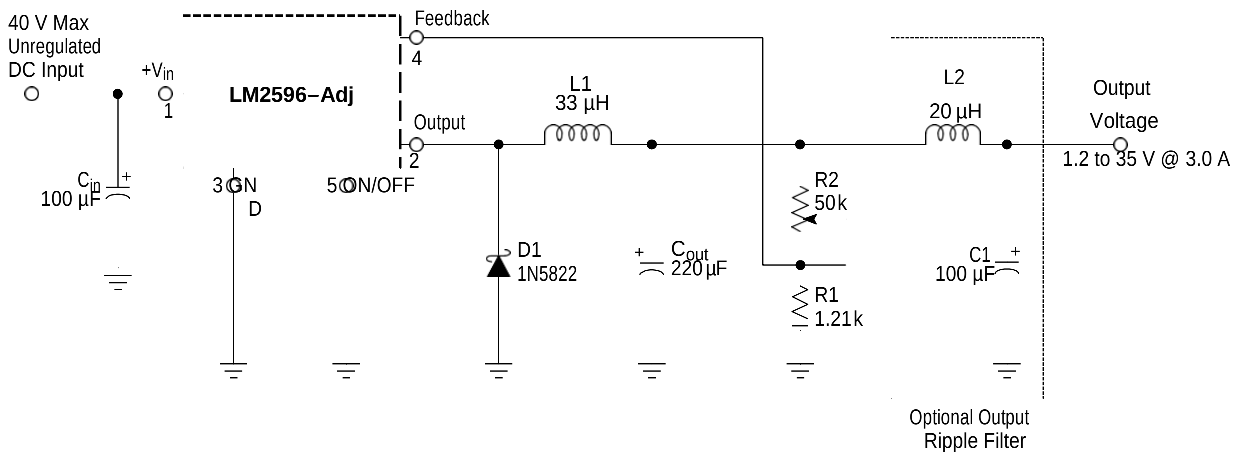
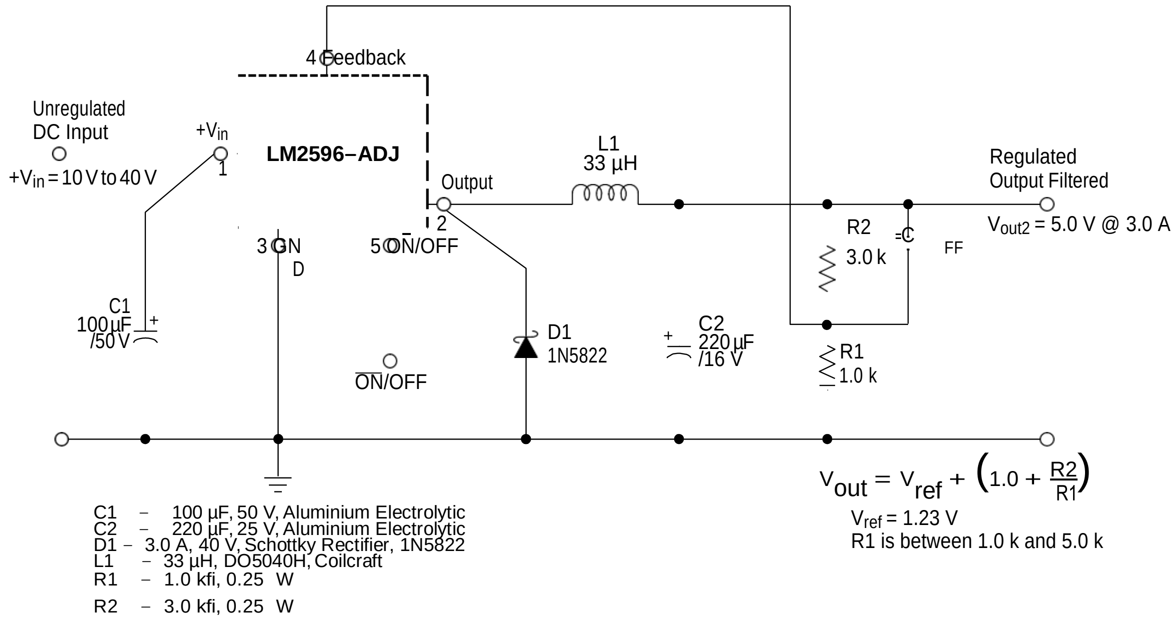


Figure 30. 1.2 to 35 V Adjustable 3.0 A Power Supply with Low Output Ripple

THE LM2596 STEP−DOWN VOLTAGE REGULATOR WITH 5.0 V @ 3.0 A OUTPUT POWER CAPABILITY. TYPICAL APPLICATION WITH THROUGH−HOLE PC BOARD LAYOUT

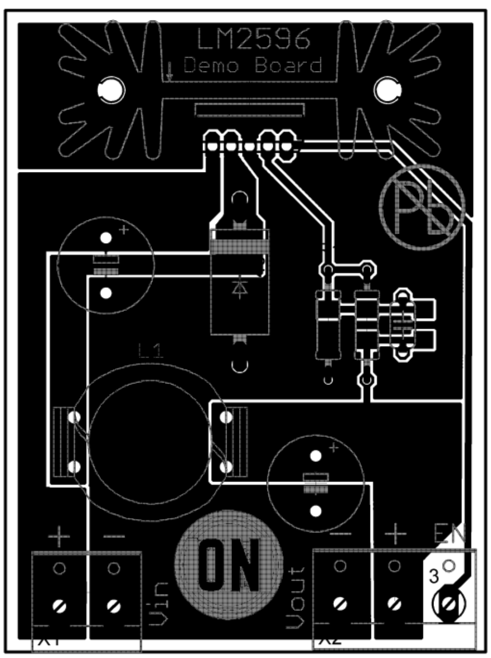


$$V_{out} = V_{ref} + \left(1.0 + \frac{R2}{R1}\right)$$

V_{ref} = 1.23 V

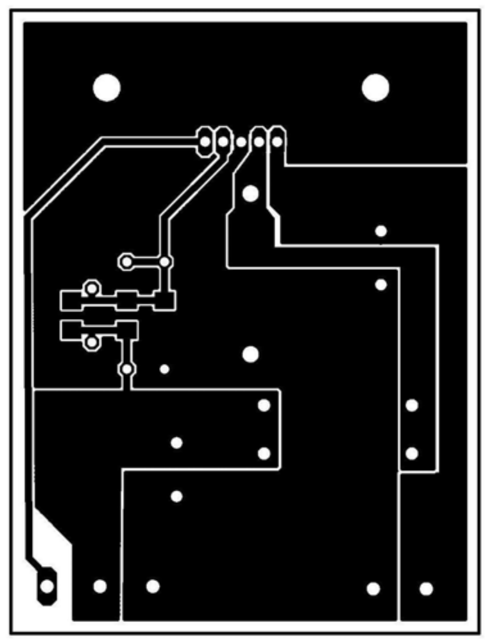
R1 is between 1.0 k and 5.0 k

Figure 31. Schematic Diagram of the 5.0 V @ 3.0 A Step−Down Converter Using the LM2596−ADJ



NOTE: Not to scale.

Figure 32. Printed Circuit Board Layout Component Side



NOTE: Not to scale.

Figure 33. Printed Circuit Board Layout Copper Side

References

- National Semiconductor LM2596 Data Sheet and Application Note
- National Semiconductor LM2595 Data Sheet and Application Note
- Marty Brown “Practical Switching Power Supply Design”, Academic Press, Inc., San Diego 1990
- Ray Ridley “High Frequency Magnetics Design”, Ridley Engineering, Inc. 1995

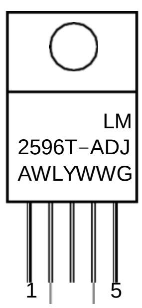
ORDERING INFORMATION

Device	Package	Shipping†
LM2596TADJG	TO−220 (Pb−Free)	50 Units / Rail
LM2596TVADJG	TO−220 (F) (Pb−Free)	50 Units / Rail
LM2596DSADJG	D^2PAK (Pb−Free)	50 Units / Rail
LM2596DSADJR4G	D^2PAK (Pb−Free)	800 / Tape & Reel

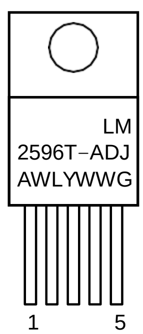
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MARKING DIAGRAMS

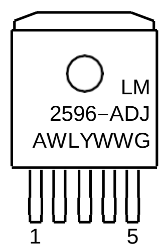
TO−220
TV SUFFIX
CASE 314B



TO−220
T SUFFIX
CASE 314D



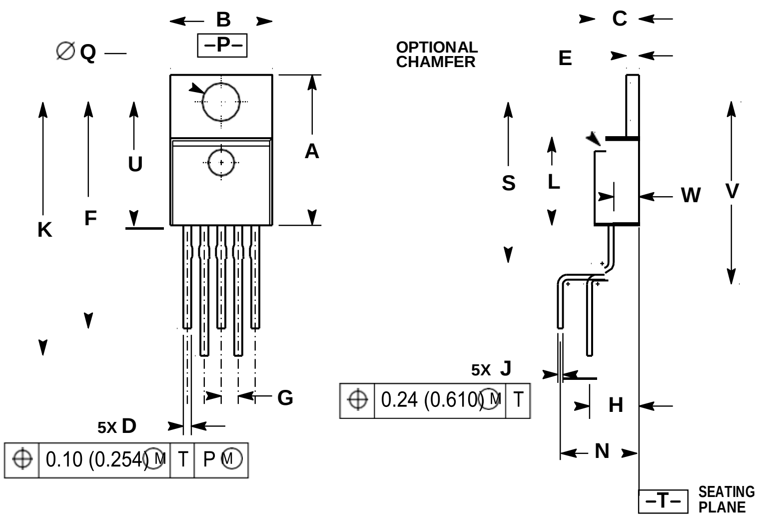
D^2PAK
DS SUFFIX
CASE 936A



A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb−Free Package

PACKAGE DIMENSIONS

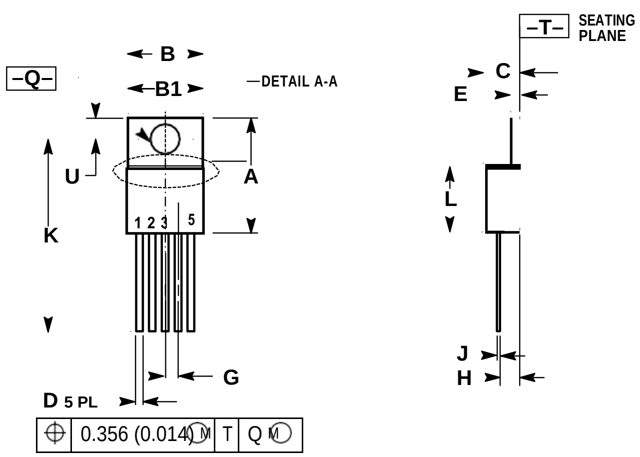
TO−220
TV SUFFIX
CASE 314B−05
ISSUE L



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 0.043 (1.092) MAXIMUM.

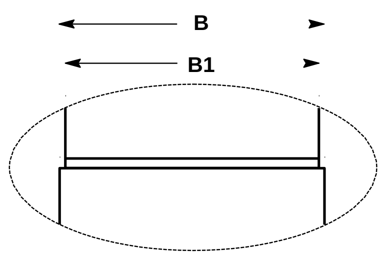
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.572	0.613	14.529	15.570
B	0.390	0.415	9.906	10.541
C	0.170	0.180	4.318	4.572
D	0.025	0.038	0.635	0.965
E	0.048	0.055	1.219	1.397
F	0.850	0.935	21.590	23.749
G	0.067 BSC		1.702 BSC	
H	0.166 BSC		4.216 BSC	
J	0.015	0.025	0.381	0.635
K	0.900	1.100	22.860	27.940
L	0.320	0.365	8.128	9.271
N	0.320 BSC		8.128 BSC	
Q	0.140	0.153	3.556	3.886
S	---	0.620	---	15.748
U	0.468	0.505	11.888	12.827
V	---	0.735	---	18.669
W	0.090	0.110	2.286	2.794

TO−220
T SUFFIX
CASE 314D−04
ISSUE F



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 10.92 (0.043) MAXIMUM.

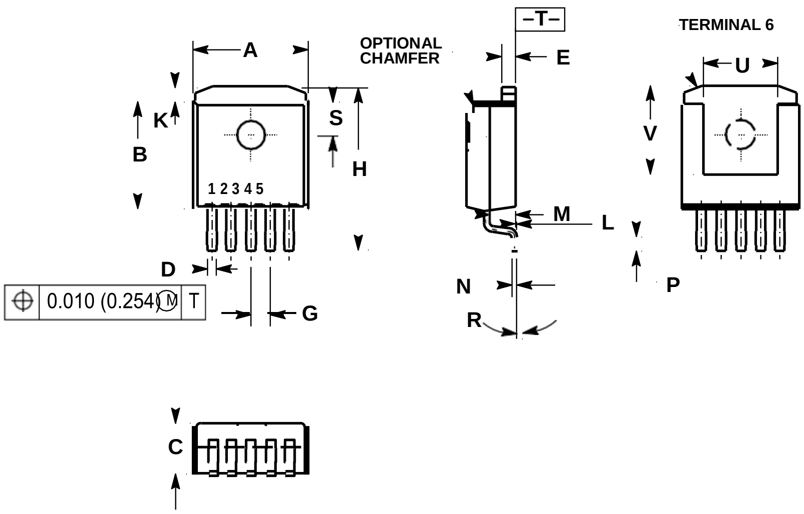
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.572	0.613	14.529	15.570
B	0.390	0.415	9.906	10.541
B1	0.375	0.415	9.525	10.541
C	0.170	0.180	4.318	4.572
D	0.025	0.038	0.635	0.965
E	0.048	0.055	1.219	1.397
G	0.067 BSC		1.702 BSC	
H	0.087	0.112	2.210	2.845
J	0.015	0.025	0.381	0.635
K	0.977	1.045	24.810	26.543
L	0.320	0.365	8.128	9.271
Q	0.140	0.153	3.556	3.886
U	0.105	0.117	2.667	2.972



DETAIL A−A

PACKAGE DIMENSIONS

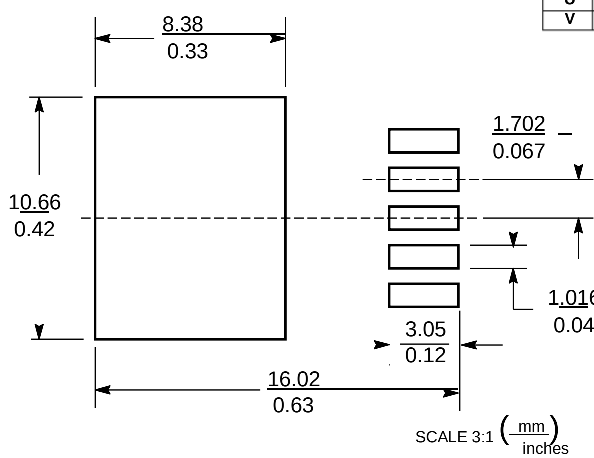
D^{2}PAK
D2T SUFFIX
CASE 936A−02
ISSUE C



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. TAB CONTOUR OPTIONAL WITHIN DIMENSIONS A AND K.
4. DIMENSIONS U AND V ESTABLISH A MINIMUM MOUNTING SURFACE FOR TERMINAL 6.
5. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.025 (0.635) MAXIMUM.

	INCHES		MILLIMETERS	
DIM	**MIN**	**MAX**	**MIN**	**MAX**
A	0.386	0.403	9.804	10.236
B	0.356	0.368	9.042	9.347
C	0.170	0.180	4.318	4.572
D	0.026	0.036	0.660	0.914
E	0.045	0.055	1.143	1.397
G	0.067 BSC		1.702 BSC	
H	0.539	0.579	13.691	14.707
K	0.050 REF		1.270 REF	
L	0.000	0.010	0.000	0.254
M	0.088	0.102	2.235	2.591
N	0.018	0.026	0.457	0.660
P	0.058	0.078	1.473	1.981
R	5° REF		5° REF	
S	0.116 REF		2.946 REF	
U	0.200 MIN		5.080 MIN	
V	0.250 MIN		6.350 MIN	

SOLDERING FOOTPRINT*



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

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

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Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5773−3850

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

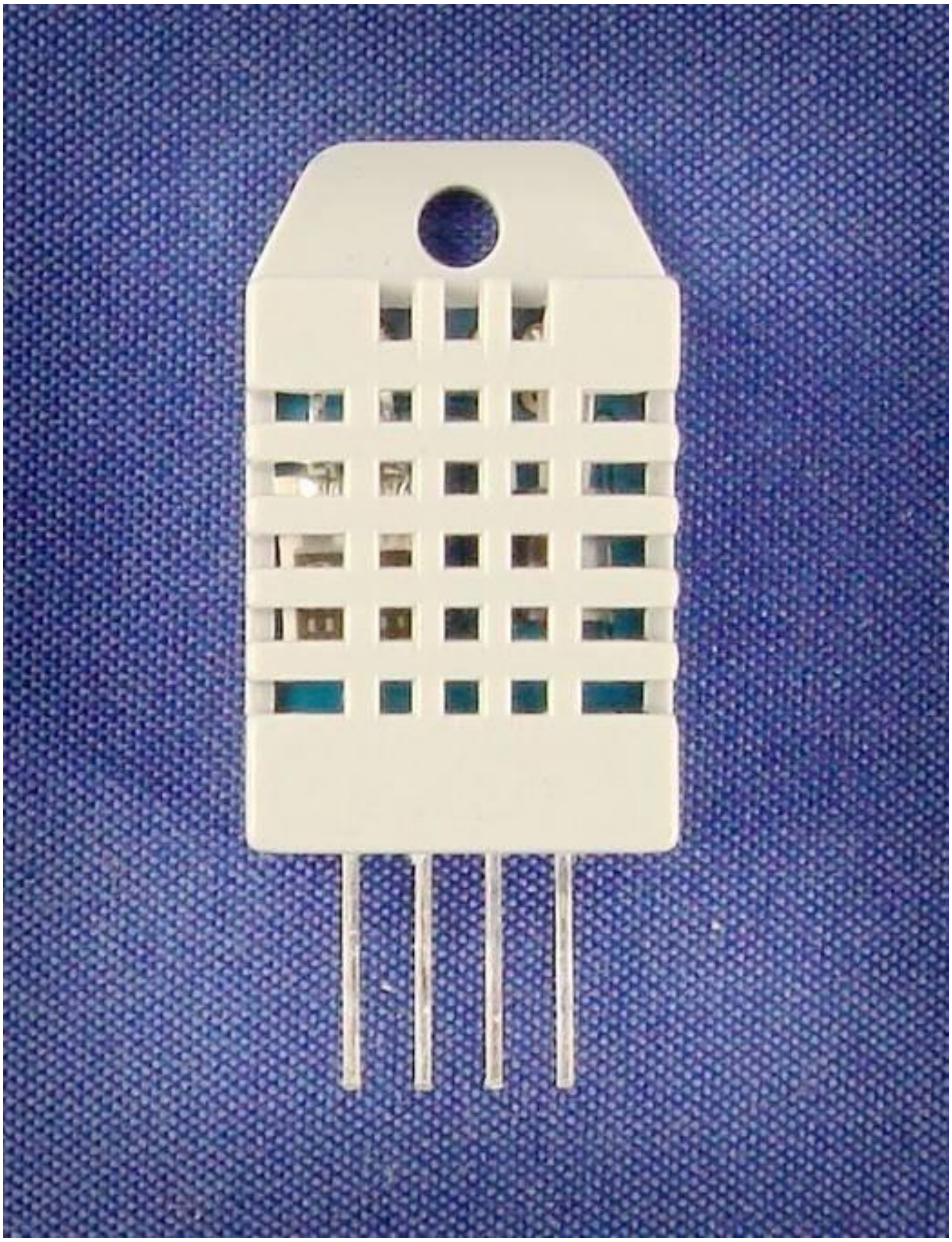
For additional information, please contact your local Sales Representative

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)

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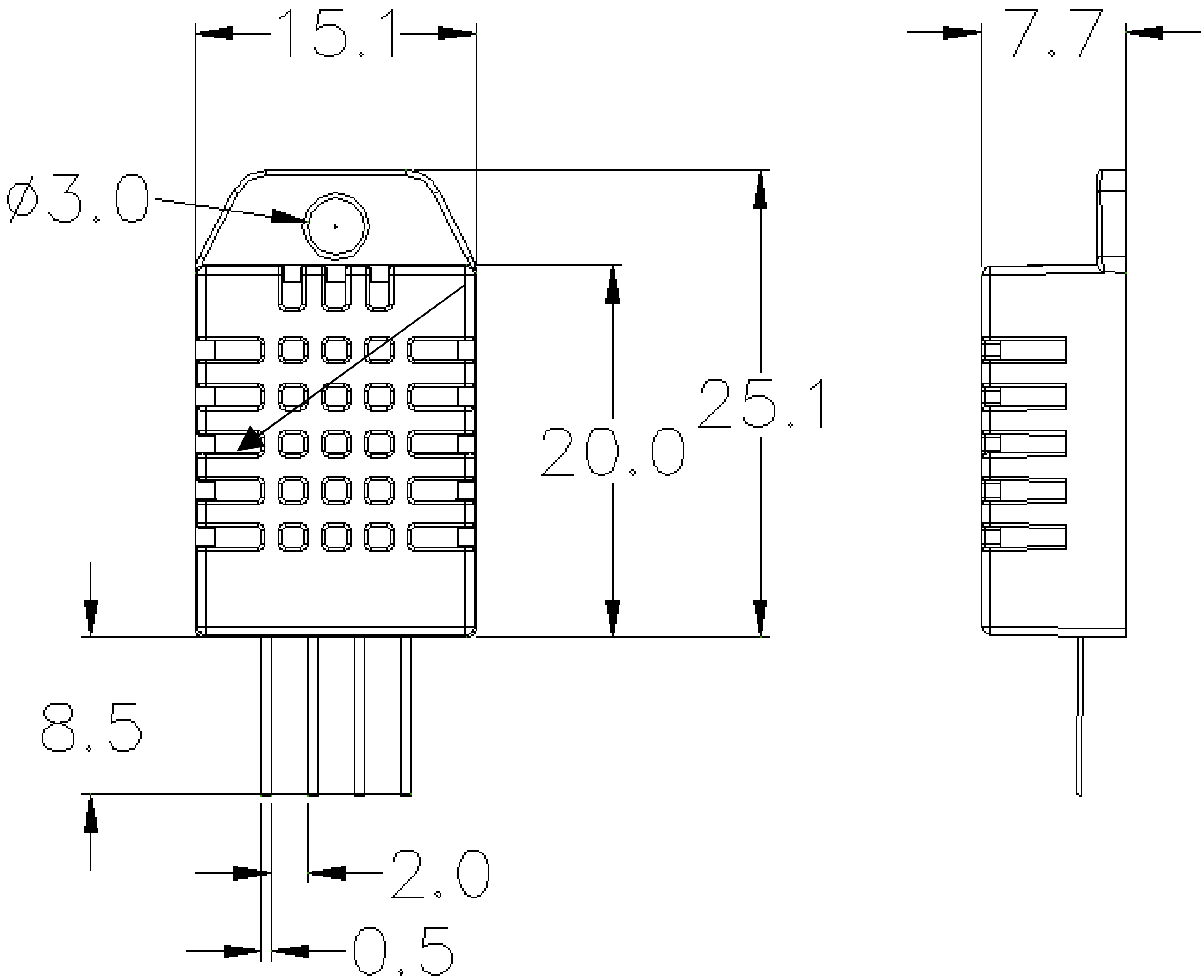

Pin sequence number: 1 2 3 4 (from left to right direction).

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

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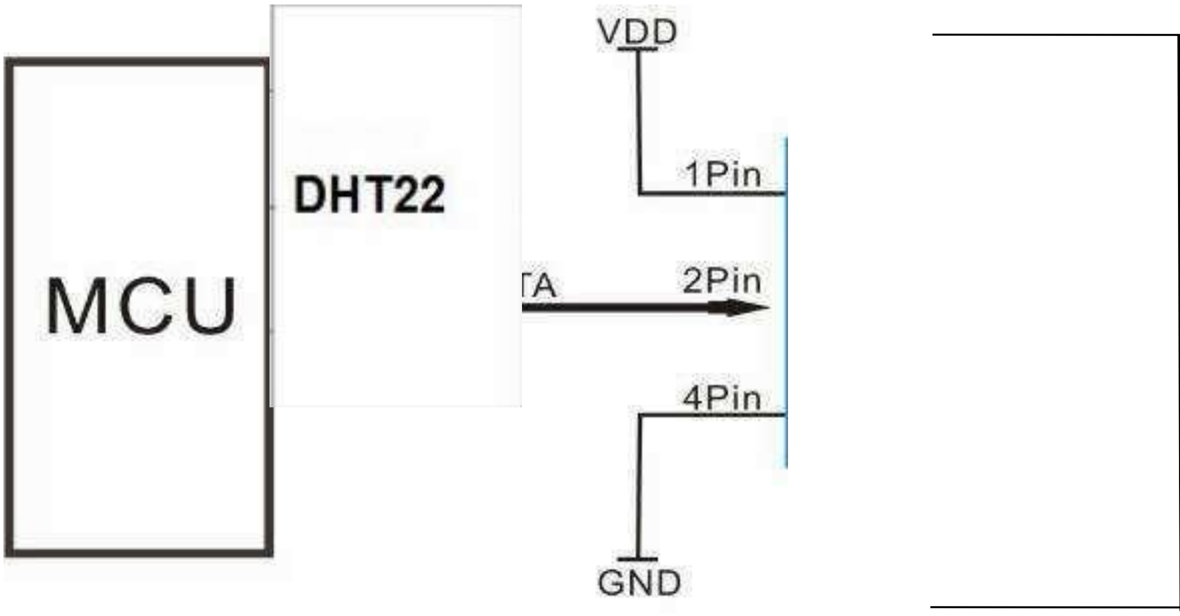
5. Electrical connection diagram:



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

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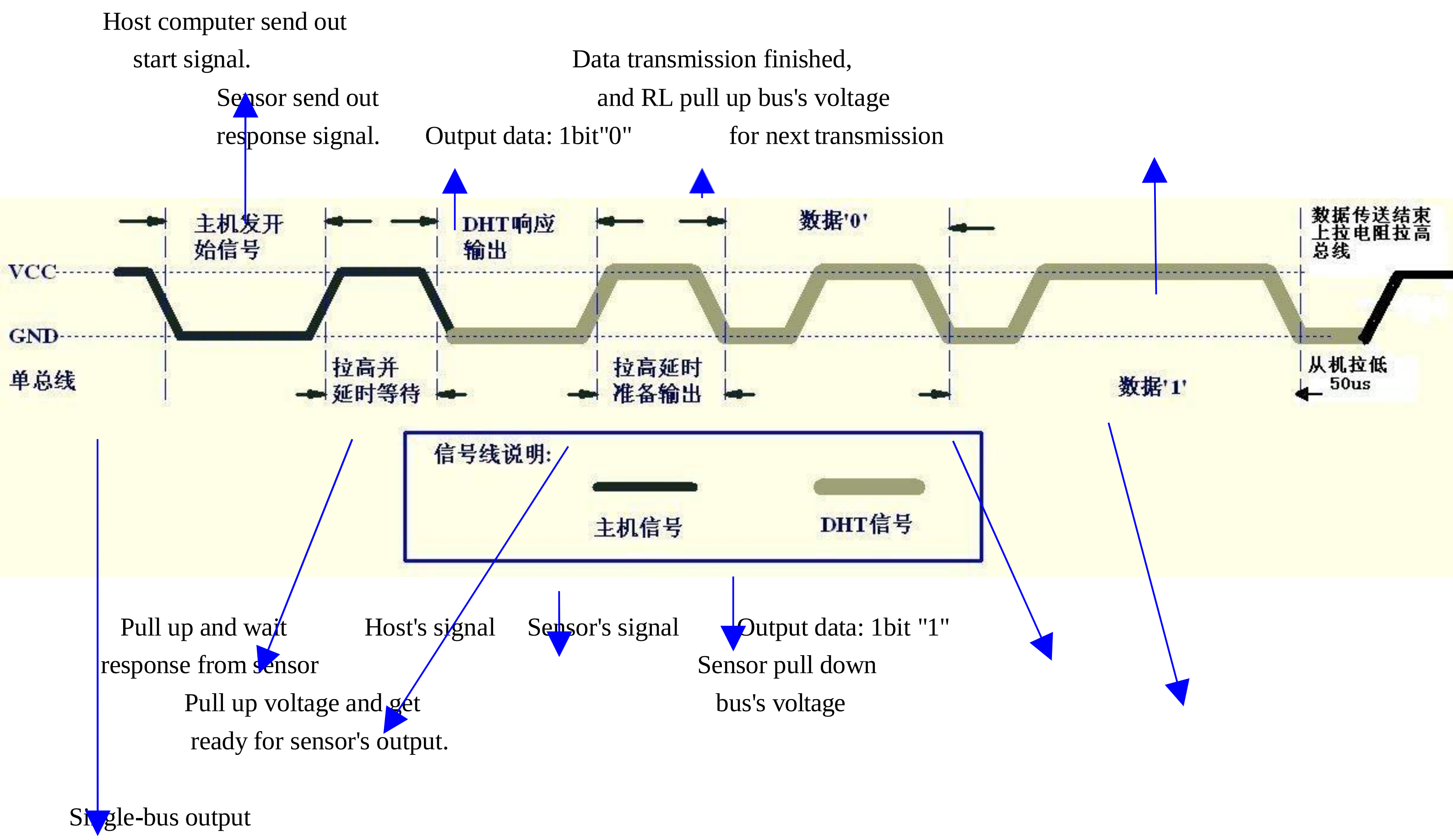
and temperature information to MCU. Without start signal from MCU, DHT22 will not give response signal to MCU. One start signal for one time's response data that reflect the relative humidity and temperature information from DHT22. DHT22 will change to low-power-consumption-mode when data collecting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

1) Check bellow picture for overall communication process:



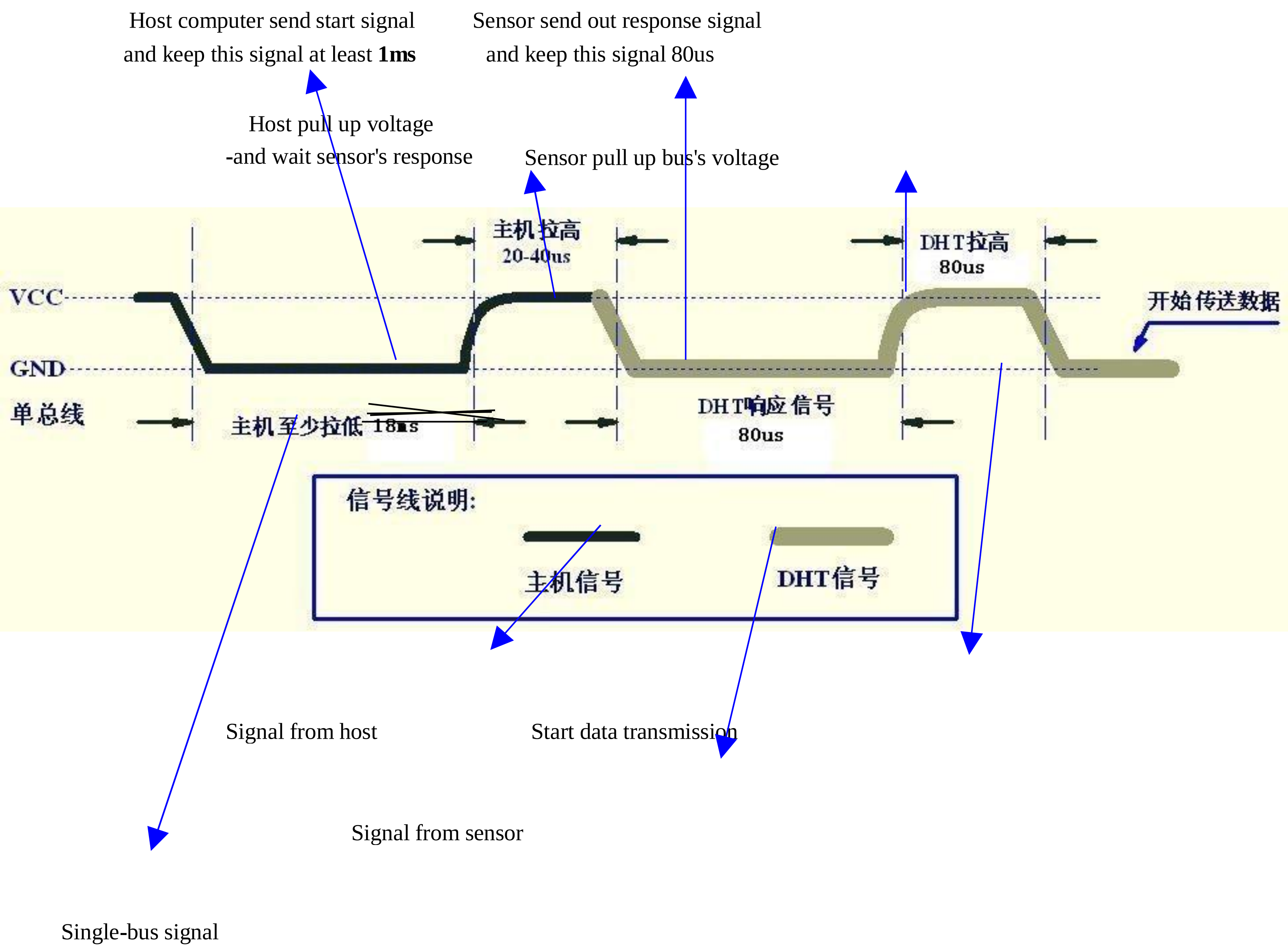
2) Step 1: MCU send out start signal to DHT22

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:

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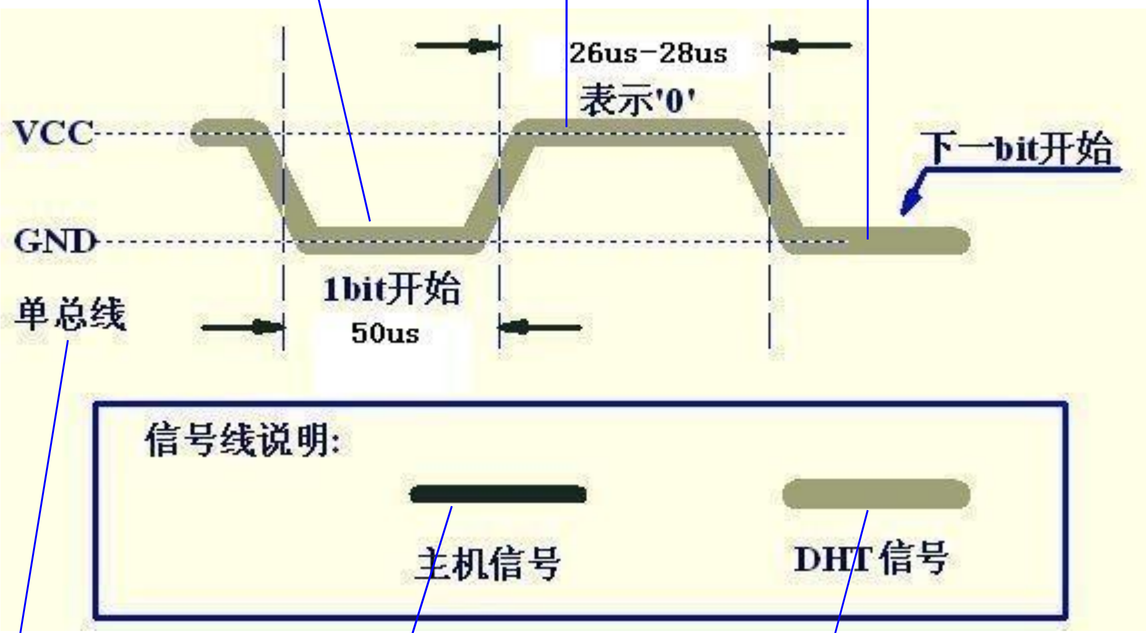
Start transmit 1bit data

Start transmit next bit data

26-28us voltage-length means data "0"



Host signal

Sesnor's signal

Single-bus signal

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:

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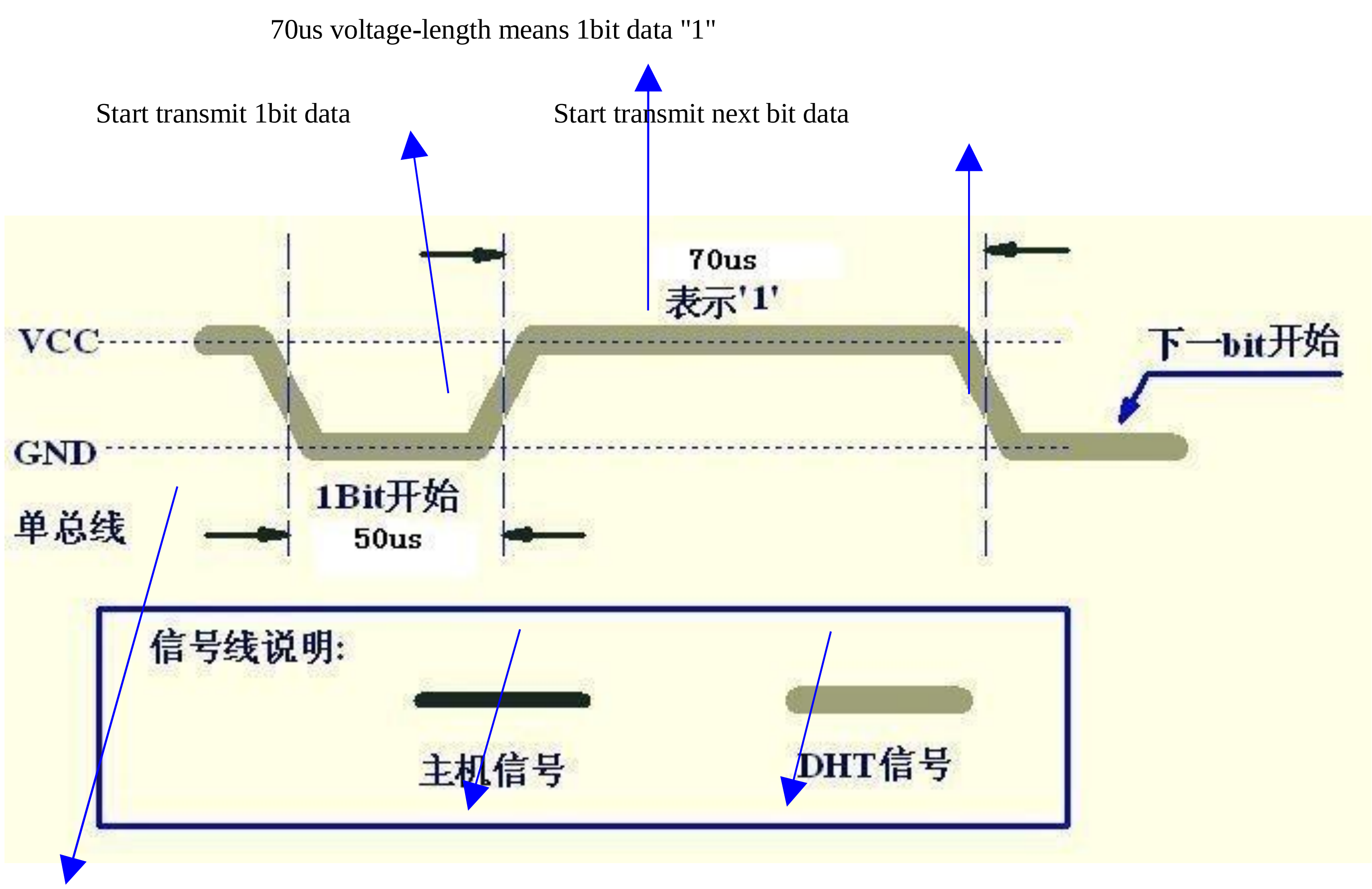

Host signal Sesnor's signal

Single-bus signal

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)

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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.

LEMBAR EKSPEDISI PERBAIKAN TUGAS AKHIR

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PROGRAM STUDI : D-3 METROLOGI DAN INSTRUMENTASI

DEPARTEMEN : FISIKA

JUDUL : MONTORING SUHU DAN KELEMBABAN UDARA MENGGUNAKAN SENSOR DHT22 BERBASIS IOT(INTERNET OF THINGS)

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Medan, 18 Agustus 2020

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