Multi level Class D BT Speaker

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Techfest Munich 2019 Workshop

1   Infineon for Makers

2   Class D audio and Infineon

3   Multilevel Class D technology

4   Workshop work to be done

5   ESP32 BT Sink

6   MA12070P amplifier

7   Infineon @Techfest

What we offer for Techfest

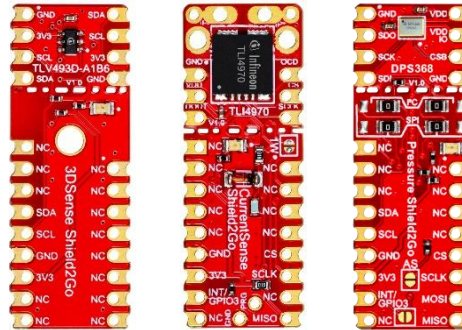Modular hardware boards **compatible with Arduino, ESP32, Raspberry Pi**

Motor Controllers
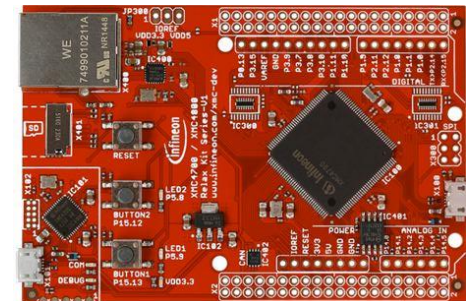**DC, BLDC, Steppers - up to 700W**

Sensors
Pressure, Magnetic, Microphone, more

Microcontroller Kits
Arduino compatible

Radar & 3D Imager
24 & 77 GHz Radar, Pico Flexx 3D cam

Digital Audio
Silicon Stereo Microphone & Class D Amps

Infineon.com/makers

Audio Class D and Infineon

› International Rectifiers aquired 5 years ago
  − >100 W analog power amplifer module design
  − Professional and indrustrial audio amplification
  − Marked insigth and demand
› MERUS ™ Auido aquied 2 years ago
  − <100 W analog and digital input monolitic ICs
  − 20 people statup from Denmark
  − Design team with multidisciplinary skills
 − Pattened Multi level technology

Soundboks – 5 year old startup

› Born at Roskilde Festival
   – DIY build - Returned with 200 request to build
› Today sold more then 50K Soundboks 2
› Released Soundboks 3 last month

Multilevel Class D

› Traditional class D (20 year old tech)
   – Large Idle loss – even at moderate volume
   – Effective only at max power
   – EMC issues
   – Complex descrete rail tracking
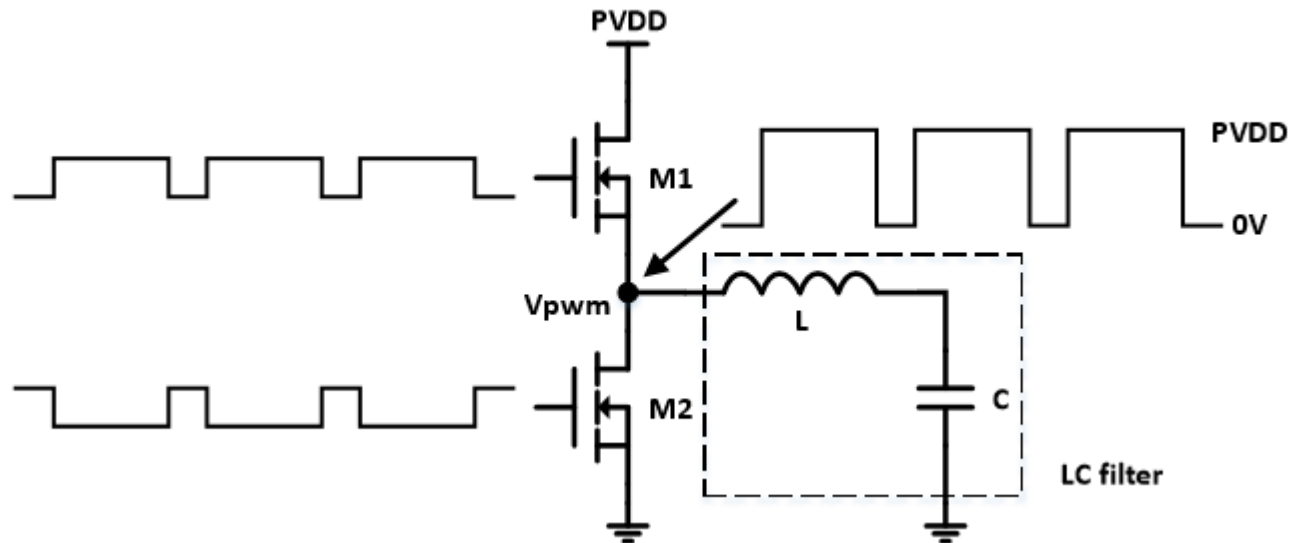
Multilevel Class D

› New tech in audio amplification
  – Low idle power loss
 – Low EMC noise
  – Requires and enables advanced modulation
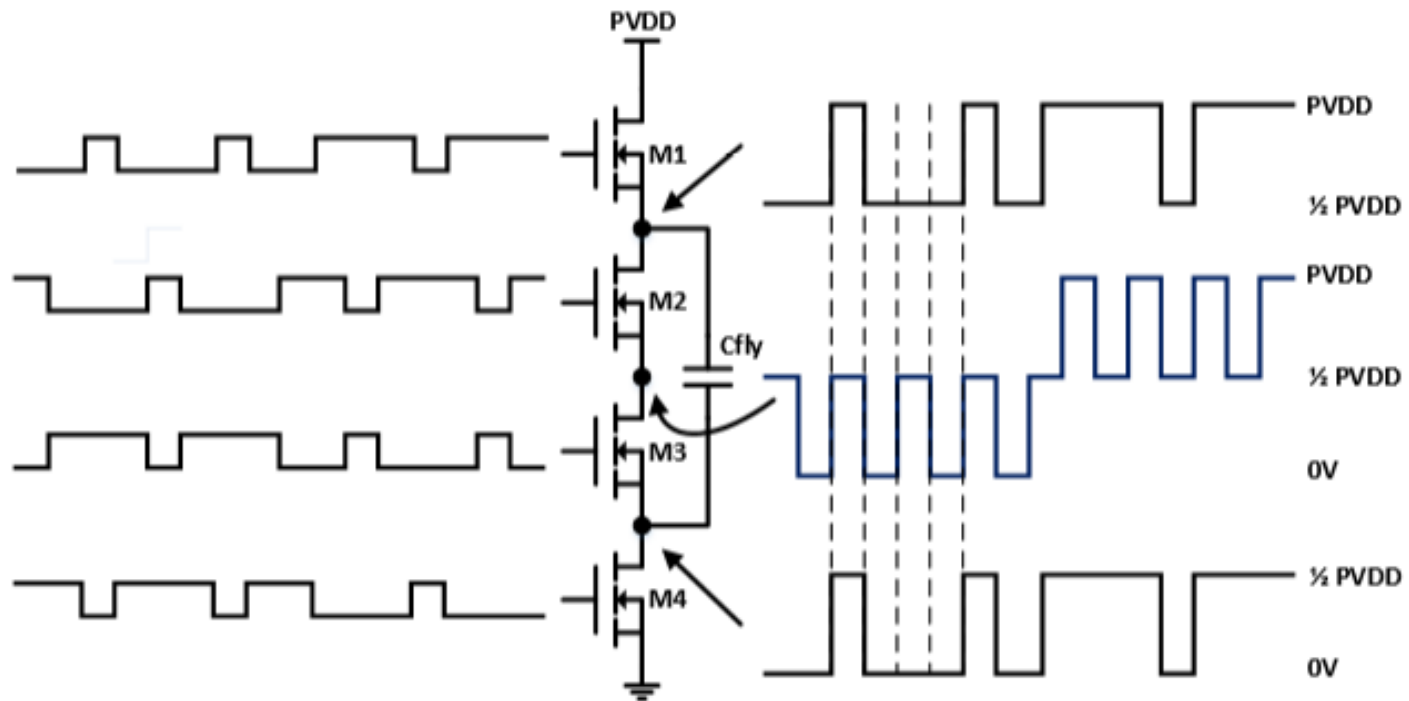
Multilevel Class D

› 3 or 5-level modulation in BTL configuration
› Dynamic modulation and modulation frequency
› Design for low power consumption, EMC or audio performance.
› Mulitlevel class D white paper
› IEEE paper on IC design from 2016
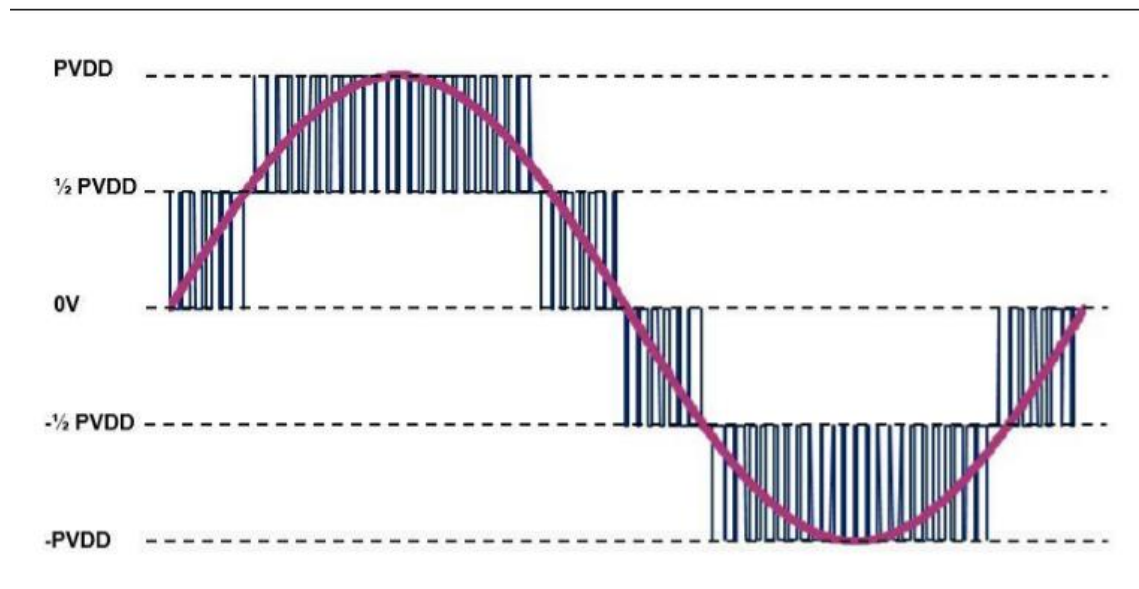
Workshop - Work to be done

› ESP32 classic Bluetooth audio sink
- Simple demo implemtaion of BT A2DP protcol
- Audio streaming / start/stop / trackinfo / bitrates / volume
- I2S 16 bit output internal or external DAC
- Add a MerusAudio ESP-IDF component
- ESP32 driver for MA120x0
- Device setup and register access
- Change from 16 to 32 bits audio samples
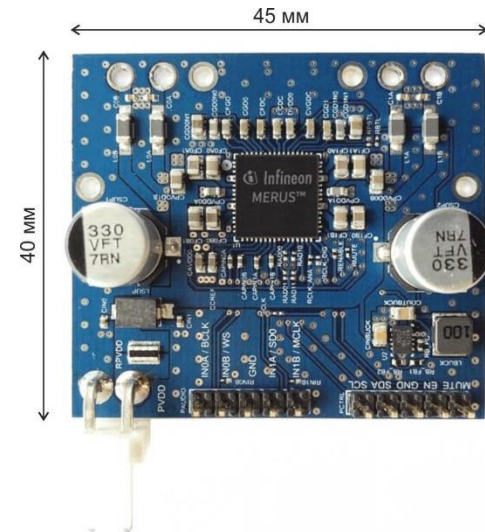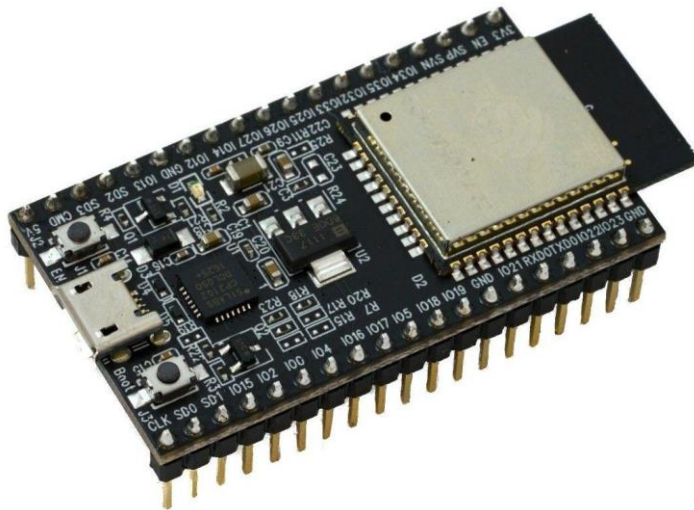
Lets do some work

› Run the ESP32 a2dp_sink demo
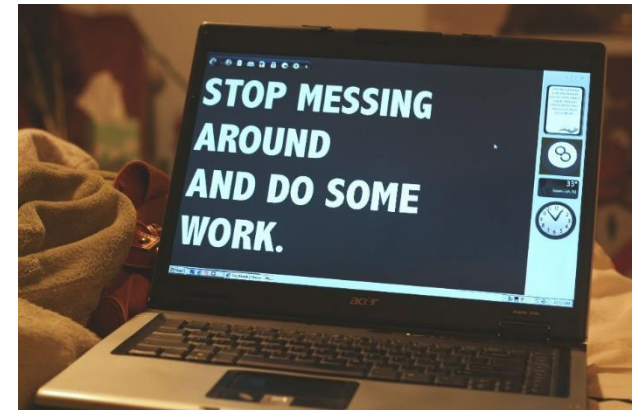 - `cd ~/esp`
  - `cp –r esp-idf/examples/bluetooth/bluedroid/classic_bt/a2dp_sink .`
  - `make menuconfig         // change serial port and link speed 230kb`
  - `make flash monitor –j6`

› Tips!
  - Change bluetooth name
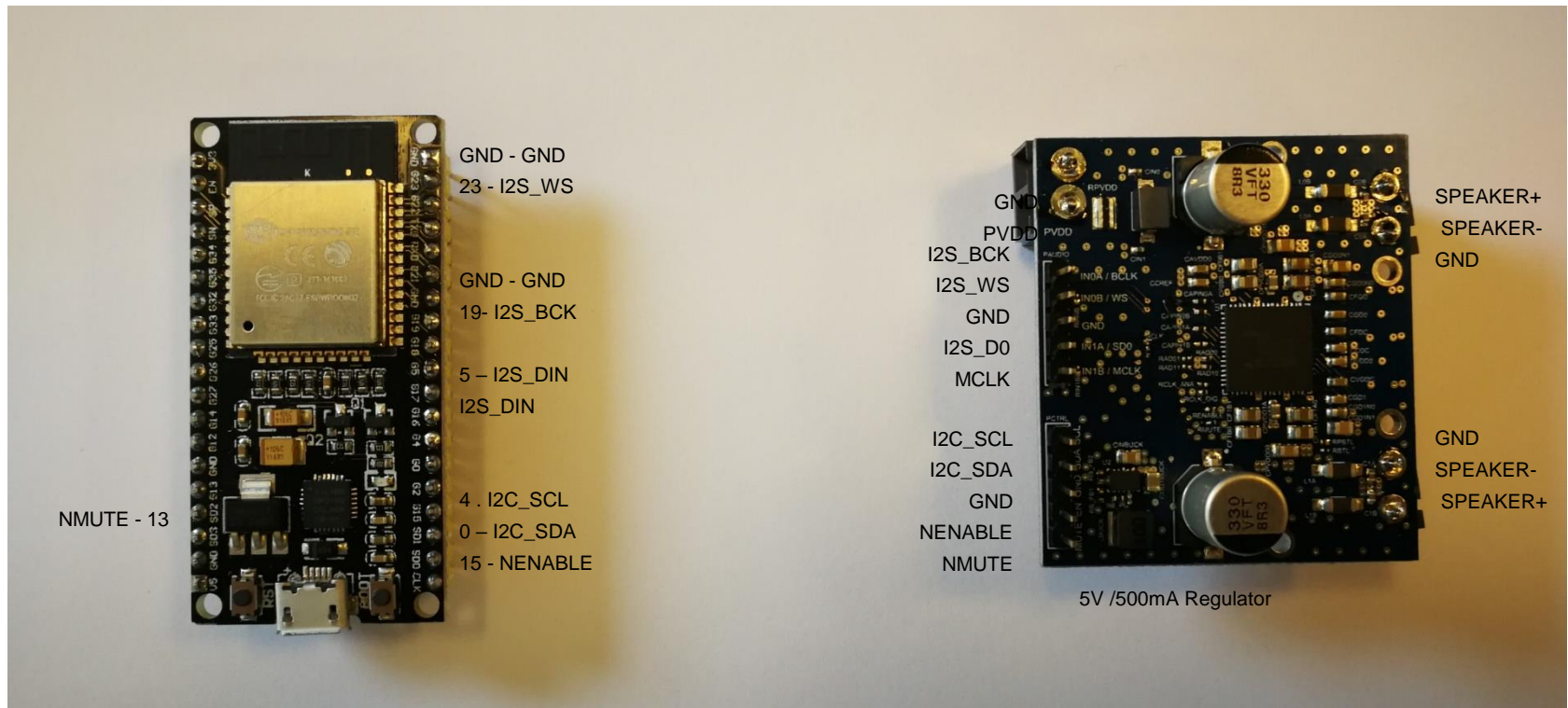 - Connect you phone, stream audio
› Challenge
  - Find the BT audio sample callback
  - Find and modify track number event
    - Add some stuf "i like AC/DC" if play AC/DC

Wire up ESP32 and MA120x0P

ESP32	Driver	Signal	Dir	MA120x0P
G15	GPIO	Enable amplifier (NC)	I PD	nENABLE
G13	GPIO	Mute amplifier (NC)	I PU	nMUTE
G19	I2S DMA	I2S_BCK – bit clock 3.072 MHz	I	I2S_BCK + MCLK
G23	I2S DMA	I2S_WS – L/R frame 48KHz	I	I2S_WS
G5	I2S DMA	I2S_Dout	I	I2S_D0
G4	I2C DMA	I2C_SCL – Clock (100kbps)	B	I2C_SCL
G0	I2C DMA	I2C_SDA – Data	B	I2C_SDA
GND	Power	2 x GROUND	P	GND

ESP32 MA12070P connections

GND - GND
23 - I2S_WS

GND - GND
19- I2S_BCK

5 – I2S_DIN
I2S_DIN

4 . I2C_SCL
0 – I2C_SDA
15 - NENABLE

NMUTE - 13

GND
PVDD
I2S_BCK
I2S_WS
GND
I2S_D0
MCLK

I2C_SCL
I2C_SDA
GND
NENABLE
NMUTE

5V /500mA Regulator

SPEAKER+
SPEAKER-
GND

GND
SPEAKER-
SPEAKER+

Close Look at MA120x0P

› I2S audio input
› I2C control interface
  – volume
  – input format
  – power modes
› Control lines
  – nenable, nmute
› Status
  – nerr and nclip

  – [MA120x0P Datasheet](#)

Add the MerusAudio esp-idf component

› https://github.com/infineon/a2dp_sink_techfest
› `cd ~/esp`
› `git clone`
  `https://github.com/jorgenkraghjakobsen/a2dp_sink_techfest.git`
› `make menuconfig  // setup serial interface and speed (230kbps)`
› `make flash monitor -j6`

› What is added to code
  – MA120x0 setup called from main
  – Change audio bits pr sample from 16->32
  – Repack sample data from BT to I2S buffer

Audio AE team at Techfest

› Raspberry pi HAT
› Raspberry drivers
› More ESP32 processing pipeline
› More amplifier boards

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