

# Building CANtact Pro

An Open Source CAN Bus Tool

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# CAN?

- Controller Area Network
- Most common network in cars
  - Also found in SCADA, ICS, avionics, motor controllers, etc...
- Multi-master bus with message priority, arbitration, CRCs
- Usually every message is trusted!
- Some higher level protocols of interest
  - CAN-TP / ISO-TP
  - Unified Diagnostic Services (ISO 14229)
  - CANOpen
  - CCP/XCP

# The Original CANtact

- CAN to USB Device
- Originally a USB Serial Device using slcan
- candleLight firmware by Hubert Denkmair
  - gs\_usb driver on Linux
  - [https://github.com/candle-usb/candleLight\\_fw](https://github.com/candle-usb/candleLight_fw)
- No isolation
- Single channel
- Cheap!
- Several clones and forks exist (CANable, candleLight, VulCAN, etc...)
  - Many of these are improvements!



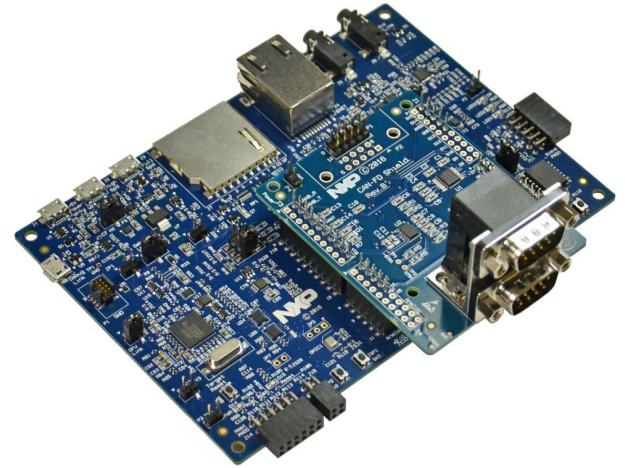
# Goals

- Two channels
- High Speed USB
- CAN FD support
- Single Wire CAN support
- Electrical isolation between USB and CAN
- Put it in a case!



# 2x CAN-FD + Single Wire CAN

- Needed to choose the right MCU
  - LPC54616J512BD100
  - 2x CAN-FD
  - High Speed USB
  - ROM-based USB bootloader
  - Development board available
- CAN-FD compliant transceivers
  - MCP25612FD: dual CAN-FD transceiver
- Single Wire CAN
  - 74LVC1G3157: dual pole single throw analogue switch
  - NCV7356D1: single wire CAN transceiver



# Isolation

- Sometimes CAN buses have bad voltages
  - Not Ideal: killing your \$150 CAN tool
  - Really Bad: killing your \$1500 laptop
- Isolated CAN transceivers exist
  - Not for CAN-FD and Single Wire though...
- **CAN Signals:** Silicon Labs Si866x
  - 150 Mbps
  - 5 kV isolation
- **GPIOs:** Optocoupler
  - Cheaper
  - ~1000x slower
- RECOM 5V isolated DC/DC module
  - Some issues with these...

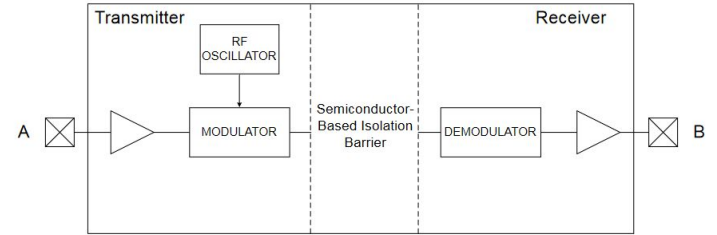
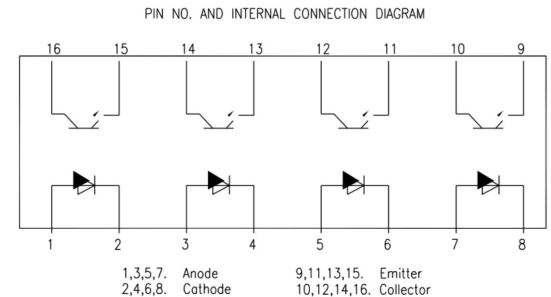


Figure 2.1. Simplified Channel Diagram



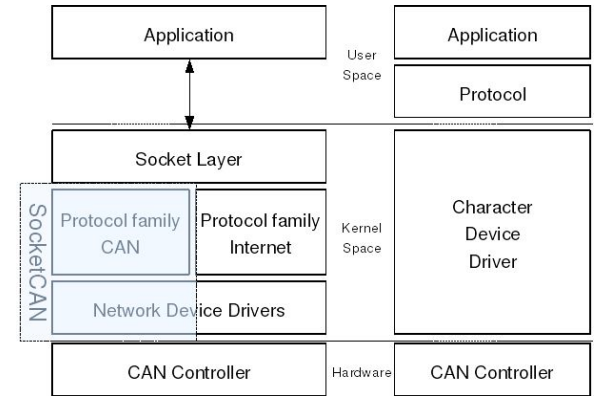
# Enclosure

- Injection moulding is expensive
- I am not a mechanical engineer
  - Fortunately, I know a few!
- Polycase
  - Prefab case, custom machining
  - Low startup cost, higher per unit cost
- Need to design PCB to fit Case!
- Contracted a Mech Eng to do CAD



# Software - SocketCAN

- Part of the Linux kernel
  - CAN devices become network devices
  - `sudo ifconfig can0 up`
- Many tools exist (can-utils, Wireshark, etc...)
- Targeted the `gs_usb` driver
- Needed to customize driver for CAN-FD support





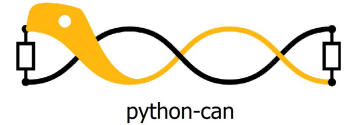
# Software - Userspace Driver

- SocketCAN is Linux only!
- Cross-platform support needs per-platform driver
- Rust + libusb
  - One codebase
  - Windows, macOS, Linux
  - cargo install cantact
- Synchronous libusb is too slow
- Implemented as async libusb driver



# Software - Python API

- Rust is good for systems software
  - Less good for hacky scripts
- The python-can library is a mature option
- Supporting python-can opens the door for:
  - CAN-TP (ISO 15765-2) support via python-can-isotp
  - Unified Diagnostic Services (ISO 14229) via uds-on-can
  - Many protocols via Scapy
- PyO3 generates Python module from Rust
- Build automation using Github Actions
  - Builds Python module with Rust, publishes to PyPI
  - `pip install contact`



# Software - BUSMASTER

- BUSMASTER is an open source CAN software from Bosch
- Windows only
- CANtact support functional
- ... a somewhat dead project 😞
- Resulted in functional C bindings on Windows (via DLL)



# Building & Selling

- PCBs manufactured and assembled by Contract Manufacturer
  - Same one used for CANTact
  - Surprisingly cheap assembly costs
- Cases manufactured by Polycase
- Final assembly by me
- Launched through CrowdSupply
  - Excellent way to get a project launched
  - Fulfillment by Mouser

**CROWD**SUPPLY



# So You Want To Build Some Hardware...

- BOM cost is critical
  - Everyone wants a cut
- Build stuff for yourself
  - Open-source hardware isn't a good business
  - Build stuff you think is cool
  - Other people might think it's cool too 😊
- Don't build in a vacuum
  - Show other people your stuff
  - Get feedback
  - Helps to find bugs
- Chip shortages suck

# Next Steps

- Rust CLI
  - No multi-device support
  - More tools
- Get `gs_usb_fd` into the Linux kernel
  - Need to submit a patch
- Breakout board?

# Thanks! Questions?

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