**Truck-Node**

Automotive controller to balance power consumption and provide baseline functionality for a connected vehicle.

**Key IP Remote Control Features**

* Report alarm status and intrusions
* Lock/unlock doors
* Arm/disarm alarm (OEM, or aftermarket)
* Alarm system functionality
* Auxiliary power control with warning for soft-shutdown of SBC
* Battery rundown protection
* Report supply voltage
* Remote start engine
* Temperature reporting

**Technical Features**

* Molex micro-fit headers
* ESP8266 Module
  + 802.11n Connectivity
  + Over-the-air firmware updates
* MQTT Client
* CAN Bus Interface

# Inputs and Outputs (IO)

## Inputs

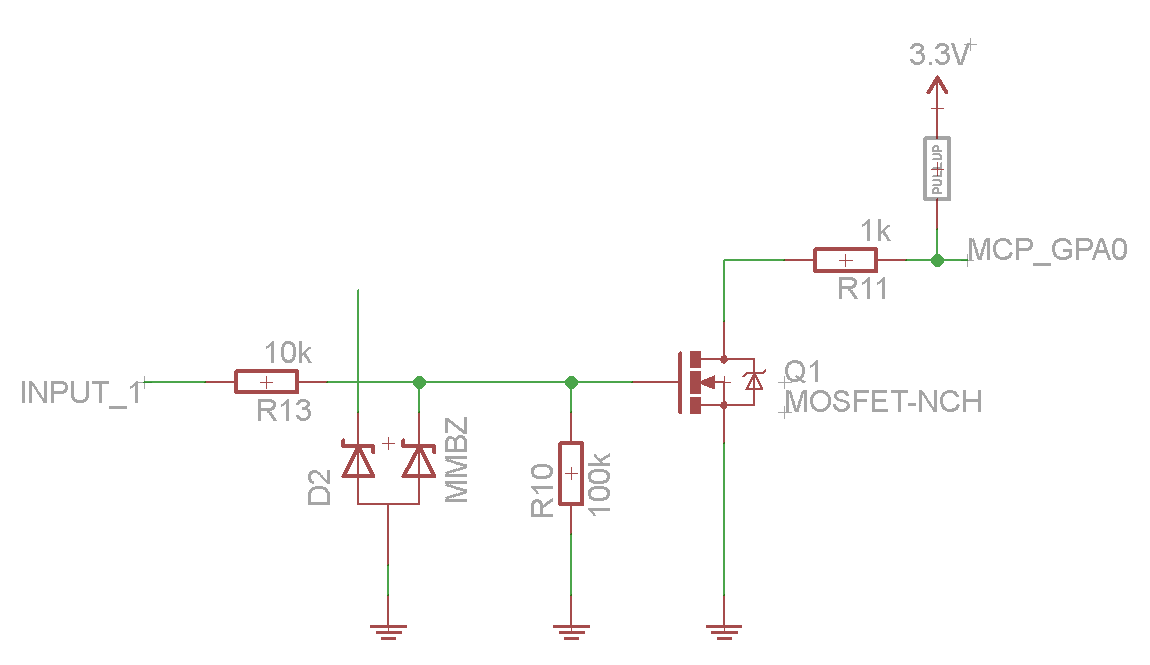
* Supply Voltage (Analog)
* Accessory Ignition Detect
* Alarm Arm OEM Status
* Door Pin Status
* Doors Locking
* Doors Unlocking

## Outputs

* Aux Power
  + Type: Dedicated High-Side N-CH MOSFET Switched 5VDC
* Aux Power Shutdown Warning
  + Type: Open-Drain; to be pulled high by SBC or other. Could do pull-up to 3v3 for broad compatibility
* Siren (Alarm)
  + Open-Drain
* Horn
  + Open-Drain
* Remote Start
  + Open-Drain

## Input Design

* Controlled impedance
  + High enough to be gentle on exterior circuits but not high enough to present problems when left floating
  + FET gate versus forward bias a bipolar
* Overvoltage tolerant
  + Will not damage if subjected to higher than designed voltages, including electro-static discharge
  + Special problem: Protect FET gate from overvoltage spikes
  + Clamp voltage over X and divert to ground by use of a TVS device and/or zener diode
* Prevent misconfigured IO expander pins from causing damage
  + Series current-limiting resistor between output and pin (*1k ohm will limit a 3.3v supplied circuit to 3.3 mAh*)
    - Low enough to keep voltage sufficiently high for logic-high value with presence of internal pull-up resistor being a divider
    - High enough to limit current to both less than maximum current:
      * Switching device (Ids)
      * IO expander
      * Voltage supply to IO expander



## PROTOTYPE

**ULN2308A TOP**

* B1 – INPUT – DOOR PIN
  + Grounded when one or more door is open
  + Pull-Up Resistor (100K)
* B2 – INPUT – DOORS UNLOCKING
  + Grounded to unlock doors
  + Pull-Up Resistor (100K)
* B3 – INPUT – DOORS LOCKING
  + Grounded to lock doors
  + Pull-Up Resistor (100K)
  + MCP I/P
* B4 – INPUT – OEM ALARM DISARM REQUEST LINE
  + Not sure what to do about this… this is actually a DISARM input, which will be called from at least the remote start

Blazer has no ARM input. To arm, one must lock doors after cycling door pin

**ULN2308A BOTTOM**

* B1 – OUTPUT – SBC Shutdown Warn [FUTUE]
  + Optional pull-up resistor but do not tie to VDD (> 3v3)
* B2 – OUTPUT – SIREN
  + MCP A1
  + Basic Open Collector to a siren
* B3 – OUTPUT – HORN
  + Basic Open Collector – may need a relay!
  + MCP A2
* B4 – OUTPUT – REMOTE START
  + Basic Open Collector
  + MCP A3
* B5 – OUTPUT – DOOR LOCK
  + MCP A4
* B6 – OUTPUT – DOOR UNLOCK
  + MCP A5
* B7 – OUTPUT – ALARM ARM
  + MCP A6
* B8 – OUTPUT – ALARM DISARM
  + MCP A7

IO BOARD J1 (BOTTOM)

* J1-1 O/P C8
* J1-2 O/P C7
* J1-3 O/P C6
* J1-4 O/P C5
* J1-5 O/P C4
* J1-6 O/P C3
* J1-7 O/P C2
* J1-8 O/P C1
* J2-1 – MCP-15 – DOOR\_PIN
* J2-2 – MCP-14 – DOORS\_UNLOCKING
* J2-3 – MCP-13 – DOORS\_LOCKING
* J2-4 – MCP-12 – OEM\_ALARM\_DISARMING

Design Notes

Inputs must be fully conditioned

Board should have a PTC fuse

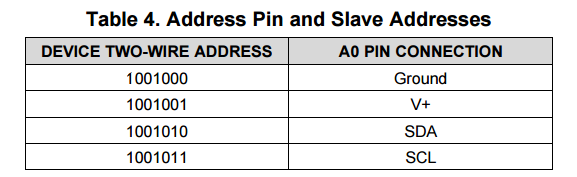
Recall problems with input clamping protection when trying to float inputs; MCP IO expander cannot hi-z float inputs

Should add RFI suppression

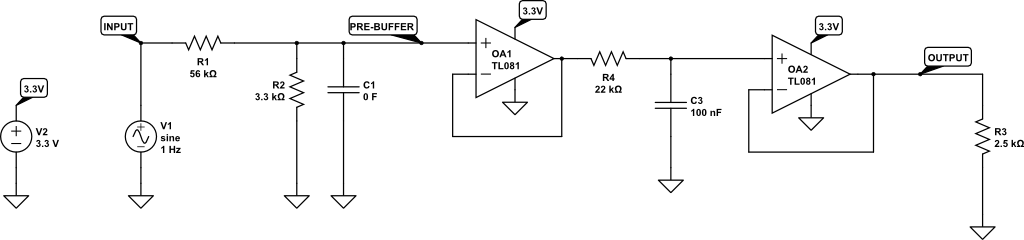
I2C Address De-confliction

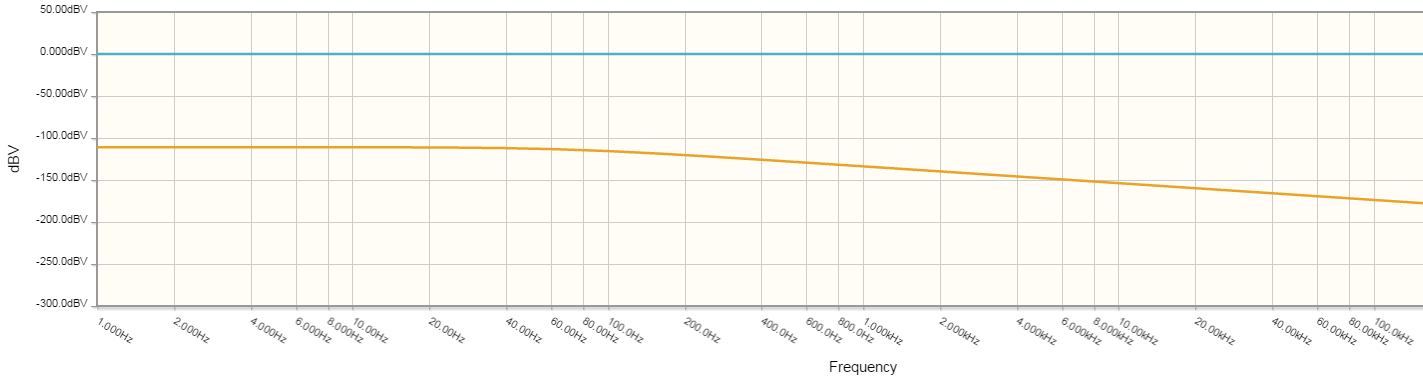
* 0100xxx0 MCP IO Expander
* 10010xx Temperature Sensor:

TM102 I2C Temperature Sensor



Voltage Monitoring





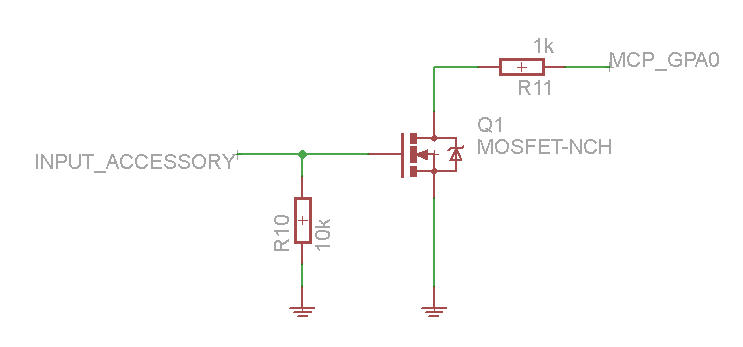
## MCP23017 I/O Expander

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **MCP Pin** | **SW** | **Direction** | **Config** | **Description** |
| GPA0 | 0 | Input | Pullup | Accessory Ignition Detect |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

# Logic Inputs

* High Voltage (0-20V)
* High Impedance (>= 10k Ohm)

It was found during real-world testing that basic signal FET transistors are not the best choice for exterior facing IO. Deciding to go for tried and tested bipolar transistors.



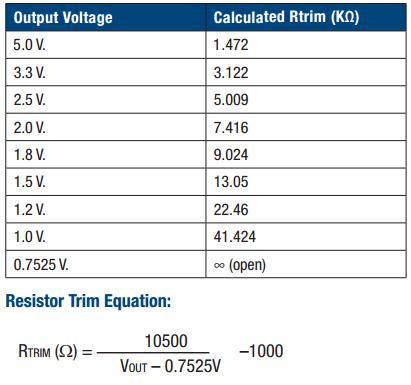
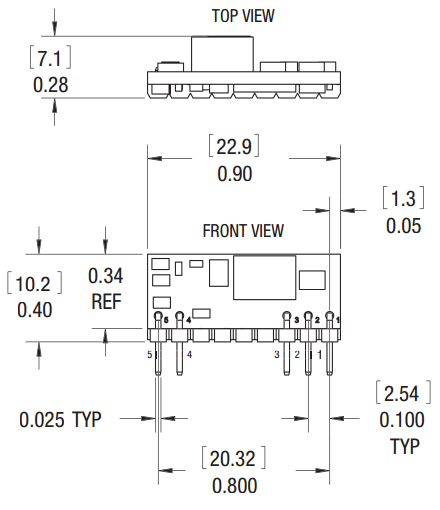
# Power Regulation

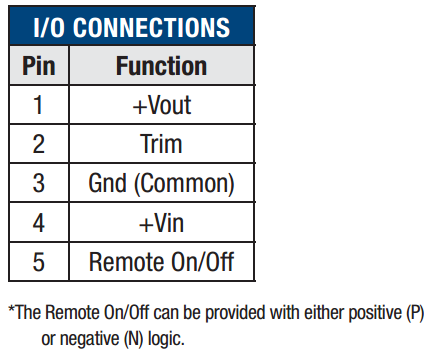
Murata Power Solutions Inc. OKX-T/5-D12N-C

Digikey: 811-2622-ND

**Input:** 8.3-13.8 nominal (15vdc max)

**Output Power:** 3A (25W)





# USB Connectivity

Do not pass power through, or isolate it if-so

* ESP8266