Workflow – 01/07/2025 | Alif Muhammad Rizky

1. Find spec for component and What component needs

2. Create flow diagram for every component

3. Make electric schematic with component

3. Simulate electric schematic

4. Create PCB (easy maintenance and user friendly)

5. Create Case (easy maintenance and user friendly)

6. Done

Whats need? And How spec?

**Goal:** Make a controller with security system and easy maintenance.

**Spec:**

1. Can handle 2 motors
2. Power total 500 Watt
3. Motor Driver Minimum 26A rate current
4. Main source 24V DC
5. Have a security system (overvoltage, overcurrent, overlaped, noise, reverse polarity, under-voltage lockout, over temperature, emergency stop, watchdog timer, error checking)
6. Reliable with 500 Watt load power.
7. Have a user interface like mini oled or integrated with aplication.
8. Modular desain for easy maintenance and upgrade
9. Setiap modul kerja harus memperhitungkan fenomena fisika
10. Type of encoder what communication?
11. Untuk kursi motion, **minimal 500 PPR**, dan **lebih baik lagi 1000 PPR atau lebih tinggi**. Motor wiper mobil yang sering digunakan mungkin memiliki encoder bawaan dengan resolusi yang bervariasi, tetapi jika Anda memasang encoder eksternal, usahakan cari yang beresolusi tinggi.

**Analisis Kebutuhan dan Penentuan Spesifikasi.**

1. Identifikasi dan kebutuhan spesifikasi komponen
2. Penentuan fitur sistem keamanan apa saja
3. Penentuan kebutuhan maintenace apa saja untuk user friendly

**Perancangan blok diagram dan logika.**

1. Diagram blok untuk sistem keseluruhan.
2. Diagram blok untuk setiap komponen.
3. Buat logic diagramnya juga untuk semua sistem kerja tiap komponen.

**Perancangan Electrical Schematic Design**

1. Pemilihan Detail Komponen
2. Spesifikasi transistor resistor kapasitor mosfet pull down atau pull up
3. Distribution power system
4. Protection sirkuit

**Perancangan PCB**

1. Software
2. Component Placement
3. Routing
4. Desain Manufaktur DFM / DFA
5. Review

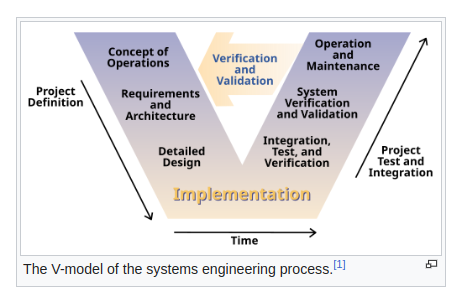
**Perancangan Casing**

1. **Pemilihan Material:** Pertimbangkan material (plastik, metal) berdasarkan kekuatan, dissipasi panas, biaya, dan lingkungan penggunaan.
2. **Desain Mekanis untuk Kemudahan Perawatan dan Pengguna:**
   1. Pertimbangkan ukuran PCB dan komponen internal.
   2. Sertakan lubang untuk konektor eksternal, tombol, layar, dan indikator.
   3. Desain sistem pemasangan (sekrup, klip) yang mudah diakses.
   4. Sediakan ventilasi yang cukup untuk mencegah *overheating*.
   5. Pastikan *mounting* yang aman untuk PCB dan komponen berat (misal: *heatsink*).
3. Pembuatan Prototipe Casing:
   1. Gunakan *3D printing* atau metode prototipe cepat lainnya untuk menguji desain.
   2. Verifikasi *fitment* dengan PCB dan komponen.

**Pemrograman Firmware**

1. Pengembangan Firmware:
   1. Tulis kode program untuk mikrokontroler sesuai diagram alir (kontrol motor, logika keamanan, antarmuka pengguna).
   2. Gunakan struktur kode yang modular dan terkomentar.
   3. Implementasikan penanganan error dan debug yang efektif.
   4. Pengujian Unit:
   5. Uji setiap modul program secara terpisah (misal: baca sensor, kontrol motor dasar, tampilan LCD).
2. Pengujian Integrasi:
   1. Gabungkan semua modul dan uji interaksi antar komponen.
   2. Verifikasi semua fitur berjalan sesuai spesifikasi.
3. Pengujian Sistem Keamanan:
   1. Uji skenario deteksi ancaman dan respons sistem.
   2. Verifikasi akurasi dan kecepatan alarm.
4. Kalibrasi dan Tuning:
   1. Kalibrasi sensor dan motor untuk performa optimal.
   2. Tuning parameter kontrol (misal: PID untuk motor).

**Final Assembly**

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Analisis Kebutuhan – 01/07/2025 | Alif Muhammad Rizky

**Component**

- STM32 (STM32F1, **STM32F4**)

- Buck Converter (MP1584, **MP2307**, AMS1117, LP2985)

- Motor Driver (BTS7960B, IR2104,  **IRF540**, DRV8301,)

- Type Motor (DC **Brushed**, BLDC)

- Circuit Protection (overvoltage, overcurrent, ovarlaped, reverse polarity, error checking, overtemperatured, undervoltage)

- Standard Communication (**CANBUS**)

- Interface (**Mini OLED**)

**Choice Component**

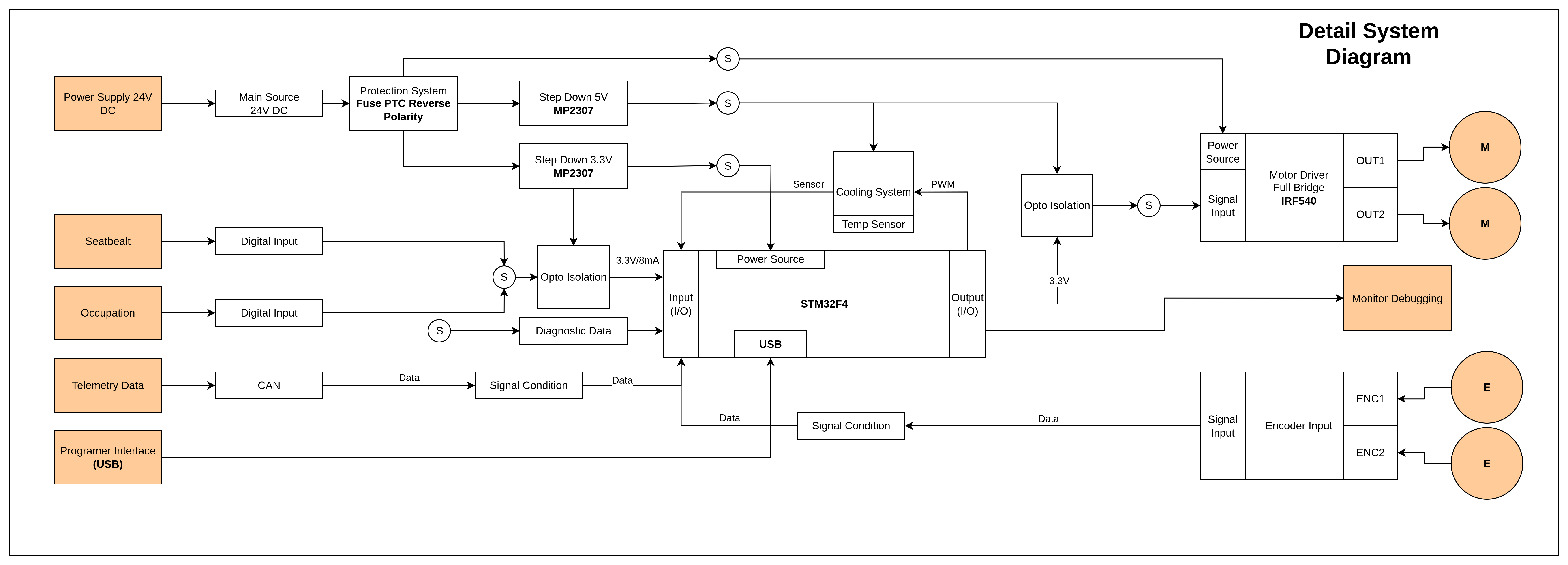
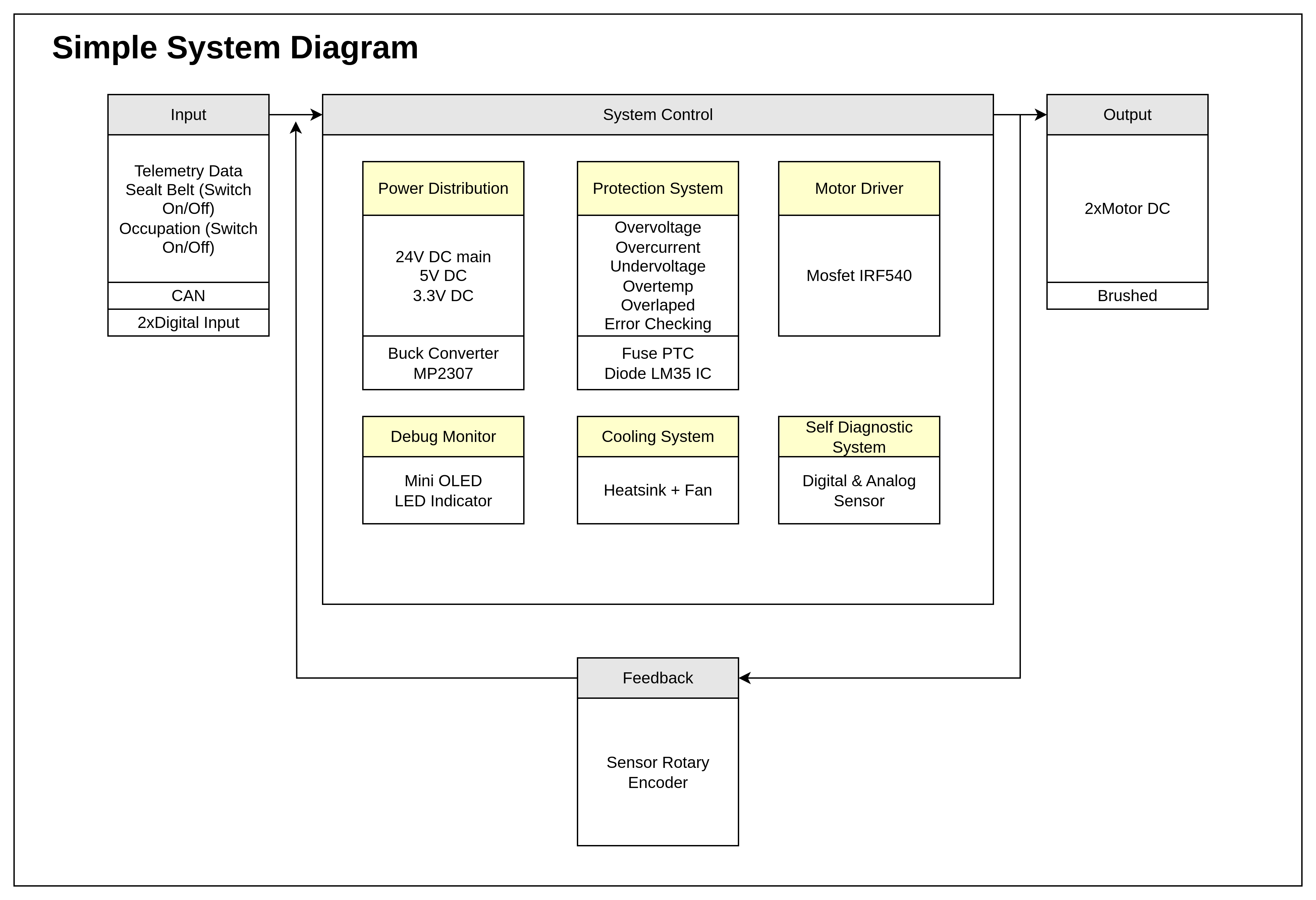
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| --- | --- | --- | --- | --- | --- | --- |
| Category | Product | Pro | Cons | Choice | Reason for Choice | Link |
| Microcontroller | STM32F1 | Low Cost, General Purpose, Popular for hobby projects | Lower performance, less suitable for complex tasks |  |  |  |
|  | STM32F4 | High Performance, FPU, DSP, Multimedia & Industrial applications | Higher cost than F1 | STM32F4 | Balances performance and cost for advanced motor control |  |
| Buck Converter | MP1584/2338/MP2307 | High Efficiency (up to 92%), Max Input 28V, 3A continuous (4A peak), Low quiescent current, Comprehensive protection | MP1584 is NOT RECOMMENDED FOR NEW DESIGNS | Modern Buck Converter (e.g., MP2338) | High efficiency for main power rails, but MP1584 is obsolete |  |
|  | AMS117 | Low Dropout (1.2V @ 1A), 1A output, Fixed output options, Thermal/Current limiting | Lower efficiency than buck, higher quiescent current than LP2985, Max Input 18V |  |  |  |
|  | LP2985 | Low Noise (30µVRMS), Ultra-low dropout (280mV), Very low quiescent current (71µA), High PSRR, Comprehensive protection | Low output current (150mA) |  |  |  |
| Motor Driver | BTS760B | High Current (43A typ), PN Half Bridge, Logic inputs, PWM up to 25kHz, Comprehensive protection | Obsolete |  |  |  |
|  | IR2104 | Half-Bridge Driver, High Voltage (up to 600V), Logic compatible, UVLO, Cross-conduction prevention | Lower gate drive current (130mA source / 270mA sink) compared to DRV8301 |  |  |  |
|  | DRV8301 | Three Phase Pre-Driver, Integrated Buck Converter (1.5A), Dual Current Shunt Amps, Wide supply (6-60V), High gate drive (1.7A source / 2.3A sink peak), 3/6-PWM, SPI, Comprehensive protection | More complex for simple applications, higher cost |  |  |  |
|  | VNH3SP30 | Full bridge motor driver, 12A continuous (30A peak), 5.5-24V operating voltage, 2.5-5V logic levels, Ultrasonic PWM (up to 20kHz), Current sense feedback, Reverse-voltage protection, Over-voltage/Under-voltage shutdown, Thermal shutdown, Short-to-ground/Vcc protection |  |  |  |  |
|  | IRF540 | High Power and High current delivery up to 33A.  Low Resistance.  Fast Switching. | Need Driver to Activate and Control  Easy Overheating | V | Needs more power |  |
| Motor | Brushed | Simplicity, Lower initial cost, Ease of repair, Robustness, Straightforward speed control | Shorter lifespan, Lower efficiency, Requires maintenance | V | Easy for repair and controll |  |
|  | BLDC | Higher efficiency, Longer lifespan, Reduced maintenance, High power density, Precise control, Low noise/vibration, Better thermal management, Versatility | Higher initial cost, Complex control systems, EMI generation, Controller maintenance |  |  |  |
| Protection | Overvoltage | Protects equipment, prevents fire hazards, automatic shutdown | Adds complexity/cost | V | Critical for system safety and reliability |  |
|  | Overcurent | Prevents overheating/damage, automatic current reduction/cutoff, various modes | Adds complexity/cost | V | Prevents damage from excessive current |  |
|  | Overload | Prevents damage from excessive current draw | Adds complexity/cost | V | Ensures system stability under heavy loads |  |
|  | Reverse Polarity | Safeguards from incorrect connections, prevents damage | Diodes cause voltage drop/power loss; Schottky allows greater reverse current | V | Protects against incorrect power connections |  |
|  | Error Checker | Ensures reliability, identifies/localizes faults, minimizes downtime, reduces repair costs | Can add complexity, requires data acquisition/processing | V | Maintains system integrity and enables proactive maintenance |  |
|  | Overtemp | Prevents equipment damage/hazards from excessive heat, activates cooling | Adds complexity/cost | V | Protects components from thermal damage |  |
|  | Undervoltage | Prevents system malfunction/damage from low supply, protects batteries | Adds complexity/cost | V | Ensures stable operation and battery longevity |  |
| Sensor | E6B2 CWZ6C OMRON Rotary Encoder | High Resolution  Have Circuit Protection | Just Incremental | V | High Resolution |  |
|  |  |  |  |  |  |  |
| Communication | CANBUS | Robust, reliable, priority-driven, fault-tolerant, high-speed (up to 8 Mbps), centralized, reduces wiring |  | V | For automotive standard |  |
|  | RS485 | Faster than RS232 (up to 10 Mbps), extended range (1200m), good noise immunity, supports multiple slaves (up to 256) |  | V |  |  |
|  | I2C | Simple, two-wire, easy to implement, good for limited space |  | V |  |  |
|  | SPI | Higher data transfer rates than I2C, flexible for faster updates |  | V |  |  |
| User Interface | Mini OLED | Low power consumption, High contrast, Wide viewing angle, Fast response time, Compact size, Multiple interface options |  | V |  |  |
|  | LED |  |  | V |  |  |

**Conclussion :**

Untuk mikroprosesor dipilih **STM32F4** karena reliable untuk kebutuhan industri dengan komputasi tinggi. Untuk buck converter atau penurun tegangan dipilih **MP2307** karena memiliki arus tinggi dan efisien yang merupakan versi lebih baik dari MP1584. Untuk motor yang digunakan adalah motor **Brushed** dengan 24 volt dan rate current 30A karena mudah dioperasikan. Untuk driver digunakan **IRF540** memiliki kemampuan dalam menghantarkan arus yang tinggi dan memiliki kecepatan switching yang tinggi dan kemudahan untuk kontrol. Dari segi keamanan circuit digunanakan semua sistem keamanan untuk menjaga sistem menjadi lebih aman dan memiliki daya tahan tinggi. Untuk protokol komunikasi digunakan **CAN** sebagai protokol komunikasi standar di bidang otomotif. Untuk debuging atau proses monitoring digunakan **Mini Oled**. Untuk sensor motor dipilih **Rotary Encoder** dengan spesifikasi minimal 500 PPR agar menghasilkan kepresisian minimal.

Spesifikasi Sistem Keamanan Mandiri Self Diagnostic

* Power Good Signal (main power, step down)
* Overvoltage dan undervoltage sensing (main power)
* Current Sensing (main power)
* Resetable fuse chip (main power)
* Fault indication (optocoupler)
* Encoder Fault
* Input Fault



[**https://forum.digikey.com/t/guide-to-bootstrap-operation-in-a-mosfet-gate-drive-circuit/43247**](https://forum.digikey.com/t/guide-to-bootstrap-operation-in-a-mosfet-gate-drive-circuit/43247)