5V_IN

5V

3V3

Q1
4  S    D_1  1
        D_2  2
3  G    D_3  5
        D_4  6
SI3421DV-T1-GE3

D1
US1M

D2
SMAJ7.0A-13-F

R1
RES 0603 5%
10k

C1
TAJD227K010RNJ

LED1
Yellow

R55
RES 0603 5%
120R

GND

GND

GND

GND
5V

U1
2  EN    FB  5     FB
1  GND
3  SW   VIN  4
TLV62568DBVR

L1
1 ___ 2
MGFL3216F2R2MT LF
2.2uH

3V3

5V

R2
RES 0603 1%
450k

FB

R3
RES 0603 1%
100k

C42
CAP 0603 X7R 16V
100pF

C2
CAP 0805 X7R 16V
10uF

C3
CAP 0805 X7R 16V
0.1uF

C4
CAP 0805 X7R 16V
4.7uF

C5
CAP 0805 X7R 16V
0.1uF

C43
CAP 0603 X7R 16V
100pF

GND

# Explanation of the Robot Controller Circuit

This document provides an explanation of the schematic diagram for a Robot Controller (version 1.0) with

its power supply circuitry. The circuit is designed for managing power distribution and regulation.

Top Section: 5V Input Protection and Load Switch

-----------------------------------------------

1. D1 (US1M) - Rectifier Diode:

   - Prevents damage from reverse polarity by blocking current flow in case of incorrect input polarity.

   - Type: Fast-recovery rectifier diode.

2. D2 (SMAJ7.0A-13-F) - TVS Diode:

   - Protects against voltage spikes by clamping excess voltage above 7V.

3. R1 (10k Resistor):

   - Pull-down resistor for stabilizing the MOSFET gate when no signal is present.

4. Q1 (SI3421DV-T1-GE3) - N-Channel MOSFET:

   - Acts as a load switch to control power delivery.

   - Gate controls current flow between Source (S) and Drain (D).

5. C1 (22 uF Capacitor):

   - Provides decoupling and stabilizes the 5V input voltage.

Bottom Section: 5V to 3.3V Step-Down (Buck Converter)

------------------------------------------------------

1. U1 (TLV62568DBVR) - Buck Converter IC:

   - Converts 5V input to a stable 3.3V output for low-voltage components.

   - Key pins: VIN (input), SW (switch), FB (feedback), EN (enable), and GND.


2. L1 (2.2 uH Inductor):

   - Maintains steady current by storing and releasing energy during switching.


3. Capacitors (C2, C3, C4, C5):

   - Input capacitors (C2: 10 uF, C3: 0.1 uF) filter noise and stabilize input.

   - Output capacitors (C4: 4.7 uF, C5: 0.1 uF) smooth the 3.3V output.


4. Resistors (R2, R3 - Feedback Voltage Divider):

   - Sets the output voltage of the buck converter using the formula:

   $V\_OUT = V\_REF * (1 + R2 / R3)$, where $V\_REF = 0.6V$.


3.3V Output Indicators

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1. LED1 (Yellow LED):

   - Indicates the presence of 3.3V output.


2. R55 (120 Ohm Resistor):

   - Limits current through the LED to a safe level.


Overall Flow

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1. The 5V input is protected against reverse polarity and overvoltage using D1 and D2.

2. The MOSFET (Q1) ensures controlled power delivery to the buck converter.

3. The buck converter (U1) steps down the voltage to 3.3V with the help of L1, capacitors, and feedback resistors.

4. An LED indicator (LED1) provides visual feedback when 3.3V is generated.

This design ensures a robust power supply for the Robot Controller, protecting it from common power-related issues.