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High Stability power supply for Avionics with 10W 28V DC input and 5V DC output using GAIA convertor modules with standing disturbances as per mil-std-704 2)

⇒ The modules that are being used in the design are as follows :-

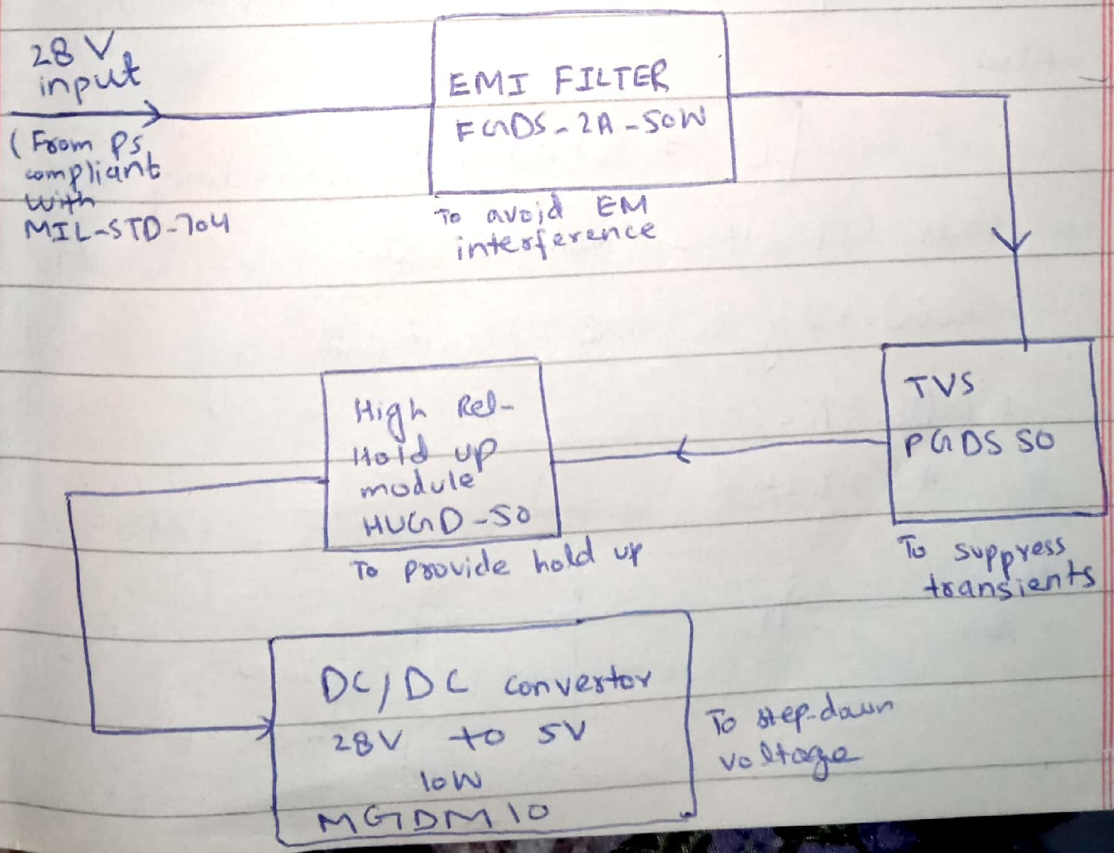
1- EMI Filter 2A, 50V - FGDS

2- Transient Voltage Suppressor 50W - PGDS50

3- High Reliability Hold up module 50W - HUGD50

4- DC/DC convertor 10W - MGDM10

⇒ The order or block diagram for this power supply is as follows :-



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⇒ Designing :-

⊙ For EMI performance and stability, an RC network is used alongwith and also common mode noise capacitance C_c.

Therefore,

$$\boxed{C_c = 10\ nF}$$ (Datasheet)

The filter output impedence must be kept low as compared to converter input impedence, therefore,

$$R < Z_{in}$$

where $Z_{in} = \frac{V_{in}^2}{P_{in}}$

$$\boxed{Z_{in} = \frac{28^2}{10} = 78.4\ \Omega}$$

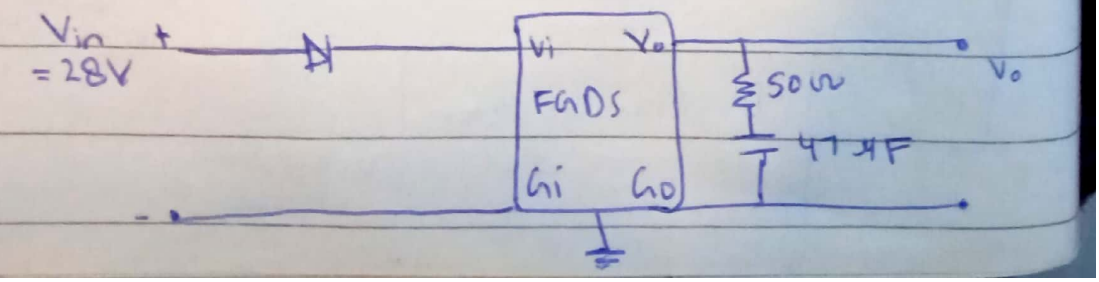
Therefore,

$$\boxed{R \approx 50\ \Omega}$$ (Supposition)

Also,

$$\boxed{C = 47\ \mu F}$$ (According to MIL-STD-461 standard at 10W load according to the datasheet of FGDS-2A-50V).

So, the initial circuit for EMI filter :



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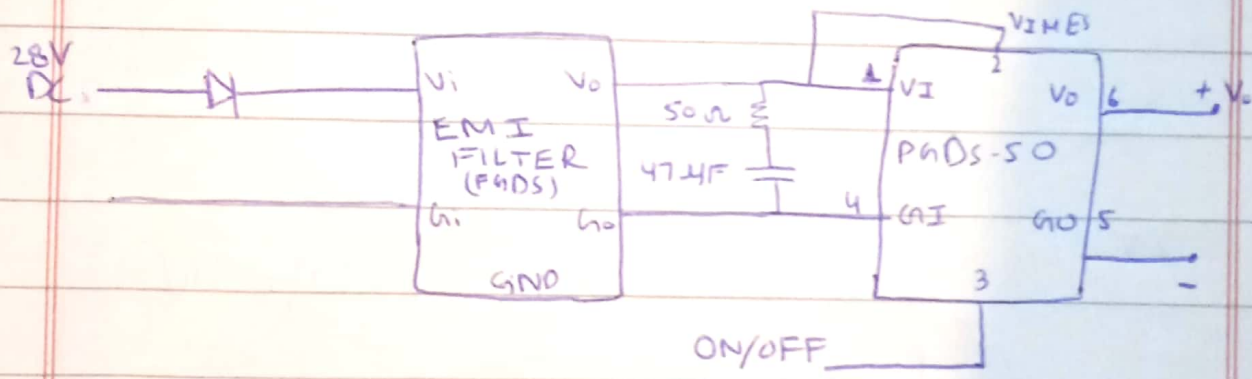
⊙ To suppress the transients, we have used Hi-Rel Pre-Regulator module PQDS-50 rated upto 50 W power. We are using H-series of the convertor, therefore, input module voltage range is 9-36V DC

So,

Transient input voltage = 40 V (max)

Duration of transient = 100 ms (max)

Attaching PQDS 50 with the rest of the circuit, it looks like as follows:



⊙ The hold-up module by QAIA is used to keep the system in operation during input bus dropout for enough time. According to the QAIA converter HUC-D50 module :-

Input current consumption = 0.1 A (min charging)

Max. input current consumption = 1.5 A (charging)

Hold up time at 10W load = 64 ms (VTh connected with GND)

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Hold up capacitance at low load = 4 μF = C_H
(with V_{Th} connected to the ground)

V_{Th} = Power fail voltage threshold) :- will be connecting it with the ground to set threshold at 8.8 V DC valid for 9-36 V DC input modules as we are going to connected the H- series convertor.

According to the datasheet,

$$R_{TH} < 0.75 \times \frac{V_{TH}}{P_{out}}$$

As,

$$V_{TH} = 8.8\ V\ DC$$

and

$$P_{out} = P_{in} \times \eta \quad \because \eta = 98\%$$

$$P_{out} = 10 \times 0.98$$

$$P_{out} = 9.8\ W$$

So,

$$R_{TH} < 0.75 \times \frac{8.8}{9.8}\ (k\Omega)$$

$$R_{TH} < 0.673 k\Omega$$

So,

$$R_{TH} \approx 500\ \Omega$$ (supposition)

Also,

$$R_{CL} = 500\Omega$$ (Data taken from graphs)

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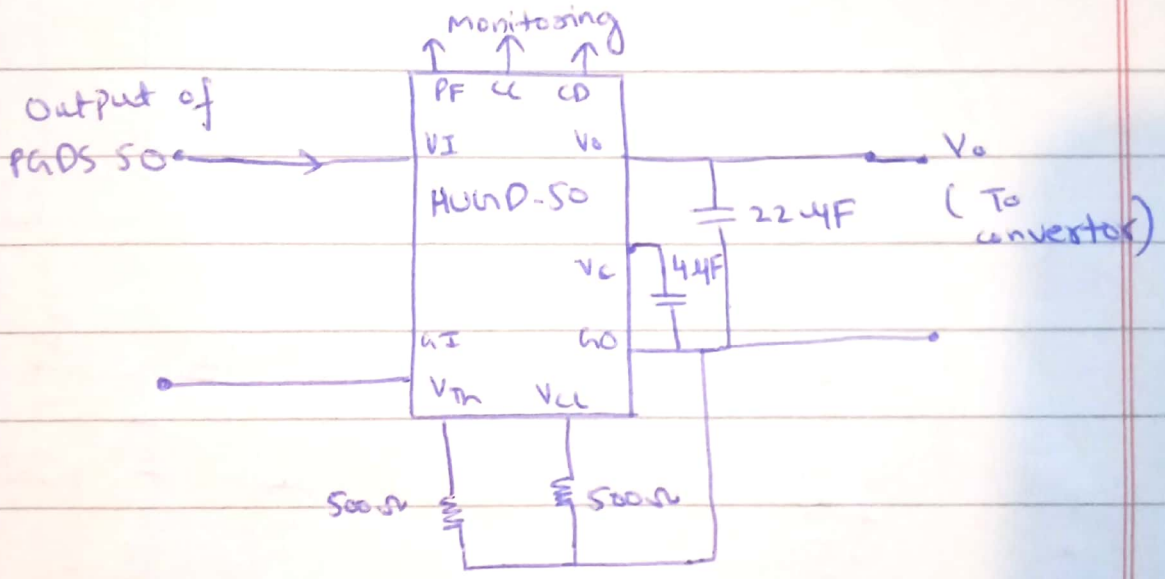
To maintain the output voltage during switching from input line to hold up capacitor, transition capacitor is being used.

Transition capacitor = 22 μF

(For 10W load, this capacitor is used according to datasheet). So, the circuit becomes as follows :-



⊙ Hi-REL DC/DC convertor of 10W is used in our design as it takes 28V dc input compliant with mil-std-704.

So,

Output current at 5V output = 2A (max)

Nominal input voltage of MGDM10 = 28V

In our case, we will use

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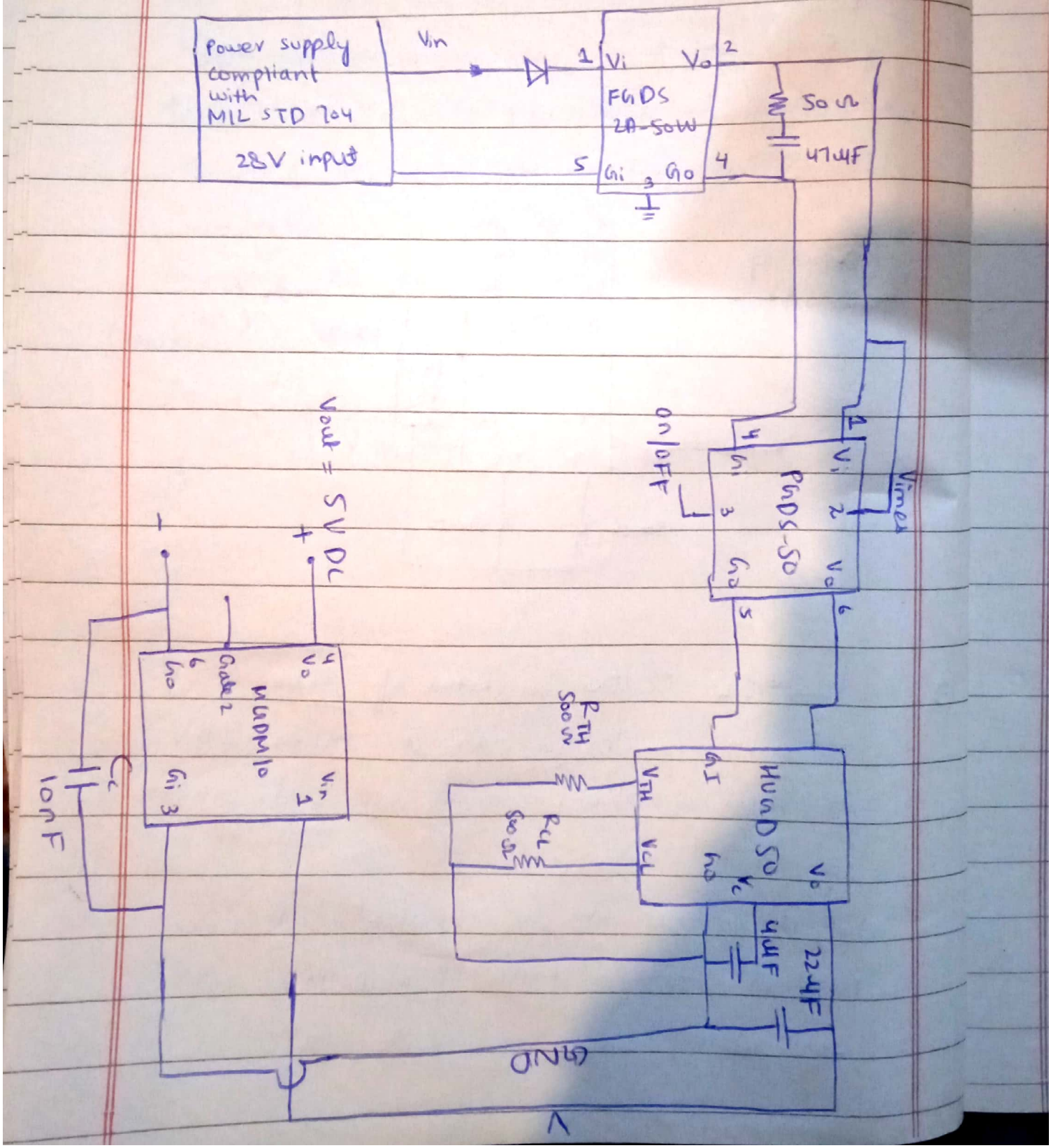
MGDM 10 with 5V DC output (output - C)
in single pin connections.

So, the overall circuit becomes:-



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Total efficiency of overall circuit

$\approx \eta_{(HUGDSO)} \times \eta_{(PUDSSO)} \times \eta_{FWDS}$

$\times \eta_{mODMIO} \approx 0.98 \times 0.96 \times 0.99 \times 0.83$

≈ 0.78 (efficient : 78%)