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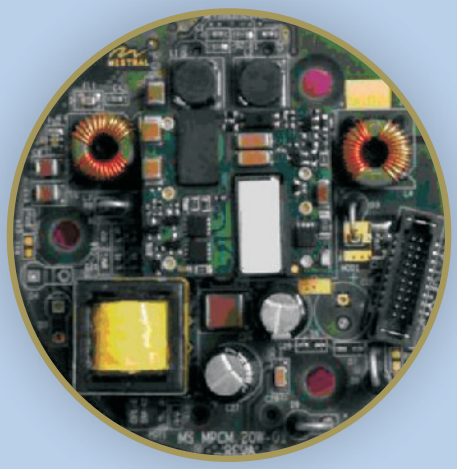
Design and Development of Power Supply Module for a Miniaturized Military Equipment

Introduction

The Power supply modules are primarily designed for advanced information and communications equipment, such as radio base stations and switches/routers, and are also used in a wide range of avionics and military applications. The key to designing a successful power supply solution in a military application is a detailed understanding of the specifications and the conditions under which the system will be operating.



> A compact, multi-function Power Supply Module for a Miniaturized Military Equipment

The Customer

The customer is an organization engaged in developing defense technologies covering various fields like aeronautics, armaments, electronic and computer sciences.

The Requirement

The customer approached Mistral to design and develop a compact, multi-function power supply module for a Miniaturized Military Equipment. The module was expected to be rugged, small, and lightweight and would have to qualify the Environmental Stress Specifications (ESS). The input voltage range had to be between 24 to 40 volts and the total output power of the card was expected to be nearly 12 watt. The power supply unit was expected to provide high voltage DC of -180V and also provide, 12V,- 12V, 5V,- 5V for the subsystems.

The power supply module also had to meet the following criteria:

Voltage	Current	L/L Regulation	Ripple(p-p)
+5V	750 mA	2.00%	10mV
-5V	250mA	2.00%	10mV
+12V	50mA	2.00%	10mV
-12V	50mA	2.00%	10mV
-180V	5 mA	3.00%	25mV

Solution Provided

The components for the Power Supply module were of industrial grade temperature range and this was done keeping in mind the environmental stress specifications (ESS) requirement. To ensure optimal size as specified by the customer, all the components were surface mounted to save on board space. The number of electrical configurations was optimized and the power supply module was built with only the needed electrical requirements.

The power supply unit developed by Mistral achieved the following power standards:

Voltage	Current	L/L Regulation	Ripple(p-p)
+5V	900 mA	2.00%	5mV
-5V	400 mA	2.00%	5mV
+12V	400 mA	2.00%	5mV
-12V	400 mA	2.00%	5mV
-180V	10 mA	3.00%	10mV

The power supply module designed adhered to the following relevant qualifications:

Test Description	Test Level	ESS
High Temperature Storage High Temperature Operating	+ 70°C + 60°C	2 Hours 2 Hours (3 Cycles VTV)
Low Temperature Storage Low Temperature Operating	- 40°C - 20°C	2 Hours 2 Hours (3 Cycles VTV)
Vibration under operating conditions	Random 6g rms in all 3 axis	10 min/axis in all 3 axis
Shock	15g (Half Sine)	3 Shocks in all six directions
EMI / EMC	Limited to Ce01 and Ce03	-
Protection against	Overload, short circuit, over voltage, reverse polarity protection	-

The Challenges

- The system input was 24 volts to 40 volts. The major challenge was in developing -180v section keeping all the required specifications in mind. Mistral developed a small miniature transformer to address this while also meeting the specifications.
- The small size of the power module was also a challenge. The custom made power supply module had to be a small circular form factor of ~70mm diameter. To achieve this, Mistral reduced the form factor by selecting the best electrical components and adopting different types of methods for component stacking.
- The damaging effects of EMI/EMC posed unacceptable risks to the unit. Below are some steps taken to overcome this challenge:
  - EMI was reduced by selecting IC package of Standard Operating Procedure type
  - All components were surface mounted and DIP packages were avoided
  - PCB vias were avoided
  - The power supplies were decoupled using appropriate electrolytic and ceramic capacitor, since the IC was working at high frequencies
  - Star wiring designs were used in power supply, instead of a loop
  - The Top and bottom layer of the board was filled with copper which increased immunity
  - Ground planes were created below the critical IC to reduce emission
  - EMI Filters were provided after each DC / Low Drop Out (LDO) regulator.

Customer Benefits

- Helped customer in designing a low cost, small factor, Power supply module that is rugged and proven in its application.
- The system has been designed keeping in mind the Environmental Stress Specifications.
- Shortened customer's end-to-end product development cycle and ensured on-time deployment schedule.

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