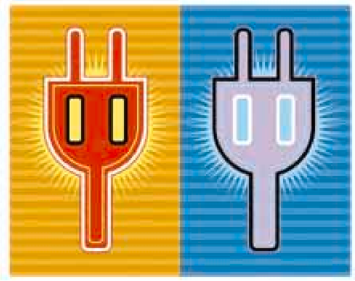

SOLVING MULTIPLE VOLTAGE OUTPUT REQUIREMENT FOR ON-BOARD IBA DESIGN

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CASE STUDY SPOTLIGHT

PROBLEM/CHALLENGE

Shortened design times and addition of functionality to electronic equipment, while maintaining low costs, have become facts of life for system designers. As additional functions, such as sequencing, and precise voltage monitoring/tracking, with the associated circuitry are added to the board, the space for the increasing power conversion and management functions are squeezed. Sophisticated customers consider all of these factors in their new designs and use available products to achieve their goals.

One such customer was faced with a requirement that almost doubled the board power requirements while at the same time increased the number of different output voltages per board from 5 to 8. With such proliferation of voltages, the need to manage, control and at the same time monitor the performance of the many converters became a must.

Previous designs, using lower power and fewer voltages, were implemented with a few external discrete control and monitoring circuits. If the same approach would have been taken with the new requirements, the component count and the development time would have made the final customer's product too large and non-competitive.

Power-One, working closely with the OEM, proposed the Z-One Digital Power Management Architecture™ that addressed not just the customer's design requirements, but added additional functionality and savings as well. The reduction in the number of components, reduction in circuit board traces, reduction in development time, flexibility to last minute changes, and increased reliability were just a few of the additional benefits provided.

SOLUTION

While system cost was one of the major concerns to the customer, the increase in on-board power and the multitude of different voltage sources required a different approach to the power conversion and management of on-board power.

Component Selection

The first consideration was the isolated dc-dc converter used to convert the 48 volt input voltage to an intermediate bus voltage that powered the many non-isolated point-of-loads (POL) dispersed throughout the circuit board. In order to use standard components and optimize the distribution copper power losses, the customer chose an intermediate bus voltage of 12 Volts. For 400 Watts of power on the board the customer could choose between a single brick and two half bricks. The customer selected two HBC25ZH half bricks, already used on previous designs, which not only reduced his inventory requirements, but gave a higher degree of power margin and allowed for greater mounting flexibility.

The next task was choosing the non-isolated POLs. In previous designs the customer used a different POL for each output voltage. The ZY7115 Z-POL has a fully software-programmable output voltage, reducing the need for multiple devices to a single programmable component and thus appreciably lowering the inventory handling costs of many different components.

The 15 Amp maximum current output of the ZY7115 was well within the average range of most of the outputs and required the paralleling of two devices for only two higher current output requirements of the 1.8V and 3.3V voltages. To parallel the 1.8V and the 3.3V for an output of

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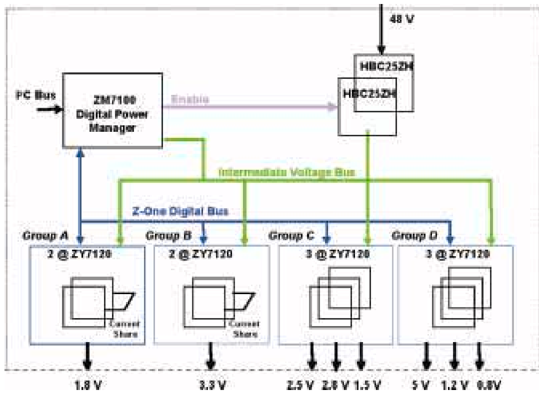

Figure 1. System Block Diagram.

30 Amps, only a single-trace digital current share connection between each of the pair is required.

In order to provide the functionality required for the eight outputs, the customer calculated that they would need about 200 discrete components taking up almost 10in^2 of board space. By using the ZY7115 Z-POLs the total number of components was reduced to 13 with a savings of 4in^2 of board space.

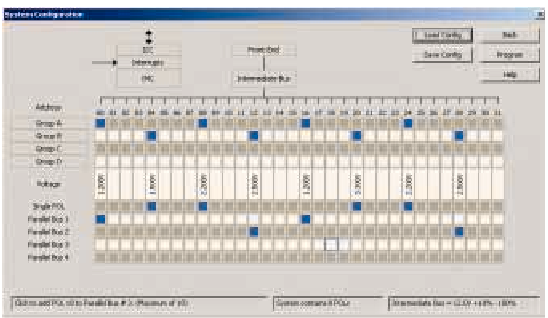

Figure 2. GUI System Programming.

The number of traces required to connect all of the external components was also reduced from approximately 600 down to 76.

Overall cost, one of the main customer's concerns, remained the same for the doubling in power, thus effectively reducing the overall \$/Watt cost in half. Additional savings were provided by shortening the development time from 8 weeks down to 3 days, and a reduction of handling and inventory costs with the use of only 3 different components. (Figure 3).

System Design

After all the components were selected, the customer needed to determine the required operating conditions of the system. By analyzing the operation requirements of all the devices powered by the Z-POLs, it was determined that they could be grouped into four separate groups with the same turn-on and turn-off conditions and similar alert and monitor signals. The ZM7100 Digital Power Manager (DPM) series is capable of controlling and monitoring up to 32 separate Z-POLs or if required, the operation of groups of Z-POL converters. Besides controlling the turn-on and turn-off sequence of each Z-POL group the, DPM acts as central point of control and communications between all the components of the conversion devices while, at the same time, providing an interface with the main host system through an I^{2}C Bus interface.

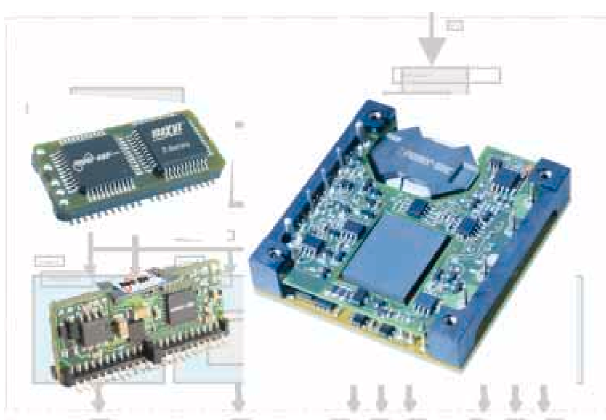

Figure 3. ZM7100, ZY7120 and HBC25Z.

The DPM communicates with the Z-POLs through a single wire Z-One digital bus, storing a continuously updated record of each device actual voltage output, current and temperature. In case of system failure, such records can serve as a tool for system failure analysis.

System Setup

The programming of the individual Z-POLs was accomplished by connecting the DPM through an I^2C interface bus to a Windows-based GUI (Figure 2) that allowed simple and quick programming, debugging and analysis of the system. All parameters stored in the non-volatile DPM memory can be changed during development or later, saving not only time, but the cost of system re-configuration. The point-and-click programming and simulation can be repeated in less than one hour, compared to weeks required for reconfiguration of the old system.

System Performance

After the system setup and simulation was completed the circuit board was disconnected from the GUI interface and was ready to be installed in the system. This process was repeated as required for each different circuit board in a system. After all the boards were installed, the whole system was powered and the actual performance closely tracked and monitored. The simulation results closely tracked the data and confirmed the results of initial system setup and test. ■

Power-One
summary

- **The on-board power was doubled from 200 Watts to 400 Watts.**
- **With the doubling of power the overall \$/Watt cost was cut in half.**
- **The development time was reduced from 8 weeks to 3 days.**
- **The component count was reduced from 200 to 13.**
- **The number of traces was reduced from 600 to 76.**
- **The power conversion and control board area was reduced from 22 inch^2 to 18 inch^2.**
- **Added many additional features to the previous system power management functions.**
- **The power management, monitoring, control, and error correction functions were integrated into the power conversion devices, thus dramatically simplifying the overall design.**