Single Board Computer Requires Additional Storage

Challenge	Solution	Result
VITA 46 SBC with VITA 42 XMC site	VITA 42 compliant XMC-554C memory board	Low risk, standards-based approach
512 GB minimum of additional storage	1TB memory capacity	1TB exceeded current needs
Expandable storage for future requirements	Industry-standard mSATA memory modules	mSATA allowed for future expansion and flexibility

Challenge

Single-board computers (SBC) are used widely in rugged, deployed defensive electronic applications. Powerful processors mounted on sturdy circuit boards execute mission plans, manage sensors, display results, coordinate communications, and other functions. These SBCs have random access memory (RAM) memory built-in, but additional permanent storage is sometimes required to collect sensor data for processing and display. In just such an application, an international aerospace developer came to Curtiss-Wright looking for that additional memory

The customer was building an aircraft subsystem for their ultimate customer. They had selected an SBC that met the VITA 46 standards. VITA (or VME International Trade Association) is a group of companies that develop industry standards for rugged computers and peripherals plus protocols that may be used with those computers. Developed by a diverse group of users and manufacturers, the VITA 46 standard met specific industry needs, but allowed for individual design differences. Many subordinate standards have been added to VITA 46 over the past few years. It is a prevalent computing format.

As mentioned, the customer required additional persistent memory to collect sensor data. During the mission, that data would be processed, analyzed, and displayed for the aircrew. The data was not expected to be off-loaded from the aircraft.

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So, the customer looked for an industry standard mezzanine card that would fit onto the SBC selected.

The VITA organization had also developed a mezzanine card standard known as VITA 42. These mezzanine cards are known as switched mezzanine cards (XMC). A memory card meeting this industry standard was highly desired.

In this case, the SBC was also conduction-cooled. So, the VITA-42 mezzanine board had to meet this requirement as well.

In search of an XMC solution for this application, the system designer turned to Curtiss-Wright. With many years of experience developing commercial off-the-shelf (COTS) storage products, the company asked Curtiss-Wright for ideas regarding an XMC card. The customer was working with requirements that stated a minimum of 512GB (gigabytes) of storage, and the ability to grow that memory in the future should it be required.

Figure 1: XMC-554C Conduction-Cooled Mezzanine Board

Solution

With its internal research and development (IRAD) funds, Curtiss-Wright had already designed the XMC-554C mezzanine card. The XMC-554C already had been used in SBCs and digital signal processors (DSP) and was successfully deployed by other customers. The XMC-554C was designed to the ANSI/VITA 42 mezzanine card standard. Two versions were available – standard and conduction-cooled. The conduction-cooled option (shown in Figure 1) was proposed.

The XMC-554C memory board uses mSATA memory cards. The mSATA industry-standard devices are inserted into a connector on the circuit board. These are replaceable as new memory capacities become available. This factor allowed for upgrades in the future.

Memory capacities are doubling at the rate of about every 18 months or so. When the XMC-554C was first designed, mSATA cards with 128GB were the largest available. Then the 256GB size became available. Then came 512GB and next 1TB. Currently, 1TB seems to be a sweet spot for size, availability, and value.

Curtiss-Wright has also used the same mSATA approach on a special design memory board replacement for another aerospace customer.

The customer sent an example SBC to Curtiss-Wright for form-fit-function (FFF) testing. Not all SBCs and DSPs adhere strictly to the ‘keep-out’ standards outlined in VITA-46. Sometimes minor custom adjustments must be made to the mezzanine layout to accommodate these slight SBC differences. In this case, no changes were required as all the SBC components met the keep-out standards. The FFF tests were successful. This fact reduced the program risk and accelerated the program schedule.

The XMC-554C presented two SATA lanes to the host SBC which could easily store and retrieve data from the persistent memory. The two lanes allowed separate process threads to be running at the same time.

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Result

After the successful FFF testing at Curtiss-Wright, the customer began testing the SBC and XMC-554C within the new aircraft system. Sensor data was stored via both SATA lanes and could be easily retrieved for processing and display. The two SATA lanes operated at 6 gigabits per second (6 Gbps), allowing high-speed transfers to and from the persistent memory.

The combination of SBC and XMC-554C was tested for temperature, shock, and vibration. The XMC-554C transferred heat efficiently to the SBC frame and onto the surrounding enclosure via the conduction-cooled connection.

The 1TB of total memory was more than enough to handle the current requirements. That capacity was enough to allow for growth before a size change was required. The mSATA approach provided the assurance of future memory capacity updates if needed. Many deployed systems are seeing more sensors added, requiring more data storage.

The two SATA lanes (512GB each) allow for separate process threads to be running. This feature boosted storage and retrieval performance for the system.

Designed to industry-driven standards, the XMC-554C provided a low-risk design approach for the customer. FFF testing at Curtiss-Wright assured the customer that technical risk was low. System testing at the customer's facility further proved that the combination worked *in situ* at the required environmental levels. The systemwas deployed and successfully operated in various missions and environments.

The successful combination of the SBC and XMC-554C assisted the program to remain on schedule.

References

> [i] VITA - Standards

> [ii] Rugged XMC SATA Solid State Drive | XMC-554C

> [iii] Case Study CCA-554

> [iv] Form-Fit-Function (FFF) Definition and Rules - Arena

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