XCU – The Next Generation of Camera Base Stations
How the innovative cradle concept was designed and tested

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APPLICATION NOTE

Third-Generation Camera Transmission Solutions

In 2011 and 2012 at different international trade shows, Grass Valley introduced the third generation of camera signal transmission systems. What makes these transmission systems unique is that for the first time it no longer mattered which type of camera cables needed to be used. Independent from the type of cables (SMPTE hybrid fiber, single mode dark fiber, or triax), all the current 1.5G and 3G video formats would be supported with full performance.

In parallel, the full system feature set is available regardless of cable type, including two independent full-bandwidth HD video return channels, four digital audio channels, a fully digital five-channel intercom system and much more.

The type of cable being selected was now only application-specific:

- Triax offers cable lengths up to 1,500 meters (4,921 ft.), is the ultimate solution for robustness, is fully field repairable, and can be found in many pre-wired installations
- SMPTE hybrid fiber offers the best solution for longer cable lengths up to 3,000 meters (9,843 ft.)
- Single mode dark fiber offers a very cost efficient solution for extremely long cable lengths of up to 40 km (24.9 miles)

With the Grass Valley Twin and Dual model camera base stations, and various 3G field converters, any combination of camera cables can be used without any limitation in quality or feature set.

XCU Flexible Base Station Solution

Implementation Strategy

At NAB 2013, Grass Valley introduced the newest idea in broadcast camera base stations (CCUs) — the XCU eXchangeable control unit. Two XCU models (XCU WorldCam and XCU Elite) have replaced the previous range of LDK 3G Transmission base stations and offer the same functionality and performance.

However, XCU also provides a unique “cradle” concept which allows for easy “slide-in” and “slide-out” of the XCU into and out of a pre-mounted XCU cradle. This unique cradle concept is a revolutionary solution and a real game-changer for video production companies — such as OB truck operators — as it helps to minimize operational costs and streamlines the reconfiguration of OB trucks for each production.

Figure 1 – The XCU concept allows for easily swapping base stations between OB trucks and fixed studios.

XCU Flexible Base Station Solution (Cont.)

Empty XCU cradles can be installed in an OB truck or fixed studio installation. All cables (except for power and camera triax/fiber) are connected to the XCU cradle allowing for the XCU base station to be easily relocated without disconnecting all but a few cables.

To prevent incorrect configuration settings, an EEPROM is built into the XCU cradle to remember the previous settings and can automatically re-configure the XCU base station to the requirements of the production environment.

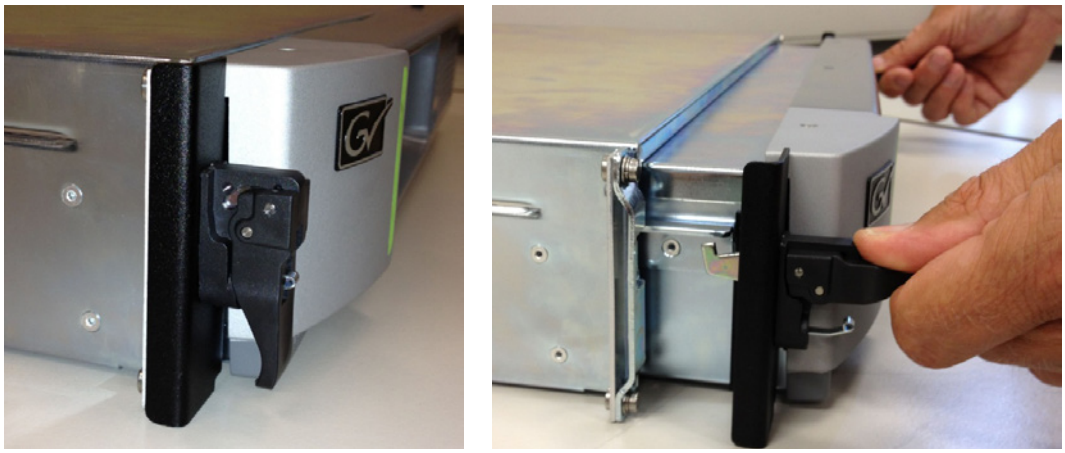


Figure 2 – The XCU base station and cradle. An EEPROM built into the cradle will remember the previous settings and can automatically re-configure the base station to the requirements of the production environment.

With the XCU WorldCam and XCU Elite, Grass Valley creates maximum business flexibility and operational excellence.

How the solution has been implemented

For the first step, high-quality docking connectors with the correct performance level had to be selected. The next step was to guarantee the connectors' performance for the total lifetime of the product.

Finally, the most important step was to make sure that the mating connectors are always perfectly aligned when they are connected together. To assure this, several guidance pins located close to the connector are used to make sure that the connectors are always perfectly aligned when they are connected or disconnected from each other (see Figures 3 and 4).

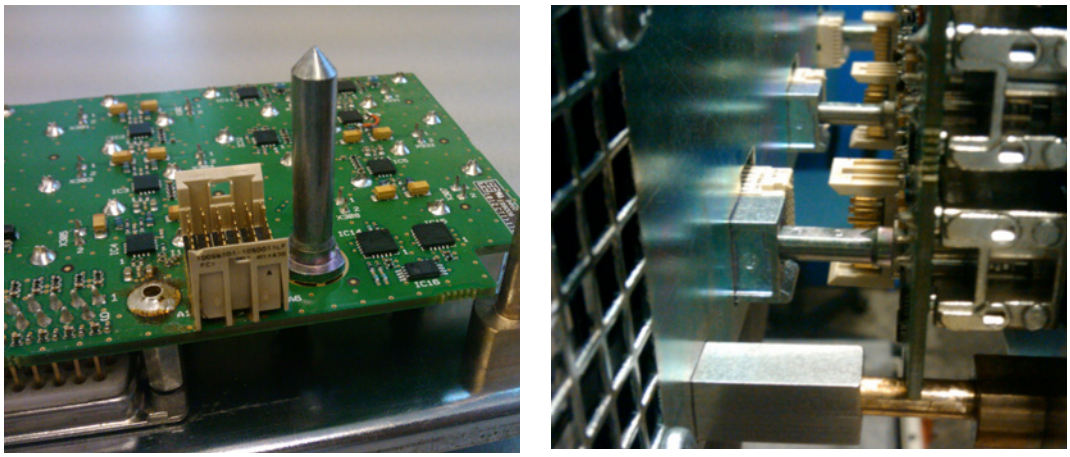


Figure 3 and Figure 4 – Detailed images of the guidance pins and the docking connectors.

XCU Flexible Base Station Solution (Cont.)

Reliability testing

Since such a system had never before been proposed, a great deal of time and testing was required during the development phase of the XCU system to make sure that the final production units would survive in a variety of practical applications and environments.

Part of this testing involved a special test rig (see Figures 5 and 6) where the XCU base station was automatically moved in and out of the cradle by a hydraulic cylinder more than 7,000 times.

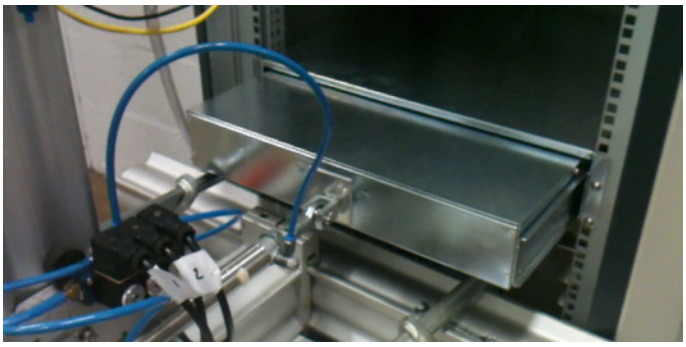


Figure 5 – *The special test setup for the reliability test.*

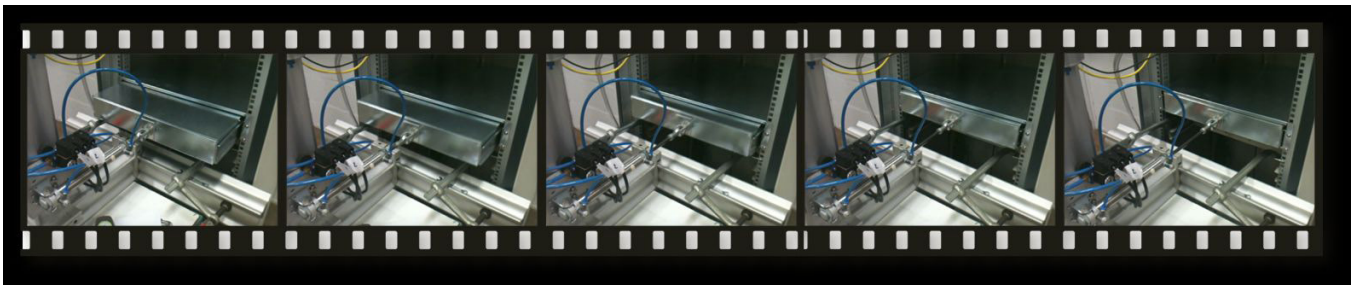


Figure 6 – *One test sequence out of over 7,000.*

To test the electrical behavior of the docking connectors, all 45 pins of the three identical connectors between the XCU base station and cradle were looped through and connected to one of the connectors on the rear of the cradle. Then the total impedance of the three individual 45-pin connectors was measured and monitored over the total test period. During the more than 7,000 mating test cycles, the changes in the electrical performance remained well within acceptable limits (see Figure 7).

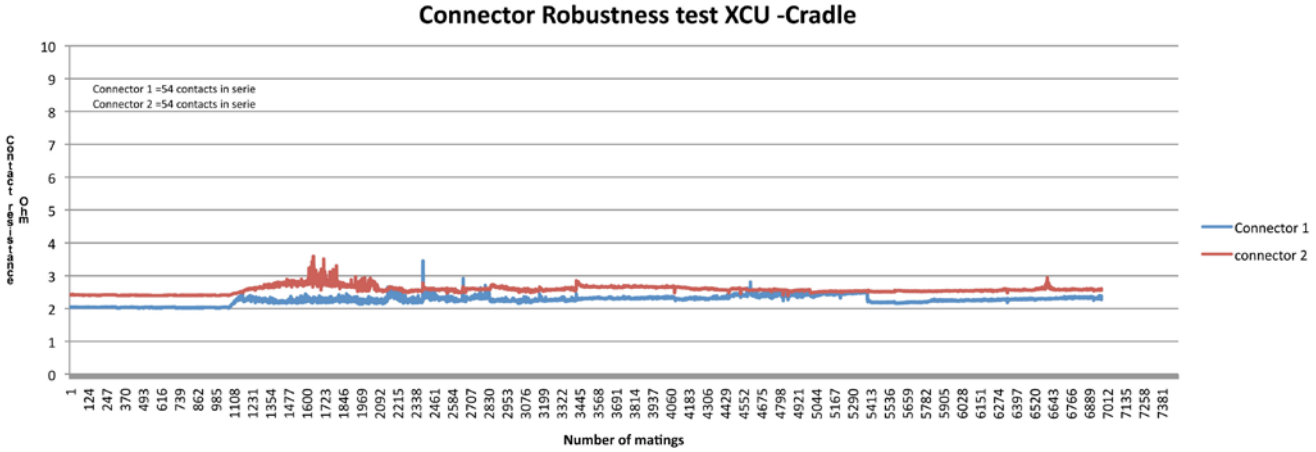
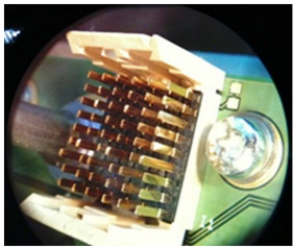


Figure 7 – *Connector robustness test results of over more than 7,000 test cycles.*

XCU Flexible Base Station Solution (Cont.)

After the completion of the test period, all connectors were carefully tested for their electrical performance, and inspected through a microscope for mechanical wear (see Figures 8 and 9).



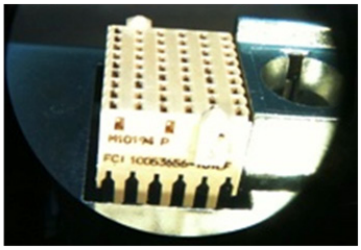


Figure 8 and Figure 9 – 45-pin docking connectors after more than 7,000 test cycles.

Since testing was performed for more than 7,000 mounting/dismounting cycles, this effectively simulated an operational time period of approximately 20 years, based on an XCU being removed and inserted once every day.

In addition, using the HALT (highly accelerated life test) process as a stress testing method for the XCU system, reliability during the development phase was also verified. In this case the XCU base station and cradle were tested through different extreme environmental conditions which included extremely high and low temperature cycling (-60°C to +100°C / -76°F to +212°F), and repetitive vibration and shock tests up to 40Gs. During these tests the mated XCU system was fully operational and all the different input and output signals were monitored.

In addition, extensive field tests with some key Grass Valley customers were performed where a wide range of XCU applications were verified. Several small adaptations and changes were made from the first development prototypes to the final production units to guaranty the expected reliability for even the most demanding broadcast applications.

Figure 10 – The XCU system in the test chamber for extensive temperature testing.