FLEXIBLE GROUND SUPPORT SYSTEM

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Abstract

Today's demanding flight test programs dictate rapid set up and quick checkout capability in order to reduce overall program time. Flight test engineers are continuously looking for smaller and more capable tools to work between the office and the flight line with minimum transition time. This demand dictates the use of more portable and flexible tools in place of currently available "Instrumentation Cart" or "Lunch-box". Both of these tools require connection to a power source. In addition they are heavy and are not rugged enough for continuous transportation. They often require several test engineers to carry on a simple checkout due to their large size and weight and inability to be in tight spaces with test engineering personnel. This paper describes a notebook-based complete quick checkout system that will allow test engineers to select and calibrate any instrumentation system quickly and without an external power source. It is designed to be outfitted into a variety of notebook PC's.

Keywords

Ground Support Unit, Data Acquisition, Telemetry, Instrumentation

Background

The development of a new vehicle requires many successful flight hours in order to complete flight certification. It is therefore the job of the instrumentation engineer to make sure that each and every flight mission will accurately provide the technologist with all of the requested data. There are many different equipment types that are on board and historically required a long list of support test equipment to complete the checkout mission. Prior to computer technological advancement and support of the software aided measurement tools, carrying the required test tools to the vehicle created a challenge. We try to review various tools that have been used to carry out their mission.

Technological Advancement

The ground support unit provides the necessary test equipment capability to handle most troubleshooting during various segments of flight test. Flight test demand is continuously advancing due to the introduction of more advanced avionics buses in newly developed vehicles, or during vehicle midlife updates. Flight test engineers use a variety of tools to perform flight-line checkout. Ground support equipment is used to perform the following tasks:

- Loads testing
- Vibration testing
- Structure coupling test
- Aircraft system check
- Telemetry check
- Recorder check
- Calibration check
- System component measurement and troubleshooting
- Final verification and calibration of each channel setting

This paper is not going to outline the procedure that is followed in each of the above tasks, since each organization handles these tasks differently. Ground support is not usually used to validate how well the aircraft system performs, it is used to make sure that the overall system is functioning and that the data acquisition system limits are set correctly. To perform all of the above tasks, ground support units need to have the capability to be moved and they need to be available in many configurations. The most common ones that started in early 70's were: Instrumentation Cart, Trailers and Mobile Van (see pictures below). In all cases they require either local power generator or power run on the tar mat.

Figure 1. Instrumentation Cart.

Figure 2. Trailers.

Figure 3. Mobile Van.

While these ground support units have provided all of the capabilities that are required for the flight test engineer to perform the task at hand, getting these units to remote sites is not always quick, easy or possible. In addition they are not suited for reaching tight areas such as areas for cockpit troubleshooting and in most cases require a variety of instrumentation to perform any and all tasks. Cost associated with conventional ground support is in most cases very high and the programs' budget strain limits the number of the ground support units to an absolute minimum.

Let's review the list of most common equipment that were used by the instrumentation engineers to perform these tasks:

- Telemetry Receiver
- Bit sync
- Decommutator
- PCM simulator
- IRIG time-code

- Strip-chart
- Scope
- Signal generator
- Bus simulators
- Computer
- CRT or LCD display
- Tape or solid-state playback unit

In the mid 1980's, relatively small computers were introduced to the commercial marketplace and by early 1990's many companies had started the development of computer-based acquisition plug in cards. Speed of these first generation PC's was limited to less than 5 megahertz. However, the user community instantly accepted the smaller PC-based ground supports unit in spite of their speed limitations. Computer-based ground support units were available in many shapes and configurations. These machines were capable of aiding the instrumentation engineers with most of their tasks. They were still heavy but weighed less than 100 pounds. The size of these ground support units was further reduced to small, rugged racks with shock mount and lifting capability for transportation. This generation of PC's was still heavy but much more portable and required much less power. In the early 1990's, yet another computer evolution led to the commercial marketplace introduction of laptop PC's and later on in mid 1990's to the introduction of notebook PC's. These machines provided reasonable performance, were battery powered, and operated for less than an hour on a fully charged battery. These machines offered small plug-in PC card capability such as PCMCIA. Companies began to develop these small types of plug-in cards to support the much-needed portable tools.

Thanks to recent technological advancement, notebooks today operate at speeds of up to 4 gigahertz with storage capacity of over 100gbyte. Depending on the make of these machines they operate more than 5 hours on single fully charged battery and weigh less than 5 pounds.

Today's ground support unit can be small and portable, enabling them to be carried out to the vehicle by instrumentation engineers. This next generation of ground support units offers the same basic capability and can serve as multiple tools to go between their desk and flight line with ease.

Let's review the available functionality of these systems as compared to required capabilities to perform these tasks:

Required Capability	**Notebook-Based Capability**
• Telemetry receiver	Available
• Bit sync	Available
• Decommutator	Available hardware & software
• PCM simulator	Available
• IRIG time-code	External
• Strip-chart	Available software based
• Scope	Available hardware & software
• Signal generator	Available hardware & software
• Bus simulators	Available hardware & software
• Computer	Included

- FireWire — Included
- FibreChannel — External
- CRT or LCD display — Available integrated LCD
- Tape or solid state playback unit — Available through plug-in interface
- Video decoder — Available software playback
- Cockpit voice — Available software playback

Conclusion

Today's demanding flight test programs dictate rapid set up and quick checkout capability in order to reduce over all program time. The utilization of modern notebook computers, add-on peripheral cards to handle instrumentation measurements and display, and integrated software has provided complete quick checkout systems that allow test engineers to select and calibrate any instrumentation system quickly and without an external power source. Examples of Ground Support Units, software setup screens, and data output from these systems are shown in the following pictures.

Figure 4. Next Generation Ground Support Unit.

Figure 5. Portable Ground Support Unit.

Figure 6. Portable Ground Support Unit.

Figure 7. Setup Screen - Bitsync Receiver.

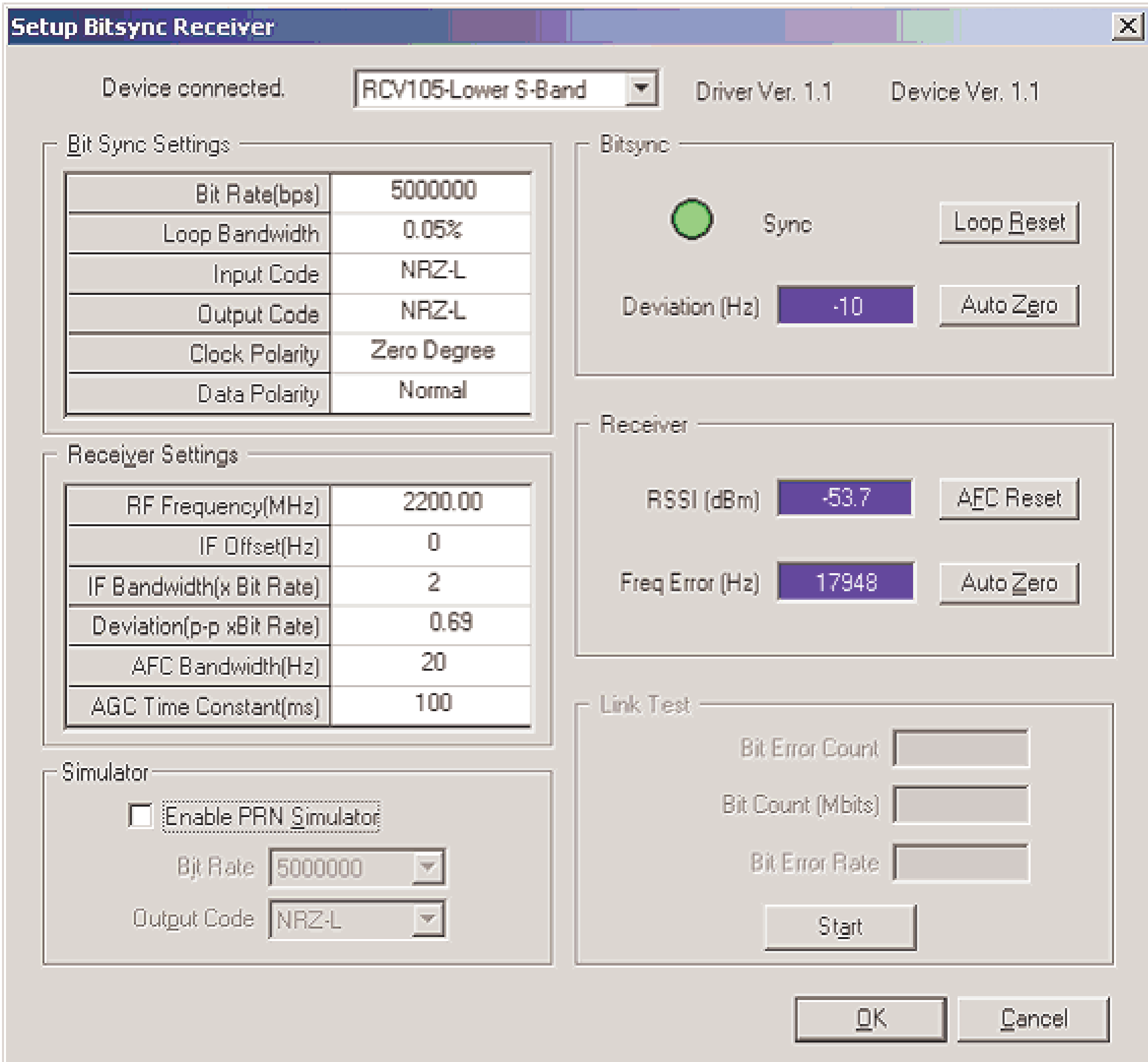

Figure 8. Setup Screen - Bitsync and Decommutator.

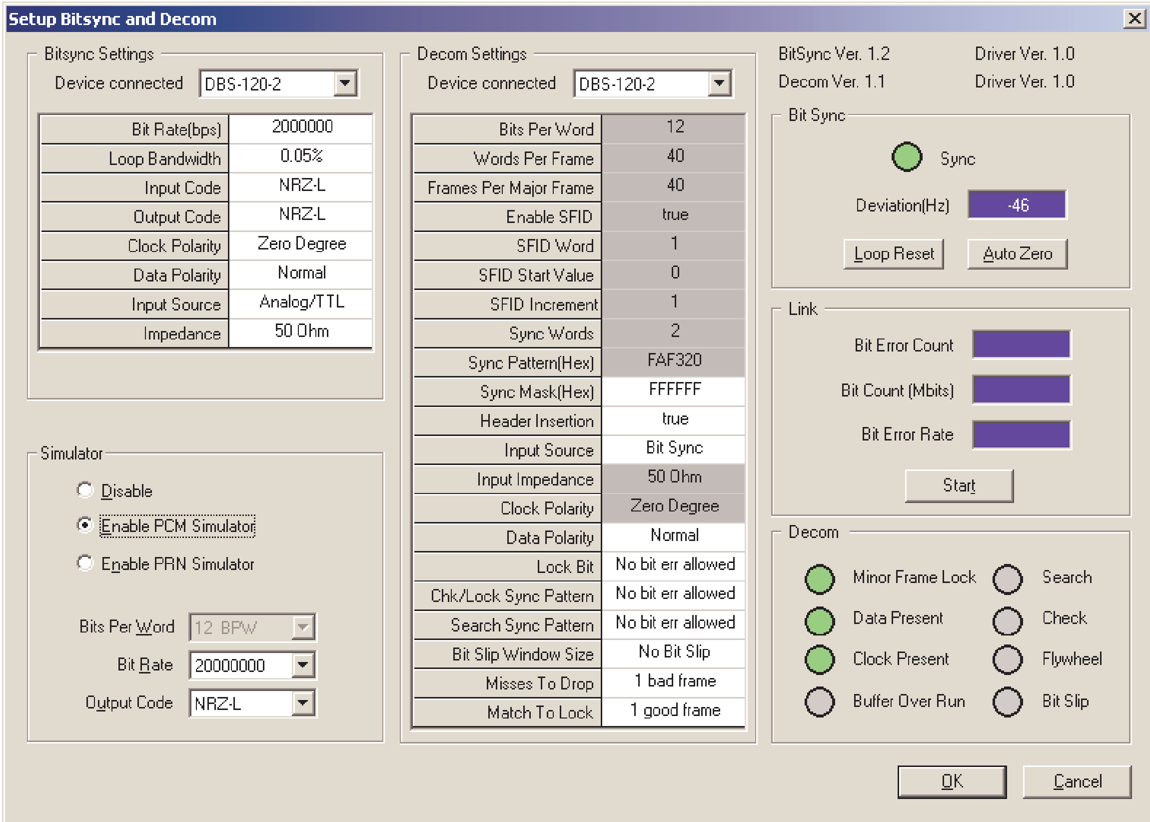

Figure 9. Setup Screen - Engineering Unit Conversion, Video.

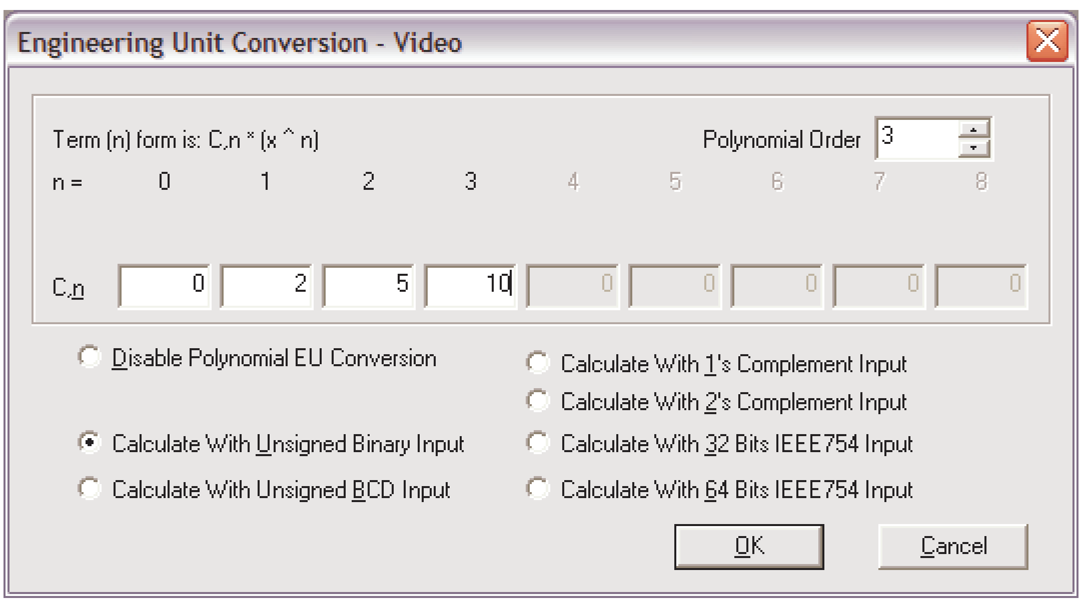

Figure 10. Data Screen Including Video.

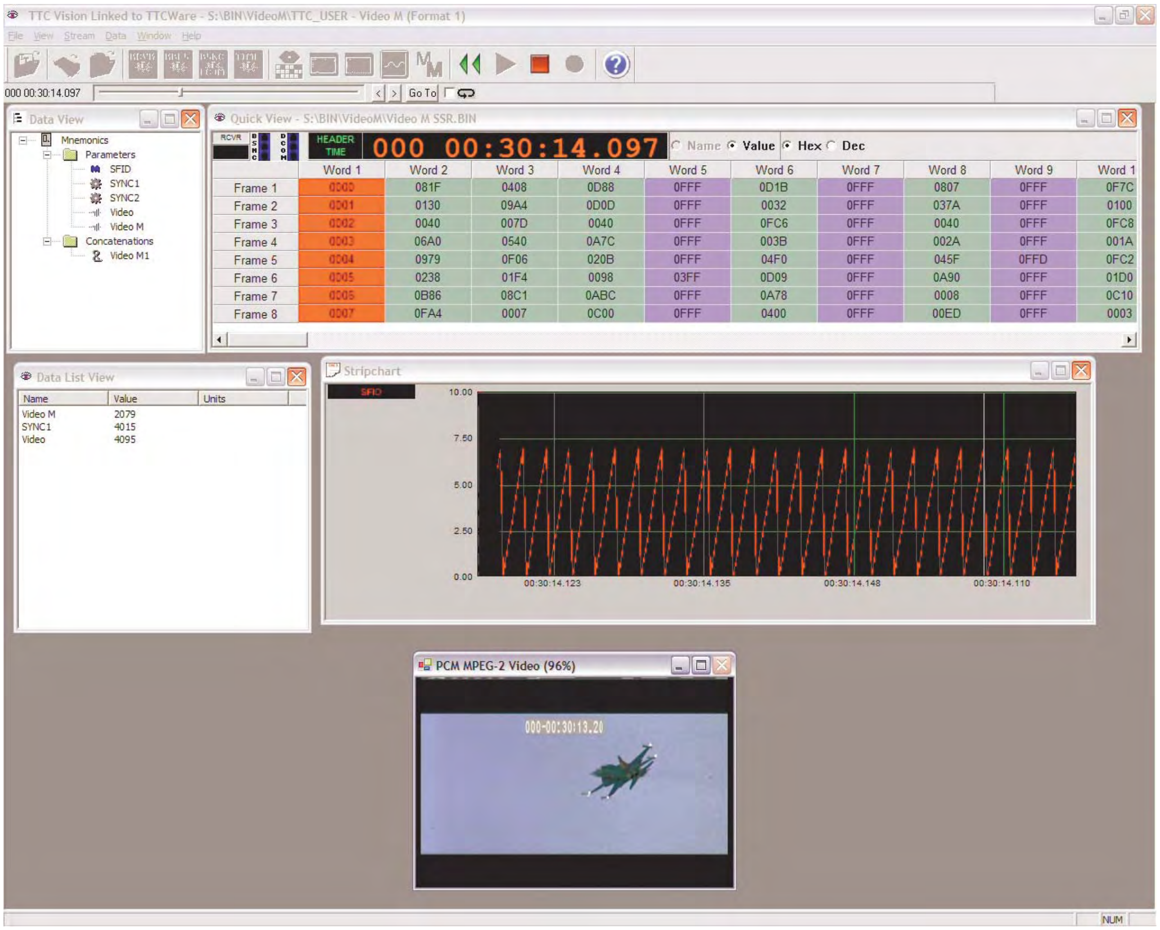

Figure 11. Data Screen - Stripchart.

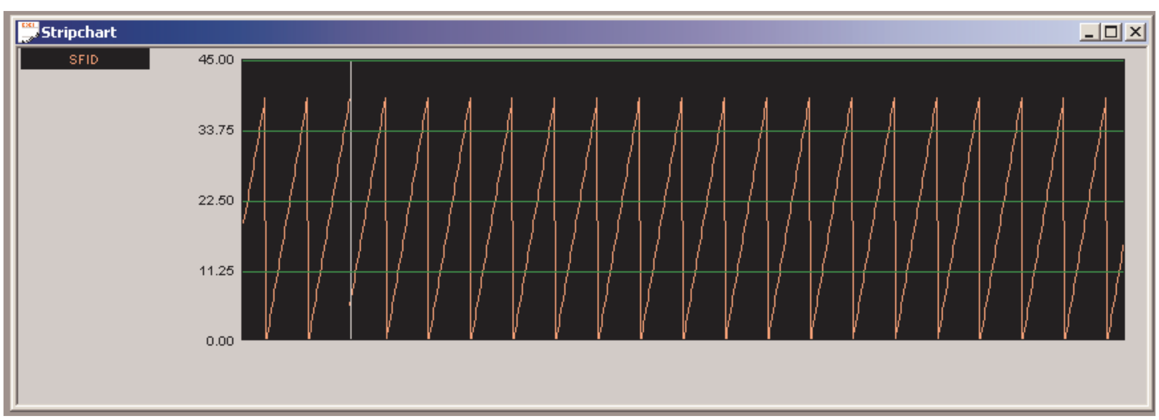

Figure 12. Setup Screen - RBDS.