DIGITAL VOICE DECODING IN TODAY'S TELEMETRY SYSTEM

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ABSTRACT

Today's telemetry systems can reduce spectrum demand and maintain secure voice by encoding analog voice into digital data using; Continuously Variable Slope Delta Modulation (CVSD) format and imbedding it into a telemetry stream. The model CSC-0390 DvD system is an excellent choice in decoding digital voice, designed with flexibility, efficiency, and simplicity in mind. Flexibility in design brings forth a capability of operating on a wide variety of telemetry systems and data formats without any specialized interfaces. The utilization of 74HC series circuit technology makes this DvD system efficient in design, low cost, and lower power consumption. In addition the front panel display and control function is also is an example of Simplicity in design and operation.

KEY WORDS

Continuously Variable Slope Delta Modulation (CVSD), Advance Data Acquisition Processing System (ADAPS), Integrated Data Flight Acquisition Processing system (IFDAPS), Digital Voice Decoder (DvD), Commercial Off The Shelf (COTS), Pulse Code Modulation (PCM), IRIG Standard, CSC-0390, 74 series circuit technology.

INTRODUCTION

CVSD is a method for which analog voice is converted into a digital compressed format. This technique can be found within the IRIG Standard 106-96 manual in Appendix F. Analog compression ratio of 12:1 to 21:1, with a single bit digital data stream as an output, can be achieved with this type conversion. A primary use for CVSD, at Edwards AFB, is to reduce signal spectrum requirements during mission test flights, while maintaining a clear audio hot mic. signal from the air vehicle to the mission control room. A Secondary use of CVSD encoded data within PCM stream, at Edwards AFB, is to reduce the demand for extra encryption devices, while maintaining secure voice on test flight missions.

At Edwards AFB, the Air Force requested a DvD system for their new ADAPS telemetry system. Randy Glass began this project, with the assistance of Robert W. Broffel, and build the CSC-0390 DvD system. Randy completed the first two operational units, before transferring to AS&M, and passed this project over to Kevin Knudtson. Taking over the project, Kevin with assistance from Jon Schmidt, made six operational units. These units are in operations on the ADAPS telemetry system and on the IFDAPS.

This new DvD system is designed with flexibility, efficiency, and simplicity in mind. Flexibility design brings forth a capability of operating on wide variety of telemetry systems and data formats. The utilization of 74HC series circuit technology makes this DvD system efficient in design, cost, and keeps power consumption low. Simplicity in design and operation is highly emphasized by simple display function for operation. Hence this new DvD system, model CSC-0390, has made digital voice processing more convenient and easier to implement.

BODY

The model #CSC-0390 fulfills the Air Force requirement of maintaining a flexible configuration. This DvD system can run on any parallel data interface, and support digital voice data rates between 8 kbs to 64 kbs. Parallel data words from 1 to 32 bits are supported starting at any bit position between 1-32 bits. The parallel bus interface to this DvD system consists of 16 address bits, 32 data bits of data, and a data strobe. Address selectability is defined in HEX format by internally dip switches, and is called the ID setting. Unit will operate on parallel interfaces with no address bits, by configuring the internal address ID to all zeros. Data words can be processed either MSB or LSB formats, and each unit can be configured manually or remotely for voice data processing. Remote setup is accomplished by adding 0001H to the internal address ID setting with corresponding configuration data for setup. This new DvD incorporates an extensive means of flexibility in order to ensure comparability on multiple computer platforms and data formats.

Flexibility is great, but the Air Force also wanted this new system to be efficient. This new DvD system is efficient in design and cost. It is designed using mostly 74HC series chip technology, which is highly stable and easy to obtain. Using 74HC parts help reduce power consumption and allowed the use of less expensive power supplies. Each DvD Chassis is designed to fit in a 19” rack and hold two complete CSC-0390 units with two complete power supplies. Each CSC-0390 DvD unit operates independently providing an excellent system of redundancy for safety of test flight missions.

Circuit design in this DvD system carries an emphasis towards real-time reaction to all data inputs. This emphasis is clearly established in the phase lock loop circuitry of the DvD bit sync. This circuitry is designed to sync up on incoming data words, and processes them out into serial data and clock. This method of bit sync provides synchronization for a one and a half word buffering scheme, which increases the efficiency of real-time processing of CVSD data. The serial data and clock are then feed to a Harris HA5564 chip to convert the digital data to an analog audio signal. Further signal conditioning is provided via a 5 stage elliptical filter, TP3040. Excellent signal to noise ratio of 60-70 dbm, see Figures 1-3, are provided in this circuitry design.

Using 74 series chip technology helps in maintain inexpensive repairs on units, since most chips cost less than $2.00 and all components are COTS. All boards in the CSC-0390 are designed to be PC fabricated, which provides a solid circuit consistency between multiple circuit cards. The efficiency of design and costs of this unit make them an excellent contender for fulfilling new DvD requirements on any advanced telemetry systems.

Simplicity is also incorporated into the design of this system. The auto bit sync circuitry provides a simple method of operation. A user only needs to know a DvD word length, start bit location, and MSB/LSB format to operate this unit effectively. The audio signal level controls are located on the front panel of each unit. Two push-buttons on the front panel are connected to a DS1669 digital potentiometer, which provides the necessary attenuation for controlling audio output level. The level of the output signal can be easily seen from the front panel through a 10 step level bar LED display, LM3904. In the event the DvD unit loses word lock, the HA5564 will be deactivated the audio output and eliminate any extraneous noise generations. Maintenance and pre-mission check-out is simplified, through the use of a built in test circuit, which tests 95% of the unit's circuitry. The test circuitry is also used for calibrating the audio output of the DvD unit. Calibration is performed to ensure and maintain a coincident output to different communication systems. This built in test is activated when the operator depresses the button "test" on the front panel which enables a 1K sign wave to be generated. The 1K sign wave is generated by a 20 bit data word of FB412 with a artificial test data strobe to lock up the phase lock loop, and causing word lock. A clear emphases of plug and play concept is designed within each unit, making them very simple to implement within a new telemetry system requiring digital voice.

CONCLUSION

This new DvD platform is based in a solid circuit design that is flexible to various computer systems and data type formats. Its efficient design and low cost provides any user with a system that is dependable and inexpensive. Its simplistic operations and maintenance of this system befits users by allowing them not to be bothered with needless extensive knowledge required for operations. The CSC-0390 Digital Voice Decoder is an easy system and solid system to enhance any modern telemetry processing system of today.

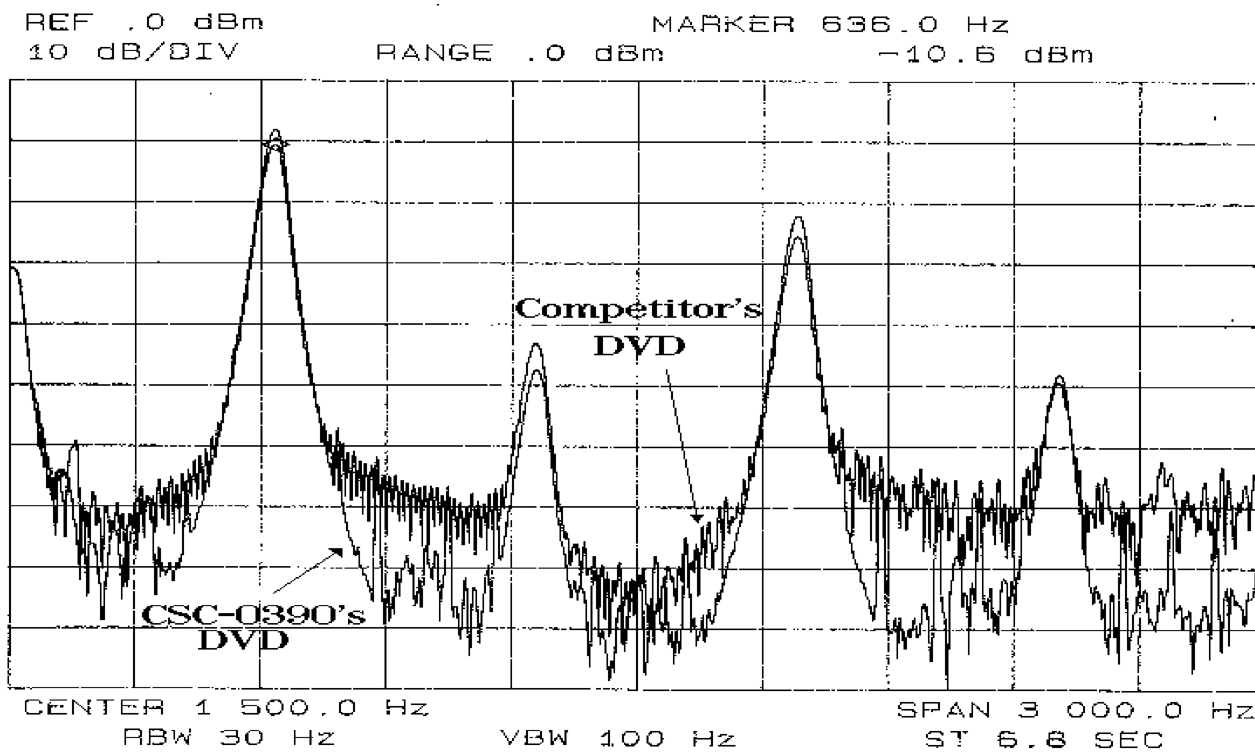

Figure 1

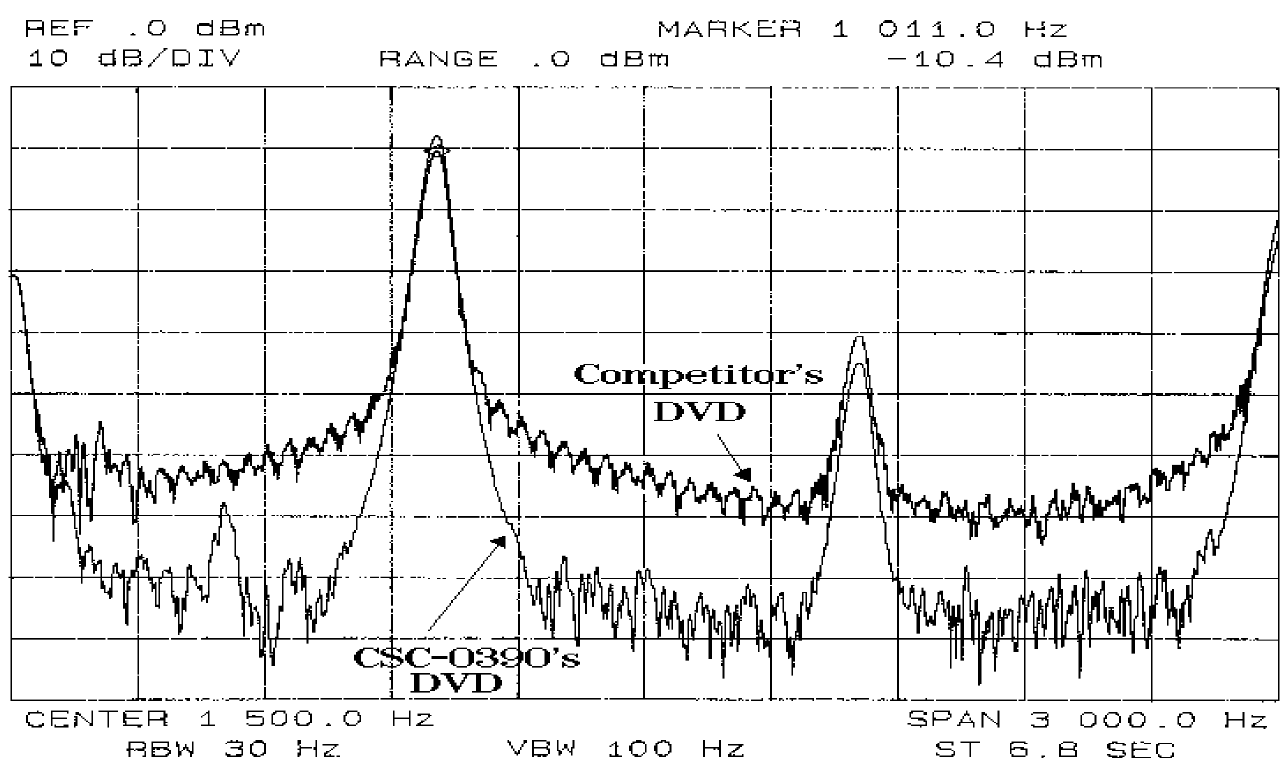

Figure 2

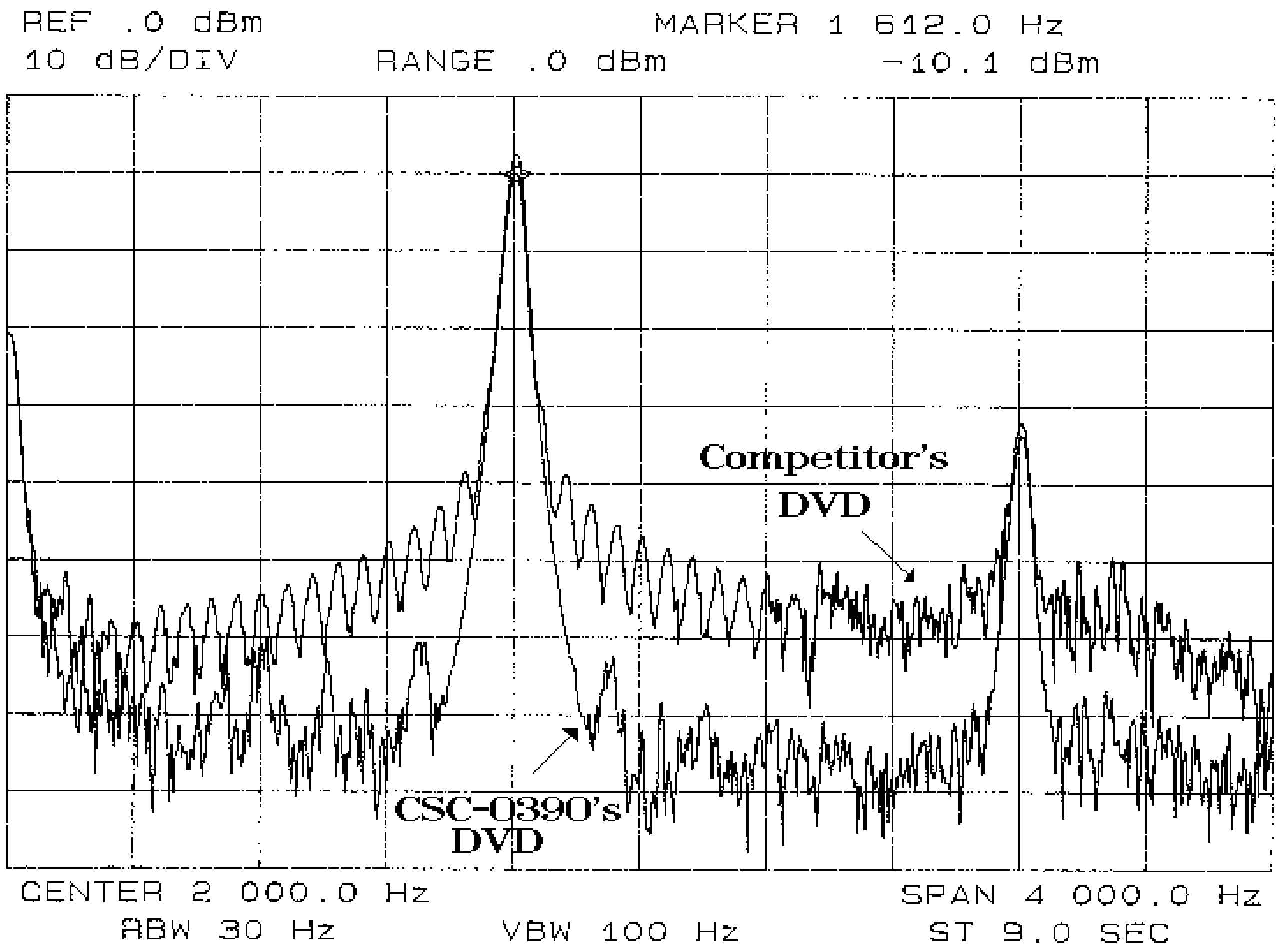

Figure 3

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Kevin Knudtson, Computer Sciences Corporation, Engineer, Edwards AFB

Randy Glass, Computer Sciences Corporation, Sr. Technician, Edwards AFB

Robert W. Broffel, Computer Sciences Corporation, Sr. Member of Technical Staff, Edwards AFB

Jon Schmidt, Computer Sciences Corporation, Technician II, Edwards AFB

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BIOGRAPH

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During 1984, I started my electronic education in Racine Wisconsin by entering into a college program for Robotic Technology. In my second year of this program, in 1986, I was offered a job at Computer Sciences Corporation to work on an Air Force computer telemetry system at Edwards AFB. This system is called IFDAPS, **I**ntegrated **F**light **D**ata **A**cquisition **P**rocessing **S**ystem. This system was the primary telemetry system used in testing Air Force's Air Vehicles at Edwards AFB and is still in use today. In 1997, as an Engineer, I began working on IFDAPS's predecessor telemetry system called ADAPS, **A**dvance **D**ata **A**cquisition **P**rocessing **S**ystem. While at Edwards AFB, I've completed an Associate of Science Degree and a Bachelor of Science Degree in Electronics, and I'm now pursuing a Bachelor of Science Degree in Computer Science.

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I began my career in electronics in 1976 when I entered the Air Force as a avionics systems specialist, during these 4 years I completed various basic and systems electronics courses. In addition I also received a Associated of Science in Electronics in 1991 from Antelope Valley Community College. In 1883 I first started working with Telemetry at Vandenburg AFB while working at the Intermediate Level Maintenance Facility, for the Space Shuttle Launch Control system. After this I worked for CSC at Ridley Mission Control in 1987, on various telemetry systems. This included; SCI computer front end. Build-up of the C-17 Quick-Look system for post-flight processing, for which I earned employee of the quarter for the redesign of a interface between the telemetry front end and a MV7800 computer. Leading up to the ADAPS build-up which is where I started working on the Digital Voice Decoder. Currently I'm working for Analytical Services and Materials, Inc. at NASA Dryden Flight Research Center, working on the System Research Aircraft (SRA), F-18B / A/C # 845.