
S-VHS/VHS Tape Qualification for High Performance Recorder Systems

Jeff Hulett and Don Longacre
Vektrex Electronic Systems, INC.

8675 Miralani Dr., STE. 150

San Diego, CA 92126-4354

Phone: 619-578-6787 FAX: 619-578-6873

email: [jhulett](mailto:jhulett@vektrex.com) or dlongacre@vektrex.com

THIC Meeting, January 20, 1998

Presentation Outline

- Project Goals/Introduction
- Initial Research
- Design Details
- Preliminary Test Data

System Design Goal Was Qualification of S-VHS Tape

- Based upon V3000 DTR6/8 System
- Research/QC Tool - Not Production Certifier
- Dropout or Signal Loss Approach with Track Average Amplitude Measurement
- Automatic
- High Tech Look at Old Problems

V3000 System



Slide4

 **VEKTREX**

DTR8 Recorder



Caveats

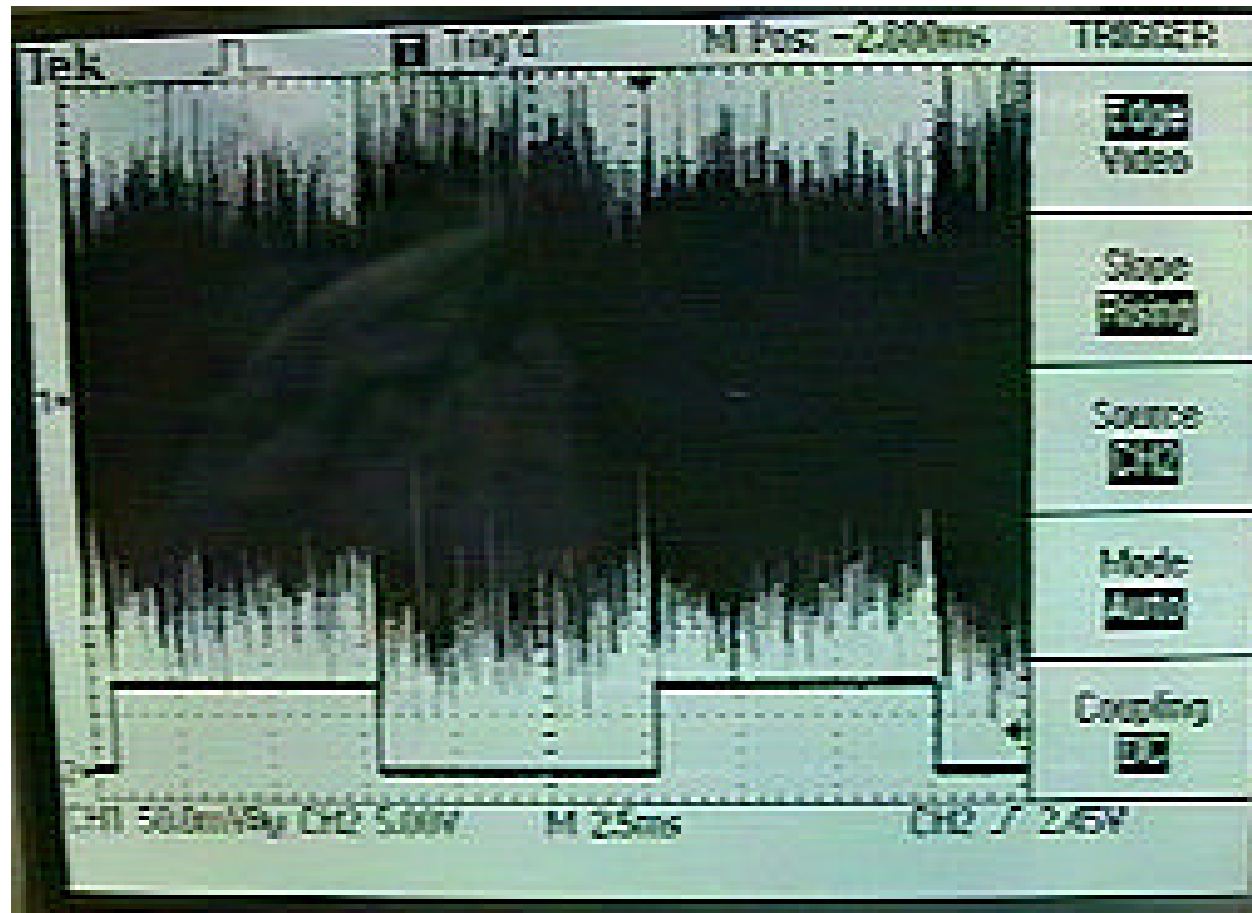
- Our Customer Supplied Test Tapes
- Only A Handful of Tapes Were Tested at Vektrex
- Some Tapes Were Obviously Used/Abused Prior to Testing
- Data Presented is Not Necessarily Typical Tape Performance of any Particular Manufacturer

Initial Dropout Research

Dropouts are measurable

- What is a dropout?
 - Momentary loss of recorded data
 - Tape imperfections
 - Low magnetic flux density
- Dropouts masked by FM processing
 - Dropouts less detectable at Wideband output (FM system)
 - RF Equalizer's Output was designer's choice to detect dropouts

Waveform changes during Helical head scan time



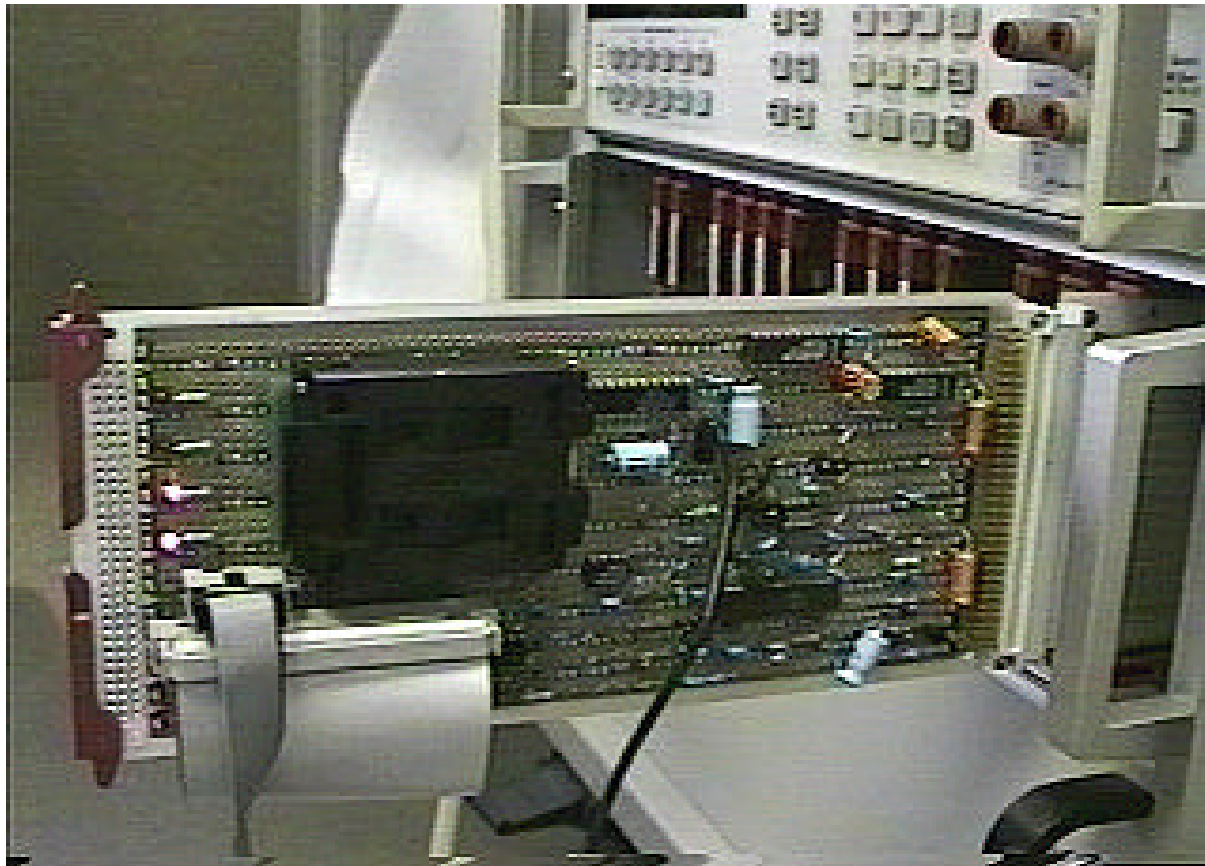
We Considered Several Design Approaches

- Rejected Approaches:
 - Fixed Dropout Threshold Level
 - Phase Locked Loop/Synchronous Demodulator
 - Envelope Threshold Assist After Demodulation
 - Head Switch Blanking

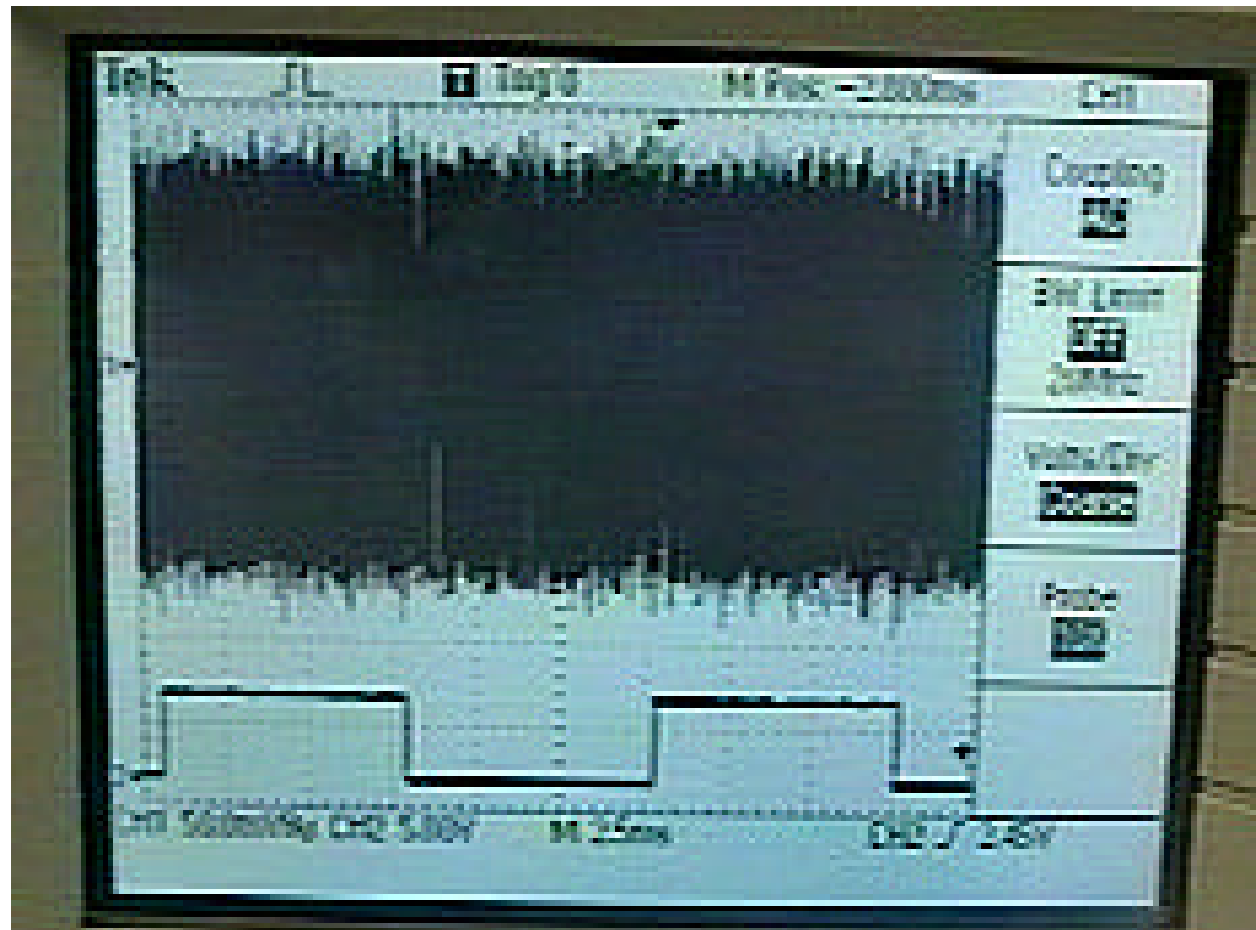
An Initial Prototype Was Constructed As A Test Platform

- AGC Was Selected To Remove Track Average Amplitude Variations
- Adjustable Thresholds
- FPGA Based Digital Processing
- Lab View - Based Software
- Data Cross-Checked with Digital Oscilloscope

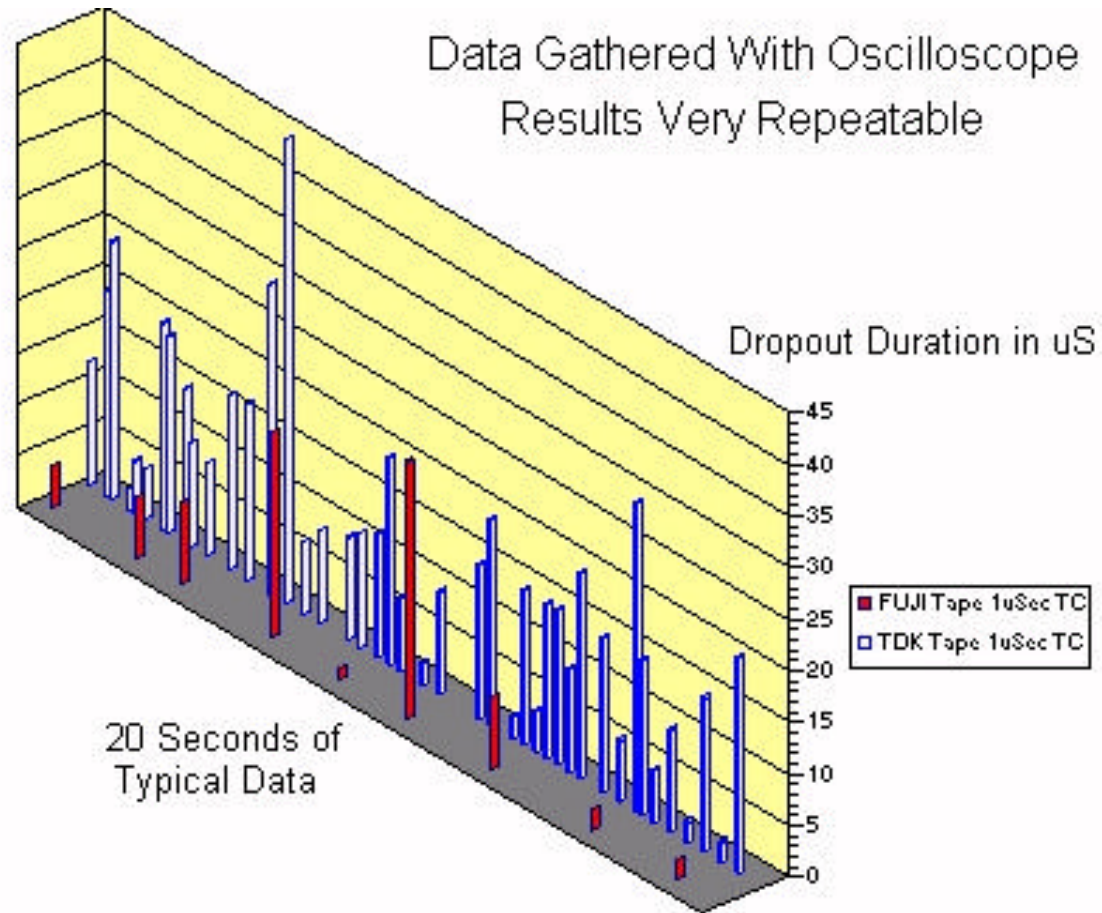
Initial Prototype



Processed Waveform Has Flattened Scan Envelope



50 Microsecond Dropout Equals 0.68 % of Scan (<1mm)



Things we've learned

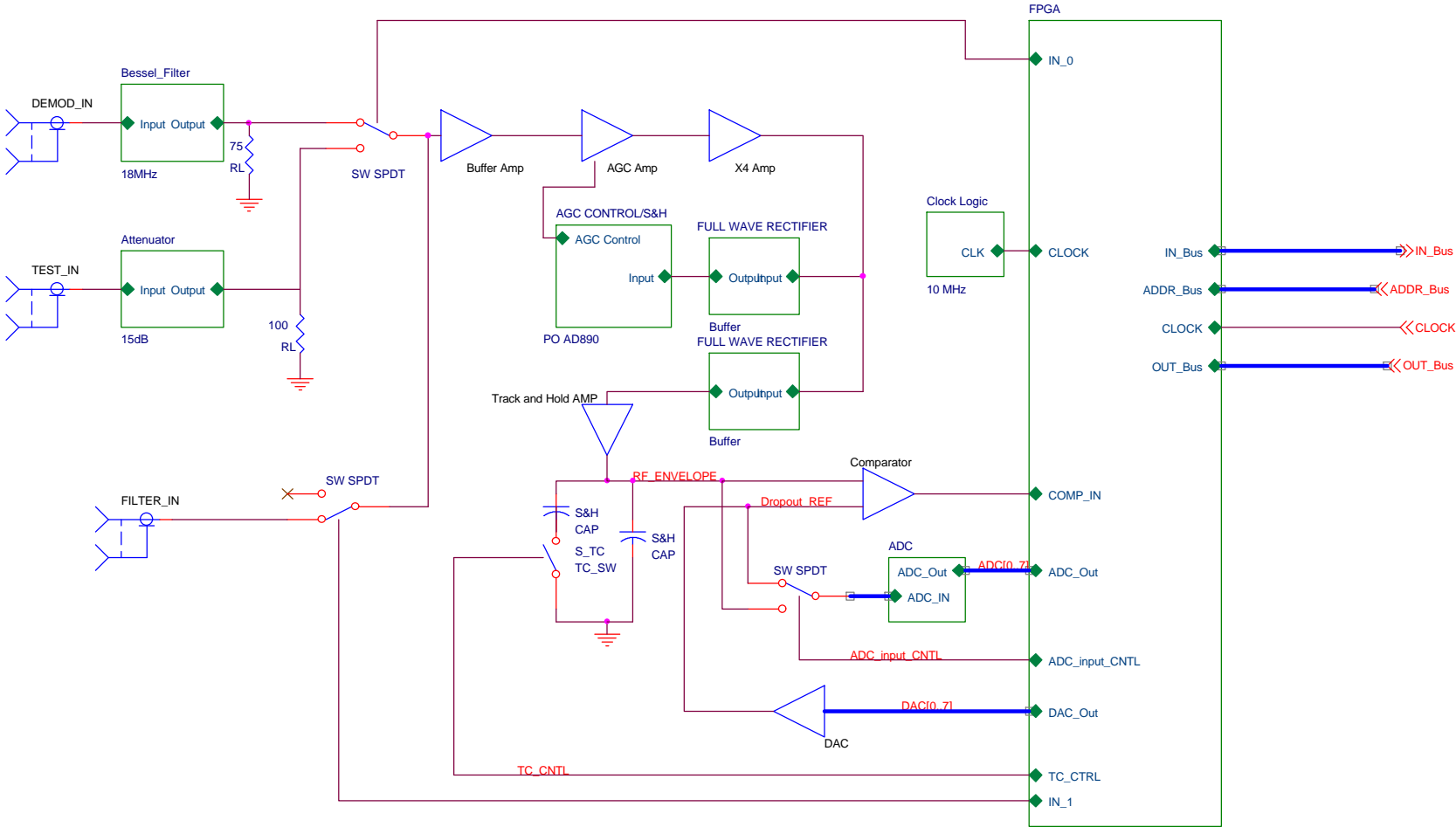
- Need an AGC to remove variations
- Envelope calibration and measurement assure AGC does not mask bad tape
- Research indicates -6dB detection threshold works well
- Dropouts vary in duration by 2 orders of magnitude suggesting statistical processing

Design Details

Design has six elements

- Dropout Detection Scheme
 - RF Equalizer Output from DTR8 Test Point
 - Precision, Wideband Channel Processing Element
 - Settable threshold setting
 - Precision amplitude comparator
 - Digital Bin separation (four bins)
 - LabVIEW software for control and display

Carrier Dropout Detector



Latest Technology Was Used In Design

- 80 MHz, Precision, Wideband, Channel Processing Element used (AD890).
- Fast Amplitude Comparator (MAX9686)
- 160 pin FPGA (Altera, EPF8820A)

Board's architecture was designed for extensive self test

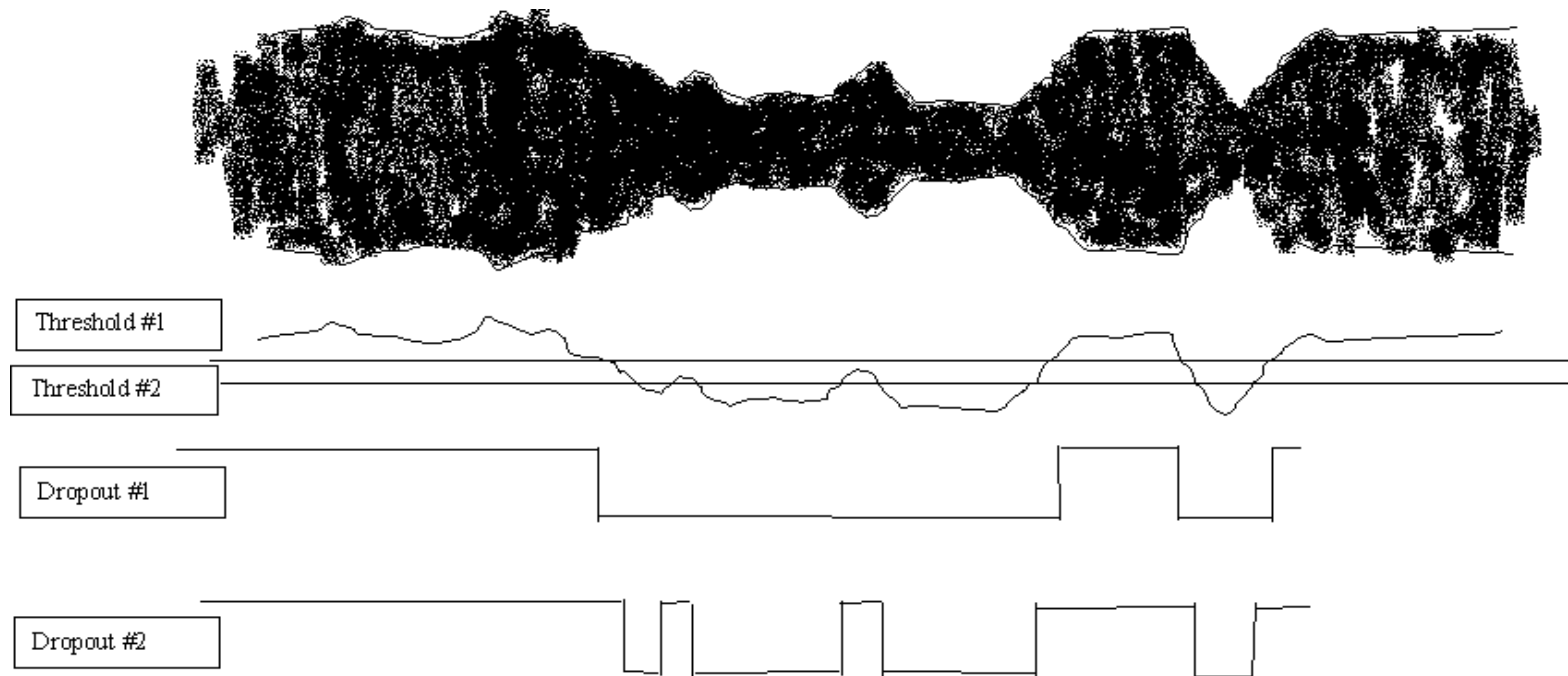
- Provides loop out and back signal paths
- Several test and configuration paths
- Analog to digital converter to measure digital to analog converter output or detected envelopes selected in the ARTS test station.
- FPGA Has Dropout Injection Capability

We Designed In Sophisticated Data Processing

- Adjustable Dropout Threshold
 - 256 Steps and 2 Time Constants
- Real Continuous Event Collection
 - 4 Bins With Programmable Bin Boundaries
 - 100 nS Resolution
- Stored Events Collected by PC
- Colored Histograms
 - Pinpoints Flaws
 - Gives Idea of Size Distribution

Bin Boundaries must be chosen carefully

- Lowering Threshold Sometimes Increases Dropout Counts



Dropout Density Metric Used As Overall Figure of Merit For Tape

- Setup menu provides flexibility with reasonable defaults
- Histograms Provided Good Detailed View, But were Difficult to Quantify
- Dropout Density
 - Simple Concept, Provides Good Overall Insight
 - % of Time Signal is Below Threshold
 - Lower Thresholds Mean Lower Dropout Densities
 - Figure Given in ppm

Setup menu provides flexibility with reasonable defaults

AUTOMATIC DROPOUT TEST OPERATIONAL PARAMETERS

Operator Name Current System Configuration

Don L.

Comment

Default Test Values

Record Type Recorder ID

DTR-8 S/N 80164

Test Parameters

Test Length

Full

0.0 100.0 200.0 300.0 400.0 500.0 600.0 700.0 787.5 Feet

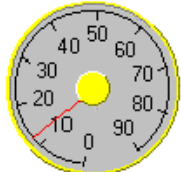
Reproduce Parameters

Dropout Threshold 70 < BIN3

-6 db 25 < BIN2 < 70 us

Dropout Time Constant 5 < BIN1 < 25 us

FAST BIN0 < 5 us



Estimated minutes to complete

RETURN

CONTINUE

DRIVE CONTROL

Pass/Fail Criteria

Fail Action Continue

Period Length 0.3 Feet

Max Dropouts/period 100

Max Dropouts/tape 10000

Min Amplitude 0.20 Vpp

Max Dropout Density 100.0 ppm

Reproduce Only

	0	1	2	3
Max Dropouts per bin per period	40	30	20	10
Max Dropouts per bin per tape	2500	2500	2500	2500

Dropout Data



Estimated minutes to complete the test as configured

AUTOMATED DROPOUT TEST

Dropout Threshold db
Dropout Time Constant
Fail Action
Elapsed time(sec)

Graph Stats

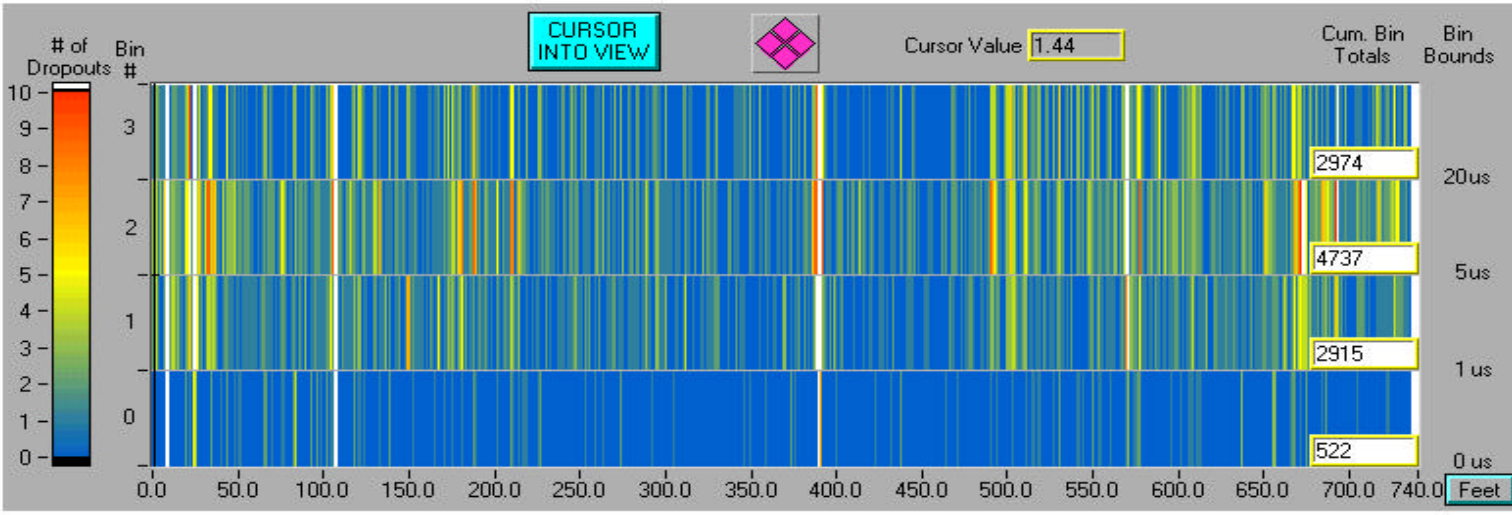
FAIL

RETURN

START

PRINT

DRIVE CONTROL



Statistical Display



Estimated minutes
to complete the test
as configured

AUTOMATED DROPOUT TEST

Dropout Threshold db

Dropout Time Constant

Fail Action

Elapsed time(sec)

Graph Stats

PASS

RETURN

START

PRINT

DRIVE CONTROL

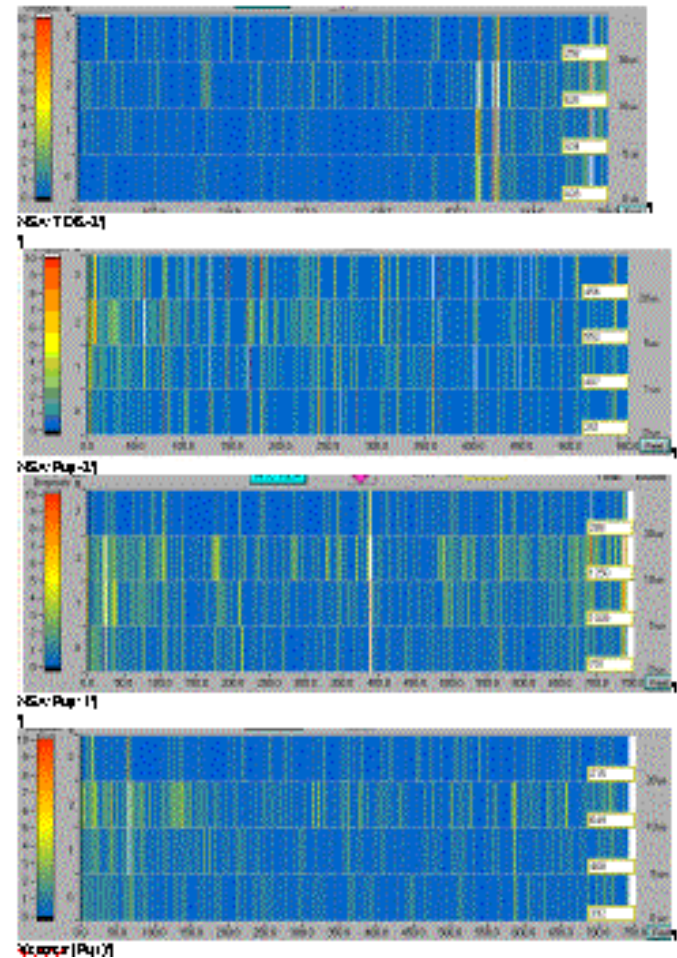
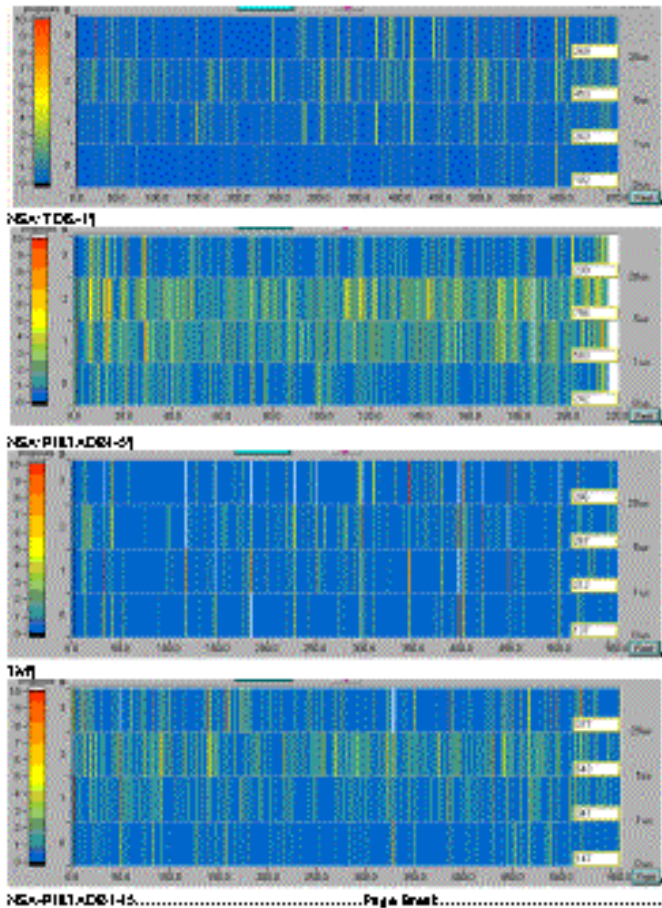
Initial Amplitude	<input type="text" value="0.18"/> Vpp	Max Detected Dropouts/period	<input type="text" value="179"/>
Min Allowed Amplitude	<input type="text" value="0.15"/> Vpp	Max Allowed Dropouts/period	<input type="text" value="400"/>
Average Dropout Density	<input type="text" value="32.0"/> ppm	Total Detected Dropout Count	<input type="text" value="4599"/>
Max Allowed Dropout Density	<input type="text" value="100.0"/> ppm	Total Allowed Dropout Count	<input type="text" value="10000"/>

Dropouts per bin per period	0	1	2	3
Max Detected	<input type="text" value="29"/>	<input type="text" value="99"/>	<input type="text" value="52"/>	<input type="text" value="15"/>
Max Allowed	<input type="text" value="100"/>	<input type="text" value="100"/>	<input type="text" value="100"/>	<input type="text" value="100"/>

Dropouts per bin per test	0	1	2	3
Max Detected	<input type="text" value="567"/>	<input type="text" value="1920"/>	<input type="text" value="1602"/>	<input type="text" value="510"/>
Max Allowed	<input type="text" value="2500"/>	<input type="text" value="2500"/>	<input type="text" value="2500"/>	<input type="text" value="2500"/>

Test Results

Each tape has its own dropout signature



Dropout system easily differentiates between tapes

- Nine tapes received for evaluation
- Summary of their dropout density
 - (TDK-2) 40.5 ppm (F183 – 5) 28.0 ppm
 - (TDK-1) 7.1 ppm (F183A –15) 11.8 ppm
 - Fuji-1 (H471S) 21.0 ppm (3M) 9.4 ppm
 - Fuji-2 (H471S) 12.6 ppm BASF 223.2 ppm
 - TDK E-HG (VHS) 26.8 ppm 3M tape was the best tape that was tested. It had a dropout density of between 5 and 10 ppm

Additional tapes tested

- We also tested (2) two tapes of our own
 - Fuji (H471S) 12.0 ppm
 - TDK – ST-120S 61.2 ppm

Summary

- System Delivered August 97
- In Place & Performing Well
- Customer Will Conduct Sample Screening of Candidate Tapes