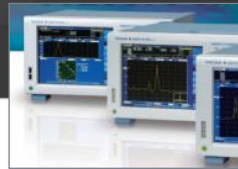


# DL850 IRIG Tutorial Rev 1.1

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# IRIG Introduction

What does IRIG stand for?

- Inter-Range Instrumentation Group

What is IRIG?

- Originated as an American Military Standard in the 1960's
- Allows for the synchronization of multiple instruments and recording of accurate time
- IRIG signals refer to a group of serial time codes
- Time code formats distinguishes the signal characteristics, e.g. modulated versus unmodulated, data rate, information included in the transmitted data, etc
- IRIG-B widely used in power electronics such as breakers, relays, and meters

How can it be used?

- Synchronized measurements across multiple DL850 units
- Lock onto a GPS clock so DL850s can be accessed remotely in various locations
- DL850 internal clock will “lock” onto the IRIG signal

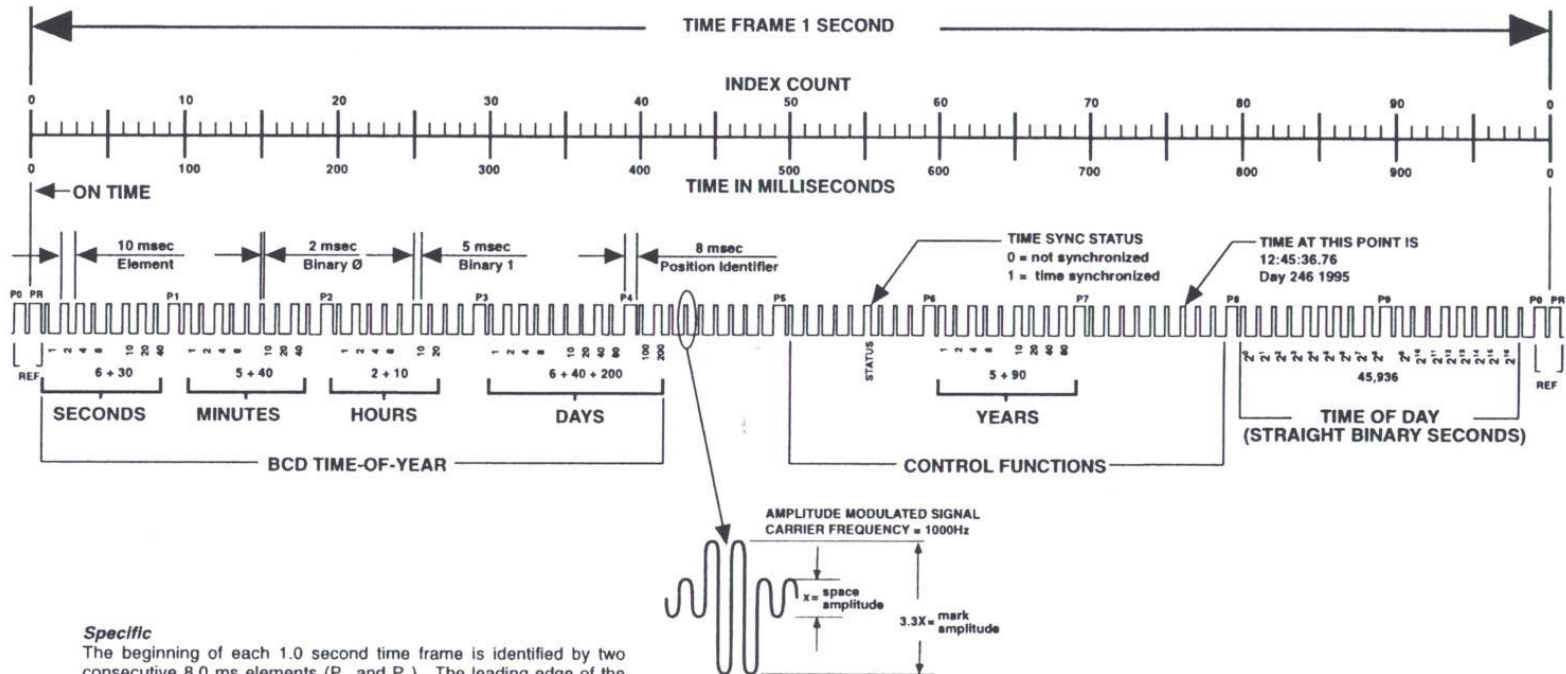
# IRIG Overview

How does it work?

- All IRIG time code formats use pulse-width coding
- Binary 1 pulse corresponds to a duration of 50% of the Bit Time
- Binary 0 pulse corresponds to a duration of 20% of the Bit Time
- Position identifiers corresponds to a duration of 80% of the Bit Time
- Position identifiers separate the various components of a time code
- Each time code produces a specific number of bits per second
- The bits contain the various time, date, time changes and time quality information of the time signal.
- Instruments can “lock” onto the time signal
- 3 groups of bits: Binary Coded Decimal, Control Functions, Straight Binary Seconds

# Example IRIG B Time Code

## IRIG B TIME



### Specific

The beginning of each 1.0 second time frame is identified by two consecutive 8.0 ms elements (P<sub>0</sub> and P<sub>R</sub>). The leading edge of the second 8.0 ms element (P<sub>R</sub>) is the "on time" reference point for the succeeding time code. 10 pps position identifiers P<sub>0</sub>, P<sub>1</sub>, ..., P<sub>9</sub> (8.0 ms duration) occur 10 ms before 10 pps "on time" and refer to the leading edge of the succeeding element.

The two time code words and the control functions presented during the time frame are pulse width coded. The binary "zero" and index markers have a duration of 2.0 ms, and the binary "one" has a duration of 5.0 ms. The leading edge is the 100 pps "on time" reference point for all elements.

The binary coded decimal (BCD) time-of-year code word consists of 30 digits beginning at index count 1. The binary coded subword elements occur between position identifiers P<sub>0</sub> and P<sub>5</sub> (7 for seconds; 7 for minutes; 6 for hours; 10 for days) until the code word is complete. An index marker occurs between the decimal digits in each subword to provide separation for visual resolution. The least significant digit occurs first. The BCD code recycles yearly.

Twenty-seven control functions occur between position identifiers P<sub>5</sub> and P<sub>6</sub>. Any control function element or combination of control function elements can be programmed to read a binary "one" during any specified number of time frames. Each control element is identified on the Control Function Field Table.

The straight binary (SB) time-of-day code word occurs between position identifiers P<sub>6</sub> and P<sub>7</sub>. Seventeen digits give the time-of-day in seconds with the least significant digit occurring first. A position identifier occurs between the 9th and 10th binary coded elements. The straight binary code recycles every 24 hours.

# IRIG Format

First letter: Format/Rate	A	<u>Bit Rate</u> 1000 PPS	<u>Bit Time</u> 1 ms	
	B	100 PPS	10 ms	
	D	1 PPM	1 minute	
	E	10 PPS	100 ms	
	G	10000 PPS	0.1 ms	
	H	1 PPS	1 second	
	1 <sup>st</sup> Digit x: Modulation Type	0	Unmodulated, DC level shift	
		1	Amplitude modulate sine wave	
2		Manchester modulated		
2 <sup>nd</sup> Digit y: Carrier Resolution	0	No Carrier		
	1	100 Hz/10 ms resolution		
	2	1 kHz / 1 ms resolution		
	3	10 kHz / 100 us resolution		
	4	100 kHz / 10 us resolution		
	5	1 MHz / 1 us resolution		
3 <sup>rd</sup> Digit z: Coded Expression	0	BCD <sub>TOY</sub> , CF, SBS		
	1	BCD <sub>TOY</sub> , CF		
	2	BCD <sub>TOY</sub>		
	3	BCD <sub>TOY</sub> , SBS		
	4	BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , CF, SBS		
	5	BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , CF		
	6	BCD <sub>TOY</sub> , BCD <sub>YEAR</sub>		
	7	BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , SBS		

## Legend

PPS: Pulse Per Second

### Binary Coded Deicmal:

BCD<sub>TOY</sub> - Time of Year

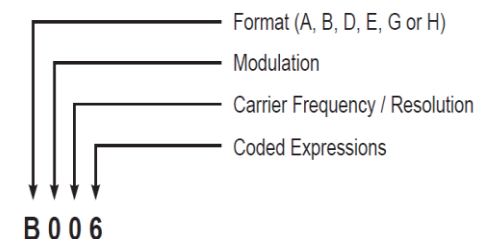
BCD<sub>YEAR</sub> - Year

### Control Functions:

CF - set of bits reserved for user applications

### Straight Binary Seconds

SBS – time of day (0 to 86400 seconds)



IRIG time codes – naming convention

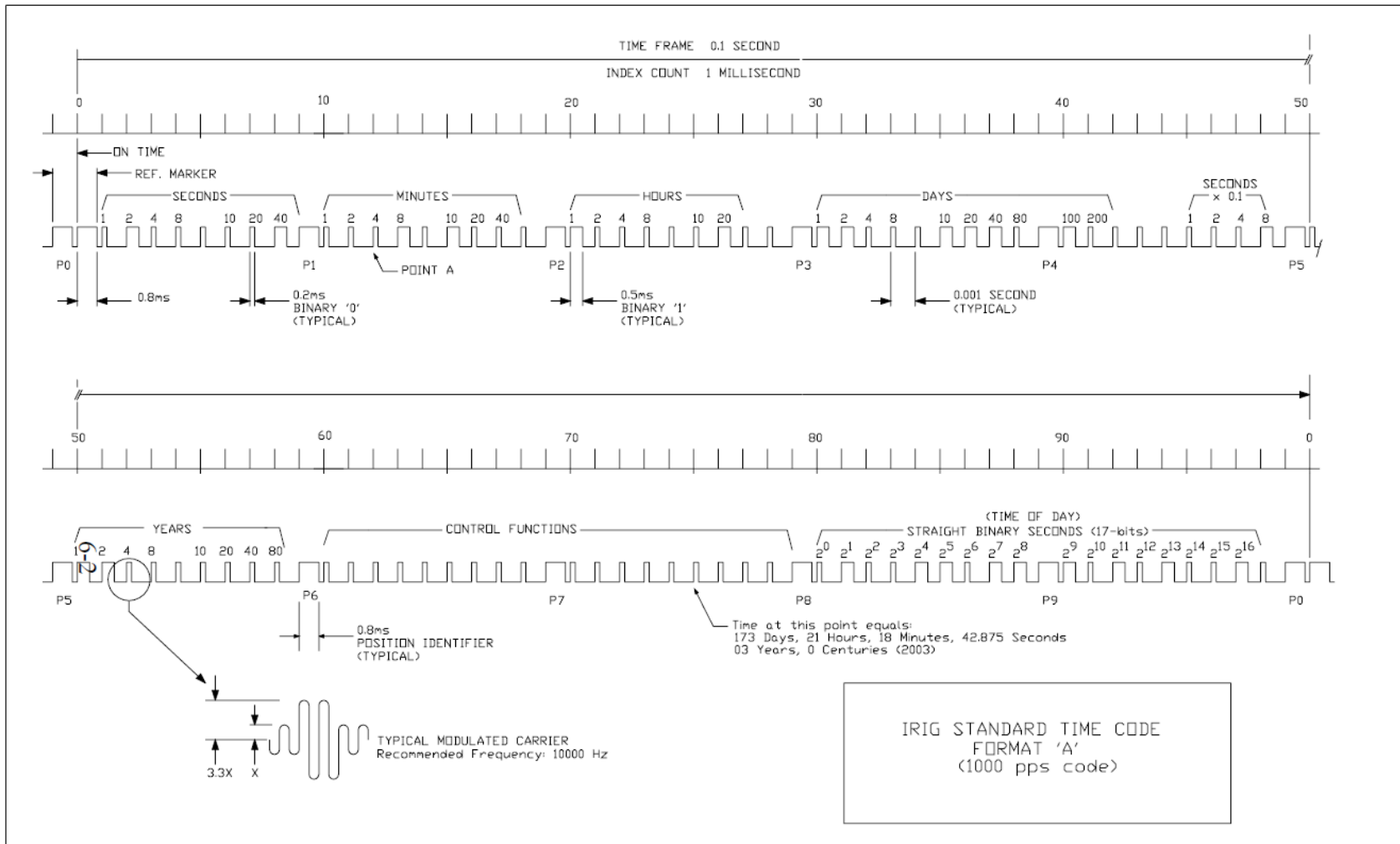
# IRIG Format

- IRIG code format consists of a single letter plus 3 digits
- Example **B122**
  - Transmit 100 PPS, 100 bits of information transmitted every second
  - Amplitude Modulated 1 kHz sine wave carrier
  - BCD encoded information
  - Jitter:  $\leq 1\%$  carrier frequency or 10  $\mu\text{s}$
- DL850 supports the following IRIG format: A002, B002, A132, B122
- Demo board IRIG function is B122

Table of Permissible Code Format

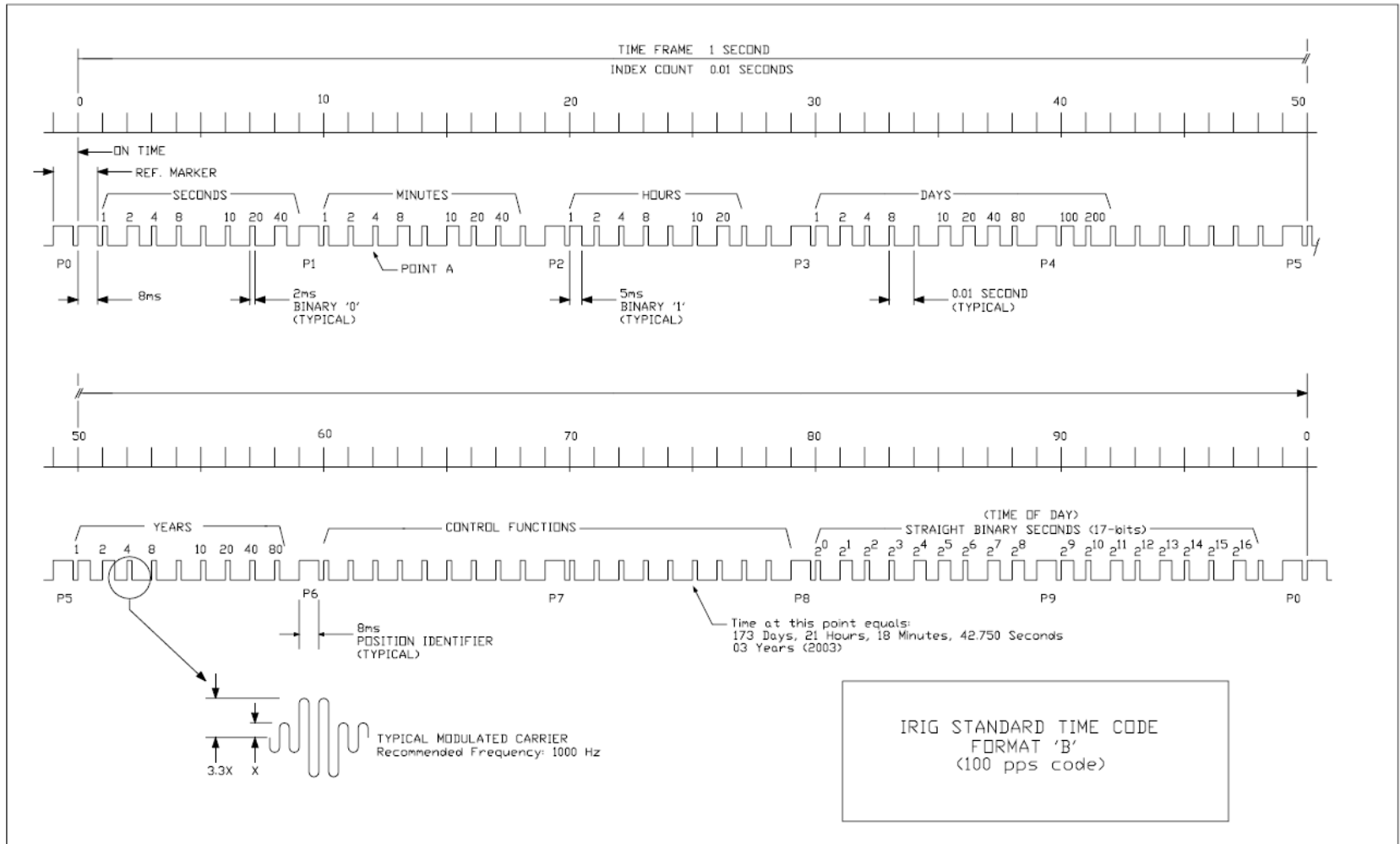
Format	Modulation Type	Carrier Frequency	Coded Expressions
<b>A</b>	0, 1, 2	0, 3, 4, 5	0, 1, 2, 3, 4, 5, 6, 7
<b>B</b>	0, 1, 2	0, 2, 3, 4, 5	0, 1, 2, 3, 4, 5, 6, 7
<b>D</b>	0, 1	0, 1, 2	1, 2
<b>E</b>	0, 1	0, 1, 2	1, 2, 5, 6
<b>G</b>	0, 1, 2	0, 4, 5	1, 2, 5, 6
<b>H</b>	0, 1	0, 1, 2	1, 2

# A000 Time Code



Format A: BCD time-of-year in days, hours, minutes, seconds, fractions of seconds and year, and straight binary seconds-of-day and control bits.

# B000 Time Code



Format B: BCD time-of-year in days, hours, minutes, seconds and year and straight binary seconds-of-day and control bits.

# Getting Started

What you will need:

- 1+ DL850/DL850V:



- 1+ BNC-to-Alligator cable



- 1-2 Demo Board:



- Modules and Probes:



700929  
Probe



720210  
100 MS/s  
Module


Note: You may choose to use your own IRIG signal source and test signal source.

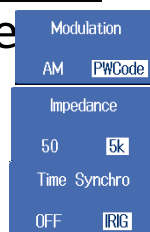
# How to Get Connected

1. Connect the USB cable from the Demo Board to the DL850
2. Connect the BNC portion of the BNC-Alligator cable to the DL850
3. Connect the Ground lead (Black) of the BNC-Alligator cable to TP2, TP5, or TP8 on the demo board
4. Connect the Test lead (Red) of the BNC-Alligator cable to TP4 of the same demo board
5. Repeat steps 2-4 for the remaining DL850 units using the same demo board
6. Power ON DL850 units
7. (Optional) Use a second demo board for test signal or use your own signal source
8. Proceed to DL850 IRIG Setup

# DL850 IRIG Setup

Follow these keystrokes to setup the DL850 IRIG synchronization

1. Press Utility 
2. Press System Config soft button
3. Press Time Synchro soft button
4. Select the IRIG Format B
5. Select the Modulation Type PWCode
6. Select the Input Impedance 5k
7. Select IRIG to start synchronization
8. When IRIG signal is stable, synchronization is complete and DL850 date and time is automatically adjusted
9. Connect Probes
10. Begin Measurement!



Note: Input Impedance refers to the impedance of the BNC cable connected to the IRIG connector

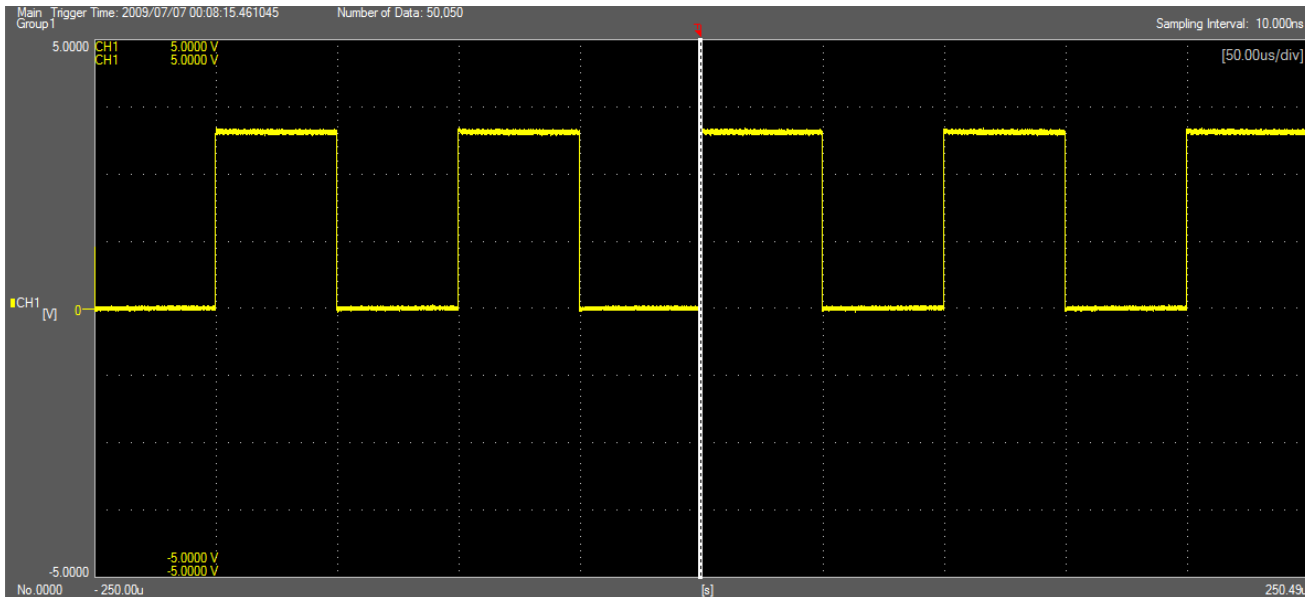
# Synchronized DL850s Example

Two DL850's synchronized to a B122 signal

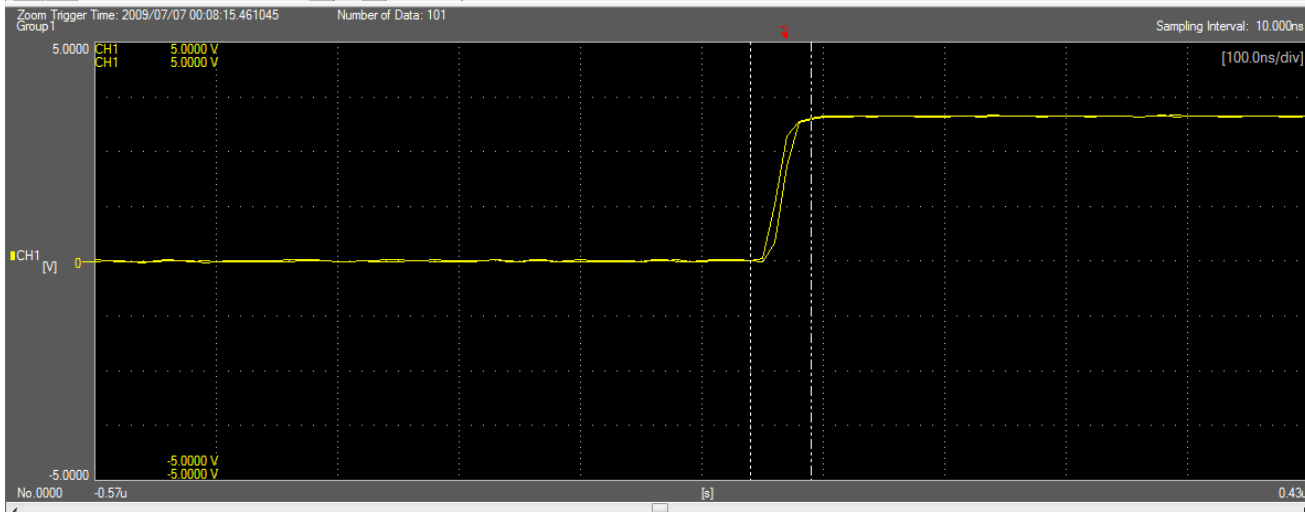


Two DL850 sync'd to 2009/07/07 00:11:58  
Trigger Time difference is 7.901 ms

# Viewed in Xviewer

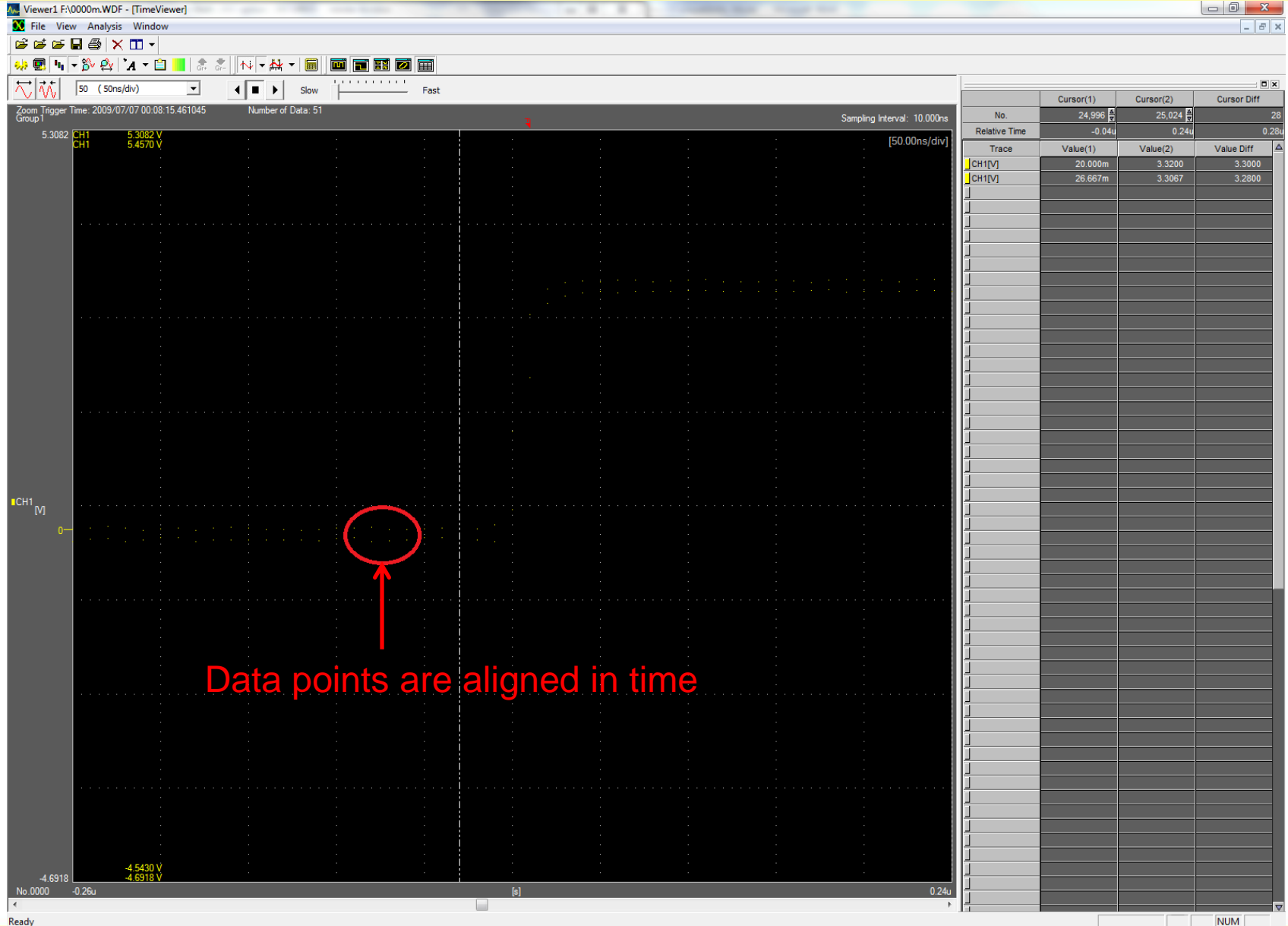


100 (100ns/div) Slow Fast



No.	Cursor(1)	Cursor(2)	Cursor Diff
	25.002	24.997	-5
Relative Time	0.02u	-0.03u	-0.05u
Trace	Value(1)	Value(2)	Value Diff
CH1[V]	3.2733	6.6667m	-3.2667
CH1[V]	3.2467	6.6667m	-3.2400

# Synchronized Data Samples



Data points are aligned in time

# Appendix – DL850 IRIG FAQ



# Appendix – DL850 IRIG FAQ

Q: Can the IRIG feature be used to synchronize the trigger input to each DL850?

A: Please use trigger in/out or a SOURCE = TIME trigger.

Q: Can the data samples be synchronized exactly using IRIG?

A: Yes. Please see the question below.

Q: Will the Xviewer software display waveform data from multiple DL850; and synchronize that data in time?

A: Yes. The Xviewer File Utility feature is capable of merging multiple channels saved by multiple DL850 units into one window display. Data samples are synchronized in time.

Q: What is the 'FILE DIVIDE' feature?

A: When realtime recording is enabled, the DL850 has the ability to move blocks of REALTIME waveform data from HDD to PC; while at the same time performing a REALTIME acquisition.

# Appendix – DL850 IRIG FAQ

Q: Does the IRIG B feature synchronize the clocks of several DL850s in one location?

A: Yes.

Q: Does the IRIG B feature synchronize the clocks of multiple DL850s in several locations?

A: Yes. It require IRIG generator with GPS.

Q: Does the IRIG B feature synchronize data sampling (each data sampling point) for each DL850 connected to a common IRIG B synch source?

A: Start timing is different with each DL850. It depends on the key or command. The Xviewer can merge these data.

Q: Can the IRIG B feature be utilized in such a way as to synchronize trigger input to each DL850?

A: Please use trigger in/out function or time trigger.

# Appendix – DL850 IRIG FAQ

Q: When two DL850 are each synced to an IRIG timecode source, can the TRIGGER SOURCE = TIME be invoked so that the pair trigger at the same instant? And in a remote location.

A: Yes.

Q: What is the accuracy of the time stamp?

A: Internal Clock is 50 ppm. (IRIG is typically 1 us)

Q: Can the IRIG feature be used to sync the clocks of several DL850 clocks in multiple locations?

A: Yes. Use an IRIG timecode generator with GPS clock source.

Q: Will the Xviewer software display waveform data from multiple DL850? and synchronize the data via the IRIG B time data?

A: Yes. The Xviewer File Utility program is capable of synchronizing the data.