**Overview of IRIG-B Time Code Standard**

**Introduction**

The IRIG time codes were originally developed by the Inter-Range Instrumentation Group (IRIG), part of the Range Commanders Council (RCC) of the US Army. The standard was first published in 1960 and has been revised several times by the Telecommunications and Timing Group (TTG) of the RCC. The latest version is IRIG standard 200-04, “IRIG Serial Time Code Formats,” updated in September, 2004.

**Available Formats**

Although the “IRIG-B” time code is best known, the standard actually defines a family of rate-scaled serial time codes. The six code formats use different pulse rates, or bit rates, as shown in the table below.

<table>
<thead>
<tr>
<th>IRIG Time Code Formats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>IRIG-A</td>
</tr>
<tr>
<td>IRIG-B</td>
</tr>
<tr>
<td>IRIG-D</td>
</tr>
<tr>
<td>IRIG-E</td>
</tr>
<tr>
<td>IRIG-G</td>
</tr>
<tr>
<td>IRIG-H</td>
</tr>
</tbody>
</table>

**Time Code Attributes**

All IRIG time code formats use pulse-width coding. A “binary 1” pulse has a duration of 50% of the index count interval, and a “binary 0” pulse has a duration of 20% of the index count interval. In addition “Position Identifiers” have a duration of 80% and are used as reference markers.

IRIG time code signals may be:

- **Unmodulated** (DC level shift, no carrier signal)
- **Modulated** (amplitude-modulated, sine wave carrier).
- **Modified Manchester** (amplitude-modulated, square wave carrier).

Three types of coded expressions are used in the IRIG standard:

- **Binary Coded Decimal** time-of-year (BCD<sub>TOY</sub>) and year (BCD<sub>YEAR</sub>)
- **Control Functions** (CF), set of bits reserved for user applications
- **Straight Binary Seconds** (SBS) time-of-day (0 to 86400 seconds)
IRIG STANDARD 200-04 (Continued)

IRIG Time Code Designations

In addition to the letter used to designate one of the six IRIG code formats, signal identification numbers are used to further describe specific characteristics. Thus, the complete IRIG time code designation consists of a letter and three digits, as shown below.

![IRIG time codes – naming convention](image)

**IRIG Signal Identification Numbers (3 Digits)**

<table>
<thead>
<tr>
<th>1st Digit</th>
<th>Modulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unmodulated – DC Level Shift (DCLS), pulse-width coded</td>
</tr>
<tr>
<td>1</td>
<td>Amplitude modulated, sine wave carrier</td>
</tr>
<tr>
<td>2</td>
<td>Manchester modulated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Digit</th>
<th>Carrier Frequency / Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No carrier (DCLS)</td>
</tr>
<tr>
<td>1</td>
<td>100 Hz / 10 ms resolution</td>
</tr>
<tr>
<td>2</td>
<td>1 kHz / 1 ms resolution</td>
</tr>
<tr>
<td>3</td>
<td>10 kHz / 100 microsecond resolution</td>
</tr>
<tr>
<td>4</td>
<td>100 kHz / 10 microsecond resolution</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3rd Digit</th>
<th>Coded Expressions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>BCD\text{TOY}, CF, SBS</td>
</tr>
<tr>
<td>1</td>
<td>BCD\text{TOY}, CF</td>
</tr>
<tr>
<td>2</td>
<td>BCD\text{TOY}</td>
</tr>
<tr>
<td>3</td>
<td>BCD\text{TOY}, SBS</td>
</tr>
<tr>
<td>4</td>
<td>BCD\text{TOY}, BCD\text{YEAR}, CF, SBS</td>
</tr>
<tr>
<td>5</td>
<td>BCD\text{TOY}, BCD\text{YEAR}, CF</td>
</tr>
<tr>
<td>6</td>
<td>BCD\text{TOY}, BCD\text{YEAR}</td>
</tr>
<tr>
<td>7</td>
<td>BCD\text{TOY}, BCD\text{YEAR}, SBS</td>
</tr>
</tbody>
</table>
## IRIG-B Overview

IRIG time code B (IRIG-B) is widely used in the electrical power industry. IRIG-B has a pulse rate of 100 pulses-per-second with an index count of 10 milliseconds over its one-second time frame. It contains time-of-year and year information in a BCD format, and (optionally) seconds-of-day in SBS.

### IRIG-B Signals

IRIG-B is typically distributed as a DC level shift, pulse-width coded signal (“unmodulated IRIG-B”) or as an amplitude-modulated signal based on a sine wave carrier with a frequency of 1kHz (“modulated IRIG-B”). Modified Manchester modulation is also specified in the standard but is less common. A comparison of IRIG-B coding methods is given in the figure below.

### IRIG-B Reference Markers

IRIG-B uses reference markers called “Position Identifiers.” The presence of two consecutive reference markers signifies the start of the time frame. The first reference marker alerts that the next rising edge will be the PPS marker. (“On-Time 1 PPS” shown above.)
IEEE-1344 Extensions

Year information was not specified in the IRIG standard prior to its 2004 revision. Before 2004, the IEEE adopted a standard (IEEE-1344) which included year data as part of the IRIG-B signal. This variation came to be known as “IEEE-1344 extensions.”

IEEE-1344 extensions use extra bits of the Control Functions (CF) portion of the IRIG-B time code. Within this portion of the time code, bits are designated for additional features, including:

- Calendar Year (now called BCD\_YEAR)
- Leap seconds, and leap seconds pending
- Daylight Saving Time (DST), and DST pending
- Local time offset
- Time quality
- Parity
- Position identifiers

To be able to use these extra bits of information, power system devices and other equipment receiving the time code must be able to decode them. Refer to individual product manuals to determine whether IEEE-1344 extensions are supported.

Since year information is now considered part of BCD (denoted as BCD\_YEAR), what was formerly considered B002 and B122 (with IEEE Extensions ON) would now be denoted as B006 and B126.

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Note: IEEE standard 1344 was updated and replaced by IEEE C37.118-2005. Nevertheless, the term “IEEE-1344 Extensions” is still used.
IRIG-B BCD time-of-year (in days, hours, minutes, seconds) and year and straight binary seconds-of-day and control bits

WIRING

Unmodulated or Demodulated?
An IRIG-B time signal can be modulated (over a carrier signal) or unmodulated (no carrier signal).

In some manufacturers’ literature the term “demodulated” is used to describe an IRIG-B signal with no carrier signal. However, the term “demodulated” does not appear in the IRIG standard. In most cases, it may be assumed that this term is synonymous with unmodulated.

IRIG-B Implementation
The IRIG 200-04 standard does not define specific signal levels for IRIG-B.

Typical techniques for transmission of unmodulated IRIG-B include:
- TTL-level signal over coaxial cable or shielded twisted-pair cable
- Multi-point distribution using 24 Vdc for signal and control power
- RS-422 differential signal over shielded twisted-pair cable
- RS-232 signal over shielded cable (short distances only)
- Optical fiber

Typical techniques for transmission of modulated IRIG-B include:
- Coaxial cable, terminated in 50 ohms or higher.
- Shielded twisted-pair cable
APPLICATION OF IRIG-B IN CSI PRODUCTS

STR-100 Satellite Time Reference

STR-IDM IRIG-B Distribution Module

CyTime Event Recorder, SER-3200

REFERENCES

For More Information (CSI)

STR Instruction Bulletin (IB-STR-01)
STR/IRIG-B Addendum (IB-STR-02)
STR-IDM Instruction Bulletin (IB-IDM-01)
SER-3200 Instruction Bulletin (IB-SER-01)
SER-3200 Reference Guide (IB-SER-02)
Tech Note: SER System Architectures (TN-101)

References


