USB-DIO32HS
High-Speed Digital I/O

USB-DIO32HS devices provide 32 bits of high-speed digital I/O, input/output scan rates up to 8 MS/s, and simultaneous hardware and software scanning. The USB-DIO32HS-OEM (above left) has a board-only form factor and header connectors. The USB-DIO32HS (above right) is a cased version with screw terminals.

Overview
The USB-DIO32HS provides 32 bits of high-speed digital I/O, and features independent input and output scan clocks, hardware and software triggering, and pattern detection/generation.

Digital I/O
The 32 DIO bits are available as two 16-bit ports that are bit-configurable for input or output. Each port is configured independently, so both software polling and hardware scanning operations can be performed at the same time.

When performing software polling, the port can contain any combination of input or output bits. When performing hardware-paced output scans, all bits in the port must be set for output. For input scans, however, the current state of any bits in the port that are configured for output are read.

Digital Output Scanning
Either digital port can output a 16-bit digital pattern. The pattern is updated at a rate up to 8 MS/s, and clocked using the output scan clock. Use both ports to output a 32-bit digital pattern. Data from one port is read and stored in the FIFO buffer until the second port is read. Both ports are output simultaneously on the rising edge of the next pacer clock signal.

Pull-Up/Down Configuration
The DIO bits can be pulled up to 5 V or down to 0 V through 47 kΩ resistors via onboard jumpers.

Clock I/O
Users can pace input scanning operations with the onboard input scan clock or with an external signal. The input clock frequency is 8 MHz, maximum.

A duty cycle of 50% is maintained when the internal input clock paces operations. When using an external clock, the signal is output immediately after the external clock input is received.

Data Transfer
The USB-DIO32HS uses a delay between the output scan clock and the data transfer pin, which allows an external device that is receiving the data to know that the data is stable at that point, and ensures a coherent data transfer between devices.

Features
- 32 bits of bidirectional TTL digital I/O
- Pattern detection and generation
- Input scan rate up to 8 MS/s
- Update rate up to 8 MS/s
- Independent input and output scan clocks
- 24 mA source, 10 mA sink output current
- External trigger and clock inputs
- Available with enclosure and screw terminals, or as a board-only OEM version with header connectors (no case, CD, or USB cable included)

Supported Operating Systems
- Windows® 10/8/7/Vista®, XP, 32/64-bit
- Linux®
- Android™

Triggering
Digital and pattern triggering are supported.

The TRIG pin is used for external TTL-level triggering, and can be used to trigger input or output scans. Trigger latency is less than 1 µs. The trigger mode is software-selectable for edge or level sensitive, and high or low logic.

Either digital port can be used for pattern triggering. A scan is triggered when a specified pattern is detected. Specific bits can be masked or ignored. Trigger latency is 1 scan clock period. You can input or output a digital pattern under the timing control of a clock signal.

USB-DIO32HS-OEM
The USB-DIO32HS-OEM has a board-only form factor with header connectors for OEM and embedded applications (no case, CD, or USB cable included). The device can be further customized to meet customer needs.
# USB-DIO32HS

## Software Support

The USB-DIO32HS is supported by the software in the table below.

### Ready-to-Run Applications

<table>
<thead>
<tr>
<th>Application</th>
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</tr>
</thead>
<tbody>
<tr>
<td>DAQami™</td>
<td>Data acquisition companion software with drag-and-drop interface that is used to acquire, view, and log data, and generate signals. DAQami can be configured to log analog, digital, and counter channels, and to view that data in real-time or post-acquisition on user-configurable displays. Logged data can be exported for use in Excel® or MATLAB®. Windows OS. DAQami is included with the free MCC DAQ Software bundle. Install DAQami and try the fully-functional software for 30 days. After 30 days, all features except for data logging and data export will continue to be available – data logging and data export features can be unlocked by purchasing the software.</td>
</tr>
<tr>
<td>InstaCal™</td>
<td>An interactive installation, configuration, and test utility for MCC hardware. Windows OS. InstaCal is included with the free MCC DAQ Software bundle.</td>
</tr>
<tr>
<td>TracerDAQ™ and TracerDAQ Pro</td>
<td>Virtual strip chart, oscilloscope, function generator, and rate generator applications used to generate, acquire, analyze, display, and export data. Supported features may vary by hardware. The Pro version provides enhanced features. Windows OS. TracerDAQ is included with the free MCC DAQ Software bundle. TracerDAQ Pro is available as a purchased software download.</td>
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### General-Purpose Programming Support

<table>
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<th>Library</th>
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<tr>
<td>Universal Library™ (UL) for Windows</td>
<td>Library for developing applications in C, C++, VB, C# .Net, VB .Net, and Python on Windows. The UL for Windows is included with the free MCC DAQ Software bundle. The UL Python API for Windows is available on GitHub (<a href="https://github.com/mccdaq/mcculw">https://github.com/mccdaq/mcculw</a>).</td>
</tr>
<tr>
<td>UL for Linux®</td>
<td>Library for developing applications in C, C++, and Python on Linux. UL for Linux is available on GitHub (<a href="https://github.com/mccdaq/uldag">https://github.com/mccdaq/uldag</a>). Open-source, third-party Linux drivers are also available for supported MCC devices.</td>
</tr>
<tr>
<td>UL for Android™</td>
<td>Library of Java classes for programmers who develop apps for Android-based mobile devices. UL for Android communicates with select MCC DAQ devices. Supports Android project development on Windows, Linux, Mac OS X. UL for Android is included with the free MCC DAQ Software bundle.</td>
</tr>
</tbody>
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### Application-Specific Programming Support

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<tr>
<td>ULx for NI LabVIEW™</td>
<td>A comprehensive library of VIs and example programs for NI LabVIEW that is used to develop custom applications that interact with most MCC devices. Windows OS. ULx for NI LabVIEW is included with the free MCC DAQ Software bundle.</td>
</tr>
<tr>
<td>DASYLab®</td>
<td>Icon-based data acquisition, graphics, control, and analysis software that allows users to create complex applications in minimal time without text-based programming. Windows OS. DASYLab is available as a purchased software download. An evaluation version is available for 28 days.</td>
</tr>
</tbody>
</table>
**Specifications**

These specifications apply to both USB-DIO32HS standard and OEM versions unless noted otherwise.

**Digital Input/Output**

- **Digital type:** TTL
- **Number of I/O:** 32 (2 ports of 16 bits)
- **Configuration:** Bit-configurable as input (power on default) or output
- **Pull-up configuration:** Each port has two 47 kΩ resistors configurable as a pull-up or pull-down (default) with an internal jumper.
  - Jumper W3: configures port 0 bit 0 to bit 7
  - Jumper W4: configures port 0 bit 8 to bit 15
  - Jumper W5: configures port 1 bit 0 to bit 7
  - Jumper W6: configures port 1 bit 8 to bit 15
- **Digital I/O transfer rate:**
  - System-paced, asynchronous: 33 to 8000 port reads/writes or single bit reads/writes per second typical, system dependent.
  - Synchronous: 0.022 Hz to 8 MHz, based on the internal clock speed of 96 MHz
- **Digital input pacing:** Onboard clock, external input scan clock (ICLK)
- **Digital input trigger source:** External single channel digital trigger (TRIG) or Pattern Detection
- **Digital output pacing:** Onboard clock, external output scan clock (OCLK)
- **Digital output trigger source:** External single channel digital trigger (TRIG) or Pattern Detection
- **Input high voltage:** 2.0 V min, 5.0 V absolute max
- **Input low voltage:** 0.8 V max, 0 V recommended min
- **Output high voltage:** 4.4 V min (IOL = –50 µA), 2.96 V min (IOL = –24 mA)
- **Output low voltage:** 0.1 V max (IOL = 50 µA), 0.77 V max (IOL = 10 mA)
- **Output current:** 24 mA source, 10 mA sink max per pin, constrained to 384 mA across all output pins (digital outputs, pacer clock outputs, and +VO)

**Pattern Trigger**

- **Trigger source:** Port 0 or Port 1
- **Trigger types:** Above pattern, Below pattern, Equal pattern, or Not equal pattern
- **Trigger stability:** Digital port must be stable for 31.25 ns to be recognized as a pattern
- **Trigger bit width:** Up to 16, adjustable through bitmask
- **Trigger latency:** Up to 16, adjustable through bitmask

**Pattern Detection**

- **Pattern:** Above pattern, Below pattern, Equal pattern, or Not equal pattern
- **Input scan clock input:** ICLKI, ICLKO, OCLKI, OCLKO
- **Input scan clock output:** Power on default 0 V, active on rising edge
- **Input clock frequency:** 8 MHz max
- **Input clock pulse width:** 10.417 ns min
- **Input Schmitt trigger hysteresis:** 0.76 V typ, 1.2 V max
- **Input Schmitt trigger threshold:** 1.74 V typ, 1.3 V min, 2.2 V max
- **Input low voltage threshold:** 0.98 V typ, 0.6 V min, 1.5 V max
- **Input low voltage limit:** –0.5 V absolute min, 0 V recommended min

**Clock Input/Output**

- **Terminal names:** ICLKI, ICLKO, OCLKI, OCLKO
- **Input clock type:**
  - ICLKI: Input scan clock input, active on rising edge
  - ICLKO: Input scan clock output, power on default 0 V, active on rising edge
  - OCLKI: Output scan clock input, active on rising edge
  - OCLKO: Output scan clock output, power on default 0 V, active on rising edge
- **Input clock frequency:** 8 MHz max
- **Input clock pulse width:** 10.417 ns min
- **Input Schmitt trigger hysteresis:** 0.76 V typ, 1.2 V max
- **Input Schmitt trigger threshold:** 1.74 V typ, 1.3 V min, 2.2 V max
- **Input high voltage limit:** 5.5 V absolute max
- **Input low voltage threshold:** 0.98 V typ, 0.6 V min, 1.5 V max
- **Input low voltage limit:** –0.5 V absolute min, 0 V recommended min
- **Output clock frequency:** 8 MHz max
- **Output clock pulse width:** Minimum 62.5 ns at 8 MHz, varies with sample rate; maintains 50% duty cycle using the internal clock. When using external clock, it follows the external clock input.
- **Output high voltage:** 4.4 V min (IOL = –50 µA), 2.96 V min (IOL = –24 mA)
- **Output low voltage:** 0.1 V max (IOL = 50 µA), 0.77 V max (IOL = 10 mA)
- **Output current:** 24 mA source, 10 mA sink max per pin, constrained to 384 mA across all output pins (digital outputs, pacer clock outputs, and +VO)

**Handshaking**

- **TXACK output:** Will have an 83.33 ns delay from the OCLKO
- **External Trigger**
  - **Trigger source:** External digital; TRIG terminal
  - **Trigger mode:** Software-selectable for edge or level sensitive, rising or falling edge, high or low level.
  - **Retrigger mode:** Trigger is rearmed after each trigger event
  - **Input clock latency:** 100 ns max
  - **Input clock pulse width:** 100 ns min
  - **Input Schmitt trigger hysteresis:** 0.76 V typ, 1.2 V max
  - **Input high voltage limit:** 1.74 V typ, 1.3 V min, 2.2 V max
  - **Input low voltage threshold:** 0.98 V typ, 0.6 V min, 1.5 V max
  - **Input low voltage limit:** –0.5 V absolute min, 0 V recommended min

**USB-DIO32HS Block Diagram**

- **Microcontroller with USB 2.0 high-speed interface**
- **FPGA**
- **Crystal 24 MHz**
- **EEPROM**
- **Power supplies**
- **Signal connectors**
- **Trigger input (TRIG)**
- **Input pacer clock input (ICLK)**
- **Output pacer clock input (OCLK)**
- **Output pacer clock output (OCLKO)**
- **Data transfer output (TXACK)**
- **+VO**
- **16-bit FIFO bus**
- **USB port**
- **D+/D–**
- **VBUS (5 V)**
- **5 V**
- **1.2 V**
- **3.3 V Always on**

- **Input type:** Schmitt trigger, 47 kΩ pull-down to ground with 33 Ω in series
- **Output type:** Schmitt trigger, 47 kΩ pull-down to ground with 33 Ω in series

**Input Schmitt trigger hysteresis:**

- **Input high voltage threshold:** 0.98 V typ, 0.6 V min, 1.5 V max
- **Input high voltage limit:** –0.5 V absolute min, 0 V recommended min

**Input low voltage threshold:**

- **Input low voltage limit:** –0.5 V absolute min, 0 V recommended min

**Output Schmitt trigger hysteresis:**

- **Output high voltage threshold:** –0.5 V absolute min, 0 V recommended min
- **Output high voltage limit:** 5.5 V absolute max
- **Output low voltage threshold:** 0.98 V typ, 0.6 V min, 1.5 V max
- **Output low voltage limit:** –0.5 V absolute min, 0 V recommended min

**Output Schmitt trigger hysteresis:**

- **Output low voltage limit:** –0.5 V absolute min, 0 V recommended min

**Input and Output Pull-up Configuration:**

- **Input pull-up:** Input pull-up to 5 V, active on rising edge
- **Output pull-up:** Output pull-up to 5 V, active on rising edge

**Input and Output Pull-down Configuration:**

- **Input pull-down:** Input pull-down to ground with 33 Ω in series
- **Output pull-down:** Output pull-down to ground with 33 Ω in series

**Input and Output Pull-up Resistance:**

- **Input pull-up resistance:** 1.2 V
- **Output pull-up resistance:** 0.1 V max (IOL = 10 mA)
## USB-DIO32HS

### Power
Supply current, USB source
- During enumeration: <100 mA
- After USB enumeration: <500 mA
+VO voltage output range
- After USB enumeration: 5 V, ± 5%
+VO output current
- After USB enumeration: 24 mA max per pin, constrained to 384 mA across all output pins (digital outputs, pacer clock outputs, and +VO)

### USB
Device type: USB 2.0 (high-speed)
Device compatibility: USB 1.1, USB 2.0, USB 3.0
USB cable length: 3 m (9.84 ft) max

### Environmental
Operating temperature range: 0 °C to 50 °C
Storage temperature range: -40 °C to 70 °C
Humidity: 0% to 90% non-condensing

### Mechanical
Signal I/O Connector
- Standard: 2 banks of screw-terminals (wire gauge range 16 AWG to 30 AWG)
- OEM: Two 1 × 28 pin 0.1 in. pitch headers
Dimensions (L × W × H):
- Standard: 128.52 × 88.39 × 35.56 mm (5.06 × 3.48 × 1.43 in.)
- OEM: 119.38 × 86.36 × 15.24 mm (4.70 × 3.40 × 0.60 in.)

### Order Information

#### Hardware

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<tbody>
<tr>
<td>USB-DIO32HS</td>
<td>USB digital I/O device with 32 bit-configurable DIO lines, and I/O scan rates up to 8 MS/s max. Includes USB cable and MCC DAQ software.</td>
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<tr>
<td>USB-DIO32HS-OEM</td>
<td>Board-only USB-based digital I/O board with 32 bit-configurable digital I/O lines, and I/O scan rates up to 8 MS/s max.</td>
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#### Software also Available from MCC

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<td>TracerDAQ Pro</td>
<td>Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version</td>
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