Digital Pattern I/O and Handshaking

**NI 653x**
- 20 MHz (80 M bytes/s) maximum transfer rate
- 32 digital (5 V TTL/CMOS) input/output lines
- 8, 16, or 32-bit transfers
- Start and stop triggering, pattern and change detection
- 32 MB onboard memory per data path (group) (NI 6534 only)
- NI-DAQ driver simplifies configuration and I/O operations

**Models**
- NI PCI-6534
- NI PXI-6534
- NI PCI-6533 (PCI-DIO-32HS)
- NI PXI-6533
- NI DAQCard-6533

**Features**
**I/O Lines**
The 32 digital I/O lines are divided into four 8-bit ports. For pattern I/O or handshaking, the ports can be grouped into two 8-bit or 16-bit groups, or a single 32-bit group. Each group can perform either input or output using the same clock source and clock rate. When configured for output, each data line can sink or source up to 24 mA when set logic low or high, respectively. When configured as inputs, the NI 653x data lines are diode-terminated to dampen the input signals at TTL levels. When performing static or unstrobed I/O, you can individually configure each of the 32 I/O lines as input or output.

**Operating Systems**
- Windows 2000/NT/XP
- Real-time performance with LabVIEW (page 134)
- Others such as Linux and Mac OS X (page 187)

**Recommended Software**
- LabVIEW
- LabWindows/CVI
- Measurement Studio

**Other Compatible Software**
- Visual Basic
- C/C++

**Driver Software (included)**
- NI-DAQ

### Pattern I/O and Handshaking I/O
With pattern I/O, you can input or output patterns under timing control of a clock signal. When using handshaking I/O to interface your NI 653x to a peripheral device, data is transferred when both the NI 653x and the peripheral are ready. See page 779 in the Digital I/O tutorial for more information.

### Change Detection
You can program the NI 653x devices to acquire data when one or more user-specified digital input lines changes state, saving valuable processing time. You can also use an NI 660x counter/timer device to timestamp when the lines change state. See page 779 in the Digital I/O tutorial for more information.

### Messaging
You can develop event-driven application programs with NI 653x devices by programming them to generate a message when conditions you specify are met. The messages can be generated when a specified number of bytes have been transferred, when a specified input pattern is matched, or when a measurement operation completes.

### Onboard Memory
NI 6534 devices provide two banks of 32 MB of onboard memory, each corresponding to a 8 M b/pin for a 32-bit group, 16 M b/pin for each 16-bit group, or 32 M b/pin for each 8-bit group. You can perform pattern I/O at deterministic high rates as long as the patterns can fit in one of these memory locations. To improve system performance for repetitive pattern output applications, you can load your patterns into the onboard memory once and then output them repeatedly, without reloading them across the computer bus.
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DMA Control Circuitry
NI 653x devices for PCI and PXI use the National Instruments MITE PCI interface. The MITE provides bus-master operation, PCI burst transfers, and high-performance DMA controllers for fast, continuous, scatter-gather DMA.

Multidevice Synchronization
All NI 653x devices except the DAQCard-6533 use the PXI trigger bus or RTSI bus to send and receive clock and trigger signals to and from other devices in your system. Using these buses, you can create synchronized systems with large numbers of digital I/O lines and systems in which digital I/O is synchronized with other types of measurements. The PXI-6534 module features phase-lock loop (PLL) circuitry to tightly synchronize with other PLL devices.

Front Panel Connector and Power-Up States
All digital I/O transmission is through a 68-pin cable connector. See pin assignments and descriptions in Figure 2 and Table 2. You can independently select the power-on state for the control and data lines through the use of CPULL and DPULL, respectively.

Driver Software
With NI-DAQ driver software, you can configure your devices interactively, write custom programs, and perform digital I/O transfers easily. With NI-DAQ, the NI 6533 and NI 6534 devices are software-compatible, providing a seamless upgrade path. Sharing clocks and triggers between NI 653x and other measurement devices is also greatly simplified. To get you started with your application quickly, NI-DAQ includes numerous example programs for LabVIEW and other ADEs.

Table 2. Signal Names and Descriptions

<table>
<thead>
<tr>
<th>Signal Names</th>
<th>Signal Types</th>
<th>Signal Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIOAx, DIOBx, DIOCx, DIODx</td>
<td>Data</td>
<td>Digital input/output lines</td>
</tr>
<tr>
<td>REQ1, REQ2, ACK1, ACK2</td>
<td>Control</td>
<td>Handshaking, timing and trigger lines</td>
</tr>
<tr>
<td>STOPTRIG1, STOPTRIG2</td>
<td>Control</td>
<td>Handshaking, timing lines</td>
</tr>
<tr>
<td>CPULL, DPULL</td>
<td>Power-up</td>
<td>Lines determine power-up states</td>
</tr>
</tbody>
</table>

Ordering Information
NI PCI-6534 ................................................................. 778287-01
NI PXI-6534 ............................................................... 778288-01
NI PCI-6533 (PCI-DIO-32HS) ........................................... 777314-01
NI PXI-6533 ............................................................... 777429-01
NI DAQCard-6533. ....................................................... 777315-01

Includes NI-DAQ driver software.

For information on extended warranty and value added services, see page 20.

Recommended Configurations

<table>
<thead>
<tr>
<th>Family</th>
<th>DAQ Device</th>
<th>Accessory</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 6534</td>
<td>PCI-6534</td>
<td>SCB-68 (776844-01)</td>
<td>SH6B-6B-D1 (183432-01)</td>
</tr>
<tr>
<td>NI 6533</td>
<td>PXI-6534</td>
<td>TB-2715 (776844-01)</td>
<td>SCB-68 (776844-01)</td>
</tr>
<tr>
<td>NI 6533</td>
<td>PCI-DIO-32HS</td>
<td>TB-2715 (776844-01)</td>
<td>SH6B-6B-D1 (183432-01)</td>
</tr>
<tr>
<td>NI 6533</td>
<td>DAQCard-6533</td>
<td>SCB-68 (776844-01)</td>
<td>PSHRB-68-D1 (777420-01)</td>
</tr>
</tbody>
</table>

*TB-2715 plugs directly into device; no cable required.

Related Products
Digital waveform generator/analyzers ....................... see page 435
High-speed digitizers .............................................. see page 438
Arbitrary waveform and function generators .............. see page 454
Multifunction data acquisition ................................. see page 189

BUY ONLINE!
Visit ni.com/products and enter pci6534, pxi6534, pci6533, pxi6533, or dagcard6533.
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Specifications

These specifications are typical for 25 °C unless otherwise noted.

Digital I/O

- Number of channels: 32 input/output
- 4 dedicated output and control
- 4 dedicated input and status

Compatibility: 5 V TTL/CMOS

Memory: 500 mVA

Digital logic levels:

<table>
<thead>
<tr>
<th>Level</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input low voltage</td>
<td>0 V</td>
<td>0.6 V</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2 V</td>
<td>5 V</td>
</tr>
<tr>
<td>Output low voltage (Iout = 24 mA)</td>
<td>–</td>
<td>0.4 V</td>
</tr>
<tr>
<td>Output high voltage (Iout = 24 mA)</td>
<td>2.4 V</td>
<td>–</td>
</tr>
</tbody>
</table>

 patterns running on the computer. Visit ni.com/products to access the most current benchmarks.

Performance Benchmarks

The performance benchmarks were conducted using LabVIEW or LabWindows/CVI programs and with the following computer systems:

- PXI 6534 – Dell Dimension XP 170x, Pentium II, Windows 98 SE
- PXI 6534 – PXI-1770, Pentium III, Windows 98
- PXI 6533 – PXI-1803/33HS – Gateway Pentium III, Win 98 SE
- PXI 6533 – PXI-1807, Pentium III, Windows 98

For pattern I/O, the benchmarks shown are the clock rates. For handshaking I/O, the time interval between transfers is not constant since both the NI 653x and the external device can pause the transfer; the benchmarks shown here present the average transfer rate rather than the sustained transfer rate.

Continuous Handshaking I/O – This benchmark configures the NI 653x device for burst mode handshaking protocol. The continuous burst mode I/O test calculates the average transfer rate over 1 GB of data transfer. The average transfer rate is calculated as the total data transferred divided by total length of time used for transfer. Single-shot burst mode handshaking I/O performance is as good or better than continuous I/O.

Continuous Pattern I/O – This benchmark uses the internal clock to control the transfer rate of the transfer. If the selected transfer rate is too high, an expected error will occur, and the internal clock rate is decreased. The benchmark executes until 1 GB of data is acquired. If an error occurs before 1 GB of data is acquired, the internal clock rate is decreased and the test stops.