Di-Series Digital Test Instruments

Versatile C-size VXI Instrument for Defense and Aerospace Applications

Teradyne’s Di-Series Digital Test Instruments (DTI) pack the industry’s most powerful combination of performance, density, flexibility, usability, and reliability into a highly integrated, standards-based solution. The Di-Series DTI increases usability, functionality and commonality while reducing the total number of instruments needed by a test system. As a result, using Di-Series instruments decreases a test systems footprint, programming, support, and cost-of-ownership. As part of Teradyne’s Core System Instrumentation (CSI) portfolio, the flexibility and performance of Di-Series instruments meet the essential requirements common to Defense and Aerospace automatic test equipment (ATE). In addition, Di-Series instruments provide the key features needed to test all levels of integration from the board level (SRA/SRU) to box level (WRA/LRU).

Key Features

- Proven Teradyne Compatibility maintains test program set (TPS) investment with previous generations of Teradyne digital instrumentation and systems
- LRU/WRA-Centric Flexibility addresses diverse requirements; units under test (UUTs) from boards to boxes, old and new designs, legacy instrument replacement
- Unmatched Performance addresses the latest technology and provides the best quality of test
- Breakthrough Usability provided by flexible hardware and innovative development and debugging software
- Reliability, Survivability and Supportability that keeps systems running based on decades of Defense and Aerospace experience

Capabilities

- 64 single-ended 50 MHz channels
- Per-channel programming of levels & timing
- 256K flexible pattern memory per channel
- 8M Deep Serial Memory per channel
- Handshake engine for asynchronous busses
- iStudio graphical development & debug tool

The Digital Test Heritage

The Di-Series instruments build upon Teradyne’s digital test success first established by the L-Series functional testers and the M9-Series DTIs. Like the M9-Series, the Di-Series instruments use VXI-compliant hardware and software for easy integration with other instruments in standard C-Size VXI-based test systems. Backward compatibility preserves prior hardware and software test investments.

Field Proven Success

Many of the world’s leading defense and aerospace factories, depots, and intermediate-level test facilities rely on Teradyne’s DTI. Our instruments are used in a wide range of applications, including the U.S. Department of Defense (DoD) Standard automatic test system (ATS) Families including U.S. Marine Corps VIPER/T (TETS), U.S. Army IFTE, Navy CASS, and RTCASS testers. Teradyne’s digital instruments also form the core of the Air Force VDATS and Teradyne Spectrum 9100 avionics testers associated with key fighter, bomber, cargo, and missile programs. The CSI family, including the Di-Series, is a key element of the Agile Rapid Global Combat Support (ARGCS) Advanced Concept Technology Demonstration whose success is helping to modernize future DoD ATS families.

Commitment to Technology

Defense and aerospace test engineers face an array of difficult test challenges that include:

- Upgrading or replacing aging test systems and maintaining compatibility with legacy equipment
- Building equipment to test multiple stages of assembly
- Preparing for next-generation platforms
- Managing the entire test development process despite ever-increasing complexity

The Di-Series DTI includes the following features and benefits that address these issues.

1. Proven Teradyne Compatibility

The digital sections of an L-Series or CASS test program set (TPS) can be translated to operate with Di-Series instruments using Teradyne’s proven TPS Converter Studio™ software. The converter
generates C-language code that controls the Di-Series instruments through the
Teradyne copyrighted CShell™ Applications Programming Interface featuring function
calls similar to L-Series language statements. The Di-Series instruments feature per-
channel levels and timing control to allow easy and conflict-free mapping from L-Series
to Di-Series. Programs previously written for the M9-Series DTI will run directly on Di-
Series instruments. Programs that used the CShell API with the M9-Series instruments
may now control the Di-Series without code changes. Programs that directly called the
M9-Series VXIplug&play driver can also use the Di-Series instruments. By replacing the
M9-Series driver at run time, the Di-Series software provides full binary compatibility,
allowing the typical M9-Series TPS to run without recompilation or linking. In addition,
the Di-Series iStudio software can convert M9-Series tests into native Di-Series code so
the TPS developer can take full advantage of new Di-Series functionality.

2. WRA/LRU-Centric Flexibility

Boxes (WRA/LRU) require numerous bus-
oriented tests that involve asynchronous
transfers. The Di-Series instruments feature
a new Handshake Engine that simplifies
asynchronous data transfer based on the
UUT response. The Handshake Engine is
simple to program, eliminates complex
multi-pattern homing loops that determine
when the UUT is ready, and reduces
delay. Other instruments generally lack
the ability to easily and quickly interact
with a UUT. The Di-Series overcomes this
limitation and addresses the requirements
of all levels of assembly from board to box.
This flexibility improves the quality of test
and reduces programming costs. Most
boxes have multiple I/O ports that operate
concurrently, with no discernable common
timing. Until now, TPS developers either
had the difficult task of sharing a single
instrument across the ports, or were forced
to equip systems with multiple, expensive
digital instruments. A unique feature of the
Di-Series is its programmable partitioning
that provides multiple, independent virtual
instruments that operate concurrently, but
totally asynchronously from one another.
Each virtual instrument can address one port
and improve operational test quality while
reducing the development effort.

Newer UUT designs require increasingly
larger quantities of test data. The Di-Series
Deep Serial Memory can efficiently address
the problems associated with loading,
unloading, and testing large blocks of test
data, testing memory, or configuring a box.
Each Di-Series channel has 8 M locations of
sequentially addressable data memory to
complement the 256K of dynamic pattern
memory that manages the repetitive control
operations. Since the Deep Serial Memory is
behind every channel, bus widths can range
from narrow serial to wide parallel buses.

The Di-Series recognizes that the signal
transmission path between the tester and
UUT can be demanding. For instance, the
same channel that supports the small
voltage swings associated with Low-Voltage
Differential Signaling (LVDS) on one TPS can
support 30 V swings associated with legacy
I/O requirements of another TPS. LVDS
features programmable edge speeds: slow
dges to avoid overshoot, undershoot, and
ringing in uncontrolled situations; or fast
dges for high accuracy and performance in
a controlled environment. With independent,
per-channel programming of edge speeds,
the Di-Series can greatly simplify TPS
debugging, optimize TPS quality, and
improve repeatability.

3. Unmatched Performance

Emerging designs increasingly use
differential pairs to permit higher speed I/O
despite several feet of cabling. The latest
designs use LVDS and legacy designs often
contained in earlier forms of differential
logic that present significant test challenges.
The Di-Series channels can be paired to
accommodate differential signals that avoid
specialized test instruments or additional
circuitry in the test adapter.

Teradyne’s Di-Series instruments can
simultaneously test the differential logic
state and the common mode offset that the
pair shares with optimal edge speeds and
line termination. Combining LVDS and 50
MHz capability provides a practical means to
provide high-performance signals in a real-
world test environment.

The Di-Series employs QuadDetect™ to more
comprehensively test digital logic states.
Other vendor instruments typically use
dual-threshold detectors: one to ensure a
minimum logic “1” and another to ensure a
maximum logic “0.” QuadDetect uses four
detectors to band the lower and upper limits
of each logic state to improve the quality
of test and decrease the No-Fault Found
escape rate.

4. Breakthrough Usability

The Di-Series hardware was designed to
maximize usability by eliminating shared
resources. Now, instead of programming
the drive, detect, and load parameters in
a limited number of sets, each Di-Series
channel can be programmed independently.
Instead of sharing a small number of drive
phases and test windows, each Di-Series
channel has an independent phase and
window. And, each channel has independent
timeout over driver edge speed. Channel
independence allows engineers and
technicians to focus on the UUT rather
than the limitations of the test system,
whether programming, debugging, or
troubleshooting.

As digital tests become more complex,
the creation and debugging of tests can
become expensive. The Di-Series is backed
by iStudio, a comprehensive graphical
development and debugging environment
that complements existing Applications
Development Environments (ADEs) and test
executives. iStudio features a Digital Test
Editor for codeless programming; visualizing
and editing the timing, levels, and patterns
that comprise a digital test. iStudio can be
used interactively on the test system, or can
be used on a stand-alone computer with
instrument simulation. A completed test can
be exported as a data file, reloaded into the
instrument, and executed under control of
the TPS using any language. Alternatively,
the Digital Test Editor can export the test
for enhancement in standard languages (C or
C#) for use in tools such as LabWindows™
or Visual Studio™. iStudio will import tests
from Teradyne’s LASAR™ and VICTORY™
suites. The Digital Test Editor provides this
functionality whether the test was originally
created in iStudio, imported from another
source, or written in a standard language.

The Di-Series iStudio is a great tool for all
phases of TPS development. Novice users
can benefit from using iStudio for learning
and interactive experimentation. Many
users employ iStudio to start a new project
graphically, and then complete it using
conventional code. Developers use iStudio to develop all of their test patterns. Virtually all users employ iStudio as the means for graphically debugging their Di-Series tests, including legacy and new TPSs.

5. Reliability, Survivability, and Supportability

Teradyne has over 50 years of experience in the test business, building the world’s most robust and reliable test systems.

Each product meets our rigorous quality requirements. To ensure the Di-Series is rugged enough for shipboard or mobile environments, it undergoes shock and testing. These and other tests along with high-density packaging maximize Mean Time Between Failure (MTBF). In addition, diagnostic self-test software verifies parametric operation of the Di-Series instruments using internal resources.

Di-Series instruments are designed for survivability in the harsh environment of testing faulty assemblies. For example, the custom pin electronics shared by all Di-Series instruments feature high-voltage, high-current output capability coupled with over-voltage protection that automatically disconnects from the UUT in less than 50 µs to avoid damage.

Teradyne has extensive experience in providing integrated hardware and software support worldwide. Support services include 24-hour repair-and-return of defective parts, hotline telephone support, comprehensive training and documentation, and in-field calibration verification.

The Di-Series instruments are available in a wide range of models that address a various performance and price needs. Models can be selected based on speed, voltage range, and the number of channels in an instrument. The full range of Di-Series models are as follows:

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>25 MHz Instruments</th>
<th>50 MHz Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>±15 V</td>
<td>Di-025-21</td>
<td>Di-025-21</td>
</tr>
<tr>
<td>±30 V</td>
<td>Di-025-11</td>
<td>Di-025-11</td>
</tr>
<tr>
<td>±15 V</td>
<td>Di-050-21</td>
<td>Di-050-21</td>
</tr>
<tr>
<td>±30 V</td>
<td>Di-050-11</td>
<td>Di-050-11</td>
</tr>
</tbody>
</table>

iStudio is a test program development and debug environment with interactive digital test editing tools.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data and clock rate</td>
<td>25 MHz (Di-025 models) or 50 MHz (Di-050 models)</td>
</tr>
<tr>
<td>Channels/VXI slot</td>
<td>64 single-ended (32 differential pairs) OR 32 single-ended (16 differential pairs)</td>
</tr>
<tr>
<td>Dynamic pattern memory</td>
<td>256K patterns</td>
</tr>
<tr>
<td>Deep serial memory</td>
<td>8 M per channel, sequentially accessed</td>
</tr>
<tr>
<td>Timing sets</td>
<td>256</td>
</tr>
<tr>
<td>Pattern branching</td>
<td>Loops, branches, conditionals, subroutines, event handlers</td>
</tr>
<tr>
<td>Algorithmic capabilities</td>
<td>CRC generation, keep &amp; toggle, Teradyne L-Series compatible MemTest</td>
</tr>
<tr>
<td>Synchronization and debugging capabilities</td>
<td>Programmable handshake, external trigger-in, external trigger out, external clock in &amp; out, test envelope (burst running signal), VXI TTL trigger bus, dynamic breakpoints</td>
</tr>
<tr>
<td>External clock synchronization</td>
<td>DC to 50 MHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive phases/test</td>
<td>Independent phase &amp; window per channel windows</td>
</tr>
<tr>
<td>Drive phase/test window resolution</td>
<td>1 ns</td>
</tr>
<tr>
<td>Drive and detect skew</td>
<td>±3 ns max across all channels</td>
</tr>
<tr>
<td>Minimum pulse width</td>
<td>10 ns</td>
</tr>
<tr>
<td>Channels per cage</td>
<td>768</td>
</tr>
<tr>
<td>Virtual instruments/cage</td>
<td>24 maximum</td>
</tr>
<tr>
<td>Drive current</td>
<td>Up to 80 mA with programmable limits</td>
</tr>
<tr>
<td>Drive &amp; detect levels</td>
<td>-5 V to +15 V OR -15 V to +5 V, 20 V max swing</td>
</tr>
<tr>
<td>Drive &amp; detect levels</td>
<td>±30 V, 30 V max swing</td>
</tr>
<tr>
<td>Over-voltage protection μs</td>
<td>Automatic relay disconnect within 50 μs</td>
</tr>
<tr>
<td>Data formats</td>
<td>Seven (NR, R0, R1, RZ, RC, RM, SC)</td>
</tr>
<tr>
<td>Driver slew rate control</td>
<td>100: 1 adjust range per channel, 1 V/ns maximum</td>
</tr>
<tr>
<td>Guided probe</td>
<td>Optional</td>
</tr>
<tr>
<td>Operating range</td>
<td>0 – 50°C ambient</td>
</tr>
</tbody>
</table>