Agilent N1055A Remote Head Module
35/50 GHz 2/4 Port TDR/TDT

For the 86100D DCA-X Series
Oscilloscope Mainframe

Data Sheet

Engineered for easy, accurate impedance and S-parameter measurements on multi-port 10/25/28 Gbps (40G/100G) designs

• Highest resolution TDR/TDT measurements
• Fast and accurate multiport S-parameters, up to 16 ports
• World’s easiest-to-use solution
Signal integrity challenges abound

As new digital designs increase in data rates to 28 Gb/s and beyond, signal integrity issues become more challenging. Additionally, industry standards such as IEEE 802.3 ba/bj/bm (40 Gb/100 Gb Ethernet), Optical Inter-networking Forum (OIF) CEI 3.0, Fibre channel, PCI Express, USB, and InfiniBand require the use of TDR/TDT and S-parameter measurements to ensure compliance and system interoperability.

A fully-integrated 86100D TDR/TDT/S-parameter measurement system

Designed for both novice and expert users alike, the Agilent N1055A remote head module provides time-domain reflectometry and transmission (TDR/TDT) capability for the 86100D DCA-X oscilloscope platform, providing fast and accurate impedance and S-parameter measurements on high-speed designs that have up to 16 ports. The 86100D DCA-X oscilloscope mainframe can be configured with one to four N1055A TDR/TDT plug-in modules to provide a 2- to 16-channel TDR/TDT measurement system that is both economical and accurate. The 2/4 port TDR/TDT remote heads can be configured with sampler bandwidth of 35 GHz or 50 GHz, providing single-ended and differential measurement capability including True-Mode stimulus functionality.

Measurements include:

- **Time-Domain Reflectometry (TDR)**
  - Impedance measurements
  - Locate the position and nature of each discontinuity
  - Propagation/time delay
  - Excess reactance (capacitance or inductance)
  - Effective dielectric constant

- **Time-Domain Transmission (TDT)**
  - Step response
  - Propagation/time delay
  - Propagation velocity
  - Rise-time degradation
  - Near-end crosstalk (NEXT)
  - Far-end crosstalk (FEXT)
  - Skew

- **S-parameters (86100D-202)**
  - Return loss
  - Insertion loss
  - Crosstalk
  - Mode conversion
    - Differential- to common-mode conversion (SCDxx)
    - Common- to differential-mode conversion (SDCxx)

Fast and accurate S-parameter measurements.
The 86100D DCA-X mainframe, equipped with N1055A modules, creates a fully-integrated TDR/TDT/S-parameter measurement system that provides calibrated results on up to 16 channels in real-time

**Single-ended and differential device testing**
Each TDR/TDT module provides single-ended, differential and common mode measurement capability, including True-Mode stimulus capability.

**Complete S-parameter analysis**
Full S-parameter measurements from DC to more than 50 GHz on up to 16 ports. Export single-ended and mixed-mode data in Touchstone file format.

**Real-time results**
Calibrated impedance and S-parameter results are displayed in real-time (no external application, monitor or computer required).

**ECal DC - 67 GHz module support**
Electronic calibration (ECal) modules provide fast and accurate calibrations with a minimum number of connections.

**Calibration made easy**
TDR/TDT calibration improves measurement accuracy. A built-in calibration wizard supports both mechanical standards (SOLT) and ECal modules.

**Fast TDR edge speed**
Fast edge speeds yield higher TDR resolution.
- 8 ps (typ) 50 GHz, calibrated
- 9 ps (typ) 50 GHz
- 18 ps (typ) 35 GHz
**Built-in ESD/EOS protection**
Each remote head integrates 67-GHz diode limiters to help protect against electrostatic discharge (ESD) and electrical overstress (EOS).

**Adjustable edge speed**
The effective TDR edge speed may be adjusted (faster or slower) to comply with standards-based testing.

**N1055A bandwidth options**
- 35 GHz (2.92 mm)*
- 50 GHz (1.85 mm)
  *upgradable to 50 GHz

**N1055A channel count options**
- 2 channels per module*
- 4 channels per module
  *upgradable to 4 channel

**High-bandwidth oscilloscope**
The N1055A's receiver can be used as an oscilloscope to analyze waveforms and perform precision jitter analysis (86100D-200) on high-speed data signals.

**Up to 16 channels per mainframe**
Up to 16 TDR/TDT channels per 86100D DCA-X mainframe minimize cable reconnections and facilitate efficient near-end crosstalk (NEXT) and far-end crosstalk (FEXT) measurements.

**Connector type option**
Minimize use of adapters and cables (and save money) by choosing the connector style that suits your needs (male or female connector).
Highest resolution TDR/TDT measurements

High TDR resolution is essential for accurately characterizing complex high-speed structures. With TDR step edge speeds as fast as 8 ps and receiver bandwidths of 50 GHz, the DCA-TDR solution resolves the magnitude and location of impedance discontinuities with unmatched performance.

TDR edge speed

TDR resolution is determined by the rise time of the TDR step generator and the effective dielectric constant of the device under test (DUT).

The edge speed that is delivered to the DUT is called the transmitted edge speed. It is measured at the output of the remote head by a high-bandwidth receiver.

10-90% edge speed (raw hardware performance):
- 35 GHz option: < 18 ps typical
- 50 GHz option: < 9 ps typical

10-90% edge speed (calibrated performance):
- 35 GHz option: 18 ps typical
- 50 GHz option: 8 ps typical

The flexible, upgradable design offers 2- and 4-channel remote head modules.

Bandwidth options:
- 35 GHz (2.92 mm connector)
- 50 GHz (1.85 mm connector)

Remote head may be configured with male or female connectors (chosen at time of order).

Bandwidth upgrades:
Upgrade a 35-GHz module to 50 GHz by ordering the appropriate N1055AU option (requires Return-to-Agilent).

Channel/port Count:
- 2 channel
- 4 channel

Channel count upgrades:
For example, a 4-channel module is required to perform both TDR and TDT measurements on a device having two differential pairs (4 ports). Upgrade from 2 channels to 4 channels by ordering the appropriate N1055AU option (requires Return-to-Agilent).
Single-ended and differential stimulus

The TDR/TDT remote heads may be configured for single-ended (SE), differential- or common-mode measurements. Step polarity, skew, amplitude and repetition rate can be independently configured for each remote head. Additionally, the N1055A may be configured for True-Mode stimulus (simultaneous positive and negative going steps), which allows a device to be tested using the conditions under which it normally operates.

Connector options:

- 35 GHz 2.92 mm: male or female
- 50 GHz 1.85 mm: male or female

*Note - All remote heads within a single module must be equipped with the same connector type.

Two remote heads form a differential pair; heads may be held together using a remote head clamp (two clamps are shipped with each module). When clamped, pin-to-pin spacing is 10 mm.

The ultra-thin remote head has also been designed so it can be directly connected to most high-bandwidth TDR probes on the market today, thereby minimizing signal degradation due to cables.
Fast and accurate multi-port S-parameters (86100D-202)

Scattering parameters (S-parameters) are generated in real-time within the oscilloscope for simultaneous display with time domain results. They are mathematically derived from TDR and TDT measurements using the 86100D Option 202 enhanced impedance and S-parameter analysis software. The N1055A’s fast rise time enables calibrated S-parameter measurements to more than 50 GHz.

Magnitude, phase and group delay plots can be configured at the touch of a button.

FlexDCA displays accurate S-parameter magnitude, phase and group delay plots simultaneously.

Minimize re-connections, maximize productivity

With up to 16 TDR/TDT channels, the DCA-TDR solution also helps to minimize cable re-connections and facilitate more efficient near end crosstalk (NEXT) and far end crosstalk (FEXT) measurements both in R&D as well as high-volume test applications. For example, a 16-port system can measure NEXT and FEXT on up to four differential lanes simultaneously.

Measure and display (in real-time) calibrated S-parameters to >50 GHz.

FlexDCA displays accurate S-parameter magnitude, phase and group delay plots simultaneously.

86100D Option 202 performs single-ended and mixed-mode S-parameter measurements on up to 16 ports (4-port device shown in screen capture). The software automatically controls the sequencing of TDR steps so a full set of S-parameters can be generated by the touch of a button.

Measure and display (in real-time) calibrated S-parameters to >50 GHz.

Minimize re-connections, maximize productivity

With up to 16 TDR/TDT channels, the DCA-TDR solution also helps to minimize cable re-connections and facilitate more efficient near end crosstalk (NEXT) and far end crosstalk (FEXT) measurements both in R&D as well as high-volume test applications. For example, a 16-port system can measure NEXT and FEXT on up to four differential lanes simultaneously.

Single-Ended

<table>
<thead>
<tr>
<th>S11</th>
<th>S12</th>
<th>S13</th>
<th>S14</th>
</tr>
</thead>
<tbody>
<tr>
<td>S21</td>
<td>S22</td>
<td>S23</td>
<td>S24</td>
</tr>
<tr>
<td>S31</td>
<td>S32</td>
<td>S33</td>
<td>S34</td>
</tr>
<tr>
<td>S41</td>
<td>S42</td>
<td>S43</td>
<td>S44</td>
</tr>
</tbody>
</table>

Select S-parameter measurements quickly and easily.

Perform efficient near-end crosstalk (NEXT) and far-end crosstalk (FEXT) measurements on differential designs that have up to four lanes.
World’s easiest-to-use solution on devices that have up to 16 ports

The 86100D-based system combines its powerful FlexDCA graphical user interface with the world’s only TDR/TDT solution that leverages accurate, easy-to-use electronic calibration (ECal) technology. This combination provides calibrated impedance and S-parameter results that are displayed in real-time within the FlexDCA user interface — no external application, monitor or computer is required.

TDR/TDT calibration

For users who do not need precision measurements and prefer to perform simple, quick impedance and S-parameter measurements on a device, a TDR/TDT calibration is not required thanks to the high-fidelity performance of the raw hardware.

N4694A DC-67 GHz electronic calibration (ECal) modules make TDR calibration and de-skew fast and easy.

The built-in calibration wizard also supports a variety of other calibration methods that include:

• ECal-based
• SOLT with calibration kit
• SLT with calibration kit
• SLT with generic standards

SOLT = Short, Open, Load and Thru
Easy set-up using graphical user interface

A graphical user interface makes it easy to configure the instrument. Port names may also be customized using meaningful names that relate to the device being tested (Example: TX1+, TX1- or J1+, J1-). FlexDCA uses the custom names when displaying signals and saving waveforms.

Built-in ESD/EOS protection

Each remote head integrates a high-performance TDR step generator and high-bandwidth sampling into a microcircuit located behind the connector. To protect these high-performance components against electrostatic discharge (ESD) and electrical overstress (EOS), each microcircuit also integrates multiple 67-GHz diode limiters into the design. While the user must still follow safe ESD and EOS practices, the diode limiters offer additional protection and help protect your investment.

Customizable displays

With the click of a button, FlexDCA can be configured to display impedance and S-parameter waveforms the way you want using overlapped, tiled or zoom-tiled displays.
**Easy channel and eye diagram simulations (86100D Option SIM)**

Generate waveform and eye diagram simulations without using an external pattern generator. 86100D Option SIM provides integrated embedding and de-embedding channel simulations using S-parameters generated using the DCA (or imported from other tools).

The N1055A TDR/TDT module, equipped with 16 bit low-noise samplers, can also be used as a receiver only and perform accurate oscilloscope, eye/mask and jitter/noise (86100D-200/300) measurements. When used with the 86107A or 86100D-PTB precision timebase circuits, the N1055A provides a high-bandwidth measurement system with < 100 fs rms intrinsic random jitter.

**N1055A receiver-only operation**

FlexDCA software integrates impedance (TDR/TDT), S-parameter (86100D-202), oscilloscope, eye/mask, jitter/noise (Option 200/300), equalization (Option 201), channel simulation (Option SIM) and other powerful features into a single application that runs on the 86100D mainframe or on a PC (using N1010A FlexDCA). For more information, refer to www.agilent.com/find/flexdca.

FlexDCA may be used to generate waveform and eye diagram simulations using S-parameters generated by the TDR/TDT system.

**One application, FlexDCA, provides comprehensive measurement capability**

The N1055A module is supported by all 86100D DCA-X DCA modes of operation.
## Specifications table

### Dual/quad electrical channel modules

<table>
<thead>
<tr>
<th>Channel options</th>
<th>32F/32M</th>
<th>34F/34M</th>
<th>52F/52M</th>
<th>54F/54M</th>
</tr>
</thead>
<tbody>
<tr>
<td>(number of channels; F = female; M = male)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of channels</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Electrical channel bandwidth</td>
<td>35 GHz</td>
<td>35 GHz</td>
<td>35/50 GHz</td>
<td></td>
</tr>
<tr>
<td>Transition time (10% to 90% calculated from TR = 0.35/BW)</td>
<td>10 ps</td>
<td>10/7 ps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel-to-channel skew range</td>
<td>± 100 ps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RMS noise

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>550 uV</th>
<th>550/950 uV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale factor (per division)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>1 mV / division</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>100 mV / division</td>
<td></td>
</tr>
<tr>
<td>DC accuracy (single marker)</td>
<td>±0.4% of full scale</td>
<td>±2 mV ±4% of (reading-channel offset), (50 GHz)</td>
</tr>
<tr>
<td>DC offset range (referenced from center of screen)</td>
<td>±500 mV</td>
<td></td>
</tr>
<tr>
<td>Input dynamic range (relative to channel offset)</td>
<td>±400 mV</td>
<td></td>
</tr>
<tr>
<td>Maximum input signal</td>
<td>+2 V / -1 V</td>
<td></td>
</tr>
<tr>
<td>Nominal impedance</td>
<td>50 ohm</td>
<td></td>
</tr>
<tr>
<td>Electrical input</td>
<td>2.92 mm (female or male option)</td>
<td>1.85 mm (female or male option)</td>
</tr>
</tbody>
</table>

1. Module is supported by 86100D DCA-X mainframe and later.
2. Upgradable from 2 channel to 4 channel after purchase (return to Agilent).
3. Connector style in the same on all channels and is selected at time of order.
4. Upgradable from 35 GHz to 50 GHz after purchase (return to Agilent).

### N1055A - 3xx

<table>
<thead>
<tr>
<th>(35 GHz bandwidth)</th>
<th>N1055A - 5xx</th>
<th>(50 GHz bandwidth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without TDR calibration</td>
<td>With TDR calibration</td>
<td>Without TDR calibration</td>
</tr>
<tr>
<td>Step rise/fall time (Transmitted, typical)</td>
<td>18 ps</td>
<td>Adjustable from 18 ps</td>
</tr>
</tbody>
</table>

1. “Transmitted” edge speed is the TDR edge speed at the output of the remote head. Step speed is validated using a connector-to-connector measurement using a high-bandwidth receiver (> 60 GHz).
Ordering options

**N1055A 35/50 GHz 2/4 Port TDR/TDT remote head**

Choose ONE option:

- N1055A-32F 35 GHz, 2 channel, 2.92 mm, female
- N1055A-32M 35 GHz, 2 channel, 2.92 mm, male
- N1055A-34F 35 GHz, 4 channel, 2.92 mm, female
- N1055A-34M 35 GHz, 4 channel, 2.92 mm, male
- N1055A-52F 50 GHz, 2 channel, 1.85 mm, female
- N1055A-52M 50 GHz, 2 channel, 1.85 mm, male
- N1055A-54F 50 GHz, 4 channel, 1.85 mm, female
- N1055A-54M 50 GHz, 4 channel, 1.85 mm, male

**N1055A included accessories**

- N1027A-1CL Cable management clips (6 at yellow, pink, blue, green)
- N1027A-2CL 2 remote head clips
- 8710-1765 Torque wrench 8 lb-in, 5/16 in
- N1027A-1CF Protective cap for 1.85 mm, female
- N1027A-1CM Protective cap for 1.85 mm, male
- N1027A-3CF Protective cap for 2.92 mm, female
- N1027A-3CM Protective cap for 2.92 mm, male

**N1055A optional accessories**

- N1027A-3MC Storage case for N1055A module
- N1027A-3AC Accessory case for N1055A module
- N1027A-1C1 Coaxial cable 1.85 mm, M/M, 67 GHz, 10 cm

**Multiple module configurations require 86100D-ETR**

86100D-ETR is required if using an N1055A module to perform a TDT measurement using a separate DCA module (for example N1045A, N1055A, 86117A, etc.) as the receiver. In this configuration, 86100D Option ETR provides internal cabling for module synchronization.

**Calibration kits**

Electronic calibration (ECal) modules

- N4694A-HMM ECal module, DC-67 GHz, 1.85 mm, male-male
- N4694A-HFF ECal module, DCA-67 GHz, 1.85 mm, female-female
- N4694A-HMF ECal module, DCA-67 GHz, 1.85 mm, male-female

Mechanical calibration kits

- 85033D 3.5mm calibration kit, 30 kHz to 6 GHz
- 85033E Standard mechanical calibration kit, DC to 9 GHz, 3.5 mm
- 85052B Standard mechanical calibration kit, DC to 26.5 GHz, 3.5 mm
- 85052C Precision mechanical calibration kit, DC to 26.5 GHz, 3.5 mm
- 85052D Economy mechanical calibration kit, DC to 26.5 GHz, 3.5 mm

- 85056A Standard mechanical calibration kit, DC to 50 GHz, 2.4 mm
- 85056D Economy mechanical calibration kit, DC to 50 GHz, 2.4 mm
- 85056K Mechanical calibration kit, DC to 50 GHz, 2.4 mm and 2.92 mm
- 85058B Standard mechanical calibration kit, DC to 67 GHz, 1.85 mm
- 85058E Economy mechanical calibration kit, DC to 67 GHz, 1.85 mm

**Generic calibration kits**
AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. Agilent is a founding member of the AXIe consortium.

Three-Year Warranty

Beyond product specification, changing the ownership experience. Agilent is the only test and measurement company that offers three-year warranty on all instruments, worldwide.

Agilent Channel Partners

Get the best of both worlds: Agilent’s measurement expertise and product breadth, combined with channel partner convenience.

Agilent Solution Partners

Get the best of both worlds: Agilent’s measurement expertise and product breadth, combined with solution partner convenience.