

# T3AWG3252 / T3AWG3352 Data Sheet

## High Definition Dual Channel Arbitrary Waveform Generator



### Accurate and Versatile Waveforms Generation

- 16 Bit Vertical Resolution
  - ✔ Exceptional signal fidelity for developing quality products with a reduced design cycle.
- 24 V<sub>pp</sub> Output Voltage and ±12 V HW Baseline Offset for a total output voltage window ±24 V or 48 V (50 Ohm into High Impedance)
  - ✔ Unmatched wide output voltage window enables generating challenging in amplitude large-signal waveforms.
- Waveform memory up to 1 Gpoint @Ch
  - ✔ Unmatched deep memory depth allows to store and reproduce complex pseudo-random waveforms for long play time testing.
- Mixed Signal Generation
  - ✔ Combining the 2 analog channels with 8 synchronized Digital Channels for debugging and validating digital design.
- Multifunctional solution instrument (AFG/AWG/DPG)
  - ✔ Arbitrary Function Generator, Arbitrary Waveform Generation and Digital Pattern Generation functionalities combined into one instrument.

### Key Specifications

| Model   | T3AWG3252  | T3AWG3352             |
|---|--|-----------------------|
| Frequency Range (Sinewave, AFG mode)          | 1 μH to 250 MHz  | 1 μH to 350 MHz       |
| Sample Rate (AWG mode, not interpolated)      | 1.0 GS/s   | 1.2 GS/s              |
| Vertical Resolution                           | 16 Bits  |                       |
| Memory  | Up to 1 Gpoint/Ch.   |                       |
| Output Voltage V <sub>pp</sub> (peak to peak) | 12 V <sub>pp</sub> (50 Ohm into 50 Ohm), 24 V <sub>pp</sub> (50 Ohm into High-Impedance) |                       |
| Digital Pattern Generator (DPG)               | 8 Channels @ 1.0 Gbps  | 8 Channels @ 1.2 Gbps |

# PRODUCT OVERVIEW

## AFG Operational Mode

- Improved Direct Digital Synthesis (DDS) based technology
- Fixed sampling clock



**Arbitrary Function Generation (AFG functionality)**

## AWG Operational Mode

- Variable Clock True-Arbitrary Technology
- Variable Sampling Clock
- Mixed Signal Generation: 2 Analog Channels and 8 Digital Channels



**Arbitrary Waveform Generation (AWG functionality)**



**Digital Pattern Generation (DPG functionality)**

## A multifunctional generator with an innovative architecture

T3AWG3352-3252 are multifunctional generators that combines many functions in one instrument, including Arbitrary Function Generator, Arbitrary Waveform Generator and Digital Pattern Generator.

These three-different functionalities are leveraging on the HW flexibility adopting two different technologies.

An improved Direct Digital Synthesis (DDS) based technology adopted when using the Function Generator (AFG) lets the user to change glitch free on-the-fly all the parameters preserving the waveform shape.

All control and setting are always one touch away: swipe gesture to change the channel, the carrier selection and have access to the modulation parameters, swipe into the waveform gallery to import a signal at a glance and use the touch-friendly virtual numeric keyboard to change parameters values.

The variable clock, true-arbitrary technology adopted when using the Arbitrary Waveform / Digital Pattern Generator lets the user to create complex waveforms of analog and digital pattern, insert them in a sequence, apply loops, jumps and conditional branches. Digital output combined and synchronized with analog output

signals represents an ideal tool to troubleshoot and validate digital design.

The waveform memory length of 128 Mpoints (up to 1 Gpoints optional) on each channel combined with number of waveforms entries up to 16,384 and the waveform repeat count higher than  $4 \cdot 10^9$  or infinite make the T3AWG3252 and the T3AWG3352 the best-in-class waveform generators for the most demanding technical applications.

This disruptive and innovative hardware architecture provides the possibility to generate unmatched performances, versatile functionality, outstanding usability, making the T3AWG3352-3252 the ideal generator for today's and tomorrow's test challenges.



## Exceptional Signal Fidelity with 16-bit Vertical Resolution



### 4V<sub>pp</sub> Sine Wave and 5 x 10 mV<sub>pp</sub> Square Wave Sequencing

Highest signal accuracy and precise waveform details generation are key contributors for developing quality products with a reduced design time. Indeed, the pressure is to get products to market faster with a shortest design cycle and with the increase of the quality goals. The exceptional Signal Fidelity of the T3AWG3352 and

T3AWG3252 with the 16-bit Vertical Resolution give the capability to emulate the thinnest details of your waveform making your testing highly efficient and increasing the confidence in your results as more stable and reliable.

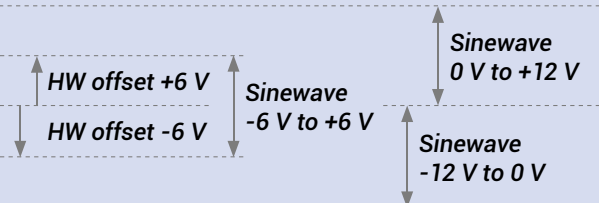
## Output Voltage Window $\pm 12\text{ V}$ (50 $\Omega$ into 50 $\Omega$ ) or $\pm 24\text{ V}$ (50 $\Omega$ into High Impedance)

Output voltage swing is a compulsory requirement for key applications for the IC and Semiconductor Test or Defense marker segment. The T3AWG3252 and T3AWG3352 generators have unmatched outstanding voltage swing capability leveraging on two different combined features. The 12 V<sub>pp</sub> (50  $\Omega$  into 50  $\Omega$ ) amplitude range and the  $\pm 6\text{ V}$  (50  $\Omega$  into 50  $\Omega$ ) hardware offset voltage. The following images show a 12 V<sub>pp</sub> sinewave (50  $\Omega$  into 50  $\Omega$ ) shifted from -12 V to 0 V to 0 V to +12 V using the hardware base voltage offset setting and a 24 V<sub>pp</sub> pulse from 0 V to 24 V (50  $\Omega$  into high Impedance).

### Output Voltage Window: $\pm 12\text{ V}$ (50 $\Omega$ into 50 $\Omega$ )

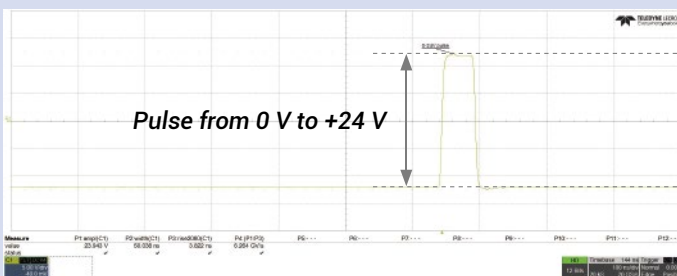


12 V<sub>pp</sub> waveform can be shifted of  $\pm 6\text{ V}$  from -12 V to 0 V to 0 V to +12 V



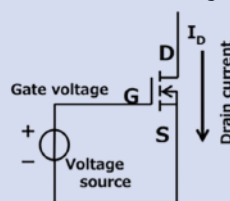
- Output Voltage peak-to-peak (12 V<sub>pp</sub>)
- Baseline Voltage Hardware Offset ( $\pm 6\text{ V}$ )

### Output Voltage Window: $\pm 24\text{ V}$ (50 $\Omega$ into High Impedance)



Pulse from 0 V to 24 V

- Output Voltage peak-to-peak (24 V<sub>pp</sub>)
- Baseline Voltage Hardware Offset ( $\pm 12\text{ V}$ )



MOSFET gate voltage-driven

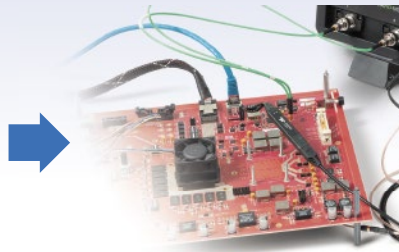
## High Definition Stimulus-Response model:

Applying an HD Stimulus with the T3AWG generator to the DUT and analysing the Response using an HD Oscilloscope  
Different measurements scenarios:

- a. Emulation of clean and **"perfect signal"**, so that uncontrolled and unknown distortions are not influencing the DUT response behavior.
- b. Emulation of **"real-world signal"** including distortions to test the DUT response behavior before any signal source is available. Playback of signals previously acquired using the oscilloscope and imported into the AWG.
- c. Emulation of extreme signal condition **"stress test"**, we can emulate difficult conditions and corner case signals that can be statistically infrequent to test the DUT response behavior.
- d. Emulation of noise or interference signal **"noise and interference immunity"**, so we can generate expected interference signal to add to expected signal and test the DUT response behavior.



*HD AWG (stimulus)*



*Device Under Test (DUT)*



*HD scope (response)*

## Accurate emulate the thinnest waveform details at largest output voltage swings

High Definition T3AWG3352-3252 generators are very powerful and ideal tools for all the High Definition stimulus-response testing scenarios.

There are case when you want to generate an **"ideal signal"** to test your device when uncontrolled and unknown distortions are not influencing the behavior of your device.

In other situation instead, you want to test your device with a **"real-world signal"** previously acquired with the

oscilloscope, imported into the HD arbitrary waveform generator and then played-back for all the time needed comfortably testing your device in the lab. Often real-world signals can be accessible to be acquired with an HD oscilloscope only for very short time or in difficult environmental situation like for high energy physics or aero-space applications. This makes impossible to do any design of your device at the place where the real-world signal can be sourced, then the HD arbitrary waveform generator provides an essential indispensable solution.

All the new emerging technologies and applications are requiring verifying the operating margin of your device emulating worst-case and infrequent corner-case conditions.

Your device needs to be tested to its performance limit and **"stress test"** during the product development is vital to avoid the risk of any device malfunction your customer ends up finding.

The High Definition T3AWG3352-3352 generators are ideal for precisely generating degraded or stressed signals thanks to the capability to emulate accurately any waveform details because of the 16-bit vertical resolution and in addition to emulate large voltage swings because of the 12 V<sub>pp</sub> combined with the  $\pm 6$  V HW Voltage baseline.

High Definition T3AWG3352-3252 have unmatched output voltage window  $\pm 24$  V, 48 V in case of 50  $\Omega$  into High Impedance or  $\pm 12$  V, 24 V in case of 50  $\Omega$  into 50  $\Omega$ .

Definitively you want your device properly working when in the presence of signals or noise interfering.

Today's technology density, co-existing of many communications systems, highest standard in product reliability make a must to go for **"noise and interference immunity"** testing.

The High Definition T3AWG3352-3352 generators are the perfect arbitrary generator for product noise susceptibility, interference immunity and EMI applications because of the excellent output signal spectral purity, the unmatched deep waveform memory enabling long play-time testing combined with versatile waveforms creation thanks to the intuitive and easy waveform sequencer user interface.

## High Definition Generator: Key Applications at a glance



Today's cars are including lots of highly sophisticated electronic control units (ECU) with very sensitive electronic components. The 16-bits vertical resolution combined with the 1.2 GS/s fast sampling rate make the High Definition T3AWG Arbitrary Generators indispensable tools for successfully and efficiently addressing the new testing challenges in automotive.

- CAN, CAN-FD, LIN, Flexray, SENT emulation and troubleshooting
- 100BASE-T1, 1000BASE-T1, BroadR-Reach emulation and immunity from interference signal and noise
- EMI debugging, troubleshooting and testing
- Electrical standards emulation up to 24 V
- Power MOSFET circuitry in automotive electronics optimization and characterization



Radars test and electronic warfare require to create specific complex true-to-life signals. The spectral purity, the wide voltage swing and the long waveform play-time make the High Definition T3AWG Arbitrary Generators the ideal tools for the military research and development sector.

- Frequency response, intermodulation distortion and noise-figure measurements characterization of components, subsystems and systems
- Phase Locked Loop (PLL) pull-in and hold range characterization
- RF I/Q modulators emulation and characterization
- RADAR base-band signals emulation to improve target resolution and detection and decrease false target return (noise immunity)
- MIL-1553, ARINC 429 and PRBS long-play time emulation



Researchers and Scientists require to emulate pulses adding amplitude and timing variation imperfections in an accurate, detailed and repeatable controlled manner. Physics, electronics, chemistry, mechanics and other disciplines can benefit from the user interface versatility combined with the fast edge generation, the excellent dynamic range and the unmatched accuracy of the High Definition T3 AWG generators.

- Emulation of signal sources adding noise and known modulation distortion
- Modulating and driving laser diode with detailed waveform generation
- Generation/playback of real-world signals previously acquired using a High Definition Oscilloscope and imported into the High Definition T3 AWG generator.
- Emulation of long PRBS sequences with the 8 digital output channels synchronous with analog waveforms
- Generation of multi-level and multi-edge pulses long waveforms with the 1 GSample @Ch memory



Today's IC, components, electronic circuits and sensors are required to be highly reliable extending the operating range in many variables. Stress test needs to be performed to confirm the mathematical model used for predicting breaking points or safe usage limits. The output voltage resolution combined with large voltage swing and the mixed mode operation make the High Definition T3AWG the best tool for developing quality components with a reduced design time.

- Clock generation for component overclock behavior and operating range limit and stress test
- Power Integrity testing of electric and electronic components for use in motor vehicles at low voltage
- Sensors signals generation: emulation of ideal signals or generation of real world signals after acquisition with a High Definition Oscilloscope.
- MOSFET gate drive amplitude signal emulation for MOSFET characterization and optimization
- Power up sequences of IC using the low impedance feature (5 Ω output impedance).

# MODEL SPECIFIC SPECIFICATIONS

## T3AWG3252 / T3AWG3352

### High Definition Dual Channel Arbitrary Waveform Generators

#### General Specifications

|  | T3AWG3252  | T3AWG3352 |
|--|--|-----------|
| <b>Number of Channels</b>                              |  |           |
| Analog   | 2  |           |
| Digital  | 0–8  |           |
| Markers  | 1  |           |
| <b>Operating Modes</b>                                 |  |           |
| AFG  | Improved Direct Digital Synthesizer (DDS) based technology |           |
| AWG  | Variable Clock "True Arb" Technology                       |           |
| <b>Amplitude peak-to-peak</b>                          |  |           |
| Voltage Range $V_{pp}$ (50 $\Omega$ into 50 $\Omega$ ) | 0 to 6 $V_{pp}$ (12 $V_{pp}$ opt.)                         |           |
| Accuracy <sup>1)</sup>                                 | $\pm(1\%$ of setting ( $V_{pp}$ ) + 5 mV)                  |           |
| Resolution   | < 0.5 mV $_{pp}$ or 5 digits                               |           |
| Output Impedance                                       | Single-ended: 50 $\Omega$ and 5 $\Omega$ (Low Impedance)   |           |
| <b>Amplitude HW Baseline Offset</b>                    |  |           |
| Range (50 $\Omega$ into 50 $\Omega$ )                  | -6 V to +6 V   |           |
| Range (50 $\Omega$ into High Impedance)                | -12 V to +12 V   |           |
| Accuracy (50 $\Omega$ into 50 $\Omega$ )               | $\pm(1.0\%$   setting   $\pm$ 5 mV)                        |           |
| Resolution   | < 4 mV or 4 digits   |           |
| <b>Amplitude DC</b>                                    |  |           |
| Amplitude Range (50 $\Omega$ into 50 $\Omega$ )        | -6 V to +6 V   |           |
| Amplitude Accuracy                                     | $\pm(1.0\%$   setting   $\pm$ 10 mV)                       |           |

<sup>1)</sup> 1 KHz Sine, 0 V offset, > 5 mVpp amplitude, 50  $\Omega$  load

## AFG Specifications

### Arbitrary Function Generator Operating Mode

#### Waveform Types

|                               | T3AWG3252   | T3AWG3352 |
|-------------------------------|---|-----------|
| <b>Output Channels</b>        |   |           |
| Connectors                    | BNC on front panel  |           |
| Output Type                   | Single-ended  |           |
| Output Impedance              | 50 $\Omega$ or 5 $\Omega$ (Low Impedance) selectable  |           |
| <b>General Specifications</b> |   |           |
| Technology                    | Direct Digital Synthesizer (DDS)  |           |
| Standard Waveforms            | Sine, Square, Pulse, Ramp, Noise, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine |           |
| Run Modes                     | Continuous, Modulation, Sweep, Burst  |           |
| Arbitrary Waveforms           |   |           |
| Vertical Resolution           | 16 bits   |           |
| Waveform Length               | 16.384 Points   |           |
| Internal Trigger Timer        |   |           |
| Range                         | 13.3 ns to 100 s  |           |
| Resolution                    | 104 ps  |           |
| Accuracy                      | $\pm(0.1\%$ setting + 5 ps)   |           |

# MODEL SPECIFIC SPECIFICATIONS

|  | T3AWG3252  | T3AWG3352  |
|--|--|--|
| <b>Sine Wave Characteristics</b>                               |  |  |
| Frequency Range  | 1 $\mu$ H to 250 MHz                             | 1 $\mu$ H to 350 MHz                             |
| Frequency Resolution   | 1 $\mu$ H or 15 digits                           | 1 $\mu$ H or 15 digits                           |
| Output Amplitude (50 $\Omega$ into 50 $\Omega$ ) <sup>2)</sup> | 0 to $\leq$ 70 MHz                               | 12 V   |
|  | > 70 MHz to $\leq$ 120 MHz                       | 9 V  |
|  | > 120 MHz to $\leq$ 180 MHz                      | 6 V  |
|  | > 180 MHz to $\leq$ 250 MHz                      | 3 V  |
| Flatness (1 $V_{p-p}$ , relative to 1 KHz)                     | DC to 250 MHz                                    | $\pm$ 0.5 dB                                     |
| Harmonic Distorsion (1 $V_{p-p}$ )                             | 1 $\mu$ H to $\leq$ 10 MHz                       | < -65 dBc  |
|  | > 10 MHz to $\leq$ 50 MHz                        | < -55 dBc  |
|  | > 50 MHz to $\leq$ 100 MHz                       | < -45 dBc  |
|  | > 100 MHz to $\leq$ 250 MHz                      | < 30 dBc   |
| Total Harmonic Distorsion (1 $V_{p-p}$ )                       | 10 kHz to 20 KHz                                 | < 0.1 %  |
| Spurious (1 $V_{p-p}$ ) <sup>3)</sup>                          | 1 $\mu$ H to $\leq$ 10 MHz                       | < -60 dBc  |
|  | > 10 MHz to $\leq$ 250 MHz                       | < -55 dBc  |
| Phase Noise (1 $V_{p-p}$ , 10 KHz offset)                      | 10 MHz   | < -120 dBc/Hz typ.                               |
|  | 100 MHz  | < -115 dBc/Hz typ.                               |
| <b>Square Wave Characteristics</b>                             |  |  |
| Frequency Range  | 1 $\mu$ H to 120 MHz                             | 1 $\mu$ H to 150 MHz                             |
| Output Amplitude (50 $\Omega$ into 50 $\Omega$ ) <sup>2)</sup> | 0 to $\leq$ 40 MHz                               | 12 V   |
|  | > 40 MHz to $\leq$ 80 MHz                        | 10 V   |
|  | > 80 MHz to $\leq$ 120 MHz                       | 7 V  |
| Frequency Resolution   | 1 $\mu$ H or 15 digits                           | 1 $\mu$ H or 15 digits                           |
| Rise/Fall time (10 % to 90 %)                                  | 2.0 ns   | 2.0 ns   |
| Overshoot (1 $V_{p-p}$ )                                       | < 2 %  | < 2 %  |
| Jitter (rms)   | < 20 ps  | < 20 ps  |
| <b>Pulse Wave Characteristics</b>                              |  |  |
| Frequency Range  | 1 $\mu$ H to 120 MHz                             | 1 $\mu$ H to 150 MHz                             |
| Frequency Resolution   | 1 $\mu$ H or 15 digits                           | 1 $\mu$ H or 15 digits                           |
| Output Amplitude (50 $\Omega$ into 50 $\Omega$ ) <sup>2)</sup> | 0 to $\leq$ 5 MHz                                | 12 V   |
|  | > 5 MHz to $\leq$ 60 MHz                         | 10 V   |
|  | > 60 MHz to $\leq$ 120 MHz                       | 7 V  |
| Pulse width  | 3 ns to (Period-3.0 ns)                          | 2.5 ns to (Period-2.5 ns)                        |
| Resolution   | 20 ps or 15 digits                               | 20 ps or 15 digits                               |
| Pulse duty cycle   | 0.1 % o 99.9 % (limitation of pulse width apply) | 0.1 % o 99.9 % (limitation of pulse width apply) |
| Leading/trailing edge transition time                          | 2.5 ns to 1000 ns                                | 2.0 ns to 1000 ns                                |
| Resolution   | 2 ps or 15 digits                                | 2 ps or 15 digits                                |
| Overshoot (1 $V_{p-p}$ )                                       | < 2 %  | < 2 %  |
| Jitter (rms, with rise time and fall time >2 ns)               | < 20 ps  | < 20 ps  |
| <b>Ramp Wave Characteristics</b>                               |  |  |
| Frequency Range  | 1 $\mu$ H to 10 MHz                              | 1 $\mu$ H to 15 MHz                              |
| Linearity (<10 KHz, 1 $V_{p-p}$ , 100 %)                       | $\leq$ 0.1 %                                     | $\leq$ 0.1 %                                     |
| Symmetry   | 0 % to 100 %                                     | 0 % to 100 %                                     |

<sup>2)</sup> Amplitudes double on HiZ load

<sup>3)</sup> excluding  $f_{sa}$ - $f_{out}$ ,  $f_{sa}$ -2 $f_{out}$



|   | T3AWG3252   | T3AWG3352                                   |
|---|---|---|
| <b>Other Waves Characteristics</b>                                |   |   |
| Frequency Range   |   |   |
| Exponential Rise, Exponential Decay                               | 1 $\mu$ H to 10 MHz                               | 1 $\mu$ H to 15 MHz                         |
| Sin(x)/x, Gaussian, Lorentz, Haversine                            | 1 $\mu$ H to 20 MHz                               | 1 $\mu$ H to 30 MHz                         |
| Frequency Resolution  |   |   |
| Sin(x)/x  | 1 $\mu$ H or 15 digits                            | 1 $\mu$ H or 15 digits                      |
| Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine | 1 $\mu$ H or 14 digits                            | 1 $\mu$ H or 14 digits                      |
| Additive Noise  |   |   |
| Bandwidth (-3 dB)   | > 200 MHz   | > 200 MHz                                   |
| Level   | 0 V to 6 V-   carrier max value( $V_{pk}$ )       | 0 V to 6 V-   carrier max value( $V_{pk}$ ) |
| Resolution  | 1 mV  | 1 mV  |
| <b>Arbitrary</b>  |   |   |
| Number of Samples   | 2 to 16.384                                       | 2 to 16.384                                 |
| Rise/Fall Time  | 2.0 ns  | 2.0 ns                                      |
| Jitter (rms)  | < 20 ps   | < 20 ps                                     |
| Frequency Range   | 1 $\mu$ H to 125 MHz                              | 1 $\mu$ H to 150 MHz                        |
| Frequency Resolution  | 1 $\mu$ H or 15 digits                            | 1 $\mu$ H or 15 digits                      |
| Frequency Accuracy  |   |   |
| Non-Arbitrary   | $\pm 2\% \times 10^{-6}$ of setting               |   |
| Arbitrary   | $\pm 2\% \times 10^{-6}$ of setting $\pm 1 \mu$ H |   |

## Modulations

|                                  | T3AWG3252   | T3AWG3352     |
|----------------------------------|---|---------------|
| <b>AM (Amplitude Modulation)</b> |   |               |
| Carrier Waveforms                | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |               |
| Modulation Source                | Internal or External  |               |
| Internal Modulating Waveforms    | Sine, Square, Ramp, Noise, Arbitrary                          |               |
| Modulating Frequency             |   |               |
| Internal                         | 500 $\mu$ Hz to 48 MHz  |               |
| External                         | max 8 MHz   |               |
| Depth                            | 0.00 % to 120.00 %  |               |
| <b>FM (Frequency Modulation)</b> |   |               |
| Carrier Waveforms                | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |               |
| Modulation Source                | Internal or External  |               |
| Internal Modulating Waveforms    | Sine, Square, Ramp, Noise, Arbitrary                          |               |
| Modulating Frequency             |   |               |
| Internal                         | 500 $\mu$ Hz to 48 MHz  |               |
| External                         | max 8 MHz   |               |
| Depth                            | 0.00 % to 120.00 %  |               |
| Peak Deviation                   | DC to 250 MHz   | DC to 350 MHz |

# MODEL SPECIFIC SPECIFICATIONS

|                                      | T3AWG3252   | T3AWG3352             |
|--------------------------------------|---|-----------------------|
| <b>PM (Pulse Modulation)</b>         |   |                       |
| Carrier Waveforms                    | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |                       |
| Modulation Source                    | Internal or External  |                       |
| Internal Modulating Waveforms        | Sine, Square, Ramp, Noise, Arbitrary                          |                       |
| Modulating Frequency                 |   |                       |
| Internal                             | 500 $\mu$ Hz to 48 MHz  |                       |
| External                             | max 8 MHz   |                       |
| Peak Deviation Range                 | 0° to 360°  |                       |
| <b>FSK (Frequency Shift Keying)</b>  |   |                       |
| Carrier Waveforms                    | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |                       |
| Modulation Source                    | Internal or External  |                       |
| Internal Modulating Waveforms        | Square  |                       |
| FSK Key Rate                         |   |                       |
| Internal                             | 500 $\mu$ Hz to 48 MHz  |                       |
| External                             | max 8 MHz   |                       |
| Depth                                | 0.00 % to 120.00 %  |                       |
| Hop Frequency                        | 1 $\mu$ Hz to 250 MHz   | 1 $\mu$ Hz to 350 MHz |
| Number of keys                       | 2   |                       |
| <b>PSK (Phase Shift Keying)</b>      |   |                       |
| Carrier Waveforms                    | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |                       |
| Modulation Source                    | Internal or External  |                       |
| Internal Modulating Waveforms        | Square  |                       |
| PSK Key Rate                         |   |                       |
| Internal                             | 500 $\mu$ Hz to 48 MHz  |                       |
| External                             | max 8 MHz   |                       |
| Depth                                | 0.00 % to 120.00 %  |                       |
| Hop Phase                            | 0° to +360°   |                       |
| Number of keys                       | 2   |                       |
| <b>PWM (Pulse Width Modulation )</b> |   |                       |
| Carrier Waveforms                    | Pulse   |                       |
| Modulation Source                    | Internal or External  |                       |
| Internal Modulating Waveforms        | Sine, Square, Ramp, Noise, Arbitrary                          |                       |
| PSK Key Rate                         |   |                       |
| Internal                             | 500 $\mu$ Hz to 48 MHz  |                       |
| External                             | max 8 MHz   |                       |
| Deviation Range                      | 0 % to 50 % of pulse period                                   |                       |
| <b>PWM (Pulse Width Modulation )</b> |   |                       |
| Carrier Waveforms                    | Pulse   |                       |
| Modulation Source                    | Internal or External  |                       |
| Internal Modulating Waveforms        | Sine, Square, Ramp, Noise, Arbitrary                          |                       |
| PSK Key Rate                         |   |                       |
| Internal                             | 500 $\mu$ Hz to 48 MHz  |                       |
| External                             | max 8 MHz   |                       |
| Deviation Range                      | 0 % to 50 % of pulse period                                   |                       |

|                                   | T3AWG3252   | T3AWG3352        |
|-----------------------------------|---|------------------|
| <b>Sweep</b>                      |   |                  |
| Type                              | Linear, Logarithmic, Staircase and user defined               |                  |
| Waveforms                         | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |                  |
| Sweep Time                        | 40 ns to 2000 s   |                  |
| Hold/Return Times                 | 0 to (2000 s-40 ns)   |                  |
| Sweep/Hold/Return Time Resolution | 20 ns or 12 digits  |                  |
| Total sweep time accuracy         | ≤ 0.4 %   |                  |
| <b>Start/Stop Frequency Range</b> |   |                  |
| Sine                              | 1 μHz to 250 MHz  | 1 μHz to 350 MHz |
| Square                            | 1 μHz to 120 MHz  | 1 μHz to 150 MHz |
| Trigger Source                    | Internal/External/Manual                                      |                  |
| <b>Burst</b>                      |   |                  |
| Type                              | Trigger and Gated   |                  |
| Waveforms                         | Standard Waveforms (except Pulse, DC and Noise) and Arbitrary |                  |
| Burst Count                       | 1 to 4,294,967,295 cycles or infinite                         |                  |

## AWG Specifications Variable Clock (True Arbitrary) Operating Mode

|  | T3AWG3252   | T3AWG3352 |
|--|---|-----------|
| <b>Sweep</b>   |   |           |
| <b>Output Channels</b>                                     |   |           |
| Connectors   | BNC on front panel                                      |           |
| Output Type  | Single-ended DC coupled                                 |           |
| Output Impedance   | 50 Ω or 5Ω (Low Impedance) selectable                   |           |
| <b>General Specifications</b>                              |   |           |
| Technology   | Variable Clock (True Arbitrary)                         |           |
| Run Modes  | Continuous, Triggered Continuous, Single/Burst, Stepped |           |
| Vertical Resolution  | 16 bits   |           |
| Waveform Length  | 16 to 128 MSamples @Channel (up to 1 GSample @Channel)  |           |
| Waveform Granularity                                       | 16  |           |
| Sequence Length  | 1 to 16384  |           |
| Sequence Repeat Counter                                    | 1 to 4,294,967,294 or infinite                          |           |
| <b>Timer</b>   |   |           |
| Range  | 23.52 ns to 7 s   |           |
| Resolution   | ± 1 sampling clock cycle                                |           |
| <b>Analog Channel to Channel Skew</b>                      |   |           |
| Range  | 0 to 3.4 μs   |           |
| Resolution   | ≤ 5 ps  |           |
| Accuracy   | ±(1%   setting   ± 20 ps)                               |           |
| Initial Skew   | < 200 ps  |           |
| <b>Bandwidth</b><br>calculated: (0.35 / rise or fall time) | 318 MHz   |           |

# MODEL SPECIFIC SPECIFICATIONS

|   | T3AWG3252                         | T3AWG3352                          |
|---|-----------------------------------|------------------------------------|
| <b>Harmonic Distorsion</b><br>Sine Wave 32 points, 1 V <sub>pp</sub>                | < -60 dBc @(1 GS/s and 31.25 MHz) | < -60 dBc @(1.2 GS/s and 37.5 MHz) |
| <b>Spurious</b><br>Sine Wave 32 points, 1 V <sub>pp</sub>                           | < -60 dBc @(1 GS/s and 31.25 MHz) | < -60 dBc @(1.2 GS/s and 37.5 MHz) |
| <b>SFDR (Spurious Free Dynamic Range)</b><br>Sine Wave 32 points, 1 V <sub>pp</sub> | < -60 dBc @(1 GS/s and 31.25 MHz) | < -60 dBc @(1.2 GS/s and 37.5 MHz) |
| <b>Rise/Fall Time</b><br>1 V <sub>pp</sub> , single-ended 10 % to 90 %              | ≤ 1.1 ns                          | ≤ 1.1 ns                           |
| <b>Overshoot</b><br>1 V <sub>pp</sub> , single-ended                                | < 2 %                             |                                    |

## Time Base and Clock

|                                      | T3AWG3252                | T3AWG3352                |
|--------------------------------------|--------------------------|--------------------------|
| <b>Sampling Rate</b>                 |                          |                          |
| Range                                | 1 S/s to 1 GS/s          | 1 S/s to 1.2 GS/s        |
| Resolution                           | 16 Hz                    |                          |
| Accuracy                             | ± 2.0 x 10 <sup>-6</sup> | ± 2.0 x 10 <sup>-6</sup> |
| R <sub>j</sub> on clock patter (rms) | < 10 ps                  | < 10 ps                  |

## Digital Outputs

|                               | T3AWG3252  | T3AWG3352 |
|-------------------------------|--|-----------|
| <b>Output Channels</b>        |  |           |
| Connectors                    | mini-SAS HD connector on rear panel (not standard pin-out) |           |
| Number of connectors          | 1  |           |
| Number of Outputs             | 8 channels   |           |
| Output Impedance              | 100 Ω Differential   |           |
| Output type                   | LVDS   |           |
| Rise/Fall time (10 % to 90 %) | < 1 ns   |           |
| Jitter (rms)                  | 20 ps  |           |
| Maximum Update Rate           | 1 GS/s   | 1.2 GS/s  |
| Memory Depth                  | 128 MSample @ Ch (up to 1 GSample)                         |           |

## Auxiliary input and output characteristics

|  | T3AWG3252   | T3AWG3352 |
|--|---|-----------|
| <b>Marker Output</b>                                 |   |           |
| connector type                                       | BNC on Front panel  |           |
| Number of connectors                                 | one   |           |
| Output impedance                                     | 50 $\Omega$   |           |
| Output level (into 50 $\Omega$ )                     |   |           |
| Amplitude  | 1 V to 2.5 V  |           |
| Resolution   | 10 mV   |           |
| Accuracy   | $\pm$ (2 % setting + 10 mV)   |           |
| Rise/Fall Ttime (10 % to 90 %, 2.5 V <sub>pp</sub> ) | < 700 ps  |           |
| Jitter (rms)   | 20 ps   |           |
| Marker out to analog channel skew                    |   |           |
| Range  | Variable Clock Mode: 0 to 3 $\mu$ s<br>AFG Mode: 0 to 14 s. in continuous mode, 0 to 3 $\mu$ s in Trig. Mode                      |           |
| Resolution   | Variable Clock Mode: 78 ps, AFG Mode: 39 ps   |           |
| Accuracy   | $\pm$ (1 % setting + 140 ps)  |           |
| Initial skew   | < 1 ns  |           |
| <b>Trigger/Gate Input</b>                            |   |           |
| Connector type                                       | BNC on the Front Panel  |           |
| Input impedance                                      | 50 $\Omega$ / 1 K $\Omega$  |           |
| Slope/Polarity                                       | Positive or Negative or both  |           |
| Input damage level                                   | < -15 V or > +15 V  |           |
| Threshold control level                              | - 10 V to 10 V  |           |
| Resolution   | 50 mV   |           |
| Threshold control accuracy                           | $\pm$ (10 %   setting   + 0.2 V)  |           |
| Input voltage swing                                  | 0.5 V <sub>pp</sub> minimum   |           |
| Minimum pulse width (1 V <sub>pp</sub> )             | 3 ns  |           |
| Initial trigger/gate delay to Analog Output          | Variable Clock Mode: < 240 * DAC clock period +32 ns<br>AFG Mode : < 360 ns (< 420 ns in triggered sweep mode)                    |           |
| Trigger in to output jitter                          | AFG mode : < 40 ps<br>Variable clock mode: 0.29 * DAC clock period  |           |
| Maximum frequency                                    | AFG: 65 Mpts on Rising/Falling Edge, 80 MTps on both edges<br>Variable Clock Mode: 42.5 MTps<br>MTps = Mega Transition per second |           |
| <b>Reference clock input</b>                         |   |           |
| Connector type                                       | SMA on rear panel   |           |
| Input impedance                                      | 50 $\Omega$ AC coupled  |           |
| Input Voltage range                                  | -4 dBm to 11 dBm sine or square wave  |           |
| Damage level   | +14 dBm   |           |
| Frequency range                                      | 5 MHz to 100 MHz  |           |
| <b>Reference clock output</b>                        |   |           |
| Connector type                                       | SMA on rear panel   |           |
| Output impedance                                     | 50 $\Omega$ AC coupled  |           |
| Frequency range                                      | 10 MHz  |           |
| Accuracy   | $\pm$ 2.0 x 10 <sup>-6</sup>  |           |
| Aging  | $\pm$ 1.0 x 10 <sup>-6</sup> /year  |           |
| Amplitude  | 1.65 V  |           |
| Jitter (rms)   | < 20 ps   |           |

# MODEL SPECIFIC SPECIFICATIONS

|                                      | T3AWG3252  | T3AWG3352 |
|--------------------------------------|--|-----------|
| <b>External modulation Input</b>     |  |           |
| Connector type                       | SMA on rear panel  |           |
| Input impedance                      | > 2 MΩ   |           |
| Number of inputs                     | One  |           |
| Input Voltage Range                  | -0,5 V to +0.5 V   |           |
| Bandwidth                            | 8 MHz with 40 MS/s sampling rate   |           |
| Vertical resolution                  | 8 bits   |           |
| <b>Power</b>                         |  |           |
| Source Voltage and Frequency         | 100 to 240 VAC ±10 % @ 45–66 Hz  |           |
| Max Power Consumption                | 100 W  |           |
| <b>Environmental Characteristics</b> |  |           |
| Temperature (operating)              | +5 °C to +40 °C (+41°F to 104 °F)  |           |
| Temperature (non operating)          | -20 °C to +60 °C (-4 °F to 140 °F)   |           |
| Humidity (operating)                 | 5 % to 80 % relative humidity with a maximum wet bulb temperature of 29 °C at or below +40 °C, (upper limit de-rates to 20.6 % relative humidity at +40 °C . Non-condensing. |           |
| Humidity (non-operating)             | 5 % to 95 % relative humidity with a maximum wet bulb temperature of 40 °C at or below +60 °C, (upper limit de-rates to 29.8 % relative humidity at +60 °C. Non-condensing.  |           |
| Altitude (operating)                 | 3,000 meters (9,842 feet) maximum at or below 25 °C  |           |
| Altitude (non operating)             | 12,000 meters (39,370 feet) maximum  |           |
| <b>EMC and safety</b>                |  |           |
| Safety                               | EN61010-1  |           |
| Main Standards                       | EN 61326-1:2013 – Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements   |           |
| Immunity                             | EN 61326-1:2013  |           |

## System specifications

|                        | T3AWG3252  | T3AWG3352 |
|------------------------|--|-----------|
| Display                | 7 inch, 1024 x 600, capacitive touch LCD   |           |
| Operative System       | Windows 10 IoT – LTSC (Long Term Service Branch)   |           |
| External Dimensions    | W 362 mm – H 143 mm – D 258 mm   |           |
| Weight                 | 6.5 kg   |           |
| Front panel connectors | CH1 OUTPUT (BNC)<br>CH2 OUTPUT (BNC)<br>MARKER OUT (BNC)<br>TRIGGER IN (BNC)   |           |
| Rear panel connectors  | Ref. Clk. IN (SMA)<br>Ref. Clk. Out (SMA)<br>Ext. Mod. IN (SMA)<br>External monitor ports (HDMI, VGA or more)<br>DIGITAL POD A[7..0]<br>1x USB 2.0 and 1x USB 3.0 or more<br>Ethernet port (10/100/1000BaseT Ethernet, RJ45 port)<br>2 PS/2 keyboard and mouse ports |           |
| Hard Disk              | 240 GB SSD or better   |           |
| Processor              | Intel® Celeron J1900, 2 GHz (or better)  |           |
| Processor Memory       | 8 GB or better   |           |

## T3AWG3-8DIG-TTL LVDS to LVTTTL adapter

(Requires T3AWG3-8 DIG)



|                     | T3AWG3252                                      | T3AWG3352 |
|---------------------|--|-----------|
| Output Connector    | 20 position 2.54 mm 2 Row IDC Header           |           |
| Output Type         | LVTTTL   |           |
| Output Impedance    | 50 $\Omega$ nominal                            |           |
| Output voltage      | 0.8 V to 3.8 V programmable in group of 8 bits |           |
| Maximum update rate | 125 Mbps@0.8 V and 400 Mbps@3.6 V              |           |
| Dimension           | W 52 mm – H 22 mm – D 76 mm                    |           |
| Input connectors    | proprietary standard                           |           |
| Cable length        | 1 meter  |           |
| Cable type          | proprietary standard                           |           |

## T3AWG3-8DIG-SMA Mini-SAS HD to 16x SMA cable (8 LVDS outputs)

(Requires T3AWG3-8 DIG)



|                  | T3AWG3252            | T3AWG3352 |
|------------------|----------------------|-----------|
| Output Connector | SMA                  |           |
| Output Type      | LVDS                 |           |
| Number of SMA    | 16 (8 bits)          |           |
| Cable length     | 1 meter              |           |
| Cable type       | proprietary standard |           |

## Ordering information

| Product Description  | Product Code      |
|--|-------------------|
| Arbitrary Waveform Generator, 2 Ch, 250 MHz, 16 bit, 128 Mpts/Ch, 6 V <sub>pp</sub> output, AFG/AWG, Wave Sequencing | T3AWG3252         |
| Arbitrary Waveform Generator, 2 Ch, 350 MHz, 16 bit, 128 Mpts/Ch, 6 V <sub>pp</sub> output, AFG/AWG, Wave Sequencing | T3AWG3352         |
| 256 Mpt/Ch Memory Option for T3AWG3K-C   | T3AWG3-M          |
| 512 Mpt/Ch Memory Option for T3AWG3K-C   | T3AWG3-X          |
| 1024 Mpt/Ch Memory Option for T3AWG3K-C  | T3AWG3-XL         |
| High Voltage (12 V <sub>pp</sub> on 50 Ohm) for T3AWG3K-C  | T3AWG3-HV         |
| Digital 8 Ch. Output (incl. Mini-SAS cable)  | T3AWG3-8 DIG      |
| LVDS to LVTTTL adapter. (Requires T3AWG3-8 DIG)  | T3AWG3-8DIG-TTL   |
| Mini-SAS HD to 16x SMA cable (8 LVDS output). (Requires T3AWG3-8 DIG)  | T3AWG3-8DIG-SMA   |
| 3U - 19" RACKMOUNT KIT for T3AWG3K-C   | T3AWG3-RACKMOUNT  |
| Warranty extended to 3 Years   | T3AWG3-W3         |
| Cable Mini SAS HD 1m for 8-DIG (spare cable). (Requires T3AWG3-8 DIG)  | T3AWG3-8DIG-MSCAB |

# ABOUT TELEDYNE TEST TOOLS



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