

# T3AFG40/T3AFG80/T3AFG120 Data Sheet

## Function/Arbitrary Waveform Generators

### Debug with Confidence

#### 40 MHz – 120 MHz

Teledyne Test Tools T3AFG40 / T3AFG80 / T3AFG120 range of function/arbitrary generators are a series of dual-channel waveform generators with specifications of up to 120 MHz maximum bandwidth, 1.2 GSa/s maximum sampling rate and 16-bit vertical resolution. The proprietary Arbitrary & Pulse techniques used in the T3AFG40 / T3AFG80 / T3AFG120 models helps to solve the weaknesses inherent in traditional DDS generators when generating arbitrary, square and pulse waveforms. With the above advantages the T3AFG40 / T3AFG80 / T3AFG120 generators can provide users with a variety of high fidelity and low jitter signals, which can meet the growing requirements of a wide range of complex applications.



### Tools for Improved Debugging

- **Deep Memory** – 8 Mpts/Ch. ✔ **Generate complex arbitrary waveforms.**
- **Wide Range of Modulation Types** – AM, DSB-AM, FM, PM, FSK, ASK, PWM, Sweep, Burst, and PSK. ✔ **Quickly set up modulated waveforms.**
- **High Resolution** – 16 bit resolution. ✔ **Generate waveforms with low noise, low spurious signal content and high dynamic range.**
- **Bandwidth Models up to 120 MHz.** ✔ **Wide choice of bandwidths.**
- **Built In Arbitrary Waveforms.** ✔ **Load and replay built in Arbitrary Waveforms.**
- **User Defined Waveforms.** ✔ **Store and recall user defined waveforms.**
- **Lower cost 5 MHz and 10 MHz single channel models are also available.** ✔ **Enquire about the T3AFG5 and T3AFG10.**

### Key Specifications

|                     |                               |
|---------------------|-------------------------------|
| <b>Bandwidth</b>    | 40 MHz, 80 MHz, 120 MHz       |
| <b>Channels</b>     | 2 Independent Channels        |
| <b>Memory</b>       | 8 Mpts/Ch                     |
| <b>Sample Rate</b>  | 1.2 GS/s                      |
| <b>Display</b>      | 4.3 inch Touch Screen TFT LCD |
| <b>Connectivity</b> | USB Host, USB Device, LAN     |

# PRODUCT OVERVIEW

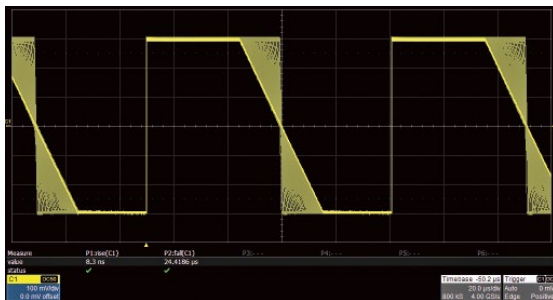
## Ordering Information

| Model    | Bandwidth | Channel | Memory per Ch | Sample Rate per Ch |
|----------|-----------|---------|---------------|--------------------|
| T3AFG40  | 40 MHz    | 2       | 8 Mpts        | 1.2 GS/s           |
| T3AFG80  | 80 MHz    | 2       | 8 Mpts        | 1.2 GS/s           |
| T3AFG120 | 120 MHz   | 2       | 8 Mpts        | 1.2 GS/s           |

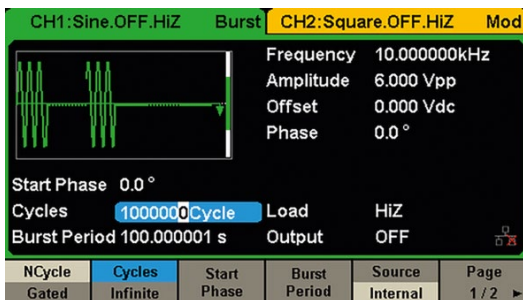
| Function                 | T3AFG40, T3AFG80, T3AFG120  |
|--------------------------|---|
| Built-in Waveforms       | 5 Standard, 196 Arbitrary   |
| Input/Output             | 2 Waveform Outputs, Counter Input, Aux In/Out, 10 MHz Clock In/Out                      |
| Modulation Functions     | AM, DSB-AM, FM, PM, FSK, ASK, PSK, PWM, Sweep, Burst, Harmonic                          |
| TrueArb and EasyPulse    | Yes   |
| Maximum Amplitude Output | < 20 MHz: 10 Vpp at 50 Ohms, 20 Vpp at HiZ<br>> 20 MHz: 5 Vpp at 50 Ohms, 10 Vpp at HiZ |
| Vertical D/A Resolution  | 16 Bits   |
| Display Size             | 4.3" Touch Screen   |

## Excellent Performance

- Bandwidths from 40 MHz to 120 MHz
- All Models have 2 Channels
- 8 Mpts/Channel memory



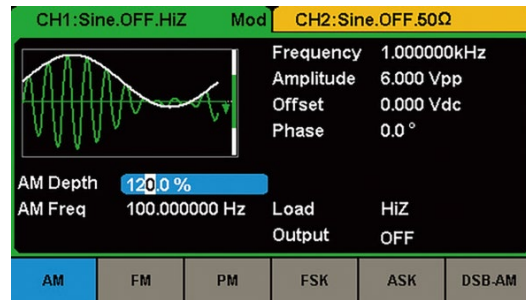
The rise/fall times can be set independently to a minimum of 8.4 ns at any frequency and to a maximum of 22.4s.



Burst mode supports 'N Cycle' and 'Gated' modes with the Burst source being configured as 'Internal', 'External' or 'Manual'.

## Great Connectivity

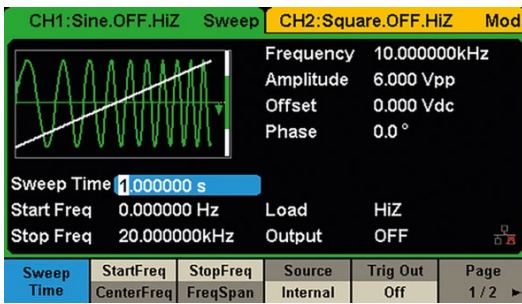
- USB host port for mass storage
- USB device port (USBTMC)
- LAN port on 2 channel models



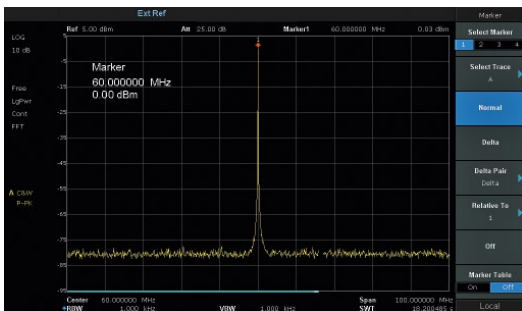
The T3AFG range of Function/Arbitrary Waveform Generators support a wide range of modulation types including AM, FM, PM, FSK, ASK, PSK and DSB-AM.



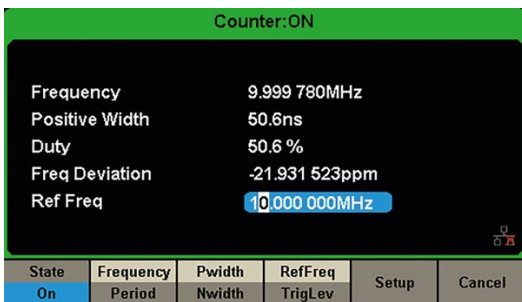
Output amplitude into a high impedance load can be as high 20 Vpp at frequencies up to 20 MHz, and 10 Vpp for frequencies greater than 20 MHz.



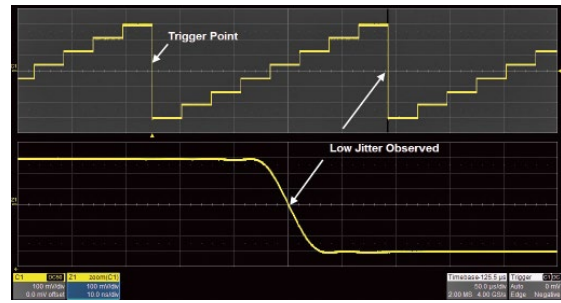
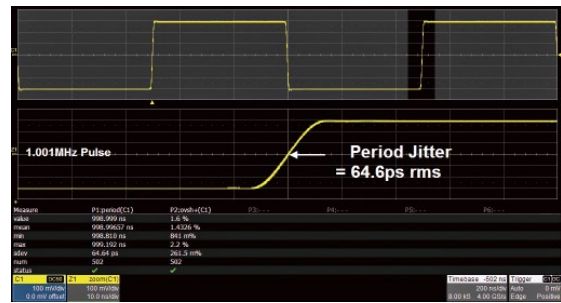
Sweep mode supports 'Linear' and 'Log' sweep, with 'Up' and 'Down' direction, and Sweep source can be configured as 'Internal', 'External' or 'Manual'.



Sine wave output exhibits almost no spurious artefacts at 60 MHz and 0 dBm.



The counter functionality, accessed via the rear panel BNC, gives a DC or AC coupled counter capability from 100 mHz to 200 MHz.



The Teledyne Test Tools T3AFG40 / T3AFG80 and T3AFG120, with its low jitter design, can generate waveforms with exceptional edge stability. With better jitter performance comes better edge stability, and higher confidence in your circuit design.

### Smart Capabilities

- Sweep output carrier can be Sine, Square, Triangle and Arbitrary waveforms
- Burst output under internal or external signal control
- Waveforms types include DC
- Frequency Resolution 1  $\mu$ Hz
- DSB-AM: Double Sideband AM modulation Function
- Harmonic Function on 2 channel models
- Multi-Language User Interface



# PRODUCT OVERVIEW

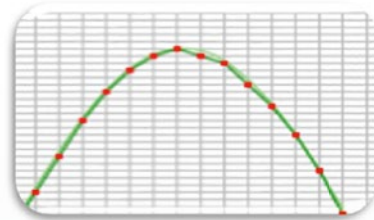
## 14 Bit Resolution



### 14 Bit Resolution

Less accurate waveform generation

## 16 Bit Resolution



### 16 Bit Resolution

- T3AFG40 / T3AFG80 / T3AFG120 are all 16 bit resolution
- 4 x higher resolution than 14 bit systems
- Lower levels of Harmonic Distortion
- Lower levels of non-harmonic spurious signals
- Improved dynamic range
- Enhanced signal fidelity



## I/O Connectivity

- LAN and USB connection
- 10 MHz Reference Input/Output
- Aux Input/Output
- External modulation input
- External burst/sweep trigger input
- External gate input
- The Aux Input/Output will output a trigger pulse when an internal source is used
- External Counter input

# SPECIFICATIONS

## Frequency Specification

| Model                | T3AFG40                                     | T3AFG80             | T3AFG120             |
|----------------------|---|---------------------|----------------------|
| Waveform             | Sine, Square, Ramp, Pulse, Noise, Arbitrary |                     |                      |
| Sine                 | 1 $\mu$ Hz ~ 40 MHz                         | 1 $\mu$ Hz ~ 80 MHz | 1 $\mu$ Hz ~ 120 MHz |
| Square               | 1 $\mu$ Hz ~ 25 MHz                         |                     |                      |
| Pulse                | 1 $\mu$ Hz ~ 25 MHz                         |                     |                      |
| Ramp/Triangular      | 1 $\mu$ Hz ~ 1 MHz                          |                     |                      |
| Gaussian white noise | > 40 MHz (-3 dB)                            | > 80 MHz (-3 dB)    | 120 MHz (-3 dB)      |
| Arbitrary            | 1 $\mu$ Hz ~ 20 MHz                         |                     |                      |
| Resolution           | 1 $\mu$ Hz                                  |                     |                      |
| Accuracy             | 10-year aging +/- 3.5 ppm at 25 Degrees C   |                     |                      |

## Sine Wave

|                                |   |
|--------------------------------|---|
| Harmonic Distortion            | DC ~ 10 MHz <- 65 dBc<br>10 MHz ~ 20 MHz <- 60 dBc<br>20 MHz ~ 40 MHz <- 55 dBc<br>40 MHz ~ 60 MHz <- 50 dBc<br>60 MHz ~ 80 MHz <- 45 dBc<br>80 MHz ~ 100MHz <- 40 dBc<br>100 MHz ~ 120 MHz <- 38 dBc |
| Total harmonic distortion.     | 0.075 %, 0 dBm, 10 Hz ~ 20 kHz  |
| Spurious signal (non-harmonic) | DC < 50 MHz <- 70 dBc<br>> 50 MHz <- 65 dBc   |

## Square Wave

|                |  |
|----------------|--|
| Rise/fall time | 9 ns (10 % ~ 90 %)                         |
| Overshoot      | 3 % (typical, 100 kHz, 1 Vpp, 50 Ohm Load) |
| Duty Cycle     | 0.001 % ~ 99.999 % Limited By Frequency    |
| Jitter         | 150 ps, 1 Vpp, 50 Ohm Load                 |

## Pulse

|                                      |  |
|--------------------------------------|--|
| Pulse width                          | 16.3 ns, Min. Accuracy +/- (0.01% + 0.3 ns)                    |
| Rise/Fall time (10 % ~ 90 %,typical) | 8.4 ns ~ 22.4 s  |
| Duty Cycle                           | 0.001 % ~ 99.999 %, 0.001 % Resolution, Limited by Pulse Width |
| Overshoot                            | 3 % (typical, 100 kHz, 1 Vpp, 50 Ohm Load)                     |
| Jitter(pk-pk)                        | 150 ps, 1 Vpp, 50 Ohm Load                                     |

## Ramp/Triangle Wave

|           |  |
|-----------|--|
| Linearity | <= 1 % of Vpp (typical, 1 kHz, 1 Vpp, 100 % symmetric) |
| Symmetry  | 0 % ~ 100 %  |

## Harmonic Output

|       |                |
|-------|----------------|
| Order | 10 Maximum     |
| Type  | Even, Odd, All |

## Arbitrary Wave

|  |  |
|--|--|
| Waveform length                                  | 8 M points                               |
| Vertical resolution                              | 16 bits                                  |
| Sample rate                                      | 75 MSa/s Arb Mode, 300 MSa/s DDS Mode    |
| Min. Rise/Fall time                              | 8 ns (typical)                           |
| Jitter(pk-pk)                                    | 150 ps, 1 Vpp, 50 Ohm Load, TrueArb Mode |
| Storage in non-volatile RAM memory (10 in total) | 10 waveforms                             |

## Noise Characteristics

|                 |                                     |
|-----------------|-------------------------------------|
| -3 dB bandwidth | Bandwidth of the waveform generator |
|-----------------|-------------------------------------|

# SPECIFICATIONS

## DC Characteristics

|          |   |
|----------|---|
| Range    | -10 V to +10 V HiZ Load<br>-5 V to +5 V 50 Ohm Load |
| Accuracy | +/- (1% + 2 mV) HiZ Load                            |

## Harmonic Output Characteristics

|       |                |
|-------|----------------|
| Order | 10             |
| Type  | All, Even, Odd |

## Output Characteristics

|                              |   |
|------------------------------|---|
| Range                        | 2 mV – 20 Vpp $\leq$ 20 MHz HiZ load, 2 mV – 10 Vpp $>$ 20 MHz HiZ load.<br>Values are halved into 50 $\Omega$ load   |
| Accuracy                     | +/- (1% + 1 mVpp) 10 kHz sine wave, 0 V offset  |
| Amplitude Flatness           | +/- 0.3 dB, 0 – 100 MHz, 50 $\Omega$ load, 2.5 Vpp (reference 10 kHz Sine wave)<br>+/- 0.4 dB, 100 MHz – 120 MHz 50 $\Omega$ load, 2.5 Vpp (reference 10 kHz Sine wave) |
| Output impedance             | 50 $\Omega$ +/- 0.5 $\Omega$ at 10 kHz sine wave.   |
| Output current               | +/- 200 mA  |
| Channel to channel Crosstalk | -60 dBc   |

## Modulation Characteristics – AM

|                      |   |
|----------------------|---|
| Carrier              | Sine, Square, Ramp, Arb                     |
| Modulation Source    | Internal/External                           |
| Modulation Wave      | Sine, Square, Ramp, Noise, Arb              |
| Modulation Depth     | 0 – 120 %                                   |
| Modulation Frequency | 1 mHz – 1 MHz, Modulation source "internal" |

## Modulation Characteristics – FM

|                      |   |
|----------------------|---|
| Carrier              | Sine, Square, Ramp, Arb   |
| Modulation Source    | Internal/External   |
| Modulation Wave      | Sine, Square, Ramp, Noise, Arb  |
| Modulation Depth     | 0 – 0.5 * BW BW is the max output frequency limited by the frequency settings |
| Modulation Frequency | 1 mHz – 1 MHz, Modulation source "internal"                                   |

## Modulation Characteristics – PM

|                      |  |
|----------------------|--|
| Carrier              | Sine, Square, Ramp, Arb                          |
| Modulation Source    | Internal/External                                |
| Modulating Waveform  | Sine, Square, Ramp, Arb, Noise                   |
| Phase Deviation      | 0 Deg – 360 Deg                                  |
| Modulation Frequency | 1 mHz to 1 MHz with 'internal' modulation source |

## Modulation Characteristics – ASK

|                     |   |
|---------------------|---|
| Carrier             | Sine, Square, Ramp, Arb   |
| Modulation Source   | Internal/External   |
| Modulating Waveform | Square with 50 % duty cycle   |
| Keying Frequency    | 1 mHz to 1 MHz Limited by frequency setting with 'internal' modulation source |

## Modulation Characteristics – FSK

|                      |  |
|----------------------|--|
| Carrier              | Sine, Square, Ramp, Arb                          |
| Modulation Source    | Internal/External                                |
| Modulating Waveform  | Square with 50 % duty cycle                      |
| Modulation Frequency | 1 mHz to 1 MHz with 'internal' modulation source |

## Modulation Characteristics – PSK

|                      |  |
|----------------------|--|
| Carrier              | Sine, Square, Ramp, Arb                          |
| Modulation Source    | Internal/External                                |
| Modulating Waveform  | Square with 50 % duty cycle                      |
| Modulation Frequency | 1 mHz to 1 MHz with 'internal' modulation source |



## Modulation Characteristics – PWM

|                                  |  |
|----------------------------------|--|
| Carrier                          | Pulse  |
| Modulation Source                | Internal/External                                |
| Modulating Waveform              | Sine, Square, Ramp, Noise, Arb                   |
| Modulation Frequency             | 1 mHz to 1 MHz with 'internal' modulation source |
| Pulse Width Deviation Resolution | Minimum 6.67 ns                                  |

## Burst Characteristics

|                   |                                       |
|-------------------|---------------------------------------|
| Carrier           | Sine, Square, Ramp, Noise, Pulse, Arb |
| Type              | Count (1–1 M cycles), Infinite, Gated |
| Carrier Frequency | 2 mHz – Maximum output frequency      |
| Stop/Start phase  | 0 Deg to 360 Deg                      |
| Internal Period   | 1 $\mu$ s – 1000 seconds              |
| Trigger Source    | Internal, External, Manual            |
| Gated Source      | Internal, External                    |
| Trigger Delay     | Maximum of 100 seconds                |

## Sweep Characteristics

|                   |                                       |
|-------------------|---------------------------------------|
| Carrier           | Sine, Square, Ramp, Arb               |
| Type              | Linear, Log                           |
| Direction         | Up, Down                              |
| Carrier Frequency | 1 $\mu$ Hz – Maximum output frequency |
| Sweep Time        | 1 ms – 500 seconds                    |
| Trigger Source    | Internal, External, Manual            |

## Frequency Counter Characteristics

|                    |  |
|--------------------|--|
| Function           | Frequency, Period, Positive / Negative Pulse Width, Duty Cycle               |
| Coupling           | DC, AC, HF REJ   |
| Frequency Range    | DC: 100 mHz – 200 MHz, AC: 10 Hz – 200 MHz                                   |
| DC Input Amplitude | 100 mV rms – +/- 2.5 V < 100 MHz<br>200 mV rms – +/- 2.5 V 100 MHz – 200 MHz |
| AC Input Amplitude | 100 mV rms – 5Vp-p < 100 MHz<br>200 mV rms – 5Vp-p 100 MHz – 200 MHz         |
| Input Impedance    | 1 M Ohm  |

## Reference Clock Input

|                 |                   |
|-----------------|-------------------|
| Frequency       | 10 MHz            |
| Amplitude       | Minimum 1.4 Vp-p  |
| Input Impedance | 5 kOhm AC coupled |

## Reference Clock Output

|                  |   |
|------------------|---|
| Frequency        | 10 MHz Synchronised to the internal reference clock |
| Amplitude        | Minimum 2 Vp-p into high impedance load             |
| Output Impedance | 50 Ohms   |

## External Trigger Input

|                       |                                |
|-----------------------|--------------------------------|
| V in Low              | -0.5 V to +0.8 V               |
| V in High             | 2 V to 5.5 V                   |
| Direction             | Up, Down                       |
| Input Impedance       | 100 kOhms                      |
| Minimum Pulse Width   | 100 ns                         |
| Maximum Response Time | 100 ns – Sweep, 600 ns – Burst |

## Trigger Output

|                   |                        |
|-------------------|------------------------|
| V out Low         | Maximum 0.44 V at 8 mA |
| V out High        | Minimum 3.8 V at -8 mA |
| Output Impedance  | 100 Ohms               |
| Maximum Frequency | 1 MHz                  |

# SPECIFICATIONS

## Sync Output

|                   |                        |
|-------------------|------------------------|
| V out Low         | Maximum 0.44 V at 8 mA |
| V out High        | Minimum 3.8 V at -8 mA |
| Output Impedance  | 100 Ohms               |
| Maximum Frequency | 10 MHz                 |
| Pulse Width       | 50 ns                  |

## Modulation Input

|                                     |                                       |
|-------------------------------------|---------------------------------------|
| Frequency                           | 0 Hz to 50 kHz                        |
| Input Impedance                     | 10 kOhm                               |
| Amplitude at 100 % Modulation Depth | Min 11 Vp-p, Typ 12 Vp-p, Max 13 Vp-p |

## General Characteristics

### Power

|                   |  |
|-------------------|--|
| Voltage           | 100 V to 240 V (+/-10 %) at 50 Hz / 60Hz<br>100 V to 120 V (+/-10 %) at 400 Hz |
| Power Consumption | Typical 25.5 W, Maximum 50 W   |

### Display

|                  |                       |
|------------------|-----------------------|
| Color Depth      | 24 bit                |
| Contrast Ratio   | 350:1                 |
| Luminance        | 300 cd/m <sup>2</sup> |
| Touch panel type | Resistive             |

### Environment

|                                |  |
|--------------------------------|--|
| Operating Temperature          | 0 Deg C to 40 Deg C                            |
| Storage Temperature            | -20 Deg C to 60 Deg C                          |
| Operating Humidity             | 5 % to 90 % < 30 Deg C   5 % to 50 % >30 Deg C |
| Non-Operating Humidity         | 5 % to 95 %                                    |
| Maximum Operating Altitude     | 3048 m < 30 Deg C                              |
| Maximum Non-Operating Altitude | 15000m   |

### Calibration

|                      |          |
|----------------------|----------|
| Calibration Interval | Annually |
|----------------------|----------|

### Mechanical

|              |  |
|--------------|--|
| Dimensions   | W x D x H = 260.3 mm x 107.2 mm x 295.7 mm |
| Net Weight   | 3.43 kg                                    |
| Gross Weight | 4.42 kg                                    |

### Compliance

|     |                  |
|-----|------------------|
| LVD | IEC 61010-2:2010 |
| EMC | EN61326-1:2013   |



## Ordering information

|                             |                         |
|-----------------------------|-------------------------|
| <b>Models</b>               | <b>T3AFG40</b> 40 MHz   |
|                             | <b>T3AFG80</b> 80 MHz   |
|                             | <b>T3AFG120</b> 120 MHz |
| <b>Standard Accessories</b> | Quick Start Guide       |
|                             | USB Cable               |
|                             | BNC Cable               |
|                             | Calibration Certificate |
|                             | Power Cord              |

# ABOUT TELEDYNE TEST TOOLS



## Company Profile

Teledyne LeCroy is a leading provider of oscilloscopes, protocol analyzers and related test and measurement solutions that enable companies across a wide range of industries to design and test electronic devices of all types. Since our founding in 1964, we have focused on creating products that improve productivity by helping engineers resolve design issues faster and more effectively. Oscilloscopes are tools used by designers and engineers to measure and analyze complex electronic signals in order to develop high-performance systems and to validate electronic designs in order to improve time to market.

The Teledyne Test Tools brand extends the Teledyne LeCroy product portfolio with a comprehensive range of test equipment solutions. This new range of products delivers a broad range of quality test solutions that enable engineers to rapidly validate product and design and reduce time-to-market. Designers, engineers and educators rely on Teledyne Test Tools solutions to meet their most challenging needs for testing, education and electronics validation.

## Location and Facilities

Headquartered in Chestnut Ridge, New York, Teledyne Test Tools and Teledyne LeCroy has sales, service and development subsidiaries in the US and throughout Europe and Asia. Teledyne Test Tools and Teledyne LeCroy products are employed across a wide variety of industries, including semiconductor, computer, consumer electronics, education, military/aerospace, automotive/industrial, and telecommunications.

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С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

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- Входной контроль качества.
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- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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