

## AT-AWG-1104 performance specifications

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Unless otherwise noted the following conditions are used:

- Ambient temperature between 0°C and 50°C
- Warm up time > 20 minutes
- Humidity: 5% to 80% RH (non-condensating) at  $\leq 30$  (0°C to 40°C), 50% max RH (non-condensing) at 40degree C

Typical values cover the expected performance over ambient temperature ranges of 23°C  $\pm$  5°C with a 95% confidence level and humidity < 50%.

| Specifications                                                              | Limits                                                                                                              |                                        |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Channel operating mode                                                      | Arbitrary                                                                                                           | DDS                                    |
| Number of Channels                                                          | 4                                                                                                                   |                                        |
| Waveforms                                                                   | Sine, Cosine, Triangle, Rectangle, Sawtooth, Ramp, Pulse, Sinc, Exponential, Sweep, DC, Noise, From File, Arbitrary |                                        |
| Sine Waves                                                                  |                                                                                                                     |                                        |
| Frequency Range                                                             | 2 $\mu$ Hz to 125 MHz                                                                                               | 3.7 MHz to 110 MHz (@ Max sample rate) |
| Amplitude Flatness<br>(1 Vp-p), typical                                     |                                                                                                                     |                                        |
| DC to 125 MHz                                                               | $< \pm 0.1$ dB                                                                                                      |                                        |
| DC to 110 MHz                                                               |                                                                                                                     | $< \pm 0.1$ dB                         |
| Harmonics Distortion<br>(1 Vp-p), typical                                   |                                                                                                                     |                                        |
| $\leq 1$ MHz                                                                | $< -66$ dBc                                                                                                         | $< -66$ dBc                            |
| 1 MHz to 5 MHz to                                                           | $< -63$ dBc                                                                                                         | $< -63$ dBc                            |
| 5 MHz to 10 MHz                                                             | $< -59$ dBc                                                                                                         | $< -59$ dBc                            |
| 10 MHz to 25 MHz                                                            | $< -53$ dBc                                                                                                         | $< -53$ dBc                            |
| 25 MHz to 75 MHz                                                            | $< -38$ dBc                                                                                                         | $< -38$ dBc                            |
| 75 MHz to 125 MHz                                                           | $< -28$ dBc                                                                                                         |                                        |
| 75 MHz to 110 MHz                                                           |                                                                                                                     | $< -31$ dBc                            |
| Non Harmonic Distortion<br>(1 Vp-p, Frequency range DC to 200 MHz), typical |                                                                                                                     |                                        |
| $\leq 1$ MHz                                                                | $< -71$ dBc                                                                                                         | $< -63$ dBc                            |
| 1 MHz to 5 MHz to                                                           | $< -71$ dBc                                                                                                         | $< -63$ dBc                            |
| 5 MHz to 10 MHz                                                             | $< -71$ dBc                                                                                                         | $< -63$ dBc                            |
| 10 MHz to 25 MHz                                                            | $< -66$ dBc                                                                                                         | $< -63$ dBc                            |
| 25 MHz to 75 MHz                                                            | $< -53$ dBc                                                                                                         | $< -61$ dBc                            |
| 75 MHz to 125 MHz                                                           | $< -47$ dBc                                                                                                         |                                        |
| 75 MHz to 100 MHz                                                           |                                                                                                                     | $< -61$ dBc                            |
| 100 MHz to 110MHz                                                           |                                                                                                                     | $< -30$ dBc                            |
| THD<br>(100 KHz, 1 Vp-p), typical                                           | $< 0.15\%$                                                                                                          |                                        |
| Phase noise<br>(20 MHz, 1 Vp-p), typical                                    |                                                                                                                     |                                        |
| 10 KHz offset                                                               | $-130$ dBc/Hz                                                                                                       |                                        |
| 100 KHz offset                                                              | $-132$ dBc/Hz                                                                                                       |                                        |
| 1 MHz offset                                                                | $-133$ dBc/Hz                                                                                                       |                                        |
| Analog Bandwidth                                                            | 125 MHz                                                                                                             | 110 MHz                                |

|                                                         |                                                                                                                  |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Arbitrary Mode Specifications</b>                    |                                                                                                                  |
| <b>Square Wave, Pulse</b><br>(1 Vp-p)                   |                                                                                                                  |
| Frequency Range                                         | 2 $\mu$ Hz to 62.5 MHz                                                                                           |
| Duty Cycle Range                                        | 1% to 99%                                                                                                        |
| Rise/Fall Time, typical                                 | < 3.5 ns                                                                                                         |
| Overshoot, typical                                      | < 5.5%                                                                                                           |
| Random jitter (rms), typical                            | < 20 ps                                                                                                          |
| <b>Triangle</b>                                         |                                                                                                                  |
| Frequency Range                                         | 2 $\mu$ Hz to 31.25 MHz                                                                                          |
| Start Phase Range                                       | 0 to 360°                                                                                                        |
| <b>Ramp</b>                                             |                                                                                                                  |
| Frequency Range                                         | 2 $\mu$ Hz to 31.25 MHz                                                                                          |
| <b>Sinc (Sine(x)/x)</b>                                 |                                                                                                                  |
| Frequency Range                                         | 2 $\mu$ Hz to 15.5 MHz                                                                                           |
| Minimum Lobe Width                                      | 8 ns                                                                                                             |
| <b>Amplitude Modulation</b>                             |                                                                                                                  |
| Modulation type                                         | Arbitrary AM, ASK                                                                                                |
| Carrier waveform                                        | All, From File, Arbitrary                                                                                        |
| Modulating waveforms                                    | All, From File, Arbitrary                                                                                        |
| Modulating source                                       | Internal                                                                                                         |
| Modulating waveform sample clock (@ Max. sampling rate) | 0.46 S/s to 125 MS/s                                                                                             |
| Memory size                                             | 2047 entries                                                                                                     |
| <b>Waveform sequencing</b>                              |                                                                                                                  |
| Waveforms                                               | All, From File, Arbitrary                                                                                        |
| Waveform repetitions                                    | 1 to (2 <sup>33</sup> – 1)                                                                                       |
| Start source                                            | Software, Internal, External                                                                                     |
| No. of waveforms                                        | 1 to 511                                                                                                         |
| <b>General</b>                                          |                                                                                                                  |
| Sample rate real time                                   | 4 S/s to 250 MS/s                                                                                                |
| Vertical res.                                           | 16 Bit                                                                                                           |
| Waveform memory                                         | 2 MSamples / Ch.                                                                                                 |
| Min. waveform length                                    | 8 points                                                                                                         |
| Waveform resolution                                     | 2 points                                                                                                         |
| Noise bandwidth (-3 dB gaussian noise), typical         | 100 MHz                                                                                                          |
| Run Modes                                               | Single, Continuous, Stepped, Burst                                                                               |
| <b>DDS Mode Specifications</b>                          |                                                                                                                  |
| <b>Phase/Frequency Modulation</b>                       |                                                                                                                  |
| Modulation type                                         | Arbitrary FM/PM, FSK, PSK                                                                                        |
| Carrier waveform                                        | All, From File, Arbitrary                                                                                        |
| Modulating waveforms                                    | All, From File, Arbitrary                                                                                        |
| Modulating source                                       | Internal                                                                                                         |
| Carrier frequency (@ Max. sample rate)                  |                                                                                                                  |
| Sine wave                                               | 3.7mHz to 110 MHz                                                                                                |
| Square                                                  | 3.7mHz to 62.5 MHz                                                                                               |
| Triangle                                                | 3.7mHz to 31.25 MHz                                                                                              |
| Ramp                                                    | 3.7mHz to 31.25 MHz                                                                                              |
| Modulating waveform sample clock (@ Max. sample rate)   | From 119.2S/s to 125 MS/s (per sample programmable)                                                              |
| Memory size                                             | 511 entries                                                                                                      |
| Frequency resolution                                    | 0.0019 Hz (FSK), 2.15E-5° (PSK) @ 125 MS/s sample rate<br>0.0037 Hz (FSK), 4.30E-5° (PSK) @ 250 MS/s sample rate |
| <b>Frequency sweep</b>                                  |                                                                                                                  |
| Carrier waveform                                        | All, From File, Arbitrary                                                                                        |
| Sweep type                                              | All waveforms                                                                                                    |
| Sweep direction                                         | Up or Down                                                                                                       |

|                                                                                           |                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sweep range (@ Max. sample rate)                                                          |                                                                                                                                                                                                                                          |
| Sine wave                                                                                 | 3.7mHz to 110 MHz                                                                                                                                                                                                                        |
| Square                                                                                    | 3.7mHz to 62.5 MHz                                                                                                                                                                                                                       |
| Triangle                                                                                  | 3.7mHz to 31.25 MHz                                                                                                                                                                                                                      |
| Ramp                                                                                      | 3.7mHz to 31.25 MHz                                                                                                                                                                                                                      |
| Sweep time (@ Max. sample rate)                                                           | 100ns to 4.2s                                                                                                                                                                                                                            |
| <b>General</b>                                                                            |                                                                                                                                                                                                                                          |
| Sample Rate Real Time                                                                     | 125 MS/s to 250 MS/s                                                                                                                                                                                                                     |
| Run Modes                                                                                 | Single, Continuous, Burst                                                                                                                                                                                                                |
| Carrier Waveform Memory                                                                   | 2048 Samples / Ch.                                                                                                                                                                                                                       |
| <b>Pulse Width Modulation</b>                                                             |                                                                                                                                                                                                                                          |
| Carrier waveform                                                                          | Pulse                                                                                                                                                                                                                                    |
| Carrier frequency                                                                         | 100 mHz to 20 MHz                                                                                                                                                                                                                        |
| Duty cycle modulating waveform                                                            | Sine, Triangle, Ramp, Noise, Manual                                                                                                                                                                                                      |
| Duty cycle modulating frequency                                                           | 10 $\mu$ Hz to 6.67 MHz                                                                                                                                                                                                                  |
| Source                                                                                    | Internal                                                                                                                                                                                                                                 |
| Duty cycle deviation                                                                      | 0 % to 100 % of pulse period                                                                                                                                                                                                             |
| <b>Frequency accuracy</b>                                                                 |                                                                                                                                                                                                                                          |
| Stability                                                                                 | < $\pm$ 5 ppm                                                                                                                                                                                                                            |
| Aging                                                                                     | < $\pm$ 2 ppm / year                                                                                                                                                                                                                     |
| <b>Max Interpolated Sample Rate</b>                                                       | 1 GS/s (4x interpolation)                                                                                                                                                                                                                |
| <b>Interpolation Factors</b>                                                              | 1x, 2x, 4x                                                                                                                                                                                                                               |
| <b>Sampling Frequency Resolution</b>                                                      | 15 digits limited by 1 nHz                                                                                                                                                                                                               |
| <b>Amplitude, 50 <math>\Omega</math> Load (1 KHz)</b>                                     | 0V to +12 Vpp                                                                                                                                                                                                                            |
| <b>Amplitude, Open Circuit</b>                                                            | 0V to +24Vpp                                                                                                                                                                                                                             |
| <b>Amplitude Resolution</b>                                                               | < 1mV                                                                                                                                                                                                                                    |
| <b>DC Accuracy, Open circuit (<math>\pm</math> 12 V range)</b>                            | $\pm$ 0.25% of amplitude range ( <i>within <math>\pm</math>10 <math>^{\circ}</math>C of calibration temperature <math>T=25^{\circ}</math>C, Humidity <math>\leq</math> 80%</i> )<br>$\pm$ 0.3% of amplitude range (0 to 50 $^{\circ}$ C) |
| <b>DC Accuracy, 50 <math>\Omega</math> Load (<math>\pm</math> 6 V range)</b>              | $\pm$ 0.25% of amplitude range ( <i>within <math>\pm</math>10 <math>^{\circ}</math>C of calibration temperature <math>T=25^{\circ}</math>C, Humidity <math>\leq</math> 80%</i> )<br>$\pm$ 0.3% of amplitude range (0 to 50 $^{\circ}$ C) |
| <b>AC Accuracy, Open circuit (0 Vpp to +24 Vpp range, 1 KHz sine wave)</b>                | $\pm$ 0.25% of amplitude range ( <i>within <math>\pm</math>10 <math>^{\circ}</math>C of calibration temperature <math>T=25^{\circ}</math>C, Humidity <math>\leq</math> 80%</i> )<br>$\pm$ 0.3% of amplitude range (0 to 50 $^{\circ}$ C) |
| <b>AC Accuracy, 50 <math>\Omega</math> Load (0 Vpp to +12 Vpp range, 1 KHz sine wave)</b> | $\pm$ 0.25% of amplitude range ( <i>within <math>\pm</math>10 <math>^{\circ}</math>C of calibration temperature <math>T=25^{\circ}</math>C, Humidity <math>\leq</math> 80%</i> )<br>$\pm$ 0.3% of amplitude range (0 to 50 $^{\circ}$ C) |
| <b>Output Impedance</b>                                                                   | Selectable: 50 Ohm, Low or High Impedance                                                                                                                                                                                                |
| <b>Short Circuit Protection</b>                                                           | Signal outputs are robust against permanent shorts against floating ground                                                                                                                                                               |
| <b>CH1, CH2, CH3, CH4</b>                                                                 |                                                                                                                                                                                                                                          |
| Output connector                                                                          | Front panel BNC                                                                                                                                                                                                                          |
| Voltage range (open circuit)                                                              | V <sub>omin</sub> = -12V<br>V <sub>omax</sub> = +12V                                                                                                                                                                                     |
| Output impedance                                                                          | 50 Ohm, Low or High Impedance                                                                                                                                                                                                            |
| I <sub>o</sub> max (only 1 channel loaded)                                                | $\pm$ 200mA max                                                                                                                                                                                                                          |
| I <sub>o</sub> max (1 or 2 channels loaded)                                               | $\pm$ 120mA max per channel                                                                                                                                                                                                              |
| I <sub>o</sub> max (all channels loaded)                                                  | $\pm$ 60mA max per channel                                                                                                                                                                                                               |
| <b>External Clock</b>                                                                     |                                                                                                                                                                                                                                          |
| Input connector                                                                           | Front panel BNC                                                                                                                                                                                                                          |
| Frequency range                                                                           | 5 MHz to 125 MHz                                                                                                                                                                                                                         |
| Min. input voltage swing                                                                  | $\Delta$ V <sub>INmin</sub> > 2V                                                                                                                                                                                                         |
| Damage level                                                                              | V <sub>INmax</sub> < 5V<br>V <sub>INmin</sub> > -5V                                                                                                                                                                                      |
| <b>External Trigger Input</b>                                                             |                                                                                                                                                                                                                                          |
| Input connector                                                                           | Front panel BNC                                                                                                                                                                                                                          |
| Frequency range                                                                           | DC to 125Mhz                                                                                                                                                                                                                             |

|                                                                |                                                            |                                                  |                |                                                                                      |
|----------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------|----------------|--------------------------------------------------------------------------------------|
| Threshold level                                                | VILmax = 0.8V, VIHmin=2V                                   |                                                  |                |                                                                                      |
| Voltage range                                                  | -0.5V to 4V                                                |                                                  |                |                                                                                      |
| Damage level                                                   | VINmax < 6V<br>VINmin > -2V                                |                                                  |                |                                                                                      |
| Slope                                                          | Rising Edge or Falling                                     |                                                  |                |                                                                                      |
| Trigger IN to Output Delay                                     | <400 ns                                                    |                                                  |                |                                                                                      |
| Trigger IN to Output Jitter                                    | ±2ns                                                       |                                                  |                |                                                                                      |
| <b>External Trigger Output</b>                                 |                                                            |                                                  |                |                                                                                      |
| Output connector                                               | Front panel BNC                                            |                                                  |                |                                                                                      |
| Output level                                                   | TTL compatible into > 1 KOhm                               |                                                  |                |                                                                                      |
| Output impedance                                               | 50 Ohm nominal                                             |                                                  |                |                                                                                      |
| <b>Digital I/O</b>                                             |                                                            |                                                  |                |                                                                                      |
| Connector                                                      | 50 pin high density (1.27mm) SCSI connector                |                                                  |                |                                                                                      |
| Connector count                                                | 1                                                          |                                                  |                |                                                                                      |
| <b>Multi Channel Specifications</b>                            |                                                            |                                                  |                |                                                                                      |
| Sampling rate tuning                                           | Programmable per channel couple (Ch1-2)                    |                                                  |                |                                                                                      |
| Skew between channels (all channels at the same sampling rate) |                                                            |                                                  |                |                                                                                      |
| Average, typical                                               | < 300 ps                                                   |                                                  |                |                                                                                      |
| Standard deviation, typical                                    | < 35 ps                                                    |                                                  |                |                                                                                      |
| Math                                                           | Sum, Difference, Multiply between the two channels (Ch1-2) |                                                  |                |                                                                                      |
| <b>Digital Pattern Generator Model</b>                         | <b>AWG1102</b>                                             | <b>AWG1102D</b>                                  | <b>AWG1104</b> | <b>AWG1104D</b>                                                                      |
| Number of Channels                                             | N/A                                                        | 18                                               | N/A            | 18/36                                                                                |
| Vector Memory Depth                                            | N/A                                                        | 1 Mpts/ch                                        | N/A            | 1 Mpts/ch                                                                            |
| Acquisition Memory Depth                                       | N/A                                                        | 2 Mpts/ch                                        | N/A            | 2 Mpts/ch                                                                            |
| Generation Sample Rate (S/s)                                   | N/A                                                        | 125 MS/s<br>(direction programmable per channel) | N/A            | 125 MS/s<br>(direction programmable per channel)                                     |
| Acquisition Sample Rate (S/s)                                  | N/A                                                        | 250 MS/s                                         | N/A            | 250 MS/s                                                                             |
| Direction Control                                              | N/A                                                        | Programmable per channel                         | N/A            | Programmable per channel                                                             |
| Output Voltage Level                                           | N/A                                                        | 1.2V to 3.6V                                     | N/A            | 1.2V to 3.6V                                                                         |
| Trigger Levels                                                 | N/A                                                        | 31                                               | N/A            | 31                                                                                   |
| Mode                                                           | N/A                                                        | 18 Digital Channels or 2 Analog Channels         | N/A            | 36 Digital Channels or 4 Analog Channels<br>18 Digital Channels or 2 Analog Channels |
| <b>General</b>                                                 |                                                            |                                                  |                |                                                                                      |
| Power supply voltage range                                     | 100 +/- 10% to 240 +/- 10% VAC                             |                                                  |                |                                                                                      |
| Power consumption                                              | 35 W max.                                                  |                                                  |                |                                                                                      |
| Power Frequency range                                          | 50/60 Hz +/- 5%                                            |                                                  |                |                                                                                      |
| PC interface                                                   | USB 2.0                                                    |                                                  |                |                                                                                      |
| External dimensions                                            | 335 x 175 x 43 mm                                          |                                                  |                |                                                                                      |
| Weight                                                         | 1.8 Kg                                                     |                                                  |                |                                                                                      |

|                                |                                                                                                                                                                                                                                          |
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| Front panel connectors         | <ul style="list-style-type: none"> <li>- CH1 BNC</li> <li>- CH2 BNC</li> <li>- Trigger Input BNC</li> <li>- Trigger Output BNC</li> <li>- External clock input BNC</li> <li>- Digital I/O Pod A, 50 pin high density (1.27mm)</li> </ul> |
| Rear panel connectors          | <ul style="list-style-type: none"> <li>- DC power jack</li> <li>- USB</li> </ul>                                                                                                                                                         |
| <b>Minimum PC Requirements</b> |                                                                                                                                                                                                                                          |
| Operative system               | Microsoft Windows 2000/XP SP2/ Vista / 7 / 10 – 32 & 64Bit Editions                                                                                                                                                                      |
| Processor                      | Pentium III processor, or equivalent                                                                                                                                                                                                     |
| Memory                         | 512Mbytes RAM                                                                                                                                                                                                                            |
| Hard Disk                      | 150Mbytes available free space                                                                                                                                                                                                           |
| Display Resolution             | 800x600                                                                                                                                                                                                                                  |
| Ports                          | USB 2.0 or 1.1                                                                                                                                                                                                                           |



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