FEATURES

- Small signal bandwidth DC ... 1GHz (x50 model)
- Voltage gain 20dB (x10), 34dB (x50), 40dB (x100) and 46dB (x200)
- DC coupling
- Closed loop OP-Amp design
- Very low noise
- High output drive
- Single supply operation / internally generated bipolar supply / internal supply regulation
- Bandwidth limited (BWL) option available for further improved noise performance

APPLICATIONS

- Pre-amp for ultra fast detectors (MCP, PMT, ...)
- Oscilloscope and transient recorder pre-amp
- High precision Time-of-Flight
- Photon-/Ion- counting
- Wideband signal processing

DESCRIPTION

The TA1000B-x models are fast, very low noise pulse pre-amplifiers with a small signal bandwidth of 400MHz ... 1.0 GHz depending on the model.

Each model is available with a bandwidth limited (BWL) option which further reduces the noise floor.

A unique feature for such high speed amplifiers is the DC coupling. DC coupling avoids count rate effects due to non DC balanced pulse trains and the corresponding charging of coupling capacitors.

SPECIFICATIONS

Voltage gain:
- TA1000B-10: 20 dB / x10
- TA1000B-50: 34 dB / x50
- TA1000B-100: 40 dB / x100
- TA1000B-200: 46 dB / x200
- non-inverting

Input:
- BNC, 50 Ohm, DC coupled

Outputs:
- BNC, low impedance, DC coupled 50Ω output option available
- \( V_{OUT} = +/- 1.3V \) max.
- \( I_{OUT} = +/- 150mA \) max.

Small signal bandwidth:
- \( (V_{OUT} = 200mV_{RMS}) \)
  - TA1000B-10 BWL: 170 MHz
  - TA1000B-50 BWL: 245 MHz
  - TA1000B-100 BWL: 245 MHz
  - TA1000B-200 BWL: 110 MHz
  - TA1000B-10: 710 MHz
  - TA1000B-50: 1000 MHz
  - TA1000B-100: 950 MHz
  - TA1000B-200: 400 MHz

Slew rate:
- \( (2V \text{ step}) \)
  - TA1000B-10: 1600 V/µs
  - TA1000B-10 BWL: 530 V/µs

Input offset voltage:
- (adjustable) +/- 1.5 mV max.
- +/- 2.0 V/°C typ.

Input referred broadband noise:
- TA1000B-10 BWL:
  - 30.2 µV\(_{RMS}\)
  - 124 µV\(_{pp}\)
- TA1000B-50 BWL:
  - 36.6 µV\(_{RMS}\)
  - 509 µV\(_{pp}\)
- TA1000B-100 BWL:
  - 34.2 µV\(_{RMS}\)
  - 318 µV\(_{pp}\)
- TA1000B-200 BWL:
  - 23.1 µV\(_{RMS}\)
  - 223 µV\(_{pp}\)
- TA1000B-10:
  - 51.2 µV\(_{RMS}\)
  - 224 µV\(_{pp}\)
- TA1000B-50:
  - 57.8 µV\(_{RMS}\)
  - 541 µV\(_{pp}\)
- TA1000B-100:
  - 55.9 µV\(_{RMS}\)
  - 542 µV\(_{pp}\)
- TA1000B-200:
  - 31.2 µV\(_{RMS}\)
  - 331 µV\(_{pp}\)
TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier
x10/x50/x100/x200, very low noise, DC coupled

Material:
Case: extruded aluminium sheath
Al Mg Si 0.5
Lid: die cast, GD-Al Si 12
Size: 65/101 x 60 x 35 mm
Weight: 126 g

Power Requirements:
Connector: 2.1 mm center pin
Supply Voltage: nominal +12V
voltage range +10 ... +18V
Supply Power: 2.5W
False polarity protection

Absolute maximum ratings:
Supply: 25V (100ms max.)
Signal input: +/- 1.8V, +/- 140mA
ESD rating: 2000V HBM, 200V MM

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal Gain [V/V]</th>
<th>Nominal Gain [dB]</th>
<th>Small Signal Bandwidth (-3dB)</th>
<th>Gain Flatness</th>
<th>Peaking (100ps Rise Time Input Pulse)</th>
<th>Input Referred Broadband Noise (DC ... 12.5GHz)</th>
<th>Input Referred LF Noise (20Hz ... 1MHz)</th>
<th>50 Ohm Option: Small Signal Bandwidth (-3dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA1000B-10</td>
<td>10</td>
<td>20dB</td>
<td>710MHz</td>
<td>0.00dB</td>
<td>6%</td>
<td>51.2μV rms, 0.224mV p-p, 0.3μV rms</td>
<td>200MHz</td>
<td></td>
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<tr>
<td>TA1000B-10 BWL(6)</td>
<td>10</td>
<td>20dB</td>
<td>170MHz</td>
<td>0.00dB</td>
<td>0%</td>
<td>30.2μV rms, 0.124mV p-p, 0.850MHz</td>
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<tr>
<td>TA1000B-50</td>
<td>50</td>
<td>34dB</td>
<td>1000MHz</td>
<td>0.22dB</td>
<td>9%</td>
<td>57.8μV rms, 0.541mV p-p, 0.5μV rms</td>
<td>245MHz</td>
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</tr>
<tr>
<td>TA1000B-50 BWL(6)</td>
<td>50</td>
<td>34dB</td>
<td>245MHz</td>
<td>0.00dB</td>
<td>0%</td>
<td>36.6μV rms, 0.509mV p-p, 1000MHz</td>
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<td></td>
</tr>
<tr>
<td>TA1000B-100</td>
<td>100</td>
<td>40dB</td>
<td>950MHz</td>
<td>0.12dB</td>
<td>8%</td>
<td>55.9μV rms, 0.542mV p-p, 12.3μV rms</td>
<td>245MHz</td>
<td></td>
</tr>
<tr>
<td>TA1000B-100 BWL(6)</td>
<td>100</td>
<td>40dB</td>
<td>245MHz</td>
<td>0.00dB</td>
<td>0%</td>
<td>34.2μV rms, 0.318mV p-p, 990MHz</td>
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<td></td>
</tr>
<tr>
<td>TA1000B-200</td>
<td>200</td>
<td>46dB</td>
<td>400MHz</td>
<td>0.00dB</td>
<td>0%</td>
<td>31.2μV rms, 0.331mV p-p, 13.6μV rms</td>
<td>110MHz</td>
<td></td>
</tr>
<tr>
<td>TA1000B-200 BWL(6)</td>
<td>200</td>
<td>46dB</td>
<td>110MHz</td>
<td>0.00dB</td>
<td>0%</td>
<td>23.1μV rms, 0.223mV p-p, 400MHz</td>
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</table>

TA1000B-x Comparison chart

(0) Simulation Results
(1) Signal input: sine wave = 200mVeff / "nominal Gain"
(2) Output Pulse Height approx. 200mVp-p, Input Rise Time 100ps
(3) defined as RMSΔ = σ = standard deviation, ref. scope pictures of output noise voltages below
(4) in 40 minutes accumulated with a 12.5GHz sampling head, ref. scope pictures of output noise voltages below
(5) measured with a HP3455A True RMS Voltmeter, this is mostly the 1/f noise
(6) BWL = Bandwidth limited option (with improved noise performance)

WARNING: The amplifiers have no thermal shutdown. Thus, be careful when connecting the output to loads less than 50 Ohms (do not shorten the output!).
Simulated voltage gain of all TAx amplifiers

0 … -400mV P-P Pulse Response:
In the following scope pictures you see the pulse response for negative output signals starting at 0V and falling down to –400mV.

The input pulse amplitudes are selected according the gain of each amplifier.
TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier
x10/x50/x100/x200, very low noise, DC coupled

TA1000B-50 (x50), Input 5mV/div, Output 100mV/div

TA1000B-100 (x100), Input 2mV/div, Output 100mV/div

TA1000B-50BWL (x50), Input 5mV/div, Output 100mV/div

TA1000B-100BWL (x100), Input 2mV/div, Output 100mV/div
The lower window of each plot shows details of the corresponding signals in the upper window. There is also a (red colored) histogram of the output signal jitter at a -100mV or –130mV threshold. The jitter's Peak-to-Peak value is visible at "PkPk" and its standard deviation in the "RMSΔ" readout.

This jitter histogram gives a good indication of the timing accuracy and resolution that can be expected. And, one can very well see that the optimum threshold setting for timing measurements is often not at half of the signal's amplitude but at some other level not too far from idle voltage where the slew rate is at maximum.
Max. Output Broadband Noise Voltage:

Normally the noise is given input referred, so to speak, it can be compared to the source signal levels. For timing applications it is often more depicting to plot the total output noise of an amplifier.

In the following scope pictures the output noise voltage of our Tx-amplifiers is accumulated over 10,000 waveforms corresponding to about 40 minutes of measurement time. Used was a TEK11801C digital sampling scope with a 12.5GHz sampling head. Thus, the displayed noise voltage is accumulated over a long period and also over the full bandwidth of each amplifier. The Tx's inputs were shortened, i.e. $Z_{\text{Source}} = 0\Omega$.

On the right side of each plot you can see a (red colored) histogram of all the voltage samples in the respective picture. This gives the probability distribution of the noise voltage levels. And, you can find some analysis data on the respective voltage distribution: Mean = average value, $\text{RMS} = \sigma = \text{standard deviation}$, $\text{PkP} = \text{Peak-to-Peak voltage} = \text{max.} - \text{min. sample voltage}$, $\mu \pm 1\sigma = \text{percentage of samples that fall within } \pm 1 \text{ standard deviation of the mean} \ (\pm 2\sigma, \pm 3\sigma \text{ respectively})$.

Sampling Head alone, 2mV/div

TA1000B-10 (x10), 5mV/div

TA1000B-10 BWL (x10), 5mV/div
TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier
x10/x50/x100/x200, very low noise, DC coupled

TA1000B-50 (x50), 10mV/div

TA1000B-100 (x100), 20mV/div

TA1000B-50 BWL (x50), 10mV/div

TA1000B-100 BWL (x100), 20mV/div
TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier
x10/x50/x100/x200, very low noise, DC coupled

TA1000B-200 (x200), 20mV/div

TA1000B-200 BWL (x200), 20mV/div