

# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier x10/x50/x100/x200, very low noise, DC coupled

## 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

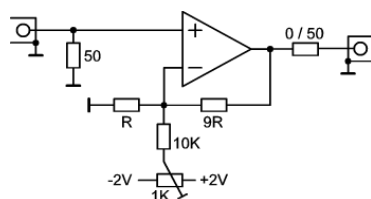


## DESCRIPTION

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.



TA1000B-10 simplified schematic

## 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

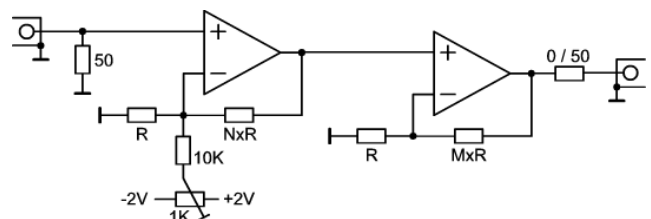
TA1000B-10: 710 MHz  
TA1000B-50: 1000 MHz  
TA1000B-100: 950 MHz  
TA1000B-200: 400 MHz

**Slew rate:** (2V step)  
TA1000B-10: 1600 V/μs  
TA1000B-10 BWL: 530 V/μs

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

**Input referred broadband noise:**  
TA1000B-10 BWL; 30.2 μV<sub>rms</sub>  
124 μV<sub>p-p</sub>  
TA1000B-50 BWL; 36.6 μV<sub>rms</sub>  
509 μV<sub>p-p</sub>  
TA1000B-100 BWL; 34.2 μV<sub>rms</sub>  
318 μV<sub>p-p</sub>  
TA1000B-200 BWL; 23.1 μV<sub>rms</sub>  
223 μV<sub>p-p</sub>

TA1000B-10; 51.2 μV<sub>rms</sub>  
224 μV<sub>p-p</sub>  
TA1000B-50; 57.8 μV<sub>rms</sub>  
541 μV<sub>p-p</sub>  
TA1000B-100; 55.9 μV<sub>rms</sub>  
542 μV<sub>p-p</sub>  
TA1000B-200; 31.2 μV<sub>rms</sub>  
331 μV<sub>p-p</sub>



TA1000B-50 / -100 / -200 simplified schematic

TA1000-X 08022011

# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplicifier 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: +/- 2.5V  
ESD rating: 2000V HBM, 200V MM

## Accessories:

External wall power supply (included)  
L-clips (AB-WL) for wall-/screw -mounting (optional)

## Available Options:

50  $\Omega$  output impedance  
BWL – bandwidth limited  
Input/Output AC coupling

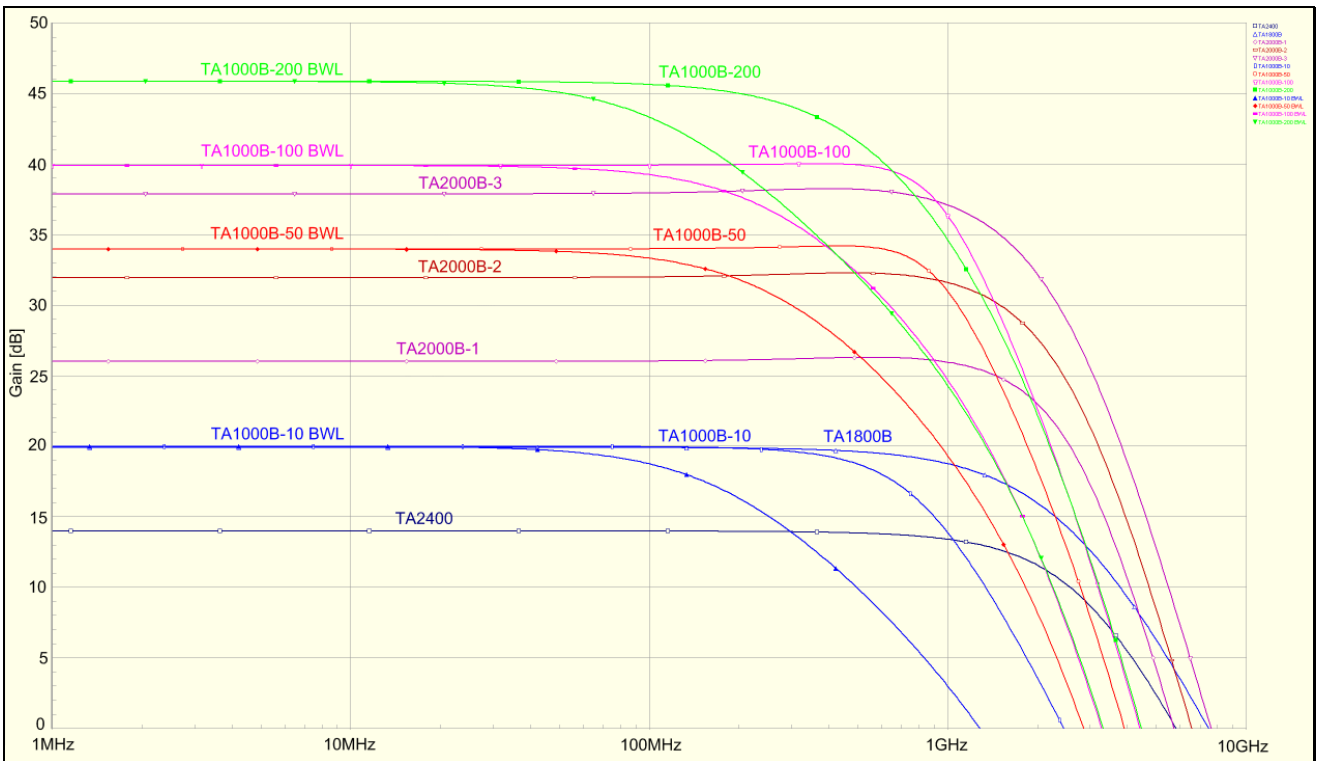
| Type                           | Nominal Gain [V/V] | Nominal Gain [dB] | Small Signal Bandwidth (-3dB) | Gain Flatness | Peaking (100ps Rise Time Input Pulse) | Input Referred Broadband Noise (DC ... 12.5GHz) |                        | Input Referred LF Noise (20Hz ... 1MHz) | 50 Ohm Output Option: Small Signal Bandwidth (-3dB) |
|--------------------------------|--------------------|-------------------|-------------------------------|---------------|---------------------------------------|---|------------------------|---|---|
|                                |                    |                   | (0) (1)                       | (0) (1)       | (0) (2)                               | (3) (4)   | (4)                    | (5)                                     | (0) (1)   |
| TA1000B-10                     | 10                 | 20dB              | 710MHz                        | 0.00dB        | 6%                                    | 51.2 $\mu$ V <sub>rms</sub>                     | 0.224mV <sub>p-p</sub> | 0.3 $\mu$ V <sub>rms</sub>              | 200MHz  |
| TA1000B-10 BWL <sup>(6)</sup>  | 10                 | 20dB              | 170MHz                        | 0.00dB        | 0%                                    | 30.2 $\mu$ V <sub>rms</sub>                     | 0.124mV <sub>p-p</sub> |   | 850MHz  |
| TA1000B-50                     | 50                 | 34dB              | 1000MHz                       | 0.22dB        | 9%                                    | 57.8 $\mu$ V <sub>rms</sub>                     | 0.541mV <sub>p-p</sub> | 0.5 $\mu$ V <sub>rms</sub>              | 245MHz  |
| TA1000B-50 BWL <sup>(6)</sup>  | 50                 | 34dB              | 245MHz                        | 0.00dB        | 0%                                    | 36.6 $\mu$ V <sub>rms</sub>                     | 0.509mV <sub>p-p</sub> |   | 1000MHz   |
| TA1000B-100                    | 100                | 40dB              | 950MHz                        | 0.12dB        | 8%                                    | 55.9 $\mu$ V <sub>rms</sub>                     | 0.542mV <sub>p-p</sub> | 12.3 $\mu$ V <sub>rms</sub>             | 245MHz  |
| TA1000B-100 BWL <sup>(6)</sup> | 100                | 40dB              | 245MHz                        | 0.00dB        | 0%                                    | 34.2 $\mu$ V <sub>rms</sub>                     | 0.318mV <sub>p-p</sub> |   | 990MHz  |
| TA1000B-200                    | 200                | 46dB              | 400MHz                        | 0.00dB        | 0%                                    | 31.2 $\mu$ V <sub>rms</sub>                     | 0.331mV <sub>p-p</sub> | 13.6 $\mu$ V <sub>rms</sub>             | 110MHz  |
| TA1000B-200 BWL <sup>(6)</sup> | 200                | 46dB              | 110MHz                        | 0.00dB        | 0%                                    | 23.1 $\mu$ V <sub>rms</sub>                     | 0.223mV <sub>p-p</sub> |   | 400MHz  |

## 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  $RMS\Delta = \sigma$  = 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!**).

# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier x10/x50/x100/x200, very low noise, DC coupled

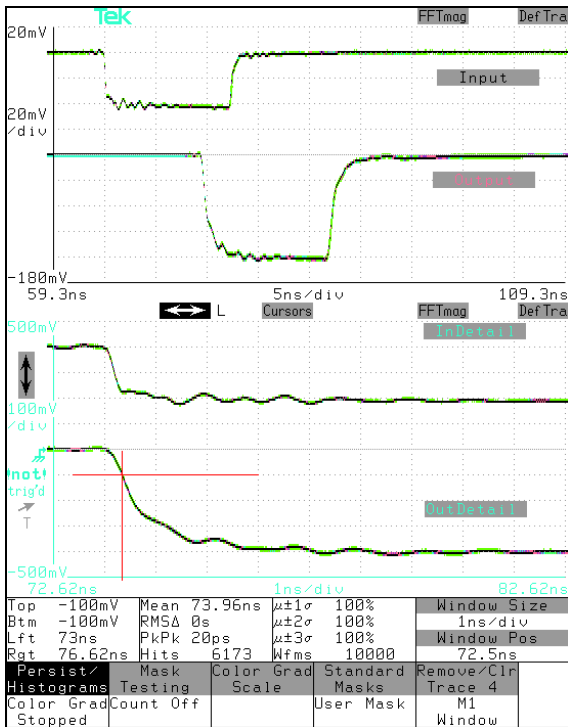


Simulated voltage gain of all TAx amplifiers

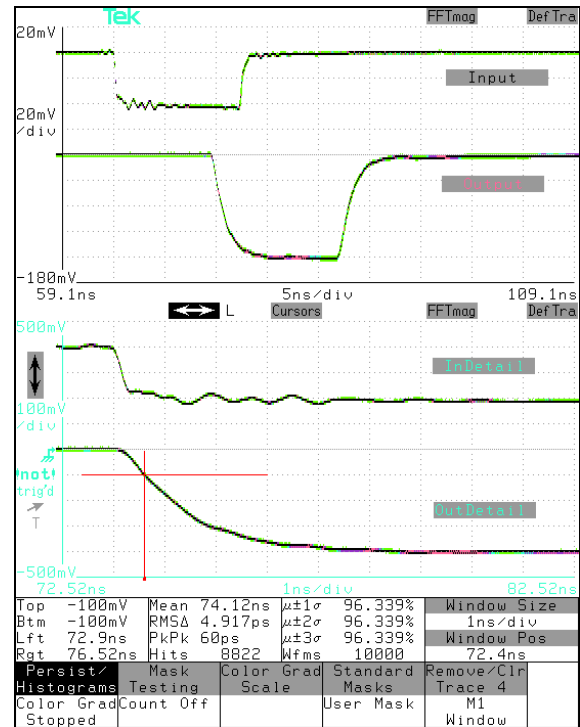
## 0 ... -400mV<sub>P,P</sub> Pulse Response:

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 to the gain of each amplifier.

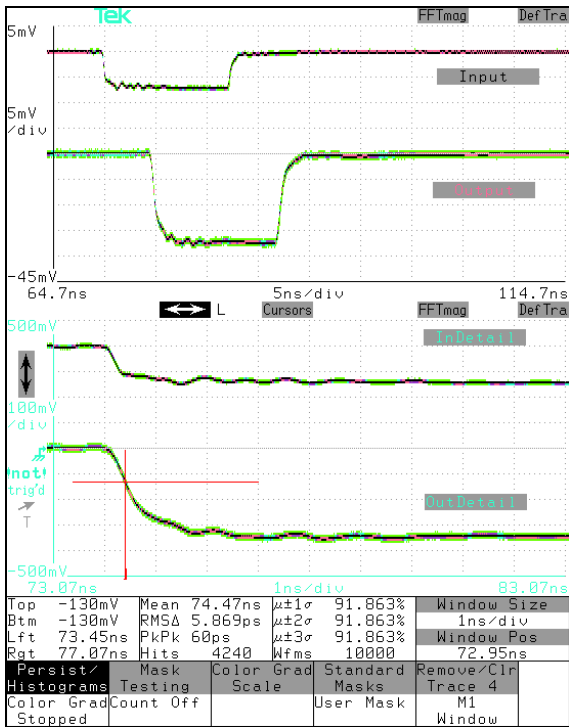


TA1000B-10 (x10), Input 20mV/div, Output 100mV/div

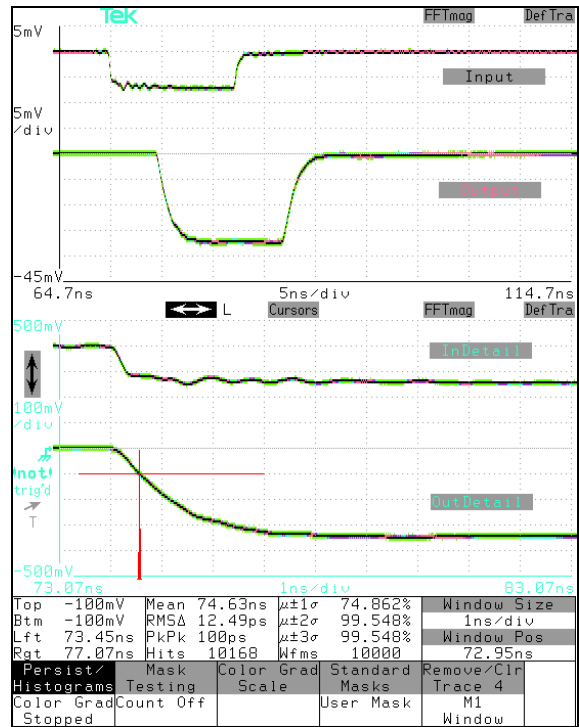


TA1000B-10BWL (x10), Input 20mV/div, Output 100mV/div

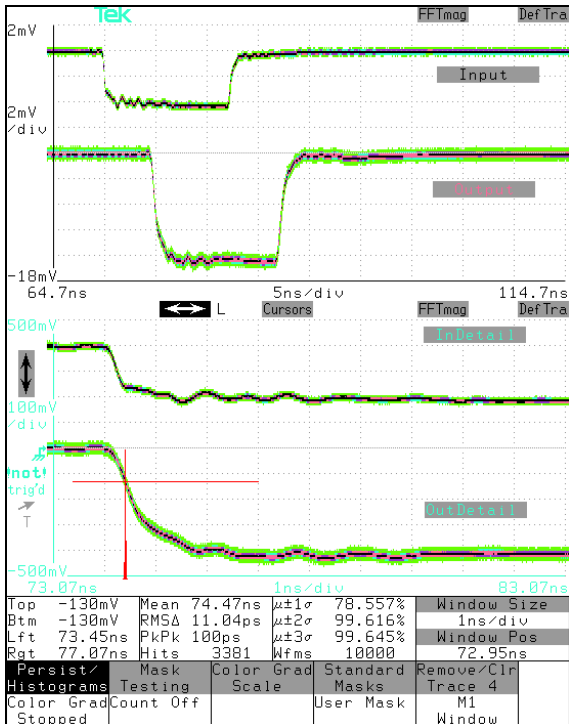
# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier x10/x50/x100/x200, very low noise, DC coupled



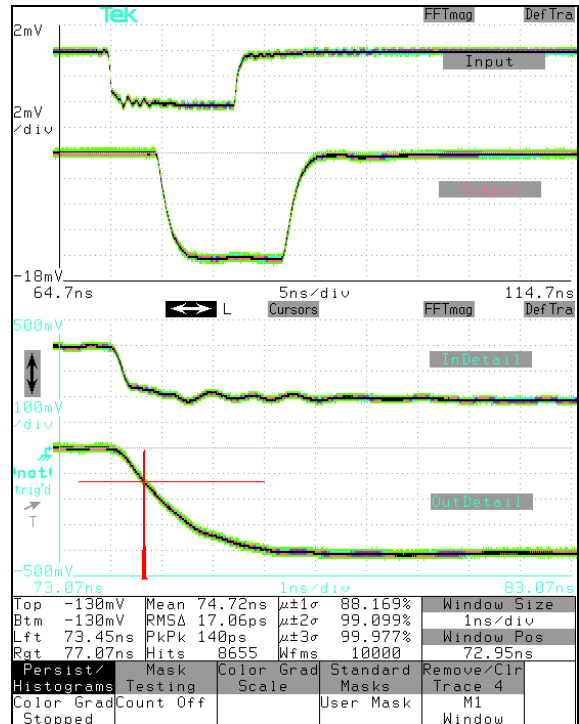
TA1000B-50 (x50), Input 5mV/div, Output 100mV/div



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

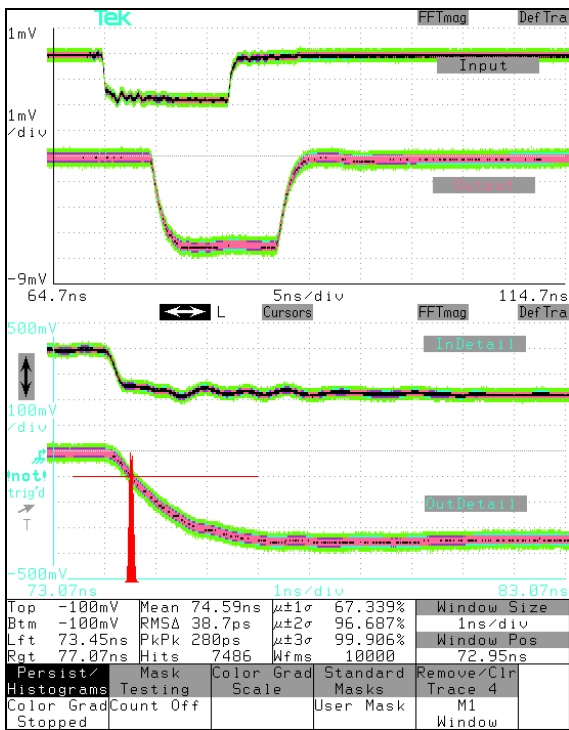


TA1000B-100 (x100), Input 2mV/div, Output 100mV/div



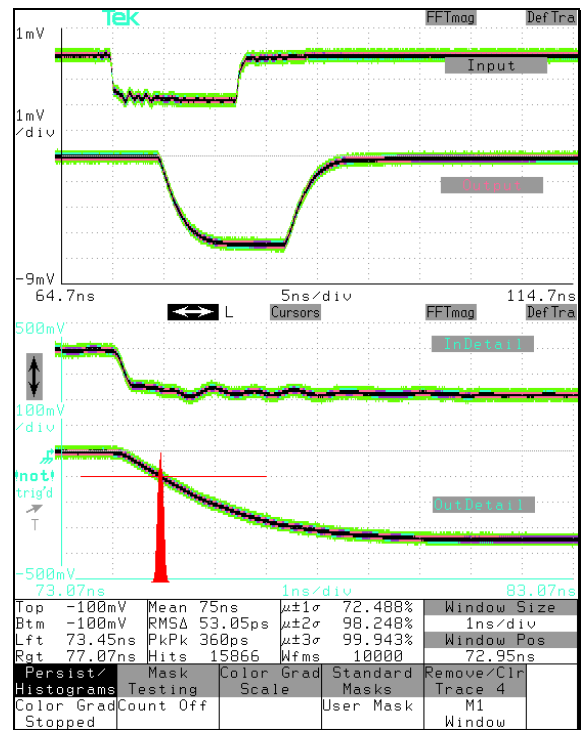
TA1000B-100BWL (x100), Input 2mV/div, Output 100mV/div

# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier x10/x50/x100/x200, very low noise, DC coupled



TA1000B-200 (x200), Input 1mV/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.

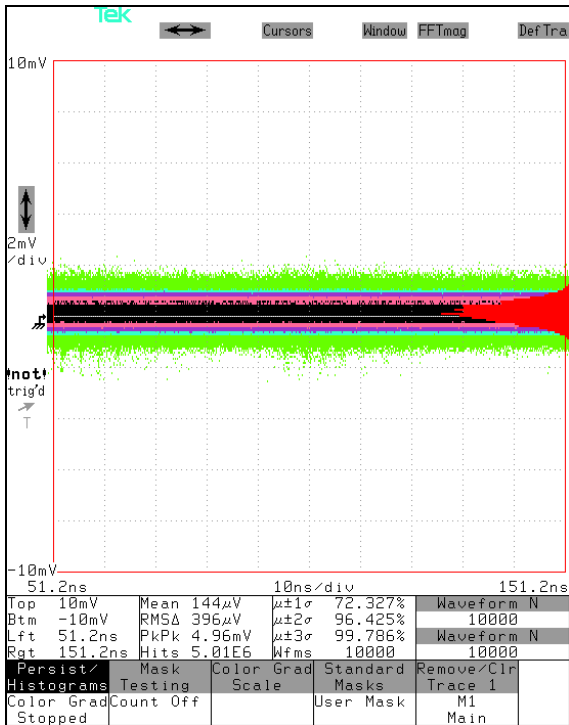


TA1000B-200BWL (x200), Input 1mV/div, Output 100mV/div

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.

# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamp x10/x50/x100/x200, very low noise, DC coupled

## Max. Output Broadband Noise Voltage:

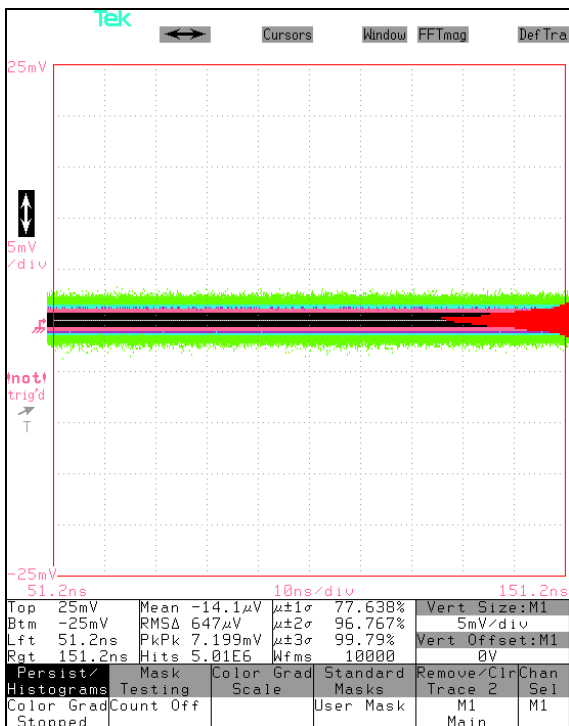


Sampling Head alone, 2mV/div

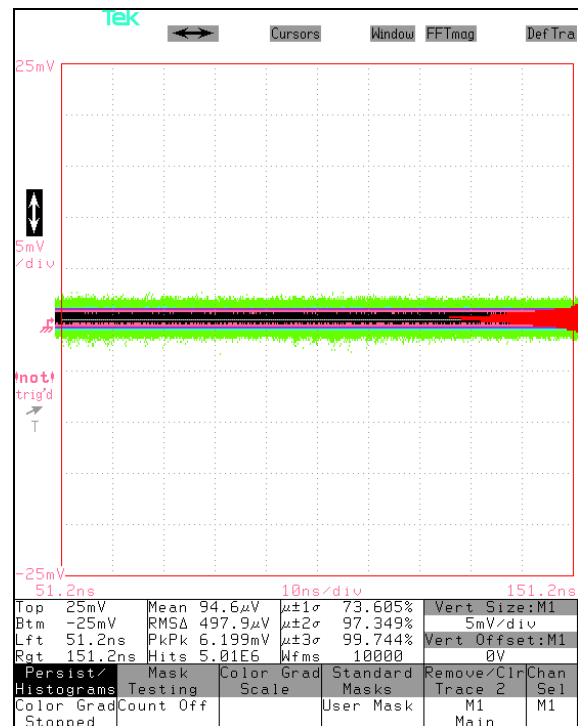
Normally the noise is given input referred, so to speak, it can be compared to the source signal levels. For timing applications it is often more depicting to plot the total output noise of an amplifier.

In the following scope pictures the output noise voltage of our TAx-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 TAx's inputs were shortened, i.e.  $Z_{Source} = 0\Omega$ .

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, **RMSΔ** =  $\sigma$  = standard deviation, **PkPk** = Peak-to-Peak voltage = max. – min. sample voltage,  **$\mu \pm 1\sigma$**  = percentage of samples that fall within  $\pm 1$  standard deviation of the mean ( $\pm 2\sigma$ ,  $\pm 3\sigma$  respectively).

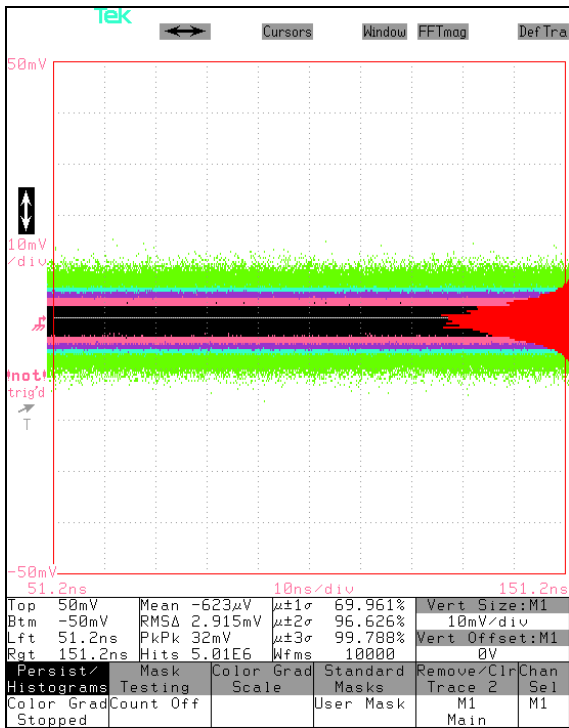


TA1000B-10 (x10), 5mV/div

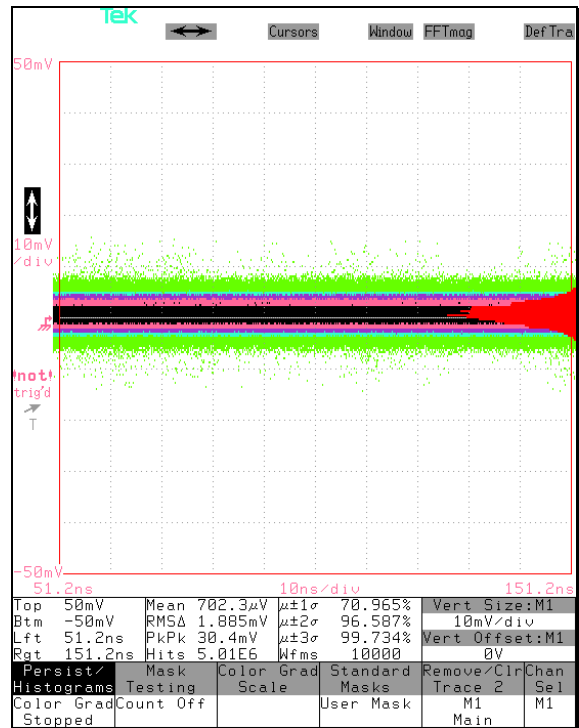


TA1000B-10 BWL (x10), 5mV/div

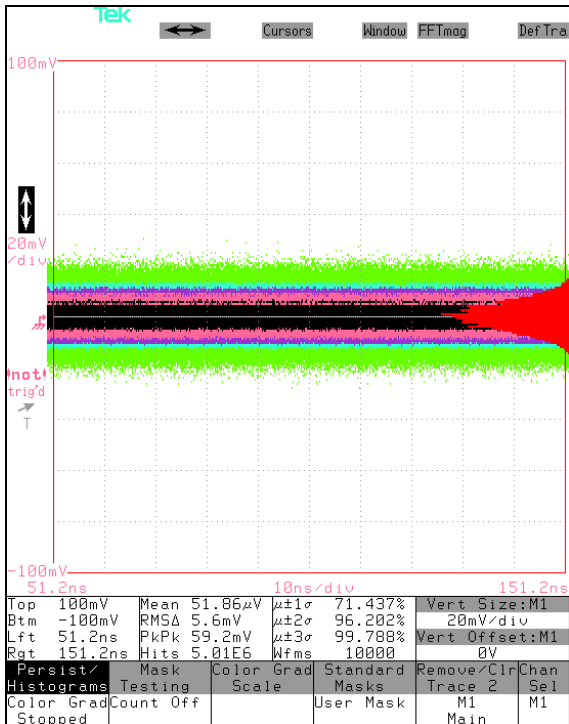
# TA1000B-10/-50/-100/-200 Fast Pulse / Timing Preamplifier x10/x50/x100/x200, very low noise, DC coupled



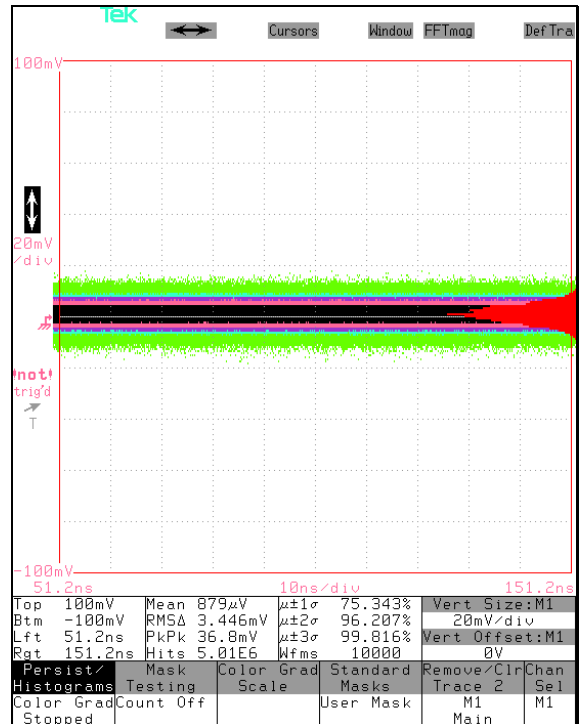
TA1000B-50 (x50), 10mV/div



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

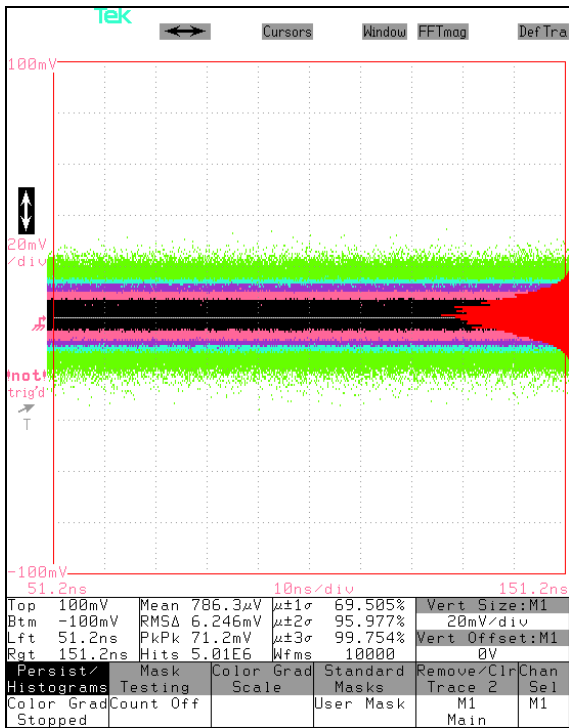


TA1000B-100 (x100), 20mV/div

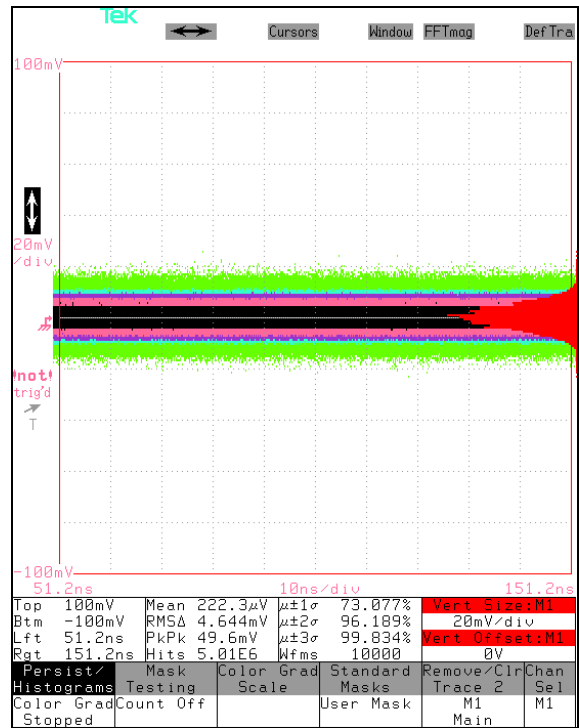


TA1000B-100 BWL (x100), 20mV/div

# 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