This Bergoz Instrumentation TechNote compares data taken on a real beam with data taken in the lab before shipment using an instrument-simulated beam, in order to predict the performance of an **In-flange.FCT** after it is installed on the beam.

The Bergoz Instrumentation **In-flange.FCT** is a wideband current transformer designed to be bolted in place as part of the accelerator vacuum chamber. Its purpose is to observe the beam longitudinal profile –or waveform– up to the highest possible frequency allowed by the current transformer bandwidth.
A ceramic ring interrupts the electrical continuity of the vacuum chamber; this prevents the wall current –an opposite polarity image of the beam current circulating on the wall chamber surface– to pass through the current transformer aperture, preventing it from interfering with the beam current reading.
Kovar tubes are vacuum-brazed on either side of the ceramic ring –often called "gap"– and TIG-welded to the stainless steel flanges.

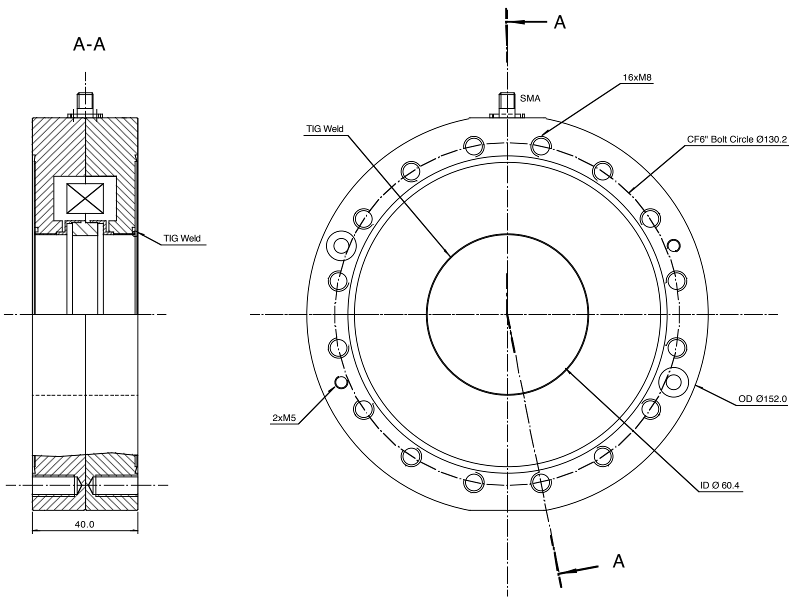

Figure 1. Mechanical drawing of an In-flange.FCT-UHV

Bergoz Instrumentation In-flange.FCTs are characterised before shipment as follows:
- Vacuum pollutant concentration is analysed with an RGA Residual Gas Analyser
- A beam current is simulated by fast pulse generators (typ. 150ps rise) for time domain measurements and by VNA Vector Network Analysers for frequency domain measurements.

These two simulation techniques are only a poor approximation of a real beam:
- Their source impedance is 50 ohms, whereas the beam –being a true current source– has infinite impedance
- The beam pulse rise time can be significantly faster than that obtained by either pulse generators or VNAs.

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It is therefore of interest to compare the **In-flange.FCT** response to a simulated beam to that of a real beam.
An **In-flange.FCT** delivered to DESY was tested on the Petra-II ring in single bunch mode.
A comparison between on-bench results and on-beam results is given hereafter.

Before the results are compared, it must be noted:
- Bench test signal readout was made using a short coaxial cable
- Beam test signal was measured with 30 meters of 1/2" RFS-type cable.
- The ceramic gap width was ca. 4mm and the gap capacitance ca. 12pf.

In-flange.FCT response on the bench

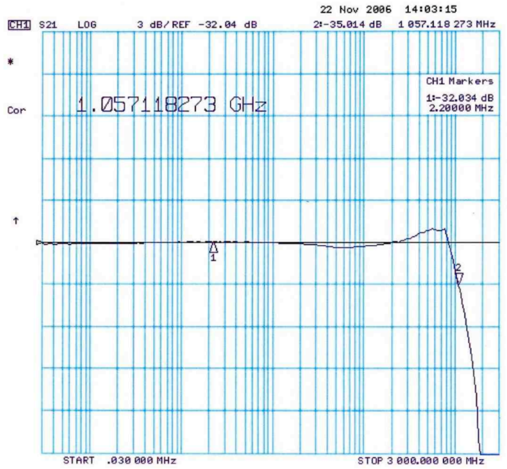

Figure 2: Frequency domain response (on bench)

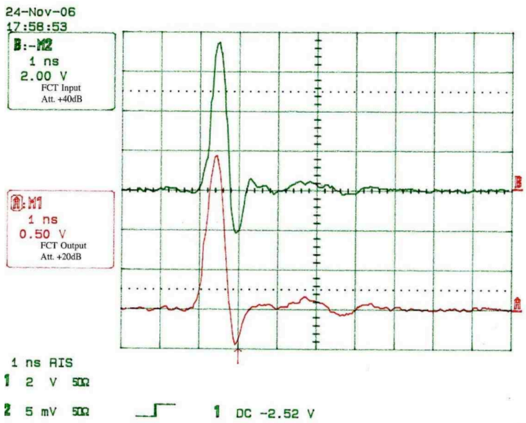

Figure 3: Time domain response (on bench)

The lower trace is the pulse input to the **In-flange.FCT.**
The upper trace is the **In-flange.FCT** output at a 50-ohm termination.
The good agreement between upper cut-off frequency 1.06 GHz (-3dB) and rise time ca. 300ps is clearly seen.

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In-flange.FCT response on-beam

Petra-II was filled with a single electron bunch of width << In-flange.FCT rise time.
The bunch has the potential of exciting resonance in the In-flange assembly way above the FCT upper cut-off.

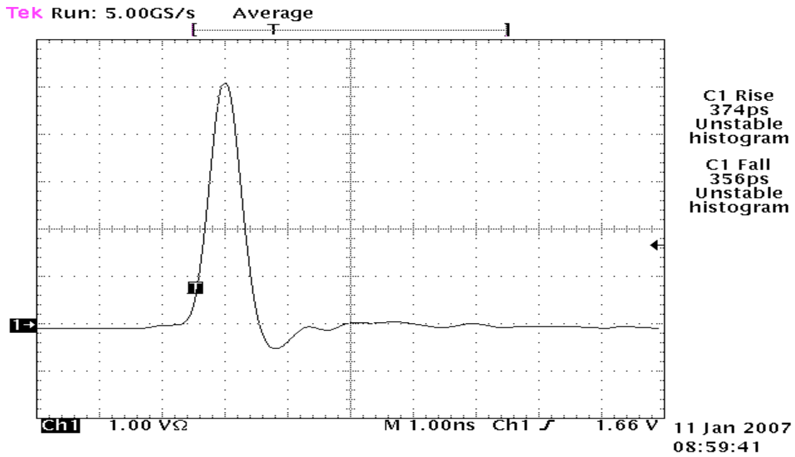

Figure 4: Time domain response (on-beam)

The output cable is 1/2" RFS-type, 30-meter long
No filter was added.
Rise time 374ps Fall time 356ps
The fast damping of the output waveform can be clearly seen.

Résumé:

In-flange.FCT measured performance data on-bench and on-beam are presented above.
Comparison shows that bench data can be trusted to predict actual performance on beam.
The slower rise and fall times may be attributable to cable attenuation and oscilloscope bandwidth limitation (TEK684A, 1 GHz).

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