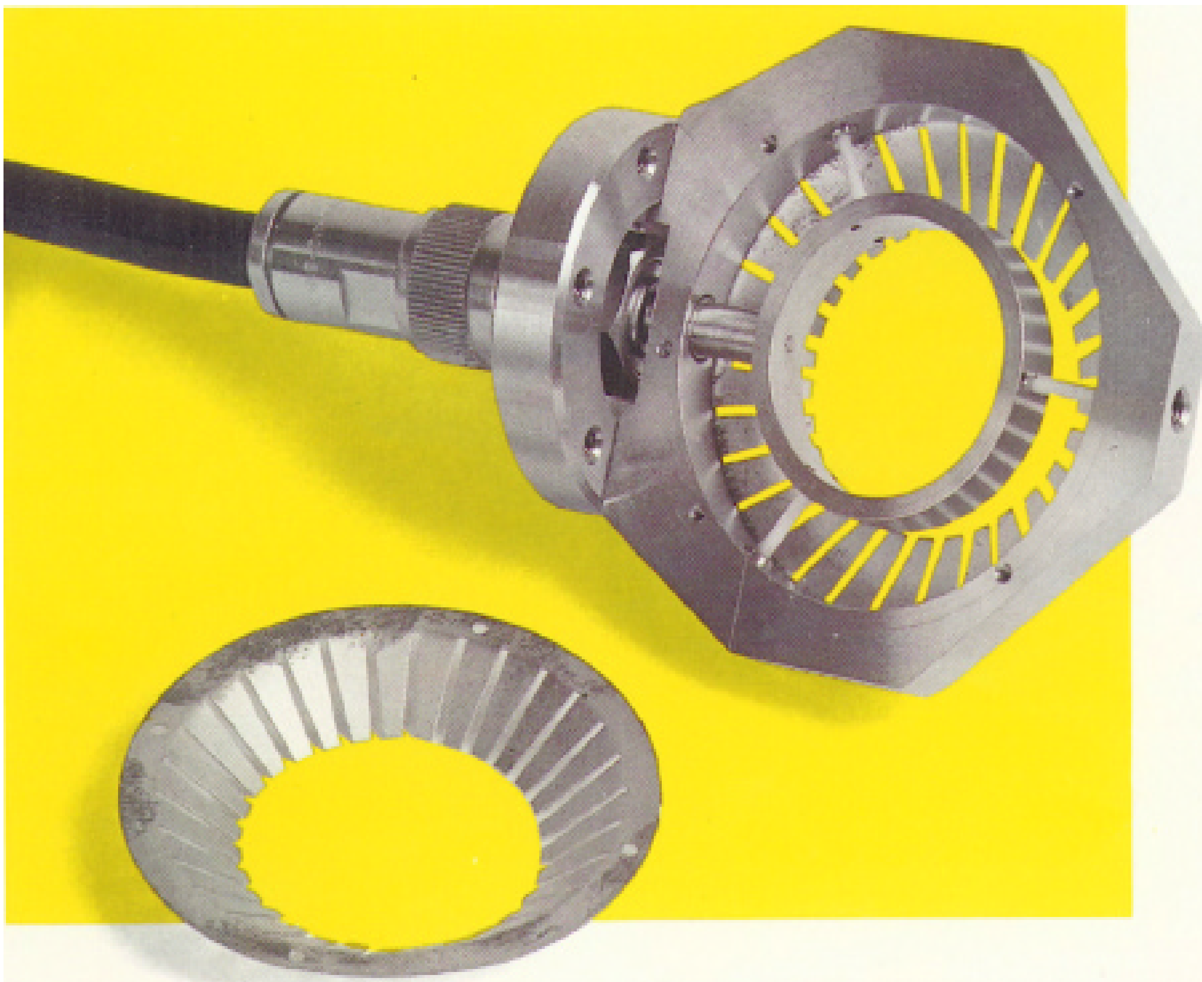
Capacitive Pick-Up

Type DB 040



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CAPACITIVE PICK-UP PROBE TYPE DB 040

Application:

The capacitive pick-up probe is used for observation of the particle beam micro-structure of RF-accelerators. The probe should be followed by a broadband signal processing system.

The pick-up signals may be used to observe the shape of bunches, as well as to measure the position of bunches in time, with reference to a RF-signal. Based on capacitive pick-ups, the following measurements may be performed:

- time of flight measurement for determination of particle energy;
- longitudinal emittance measurements;
- determination of minimum acceleration voltage for RF-structures (phase-scan);
- measurement and monitoring of stability of an accelerator with respect to the energy.

Principle:

By passing the inner electrode, the particle bunch induces a current on the electrode, which is proportional to the time derivation of intensity distribution within the bunch.

The principle of signal generation is shown schematically in **Fig. 1.**

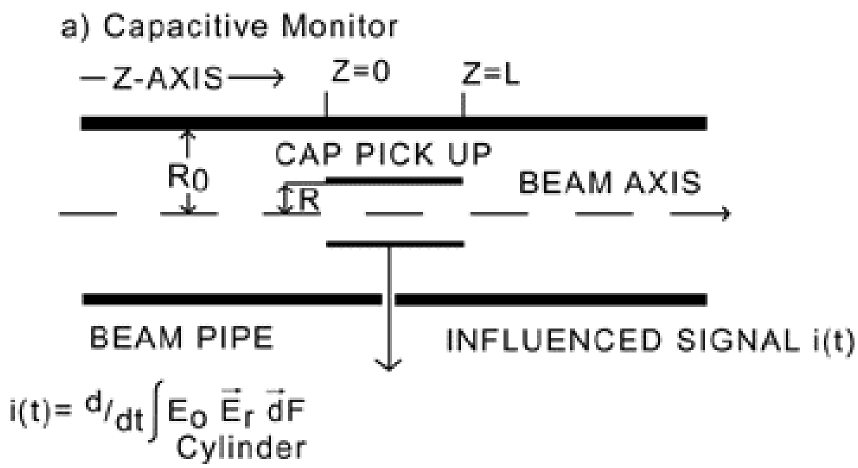


Fig. 1

Cover Photograph.: *Capacitive pick-up probe with removed front segmented aperture. Inner ring is provided for current pick-up; also seen is the sealing flange with vacuum-sealed N-type connector and segmented apertures for tuning of impedance.*

Principle (continued):

The induced signals usually require a signal processing system with a bandwidth of greater than 1 GHz. Therefore, the geometry of the pick-up has to be designed carefully with respect to the broadband response; the probe impedance is typically matched to 50 Ohms. Each capacitive pick-up will be checked by use of a time domain reflectrometer before delivery to the customer. Correct controlling is provided by timing the two segmented apertures.

Measurements below show two (2) typical probe signals, measured in the time domain (left) and in the frequency domain (right). The time scale on the left is 1 ns/div.; the difference between two signals (top and bottom) is the rise time which is made very clear in the frequency domain on the right.

Fig. 2

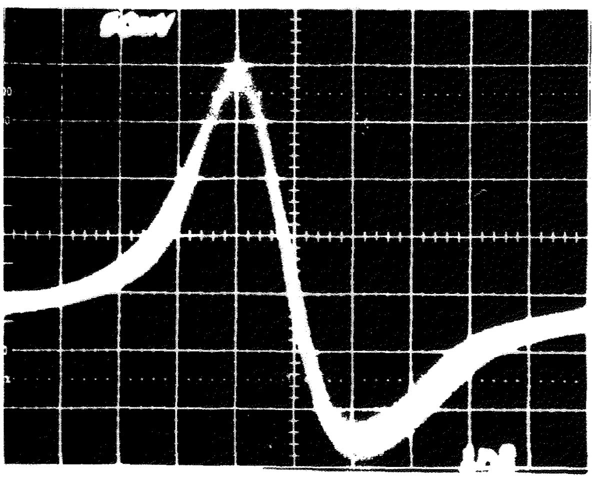
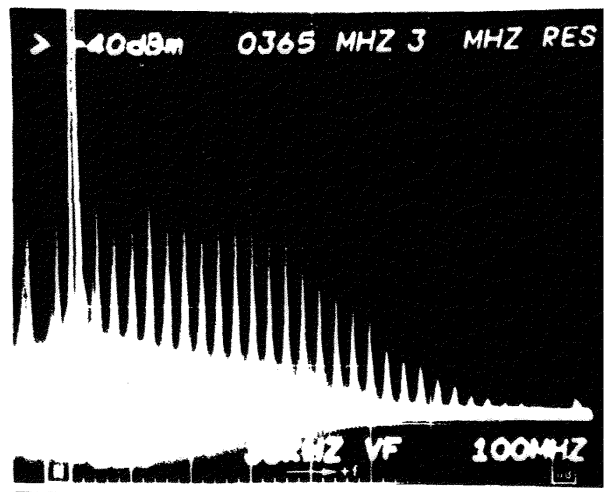


Fig. 3



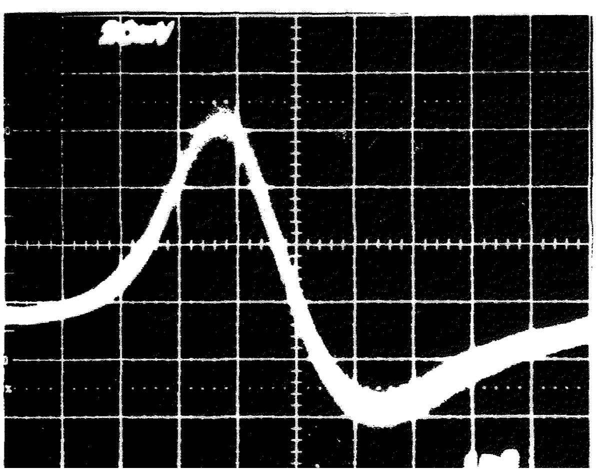


Fig. 4

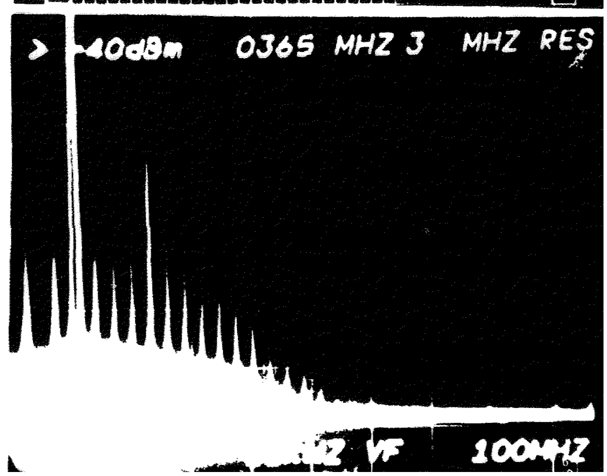


Fig. 5

Technical Specifications:

Material	:	Stainless steel
Segmented apertures	:	Copper
Probe support	:	Probe can be mounted either to a CF-100 flange or to a compressed air actuated feedthrough. In both cases, the center of probe coincides with the center of beam pipe, if a standard diagnostic chamber is used.

Electrical insulation:

Inner and outer ring	:	$A1_2O_3$ Studs
Outer ring (= ground) beam pipe	:	$A1_2O_3$ Ceramic disc

NOTE: For reasons of ground loop suppression, the outer conductor is insulated from the vacuum system.

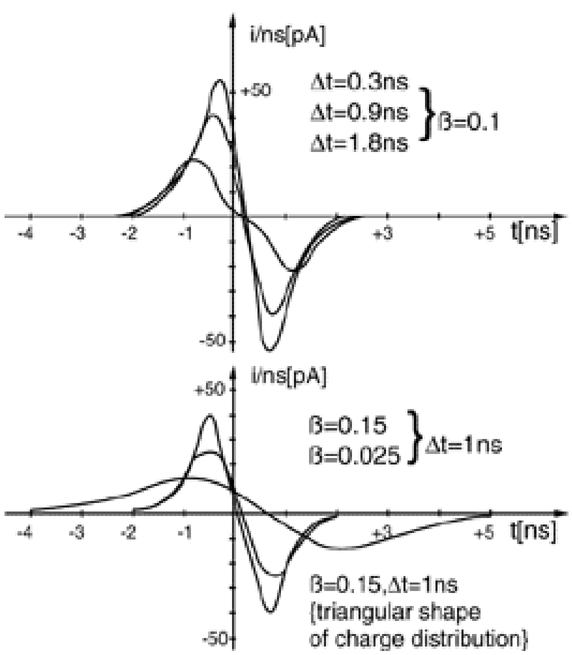


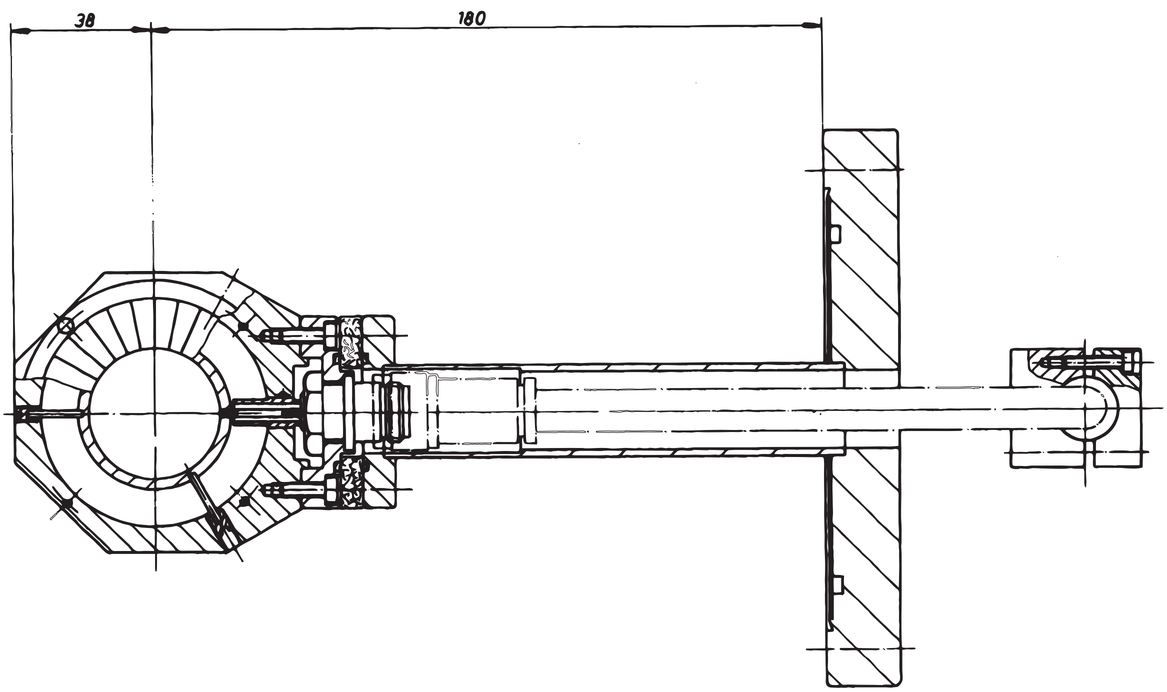
Fig. 6

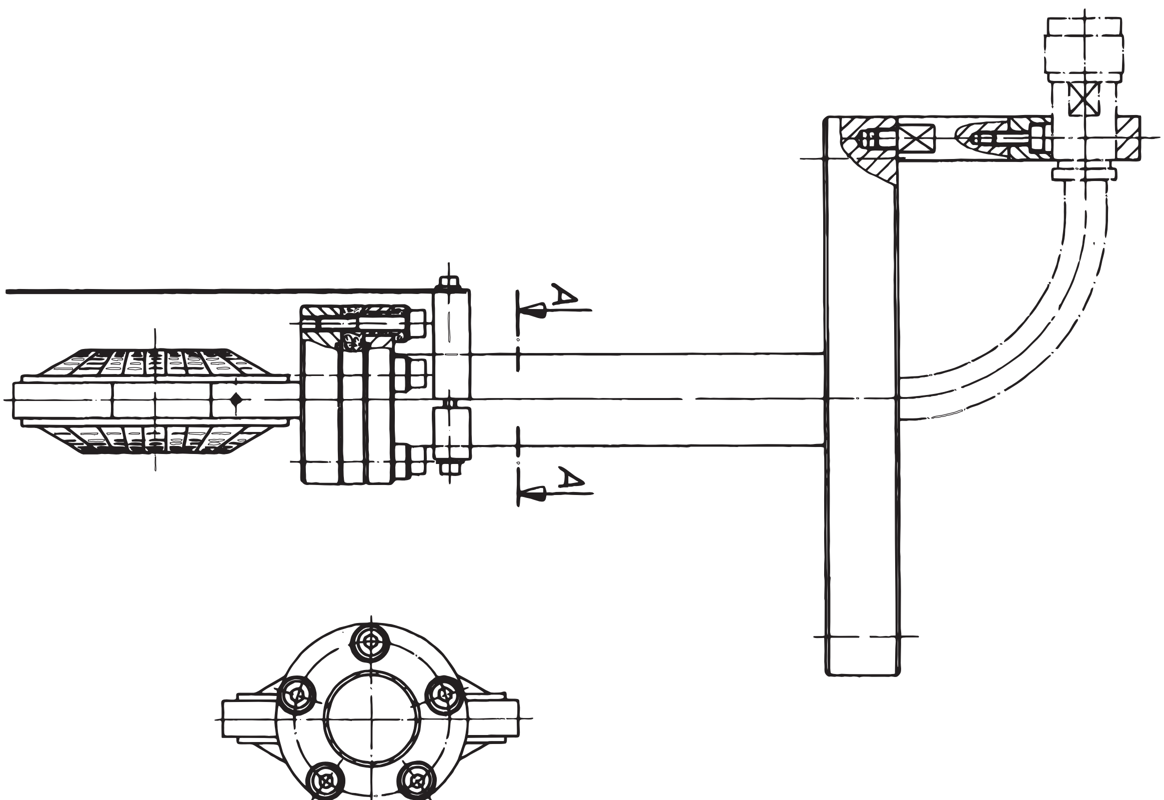
The diagram shows the calculated signal currents for various particle velocities and different bunch lengths. The ordinate gives the current in terms of one electrical charge unit, passing the probe. The calculations are for the standard type of probe (compare specifications.)

Probe Dimensions:

Inner ring	:	Inner diameter: 1.48 inches. Length in beam direction: 0.4 inches.
Outer ring	:	Inner diameter: 2.44 inches. Outside dimensions: approximately 3.15 x 3.15 inches.
Impedance	:	Ring system: 100 Ohms, tunable by deforming the segmented apertures.
Impedance of cable and connector	:	50 Ohms
Remark	:	Looking from amplifier**,** impedance is 50 Ohms, matched to commercial available broadband electronics (for example: amplifiers, sampling- and real time oscilloscopes).
Bandwidth	:	Approx. 2 GHz
Coefficient of reflection	:	Less than 5 % for a test pulse with 25 ps rise time.
Signal feedthrough	:	Vacuum -sealed connector, N –type.

NOTE: For obtaining correct signal, the geometry of probe should be matched to the parameters of RF-accelerator (e.g. particle velocity, time structure of particle bunches, beam diameter).





All dimensions are in millimeters