Electron Pickups

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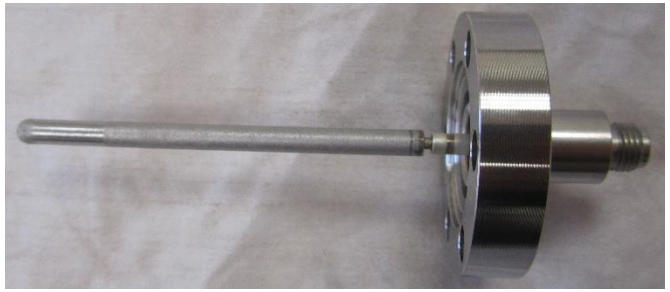
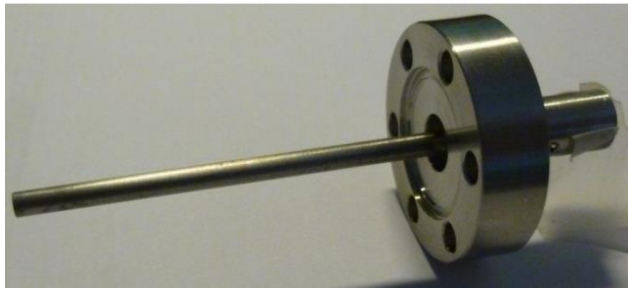


IFMIF



ESS

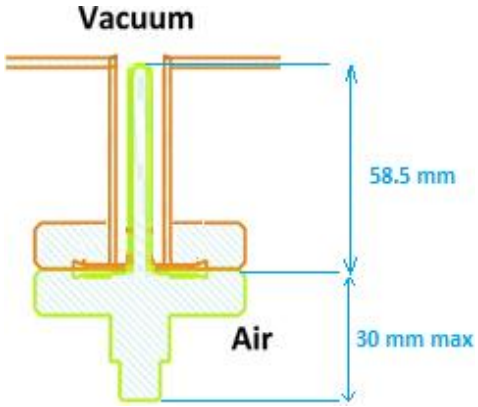
Generalities

❑ The electrons measured by e- current pickup are generally those created in the plasma and do not come directly from the MP

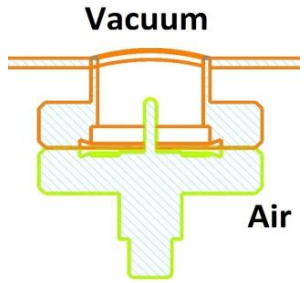
➔ we can have electron signal even when there is no resonant multipacting occurring
➔ The use of e- current pickup measurements is an efficient way to monitor electron buildup likely to create an electric discharge

❑ The e- current pickup allows to give an image of the electron activities accruing in the its neighborhood

➔ We are not sur to detect a very local MP which is not influencing the pick up neighborhood: in that case PMs are more appropriate but protection threshold are difficult to establish. The vacuum fluctuation or local thermal increase can give an indication of a MP creation. In TW operation odd RF power reflection could be an indication of impedance variation du to the MP.
➔ We need to place the pickup near the most critical parts (the coupler ceramic window)
➔ For more efficient detection, pickup antenna tip needs to be close to the external conductor RF surface, without influencing the RF configuration.



Pick-up for IFMIF coupler



Pick-up for TTF-III coupler

❑ To increase the detection efficiency of the e- current pickup, we usually apply a bias voltage on its antenna.

Bias applied to the e- current antenna

❑ The choice of the Bias Voltage depends of the laboratories experiences. Many choices are possible.

Examples:
- CEA: typical value 48V (generally between 45V and 50V)
- LAL (IJCLAB): typical value 30V (XFEL Couplers)

At CEA, experience showed that's, generally, increasing bias voltages beyond 45V has no significant influence of the measured current.

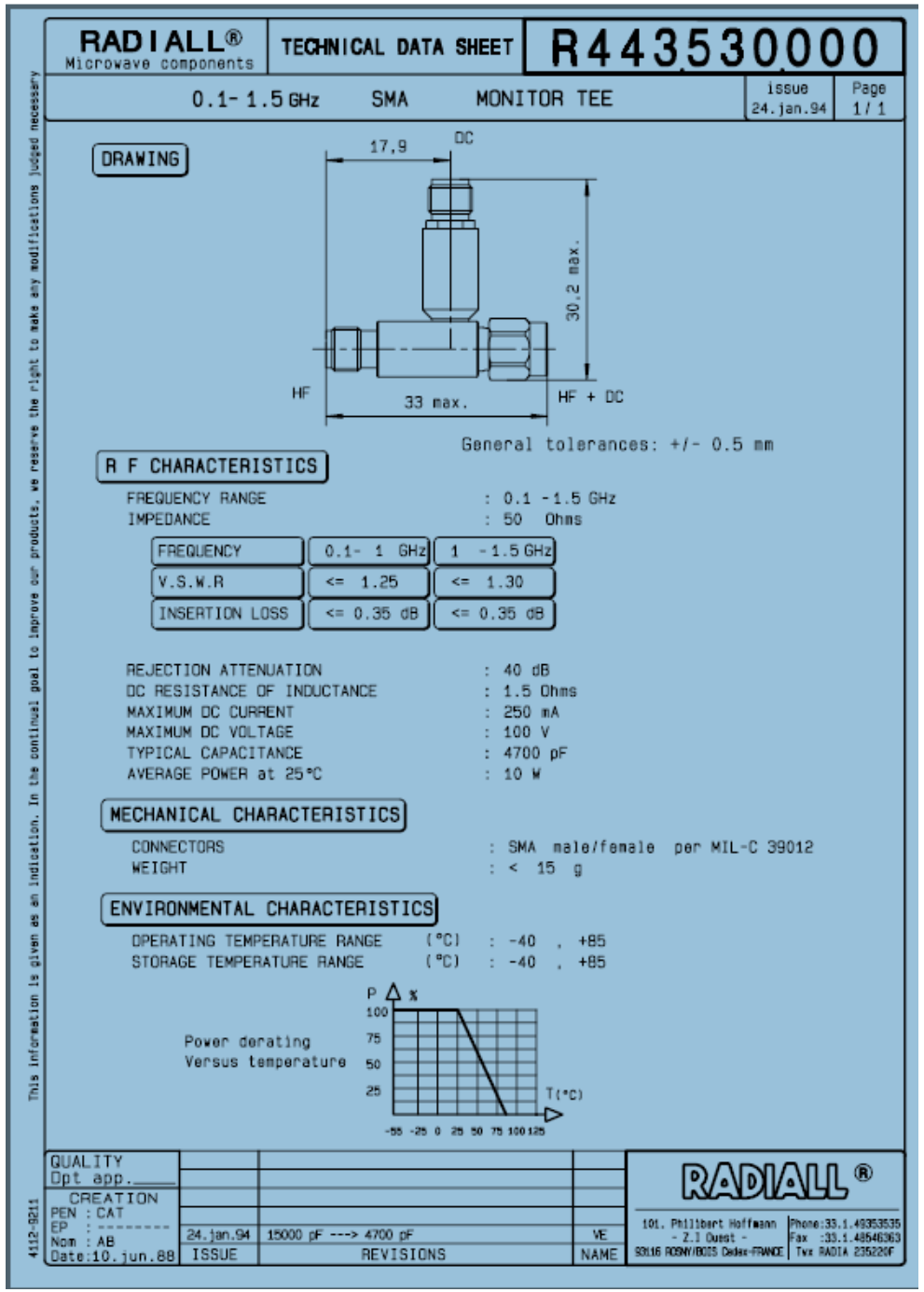
❑ Some typical values we use at CEA:

- ✓ Bias = +48 V
- ✓ Current detection range= 0 to 10 mA converted to 0 to 10V ➔ 1V/mA
- ✓ Interlock threshold : ~ 5mA (could be modified depending on the vacuum behavior)
- ✓ Rising time = 16 µs from 0 to 10 volts (equivalent to 0 to 10 mA)
- ✓ E- current after RF conditioning (test stand) : less than 1 mA
- ✓ Pressure at the end of RF conditioning at max operating power (test stand) : less than 10^{-7} mbar (coupler gauge)
- ✓ Pressure interlock threshold for RF conditioning (test stand): $6x10^{-7}$ mbar to 10^{-6} mbar

For ESS the more strict values are chosen : vacuum < $2x10^{-8}$ mbar (Coupler gauge); Current < 0.15 mA at the end of the RF conditioning

❑ Recommendation: for prototype couplers, start with strict interlock thresholds and short pulses. Then, try to optimize the interlock threshold values based on the observation you make during the test and using the typical values

If very low RF coupling still possible with the pickup antenna. The use of a Monitor Tee (DC Block) will allow to make RF measurements in order to determine the position of short circuit corresponding to the maximum E field near the ceramic window.



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0.1- 1.5 GHz SMA MONITOR TEE — issue 24.jan.94 — Page 1/1

This information is given as an indication. In the continual goal to improve our products, we reserve the right to make any modifications judged necessary

DRAWING

General tolerances: +/- 0.5 mm

R F CHARACTERISTICS

FREQUENCY RANGE : 0.1 -1.5 GHz
IMPEDANCE : 50 Ohms

FREQUENCY	0.1- 1 GHz	1 -1.5 GHz
V.S.W.R	<= 1.25	<= 1.30
INSERTION LOSS	<= 0.35 dB	<= 0.35 dB

REJECTION ATTENUATION : 40 dB
DC RESISTANCE OF INDUCTANCE : 1.5 Ohms
MAXIMUM DC CURRENT : 250 mA
MAXIMUM DC VOLTAGE : 100 V
TYPICAL CAPACITANCE : 4700 pF
AVERAGE POWER at 25°C : 10 W

MECHANICAL CHARACTERISTICS

CONNECTORS : SMA male/female per MIL-C 39012
WEIGHT : < 15 g

ENVIRONMENTAL CHARACTERISTICS

OPERATING TEMPERATURE RANGE (°C) : -40 , +85
STORAGE TEMPERATURE RANGE (°C) : -40 , +85

Power derating
Versus temperature

QUALITY Dpt app.
CREATION PEN : CAT EP : --------- Nom : AB Date:10.jun.88

ISSUE	REVISIONS	NAME
24.jan.94	15000 pF ---> 4700 pF	VE

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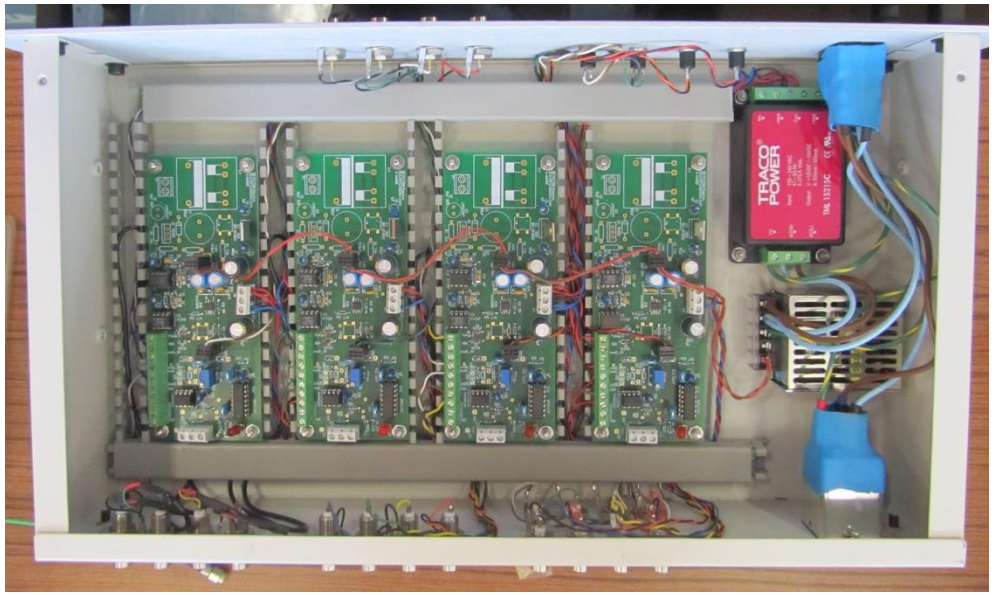
Pick up electron
Test 10mA 1-2-3-4
0-10V out 1V/mA 1-2-3-4

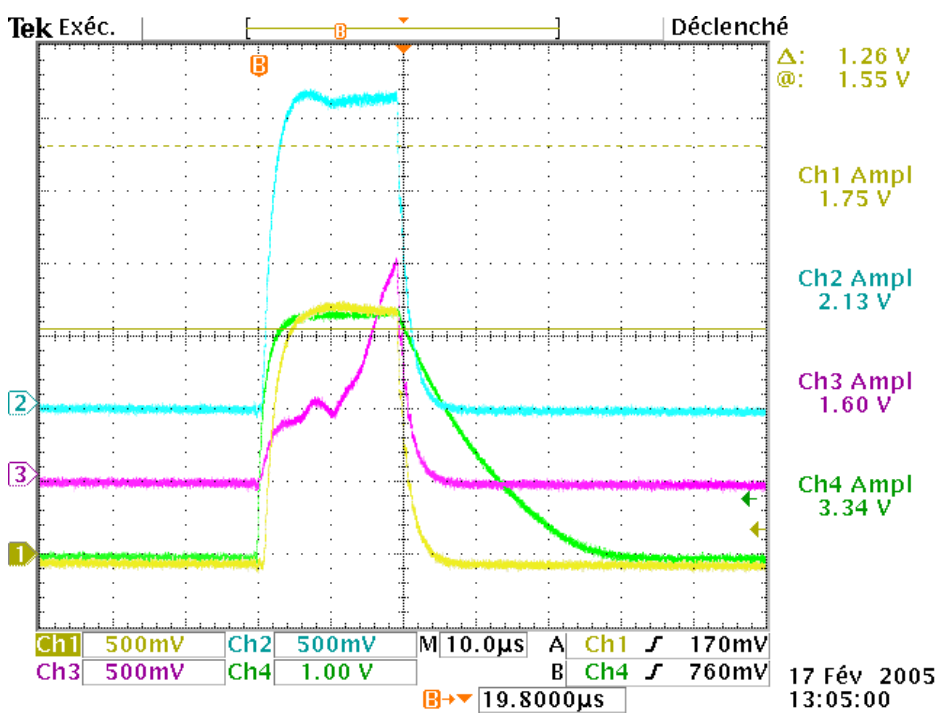

TRACO POWER

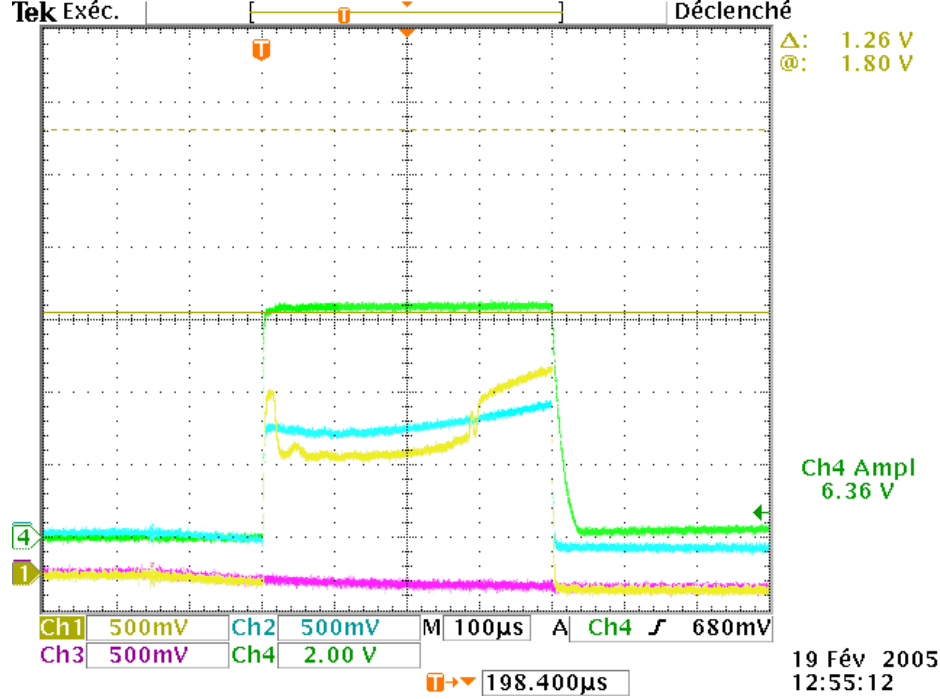

Interlock out 4-3-2-1
Pickup in 4-3-2-1
Seuil in 4-3-2-1
0-10V
0/10V out 1mA/V 4-3-2-1

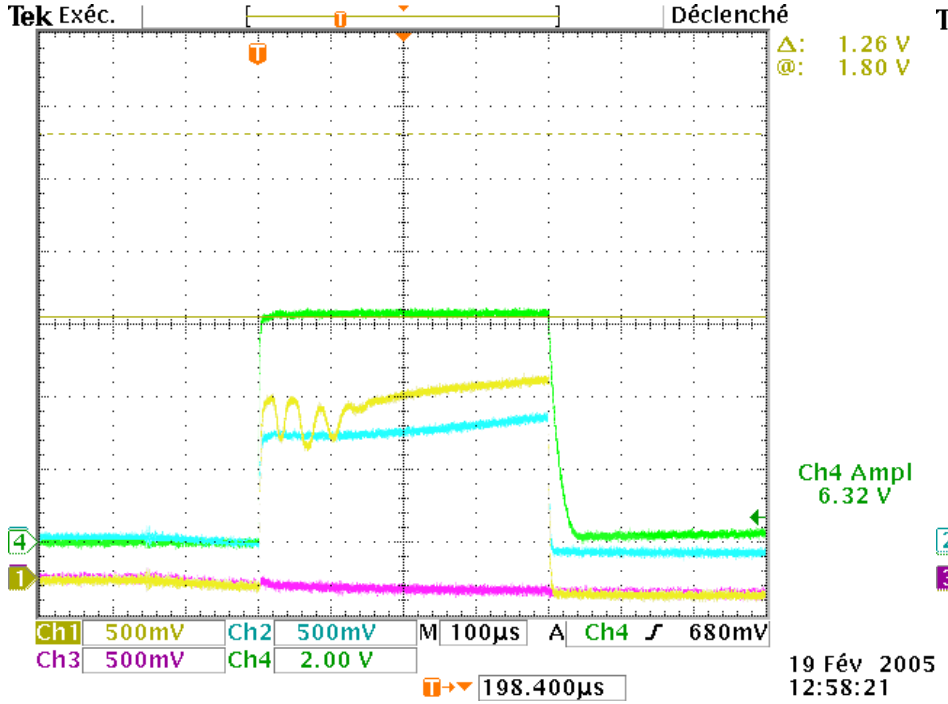
Example:
TTF-III couplers

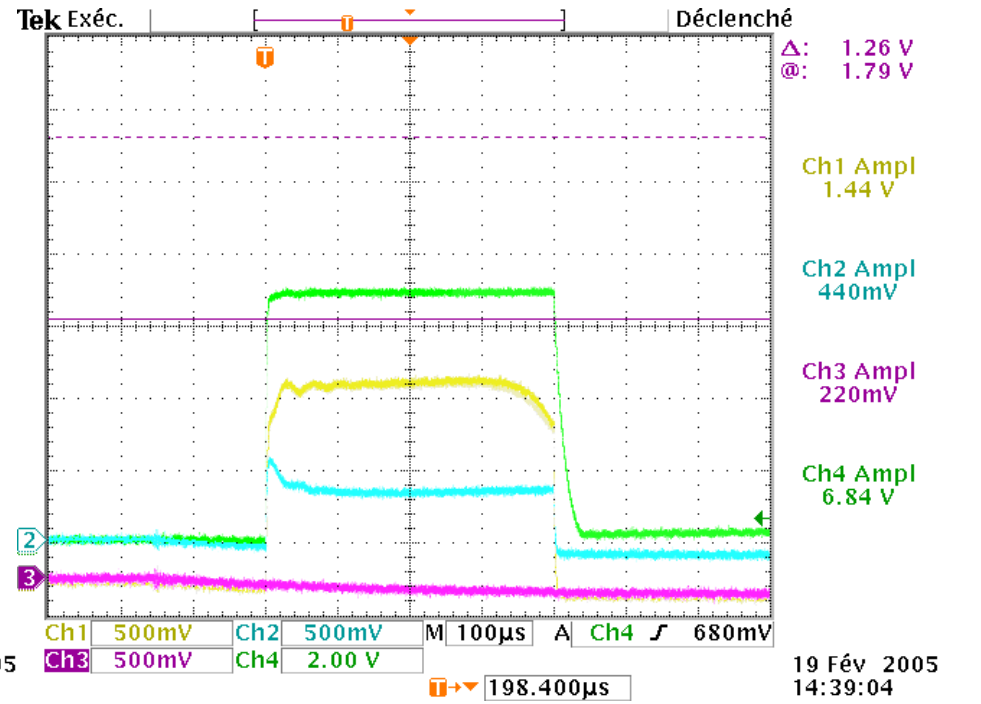
Pickup bias = 30V

All signal except the green one are pickup current signals 1V=1mA

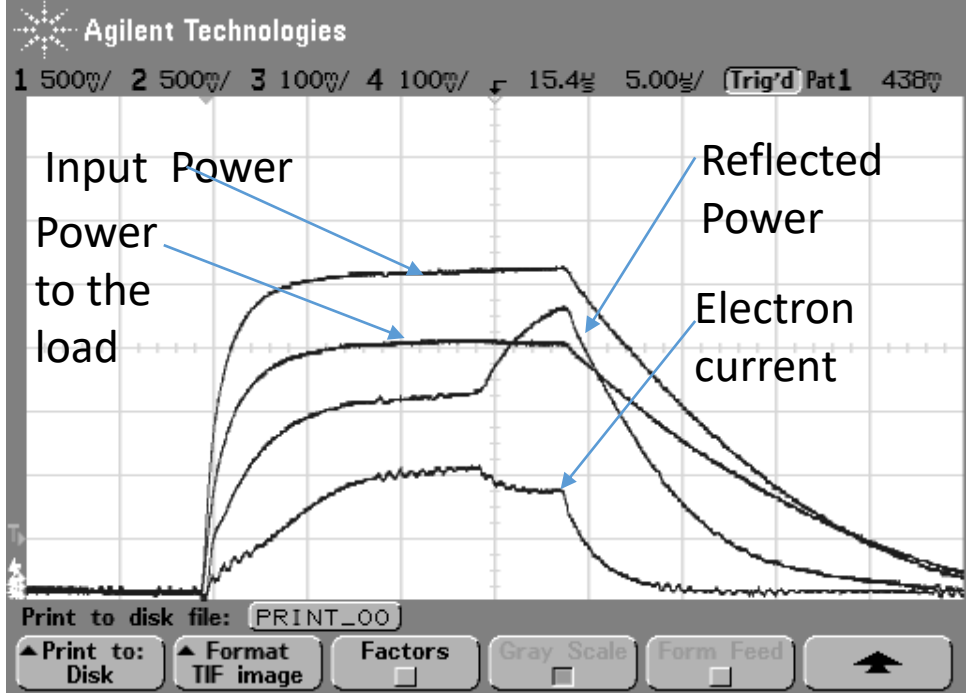


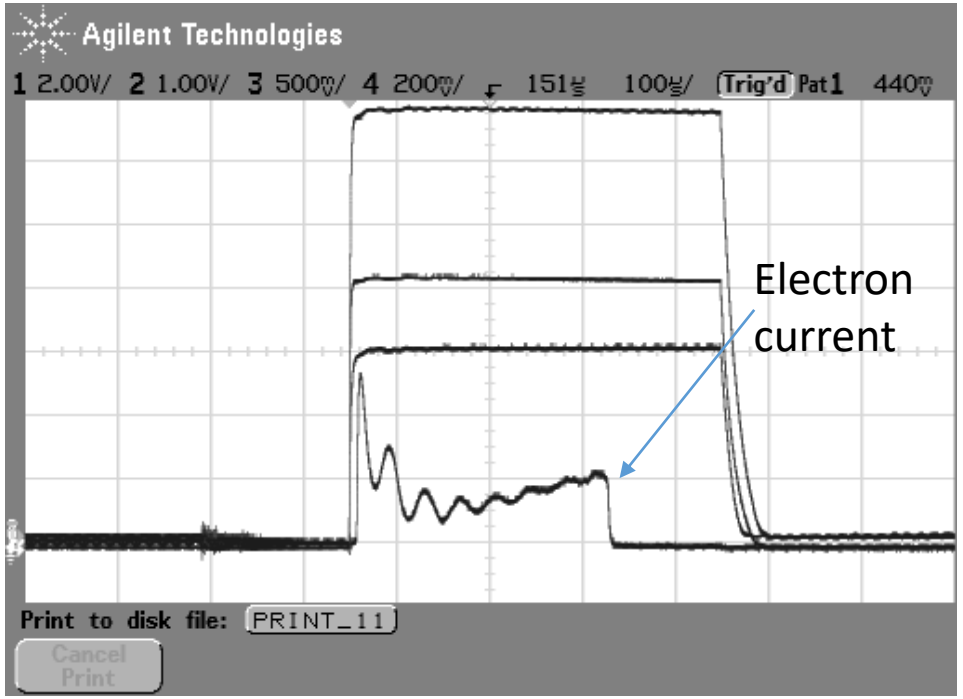


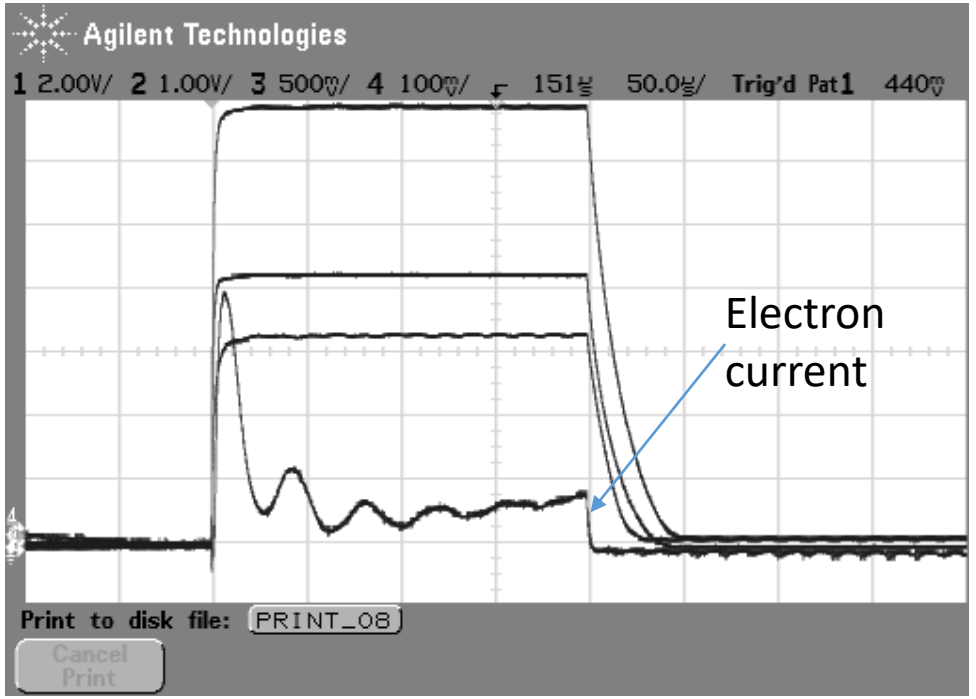




Example:
TTF-III couplers
Pickup bias = 30V







Example
IFMIF Coupler:
Bias 45V

Upstream coupler and downstream coupler pickup currents