EUROPEAN PARTNERSHIP | Co-funded by the European Union | METROLOGY PARTNERSHIP | EURAMET | ELITE 24GRD05 | www.ffii.es www.lcoe-hv.com | POLITÉCNICA | FUNDACIÓN PARA EL FOMENTO DE LA INNOVACIÓN INDUSTRIAL | LCOE LABORATORIO CENTRAL OFICIAL DE ELECTROTECNIA

EXTENSION OF THE FFII TRACEABILITY CHAIN

Authors: Ángel Ramírez (FFII), Abderrahim Khamlichi (FFII), Fernando Álvarez (UPM), Eduardo Arcones (UPM), Adrián Gómez (UPM)

Impulse-current measurements up to 200 kA / 10/350 µs

24GRD05 ELITE / WP3 / FFII–LCOE

FFII is extending its shunt-based traceability chain through three Pearson monitors to support portable calibrations and a planned 10/350 µs extension to 200 kA.

3 waveforms
4/10, 8/20 and 10/350 µs

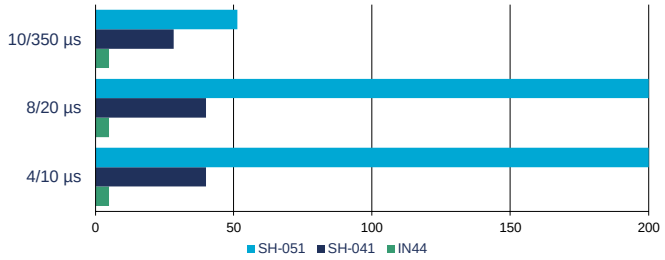
3 Pearson monitors
5664, 1330 and 2093

200 kA
10/350 µs extension target

EXISTING SHUNT CHAIN

Three calibrated coaxial shunts cover complementary ranges. Usable peak current is the lower of the peak rating and the I²t-limited current for each waveform.

III-2-IN44-131 5 kA / 80 kA²·s • III-1-SH-041 40 kA / 200 kA²·s
III-2-SH-051 200 kA / 660 kA²·s



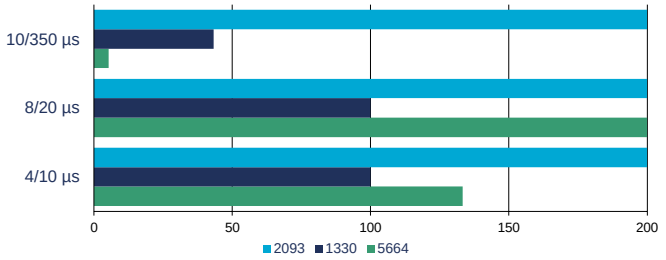
Sensor	4/10	8/20	10/350
IN44	5	5	5
SH-041	40	40	28.3
SH-051	200	200	51.4

10/350 µs limitation: SH-051 is nominally 200 kA, yet ≈51.4 kA is the calculated I²t-limited peak for a 10/350 µs waveform.

NEW PEARSON CHAINS

Three monitors combine fast response with different current–time-product ratings. Their usable limits below are capped at the 200 kA WP3 target.

5664 Fast portable, 0.25 µs; 8 A·s
1330 Intermediate/redundant, 0.25 µs; 65 A·s
2093 High charge, 1,200 A·s



Monitor	4/10	8/20	10/350
Pearson 5664	133.3	200	5.3
Pearson 1330	100	100	43.3
Pearson 2093	200	200	200

Pearson 2093 bridges the 10/350 µs rating gap above the existing high-current shunt. Validation of the full chain is the next step.

TRACEABILITY TRANSFER

Calibrated shunts and Pearson monitors will measure the same safe-overlap impulses. The comparison will establish scale factor, linearity, repeatability and dynamic response.

CALIBRATED SHUNTS
Traceability origin

›

SIMULTANEOUS COMPARISON
Safe overlap and corrections

›

PEARSON REFERENCE CHAINS
Portable reference sensors

Complete chain: sensor + output cable + termination + attenuator (if needed) + digitiser + evaluation software.

Pearson-to-Pearson comparison adds redundancy; traceability originates from the calibrated shunts and acquisition chain.

CHARACTERISATION AND UNCERTAINTY EVALUATION (NEXT STEPS FOR M18-M36)

1 Define complete measurement chains

2 Characterise components

3 Validate under impulse conditions

4 Build uncertainty budgets

5 Validate up to 200 kA through the intercomparison

A / SCALE FACTOR AND LINEARITY

Impulse calibration of complete reference chain
Amplitude linearity across the usable range
Frequency response and step response

B / THERMAL BEHAVIOUR

Short-term self-heating stability
Ambient-temperature coefficient
Assess reference and DUT sensors separately

C / ACQUISITION AND EVALUATION

Oscilloscope, attenuation, cable and termination
Resolution of reference and DUT chains
IEC 61083-2 software contribution

D / DYNAMIC AND INSTALLATION EFFECTS

Nearby-current and return-conductor influence
Positioning and centring
Generator noise analysis and filtering

REFERENCE CHAIN OUTPUTS

Pearson: characterised 5664, 1330 and 2093 systems for portable/on-site use.
Shunts: updated scale factors, drift, thermal and proximity corrections.

UNCERTAINTY AND WP3 VALIDATION

Budgets by waveform, current range and calibration configuration.
Target: traceable 10/350 µs measurements up to 200 kA through WP3 intercomparison.

Proposed test programme. Final uncertainty components and test levels will follow detailed system definition. Chart limits are calculated from stated ratings and capped at 200 kA; they are not yet validated traceable ranges.