microSilicon

The silicon detector for small photon and all electron fields

PTW THE DOSIMETRY COMPANY

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The microSilicon is a new silicon solid state detector with an optimized design. It can perfectly be used for the scanning of small photon fields thanks to its ingenious characteristics.

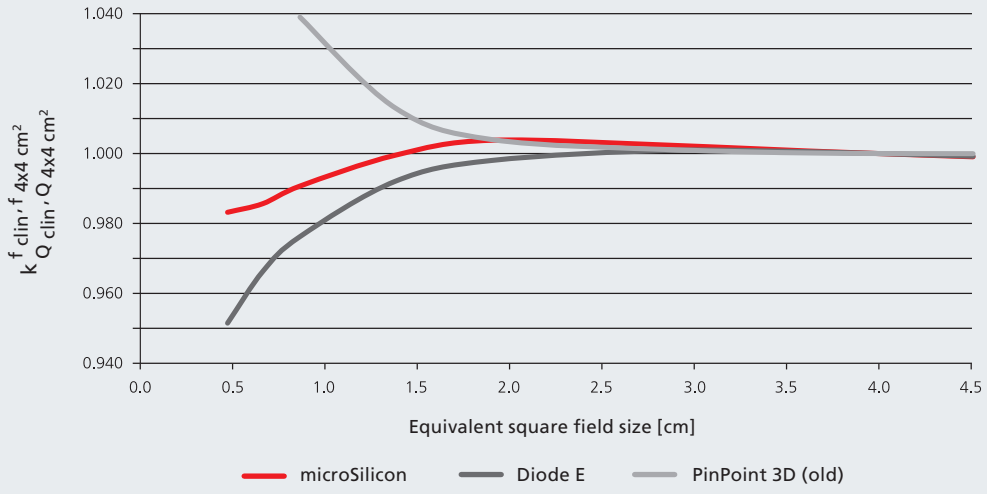
It is a non-shielded detector that extends its field of application to electron fields of all sizes.

Highlights

- THE silicon detector for small photon fields
- Unshielded diode, perfectly suited for electrons
- Excellent dose stability (@6MV only 0.1%/kGy)
- Very small detector to detector variation
- Very low dose per pulse dependence
- Very small sensitivity variation with temperature
- Improved water equivalence

Small Field Output Correction Factors

Small field output correction factors of the predecessor Dosimetry Diode E (T60017), the ionization chamber PinPoint 3D (T31016) and the new microSilicon (T60023).



Very close to the truth

Small field output correction factors should be applied when performing small field measurements. The magnitude of these factors increases with decreasing field size. Compared to other small field detectors, the microSilicon small field output correction factors have a very small magnitude.

The direct comparison to its predecessor Dosimetry Diode E T60017 shows that the result of the optimization within the new detector generation is obvious. To summarize, the small magnitude of correction factors implies the closeness to the true output factor. Additionally, the detector to detector variation of the microSilicon is almost negligible, which provides a sound basis for reliable small field correction factors.

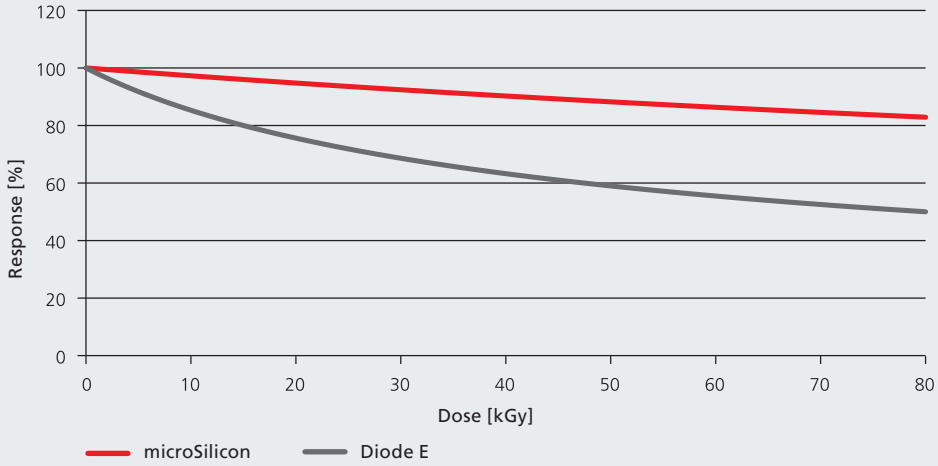
Dose Stability

The microSilicon shows only a small loss of response over accumulated dose.

Photons
The loss of response over accumulated dose at the clinically most frequently used energy of 6 MV photons is only 0.1 % per kGy.
It is 0.5 %/kGy for 18 MV.

Electrons
The small loss of response with electron irradiation is only 0.5 %/kGy for 10 MeV:

Dose Stability at 10 MeV electrons



Water equivalence

The new design results in a very small water equivalent window thickness. This has positive effects on the output factors, the small field output correction factors and the location of the effective point of measurement, which is now closer to the detector surface compared to the predecessor Dosimetry Diode E T60017. The profiles scanned with the micoSilicon are very close to a theoretical true profile.

For further information about the characterization of the microSilicon see
A.-B. Schönfeld et al., Characterization of the new mircoSilicon diode detector, Med. Phys. 2019, aapm.onlinelibrary.wiley.com/doi/10.1002/mp.13710

Specifications

microSilicon
Type 60023

Detector type	p-type silicon diode
Application	relative dosimetry in radiotherapy beams
Measuring quantities	absorbed dose to water
Reference radiation quality	^{60}Co
Nominal sensitive volume	0.03 mm^3
Design	waterproof, disk-shaped sensitive volume perpendicular to detector axis
Reference point	on chamber axis, 0.9 mm from chamber tip Photons: corresponds to the effective point of measurement Electrons: effective point of measurement is 0.3 mm from tip
Direction of incidence	axial
Nominal response	19 nC/Gy
Temperature response	typical ≤ 0.1 %/K, maximum ≤ 0.3 %/K
Directional response	≤ ± 1 % for rotation around the chamber axis ≤ ± 1 % for tilting of the axis up to ± 20°
Bias voltage	0 V
Entrance window	0.3 mm RW3, 0.01 mm Al, 0.48 mm epoxy
Total window area density	92 mg/cm^2
Water-equivalent window thickness	0.9 mm
Sensitive volume	radius 0.75 mm, thickness 18 µm
Outer dimensions	diameter 7 mm, length 45.5 mm
Radiation quality	(6 ... 25) MeV electrons; ^{60}Co ... 25 MV photons
Field size	(1 x 1) cm^2 ... (40 x 40) cm^2 for electrons (1 x 1) cm^2 ... (10 x 10) cm^2 for photons
Small fields*	down to 0.4 cm
Connecting systems	BNT, TNC, M

* This detector is well suited for measurements in small and very small fields. Please note that for high accuracy measurements any detector may need correction factors in small fields. The small field size limit is provided as equivalent square field size following the methodology of IAEA TRS483:2017. In accordance with TRS483, the smallest field size considered is 0.4 cm.

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