SCANDITRONIX WELLHÖFER

The accurate and reliable choice for patient dose verification

# 3G-*p*Si *in vivo* detectors

Detectors for teletherapy and brachytherapy

Member of the IBA group

# 3G-*p*Si new generation patient detectors

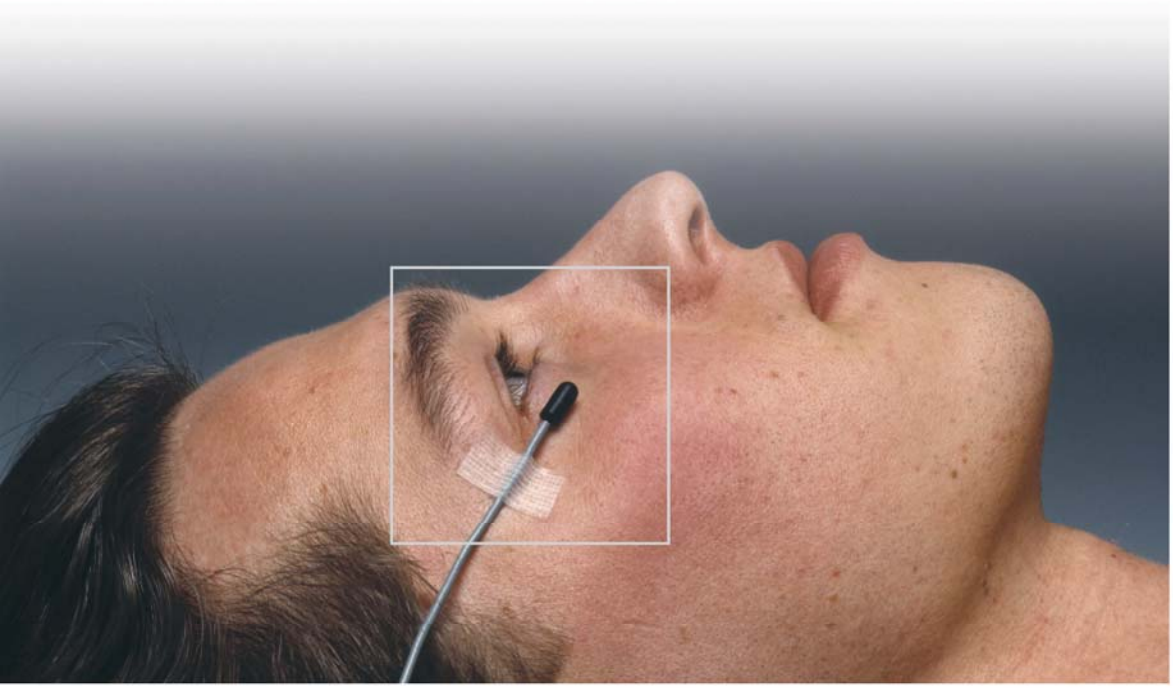
For more than thirty years, Scanditronix Wellhöfer has been the leader in detector technology. Refined specifications and new technology make our third generation semiconductor detectors the ideal choice for *in vivo* patient dosimetry. The unique high-doped *p*-type detectors provide dose-rate independence – both when new and after more than 10.000 measurements.

**3G-*p*Si detectors** are designed to minimize the need for correction factors, thus facilitating the implementation of a frequent and accurate *in vivo* dosimetry routine.

**A 3-year warranty** is standard on all detectors – demonstrating the unsurpassed accuracy and life expectancy of these detectors.

## Major advantages of the 3G-*p*Si patient detectors:

- Significantly improved long-term stability
- Build-up caps optimized for low field perturbation and minimized directional dependence
- Dose rate independence
- Ease of use
  - Fewer corrections needed
    Field size and directional dependencies minimized by use of build-up caps
- Low recalibration frequency
  - Designed for longterm stability
- 3-year warranty
  - Virtually no radiation damage effects
  - High usage capability
  - Low lifetime costs



## Proven dose rate independence

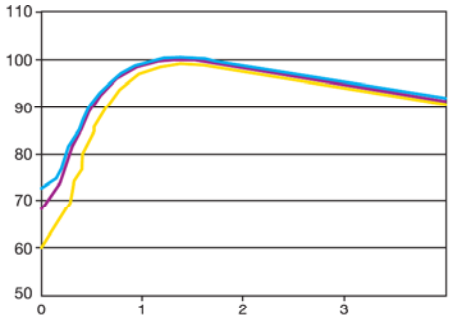
One of the main features of the 3G-*p*Si detectors is the proven dose rate independence. Even after receiving over 200 kGy of absorbed dose using high photon energies, where there is significant neutron contribution, the detectors continue to measure accurately. The use of 3G-*p*Si detectors guarantees minimum sensitivity decrease with absorbed dose and maintained dose rate independence. This stability reduces the need for frequent recalibration.

## Low temperature dependence

The 3G-*p*Si detectors have a stable temperature curve even after several hundred of kGy of accumulated irradiation. By applying a single correction factor, detector response due to temperature variations is easily compensated for.

## Reducing the need for corrections

The major reason for the need of corrections in patient dose measurements is the fact that, for photon beams, the ratio between the dose at surface and the dose at Dmax varies with field size, SSD, wedges etc. In selecting a detector with a suitable build-up, the measurement is virtually performed at Dmax, which makes it independent of these physical aspects. Another benefit gained from the build-up caps is that any directional dependence in the actual detector is practically eliminated.




Build-up curves for 10x10, 20x20 and 30x30 $cm^2$ fields in a 6 MV photon beam.

## Field perturbation

The build-up caps have been optimized to minimize perturbation and reduce the need for corrections. However, in cases where cumulative perturbation effects are an issue, our special low perturbation detector with less build-up like EDD-2$^{3G}$ or EDP-HL$^{3G}$ may be a better choice.

**The following table is a guide to select the appropriate detector.**

| | Photons | Electrons | Cobalt |
|---|---|---|---|
| **Entrance dose, few corrections** | EDP-10$^{3G}$ (4-8 MV)<br>EDP-15$^{3G}$ (6-12 MV)<br>EDP-20$^{3G}$ (10-20 MV)<br>EDP-HL$^{3G}$ (16-25 MV) (1 | EDD-2$^{3G}$<br>EDP-5$^{3G}$ | EDP-5$^{3G}$ (1.25 MeV) |
| **Total body irradiation** | EDD-5$^{3G}$ (2 | – | – |
| **Entrance dose, low perturbation** | EDD-2$^{3G}$<br>EDP-HL$^{3G}$ (16-25 MV) | EDD-2$^{3G}$ | EDD-2$^{3G}$ |
| **Exit dose** | EDD-2$^{3G}$<br>Any detector can be used | – | EDD-2$^{3G}$ |
| **Risk organ monitoring, measurements outside the field** | EDD-5$^{3G}$ | EDD-5$^{3G}$ | EDD-5$^{3G}$ |
| **Intracavitary (Teletherapy)** | IDF-1$^{3G}$ | – | – |
| **Brachytherapy** | IDF-1$^{3G}$ (e.g. rectum)<br>IDF-3 (e.g. rectum)<br>IDF-5 (e.g. rectum)<br>IDF-thin (e.g. bladder) | | |

(1 High energy, low perturbation; can be used up to 25 MV.

(2 When using spoiler (build-up), otherwhise same recommendations as entrance dose, few corrections.

# 3G-*p*Si *in vivo* detectors in teletherapy

EDD-2[3G] has a 2 mm water equivalent build-up. Primarily designed for low field perturbation and low directional dependence. This detector is very useful for electrons and exit dose measurements in all beam types.

EDD-5[3G] has a drop shaped encapsulation, which is equivalent to 5 mm build-up in water. This detector is specially designed for risk organ monitoring outside the primary field.

EDP-5[3G] has a 5 mm water equivalent build-up. Primarily designed for measurements in Cobalt and electrons.

EDP-10[3G] has a 10 mm water equivalent build-up. Primarily designed for measurements in 4-8 MV photons.

EDP-15[3G] has a 15 mm water equivalent build-up. Primarily designed for measurements in 6-12 MV photons.

EDP-20[3G] has a 20 mm water equivalent build-up. Primarily designed for measurements in 10-20 MV photons.

EDP-HL[3G] has a 14 mm water equivalent build-up. Primarily designed for measurements in high-energy photon beams where low field perturbation is critical.

IDF-1[3G] is a detector specifically designed for intracavitary measurements in teletherapy.

## Sensitivity decrease with absorbed dose

| Detector | Application area | Sensitivity decrease measured at 250 Gy | |
|---|---|---|---|
| EDD-2[3G] | entrance dose, low perturbation, exit dose, electrons, $^{60}$Co | <1% (less than the meas. accuracy), | in $^{60}$Co |
| EDD-5[3G] | risk organ monitoring, TBI | <1% (less than the meas. accuracy), | in $^{60}$Co |
| EDP-5[3G] | TBI, electrons, $^{60}$Co, exit | <1% (less than the meas. accuracy), | in $^{60}$Co |
| EDP-10[3G] | 4-8 MV, entrance dose, few corrections, exit | <1% (less than the meas. accuracy), | at 5 MV |
| EDP-15[3G] | 6-12 MV, entrance dose, few corrections, exit | <1% (less than the meas. accuracy), | at 6 MV |
| EDP-20[3G] | 10-20 MV, entrance dose, few corrections, exit | 1.2%, | at 15 MV |
| EDP-HL[3G] | 16-25 MV, entrance dose, low perturbation, exit | 4%, | at 21 MV |
| IDF-1[3G] | 4-12 MV, intracavitary, external beam<br>12-16 MV, intracavitary, external beam | <1% (less than the meas. accuracy),<br>1.2 %, | at 5 MV<br>at 15 MV |


## Detector support

The detector support with automatic detector retraction is a significant time saving device. Additionally, it provides a safe, tangle free environment for the diodes when not in use. It can be configured with all available detector cable lengths. The mechanics allow a detector to be pulled out to any length up to 3.50 m at constant force. The detector cable locks into position by simply moving it towards the central axis of the support. The cable retracts automatically when it is moved out from the centre. Additionally, the support has an integrated numerical index which clearly identifies each detector, thus helping to ensure that the correct detector is chosen for a given procedure.

## Calibration phantom

Since the temperature dependency of 3G-*p*Si detectors is stable, few corrections are required. However, an easy way to handle the correction process is to use our calibration phantom, which allows the user to calibrate the detectors at skin temperature. To achieve skin temperature the phantom should be filled with 40° water. The water temperature may be checked with the accompanying thermometer.

# Technical specifications

## 3G-*p*Si Detectors, General Specifications

| | |
|---|---|
| Sensitivity: | 25 nC/Gy |
| SVWT: | 0.25 ± 0.10% |
| Diameter: | 2.0 mm |
| Cable length: | 4 m (2 m on request) |

## External Detectors

| | EDD-2$^{3G}$ | EDD-5$^{3G}$ | EDP-5$^{3G}$ | EDP-10$^{3G}$ - 15$^{3G}$ -20$^{3G}$ | EDP-HL$^{3G}$ |
|---|---|---|---|---|---|
| Build-up material/ Encapsulation: | Epoxy and Si | PVC, epoxy and Si | Polystyrene and epoxy | Stainless steel and epoxy | Tanthal |
| Perturbation, typical values at 5 cm depth in recommended energy: | 1% | – | 3% | 5-6 % | 1.5% |
| Directional dependence, max. values within ± 45° in recommended energy: | axial < 2% tilt < 3% * | axial < 2% tilt < 3% * | < 2% | < 2% | < 6% within 30° |
| Sensitivity decrease per 250 Gy: | < 1% in $^{60}$Co | < 1% in $^{60}$Co | < 1% in $^{60}$Co | < 1% at 5 MV (EDP-10$^{3G}$) < 1% at 6 MV (EDP-15$^{3G}$) < 1.2% at 15 MV (EDP-20$^{3G}$) | 4% at 21 MV |
| Physical dimensions: | | | | | |
| width | 8 mm | 5 mm | 12 mm | 12 mm | 12 mm |
| thickness | 3.5 mm | 11.5 mm | 6.5 mm | 6.5 mm | 6.5 mm |

## Intracavitary Detectors

| | IDF-1$^{3G}$ | IDF-3 | IDF-5 | IDF-thin |
|---|---|---|---|---|
| Application: | Teletherapy | Brachytherapy | Brachytherapy | Brachytherapy |
| Build-up material/ encapsulation: | PVC, epoxy, MD-polyethylen | PVC, epoxy, MD-polyethylen | PVC, epoxy, MD-polyethylen | FEP, epoxy |
| Directional dependence, – a* (radial) within ± 180 – b* (axial) within ± 30 in 5MV | – <3% – <5% | – <3% – <5% | – <3% – <5% | – <3% – <5% |
| Physical dimensions: | | | | |
| diameter | 7 mm | 7 mm | 7 mm | 3 mm |
| length | 260 mm | 260 mm | 260 mm | 450 mm |
| No. of diodes | 1 | 3, resolution 20 mm | 5, resolution 20 mm | 1 |

* see picture page 7

## Calibration Phantom, External Detectors

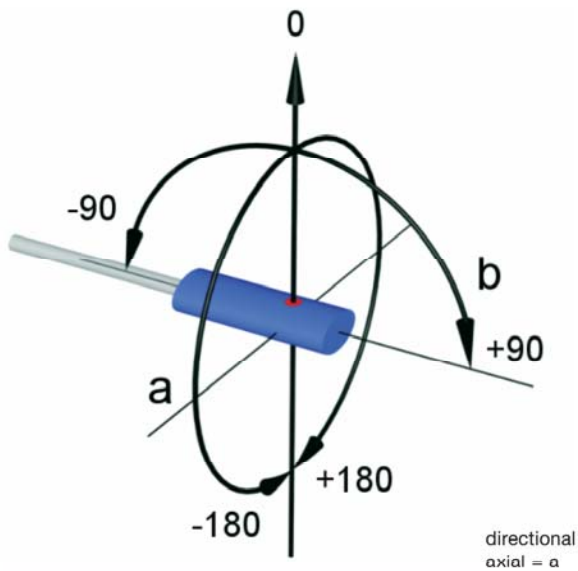
| | |
|---|---|
| Size: | 295 x 295 x 50 mm³ |
| Material: | PMMA |
| including 1 thermometer | |

## Calibration Phantom, Intracavitary Detectors

| | |
|---|---|
| Size: | 200 x 200 x 220 mm³ |
| Material: | PMMA, 10 mm |
| Weight: | 2,3 kg |

## Detector Support

| | |
|---|---|
| Size: | 1080 x Ø 250 mm |
| Weight: | 21 kg (26 with cables) |
| Number of mountable detectors: | 12 (cables to be included) |
| Mounting console: | (to be used when ceiling is higher than 3 m) |
| Adjustable length: | 200 – 1000 mm |
| Weight: | 14 kg (full length) |




directional dependence
axial = a
tilt = b

Technical data is subject to change without prior notice.

# Product range

## Dosimetry in Radiotherapy

- Relative Dosimetry
- IMRT
- Absolute Dosimetry
- In Vivo Dosimetry
- Software Applications
- Film Dosimetry
- Quality Assurance
- Patient Positioning Lasers

## Dosimetry in Radiology

- Patient Dose Monitoring
- QA of Film Processing Units
- QA of X-Ray Units
- QA of Computed Tomography
- QA of Ultrasound Units

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