DMC 3000 User's Guide

MIRION TECHNOLOGIES Health Physics Division

Radiation Safety. Perfected.

151153EN-G

Revision Log

Revision	Date	Verified by	Approved by	Origin and description of revision	Modified Pages
A-D	From 2012-06 to 2012-10	J. PEREZ	P. MARTIN	N.A	/
E	2015-03	J. PEREZ	P. MARTIN	DEVN 23331 Introduction of Beta and Neutron Modules	All pages
F	2015-04	J. PEREZ	C. DONNAY	DEVS 23437 Drawings edited	14-16, 19
G	2015-11	R. DANQUIGNY	P. MARTIN	DEVS 23988 New features Introduction of PRD module	7-11; 21-22; 42-43; 45

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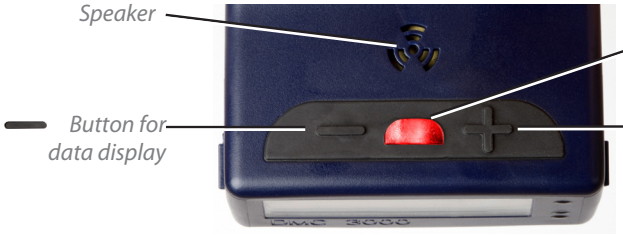
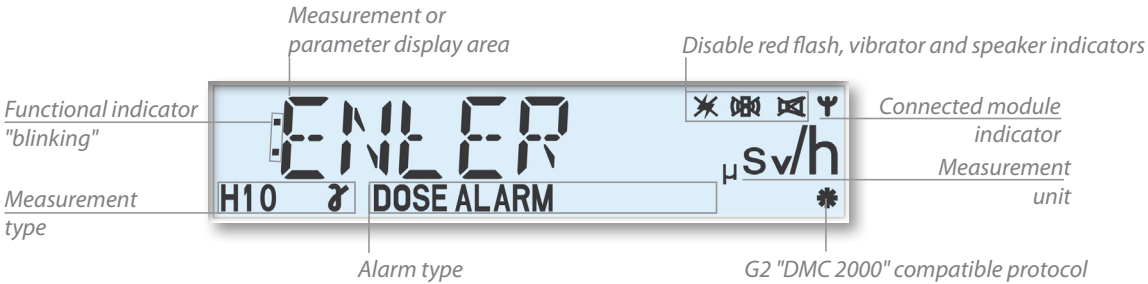

Speaker
Front red flashing LED for alarm
Button for data display
Button for parameters display


Large backlit display with 8 digits
Top red LED for alarm
Green LED for gamma counting
Blue LED for Hp(0,07), neutron and PRD counting
H10
RATE ALARM
DMC 3000


Measurement or parameter display area
Disable red flash, vibrator and speaker indicators
Functional indicator "blinking"
Connected module indicator
Measurement unit
Measurement type
H10
DOSE ALARM
Alarm type
G2 "DMC 2000" compatible protocol

2.1 Use and Functionality

The DMC 3000 is the **compact, rugged and reliable dosimeter** designed to detect a wide range of X-ray and gamma radiations.

The **large-format**, **backlit**, **high-contrast 8-digit LCD display** provides clear dose and dose rate readings for deep dose equivalent *H*p(10).

Additionally, it provides multiple methods to alert the wearer of alarm conditions, including:

- A **high decibel speaker**
- 1 **flashing LED** on the front face
- A **backlit LCD display**
- **3 bright LEDs** on the top
- A **vibrator.**

  (*See Chapter 5 for a complete description of these alarms.*)

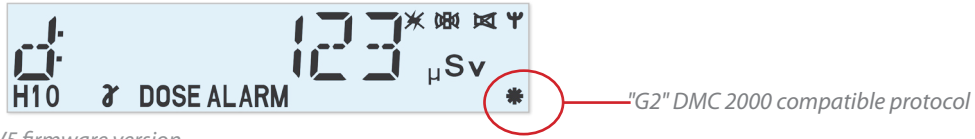
The indication of dose increment is visible with the green LED or blue LED even when an alarm is given by the two red LEDs.

Two buttons are used for easy access to all the DMC 3000's functionality.
(See Chapter 4 for more information on button use.)

2.2 Compatibility with Mirion Technologies Products

The DMC 3000 features two protocols, **G3** and **G2**, that use the same communication medium, with an omni-directional, low-frequency (125 kHz) transceiver.

- The enhanced "**G3**" communication protocol to support additional features and attached measurement modules. It also includes a compatibility mode for previous Mirion Technologies products including Access Control, Turnstiles and Telemetry devices.
- The compatible **DMC 2000 communication protocol "G2"** is indicated on the DMC 3000 by an asterisk in the display's bottom right corner. This guarantees compatibility with the existing Mirion readers (LDM 220, LDM 2000 and LDM 3000) and software (DosiServ, DosiCare, DosiFFR and Sentinel).



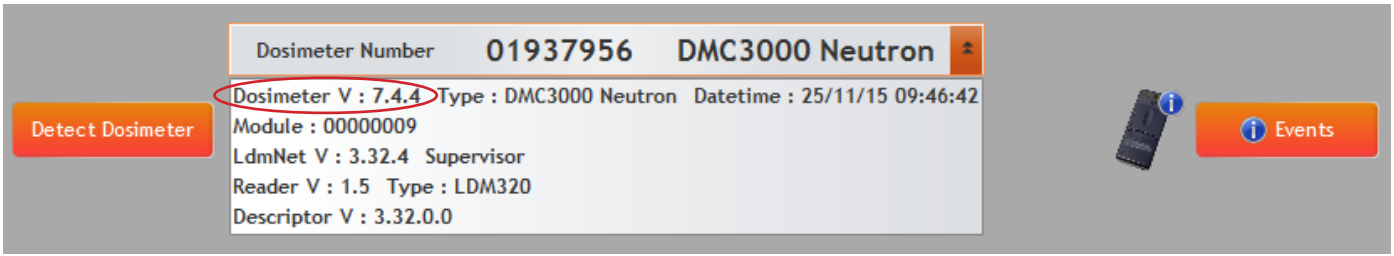
Note: G2 protocol is available only on V5 firmware version.

The enhanced communication protocol "**G3**" requires new readers such as the LDM 320D, LDM 320W, LDM 3200 or LDM 2000 with upgraded firmware.

Attached measurement modules (neutron *H*p(10), beta *H*p(0,07), PRD...) can be added when the DMC 3000 is in "G3" protocol **and** with firmware version V.7. See §10 for Add-on modules information.

Telemetry module can be added to the DMC 3000 whatever the protocol "G2" or G3".

If the firmware version is not viewable by pressing "+" key, use DMC*User* software.



V7 firmware version:

- **V 7.2.1**: G3-only protocol; compatible with neutron *H*p(10) and beta *H*p(0,07) modules.
- **V 7.4.4**: Added dose display resolution of 0.1 µSv, added prealarm latched until acknowledgement.
- **Future release**: Added PRD module support.

The DMC 3000 must be calibrated for *H*p(0,07) gamma at the factory prior to initial use with the *H*p(0,07) Module. Check the verification certificate to see the calibration in *H*p(0,07) of your DMC 3000.

Please contact Mirion Technologies for compatibility diagnostic and information.

2.3 Functionalities

2.3.1 Dose, Rate Notification

The high contrast and backlit LCD display provides clear indication of dose, rate and other information with 8 digits and symbols. Whatever the unit there is no scale change for the whole range.

Notification:

- d: for dose
- R: for rate
- h: Run time (hh:mm:ss)
- t: Remaining Time before alarm
- V: Life dose or life time
- M: maintenance dose or time
- xxx dEF Default, "xxx" identifies the type of default (see §*5.6.3 Troubleshooting guide*)

Dose, Rate unit can be:

- µSv (/h),
- mSv (/h),
- mrem (/h)

Blinking Alarm Indicator:

- DOSE ALARM: Dose Alarm
- ALARM RATE: Rate Alarm
- DOSE ⚠: Dose pre-alarm
- ⚠ RATE: Rate pre-alarm
- 🕒: Time Alarm

Origin of dose/Rate displayed (measurements or alarm thresholds).

- H10 γ: X+Gamma *Hp*(10)
- H10 n: Neutron *Hp*(10)
- H10 Tγn: total dose ((X+Gamma) + neutron *Hp*(10))
- H .07 γ: beta and X+Gamma *Hp* (0.07)
- γ: Gamma rate in counts per second (PRD)

The data information displayed on the DMC 3000 is selectable using DMC*User* software.
When in pause mode (no measurement) the DMC 3000 can display PAUSE, SLEEP, ASSIGN, the wearer name, the calibration due date or a user message

2.3.2 Dose Increment Notification

The green LED gives the rate of primary X+Gamma *H*p(10) dose increments (one flash each 1 µSv).
The blue LED is dedicated to secondary *H*p(0,07) or neutron dose increments with DMC 3000 attachments.

An audible beep can also be generated, following the primary X+Gamma dose increment (see below configuration) or secondary Neutron or *H*p(0,07) dose increment.

NO bIP	no audible signal for dose increments
bIP 100	1 beep every 100 µSv (10 mrem)
bIP 10	1 beep every 10 µSv (1 mrem)
bIP 1	1 beep every 1 µSv (0.1 mrem)
bIP 0.1	1 beep every 0.1 µSv (0.01mrem)
bIP 0.05	1 beep every 0.05 µSv (0.005mrem)

The configuration of the blue LED on secondary dose increments and the audible beep if from the secondary dose is selectable separately (see user's manuals of module).

2.3.3 Display Dose Resolution

On firmware V7.4.4 or greater, the dose resolution on the display is selectable (10, 1 or 0.1 µSv) (*See note 1*) with DMC*User*:

- With resolution 10 or 1µSv, the dose is displayed over the entire range without any unit change.
- With resolution 0.1 µSv, the dose is displayed with 0.1 µSv resolution from 0.0 µSv up to 999 999.9 µSv then the dose is displayed with 1µSv resolution up to 9 999 999 µSv.

Note 1: or equivalent depending on unit selected.
Note 2: the dose change is linked to the number of counts and the algorithm parameters of the dosimeter (efficiency, integrated time 10s, 60s).

2.3.4 Remaining Time before Alarm

Displayed as a timer counting down, the time to alarm corresponds to either the time alarm or the time to reach the dose alarm point, whichever is shortest.

The time to reach the dose alarm point is calculated as follows:

time duration before dose alarm = (dose alarm threshold - cumulative dose) / current dose rate

2.3.5 Rate Alarm Latched

The DMC 3000 allows users to latch the rate alarm.
Three options are offered:

- regular speaker sound follows the rate alarm
- rate alarm latched 10 seconds. Speaker sound and visual alarms are tended to 10 seconds after the rate alarm stops (*See note*)
- rate alarm latched until pause

Note:
This new feature is available and configurable only in G3 protocol.

2.3.6 Rate Pre-Alarm Latched until acknowledgement

On version V7.4.4 (or greater), the rate pre-alarm (Alert) can be latched until acknowledgement for a recognition by the worker.

2.3.7 Add-on Module

An additional module, such as a telemetry device, *Hp*(0,07) beta, *Hp*(10) Neutron or PRD module can be attached at the bottom of the DMC 3000 simply by removing the battery cover.

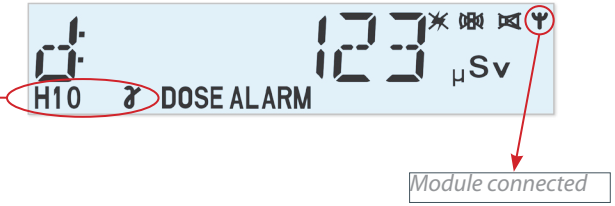
All these add-on modules have their own parameters saved on non-volatile memory and modify the display configuration of the DMC 3000 when attached to it.

A module must be connected/disconnected to the DMC 3000, only when in PAUSE.

The Ψ icon appears at the top right corner of the display when a module is detected and measurement type icon (on the bottom left corner of the display) gives the origin of Dose/Rate displayed (measurement or alarm threshold).

Origin of Dose/Rate displayed
(measurements or alarm thresholds).

- H10 γ: X+Gamma *Hp*(10)
- H10 n: Neutron *Hp*(10)
- H10 Tγn: total dose ((X+Gamma) + neutron *Hp*(10))
- H .07 γ: beta and X+Gamma *Hp*(0.07)
- γ: Gamma rate in counts per second (PRD)



2.4 Historical Data Function

DMC 3000 series dosimeters in G3 protocol have a historical data function which allows the following features:

- Recording and dating of changes equal or greater than 1 µSv (0.1 mrem) in the cumulative doses (primary and/or secondary) with the current Rate by intervals of 10 seconds, 1 minute, 10 minutes, 1 hour or 24 hours depending on the dosimeter's configuration.
- Recording and dating of maximum rate between two dose records
- Recording every second during 10s on rate alarm transition
- Decreasing of the interval or record (10s instead of 1mn for exemple) when in Rate alarm for better accuracy
- Recording and dating of significant events such as:
  - alarms and warnings
  - acknowledgment of warnings
  - assignment of identifier, task and RWP codes
  - change in operating mode (Pause and Run)
  - dosimeter fault
  - parameter changes

In order to date accurately all the data, the DMC 3000 is equipped with a Real Time Clock to keep the clock time. In satellite mode, this RTC could be set during configuration with a reader during entry.

In G3 protocol, all the events and dose increments are dated in date format (DD/MM/YYYY and HH:MM:SS) and the time size of recording is doubled (DMC 3000 alone or the same DMC 3000 with module) compared to G2 (DMC 2000 compatible) protocol (see note).

Note:
Calculated with an increment of dose every 10 histogram steps.

2.5 Handling Recommendations

As the DMC 3000 offers the ability to clip it either outside the pocket, (standard or belt clip) or inside (front side clip), users should remember to wear the dosimeter with its back side facing the body. (*See label on the battery cover.*)

Warning:
For the DMC 3000 vibrator alarm to be effective, the unit must be in contact with the body for the user to feel it.

As the energy range of the DMC 3000 starts at 15 keV, the detection area of the dosimeter should not be covered with any heavy material, like metal, in order to ensure the most accurate dose measurement. Belt clip is strongly discouraged when a module is attached to the dosimeter, because module reduce the gap of the clip.

The use of a front facing clip is forbidden with an *Hp*(0,07) beta module, because no material must be in front of the beta detector.

The DMC 3000 will warn you when the battery needs to be replaced. A completely discharged battery can cause leakage that may damage your DMC 3000. Thus, dead batteries should be removed or replaced promptly.

Only approved batteries or high quality Alkaline batteries should be used with your DMC 3000 (see Chapter 6).

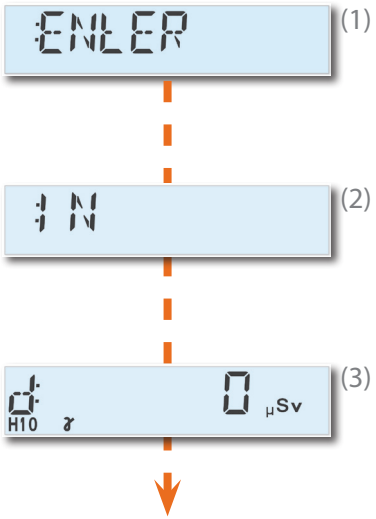
There are no serviceable parts inside your DMC 3000. Thus, tampering with the case will compromise the waterproofing and void the warranty.

3.1 Fast Entry Mode

The DMC 3000 can be started up using a simplified and quick procedure.

Fast entry must be enabled using DMC*User* software.

- When **fast entry** is enabled, the message "**ENtER**" (1) is displayed. Simply pressing one of the 2 control buttons immediately switches the DMC 3000 dosimeter into **Run** mode.
- The message "**IN**" (2) is briefly displayed *(*)*.
- The dosimeter switches to measurement mode (3).
- The display starts to indicate the dose measurement.



Note:
There are two configurations of fast entry (Fast entry and permanent fast entry)
- In fast entry, as soon as the dosimeter switches back to Pause mode, the fast entry mode is disabled. To return to fast entry mode set parameters again.
- If the permanent fast entry mode is set, the DMC 3000 will revert to fast entry mode when back in Pause.
(*) Depending on the versions, the message "IN" may not be displayed.

3.2 Operating Modes

DMC 3000 dosimeter can be used in the following modes:

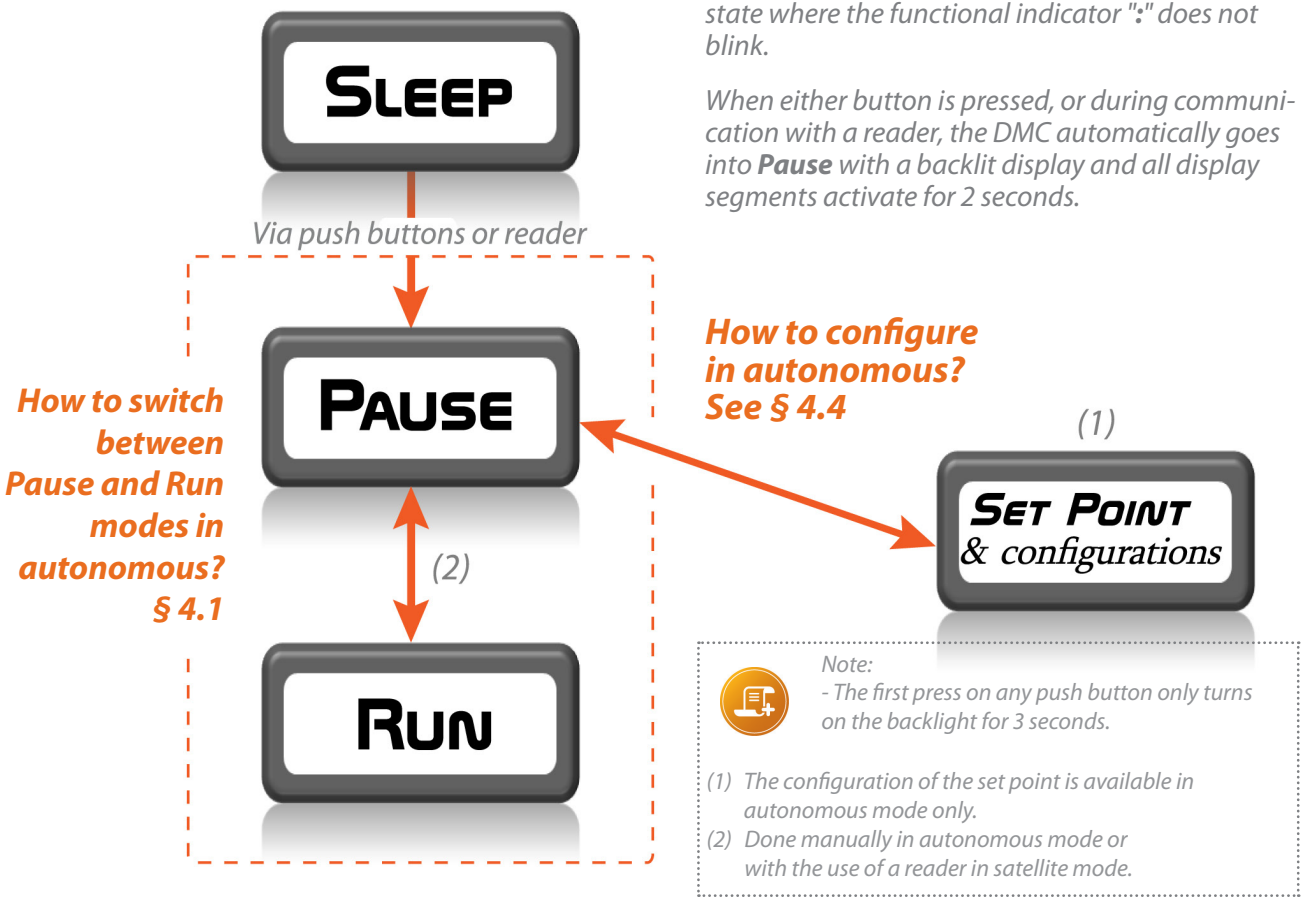
- **Autonomous mode**:
  Dosimeter's two buttons can be used to set alarm set points and switch back and forth between **Pause** and **Run**.

- **Satellite mode**:
  DMC*User* software must be used to configure the DMC 3000.
  Readers must be used to turn ON (Run) and OFF (Pause) the DMC 3000.

Note:
DOSIMASS-DM does not have the ability to modify the DMC 3000's parameters.

*The **sleep mode** state is a low-power consumption state where the functional indicator ":" does not blink.*

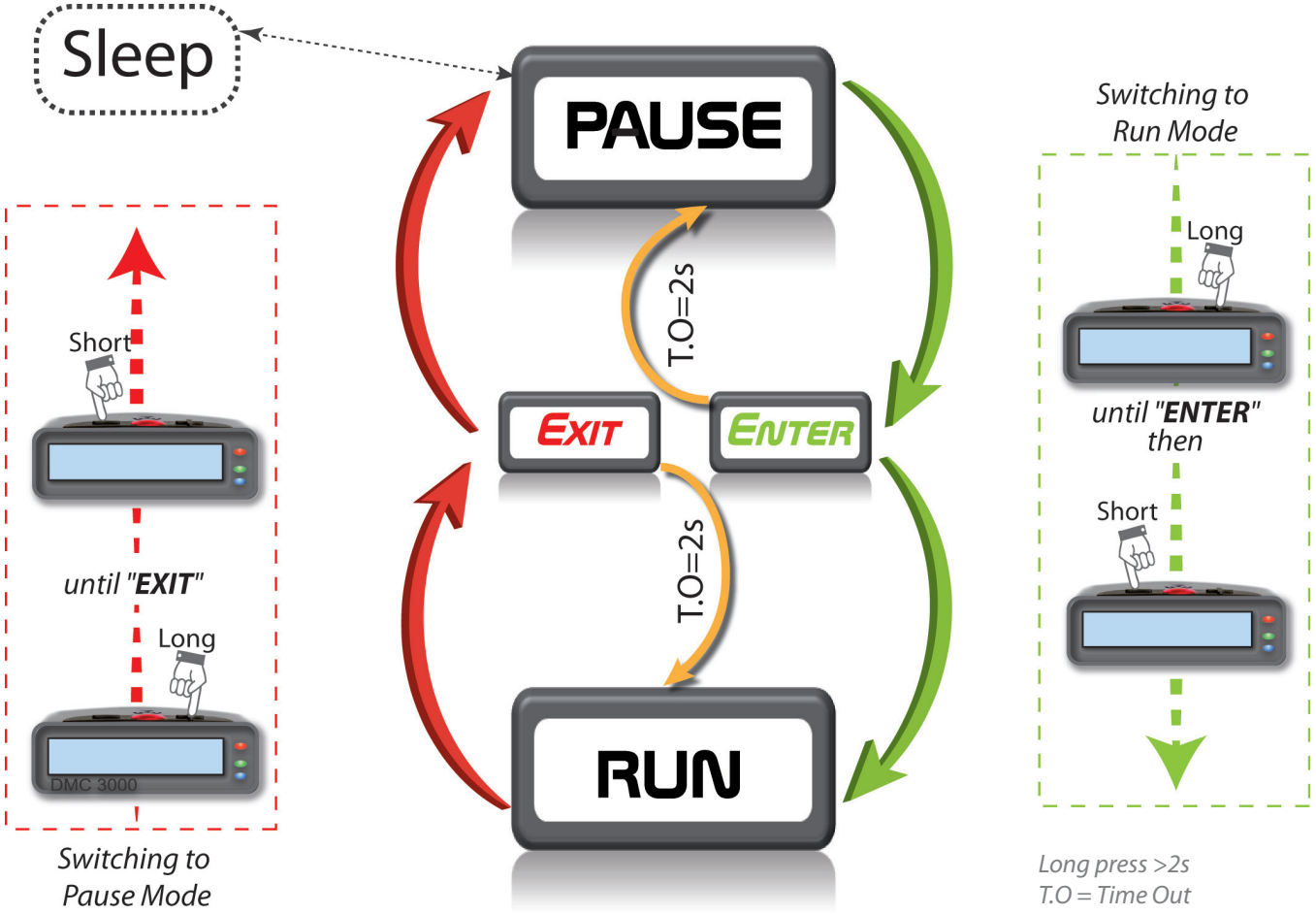
*When either button is pressed, or during communication with a reader, the DMC automatically goes into **Pause** with a backlit display and all display segments activate for 2 seconds.*



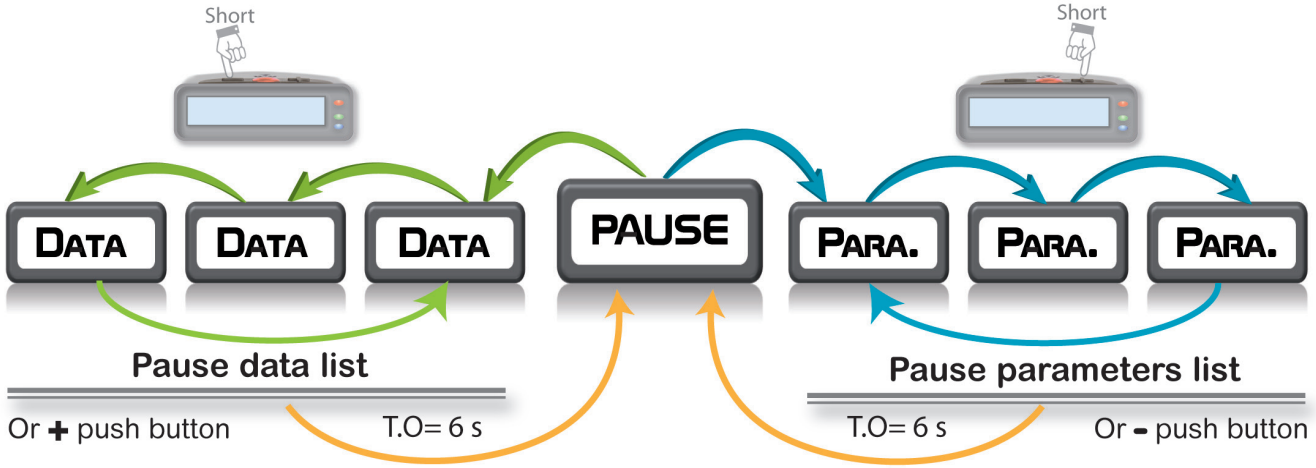
Note:
- The first press on any push button only turns on the backlight for 3 seconds.

(1) The configuration of the set point is available in autonomous mode only.
(2) Done manually in autonomous mode or with the use of a reader in satellite mode.

4.1 Run / Pause Flow Diagram



4.2 Browsing Diagram in Pause



Exemple of Data available	Display
Last recorded X + Gamma *Hp*(10) dose	d 0.4 10 mSv
Last maximum X + Gamma *Hp*(10) peak rate	P. 0.23 mSv/h
Last duration in Run	h00 12406
Current Time (AM/PM or 24H format)	PM09 4126
Current Date (MM--DD--YY or DD/MM/YY format)	05-21-07

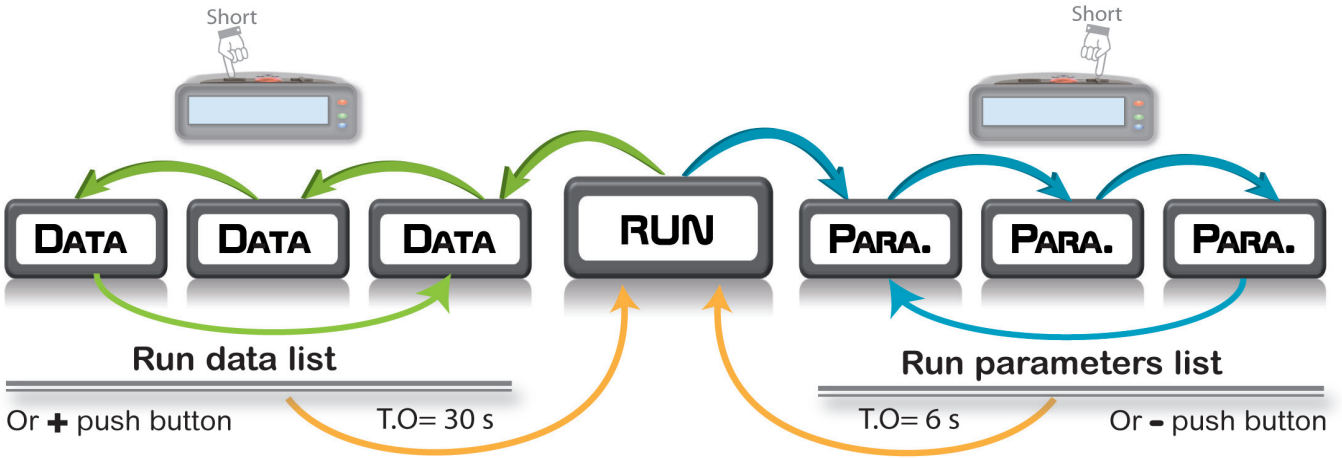
Data list in Pause and Run are configurable with **DMC*User*** (choice and order) and depend on module connected and configuration. See § 4.5 for complete list.

Parameters	Display
Dosimeter number	D 1900986
Wearer's name	JOHN
Wearer ID	I dMA 1234
Dose alarm set point	d 0.950 mSv
Dose warning set point	d 0.150 mSv
Rate alarm set point	P. 0.950 mSv/h

Parameters	Display
Rate warning set point	P. 0.099 mSv/h
Run time warning set point	h0 100000
Chirp mode	bi P 100
Date of next calibration	C1.10.01.13
Dosimeter mode	SAt
Software version	VER07.15

Parameter list in Pause and Run are configurable with **DMC*User*** (choice and order) and depend on module connected and configuration. See § 4.5 for complete list.

4.3 Browsing Diagram in Run

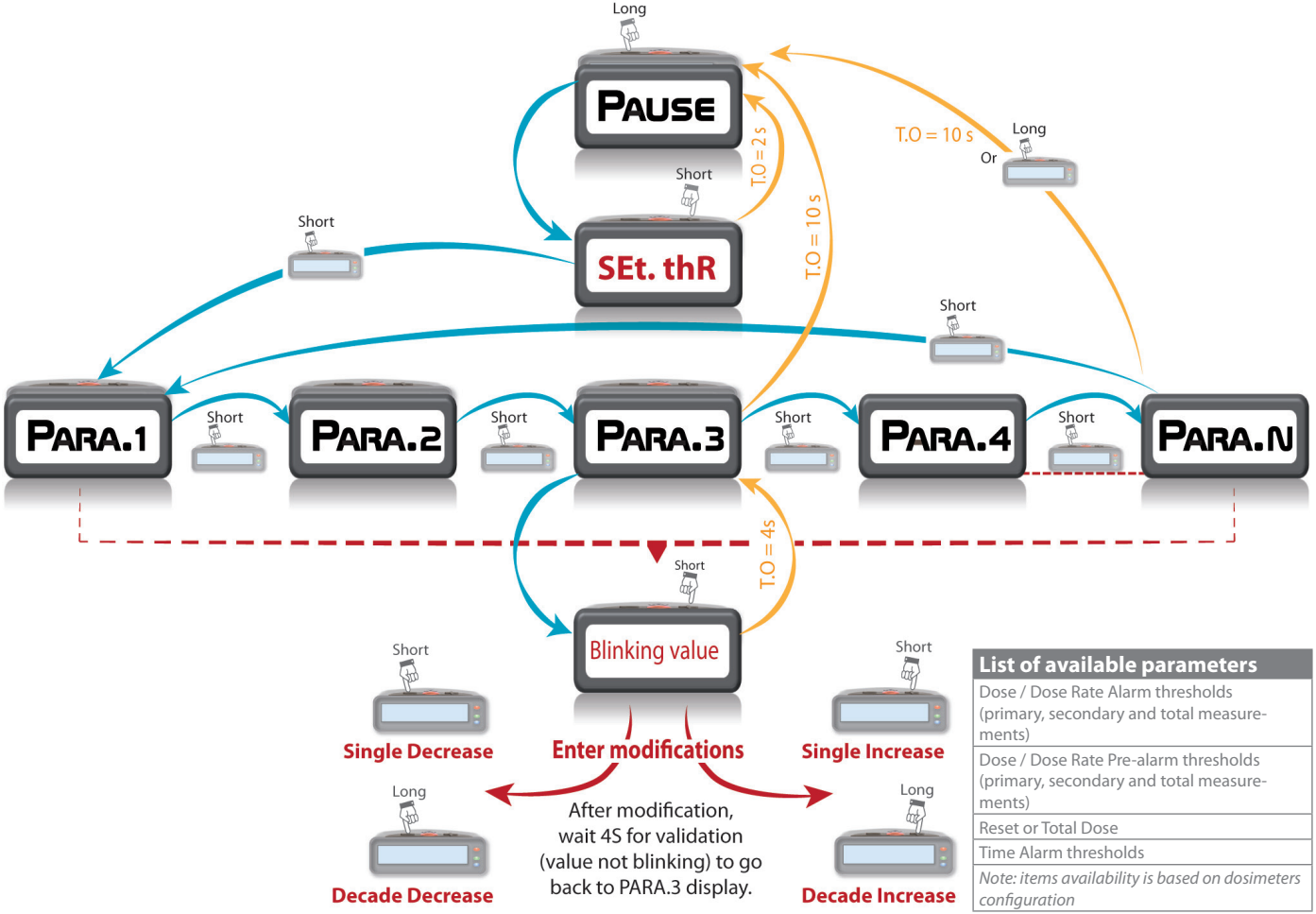


Exemple of Data available	Display
Current X + Gamma *Hp*(10) dose	10 µSv
Current X + Gamma *Hp*(10) rate	0 µSv/h
Current *Hp*(0,07) shallow dose	20 µSv
Current *Hp*(0,07) shallow rate	10 µSv/h
Remaining time before alarm in Run	t0092501
Date	05-21-07

Parameters	Display
Dosimeter number	01900986
Wearer's name	JOHN
RWP	RWNA 1234
Date	05-21-07
X + Gamma *Hp*(10) Dose alarm set point	950 µSv DOSE ALARM
X + Gamma *Hp*(10) Rate alarm set point	950 µSv/h RATE ALARM

Parameters	Display
Run-time warning set point	H0083456 ALARM
Chirp mode	bIP 100
Operating mode	SAt
Hp(0,07) shallow dose alarm set point	9500 µSv DOSE ALARM
Hp(0,07) shallow rate alarm set point	9500 µSv/h RATE ALARM

4.4 Set Point Modifications in autonomous mode



List of available parameters
Dose / Dose Rate Alarm thresholds (primary, secondary and total measurements)
Dose / Dose Rate Pre-alarm thresholds (primary, secondary and total measurements)
Reset or Total Dose
Time Alarm thresholds
Note: items availability is based on dosimeters configuration

4.5 Data & Parameters List

The following data and parameter options are available in **Pause** and **Run** mode.
They can be selected and ranked by preference, using **DMC*User*** software.

Data
Hour (*1*)
Date (*1*)
Full life dose (*1*)
Full life duration (*1*)
Total maintenance dose (*1*)
Total maintenance duration (*1*)
Dose (*1*)
Current rate (*1*)
Maximum rate (*1*)
Duration of integration in Run (*1*)
Remaining time before alarm in Run (*1*)

Parameters
User name (*1*)
Dosimeter number (*1*)
Type of autonomous dose (cumulated or reset) (*1*) (*2*)
Date of next internal calibration (*1*)
Dose alarm setpoint (*1*) (*2*)
Rate alarm setpoint (*1*) (*2*)
Duration setpoint (*1*) (*2*)
Dose warning setpoint (*1*) (*2*)
Rate warning setpoint (*1*) (*2*)

Parameters
Beeps at dose change (*1*)
Autonomous or satellite flag (*1*)
Software version (*1*)
FLASH memory checksum (*1*)
Worker identifier (*1*)
Worker order task code (OT) (*1*)
Thermoluminescent film number (TLD) (*1*)
Radiation Work Permit (RWP) (*1*)

(1)This item's availability is based on the dosimeter's configuration.
For example, if the rate display is not chosen the current rate and maximum rate will not be displayed.
In G2 protocol, some data or parameters are not available.

(2)These items are settable in autonomous mode.

(3) See DMCUser software for the complete list of data and parameters available.

5- Alarms

The DMC 3000 dosimeter provides multiple methods to alert the wearer of alarming conditions:

- A loud audible alarm is emitted by the dosimeter speaker
- A message or symbol "Alarm Type" appears on the high-contrast LCD display with backlight ON during 3 seconds
- Very bright red flashes from the front red flashing LED
- Red flashes from the top red LED
- Vibrations

Note:
- In case of simultaneous alarms, corresponding messages and symbols are displayed based on priority level.
- Speaker, vibrator, blacklight, front red flashing LED and top red LED can be disabled when configuring the DMC 3000. This function can be modified using the ***DMCUser*** *maintenance software in G3 protocol only.*
Look at the pictogram on the top right corner of the display to know which alarm is disabled.

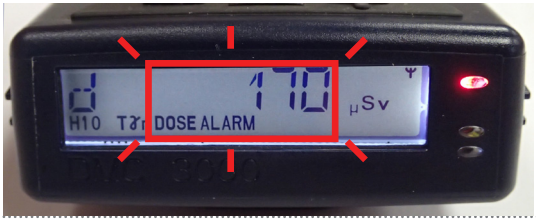
Note:
Alarm type displayed is independent of the measurement displayed (for exemple, alarm type can be "RATE ALARM" when Dose value is displayed).

5.1 Dose and Rate Alarms or Warnings

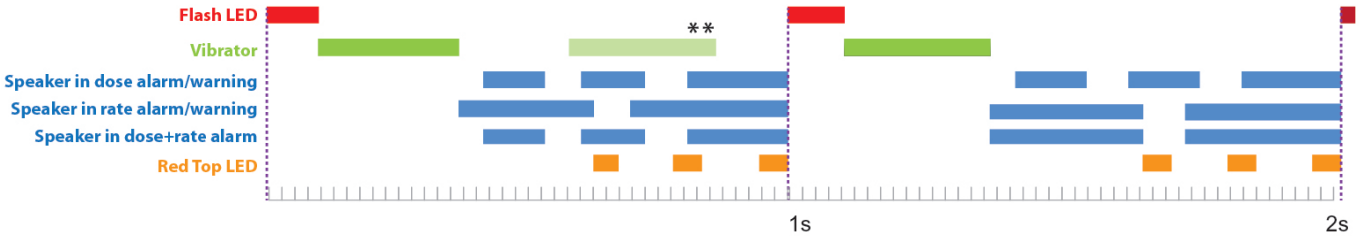
- On DMC 3000 firmware V.7, the DMC 3000 has 2 configurable dose alarms from **1 µSv to 10 Sv** and 2 configurable rate alarms from **10 µSv/h (*)** to **10 Sv/h** for *H*p(10) (X + Gamma) deep dose, X + *H*p(0,07) Gamma + Beta shallow dose or *H*p(10) Neutron dose and 2 configurable total dose alarms Gamma + Neutron.
  (*) Please contact Mirion Technologies for a rate set point between 1 µSv/h and 10 µSv/h.

  Dose and rate warnings are acknowledgeable by pressing either push button for longer than 3 seconds.
- The rate alarm and warning occur when the rate exceeds the set point. The rate alarm and warning disappear when the rate decreases to 80% of the set point if latched feature is enabled (see §2.3.5 and §2.3.6).
- On DMC 3000 firmware V.7, the displayed value of dose or rate blinks simultaneously with the indicator when it has generated the alarm or warning, see example below.

Note:
When displaying a measure (here, Total dose), the value and DOSE ALARM are blinking, notifying an alarm on the total Gamma+Neutron dose.

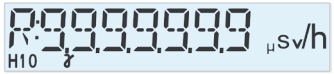


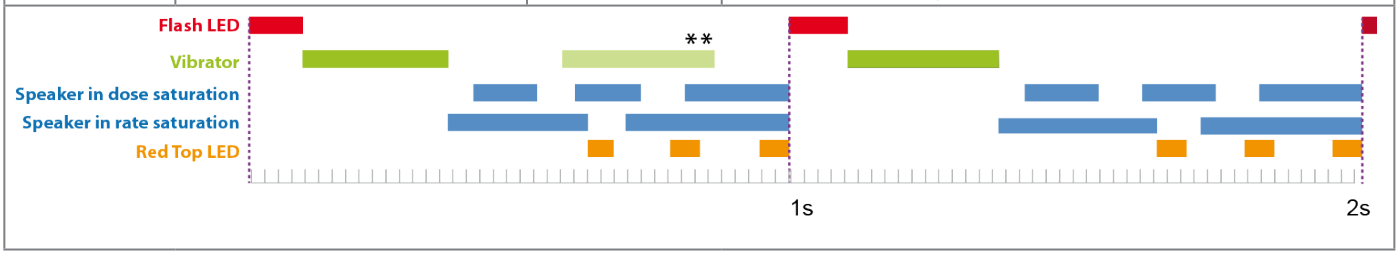
Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Dose Alarm		**3 beeps** every second	**FLASH LED** 1 flash every second  **VIBRATOR** 1 vibration (**) every second *** An extra vibration is added if the speaker is disabled.* **TOP LED** 3 red flashes every second
Dose Warning *(See note)*			
Rate Alarm		**2 long beeps** every second	
Rate Warning *(See note)*			*Note : Acknowledge by pressing + or - button longer than 3s.*



5.2 Saturation

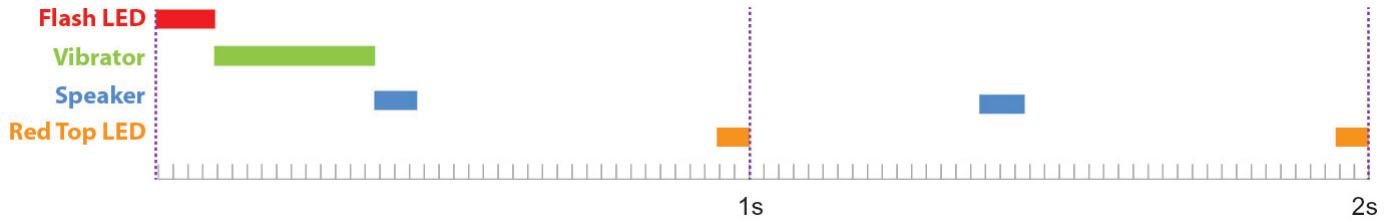
When the dose or dose rate reach the maximum value the saturation is displayed as follows:

Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Dose Saturation		**3 beeps** every second	**FLASH LED** 1 flash every second  **VIBRATOR** 1 vibration (**) every second *** An extra vibration is added if the speaker is disabled.* **TOP LED** 3 red flashes every second
Rate Saturation (see note)		**2 long beeps** every second	*Note: during the rate saturation and after the rate saturation, the message "RAtE SAt "is displayed in alternance with the current display.*



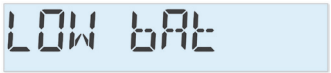
5.3 Time Alarm

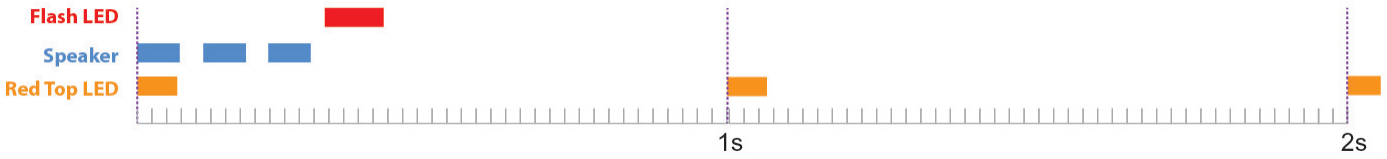
Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Time Alarm	h: 080000 ALARM	**1 short beep** every second	**FLASH LED** 1 flash every 10 seconds **VIBRATOR** 1 vibration every 10 seconds **TOP LED** 1 red flash every second



5.4 Low Battery

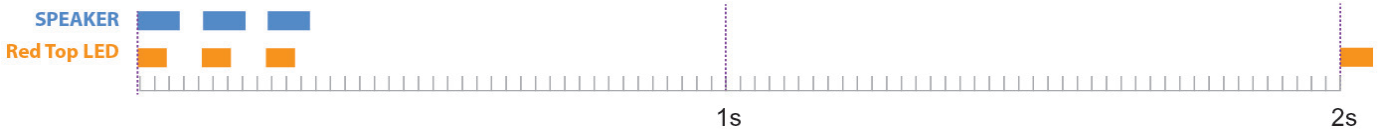
The DMC 3000 emits a low battery alarm if the battery voltage drops below 1.2 V.

Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Low Battery — In Run	 xx is the remaining time in Run mode from 9 to 1 hours. Then the DMC goes into power loss for 90 seconds and then turns off.	**3 short beeps** every **10 minutes**	**FLASH LED** 1 flash every 10 minutes **NO VIBRATOR** **TOP LED** 1 red flash every second
Low Battery — In Pause	 After 72 hours of low battery in PAUSE mode, the DMC goes into power loss during 90 seconds and then turns off.		



5.5 Power Loss (after low battery)

Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Power Loss	bAt dEF	**3 short beeps** every **10 seconds**	**NO FLASH LED** **NO VIBRATOR** **TOP LED** 3 red flashes every 2 seconds

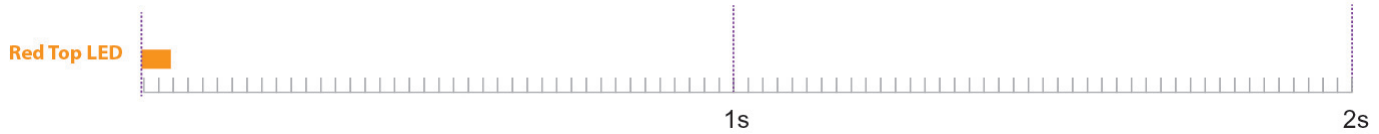


5.6 Faults

5.6.1 Minor Fault

If the calibration due date is exceeded, an alarm message is displayed.

Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Minor Fault	CALI dAt Dosimeter needs a new calibration.	**none**	**NO FLASH LED** **NO VIBRATOR** **TOP LED** only 1 red flash



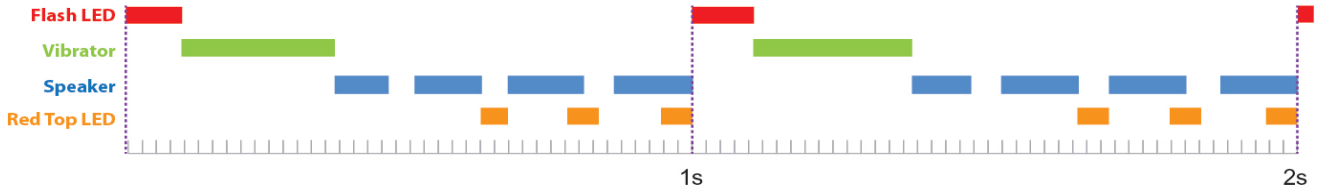
5.6.2 Major Faults

The DMC 3000 conducts periodic self tests every 10 minutes in **Run**, **Pause** and **Sleep** modes. Most of the tests are also performed every second in **Run** mode. All the main functions are controlled by the microcontroller and all the data, parameters and configurations integrity are protected by the CRC16.

The calibrations and algorithm parameters are protected by the CRC16 and saved inside a specific and dedicated EEPROM. The different DC voltages on the electronic board are periodically measured and controlled.

If a fault is detected, an alarm is generated and a message is alternately shown with the measure on the display. A major fault prevents the DMC 3000 from going into RUN mode

Alarm Type	Display	Speaker	Flash LED, Vibrator and Top Red LED
Major Fault (Asic, EEPROM, Detection, Data Integrity) *(*)*	OPti dEF	**4 beeps** every **second**	**FLASH LED** 1 flash every second **VIBRATOR** 1 vibration every second **TOP LED** 3 red flashes every second



(*) See 5.6.3 for the list of faults and solutions to perform

5.6.3 Troubleshooting Guide

The following troubleshooting guide describes the dosimeter's major fault messages and how to manage them. For safety reasons, the DMC 3000 cannot be set to **Run** mode when a major fault is displayed in **Pause** mode.

Major Faults		
Display	**Cause**	**Solution**
OPtI dEF OPtX dEF	Physical problem related to the detection circuit and detectors (optical check) of the DMC 3000 (OPtI dEF) or of the module (OPtX dEF).	Contact Mirion for verification. **See § 5.5.4 Optical test and pulse test**
PLSi dEF PLSX dEF	Physical problem related to the detection circuit and detectors (no pulse during the last check period) from the DMC 3000 (PLSi dEF) or from the module (PLSX dEF).	Confirm the default with a source of radiation. If the fault persists, contact Mirion for verification.
ASIN dEF ASEX dEF	Physical problem related to the detection circuit (no communication with the microprocessor) of the DMC 3000 (ASIN dEF) or of the module (ASEX dEF).	When ASEX dEF occurs, check the connection to the module. Make sure that no disconnection can occur while in Run mode. If the fault persists, contact Mirion for verification.
E2P dEF RAM dEF	Problems accessing the data saved in memory.	Contact Mirion for verification.
PROG dEF	Problems accessing the software program saved in memory.	Contact Mirion for verification.
PARA dEF	Problem with the parameters' data integrity saved in memory.	Contact Mirion for verification.

Major Faults		
Display	**Cause**	**Solution**
ShKI dEF ShKX dEF	Pulse counting limitation due to an amount of mechanical shocks or electromagnetic interference on the DMC 3000 (ShKI dEF) or on the module (ShKX dEF).	Confirm whether or not this fault occurs with "normal use" (no high mechanical or electromagnetic stress). Contact Mirion for verification.
bUZZ dEF	Electrical problem related to the speaker circuit (DC 3V or audio frequency).	Verify that the speaker cavity is not obstructed and the battery voltage is not too low (low battery fault). Contact Mirion for verification.
MOd dEF	Electrical problem or configuration problem of the DMC 3000 and its link to the module.	Put the DMC 3000 in pause then do a "Detach Module" with DMC*User* software, or remove the battery to remove the faults. Check that DMC 3000 firmware is more recent than V.7. Check the connection and connection board then connect the module. See §2.2 for compatibility, see §10 for Add-on Modules.
WRNG MOd ALGO dEF	The module is not recognized by the DMC 3000.	Check the configuration of the DMC 3000 that could accept this type of module.

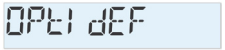
Minor Faults		
Display	**Cause**	**Solution**
CALI dAt CALX dAt	Exceeded due date of calibration	Perform a calibration check on DMC 3000 (CALi dAt) or on the module (CALX dAt).
HI St dEF	Missing bit/pointer in the histogram	Verify that the battery voltage is sufficient and perform an entry with DMC*User* software. If the fault persists, contact Mirion for verification.

5.6.4 Optical Test and pulse Test

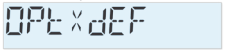
For a complete check of the gamma and X-ray detection capabilities, two complementary tests are performed.

First, a periodic optical test is performed every 10 minutes in **Pause**, **Sleep** and **Run** modes by generating light pulses on all detectors to simulate gamma photons, beta or neutron radiation.

If the number of pulses detected is less than expected on the detection circuit of the DMC 3000, a fault

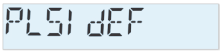


is displayed, indicating that the detection function is no longer operational. If the module detection circuit fail,

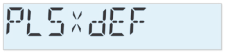


is displayed.

In addition to the optical test, the background counting is verified. If the duration between two pulses is too long compared to the statistical time calculation, then a fault



(DMC 3000 fault) or

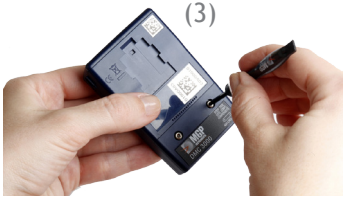


(module fault) is displayed.

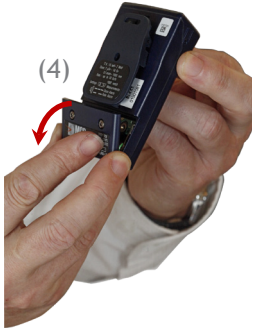
(1)

(2)

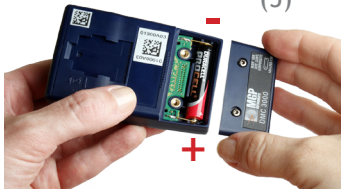
(3)



(4)



(5)



(6)

Battery Type:
Alkaline 1.5 V AAA LR03

Screw Type:
Torx N° 8, ISO 14583

When engaging the battery in the compartment, make sure to follow the polarity indicated by the drawing in the battery compartment.

Take care to not damage the gasket. We recommend to replace the battery cover every five years or if gasket is damage. For proper sealing, equal and proper torque should be applied on both screws.

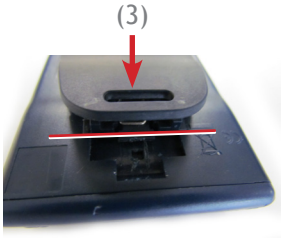
Removal

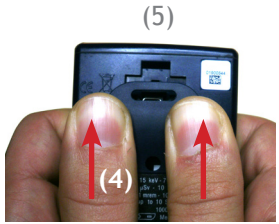
- Remove the belt clip (2). (See §7.1)
  Not necessary with standard or front facing clip.
- Unscrew the two screws (3) with the screwdriver provided with your DMC 3000 (1).
- Rotate and remove the battery cover (4).
- Disengage the AAA battery on the + side first (5).

Replacement

- Engage first the - side of the AAA battery on the compartment (5) by compressing the spring contact and push the battery into its compartment.
- Engage the battery cover bottom side first (6) and rotate.
- Hand tight with the tool provided (1) at 0.25 to 0.35 Nm (2.2 to 3.1 in.Lb).

7.1 Standard or Belt Clip





Removal

- Before removing/installing the clip, make sure that the battery cover is in place.
- Use the screwdriver/clip removal tool provided with your DMC 3000.
- Engage the head of the tool on the top of the clip as shown.
- Lift the clip lug of the clip (1) while sliding down the clip (2).

Replacement

- Engage the clip on the middle of its location (3). Press the clip strongly with the thumbs (4) until the spring is compressed then slide up the clip (5) until locked (click sound).

7.2 Front Facing Clip

Removal / Replacement

- Lift up (6) on both sides and disengage the clip from the attachment guide (7).

8.1 Manual Calibration

This method can be used for the DMC 3000 itself and for any attached module. For attached module, as the calibration parameters are saved on the module itself, Module may be calibrated on any compatible DMC 3000 as a host for the calibration process

One specific efficiency coefficient multiplier is available for each type of measurement (*H*p(10) gamma, *H*p(0,07) X + Gamma, *H*p(0,07), Beta *H*p(10) neutron).

Use the proper source depending on the type of measurement.

Hereafter is the method for the *H*p(10) X+Gamma calibration:

- Expose the dosimeter with a gamma source ^{137}Cs *(note)* to a minimum dose of 500 µSv, that is the expected dose and read on the dosimeter display the "Read Dose."
- Look up the *H*p(10) Gamma Efficiency Coefficient Multiplier using **DMC*User*** software. This calibration factor is called "**K OLD**".
- Determine the new *H*p(10) Gamma Efficiency Coefficient Multiplier "**K NEW**" using the following equation:

  K NEW = **K OLD** x Read dose / Expected dose.

- Turn off the dosimeter and set the *H*p(10) Gamma Efficiency Coefficient Multiplier to the new value "**K NEW**" using **DMC*User*** software.
- Expose the dosimeter with the same source and check that the response of the dosimeter is within the limit.

Note:
The DMC 3000 is equipped with 2 detectors, one for high energy gamma and >50 kev X-ray and a second detector for low energy X-ray down to 15 kev. Calibration with a Gamma source (^{137} Cs or ^{60}Co) or Gamma source and low energy X-ray may be considered based on service environment. Mirion Technologies provides a calibration check at 3 energy levels (16 keV X-rays, ^{241}Am and ^{137}Cs) and ^{60}Co on request, in accordance with ISO/IEC 17025 (COFRAC accreditation Nber 2-1663).
- In G3 protocol Hp(10) Gamma Efficiency Coefficient Multiplier is set at 1.00 in factory.
- Decreasing the Hp(10) Efficiency Coefficient in G2 protocol or Hp(10) Gamma Efficiency Coefficient Multiplier in G3 protocol will increase the DMC 3000 response.

8.2 Maintenance

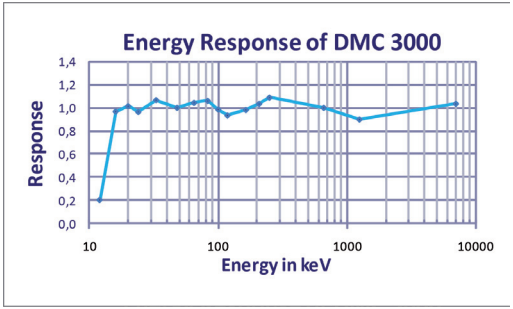
Mirion Technologies recommends to perform a complete check at least every year, including:

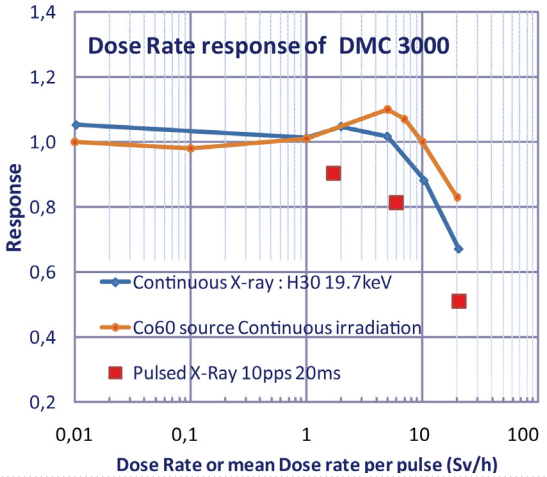
- Calibration check
- Display, top and flashing LEDs inspection
- Check on wake from sleep, the dosimeter will perform a self test in which the following can be observed: the speaker will chirp once, the front flash LED and the three (3) top LEDs (red, green, blue) will briefly illuminate, all display segments will light and the back light will turn on
- Speaker check (turn on your DMC with rate warning set point at "0")

Note:
The DMC 3000 is provided with an initial factory calibration traceable to international reference standards.
Mirion recommends an annual calibration check; although the re-calibration interval may be determined by the customer based on service environment, frequency of use and requirements defined by local regulations.

9.1 Physical Characteristics

- Compliant with IEC 61526 Ed. 3, ANSI 42.20 (*)
  (*) Isotropy at ^{241}Am and ^{137}Cs with angle ± 75°
- **Measurement and display**:
  - X-ray and gamma energy range: 15 keV to 7 MeV
  - Energy response better than ± 20% from 16 keV to 7 MeV (typically ± 10%)
- **Accuracy *Hp*(10)**:
  - ≤ ± 10% (16 keV)
  - ≤ ± 10% (^{241}Am)
  - ≤ ± 5% (^{137}Cs)
  - ≤ ± 10% (^{60}Co)
- **Display units**: mSv, µSv, or mrem
- **Display dose**: 1 µSv to 10 Sv (0.1 mrem to 1000 rem)
- **Display rate**:
  0.01 mSv/h to 10 Sv/h (1 mrem/h to 1000 rem/h)
  or 0.001 mSv/h to 10 Sv/h (0.1 mrem/h to 1000 rem/h)
  (extended option(**))
- **Measurement range**:
  - 1 µSv to 10 Sv (0.1 mrem to 1000 rem)
  - 0.1 µSv/h to 20 Sv/h (0.01 mrem/h to 2000 rem/h)
  - Saturation indication : above 10 Sv (1000 rem) or 10 Sv/h (1000 rem/h)
- **Dose rate linearity**:
  ≤ ± 20 % up to 10 Sv/h (1000 rem/h) (Co and X H30 20 keV)





(**) - Mandatory if rate alarms are set below 50 µSv/h (5 mrem/h) in order to display rate with better accuracy, if fast response time for rate alarm is not required.
- Recommended for rate alarms settings below 100 µSv/h (10 mrem/h), if fast response time for rate alarm is not required.

9.2 Electrical Characteristics

- Standard AAA (LR03) 1.5 V Alkaline battery
- 9 calendar month battery life (typical, 8 h per day, 5 days per week in Run mode, without excessive alarms (*)
- 2500 h battery life in continuous run, without excessive alarm (*)

(*) 0.2% of the time in alarm

9.3 Mechanical Characteristics

- Rugged, high impact polycarbonate-ABS case
- Dimensions: Typ. 86 x 56 x 21 mm (3.4 x 2.2 x 0.8 in) without clip ; Max 60 x 88 x 29 mm with clip
- Weight with alkaline battery and standard clip: < 88 g (3.1 oz)
- Worn with replaceable clips (2 different style back clips or one front-facing clip for DMC worn inside the pocket)

9.4 Environmental Characteristics

- **Temperature range**: -10°C to 50°C (14°F to 122°F): deviation in response less than ±5%
- **Relative humidity**: <95% RH at 35°C (95°F)
- **Storage**: -20°C to 71°C (-4°F to 160°F) without battery
- Shock, vibration and drop resistant (1.5 meter on concrete)
- **Waterproof IP67** 1m (39 in) during 1 hour
- EMC: complies and exceeds standards by a large margin (CE compliant, certificate number 153720)
  - MIL STD 461F RS103 (pulsed electric field): exceeds 200 V/m from 10 kHz to 5 GHz
  - MIL STD 461F RS101 (magnetic field 30 Hz to 100 kHz)

9.5 Factory Calibration and verification

- Approved under ISO/IEC 17025 (COFRAC accreditation Nber 2-1663) with three energy references:
  - 16 keV (X); ~ 0,7 mSv/h with ± 8.5% extended uncertainty k=2
  - 59.3 keV (^{241}Am); ~ 23 mSv/h with ±5% extended uncertainty k=2
  - 662 keV (^{137}Cs); ~ 24 mSv/h with ± 5% extended uncertainty k=2
  - only on request: 1.2 MeV (^{60}Co) ~ 5,5 mSv/h with ± 6.5% extended uncertainty k=2

9.6 Functional Characteristics

- **Indicators:**
  - Large-format, backlit, high-contrast LCD display (8 alphanumeric characters + symbols)
  - Indicator lights (red, green and blue LEDs)
  - Flash red alarm LED
  - Vibrator
  - 2 selection buttons for acknowledging warnings, viewing parameters and measurements (data)
  - Alarming speaker with level of 85 dB (A) typical (> 90 dB (C) peak) at 30 cm (11.8 in), frequency < 5000 Hz

- **Alarms:**
  - Precision: the alarm is triggered when the measured value reaches the corresponding alarm threshold value
  - Dose alarm: two thresholds (alarm and warning). Can be adjusted over the entire display range (only the warning can be acknowledged)
  - Dose rate alarm: two thresholds (alarm and warning). Can be adjusted over the entire display range (only the warning can be acknowledged)
  - Acknowledgment of warnings is accomplished by pressing and holding either push button for at least 3 seconds.

- **Checks:**
  - Periodic detector test (every 10 minutes) for both low and high energy detectors
  - Internal data integrity check with CRC16
  - Periodic battery test (every 10 minutes)
  - Component test (integrated circuit, memories)
  - Specific and dedicated EEPROM for calibration and algorithm parameters

- **Memory:**
  - Data storage in EEPROM for more than 10 years
  - Historical record of dose increments and events
  - RTC for date stamping information
  - 3800 history events at programmable intervals of 10 seconds, 1 minute, 10 minutes, 1 hour or 24 hours in G2 protocol
  - Up to 10 days of record with 1 minute interval in G3 protocol with average ambiant rate of 5 µSv/h. See table below:

Total duration of record without overlap (DMC 3000 in G3 protocol (firmware V7), with/without Neutron or Beta Hp(0,07) Module) *(**)*						
Interval of dose stamp	**Minimum Value** : one increment of dose equal or greater than 1µSv each interval in Primary and secondary (if module) doses			**Average Value:** one increment of dose equal or greater than 1µSv each 10 interval in Primary and secondary (if module) doses		
	Average rate	Without Module	With Module (*)	Average rate	Without Module	With Module (*)
10 seconds	360 µSv/h	4 hours	2 hours	32 µSv/h	42 hours	19 hours
1 minute	60 µSv/h	23 hours	10 hours	6 µSv/h	10 days	5 days
10 minutes	6 µSv/h	10 days	4 days	55 nSv/h	100 days	50 days
1 hour	1 µSv/h	60 days	26 days	10 nSv/h	640 days	290 days
24 hours	40 nSv/h	1400 days	630 days	4 nSv/h	15 000 days	7 000 days

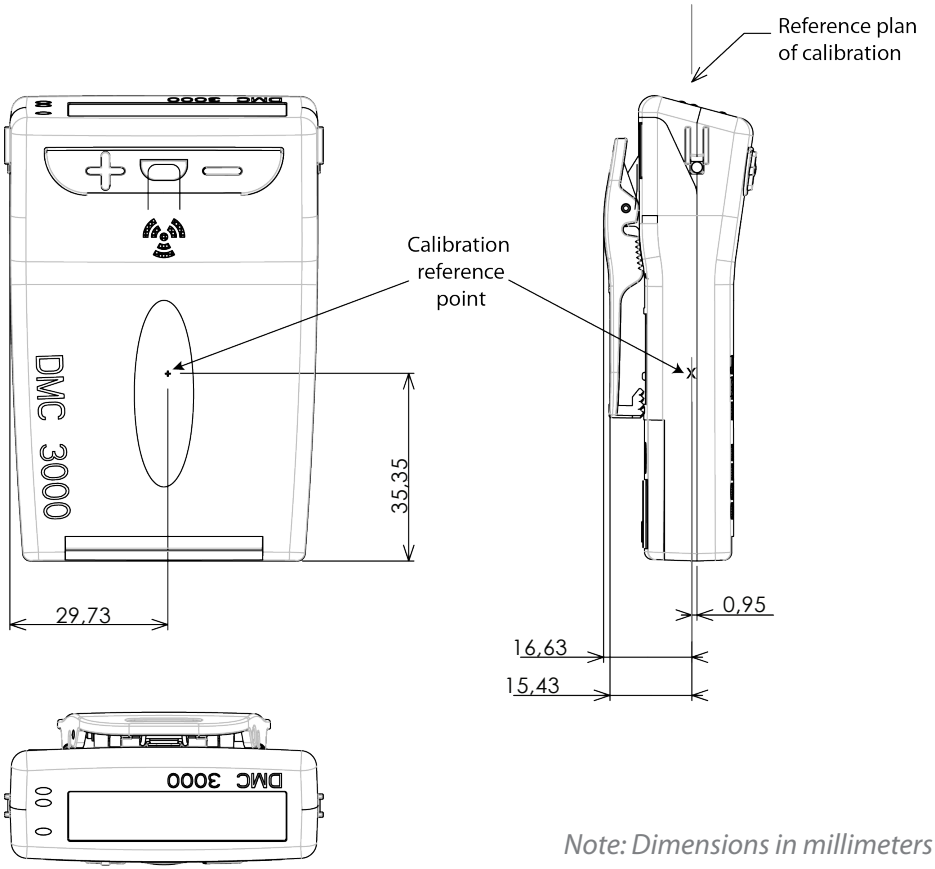
(*) with Hp(0,07) Beta Module (worst case)
(**) with raw counts

9.7 Environment

In accordance with European regulation (Directive DEEE 2002-96-CE), dosimeters should not be thrown out with non-sorted waste, but must be selectively collected.

The batteries should not be recharged or thrown in fire.

9.8 Reference point of calibration



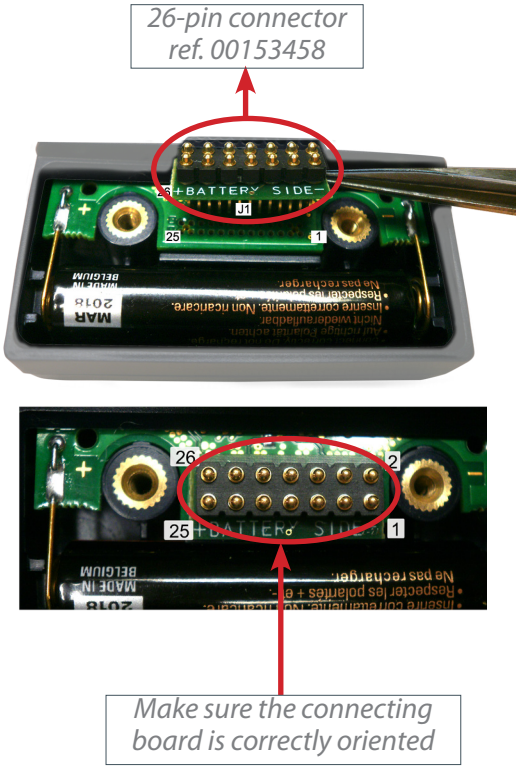
Note: Dimensions in millimeters

The DMC 3000 is provided with an extension capability at the bottom of the case.

For this purpose, a 26-pin connector allows connection for the following:

- Bidirectional serial communication
- Report alarm signal
- Detection module (*H*p(10) Neutron, *H*p(0,07) beta, etc.) or Telemetry module (see *§2.2*)
- External power

Before connecting any add-on module, it is necessary to equip your DMC 3000 with a 26-pin connector, ref. 00153458 on top of the DMC 3000 board and your DMC 3000 must be in Pause.



10.1 Dedicated documentation

- **DOC003284** for the beta *H*p(0,07) module
- **DOC003285** for the neutron *H*p(10) module
- **15-00100** for the telemetry module
- **DOC006094** for the PRD module

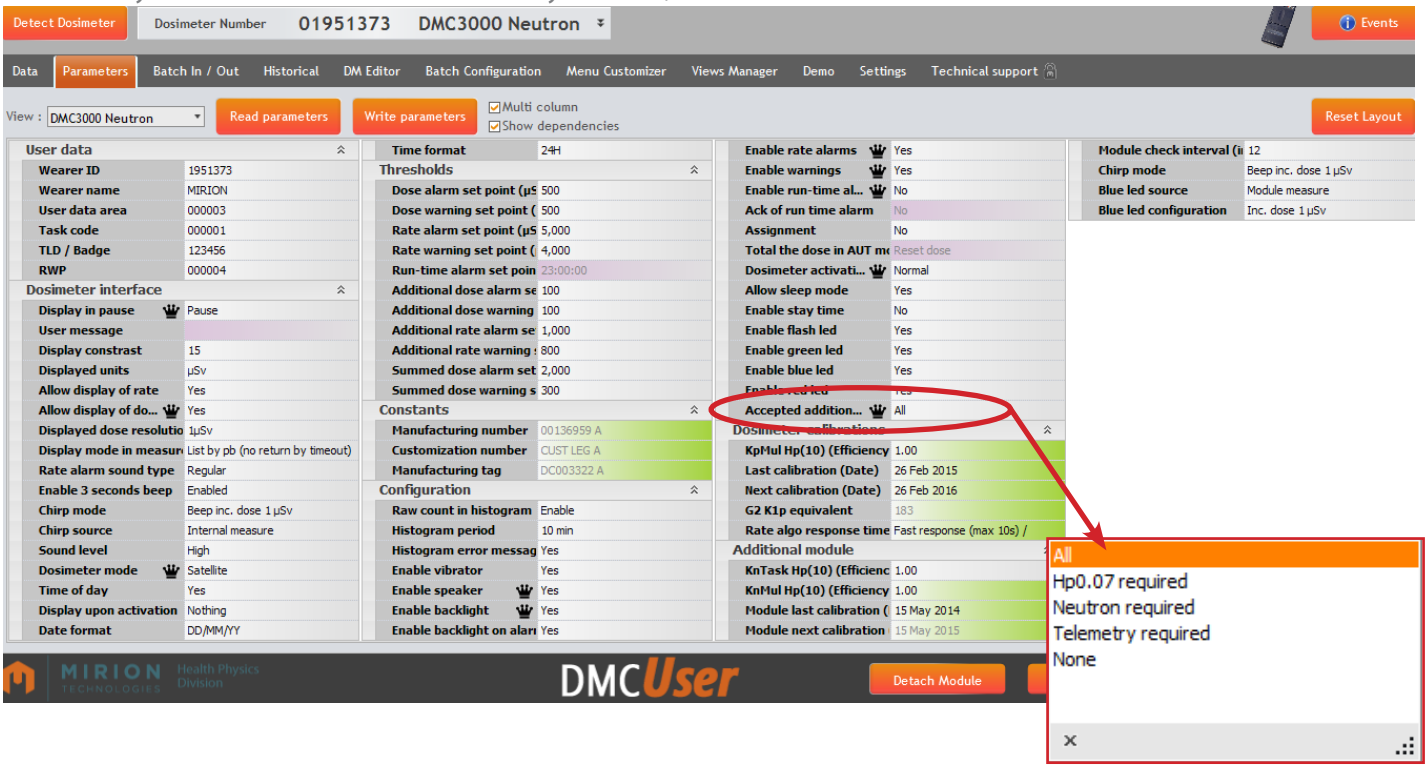
10.2 Module Attachment

- Ensure dosimeter is in Pause mode (i.e not in Run or Sleep mode)
- Refer to the dedicated documentation to install the module

10.3 DMC*User* parameters

DMC*User* parameter settings shall be configured as follows.

- For "accepted external module" select "ALL" or "telemetry required" or "Hp(0.07) required" or "neutron required" if a specific module is needed.
- Telemetry module can be enable/disable by the user, select "enable external module".



10.4 Module Detachment

For detachment, ensure the dosimeter is in pause Mode.

To clear "MOD dEf" alert indication from dosimeter display, it is recommended to perform the following:

Select "Detach module" in the bottom of DMCUser's window or remove the dosimeter's battery and then put it immediately back into place.

Note :
If the external module configuration is with " Module required" (for example "Neutron required" the Detach Module action cannot clear the "MOD dEf" alert indication.
Due to current being present on the pins when the DMC 3000 is energized, take care when attaching new modules or adapter board not to short any of the pins.
The add-on module must be attached or removed only when the DMC 3000 is in PAUSE.

The items listed below can be ordered from Mirion Technologies.

Spare Parts	Mirion Technologies Reference Number
Alkaline battery (x10) 1.5V AAA (LR03)	153 634
Battery cover - full set (x10)	153 651
Standard clip (x25)	153 631
Belt clip (x10)	153 632
Front facing clip (x10)	153 633
Set of colored standard clips (x25 in each of the 12 colors (*) = total of 300 clips)	153 650

(*) Available colors are: beige, white, black, red, yellow, purple, orange, brown, pink, grey, green and blue.

Accessories	Mirion Technologies Reference Number
Screwdriver for changing battery/ clip (x10)	153 630
26-pin connector 00153458 (x10) for add-on module	153 635
Telemetry Module (includes a 26-pin connector)	ATR000053
Hp(10) Neutron Module in individual box (includes a 26-pin connector)	NOM001229
Hp(0,07) Beta Module in individual box (includes a 26-pin connector)	NOM001230
PRD Module in individual box (includes a 26-pin connector)	NOM002153

Front facing clip | Belt clip | Standard clip

Racks	Mirion Technologies Reference Number
Wall mounted rack of 40 DMC 3000 (*)	172 609
Wall mounted rack of 10 DMC 3000 (**)	166 010

(*) =compatible with DMC 2000S and GN, can be fixed at the same location as the previous 40 DMC 2000S/GN reference 118 938
(**) =compatible with DMC 2000S and GN

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DECLARATION CE DE CONFORMITE

aux exigences de protection des directives 2004/108/CE
"Compatibilité Electromagnétique" et 2006/95/CE "Basse Tension "

Nous déclarons que le produit :
We declare that the following product :

Dosimètre électronique DMC 3000
Numéro de légende: 136959
(nom, type ou modèle, options de constitution, numéros de série ou de lot)

est conforme aux normes génériques ou spécifiques harmonisées suivantes:
is in accordance with the following generic or specific harmonised standards :

EN 61000-6-2 (Edition 2005)
EN 61000-6-4 (Edition 2006)

(Références, dates de validité)

sur la base du dossier: **Rapport d'essais**
on the basis of the file :
numéro : **153797 – A**

Nom et titre du signataire (1) :
Name and title of subscriber:
Bruno MOREL
Directeur Général Division HPH

Lieu, date et signature :LAMANON
Place, date, signature: Le 12 avril 2012

Année d'apposition du marquage CE : 2012
Year when CE mark affixed:

(1)Le signataire doit avoir reçu pouvoir pour engager la société

153720	-	A

Format 111 911 J

MIRION TECHNOLOGIES

VERIFICATION CERTIFICATE

N° 1412040012

Name and address of the customer

Issued for :
MIRION TECHNOLOGIES (MGPI) SA
ROUTE D'EYGUIERES
13113 LAMANON

Note: calibration target could be different than 1

Route de la provence
F-13113 LAMANON
tél. 33 (0)4 90 59 59 59
fax 33 (0)4 90 59 55 18

Certificate single number

Our references

Ref:

Date and Name of operator

Filled in when adjustment

Designation: **DOSIMETER** Manufacturer : **Mirion Technologies** Reference quantity : **Personal dose equivalent rate Hp(10)**

Device checked : Type	Serial Nb	Checking date	Technician	Isotope or Energy	Reference value (mSv/h)	Tol (1) (+- %)	Inc (2) (+- %)	Before adjustment: Expected dose (mSv)	K (4)	Read dose (mSv)	R (3)	Verification: Expected dose (mSv)	K (4)	Read dose (mSv)	R (3)	Check with/without adjustment	Statement
154022 - EQUIV UVS 102 G2 Cs	01902710	26/03/2012	MAM Hp(10)	^{137}Cs	23,81	10	5	0,44	178	0,44	1,01	0,55	181	0,55	0,99	With	Compliant
				^{241}Am	22,86	15	5	0,46		0,42	0,90	0,42		0,38	0,90		
				16KeV	0,76	19	9	0,04		0,04	0,97	0,01		0,01	0,99		
				^{60}Co	5,28	17	7	0,10		0,09	0,92	0,20		0,18	0,87		

The Certificate can be with or without the Hp(0.07) calibration for X+Gamma depending on the version

Rate at which the dosimeter is irradiated

Tolerance on the calibration target

Expected dose in regard of exposure time (=expected dose on the dosimeter for a response (R) at 1)

Read dose

Reading dose after verification

Response after adjustment or verification
R = Read dose / Expected dose

New efficicency coefficient of dosimeter (as left)

Efficiency coefficient of the dosimeter as found

Response before adjustment
R = Read dose / Expected dose

Procedure's reference number

Logo of the accreditation organism
Accreditation #: 2.1663
See www.cofrac.fr

Complementary information :
This certificate contains 1 DOSIMETER(S)

(1) Tolerance : Specification range (2) Extended uncertainty calculated with K=2 (3) Response (Read dose/Expected dose)
(4) Efficiency coefficient (Kp ou Ks ou Kb ou Kn depending on device type)
K"x"mul are set to 1 if check with adjustment

Procédure/Procedure : Gamma : 127023-N Neutron : 133102-D Bêta : DOC002725-A
Equipement de référence/Reference equipment : Gamma: 410180 - 410197 Neutron : 134443 - 134712 Bêta : 143922
Conditions d'environnement/Environment condition : Température / temperature: 23°C +/-3°C - hygrométrie / hygrometry: Sans objet / Without object

cofrac ETALONNAGE

n° 121878 J — Forms reference

Serial numbers of the calibrators used.

Notes :

Notes :

Notes :

Information

Photos and product representations are for illustration and explanation only.

The publication, translation or reproduction, either partly or wholly, of this document are not allowed without our written consent.

Directive 2002/96/EC of the european parliament and of the council of january 2003 on waste electrical and electronic equipment (WEEE). At the end of the product's useful life, please dispose of it at appropriate collection points provided in your country.
If necessary, please send an email to:
environnement-iso14001@mirion.com

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