PU
User manual

DaveyTronic® SP / UG

Davey Bickford

Enaex

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Read this manual

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GLOSSARY OF TERMS

DT – DaveyTronic®

DTSP – DaveyTronic® Super Pit

DTUG – DaveyTronic® Underground

DRB2 – DaveyTronic® Remote Blaster 2

DBD – DaveyTronic® Blast Driver

PU – Programming Unit

DEDD – DaveyTronic® Electronic Delay Detonator

RFID – Radio Frequency Identification

UTM – Unversal Transverse Mercator

GNSS – Glabal Navigation Satelite System

System overview

DAVEYTRONIC® SP/UG system

The Daveytronic® SP/UG system is a digital blasting system where one sets comprises of the following devices and accessories:

DAVEYTRONIC® SP system	DAVEYTRONIC® UG system

- One or more Programming Units (PU – SP/UG)
- One Daveytronic® Remote Blaster (DRB2 – SP/UG)
- One or more Daveytronic® Blast Drivers (DBD – SP/UG)
- Bus lines
- Wire connectors
- Daveytronic® electronic detonators

Note: All information depicted in this manual applies to the functionality of the DT system. The functionality for all devices and accessories of SP and UG remain the same, where the area of application would differ from Opencast to Underground and methods used to communicate to the Network.

Note: DEDDs are completely different from conventional electric detonators. They can only be used with dedicated equipment, and cannot be initiated with a standard electric exploder.

The Daveytronic® system sets up a coded bi-directional communication between the detonators and the blasting and programming equipment.

This mode of communication between the detonators and the equipment:

- Allows programming of a delay for each detonator.
- Ensures testability at the shot and from the firing location.
- Controls the energy for each detonator up to firing time.
- Reports any anomaly to the operator.
- Prevents firing unless using the dedicated DRB2.

This technology allows for optimal control of the firing sequence precision. Additionally, the DRB2 and DBD control and supervise the entire firing procedure and ensure the correct implementation of safety procedures to guarantee the correct operation of the system.

Safety

Radio interference

The functionality of DEDDs is not affected by electric fields with an intensity of up to 30 Volts per meter. Fields at this level are rarely encountered, as they are considerably higher than the fields emitted by standard transmission devices (telephones, cellular phones, CB, radio, etc.), or even by HV power lines.

Higher intensity electromagnetic fields may affect communication between detonators and the PUs, DRB2 or DBD, and may even damage the electronic circuit, but in no way can electromagnetic fields initiate the detonators.

Electrostatic discharges

DEDDs can resist a potential of 30 kV / 3500 pF pin to pin and pin to case charge. A discharge of this strength may destroy the electronic circuit, but it will not initiate the detonators. Discharges of this type are very unlikely in the conditions in which the detonators are used.

Lightning

Even though the DEDDs has high resistance to initiation from extraneous currents, all types of explosives and detonators are susceptible to detonate when hit by lightning. Follow all applicable regional and mine specific laws and regulations regarding the approach and progress of electrical storms.

WARNING: As a precaution, it is recommended that all loading operations should be suspended if a thunderstorm is approaching, in accordance with local laws, regulations, acts and procedures

Impact

The DEDD has the same impact resistance as conventional detonators, both electric and non-electric. The same precautions must be taken when handling DEDDs.

Misfires

The DEDDs normally discharges its firing energy in less than one second. However, in the event of any malfunction in the circuit, a safety circuit discharges the energy in 5 minutes. This means that the maximum time after which the energy will be completely discharged is 5 minutes.

WARNING If a misfire is suspected, it should be handled always adhering and following all applicable local laws, regulations, acts and procedures.

General precautions

WARNING:

ALWAYS use approved devices and hardware when using DEDDs.

NEVER connect DEDDs to any energy supply other than the DRB2, DBD or PU: batteries and 110/220V circuits are strictly FORBIDDEN.

NEVER connect conventional electric detonators and DEDDs to the same circuit.

NEVER connect conventional electric detonators to the DRB2, DBD or PU.

NEVER connect electronic detonators from different manufacturers to the the DRB2, DBD or PU .

NEVER use the DTSP/UG unless you have been properly trained, certificated and approved for its use as per the required regional laws and regulations.

Implementation modes

The DT SP/UG system comprises of 3 different devices: the PU, the DRB2 and the DBD. The combination of the 3 different devices allows the system to be used in various configurations suitable for various different operational needs.

WIRED Mode

Operating the DT SP/UG blasting system in WIRED mode requires the use of 1 up to 6 PUs, and a DRB2. The DEDDs are programmed using the PUs. The firing circuit is connected directly to the DRB2 firing terminals.

The Programming Unit (PU)

Up to 6 PUs can be associated with a DRB2 and each PU is capable of programming and testing up to 1,000 detonators.

The Remote Blaster (DRB2)

WARNING: The DRB2 provides the menu driven instructions and the energy necessary to fire the DEDDs. Operation of the DRB2 must only be carried out from a safe firing location, always adhering and following all applicable local laws, regulations, acts and procedures.

In WIRED mode the DRB2 manages its proper network, carries out checks of the functionality of each DEDD on the firing circuit and then transmits the secure commands to fire each DEDD.

The DRB2 can manage a maximum of 1500 DEDD on its proper network (contact your local Enaex representative for more information).

WIRELESS mode

The DT SP/UG system can also be operated in WIRELESS mode. The WIRELESS configuration requires a DRB2, 1 DBD in Monoblast, up to 8 DBDs in Multibast, 3 DBD in Synchroblast and up to a maximum of 6 PUs per DBD.

The DBDs are connected to the firing circuits and are placed close to the shot, in an area protected from fly rock. The DRB2 is used from the firing location in a safe area for the operator.

The location and distance from a blast, of the DBDs are specified as per the local Enaex representative and should be adhered to at all times.

The Programming Unit (PU)

Up to 6 PUs can be associated with a DBD and each PU is capable of programming and testing up to 1,000 detonators.

The Remote Blaster (DRB2)

WARNING: The DRB2 transmits the menu driven instructions necessary to fire the detonators. Operation of the DRB2 must only be carried out from a safe firing location, always adhering and following all applicable local laws, regulations, acts and procedures.

In WIRELESS mode, the DRB2 sends orders and receives information from the DBD by means of bidirectional wireless communication. At all times, the DRB2 screen displays the status of the DBD.

Blast Driver (DBD)

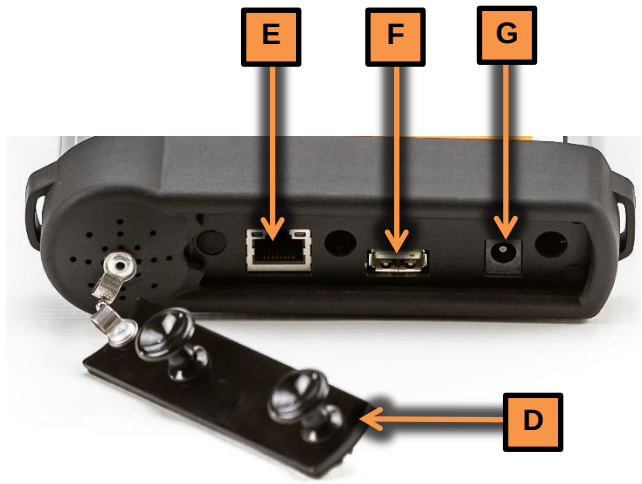
WARNING: The DBD executes the received instructions and provides the energy necessary to fire the detonators. Remotely controlled operation of the DBD by the DRB2, must only be carried out from a safe firing location, always adhering and following all applicable local laws, regulations, acts and procedures.

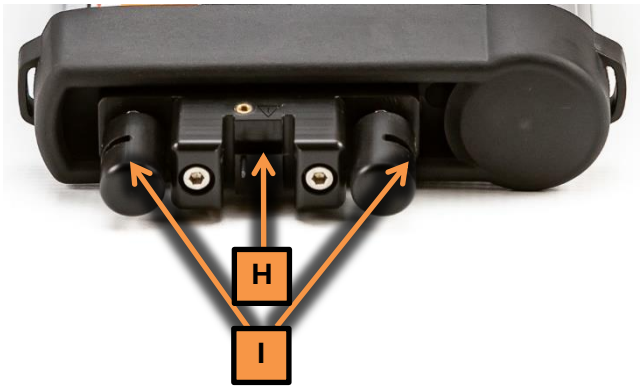
The DBD is remotely controlled by a DRB2. The DBD manages its network, carries out checks of the functionality of each detonator on the firing circuit and then transmits the secure commands to fire each detonator when ordered to do so by the DRB2

The Programming Unit (PU)

Getting started

PU Presentation





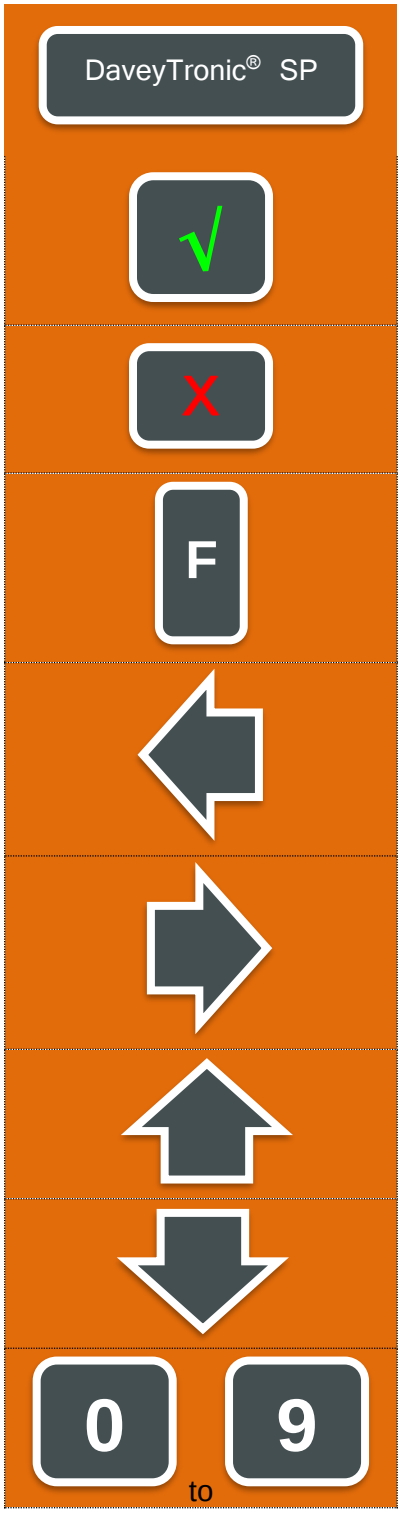
A	⇨	ON/OFF button	D	⇨	Dustproof plate	G	⇨	Charger socket
B	⇨	LCD screen	E	⇨	Ethernet port	H	⇨	Detonator connection terminal
C	⇨	Keypad	F	⇨	USB port	I	⇨	Firing line connection terminals

The PU has 3 connection points which are accessed by removing the dustproof plate at the bottom of the PU (simply pull on the 2 fast opening terminals): an Ethernet connection, a USB connection and a charging point.
The PU supply voltage is 10-12 V DC and the rated current is 4A max.

WARNING: Only connect a firing line to the PU firing line connection terminals. Never connect other equipment to these terminals.

Keypad

The PU operating controls include 18 buttons described below:



ON/OFF button
- Switch ON (hold for 1 sec)
- Switch OFF (hold for 1 sec)

ENTER button
- Choice of selected menu
- Confirmation

CANCEL button
- Return to previous menu
- Cancel an action
- Erase character /digits

FUNCTION button
- Access to function menu

LEFT ARROW button
- Access to configured menu
- Change value or settings within field
- Move cursor in blast plan name

RIGHT ARROW button
- Access to configured menu
- Change value or settings within field
- Move cursor in blast plan name

UP ARROW button
- Scroll characters /digits
- Change field

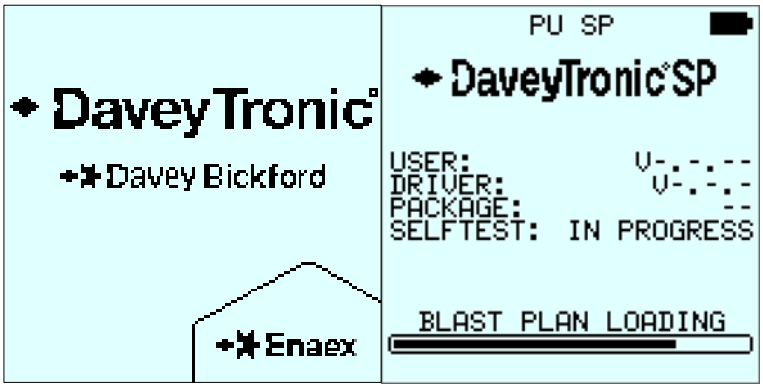
DOWN ARROW button
- Scroll characters / digits
- Change field

NUMERICAL buttons:
- Select option
- Type delay

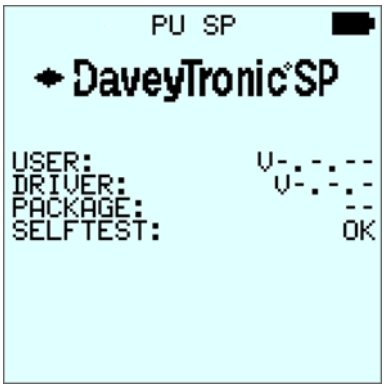
Start

The PU is switched ON by pressing

for approximately 1 second. Backlighting is active for approximately 8 seconds, then a Davey Bickford screen is displayed followed by the screen below showing the software version, the blast plan loading, the self-test progress and the battery level:



After an audible beep, the screen below is displayed for 1 second, showing the result of the self-test.



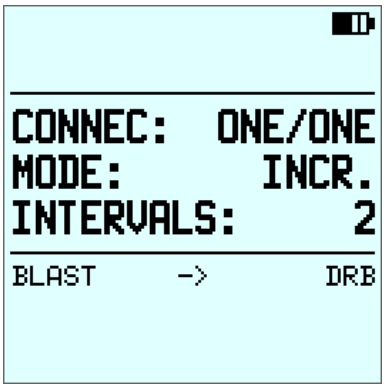
Note:	-	***If the PU fails the self-test, an error number and corresponding text is displayed. Use another PU to program the blast and contact your local Enaex representative to inspect the PU.***

	-	***It is recommended to write down the error number or take a picture of the PU screen when reporting the error.***

Then depending on the delay and connection mode configured (refer to the Delay mode and Connection mode chapter) one of the screens below is displayed.

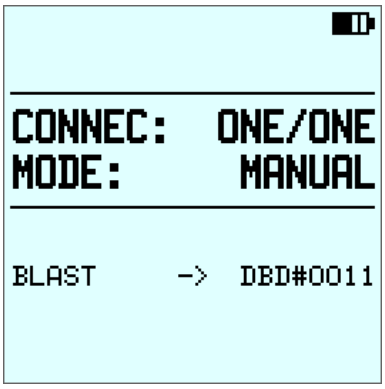
One by One connection mode

Incremental mode



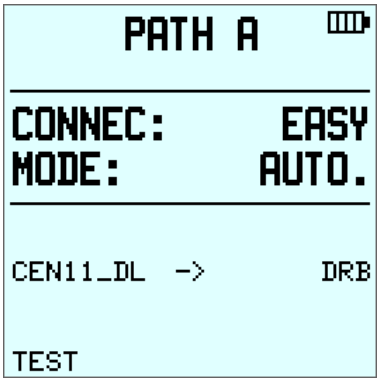
One by One connection mode

Manual mode

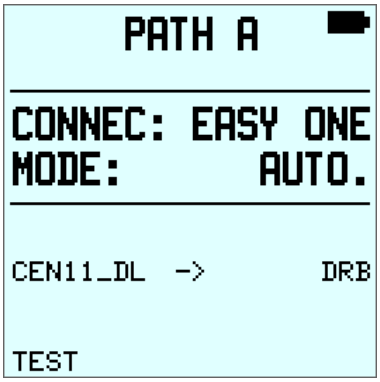


Programming modes (AUTO shown)

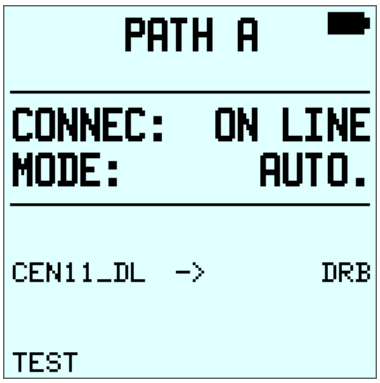
Easy / On Line



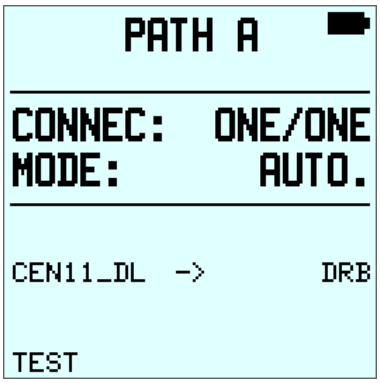
Easy / One by One



On Line



One by One

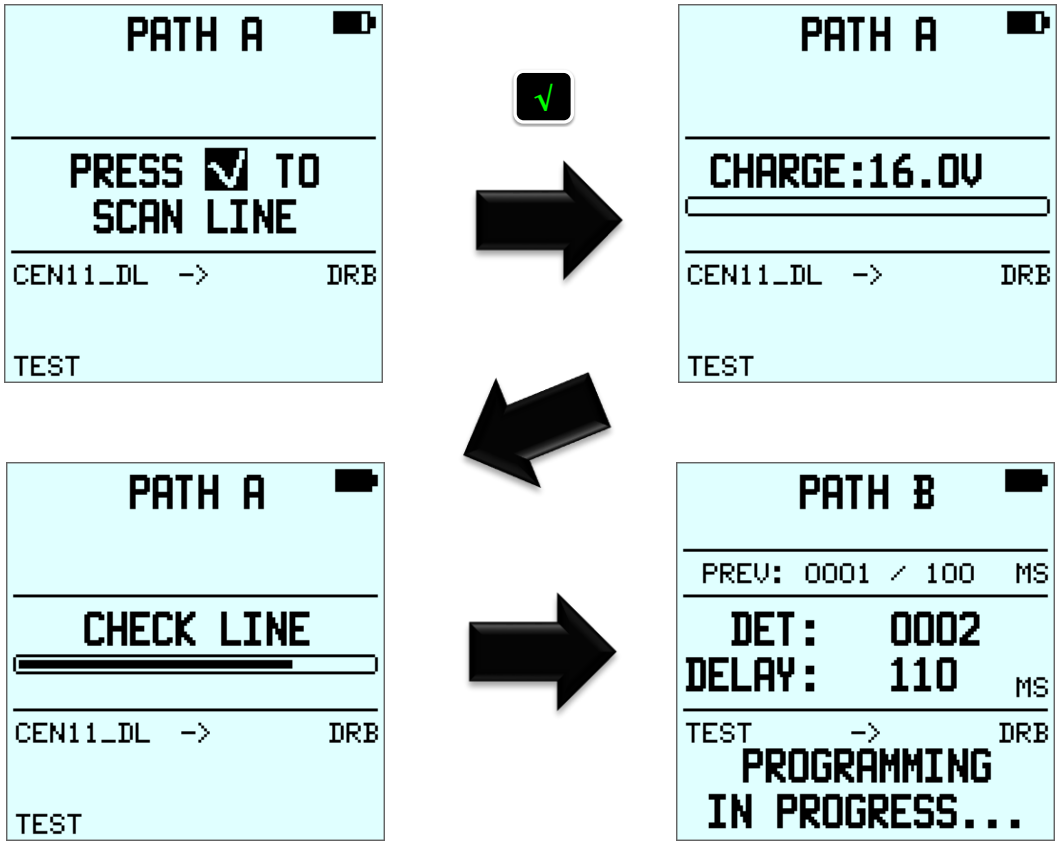


These programming configuration settings will appear for five seconds on the PU screen following a successful self-test at start up

Main screen

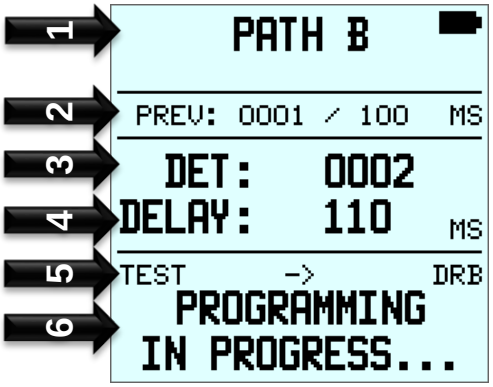
After the self-test has completed, and programming configuration has been displayed, the PU automatically progresses to the next display dependent on the configured connection mode.

Easy or online connection mode



One by One connection mode

The PU will automatically progress to the Main screen, classified as the programming screen of the PU SP/UG.



On the PU Main screen, the sections displayed are explained as follows:

1	In Automatic programming mode, this section displays the path as defined by the user during the blast design phase (Refer to the Blast design software manual for the software used in your region). In the sample screen the path name is B. The path name can be a letter (from A to R) and is extracted from the Blast Plan file when creating a new blast plan.
2	This section displays the previous programmed DEDD details. It indicates the sequence number (a number assigned to a DEDD in the order it was programmed e.g first detonator programmed on this PU would have the sequence number 0001) and delay in ms. *Note 1: When the first detonator is programmed or an **ADDED** detonator (including detonators added while using **AUTOMATIC** mode), and there is no previous detonator in the PU blast plan, this line will be blank.* *Note 2: If the previous detonator has been skipped, the delay is replaced with **SKIP**.*
3	This section indicates the sequence number of the next detonator to be connected and programmed.
4	This section indicates "-----" if the PU has no suggested delay, or the suggested delay in milliseconds of the DEDD to be programmed.
5	This section indicates the blast plan name and the associated devices (DRB2 or DBD)
6	These section display information messages such as the errors (***NO DIALOGUE***…) and general information (***LEAKAGE***…).

Note:	-	*If "Easy Online" or "Online" connection mode was previously configured, the operator has to press √ to scan detonators connected on the line and access to the main screen (refer to the* PROGRAM DETS *chapter).*

Function menu

From the **MAIN** operating screen, press F to access the **FUNCTION** menu.

Dependant on the programming method the PU is configured for (Manual or Automatic), the PU function menu is as follows:

TEST gives users access to the test functions such as LINE TEST, SEARCH MISS, COUNT DET and OHM METER

SKIP allows the user to skip a detonator indicated on the designed blast plan, but not physically present on the shot.

LIST provides information on previously programmed detonators.

READ allows the user to read a detonator, and change the delay if previously programmed.

ADD allows the user to add a detonator physically present on the shot, but not indicated on the designed blast plan. *(**ADD** is hidden when a delay mode other than "Auto" is configured)*

BLAST PLAN SETUP allows users to configure a new blast plan network or modify an existing network

SETTINGS allows users to adapt the PU interface to the operating circumstances

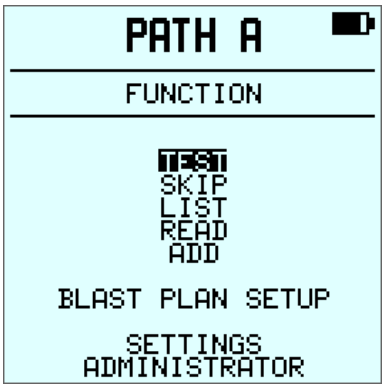
ADMINISTRATOR gives access to the software update function or to the export tag function

All of the functions are described in chapters below

In all the menu screens, you can select a menu item using the following methods:

1. Use ↓ and ↑ to highlight the menu and press √ to select the menu
2. Use the numeric buttons 1 to 9 to select the corresponding menu item

Automatic Programming

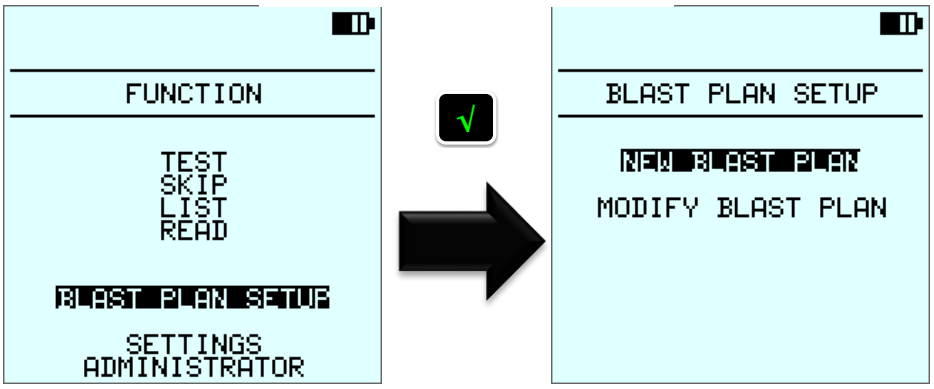


Manual Programming

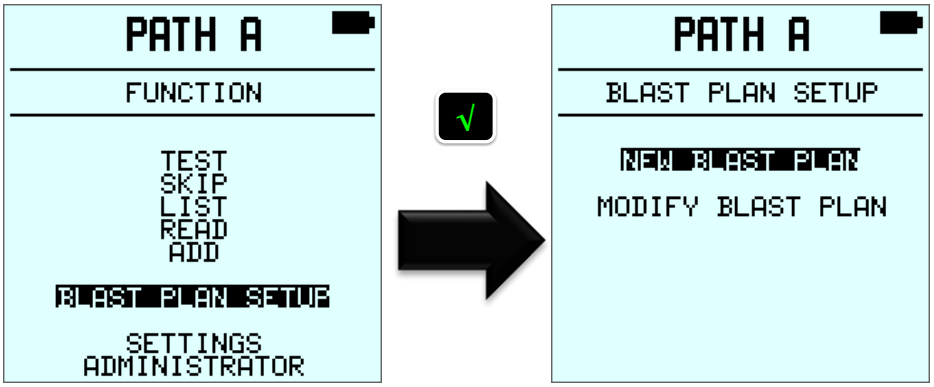
Blast Plan setup Menu

From the **MAIN** operating screen, press F to access the **FUNCTION** menu and use ▼ to select **BLAST PLAN SETUP**. Confirm the selected menu using the √ button. Use the numerical buttons **5** when Manual programming is selected or **6** if Automatic programming is selected.. Here you can configure a **NEW** blast plan or **MODIFY** the blast plan name or to configure the PU for WIRED or WIRELESS mode.

Manual Programming



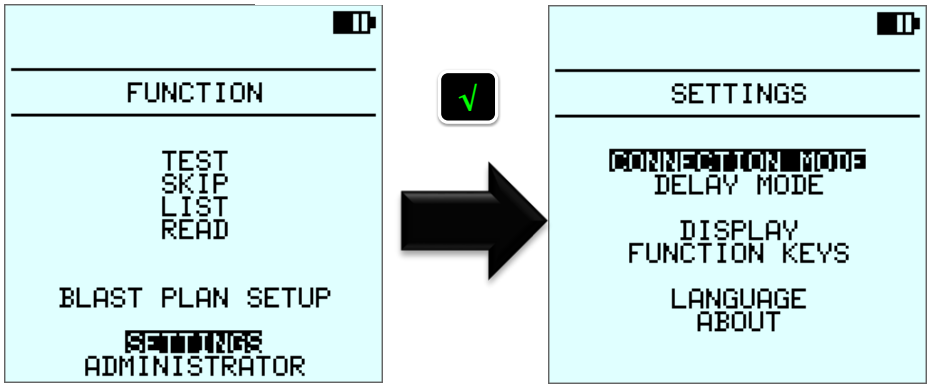
Automatic Programming



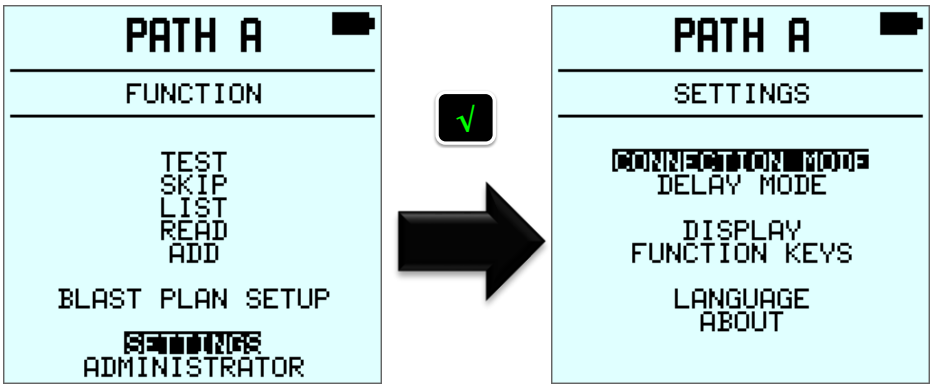
SETTINGS Menu

From the **MAIN** operating screen, press F to access the **FUNCTION** menu and use ↓ to select **SETTINGS and** confirm with √ to access screen or use numerical buttons **6** when manual programming is selected or **7** when Automatic programming is selected.

Manual Programming



Automatic Programming



Connection mode

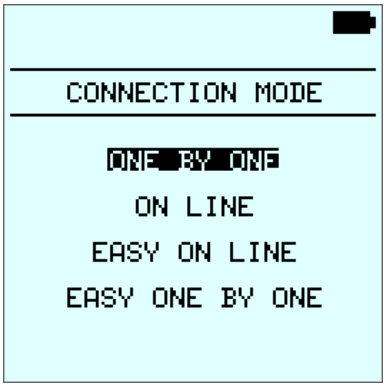
The DT SP/UG Blasting System gives the user access to various available options to program detonators by means of different connection methods.

The following connection modes are available:

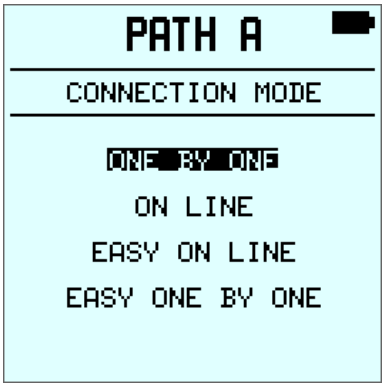
- **One by One** and **Easy One by One:** the operator connects each detonator individually to the PU in order program it. This avoids having to lay down the bus line, allowing vehicle access.
- **On Line** and **Easy On Line :** the operator connects the bus line to the PU and then connects the detonator to the busline in order to program it. This assists with ensuring proper connection of the detonator to the bus line during programming.

From the **SETTINGS** screen, use the ↑ and ↓ arrow buttons to select **CONNECTION MODE and press** √ to confirm selection or use numerical button **1**. The below screen is displayed.

Manual Programming



Automatic Programming



One by One connection

Use the ⬆ and ⬇ arrow buttons to select **ONE BY ONE** connection mode, then press √ to confirm or press x to cancel or press **1** to select **ONE BY ONE** connection mode.

From the **CONNECTION MODE** screen, press x twice to return to the main screen in order to start programming.

In **ONE BY ONE** mode, connect the detonators one by one to the PU's detonator connection terminal. Any **DELAY** mode can be used with this **CONNECTION MODE** (Manual, Incremental or Auto).

This connection method is particularly useful when programming the detonators without having to lay down bus lines: this allows an easy access for vehicles between the holes.

ON LINE connection

Use the ⬆ and ⬇ arrow buttons to select **ON LINE** connection mode, then press √ to confirm or press x to cancel or press **2** to select **ON LINE** connection mode.

From the **CONNECTION MODE** screen, press x twice to return to the main screen in order to start programming.

In **ON LINE** connection mode, connect the bus line to the PU and connect the detonators directly to the bus line one after the other. The PU detects and programs each detonator as the user presses √ once the detonator has been connected to the bus line. The physical location of the connectors on the bus line is independent of their delays or programming order (for instance the third detonator to be programmed can be connected between n°1 and n°2). However, a clear and systematic way of connecting the detonators to the bus line guarantees easy identification of the detonators. Any **DELAY** mode can be used with this **CONNECTION MODE** (Manual, Incremental or Auto). This connection method assists with ensuring a good connection of the detonators to the bus lines.

Easy On Line Connection.

Use the ⬆ and ⬇ arrow buttons to select the **EASY ON LINE** mode. Then press √ to confirm or press x to cancel or press **3** to select **EASY ON LINE** connection mode.
From the **EASY ON LINE** screen, press x twice to return to the main screen in order to start programming.

In **EASY ON LINE** connection mode, the operator connects the bus line to the PU, then connects each detonator on the bus line to program it: the PU detects when the detonator is connected.

Any **DELAY** mode can be used with this **CONNECTION MODE** (Manual, Incremental or Auto). This connection method assists with ensuring a good connection of the detonators to the bus lines. In Incremental mode or Automatic mode, the operator will not have to confirm the proposed delay: the delay will be automatically accepted when the detonator is connected and detected without having to press √.

Easy One by One connection

Use the ↑ and ↓ arrow buttons to select **EASY ONE BY ONE** connection mode, then press √ to confirm or press x to cancel or press **4** to select **EASY ONE BY ONE** connection mode.

From the **CONNECTION MODE** screen, press x twice to return to the main screen in order to start programming.

In **EASY ONE BY ONE** mode, connect the detonators one by one to the PU's detonator connection terminal. The PU detects when the detonator is connected. Any **DELAY** mode can be used with this **CONNECTION MODE** (Manual, Incremental or Auto).

This connection method is particularly useful when programming the detonators without having to lay down bus lines: this allows an easy access for vehicles between the holes. In Incremental mode or Automatic mode, the operator will not have to confirm the proposed delay: the delay will be automatically accepted when the detonator is connected and detected without having to press √.

Delay mode

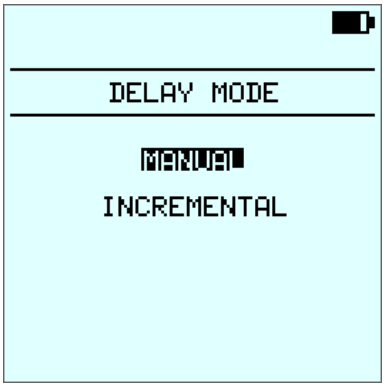
The following delay modes are available when manual programming is used;

- ***Manual***: the user inputs the delay for each detonator connected, using the PU numerical buttons
- ***Incremental***: once the PU has detected an increment, it will suggest the delay for each detonator connected.

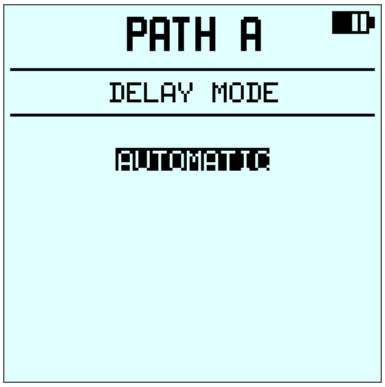
The following delay modes are available when automatic programming is used;

- ***Automatic***: the delay for each detonator is designed and then downloaded from blast design software and uploaded to the PU.

Manual/Incremental

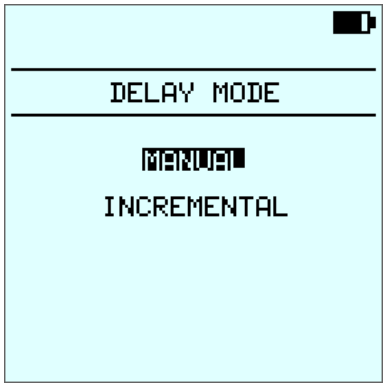


Automatic



Manual mode

When in the **DELAY MODE** screen as indicated below, press **1** or the arrow buttons to select ***Manual*** mode.

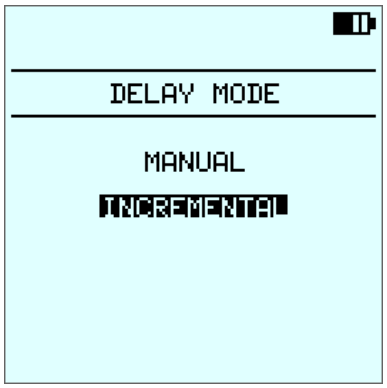


In ***Manual*** mode, the PU prompts the operator to enter each individual delay. Use the numerical buttons to select desired delay and press √ to confirm.

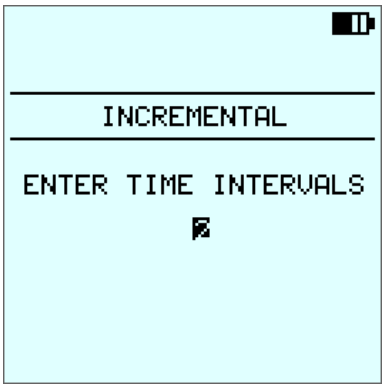
IMPORTANT: The order in which detonators are programmed is independent of their delay time.

Incremental mode

When in the **DELAY MODE** screen as indicated below, press **2** or the arrow buttons to select ***Incremental*** mode.



Use the PU numerical buttons to enter the suitable number of time intervals between 1 and 9, and then press √ to confirm or ✕ to return to the **DELAY MODE** screen



IMPORTANT: The PU's configuration is saved even when the PU is turned OFF or reset. The operator can change between ONE/ONE, ON LINE and EASY modes and MANUAL or INCREMENTAL modes as well as altering the TIME INTERVALS number at any time during programming, but changing from Automatic to Manual and vice versa requires a new blast plan to be created on the PU.

Incremental Example 1:

Scenario: Full column blast holes on 2 rows of 10 holes each, planned 10 ms between holes and 42 ms between rows, starting the first hole on 1000 ms.

→ configure the PU for a time interval of 1 and program the first 2 detonators using the timing: 1000 ms and 1010 ms. The PU will propose the next delay of 1020 ms for the third hole as a 10 ms interval has been detected by the PU when programming the first 2 detonators. At the end of the first row, the delay of the first two holes of the second row will have to be entered manually to detect the 10 ms increment again.

Incremental Example 2:

Scenario: Double decked blast holes on 2 rows of 10 holes, planned 3 ms between decks, 10 ms between holes and 42 between rows.

→ configure the PUfor a time interval of 2 and program the first hole detonators of the blast, 0 ms, 3 ms and then the first detonator of the second hole, 10 ms. The PU will propose 13 ms for the fourth detonator as a first interval of 3ms has been detected on the PU when programming the first 2 detonators. The PU will then propose 20 ms for the fifth detonator, as a second interval of 7 ms has been detected on the PU when programming the second and the third detonator.

At the end of the first row, the delay of the first 3 detonators of the second row will have to be entered manually for the PU to determine the 3 ms and 7 ms increment again.

Note that another solution consists of selecting only one time interval and programming deck by deck (all bottom detonators first then all top detonators) as in Example 1.

NOTE: Example 1 can also be used to program each deck individually where all top then bottom deck detonators are programmed.

NOTE: An incremental time of 2 can also be used to program single decked holes, but 2 rows at a time.

WARNING: DO NOT DISCONNECT the detonator before the PU displays the next detonator sequence number or the message REMOVE LAST DET.

Automatic mode:

In ***Automatic*** programming mode, the PU already contains the planned delay as designed by the operator using blast design software when the ***Blast Plan*** is imported during ***New Blast Plan*** operation. The operator can change the delay by using the PU numerical buttons.

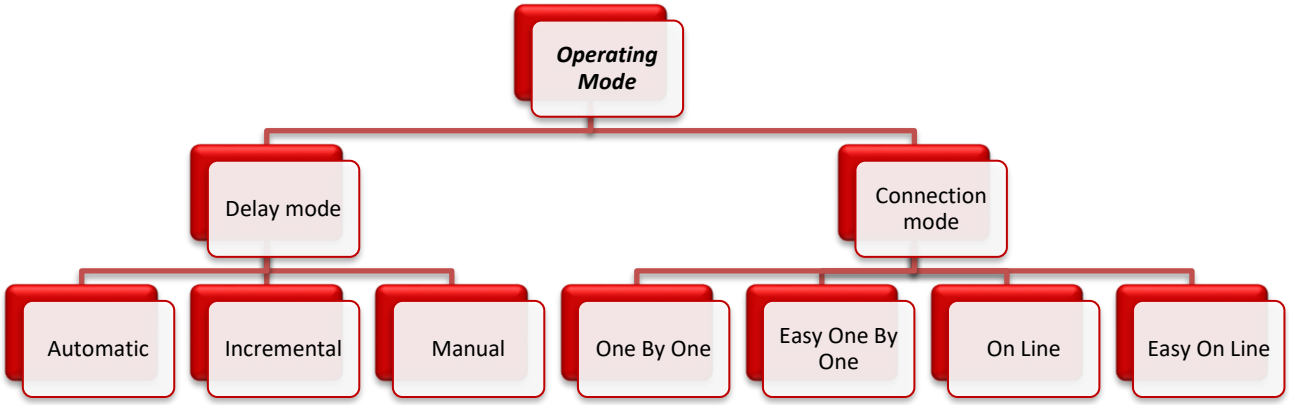
Automatic mode can be selected when the operator creates a new blast plan

When all the detonators defined in the imported blasting plan are programmed, the programming screen proposes the programming of *ADDED* detonators similar to if the operator had selected the ADD function (the operator must use the keyboard to enter the delay manually for each detonator ADDED).

In Automatic programming mode, the text **PATH "X"** is displayed at the top of all the PU screens to indicate which path is associated to the PU. "X" represents the name of the path as a letter (from A to R). The path name (letter) is extracted from the Blast Plan file uploaded from the D&B software when creating a new blast plan.

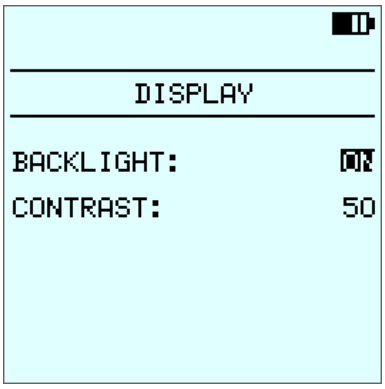
Overview of the Operating mode

The diagram below summarises the options available in the **OPERATING MODE** menu (both for the connection and delay modes).



DISPLAY function

Automatic and Manual Programming



In the **SETTINGS** menu, select **DISPLAY** and confirm with √ or use numerical buttons **6** when manual programming is selected or **7** when Automatic programming is selected, to access the **DISPLAY** screen. Change between **BACKLIGHT** and **CONTRAST** with the ↓ and ↑ arrow buttons. The selected parameter will appear in white fonts on black background. Change the parameter with the ← and → arrow buttons. Exit the **DISPLAY** screen with ✕ to cancel modification or √ to save settings

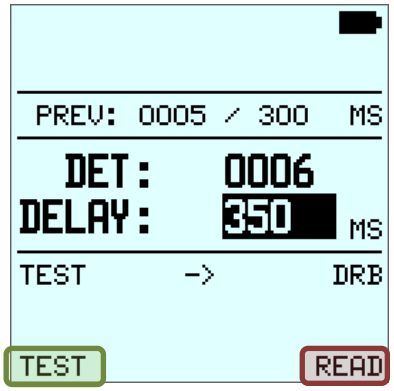
BACKLIGHT refers to the screen and keypad backlight and can be turned **ON** or **OFF**. If it is turned **ON**, backlighting of the screen and buttons stays active and automatically turns off if the PU is idle for 2 minutes. If it is turned **OFF** there is no backlighting of the screen nor keypad.

CONTRAST can be changed from 0 to 100% in order to adjust the readability of the screen under several lighting conditions.

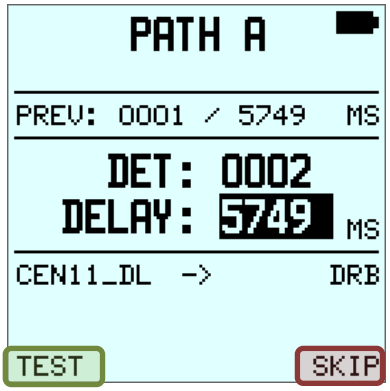
FUNCTION KEYS

The ← and → arrow buttons can be configured as shortcuts to certain functions. In the **MAIN** operating window, the selected function will appear on the bottom left-hand side of the screen (shortcut is ← arrow button: see in green below) and on the bottom right-hand side of the screen (shortcut is → arrow button: see in red below).

Manual Programming

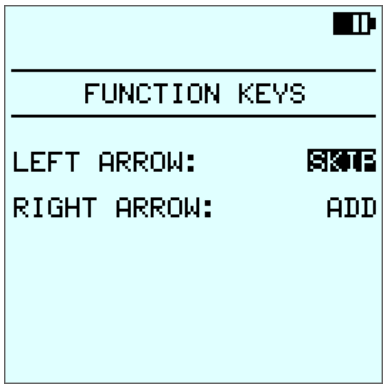


Automatic Programming

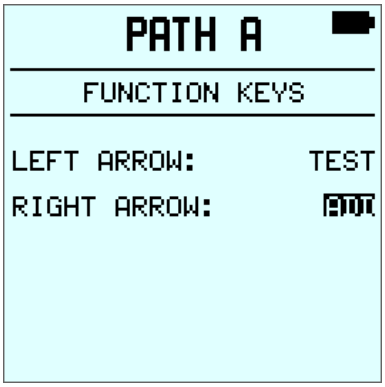


In the **SETTINGS** menu, select **FUNCTION KEYS** and confirm with √ or use numerical button **4** to access the **FUNCTION KEYS** screen. Change the shortcut selected with the ↑ and ↓ arrow buttons. The selected function will be highlighted. Change the function associated to the shortcut with the ← and → arrow buttons and assign the selected function to the shortcut key with √. Exit the menu and cancel the modification by pressing ✕.

Manual Programming



Automatic Programming



Note: The shortcut menus are only displayed if they are available (depending on each page, function and active mode).

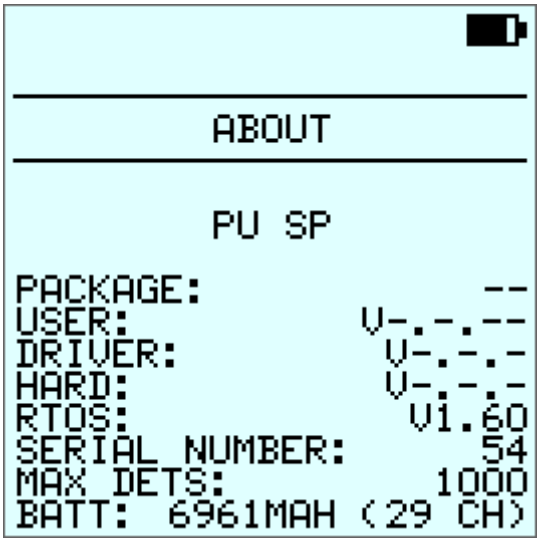
LANGUAGE

In the **SETTINGS** menu, select **LANGUAGE** and confirm with √ or use numerical button **5** to access to the **LANGUAGE** menu.

When **LANGUAGE** screen is displayed, press the numerical button **1** for FRANCAIS (French), **2** for ENGLISH (English), **3** for ESPANOL (Spanish), **4** for PORTUGUES (Portuguese), **5** for SVENSKA (Swedish), **6** for SUOMALAINEN (Finnish), **7** for РУССКИЙ (Russian) or **8** for TURK (Turkish) to select the appropriate language or use the ▲ and ▼ arrow buttons to highlight the requested language and press √ to select it.

ABOUT

The "about screen" displays the current package, user software and driver versions, the hardware version, RTOS version, the PU serial number and its maximum number of programmable detonator.
This software version now includes the recorded calibrated capacity of the battery, and the number of charge cycles until the next calibration is due
(e.g., 6961 mAh capacity / 29 charges to next calibration)



ADMINISTRATOR menu

The **ADMINISTRATOR** menu gives access to the following menus

- **SOFTWARE UPDATE**: Update the PU software
- **EXPORT RFID TAG**: Export the PU RFID card data to an USB key (for maintenance purposes)
- **ABOUT :** displays the about screen (available only if the self-test fails)
- **RESET TAG :** resets the RFID card (available only if the self-test fails)

The **ADMINISTRATOR** menu can only be accessed with an administrator password. Contact your Enaex representative for access.

Switch off

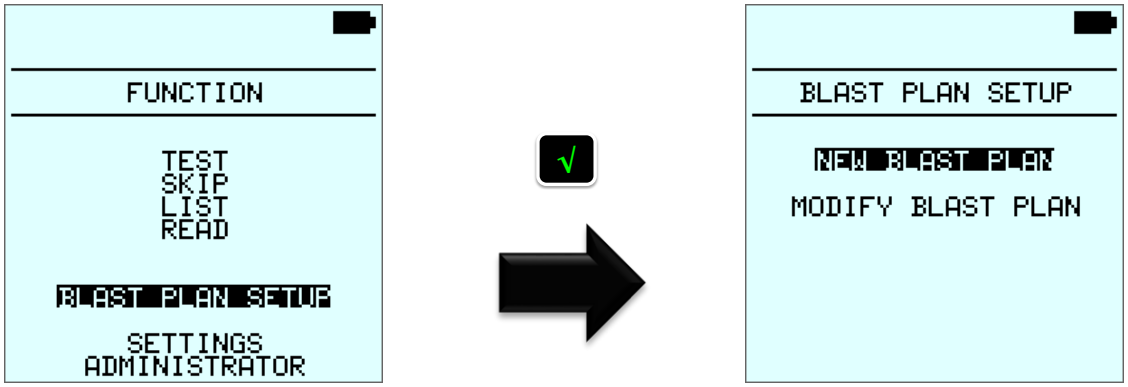
Switch OFF the PU by pressing

for approximately 1 sec from any menu.

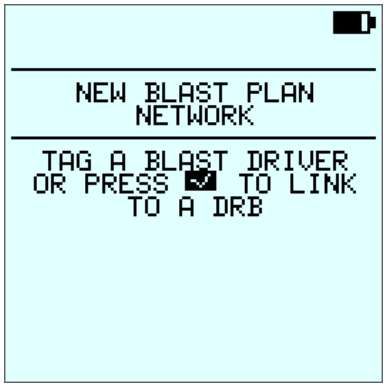
The programming operation

NEW BLAST PLAN

Before programming detonators, a new blast plan must be created. From the **MAIN** operating screen, press F to access the **FUNCTION** menu and use the ↑/↓ to select **BLAST PLAN SETUP** and press √ or use numerical button **5** when manual programming is selected or **6** when Automatic programming is selected, to enter the menu.



Select **NEW BLAST PLAN** and press √ in order to create a new one.



The above screen is then displayed.

The PU must be associated with the equipment that will be used to fire the detonators. The associated equipment can be a DRB2 or a DBD. Press √ to link a DRB2 or tag the associated DBD (its serial number automatically appears as DBD #XXXX once the tag is detected by the PU).

Note:	***"Tagging" is reading the DBD RFID tag by the PU. The position of RFID card and reader are symbolized on the device by the logo . See below on how to position the PU ontop of the DBD to associate the DBD with the PU.***

The associated equipment is then displayed as on the screen below : **-> DBD #xxxx** (xxxx = serial number) or DRB2 depending on network selected.

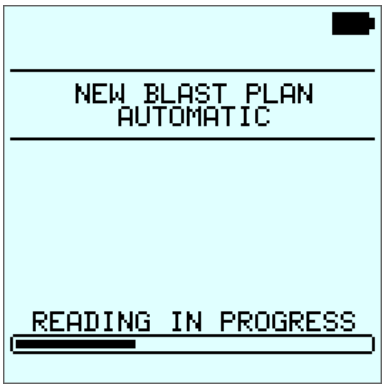
Select programming mode (***Automatic*** mode: Yes or No) with ⬆/⬇ and press ☑ to confirm. Setting the PU in Manual mode allows selection of the ***Manual*** or ***Incremental*** **DELAY MODE** which can be configured in the **SETTINGS** menu. For *Automatic* mode (blast plan designed by software), please refer to next chapter.

Set Automatic mode

If **YES** is selected, the screen below will be displayed. The operator is requested to connect the USB key with the blast plan file on it (file: ***PU_Auto_BlastPlan.BPD***).

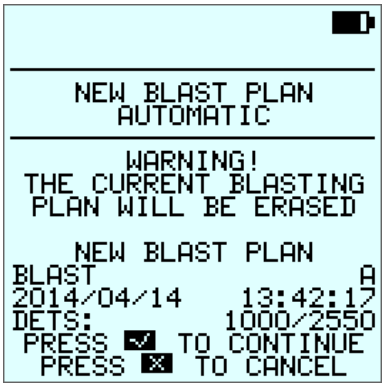
Note: Use the Davey Bickford's **DB_D2D_To_BPD** software *to convert a blast plan designed using an old version of blast plan design software that is not compatible with this current SP/UG package version. Refer to the related* ***DB_D2D_To_BPD quick start guide*** to use it.

Once the USB key containing the file is detected, the PU begins downloading the blast plan. The progress is displayed at the bottom of the screen in the status bar.



Note: If a USB key is *detected and the file is not found, "NO BLASTING PLAN" message is displayed and the operator has to press* ✕ *and then return to the* **NEW BLAST PLAN** *menu.*

When reading is complete and the correct blast plan is found, the following data is displayed: Blast Plan name, path, date and time, number of detonators on the path and number of detonators on the Blast Plan.



A warning message is displayed to inform the user that all previous data will be erased from the PU. To cancel, press and return to the **NEW BLAST PLAN** menu or press to start updating the RFID tag. The progress is displayed at the bottom of the screen in the status bar.

When the RFID tag update is completed, the PU returns automatically to the **MAIN** menu.

Set Manual mode

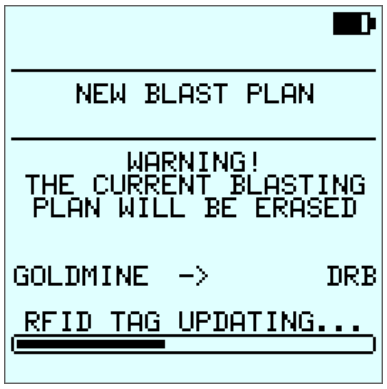
Select **NO** in the automatic mode screen to enable the Manual or Incremental mode. The operator is prompted to enter the name of the blast plan.

Note: by default the PU display the name of the last blast name saved.

The operator may change the blast plan name by scrolling the characters with and and moving the cursor with and . Press to validate the name and continue.

Characters allowed for the Blast Plan name are: **A** to **Z**, **0** to **9**, **-**, _ and space.

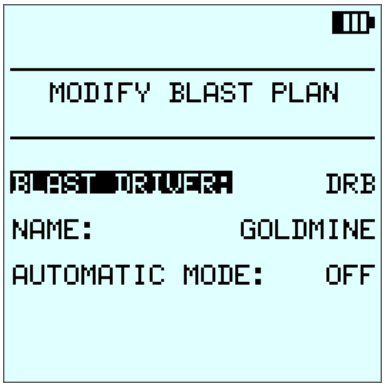
A warning message is displayed to inform the user that all previous data will be erased from the PU. To cancel, press ✕ and return to the **NEW BLAST PLAN** menu or press √ to start updating the RFID tag. The progress is displayed at the bottom of the screen in the status bar.



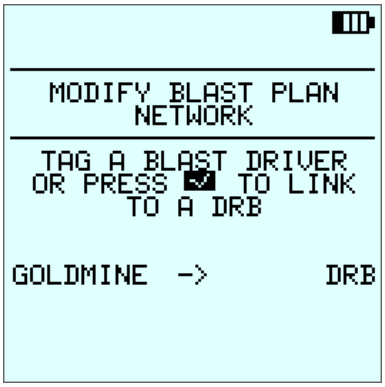
When the RFID tag update is completed, the PU returns automatically to the **MAIN** menu.

MODIFY BLAST PLAN – MANUAL PROGRAMMING

From the **MAIN** operating screen, press F to access the **FUNCTION** menu and use the ⬆/⬇ to select **BLAST PLAN SETUP** and press √ or use numerical button **5** when manual programming is selected or **6** when Automatic programming is selected, to enter the menu. Use ⬆/⬇ to select **MODIFY BLAST PLAN** and press √ to confirm.



Highlight the line "Blast Driver: …" with ⬆/⬇ and press √ to modify the associated equipment.

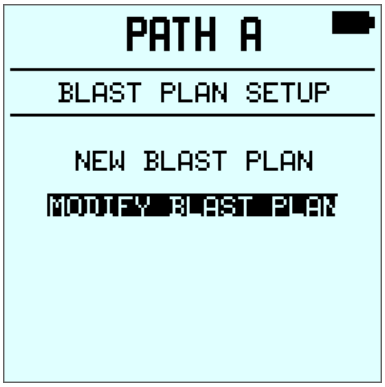


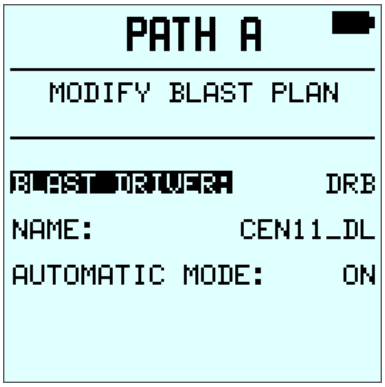
The PU must be associated with the equipment that will be used to fire the detonators. The associated equipment can be a DRB2 or a DBD. Press √ to link a DRB2 or tag the associated DBD (its serial number automatically appears as DBD #XXXX once the tag is detected by the PU).

You can change the Blast Plan name. Highlight the line "NAME:" with ⬆/⬇ and press √ to modify the name.

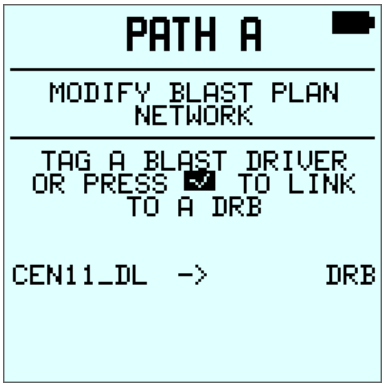
MODIFY BLAST PLAN – AUTOMATIC PROGRAMMING

From the **MAIN** operating screen, press i to access the **FUNCTION** menu and use the ⬆/⬇ to select **BLAST PLAN SETUP** and press √ or use numerical button **5** when manual programming is selected or **6** when Automatic programming is selected, to enter the menu. Use ⬆/⬇ to select **MODIFY BLAST PLAN** and press √ to confirm.



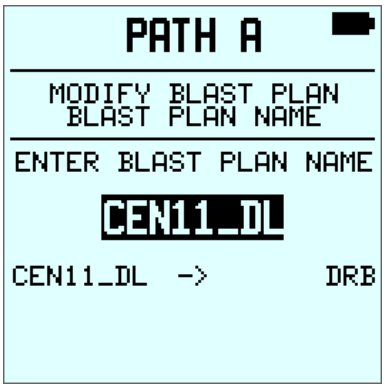


Highlight the line "Blast Driver: …" with ⬆/⬇ and press √ to modify the associated equipment.



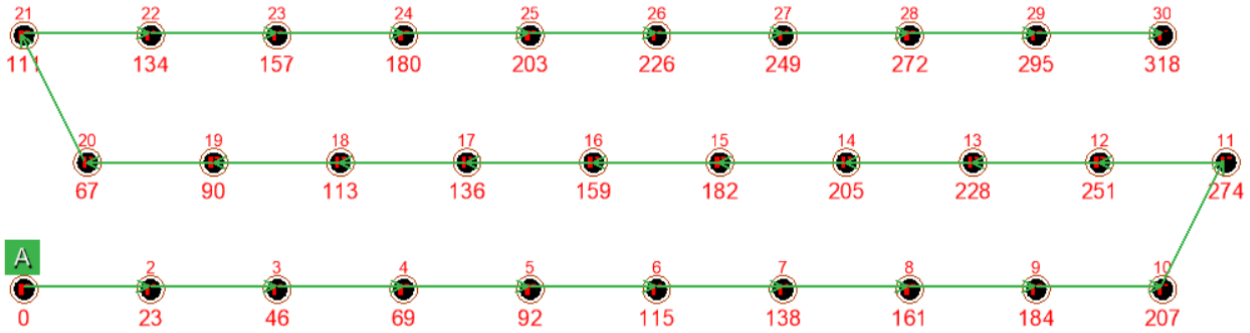
The PU must be associated with the equipment that will be used to fire the detonators. The associated equipment can be a DRB2 or a DBD. Press √ to link a DRB2 or tag the associated DBD (its serial number automatically appears as DBD #XXXX once the tag is detected by the PU).

You can change the Blast Plan name. Highlight the line "NAME:" with ▲/▼ and press √ to modify the name.



PROGRAM DETS

Every detonator is identified by the PU, the DRB2 and the DBD by its unique identification number. During the programming operation, the PU allocates a sequence number to the detonator and the operator chooses a delay time in accordance with the blast plan. The detonator's unique ID number, associated sequence number and delay are stored in the PU RFID tag. It is possible to program several detonators with the same delay.



Example of a blast plan displaying sequence numbers and delays

The sequence number advances automatically after each detonator is programmed. The designed blast plan should be followed and checked during programming. By writing down the detonator sequence number on the designed blast plan during programming, makes it easier to locate each sequence number and associated detonator during fault finding.

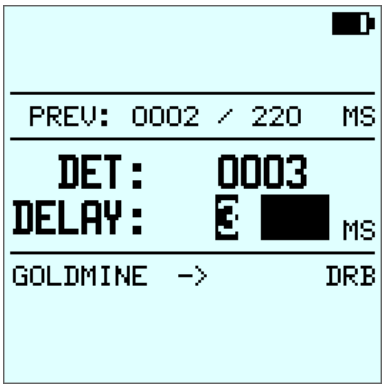
A blast can be programmed using 1 and up to a maximum of 6 PUs. The total number of detonators programmed for a blast should not exceed the maximum number of detonators that a DRB2 or DBD can communicate with.

IMPORTANT: the PU(s) must be reset before starting to program a new shot.

Programing in One by One connection mode

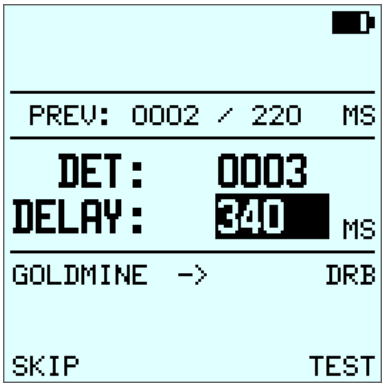
In *One/One* connection mode, the operator connects each detonator individually to the PU to program it:

- In *Manual* mode, enter the delay with the numerical buttons and connect each detonators to the PU's detonator connection terminal.

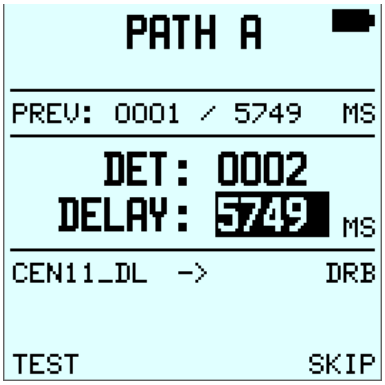


- In *Incremental* mode (if the delay is known by the PU) or in Automatic mode, the proposed delay of the next detonator to be programmed is displayed on the screen.
  Note: the proposed delay can be modified by entering a new delay with numerical buttons.

Manual Programming

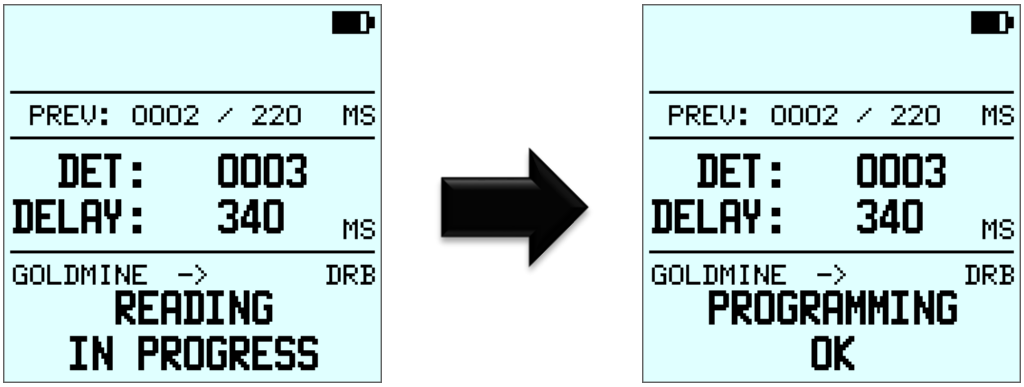


Automatic Programming

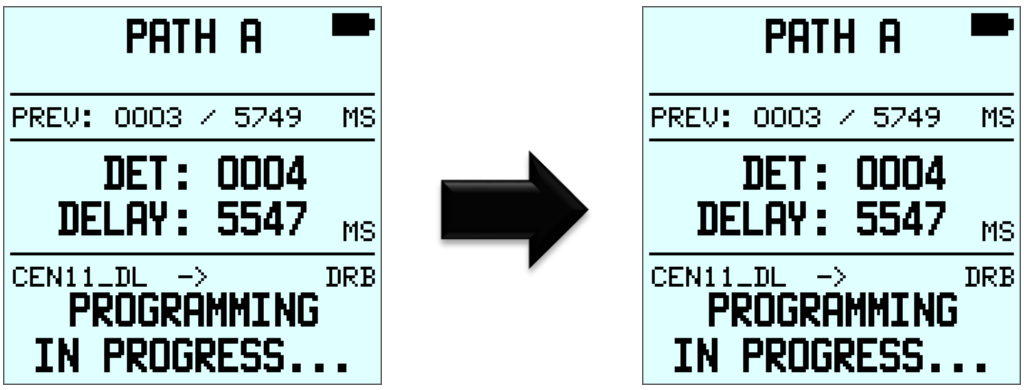


Whatever the programming mode, the operator must confirm the entered or the proposed delay, by pressing the √ button. The screen then displays *READING IN PROGRESS*. If the PU successfully programs the connected detonator, the message *PROGRAMMING OK* is displayed.

Manual Programming

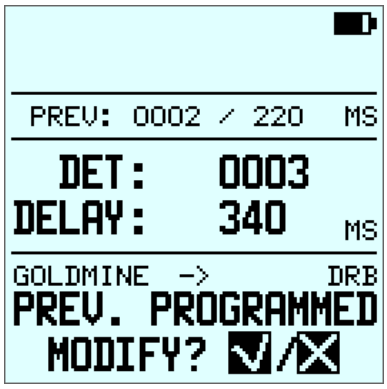


Automatic Programming

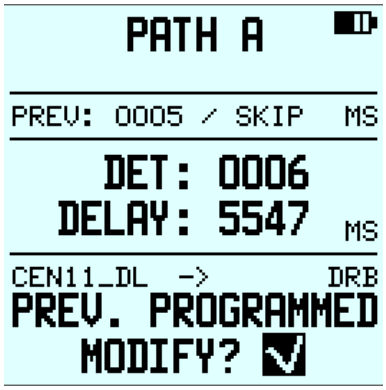


To continue programming disconnect the detonator and connect the next detonator to the PU. If the detonator has been previously programmed, the PU is capable of recognizing it and will prevent it from being programmed again. A long beep will sound and a message *PREV. PROGRAMMED* will be displayed where the user can modify the delay if needed: by pressing √ the PU will enter the programming screen and enables the users to change the delay. Press X to avoid modifying and to return to previous screen.

Manual Programming

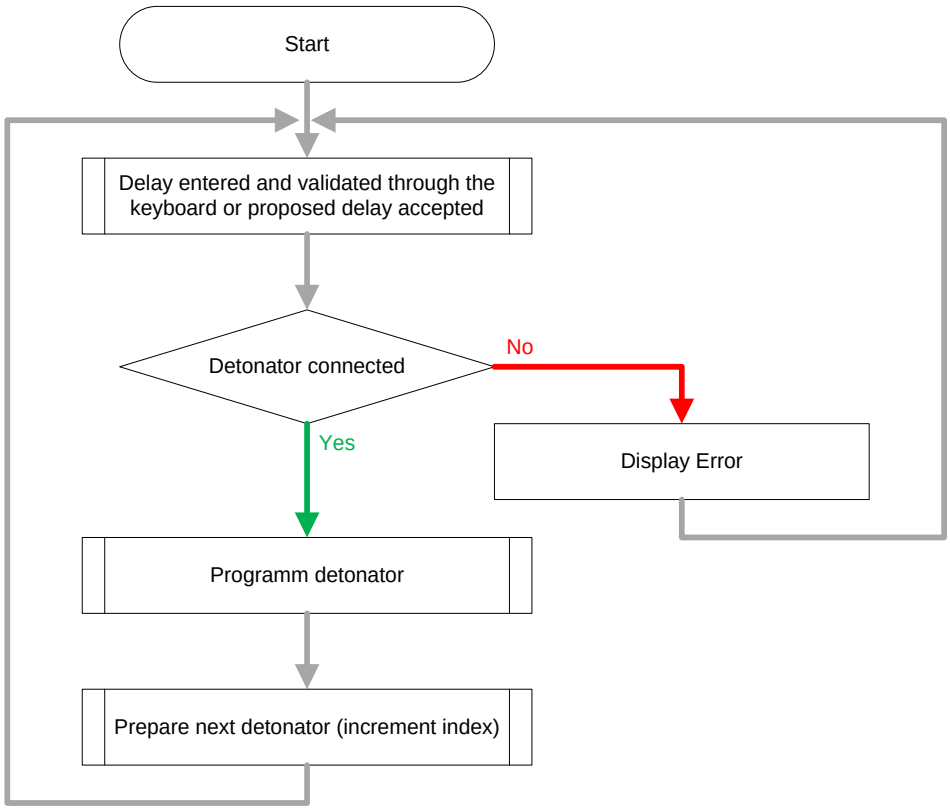


Automatic Programming



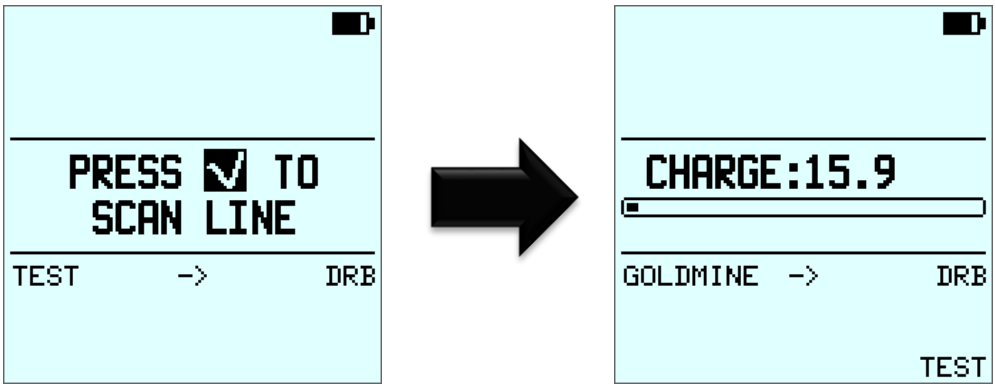
If an error occurs during programming, warning message will be display at the bottom of the screen, refer to the “Dealing with errors during Programming” chapter.

Simplified Flow Chart for One By One Connection mode



Programing in EASY ONE BY ONE connection mode

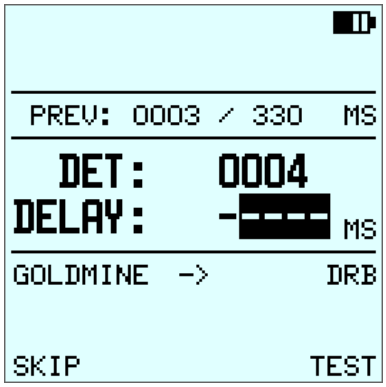
When starting the PU in any EASY MODE, the below screen is displayed where the user would have to press √ to charge and scan the line of the PU.



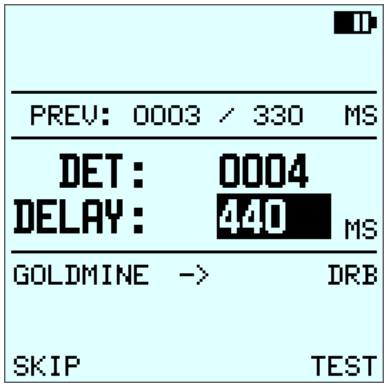
When charging is completed, the programming screen is displayed.

The sequence number of the next detonator to be programmed is displayed. Depending on the delay mode, in manual mode manually enter the delay using the numerical buttons and accept using √ then connect the detonator or accept the automatically proposed delay by connecting the detonator.

Manual delay



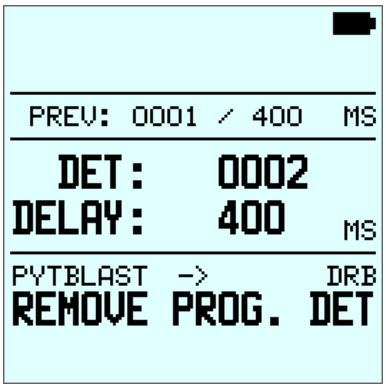
Proposed delay



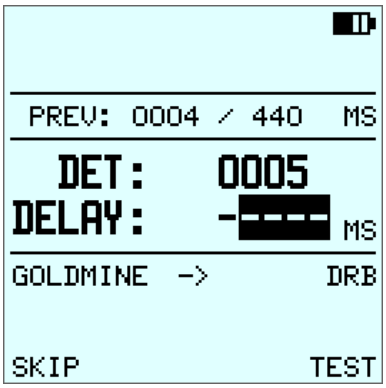
Press √ to validate the proposed or manually entered delay. The sequence number will then be flashing on the PU screen.

Connect the detonator related to the sequence number. When the detonator is detected by the PU, the sequence number stops flashing, three shorts beeps are played and the screen displays *READING IN PROGRESS*.

If PU successfully programs the connected detonator, the PU displays the message “REMOVE PROG. DET”.

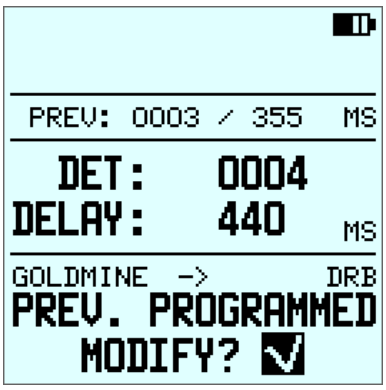


To continue programming, disconnect the detonator, the PU displayed sequence number will increment automatically, allowing for the next detonator connected to the PU to be programmed.

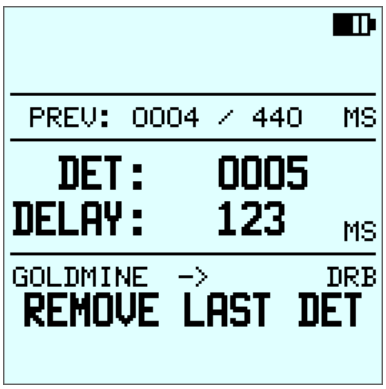


If the connected detonator was previously programmed, the PU is capable of recognizing this and will prevent it from being programmed again. A long beep will sound and a message *PREV.*

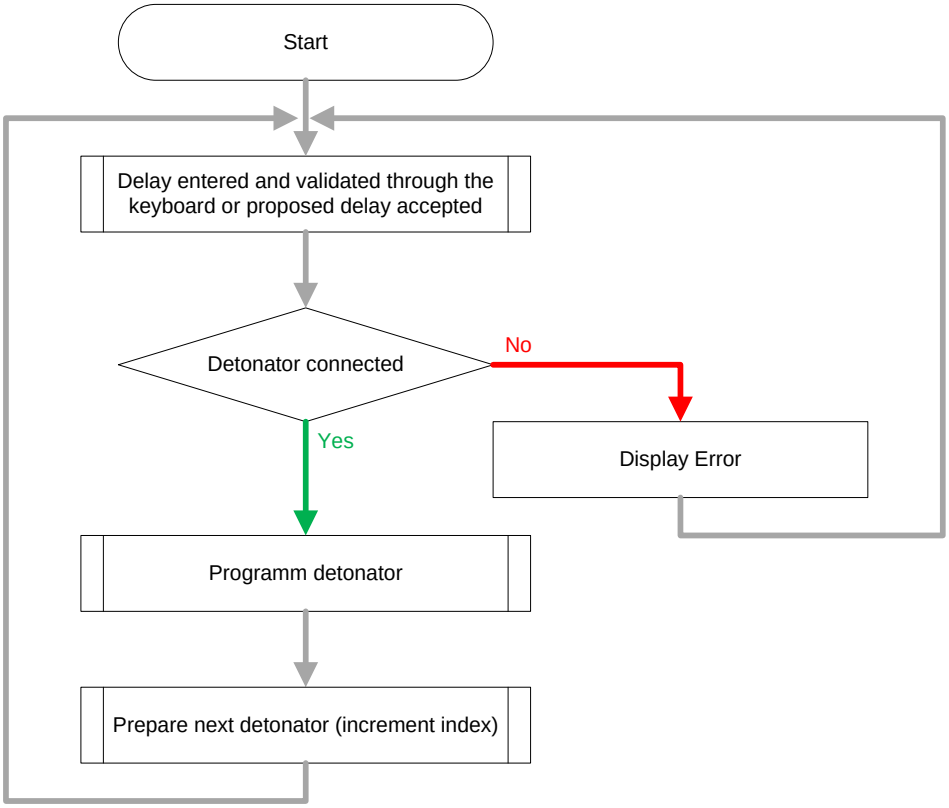
PROGRAMMED will prompt the operator to modify the delay if needed: press √ to change the delay or disconnect the detonator to avoid modifying its delay and to return to previous screen.



If an additional detonator is connected to the line before the programming of the previous detonator is completed or if 2 (or more) detonators are connected onto the line simultaneously, the flashing message ***"REMOVE LAST DET"*** will appear on the PU screen. Remove the last 2 connected detonators to get rid of the message. The same sequence number will be flashing. Connect the detonator again, enter the delay and press √.



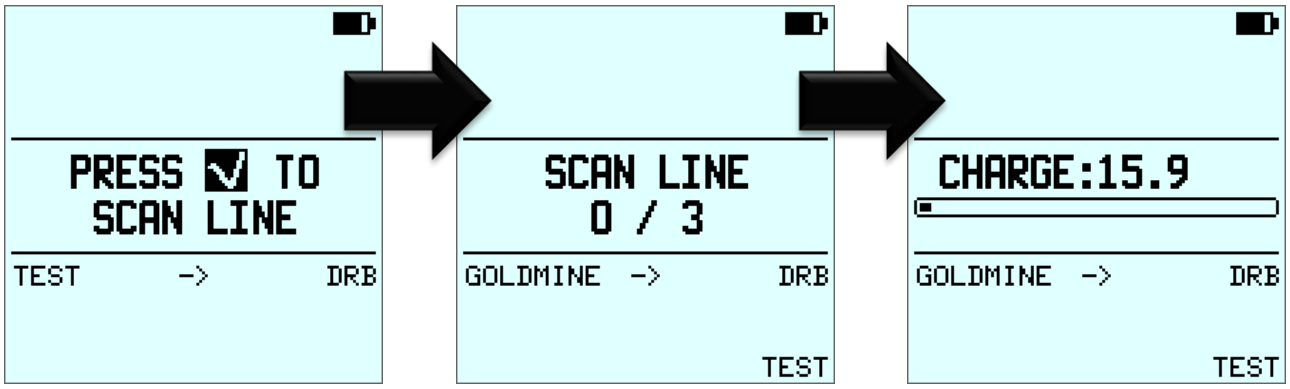
Simplified Flow Chart for One By One Connection mode



WARNING: THE DETONATORS SHOULD NOT BE REMOVED UNTIL THE PROGRAMMING IS COMPLETED BY THE PU (i.e. until you hear the 2 beeps, the PU requests the removal of the detonator or if the sequence number of the next detonator sequence number is displayed).

Programing in On Line connection mode

From main screen, press √ to scan the line for detonators: the PU scans the bus line to detect any detonator connected and display an error if any non-programmed detonator is detected.

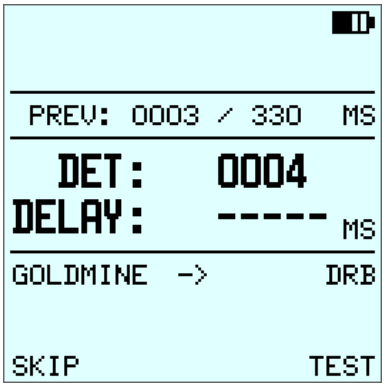


Note: If programming has to be interrupted, switch off the PU and disconnect the bus line from the PU. To restart, switch on the PU and wait until the self-test is finished to reconnect the firing line. Restart the procedure by pressing √ to scan the line. This line can be a new line or a line with previously programmed detonators. Do not connect the line after executing the line scan.

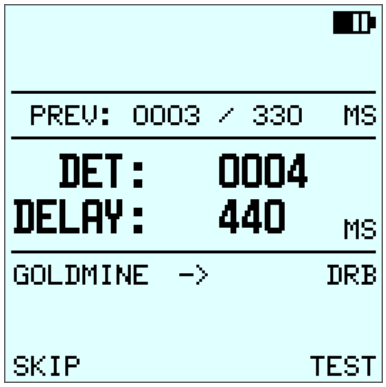
When scanning is completed, the programming screen is displayed.

The sequence number of the next detonator to be programmed is flashing. Depending on the delay mode, the delay is displayed as **- - - - -** (unknown delay) or the value of the proposed delay.

Manual delay

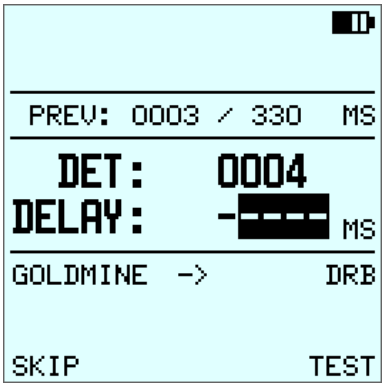


Proposed delay

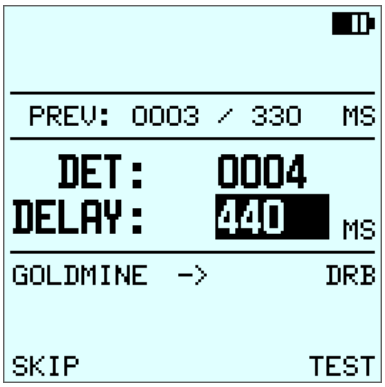


Connect the detonator with the corresponding sequence number. When the detonator is detected the sequence number stops flashing and three shorts beeps are heard.

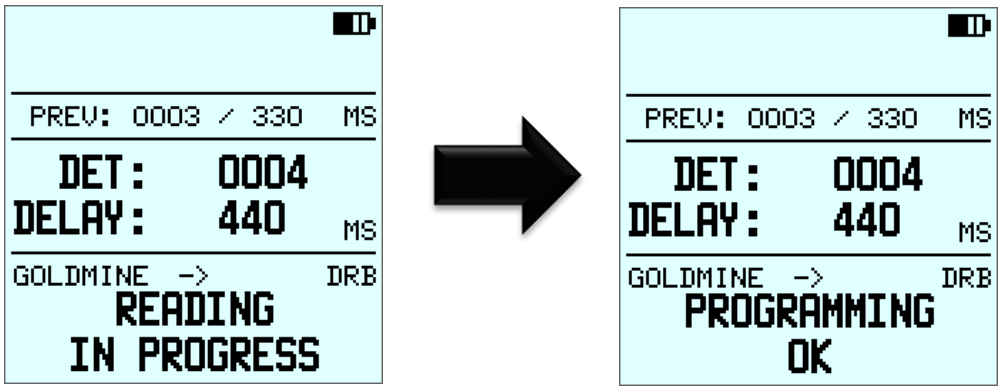
Manual delay



Proposed delay

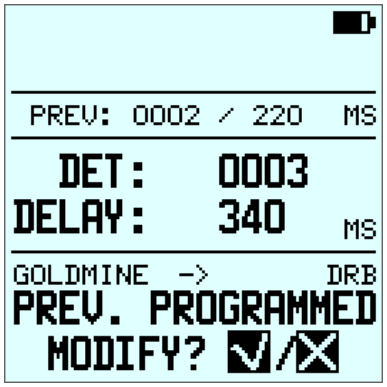


Depending on the delay mode either manually enter the delay using the numerical buttons and accept it using √ or automatically accept the proposed delay using √. The screen then displays *READING IN PROGRESS* and a single short beep is played. If the PU succeeds in programming the connected detonator, the message *PROGRAMMING OK* is displayed and 2 short beeps are heard.

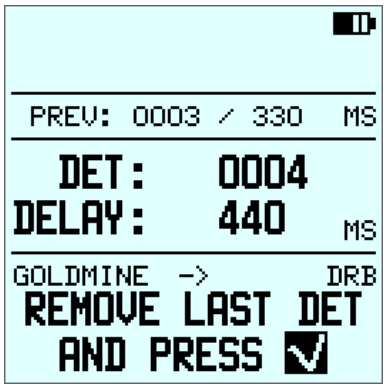


Once programming is completed, the sequence number of the next detonator to be connected to the line and to be programmed is flashing on the PU screen.

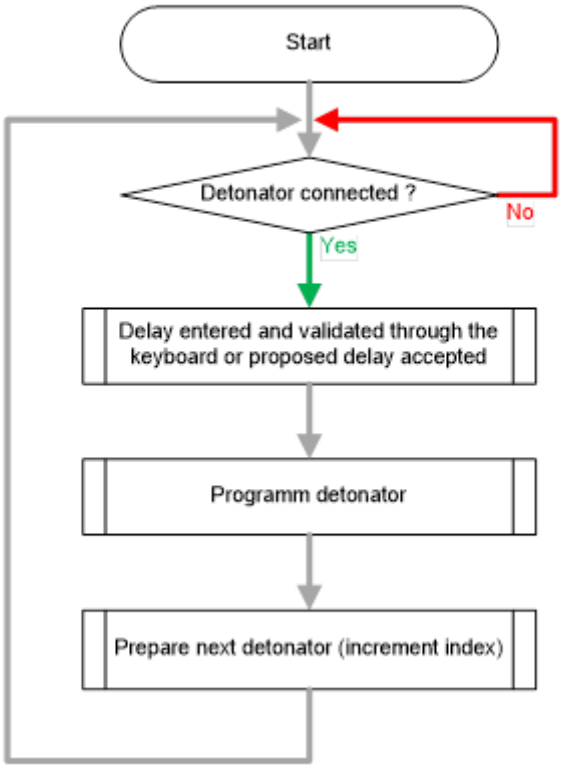
If the connected detonator was previously programmed, the PU is capable of recognizing this and will prevent it from being programmed again. A long beep will sound and a message *PREV. PROGRAMMED* will prompt the operator to modify the delay if needed: press √ to change the delay or press x to avoid modifying its delay and to return to previous screen.



If an additional detonator is connected to the line before the programming of the previous detonator is completed or if 2 (or more) detonators are connected onto the line simultaneously, the flashing message ***"REMOVE LAST DET"*** will appear on the PU screen. Remove the last 2 connected detonators to get rid of the message. The same sequence number will be flashing. Connect the detonator again, enter the delay and press √.

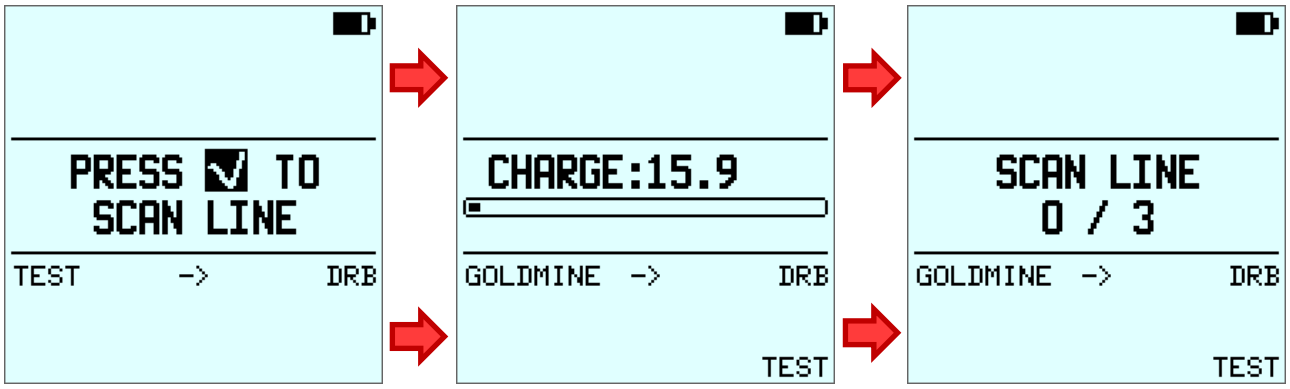


Simplified Flow Chart for On Line Connection mode



Programing in Easy On Line connection mode

From PU main screen, press √ to scan the line for detonators: the PU scans the bus line to detect any detonators connected and displays an error if any non-programmed detonator is detected.

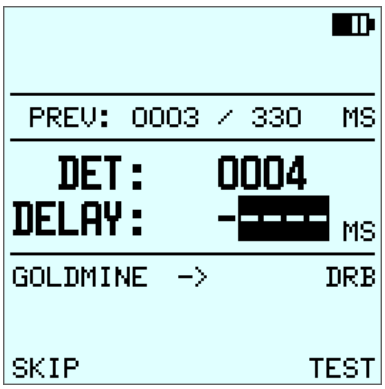


Note: If programming has to be interrupted, switch off the PU and disconnect the bus line from the PU. To restart, switch on the PU and wait until the self-test is finished to reconnect the firing line. Restart the procedure by pressing √ to scan the line. This line can be a new line or a line with previously programmed detonators. Do not connect the line after executing the line scan.

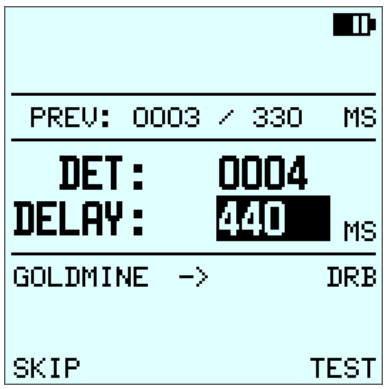
When scanning is completed, the PU programming screen is displayed.

The sequence number of the next detonator to be programmed is displayed. Depending on the delay mode either manually enter the delay using the numerical buttons and accept it using √ then connect the detonator or accept the automatically proposed delay by connecting the detonator

Manual delay



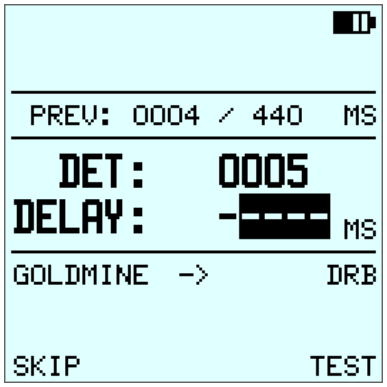
Proposed delay



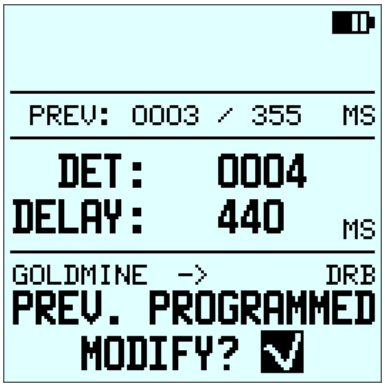
Press √ to validate the proposed or manually entered delay. The sequence number will be flashing.

Connect the detonator related to the sequence number. When a detonator is detected the sequence number stops flashing, three shorts beeps are heard and the screen displays *READING IN PROGRESS*.

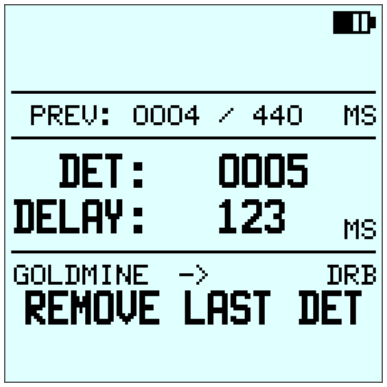
If PU successfully programs the connected detonator, the sequence number will increment allowing for programming of the next detonator



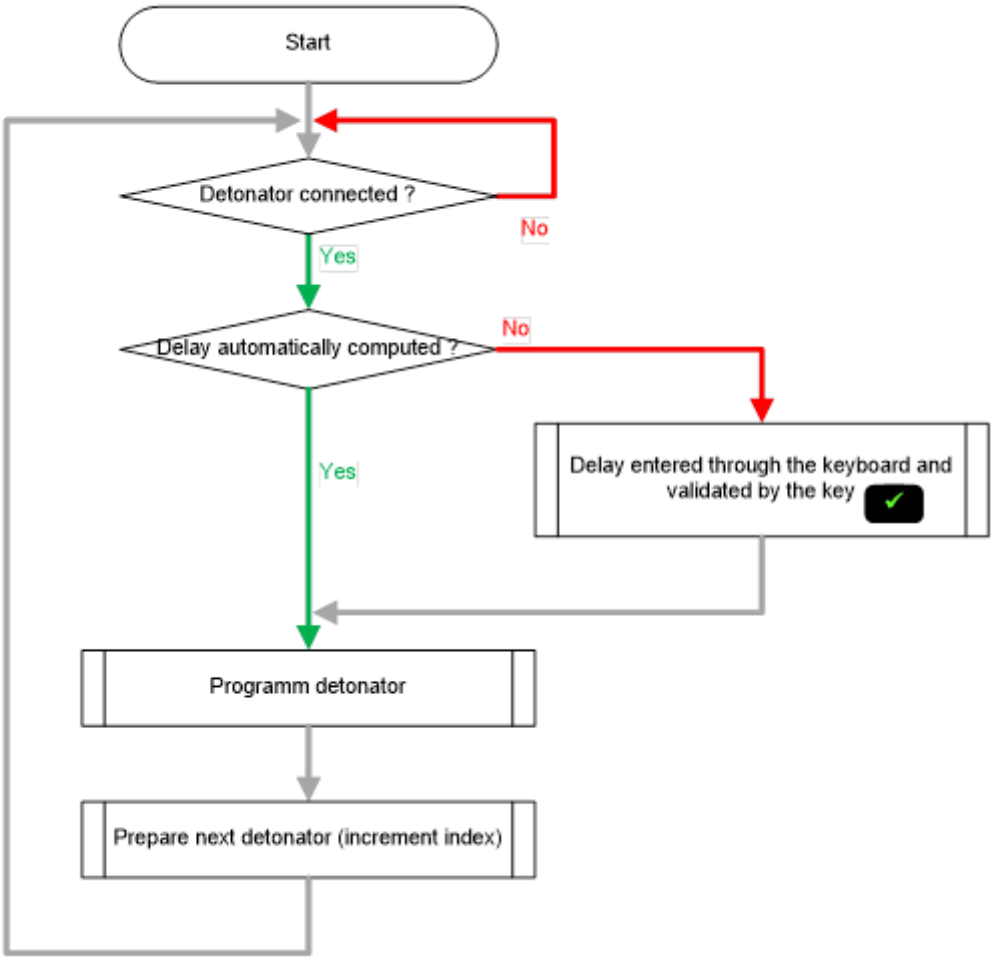
If the connected detonator has been previously programmed, the PU is capable of recognizing it and will prevent it from being programmed again. A long beep will sound and a message *PREV. PROGRAMMED* will prompt the operator to modify the delay if needed: press √ to change the delay or disconnect the detonator to avoid modifying its delay and to return to previous screen.



If an additional detonator is connected to the line before the programming of the previous detonator is completed or if 2 (or more) detonators are connected onto the line simultaneously, the flashing message ***"REMOVE LAST DET"*** will appear on the PU screen. Remove the last 2 connected detonators to get rid of the message. The same sequence number will be flashing. Connect the detonator again, enter the delay and press ✓.



Simplified Flow Chart for Easy On Line Connection mode



WARNING: THE DETONATORS SHOULD NOT BE REMOVED UNTIL THE PROGRAMMING IS COMPLETED BY THE PU (i.e. until you hear the 2 beeps, the PU requests the removal of the detonator or if the sequence number of the next detonator sequence number is displayed).

System capability when Programing in On Line and Easy In Line connection mode

The maximum amount of detonators that could be programmed in On Line and Easy On Line connection mode depends on their wire lengths. Refer to the table below:

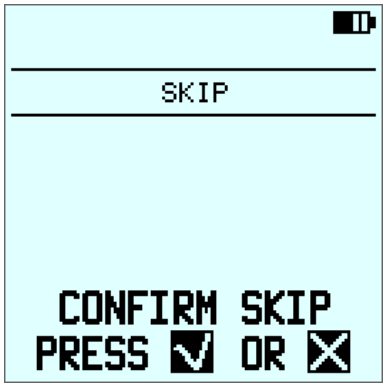
Wire length (m)	25	40	60	80	100
Maximum amount of detonators	400	400	300	240	200

Note : Leakage may decrease the system capability

SKIP function

This function is useful if the blast plan indicates a hole, but the hole is not physically present on the shot.This could be because of a drilling problem for example. From the **MAIN** operating screen, which displays the sequence number to be skipped, press to access the **FUNCTION** menu and use ⬆/⬇ to select **SKIP**.

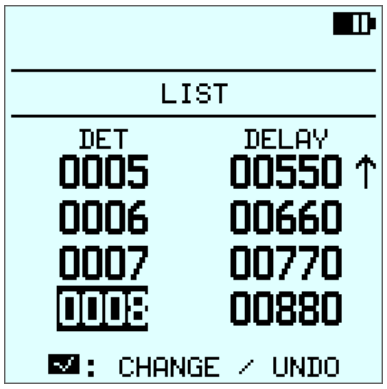
Confirm with √ to access screen below. Press √ to confirm or ✕ to cancel the **SKIP** function and to return to MAIN programming screen.



If operator has pressed the √, the PU skips the current sequence number and displays the following sequence number and detonator to be programmed.

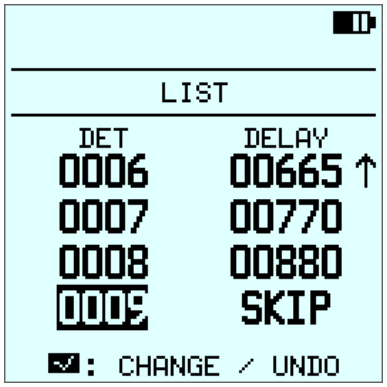
LIST function

From the **MAIN** operating screen, press F to access the **FUNCTION** menu and use ⬆/⬇ to select **LIST**. Confirm with √ to display the list of detonators programmed by the PU. The PU displays the detonators sequence numbers and their delay in ms over 4 lines.



Press ⬆/⬇ to browse through the list. Press X to return to the **MAIN** operating screen.

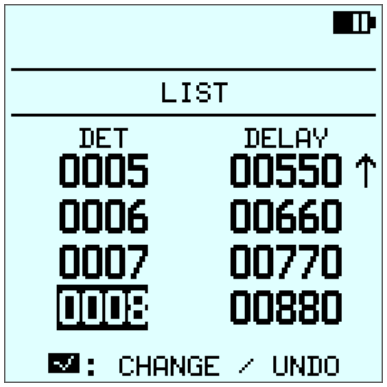
The **LIST** function lists all programmed detonators saved in the PU's memory. This list can be accessed at any time and does not require any detonator to be physically connected to the PU. ***SKIPPED*** detonators will appear with the text *SKIP* as delay value.



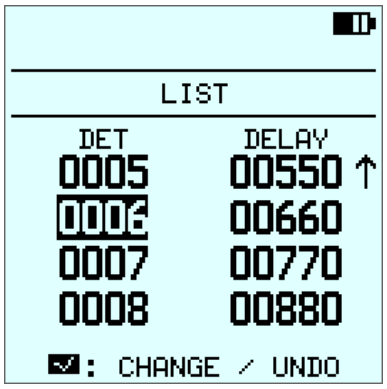
UNDO

The **UNDO** function is only active from the **LIST** menu. It is possible to go back any number of steps in the programming sequence. As such, programming can be resumed from the last correct detonator.

For instance, if the operator realises after programming detonator #0008 that the last 3 detonators have been incorrectly programmed the following steps can be taken to delete the incorrectly programmed detonators form the PU memory: Press F to access the **FUNCTION** menu and use ⬆/⬇ to select **LIST**. Confirm with √ to access screen below.



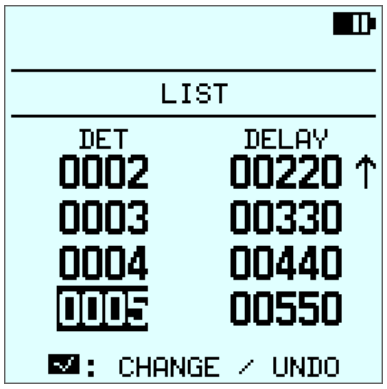
Then press ⬆/⬇ to select the detonator #0006.



Press √ to display the screen below.

Press ⬆/⬇ and √ to select the UNDO function and to display screen below which asks to confirm deleting the last 3 programmed detonators using √ or to cancel with ✕ and to return previous screen.

After pressing √ to confirm, the 3 sequence numbers #0006,#0007 and #0008 are erased from the PU's memory. The screen returns to the list, displaying the last programmed detonator (now #0005).



Press X to exit the **LIST** function and to return to the **MAIN** operating screen to resume programming #0006.

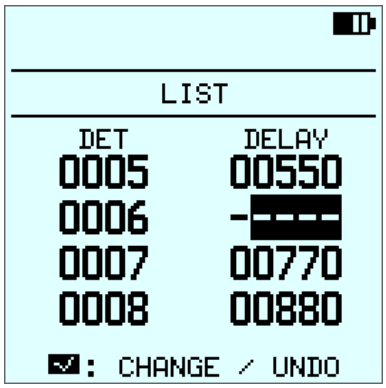
If the list is empty, the screen below is displayed. Press √ to return to the **MAIN** operating screen to resume programming #0001.

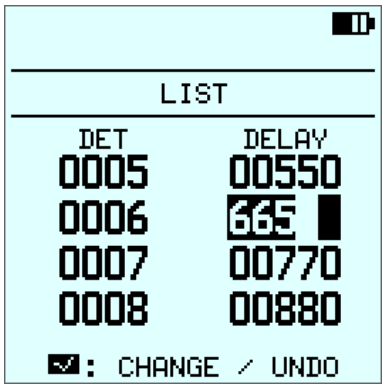
NOTE: To use the UNDO function in On Line or Easy connection mode: first disconnect all detonators intended to be removed from the PU memory from the line, and then follow the procedure described above.

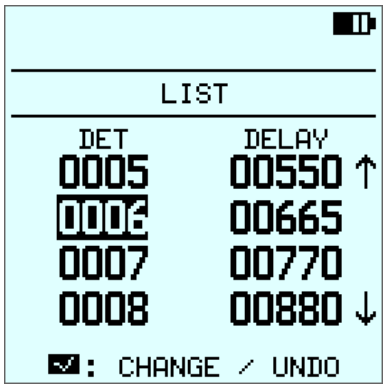
WARNING : In On Line or Easy connection mode, only attempt to reconnect and reprogram the erased detonators after they have been removed from the line for at least 1 minute. This will ensure the detonators are detected when they are reconnected to the line.

CHANGE DELAY

To reprogram a detonator without connecting it to the PU, select the sequence # in the list, press √, select **CHANGE DELAY xxxx** using ↑/↓ and press √. Enter the new delay and confirm using √.



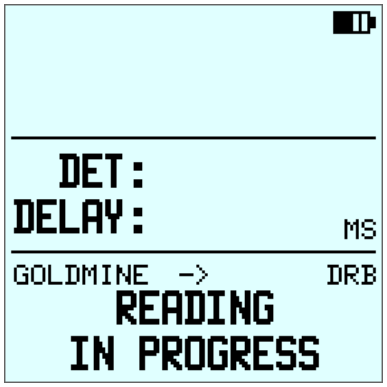




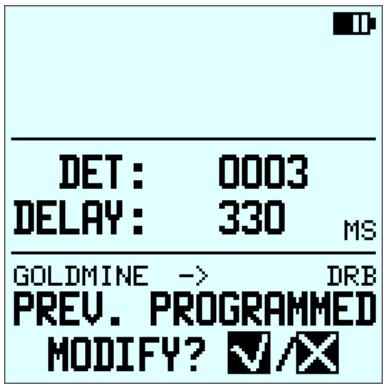
READ function

From the **MAIN** operating screen, press ! to access the **FUNCTION** menu and use ↑/↓ to select **READ**.

Connect the detonator to be read to the PU and confirm with √. The screen below is displayed while the detonator is being read.

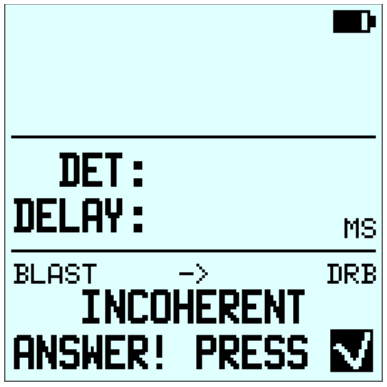


The screen below is displayed indicating the detonator's sequence # and its corresponding delay. Press ☒ to return to the **MAIN** operating screen without changing the delay, or press ☑ to change the delay. Enter the new detonator delay using the keypad and press ☑ to program it. The PU then returns to the **MAIN** operating screen.



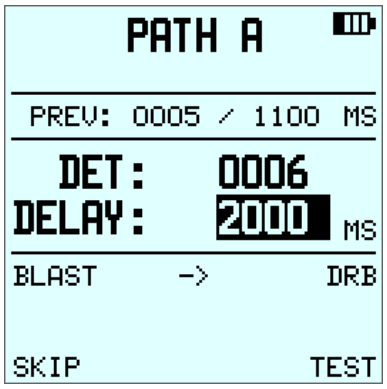
When the **READ** function is used on a detonator that has not been programmed yet by the PU, screen below is displayed showing is unique identity number. Escape the function by pressing ☑.

NOTE: For the READ function, the detonators has to be individually connected to the PU. If the READ function is used while the PU is connected to the bus line, with several detonators attached, the message "NO DIALOGUE" or "INCOHERENT ANSWER" is returned.



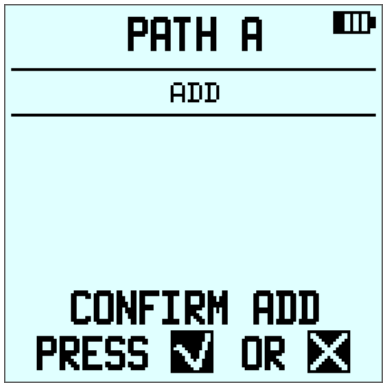
ADD function

This function is useful if an extra hole or detonator (not accounted for at the design stage) is encountered while programming in automatic mode. An added detonator has a sequence number followed by the + sign. The sequence number of the first added detonator is 0001+. In the following example, an extra detonator must be inserted between sequence numbers #0005 and #0006. From the PU's **MAIN** operating screen, after having programmed detonator #0005 and before programming detonator #0006:

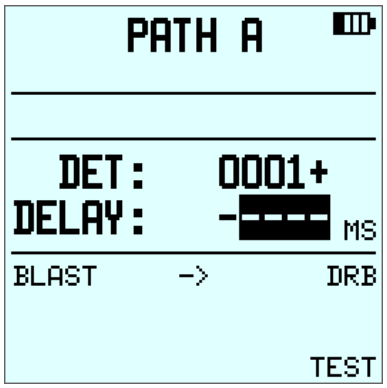


Press F to access the **FUNCTION** menu and use ▼ / ▲ to select **ADD**. Confirm with ✓ to access screen below:

Note: ADD menu is only available when the automatic mode is set



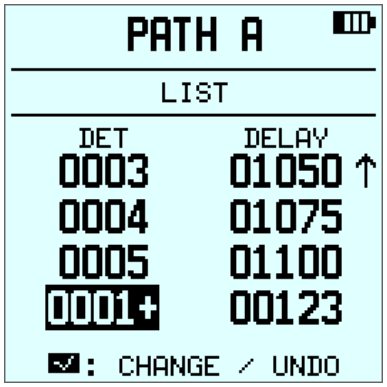
Press √ to confirm or x to cancel.



Enter the delay and connect the detonator to the PU or bus line dependant to the current connection mode.

After programing of the added detonator, the **MAIN** operating screen proposes the delay for sequence number #0006.

In the **LIST** function, ***ADDED*** detonators always appear at the end of the table, no matter their physical position and programming sequence. The symbol (+) indicates that the detonators were added during programming.



Dealing with errors during programming

Error messages

Error messages are displayed on 2 lines at the bottom of the PU's screen.

No dialogue

MESSAGE	INTERPRETATION:
NO DIALOGUE PRESS ☑	**The PU cannot communicate with the detonator**
CAUSES	**CORRECTIVE ACTIONS:**
Detonator not connected	● Check the connection.
Wires cut	• Check the wire outside the hole. • Check line • Note leakage
Defective detonator	● Do not connect, replace the detonator or re-prime the charge. **WARNING: A defective detonator cannot be initiated and must be dealt with, always adhering and following all applicable local laws, regulations, acts and procedures.**

Incoherent Answer

MESSAGE	INTERPRETATION:
INCOHERENT ANSWER! PRESS ☑	**The PU receives an answer from the detonator but cannot decode it.**
CAUSES	**CORRECTIVE ACTIONS:**
Beyond communication limit	● The network is too large to communicate with the detonator. Reduce the size of the circuit.
Defective detonator	● Disconnect the detonator from the line and replace the detonator or re-prime the charge. **WARNING: A defective detonator cannot be initiated and must be dealt with, always adhering and following all applicable local laws, regulations, acts and procedures.**

Current Leakage

MESSAGE	INTERPRETATION:
LEAKAGE XX.X mA CONTINUE ☑/☒	**Current consumption is higer than expected. Value is displayed and refreshed continuously.**
CAUSES	**CORRECTIVE ACTIONS:**
Wire insulation damaged outside hole	● Locate the defect and ensure proper wire insulation.
Wire insulation damaged inside the hole	● Disconnect the detonator from the line and replace the detonator or re-prime the charge. ● If re-priming or replacement is not possible: Try to program the detonator: • If programming is possible: measure leakage, note it on the blast plan and record the detonator sequence number.

	WARNING: Any leakage > 0.4mA on a single detonator may lead to a communication breakdown. The defective detonator should be connected to its own bus line. • Programming is impossible: treat the detonator as defective and disconnect the detonator from the line **WARNING: A defective detonator cannot be initiated and must be dealt with, always adhering and following all applicable local laws, regulations, acts and procedures.**

Delay Exceeds Limit

MESSAGE	INTERPRETATION:
OUT OF LIMITS PRESS ☑	**The entered delay is not between 0 and 14000 ms**
CAUSES	**CORRECTIVE ACTIONS:**
Value exceeds limit	● Press √ and type in a new delay between 0 and 14000 ms

Incompatible detonator

MESSAGE	INTERPRETATION:
INCOMPATIBLE DET! **Easy modes connection**	**Detonator connected is not compatible with the SP/UG system**
INCOMPATIBLE DET! PRESS ☑ **One/One or OnLine connection mode**	
CAUSES	**CORRECTIVE ACTIONS:**
Entry level detonator	● Press ☑ (In Inline or in One/One connection mode) and disconnect the detonator

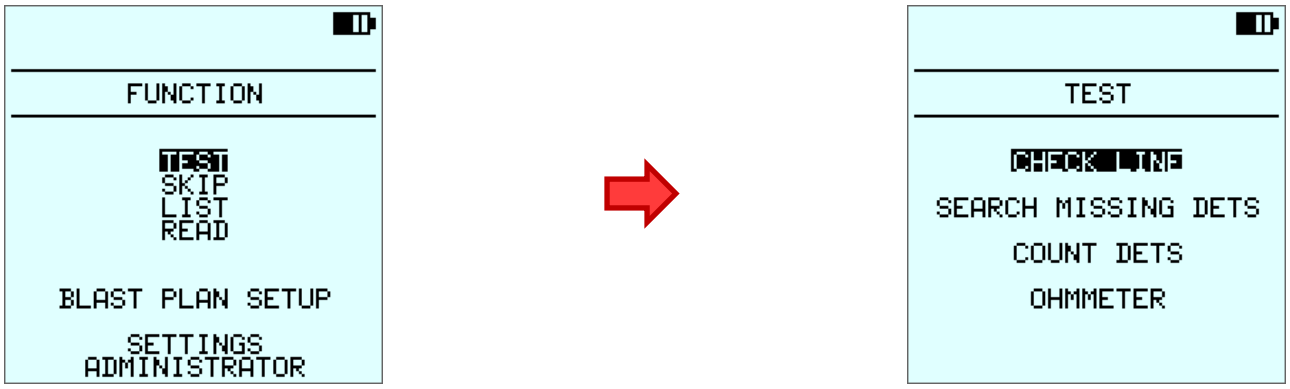
IMPORTANT: All errors encountered during programming must be indicated on the printed blast design alongside the corresponding hole where the error was encountered

Checking the bus line

When a branch of the firing circuit has been programmed and connected, this branch must be tested using the PU's test functions. The test functions allow the operator to check the integrity of the firing circuit (or the branch) and the functionality of the detonators. Before leaving the shot, the operator must test all the circuit's branches or the entire blast network.

- **CHECK LINE**: check the circuit integrity (leakage, open line, short circuit)
- **SEARCH MISS DETS**: checks for programmed dets not connected to the circuit
- **COUNT DETS**: counts the amount of detonators connected to the circuit (even if not programmed)
- **OHMMETER**: locate an anomaly detected by the **CHECK LINE**

From the **MAIN** operating screen, press F to access the **FUNCTION** menu. Select **TEST** and confirm with √ or press 1 to access the **TEST** menu and use ▲ / ▼ to scroll in the menu.

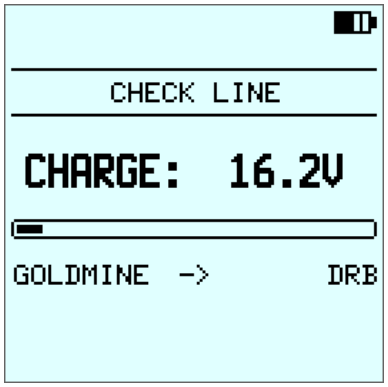


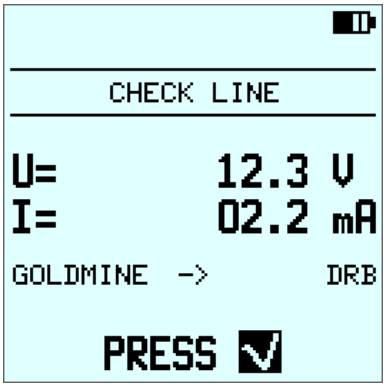
Check Line (TEST menu + 1)

Note: The CHECK LINE function can be done with any PU and no need to use the PU used to program that section of the shot.

The **CHECK LINE** function detects current leakage by measuring current consumption. The maximum value for charging voltage depends on the number of detonators on the line and is generally around 16V DC.

The PU displays the consumption current on the line in mA and the measuring voltage in Volts. The voltage is around 12V (depending on the number of detonators connected). The status bar on the second line visualises the current measurement, ranging from 0 to 20 mA.





Residual current consumption of the detonators connected on line is given in the tablebelow. Always check that measured voltage is **not zero.** Maximum consumption combined with zero voltage indicates a short-circuit (00.0V and 20.0mA).

Number of dets	Current consumption (mA)
50	0,2
100	0,4
150	0,6
200	0,8
250	1
300	1,2
350	1,4
400	1,6
450	1,8
500	2
625	2,5
750	3
875	3,5
1000	4

IMPORTANT: The CHECK LINE function's maximum displayed current value is 20.0 mA.

IMPORTANT: The CHECK LINE function can remain operational while detonators are being connected. Current leakage will be detected immediately.

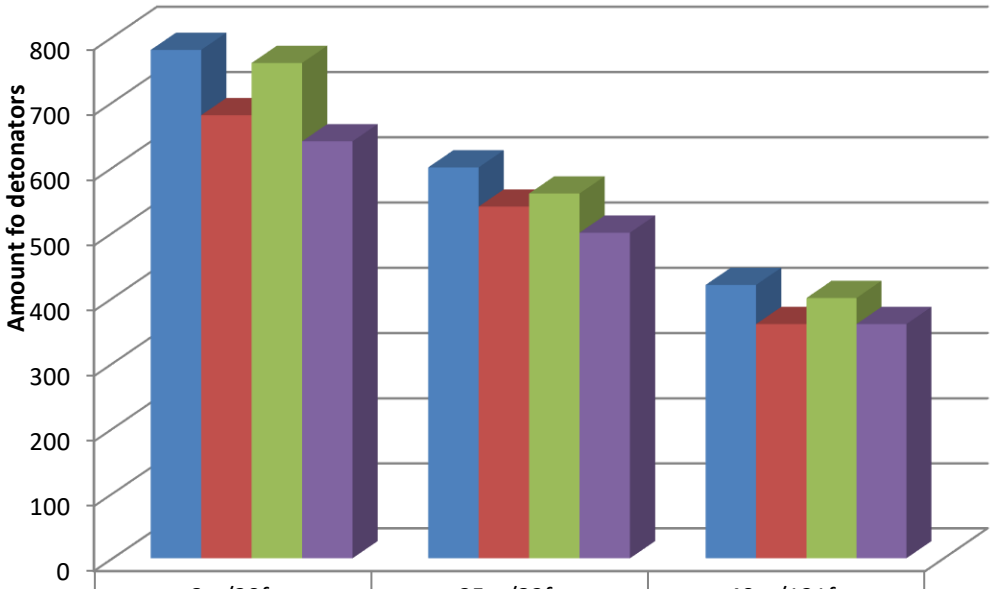
WARNING: A line consuming less than 0.5mA is considered to be free of leakage, no matter how many detonators are connected.

WARNING: Disconnect the line immediately if a short-circuit is detected in order to avoid PU battery depletion. To save PU battery power, it is recommended to use another PU to solve a serious leakage problem.

Search Miss Dets (TEST menu +2)

Note: The SEARCH MISS DETS function must be done with the PU used to program that section of the shot.

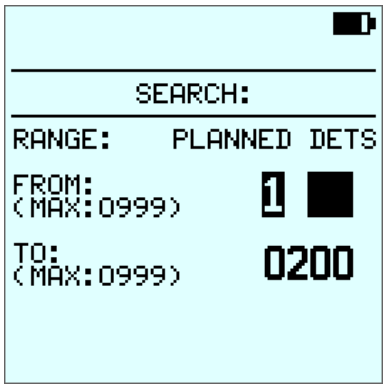
The **SEARCH MISS** function lists detonators programmed with the PU, which are not (properly) connected to the bus line. The PU can check a maximum range of 200 detonators at a time. The following table indicates the maximum amount of detonators that can be tested when connected to a bus line.



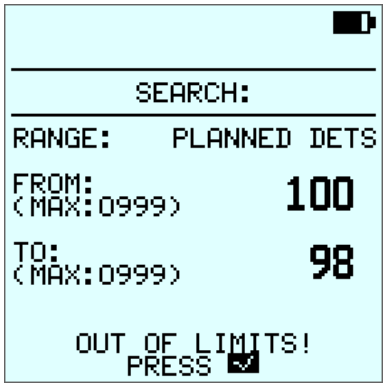
	6m/20ft	25m/82ft	40m/131ft
500m bus line - No leakage	780	600	420
500m bus line - 5mA leakage	680	540	360
1000m bus line - No leakage	760	560	400
1000m bus line - 5mA leakage	640	500	360

If less than 200 detonators are programmed, the PU proposes a range corresponding to the quantity programmed. If more than 200 detonators are programmed, a range of a maximum of 200 detonators has to be chosen to run the test.

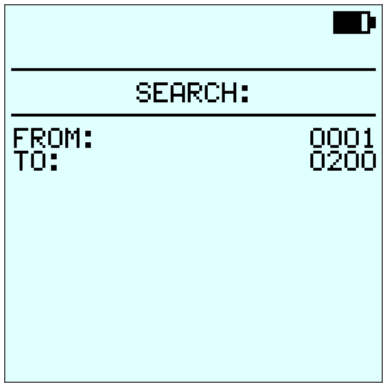
To change the range start and stop value, select the value you want to change (From or To) by pressing ↑/↓ and use the numerical buttons to enter the value.



After confirming the range by pressing √, if values are not in the allowed range, a specific error message is displayed:

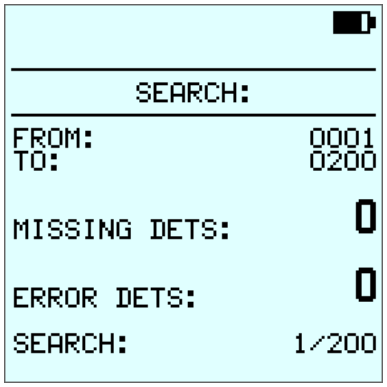


If values are in the authorized range, the test begins by testing for an open line:

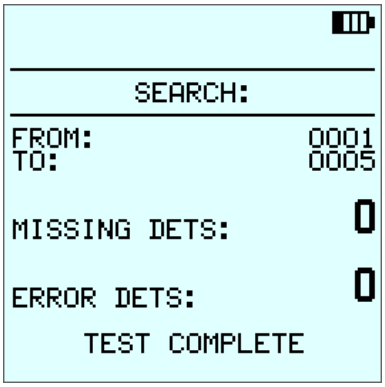


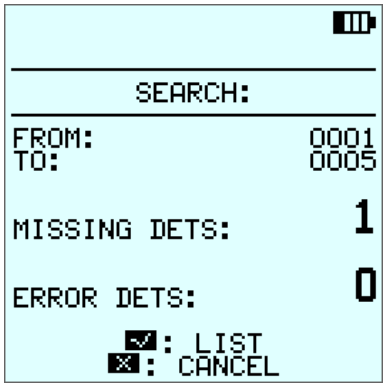
If line is open, a specific error message is displayed after some seconds:

If line is not open, the line is charged and searching begins:

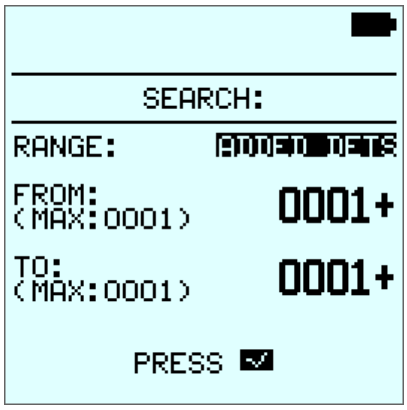


After all programmed detonators has been searched for and the test is complete, the PU displays a summary of **SEARCH MISS** test.





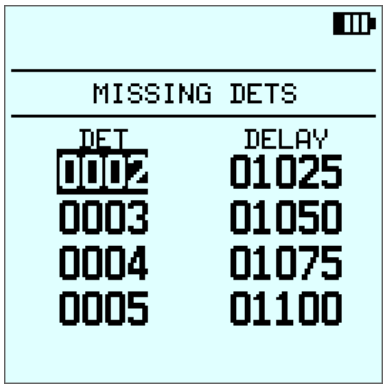
Any detonators added to the programming – usually in AUTO mode - are checked by selecting the Range option and scrolling across to select Added Dets



The procedure is then identical to the SEARCH MISS tests for the Planned Dets

If no missing or error detonator has been detected, press √ to exit and return to the **MAIN** operating screen.

If missing detonators or error detonators are detected, press √ to display the list of these detonators or x to exit.



Use the ⬆ and ⬇ arrow buttons to scroll up and down the list or press x to exit.

NOTE: The PU shows the sequence number and corresponding delay of the missing detonator. It is necessary to keep track of the programming sequence in order to physically locate missing detonators or error detonators.

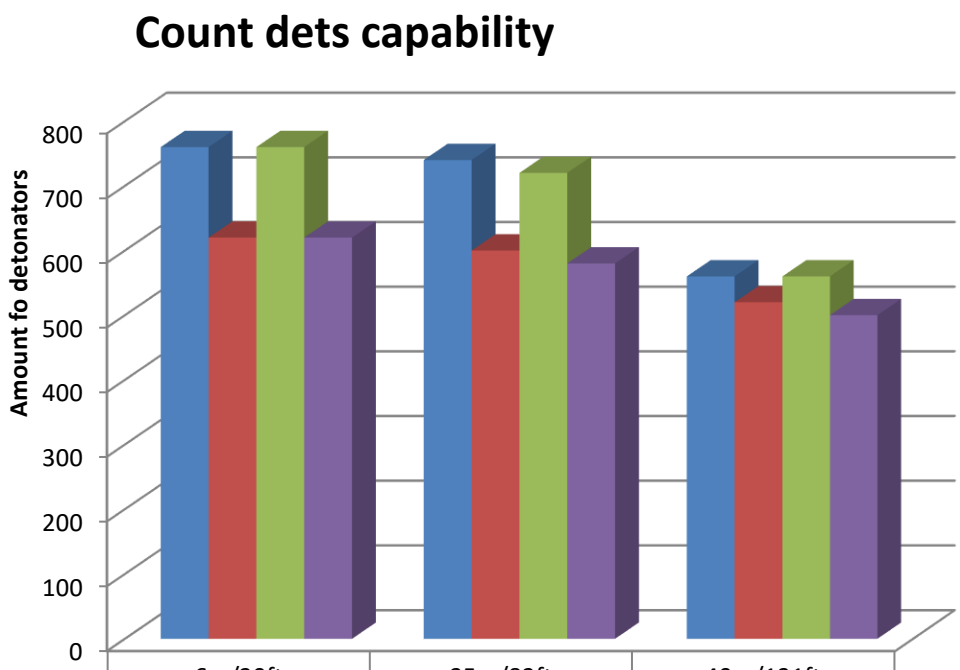
Sequence number that have been skipped within the search range (refer to the SKIP function ***chapter) won't be reported as 'missing'***

Count Dets (TEST menu +3)

Note: The COUNT DETS function can be done with any PU and no need to use the PU used to program that section of the shot.

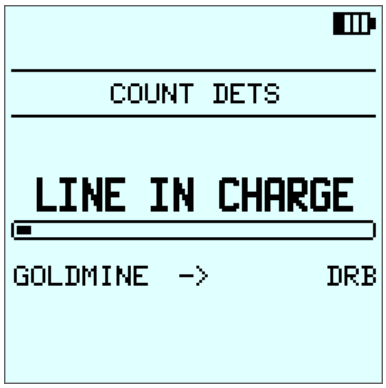
The **COUNT DETS** function counts how many detonators are connected to the bus line connected to the PU.

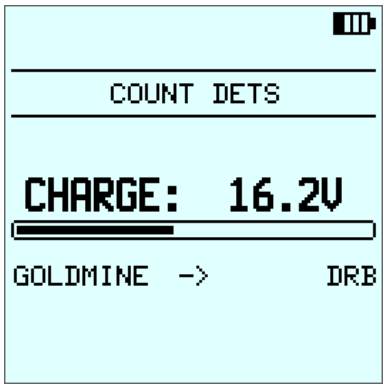
The following table indicates the maximum amount of detonators that can be tested for connected to a a bus line, connected to a PU during the Count Dets test.



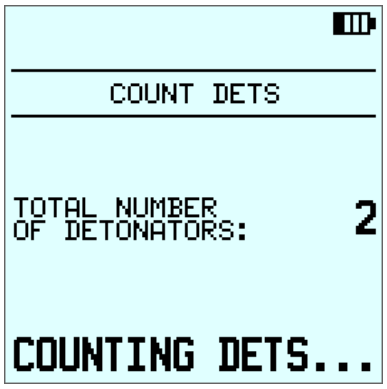
	6m/20ft	25m/82ft	40m/131ft
500m bus line - No leakage	760	740	560
500m bus line - 5mA leakage	620	600	520
1000m bus line - No leakage	760	720	560
1000m bus line - 5mA leakage	620	580	500

After starting the **COUNT DETS** procedure, the line is charged.



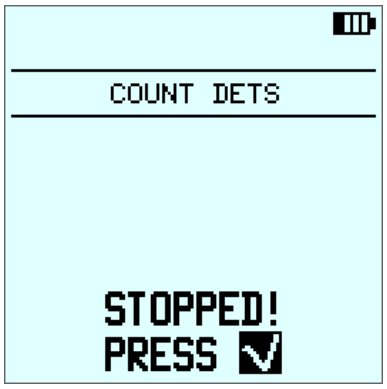


Then, the message ***COUNTING DETS***… flashes on the last line. The number of detonators detected is displayed on the screen as the search progresses. The Number displayed is not the detonator sequence number, but rather actual amount of detonators detected.



At the end of the test, the PU displays the number of detonators detected. The number of detonators detected must correspond to the number of detonators programmed. Exit to the **MAIN** operating window by pressing √.

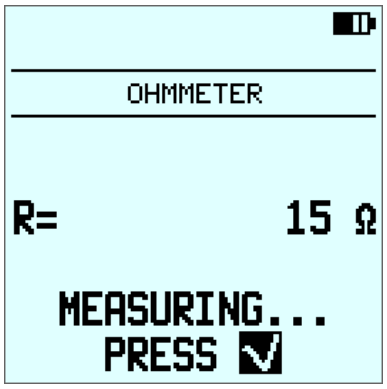
The **COUNT DETS** test can be stopped by pressing ×, and the function is then exited by acknowledging the interruption message by pressing √.



IMPORTANT: The number of detonators that can be detected by the COUNT DETS function depends on the length of the detonator wires, refer to the table above.

Ohmmeter (Test +4)

This function measures the resistance on a line and the maximum measurable value is 999Ω. This function assists in finding the approximate location of a short-circuit.



Example: from screen above (15Ω) for an M35 bus line (13 Ω per 100 m / 13 Ω per 328 ft):

It can be assumed that a short circuit is located approximately (15/13) x 100 m = 115 m or (15/13) x 328 ft = 378 ft from the measuring point.

IMPORTANT: All tests results and errors must be written on the design blast plan print out.

Errors during Bus Line Check phase

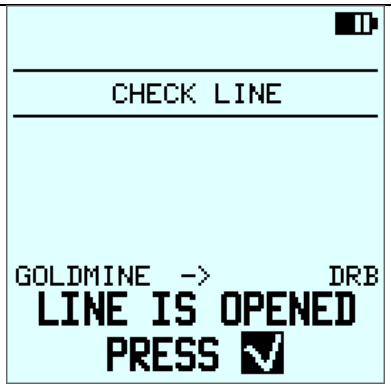
First remarks

IMPORTANT: The CHECK LINE function becomes saturated at 20mA. If 20mA is displayed, a leakage of at least 19mA is present and may indicate the presence of a short-circuit (if voltage = 00.0V).

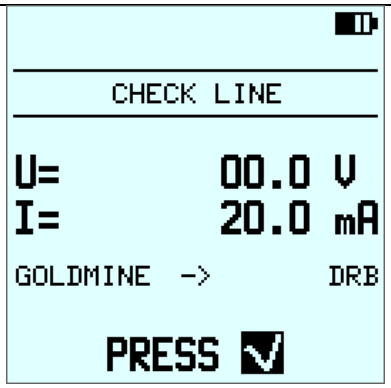
WARNING: In this case, disconnect the PU quickly in order to save battery power and is possible use a PU not used during programming.

Messages or measurements indicating errors or circuit malfunctioning during the circuit checking phase are displayed on the PU screen

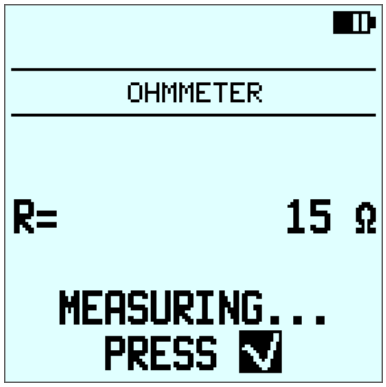
Open circuit

MEASUREMENT/MESSAGE	INTERPRETATION
	Using the **CHECK LINE** function, an **open line** is indicated by a message "Line is opened" displayed in the bottom of the screen

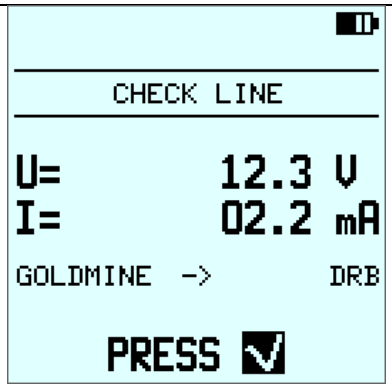
Short circuits

MEASUREMENT/MESSAGE	INTERPRETATION
	Using the **CHECK LINE** function, a **short circuit** is indicated by the combination of maximum current consumption and zero or very low voltage.

To locate a short-circuit use the **OHMMETER** function

MEASUREMENT/MESSAGE	CORRECTIVE ACTIONS:
	1. Use the **OHMMETER** function to locate the approximate position of a short-circuit. 2. Search around the approximate position for any possible cause of short-circuit : • Defective connection. • Damaged detonator wires. • Damaged bus line. • Line ends not separated and/or badly insulated.

Current leakage

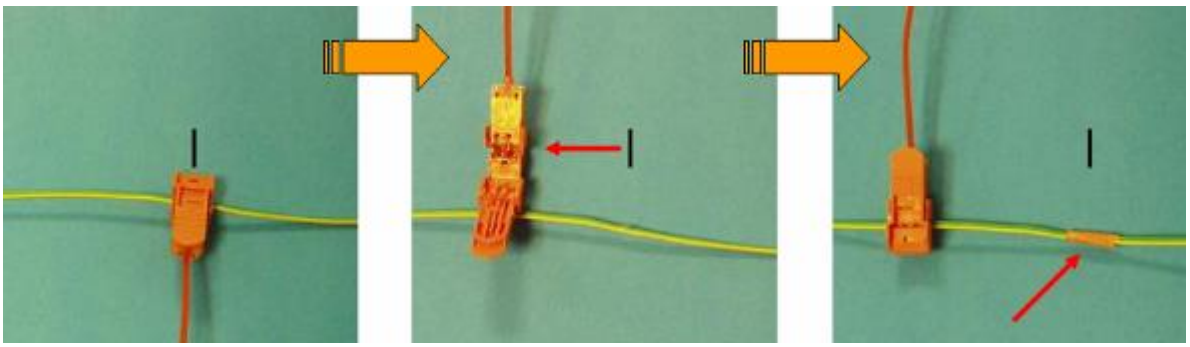
MEASUREMENT/MESSAGE	INTERPRETATION:
	A current leakage is indicated by a current draw and a non-zero voltage.

CORRECTIVE ACTIONS

1. Isolate leakage by halving and testing the circuit until the problem is located.

   Note: if the PU is connected to the bus line in **LINE TEST** mode while each detonator is connected, these problems are significantly limited

2. If necessary, disconnect detonators causing leakages. Reconnect them, reversing the polarity of the wire because leakage could result from two close dets having one of their wire damaged



Invert the position of the connector while keeping the bus line in the same position, and reconnect a few cm further

Use adhesive tape to insulate the bus line where the connector was previously positioned

3. Isolate problematic detonators on a special bus line and hook them up to the circuit last

4. If a part of a bus line has a very high leakage, do not connect it, but locate the concerned detonators

WARNING: These detonators may not be initiated and should be dealt with in accordance with the applicable rules.

The causes of current leakage are the same as those responsible for short-circuits :

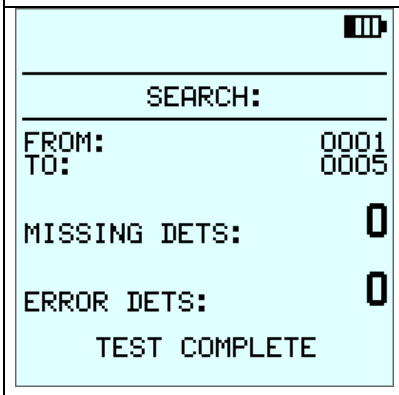
- Defective connection
- Damaged detonator wires
- Damaged bus line
- Line ends not separated and/or badly insulated

WARNING: 1- All leakage must be located and reduced to the lowest possible level. Leakage on any one line must be below 5mA.

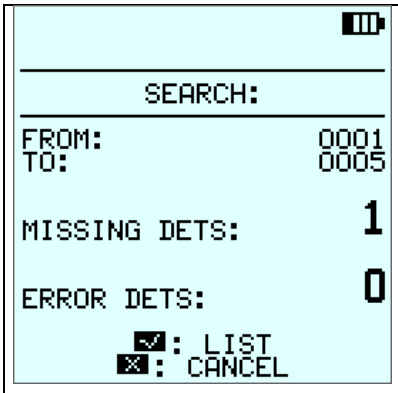
2- The level of leakage on the entire circuit must be less than 15 mA.

3- If there is a significant current leakage, this can lead to communication problems with the equipment.

Dealing with errors during search miss

MESSAGE	INTERPRETATION:
	All detonators have been correctly connected. No error message is displayed.
CORRECTIVE ACTION:	
NONE, the circuit is ready for checking, and for the firing procedure.	

MESSAGE	INTERPRETATION:

	A programmed detonator is not connected (properly) to the bus line.
CAUSES	**CORRECTIVE ACTIONS:**
1- Improper connection	● Identify missing detonator by pressing ✓ and check its connection to the bus line

Dealing with error during the use of the PU

Low Battery

MESSAGE	INTERPRETATION:
LOW BATTERY **SHUTDOWN IMMINENT**	**The PU battery is worn**
CAUSES	**CORRECTIVE ACTIONS:**
Insufficient charge	● Recharge the PU OR ● Use PU to PU transfer to change PUs (refer to the related chapter) Comments: Note: With a low battery indication the PU can program an additional 100 detonators if there is no current leakage In order to save battery, carry out tests with a second PU. **WARNING: If the PU turns itself off whilst programming and PU to PU transfer was done:** **Check the last detonator programmed with the READ function** **Confirm that it has been programmed with the LIST/1 BLAST PLAN function.** **Resume programming**

System error

MESSAGE	INTERPRETATION:
SYSTEM ERROR	This specific screen is displayed to give details on the context of an unexpected system error: • Source of the error. • Source code file. • Line in the source code file • Description of the error (up to 4 lines)
CAUSES	**CORRECTIVE ACTIONS:**
system error	Switch off and contact your supplier

NOTE: Always record, or photograph error messages seen on screens and pass on to Enaex personnel. This enables accurate and timely troubleshooting.

RFID Tag is corrupted

MESSAGE	INTERPRETATION:
RFID TAG ANALYSIS **RFID TAG IS CORRUPTED**	The PU has detected a discrepancy between programmed detonator data and the checksum. PU memory integrity is not guaranteed anymore.
CAUSES	**CORRECTIVE ACTIONS:**
System error	Press √ button Wait for the end of the process Press √ button to proceed with tag recovery Wait for the end of the process ….Wait for the end of the process Depending on the issue with the RFID tag, this process will recover a part (or all) the programmed detonator data.

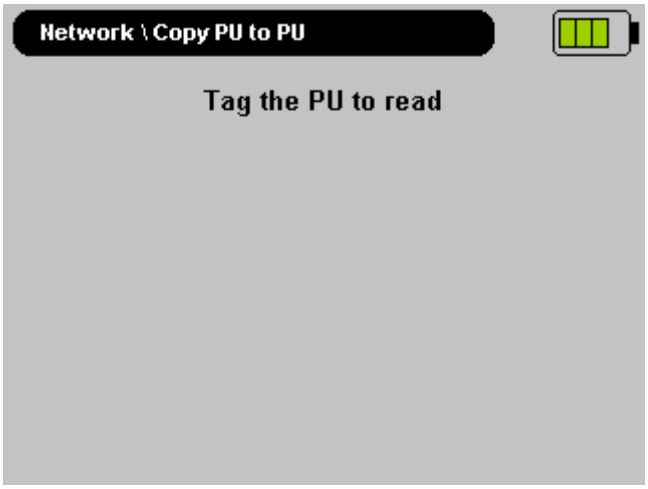
NOTE: Always record, or photograph error messages seen on screens and pass on to Enaex personnel. This enables accurate and timely troubleshooting.

PU to PU transfer

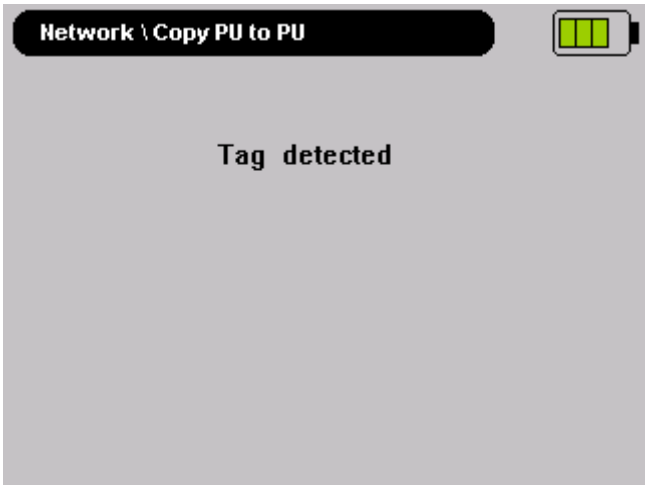
In the event of a PU failure (e.g. battery problems), the data contained in a PU can be recovered by the DRB2 and transferred to another PU. The function is accessible through the **NETWORK** menu.

*Note: It is assumed that "**Erreur ! Source du renvoi introuvable.**" has been read before reading this chapter*

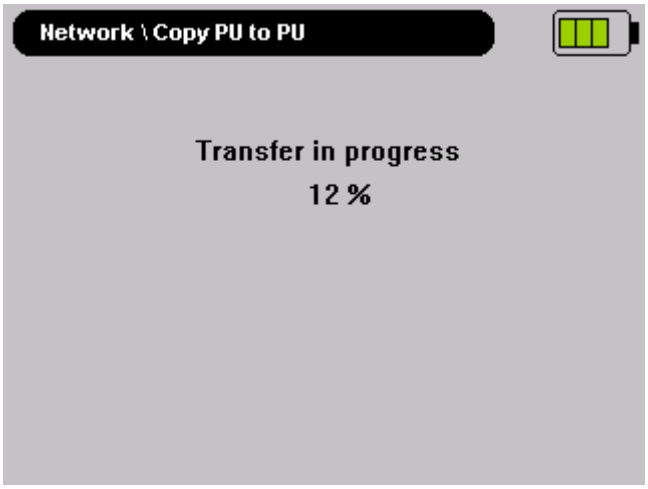
In the **MAIN** menu of the DRB2, use ⬆/⬇ on the left hand side of the DRB2 to select **NETWORK** and press √. In the **NETWORK** menu screen, use ⬆/⬇ on the left hand side of the DRB2 to select **Copy Pu to PU** and press √.



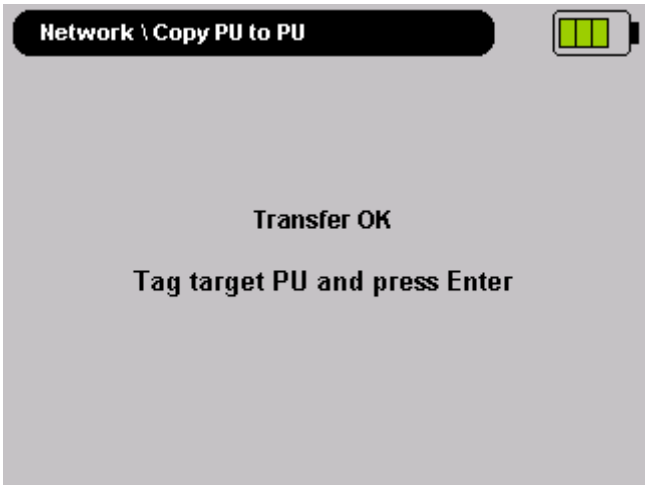
Tag the PU of which the data has to be recovered (source PU) with the DRB2.



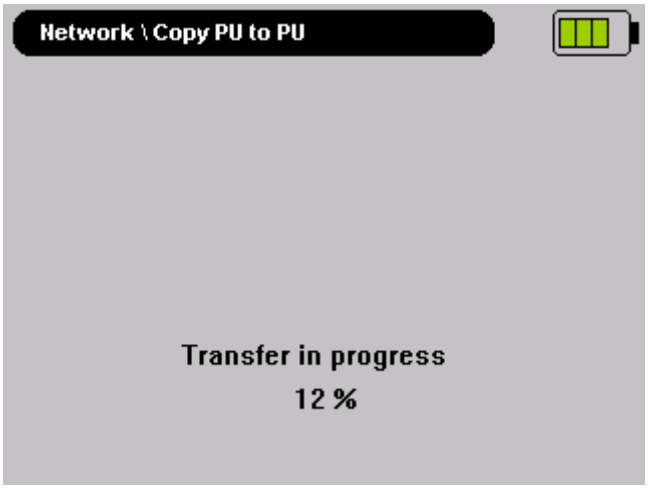
The transfer of the blast plan of the source PU to the DRB2 continues as long as the percentage increases and the message "***Transfer in progress….***" is displayed.



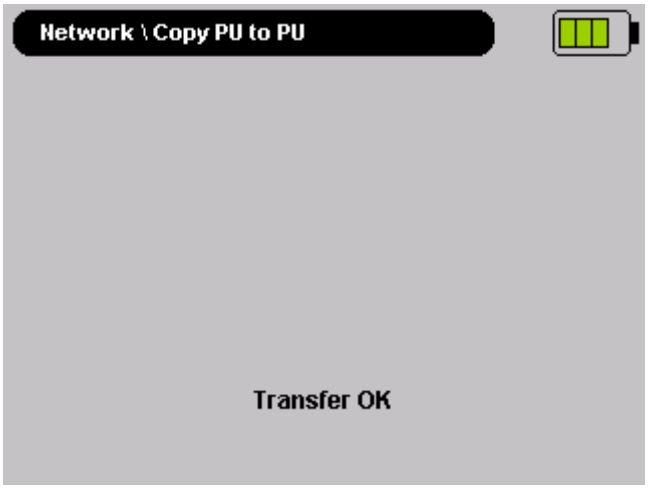
The next screen below displays the message "***Transfer OK***" and prompts the users to tag the PU to which the data will be copied (target PU), with the DRB2.



The transfer of the blast plan from the DRB2 to the target PU continues as long the percentage value increases and the message "***Transfer in progress…..***" is displayed.



When the message ***"Transfer OK"*** is displayed for the second transfer, the process is completed. The blast plan has been transferred from the source PU to a target PU.



Maintenance

Warning

For user in USA:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device must be professionally installed

This portable equipment with it's antenna complies with FCC's radiation exposure limits set forth for an uncontrolled environment. To maintain compliance, follow the instructions below :

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Avoid direct contact to the antenna, or keep contact to a minimum while using this equipment.

For users in Canada:

This portable equipment with it's antenna complies with RSS102's radiation exposure limits set forth for an uncontrolled environment. To maintain compliance, follow the instructions below :

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Avoid direct contact to the antenna, or keep contact to a minimum while using this equipment.

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.

2. This device must accept any interference, including interference that may cause undesired operation of the device.

Cet équipement portable avec ses antennes est conforme aux limites d'expositions de la CNR102 applicables pour un environnement non contrôlé. Pour maintenir la conformité suivez les instructions ci-dessous:

Cet émetteur ne doit pas être co-localisé ou opérer en conjonction avec toute autre antenne ou émetteur.

Évitez tout contact direct avec l'antenne ou gardez le contact au minimum pendant l'utilisation de cet équipement.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage.

2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Temperature

Operating temperature:	-20°C to +50°C / -4°F to +122°F
Battery charging:	0°C to +40°C / -32°F to +104°F
Storage temperature:	-40°C to +70°C / -40°F to +158°F

Battery management

Only use the "spider" charger, or the car adapter provided to charge the batteries of the equipment. Recharge all equipment at least once a month. The user must not remove the batteries.

Battery Information

Type: MP 176065 xlr Prismatic Lithium-ion rechargeable battery pack – 1 Cell 3.65V 6,8Ah
Reference: N° 176065 xlr, INP20/60/65
Manufacturer: SAFT SA
Nominal voltage: 3.65 Volts
Nominal capacity: 6.8 Ah
Nominal energy: 24.8 Wh

Spider adapter:

REFERENCE: 60284

For indoor use only

Notes on environmental conditions to be respected during charge:

> Altitude up to 2000 m (6560 ft)

> Ambient temperature between 0 °C and 40 °C (14 °F and 104°F)

> Maximum relative humidity 80 % for temperatures up to 31 °C (88°F) decreasing linearly to 50 % relative humidity at 40 °C (104°F)

> Mains supply voltage fluctuations not exceeding ±10 % of the nominal voltage.

NOTE : For charging the battery at an altitude between 2000 m and 4000 m (6560 ft and 13120 ft), your Enaex representative can recommend a suitable charger that conforms to the «…. IEC 62368-1 (2nd Ed.) : 2014 standard

Note :

- ***Do not store the battery fully charged at high temperature (over 25/30°C) this will reduce the battery life.***
- ***Ideal storage temperature is between 5 and 15°C (New batteries, or equipment stored)***
- ***Unutilized equipment should not be stored fully charged for more than one month, but between 20 and 60% of charge.***
- ***Avoid charging at high temperature (room temperature over 30/35°C) as this is shortening battery life, and may stop the charge cycle before fully charging, resulting in reduced capacity.***
- ***Charging below 0°C is not possible (the hardware does not allow the charging, but the software show the animation)***
- ***Charge should be checked every 6 months, for unutilized equipment.***
- ***Capacity is reduced when operated below 0°C***
- ***Discharge at temperature over 60°C is difficult to monitor. (This is the case when equipment is under direct sunlight) The capacity bargraph may not reflect real capacity.***

WARNING:

Charging mode (plugged in to mains supply) is prohibited in outdoor use; charging mode (plugged in to mains supply) is for indoor use ONLY.

Equipment must be connected to a source limited in power (PS2 < 100W) and conform to IEC60950-1 or IEC62368-1 safety standard

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The level of safety of this equipment is only guaranteed for usage that conforms to the intended use, as described in this manual.

Equipment must be connected to electrical installations respecting the regulations of the country in which they are used. They must include protections against voltage and current surge, and earth defects

Risk of explosion is high if the battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.

Maintenance of the equipment can only be performed by trained and authorised personnel.

Equipment must be connected to a source limited in power and conform to EN60950-1.

The power cable plug is used as a circuit cutter. The power plug must be close to the equipment. The power plug and the jack plug must be easily accessible at all times during charging

Do not install the equipment close to a heat source or close to a humidity source.

For your own safety, it is imperative that before any maintenance operation, the equipment is switched off.

The user of the equipment must not access the inside of the units. Contact your Enaex representative in case of issues or suspected malfunctions.

While the equipment is being recharged, it cannot be used (except during datalogger downloading). This precaution prevents the equipment from functioning while it is connected to a power source.

Power consumption and battery autonomy

The autonomy of the PU is around 7 hours (screen and keyboard light on), and the PU continuously displays a battery level indicator on the upper right-hand side of the display. The charge level is indicated according to the following rule:

From 0 to 18%:

From 19 to 37%:

From 38 to 68%:

From 69 to 88%:

From 89 to 100%:

When the battery of the PU is worn the following screen is displayed at power ON and the battery icon is crossed out.

Recharging the battery

Charging duration from a flat battery is around 4 hours, and up to four units can be charged at the same time using the spider charger. Only use the "spider" charger, or the car adapter provided for recharging the batteries of the equipment. Recharge all equipment at least once a month.

Batteries of the PU are recharged by plugging one of the spider charger cables into the charging point of the PU. The charging point can be accessed by removing the dustproof plate at the bottom of the PU (simply pull on the two fast opening terminals).

When charging, the sequence of battery charge indicator indicates the battery charge level according to the following rule:

From 0 to 24%:	⇨⇨⇨…
From 25 to 49%:	⇨⇨⇨⇨…
From 50 to 74%:	⇨⇨⇨⇨⇨…
From 75 to 99%:	⇨⇨⇨⇨⇨⇨…
100%:	displayed at the end of charge

Moreover, during charge:

- backlighting of the screen is ON

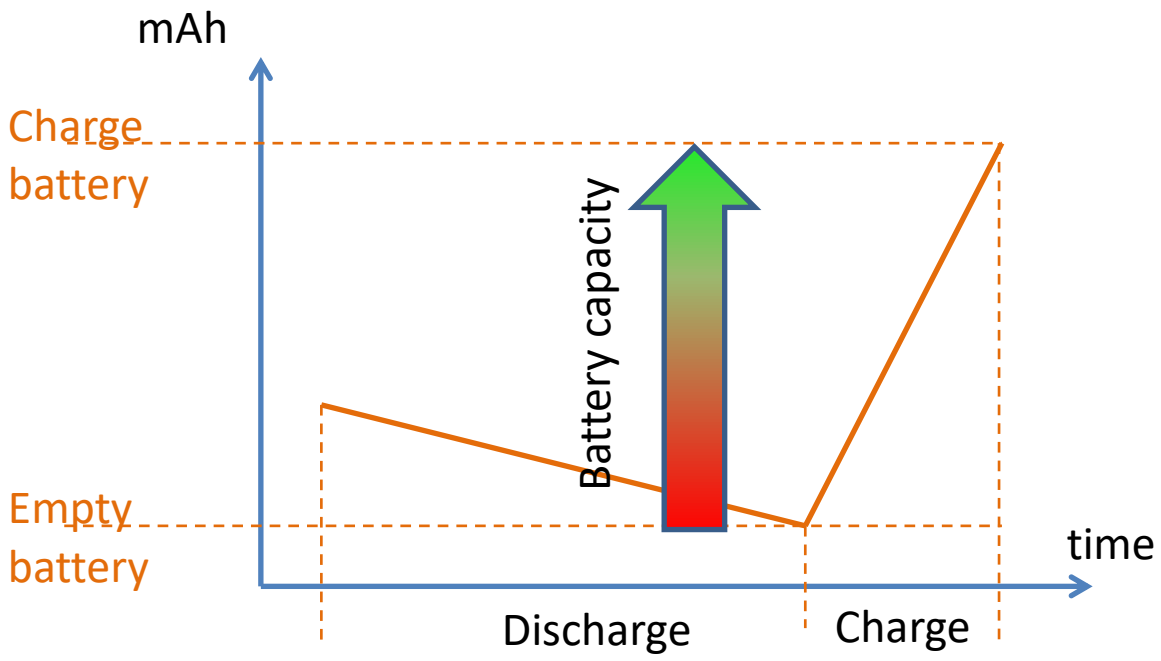
- backlighting of keypad is OFF and keypad is inactive

The message ***"Battery charged"*** is displayed when the battery is fully charged.

Battery calibration

Principle

Battery calibration is a process than computes the real capacity of the equipement's battery. During this process, the equipement drains its own battery. Once it is empty, it starts a charge cycles and measure the quantity of energy that is stored in the battery. At the end of the process, equipement computes the capacity of the battery in mAh.


mAh
Charge battery
Empty battery
Battery capacity
time
Discharge
Charge

Advantages:

- Computed battery capacity takes into account battery aging and equipement battery indicators reliability is improved
- Equipement will prompt a warning as soon as the battery is depleted (computed battery capacity too low)

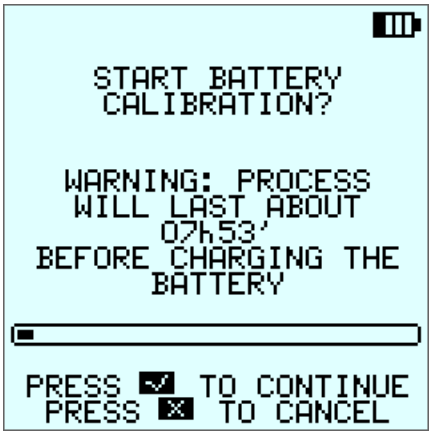
Calibration process is started every 30 charges of over 30 mins (refer to the

WARNING: Battery calibration includes a battery discharging phase that can take a very long time. If the equipment proposes a calibration it is recommended to begin this calibration with depleted battery to minimize the discharge time. If you launch a battery calibration with a fully charged battery the calibration could last more than 12 hours for DRB2 and DBD and 24 hours for the PU.

PU battery calibration

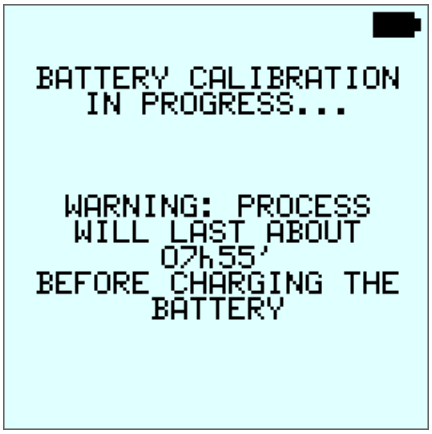
The PU software checks the number of charges. If this number is higher than 30 the PU propose the user to calibrate the battery indicator.

Calibration is done by completely discharging the battery and charging the battery again. While the PU discharging is very long (can last more than 24 hours) we advise the user to launch the battery calibration when the PU battery charge is less than 50%.



If the button is pressed or after 5 minutes, the PU proceeds automatically with standard charging.

Once the button is pressed, the device launches the calibration procedure.



The discharge of the battery is launched:

Discharging phase: ⇨⇨⇨⇨⇨⇨…

When battery reaches the minimum charge level, the calibration begins to charge the battery to identify the real battery capacity. This capacity is then used to display the battery gauge.

Charging phase: ⇨⇨⇨⇨⇨⇨…

Battery status indicator – Used battery

After calibration, the battery is calibrated and the equipment displays a more accurate status of the battery. The indicator is now proportional to the real capacity of the battery (not to the theoretical value of a brand new battery).

When a battery should be replaced (after 2 consecutive calibration that recorded a used battery) the battery indicator changes from to .

Cleaning

For a longer use, keep the equipment as clean as possible.

- Clean with a ***SOFT*** cloth and cleaning product
- Do not use corrosive substances
- Do not spill liquids on the equipment

Annual inspection

The devices of the blasting system must undergo annual maintenance by the manufacturer or an agency approved by the manufacturer.

IMPORTANT: Like any other blasting machine, DRB2s, DBDs and PUs, must be checked annually by Enaex or an Enaex certified agent, in accordance with the manufacturer's specifications and applicable regulations. Contact Enaex for this service.

WARNING: All work performed on the blasting equipment must be carried out by the manufacturer or a certified agent.

Consumable material or parts subject to wear and tear will be replaced according to the Enaex preventive maintenance plan. Spare parts will be provided and installed by your Enaex representative.

Auto test / Self-test

After switching on the equipment, self-tests are processed automatically. Check on the screens (PU and DRB2) and on the LED's (DBD) for the result of these self-tests. If an error occurs, and is repeated after a second attempt to re-start the equipment, return the affected equipment to the manufacturer or an agency approved by the manufacturer.

Software revisions

Enaex constantly develops new software to offer customers additional functions. Contact your Enaex representative for the latest software versions.

Rating and characteristics of fuses

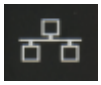
Fuses used in the equipment are NANO Slo-Blo Fuse 452/454 Series and have interruptive ratings of 50 amperes at 125 VAC/VDC.

Symbol and Tags

In addition to the symbols used on the buttons, the following symbols and tags are used on the equipment:

USB connection

Aerial plug

Ethernet connection 

RFID tag or tag reader

Earthing plug

Connection for synchronising multiple DBDs

Caution: Fire line terminals

All pieces of the DAVEYTRONIC® SP/UG Blasting System (DRB2, DBD, PU) are considered as dangerous goods, UN 3481 **Class 9,** due to the capacity of the contained Lithium-ion battery**.** In order to ship this equipment:

1. No particular packaging is required. The usual packaging protecting the equipment from damage during transport is sufficient.
2. A particular sticker, as provided by your Enaex representative has to be put on the packaging.
3. The sticker has to be completed with the correct shipment data:
   a. the shipper's name and address
   b. the consignee's name and address
   c. The total net weight of the batteries in the package. The weight of 1 battery is 0.153 kg. The weight to be indicated on the sticker is the total net battery weight calculated as 0.153 kg X Number of devices

   Example: shipment of 2 PUs and 2 DRB2s, is 4 pieces of equipment in total, 4 x 0.153 kg = 0.612 kg. The NET WEIGHT field to be filled in should be 0.612 kg.

4. Required document: the Shipper's Declaration for Dangerous Goods

Example: (https://www.iata.org/whatwedo/cargo/dgr/Documents/Shippers-Declaration-Open-Format-Non-Fillable.pdf)

Range of environmental conditions

Refer to the related technical datasheet.

Assembly, location and mounting

The PU and DRB2 are handheld units. They do not require any mounting or assembly. The DBD must be located close to the shot, at a location protected from flyrock.

The only mobile part in the equipment is the antenna that must be screwed onto the DRB2 and DBD, when configuring the WIRELESS mode. Gently screw (clockwise) the antenna on the equipment before operation, and unscrew (counter clockwise) after operation.

Connections

No cable connection between the equipment is required for the data transfer. All data transfer is done by RFID communication.

- The DBD includes an RFID tag that can be read by the PU.
- The PU includes an RFID tag that can be read by the DRB2. It also includes a RFID reader that can read the DBD RFID tag.
- The DRB2 contains a RFID reader/writer:
  - to read the PU's RFID tag
  - to writer data to PU RFID tag (Refer to the "PU to PU transfer" chapter).

Communication between the DRB2 and the DBD during the testing and firing procedure can be done by:

- Remote radio communication through RF modems

At the time of publication, all information in this manual is as accurate and up-to-date as possible. Since Enaex cannot anticipate or control the conditions under which this information and its products may be used, each operator should review the information in the specific context of its intended application. Enaex will not be responsible for damages of any nature resulting from the use or reliance upon the information. No express or implied warranties are given other than those implied mandatory by law.

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