


Division of Mines and Mineral Resources — Report 1990/02

Instructions for the use of the Remote-firing Shot Boxes Model RFB-1-TDM

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INTRODUCTION

These instructions are to be carried out in full—**ANY VARIATION COULD HAVE FATAL RESULTS.**

SET UP OF TIMERS

Turn on the power to each clock unit by turning the key-operated **CLOCK** power switch (1), located on the side of each unit, on. Before operation connect the reset box leads to the connector on each timer box marked 'RESET INPUT'. Press the reset button once; this will reset the timers to 00:00 and synchronize them. It may be found practical to reset each as close to a real hour as possible, thus enabling real time to correlate to the timers. Disconnect the reset box leads from the timer units.

EXPLOSIVE FIRING SHOT BOX

- (1) Make sure the arming circuit is disabled, i.e. the key-operated **ARM** switch (3) is depressed.
- (2) Radio through to the Recorder to determine the time to be set for the detonation.
- (3) Set the time on the box by rotating the switches (2) at the bottom of the box to the desired shot time.
- (4) Radio back to the Recorder to confirm detonation time.
- (5) Two minutes before detonation time unshort the shot cable ends and connect to the two mounting posts marked 'OUTPUT' on the side of the box.
- (6) At approximately 1 minute to detonation time, radio the Recorder and give the proceed message if it is considered safe to fire. If the proceed message is given back by the Recorder then turn the **ARM** switch key (3) to allow the switch to pop up, thus arming the detonation circuits. The shot voltage meter should show a reading above the red zone. If this does not happen then a misfire may occur. The high voltage batteries should be replaced and the previous procedure repeated.

RADIO COMMUNICATION AT THIS POINT SHOULD BE MAINTAINED AND MONITORED CLOSELY. IF RADIO COMMUNICATIONS FAIL OR IF IT IS CONSIDERED UNSAFE TO FIRE, THEN THE KEY SWITCH (3) SHOULD BE DEPRESSED AND LOCKED IMMEDIATELY TO DISENGAGE THE DETONATION CIRCUIT.

- (7) About 10 seconds before detonation a final confirmation will be given by the Shot Firer. The Shot Firer will depress the

button marked **SHOT ENABLE** (4) and hold it down. If for any reason it has become unsafe to detonate the shot, the enable button (4) should be released, the key switch (3) depressed and locked, the shot line disconnected from the unit, and the shot cable shorted. The Recorder should then be notified.

- (8) If it is safe to detonate the shot, hold the shot enable button (4) down until the seconds display passes through zero. If the shot does not go off the shot enable button (4) should be released, the key switch (3) depressed and locked, the shot line disconnected from the unit, and the shot cable shorted. The Recorder should be notified of a misfire.
- (9) After a successful detonation the shot enable button (4) should be released and the key switch (3) depressed and locked immediately after the detonation.

RECORDER TRIGGERING BOX

- (1) Connect trigger cable from the recorder timing box to the trigger input of the seismograph.
- (2) Receive message from the Shot Firer on the time of detonation.
- (3) Set the time on the box by rotating the switches (2) at the bottom of the box to the desired shot time.
- (4) Confirm detonation time.
- (5) Set up seismograph as required about 1 minute before the shot.
- (6) Switch the record enable switch (3) to on.
- (7) The final confirmation will be given by the Shot Firer approximately 10 seconds before the shot.
- (8) Wait until the seconds display passes through zero for the recording to take place.
- (9) Wait for the all clear from the Shot Firer.
- (10) If the record is not correct notify the Shot Firer who will take appropriate action.
- (11) Switch the record enable switch (3) to off.

AT THE END OF THE DAYS USE

- (1) Put the two clock modules side by side and look for any noticeable difference between the times (or changing of the time) of the two modules. If there is a noticeable difference then notify the Recorder of the change in synchronization and replace both internal 9 volt batteries.

- (2) Turn off the power to the units by turning the key-operated CLOCK power switch (1) located on the side of each unit.

TESTING OF THE DETONATOR FIRING CIRCUIT

- (1) Turn on the power to the firing unit using the key-operated switch (1) on the side of the box.
- (2) Connect a 1 ohm (5 w) or similar resistor across the output of the unit. No other connection is to be made to the output during this test.
- (3) Set a firing time approximately 1 minute ahead of the displayed time, using the thumb wheel switches (2).
- (4) Turn the ARM switch key (3) to allow it to pop up thus arming the detonation circuit. Make sure the SHOT VOLTAGE meter is indicating above the red zone; if this is not happening then the high voltage batteries need to be changed or a service technician called in.
- (5) At approximately 10 seconds to detonation press the button marked SHOT ENABLE (4) whilst watching the SHOT VOLTAGE meter.
- (6) When the clock display (seconds) passes through 00 the SHOT VOLTAGE meter should dip into the red zone momentarily; if this does not happen then a service technician should be called in. If this does occur then the detonation circuit is functioning properly.

TECHNICAL

Introduction

The synchronized shot firing boxes are designed with a high degree of time stability and accuracy over a 24 hour period. There is a three-stage safety interlock to prevent premature firing of detonators.

There are 3 modules in the system:

- (a) shot firing unit
- (b) seismic recorder trigger unit
- (c) reset (synchronization) unit

General Technical Description

The shot firing unit and the seismic recorder unit are both controlled by a specially cut crystal (with built in oscillator) running at 8.388608 MHz and manufactured by Hy-Q. This frequency is then divided down into two base frequencies;

- (i) 32 Hz, used to control the phase and backplane of the LCD display,
- (ii) 1 Hz, used as the base frequency of the modules.

Time is displayed on an LCD module; the time displayed is in minutes and seconds since the system was reset (or synchronized).

Two thumb-wheel switches are used to set the shot (and record) times; these indicate the time (in minutes) that the shot (recording) will take place compared to the time shown on the LCD (i.e. when both times are the same the shot will occur). The shot will occur at a full minute interval, for example at 26 minutes 0 seconds or 01 minutes 0 seconds. Two 4-bit comparators are used to compare the minutes display on the LCD and the minutes preset on the thumb-wheel switches.

The input to the seconds display is input to an 8 input NOR gate, which gives an output of '1' when a seconds display of 00 is given.

The first level of safety is now reached. The output of this NOR gate is an input to a logical AND gate whose other input is from the SHOT ENABLE switch. Two conditions must apply for the shot signal to pass to the next level in the system;

- (1) the seconds display must indicate 00, and
- (2) The SHOT ENABLE switch must be depressed.

Only then can the signal pass to the next stage.

When and only when the LCD display matches the thumb wheel settings, the seconds show 00, and the shot enable switch is depressed, the shot signal can pass to an optocoupler (via a high current driver in the form of a C-MOS 555 IC). The optocoupler acts as another safety device in two forms;

- (1) it isolates the high voltage supply of the blaster unit or external power supply of the seismograph from the sensitive C-MOS circuitry of the timers, and
- (2) incorporates another level of safety in that no signal can pass unless the SHOT ENABLE switch is depressed, as the base of the output transistor is shorted to ground. This stops any signal from passing through the optocoupler.

Detonator Trigger Board

The detonation circuit board is powered by three 22.5 volt batteries and coupled to the shot control circuitry via an optocoupler. The input (base of the optocoupler transistor) is grounded in standby mode, thus not allowing a signal to pass from the shot control circuitry. This grounding is disabled (allowing a signal to pass) by depressing the shot enable button (4). The power to the detonation circuitry is switched on from the detonation arm switch (3). This then charges a 100 µF capacitor to the full battery voltage (67.5 volts), which is indicated on the shot voltage meter. When the shot signal from the shot control circuit is passed through the optocoupler it triggers the SCR, thus discharging the 100 µF capacitor via the detonator connected across the output.

The safety circuits incorporated in this unit include;

- (a) The outputs to the detonator are completely shorted whilst the ARM key switch (3) is depressed and locked.
- (b) The power to the detonation circuit is disconnected whilst the ARM key switch (3) is depressed and locked.
- (c) No signal can pass to the detonation circuit from the optocoupler whilst the SHOT ENABLE switch (3) is not depressed.

Features

Power supply:
 Detonator circuit 3 × V72 PX 22.5 volt batteries
 Clock circuit 1 × 276-P 9 volt battery

Rating:
 100 µF at 200 volts

Safety:
 Three-stage safety interlock.
 Timer circuitry is opto isolated from detonation circuitry.
 Internal closed loop across detonation output when

not armed.
Arm switch is a key lock (depress to disarm and lock).

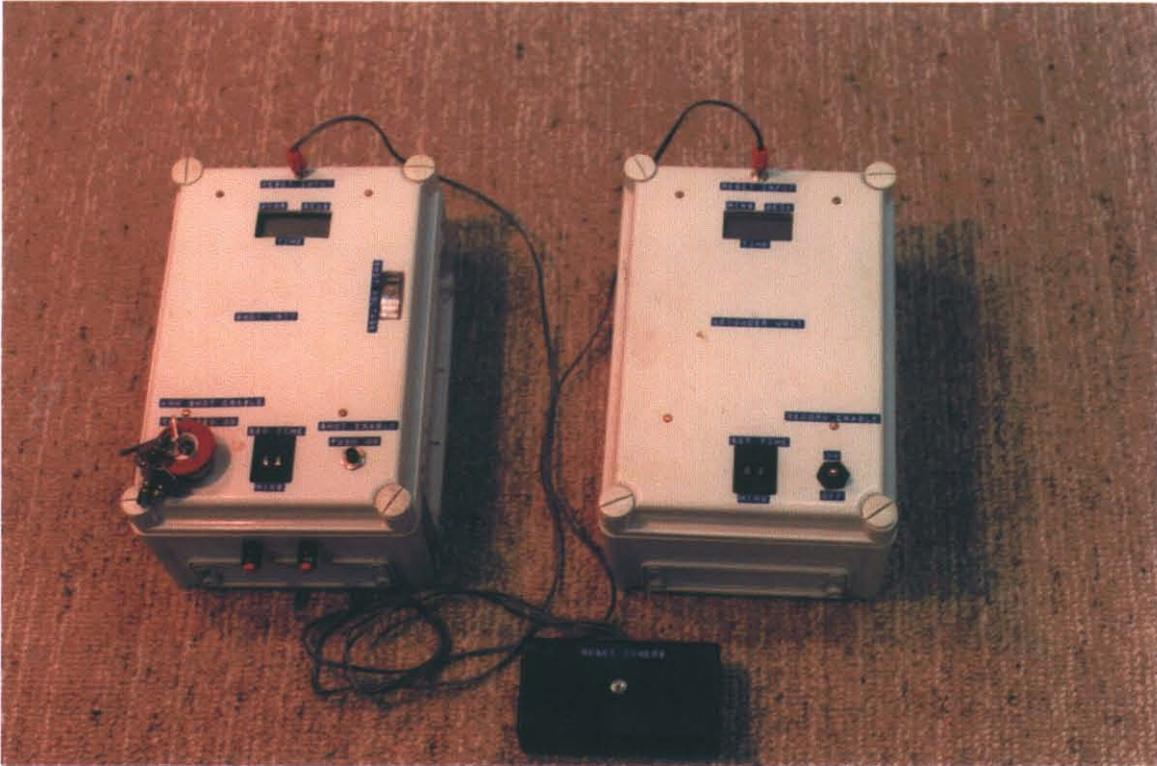
Housing:
High impact, waterproof plastic case.

Specifications

Battery life:
Detonator circuit — 100 shots for a 1 detonator shot.
Clock circuit — 96 hours continuous operation

Number of detonators : Reels of twin flex shot wire
(rated at 4 ohms per 100 metres)
46 : 0
40 : 1
36 : 2

[2 February 1990]



EXPLOSIVE FIRING SHOT BOX CIRCUIT DIAGRAM

