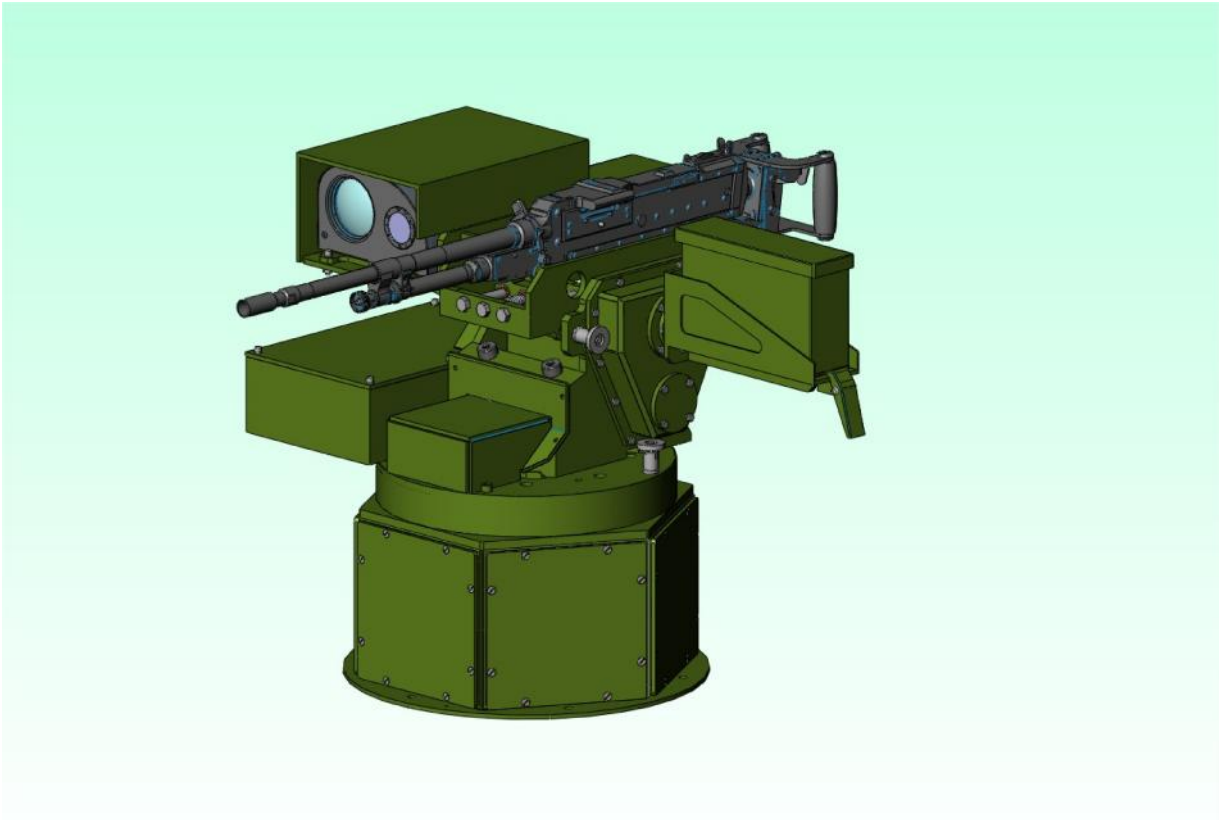
REMOTE CONTROL WEAPON STATION RCWS-RO-E



OPERATOR'S MANUAL

PREFACE

The Operator's Manual (OM) has been prepared to instruct the user in the operation, care and maintenance of the system RCWS-RO-E

Issued copies of the OM will not be updated automatically and holders must ensure that they are in possession of the latest issue.

Every endeavour has been made to confirm that the information contained in the OM is correct, but the user should additionally ensure that all normal safety procedures are followed.

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Annexes:

Abbreviations

OM – Operator's Manual

RCWS-RO-E - Remote Control Weapon Station (Romanian, for Egypte)

CP - Control Panel

BS - Sensors Block

CBS – Control Board for Sensors block

DIS - Display

WA- Weapon Assembly

PCB - Printed Circuit Board

LED - Light Emitted Diode

CDM - Control Distribution box- Machine

CDT - Control Distribution box – Turret

TC - Thermal Camera

NUC - Non Uniformity Correction

FOV - Field Of View

DC - Day Camera

MH - Horizontal Motor

MV- Vertical Motor

IH- Horizontal Incoder

EV- Vertical Encoder

STAB-H - Horizontal STABilization module

STAB-V - Vertical STABilization module

BF - Brake block

SBF - Control Brake Block

SR - Slip-Rings

GPMG 7.62 – Ceneral Purpose Machine Gun 7.62 calibre

LB – long burst

SB – short burst

SS – single shot

SOC- State Of Charge

BIT- Built In Test

1. Introduction

Remote Controlled Weapon Station (RCWS-RO) is a light-weight weapon system fitted with a light machine gun for use on a variety of soft skinned, light armoured and Mine Protected Vehicles (MPV). Some typical applications are: protection against the dismounted threat, providing a first order defence for logistic transport carriers, as well as support and repair vehicles. The system can be operated by one crew member from under or behind cover

The RCWS-RO-E fitted with an 7.62 GPMG Machine Gun is effective against enemy targets up to a range of 600m. For easy operation in a typical vehicle cabin, the RCWS-RO-E operator controls the turret and fires the weapon using Gunner Station with a simple Human Machine Interface (HMI), consisting of a display (DIS) and a Control Panel (CP) containing a Joystick..

Video images received from the video cameras on *the* turret are displayed to the operator. The display indicates fixed ballistic aiming lines to help the operator compensate for target range.

The weapon is remotely operated including the aiming and safe firing of the weapon which is done electrically. The turret can be factory configured to limit the arc of fire in both elevation and traverse.

RCWS-RO-E can be supplied in different configurations catering for different weapon types and optical sensors. This document, however, addresses exclusively the Manroy 7.62mm Machine Gun. The standard configuration of RCWS-RO-E incorporates a day video CCD camera and a Thermal Camera (TC)

System benefits:

- Allows under-armour protected target engagement without exposing the crew
- Provides better accuracy than a typical weapon ring station
- Provides "on-the-move" engagement capability
- Accurate target confirmation *I* identification is possible using the video image.
- Provides continuous fire command and control, day and night, in harsh environmental conditions (dust, smoke, fog), with a high probability to discover and destroy the enemy targets.
- Allows both, field observation and gun firing towards the targets
- RCWS-RO is electrically controlled in the basic mode. It may be **manually controlled too**, as an auxiliary mode

2. General description

The main subsystems of RCWS-RO-E are (fig.1):

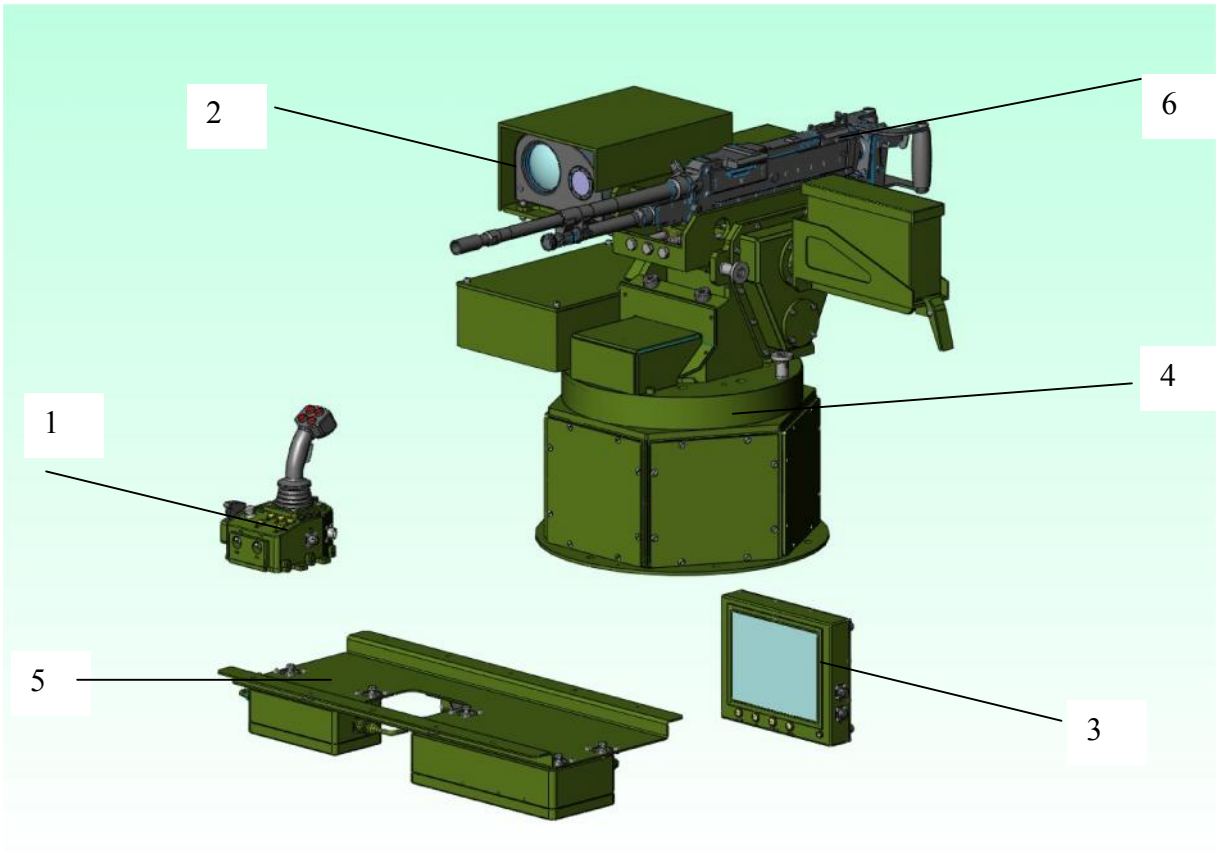


Fig.1

- **Control panel CP -(1)**

  -it is a Human-Machine Interface (HMI) which allows the operator to control the weapon station by means of command buttons and a joystick

- **Sensors block BS –(2)**

  - contains a day camera, a thermal camera and a Control Board

  - allows night/day battlefield observation and video signal transfer to the display

  - allows distance-to-target measuring and data transfer to DIS

- **Display DIS- (3)**

  - displays the image of the battlefield when receives the signals from the video sensors located in BS

  - generates and positions the aiming reticle

- **Weapon assembly WA- (4)**

  - it is mounted on the vehicle hull and provides:

  - weapon, firing mechanism and ammunition box mounting

- sensor block mounting
- control boxes and **actuating mechanisms** mounting
- slip-rings and bearing mounting
- Actuating mechanisms -provides azimuth (transverse) and elevation motions. Contains motors with brakes and gear boxes
- control boxes for tranverse and elevation motions
- gyrosensors for stabilisation –transverse and elevation motion
- encoders for motion feedback- incoder for transverse, encoder for elevation

NOTE: *All the subsystems mentioned above are mounted in Weapon Assembly **WA (4);** only the control distribution box **CDM** (for transverse motion) and the control boxes for brakes (**BF** abd **SBF**)are mounted in the cabin under the roof **(5)***

- **Weapon - (6)**
  - it is a 7.62 GPMG coaxial machine gun -electrically controlled.
  - it is mounted on **WA**
- **Cables (not shown)**
  - provide power supply and subsystems interconnections

3. System description

3.1 Control panel CP

Location: in the cabin, in front of the rear left seat

It is a microcontroller-based subsystem which allows the operator to control the weapon station by means of a joystick. CP contains a microcontroller PCB, a rugged case with control buttons & LEDs and a joystick.

CP functions:

- **commands:**
  - azimuth and elevation movements for the weapon assembly WA
  - FOVs switching for the thermal camera or day camera
  - thermal camera polarity (white hot/black hot), NUC, focus
  - operation modes: observing, target acquisition and firing
  - auxiliary modes : boresighting, reference setting, elevation limits setting, CDM and CDT drivers setting, errors displaying
  - returning to pre-established “Reference” (ZERO) position

- fire control (single shot, short burst, long burst -continuous)
- stabilization mode
- power supply for the whole system

- **acquires :**
  - "Zero" position of the weapon assembly WA
  - "UP" and "DOWN" limit positions for the weapon
  - WA functionality information
  - BS functionality information
- **signalizes**
  - components status: green - OK, red or blinking red - ERROR , blinking green-red - power supply under 18 V

CP commands (fig.2 and fig.3)

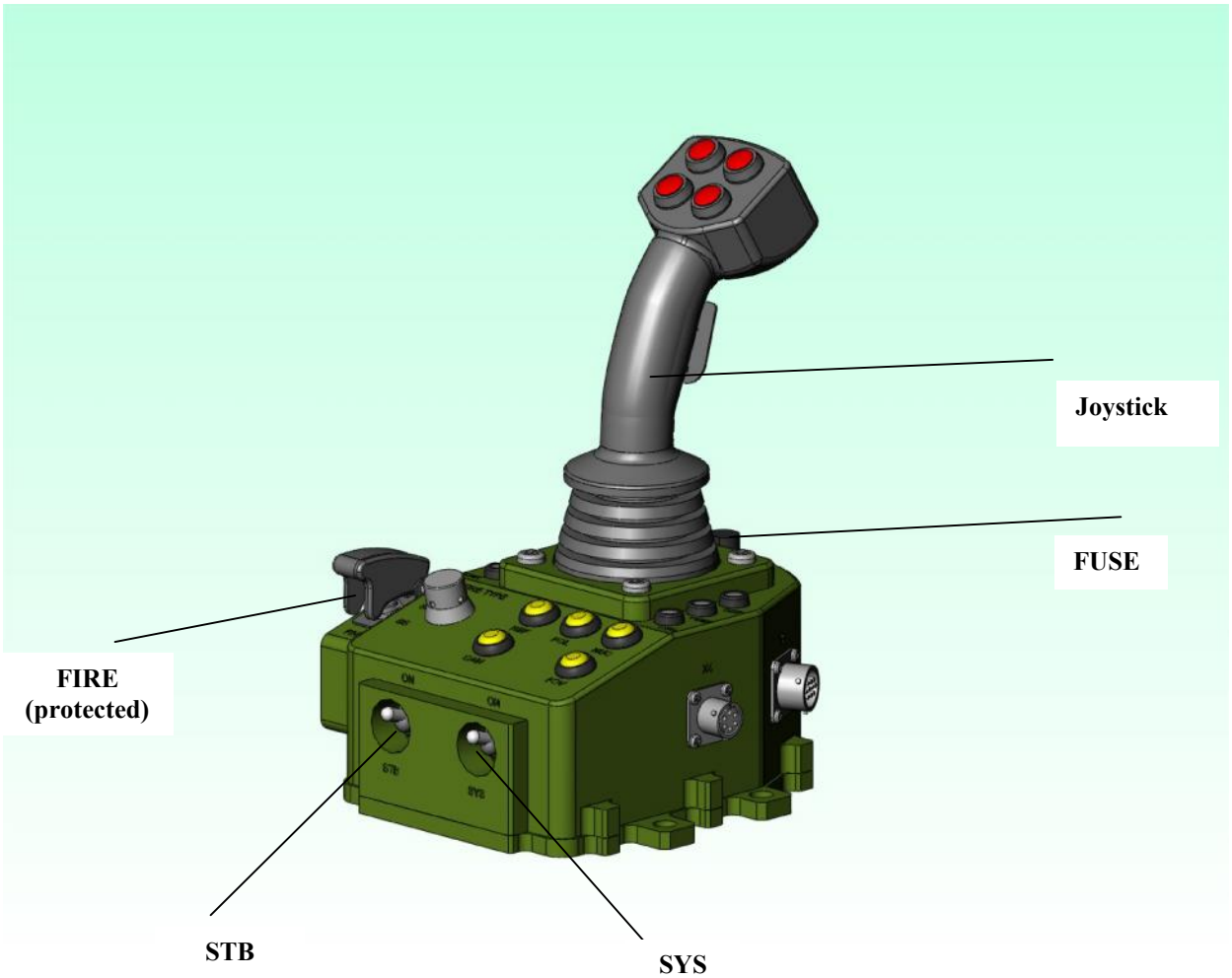


fig. 2

Switches (fig 2)

SYS-System

STAB- Stabilization

FIRE- firing start (protected switch)

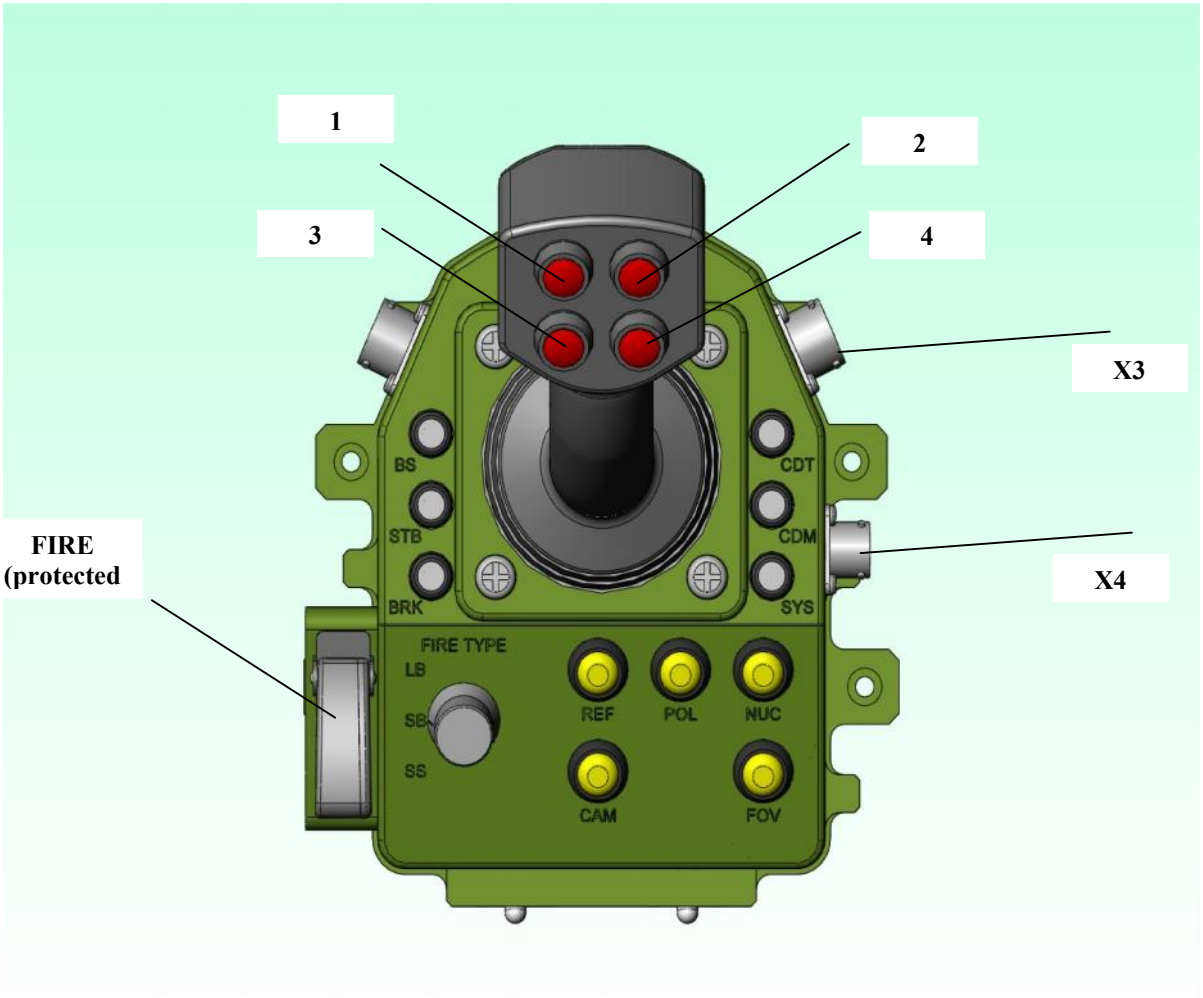


Fig.3

LEDs for status (fig.3)

BS – sensors block
STB- Stabilization
BRK – brake
SYS - system
CDM – control distribution box - cabin
CDT – control distribution box- turret (WA)

Push buttons (fig.3)

REF – reference position
POL – polarity for TC
NUC – non uniformity correction
FOV – Field Of View switch
CAM – camera switch

Rotary switch (fig.3)

FIRE TYPE
LB – long burst
SB – short burst
SS – single shot

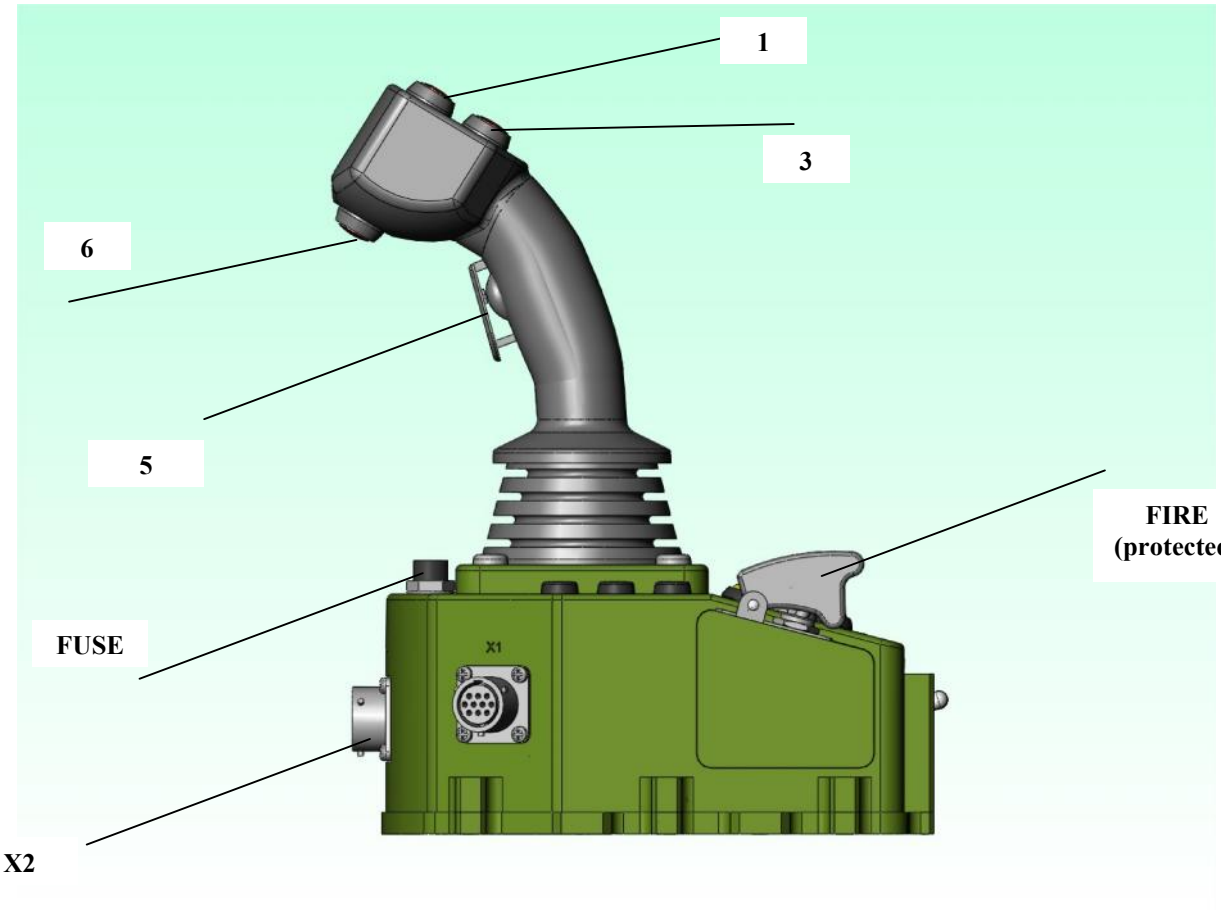


Fig.4

Joystick buttons (fig.3 and fig.4)

1- FOCUS near

2- FOCUS far

3- TARGET ACQUISITION mode

4- FIRING mode

5- DEAD MAN switch (presence switch)

6- VELOCITY switch

NOTE ***1…..6*** *buttons on the joystick have the functions described above only in Operating mode*

The buttons may have different functions in auxiliary modes (see chapter 7). In that case, an Electronic Tool (ETA) is plugged in the connector X1 (fig.4) for calibrating/setting purposes

Connectors: (fig.3 and fig.4)

XI- service connector

X2- communication connector

X3- Power supply connector

X4- Display connector

3.2. Sensors block BS

Location: on the Weapon Asembly WA

BS provides night/day video images to the gunner, in order to observe the battlefield, to acquire information about the targets and to be prepared for firing.

BS contains a day colour CCD camera DC, an uncooled thermal camera TC (Fig. 5) and a Control Board CBS

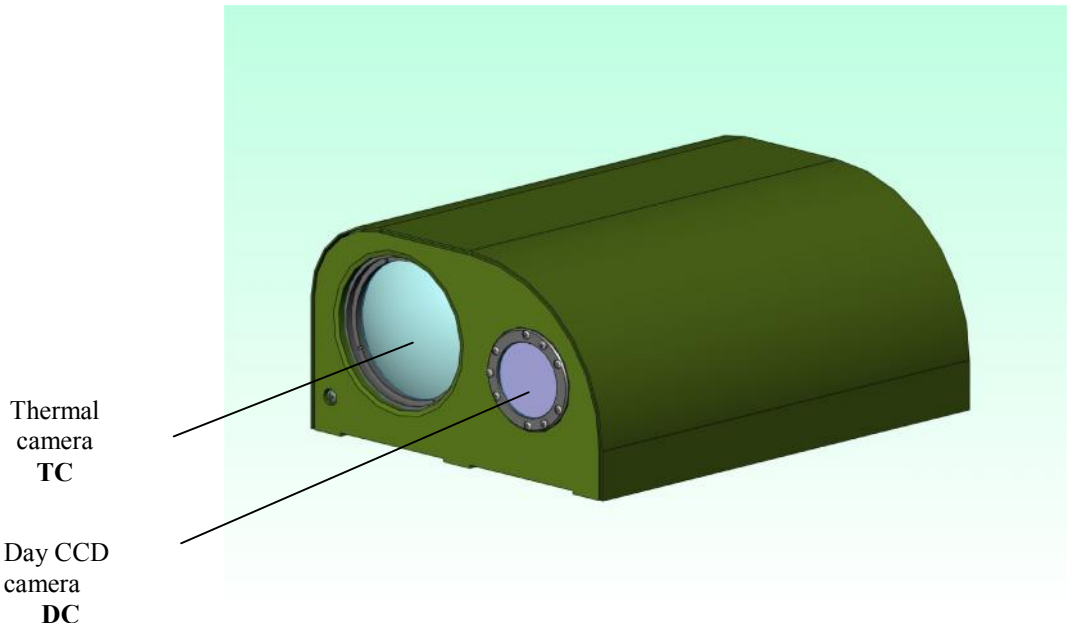


Fig 5

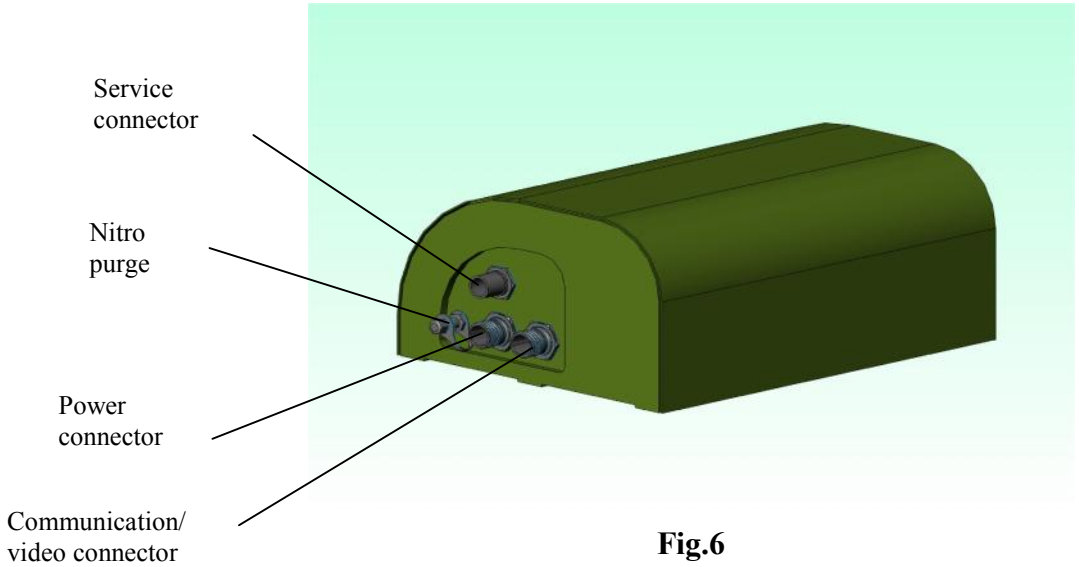


Fig.6

The CBS board provides:

- power supply distribution to the components
- video signals control
- command signals distribution for video sensors
- protection for the sensors

3.3 Display DIS

Location: in the cabin, in front of the rear left seat, above the CP

Provides images and necessary overlayed data from BS to the operator

DIS functions:

- Generates the aiming reticle for boresighting
- Generates the stadia scale and the firing reticle
- Displays the image of the battlefield
- Displays simbols for platform position, FOVs, erors
- Displays the boresighting and the firing reticles, as well as the stadia scale
- Provides brightness and contrast adjustments

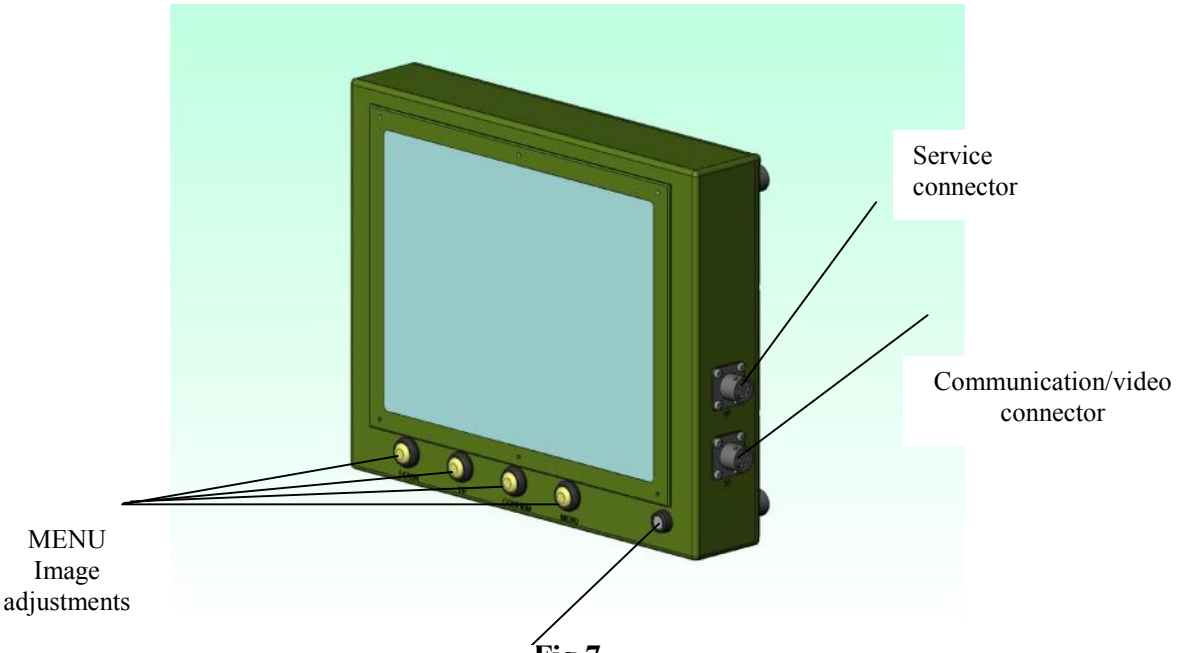


Fig.7

3.4 Weapon Assembly WA

It is mounted outside the vehicle, on the roof.

Contains:

- weapon cradle which will receive the 7.62 GPMG to be mounted on
- motors and resolvers for azimuth/elevation motion of the weapon
- gyro sensor blocks for stabilization system
- encoders for stabilization systems
- control boxes for azimuth/elevation **CDM/CDT**
- sensors block **BS**
- brake block **BF** and control brake block **SBF**
- ammunition box
- ballistic protection.

NOTE: ***Control*** **Distribution** *box – Machine* ***CDM,*** *brakes block* ***BF*** *and control brakes block* ***SBF*** *are mounted inside the cabin, under the roof*

3.4.1 Motors and resolvers

3.4.1.1. For Azimuth motion -MH- Provides transverse motion of the **WA.** Consists from a DC brushless motor and a resolver (coaxial mounted) for closed loop control of the horizontal motion

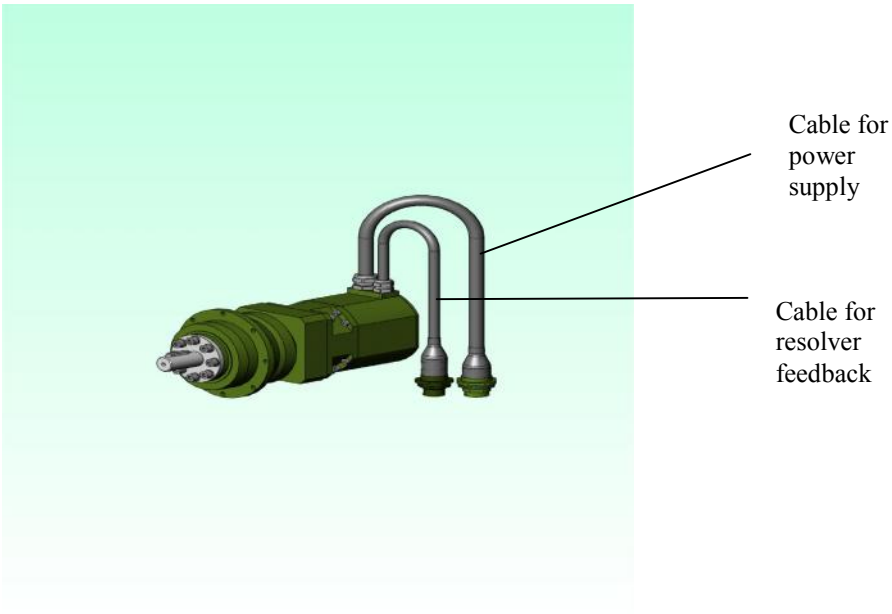


Fig.8

3.4.1.2. For Elevation motion -MV- Provides vertical motion of the **WA.** Consists from a DC brushless motor and a resolver (coaxially mounted) for closed loop control of the vertical motion

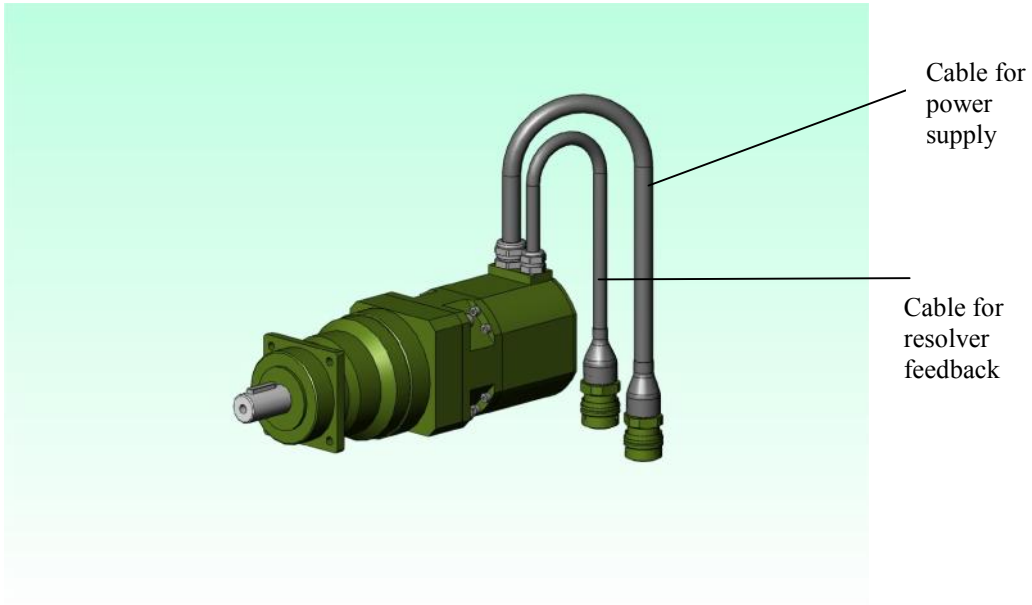


Fig.9

3.4.2 Gyro sensors blocks

3.4.2.1 For azimuth motion STAB H - provides to **CDM** data about the **WA** movements in transverse direction (azimuth), in order to stabilize the horizontal motion (if the stabilization is coupled from the **CP** switch STAB)

- contains a Fiber Optic Gyro (FOG)

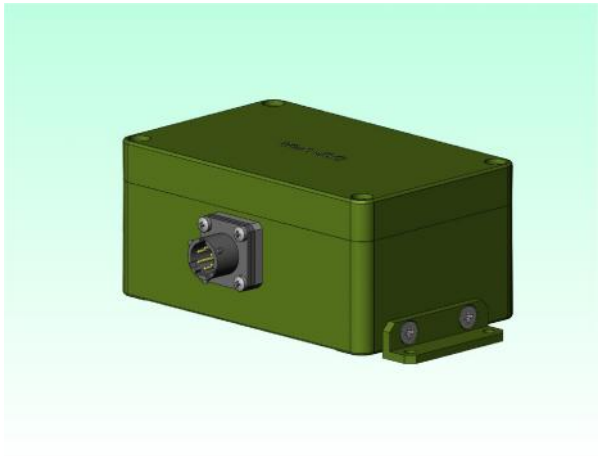


Fig.10

3.4.2.2 For elevation motion STAB V - provides to **CDM** data about the **WA** movements in vertical direction (elevation), in order to stabilize the elevation motion (if the stabilization is coupled from the **CP** switch STAB)

- contains a Fiber Optic Gyro (FOG)

Fig.11

3.4.3 Encoders

3.4.3.1 For Azimuth motion - Incoder H - Provides the Absolute Azimuth angle of the **WA**

- It is mounted on the vertical WA axis , in a common assembly with the sliprings

Fig.12

3.4.3.2 For Elevation motion - Encoder V - Provides the Absolute elevation angle of the weapon

- It is mounted on the horizontal axis of the weapon

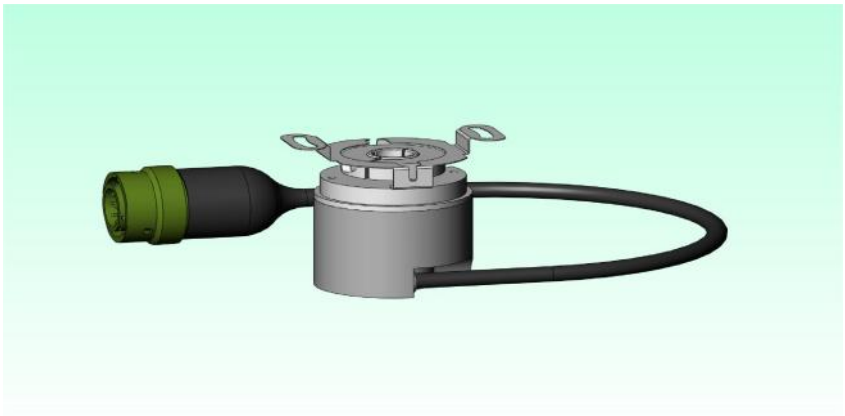


Fig.13

3.4.4 Control boxes

3.4.4.1 For Azimuth motion - CDM - is mounted inside the cabin, under the roof

Functions:

- provides horizontal drive control for azimuth motion
- receives data from the Gyro sensor block **STAB H,** for stabilization control
- receives data from the **Incoder H,** for stabilization control
- controls the brakes of the azimuth motor, in order to allow manual control of the **WA** and manual firing

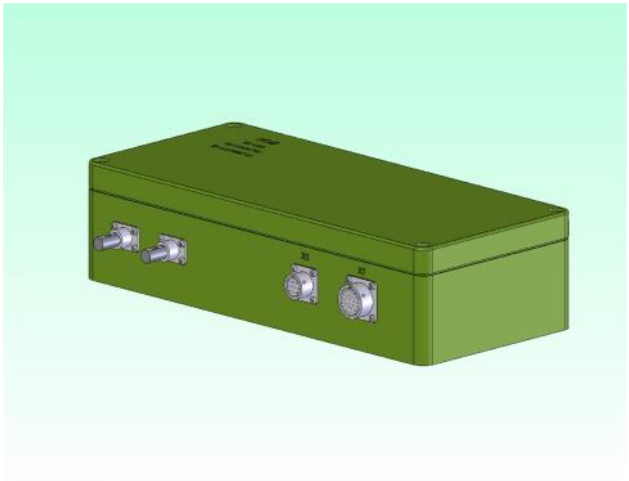


Fig.14

3.4.4.2 For elevation motion- CDT- is mounted on the **WA**

Functions:

- provides vertical drive control for elevation motion
- receives data from the Gyro sensor block **STAB V,** for stabilization control
- receives data from the **Incoder V,** for stabilization control
- controls the brakes of the elevation motor, in order to allow manual control of the **WA** and manual firing
- provides the electrical command to the weapon solenoid for remote firing
- transfers the video signal and the commands from **CP** to **BS**

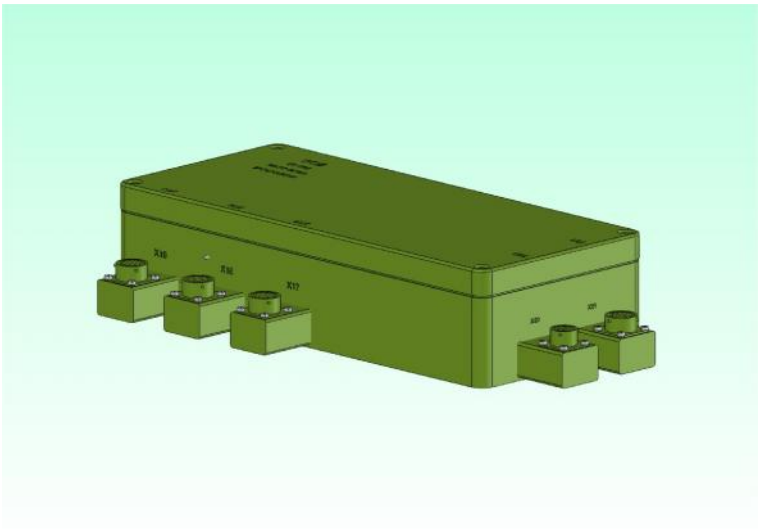


Fig.15

3.4.5 Brake block - BF – is mounted inside the cabin, under the roof

- contains 2 lead-acid rechargeable batteries**,** to power the brakes and free them for manual control and manual firing
- the battery are charged permanently from the vehicle power supply; the status of charge is shown by SBF

Fig.16

3.4.6 Control brake block – SBF- is mounted inside the cabin, under the roof, near **BF**

- provides the status of charge for the batteries from **BF**, by means of the three LEDs (green, yellow, red)

- the switch on the SBF commands the brakes to unblock, in order to free the **WA** motion in both (azimuth and elevation) directions, for manual use of RCWS-RO-E.

- The green LED above the switch shows blocked/unblocked status of MH and MV brakes

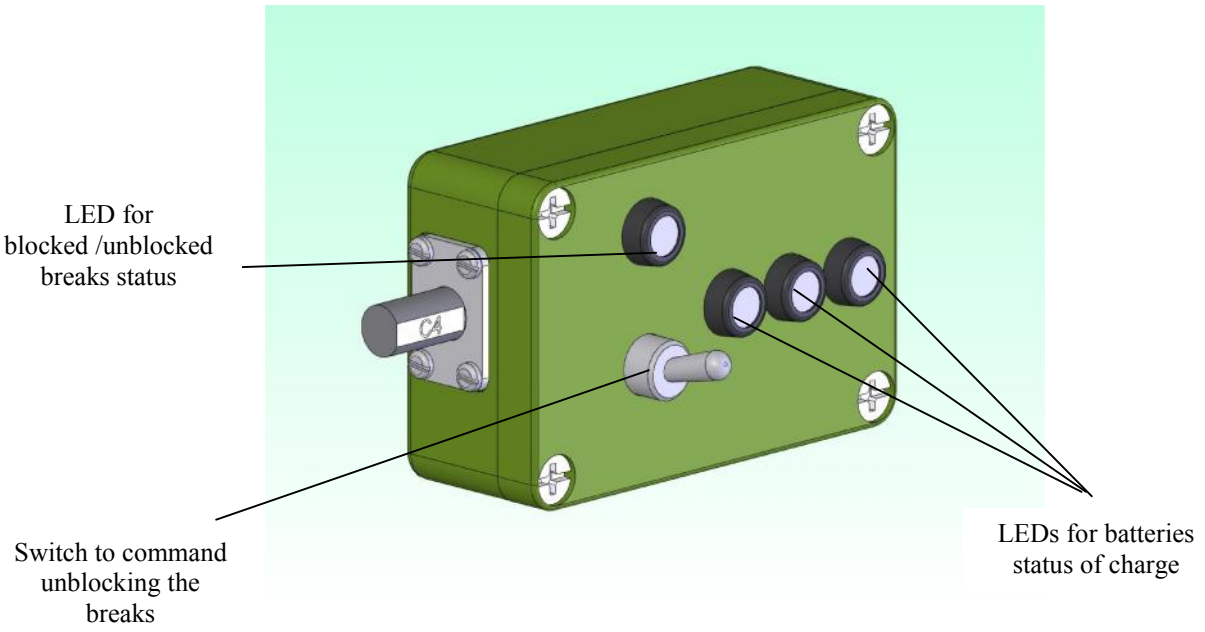


Fig.17

3.4.6 Slip-rings SR - is an assembly mounted between the fixed part of WA and the mobile one.

-provides electrical signals transmission from the CP to the mobile part of WA; contains 36 electrical circuits for power, video and communication signals

Fig.18

3.5 Weapon - is mounted on the WA, in the weapon cradle

The 7.62 mm machine gun GPMG is designed for use mounted in a remote weapon station on AFV's or similar vehicles, boats, helicopters and other moving platforms.

The weapon is fired electrically and is fitted with a spade grip backplate unit to allow reversionary manual control in the event of electrical failure..

The gun is a fully automatic, air-cooled, gas operated, belt fed weapon, capable of a high rate of fire. It is simple to operate and quick to strip and assemble

The gun has integral front and rear iron sights.

Front and rear mounting points are included in the gun receiver, providing a means of attaching the weapon to the gun mount.

Ammunition is linked in belts using disintegrating M13 links and packed in sealed boxes. Spent cases are deflected downward after extraction from the barrel and are ejected through an opening in the underside of the receiver. Links are ejected out of an opening in the right hand side of the receiver.

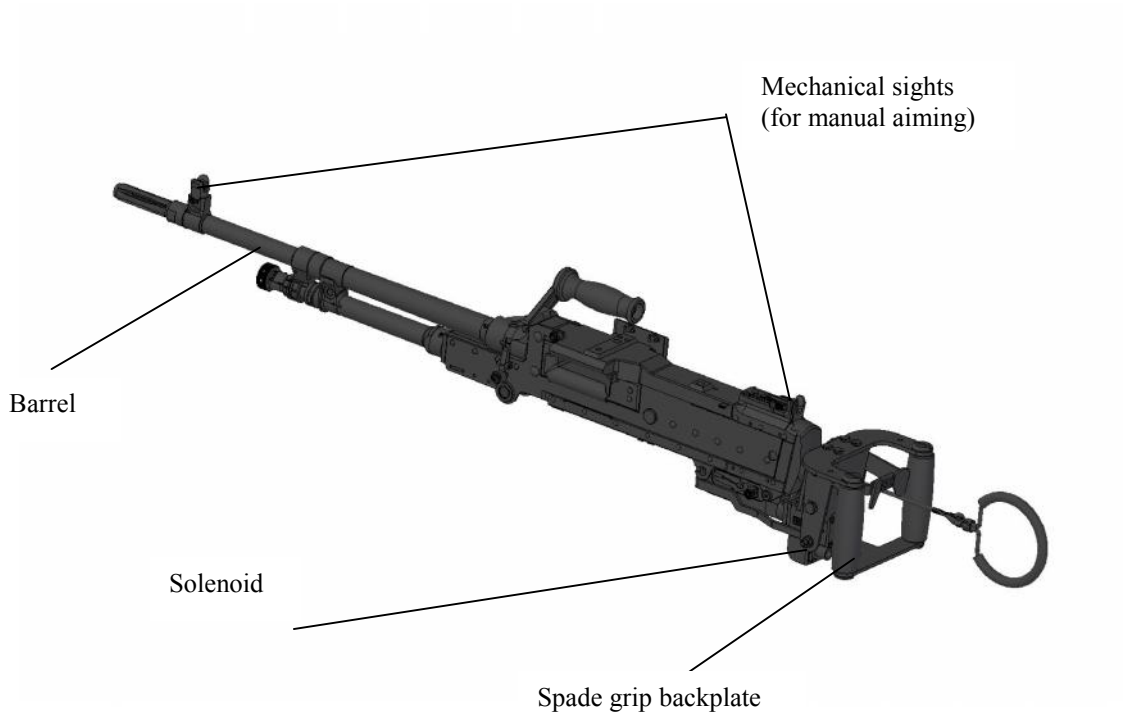


Fig.19

The spade grip backplate consists of a housing containing a buffer unit, around which is fitted a frame, containing two hand grips and a trigger connected to the operating rod of the EFU. The buffer absorbs the remaining energy of the working parts at the end of the recoil stroke and provides the initial energy for the counter recoil stroke. The hand grips and trigger lever provides a means of controlling and firing the gun manually in the event of failure of the electrical supply to the EFU.

The main weapon assemblies are shown below:

1. Barrel Assembly
2. Spade Grip Backplate Assembly (including a Recoil Buffer)
3. Breech Block & Piston Assembly and return Spring
4. Electric Firing Unit (EFU)
5. Receiver Assembly

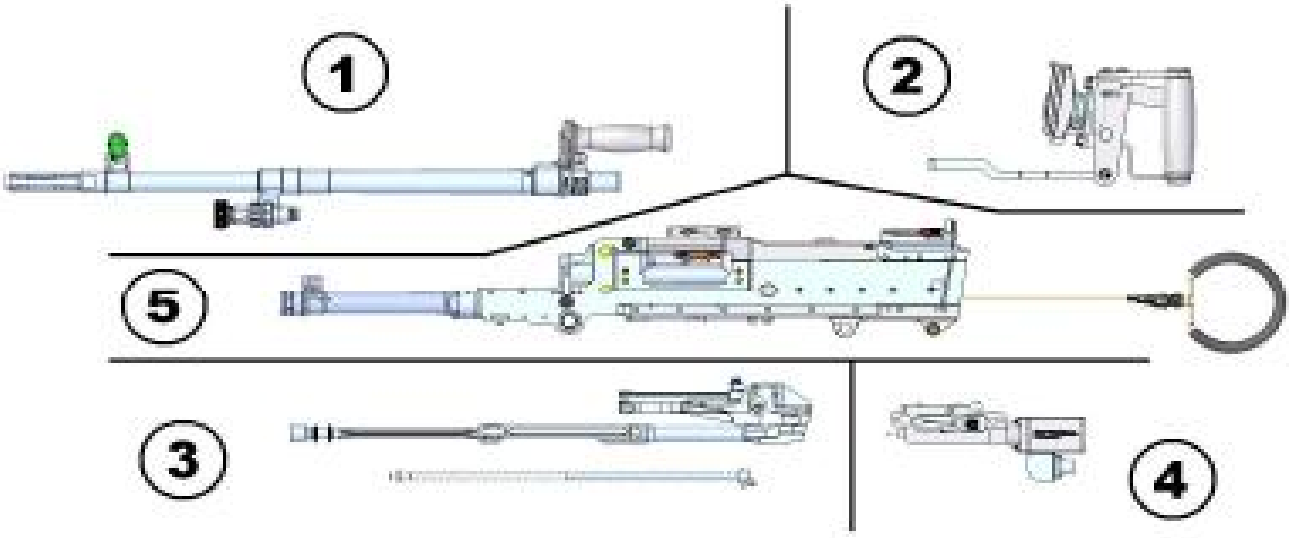


Fig.20

The gun is suitable for use with all types of 7.62 mm NATO ammunition including ball, tracer and armour piercing. The ammunition is linked together in belts using disintegrating M13 metal links (Fig .) and is normally packed in metal ammunition cases holding approximately 200 rounds. The belts may be further linked to form continuous lengths of any number of rounds. Various combinations of ball and tracer rounds are commonly specified.

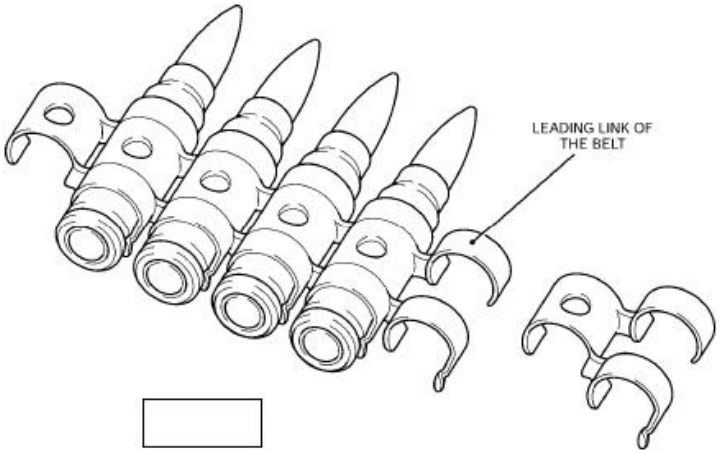


Fig.21

NOTE: *A complete **User Handbook** for the **weapon** is annexed to the present Operator's Manual*

4. Delivery Kit

For each delivery:

- Remote Control Weapon Station RCWS-RO- E
- Cleaning set
- Operator's Manual (weapon User Handbook attached)
- Declaration of Conformity
- Certificate of Warranty

Special tools:

- Electronic Tool for Adjustments (**ETA**)- one item for 15-20 systems
- Boresighting sight **THP**- one item for 15-20 systems

5. Technical features

5.1 Weapon Assembly WA

- azimuth range.....……..... n x 360^0
- elevation range (UP).....+60º±2º;
- elevation range (DOWN).....-20º±1º;
- azimuth speed:
  - a) high…….....min. 1 rad/sec;
  - b) low…….....max. 0,27 mrad/sec;
- elevation speed:
  - a) high…….....min.0,4 rad/sec;

b) low…….....max. 0,27 mrad/sec;

- The weapon is stabilised in the inertial reference frame to an accuracy of 1.0 mRad RMS in both axes while the vehicle is moving 24 km/h over a smooth gravel road.

- operating voltage …….....18÷ 32Vcc;
- power consumption (average)…….....max.7 A;
- power consumption (max 1 sec.).....max.25 A;
- weight (without gun and ammunition)..... max. 165 Kg
- overall dimensions..... max.849x671x602 mm
- environmental conditions.....MIL STD 810 F
- ballistic protection ……. level 3 against 7.62 ammunition

5.2 Sensors block BS

5.2.1 Thermal camera TC

- type.....uncooled
- spectral range.....8 ÷ 12 μm
- microbolometer matrix.....…… min.640x480 pixels;
- lens focal distance.....……45/135 mm ;
- two FOVs..... min.12,6°x9,4°(H) and $4,1^0$x3^0(V)
- digital zoom.....2x
- detection range (man target) .....min 2500m
- video output.....video composite CCIR

5.2.2 Day CCD camera DC

- senzor…….....1/4 inch CCD
- pixels…….....min. 440 000
- rezolution……..... .....min 460 TV lines
- FOV.....min. 1.6° to 42.2° (H)
- S/N ratio……..…….....min 50 dB
- lens…….....optical zoom, min 26x;
- detection range (man target) .....min 8500m
- interface.....…….....RS 232 /485
- supply voltage.....…..….....12 V cc
- video output.....video composite CCIR

5.3 Display DIS

- size.....10,4"
- input.....VGA/PAL – composite video
- resolution.....800X600 pixels
- overlay PCB.....letters and symbols
- supply voltage..... 18÷ 32Vcc
- environmental conditions.....according military standards

5.4 Weapon

Calibre ..... 7.62 mm

Length (extended butt)..... 1120 mm (44")

Weight

(1) Gun (with barrel) .....13.6 kg (30 lb)

(2) Barrel .....2.83 kg (6 lb)

Length of barrel.....679 mm (26.75")

No. of grooves.....4

Pitch of rifling.....1 in 305 mm (right hand)

System of operation .....Gas with recoil buffer & return spring assistance

Rate of fire.....650 – 950 rpm

Sights: .....Fixed foresight

Rearsight, aperture graduated in steps of 100m

Folded down .....200 to 800 metres

Raised .....800 to 1800 metres

6. Safety rules

Several safety aspects have been introduced in order to offer a complete safe-to-use system under normal operational conditions and within the operational guidelines.

- The RCWS-RO-E system is used from the safety of a vehicle and personnel are not required outside the vehicle to aim or fire the weapon. (only in case of electrical failure, the system may be controlled manually)
- The weapon trigger switch is situated on the left of the CP, behind a safety flap to prevent accidental activation.

- Before the weapon can be commanded to fire, several operations must be performed:

-The „operating" mode must be switched from „Observation", first to „target acquisition". Now the stadia scale allow to estimate the distance to the target

- The firing mode is selected by pressing the button of the joystick; and the firing reticle is available and the aiming is performed

- The „Fire type" selector must be switched from „0" to „ single shot", „short burst" or „long burst"

- The FIRE switch flap must be removed

- The Fire switch must be turned „ON"

The firing can be performed ONLY after these 5 succesive operations !

- The CP incorporates a Gunner Grip (dead man switch) to prevent the turret from moving when the Joystick is accidentally moved while the turret is enabled.
- A hatch open sensor is monitored to disable turret movement and firing of the weapon while the hatch is open. The override on the CP can be used to override the hatches open state in the event where the hatches open sensor is faulty and prevents normal weapon system operation.
- Safe operation with the gun : the procedures for loading, unloading and clearing the gun, firing and firing precautions, causes and actions for dealing with stoppages are described in User Handbook for GPMG 7.62, which is an annex to the present Manual

7. Mounting and operating instructions

All the components of the RCWS-RO-E system are mounted on the locations destined for observation and firing. No additional operations for positioning or adjustments are necessary

7.1 Preliminary checking

- check the Delivery kit
- check the operator's working post: Seat, Control Panel, Display
- check the WA mounting and the gun mounting on WA
- check the ammunition box mounting and the gun feeding
- check the cocking mechanism
- check the BF batteries status of charge - on the SBF box under the roof
- check the general aspect of the subsystems (no hits, no exfoliations, no corrosion)

7.2- Starting the system

NOTE *the system can be electrically (remotely) operated* ***only*** *if the hatch is closed !*

After closing the hatch, put the SYS switch to *ON* position.

The system becomes a self testing procedure (BIT):

- The LEDs **CDM, CDT, BS STB** light green for 0.5 sec, then light red for 0.5 sec, than remain off for 0.5 sec and finally light according each status of the subsystem

- The led on DIS lights green for 0.5 sec, then lights red for 0.5 sec, than remains off for 0.5 sec and finally light according DIS status.

- During BIT, the screen displays „SELFTEST – Please wait" while DIS is self tested, then „SYSTEM TEST – Please wait" during the self test for all the subsystems

- After BIT is finished, the **Observation Mode** screen is dysplayed as default

a) All the 6 LEDs on the CP must light as follows:

SYS –green- all the subsystems are powered from the vehicle voltage supply

CDM, CDT, BS – green- these subsystems are working properly **(**if the LED is blinking green the BIT/ initialization is performed)

– **green**, if the STAB switch is ON, no light if STAB switch is *OFF*

BRK- no light – it will be lit **red** if the brakes are released (the switch on SBF is *ON*)

If:

- **CDM, CDT, BS,** are **red** or are blinking red, there is an error in the system (subsystem failure or no communication)

- **STB** is **red** if the stabilization is coupled but there is an error

- **BRK** is **red,** the brakes are released and the **WA** may be operated manually

b) the display DIS is powered and an image of the external viewed objects, transmitted by BS optical sensors, appears on the screen

NOTE *If the chosen camera is TC, the image might appear after 30-40 sec. delay, because of the thermal sensor initialing*

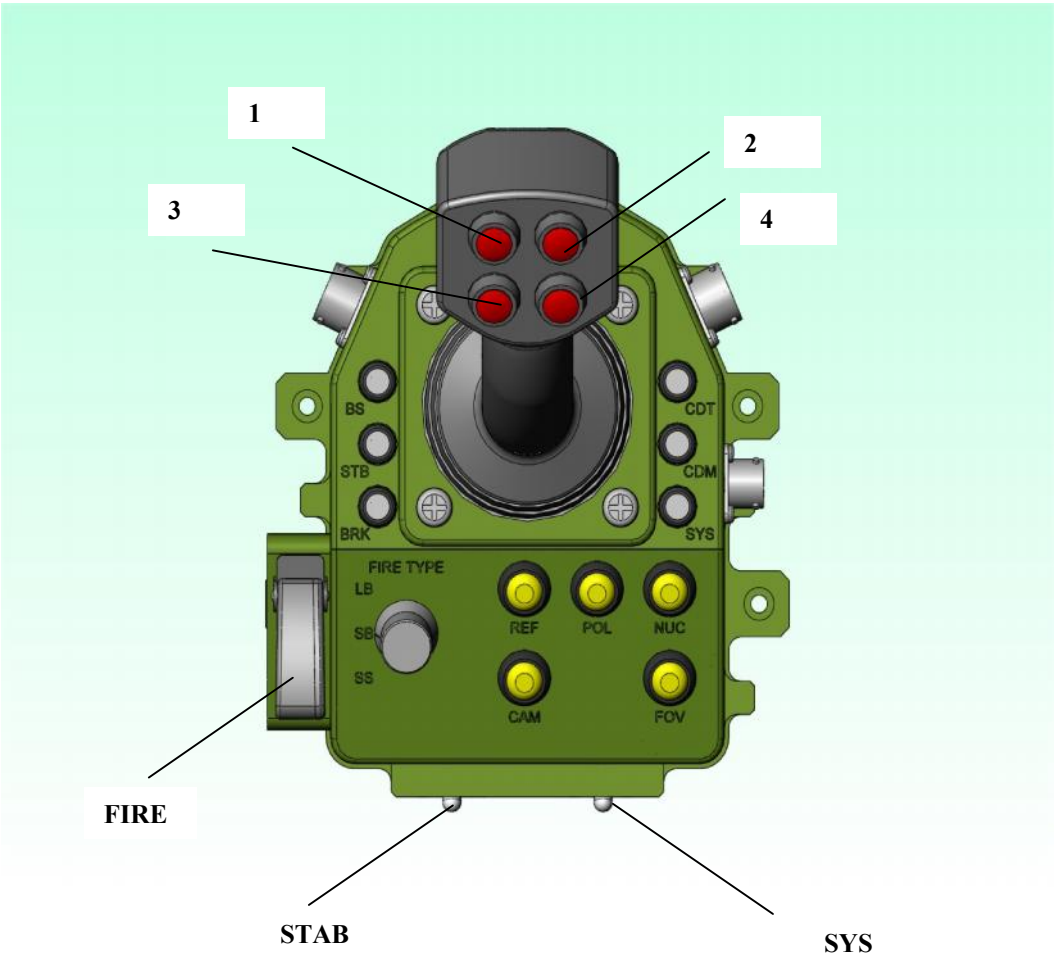


Fig.22

7.3 Operating the system

7.3.1 Operating modes

7.3.1.1 Observation Mode

When coupling the system from the SYS switch, the Observation Mode is chosen automatically as default; in this mode, all the commands are available, excepting aiming and firing:

- STAB - couples/uncouples the stabilization
- REF - brings the WA to the "ZERO" reference
- CAM – switch the image from TC to DC and reverse
- FOV- switch the Field of Views for the chosen camera by successive pushing
- NUC – performs Non Uniformity Control for TC (if TC is chosen from CAM switch)

- POL- changes the polarity (White hot/black hot) for TC (if TC is chosen from CAM switch)
- Buttons 1 and 2 on the joystick- when kept pressed, switch FOCUS NEAR/FOCUS FAR
- Button 3 on the joystick- Switch to **Target Acquisition** mode
- Button 4 on the joystick- Switch to **Firing** mode
- Button 5 on the joystick- Presence switch (Dead Man Switch). The WA assembly can be rotated **only** if this button is kept pressed
- Button 6 on the joystick – when kept pressed, switches WA velocity from Low to High, both in azimuth and elevation
- The WA displacements can be controlled by pushing the joystick arm : a) to the right/left for azimuth motion
  b) forward / backward for elevation motion

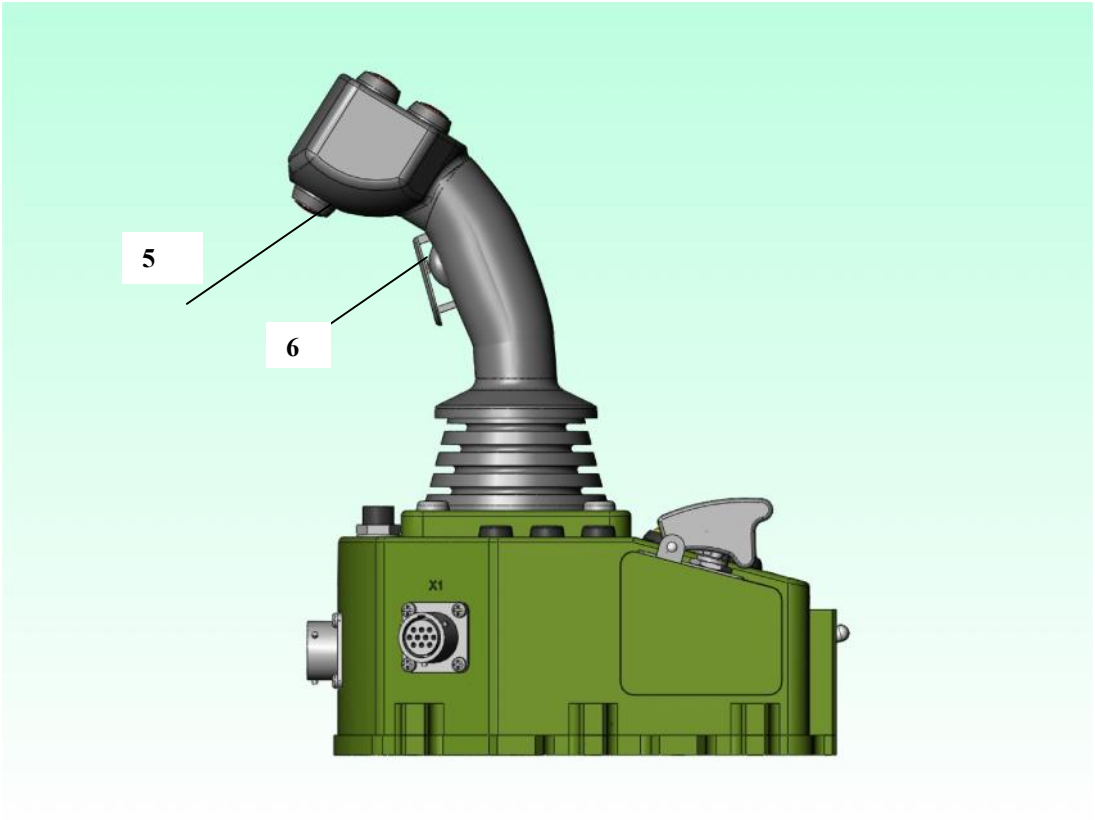


Fig.23

Details:

- The FOV available are:

For TC:

Nr	Type	FOV (°)	ZOOM type	Obs.
1	**WFOV**	**14.3**	**optical**	The same as DC
2	**NFOV**	**4.6**	**optical**	The same as DC
3	**EZOOM**	**X2**	**digital**	Only for NFOV

For DC:

Nr	Type	FOV(°)	Zoom type	Obs.
1	**VWFOV**	**42**	**optical**	
2	**WFOV**	**14.3**	**optical**	The same as TC
3	**NFOV**	**4.6**	**optical**	The same as TC
4	**VNFOV**	**1.7**	**optical**	

Display information:

The screen permanently displays the image provided by BS optical sensors (TC or DC)

There are symbols and text overlaid for additional information:

a) gun position (azimuth and elevation) - on the left:

(the bolded lines indicate the current position of the gun

b) image information- on the right :

c) absence of the video signal- left down

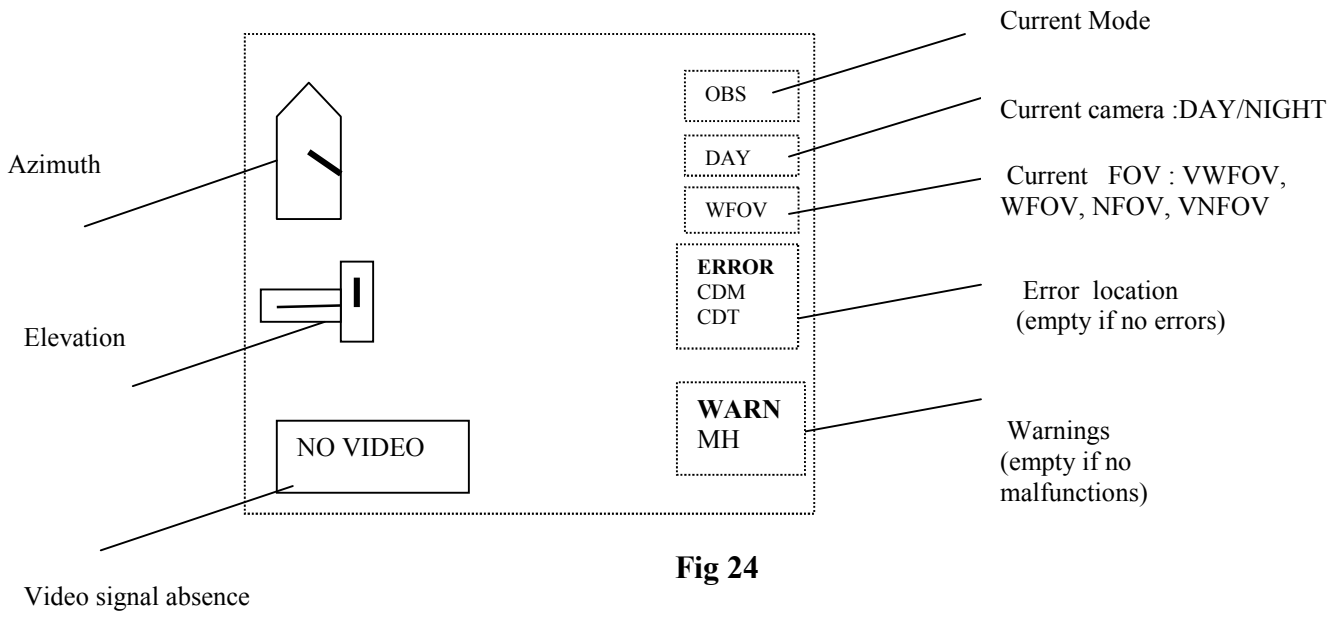


Fig 24

ERROR – indicates the subsystems which is failed or has no communication with CP

WARN - provides a warning message for**:**

- **in operation modes-** Subsystems which have a function problem (ex. the temperature becomes too high-**MH,** power supply is under **22 V**)
- **in auxiliary modes: -** function not set yet, but which needs to be set (ex. **LIM** needs to be set after **REF** has been set**) -** after **LIM** is set, the warning disappears

One may leave the Observation Mode:

- switching to Target Acquisition Mode (button 3 on the Joystick)
- switching to Firing Mode (button 4 on the joystick)
- switching to an auxiliary mode (see chapter 7.3.2)

7.3.1.2 Target Acquisition mode

This mode is available, from Observation Mode, by pushing the button 3 on the joystick arm. In this case, the NFOV is automatically selected, in order to have an optimal image of the target (maximum optical zoom) .

This mode is destined to estimate the distance to the target in order to aim correctly for an accurate shot

In this mode, the following commands are available (fig.23, fig.24):

- STAB - couples/uncouples the stabilization
- REF - brings the WA to the "ZERO" reference
- CAM – switch the image from TC to DC and reverse
- FOV- switch to the Observation Mode ; the FOV for the current camera switches in the next one available
- NUC – performs Non Uniformity Control for TC (if TC is chosen from CAM switch)
- POL- changes the polarity (White hot/black hot) for TC (if TC is chosen from CAM switch)
- Buttons 1 and 2 on the joystick- when kept pressed, switch FOCUS NEAR/FOCUS FAR
- Button 3 on the joystick- Switch to **Observation** mode
- Button 4 on the joystick- Switch to **Firing** mode

- Button 5 on the joystick- Presence switch (Dead Man Switch). The WA assembly can be rotated **only** if this button is kept pressed
- Button 6 on the joystick – when kept pressed, switches WA velocity from Low to High, both in azimuth and elevation
- The WA displacements can be controlled by pushing the joystick arm : a) to the right/left for azimuth motion
  d) forward / backward for elevation motion

Display information:

The images from the optical sensors are displayed in Narrow Field of View- NFOV

The permanent information is displayed - see the Observation Mode

In addition, a stadia scale - for vehicle-target (V) or Man-target(M) - is supplementary overlaid:

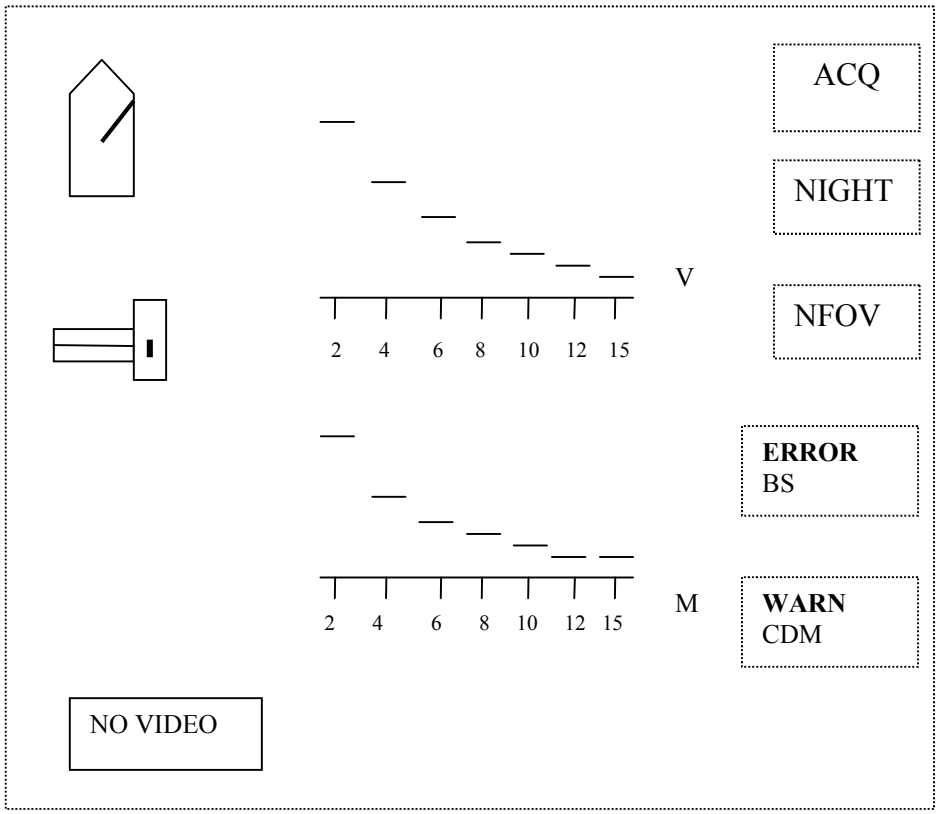


Fig.25

One has to control the WA motion from the joystick, in order to place an object from the image (Man or Vehicle) in the zone where it can fit between the horizontal line and the dashed form; the distance to the target is estimated by reading the figures on the horizontal line in the area where the target is completely located between the two lines (the base line and the segment of the dashed form)

One may leave the Target Acquisition Mode:

- switching to Observation Mode (button 3 on the Joystick or FOV button)
- switching to Firing Mode (button 4 on the joystick)
- switching to an auxiliary mode (see chapter 7.3.2)

7.3.1.3 Firing mode

This mode is available from **Observation Mode** or from T**arget Acquisition Mode** by pushing the button 4 on the joystick arm.

In this case, the NFOV is automatically selected, in order to have an optimal image of the target (maximum optical zoom)

This mode is destined to aim the target before shooting. An aiming reticle is displayed on the screen

In this mode, the following commands are available (fig.23, fig.24):

- STAB - couples/uncouples the stabilization
- FIRE TYPE – a rotary switch; one may choose the followings types of shots : Single Shot SS, Short Burst SB or Long Burst LB
- FIRE – protected switch - which can be operated if FIRE TYPE rotary switch is positioned on one of the three options: SS, SB or LB
- REF - brings the WA to the "ZERO" reference
- CAM – switch the image from TC to DC and reverse
- FOV- switch to the Observation Mode ; the FOV for the current camera switches in the next one available
- NUC – performs Non Uniformity Control for TC (if TC is chosen from CAM switch)
- POL- changes the polarity (White hot/black hot) for TC (if TC is chosen from CAM switch)
- Buttons 1 and 2 on the joystick- when kept pressed, switch FOCUS NEAR/FOCUS FAR
- Button 3 on the joystick- Switch to **Target Acquisition** mode
- Button 4 on the joystick- Switch to **Observation** mode
- Button 5 on the joystick- Presence switch (Dead Man Switch). The WA assembly can be rotated **only** if this button is kept pressed

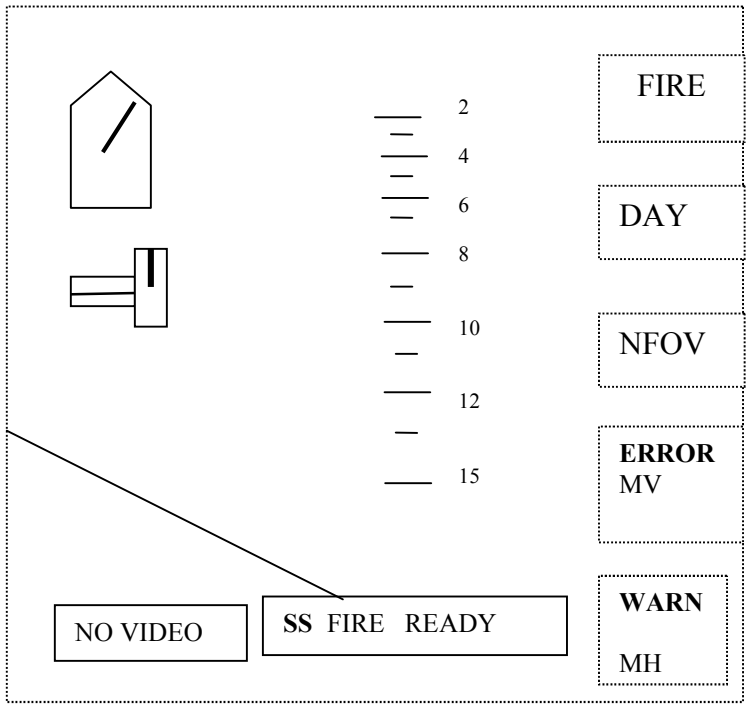
- Button 6 on the joystick – when kept pressed, switches WA velocity from Low to High, both in azimuth and elevation
- The WA displacements can be controlled by pushing the joystick arm : a) to the right/left for azimuth motion
  e) forward / backward for elevation motion

Display information:

The images from the optical sensors are displayed in Narrow Field of View- NFOV

The permanent information is displayed - see the Observation Mode

In addition, an aiming reticle is supplementary overlaid:



"**Fire Ready**" message

Fig.26

The distances estimated in Target Acquisition Mode are used for aiming. The gunner has to superpose the line of the aiming reticle corresponding to the distance to target, measured on the stadia scale , on the target to be shot. It means that the elevating angle of the weapon is adjusted according to the type of target and to the estimated range to target.

When all the safety conditions for starting the fire are fulfilled, a message SS (SB, LB) FIRE READY is displayed on the bottom of the screen, depending on the fire type. This message will last as long as the safety fire conditions last (see chapter 6).

The FIRE switch can be pushed now, after removing the protection flap

One may leave the Firing Mode:

- switching to Observation Mode (button 4 on the Joystick or FOV button)
- switching to Target Acquisition Mode (button 3 on the joystick)
- switching to an auxiliary mode (see chapter 7.3.2)

7.3.2 Auxiliary modes

These modes are not available for the operators. They are destined for maintenance personnel who might need to perform some settings and adjustments periodically or at request.

A special tool **ETA** is provided for this purpose. This special electronic tool must be connected to the CP (X1 panel connector)

7.3.2.1 –Boresighting the gun with BS sensors

- The rotary switch on ETA is put on ALIGN position
- The FOV is automatically switched to NFOV
- A special reticle (crosshair) is generated by DIS

a) Method 1

- A panel with three cross-marks, situated at 25 m distance from the gun, is used. The distance between the three cross-marks depends upon the distance between the gun axis, the TC optical axis and DC optical axis which should be convergent at 800-1000m.
- The height of the gun mark on the panel shall be the same as the gun height on the vehicle
- A laser pointer is mounted in the gun barrel; move the WA, so the laser point on the panel to be superposed on the gun mark on the same panel
- Move the cross-hair reticle (by pushing the **1,2,3,4** buttons on the joystick arm) for each camera (TC and DC) so to be superposed respectively to the TC an DC marks on the panel
- The position is stored by pushing and keeping pushed REF button more than 2 seconds
- Now, the boresighting is finished and stored

b) Method 2

- A thin object is chosen at a 1000 m distance (ex: an antenna , a building edge)
- A THP sight (provided as a special tool) is mounted in the gun barrel
- The thin object chosen is aimed by the THP, rotating the WA in azimuth/elevation
- Move the cross-hair reticle (by pushing the **1,2,3,4** buttons on the joystick arm) for each camera (TC and DC) so to aim the same thin object
- The position is stored by pushing and keeping pushed REF button more than 2 seconds

- Now, the boresighting is finished and stored

NOTE *The buttons STAB, FOV are inactive*

The button REF has a storage function

*The buttons **1,2,3,4** on the Joystick arm are used to move the cross-hair for cameras in order to perform boresighting. Their functions are different in this **Boresighting mode** with respect **to Operating modes***

7.3.2.2 FOV calibration

- The rotary switch on ETA is put on CAL position

- The FOV is automatically switched to NFOV

- A special reticle (rectangle) is generated by DIS

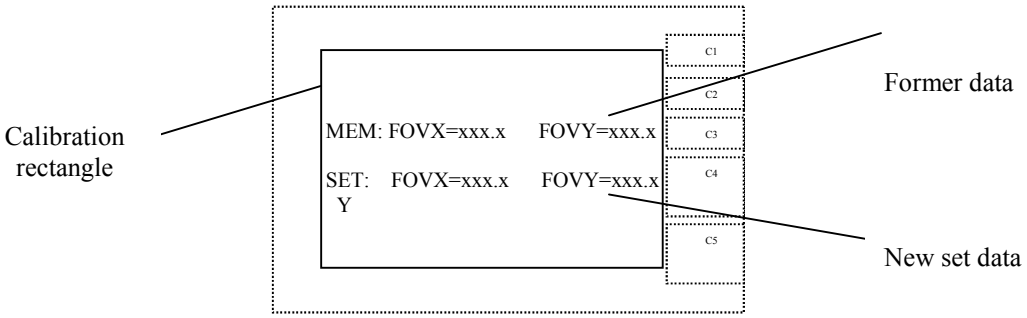


Fig.27

- A panel with one mark , situated at 25 m distance from the BS is used; the generated rectangle has predefined dimensions

- A corner of the generated reticle (rectangle) is superposed with the mark on the panel, by moving WA from the joystick; push button 3on the joystick arm

- The diagonal corner of the rectangle is superposed with the same mark on the panel by moving WA from the joystick; push any button 4 on the joystick arm

- Switch the current camera (TC to DC or reverse) and proceed to the same operations (two diagonal corners of the rectangle confirmed with 3 and 4 buttons respectively

- the calibration is stored by pushing and keeping pushed REF button more than 2 seconds

- now both cameras FOV is calibrated with the DIS, so the aiming reticle (generated in **Firing Mode**) is correctly dimensioned

NOTE *The buttons STAB, FOV are inactive*

The button REF has a storage function

*The buttons **1,2,** on the Joystick arm are used to for FOCUS, while the buttons **3** and **4** are used to confirm the positions for FOV calibration .*

7.3.2.3 Reference setting

- The rotary switch on ETA is put on REF position

- The gun position is adjusted to be parallel to the ground (in elevation)
- The gun position is mechanically adjusted to be parallel to the longitudinal axis of the vehicle (in azimuth)
- Push and keep pushed the REF buttons more than 2 seconds.
- The ZERO position is now stored (the in-coder-IH and the en-coder-EV are reset)

NOTE *The buttons STAB and REF are inactive*

*The buttons **1,2,3,4** on the Joystick arm are inactive*

7.3.2.4 Extreme elevation angles setting

- The rotary switch on ETA is put on LIM position
- The gun is moved DOWN to a desired position (around - 20°)
- Push and keep pushed the REF buttons more than 1 seconds
- The gun is moved UP to a desired position (around + 60°)
- Push and keep pushed the REF buttons more than 2 seconds

The extreme elevation angles are now stored (the in-coder-IH and the en-coder-EV are reset)

NOTE *Close to the extreme elevation positions, the high speed of the gun is automatically lowered (not to hit violently the end limits of their displacements)*

The button STAB is inactive

The button REF has a storage function

*The buttons **1,2,3,4** on the Joystick arm are inactive Their functions are completely different in each **Auxiliary mode** with respect **to Operating modes***

7.3.2.5 Drivers setting

- The rotary switch on ETA is put on DRIVE position
- A special cable is connected to the CDM and CDT
- A PC special software is used the set the drivers for both MH and MV in order to move the WA smoothly

NOTE *This mode is used only in the supplier's facilities to adjust the motors drivers parameters*

The button STAB, both WA movements (azimuth and elevation), controlled by joystick, are inactive

Button REF has a storage function

*The buttons **1,2,3,4** on the Joystick arm are inactive*

The LEDs CDM, CDT on the CP are blinking green.

7.3.2.6 Errors

- The rotary switch on ETA is put on ERR position
- All the system errors are displayed on the DIS screen
- This screen must be communicated to the manufacturer, for locating the failure and the subsystem failed.

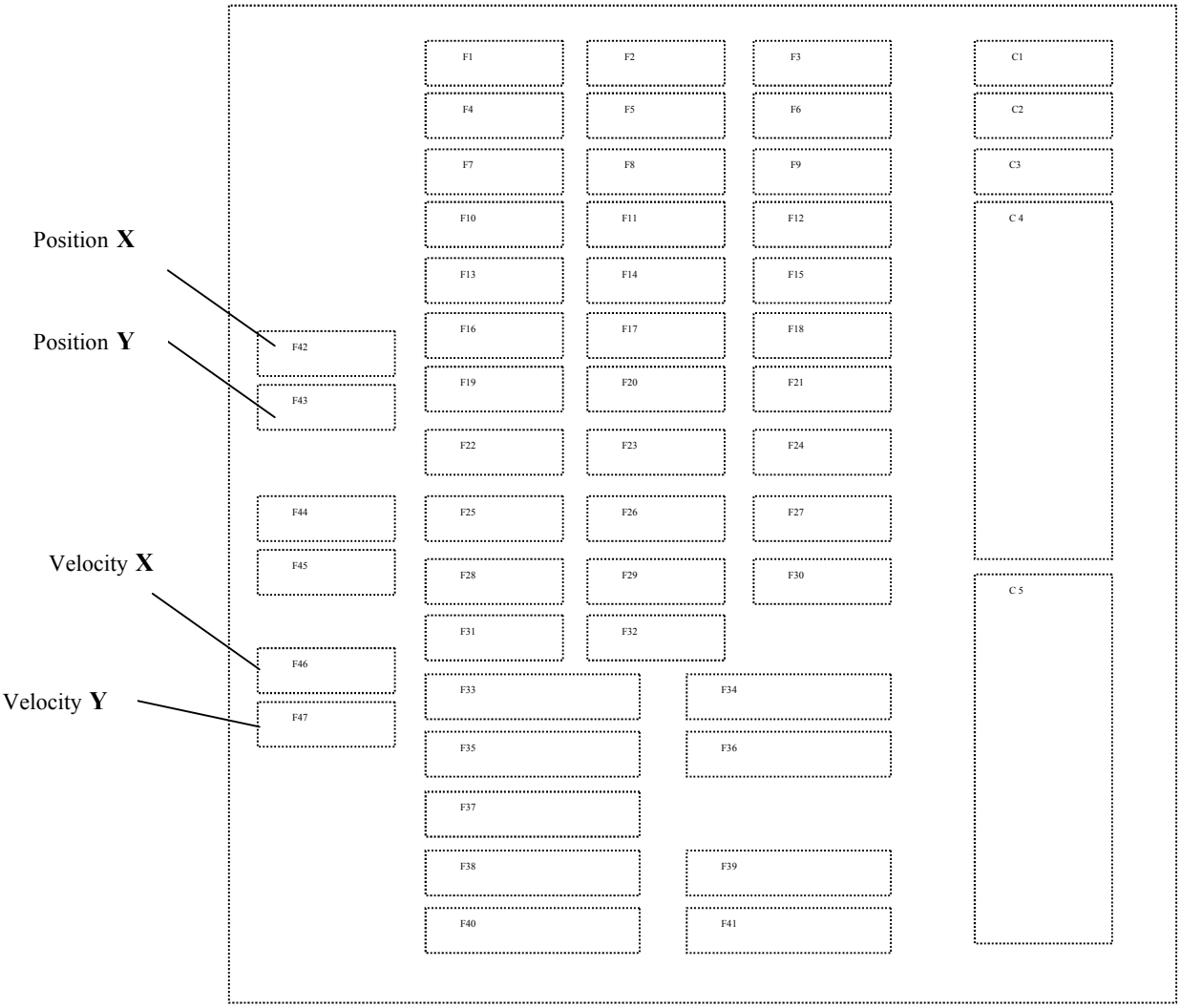


Fig.28

NOTE *The buttons STAB , REF are inactive*

*The buttons **1,2,3,4** on the Joystick arm are inactive*

*This screen shows also the position of the **WA**(zone F42, F43) and may be used to read the **WA velocity** in azimuth and elevation (zone F46 and F47)*

*This screen shows also the **software version** of each subsystem, to be communicated to the manufacturer (zones F37 to F41)*

7.3.2.7 No fire zones setting

-The rotary switch on ETA is put on F ZONE position

- 4 (four) possible zones for inhibiting the fire are displayed to be filled in, in order to be set max. 4 (four) NO FIRE ZONES.

- the beginning and the end of each zone- B and E (in azimuth) may be set, together with a min elevation angle to be the limit for gun DOWN motion. The azimuth/elevation angles are confirmed by pushing the buttons 3 (at the beginning) and 4 (at the end) on the joystick arm. It means that, in the azimuth zone chosen, the gun may fire only for elevation angles BIGGER that the one set.

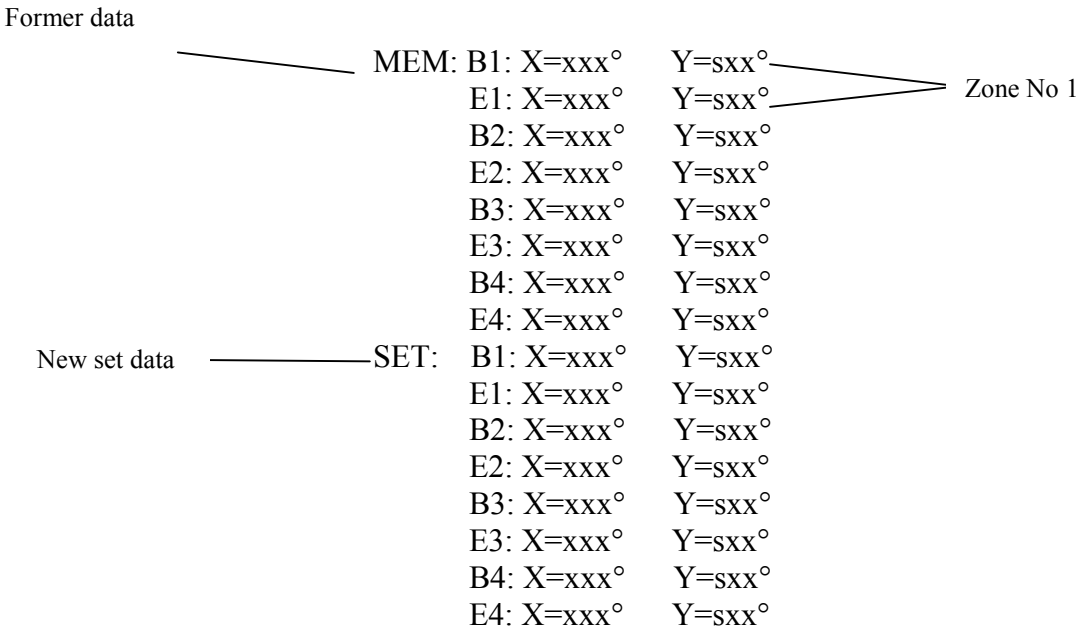


Fig.29

- The zone may ne stored by pushing and keeping pushed REF button more than 2 seconds

- Now, the firing zone (No1) is set

- One may proceed with the same steps for the rest (max. 3 available !) NO FIRE ZONES

NOTE *The buttons STAB is inactive*

The button REF has a storage function

Usually, the NO FIRE ZONES are factory settings, specially located for each type of vehicle. Changing these zones may be performed only with manufacturer support! A wrong set up, performed by the user, may cause huge damages and human lives loss !

7.3.3 Manual mode

In case of power supply failure, the WA may be operated manually.

BF contains rechargeable batteries to power the brakes when the vehicle power

supply is off

The switch on the SBF must be put to ON; now the MH and MV brakes are released.

The hatch is opened. The operator may control the gun and may fire manually from the spade grip plate of the weapon. No remote control or images on display are available.

The LEDs on SBF panel show the state of charge (SOC) of the batteries located in BF. The table below presents the combination indicating batteries SOC:

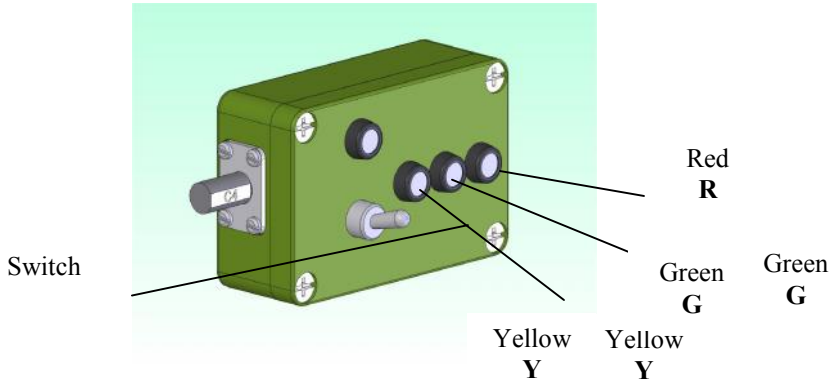


Fig.30

Battery voltage (V)	Switch status	Power supply (U) status	Y	G	R	Remarks
>30	0	0	0	0	0	
		1	1	1	1	
	1	0	b	b	b	**Switch status** 0 = uncoupled 1 = coupled
		1	1	1	1	
[29,30]	0	0	0	0	0	
		1	1	0	0	
	1	0	b	0	0	
		1	1	0	0	**Power supply (U) status** 0 → U<20,4V 1 → U>20,4V
[28,29]	0	0	0	0	0	
		1	1	1	0	
	1	0	b	b	0	**LEDs status**
		1	1	1	0	
[22,28]	0	0	0	0	0	Y, G, R= 0 → no lit Y, G, R = 1 → lit Y, G, R = b →blinking (lit 0,3 s; no lit 2,7 s)
		1	0	1	0	
	1	0	0	b	0	
		1	0	1	0	
[21,22]	0	0	0	0	0	
		1	0	1	1	
	1	0	0	b	b	

		1	0	1	1	
<21	0	0	0	0	0	
		1	0	0	1	
	1	0	0	0	b	
		1	0	0	1	

NOTE: *If the BF batteries voltage is under 21V, the manual mode cannot be used, even if the switch is ON*

- If the vehicle power supply voltage is under 20.4 V (or is switched off) the brakes are powered from BF

- The batteries from BF are permanently charged from the vehicle power supply , between 20.4V and 30 V.

-if the vehicle power supply voltage is more than 30 V, the battery charging is stopped (overcharge protection)

8. Maintenance

All the subsystems of the RCWS-RO-E are sealed and require no special maintenance operations.

8.1 Preventive maintenance to the user is limited to:

- visual inspection;
- outside cleaning BS; inside cleaning CP and DIS
- gun cleaning (according GPMG 7.62 User Handbook)
- operational check
- replacing damaged or lost parts with spare parts procured from the manufacturer.

These activities shall be performed:

- at start-up
- after a repair
- prior to and after a mission
- periodically (if the device has not been used):
  - monthly: visual inspection and cleaning
  - every 3 months: operational check
  - every 3 years: checking and replacing the rubber parts

8.1.1 Visual inspection

During visual inspection, make sure the WA subsystems (**fig 31**) are firmly mounted in their brackets and check the integrity of the buffers, the cleanness of the exterior surfaces of BS, the electrical coupling and the gun safe mounting

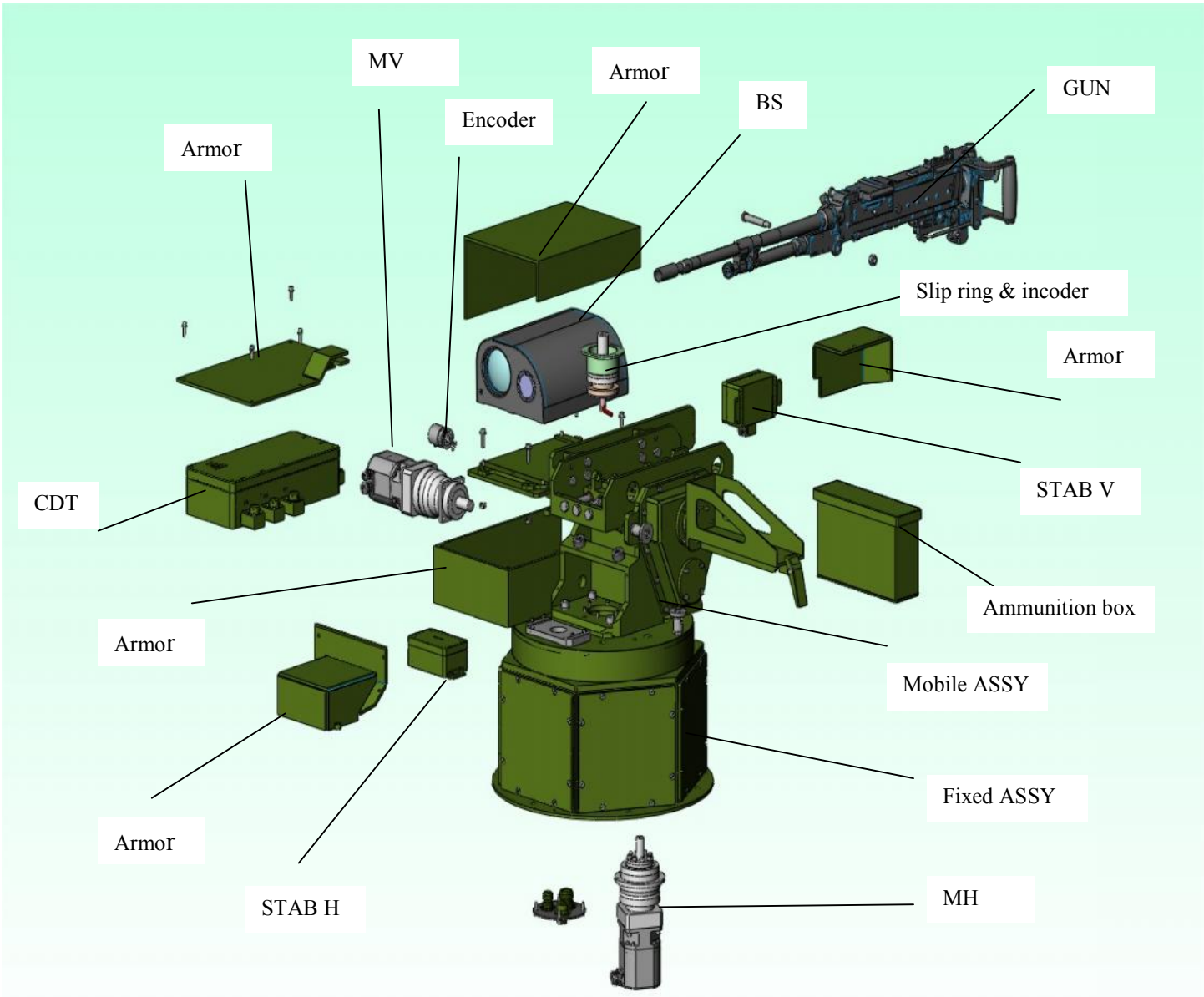


Fig.31

Check the cabin subsystems : the roof assy (containing CDM, BF, SBF- **fig.32**) , the switches and the buttons on CP (**fig.33**), the DIS (**fig.34**) screen cleanining status; check the harness and the connections between the subsystems.

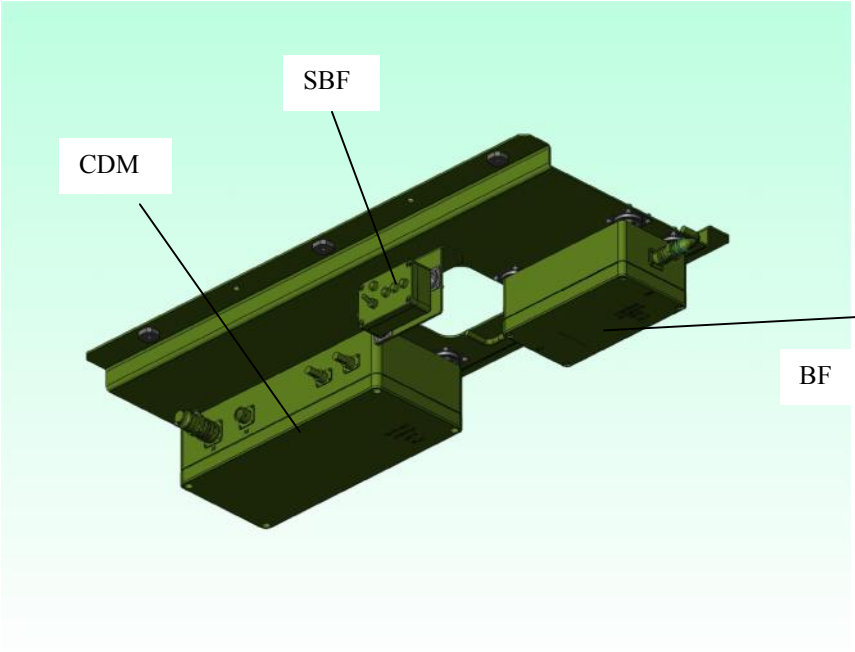


Fig.32

Fig.33

Fig.34

8.1.2 Cleaning (WA and cabin subsystems)

- Clean dust the mechanical parts of the subsystems with a common cloth.
- If you detect mud or fats, use clean water to damp the cloth and soap or mild detergent. Make sure that the water with detergent doesn't reach the optical parts, as they may be damaged in contact with a more strong detergent.
- Clean the exterior optical surfaces as follows:
  - clean dust with the cotton cloth included in the delivery kit;
  - remove mud stains with a soft paper serviette, moistened into water;

– after cleaning, steam the optical surfaces (by blowing) and wipe them gently with a dry clean cloth;

WARNING!

It is forbidden to use gasoline or organic solvents when cleaning the subsystems.

NOTE *The weapon has to be cleaned according to specific instructions (procedures) from 7.62 GPMG User Handbook*

8.1.3 Operational check

- During the operational check, the electrical and software operating procedures are verified

- The operational check is made according to the chapter 7.3.1

8.2 Corrective maintenance

8.2.1 Failures

If a failure occur, the user has to take the appropriate measures:

- Study the "Troubleshooting" (chapter 9) and see if the failure can be solved according the manual indications
- replace the foulty item with a spare part, if the failure was located and if the spare part is available in user warehouse (see chapter 10)
- claim for the spare part if it was not ordered, and replace it when available
- if the failure was not located, connect the special tool ETA to the X1 input of the CP and move the Rotary switch on the ERRORS position
- send the report displayed on the screen to the manufacturer and wait for his decision/action

8.2.2 Adjustments

If the firing accuracy seems to be damaged, some adjustments could be necessary in order to retrieve the factory parameters

The user has to:

- connect the special tool ETA to the X1 input of the CP and move the Rotary switch on the appropriate position (CAL, ALIGN, LIM, REF, ERR, FZONE)

-proceed to adjust the chosen parameter according to chapter **7.3.2 – Auxiliary modes**

NOTE *The special tool ETA si not used during operation and firing. It is used only for maintenance and adjustments*

Usually, the NO FIRE ZONES are factory settings, special located for each type of vehicle. Changing these zones may be performed only with manufacturer support! A wrong set up performed by the user may cause huge damages, even human lives loss!

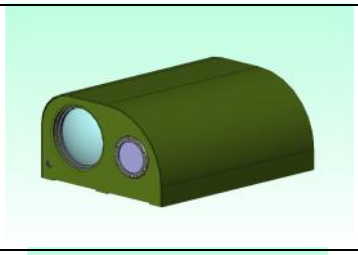
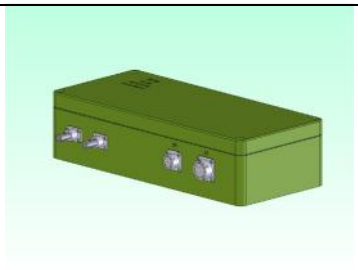
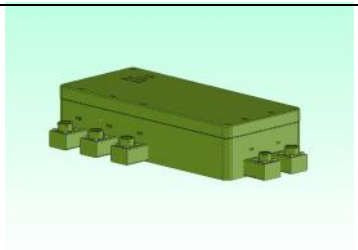
9 Troubleshooting

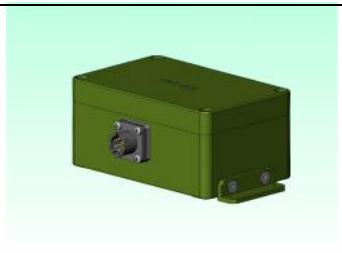
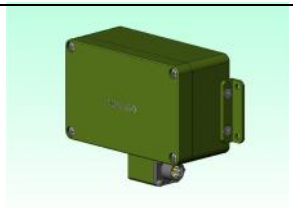
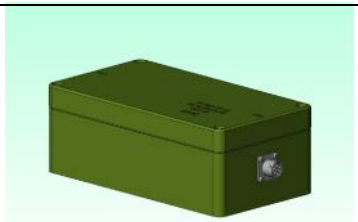
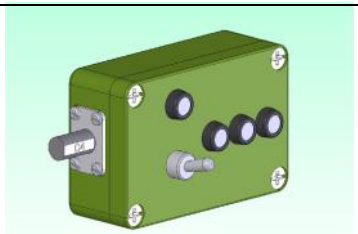
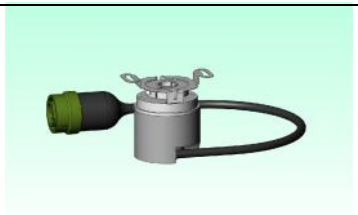
Symptom	Possible causes	Corrective actions
When the SYSTEM switch of the CP is turned "ON", the SYSTEM led doesn't light	- There is no voltage in the vehicle power system - The power supply cable connector has not been coupled correctly to the CPU -The fuse of the CP is burnt out or the SYSTEM signalling LED has failed	-Check for the voltage -Check the firm coupling of the connector to the CPU -Replace the fuse; if it burns out again, send the device for check or repair immediately -replace the SYSTEM led
LEDs CDM, CDT, BS, STB are blinking red-green	Power supply voltage less than 18 V	Check the vehicle batteries and charge them
LEDs on CP are not lighting as programmed	The LED is failed	Check the LEDs with BIT If the start sequence is not OK, change CP
The buttons on CP have no the expected action	The button is failed You've chosen the wrong mode There are errors in the system	Change CP Check the chosen mode and go to the right mode Check the errors with ETA, in auxiliary ERR mode, and change the indicated failed subsystem
The LED on CP corresponding to a subsystem is blinking green	The system is initializing ETA is coupled in auxiliary mode DRIVE and CDM , CDT are adjusted	Wait for the block to be initialized (no failure) Check the current mode- NO failure
The LED on CP corresponding to a subsystem is red	The subsystem is not connected The communication between that subsystem and CP failed	Check the connection Change successively the subsystem, then CP and the cables between them
The LED on CP corresponding to a subsystem is blinking red (the system might work , but not	This subsystem is failed or another subsystem controlled by the first	Check the connection between subsystems; if the failure still persists, check the

Symptom	Possible causes	Corrective actions
entirely)	one is failed	errors using ETA, in auxiliary mode ERR
The LED on CP corresponding to STB function is red	STB switch is OFF The conditions for activating the stabilisation are not fulfilled	No failure Check the conditions for activating the stabilization
The LED on CP corresponding to STB function is blinking red	A subsystem (at least) working in stabilization function is failed	Check the error messages or check the errors using ETA, in auxiliary mode ERR
The LED on CP corresponding to BRK function is red	The switch on SBF is ON	Put the switch to OFF (no failure)
The LED on CP corresponding to BRK function is not lighting when the switch is ON	The switch on SBF failed It is a failure in BF The cable between BF and SBF , or the cable between CP and BF failed	Change SBF Change BF Change the cables
The LED on DIS does not light (while the LED SYS on CP lights)	DIS is not connected LED failed (the image exists on the screen) Cable between CP and DIS failed DIS failed CP failed	Check DIS connection Check the BIT sequence and change DIS Change the cable Change DIS Change CP
The LED on DIS is blinking green	DIS is initializing	Wait for finishing the initialisation
The LED on DIS is red	The communication between CP and DIS failed	Change successively DIS, CP and the cable between them
The LED on DIS is blinking red	DIS failed	Change DIS Check the errors in auxiliary ERR mode
There is no image, though the LED on DIS is green	DIS failed	Change DIS
NO VIDEO message displayed	BS is not connected BS failed DIS failed Cable video failed	Check BS connection Change BS Change DIS Change the cable
The LEDs on SBF don't light	The power supply voltage is too low The LED is failed	No failure Check the BIT (all LEDs blinking 3 times) and change SBF
The LEDs on SBF are blinking	There is no power supply BF is not connected	Check the power supply (no failure) Check BF connection
When the Joystick arm is pushed in any direction, the WA is not rorating in azimuth	The power supply is under 18 V	-Check the power supply

Symptom	Possible causes	Corrective actions
	The conditions for rotating are not fulfilled (hatch closed, dead man switch pushed) There is a failure in CDM or MH	Check the conditions to rotate Check the error messages or check the errors using ETA, in auxiliary mode ERR and change the failed subsystem
When the Joystick arm is pushed in any direction, the WA is not rorating in elevation	The power supply is under 18 V The conditions for rotating are not fulfilled (hatch closed, dead man switch pushed) There is a failure in CDT or MV	-Check the power supply Check the conditions to rotate Check the error messages or check the errors using ETA, in auxiliary mode ERR and change the failed subsystem
The overlay grafics for the selected mode are not displayed	BS failed BS not connected properly in the system	Change BS Check the BS connection
The stabilization is not working when the switch STB on CP is put to ON	A subsystem (at least) working in stabilization function is failed (the STB LED on CP is blinking red	Check the error messages or check the errors using ETA, in auxiliary mode ERR
The FIRE switch on CP is not working	The conditions for firing are not fulfilled The switch is failed	Check the conditions for firing: the message XX FIRE READY has to be displayed on the bottom of the screen (XX= SS, SB,LB) Change CP

10. Spare parts

Nr.	ITEM	PICTURE	P/N	PRODUCED BY	NOTES
1.	Sensor block BS		A.726.02.006.0.	S.C. PROOPTICA S.A.	
2.	Display 10.4” DIS		A.726.02.008.0.	S.C. PROOPTICA S.A.	
3	Control Panel CP		A.726.02.007.0.	S.C. PROOPTICA S.A.	
4	Control box for azimuth CDM		A.726.02.010.0.	S.C. PROOPTICA S.A.	
5	Control box for elevation CDT		A.726.02.011.0.	S.C. PROOPTICA S.A.	
6	Horizontal motor MH		A.726.02.002.0.	S.C. PROOPTICA S.A.	

Nr.	ITEM	PICTURE	P/N	PRODUCED BY	NOTES
7	Vertical Motor MV		A.726.02.003.0.	S.C. PROOPTICA S.A.	
8	Gyro sensor block for azymuth STAB H		A.726.02.004.0.	S.C. PROOPTICA S.A.	
9	Gyro sensor block for elevation STAB V		A.726.02.005.0.	S.C. PROOPTICA S.A.	
10	Brake block BF		A.726.02.009.0.	S.C. PROOPTICA S.A.	
11	Control brake block		A.726.02.012.0.	S.C. PROOPTICA S.A.	
12	Encoder V		A.726.02.015.0.-	S.C. PROOPTICA S.A	
13	Incoder H + slip-ring SR-ASSY		A.726.02.014.0.-	S.C. PROOPTICA S.A	

- Spare parts are provided upon customer's request.

- The system may be repaired, at user's level, by replacing the whole damaged blocks only. -

- The exploded drawings of the RCWS-RO-E and of the subsystems (spare parts) are presented in Annex 3

11. Storage and transportation conditions

11.1. Storage

Packed products may be stored, before mounting on the vehicles, in storage areas which are unheated, with natural aeration, made of stone, concrete, wood and thermally insulated.

Storage temperature: -40° to + 60° C

The products shall be placed on shelves or on the ground, not closer than 1 m to heating sources and away from direct and long exposure to sun rays.

It is not allowed to store the products in the same room as inflammable liquids, charged batteries or containers with corrosive chemical substances, petroleum or radioactive products.

Products can be packed for storage as below:

Wipe them of dust and moisture and wrap them in textile or nylon covers, place them in a transport box (crate), separating the four main subsystems with corrugated board

11.2. Transport

Packed products can be transported by any means of transport (by road, sea or air).

For sea transportation, the systems have to be covered with a protection wax, which may be removed by hot water

The transport packing must ensure the integrity of the product for the type of transport and climate conditions agreed by the contract.

12. Warranty

Unless otherwise stipulated in the contract, the manufacturer provides a warranty period of 12 months, provided that the operation requirements and the safety rules in this operator's manual are followed. The warranty period starts on the date of delivery of this product to the customer