Portable Ground Control Station

A Universal Off-the Shelf Solution

User manual V 1.1

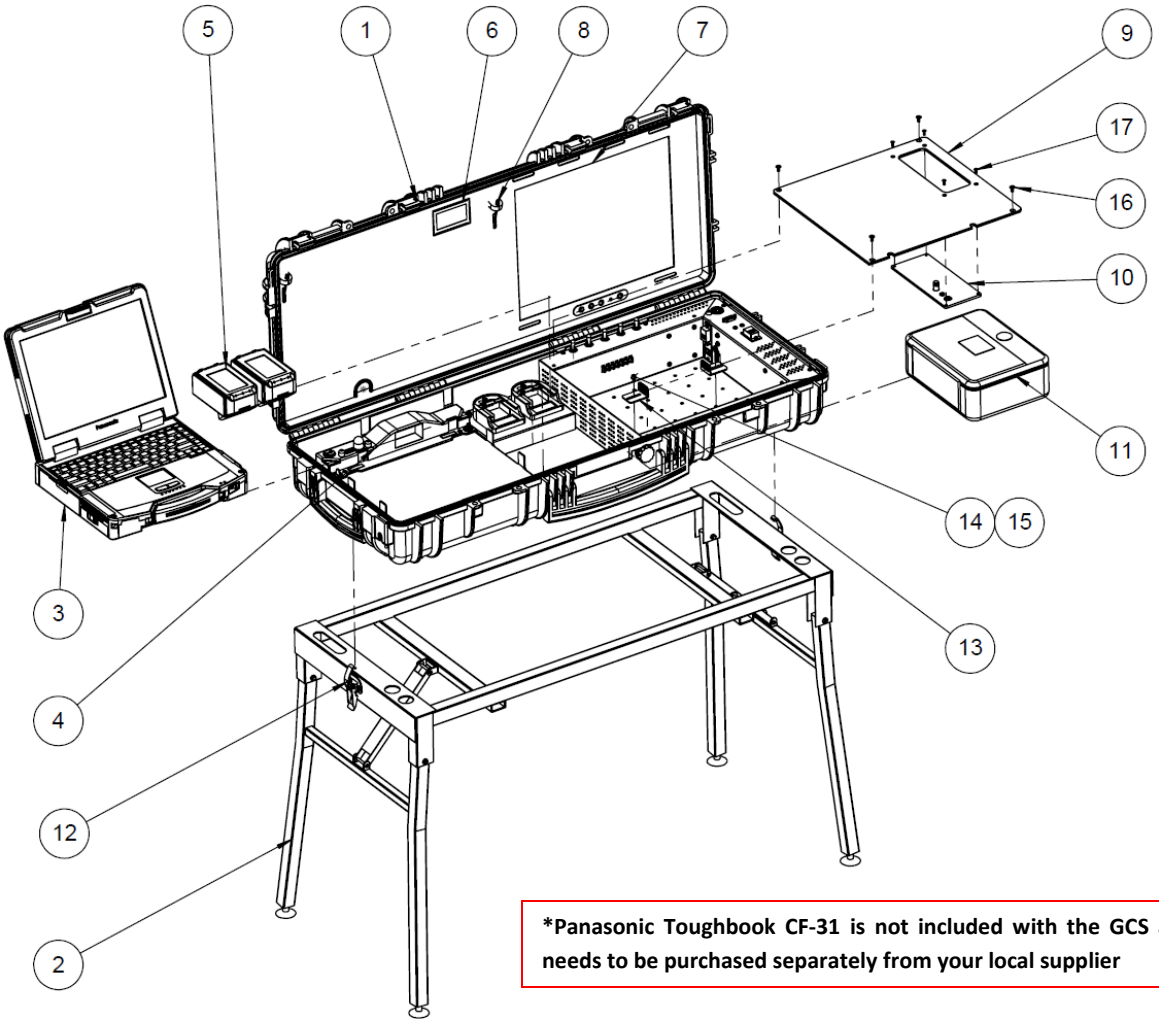
Contents

1 System overview

Thank you for purchasing UAV Factory's portable ground control station. UAV Factory's off-the-shelf portable Ground Control Station (GCS) is a flexible and universal solution for controlling unmanned vehicles and payloads. The general overview of the GCS is given in Figure 1.

The GCS can be configured to control unmanned aircraft vehicles (UAV), ground robots, bomb disposal robots, remotely operated vehicles (ROV) and other robotic devices. The GCS can also be configured to control and monitor other measurement and sensing equipment.

Based on Panasonic's field proven CF-31 Toughbook(1), the GCS has additional 17'' sunlight readable touch screen display, advanced power distribution system with hot-swappable dual batteries and status monitoring features. The GCS is housed in a military grade rugged, lightweight case which makes it ideal for use in harsh environments.



***Panasonic Toughbook CF-31 is not included with the GCS and needs to be purchased separately from your local supplier**

No.	Component Name	QTY.
1	Ground Station case	1
2	Foldable stand	1
3	Panasonic CF-31 Toughbook	1
4	Docking station	1
5	Lithium-Ion battery	2
6	Power status display	1
7	17" Display	1
8	Antenna pass-through	2
9	MEC protection lid	1
10	Configurable connection panel	1
11	Cordura accessories bag	1
12	Stand Clamp	2
13	Mounting bracket	6
14	Hex socket head cap screw M4x6 DIN 912 Zn	6
15	Washer ALE 4,3A DIN125	6
16	Countersunk Allen Screw M 4x8 DIN7991	4
17	Countersunk Allen Screw M 3x12 DIN7991	4

Figure 1 Portable ground control station system overview

2 Specifications

Mechanical Specifications	
Dimensions	1000 x 420 x 170 mm
Weight (excl. Panasonic Toughbook CF-31)	18.9 kg
Environmental protection	IP66 when closed
Operating temperature	-20 to +70 °C (if equipped with wide temperature display)
Electronics compartment dimensions	320 x 270 x 80 mm
Mounting base	M4 threaded mounting grid, 45 mm pitch, aluminum mount kit included
Accessory bag internal dimensions	220 x 160 x 70 mm
Case features	Rugged plastic case, side handles, carry handle, wheels, pressure purge valve, shoulder strap (optional)
Computer mounting type	Docking
Electrical Specifications	
DC input	10 – 32 VDC Over-voltage protection, reverse polarity protection
Battery type	Lithium Ion
Battery Capacity	108 Wh
Battery Operation time	2 hours (typical)
Connections (all routed to Panasonic CF-31)	2 serial (RS-232), 5 USB, 2 Ethernet, 1 Composite Video in (IMPERX video device needed), 1 Microphone in, 1 Audio out, PCMCIA slot, HDMI
Connections to 17” display	Composite Video (Optional), external VGA input (Optional)
DC power output 1	12V 5A fused, 50 W
DC power output 2	12V 5A fused, 50 W
Antenna pass-through	Two 50 Ohm antenna pass-through to upper lid SMA-RP termination, RG 142
Computer Specifications (not included with GCS)	
Model	Panasonic Toughbook CF-31 (all specifications as per manufacturer datasheets)
Durability	MIL-STD-810G & IP65 certified (6' drop)
Display Type	13.1" XGA touch screen LED 1024x768
Brightness	1100 nits
17” Display Specifications	
Display Type	17 " TFT 1280 x 1024 (SXGA) Optional touch screen Optional AR glass
Brightness	1400 nits
Touchscreen type (optional)	Resistive

3 System Description

3.1 Power distribution system

Portable Ground Control Station has an integrated power system which has three independent power sources - one external power input and two Lithium battery cartridges. Allthree power sources are interchangeable and GCS will switch automatically between availablesources, with preference given to the external power input.

The required external power input voltage is in the range of 10 to 32 Volts DC.In case both battery cartridges are discharged and external power voltage is below 10 Volts, the system shuts down automatically to prevent battery damage.

Figure 2 shows schematic drawing of the power distribution system in the GCS. External power and batteries are connected to the power source selector which provides power to the Laptop, LCD display and to two auxiliary power outputs located in MEC.Each power source and output is fused to protect the system from short circuit and overload; fuses are marked with blocks numbered from F1 to F7. The external power input has additional overvoltage protection and reverse polarity protection.

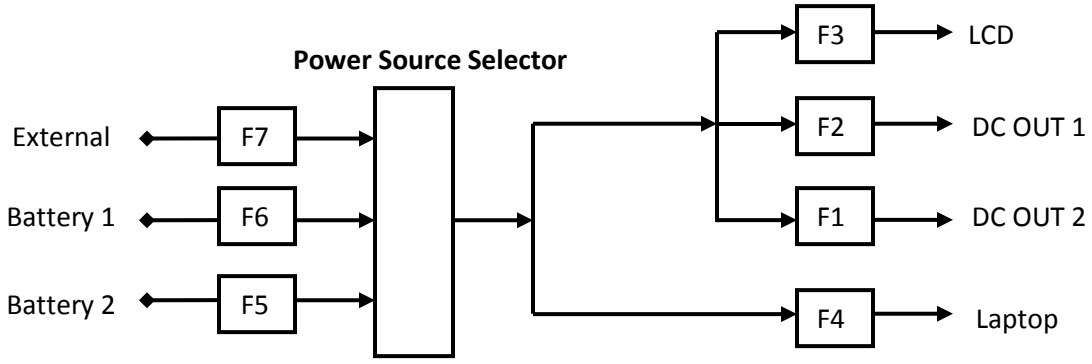


Figure 2 Power distribution diagramofModular Electronics Compartment

3.2 The modular electronics compartment

The modular electronics compartment (MEC), shown in Figure 3 allows installing the application-specific hardwareinside the GCS.Using theM4 mounting grid and included standard mounting kit, most hardware devices can be quickly installed in MEC. Circuit boards can be installed directly on the base of the electronics compartment using standoffs. The MEC is protected by a removable lid, shown in Figure 4. Once the user-specific devices are installed in MEC, the lid is closed and remains closed, unless modification to the internal device configuration is required. The lid has an additional configurable connection panel as shown in Figure 4. This connection panel is used for routing additional connections or switches from equipment installed in the MEC. The GCS comes with three blank connection panels and with the additional label set described in Table 1. Connection panels can be further machined to accommodate additional connectors and switches.

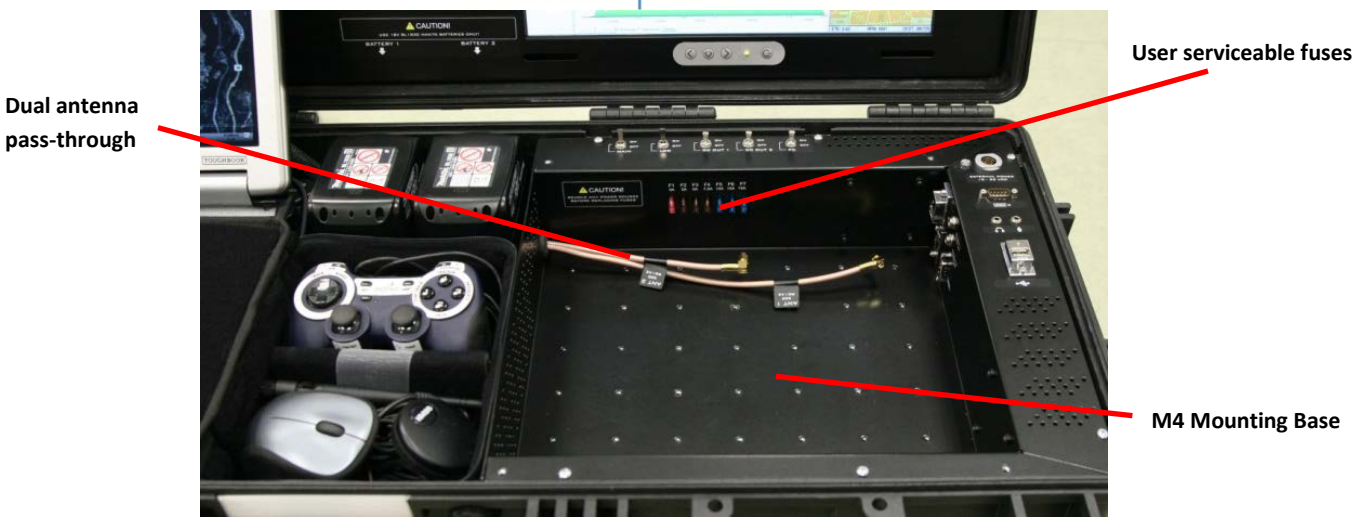


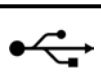
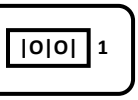
Figure 3 Layout of the modular electronic compartment.

Figure 4 MEC protection lid with configurable connection panel.

Two SMA-RP terminated antenna pass-through cables (Figure 3) can be used to connect the SMA-RP antennas in the upper lid to the hardware devices located in the modular electronics compartment. Alternatively, antenna connectors can be located on the user-configurable connection panel as shown in Figure 4.

If Omni-directional antennas are used, it is convenient to use the integrated antenna pass-through. If antennas need to be routed outside the GCS, such as to an antenna mast or tracking antenna, it is more convenient to use the antenna connections located directly on the connection panel.

Table 1 Label set description

Label	Label Description
ANT 3	Antenna Connection
ANT 4	Antenna Connection
GPS	GPS connection
RC	RC transmitter connection
DC	DC OUT 1
DC	DC OUT 2
	USB
	Ethernet
	COM1 connection
VIDEO IN	Composite video connection

3.3 Connections

Ground Control Station is designed to provide a complete set of connections for electronics located inside the MEC. There are three groups of electrical connections in the GCS (Figure 5). Group 1 is intended for external device connectionand features one serial (RS-232) port, one microphone in, one Audio out and one USB. One VGA input for the 17" display can be optionally installedin the GCS. This option allows users to switch between the VGA input and the Panasonic Toughbook.

Group 2 is located inside the MEC and is used for connecting application specific hardware to the GCS. Group 2features one USB, one serial (RS-232), one Ethernet, one Composite Video (Video In 1) and two power outputs. Please note that for capturing composite video on the Panasonic CF-31, the IMPERX VCE-PRO capture device is needed. An optional Composite Video (Video In 2) can be factory installed to provide direct connection to the 17" display. The overview of Group 1 and Group 2 connectors is given in Figure 6.

Additional two USB ports and one Ethernet are accessible in Toughbookitself - these connections are marked as Group 3 in Figure 5.

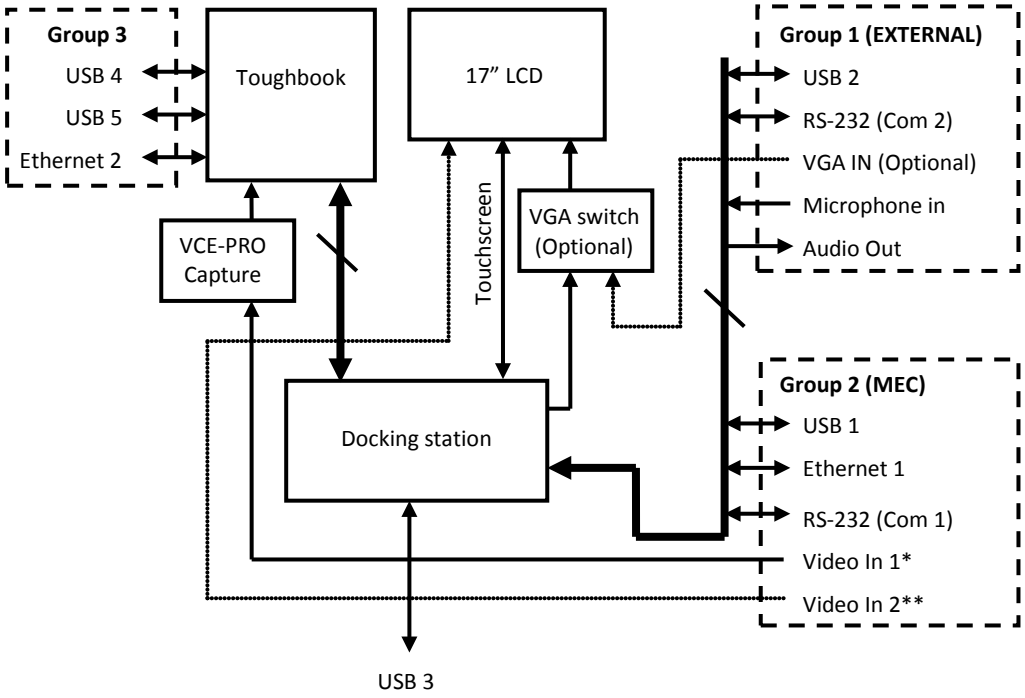
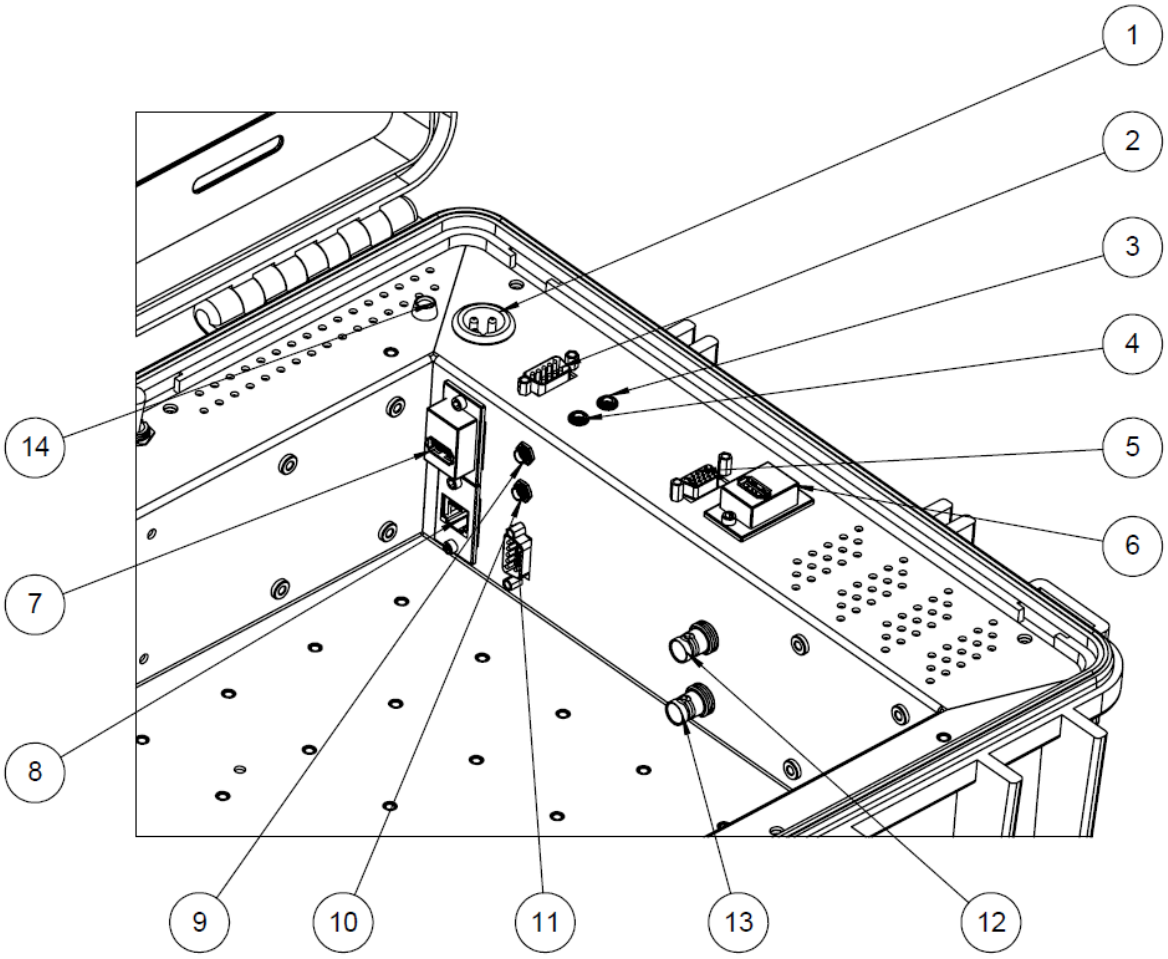


Figure 5 Communication diagram.

* IMPERX VCE-PRO capture device is needed.

** Video input connected directly to the 17" display (optional).



No.	Component Name
1	External Power
2	RS232
3	Microphone
4	Audio Out
5	VGA In (Optional)
6	USB
7	USB
8	Ethernet
9	DC Out 1
10	DC Out 2
11	RS232
12	Video In1
13	Video In2 (Optional)
14	External Power Indicator

Figure 6 Group 1 and Group 2 connectors overview.

External power connector is the XLR type connector which is located in the top right corner of the MEC (Figure 6). The external connector pinout is given in Figure 7.

Modular electronics compartment provides two power outputs for application specific electronics, marked as ‘DC OUT 1’ and ‘DC OUT 2’, as shown in Figure 6. Each output provides up to 50 W of continuous power for internal electronics. Figure 8 shows power output socket polarity diagram.

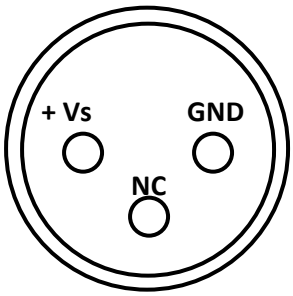


Figure 7 External power socket pinout

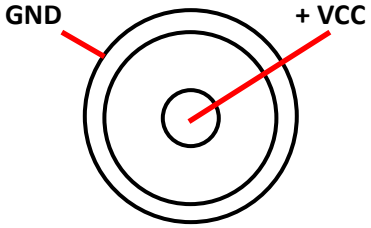


Figure 8 Power output socket polarity diagram

3.4 Switch description

The ground control station has five switches on the control panel as shown in Figure 9. Each switch is labeled and has two positions- “ON” and “OFF” respectively. Switch descriptions are given in Table 2. Additional switch is factory installed on the control panel if optional VGA input is integrated in the GCS.

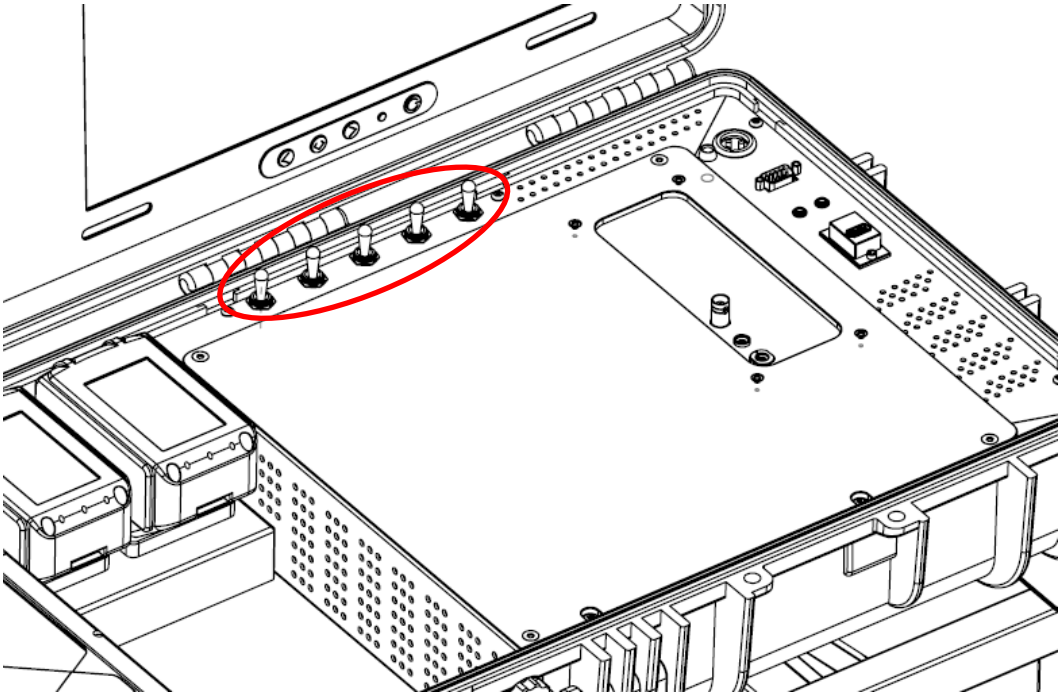


Figure 9 Control panel

Table 2 Switch description

Switch name	Description
MAIN	Main power switch. Turns on the GCS.
LCD	Turns on the 17”LCDdisplay.
DC OUT 1	Turns on power supply ‘DC output 1’ in MEC
DC OUT 2	Turns on power supply ‘DC output 2’ in MEC
PC	When switch is “ON”,theToughbook is powered from the GCS’s power supply. When switch is “OFF”,theToughbookispoweredfrom its internal battery.
VGA (Optional)	VGA source selection for the 17” display. When “PC” is selected, the display is connected directly to Toughbook’s VGA and acts as ‘extended display’. When “EXT” is selected, the display is connected to the external VGA source.

4 GCSsetup

4.1 Electronics installation in MEC

The MEC lid can be opened by removingfour screws as shown in Figure 1. Application specific electronicscan be installed into the modular electronics compartment using M4 mounting grid and included standard mounting kit. Mounting kit includes 6 mounting brackets, 1 meter of 20mm Nylon webbing and 12 plastic slides.Place electronics in the MEC and attach it with the Nylon webbing to the mounting brackets. Use supplied M4 screws to attach mounting brackets to the MEC mounting grid. MEC has a suite of connections dedicated for application-specific electronics (please refer to section 3.4).

The example of application specific electronics installation is shown in Figure 10 and Figure 11. Figure 10 shows Procerus Technologies Kestrel autopilot (2) communication module installation. The module is connected to the DC OUT 1 power output which provides 12 V supply. The autopilot communication module uses ANT 1 pass-through connection for antenna and COM 1 for serial connection to Toughbook.

Figure 11 shows typical Kestrel autopilot communication module installation with Rotoconcept's digital video receiver (3). In this configuration, video receiver uses ANT 1 and ANT 2 pass-through coaxial cables, DC OUT 2 power source and Ethernet connection for communication with Toughbook. The Procerus autopilot module is powered from DC OUT 1, and connected to COM1 serial. Antenna connectorislocated on the configurable panel on the top of the MEC protection lid.

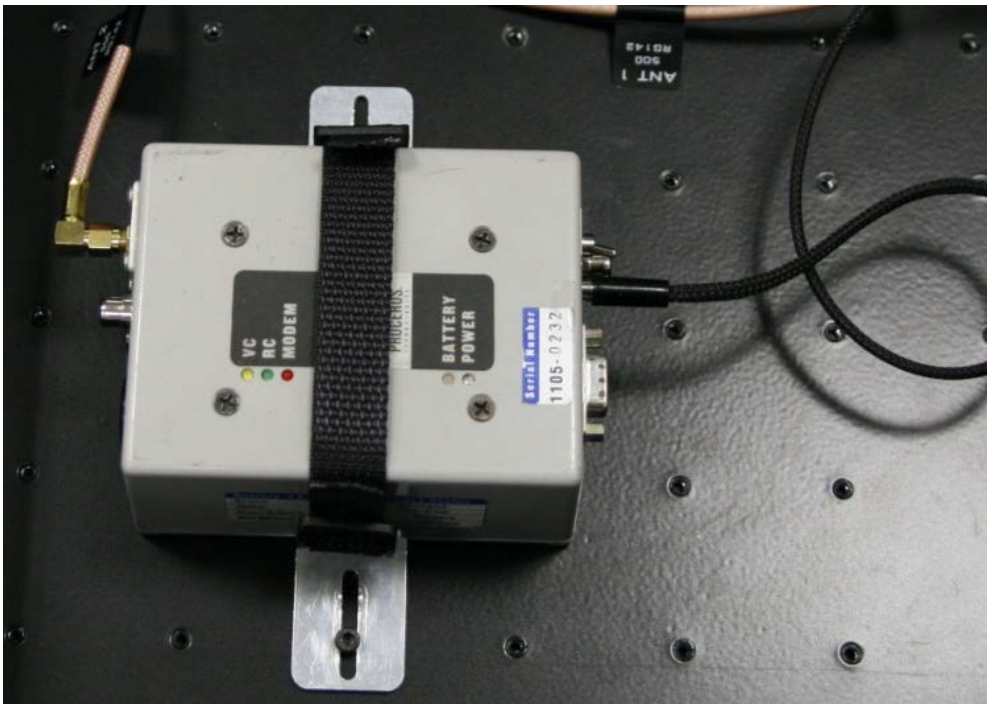


Figure 10 Example of hardware mounting inside MEC using adjustable aluminum mounts

Figure 11 Example of hardware installation in MEC for an unmanned aircraft vehicle

4.2 Battery installation

Ground control station uses two COTS Lithium-Ion MAKITA BL1830 batteries (Figure 12). Use only original 18V BL1830 MAKITA batteries (4). To remove the battery push the release button as shown in Figure 12 and pull the battery cartridge away from the mount.

Thebatterycartridgesand external power supply can beremoved or connected any time during normal operation-the power system automatically controls power source selection. The external power is a priority source.

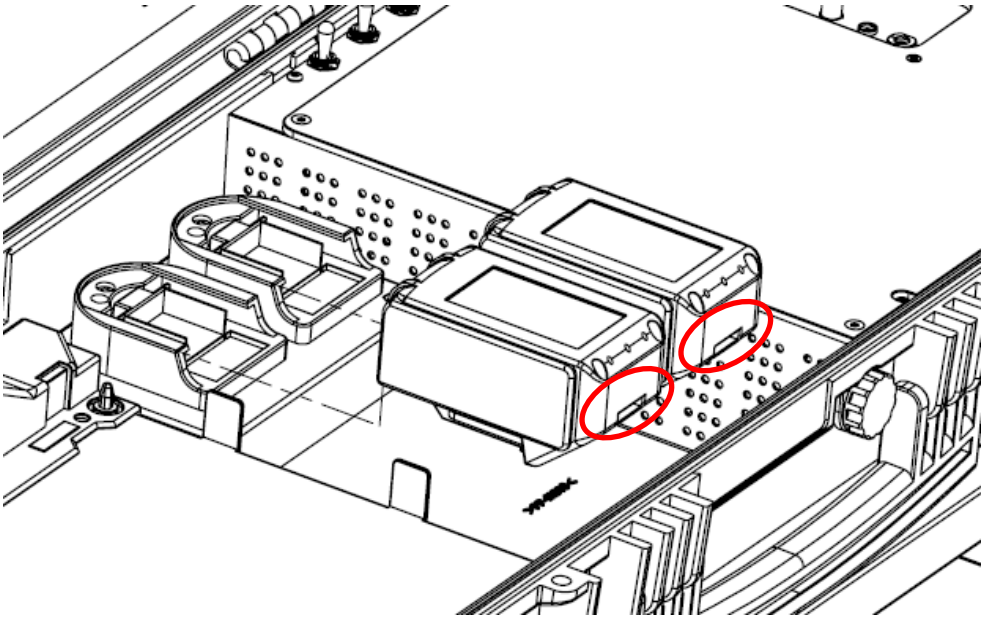


Figure 12 Battery installation

4.3 Battery charger

GCS comes with the standard MAKITA charger (Figure 13) for the BL1830 batteries. Charging time for one battery is approximately 30 minutes. Both 240 VAC and 110 VACcharger versions are available. The 12V DC charger version can be purchased separately.

Figure 13 MAKITA battery charge

4.4 External power connection

GCS comes with the AC/DC adapter (Figure 14) which is used as external power source from 110 – 240 VAC mains supply. When external power is connected, the LED which is located near the connector should light green.

Figure 14 AC/DC power adapter

4.5 Toughbook installation

The GCS has an integrated CF-31 Toughbook docking station.The docking station is also compatible with the CF-30 Toughbook.

Before installing the Toughbook, insure that protection lid on the back side is opened (Figure 15). Install the Toughbook into the docking station as shown in Figure 16.Once the Toughbook is located in the docking station, the docking handle needs to be engaged as shown in Figure 16. To remove the Toughbook from the GCS, first disengage the docking handle and then remove the Toughbook.

Figure 15 Protection lid is opened

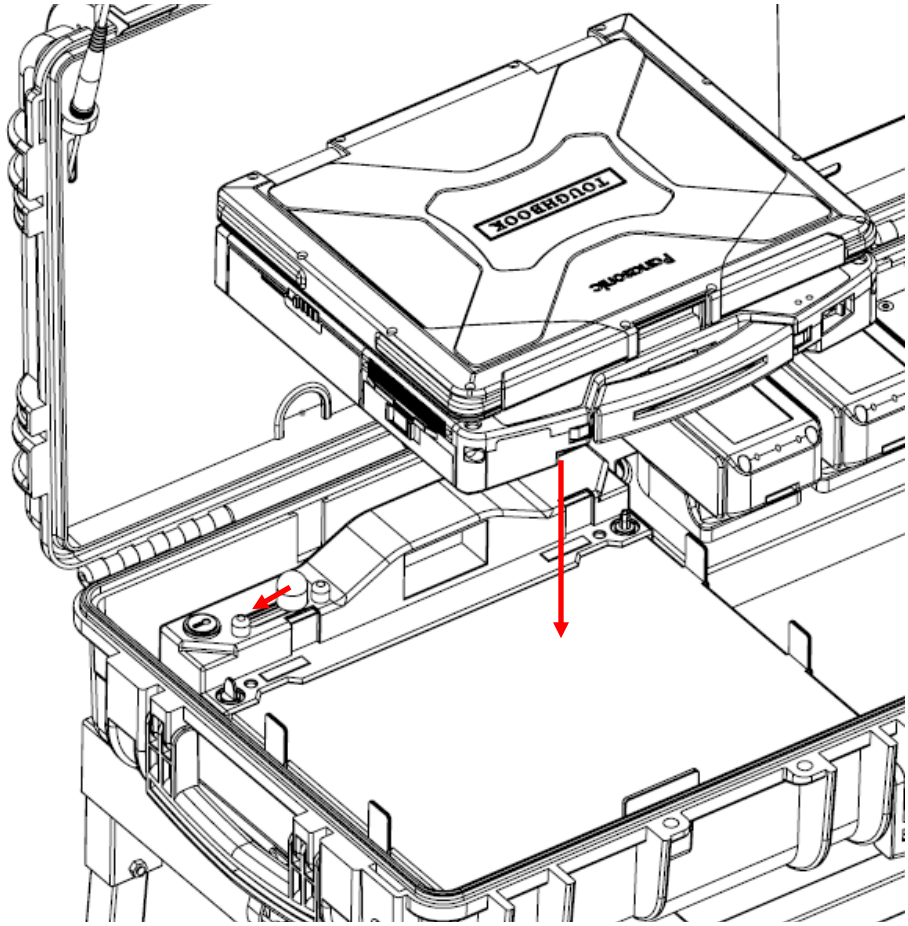


Figure 16 Toughbook docking

4.6 Foldable stand

The optional foldable stand is availablefor the GCS. Place the GCS on the top of the stand as shown in Figure 17 and attach it to the stand using two clamps from both sides.

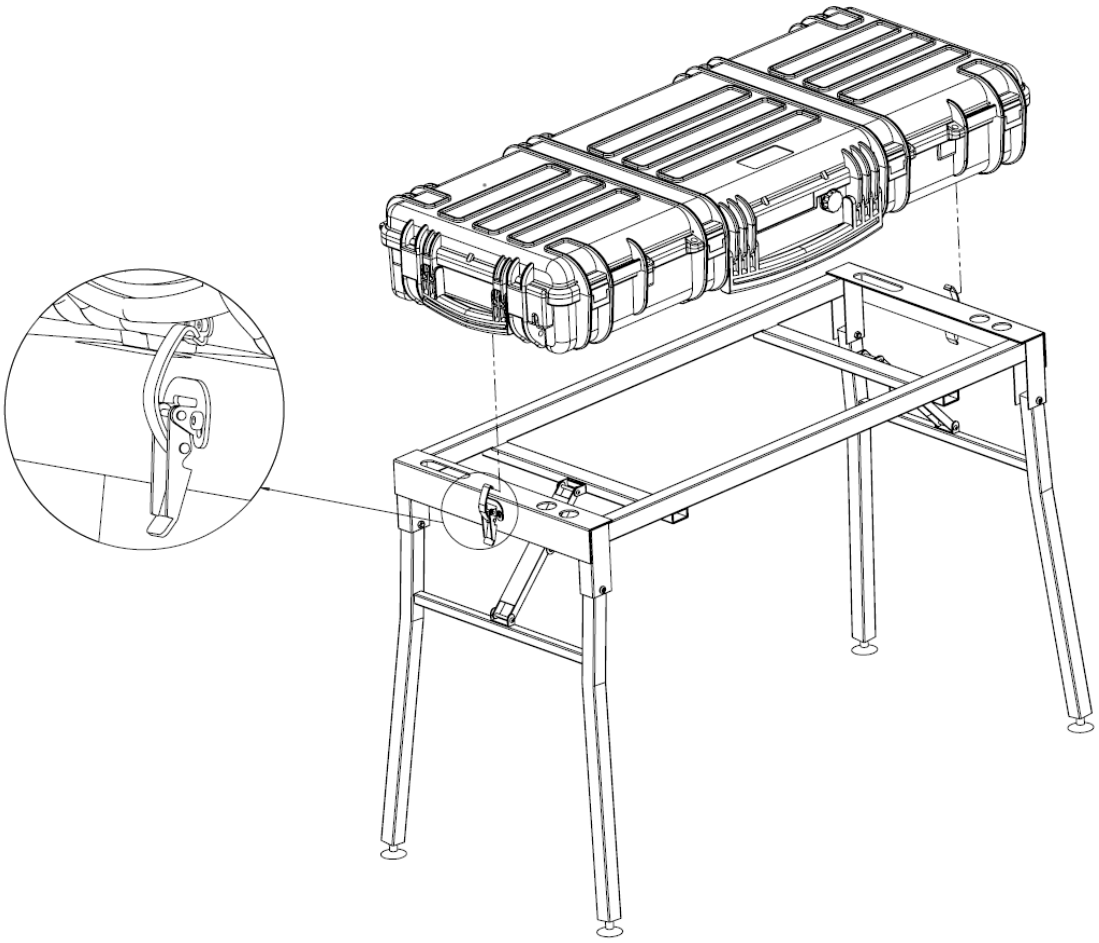


Figure 17 Foldable stand attachment

5 Operation

To turn on the Ground Control Station turn on the “MAIN” switch on the control panel (see Figure 9 for details).All GCS power parameters are displayed on a dedicated display located in the upper part of the GCS (Figure 1).

5.1 Power Status Display

The power status display shows the GCS power status as shown in Figure 18.The following parameters are displayed on the power status display: the total system power, internal temperature, external power voltage and battery voltage.If system is running on batteries, the display shows “arrow” above the appropriate battery symbol as shown in Figure 18.Power status symbol description is given in Table 3.

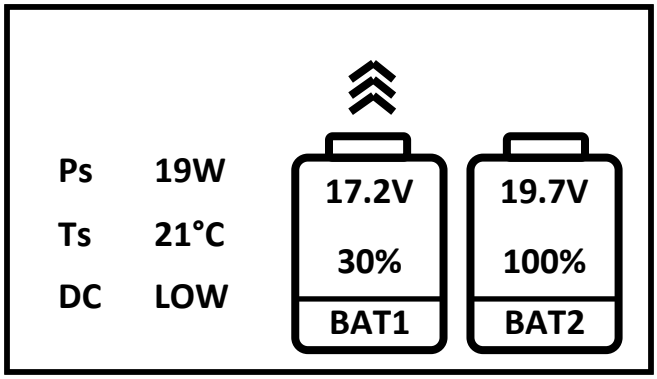


Figure 18 Power status display

Table 3 Power status symbol description

Label	Description
Ps	System total power in Watts.
Ts	Internal board temperature in Celsius.
DC	External power voltage. Displays “LOW” when voltage is below 10 Volts.
BAT1	Battery 1 status. Upper value shows battery voltage. Lower value shows remaining battery capacity
BAT2	Battery 2 status. Upper value shows battery voltage. Lower value shows remaining battery capacity

5.2 VGA setup

In order to configure the Toughbook connection to the 17" LCD, navigate to Screen Resolution window as shown in Figure 19 for Windows 7. Make sure that Toughbook is docked and 17" LCD is switched on as well as VGA switch (optional) is in "PC" position. Set 1280 x 1024 resolution for second display and select "Extend these displays" in the multiple display bar. Click "Ok" to save changes.

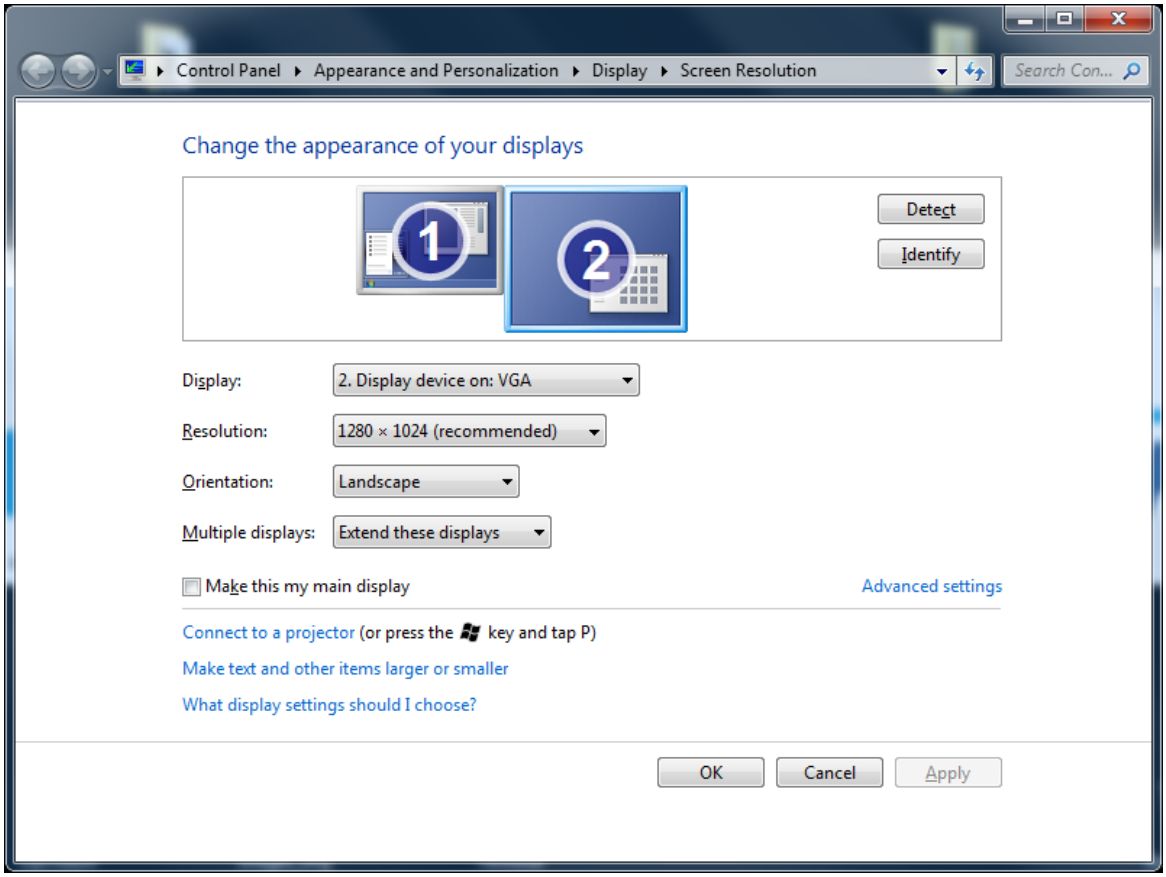


Figure 19 Second display setup screen

5.3 17" LCD display setup

Oncethe Ground Control Station is turned on, the 17" LCD display can be powered on to extend the Toughbook display. Alternatively, the 17" display can show the information from optional composite video input or optional VGA input. To turn on the LCD display, usethe"LCD" switch (please refer to section 3.4 for details). The LCD display brightness, contrast and signal source can be configuredusingtheintegrated LCD control panel (Figure 20). The control panel has an additional LCD power switch which can be used to turn off the LCD.

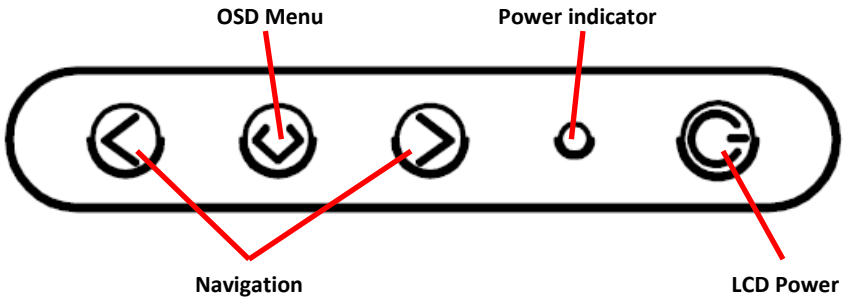


Figure 20 LCD display control panel

To adjust brightness and contrast of the LCD press "OSD Menu" (On Screen Display) button on the LCD control panel. Figure 21 shows the brightness sub page in the OSD menu. Press "OSD Menu" once more and select brightness or contrast using navigation buttons. Press "OSD menu" button and adjust brightness or contrast from 0 to 100 using navigation buttons. To save adjustment press "OSD menu" and navigate to for exit.

Figure 21 Brightness sub page

To select the signal source press "OSD menu" and navigate to the signal source sub page (Figure 22). Press "OSD menu" once more to enter into the sub page and select the necessary signal source by navigation buttons. In case of using

Toughbook VGA output or external VGA (optional) select VGA source. In case of using composite video source (Video input 2) select AV source. Press “OSD menu” to save changes and exit from the sub page.

Figure 22 Signal source sub page

The color adjustment should be done when Toughtbook is connected for the first time to the LCD. Press “OSD menu” and navigate to the color settings as shown in Figure 23. Select the automatic color adjustment  and press “OSD menu” button. Make sure that Toughbook is connected to the LCD and PC switch is “on” before using the color auto adjust. This function will improve image quality but some minor flickering can be still observed on the 17” display while Toughbook is charging the internal battery. This is common issue for the external display connection through the docking station via the VGA. High charging current goes through the same docking connector as VGA signal.

Figure 23 Color settings sub page

6 Troubleshooting

Problem	Possible reason	Solution
GCS is connected to external power supply, but doesn't work.	Not enough voltage	Connect batteries or appropriate power supplyinthe 10 – 32 VDC range.
	External power fuse is blown	Check fuse F1. Replace if necessary.
Batteries are connected, but GCS doesn't work	Both batteries are empty	Replace batteries
	Battery fuses are blown	Check fuses F2 and F3. Replace if necessary.
17" display doesn't work	LCD display fuse is blown	Check fuse F7. Replace if necessary.
	LCD was switched off on the control panel	Turn on LCD using power button on the LCD control panel
17" display shows "No signal"	Dock handle is not engaged	Check that Toughbook is docked.
	Wrong VGA configuration	Refer to section 0.
	VGA switch position is wrong	Check VGA switch position
	Wrong signal source	Refer to section 0.
No power at DC OUT 1.	DC OUT 1 fuse is blown	Check fuse F5. Replace if necessary.
No power at DC OUT 2.	DC OUT 2 fuse is blown	Check fuse F6. Replace if necessary.
No power output to the Toughbook when switch "PC" is on.	Fuse is blown	Check fuse F4. Replace if necessary.

7 Contacts

Please use the following information to contact UAV Factory:

UAVFACTORY LTD.

24A-52 Ganibu Dambis

Riga, Latvia, LV1105

Tel: +371 29119398

Email: info@uavfactory.com

8 User manual version history

Version	Comments, Updates	Date	Author
1.0	First manual version for Portable Control Station	03.06.2012	AG
1.1	Added note regarding the 17” display and VGAsetup	07.23.2012	AG

9 References

1. Panasonic. [Online] http://www.panasonic.com/business/toughbook/fully-rugged-laptop-toughbook-31.asp.

2. Procerus Technologies. [Online] http://www.procerus.com/index.php.

3. Rotoconcept Robotics. [Online] http://www.rotoconcept.com/.

4. Makita BL1830. [Online] http://www.makita.com.au/products/lxt/lithium-ion/item/lithium-ion/bl1830-18v-li-ion-battery?Prodid=.