MPS45
AIR DATA TEST SET

OPERATING MANUAL

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FIGURES

SECTION 1 PRELIMINARY

This manual contains the operating procedures for the MPS45 air data test set and is suitable for both workshop and flight-line servicing.

1.1 SAFETY

The MPS45 is designed to be safe when operated in the manner described in this manual, it should be used only in the described way and for no other purposes. The manual contains Safety Instructions that must be followed, the instructions are either warnings or cautions given to protect the Operator and the equipment from damage.

Use trained technicians and good engineering practices for all the procedures in this manual.

1.2 WARNING

Potentially explosive atmospheres may occur during aircraft refuelling. This equipment is **not** certified for use within potentially explosive atmospheres. An appropriate risk assessment should be performed when this equipment is to be used on aircraft with particular attention being given to the dangers arising from re-fuelling operations. Within the EU, organisations operating equipment where potentially explosive atmospheres may occur are required to conform to the ATEX 137 Worker Protection Directive, EU 99/92/EC. Contact DMA for details of the ATEX certification standards applicable to the MPS range of products.

The following warnings apply to the internal battery:

- do not attempt to invert the connection of the battery;
- do not disassemble, crush or puncture the battery;
- do not short-circuit the battery; if a short-circuit is detected or even just suspected, remove the battery and leave it in a safe open place, away from other objects or people, for at least 15 minutes.
- do not dispose of the battery in fire or water;
- do not expose the battery to temperatures above 60°C (140°F);
- keep the battery away from children;
- avoid exposing the battery to excessive shock or vibration;
- do not use a damaged battery;
- if the battery is leaking fluids, do not touch them; in case of eye contact with the fluids, clean the eyes thoroughly with water for at least 15 minutes, and make sure all fluid was washed away, then seek medical attention;
- disposal of battery must be done according to local regulations and laws; contact your sales representative for more information.

1.3 PRESSURE

Never apply pressure greater than the maximum safe working pressure to the equipment.

1.4 TOXIC MATERIALS

There are no known toxic materials used in the manufacture or build standard of this

MPS45. An internal rechargeable totally sealed battery is housed within the instrument and is easily removable from the front panel.

1.5 MAINTENANCE AND REPAIR

The MPS45 is to be maintained and repaired using the approved procedures and be carried out only by DMA authorized agencies or the manufacturer.

1.6 INFORMATION AND ADVICE

Contact the manufacturer, subsidiary or agent for further detailed technical advice.

1.7 NOTE

This Manual is applicable starting from SW Version 1.07.

1.8 IMPORTANT NOTES

- The manual vent valves on the front panel must be closed before the start of testing.
- Connect the ADTS to the static and pitot ports only after the start up procedure is completed.
- For optimum operation and highest precision, the MPS45 should be operated with the front panel face up.
- When transporting the MPS45 in an unpressurized aircraft, use the VENT/SEAL valve (if available on the case) to prevent damage, to keep the pressure inside and outside of the case equal.
- It is recommended to mount the MPS45 at a height of 1 meter above floor level where fuel vapor could be present, for example during re-fueling operations.
- The total volume of the pneumatic circuit of the MPS45 is small. When no pneumatic load is connected to the ADTS, thermal effects could result in apparent leaks. The final inspection and calibration procedures indicate rate values and stabilization times that must be followed in order to compensate for thermal effects.

1.9 GETTING STARTED

Prior to using the MPS45 the following points should be considered.

1.9.1 INTERNAL BATTERY

The internal battery can be removed from the front panel. It is not strictly required for operating the MPS45. However it also serves as an emergency back up system, to safely return the instrument and aircraft system to ground conditions in the event of an external power failure during testing.

1.9.2 BATTERY CHARGING

The internal Battery has an operational life of 2 hours when fully charged. On receipt of the MPS45 the internal battery will require charging. Due to internal monitoring circuits, the battery will slowly discharge when not in use. The battery is recharged whenever the MPS45 is connected to an AC power supply.

The time needed to fully recharge the battery when connected to the AC supply is 2 to 3 hours.

The battery should never over-discharge. When the MPS45 is not being used for long periods of time, it is suggested to recharge the battery at least once every 6 months.

1.9.3 INTERNAL LEAK TEST

When carrying out a preliminary Leak Test of the MPS45, in order to establish the correct operation, it is very important to follow the altitude and airspeed rates that are indicated in the MPS45 Calibration and Adjustment manual. Higher rate values could cause thermal effects that would be detected as leaks. If it is not possible to control the indicated rates, then the stabilization times must be longer, for example 30 minutes.

1.9.4 DMA ADAPTOR KIT USE

Certain DMA pitot static adapter kits require an external vacuum source, to keep the static adapters fixed to the aircraft fuselage by means of vacuum cups. The MPS45 provides a vacuum port on the front panel.

1.9.5 STATIC & PITOT PORTS SEALS

Do not use any tools to tighten the MPS45 pneumatics ports. The “AN” fittings on the MPS45 front panel incorporate an O-ring seal, and only require finger-tight fastening.

For the replacement of the seals after a long period of use, use O-Ring series 2015, 2018 and 2031.

1.9.6 VACUUM AND OVERPRESSURE GENERATION

The MPS45 generates vacuum and pressure inside its internal reservoirs, for controlling the Static and Pitot lines. The pumps only run when needed, in order to save power and ensure a longer operational life.

1.9.7 28V DC SUPPLY

The MPS45 can be optionally powered from a 28V DC power supply (option A0).

Use only cables marked “CBL110929GPA” for powering the MPS45 from a 28V DC supply! Other cables could damage the instrument.

1.9.8 FIELD ALTITUDE

The pressure control system of the MPS45 needs to know the altitude at which the unit is operated. On dispatch from Production the Qfe is set to a value of 260 feet.

If the field altitude (“QFE” parameter) is not set correctly, the MPS45 may not be able to control altitude values below the ambient pressure.

To set the correct field elevation value, follow the instructions given in the Calibration and Adjustments Manual.

1.9.9 INTERNAL HEATER

The MPS45 can be equipped with an internal heater module (option W1), that allows operating the unit at temperatures down to -20°C (-4°F).

At power-on, if the internal temperature is too low, the internal heater is started automatically, and a message appears on the display. As soon as the internal temperature reaches the minimum value for ensuring nominal operation, the ADTS carries out its regular start-up procedure.

SECTION 2 GENERAL INFORMATION

The DMA MPS45 is an automatically controlled low cost Air Data Test solution for troubleshooting and certification of aircraft pitot-static systems with RVSM accuracy requirements. It provides facilities for the simulation of altitude and airspeed. All rate values are also controlled.

The MPS45 instrument is simple and fast to use. The operator interface is easy to understand by both experts and first time users. All testing and troubleshooting with the MPS45 is carried out via the touch-screen and an intuitively arranged color-coded keyboard on the front panel (FIG 2).

The values of pressure, altitude, airspeed and associated rates are shown on the color graphical LCD display. Commanded and measured test values are simultaneously displayed at all times.

The MPS45 is also compatible with the DMA MPSRC remote control (FIG 3), that provides the same operating interface. The MPS45 is designed to reject any commanded values which exceed pre-programmed limits. Limiting values are password protected.

Test profiles can be programmed and automatically executed by the MPS45.

The Unit Under Test (UUT) is safely isolated in the event of any power loss.

The MPS45 incorporates two internal pump units for pressure and vacuum supplies. The pumps only run when required, to save power and ensure a longer operating life.

2.1 MAIN PARTS

The MPS45 main parts are:

- Power supply.
- Static and Pitot lines pneumatic components.
- Electronic circuits, including microprocessor-based systems for pressure measurement and control.
- Internal battery.
- High Performance Piezoresistive Pressure sensors.
- Compressor – vacuum membrane type pump units.
- Keyboard and Color Touch-Screen Display.

The front panel (FIG 1) provides operating controls and displays, pressure fittings and connectors for external control.

The equipment is packaged within a lightweight HDPE (high density polyethylene) case.

2.2 MAIN TECHNICAL SPECIFICATION

2.2.1 FUNCTION

- Generation of pressure and vacuum sources using the internal pumps.
- Generation of static (absolute) pressure or altitude.
- Generation of total (absolute) pressure or dynamic (differential) pressure or airspeed.
- Simultaneous generation of altitude and airspeed.
- Generation of altitude rate (climb or dive) (feet/min).

- Generation of airspeed rate (increasing or decreasing) (knots/min).
- Generation of static (Ps) pressure rate (climb or dive) (hPa/min).
- Generation of dynamic (Qc) pressure rate (increasing or decreasing) (hPa/min).
- Generation of total (Pt) pressure rate (increasing or decreasing) (hPa/min).
- Generation of Mach number.
- Generation of Engine Pressure Ratio (E.P.R.) as Pt / Ps ratio.
- Leakage test.
- Automatic Vent to ambient pressure.
- Maximum LIMIT set values: the ADTS permits the simple setting of maximum values (limits) to which the unit can operate. It is supplied at the time of delivery with the following default values set by the manufacturer:
  - Max altitude: 50,000 feet.
  - Min. altitude: -1,500 feet.
  - Max. airspeed: 450 knots.
  - Max vertical speed: 3,000 feet/min.
  - Set airspeed rate: 300 kt/min.
  - Max. Mach number: 1.
- Low battery mode, allowing only pressure measurement and return to ambient pressure.
- Automatic safety protection avoids negative Qc values (Ps < Pt) in airspeed and Qc control modes.

2.2.2 RANGE, ACCURACY

Altitude

- Range: from -7,500 to 80,000 feet.
- Resolution: 1 foot
- Accuracy: ± 3 feet @ sea level;
  ± 7 feet @ 30,000 feet;
  ± 18 feet @ 50,000 feet.

Vertical speed:

- Range: from 0 to 50,000 feet/min.
  The maximum value depends on the volume of the pneumatic load.
- Resolution: 5 feet/min below 1,500 feet/min.
- Accuracy: ± 1% of reading.

Airspeed:

- Range: from 0 to 850 knots. Optional: 0 to 1,000 knots.
- Resolution:
  - standard: 1 knot below 50 knots;
    0.1 knots above 50 knots;
  - Ultra-Low Speed: 1 knot below 20 knots;

0.1 knots above 20 knots.

- Accuracy: ± 0.8 knots @ 50 knots;
  ± 0.1 knots above 500 knots.

Airspeed rate:

- Range: from 0 to 500 knots/min.
  The maximum value depends on the volume of the pneumatic load.
- Resolution: 10 knots/min.
- Accuracy: ± 10 knots/min ± 1% of reading.

Mach number:

- Range: from 0 to 6 (limited by airspeed range).
- Resolution: 0.001.
- Accuracy: ± 0.002 @ sea level.

2.2.3 POWER

90 to 240 VAC and 50 to 400 Hz.

Maximum power consumption: 120 W.

Optional 28V DC (option A0) with cable “CBL110929GPA”.

An internal battery is included, providing 2 hours operation.

Maximum current output from the Encoding Altimeter connector (option B7):

- 24V line (pins 1, 2): 300 mA;
- 5V line (pin 5): 500 mA.

2.2.4 PRESSURE MEDIA

Air

2.2.5 MEASURE UNITS

The operator can change the default units as required. Upon request, DMA can deliver the ADTS with different default units.

- Default Units are: feet, knots, hPa.
- The following additional aeronautical and pressure units are available by pressing the appropriate key:
  - for Altitude: meter and hectometer
  - for Pressure: inHg, mmHg, Pa, kPa, inH_2O, p.s.i.
  - for Airspeed: mph and km/h.

2.2.6 PHYSICAL SPECIFICATIONS

Dimensions: W 22” x D 14” x H 9” (55.8 cm x 35.6 cm x 23 cm).

Weight: 33 lbs (16 kg).

2.2.7 ENVIRONMENTAL LIMITS

Temperature ranges:

- Operating: from -10°C to 50°C. Optional: -20°C to 50°C.

- Storage: from -20°C to 70°C.
- Extended range available on request.

CE compliant.

2.2.8 CALIBRATION

The MPS45 can be calibrated in-house, if desired: calibration is performed by software adjustment only, and the parameters are password protected for security. No mechanical adjustments are required to calibrate the MPS45.

Using a transfer calibration standard (for example the DMA's own PAMB11H), the MPS45 can be calibrated in typically less than 40 minutes. Please refer to the MPS45 Calibration and Adjustment Manual for more information.

Stability of the calibration is better than 80 ppm full-scale over 2 years.

2.2.9 START-UP TIME

The MPS45 goes through an automatic self-test at each power-on.

The equipment is ready for operation about 180 seconds after power-on.

NOTE *if the internal heater is installed, the start-up time could become longer, depending on the ambient temperature.*

2.2.10 CONTROL CAPABILITY WITH INTERNAL PUMPS

The control capability is optimized to allow allow up to 6,000 feet/min at 50,000 feet with the following loads:

- Static line: 125 cu. in. (2 liters).
- Pitot line: 80 cu. in. (1.3 liters).

2.2.11 PROTECTION

The MPS45 comes equipped with built-in protection to safeguard the test set itself and the instruments under test, ensuring there will be no more damaged instruments or air data test set as so often occurred on older equipment.

The hardware is intrinsically safe:

- control valves are normally closed when not powered;
- manual vent valves never allow Pt < Ps;

The software also incorporates the following safety functions:

- user-defined limits for all controlled values and rates;
- protection against Pt < Ps;
- protection against excessive leaks in MEASURE mode.

In case of AC power loss, the MPS45 automatically switches to battery operation.

If the battery is flat or not available, the static and pitot lines remain sealed.

When power is restored, the MPS45 senses the current pressure values and begins controlling again.

In case of emergency, the manual venting valves enable the Operator to safely bring all lines back to ambient pressure.

2.2.12 EXTERNAL SUPPLY PORTS

The MPS45 vacuum source is connected to a pneumatic port on the front panel. The port supports the use of DMA adaptor kits with suction cups.

2.2.13 OPTIONAL MULTIPLE ISOLATOR FUNCTION

The MPS45 can be provided with up to eight Ps and four Pt connections.

The Multiple Isolator function enables the Operator to individually seal each port, to allow advanced leak checking procedures and generation of different pressure levels.

2.2.14 ADDITIONAL CONNECTIONS

The MPS45 comes equipped with an RS232 port, that enables communication with an external PC for remote control. Refer to SECTION 12 for more information. The MPSRC also connects to the RS232 port.

One type A USB port is also provided on the front panel. The MPS45 enables transferring profiles and profile results to and from USB pen drives.

An optional Encoding Altimeter connector enables the MPS45 to receive gray code input.

Additional data communication ports are available as options:

- IEEE 488 (GPIB);
- ARINC 429;
- Ethernet.

Finally, other connectivity options, such as wireless LAN and Bluetooth, are available as external dongles.

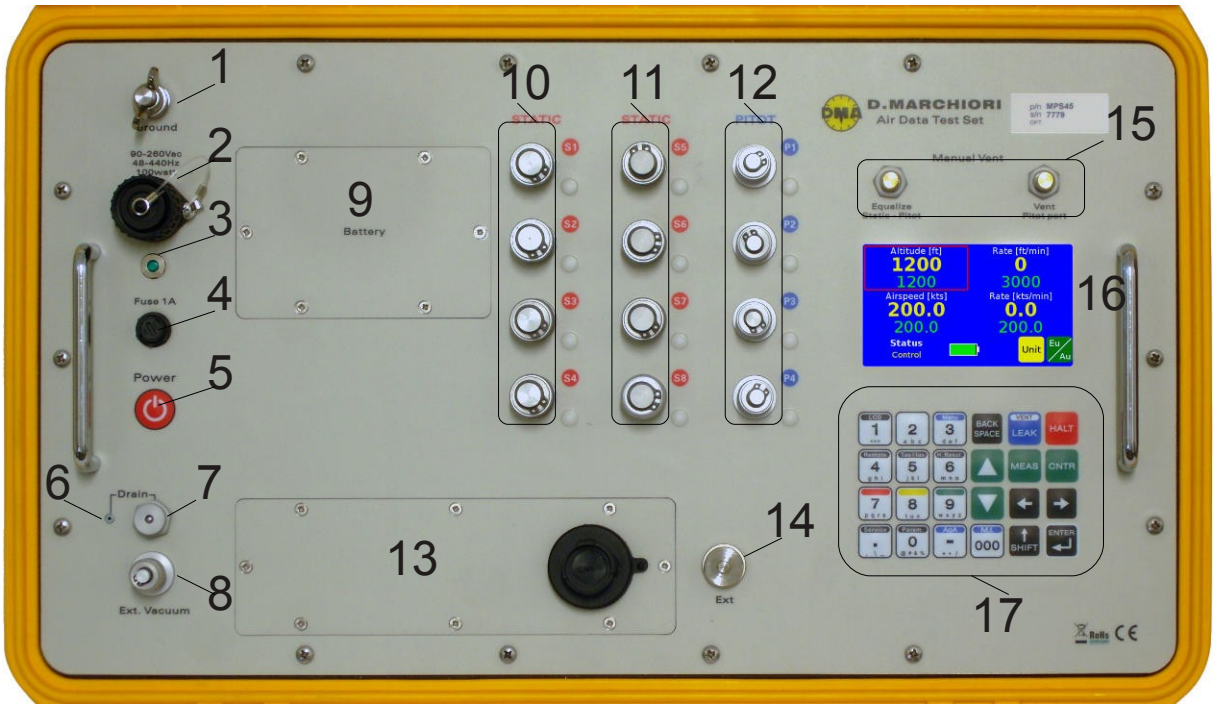

FIG 1 MPS45 FRONT PANEL

1. Electrical ground connector
2. External power socket
3. AC power LED
4. Fuse
5. Power button
6. Drain valve
7. Drain button
8. Vacuum port
9. Battery compartment
10. Static line outputs
11. Static line outputs
12. Pitot line outputs
13. Additional communication ports
14. RS232 port
15. Manual vent valves
16. Display
17. Keyboard

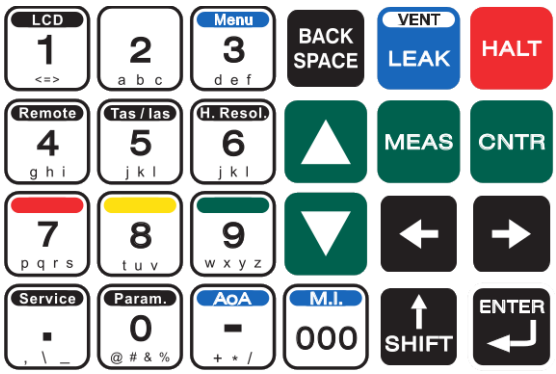

FIG 2 KEYBOARD LAYOUT

FIG 3 MPSRC REMOTE CONTROL

SECTION 3 CONTROL KEYS AND TOUCH SCREEN

The Operator interacts with the MPS45 via the touch-screen and the 24-element keyboard (FIG 2) on the front panel.

The color graphical LCD display features a dot matrix of 480x272 pixels.

The MPSRC remote control (FIG 3) provides the same keyboard layout as the front panel, and a color graphical LCD touch-screen display, featuring a dot matrix of 320x200 pixels.

Four rows of keys provide access to all of the MPS43's control and operational functions.

Keys are color coded for ease of use. A telephone format 0 to 9 keypad is included for entry of target values.

All functions can be accessed using the keypad. The touch screen provides faster access to some functions, depending on the current display mode.

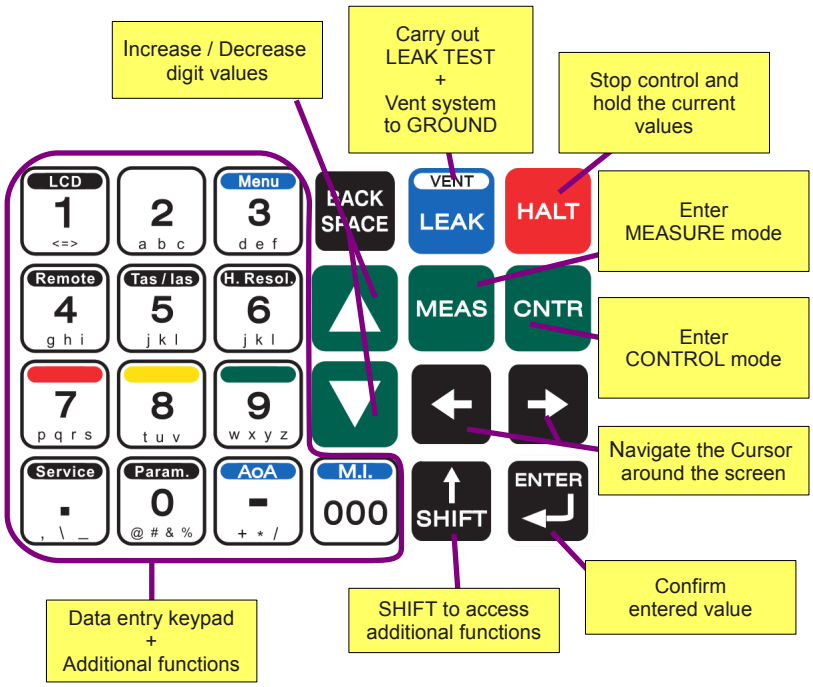

FIG 4 KEYBOARD EXPLANATION

Rightmost – operation keys:

HALT: stops the pressure control and sets the current pressure values as targets. This actions the stopping of a running test, while keeping the control system enabled and actively compensating leaks.

MEAS: sets the MPS45 into MEASURE mode. The pressure control system is turned off, leaving only the pressure measuring system active. This function is used to achieve extra accuracy, because it avoids any controller-induced effects on the measured pressures.

CNTR: sets the MPS45 into CONTROL mode. The control system reaches and stabilizes the Ps/altitude and Pt/airspeed targets.

NOTE MEAS *and* CNTR *are the most frequently used keys in the general operation of the MPS45.*

The ← and → keys are used to change the selection around the Status and Leak screens, and to navigate inside menus. The numerical keypad is used for data entry into the

selected area of the screen.

SHIFT: has the same function as a shift key on a computer keyboard. It is used together with other keys to command alternative key functions (e.g. SHIFT followed by **4** to activate the “Remote mode”).

A summary of SHIFT key operations is shown in SECTION 13. Please note that the SHIFT key must be pressed **before** other keys, and not at the same time. A small arrow appears in the lower-left corner of the display while the SHIFT key is active.

The ENTER key is used to input desired data the MPS45. The operation is the same as the “Enter” key on a computer keyboard.

BACKSPACE: is used to delete the last entered digit for correcting mistakes.

LEAK: is used to automatically perform a leak test using the built in timer/stopwatch function of the MPS45. The HALT, MEAS and CNTR end the leak test.

VENT (activated by pressing SHIFT then LEAK in sequence) is used to vent the pressure in the static and pitot lines to ambient pressure. This function enables the safe disconnection of test lines from the aircraft / UUT at the end of testing. The MEAS and CNTR keys are used to restore the MPS45 to the MEASURE and CONTROL modes respectively, after the vent function has been activated. The HALT key interrupts the procedure and returns the MPS45 to CONTROL mode.

The UP and DOWN triangle keys ▲ and ▼ are used:

- to increase or decrease the selected parameters (altitude, airspeed, rate etc.) by a selected value;
- to navigate inside the menus;
- in the Display Screen, to adjust the display brightness (refer to paragraph 10.2).

Numerical keypad

The keypad is a standard telephone layout ten-number keypad. The numerical keys (0–9) are used to enter any desired value for the various controlled parameters. After keying in a number, the Operator must always press ENTER to confirm and commit the value into the system.

NOTE *For some optional operations, number keys may be used in combination with the SHIFT key, to access additional functions.*

The **000** key is a shortcut to enter three consecutive zeros.

The decimal point key (**.**) is used to input decimal points when required (e.g. airspeed).

The minus key (**–**) is used to enter negative numbers (e.g. an altitude value below sea level).

Entering text using the numerical keypad

The numerical keypad is also used to enter text data. Each key can be used to enter the letters and symbols that are printed on the key itself. Press the key repeatedly to cycle through all its symbols.

An empty space can be entered by pressing once the key '**1**'.

SECTION 4 CONTROLLED UNITS, OPERATIONAL MODES, MENUS AND SCREENS

The MPS45 supports multiple operational modes, menus and screens.

- Modes are defined by the operating characteristics that are relevant during operation in the specific mode.
- Screens refer to data that is shown on the LCD display. Some screens may be read only, not allowing parameters to be entered or changed.
- Menus are screens that contain a list of parameters and allow their values to change.

4.1 CONTROLLING AND DISPLAYING AERONAUTICAL OR PRESSURE UNITS

The MPS45 can display and control either **A**eronautical **U**nits (Au) (altitude and airspeed) or **E**ngineering **U**nits, (Eu) pressures (static and dynamic).

For rate control:

- When controlling aeronautical units, the altitude and airspeed rates are controlled.
- When controlling pressures, the Ps and Qc/Pt rates are controlled.

The display settings are independent from the control mode. For instance, it is possible to display static pressure while controlling altitude rate.

The controlled and displayed units can be changed by touching the Eu/Au button on the status screen (FIG 5).

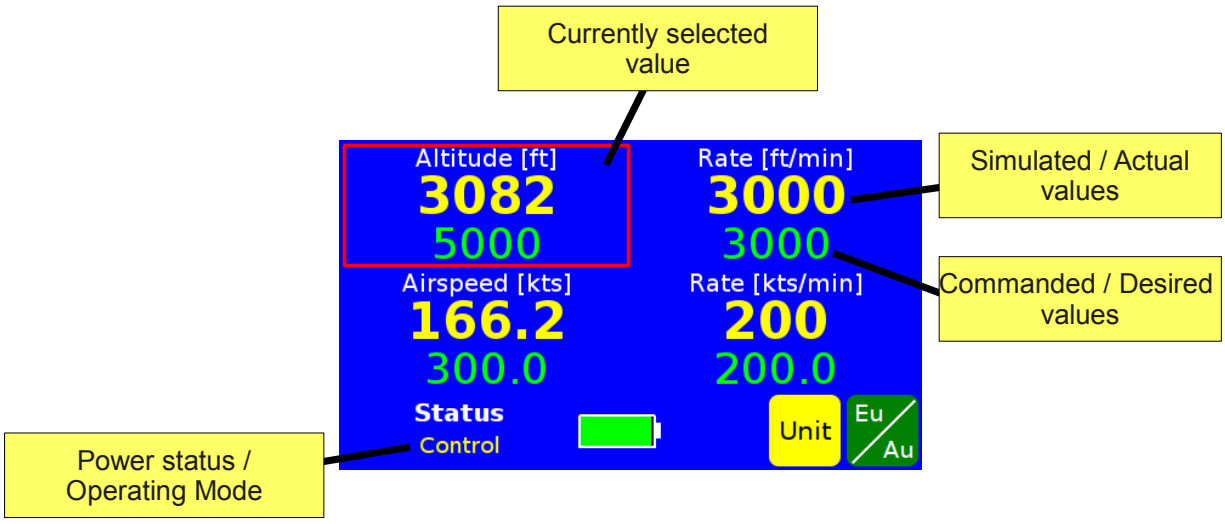

FIG 5 THE STATUS SCREEN (AERONAUTICAL UNITS)

- To change the **display** mode, select the altitude/Ps or airspeed/Pt/Qc values in the left part of the screen;
- to change the **control** mode, select the altitude/Ps or airspeed/Pt/Qc **rate** values in the right part of the screen;

then touch the Eu/Au button.

NOTE *some automatic procedures (like returning to ambient pressure or valve mapping) are only available in either pressure or aeronautical units. The Operator will need to switch the MPS45 to the correct units before starting such procedures.*

When the ADTS is displaying or controlling Qc or Pt, the orange button Qc/Pt allows to switch the display between differential Qc and absolute Pt values.

4.2 OPERATIONAL MODES

4.2.1 CONTROL MODE

This is the primary mode for control of the MPS45. Air data parameter entry and all the operational/control functions are all performed in this mode. The main display used in this mode is the status screen (FIG 5).

While the MPS45 is in the CONTROL mode, the internal pumps are running when required by the control system.

Entry to the CONTROL mode is by pressing the CNTR or HALT keys. The latter also changes the commanded values to the currently simulated pressures.

NOTE *when the battery level is low, the MPS45 will automatically switch from CONTROL to MEASUREMENT mode. It will not be possible to switch back to CONTROL mode until the MPS45 is connected to AC power. Refer to paragraph 4.2.5 for more details.*

When the simulated values are very close to the commanded values, the MPS45 shows “Stabilization” in the lower-left corner of the screen. The parameters of this indication can be tuned; please refer to the Calibration and Adjustment manual for more information.

4.2.2 MEASURE MODE

The MEASURE MODE is used to place the system into the mode where only the pressure measuring system is active and the control system is turned off. The unit under test (UUT) becomes completely isolated from the pressure generator, and precise measurements can be obtained when the line pressures in the UUT under test are stabilized. Whenever a precision measurement is required, in particular when large volumes are involved, the MEAS function should be used: all control functions are disabled and only sensor measurement functions are active. The MEASURE mode can be accessed from all menus.

Entry to the MEASURE MODE is by pressing the MEAS key.

CAUTION *When the MPS45 is in MEASURE or LEAK mode of operation, the MPS45 may automatically switch to CONTROL mode if a problem is detected; for example, a high altitude leak or a negative Qc pressure. It is possible to permanently store the values that trigger such operation; if desired, consult the MPS45 Calibration and Adjustment Manual.*

CAUTION *The automatic protection against negative Qc pressure values is not active while the ADTS is in Pt control mode, allowing greater versatility when the instrument is being used in a non pitot static test application.*

Different measure modes

The MPS45 supports mixed MEASURE and CONTROL modes for particular leak testing procedures.

By pressing the MEAS key repeatedly, it is possible to change the state of the control system among the MEASURE, “STATIC MEASURE” and “DYNAMIC MEASURE” modes.

- In STATIC MEASURE mode, the altitude/Ps channel stays in MEASURE mode, while the airspeed/Qc channel remains under control.
- In DYNAMIC MEASURE mode, the airspeed/Qc/Pt channel stays in MEASURE mode, while the altitude/Ps channel remains under control.

The current mode is always indicated in the lower-left corner of the Status Screen (FIG 5).

NOTE *while in the mixed MEASURE/CONTROL modes, the MPS45 will automatically switch to CONTROL mode if any problems are detected.*

4.2.3 VENT AND "AMBIENT PRESSURE REACHED" MODES

The Vent mode is used to vent the pitot and static ports of the MPS45 to the ambient pressure condition. The "Ambient Reached" mode is the operation mode that follows a successful venting procedure.

For more information about the venting procedure, refer to paragraph 7.3.

The Operator can leave the Ambient Reached mode with the MEAS, CNTR or HALT keys.

NOTE *The "Ambient Pressure Reached" mode is similar to the MEASURE mode (paragraph 4.2.2) with one difference: the Ps and Pt ports are internally interconnected, forcing zero Qc value. The MPS45 may repeat the venting procedure automatically, if the simulated pressures move away from the ambient pressure, due to thermal effects.*

4.2.4 LEAK MODE

The LEAK mode initiates the automatic leak test and the internal timer/stopwatch measurement feature of the MPS45.

While in the LEAK mode, the display shows the Leak Screen (FIG 6).

Entry to the LEAK mode is by pressing the LEAK key. If pressed again, the LEAK key restarts the leak measurement.

A leak test can be interrupted with the MEAS, CNTR or HALT keys.

4.2.5 MODE LIMITATIONS DUE TO LOW BATTERY LEVEL

When the battery level is low, the MPS45 disables the CONTROL mode. The only allowed modes are MEASURE (paragraph 4.2.2) and VENT (paragraph 4.2.3).

When the MPS45 is connected to AC power, the CONTROL mode will be accessible once again.

4.3 SCREENS

4.3.1 STATUS SCREEN

The Status Screen (FIG 5) is the most used screen during the ADTS operation. It is displayed when the MPS45 is turned on. Simulated (actual) values are displayed above the commanded (target) values, each with its measure unit.

The screen displays four physical quantities:

- altitude, airspeed and the corresponding rates, when the ADTS is controlling aeronautical units;
- static pressure, dynamic/total pressure, the static pressure rate and the dynamic/total pressure rate, when the ADTS is controlling pressures;
- Mach number, when enabled.

The physical quantity in the lower-right corner can be selected by pressing the SHIFT and '**–**' keys. The possible choices are:

- airspeed/Pt/Qc rate (depending on the current control mode);

- Mach number.

Each quantity can be selected by pressing on the touch screen, or using the keyboard ← and → keys.

A red frame indicates the currently selected quantity.

The lower part of the screen displays:

- the current operational mode of the ADTS (refer to chapter 4.2). Touching this area of the screen is equivalent to pressing the MEAS or CNTR key.
- the actual AC/battery status. A small diagram displays the battery charge level. When the AC is connected, the battery is displayed full with a black '**C**'.
- up to three colored buttons. Their function can vary with respect to the current operational mode. The buttons can be activated either by touching them or pressing the SHIFT and one among the '**7**', '**8**' and '**9**' keys.

4.3.2 LEAK SCREEN

The Leak Screen (FIG 6) is shown when the MPS45 is in LEAK mode. It displays:

- the measured leaks (in the left part of the screen);
- the currently measured rates (in the right part of the screen);
- the elapsed or remaining time in seconds.

The leak values are calculated by subtracting the current values from the values at the beginning of the leak test. Therefore, a decreasing quantity will have a negative sign.

NOTE *The leak values for airspeed and Qc are calculated by comparing the current Pt with the Ps at the beginning of the test. In other words, they are a measure of the Pt leak rate, and are independent from any altitude/Ps leaks.*

The displayed rates are the currently measured rate values.

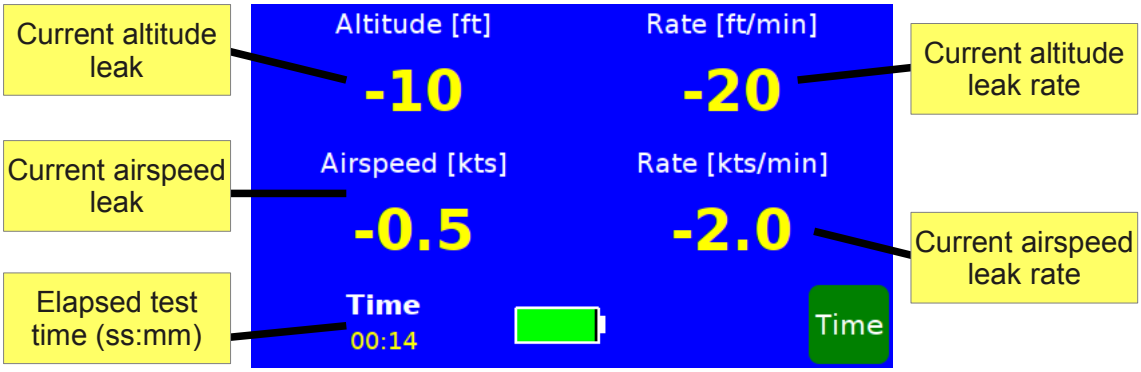

FIG 6 LEAK SCREEN IN AERONAUTICAL UNITS

4.4 MENUS

The MPS45 can display two kind of menus:

- choice menus, composed of buttons;
- value menus, displaying a set of values that may also be changed.

All MPS45 functions can be accessed from the Main Menu and its sub-menus[1].

1 a “sub-menu” is a menu which is accessed from another menu.

Most MPS45 settings can be accessed through the Settings Menus.

4.4.1 CHOICE MENUS

An example of choice menu is the Main Menu (FIG 7), which is opened by pressing sequentially the keys SHIFT + **3**.

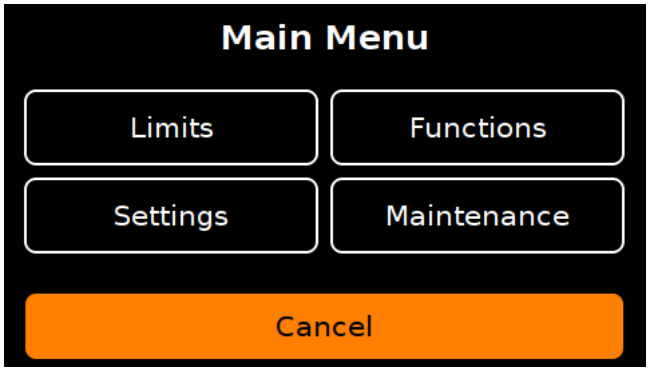

FIG 7 THE MAIN MENU

The Operator can choose one of the displayed options by touching it, or by using the ← and → and ENTER keys.

To exit the menu, the Operator can touch the orange button at the bottom of the screen, or by pressing the SHIFT + **7** keys.

4.4.2 VALUE MENUS

An example of value menu is the Limits Menu (FIG 8) that can be accessed from the Main Menu.

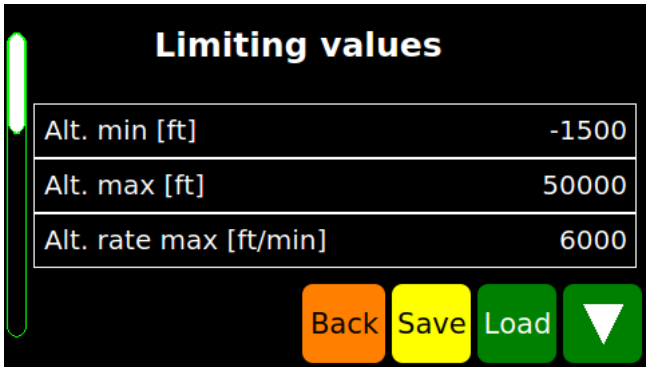

FIG 8 LIMITS MENU

The central part of the screen shows at most three values. The bar on the left indicates at which part of the menu is being shown.

The Operator can move through the menu by pressing the ▲ and ▼ keys on the keyboard or by touching the corresponding buttons on the screen.

The selected item can be changed by just entering the new value using the keypad. The value will be committed either by pressing the ENTER key, or by selecting another item.

The square buttons in the lower part of the screen may change among different menus. The “Back” button always exits the menu.

4.5 SELECTING MEASURE UNITS

The MPS45 can display both simulated and commanded values in several measure units.

The measure units can be changed from any screen featuring the yellow Unit button (e.g. the Status Screen). When the Unit button is pressed, a choice menu will appear, displaying all the measure units for the selected quantity. Refer to FIG 9 for an example.

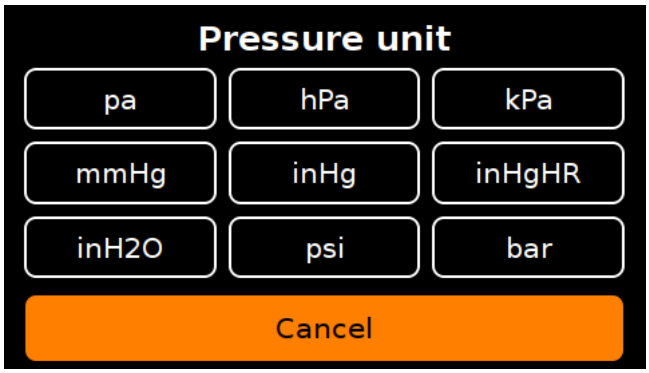

FIG 9 SELECTION OF THE PRESSURE UNIT

MPS45 supports the following measure units:

Pressure: *pa (pascal), hpa (hectopascal), kpa (kilopascal), mmHg (millimeters Hg), inHg (inches Hg), inH2O (inches water at 4°C), psi (pounds per square inch), bar.*

Altitude: ft (feet), mt (meters), hm (hectometers).

Airspeed: kts (knots), km/h (kilometers per hour), mph (miles per hour)

The rate units always correspond to the measure unit of the “base” quantity: if the altitude unit is feet, then the altitude rate unit will be feet/minute; if the pressure unit is hectopascal, then the pressure rate unit will be hectopascal/minute, and so on.

To permanently store new measure units as default in the MPS45 non-volatile memory, use the same procedures for permanent storage of new limits, as described in paragraph 8.2.

SECTION 5 START UP PROCEDURE

- Place the MPS45 with the panel face up.
- Check that the VENT/SEAL valve on the case, if present, is in the “VENT” position.
- Connect the power cord to the military style connector on the front panel.

  NOTE *when using 28V DC power supply, use cable “CBL110929GPA”* ***only****.*
- Leave static and pitot lines disconnected. All lines should be connected only after start-up is completed and the test set is at ambient pressure.
- Turn the power toggle switch to “ON”.
- The MPS45 display will first show a DMA logo; followed by the serial number of the unit and last calibration date.

When the start-up and self-check is completed, there are two possible scenarios:

1. If the altitude measured in the static line is less than 8,000 ft above QFE, then the MPS45 will automatically vent the pitot and static lines to ambient. When the venting process is completed, the display will read: "Ambient pressure reached". After this message is displayed, press the MEAS, CNTR or HALT key and start operating the unit.
2. If the altitude measured in the static line is greater than QFE + 8,000 ft, the following conditions will be automatically imposed:
   - the Commanded Altitude will be set to the value measured in the static line,
   - the Commanded Airspeed will be set to the value measured in the pitot line,
   - the Commanded Altitude Rate will be set at a fixed value (normal default 3000 ft/min).

   The Operator is then able to change the commanded values into suitable test points for the UUT and press CNTR to set the ADTS to CONTROL mode, or to return to ambient conditions.

NOTE *The reason for providing two start-up modes is to ensure that, in “normal” condition, the ADTS allows the Operator to connect the units under test right after start-up. On the other hand, when the altitude is found to be high, it is assumed that an interruption occurred, such as a power failure, and the Operator would like to resume the test, instead of returning to ambient pressure.*

To vent the MPS45 and zero the airspeed/Qc line, press the VENT (i.e. SHIFT + LEAK) key.

Again, wait until "Ambient pressure reached" is displayed, then press the MEAS key to enter MEASURE mode.

NOTE *For maximum accuracy of AIRSPEED measurements at low airspeed, refer to chapter 7.4.2.*

SECTION 6 ENTERING AIR DATA TEST PARAMETERS

Air Data Parameters (Altitude, Airspeed and rates) can be commanded (entered) in two ways:

1) by operating the MPS45 in the CONTROL mode. When the CONTROL mode is active, the MPS45 starts to change the pressures as soon as a new air data value is entered.

2) by operating the MPS45 in MEASURE mode. If it is desired that the MPS45 starts to change pressures only after **all** the new air data parameters have been entered, it is necessary to switch to MEASURE mode, then enter **all** the new target values and then return to CONTROL mode by pressing the CNTR key. All the new commands will then be activated together.

New target values can also be entered by using the triangle keys ▲ (to increase) or ▼ (to decrease).

NOTE *If any value greater than the actual limits (the values programmed in the Limits Screen) is selected, the value will be not accepted and instead the actual limit value will automatically be entered. As an example, if an airspeed value of 999 knots is entered while the limit value is set at 400 knots, then when the ENTER key is pressed, the commanded value will become 400 knots.*

6.1 ENTERING SPECIFIC COMMANDED VALUES

The MPS45 is operated by entering Commanded values for Altitude, Airspeed, Altitude Rate, Airspeed Rate (or static pressure, dynamic pressure and corresponding rates) from the Status Screen (FIG 5). To enter a Commanded value, the corresponding area of the screen must be selected. The values can be selected by touching them, or with the keyboard ← and → keys.

The selected commanded values can be changed in two ways:

- entering the new value using the numerical keypad, and pressing either ENTER or the ← or → keys when finished, to confirm the value. Press the BACKSPACE key to delete the last digit. To cancel the editing, just delete all digits and confirm. While the value is being edited, a cursor mark is shown. Once the value is confirmed, the cursor mark disappears.
- using the triangle keys ▲ and ▼ to increment or decrement the value. The value is automatically confirmed.

The MPS45 will not accept values outside of the programmed limits (refer to SECTION 8).

NOTE *to enter aeronautical set points while in pressure control mode, or vice-versa, use the Eu/Au function as explained in chapter 4.1.*

6.2 MACH NUMBER AND AIRSPEED/QC LIMITS

The Mach number is calculated from the current altitude/Ps and airspeed/Qc values. The MPS45 considers at any time both the airspeed and the Mach number limiting values, when controlling altitude/airspeed or Ps/Qc.

- If an **airspeed** command exceeds the **airspeed** limit, it is **rejected**.
- If a **Mach** command exceeds the **airspeed or Mach** limits, it is **rejected**.
- If an **airspeed** command exceeds the **Mach** limit only, it is **accepted**, but it will be limited later.

When the **current** altitude and airspeed values result in a Mach number outside the limits, the Mach number limit is enforced. The airspeed/Qc indication in the lower-right corner of the Status Screen (FIG 5) will flash with a black background to signal that the airspeed/Qc is being limited due to the Mach number.

NOTE *if the Mach number is displayed, it will flash on a red background instead.*

CAUTION *The Mach number limit is **not** enforced in **Pt** control mode.*

6.3 ACOUSTIC ALARM FUNCTION

When the simulated (actual) values are almost at the commanded (target) values, an acoustic alarm will start sounding (beep-beep) to warn the operator that the MPS45 is approaching the target values.

The acoustic alarm function can be enabled or disabled from the Settings Menu, or by pressing the SHIFT + **2** keys.

The tolerance values are around 10 feet altitude and 1 knot airspeed.

SECTION 7 ADVANCED OPERATIONS

7.1 SPECIFIC PITOT PRESSURE VALUE COMMAND

When the MPS45 is displaying pressures (see chapter 4.1), the Status Screen (FIG 5) can show either the dynamic (Qc) pressure or the total pressure. The display mode can be changed by touching the orange button Qc/Pt or by pressing SHIFT + 7.

NOTE *While in Pt, pressure, control mode, it is possible to command and achieve negative Qc values, i.e. a Pt value lower than the Ps value.*

NOTE *The orange button Qc/Pt only switches the display mode. In order to change the control mode, the Operator must select the Pt/Qc rate and then touch the Eu/Au green button.*

7.2 LEAK TEST

The MPS45 can perform a leak test of the static and pitot lines using a built-in timing function. Leak rates for pitot and static lines are calculated every second and are automatically shown in the selected units in the Leak Screen.

The MPS45 can perform three kinds of leak tests:

1. “Free-running”, without time limit.
2. Timed.
3. Fully automatic, at pre-programmed altitude/Ps and airspeed/Qc/Pt values.

All kinds of leak tests are enabled by pressing the LEAK key. The Leak Screen (paragraph 4.3.2) will appear.

NOTE *The leak test can be performed either in aeronautical or pressure units. FIG 6 is an example of the Leak Screen in aeronautical units.*

NOTE *The pneumatic circuit inside the MPS45 consists of a small volume (0.07 liter for Ps and Pt). For this reason, any leak test conducted on the MPS45 without any pneumatic load and high rate values may give unexpected results, due to the fast change of the temperature inside the pneumatic circuitry. In order to conduct a leak test of the MPS45 alone, please refer to the Final Inspection and Calibration Certificate for the rate values and stabilization time required.*

7.2.1 FREE-RUNNING LEAK TEST

When the LEAK key is pressed, the MPS45 starts a free-running leak test: it begins counting the seconds and displaying the leak rates for the pitot and static circuits.

For the best measurement results, wait until the values in the Leak Screen are stabilized after pressing the LEAK key. Typically this will happen after one minute. When the stabilization has occurred, press the LEAK key once again to reset the clock for a fresh start of a leak test.

7.2.2 TIMED LEAK TEST

A timed leak test can be prepared by touching either the time indication in the lower-left part of the display, or the Time button. After setting the leak test time, the Leak Screen will be shown again, but the time will count backwards. At the end of the test, the Leak Test Results Screen (FIG 10) will be displayed.

To end a leak test, press any of the MEAS, CNTR or HALT keys.

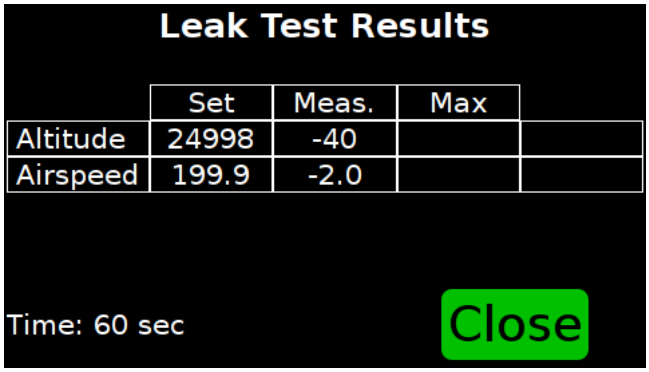

FIG 10 LEAK TEST RESULTS SCREEN

7.2.3 FULLY AUTOMATIC LEAK TESTS

Fully automatic leak tests are a powerful feature of the MPS45: they allow the Operator to test complex pneumatic systems, at various altitude/airspeed values, taking advantage of the Multiple Isolator function (chapter 10.9) where available, to achieve a detailed overview of the pneumatic circuit.

A fully automatic leak test consists of the following steps:

1. reach pre-programmed altitude and airspeed values (or Ps and Pt/Qc values);
2. wait some time for stabilization;
3. run a timed leak test, isolating each port if the Multiple Isolator function is installed;
4. list the ports that are leaking more than the pre-programmed tolerances.

NOTE *if the Multiple Isolator is not available, the leak test will collect information about each line (Ps, Pt) as a whole.*

During the automatic leak test, if the Multiple Isolator is installed, the lower-right corner of the display lists all the ports in different colors:

- Blue if the port was not yet tested;
- Pink if the port is being tested;
- Green if the port is found to be tight;
- Red if the port is found to be leaking.

If any suitable profiles are available, the Leak Screen (paragraph 4.3.2) displays a yellow button Auto. The Operator can touch that button to select the profile and start the test.

Please refer to SECTION 11 for more information about test profiles. In order to be eligible for automatic leak testing, a profile must have the following characteristics:

- the name must begin with “leak”;
- the first step must request a leak test.

Example

This paragraph explains how to create a quick leak test at 5,000 feet and 150 knots.

NOTE *suitable values for altitude and airspeed set points, stabilization times and leak rates are to be found for each individual configuration. They depend on many factors, such as the number and type of probes, type of adaptor kit, pneumatic volumes etc. For more information, contact your sales representative.*

1. Press the SHIFT + 3 keys and select “**Functions**”, “**Profiles**”, “**Edit**”.

2. Select an empty slot and touch the yellow button Select.
3. Enter the following data:
   - Name: “**leak 1**” (remember to press ENTER when finished),
   - Units: aeronautical,
   - Steps: 1.
4. Touch the yellow button Steps.
5. Enter the following data, ignoring the other fields:
   - Altitude: 5,000 feet,
   - Altitude rate: 3,000 feet/min,
   - Airspeed: 150 knots,
   - Airspeed rate: 300 knots,
   - Stab. Time: 10 sec,
   - Leak test: aeronautical,
   - Leak stab. time: 10 sec,
   - Leak meas. time: 10 sec,
   - Max alt.leak: 15 feet/min,
   - Max airsp.leak: 1 knots/min.
6. Touch the orange button Back.
7. Touch the green button Save.

To run this test after mounting the adaptor kit:

1. Press the LEAK key.
2. Touch the yellow button Auto.
3. Find the profile named “**leak 1**” and select it.
4. Touch the yellow button Select.
5. Wait for the test to be completed.

7.3 AUTOMATIC RETURN TO AMBIENT PRESSURE

MPS45 can automatically vent the static and pitot ports to the ambient pressure condition. The venting procedure operates as follows: when the VENT key (i.e. SHIFT + LEAK) is pressed the MPS45 will:

1. set the airspeed to a fixed value;
2. command an altitude value equal to ambient pressure;
3. reach the ambient pressure with controlled rates. Rate values are set as follows:
   - the altitude rate is set from the Settings Menu; refer to the Calibration and Adjustments manual for information;
   - the airspeed rate is set to the current maximum airspeed rate limit.

When the ambient pressure is reached, the message: “Ambient pressure reached” will be displayed, and the MPS45 will switch to “Ambient pressure reached” mode.

NOTE *the VENT/SEAL valve on the case, if present, must be in the "VENT" position.*

To interrupt the venting procedure, the Operator can press the MEAS, CNTR or HALT keys.

For more information about the "Ambient Pressure Reached" mode, refer to chapter 4.2.3.

The airspeed value for step 1. is zero knots by default. For more information, refer to the MPS45 Calibration and Adjustment Manual.

7.4 PRECISION MEASUREMENTS

7.4.1 OPERATION ON LARGE OR VERY SMALL VOLUMES

A precision measurement can only be obtained when the test lines pressures are stabilized. Even though the stability of the controlled values in the CONTROL mode are very good, the MEASURE mode should be used whenever a very precise measurement is required.

The MEASURE mode function should always be used if large test volumes are being measured, such as with an older aircraft.

On the other hand, if the volumes are very small, the pressure changes could generate thermal effects that may lead to long settling times.

The suggested procedure to follow in these cases is the following:

1. set the commanded values and wait for the MPS45 to reach them;
2. remain in CONTROL mode for some minutes, to allow the MPS45 to "actively" stabilize thermal effects and other transients;
3. enter MEASURE mode by pressing the MEAS key;
4. remain in MEASURE mode for some minutes, to allow further stabilization;
5. measure the values;
6. return to CONTROL mode, by pressing the CTNR key.

7.4.2 DIFFERENTIAL PRESSURE ZERO ADJUSTING AND ULTRA-LOW SPEED FUNCTION

For the most accurate low Airspeed measurements, it is recommended that the MPS45 differential pressure readings should be zeroed at the start of each new test sequence, where a precision airspeed measurement is required. Zeroing ensures the best accuracy of low airspeed measurement.

The Altitude channel of the MPS45 is not affected.

Zeroing is accomplished by setting the pressure differential between the pitot and static lines to zero at the ambient pressure.

The procedure will be activated only at the following conditions:

- When the MPS45 is in the CONTROL mode of operation.
- When the airspeed commanded value is zero.
- When the pressure inside the static line is very close to the ambient pressure.
- When the pressure inside the pitot line is almost the same as that in the static line.
- When the altitude rate is close to 0 feet/min (or the Ps rate is close to 0 hPa/min).

Once the equipment satisfies these conditions, the Operator may enable the "Ultra-low speed function" to enhance the resolution at very low airspeeds.

The ultra-low speed function can be enabled by entering the Main Menu (SHIFT + 3) and selecting “Functions” and then “ULS”. As long as the function is active, the air speed resolution is increased as described in the following table, and the Status Screen displays “ULS” in the lower-left corner.

	Normal	***Ultra low speed***
Minimum measured speed with 1 knot resolution	10 knots	2 knots
Minimum measured speed with 0.1 knots resolution	20 knots	50 knots

As soon as the altitude significantly changes, or any other of the above conditions are no longer satisfied, the MPS45 will automatically exit the ultra-low speed function.

NOTE *The airspeed rate command is not enforced while in ULS mode.*

7.5 ENCODING ALTIMETER (OPTION)

An optional front panel connector is used to connect the Encoding Altimeter or Encoding Device, to test the altitude reporting Gray code. Any unit can be tested, if a proper cable is prepared.

NOTE *the last page of this manual contains the wiring diagram for the adapter cable to connect the UUT to the MPS45.*

When an Encoding Altimeter/Encoding Device is to be tested, connect it to the MPS45, before the ADTS is powered on.

To start a test of the encoding altimeter, press the orange button Enc on the Status Screen. The MPS43 will switch to the Encoding Altimeter Test Screen (FIG 11).

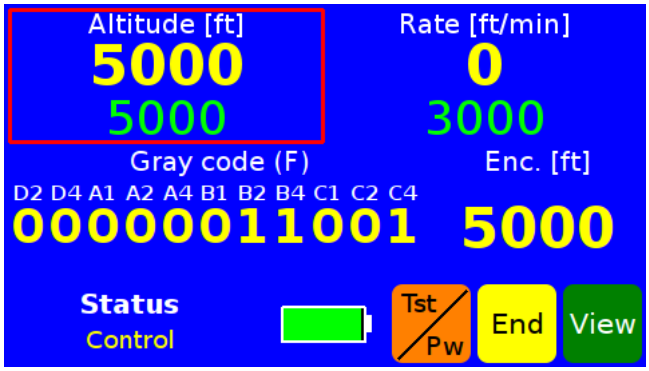

FIG 11 THE ENCODING ALTIMETER TEST SCREEN

The “Gray code” label shows the 24 signals coming from the encoding device. The “Enc.” label shows the decoded value.

The ADTS will also signal the change of the reading from the encoding device:

- an acoustic sound will warn the Operator at every altitude transition point;
- the Gray code and the decoded altitude will flash in green if the new value is correct, or in red if the new value is incorrect. All errors are recorded.

The green button View shows the results of the current test in the Encoding Altimeter Results Screen (FIG 12). The yellow button End shows the results and ends the test, returning the MPS45 to the Status Screen.

The orange button Tst/Pw switches between the standard display (FIG 11) and an alternate display, in which the yellow and green button control the power supply to the encoder and vibrator of the connected altimeter.

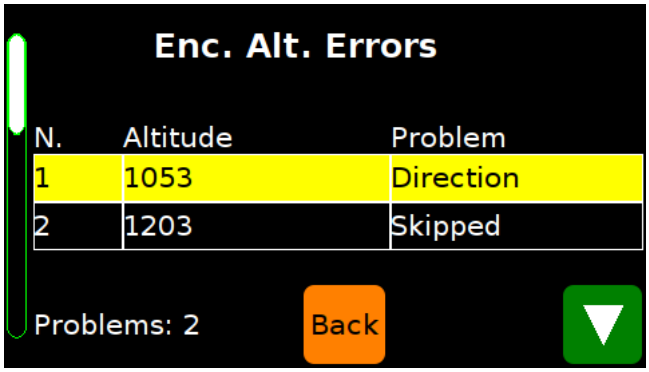

FIG 12 THE ENCODING ALTIMETER RESULTS SCREEN

The Encoding Altimeter Test records the following kinds of errors:

- Invalid Gray code: when the Gray code does not correspond to any altitude value, and cannot be decoded. This error is marked as “Invalid”.
- Direction error: when the encoded altitude increases while the simulated altitude is decreasing, or vice-versa. This error is marked as “Direction”.
- Skip error: when the encoding altimeter skips one or more values (for instance, switching from 1,000 to 1,200 feet). This error is marked as “Skip”.

SECTION 8 CHANGING PRESET LIMITS

8.1 GENERAL

The MPS45 allows the pre-programmed maximum parameter values for all functions to be changed. Limiting values can be changed from the Limits Menu (FIG 8).

The Limits Menu is accessible from the Main Menu, that can be opened by pressing the keys SHIFT + 3.

NOTE *The Limits Menu only displays the limits of the currently controlled units (aeronautical or pressures).*

CAUTION *Limits are pre-set at the factory to handle most standard test conditions and to protect most aircraft instrumentation. The operator should exercise extreme caution in setting limits outside normal default values.*

NOTE *Damage to the aircraft or to unit under test could occur, if caution is not observed.*

Limiting values can be changed for the duration of one power-on cycle, or stored permanently, in order to be recalled in the future. The MPS45 allows to store different sets of limiting values. The operator should consider carefully which requirement best suites the needs of all test set users and units under test.

Changes to the values inside the Limits Menu are immediately active. All future operations will automatically utilize the new limits until power is turned off, or the limits are changed again.

8.2 LOADING AND SAVING LIMITING VALUES

The MPS45 stores the limiting values and the choice of measure units inside test profiles. When the equipment is powered up, it loads the limiting values and units from the profile named "**Default**".

Touch the green button Load or press the keys SHIFT + 9 to load and apply the limiting values that were previously saved inside a test profile. The display will show a list of the available profiles.

Touch the yellow button Save or press the keys SHIFT + 8 to save the current limiting values. The Operator must indicate an existing profile or an empty memory location.

NOTE *measure units are loaded and saved together with limiting values.*

NOTE *in order to change the power-on values, the Operator must overwrite the profile named "**Default**".*

Limiting values are also loaded when a profile is selected for execution, as described in chapter 11.3.

SECTION 9 SAFETY MANUAL OPERATION

9.1 MANUAL VENT

In the event of power loss and failure of the battery, the Ps and Pt lines can be returned to ambient pressure by means of manual valves.

The three needle valves (FIG 1 items 15.), located on the front panel, are used for the manual venting.

Turn counter- clockwise to open the needle valves.

The needle valves must be rotated together, very slowly, to avoid excessive rate values. Too fast rotation of Pitot Vent needle valve can change too quickly the pitot pressure and too fast a rotation of Cross Bleed (“Equalize”) needle valves can increase the Altitude Rate to excessive values.

The suggested procedure is the following:

1. Slowly open the Ps-Pt cross-bleed valve. If the altitude tends to go outside the safe working limits, then slightly open the Pt vent valve.
2. When both cross-bleed valves are open, slowly open the Pt vent valve until all lines return to ambient pressure.

CAUTION *When the manual venting is completed, all manual venting needle valves must be turned fully clockwise to be closed, to restore the seal on pneumatic circuit.* ***Do not over-tighten.***

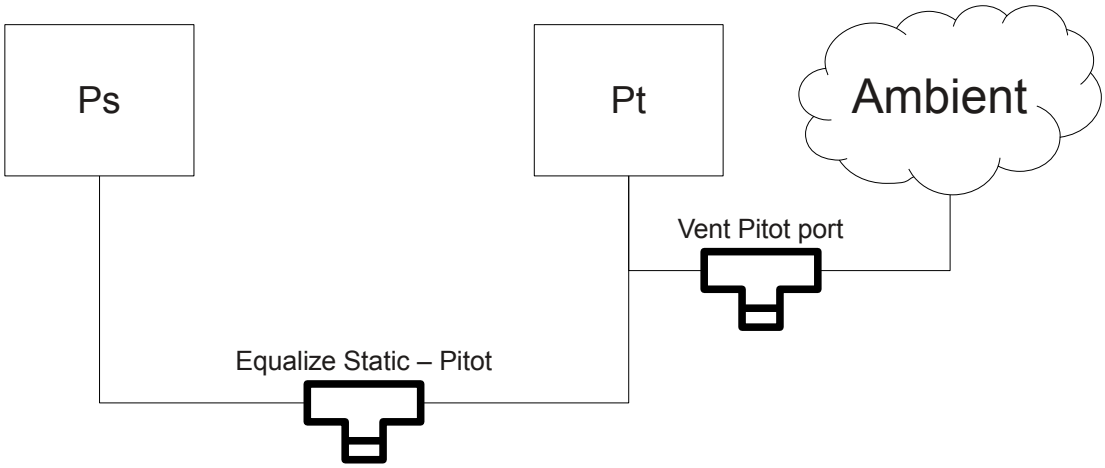

FIG 13 SCHEMATIC OF THE MANUAL VENTING VALVES

SECTION 10 SPECIAL FUNCTIONS

10.1 MACH NUMBER

Mach Number can be entered as a control parameter in place of an Airspeed value. To enter a Mach Number, enter the Main Menu (SHIFT + 3), then select “Functions” and “Mach”. The Status Screen will change as in FIG 14.

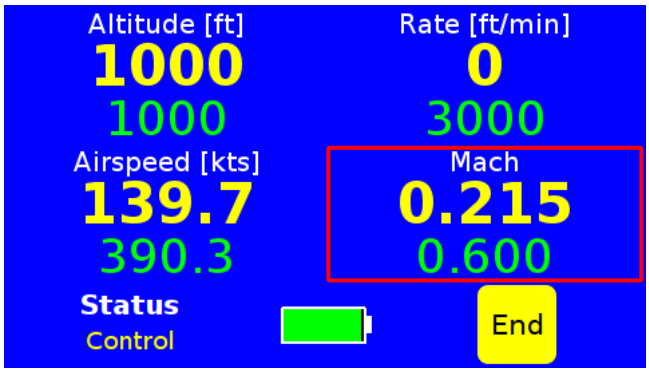

FIG 14 STATUS SCREEN SHOWING MACH NUMBER

The operation is the same as the “normal” Status Screen. The Mach number visualization can be deactivated by touching the End yellow button.

***NOTE**: the Mach Number is limited by the lowest value between the Airspeed limit and the Mach limit itself.*

10.2 SETTING DISPLAY BRIGHTNESS

To set the brightness of the display, press SHIFT + 1. Adjust the value with the ▲ and ▼ keys or the keypad. Press ENTER to save, or any other key to cancel.

10.3 BATTERY LEVEL

The Status Screen always displays the battery level.

***NOTE**: while the MPS45 is connected to the AC power, the battery level will always be shown as 100%. To obtain an accurate reading, keep the power cable disconnected for one minute, with the ADTS in MEASURE mode. The current battery level may also change while the pumps are running.*

10.4 CENTER LINE CORRECTION

If there is an altitude difference between the ADTS and the UUT, the Centerline Correction function, can be used to correct the error due to such a difference.

The Centerline Correction value can be set by entering the Main Menu (SHIFT + 3) and selecting “Functions” and “Alt. Offset”.

If the altitude of the UUT is higher than the ADTS, the correction value must be a positive number and vice versa.

Two asterisk “*” near the commanded Altitude value show the Operator that the corrected altitude is currently displayed.

To deactivate the Centerline Correction function, just set the offset to 0.

10.5 VALVES FINE TUNING (MAP)

The control valves condition, over a period of time, can be the reason for a malfunction or poor performance of the control stability/precision. Whenever the equipment does not stabilize properly at the target values it is recommended the valve tuning procedure is performed, (this is a fully automatic procedure) to restore the equipment to the correct working condition.

The Procedure for carrying out this valve fine tuning is described in the MPS45 Calibration and Adjustment Manual. This procedure, is restricted to SERVICE and must be accomplished ONLY by skilled operators.

10.6 FINE TUNING FUNCTION

The "Fine Tuning" function is only provided for skilled operators, to fine tune the MPS45 by the adjustment of the defined stored internal parameters; it is therefore restricted to SERVICE operators, see the MPS45 Calibration and Adjustments Manual. This function is not described in this manual.

10.6.1 SAVING VARIABLE PARAMETERS

The fine-tuning parameters can be saved in the MPS45 non-volatile memory. The procedure is described in the MPS45 Calibration and Adjustment Manual.

10.7 TRUE AIRSPEED

The MPS45 can show both the default I.A.S. (Indicated Air Speed) and T.A.S. (True Air Speed). The Operator can input the temperature for the true airspeed calculation by either pressing SHIFT + 5 or entering the Main Menu (SHIFT + 3) and selecting “Functions” and then “Tas / Ias”.

When the True Airspeed is shown, the Status Screen displays “TAS” instead of “Airspeed” above the airspeed values (FIG 15).

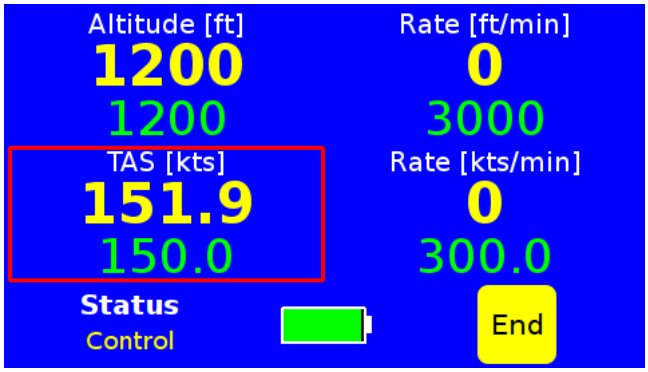

FIG 15 STATUS SCREEN SHOWING TRUE AIRSPEED

To restore the equipment to the IAS read out, touch the yellow button Dis. in the Tas / Ias menu or the yellow button End in the Status Screen.

10.8 E.P.R. (ENGINE PRESSURE RATIO)

For gas turbine engine testing, the Engine Pressure Ratio (i.e., Pt/Ps) function is carried out starting from a desired static pressure value (inlet pressure) and with the Altitude / Ps Rate set to any value other than zero.

Connect the system to be tested following the aircraft maintenance manual procedures.

Open the Main Menu (SHIFT + 3) and select “Functions” and “EPR”. The EPR Menu will show, allowing the operator to enter the desired values of the Static Pressure (inlet) and the target EPR value. Press the yellow button Go when ready. The Status Screen will show the EPR instead of the airspeed / Qc rate (FIG 16). The EPR and altitude / Ps can be changed at any time.

To close the EPR visualization, press the square yellow button End.

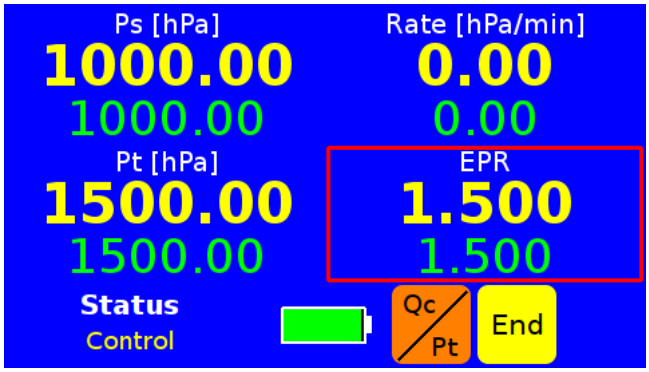

FIG 16 STATUS SCREEN SHOWING EPR

10.9 MULTIPLE ISOLATOR FUNCTION (OPTION)

The optional Multiple Isolator allows the Operator to close individual pneumatic ports; this function allows easier leak checking when testing multiple connections, and also permits the Operator to generate different pressure values behind each port.

10.9.1 BASIC USAGE: LEAK CHECKING ON INDIVIDUAL PORTS

The basic use case of the multiple isolator consists of isolating single ports to identify the source of a leak, when more than one pneumatic output is connected. In fact, the standard leak test function (chapter 7.2) permits to detect the presence of a leak, but does not enable to detect which part of the whole pneumatic circuit is leaking.

By closing each individual port, the Operator can detect which one is leaking, because the leak rate will immediately decrease after the leaking port is closed.

The lower-right corner summarizes the state of all ports.

Press SHIFT **+000** to display the Multiple Isolator Screen (FIG 17). The upper part of the display shows the state of the output ports for the selected channel. If the altitude/Ps is selected, the Static ports are displayed; if the airspeed, Pt or Qc are selected, the Pitot ports are displayed.

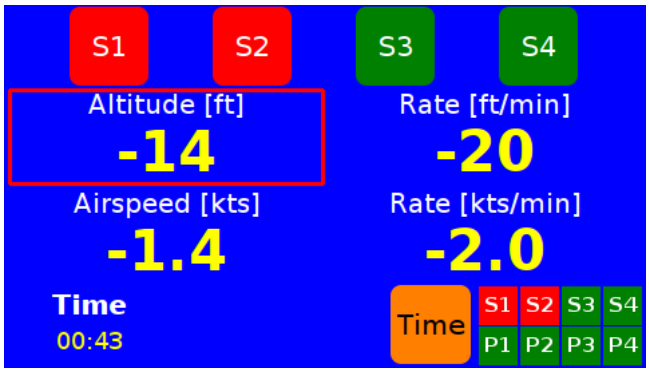

FIG 17 THE MULTIPLE ISOLATOR SCREEN

The rest of the screen is organized as the Leak Screen (FIG 6); the displayed values have the same meaning.

Touch the upper buttons or press the 1 – 4 keys, to close or open a single port. Closed (isolated) ports are displayed in red, open ports are green.

The display shows a free running leak test, as described in paragraph 7.2.1.The orange button Time starts a timed test.

To leave the Multiple Isolator Screen, open all isolated ports and press SHIFT + **000**.

10.9.2 "SPECIAL" MULTIPLE ISOLATOR FUNCTION

The "special" Multiple Isolator function enables the Operator to generate different pressure values behind every port.

CAUTION *The pressure behind closed ports is **not** controlled nor monitored by the MPS45. Leaks may damage the instruments under test! Make sure there are no leaks before using the special Multiple Isolator function.*

After closing (isolating) a port, press the MEAS key; the display will be as in FIG 18. The MPS45 switches into MEASURE mode and the buttons in the upper part of the screen disappear. Enter the new commanded values and press CNTR to enter CONTROL mode. To close or open a pneumatic port, press SHIFT + **000**.

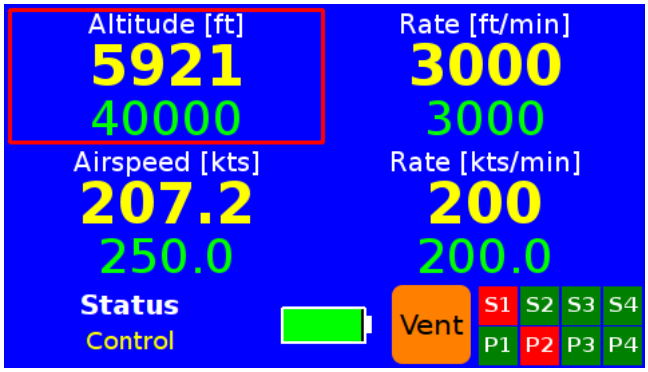

FIG 18 THE SPECIAL MULTIPLE ISOLATOR SCREEN

At any time, touch the orange button Vent or press the SHIFT + LEAK keys to **safely** open all closed ports and return to ambient pressure.

NOTE: *when opening a port, the MPS45 checks the difference between the current pressure and the pressure that was isolated behind the port. If the difference is too big, as evident on the UUT versus the MPS45 display, the MPS45 actions an automatic return to the isolated pressure levels before opening the port. The VENT function does this for all closed ports and then returns to ambient pressure.*

To open all isolated ports simultaneously, ignoring any difference among the current and isolated pressures, from the Multiple Isolator Screen (FIG 17) press the SHIFT + **3** keys and select "Open all".

10.9.3 USAGE EXAMPLE

This paragraph describes the procedure to generate:

- 1,000 feet (28.856 inHg) at port S1 and 150 knots (29.947 inHg) at port P1;
- 2,000 feet (27.821 inHg) at port S2 and 200 knots (29.780 inHg) at port P2;
- 3,000 feet (26.817 inHg) at port S3 and 300 knots (31.351 inHg) at port P3.

At any time, the VENT function safely re-opens all ports and returns to ambient pressure.

1. Reach 1,000 feet and 150 knots;
2. Press the SHIFT + **000** keys, select the altitude and touch the button S1, then select the airspeed and touch the button P1.
3. Press the CNTR key and reach 2,000 feet and 200 knots.
4. Press the SHIFT + **000** keys, select the altitude and touch the button S2, then select the airspeed and touch the button P2.
5. Press the CNTR key and command 3,000 feet and 300 knots.

The target pressures are reached.

Press the VENT key (SHIFT + LEAK) or touch the orange button Vent to safely open all ports and return to ambient pressure.

10.10 ALTITUDE AND AIRSPEED OSCILLATION (OPTION)

The MPS45 ADTS can be configured to generate oscillations on the Static and Pitot channels.

The function can be enabled by entering the Main Menu (SHIFT + 3) and selecting “Functions”, “Oscillation” and the desired channel. The Operator must enter the following parameters:

- **Offset**: the average altitude value;
- **Amplitude**: the amplitude of the oscillation;
- **Period**: the period of the oscillation, expressed in seconds.

Touch the green button Go to activate the function. The MPS45 will go through an initial preparation stage, and then will start oscillating.

***NOTE**: the maximum amplitude and frequency of the oscillations are limited by the volume and geometry of the pneumatic load.*

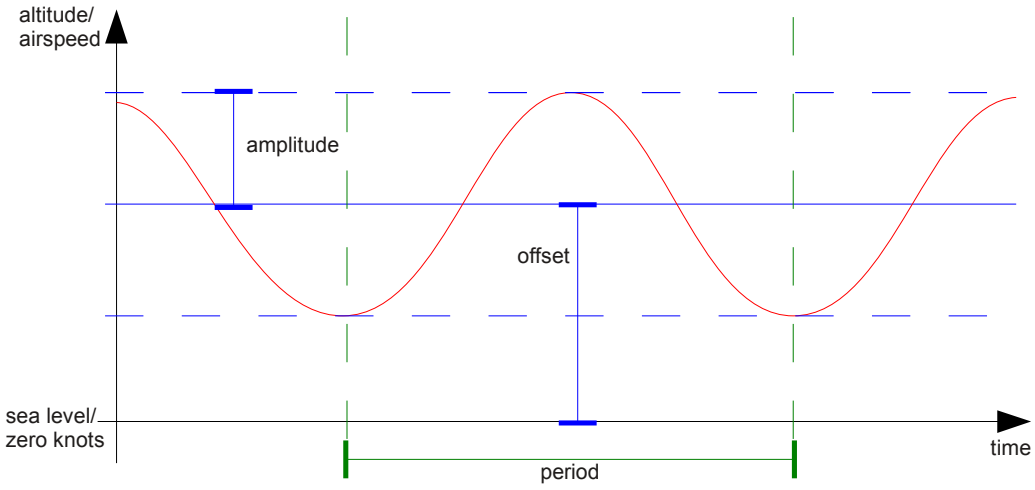

FIG 19 OSCILLATION PARAMETERS

SECTION 11 TEST PROFILES

11.1 INTRODUCTION

If a particular test profile (a set of control points, each one identified by Altitude, Airspeed, Altitude Rate and Airspeed Rate, or Ps, Qc/Pt, Ps Rate and Qc/Pt Rate) must be performed frequently (for example, when required by a particular UUT test specification), the equipment can be easily programmed to memorize such a profile. Then, when it is required again, it can be selected to carry out the test automatically.

During the automatic test execution, the equipment will go through all the programmed test points. When the MPS45 has reached and stabilized each step, if the stabilization time is not zero, it prompts the Operator for the readings of the UUTs.

The MPS45 can display and memorize the results of a test profile.

The function can be enabled by entering the Main Menu (SHIFT + 3) and selecting “Functions” and then “Profiles”.

Each profile also contains a set of limiting values and the selection of measure units. For this reason, test profiles can also be used to save and organize different sets of limiting values.

11.1.1 PROFILES AND PROFILE RESULTS

A test profile contains a sequence of test points, that the MPS45 follows when the profile is run. Each test point contains the following data:

- altitude/Ps;
- altitude/Ps rate;
- upper and lower tolerance for the UUT readings of altitude/Ps;
- airspeed/Qc/Pt;
- airspeed/Qc/Pt rate;
- upper and lower tolerance for the UUT readings of airspeed/Qc;
- stabilization time;
- optional information about a leak test:
  - leak test units (aeronautical or pressure units)
  - additional stabilization time;
  - leak measurement time;
  - maximum leak allowed for the altitude/Ps;
  - maximum leak allowed for the airspeed/Pt.

The tolerance values are used to check if the UUT readings are acceptable or not.

The summary of the results of all set-points is called “profile result”. The MPS45 supports up to 3 UUTs. That is: 3 altitude/Ps, 3 airspeed/Qc and 3 Mach number readings for each profile step (e.g. Captain, First Officer, Standby).

In addition to the test points, a test profile also contains:

- limiting values for the controlled quantities,
- measure units selection,

- altitude offset to be applied.

11.1.2 MEMORY ORGANIZATION

The non-volatile memory of the MPS45 contains 30 locations for storing the profiles. Every time a profile is saved into one memory location, it overwrites the previously saved profile in the same location.

The same thing applies to the profile results. The MPS45 contains 300 profile results.

11.2 ENTERING TEST PROFILES

A test profile can be changed or created by touching the “Edit” button on the Profiles Menu.

The MPS45 will show the Profile Selection Menu for selecting the memory location. If the Operator selects an empty memory location, a new profile will be created.

After pressing the Select button, the display will show the Profile Editing Menu (FIG 20). This menu allows the Operator to set:

- name of the profile,
- controlled units (aeronautical or pressures),
- number of steps,
- altitude offset (only when controlling aeronautical units),
- limiting values.

***NOTE**: if the profile name begins with “leak”, the profile will be listed among the automatic leak tests. Refer to paragraph 7.2.3 for more information.*

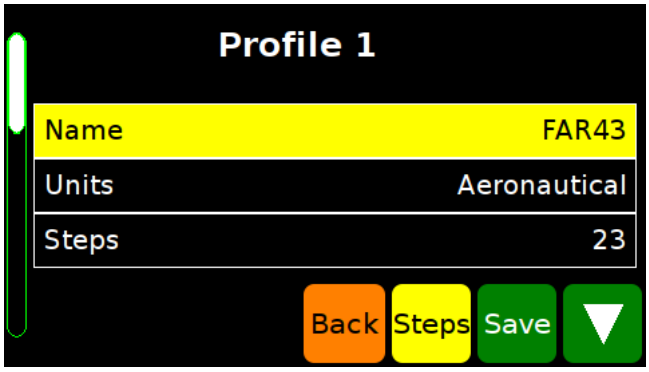

FIG 20 THE PROFILE EDITING MENU

Touch the Steps button, to open the Profile Step Selection screen (FIG 21). For each step, the MPS45 displays:

- the altitude/Ps target;
- the airspeed/Pt/Qc target;
- the stabilizazion time;
- an indication, whether the leak test is required or not.

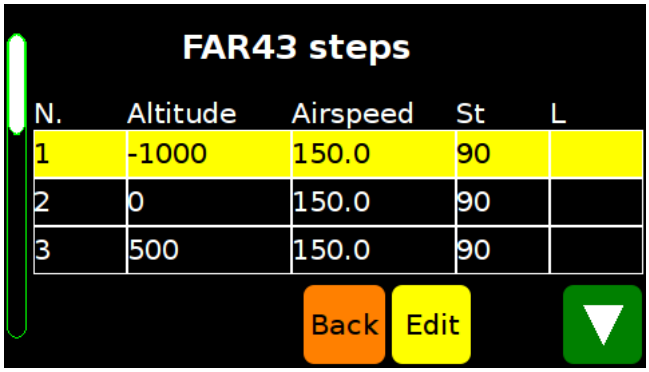

FIG 21 THE PROFILE STEP SELECTION SCREEN

The Operator can select a step and press the yellow button Edit to open the Profile Step Editing Menu (FIG 22).

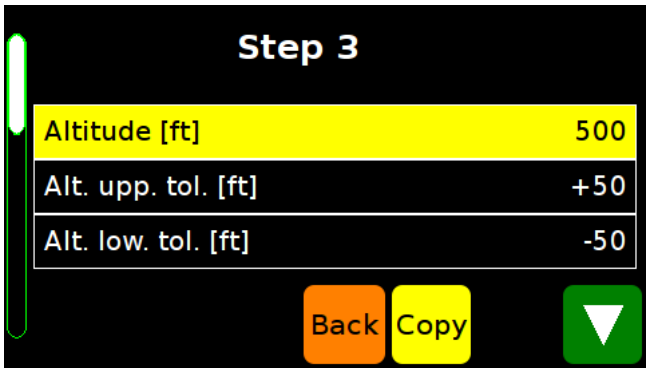

FIG 22 THE PROFILE STEP EDITING MENU

The Profile Step Editing Menu allows the Operator to change all the parameters of the selected step.

The Copy button copies all the values from the previous step to the currently displayed one.

The orange Back button allows the Operator to return from each screen to the previous one. After entering all the profile data, touch the Back button on the Profile Editing Menu (FIG 20) and the MPS45 will ask whether to save the profile or not.

NOTE *unsaved changes are immediately lost.*

11.3 RUNNING TEST PROFILES

A test profile can be started by touching the “Run” button on the Profiles Menu. The display will show the Profile Selection Menu for selecting the profile to run.

NOTE *If the profile requires an altitude offset, the Operator will be asked to confirm it.*

While a test profile is running, the MPS45 will show a slightly modified Status Screen (FIG 23); the lower-right part of the display summarizes the current state of the profile.

1. the commanded values of the set-points are set and stabilized;
2. if the stabilization time is not zero, the display shows the Profile Step Results Menu, allowing the Operator to enter the UUT readings. The first line of the menu selects the UUT. The Menu is closed with the Ok or Skip buttons;
3. a leak test is run if required. The Leak Results Screen (FIG 10) is displayed afterwards, for 60 seconds. The Operator may dismiss the results' display before the timeout is expired.

4. the results of the step are stored into the active profile results. The MPS45 switches to the next profile step.

After the last profile step is executed, the MPS45 switches back to the Status Screen.

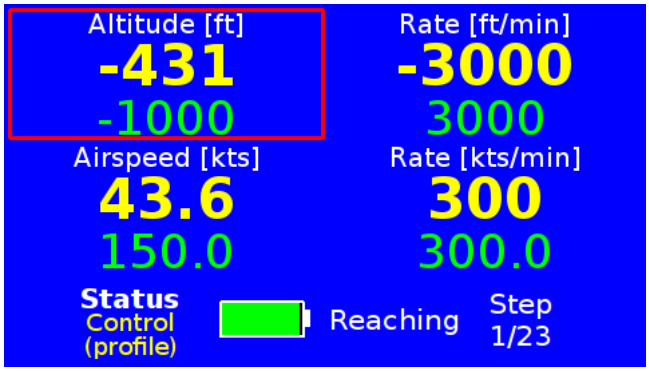

FIG 23 STATUS SCREEN WHILE RUNNING A TEST PROFILE

While the profile is running, touching any part of the display and pressing any key will show the Profile Running Menu. That menu allows the Operator to:

- skip the current step;
- stop the profile;
- show intermediate results.

11.4 PROFILE RESULTS

As explained in chapter 11.1.1, the MPS45 can record the results of test profiles.

When a profile is completed, the results can be saved into the non-volatile memory of the ADTS. Saved results can be reviewed on the MPS45 display, copied into a USB pen drive, or downloaded to a PC.

The MPS45 prompts the Operator to save the results as soon as the test profile is completed.

NOTE *unsaved results are immediately lost.*

Saved profile results are shown by selecting “Results” from the Profiles Menu, and selecting the results to show. The Profile Results Screen (FIG 24) will appear. The ▲ and ▼ keys cycle through the steps. If the displayed step included a leak test, its results can be seen by touching the Leak button. The button Spd / Ma selects between airspeed and Mach values. The results of skipped profile steps are left blank.

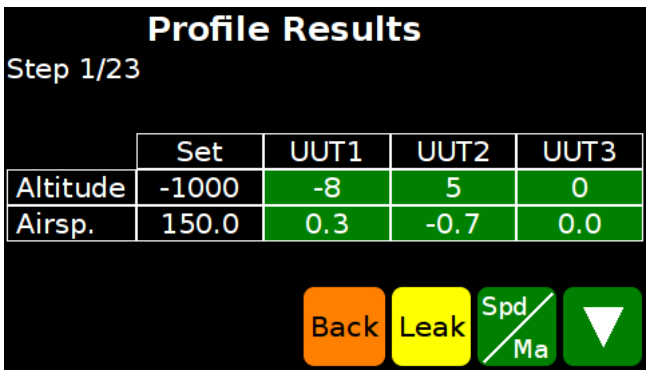

FIG 24 THE PROFILE RESULTS SCREEN

11.5 EXAMPLE

This chapter explains how to create an example test profile, with the following data:

Step no.	*Altitude [ft]*	*Alt. rate [ft/min]*	*Airspeed [kts]*	*Airsp. rate [kts/min]*
1	-1,000 ± 50	3,000	150 ± 5	300
2	0 ± 50	3,000	150 ± 5	300
3	500 ± 50	3,000	150 ± 5	300
4	1,000 ± 50	3,000	150 ± 5	300
5	1,500 ± 50	3,000	150 ± 5	300

Stabilization time for each step: 90 sec.

1. From the Status Screen, check that the measure units are feet and knots;
2. Enter the Main Menu (SHIFT + 3) and select Functions → Profiles → Edit.
3. Select an empty slot and touch the yellow button Select.
4. Enter the following values (remember to press ENTER after each entry):
   a) profile name (for example “test”);
   b) units: aeronautical;
   c) steps: 5.
5. Touch the yellow button Steps.
6. Select step 1 and touch the yellow button Edit.
7. Enter the data for step 1:
   a) Altitude: -1,000;
   b) Alt. upp. tol: 50;
   c) Alt. low. tol: -10;
   d) Alt. rate: 3,000;
   e) Airspeed: 150;
   f) Airsp. upp.tol: 5;
   g) Airsp. low.tol: -5;
   h) Airsp. rate: 300;
   i) Stab. time: 90;
   j) Leak test: Off
8. Press the orange button Back.
9. Select step 2 and touch the yellow button Edit.
10. Touch the yellow button Copy and confirm. The values from step 1 will be copied into step 2.
11. Change the only value that differ between the two steps:
    a) Altitude: 0.
12. Press the orange button Back.

13. Select step 3 and touch the yellow button Edit.
14. Copy the values from the previous step and edit them. Repeat for steps 4 and 5.
15. After entering all the data, press the orange button Back to leave the profile editing menus.
16. Confirm saving the profile.

SECTION 12 REMOTE CONTROL

The MPS45 ADTS allows remote control by means of a Personal Computer, laptop or other portable devices.

The ADWIN software is the official remote control software from D.Marchiori. It is available for Windows and Unix platforms.

The MPS45 Remote Protocol Manual describes the communication protocol, and allows software developers to integrate communication with the ADTS inside custom-made software.

For information about the protocol, the available software, or for assistance during the development, contact your sales representative.

Remote control of the MPS45 is enabled in REMOTE mode, and is activated by pressing the SHIFT + **4** keys. While in REMOTE mode, only the HALT key and the visualization settings (e.g. measure units) are active; any other key or touching the display allow to leave the mode and return to front-panel operation.

12.1 WIRED CONNECTIONS

The MPS45, in standard configuration, is fitted with a RS232 port. A USB port is available as option.

DMA provide a RS232 cable, and also a USB-RS232 cable, for systems that do not feature a RS232 port.

The USB connection and the DMA USB-RS232 cables are identified by the operating system as a USB/RS232 converters.

12.1.1 ETHERNET

The MPS45 front panel can be fitted with an Ethernet port. Communication to the ADTS is by means of a TCP/IP connection. IP address and TCP port number can be set from the front-panel display.

12.1.2 GPIB

An optional GPIB port allows the MPS45 to be integrated into existing Automatic Test Equipments.

The GPIB address of the MPS45 is set from the front-panel display.

12.2 WIRELESS CONNECTIONS

The front-panel USB port allows to plug adapters that enable wireless control of the MPS45.

To enable wireless remote control, plug the adapter, wait for 5 seconds and then press the SHIFT + **4** keys. The MPS45 will allow the Operator to select the available connection option.

12.2.1 BLUETOOTH

The MPS45 can be controlled by means of a “Serial Port Profile” (SPP) Bluetooth connection.

1. Connect the Bluetooth adapter, wait for 5 seconds and select Bluetooth REMOTE mode.

2. On the PC, search for Bluetooth device. The MPS45 will be detected as “MPS45 S/N xxxx”, where “xxxx” is the serial number of the unit.
3. Enter the PIN code “xxxx0000” to pair the devices. The PIN code is the serial number of the unit, followed by four zeroes.

12.2.2 WI-FI

A Wi-Fi dongle allows the MPS45 to be controlled over a TCP/IP connection on a Wireless LAN.

1. Connect the Wi-Fi adapter, wait for 5 seconds and select Wi-Fi REMOTE mode.
2. On the PC, search for wireless networks. The MPS45 will be detected as “MPS45 S/N xxxx”, where “xxxx” is the serial number of the unit.
3. Use the password “xxxx0” to connect to the Wi-Fi network. The password is the serial number of the unit, followed by one zero. The IP address of the PC will be set automatically.
4. The MPS45 accepts connections at IP address 192.168.0.1, on TCP port 1234.

SECTION 13 SPECIAL FUNCTIONS KEYS SUMARY

Remember; press SHIFT followed by...

SHIFT LEAK	Vent to ambient pressure
SHIFT **1**	Display Brightness Setting
SHIFT **2**	Audible Beep/beep ON/OFF Setting
SHIFT **3**	Enter the Main Menu
SHIFT **4**	Enter the Remote Mode
SHIFT **5**	Shorthand for the Tas / Ias menu
SHIFT **7**	Same as touching the orange square button, if displayed
SHIFT **8**	Same as touching the yellow square button, if displayed
SHIFT **9**	Same as touching the green square button, if displayed
SHIFT **0**	Shorthand for the Settings Menu
SHIFT **DOT**	Only for Company Service

SECTION 14 CALIBRATION

14.1 GENERAL

It is recommended that the MPS45 be calibrated at least once per year, preferably by an ISO17025 accredited laboratory with a Best Measurement Uncertainty no greater than ± 0.01% of reading over the entire MPS45 sensor ranges.
Full details for carrying out the calibration of the MPS45 are to be found in the MPS45 Calibration and Adjustments Manual.

14.2 CALIBRATION SERVICE

In Italy, D. Marchiori s.r.l. maintain Accredia accredited calibration laboratory LAT No. 106, guaranteeing low Uncertainties from the National Physical Laboratory for the Air Data pressure range.

D. Marchiori s.r.l. specialise in the service and calibration of Air Data Test Sets and other aerospace and meteorological instrumentation and will be happy to support your test equipment.

SECTION 15 ENCODING ALTIMETER CONNECTOR DETAIL

The following diagram enumerates the pin connections for the Encoding Altimeter interface plug / socket located on the front panel of the MPS45 (option H0).

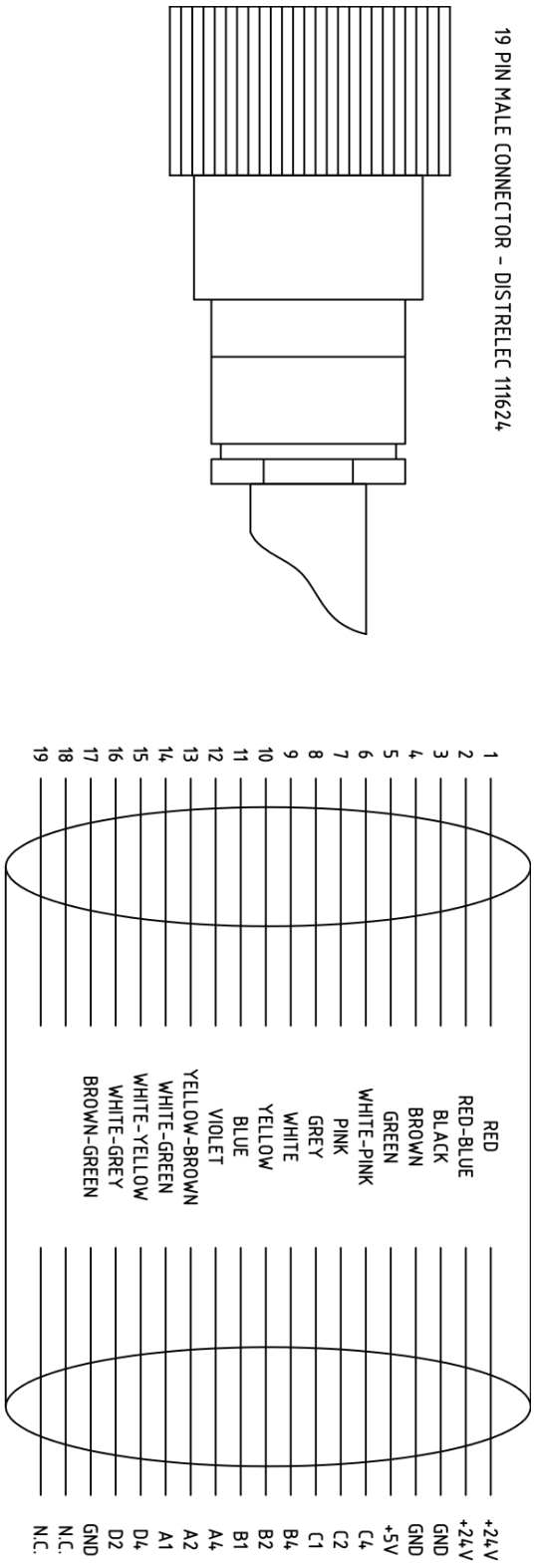

FIG 25 WIRE DIAGRAM OF THE ENCODING ALTIMETER CONNECTOR

SECTION 16 MAINTENANCE, RETURN AND DISPOSAL INFORMATION

The MPS45 contains complex electrical and electronic parts. It must disposed of properly.

Please do not dispose of this equipment in landfill, with household or municipal waste.

Due to the fact that all products are for specifically professional use, D.Marchiori s.r.l. offers, to customers in the European Union, a maintenance service, that ensures take-back return for damaged, malfunctioning and presumably unrecoverable instruments.

Customers can contact D.Marchiori s.r.l. whenever they believe that any of such conditions applies, and arrange the shipment of the equipment to Italy.

D.Marchiori s.r.l. will inspect and verify the equipment, and then will contact the customer, in order to arrange repair, substitution or purchase as used product. Only if the equipment cannot be repaired, D.Marchiori s.r.l. will inform the customer, and then dispose of the product, according to current regulations on waste disposal and recycling, at its own expense.

D.Marchiori s.r.l. is registered with the Italian National Register of EEE Producers, according to Italian D.lgs 49/2014 (registration number IT15090000008988) and in accordance with European Union Directive 2012/19/EU – WEEE (Waste Electrical and Electronic Equipment).