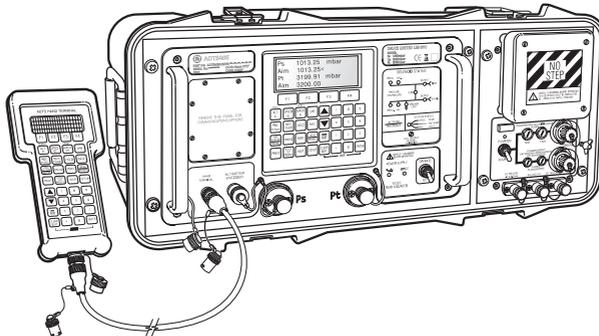
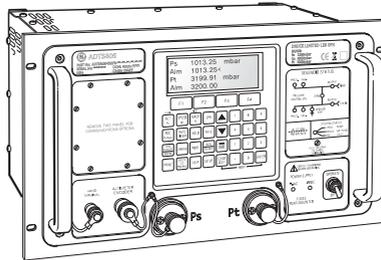




Druck

ADTS 405 R/F Mk2

Air Data Test Set
Instruction Manual



Introduction

This technical manual provides operating instructions for the Druck Air Data Test System ADTS 405 Mk2 series.

Scope

This technical manual contains a brief description, operation and testing procedures for the user of this equipment.

Safety



CAUTION See Safety and Installation Guide 124M8686.

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual:

- Do not use this equipment for any other purpose than that stated. Incorrect use can prevent the protection given by the equipment from working.
- See Safety and Installation Guide 124M8686, also supplied, for essential operating and Safety instructions that must be followed to ensure safe operation.
- Use suitably qualified* Technicians and good engineering practice for all procedures in this publication.

Pressure

Do not apply pressure greater than the maximum safe working pressure specified in this manual when using the ADTS 405 Mk2 series.

Toxic Materials

There are no known toxic materials used in this equipment.

Maintenance

The equipment must be maintained using the manufacturer's procedures and should be carried out by authorized service agents or the manufacturer's service departments.

For technical advice contact GE or subsidiary manufacturer of this product.

* A qualified technician must have the necessary technical knowledge, documentation, special test equipment and tools to carry out the required work on this equipment.

Marks and Symbols on the Equipment

Symbol	Description
	This equipment meets the requirements of all relevant European safety directives. The equipment carries the CE mark.
	This symbol, on the equipment, indicates that the user should read the user manual.
	This symbol, on the equipment, indicates a warning and that the user should refer to the user manual. Ce symbole, sur l'appareil, est un avertissement qui indique que l'utilisateur doit consulter le manuel d'utilisation.
	This symbol warns the user of the danger of electric shock. Ce symbole alerte l'utilisateur sur le danger de choc électrique.
	Do not dispose of this product as household waste. Use an approved organization that collects and/or recycles waste electrical and electronic equipment. For more information, contact one of these: - Our customer service department: www.gemeasurement.com - Your local government office.

Associated Publications

The following table lists the Druck publications referenced in this manual:

Publication	Title
124M8686	ADTS 405 F/R Mk2 Safety and Installation Guide
K0199	Calibration Manual
K0154	IEEE 488 Option 2 Manual
K0157	SCPI IEEE 488 Manual
K0170	Altimeter Encoder Option Manual
K0220	Line Switching Unit LSU 100/101 Manual
K0223	Line Switching Unit Operating and Communications Manual

Abbreviations

The following abbreviations are used in this manual; the abbreviations are the same in the singular and plural.

Abbreviation	Description
A	Ampere
abs	Absolute
ac	Alternating current
ALT	Altitude
CAS	Calibrated airspeed
dc	Direct current
e.g.	For example
EOC	End of conversion
EPR	Engine pressure ratio
EPROM	Electrically programmable read only memory
etc.	And so on
ft	Foot
g	Gauge
Hg	Mercury
Hz	Hertz
IAS	Indicated airspeed
i.e.	That is
IEEE 488	Institute of Electrical and Electronic Engineers Standard 488 Data
in	inch
kg	Kilogram
kts	Knots
LED	Light emitting diode
m	Metre
mA	Milliampere
max	Maximum
mbar	Millibar
mV	Millivolts
No.	Number
Nm	Newton meter
Ps	Static pressure
psi	Pounds per square inch

Abbreviation	Description
Pt	Total pressure (pitot)
Qc	Differential pressure Pt-Ps
QFE	Local atmospheric pressure
QNH	Barometric pressure at sea level
ROC	Rate of climb
Vc	Calibrated velocity
Vt	True velocity
+ve	Positive
-ve	Negative
°C	Degrees Celsius
°F	Degrees Fahrenheit

Glossary

The terminology used in this manual is specific and individual interpretation must not be introduced. The terms are defined as follows:

Item	Description
Adjust	To bring to a more satisfactory state; to manipulate controls, levers, linkages, etc. to return equipment from an out-of-tolerance condition to an in-tolerance condition.
Align	To bring into line; to line up; to bring into precise adjustment, correct relative position or coincidence.
Assemble	To fit and secure together the several parts of; to make or form by combining parts.
Calibrate	To determine accuracy, deviation or variation by special measurement or by comparison with a standard.
Check	Make a comparison of a measure of time, pressure, temperature, resistance, dimension or other quality with a known figure for that measurement.
Disconnect	To detach the connection between; to separate keyed or matched equipment parts.
Dismantle	To take apart to the level of the next smaller unit or down to all removable parts.
Ensure	To confirm that a proper condition exists; to find out with certainty.
Examine	To perform a critical visual observation or check for specific conditions; to test the condition of.
Fit	Correctly attach one item to another.
Inspect	Review the work carried out by Specialists to ensure it has been performed satisfactorily.

Item	Description
Install	To perform operations necessary to properly fit an equipment unit into the next larger assembly or system.
Maintain	To hold or keep in any particular state or condition especially in a state of efficiency or validity.
Operate	Ensure that an item or system functions correctly as far as possible without the use of test equipment or reference to measurement.
Readjust	To adjust again; to move back to a specified condition; to bring back to an in-tolerance condition.
Reconnect	To rejoin or refasten that which has been separated.
Refit	Fit an item which has previously been removed.
Remove	To perform operations necessary to take an equipment unit out of the next larger assembly or system. To take off or eliminate. To take or move away.
Repair	To restore damaged, worn out or malfunctioning equipment to a serviceable, usable or operable condition.
Replace	Remove an item and fit a new or a serviced item.
Reset	To put back into a desired position, adjustment or condition.
Service	To perform such operations as cleaning, lubricating and replenishing to prepare for use.
Test	Ascertain by using the appropriate test equipment that a component or system functions correctly.

Returned Goods Procedure

If the unit requires calibration or is unserviceable, return it to the nearest GE Service Centre listed at: **www.gemeasurement.com**

Contact the Service Department to obtain a Return Authorization (Worldwide excluding USA).

In the USA, obtain a Return Material Authorization [RMA].

Provide the following information on either a RGA or RMA:

- Product (i.e. ADTS 405F Mk2 or ADTS 405R Mk2).
- Serial number.
- Details of defect/work to be undertaken.
- Include any error code(s) and hex value(s) if available. See Section 6.2, "Error Messages," on page 57 for more details.
- Operating conditions.

Safety Precautions



INFORMATION Service by unauthorized sources will affect the warranty and may not guarantee further performance.

You must inform GE if the product has been in contact with any hazardous or toxic substance. The relevant COSHH or in the USA, MSDS, references and precautions to be taken when handling.

Approved Service Agents

For the list of service centers:

www.gemeasurement.com

Pressure Units and Conversion Factors

Pressure Units	Factor (hPa)	Pressure Units	Factor (hPa)
mbar	1.0	cmH ₂ O @ 20°C	0.978903642
bar	1000.0	mH ₂ O @ 20°C	97.8903642
Pa (N/m ²)	0.01	kg/m ²	0.0980665
hPa	1.0	kg/cm ²	980.665
kPa	10.0	torr	1.333223684
MPa	10000.0	atm	1013.25
mmHg @ 0°C	1.333223874	psi	68.94757293
cmHg @ 0°C	13.33223874	lb/ft ²	0.4788025898
mHg @ 0°C	1333.223874	inH ₂ O @ 4°C	2.4908891
inHg @ 0°C	33.86388640341	inH ₂ O @ 20°C	2.486413
mmH ₂ O @ 4°C	0.0980665	inH ₂ O @ 60°F	2.487641558
cmH ₂ O @ 4°C	0.980665	ftH ₂ O @ 4°C	29.8906692
mH ₂ O @ 4°C	98.0665	ftH ₂ O @ 20°C	29.836983
mmH ₂ O @ 20°C	0.097890364	ftH ₂ O @ 60°F	29.8516987

To convert from pressure Value 1 (in pressure Units 1) to pressure Value 2 (in pressure Units 2), calculate as follows:

$$Value2 = \frac{Value1 \times Factor1}{Factor2}$$

Contents

1.	Description	1
1.1	Introduction	1
1.2	Operating Range and Performance	1
1.3	Operating Limits	2
2.	Installation	5
2.1	List of Parts	5
2.1.1	ADTS 405F Mk2 Standard Packaging List	5
2.1.2	ADTS 405R Mk2 Standard Packaging List	5
2.2	Packaging for Storage or Transportation	6
2.2.1	Environment	6
2.2.2	Procedure	6
2.3	Power Supply	9
2.3.1	AC Input	9
2.3.2	DC Input (Option ADTS 405F Mk2 Only)	9
2.3.3	ADTS 405R Mk2 Rack-mounted Version	9
2.4	Positioning of the ADTS	10
2.4.1	ADTS 405R Mk2 Rack-mounted Version	10
2.4.2	ADTS 405F Mk2 Flight-line Version	11
2.5	Product Views	12
3.	Getting Started	15
3.1	Preparation	15
3.2	Start-up	15
3.2.1	Connections	15
3.2.2	Power-up	16
3.2.3	Units of Measure	18
3.3	Keypad Display	19
3.4	Operation Quick Reference	19
3.5	Operating Mode Overview	22
3.5.1	Measure Mode (Pressure Measurement Mode)	23
3.5.2	Control Mode (Pressure Control Mode)	24
3.5.3	Leak Measure Mode (Timed Average Leak Rate Measurement)	25
3.5.4	Go to Ground (Control to Local Ground Pressure)	26
4.	Operation	27
4.1	Control or Measure Parameter	27
4.1.1	Display Functions	27
4.1.2	Rate Timer Displays	29

4.1.3	Pt Only Display	30
4.2	Changing the Display	30
4.2.1	Change to Single, Dual or Triple Display	31
4.2.2	Changing the Display for Pt Only	31
4.3	Changing the Units	31
4.3.1	Changing the Measurement Units	31
4.3.2	Changing the Unit Type	31
4.4	Aim	32
4.5	Leak Measure	32
4.5.1	UUT Leak Test	32
4.5.2	ADTS 405 Mk2 Leak Test	32
4.6	Aircraft System Protection	34
4.6.1	Auto Recovery Facilities	35
4.6.2	Limit Checking	35
4.7	Changing Parameters	36
4.7.1	Mach Test and Constant Mach	36
4.7.2	True Airspeed	36
4.8	Airspeed Switch Test	36
4.9	Engine Pressure Ratio (EPR)	37
4.9.1	Example EPR Test	37
4.10	Testing Aircraft Systems or UUT	38
4.10.1	Go To Ground and Shutdown	38
4.10.2	While Going to Ground	38
4.10.3	Resuming Testing after Going to Ground	38
4.11	Setup Options	39
4.11.1	Change Units in Full Setup Mode	39
4.11.2	Change Units in Minimum Setup Mode	40
4.12	Configuration Options	40
4.13	Communications Panel Options	40
4.13.1	Ethernet System	40
4.13.2	Changing the Default Access Password	42
4.13.3	Access ADTS Files	43
4.14	IEEE 488 Option	45
4.14.1	Enabling the IEEE 488 Option	45
4.14.2	IEEE 488 Connector	46
4.15	Enabling the Altimeter Encoder Option	47

5. Maintenance 49

5.1	Introduction	49
5.2	Materials	49
5.3	Maintenance Tasks	50
5.4	Routine Maintenance	51
5.4.1	Servicing Procedures	51
5.4.2	Replacing the Output Connector O-ring	51
5.4.3	Fuse Replacement	51

5.5	Cable Tests	55
5.5.1	Hand Terminal Cables	55
5.5.2	AC Power Regional Line Plug Cables	55
5.5.3	DC Power Cable	56
6.	Testing and Fault Finding	57
6.1	Introduction	57
6.2	Error Messages	57
6.3	Warning Messages	57
6.4	Standard Serviceability Test	58
6.4.1	Connection and Power-on Checks	58
6.4.2	Pump Unit (ADTS 405F Mk2)	59
6.4.3	Completion	59
6.5	Fault Finding	59
6.6	Fault Diagnosis	60
6.7	Ventilating after Overpressure	62
6.8	Further Testing	63
6.8.1	Environmental and Preliminary Operations	63
6.8.2	Pressure Leak Check	63
6.8.3	Vacuum Leak Check	64
6.8.4	Range Check	64
6.8.5	Controller Stability	64
6.8.6	External Communication Ports	66
6.8.7	Altimeter Encoder	68
7.	Reference	71
7.1	Introduction	71
7.2	Keypad Display	72
7.2.1	F1 - F4	72
7.2.2	ALT/Ps	72
7.2.3	SPEED/Qc	72
7.2.4	MACH/Pt	73
7.2.5	EPR	73
7.2.6	ROC/Ps RATE	74
7.2.7	RATE TIMER	74
7.2.8	HOLD	74
7.2.9	RATE	75
7.2.10	LEAK MEASURE/CONTROL	76
7.2.11	GROUND	76
7.2.12	[GO TO GROUND]	77
7.2.13	[DISPLAY QFE]	77
7.2.14	[DISPLAY QNH]	77
7.2.15	PORT	77
7.2.16	REMOTE	77

7.2.17	PRINT	78
7.2.18	EXECUTE TEST PROGRAM	78
7.2.19	HELP	80
7.2.20	▲ or ▼ (Nudge Keys)	80
7.2.21	Number 0 to 9	80
7.2.22	-000	80
7.2.23	CLEAR/QUIT	81
7.2.24	ENTER	81
7.2.25	CLEAR + ENTER (ABORT)	81
7.3	SETUP	82
7.3.1	FULL SETUP	82
7.3.2	SETUP, [UNITS]	82
7.3.3	SETUP, [LIMITS]	83
7.3.4	SETUP, [OSC]	84
7.3.5	SETUP, [MORE], [CONTROL], [Ps Pt DUAL]	84
7.3.6	SETUP, [MORE], [DISPLAYS/OPTIONS], [DISPLAY TYPE]	85
7.3.7	SETUP, [MORE], [DISPLAYS/OPTIONS], [OPTIONS]	86
7.3.8	SETUP, [MORE], [CLOSE OUTPUT VALVES]	86
7.3.9	SETUP, [MORE], [OPEN OUTPUT VALVES]	87
7.3.10	SETUP, [MORE], [SYSTEM SELF TEST]	87
7.3.11	SETUP, ALT	87
7.3.12	SETUP, SPEED, [AUTO ZERO]	87
7.3.13	SETUP, SPEED, [CAS/TAS]	88
7.3.14	SETUP, SPEED, [Pt TEMPERATURE]	88
7.3.15	SETUP, MACH	88
7.3.16	SETUP, RATE TIMER	88
7.3.17	SETUP, RATE	88
7.3.18	SETUP, LEAK MEASURE CONTROL, [AUTO LEAK]	89
7.3.19	SETUP, LEAK MEASURE CONTROL, [AUTO LIMIT]	89
7.3.20	SETUP, GROUND	89
7.3.21	SETUP, [PORT]	89
7.3.22	SETUP, PRINT, [DATE/TIME]	89
7.3.23	SETUP, EXECUTE TEST PROGRAM	89
7.3.24	SETUP, HELP	89
7.3.25	SETUP, ▲ or ▼ (Nudge Keys)	90
7.3.26	MINIMUM SETUP	90
7.3.27	SETUP, [UNITS], [AERO]	90
7.3.28	SETUP, [UNITS], [PRESS]	90
7.3.29	SETUP, [LIMITS]	91
7.3.30	SETUP, HELP	91
7.4	CONFIGURATION	92
7.4.1	Procedure	92
7.4.2	Functions	92
7.4.3	CONFIG, [UNITS]	92
7.4.4	CONFIG, [LIMITS], [EDIT LIMITS], [EDIT EXISTING]	93
7.4.5	NAME	93

7.4.6	MIN ALT, MAX ALT, MIN CAS, MAX CAS	94
7.4.7	MAX MACH	94
7.4.8	MAX ROC, MAX RATE CAS	94
7.4.9	MIN Ps, MAX Ps, MIN Qc, MAX Qc	94
7.4.10	MAX RATE Ps, MAX RATE Qc	94
7.4.11	ALTITUDE CORRECTION	94
7.4.12	ARINC LIMITS	94
7.4.13	SAVING LIMITS	95
7.4.14	CONFIG, [LIMITS], [EDIT LIMITS], [MAX LIMITS]	95
7.4.15	CONFIG, [LIMITS], [EDIT LIMITS], [EDIT NEW]	96
7.4.16	CONFIG, [LIMITS], [CLEAR LIMITS]	96
7.4.17	CONFIG, [LIMITS], [LOCK AIRCRAFT]	96
7.4.18	CONFIG, [LIMITS], [DEFAULT AIRCRAFT]	96
7.4.19	CONFIG, [MORE], [CONTROL], [CONTROL MODE]	96
7.4.20	CONFIG, [MORE], [DISPLAY/OPTIONS], [DISPLAY TYPE]	96
7.4.21	CONFIG, [MORE], [CONTROL], [CONTROL LOCK]	96
7.4.22	CONFIG, [MORE], [DISPLAY/OPTIONS], [DISPLAY TYPE]	96
7.4.23	CONFIG, [MORE], [DISPLAY/OPTIONS], [OPTIONS]	96
7.4.24	CONFIG, [MORE], [DATE/FORMAT]	96
7.4.25	CONFIG, [MORE], [SETUP MODE]	97
7.4.26	CONFIG, SPEED, [AUTO ZERO]	97
7.4.27	CONFIG, SPEED, [CAS/TAS]	97
7.4.28	CONFIG, SPEED, [Pt TEMPERATURE]	97
7.4.29	CONFIG, RATE TIMER	97
7.4.30	CONFIG, RATE	97
7.4.31	CONFIG, LEAK MEASURE, [AUTO LEAK ON/OFF]	97
7.4.32	CONFIG, LEAK MEASURE, [AUTO LEAK LOCK]	97
7.4.33	CONFIG, LEAK MEASURE, [AUTO LIMIT ON/OFF]	97
7.4.34	CONFIG, LEAK MEASURE, [AUTO LIMIT LOCK]	97
7.4.35	CONFIG, GROUND	98
7.4.36	CONFIG, PORT	98
7.4.37	CONFIG, REMOTE	98
7.4.38	CONFIG, ETP, [AUTO RUN]	98
7.4.39	CONFIG, ETP, [ERASE PROGRAMS]	98
7.4.40	CONFIG, ETP, [RESULT]	98
7.4.41	CONFIG, NUDGE	98
7.4.42	CONFIG, 000	98

8. Specification 101

8.1	Pressure/Vacuum Requirements	103
8.2	Warm-up Requirements	103
8.3	Measurement and Control Range Specifications	103
8.3.1	Operating Range and Performance	103
8.4	Control Performance	105
8.4.1	Stability	105

8.4.2	Rate Control	105
8.4.3	Control Response	106
8.4.4	Dynamic Testing	106
8.4.5	Control Offset	106

Appendix A. Menus 107

A.1	Full Setup Menu	108
A.2	Minimum Setup Menu	111
A.3	Configuration Menu	112

Appendix B. Errors and Warnings 117

B.1	Error Messages	117
B.2	Warning Messages	118

Figures

Figure		Page
2-1	Equipment and Parts	7
2-2	ADTS 405R Mk2 Altitude Reference	10
2-3	ADTS 405F Mk2 Altitude Reference	11
2-4	ADTS 405F Mk2 General View	12
2-5	ADTS 405R Mk2 Front Panel View	13
2-6	ADTS 405R Mk2 Rear Panel View	14
3-1	ADTS 405 Mk2 Keypad Display	19
4-1	Single Display	28
4-2	Dual Display	28
4-3	Triple Display	29
4-4	Rate Timer Display - Aeronautical Units	29
4-5	Rate Timer Display - Pressure Units	30
4-6	Pt Only Display	30
4-7	Configuring Windows For ADTS Subnet IP Address	41
4-8	Ping Test From Windows Command Prompt	42
4-9	PuTTY Configuration	43
4-10	Changing the Default Password	43
4-11	ADTS File System Directories Screen	45
5-1	Output Connector O-ring Seal	51
5-2	ADTS 405F Mk2 AC Fuse Positioning	52
5-3	ADTS 405F Mk2 DC Fuse Positioning	53
5-4	ADTS 405R Mk2 AC Fuse Positioning	54
6-1	Fault Finding Chart	60
6-2	External Communication Ports	66
7-1	ARINC 565 Operating Limits	95

Tables

Table	Page
1-1 Operating Limits - 850 kts Range	2
1-2 Operating Limits - 1,000 kts Range	3
2-1 Storage Conditions	6
2-2 Spares and Accessories List	8
2-3 AC Power Supply Requirements	9
2-4 DC Power Supply Requirements	9
3-1 Aeronautical Units of Measure	18
3-2 Pressure Units of Measure	18
3-3 Keypad Key Functions	19
4-1 Default IP Address Configuration	41
4-2 Default User Name and Password	42
4-3 Win SCP Client Credentials	44
4-4 IEEE 488 Connector Pin-out	46
5-1 Maintenance Chart	49
5-2 Maintenance Materials List	49
5-3 Tool and Test Equipment Requirements	50
5-4 AC Input Connector	56
5-5 DC Input Connector	56
6-1 Fault Advice and Action	61
6-2 Optional Cable (AAU-32 Units)	69
7-1 Rates in Aeronautical Units	75
7-2 Rates in Pressure Units	75
7-3 Aeronautical Units Dual Display	85
7-4 Pressure Units Dual Display	85
7-5 Aeronautical Units Triple Display	86
7-6 Pressure Units Triple Display	86
7-7 Setup Modes	97
8-1 Rack-mount ADTS 405R Mk2 Specification	101
8-2 Flight-line ADTS 405F Mk2 Specification	102
8-3 Performance Expressed in Aeronautical Units	104
8-4 Static and Pitot Performance Expressed in Pressure Units	104
8-5 Qc, Rate Qc and EPR Performance Expressed in Pressure Units	105
8-6 Controller Stability	105
8-7 Rate Control Capabilities	106
A-1 Menu Hierarchy Key	107
B-1 Error Messages	117
B-2 Warning Messages	118

1. Description

1.1 Introduction

There are two versions of this Air Data Test System (ADTS), a 19", 6U high (10½") rack-mounted unit (ADTS 405R Mk2) and a flight-line unit (ADTS 405F Mk2).

The ADTS 405R Mk2 is a rack-mounted system and, with external pressure and vacuum supplies connected, provides measurement and control of pitot and static systems and components. The unit can be used for leak checks, calibration accuracy checks and functional tests of air data instruments, components and systems.

The ADTS 405F Mk2 is a self-contained flight-line air data test system providing complete pitot and static measurement and control. The unit can be used for on-aircraft sense and leak testing, calibration accuracy checks and functional tests of air data instruments, components and systems. The ADTS 405F Mk2 comprises a controller-rack and pump-rack enclosed in a high density, polyethylene case.

The ADTS 405 Mk2 displays and operates in either units of pressure measurement or aeronautical units. In the control mode, the rate that the pressures change towards new set-points can be controlled in true aeronautical rate units.

There are two independent pneumatic channels connect to the aircraft or instrument systems, one for static and one for pitot. They can be operated as measure only channels with leak testing facility or each can be control channels producing true pressure conditions for altitude and airspeed.

To protect sensitive instruments and equipment a "ground" facility automatically and safely controls both channels to atmospheric pressure at the previously entered rates of change and then informs the operator when both channels are safely at "ground".

The operator interface is either a hand terminal connected to the front panel or the key pad and display on the front panel. Both provide information and control selections for the user through the keys and display. The keypad has a back-light for improved operation in poor light conditions. The unit can also be controlled remotely using the IEEE 488 communications interface. The front panel contains the operate switch and a mimic panel with LED indicators showing the operation of the solenoid-operated pneumatic valves.

The pump-rack, on the ADTS 405F Mk2, produces pressure and vacuum supplies for the controller-rack and for external services. Located on the front panel, the external connectors provide for external pressure and vacuum supplies (EXT PRESSURE and EXT VACUUM) and an auxiliary static (vacuum) output (AUX). The rack is cooled by a fan located under a protective cover on the front panel. The power supply connection for the ADTS 405F Mk2 is located on the front panel.

1.2 Operating Range and Performance

The ADTS 405 Mk2 is supplied in one of two full-scale ranges (850 or 1000 kts) for measurement and control of the pitot pressure channel.

Chapter 1. Description

Operating limits are set, predefined tabular limits known as STANDARD, CIVIL and MAX these can be selected through the SETUP menu (see Section 7.3.3, "SETUP, [LIMITS]," on page 83). Operators may also configure the display to aeronautical or pressure units but should be aware that when units of pressure are selected, wider full-scale pressure limits will be enabled for some parameters.

1.3 Operating Limits

The following sets of operating limits are supplied with the ADTS 405 Mk2.

Table 1-1: Operating Limits - 850 kts Range

Parameter	Max Limits	Standard Limits	Civil Limits
Min Alt	-3,000 ft	-2,000 ft	-1,000 ft
Max Alt	105,000 ft	80,000 ft	50,000 ft
Min CAS	-100 kts	0.0 kts	0 kts
Max CAS	850 kts	850 kts	450 kts
Min Ps	3.0 mbar	27.615 mbar	115.972 mbar
Max Ps	1355.00 mbar	1088.657 mbar	1050.406 mbar
Min Qc	-1,352.00 mbar	0.0 mbar	0.0 mbar
Max Qc	1,700.00 mbar	1688.00 mbar	368.01 mbar
Max Mach	12.35	2.5	1
Max ROC	100,000 ft/min	9,000 ft/min	6,000 ft/min
Max Rate CAS	2,000 kts/min	600 kts/min	600 kts/min
Max Rate Ps	10,000.00 mbar/min	200.00 mbar/min	100.00 mbar/min
Max Rate Qc	10,000.00 mbar/min	200.00 mbar/min	100.00 mbar/min
ARINC Limits	OFF	OFF	OFF
Alt Correction	0 ft	0 ft	0 ft

Table 1-2: Operating Limits - 1,000 kts Range

Parameter	Max Limits	Standard Limits	Civil Limits
Min Alt	-3,000 ft	-3,000 ft	-1,000 ft
Max Alt	105,000 ft	80,000 ft	50,000 ft
Min CAS	-100 kts	0.0 kts	0 kts
Max CAS	1,000 kts	1,000 kts	450 kts
Min Ps	3.0 mbar	27.615 mbar	115.972 mbar
Max Ps	1355.00 mbar	1,128.029 mbar	1050.406 mbar
Min Qc	-1,352.00 mbar	-16.303 mbar	0 mbar
Max Qc	2,500.00 mbar	2,490.50 mbar	368.01 mbar
Max Mach	14.97	5	1
Max ROC	1000,000 ft/min	15,000 ft/min	6,000 ft/min
Max Rate CAS	2,000 kts/min	700 kts/min	600 kts/min
Max Rate Ps	10,000.00 mbar/min	200.00 mbar/min	100.00 mbar/min
Max Rate Qc	10,000.00 mbar/min	200.00 mbar/min	100.00 mbar/min
ARINC Limits	OFF	OFF	OFF
Alt Correction	0 ft	0 ft	0 ft

2. Installation



CAUTION Do not use any equipment that is known to be or suspected to be damaged or faulty.

Note: Please keep the special packing boxes so that the ADTS can be safely shipped for calibration, repair or storage.

2.1 List of Parts

On receipt of the ADTS 405 Mk2 check the contents of the packaging against the following lists.

2.1.1 ADTS 405F Mk2 Standard Packaging List

- i. Flight-line ADTS 405F Mk2.
- ii. Accessory bag.
- iii. Power supply cable 2 m or 10 m (regional plug as per order).
- iv. Hand terminal (optional).
- v. Hand terminal cable - 2 m (optional).
- vi. Hand terminal cable - 18 m (optional).
- vii. User Manual K0572 (this publication).
- viii. O-ring kit.
- ix. Safety and Installation Guide 124M8686.

2.1.2 ADTS 405R Mk2 Standard Packaging List

- i. Rack-mount ADTS 405R Mk2.
- ii. Power supply cable 2.5 m (regional plug as per order).
- iii. User Manual K0572 (this publication).
- iv. Input, hose, 15 m, green, AN6 - open.
- v. Input, hose, 15 m, yellow, AN4 - open.
- vi. O-ring kit.
- vii. Expansion port dongle.
- viii. Safety and Installation Guide 124M8686.

2.2 Packaging for Storage or Transportation



WARNING The flight-line unit can be moved by use of the handle and wheels, but if it is to be lifted, it is a two-person lift.

2.2.1 Environment

The optimum conditions for ADTS 405 Mk2 equipment during transit, preparation for calibration and repair and when being storage are detailed as below. Items in storage are defined as being non-operational. If the ADTS becomes exposed to moisture or very high humidity, dry as soon as possible and temporarily store in a low humidity area. The following conditions apply for storage or shipping:

Table 2-1: Storage Conditions

Parameter	Permitted Range
Temperature	-51°C to 70°C (-60° to +158°F)
Altitude	Up to 50,000 feet (15,240 metres)

2.2.2 Procedure

1. The unit should be at zero/ambient pressure.
2. Disconnect all hose assemblies and stow them in the shoulder bag.
3. Switch power OFF and disconnect from the electrical power supply.
4. Disconnect the power supply cable and the hand terminal cable.
5. Disconnect the hand terminal cable from the hand terminal.

When using packing materials other than the original, proceed as follows:

1. Wrap unit in polyethylene sheeting.
2. Select a double-wall cardboard container. Inside dimensions must be at least 15 cm greater than the equipment. The carton must meet test strength requirements of > 125 kg.
3. Protect all sides with shock-absorbing material to prevent equipment movement within the container.
4. Seal carton with approved sealing tape.
5. Mark carton "FRAGILE" on all sides, top, and bottom of shipping container.

Note: For ADTS 405R Mk2 rack-mount units, loose or peripheral items should be placed in a sealed polythene bag. For ADTS 405F Mk2, stow the power supply cable, hand terminal cable and the hand terminal in the ADTS 405F Mk2 lid. Fit the lid to the unit.

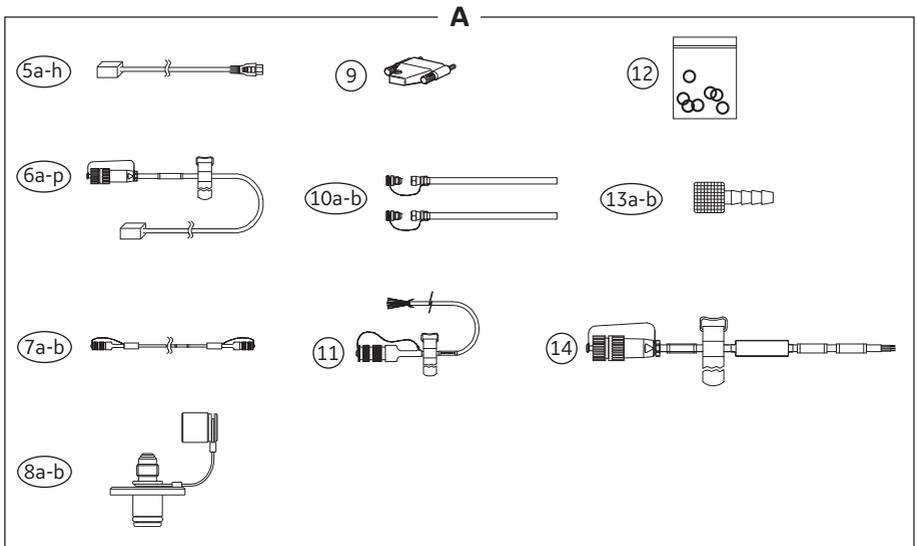
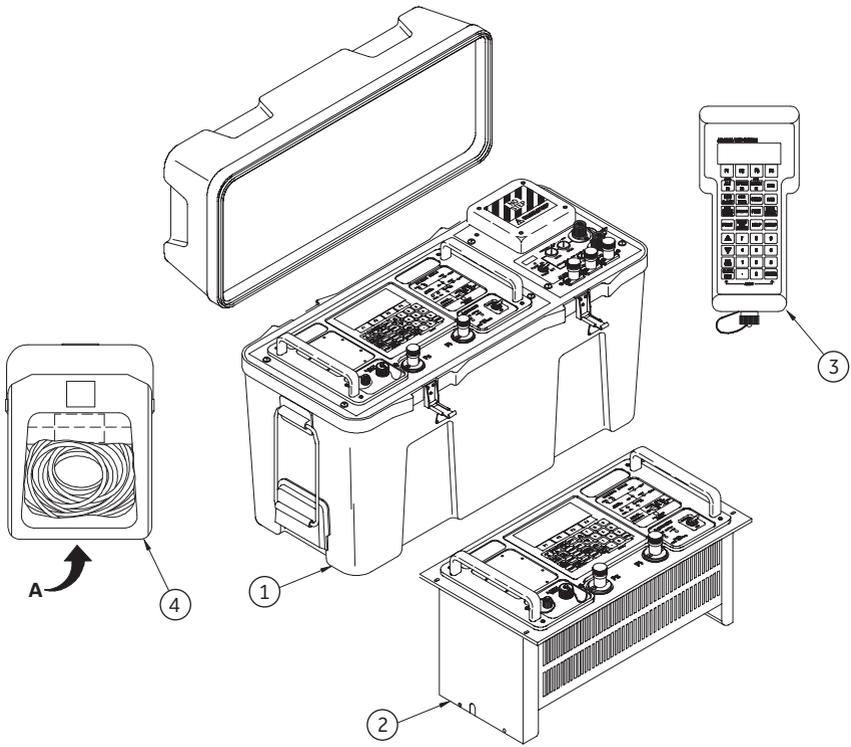


Figure 2-1: Equipment and Parts

Table 2-2: Spares and Accessories List

Item	Part Number	Description	Used On
1	-	ADTS 405F Mk2 Flight-line Air Data Test Set	-
2	-	ADTS 405R Mk2 Rack-mount Air Data Test Set	-
3	AS405-111-1728M0	ADTS Hand Terminal	ADTS 405F/R
4	AS505-57-3124M0	Accessory Bag	ADTS 405F
5a	AA405F-30	AC Power Lead, UK, 2.5 m	
5b	AA405F-31	AC Power Lead, USA/Canada, 2.5 m	
5c	AA405F-32	AC Power Lead, Europe, 2.5 m	
5d	AA405F-33	AC Power Lead, Australia/New Zealand, 2.5 m	
5e	AA405F-34	AC Power Lead, India, 2.5 m	ADTS 405R
5f	AA405F-35	AC Power Lead, China, 2.5 m	
5g	AA405F-36	AC Power Lead, South Africa, 2.5 m	
5h	AA405F-37	AC Power Lead, Japan, 2.5 m	
6a	AA405F-1	AC Power Lead, UK, 2 m	
6b	AA405F-2	AC Power Lead, UK, 10 m	
6c	AA405F-3	AC Power Lead, USA/Canada, 2 m	
6d	AA405F-4	AC Power Lead, USA/Canada, 10 m	
6e	AA405F-5	AC Power Lead, Europe, 2 m	
6f	AA405F-6	AC Power Lead, Europe, 10 m	
6g	AA405F-7	AC Power Lead, Australia/New Zealand, 2 m	
6h	AA405F-8	AC Power Lead, Australia/New Zealand, 10 m	
6i	AA405F-9	AC Power Lead, India, 2 m	ADTS 405F
6j	AA405F-10	AC Power Lead, India, 10 m	
6k	AA405F-11	AC Power Lead, China, 2 m	
6l	AA405F-12	AC Power Lead, China, 10 m	
6m	AA405F-13	AC Power Lead, South Africa, 2 m	
6n	AA405F-14	AC Power Lead, South Africa, 10 m	
6o	AA405F-15	AC Power Lead, Japan, 2 m	
6p	AA405F-16	AC Power Lead, Japan, 10 m	
7a	AS405-33-1891M0	Hand Terminal Lead, 2 m	ADTS 405F/R
7b	AS405-34-1891M0	Hand Terminal Lead, 18 m	
8a	AA405F-17	Pressure Port Connector AN4	
8b	AA405F-18	Pressure Port Connector AN6	ADTS 405F/R
9	AS405-22-1891M0	Expansion Port Dongle	ADTS 405R

Table 2-2: Spares and Accessories List

Item	Part Number	Description	Used On
10a	AA500F-19	Red Hose (State Length in Metres)	ADTS 405F/R
10b	AA500F-20	Blue Hose (State Length in Metres)	
10c	AS405-53-1729M0	Yellow Hose, 15 m	ADTS 405R
10d	AS405-54-1729M0	Green Hose, 15 m	
11	AS405-60-1891M0	Altimeter Encoder Cable	ADTS 405F/R
12	AS405-82-1891M0	O-ring Kit	ADTS 405F/R
13a	AA500F-22	Hose Connector AN4	ADTS 405F/R
13b	AA500F-23	Hose Connector AN6	
14	AS405-31-1891M0	DC Power Cable	ADTS 405F

2.3 Power Supply

See Safety and Installation Guide 124M8686 for full details.

2.3.1 AC Input



RISK OF ELECTRIC SHOCK The power supply switch on the front panel is not classified as a disconnecting device. To isolate the power supply disconnect the power supply connector.

Table 2-3: AC Power Supply Requirements

Voltage	Frequency	Power
100/120/230 V	50/60 Hz	500 VA
115 V	400 Hz	

2.3.2 DC Input (Option ADTS 405F Mk2 Only)



INFORMATION A protective earth connection must also be made for DC operation or specified EMC performance may be impaired.

Table 2-4: DC Power Supply Requirements

Voltage	Power
16 to 30 V	500 VA

2.3.3 ADTS 405R Mk2 Rack-mounted Version

1. The unit must be connected to the correct electrical power supply as stated, beside the power connectors on the rear panel.
2. Install an easily accessible isolator in the power supply circuit.

- The power supply connector on the rear panel of the unit will not be accessible when fitted in the equipment rack.

2.4 Positioning of the ADTS

2.4.1 ADTS 405R Mk2 Rack-mounted Version



WARNING Observe the appropriate safety instructions and procedures detailed in the aircraft maintenance manual and component maintenance manuals.

It is important that the position of the ADTS 405R Mk2 in relation to the UUT is known. An altitude correction must be made to allow for the difference in height between the reference level, indicated on the mimic panel, and the UUT. See Section 7.3.11, “SETUP, ALT,” on page 87 for details of altitude correction.

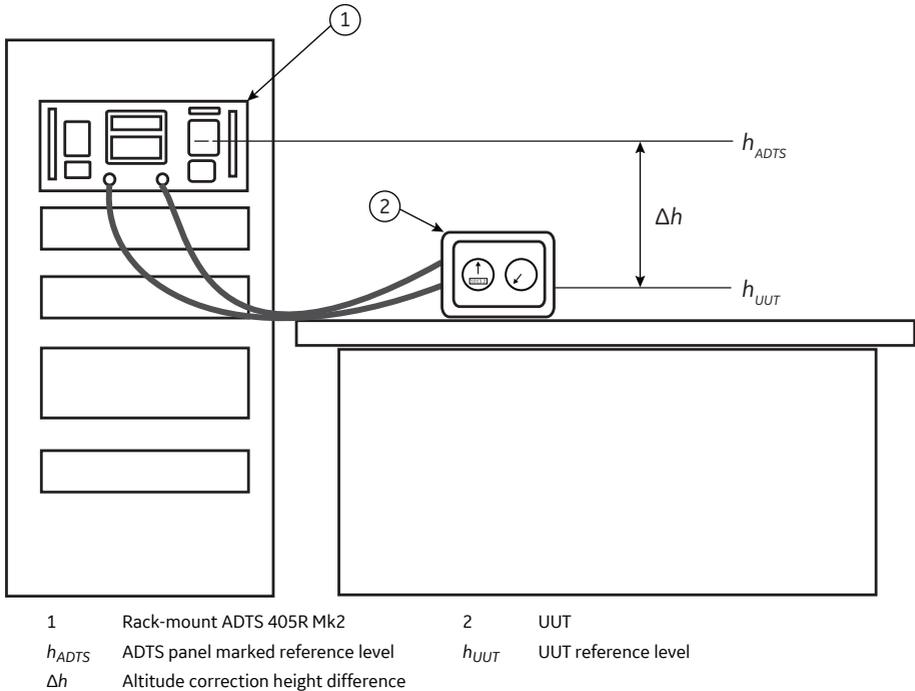


Figure 2-2: ADTS 405R Mk2 Altitude Reference

The corrected altitude output equals the true altitude output increased by height difference. See equation below:

$$\Delta h = h_{ADTS} - h_{UUT}$$

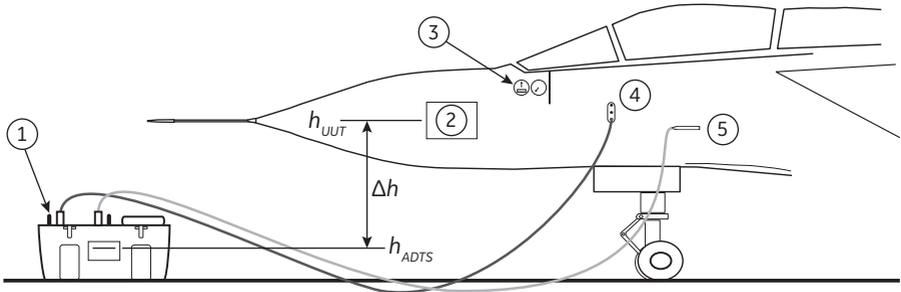
Note: The Δh altitude correction value should be negative when the ADTS is positioned higher than the unit under test.

2.4.2 ADTS 405F Mk2 Flight-line Version



WARNING The ADTS should not be placed in contact with hazardous fuel vapor concentrations.

It is important that the position of the ADTS 405F Mk2 in relation to the aircraft altitude sensors is known. An altitude correction must be made to allow for the difference in height between the reference level and the aircraft's altitude sensors. See Section 7.3.11, "SETUP, ALT," on page 87 for details of altitude correction.



1	Flight-line ADTS 405F Mk2	2	Air Data Computer
3	Cockpit instrumentation	4	Static port
5	Pitot port	h_{ADTS}	ADTS panel marked reference level
h_{UUT}	UUT reference level	Δh	Altitude correction height difference

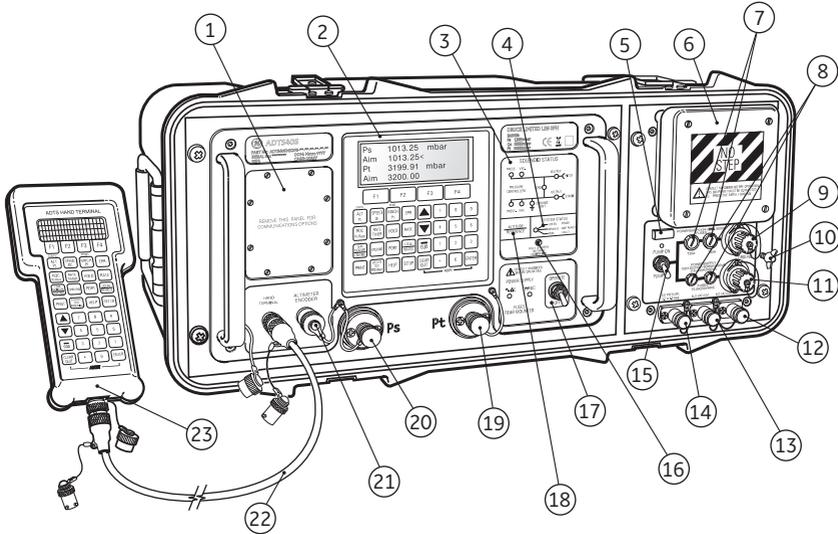
Figure 2-3: ADTS 405F Mk2 Altitude Reference

The corrected altitude output equals the true altitude output increased by height difference. See equation below:

$$\Delta h = h_{UUT} - h_{ADTS}$$

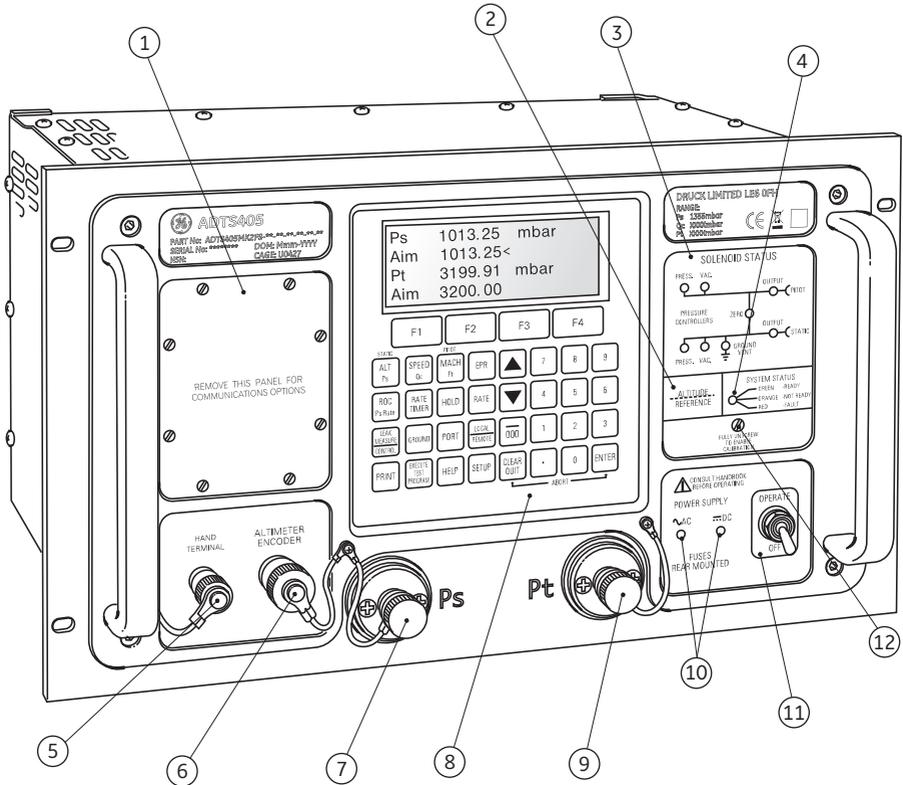
Note: The Δh altitude correction value should be positive when the ADTS is positioned below the aircraft.

2.5 Product Views



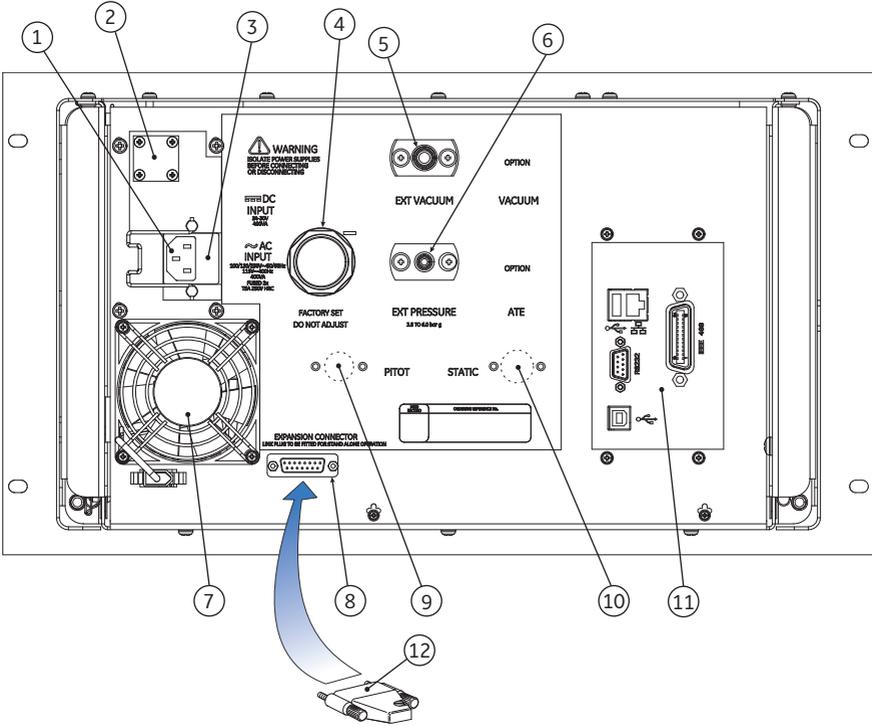
- | | | | |
|----|---------------------------------------|----|---|
| 1 | Cover plate for communications option | 2 | Keypad and display |
| 3 | Solenoid valve status indicator | 4 | System status indicator |
| 5 | Elapsed time indicator | 6 | Fan outlet cover |
| 7 | DC power supply fuses (optional) | 8 | AC power supply fuses |
| 9 | DC power supply connector (optional) | 10 | Cross bonding connector |
| 11 | AC power supply connector | 12 | Vacuum input connector |
| 13 | Auxiliary vacuum output connector | 14 | Pressure input connector |
| 15 | Pump power supply switch | 16 | Calibration enable switch |
| 17 | Power supply switch | 18 | Altitude sensor datum height (altitude reference level) |
| 19 | Pitot output connector | 20 | Static output connector |
| 21 | Altitude encoder connector (optional) | 22 | Hand terminal cable |
| 23 | Remote hand terminal | | |

Figure 2-4: ADTS 405F Mk2 General View



- | | | | |
|----|---|----|---|
| 1 | Cover plate for communications connectors | 2 | Altitude sensor datum height (altitude reference level) |
| 3 | Solenoid valve status indicator | 4 | System status indicator |
| 5 | Hand terminal connector | 6 | Altitude encoder connector (optional) |
| 7 | Static output connector | 8 | Keypad and display |
| 9 | Pitot output connector | 10 | Power connection indicators |
| 11 | Power supply switch | 12 | Calibration enable switch |

Figure 2-5: ADTS 405R Mk2 Front Panel View



- | | |
|-------------------------------------|--|
| 1 AC power supply connector | 2 DC power supply connector (optional) |
| 3 AC fuses holder | 4 Pressure regulator |
| 5 Source vacuum input connector | 6 Source pressure input connector |
| 7 Cooling fan air intake | 8 Expansion port (used with GE PV103R pump unit) |
| 9 Pitot output connector (optional) | 10 Static output connector (optional) |
| 11 Communications connectors | 12 Expansion port dongle. |

Figure 2-6: ADTS 405R Mk2 Rear Panel View

Note: The expansion port dongle (12) must be fitted when the expansion port (8) is not in use.

3. Getting Started



WARNING Observe safety precautions stated in local orders and the aircraft or equipment servicing procedures.

Make sure the electrical and pneumatic connectors, electrical cables, pipes and positioning of the ADTS 405 Mk2 comply with the instructions in this manual and local regulatory requirements.

3.1 Preparation



RISK OF ELECTRIC SHOCK The electrical supply must include a connection to a protective earth. See Safety and Installation Guide 124M8686 for start-up safety checks and information.

Carry out the following before use:

- a. If necessary, carry out the maintenance detailed in Section 5.3, “Maintenance Tasks,” on page 50.
- b. Make sure the air data test system power supply switch on the front panel is set to OFF.
- c. Connect the air data test system to the electrical supply.
- d. Inspect the pneumatic hoses for damage, ingress of dirt and moisture. Make sure the aircraft adapters are serviceable.

3.2 Start-up



INFORMATION Before use, the ADTS 405 Mk2 should be tested. Review and become familiar with the overall operating states and test procedures before starting any test process on an aircraft or component.

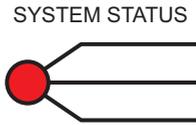
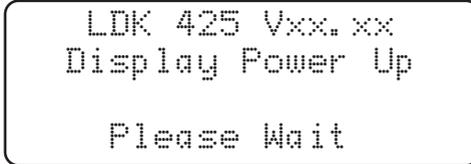
3.2.1 Connections

- a. Connect the hoses for the test procedures to the air data test system:
 - i. Red hose to the STATIC output (Ps).
 - ii. Blue hose to the PITOT output (Pt).
- b. Temporarily seal the free ends of the hoses.

Note: When connected take care not to restrict air flow to the hoses.
- c. Connect the hand terminal to the air data test system through the hand terminal connector on the front panel. If necessary, connect the hand terminal through the extension cable.

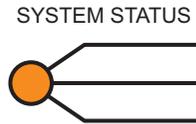
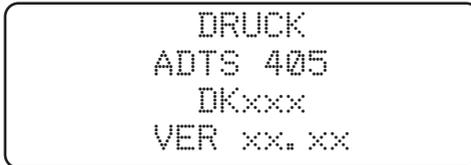
3.2.2 Power-up

- a. Check the power indicator is illuminated and set the front panel power switch to **OPERATE**.
- b. The display will show the following sequence:
 1. Display power-up screen. The display, on the front panel or hand-terminal, shows the following. The system status indicator LED is initially colored red, this is normal.

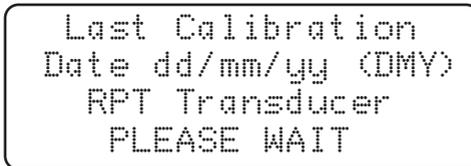


Note: Vxx.xx will display the current software version number.

2. Controller power-up screen. After a short time the display shows the following. The system status indicator LED changes to orange in color.

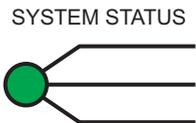
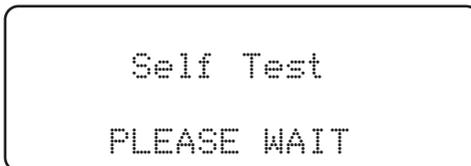


3. Date of the last calibration and type of main transducer fitted.



Note: Date format can be set to a leading value of day or month in SETUP.

4. Self-test message and front panel LED status. The system status LED changes to green in color.



5. Measuring ground pressure message. The system opens the zero valves and after approximately 7 seconds the valves close and the routine continues. The display shows:

```

Measuring Ground
Pressures

PLEASE WAIT

```

6. Equalizing system pressures message. The system opens the output valves, Ps and Pt port pressures will safely remain at the original measured values:

```

Equalising System
Pressures
(Vaives May Pulse)

PLEASE WAIT

```

7. Display shows Leak Measure mode and the number of parameters last selected in configuration:

```

Alt      0      ft
Leak Measure
CAS      0.0    kts
Leak Measure  WARMUP

```



INFORMATION The ADTS 405 Mk2 system may now be used. But for full specification, accuracy and stability, wait the warm-up period of 15 minutes. The display shows “WARMUP” in the lower right hand corner. This message clears automatically after the time period.

Note: (1) The ADTS 405 Mk2 is a continuous, self-monitoring system. If the system detects an error, the display shows an error message. Lists of errors are detailed in Section 6.2, “Error Messages,” on page 57.

Note: (2) The display at power-up can be changed, see Section 7.3.6, “SETUP, [MORE], [DISPLAYS/OPTIONS], [DISPLAY TYPE],” on page 85.

3.2.3 Units of Measure

When operating, in either pressure measure or pressure control modes, the ADTS 405 Mk2 can display the following unit information:

Table 3-1: Aeronautical Units of Measure

Aeronautical Function	Display Abbreviation	Displayed Units
Altitude	ALT	ft, m
Calibrated and True Airspeed	CAS, TAS	kts, km/h, mph
Mach	MACH	-
Rate of Climb	ROC	ft/m, m/m, m/s, hm/m
Rate of Airspeed	Rt CAS,	kts/m, km/h/m, mph/m
Rate of Mach	RtMCH	Mach/m

Table 3-2: Pressure Units of Measure

Pressure Function	Display Abbreviation	Displayed Units ^a
Static (Absolute)	Ps	[P]
Pitot (Absolute)	Pt	[P]
Dynamic or Impact (Differential)	Qc	[P]
Engine Pressure Ratio	EPR	-
Rate of Ps	Rt Ps	[P]/m
Rate of Pt	RtPt	[P]/m
Rate of Qc	Rt Qc	[P]/m
Rate of EPR	Rt EPR	EPR/m

- a. Where [P] is the currently selected pressure units from the following list: mbar, inHg, mmHg, inH₂O (4°C), inH₂O (20°C), psi, hPa, kPa, inH₂O (60°F), kg/cm² or %FS.

3.3 Keypad Display

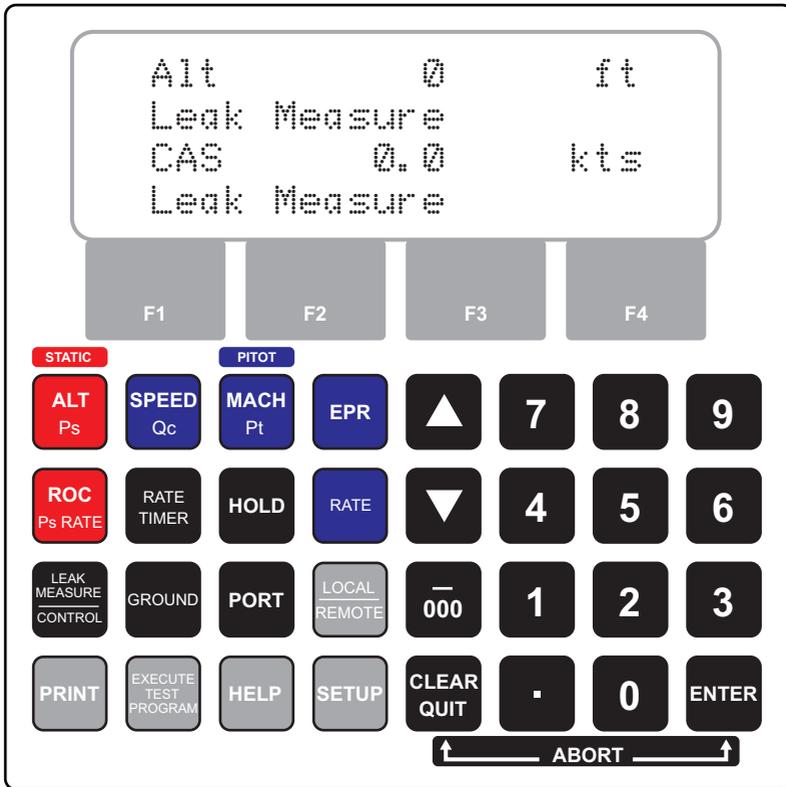


Figure 3-1: ADTS 405 Mk2 Keypad Display

3.4 Operation Quick Reference

The operation quick reference guide shows the key functions. See Chapter 7, on page 71 for full details.

Table 3-3: Keypad Key Functions

Key	Function
F1 ... F4	Function keys (soft-keys) for menus.
ALT Ps	Altitude (Aeronautical units) or Ps (Pressure units).

Table 3-3: Keypad Key Functions

Key	Function
	Airspeed (Aeronautical units) or Qc (Pressure units).
	Mach (Aeronautical units) or Pt (Pressure units).
	Engine pressure ratio (Pressure units only).
	Rate of climb (Aeronautical units) or Rate of Ps (Pressure units).
	Start timing rate of change.
	Hold pressure at present value. Press again to release.
	Rate of change of pitot parameter. Press SPEED/QC or MACH/Pt , then press RATE .
	Switches between measure mode (for leak testing) and control mode.
	Controls Ps to atmospheric pressure and Qc to zero at current rates of change.
	See Line Switching Unit user manual.
	Switches (toggles) between remote and local operation.
	Prints current parameter values.
	Execute downloaded test programs.

Table 3-3: Keypad Key Functions

Key	Function
	Press HELP then other key for further information.
	The settings in the setup menu are only temporary and are lost at power-down. For more details see Appendix A.1, "Full Setup Menu," on page 108 and Appendix A.2, "Minimum Setup Menu," on page 111.
	This combination of key presses enters the configuration menu. To enter the configuration menu, press and hold the F1 key, and then press the SETUP key. The settings in configuration menu are permanent. They are not lost after a power-down. For more details see Appendix A.3, "Configuration Menu," on page 112.
	Increases the aim value.
	Decreases the aim value.
	Number entry.
	Minus sign for first number entry, 000 (thousand) if not the first number of entry.
	Clear number entry, or quit from menu, or clear warning message.
	Complete number entry.
	This combination of key presses causes the ADTS to abort. The ADTS with immediately stop, close the output valves, and perform a power-up restart. To initiate an abort, press and hold the QUIT/CLEAR key, and then press the ENTER key.

3.5 Operating Mode Overview



INFORMATION Once initialized, wait 15 minutes to allow the pressure measurement system to reach a stable operating temperature. The warm-up period can be reduced to 5 minutes if the system has been powered following a short period of inactivity.

The air data test system can now be set for a variety of functions and modes that follow:

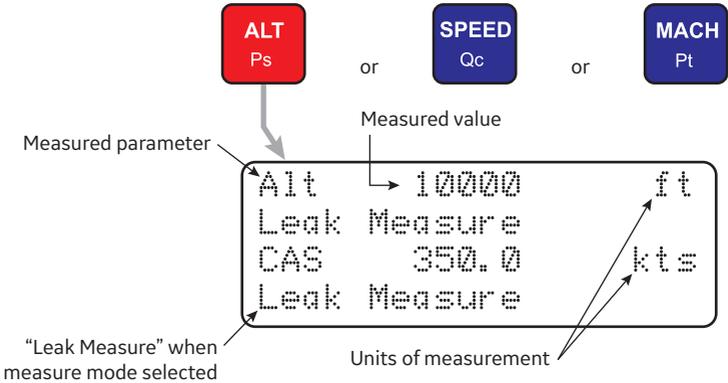
1. Pressure measurement mode.
2. Pressure control mode.
3. Timed leak rate measurement.
4. Control to local ground pressure.

The ADTS 405 Mk2 always powers-up in Measure mode with the pressure controllers off. When changing to Control Mode the pump unit must be switched on and producing the correct pressure and vacuum.

Each operating function shows the required key presses to set displays and selections.

3.5.1 Measure Mode (Pressure Measurement Mode)

To select the measured parameter press:



Change display
single, dual or triple
press:



- [MORE]
- [CONTROL]
 - [Ps Pt DUAL]
- [DISPLAYS/OPTIONS]
 - [DISPLAY TYPE]
 - [OPTIONS]

Change units from
aeronautical to
pressure:



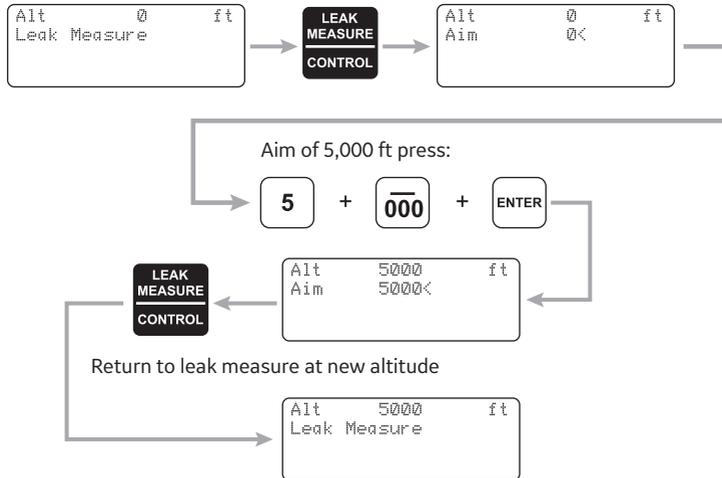
- [UNITS]
 - [NEXT]
 - [PREV]
 - [SAVE]

3.5.2 Control Mode (Pressure Control Mode)

For ADTS 405F Mk2 set the pump switch to "PUMP ON"

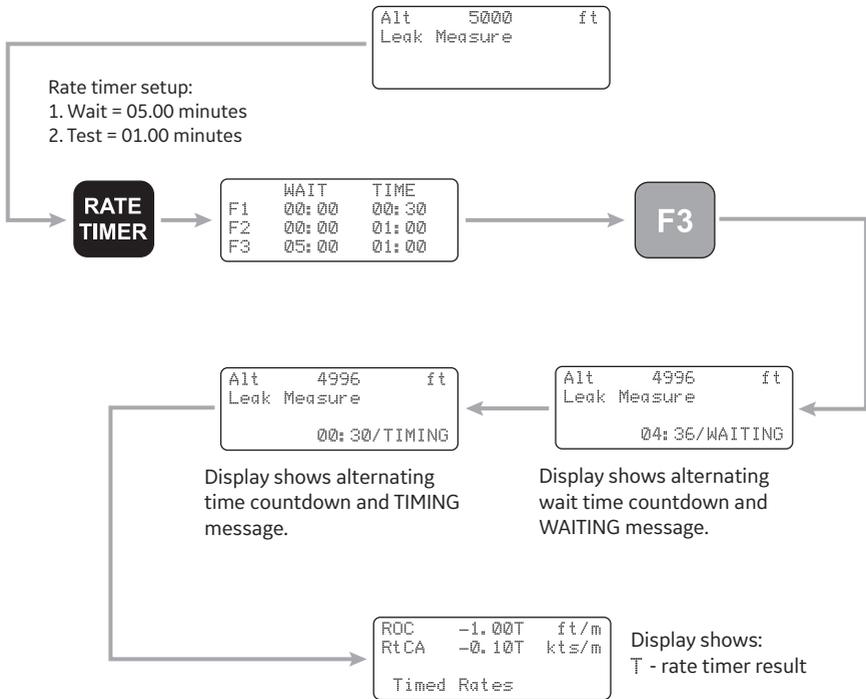


From leak measure press:



3.5.3 Leak Measure Mode (Timed Average Leak Rate Measurement)

Static channel altitude 5,000 ft, measure leak:

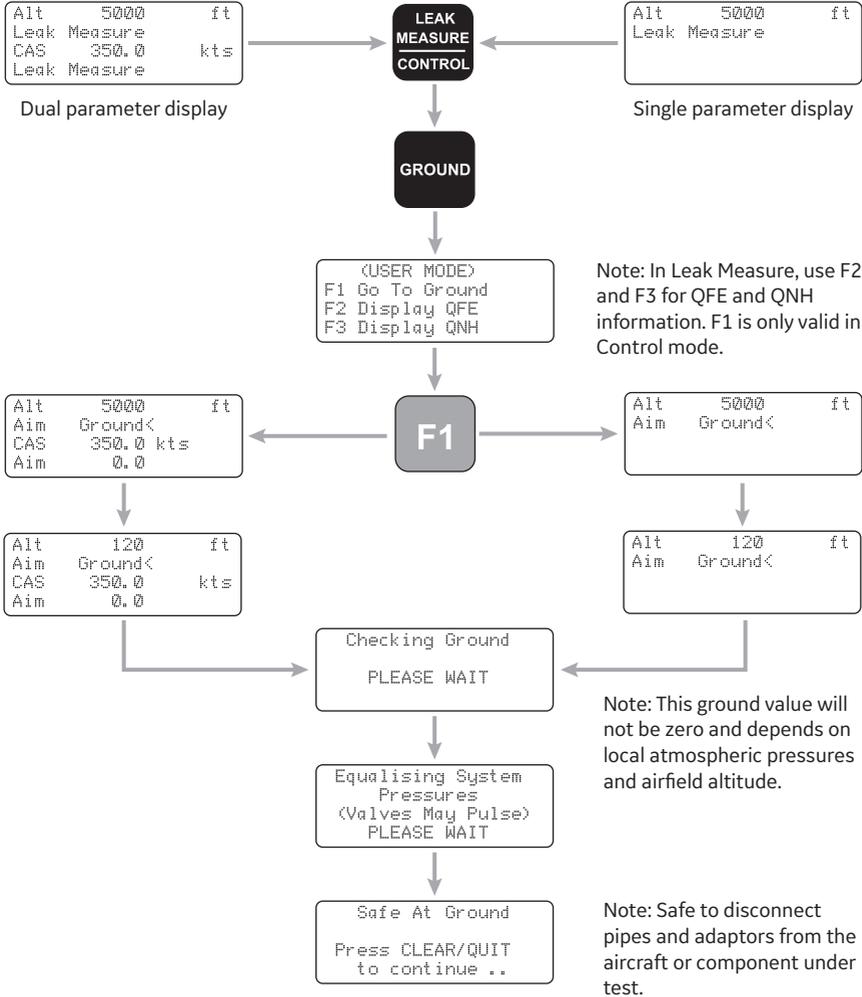


Note: Compressing a gas generates heat. Gas heated or cooled in an enclosed volume causes a pressure change. It is important, especially for leak testing, to allow enough time for the heated gas to cool and the pressure to stabilize.

When setting the rate timer, consider three factors:

1. The volume of the system to be tested (large volumes take longer to stabilize).
2. The pressure change (the higher the change the greater heat generated).
3. The ambient air temperature.

3.5.4 Go to Ground (Control to Local Ground Pressure)



4. Operation



WARNING See Safety and Installation Guide 124M8686 for guidance on safety and standard operating conditions.

The procedures show the steps required to make sure the ADTS 405 Mk2 is serviceable and of the settings required to test an aircraft system or component in the following notation:

1. All key presses are highlighted in **bold** and shown as identified on the keypad.
2. Key presses inside brackets e.g., [MORE], are soft key presses (i.e, function key selections {F1 to F4} indicated on the display screen).

For further information on a particular ADTS function and using the Help System refer to Section 7.2.19, "HELP," on page 80. The help information includes further details of the function and details associated functions.

For a summary of Setup and Configuration procedures refer to the Section 3.4, "Operation Quick Reference," on page 19.

4.1 Control or Measure Parameter

To change the (displayed) parameter:

- a. Value parameters: Press the parameter key e.g., press **SPEED/Qc** to display airspeed.
- b. Rate parameter: Press the associated parameter key followed by the rate key for that channel. e.g, display airspeed rate, press **SPEED/Qc** then **RATE. ROC/Ps** Rate may be directly pressed without first pressing **ALT/Ps**.

Note: The displayed parameters depend on the last keys pressed.

To display two parameters:

- a. Press each value parameter in turn, e.g., display altitude and airspeed together, press **ALT/Ps** then **SPEED/Qc**.
- b. In control mode, an arrow, at the right-hand end of the aim value, indicates the last parameter selected. This can be changed by entering a new value.

To display a value parameter together with its rate:

- a. Press the parameter key followed by the associated rate key, e.g, display airspeed and rate of speed together, press **SPEED/Qc** then **RATE**.

Note: If **ROC/Ps RATE** is pressed, the display automatically shows ALT and ROC. See Section 7.2.9, "RATE," on page 75 for display details.

4.1.1 Display Functions

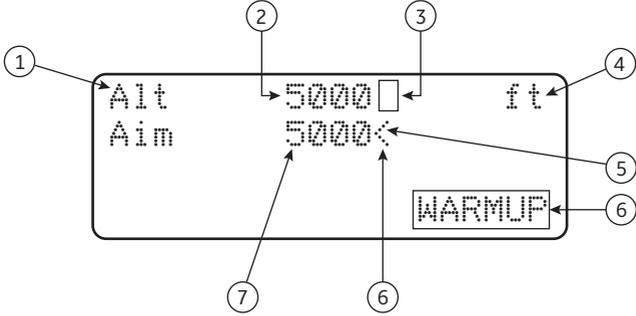
The display normally shows pressures and rates or aeronautical equivalents. It can be setup to show, at the same time, one parameter (single), two parameters (dual) or three parameters (triple).

The triple display always shows altitude and airspeed; with pressure units selected, the display always shows Ps and either Qc, Pt or EPR. When **ALT** or **CAS** are selected the display

Chapter 4. Operation

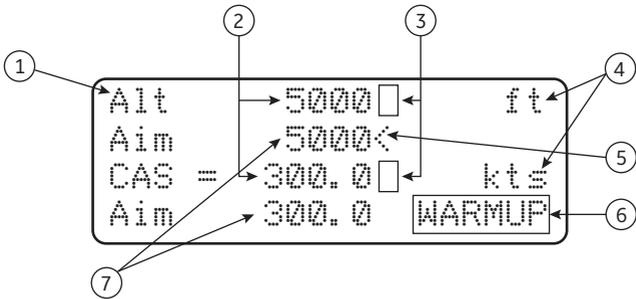
shows the aim and measured values of ALT and CAS as a dual display. With any other selected parameter the display shows the measured values of altitude and airspeed and, the aim and measured value of the other selected parameter. Additional display modes are available for certain options.

Note: The ADTS 405 Mk2 automatically returns to the pressure display if left inactive in any setup or menu type display for a period of more than 1 minute.



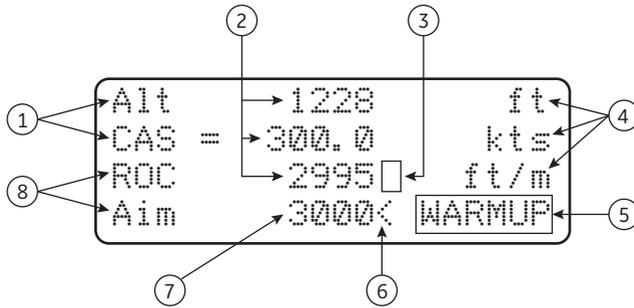
- 1 Controlled or measured parameter.
- 2 Measured value.
- 3 "T" for timed rate of change.
- 4 Units of measurement.
- 5 "<" Pointer for parameter, i.e. aim that changes on data entry.
- 6 Special messages, e.g. warm-up period.
- 7 Aim (set-point or target) in control mode, or "Leak Measure" when the pressure controller is off.

Figure 4-1: Single Display



- 1 Controlled or measured parameter.
- 2 Measured value.
- 3 "T" for timed rate of change.
- 4 Units of measurement.
- 5 "<" Pointer for parameter, i.e. aim that changes on data entry.
- 6 Special messages, e.g. warm-up period.
- 7 Aim (set-point or target) in control mode, or "Leak Measure" when the pressure controller is off.

Figure 4-2: Dual Display



- | | | | |
|---|---|---|---|
| 1 | Constant indication of values. | 2 | Measured value. |
| 3 | "T" for timed rate of change. | 4 | Units of measurement. |
| 5 | Special messages, e.g. warm-up period. | 6 | "<" Pointer for parameter, i.e. aim that changes on data entry. |
| 7 | Aim (set-point or target) in control mode, or "Leak Measure" when the pressure controller is off. | 8 | Current changing parameter. |

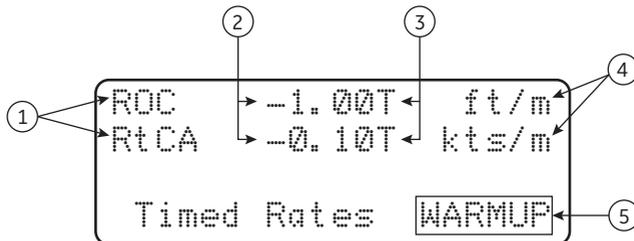
Figure 4-3: Triple Display

4.1.2 Rate Timer Displays

When in Leak Measure mode and, after completing a rate timing, the system generates the rate timer displays. These displays are independent of the display mode (single, dual, triple or option).

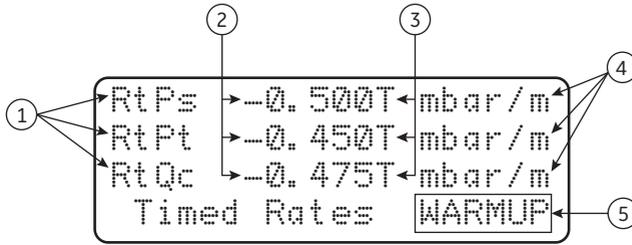
Note: There is no pointer for the primary parameter, values cannot be entered in the rate timer displays.

Pressing a parameter key (**ALT**, **ROC**, etc) or **CLEAR/QUIT** exits the rate timer displays.



- | | | | |
|---|--|---|-----------------------|
| 1 | Measured parameter. | 2 | Measured value. |
| 3 | "T" for timed rate of change. | 4 | Units of measurement. |
| 5 | Special messages, e.g. warm-up period. | | |

Figure 4-4: Rate Timer Display - Aeronautical Units

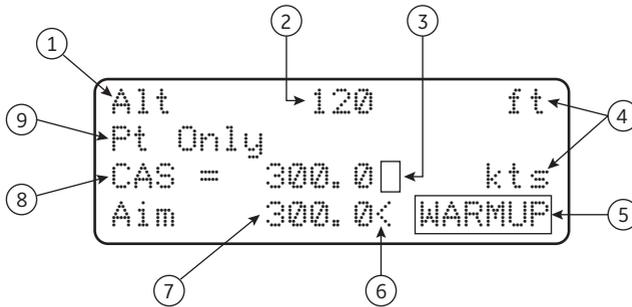


- 1 Measured parameter.
- 2 Measured value.
- 3 "T" for timed rate of change.
- 4 Units of measurement.
- 5 Special messages, e.g. warm-up period.

Figure 4-5: Rate Timer Display - Pressure Units

4.1.3 Pt Only Display

The Pt only display overrides the other display modes (single, dual and triple). The measured altitude and the CAS are produced from Ps in measure mode.



- 1 Always displays "Alt" for altitude.
- 2 Measured altitude.
- 3 "T" for timed rate of change.
- 4 Units of measurement.
- 5 Special messages, e.g. warm-up period.
- 6 "<" Pointer for parameter, i.e. aim that changes on data entry.
- 7 Aim (set-point or target) in control mode, or "Leak Measure" when the pressure controller is off.
- 8 Controlled or measured parameter.
- 9 "Pt Only" measure indicating Pt only mode.

Figure 4-6: Pt Only Display

4.2 Changing the Display

The display can show either one, two or three parameters as follows.

Note: The display cannot be changed with SETUP switched off or in minimum mode.

4.2.1 Change to Single, Dual or Triple Display

- a. Press **SETUP**.
- b. Select [MORE].
- c. Select [DISPLAYS/OPTIONS].
- d. Select [DISPLAY TYPE].
- e. Using [NEXT] or [PREV].
- f. Select either SINGLE, DUAL or TRIPLE, ENCODER (more display types with options fitted).
- g. Press [SAVE] to accept.
- h. Press **CLEAR/QUIT** repeatedly to return to user display.

4.2.2 Changing the Display for Pt Only

- a. Press **SETUP**.
- b. Select [MORE].
- c. Select [Control], [Ps Pt Dual].
- d. Select [Pt Only Mode].
- e. Press **CLEAR/QUIT** repeatedly to return to user display.

4.3 Changing the Units

In Full Setup Mode any set of aeronautical or pressure units can be selected.

4.3.1 Changing the Measurement Units

- a. Press the **SETUP** key.
- b. Select [UNITS].
- c. Use [NEXT] and [PREV] keys to select the required units.
- d. Select [SAVE] to accept.
- e. Press **CLEAR/QUIT** repeatedly to return to the main pressure display.

Note: (1) In Minimum Setup Mode only the default aeronautical and pressure units can be selected.

Note: (2) If Setup Mode is switched off, units cannot be changed.

4.3.2 Changing the Unit Type

- a. Press the **SETUP** key.
- b. Select [UNITS TYPE].
- c. Select either [AERO] or [PRESS] to select the unit type.
- d. Select [SAVE] to accept.
- e. Press **CLEAR/QUIT** repeatedly to return to the main pressure display.

Note: (1) The default pressure and aeronautical units are defined in the CONFIG mode.

Note: (2) Display cannot be changed with SETUP switched off or in minimum mode.

4.4 Aim

The ADTS 405 Mk2 must be in control mode to set a new aim (current aim displayed). If the aim field shows "Leak Measure" press **LEAK MEASURE/CONTROL** to enter control mode.

- a. Press the value or rate parameter to change, e.g. **ALT Ps, SPEED Qc, MACH Pt** or **RATE**.
- b. Using the numeric keys, type in the new aim value. The existing aim is replaced when the first digit of the new aim is pressed. Each digit is displayed as it is pressed. If an error is made during the entry of data, press **CLEAR/QUIT** to restore the original aim.
- c. Press **ENTER** to action the new aim.

Note: The **-000** key can be used as a quick way of entering thousands.

4.5 Leak Measure

4.5.1 UUT Leak Test

- a. Press **LEAK MEASURE/CONTROL** to return to Leak Measure mode.
- b. Press **RATE TIMER, F3** - [Wait 05:00, Time 01:00].
- c. Different wait and time periods can be selected by pressing **F1** or **F2**.
- d. Wait until rate timer has completed and the results displayed.
- e. Check rate of climb is less than ± 100 ft/min and rate of airspeed (CAS) is less than ± 1 kts.
- f. Press **LEAK MEASURE/CONTROL** to return to Control mode.
- g. Press **GROUND, F1**, [Go to Ground].
- h. Wait until for the display shows "Safe At Ground".

4.5.2 ADTS 405 Mk2 Leak Test

It is important to check that the ADTS 405 Mk2 and the connecting equipment does not leak. Before use a leak check should be carried out as follows:

- a. Connect the pitot and static hoses to the ADTS 405 Mk2.
- b. Temporarily seal the free ends of the hoses.
- c. Set the display to dual display, see Section 4.2.1, "Change to Single, Dual or Triple Display," on page 31.
- d. Set the units to feet and kts, see Section 4.3.1, "Changing the Measurement Units," on page 31.
- e. Using the **SETUP** menu, choose the limits set for the aircraft or UUT, see Section 4.6.2, "Limit Checking," on page 35.
 - i. Press **SETUP**, [LIMITS], and [NEXT] until required wait is shown/set.

- ii. Press [SEL] to save and then press **CLEAR/QUIT** until the main pressure screen shown below is displayed.

Alt	0	ft
Leak Measure		
CAS	0.0	kts
Leak Measure		

Note: The numeric value of the parameters displayed change with each power-up sequence. The amount of change depends on local atmospheric pressure conditions at the time of power-up.

- f. Press the **LEAK MEASURE/CONTROL** key to turn on the pressure controllers.
- g. Enter a suitable altitude and airspeed, example follows:

To apply an altitude of 5,000 ft at a rate of climb of 6000 ft/min and an airspeed of 300 kts at a rate of 600 kts/min:

- i. **SPEED/Qc** then **RATE** to select rate of change of speed.
- ii. **6, 0, 0, ENTER** to set the rate.
- iii. **SPEED/Qc** to select airspeed.
- iv. **3, 0, 0, ENTER** to set an airspeed of 300 kts (airspeed [CAS] now starts increasing).
- v. **ROC/Ps RATE** to select rate of climb.
- vi. **6, -000, ENTER** to set the rate of climb.
- vii. **ALT/Ps** to select the altitude.
- viii. **5, -000, ENTER** to set altitude ([Alt] altitude now starts increasing).
- ix. **SPEED/Qc** to view altitude and airspeed together.

Note: When altitude and airspeed are changing at the same time, and automatic airspeed rate is enabled, the system automatically adjusts the airspeed rate so that the aim points are reached at the same time. The airspeed rate will not exceed the entered aim value.

- h. Wait for the aim values to be achieved. Observe over a period of 1 minute that the value of Alt stays within ± 10 ft and the value of CAS with ± 1 kts.

Alt	4998	ft
Aim	5000	
CAS =	299.0	kts
Aim	300.0	

- i. Press the **LEAK MEASURE/CONTROL** key to enter into Leak Measure mode.

```
Alt      4998      ft
Leak Measure
CAS      299.0     kts
Leak Measure
```

- j. Press **RATE TIMER** and select a suitable wait and time period. After the rate timer test has completed, the ADTS will show the leak rates:

```
ROC      -1.00T      ft/m
RtCA     -0.10T     kts/m

Timed Rates
```

- k. After a successful leak test, the ADTS 405 Mk2 is ready to be connected to an aircraft system or unit under test.
- l. If the preliminary leak test is unsuccessful, leave the system to achieve thermal stability for a further 5 minutes, press **CLEAR/QUIT** and repeat the leak test.

Note: Compressing a gas generates heat. Gas heated or cooled in an enclosed volume causes a pressure change. It is important, especially for leak testing, to allow enough time for the heated gas to cool and the pressure to stabilize.

- m. After another unsuccessful leak test:
- Disconnect both hoses, check the condition of the o-rings on the Ps and Pt connectors. Replace if necessary as detailed in the Section 5.4.2, "Replacing the Output Connector O-ring," on page 51. Then firmly replace the blanking caps.
 - Press **CLEAR/QUIT** and repeat the leak test procedure.
 - After a successful leak test without hoses connected:
 - Replace or repair the faulty hose(s) and re-test.
 - If the ADTS 405 Mk2 fails the leak test without hoses connected, switch off and return the unit to the repair depot.

4.6 Aircraft System Protection

The ADTS 405 Mk2 protects the aircraft system against user error and leaks in the aircraft system.

Note: The pumps must be switched on.

The system protection operates by:

- Limit checking of user entered set-points.
- Automatic regain of control if leak rate is over limit during leak testing.
- Automatic regain of control if a leak takes the system pressures outside of limits.

4.6.1 Auto Recovery Facilities



INFORMATION The pressure controllers in the ADTS 405 Mk2 can “feed” a leak in an aircraft system. When first testing an aircraft system, a leak test must be carried out at low altitude and airspeed.

If, during a leak test, a leak in the system produces a rate of climb greater than the rate set in limits or a rate of change of airspeed greater than the rate set in limits, then the pressure controllers automatically regain control to minimize damage to the aircraft system. This AUTO LEAK RECOVERY facility can be disabled.

If a leak causes the system pressures to exceed any limit during a leak test, the pressure controllers automatically regain control. This AUTO LIMIT RECOVERY facility can be disabled.

If negative airspeed (or Qc) occurs in measure mode, the zero valve is automatically opened for 1 second to balance the airspeed. This only applies when the minimum CAS (or Qc) limit is zero.

Limits cannot be changed with SETUP switched off or Limit Lock enabled.

4.6.2 Limit Checking

The system checks all data entered against minimum and maximum limits set for the particular limit set in use. If these limits are exceeded, the data entry is ignored and a warning message displayed showing the minimum and maximum values that can be entered. The system also checks all limits of associated parameters. If these limits are exceeded when a new value is entered, the display shows the name of the associated parameter, e.g. If a Mach limit is exceeded when entering an airspeed value the display shows “Mach” and the equivalent maximum and minimum limits as airspeed values.

Similarly, if an ARINC 565 limit is exceeded when entering a value and ARINC limits are enabled, the display shows ‘ARINC’.

Select the limits in use:

- a. Press **SETUP**.
- b. Select [LIMITS].
- c. Use [NEXT] or [PREV] to select the limits required. Each set of limits is identified by its name, including the predefined sets of limits (“Standard”, “Civil” and “Max” see Section 1.3, “Operating Limits,” on page 2).
- d. Select [SEL] to select the limits.
- e. Press **QUIT/CLEAR** to return to the pressure display.

Using the CONFIG function, new sets of limits can be created and existing sets of limits can be edited. In addition, the set of limits in use at power-up can be selected. If required, this selection can be locked to prevent unauthorized changing of the limits.

Using the SETUP function, previously stored sets of limits can be recalled for use. Each set of limits is stored under an aircraft name. Three predefined sets of limits “Standard”, “Civil” and “Max” limits are supplied with the ADTS 405 Mk2.

Note: The ADTS 405 Mk2, when delivered, contains “Standard” and “Civil” limits; to set and store “Max” limits, for the first time, enter configuration. The “Max” limits depend on

the range of the pitot channel, i.e. either 850 or 1,000 kts. See Section 1.3, "Operating Limits," on page 2.

4.7 Changing Parameters

4.7.1 Mach Test and Constant Mach

To go to 0.8 Mach, enter Control Mode and proceed as follows:

- a. Press **SPEED** then **RATE** to select rate of change of airspeed.
- b. Enter required rate, e.g. 300 kts/min.
- c. Press MACH.
- d. Enter 0.8.
- e. Wait for the Mach to be achieved.

Note: If the altitude changes the system automatically adjusts the airspeed to keep the Mach value constant.

4.7.2 True Airspeed

The normal airspeed parameter is Calibrated Airspeed (CAS) (equivalent to IAS for testing purposes).

The airspeed parameter may be changed to True Airspeed (TAS) as follows:

- a. Press **SETUP** then **SPEED**.
- b. Select [CAS/TAS].
- c. Select [TAS].
- d. Press **QUIT/CLEAR** repeatedly to exit setup.
- e. Press **SPEED**.

The display now shows the airspeed parameter as TAS.

Note: Airspeed parameter type can only be changed in Full Setup mode. Rate of change of airspeed will still be shown as Rate CAS.

Pitot temperature (θ_t) is used in the calculation of TAS. Pitot temperature can only be changed in Full Setup mode. To enter (θ_t):

- a. Press **SETUP**.
- b. Press **SPEED**.
- c. Select [Pt TEMPERATURE].
- d. Enter the temperature measured by the aircraft's pitot temperature sensor.
- e. Press **QUIT/CLEAR** three times to return to user display.

4.8 Airspeed Switch Test

The following example shows how an airspeed switch can be functionally checked.

Note: For low airspeed switches (i.e. 130 kts) the Pt Only facility could be used.

- a. Press **LEAK MEASURE/CONTROL** to enter control mode. Press **SPEED/Qc**.
- b. If necessary, press **RATE** and enter a change of airspeed low enough to observe switch operation.
- c. Enter an Aim value below the operating limits of the switch (i.e., airspeed switch operating at 130 kts \pm 2 kts set 127 kts).
- d. Press **ENTER** and observe the airspeed changing.
- e. Using the nudge facility, set to an appropriate step value, increase the Aim value.
- f. Increase the Aim until the switch operates (contacts close) and record the value.
- g. Change the Aim to above the airspeed operating range (i.e. 133 kts). Repeat (steps c. to e.), decreasing the Aim value until the airspeed switch operates (contacts open) and record value.
- h. This procedure can be repeated. If many operations of a switch are required use the oscillating facility detailed in Full Setup, see Section 7.3.4, "SETUP, [OSC]," on page 84. The above method (steps a. to g.) can be applied for the other parameters:

Airspeed Switch	Application
Altitude switch	Low altitude warning Landing gear configuration warning Height lock
Mach switch	Speed brake scheduling Mach cruise lock

4.9 Engine Pressure Ratio (EPR)

The ADTS 405 Mk2 may be used to check EPR sensors and indicators. Use Ps for INLET pressure and Pt for OUTLET pressure. To carry out an EPR check, the display must be showing pressure units e.g, mbar or in Hg.

4.9.1 Example EPR Test

To enter an EPR of 1.8 with inlet pressure of 500 mbar (15 inHg), proceed as follows:

- a. If the display shows "Leak Measure", press **LEAK MEASURE/CONTROL** to regain control.
Note: The pressure/vacuum pumps must be switched on.
- b. Press **ROC/Ps RATE** to select rate of change of static.
- c. Enter required rate of change e.g, 1,000 mbar/min, (30 inHg/min).
- d. Press **EPR** then **RATE** to select EPR rate.
- e. Enter required value e.g, 5 EPR/min and press **ENTER**.
- f. Press **ALT/Ps**.
- g. Enter 500 mbar (15 inHg) and press **ENTER**.
- h. Press **EPR**.
- i. The ADTS will control the pressures to the desired EPR value.

Note: EPR testing can also be performed by specifying the actual INLET and OUTLET values.

4.10 Testing Aircraft Systems or UUT



CAUTION Observe the appropriate safety instructions and procedures detailed in the aircraft maintenance manuals or component maintenance manuals.

- a. Connect the applicable hoses and adapters to the aircraft system or UUT.
- b. Do a leak test detailed in the appropriate aircraft or component manual, to make sure that the connections to the aircraft system or UUT are not leaking.

4.10.1 Go To Ground and Shutdown

At the end of testing and, before disconnecting from the aircraft system or UUT, the pressures in the system must be taken to the local atmospheric pressure (ground) with zero airspeed, as follows:

- a. If the display shows “Leak Measure”, press **LEAK MEASURE/CONTROL**.
- b. Press **GROUND, F1** [Go To Ground].
- c. Wait for the display to show “Safe At Ground”.
- d. It is now safe to disconnect the aircraft system or UUT.

The pressure in the system changes towards ground. The ground pressure or “Ground” replaces the static or altitude aim value.

4.10.2 While Going to Ground

If required, new rates of change can be entered while going to ground.

- a. To change the ROC or static rate, press **ROC/Ps RATE** and enter the new value.
- b. To change the airspeed or Qc rate, press **SPEED/Qc** then **RATE** and enter the new value.

4.10.3 Resuming Testing after Going to Ground

When the airspeed reaches zero and the Ps channel pressure nears ground, the system re-measures atmospheric pressure to update the recorded ground pressure (QFE). During this period, the display shows the message “Checking Ground”. The ADTS 405 Mk2 then reconnects to the aircraft system and equalises the system pressures. Commands cannot be entered when these two messages are displayed.

The Ps channel pressure is then taken to the new recorded atmospheric pressure and, at this new pressure, the display shows the message “Safe At Ground”. The ground vent and zero valves remain open to keep the aircraft system vented to atmosphere.

- a. Press **CLEAR/QUIT** to continue with normal operation. The ground vent and zero valves automatically close.
- a. Press **LEAK MEASURE/CONTROL** to return to Control mode.

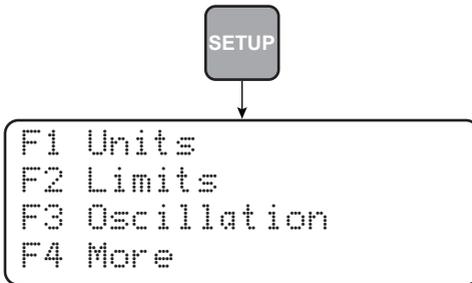
- b. Enter a new altitude (static) or new airspeed (Qc) set-point.

4.11 Setup Options

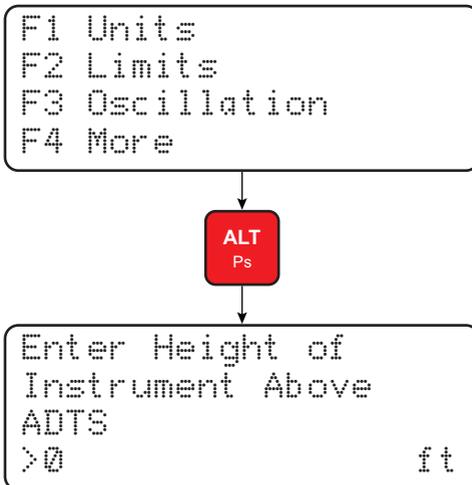
The **SETUP** key provides access to secondary functions using a menu system, extends the keyboard and allows many of the ADTS 405 Mk2 functions to be customized. All changes made under setup are temporary and will be lost when the system is switched off. The range of options allowed in setup is determined by the setup mode. See Appendix A.1 and Appendix A.2 for the **SETUP** menu hierarchy.

Example

- a. Press **SETUP** and the display shows:



- b. Pressing a function key (**F1** to **F4**) enters the setup menu.
 c. When in setup, pressing a key (**ALT Ps** in this example) enters a menu or setting that applies to the parameter.



4.11.1 Change Units in Full Setup Mode

- a. Press **SETUP**.

- b. Select [UNITS].
- c. Select required pressure units for display using [NEXT], [PREV] and [SAVE].
- d. Use **CLEAR/QUIT** to return to pressure display.

4.11.2 Change Units in Minimum Setup Mode

- a. Press **SETUP**.
- b. Select [UNITS TYPE].
- c. Select [PRESS].
- d. Use **CLEAR/QUIT** to return to the main pressure display.

Note: Pressure units cannot be selected when setup mode is switched off.

4.12 Configuration Options

CONFIG is similar to SETUP with many identical functions. See Appendix A.3 for the CONFIG menu hierarchy.

The changes made under CONFIG are permanent and remain set after the system is switched off. CONFIG can be used to change the power-up default settings of the ADTS 405 Mk2 functions.

- a. Hold down the **F1** key while pressing **SETUP** provides access to the CONFIG mode. CONFIG may be password protected using a four digit PIN. If PIN protected, the display prompts for entry of the PIN. Press each digit of the PIN in turn (ENTER is not required) as each digit is entered, an asterisk appears. If an incorrect PIN is entered, the complete PIN is requested again.
- b. When the correct PIN is entered, the CONFIG menu appears.

Note: The PIN may be changed using CONFIG, **-000**.

- c. To use the configuration menu, press the appropriate function key to select the required menu item. To configure a parameter key, enter configuration menu then press the required parameter key. Each parameter key configuration provides changes to the normal user mode function and to the settings available in the setup menu.
- d. Once a parameter has been changed in configuration, use **CLEAR/QUIT** to return to the previous menu. After all required key parameters have been changed, repeatedly press **CLEAR/QUIT** until the display shows the normal operating mode.

4.13 Communications Panel Options

4.13.1 Ethernet System

The ADTS 405 Mk2 is equipped with an TCP/IP Ethernet interface, and appears on the network as up to two separate IP addresses. The first IP address relates to the ADTS instrument supervisor and contains access to the functions described above. The second address relates to the communications adapter (if fitted). There are no user related functions

accessible within the communications adapter IP port at this time, however the functionality of the port may be assessed and tested if required.

The system is supplied with factory default IP addresses as follows:

Table 4-1: Default IP Address Configuration

IP Address	Function
192.168.2.2	Supervisor
192.168.2.3	Communications Adapter

The ports are most simply tested using a network 'ping' to these addresses.

Connect the ADTS to a computer equipped with a network interface, using a UTP network cable. The network interface should be configured with an IP address on the same subnet.

Example:

If the ADTS has the default IP addresses then the host network address should be configured as 192.168.2.1/255.255.255. The method for doing this may vary but the following example screens show the method under Windows 7. It is suggested to take careful note of the original computer settings so they may be restored after the check.

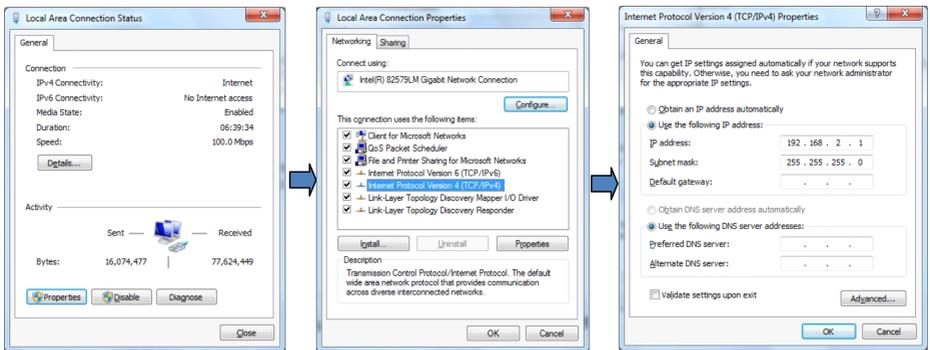
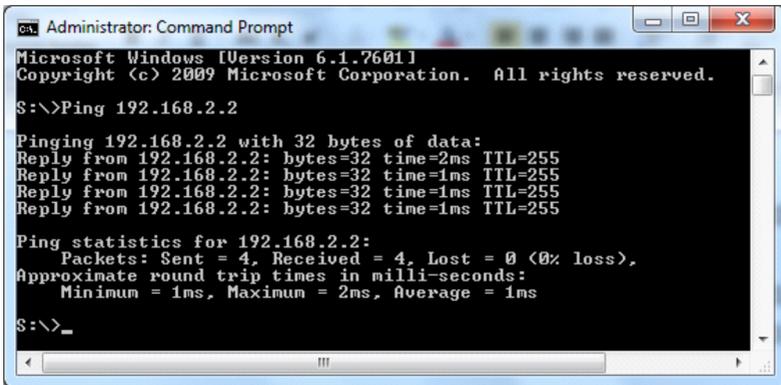


Figure 4-7: Configuring Windows For ADTS Subnet IP Address

A ping to either of the above ADTS IP addresses should give the following typical response seen in Figure 4-7 Ping Test from Windows Command Prompt below:



```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

S:\>Ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time=2ms TTL=255
Reply from 192.168.2.2: bytes=32 time=1ms TTL=255
Reply from 192.168.2.2: bytes=32 time=1ms TTL=255
Reply from 192.168.2.2: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

S:\>_
```

Figure 4-8: Ping Test From Windows Command Prompt

The IP address settings may be changed to match local network requirements using the CONFIG and SETUP menus, as described in Section 4.11 and Section 4.12.

An SSH server is available on each IP address for general purpose file access. The factory default user name and password for accessing the server is:

Table 4-2: Default User Name and Password

Parameter	Value
User Name	adts
Password	druk

It is strongly advised that the default password be changed as part of the initial end user customization.

4.13.2 Changing the Default Access Password

Configure the network interface with an IP address on the same subnet (as described above). Open an SSH client program. If using a PC then a third party client such as PuTTY may be used.

Example:

- a. Open the Configuration screen.

- b. Enter the supervisor IP address and select the SSH as the required connection type, see Figure 4-9.

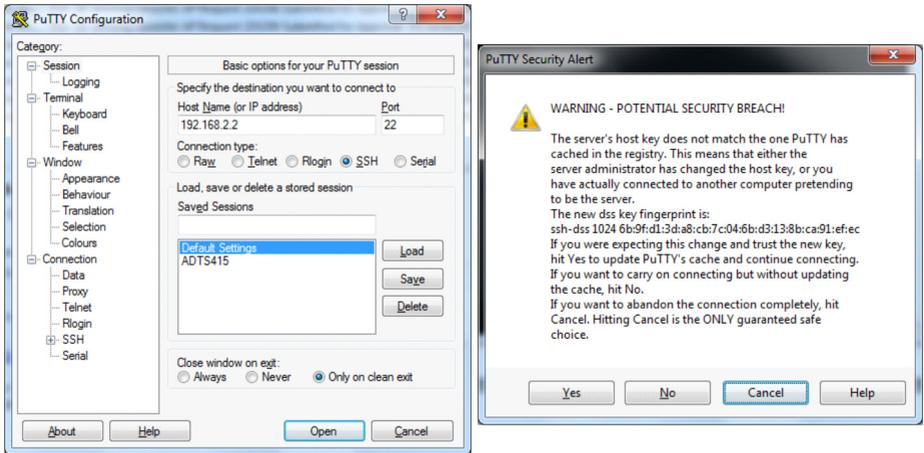


Figure 4-9: PuTTY Configuration

- c. Press "OPEN" and select "YES" to any security warnings.
- d. Enter the user name "adts" and the default or current password when prompted.
- e. At the \$ prompt, enter command <passwd> followed by the <RETURN> key.
- f. Follow the screen prompts by Enter the existing password followed by the new password and further confirmation entry. The results of a successful change should look like the PuTTY window in Figure 4-10.

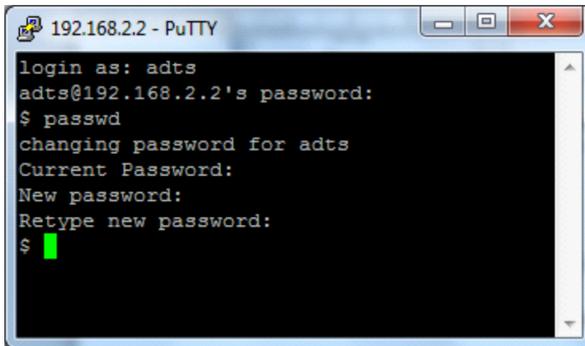


Figure 4-10: Changing the Default Password

Close the PuTTY window and confirm that a new connection can still be gained using the new password.

4.13.3 Access ADTS Files

Working with the filing system is best done using a window based FTP client that also supports SSH, such as Win SCP. The following example sequence shows how access is gained and what file directories are visible.

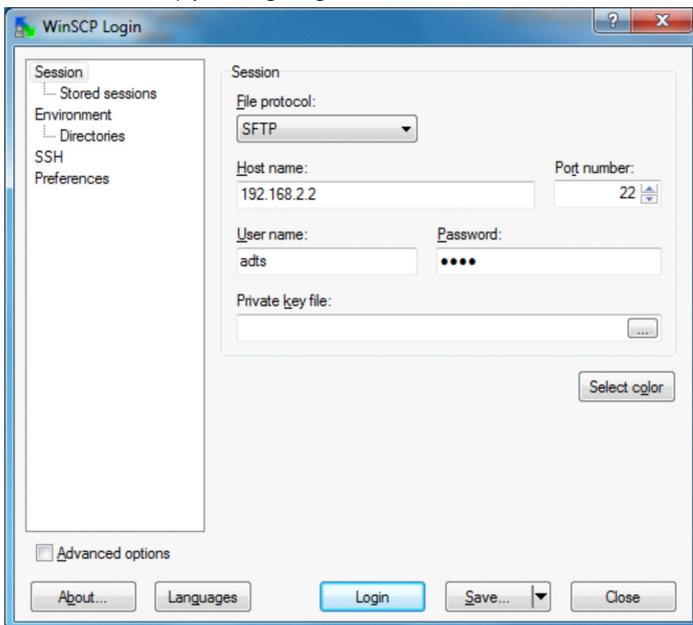
Chapter 4. Operation

- a. Open Win SCP and create an SFTP login using the following credentials and save under a suitable name for future connections:

Table 4-3: Win SCP Client Credentials

Parameter	Value	Notes
Host Name:	192.168.2.2	The IP address of the ADTS supervisor Ethernet adaptor.
Port:	22	
User name:	adts	
Password:	druk	Or new password if changed.
Private key:		(leave blank)

- b. Connect to the unit by pressing “Login”:



- c. The ADTS 405 Mk2 file system directories (under folder fs\etfs) are visible in the right hand pane as shown in Figure 4-11 file system directories screen below:

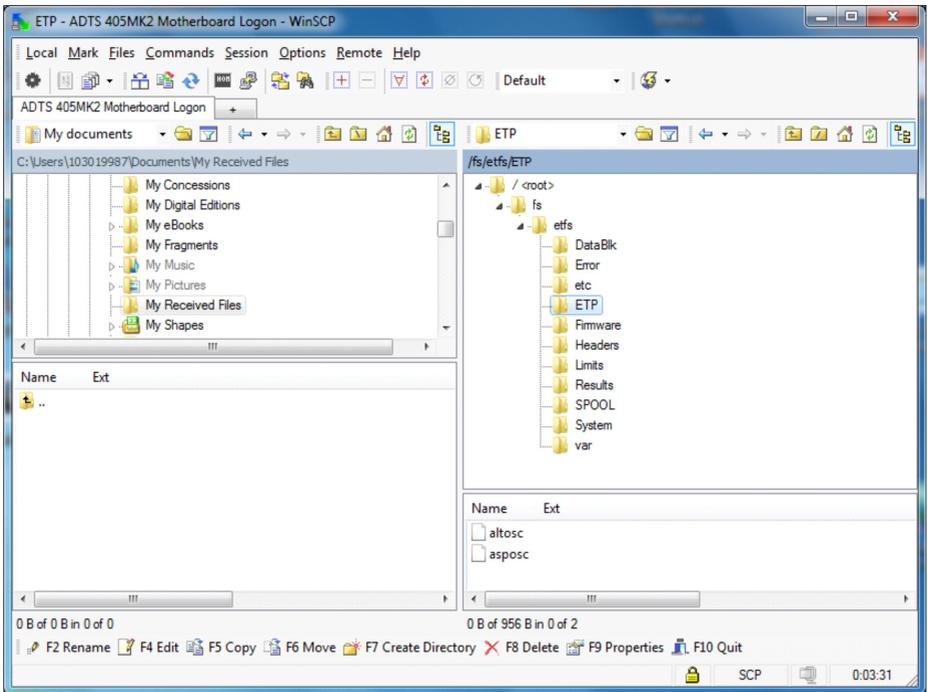


Figure 4-11: ADTS File System Directories Screen

The example ETP (Test Programs) directory can be seen to contain two default test programs, “altosc” and “asposc”, used for oscillation of altitude and airspeed. New prepared programs may be added from the PC left panes by drag and drop to the ETP directory. They will then become available for stand-alone use under the front panel ETP key. Unwanted programs may be deleted from the ETP directory as required.

Similarly, any reports previously generated using the “PRINT” key will be available under the “SPOOL” directory. This may be transfer to the PC window for archive or hard copy print as required.

- d. The access session can now be closed using the Win SCP “Session” tab > Disconnect.

4.14 IEEE 488 Option

4.14.1 Enabling the IEEE 488 Option

Use the configuration menu to enable and disable the IEEE 488 facility. To enable the IEEE 488 facility, set the ADTS 405 Mk2 to the SCPI IEEE option and set the Address to 1 as follows:

Chapter 4. Operation

- a. Press and hold down **F1** then press **SETUP** to enter the configuration menu. Release both keys.
- b. If requested, enter PIN details.
- c. Press [MORE], [DISPLAY/OPTIONS], [OPTIONS], [IEEE-488], [SCPI/OPT2].
- d. Check the display shows that SCPI is selected. If the settings are correct, press **CLEAR/QUIT** until the display shows the main pressure display.

Note: When enabled, the IEEE 488 facility will be available from power-up of the ADTS 405 Mk2. The setting is held in non-volatile memory.

4.14.2 IEEE 488 Connector



INFORMATION The cover plate for communications option must always be fitted when the equipment is used outdoors, or in an environment where moisture may enter the unit through the connector panel.

The IEEE 488 connector is located behind the (optional) communications module cover plate. The connector's pin-out is detailed in Table 4-4:

Table 4-4: IEEE 488 Connector Pin-out

Pin Number	Function
1	D101
2	D102
3	D103
4	D104
5	E01
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	Shield ^a
13	D105
14	D016
15	D107
16	D108
17	REN
18	GND ^b
19	GND ^b

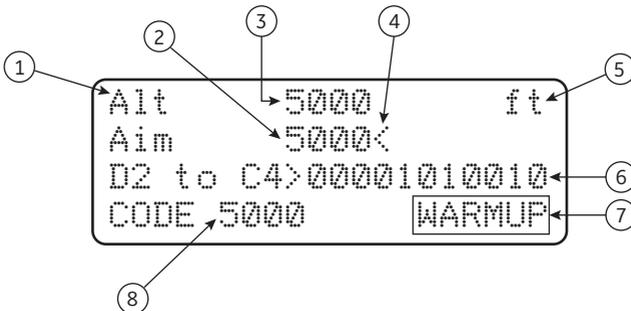
Table 4-4: IEEE 488 Connector Pin-out

Pin Number	Function
20	GND ^b
21	GND ^b
22	GND ^b
23	GND ^b
24	GND ^b

- a. Chassis connection.
- b. 0V return for signals (not chassis).

4.15 Enabling the Altimeter Encoder Option

- a. Press and hold down **F1** and press **SETUP** to enter the configuration menu. Release both keys.
- b. Press [MORE], [DISPLAY/OPTIONS], [DISPLAY TYPE], [NEXT], [ENCODER].
- c. Check the display shows “Encoder” is selected.
- d. Press [SAVE], then repeatedly press **CLEAR/QUIT** until the display shows the following:



- | | | | |
|---|--|---|---|
| 1 | Controlled or measured parameter. | 2 | Aim (set-point or target) in control mode, or “Leak Measure” when the pressure controller is off. |
| 3 | Measured value. | 4 | “<” Pointer for parameter, i.e. aim that changes on data entry. |
| 5 | Units of measurement. | 6 | Altitude encoder bit code. |
| 7 | Special messages, e.g. warm-up period. | 8 | Altitude encoder decoded value. |

Note: With an incorrect bit combination such as all zeros, the display shows “ENCODER ERROR” in the place of the decoded value.

5. Maintenance

5.1 Introduction

This section details the recommended maintenance tasks to be carried out by the operator. The maintenance chart shows the periodicity of each task and a code referenced to the task detailed in Section 5.3, “Maintenance Tasks,” on page 50.

Table 5-1: Maintenance Chart

Task	Code	Period
Inspect	A	Daily, before use
Inspect	B	Weekly
Test	C	Before use
Test	D	Daily, before use
Calibrate	E	Every 12 months ^a
Replace	F	As detailed in fault finding or when detailed after inspection
Clean	G	Weekly ^a
Service	H	1,000 hours recorded by the pump unit elapsed time indicator or the equipment running log.
Service	J	3,000 hours recorded by the pump unit elapsed time indicator or the equipment running log.

- a. Periodicity may change depending on usage and environment, refer to the Engineering Authority.

5.2 Materials

This lists materials required for the user to maintain the ADTS 405 Mk2. The item number and name in the table identifies the item in the maintenance tasks (for example, “Use a soft bristle brush, item 4, Table 5-2”). The description provides further information required to identify the item.

Table 5-2: Maintenance Materials List

Item Number	Item Name, Description
1	Cloth, Cotton, Lint-free
2	Alcohol, Isopropyl (MIL-A-10428, Grade A)
3	Detergent, Mild, liquid
4	Brush, soft bristle (MIL-B-43871)

Note: Equivalent substitutes can be used.

Table 5-3: Tool and Test Equipment Requirements

(1)	(2)	(3)
Ref Code	Nomenclature	Example Manufacturer's part number
1	Multimeter, Digital	Fluke 87V
2	Insulation Tester, 500 V	Fluke 1507

5.3 Maintenance Tasks

- a. Visually inspect the unit for obvious signs of damage and check that all the equipment is present; record any deficiencies.
- b. Visually inspect the pneumatic output connectors for damage.
 - i. Inspect the small o-ring on each pneumatic output connector for cuts and any signs of wear; if necessary, replace as detailed in Section 5.4, "Routine Maintenance," on page 51.
 - ii. Visually inspect pneumatic hoses, electrical cables for cuts, splits and damage; replace as necessary.
- c. Before use, power-up the unit as detailed in Section 3.2.2, "Power-up," on page 16.
 - i. Check the date of the last calibration and, if necessary, refer to task E.
 - ii. Record any error messages and refer to Section 6.2, "Error Messages," on page 57.
- d. Daily and before use, carry out the Standard Serviceability Test detailed in Section 6.4, "Standard Serviceability Test," on page 58.
- e. Normal calibration period is 12 months. When calibration is due, the unit should be withdrawn from service and returned to depot or calibration facility.
 1. The date of calibration is stored in the unit and displayed in the power-up sequence and on a label on the front panel.
 2. Do not use a unit with out-of-date calibration.
 3. Engineering authority may change the periodicity of calibration depending on usage and the operating environment.
- f. As detailed in fault finding or when detailed after inspection replace the listed items in 2-1 "Packaging".
- g. Clean the unit every week.
 - i. Clean the front panel with a damp lint-free cloth (item 1, Table 5-2) and mild liquid detergent (item 3, Table 5-2).
 - ii. Remove any stubborn dirt using Isopropyl alcohol (item 2, Table 5-2) and allow to dry.
 - iii. Clean all pneumatic connectors with a soft brush (item 4, Table 5-2).

- iv. Remove any stubborn dirt using Isopropyl alcohol (item 2, Table 5-2) and allow to dry.
- h. Withdraw the unit from service and return to the repair depot.

5.4 Routine Maintenance



INFORMATION Absolute cleanliness of the work area, tools and equipment is essential. Carry out the maintenance tasks detailed in Section 5.3, “Maintenance Tasks,” on page 50.

5.4.1 Servicing Procedures

The following procedures provide instructions to test and replace items for the operator. Return the unit to the service depot for further testing and replacement of items.

5.4.2 Replacing the Output Connector O-ring

Do the inspection as detailed in maintenance task B, do the following if the o-ring is worn or damaged:

- a. Carefully remove the o-ring from the small groove at the top of the connector.
- b. Fit a new o-ring in the small groove at the top of the connector.
- c. Check the o-ring is located in the groove and not damaged after fitting.

Note: Damage to this o-ring causes leaks.

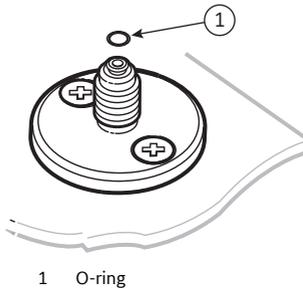


Figure 5-1: Output Connector O-ring Seal

5.4.3 Fuse Replacement

Replace the fuse when detailed in Section 6.6, “Fault Diagnosis,” on page 60.



RISK OF ELECTRIC SHOCK There is a risk of electric shock/electrocution if there is not a protective earth in place. The ADTS must, at all times, be connected to the supply protective earth/ground. The power supply cable and connector must be correctly rated for the power supply. Only use power cables supplied by GE specifically for the ADTS.

5.4.3.1 Replacing ADTS 405F Mk2 AC Fuses



WARNING Only replace the fuses with the correct type.

The ADTS 405F Mk2 has two 20 mm High Breaking Capacity (HBC) fuses for the AC supply. They are located in the holder mounted on the pump-rack front panel. They protect the entire unit. The fuses are connected in the live and neutral supply circuit. For fuse specification, see Table 8-2 on page 102.

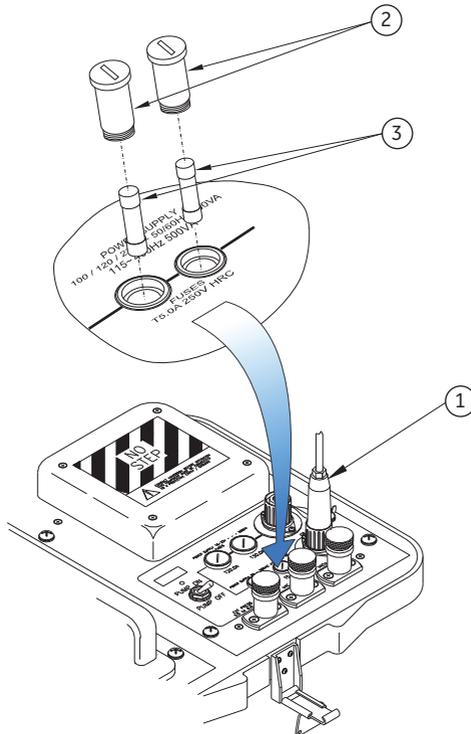


Figure 5-2: ADTS 405F Mk2 AC Fuse Positioning

- Set the power switch to OFF.
- Isolate the power supply to the instrument and disconnect the power supply connector (1).
- Remove the fuse holders (2) from the front panel and replace the fuse cartridges (3).
- Refit the fuse holders (2) in the front panel.
- Connect the power supply connector and switch on the power supply.
- Set the unit power switch to ON.

Note: If the fuse blows immediately after switch-on contact the manufacturer or Service Agent.

5.4.3.2 Replacing ADTS 405F Mk2 DC Fuses



WARNING Only replace the fuses with the correct type.

The ADTS 405F Mk2 has two 1.25" Time Lag fuses for the DC supply. They are located in the holder mounted on the pump-rack front panel. They protect the entire unit. The fuses are connected in the supply positive and the common (0 V) return. For fuse specification, see Table 8-2 on page 102.

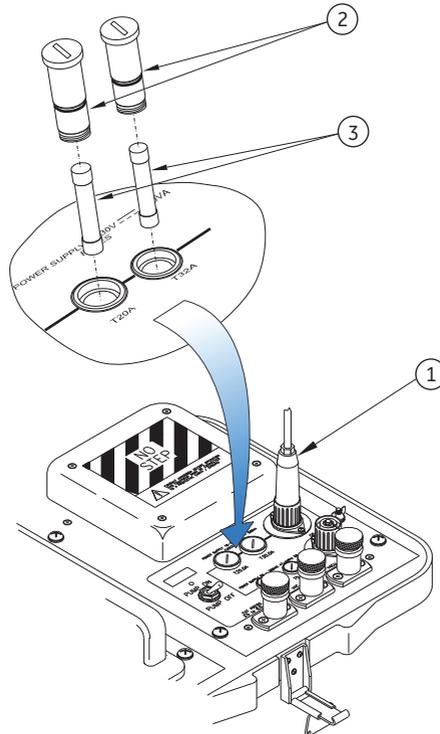


Figure 5-3: ADTS 405F Mk2 DC Fuse Positioning

- Set the power switch to OFF.
- Isolate the power supply to the instrument and disconnect the power supply connector (1).
- Remove the fuse holders (2) from the front panel and replace the fuse cartridges (3).
- Refit the fuse holders (2) in the front panel.
- Connect the power supply connector and switch on the power supply.
- Set the unit power switch to ON.

Note: On the ADTS 405R Mk2, DC over-current protection fusing is internal and not user serviceable.

5.4.3.3 Replacing ADTS 405R Mk2 AC Fuses



WARNING Only replace the fuses with the correct type.

5.4.3.4 The ADTS 405R Mk2 has two 20 mm High Breaking Capacity (HBC) fuses for the AC supply. These are located in the holder mounted on the power input connector on the rear of the rack. They protect the entire unit. The fuses are connected in the live and neutral supply circuit. For fuse specification, see Table 8-1 on page 101.

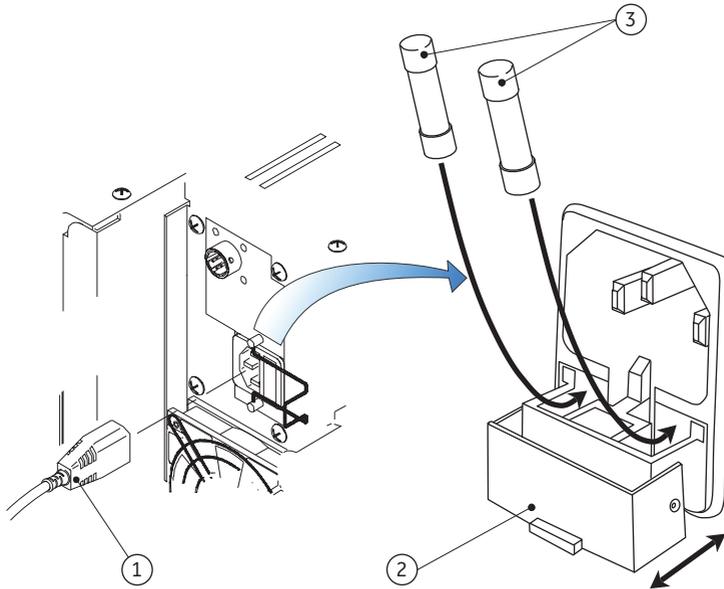


Figure 5-4: ADTS 405R Mk2 AC Fuse Positioning

- Set the power switch to OFF.
- Isolate the power supply to the instrument and disconnect the IEC power supply connector.
- Pull the capped lid of the fuse carrier (2) on the power supply input socket assembly.
- Replace the fuse cartridges (3).
- Refit the fuse carrier (2) flush in the power supply inlet socket assembly.
- Refit and reconnect rack-mounted units.
- Switch on the power supply and set the power switch to ON. The instrument should now be operational.

Note: (1) To gain access to rack-mounted instruments, it may be necessary to partially or completely withdraw the instrument. Isolate pneumatic supplies and depressurize all pressure supply inlet and outlet lines.

Note: (2) If the fuse blows immediately after switch-on, contact the manufacturer or Service Agent.

5.5 Cable Tests



RISK OF ELECTRIC SHOCK Do the Standard Serviceability Test, detailed in Section 6.4, “Standard Serviceability Test,” on page 58, prior to performing a cable test.

5.5.1 Hand Terminal Cables

Note: For parts AS405-33-1891M0 (2 m) and AS405-34-1891M0 (18 m).

- a. Prepare to measure continuity using the DMM (item 1, Table 5-3) set to the applicable resistance range.
- b. Measure the continuity between corresponding six pins at each end of each cable assembly. The measured resistance must not exceed 2.0 Ω .
- c. This resistance value is the expected maximum value for the 18 m (60 ft) cable. The resistance value varies depending on the length of the cable.
- d. Measure insulation using the Insulation tester (item 2, Table 5-3), set to the 250 V test range.
- e. Measure the insulation resistance between the shell of the connector and all individual pins in turn.
- f. Measure the insulation resistance between the shell of the applicable connectors and all pins in turn.
- g. Measure also the resistance between individual pairs of pins (i.e., 1-2, 1-3, 1-4, 1-5, 1-6, 2-3, 2-4, 2-5, 2-6, 3-4, 3-5, 3-6, 4-5, 4-6 and 5-6). In all cases the resistance must exceed 10 M Ω .

5.5.2 AC Power Regional Line Plug Cables

Note: For parts AA405F-1 to AA405F-16.

- a. Prepare to measure continuity using the DMM (item 1, Table 5-3) set to the applicable resistance range.
- b. Measure the continuity between corresponding ADTS connector pin and the regional power plug pin using the connectivity Table 5-4 below. The measured resistance must not exceed 0.8 Ω .

Note: This resistance value is the expected maximum value for the longest 10 m (32 ft) cables. The resistance value varies depending on the length of the cable.

- c. Prepare to measure insulation using the Insulation tester (item 2, Table 5-3), set to the 500 V range. This test will be most practically performed at the regional line plug end of the cable.
- d. Measure the insulation resistance between Live and Protective Ground.
- e. Measure the insulation resistance between Neutral and Protective Ground.

Chapter 5. Maintenance

- f. Measure the insulation resistance between Live and Neutral.
- g. In all cases the insulation resistance must exceed 2 M Ω .

Table 5-4: AC Input Connector

ADTS Pin	European Color	USA Color	Function
1	Brown	Black	Live
4	Blue	White	Neutral
EARTH	Green/Yellow	Green	Protective Ground

5.5.3 DC Power Cable

Note: For part AS405-31-1891M0.

- a. Prepare to measure continuity using the DMM (item 1, Table 5-3) set to the applicable resistance range.
- b. Measure the continuity between corresponding ADTS connector pin and the conductors at the open end of the cable using the connectivity Table 5-5 below. The measured resistance should not exceed 0.5 Ω .

Note: This resistance value is the expected maximum value for the 5 m (16 ft) cable length supplied.

- c. Prepare to measure insulation using the Insulation tester (item 2, Table 5-3), set to the 500 V range. This test will be most practically performed at the open end of the cable.
- d. Measure the insulation resistance between Gray (+28 V) and Green (Protective Ground).
- e. Measure the insulation resistance between White (0 V) and Green (Protective Ground).
- f. Measure the insulation resistance between Gray (+28 V) and White (0 V).
- g. In all cases the insulation resistance must exceed 2 M Ω .

Table 5-5: DC Input Connector

ADTS Pin	Cable Color	Function
1	Gray	+28 V
2	White	0 V Return
EARTH	Green	Protective Ground

6. Testing and Fault Finding

6.1 Introduction

The ADTS 405 Mk2 contains a built-in, self-test and diagnostic system. The system continuously monitors the performance of the unit and at power-up carries out a self-test. Warning and error messages are displayed during normal operation if out of range values are entered or if faults occur.

This section details the standard serviceability test and the error messages and codes that can be displayed. A fault diagnosis flow chart and table provide the probable cause and procedures to rectify specific symptoms.

6.2 Error Messages

At power-up, the ADTS 405 Mk2 indicates if there is a fault by displaying an error code, for example:

- 701:HHHH PS SELF-TEST ERROR

The HHHH is a hexadecimal code containing additional information record the whole error code check that the error code is complete and listed in the table before returning the unit to the repair depot. In the event of a fault, the built-in, self-test and diagnostic system displays an error message and error code. A unit displaying an error should be returned to the repair depot.

See Appendix B.1, "Error Messages," on page 117 for a list of error messages.

Note: (1) If the display shows "ERROR 703 START UP Ps SELF TEST TIME ERROR", check that the expansion port dongle (item 8, Table 2-2) is correctly connected in the expansion port on the rear panel (Figure 2-6).

Note: (2) Some errors display extra information using a four digit hexadecimal code. This should always be recorded with the error number to provide information for the repair depot.

6.3 Warning Messages

During operation, the ADTS 405 Mk2 indicates a warning by displaying a warning code, for example:

- 2:INVALID USER INPUT

See Appendix B.2, "Warning Messages," on page 118 for a list of warning messages, their probable cause, and required action.

6.4 Standard Serviceability Test

The following procedure can be used to check the functions and facilities of the ADTS 405 Mk2. For further information, refer to Chapter 7., “Reference,” on page 71.

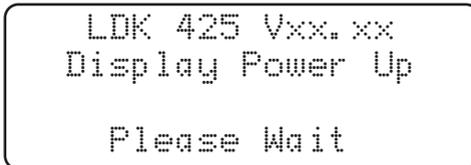
In the following procedures:

- All key presses are highlighted in **bold** and shown as identified on the keypad.
- Key presses inside brackets e.g. [MORE], are soft key presses (i.e, function key selections {F1 to F4} indicated on the display screen).

Note: When the display shows a message indicating entry of incorrect data or values, pressing **CLEAR/QUIT** clears the message and allows the correct entry to be made.

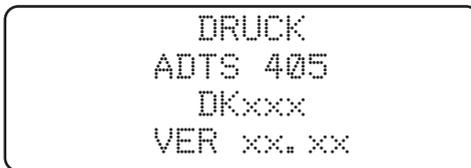
6.4.1 Connection and Power-on Checks

- a. Connect power to the unit and, if necessary, connect the hand terminal.
- b. Make sure that the blanking caps are fitted to the Ps and Pt front panel outputs.
- c. Check power indicator is on.
- d. Set the front panel switch to OPERATE.
- e. Set the front panel switch for the pump unit to PUMP ON and check that the pump power indicator lights.
- f. Check the display shows the first stage power-up message as below (where: xx.xx is the version number of the installed display driver software):



```
LDK 425 Vxx.xx  
Display Power Up  
  
Please Wait
```

- g. Check the second stage power-up message displays as below (where: xx.xx is the version number of the installed main operating software):



```
DRUCK  
ADTS 405  
DKxxx  
VER xx.xx
```

Note: “ADTS 405” may be replaced by an alternative identity string. The software version may also be supplemented by extra alpha characters.

- h. The ADTS 405 Mk2 displays any detected errors. Check that the power-up sequence continues through the following stages without error:
 - Calibration date.
 - Self-test.
 - Measuring ground pressures.

- Equalizing system pressures.

Note: See Section 3.2.2, “Power-up,” on page 16 for a typical power-up sequence.

- Check that the display then changes to show measured altitude and airspeed (CAS or TAS) values.
- Press the **MACH/Pt** key and check the display changes to show Altitude and Mach measured values.

Note: (1) The displayed values change as atmospheric pressure changes at power-up.

Note: (2) The display shows the “WARMUP” message in the lower right corner indicating that full pressure accuracy and stability may not be achieved. The WARMUP message clears after 15 minutes. This indication does not inhibit operation and these tests may proceed without waiting for the message to clear.

Note: (3) An automatic zero (if enabled) takes place regularly. The display shows “ZERO” and the state of the valves, on the mimic panel, change for approximately 6 seconds. Commands may still be entered while auto-zero takes place.

6.4.2 Pump Unit (ADTS 405F Mk2)

- Set the front panel switch for the pump unit to PUMP ON and check that the pump power indicator lights.
- Press **LEAK MEASURE/CONTROL** to go to control mode.
- Enter an altitude aim of 5000 ft by pressing **5, 0, 0, 0, ENTER**.
- Enter rate or use default rates.
- Enter an airspeed aim of 500 kts by pressing **SPEED/Qc, 5, 0, 0, ENTER**.
- Check that these aim values are achieved.

6.4.3 Completion

On completion of this test procedure, select **GROUND**, [Go to Ground] wait until the unit is at ground, switch off and disconnect the power supply.

6.5 Fault Finding

In the event of a more serious ADTS system fault which prevents visibility of specific error messages and fault codes on the instrument display, fault location chart Figure 6-1 can be used in conjunction with Table B-1 to direct what service or repair actions may be required.

6.6 Fault Diagnosis

If a fault occurs, refer to the fault finding chart, Figure 6-1 and Table 6-1.

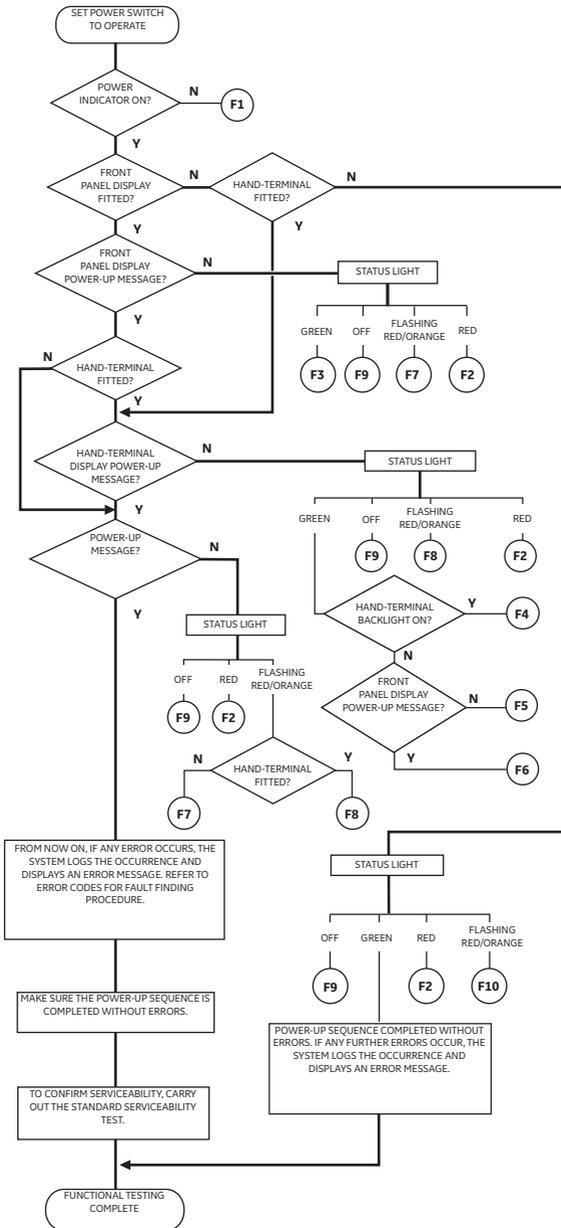


Figure 6-1: Fault Finding Chart

Table 6-1: Fault Advice and Action

Fault	Symptom	Probable Cause	Action
F1	Pump power-on indicator does not light.	Faulty power supply. Unserviceable fuse, AC/DC power supply. Faulty power supply cable.	Check power supply. Check/replace power supply fuse or reset circuit protection device. Check/replace fuse (front panel). Replace cable and re-test.
F2	AC or DC power indicator does not light.	AC or DC power supply cable to ADTS 405 Mk2 rack. ADTS 405 Mk2 rack AC input fuse. PSU fault.	Check/replace cables. Check/replace fuses. Record fault and return ADTS 405 Mk2 to depot for repair.
F3	Display power-up message appears and status light remains red.	Internal control computer fault.	Record fault and return ADTS 405 Mk2 to depot for repair.
F4	No front panel display power-up message, status light green.	Display fault.	Use an available hand-terminal. Record fault and return ADTS 405 Mk2 to depot for repair.
F5	No hand-terminal display, status light green. Hand-terminal key illumination on.	Hand-terminal fault (cable OK).	Replace hand-terminal. Record fault and return hand-terminal to depot for repair.
F6	No hand-terminal display, status light green. Hand-terminal key illumination not on.	Hand-terminal.	Replace hand-terminal. Hand-terminal or hand-terminal cable fault. Record fault and return hand-terminal/cable to depot for repair.
F7	No front panel display DK415 message. Status light flashing red/orange.	No front panel display detected. Internal fault.	Record fault and return ADTS 405 Mk2 to depot for repair.
F8	No hand-terminal or front panel display DK415 message. Status light flashing red/orange.	No hand-terminal or front panel display detected. Hand-terminal fault. Cable fault. Internal fault.	Remove hand-terminal and re-test.
F9	Status light off.	Internal PSU fault.	Record fault and return ADTS 405 Mk2 to depot for repair.
F10	Status light steady orange.	System fault.	Record fault and return ADTS 405 Mk2 to depot for repair.

6.7 Ventilating after Overpressure



INFORMATION Only select items detailed in the following menus, incorrect selections can cause changes to safety limits and the calibration data of the system.

To calibrate or test the ADTS 405 Mk2, an external pressure source is connected to the Ps and/or Pt output connectors. If, during calibration or test procedures, an overpressure occurs, the output valves close to protect the system.

After the valves close, pressure may be trapped in the internal system; the display may show on the next power-up error 701:0100 or 702:0100.

To vent the pressure:

- a. Remove the source of pressure and vent Ps and Pt to atmosphere (caps off).
- b. Re-power the ADTS 405 Mk2. During the power-up screen:

```
DRUCK
ADTS 405
DKxxx
VER xx. xx
```

- c. Press **F1** and **F4** simultaneously. The ADTS 405 Mk2 enters maintenance mode.

Note: The system may prompt for a PIN. This is not the CONFIG PIN but the Calibration PIN. If this Calibration PIN is enabled and not entered, the system will not execute the following procedure.

- d. In maintenance mode with the following screen display:

```
(MAINTENANCE)
F1 Data Block
F2 Suystem Config
F3 More
```

- e. Select **F3**. The display shows:

```
(MAINTENANCE)
F1 System
F2 Hardware
F3 More
```

- f. Select **F1**. The display shows:

```
(SYSTEM)
F1 Vent System
F2 Set System Ready
F3 View Temperature
```

- g. Select **F1**. The display shows:

```
Going To Ground
PLEASE WAIT
```

- h. When complete, press **CLEAR/QUIT** three times to reset the system.

6.8 Further Testing

Perform the following tests if a pneumatic leak or a controller instability is suspected.

6.8.1 Environmental and Preliminary Operations

Do the tests in a room with a stable temperature environment and within the operating temperature range. The room must be free from drafts. Read the whole of the test procedure before commencement.

Note: The unit must be thermally stable; switch on and leave the unit for at least 1 hour to achieve thermal stability.

Change the units to mbar as follows:

- Press **SETUP** then select [UNITS].
- Repeatedly select [NEXT] until the display shows “mbar”.
- Select [SAVE] and then press **CLEAR/QUIT** twice and the display now shows Ps and Pt in units of mbar.

6.8.2 Pressure Leak Check

This check confirms that the unit does not leak under positive pressure conditions:

- Press **LEAK MEASURE/CONTROL** to enter control mode. The display shows “Aim” in place of “Leak Measure”.
- Enter a Ps aim of 1016 mbar by pressing: **ALT/Ps, 1, 0, 1, 6, ENTER**.
- Enter a Qc aim of 272 mbar by pressing: **SPEED/Qc, 2, 7, 2, ENTER**. Wait for the aim values to be achieved then wait for 1 min.
- Press **LEAK MEASURE/CONTROL** to return to Leak Measure mode.
- Press **RATE TIMER** and select [WAIT 05:00], [TIME 01:00]. Observe that the “Waiting” time is shown on the display as it counts down, followed by the “Timing” time.

Chapter 6. Testing and Fault Finding

- f. At the end of the “Timing” period, the display shows the rate of change of Ps, Qc and Pt with a “T” to indicate timed average.
- g. Check that the Ps, Qc and Pt rates are less than or equal to ± 0.5 mbar/min. If the leak rate is not achieved, allow further thermal stabilization time and re-test by pressing **RATE TIMER** and selecting [WAIT 05:00], [TIME 01:00].
- h. Press **CLEAR/QUIT** to exit rate display.

6.8.3 Vacuum Leak Check

This check confirms that the unit does not leak under vacuum conditions:

- a. Press **LEAK MEASURE/CONTROL** to enter control mode. The display shows “Aim” in place of “Leak Measure”.
- b. Enter a Ps aim of 100 mbar by pressing: **ALT/Ps, 1, 0, 0, ENTER**.
- c. Enter a Qc aim of 0 mbar by pressing: **SPEED/Qc, 0, ENTER**.
- d. Wait the required time for temperature stabilization e.g, 1 minute.
- e. Press **LEAK MEASURE/CONTROL** return to Leak Measure mode.
- f. Press **RATE TIMER** and select [WAIT 05:00], [TIME 01:00]. Observe that the “Waiting” time is shown on the display as it counts down, followed by the “Timing” time.
- g. At the end of the “Timing” period, press **ROC/Ps RATE** to display the measured rate of change of Ps (“T” is shown after the value indicating a timed average).
- h. Check that the Ps, Qc and Pt rates are less than or equal to ± 0.5 mbar/min. If the leak rate is not achieved, allow further thermal stabilization time and re-test by pressing **RATE TIMER** and selecting [WAIT 05:00], [TIME 01:00].
- i. Press **CLEAR/QUIT** to exit special rate time display.

6.8.4 Range Check

Using key presses based on the pressure and vacuum leak checks, control the Ps and Qc pressures to the normal limits of operation and make sure that these are achieved. Use minimum Ps and zero Qc and then maximum Ps and maximum Qc.

Note: Do not exceed the maximum Pt as shown on the front panel of the unit. Use maximum available rates of change to minimize test times.

6.8.5 Controller Stability

This check confirms the control stability:

- a. Press **LEAK MEASURE/CONTROL** to turn the pressure controllers on. “Aim” replaces “Leak Measure” on the display.
- b. Enter a Ps aim of 510 mbar with a rate of change of 204 mbar/min. by pressing the following:
ALT/Ps, 5, 1, 0, ENTER, ROC Ps RATE, 2, 0, 4, ENTER
- c. Enter a Qc aim of 0 mbar with a rate of change of 204 mbar/min. by pressing the following:
SPEED/Qc, 0, ENTER, RATE, 2, 0, 4, ENTER

d. Press **Ps** and wait for the aim values to be achieved.

e. If auto-zero is enabled, wait for an auto-zero to take place.

Note: During auto zero, the valve state changes on the mimic panel and the display shows “Zero” in place of the airspeed aim value. The time to auto-zero should be less than 1 minute from achieving the aim value.

f. Wait for a minimum of 20 seconds after auto-zero before proceeding.

g. Observe the measured values of Ps and Qc on the display for 1 minute.

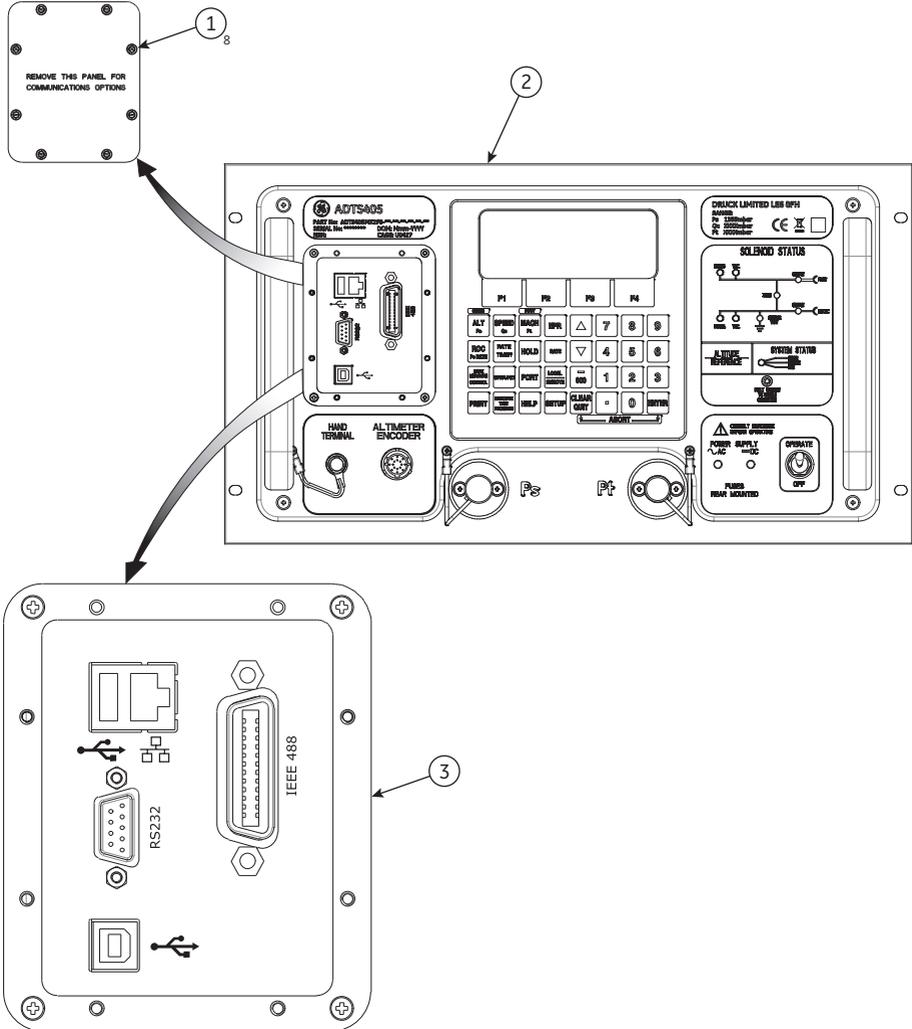
h. Check that the displayed value of Ps remains within ± 0.068 mbar.

i. Check that the displayed value of Qc remains within ± 0.068 mbar.

Note: If a further auto zero takes place, allow the display to stabilize following the auto zero before proceeding.

6.8.6 External Communication Ports

The following tests should only be done if the serviceability of an option facility is suspected or when an error occurs.



- 1 Loosen the eight captive screws to remove the cover plate from the communications connector panel.
- 2 ADTS 405 Mk2 front panel
- 3 Details of communications connector panel that is behind the cover plate (1).

Figure 6-2: External Communication Ports

6.8.6.1 USB 'A' Port

This port is for future function expansion only. Current use is for service purposes only.

6.8.6.2 USB 'B' Port

This port is for future function expansion only. Current use is for service purposes only.

6.8.6.3 RS 232 Port

This port is for future function expansion only. Current use is for service purposes only.

Note: There are no operator accessible functions on any of the USB ports.

6.8.6.4 Ethernet Port

This port provides password controlled access to various sections of the internal ADTS filing system. Areas available and relevant to operator activities are:

1. The "Printed" records archive (see Section 7.2.17, "PRINT," on page 78).
2. The Test Programs archive (see Section 7.2.18, "EXECUTE TEST PROGRAM," on page 78).

6.8.6.5 IEEE 488 Port

The IEEE 488 port requires specialist knowledge of both IEEE 488 communications and test programming for specified, authorized test procedures. Only qualified personnel should use this facility, the test procedure must be authorized by the appropriate engineering authority.

If the display does not show that SCPI is selected, follow the procedure in Section 4.14.1, "Enabling the IEEE 488 Option," on page 45, then carry out the following procedure:

- a. Press [SCPI].
- b. Press **CLEAR/QUIT**, [DEVICE ADDRESS].
- c. Check the address displayed is 1.
- d. If not, press 1 on the numeric keypad and then **ENTER**.
- e. If any changes have been made, press **CLEAR/QUIT** until requested to accept the changes, then press **ENTER**.
- f. The ADTS 405 Mk2 automatically restarts. When the display shows the main pressure display, perform the test detailed in Section 6.8.6.6, "Programming a Test of the IEEE 488 Facility," on page 67.

6.8.6.6 Programming a Test of the IEEE 488 Facility

There are many different programs and items of equipment for communicating over the IEEE 488 interface. In the following example, the user must be familiar with the IEEE 488 bus controller to be used.

The following example commands can be used to check for correct operation of the IEEE 488 interface. Initialize the bus controller as follows:

- a. Set Address 1 as the talker listener address.
- b. Make sure that bus time-out periods are set sufficiently high (e.g, 5 seconds).

Chapter 6. Testing and Fault Finding

- c. Set the bus controller to send EOI with last byte and to expect EOI on last byte of received data.
- d. Send interface clear (IEEE 488 command).
- e. Send "SOURCE:STATE OFF" (one space between STATE and OFF).
- f. Send "SOURCE:STATE?"
- g. Instruct device 1 to TALK and input the response string. The response string should be "OFF".

If the above test fails do the following:

- i. Check the continuity of the IEEE 488 cable, if unserviceable, replace the cable.
- ii. Do steps a. to g. again.

If the test fails again, return the ADTS 405 Mk2 to the repair depot.

6.8.7 Altimeter Encoder

To enable and disable this Altimeter Encoder facility access the configuration menu. When enabled, this facility will be available from power-up of the ADTS 405 Mk2 with the settings held in non-volatile memory.

If the altimeter encoder displays ENCODER ERROR then check the continuity of the altimeter encoder option cable. The, optional, 15-core cable is supplied for the AAU-32 encoder unit. See connection details in Table 6-2.

- a. If the cable is unserviceable, replace the cable.
- b. Repeat the procedure 3.8 Enabling the Altimeter Encoder Option.

If the test fails again, return the ADTS 405 Mk2 to the authorized maintenance or repair center.

Table 6-2: Optional Cable (AAU-32 Units)

ADTS Connector Pin	Function	Cable Color	AAU-32 Connector Pin
1	C4 LSB	Brown	B
3	C2	Red	C
5	C1	Orange	D
7	B4	Yellow	E
9	B2	Green	F
11	B1	Blue	G
13	A4	Violet	H
22	A2	White	J
2	A1	Gray	K
4	D4	Black	L
n/c	D2 MSB	Turquoise ^a	n/c
8	Common (0V) signal	Pink	A
10	Common (0V) power	Yellow/Red	b + M
14	Vibrator +24 V	Red/Blue	p
12	Encoder +24 V	Green/Red	c
Shell	Case/Ground	Shell	a + Shell

- a. The D2 data line (turquoise cable) is not defined for the AAU-32, it is for above 62,000 ft and not connected.

7. Reference

7.1 Introduction

This section includes a full description of each key function including references to associated functions. The available keys are:

- F1 - F4
- ALT Ps
- SPEED Qc
- MACH Pt
- EPR
- ROC Ps RATE
- RATE TIMER
- HOLD
- RATE
- LEAK MEASURE/CONTROL
- GROUND
- PORT
- REMOTE
- PRINT
- EXECUTE TEST PROGRAM
- HELP
- SETUP
- ▲ (nudge up)
- ▼ (nudge down)
- 0 to 9
- - 000
- CLEAR/QUIT
- ENTER
- . (decimal point)

Double key presses give:

- ABORT (CLEAR + ENTER)
- CONFIGURATION (F1 + SETUP)

7.2 Keypad Display

7.2.1 F1 - F4

These function keys or soft-keys are used to select choices from menus. The menu choices may be shown directly over the keys or displayed as a list. When a menu is displayed, press the appropriate function key to select the required choice. **CLEAR/QUIT** can be used to leave a menu without making a selection.

7.2.2 ALT/Ps

1. In aeronautical units (ft or m), this key selects an altitude display.
2. In pressure units (mbar, inHg etc.), this key selects a static pressure (Ps) display.
3. **SETUP**, [UNITS] can be used to change the units of display, if setup mode is not switched off.
4. Before entering a new altitude or Ps aim, set the rate of change using the **ROC/Ps RATE** key.
5. In Control Mode (Aim display), enter a new altitude or Ps aim using the numeric keys. Use **LEAK MEASURE/CONTROL** to exchange between control and measure mode.

7.2.3 SPEED/Qc

1. In aeronautical units (kts, km/h), this key selects an airspeed (CAS or TAS) display. In pressure units (mbar, inHg etc.), this key selects dynamic pressure and the display shows (Qc).
2. The airspeed can be displayed and entered as either Calibrated Airspeed (CAS, Vc) or True Airspeed (TAS, Vt).

Note: For testing purposes, Calibrated Airspeed equates to Indicated Airspeed (IAS).
3. The Pt temperature value affects the calculation of TAS. The value of Pt temperature, normally measured by the aircraft temperature sensor, can be changed by **SETUP**, **SPEED/Qc**, [Pt TEMPERATURE] only in full setup mode.
4. Use **SETUP**, **SPEED/Qc**, [CAS/TAS] to select CAS or TAS.
5. CAS/TAS can be changed in full setup mode.
6. If the altitude aim is changed, after the entry of CAS, the Mach and TAS aim values change while the CAS value remains unchanged*.
7. If the altitude aim is changed, after the entry of TAS or Mach, the CAS aim value changes while the TAS and Mach values remain unchanged*.
8. If the Ps aim is changed, after the entry of Qc, then the Pt aim value changes while the Qc remains unchanged*.

* The display shows = symbol next to the parameter that remains unchanged.

9. If the Ps aim is changed, after the entry of Pt, then the Qc aim value changes while the Pt remains unchanged*.
10. **SETUP**, [UNITS] can be used to change the units of display, if setup mode is not switched off.
11. Before entering a new CAS or Qc aim, the rate of change should be set using the **RATE** key.
12. In Control Mode (AIM display), a new CAS or Qc can be entered using the numeric keys. Use **LEAK MEASURE/CONTROL** to change between control and measure mode.

7.2.4 MACH/Pt

1. In aeronautical units (ft/kts or m/km/h), this key selects a Mach display.
2. In pressure units (mbar, inHg etc.), this selects a total pressure (Pt) display.
3. If the altitude aim is changed, after the entry of CAS, the Mach and TAS aim values change while the CAS value remains unchanged*. If the altitude aim is changed, after the entry of TAS or Mach, the CAS aim value changes while the TAS and Mach values remain unchanged*.
4. If the Ps aim is changed, after the entry of Qc, then the Pt aim value changes while the Qc remains unchanged*.
5. If the Ps aim is changed, after the entry of Pt, then the Qc aim value changes while the Pt remains unchanged*.
6. Before entering a new Mach or Pt aim, set the rate of change of speed using the **SPEED/Qc** key.
7. Press the **RATE** key.
8. In Control Mode (AIM display), a new Mach or Pt aim can be entered using the numeric keys, Use **LEAK MEASURE/CONTROL** to change between control and measure mode.

7.2.5 EPR

The ADTS 405 Mk2 can be used to check EPR sensors and indicators.

1. Engine Pressure Ratio (EPR) is only available in pressure units (mbar, inHg etc.).
2. For EPR testing, use Ps as INLET pressure and EPR to set the ratio of OUTLET pressure (Pt) to INLET pressure.
3. Before entering a new EPR aim, the rate of change should be set using the **RATE** key.
4. In Control Mode (Aim display), a new EPR aim can be entered using the numeric keys. Use **LEAK MEASURE/CONTROL** to enter measure mode and make the appropriate Ps and Pt control state changes.

* The display shows = symbol next to the parameter that remains unchanged.

7.2.6 ROC/Ps RATE

1. In aeronautical units (ft or m), this key selects a Rate of Climb (ROC) or vertical speed display.
2. In pressure units (mbar, inHg etc.), this key selects a rate of change of Ps display.
3. **SETUP**, [UNITS] can be used to change the units, if setup mode is not switched off.
4. In Control Mode (AIM display), a new ROC or Ps rate can be entered using the numeric keys. Use **LEAK MEASURE/CONTROL** to change between control and measure mode.

7.2.7 RATE TIMER

The **RATE TIMER** key starts an internal timer for one of three predefined times. On the completion of the time period, the average rate of change over the time period is displayed.

Each selected TIME period can have an associated WAIT period to allow pressures to settle before the timing starts. The WAIT period counts down to zero before the TIME period starts.

To use the rate timer:

1. Press **RATE TIMER**.
2. Press F1, F2 or F3 to select the required WAIT and TIME periods.

The main pressure displays shows the WAIT or TIME period counting down.

After timing, the timed average value, identified by a **T** directly to the right of the value, replaces the instantaneous rate value. In measure mode the display changes to show the timed rate of all associated parameters on the same screen. Pressing one of the set-point keys (e.g., ALT, ROC, SPEED etc.,) or **CLEAR/QUIT** exits from this screen.

3. At any time during rate timing or when a timed value is displayed, pressing the **RATE TIMER** key allows for either the restarting or canceling of the timing. When timing is canceled, the rate displays return to instantaneous values.
4. The timed average value remains until a new aim is entered. During this time, it is possible to view any parameter.
5. The WAIT and TIME periods can be changed using **SETUP, RATE TIMER**, providing SETUP lock is not enabled.

7.2.8 HOLD

When **HOLD** is pressed, a changing pressure is instantaneously held. Pressing **HOLD** again releases the pressure to continue to the aim value. The **HOLD** facility applies to both channels simultaneously. Two examples of how the HOLD facility can be used are shown below:

7.2.8.1 Example 1 - Airspeed Switch Test

- a. Take the airspeed to a value just below the expected trip point.
- b. Enter a low rate of speed.
- c. Enter a new airspeed aim above the trip point.

- d. Immediately the switch trips, press HOLD. (see Section 7.2.8, "HOLD," on page 74 for more details)
- e. Read the airspeed value - this is the trip value for increasing airspeed.
- f. Enter a new airspeed aim below the expected trip value.
- g. Immediately the switch trips, press HOLD.
- h. Read the airspeed value - this is the trip value for decreasing airspeed.
- i. Press HOLD again to release hold.

7.2.8.2 Example 2 - Start Both Ps and Pt Ramping to New Aims Simultaneously

For both channels to start moving to new aims at the same time, use the following sequence:

- a. Press HOLD.
- b. Enter Ps channel aim.
- c. Enter Pt channel aim.
- d. Enter required rates.
- e. Press HOLD again to release hold.
- f. HOLD is automatically released when entering Measure Mode.

7.2.9 RATE

1. In aeronautical units (kts, km/h), this key selects a rate of change of airspeed (Rate CAS) display. The following rates are available in aeronautical units:

Table 7-1: Rates in Aeronautical Units

Key-press Sequence	Rate of Change Display
SPEED, RATE	Rate CAS ^a
MACH, RATE	Rate MACH

a. Rate CAS is displayed with the airspeed in either CAS or TAS.

2. In pressure units (mbar, inHg etc.), this key selects a rate of change of pressure (Rate Qc, Rate Pt or Rate EPR) display. The actual display depends on the parameter selected before pressing **RATE**. The following rates are available in pressure units.

Table 7-2: Rates in Pressure Units

Key-press Sequence	Rate of Change Display
Qc, RATE	Rate Qc
Pt, RATE	Rate Pt
EPR, RATE	Rate EPR

3. If setup mode is not switched off, **SETUP**, [UNITS] can be used to change the units of display.

4. A new rate aim can be entered using the numeric keys, if the unit is in Control Mode (Aim displayed). Use **LEAK MEASURE/CONTROL**, to change between Control and Measure mode.
5. If the automatic airspeed rate is selected (using **SETUP, RATE**) the airspeed rate is automatically adjusted to simultaneously achieve both altitude and airspeed aim values. This adjustment normally requires a reduction in the rate from the aim value; the rate does not exceed the aim value. When airspeed (not Qc) is automatically reduced, the display shows (A) after RATE CAS.

7.2.10 LEAK MEASURE/CONTROL

This key switches between **MEASURE** and **CONTROL** mode. The controllers are switched off in Measure mode, so it can be used to measure leaks in the aircraft system.

Note: The pneumatic supply pumps must be switched on before going to **CONTROL** mode.

1. In Measure mode, the display shows “LEAK MEASURE”.
2. Press **LEAK MEASURE/CONTROL** to switch the controllers on.
3. The display briefly shows “REGAINING CONTROL” while the pressure controllers adjust to the system pressure. No significant pressure transients are produced when regaining control.
4. In “CONTROL” mode, the display shows “Aim” value.
5. Two safety systems are built-in to protect the aircraft systems during leak testing. These are Auto Leak recovery and Auto Limit recovery. Auto Leak recovery automatically regains control if the leak rate exceeds the currently set limits on either channel.
6. Auto Leak recovery can be switched off using **SETUP, LEAK MEASURE/CONTROL, [AUTO LEAK]**.
7. If negative airspeed or Qc occurs in measure mode, the zero valve automatically opens for a period of 1 second to balance the airspeed or Qc. This only applies when the minimum CAS (or Qc) limit is zero.
8. Auto Limit recovery automatically regains control if the pressure on either channel leaks outside of the selected limits, (except for negative airspeeds).
9. Auto Limit recovery can be switched off using **SETUP, LEAK MEASURE/CONTROL, [AUTO LIMIT]**.

Note: Auto Limit and Auto Leak recovery functions require the pneumatic supply pump to be switched on.

7.2.11 GROUND

1. This key enables a display of ground pressure or automatically controls the pressures in the aircraft system to local atmospheric pressure.
2. The local atmospheric pressure is recorded by the ADTS 405 Mk2 during the power-up sequence.
3. When GROUND is pressed, a menu gives a choice of three ground functions.

Note: Both channels (Ps and Pt) must be set to 'Cntrl' for go to ground.

7.2.12 [GO TO GROUND]

Note: The Go-to-Ground operates only in Control Mode.

1. Selecting [GO TO GROUND] automatically enters an altitude or static aim equivalent to local atmospheric pressure (QFE) and an airspeed or dynamic pressure aim of zero. The system pressures will then be controlled towards these aims, in the normal way, at the rates set by the **ROC/Ps RATE** and **RATE** keys. At any time when going-to-ground, a new rate of change can be entered, the ADTS 405 Mk2 continues going-to-ground.
2. At any time during going-to-ground, a new value aim for ALT, CAS, TAS, Mach, Ps, Qc, Pt or EPR can be entered. This causes the procedure to stop and normal controlling operation to start.
3. When the airspeed is zero and the Ps channel pressure is close to ground, the QFE is re-measured to update the stored "ground" pressure value, the display shows the message "CHECKING GROUND". The ADTS 405 Mk2 then reconnects to the system under test and equalizes the pressures.
4. The display shows the message "Safe At Ground"; the ground and zero valves remain open so that the aircraft system permanently vents to atmosphere. No commands can be entered when these two messages are displayed.
5. Press **CLEAR/QUIT** to continue with normal operation. The ground and zero valves then automatically close.

7.2.13 [DISPLAY QFE]

1. When [DISPLAY QFE] is selected, the local atmospheric pressure recorded during the power-up sequence is displayed as QFE in the default units set in configuration.
2. Press **CLEAR/QUIT** to return to the normal user display.

7.2.14 [DISPLAY QNH]

1. When [DISPLAY QNH] is selected, the local atmospheric pressure recorded during power-up is converted to the equivalent sea level pressure. The display shows QNH, in the default units set in configuration, together with the station (airfield) altitude.
2. The station (airfield) altitude can be changed in full setup mode by using **SETUP, GROUND**.

7.2.15 PORT

This function sets the port option, this changes the ADTS 405 Mk2 from a single pitot-static output system to a multi-port system by using a Druck Line Switching Unit (LSU 100 Series). Refer to the option manual.

7.2.16 REMOTE

Enters Remote Mode; this mode allows an external IEEE 488 bus device to control the unit. In this mode the keypad (except the Remote key) is disabled. If remote lock is disabled, pressing

Chapter 7. Reference

the remote key when the “REMOTE” message is not displayed forces the unit into remote mode as if the external device has taken control of the unit.

Note: This may change operator settings such as the current limit set. Refer to the option user manual for further details.

7.2.17 PRINT

The ADTS 405 Mk2 contains a print facility to print the displayed readings together with up to nine user readings (e.g., Pilot, Copilot, Aux) to a text file stored within the ADTS internal file storage system which may be accessed and printed via PC.

Access to the stored 'Print' files area within the ADTS is gained via the Ethernet port, using a PC to create a secure file transfer connection. Details of how to set up an Ethernet connection are given in Section 4.13.1, “Ethernet System,” on page 40.

1. This key causes a printout of the date and time followed by the measured value of the parameters. A prompt asks for the entry of a reading which can consist of any characters **A** to **Z**, **0** to **9**. (decimal point) or - (minus), in any order. It can be used to enter the value from the unit or system under test or alternatively a test number. When no more entries are required, press **CLEAR/QUIT**.
1. To enter an alphabetic character (A to Z), press the [ALPHA] key and use the ▲ or ▼ (nudge keys) to change to the required character. To enter another alphabetic character, press the [ALPHA] key again. Press [BACK] to delete the last character.
2. Up to nine user readings can be entered sequentially. The display prompts for the next user reading each time one is entered. When no further readings are required, press **CLEAR/QUIT**. Example print output:
04Mar00 09:47 Ps 700.00 mbar Qc 30.00 mbar Usr Rgd

7.2.18 EXECUTE TEST PROGRAM

A test program can contain operator prompts to enter numeric values from instruments; test results can be stored in the ADTS 405 Mk2 and later printed, by a suitable printer, using the serial output port or Ethernet option.

7.2.18.1 Executing Test Programs (Without Auto Run)

- a. Press the **EXECUTE TEST PROGRAM** key. This displays the first of the available test programs. The top line shows the file name and the second and third lines show the TITLE.
- b. Use [NEXT] or [PREV] to step through the available programs until the required program is displayed. Press [RUN] to select the program.

The display shows a menu allowing the following selections:

[F1] Run all tests: This starts the program from the beginning.

[F2] Run specific tests: This allows execution to start with any one of the individual TESTS contained within the test program. Use [NEXT], [PREV] and [SEL] as above.

- c. Select [Run all tests]: The display returns to the normal user display. “TP”, in the bottom right hand corner of the display, indicates execution of a test program.

Various commands prompts the operator by displaying messages on screen such as: “Press the ETP key”. The “ETP” key is the general key for moving onto the next step.

Note: The **CLEAR/QUIT** key should only be used to terminate test program execution.

- d. At the end of each test, the operator has a choice of continuing, exiting test program execution or going to manual mode. In manual mode, any of the normal keypad functions may be used.
- e. When the manual testing is complete, press **EXECUTE TEST PROGRAM** and the test program continues from where it left off. This feature may be disabled by including the KEYLOCK command in the test program. While in manual mode the display prompts “TPM”.
- f. When a “go” command is executed, “GO” flashes in the lower right hand corner of the screen. At this point the user should record any instrument readings or displayed leak rates, as required, before continuing by pressing EXECUTE TEST PROGRAM. F4 may be used to continue at a “go” command as an alternative to pressing **EXECUTE TEST PROGRAM**.

7.2.18.2 Loading Program Files

New program files may be prepared on a PC and transferred to the ADTS using the Ethernet port access procedure described in Section 4.13.3, “Access ADTS Files,” on page 43.

7.2.18.3 Deleting Program Files

If a test program within an ADTS 405 Mk2 is no-longer required, then it may be deleted. To delete a test program, proceed as follows:

- a. Enter configuration (CONFIG) by pressing and holding **F1** and pressing **SETUP**.
- b. At the first menu level of configuration, press the **EXECUTE TEST PROGRAM** key, then F2. The display then shows the file name and title of the first file in the list. Use [NEXT] and [PREV] to step through the files until the display shows the file to be deleted.
- c. Select [DEL] to delete the file, then press **CLEAR/QUIT** to quit from configuration.
- d. Select [YES] to confirm quit.

Note: If the deleted program is marked as “AUTO RUN” then an additional screen asks to confirm if the auto run status should be removed before deletion.

7.2.18.4 Auto Running a Program

To run a program each time the ADTS 405 Mk2 is switched on, the “Auto run” feature should be enabled. The enabled program starts, from the first line, after successful completion of the ADTS power-up sequence. To setup the auto run feature, proceed as follows:

- a. Enter configuration (CONFIG) by pressing and holding **F1** and pressing **SETUP**.
- b. At the first menu level of configuration, press the **EXECUTE TEST PROGRAM** key, then F1. The display shows the name of the current file to “Auto run” or “*NONE*” if auto run is not selected. To change this selection use the [NEXT] and [PREV] keys and when the correct file is displayed press [SEL].

- c. To de-select auto run press [NONE].

7.2.19 HELP

The **HELP** key provides help on each key. The help message generally gives associated functions and ways of changing the use of each key. To get help on any of the keys on the keypad:

- a. Press **HELP**, then press the required key for information. Some help screens show a flashing [MORE] over the F4 key, press **F4** for further information.
- b. Press **CLEAR/QUIT** to exit the help system.

7.2.20 ▲ or ▼ (Nudge Keys)



INFORMATION Make sure the nudge increment is set to a suitable value before using the nudge facility to change the aim value. See Section 7.3.25, “**SETUP, ▲ or ▼ (Nudge Keys),**” on page 90 to change the value of increment for the nudge facility.

Change the current aim up or down by a small increment. This facility can be used to align a pointer of an instrument to a precise indicated value and compare this indicated value with the measured value. This facility may be used for pressure switch testing as follows:

- a. Aim for a pressure just below the expected operating point.
- b. When the pressure is achieved, repeatedly press ▲ until the switch operates.
- c. Record the pressure reading shown on the display.
- d. Repeat this procedure using the ▼ until the switch returns to its original condition, refer to Section 4.8, “Airspeed Switch Test,” on page 36 for an example. Holding the nudge function automatically repeats the function.
- e. Record the pressure reading shown on the display.

Note: (1) Holding down one of the ▲▼ keys automatically repeats the function.

Note: (2) The nudge value can be used for large increments e.g., 100 kts or 5,000 ft to “step through” cardinal points on a test.

7.2.21 Number 0 to 9

Use these keys for numeric entry. All data entry is based on over-writing the existing value, when the first numeric key is pressed, the existing number is replaced by the key pressed.

- a. Press **ENTER** to complete numeric entry. Press **CLEAR/QUIT** if a mistake is made during numeric entry. At any time, the existing number may be recovered by pressing **CLEAR/QUIT**.

7.2.22 -000

This key performs two functions during numeric entry.

1. If it is the first numeric key pressed, it produces a minus sign for the entry of negative numbers.

2. If it is a subsequent key pressed during numeric entry it produces three zeros for fast entry of thousands.

Note: When -000 is pressed during entry of an aircraft name for limits, or in the Print facility, it always produces “-”.

Example, follow the procedure below to enter -1000:

- a. Press **-000**: (Display shows -)
- b. Press **1**: (Display shows -1)
- c. Press **-000**: (Display shows -1000)

7.2.23 CLEAR/QUIT

1. During numeric entry, **CLEAR/QUIT** removes the new number and restores the previously entered number. Once the **ENTER** key has been pressed, the old number cannot be restored.
2. When menus are displayed, **CLEAR/QUIT** exits the menu, generally to the previous display.
3. For those displays containing a [SAVE] option, changes made before pressing **CLEAR/QUIT** are ignored. For all other displays, changes are saved when **CLEAR/QUIT** is pressed.
4. When warning messages are displayed, pressing **CLEAR/QUIT** removes the message.

7.2.24 ENTER

The **ENTER** key completes numeric entry.

7.2.25 CLEAR + ENTER (ABORT)



INFORMATION The abort function should only be used as a last resort.

Pressing **CLEAR/QUIT** and **ENTER** together, restarts the ADTS 405 Mk2 from the power-up sequence. Output valves close immediately and open during the restart sequence. The restart sequence starts with the display showing:

```

DRUCK
ADTS 405
DKxxx
VER xx. xx

```

Use the abort function in only the following circumstances:

1. When a restart is required after the system has shutdown displaying an error message.
2. As an emergency measure with a serious problem concerning the aircraft or component under test.

3. After this restart sequence, the system vents, at a safe rate, both channels (pitot and static) to atmosphere during the power-up sequence.

7.3 SETUP

Pressing the **SETUP** key causes the system to enter a setup mode preset in the configuration mode. The following section describes the three functions of setup: full, minimum and off. The full setup allows access to all setup functions. Minimum setup allows access to some setup functions, the off function prevents access to the setup functions.

7.3.1 FULL SETUP

Full setup allows access to secondary functions that do not have an assigned key. Any parameter changed under setup returns to the default settings on power-down.

The CONFIG mode may be used to change the default settings so that the ADTS 405 Mk2 powers up in the required state. Most setup parameters are also available under CONFIG. Additional parameters are only available under CONFIG.

1. Certain parameters in setup can be locked in CONFIG mode preventing inadvertent changes such as aircraft limits at power-up with a particular set of limits that must not be changed. Attempting to change a locked parameter causes the display to show a warning message.
2. Pressing the **SETUP** key makes the setup functions available. Pressing the function keys selects the setup menus, using the appropriate function key selects the required menu choice. To setup a parameter key, press **SETUP** then press the required parameter key. Each parameter key setup provides settings to the normal user mode function of the key. Further menus are used under certain direct key setup functions.
3. Once a setting has been changed in setup, use **CLEAR/QUIT** to return to the preceding menu. After all required parameters have been changed, repeatedly press **CLEAR/QUIT** until the display shows the main pressure display.
4. The following section describes each setup function. Intermediate menus are not described.

Note: Section 3.4, "Operation Quick Reference," on page 19 provides details of the setup menu and function keys.

7.3.2 SETUP, [UNITS]

- a. Use [NEXT] or [PREV] to step through the available units until the display shows the required units.
- b. Select [SAVE] and then press [QUIT] to make the selection. The available units are:
 - ft and kts (includes Mach)
 - ft and mph (includes Mach)
 - m and km/h (m/min) (includes Mach)
 - m and km/h (m/s) (includes Mach)
 - m and km/h (hm/min) (includes Mach)

- mbar
- inHg
- mmHg
- inH₂O 4°C
- inH₂O 20°C
- inH₂O 60°F
- psi
- hPa
- kPa
- kg/cm²
- % full-scale

7.3.3 SETUP, [LIMITS]

The ADTS 405 Mk2 is preprogrammed with the manufacturer's STANDARD, CIVIL and MAX limit sets. Different sets of additional aircraft limits can be programmed using the CONFIG mode. SETUP, [LIMITS] allows the selection of the set of limits to be used, each set of limits is identified by its aircraft name.

Note: The ADTS 405 Mk2, when delivered, contains “Standard” and “Civil” limits; to set and store “Max” limits, for the first time, enter configuration. The “Max” limits depend on the range of the pitot channel either 850 or 1000 kts, see Section 1.3, “Operating Limits,” on page 2.

1. Use [NEXT] or [PREV] to step through the aircraft names select [SEL] and press QUIT when the display shows the required name.
2. Use CONFIG, [LIMITS] to program the sets of limits. Each set of limits includes:
 - Max ALT
 - Min ALT
 - Max CAS
 - Min CAS
 - Max Mach
 - Max ROC
 - Max Rate CAS
 - Max Ps
 - Min Ps
 - Max Qc
 - Min Qc
 - Max Rate Ps
 - Max Rate Qc
 - ARINC limits on or off

- Altitude correction value
- c. The set of limits used at power-up (default) can be selected using CONFIG, [LIMITS], [DEFAULT AIRCRAFT]. The default aircraft settings can be locked using CONFIG, [LIMITS], [LOCK AIRCRAFT] so that the operator cannot change the limits.
- d. If the selected set of limits result in the measured pressures being outside the limits, the display shows the warning message “**OUTSIDE LIMITS GO TO GROUND**” the Ps and Pt channels should be taken to ground or to pressures within the new selected limits. This warning message is also displayed if the pressures measured directly after power-up are outside the limits used at power-up.
- e. After selecting a set of limits, the altitude correction value can be changed using **SETUP, ALT**. The maximum Mach limit can be changed or switched off using **SETUP, MACH**.

7.3.4 SETUP, [OSC]

The ADTS 405 Mk2 has an oscillation facility that causes the pressure to oscillate about the aim value at a user defined frequency and amplitude.

- a. Select oscillation channel Ps or Pt.
- b. Select [AMPL/FREQ] and enter the required amplitude and frequency.
- c. Select [START] to start oscillation.
- d. Select [STOP] to stop oscillation at the end of a half cycle.
- e. Select [FREEZE] to stop oscillation immediately.

7.3.5 SETUP, [MORE], [CONTROL], [Ps Pt DUAL]

1. Dual channel is the normal mode of operation where both Ps (static) and Pt (pitot) channels are connected to the unit or aircraft system under test.
2. To test instruments such as airspeed indicators with only the Pt (pitot) channel connected, use **SETUP, [MORE] [CONTROL] [Ps Pt DUAL]** and select [Pt].
3. When using [Pt ONLY], the blanking cap must be removed from the Ps (static) channel so that Ps is open to atmosphere. All the functions associated with the Ps channel are disabled.
4. Similarly, to test instruments such as altimeters with only Ps (static) channel connected, select **SETUP, [MORE] [CONTROL] [Ps Pt DUAL]** and select [Ps]. All the functions associated with the Pt channel are disabled; the blanking cap can remain fitted to this channel.
5. To return to dual channel operation, select **SETUP, [MORE], [CONTROL] [Ps Pt DUAL]** and select [DUAL] and connect both channels to the unit or aircraft system under test.
6. The channel controllers must be in measure mode when changing [CONTROL].
7. The Ps (static) pressure must be within ± 10 mbar of the recorded QFE to select Pt only. The control channel selection can be locked in CONFIG.

7.3.6 SETUP, [MORE], [DISPLAYS/OPTIONS], [DISPLAY TYPE]

The display can be configured for SINGLE, DUAL or TRIPLE displays. The key press sequence changes the display parameters, the 2nd key press column shows the parameter that changes on entry of a numeric value.

The tables show all available parameter combinations with an associated key press sequence.

Table 7-3: Aeronautical Units Dual Display

1 st Key Press	2 nd Key Press	Upper Display	Lower Display
ALT	SPEED	ALT	CAS or TAS
ALT	MACH	ALT	MACH
Any key	ROC	ALT	ROC
SPEED	RATE	CAS or TAS	RATE CAS
MACH ^a	RATE	MACH	RATE MACH
SPEED	MACH	MACH	CAS/TAS
SPEED	ALT	ALT	SPEED
MACH	ALT	ALT	MACH
MACH	SPEED	MACH	SPEED

- a. The Mach parameter changes on numeric entry.

Table 7-4: Pressure Units Dual Display

1 st Key Press	2 nd Key Press	Upper Display	Lower Display
Ps	Qc	Ps	Qc
Ps	Pt	Ps	Pt
Ps	EPR	Ps	EPR
Any key	RATE Ps	Ps	RATE Ps
Qc	RATE	Qc	RATE Qc
Pt	RATE	Pt	RATE Pt
EPR	RATE	EPR	RATE EPR
Pt	Qc	Pt	Qc
Qc	Ps	Ps	Qc
Pt	Ps	Ps	Pt
EPR	Ps	Ps	EPR
Qc	Pt	Pt	Qc

Table 7-5: Aeronautical Units Triple Display

1 st Key Press	2 nd Key Press	Display
Any key	SPEED	ALT, CAS or TAS
Any key	MACH	ALT, CAS or TAS, MACH
Any key	ROC	ALT, CAS or TAS, ROC
SPEED	RATE	ALT, CAS or TAS, RATE CAS
Any key	ALT	ALT, CAS or TAS

Table 7-6: Pressure Units Triple Display

1 st Key Press	2 nd Key Press	Display
Any key	Qc	Ps, Qc
Any key	Pt	Ps, Qc, Pt
Ps	EPR	Ps, EPR
Any key	ROC	Ps, Qc, RATE Ps
Qc	RATE	Ps, Qc, RATE Qc
Pt	RATE	Ps, Pt, RATE Pt
EPR	RATE	Ps, EPR, RATE EPR
Qc	Ps	Ps, Qc
EPR	Ps	Ps, EPR

At the end of rate timing, the rate of change on both channels are displayed for aeronautical units ROC and RATE CAS and for pressure units RATE Ps, RATE Pt and RATE Qc. This is the same for all display modes.

7.3.6.1 Option Displays

The key presses function, for the option displays, in the same way as a “single display” (i.e., the single displayed parameter comes from the last key press), with the lower half of the display screen showing any available data from the option.

7.3.7 SETUP, [MORE], [DISPLAYS/OPTIONS], [OPTIONS]

This function allows changes to option hardware that may be fitted. See option manuals for further details. If an option, that is not fitted, is selected the display shows the error message “Option Hardware not fitted”. Refer to the option user manual.

7.3.8 SETUP, [MORE], [CLOSE OUTPUT VALVES]

This function closes the Ps and Pt valves to enable leak checking of the internal pneumatics of the ADTS 405 Mk2, with the aircraft system isolated, but still connected. All the normal functions of the ADTS 405 Mk2 may be used in this mode.

Note: For safety, the output valves can only be closed when the ADTS 405 Mk2 is at ground.

7.3.9 SETUP, [MORE], [OPEN OUTPUT VALVES]

This function opens the Ps and Pt output valves after using the [CLOSE OUTPUT VALVES] function.

Note: For safety, the output valves can only be opened when the ADTS 405 Mk2 is at ground.

7.3.10 SETUP, [MORE], [SYSTEM SELF TEST]

This function starts a self-test, the system pressures must be at ground pressure and the system in Leak Measure mode. The self-test is the same test routine as in the power-up sequence. At the end of the self-test the output valves open.

7.3.11 SETUP, ALT

This function allows the altitude correction value to be changed. If altitude correction is in use the display shows, after warm-up, "A/C" in the lower right hand corner.

The altitude correction facility corrects for the pressure difference when the ADTS 405 Mk2 and the aircraft system are at different heights.

The ADTS 405R Mk2 altitude reference level is marked on the front panel just to the left of the Status LED (assumes front panel is vertical). The ADTS 405F Mk2 altitude reference level is marked on the side product label of the flight-line case (assumes front panel is horizontal). If the ADTS is below the aircraft system, enter the correction value as a positive number. See Section 2.4, "Positioning of the ADTS," on page 10.

- a. Enter the height difference between the aircraft system and the ADTS 405 Mk2 altitude reference level. The units of entry are the current units or default aeronautical units, see Section 7.4.3, "CONFIG, [UNITS]," on page 92.

7.3.12 SETUP, SPEED, [AUTO ZERO]

This function enables or disables the auto zero function. When enabled, this optimizes airspeed accuracy at low airspeeds.

1. When enabled the ADTS 405 Mk2 performs an auto zero when the following conditions are met:
 - Ps and Pt pressures are stable.
 - If in control mode, a zero airspeed or Qc aim has been achieved.
 - If in leak measure mode, the airspeed is less than 20 kts (or Qc equivalent).
2. The auto zero will be initiated within 1 minute of achieving a new aim value and thereafter, every 5 minutes.
3. The auto zero sequence can be interrupted at any time by entering a new command over the keypad or option interface.
4. The controllers must be in measure mode when enabling or disabling auto zero.

7.3.13 SETUP, SPEED, [CAS/TAS]

1. This function changes the airspeed display between Calibrated Airspeed (CAS or Vc) and True Airspeed (TAS or Vt). For testing purposes, CAS is equivalent to Indicated Airspeed (IAS).
2. The value of TAS displayed depends on the Pt temperature, see Section 7.3.14, "SETUP, SPEED, [Pt TEMPERATURE]," on page 88.

7.3.14 SETUP, SPEED, [Pt TEMPERATURE]

The function allows the value of Pt temperature to be entered, this is used in the calculation of TAS.

- a. Enter the pitot temperature measured by the aircraft's pitot temperature sensor in the units shown on the display.
- b. The default units of temperature measurement may be changed using CONFIG, [UNITS], [TEMPERATURE].

7.3.15 SETUP, MACH

This function allows the Mach limit to be changed or disabled. The initial Mach limit comes from the current aircraft limits. To change the limit enter a numeric value or select as follows:

- a. Select [OFF] to disable the Mach limit.
- b. Select [ON] to enable the Mach limit.
- c. Select [DEFAULT] to restore the Mach limit from the aircraft limits in use.

7.3.16 SETUP, RATE TIMER

This function allows the Wait/Time values to be set for F1, F2, and F3 of the RATE TIMER function. To change the times:

- a. Select the function to be changed: F1, F2 or F3.
- b. Enter the [WAIT] value in minutes and seconds.
- c. Enter 00:00 if a wait is not required.
- d. Select [TIME].
- e. Enter the [TIME] value in minutes and seconds.
- f. Press **CLEAR/QUIT**.
- g. Select another WAIT/TIME or press **CLEAR/QUIT**.

7.3.17 SETUP, RATE

This function selects automatic airspeed rate control ON or OFF. If the automatic airspeed rate is selected (using **SETUP, RATE**) the airspeed rate is automatically adjusted to simultaneously achieve both altitude and airspeed aim. This adjustment normally requires a reduction in the rate from the aim value; the rate does not exceed the aim value. When airspeed is automatically reduced, the display shows RATE CAS aim as (A).

This function only applies when using Aeronautical units:

- ft and kts

- ft and mph
- m and km/h (m/min)
- m and km/h (m/s)
- m and km/h (km/min)

7.3.18 SETUP, LEAK MEASURE CONTROL, [AUTO LEAK]

This function enables or disables the auto leak recovery facility. See Section 7.2.10, "LEAK MEASURE/CONTROL," on page 76.

7.3.19 SETUP, LEAK MEASURE CONTROL, [AUTO LIMIT]

This function enables or disables the auto limit recovery facility. See Section 7.2.10, "LEAK MEASURE/CONTROL," on page 76.

7.3.20 SETUP, GROUND

This function enables the station (airfield) altitude to be entered and is used when displaying QNH. See Section 7.2.11, "GROUND," on page 76 for further details.

- Enter the station (airfield) altitude in the units shown on the display. See Section 7.4.3, "CONFIG, [UNITS]," on page 92, [AERONAUTICAL] units for the default units.

7.3.21 SETUP, [PORT]

This function sets up the port option. If an option, that is not fitted, is selected the display shows the error message "Option Hardware not fitted". Refer to the Line Switching Unit, User Manual.

7.3.22 SETUP, PRINT, [DATE/TIME]

This function allows the system time and date to be set. The time and date is maintained by a battery-backed clock when the ADTS 405 Mk2 is switched off.

- Use [TIME] or [DATE] to select between time or date.
- To change the time or date, enter all six digits and press ENTER.
- The date format can be either US (mm/dd/yy) or UK (dd/mm/yy) using CONFIG,[MORE], [DATE FORMAT]. The time format is hh:mm:ss.

7.3.23 SETUP, EXECUTE TEST PROGRAM

This function sets up the results file options.

Result data generated by the test program can either be sent out to the printer port or saved to a result file and stored in the ADTS 405 Mk2. Pressing **F1**, the [PRINT/SAVE] key, sets the option.

Any of the results files, stored in the ADTS 405 Mk2, can be sent to the printer port. Press **F2**, the [PRINT FILE] key, to select the required file.

7.3.24 SETUP, HELP

This function provides help on the setup key.

7.3.25 SETUP, ▲ or ▼ (Nudge Keys)



INFORMATION Make sure the nudge increment is set to a suitable value before using the nudge facility to change the aim value.

This function allows the increment value of the nudge key to be adjusted for every parameter.

1. When **SETUP**, ▲ or ▼ are pressed, the display shows the value of nudge for the parameter last displayed.
2. Enter a new value to replace the present value.
3. Use [NEXT] or [PREV] to display other parameters.
4. Press **CLEAR/QUIT** when the nudge values of all the required parameters have been changed.

In aeronautical units, the parameters available are:

- ALT
- CAS/TAS
- MACH
- ROC
- RATE CAS

In pressure units, the parameters available are:

- Ps, RATE Ps
- Pt
- Qc, RATE Qc
- EPR, RATE EPR

5. The nudge value can be used for large increments e.g. 100 kts or 5,000 ft to “step through” the cardinal points of a test.

7.3.26 MINIMUM SETUP

Minimum setup allows access to a limited number of setup functions. Any parameter changed under setup returns to the default settings at power-down. The CONFIG mode may be used to change the default settings so that the ADTS 405 Mk2 powers-up in the required state.

7.3.27 SETUP, [UNITS], [AERO]

The current operating limits are changed to the default aeronautical units. These units can be programmed using CONFIG, [UNITS], [AERO].

7.3.28 SETUP, [UNITS], [PRESS]

The current operating limits are changed to the default pressure units. These units can be programmed using CONFIG, [UNITS], [PRESS].

7.3.29 SETUP, [LIMITS]

The ADTS 405 Mk2 is preprogrammed with the manufacturer's STANDARD, CIVIL and MAX limit sets. Different sets of additional limits can be programmed using the CONFIG mode. SETUP, [LIMITS] allows the selection of the set of limits to be used, each set of limits is identified by an aircraft name or component/system number.

- a. Use [NEXT] or [PREV] to step through the aircraft names and when the display shows the required name, press [SEL], then **CLEAR/QUIT**.
- b. Use CONFIG, [LIMITS] to program the sets of limits. Each set of limits includes:
 - Max ALT
 - Min ALT
 - Max CAS
 - Min CAS
 - Max Mach
 - Max ROC
 - Max Rate CAS
 - Max Ps
 - Min Ps
 - Max Qc
 - Min Qc
 - Max Rate Ps
 - Max Rate Qc
 - ARINC limits on or off.
 - Altitude correction value.

The set of limits used at power-up (default) can be selected using CONFIG, [LIMITS], [DEFAULT AIRCRAFT]. The default aircraft set of limits can be locked using CONFIG, [LIMITS], [LOCK AIRCRAFT] so that an operator cannot change the limits.

If the selected set of limits result in the measured pressure values being outside the limits, the display shows the warning message **“OUTSIDE LIMITS GO TO GROUND”** the Ps and Pt channels should be taken to ground or to pressures within the new selected limits. This warning message is also displayed if the pressures measured directly after power-up are outside the limits used at power-up.

After selecting a set of limits, the altitude correction value can be changed using SETUP, ALT. The maximum Mach limit can be changed or turned off using SETUP, MACH.

7.3.30 SETUP, HELP

This function provides help on the setup key.

7.4 CONFIGURATION

1. Any parameters, changed in any mode of **SETUP**, return to the default settings when the system is next switched on. The **CONFIG** mode may be used to change the default settings so that the ADTS 405 Mk2 powers-up in a specified state. Most **SETUP** parameters are also available in **CONFIG**; other parameters are only available in **CONFIG**.
2. Some parameters, changed in setup mode, can be locked in **CONFIG** preventing access. For example, a system used in a servicing procedure for a specific aircraft type can be set to power-up with a specific set of limits that must not be changed. The setup menus can also be locked out or access restricted preventing changes to operating parameters.

7.4.1 Procedure

- a. Holding down **F1** then pressing **SETUP** causes the system to enter **CONFIG** mode. **CONFIG** may be password protected using a four digit PIN. If PIN protected, the display prompts for entry of the PIN. Press each digit of the PIN in turn (**ENTER** is not required) as each digit is entered, an asterisk appears. If an incorrect PIN is entered, the complete PIN is requested again.
- b. When the correct PIN is entered, the **CONFIG** menu appears.
- c. The PIN may be changed using **CONFIG**, **-000**.
- d. To use the configuration menu, press the appropriate function key to select the required menu item. To configure a parameter key, enter configuration menu then press the required parameter key. Each parameter key configuration provides changes to the normal user mode function and to the settings available in the setup menu.
- e. Once a parameter has been changed in configuration, use **CLEAR/QUIT** to return to the previous menu. After all required key parameters have been changed, repeatedly press **CLEAR/QUIT** until the display shows the normal operating mode.

7.4.2 Functions

In the following section, each description of a **CONFIG** function is headed by the menu/key sequence required to select it. Intermediate menus are not described. Many of the functions are equivalent to the setup functions; refer to **SETUP** for the details of the function.

7.4.3 **CONFIG**, [UNITS]

This function allows the default units to be configured.

1. The default [AERONAUTICAL] units are used at power-up for the altitude (and airspeed) display. The default units are also used for the limits entry in **CONFIG** and entry of any altitude or airspeed related functions in **SETUP** or **CONFIG** e.g., airfield altitude or altitude correction.
2. The default [PRESSURE] units are used for limits entry in **CONFIG** and entry of any pressure values in **SETUP** or **CONFIG**.

3. The default [TEMPERATURE] units are used for entry of temperature values in SETUP or CONFIG.
4. The default [AERONAUTICAL] and [PRESSURE] are set in MINIMUM SETUP, [UNITS].

7.4.4 CONFIG, [LIMITS], [EDIT LIMITS], [EDIT EXISTING]

This function allows existing sets of limits to be configured.

- a. Use [NEXT] or [PREV] to select the set of limits by aircraft name or component/system name/number when the display shows the required aircraft limits, press [SEL] to edit the limit values.
- b. Use [NEXT] or [PREV] to step through each limit or associated parameter in turn. Enter a new numeric value to change a limit.
- c. Press **CLEAR/QUIT** when all required changes have been made and select [YES] to save changes.

The ADTS 405 Mk2, when delivered, contains “Standard” and “Civil” limits; to set and store “Max” limits, for the first time, enter configuration. The “Max” limits depend on the range of the pitot channel either 850 or 1000 kts, see Section 1.3, “Operating Limits,” on page 2. The system's defined “STANDARD”, “CIVIL” and “MAX” limit sets cannot be redefined. A defined set can be edited but must be saved using a different name. This method could save time.

The parameters are:

- Name
- Max Alt
- Min Alt
- Max CAS
- Min CAS
- Max Mach
- Max ROC
- Max Rate CAS
- Max Ps
- Min Ps
- Max Qc
- Min Qc
- Max Rate Ps
- Max Rate Qc
- ARINC Limits
- Altitude Correction

7.4.5 NAME

The aircraft name or component/system name/number is used for selecting the set of limits in SETUP or CONFIG. Enter up to 8 characters using 0 to 9, - (minus), (decimal point) and any alphabetic characters in any order or combination.

Chapter 7. Reference

- a. To enter a alphabetic character (A to Z), press [ALPHA] and use the nudge keys to change to the required character. Press [ALPHA] again to enter another alphabetic character.
- b. Press [BACK] to delete the last character. When editing text use the **CLEAR/QUIT** key to cancel editing.

7.4.6 MIN ALT, MAX ALT, MIN CAS, MAX CAS

These are the fundamental aeronautical unit limits.

7.4.7 MAX MACH

This limit only applies in aeronautical mode. It can be used to set a maximum Mach (e.g., Mach 1.05). If a Mach limit is not required, enter a high value (e.g. 10). The Mach limit can be changed or disabled in full setup mode using **SETUP**, [MACH], see Section 7.3.15, "SETUP, MACH," on page 88 for further details on Mach limits.

7.4.8 MAX ROC, MAX RATE CAS

These limits are the maximum rate of change for altitude and airspeed and only apply in aeronautical units.

7.4.9 MIN Ps, MAX Ps, MIN Qc, MAX Qc

These are the fundamental pressure unit limits.

7.4.10 MAX RATE Ps, MAX RATE Qc

These limits are the maximum rate of change for Ps and Qc and only apply in pressure units.

7.4.11 ALTITUDE CORRECTION

The altitude correction value for a specific aircraft may be entered as well as its limits.

The altitude correction value can be changed during operation in full and minimum setup modes using **SETUP**, [ALT]. See Section 7.3.11, "SETUP, ALT," on page 87 for further details on altitude correction.

7.4.12 ARINC LIMITS

1. ARINC 565 operating limits are enabled by setting ARINC LIMITS ON and implemented as shown in Figure 7-1.
2. Due to the shape of the altitude/airspeed envelope, these limits cannot be implemented using the above altitude, airspeed and Mach limits. Using the [ON/OFF] function key select the required ARINC limits ON or OFF.
3. When used in combination with another set of limits, the lower (more restricting) limits apply.

- If ARINC limits are selected and any of the other limits are greater than the values of the ARINC limits a display message requests confirmation that the lower, ARINC limit, is to be used before the limit is saved.

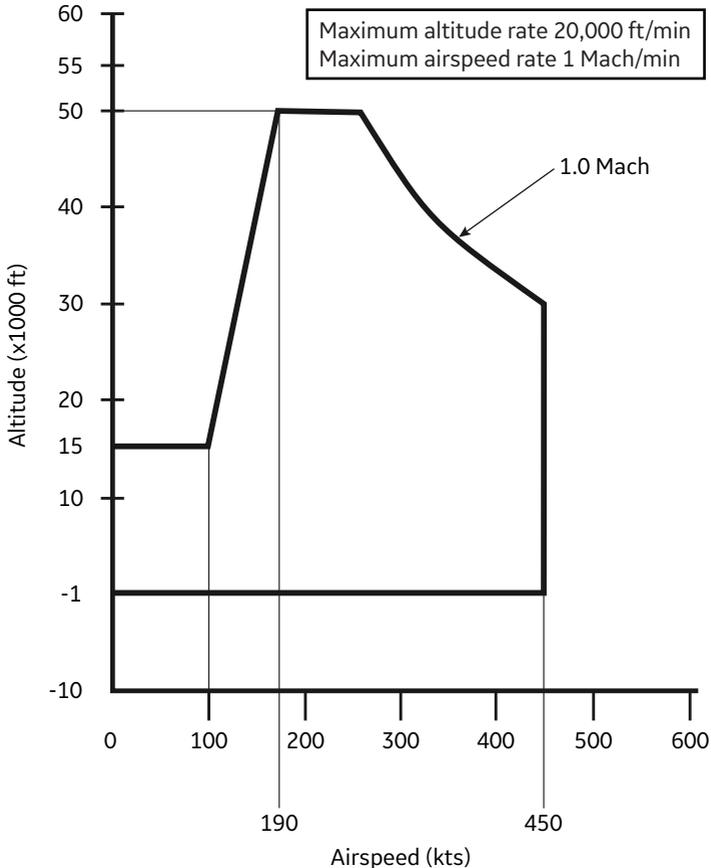


Figure 7-1: ARINC 565 Operating Limits

7.4.13 SAVING LIMITS

When all limits and associated functions are set, press **CLEAR/QUIT** to exit the limit editing screen. If changes have been made, the display shows a request for confirmation before saving the changes. If the system detects any errors (e.g., duplicate aircraft names, values out of range or editing system-defined limits) the display changes to the edit screen for the error to be corrected.

7.4.14 CONFIG, [LIMITS], [EDIT LIMITS], [MAX LIMITS]

This function makes a set of maximum limits; a set of MAX limits can be edited using CONFIG, [LIMITS], [EDIT LIMITS], [EDIT EXISTING] and saved with a new name. This is a quick method

for setting-up a set of limits similar to the maximum system limits. The system displays an error message if MAX limits already exist.

7.4.15 CONFIG, [LIMITS], [EDIT LIMITS], [EDIT NEW]

This function is identical to [EDIT EXISTING] and creates a new set of limits. Default values are taken from "Standard" limits. See [EDIT EXISTING] in Section 7.4.14 for further details.

7.4.16 CONFIG, [LIMITS], [CLEAR LIMITS]

This function clears an existing set of limits. Use [NEXT] or [PREV] to display the name of the limits. Select [SEL] to clear the limits followed by [YES].

7.4.17 CONFIG, [LIMITS], [LOCK AIRCRAFT]

This function prevents changes to the default limits. If lock is [ON], no changes to the power-up default aircraft limits can be made from setup.

7.4.18 CONFIG, [LIMITS], [DEFAULT AIRCRAFT]

This function selects the set of limits used at power-up. Use [NEXT] or [PREV] to display the name of the required limits. Select [SEL].

7.4.19 CONFIG, [MORE], [CONTROL], [CONTROL MODE]

CONFIG equivalent of SETUP function.

7.4.20 CONFIG, [MORE], [DISPLAY/OPTIONS], [DISPLAY TYPE]

CONFIG equivalent of SETUP function.

7.4.21 CONFIG, [MORE], [CONTROL], [CONTROL LOCK]

This function prevents changes to the default CONTROL SETTING. If lock is [ON], no changes to the control channel selection can be made from setup.

7.4.22 CONFIG, [MORE], [DISPLAY/OPTIONS], [DISPLAY TYPE]

CONFIG equivalent of SETUP function.

7.4.23 CONFIG, [MORE], [DISPLAY/OPTIONS], [OPTIONS]

Refer to the option user manuals.

7.4.24 CONFIG, [MORE], [DATE/FORMAT]

This functions allows the display date format to be selected between [MDY] (mm/dd/yy) and [DMY] (dd/mm/yy).

7.4.25 CONFIG, [MORE], [SETUP MODE]

This function enables, disables or limits access to the secondary functions. There are three setup modes:

Table 7-7: Setup Modes

Mode	Description
FULL	This mode provides complete access to all secondary functions when the SETUP key is pressed. All pressure and aeronautical units can be selected.
MINIMUM	This mode provides limited access to the secondary functions when the SETUP key is pressed. This prevents access to error recovery, rate timers etc. Units can only be changed between two preselected types. See Section 7.3 for full details.
OFF	This mode prevents access to all secondary functions.

7.4.26 CONFIG, SPEED, [AUTO ZERO]

CONFIG equivalent of SETUP function.

7.4.27 CONFIG, SPEED, [CAS/TAS]

CONFIG equivalent of SETUP function.

7.4.28 CONFIG, SPEED, [Pt TEMPERATURE]

CONFIG equivalent of SETUP function.

7.4.29 CONFIG, RATE TIMER

CONFIG equivalent of SETUP function.

7.4.30 CONFIG, RATE

CONFIG equivalent of SETUP function.

7.4.31 CONFIG, LEAK MEASURE, [AUTO LEAK ON/OFF]

CONFIG equivalent of SETUP function, see Section 7.2.10, "LEAK MEASURE/CONTROL," on page 76 for details.

7.4.32 CONFIG, LEAK MEASURE, [AUTO LEAK LOCK]

Prevents changes to AUTO LEAK setting in SETUP.

7.4.33 CONFIG, LEAK MEASURE, [AUTO LIMIT ON/OFF]

CONFIG equivalent of SETUP function, see Section 7.2.10, "LEAK MEASURE/CONTROL," on page 76 for details.

7.4.34 CONFIG, LEAK MEASURE, [AUTO LIMIT LOCK]

Prevents changes to AUTO LIMIT setting in SETUP.

7.4.35 CONFIG, GROUND

CONFIG equivalent of SETUP function.

7.4.36 CONFIG, PORT

Refer to the Line Switching Unit User Manual.

7.4.37 CONFIG, REMOTE



INFORMATION Changing between sets of limits can cause damage to sensitive instruments. Entering CONFIG disables lock out. There are two sets of limits: “REMOTE” and “LOCAL”.

This function disables the front panel keypad and allows the ADTS 405 Mk2 to be controlled by a remote device such as a PC. The front panel display shows the “REMOTE” message. To return to “LOCAL” control (keypad) press the **REMOTE/LOCAL** key. The remote device can disable this key.

Some ATE systems may require the ADTS 405 Mk2 set in the remote mode before the remote device starts communicating. If remote lock is disabled, set the ADTS 405 Mk2 while in local control, by pressing the **REMOTE/LOCAL** key.

7.4.38 CONFIG, ETP, [AUTO RUN]

Causes a down-loaded test program to operate (Execute Test Program) on power-up. See the Test Program Manager User Manual for further details.

7.4.39 CONFIG, ETP, [ERASE PROGRAMS]

Removes a down-loaded test program from non-volatile memory. See the Test Program Manager User Manual for further details.

7.4.40 CONFIG, ETP, [RESULT]

1. Configures the PRINT/SAVE mode as in setup mode.
2. Selects and deletes a result file stored in the ADTS 405 Mk2.

7.4.41 CONFIG, NUDGE

CONFIG equivalent of SETUP function.

7.4.42 CONFIG, 000

1. This function enables, changes or disables the CONFIG PIN code protecting access to CONFIG menu.
2. When enabled, the PIN must be entered before it can be changed. The prompt asks for “Enter existing PIN”, then a new PIN can be entered. This must comprise four numeric digits.
3. Once entered, the prompt asks for the new PIN again to protect against data entry errors. To disable the PIN, so that CONFIG can be entered without a PIN, enter 0000.

Note: Access to maintenance functions may also be PIN protected. This PIN number is not the same as the CONFIG PIN.

8. Specification

Table 8-1: Rack-mount ADTS 405R Mk2 Specification

Parameter		Value
Size	Standard 19" rack front panel:	6U high (10.50")
	Depth behind front panel:	255 mm (10.04")
	Rear panel connections available:	Yes
Weight ^a		12 kg (26.5 lb)
EMC		EN 61326-1
Electrical Safety		EN 61010-1
AC Power Supply	Single phase AC in the range (automatic range switching):	100/120/230 V, 50/60 Hz 115 V, 400 Hz
	Power:	400 VA
	Installation Category:	II
	Fuse:	T5AH250V
DC Power Supply	Supply range:	16 to 30 V
	Power:	400 VA
	Fuse:	Not user serviceable.
Operating Environment		Indoor use.
Operating Altitude		Up to 4,570 metres (15,000 ft)
Operating Temperature		-20°C to 50°C (-4°F to 122°F)
Storage and Shipping Temperature		-51°C to 70°C (-60°F to 158°F)
Ingress Protection		IP23
Operating Humidity		0 to 95% RH (non-condensing)
Pollution Degree		3
Pressure Safety	Pressure Equipment Directive Class:	Sound Engineering Practice (SEP)
Shock and Vibration		ETSI EN 300 019-2-5 Class 5.1 Ground Vehicle Installations. Test method: EN 60068-2-64 Random Vibration.
Pressure Fittings	Ps:	MS33656-6
	Pt:	MS33656-4
	Pressure Supply:	MS33656-4
	Vacuum Supply:	MS33656-6

a. Nominal value. Actual value may vary due to configured optional extras.

Table 8-2: Flight-line ADTS 405F Mk2 Specification

Parameter		Value
Size ^a	Height:	463 mm (18.22")
	Length:	781 mm (30.73")
	Width:	331 mm (13.03")
Weight ^a		33.5 kg (73.9 lb)
EMC		EN 61326-1 MIL-STD-461F (Extended environment)
Electrical Safety		EN 61010-1
AC Power Supply	Single phase AC in the range (automatic range switching):	100/120/230 V, 50/60 Hz
		115 V, 400 Hz
	Power:	500 VA
	Installation Category:	II
	Fuse:	T5AH250V
DC Power Supply	Supply range:	16 to 30 V
	Power:	500 VA
	Fuse:	T20AH250V (left) T32AH250V (right)
Operating Environment		Indoor and outdoor use.
Operating Altitude		Up to 4,570 metres (15,000 ft)
Operating Temperature	Standard Range	-20°C to 50°C (-4°F to 122°F)
	Extended Range	-40°C to 55°C (-40°F to 131°F)
Storage and Shipping Temperature		-51°C to 70°C (-60°F to 158°F)
Operating Humidity		0 to 95% RH (non-condensing)
Pollution Degree		3
Pressure Safety	Pressure Equipment Directive Class:	Sound Engineering Practice (SEP)
Shock and Vibration		ETSI EN 300 019-2-5 Class 5.1 Ground Vehicle Installations. Test method: EN 60068-2-64 Random Vibration.
Pressure Fittings	Ps:	MS33656-6
	Pt:	MS33656-4

a. Nominal value. Actual value may vary due to configured optional extras.

8.1 Pressure/Vacuum Requirements

See Safety and Installation Guide 124M8686.

8.2 Warm-up Requirements

If the ADTS 405 Mk2 temperature has stabilized within the operating temperature range before switching on, the test set requires a warm-up period of 15 minutes to achieve the stated accuracy.

8.3 Measurement and Control Range Specifications



WARNING This equipment is not rated for use in potentially explosive and hazardous atmospheres.

8.3.1 Operating Range and Performance

The ADTS 405 Mk2 is supplied in one of two full-scale ranges (850 or 1000 kts) for measurement and control of the pitot pressure channel. The following operating parameters are based on a 1000 kts capability test systems. Variations for 850 kts test systems are shown, where appropriate, in brackets.

For both full-scale ranges, limits are set predefined tabular limits known as STANDARD, CIVIL and MAX* these can be selected through the SETUP menu.

* The ADTS is supplied without MAX limits, a prompt in the SETUP limits menu asks for MAX limits to be created. This function automatically loads the maximum values appropriate for the full-scale range.

Chapter 8. Specification

Operators may also configure the display to aeronautical or pressure units but should be aware that when units of pressure are selected, wider full-scale pressure limits will be enabled for some parameters.

Table 8-3: Performance Expressed in Aeronautical Units

Parameter	Altitude	Rate of Climb (ROC)	Calibrated Airspeed (CAS)	Mach	Rate of change of Airspeed
Units	feet	ft/min	kts	-	kts/min
Maximum Range ^a	-3000 to 105,000	100,000	-100 to 1000	14.97	2000
Calibrated or Standard Range ^a	0 to 80,000	9,000	-100 to 1000	5	700
Accuracy ^b	±3 at 0 ±7 at 30,000 ±29 at 60,000	±1% of value	±0.5 at 50 ^c ±0.07 at 550 ±0.05 at 1000	Better than 0.005	±5% of value
Resolution	1	1	0.1	0.001	0.1

- Altitudes above 80,000 ft and the peak rates of climb are available but subject to the use of a suitable vacuum pump.
- Accuracy, (expanded uncertainty K=2); includes non-linearity, hysteresis and repeatability over full temperature range, 12 months drift and calibration standard uncertainty.
- The accuracy figures stated assume that the auto-zero function is enabled.

Table 8-4: Static and Pitot Performance Expressed in Pressure Units

Parameter	Static (Ps)	Rate Ps	Pitot (Pt) 1000 kts	Pitot (Pt) 850 kts
Units	mbar abs	mbar/min	mbar abs	mbar abs
Maximum Range ^a	3 to 1355	10,000	3 to 3500	3 to 2700
Calibrated or Standard Range ^a	35 to 1355	200	35 to 3500	35 to 2700
Accuracy ^b	±0.1	±1% within 5 seconds	0.26 mbar	0.20 mbar
Resolution	0.01	0.01	0.01	0.01

- Pressures below 35 mbar absolute and the peak rates of change are available but subject to the use of a suitable vacuum pump.
- Accuracy, (expanded uncertainty K=2); includes non-linearity, hysteresis and repeatability over full temperature range, 12 months drift and calibration standard uncertainty.

Table 8-5: Qc, Rate Qc and EPR Performance Expressed in Pressure Units

Parameter	Differential (Qc) 1000 kts	Differential (Qc) 850 kts	Rate Qc	EPR
Units	mbar diff	mbar diff	mbar/min	-
Maximum Range ^a	-1352 to 3377	-1352 to 2700	10,000	0.1 to 10
Calibrated or Standard Range ^a	-1320 to 2500	-1320 to 1700	200	0.1 to 10
Accuracy ^b	RSS of Ps and Pt	RSS of Ps and Pt ^c	±1%	Better than 0.005
Resolution	0.01	0.01	0.01	0.001

- Pressures below 35 mbar absolute and the peak rates of change are available but subject to the use of a suitable vacuum pump.
- Accuracy, (expanded uncertainty K=2); includes non-linearity, hysteresis and repeatability over full temperature range, 12 months drift and calibration standard uncertainty.
- The accuracy figures stated assume that the auto-zero function is enabled.

8.4 Control Performance

8.4.1 Stability

The ADTS 405 Mk2 provides stable pressure values at the outlet ports and continues to control smoothly without oscillation into volumes of up to 17 litres (1,000 cubic inches) on Ps and a volume of up to 10 litres (600 cubic inches) on Pt at rates up to 6,000 ft/min. Lower volumes enable higher rates of change to be achieved.

The following are the figures based on a 40 ppm of Ps full-scale or Qc full-scale over a bandwidth of 0.1 to 1.5 Hz and using RMS values. Below are shown the two Qc ranges used by the ADTS 405 Mk2.

Table 8-6: Controller Stability

Channel	Pressure Range	Controller Stability
Ps	1,355 mbar (40 inHg)	±0.038 mbar (±0.0011 inHg)
Qc	1,700 mbar (50 inHg)	±0.045 mbar (±0.0014 inHg)
Qc	2,500 mbar (74 inHg)	±0.070 mbar (±0.0021 inHg)

8.4.2 Rate Control

The ADTS 405 Mk2 operates in both aeronautical rates and pressure rates, e.g. ft/min and mbar/min and controls Ps, Pt and Qc parameters in either aeronautical or pressure units.

Chapter 8. Specification

The following are possible:

Table 8-7: Rate Control Capabilities

Channel	Rate Control Capabilities
Ps	ft/min or metres/min - maximum rate 100,000 ft/min Absolute pressure units/min
Pt	Absolute pressure units/min
Qc	kts/min or km/h/min - maximum rate 2,000 kts/min Differential pressure units/min

Using a single vacuum pump, a rate of 20,000 ft/min can be achieved with a volume of 10 litres (600 cubic inches) connected to the static (Ps) channel and 6.7 litres (400 cubic inches) connected to the pitot (Pt) channel.

8.4.3 Control Response

The required operating pressure value will be achieved without any overshoot, independent of the system volume, on either Ps or Pt channels. The system response to input commands takes place within a 400 millisecond period.

8.4.4 Dynamic Testing

The ADTS 405 Mk2 can generate sinusoidal variations of either the Ps or Pt or both channels. Frequency and amplitude of the required oscillation can be programmed; external volumes limit the achievable results. Maximum drift from the mean value during dynamic testing should be no more than twice that specified for steady state testing.

8.4.5 Control Offset

The displayed value will be within the control stability values for the appropriate channel.

Appendix A. Menu

Table A-1: Menu Hierarchy Key

Nomenclature	Description
	Example key press on keypad display.
	Simultaneous key press on keypad display. In this example, press and hold the F1 key, and press the SETUP key to enter the CONFIG menu.
[NEXT]	Item in soft menu, keys labeled F1 to F4.
(SINGLE, DOUBLE, ...)	Sequence of parameters selected by [NEXT] key.
(aircraft1, aircraft2, ...)	Sequence of names selected by [NEXT] key.
data entry	Enter number from keypad.

A.1 Full Setup Menu

Key/selection	Function and Comments
SETUP	Enters the SETUP menu.
[Units]	Select displayed units.
[NEXT]	Step through available units.
[PREV]	As [NEXT], but in reverse order.
[SAVE]	Select displayed units.
[Limits]	Select set of limits.
[NEXT]	(aircraft 1, aircraft 2, ...)
[PREV]	As [NEXT], but in reverse order.
[SEL]	Select displayed limit set.
[Oscillation]	Oscillate about aim.
[Ps]	For Ps channel.
[Start Ps Osc]	Start the Ps channel oscillation.
[Stop Ps Osc]	Stop the Ps channel oscillation.
[Freeze Ps Osc]	Freeze the Ps channel oscillation.
[Ps Osc Ampl/Freq]	Ps channel oscillation amplitude and frequency.
[AMPL]	Oscillation amplitude in current units.
[FREQ]	Frequency of oscillation in Hz.
[data entry]	
[data entry]	
[Pt]	See [Ps] for menu hierarchy.
[More]	
[Control]	Selects Ps only, Pt only or dual channel control.
[Ps]	
[Pt]	
[DUAL]	
[Displays/Options]	
[Display Type]	Select single, dual or triple display. (SINGLE, DUAL, TRIPLE, ENCODER, ...)
[NEXT]	As [NEXT], but in reverse order.
[PREV]	As [NEXT], but in reverse order.
[SAVE]	Save display type.
[I/O Setup]	Configure Ethernet.
[ENET SUPER]	Supervisor node Ethernet parameters.
[-]	DHCP option not available, see CONFIG menu.
[Fixed IP]	Setup fixed IP address.
[ADDR]	IP address.
[MASK]	Subnet mask.
[BCST]	Broadcast address.
[Show active]	Confirm active IP settings.
[ENET COMMS]	Communications node Ethernet parameters.
[-]	DHCP option not available, see CONFIG menu.
[-]	Fixed IP option not available, see CONFIG menu.
[Show active]	Confirm active IP settings.
[Options]	See option manual.
[Close O/P Valves]	Close ADTS output valves.
[System Self Test]	Start ADTS self-test.

Key/selection	Function and Comments
	<p>Enters the SETUP menu.</p>
 <ul style="list-style-type: none"> <li>[System Date/Time] <li>└─ [DATE] <li> └─ data entry <li>└─ [TIME] <li> └─ data entry 	<p>Set the ADTS date and time. ADTS system date.</p> <p>ADTS system time.</p>
 <ul style="list-style-type: none"> <li>[Print/Save] <li>└─ [PRN] <li>└─ [SAV] <li>└─ [Print file] <li>└─ [NEXT] <li>└─ [PREV] <li>└─ [PRN] 	<p>Choose destination for results data. Print results data. Save results data to file. Print results file options. Step through available results files. As [NEXT], but in reverse order. Print the selected results file.</p>
	<p>Help on SETUP menu.</p>
 <ul style="list-style-type: none"> <li>data entry <li>└─ [NEXT] 	<p>Enter nudge increment, e.g. 2 ft. Select the nudge value for: When in aeronautical units: Altitude, CAS/TAS, Mach, ROC, Rate CAS, Rt Mach. When in pressure units: Ps, Pt, Qc, EPR, Rate Ps, Rate Pt, Rate Qc, Rate EPR. As [NEXT], but in reverse order.</p>
 <ul style="list-style-type: none"> <li>└─ [PREV] 	<p>See SETUP + ▲ for menu hierarchy.</p>

A.2 Minimum Setup Menu

Key/selection	Function and Comments
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SETUP	Enters the SETUP menu.
├─ [Units Type]	Select units type.
│ └─ [AERO]	Select aeronautical units.
│ └─ [PRESS]	Select pressure units.
├─ [Limits]	Select set of limits.
│ └─ [NEXT]	(aircraft 1, aircraft 2, ...)
│ └─ [PREV]	As [NEXT], but in reverse order.
│ └─ [SEL]	Select displayed limit set.
└─ [More]	
└─ [Control]	Selects Ps only, Pt only or dual channel control.
└─ [Ps]	
└─ [Pt]	
└─ [DUAL]	

SETUP	Enters the SETUP menu.
├─ ALT Ps	Altitude correction value.
├─ PORT	See Line Switching Unit user manual.
└─ HELP	Help on SETUP menu.

A.3 Configuration Menu

Key/selection	Function and Comments
---------------	-----------------------

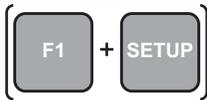


Enters the CONFIG menu.

[Units]	
[Aeronautical]	Sets the default aeronautical units.
[NEXT]	Step through available units.
[PREV]	As [NEXT], but in reverse order.
[DEF]	Select the default aeronautical units.
[SAVE]	Save the selected units.
[Pressure]	Sets the default pressure units.
[NEXT]	Step through available units.
[PREV]	As [NEXT], but in reverse order.
[DEF]	Select the default pressure units.
[SAVE]	Save the selected units.
[Temperature]	Sets the default temperature units.
[°C]	
[°F]	
[Limits]	Configure sets of limits.
[Edit limits]	Change limit values.
[Edit existing]	Change existing limit values.
[NEXT]	(aircraft 1, aircraft 2, ...)
[PREV]	As [NEXT], but in reverse order.
[SEL]	Select limit item to edit.
[NEXT]	Step through available limit items: Name, Max Altitude, Min Altitude, Max CAS, Min CAS, Max Mach, Max ROC, Max Rate CAS, Max Ps, Min Ps, Max Qc, Min Qc, Max Rate Ps, Max Rate Qc, ARINC limits, Alt Correction.
[PREV]	As [NEXT], but in reverse order.
[ALPHA]	Inserts an alphabet character into limit name.
▲	Select the next letter in the alphabet.
▼	Select the previous letter in the alphabet.
[BACK]	Delete last character in limit name.
[ON]	Turn on ARINC 565 limits.
[OFF]	Turn off ARINC 565 limits.
data entry	Enter numerical limit value.
[Max limits]	Creates a new set of maximum limits called "MAX".
[Edit new]	Creates a new set of limit values. See [Edit Existing] for menu hierarchy.
[Clear Limits]	Clear an existing set of limits.
[NEXT]	(aircraft 1, aircraft 2, ...)
[PREV]	As [NEXT], but in reverse order.
[SEL]	Clear the selected limits.
[YES]	Confirm delete.
[NO]	Cancel delete.

Key/selection

Function and Comments



Enters the CONFIG menu.

[Limits]

Configure sets of limits.

[Lock aircraft]

Prevents changes to aircraft limits.

[ON]

Turn on to make SETUP menu limits readonly.

[OFF]

[Default aircraft]

Prevents changes to aircraft limits.

[NEXT]

(aircraft 1, aircraft 2, ...)

[PREV]

As [NEXT], but in reverse order.

[SEL]

Select aircraft limits used at power-up.

[More]

[Control]

Selects Ps only, Pt only or dual channel control.

[Control mode]

[Ps]

[Pt]

[DUAL]

[Control lock]

Prevents the SETUP menu from changing the control mode.

[ON]

[OFF]

[Displays/options]

[Display type]

Select single, dual or triple display.

[NEXT]

(SINGLE, DUAL, TRIPLE, ENCODER, ...)

[PREV]

As [NEXT], but in reverse order.

[SAVE]

Save display type.

[I/O Options]

Configure the Ethernet settings.

[ENET SUPER]

Supervisor node Ethernet parameters.

[DHCP]

Enables DHCP client.

[Fixed IP]

Setup fixed IP address.

[ADDR]

IP address.

[MASK]

Subnet mask.

[BCST]

Broadcast address.

[Show active]

Confirm active IP settings.

[ENET COMMS]

Communications node Ethernet parameters. See [ENET SUPER] for menu hierarchy.

[Options]

See option manual.

[Date format]

Format of date text.

[DMY]

UK format, i.e. DD/MM/YY.

[MDY]

US format, i.e. MM/DD/YY.

[SETUP mode]

Limits access of SETUP menu functions.

[OFF]

Disables the SETUP menu.

[MIN]

Shows the minimum SETUP menu.

[FULL]

Shows the full SETUP menu.

Key/selection **Function and Comments**

<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 10px;">F1</div> + <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 10px;">SETUP</div>	<p>Enters the CONFIG menu.</p>
<p>SPEED Qc</p> <ul style="list-style-type: none"> [Auto zero] <ul style="list-style-type: none"> [ON] [OFF] [CAS / TAS] <ul style="list-style-type: none"> [CAS] [TAS] [Pt temperature] <ul style="list-style-type: none"> data entry 	<p>Auto zero function.</p> <p>Select between calibrated or true airspeed. Calibrated airspeed. True airspeed. Temperature for true airspeed. Enter pitot temperature.</p>
<p>RATE TIMER</p> <ul style="list-style-type: none"> [Wait/time on F1] <ul style="list-style-type: none"> [TIME] <ul style="list-style-type: none"> data entry [WAIT] <ul style="list-style-type: none"> data entry [Wait/time on F2] [Wait/time on F3] 	<p>Leak test WAIT and TIME for F1 preset. Duration of leak test. Change duration time entry. Wait time before start of leak test. Change wait time entry. See [Wait/Time on F1] for menu hierachy. See [Wait/Time on F1] for menu hierachy.</p>
<p>RATE</p> <ul style="list-style-type: none"> [ON] [OFF] 	<p>Automatic airspeed rate control. Manual airspeed rate control.</p>
<p>LEAK MEASURE CONTROL</p> <ul style="list-style-type: none"> [Auto leak on/off] <ul style="list-style-type: none"> [ON] [OFF] [Auto leak lock] <ul style="list-style-type: none"> [ON] [OFF] [Auto limit on/off] <ul style="list-style-type: none"> [ON] [OFF] [Auto limit lock] <ul style="list-style-type: none"> [ON] [OFF] 	<p>Automatic leak recovery.</p> <p>Allow auto leak recovery in SETUP menu.</p> <p>Automatic limit recovery.</p> <p>Allow auto limit recovery in SETUP menu.</p>
<p>GROUND</p> <p>data entry</p>	<p>Station altitude.</p>
<p>PORT</p>	<p>See Line Switching Unit user manual.</p>

Appendix B. Errors and Warnings

B.1 Error Messages

The following table lists the ADTS 405 Mk2 error messages:

Table B-1: Error Messages

Number	Message	Hexadecimal Code
515	PSU NO LONGER READY	
516	UNKNOWN CONTROLLER ERROR	
517	RING TIME OUT	
601	INTERNAL RAM ERROR	
603	ERROR WRITING TO EEPROM	
701	Ps SELF-TEST ERROR	✓
702	Pt SELF-TEST ERROR	✓
703	Ps SELF-TEST TIME OUT ERROR	
704	Pt SELF-TEST TIME OUT ERROR	
710	Ps CONTROLLER ERROR	✓
711	Ps CONTROLLER ERROR	✓
712	Ps CONTROLLER ERROR	✓
713	Ps CONTROLLER ERROR	✓
714	Ps CONTROLLER ERROR	✓
717	Ps CONTROLLER ERROR	✓
720	Pt CONTROLLER ERROR	✓
721	Pt CONTROLLER ERROR	✓
722	Pt CONTROLLER ERROR	✓
723	Pt CONTROLLER ERROR	✓
724	Pt CONTROLLER ERROR	✓
727	Pt CONTROLLER ERROR	✓
801	IEEE488 DRIVER FAILED TO OPEN	
802	IEEE488 DRIVER FAILED TO RESET	
900	INTERNAL SOFTWARE	
999	INTERNAL ERROR	

B.2 Warning Messages

The following table lists the ADTS 405 Mk2 warning messages with the possible cause and action to be taken:

Table B-2: Warning Messages

Number	Message	Probable Cause	Action
2	INVALID USER INPUT	The numeric value entered was outside the allowed range.	Re-enter value within allowed range.
3	OPERATE CAL ENABLE ON STATUS PANEL	Calibration started before removing calibration enable plate on the front panel	Refer to main fault finding chart in the service manual.
4	ONLY VALID IN CONTROL MODE	Selection not allowed in Leak measure mode.	Select controller on.
210	Ps SOFT START TIMEOUT	The Ps controller has failed to go into control mode.	Select CONTROL again. If fails again, refer to main fault finding chart in the service manual.
212	Ps PRESSURE FAIL	The Ps controller has detected loss of supply pressure and automatically switched all channels to measure mode. This can occur at very high rates of pressure change in large volume systems if the pumps cannot produce enough pressure.	Restore pressure supply BEFORE going to control mode again. Refer to main fault finding chart in the service manual.
213	Ps VACUUM FAIL	The Ps controller has detected loss of supply vacuum and automatically switched all channels to measure mode. This can occur at very high rates of pressure change in large volume systems if the pumps cannot produce enough vacuum.	Restore vacuum supply BEFORE going to control mode again. Refer to main fault finding chart in the service manual.
220	Pt SOFT START TIMEOUT	The Pt controller has failed to go into control mode.	Select CONTROL again. If fails again, refer to main fault finding chart in the service manual.

Table B-2: Warning Messages

Number	Message	Probable Cause	Action
222	Pt PRESSURE FAIL	The Pt controller has detected loss of supply pressure and automatically switched all channels to measure mode. This can occur at very high rates of pressure change in large volume systems if the pumps cannot produce enough pressure.	Restore pressure supply BEFORE going to control mode again. Refer to main fault finding chart in the service manual.
223	Pt VACUUM FAIL	The Pt controller has detected loss of supply vacuum and automatically switched all channels to measure mode. This can occur at very high rates of pressure change in large volume systems if the pumps cannot produce enough vacuum.	Restore vacuum supply BEFORE going to control mode again.
301	LEAK RATE TOO HIGH REGAINING CONTROL	Control mode automatically regained for aircraft safety as leak rates too high.	Correct leak and retest.
302	OUTSIDE LIMITS REGAINING CONTROL	Control mode automatically regained for aircraft safety as the measures values have drifted outside the operating limits due to leaks.	Correct leak and retest. If leak Ps, ensure that normal Qc pressure is applied (e.g. 200 kts to avoid negative airspeed).
303	ZERO OFFSET TOO LARGE	The zero offset measured during auto-zero was outside.	Return to maintenance depot for calibration.
304	INITIALIZING SYSTEM	This only occurs on main system software upgrade.	If message occurs during normal operation, return to maintenance depot.
305	OUTSIDE LIMIT GO TO GROUND	Measured pressure is outside new limits selected or power-up limits.	Control pressure to within limits.
306	SWITCH PUMPS ON	Cannot select control mode with pumps off.	Switch pumps on.
307	COMMUNICATION RING FAULT-PACKET IS CORRUPT	Internal error.	If the fault can be repeated, return to maintenance depot.
308	UPDATING SYSTEM	Software upgrade.	Wait 1 minute.

Appendix B. Errors and Warnings

Table B-2: Warning Messages

Number	Message	Probable Cause	Action
309	CANNOT CONTROL	Failed pump test.	Check system limits.
310	PUMP TEST FAILED	Pump not achieving limits.	Set lower limits.



Office Locations

Australia

Springfield Central

Phone: 1300 171 502
Email: custcare.au@ge.com

India

Bangalore

Phone: 1-800-301-62632
Email: cc.ms.india@bhge.com

Netherlands

Hoevelaken

Phone: +31 334678950
Email: NL.sensing.sales@bhge.com

USA

Boston

Phone: 1-800-833-9438
Email: custcareboston@bhge.com

France

Toulouse

Phone: +33 562 888 250
Email: sensing.FR.cc@ge.com

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K0572 Revision D | English