

# Avro ARJ Panel Version 4.0 for MS FS2004

## Panel Manual



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[Http://www.baepanelproject.com](http://www.baepanelproject.com)

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## 1 Some words about the Avro ARJ Panel Version 4.0

Originally I have only planned to rework version 3.1 with a new overhead panel and a couple of smaller insignificant changes as well as the complete adaptation for FS2004. It was just a gimmick a couple of time ago when I tested different functions of the real autopilot, however, I understood the system with the time and after that it was my goal to realize this Digital Flight Guidance System (DFGS) for the ARJ panel. Since I rework the panel anyway, it was obvious to take this system already into the new version. The effort for this system was, however, so big that I decide not to realize an interim version but a completely new panel. The result is the most complex and most complicated panel what I made till now.

What offers version 4.0 now? Like in the new BAe 146 panel, all systems are realistically converted. The handling of the systems, such as electrical, hydraulics, fuel and pressurization, corresponds almost completely the real cockpit handling. Of course all back-up systems are also realized. This was only possible because I have separated all systems from the standard Flight simulator functions and integrated my completely own systems. With this way I could realize a real battery life time of approx. 20 minutes, a real working APU and a GPU. But take care: Detached from the flight simulator doesn't mean an unlimited life time. All physical restrictions are integrated, i.e. the battery although discharges after 20 minutes if only the battery is in use and the APU only works as long as you have enough fuel in the tanks. If the generators or the APU generator is running you could charge the battery again like in reality.

The DFGS system doesn't operate like the standard autopilot. Like already described above, the DFGS corresponds to the real system why you must part with different habits to control the system correctly. This especially for the autothrottle and the thrust rating panel (TRP). Everything of this system takes getting used to but it corresponds to the real system. Also new is the almost complete functionality of the FADEC system which permanently monitors e.g. the limits of the jet engines and prevents excessive speeds and too high engine temperatures.

Because of the free time and the necessary expenditure, it was unfortunately not possible to realize a new pedestal panel yet. This revision is carried out together with the planned FMS (GNS X). Together with this revision, also the two still missing ND modes Map (Flight plan) and WXR (weather radar) will come. But I finally need something to do for further versions.

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## 2 Installation

Like with all other Flight simulator add-ons it's very important, that you exactly follow this installation description step by step. When you start an aircraft with this panel and something didn't work it's mostly the reason of an overlooked part of the installation manual.

Another reason is, that this panel has a lot of special functions which just could be used when you change some parts also in the aircraft.cfg. Everything you have to do is precisely described in this section.

**Do not install the Panel and all files of this Panel when the Flight Simulator is running. First exit FS2004 and then follow the next steps!**

**Another very important thing is NOT to use any automatic Flightsim addon installers or any program which unzips all files automatically to the correct folders!**

### 2.1 Installation of the Panel

- Unzip all files of the Panel.zip into the panel folder of your Avro ARJ aircraft.
- Unzip all files of the Gauges.zip into the gauges folder of your FS2004.

Take care, that you also unzip the file ML\_ARJv40.cab into the gauges folder. Do not unzip the cab file itself. The Flight Simulator unzips this cab file automatically when he needs it. Just take care, that the file is in your gauges folder!

Also very important is to unzip the file ML\_ARJv40.cfg, which is in the gauges.zip, into the gauges folder. This file is necessary for the sounds which are played from the gauges. A separate \*.dll file is no longer needed.

- Unzip Sounds.zip into the main sound directory of the Flight Simulator. **Do NOT use the Sound folder of the Aircraft!**

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### 2.1.1 Installing the Panel files for Aircraft with Virtual Cockpits

Since a short time also Avro ARJ's with virtual cockpits are available. As it doesn't look very nice having both views, my inside views and the virtual cockpit (VC), I've included a separate panel.cfg for aircraft models which have a VC. This separate file deletes my inside views, so you just have the 2D panel and the virtual cockpit which is shipped with the aircraft.

The installation is the same as described above. After you have unzipped all files, delete the panel.cfg from your panel folder and rename the file "Aircraft with VC panel.cfg" into panel.cfg. That's all.

### 2.1.2 Preparing your Avro ARJ for this Panel

Because of the complexity of this panel it was necessary to make some changes in the aircraft.cfg and airfile. This especially for the complete DFGS system. When you don't change the flight dynamics, it could be that this system (autopilot, autothrottle and FADEC) don't work and you overheat the engines. But the replacement of the flight dynamics are also important for other things like flaps, fuel, electricity and others.

I've included replacement files for all available Avro ARJ's. The included replacement files are:

Jon Murchison 146-200 Airfiles.ZIP	Replacement FDE files for Jon Murchison's BAe 146-200 (Avro RJ85) aircraft.
Jon Murchison 146-200QT Airfiles.ZIP	Replacement FDE files for Jon Murchison's BAe 146-200 QT (Avro RJ85 freighter) aircraft.
Jon Murchison 146-300 Airfiles.ZIP	Replacement FDE files for Jon Murchison's BAe 146-300 (Avro RJ100) aircraft.
Jon Murchison 146-300QT Airfiles.ZIP	Replacement FDE files for Jon Murchison's BAe 146-300 QT (Avro RJ100 freighter) aircraft.
Jon Murchison 146STA Airfiles.ZIP	Replacement FDE files for Jon Murchison's BAe 146 STA aircraft.
Mike Stone 146-200 Airfiles.ZIP	Replacement FDE files for Mike Stone's BAe 146-200 (Avro RJ85) aircraft.
Paul Hannity 146-200 Airfiles.ZIP	Replacement FDE files for Paul Hannity's BAe 146-200 (Avro RJ85) aircraft.
Paul Hannity 146-300 Airfiles.ZIP	Replacement FDE files for Paul Hannity's BAe 146-300 (Avro RJ100) aircraft.



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Before installing those files please check which model you use. Now make a backup of the already existing aircraft.cfg and the \*.air file in your Avro ARJ aircraft folder and unzip the correct replacement files into this folder. If you have installed some further repaints for the models, please don't forget to add them once again in the aircraft.cfg.

Do not use the included replacement flight dynamics with my BAe 146 panel. The reason is, that the BAe 146 has much higher EGT temperatures than the new engines of the Avro ARJ. Of course you must use the same aircraft as the BAe 146 and ARJ models are all the same, but it's important for the panel.

If you found a new aircraft model from another designer and I haven't included replacement FDE's for his model, just drop me a note in the BAe Panel Project forum. Of course I will built a set of flight dynamics for this new model too and upload them on the BAe Panel Project site.

### ***Additional Notes***

The included flight dynamics are just betaversions at the moment. For the FDE's I got a lot of help from Wolfram Beckert and Jacek Simon. However there are still a lot of things to do to create flight dynamics which could be compared to the vreal world dynamics. The work on the FDE's is still in process. As soon as the final version of the dynamics are available, I will upload them as an update on the BAe Panel Project website.

### **2.1.3 Installing the Aircraft Sounds**

This new panel version contents also a set of completely new Avro ARJ and BAe 146 sounds which are created and modified from **Mark Cranston**. Those new sounds could be found in the zip file "Aircraft Sounds.zip" Just unzip all files of this included zip file into the sound folder of your Avro ARJ aircraft. If you have already installed a soundset in this folder, it's necessary to delete all files there before you could install the new sounds. If not, take care at least to replace the maybe existing file sound.cfg.

**That's it. Now you can start FS2004 again.**

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## **3 Panel Description**

### **3.1 The Electric System**

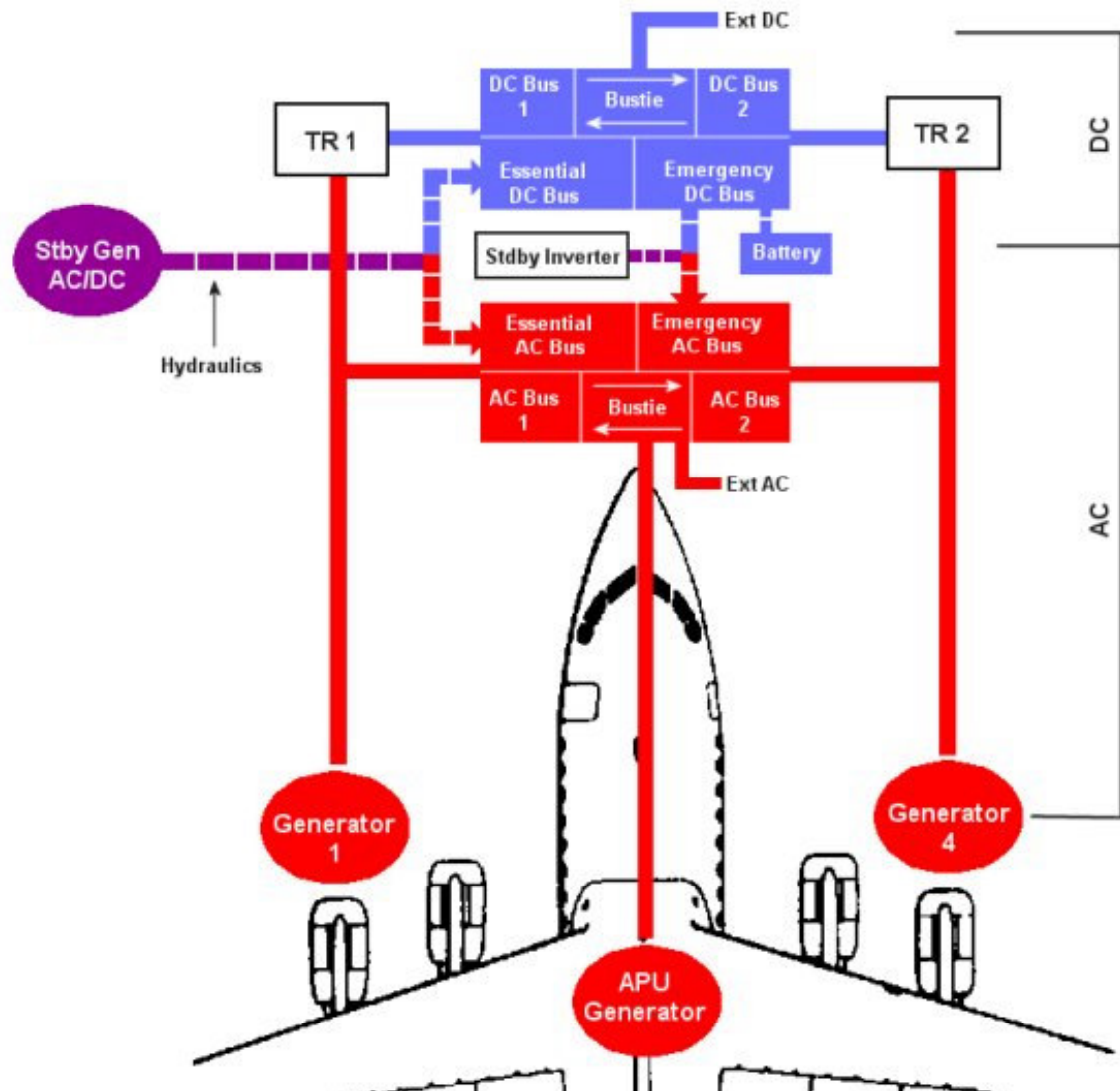
If you've followed the installation closely you remember that you had to put the line "electric\_always\_available = 1" into the aircraft config. Normally this means that you always have electricity no matter if the battery is empty or not. Take care because this doesn't apply to this panel as it comes with an own integrated electrical system. The "electric\_always\_available = 1" has just to be added to disconnect the Avro ARJ panel from the Flightsimulator electricity. You will lost electrical power with this panel regardless of what you have selected in the FS or with FSUIPC.

The complete electrical system based very close to the electrical system of the real ARJ. Because of the fact that I've programmed an own integrated electrical system I could also realize a fully working APU and GPU (not just dummies). Also I could gave both integrated Batteries a lifetime of about 20 minutes.

As written, all systems base very closely on the real aircraft. If there were any deviations to the real thing I wrote it in this manual. So you have a good possibility to compare all functions with the real Avro ARJ.



### 3.1.1 Electrical System Overview



The above picture (based on the real ARJ) gives an overview of the complete electrical system and shows which busses are fed from which electrical source. Version 4.0 of the Avro ARJ panel contents now all of the pictured busses and sources and it is possible to see the coherences and how they work together.

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Some technical background:

*All following descriptions based on the real Avro ARJ and are fully implemented in version 4.0 of the ARJ panel.*

The main electrical power source is a 40 kVA integrated-drive AC generator on each outboard engine. An identical generator is also driven by the APU (APU generator). This AC is fed to two busbars from which the AC services are taken. It is also fed two TR's (transformer/rectifiers) which convert it to 28V DC for the two DC busbars.

Both AC and DC busbars can be tied together with the AC and DC bus ties. If the bus tie switches are set to "Auto" and just engine 1 is running and the generator of engine 1 is on, AC 2 and DC 2 are provided with electrical power via the bus ties from AC 1 and DC 1.

In normal mode the essential AC (SAC) and DC (SDC) bus is provided with electrical power from AC 1 and DC 1. If generator 1 and generator 2 faults the essential bus has another electrical source. A hydraulically driven (and thus not time limited) standby generator provides 5 kVA of AC power and 50 amps DC and this will power the essential and emergency AC and DC busbars. The standby generator required a running engine 3 and working hydraulic pump of engine 3. It is not possible to feed the standby generator just with engine 2 and an opened PTU valve as the standby generator needs at least a pressure of 2800 psi and the PTU just allows a transfer of 2600 psi from engine 2.

The final backup, if the standby generator also has failed, is from the aircraft batteries. This DC source (MDC) will supply a solid state standby inverter for emergency AC (MAC). All other busses are isolated now and only the emergency servitudes are available. MAC is just activated if the standby inverter switch is set to "Arm".

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### 3.1.2 Electrical allocation of the gauges

#### Hot Battery Bus

- Clock
- Battery Ammeter

#### Emergency AC Bus (MAC)

- ADF
- Yellow Brake Pressure Indicator
- Altimeter
- DBI (RMI)

#### Essential AC Bus (SAC)

- Rotary Beacon Light
- Landing Lights
- Taxi Lights
- Left main pitot heat
- Automatic Pressurization
- Temperature indicators
- Nav 1 (Battery 1 as backup)
- Transponder
- Comm 2
- PFD
- ND
- Altimeter
- Flap Indicator
- Engine Vibration Indicators
- EGPWS and Pullup Warning Light
- Windshear Caution and Warning

#### Battery Bus

- Antiskid (if in Battery mode)
- DC pump (if in Battery mode)

#### Emergency DC Bus (MDC)

- Aux pitot heat
- Pitot heat annunciators
- Engine Air 2 and 3 Valve
- APU Air Valve
- Pack 1 and 2
- Manual Pressurization
- Common Feed Valves
- Comm 1
- Standby Attitude
- Combined Altimeter / Airspeed
- Stall Ident Valve Annunciators
- N2
- EGT
- Fuel Quantity

#### Essential DC Bus (SDC)

- Navigation Lights (see also GPU)
- Cockpit Flood Lights
- Engine Anti-ice Annunciators
- Pack Annunciators
- Feed Tank Indicators
- Nav 2
- OAT
- Oil temp / Oil Pressure
- N1
- Fuelflow

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**AC Bus 1**

- Panel and Instrument Lights (also MDC when Flight Deck emergency lights are armed or on)
- Engine 1 and 3 electrical fuel pump valves
- TCAS / VSI
- Autopilot / Autothrottle
- Flight Deck auto temperature control
- Flight Deck manual temperature control
- Cabin manual temperature control

**AC Bus 2**

- Strobes
- Logo Lights
- Right main pitot heat
- Engine 2 and 4 electrical fuel pump valves
- Green Brake Pressure Indicator
- Flight Deck Fan
- Cabin Fan
- Cabin auto temperature control

**DC Bus 1**

- Engine Anti-ice 1 and 3
- Engine Air 1 Valve
- Inner Wing Anti-ice Valve
- Left standby pump
- Spoiler Indicators
- Yaw Damper

**DC Bus 2**

- Engine Anti-ice 2 and 4
- Engine Air 4 Valve
- Outer Wing Anti-ice Valve
- X-Feed Valve
- Right standby pump
- Fuel Temp Indicator
- Fasten Seat Belt
- No Smoking
- Gear Indicators
- Antiskid (if not in Battery mode)
- TRP

**Additional Notes**

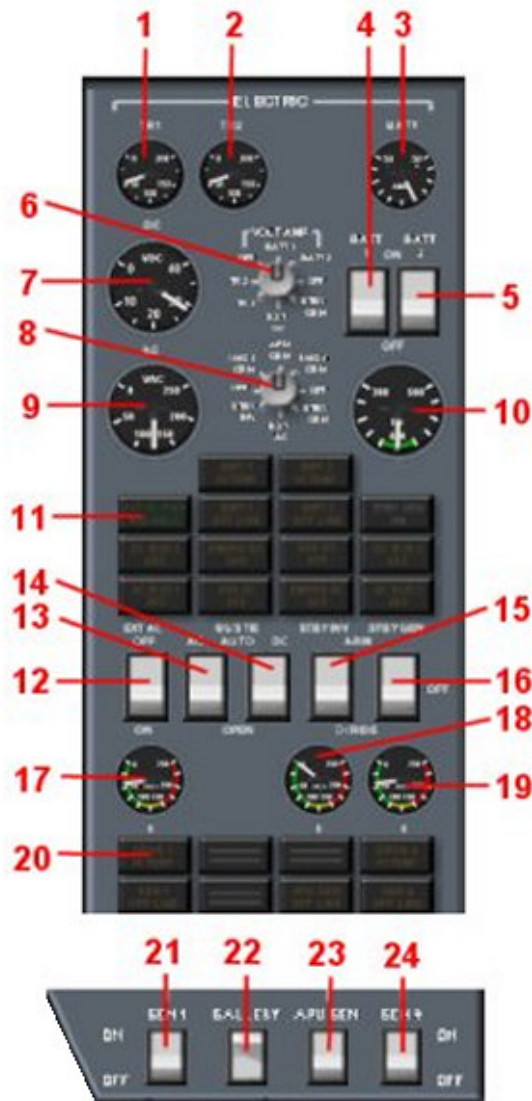
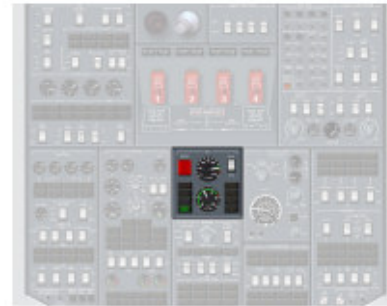
The MWS and AFGS annunciators have different electrical sources. You will find them in the corresponding chapter of this manual.

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### 3.1.3 Activation of the Electrical Busses

Hot Battery Bus	The Hot Battery Bus is always available as long as the Battery is full.
Battery Bus	The Battery Bus is available when Battery 1 and/or Battery 2 is switched on.
Emergency AC Bus (MAC)	The MAC Bus is available when the Battery Bus, the Generators, the APU or the GPU is available and the standby Inverter is switched on.
Emergency DC Bus (MDC)	The MDC Bus is available when the Battery Bus, the APU, the GPU, DC1 or SDC is available.
Essential AC Bus (SAC)	The SAC Bus is available when AC 1, the APU or the GPU is available. SAC is also available when the green hydraulic system is available and the Standby Generator is switched on.
Essential DC Bus (SDC)	The SDC Bus is available when the APU, the GPU or Generator 1 is available. SDC is also available when Generator 4 together with the DC Bustie switch is on or when the green hydraulic system is available and the Standby Generator is switched on.
AC 1 Bus	AC 1 is available when the APU, the GPU or Generator 1 is available. AC 1 is also available when Generator 4 is available and the AC Bustie switch is on.
AC 2 Bus	AC 2 is available when the GPU or Generator 4 is available. AC 2 is also available when the aircraft is on ground and the APU is on or when Generator 1 is available and the AC Bustie switch is on.
DC 1 Bus	DC 1 is only available when the start power switch is not set to cold. Then DC 1 is available when the APU, the GPU or AC 1 is available or when Generator 4 is available and the DC Bustie switch is on.
DC 2 Bus	DC 2 is only available when the start power switch is not set to cold. Then DC 2 is available when the GPU or AC 2 is available or when Generator 1 is available and the DC Bustie switch is on. DC 2 is also available when the aircraft is on ground and the APU is available.

### 3.1.4 The Electric and APU Unit



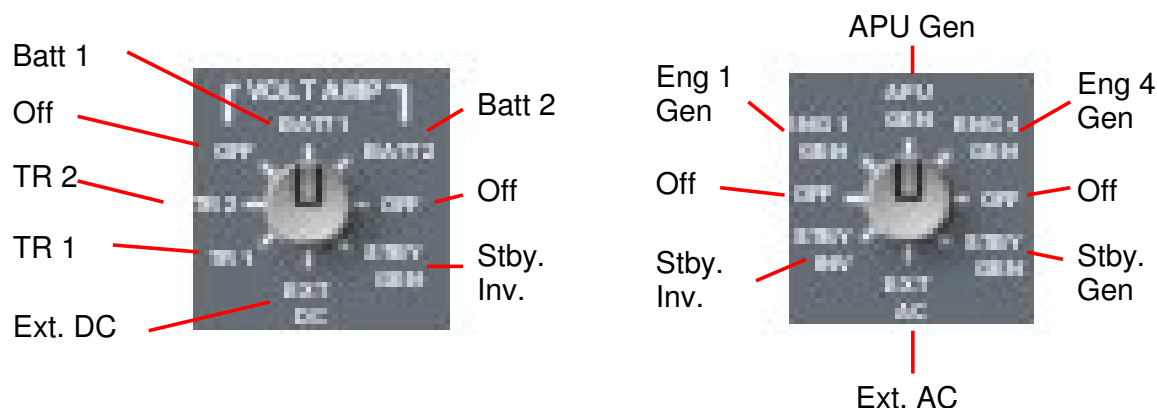
1	TR1 Ammeter (transformer/rectifier). This indicator continually monitors the TRU (transformer/rectifier unit) output (amperes) of TR1.
2	TR2 Ammeter (transformer/rectifier). This indicator continually monitors the TRU (transformer/rectifier unit) output (amperes) of TR2.
3	Battery Ammeter of Battery 1 or 2 in the case of what is selected with the DC selector pos. 6.
4	Battery 1 master switch
5	Battery 2 master switch
6	DC selector. Please see below for a more detailed description.
7	DC Voltmeter. Reads 28 volts except when Battery 1 or 2 is selected with the DC selector pos. 6 or when cold start is in use. When cold start is in use the DC voltmeter shows 36 volts for TRU 1 or TRU 2.
8	AC selector. Please see below for a more detailed description.
9	AC Voltmeter. Reads 115 volts in all selected positions.
10	Frequency meter. Reads 400 HZ in all selected positions.
11	Electrical master annunciator. Please see below for a description of the annunciator lights.
12	External AC master switch. If a GPU is possible and the external AC is connected to the aircraft, this switch will activate the external AC. The switch has no function if no GPU is available.
13	AC Bus Tie switch. When in "Auto" position the bus tie is opened and AC 2 could be provided with power from AC 1 and reverse.
14	DC Bus Tie switch. When in "Auto" position the bus tie is opened and AC 2 could be provided with power from AC 1 and reverse.
15	Standby inverter switch. If the battery is on this switch is set to "Arm" the emergency AC bus is activated.
16	Standby generator switch. If engine 3 is running, hydraulic pump 3 is on and this switch is set to "Arm" the aircraft is provided with electrical power for the essential busses from the standby generator in a loss of AC and DC from the generators and APU generator. When the standby generator is activated both batteries are disconnected.
17	Generator 1 Ammeter.



18	APU Generator Ammeter. This gauge shows the amperes of the APU generator when it is in use. The APU generator is not in use if the generators of engine 1 and 4 are activated. If one engine generator fails or is switched off the APU generator will automatically be connected when available.
19	Generator 4 Ammeter.
20	Generator Annunciator. Please see below for a detailed description of the annunciator lights.
21	Generator 1 master switch.
22	Gallery / Shed switch (just a clickable dummy without any function).
23	APU Generator master switch.
24	Generator 4 master switch.
25	APU RPM indicator displays APU engine speed.
26	APU master switch. Activates the APU engine if the Battery is on and not disconnected (by the standby generator for example).
27	APU activation light. This green light comes up if the APU is running with enough speed.
28	APU engine TGT indicator.
29	APU annunciator. Please see below for a detailed description of the annunciator lights.

### The AC and DC selectors

The letters of the AC and DC selectors are very small in the Avro ARJ panel. That's why I show here an enlarged picture of both selectors:



## The Electric Master Annunciator (pos. 11)



The above picture shows the warning lights of the electrical annunciator. The amber “Off” lights came up if the corresponding bus is not available. For example: The “DC Bus 1 Off” light came up if DC bus 1 is not provided with electrical power.

The green “Ext AC PWR Available” light came up if a GPU AC is connected to the aircraft. If you now switch on the external AC master witch (pos. 12) the aircraft is fed with electrical power from the GPU.

The Batt 1 and Batt 2 Off Line lamps came up if the batteries are switched off but the aircraft has electrical power from the generators for example and so the batteries are not charged. The lights came also up when the batteries are disconnected by the standby generator for example.

The “STBY GEN ON” light came up when the standby generator is available and activated. The standby generator is available when engine 3 is running and the hydraulic pump of engine 3 is on. It will be switched on automatically when the standby generator master switch is set to “Arm” (pos. 16) and the AC or DC connection from the generators and APU generator fault or are switched off.

The Battery 1 and Battery 2 Hi Temp lamps have no function in the Avro ARJ panel.

The complete electrical master annunciator is provided with electrical power from the MAC bus. That’s why those lights are already visible after activating one of the batteries.

### The Generator Annunciator (pos. 20)



The Gen 1 and Gen 4 Off Line lamps illuminate if the corresponding generator is off or disconnected. For example: When the Start Master switch is on the DC busses are disconnected and so the generators 1 and 4 off line.

The APU generator lamp illuminates when the APU generator is offline.

The electrical power source of the Generator 1 and 4 off line annunciators is SDC. The Drive 1 and 4 Hi Temp annunciators have no function in the Avro ARJ panel.

### The right APU Annunciator (pos. 29)



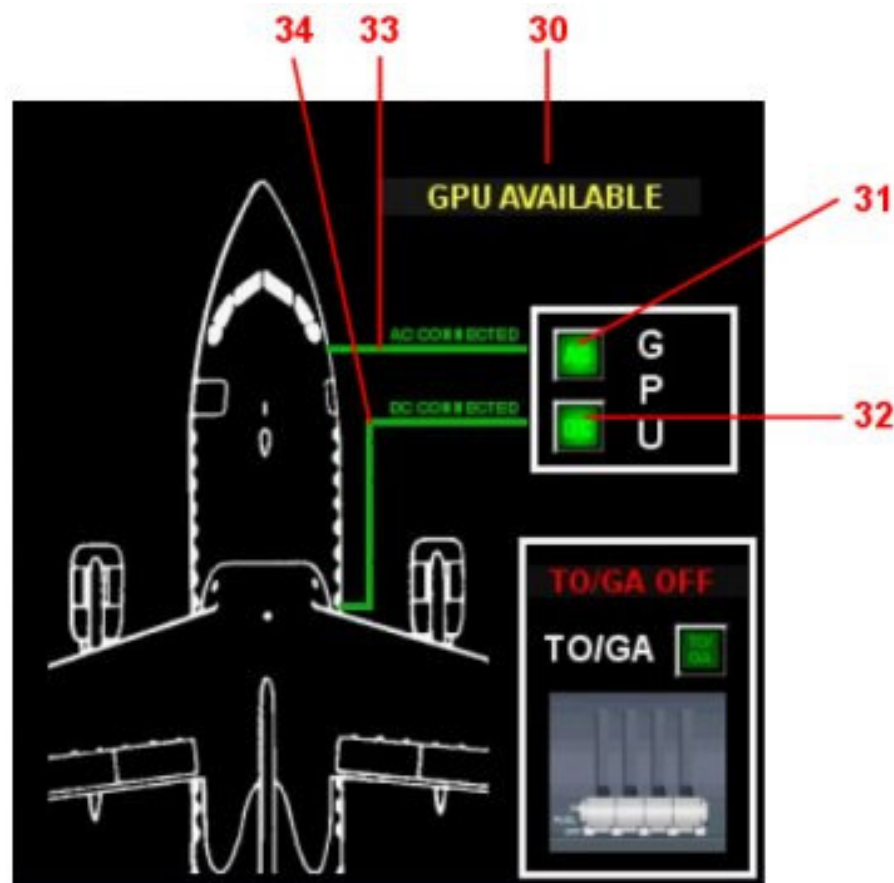
The “APU Oil Lo Press” lamp came up after the APU was started and before the APU engine has enough RPM. The light should go out at about 40% RPM.

The “APU Fuel Lo Press” light came up when the APU is started from a cold and dark cockpit, with no GPU available. In this case the APU is started on batteries and since the AC busses are de-powered well the fuel pumps as well. Nevertheless, the APU will start but indicating fuel lo press.

The “APU Fuel Valve” and “APU NRV Leak” lamps have no function.

### 3.1.5 The Avro ARJ GPU

The GPU is placed in a separate panel window of the ARJ panel. You could open it directly with the corresponding GPU window toggle on the left side of the main panel.



30	This text shows if the GPU is available (yellow text) or not available (red text).
31	GPU AC connection button. If the GPU is available you connect the aircraft with the GPU AC when clicking on this button. The button lights up if the AC connection is active.
32	GPU DC connection button. If the GPU is available you connect the aircraft with the GPU DC when clicking on this button. The button lights up if the DC connection is active.
33	This line is visible when the GPU is available and the AC connection is active.
34	This line is visible when the GPU is available and the DC connection is active.

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### ***Additional Notes for the GPU***

The GPU is available when the aircraft is on ground and the aircraft is not moving.

You activate the GPU when available by clicking on the AC and/or DC buttons (pos. 31 and 32) in the GPU window. After that you could see the two green electrical lines (pos. 33 and 34) going from the GPU unit to the aircraft. Now you have to switch on the GPU with the GPU AC switch (pos. 12). The GPU provides the aircraft now with AC from the GPU and DC via the TR's.

The external DC is just necessary when starting the engines with external DC. The corresponding switch in the starter unit has to be set to "Ext DC".

### ***Additional Notes for the complete electrical system***

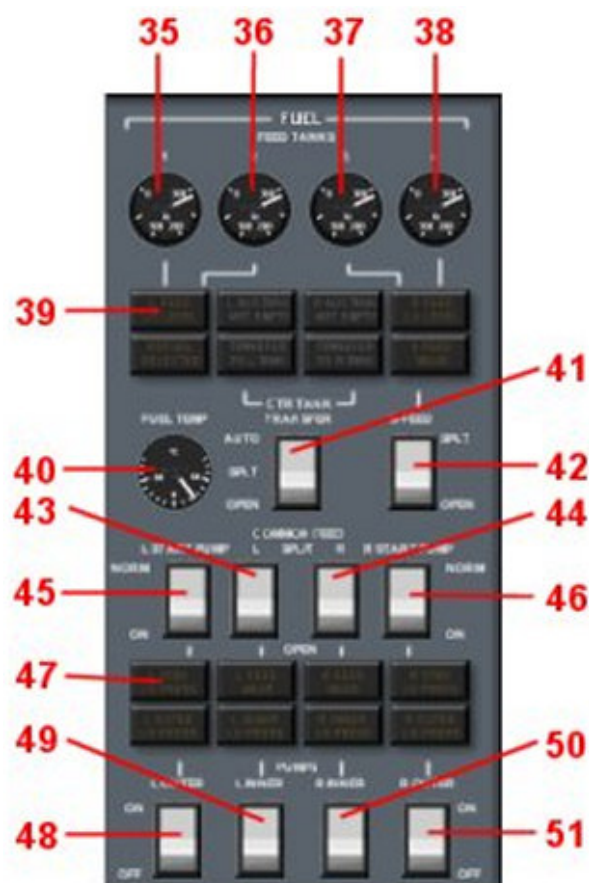
As written the complete electrical system base very close on the real ARJ aircraft. To realize this it was necessary to program a close system in which every part exactly works together with a respective other part. All systems frame a closed unit. Because of this there are some important things which are necessary to know:

- If just the batteries are activated and you have no electrical power from the APU, GPU or the generators the batteries discharge. You have about 20 minutes electrical power from each battery.
- The APU could just be started when the battery is on and not disconnected. To get electrical power from the APU (AC and DC) it's necessary to switch on the APU generator.
- The APU did not support AC 2 when both generators are off and you're airborne. In this case you will lost AC 2. DC 2 could be supported with the DC bustie.
- As soon as the generators, the APU or GPU is active, the batteries will be charged.
- When the standby generator is active the batteries are disconnected and will discharge.

You will find more information about the electrical backup systems in the corresponding chapters of this manual. Because of this take care also to read the hydraulic section as you find here some more details about the standby generator.

## 3.2 The Fuel System

### 3.2.1 The Fuel Unit in the Overhead Panel



35	Fuel quantity of the left outer feed tank (max. 600 lbs.).
36	Fuel quantity of the left inner feed tank (max. 600 lbs.).
37	Fuel quantity of the right inner feed tank (max. 600 lbs.).
38	Fuel quantity of the right outer feed tank (max. 600 lbs.).
39	Fuel Transfer and Feed Tank Annunciator. Please see detailed description below.
40	Fuel temperature of the right wing tank.

41	Center fuel transfer switch. The switch has three positions. If the switch is in the “Auto” position (switch up) and the aircraft is airborne fuel is used from the wing tanks until they reach 7470 lbs. After that an electrical pump transfers fuel from the center tank to the wing tanks to keep them at 7470 lbs. Until the center tank is empty. After that fuel is automatically used from the wing tanks. The “Auto” mode did not work if the aircraft is on ground. If the centertransfer switch is in the shut position (center position) fuel is just used from the wing tanks. The “Open” (lower) position of the switch has almost the same function than the “Auto” position except the fact that this position always transfers fuel from the center tank to the wing tank no matter if the aircraft is on ground or not.
42	X-Feed valve switch. The X-Feed valve is positioned between the left and right wing and enables all four engines to be pressure-fed by the pumps in one wing when opened.
43	Left common feed valve. The left common feed valve enables the two left engines to be supplied from one of the left pumps.
44	Right common feed valve. The right common feed valve enables the two right engines to be supplied from one of the right pumps.
45	Left standby pump. This switch activates the left hydraulically driven standby pump to keep the left feed tanks fuel.
46	Right standby pump. This switch activates the right hydraulically driven standby pump to keep the right feed tanks fuel.
47	Fuel Pump and Feed Annunciators. Please see detailed description below.
48	Electrical fuel pump for the left outer feed tank and Engine 1.
49	Electrical fuel pump for the left inner feed tank and Engine 2.
50	Electrical fuel pump for the right inner feed tank and Engine 3.
51	Electrical fuel pump for the right outer feed tank and Engine 4.



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### ***Additional Notes***

For starting the Engines it's necessary to switch on the corresponding electrical fuel pump. Of course it's also possible to feed the engine with fuel from another pump and an opened common feed or opened X-Feed valve (when using an electrical fuel pump from the other wing).

The fuel flow of the ARJ is normally given by gravity and the wing's anhedral. That's why it is not imperative to have the electrical fuel pumps on in flight or after the engines are started. Nevertheless there are a couple of reasons why you should do it. The first reason is that you need the electrical fuel pumps in high altitudes or in abnormal situations to ensure the fuel flow. The second reason is that if the outer feed tanks are empty (this could happen when the wing tanks are almost empty and the outer fuel pumps are off) you have no possibility to refuel the outer feed tanks and so no possibility to restart the engines after the shutdown because of low fuel. That's why I highly recommend to leave the electrical fuel pumps on for the complete flight.

#### Fuel Transfer and Feed Tank Annunciator (pos. 39)



The L Feed and R Feed Lo Level lights came up if one of the left or right feed tanks is below 600 lbs. The X-Feed Valve light is just a “not in position” light which illuminates for a short time after pressing the X-Feed valve switch. The white Transfer to L and R Tank lights came up when the center transfer mode is active and so fuel from the center tank is pumped to the wing tanks.

The “Refuel Selected” and Aux Tank lights have no function yet.

#### Fuel Pump and Feed Valve Annunciator (pos. 47)

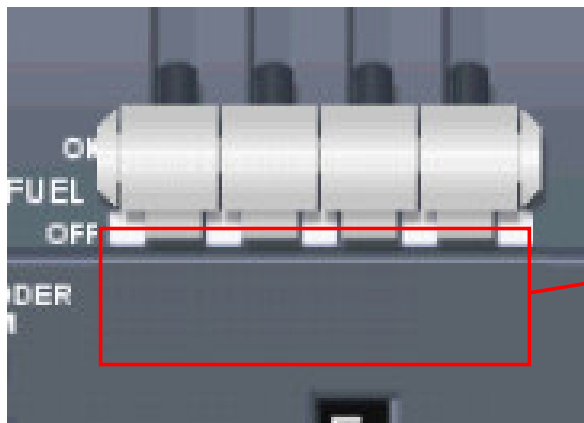


The L stby lo press light has two functions. The first function is a “not in position” light which came up a short time after the left standby pump is switched on or off. The light is also on if the right standby pump is active and the left standby pump is off. The R stby lo press light has the same functions than the left light.

The L Feed and R Feed Valve lights are just “not in position” lights. They illuminate for a short time after the left or right common feed valves are opened or closed.

The L and R outer and L and R inner Lo Press lights illuminate if the corresponding feed tank has no fuel and the electrical fuel pump is on. The lights will also illuminate when the corresponding fuel pump is off and the system is completely supported with electrical power.

### **3.2.2 The High Pressure (HP) Valve switches in the Pedestal Panel**

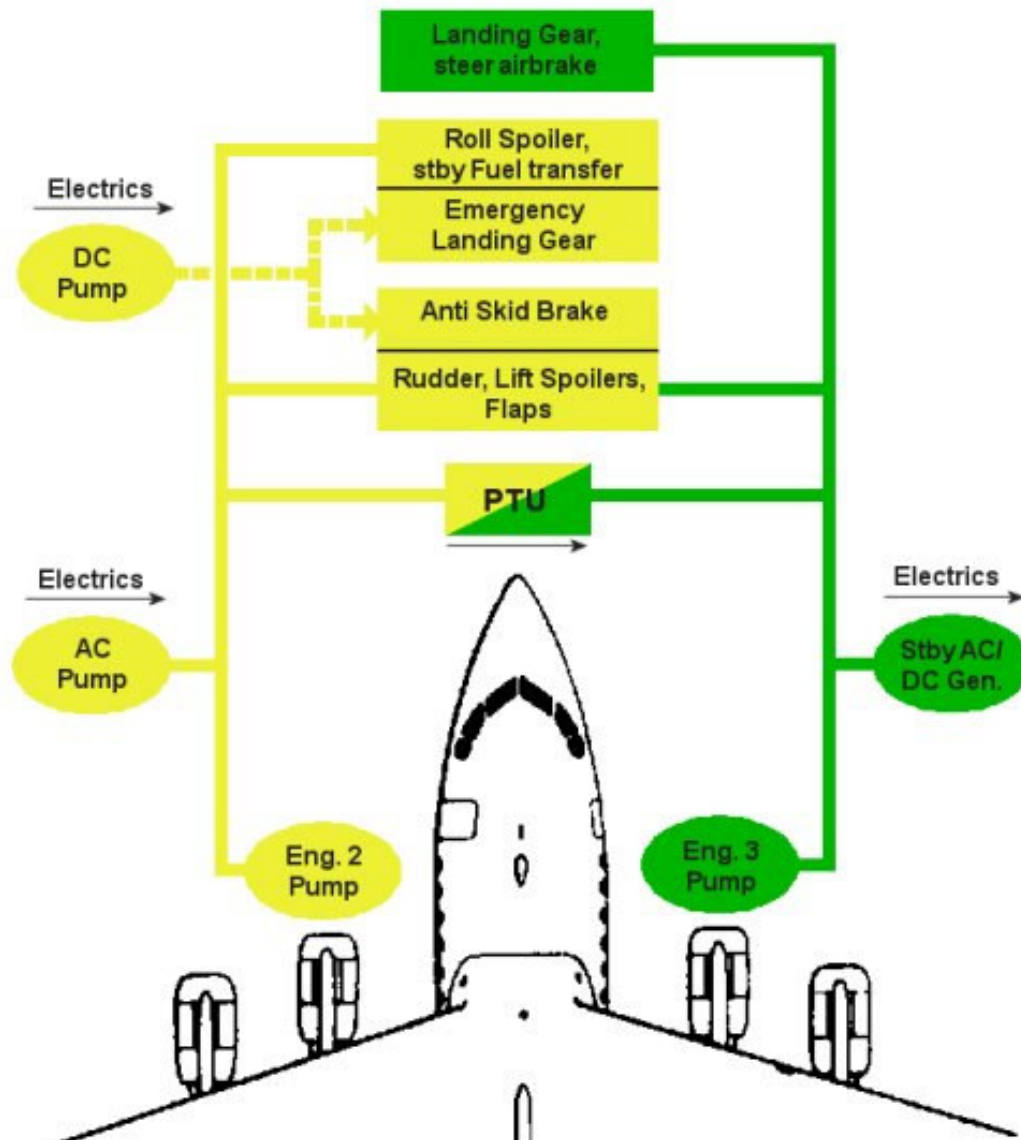


Mouseclick area to move the Throttle to the HP fuel cut-off position and back.

As in the real aircraft you will find the switches for the HP valves now in the Throttle of the ARJ panel. The function of this fuel cut-off valve is very simple. Just move the throttle completely back. After this you can click below each throttle to close the HP valve of the corresponding engine. If the engine is switched off and the Throttle is in the fuel cut-off position you see no movement of the Throttle also when using any hardware throttle.

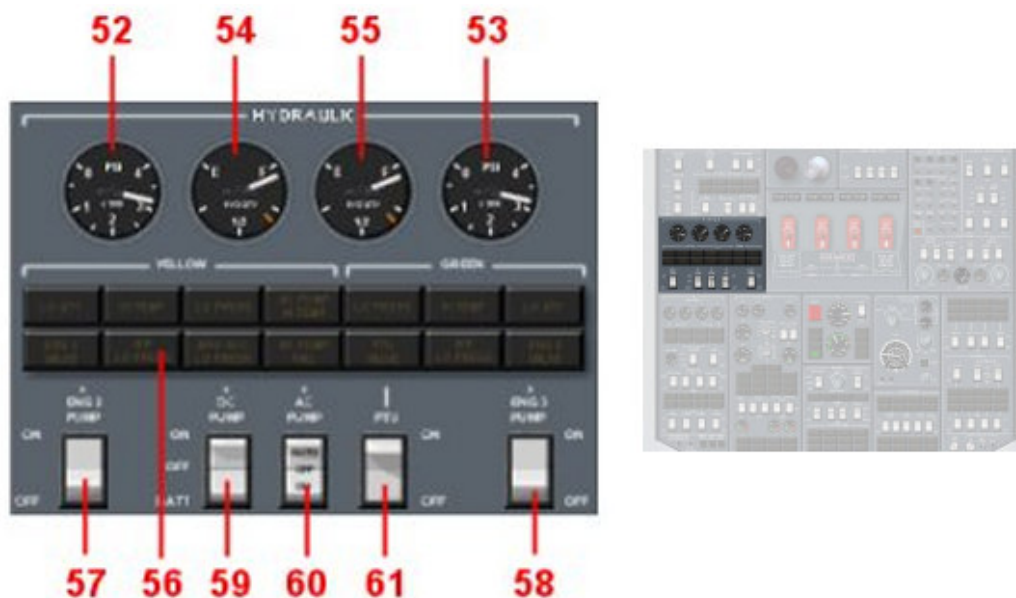
Before you can restart the engine again or moving the throttle, it's necessary to open the high pressure fuel valve again. This will be done on the same way. Just click below the corresponding throttle to bring it back to the “On” position. If you are using any hardware throttle you have to move the throttle completely back before the cut-off valve could be opened or closed.

### 3.3 The Hydraulic System



The above picture (based on the real Avro ARJ) gives an overview of the complete ARJ hydraulic system and shows which aircraft systems are fed from which hydraulic source. Except the roll spoilers version 4.0 of the ARJ panel contents now all of the above pictured systems very close to the real hydraulically system.

### 3.3.1 The Hydraulic Unit in the Overhead Panel



52	Yellow System Hydraulic Pressure (x 1000 psi).
53	Green System Hydraulic Pressure (x 1000 psi.).
54	Yellow system hydraulic contents
55	Green system hydraulic contents
56	Hydraulic Annunciator. Please see below for a detailed description.
57	Yellow System Engine 2 Hydraulic Pump switch.
58	Green System Engine 3 Hydraulic Pump switch.
59	DC Pump switch. Please see below for a detailed description of the backup systems.
60	AC Pump switch. Please see below for a detailed description of the backup systems.
61	PTU Valve switch. This switch opens the PTU valve to supply a fault systems with hydraulic pressure of the running system. Please see also below for a detailed description of the backup systems.

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The Hydraulic Annunciator (pos. 56)



The Eng 2 and Eng 3 Valve lights are just “not in position” lights. They illuminate for a short time after the pumps of engine 2 or engine 3 are switched on or off.

The Air Lo Press lights (one for engine 2 – left and one for engine 3 – right) came up if the corresponding engine gives not enough pressure for the corresponding hydraulic pump. That’s why the light is on if the corresponding engine is off.

The “BRK ACC LO PRESS” light illuminates if you have not enough hydraulic pressure for the brakes and parking brakes. Please see also the description of the backup systems below.

The left “Lo Press” light came up if the yellow hydraulic system is below a pressure of 1500 psi. The right “Lo Press” light came up if the green hydraulic pressure is below 1500 psi. or if the standby generator is active. Please see also the descriptions of the backup systems below.

The PTU Valve light is a “not in position” light which illuminates for a short time after the PTU valve is switched on or off.

All other lights of the hydraulic annunciator have no functions.

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### 3.3.2 The Hydraulic Backup Systems

As written in the electric, fuel and hydraulic chapter, the Avro ARJ contains a lot of backup systems for all functions. It was my goal to realize all of them as real as possible. In this chapter you will find a description of the hydraulic based backup systems and the backup systems to keep the hydraulic systems alive.

#### Backup's for the hydraulic system

##### *Power Transfer Unit PTU*

Normally the hydraulics run off the inboard engines, so the engine driven pump of engine 2 supports the yellow system and the engine driven pump of engine 3 supports the green hydraulic system. The services of each system are shown in the graphic overview of the hydraulic. A power transfer unit (PTU) enables the yellow system to run green system if the engine 3 pump fails. The PTU will be opened with the switch pos. 61.

##### *AC Pump*

As well as the PTU, there are two further backups which are driven by the electrical system of the ARJ. An electrical pump running off the AC busbar could feed the yellow system if the electrical AC bus provides electrical power (generators or APU running). This electrical pump will be activated with the AC pump switch (pos. 60). If the switch is in the off position (center position) the pump is switched off. In Auto mode (upper position) the AC pump will be activated when the system itself recognizes a fault of the engine 2 pump. In the on position (lower position) the AC pump is always on. If the PTU is opened (switch pos. 61) the AC pump could also provide hydraulic pressure for the green system if both inboard engines failed. In this case the green hydraulic system could just provide a pressure of 2600 psi. and not 3100 psi. as with a running engine 3 and engine 3 pump on. Nevertheless all green services could be used except the standby generator which needs at least a pressure of 2800 psi. You will find more information about the standby generator below.

##### *DC Pump*

A DC electrical pump provides further backup by providing a dedicated hydraulic supply only to the landing gear and to the brakes (in the real aircraft the DC pump only provides hydraulic pressure to the emergency landing gear lowering and to the anti-skid brakes – so here is a difference to the real ARJ). In this panel the DC pump could be set to off or to the “Batt” position (lower position of the switch pos. 59). In the “Batt” position the DC pump is running with electrical power from the battery and so the DC pump works as soon as the battery is switched on. In this case the parking brakes could be activated before an engine runs and/or before the APU is running.

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### Backup's for other systems supported by the hydraulic system

The hydraulic system of the Avro ARJ could not only be fed by the electrical system, it could also provide power (pressure and/or electrical power) to other systems.

#### *Hydraulically driven Standby Pumps*

Backup for the fuel system in the event of electrical failure is provided by hydraulically driven standby pumps. The hydraulic standby pumps keep the feed tanks full in the event of a failure of an electrical fuel pump. The standby pumps could be switched on in the fuel unit with the two switches pos. 45 and 46. You will find some further information about this backup and the corresponding annunciator lights in the chapter "The Fuel System".

#### *Standby Generator*

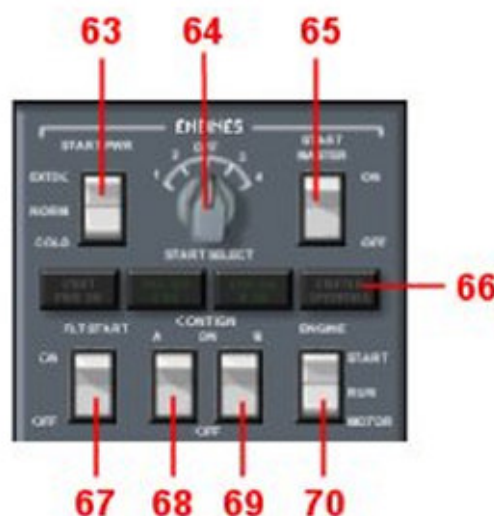
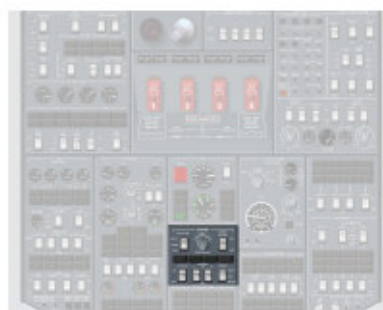
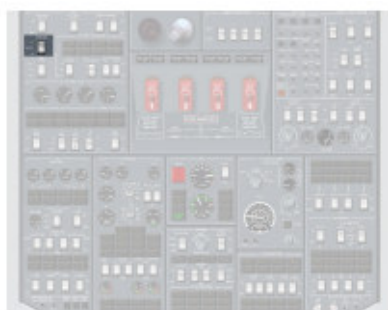
A hydraulically driven AC/DC standby generator provides backup for the electrical system using the green hydraulic system in the event of a failure of both engine driven generators and APU generator. As the standby generator at least needs a pressure of 2800 psi, it's not possible to activate it just with the yellow system and an opened PTU. You need to have a fully working green system for it.

The standby generator could be armed with the switch pos. 16 in the electric unit of the overhead panel. If the generator is armed it will be activated automatically when the engine driven generators and APU generator fault or all of them are switched off. An activated working standby generator is also indicated with a white annunciator light in the electric main annunciator. If the standby generator is active, the batteries are isolated. In this case the batteries will not be charged. Also a result of this is that you could not activate a stopped APU as the APU needs the battery for starting.

When the standby generator runs hydraulic power for this is high and the remainder of green system services are inoperative. Unfortunately it was not possible to realize all limitations when the standby generator is active with this panel (I'm currently working on them).



### 3.4 The Engine Starter and Ignition



62	Ground Ignition selector switch. With this switch you choose which of the two ignitions (A or B) is used for starting the engines on ground. Normally both ignitions are used (switch in the center position).
63	Start power switch. This switch has three positions. The upper position "EXT DC" is used to provide the starter with external DC from a GPU. A GPU must be available and the external DC has to be connected for this function. The "Norm" position is used for normal starting. The "Cold" position (lower position) is used at high altitudes or low outside air temperatures. In normal position all DC busses remain powered. When starting with this switch set to "Cold" the other DC busses are disconnected. This because the TRU output voltage is higher (36 volts) and may damage the DC servitudes. For normal and cold starting you need AC power either from the APU or GPU.
64	Engine selector for the starting.

65	Start master switch. The engines are started with DC electrical starter motors which are powered from the start bus. This start bus is connected directly to the TR1 and TR2 outputs by switching the start master switch to on.
66	Engine starter annunciator. Please see below for detailed descriptions.
67	Flight start switch to start an engine in flight. This switch did not base exactly on the real ARJ. In the real aircraft you have to activate this switch (position on), move the throttle forward and then move the switch back to the off position to start the engine. In this panel you have to activate the start master switch (pos. 65) and then to switch on the flight start switch. The selected engine will then start automatically (just if you are airborne of course).
68	Continuous Ignition switch for Ignition A. The continuous ignition is normally switched on while take off and a short time before landing to prevent an engine failure.
69	Continuous Ignition switch for Ignition B. The continuous ignition is normally switched on while take off and a short time before landing to prevent an engine failure.
70	Engine starter switch. Press this switch to start the engine. The switch goes back to the center position automatically after the engine is running. Do not select another engine as long as the switch is in the start (upper) position.

#### The Engine Starter Annunciator (pos. 66)



The “Start PWR ON” light came up when the start master switch (pos. 65) is on or while the APU is starting.

The green engine ignition lights came up while the engine is starting and the ignition is active (whichever ignition is selected with the switch pos. 62) and N2 is below 40%. In Flightstart just engine ignition A lights up.

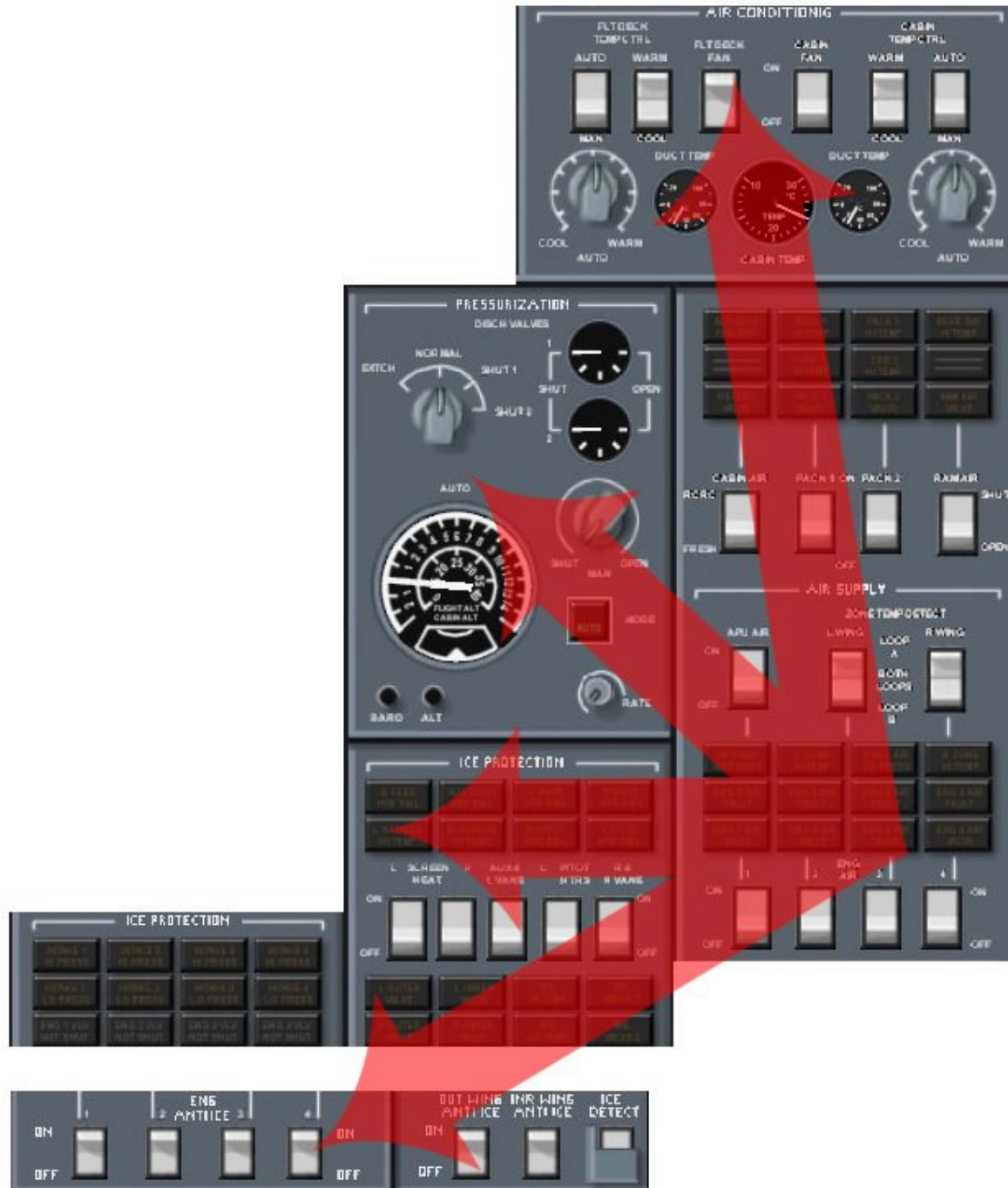
The starter operating light illuminates whenever the starter motor is energized. Do not select another engine while the light is on.

#### **Additional Notes**

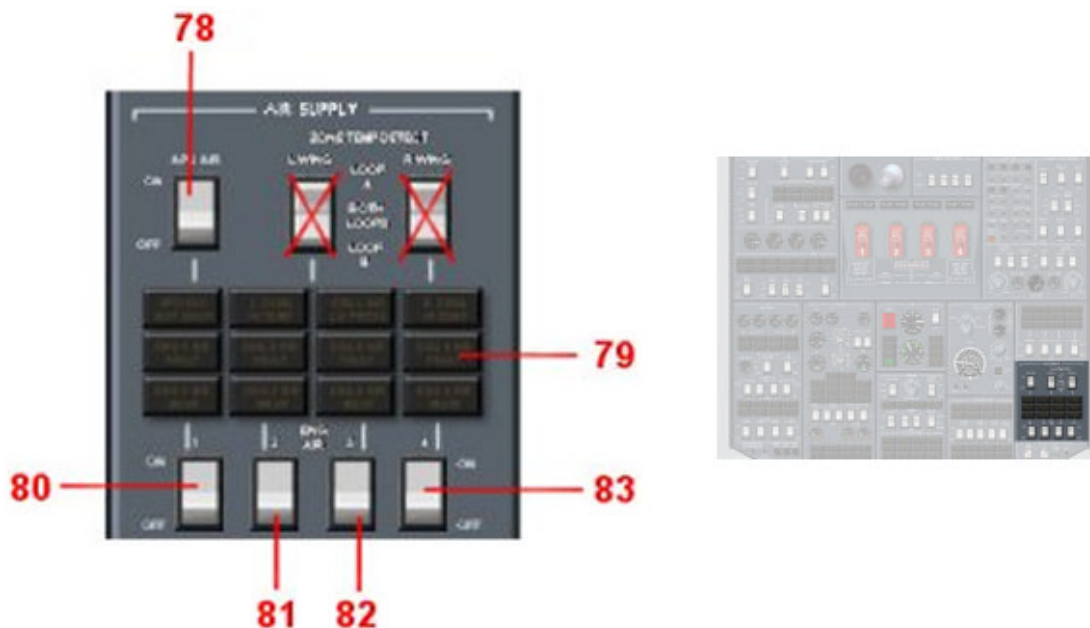
If the start master switch (pos. 65) and the APU generator is on, both engine generators are disconnected. If the APU generator is off and both generators are on, one of the engine generators is disconnected when the start master is on.

Please see the checklists for a detailed description of the engine start-up sequence.

### 3.5 The Air Supply and provided Units



### 3.5.1 The Air Supply Unit



78	APU air switch. If the APU is running you could provide the pressure for the required air supply (the packs or pressurization for example) from the APU. Air from the APU is normally used on ground while engine air used in flight.
79	Air supply annunciator. Please see below for further descriptions.
80	Engine 1 air switch. If engine 1 is running this switch opens the valve for the air supply from engine 1.
81	Engine 2 air switch. If engine 2 is running this switch opens the valve for the air supply from engine 2.
82	Engine 3 air switch. If engine 3 is running this switch opens the valve for the air supply from engine 3.
83	Engine 4 air switch. If engine 4 is running this switch opens the valve for the air supply from engine 4.

#### **Additional Notes**

The red crossed switches have no function yet.

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The Air Supply Annunciator (pos. 79)



Like the temperature and packs annunciator it's not possible to realize some functions of the air supply annunciator with a Flight simulator panel. That's why a lot of the annunciator lights have no function.

The realized functions are:

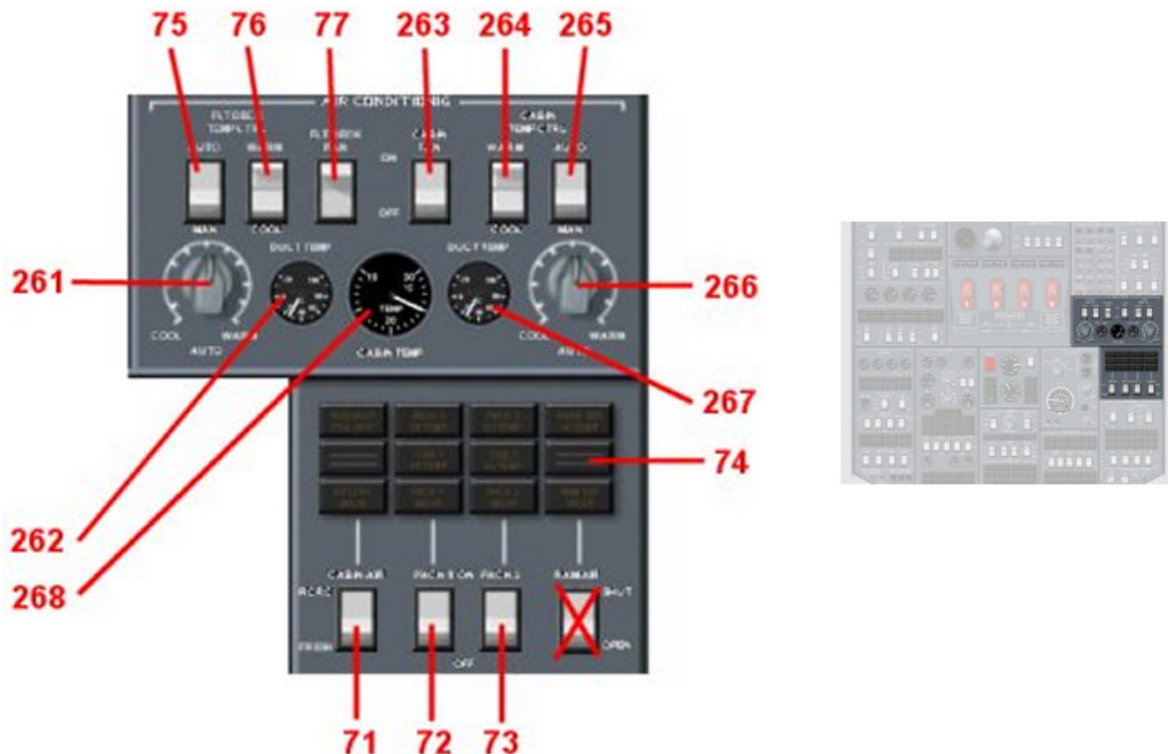
The "APU VLV NOT SHUT" is just a "not in position" light for the APU air switch pos. 78 (or better for the APU air valve). It illuminates a short time after the APU air is switched on or off.

The engine air valve annunciators illuminates whenever the corresponding engine air is switched on and the engine itself is off. The lights came also up if the necessary electrical power supply is not given. Engine air 1 needs DC 1, engine air 2 and 3 needs MDC and engine air 4 needs DC 2 to operate. The annunciator itself needs essential DC (SDC) to work.

***Additional Notes for the air supply unit***

Normally on ground just APU air is used for the air supply. The reason is that more thrust is lost with the engine air on. That's why you should also use APU air if performance will not allow engine air. You must never take off with engine anti-ice and engine air selected together (too much thrust will be bleed through the engines and so not enough power is given for a safe take-off). If the APU air is fault you could use engine air 4 for pressurization on ground. But this just without switching on the packs.

### 3.5.2 The Air Conditioning Unit



71	Cabin air circulation switch. With this switch you decide if you want to have an air recirculation or fresh air. Air recirculation (switch position RECIRC) is only available with both Packs or APU air on. Loss of one pack or cabin high altitude warning will automatically revert the system to the fresh mode. Below 10000 ft the cabin air should be in RECIRC (more performance on engines) and above 10000 ft. it should be FRESH (passenger comfort).
72	Air conditioning pack 1 switch. The switches operate isolation/flow control valves that allow engine air or APU air through to each of the packs. Without APU or engine air the packs are not working.
73	Air conditioning pack 2 switch (see also description above).
74	Temperature and Packs annunciator. Please see below for further descriptions.



75	Flight Deck temperature control Auto/Man mode switch
76	Flight Deck Warm/Cold switch for manual flight deck temperature control. When pressings and holding the switch (spring-loaded-to-centre-switch) you will increase or decrease the Flight Deck duct temperature and so regulate the temperature of the cockpit. The switch has no function when the Auto/Man switch (pos. 75) is set to Auto. For more information about controlling the Flight Deck temperature please read the chapter below.
77	Flight Deck fan switch. This switch is used to control an air supply boost valve in the outlet duct from no. 1 pack. When this is used, this valve closes the no. 1 pack air supply to the cabin increasing the air supply to the flight deck. This additional cooling is to be used on the ground only.
261	Flight Deck temperature controller for Auto mode. With this knob you could increase or decrease the Flight Deck temperature. For more information about controlling the Flight Deck temperature please read the chapter below..
262	Flight Deck duct temperature indicator.
263	Passenger Cabin fan switch.
264	Passenger Cabin Warm/Cold switch for manual cabin temperature control. When pressings and holding the switch (spring-loaded-to-centre-switch) you will increase or decrease the cabin duct temperature and so regulate the temperature of the passenger cabin. The switch has no function when the Auto/Man switch (pos. 265) is set to Auto. For more information about controlling the cabin temperature please read the chapter below.
265	Passenger cabin temperature control Auto/Man mode switch
266	Passenger cabin temperature controller for Auto mode. With this knob you could increase or decrease the Flight Deck temperature. For more information about controlling the cabin temperature please read the chapter below..
267	Passenger cabin duct temperature indicator.
268	Passenger cabin temperature indicator.

### **Additional Notes**

The red crossed switches have no function yet.



## The Temperature and Packs Annunciator (pos. 74)



The “AVIONIC FAN OFF”, “REAR BAY HI TEMP”, “CAB 1 HI TEMP”, “CAB 2 HI TEMP” and “RAM AIR VALVE” lamps have no function yet.

The “PACK 1 HI TEMP” and “PACK 2 HI TEMP” lamps illuminate when the corresponding pack (duct temp) gets higher than 65 °C. In this case the pack (1 or 2) will be automatically switched off and so the “PACK 1 VALVE” or “PACK 2 VALVE” will illuminate. In the case of a high pack temperature you have to reduce the temperature in manual mode and then switch off and on the corresponding pack again. If the temperature is still too high, you have to wait until the temperature is below 65°C and then repeat the procedure again.

“Recirc Valve” This is a “not in position” light which illuminates a short time after the cabin air circulation switch pos. 71 is moved. It also lights up in the event of a pack failure, high temperature or cabin high altitude indication. In this case the valve will revert automatically to fresh. The light goes out after the cabin air circulation switch is set to fresh.

The pack 1 and pack 2 annunciator lights are also “not in position” lights for the two pack switches (or better for the valves of the two packs). The annunciator lights also came up when you switch on the packs without having air from the APU or engines.

### ***Additional Notes for the air conditioning unit***

The complete air conditioning system uses power from the AC 1 and AC 2 bus. AC 1 supports electrical power for the flight deck auto and manual temperature control and the cabin manual temperature control. AC 2 supports electrical power to the flight deck and cabin fan and the cabin auto temperature control. If both electrical busses are off line, no temperature control is possible and the flight deck and cabin temperature will increase or decrease to the outside temperature.

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The both packs supply different systems. No. 1 pack supplies air conditioning to the flight deck and augments the passenger cabin supply. No. 2 pack supplies air conditioning the passenger cabin. The pressurization system works with either pack 1 or pack 2. No. 1 pack is supplied from engines 1 and 2 and no. 2 pack from engines 3 and 4. There is no crossfeed possible, so take care that you have air for the corresponding conditioning system from the named engine. The APU can provide pack 1 and pack 2 when the APU is running and the APU Air switch (pos. 78) is on.

### 3.5.2.1 Controlling the cabin temperature in auto mode

After starting the panel, the cabin temperature controlling is automatically set to auto. The auto mode of the cabin control is available as soon as you have air from the APU or engine 3 or 4 and electrical power from the AC 2 bus. As long as there is no air or AC 2 not available, the passenger cabin has the same temperature as the surrounding air (OAT).

Decisive for the auto temperature controlling is, that the Auto/Man switch (pos. 265) is set to "Auto". If this is done and you have air and electrical power, the system scans the position of the temperature controlling knob pos. 266. The center position (standard) of this knob determines a cabin temperature of 25°C. You can see the actual passenger cabin temperature with the indicator pos. 268. You can also move the mouse over this indicator to see the actual temperature with the yellow tool tip text.

The passenger cabin could be increased or decreased by moving the warm/cold knob pos. 266 to the left (cold) or to the right side (warm). Each mouse click increases or decreases the temperature of 1°C. So the fully left side of the knob results in a cabin temperature of 20°C and the fully right side results in a temperature of 30°C. A colder or warmer cabin temperature is not possible with the auto mode.

The temperature for the passenger cabin will be regulated automatically from the system with the duct temp. The actual duct temp for controlling the passenger cabin is shown in the indicator pos. 267 (move the mouse over the indicator to see the actual duct temp in the yellow tool tip text). When increasing the cabin temp, the system augments the duct temp to about 40°C - 50°C until the cabin temperature catches the selected temperature of the warm/cold knob. After that, the system reduces the duct temp to the desired cabin temperature to hold it. A manual duct temperature control is not necessary in the automatic mode. The same when reducing the cabin temperature. In this case, the system reduces the duct temp to about 3°C until the desired temperature is reached and then increase the duct temp to the desired cabin temperature.

### 3.5.2.2 Controlling the cabin temperature in manual mode

The manual temperature control is activated when the Auto/Man switch pos. 265 is set to “Man”, air from the APU or engine 3 or 4 is available and the electrical AC 1 bus is powered. Contrary to the auto temperature control you have no temperature limits in the manual mode. The advantage of this is that you could select every cabin temperature you want but this has also the disadvantage that you could overheat the pack (duct temp more than 65°C).

In the manual mode you could not select a cabin temperature directly. The temperature will be set by increasing or decreasing the duct temp with the spring-load switch pos. 264. A single click on the switch increases or decreases the duct temp of 0,1°C. The longer you press the switch to warm or cold, the faster you change the duct temp. The higher the difference between the duct temp and the actual cabin temp is, the faster the cabin temperature will increase or decrease. As soon as the cabin temperature reaches the desired value you have to reduce or raise the duct temp to the desired cabin temperature manually with the duct temp.

Here's an example of setting the cabin temperature to about 28°C in manual mode:

First set the temperature control to “Man” with the switch pos. 265. After that press the warm/cold switch pos. 264 as long as you have a high enough duct temp for the temperature change. In our example we have an actual cabin temperature of 25°C and want to have a cabin temperature of 28°C. That's why we decide to increase the duct



temp to about 40°C. This is a high enough value for a fast enough changing of the cabin temperature. If you want to reach the desired temperature faster, you could also set a higher duct temp (45°C for example). The warm/cold switch of the manual duct temperature control is programmed on this way, that you could see the selected duct temp with the yellow tool tip text (see picture). You can also see the selected duct temperature

in the indicator pos. 267, which also have a yellow tool tip text. As soon as the duct temp is higher than the cabin temperature, the cabin temperature will increase. You could see the actual cabin temperature in the indicator pos. 268. This indicator has also a yellow tool tip text which gives you a close readout of the value (see picture). When the cabin temperature has reached the desired temperature (28°C in our example), you have to set the duct temp back to the desired cabin temperature (with the switch pos. 264) to stop the cabin temperature increasing. Reducing the cabin temperature works on the same way with the difference that you have to set a lower duct temp value than the cabin temperature.



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### 3.5.2.3 Controlling the flight deck temperature

Controlling the flight deck temperature is almost the same as controlling the passenger cabin temperature. There is no temperature indicator for the flight deck included, so the controlling has to be done only with the duct temperature. Both modes (auto and manual) of the FD temperature control needs air from the APU or from engine 1 or 2 and electrical power from AC 1.

In auto mode, the warm/cold controlling knob pos. 261 has the same function as with the cabin temperature control. This means, that in the center position you have a flight deck temperature of 25°C, in the fully left position a temperature of 20°C and in the fully right position a temperature of 30°C.

In manual mode the flight deck duct temperature controls the FD temperature. As written above, there's no indicator to see the actual flight deck temperature. Because of this I have simplified the controlling. When you set the duct temp to 30°C a flight deck temperature of 30°C is simulated. Like with the cabin temperature control it's also possible to overheat the pack with the manual control of the flight deck temperature controlling, when setting the duct temp higher than 65°C.

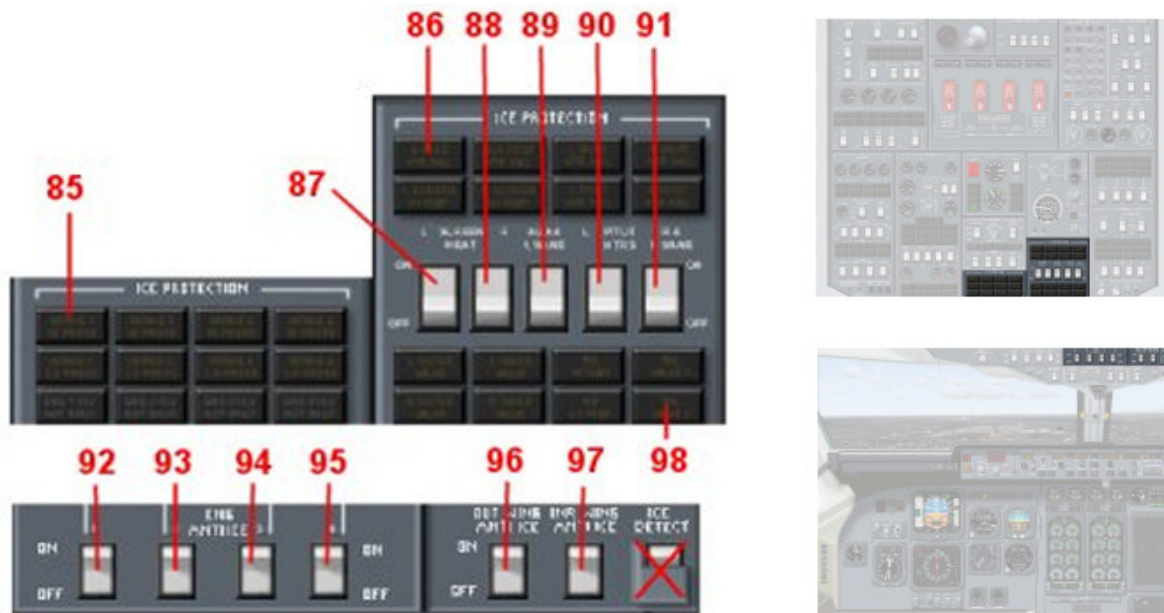
### 3.5.2.4 Overheating of the Packs

In manual mode it's possible to overheat one of the two packs or both packs when setting a higher duct temp than 65°C. If this happens, the amber high temp warning light illuminates (please see also "The Temperature and Packs Annunciator") and the dedicated pack will be automatically switched off. Because of the missing (switched off) pack, there's no temperature control for the flight deck or cabin possible and the temperature reduces to the outside air temperature after some delay. In the case of the lost of both packs, there's also no cabin pressurization possible (very dangerous situation)!

If a pack overheat happens, it's necessary to switch off the dedicated pack and change to the manual temperature control. Than reduce the duct temp by pressing cold for a couple of seconds (temperature must be lower than 65 °C but higher than 3°C). Now switch on the dedicated pack again and watch if the temperature rises to the selected value. If the pack still overheats, repeat the procedure.

In case both packs are lost (and not recovered) you will have pressurisation problems and the cabin altitude will start rising. In this case you need to perform an emergency descent (if the problem occurs at high altitude).

### 3.5.3 The Ice Protection System



85	Engine anti-ice annunciator. Please see below for detailed descriptions.
86	Screen, vane and pitot annunciator. Please see below for detailed descriptions.
87	Left screen heat switch.
88	Right screen heat switch.
89	Aux and left vane heating.
90	Left pitot heat
91	Right pitot and right vane heat switch.
92	Engine anti-ice for engine 1
93	Engine anti-ice for engine 2
94	Engine anti-ice for engine 3
95	Engine anti-ice for engine 4

96	Outer wing anti-ice switch
97	Inner wing anti-ice switch
98	Wing and tail anti-ice annunciator. Please see below for further descriptions.

#### The Engine Anti-ice Annunciator (pos. 85)



The complete engine anti-ice annunciator is supplied with electrical power from the essential DC bus (SDC).

The white engine 1 to engine 4 valve not shut annunciators came up when the corresponding engine anti-ice valve is open. The lights illuminate also when the engine anti-ice switch is off but the electrical supply (DC 1 for engine 1 and 3 and DC 2 for engine 2 and 4) is not given. In this case the valves open automatically.

The intake low pressure lights came up when the air intake anti-icing duct indicates low pressure. This happens when the engine anti-ice switch is on but the corresponding engine is not running. The light is also on when the engine anti-ice switch is on and the corresponding engine is below flight idle.

The intake high pressure lights have no function yet.

#### The Screen, Vane and Pitot Annunciator (pos. 86)





The screen, vane and pitot heater annunciator is fed from two different electrical buses. The Aux and left valve heater fail lamps are supplied with power from the emergency DC bus (MDC) while all other lamps are supplied with power from the essential DC bus (SDC).

The “Q FEED HTR FAIL” light comes up when left or right pitot heat is on, the standby generator is active and the left landing or taxi light is on. This is one of the limitations when the standby generator is active which is also called: “power reduced to essential level”.

The aux pitot heater fail light and the left valve light came always up when the aux pitot heater and left vane heating is switched off (switch pos. 89),

The right valve heater fail and the right pitot heater fail lights illuminates when the right pitot heat is switched off (switch pos. 91) or if the right pitot heat is on and the necessary electrical power (AC 2 bus) is not given.

The left pitot heater fail light comes up when the left pitot heat is switched off (switch pos. 90) or if the left pitot heat is on and the necessary electrical power (essential AC bus) is not given.

The screen hi temp lights have no function yet.

#### The Wing and Tail Anti-Ice Annunciator (pos. 98)



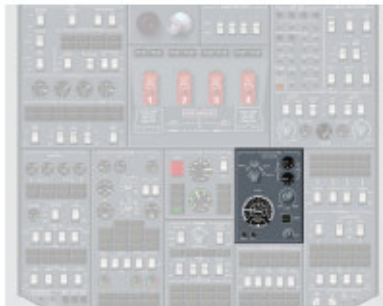
The left and right outer valve annunciator lights illuminates when the outer wing anti-ice is switched on (switch pos. 96) while the aircraft is on ground. The inner valve lights goes on when the inner valve is switched on (switch pos. 97) while the aircraft is on ground.

The “Air Lo Temp” light illuminates when the aircraft is airborne and one engine is off (lo air pressure from the engine) or one of the engine air switches (pos. 80 – 83) is off.

The tail anti-ice is not realized so all of the tail anti-ice annunciators have no function yet.



### 3.5.4 The Pressurization Unit



99	Discharge Valve switch. This switch has four positions. Position "Ditch" will be selected below 2000 ft. for an emergency landing on water. "Shut 1" closes discharge valve 1 and "Shut 2" closes discharge valve 2. The position "Normal" is the standard setting and both valves opens and closes as selected (manually in "Man" mode or automatically in "Auto" mode).
100	Indicator for the opening angle of valve 1.
101	Indicator for the opening angle of valve 2.
102	Man / Auto button. If "AUTO" mode is available you could change to manual mode "MAN" with this button.

---

103	Knob for controlling the opening angle of the discharge valve in manual mode.
104	Altitude selector for automatic mode.
105	Knob for setting the target altitude for automatic mode.
106	Cabin VSI indicator (gauge is placed in the PRS subpanel).
107	Cabin altitude indicator (gauge is placed in the PRS subpanel).
243	Knob for controlling the opening angle of the discharge valve in auto mode.

### ***Additional Notes***

Unfortunately it was not possible to realize a fully realistic working pressurization control with this panel as the Flight simulator did not support any part of a cabin pressurization. However it was my goal to realize one very close to the real one with some tricks. Nevertheless there are minor differences to the real pressurization control.

The complete cabin pressurization just works if the system is supplied with air from the engines or from the APU (for more details please see the chapter The Air Supply).

The illuminated letters “MAN” or “AUTO” on the button pos. 102 is just visible when the electric supply is given. If no electrical supply is given (The manual mode works with emergency DC, MDC and the automatic mode requires essential AC, SAC), the aircraft climbs or descend with the same vertical speed as the aircraft and the cabin alt is the same as the aircraft altitude.

To compress the cabin it's necessary that you have air from the APU or from the engines. If no air is given, the aircraft climbs or descend with the same vertical speed as the aircraft and the cabin alt is the same as the aircraft altitude.

The triple gauge (pos. 106 and 107) has normally a third needle (that's why it called triple gauge) which shows the cabin pressure. This third needle is not realized as there is no possibility to show an inexistent value. Well, I could realize a dummy needle but with an eye on the frame rates I decide not to make it.

When you are on the ground, and you select -2000 ft, the system will not pressurize immediately. It first needs to sense that the aircraft has taken off. What happens actually is that when you have started number 2 engine, the press system when in auto will start pre-pressurization to a pressure altitude not more than 400 ft below actual pressure altitude, this to avoid surges during take-off....

---

In case both packs are lost (and not recovered) you will have pressurisation problems and the cabin altitude will start rising. In this case you need to perform an emergency descent (if the problem occurs at high altitude). For more information please see also chapter Overheating of the Packs.

<b>IMPORTANT</b> Do not change the mode (Auto to Man or Man to Auto) in flight. As in the real aircraft only one mode is annunciated at a time!
-------------------------------------------------------------------------------------------------------------------------------------------------

#### 3.5.4.1 Controlling the cabin pressure in manual mode

Controlling the cabin pressure in manual mode is very simple. First take care that the pressurization system is fed with air from the APU on ground and emergency DC is given. The pressurization could be controlled as soon as you have electricity (you will see "MAN" on the Man/Auto button pos. 102) and air from the APU (or engines in flight). If essential AC (SAC) is given the mode changes automatically to "AUTO" as soon as SAC is available. If you prefer to fly in manual mode you must press the button pos. 102. After this you will see "MAN" on the button. The pressurization is now controlled manually.

Compared to the auto mode, the rate of climb or rate of descend could not be controlled directly but you could control the opening angle of the discharge valves with the knob Pos. 103. If the knob is in the left position (as in the picture above), the valves are fully closed. The more you open them, the more air flows through the valves. The valve indicators Pos. 100 and 101 shows you how much the valves are opened.

When you open the discharge valve and you have bleed air from the APU or engines the cabin altitude rises accordingly the opening angle of the valves. The rate of change (climb or descent) is shown in the cabin VSI indicator (pos. 106). The more you open the valve the higher the rate is.

One of the differences to the automatic mode is, that the manual mode did not close the valves when the desired altitude is reached. After reaching the desired cabin altitude you have to move the knob pos. 103 back to the center position to close the discharge valves.

Typical cabin altitudes for cruise are:

FL240 = 4000 ft.  
FL270 = 5000 ft.  
FL280 = 6000 ft.

Those are the altitudes the automatic pressurization mode will adjust.

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### 3.5.4.2 Controlling the cabin pressure in automatic mode

#### Climb

First take care that the pressurization system is fed with air from the APU on ground (or air from the engines in flight) and essential AC (SAC) is given. As soon as SAC is available the text on the button pos. 102 changes to "Auto". Now the complete pressurization is controlled automatically if also air is available.

Now you have to set a target altitude with the altitude selector pos. 104 by pressing on the knob pos. 105 as long as the needle reaches the desired cabin altitude. The cabin altitude selector has a smaller inner ring where you could find a reference to the flight altitude. The outer ring shows the cabin altitude. The pressure calibration using QNH is not realized with this panel. If you would like to cruise at FL240 for example, you should bring the needle to "4" on the outer ring.

After the preferred altitude is selected you should select the cabin rate of climb (ROC) or cabin rate of descent (ROD). In AUTO mode, you can command the ROC/ROD of the cabin by turning the "rate" button pos. 243. The left position is 0. Each mouse click on the knob increases or decreases the rate in 200 steps.

A standard ROC or ROD is 400 ft./min., this means you have to open the rate with two mouse clicks. After take off you can see the selected ROC or ROD in the cabin VSI pos. 106. Of course you could also select a higher ROC or ROD in case of quicker than normal descent for example to avoid the aircraft catching up the cabin, in which case the cabin would then descent at the same rate as the aircraft since negative pressure is not allowed.

After the aircraft is taking off the system starts to go to the target altitude. The cabin VSI and cabin altitude will now be controlled automatically so you have nothing more to do here. It's not necessary to move back the rate knob pos. 243 to zero when the target altitude is reached.

If you select a lower target altitude in the altitude selector pos. 104 as you really fly, the cabin altitude and cabin VSI stops at the target altitude. For example: If you select a target altitude of 24000 ft. and the aircraft passes 24000 ft. and continues the climb the cabin VSI goes back to zero at 24000 ft. and the cabin altitude didn't continue the climb because the discharge valves are closed.

---

## Descent

Before you descent it's necessary to set the new desired altitude with the altitude selector pos. 104. This new altitude is normally the altitude of the destination airport. If this altitude is selected and the aircraft starts to descent, the automatic pressure control starts to go to this target when the rate (pos. 243) is not set back to zero (fully left knob position).

The ROD is controlled with the selected rate pos. 243. In the third knob position, the cabin altitude descends with a ROD of 400 ft./min. The more you move the knob pos. 243 to the right, the higher is the ROD.

As soon as the cabin altitude reaches the selected altitude, the discharge valves will be closed automatically. Take care that this did not happen before the aircraft is close the selected altitude. If the cabin altitude reaches the target altitude too soon, the cabin would then descent at the same rate as the aircraft since negative pressure is not allowed. If that happens at 6000 ft descending at 2000 ft/ min for example you will hurt your ears.

### **3.5.4.3 Protection Built-In for the Pressurization**

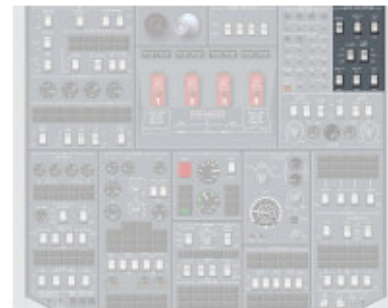
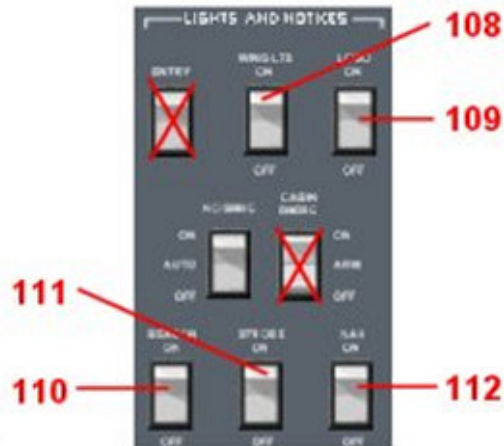
The real Avro ARJ discharge valves have some protection built in for the pressurization. Some of them are also realized in this panel.

- When there is no bleed to the discharge valves, they close.
- If the cabin altitude rises above 15.000 feet, they close.
- If the cabin altitude exceeds 9300 feet, the MWS CABIN HI ALT red warning is triggered, and the airco goes to fresh if recirc was selected.
- Upon landing, with thrust levers retarded below 80% N1 and gear touched the ground, the outflow valves are commanded to fully open to equilibrate residual pressure difference. This can only work with engine n°4 ENG AIR switch on. The outflow valves operate with air taken from the ENG AIR valves or APU AIR valve directly, not from the packs. However, they do control air flowing through the cabin which is coming from the packs

Not realized is the real world function that, if the delta p = pressure difference between inside and outside exceeds 7.4 PSI, the discharge valves will open to maintain that maximum. If the delta p is less than -0.5 PSI, they open inwards (negative pressure differential).

## 3.6 The Aircraft and Cockpit Lights

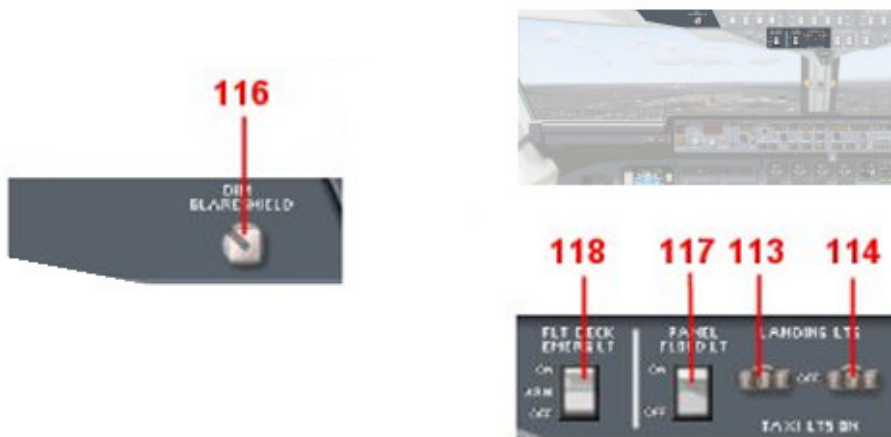
### 3.6.1 The Light switches



108	Wing lights switch.
109	Logo lights switch.
110	Beacon light switch.
111	Strobes light switch.
112	Navigation lights switch (please see also additional notes).



115	Instrument light switch.
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113	Left landing and taxi light switch. The switch has three positions. In the center position the left landing and taxi lights are off. In the upper position the left landing lights are on and in the lower position the left taxi lights are on.
114	Right landing and taxi light switch. The switch has three positions. In the center position the right landing and taxi lights are off. In the upper position the right landing lights are on and in the lower position the right taxi lights are on.
116	Glareshield (MCP and Nav1) and upper letter light switch.
117	Panel flood light switch (in the real aircraft here is normally the rwy exit light switch). Please see also additional notes.
118	Flight deck emergency light switch. This switch has three positions. In the lower position the emergency lights are off. In the center position the emergency lights are armed and will be switched on automatically in emergency electrical level. In the upper position the emergency lights are always on. Please see below for more information about the emergency light switch.

### **Additional Notes**

The red crossed switches in the lights unit have no function yet.

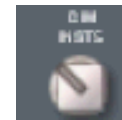
Normally the navigation lights are powered with electricity from the essential DC bus (SDC). But the navigation lights are also fed with an AC-sub-busbar powered from the ground power unit (GPU). This sub-busbar is connected to the main AC 2 bus when external power is given and switched on. That's why the navigation lights are also always on if the GPU is activated. No matter if the navigation light switch (pos. 112) is on or off.



The cockpit flood lights are normally fed with power from the essential DC bus. If the emergency light switch (pos. 118) is armed or on, the cockpit lights are additionally fed with power from the emergency DC (MDC) and in case of a failure of MDC with power from the battery busbars.

If the standby generator is active and the left landing or taxi light (pos. 113) is on, the Q-Feed-Pitot heat is off and the “Q FEED HTR FAIL” light comes up in the screen, vane and pitot annunciator. This is one of the limitations when the standby generator is active which is also called: “power reduced to essential level”. You will find some more information in the chapter “The Ice Protection System”.

### 3.6.2 The different cockpit lights



Switch pos. 115 activates the instrument lights in all panel windows.



Switch pos. 117 activates the panel flood light (please see also additional notes below).



Switch pos. 116 activates the illuminated letter lights in the glareshield and overhead panel



### Additional Notes

Sometimes it could happen that the instruments are not visible (dark) or show strange values and dark frames after switching on or off the panel flood lights. This could be solved when switching on and off the instrument lights again with the switch pos. 115.

### 3.7 The Antiskid and Spoilers



119	Antiskid and Spoiler Annunciator. Please see below for detailed descriptions.
120	Antiskid switch. This switch has three positions. In the lower position the Antiskid system works with electrical power from the battery bus. In the center position the Antiskid system is switched off. In the upper position the Antiskid system works with power from the DC 2 bus.
121	Auto spoiler switch. If the autospoiler is armed (upper position) the spoiler will be deployed as soon as the aircraft is on ground (weight on wheels).

#### The Antiskid and Spoiler Annunciator (pos. 119)



In the Antiskid and Spoiler annunciator are just the two lights “Anti Skid inop” and “Anti Skid Fault” realized, because there is no freeware aircraft available at the moment which supports roll spoilers. Both realized lights came up when the antiskid system is fault or the electrical supply for the antiskid system is not given.

#### **Additional Notes**

The red crossed switches have no function at the moment.

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The complete antiskid system is just a dummy at the moment as the Flightsimulator did not support any effects at the moment (a poor fact). However I've realized this system with some custom variables to give the possibility to see what happens in the cockpit with this system.

### **3.7.1 Using the Autospoiler**

The Avro ARJ autospoiler could be activated with the switch pos. 121. If the autospoiler is on the system has the following functions:

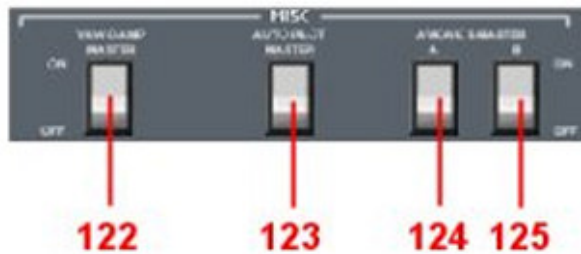
- The spoilers will be fully deployed automatically when there is weight on wheels and the throttles are moved back to the idle position. The spoilers will not deploy if the aircraft is not on ground or if the throttles are not in the idle position
- The spoilers will be retract automatically when the aircraft has weight on wheels and the speed is below 25 knots.

### ***Additional Notes***

In the real aircraft it's sufficient when there are at least three of four throttle levers in the idle position. This is not realized with this panel. Here you need to have all throttles in the idle position to deploy the spoilers.

### 3.8 Further Switches in the Overhead Panel

#### 3.8.1 The Master Switches



122	Yaw damper master switch.
123	Autopilot master switch.
124	Avionics A master switch. Please see details below.
125	Avionics B master switch. Please see details below.

#### **Additional Notes**

The autopilot master switch does not activate the autopilot itself. This will be done in the glareshield panel. However it's necessary to activate the master switch before activating the autopilot. Otherwise the autopilot will not work and you will see a red warning light in the AFGS.

The yaw damper will be activated directly with the yaw damper master switch. If the necessary electrical power supply is given (the yaw damper works with the DC 1 bus) it will be activated as soon as the switch is on. If the yaw damper master switch is off you will see an amber warning light in the AFGS.

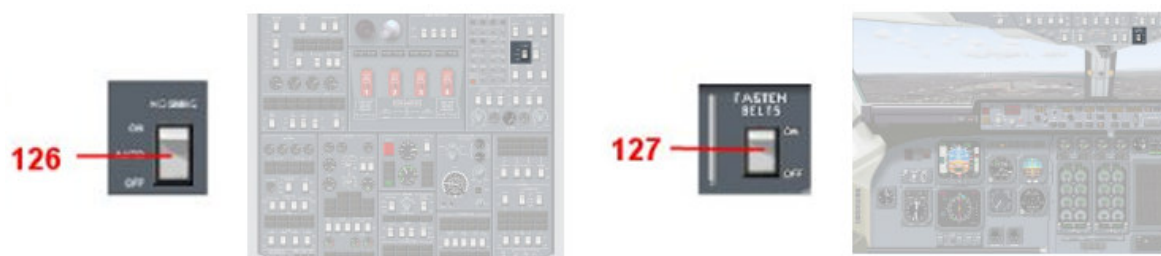


### 3.8.2 The Avionic A and Avionic B allocations

The Avro ARJ has two avionic busses used for the radios and navigation instruments. The allocation of each instrument is:

Avionic Bus A	Avionic Bus B
<ul style="list-style-type: none"> <li>• Comm 1</li> <li>• Nav 1</li> <li>• ADF</li> <li>• Transponder</li> <li>• Nav 1 related information of the PFD and ND (DME, CDI, GSI)</li> <li>• ADF needle of the ND</li> <li>• DBI (RMI) DME 1</li> <li>• DBI (RMI) ADF needle</li> </ul>	<ul style="list-style-type: none"> <li>• Comm 2</li> <li>• Nav 2</li> <li>• Nav 2 needle of the ND</li> <li>• DBI (RMI) DME 2</li> <li>• DBI (RMI) VOR 2 needle</li> </ul>

### 3.8.3 No Smoking and Fasten Seat Belts Switches



126	No smoking switch. This switch has three positions. The lower position is "Off", the center position "Auto" and the upper position continuously "On".
127	Fasten seat belt switch.



### 3.9 The Automatic Starter

The new AVRO Panel contains an invisible switch for automatic start. This switch is set for the user who doesn't want to go through the cold start-up procedure. I prefer you to go through the cold start-up procedure rather than using this switch. Nevertheless some Flightsim pilots do prefer to have such an automatic starter. For them I've implemented it.



When using the automatic starter, the next points will be executed and activated:

- All electrical busses are activated
- Hydraulic DC pump is connected with the battery
- APU is started
- Fuel valves are opened and fuel pumps are switched on
- Engines are started
- Hydraulic pumps are activated
- Flight Deck Emergency Lights are armed
- Avionics A and B are switched on

Next points are not executed by automatic start:

- Autopilot Master Switch and Yaw Damper are not activated
- Anti Skid is not switched on
- All anti-ice and de-ice switches are not set to on
- There is no Cabin Altitude chosen and the discharge valves stay closed
- All extern and intern lights are out
- PFD and ND are not switched on
- TRP settings are not resolved

All these points which will not be executed by the automatic start, must be done manually after the autostart is activated.

### 3.10 Control units of the PFD and ND



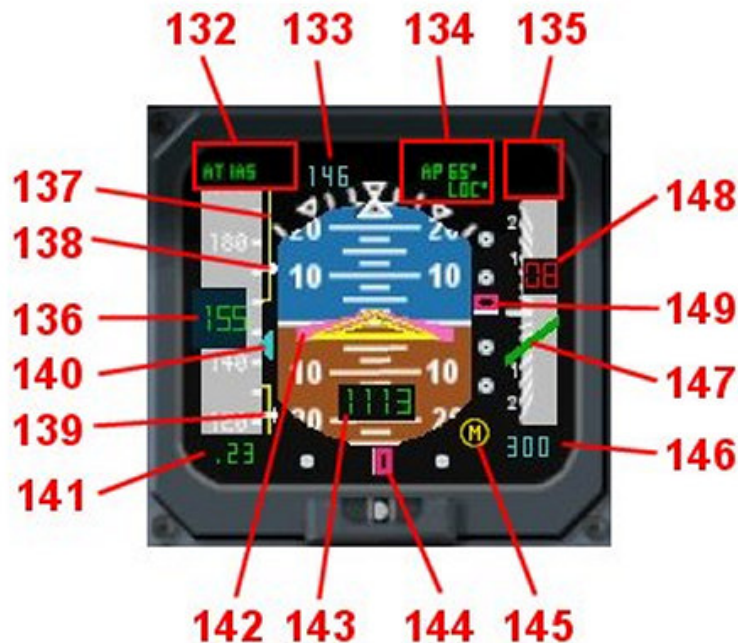
128	Decision Height selector (sets the decision height in 10 feet steps)
129	Switch to change the ND view from ARC to Rose Mode
130	Switch to NAV / GPS Mode
131	Display main switch for ND and PFD

#### **Additional Notes**

In a real ARJ, the switches pos. 129 and 130 can be found in the EFIS Control Panel (ECP) in the pedestal panel. This unit is not released yet in this version. It will be done in the next updating of the pedestal panel which contains the map and WXR display modes, and the GNS-X.

Instead of the switches pos. 129 and 130, there is a display brightness control and lucency control of the WX screen in the real ARJ. The decision height control is placed like in a real ARJ and could be found on the same location.

### 3.11 The Primary Flight Display (PFD)



*Picture of the PFD is different to the actual used PFD in the ARJ panel!*

132	Left autothrottle status indication (see chapter 3.11.2 for more information).
133	Selected autothrottle speed (IAS or Mach depending on what you've chosen with the CO switches of the MCP).
134	Status indication of the captured autopilot modes (see chapter 3.11.2 for more information).
135	Status indication of the armed autopilot modes (see chapter 3.11.2 for more information).
136	Airspeed digits. Red speed digits means that the speed is too low and you are in danger to stall or the speed is too high and you are in an over speed. Yellow speed digits means that the speed is above the acceptable maximum speed of the respectively flaps setting or the speed is just 20 knots from stall speed. Green digits means that the speed is within the acceptable guidelines.
137	Limitation beams for the maximum speed flap positions above and security beams to indicate the range in distance of 20 knots to stall speed

138	Speed bug of the in TRP set $V_{FTO}$ speed
139	Speed bug of the in TRP set $V_R$ speed
140	Speed bug for the in MCP selected autothrottle speed (IAS or Mach depending of the position of the CO switches on the MCP)
141	Digital speed in Mach
142	Flight Director V-Bar
143	Digital radio altimeter displays below 2500 ft radio altitude. The green coloured digits change into yellow as soon as you are below the selected decision height.
144	Localizer position needle. Indicates when Nav 1 receives a localizer signal (see also chapter 3.11.1). If no LOC signal is received, the PFD shows the red text "LOC". When Nav 1 receives an ILS signal, the range of the LOC indicator is 1/10 of the HSI range. By this a more precise adjusting on the localizer course, also by manual approach, is possible.
145	Outer, Middle and Inner marker
146	Digital decision height indicator. This indicator shows up permanently below 2500 ft. or if another decision height is set with knob Pos. 128. In this case the decision height is shown for about 10 seconds. If the radioalt is reaching the selected decision height, the indication is flashing for a few seconds. After that a big yellow "DH" is shown instead of the decision height to let the pilots know that the aircraft is below the selected decision height.
147	Vertical speed indicator
148	Digital vertical speed indicator. The vertical speed is shown with two digits in red colour in case of negative VSI above the needle and in green colour in case of positive VSI below the needle.
149	Glideslope indicator. Indicates when Nav 1 receives a glideslope signal and the aircraft is within the range a GS could be armed (see also chapter 3.11.1). If the GS signal is outside a range where it could be armed, a red text "GS" will be shown. When Nav 1 receives only a VOR signal or no GS signal the indication will be completely hidden like in the real ARJ.

### **Additional Notes**

The Avro ARJ PFD is programmed exactly as it is in the real ARJ. Entirely the speed trend indicator isn't transformed in this panel.

The PFD will be visible by activating the power supply of the essential AC Bus (SAC) and the display is switched on with the display master switch pos. 131.

The navigation data of the PFD (e.g. GS and LOC indication) will be visible if the Avionic Bus (Avionic A for displaying Nav 1 information) is switched on.

According to the used flight simulator aircraft model it's possible that the green range of the speed indication with full flaps will be very small. That's because the maximum flap speeds of the PFD are used from the real ARJ and the lower flap speed (stall area) is used from the flight simulator airfile. If the stall speed of the airfile is very high, the green area gets smaller because the maximum flap speed always is the same.

The Avro ARJ PFD can be zoomed in by mouse click on the PFD. Clicking ones again on the indication becomes the normal view. Unfortunately the used standard fonts are not very clear and therefore it is possible that the digital text of the PFD in the zoomed view is not so beautiful.

### 3.11.1 Different LOC and GS indications in the PFD



GS Display when Nav 1 receives a glideslope signal from an ILS station.



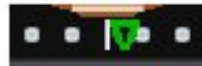
GS Display when Nav 1 receives an ILS signal but no glideslope signal or the aircraft is not in the range to arm the GS signal of an ILS station.



No GS Display when Nav 1 has no signal or the signal from a VOR station.



LOC Display when Nav 1 receives a localizer signal from an ILS station



LOC Display when Nav 1 receives a CDI signal from a VOR station



LOC Off Display when Nav 1 receives no ILS or CDI signal.

### 3.11.2 The PFD status indication of the autothrottle and autopilot

The Avro ARJ PFD shows the selected and preselected roll, pitch and thrust modes of the DFGS auto flight system (autopilot and autothrottle) in the upper display area. For a better description, I have divided the modes in the three areas pos. 132, 134 and 135.

Thrust mode status indications (area pos. 132)

Text	Colour	Description
---	White	Power supply by the AC 1 bus not available
A/T	White	Autothrottle is armed but not active yet = no autothrottle adjustment of the thrust. Also visible when descending using LVLCHG.
A/T	Green	Autothrottle is active. All thrust levers are adjusted from the system as long as the FADEC is not deactivated.
TO REDU	White	Toga Redu Mode of the TRP is armed. Other autothrottle modes (IAS and Mach) are not active. Toga is not activated and/or autothrottle is disabled.
TO REDU	Green	Toga Redu Mode of the TRP is active and thrust is adjusted by the autothrottle. Other modes (IAS and Mach) are not active.
TO MAX	White	Toga Max Mode of the TRP is armed. Other autothrottle modes (IAS and Mach) are not active. Toga not activated yet and/or the autothrottle disabled.
TO MAX	Green	Toga Max Mode of the TRP is active and thrust is adjusted by the autothrottle. Other modes (IAS and Mach) are not active.
MCT	White	MCT (maximum continuous thrust) Mode of the TRP is armed. Other autothrottle modes (IAS and Mach) are not active. Toga not activated yet and/or autothrottle disabled.
MCT	Green	MCT Mode of the TRP is active and thrust is adjusted by the autothrottle. Other modes (IAS and Mach) are not active yet.
CLBNRM	White	Climb Norm Mode of the TRP is armed. Other autothrottle modes (IAS and Mach) are not active. Toga is not activated yet and/or autothrottle disabled.

<b>Text</b>	<b>Colour</b>	<b>Description</b>
CLBNRM	Green	Climb Norm Mode of the TRP is active and thrust is adjusted by the autothrottle. Other modes (IAS and Mach) are not active.
CLBMAX	White	Climb Max Mode of the TRP is armed. Other autothrottle modes (IAS and Mach) are not active. Toga is not activated yet and/or autothrottle disabled.
CLBMAX	Green	Climb Max Mode of the TRP is active and thrust is adjusted by the autothrottle. Other modes (IAS and Mach) are not active.
IAS	Green	The autothrottle is activated and adjust the necessary thrust for the preselected speed of the MCP automatically. This function is only available in ALT, VS or APP mode.
MACH	Green	The autothrottle is activated and adjust the necessary thrust for the preselected mach of the MCP automatically. This function is only available in ALT, VS or APP mode.
RETARD	Green	Autothrottle Retard is active. In this mode the thrust levers will be automatically moved to idle for 10 seconds. This function will be executed when a descent with VS or LVLCHG is triggered.

Captured AP Mode status indications (area pos. 134)

<b>Text</b>	<b>Colour</b>	<b>Description</b>
--	White	Power supply by AC 1 bus is not available and/or autopilot main switch (pos. 123) is disabled.
AP	Green	Autopilot is active.
AP	Red	Autopilot is switched on but is not available (e.g. if aircraft is on ground). The red indication is also visible for a couple of seconds when the AP will be disabled.
FD	Green	Autopilot is disabled but flight director is enabled. Indication "FD" changes into "AP" as soon as autopilot will be switched on, independently whether FD is switched on or not.



<b>Text</b>	<b>Colour</b>	<b>Description</b>
TO	Green	Vertical TO mode of the autopilot. Please see chapter 3.16.2.1 for more information.
TRK	Green	Lateral TRK mode of the autopilot. Please see chapter 3.16.2.1 for more information.
ROLL	Green	Lateral ROLL mode of the autopilot. Please see chapter 3.16.2.1 for more information.
VS	Green	VS Mode of the MCP is activated.
ALT	Green	ALT Mode of the MCP is activated.
ACQ	Green	ACQ is visible when the difference between the real altitude and the preselected altitude is about 300 feet. The indication starts flashing 50 feet before reaching the selected altitude.
IAS	Green	LVLCHG of the autopilot is active. This will be either by LVLCHG button ("ON" on the button lights up) or by the thrust button of the MCP. VS, ALT or APP is not active. The indication is flashing for a short time after activating the LVLCHG modes.
HDG	Green	HDG Mode of the MCP is activated.
VOR1	Green	VORLOC Mode of the MCP is activated and VOR hold is active.
BLC1	Green	VORLOC Mode or APP Mode of the MCP is activated and Back course (BC) hold is active.
LOC1	Green	APP Mode of the MCP is activated, Localizer hold is active and LOC is captured.
LOC*	Green	APP Mode of the MCP is activated, Localizer hold is active, LOC and GS are captured.
GS*	Green	APP Mode of the MCP is activated, Glideslope hold is active and GS is captured.
LNAV	Green	Flightplan Mode (GPS mode) of the autopilot is switched on.

---

Armed Mode status indication (area pos. 135)

Text	Colour	Description
LOC1	White	APP Mode of the MCP is activated and Localizer hold is armed.
VOR1	White	VORLOC Mode of the MCP is activated and VOR hold is armed.
BLC1	White	VORLOC Mode or APP Mode of the MCP is activated and Back course (BC) hold is armed.
GS1	White	APP Mode of the MCP is activated and Glideslope hold is armed.

Descriptions of the current autopilot and autothrottle functions can be found in the corresponding chapter of this manual.

### 3.12 The Avro ARJ Navigation Display (ND)



150	DME or distance indication. In Nav mode the ND shows DME1 (DME2 is not available at the moment) and in GPS mode „DIST“ will be displayed. If the Avionic A main switch (pos. 124) is disabled, ---- will be displayed.
151	Nav 1 DME distance. If the Avionic A main switch (pos. 124) is disabled, ---- will be displayed.
152	Selected heading curse of the MCP.. If the autopilot master switch (pos. 123) is disabled or AC 1 not available, --- will be displayed.
153	Navigation mode indication of the ND. For more information please see chapter 3.12.1 of this manual.

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154	Dummy indication (no function) in Rose Mode.
155	Wind heading indication
156	Wind speed indication
157	Heading bug
158	Nav 2 course indication
159	ADF course indication
160	Localizer course of Nav 1 selected in the MCP.
161	Nav 1 localizer indicator. This CDI needle is only visible if Nav 1 receives a VOR signal (green) or ILS signal (red).
162	Glideslope indication. This indication is only visible if Nav 1 is set to an ILS signal and a Glideslope signal is received. When Nav 1 is set to an ILS signal and no GS signal is received, the red text "GS" is displayed. If Nav 1 receives no signal or is set to a VOR station, the indication is not visible.

### ***Additional Notes***

The Avro ARJ PFD is programmed exactly like the real ARJ ND. The indicated map and flight plan displays are not available at the moment. They will come with a further update or new version.

The ND is only visible when the power supply of the essential AC Bus (SAC) is available and the master display switch pos. 131 is on.

The navigation relevant dates of the ND (heading indication and DME dates) will only be visible if the corresponding Avionic Bus (Avionic A for displaying Nav 1 and ADF dates and Avionic B for displaying Nav 2 dates ) is switched on.

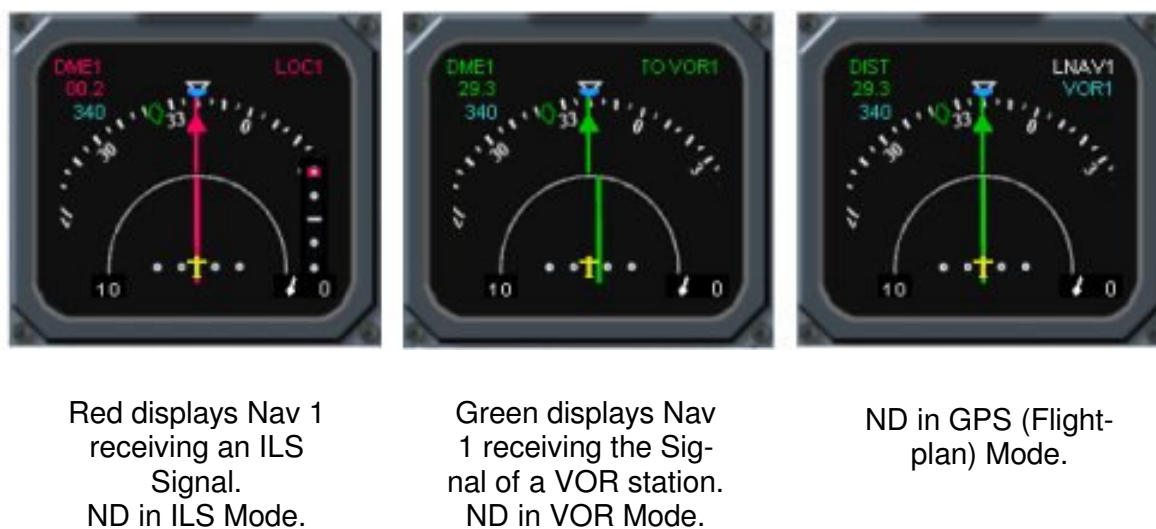
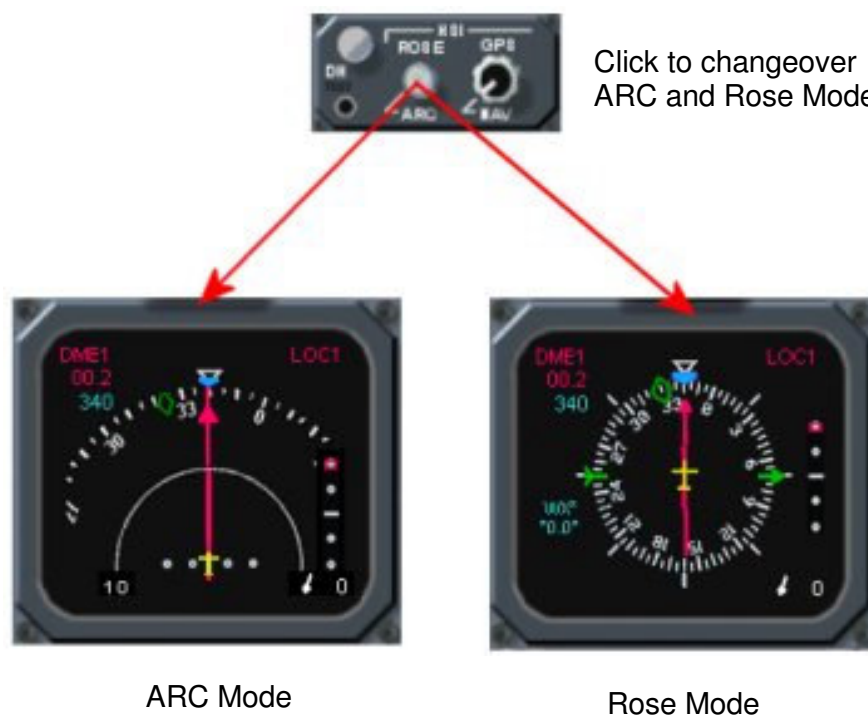
The navigation display (ND) can be zoomed in by a mouse click on the display. Clicking ones again on the display becomes the normal view.

### 3.12.1 Navigation mode indication of the ND

The current navigation modes will be displayed In the upper right area of the ND (pos. 153). The respective indication text and it's signification is described below.

Text	Colour	Description
----	White	Is displayed if Avionic A is disabled or not available.
LOC1	Red	Is displayed if Nav 1 is set to an ILS and a localizer signal is received.
VOR1	Green	Is displayed if Nav 1 is set to a VOR station.
FROM	Green	Is displayed if Nav 1 is set to a VOR station and the aircraft is flying away from the VOR station.
TO	Green	Is displayed if Nav 1 is set to a VOR station and the aircraft is flying to the VOR station.
LNAV1	White	Is displayed if the aircraft is in LNAV mode, i.e. the GPS mode is active and a flight plan is be flown on GPS.
VOR1	Blue	Is displayed if the aircraft is in LNAV mode and navigation to VOR 1 is in standby.

### 3.12.2 Die verschiedenen Anzeigen des ND's



### 3.13 Further primary and standby Instruments



163	DBI DME Nav 1
164	DBI DME Nav 2
165	VOR 2 and ADF needle (depending of pos. 168)
166	VOR 1 and ADF needle (depending of pos. 167)
167	Changeover switch for VOR 1 - ADF
168	Changeover switch for VOR 2 auf ADF
169	Standby Altimeter
170	Barometer setting knob
171	Standby Attitude
172	Flight director needles of the standby attitude. These needles are displayed automatically if a Nav mode (NAV, BC or APP) is activated on the MCP.



173	TCAS (Vertical Speed Indicator)
174	Combined gauge for altimeter (upper) and airspeed (lower).
175	Further barometer setting knob.

### ***Additional Notes***

The Avro ARJ panel has two independent DBI's. The second DBI is located in the pressurization / TRP window. Like the DME displays, the functionality of both gauges is identically, but the needles can be set interdependent.

The TCAS of the real ARJ is not programmed yet. Instead of the TCAS there is a vertical speed indication in the panel like it was used in several BAe 146 and in the pre-EFIS version of the BAe 146.

### The Primary and Standby Instrument Off Flags



### 3.14 The Engine Instruments



176	Oil pressure, temperature and quantity.
177	Engine vibration

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178	Digital engine thrust limit. This display starts blinking when an illegal bleed state occurs. For more information please see chapter 3.16.3.2 of this manual.
179	Engine N1 % RPM
180	Engine thrust limit indicator
181	Engine EGT temperature
182	Engine N2 % RPM
183	Fuel Flow indicator (Lbs x 100)
184	Digital fuel flow display (Lbs x 1000). This display changes to fuel used for a couple of seconds after pressing the fuel used push button (pos. 188).
185	Fuel quantity of the left wing tank. The second PED (primary engine display) (for engine 3 and 4) shows no value here.
186	Fuel quantity of the center tank. The second PED (for engine 3 and 4) shows here the fuel quantity of the right wing tank.
187	Push button to changeover to manual thrust limitation and setting knob for adjusting the manual thrust limit. For more information please see chapter 3.16.3.3 of this manual.
188	Push button to display fuel used. When this button is pressed, the digital display. Pos. 184 shows fuel used for about 10 seconds. After this 10 seconds the display changes back to fuel flow.
189	Fuel used reset button. Pressing this button sets the fuel used display back to zero.

### ***Additional Notes***

The oil quantity indicator is just a fake as the flight simulator did not support any oil quantity.

Chapter 3.16.3.2 contents a much closer description of the TRP handling and adjusting of the thrust limit settings.

The engine displays and indication of the primary engine display have different electrical sources. While some of them are supported with power from the MDC bus, others are supported with power from SDC. An exact listing of the necessary electrical sources for each engine indicator could be found in chapter 3.1.2 of this manual.

For a better readability, the PED's could be enlarged with a mouse-click on each gauge. A further mouse-click closes the PED's again.

### 3.14.1 Full Authority Digital Engine Control (FADEC)

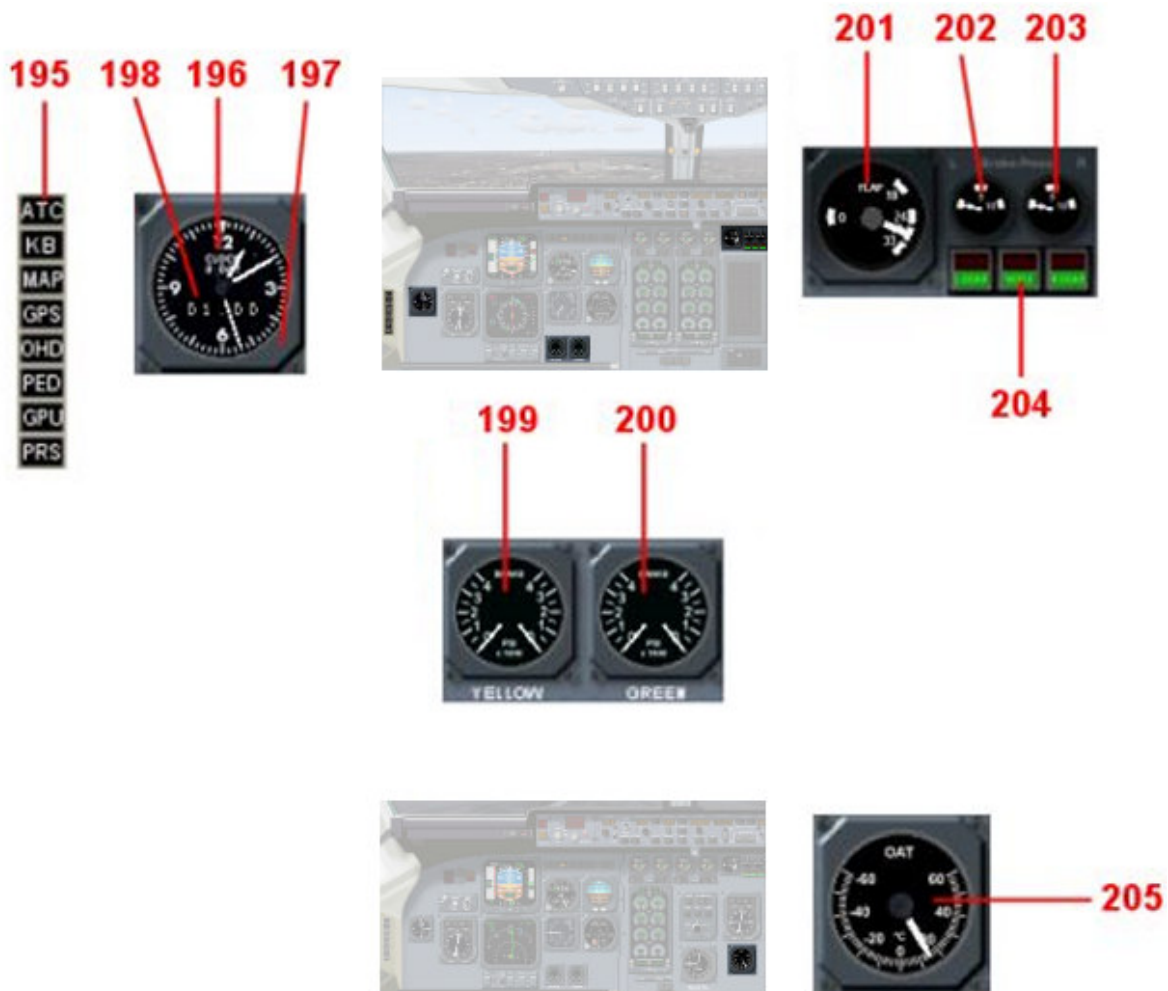
The Avro ARJ panel is equipped with a very realistically working Full Authority Digitally Engine Control (FADEC). This system supervises continuously all engines and prevents e.g. too high N1 rotations or too high engine temperatures. Beside this, it supports many functions of the autothrottle and is responsible for the regulation of the thrust limits.

If the FADEC of an engine will be switched off, it is no longer monitored. This means e.g. that the engines could be operated above 97% N1. But because of it is also possible to overstress or overheat the engines now. Also the TRP couldn't control the autothrust of this engine any longer and so it results in an unequal controlling of the engines. A deactivation of the FADEC should always be act with caution.



190	Engine number. The number illuminates as soon as the FADEC system is supported with electricity.
191	FADEC error indicator (not realized in the ARJ panel yet).
192	The blue arrows of the FADEC systems are only active when flying without an engaged autothrottle. The blue arrow illuminates when the thrust of the corresponding engine is lower than the thrust of the master engine (selected with the TRP). It commands the pilot to increase the throttle of this engine until it is within the reference value of the selected master engine.
193	The white arrows of the FADEC systems are only active when flying without an engaged autothrottle. The white arrow illuminates when the thrust of the corresponding engine is higher than the thrust of the master engine (selected with the TRP). It commands the pilot to decrease the throttle of this engine until it is within the reference value of the selected master engine.
194	Switch to deactivate the FADEC for each engine. A switched off FADEC is shown with the white illuminated text "OFF" on each switch.

### 3.15 Further Gauges in the Main Panel



195	Panel window toggles. Please see gauge tooltip texts for window info.
196	Clock
197	Invisible mouse click area for setting time
198	Simulation rate readout and mouse click position for the simulation rate.
199	Yellow brake pressure indicator
200	Green brake pressure indicator (without function yet).

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201	Flap position indicator
202	Left spoiler indicator
203	Right spoiler indicator
204	Landing gear lights.
205	Outside air temperature (OAT). This gauge is in the PRS subpanel.

### ***Additional Notes***

In the real ARJ panel you have a switch in the pedestal panel to choose if the brake pressure is used from the yellow or from the green hydraulic system. This is not realized with this panel yet. At the moment the complete brake pressure is realized with the yellow hydraulic system. That's why the green brake pressure indicator is without any function yet.

As I've realized a very complex hydraulic system, you should believe the brake pressure indicators more than the standard text you see in the FS window. For example. If you activate the parking brakes after a flight and then you switch off the hydraulics you still have the information in the standard FS text that the brakes are set, but they aren't. If emergency AC (MAC) is given and so the brake pressure indicators work but they show zero, the brakes won't work no matter what the red FS text told you.

The spoiler indicators pos. 202 and 203 are normally indicators for the roll spoilers. Unfortunately there is no freeware FS aircraft at the moment which supports any type of roll spoilers. That's why I decide to put the brake spoilers in here.



### 3.16 The Digital Flight Guidance System (DFGS)



The Avro ARJ DFGS is a very complex automatic flight system. This system was realized with this panel as good as possible and you should never make the mistake to compare it with the standard autopilot of the Flight simulator. On the next pages you will find a lot of very important information about the DFGS and the handling of it. Please take care to understand everything before using the system.



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### 3.16.1 DFGS System Description

The DFGS contains two digital flight guidance computer (DFGC), the mode control panel (MCP), the thrust rating panel (TRP) and several servos/actuators and position sensors, to implement the DFGC commands

The digital flight guidance computer performs a couple of commands for the flight director which are displayed on the primary flight display (PFD) (please see chapter 3.11). Those commands are followed by the pilot manually or, when the autopilot is switched on, will be executed directly via servos by the DFGC.

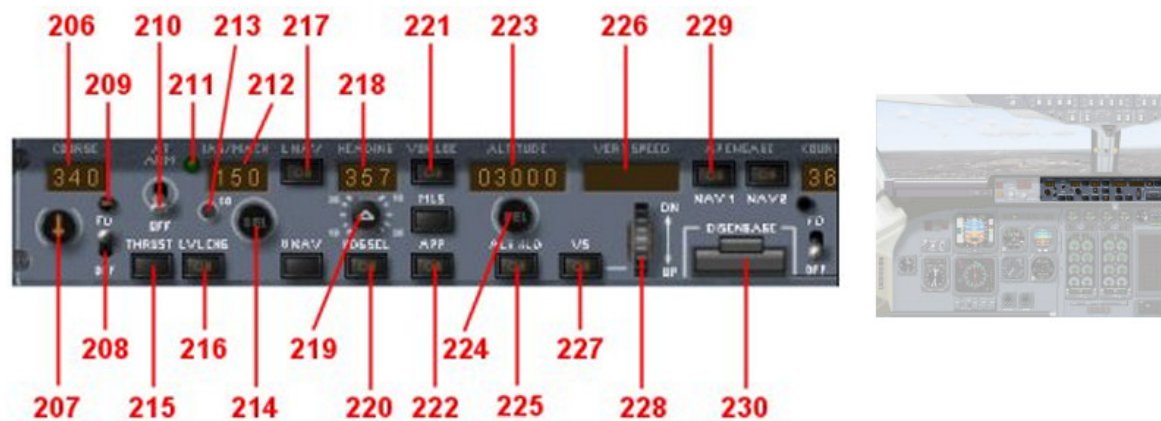
Airspeed, mach, heading, altitude and vertical speed are selected on the mode control panel (MCP). Flight director/autopilot modes are also selected or preselected on the MCP. These are displayed on the primary flight display for confirmation (pos. 132 – 135 on the PFD)

In autothrottle speed/mach control mode or thrust control mode, the digital flight guidance computer (DFGC) cooperates with the full authority digital engine control (FADEC). In an initial control loop, the four throttles are brought to the position corresponding to the thrust target by the DFGC via a common servomotor. The thrust target is calculated in the DFGC. In a second control loop the FADEC regulates the fuel flow to each individual engine according to the thrust target. Minor differences are automatically compensated for by the FADEC. For monitoring purposes the thrust target is displayed on the primary engine display (PED). The engines themselves are always under FADEC control, if FADEC is not switched off. In this way the thrust limit (Toga Max, Toga Redu, MCT, Climb Max and Climb Norm) indicated on the thrust rating panel (TRP) is complied with.

When the aircraft exceeds the engine or technical airspeed limits, the system contains a couple of safety functions to reduce or increase the power in an engine overspeed, engine over temperature or stall and overspeed. If necessary, the setting of the MCP will be adapted automatically.

A power monitoring also takes place when the autothrottle is switched off by the FADEC system. In this case the FADEC monitors the engine revolution and temperature. When the pilot increases the throttles too much and N1 exceeds 97% N1 or the temperature rise above 660°C, the system reduces the thrust automatically to bring it back within the limitations. When the FADEC is switched off for an engine, there's no monitoring of this engine and no safety function take place. So always take care that the FADEC is active and switched on.

### 3.16.2 The Mode Control Panel (MCP)



206	Digital Nav 1 course display
207	Knob to adjust Nav 1 course
208	Switch to engage/disengage Flight Director 1.
209	FD master lamp 1. This lamp illuminates when Flight Director 1 is active.
210	Autothrottle master switch.
211	Signal lamp of the autothrottle master switch.
212	Display for the preselected IAS/Mach speed. The preselected speed is also visible in the primary flight display (pos. 133).
213	IAS / Mach changeover button.
214	Knob to adjust the preselected IAS or Mach speed.
215	Button to activate the TRP thrust mode. For more information please see the complete chapter 3.16.3 of this manual.
216	Button to activate the LVLCHG (level change) mode. For more information please see the complete chapter 3.16.3 of this manual.
217	LNav button to activate the standard FS GPS mode (a real LNav mode will be realized together with the GNS-X in a further version).

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218	Digital HDG course display.
219	Knob to adjust the HDG course.
220	Button to activate the AP HDG mode.
221	Button to activate VOR hold, Localizer hold or BC hold. More information about the separate functions could be found in chapter 3.16.2.2.
222	Button to activate Approach course hold (APP) or BC hold. More information about the separate functions could be found in chapter 3.16.2.2.
223	Digital display of the preselected altitude.
224	Knob to adjust the preselected altitude.
225	Button to activate ALT hold. When pressing the button and the autopilot is available, the aircraft holds the current altitude. Climbing or descending to a preselected altitude is only possible with the thrust mode, LVLCHG or VS hold. More information could be found in chapter 3.16.2.3 of this manual.
226	Digital display of the preselected vertical speed. This display is only visible, if VS hold is pressed (button pos. 227) and the preselected altitude (pos. 223) is different to the current altitude. Only when those conditions are true, VS hold could be activated.
227	Button to activate VS hold. VS hold could only be activated when the preselected altitude (pos. 223) is different to the current altitude.
228	Wheel to adjust the preselected vertical speed.
229	Button to activate the autopilot.
230	Autopilot disengage switch. This switch disengage the function of all autopilot modes, while the modes are still preselected (but without any function). The auto-throttle will not be disengaged with this switch.

### **Additional Notes**

All digital displays and „On“ lights of the MCP are only visible if the electrical AC 1 bus is available and the autopilot master switch (pos. 123) is on.

Like in the real ARJ, the VNav button has no function. However the button is available in the MCP but the function of it was never realized from British Aerospace.

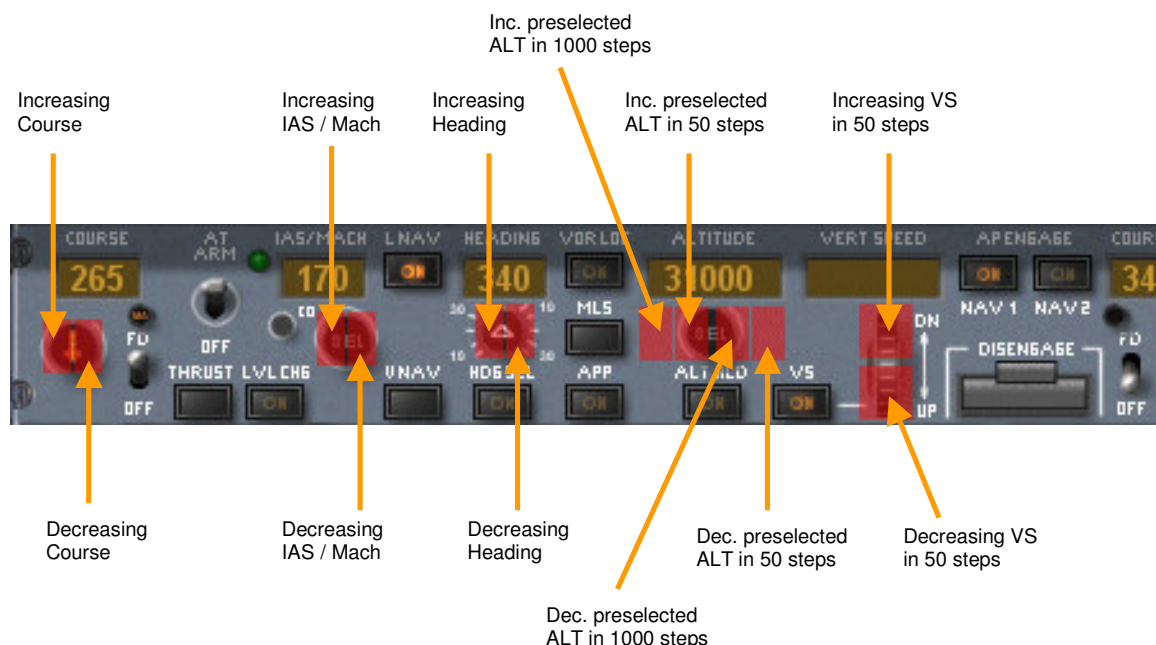
The microwave landing system (MLS) was offered from British Aerospace as an option for the ARJ. I don't know if an ARJ was ever equipped with this system. The MLS was formerly planned to replace the ILS system but had no success because of the too high costs. This ARJ panel is not equipped with the MLS system because Microsoft didn't support a MLS nor is any FS airport equipped with a MLS. Like in the real ARJ the button is existent in the MCP (if the aircraft is equipped with MLS or not) but has no function.

Because of the fact that currently just the "Captain's side" of the ARJ panel is realized, all Nav 2 modes of the autopilot have no function. This means exactly that the second Flight Director switch and it's lamp, the Nav 2 autopilot main switch and the Nav 2 course selector are just dummies yet.

Normally the autopilot of the real ARJ will be disengaged with a switch on the yoke. This is not realized with this panel. In this panel you engage or disengage the autopilot with the button pos. 229, when the electrical AC 1 bus is available and the autopilot master switch of the overhead panel is on.

Like in the real ARJ, the IAS/Mach display pos. 212 changes to Mach at an altitude of 24500 ft. when climbing and changes to IAS at an altitude of 23500 ft. when descending.

### Mouse click areas of the MCP



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### 3.16.2.1 TRK, ROLL and TO Mode

As soon as you switch on the autopilot on the MCP and it is available, the DFGS starts to control the aircraft. The system comprises the continuous and simultaneous controlling of pitch, roll and yaw commands. Because of this it is not possible to control the pitch manually while the autopilot controls a roll command or contrariwise.

If no lateral mode (HDG for example) or vertical mode (ALT for example) is engaged and the autopilot is switched on, the system starts either the TRK or ROLL mode for the lateral controlling of the aircraft and the TO mode for the vertical controlling of the aircraft. Except engaging another vertical or lateral mode of the MCP, there's no other way to disengage those modes. As soon as you disengage a vertical mode and no other vertical mode is active, the TO mode engages again. The same with the lateral modes.

#### TRK Mode of the Autopilot

When you are on ground and you start the aircraft systems, the TRK mode is the first lateral mode which is armed and the lateral axis of the flight director is assigned to the TRK mode. You could recognize this with the green text "TRK" in area 134 of the PFD when engaging the flight director (just to remember, it's not possible to activate the autopilot on ground).

The TRK mode has a very special function. While take off the current aircraft heading (which is normally the heading of the runway) will be stored from the DFGS system when the airspeed notify exactly 80 knots. When you change the direction of the aircraft, the flight director always shows the direction to the stored track. This could happen when the aircraft direction changes because of a strong cross wind after lift off for example. When you engage the autopilot, the aircraft turns back to the stored track and hold it similar a heading hold function. The only difference to heading hold is, that you could not change this stored track.

The TRK mode will be disengaged automatically when another lateral mode is engaged on the MCP. Also the stored track will now be cleared. Because of this, the TRK mode will not be activated a second time on the flight. If you disengage the activated lateral mode, ROLL mode will be used instead. After landing and switching off all MCP modes, the TRK modes will be armed again when you engage the flight director. So the TRK mode will be back when preparing another take off.

#### ROLL Mode of the Autopilot

The ROLL mode of the DFGS system is similar to the TRK mode, but it will just be engaged when the aircraft is not on ground and when another lateral mode was active after the TRK mode. An active ROLL mode is shown with the green text "ROLL" in area 134 of the PFD. The Roll mode will be activated automatically when a lateral mode (HDG for example) will be disengaged without another active lateral mode on the MCP.

When the aircraft turns to a VOR radial and you switch off VOR/LOC in this situation, ROLL will be engaged and the aircraft holds the current heading while VOR/LOC was disengaged. The ROLL mode is also active when VOR/LOC or APP is engaged, HDG hold is off and the aircraft has not captured the VOR or ILS localizer. It will be disengaged automatically when the VOR or ILS localizer signal is captured.

### TO Mode of the Autopilot

The TO mode is another vertical mode of the DFGS system. It is the standard mode when no other vertical mode (ALT, VS or LVLCHG) is active. Also this mode is armed on ground after engaging the flight director. The TO mode is shown with the green text "TO" in area 134 of the PFD.

The TO mode has two functions. When you engage the flight director on ground, the TO mode belongs to the flight director pitch command. This could be a climb command when the preselected altitude is higher than the aircraft altitude or an altitude hold command when you press the ALT button on ground. After engaging the autopilot, the TO mode takes control over the aircraft pitch as long as no other vertical mode is used. When the preselected altitude is higher than the current altitude, the TO mode is coupled to the LVLCHG climb command (when using a LVLCHG function to climb) until the preselected altitude is reached or another vertical mode will be engaged.

If another vertical mode was active before, the TO mode forces the aircraft to hold the current altitude when it will be engaged from the DFGS. This could happen when you switch off ALT hold with no other vertical mode in use. In this case the TO mode will be engaged from the system automatically and holds the current altitude. The same when disengaging LVLCHG.

When the TO mode is engaged and the autothrottle is active, the system will also change the autothrottle function if necessary. When you climb with LVLCHG for example and you disengage this mode, TO engages and forces the autothrottle to change from AT CLBNRM to AT IAS. From now on the TRP stops controlling the thrust and the autothrottle starts moving the throttles to hold the preselected airspeed independent from the TRP calculated thrust, as no longer pitch commands are possible to regulate the airspeed.



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### 3.16.2.2 Lateral Navigation with the MCP

The lateral navigation modes of the ARJ autopilot corresponds extensively those of other autopilots and in some cases those of the standard flight simulator autopilot. Nevertheless there are some specialities, which are described below.

Because of the fact that the current version didn't have a FMS (GNS-X), the LNav function of the MCP just activates the standard FS GPS mode. This mode could be engaged with the button pos. 217 in the MCP or with the NAV/GPS switch pos. 130. The available AC 1 bus and activated autopilot is assumption for the LNav mode. Further descriptions of the GPS mode (current LNav function) could be found in the MS Flight simulator GPS manual

Heading (HDG) hold will be engaged with the button pos. 220. If no VOR or APR mode is active and the autopilot is available and on, the aircraft turns to or follows the preselected heading course. In the area pos. 134 of the PFD, you could see now the green "HDG" message. If the autopilot is disengaged but the flight director is on, the FD indicator of the PFD shows the turn direction but without an automatic capture of the heading course. If the autopilot and the flight director is switched off, HDG hold could not be engaged.

If a VOR or APR mode is active and the aircraft has already captured the VOR or APR course, it's not possible to engage HDG hold. In the area pos. 134 of the PFD the green message "VOR1", "BLC1" "LOC1" or "LOC\*" is shown. If anyhow the HDG hold should be activated, it's first necessary to disengage the current active VOR or APR mode with the button pos. 221 or 222.

If a VOR or APR mode is switched on with the button pos. 221 or 222 but the aircraft has not yet captured the lateral VOR or APR course (in area pos. 135 of the PFD the white message "VOR1", "LOC1" or "BLC1" is shown), heading hold could be activated and the aircraft turns to the preselected HDG course. The PFD shows now additionally to the white VOR or APR text in the PFD area 135, the green message "HDG" in area 134. As soon as the armed VOR or APR course is captured, heading hold will be disengaged automatically and the PFD messages changes according the now engaged mode.

The button VORLOC (pos. 221) activates either VOR, LOC or backcourse (BC) hold when AC 1 and the autopilot is available. But this only if the approach hold mode is not engaged. If you would like to change from APR hold to VORLOC, it's necessary first to disengage the APR mode with the button pos. 222.

If no APR mode is active and the autopilot is also switched off but the flight director is on, the FD indicator of the PFD shows the direction of the adjusted VOR, BC or LOC course when the button pos. 221 is pressed. In this case the aircraft did not turn to that indicated course automatically. It's not possible to activate VORLOC when neither the autopilot or flight director is engaged.



The VORLOC button of the MCP has two function. If VORLOC is engaged, the VOR, LOC or BC mode will engage, depending on the aircraft's actual intercept track. If that track is more than  $\pm 100^\circ$  from the selected front course, then BC hold will be activated automatically like in the real ARJ. An armed BC mode is shown with the white message "BLC1" in the PFD area pos. 135 and a captured BC course is shown with the green text "BLC1" in the PFD area 134. If the current aircraft course is smaller than  $\pm 100^\circ$  to the selected course, VOR or LOC will be engaged. The principle of the PFD annunciation is the same. An armed VOR or LOC mode is displayed with the white text "VOR1" or "LOC1" in area 135 and a captured VOR or LOC mode is displayed with the green text "VOR1" or "LOC1" in area 134.

Engaging the APR mode with the button APP (pos. 222) automatically disengages a VORLOC mode. Like the VORLOC button, the APP button has two functions. It will either engage approach hold (APR hold) or backcourse hold (BC hold) also depending on the aircraft's actual intercept track. If that track is more than  $\pm 100^\circ$  from the selected front course, then BC hold will be activated automatically. An armed BC mode is shown with the white message "BLC1" in the PFD area pos. 135 and a captured BC course is shown with the green text "BLC1" in the PFD area 134. BC hold did not support any glideslope hold. If the current aircraft course is smaller than  $\pm 100^\circ$  to the selected course, APR hold will be engaged. An armed APR localizer is displayed with the white text "VOR1" or "LOC1" in area 135 and a captured APR localizer is displayed with the green text "LOC1" or "LOC\*" in area 134.

If the autopilot is switched off but the flight director is on, the FD indicator of the PFD shows the direction of the adjusted APR or BC course when the button pos. 222 is pressed. In this case the aircraft did not turn to that indicated approach or backcourse automatically. It's not possible to activate APP when neither the autopilot or flight director is engaged.

To the VOR, LOC, BC and APR modes, it applies equally that the current lateral mode, e.g. ROLL or HDG, will be engaged as long as those modes are armed. As soon as one of those modes are captured, all other lateral modes will be disengaged automatically. APR has always a higher priority than VOR or BC.

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### 3.16.2.3 Vertical Modes of the MCP

While the lateral modes of the ARJ autopilot still corresponded somewhat to the standard AP modes of the flight simulator, the differences of the vertical modes are very big.

The ALT HLD button (pos. 225) engages altitude hold (ALT hold) if the autopilot is available and switched on. But a pressing of this button did not commands the autopilot to climb or descent to the preselected altitude but effect a hold of the current altitude while the button was pressed. Because of this, the ALT HLD button did not excites a flight director command (climb or descent). All other vertical modes (VS hold and LVLCHG) will be automatically disengaged when the ALT HLD button is activated. A climb or descent to a preselected altitude (digital display pos. 223) is only possible with LVLCHG, Thrust or VS hold.

If you would like to climb or descent to a preselected altitude with a given vertical speed, this must take place with the VS mode of the MCP. For this it's first necessary to selected the desired altitude with the MCP (digital display pos. 223). This preselected altitude must not be the same altitude than the current aircraft altitude. Otherwise it's not possible to activate the VS hold button (pos. 227) or to select a desired vertical speed as the VSI window pos. 226 doesn't show any value. VS hold is also not possible while APP is active. If you would like to activate VS hold while APP is engaged, it's first necessary to disengage APP with the button pos. 222.

Is the preselected altitude smaller or larger than the current altitude and APP is not engaged, VS hold could be activated with the button pos. 227. ALT hold, Thrust or LVLCHG will than be disengaged automatically and the amber "ON" light illuminates on the VS button. Like in the real ARJ, the digital VSI selector pos. 226 will now show "0". The desired vertical speed could now be adjusted with the wheel pos. 228 (please see also the mouse click areas of the MCP). From now on the aircraft climbs or descents with the selected vertical speed until the preselected altitude is reached. In area pos. 134 the PFD shows the green message "VS" as long as VS hold is active. About 300 feet before the preselected altitude is reached, "ACQ" is shown instead of "VS". This green "ACQ" message starts blinking about 50 ft. below or above the preselected altitude. As soon as the ARJ reaches the preselected altitude, the annunciator text of the PFD changes to the green text "ALT", the digital VS display (pos. 226) and the "ON" light of the VS hold button goes off while the "ON" light of the ALT hold button starts illuminating.

The Thrust and LVLCHG functions for climbing or descending to a preselected altitude are described in chapter 3.16.3.4 of this manual.

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### 3.16.3 The Avro ARJ Autothrottle

#### 3.16.3.1 Basics about the ARJ Autothrottle

The Avro ARJ Autothrottle was completely new programmed and is very different compared to the standard MS autothrottle. All real autothrottle functions were realized as good as possible to create a system which could be compared with the real one with the handling and the reaction of the system. Because of this the operation is very extensive and requires some training.

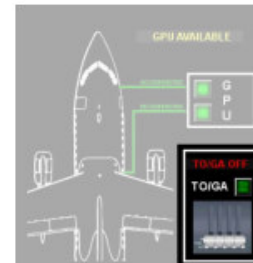
Basically you could classify the ARJ autothrottle into four modes.

Mode 1	Autothrottle is not active. There's no automatic regulation of the throttles and the pitch to catch or hold a selected speed.
Mode 2	Autothrottle is not active. There's no regulation of the throttles. The autopilot tries to hold or catch a preselected speed only with pitch changing.
Mode 3	Autothrottle is active. The throttles will be regulated automatically according the calculated thrust of the TRP. The autopilot tries to hold or catch the pre-selected speed with pitch changing.
Mode 4	Autothrottle is active. The throttles will be regulated automatically to hold the preselected speed independent from the TRP calculated thrust but within the FADEC controlled limits.

Every mode has different pre-conditions and conditions. Those are:

Mode 1	Autothrottle off and autopilot off or not available.
Mode 2	Autothrottle switched off but autopilot available. Mode 2 is active as soon thrust or LVL CHG is used for climbing or descending to a preselected altitude. The activated autopilot tries to hold or catch the preselected speed with pitch changing. The target pitch could be regulated by increasing or decreasing the throttles manually. Decreasing the throttles cause a lower pitch and increasing the throttles a higher pitch.
Mode 3	Autothrottle switched on and autopilot available. Mode 3 is active as soon thrust or LVL CHG is used for climbing or descending to a preselected altitude. The throttles will be controlled automatically from the TRP calculated thrust rate. The pitch for the climb or descent will be controlled from the autopilot to reach or hold the preselected speed.
Mode 4	Autothrottle switched on and autopilot available. Mode 4 is active when climbing or descending with VS hold or when ALT hold is active. The throttles will be controlled from the system to hold the selected speed independent from the TRP settings. Mode 4 is also active when approaching with APP hold.

### 3.16.3.2 The Thrust Rating Panel (TRP)



231	Master switch. This button selects engine 1 or 2 as master engine. With the current ARJ panel, this function has just an effect to the white and blue arrows of the FADEC system. The synchronisation mode is not realized.
232	Digital readout for the N1 limit, temperature which is used to calculate the limit, $V_1$ , $V_R$ , or $V_{FTO}$ speed depending on the position of the selector wheel (pos. 236).
233	Button to select Toga Redu or Toga Max mode.
234	Button to activate the MCT mode (Maximum Continuous Thrust).
235	Button to activate Climb Norm or Climb Max mode.
236	Outer selector wheel to select the N1 limit, temperature which is used to calculate the limit, $V_1$ , $V_R$ , or $V_{FTO}$ speed for the display pos. 232. The mouse click positions are on each text outside the selector wheel (N1 or TEMP for example).
237	Inner selector wheel. With the inner wheel the temperature which is used to calculate the N1 limit or the $V_1$ , $V_R$ , or $V_{FTO}$ speed will be changed depending of the position of the outer selector wheel pos. 236.

---

238	Button to activate Toga. This button is placed in the GPU sub-panel.
239	This text shows if Toga is off „TO/GA OFF” (red) or active “TO/GA ON” (green). The gauge is placed in the GPU sub-panel.

When using a Toga mode, LVLCHG and thrust in the MCP, the Thrust Rating panel (TRP) regulates the throttles according to the N1 defaults of the TRP. Those N1 values could be different in the individual modes. The display (pos. 232) shows the N1 reference value which is assigned to the autothrottle system when the selector knob pos. 236 is in position N1. This value will also be assigned to the primary engine display (PED) and is shown there in the N1 bugs (pos. 180) and in the digital display pos. 178. But this only when you are not using a manual value for the N1 setting (recognizably with a "M" before the limit announcement pos. 178). How to set a manual N1 value is written in chapter 3.16.3.3.

#### Settings, which must be done at the TRP before the flight

To get correct calculated N1 values from the TRP, the system requires some necessary settings from the Pilot which have to be done before using the system.

The first thing which has to be done is to enter the outside air temperature. For this the outer setting knob (pos. 236) must be moved to “TEMP”. When loading the panel for the first time, the display shows “0”. When the setting knob is in position “TEMP”, you could adjust the temperature with mouse clicks of the inner wheel pos. 237. The actual temperature is shown in the OAT indicator right below the TRP.

The adjustment of the temperature is very important, because it's necessary for the Toga modes. If you change this temperature you can see the changing of the N1 reference value. This is one of the decisive advantages of the TRP to save engine lifetime.

Because of the observation of the outside air temperature, the system continuously adjusting the thrust to prevent an overstress and overheating of the engines. To what extent the influence of the temperature to the N1 reference values, could be seen in the table in the appendix (Toga Ratings, chapter 5.4).

The Toga values will also be effected from the Engine Anti-Ice and Engine Air settings, which are necessary for the start. The N1 reference values scale down automatically when Engine Anti-Ice or Engine Air is on. You must never takeoff with Engine Anti-Ice and Engine Air selected on together (too much thrust will be bleed form the engines i.e. not enough thrust will be produced for a safe takeoff). If you do select both on the ground this is called an illegal bleed state and the N1 set in the PED will flash to indicate this fact. An illegal bleed state will only occur with TOGA MAX or TOGA REDU.

After that you have to adjust the values for  $V_1$ ,  $V_R$  and  $V_{FTO}$ . This will be done in the same way you've adjusted the outside air temperature. First the outside adjusting wheel is placed to the appropriate value.



Set to adjust  $V_1$



Set to adjust  $V_R$



Set to adjust  $V_{FTO}$

Now the TRP display shows the corresponding values for  $V_1$ ,  $V_R$  and  $V_{FTO}$ . Those values could be adjusted with mouse clicks on the inner wheel. The pre-set values of the appropriate speeds depend primarily on the weight of the aircraft. In the appendix of this manual are the reference tables, from which the respective speeds can be inferred (please see chapter 5.2).

The adjusted  $V_R$  and  $V_{FTO}$  speeds are also shown with so called speed bugs in the PFD (see chapter 3.11). Those values are just a help for the pilot but have no effect on the flight characteristics of the ARJ.

On the TRP you could select the following modes:

### Toga Redu

Toga Redu will be activated with the TRP button pos. 233. The Toga Redu mode is shown in the PFD (area pos. 132) with the text "TOGA REDU". The letters are white when the mode is armed and green when the mode is active. If the autothrottle is also active, the PFD message shows "AT TOGA REDU". Since the TRP could only regulate the throttles with an activated autothrottle, the AT switch of the MCP must be on (position 210). Otherwise no automatic regulation of the throttles is possible.

Toga Redu is calculated on the basis of the environmental conditions (outside air temperature and airfield altitude) and handed over to the system. Also the following conditions are important for the calculation:

- No Bleed (i.e. only APU air used)
- Engine Anti-Ice on
- Engine Air on (Cabin Air)

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The tables of Appendix 5.4 gives you an overview of the Toga ratings and could be used to compare the values.

**You must never takeoff with Engine Anti-Ice and Engine Air selected on together. If you do select both on the ground this is called an illegal bleed state and the N1 set in the PED (pos. 178) will flash to indicate this fact.**

To activate Toga Redu for take off (TO) it's necessary to select Toga Redu on the TRP and to switch on the autothrottle on the MCP. After that you see the white text "AT TO REDU" on the PFD. At this time the Toga text of the GPU sub-panel still shows the red text "TOGA OFF".

A standard procedure to activate Toga for take off is to move the throttles forward to about 60% N1 and then pressing the Toga button. (pos. 238). As soon as the Toga button is pressed, the TRP controls the throttles to capture the TRP controlled Toga thrust. The white PFD text "AT TO REDU" changes into green. The active Toga is also shown in the GPU sub-panel with the green text "TOGA ON". Both Toga modes (Toga Redu and Toga Max) are the only ones which could be activated on ground.

**Do not use Toga for more than 5 minutes. Otherwise the engines could damage!**

The Toga modes have the following conditions (summary):

- The Toga modes control the thrust of the engines according the N1 reference values of the TRP independent the aircraft speed.
- You must never takeoff with Engine Anti-Ice and Engine Air selected on together.
- The N1 reference values of the Toga modes changes depending upon environmental condition (altitude and outside air temperature) and start conditions (Engine Anti-Ice, Engine Air). The appropriate values of the TRP could be found in appendix 5.4.
- To activate Toga on ground you have to press the Toga button pos. 238. The real aircraft have the Toga switch on throttle 2 and 3.
- Toga will be disengaged automatically after the aircraft take off and another TRP mode is selected (with the Thrust button of the MCP for example). It's not necessary to press the Toga button once again.

### Toga Max

Toga Max has the same conditions as Toga Redu. Contrary to Toga Redu, the system sets a higher revolutions and thus power of the engines when Toga Max is selected. Those leads however to a larger demand of the engines. Toga max should be used therefore only unless performance requires (e.g. very high outside temperature, short runway).



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### Climb Norm

At about 1000 feet above ground, the thrust mode will be changed from TOGA, to climb. This is done by pressing either the CLIMB button on the TRP (pos. 235), or Thrust on the MCP (pos. 215). One press of CLIMB on the TRP will set climb normal, pressed again will give climb max, where as the Thrust button on the MCP will only set Climb Norm. The Thrust button on the MCP could be seen as a changeover switch why it has no illuminated "On" light. You could also press LVLCHG (pos. 216) which has the same result as the Thrust button and changes the mode to Climb Norm.

As with the Toga modes, the autothrottle of the MCP has to be on since otherwise no regulation of the thrust can take place via the TRP. Unlike the Toga mode, the climb modes could not be activated on ground. A Take off with Climb Norm or Climb Max is thus not possible.

When Climb Norm is armed (Climb Norm selected but without a switched on autothrottle or aircraft on ground), the PFD shows the white text "CLBNRM" in the area pos. 132. As soon as the system is active and Climb Norm possible and working, the colour of the text changes into green. When you see the green text "AT CLBNRM", the TRP controls the thrust and throttles with the calculated N1 values. When the TRP selector knob (pos. 236) is in position N1, the TRP display shows the calculated N1 reference value.

Above 12.000 feet altitude, Climb Norm will not be used for descents in reality. When using Climb Norm with a lower altitude selected in the MCP, the throttles will retard to flight idle and stay there until the selected altitude is reached or a higher altitude in the MCP is adjusted.

### Climb Max

Climb Max has the same conditions as Climb Norm. Contrary to Climb Norm, the system sets a higher revolutions and thus power of the engines when Climb Max is selected. When you climb with Thrust or LVLCHG, and so using the TRP, it could be necessary to have more power in higher altitudes to get acceptable rate of climbs. In such a case you could change from Climb Nor to Climb Max by pressing the climb button of the TRP (pos. 235)

The N1 reference value increases now for the calculated values of Climb Norm and release more engine thrust. The climbing rate rise too because no changing of the selected speed has taken place.

When Climb Max is armed (Climb Max selected but without a switched on autothrottle or aircraft on ground), the PFD shows the white text "CLBMAX" in the area pos. 132. As soon as the system is active and Climb Max is possible and working, the colour of the text changes to green. When you see the green text "AT CLBMAX", the TRP controls the thrust and throttles with the calculated N1 values. When the TRP selector knob (pos. 236) is in position N1, the TRP display shows the calculated N1 reference value.

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### MCT (Maximum Continuous Thrust)

The MCT mode of the TRP will normally only be used if one engine fault or in other comparable emergency situations. This mode hands over the maximum continuous thrust to the system and the throttles will be automatically moved to the according position. This maximum thrust can, depending upon environmental conditions (outside air temperature, altitude), be different but is usually approx. 96% N1.

When MCT is armed (MCT selected but without a switched on autothrottle or aircraft on ground), the PFD shows the white text "MCT" in the area pos. 132. As soon as the system is active and MCT is possible and working, the colour of the text changes to green. When you see the green text "AT MCT", the TRP controls the thrust and throttles with the calculated N1 values. When the TRP selector knob (pos. 236) is in position N1, the TRP display shows the calculated N1 reference value.

### **Additional Notes**

The complete TRP system requires electrical power from the DC 2 bus. If DC 2 is not available, the TRP could not control the thrust and throttles and the TRP display and the illuminated TRP buttons are not visible.

The entered outside air temperature is among other things the target for the computation of the N1 values. In several modes, the TRP calculates a correction value of this temperature. This correction temperature will be shown in the TRP temp display in the real aircraft. This panel uses also the correction value for the Toga Redu and Climb Norm modes but compared to the real aircraft, the correction temperature will not be displayed on the TRP.

All TRP thrust modes will just be active while using Toga or when climbing or descending with LVLCHG or Thrust. All of those modes will be disengaged as soon as VS hold or ALT hold will be activated. If you press a TRP mode while ALT hold is active, the PFD shows no longer "AT IAS" or "AT MACH" but the corresponding TRP mode in area pos. 132 (see also chapter 3.16.3.4). Nevertheless no TRP mode will be activate but the preselected speed will increase about 10 knots. This increased value will not be shown in the MCP or PFD. This could be cancelled by pressing LVLCHG. After that the actual speed will be hand over to the speed setting of the MCP, the current speed setting and the system. The PFD shows now "AT IAS" or "AT MACH" again.

When the autothrottle is not available or switched off, the real ARJ offers a synchronization of the throttles corresponding the selected master engine (button pos. 231). Because of this the remaining three throttles could be adjusted (synchronized) just with the throttle of the master engine within a small range. Since this automatic synchronisation is hardly ever used in reality (all four throttles were moved), I have not realized this function in this panel

### 3.16.3.3 Adjusting manual values for the Autothrottle

With the Avro ARJ it's also possible to set manual values for N1. Those values have no effect on the TRP calculated thrust or the autothrottle. When the autothrottle is on and active, the system will still proceed the TRP calculated thrust for all engines. Nevertheless the manual settings are an important help for the pilot if the TRP fails or when you have to proceed the flight without the autothrottle system. When making a manual setting, the N1 bug of the PED moves to the adjusted position independent from the TRP calculated thrust.

Manual setting have to be done for each engine separately!



Pressing the Pull Set knob (pos. 187) changes over to the manual mode. A manual mode could be recognised when the digital display of the N1 limit (pos. 178) in the PED shows a "M" before the N1 value. The next picture shows a manual setting for engine 2.



When activating a manual setting for an engine for the first time, it has an adjusted value of 97%. This value could now be changed from the pilot in single steps (see below). The new adjusted value will be stored, so it's still available as soon as you engage the manual mode again.



Mouse click area to decrement the manual N1 Setting

Mouse click area to increment the manual N1 Setting

Pressing the Pull Set knob again will change the digital readout and the N1 bug back to the TRP calculated N1 thrust but the last manual setting will be stored.

When the autothrottle is not available and you've made a manual setting, the throttles must be adjusted manually by the pilot to increase or decrease thrust for the adjusted value.

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### 3.16.3.4 Climbing and Descending using LVLCHG and Thrust

The handling using VS Hold is already described in chapter 3.16.2.3 of this manual. If appropriate level changes are accomplished using Thrust or LVLCHG, there are several points important for taking care about which are described in this chapter. A condition for all points of the following description is that the autothrottle is available and turned on.

The possibilities of the Thrust button (pos. 215) are limited, because it could not activated when VS hold, ALT hold or LVLCHG is engaged (pressing the Thrust button in this case does not cause anything). Therefore this button is used actually only after take off for connecting the Climb Norm mode of the TRP.

Climbing with Thrust or LVLCHG is a standard procedure of the ARJ and will normally preferred instead of climbing with VS hold. However it's very important to tell the system what you want to do. Therefore you have to set the preselected altitude and airspeed on the MCP before using the system. Otherwise you will be very fast in a dangerous situation.

After take off, the aircraft is normally still in the Toga mode (the PFD shows „AT TO REDU“ or „AT TO MAX“). At about 350 feet AGL the autopilot will be engaged. From now on, the system controls the speed with increasing or decreasing the pitch to reach or hold the preselected airspeed of the MCP. Also very important for this is the preselected altitude. If the preselected altitude is higher than the current altitude, the system assumes a climbing, so the minimum pitch will always be zero. If the preselected altitude is lower than the current altitude, the system assumes a descent, moves the throttle to flight idle (retard) and the maximum pitch is zero. Because of this it's very important to adjust the preselected airspeed and altitude before a TRP mode is used. The desired airspeed and altitude should always be set already on ground.

Pressing the Toga button on ground will set pitch to hold the preselected speed (Vsel) + 10 knots until either Thrust or LVLCHG is pressed, or the Vsel is changed. Cancelling Vsel + 10 knots with the described methods is only possible above 350 ft. AGL. Below 350 ft. AGL nothing changes.

If the preselected speed is too high (much higher than the actual aircraft speed), the pitch of the aircraft reduces to zero (never below zero when climbing) and waits until the speed rises to allow a positive climb. If this is not possible, you should decrease the preselected speed. The first elected speed after take off should be below 200 knots while 210 – 250 knots could be adjusted for climbing below 10000 feet.

At about 1000 feet AGL the Thrust button could be pressed. Now Toga will be disengaged, the TRP mode changes to Climb Norm and the PFD shows the green message „AT CLBNRM“ to indicate this. The N1 reference values of the TRP and PED as well as the N1 bugs of the PED change the settings now automatically to the calculated climb values of the TRP. As with the Toga mode, the throttles will be still controlled from the system to reach or hold the TRP climbing values. If no speed change was done between 350 ft. AGL and 1000 ft. AGL, Vsel + 10 knots is cancelled now, and the AP uses Vsel directly for the speed setting.

When the pitch of the aircraft is stable, N1 is within the TRP reference value and you want to increase the speed, you should increase the speed of the MCP not too fast to prevent a massive reducing of the pitch to zero.

In higher altitudes it could be that, depending on the aircraft weight, the TRP thrust is not high enough to get acceptable climbing rates with Climb Norm. In such a case you should change the climbing mode from Climb Norm to Climb Max on the TRP to get more power. If the climbing rate continuously decrease, you should reduce the preselected airspeed in small steps to hold an acceptable climbing rate.

When climbing, the digital speed selector of the MCP changes to mach at 24500 feet. The PFD shows now "MACH" instead of "IAS" and the system tries now to hold the preselected mach number.

300 feet before reaching the preselected altitude, the PFD message "IAS" or "MACH" changes to "ACQ" and 50 feet below the preselected altitude, this message starts blinking. As soon as the aircraft reaches the preselected altitude, the PFD shows the green text "ALT" while the "ON" light of the ALT hold button starts illuminating to show that ALT hold is now active. Until this time, the TRP has controlled the thrust. From now on the autothrottle changes its operation mode and the throttles will be controlled from the DFGS to hold the preselected speed independent from the N1 reference value of the TRP but within the engine limitations when FADEC is on. The PFD changes the message "AT CLBNRM" or "AT CLBMAX" to "AT IAS" or "AT MACH".

The functionality of the LVLCHG button is identical to the Thrust button in a lot of points. However contrary to the Thrust button, LVLCHG could be used almost at any time of the flight. Because of this, LVLCHG could also be used for descents what is not possible with the Thrust mode because of its limitations. Nevertheless also LVLCHG has some limitations. As with all other AP and AT mode, LVLCHG could just be engaged when either the Flight director or the AP is on. When you engage LVLCHG and this mode will not be disengaged automatically or together with another mode, it could just be disengaged when FD and the AP is off. Pressing ALT or VS hold, disengage LVLCHG automatically and allocates the new mode to the DFGS.

When the preselected altitude is not equal the current altitude, a pressing of the LVLCHG button results in a deactivation of the current vertical mode (ALT or VS hold) and engage LVLCHG while the TRP activates Climb Norm automatically. From now on everything else is identical like climbing using the Thrust button. This means that the TRP controls the thrust and throttles regarding the calculated N1 value and the preselected speed will be hold with increasing or decreasing the pitch. Minimum pitch when climbing and maximum pitch when descending is respectively zero.

Contrary to the thrust mode, it's also possible to descent with LVLCHG. In the real aircraft LVLCHG will not be used for descending above 12000 feet. Above 12000 feet altitude a descent with VS hold should always preferred.

---

If the preselected altitude of the MCP is lower than the current altitude and you press LVLCHG, the system disengage all current active vertical modes (like ALT and VS hold), activates LVLCHG and then decreases the throttles to idle for about 10 seconds while the PFD shows the green message "RETARD". Because of the decreasing of the throttles, the aircraft starts now descending. The throttles stay in flight idle all the time while LVLCHG is used for a descent, no matter what TRP mode is selected. This means that there is no controlling of any N1 value from the TRP while descending. The system tries to hold and catch the selected airspeed also with increasing or decreasing of the pitch. Because of the withdrawn throttles and low thrust you could reach descending rates of about 5000 ft./min. This is one of the reasons why LVLCHG is not used for descents in high altitudes.

When descending, the digital speed selector of the MCP changes back to IAS at 23500 feet. The PFD shows now "IAS" when mach was selected before and the system tries now to hold the preselected IAS.

When you come close to the preselected altitude, the procedure is the same as when climbing. 300 feet before reaching the preselected altitude, the PFD message changes to "ACQ" and about 50 feet above the preselected altitude, this message starts blinking. As soon as the aircraft reaches the preselected altitude, the PFD shows the green text "ALT" while the "ON" light of the ALT hold button starts illuminating to show that ALT hold is now active. Now the autothrottle changes it's operation mode again and the throttles will be controlled from the DFGS to hold the preselected speed. At the same time the PFD changes the green message back to "AT IAS" or "AT MACH".

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### 3.16.3.5 Automatic Safety Functions of the Autothrottle

The DFGS provides several automatic safety functions for the autothrottle system to correct wrong handlings or to prevent that the aircraft takes up a critical flight condition (stall or overspeed).

- If the FADEC is active it monitors the complete thrust. While the TRP system already prevents too high N1 revolutions and engine temperatures with the reference values, a too high temperature or engine revolution could happen when using VS or ALT hold because in this case the autothrottle controls the thrust for the preselected speed and not with the TRP reference values. The FADEC monitors this and reduces the thrust automatically when the engine revolution or temperature gets too high, no matter what mode is active. This safety reducing of the thrust (and throttle) does take place instantly and very intensive. Because of this the difference between the preselected speed and the current aircraft speed should not be too high to prevent big throttle movements. The pilot should select the desired speed advisedly when IAS or mach hold is active.
- Especially when descending using VS hold you could come very fast into an overspeed situation. A stall is also possible when climbing with VS hold. As soon as the system recognizes a stall or overspeed when VS hold is active, the DFGS changes automatically from VS hold to LVLCHG. Now the throttles will be controlled from the TRP and the speed with increasing or decreasing the pitch. When you come close an overspeed, the new preselected airspeed for LVLCHG will be 20 knots below the recognized overspeed and when you come close a stall the preselected speed will be the recognized stall speed + 20 knots.



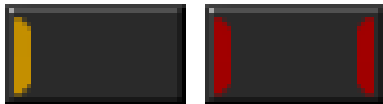
## 3.17 The Master Warning System (MWS)

### 3.17.1 The MWS Units



The master warning system (MWS) in association with glareshield-mounted red/amber flashing attention lights and a small number of audio warnings, indicates aircraft system faults or emergencies on the master annunciator panel. Annunciator captions are illuminated in red, amber, green or white according to the categories of alert. Any of the red or amber warnings will cause the appropriate glareshield warning lights to flash and the annunciator panel caption to illuminate until cancelled by pressing either glareshield light.

Some caution and warning lights contents also an acoustic warning. The caution and warning lights which have also a sound are marked with an amber beam (ear) on the left side of the caution light and a red beam (ear) on the left and right side of the warning light.



Ears may be singled or doubled and signify degree of importance of warning. These annunciators are accompanied by an audio warning and operation of the flashing red or amber lights on the glareshield panel. One ear causes a single metallic “ding” sound and a double ear cause a triple metallic “din, ding, ding” sound each four seconds.

Red annunciator lights indicates a fault condition requiring immediate crew action. Amber annunciator lights with an ear indicates high category caution which immediate crew attention and amber annunciator lights without an ear indicates low category caution. White annunciator lights (in the lower MWS) support system functioning and green annunciator lights advisory.



Arrows of some MWS annunciator lights indicates a further annunciators illuminated on the overhead (up arrow) or on the main panel (right arrow) which should be observed for more information about the fault.



The attention lights in the glareshield panel left from the Nav1 radio flashes if the main MWS unit recognizes a faulty system, necessary switched off unit or any other warning or caution.

The red MWS attention light blinks when a red MWS warning light is on and the amber MWS attention light blinks when an amber MWS light is on.

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### 3.17.2 Description of the MWS Annunciator Lights

Below are the descriptions of each MWS caution- warning- and reference lamps. It is written in such a way that the description of the lamps goes from above downward (LINE) and from left to the right.

#### ***Annunciator lights of the upper MWS:***

##### Line 1

The Engine Fire Handles des MWS are not realized yet. Because of this, all four lamps in this line have currently no function

##### Line 2

These four red warning lights serve for the announcement of an engine fire for each engine (engine 1 left - engine 4 right). A fire warning of the MWS involves also an acoustic warning.

##### Line 3

In the real ARJ those red lamps shows a Pylon Overheat. In the ARJ panel the four red warning lamps shows an overheat (EGT temperature) of each engine (engine 1 left - engine 4 right). The lamps go on at a temperature of more than 660°C. It involves also an acoustic warning.

##### Line 4

The red warning lights of line 4 are for the oil pressure of each engine (engine 1 left - engine 4 right). They illuminate when an engine has a low oil pressure or when the corresponding engine is not running. The oil pressure warning lamps involves also an acoustic warning.

##### Line 5

The four amber caution lamps of line 5 illuminate when the fuel pump of the corresponding engine (engine 1 left - engine 4 right) is not turned on. They are also on, if the fuel pressure of the respective engine drops too far so the engine is no longer supplied with fuel.

##### Line 6

The „APU FIRE“ and „ELECT SMOKE“ lamps of line 6 are not realized yet.

##### Line 7

The red "CONFIG" warning lamp lights up when a wrong configuration while takeoff (more than 60% N1) or landing is existent. The system scans the flap, trim and the gear position. The "FLAP INOP" lamp is not realized yet in this panel. The red "CABIN HI ALT" warning lamp illuminates when the cabin altitude exceeds 9000 ft. Both red warning lamps involves also an acoustic warning.

---

### Line 8

The amber caution lamp „ENG VIBN“ lights up, if engine exceeds a vibration of 1,6. The „ENG OVRSPD“ lamp illuminates as soon as engine 1 exceeds 100% N1. The "APU" caution lamp marks an error of the APU system. The up-arrow indicate that more information about the APU fault could be found in a separate lamp of the overhead panel (please see there). The amber "STALL IDENT" lamp goes on as soon as a stall is recognized from the system. All lamps of line 8 involve also an acoustic warning.

### Line 9

The amber "ANTI SKID" caution lamp lights up, if anti skid is not available or not turned on. The "SPLR" caution lamp is not realized yet. The "ICE PROT" lamp illuminates, if the ice protection system in the overhead panel locates an error or is not available. Further information about the ice protection fault could be found in the corresponding annunciator lamp of the overhead panel. The amber "AIR COND" caution light illuminates, if e.g. the packs were activated but no air of the APU or the engines is available. It also illuminates if the packs were overheated. Further information about the fault of the air conditioning system could be found in the corresponding annunciator lamp of the overhead panel. All lamps of line 9 involves also an acoustic warning.

### Line 10

The amber "HYD" caution lamp lights up when the hydraulic system has a fault or when the system is not available. It illuminates also, if the standby generator is active. Further information about the hydraulic fault could be found in the corresponding annunciator lamp of the overhead panel. The "FUEL" lamp marks an error in the fuel system of the ARJ or if the fuel pressure drops too far within the system. Further information could be found in the corresponding lamp of the overhead panel. The "ELECT" annunciator illuminates, if a necessary electrical bus is not available or the system determines an error in a bus. Further information could be found in the corresponding lamp of the overhead panel. The amber "AIR SUPPLY" lamp goes on, if no air is available for the appropriate system, or the system determines an error of the air distribution. Further information could be found in the corresponding lamp of the overhead panel. All caution lamps of line 10 involve also an acoustic warning.

### Line 11

The amber „RUDDER LMTR“ lamp is not realized yet. The lamp "CAB DOOR NOT SHUT" illuminates, if the doors of the aircraft are opened. The amber "WING NOT DE ICED" lamp goes on, if the flap position amounts to 18° or more, the inner wing deice is on but the outer wing deice is off. The "ICE DETECTED" lamp is not realized yet because it's not possible at the moment to scan icing conditions with the flight simulator. The "CAB DOOR NOT SHUT" and "WING NOT DE ICED" lamps of line 11 involve also an acoustic warning.

---

### Line 12

All lamps of line 12 are not realized in this panel yet.

### Line 13

The amber "FLAP FAULT" lamp in line 13 is not realized yet. The lamp "LWR DOOR NOT SHUT" goes on, if the airplane doors are opened. The lamp "EMERG LTS NOT ARMED" illuminates, if the cockpit emergency Lights are not armed. The lamp "OVHD DIM FAIL" is not realized yet.

### Line 14

All lamps of line 14 are not realized in this panel yet.

### Line 15

In LINE 15 only the amber "PARK BRK ON" lamp is realized (second lamp from left). This annunciator illuminates as soon as the parking brakes are set.

## ***Annunciator lights of the lower MWS***

### Line 1

The white annunciator lamp „AUTO SPLR OFF“ illuminates, if the autospoiler is switched off. Further lamps of line 1 are not realized with this ARJ panel.

### Line 2

The white annunciator lamp „FUEL FEED OPEN“ illuminates, if one of the fuel feed valves (common or X-feed) is opened. The white „FUEL TRANSFER“ annunciator is on, if the center fuel transfer switch in the overhead panel (pos. 41) is set to “Auto” or “On” and the fuel transfer of the center tank is active. The white annunciator Lampe „SCRN HEAT SEL OFF“ illuminates, if one of the screen heats is switched off. The lamp „EMERG LTS ON“ illuminates, if the cockpit emergency light is switched on or if the system activates the emergency light automatically when the switch is set to “Auto”.

### Line 3

The first lamp of line 3 is not realized in this panel. The green advisory lamp „AIR SEL ON GROUND“ is on, if engine air is used on ground. The white annunciator „EXT PWR NOT SHUT“ illuminates, if the GPU is connected to the aircraft.

### Line 4

The green annunciator „BRK FANS SEL OFF“ is not realized in this panel yet. The green lamp “ENG IGN ON” illuminates, if the ignitions are active or continuous ignition is on. The green advisory lamp „ENG A ICE ON“ illuminates, if engine anti-ice of any engine is switched on. The lamp „WING / TAIL A ICE ON“ illuminates, if wing and tail anti-ice is switched on.

---

***Additional Notes of the MWS system***

The MWS could be enlarged by clicking on it with the mouse.

Each warning light of the MWS has a separate tool tip text for the mouse. As soon as you move the mouse pointer over the light you get an information of the light.

The MWS uses electrical power from the emergency DC bus (MDC). However the systems for which the warning lights are for have different electrical sources. That's why you see some lights already after activating the MDC bus and some lights after the corresponding electrical bus of those systems are activated.

The MWS caution and warning attention lights in the glareshield panel could be disengaged when clicking on the lights. As soon as a new caution or warning light of the MWS came up the lights go on again.

The acoustic MWS caution and warning "ding" sounds could be disengaged when clicking on the MWS attention lights. As soon as a new caution or warning situation occurs, the MWS warning sound and light came up again.

### 3.18 Further Annunciator Lamps in the ARJ Mainpanel



The annunciator lamps right of the PFD have the following functions:

The first amber double-lamp „CMPTR MSTR“ illuminates, if Nav 1 is not available and so the DFGS gets no information from it. A reason could be that the necessary electrical bus is not available or the corresponding avionic bus is switched off.

The red „AP“ annunciator illuminates for a short time after switching off the autopilot. If this lamp illuminates continuously, the AP is switched on but not available. The amber „AT“ lamp below, illuminates for a short time after the autothrottle is disengaged.

The amber „FTC“ lamp is not realized in the ARJ panel yet. The amber „EL TRIM“ lamp below illuminates, if the position of the elevator trim is not within the aircraft configuration range.

The white „AIRB“ lamp illuminates, if the spoilers are set. The amber „YD“ caution lamp below illuminates, if the yaw damper is switched off.

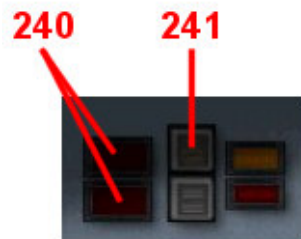
The green „CAT 3“ and „CAT 2“ lamps illuminate, if one of both CAT landing conditions are possible.

The „AUTO LAND“, „SPLY“, „SPLG“ lamps and the both amber „IDENT“ lamps are not realized in this panel yet.



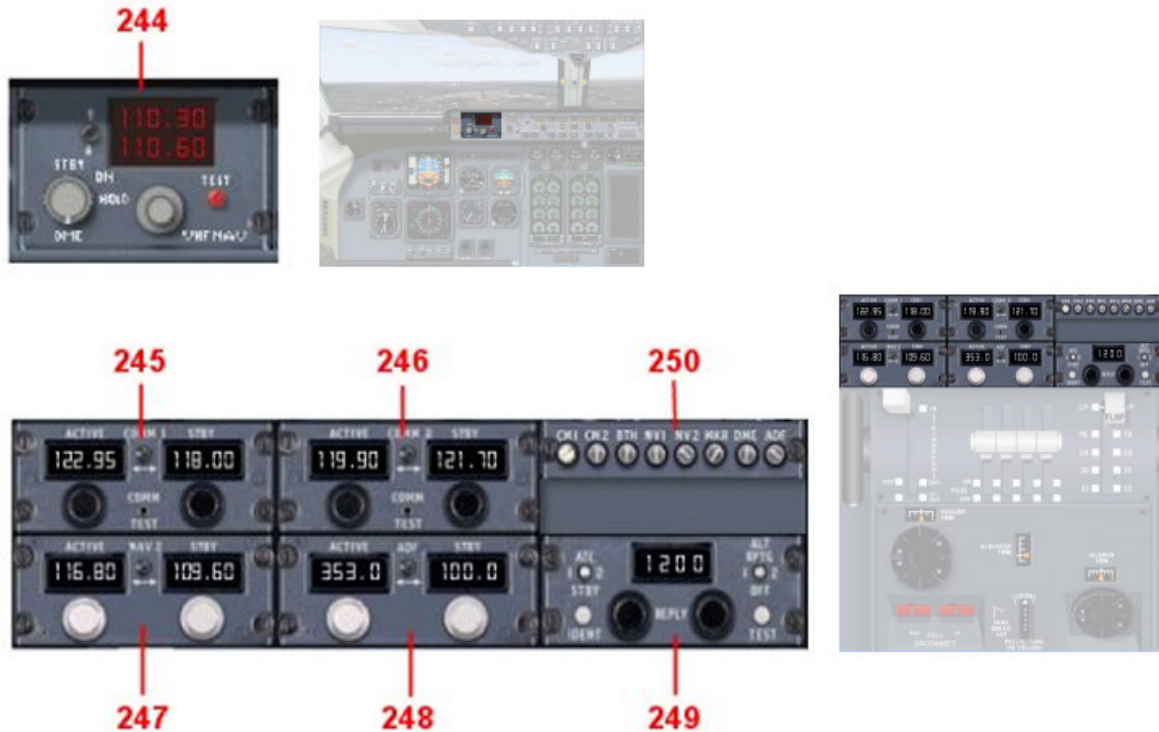


The white „FGC1“ lamp illuminates, if the AP main switch (pos. 123) in the overhead panel is off. The white “YD” lamp below illuminates, if the yaw damper switch (pos. 122) is off. The white „NO CAT3 LAND“ double-lamp illuminates while performing an ILS landing without CAT 3 conditions.



240	Stall warning lamps
241	„NO AUTOLAND“ annunciator lamp. This annunciator illuminates under CAT 2 and CAT 3 conditions without the possibility of an autoland. The autoland is not realized with this panel yet. Because of this, the lamp will always illuminate under CAT and CAT 3 conditions. An autoland will come with a further version of the ARJ panel.

### 3.19 The Avro ARJ Radios



244	Nav 1 radio.
245	Comm 1 receiver (in the pedestal sub panel).
246	Comm 2 Receiver (in the pedestal sub panel).
247	Nav 2 radio (in the pedestal sub panel).
248	ADF receiver (in the pedestal sub panel).
249	Transponder (in the pedestal sub panel).
250	Audio unit (in the pedestal sub panel).

### **Additional Notes**

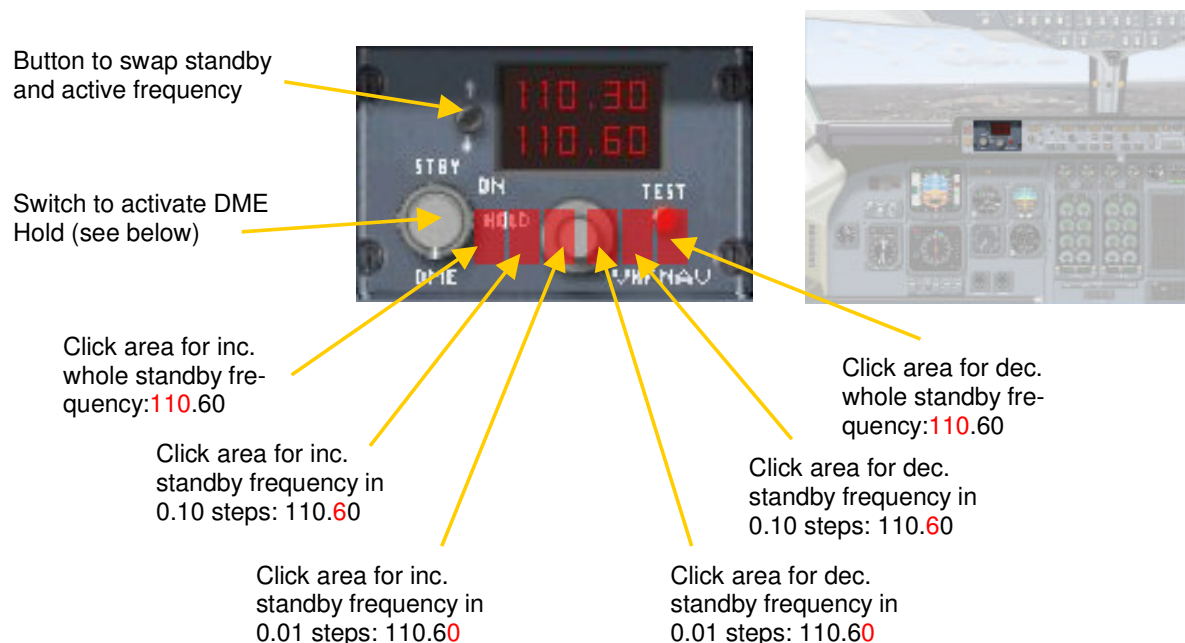
It is possible to set the active and standby frequency of Nav 2 and ADF without changing anything in the aircraft.cfg.

The audio panel did not base on the real ARJ. I've used the standard 737 audio panel because XML programmed audio panels still make problems on some computers. Because of this, it was not possible to include the audio signal to any of the used avionic or electrical busses. This is the reason why you maybe could hear an ATC or ATIS message no matter if the systems are on or off.

The radios in the pedestal panel are not placed as they are in the real Avro ARJ. Like already written the pedestal panel is one of the things I would like to rework in another version or update.

#### **3.19.1 The Nav 1 Radio**

The digital display of the NAV 1 radio contents the active frequency (upper area) and the standby frequency (lower area). Both frequencies are only visible, if the essential AC bus is available (battery bus is used for backup) and the avionic A bus in the overhead panel is switched on.

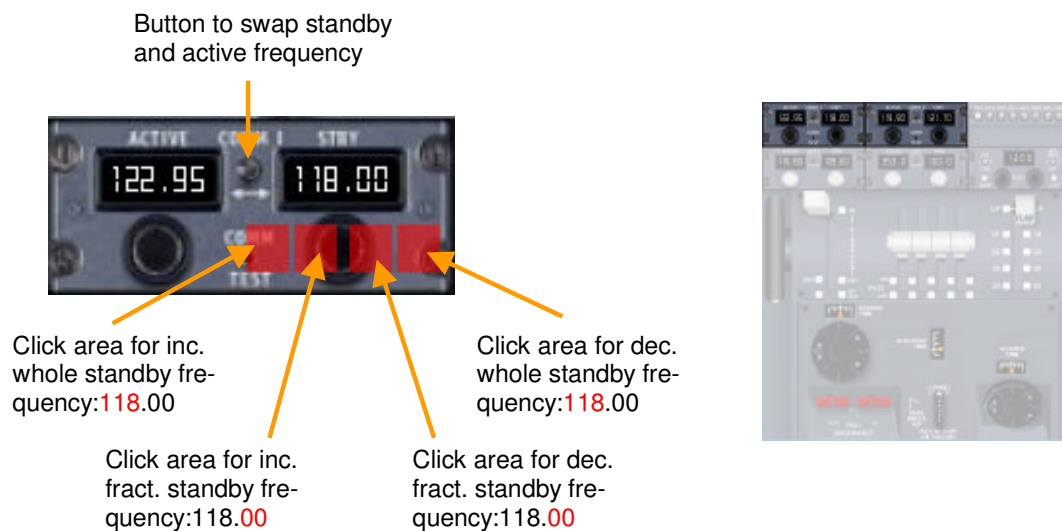


With the ARJ Nav 1 radio, it is only possible to set the standby frequency. The swap button changes the standby and active frequency. This function works independent from the setting in the aircraft.cfg. It's not necessary to make any changes in this file.

The DME hold function of this panel isn't equal to the real DME hold. While the real DME hold continuously indicates the distance of the last frequency (corresponds a third Nav) during a further Nav 1 station could be adjusted, the DME hold of this panel freezes the distance of the active Nav 1. This can be used e.g. to determine a certain distance between two freely selectable points or to determine a covered distance. The hold function and switch can only be adjusted when Nav 1 receives a DME signal. The DME Hold affects the DME announcement of the DBI and the ND.

### 3.19.2 The Comm 1 and Comm 2 Receiver

The two Comm receivers are developed identically. The digital displays of Comm 1 are only visible if the emergency DC bus (MDC) and the avionic A bus is available. Comm 2 needs electrical power from the essential AC bus (SAC) and a switched on avionic B bus.



In both Comm receivers, only the standby frequency could be adjusted (dependent on the settings of the aircraft.cfg). The standby and active frequency could be changed with the swap switch between the digital displays.

### 3.19.3 The Nav 2 Radio

The Nav 2 radio has also a digital display for the active frequency (left) and for the standby frequency (right). Both displays are only visible if the essential DC bus (SDC) is available and the avionics B bus is connected. In contrast to the Nav 1 radio and the two to Comm receivers, you can adjust the active and standby frequency at the same time, independently the entries of the aircraft.cfg.

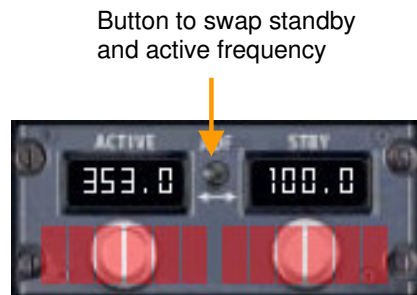


Below each frequency are left and right from the white adjusting wheels three mouse click areas. The outer areas adjust the frequency in whole steps (116.80), the middle areas set the frequency in tenth steps (116.80) and the inner areas adjust the frequency in hundredth steps (116.80).

Changes of the active frequency are transferred directly to the flight simulator, while changes of the standby frequency are only activated with operation of the swap switch between the digital frequency displays. However you could preselect a standby frequency or change an active frequency at each time.

### 3.19.4 The ADF Receiver

The ADF receiver has a digital display for the active frequency (left) and for the standby frequency (right). Both displays are only visible if the emergency AC bus (MAC) is available and the avionic A bus is connected. In contrast to the Nav 1 radio and the two to Comm receivers, you can adjust the active and standby frequency at the same time, independently the entries of the aircraft.cfg.



Below each frequency are left and right from the white adjusting wheels three mouse click areas. The outer areas adjust the frequency in thousands and hundreds steps (353.0), the middle areas set the frequency in tens (353.0) and the inner areas adjust the frequency in single and tenth steps (353.0).

Changes of the active frequency are transferred directly to the flight simulator, while changes of the standby frequency are only activated with operation of the swap switch between the digital frequency displays. However you could preselect a standby frequency or change an active frequency at each time.

### 3.19.5 The Transponder

The transponder of the ARJ panel is almost equal to the functions of the standard transponder of the flight simulator. The digital display is only visible if the essential AC bus (SAC) is available and the avionics A bus is connected.



Underneath the digital display are four mouse click areas, which are assigned to the four numbers of the transponder. As with the standard FS transponder, you can only increase each number. If a number reaches "9", it begins again with "0".



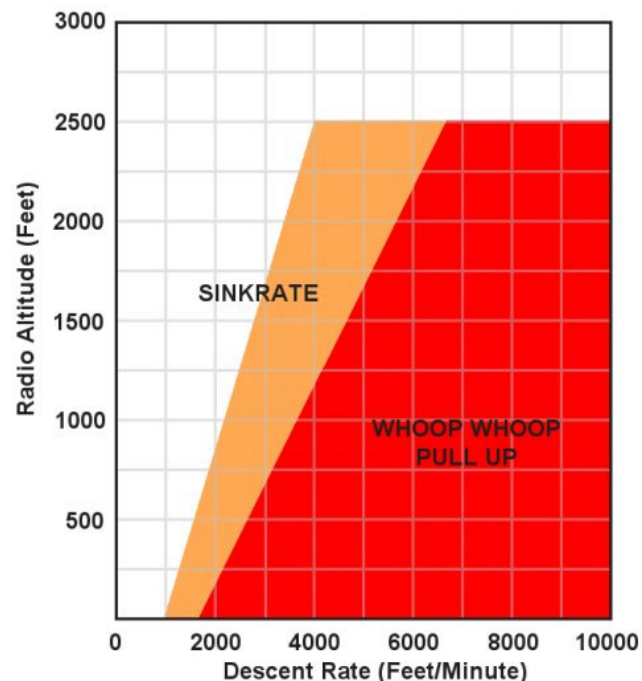
### 3.20 The AlliedSignal MK VII EGPWS



The enhanced ground proximity warning system (EGPWS) of the Avro ARJ generates visual and acoustic warnings when the aircraft approaches the ground in a dangerous manner. It also generates acoustic altitude information in order to inform the pilots that they are approaching the ground.

The ground proximity warning computer (GPWC) monitors and processes specific signals from the aircraft and triggers warning if one of the seven included warning modes is violated. For each mode acoustic warnings (synthetic voice) are defined. In the event that a multiple acoustic warnings trigger at the same time, they have different degrees of urgency. Some of the acoustic warnings ("Pull up" warnings) also triggers a visual warning in the GPWS annunciator pos. 242. The warning envelopes are described in detail in the following chapters of this manual.

#### 3.20.1 GPWS Mode 1 Excessive Descent Rate



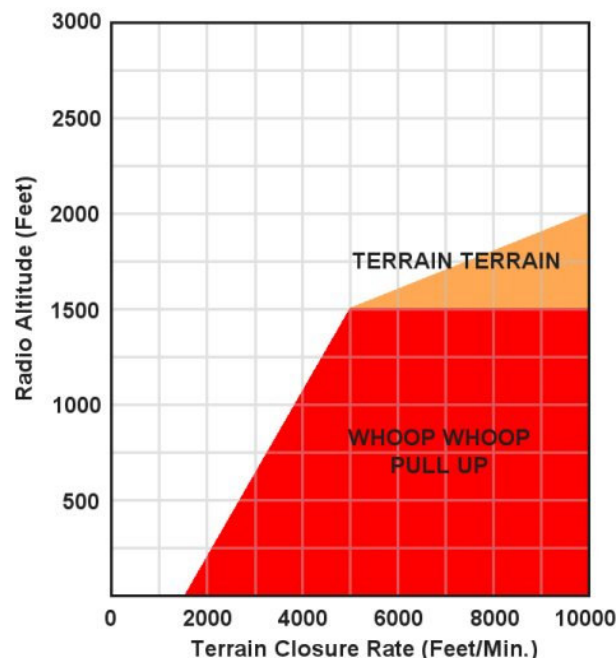


Mode 1 provides alerts for excessive descent rates with respect to altitude above ground level (AGL) and is active for all phases of flight. The outer boundary of this mode activates the acoustic "Sinkrate" alert without triggering a visual warning of the lamp pos. 242. The conditions for the acoustic "Sinkrate" warning could be seen in the picture above (amber area). The sinkrate warning is active and repeats continuously until the outer boundary is exited.

The inner boundary of mode 1 activates an acoustic "whoop whoop" which is followed by a synthetic voice callout "Pull Up". It triggers also the red warning lamp pos. 242 in the glareshield panel. The acoustic warning repeats continuously and the visual warning illuminates until the inner boundary is exited.

### 3.20.2 GPWS Mode 2 Excessive Closure Rate

Mode 2 provides alerts to help protect the aircraft from impacting the ground when rapidly rising terrain with respect to the aircraft is detected. This mode based on radio altitude and how fast radio altitude is decreasing (closure rate).



Mode 2 is active during climb out, cruise and initial approach (flaps not in landing configuration and aircraft not in glideslope centreline).

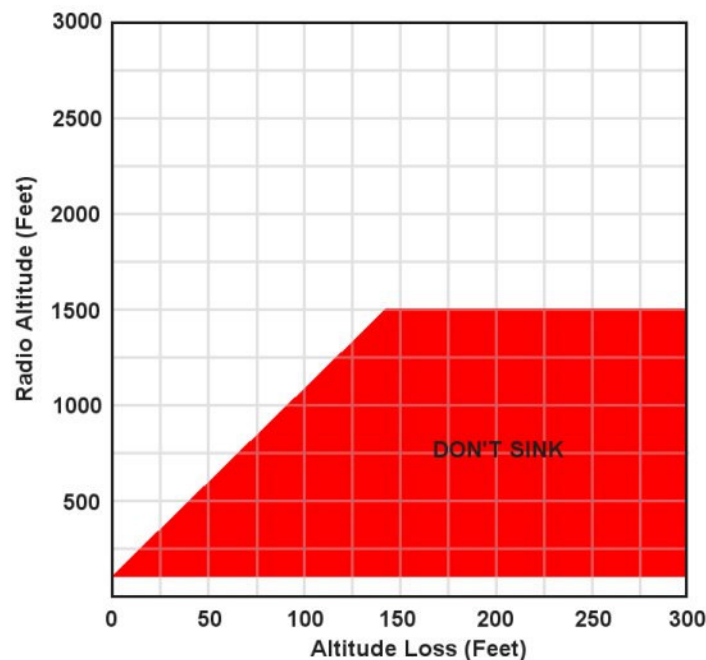
If the aircraft penetrates the caution envelope (amber area in the above picture), the aural message "Terrain Terrain" is generated without a visual warning in the GPWS lamp pos. 242. If the aircraft continuous to penetrate the envelope, the EGPWS warning light pos. 242 illuminates and the acoustic warning "whoop whoop", followed by the synthetic voice message "Pull Up", repeats continuously until the warning envelop is exited.

### ***Additional Notes to mode 2***

The real AlliedSignal MK VII EGPWS has two sub modes 2A and 2B. In the ARJ panel just mode 2A is realized. The description of mode 2 above based on the description of the real mode 2A.

### **3.20.3 GPWS Mode 3 Altitude Loss after Take Off**

Mode 3 provides alerts for significant altitude loss after take off. With gear and flaps not in landing configuration. The amount of altitude loss that is permitted before an alert is given is a function of the height of the ARJ above terrain as shown in the picture below.



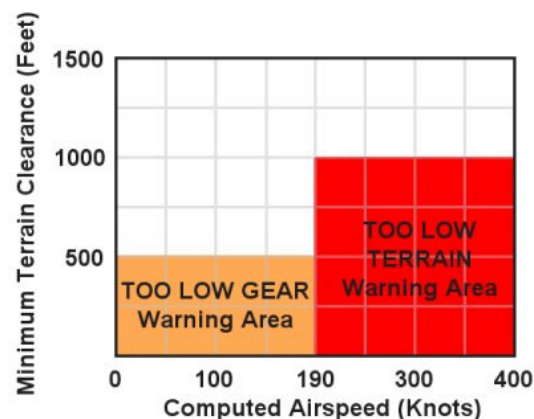
This protection is available until the EGPWS determines that the ARJ has gained sufficient altitude that is no longer in the take off phase of flight.

Significant altitude loss after take off activates the EGPWS aural message “Don’t sink, don’t sink” without triggering a visual warning in the EGPWS lamp pos. 242. Upon establishing a positive rate of climb, the aural message of the EGPWS will cease.

### 3.20.4 GPWS Mode 4 Unsafe Terrain Clearance

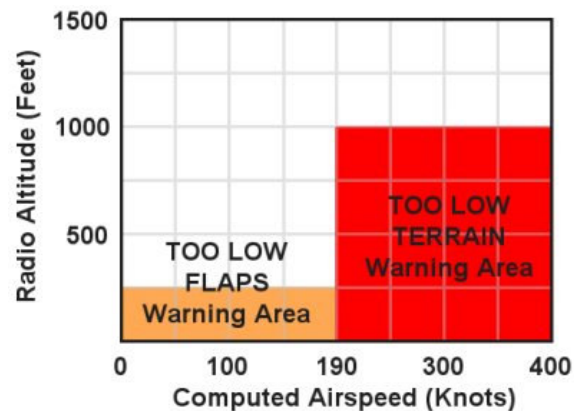
Mode 4 provides alerts for insufficient terrain clearance with respect to phase of flight, configuration and speed. Mode 4 exists in three forms, 4A, 4B and 4c (not realized with this panel).

Mode 4A is active during cruise and approach with gear and flaps up. This provides alerting during cruise for inadvertent flight into terrain where terrain is not rising significantly, or the aircraft is not descending excessively. It also provides alerting for protection against unintentional gear-up landing.



Below 1000 ft. AGL and above 190 knots airspeed, the mode 4A aural alert is “Too Low Terrain” (red area in the above picture). There is no visual warning in the EGPWS warning lamp pos. 242. Below 500 feet AGL and less than 190 knots the aural alert “Too Low Gear” came up to inform the pilot that the gear is not down. Both aural messages repeated continuously until the aircraft starts climbing or until the gear is down. Between 1000 feet AGL and 245 feet AGL the “Too Low Terrain” warning stays active also with gear down when the flaps are not in landing configuration (see mode 4B).

Mode 4B is active during cruise and approach with gear down and flaps not in landing configuration.



Below 1000 feet and above 190 knots airspeed the mode 4B aural alert is “Too Low Terrain” (red area in the above picture). There is no visual warning in the EGPWS warning lamp pos. 242. Below 245 feet AGL and less than 190 knots airspeed, the mode 4B aural alert is “Too Low Flaps” al without visual warning in the EGPWS warning lamp. There’s no way to disengage the flap warning, as the ARJ panel did not content an flap override switch at the moment. Both aural messages repeated continuously until the aircraft starts climbing or until the flaps are in the landing configuration. Between 1000 feet AGL and 500 feet AGL the “Too Low Terrain” warning stays active also with flaps in the landing configuration but gear is up (see mode 4A).

#### **Additional Notes to mode 4**

Mode 4C, which is also part of the real Avro ARJ, is not realized at the moment.

In mode 4A the red area increases the value from 190 knots to 250 knots and in mode 4B from 159 knots to 250 knots. Because of several reasons this is not realized in this panel. The values 190 knots are fix for both modes.

#### **3.20.5 Mode 5 Excessive Deviation below Glideslope**

Mode 5 provides an aural alert “Glideslope,” if the aircraft is below 1000 feet AGL, above 150 feet AGL and 1.3 dots or greater below the glideslope beam (no soft alert is realized with this panel). Below glideslope alerts are enabled only if the localizer is within 2 dots, landing gear and flaps are selected and a front course approach is determined.

EGPWS mode 5 alerts are inhibit during backcourse approaches to prevent nuisance alerts due to false fly up lobes from the glideslope.

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### 3.20.6 GPWS Mode 6 Advisory Callouts

#### 3.20.6.1 Altitude Callouts

Mode 6 of the EGPWS contains altitude callouts which consist of predefined Radio Altitude based voice callouts. There is no visual alerting provided with these callouts. The Avro ARJ is equipped with the following acoustic altitude messages:

Callout	Occurs at (feet AGL)
Twenty Five Hundred	2500
One Thousand	1000
Five Hundred	500
Four Hundred	400
Three Hundred	300
Two Hundred	200
Approaching Minimums	DH + 80
Minimums	DH
One Hundred	100
Eighty	80
Sixty	60
Fifty	50
Forty	40
Thirty	30
Twenty	20
Ten	10

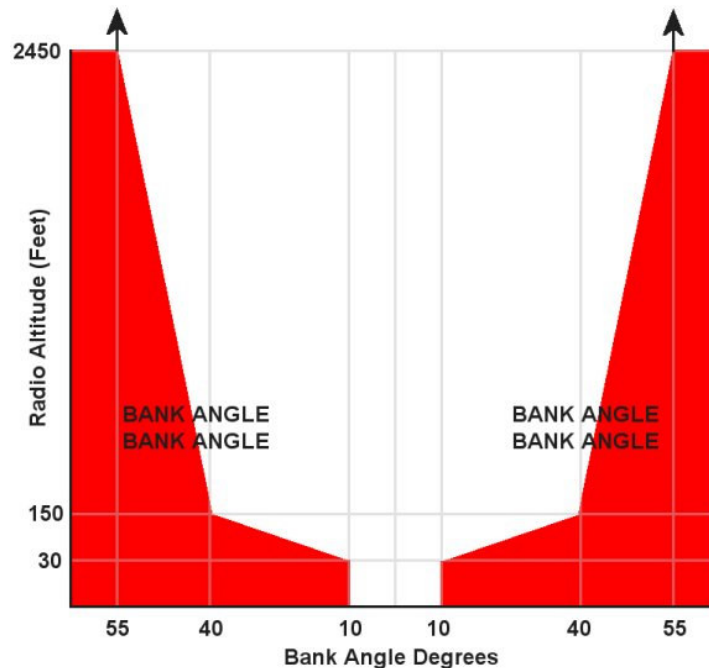
Decision Height based callouts (Approaching Minimums and Minimums) require the landing gear down to be down and occur when descending through the radio altitude corresponding to the selected decision height (pos. 128).

### 3.20.6.2 Bank Angle Callout

The callout “Bank Angle, Bank Angle”, which is also part of Mode 4, advises of an excessive roll angle. Bank angles in excess of:

- $\pm 10^\circ$  between 5 and 60 feet,
- $\pm 10^\circ$  to  $40^\circ$  between 30 and 150 feet,
- $\pm 40^\circ$  to  $55^\circ$  between 150 and 2450 feet,

produce the bank angle advisory (red area in the picture below). Bank angle advisories are inhibited below 5 feet.



#### ***Additional Notes to the Bank Angle callouts***

The real EGPWS contents different excessive bank angle envelopes depending on passenger aircraft or transport aircraft. This panel contents only the bank angle envelopes for passenger aircraft.

### 3.20.7 GPWS Mode 7 Windshear Alerting



269	Windshear Caution light
270	Windshear Warning light

Mode 7 is designed to provide alerts if the aircraft encounters windshear. Two alerting provides either a windshear caution alert, which is shown in the caution lamp pos. 269 and without any acoustic warning, or a windshear warning which is shown in the warning lamp pos. 270 and which also contains an acoustic alert "Windshear, Windshear, Windshear".

A windshear caution results in illumination of the amber windshear caution light pos. 269. Such a windshear caution will be given if:

- Increasing headwind (more than 2 knots within 1 second)
- Decreasing tailwind (more than 2 knots within 1 second)
- Wind direction changing from tailwind to headwind

A windshear warning results in illumination of the red windshear warning light pos. 270 and an aural message "Windshear, Windshear, Windshear". Both, light and aural alert, remain on as long as the aircraft is exposed to conditions in excess of the warning alert threshold. The windshear warning will be given if:

- Increasing tailwind (more than 2 knots within 1 second)
- Decreasing headwind (more than 2 knots within 1 second)
- Wind direction changing from headwind to tailwind



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Mode 7 windshear alerting is active under the following conditions:

- During takeoff; from rotation speed until an altitude of 1500 ft AGL is reached.
- During approach; from an altitude of 1500 feet don to 10 feet AGL.
- During a missed approach; until an altitude of 1500 feet AGL is reached.

### ***Additional Notes to mode 7***

The real Mode 7 contents also a scanning of the up- and downdraft caused by the windshear. This was not possible to realize with this panel. Instead of the up- and downdraft, the gauge is programmed to scan the wind speed in relation to the ind direction to simulate an up- or downdraft.

The acoustic “Windshear, Windshear, Windshear” warning will not repeat in the real EGPWS. In this panel, the acoustic warning remains on as long as you are in the wind-shear situation.

### **3.20.8 GPWS Message Priority**

To prevent that acoustic messages will not operate at the same time, the EGPWS system has a priority for each acoustic warning, which is shown in the table below. This has no validity for the optical warnings.

1	“Windshear, Windshear, Windshear”
2	“Pull Up”
3	“Terrain, Terrain”
4	“Minimums”
5	“Too Low Terrain”
6	“Too Low Gear”
7	“Too Low Flaps”
8	“Sinkrate”
9	“Don’t Sink”
10	“Glideslope”
11	“Approaching Minimums”
12	“Bank Angle, Bank Angle”
13	Altitude Callouts

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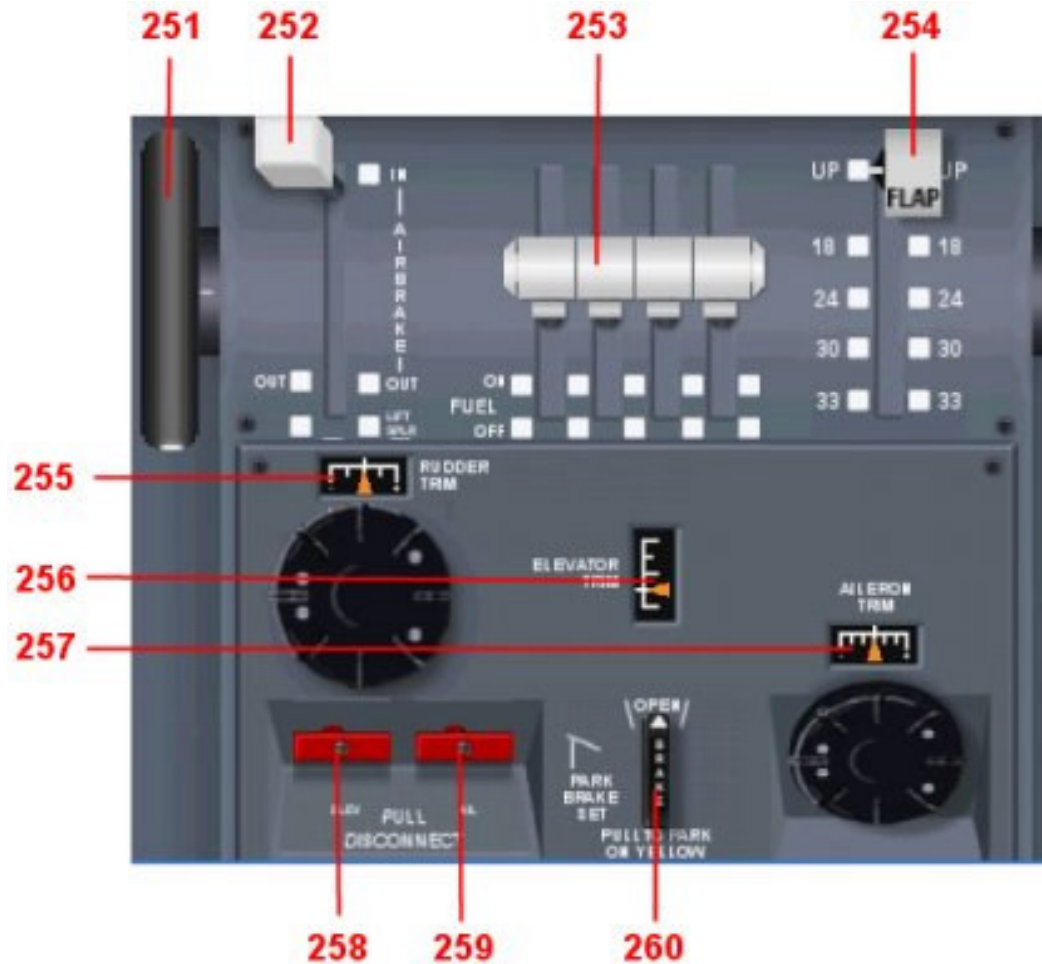
### 3.20.9 GPWS Short Level Self Test

The short level self test is intended to provide a Go/No Go confidence test to indicate EGPWS functionality. A short level self test sequence is as follows:

- Warning light pos. 242 illuminates
- Voice “Glideslope” sounds
- Voice “Pull Up” sounds
- Voice “Glideslope” sounds
- Voice “Pull Up, Pull Up, Pull Up” sounds
- Warning light pos. 242 turns off
- Warning light pos. 270 illuminates
- Voice “Windshear, Windshear, Windshear” sounds
- Warning light pos. 270 turns off
- Caution light pos. 269 illuminates
- Caution light pos. 269 turns off

If the self test will not work as listed above, the EGPWS system is not working. In this case check if the essential AC bus (SAC) is powered. The complete EGPWS system needs electrical power from the SAC bus. If there is no power no EGPWS warning is active and the self test will not work.

### 3.21 The Pedestal Panel



251	Elevator trim wheel
252	Spoiler lever (lift spoilers are not realized).
253	Throttles. For the function of the lower fuel off position (HP valve closed) please see the chapter "The High Pressure (HP) Valve switches in the Pedestal Panel"
254	Flap lever.
255	Rudder trim indicator.

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256	Elevator trim indicator.
257	Aileron trim indicator.
258	Elevator disconnect switch.
259	Aileron disconnect switch.
260	Parking brake switch.

***Additional Notes***

For a description of the radios please see the chapter “The Avro ARJ Radios” of this manual.

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## 4 The Avro ARJ Checklists

### 4.1 Overview Start-up Procedures (detailed)

1. Switch on the batteries (Pos. 4 and 5) (see page 11)
2. Set the DC selector (pos. 6) to position BATT1 (see page 11)
3. Check voltmeter (pos. 7) (see page 11)
4. Set the standby inverter to ARM (switch pos. 15) (see page 11)
5. Emergency AC Off light in the electric master annunciator pos. 11 goes off. (see page 11)
6. Parking brakes set
7. Switch on the APU generator (pos. 23) (see page 11)
8. If GPU is available connect external AC (pos. 31) (see page 11)
9. Switch on the external AC master switch (pos. 12) (see page 11)
10. Start APU (switch pos. 26) (see page 11)
11. Green APU available light (pos. 27) comes on at 100% rpm and all other APU warning lights goes off (pos. 29) (see page 11)
12. The START PWR ON light in the starter annunciator (pos. 66) goes off. (see page 27)
13. Airbrake (Spoilers) in
14. Master switches all on (pos. 122 – 125) (see page 53)
15. Anti Skid on (switch pos. 120) (see page 51)
16. External lights set (see page 46)
17. Bus ties both armed (switch pos. 13 and 14) (see page 11)
18. Standby generator armed (switch pos. 16) (see page 11)
19. Generator 1 and 4 off (switch pos. 21 and 24) (see page 11)
20. Gear indicator (pos. 204) checked (three greens) (see page 73)

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21. APU air on (switch pos. 78) (see page 30)
  22. Pack 2 on (switch pos. 73) (see page 32)
  23. Cabin air recirc as required (switch pos. 71) (see page 32)
  24. Set DC pump to BATT (switch pos. 59) (see page 23)
  25. Switch on AC pump (pos. 60) and PTU (pos. 61) (see page 23)
  26. Check yellow and green hydraulic pressurization (pos. 52 and 53) (see page 23)
  27. Check Trim positions (pos. 255 - 257) (see page 120)
  28. Start Master is off (Pos. 65) (see page 27)
  29. Switch off AC pump and PTU (pos. 60 and 61) (see page 23)
  30. continuous ignition off (pos. 68 and 69) (see page 27)
  31. Engine anti-ice off (pos. 92 – 95) (see page 38)
  32. Wing anti-ice off (pos. 96 and 97) (see page 38)
  33. Engine air off (pos. 80 – 83) (see page 30)
  34. Flight deck emergency lights armed (pos. 118) (see page 46)
  35. Thrust levers off (pos. 253) (see page 120)
  36. Flight instruments checked
  37. Avionics checked
  38. No Smoking signs on (pos. 126) (see page 54)
  39. Check the parking brake pressure (indicator pos. 199) (see page 73)
  40. Hydraulics all off except DC pump set to BATT (see page 23)
  41. Fuel panel checked (see page 18)
  42. Set pressurization (please see chapter 3.5.4 - 3.5.4.3) (see page 41)
  43. Switch on the fasten seat belts light and sign (pos. 127) (see page 54)

- 
44. Flowmeters zeroed for all four engines (pos. 188 and 189) (see page 70)
  45. Fuel contents checked (see page 70)
  46. Throttle HP valves opened – Throttle in the “On” position (see page 21)
  47. Electrical fuel pumps all on (pos. 48 – 51) (see page 18)
  48. Engine Anti-ice on (pos. 92 – 95) (see page 38)
  49. If external DC is used for starting connect external DC with pos. 32 (see page 16)
  50. Start Power as required (switch pos. 63) (see page 27)
  51. Start master on (pos. 65) (see page 27)
  52. White START PWR ON light came up (pos. 66) (see page 27)
  53. Select engine with selector pos. 64) (see page 27)
  54. Engine starter to position start (pos. 70) (see page 27)
  55. All four starter annunciator lights came up while starting (pos. 66) (see page 27)
  56. When the starter switch goes back to to the “RUN” position and the green ignition lights and the white “STARTER OPERATING” light goes off select the next engine for starting.
  57. Set start power to Normal (pos. 63) (see page 27)
  58. Set start selector and start master to off (pos. 64 and 65) (see page 27)
  59. Engine anti-ice as required (pos. 92 – 95) (see page 38)
  60. Generator 1 and 4 on (pos. 21 and 24) (see page 11)
  61. Check generator Ammeters. Ammeter of Gen 1 and 4 should be indicated while APU ammeter should be on 0 (see page 11)
  62. Switch on Hydraulics (pos. 57 and 58) (see page 23)
  63. Switch off DC pump (pos. 59) (see page 23)
  64. Check hydraulic pressure (pos. 52 and 53) (see page 23)
  65. Check parking brake pressure (pos. 199) (see page 73)
  66. Switch off external AC (pos. 12) when ext. AC was in use (see page 11)
  67. Disconnect GPU (pos. 31 and 32) when GPU was in use (see page 16)

For the complete Checklist please see next chapter!



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## 4.2 Complete Panel Checklist

Based on the real Avro ARJ Checklist but with some minor changes for the use with this Panel in the Flight Simulator.

### Safety Check before A/C Power on / Flight Deck Safety Check

• Airbrake	IN
• Flaps	SELECTION NOTED
• Batteries	CHECKED AND ON
• Parking Brake	SET
• Master Switches (left to right)	ON
• Anti Skid	ON
• Bus Ties	AUTO
• Standby Inverter	ARM AND CHECKED
• Standby Generator	ARM
• Generator 1 and 4	OFF
• Ext AC (if required)	CHECKED AND ON
• Fuel Pump 2	ON
• APU Generator	ON
• APU	START: EGT / RPM CHECKED
• Gear Indicator	3 GREENS
• EFIS Displays	ON
• DC Pump	BATT
• AC Pump and PTU	ON / ON CHECKED
• Thrust Levers	CONFIG CHECKED / OFF
• Trims	CHECKED
• PTU and AC Pump	OFF / OFF
• Continuous Ignition	BOTH OFF
• Wing Ice Protection	ALL OFF
• Engine Air	OFF
• Emergency Lights	ARMED
• Glareshield	CHECKED
• Autopilot	CHECKED / OFF
• Central Panel	CHECKED
• Avionics/PA/Comm	ON / SET
• APU Air / Pack 2	ON / ON
• External Lights	SET
• Galley	ON
• Control Disconnect	BOTH HANDLES IN
• No Smoking Signs	ON
• Flight Instruments	CHECKED

---

**Before Start Checklist**

- |                                       |                         |
|---------------------------------------|-------------------------|
| • Brakes                              | PARK / PRESSURE CHECKED |
| • Hydraulic Pump 2 / Hydraulic Pump 3 | OFF / OFF               |
| • Electrical Fuel Pumps               | ALL ON                  |
| • Fuel Panel                          | CHECKED AND SET         |
| • Pressurization                      | CHECKED AND SET         |
| • Fasten Seat Belts                   | ON                      |
| • Fuel Quantity                       | CHECHED                 |
| • Flow Meters                         | ZEROED                  |
| • Speeds / N1s                        | CHECKED / BUGS SET      |

**Starting**

- |                     |                |
|---------------------|----------------|
| • Doors and Windows | CLOSED         |
| • Rotary Beacon     | ON             |
| • Packs and APU Air | OFF            |
| • AC Pump           | OFF            |
| • Start Power       | AS REQUIRED    |
| • Start Master      | ON             |
| • Start Selector    | ENGINE NO..... |
| • Engine            | START          |
| • Engine Anti Ice   | ON             |

**After Start**

- |                                       |                 |
|---------------------------------------|-----------------|
| • Start Power                         | NORM            |
| • Start Selector and Master           | OFF             |
| • Engine Anti-ice                     | AS REQUIRED     |
| • Generator 1 and 4                   | CHECKED AND ON  |
| • Hydraulic Pump 2 / Hydraulic Pump 3 | ON / ON CHECKED |
| • Engine Air                          | AS REQUIRED     |
| • APU Air                             | AS REQUIRED     |
| • Packs                               | AS REQUIRED     |
| • APU                                 | AS REQUIRED     |
| • DC Pump                             | OFF             |
| • Heaters                             | ALL ON          |

---

### Before Take Off Checklist

- |                       |                   |
|-----------------------|-------------------|
| • Taxi Lights         | ON                |
| • Brakes              | CHECKED           |
| • Flaps               | SET AND CHECKED   |
| • Flight Instruments  | CHECKED / QNH SET |
| • Trims               | SET FOR TAKE OFF  |
| • Config              | CHECKED           |
| • Nav Aids            | SET AS CLEARED    |
| • Speeds / N1s        | CHECKED           |
| • Continuous Ignition | AS REQUIRED       |

### Line Up Checklist

- |               |                                                      |
|---------------|------------------------------------------------------|
| • Cabin       | READY                                                |
| • Transponder | SET CODE                                             |
| • Strobes     | ON                                                   |
| • FMA         | AT TO REDU (OR MAX) WHITE<br>FD TO TRK GREEN CHECKED |
| • MWS         | CHECKED                                              |
| • Controls    | CHECKED FULL AND FREE                                |
| • RWY Heading | CHECKED                                              |
| • Lights      | TAKE OFF                                             |

### After Take off

- |              |                 |
|--------------|-----------------|
| • Gear       | UP / LIGHTS OUT |
| • Flaps      | UP              |
| • Engine Air | ON              |
| • Packs      | BOTH ON         |
| • APU Air    | OFF             |
| • TRP        | CLIMB           |

### Climb

- |                       |                      |
|-----------------------|----------------------|
| • APU                 | STOP                 |
| • Altimeters          | 1013 SET AND CHECKED |
| • Continuous Ignition | AS REQUIRED          |
| • Pressurization      | CHECKED              |
| • Fasten Belts        | AS REQUIRED          |
| • No Smoking          | AS REQUIRED          |

---

## Descent

- Pressurization SET AND CHECKED
- Fasten Seat Belts AS REQUIRED
- No Smoking AS REQUIRED

## 10.000 FT

- Fasten Seat Belts ON
- Lights ON
- Pressurization CHECKED

## Approach

- Altimeters QNH SET AND CHECKED
- Flight Instruments SET AND CHECKED
- Fuel Panel SET
- No Smoking ON
- Fasten Seat Belts ON
- Cabin SECURED
- APU AS REQUIRED
- Nav Switch NAV
- Engine Air AS REQUIRED

## Landing

- Gear DOWN 3 GREENS
- Brake Pressure CHECKED
- APU Air AS REQUIRED
- Packs AS REQUIRED
- Engine Air AS REQUIRED
- Flaps SET FOR LANDING
- Auto Throttle DISCONNECT

---

### After Landing

- APU AS REQUIRED
- Continuous Ignition and Anti Ice AS REQUIRED
- Airbrakes/Spoilers IN
- Flaps UP
- Strobe Lights OFF
- APU Air AS REQUIRED
- Packs AS REQUIRED
- Engine Air OFF
- Taxi Lights ON

### Shutdown Checklist

- Hydraulics ALL OFF
- Fuel Pumps AS REQUIRED
- Generator 1 and 4 OFF
- Rotary Beacon OFF
- Fasten Belts OFF
- No Smoking OFF
- Taxi Lights OFF
- Thrust Levers FUEL OFF
- Brakes YELLOW / PARK

### Leaving Aircraft Checklist

- EFIS OFF
- Master Switches (right to left) OFF
- Anti Skid OFF
- Emergency Lights OFF
- Lights and Notices OFF EXCEPT NAV LIGHTS
- Packs OFF
- APU Air OFF
- APU Generator OFF
- APU STOP
- Engine Anti Ice ON
- Fuel Pumps OFF
- Galley OFF
- Batteries OFF

---

## 5 Avro ARJ Appendix

### 5.1 Appendix 1 Flap Limitation Speeds

Flap Setting	IAS
18°	215 knots
24°	180 knots
30°	170 knots
33°	150 knots

## 5.2 Appendix 2 Speedcharts

27000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	104	96	90
V <sub>2</sub>	115	106	100
V <sub>FTO</sub>	147		
V <sub>ER</sub>	157		
Landing Flaps	33°	24°	
V <sub>REF</sub>	100	114	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	106	125	155

28000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	106	98	90
V <sub>2</sub>	117	107	100
V <sub>FTO</sub>	151		
V <sub>ER</sub>	161		
Landing Flaps	33°	24°	
V <sub>REF</sub>	102	116	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	108	127	158

29000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	108	100	92
V <sub>2</sub>	119	109	101
V <sub>FTO</sub>	154		
V <sub>ER</sub>	164		
Landing Flaps	33°	24°	
V <sub>REF</sub>	104	117	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	109	128	160

30000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	111	102	94
V <sub>2</sub>	120	110	103
V <sub>FTO</sub>	157		
V <sub>ER</sub>	167		
Landing Flaps	33°	24°	
V <sub>REF</sub>	106	119	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	111	130	163



31000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	113	104	96
V <sub>2</sub>	122	112	105
V <sub>FTO</sub>	159		
V <sub>ER</sub>	169		
Landing Flaps	33°	24°	
V <sub>REF</sub>	108	121	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	113	132	166

32000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	115	106	98
V <sub>2</sub>	124	114	106
V <sub>FTO</sub>	162		
V <sub>ER</sub>	172		
Landing Flaps	33°	24°	
V <sub>REF</sub>	109	122	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	115	134	168

33000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	117	108	100
V <sub>2</sub>	125	115	108
V <sub>FTO</sub>	165		
V <sub>ER</sub>	175		
Landing Flaps	33°	24°	
V <sub>REF</sub>	111	124	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	116	135	171

34000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	120	110	102
V <sub>2</sub>	127	117	109
V <sub>FTO</sub>	167		
V <sub>ER</sub>	177		
Landing Flaps	33°	24°	
V <sub>REF</sub>	113	126	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	118	137	173

35000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	122	112	104
V <sub>2</sub>	139	118	111
V <sub>FTO</sub>	170		
V <sub>ER</sub>	180		
Landing Flaps	33°	24°	
V <sub>REF</sub>	115	128	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	120	139	176

36000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	124	114	106
V <sub>2</sub>	131	120	113
V <sub>FTO</sub>	172		
V <sub>ER</sub>	182		
Landing Flaps	33°	24°	
V <sub>REF</sub>	116	129	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	121	140	178

37000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	126	116	108
V <sub>2</sub>	132	122	114
V <sub>FTO</sub>	174		
V <sub>ER</sub>	184		
Landing Flaps	33°	24°	
V <sub>REF</sub>	118	131	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	123	142	181

38000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	128	118	109
V <sub>2</sub>	134	123	116
V <sub>FTO</sub>	177		
V <sub>ER</sub>	187		
Landing Flaps	33°	24°	
V <sub>REF</sub>	119	132	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	124	143	183

39000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	130	120	111
V <sub>2</sub>	136	125	117
V <sub>FTO</sub>	179		
V <sub>ER</sub>	189		
Landing Flaps	33°	24°	
V <sub>REF</sub>	121	134	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	126	145	186

40000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	132	122	113
V <sub>2</sub>	137	127	119
V <sub>FTO</sub>	181		
V <sub>ER</sub>	191		
Landing Flaps	33°	24°	
V <sub>REF</sub>	123	136	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	128	147	188

41000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	134	124	115
V <sub>2</sub>	138	128	121
V <sub>FTO</sub>	184		
V <sub>ER</sub>	194		
Landing Flaps	33°	24°	
V <sub>REF</sub>	124	137	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	129	148	190

42000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	136	126	117
V <sub>2</sub>	140	130	122
V <sub>FTO</sub>	186		
V <sub>ER</sub>	196		
Landing Flaps	33°	24°	
V <sub>REF</sub>	125	139	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	131	149	193

43000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	137	127	118
V <sub>2</sub>	142	132	124
V <sub>FTO</sub>	188		
V <sub>ER</sub>	198		
Landing Flaps	33°	24°	
V <sub>REF</sub>	127	140	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	132	151	195

44000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	139	129	120
V <sub>2</sub>	144	133	125
V <sub>FTO</sub>	191		
V <sub>ER</sub>	201		
Landing Flaps	33°	24°	
V <sub>REF</sub>	128	142	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	133	152	198

45000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	141	131	122
V <sub>2</sub>	146	135	127
V <sub>FTO</sub>	193		
V <sub>ER</sub>	203		
Landing Flaps	33°	24°	
V <sub>REF</sub>	130	143	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	135	154	200

46000 kg			
Take Off Flaps	18°	24°	30°
V <sub>R</sub>	143	132	124
V <sub>2</sub>	147	136	128
V <sub>FTO</sub>	195		
V <sub>ER</sub>	205		
Landing Flaps	33°	24°	
V <sub>REF</sub>	131	144	
Abnormal Flaps	30°	18°	0°
V <sub>REF</sub>	136	156	203

### 5.3 Appendix 3 Speedbug Card

BA	Avro RJ TAKE/OFF	T <sub>AMB</sub> +10	RUNWAY	
MSA		T <sub>REDU</sub> +12	POSITION	
		ZERO WIND TOPL	EMERG TURN	
		WIND + CORR -	NORM TOPL	V <sub>R</sub>
		QNH + CORR -	V <sub>R</sub> - V <sub>1</sub>	DRY WET
		NORM TOPL	NORM TOPL	V <sub>1</sub>
		RTOW	V <sub>1</sub>	
		TOW	V <sub>R</sub>	
		FLAP	V <sub>2</sub>	
		N1 <sub>REF</sub>	V <sub>FTO</sub>	
		N1 <sub>REDU</sub>	TRIM	

## 5.4 Appendix 4 TRP Toga Charts

### 5.4.1 TOGA Rating No Bleed

TOGA RATING NO BLEED																					
Pressure Altitude ft (000)		Ambient Temperature DEG. C																			
		N1 REF FLAT RATED RANGE										N1 REF FULL RATED RANGE									
		-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
8 N1 Ref.	95.3	96.1	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	96.0	95.1	94.3	93.4	92.6	91.7	90.9	90.0
N1 Redu	92.4	93.2	94.0	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	93.1	92.3	91.5	90.6	89.8	89.0	88.2	90.0
6 N1 Ref.	92.5	93.3	94.2	95.0	95.9	96.7	97.0	97.0	97.0	97.0	97.0	97.0	97.0	96.2	95.4	94.5	93.7	92.8	92.0	91.1	90.3
N1 Redu	89.7	90.5	91.3	92.2	93.0	93.8	94.1	94.1	94.1	94.1	94.1	94.1	94.1	93.3	92.5	91.7	90.9	90.0	89.2	88.4	90.3
4 N1 Ref.	89.7	90.5	91.4	92.2	93.1	93.9	94.8	95.6	96.5	97.0	97.0	97.0	97.0	96.5	95.6	94.8	93.9	93.1	92.2	91.4	90.5
N1 Redu	87.0	87.8	88.6	89.4	90.3	91.1	91.9	92.7	93.6	94.1	94.1	94.1	94.1	93.6	92.8	91.9	91.1	90.3	89.5	88.6	90.5
2 N1 Ref.	86.9	87.7	88.6	89.4	90.3	91.1	92.0	92.8	93.7	94.5	95.3	96.1	96.9	96.0	95.2	94.3	93.5	92.6	91.8	90.9	90.9
N1 Redu	84.2	85.1	85.9	86.7	87.5	88.4	89.2	90.0	90.8	91.7	92.4	93.2	93.9	93.1	92.3	91.5	90.6	89.8	89.0	90.9	90.9
1 N1 Ref.	85.5	86.3	87.2	88.0	88.9	89.7	90.6	91.4	92.3	93.1	93.9	94.7	95.5	96.1	95.2	94.4	93.5	92.7	91.8	91.0	91.0
N1 Redu	82.9	83.7	84.5	85.4	86.2	87.0	87.8	88.7	89.5	90.3	91.1	91.9	92.6	93.2	92.3	91.5	90.7	89.9	89.0	91.0	91.0
0 N1 Ref.	84.1	84.9	85.8	86.6	87.5	88.3	89.2	90.0	90.9	91.7	92.5	93.3	94.1	94.9	95.3	94.4	93.6	92.7	91.9	91.0	91.0
N1 Redu	81.5	82.4	83.2	84.0	84.8	85.7	86.5	87.3	88.1	88.9	89.7	90.5	91.3	92.1	92.4	91.6	90.7	89.9	89.1	91.0	91.0
-1 N1 Ref.	82.7	83.5	84.4	85.2	86.1	86.9	87.8	88.6	89.5	90.3	91.1	91.9	92.7	93.5	94.3	94.5	93.6	92.8	91.9	91.1	91.1
N1 Redu	80.2	81.0	81.8	82.6	83.5	84.3	85.1	85.9	86.8	87.6	88.4	89.2	89.9	90.7	91.5	91.6	90.8	90.0	89.1	91.1	91.1

## 5.4.2 TOGA Rating Engine Anti-Ice On

Pressure Altitude ft (000)		TOGA RATING Engine Anti-Ice On																			
		Ambient Temperature DEG. C																			
		N1 REF FLAT RATED RANGE										N1 REF FULL RATED RANGE									
		-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
8 N1 Ref.		95.5	96.3	97.0	97.0	97.0	97.0	97.0	97.0	97.0	96.0	95.3	94.6	93.9	93.2	92.5	91.8	91.1	90.4	89.7	89.0
N1 Redu		92.6	93.4	94.1	94.1	94.1	94.1	94.1	94.1	94.1	93.1	92.4	91.8	91.1	90.4	89.7	89.0	88.4	87.7	87.0	86.0
6 N1 Ref.		92.7	93.5	94.4	95.2	96.1	96.9	97.0	97.0	97.0	96.2	95.5	94.8	94.1	93.4	92.7	92.0	91.3	90.6	89.9	89.2
N1 Redu		89.9	90.7	91.5	92.3	93.2	94.0	94.1	94.1	94.1	93.3	92.6	92.0	91.3	90.6	89.9	89.2	88.6	87.9	87.2	86.2
4 N1 Ref.		89.9	90.7	91.6	92.4	93.3	94.1	95.0	95.8	96.7	96.5	95.7	95.0	94.3	93.6	92.9	92.2	91.5	90.8	90.1	89.4
N1 Redu		87.2	88.0	88.8	89.6	90.5	91.3	92.1	92.9	93.8	93.6	92.8	92.2	91.5	90.8	90.1	89.4	88.8	88.1	87.4	86.4
2 N1 Ref.		87.1	87.9	88.8	89.6	90.5	91.3	92.2	93.0	93.9	94.7	95.4	94.2	93.5	92.8	92.1	91.4	90.7	90.0	89.3	88.6
N1 Redu		84.4	85.3	86.1	86.9	87.7	88.6	89.4	90.2	91.0	91.9	92.5	91.4	90.7	90.0	89.3	88.7	88.0	87.3	86.6	85.6
1 N1 Ref.		86.7	86.5	87.4	88.2	89.1	89.9	90.8	91.6	92.5	93.3	94.0	94.7	93.6	92.9	92.2	91.5	90.8	90.1	89.4	88.7
N1 Redu		83.1	83.9	84.7	85.6	86.4	87.2	88.0	88.9	89.7	90.5	91.2	91.9	90.8	90.1	89.4	88.8	88.1	87.4	86.7	85.7
0 N1 Ref.		84.3	85.1	86.0	86.8	87.7	88.5	89.4	90.2	91.1	91.9	92.6	93.3	94.0	93.0	92.3	91.6	90.9	90.2	89.5	88.8
N1 Redu		81.7	82.5	83.4	84.2	85.0	85.8	86.7	87.5	88.3	89.1	89.8	90.5	91.2	90.2	89.5	88.9	88.2	87.5	86.8	86.0
-1 N1 Ref.		82.9	83.7	84.6	85.4	86.3	87.1	88.0	88.8	89.7	90.5	91.2	91.9	92.6	93.1	92.4	91.7	91.0	90.3	89.6	88.9
N1 Redu		80.4	81.2	82.0	82.8	83.7	84.5	85.3	86.1	87.0	87.8	88.5	89.1	89.8	90.3	89.6	88.9	88.3	87.6	86.9	86.0



### 5.4.3 TOGA Rating Cabin Air On

Pressure Altitude ft (000)		TOGA RATING Cabin Air On																			
		Ambient Temperature DEG. C																			
		N1 REF FLAT RATED RANGE										N1 REF FULL RATED RANGE									
		-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
8 N1 Ref.		95.2	95.0	95.9	97.0	97.0	97.0	97.0	97.0	97.0	97.0	96.5	95.5	94.5	93.6	92.6	91.6	90.6	89.7	88.7	87.7
N1 Redu		92.3	93.1	93.9	94.1	94.1	94.1	94.1	94.1	94.1	94.1	93.6	92.6	91.7	90.7	89.8	88.9	87.9	87.0	86.0	91.6
6 N1 Ref.		92.4	93.2	94.1	94.9	95.8	96.6	97.0	97.0	97.0	97.0	96.9	95.9	94.9	94.0	93.0	92.0	91.0	90.1	89.1	88.1
N1 Redu		89.6	90.4	91.2	92.1	92.9	93.7	94.1	94.1	94.1	94.1	94.0	93.0	92.1	91.1	90.2	89.2	88.3	87.3	86.4	91.8
4 N1 Ref.		89.6	90.4	91.3	92.1	93.0	93.8	94.7	95.5	96.4	97.0	96.9	96.3	95.3	94.4	93.4	92.4	91.4	90.5	89.5	88.5
N1 Redu		86.9	87.7	88.5	89.3	90.2	91.0	91.8	92.6	93.5	94.1	93.9	93.4	92.5	91.5	90.6	89.6	88.7	87.7	86.8	92.0
2 N1 Ref.		86.8	87.6	88.5	89.3	90.2	91.0	91.9	92.7	93.6	94.4	95.2	95.9	95.7	94.8	93.8	92.8	91.8	90.9	89.9	88.9
N1 Redu		84.1	85.0	85.8	86.6	87.4	88.3	89.1	89.9	90.7	91.6	92.3	93.0	92.9	91.9	91.0	90.0	89.1	88.1	87.2	92.2
1 N1 Ref.		85.4	86.2	87.1	87.9	88.8	89.6	90.5	91.3	92.2	93.0	93.8	94.5	95.3	95.0	94.0	93.0	92.0	91.1	90.1	89.1
N1 Redu		82.8	83.6	84.4	85.3	86.1	86.9	87.7	88.6	89.4	90.2	90.9	91.7	92.4	92.1	91.2	90.2	89.3	88.3	87.4	92.3
0 N1 Ref.		84.0	84.8	85.7	86.5	87.4	88.2	89.1	89.9	90.8	91.6	92.4	93.1	93.9	94.6	94.2	93.2	92.2	91.3	90.3	89.3
N1 Redu		81.4	82.3	83.1	83.9	84.7	85.6	86.4	87.2	88.0	88.9	89.6	90.3	91.0	91.8	91.3	90.4	89.5	88.5	87.6	91.2
-1 N1 Ref.		82.6	83.4	84.3	85.1	86.0	86.8	87.7	88.5	89.4	90.2	90.9	91.6	92.3	93.0	92.4	91.7	91.0	90.3	89.6	88.9
N1 Redu		80.1	80.9	81.7	82.5	83.4	84.2	85.0	85.8	86.7	87.5	88.2	88.9	89.5	90.2	89.6	88.9	88.3	87.6	86.9	91.1

## 6 Known Bugs and FAQ's

- Do I need FSUIPC.dll for this panel?

*No! The complete panel based fully on FS2004 and FS2002 variables and did not require any FSUIPC function.*

- Could I use the included replacement FDE's for Jon Murchison's aircraft also in FS2002 and will the TRP also work in FS2002?

*Yes, that's possible*

- Why takes it such a long time to load the aircraft and the panel?

*When loading the first thing the panel do is to deactivate the Flight simulator systems (especially the electrical system) then this panels it's own systems for the electricity, the fuel system and the hydraulics. This takes a while but it will not brake down the frames as it is ju8st necessary one time when loading the panel.*

- After installing the panel almost all of the gauges are missing!

*The reason is, that you didn't unzip the MI\_ARJv40.cab into the gauges folder or you have completely unzipped the files of the cab file into the gauges folder. Do not unzip the cab file itself. The Flight simulator unzips this cab file automatically when he needs it. Just take care, that the file is in your gauges folder!*

- All Instruments are off when starting the panel!

*That's correct. Please go back and read the start-up procedure or the checklist to activate all gauges.*

- Why are both displays (PFD and ND) dark while all other instruments are working?

*That's because you may forgot to switch on the EFIS displays. The PFD and ND have an own Master Switch below the ND. Just switch it on and you could see the displays.*

- Is it possible to save a situation and the switch positions?

*Unfortunately this is not possible, I've programmed all gauges with XML and this programming language did not allow to write to \*.ini files or to read any \*.ini files.*

- 
- Is it possible to start the panel with the FS autostart Strg+E?

*No this is not possible. You have to go through the complete start-up procedure to activate the panel or you could use the invisible auto starter of the overhead panel. Please read the corresponding chapter in this manual.*

- How could I control the autopilot and the radios with my hardware?

*Unfortunately this is not possible as I had to use standard variables for the complete radios and the autopilot. It's not possible yet to control custom variables with any hardware at the moment.*

- The letters in the overhead panel are too small. I couldn't read them!

*I know this but it was necessary to give the panel a realistic look. For a better handling I recommend to print this manual. Another way is to move the mouse upon the switch or instrument and you will a tooltip text which shows you what for the switch or instrument is.*

- The EPR gauge shows always zero also when the engines are running.

*Some Avro ARJ aircraft did not have the necessary EPR entry in the airfile. If you are using Jon Murchison's aircraft please use the included airfile which correct this.*

- I just could set heading in 10 degree steps

*There could be two reasons for this problem. The first reason is that the problem is caused from FSUIPC.dll. If you are using this module there's an easy way to solve this problem. Just activate "Fix Control Acceleration" somewhere in the FSUIPC menu. The second reason is that the problem is caused from a calibration of your joystick while the Flight Simulator is running. It seems that sometimes this calibration from within the Flight Simulator also results a loss of the HDG or ALT setting in single steps. To solve this first disable the joystick and exit the game. After this unplug your joystick and uninstall the joystick software and joystick drivers and re-install them again. Plug in your joystick when prompted by the software installation program until all drivers and programs are installed. After this you should be able again to set the heading in single steps.*

- The gauges stays dark after deactivating the panel flood light.

*This happens because the main panel bitmap with all gauges will not refresh sometimes. To solve this just switch on and off or off and on the gauge lights.*

- 
- I could not switch on or off the HP fuel cut-off switch in the pedestal panel.

*It's just possible to switch the fuel cut-off switches if the throttles are in the Idle position. If the fuel cocks are closed (switch is off) and you are using a hardware throttle, you couldn't see the real position of the throttles in the panel. Please take care that your throttle is moved back to the zero position. Sometimes it could also be that your throttle calibration is not correct. When you load the pedestal panel and you move the mouse over the throttle or over one of the throttle movement areas (not directly over the fuel cut-off switches!) you should not read more than 9% in the tool tip text. If you read more than 9% you should recalibrate the zero position of your throttle.*

- I could not activate the reverse thrust!

*Well, the reason for this is simple. The ARJ and BAe 146 didn't have any reverse thrust.*

- I could not activate the autopilot on ground

*Yes, that's correct. The autopilot could just be used when you're airborne. However the Flight Director also works on ground.*

- Why do I have such strange climbing rates with the TRP?

*The reason for this is not because of the panel but because of the flightdynamics of the aircraft you're using. The TRP uses real world values for the two climbing modes climb norm and climb max. Some FS aircraft models have too much power in lower altitudes. Because of this you have a very high climbing rate when activating the TRP climb modes. If you are using Jon Murchison's or Mike Stone's ARJ, please replace the flightdynamics with the included ones. This should solve your problem.*

- Why does the throttle in the pedestal panel sometimes jumps up and down?

*It's because you are using a hardware throttle. When using a hardware throttle, the flight simulator always tries to capture the position of your hardware throttle. That's not really a problem because the AT has a higher priority but it didn't look very nice. To solve this, just move your hardware throttle to a position which is almost equal to the AT throttle position. But as written, it's not really necessary as the AT controls the thrust all the time when it's active.*

- 
- How could I open the second door or the cargo doors?

*Opening the second aircraft entry or the cargo doors is possible with the standard key command. However there are a few things which are important for this. The cargo doors just could be opened if the fuel cocks in the pedestal panel are opened, the batteries are switched on and at least the DC pump of the hydraulic system is on (brake pressure must be available). After this, the key command work.*

- Why is it not possible to activate different throttles with the key command "E +" in flight?

*The reason for this is the complexity of the panel. There are a lot of processes active while flying (FADEC, AP commands, system commands, ...) which have to use standard MSFS key commands. Because of this, the second key command gets lost. Nevertheless there is a solution for this problem if it's necessary for you to use key sequences in flight. Just download and install "rcbse-10.zip" from Rob Barendregt. This file could be found on Avsim or Flightsim.com and should solve the problem.*

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## 7 Credits

I had a lot of help from real BAe 146 and Avro ARJ pilots and ARJ enthusiasts to realize this panel as it is now. Here is a listing of all people I would like to thank for their patience, detailed descriptions and further help:

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If you need help for this panel, if you have some critic or comments or if you just want to say thank you, please use the support forum of the BAe Panel Project website <http://www.baepanelproject.com> rather than sending me an Email.

**And now have fun flying the Avro ARJ**