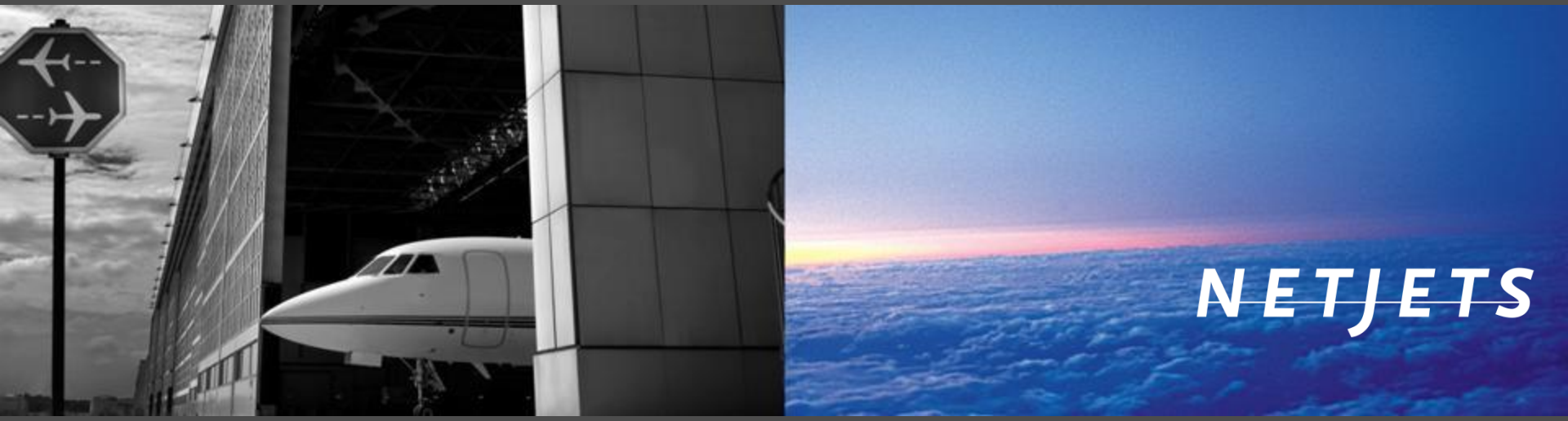


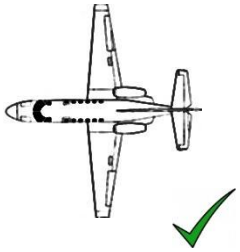
Setting up a new fleet in your FDM programme

A perspective from the business jet operator

Pedro Duarte
NetJets Europe
February 2014

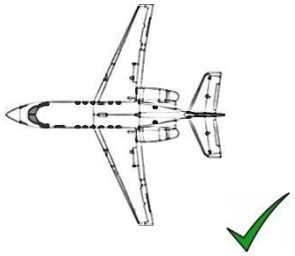
The NetJets fleet

Manufacturers and aircraft types

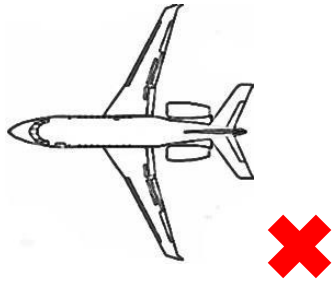


Cessna
Citation Bravo

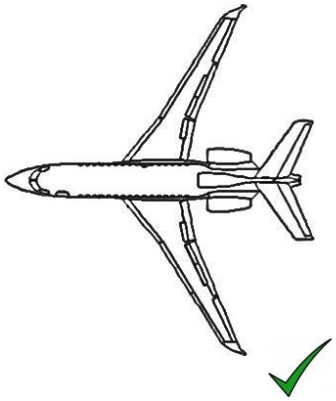
Cessna
Citation XLS



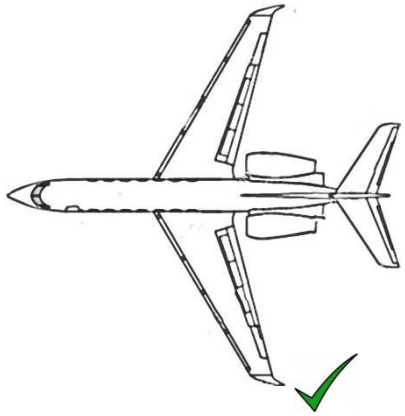
Hawker Beechcraft
750/800



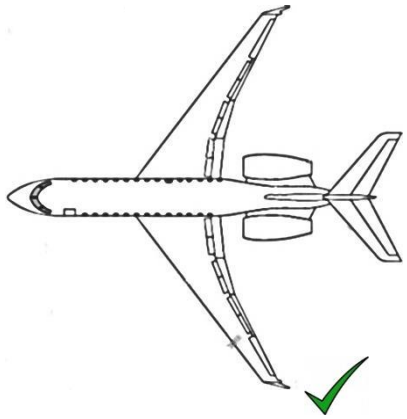
Dassault
Falcon 2000



Dassault
Falcon 7X



Gulfstream
G550



Bombardier
Global 6000

2014: Embraer
Phenom 300

2015: Bombardier
Challenger 350

NETJETS

Preparation

Data recording and parameters

Aircraft operation and systems

Company procedures

Preparation

Data recording and parameters

- QAR specification
- Frame Layout

AIRCRAFT MAINTENANCE MANUAL

FDR 1/FDR 2 PARAMETERS

PARAMETER NAME	SIGNAL TYPE	ORIGIN	SUB-FRAME	WORD	BIT	RESOLUTION	RANGE	REMARK
YAW CONTROL POSITION Copilot	ARINC 429	FBW/MAIC label 125	ALL	47	12-1	0.0625% of Mechanical Stop (MS) signed	±128%	
			ALL	111	12-1	0.0625% of Mechanical Stop (MS) signed		
			ALL	175	12-1	0.0625% of Mechanical Stop (MS) signed		
			ALL	239	12-1	0.0625% of Mechanical Stop (MS) signed		
			ALL	303	12-1	0.0625% of Mechanical Stop (MS) signed		
			ALL	367	12-1	0.0625% of Mechanical Stop (MS) signed		
			ALL	431	12-1	0.0625% of Mechanical Stop (MS) signed		
			ALL	495	12-1	0.0625% of Mechanical Stop (MS) signed plus =Left foot		
PITCH CONTROL SURFACE POSITION LH	ARINC 429	FBW/MAIC label 102	ALL	40	12-1	0.087890625°signed	+19° -28°	
			ALL	104	12-1	0.087890625°signed		
			ALL	168	12-1	0.087890625°signed		
			ALL	232	12-1	0.087890625°signed		
			ALL	296	12-1	0.087890625°signed		
			ALL	360	12-1	0.087890625°signed		
			ALL	424	12-1	0.087890625°signed		
			ALL	488	12-1	0.087890625°signed plus = Trailing Edge (TE) down		
PITCH CONTROL SURFACE POSITION RH	ARINC 429	FBW/MAIC label 103	ALL	41	12-1	0.087890625°signed	+19° -28°	
			ALL	105	12-1	0.087890625°signed		
			ALL	169	12-1	0.087890625°signed		
			ALL	233	12-1	0.087890625°signed		
			ALL	297	12-1	0.087890625°signed		
			ALL	361	12-1	0.087890625°signed		
			ALL	425	12-1	0.087890625°signed		
			ALL	489	12-1	0.087890625°signed plus = Trailing Edge (TE) down		

APPENDIX A - LIST OF RECORDED PARAMETERS - Issue: 1

Effectivity: A/C WITH TWO HIGH SPEED FRAME FDR (M1015 AND M1206)

31-31-00

SSFDR DATA INTERPRETATION -FLIGHT DATA RECORDER CONFIGURATION STANDARD (FRCS) REPORT

RELEASED

PARAMETER : Autothrottle Control Enum AT1 (Bit 21-17)
Sync. Code : FALSE
Mnemonic :
ID : AT1 CTRL
Modified Date : 8/8/2011

User-Definable Parameter Fields:
Display Length :

Comments:
Disc Word 1 – AFCS (AT1); Units of Measure=Enum; Output Data Type= text; Column Width= 28; Test Data= 0 to 1; Inc= 1

Samples:
Time Offset: WORD OFFSET
Subframe: 1 Word: 94 Bits: 8 - 12
Time Offset: WORD OFFSET
Subframe: 2 Word: 94 Bits: 8 - 12
Time Offset: WORD OFFSET
Subframe: 3 Word: 94 Bits: 8 - 12
Time Offset: WORD OFFSET
Subframe: 4 Word: 94 Bits: 8 - 12

Conversions:
Signed Value : FALSE
Units of Measurement: Enum
Discrete Interpretation
: 0 None
: 1 Hold A/S Cruise
: 2 Hold A/S Approach
: 3 Thrust Climb
: 4 Thrust Descend
: 5 Hold Vert Spd GA
: 6 Posn Throttle T/O
: 7 Posn Throttle GA
: 8 Posn Throttle Windshear
: 9 Position Throttle Flex T/O
: 10 Posn Throttle Retard
: 11 Posn Throttle EDM
: 12 Thrust Takeoff
: 13 Thrust Rating

Parameter Accuracy:
Parameter Range : 0 - 1
Transport Delays : 0
Resolution : 1

Sensor and Signal Items:

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Preparation

Data recording and parameters

QAR specification

Frame Layout

Compatibility with current definitions

- Can you enable all measurements and events?

Additional features

- Do you see any parameters you have never seen before?

Preparation

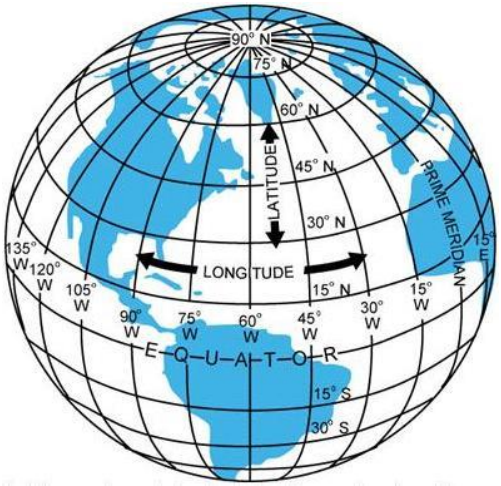
Data recording and parameters

QAR specification

Frame Layout

Are the parameters really identical?

- Source
- Decoding algorithm
- Meaning
- Sampling rate



Multiple sources:

- Pressure Altitude
- Radio Altimeter
- Airspeed
- Mach

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Preparation

Data recording and parameters

QAR specification

Frame Layout

Are the parameters really identical?

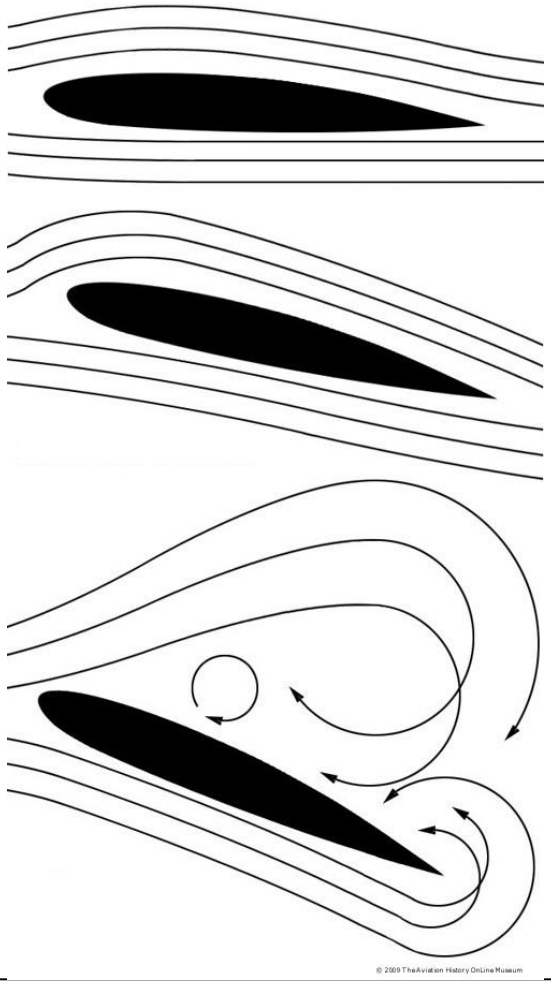
- Source
- Decoding algorithm
- Meaning
- Sampling rate

- Units
- Range (maximum and minimum values)

Preparation

Data recording and parameters

Angle of attack



Can be measured as:

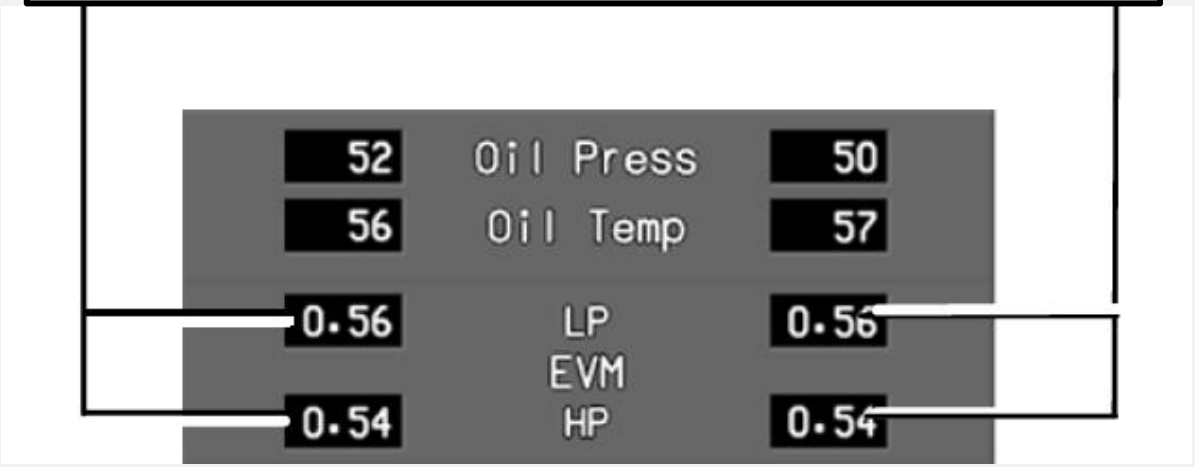
- Absolute value (degrees)
- Relative to stall conditions

Preparation

Data recording and parameters

Engine Vibration

Engine Vibration in Inches Per Second (IPS)
Range: 0.0 to 5.0 IPS



Preparation

Data recording and parameters

QAR specification

Frame Layout

Are the parameters really identical?

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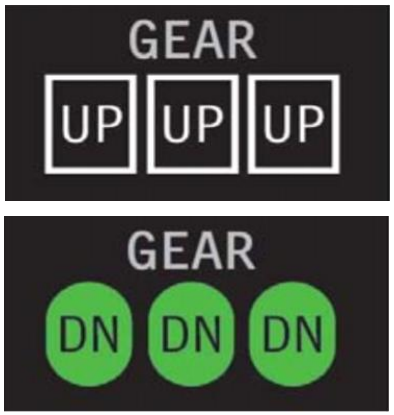
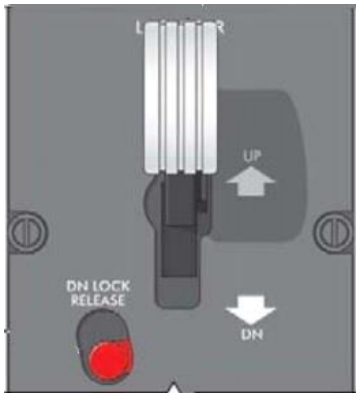
- Meaning
- Sampling rate

Gear position





Preparation

Data recording and parameters

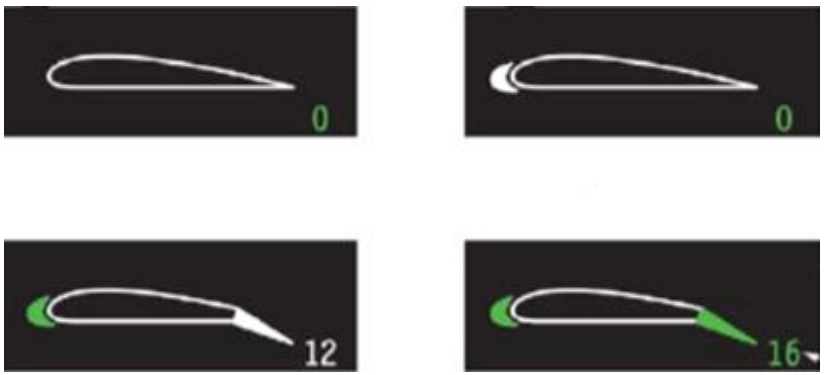
QAR specification

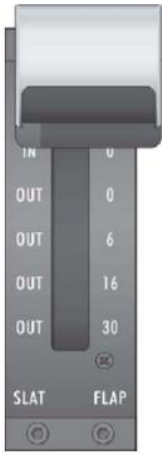
Frame Layout

Are the parameters really identical?

- Source
- Decoding algorithm
- Meaning
- Sampling rate

Flap position





Preparation

Data recording and parameters

QAR specification

Frame Layout

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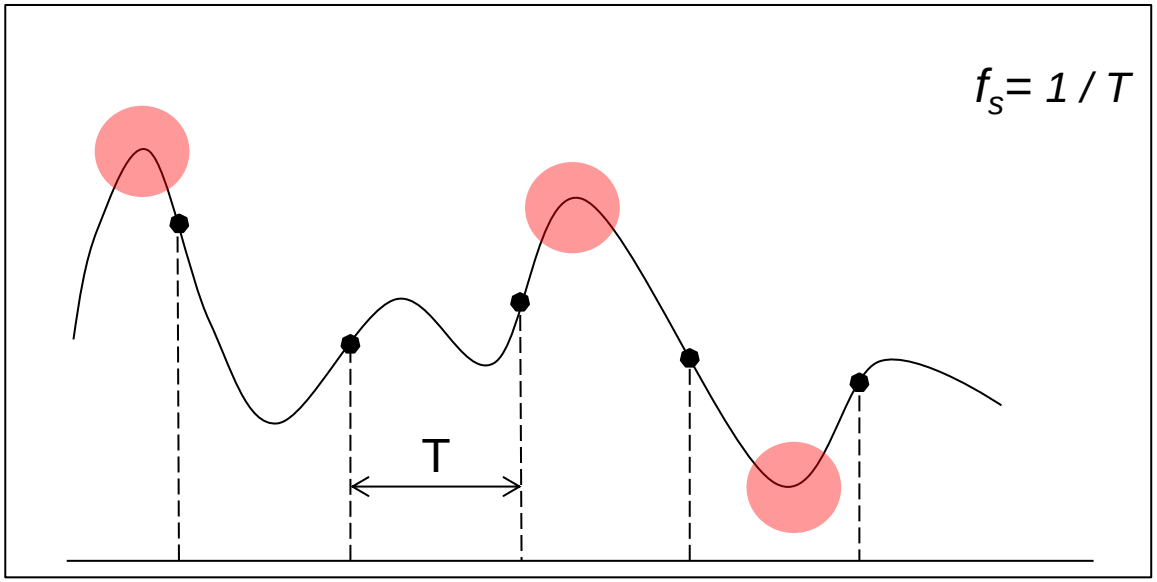
- Sampling rate



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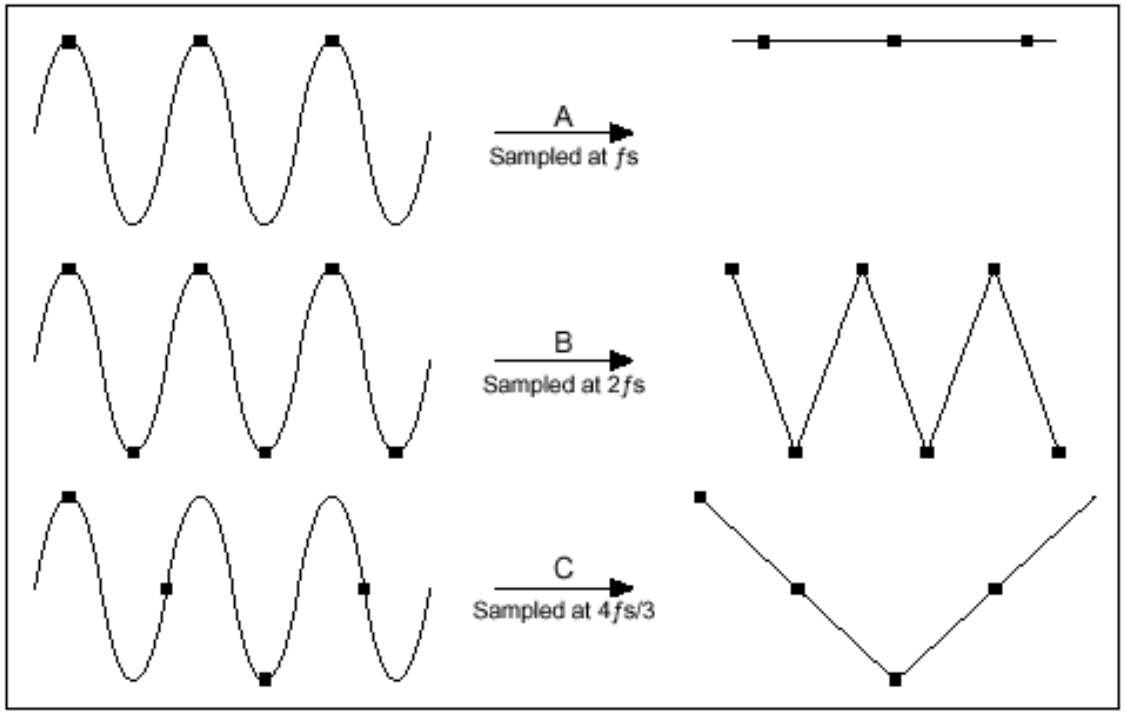
Preparation

Data recording and parameters

Effect of different sampling rates on the same continuous signal



Preparation

Data recording and parameters

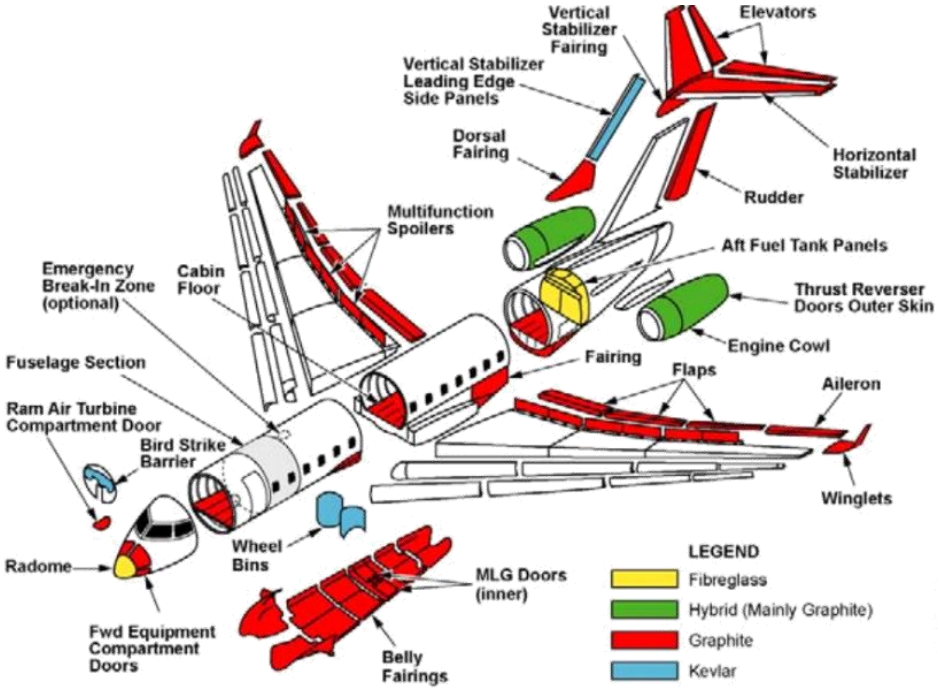
Aircraft operation and systems

Company procedures

Preparation

Aircraft operation and systems

- Aircraft Manual
- Maintenance Manual



NETJETS

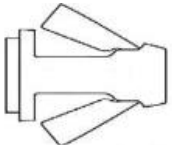
Preparation

Aircraft operation and systems

Systems operation and limitations

Flaps

Spoilers &
Airbrakes



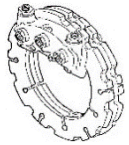
Thrust
Reverser

AP

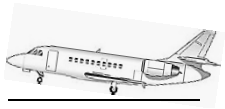
AFCS
Modes

AT

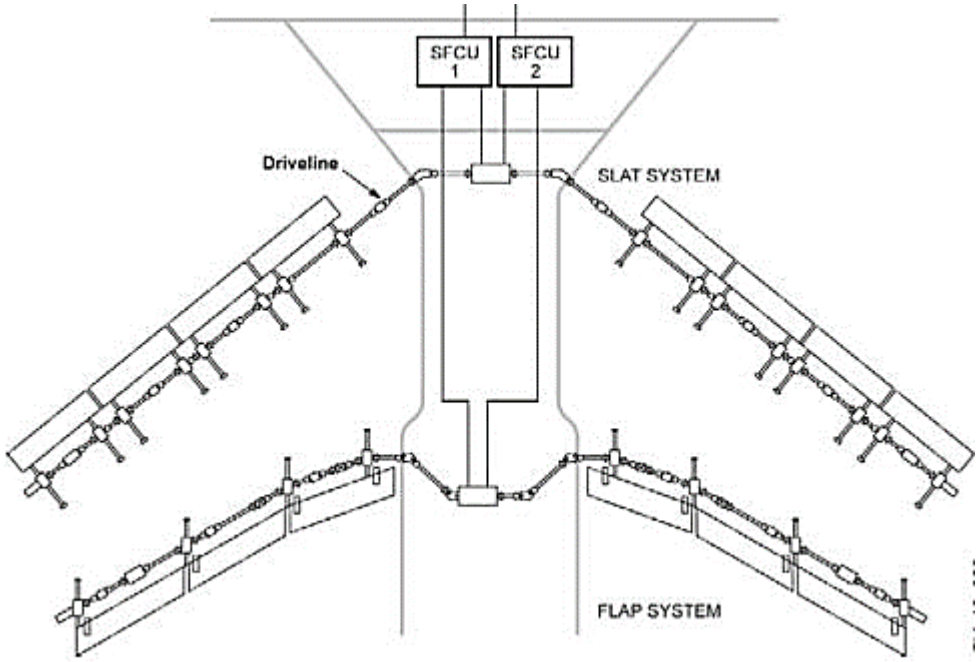
Autothrottle



Brakes



Air/Ground
Logic



NETJETS

Preparation

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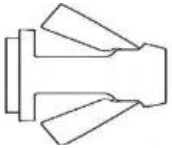
Flaps

Spoilers & Airbrakes



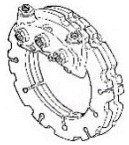
Thrust Reverser

AP

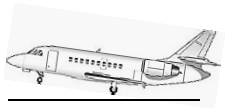
AFCS Modes

AT

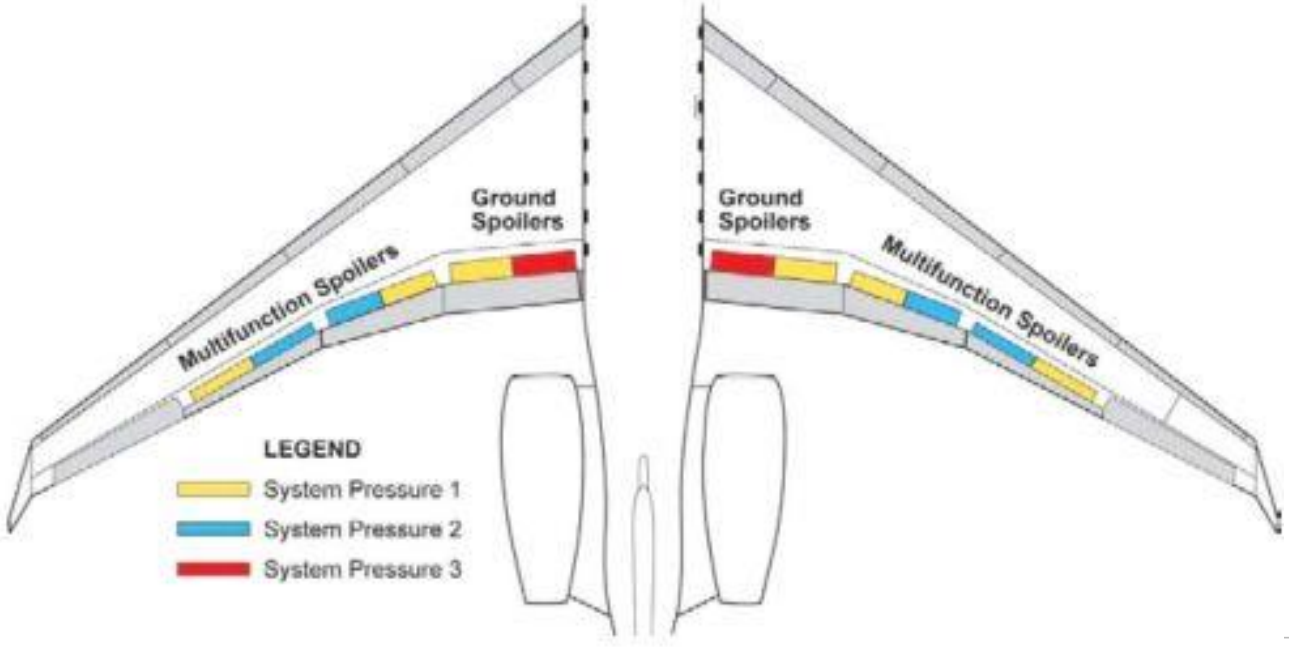
Autothrottle



Brakes



Air/Ground Logic



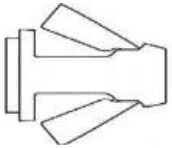
Preparation

Aircraft operation and systems

Systems operation and limitations

Flaps

Spoilers & Airbrakes



Thrust Reverser

AP

AFCS Modes

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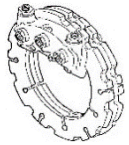
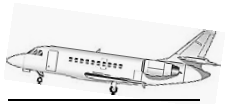
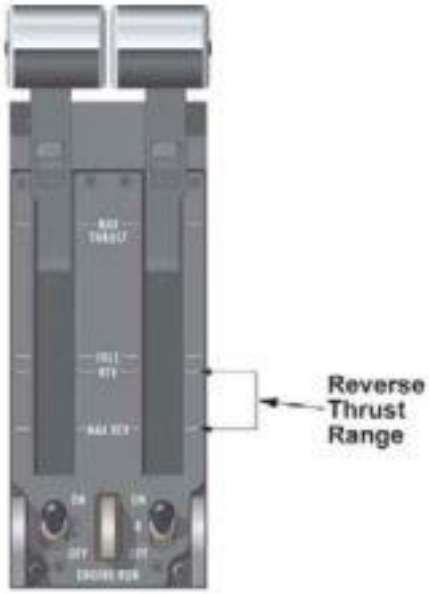
Autothrottle

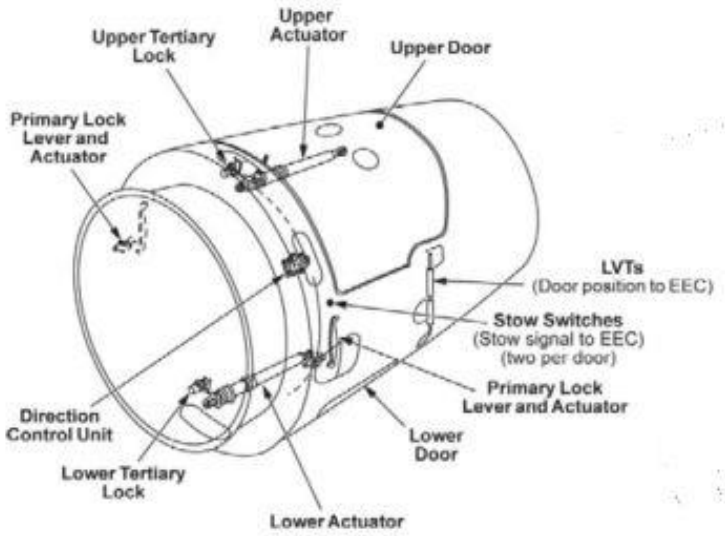


Brakes



Air/Ground Logic



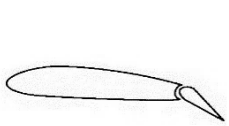


NETJETS

Preparation

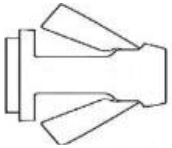
Aircraft operation and systems

Systems operation and limitations



Flaps

Spoilers & Airbrakes



Thrust Reverser

AP

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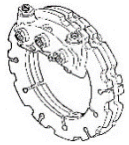

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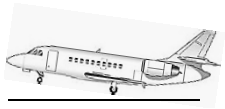
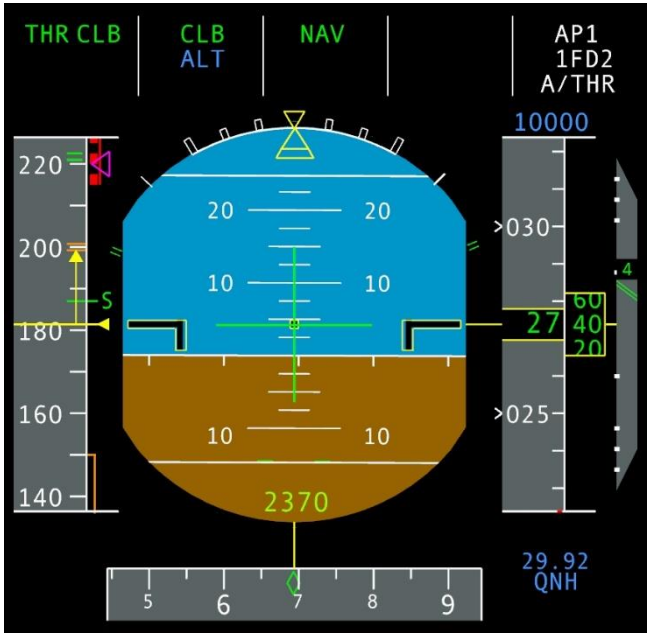


Air/Ground Logic



NETJETS

Preparation

Aircraft operation and systems

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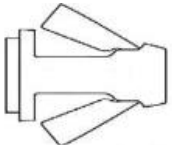
Spoilers & Airbrakes



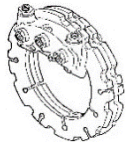
Thrust Reverser

AP

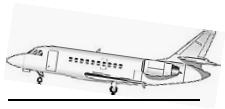
AFCS Modes

AT

Autothrottle



Brakes

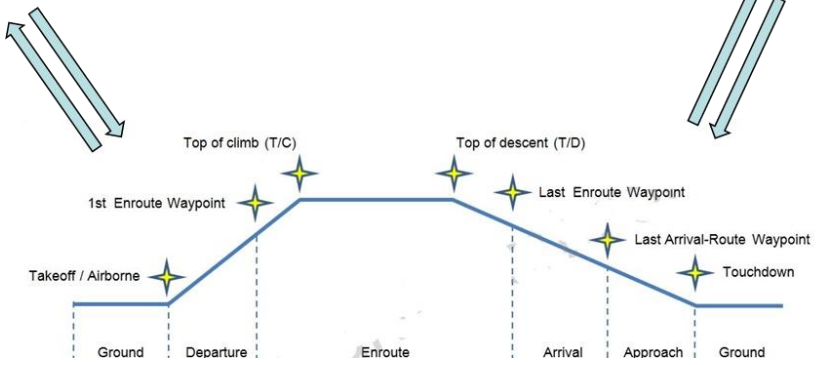


Air/Ground Logic

Active Mode Indications (A/T Mode)	
SPD	Speed or Mach Control
THRUST	Thrust Control
HOLD	Takeoff Throttle Hold
TO	Takeoff Thrust Control
RETARD	Retard
GA	Go-Around Thrust Control
LIM	Airspeed Limiting
USPD	Underspeed
EDM	Emergency Descent Mode
WSHR	Windshear

Armed Mode Indications (A/T Mode)	
TO	Takeoff Armed
SPD	Speed Armed

AT



NETJETS

Preparation

Aircraft operation and systems

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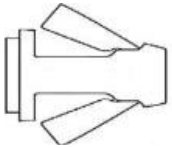
Spoilers & Airbrakes



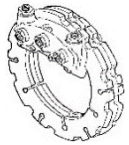
Thrust Reverser

AP

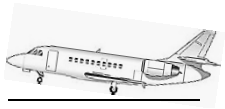
AFCS Modes

AT

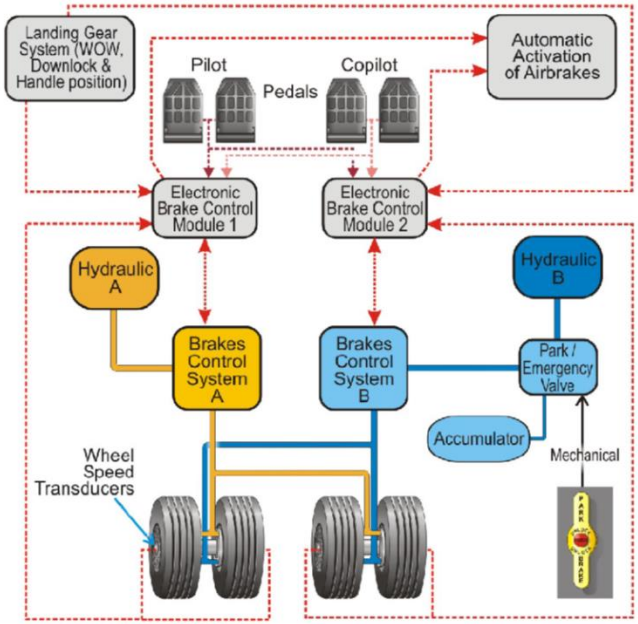
Autothrottle

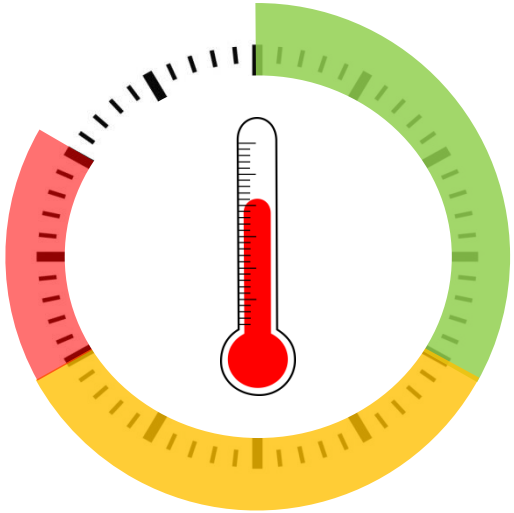


Brakes



Air/Ground Logic





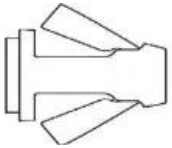
Preparation

Aircraft operation and systems

Systems operation and limitations

Flaps

Spoilers &
Airbrakes



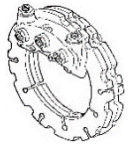
Thrust
Reverser

AP

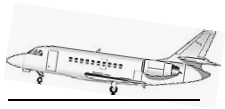
AFCS
Modes

AT

Autothrottle



Brakes



Air/Ground
Logic

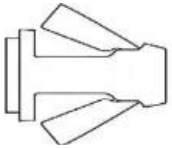
Preparation

Aircraft operation and systems

Systems operation and limitations

Flaps

Spoilers & Airbrakes



Thrust Reverser

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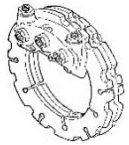
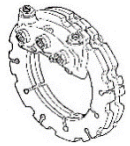


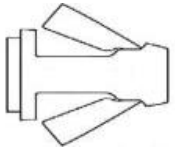
Brakes

Air/Ground Logic

Ground spoiler deployment



Autobrake activation



Thrust reverser deployment

NETJETS

Preparation

Data recording and parameters

Aircraft operation and systems

Company procedures

Preparation

Company procedures

Special airports

Set up VNAV/LNAV, LPV approaches

Different criteria for events

Specific procedures and limits

Configuration gates

Altitude/airspeed envelopes

Management of airworthiness events

Tolerances

Preparation

Suggestions

- List of events and measurements
- List of all aircraft limitations
- Ask your questions now

Setting up

Configuration

Analyse flight data

System maintenance

Setting up

Configuration

- Check the frame layout
  - Most relevant parameters and/or related with events
- Check discrete mappings
  - Flight Director & Autothrottle modes
  - GPWS
  - TCAS
  - CAS messages
  - Levers (gated positions)
- Envelopes
  - V_{mo}, M_{mo}, performance related
- Constants
  - MTOW, MLW, Operating temperatures, Altitude

Setting up

Configuration

Analyse flight data

System maintenance

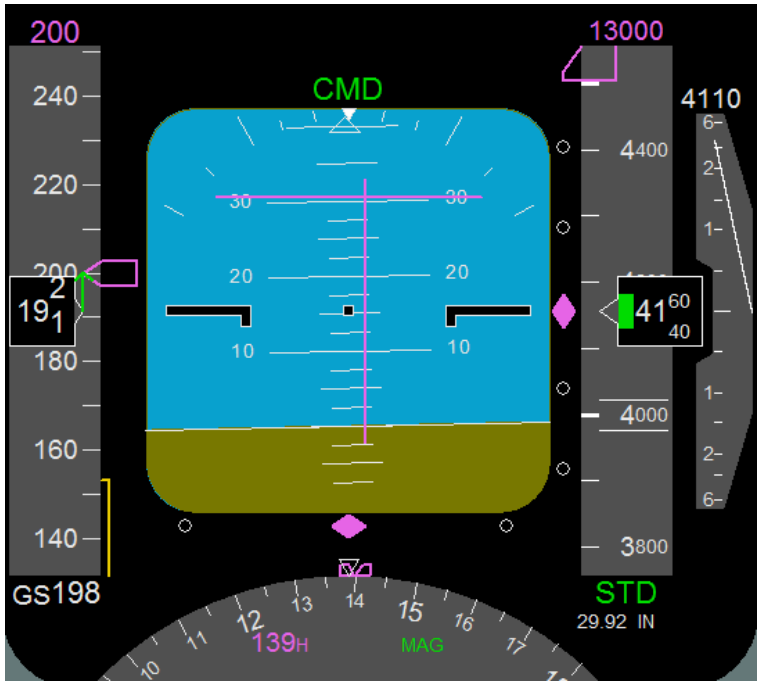
Setting up

Analyse flight data

- Look at the data!
  - GPS accuracy, ILS deviations, control surfaces, etc…
  - Check your virtual panels
- Make sure all measurements are created
  - Events: change event threshold to force creation
- Synchronization
  - Pitch ⟺ Accelerations ⟺ Air/Ground ⟺ Wheel Spin
  - Levers ⟺ Actual position

Setting up

Analyse flight data



Setting up

Configuration

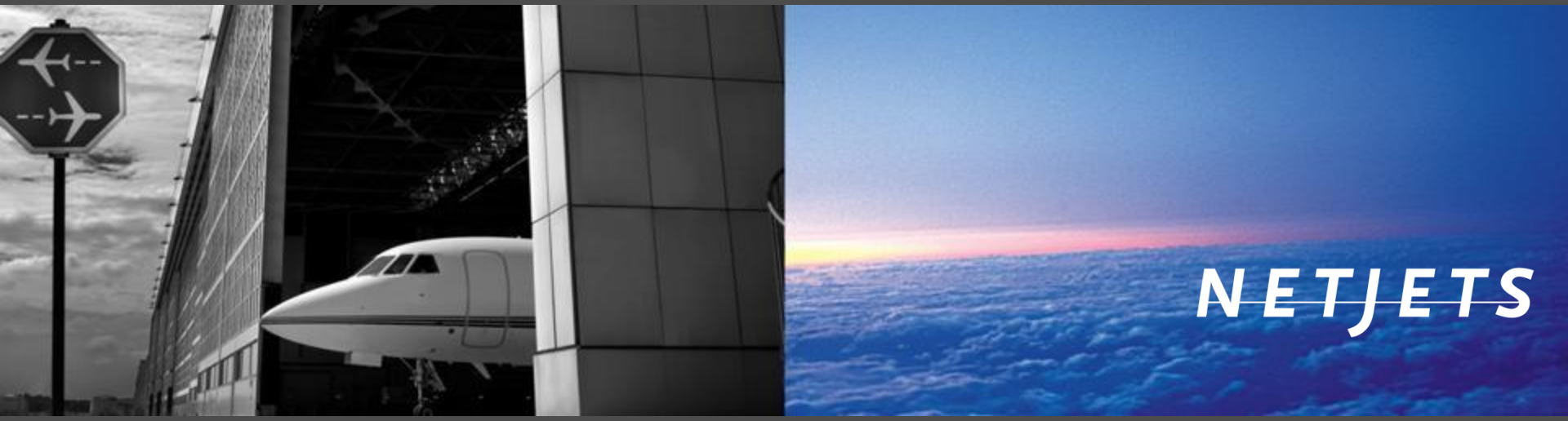
Analyse flight data

System maintenance

Setting up

System maintenance

- Validate events!
- Keep checking that all measurements are calculated
- Beware of major aircraft software updates



Thank you!