

Humidifier Operation with Aircraft W off W (3.5 hours delay activation)

The following procedure is use to operate the Humidifier System on the ground as it would operate in flight. The procedure is used for troubleshooting purposes only. For return to service, follow the AMM.

Procedure summary:

- 1) Aircraft is outside
- 2) Humidifier BOB is installed
- 3) Electrical power is applied to the aircraft
- 4) Humidifier system is turned on
- 5) Aircraft is put in a W off W configuration and Altitude is simulated to 16,384 ft
- 6) Technician wait 3.5 hours after W off W signal is sent
- 7) APU is started and Air Conditioning Packs are turned On
- 8) Altitude is changed to 32,768 ft
- 9) System starts to operate and is monitored on the different ARINC 429 labels.
(Operate the system for 2-3 cycles)
- 10) Altitude is decreased to 24,576 ft and the system stop operating
- 11) Altitude is decreased to 16,384 ft and the system purge
- 12) All parameters are brought to ground level.
- 13) End of task

Note:

The procedure is performed using an ARINC 429 Data Bus Analyser to simulate Aircraft Altitude and W off W signal. The Humidity level is simulated using a Square wave generator (commercially available).

The procedure has been created using the minimum quantity of GSEs to simplify the task.

If for any reason, while performing the procedure, the power is interrupted or the system is resetted, then the HCU internal 3.5 hours timer re-start at 00:00 .

Tools and Equipment require

- **GSE 21X-71-01 CPC Breakout Box**
- **GSE 34-00-04 Kit Data Bus Analyser or equivalent**
- **Square wave generator (commercially available)**

1. Set up

- a) Connect electrical power to the aircraft (TASK 24-00-00-861-801).
- b) Obey all the air conditioning/pressurization safety precautions (TASK 21-00-00-910- 801).
- c) Open the baggage compartment door (834).
- d) Set the following SSPC's OUT:

Location	designator	Legend
EMS CDU	AIR COND/PRESS	HUMIDIFIER
		R PACK CTRL CH A

- e) Disconnect HCU connector A248P1 (FS 846R) and insert Breakout Box (BOB) reference 92088-0950-D38999/26FE35SN or 92090-0950-D38999/26FE35SN.

NOTE: BOB must be in initial state (All jumpers in)

2. Humidifier PBIT

- a) Make sure the humidifier water system is serviceable.
- b) Apply water system pressure
- c) Set the following SSPC's IN:

Location	designator	Legend
EMS CDU	AIR COND/PRESS	HUMIDIFIER
		R PACK CTRL CH A

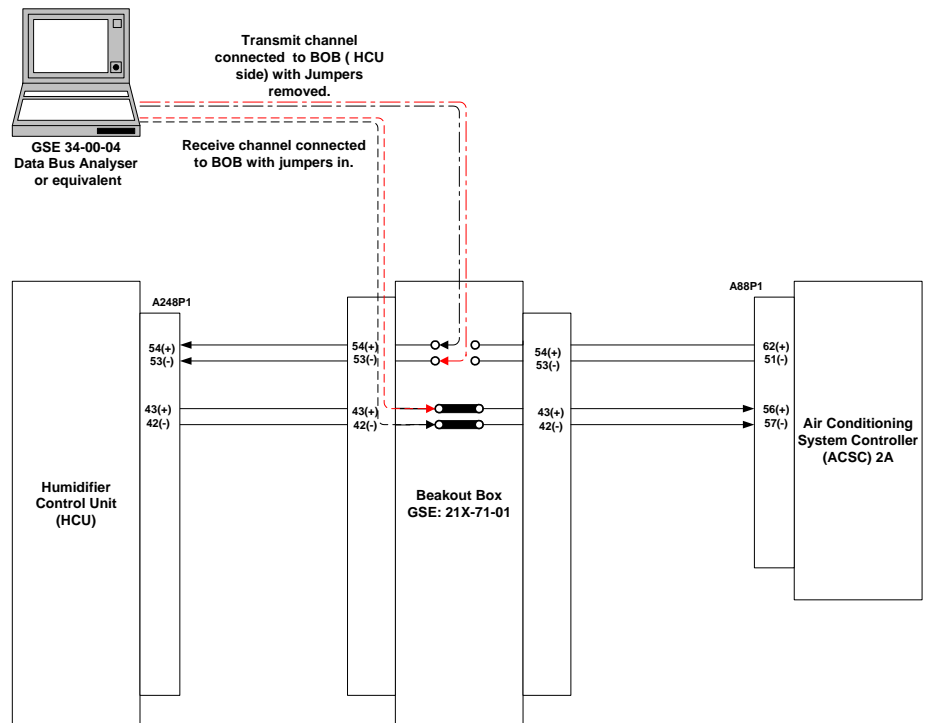
- d) Let the power-on built in test (PBIT) operate for 4 minutes.
- e) Make sure that the EICAS displays show as follows:
 - On the AIR COND synoptic page, none of the valves/pack borders are in magenta/amber color.
 - There are no dashes for the temperature values.

- HUMIDIFIER FAIL advisory message does not show.
 - There are no ECS-related CAS fail/fault messages.
 - Make the selection ACTIVE FAULT ACSC_2A (TASK 45-45-00-970-802).
 - Make sure that no ECS-related failure message shows on the PMAT.
- f) Turn off the water system pressure
- g) Set the following SSPC's Out:

Location	designator	Legend
EMS CDU	AIR COND/PRESS	HUMIDIFIER
		R PACK CTRL CH A

3. Installation of databus analyzer

- a) Remove jumper 54& 53 from the BOB and connect Data Bus Analyzer Transmit Channel to 54 (+) and 53(-) on the HCU side.
- b) Connect Data Bus Analyzer Receive Channel to BOB jumper 43 (+) and 42 (-) in parallel to read labels coming from HCU.



4. ARINC 429 Labels set up

- a) Configure Data Bus Analyzer transmitter in order to transmit labels 210, 212 and 271 with the bits set as shown below. (See Labels format in Appendix.)

A/C Altitude Label 210

Hexadecimal #	0	0	0	0	0	1	8	8	
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1	
Set bits	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1	1 0 0 0	1 0 0 0	
Field description	P	SSM	S	Aircraft Altitude			Spare	SDI	Label 210

Aft Cabin Temp Label 212

Hexadecimal #	0	0	C	8	0	1	8	A	
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1	
Set bits	0 0 0 0	0 0 0 0	1 1 0 0	1 0 0 0	0 0 0 0	0 0 0 1	1 0 0 0	1 0 1 0	
Field description	P	SSM	S	Aft Cabin Temp			Spare	SDI	Label 212

ACSC Status Label 271

Hexadecimal #	8	1	8	9	0	1	B	9
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1
Set bits	1 0 0 0	0 0 0 1	1 0 0 0	1 0 0 1	0 0 0 0	0 0 0 1	1 0 1 1	1 0 0 1
Field description	P	SSM	See Label 271 definition for details			Spare	SDI	Label 271

NOTE: Data Bus Analyzer must transmit at a frequency of 12.5 KHz and the repetition rate must be selected to 100mS.

- b) Configure Data Bus Analyzer receiver to receive labels 100, 200, 210, 211 and 353 (bin 32). See Labels format in Appendix.

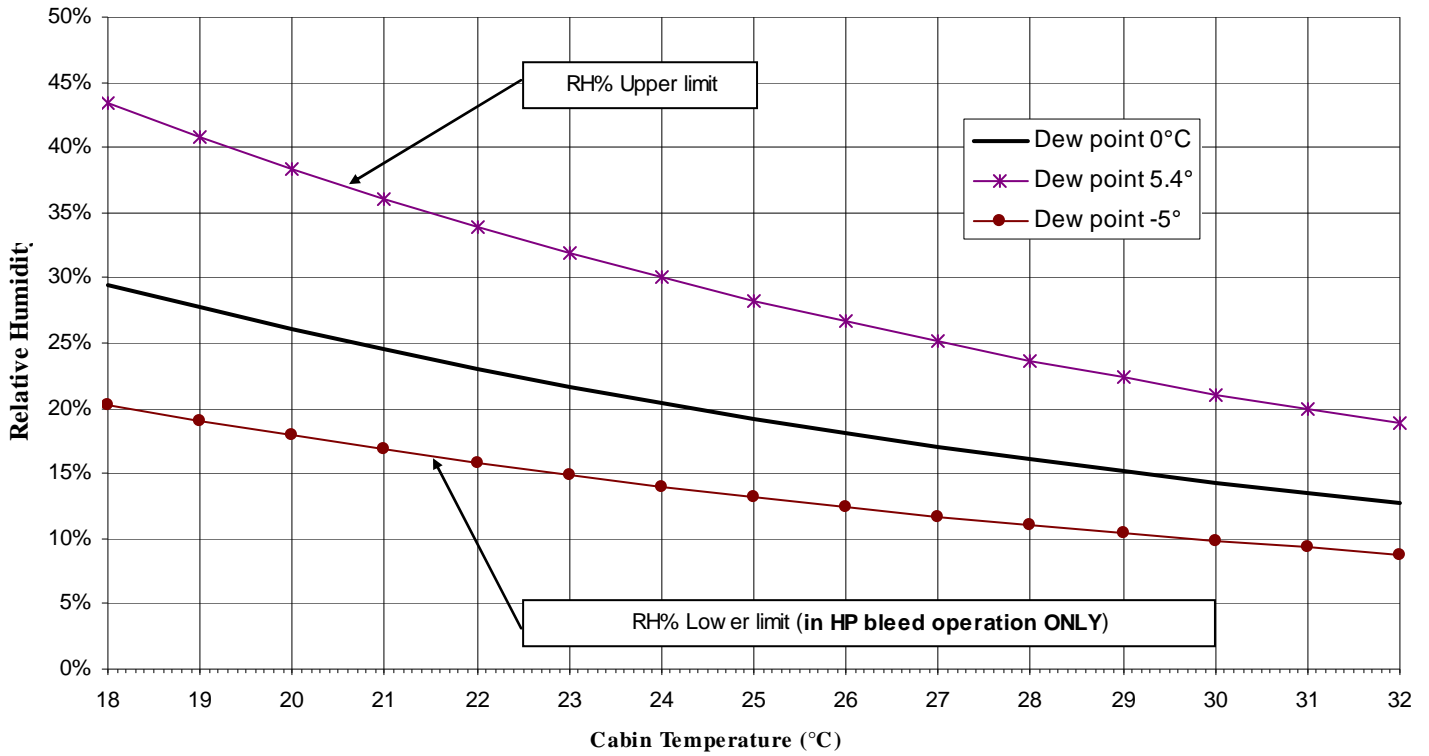
5. Installation of Square wave generator

- a) Install the square wave generator as follows:
 b) Remove BOB jumpers 13 and 21 and connect square wave generator to 13(+) and 21(-) to the breakout box HCU side.

6. Square wave generator set up:

- a) Set square wave signal to 5 V.
 b) Set frequency between 7200 and 7300 Hz.
 c) Make sure the Frequency selected provides a Humidity level below the 0°C Dew point curve from the following graphic.

Cabin Relative Humidity - Dew Point 0°C



d) The Humidity sensor transmits at the frequency corresponding to the Humidity Level.:

Number of Pulses per second [Hz]	Humidity [%]
< 5771	105
5874	100
6063	90
6233	80
6388	70
6532	60
6668	50
6801	40
6933	30
7070	20
7214	10
7370	0
> 7453	-5

7. Humidifier Operation

- a) Make sure the humidifier water system is serviceable and in operation.
- b) Apply water system pressure
- c) Set the following SSPC's IN:

Location	designator	Legend
EMS CDU	AIR COND/PRESS	HUMIDIFIER
		R PACK CTRL CH A

- d) Let the power-on built in test (PBIT) operate for 4 minutes.
- e) Make sure that the EICAS displays show as follows:
 - On the AIR COND synoptic page, none of the valves/pack borders are in magenta/amber color.
 - There are no dashes for the temperature values.
 - HUMIDIFIER FAIL advisory message does not show.
 - There are no ECS-related CAS fail/fault messages.
 - Make the selection ACTIVE FAULT ACSC_2A (TASK 45-45-00-970-802).
 - Make sure that no ECS-related failure message shows on the PMAT.
- f) Select an aircraft altitude of 16,384 ft by setting all bits of label as follow:

A/C Altitude		Label 210																	
Hexadecimal #	8	4	0	0	0	1	8	8											
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1											
Set bits	1 0 0 0	0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1	1 0 0 0	1 0 0 0											
Field description	P	SSM	S	Aircraft Altitude						Spare	SDI	Label 210							

- g) Put the aircraft in a Weight Off Wheel configuration by setting all bits of label as follow:

ACSC Status		Label 271																	
Hexadecimal #	0	0	0	1	0	1	B	9											
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1											
Set bits	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1	0 0 0 0	0 0 0 1	1 0 1 1	1 0 0 1											
Field description	P	SSM	See Label 271 definition for details						Spare	SDI	Label 271								

- h) Wait 3.5 hours.
- i) Start the APU
- j) Pressurize the air conditioning system with the APU (TASK 21-00-00-862-801).
- k) Turn on Air Conditioning Packs
- l) On the data bus analyser, make sure label 100 bit 14 reads 0
- m) Select an aircraft altitude of 32,768 ft by setting the bits of label 210 as follow:

A/C Altitude	Label 210																															
Hexadecimal #	8		8		0		0		0		1		8		8																	
Bits #	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Set bits	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0
Field description	P	SSM	S	Aircraft Altitude								Spare		SDI		Label 210																

- n) As soon as 32,768 ft is selected, make sure the data bus analyser shows as follows:
 - Label 100 bit 23 = 1 (HWSOV commanded open)
 - Label 100 bit 22 = 1 (HWFV commanded open)
 - Label 100 bit 14 = 1 (humidifier status on).
- o) Monitor the Humidifier Boiler water level on Label 211 and make sure the water level is increasing. The boiler will stop filling when the boiler water level reaches 170 mm \pm 7 mm.
- p) Once water level has reached 170 mm \pm 7 mm., make sure the data bus analyser shows as follows:
 - Label 100 bit 23 = 0 (HWSOV commanded closed)
 - Label 100 bit 22 = 0 (HWFV commanded closed).
 - Label 100 bit 29 = 0 (TAV_H not fully closed).
- q) After 5 minutes of operation, do the checks that follow:
 - On the data bus analyser, label 353 all bits = 0 (no failures detected)
- r) Monitor the Boiler Temperature (Label 200). Make sure the temperature is between 70 and 120°C.
- s) Continue to operate the humidifier system for 2 complete cycles of water filling/consumption (125 to 170 mm and back).

t) Select an aircraft altitude of 24,576 ft by setting the bits of label 210 as follow:

A/C Altitude		Label 210						
Hexadecimal #	0	6	0	0	0	1	8	8
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1
Set bits	0 0 0 0	0 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1	1 0 0 0	1 0 0 0
Field description		SSM	Aircraft Altitude			Spare	SDI	Label 210

u) Make sure the data bus analyser shows as follows to confirm that the Humdidfier has stopped operating.

- Label 100 bit 23 = 0 (HWSOV commanded closed)
- Label 100 bit 22 = 0 (HWFV commanded closed).
- Label 100 bit 29 = 1 (H_TAV = Full Closed)

v) Select an aircraft altitude of 16,384 ft by setting Label 210 bits as follow:

A/C Altitude		Label 210						
Hexadecimal #	8	4	0	0	0	1	8	8
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1
Set bits	1 0 0 0	0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1	1 0 0 0	1 0 0 0
Field description		SSM	Aircraft Altitude			Spare	SDI	Label 210

w) Label 100 bit 21 should be as follow:

- Label 100 bit 21 = 1 (Drain Valve open command)

x) When Humidifier water level (label 211) shows empty (less than 50 mm), Select an aircraft altitude of 0 ft by setting the bits of Label 210 as follow:

A/C Altitude		Label 210						
Hexadecimal #	0	0	0	0	0	1	8	8
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1
Set bits	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1	1 0 0 0	1 0 0 0
Field description		SSM	Aircraft Altitude			Spare	SDI	Label 210

y) Set the bits of label 271 as follow:

ACSC Status		Label 271							
Hexadecimal #	8	1	8	9	0	1	B	9	
Bits #	32 31 30 29	28 27 26 25	24 23 22 21	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1	
Set bits	1 0 0 0	0 0 0 1	1 0 0 0	1 0 0 1	0 0 0 0	0 0 0 1	1 0 1 1	1 0 0 1	
Field description	P	SSM	S	See Label 271 definition for details			Spare	SDI	Label 271

- Label 100 bit 23 = 0 (HWSOV commanded closed)
- Label 100 bit 22 = 0 (HWFV commanded closed).

z) Release the APU-supplied conditioned air pressure (TASK 21-00-00-862-802).

aa) Set the following SSPC's Out:

Location	designator	Legend
EMS CDU	AIR COND/PRESS	HUMIDIFIER
		R PACK CTRL CH A

bb) Remove BOB

cc) Set the following SSPC's IN

Location	designator	Legend
EMS CDU	AIR COND/PRESS	HUMIDIFIER
		R PACK CTRL CH A

dd) Wait 4 minutes for the Pbit to be performed

ee) If no failure indication, then Remove External AC power

8. Close Out

- Remove all tools, equipment, and unwanted materials from the work area.
- Close the baggage compartment door (834).
- Remove the electrical power from the aircraft (TASK 24-00-00-861-802).

Appendix

ARINC EMISSION: HCU internal discrete status

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	TAV_FC	Not Full Closed	Full Closed
28	TAV_FO	Not Full Open	Full Open
27	MAN_PURGE	Purge Off	Purge On
26	HCU_SHOP	Normal Mode	ATP Mode
25	WATER_TANK_EMPTY	Not Empty	Empty
24	HUMID_SELECTED	Not Selected	Selected
23	FC_HWSOV	No Command	Command
22	FC_HWFV	No Command	Command
21	FC_HDV	No Command	Command
20	FC_TAV	TAV_H Disabled	TAV_H Enabled
19	POWER_FAIL	Warm start	Cold start
18	DI_SPARE_1	Open circuit	Ground
17	DI_SPARE_2	Open circuit	Ground
16	HUMID_ON_1	Off	On
15	FC_SPARE	No Command	Command
14	Humidifier Status	Off	On
13	SPARE		
12	SPARE		
11	SPARE		
10	HCU SDI		
9			
8	LABEL: 100		
7			
6			
5			
4			
3			
2			
1			

ARINC EMISSION: HCU HWBTS (deg C)

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	SIGN		
28	128		
27	64		
26	32		
25	16		
24	8		
23	4		
22	2		
21	1		
20	SPARE		
19	SPARE		
18	SPARE		
17	SPARE		
16	SPARE		
15	SPARE		
14	SPARE		
13	SPARE		
12	SPARE		
11	SPARE		
10	HCU SDI		
9			
8	LABEL: 200		
7			
6			
5			
4			
3			
2			
1			

ARINC EMISSION: HCU HTS (deg C)

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	SIGN		
28	32		
27	16		
26	8		
25	4		
24	2		
23	1		
22	.5		
21	0.25		
20	SPARE		
19	SPARE		
18	SPARE		
17	SPARE		
16	SPARE		
15	SPARE		
14	SPARE		
13	SPARE		
12	SPARE		
11	SPARE		
10	HCU SDI		
9			
8	LABEL: 201		
7			
6			
5			
4			
3			
2			
1			

ARINC RECEPTION: AIRCRAFT ALTITUDE (FT)

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	SIGN		
28	32768		
27	16384		
26	8192		
25	4096		
24	2048		
23	1024		
22	512		
21	256		
20	128		
19	64		
18	32		
17	16		
16	8		
15	4		
14	2		
13	SPARE		
12	SPARE		
11	SPARE		
10	ACSC SDI		
9			
8	LABEL: 210		
7			
6			
5			
4			
3			
2			
1			

ARINC EMISSION: HCU water level (mm)

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	SIGN		
28	256		
27	128		
26	64		
25	32		
24	16		
23	8		
22	4		
21	2		
20	1		
19	0.5		
18	0.25		
17	SPARE		
16	SPARE		
15	SPARE		
14	SPARE		
13	SPARE		
12	SPARE		
11	SPARE		
10	HCU SDI		
9			
8	LABEL: 211		
7			
6			
5			
4			
3			
2			
1			

ARINC EMISSION: HCU status label

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	TRIM OFF DEMAND	NOT ACTIVE	ACTIVE
28	HUMIDIFIER	OK	FAILED
27	IBIT RUNNING	NO	YES
26	HUMIDIFIER SELECTED	NO	YES
25	SPARE		
24	SPARE		
23	SPARE		
22	SPARE		
21	SPARE		
20	SPARE		
19	SPARE		
18	SPARE		
17	SPARE		
16	SPARE		
15	SPARE		
14	SPARE		
13	SPARE		
12	SPARE		
11	SPARE		
10	HCU SDI		
9			
8	LABEL: 270		
7			
6			
5			
4			
3			
2			
1			

ARINC EMISSION: HCU internal failures report

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	HUMIDIFIER FAULT	OK	FAULT
28	SPARE		
27	INTERNAL FAILURE	OK	FAILED
26	ARINC LINK WITH ACSC	OK	FAILED
25	HWSOV	OK	FAILED
24	HWFV	OK	FAILED
23	TAV_H	OK	FAILED
22	WATER SPILL OUT	OK	FAILED
21	HWB TEMP OVERHEAT	OK	ALARM
20	HWBTS	OK	FAILED
19	HTS	OK	FAILED
18	HHS	OK	FAILED
17	DEW TEMPERATURE	OK	FAILED
16	HWB LEVEL SENSOR	OK	FAILED
15	HDV	OK	FAILED
14	OUTPUTS	OK	FAILED
13	WATER FILLING CONTROL	OK	FAILED
12	SPARE		
11	SPARE		
10	HCU SDI		
9			
8	LABEL: 353		
7			
6			
5			
4			
3			
2			
1			

ARINC RECEPTION: AIRCRAFT ALTITUDE (Feet)

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	SIGN		
28	32768	0	
27	16384	1	
26	8192	0	
25	4096	0	
24	2048	0	
23	1024	0	
22	512	0	
21	256	0	
20	128	0	
19	64	0	
18	32	0	
17	16	0	
16	8	0	
15	4	0	
14	2	0	
13	SPARE		
12	SPARE		
11	SPARE		
10	ACSC SDI		
9			
8	LABEL: 210		
7			
6			
5			
4			
3			
2			
1			

ARINC RECEPTION: AFT CABIN TEMPERATURE (Deg C)

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	SIGN		
28	256		
27	128		
26	64		
25	32		
24	16		
23	8		
22	4		
21	2		
20	1		
19	0.5		
18	0.25		
17	0.125		
16	SPARE		
15	SPARE		
14	SPARE		
13	SPARE		
12	SPARE		
11	SPARE		
10	ACSC SDI		
9			
8	LABEL: 212		
7			
6			
5			
4			
3			
2			
1			

ARINC RECEPTION: ACSC Status Information

Bit #	Function	Bit Status	
		0	1
32	Parity		
31	Status matrix		
30			
29	Pack manual mode selection	Auto	Manual
28	Pack status (FCV status)	Not closed	Full closed
27	Flow mode	Low/Norm.	high
26	Pack control	Normal	Failed
25	HASOV1_FC	Not Full Closed	Full Closed
24	HASOV2_FC	Not Full Closed	Full Closed
23	Trim Air Off Push Button	Not Selected	Selected
22	EEPROM_ERASURE	NO	YES
21	IBIT DEMAND	NO	YES
20	WOW	Flight	Ground
19	EMERG_PRESS	OFF	ON
18	No data from HCU	NO	YES
17	Humid_activated	OFF	ON
16	SPARE		
15	SPARE		
14	SPARE		
13	SPARE		
12	SPARE		
11	SPARE		
10	ACSC channel SDI		
9			
8	LABEL: 271		
7			
6			
5			
4			
3			
2			
1			