28-104V

Testing of Nav5plus receiver performance (EN 300065)

This document is McMurdo Limited copyright and contains proprietary owned Intellectual property rights and confidential data. All rights are strictly reserved. The information must not be used except for the agreed purpose. Unauthorised use, reproduction or issue to any third party is not permitted without written authority of McMurdo Limited. This document is to be returned to McMurdo when the agreed purpose is fulfilled.

McMurdo Limited
Silver Point
Airport Service Road
Portsmouth
Hampshire
PO3 5PB

ISSUE RECORD

C.N	C2862				
DATE	09-03-04				
ISSUE	1				

COMPILED BY	CHECKED BY	ENGINEERING APPROVAL
Date	Date	Date

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

Introduction

The Nav5plus Navtex receiver is an updated version of the existing Nav5. The objective of these tests is to ensure the Nav5plus complies with EN 300 065.
The Nav5plus also includes a second (490kHz) receiver which needs to be tested.

Some requirements are checked by inspection, and some require measurement.

Conclusions

The Nav5plus meets the requirements of EN300 065-1 as tested below.

Further actions required

None.

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

Reference documents

The original Nav5 was tested by Assessment Services, and reference should be made to their report 102151 (February 1993).
ETSI EN 300 065-1 V1.1.3 (2001-05)
IEC 1097-6 (EN61097-6) (1995)
IEC60945 (2002)
EMC test report 04J025CR from Hursley EMC Services

Location etc of tests

Testing was carried out in the McMurdo Ltd electronics laboratory.
Personnel carrying out the tests was John Knapp.
Testing was carried out between 03/02/04 and 08/03/04

Equipment tested

Nav5plus assembly 28-224A, serial number 677B with the following modifications made for EMC compliance:
C110, C111, C112, C116 added with a value of 10n (previously no fit)
R210, R213, R310, R313 changed from 100k to 22k
1n capacitor added between pins 1 and 2 of U201
1n capacitor added between pins 1 and 2 of U302
Ferrite clamp added around ribbon between CPU board and receiver board

Equipment used

PC running HyperTerminal, sending text files.
Codec to generate FEC data stream from text files from PC. ICS electronics DSC2-006, serial number 00600775.
Attenuator to reduce output level from Codec to that suitable for signal generator modulation input.
RF signal generator Marconi 2030, serial number 119562/056 (SG1)
RF signal generator Marconi 2022D, serial number 119133/053 (SG2)
RF signal generator Hewlett Packard 8657B, serial number 3630U8273 (SG3)
RF signal generator Adret 742A, serial number 156 (SG4)
Combiners, with attenuation in each leg of 3dB
Power supply PDA3502A 000396
Spectrum analyser Agilent E4403B MY41440411

Note SG3 was substituted for SG1 as the calibration date expired.

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

General notes on testing

Testing of the unit is carried out at 12V, as it is meant to function at nominal voltages of 12 and 24V.

For testing of character reception (e.g. call sensitivity and intermodulation) the PC repeatedly sends the Standard Test Signal in IEC1097-6, which includes all the characters required by EN 300 065 and punctuation characters. This has forward error correction applied by the Codec and is output as a digital data stream at approximately 0 and 5V. The attenuator reduces this to approximately 0 to 1V which is then applied to the modulation input of the signal generator. The signal generator is set to the appropriate settings to give a 518kHz +/-85Hz FSK signal out. This is checked by forcing the Codec output high and low (using test mode) and ensuring the two test frequencies (517.915 and 518.085kHz) are correct to less than 1Hz (2ppm).

Input test levels vary between the two required standards EN 300 065 and IEC1097-6. EN 300 065 calls up 20dBuV (-87dBm) whereas IEC6097-6 requires 2uV+6dB (-95dBm), a difference of 8dB. Most of the testing in EN 300 065 is carried out with antenna (b), 10 ohms in series with 150pF. IEC1097-6 is not explicit about which antenna should be used. However, both specifications say call sensitivity should be checked at 2uV with antenna (a), 50 ohms, and 5uV with antenna (b). The difference between these levels is 8dB, implying that testing with antenna (a) should be carried out at a level 8dB lower than if antenna (b) is used.
The Nav5 and Nav5plus are intended to work with a 50 ohm antenna, i.e. antenna (a), not (b). To allow for this, testing is carried out 8dB below the levels in EN 300 065 using a 50 ohm source. This applies to both the wanted and unwanted signals.

As this is an upgrade to the Nav5, testing is only carried out at the ‘Normal Test Conditions’ described in section 4.3. There are no ‘Extreme Tests’ as defined in sections 4.4, 4.5 and 4.6.

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

Tests and results

3. General requirements

3.1 Construction

3.1.1 The Nav5plus meets this requirement.

3.1.2 The Nav5plus meets this requirement. All controls are labelled, and further information is provided behind the printer door. All terminals are identified with a label on the rear panel. Supply voltage is also shown on this label. The type designation label will be affixed to the rear of the case.

3.1.3 The Nav5plus meets this requirement by allowing the LCD backlight to be turned off.

3.1.4 The Nav5plus meets this requirement and also receives on 490kHz. Both frequencies are received simultaneously, so 518kHz is always on by default.

3.1.5 The Nav5plus meets this requirement by carrying out a self test when turned on and printing the selected B12 characters. The operator can also carry out a self test manually. No audio output is provided.

3.1.6 The Nav5plus meets this requirement. The operator can disable any selection of B1 characters.

3.1.7 The Nav5plus meets this requirement. This information is printed when turned on, and can be accessed through the menu.

3.1.8 The Nav5plus meets this requirement. The operator can disable any selection of B2 characters except A, B, D and L.

3.1.9 The Nav5plus meets this requirement. This information is printed when turned on, and can be accessed through the menu.

3.1.10 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.1.11 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.1.12 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.1.13 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.1.14 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.1.15 The Nav5plus meets this requirement. An alarm sounds when the paper is about to run out.

3.1.16 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.1.17 The Nav5plus meets this requirement. It was confirmed on the Nav5 and has not been altered.

3.2 Safety precautions

3.2.1 The Nav5plus meets this requirement. Insufficient power is dissipated to cause a large temperature rise. The supply is fused.

3.2.2 The Nav5plus meets this requirement. There is a reverse protection diode and transient protection device.

3.2.3 The Nav5plus meets this requirement. There is an earthing stud on the rear of the unit.

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

3.2.4 The Nav5plus meets this requirement. There are no voltages or combinations of voltages greater than 50V.

3.2.5 This does not apply because of 3.2.4 above.

3.2.6 The Nav5plus meets this requirement. Data is retained by battery backed up memory.

4. Test conditions

See general notes above.

5. Receiver and signal processor

5.1 Call sensitivity

The Nav5plus meets this requirement with an error rate of 0%.
For comparison, the Nav5 gave an error rate of 0%.

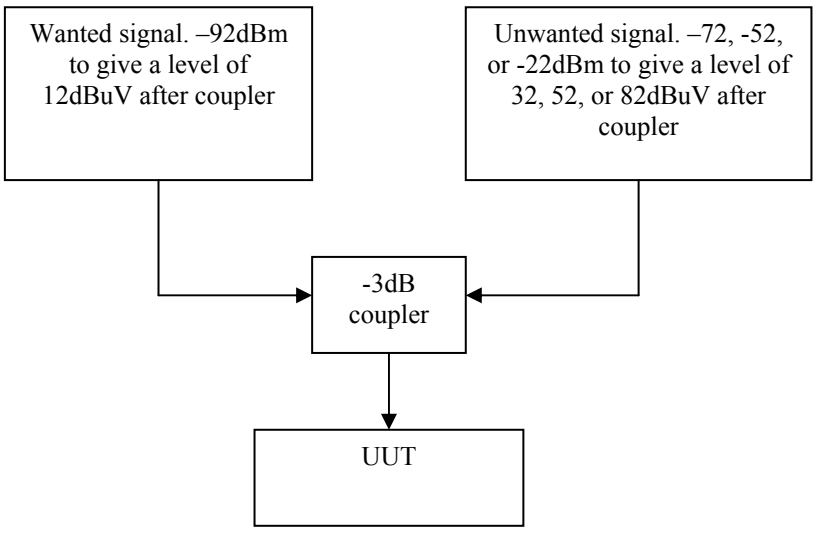
518kHz
Tested with artificial antenna (a) and a 2uV (-101dBm) signal, with the repeated STS defined above. SG1 generating test signals.
0 errors were detected in 1343 characters giving an error rate of 0% against the test limit of <4%.
The signal level was reduced until an error appeared, and this occurred at -116dBm (15dB better than the test level).

490kHz
Tested with artificial antenna (a) and a 2uV (-101dBm) signal, with the repeated STS defined above. SG1 generating test signals.
0 errors were detected in 1343 characters giving an error rate of 0% against the test limit of <4%.
The signal level was reduced until errors appeared, and this occurred at -114dBm (13dB better than the test level).

5.2 Interference rejection and blocking immunity

The Nav5plus meets this requirement with an error rate of 0%.
For comparison, the Nav5 gave a worst case error rate of 0.4%.

This test was carried out with antenna (a) and with levels reduced by 8dB as discussed above. The test set up is:



THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

With a 518kHz wanted signal, for each frequency range the unwanted signal was swept to look for frequencies that cause errors. If errors were seen then a measurement of the error rate was taken, to compare against the test limit of 4%. This was then repeated for a 490kHz wanted signal.

518kHz. SG1 generating wanted signal, SG2 generating unwanted signal

Frequency range	Unwanted signal level	Error rate	Pass/fail
100kHz-515kHz	82dBuV	0%, occasional errors seen at 86dBuV at 515kHz.	Pass
515kHz-517kHz	52dBuV	0%, occasional errors seen at 75dBuV at 517kHz.	Pass
517kHz-517.5kHz	32dBuV	0%, occasional errors seen at 45dBuV at 517.5kHz.	Pass
518.5kHz-519kHz	32dBuV	0%, occasional errors seen at 46dBuV at 518.5kHz.	Pass
519kHz-521kHz	52dBuV	0%, occasional errors seen at 73dBuV at 519kHz.	Pass
521kHz-30MHz	82dBuV	0%, occasional errors seen at 87dBuV at 521kHz.	Pass
156MHz-174MHz	82dBuV	0%, no errors seen up to greater than 107dBuV at 165MHz	Pass
450MHz-470MHz	82dBuV	0%, no errors seen up to greater than 107dBuV at 460MHz	Pass

490kHz. SG3 generating wanted signal, SG2 generating unwanted signal

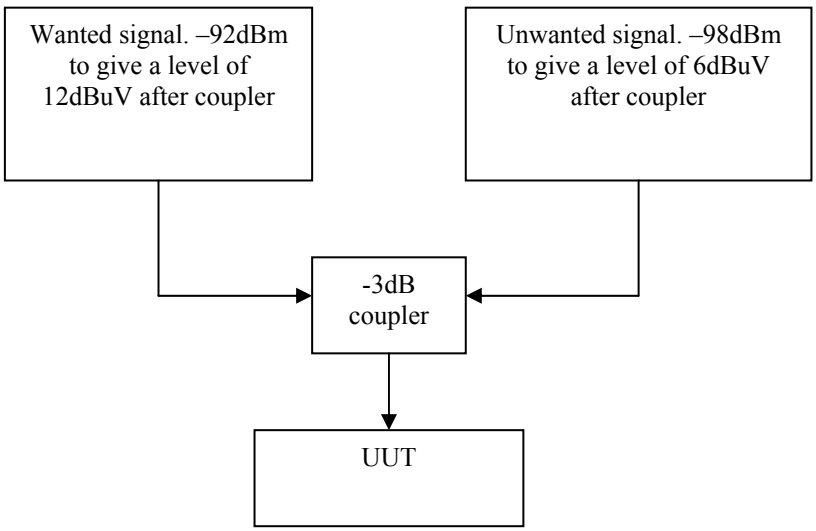
Frequency range	Unwanted signal level	Error rate	Pass/fail
100kHz-487kHz	82dBuV	0%, occasional errors seen at 89dBuV at 487kHz.	Pass
487kHz-489kHz	52dBuV	0%, occasional errors seen at 74dBuV at 489kHz.	Pass
489kHz-489.5kHz	32dBuV	0%, occasional errors seen at 51dBuV at 489.5kHz.	Pass
490.5kHz-491kHz	32dBuV	0%, occasional errors seen at 51dBuV at 490.5kHz.	Pass
491kHz-493kHz	52dBuV	0%, occasional errors seen at 74dBuV at 491kHz.	Pass
493kHz-30MHz	82dBuV	0%, occasional errors seen at 87dBuV at 493kHz.	Pass
156MHz-174MHz	82dBuV	0%, no errors seen up to greater than 107dBuV at 165MHz	Pass
450MHz-470MHz	82dBuV	0%, no errors seen up to greater than 107dBuV at 460MHz	Pass

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

5.3 Co-channel rejection

The Nav5plus meets this requirement with an error rate of 0%.
For comparison, the Nav5 gave an error rate of 0%.

This test was carried out with antenna (a) and with levels reduced by 8dB as discussed above. The test set up is:



With a 518kHz wanted signal, the error rate was noted for the unwanted signal level above, to compare against the test limit of 4%. If there were no errors, then the unwanted signal was increased until some occasional errors were seen, and the level noted. This was then repeated for a 490kHz wanted signal.
SG3 used to generate wanted signal, SG2 to generate unwanted signal.

518kHz
Error rate at levels above: 0% (0 errors in 1000 characters)
Unwanted signal level to give errors: 37dBuV
Margin over test level: 31dB

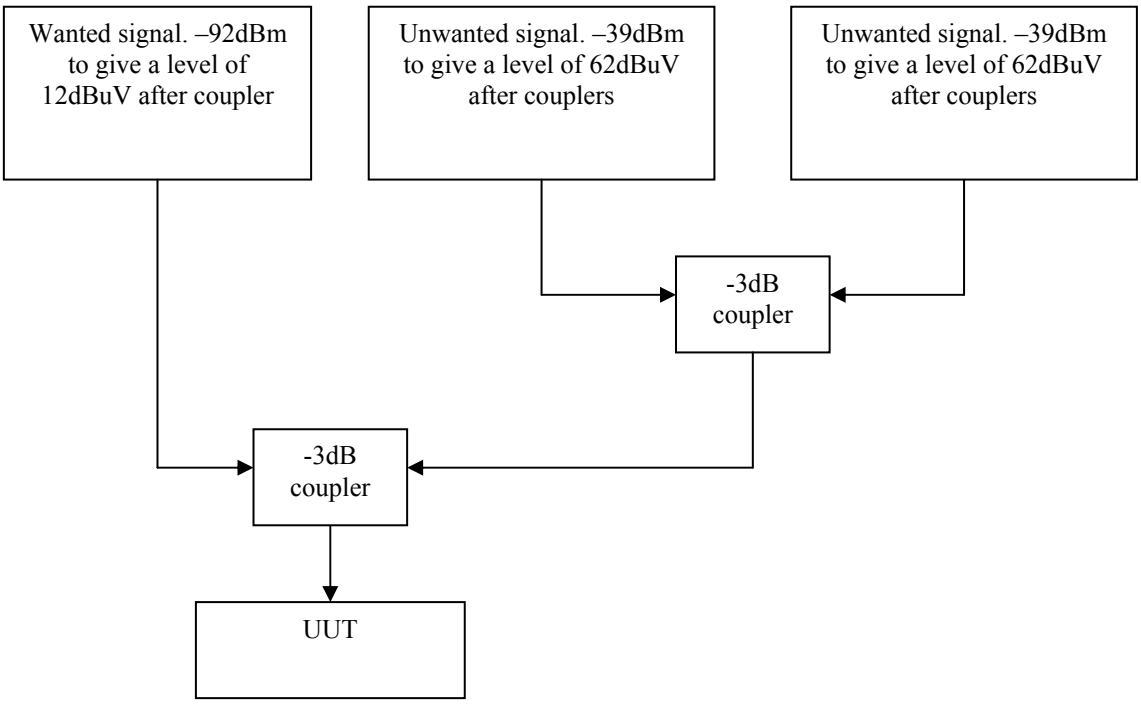
490kHz
Error rate at levels above: 0% (0 errors in 1000 characters)
Unwanted signal level to give errors: 44dBuV
Margin over test level: 38dB

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

5.4 Intermodulation

The Nav5plus meets this requirement with an error rate of 0%.
For comparison, the Nav5 gave an error rate of 0%, but was only tested with the first frequency pair.

This test was carried out with antenna (a) and with levels reduced by 8dB as discussed above. The test set up is:



With a 518kHz wanted signal, the error rate was noted for the unwanted signal level above, to compare against the test limit of 4%. This was carried out at the pairs of frequencies shown in the table. If there were no errors, then the unwanted signals were increased until some errors were seen.
This was then repeated for a 490kHz wanted signal.
SG3 used to generate wanted signal, SG2 and SG4 to generate unwanted signals.

518kHz

Freq. 1	Freq. 2	Error rate	Pass/Fail	Comments
1036kHz	1554kHz	0/1000=0%	Pass	Occasional errors at 89dBuV (27dB over)
516kHz	514kHz	0/1000=0%	Pass	Occasional errors at 78dBuV (16dB over)
515kHz	512kHz	0/1000=0%	Pass	Occasional errors at 78dBuV (16dB over)
514kHz	510kHz	0/1000=0%	Pass	Occasional errors at 78dBuV (16dB over)
516kHz	515kHz	0/1000=0%	Pass	Occasional errors at 82dBuV (20dB over)
515kHz	513.5kHz	0/1000=0%	Pass	Occasional errors at 83dBuV (21dB over)
514kHz	512kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
516kHz	515.33kHz	0/1000=0%	Pass	Occasional errors at 80dBuV (18dB over)
515kHz	514kHz	0/1000=0%	Pass	Occasional errors at 84dBuV (22dB over)
514kHz	512.67kHz	0/1000=0%	Pass	Occasional errors at 80dBuV (18dB over)
516kHz	515.5kHz	0/1000=0%	Pass	Occasional errors at 81dBuV (19dB over)
515kHz	514.25kHz	0/1000=0%	Pass	Occasional errors at 84dBuV (22dB over)
514kHz	513kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
520kHz	522kHz	0/1000=0%	Pass	Occasional errors at 78dBuV (16dB over)
521kHz	524kHz	0/1000=0%	Pass	Occasional errors at 79dBuV (17dB over)
522kHz	526kHz	0/1000=0%	Pass	Occasional errors at 80dBuV (18dB over)
520kHz	521kHz	0/1000=0%	Pass	Occasional errors at 81dBuV (19dB over)
521kHz	522.5kHz	0/1000=0%	Pass	Occasional errors at 83dBuV (21dB over)
522kHz	524kHz	0/1000=0%	Pass	Occasional errors at 84dBuV (22dB over)

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

520kHz	520.67kHz	0/1000=0%	Pass	Occasional errors at 78dBuV (16dB over)
521kHz	522kHz	0/1000=0%	Pass	Occasional errors at 85dBuV (23dB over)
522kHz	523.33kHz	0/1000=0%	Pass	Occasional errors at 80dBuV (18dB over)
520kHz	520.5kHz	0/1000=0%	Pass	Occasional errors at 83dBuV (21dB over)
521kHz	521.75kHz	0/1000=0%	Pass	Occasional errors at 85dBuV (23dB over)
522kHz	523kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
531kHz	544kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
531kHz	537.5kHz	0/1000=0%	Pass	Occasional errors at 91dBuV (29dB over)
531kHz	535.33kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
531kHz	534.25kHz	0/1000=0%	Pass	Occasional errors at 95dBuV (33dB over)
530kHz	542kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
530kHz	536kHz	0/1000=0%	Pass	Occasional errors at 90dBuV (28dB over)
530kHz	534kHz	0/1000=0%	Pass	Occasional errors at 93dBuV (31dB over)
530kHz	533kHz	0/1000=0%	Pass	Occasional errors at 95dBuV (33dB over)
540kHz	562kHz	0/1000=0%	Pass	Occasional errors at 90dBuV (28dB over)
540kHz	551kHz	0/1000=0%	Pass	Occasional errors at 96dBuV (34dB over)
540kHz	547.33kHz	0/1000=0%	Pass	Occasional errors at 90dBuV (28dB over)
540kHz	545.5kHz	0/1000=0%	Pass	Occasional errors at 100dBuV (38dB over)

490kHz

Freq. 1	Freq. 2	Error rate	Pass/Fail	Comments
1036kHz	1526kHz	0/1000=0%	Pass	Occasional errors at 89dBuV (27dB over)
488kHz	486kHz	0/1000=0%	Pass	Occasional errors at 82dBuV (20dB over)
487kHz	484kHz	0/1000=0%	Pass	Occasional errors at 86dBuV (24dB over)
486kHz	482kHz	0/1000=0%	Pass	Occasional errors at 89dBuV (27dB over)
488kHz	487kHz	0/1000=0%	Pass	Occasional errors at 82dBuV (20dB over)
487kHz	485.5kHz	0/1000=0%	Pass	Occasional errors at 86dBuV (24dB over)
486kHz	484kHz	0/1000=0%	Pass	Occasional errors at 90dBuV (28dB over)
488kHz	487.33kHz	0/1000=0%	Pass	Occasional errors at 82dBuV (20dB over)
487kHz	486kHz	0/1000=0%	Pass	Occasional errors at 85dBuV (23dB over)
486kHz	484.67kHz	0/1000=0%	Pass	Occasional errors at 88dBuV (26dB over)
488kHz	487.5kHz	0/1000=0%	Pass	Occasional errors at 81dBuV (19dB over)
487kHz	486.25kHz	0/1000=0%	Pass	Occasional errors at 86dBuV (24dB over)
486kHz	485kHz	0/1000=0%	Pass	Occasional errors at 90dBuV (28dB over)
492kHz	494kHz	0/1000=0%	Pass	Occasional errors at 83dBuV (21dB over)
493kHz	496kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
494kHz	498kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
492kHz	493kHz	0/1000=0%	Pass	Occasional errors at 82dBuV (20dB over)
493kHz	494.5kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
494kHz	496kHz	0/1000=0%	Pass	Occasional errors at 89dBuV (27dB over)
492kHz	492.67kHz	0/1000=0%	Pass	Occasional errors at 81dBuV (19dB over)
493kHz	494kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
494kHz	495.33kHz	0/1000=0%	Pass	Occasional errors at 87dBuV (25dB over)
492kHz	492.5kHz	0/1000=0%	Pass	Occasional errors at 83dBuV (21dB over)
493kHz	493.75kHz	0/1000=0%	Pass	Occasional errors at 85dBuV (23dB over)
494kHz	495kHz	0/1000=0%	Pass	Occasional errors at 88dBuV (26dB over)
503kHz	516kHz	0/1000=0%	Pass	Occasional errors at 89dBuV (27dB over)
503kHz	509.5kHz	0/1000=0%	Pass	Occasional errors at 94dBuV (32dB over)
503kHz	507.33kHz	0/1000=0%	Pass	Occasional errors at 85dBuV (23dB over)
503kHz	506.25kHz	0/1000=0%	Pass	Occasional errors at 96dBuV (34dB over)
502kHz	514kHz	0/1000=0%	Pass	Occasional errors at 89dBuV (27dB over)
502kHz	508kHz	0/1000=0%	Pass	Occasional errors at 93dBuV (31dB over)
502kHz	506kHz	0/1000=0%	Pass	Occasional errors at 95dBuV (33dB over)
502kHz	505kHz	0/1000=0%	Pass	Occasional errors at 96dBuV (34dB over)
512kHz	534kHz	0/1000=0%	Pass	Occasional errors at 92dBuV (30dB over)
512kHz	523kHz	0/1000=0%	Pass	Occasional errors at 98dBuV (36dB over)
512kHz	519.33kHz	0/1000=0%	Pass	Occasional errors at 91dBuV (29dB over)
512kHz	517.5kHz	0/1000=0%	Pass	Occasional errors at 99dBuV (37dB over)

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED

5.5 Spurious emissions

The Nav5plus meets this requirement.

See EMC report 04J025CR referenced above.

In addition, a test was made of conducted emissions from the aerial port. A spectrum analyser with an input impedance of 50 ohms (antenna (a)) was attached to the aerial connector, and a search made for any significant emissions in the range 9kHz to 2GHz. The largest emissions are listed, a specific check was made at 490kHz and 518kHz, but no emissions were seen above the noise floor of the spectrum analyser (about –95dBm)
Any emissions seen are required to have a power less than 1nW (-60dBm).

Frequency	Power	Pass/Fail
68.8MHz	-64dBm	Pass
70.8MHz	-65dBm	Pass
97.8MHz	-66dBm	Pass
186MHz	-66dBm	Pass
272MHz	-65dBm	Pass

The same antenna is used by both receivers simultaneously, so a separate check at 490kHz is not required.

5.6 Protection of input circuits

The overload test has not been carried out due to lack of equipment capable of generating 30V RMS of RF. However, the design of the input stage is based on that of the Nav5, including clipping diodes to limit any overload, and so no problems are expected.

The DC impedance from antenna to case is <1 ohm with the case link in place, against the specification of <100k. Hence the Nav5plus meets this requirement.

6. Printing device

The Nav5plus uses the same printer as Nav5, and hence meets these requirements. It has a low noise level, prints 40 characters per line, and has a total capacity of 210000 characters.

7. Interference

The Nav5plus meets this requirement. See EMC report 04J025CR as referenced above

THIS DOCUMENT IS UNCONTROLLED UNLESS OTHERWISE STATED