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TITLE: **CONFIDENTIAL TEST REPORT**

PRODUCT DESCRIPTION: NAVTEX Receiver
Type: **NAV-5**

TYPE OF TEST **R.F. SUSCEPTIBILITY & ELECTROSTATIC DISCHARGE**

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DATE: 9/3/94

WORK COMMENCEMENT DATE: 14/02/94

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WORK SITE LOCATION:
(if different from above)

CUSTOMERS OWN REF: P.O. No. 2686 (ref.JRS)

PRODUCT IDENTIFICATION: NAV-5

PROJECT OBJECTIVES: Testing to IEC Immunity Test Standards for R.F. Susceptibility (conducted and radiated) and Electrostatic Discharge.

TEST EQUIPMENT USED:

Item No.	QTY	Description	MFR & Model No.
1	1	Standard dielectric table (height: 800mm)	Cranage EMC Tech.
2	1	Standard dielectric table (height: 100mm)	Cranage EMC Tech.
3	1	Screened test room 5.4m(L) x 2.9m(W) x 3.2m(H)	Cranage EMC Tech. (Facility ref. P2024)
4	1	Stripline Test Cell. 80MHz to 300MHz	Cranage EMC Tech. (ref. stan. IEC801-3: 1984)
5	1	Broadband Isotropic Electric Field Probe 10kHz to 1GHz	Aeritalia TE307 with TE308 repeater
6	1	Broadband Power Amplifier, 20W, 150kHz to 300MHz	ENI 420LA
7	1	Broadband Power Amplifier, 1W, 10MHz to 1000MHz	Cranage EMC Tech. Model 140
8	1	Log Periodic Antenna 300MHz to 1800MHz	A.H. Systems Inc. Model SAS-200/510
9	1	Standard dielectric tripod (2m)	Cranage EMC Tech.
10	1	Signal Generator 10kHz to 990MHz	Hewlett Packard
11	1	100MHz Oscilloscope with X10 probe	Hitachi Model V-1050F
12	1	Mains stop filter	Wireton Limited Type M (ref. stan. EN55020: 1988)
13	1	ESD generator	MWB Instruments B-ESD (sn. 10492)

ENVIRONMENTAL CONDITIONS OF TEST:

The following tests were carried out in the screened test room (3).
(Ambient conditions: Temperature =18°C, RH = 57%, normal atmospheric pressure).

TEST CONFIGURATION:

The Equipment Under Test (EUT) comprised a NAV-5 NAVTEX Receiver connected via 3m length twisted pair cable (30/0.25mm) to an external 12V power supply. A signal cable was connected via 2m length twisted pair cable (16/0.2mm) to the remote alarm socket of the EUT. The far ends of the twisted signal pair were soldered to the centre pin of a BNC socket.

A computer controlled transmitting device, used to emulate typical data transmissions, was located in the adjacent screened measurement room.

The NAVTEX transmitting and receiving antennae were positioned sufficiently close to each other in the screened test room (3) so as to provide an adequate receive signal level to the EUT.

Conducted RF Immunity :-

The EUT was operated within the stripline test cell (4), 50mm above the earth reference plane, and 950mm above the floor of the screened room (3).

The mains stop filter (12) was located on the floor of the screened room (3) at the 12V power point.

Radiated RF Immunity :-

80MHz to 300MHz :-

The EUT was operated within the stripline test cell (4). The field probe (5) was positioned 150mm to the left hand side of the front panel and used to provide continuous feedback of the electric field level at the EUT.
RF input, remote alarm and power cables were orientated orthogonal to the E-field vector.

300MHz to 990MHz :-

The EUT was re-positioned on the standard dielectric table (1).
The radiating antenna (8) was positioned on the centre axis of the EUT at a distance of 1m in front of the front panel, and orientated vertically.

The 'isotropic centre' of the field probe (5) was positioned on the horizontal centre axis of the EUT and spaced 150mm to the left hand side of the EUT front panel.

Electrostatic Discharge :-

The EUT was re-positioned on the standard dielectric table (2) which was placed on top of table (1). An aluminium sheet 0.3mm thick was interposed between the two tables and connected directly to the screened room earth reference point. The ESD generator grounding strap was also connected to the earth reference point.

TEST METHOD:

A computer controlled transmitting device was used to transmit a NAVTEX test signal to the EUT during radio frequency tests and after each electrostatic discharge event. The print out was then examined for errors which may be attributed to either type of interference source.

The RF signal measured at the receive antenna was checked to be within acceptable limits, eg. in the range 20 to 35dBμV. Measured value for the test configuration = 27dBμV.

Spot frequency checks were undertaken at 2.072MHz, 4.144MHz, 7.372MHz, 14.7456MHz, and 66.348MHz.

Conducted RF Immunity :-

Method as defined by IEC801-6.

A common mode RF disturbance was applied in conformity with the test plan, ie. equivalent to radiated field of 10V/m; swept signal was amplitude modulated to a depth of 80% at 1kHz in the frequency range 0.15 to 80MHz; excluded frequencies in the range 425 to 513kHz.

The mains stop filter (12) was used to inject an RF signal onto the low voltage power cable and remote alarm cable of the EUT. The unmodulated signal was adjusted to 10V rms using the signal generator (10) and measured in conjunction with the wideband oscilloscope (11) connected to the injection point. Modulation was then applied and signal amplitude manually controlled during sweep testing.

Sweep testing was carried out in five discrete bands. The frequency ranges were determined empirically and related to the transmission duration of a repeating 'test' message and the optimised print out capability of the EUT:-

i) Power cable, RF injection test:

Frequency Band (MHz)	Frequency Step (kHz) <1% freq. start
0.15 to 0.425	1.5
0.531 to 3.311	5
3.311 to 32.861	30
32.861 to 65.021	300
65.021 to 80	600

ii) Remote alarm cable, RF injection test:

Frequency Band (MHz)	Frequency Step (kHz) <1% freq. start
0.15 to 0.425	1.5
0.531 to 3.351	5
3.351 to 32.061	30
32.061 to 65.221	300
65.221 to 80	600

Radiated RF Immunity :-

The principles of IEC801-3 were used to establish a field level of 10V/m. Owing to the difficulty in controlling a constant value of electric field strength at the EUT for each frequency step over the range 80MHz to 990MHz, it was decided to depart from the conventional frequency swept method and resort to a quasi-continuous approach based on spot frequency programming and manual amplitude adjustment in response to an electric field measurement taken in proximity of the EUT.

The EUT was tested for susceptibility to vertically polarised fields exclusively since this was considered to be representative of the 'in-service' situation.

The RF signal was amplitude modulated to a depth of 80% at 1kHz in the range 80MHz to 990MHz, in frequency steps of 5MHz.

The stripline test cell (4) was used for frequencies in the range 80MHz to 295MHz.

The log periodic antenna (8) was used for frequencies in the range 300MHz to 990MHz. In this instance field uniformity was established at the EUT by taking a reading 150mm on either side of the front panel, eg.

E-field value (LHS) = 10V/m
" " (RHS) = 12V/m

Electrostatic Discharge :-

All accessible parts of the EUT which would normally be in contact with the operator were examined for ESD immunity (air and contact discharge). On completion of all discharge tests, a NAVTEX test transmission was initiated to validate operational functionality.

The discharge electrode was positioned orthogonal to the selected EUT discharge surface. After each discharge test the ESD generator was withdrawn from the EUT then a re-approach made to the new discharge point.

Single air discharge tests were performed at +8kV and -8kV on the following EUT surfaces :-

a) Push-buttons (8off, 1 point, centre)
b) LCD display window (1 point, centre)
c) Hinged printer door (1 point, centre)
d) EUT enclosure (2 sides, centre for each side)
e) Rear connector (3 points, centre, left, right)
f) Paper roll holder (1 point, RHS of roll)

Total number of air discharge tests = 16

When a discharge 'in air' was known to occur, a NAVTEX test transmission was immediately initiated to validate operational functionality.

Single contact discharge tests were performed at +4kV and -4kV on the following EUT surfaces :-

g) Hinged printer door (1 point, centre)
h) EUT enclosure, front flange (3 points, left centre, top centre, right centre)
i) EUT enclosure, sides (4 points, centre of each fixing screw)
j) EUT enclosure, rear (1 point, top centre)
k) Paper roll holder (1 point, RHS of roll)

Total number of contact discharge tests = 10

TEST RESULTS:

1.0 Conducted RF Immunity :-

1.1 Low Voltage Power Cable

EUT sensitive to RF at 531 kHz. Considered to be receiver performance issue not EMC problem. EUT immune to all other frequencies.

1.2 Remote Alarm Cable

EUT sensitive to RF in range 150kHz to 425kHz. Specific frequency not identified but test stopped at this point to investigate and problem eliminated by grounding EUT to earth reference plane of stripline (4). Tests repeated and extended to full range. EUT immune to all frequencies in earthed configuration.

2.0 Radiated RF Immunity :-

Initial susceptibility problems discovered in range 80MHz to 122.7MHz. Test stopped to investigate and discovered to be due to insufficient receive signal (10dBμV). Since standard performance checks are done at 20dBμV and typical in-service levels in the order of 35dBμV it was decided to close-couple NAVTEX transmit and receive antennae. Taping them together gave 27dBμV. Tests repeated and extended to full range. EUT immune to all frequencies.

3.0 Electrostatic Discharge :-

3.1 EUT sensitive to air discharge at paper roll holder (f). LCD clears, but print out and receive functions continue to work satisfactorily. Full EUT recovery after power-down. Vital operations function satisfactorily and user is made aware of LCD problem by visual means. EUT immune at all other points tested.

3.2 EUT sensitive to contact discharge to paper roll holder (k). Effects as per 3.1 above. EUT immune at all other points tested.