



**COMPLIANCE
ENGINEERING**
EMC - Shielding - Environmental

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EMC Compliance Test Report

AS/NZS 61000-6-1: 2006
Report Number: TR2192B



JEC Marine
Ventilation Fan
(Model: MF1)

The results detailed in this test report relate only to the specific sample/s tested. It is the Manufacturer's responsibility to ensure that all production units are manufactured with equivalent EMC characteristics. This report is not to be reproduced except in full, without written approval from Compliance Engineering Pty Ltd.



COMPLIANCE CERTIFICATE

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Device: Ventilation Fan
 Model No: MF1



Reference Standard: AS/NZS 61000-6-1: 2006 Immunity standard for residential, commercial and light-industrial environments

Summary Result:	Electrostatic Discharge Immunity (IEC 61000-4-2)	Complied
	Radiated RF Immunity Measurements (IEC 61000-4-3)	Complied
	Fast Transient Burst Immunity (IEC 61000-4-4)	Complied
	Surge Immunity (IEC 61000-4-5)	Complied
	Conducted RF Immunity Measurements (IEC 61000-4-6)	Complied
	Radiated Magnetic Field Immunity (IEC 61000-4-8)	Complied

Test Dates: 10th to 11th October 2017

Tests Performed by: David Beecher
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The Ventilation Fan (Model: MF1) complies with the immunity requirements detailed in AS/NZS 61000-6-1: 2006 Immunity standard for residential, commercial and light-industrial environments.

		17 th October 2017
Prepared By: David Beecher Test Engineer Compliance Engineering Pty Ltd	Approved By: Andrew Burden Technical Manager Compliance Engineering Pty Ltd	Date

EMC Compliance Test Report

1. INTRODUCTION

EMC compliance tests were performed on the Ventilation Fan (Model: MF1) with the immunity requirements detailed in AS/NZS 61000-6-1: 2006 Immunity standard for residential, commercial and light-industrial environments.

2. RESULTS SUMMARY

Performed in accordance with AS/NZS 61000-6-1: 2006

Electrostatic Discharge Immunity (IEC 61000-4-2)	Complied
Radiated RF Immunity Measurements (IEC 61000-4-3)	Complied
Fast Transient Burst Immunity (IEC 61000-4-4)	Complied
Surge Immunity (IEC 61000-4-5)	Complied
Conducted RF Immunity Measurements (IEC 61000-4-6)	Complied
Radiated Magnetic Field Immunity (IEC 61000-4-8)	Complied

3. TEST SAMPLE

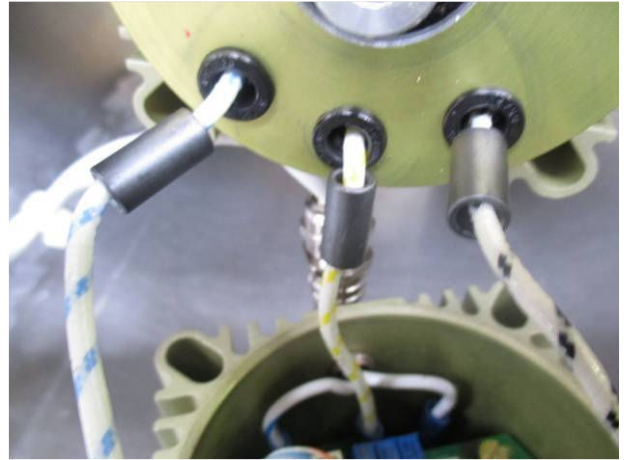
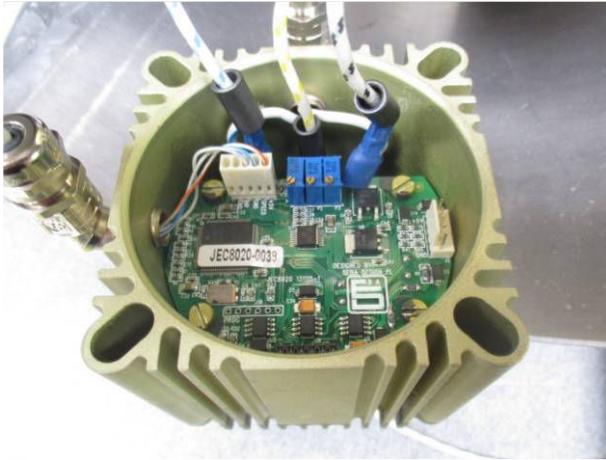
The equipment under test (EUT) is described as follows:

Ventilation Fan

Model No: MF1
 Serial: N/A



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4. MODIFICATIONS

No modifications were performed on the above samples by Compliance Engineering Pty Ltd.

5. CONFIGURATION

The EUT was powered from a 26 VDC power supply and was set to maximum RPM.

6. TEST FACILITY

All measurements were performed at Compliance Engineering Pty Ltd: Unit 1, 70 Rushdale Street, Knoxfield, Victoria, Australia.

7. IMMUNITY PERFORMANCE CRITERION

The performance of the EUT was subject to the following performance criterion as specified in the referenced Standard:

Performance Criterion A: The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

Performance Criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

Performance Criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use.

8. ELECTROSTATIC DISCHARGE IMMUNITY

8.1 REQUIREMENTS

AS/NZS 61000-6-1: 2006 (Referencing IEC 61000-4-2)

Applications: 10 discharges per type, polarity and level
 Contact Discharge: ± 4 kV
 Air Discharge: N/A
 Discharge Network: 150 pF/330 Ω

8.2 TEST EQUIPMENT

Asset	Equipment	Model No	Serial No	Cal Due
182	ESD Generator	NSG 437	115	July 18

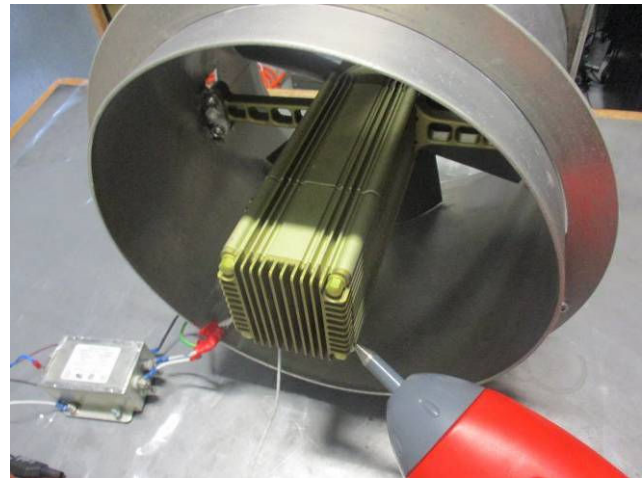
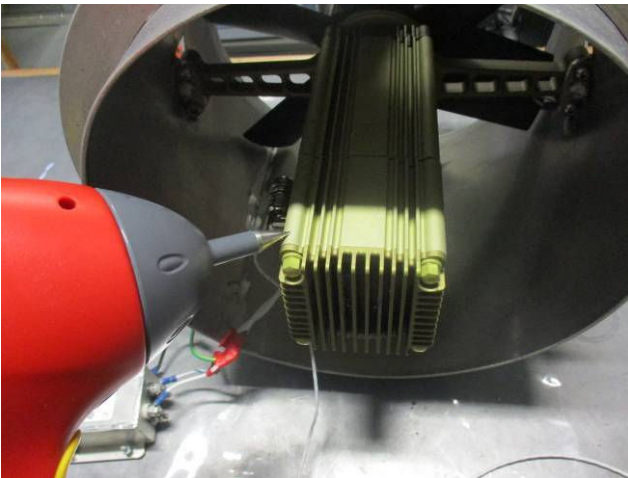
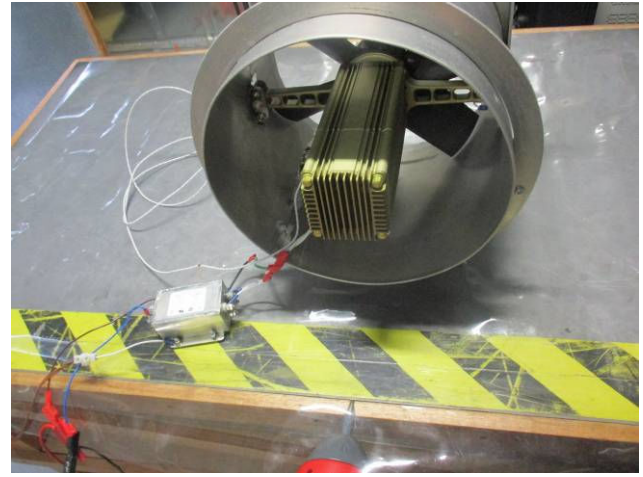
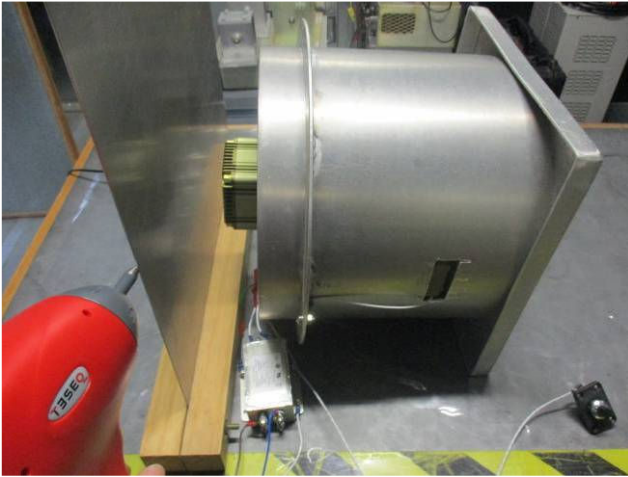
8.3 PROCEDURE

A horizontal coupling plane (HCP) was placed on top of a wooden table (0.8 metres high) standing on a ground reference plane.

The test sample and its cables were isolated from the HCP by an insulating film 0.5 mm thick (*Note: Floor standing equipment is isolated from the ground reference plane by an insulating support 100 mm thick*). The test sample was located no closer than 1 metre from the enclosure walls or any other metallic structure.

The contact discharge method was used to apply discharges to all conductive surfaces of the test sample and the HCP (1.6 metres x 0.8 metres). The air discharge method was used to apply discharges to insulating surfaces and to all accessible ports of the test sample.

The HCP was connected to the ground reference plane via a cable with a 470 k Ω resistor located at each end. Discharges were applied to the HCP around each side of the test sample.





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8.4 RESULTS

Contact Discharge			
Application	Voltage	Observation	Result
HCP	± 4.0 kV	No Interference evident	Pass
VCP		No Interference evident	Pass
Top Housing		No Interference evident	Pass
Bottom Housing		No Interference evident	Pass
Motor shaft		No Interference evident	Pass
Speed Control		No Interference evident	Pass

Environmental Conditions: Temperature 18.5°C, Humidity 49%

8.5 ASSESSMENT

The Ventilation Fan (Model: MF1) complied with ESD immunity requirements detailed in AS/NZS 61000-6-1: 2006

9. RADIATED RF IMMUNITY

9.1 REQUIREMENTS

AS/NZS 61000-1: 2006 (Referencing IEC 61000-4-3)

Frequency: 80 MHz to 1 GHz (3 V/m)
1.4 GHz to 2 GHz (3 V/m)
2 GHz to 2.7 GHz (1 V/m)

Step Size: 1 %
Dwell: 2 seconds
Modulation: 80 % AM, 1 kHz



9.2 TEST EQUIPMENT

Asset No	Equipment	Model No	Serial No	Cal Due
402	RF Power Amplifier	MT400	1203	NR
292	Signal Generator	SMHU	DE22370	Feb 18
81	RF Field Probe	HI-4433 GRE	96706	Feb 18
93	Field Monitor	FM5004	300226	NR
64	Power Sensor	8482A	2652A22102	Dec 17
63	Power Meter	437B	3125U18812	Feb 18
87	Power Meter	8482A	A13596	Feb 18
88	Power Sensor	437B	3125U19690	Dec 17
267	Dual Directional Coupler	5982	8919	May 19

NR = Not required

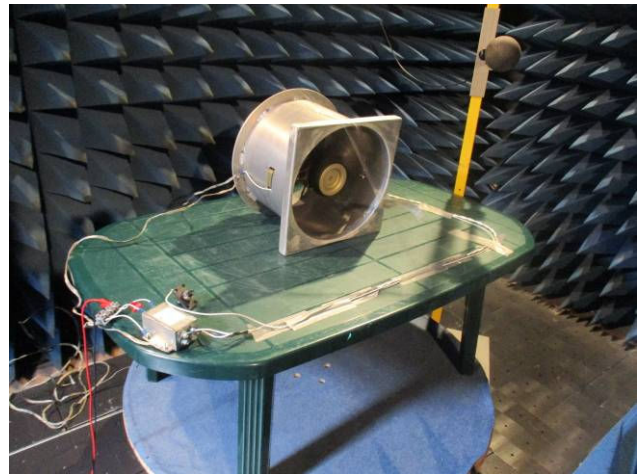
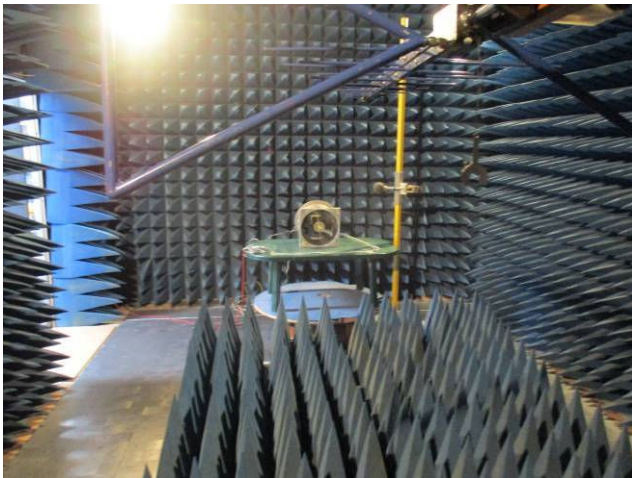
9.3 PROCEDURE

Calibration: The electric field was calibrated at a set distance (2.5 m below 2 GHz and 4.2 m above 1 GHz) from the transmitting antenna. The frequency range of 80 MHz to 2.7 GHz was swept incrementally using 1% step sizes, whilst the RF field was measured using an electric field probe and leveled (unmodulated). The drive level to the amplifier and forward power into the antenna were recorded and stored for reference.

Device Testing: The electric field probe was replaced with the device and the frequency range 80 MHz to 2.7 GHz was swept incrementally, using the pre-recorded data for reference. Amplitude modulation (80% AM, 1 kHz) was applied to the interfering field with a dwell time of 2 seconds at each frequency increment. Both horizontal and vertical radiating antenna polarisations were used to illuminate the device in turn.

The test sample was positioned on a non-conductive table, 0.8 m above the reference ground plane. Where applicable, cabling to the device was left exposed to the electromagnetic field for a distance of 1 m. All wiring less than or equal to 3 m, was bundled low-inductively to a 1 m length. All wiring greater than 3 m, had RF absorbing beads placed 1 m along the wiring.

The test sample construction was inspected (enclosure material, PCB layout, cabling orientation etc) and a technical determination was made regarding the faces of the test sample that will be subjected to the radiated RF field.



9.4 RESULTS

Face	Field	Frequency	Polarisation	Result
Front	3 V/m 80% AM	80 MHz – 1 GHz	Vertical & Horizontal	Pass
		1.4 GHz – 2 GHz	Vertical & Horizontal	Pass
	1 V/m 80% AM	2 GHz – 2.7 GHz	Vertical & Horizontal	Pass

Environmental Conditions: Temperature 19.5°C, Humidity 53%

9.5 ASSESSMENT

The Ventilation Fan (Model: MF1) complied with radiated RF immunity requirements detailed AS/NZS 61000-6-1: 2006.

10. FAST TRANSIENT BURST IMMUNITY

10.1 REQUIREMENTS

AS/NZS 61000-6-1: 2006 (Referencing IEC 61000-4-4)

Level: DC input port ± 0.5 kV
Signal & Control Lines ± 0.5 kV
Application Time: 2 minute per polarity for each test

10.2 TEST EQUIPMENT

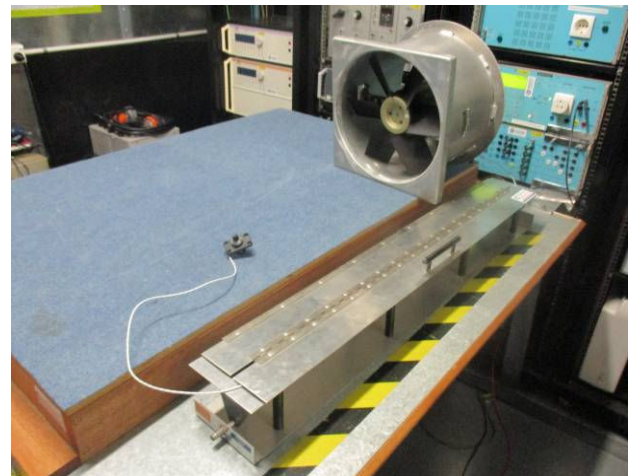
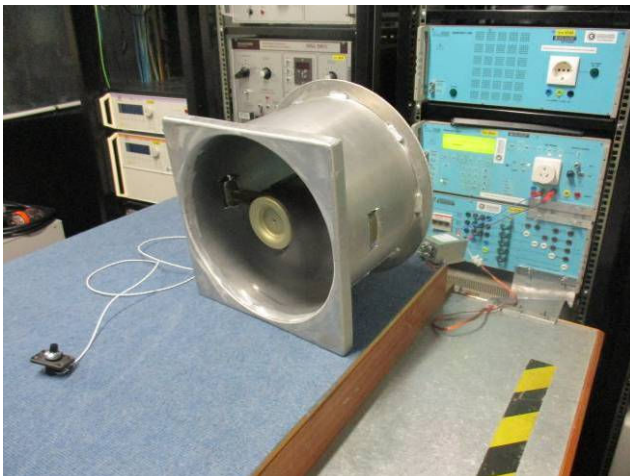
Asset No	Equipment	Model No	Serial No	Cal Due
43	Transient Generator	TRA2000	782	Jul 17
58	Capacitive Coupling Clamp	CE 61000-4-4	1050	NR

NR = Not Required

10.3 PROCEDURE

The EUT was placed on a wooden table 0.1 metre above a ground reference plane. (Note: Floor mounted equipment is insulated from the ground reference plane by 0.1 metre insulating supports).

The length of the power cables between the coupling devices and the EUT was 0.5 metres ± 0.05 . (Non-detachable supply cables more than 0.5 metres long, have the excess cable folded to avoid a flat coil and situated 0.1 metre above the ground reference plane). Transients on signal lines were applied via a capacitive coupling clamp fixture.



10.4 RESULTS

Fast Transient Burst Immunity Measurements			
Application	Test Voltage	Observation	Result
DC Port	$\pm 0.5\text{kV}$	No Interference evident	Pass
Speed control cable	$\pm 0.5\text{kV}$	No Interference evident	Pass

Environmental Conditions: Temperature 19.5°C, Humidity 49%

10.5 ASSESSMENT

The Ventilation Fan (Model: MF1) complied with fast transient burst immunity requirements detailed in AS/NZS 61000-6-1: 2006.

11. SURGE IMMUNITY

11.1 REQUIREMENTS

AS/NZS 61000-6-1: 2006 (Referencing IEC 61000-4-5)

DC input port: $\pm 0.5\text{ kV}$
 Application: 5 pulses
 Application Rate: Maximum of 1 every 5 seconds (prefer 1/min)

11.2 TEST EQUIPMENT

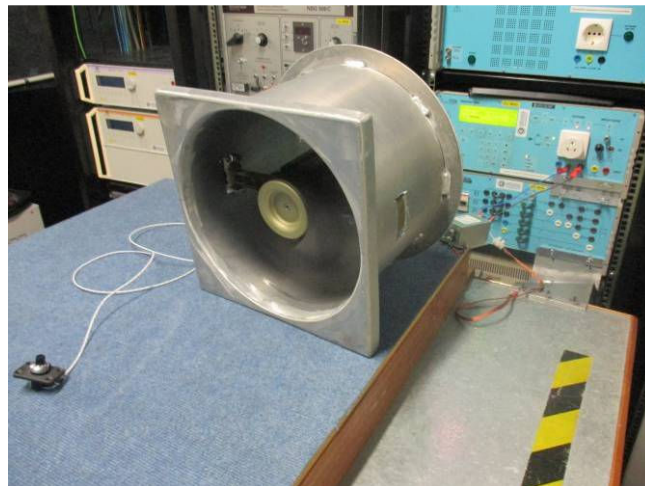
Asset No	Equipment	Model No	Serial No	Cal Due
43	Transient Generator	TRA2000	782	Jul 18

11.3 PROCEDURE

The test sample was placed on a ground reference plane. The length of the power cable between the coupling devices and the test sample was less than 1 metre.

Non-detachable supply cables more than 1 m long have the excess length gathered into a flat 0.4 m diameter coil.

The applied surge voltage was increased from the minimum severity level up to the required test level, in order to determine any threshold of failure.



11.4 RESULTS

Surge Immunity Measurements - DC input port 26 VDC			
Application	Voltage	Observation	Result
DC input port	±0.5 kV	No interference evident	Pass

Environmental Conditions: Temperature 19.5°C, Humidity 49%

11.5 ASSESSMENT

The Ventilation Fan (Model: MF1) complied with surge immunity requirements detailed in AS/NZS 610006.1: 2006.

12. CONDUCTED RF IMMUNITY MEASUREMENTS

12.1 REQUIREMENTS

AS/NZS 61000-6-1: 2006 (Referencing IEC 61000-4-6)

Frequency: 0.15 MHz to 80 MHz
 Test Level: 3 Vrms
 Dwell Time: 2 seconds
 Modulation: 80 % AM, 1 kHz

12.2 TEST EQUIPMENT

Asset	Equipment	Model No	Serial No	Cal Due
226	Spectrum Analyser	HP8591E	3230A00575	May 18
265	RF Power Amplifier	150L	9420	N/R
287	Signal Generator	SMHU52	831914/005	Jan 18
242	Power Meter	437B	3125U21955	N/R
243	Power Sensor	8482A	2652A18167	Feb 18
318	Power Meter	437B	3125U26212	N/R
245	Power Sensor	8482A	US37292957	Feb 18
89	Directional Coupler	C5100	5954	Feb 19
192	EM Clamp	KEMZ 801	21048	Oct 18
139	Coupling/Decoupling Network	FCC-801-M3-16A	7014	Oct 18

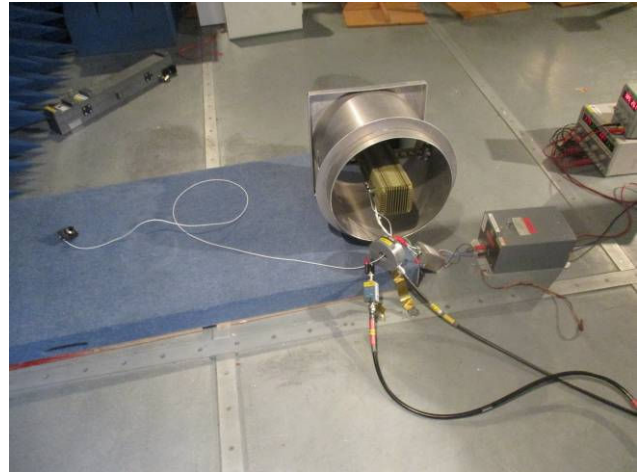
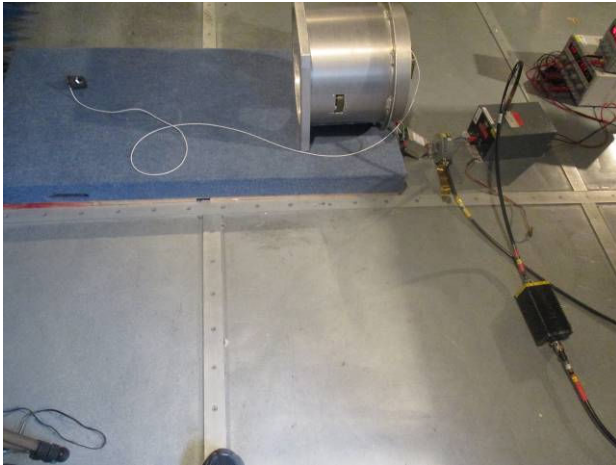
NR = Not required

12.3 PROCEDURE

Calibration: Prior to measurements, a CDN and/or EM clamp calibration was performed with the signal generator drive level and forward power required to produce 3 Vrms over the frequency range of 0.15 MHz to 80 MHz (using 1% frequency steps). This was recorded for future reference.

Device Testing: The EUT was located on a non-conductive support, 0.1 metre above the reference ground plane. The CDN and/or EM clamp was coupled to the cable at a distance of 300 mm away from the input connector. Cables not being tested were decoupled with ferrite RF absorbing beads. Cables attached to different connector ports were tested individually. The earth connection from the chassis of the EUT was connected to a CDN and tested individually.

The frequency range 0.15 MHz to 80 MHz was swept incrementally using the pre-recorded reference data. Modulation (80%, 1 kHz AM) was applied to the CW signal with a dwell time of 2 seconds at each frequency increment.



12.4 RESULTS

Conducted RF Immunity Measurements – EUT Standby mode				
Application	Frequency (MHz)	Level (V RMS)	Observation	Result
DC input port	0.15 - 80	3	No Interference Evident	Pass
Speed control cable	0.15 - 80		No Interference Evident	Pass

Environmental Conditions: Temperature 17.8 - 22.1 °C, Humidity 38 -42%

12.5 ASSESSMENT

The Ventilation Fan (Model: MF1) complied with conducted RF immunity requirements detailed in AS/NZS 61000-6-1: 2006.

13. RADIATED MAGNETIC FIELD IMMUNITY

13.1 REQUIREMENTS

AS/NZS 61000-6-1: 2006 (Referencing IEC 61000-4-8)

Magnetic Field: 50 Hz, 3 A/m (37.7 Milligauss)
 Orientation: X, Y & Z

13.2 TEST EQUIPMENT

Asset	Equipment	Model No	Serial No	Cal Due
26	Magnetic Field Meter	HI-3624	102214	Apr 18
150	Magnetic Field Generator	MFG1000	1650	NR

NR = Not Required

13.3 PROCEDURE

Prior to measurements, a magnetic field calibration was performed, with a magnetic field probe positioned centrally inside a loop antenna. The magnetic field was increased until the required filed level was achieved.

The EUT was then placed on a wooden support 0.4 m above the ground reference plane with the loop antenna surrounding the EUT.

The unit was monitored for any change in state. The EUT was tested in 3 different orientations (X, Y, and Z) in turn.



13.4 RESULTS

Magnetic Field Immunity Measurements				
Orientation	Frequency	Field	Observation	Result
X	50 Hz & 60 Hz	3 A/m	No Interference evident	Pass
Y			No Interference evident	Pass
Z			No Interference evident	Pass

Environmental Conditions: Temperature 18.6 °C, Humidity 48%

13.5 ASSESSMENT

The Ventilation Fan (Model: MF1) complies with requirements detailed in Radiated Magnetic Field Immunity requirements detailed in AS/NZS 61000-6-1: 2006.

14. CONCLUSION

The Ventilation Fan (Model: MF1) complies with the requirements detailed in the AS/NZS 61000-6-1: 2006 Immunity standard for residential, commercial and light-industrial environments.