Environmental Testing

For

SRT Marine Technology Limited

On

Iris AIS700 Class B AIS Transceiver/Splitter

Report No. TRA-037294-26-CR-01B

NOVEMBER 2017

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SRT Marine Technology Limited

On

Iris AIS700 Class B AIS Transceiver/Splitter

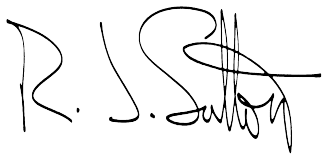
Issue Number	Issue Date	Comments
A	31.10.17	Original
B	28.11.17	Additional specimen, S9, Specification 3.1.4,3.1.5, Procedure 4.1.4,4.1.5, Results 5.1.4, 5.1.5, Figure 2.4 and 2.5 added to report

Engineer

Ryan Ballard

Test Engineer

Approval



Rob Sutton

Verification Controller

Environmental Testing

For

SRT Marine Technology Limited

On

Iris AIS700 Class B AIS Transceiver/Splitter

SUMMARY

At the request of SRT Marine Technology Limited three Iris AIS700 Class B AIS Transceiver/Splitter specimens were submitted for Environmental testing in accordance with Maritime Navigation and Radiocommunication Equipment and Systems - General Requirements - Methods of Testing and Required Results BS EN 60945:2002 and Element Materials Technology Warwick Limited quotations TRA-037294-00 and TRA-037294-01 dated 20th and 26th July 2017.

The environmental programme contained the follow tests:

- Low Temperature Storage Test
- Dry Heat Storage Test
- Damp Heat Functional Test
- Dry Heat Functional Test
- Low Temperature Functional Test
- Vibration - Resonance Search
- Vibration - Endurance Test

All testing was completed. However due to a test omission by Element during the original tests a third specimen was sent by SRT Marine Technology Limited in order to complete the Dry Heat Functional and Low Temperature Functional temperature tests.

An Element engineer performed performance checks throughout the tests on the Iris AIS700 Class B AIS Transceiver/Splitter specimens using SRT Marine Technology Limited supplied diagnostic equipment. Visual inspections of the specimen after each test also showed no signs of external damage or degradation.

At the conclusion of the environmental testing the specimens were returned to SRT Marine Technology Limited for further investigation.

Client:	SRT Marine Technology Limited Wireless House Westfield Industrial Estate Midsomer Norton Bath Somerset BA3 4BS United Kingdom
Specimen Receipt:	28th September and 7th November 2017
Date of Test:	28th September to 10th October and 7th to 14th November 2017

The work that forms the subject of this report was carried out on behalf of SRT Marine Technology Limited in accordance with their Order No. POR006484 under the terms of conditions of Element Materials Technology Warwick Ltd Works Order No. TRA-037294-00.

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1. INTRODUCTION

At the request of SRT Marine Technology Limited three Iris AIS700 Class B AIS Transceiver/Splitter specimens were submitted for Environmental testing in accordance with Maritime Navigation and Radiocommunication Equipment and Systems - General Requirements - Methods of Testing and Required Results, BS EN 60945:2002 and Element Materials Technology Warwick Limited quotations TRA-037294-00 and TRA-037294-01 dated 20th and 26th July 2017.

The purpose of the test was to assess the general robustness of the Iris specimens after subjecting them to the specified tests.

2. SPECIMEN

Part Name	Iris AIS700 Class B AIS Transceiver/Splitter
Serial No:	50922170008
Element Stores No:	TRA-037294-S1
Date Received:	28th September 2017

Part Name	Iris AIS700 Class B AIS Transceiver/Splitter
Serial No:	50922170011
Element Stores No:	TRA-037294-S2
Date Received:	28th September 2017

Part Name	Iris AIS700 Class B AIS Transceiver/Splitter
Serial No:	S0922170028
Element Stores No:	TRA-037294-S9
Date Received:	7th November 2017

The specimens were subjected to the tests defined in Section 3.

3. SPECIFICATION

Tested in accordance with Maritime Navigation and Radiocommunication Equipment and Systems - General Requirements - Methods of Testing and Required Results BS EN 60945:2002.

3.1. TEMPERATURE TESTING

3.1.1. LOW TEMPERATURE STORAGE TEST

In accordance with BS EN 60945:2002, Section 8.4.1

Test Condition	-25°C (± 3°C)
Soak Duration	Ten to Sixteen hours
Ramp Rates	1 °C/ minute
Post Test Stabilization	Returned to ambient temperature
Equipment State	Unpowered

3.1.2. DRY HEAT STORAGE TEST

In accordance with BS EN 60945:2002, Section 8.2.1

Test Condition	70°C (± 3°C)
Soak Duration	Ten to Sixteen hours
Ramp Rates	1 °C/ minute
Post Test Stabilization	Returned to ambient temperature
Equipment State	Unpowered

3.1.3. DAMP HEAT FUNCTIONAL TEST

In accordance with BS EN 60945:2002, Section 8.3.1

Test Condition	40°C (± 2°C), 93 %RH (± 3 %RH)
Soak Duration	Ten to Sixteen hours
Ramp Rate (Up)	Three hours from ambient to test condition (± 30 minutes)
Ramp Rate (Down)	One hour (minimum)
Post Test Stabilization	Returned to ambient temperature
Number of Cycles	One
Equipment State	Powered for two hours at test condition (at conclusion of soak period)

3.1.4. DRY HEAT FUNCTIONAL TEST

In accordance with BS EN 60945:2002, Section 8.2.2

Test Condition	55°C (± 3°C)
Soak Duration	Ten to Sixteen hours
Ramp Rates	1°C/ minute
Post Test Stabilization	Returned to ambient temperature
Equipment State	Powered

3.1.5. LOW TEMPERATURE FUNCTIONAL TEST

In accordance with BS EN 60945:2002, Section 8.4.2, Exposed Equipment.

Test Condition	-25°C (± 3°C)
Soak Duration	Ten to Sixteen hours
Ramp Rates	1°C/ minute
Equipment State	Powered for 2 hours after soak duration
Post Test Stabilization	Returned to ambient temperature

3.2. VIBRATION TESTING

In accordance with BS EN 60945:2002, Section 8.7.2

3.2.1. RESONANCE SEARCH

Frequency Range	5-100 Hz (Up sweep only)
Amplitude	5-13.2 Hz - ± 1mm (± 10 %) 13.2-100 Hz 7 m/s^2
Sweep Rate	0.5 octave/minute
Equipment State	Powered
Orientation	3 orthogonal axes

3.2.2. ENDURANCE TEST

A two hour endurance test shall be performed at each resonance found during the resonance search. A resonance is considered as either a visual or audible change in the specimen characteristics or any frequency that produces a resonance with a magnitude five times greater than the input level. If no resonances are found a two hour endurance test shall be performed at 30 Hz. The endurance test shall be performed to the same amplitude profile as the resonance search.

4. PROCEDURE

4.1. TEMPERATURE TESTING

4.1.1. LOW TEMPERATURE STORAGE TEST

Two unpowered Iris AIS700 Class B AIS Transceiver/Splitter specimens were placed upon a wire rack shelf inside a climatic chamber with four PRTs placed close to the specimens to monitor the local environment. SRT Marine Technology Limited cables were connected to the specimens and run outside of the chamber to allow connection to a laptop and antenna for performance checks. After ramping to -25 °C a sixteen hour soak was commenced. At the conclusion of this period the chamber was ramped to ambient temperature and the chamber was stabilized. After stabilization the specimens were powered and a performance check was completed by an Element engineer using SRT Marine Technology Limited supplied test equipment. A setup photograph is shown in Figure 1.1.

4.1.2. DRY HEAT STORAGE TEST

Two unpowered Iris AIS700 Class B AIS Transceiver/Splitter specimens were placed upon a wire rack shelf inside a climatic chamber with four PRTs placed close to the specimens to monitor the local environment. SRT Marine Technology Limited cables were connected to the specimens and run outside of the chamber to allow connection to a laptop and antenna for performance checks. After ramping to 70 °C a sixteen hour soak was commenced. At the conclusion of this period the chamber was ramped to ambient temperature and the chamber was stabilized. After stabilization the specimens were powered and performance check was completed by an Element engineer using SRT Marine Technology Limited supplied test equipment

4.1.3. DAMP HEAT FUNCTIONAL TEST

Two unpowered Iris AIS700 Class B AIS Transceiver/Splitter specimens were placed upon a wire rack shelf inside a climatic chamber with four PRTs and an aspirated wick placed close to the specimens to monitor the local environment. SRT Marine Technology Limited cables were connected to the specimen and run outside of the chamber to allow connection to a laptop and antenna for performance checks. After ramping to 40°C, 93 %RH a sixteen hour soak was commenced. At the conclusion of the soak period the IRIS specimens were powered for half an hour and allowed to stabilise before a two hour powered soak and performance check was completed. At the conclusion of this period the chamber returned to ambient temperature.

4.1.4. DRY HEAT FUNCTIONAL TEST

A powered Iris AIS700 Class B AIS Transceiver/Splitter specimen was placed upon a wire rack shelf inside a climatic chamber with two PRTs placed close to the specimen and one PRT attached to its casing. SRT Marine Technology Limited cables were connected to the specimen and run outside of the chamber to allow connection to a laptop for performance checks, Figure 1.2. After ramping to 55°C the ten to sixteen hour soak was commenced. At the conclusion of this period which completed eighteen hours, a performance check on the Iris AIS700 Class B AIS Transceiver/Splitter specimen was completed by an Element engineer using SRT Marine Technology Limited supplied test equipment. The chamber was then ramped down to ambient temperature.

4.1.5. LOW TEMPERATURE FUNCTIONAL TEST

An unpowered Iris AIS700 Class B AIS Transceiver/Splitter specimen was placed upon a wire rack shelf inside a climatic chamber with two PRTs placed close to the specimen and one PRT attached to its casing. SRT Marine Technology Limited cables were connected to the specimens and run outside of the chamber to allow connection to a laptop for performance checks, Figure 1.2. After ramping to -25 °C a sixteen hour soak was commenced. At the conclusion of this period the Iris AIS700 Class B AIS Transceiver/Splitter was powered and allowed to operate for two hours. During this time a performance check was completed by an Element engineer using SRT Marine Technology Limited supplied test equipment. At the conclusion of this period the chamber was returned to ambient temperature.

4.2. VIBRATION TEST

Two powered Iris AIS700 Class B AIS Transceiver/Splitter specimens were secured to a fixture plate which was bolted to a hydrostatic slip plate in the horizontal axes and to a head expander in the vertical axis. A tri-axial and uni-axial control accelerometer, utilising an average control strategy, were mounted at diagonally opposed fixing positions. A monitor accelerometer was also affixed to the top of each specimen to measure any resonances. Setup photographs are shown in Figures 1.2-1.5.

The Iris AIS700 Class B AIS Transceiver/Splitter specimens were powered and monitored by an Element engineer using SRT Marine Technology Limited supplied test equipment throughout vibration testing.

Performance checks completed throughout the testing consisted of applying power to the Iris AIS700 Class B AIS Transceiver/Splitter specimens which were connected by cabling to a laptop and GPS antenna. A ProAIS2 software program was launched from the laptop and used to connect to the specimens. An LED on the specimens would also be functional when powered. All equipment was provided by SRT Marine Technology Limited.

5. RESULTS

5.1. TEMPERATURE TESTING

5.1.1. LOW TEMPERATURE STORAGE TEST

The Low Temperature Storage Test was completed. Once the specimens had stabilised at ambient temperature power was applied and a performance check was completed by an Element engineer at a nominal and extreme voltage condition. During the extreme voltage check the LED on the specimens changed from green to red. SRT advised that the indication of a red 'error' condition was not a failure of the product but a Built-In-Integrity-Test report identifying to the operator that an error had occurred. In this case the error report was an excessive voltage at the power supply input.

A result trace is shown in Figure 2.1

5.1.2. DRY HEAT STORAGE TEST

The Dry Heat Storage Test was completed. Once the specimens had stabilised at ambient temperature power was applied and a performance check was completed by an Element engineer at a nominal and extreme voltage condition. During the extreme voltage check the LED on the specimens changed from green to red. SRT advised that the indication of a red 'error' condition was not a failure of the product but a Built-In-Integrity-Test report identifying to the operator that an error had occurred. In this case the error report was an excessive voltage at the power supply input.

A result trace is shown in Figure 2.2

5.1.3. DAMP HEAT FUNCTIONAL TEST

The Damp Heat Functional Test was completed. Once the Iris AIS700 Class B AIS Transceiver/Splitter specimens had completed the sixteen hour soak period power was applied for half an hour before the specimens were left in an operational state for two hours. During this duration a performance check was completed at nominal voltage by an Element engineer. At the conclusion of the powered segment the chamber was returned to ambient temperature.

A result trace is show in Figure 2.3

5.1.4. DRY HEAT FUNCTIONAL TEST

The Dry Heat Functional Test was completed. After conclusion of the eighteen hour soak period a performance check was completed by an Element engineer at a nominal and extreme voltage condition. During the performance checks the specimen LED remained lit and the script on the ProAIS software continued to scroll. At the conclusion of the performance checks the chamber was returned to ambient temperature.

A result trace is shown in Figure 2.4

5.1.5. LOW TEMPERATURE FUNCTIONAL TEST

The Low Temperature Functional Test was completed. Once the sixteen hour soak period was concluded power was applied to the specimen which was then left operational for a further two hours at -25°C.
Whilst powered a performance check was completed by an Element engineer at a nominal and extreme voltage condition. During the performance checks the specimen LED remained lit and the script on the ProAIS software continued to scroll. At the conclusion of the powered segment the chamber was returned to ambient temperature.

A result trace is shown in Figure 2.5

5.2. VIBRATION TEST

All requested vibration tests were completed. During the resonance searches no resonances were found therefore all endurance tests were performed at a fixed 30Hz frequency for two hours in each axis. The specimen was powered for the duration of all vibration tests whilst performance checks were completed. Checks consisted of checking that the LED on the specimens remained lit and that a script in the ProAIS2 software program continued to scroll.

Result plots for the Z Axis testing are shown in Figures 3 to 5.
Result plots for the Y Axis testing are shown in Figures 6 to 8.
Result plots for the Z Axis testing are shown in Figures 9 to 11.

At the conclusion of the environmental testing the specimens showed no signs of external damage or degradation and were returned to SRT Marine Technology Limited for further investigation.

6. QUALITY ASSURANCE

Our technical competence and quality control arrangements are in accordance with the conditions of our UKAS accreditation. The quality management system for the Test Laboratory is accredited by the United Kingdom Accreditation Service, designated as UKAS Testing Laboratory No 0026.

The quality assurance system has been approved against the international quality standard ISO 9001 by Lloyd's Register Quality Assurance under their Certificate No LRQ 4007187.

7. EQUIPMENT AND INSTRUMENTATION

7.1. TRACEABILITY

All equipment has been calibrated as required using standards traceable to National or International standards, in accordance with the requirements of BS EN ISO 17025. Traceability is established through UKAS accredited calibration laboratories.

The test equipment and instrumentation used for each test are detailed in Table 1.

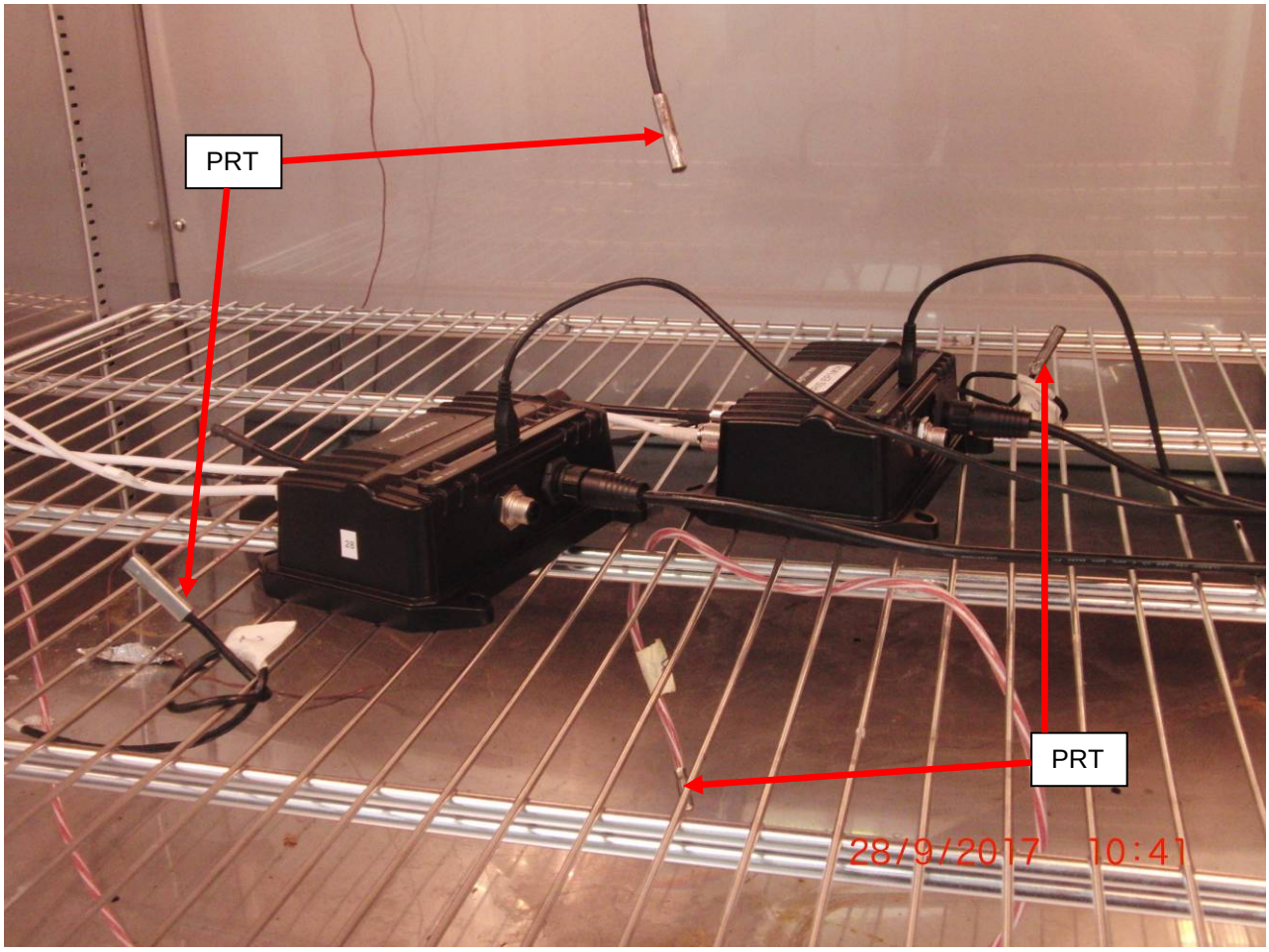
Each item of calibrated equipment and instrumentation was used within its valid calibration period.

7.2. TEST EQUIPMENT AND INSTRUMENTATION

Description	QA Number	Calibration Due Date
Climatic Chamber	7344	20/03/18
Chart Recorder	7073	02/03/18
Platinum Resistance Thermometer	7254	11/10/17
Platinum Resistance Thermometer	7261	11/10/17
Platinum Resistance Thermometer	7263	17/02/18
Platinum Resistance Thermometer	7374	31/08/18
Platinum Resistance Thermometer	7373	31/08/18
Platinum Resistance Thermometer	7372	31/08/18
Aspirated Wick	2264	29/03/18
Digital Multimeter	7347	07/04/18
Power Supply	R0248	N/A
875 Vibration System	7029	N/A
875 Amplifier	7030	N/A
M+P Vibpilot	7035	13/09/18
M+P Vibpilot	7199	13/09/18
Computer Controller	7036	N/A
Charge Amp	6009	31/05/18
Charge Amp	7267	06/07/18
Accelerometer- Control 1x	7331	01/02/18
Accelerometer- Control 1y	7320	09/01/18
Accelerometer- Control 1z	7431	09/01/18
Accelerometer- Control 2	7326	14/05/18
Accelerometer- Monitor	7114	19/12/17
Digital Multimeter	TracMM4	07/04/18

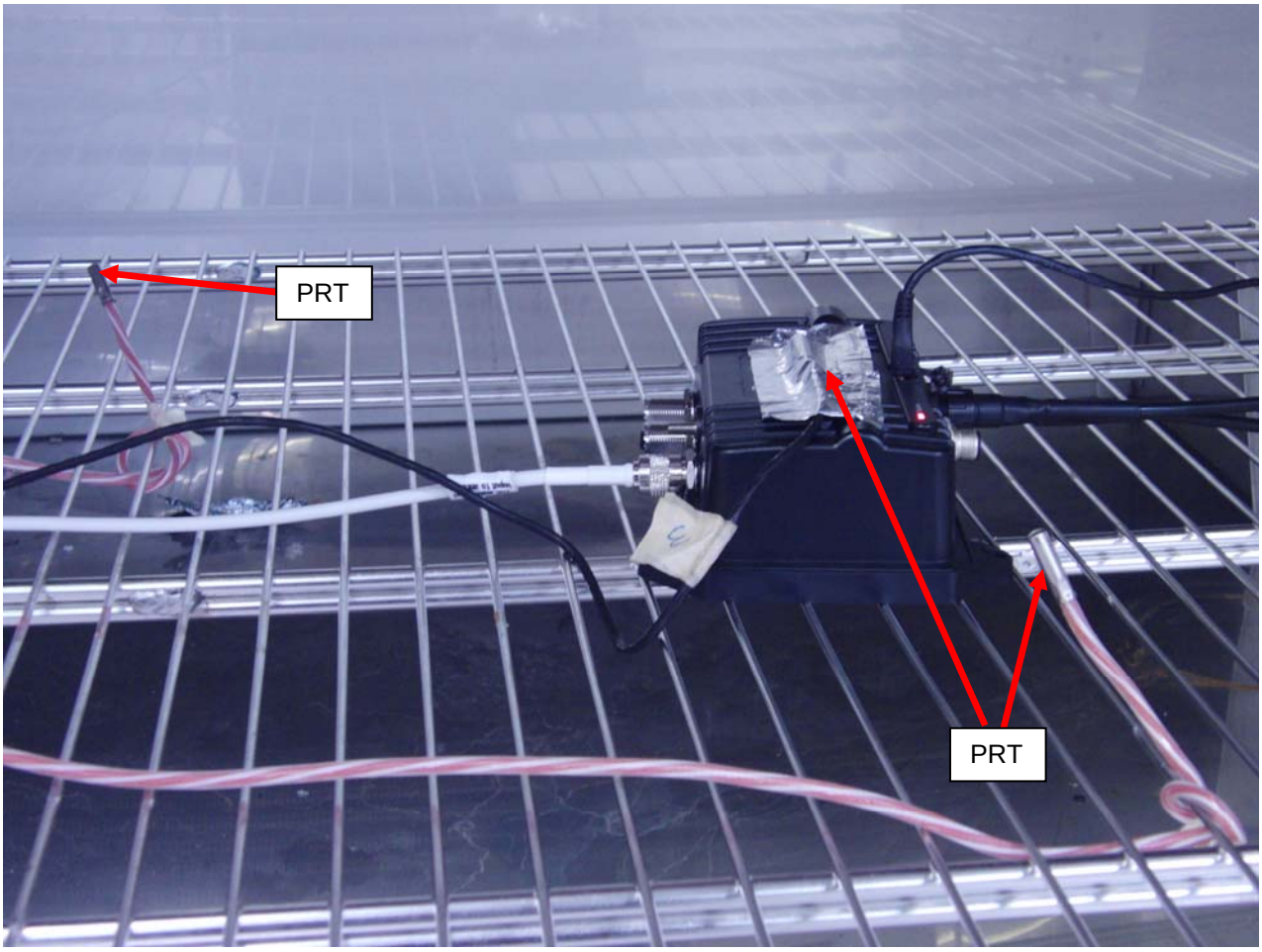
TEST EQUIPMENT AND INSTRUMENTATION

TABLE 1



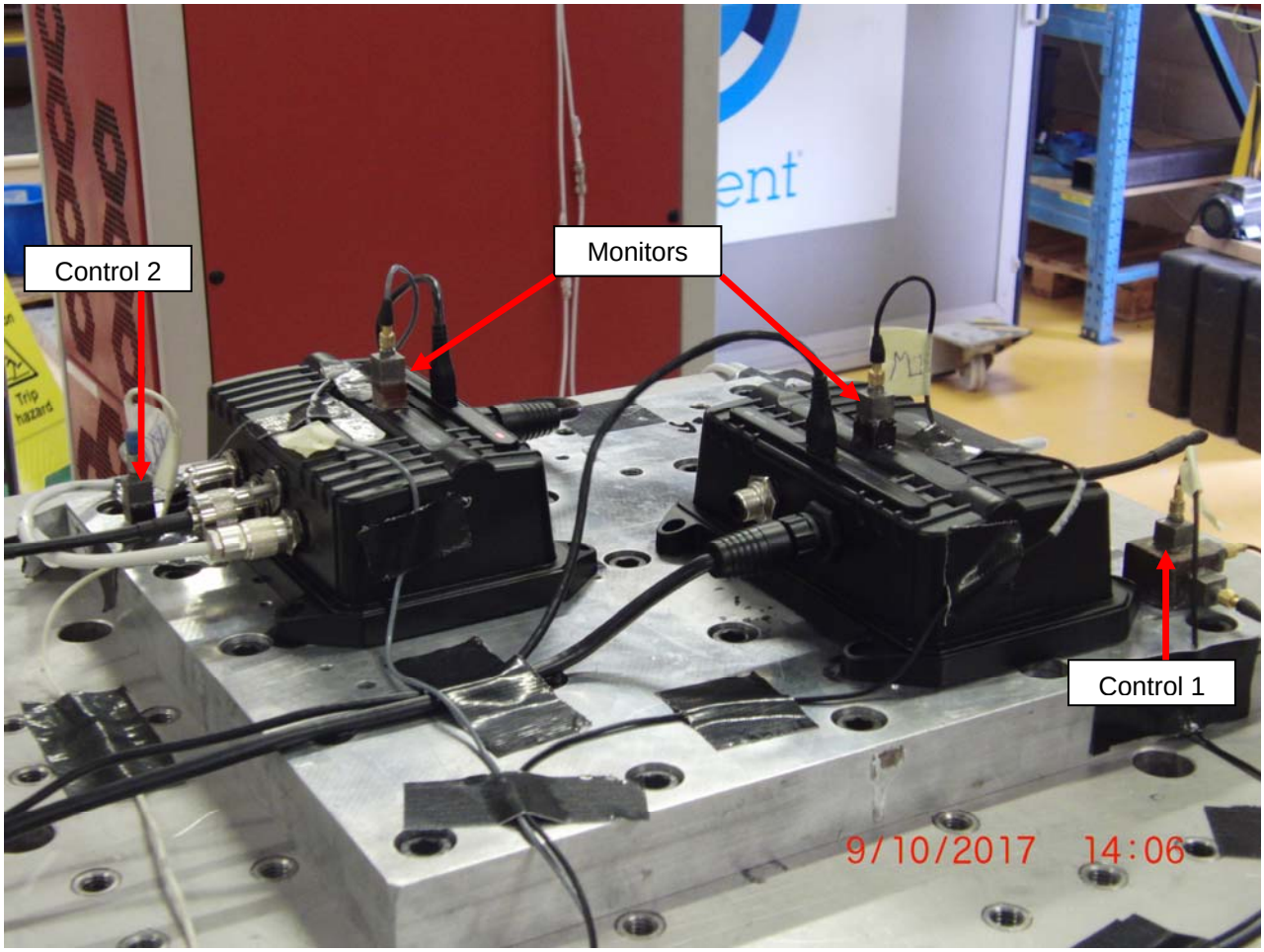
TEMPERATURE TESTS
PRT POSITIONS

FIGURE 1.1



TEMPERATURE TESTS
PRT POSITIONS

FIGURE 1.2



VIBRATION TEST
TEST SETUP

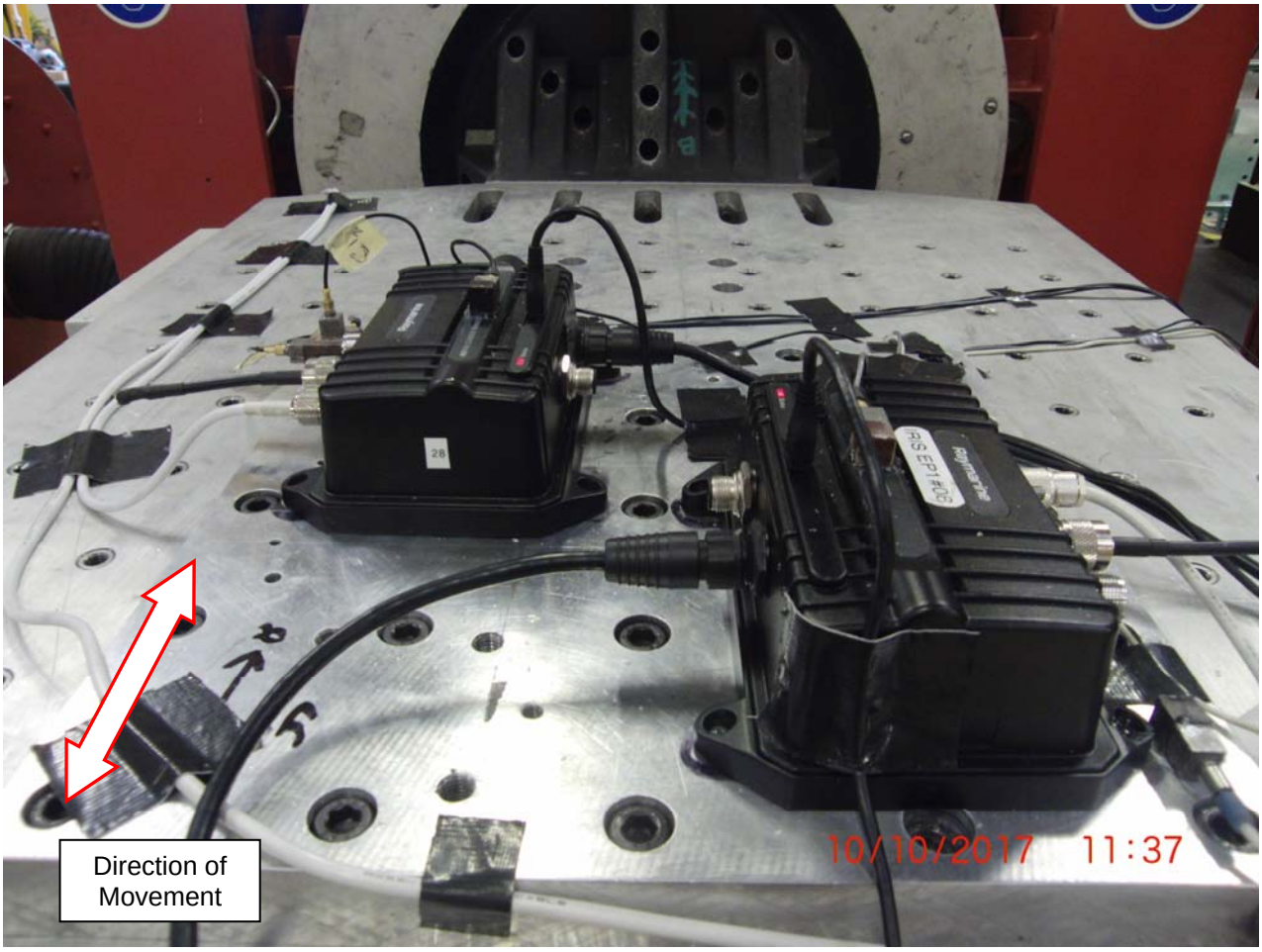
FIGURE 1.3

Z AXIS
TEST SETUP

FIGURE 1.4

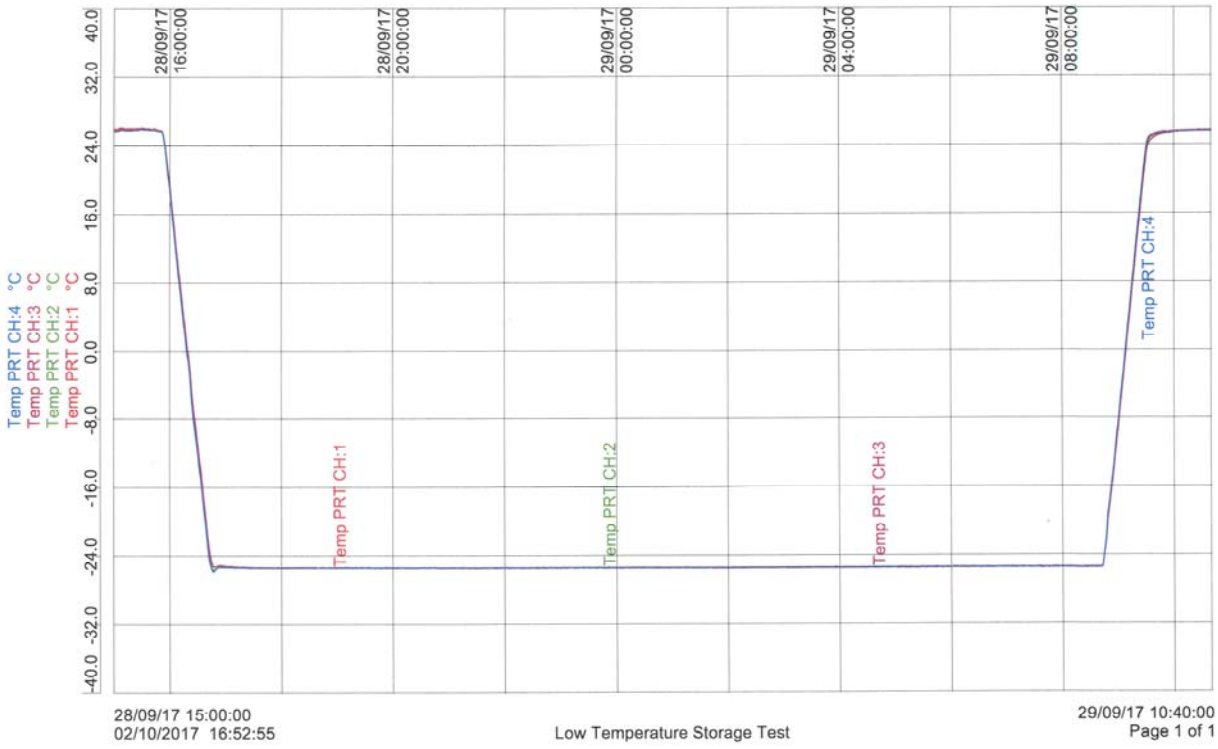
Y AXIS
TEST SETUP

FIGURE 1.5



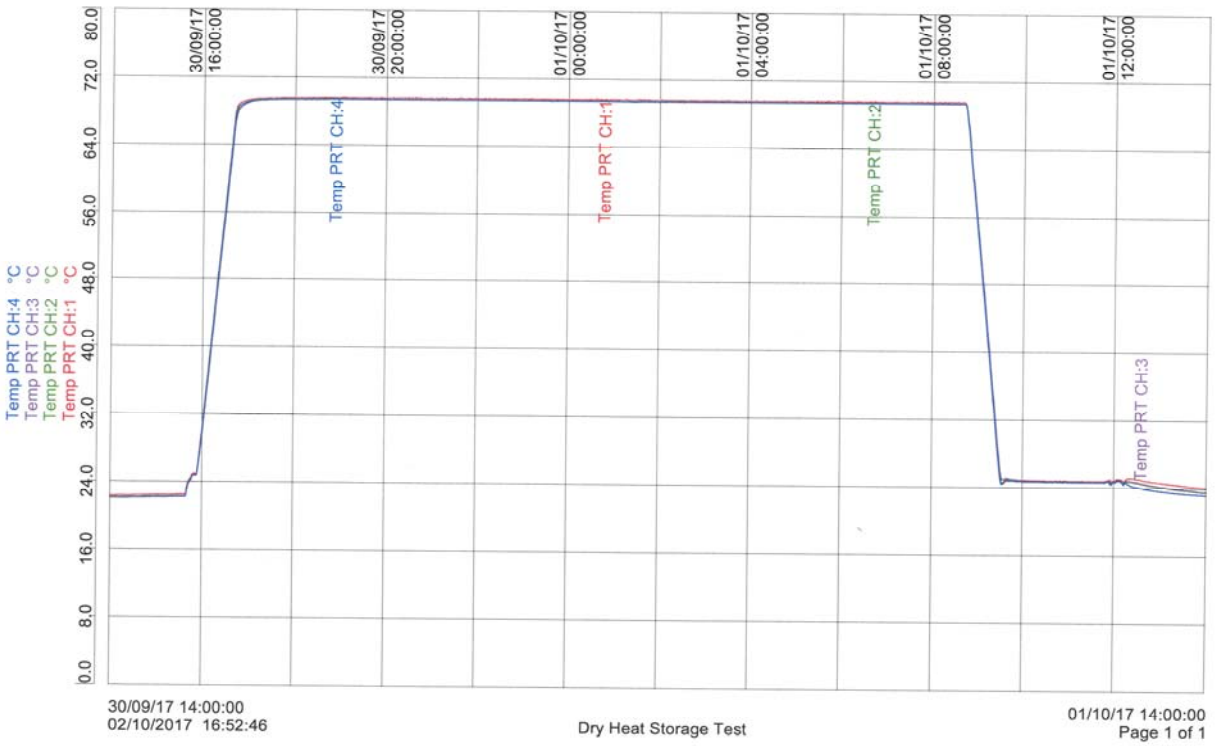
X AXIS
TEST SETUP

FIGURE 1.6



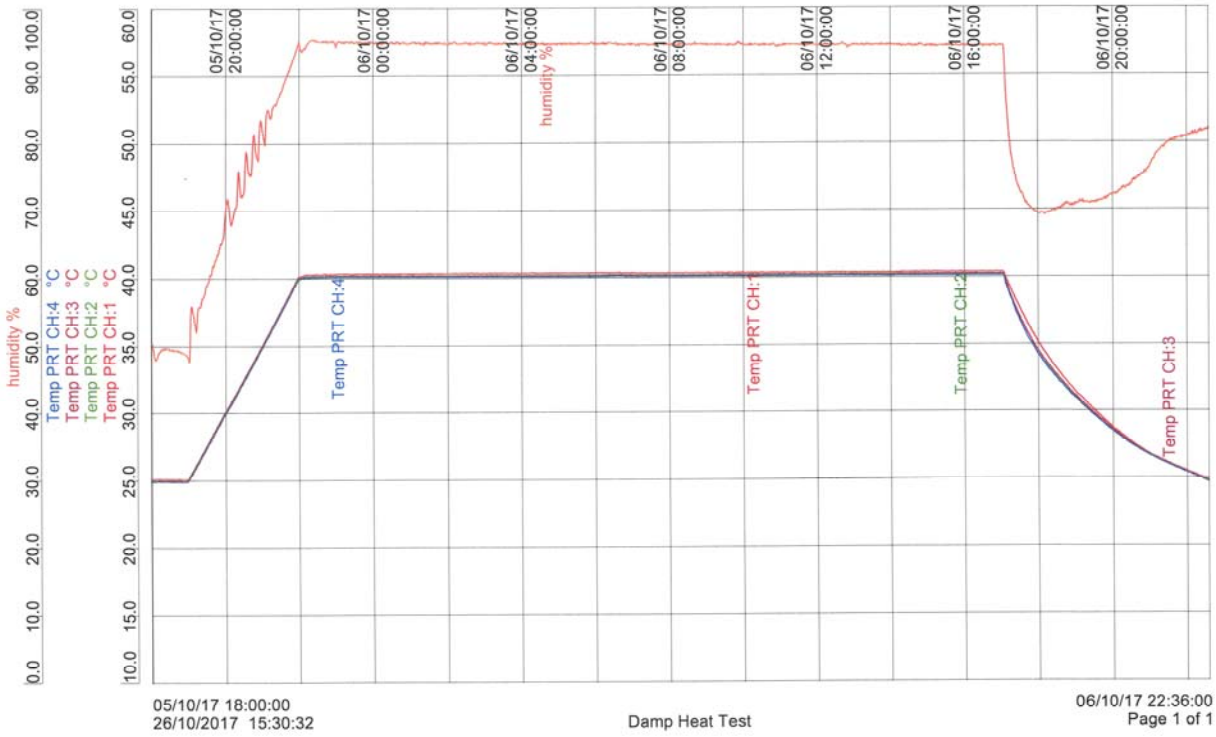
LOW TEMPERATURE STORAGE TEST
RESULT TRACE

FIGURE 2.1



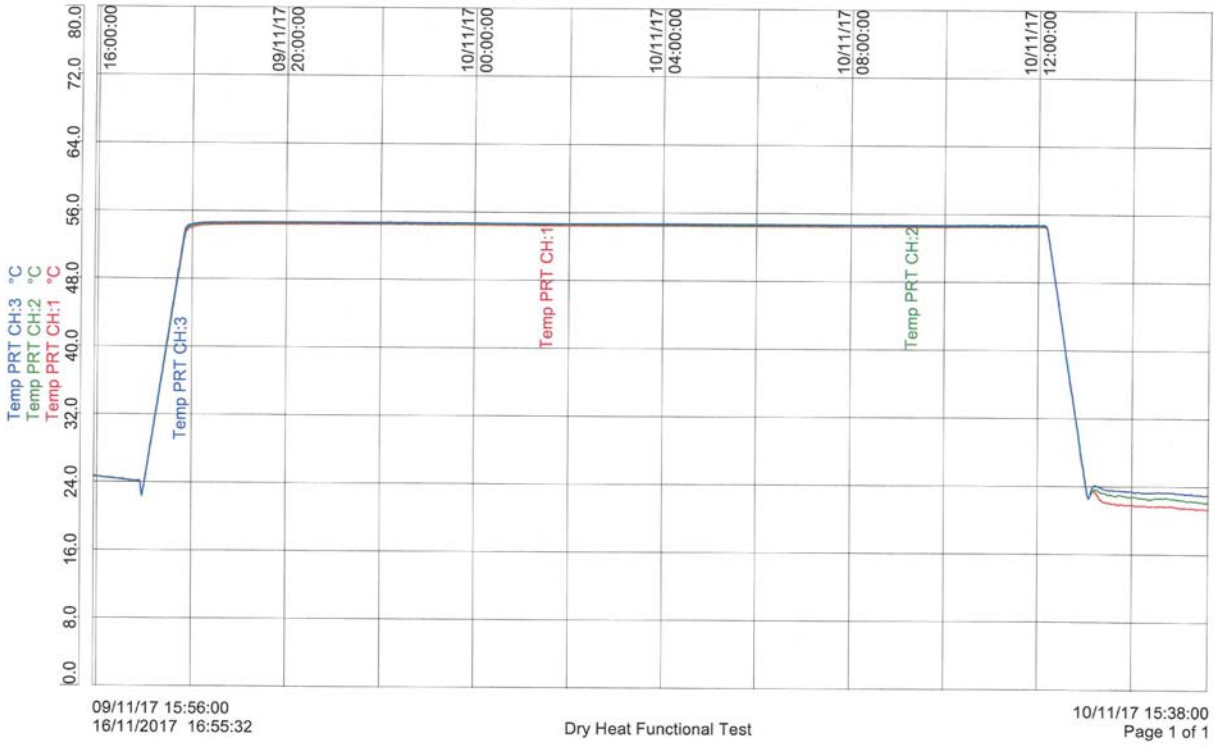
DRY HEAT STORAGE TEST
RESULT TRACE

FIGURE 2.2



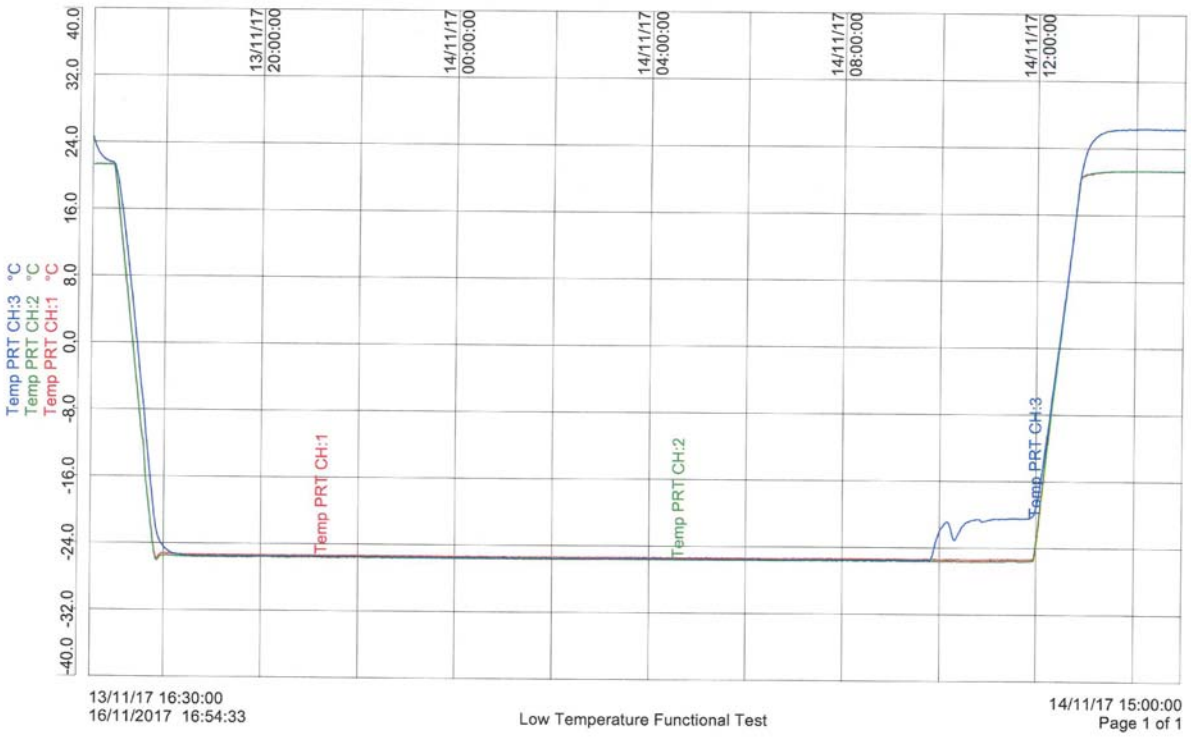
DAMP HEAT FUNCTIONAL TEST
RESULT TRACE

FIGURE 2.3



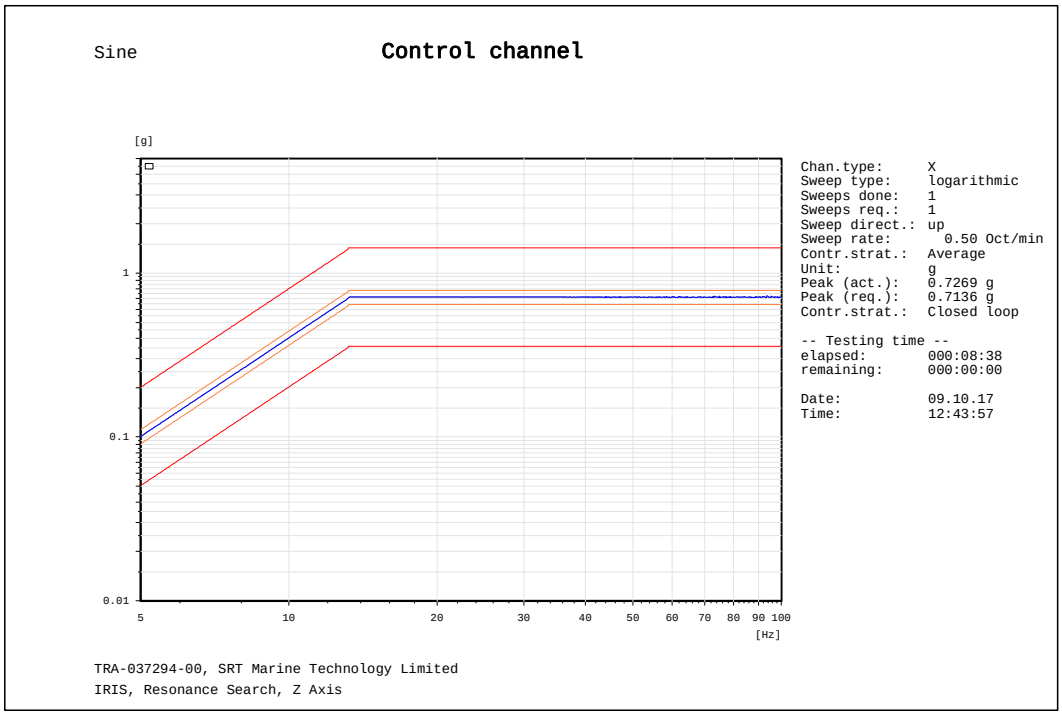
DRY HEAT FUNCTIONAL TEST
RESULT TRACE

FIGURE 2.4



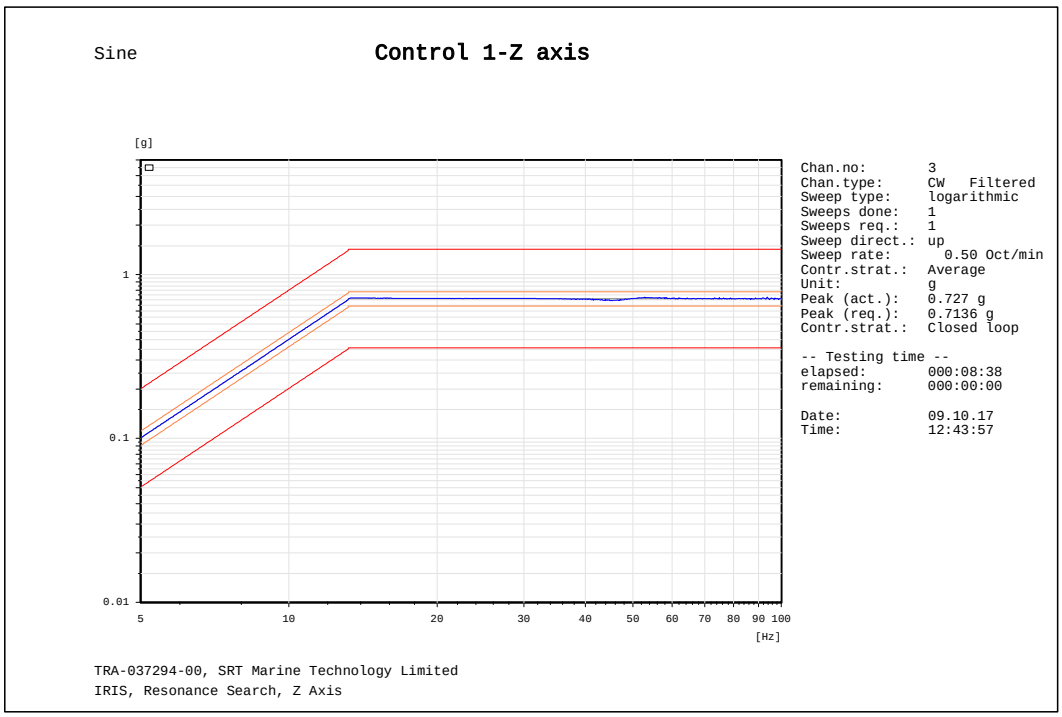
LOW TEMPERATURE FUNCTIONAL TEST RESULT TRACE

FIGURE 2.5



C:\VcpNT\Daten\m+p\TRA-037294-00 SRT Marine Technology Ltd\Run001 Resonance Search Z Axis_002.rsn

RUN001 RESONANCE SEARCH
Z AXIS **FIGURE 3.1**



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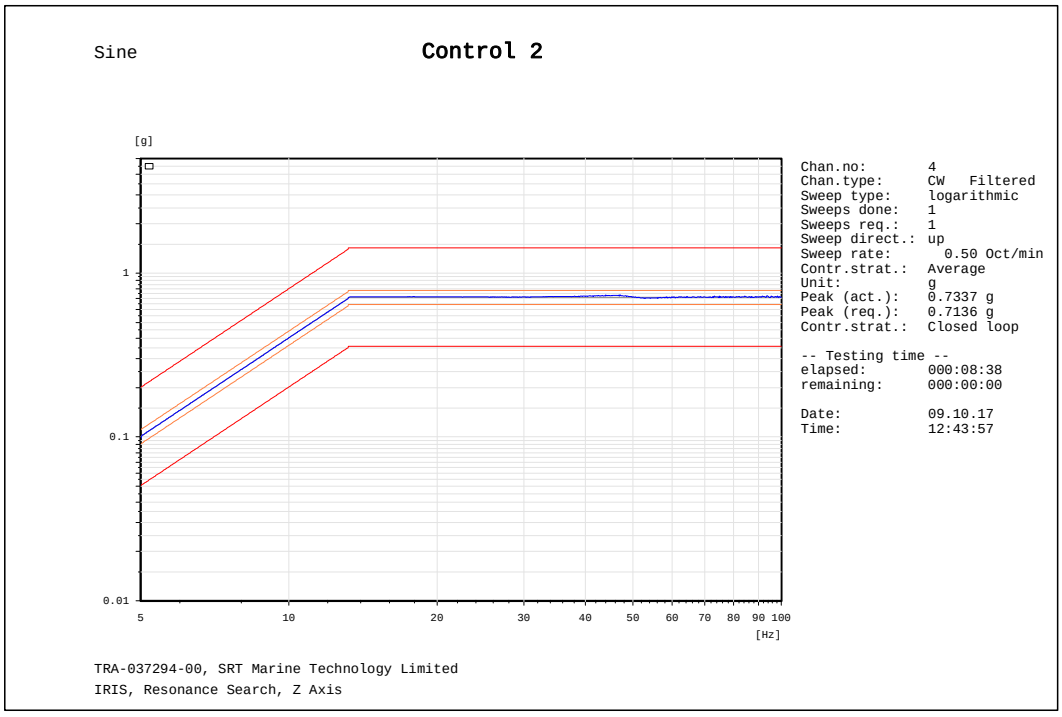
RUN001 RESONANCE SEARCH
Z AXIS **FIGURE 3.2**



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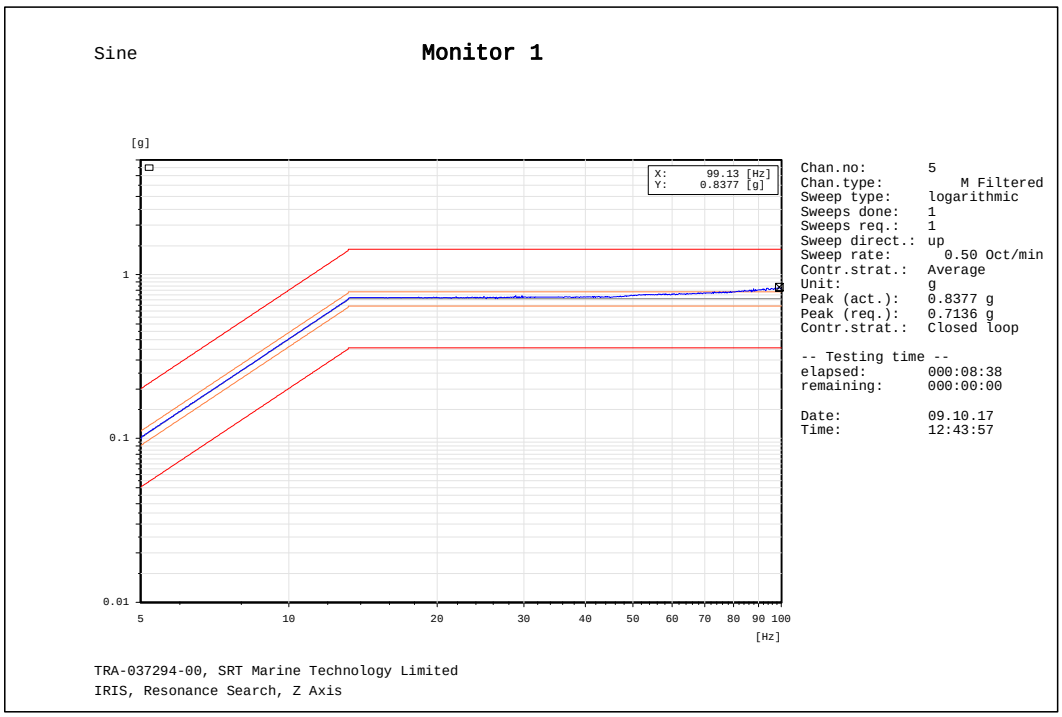
RUN001 RESONANCE SEARCH
Z AXIS **FIGURE 3.3**



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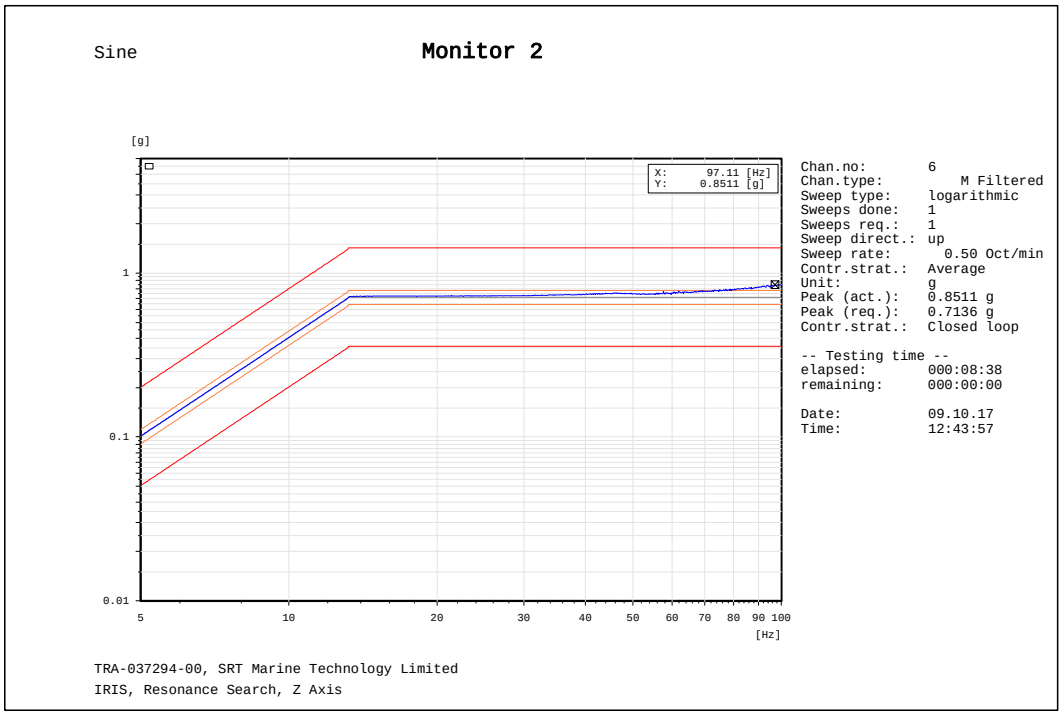
RUN001 RESONANCE SEARCH
Z AXIS **FIGURE 3.4**



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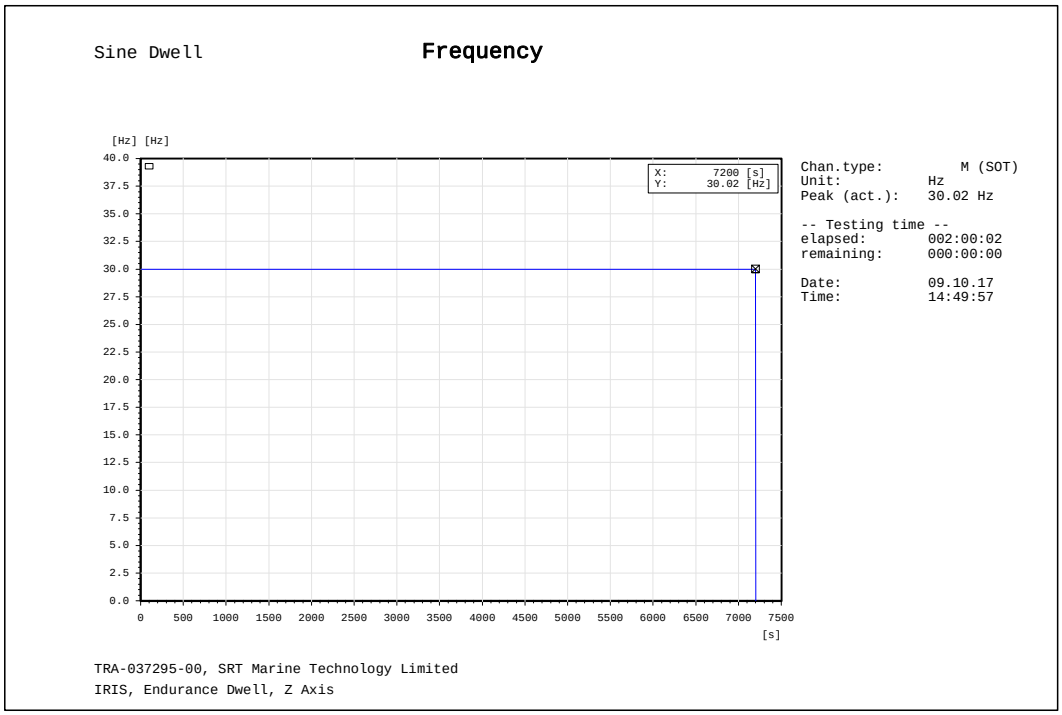
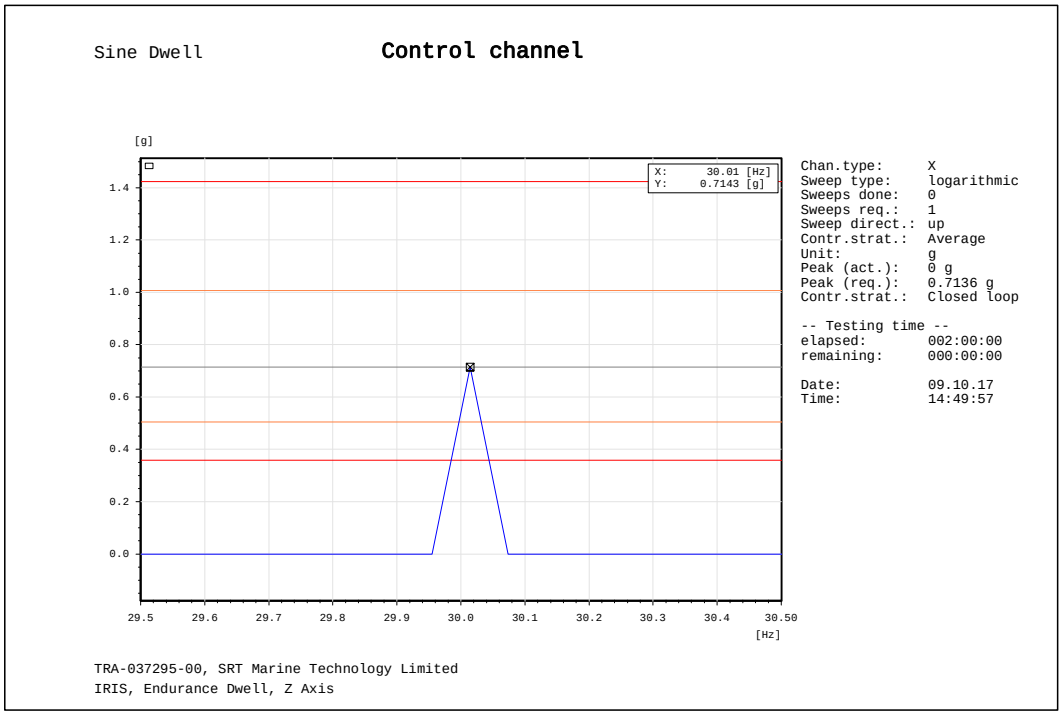
RUN001 RESONANCE SEARCH
Z AXIS

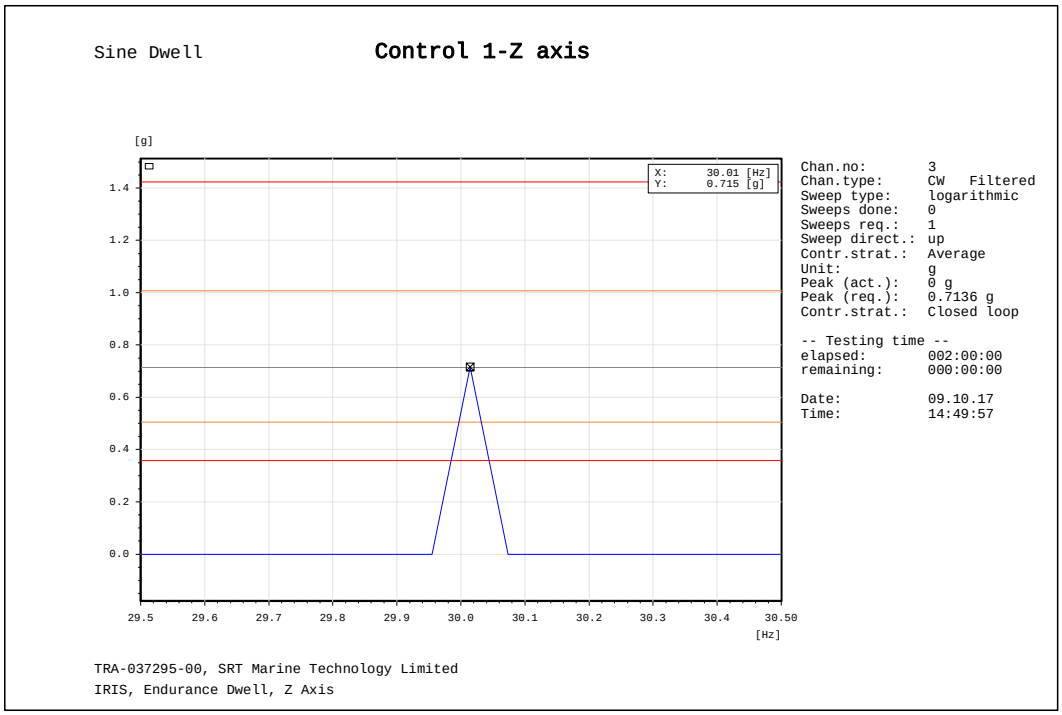
FIGURE 3.5



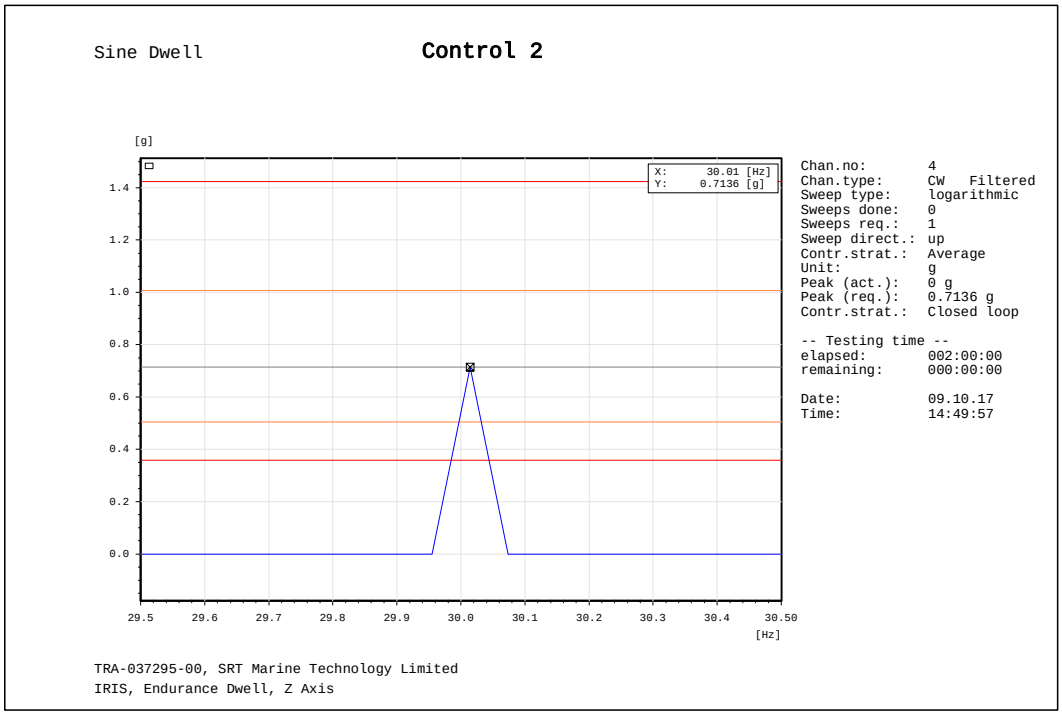
RUN002 SINE DWELL- FREQUENCY
Z AXIS **FIGURE 4**



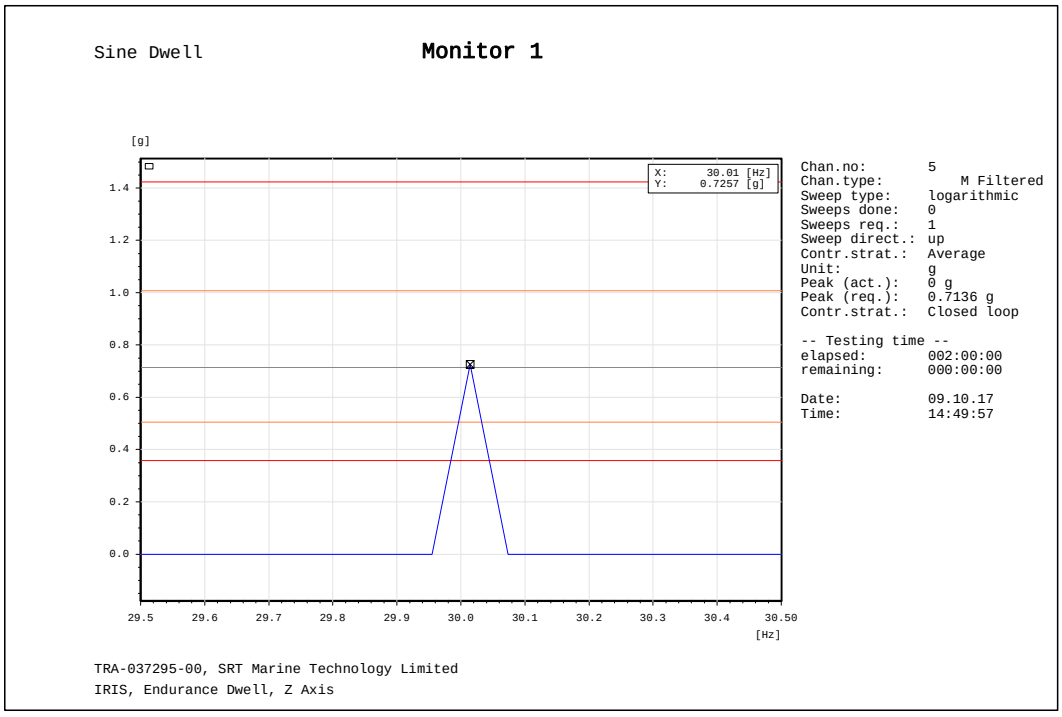
RUN002 SINE DWELL
Z AXIS **FIGURE 5.1**



RUN002 SINE DWELL
Z AXIS **FIGURE 5.2**



RUN002 SINE DWELL
Z AXIS **FIGURE 5.3**



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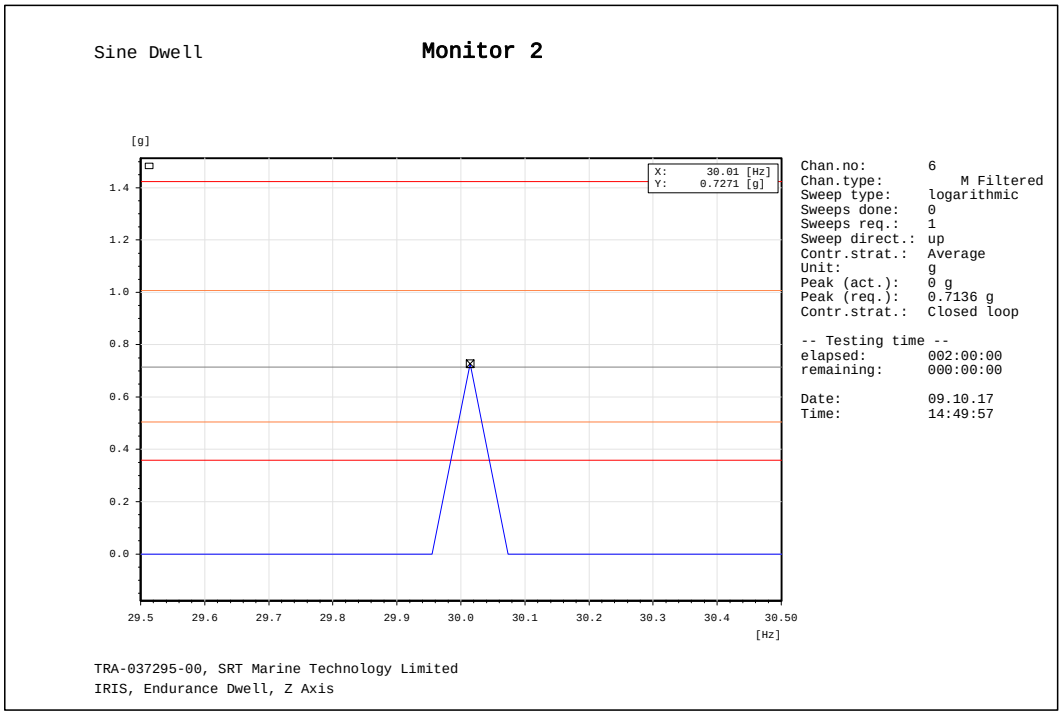
RUN002 SINE DWELL
Z AXIS **FIGURE 5.4**



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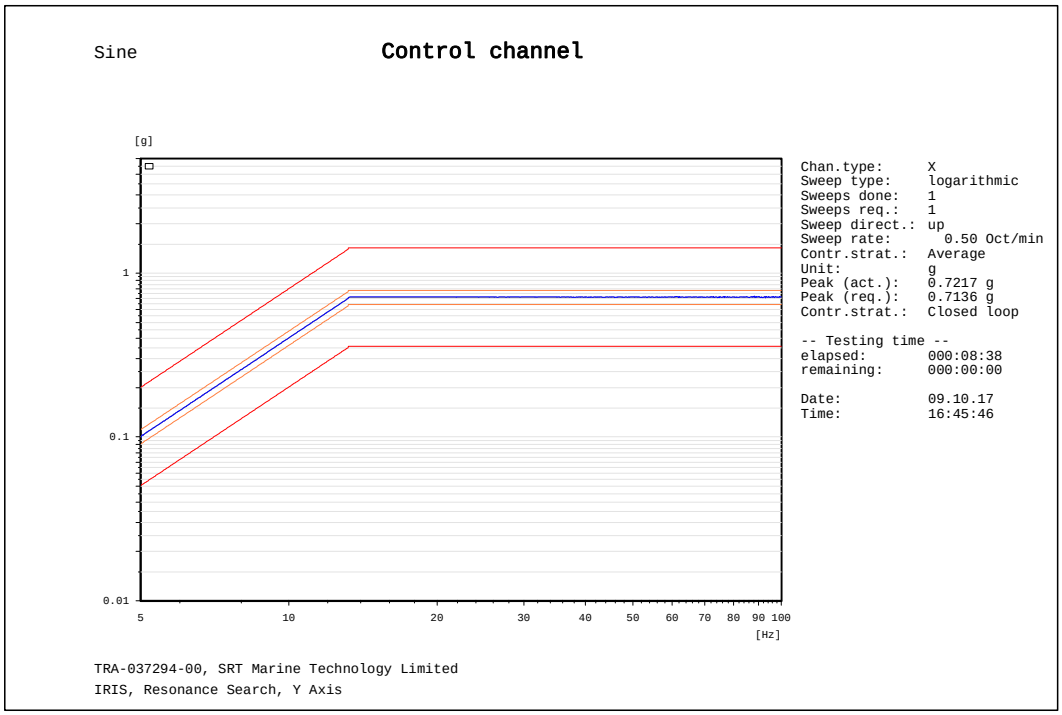
RUN002 SINE DWELL
Z AXIS **FIGURE 5.5**



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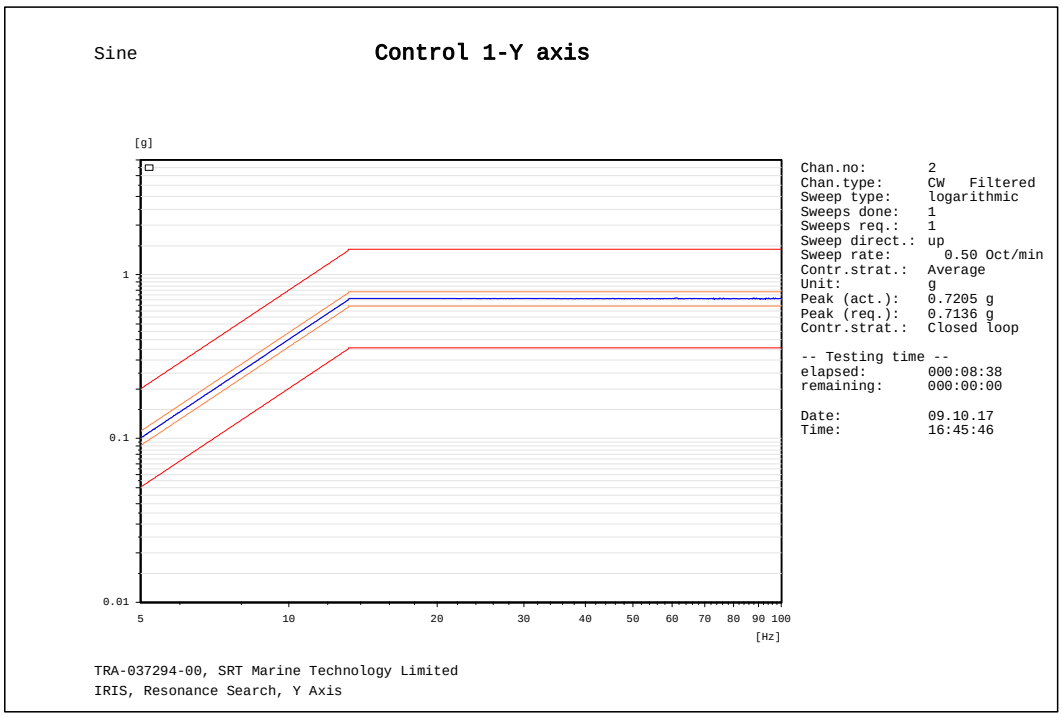
RUN003 RESONANCE SEARCH
Y AXIS **FIGURE 6.1**



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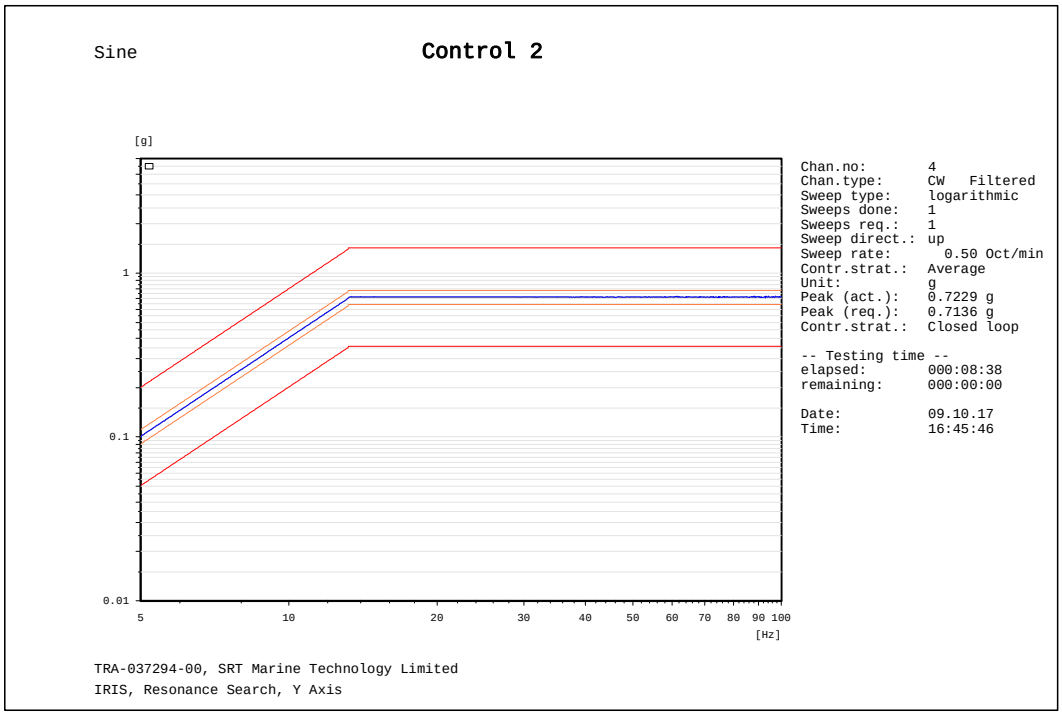
RUN003 RESONANCE SEARCH
Y AXIS **FIGURE 6.2**



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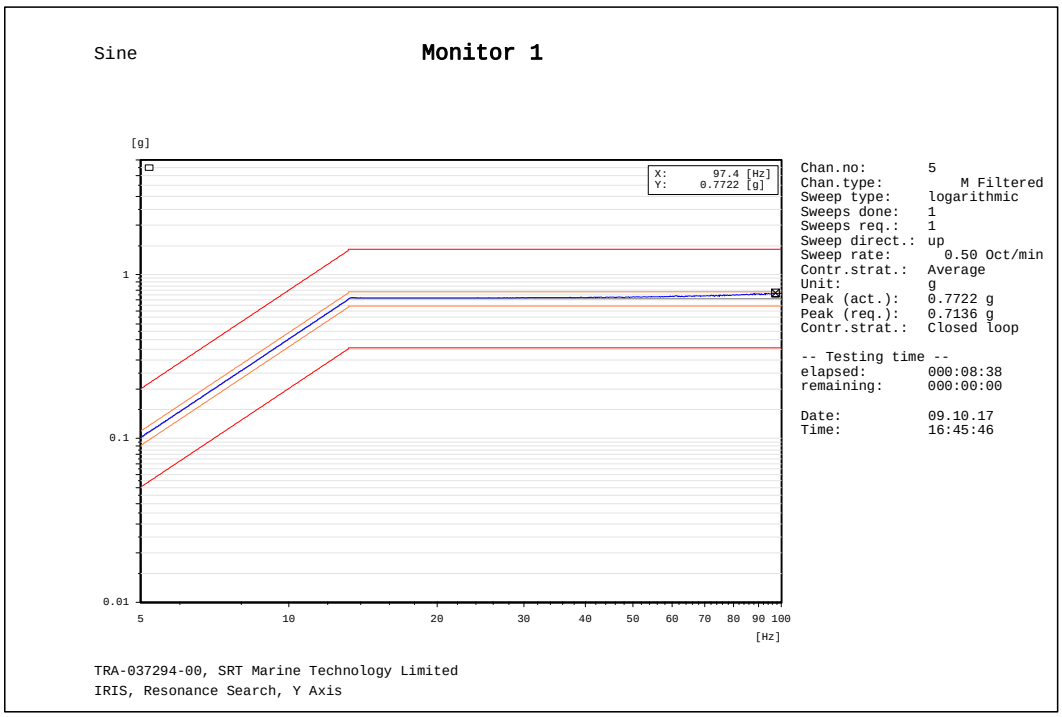
RUN003 RESONANCE SEARCH
Y AXIS **FIGURE 6.3**



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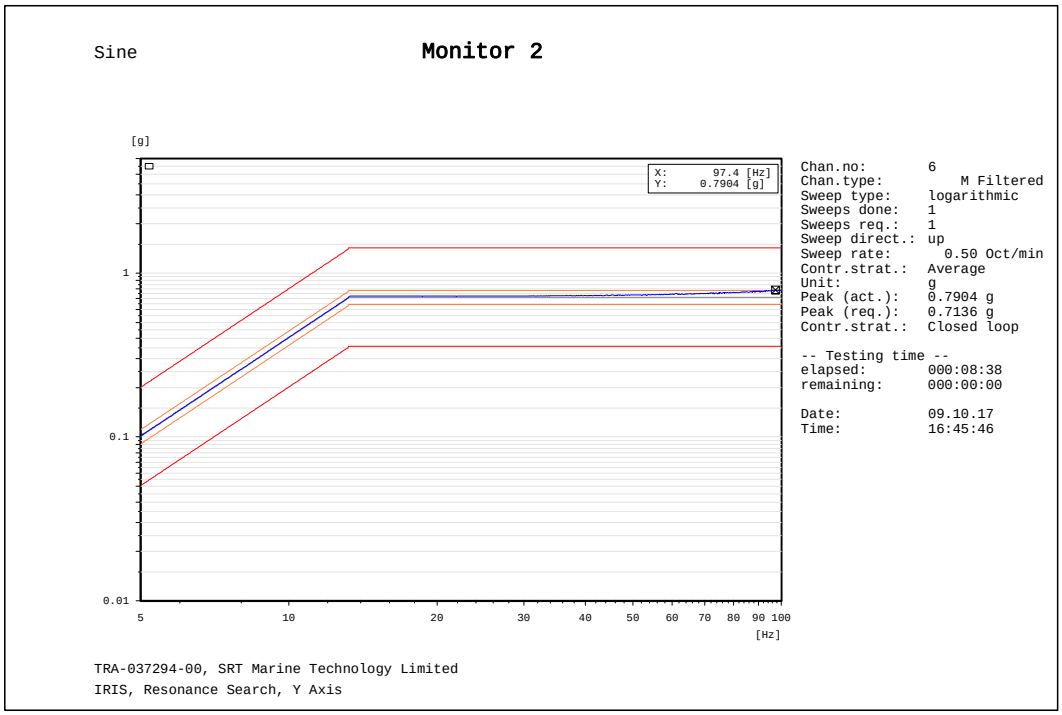
RUN003 RESONANCE SEARCH
Y AXIS **FIGURE 6.4**



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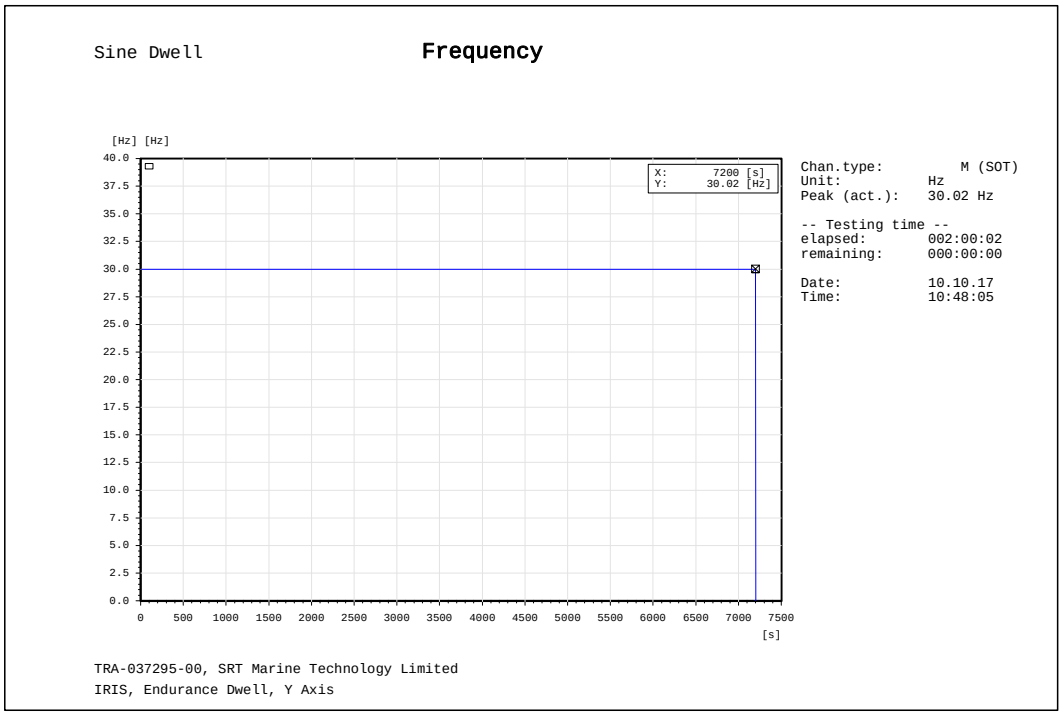
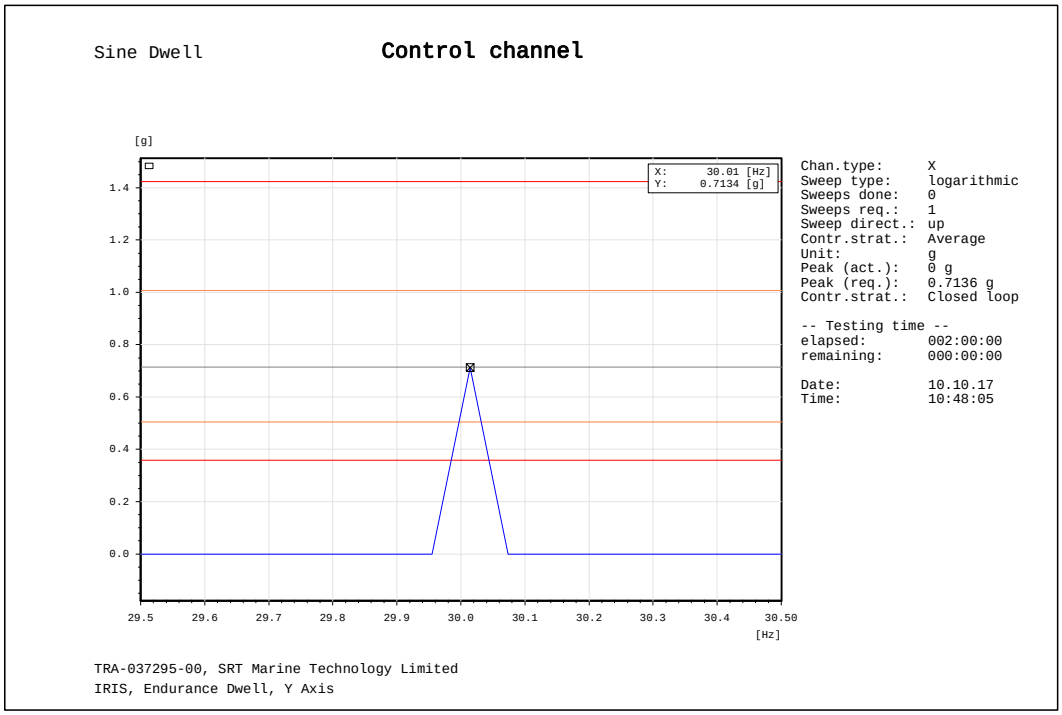
RUN003 RESONANCE SEARCH
Y AXIS

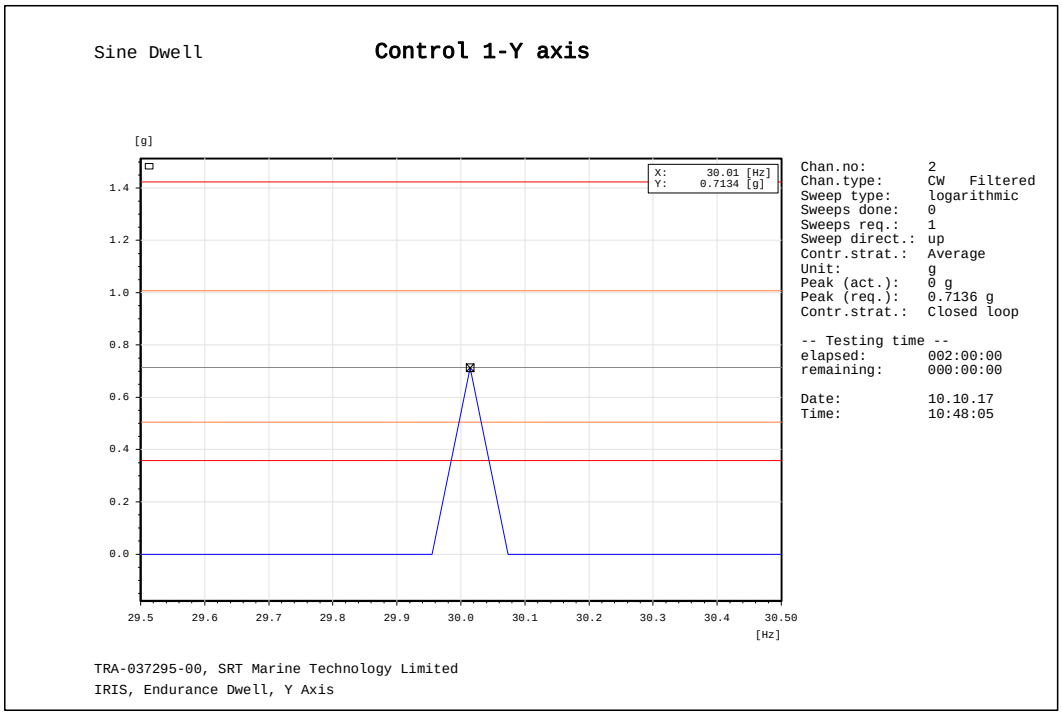
FIGURE 6.5



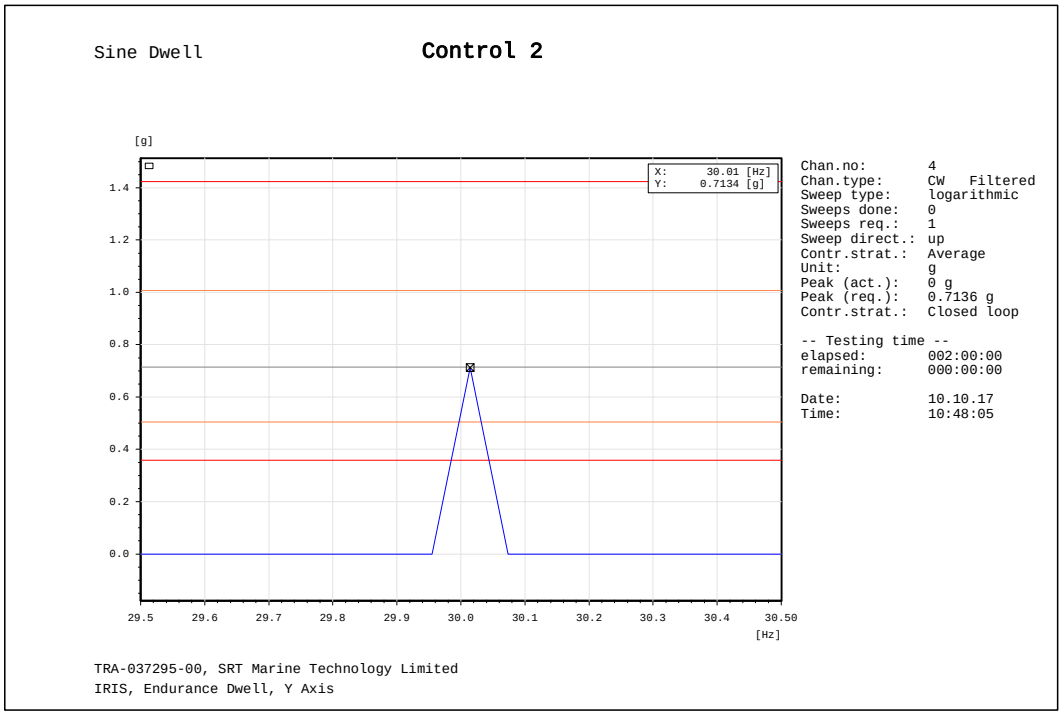
RUN004 SINE DWELL- FREQUENCY Y AXIS **FIGURE 7**



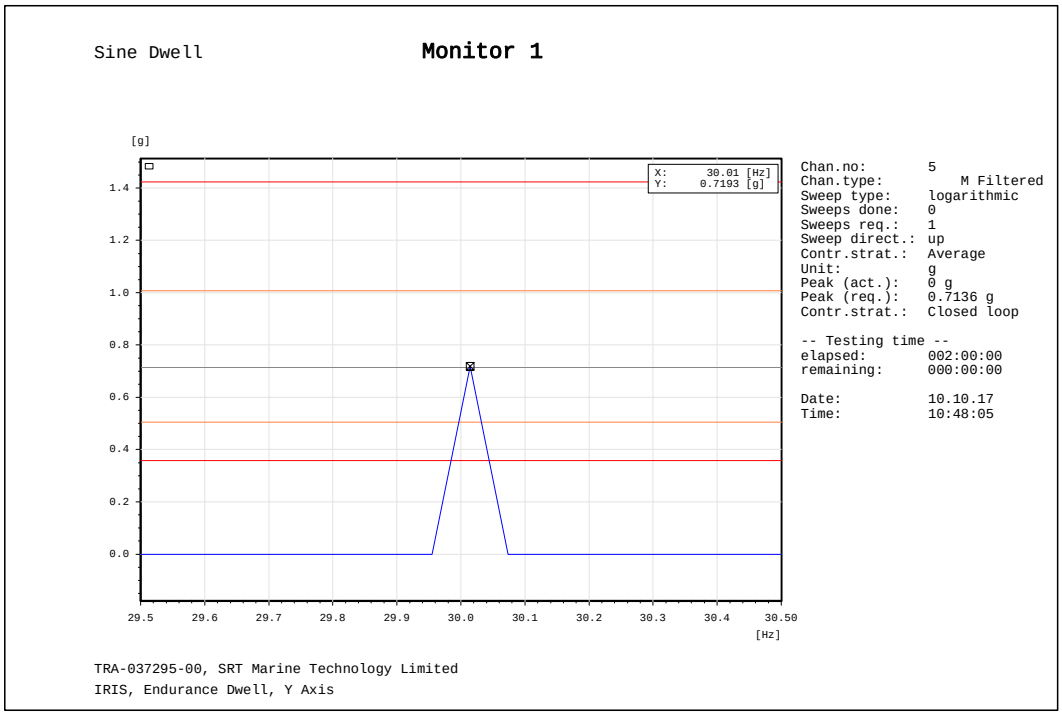
RUN004 SINE DWELL Y AXIS **FIGURE 8.1**



RUN004 SINE DWELL
Y AXIS **FIGURE 8.2**



RUN004 SINE DWELL
Y AXIS **FIGURE 8.3**



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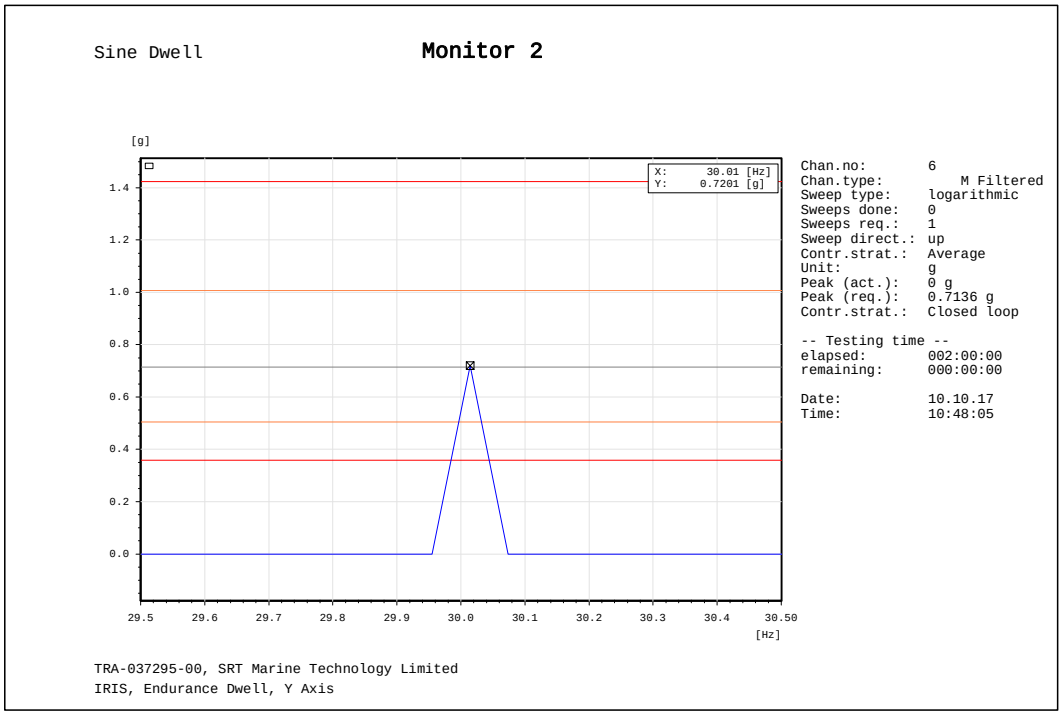
RUN004 SINE DWELL
Y AXIS **FIGURE 8.4**



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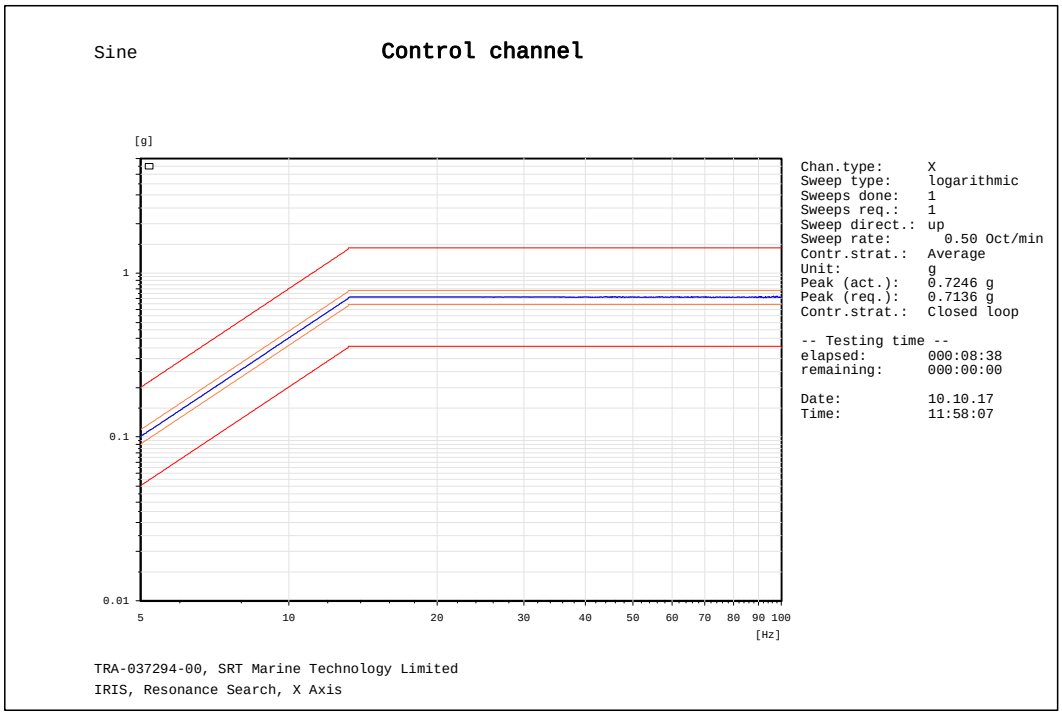
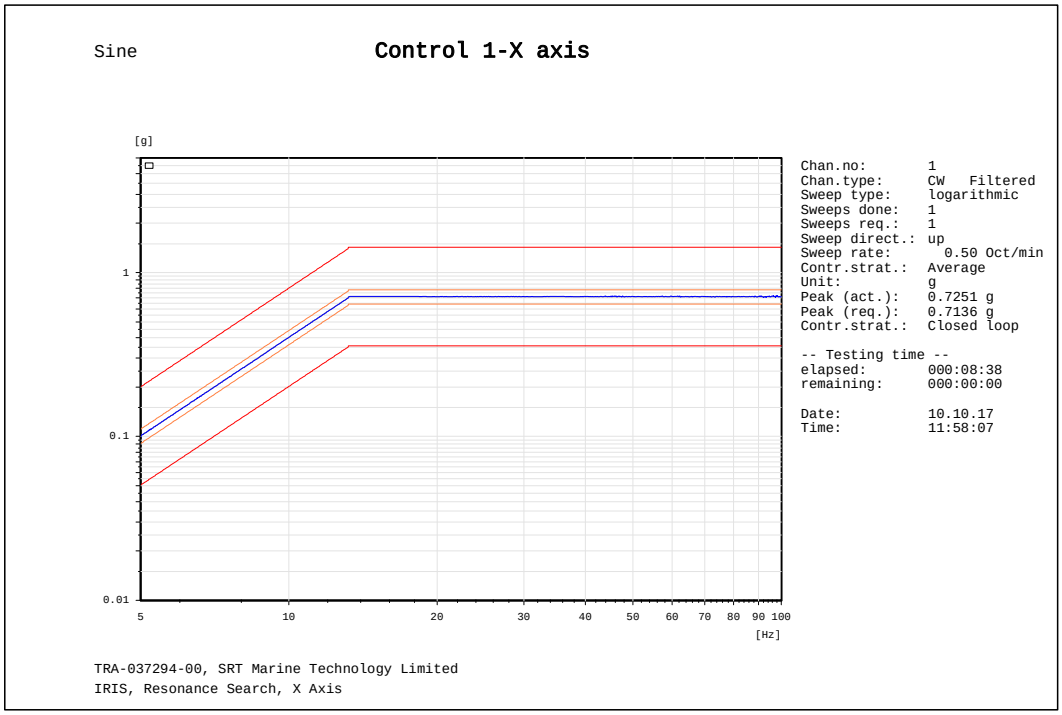
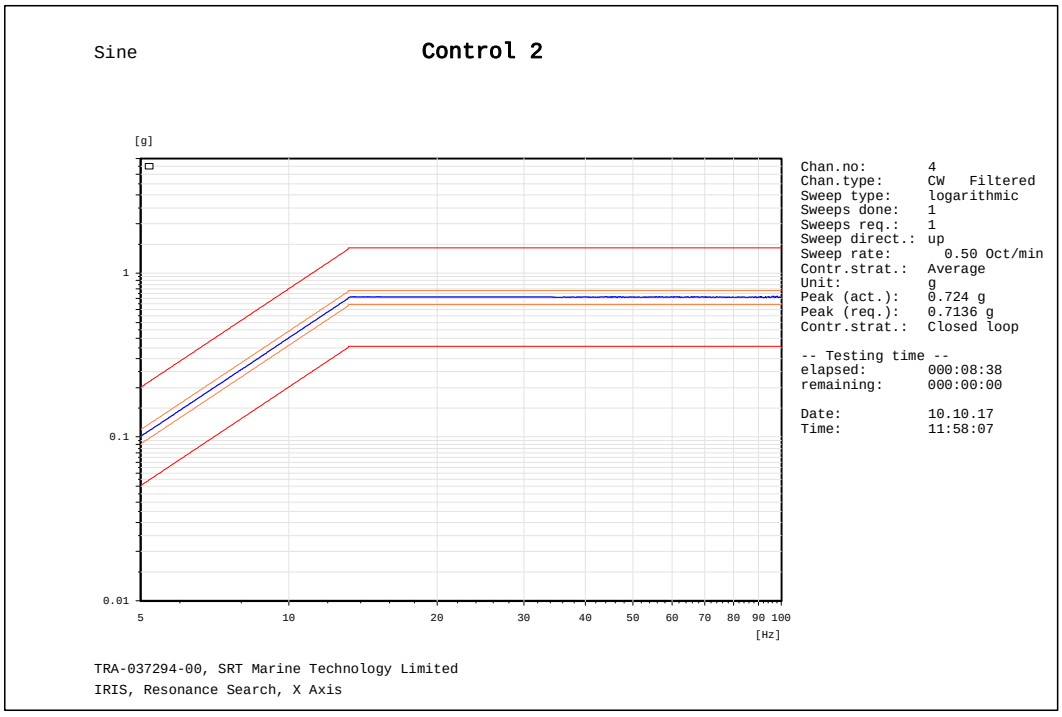
RUN004 SINE DWELL
Y AXIS **FIGURE 8.5**



RUN005 RESONANCE SEARCH
X AXIS **FIGURE 9.1**



RUN005 RESONANCE SEARCH
X AXIS **FIGURE 9.2**



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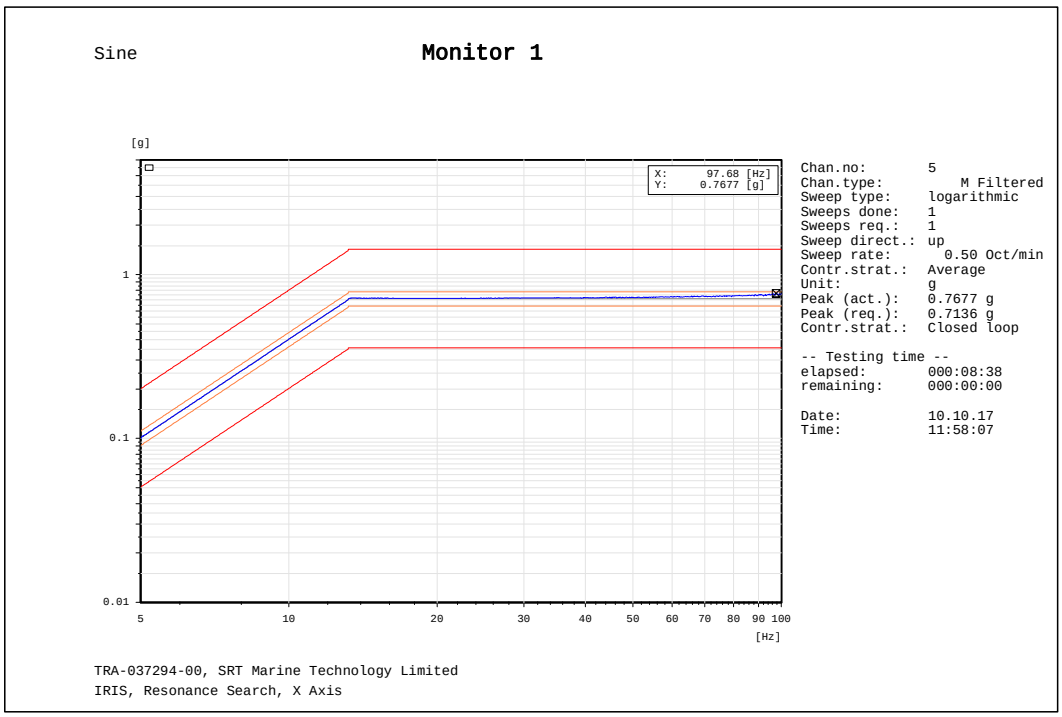
RUN005 RESONANCE SEARCH
X AXIS **FIGURE 9.3**



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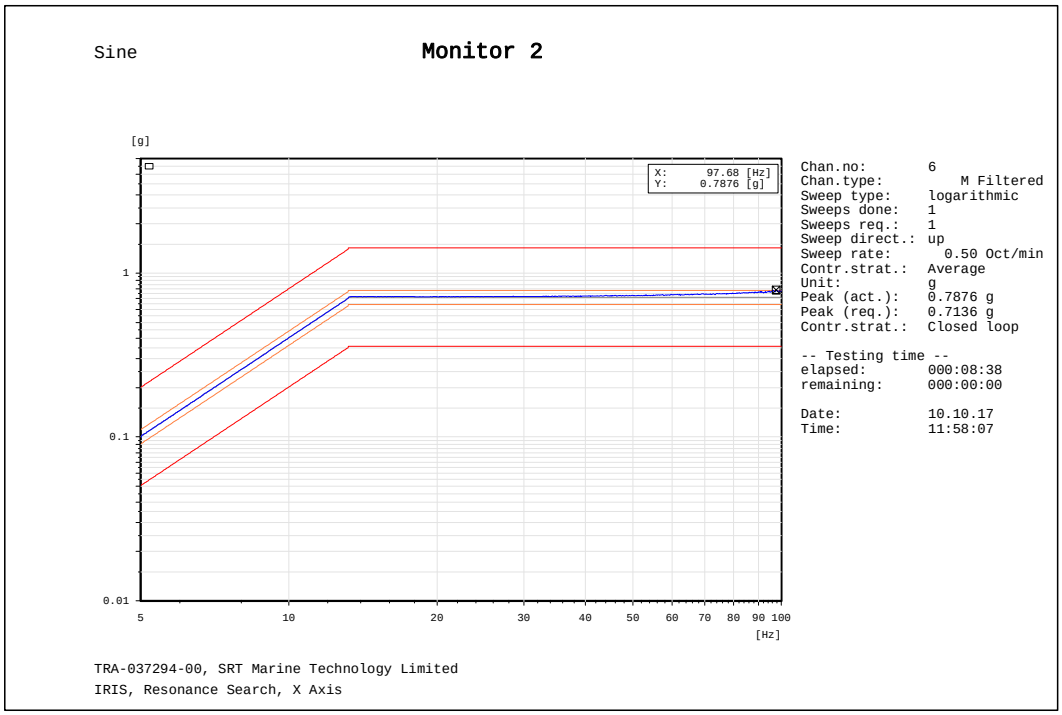
RUN005 RESONANCE SEARCH
X AXIS **FIGURE 9.4**



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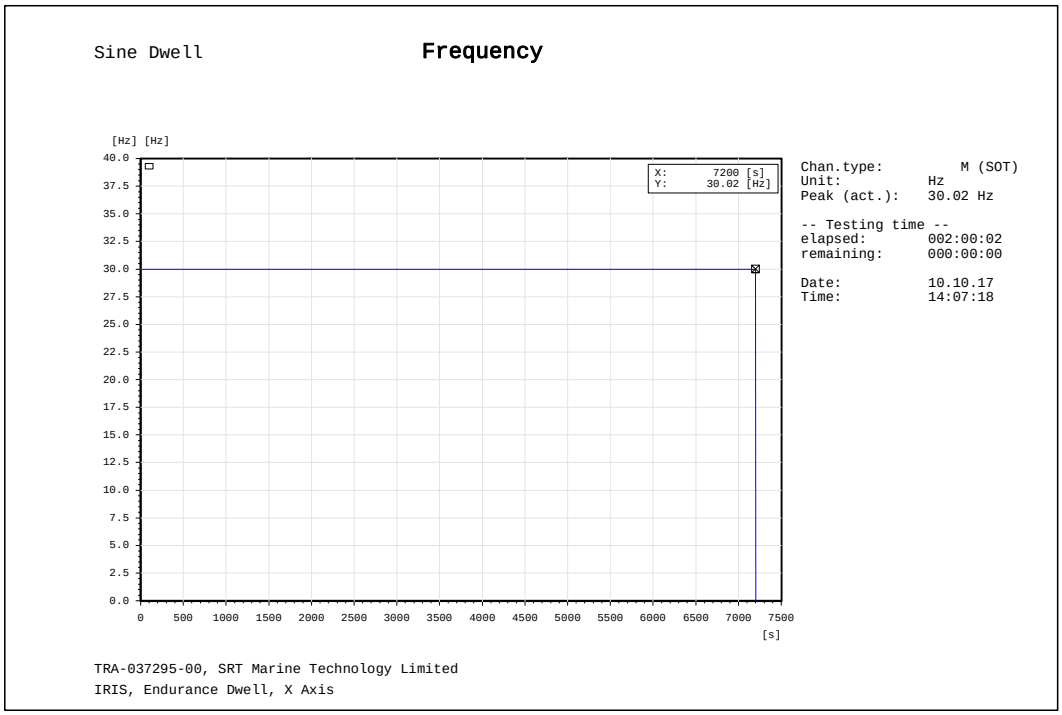
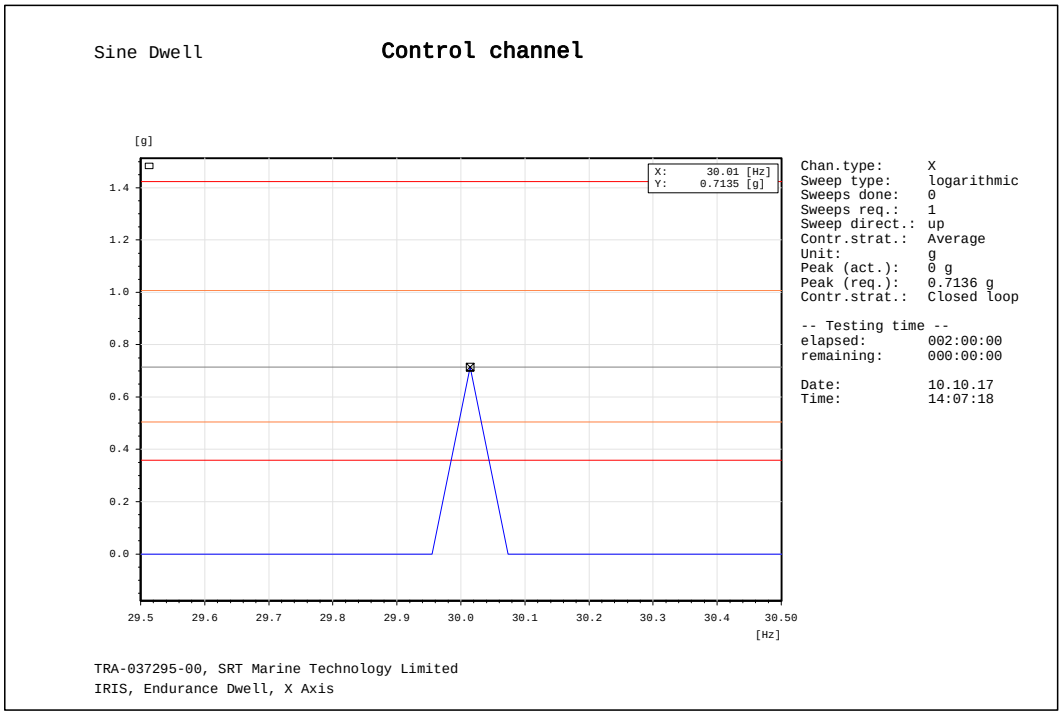
RUN005 RESONANCE SEARCH
X AXIS

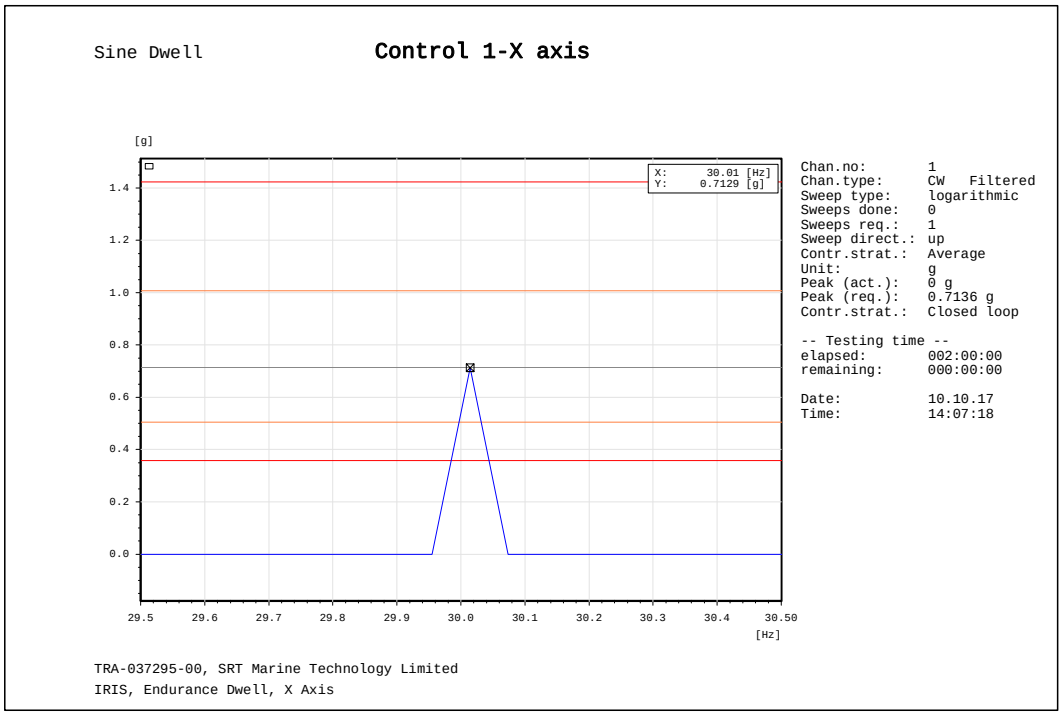
FIGURE 9.5



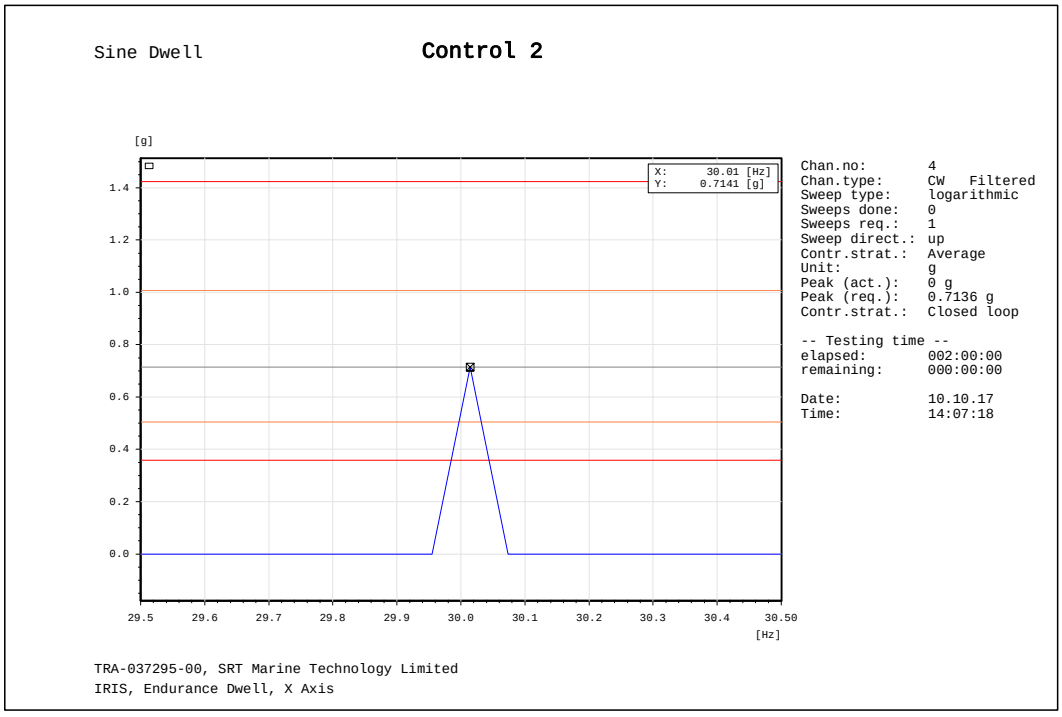
RUN006 SINE DWELL- FREQUENCY
X AXIS **FIGURE 10**



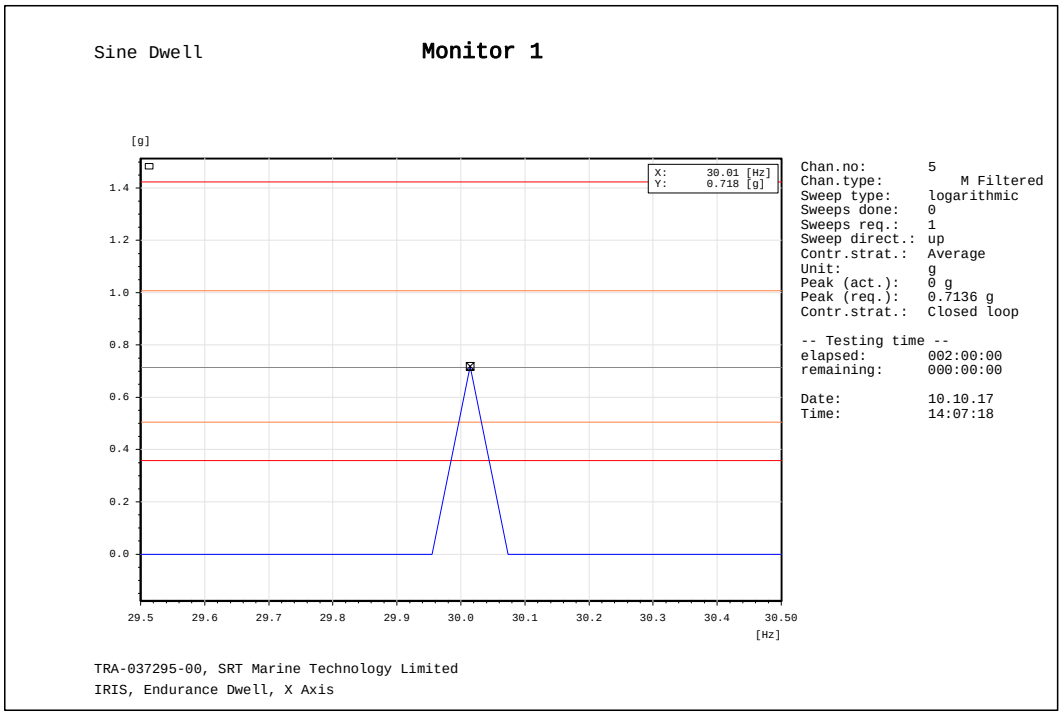
RUN006 SINE DWELL
X AXIS **FIGURE 11.1**



RUN006 SINE DWELL
X AXIS **FIGURE 11.2**

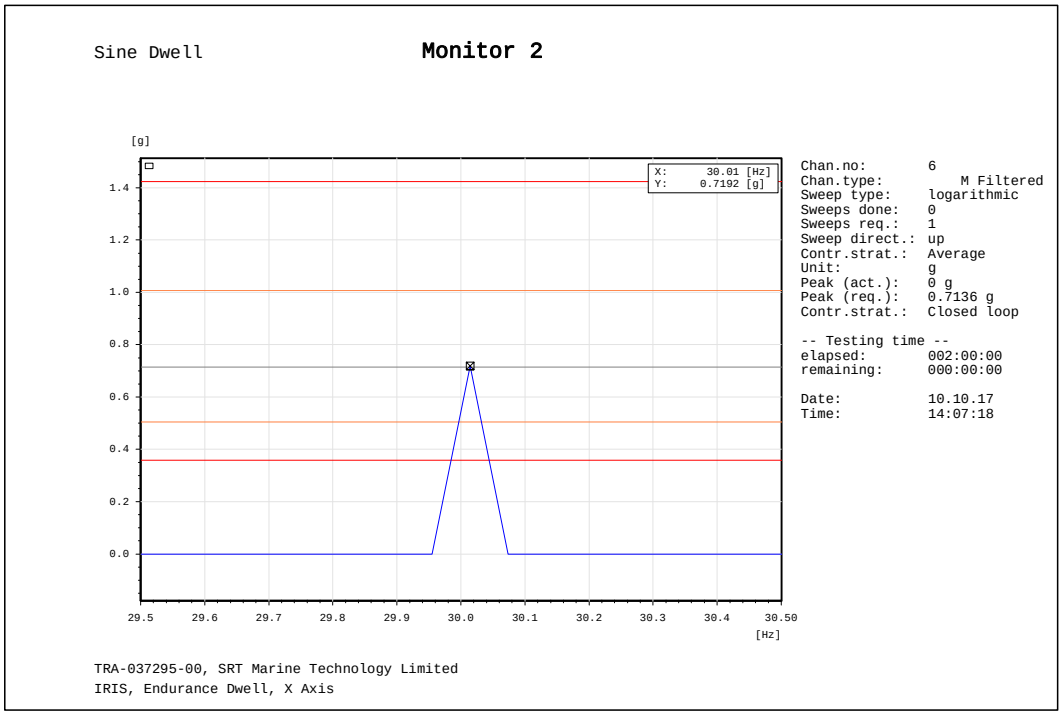


RUN006 SINE DWELL
X AXIS **FIGURE 11.3**



RUN006 SINE DWELL
X AXIS

FIGURE 11.4



RUN006 SINE DWELL
X AXIS

FIGURE 11.5