COMPLIANCE TESTING REPORT TO FCC TITLE 47 PART 15 SUBPART C V2V Operation

Client:	Industrea Mining Technology Pty Ltd T/A: Digital Mining Technology
Address:	3 Co-wyn Close, Fountaindale, NSW, 2258, Australia
Report Number:	0510INT_PROD1177-X-Y_FCC15C
Date of Testing:	28th November to 29th March 2023
File Number:	INT211029-A
Equipment Name:	IVU Plus
Model Number	PROD1177-U-USA PROD1177-H-USA
FCC ID:	YIY-PROD1177
Description:	Rugged, multipurpose telematics computer intended for use in surface mining industry trucks/vehicles.
Result:	The sample tested **COMPLIED** with the applicable requirements of the standard. (Refer to Compliance Summary page for details).
Tested by:	Steve Garnham Test Engineer
Approved by:	Richard Turner Assessment Engineer
Date of Issue:	10th May 2023

Results appearing herein relate only to the sample(s) tested.

This report is issued errors and omissions exempt and is subject to withdrawal at Austest Laboratories discretion.

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TEST LABORATORY
CERT #2765.02

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1 REPORT REVISION HISTORY

Date	Report Number	Changes
31/03/2023	0329INT_PROD1177-X-Y_FCC15C	Original Report.
10/05/2023	0510INT_PROD1177-X-Y_FCC15C	Section 6.1, paragraph 2 revised to include indication of V2V duty cycle. Co-location statement added as Section 16.

2 REFERENCES

Document		Issue/ Amended
FCC Title 47	FCC Title 47 Part 15 – Radio Frequency Devices	Current as of March 2023
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
558074 D01	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under Section 15.247 of the FCC rules	v05r02 April 2, 2019
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz	2014
Client Test Plan	IND04 153, Design Verification IVU Plus Certification Procedure	ver. 3 03/08/2022

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3 COMPLIANCE SUMMARY

DISCLAIMER: Austest Laboratories makes no claim regarding the consistency of production versions of the EUT. The results in this report apply only to the sample tested, as described in Section 5 of this report.

FCC Part 15, Subpart C – Intentional Radiators		Result	Notes
15.203	Antenna Requirement	N.A.	-
15.205	Restricted Bands of Operation	Complied	-
15.207	Conducted Limits	N.A.	-
15.209	Radiated Emission Limits, General Requirements	Complied	-
15.247	Operation within the Bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz	Complied	(i)
15.247(a)(1)	Channel Separation, Frequency Hopping Systems	N.A.	-
15.247(a)(1)(iii)	Number of Hopping Channels	N.A.	-
15.247(a)(1)(iii)	Time of Occupancy	N.A.	-
15.247(a)(2)	Digital Modulation – 6 dB Bandwidth (≥500kHz)	Complied	
15.247(b)(3)	Maximum Peak Conducted Output Power: (1 Watt)	Complied	-
15.247(d)	Out of Band Emissions (non-restricted)– 100kHz BW: (≥-20dBc)	Complied	-
15.247(e)	Digital Modulation – Power Spectral Density: (<8dBm/3kHz)	Complied	
15.247(i)	Maximum Permissible Exposure (MPE)	Complied	-
2.1049	99% Bandwidth	Noted	-

Notes

(i) The EUT's V2V mode operated only in the band 902MHz – 928MHz.

4 MODIFICATIONS

None.

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5 EQUIPMENT UNDER TEST INFORMATION

5.1 EUT summary

EUT Name:	IVU Plus	
EUT Model:	PROD1177-U-USA PROD1177-H -USA	
EUT Serial Number(s):	1776 2204 0001 P2U (-U) 1776 2204 0005 P2H (-H)	
External Power Supply:	9 – 36 VDC	
Operating Frequencies (V2V):	920.0 MHz / 921.0 MHz	
Transmit Power (V2V):	20 dBm (as per the manufacturer's default firmware)	
Modulation Technique (V2V):	4GFSK	
Number of Channels (V2V):	2	
Antenna Specifications (V2V):	External 3.0dBi (as per the antenna manufacturer's specs. Refer Appendix D)	

5.2 EUT Description

The EUT was a rugged, multipurpose telematics computer intended for use in surface mining industry trucks/vehicles. Applications include CAS-GPS collision avoidance, vehicle monitoring, fleet management and general remote data logging and management.

The EUT was housed in a painted metal case and contained the following radio circuits:

- V2V transceiver, operating at either 920.0 MHz or 921.0 MHz.
- Doodle Labs NM-DB-2M WLAN transceiver, operating at 2.4 GHz.
- Thales PLS63-W 2G/3G/LTE modem.
- Septentrio AsteRx-m2a GPS module, utilising two GPS antennas (-U model).
- uBlox ZED-F9P GPS module, utilising a single GPS antenna (-H model).

The EUT was intended to be powered by either a 12V or 24 V vehicle battery supply. The EUT also had an internal battery, Lithiumwerks ANR26650M1B LiFePo cell with nominal voltage of 3.3V.

Equivalent Model Nos:
Refer to Appendix C, for client declaration relating to equivalent model numbers.

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6 TEST SETUP AND EUT CONFIGURATION

6.1 EUT Configurations

The EUT's V2V function was controlled by following instructions provided in the client's test plan.

The EUT was configured for V2V constant transmission with PN9 random modulation as verified with an analyser on either 920.0 MHz or 921.0 MHz using either 4GFSK modulation or CW as required. This would be 100% duty cycle as the transmission was constantly on. The transmit power did not change from the default configuration, specified by the client as 20 dBm.

Both the CELL and WLAN outputs were turned off using software commands.

For measurement of radiated spurious emissions, the EUT's LAN port was connected to a remotely located switch and laptop to enable control of the operating mode.

Prescan results indicated no significant difference between operation at 920.0 MHz or 921.0 MHz. Final testing was performed with V2V transmission at 921.0 MHz.

Refer to the photographs in Appendix B for the EUT test setup and physical configuration.

6.2 Supporting Equipment

Equipment	Brand & Model
Camera	PROD0118
Display	PROD0839A
Variable DC Power Supply	Austest
Ethernet Switch	Netgear FS108
Laptop	Lenovo Thinkpad T430

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6.3 Cables

PROD1177-U

EUT Port	Source/Load	Cable Type	Length*
Deutsch Connector	Multiple Cables / Loop Back	Supplied cable harness	1.3m
Deutsch Connector	Camera PROD0118	Supplied cable harness	1.3m
Deutsch Connector	USB	Supplied cable harness	1.3m
Deutsch Connector	DC Supply In	Supplied cable harness	1.3m
LAN	Ethernet Switch	Supplied Shielded RJ45	3m
Display	PROD0839A	As Supplied	15.3m
GSM	Laird TRA6927M3PWN-001 antenna	Coax	3m
V2V	Laird, TRAB923NP antenna	Coax	5.3m
GPS	Tallysman 33-3972-01-01 antenna	Coax	3m
GPS-B	Tallysman 33-3972-01-01 antenna	Coax	3m
WLAN	SYSKIM OYH 02020-NF antenna	Coax	3m

*Cable length was adjusted by bundling or cut to length in accordance with the standard.

PROD1177-H-

EUT Port	Source/Load	Cable Type	Length*
Deutsch Connector	Multiple Cables / Loop Back	Supplied cable harness	1.3m
Deutsch Connector	Camera PROD0118	Supplied cable harness	1.3m
Deutsch Connector	USB	Supplied cable harness	1.3m
Deutsch Connector	DC Supply In	Supplied cable harness	1.3m
LAN	Ethernet Switch	Supplied Shielded RJ45	3m
Display	PROD0839A	As Supplied	15.3m
GSM	Laird TRA6927M3PWN-001 antenna	Coax	3m
V2V	Laird, TRAB923NP antenna	Coax	5.3m
GPS	Tallysman 33-3972-01-01 antenna	Coax	3m
WLAN	SYSKIM OYH 02020-NF antenna	Coax	3m

*Cable length was adjusted by bundling or cut to length in accordance with the standard.

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7 TEST SPECIFICATIONS

7.1 Test Facility

Testing was performed at Austest Laboratories located at 46 Glenola Farm Lane in Yarramalong Valley, New South Wales, Australia.

Radiated emission testing was performed at an OATS, where some ambient signals may have exceeded the continuous disturbance limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements.

7.2 Accreditations and Listings

Test facilities at Austest Laboratories are accredited by A2LA, Certificate Number 2765.02. The tests reported herein have been performed in accordance with its terms of accreditation.

Austest Laboratories Yarramalong and Castle Hill test facilities are accredited with the FCC under the ACMA-FCC APEC-TEL MRA. Designation Number AU0003 / Registration number 520620.

7.3 Deviations from Standards and/or Accreditations

No deviations to the standard or Austest accreditation was required.

7.4 Test Witnesses

None.

7.5 Test Equipment

All critical items are maintained on a scheduled calibration recall program, or verified with equipment maintained on a scheduled calibration program. Emission measurements are traceable to Australian National standards or international equivalents.

ID	Brand/Model	Description	Calibration due
72	HP8574B	Spectrum Analyser / EMI Rx	07/11/2023
74	HP8447x	RF Preamp	07/04/2023
83	OATS 1 / FSOATS 1	3m/10m Open Area Test Site NSA, Svswr compliant	16/04/2023
1101	AH Systems SAS-200/571	DRG Horn 1-18GHz	03/05/2024
1132	AH Systems SAS-200/574	DRG Horn 18-40GHz	03/05/2024
1241	Com-Power PAM-118A	RF Preamp	20/05/2024
1385	FSP40	Spectrum analyser 38GHz	16/02/2025
1844	Ametek CBL6141B	Bilog Antenna	09/08/2023
-	Huber + Suhner	Coax Cables	14/04/2024
-	HP85869C	Test Software	Verified
-	Rohde & Schwarz	RS Commander Capture Software	Verified

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7.6 Measurement Uncertainty

Measurement uncertainty U_{Lab} was calculated for a 95% level of confidence and based on a coverage factor of k=2.

Emissions Tests

Measurement	Uncertainty	
	U_{cispr}	U_{Lab}
RF Frequency	-	±5 part in 10^{10}
RF power conducted	-	±1.3dB
Radiated Emissions – 30 MHz to 1000 MHz	6.3 dB	±4.7 dB
Radiated Emissions – 1 GHz to 6 GHz	5.2 dB	±4.8 dB
Radiated Emissions – 6 GHz to 18 GHz	5.5 dB	±5.3 dB

7.7 Emission test criteria

The laboratory expanded MIU (U_{lab}) is less than the CISPR 16-4-2 criterion for the expanded MIU (U_{cispr}) and therefore:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit.
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

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8 ANTENNA REQUIREMENT, §15.203

The requirement of this Section was not applicable, since the EUT must be professionally installed, typically in mining equipment.

9 RESTRICTED BANDS OF OPERATION, §15.205

The EUT complied with the requirements of this Section since it did not operate within the listed Restricted Bands of Operation. Out of band emissions falling within the Restricted Bands of Operation were below limits specified in FCC section 15.209.

10 DTS BANDWIDTH, §15.247(a)(2)

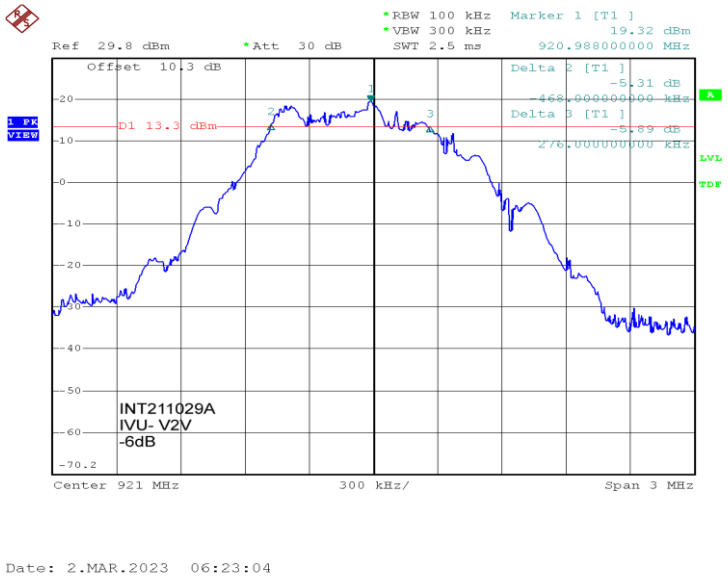
Test Dates:	2nd March 2023	Temperature:	25°C	Humidity:	68%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

The EUT was configured and operated as per sect 6.1 of this report.

Measurements were performed on the PROD1177-U-USA sample by applying the procedure detailed in ANSI C63.10, Clause 11.8.1 DTS Bandwidth Option 1 and measured at the V2V antenna port.

The 6 dB bandwidth was calculated using the analyser ndB down marker function.

Frequency MHz	6 dB Bandwidth (kHz) (limit >500kHz)
921.0	744



DTS Bandwidth

11 MAXIMUM PEAK CONDUCTED OUTPUT POWER, §15.247(b)(3)

Test Dates:	14th March 2023	Temperature:	25°C	Humidity:	68%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

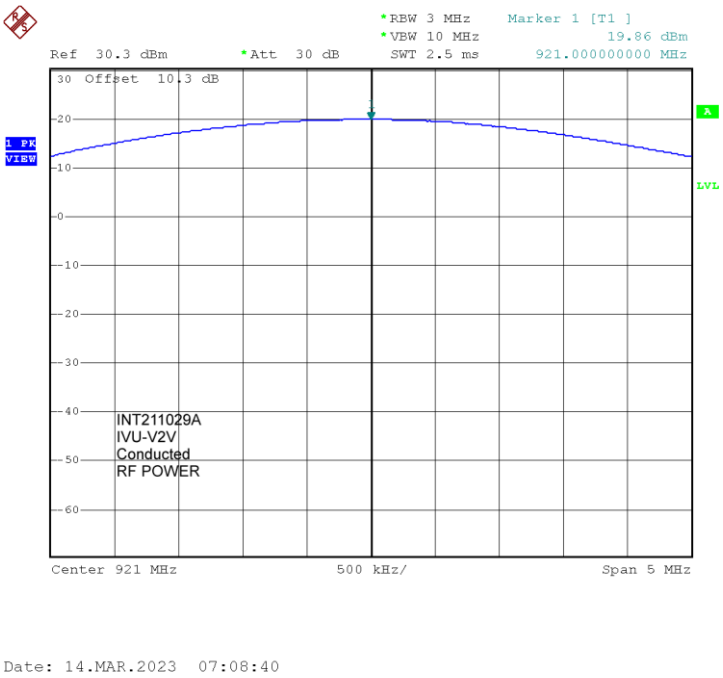
The EUT was configured and operated as per sect 6.1 of this report.

A conducted RF measurement was performed at the V2V antenna port, refer to C63.10 clause 11.3 and applying the procedure detailed in ANSI C63.10, Clause 11.9.1.1 RBW ≥ DTS Bandwidth.

Measurements were performed on the PROD1177-U-USA sample.

The power was measured directly from the marker results, the 10dB pad and cable loss used for the conducted measurements were compensated for.

Frequency	Peak Conducted Power		Limit		Margin
MHz	dBm	W	dBm	W	dB
921.0	19.86	0.097	30.0	1.00	-10.14



Maximum Peak Conducted Power

12 POWER SPECTRAL DENSITY, §15.247(e)

Test Dates:	2nd March 2023	Temperature:	25°C	Humidity:	68%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

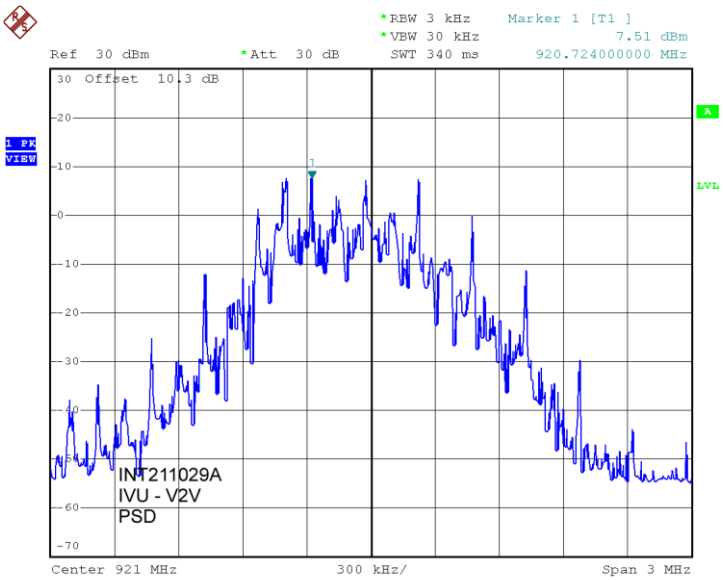
The EUT was configured and operated as per sect 6.1 of this report.

A conducted PSD measurement was performed at the V2V antenna port, refer to C63.10 clause 11.3 and applying the procedure detailed in ANSI C63.10, Clause 11.10.2 Method PKPSD (peak PSD)

Measurements were performed on the PROD1177-U-USA sample.

The PSD was measured directly from the marker results, the 10dB pad and cable loss used for the conducted measurements were compensated for.

Frequency MHz	Peak Conducted PSD dBm/3 kHz	Limit dBm/3 kHz	Margin dB
921.0	7.51	8	0.49



PSD

13 OCCUPIED BANDWIDTH, 99%: §2.1049

Test Dates:	1st March 2023	Temperature:	23°C	Humidity:	78%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

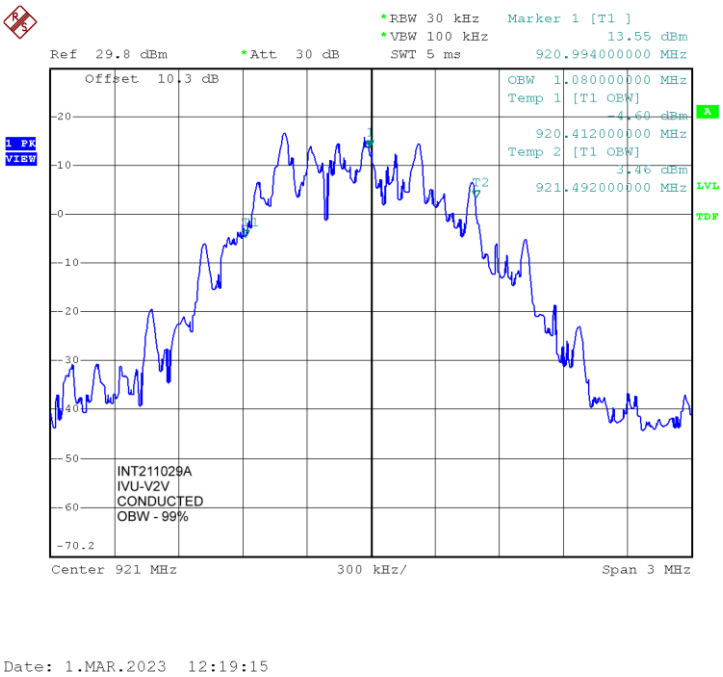
Measurements were performed on the V2V antenna port by applying the procedure detailed in ANSI C63.10 Clause 6.9.3, Occupied bandwidth -power bandwidth (99%) measurement procedure.

Measurements were performed on the PROD1177-U-USA sample.

The result was obtained directly from the markers, the cable and antenna loss used for the conducted measurements were compensated for.

Conducted measurements:

Frequency MHz	Result
921.0	1.08MHz



99% OBW

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14 CONDUCTED SPURIOUS EMISSIONS, OUT OF BAND, §15.247(d)

Test Dates:	2nd March 2023	Temperature:	25°C	Humidity:	68%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

14.1 EUT Operating Mode

Refer Section 6.
Measurements were performed on the PROD1177-U-USA sample.

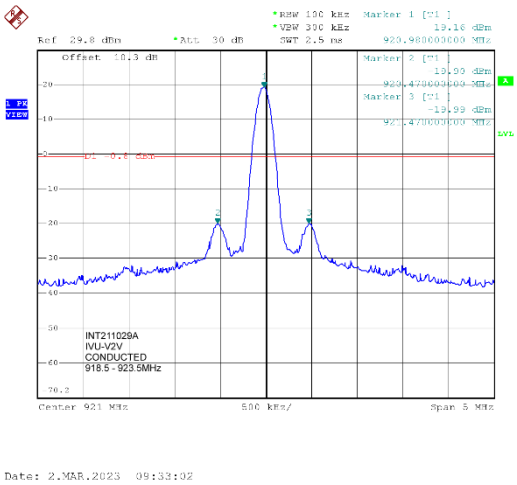
14.2 Test Method

a. Measurements were performed with reference to ANSI C63.10, Clause 11.11.1 (a).
b. The analyser RF input was connected via a 10dB pad and cable directly to the EUT RF output antenna port.
c. The analyser RBW was set to 100kHz, VBW to 300kHz, Peak Detector max hold.

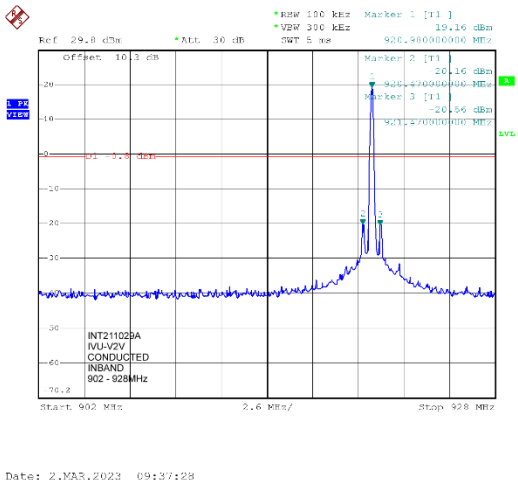
14.3 Test Results

14.3.1 Reference in-band levels

The following measurements were made with a 100 kHz RBW to determine the limit for emissions in the non-restricted bands.



921MHz Fundamental Reference



902MHz – 928MHz

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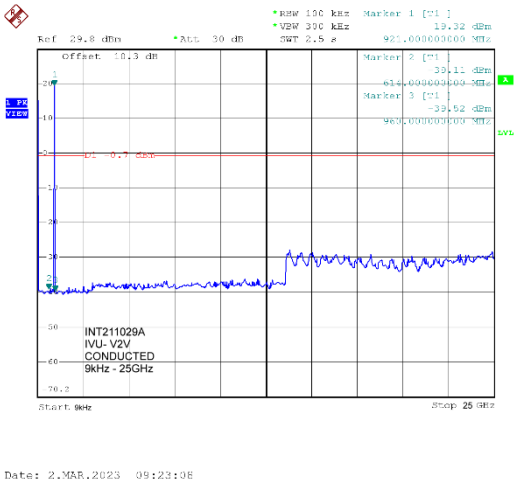
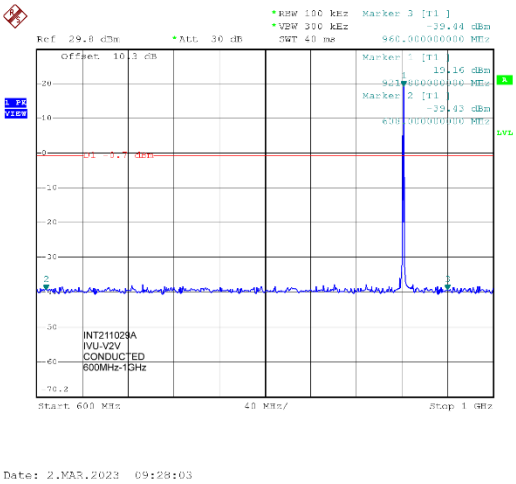
14.3.2 Measured Nonrestricted Bands: 9kHz to 25GHz.

All measured non-fundamental emission levels in the non-restricted bands were below the in-band -20dBc reference level.



9kHz to 25GHz



600MHz to 1GHz

15 RADIATED EMISSIONS §15.209, RESTRICTED BANDS

15.1 EUT Operating Mode

- Refer to Section 6.1 of this report.
- Preliminary measurements indicated that emissions related to the V2V transmission were similar between PROD1177-U-USA and PROD1177-H-USA units.
- Final testing was performed on the PROD1177-U-USA unit.

15.2 Test Method

a. Measurements were performed in accordance with ANSI C63.10, KDB 558074. Peak measurements were performed using a Peak Detector; Average measurements were performed with an average detector; video averaging was not employed.

b. The measuring receiver BW settings were:

Frequency Range	Antenna	Measurement	Detector	RBW	VBW
0.15 to 30 MHz	60 cm Loop	Pre-scan	Peak	9 kHz	30 kHz
		Final Quasi-Peak	Quasi-Peak	9 kHz	-
30 to 1000 MHz	Hybrid (Bicon/log)	Pre-scan Peak	Peak	120 kHz	300 kHz
		Final Quasi-Peak	Quasi-Peak	120 kHz	-
Above 1000 MHz	Double-ridged guide horn	Pre-scan Peak	Peak	1 MHz	3 MHz
		Pre-scan Average	Average	1 MHz	3 MHz
		Final Peak	Peak	1 MHz	3 MHz
		Final Average	Average	1 MHz	3 MHz

c. The EUT was setup on a non-conductive turntable:- :-
   i. For measurement below 1GHz at a height of 0.8m above the OATS conductive ground plane and at the indicated test distance away from the measuring antenna.
   ii. For measurements above 1GHz at a height of 1.5m above the OATS conductive ground plane with RF absorber placed between the test table and measuring antenna.

d. To maximise emissions, the EUT was rotated through 360° and the measuring antenna height adjusted between 1m to 4m in the following antenna orientations:-
   i. Loop antenna (9kHz to 30MHz) over a non-metallic ground plane,– Coaxial, Coplanar and also horizontal (parallel to ground) orientations.
   ii. Bilog antenna (30MHz to 1GHz) - Both vertical and horizontal polarizations.
   iii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.

e. The maximised emission level was measured and the above repeated for all measurement frequencies.

f. Average level measurements were not made where the peak level did not exceed the average limit.

g. Linearity of the measuring system was checked, reducing gain when required.

h. Test distances: Where the actual test distance used was different to that specified, then the test data results shown in any tables were extrapolated to the required distance using the formula specified within ANSI C63.10:2013. For simplicity, the test data plots have the limit lines adjusted to reflect any different test distance giving a visual indication of the relative margins.

i. **Ambient Emissions**: Measurements were performed at an Open Area Test Site (OATS), where some ambient signals may exceed the limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements. The ambient emissions are indicated as a '1' or 'A' on the scans, refer to the notes after the graphs.

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15.3 Example Calculation

The final field strength levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

Calculation	Example		
$E = V + AF + L_{cbl} - G_{pre}$	V = 40.0 dBµV AF = 12.0 dB/m	L_{cbl} = 2.9 dB G_{pre} = 22.5 dB	E = 40 + 12 + 2.9 – 22.5 = 32.4 dBµV/m

Where
- E = Radiated Electric Field Strength in dBµV/m,
- V = EMI Receiver measured signal input voltage in dBµV,
- AF = Antenna Factor of the measuring antenna in dB/m,
- L_{cbl} = Total cable insertion loss in dB and
- G_{pre} = Preamplifier gain in dB.

15.4 Test Results

15.4.1 Radiated Emissions: 9kHz to 30MHz.

Test Date:	6th March 2023	Temperature:	29°C
Test Officer:	Steven Garnham	Humidity:	42%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

As the measurements were performed at 10 meters for frequencies below 150kHz and at 3 meters for frequencies between 150kHz and 30MHz, the test data was extrapolated to the distance defined by limits (300m for 9-490kHz and 30m for 490kHz – 30MHz), with reference to ANSI C63.10 Clause 6.4.4.1.

Prescan results were used to identify the orientation that produced the highest measured emissions in the three antenna positions, Coaxial, Coplanar and Parallel.
Final measurements were performed over a non-conductive ground plane as specified in ANSI C63.10:2013, clause 5.2.

No significant intentional radiation was found. All intentional radiation was >20dB below the limits specified in section 15.209.

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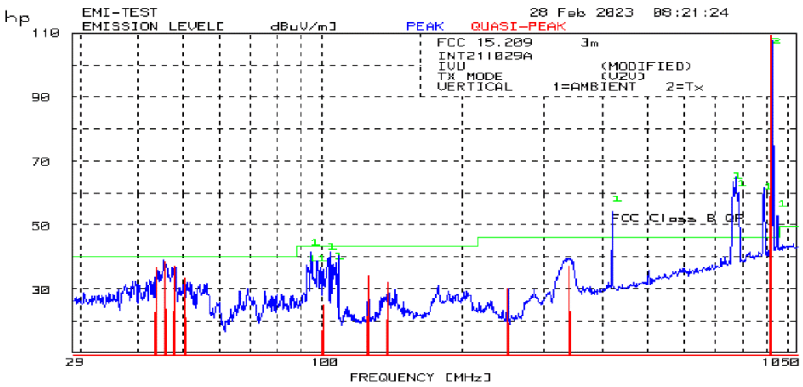
15.4.2 Radiated Emissions: 30MHz to 1000MHz at 3m distance.

Test Date:	28th February 2023	Temperature:	28°C
Test Officer:	Steven Garnham	Humidity:	53%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

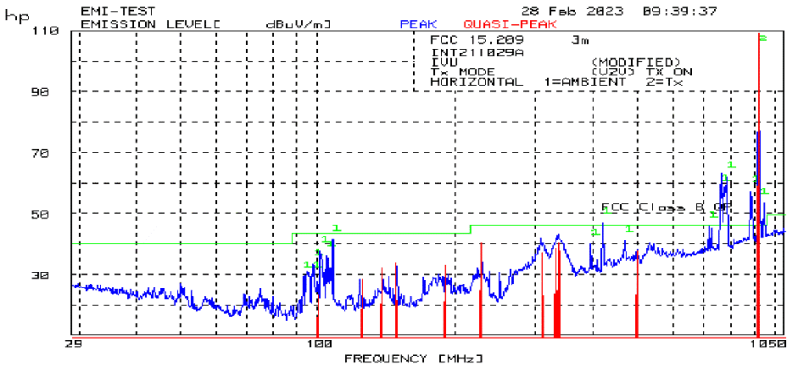
The 6 highest EUT emissions, 30 MHz to 1 GHz, are tabulated below with reference to the limits of 15.209: **(Note that only the 331.0MHz emission was within the listed 15.205 restricted bands. The others were only required to be >-20dBc but have been included for reference purposes).

Frequency MHz	Antenna Pol.	QP Level (dBµV/m)	QP Limit (dBµV/m)	QP Pass Margin (dB)
45.9	Vertical	38.2	40.0	*-1.8
47.9	Vertical	37.1	40.0	*-2.9
50.6	Vertical	36.7	40.0	*-3.3
227.1	Horizontal	40.4	46.0	-5.6
335.7	Horizontal	40.2	46.0	-5.8
**331.0	Horizontal	38.3	46.0	-7.7

*Results were within the Laboratory's measurement uncertainty.



Radiated Emissions (30MHz to 1000MHz – Vertical)



Radiated Emissions (30MHz to 1000MHz – Horizontal)

Note: A Green '1' indicates an ambient emission and was not from the EUT.

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2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990

TEST LABORATORY
CERT #2765.02

15.4.3 Radiated Emissions: 1 GHz to 18 GHz at 3m distance.

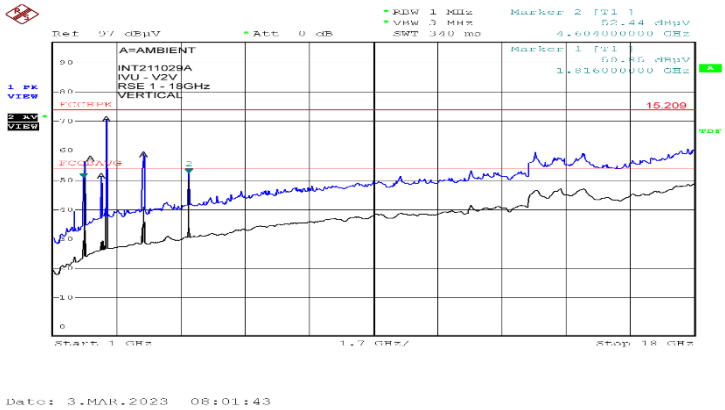
Test Date:	3rd March 2023	Temperature:	24°C
Test Officer:	Steven Garnham	Humidity:	61%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

The highest measured EUT intentionally radiated emissions above 1 GHz are tabulated below with reference to the limits of 15.209:
**(Note that the 2nd harmonic at 1842MHz was not within a 15.205 restricted band and therefore was only required to be >-20dBc but has been included for reference purposes).

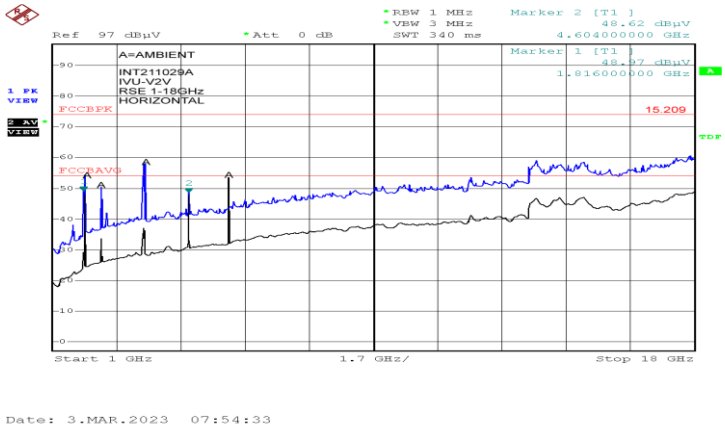
Frequency MHz	Antenna Pol.	Pk Level dBµV/m	Pk Limit dBµV/m	Margin dB	Avg Level dBµV/m	Avg Limit dBµV/m	Margin dB
**1842	Vertical	51.0	74.0	>-20	50.1	54.0	*-3.9
**1842	Horizontal	51.9	74.0	>-20	49.6	54.0	*-4.4
2763	Vertical	41.2	74.0	>-20	36.9	54.0	-17.1
4605	Vertical	53.6	74.0	>-20	51.6	54.0	*-2.4
4605	Horizontal	50.0	74.0	>-20	47.2	54.0	-6.8

*Results were within the Laboratory's measurement uncertainty.

Note: 'A' indicates an ambient emission and was not from the EUT.



1 – 18GHz Vertical



1 – 18GHz Horizontal

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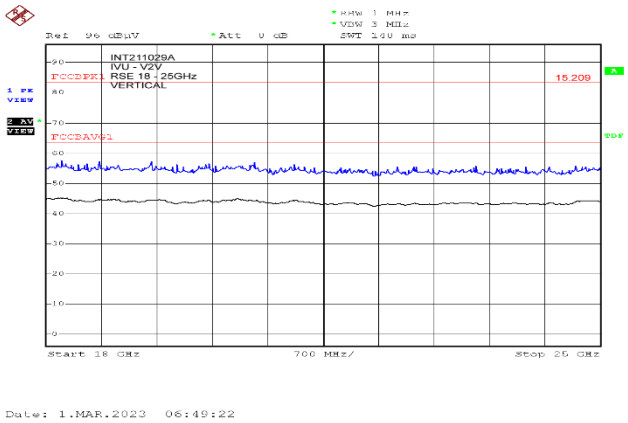
15.4.4 Radiated Disturbances: 18GHz to 25GHz at 1m distance.

Test Date:	1st March 2023	Temperature:	23°C
Test Officer:	Steven Garnham	Humidity:	78%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

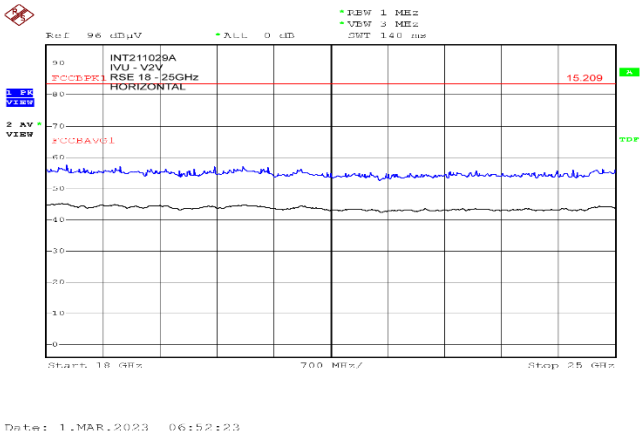
Measured field strength levels performed at a 1 meter distance were extrapolated to a 3 meter distance using the extrapolation factor of 20dB/decade.

No significant intentional radiation was found. All intentional radiation was >10dB below the limits specified in section 15.209.

Following plots indicate limits calculated for a 1m distance.



18 – 25GHz Vertical



18 – 25GHz Horizontal

16 CO-LOCATION VERIFICATION

Co-location transmissions were evaluated in all co-location configurations of V2V transmitter, WLAN transmitter and 2G/3G/LTE modem transmitting simultaneously.

It was verified that there were no significant emissions related to co-location transmissions observed.

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APPENDIX G– CLIENT DECLARATION

Wabtec CORPORATION

Industrea Mining Technology Pty Ltd
T/A Digital Mining Technology
3 Co-Wyn Close, Fountaindale
NSW 2258, Australia
T: +61 2 8863 4730 www.wabteccorp.com

Ref. No.: DMT/PVS/2020-032
September 22, 2022

Subject: IVU Plus - Product Equivalence Declaration

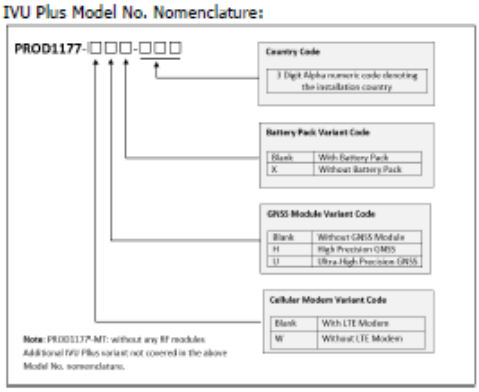
Industrea Mining Technology Pty Ltd, declares IVU Plus PROD1177-yyy-xxx variant models listed in the below table have the same hardware, RF modules, external antennae, power supply and construction characteristics. Only difference being the permutation and combination of plugging in the optional RF modules, viz. WiFi Module (NM-DB-2M), Cellular Modem (PLS63-W), High Precision GNSS Module (ZED-F9P), Ultra High precision (AsteRx-m2a or AsteRx-m3 Pro+) and battery pack as detailed below.

IVU Plus Model No. & Variants:

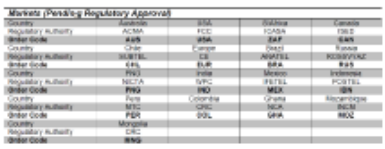
Model No.	RF Modules (yyy)					Internal Battery
	V2V SRD	WIFi Module	Cellular Modem	Ultra-high Precision GNSS Receiver Module	High Precision GNSS Receiver Module	
PROD1177-WH-xxx	✓	✓	-	-	✓	✓
PROD1177-WU-xxx	✓	✓	-	✓	-	✓
PROD1177-W-xxx	✓	✓	-	-	-	✓
PROD1177-WHX-xxx	✓	✓	-	-	✓	-
PROD1177-WUX-xxx	✓	✓	-	✓	-	-
PROD1177-WX-xxx	✓	✓	-	-	-	-
PROD1177-H-xxx	✓	✓	✓	-	✓	✓
PROD1177-U-xxx	✓	✓	✓	✓	-	✓
PROD1177-xxx	✓	✓	✓	-	-	✓
PROD1177-HX-xxx	✓	✓	✓	-	✓	-
PROD1177-UX-xxx	✓	✓	✓	✓	-	-
PROD1177-X-xxx	✓	✓	✓	-	-	-
PROD1177-MT	-	-	-	-	-	✓

Where xxx denotes the installation country code

IVU Plus Model No. Nomenclature:



Country Code:



Kind Regards,

Steve Clifton
Senior Engineering Director
Industrea Mining Technology Pty Ltd
T/A Digital Mining Technology
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APPENDIX H– V2V ANTENNA SPECIFICATION

Laird
Smart Technology. Delivered.

Phantom®
800 MHz-5.8GHz Antennas

SPECIFICATIONS

ELECTRICAL	
VSWR	< 2.1
Nominal Gain	3 dB-M.E.G.
Maximum Power	100 W
Nominal Impedance	50 Ω
Polarization	Vertical
Pattern	Omnidirectional
Half-Power Beamwidth (Elevation° x Azimuth°)	130° x 360°
Coaxial Cable Length & Type	None
Terminations	NMO Socket or, type N-female

MECHANICAL	
Color	Black or White
Height (initially)	2¾"
Diameter	1.438"
Weight	0.173 lb
Material	ABS
Mounting Information	NMO (PN: MB8, MAB8) Sold Separately
Noise Suppressor	BlackHawk NS1535 1-35 VOLT, 15 Amp Noise Suppessor (Sold Separately)

Permanent Mounting Option:
Please order by antenna model and insert letter "P" to indicate permanent mounting option (TRA8063P).

MODEL AND ORDERING INFORMATION

MODEL	DESCRIPTION
TRA8063	806-870 MHz 3 dB-MEG Phantom® ¾ NMO, White Radome
TRA8213	821-896 MHz 3 dB-MEG Phantom® ¾ NMO, White Radome
TRA8903	890-960 MHz 3 dB-MEG Phantom® ¾ NMO, White Radome
TRA9023	902-928 MHz 3 dB-MEG Phantom® ¾ NMO, White Radome
TRA18503	1.85 - 1.99 GHz 3dB-MEG Phantom® ¾ NMO, White Radome
TRA24003	2.4 – 2.5 GHz 3 dB-MEG Phantom® ¾ NMO, White Radome
TRA58003	4.9 – 6.0 GHz 3 dB-MEG Phantom® ¾ NMO, White Radome
TRADCAGP	G - Drop ceiling antenna adaptor for P-mount Phantom w/ 6"x6"x0.016" ground plane
Sealtube3	Heat shrink tubing 3"x1"DIA install (use for jaw protector on installation wrench)

Add "B" to model number for black radome. Example: TRAB8063
Add "P" to model number for Permanent Mount. Example: TRA8063P

ANT-DS-PHANTOM 800-5800 MHz 1214

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