TIMCO ENGINEERING, Inc.

An IIA Company

FCC 47 CFR Part 90/22/80

VHF Test Report

APPLICANT	CODAN RADIO COMMUNICATIONS
FCC ID	H4JVT-4E150
MODEL NUMBER	VT-4E150
PRODUCT DESCRIPTION	VHF BASE STATION TX
DATE SAMPLE RECEIVED	4/28/2020
FINAL TEST DATE	4/30/2020
REPORT NUMBER	1009AUT20_PT90 22 80 VHF TestReport_

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
UNDER ISO/IEC 17025, AND ISO/IEC 17065

A2LA ACCREDITED
Certificate #0955.01

TABLE OF CONTENTS

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

SIGNATURE PAGE

Timco Engineering, Inc. attests that:

☒	The EUT tested herein **fulfills** all approval requirements and/or the customer requirements as identified in this test report.
☐	The EUT tested herein **does not fulfill** all approval requirements and/or the customer requirements as identified in this test report.

This report relates only to the Equipment Under Test (EUT) sample(s) tested.

This report shall not be reproduced except in full without the written approval of Timco Engineering, Inc.

To the best of my knowledge and belief, this device has been tested in accordance with the standards identified in this test report, and these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Name and Title Franklin Rose, Project Manager / EMC Specialist

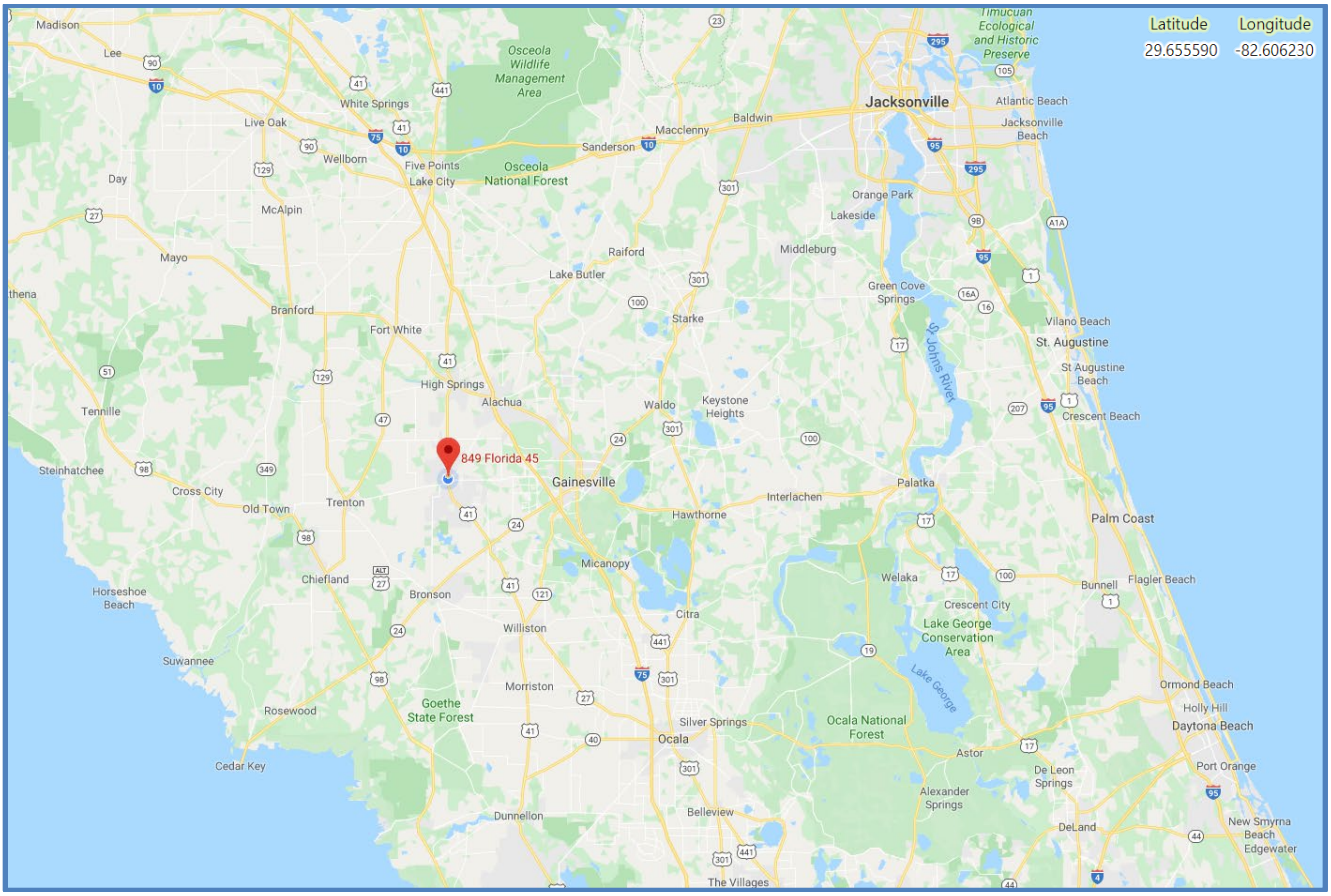
Name and Title Tim Royer, Project Manager / EMC Engineer

Name and Title Sharon Hoffman, Senior Marketing Director / Operations

Date 4/30/2020

TEST LABORATORY INFORMATION

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669, USA



United States	FCC Accredited and Recognized Test Lab & TCB # US1070
	DHS Recognized P25 CAP Test Facility # P25CAPTIMCO081016
Australia / New Zealand	U.S. CABs Recognized by Australia ACMA Under MRA
Canada	U.S. Lab & CB Recognized by Canada ISED, Designation # US0111, Test Site # 2056A
Chinese Taipei	U.S. CABs Recognized by Chinese Taipei BSMI/NCC Under MRA
European Union	U.S. EMC & RE Directive NB's, Designation # US0111, Notified Body # 1177
Hong Kong	U.S. Labs & CBs Recognized by Hong Kong OFCA Under MRA
Israel	U.S. CABs Recognized by Israel MOE/MOC Under MRA
Japan	U.S. RCBs Recognized by Japan MIC
Korea	U.S. CABs Recognized by Korea RRA Under MRA
Mexico	U.S. CABs Recognized by Mexico IFT Under MRA
Singapore	U.S. Labs & CBs Recognized by Singapore IMDA Under MRA
Vietnam	U.S. CABs Recognized by Vietnam MIC Under MRA

TEST INFORMATION

Report Version	Description	Issue Date
Rev1	Initial Issue	4/30/2020
Rev2		
Rev3		
Rev4		
Rev5		
Rev6		

Test Conditions	Temperature during testing: 26ºC, Humidity during testing: 50%
Test Exercise	The EUT was operated in accordance with the service manual using software supplied by the manufacturer.
Applicable Standards	ANSI/TIA 603-E, March 2016 ANSI C63.26, December 11, 2015 FCC CFR 47 Part 2, December 5, 2019 FCC CFR 47 Part 90, November 25, 2019
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

EUT INFORMATION

EUT Description	VHF BASE STATION TX		
Model Number	VT-4E150		
Modified for Testing	☐		
Modification	n/a		
Antenna Connector	☐ UHF	☐ BNC	☒ N
	☐ TNC	☐ SMA	☐ Other
EUT Power Source	☐ AC Power (110-120 V)	☒ DC Power (13.8 V)	☐ DC Battery (7.4 V)
Test Item	☐ Engineering Prototype	☐ Pre-Production	☒ Post-Production
Type of Equipment	☒ Fixed	☐ Mobile	☐ Portable

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

2.1033 APPLICATION REQUIREMENTS

§2.1033 Application for certification.

(c) Applications for equipment other than that operating under parts 15, 11 and 18 of this chapter shall be accompanied by a technical report containing the following information:

Application Requirement	Requirement	Information
2.1033(c)(1)	The full name and mailing address of the applicant for certification	CODAN RADIO COMMUNICATIONS 43 ERIE STREET VICTORIA BC V8V 1P8 CANADA
2.1033(c)(2)	FCC Identifier	H4JVT-4E150
2.1033(c)(4) 2.1033(c)(13)	Type(s) of Emission & description of Digital Modulation Techniques	☒
2.1033(c)(5)	Frequency Range	Granted Range: 136 – 174 MHz (Part 90: 150.8 – 173.4 MHz) (Part 80: 150.8 – 162.0125 MHz) (Part 22: 150.8 – 161.775 MHz)
2.1033(c)(6),(7)	Range of operating power or specific operating power levels, and Maximum Power Rating.	0.5 - 8 W
2.1033(c)(6)	Description of means to vary power	Variable (in software)
2.1033(c)(8)	The DC voltage & current at the final amplifier for normal operation	13.8 V DC * 2.8 A = 38.64 W
2.1033(c)(14)	Test Results satisfying 2.1046 – 2.1057	☒
2.1033(c)(20)	Part 90 devices operating in the 700 MHz Interoperability Channels must meet P25 CAP CAI or 90.548.	☐
2.1033(c)(21)	Contain > 1 Drawing or Photograph of each test setup applicable to the device	☒

2.1041 MEASUREMENT PROCEDURE

§2.1041 Measurement procedure.

(a) For equipment operating under parts 15 and 18, the measurement procedures are specified in the rules governing the particular device for which certification is requested.

(b) For equipment operating in the authorized radio services, measurements are required as specified in §§2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055 and 2.1057. The measurement procedures in ANSI C63.26-2015 (incorporated by reference, see §2.910) are acceptable for performing compliance measurements for equipment types covered by the measurement standard. See also §2.947 for acceptable measurement procedures.

2.1046 – 2.1055 TECHNICAL REQUIREMENTS

General Requirement (FCC PT 2)	Specific Requirement (FCC PT 90)	Requirement	Complies	N/A
2.1051	90.210 80.211 22.359	Conducted Spurious Emissions at Antenna Terminals	☒	☐
2.1053	90.210 80.211 22.359	Radiated Field Strength of Spurious Emissions	☒	☐

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

2.1057 FREQUENCY SPECTRUM TO BE INVESTIGATED

Requirements: 2.1057, ANSI C63.26 S 5.1.2

§2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

5.1.2 Number of fundamental frequencies to be tested in EUT transmit band

5.1.2.1 General requirement

Measurements of transmitters shall be performed and, if required, reported for each frequency band in which the EUT can be operated with the device transmitting at the number of frequencies in each band specified in Table 2.

Table 2—Number of frequencies to be tested

Frequency range over which EUT operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

5.1.2.2 Test channels and test modes (streamlined test requirements)[25]

Measurement of all modes and all channels is not always necessary to demonstrate compliance. Regardless of the test reduction methods selected, a device must comply with all the applicable rule parts under all modes of operation. A detailed technical rationale must be provided as justification for the selection of a subset of operational modes as being representative of "worst case" conditions.

[25] Use of the procedures in 5.1.2.2 is subject to the discretion of the regulatory authority.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

2.1051 CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINALS

§2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

5.2 RF output power measurement procedures

This subclause provides guidance for performing the power measurements necessary to demonstrate compliance to the RF output power limits imposed by regulatory authorities on transmitters. In addition, these procedures can also be utilized to collect the data necessary to demonstrate compliance to regulatory limits placed on unwanted (out-of-band and spurious) emissions.

Test Procedure: ANSI C63.26 S 5.2.3.3

5.2.3.3 Measurement of peak power in a narrowband signal with a spectrum/signal analyzer or EMI receiver

This procedure can be used to measure the peak power in either a CW-like or noise-like narrowband RF signal. The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW $\geq 3 \times$ RBW.

a) Set the RBW $\geq$ OBW.

b) Set VBW $\geq 3 \times$ RBW.

c) Set span $\geq 2 \times$ OBW.

d) Sweep time $\geq 10 \times$ (number of points in sweep) $\times$ (transmission symbol period).

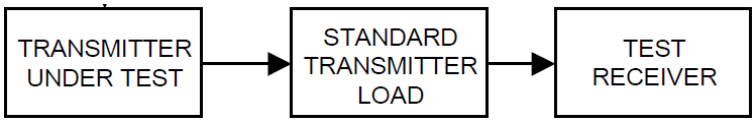
e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use the peak marker function to determine the peak amplitude level.

Test Setup Block Diagram:



849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

2.1053 FIELD STRENGTH OF SPURIOUS EMISSIONS

§2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

5.5.2 Common requirements

5.5.2.1 General

This subclause details the common requirements applicable to all radiated measurements, except for performing radiated output power measurements per 5.2.7. When conducted measurements cannot be performed (e.g., the EUT utilizes an integrated antenna), then a radiated test configuration must be used to measure the compliance-related technical parameters. Such radiated measurements shall use substitution methods unless a test site validated to ANSI C63.4 requirements is utilized, in which case, radiated fundamental and/or unwanted emissions can be measured using the direct radiated field strength method.

When performing radiated measurements, regardless of whether substitution or direct field strength methods are utilized, the EUT shall be rotated through three axes and the receive (measurement) antenna shall be oriented in both horizontal and vertical polarization. When the direct field strength method is used, then the equations provided in 5.2.7 can be used to determine the radiated output power from either a field strength or received power measurement. Detailed guidance with respect to performing band-edge compliance testing is provided in 5.7.3.

Pre-scan measurements are often performed to identify unwanted emission frequencies and to isolate the associated test variables (e.g., measurement antenna height and polarization, axis orientation, etc.) as discussed in 5.5.2.5. Final compliance tests are performed subsequently using the specified detector(s) at the frequencies and EUT and measurement antenna orientations identified in the pre-scan.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

FIELD STRENGTH OF SPURIOUS EMISSIONS

5.5.2.2 Instrumentation

5.5.2.2.1 General considerations

In addition to the following considerations, the instrumentation and associated guidance provided in Clause 4 shall be applied when performing radiated emissions measurements.

The RF sensitivity of the complete measurement system, relative to the applicable regulatory limit, shall be adequate to permit the anticipated signals (and their related power levels) to be detected and measured. For such purposes, a system noise floor established at 10 dB or more below the relevant power or emission limit is typically adequate. Low-noise preamplifiers, high gain antennas, or reduced test distances (while still maintaining measurement antenna beamwidth coverage of the EUT and a far-field measurement distance relationship) may be required to improve the noise floor-to-limit ratio. These specifics regarding the measurement conditions shall be thoroughly explained in the test report. The use of external band-pass, band-stop, low-pass, and/or high pass filters may be required to provide adequate protection of the measurement instrumentation from overload (see 4.2.3). The insertion losses associated with these external peripherals, to include connecting cables, shall be accounted for in the final measurement data.

5.5.2.2.2 Measurement antenna

Radiated measurements shall be made using antenna(s) as specified in 4.4. The measurement antenna shall be positioned at a suitable test distance from the periphery of the EUT such that the measurement is performed in the far field of the transmitting (EUT) antenna. A practical limitation on test distance can also be set by the available antenna calibration data. The main "beam" or main lobe of the pattern for any antenna used shall be large enough to encompass the physical size of the EUT, or system arrangement, when located at the measurement distance. If the 3 dB beamwidth of the antenna at the specified measurement distance is not large enough to encompass the physical size of the EUT or system arrangement, then multiple radiated scans with the 3 dB beamwidth of the antenna focused on different portions of the EUT or system arrangement will be necessary to ensure that the entirety of the EUT or system arrangement has been measured.

5.5.2.2.3 Test site

The test site shall satisfy the applicable requirements specified in 4.6.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

FIELD STRENGTH OF SPURIOUS EMISSIONS

5.5.2.3 Test arrangement for EUT and antenna positioning

5.5.2.3.1 Test arrangements for tabletop EUTs

For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, the EUT shall be placed on a RF-transparent table or support at a nominal height of 80 cm above the reference ground plane. Radiated measurements shall be made with the measurement antenna positioned in both horizontal and vertical polarization. The measurement antenna shall be varied from 1 m to 4 m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level (i.e., field strength or received power). When orienting the measurement antenna in vertical polarization, the minimum height of the lowest element of the antenna shall clear the site reference ground plane by at least 25 cm.

Figure 4 shows a typical EUT configuration with a wireless device placed on a tabletop on an appropriate radiated test site. The measurement antenna shall be placed at the specified distance from the closest point of the EUT. Tabletop devices shall be placed on a RF transparent platform with nominal top surface dimensions of 1 m by 1.5 m. Any necessary support equipment shall be placed far enough away from the EUT, such that changes in relative position of the EUT and support equipment do not influence the measured values. If the EUT requires a connection to a server or computer, via control/data cable(s), to exercise the product, then the controlling server or computer may be placed outside of the test area.

For radiated measurements performed at frequencies above 1 GHz, the EUT shall be placed on an RF transparent table or support at a nominal height of 1.5 m above the ground plane. Radiated measurements shall be made with the measurement antenna positioned in both horizontal and vertical polarization. The height scan of the measurement antenna shall be varied from 1 m to 4 m in a search for the relative positioning that produces the maximum radiated signal level (i.e., field strength or received power). When using the direct field strength method and the EUT is manipulated through three different orientations, then the scan height range of the measurement antenna is limited to 2.5 m, or 0.5 m above the top of the EUT, whichever is higher.

NOTE—The use of waveguide and/or flexible waveguide may be necessary when performing measurements at frequencies above 10 GHz to achieve usable signal-to-noise ratios at acceptable measurement distances. If so, it may be necessary to restrict the height search of the antenna, or conversely to raise or lower the EUT relative to the elevation of the measurement antenna, including its relative angle with respect to the ground plane. In any case, special care should be exercised to ensure that the maximum emissions are identified and measured.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

FIELD STRENGTH OF SPURIOUS EMISSIONS

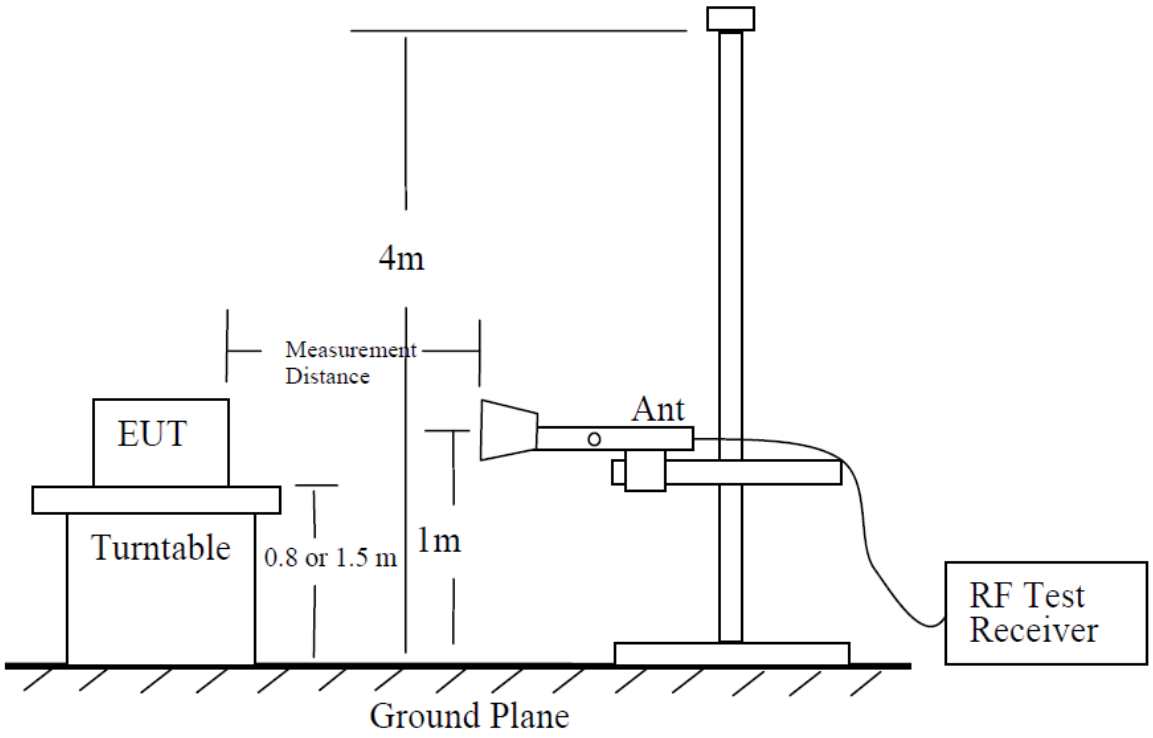


Figure 4—Test set-up for radiated spurious measurements

Radiated unwanted emissions measurements shall be made over the frequency range specified in 5.1, dependent upon the relevant operational frequency band. These radiated measurements shall be made around the EUT (or alternatively, with the EUT rotated on a turntable), while varying the measurement antenna height and examining both horizontal and vertical polarization of the measurement antenna, as described above. Ordinarily, this will require the use of a turntable and an antenna positioner.

The EUT shall be set up in its typical configuration and arrangement and operated in its various modes of operation. Unless the EUT uses an integral antenna, the EUT shall be terminated with a non-radiating transmitter load. In cases where the EUT uses an adjustable antenna, the antenna shall be adjusted through typical positions and lengths to maximize emissions levels. EUTs with integral antennas shall be evaluated in their normal orientation. Where EUTs are designed to be installed in one of two distinct orientations, they shall be tested in both of their possible orientations. EUTs that can be operated in one of multiple orientations (e.g., handheld, portable, or modular devices) shall be tested in a minimum of three orientations. See Figure 5. When large antennas (e.g., high gain) or antennas not structurally supported by the EUT are utilized, a RF transparent supporting structure shall be used to facilitate the compliance testing. In all cases, the EUT, including the transmit antenna, shall be orientated such that the measurement of the emission is maximized.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

FIELD STRENGTH OF SPURIOUS EMISSIONS

Cables or wires inclusive to the EUT shall be configured so as to maximize the measured emission levels. The EUT controls shall also be adjusted to maximize the emission according to the manufacturer's specifications. The modulation applied shall be based on the guidance provided in the manufacturer's specifications. When necessary, field strength measurements shall be converted to ERP or EIRP for comparison to the applicable regulatory limits. See 5.2.7 for additional guidance.

5.5.2.3.2 Test arrangements for floor-standing EUTs

The floor standing EUT should be installed and tested as described in the manufactures instruction manual. If the installation methods are described for indoor and outdoor installations, one of the more typically used installation methods shall be tested. If the installation method provided in the manufacturer's instruction is not practical for testing, then EUT installation method provided in the latest edition of ANSI C63.4 may be used. The grounding of EUT must be achieved in accordance with manufacturer's instructions. However, if grounding studs are provided only at the top of EUT, grounding(s) of EUT may be achieved within 20 cm from the bottom of the EUT cabinet. Grounding of the EUT arbitrarily at middle of the cabinet is not allowed. The grounding material and size should be in accordance with manufacturer's instructions. Electromagnetically shielded ground wires shall not be used. If installation requires use of metal conduits for data, RF, and power cables, then typical or equivalent conduits may be used during the tests. The conduits should be elevated at least 1 cm above the ground plane and can be grounded only at the end of the conduit. All exposed cables shall be routed in accordance with latest edition of ANSI C63.4. The body of the loads connected to the RF ports should be electrically isolated from the cabinet or ground-plane. RF loads can be located outside the measurement area. Leakage radiation from the loads shall not overload the measurement receiver/analyzer.

5.5.2.4 Operational configurations

The EUT shall be tested while operating on the frequency per manufacturer specification. For EUTs that can operate on more than one frequency, unless otherwise specified, measurements shall be performed with the EUT transmitting on a frequency or frequencies as specified in 5.1 for each frequency band of operation.

a) Set the transmitter to operate in continuous transmit mode. For transmitters unable to be configured for ≥98% duty cycle even in a test mode, configure the system to transmit at the maximum duty cycle supported.

b) Compliance testing shall be performed with the minimum number of channels specified in 5.1 for each supported frequency band. A compliance test shall be performed on all channel sets supported by the EUT and permitted under the applicable regulatory requirements.

c) Compliance testing shall be performed for each supported frequency/channel using every available modulation supported by the transmitter, and at minimum and maximum data rate, in an effort to examine all possible combinations with the potential for producing the maximum emission amplitude. The test report shall clearly indicate how the various combinations were examined and a technical justification for any applied streamlining of test requirements. See 5.1.2.2 for guidance with regards to potential streamlined test requirement guidance.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

FIELD STRENGTH OF SPURIOUS EMISSIONS

5.5.2.5 Pre-scan testing

Exploratory radiated measurements (pre-scans) may be performed to determine the general EUT radiated emissions characteristics and, when necessary, the EUT-to-measurement antenna orientation that produces the maximum emission amplitude. Pre-scans shall only be used to determine the emission frequencies (i.e., not amplitude levels). The information garnered from a pre-scan can then be used to perform final compliance measurements using either the substitution or direct field strength method.

Pre-scan tests shall be performed following the test procedures provided in 5.5.2.3 and 5.5.2.4. When maximizing the emissions from the EUT for measurement, the EUT and its transmitting antenna(s) shall be rotated through 360°. For each mode of operation to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

5.5.4 Radiated measurement using the field strength method

5.5.4.1 General

Using the test configuration shown in Figure 6, measure the radiated emissions directly from the EUT and convert the measured field strength or received power to ERP or EIRP, as required, for comparison to the applicable limits. As stated in 5.5.1, the field strength measurement method using a test site validated to the requirements of ANSI C63.4 is an alternative to the substitution measurement method described in 5.5.3.

The test site shall satisfy the requirements in 4.6.3. The measurements shall be performed using the instrumentation specified in Clause 4, and using the common procedures in 5.5.2.

5.5.4.2 Radiated measurements for acquiring final compliance data

Final compliance data (i.e., data to be reported to the regulatory agency in support of an application for an equipment authorization) shall be collected in accordance with the procedures provided in 5.5.2, with the EUT transmitting for each frequency specified in 5.1.2. The emission characteristics of the EUT can be identified from the pre-scan measurement information obtained as specified in 5.5.2.5. Final measurements shall be performed for the worst case combination(s) of variable technical parameters that result in the maximum measured emission amplitude as per the guidelines provided in 5.1.2. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), and the frequency and amplitude data for the six highest-amplitude spurious emissions.

When reduced measurement distances or higher gain antennas are used in the measurement, a far-field measurement distance relationship and measurement antenna beamwidth coverage of the EUT must be maintained. When preamplifiers are used to improve the measurement system noise floor, overload protection shall be ensured (see guidance in 4.2). Any deviations from the specific measurement conditions or requirements shall be fully described in the test report.

See 5.5.2.5 and/or Annex C for guidance on converting measured field strength or received power data to ERP or EIRP, as applicable, for comparison with the applicable regulatory limits.

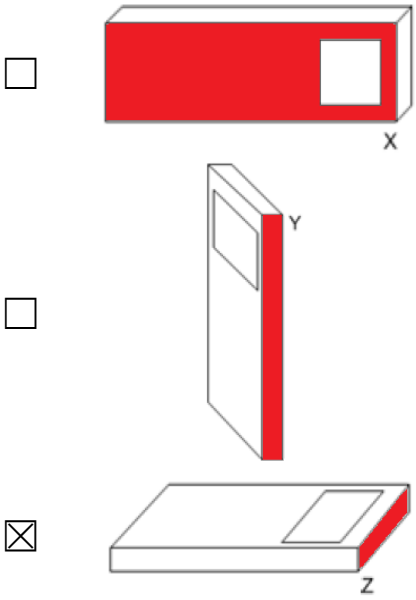
849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

FIELD STRENGTH OF SPURIOUS EMISSIONS

5.5.5 Recording test results

A minimum of six data points representing the highest identified unwanted emission amplitude levels revelant to the limit and associated frequencies must be included in the test report. This information shall be reported in a combination of both plots and tabular data as necessary to demonstrate compliance to the applicable technical requirement(s). When multiple operating modes are evaluated, only the "worst case" plots for each mode in each operating band need to be provided in the test report, along with an explanation and technical rationale supporting the identification of the "worst case." Test set-up photos shall be included and shall be of a sufficient quantity and detail as to allow for replication of the tests (i.e., a single photograph made from several meters away from the EUT is typically not sufficient). Data content and format shall conform to the requirements specified in Clause 8. While it is recognized that a graphical format is not applicable to final tests that utilize the traditional two-stage substitution measurement for every emission, graph(s) of preliminary swept measurement(s) that identify the emissions to be measured during final testing shall be presented in the report.

Worst-Case EUT Orientation



849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4 or EN TR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: "Uncertainty in EMC Measurements" and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	Notes
TR 100 028 PARAGRAPH 7.1.1 – FREQUENCY ERROR < 30 MHz	± 0.063 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR < 200 MHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR < 1 GHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR ≤ 18 GHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR ≤ 40 GHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.2 - CONDUCTED POWER MEASUREMENT	±0.643 dB	(1)
TR 100 028 PARAGRAPH 7.1.4.1 - CONDUCTED SPURIOUS EMISSIONS 9 kHz – 150 kHz	± 3.14 dB	(1)
TR 100 028 PARAGRAPH 7.1.4.1 - CONDUCTED SPURIOUS EMISSIONS 150 kHz – 30 MHz	± 3.08 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS < 200 MHz	± 2.16 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS < 1 GHz	± 2.15 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS < 18 GHz	± 2.14 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS ≤ 40 GHz	± 2.31 dB	(1)
FLUKE Multimeter AC Voltage Uncertainty	± 2.263 %	(1)
FLUKE Multimeter DC Voltage Uncertainty	± 0.453 %	(1)
Temperature (C°)	± 0.81 C°	

Notes: (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

EMC EQUIPMENT LIST

Device	Manufacturer	Model	SN	Calibration Date	Cal Due Date
EMI Test Receiver R & S ESU 40 firmware v 4.43 SP 3 BIOS v5.1-24-3	Rohde & Schwarz	ESU 40	100320	08/28/18	08/28/20
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 KMKM-0670-01 KFKF-0197-00	02/27/19	02/27/21
CHAMBER	Panashield	3M	N/A	03/15/19	03/15/21
Antenna: Active Loop	ETS-Lindgren	6502	00062529	12/11/17	12/11/20
Antenna: Biconical 1096	Eaton	94455-1	1096	08/01/17	08/01/20
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/26/17	07/26/20
Ant: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	02/25/20	02/25/23

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

ANNEX I – MANUFACTURER-PROVIDED INFORMATION

Note: The accuracy and precision of the following information provided by the manufacturer of the equipment under test has not been verified using test methods, cannot be verified, or is not necessary to verify.

N/A.

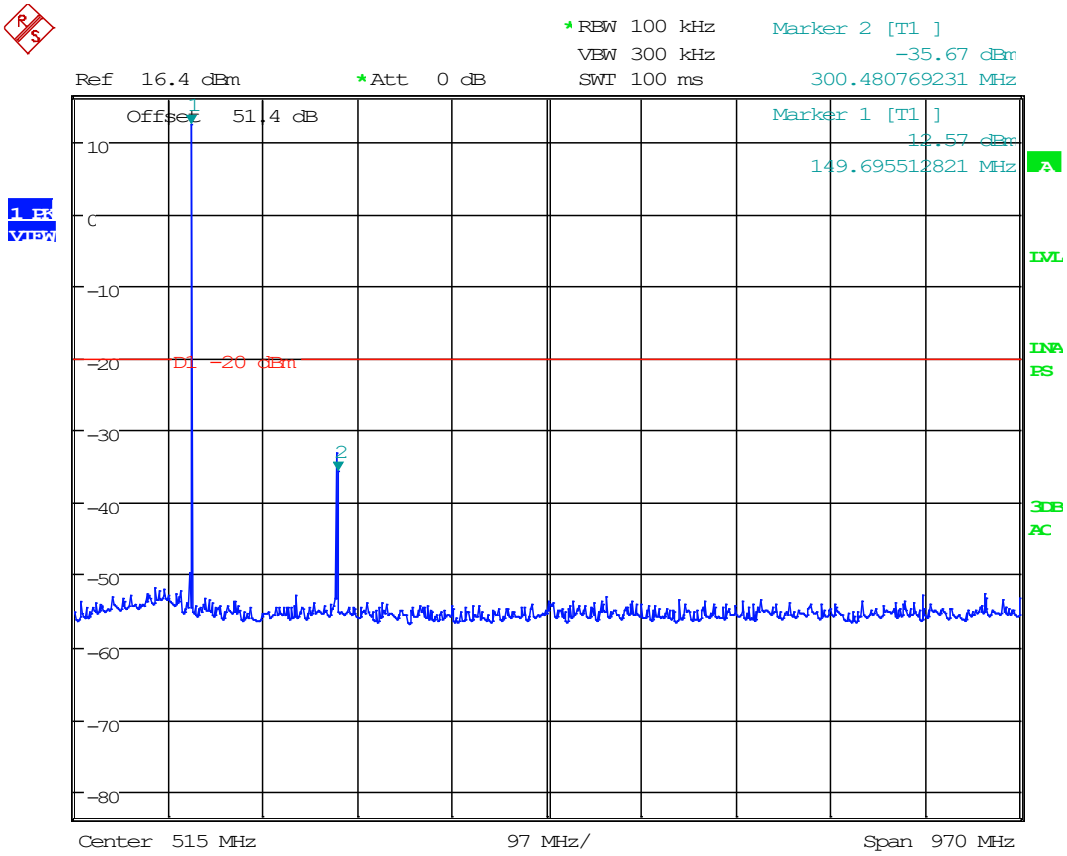
849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

ANNEX II – MEASUREMENT DATA

Test Engineer: FR, TR
Test Date: 4/29/2020

Conducted Spurious Emissions

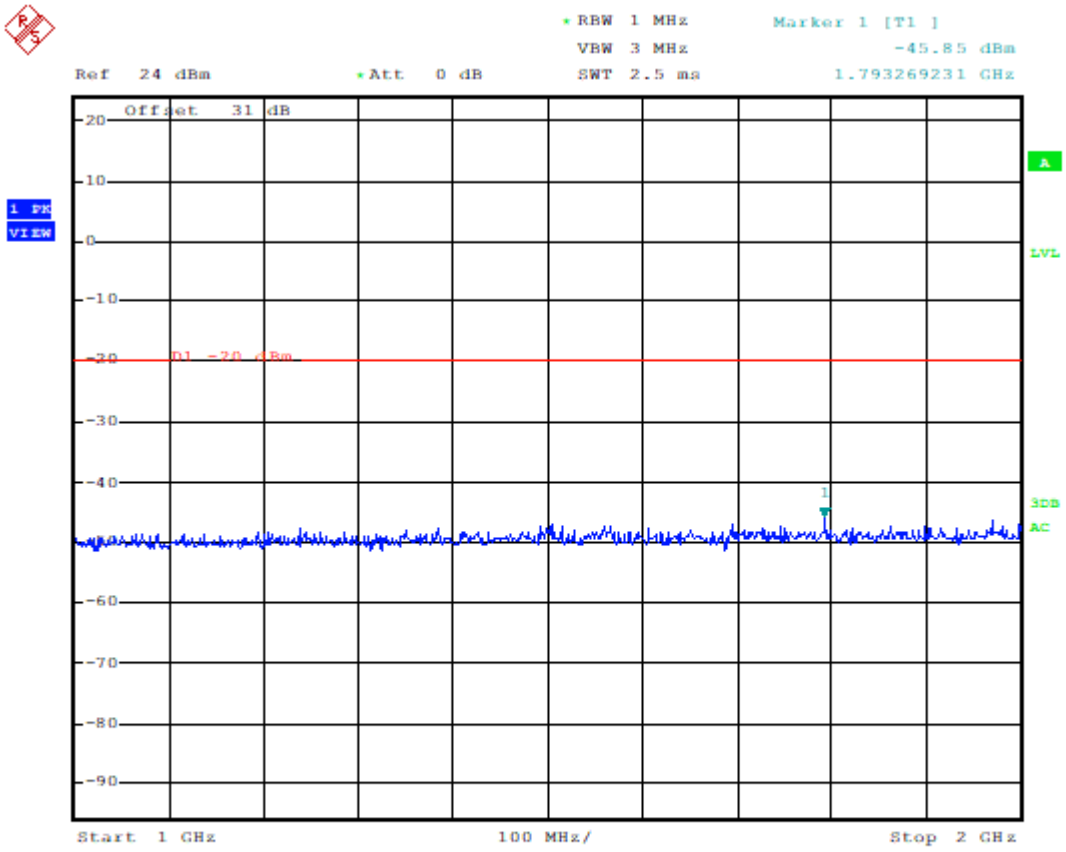
150.8125 MHz, Below 1 GHz



Date: 1.MAY.2020 17:01:27

Conducted Spurious Emissions

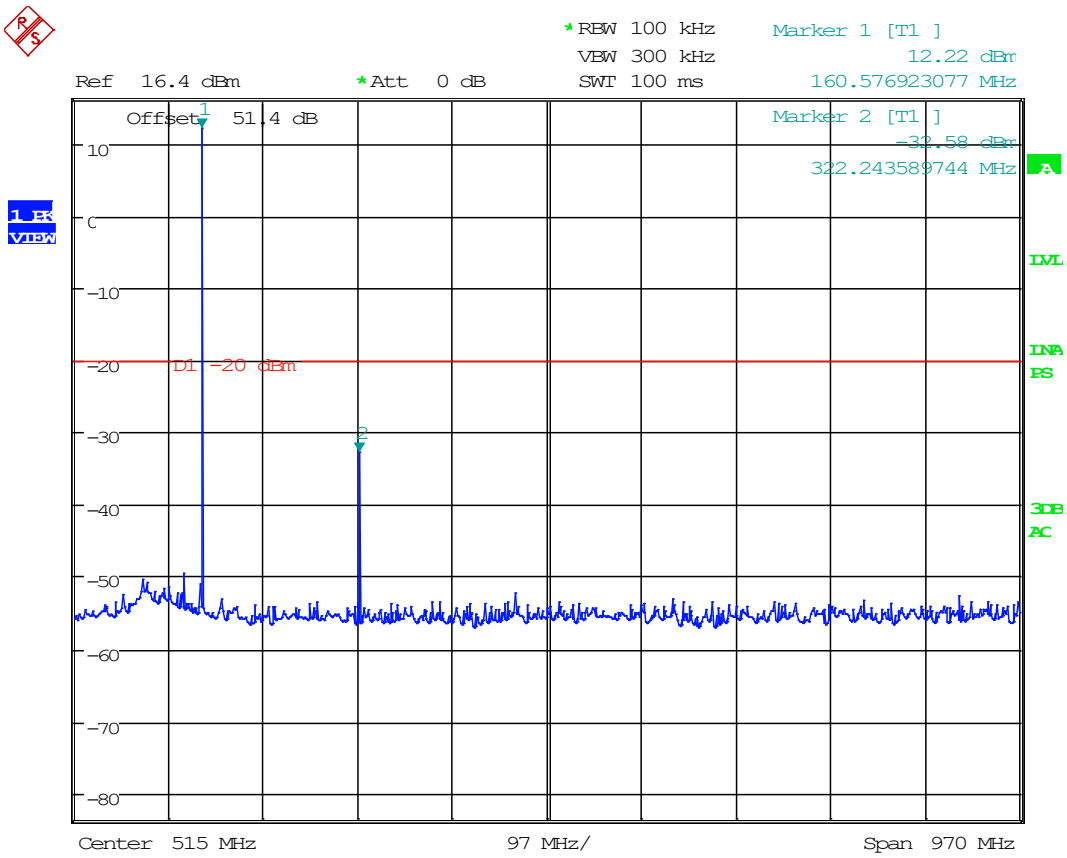
150.8125 MHz, Above 1 GHz



849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Conducted Spurious Emissions

161.000 MHz, Below 1 GHz

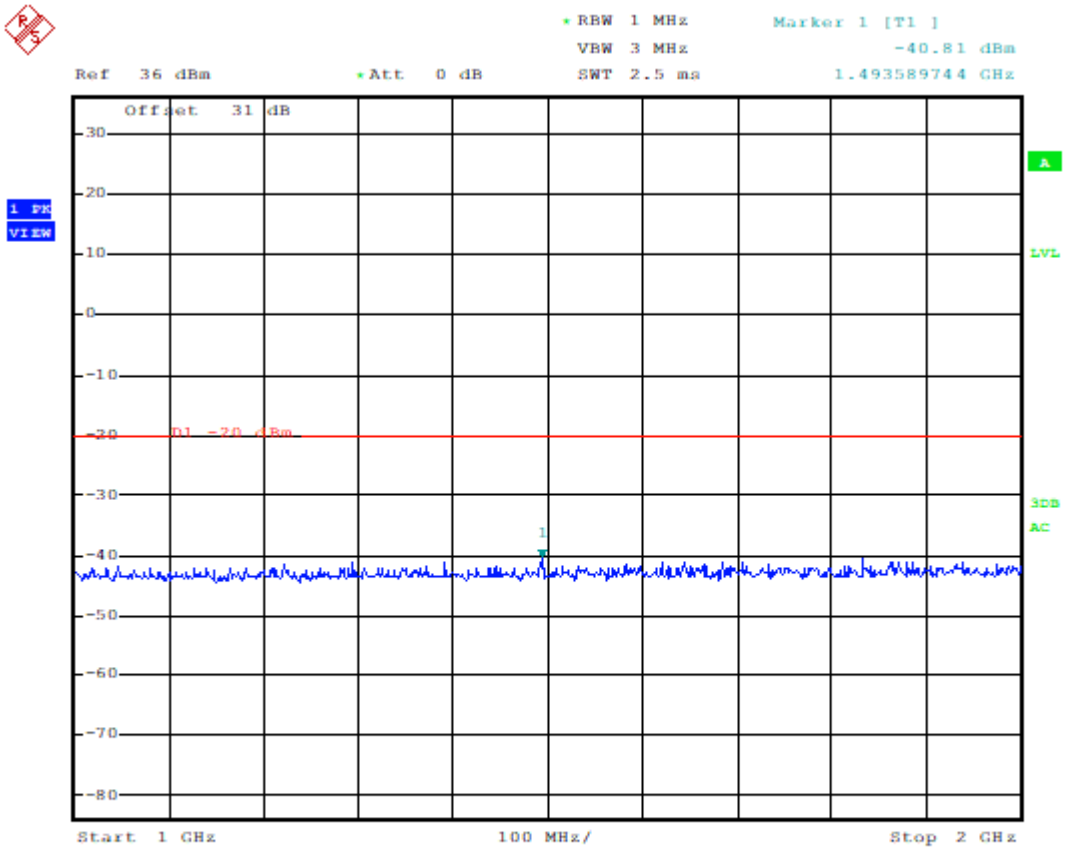


Date: 1.MAY.2020 17:00:10

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Conducted Spurious Emissions

161.000 MHz, Above 1 GHz

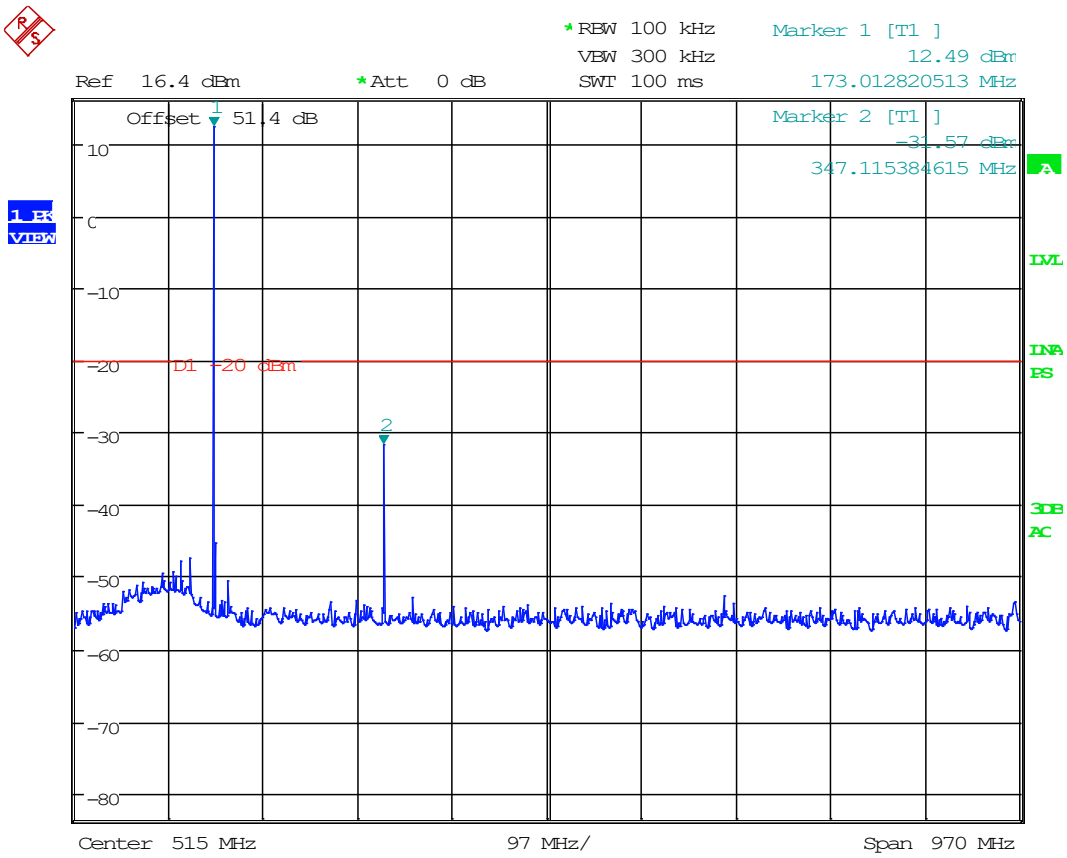


Date: 29.APR.2020 13:27:50

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Conducted Spurious Emissions

173.400 MHz, Below 1 GHz

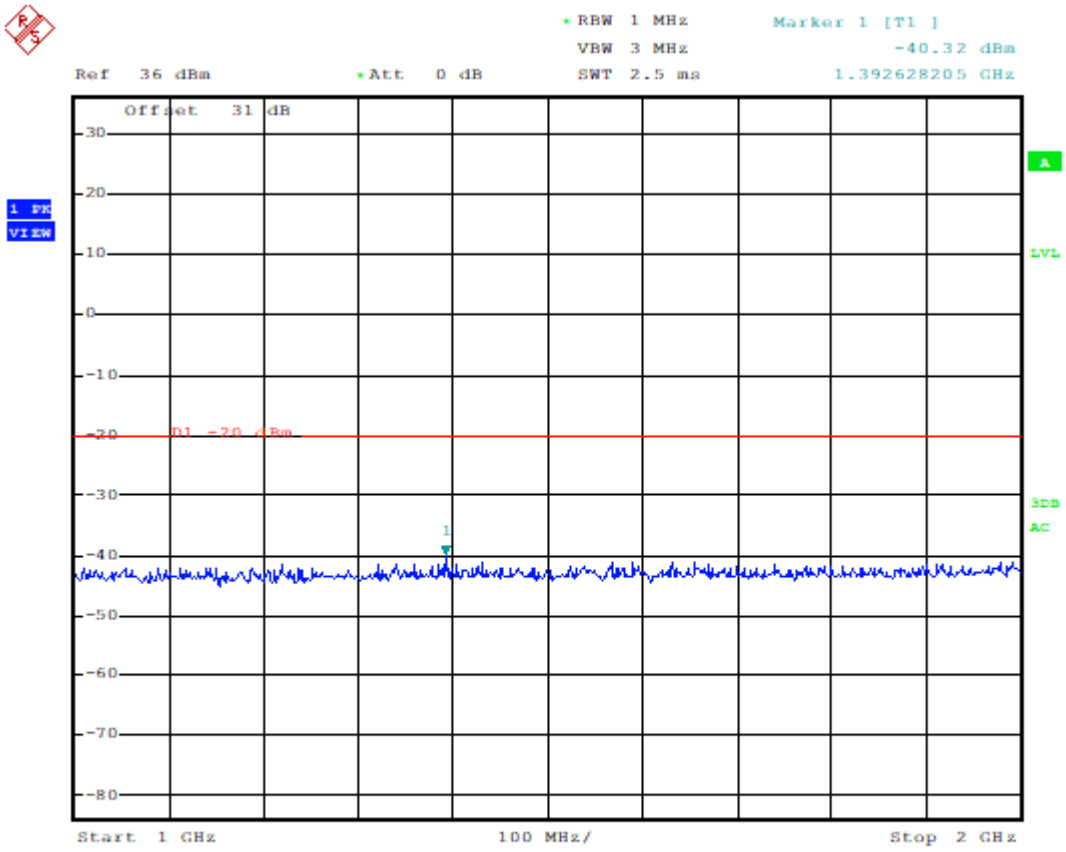


Date: 1.MAY.2020 17:03:43

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Conducted Spurious Emissions

173.400 MHz, Above 1 GHz



Date: 29.APR.2020 13:30:13

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Test Engineer: TR
Test Date: 4/30/2020

Radiated Spurious Emissions

150.8125 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Correction Factor (dB/m)	Field Strength (dBµV/m)	ERP (dBm)	Limit (dBm)	Margin (dBm)
150.81	301.63	21.10	H	2.08	13.80	36.98	-47.14	-13.00	34.14
150.81	301.63	19.11	V	2.08	13.80	34.99	-49.13	-13.00	36.13
150.81	452.44	16.53	V	2.46	16.00	34.99	-47.85	-13.00	34.85
150.81	452.44	13.06	H	2.46	16.00	31.52	-51.32	-13.00	38.32
150.81	603.25	13.04	H	2.86	18.90	34.80	-46.59	-13.00	33.59
150.81	603.25	9.62	V	2.86	18.90	31.38	-50.01	-13.00	37.01
150.81	754.06	7.30	V	3.22	21.20	31.72	-48.67	-13.00	35.67
150.81	754.06	14.37	H	3.22	21.20	38.79	-41.60	-13.00	28.60
150.81	904.88	-0.52	H	3.54	21.80	24.82	-55.33	-13.00	42.33
150.81	904.88	1.51	V	3.54	21.80	26.85	-53.30	-13.00	40.30
150.81	1055.69	-0.87	H	3.77	26.75	29.65	-48.73	-13.00	35.73
150.81	1055.69	-2.41	V	3.77	26.75	28.11	-50.27	-13.00	37.27
150.81	1206.50	0.22	V	3.95	28.05	32.22	-45.74	-13.00	32.74
150.81	1206.50	4.57	H	3.95	28.05	36.57	-41.39	-13.00	28.39
150.81	1357.31	3.83	H	4.24	28.76	36.83	-40.91	-13.00	27.91
150.81	1357.31	5.12	V	4.24	28.76	38.12	-39.62	-13.00	26.62
150.81	1508.13	-1.02	V	4.49	27.77	31.24	-46.81	-13.00	33.81
150.81	1508.13	4.10	H	4.49	27.77	36.36	-41.69	-13.00	28.69

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Radiated Spurious Emissions

161.000 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Correction Factor (dB/m)	Field Strength (dBµV/m)	ERP (dBm)	Limit (dBm)	Margin (dBm)
161.00	322.00	21.25	V	2.09	13.80	37.14	-46.98	-13.00	33.98
161.00	322.00	20.40	H	2.09	13.80	36.29	-47.83	-13.00	34.83
161.00	483.00	11.40	H	2.60	17.40	31.40	-50.71	-13.00	37.71
161.00	483.00	21.80	V	2.60	17.40	41.80	-40.31	-13.00	27.31
161.00	644.00	29.01	V	2.96	20.40	52.37	-28.36	-13.00	15.36
161.00	644.00	22.21	H	2.96	20.40	45.57	-35.16	-13.00	22.16
161.00	805.00	10.59	H	3.36	21.00	34.95	-45.53	-13.00	32.53
161.00	805.00	12.16	V	3.36	21.00	36.52	-43.96	-13.00	30.96
161.00	966.00	2.19	V	3.65	24.10	29.94	-49.34	-13.00	36.34
161.00	966.00	-2.65	H	3.65	24.10	25.10	-54.18	-13.00	41.18
161.00	1127.00	0.37	H	3.87	27.26	31.50	-46.71	-13.00	33.71
161.00	1127.00	2.22	V	3.87	27.26	33.35	-44.86	-13.00	31.86
161.00	1288.00	2.95	V	4.09	28.61	35.65	-42.14	-13.00	29.14
161.00	1288.00	-1.15	H	4.09	28.61	31.55	-46.24	-13.00	33.24
161.00	1449.00	3.90	V	4.41	28.09	36.40	-41.55	-13.00	28.55
161.00	1449.00	7.33	H	4.41	28.09	39.83	-38.12	-13.00	25.12
161.00	1610.00	0.77	H	4.67	28.18	33.62	-44.30	-13.00	31.30
161.00	1610.00	0.54	V	4.67	28.18	33.39	-44.53	-13.00	31.53

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

Radiated Spurious Emissions

173.400 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Correction Factor (dB/m)	Field Strength (dBµV/m)	ERP (dBm)	Limit (dBm)	Margin (dBm)
173.40	346.80	19.33	V	2.11	14.40	35.84	-47.91	-13.00	34.91
173.40	346.80	25.60	H	2.11	14.40	42.11	-41.64	-13.00	28.64
173.40	520.19	18.56	H	2.74	17.20	38.50	-43.71	-13.00	30.71
173.40	520.19	22.14	V	2.74	17.20	42.08	-40.13	-13.00	27.13
173.40	693.59	29.84	V	3.09	21.30	54.23	-26.12	-13.00	13.12
173.40	693.59	34.82	H	3.09	21.30	59.21	-21.14	-13.00	8.14
173.40	866.99	-1.51	H	3.52	23.00	25.01	-54.68	-13.00	41.68
173.40	866.99	-1.59	V	3.52	23.00	24.93	-54.76	-13.00	41.76
173.40	1040.39	-2.11	V	3.76	26.79	28.44	-49.92	-13.00	36.92
173.40	1040.39	1.12	H	3.76	26.79	31.67	-46.69	-13.00	33.69
173.40	1213.78	2.01	H	3.97	28.18	34.16	-43.76	-13.00	30.76
173.40	1213.78	-1.54	V	3.97	28.18	30.61	-47.31	-13.00	34.31
173.40	1387.18	0.38	V	4.33	28.51	33.22	-44.60	-13.00	31.60
173.40	1387.18	4.66	H	4.33	28.51	37.50	-40.32	-13.00	27.32
173.40	1560.58	0.49	H	4.60	27.86	32.95	-45.07	-13.00	32.07
173.40	1560.58	-0.47	V	4.60	27.86	31.99	-46.03	-13.00	33.03
173.40	1733.98	-1.98	V	4.83	29.59	32.44	-45.06	-13.00	32.06
173.40	1733.98	-0.98	H	4.83	29.59	33.44	-44.06	-13.00	31.06

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

END OF TEST REPORT

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM