



849 NW STATE ROAD 45  
NEWBERRY, FL 32669 USA  
PH: 888.472.2424 OR  
352.472.5500  
FAX: 352.472.2030  
EMAIL: [INFO@TIMCOENGR.COM](mailto:INFO@TIMCOENGR.COM)  
[HTTP://WWW.TIMCOENGR.COM](http://WWW.TIMCOENGR.COM)

## AMPLIFIER

### FCC PART 22 TEST REPORT

|                      |                                                                        |
|----------------------|------------------------------------------------------------------------|
| Applicant            | CRESCEND TECHNOLOGIES, LLC                                             |
| Address              | 140 E. State Parkway<br>SCHAUMBURG IL 60173 USA                        |
| FCC ID               | CWWP15XXUH1                                                            |
| Model Number         | P15 SERIES UHF-H                                                       |
| Product Description  | AMPLIFIER                                                              |
| Date Sample Received | 10/23/2017                                                             |
| Date Tested          | 12/06/2017                                                             |
| Tested By            | Franklin Rose                                                          |
| Approved By          | Sid Sanders                                                            |
| Test Results         | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL |

| Report Number      | Version Number | Description      | Issue Date |
|--------------------|----------------|------------------|------------|
| 1532UT17TestReport | Rev1           | Initial Issue    | 12/06/2017 |
| 1532UT17TestReport | Rev2           | Clerical updates | 12/19/2017 |

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL  
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

## TABLE OF CONTENTS

|                                                                |    |
|----------------------------------------------------------------|----|
| GENERAL REMARKS.....                                           | 4  |
| EUT DESCRIPTION .....                                          | 5  |
| TEST RESULTS SUMMARY .....                                     | 6  |
| RF POWER OUTPUT and AMPLIFIER GAIN. §4.5 .....                 | 7  |
| Test Data:    Power Output Measurement Table .....             | 7  |
| AGC THRESHOLD §4.2.....                                        | 8  |
| Test Data:    AGC Table.....                                   | 8  |
| OUT-OF-BAND REJECTION § 4.3 .....                              | 8  |
| INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 456.025 MHz.....   | 9  |
| Test Data: 456.025 MHz – 6.25 kHz Test Signal .....            | 10 |
| Test Data: 456.025 MHz – 6.25 kHz Output Signal.....           | 11 |
| Test Data: 456.025 MHz – 12.5 kHz Test Signal .....            | 12 |
| Test Data: 456.025 MHz – 12.5 kHz Output Signal.....           | 13 |
| Test Data: 456.025 MHz – 25 kHz Test Signal .....              | 14 |
| Test Data: 456.025 MHz – 25 kHz Output Signal .....            | 15 |
| Test Data: 456.025 MHz – P25 Phase 1 C4FM Test Signal .....    | 16 |
| Test Data: 456.025 MHz – P25 Phase 1 C4FM Output Signal.....   | 17 |
| Test Data: 456.025 MHz – P25 Phase 2 H-CPM Test Signal.....    | 18 |
| Test Data: 456.025 MHz – P25 Phase 2 H-CPM Output Signal ..... | 19 |
| INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 459.975 MHz.....   | 20 |
| Test Data: 459.975 MHz – 6.25 kHz Test Signal .....            | 20 |
| Test Data: 459.975 MHz – 6.25 kHz Output Signal.....           | 21 |
| Test Data: 459.975 MHz – 12.5 kHz Test Signal .....            | 22 |
| Test Data: 459.975 MHz – 12.5 kHz Output Signal.....           | 23 |
| Test Data: 459.975 MHz – 25 kHz Test Signal .....              | 24 |
| Test Data: 459.975 MHz – 25 kHz Output Signal .....            | 25 |
| Test Data: 459.975 MHz – P25 Phase 1 C4FM Test Signal .....    | 26 |
| Test Data: 459.975 MHz – P25 Phase 1 C4FM Output Signal.....   | 27 |
| Test Data: 459.975 MHz – P25 Phase 2 H-CPM Test Signal.....    | 28 |
| Test Data: 459.975 MHz – P25 Phase 2 H-CPM Output Signal ..... | 29 |
| INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 470.025 MHz.....   | 30 |
| Test Data: 470.025 MHz – 6.25 kHz Test Signal .....            | 30 |
| Test Data: 470.025 MHz – 6.25 kHz Output Signal.....           | 31 |
| Test Data: 470.025 MHz – 12.5 kHz Test Signal .....            | 32 |
| Test Data: 470.025 MHz – 12.5 kHz Output Signal.....           | 33 |
| Test Data: 470.025 MHz – 25 kHz Test Signal .....              | 34 |
| Test Data: 470.025 MHz – 25 kHz Output Signal .....            | 35 |
| Test Data: 470.025 MHz – P25 Phase 1 C4FM Test Signal .....    | 36 |
| Test Data: 470.025 MHz – P25 Phase 1 C4FM Output Signal.....   | 37 |
| Test Data: 470.025 MHz – P25 Phase 2 H-CPM Test Signal.....    | 38 |
| Test Data: 470.025 MHz – P25 Phase 2 H-CPM Output Signal ..... | 39 |
| INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 491.000 MHz.....   | 40 |
| Test Data: 491.000 MHz – 6.25 kHz Test Signal .....            | 40 |
| Test Data: 491.000 MHz – 6.25 kHz Output Signal.....           | 41 |
| Test Data: 491.000 MHz – 12.5 kHz Test Signal .....            | 42 |



|                                                                               |    |
|-------------------------------------------------------------------------------|----|
| Test Data: 491.000 MHz – 12.5 kHz Output Signal.....                          | 43 |
| Test Data: 491.000 MHz – 25 kHz Test Signal .....                             | 44 |
| Test Data: 491.000 MHz – 25 kHz Output Signal .....                           | 45 |
| Test Data: 491.000 MHz – P25 Phase 1 C4FM Test Signal .....                   | 46 |
| Test Data: 491.000 MHz – P25 Phase 1 C4FM Output Signal.....                  | 47 |
| Test Data: 491.000 MHz – P25 Phase 2 H-CPM Test Signal.....                   | 48 |
| Test Data: 491.000 MHz – P25 Phase 2 H-CPM Output Signal .....                | 49 |
| INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 511.975 MHz.....                  | 50 |
| Test Data: 511.975 MHz – 6.25 kHz Test Signal .....                           | 50 |
| Test Data: 511.975 MHz – 6.25 kHz Output Signal.....                          | 51 |
| Test Data: 511.975 MHz – 12.5 kHz Test Signal .....                           | 52 |
| Test Data: 511.975 MHz – 12.5 kHz Output Signal.....                          | 53 |
| Test Data: 511.975 MHz – 25 kHz Test Signal .....                             | 54 |
| Test Data: 511.975 MHz – 25 kHz Output Signal .....                           | 55 |
| Test Data: 511.975 MHz – P25 Phase 1 C4FM Test Signal .....                   | 56 |
| Test Data: 511.975 MHz – P25 Phase 1 C4FM Output Signal.....                  | 57 |
| Test Data: 511.975 MHz – P25 Phase 2 H-CPM Test Signal.....                   | 58 |
| Test Data: 511.975 MHz – P25 Phase 2 H-CPM Output Signal .....                | 59 |
| NOISE FIGURE §4.6 .....                                                       | 60 |
| OUT OF BAND / OUT OF BLOCK EMISSIONS §4.7 .....                               | 60 |
| ANTENNA CONDUCTED EMISSIONS §4.7.....                                         | 61 |
| Test Data: 456.025 MHz, 459.975 MHz, 470.025 MHz, 491.000 MHz, 511.975 MHz .. | 62 |
| FREQUENCY STABILITY MEASUREMENTS §4.8.....                                    | 63 |
| FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS §4.9 .....                     | 64 |
| Test Data: 456.025 MHz Radiated Emission Table .....                          | 64 |
| Test Data: 459.975 MHz Radiated Emission Table .....                          | 65 |
| Test Data: 470.025 MHz Radiated Emission Table .....                          | 65 |
| Test Data: 491.000 MHz Radiated Emission Table .....                          | 66 |
| Test Data: 511.975 MHz Radiated Emission Table .....                          | 66 |
| EQUIPMENT LIST .....                                                          | 67 |
| STATEMENT OF MEASUREMENT UNCERTAINTY.....                                     | 68 |

## GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

## Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

## Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, 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 the necessary measurements were made at:

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



### Tested by:

Name and Title: Franklin Rose, Testing Technician/Project Manager

**Date: 12/06/2017**



### Reviewed and approved by:

Name and Title: Sid Sanders, Engineer

**Date: 12/15/2017**

## EUT DESCRIPTION

|                                    |                                                                                                                                           |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EUT Description</b>             | AMPLIFIER                                                                                                                                 |
| <b>FCC ID</b>                      | CWWP15XXUH1                                                                                                                               |
| <b>Model Number</b>                | P15 SERIES UHF-H                                                                                                                          |
| <b>Operating Frequency</b>         | 450 - 512 MHz                                                                                                                             |
| <b>Type of Emission</b>            | 16K0F3E, 16K0F3D, 11K3F3E, 11K3F3D, 8K10F1E, 8K10F1D, 8K10F1W, 4K00F1E, 4K00F1D, and G3D (complies using CW signal, per KDB 935210 s.4.1) |
| <b>EUT Power Source</b>            | <input type="checkbox"/> 110–120Vac/50– 60Hz                                                                                              |
|                                    | <input checked="" type="checkbox"/> DC Power 27V                                                                                          |
|                                    | <input type="checkbox"/> Battery Operated Exclusively                                                                                     |
| <b>Test Item</b>                   | <input type="checkbox"/> Prototype                                                                                                        |
|                                    | <input type="checkbox"/> Pre-Production                                                                                                   |
|                                    | <input checked="" type="checkbox"/> Production                                                                                            |
| <b>Type of Equipment</b>           | <input checked="" type="checkbox"/> Fixed                                                                                                 |
|                                    | <input type="checkbox"/> Mobile                                                                                                           |
|                                    | <input type="checkbox"/> Portable                                                                                                         |
| <b>Test Conditions</b>             | The temperature was 26°C with a relative humidity of 50%.                                                                                 |
| <b>Revision History to the EUT</b> | None                                                                                                                                      |
| <b>Test Exercise</b>               | The EUT was operated in a normal mode.                                                                                                    |
| <b>Applicable Standards</b>        | FCC CFR 47 Part 22, FCC CFR 47 Part 90, KDB 935210 D05 v01r02, 971168 D01 v03, KDB 971168-D03 v01 , ANSI C63.26-2015                      |
| <b>Test Facility</b>               | Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.                                                                    |

**EUT Notes:** The EUT is an amplifier which receives RF input signal through a permanently conducted connection. The EUT amplifies when a  $\geq +16$  dBm signal is received via this connection. Therefore, a KDB inquiry was filed to exempt this device from Noise figure measurements, and was accepted by the FCC in KDB inquiry 925403. Furthermore, since the device will never handle multiple signals, another KDB inquiry was filed to exempt this device from Out-Of-Block Intermodulation testing which was also accepted by the FCC in KDB inquiry 885618. Testing reflects these exemptions.

## TEST RESULTS SUMMARY

| FCC RULE PART                                              | Limit          | TEST DESCRIPTION                         | RESULT<br>PASS/FAIL           |
|------------------------------------------------------------|----------------|------------------------------------------|-------------------------------|
| Part 2.1046(a), FCC Pt. 22.627, KDB 935210-D05 v01r02 §4.5 | 1000 W ERP     | Input/output power                       | PASS                          |
| KDB 935210-D05 v01r02 §4.2                                 | Reporting Only | AGC Threshold                            | PASS                          |
| KDB 935210-D05 v01r02 §4.3                                 | Reporting Only | Out-Of-band rejection                    | n/a                           |
| 90.210 & KDB 935210-D05 v01r02 §4.4                        | Reporting Only | Input-versus-output signal comparison    | PASS                          |
| KDB 935210-D05 v01r02 §4.6                                 | 9 dB           | Noise Figure                             | Exempt per KDB Inquiry 925403 |
| 90.210 & KDB 935210-D05 v01r02 §4.4                        | -15.45 dBm     | Out-of-band/out-of-block Intermodulation | Exempt per KDB Inquiry 885618 |
| 90.210 & KDB 935210-D05 v01r02 §4.4                        | -15.45 dBm     | Spurious Emissions Conducted             | PASS                          |
| FCC Pt. 22.355, KDB 935210-D05 v01r02 §4.8                 | 2.5 ppm        | Frequency Stability                      | n/a                           |
| 90.210 & KDB 935210-D05 v01r02 §4.4                        | -15.45 dBm     | Spurious emissions radiated              | PASS                          |

**Note:** The most strict limit possible for this device was used for all measurements which utilize a limit for emissions outside 250% of the bandwidth. This was found by combining the least output power level with the most strict >250% BW dBc limit in 90.210 used by this device. This is expressed as:

**491.00 MHz output of 51.26 dBm – 66.71 dBc (Mask D) = -15.45 dBm**

## RF POWER OUTPUT and AMPLIFIER GAIN. §4.5

**Rule Part No.:** FCC Parts 22.627, Part 2.1046(a)

**Requirements:** 1000 W ERP

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
 § 4.5.1 General  
 § 4.5.2 Determining Amplifier/Booster Gain  
 § 4.5.4 Power Measurement Method 2: Using a power meter

The Input and Output power levels were recorded and the gain calculated using the following formula:

$$\text{Gain}_{\text{dB}} = \text{Output Power}_{\text{dBm}} - \text{Input Power}_{\text{dBm}}$$

### Test Data: Power Output Measurement Table

| Mode | Input Freq (MHz) | Input Power (dBm) | Output Power (dBm) | Output Power (W) | Gain (dB) |
|------|------------------|-------------------|--------------------|------------------|-----------|
| CW   | 456.025          | 16.00             | 51.4               | 138.04           | 35.4      |
| CW   | 459.975          | 16.00             | 51.34              | 136.14           | 35.34     |
| CW   | 470.025          | 16.00             | 51.33              | 135.83           | 35.33     |
| CW   | 491.000          | 16.00             | 51.26              | 133.66           | 35.26     |
| CW   | 511.975          | 16.00             | 51.42              | 138.68           | 35.42     |

### Part 2.1033 (C) (8) DC Input into the final amplifier

INPUT POWER: (13.8 VDC) (44 A) = **607.2 Watts Maximum**

## AGC THRESHOLD §4.2

**Rule Part No.:** KDB935210 § 4.2

**Requirements:** Reporting only

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
§ 4.2 Measuring AGC threshold

### Test Data: AGC Table

| Frequency (MHz) | Input Level (dBm) | Booster Output (dBm) |
|-----------------|-------------------|----------------------|
| 491             | 14.0              | 0.0                  |
| 491             | 15.0              | 0.0                  |
| 491             | 16.00             | 51.26                |
| 491             | 17.00             | 51.26                |
| 491             | 18.00             | 51.26                |
| 491             | 19.00             | 51.26                |

**Note:** Yellow denotes level below AGC; green denotes AGC level +3 dB

**Results:** The EUT does not use AGC

## OUT-OF-BAND REJECTION § 4.3

**Rule Part No.:** KDB 935210 §4.3 Out of band rejection  
KDB 971168

**Requirements:** Reporting Only

**Procedure:** KDB 935210 §4.3 Out of band rejection  
KDB 971168

**Results:** N/A. The EUT amplifies all signals which are passed to it, and does not reject signals which are out-of-band.

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 456.025 MHz

**Rule Part No.:** FCC Pt. 90.210  
KDB 935210-D05 v01r02 §4.4  
KDB 971168-D01 v03 §4  
KDB 971168-D03 v01

**Requirements:** For devices that are classified as signal boosters under §§ 20.21 or 90.219, please refer to KDB Publication 935210 for the applicable procedures. In addition, for any devices like amplifiers, repeaters, and boosters, a comparison of the input modulated spectrum and the output modulated spectrum are required. This corresponds to the occupied bandwidth test required under § 2.1049.

A signal booster must be designed such that all signals that it retransmits meet the following requirements:

The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed.

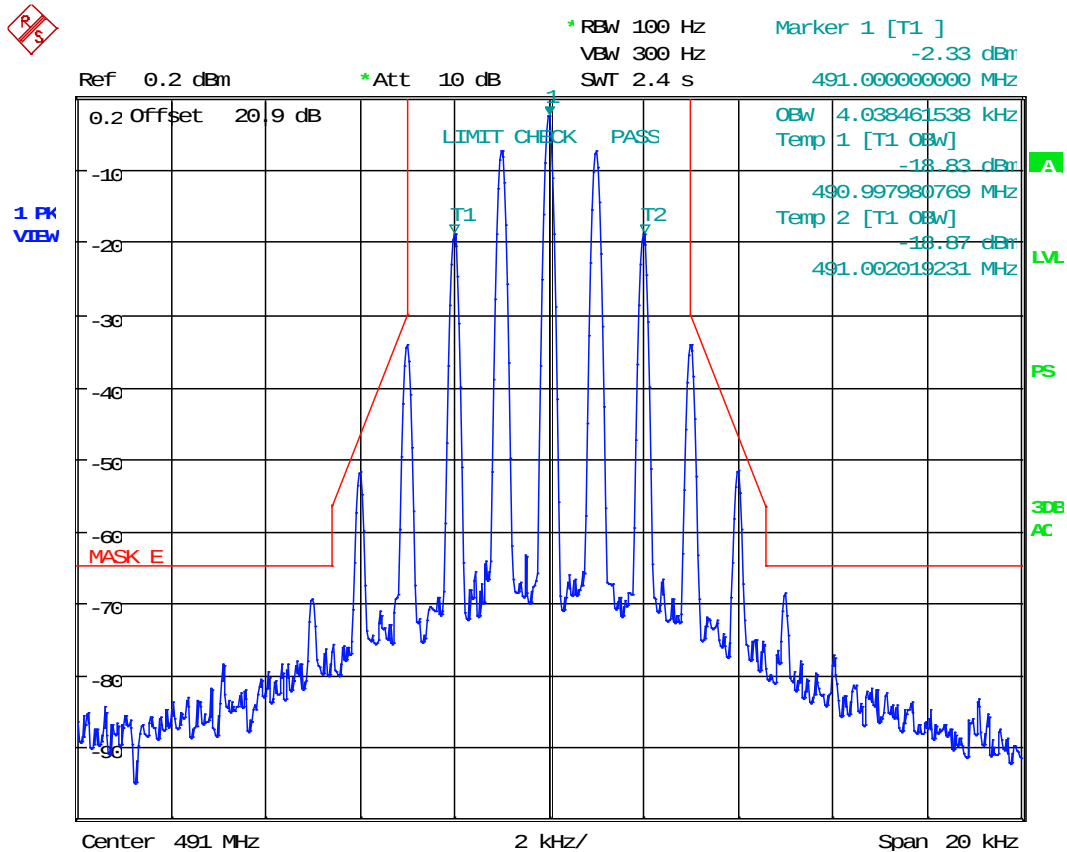
There is no change in the occupied bandwidth of the retransmitted signals.

The retransmitted signals continue to meet the unwanted emissions limits of §90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

**Procedure:** KDB935210 § 4.4 - Input versus output signal comparison  
  
KDB 971168-D01 v03 §4 - The relative OBW must be measured and reported when it is specified in the applicable rule part; otherwise, the 99 % OBW shall be measured and reported.

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

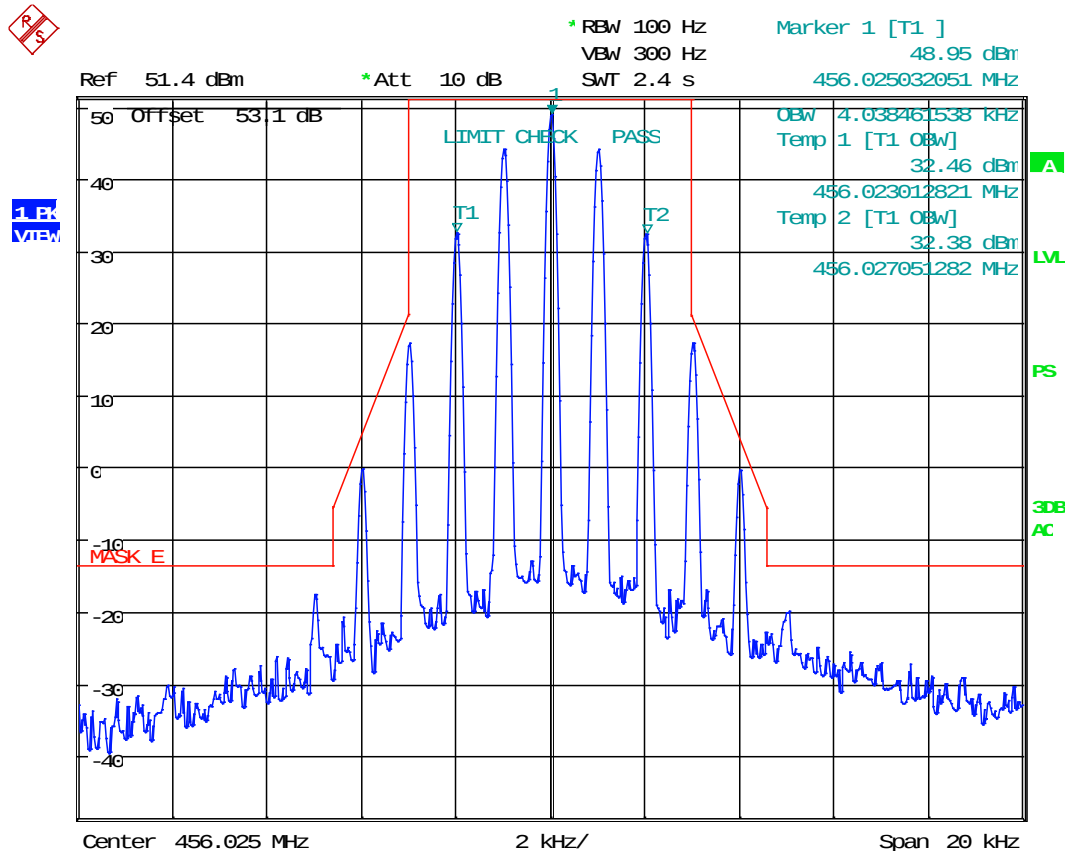
Test Data: 456.025 MHz – 6.25 kHz Test Signal



Date: 30.NOV.2017 13:41:00

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

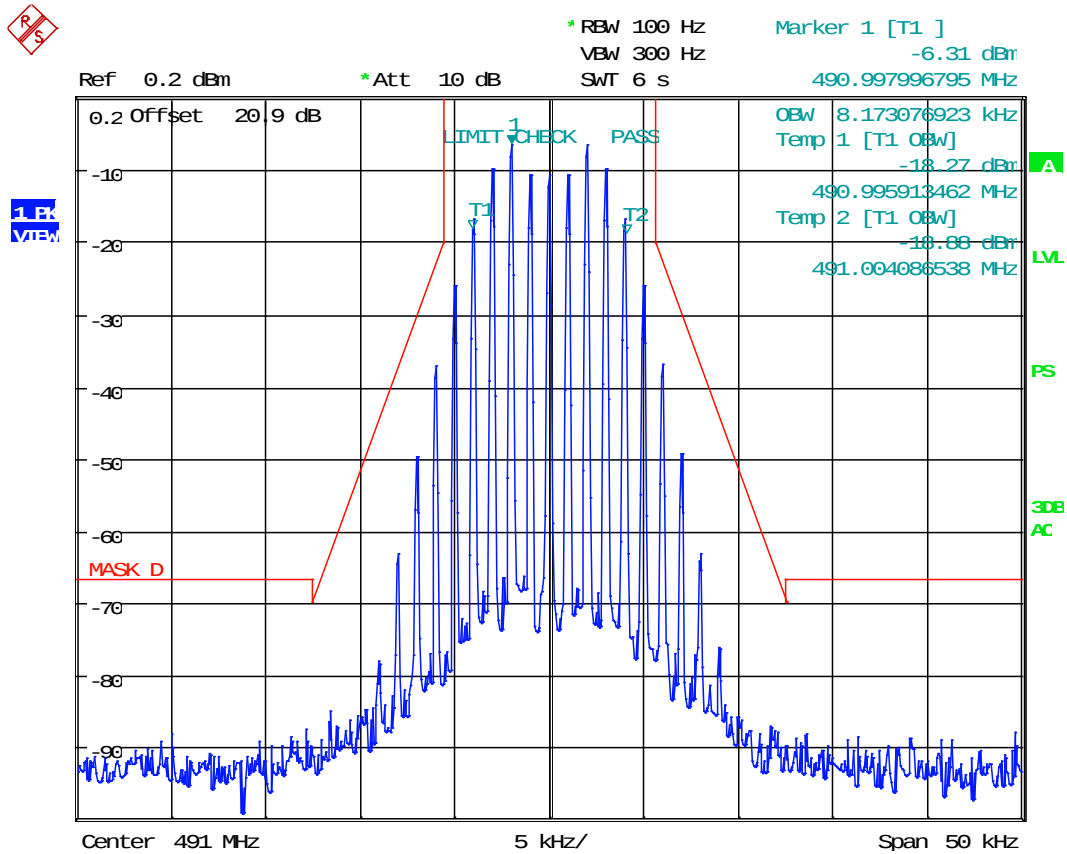
Test Data: 456.025 MHz – 6.25 kHz Output Signal



Date: 1.DEC.2017 14:40:26

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

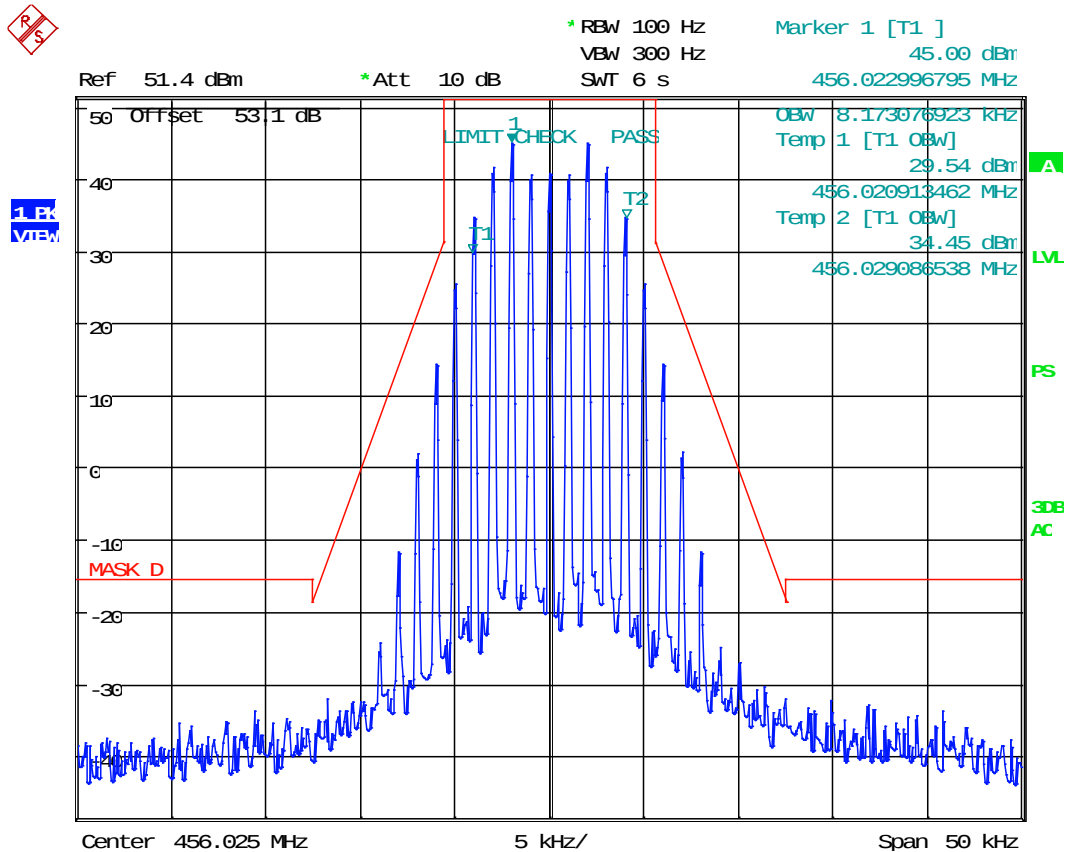
Test Data: 456.025 MHz – 12.5 kHz Test Signal



Date: 30.NOV.2017 13:45:54

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

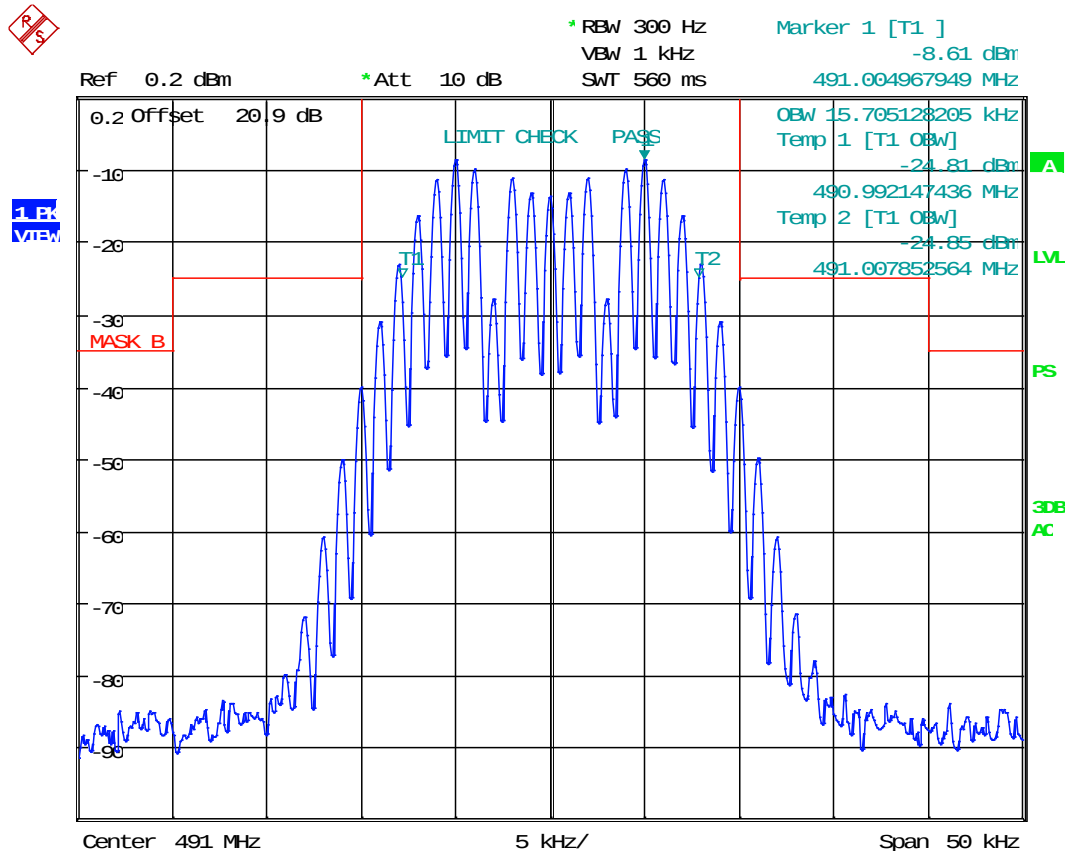
Test Data: 456.025 MHz – 12.5 kHz Output Signal



Date: 1.DEC.2017 14:46:38

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

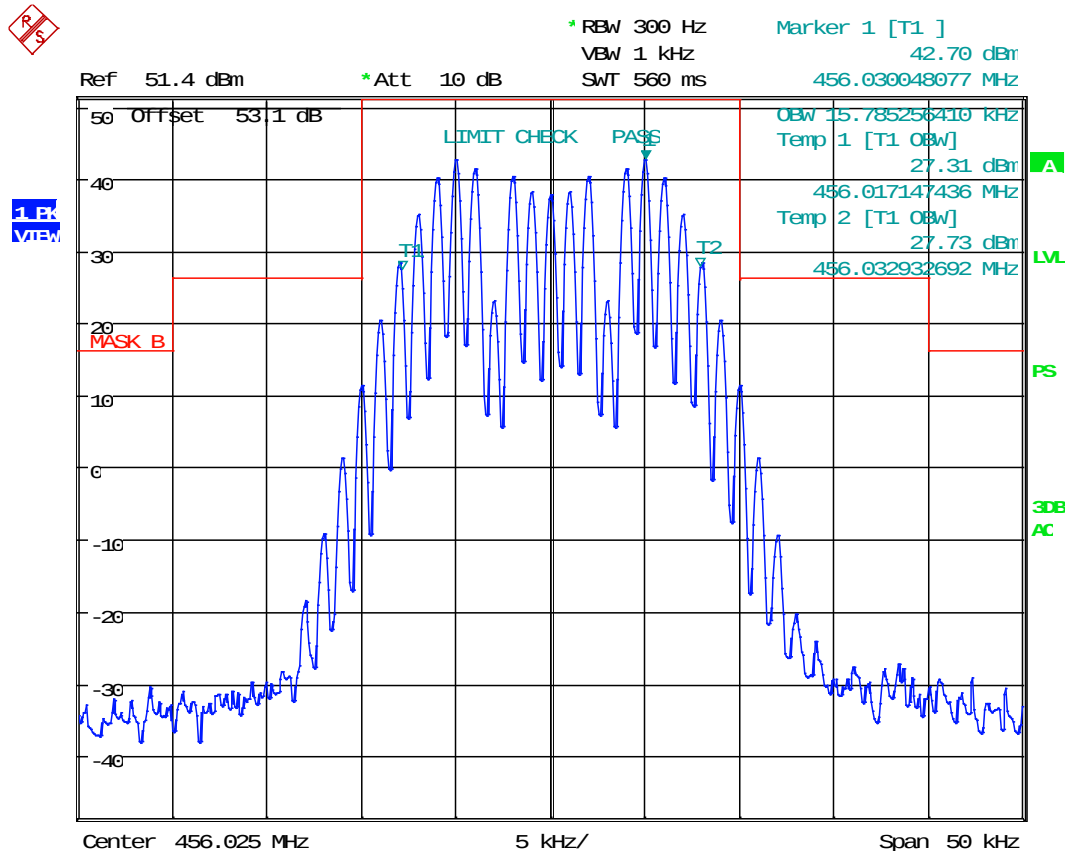
Test Data: 456.025 MHz – 25 kHz Test Signal



Date: 30.NOV.2017 13:47:43

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

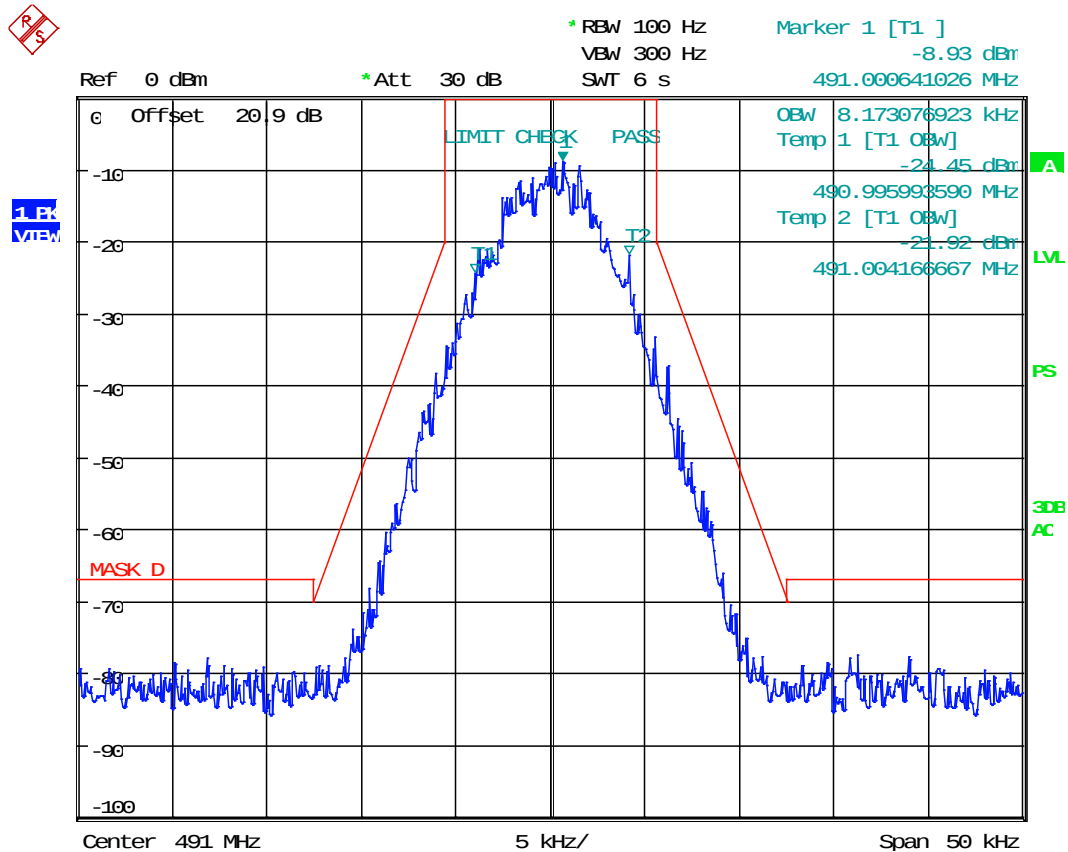
Test Data: 456.025 MHz – 25 kHz Output Signal



Date: 1.DEC.2017 15:13:57

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

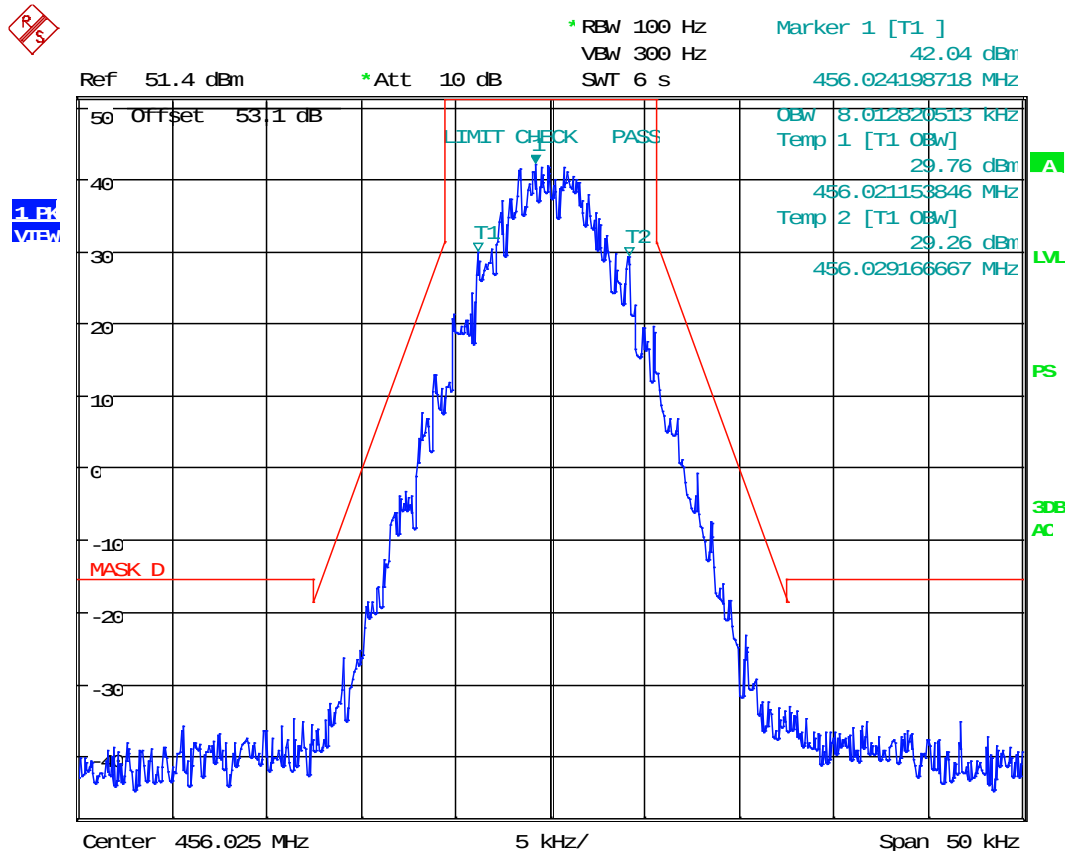
Test Data: 456.025 MHz – P25 Phase 1 C4FM Test Signal



Date: 1.DEC.2017 15:46:39

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

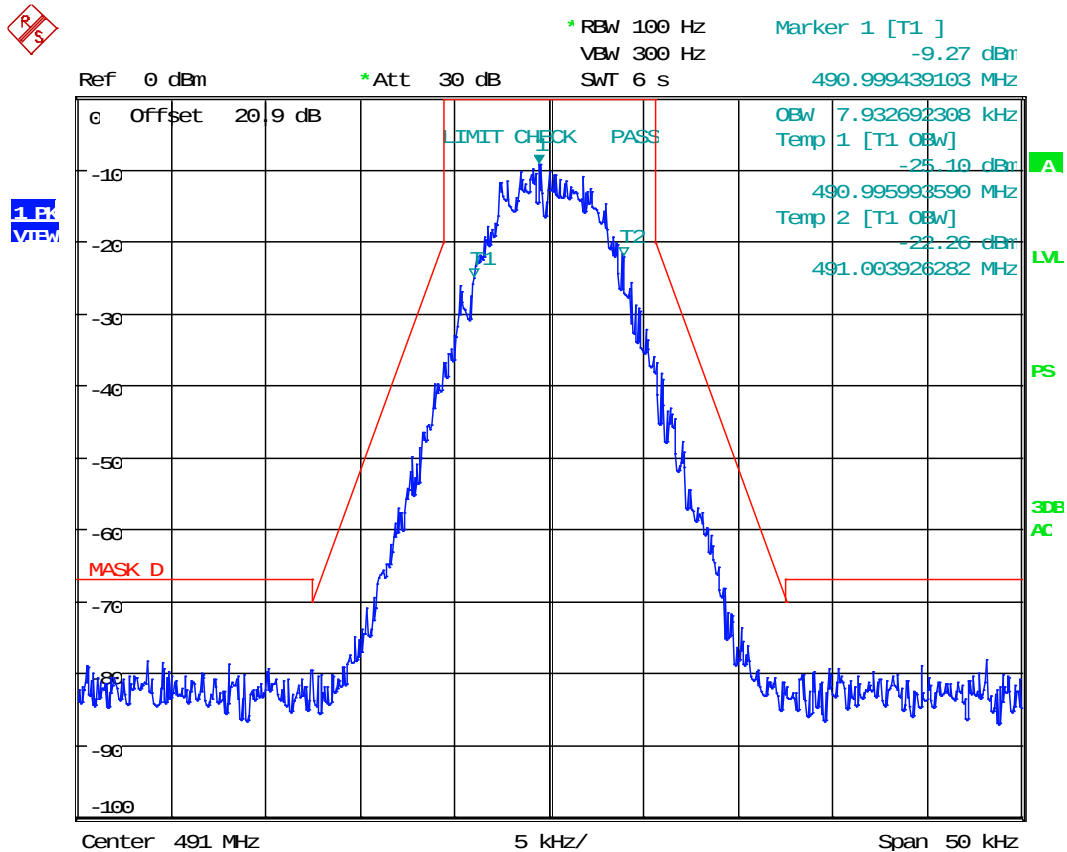
Test Data: 456.025 MHz – P25 Phase 1 C4FM Output Signal



Date: 1.DEC.2017 15:22:32

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

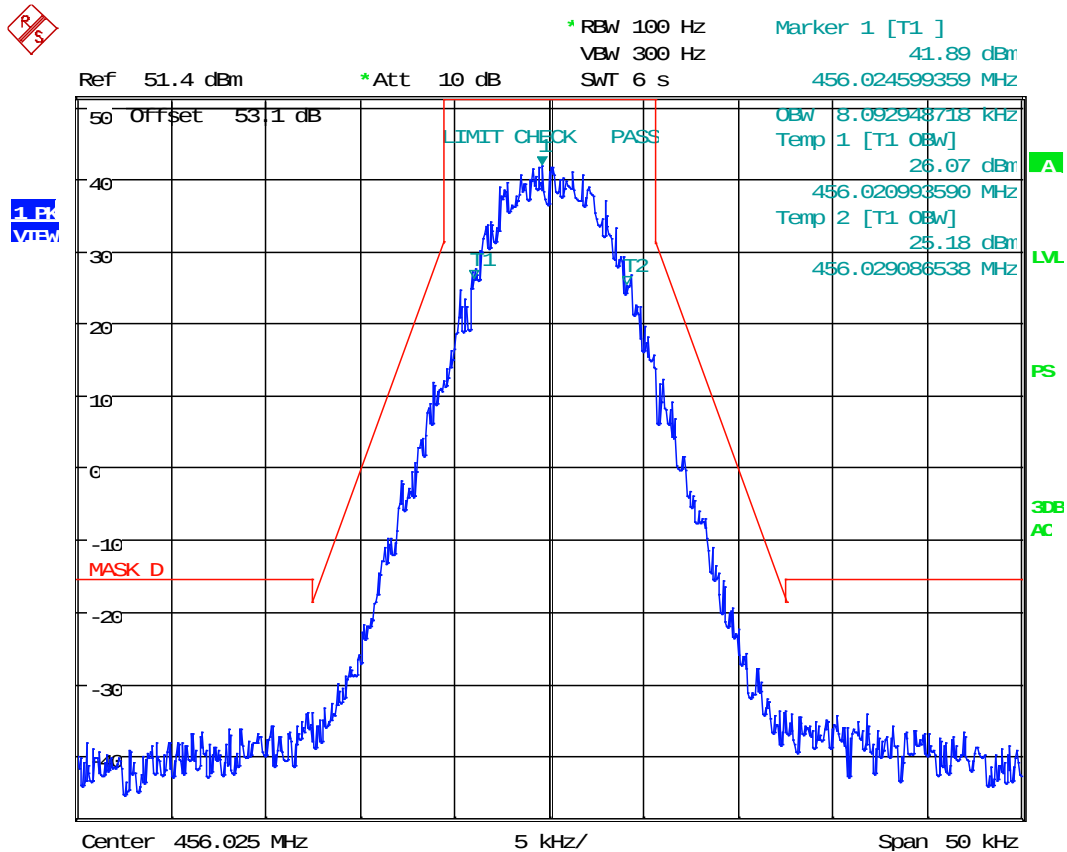
Test Data: 456.025 MHz – P25 Phase 2 H-CPM Test Signal



Date: 1.DEC.2017 15:48:13

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

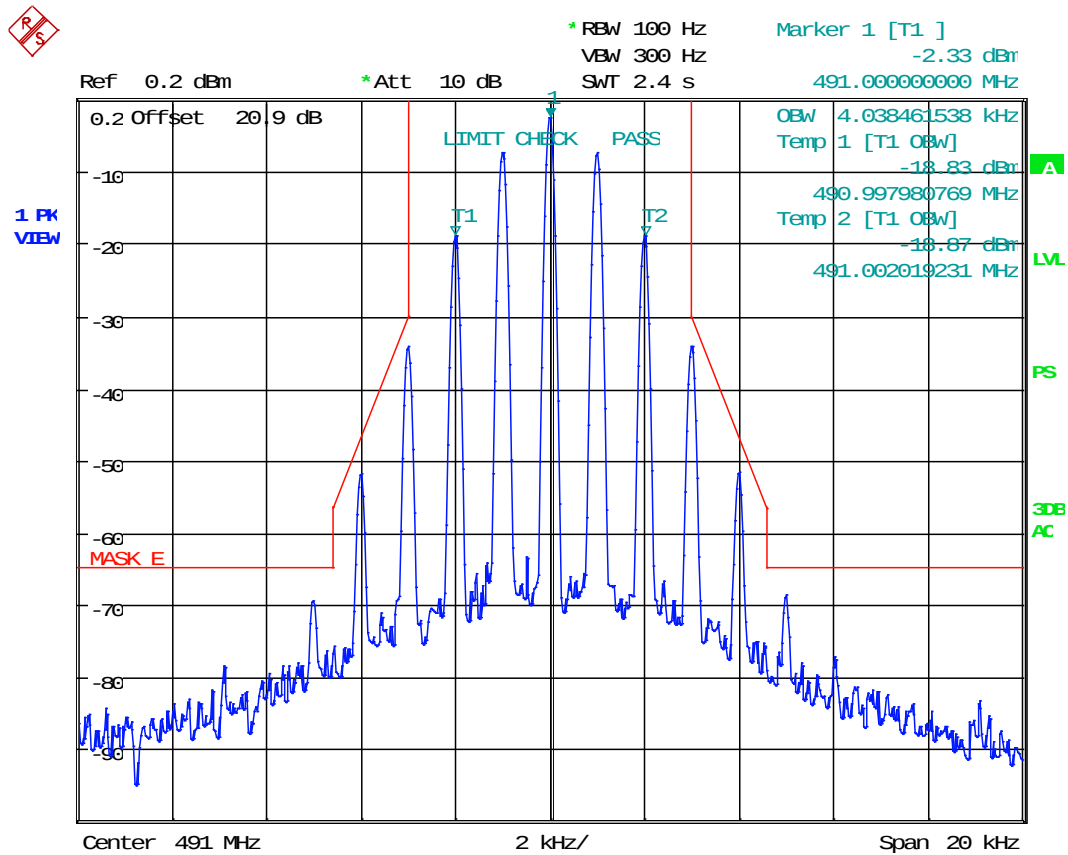
Test Data: 456.025 MHz – P25 Phase 2 H-CPM Output Signal



Date: 1.DEC.2017 15:24:21

# INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 459.975 MHz

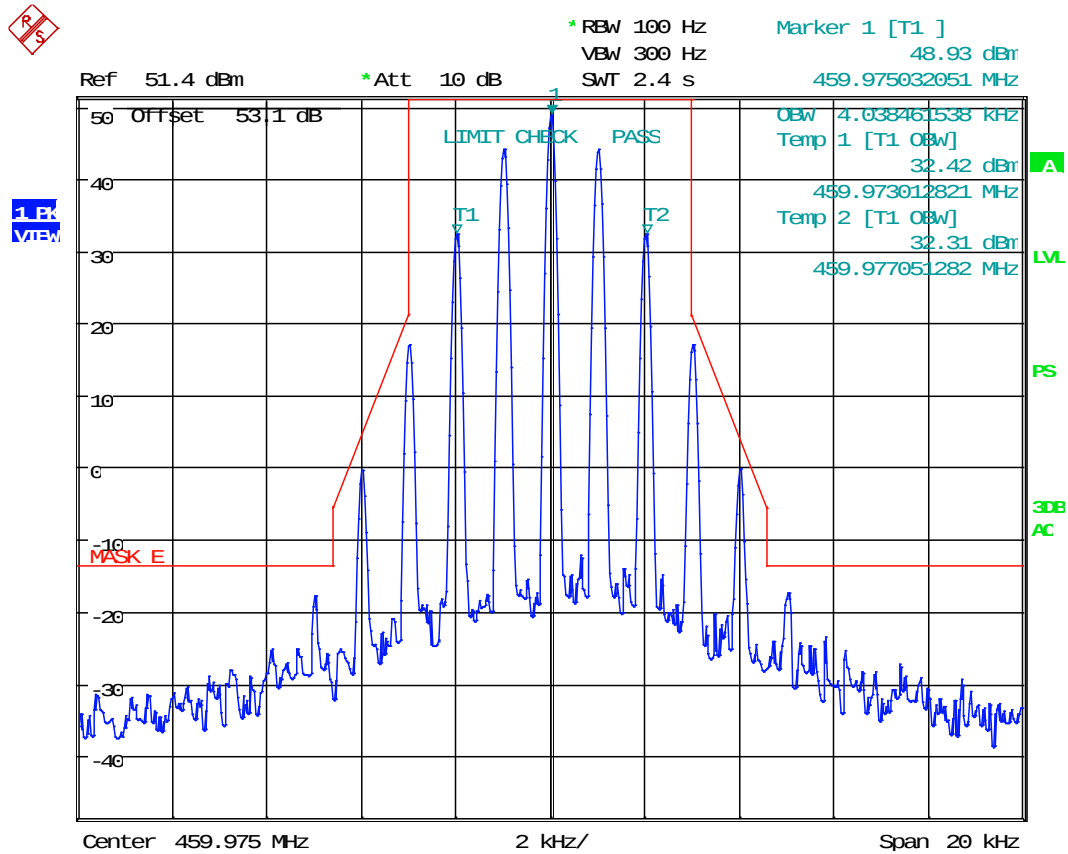
Test Data: 459.975 MHz – 6.25 kHz Test Signal



Date: 30.NOV.2017 13:41:00

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

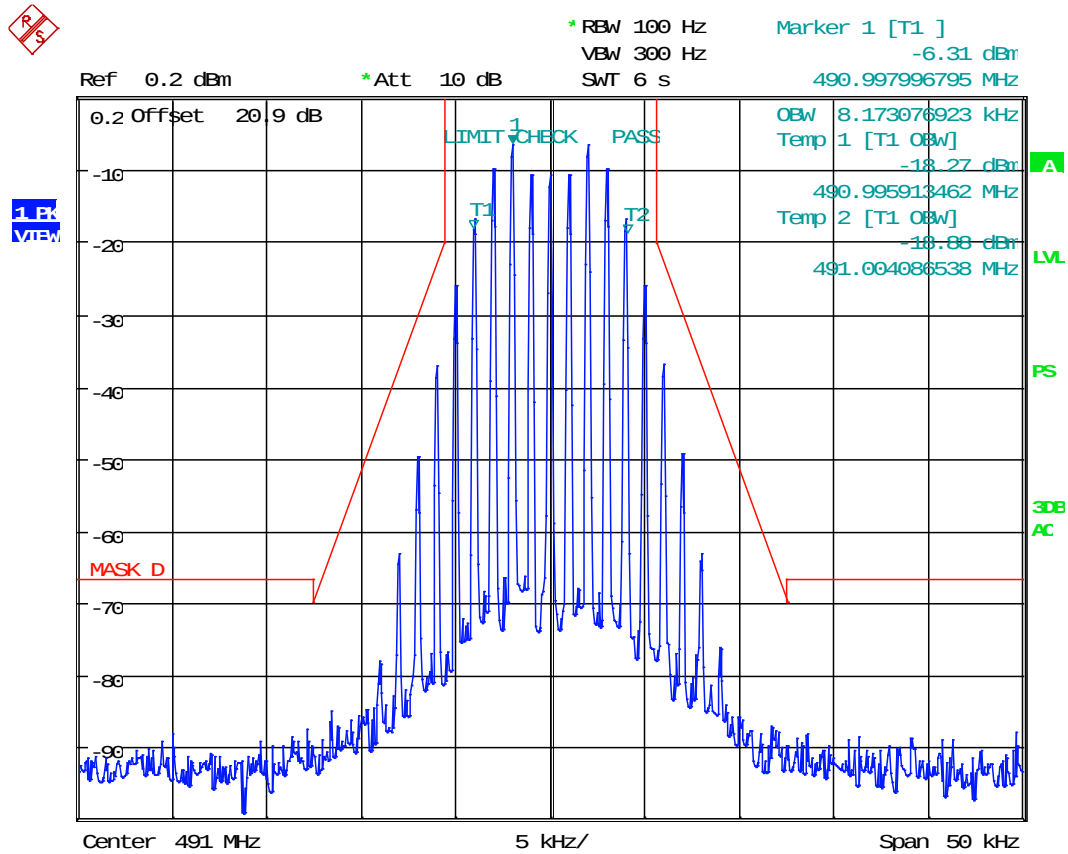
Test Data: 459.975 MHz – 6.25 kHz Output Signal



Date: 1.DEC.2017 14:39:20

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

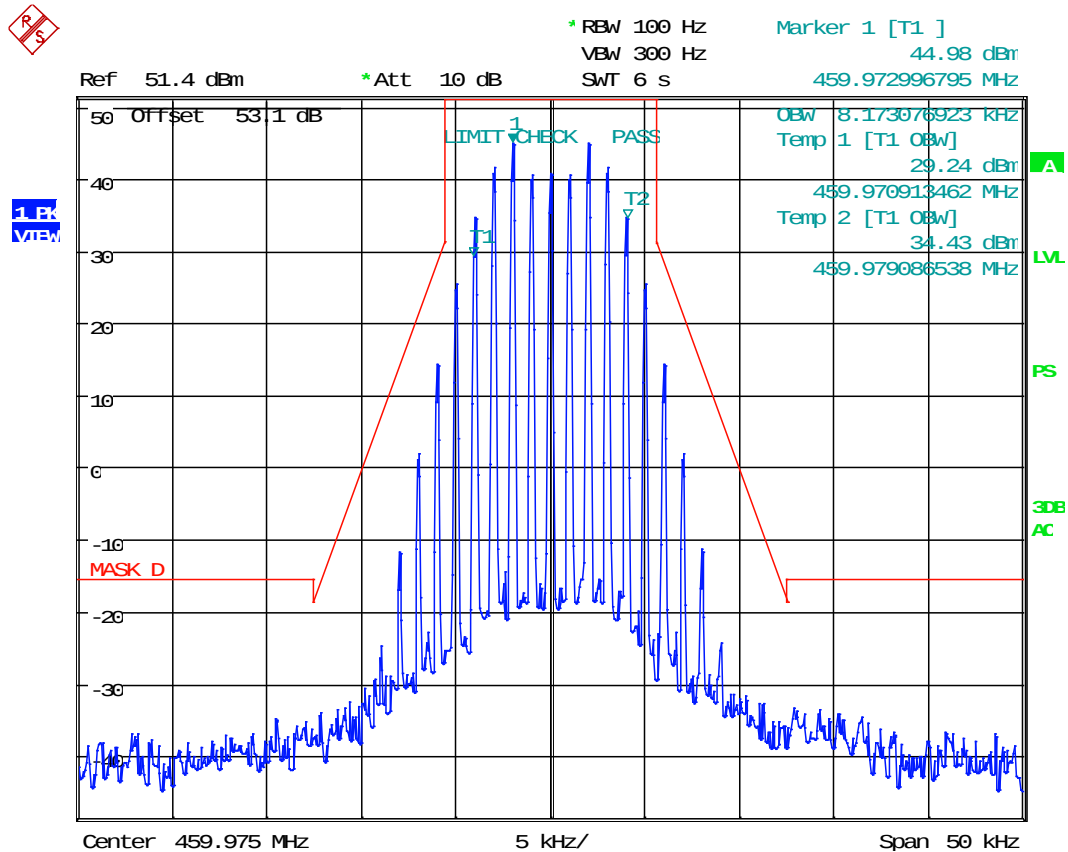
Test Data: 459.975 MHz – 12.5 kHz Test Signal



Date: 30.NOV.2017 13:45:54

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

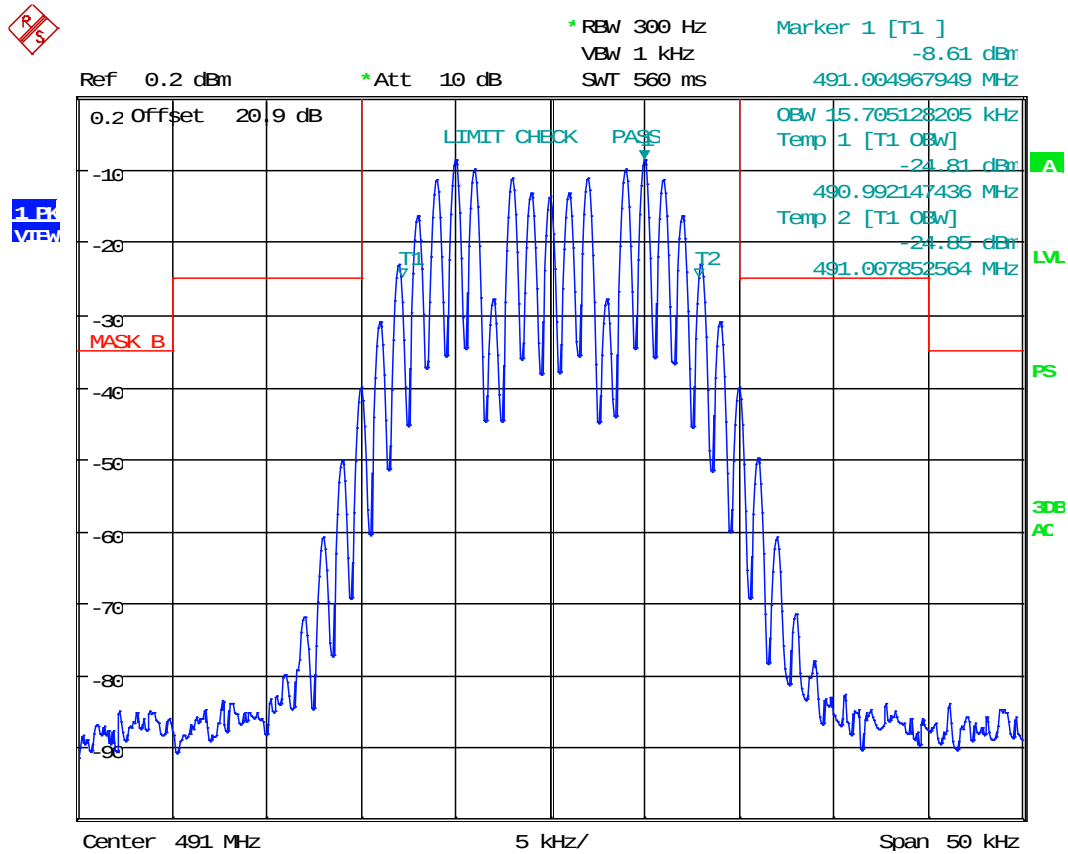
Test Data: 459.975 MHz – 12.5 kHz Output Signal



Date: 1.DEC.2017 14:48:10

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

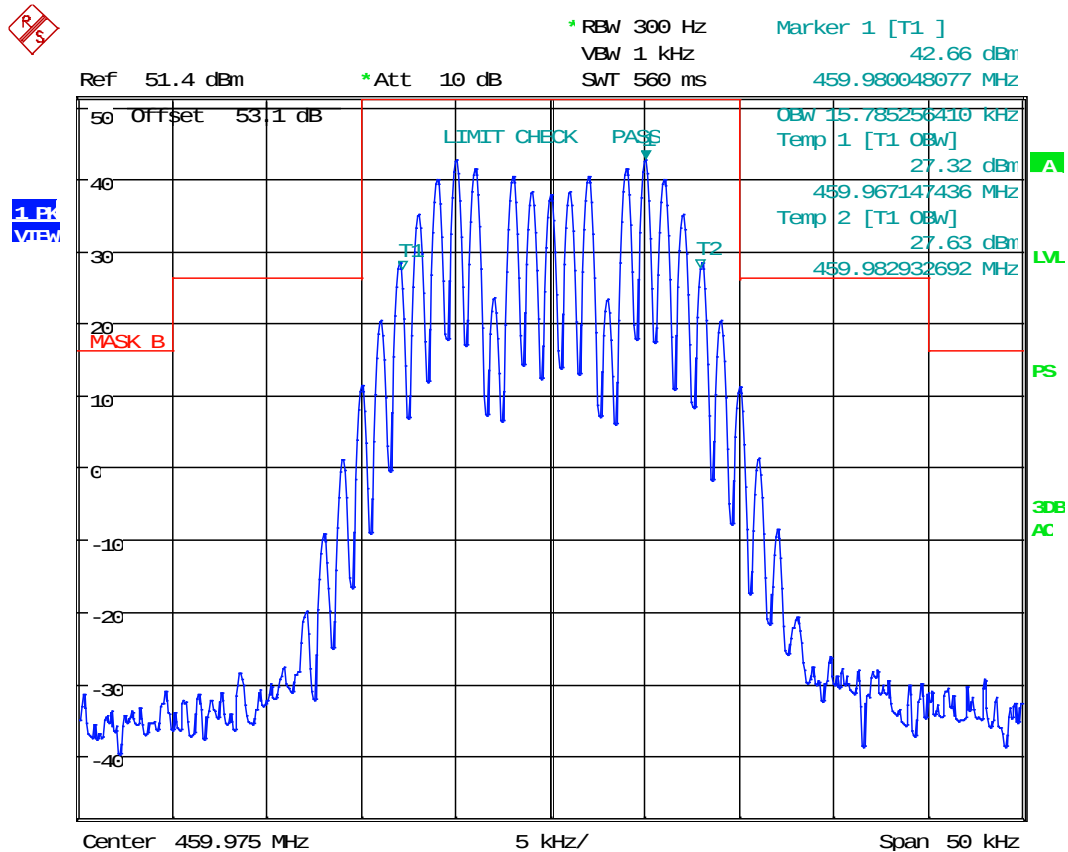
Test Data: 459.975 MHz – 25 kHz Test Signal



Date: 30.NOV.2017 13:47:43

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

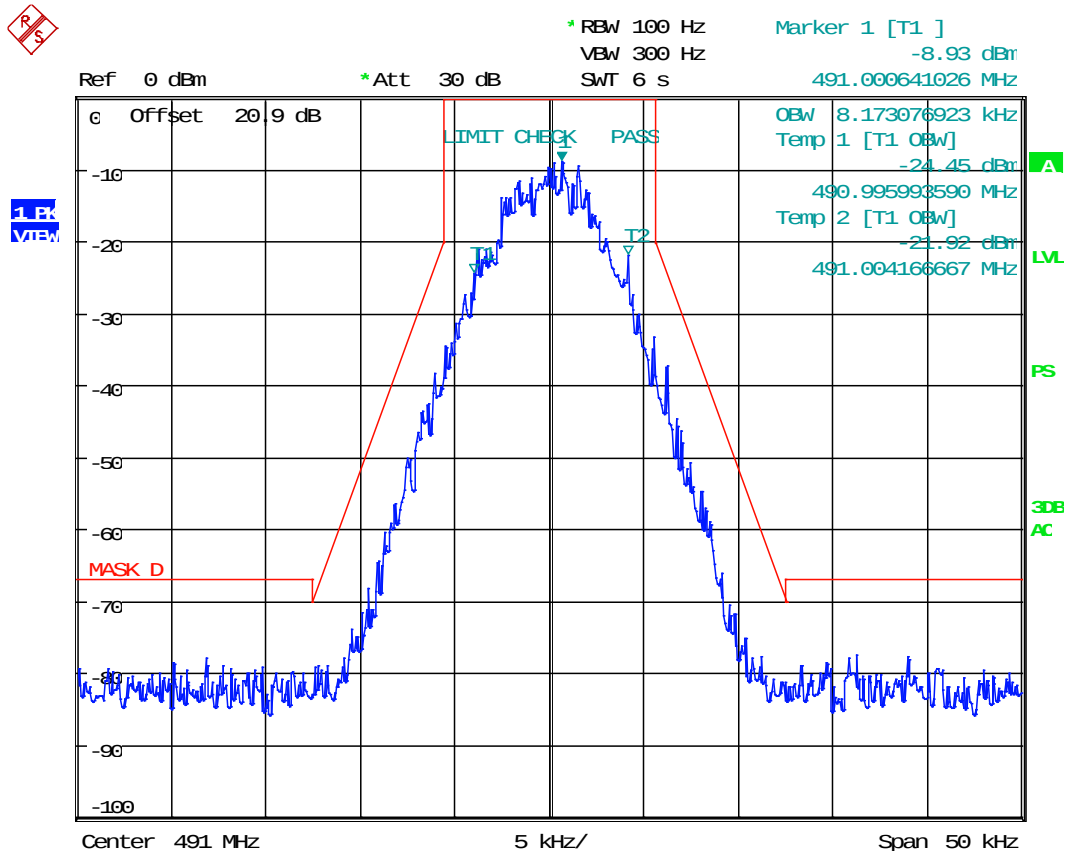
Test Data: 459.975 MHz – 25 kHz Output Signal



Date: 1.DEC.2017 15:15:37

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

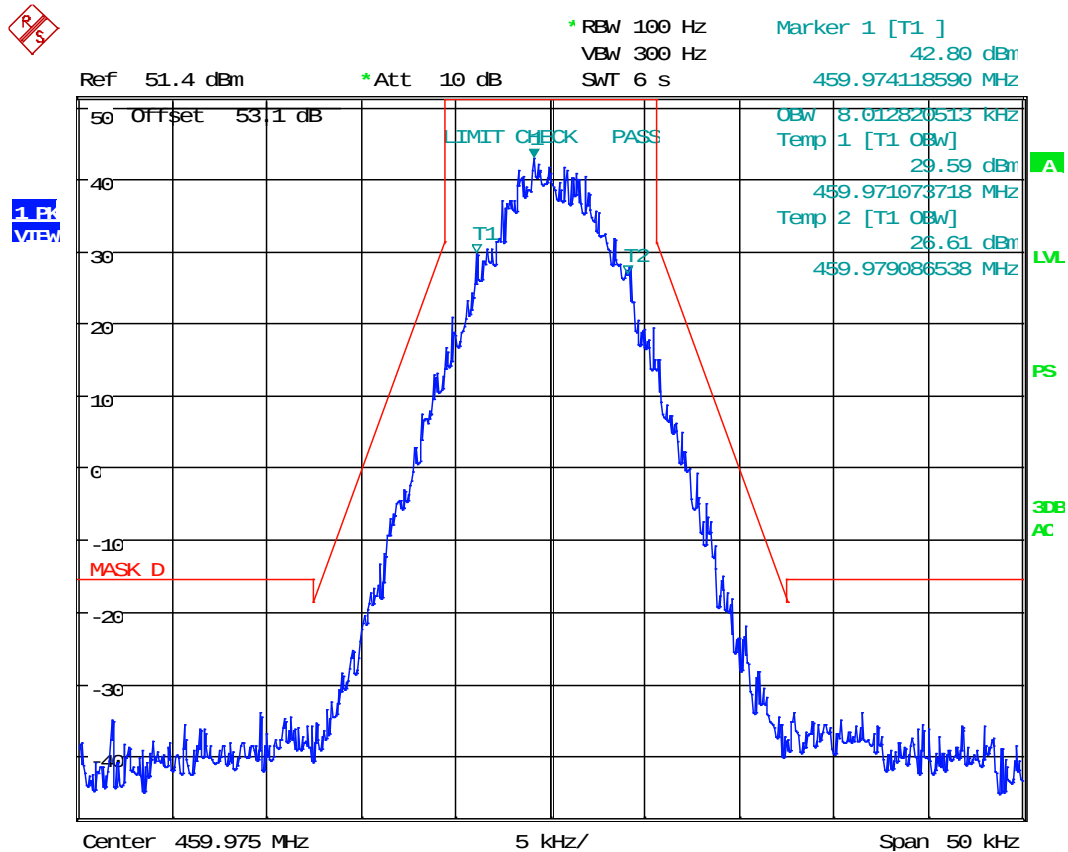
Test Data: 459.975 MHz – P25 Phase 1 C4FM Test Signal



Date: 1.DEC.2017 15:46:39

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

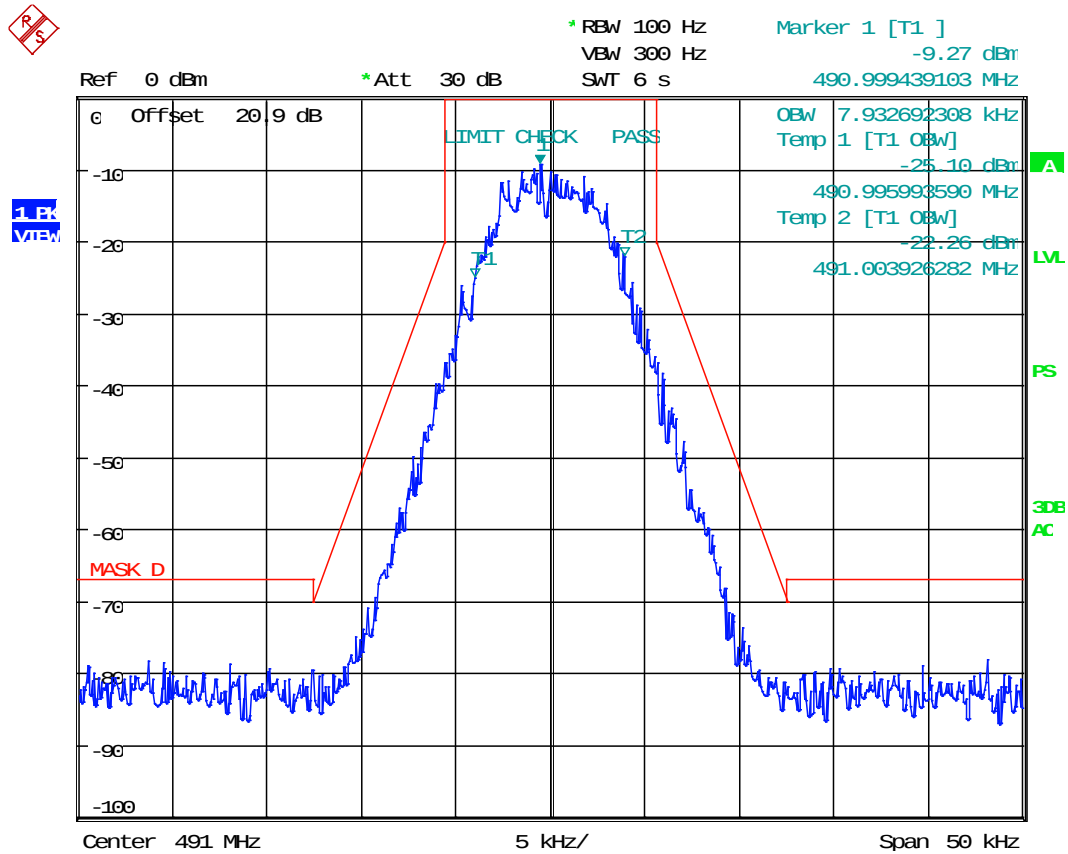
Test Data: 459.975 MHz – P25 Phase 1 C4FM Output Signal



Date: 1.DEC.2017 15:31:50

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

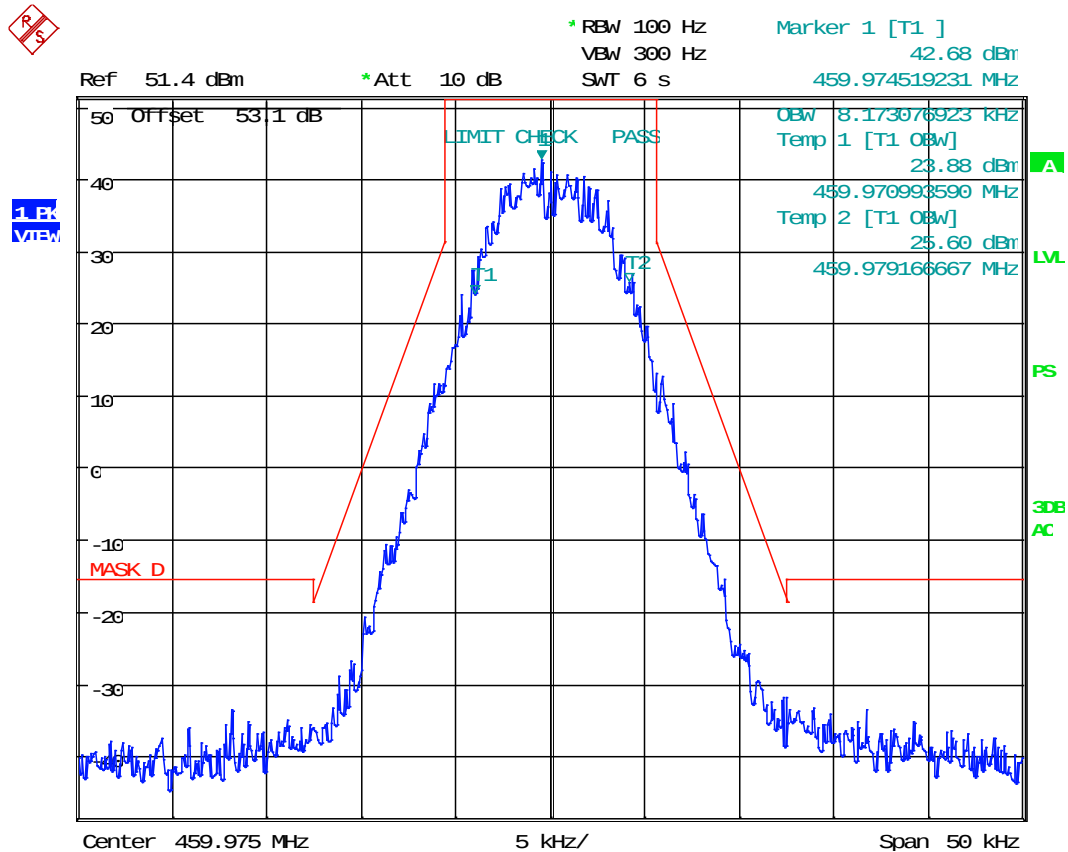
Test Data: 459.975 MHz – P25 Phase 2 H-CPM Test Signal



Date: 1.DEC.2017 15:48:13

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

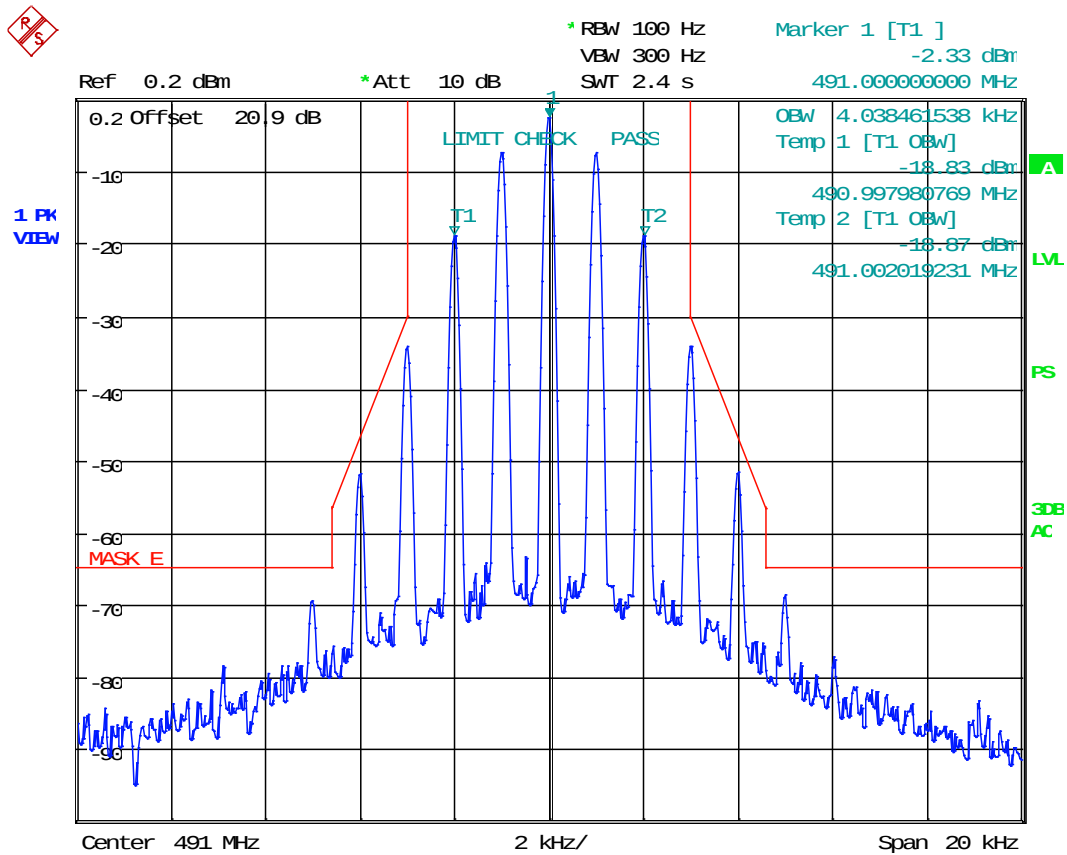
Test Data: 459.975 MHz – P25 Phase 2 H-CPM Output Signal



Date: 1.DEC.2017 15:27:39

# INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 470.025 MHz

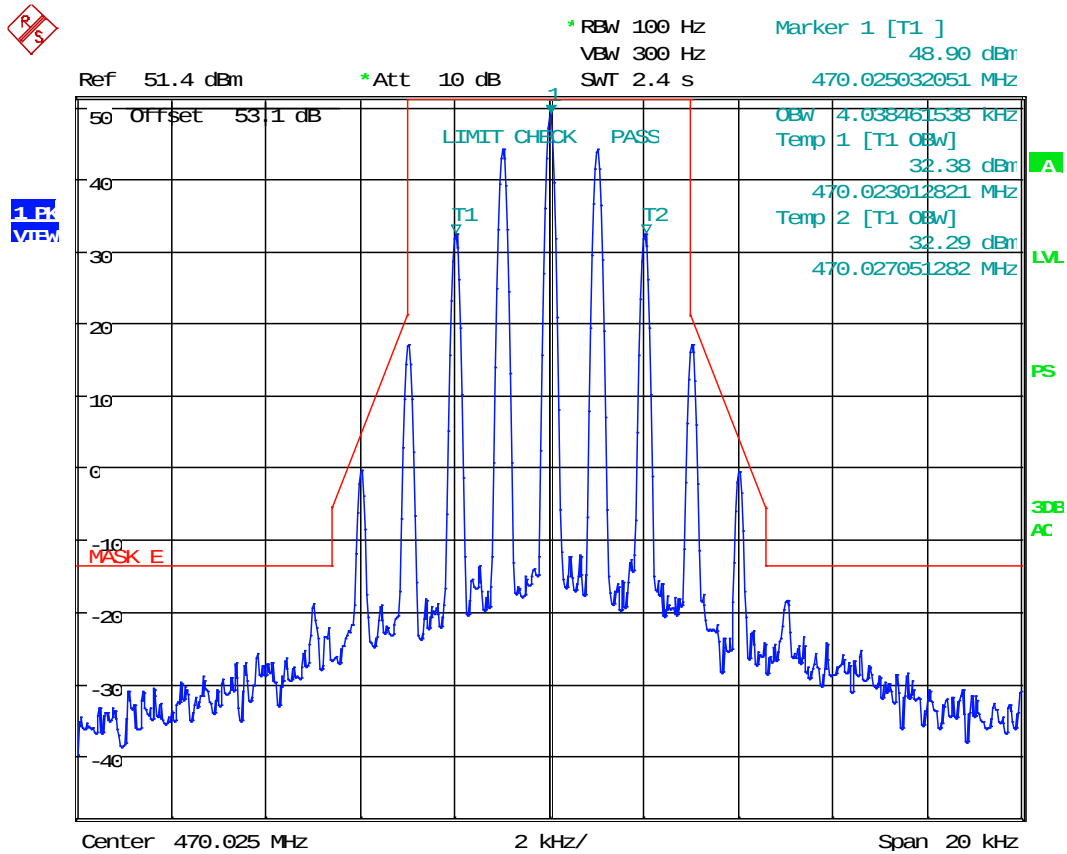
Test Data: 470.025 MHz – 6.25 kHz Test Signal



Date: 30.NOV.2017 13:41:00

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

Test Data: 470.025 MHz – 6.25 kHz Output Signal

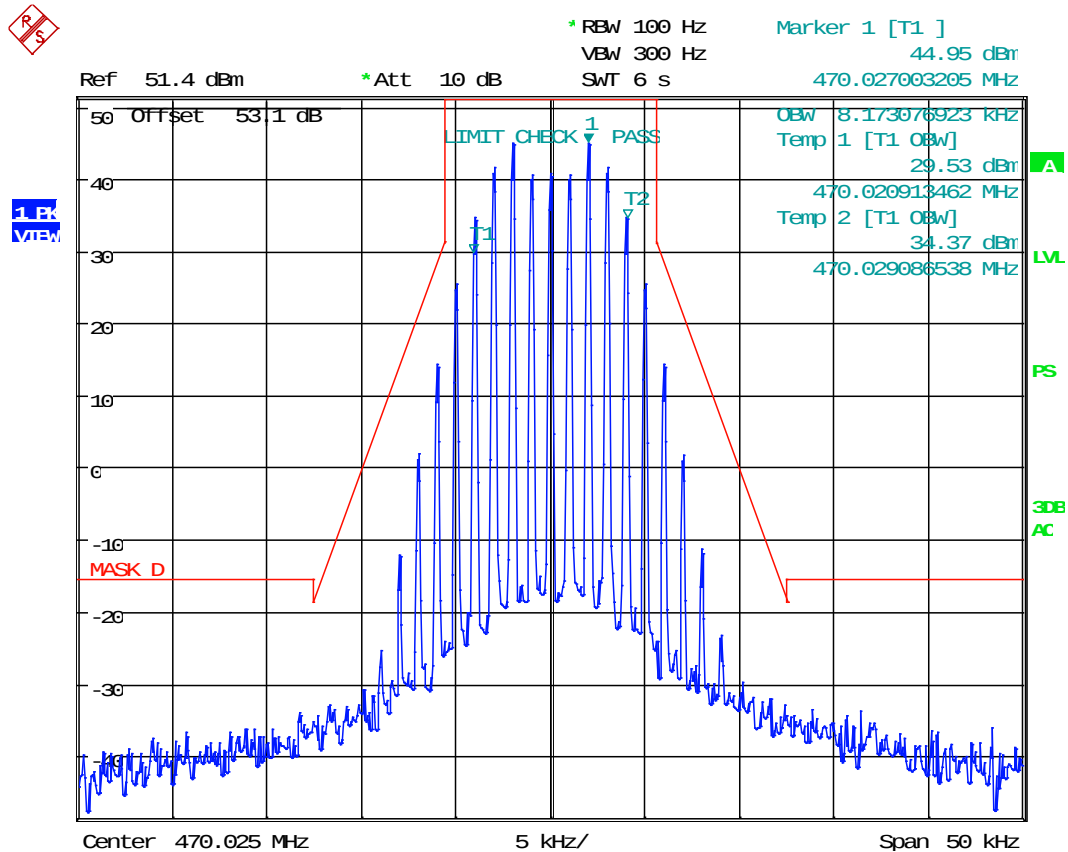


Date: 1.DEC.2017 14:42:41



## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

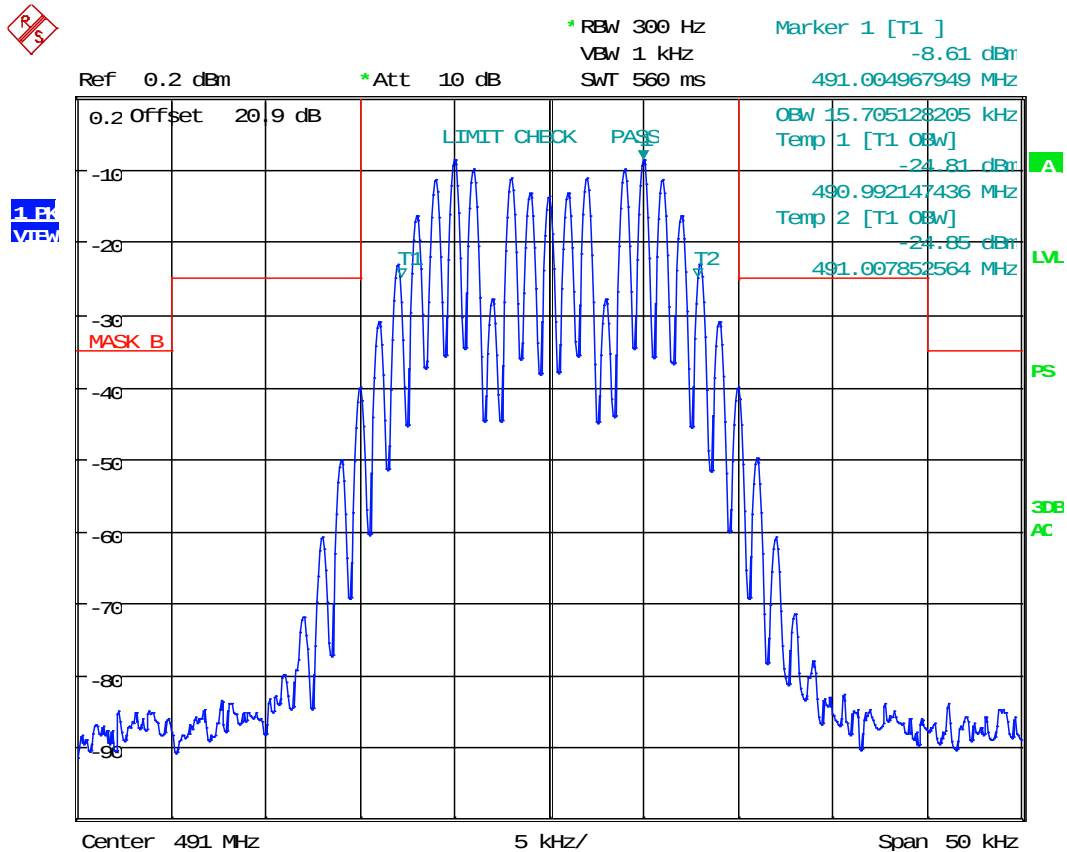
Test Data: 470.025 MHz – 12.5 kHz Output Signal



Date: 1.DEC.2017 14:53:09

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

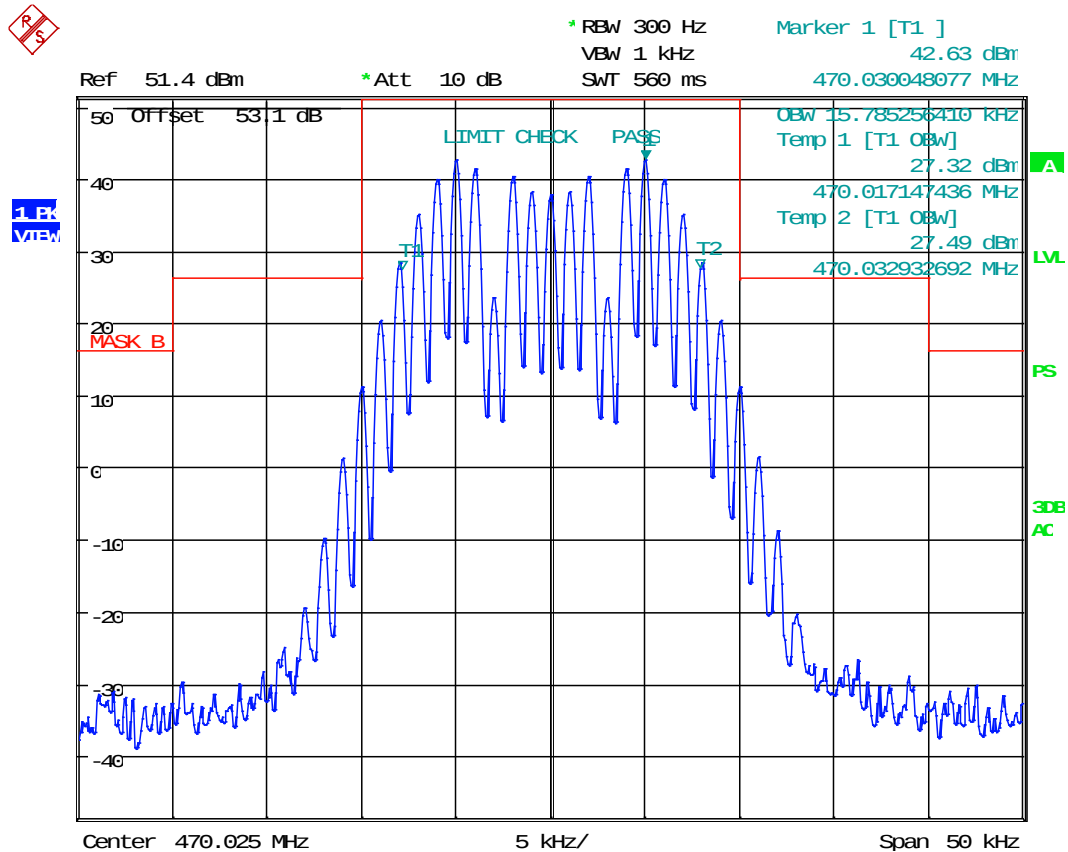
Test Data: 470.025 MHz – 25 kHz Test Signal



Date: 30.NOV.2017 13:47:43

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

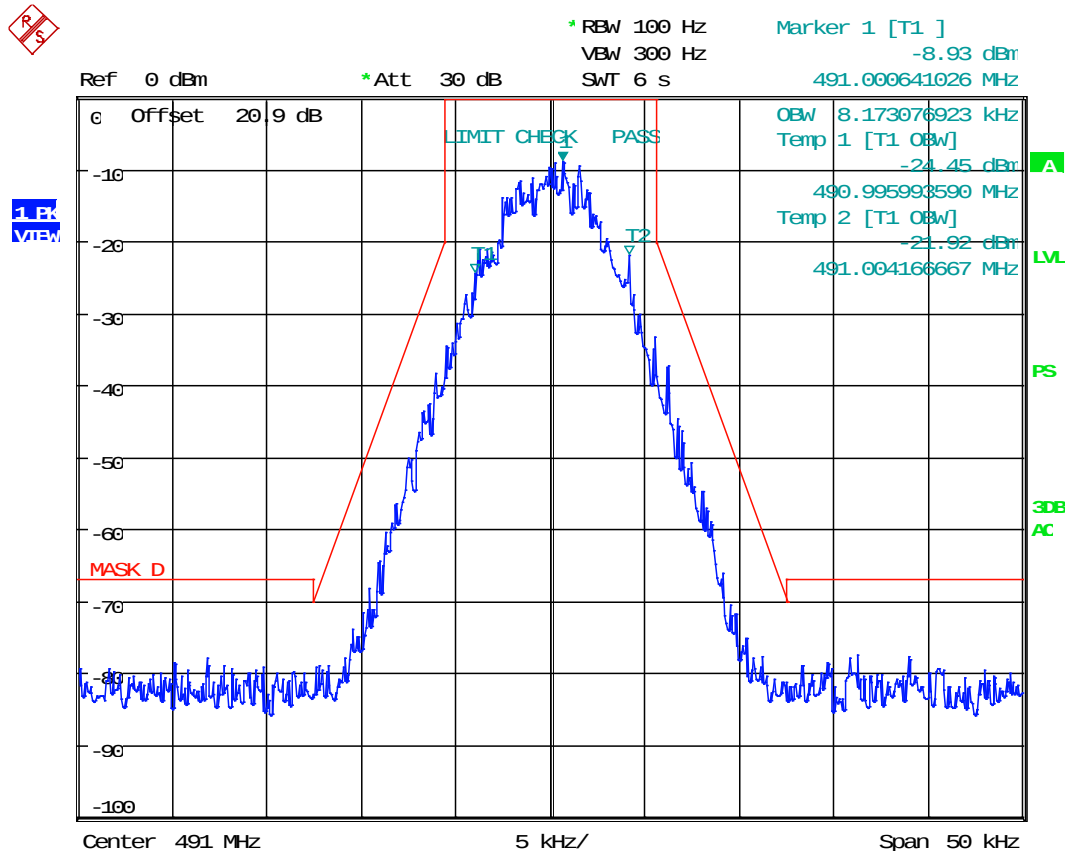
Test Data: 470.025 MHz – 25 kHz Output Signal



Date: 1.DEC.2017 15:16:25

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

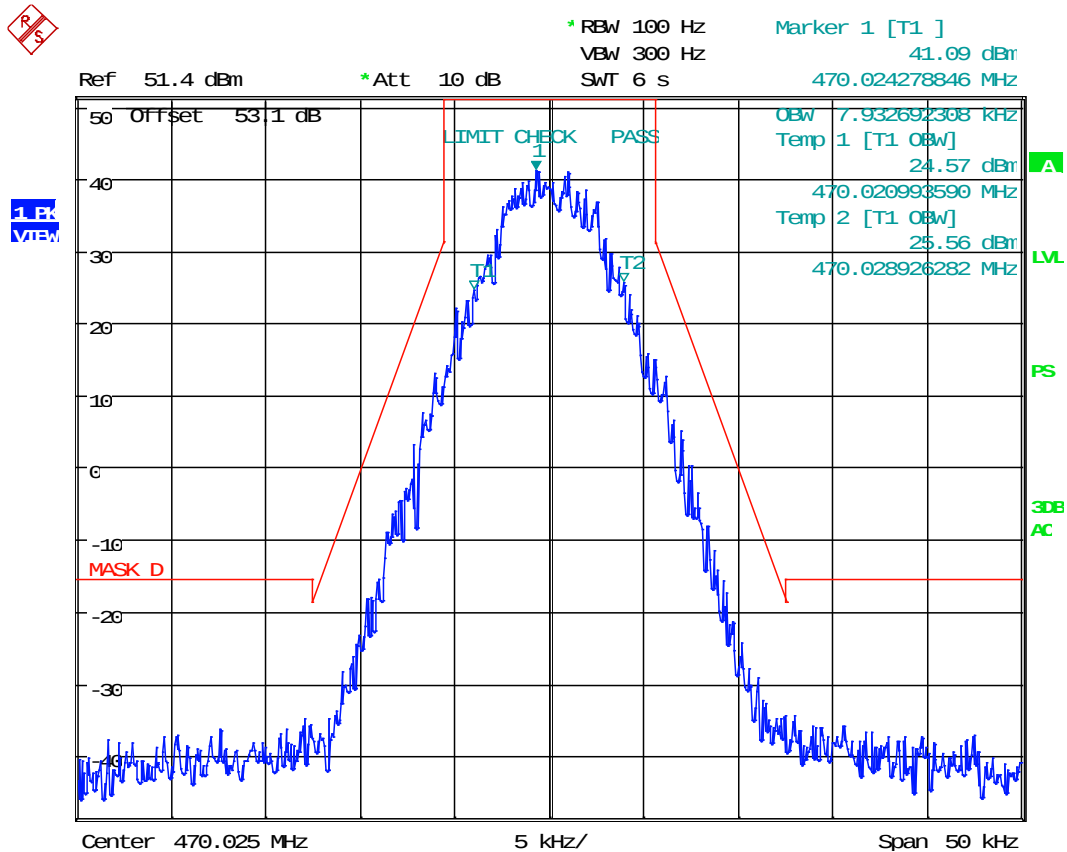
Test Data: 470.025 MHz – P25 Phase 1 C4FM Test Signal



Date: 1.DEC.2017 15:46:39

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

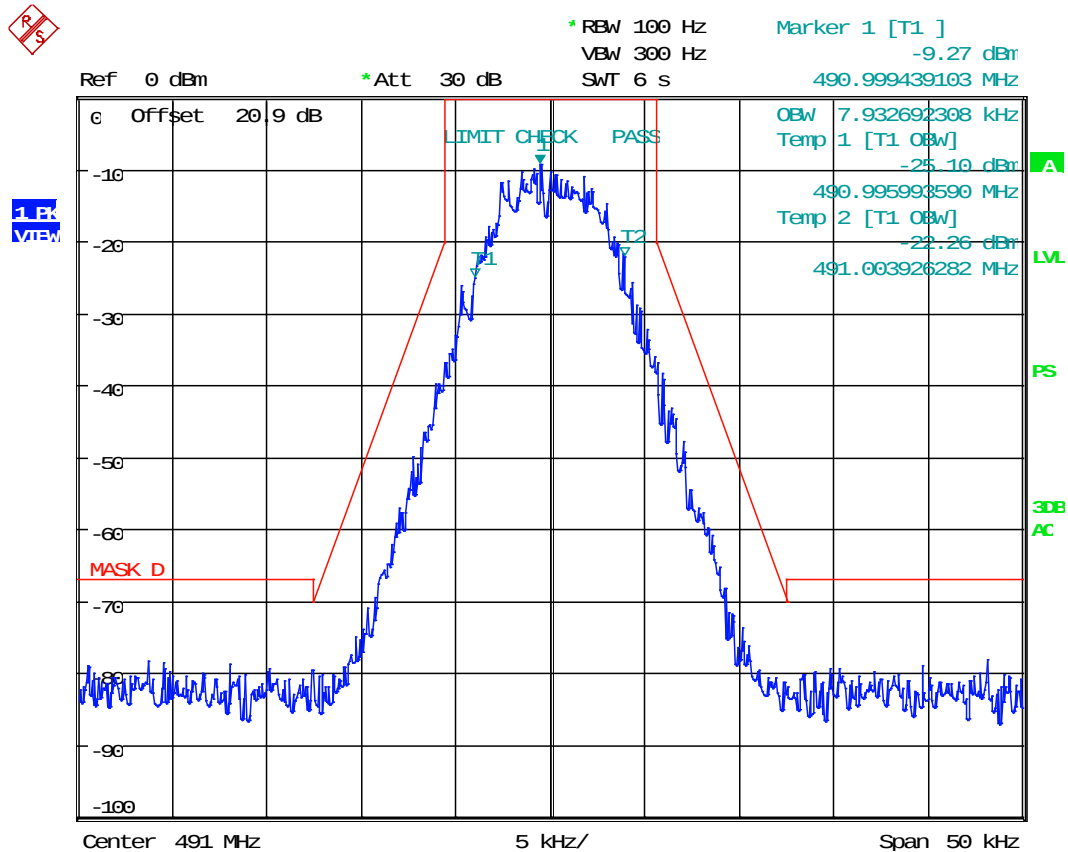
Test Data: 470.025 MHz – P25 Phase 1 C4FM Output Signal



Date: 1.DEC.2017 15:33:21

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

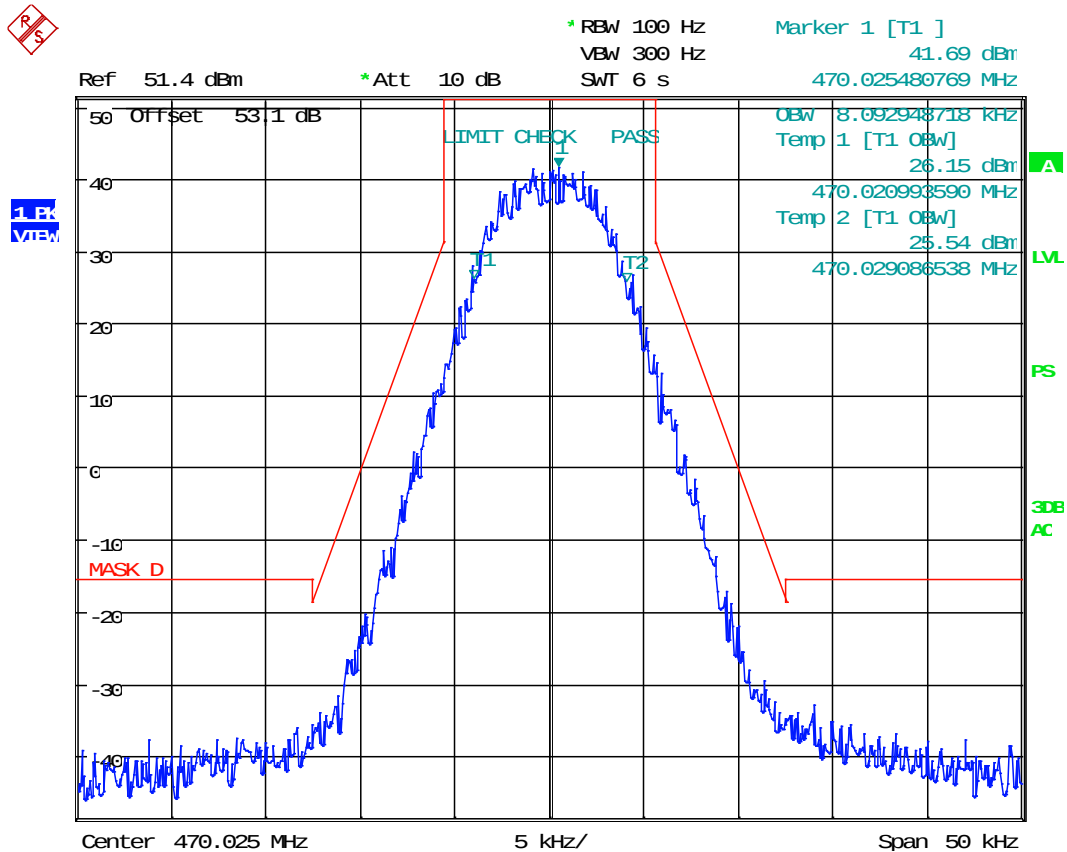
Test Data: 470.025 MHz – P25 Phase 2 H-CPM Test Signal



Date: 1.DEC.2017 15:48:13

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

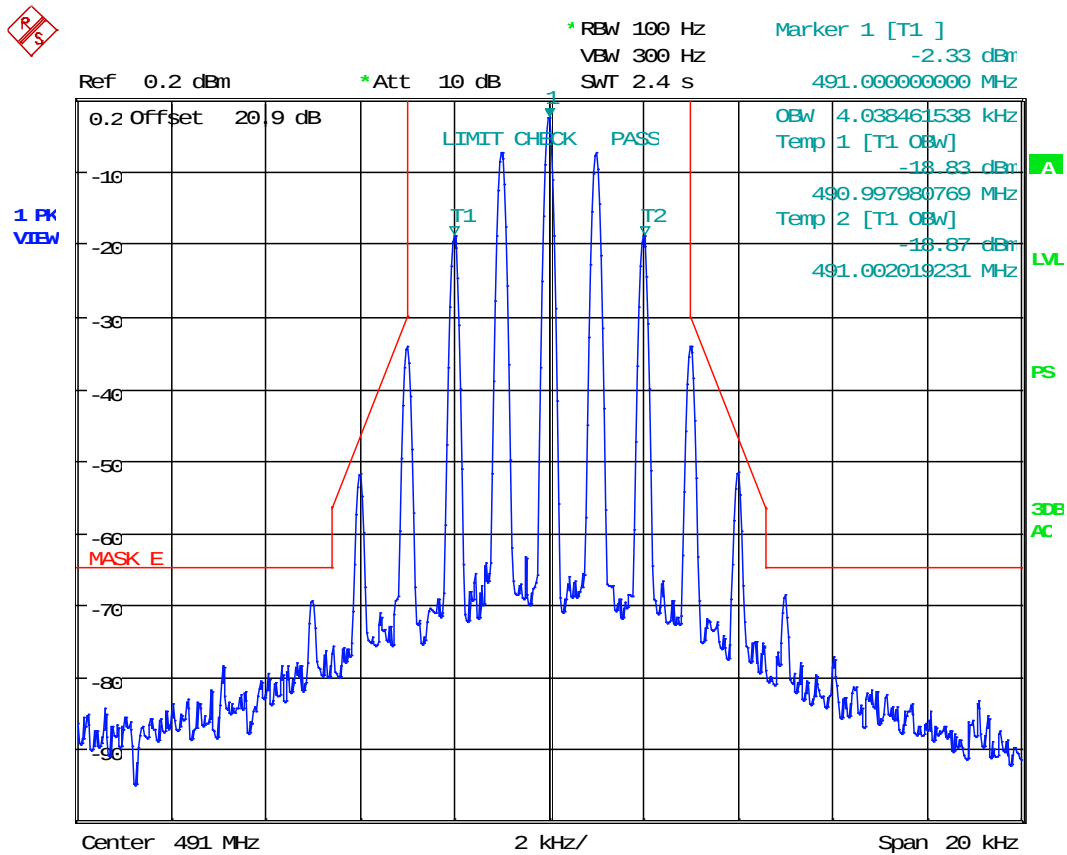
Test Data: 470.025 MHz – P25 Phase 2 H-CPM Output Signal



Date: 1.DEC.2017 15:34:22

# INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 491.000 MHz

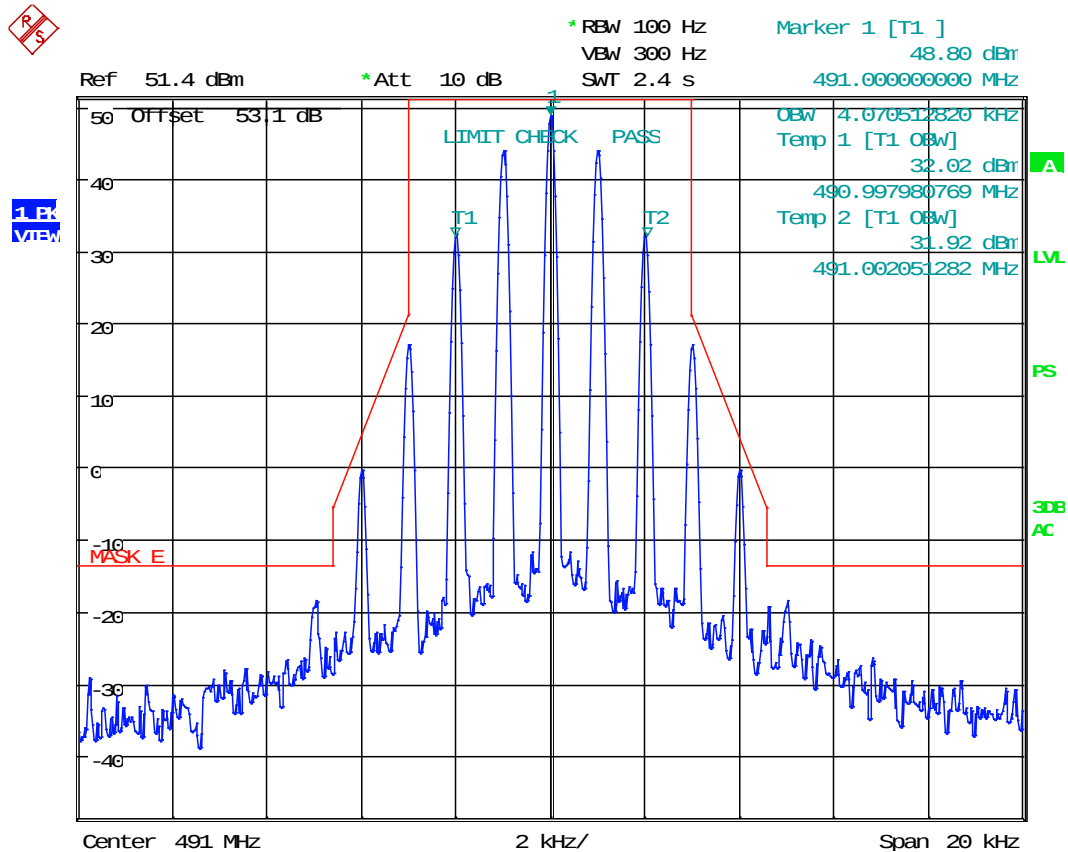
Test Data: 491.000 MHz – 6.25 kHz Test Signal



Date: 30.NOV.2017 13:41:00

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

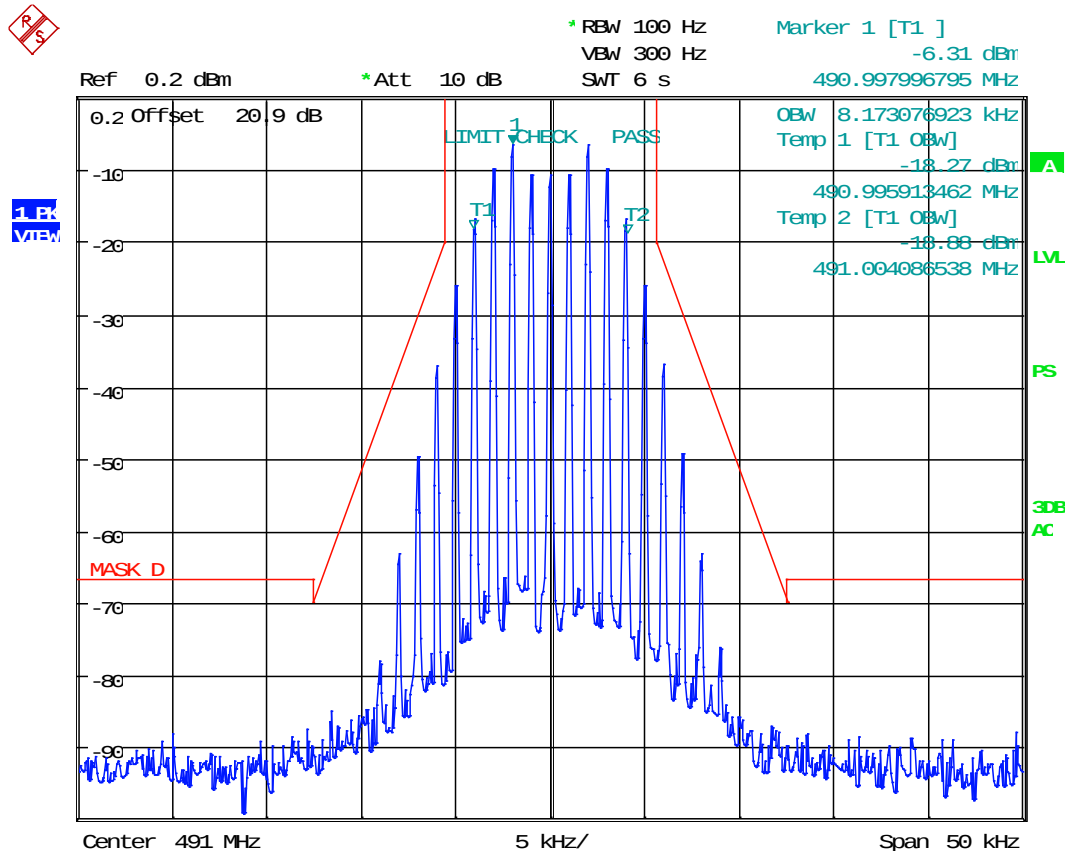
Test Data: 491.000 MHz – 6.25 kHz Output Signal



Date: 1.DEC.2017 14:43:47

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

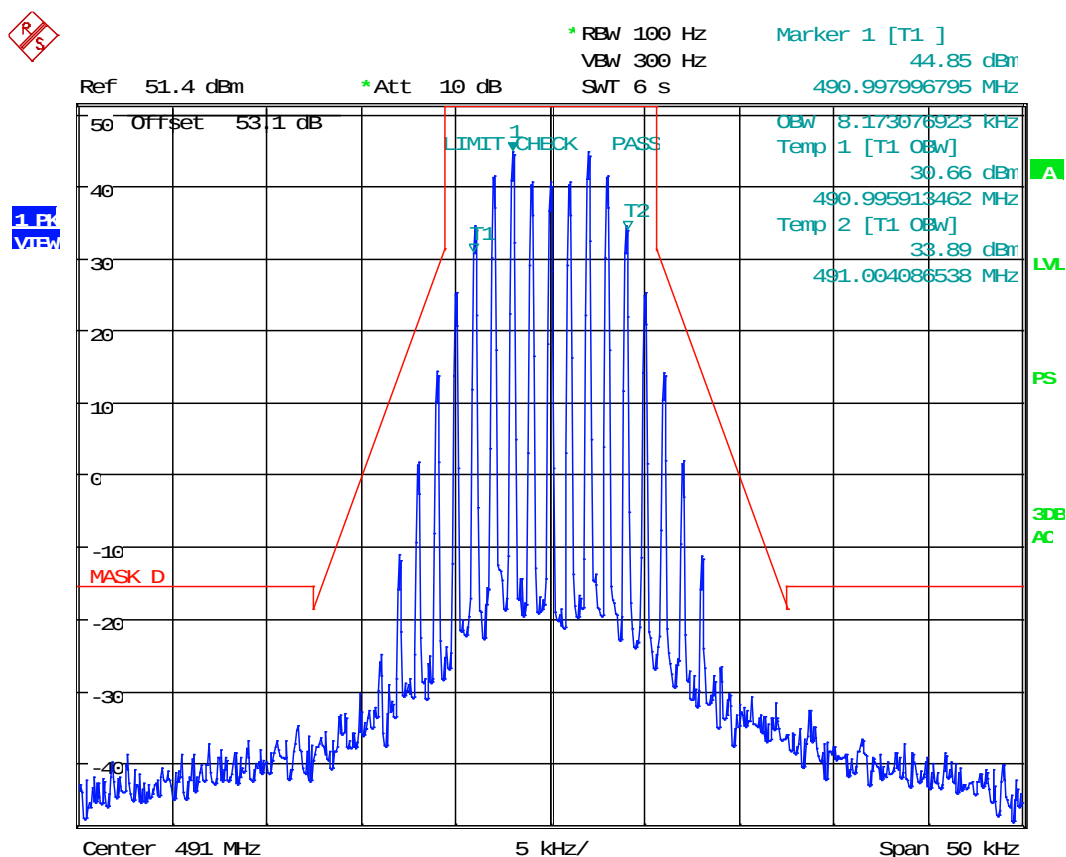
Test Data: 491.000 MHz – 12.5 kHz Test Signal



Date: 30.NOV.2017 13:45:54

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

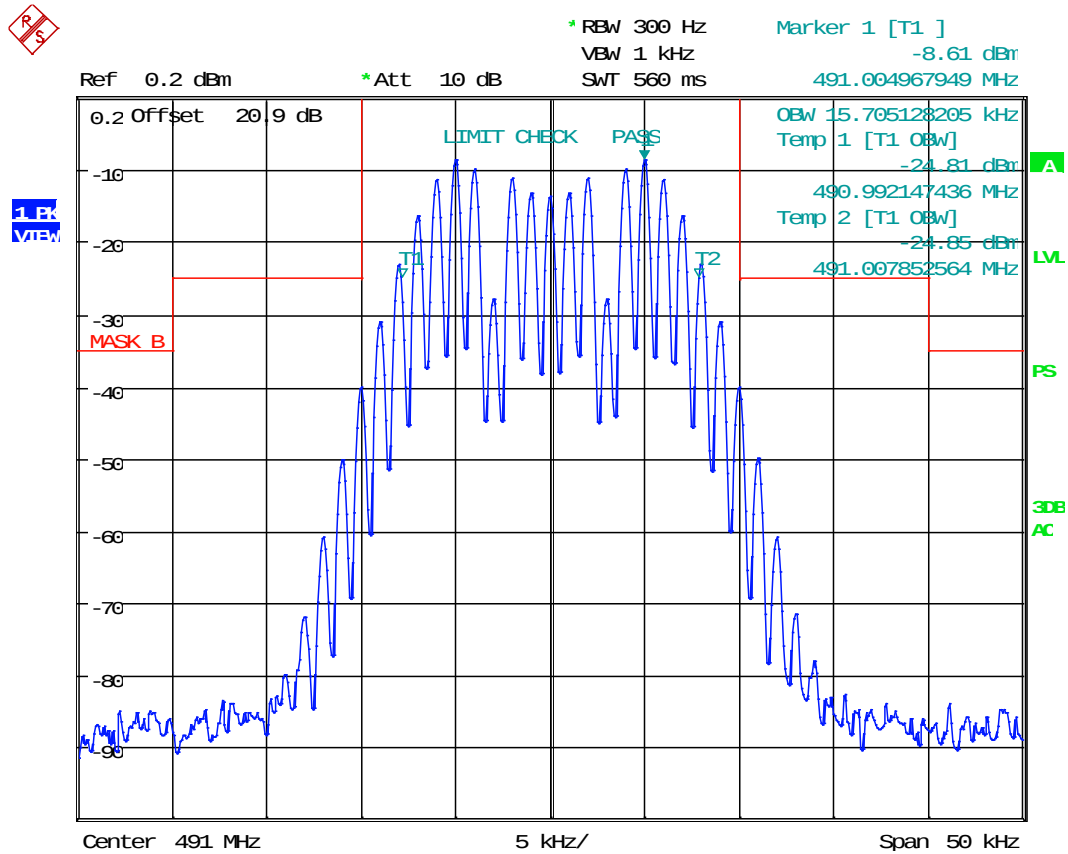
**Test Data: 491.000 MHz – 12.5 kHz Output Signal**



Date: 1.DEC.2017 14:54:26

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

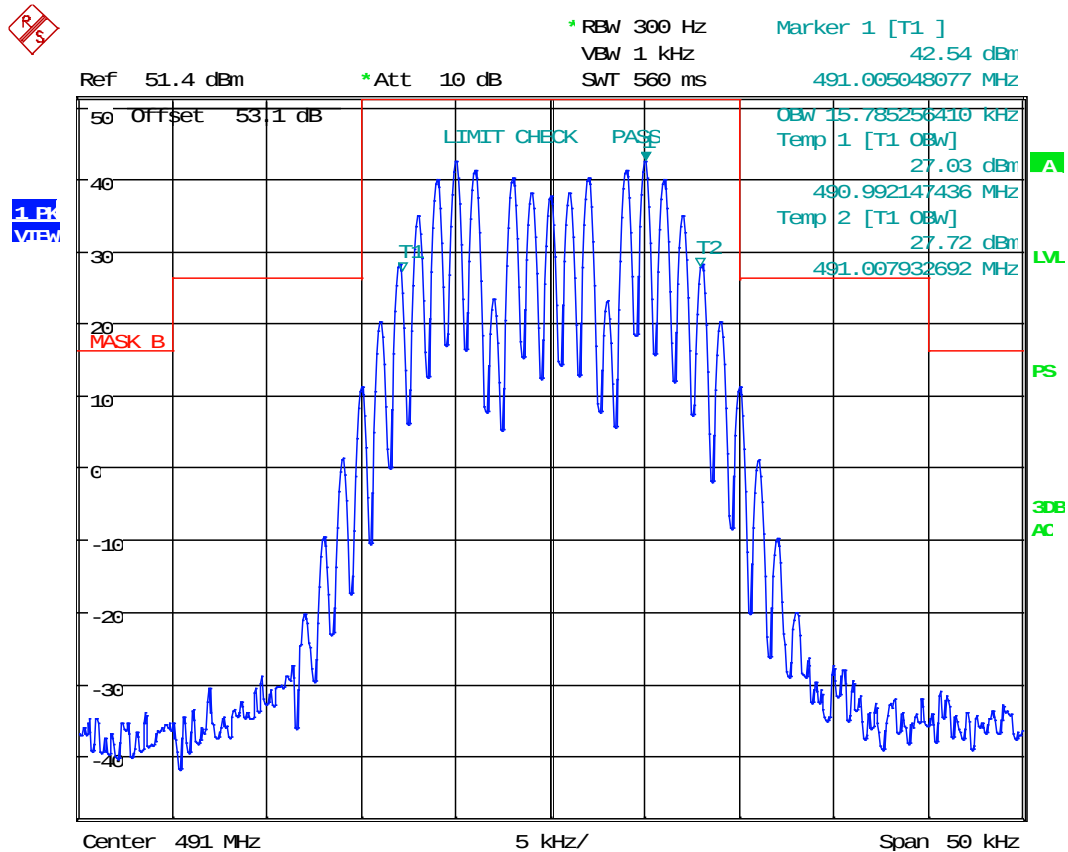
Test Data: 491.000 MHz – 25 kHz Test Signal



Date: 30.NOV.2017 13:47:43

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

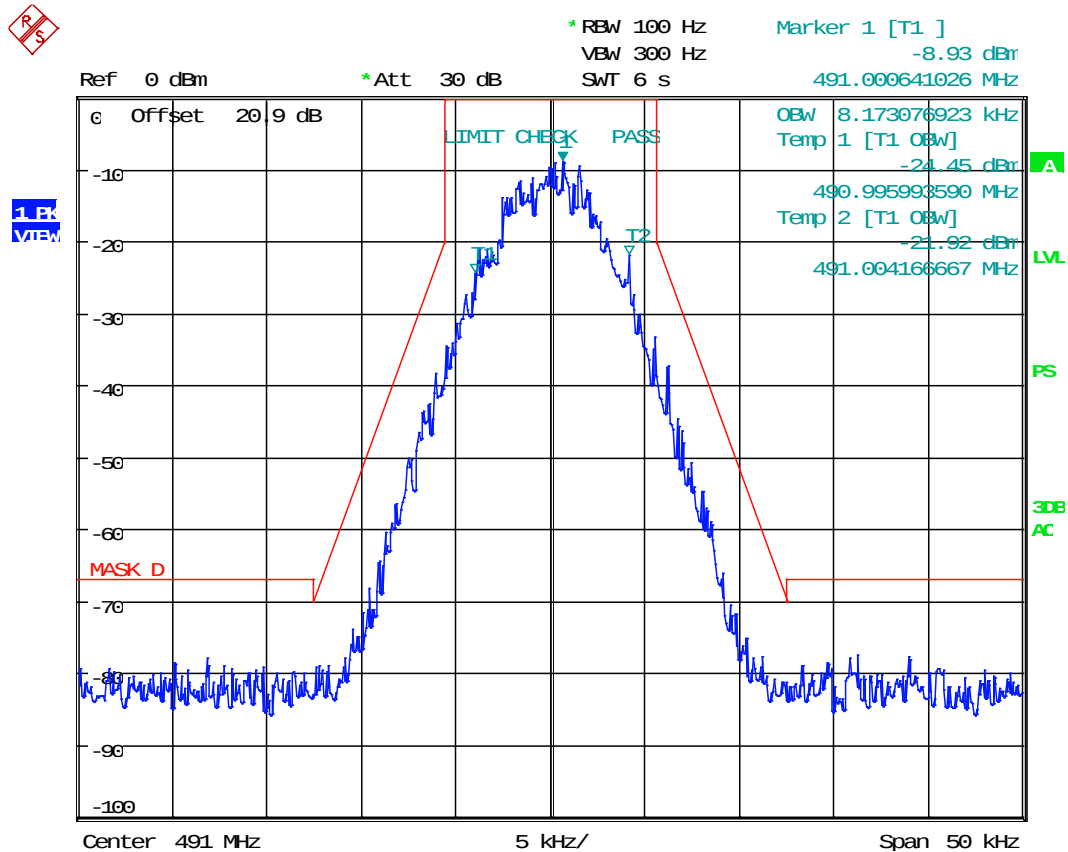
Test Data: 491.000 MHz – 25 kHz Output Signal



Date: 1.DEC.2017 15:17:24

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

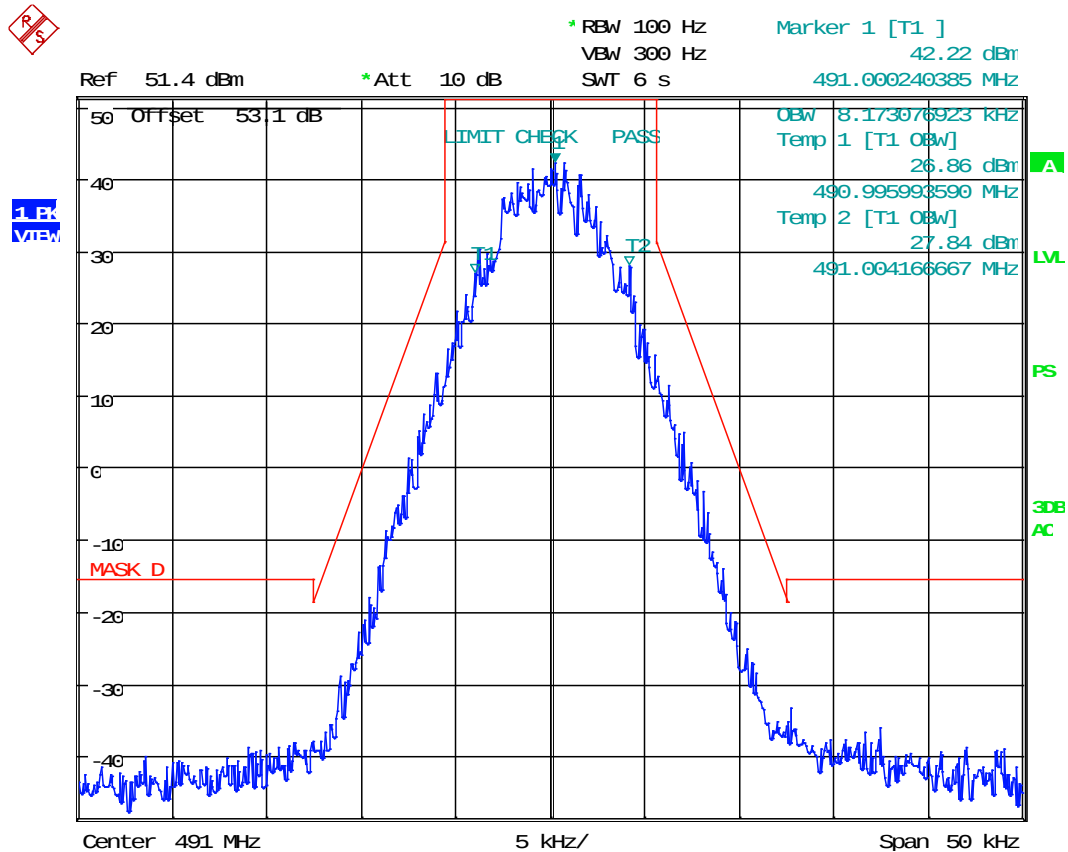
**Test Data: 491.000 MHz – P25 Phase 1 C4FM Test Signal**



Date: 1.DEC.2017 15:46:39

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

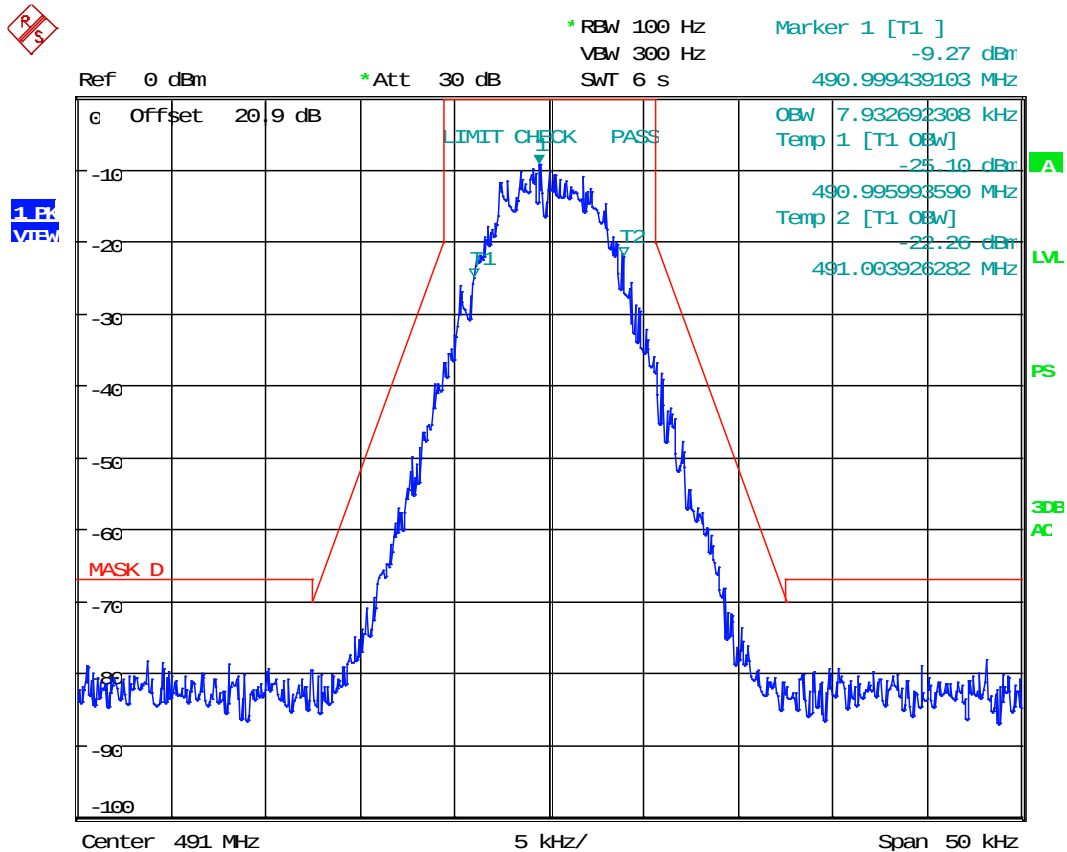
Test Data: 491.000 MHz – P25 Phase 1 C4FM Output Signal



Date: 1.DEC.2017 15:36:57

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

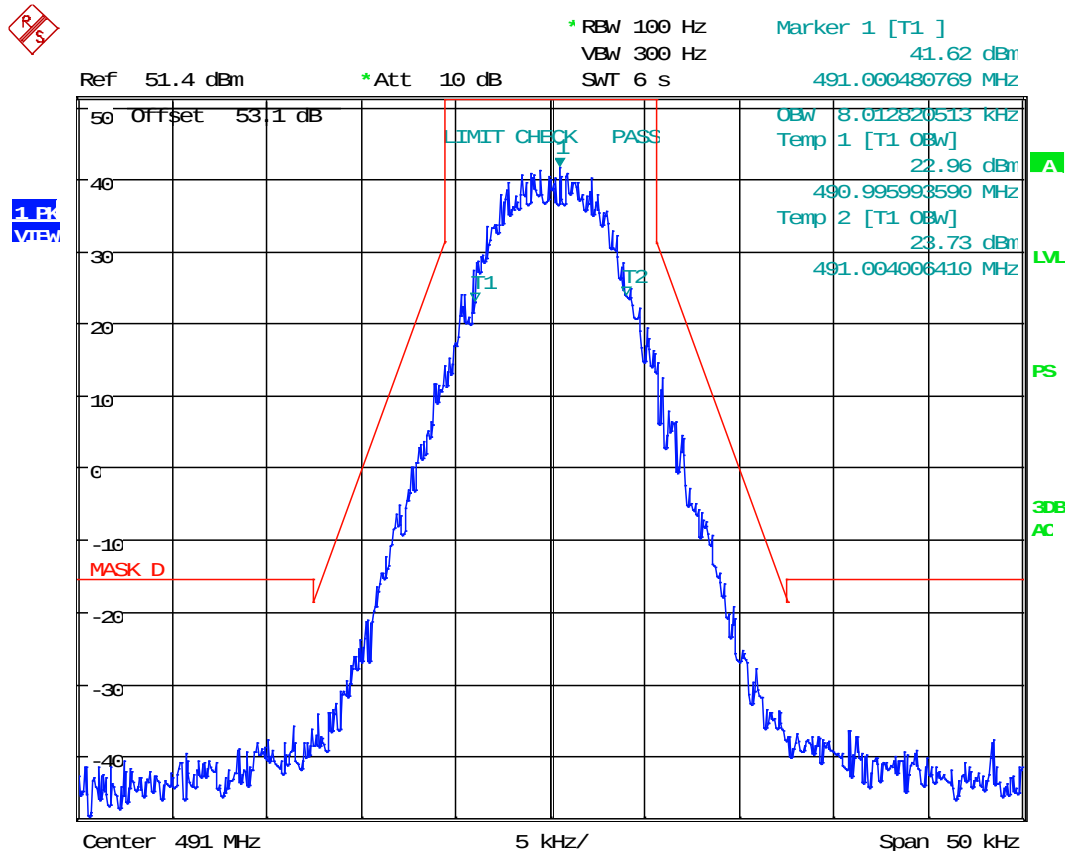
Test Data: 491.000 MHz – P25 Phase 2 H-CPM Test Signal



Date: 1.DEC.2017 15:48:13

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

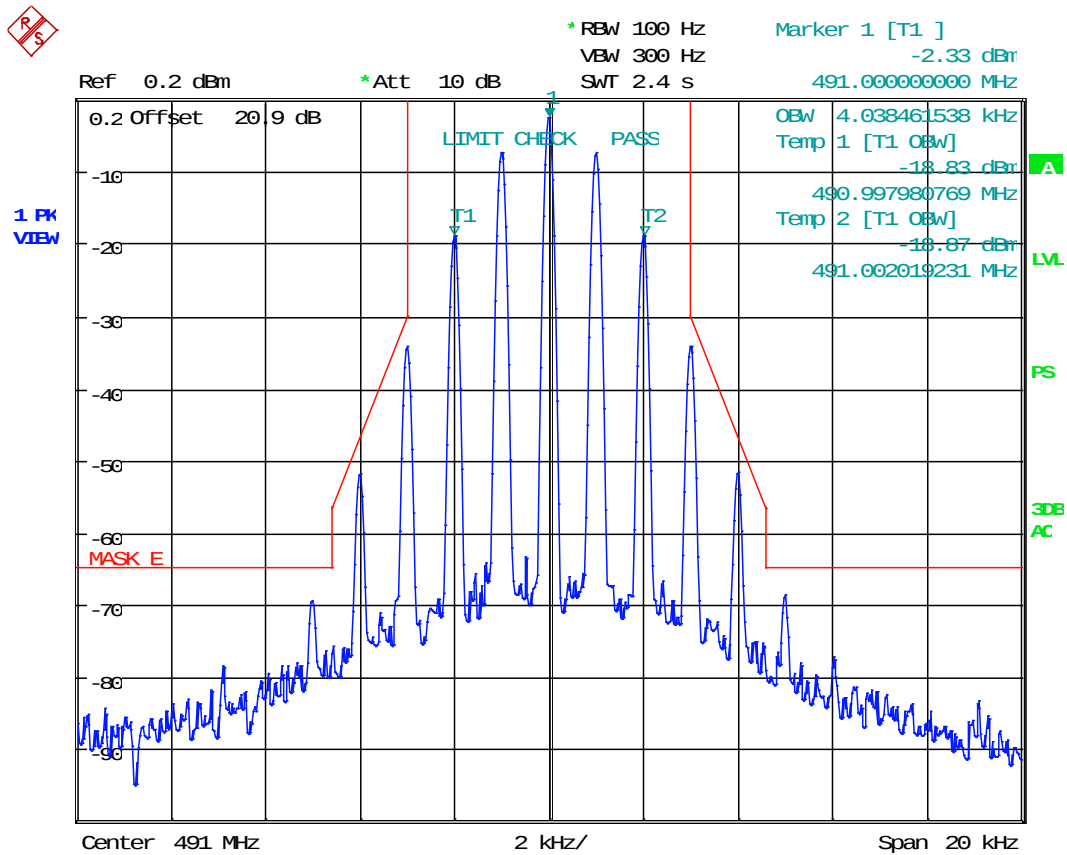
Test Data: 491.000 MHz – P25 Phase 2 H-CPM Output Signal



Date: 1.DEC.2017 15:35:37

# INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4, 511.975 MHz

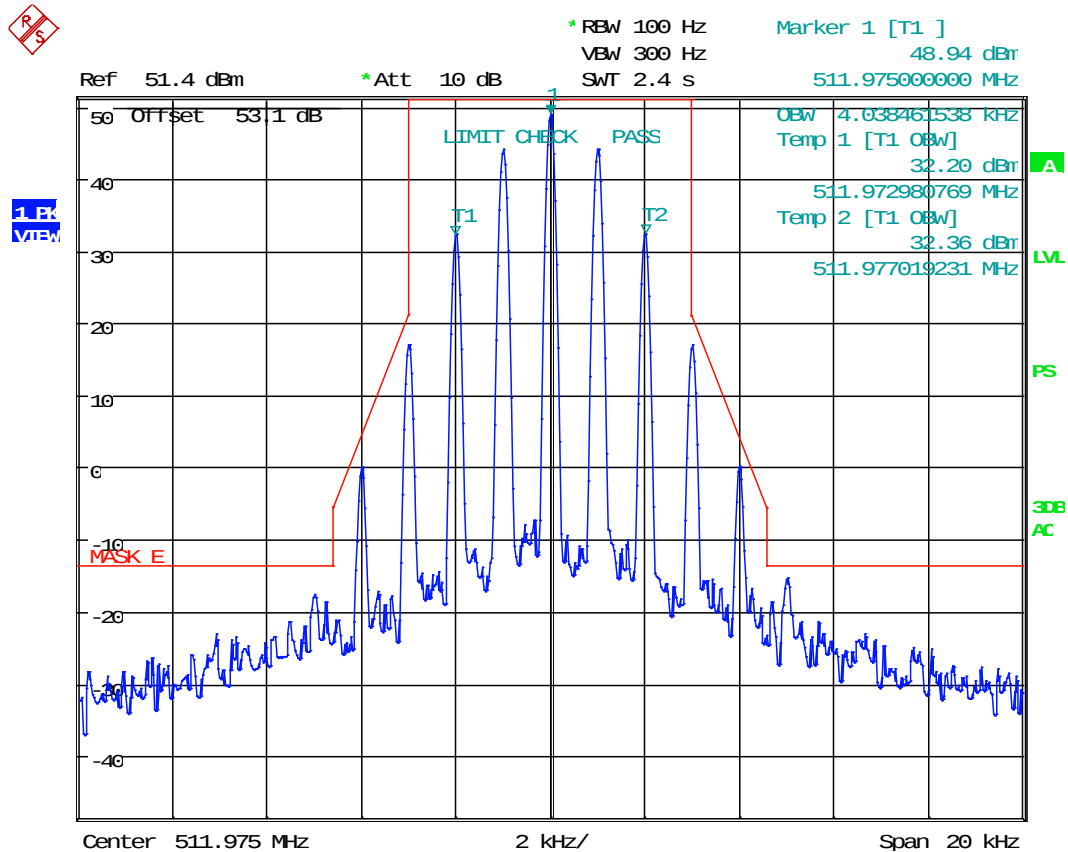
Test Data: 511.975 MHz – 6.25 kHz Test Signal



Date: 30.NOV.2017 13:41:00

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

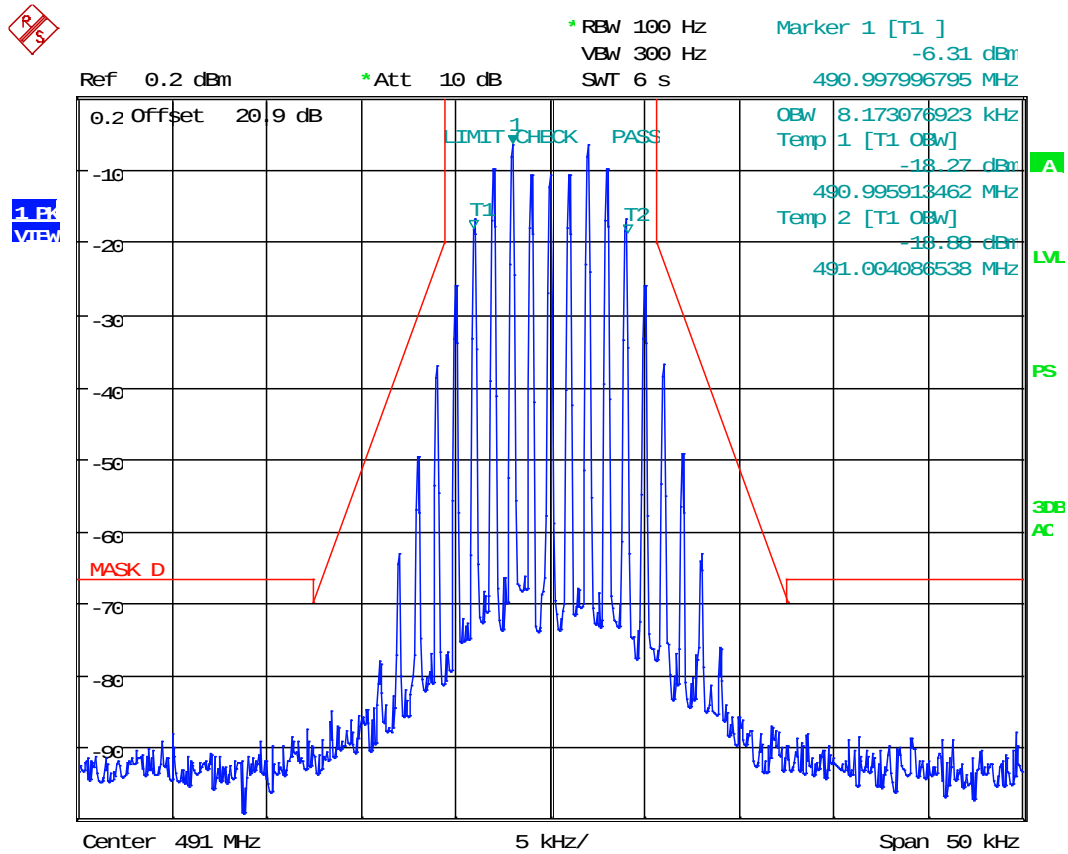
Test Data: 511.975 MHz – 6.25 kHz Output Signal



Date: 1.DEC.2017 14:44:43

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

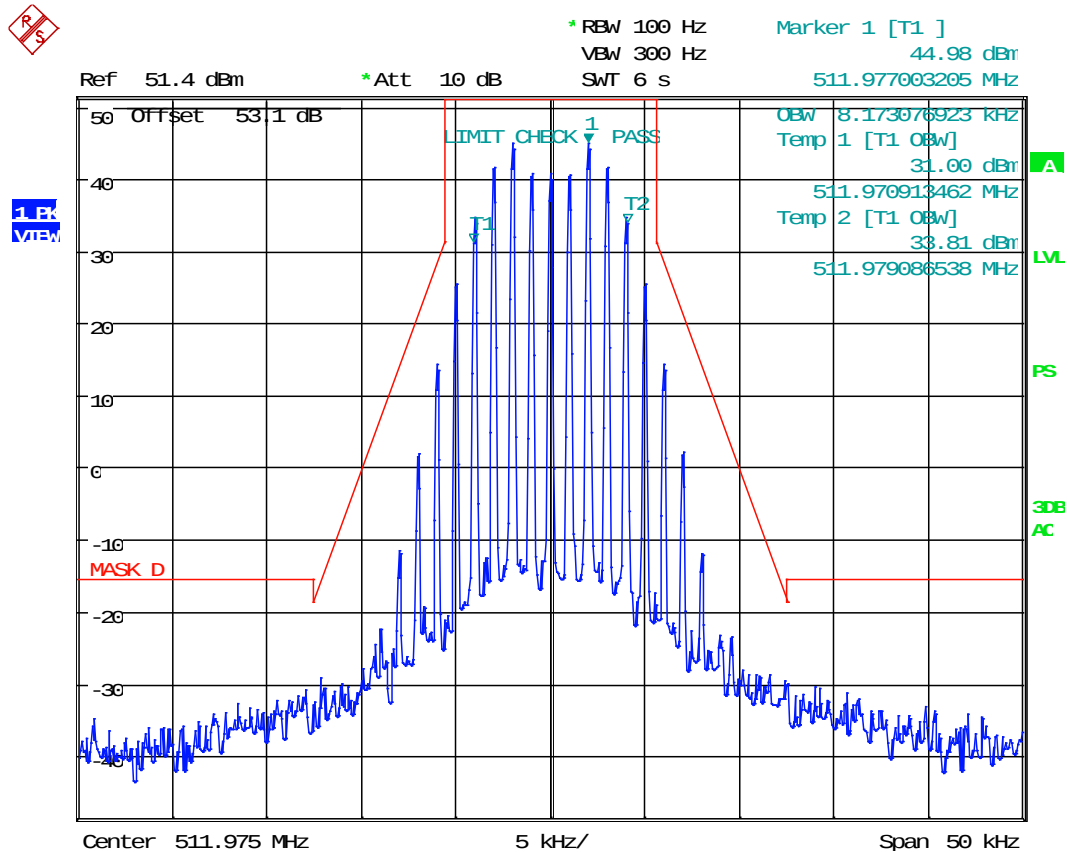
Test Data: 511.975 MHz – 12.5 kHz Test Signal



Date: 30.NOV.2017 13:45:54

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

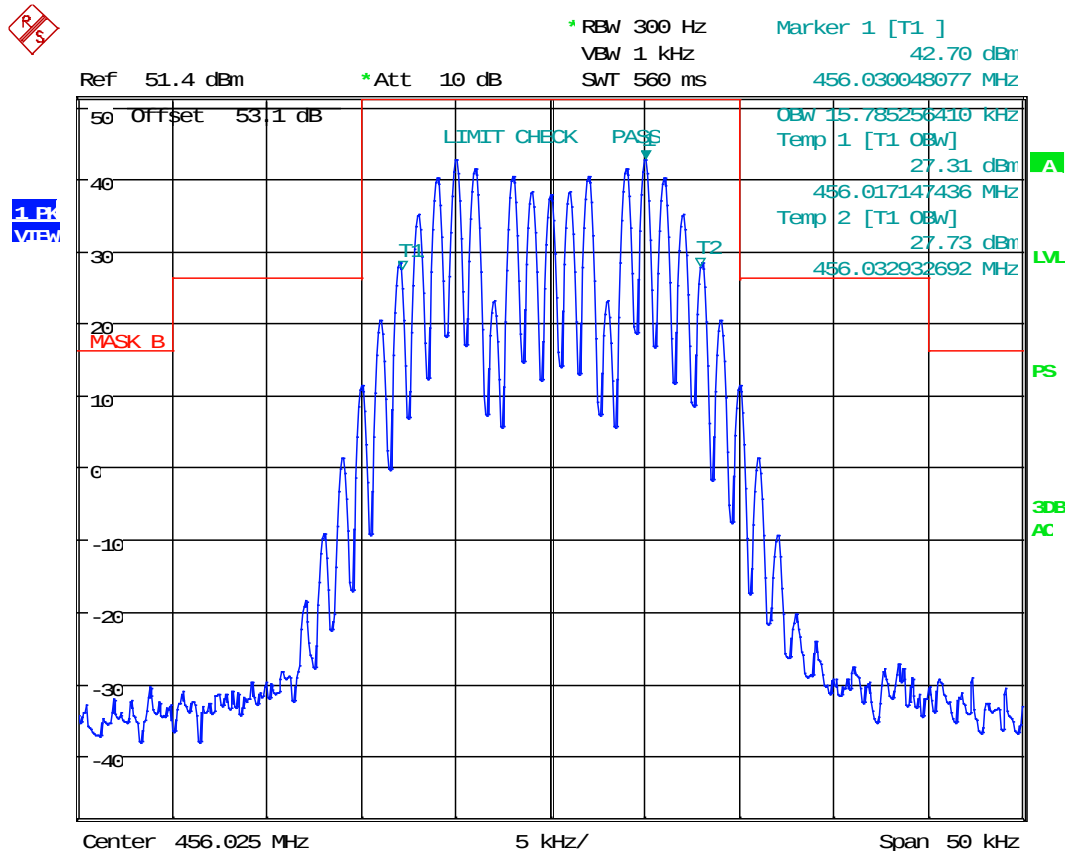
Test Data: 511.975 MHz – 12.5 kHz Output Signal



Date: 1.DEC.2017 14:55:48

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

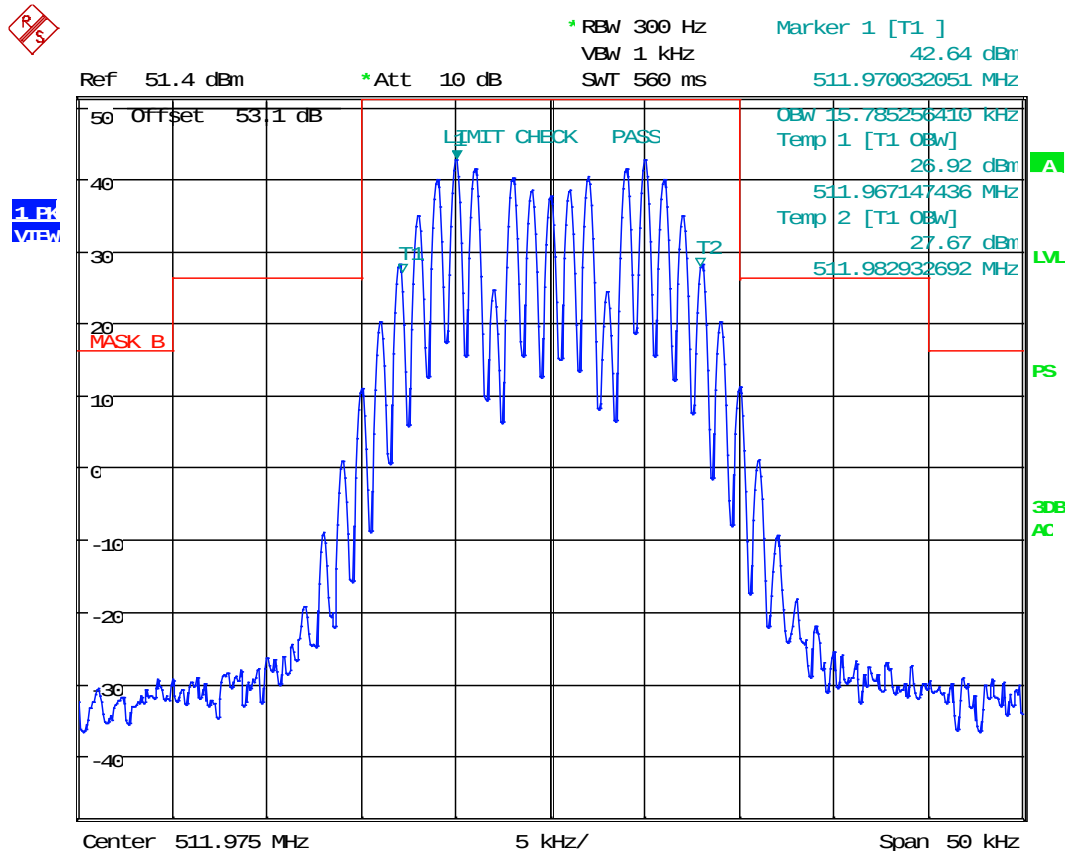
Test Data: 511.975 MHz – 25 kHz Test Signal



Date: 1.DEC.2017 15:13:57

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

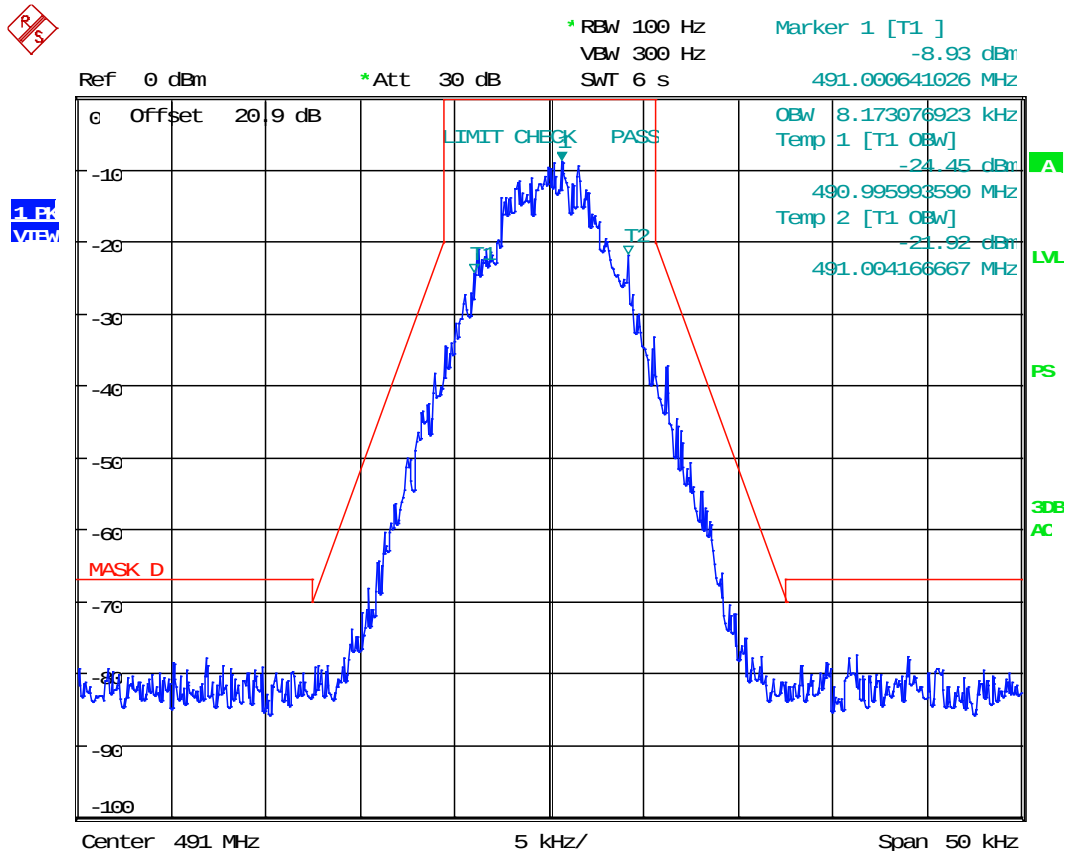
Test Data: 511.975 MHz – 25 kHz Output Signal



Date: 1.DEC.2017 15:18:11

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

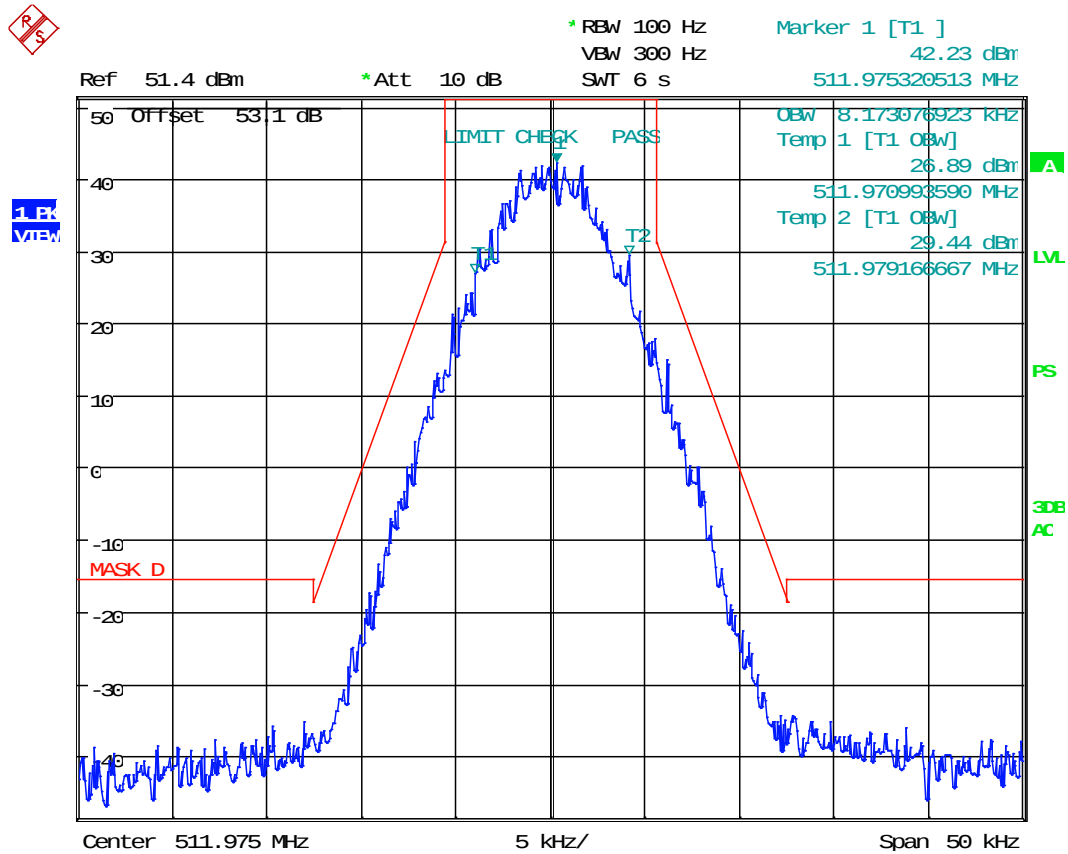
Test Data: 511.975 MHz – P25 Phase 1 C4FM Test Signal



Date: 1.DEC.2017 15:46:39

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

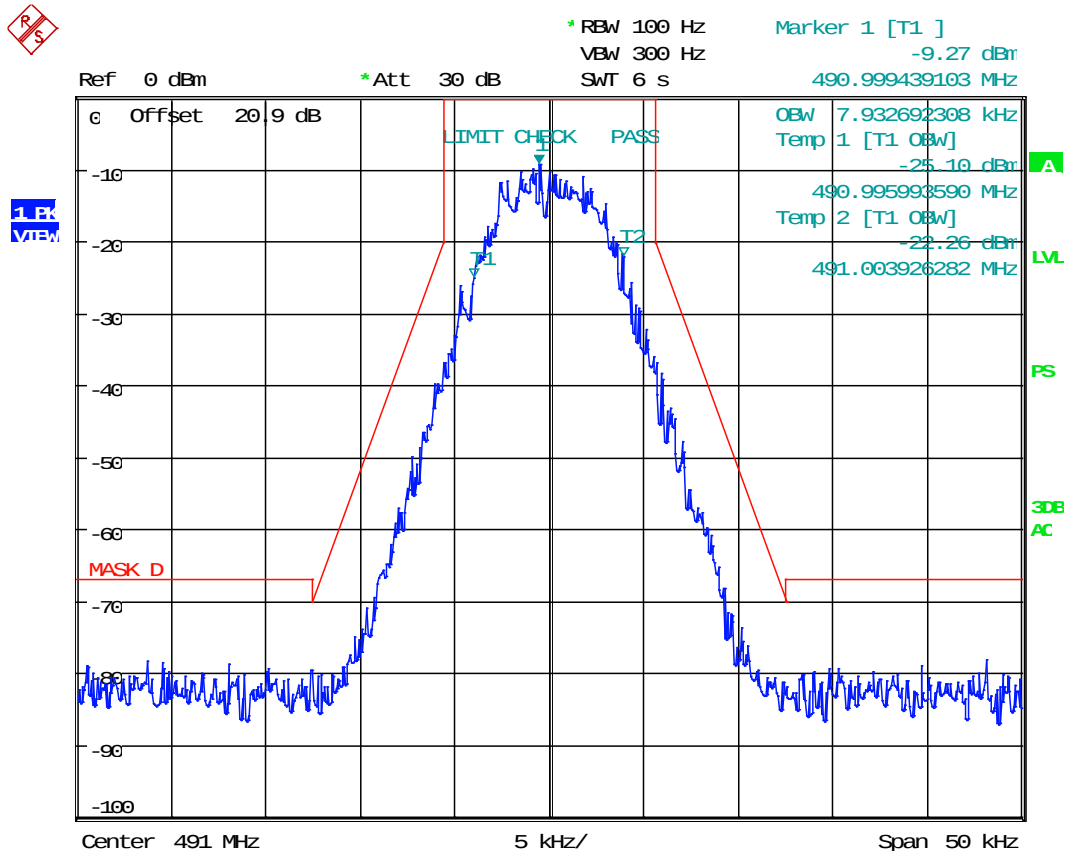
Test Data: 511.975 MHz – P25 Phase 1 C4FM Output Signal



Date: 1.DEC.2017 15:38:34

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

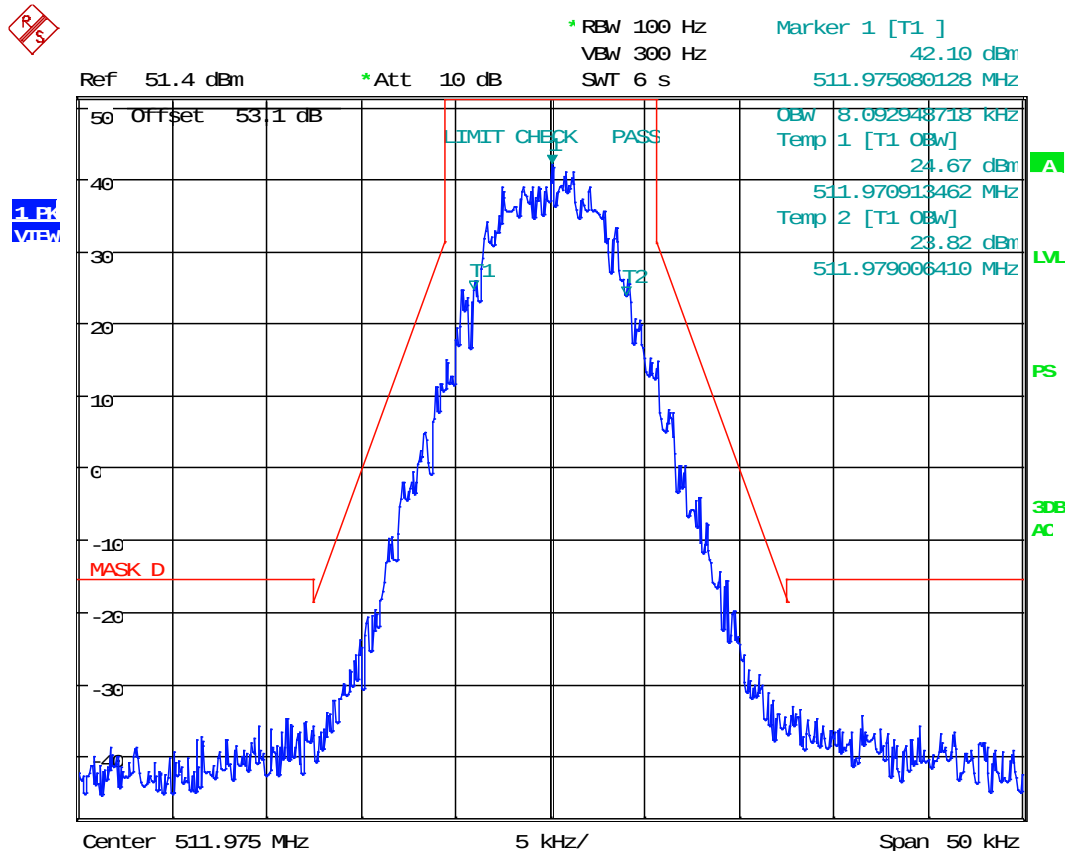
Test Data: 511.975 MHz – P25 Phase 2 H-CPM Test Signal



Date: 1.DEC.2017 15:48:13

## INPUT-VERSUS-OUTPUT SIGNAL COMPARISON §4.4

Test Data: 511.975 MHz – P25 Phase 2 H-CPM Output Signal



Date: 1.DEC.2017 15:40:20

## NOISE FIGURE §4.6

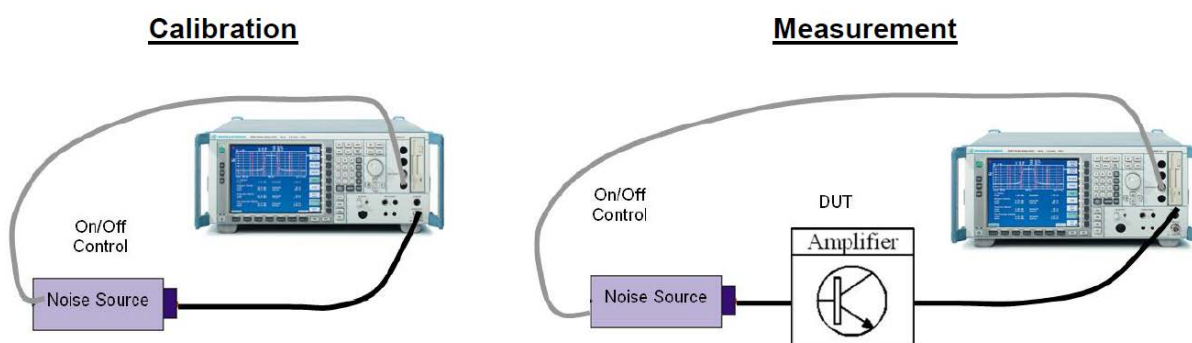
**Rule Part No.:** KDB 935210-D05 v01r02 §4.6

**Requirements:** 9 dB

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
§ 4.6 Noise Figure Measurements

1MA178\_2e R&S Application Note the Y Factor Technique Noise Figure  
§ 2 Background Theory and Equations  
§ 3 Detailed Measurement Steps

**Setup Diagram:**



**Result: Not Applicable per KDB Inquiry 925403**

## OUT OF BAND / OUT OF BLOCK EMISSIONS §4.7

**Rule Part No.:** FCC Pt. 90.210  
KDB 935210-D05 v01r02 §4.7.2

**Requirements:** -15.45 dBm (see Note on Pg. 7)

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
§ 4.7.1 General  
§ 4.7.2 Out of Band/ Out of block emissions conducted measurements

**Result: Not Applicable per KDB Inquiry 885618**

## **ANTENNA CONDUCTED EMISSIONS §4.7**

**Rule Part No.:** FCC Pt. 90.210  
KDB 935210-D05 v01r02 §4.7.3

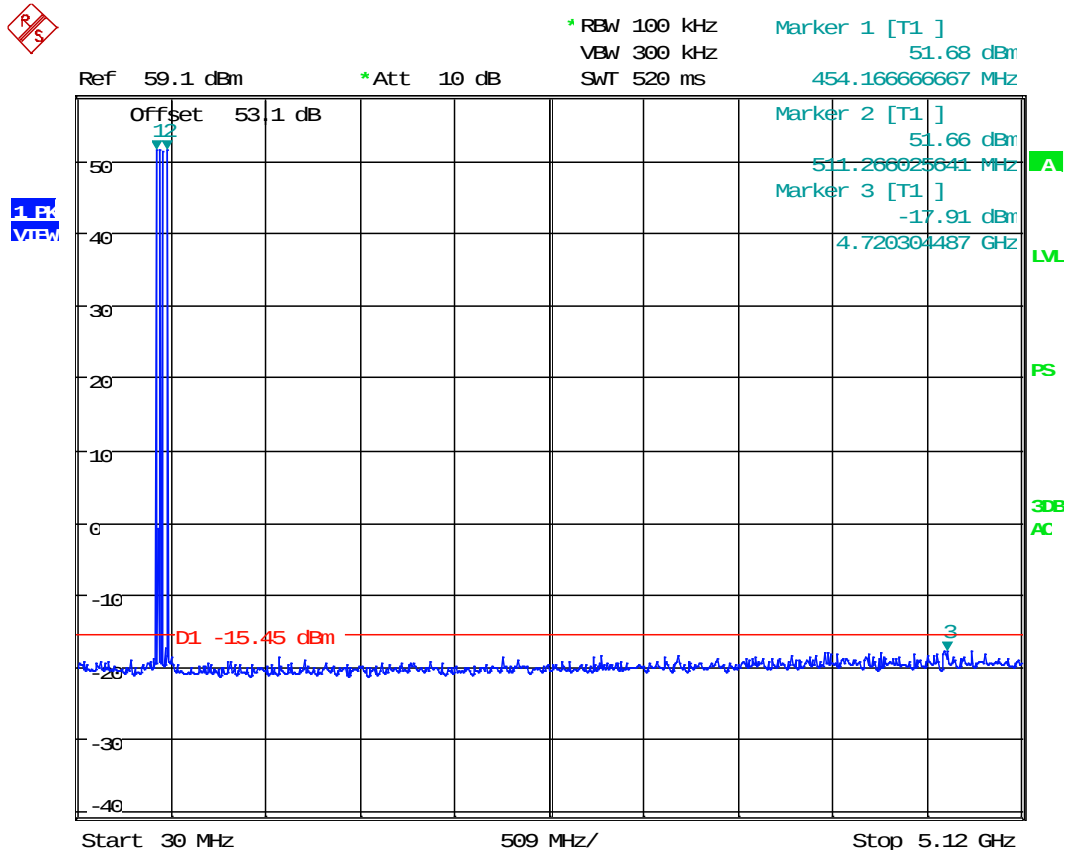
**Requirements:** -15.45 dBm in any 100 kHz bandwidth (see Note on Pg. 7)

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
§ 4.7.1 General  
§ 4.7.3 EUT Spurious emissions conducted measurements

**Note:** All test frequencies were transmitted while the trace was set to Peak Max Hold, and the most strict limit line was applied to the screen to show compliance while in the required Resolution Bandwidth (limit line set as per the Note found on Pg. 7).

## ANTENNA CONDUCTED EMISSIONS §4.7

Test Data: 456.025 MHz, 459.975 MHz, 470.025 MHz, 491.000 MHz, 511.975 MHz



Date: 1.DEC.2017 12:09:21

## Results Meet Requirements

## **FREQUENCY STABILITY MEASUREMENTS §4.8**

**Rule Part No.:** FCC 22.355  
KDB 935210-D05 v01r02 §4.9

**Requirements:** 2.5 ppm

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
§ 4.8 Frequency Stability Measurements

FCC Part 22 states "Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1 of this section."

This requirement presumes that the EUT processes an input signal in ways that can influence the output signal frequency/frequencies; however, most signal boosters do not incorporate an oscillator. If the amplifier, booster, or repeater does not alter the input signal in any way, then a frequency stability test may not be required per KDB 935210-D05 v01r02 §4.9.

**Result: Not required per KDB 935210-D05 v01r02 §4.9**

## FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS §4.9

**Rule Part No.:** FCC Pt. 90.210  
KDB 935210-D05 v01r02 §4.9

**Requirements:** -15.45 dBm in any 100 kHz bandwidth (see Note on Pg. 7)

**Procedure:** KDB935210 Measurement Guidance for Industrial Boosters  
§ 4.7.1 General  
§ 4.9 Spurious emissions radiated measurements

The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 9 KHz to at least the tenth harmonic of the fundamental. The EUT was oriented in the worst-case polarity, and was scanned in the worst-case emission range as determined in prior testing. Measurements were made at the test site of **TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.**

**NOTE:** The highest six (6) emissions per tuned frequency are tabulated in the plots below. Emissions under 20 dB within the applicable limit(s) are not required to be shown.

### Test Data: 456.025 MHz Radiated Emission Table

| Tuned Frequency (MHz)    |                  |                         |           |             |              |
|--------------------------|------------------|-------------------------|-----------|-------------|--------------|
| 456.025 MHz              |                  |                         |           |             |              |
| Emission Frequency (MHz) | Antenna Polarity | Field Strength (dBuV/m) | ERP (dBm) | Limit (dBm) | Margin (dBm) |
| 4560.25                  | V                | 53.68                   | -43.70    | -15.45      | -28.25       |
| 4560.25                  | H                | 53.40                   | -43.98    | -15.45      | -28.53       |
| 3192.18                  | V                | 53.38                   | -44.00    | -15.45      | -28.55       |
| 3192.18                  | H                | 52.91                   | -44.47    | -15.45      | -29.02       |
| 4104.23                  | V                | 52.87                   | -44.50    | -15.45      | -29.05       |
| 2736.15                  | V                | 52.41                   | -44.96    | -15.45      | -29.51       |

## FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS §4.9

### Test Data: 459.975 MHz Radiated Emission Table

| Tuned Frequency (MHz)    |                  |                         |           |             |              |
|--------------------------|------------------|-------------------------|-----------|-------------|--------------|
| 459.975 MHz              |                  |                         |           |             |              |
| Emission Frequency (MHz) | Antenna Polarity | Field Strength (dBuV/m) | ERP (dBm) | Limit (dBm) | Margin (dBm) |
| 4599.75                  | H                | 53.79                   | -43.59    | -15.45      | -28.14       |
| 4599.75                  | V                | 53.40                   | -43.98    | -15.45      | -28.53       |
| 3219.82                  | H                | 52.99                   | -44.39    | -15.45      | -28.94       |
| 3679.80                  | H                | 52.64                   | -44.73    | -15.45      | -29.28       |
| 2759.85                  | V                | 52.44                   | -44.94    | -15.45      | -29.49       |
| 3219.82                  | V                | 52.37                   | -45.01    | -15.45      | -29.56       |

### Test Data: 470.025 MHz Radiated Emission Table

| Tuned Frequency (MHz)    |                  |                         |           |             |              |
|--------------------------|------------------|-------------------------|-----------|-------------|--------------|
| 470.025 MHz              |                  |                         |           |             |              |
| Emission Frequency (MHz) | Antenna Polarity | Field Strength (dBuV/m) | ERP (dBm) | Limit (dBm) | Margin (dBm) |
| 4700.25                  | V                | 53.96                   | -43.42    | -15.45      | -27.97       |
| 4700.25                  | H                | 53.49                   | -43.89    | -15.45      | -28.44       |
| 3290.18                  | H                | 53.06                   | -44.31    | -15.45      | -28.86       |
| 3290.18                  | V                | 53.00                   | -44.37    | -15.45      | -28.92       |
| 4230.23                  | V                | 52.54                   | -44.84    | -15.45      | -29.39       |
| 2820.15                  | H                | 52.53                   | -44.85    | -15.45      | -29.40       |

## FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS §4.9

### Test Data: 491.000 MHz Radiated Emission Table

| Tuned Frequency (MHz)    |                  |                         |           |             |              |
|--------------------------|------------------|-------------------------|-----------|-------------|--------------|
| 491.000 MHz              |                  |                         |           |             |              |
| Emission Frequency (MHz) | Antenna Polarity | Field Strength (dBuV/m) | ERP (dBm) | Limit (dBm) | Margin (dBm) |
| 3437.00                  | V                | 54.44                   | -42.94    | -15.45      | -27.49       |
| 3437.00                  | H                | 54.10                   | -43.28    | -15.45      | -27.83       |
| 4910.00                  | V                | 53.99                   | -43.39    | -15.45      | -27.94       |
| 4910.00                  | H                | 53.49                   | -43.89    | -15.45      | -28.44       |
| 4419.00                  | V                | 53.40                   | -43.98    | -15.45      | -28.53       |
| 4419.00                  | H                | 52.90                   | -44.48    | -15.45      | -29.03       |

### Test Data: 511.975 MHz Radiated Emission Table

| Tuned Frequency (MHz)    |                  |                         |           |             |              |
|--------------------------|------------------|-------------------------|-----------|-------------|--------------|
| 511.975 MHz              |                  |                         |           |             |              |
| Emission Frequency (MHz) | Antenna Polarity | Field Strength (dBuV/m) | ERP (dBm) | Limit (dBm) | Margin (dBm) |
| 3071.85                  | V                | 62.40                   | -34.97    | -15.45      | -19.52       |
| 3583.82                  | V                | 54.51                   | -42.87    | -15.45      | -27.42       |
| 3583.82                  | H                | 54.33                   | -43.05    | -15.45      | -27.60       |
| 5119.75                  | V                | 53.97                   | -43.41    | -15.45      | -27.96       |
| 5119.75                  | H                | 53.68                   | -43.70    | -15.45      | -28.25       |
| 4607.77                  | H                | 53.55                   | -43.83    | -15.45      | -28.38       |

## EQUIPMENT LIST

| Device                                             | Manufacturer       | Model                              | Serial Number                                        | Cal / Char Date | Due Date   |
|----------------------------------------------------|--------------------|------------------------------------|------------------------------------------------------|-----------------|------------|
| Coaxial Cable -<br>BMBM-0065-01<br>Black DC-2G     | Belden             |                                    | BMBM-0065-01                                         | 07/18/16        | 07/18/18   |
| Antenna: Biconical<br>1096                         | Eaton              | 94455-1                            | 1096                                                 | 08/01/17        | 08/01/19   |
| Antenna: Log-<br>Periodic 1243                     | Eaton              | 96005                              | 1243                                                 | 02/09/16        | 02/09/18   |
| Coaxial Cable -<br>Chamber 3 cable set<br>(backup) | Micro-Coax         | Chamber 3<br>cable set<br>(backup) | KMKM-0244-02<br>; KMKM-0670-<br>01; KFKF-0197-<br>00 | N/A             | N/A        |
| CHAMBER                                            | Panashield         | 3M                                 | N/A                                                  | 04/25/16        | 12/31/17   |
| HP Signal Generator                                | HP                 | 8648C                              | 3847A04696                                           | 04/05/2017      | 04/05/2019 |
| Antenna: Double-<br>Ridged Horn/ETS<br>Horn 2      | ETS-Lindgren       | 3117                               | 00041534                                             | 03/01/17        | 03/01/19   |
| EMI Test Receiver R<br>& S ESIB 40 Screen<br>Room  | Rohde &<br>Schwarz | ESIB 40                            | 100274                                               | 08/16/16        | 08/16/18   |
| Software: Field<br>Strength Program                | Timco              | N/A                                | Version<br>4.10.7.0                                  | N/A             | N/A        |
| Antenna: Active Loop                               | ETS-Lindgren       | 6502                               | 00062529                                             | 11/18/15        | 12/18/17   |
| EMI Test Receiver R<br>& S ESU 40<br>Chamber       | Rohde &<br>Schwarz | ESU 40                             | 100320                                               | 04/01/16        | 04/01/18   |
| Coaxial Cable -<br>BMBM-0130-00<br>Black           | Alpha Wire         |                                    | BMBM-0130-00                                         | 05/24/16        | 05/24/18   |
| Coaxial Cable -<br>BMBM-0155-01<br>Black           | BELDEN             |                                    | BMBM-0155-01                                         | 06/01/16        | 06/01/18   |
| Coaxial Cable -<br>BMBM-0065-00 Black              | Belden             |                                    | BMBM-0065-00                                         | 06/08/16        | 06/08/18   |
| Coaxial Cable -<br>BMBM-0155-00<br>Black           | MIYAZAKI           |                                    | BMBM-0155-00                                         | 05/24/16        | 05/24/18   |
| Splitter 1-1000MHz                                 | Mini-Circuits      | ZFSC-4-1-<br>BNC+                  | U115700825                                           | N/A             | N/A        |
| Signal Generator R &<br>S SMU 200A                 | Rohde &<br>Schwarz | SMU200A                            | 103195                                               | 02/29/16        | 02/28/18   |
| Non Radiating 50<br>OHM Load                       | Sierra Elec        | 160B-600X                          | 1038                                                 | 09/13/16        | 09/13/18   |
| Attenuator N 30dB<br>500W DC-2.5G                  | Bird               | 8325                               | 1761                                                 | 05/18/15        | 12/18/17   |
| Attenuator N 20dB<br>2W DC-13G                     | Narda              | 757C                               | 30201                                                | 05/24/17        | 05/24/19   |
| Attenuator N 20dB<br>2W DC-13G                     | Narda              | 777C                               | 36124                                                | 05/24/17        | 05/23/19   |
| Bore-sight Antenna<br>Positioning Tower            | Sunol Sciences     | TLT2                               | N/A                                                  | N/A             | N/A        |

### \*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

## 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 ENTR 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 |
|-----------------------------------------------------------------------|-------------------------|-------|
| RF Frequency Accuracy                                                 | $\pm 49.5$ Hz           | (1)   |
| RF Conducted Power                                                    | $\pm 0.93$ dB           | (1)   |
| Conducted spurious emission of transmitter valid up to 40GHz          | $\pm 1.86$ dB           |       |
| Occupied Bandwidth                                                    | $\pm 2.65$ %            |       |
| Audio Frequency Response                                              | $\pm 1.86$ dB           |       |
| Modulation limiting                                                   | $\pm 1.88$ %            |       |
| Radiated RF Power                                                     | $\pm 1.4$ dB            |       |
| Maximum frequency deviation:<br>Within 300 Hz and 6kHz of audio freq. | $\pm 1.88$ %            |       |
| Within 6kHz and 25kHz of audio Freq.                                  | $\pm 2.04$ %            |       |
| Rad Emissions Sub Meth up to 26.5GHz                                  | $\pm 2.14$ dB           |       |
| Rad Emissions Sub Meth up to 18-40 GHz                                | $\pm 2.04$ %            |       |
| Adjacent channel power                                                | $\pm 1.47$ dB           | (1)   |
| Transient Frequency Response                                          | $\pm 1.88$ %            |       |
| Temperature                                                           | $\pm 1.0^{\circ}$ C     | (1)   |
| Humidity                                                              | $\pm 5.0$ %             |       |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=1.96$ .

## END OF REPORT