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Passive RF and microwave devices, intermodulation level measurement – Part 5: Measurement of passive intermodulation in filters

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IEC 62037-5:2021-11 RLV(en)

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CONTENTS

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PASSIVE RF AND MICROWAVE DEVICES, INTERMODULATION LEVEL MEASUREMENT –

Part 5: Measurement of passive intermodulation in filters

FOREWORD

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This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) dynamic testing requirements updated to define impact energy and locations to apply impacts to devices under test.

The text of this International Standard is based on the following documents:

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46/837/FDIS	46/858/RVD

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The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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PASSIVE RF AND MICROWAVE DEVICES, INTERMODULATION LEVEL MEASUREMENT –

Part 5: Measurement of passive intermodulation in filters

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1 Scope

This part of IEC 62037 defines test fixtures and procedures recommended for measuring levels of passive intermodulation generated by filters, typically used in wireless communication systems. The purpose is to define qualification and acceptance test methods for filters for use in low intermodulation (low IM) applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-75:2014, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 62037-1~~:2012~~, *Passive RF and microwave devices, intermodulation level measurement – Part 1: General requirements and measuring methods*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

DUT	Device under test
IM	Intermodulation
PIM	Passive intermodulation
VSWR	Voltage standing wave ratio

4 General comments on PIM testing of filter assemblies

4.1 Sources of error: back-to-back filters

Testing filter assemblies for PIM ~~may~~ can be error prone if certain precautionary guidelines are not followed. Since PIM can be a frequency-dependent phenomenon, mathematically related to the harmonics of the input signals and combinations thereof, consideration should be given not only to the behaviour of the test set-up under fundamental stimulation, but also its harmonic performance. In particular, consider a receive-band PIM test set-up as shown in Figure 1. As shown, this set-up could be used to measure the PIM in a two-port device under test (DUT); however, the accuracy of the measurement could be in question due to the back-to-back filters (diplexers) used.

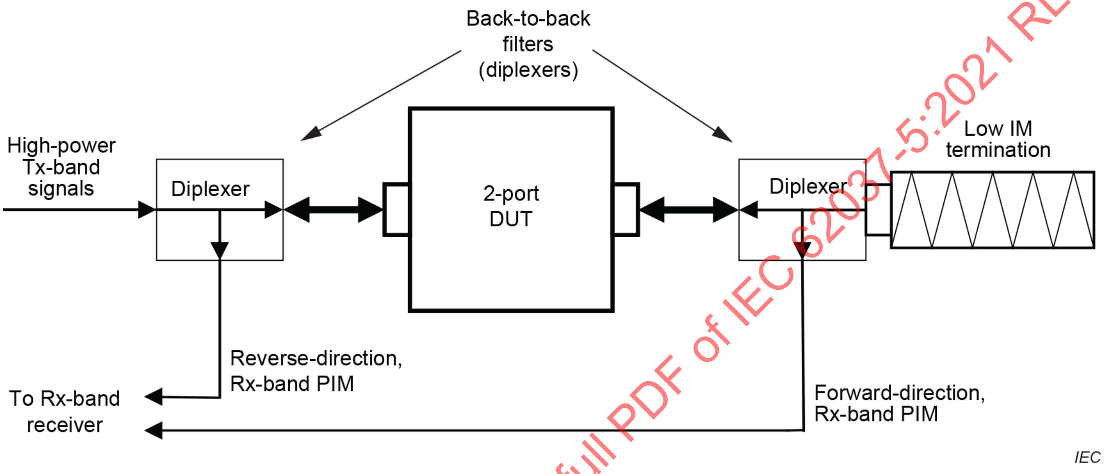

Figure 1 – Typical receive band PIM test set-up

While the diplexers certainly appear as a matched load around the fundamental frequencies and receive-band IM products, they ~~may~~ can be very poorly matched at the harmonics of the fundamentals. A poor match will set up a standing wave at the harmonic frequencies which ~~may~~ can re-illuminate any PIM sources within the DUT with higher-than-typical current densities. Furthermore, the measured IM response will become highly dependent upon the electrical length of the DUT because the locations of the peaks and valleys of any standing waves will move with respect to the PIM sources as the electrical length of the DUT changes.

4.2 Environmental and dynamic PIM testing

Environmental and dynamic PIM testing, which ~~may~~ can include placing vibrational or thermal stresses upon filter assemblies while concurrently measuring the PIM produced, may not give accurate or repeatable results. There are several significant factors affecting the results of these types of PIM tests.

a) DUT/test system isolation – it is highly desirable that any environmental and dynamic stresses placed upon a DUT be isolated from the test system such that there are no measurable residual effects. This not only addresses the practical issues of test system reliability and maintenance, but it directly affects the issue of measurement repeatability. That is, should a particular piece of the test system require replacement after a set number of trials, then the results of subsequent measurements may be skewed by the performance of the replaced part.

b) Measurement repeatability – it should be possible to repeat the results obtained from a particular measurement within a specific precision. However, the inherent sensitivity of the PIM response ~~may~~ can prevent a desired precision from being achieved.

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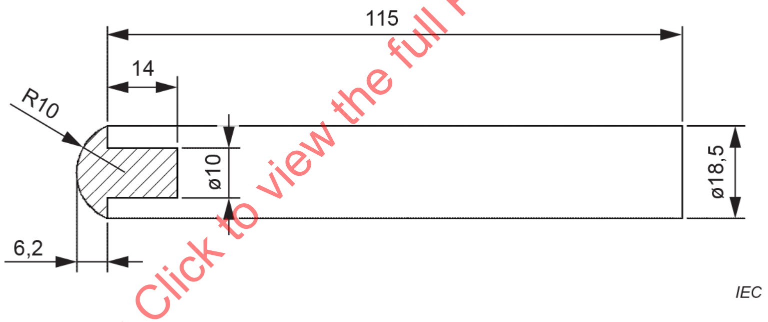
c) Stress repeatability – the particular stress placed upon the DUT shall be repeatable both between tests upon the same DUT and tests between different DUTs. However, in the experience of many, it is likely that the repeatability of the particular stress will be far worse than that of the particular PIM test results so that the standard specifying the stress may not be unnecessarily rigorous.

Based upon these factors, measuring PIM from a filter assembly whilst it undergoes thermal or vibrational stresses is not currently recommended.

A less vigorous form of dynamic testing ~~may~~ should be performed on a filter assembly in order to demonstrate that stability of the PIM level is maintained after certain ~~vibrational~~ stresses have been applied. This style of dynamic test ~~can take~~ typically takes the form of ~~tapping~~ striking the assembly with an instrument that will not damage the surface of the assembly~~, such as a length of nylon rod or hard rubber hammer~~. The impact of this tapping shall be at least that described in IEC 60068-2-75:2014, Clause 7 for the 0,14 J drop, with conditions given in IEC 60068-2-75:2014, Table 1 and Table 2, that is, a 0,25 kg striking element of polyamide (Rockwell hardness: 85 < HRR < 100) dropped from a height of 56 mm.

The impact shall be applied as close as possible to each of the connectors of the filter, while still impacting the filter body. The impact near each connector shall be repeated three times. Also, for any side of the filter that has no connectors, three impacts shall be applied along one edge of that side. The shape of the striking element shall be the same as described in IEC 60068-2-75, for ≤ 1 J. An example, taken from IEC 60068-2-75:2014, Annex A, is shown Figure 2.

Dimensions in millimetres



SOURCE: IEC 60068-2-75:2014, Figure A.1.

Figure 2 – Example of a striking element for ≤ 1 J

The results of the PIM tests shall be documented in a report. That report shall state

1) the test severity level, i.e. the weight and drop height for the impact test,
2) the frequency range(s) of the PIM test(s), the greatest PIM value after the application of the impacts.

If something other than the vertical hammer test method is applied, then there shall be documentation showing that the alternative test method produces an impact at least as great as the vertical hammer test.

4.3 General test procedure

An appropriate test set-up ~~can~~ shall be selected from the example schematics described in Clause 4, according to the specific test requirements called for. The procedure is as follows:

a) calibrate the test set-up for correct carrier signal level and IM receiver level as described in ~~Clause 7 of~~ IEC 62037-1~~:2012~~;
b) connect the filter DUT in the test set-up;

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c) measure the IM performance of the DUT on the receiver.

The results obtained ~~should~~ shall be expressed in one of the forms indicated in ~~Clause 8 of~~ IEC 62037-1~~:2012~~.

5 Example of test equipment schematics for filter testing

5.1 General

Several examples of schematics are presented. Each figure corresponds to a particular test scenario as indicated in the matrix in Table 1. It will be noted that some of the example schematics are modifications of the test configurations shown in ~~Figure 1 and Figure 2 of~~ IEC 62037-1~~:2012~~. These modifications allow the operator to satisfactorily perform a range of tests which are more specific to the requirement of filter assemblies.

It is imperative that the residual PIM level of the test system be verified prior to measurement of the filter assembly. It is strongly recommended that this level be at least 10 dB below the PIM level requirement of the filter assembly, in order to minimize errors due to the system itself. This measurement can be carried out in the following example set-ups by ~~precluding~~ excluding the DUT from the measurement system and monitoring the resultant PIM level under the normal test conditions. The only systems which deviate slightly from this are Figure 6 and Figure 9 and notes are provided for these two set-ups, indicating the test point at which the system residual intermodulation distortion can be measured with the DUT removed.

Table 1 – Summary table referencing examples of test equipment schematics for measuring PIM on filter-type devices

	Tx band	Rx band	
Measurement type	**Two high-power carriers**	**Two high-power carriers**	**One high-power carrier + injected interferer**
N-port, forward IM	Figure 5	Figure 4	Figure 7
N-port, reverse IM		Figure 5	Figure 8
N-port, receive port IM		Figure 6	Figure 9

Figure 6 and Figure 9 outline equipment set-ups which measure the PIM present at a receive port of the filter assembly. These set-ups are distinct from those measuring PIM in the reverse direction (Figure 5 and Figure 8) and can give quite different results. It is therefore important that consideration is given to using the appropriate measurement system, in order to measure the required PIM performance.

5.2 Transmit band testing

Passive IM testing within the transmit band is typically performed on isolators and other relatively high PIM components. For this test, two carriers are combined into a single transmission line and then passed through the DUT. Once these are through the DUT, it is advisable to sufficiently attenuate the two carriers to prevent the generation of active IM products and possible damage within the receiver. A low noise amplifier is typically not required due to the high PIM signal levels present from the DUT in these tests. This is described in Figure 3.

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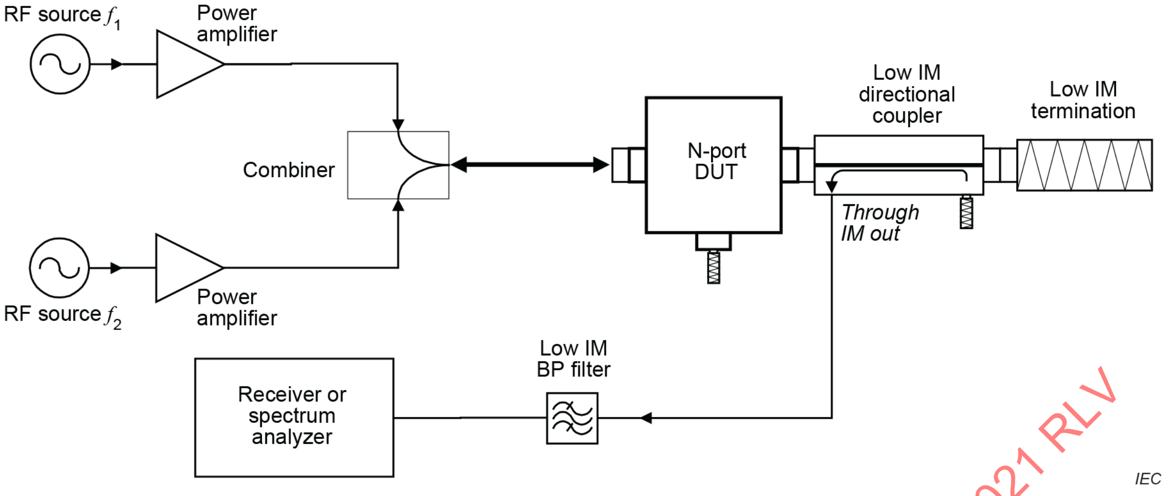

The combiner port-to-port isolation plus band stop/low pass filters should be optimized to set the test bench system residual to an acceptable level.

Consideration should be given to the possible generation of IM products within the receiver/spectrum analyzer and whether a sufficient dynamic range can be obtained. An optional IM band pass filter may be used to allow these conditions to be met.

Unused DUT ports shall be terminated in a matched load.

The low IM directional coupler could alternatively be replaced by an appropriate diplexer.

a) In this instance, it is strongly recommended that the replacement diplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement diplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 3 – Typical test equipment schematic for measuring transmit-band, forward, passive IM products on an N-port DUT using two high-power carriers

5.3 Receive band testing – Dual high-power carriers

When testing for PIM products in the receive band, a much greater measurement sensitivity is required than for transmit band testing. For this reason, a low-noise amplifier and bandpass filter are typically utilized before the measurement receiver (or spectrum analyzer).

Examples of schematics for both forward and reverse PIM testing on N-port devices are shown in Figure 4, Figure 5 and Figure 6.

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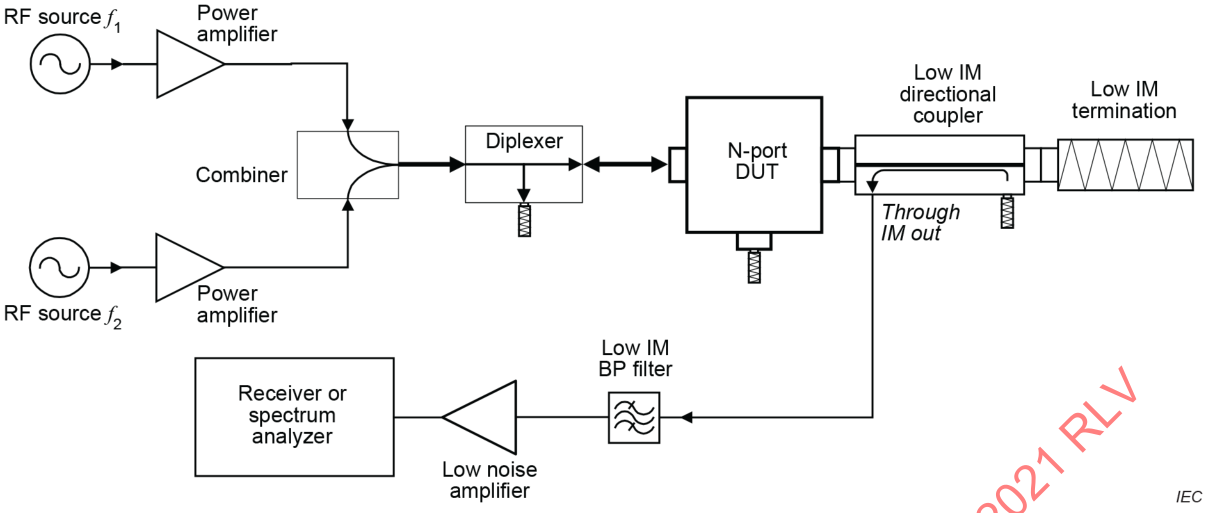

The low IM directional coupler could alternatively be replaced by an appropriate diplexer.

a) In this instance, it is strongly recommended that the replacement diplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement diplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

The combiner and diplexer could alternatively be replaced by an appropriate triplexer.

1) In this instance, it is strongly recommended that the replacement triplexer has a good VSWR in both the Tx and Rx bands.

2) Due to the potentially reflective nature of the replacement triplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 4 – Typical test equipment schematic for measuring receive-band, forward, passive IM products on an N-port DUT, using two high-power carriers

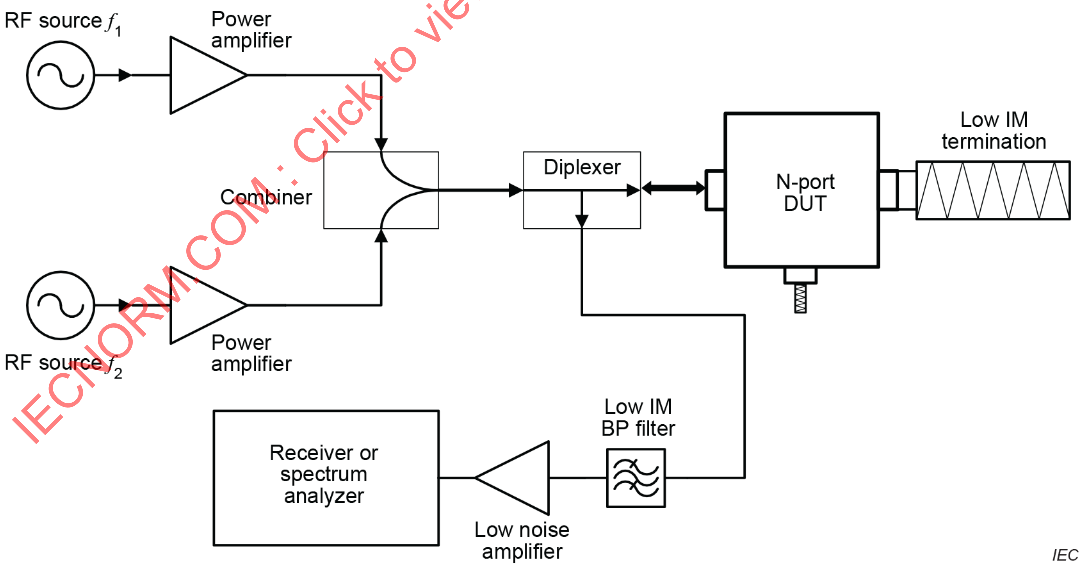

Figure 5 – Typical test equipment schematic for measuring receive-band, reverse, passive IM products on an N-port DUT, using two high-power carriers

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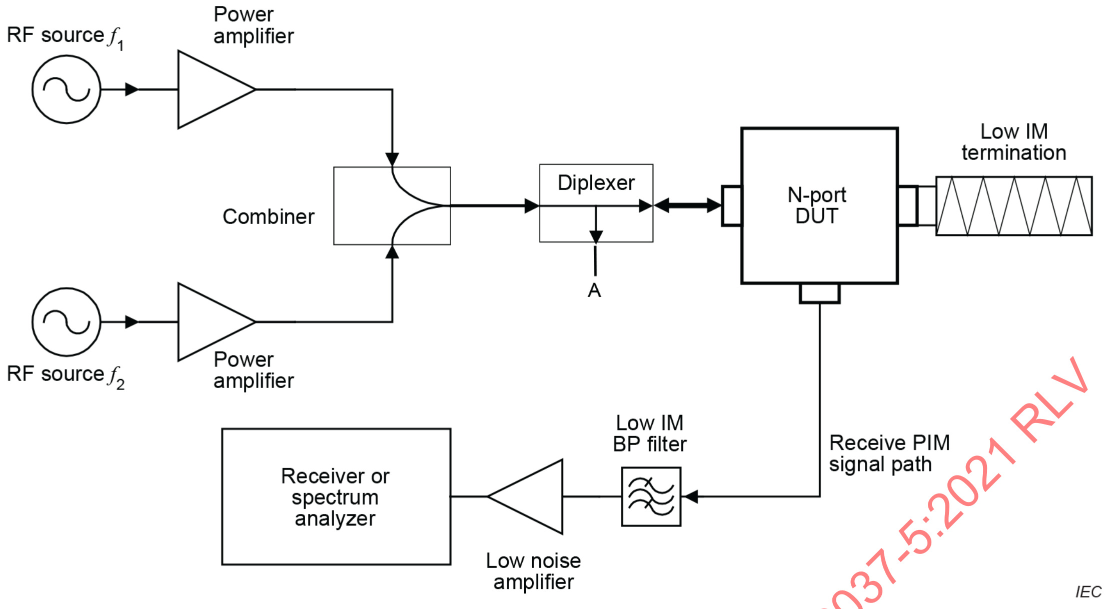

Point A can be used as a test point to monitor the system residual level (with the DUT removed). To be terminated during DUT measurement.

The combiner and diplexer could alternatively be replaced by an appropriate triplexer.

a) In this instance, it is strongly recommended that the replacement triplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement triplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 6 – Typical test equipment schematic for measuring receive-band, passive IM products on an N-port DUT, using two high-power carriers

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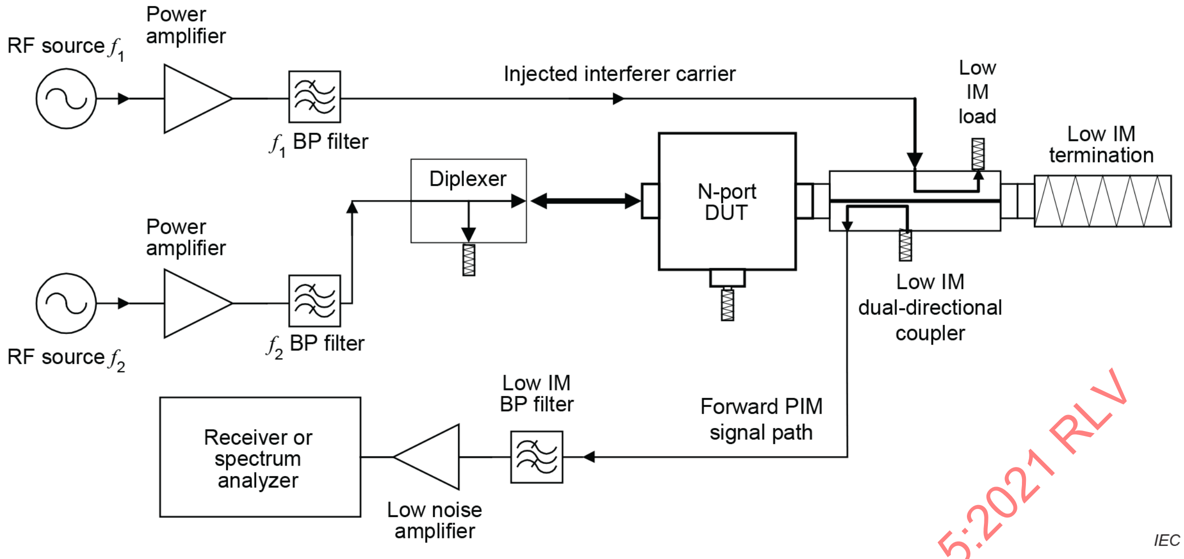
The following remarks apply to Figure 5 and Figure 6:

1) The combiner port-to-port isolation plus diplexer should be optimized to set the test bench system residual to an acceptable level.
2) Consideration should be given to the possible generation of IM products within the receiver/spectrum analyzer and whether a sufficient dynamic range can be obtained. An optional IM band pass filter plus low noise amplifier may be used to allow these conditions to be met.
3) Due to the potentially reflective nature of the diplexer and DUT, it should be recognized that there is a mechanism that supports multipathing.
4) It is strongly recommended that the diplexer has a good VSWR in both the Tx and Rx bands.
5) Unused DUT ports shall be terminated in a matched load.

5.4 Receive band testing – Injected interferer

To simulate the PIM performance of filters due to signals originating both internally to the system and externally to the system, injected interferer testing may be performed. For these tests, one carrier remains at full power. The other carrier is typically reduced in power by some 20 dB to 40 dB relative to the strongest carrier. Typical test equipment schematics are shown in Figure 7, Figure 8 and Figure 9.



The low IM dual directional coupler could alternatively be replaced by an appropriate diplexer.

a) In this instance, it is strongly recommended that the replacement diplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement diplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 7 – Typical test equipment schematic for measuring receive-band, forward, passive IM products on an N-port DUT, using the injected interferer technique

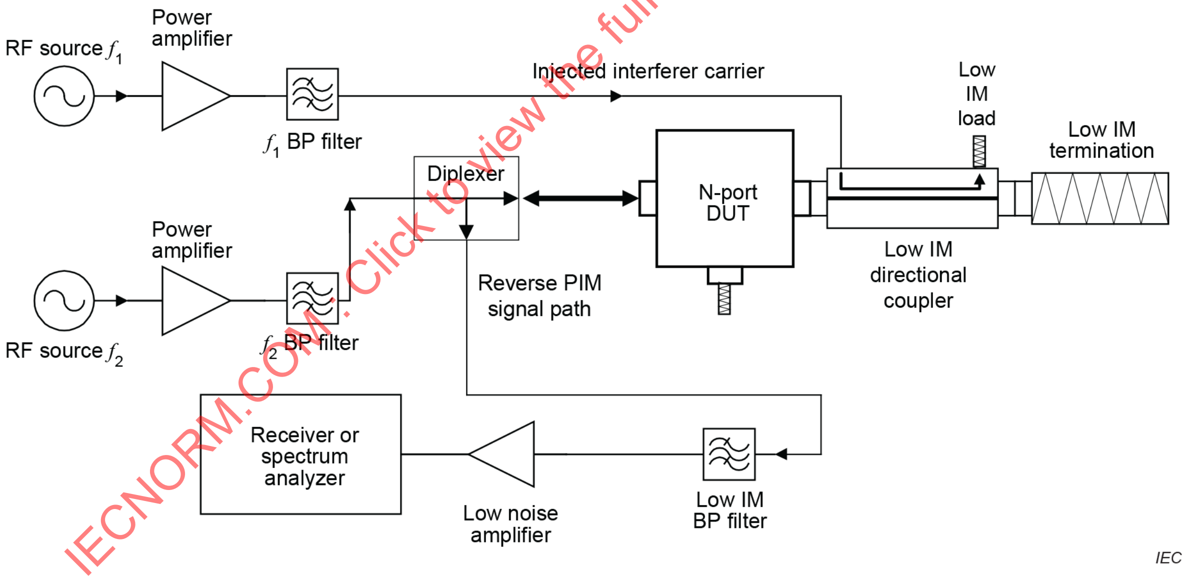


Figure 8 – Typical test equipment schematic for measuring receive-band, reverse, passive IM products on an N-port DUT, using the injected interferer technique

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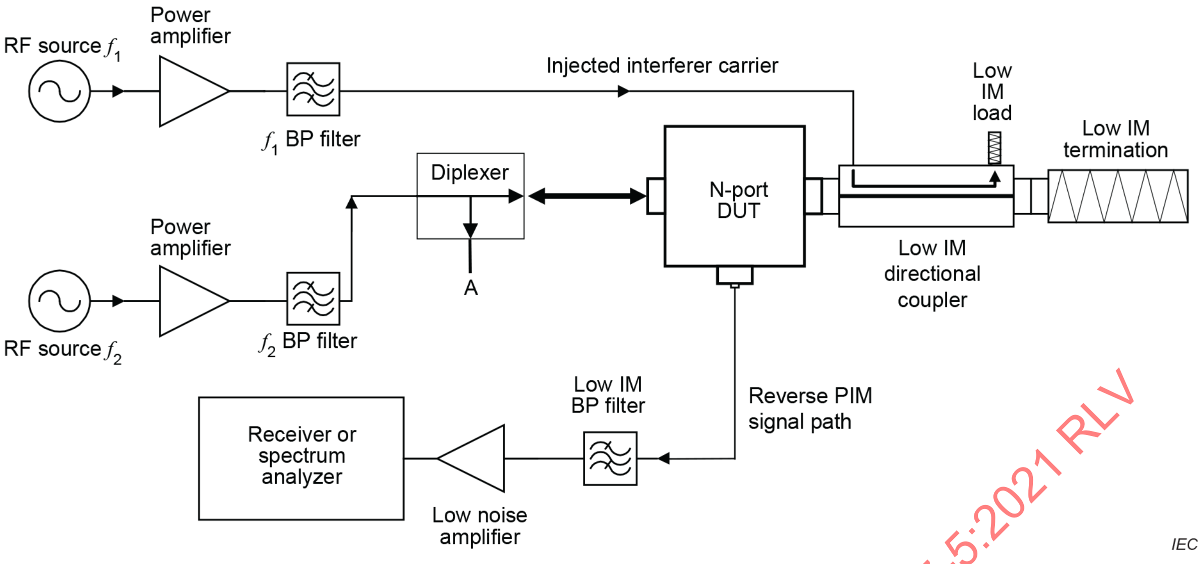

Point A can be used as a test point to monitor the system residual level (with the DUT removed). To be terminated during DUT measurement.

Figure 9 – Typical test equipment schematic for measuring receive-band, passive IM products on an N-port DUT, using the injected interferer technique

The following remarks apply to Figure 7, Figure 8 and Figure 9:

1) Due to the potentially reflective nature of the diplexer and DUT, it should be recognized that there is a mechanism that supports multipathing.

2) Care should be taken to minimize generation of IM in the injected interferer power amplifier. This ~~may~~ can be achieved by the use of an f_1 band pass filter.

3) Unused DUT ports shall be terminated in a matched load.

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Dispositifs RF et à micro-ondes passifs, mesure du niveau d’intermodulation – Partie 5: Mesure de l’intermodulation passive dans les filtres

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This part of IEC 62037 defines test fixtures and procedures recommended for measuring levels of passive intermodulation generated by filters, typically used in wireless communication systems. The purpose is to define qualification and acceptance test methods for filters for use in low intermodulation (low IM) applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-75:2014, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 62037-1, *Passive RF and microwave devices, intermodulation level measurement – Part 1: General requirements and measuring methods*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

DUT	Device under test
IM	Intermodulation
PIM	Passive intermodulation
VSWR	Voltage standing wave ratio

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4 General comments on PIM testing of filter assemblies

4.1 Sources of error: back-to-back filters

Testing filter assemblies for PIM can be error prone if certain precautionary guidelines are not followed. Since PIM can be a frequency-dependent phenomenon, mathematically related to the harmonics of the input signals and combinations thereof, consideration should be given not only to the behaviour of the test set-up under fundamental stimulation, but also its harmonic performance. In particular, consider a receive-band PIM test set-up as shown in Figure 1. As shown, this set-up could be used to measure the PIM in a two-port device under test (DUT); however, the accuracy of the measurement could be in question due to the back-to-back filters (diplexers) used.

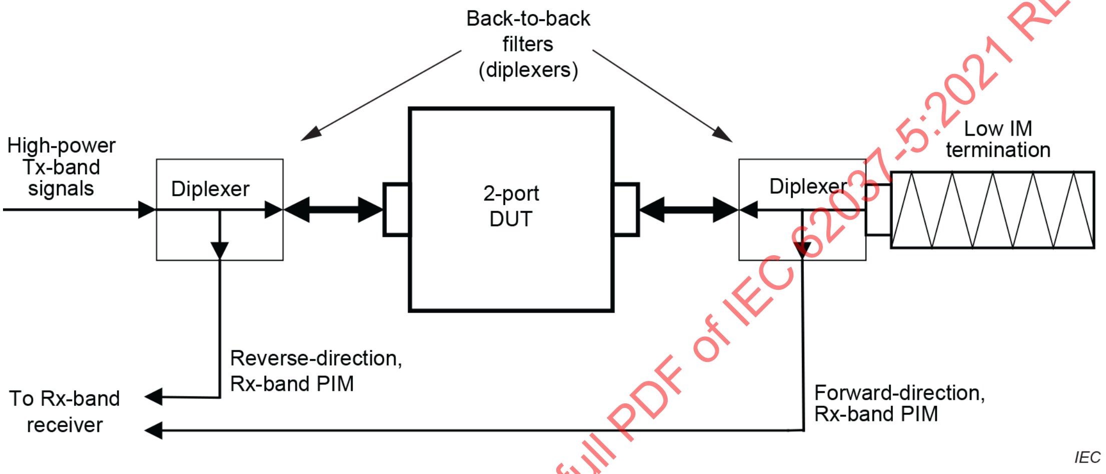

Figure 1 – Typical receive band PIM test set-up

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While the diplexers certainly appear as a matched load around the fundamental frequencies and receive-band IM products, they can be very poorly matched at the harmonics of the fundamentals. A poor match will set up a standing wave at the harmonic frequencies which can re-illuminate any PIM sources within the DUT with higher-than-typical current densities. Furthermore, the measured IM response will become highly dependent upon the electrical length of the DUT because the locations of the peaks and valleys of any standing waves will move with respect to the PIM sources as the electrical length of the DUT changes.

4.2 Environmental and dynamic PIM testing

Environmental and dynamic PIM testing, which can include placing vibrational or thermal stresses upon filter assemblies while concurrently measuring the PIM produced, may not give accurate or repeatable results. There are several significant factors affecting the results of these types of PIM tests.

a) DUT/test system isolation – it is highly desirable that any environmental and dynamic stresses placed upon a DUT be isolated from the test system such that there are no measurable residual effects. This not only addresses the practical issues of test system reliability and maintenance, but it directly affects the issue of measurement repeatability. That is, should a particular piece of the test system require replacement after a set number of trials, then the results of subsequent measurements may be skewed by the performance of the replaced part.

b) Measurement repeatability – it should be possible to repeat the results obtained from a particular measurement within a specific precision. However, the inherent sensitivity of the PIM response can prevent a desired precision from being achieved.

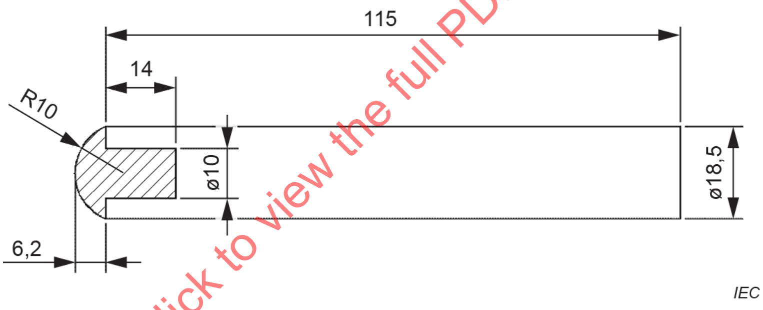
c) Stress repeatability – the particular stress placed upon the DUT shall be repeatable both between tests upon the same DUT and tests between different DUTs. However, in the experience of many, it is likely that the repeatability of the particular stress will be far worse than that of the particular PIM test results so that the standard specifying the stress may not be unnecessarily rigorous.

Based upon these factors, measuring PIM from a filter assembly whilst it undergoes thermal or vibrational stresses is not currently recommended.

A less vigorous form of dynamic testing should be performed on a filter assembly in order to demonstrate that stability of the PIM level is maintained after certain stresses have been applied. This style of dynamic test typically takes the form of striking the assembly with an instrument that will not damage the surface of the assembly. The impact of this tapping shall be at least that described in IEC 60068-2-75:2014, Clause 7 for the 0,14 J drop, with conditions given in IEC 60068-2-75:2014, Table 1 and Table 2, that is, a 0,25 kg striking element of polyamide (Rockwell hardness: 85 < HRR < 100) dropped from a height of 56 mm.

The impact shall be applied as close as possible to each of the connectors of the filter, while still impacting the filter body. The impact near each connector shall be repeated three times. Also, for any side of the filter that has no connectors, three impacts shall be applied along one edge of that side. The shape of the striking element shall be the same as described in IEC 60068-2-75, for ≤ 1 J. An example, taken from IEC 60068-2-75:2014, Annex A, is shown Figure 2.

Dimensions in millimetres



SOURCE: IEC 60068-2-75:2014, Figure A.1.

Figure 2 – Example of a striking element for ≤ 1 J

The results of the PIM tests shall be documented in a report. That report shall state

1) the test severity level, i.e. the weight and drop height for the impact test,
2) the frequency range(s) of the PIM test(s), the greatest PIM value after the application of the impacts.

If something other than the vertical hammer test method is applied, then there shall be documentation showing that the alternative test method produces an impact at least as great as the vertical hammer test.

4.3 General test procedure

An appropriate test set-up shall be selected from the example schematics described in Clause 4, according to the specific test requirements called for. The procedure is as follows:

a) calibrate the test set-up for correct carrier signal level and IM receiver level as described in IEC 62037-1;
b) connect the filter DUT in the test set-up;
c) measure the IM performance of the DUT on the receiver.

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The results obtained shall be expressed in one of the forms indicated in IEC 62037-1.

5 Example of test equipment schematics for filter testing

5.1 General

Several examples of schematics are presented. Each figure corresponds to a particular test scenario as indicated in the matrix in Table 1. It will be noted that some of the example schematics are modifications of the test configurations shown in IEC 62037-1. These modifications allow the operator to satisfactorily perform a range of tests which are more specific to the requirement of filter assemblies.

It is imperative that the residual PIM level of the test system be verified prior to measurement of the filter assembly. It is strongly recommended that this level be at least 10 dB below the PIM level requirement of the filter assembly, in order to minimize errors due to the system itself. This measurement can be carried out in the following example set-ups by excluding the DUT from the measurement system and monitoring the resultant PIM level under the normal test conditions. The only systems which deviate slightly from this are Figure 6 and Figure 9 and notes are provided for these two set-ups, indicating the test point at which the system residual intermodulation distortion can be measured with the DUT removed.

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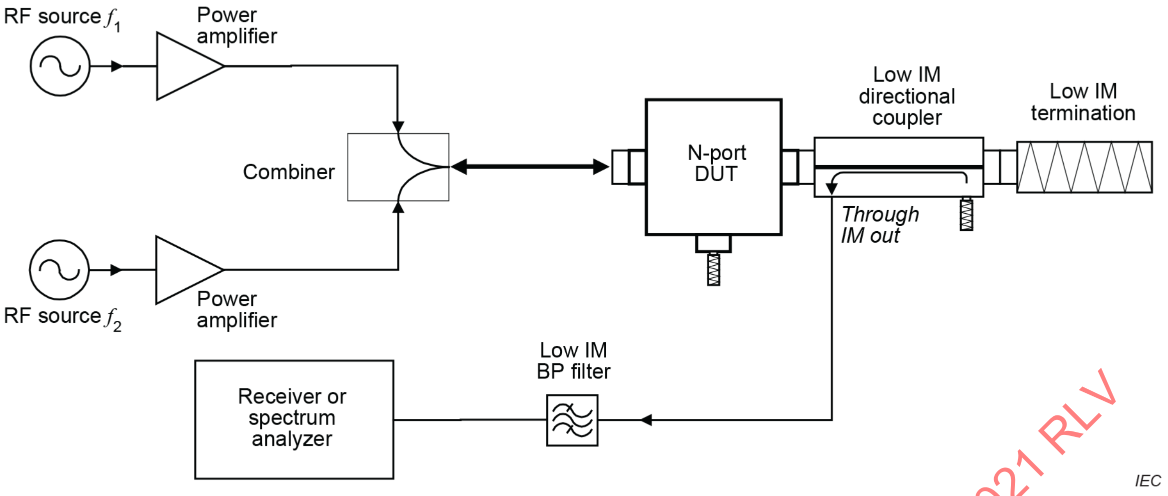
Table 1 – Summary table referencing examples of test equipment schematics for measuring PIM on filter-type devices

	Tx band	Rx band	
Measurement type	**Two high-power carriers**	**Two high-power carriers**	**One high-power carrier + injected interferer**
N-port, forward IM	Figure 5	Figure 4	Figure 7
N-port, reverse IM		Figure 5	Figure 8
N-port, receive port IM		Figure 6	Figure 9

Figure 6 and Figure 9 outline equipment set-ups which measure the PIM present at a receive port of the filter assembly. These set-ups are distinct from those measuring PIM in the reverse direction (Figure 5 and Figure 8) and can give quite different results. It is therefore important that consideration is given to using the appropriate measurement system, in order to measure the required PIM performance.

5.2 Transmit band testing

Passive IM testing within the transmit band is typically performed on isolators and other relatively high PIM components. For this test, two carriers are combined into a single transmission line and then passed through the DUT. Once these are through the DUT, it is advisable to sufficiently attenuate the two carriers to prevent the generation of active IM products and possible damage within the receiver. A low noise amplifier is typically not required due to the high PIM signal levels present from the DUT in these tests. This is described in Figure 3.



The combiner port-to-port isolation plus band stop/low pass filters should be optimized to set the test bench system residual to an acceptable level.

Consideration should be given to the possible generation of IM products within the receiver/spectrum analyzer and whether a sufficient dynamic range can be obtained. An optional IM band pass filter may be used to allow these conditions to be met.

Unused DUT ports shall be terminated in a matched load.

The low IM directional coupler could alternatively be replaced by an appropriate diplexer.

a) In this instance, it is strongly recommended that the replacement diplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement diplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 3 – Typical test equipment schematic for measuring transmit-band, forward, passive IM products on an N-port DUT using two high-power carriers

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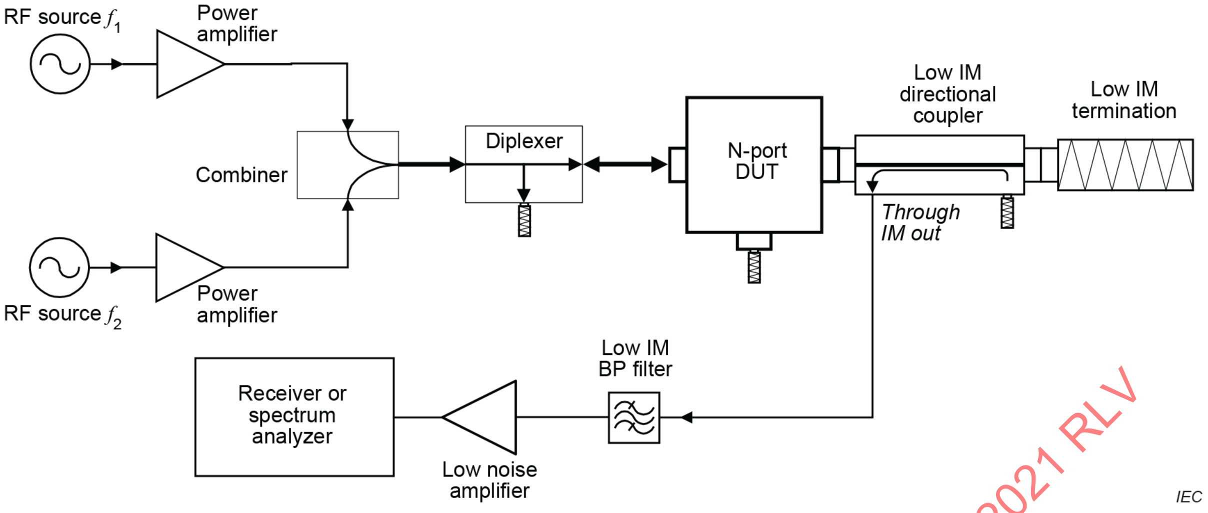
5.3 Receive band testing – Dual high-power carriers

When testing for PIM products in the receive band, a much greater measurement sensitivity is required than for transmit band testing. For this reason, a low-noise amplifier and bandpass filter are typically utilized before the measurement receiver (or spectrum analyzer).

Examples of schematics for both forward and reverse PIM testing on N-port devices are shown in Figure 4, Figure 5 and Figure 6.



The low IM directional coupler could alternatively be replaced by an appropriate diplexer.

a) In this instance, it is strongly recommended that the replacement diplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement diplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

The combiner and diplexer could alternatively be replaced by an appropriate triplexer.

1) In this instance, it is strongly recommended that the replacement triplexer has a good VSWR in both the Tx and Rx bands.

2) Due to the potentially reflective nature of the replacement triplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 4 – Typical test equipment schematic for measuring receive-band, forward, passive IM products on an N-port DUT, using two high-power carriers

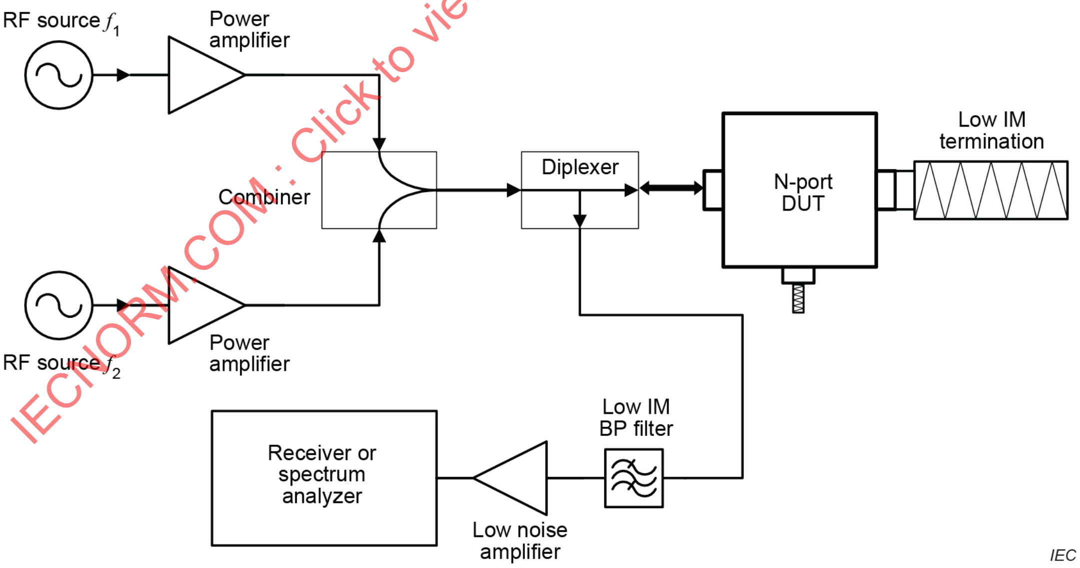


Figure 5 – Typical test equipment schematic for measuring receive-band, reverse, passive IM products on an N-port DUT, using two high-power carriers

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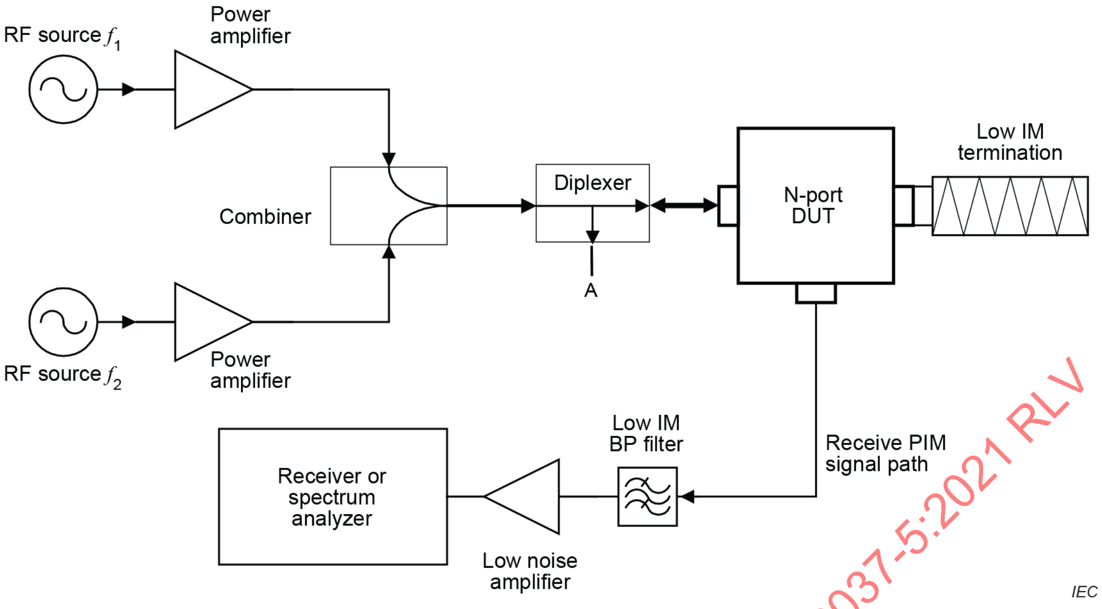

Point A can be used as a test point to monitor the system residual level (with the DUT removed). To be terminated during DUT measurement.

The combiner and diplexer could alternatively be replaced by an appropriate triplexer.

a) In this instance, it is strongly recommended that the replacement triplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement triplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 6 – Typical test equipment schematic for measuring receive-band, passive IM products on an N-port DUT, using two high-power carriers

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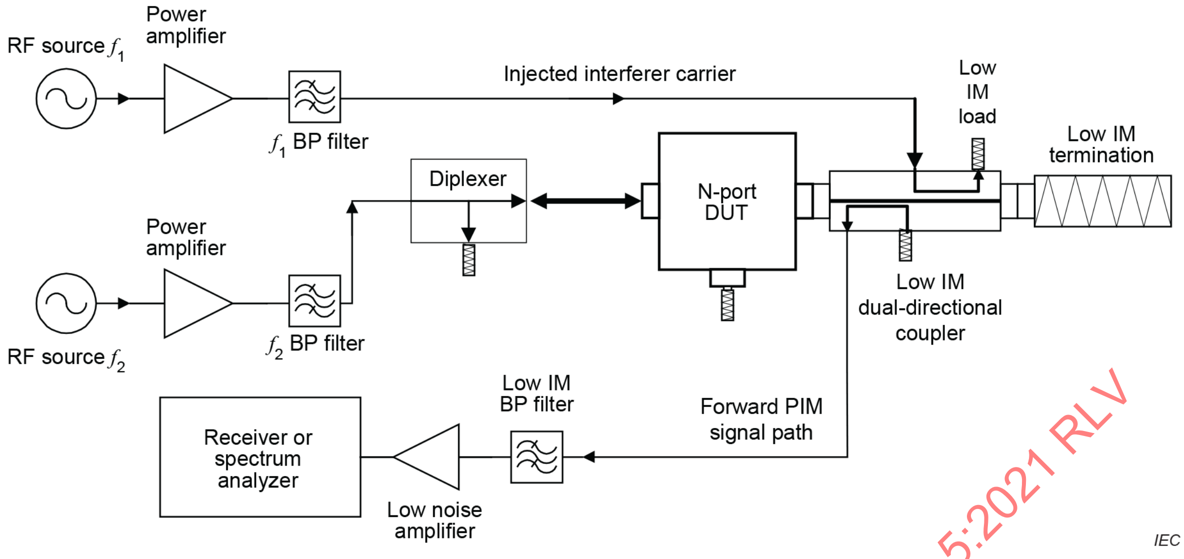
The following remarks apply to Figure 5 and Figure 6:

1) The combiner port-to-port isolation plus diplexer should be optimized to set the test bench system residual to an acceptable level.
2) Consideration should be given to the possible generation of IM products within the receiver/spectrum analyzer and whether a sufficient dynamic range can be obtained. An optional IM band pass filter plus low noise amplifier may be used to allow these conditions to be met.
3) Due to the potentially reflective nature of the diplexer and DUT, it should be recognized that there is a mechanism that supports multipathing.
4) It is strongly recommended that the diplexer has a good VSWR in both the Tx and Rx bands.
5) Unused DUT ports shall be terminated in a matched load.

5.4 Receive band testing – Injected interferer

To simulate the PIM performance of filters due to signals originating both internally to the system and externally to the system, injected interferer testing may be performed. For these tests, one carrier remains at full power. The other carrier is typically reduced in power by some 20 dB to 40 dB relative to the strongest carrier. Typical test equipment schematics are shown in Figure 7, Figure 8 and Figure 9.



The low IM dual directional coupler could alternatively be replaced by an appropriate diplexer.

a) In this instance, it is strongly recommended that the replacement diplexer has a good VSWR in both the Tx and Rx bands.

b) Due to the potentially reflective nature of the replacement diplexer and DUT, it should also be recognized that there would be a mechanism that supports multipathing.

Figure 7 – Typical test equipment schematic for measuring receive-band, forward, passive IM products on an N-port DUT, using the injected interferer technique

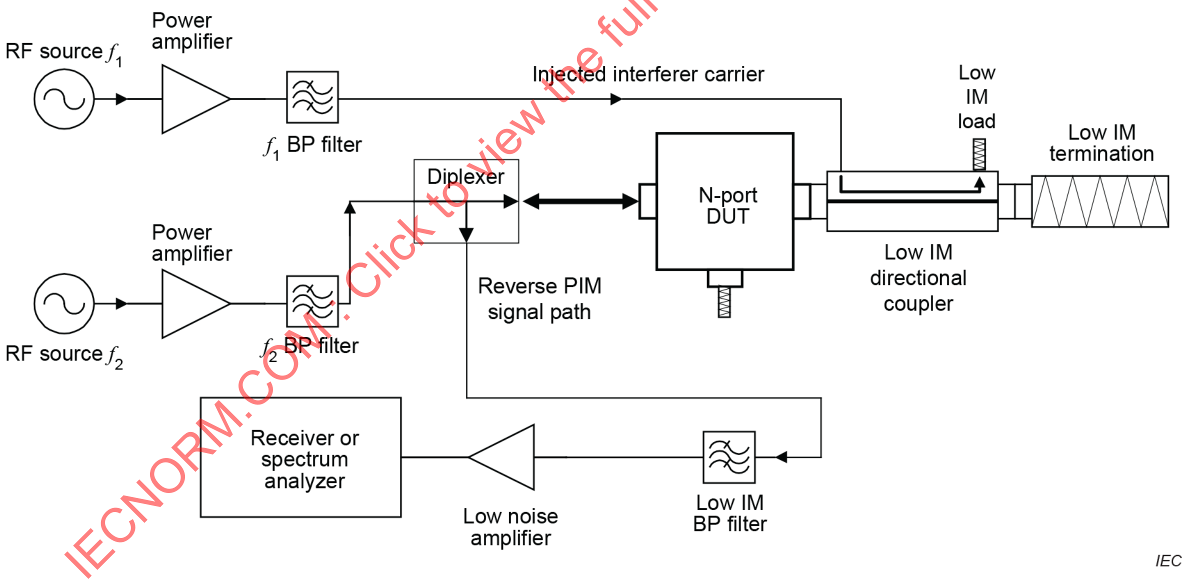


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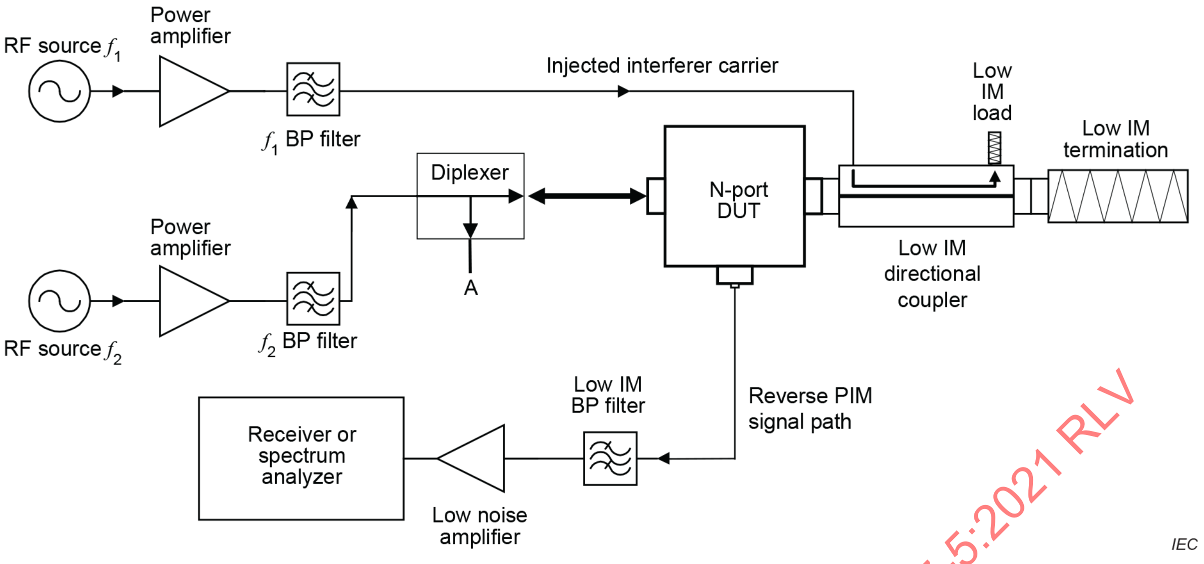
Figure 8 – Typical test equipment schematic for measuring receive-band, reverse, passive IM products on an N-port DUT, using the injected interferer technique



Point A can be used as a test point to monitor the system residual level (with the DUT removed). To be terminated during DUT measurement.

Figure 9 – Typical test equipment schematic for measuring receive-band, passive IM products on an N-port DUT, using the injected interferer technique

The following remarks apply to Figure 7, Figure 8 and Figure 9:

1) Due to the potentially reflective nature of the diplexer and DUT, it should be recognized that there is a mechanism that supports multipathing.
2) Care should be taken to minimize generation of IM in the injected interferer power amplifier. This can be achieved by the use of an f_1 band pass filter.
3) Unused DUT ports shall be terminated in a matched load.

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SOMMAIRE

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

DISPOSITIFS RF ET À MICRO-ONDES PASSIFS, MESURE DU NIVEAU D'INTERMODULATION –

Partie 5: Mesure de l'intermodulation passive dans les filtres

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L'IEC 62037-5 a été établie par le comité d'études 46 de l'IEC: Câbles, fils, guides d'ondes, connecteurs, composants passifs pour micro-onde et accessoires. Il s'agit d'une Norme internationale.

Cette seconde édition annule et remplace la première édition parue en 2013. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) mise à jour des exigences d'essais dynamiques pour définir l'énergie de choc et les emplacements auxquels les chocs doivent être appliqués aux dispositifs en essai.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
46/837/FDIS	46/858/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue utilisée pour l'élaboration de la présente Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 62037, publiées sous le titre général *Dispositifs RF et à micro-ondes passifs, mesure du niveau d'intermodulation*, est disponible sur le site web de l'IEC.

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DISPOSITIFS RF ET À MICRO-ONDES PASSIFS, MESURE DU NIVEAU D'INTERMODULATION –

Partie 5: Mesure de l'intermodulation passive dans les filtres

1 Domaine d'application

La présente partie de l'IEC 62037 définit les dispositifs et les procédures d'essai recommandés pour mesurer des niveaux d'intermodulation passive générés par des filtres, généralement utilisés dans des systèmes de communication sans fil. L'objectif est de définir des méthodes d'essai de qualification et de réception pour des filtres destinés à être utilisés dans des applications de faible intermodulation (faible IM).

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-75:2014, *Essais d'environnement – Partie 2-75: Essais – Test Eh: Essais au marteau*

IEC 62037-1, *Dispositifs RF et à micro-ondes passifs, mesure du niveau d'intermodulation – Partie 1: Exigences générales et méthodes de mesure*

3 Termes, définitions et termes abrégés

3.1 Termes et définitions

Aucun terme n'est défini dans le présent document.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.2 Termes abrégés

DUT	Device under test (dispositif en essai)
IM	Intermodulation
PIM	Passive intermodulation (intermodulation passive)
ROS	Rapport d'onde stationnaire

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4 Commentaires d'ordre général sur les essais d'intermodulation passive des assemblages de filtres

4.1 Sources d'erreur: filtres dos à dos

Le fait de soumettre aux essais des assemblages de filtres pour l'intermodulation passive peut être une source d'erreur si certaines lignes directrices préventives ne sont pas suivies. Dans la mesure où l'intermodulation passive peut être un phénomène dépendant de la fréquence, lié mathématiquement aux harmoniques des signaux d'entrée et à leurs combinaisons, il convient de tenir compte non seulement du comportement du montage d'essai sous stimulation à la fréquence fondamentale, mais aussi de ses performances harmoniques. En particulier, un montage d'essai d'intermodulation passive dans la bande de réception, tel que représenté à la Figure 1, est pris comme exemple. Comme l'indique la figure, ce montage pourrait être utilisé pour mesurer l'intermodulation passive dans un dispositif en essai à deux ports; néanmoins, la précision de la mesure pourrait être remise en question en raison des filtres dos à dos (diplexeurs) utilisés.

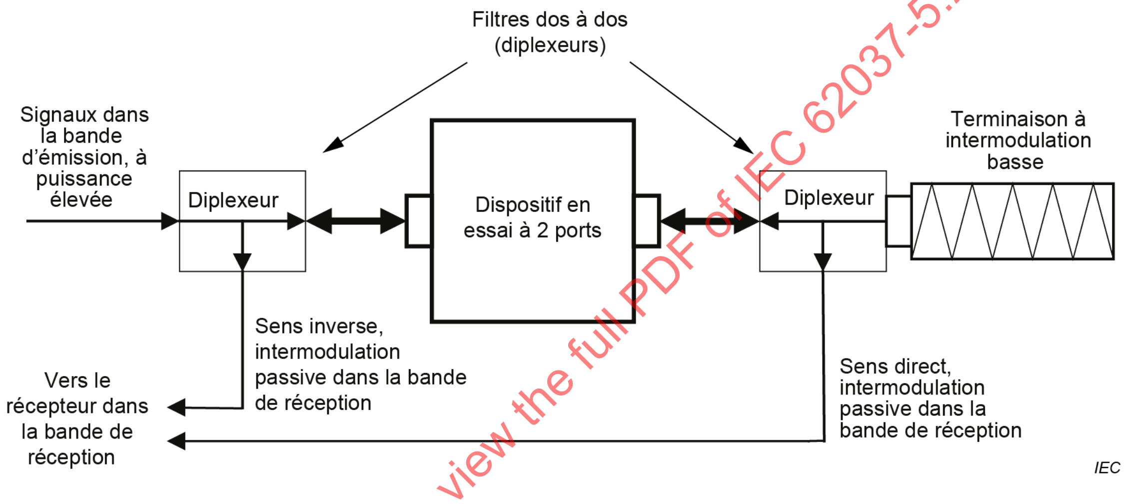

Figure 1 – Montage d'essai d'intermodulation passive dans la bande de réception type

Alors que les diplexeurs apparaissent certainement comme une charge adaptée autour des fréquences fondamentales et des produits d'intermodulation passive dans la bande de réception, ils peuvent être très mal adaptés au niveau des harmoniques des fréquences fondamentales. Une mauvaise adaptation crée une onde stationnaire aux fréquences harmoniques, ce qui peut perturber de nouveau toutes les sources d'intermodulation passive dans le DUT, avec des densités de courant plus élevées que les densités typiques. De plus, la réponse d'intermodulation mesurée devient fortement dépendante de la longueur électrique du DUT, dans la mesure où les emplacements des crêtes et des creux de toutes les ondes stationnaires se déplacent par rapport aux sources d'intermodulation passive, puisque la longueur électrique du DUT varie.

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4.2 Essais environnementaux et dynamiques d'intermodulation passive

Les essais environnementaux et dynamiques d'intermodulation passive, qui peuvent comprendre des vibrations ou des contraintes thermiques sur les assemblages de filtres, tout en mesurant en parallèle l'intermodulation passive produite, peuvent ne pas donner de résultats précis ou reproductibles. Il existe plusieurs facteurs significatifs affectant les résultats de ces types d'essais d'intermodulation passive.

a) Isolation du DUT par rapport au système d'essai. Il est fortement souhaitable que toutes les contraintes environnementales et dynamiques appliquées à un DUT soient isolées du système d'essai, de telle sorte qu'il n'y ait pas d'effets résiduels mesurables. Cela concerne non seulement les questions pratiques de fiabilité et de maintenance du système d'essai, mais affecte aussi directement la question de la reproductibilité de la mesure. Cela signifie que, le remplacement d'une pièce particulière du système d'essai étant exigé après un nombre