Application Note

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Intermodulation Distortion

An insight intermodulation distortion measurement methods using the IFR 2026A/B MultiSource Generator.

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Introduction

Intermodulation distortion (IMD) is a common problem in a variety of areas of electronics. In RF communications in particular it represents a difficult challenge to designers who face tougher requirements on component and sub system linearity. This trend is driven in part, by an increase in radio spectrum congestion.

This paper aims to identify the mechanisms responsible for generating intermodulation distortion and to examine some of the methods which may be used to measure and combat the problem. The emphasis is largely directed towards radio communications, yet many of the principles are directly applicable to other fields of application. Where appropriate, examples of real test applications are introduced.

What is 'IMD'?

Intermodulation distortion is the result of two or more signals interacting in a non linear device to produce additional unwanted signals. These additional signals (intermodulation products) occur mainly in devices such as amplifiers and mixers, but to a lesser extent they also occur in passive devices such as those found in many transmission systems. For example, RF connectors on transmission feeds may become corroded over time resulting in them behaving as non linear diode junctions. The same can apply at the junction of different metals or where magnetic materials are used.

Two interacting signals will produce intermodulation products at the sum and difference of integer multiples of the original frequencies.

For two input signals, the output frequency components can be expressed as:

mf1±nf2

where, m and n are integers $^{3}1$

The order of the intermodulation product is the sum of the integers m+n. The 'two tone' third order components, (2*f1-f2 and 2*f2-f1) are particularly important because unlike 2nd order distortion, i.e. harmonic distortion at 2*f1 or 2*f2, they can occur at frequencies close to the desired/interfering signals and so cannot be easily filtered. Higher order intermodulation products are generally less important because they have lower amplitudes and are more widelyspaced. The remaining third order products, 2f1+f2 and 2f2+f1, do not generally present a problem. The distribution of harmonics and third order products are shown in figure 1.

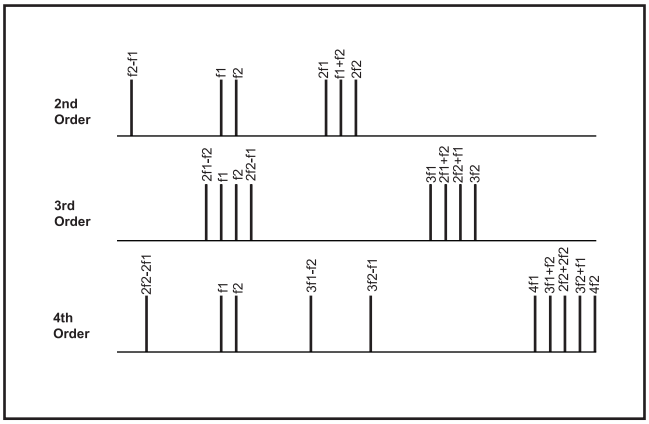


Figure 1 - Distribution of harmonics and intermodulation products

Example. If two signals, f1 and f2, at 90 MHz and 95 MHz respectively are applied to an amplifier, any non linearity of the device will result in two tone third order intermodulation products at 85 MHz ((2 x 90) - 95)) and 100 MHz ((2 x 95) - 90), plus two further signals at 275 MHz and 280 MHz, 2nd order harmonics at 180 MHz and 190 MHz and additional 3rd order intermodulation products (or 3rd harmonics) at 270 MHz and 285 MHz.

It is also possible for second order intermodulation products to be generated at the same frequency as the third order intermodulation products. This is usually because there is already harmonic distortion occurring on the input to the device under test, possibly from the applied test signal. Depending on the phase relationship between the second and third order intermodulation products, this effect may contribute constructively or destructively to the amplitude of the combined intermodulation products. This results in the real two tone third order intermodulation level being either exaggerated or under represented respectively.

The magnitude of intermodulation products cannot be predicted easily but it is known that their amplitude diminishes with order.

Third order intermodulation products have an amplitude proportional to the cube of the input signal whereas second order components have an amplitude proportional to the square of the input signal. Thus if two input signals, equal in magnitude, each rise by 1 dB then the third order intermodulation products rise by 3 dB, and the 2nd order components by 2 dB. Higher order terms behave accordingly. However, although 3rd order intermodulation products grow at higher rates, their levels are initially very small compared to lower order components which generally dominate. This RF level dependency leads to a simple test to establish the mechanism responsible for various distortion products, i.e. 2nd order or 3rd order effects.

Intermodulation products either side of signal tones may not behave symmetrically. The difference in their level indicates the presence of a more complex mechanism, or in the case of widely spaced tones it may indicate the effects of frequency response.

Amplifier Compression

Throughout the linear response region of an amplifier, level changes at the input will result in equal level changes at the output, assuming a fixed gain. For high input levels the amplifier output is limited by a number of factors, most notably by the magnitude of the DC rails. At the point which the amplifier output becomes non linear with respect to its input, the amplifier is said to have gone into compression. A graphical plot of input level against output level allows the point of amplifier compression can be found. The 1 dB compression point is the point at which the amplifier gain falls by 1 dB. It is used to compare amplifier performance and is shown in Figure 2. Compression may occur quickly or slowly depending upon the design of the amplifier.

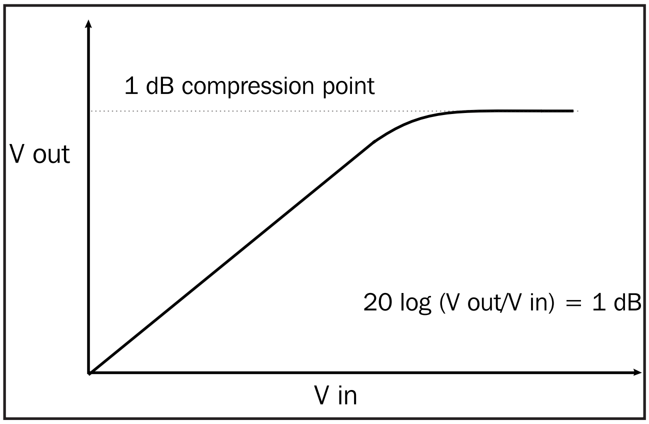


Figure 2 - 1 dB compression

Second and Third Order Intercept Point

If the levels of fundamental, 2nd order and 3rd order components are plotted against input level, theoretically there would be points where the second order and third order levels intercept the fundamental. These points are known respectively as a SOI, second order intercept point and TOI, third order intercept point, (otherwise known as IP3). In reality, the amplifier reaches compression first. From the graph, TOI or SOI are found by extrapolation. Figure 3 shows an example TOI (IP3) and SOI.

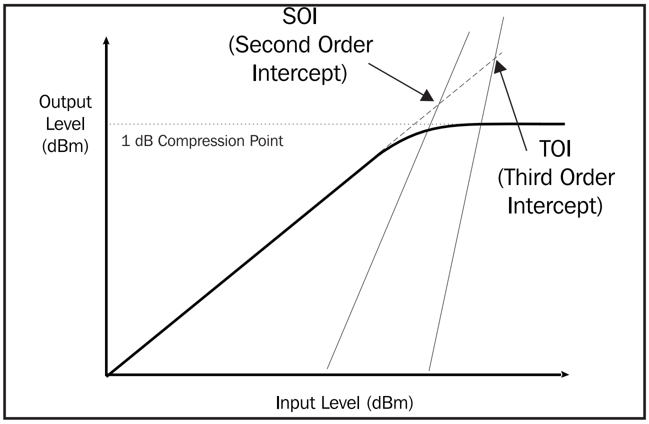


Figure 3 - Graph of SOI and TOI

The third order intercept point is used as a means of rating different amplifiers and mixers, allowing a comparison of the devices independent of their input level, unlike specifications for intermodulation distortion levels.

In the absence of any specified value for IP3, it may be estimated from the specified 1 dB compression point. As a rule of thumb, the third-order intercept point is approximately 10 dB higher than the 1 dB compression point for systems operating at high frequencies and 15 dB higher for systems operating at lower frequencies.

From a single intermodulation measurement, IP3 can be estimated using the following formula:

IP3 (dBm)= P(dBm) + A(dB)/2

Where A is the difference in power (dB) between the desired or interfering signal, and the third-order intermodulation product. P is either the input or output power (dBm), given the input or output values for IP3 respectively. The value of A must be measured accurately using a spectrum analyzer under constant conditions (temperature, frequency, power). Any change in these conditions will invalidate the measured value of A.

Receiver intermodulation

Receiver front end designs include both mixers and amplifiers. A measure of receiver linearity is the intermodulation attenuation in the presence of two interfering RF tones lying within the preselector bandwidth, (see Figure 4). The interfering tones themselves do not fall inside the IF passband, but their intermodulation products do. The interference due to intermodulation is primarily of interest at the limits of receiver sensitivity in the presence of relatively large interferers. At these levels the following useful relationship can be used.

Pimp = 2PA + PB - 2PIP3

Where Pimp = level of the intermodulation product in dBm

PA = level of the nearest interfering tone.

PB = level of the furthest interfering tone.

PIP3 = Third order intercept point.

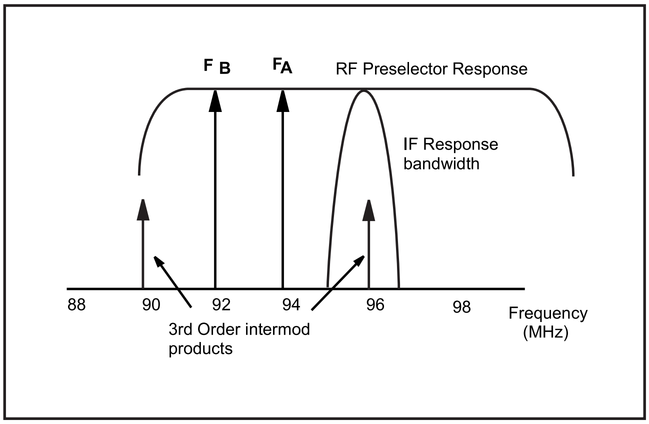


Figure 4. Receiver intermodulation rejection

The interfering signals, FA and FB represent nearby transmissions on neighboring channels of a system such as FDM (frequency division multiplex) or rogue transmissions in an unplanned radio environment. This is symptomatic of many FDM systems i.e. a mobile radio in close proximity to a base station tower operating on a number of channels simultaneously.

The frequency spacing of the two tones used in tests is chosen to be greater than the receivers I.F. bandwidth to ensure that the measurement is not affected by the selectivity characteristics of the receiver. The two frequencies must also be chosen to ensure that their intermodulation products fall inside the receiver IF bandwidth. For example AMPS (Advanced Mobile Phone System) receiver intermodulation tests are performed with interferers spaced 60 kHz and 120 kHz away from the in channel signal, which equates to 2 and 4 channels offset respectively. AMPS radios are also tested with 300 kHz and 600 kHz spacings.

Three Tone IM Distortion

Some devices are operated in conditions where a number of inputs may be present, in which case testing should be carried out with multiple outputs.

The effect of intermodulation distortion may differ with the introduction of further interfering signals. With three signals present at the input of an amplifier or mixer, three sets of IM products are produced (caused by f1&f2 combining, f1&f3 combining and f2&f3 combining), this is shown in figure 5. A total of 15 different third order products may be generated (including 3rd harmonics) of which 6 are important. For equally spaced tones, 2 of these 6 occur at the same frequency as two of the interfering tones, (C and D in figure 5 below). The phase relationship between these intermodulations and the associated interfering signal modifies their combined level. This in turn results in a change in the level of the other intermodulation products generated.

A test system assembled for this purpose should allow control of the phase of each signal relative to a common reference, in order that the worse case intermodulation distortion products may be found.

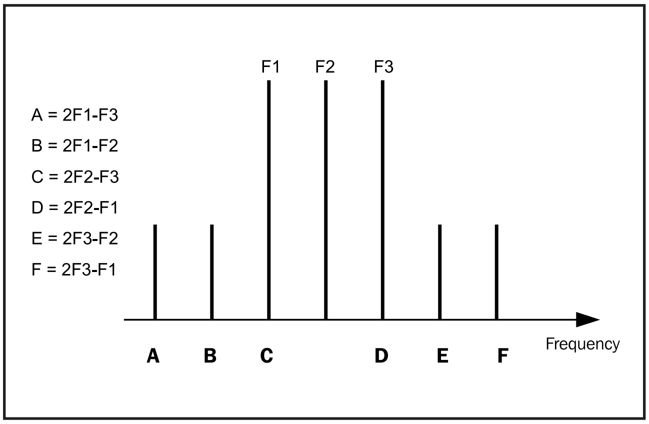


Figure 5. Three tone intermodulation products

For three signals, the worst intermodulation levels are typically when the phase of the signals are adjusted to give the largest amount of peak envelope power.

Measuring Intermodulation Distortion Products

The level of intermodulation may be dependent on many variables such as: the input frequency, amplitude and terminating impedance. Therefore, any measurement of third order IM distortion products must be done under constant, controlled conditions.

The standard means of measuring intermodulation products is to combine the output of two or more signal generators, as shown in figure 6.

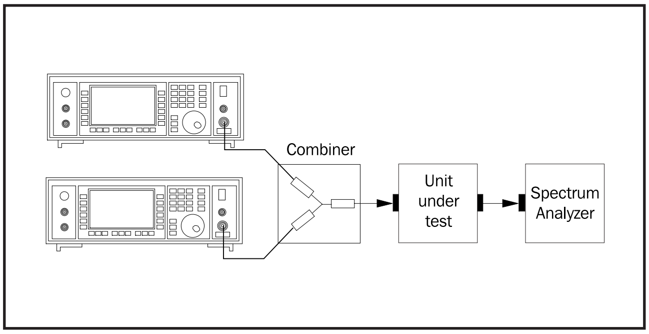


Figure 6. Basic test set up for intermodulation testing

The signal generators are used to control the individual components of the combined signal. This combined signal is then fed into either an amplifier, receiver, mixer or other component. The output of the device is then monitored on a spectrum analyzer.

IM Measurement Problems

There are a number of problems associated with intermodulation product measurement. These relate both to the way in which the signals are combined and to the correct use of the measuring equipment.

Combiners

Figure 6 illustrates a very simple test set up using a star network resistive combiner. In principle this would work, but in practice the combiner gives little isolation (6 dB) between the two signal generators. The signal from the output of one signal generator will be injected into the output of the other signal generator. However, the combiner ensures that the generators are correctly matched and that they can be operated over a wide range of frequencies.

The presence of the signal from one generator at the output of a second generator will cause its output level to modulate. If the unwanted signal is within the signal generator's Automatic Level Control (ALC) bandwidth the signal generator will try to remove it by generating AM onto the desired signal, thus canceling the modulation caused by the foreign signal. This results in the signal generator no longer producing a single signal at the required frequency, but also producing side bands (beat notes) at an offset from this signal. This offset is equal to the difference between the desired and unwanted signals which makes them indistinguishable from intermodulation products that may be generated by the device under test.

Figure 7 shows the equivalent circuit of two signal generators combined in this way.

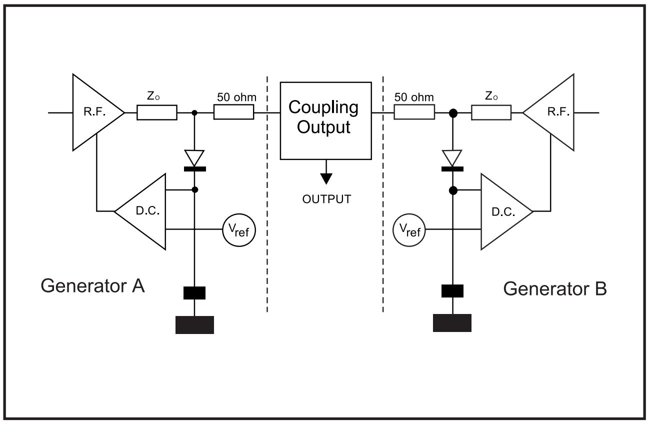


Figure 7. Equivalent circuit of two combined signal generators

There are a number of different ways in which the test set-up can be altered in order to minimize these distortion problems. For example, reactive (hybrid) combiners can be used in place of resistive combiners. These give better isolation (>40 dB typically) and lower insertion loss (<4 dB typically) but only over a limited frequency range (1 to 1.5 octaves typically). In theory this offers >34 dB improvement in isolation over simple resistive combiners. However, to achieve this level of performance the load VSWR must be very good otherwise the benefits of isolation are lost

Isolation between the two signal generators can be further enhanced by including a 3-port circulator between the combiner and signal generator. A signal from the signal generator can pass to the combiner whereas a signal from the combiner is directed to the terminated port (figure 8). Thus by coupling port C to ground via a matched load any reflected signals are removed from the system and no signal should pass from port C to port A. Again, these devices are inherently narrowband and under certain conditions they may generate their own intermodulation products.

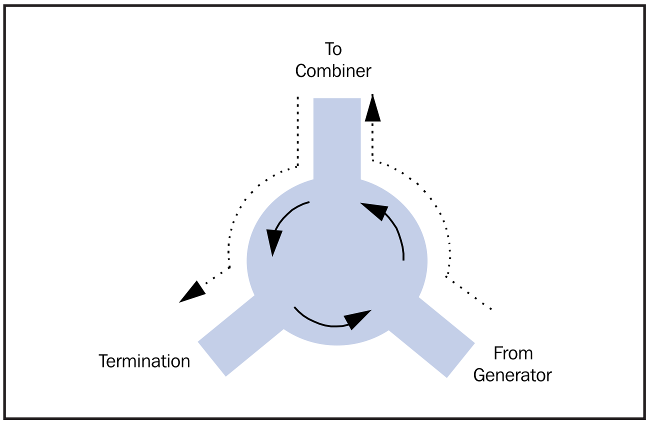


Figure 8. Three port isolator

For mixer testing a low pass filter should be inserted between the combiner and the device under test to reduce harmonic levels. Unlike amplifiers, mixers are non linear devices by design and unwanted intermodulation products together with sum and difference products are generated by their natural multiplying processes. Any harmonic distortion from the mixer is indistinguishable from that of the signal generator. The phase relationship of these harmonics can lead to constructive or destructive combinations resulting in the 2nd order intermodulation distortion product being ambiguous.

In order to provide a test set-up that ensures the most accurate results, attenuator pads must also be added at various positions in the test set-up, to maintain adequate levels of matching in the system. An example test set-up is shown in figure 9.

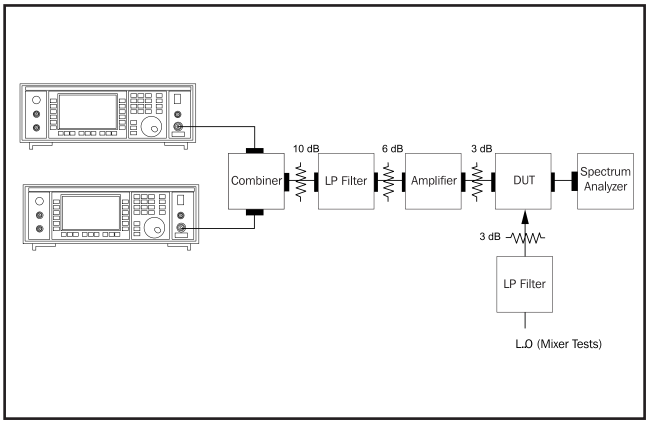


Figure 9. Intermodulation test set up

Spectrum Analyzer set-up

Spectrum analyzers produce intermodulation products if operated incorrectly. One parameter of importance when considering a spectrum analyzer's suitability is it's intermodulation free dynamic range. As a quick check, if the intermodulation product displayed on the analyzer is real, it's level relative to the carrier will not be affected by varying the input attenuation on the analyzer. As a rule, spectrum analyzers are designed to operate at their best with about -30 dBm to -40 dBm at the mixer input. Normally the only device in front of the mixer is the input attenuator. Therefore with tone levels of 0 dBm the input attenuation should be set to at least 30 dB. As the attenuation level is increased so the noise floor rises and potentially hides any intermodulation products. The measurement bandwidth must therefore be reduced in order to reduce the noise floor.

2026A/B MultiSource Generator

Figure 10. The 2026A\B MultiSource Signal Generator

The process of making intermodulation distortion measurements is greatly simplified by the IFR 2026A\B multisource signal generator. The 2026A\B is a multiple source generator which offers up to three RF signal generators in one box. The use of a built in combiner, switches and cables eliminates many of the measurement uncertainties introduced by connecting together separate signal generators. The 2026A\B thereby guarantees the level of intermodulation products introduced during amplifier or receiver intermodulation testing. All of the alignment processes, including the internal frequency standard and the correction factors for the signal source RF paths, are digitally derived so that realignment can be undertaken without removal of the covers. Digital alignment also eliminates the use of mechanical adjusters, minimizing long term drift and vulnerability to mechanical shock. The combiner design is a modified star combiner with broad bandwidth and much greater isolation than the traditional star network illustrated in figure 6.

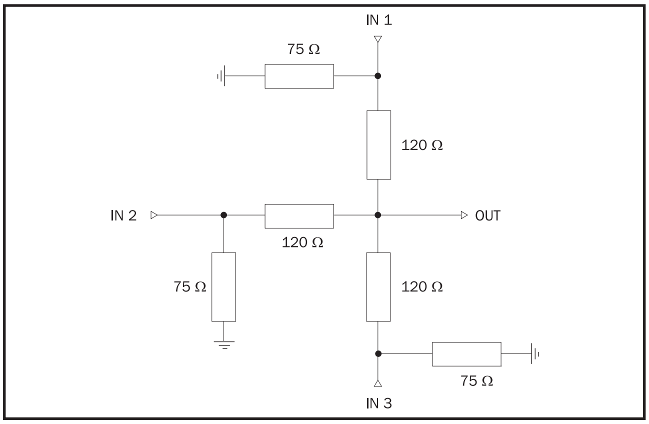


Figure 10b. 2026 Combiner network schematic

The isolation between the input ports of a modified star combiner such as that used in the IFR 2026A\B, is 28 dB as opposed to 9.5 dB for a traditional combiner. This allows the 2026A\B to easily achieve considerably higher levels of performance than multiple generator test set-ups.

The process of intermodulation testing is further simplified by the IFR 2026A\B. It provides pre-defined test set-ups for the measurement of amplifier and receiver intermodulation distortion. Each set-up is displayed as a pictorial representation of the internal signal source routing. A spectral diagram is used to show the parameters to be entered in each application in well known engineering terminology.

The 2026A\B is particularly well suited to those interested in the testing of amplifiers and mixers used in UHF/VHF radio applications. For example, published standards such as IS-20, IS-54, IS-95 and IS-98 all have a requirement for intermodulation and interference testing.

Using 2026 to test AMPS radios

The method used for testing AMPS radios requires three signal generators: one to simulate the receiver and two interferers. The mobile is set up with the expander disabled. Using a 2026A\B it is possible to internally generate all the necessary signals and route them through a single combined output into the mobile radio. With the mobile set into an appropriate test mode, the in channel signal is set to have a 1 kHz tone with either 8 kHz or 3 kHz peak deviation depending upon the mobile type, i.e. wide or narrow, AMPS/NAMPS. The input level is reduced to find the 12 dB SINAD reference sensitivity of typically between -116 dBm and -118 dBm which occurs at a C/N ratio of approximately 10 dB.

The input power is then increased by 3 dB and the two interferers introduced first at ±60 kHz and ±120 kHz and then at ±300 kHz and ±600 kHz. In each case the level of both tones is increased until 12 dB SINAD is restored. The level difference between the interferers and the in channel signal is noted. This difference should be better than between 65 dB and 73 dB depending upon the class of mobile and the tone spacings used.

The 2026A\B is ideally suited to performing this measurement in the applications mode and simplifies many of the manual procedures.

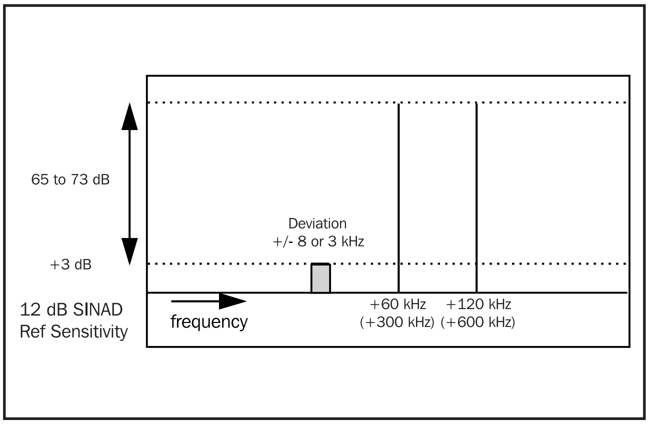


Figure 11. Test Set up for AMPS radios

The specification for the test signals are that their own internally generated intermodulations are better than -86 dBc and that they have a phase noise above 60 kHz offset of better than -130 dBc/Hz. Given that the interferer levels are circa -30 dBm during this test, both of these requirements are comfortably met by the 2026 MultiSource Generator.

Using 2026A\B to test TACS receivers

The TACS (Total Access System) employs a slightly different technique to measure intermodulation rejection. Again, three signals are used; an in channel signal and two interferers, one of which is modulated with a 400 Hz sine wave with a peak deviation of ±5.7 kHz. The in channel signal is modulated with a 1 kHz tone with a peak deviation of ±5.7 kHz. This is then adjusted to achieve 20 dB SINAD (psophometrically weighted) and should be met with an input level of less than -113 dBm (or 26 dBmV/m where the mobile has an integral aerial). The interferers are spaced at 4 and 8 channels offset from the in channel signal with the modulated interferer positioned furthest away. The RF level ratio of the interferers, with respect to the in channel signal at which a 6 dB reduction in SINAD occurs, is the intermodulation rejection ratio which should be better than 65 dB or 55 dB, depending on the class of the radio.

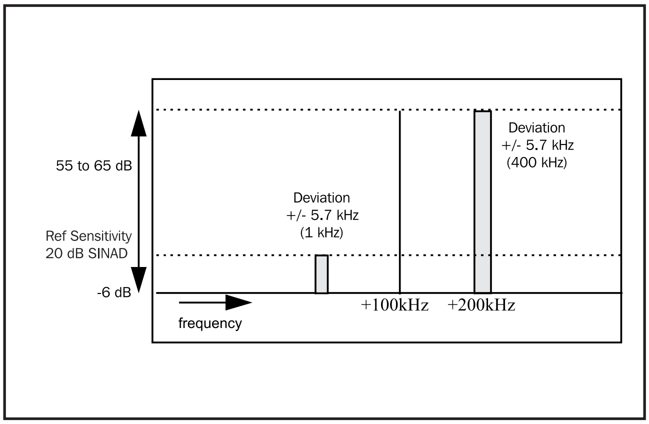
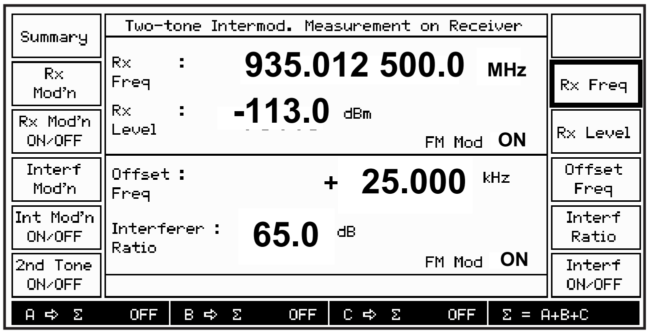


Figure 12. Test set up for TACS

Using the 2026A\B, a fast pass/fail test can be set-up by specifying the desired rejection ratio and ensuring that SINAD does not degrade by more than 6 dB when the interferers are introduced.


Two-tone Intermod. Measurement on Receiver

Rx Freq : 935.012 500.0 MHz

Rx Level : -113.0 dBm

FM Mod ON

Offset Freq : + 25.000 kHz

Interferer Ratio : 65.0 dB

FM Mod ON

A ⇨ Σ OFF | B ⇨ Σ OFF | C ⇨ Σ OFF | Σ = A+B+C

Figure 13. 2026 screen shot for RX intermodulation testing

It is also possible to route a radio test set such as the 2945A, 2965A, 2966A or 2967 from Aeroflex, through the 2026A\B via the external combiner input. This allows for the combination of the signal generator output with the two interferers. In this configuration, the test set provides the necessary signaling to page the mobile and hold it in a call. It also provides the means by which SINAD can be measured. A power attenuator should be fitted to the 2026A\B output to ensure the transceiver TX output does not radiate back and overload the signal generator.

This approach may also be used when testing broadband digital mobile receivers.

Using 2026A\B for CDMA receiver testing

CDMA testing in accordance with IS-97-A/98-A requires that two CW signals, set to 900 kHz and 1700 kHz offset from the center frequency, are combined with a CDMA modulated wanted signal to allow for a frame erasure rate (FER) measurement to be performed. The CW interferers are nominally set to -30 dBm with the wanted signal set to -110 dBm. A possible test set up using the 2026A\B is shown in figures 14 and 15 below.

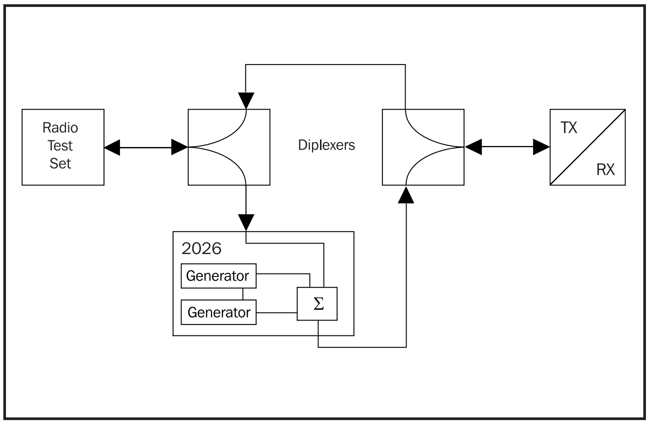


Figure 14. Possible set-up for CDMA receiver tests

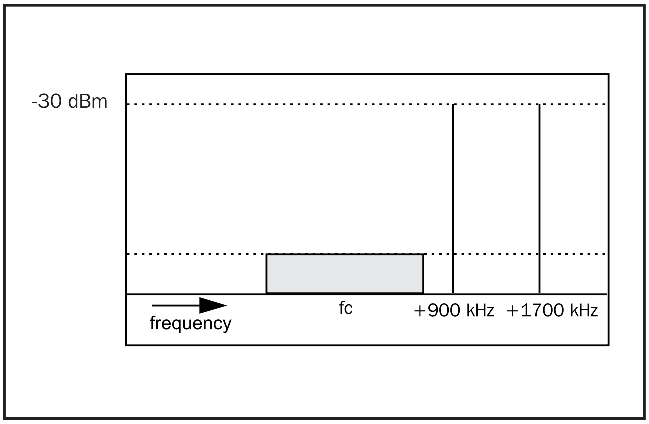


Figure 15. CDMA intermodulation response testing

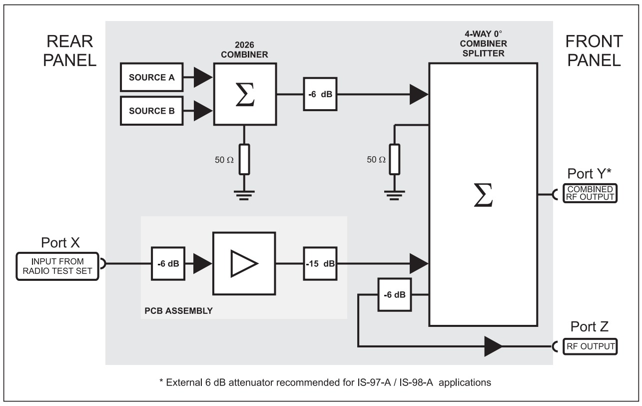
This procedure is greatly simplified by using the CDMA derivative of the 2026A\B; the IFR 2026Q. The 2026Q has been designed to work directly with a CDMA radio test set to produce a fully integrated radio receiver test solution for CDMA cellular and PCS systems in accordance with IS-97-A/98-A.

2026Q CDMA Interferer MultiSource Generator

The 2026Q (figure 16) offers all of the virtues of the 2026A\B, plus the additional capability of CDMA handset and basestation testing facilities.

Figure 16. 2026Q

The 2026Q is designed to produce a fully calibrated combined RF output containing any mix of internally generated interference signals from its two RF sources, together with a calibrated signal path for a radio test set transmit output. A return path from the transceiver back to the radio test set receiver input is also provided through the instrument as illustrated in figure 17.



* External 6 dB attenuator recommended for IS-97-A / IS-98-A applications

Figure 17. 2026Q configured for radio testing with a test set

Intermodulation Distortion In Radio Transmission

Intermodulation distortion causes problems in the transmission and reception of broadcast signals. The intermodulation products generated under these circumstances are more difficult to predict and prevent, as they behave differently to those previously discussed. For example, the rules relating to the prediction of the third order intercept no longer apply.

Where space is at a premium, antennas are placed relatively close together and so the signal is only attenuated by, say, 40 dB. Reverse intermodulation can then occur where the transmitter amplifier has two input signals, one on the input and other due to the picked up signal which appears on the amplifier output as shown in figure 18.

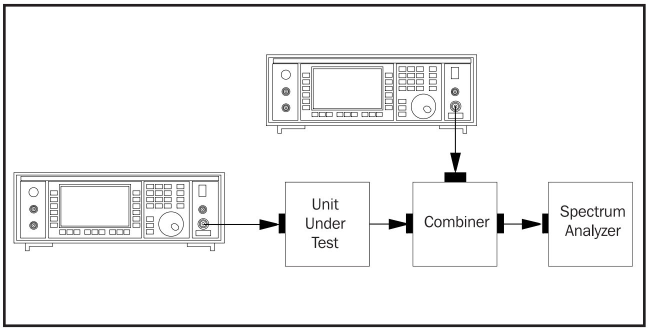


Figure 18. Backwards intermodulation testing

The main cause of intermodulation products in a specific transmission is dominated by the transmitter design. There are two main transmitter designs shown in figure 18. Figure 18a shows a transmitter utilizing a single power amplifier where more than one signal is present at the input of the amplifier and intermodulation products are produced in the normal way. Figure 18b utilizes three smaller power amplifiers, one for each signal. We would therefore expect no intermodulation products to be produced but because the isolation between the signals is not perfect then a reverse signal is fed from one amplifier to another.

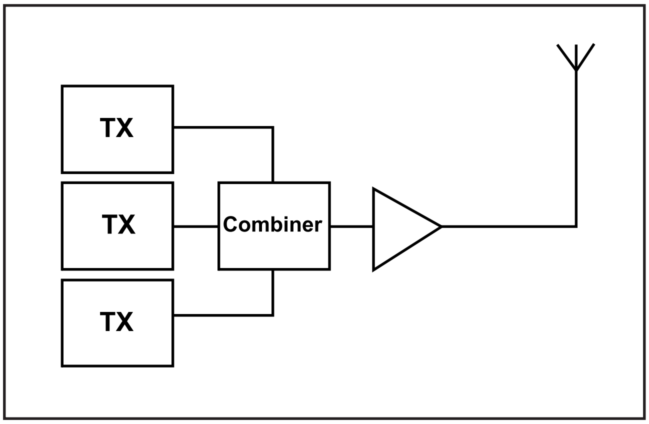


Figure 18a. Single amp TX block diagram

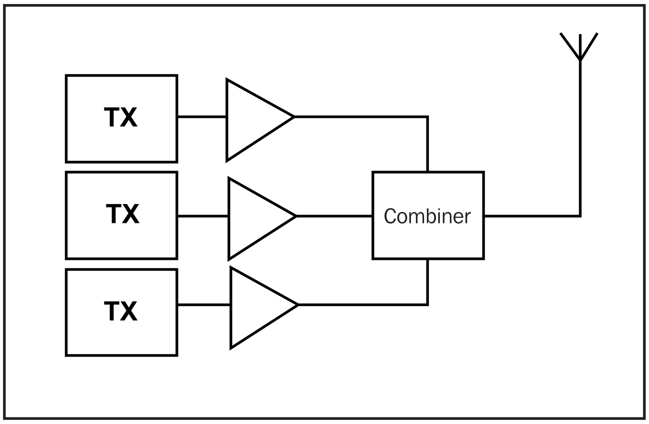


Figure 18b. Multi amp configuration

This reverse signal interacts with the transmission signal causing an intermodulation product to be broadcast which could then interfere with other systems.

Reducing Intermodulation Distortion

The stringent requirements of modern communications systems demand that transmitter design employs techniques to significantly reduce performance limiting factors such as intermodulation distortion. A number of linearisation techniques for RF transmitters and power amplifiers have become essential in eliminating the distortion generated by upconversion and power control processes, and by the power amplifier itself. These techniques include Cartesian loop, feedforward correction, predistortion, envelope elimination and restoration (EE&R) and linear amplification using nonlinear components (LINC) / combined analog locked-loop universal modulator (CALLUM). These techniques for increasing linearity and therefore reducing intermodulation distortion, will be discussed briefly below.

Cartesian loop

The Cartesian loop technique provides linearisation of a complete transmitter as opposed to just the power amplifier and is shown in figure 20.

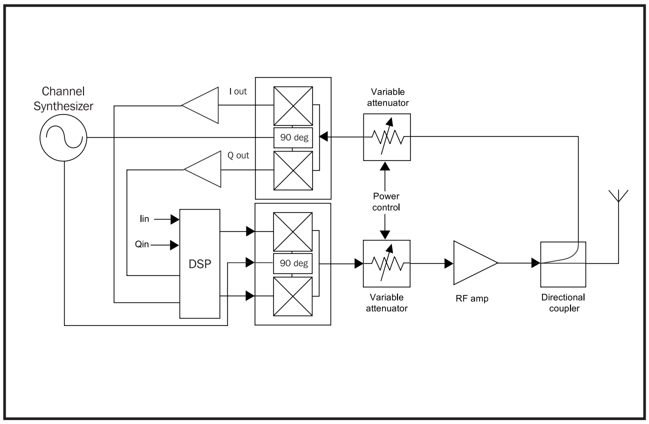


Figure 20. Cartesian loop structure

This technique combines the upconversion and power amplification processes by taking the baseband IQ signals and translating them into an RF carrier frequency at a high power level. The result is that any non-linearities in the upconvertor, driver-amplifier chain and RF power amplifier are negated. The improvement in linearity depends on the type of amplifier employed but more significantly, it is limited by the delay around the feedback loop. Therefore, the linearity improvement that can be obtained depends on the bandwidth over which the feedback must operate. Recently, commercial designs have met the stringent noise specifications of the European Terrestrial Trunked Radio Access (TETRA) system, proving that high levels of performance are achievable.

Feedforward correction

A recent resurgence of interest in feedforward correction techniques has led to their application in military HF communications and cellular radio base stations, mobile units and similar equipment. The technique involves generating an error signal and then subtracting it from the input signal to give a relatively clean, amplified version of the input. A basic feedforward configuration is shown in figure 21.

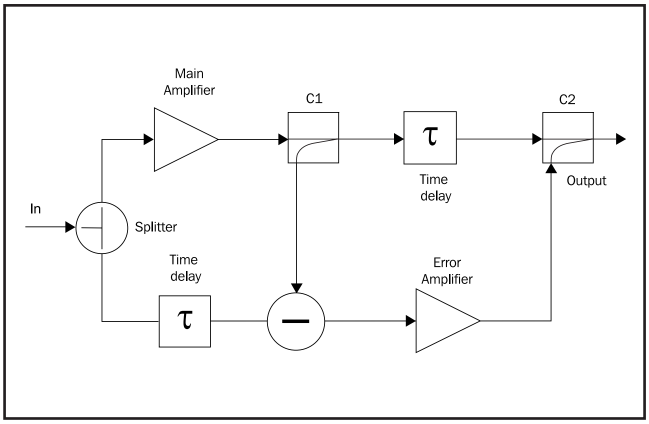


Figure 21. Basic feedforward configuration

The input signal is split to form two identical paths. The signal in the top path is amplified by the main power amplifier. Here, intermodulation, harmonic distortion components and noise are added as a result of the non linearity of the amplifier. The directional coupler takes a sample of the main paths signal and feeds it, 180° out of phase, into the subtractor. In the subtractor a time delayed portion of the original signal is subtracted from the sample of the main signal to give an error signal. This error signal is linearly amplified to a level where it cancels out the distortion on the time delayed main signal.

This technique may be susceptible to drift in gain and group delay characteristics due to variations in temperature, supply voltage and other variable conditions.

RF predistortion

Predistortion is conceptually the simplest form of linearisation available for an RF power amplifier. Most predistortion systems are based on predistortion of the input system and fall into one of three categories:

· RF predistortion

· IF predistortion

· Baseband predistortion

The techniques used in RF and IF predistortion are generally similar. Their main advantage is their ability to linearize the entire bandwidth of an amplifier or system simultaneously, therefore making them useful in PCN basestation applications. It is generally used in conjunction with feedforward systems in order to achieve higher degrees of linearity. RF predistortion is a mature technology, with variations such as baseband predistortion proving increasing useful.

Adaptive Baseband Predistortion

As the name suggests, in this system predistortion is applied at baseband before upconversion to RF. The basic form of the system is shown in figure 22.

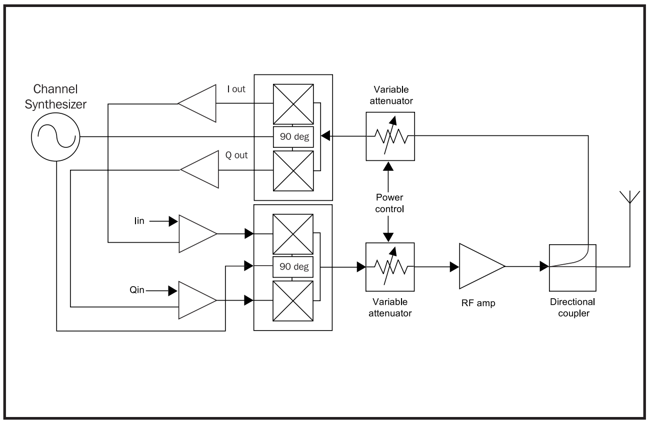


Figure 22. Adaptive Baseband Predistortion Scheme

A feedback path is generally provided to support real-time adjustment of the predistortion coefficient in order to maintain a high level of linearity. The baseband predistortion method has proved to be less popular than the Cartesian loop approach. This is due to the additional signal processing required and the need for one or more analog-to-digital converters in the feedback path, which greatly add to the overall power consumption. Solutions to the problem of increased power consumption are beginning to appear suggesting that this method may become increasingly-popular in the future.

EE&R (Envelope Elimination and Restoration)

The EE&R technique has the advantage that it can be implemented in a number of different ways. Circuits demonstrating the EE&R technique implemented as a linear transmitter and as an amplifier linearisation technique are shown in figure 22a and figure 22b respectively.

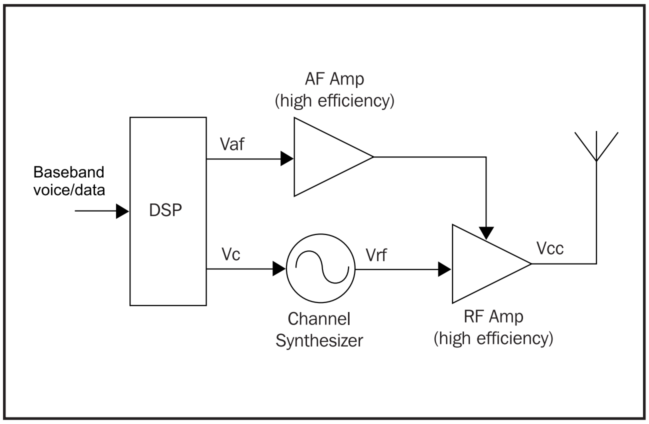


Figure 22a. EE&R implemented as a linear transmitter

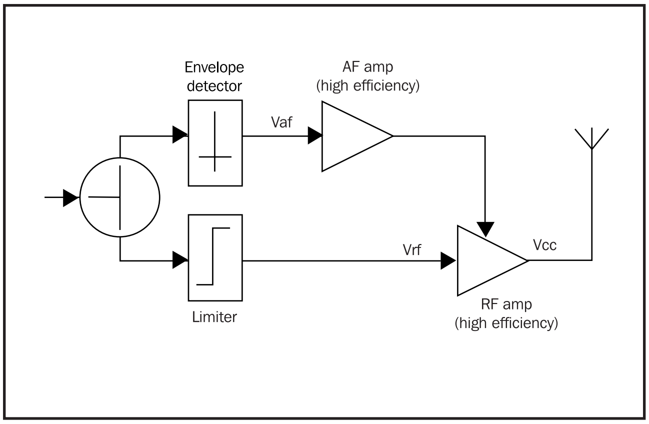


Figure 22b. EE&R implemented as amplifier linearization

The technique has the theoretical potential to achieve 100% DC to RF power conversion efficiency at all envelope levels of the modulation signal. In practice, the efficiency falls short of this, however, the actual figure may still be in the region of 75%-90%. Despite these impressive figures, there are a number of practical limitations to the linearity available from the system. Most significantly, where low envelope levels are used, the RF power transistor may cut off introducing significant distortion into the system. For systems such as p/4-DQPSK systems which involve relatively modest levels of envelope variation, the technique offers good potential.

LINC/CALLUM

Both the LINC technique and its derivative the CALLUM technique involve creating the linear RF waveform, only at the output of the transmitter (the rest of the transmitter processes being nonlinear). Figure 23 shows the basic LINC technique. These techniques are dealt with very briefly, since there are limited commercial transceiver designs which employ either LINC or CALLUM.

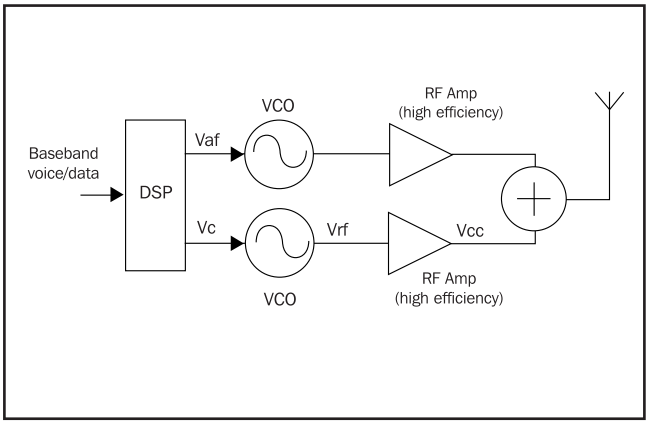


Figure 23. Basic Format of the LINC Technique

The modulating signal is generated in the digital signal processor as two constant envelope phase modulated signals. After upconversion and amplification, these two signals will add to produce the required linear output signal.

In order to reduce the intermodulation distortion unwanted signals must be screened and device linearity must be improved.

Conclusion

Intermodulation distortion has a debilitating effect on the performance of telecommunications networks. The resulting decreased system capacity and degraded call quality at cell sites results in reduced revenue for the wireless service provider. Controlling the generation of intermodulation is key to maintaining capacity and service quality. Likewise, receivers need to have minimised intermodulation distortion in order to maintain call quality; an increasingly difficult task in todays increasingly congested networks. Effective, reliable testing of the effects of intermodulation is made accurate and simple with the IFR 2026 and 2026Q signal generators.

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CHINA Beijing
Tel: [+86] (10) 6539 1166
Fax: [+86] (10) 6539 1778

CHINA Shanghai
Tel: [+86] (21) 5109 5128
Fax: [+86] (21) 5150 6112

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1628 604455
Fax: [+44] (0) 1628 662017

UK Cambridge
Tel: [+44] (0) 1763 262277
Fax: [+44] (0) 1763 285353

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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www.aeroflex.com

info-test@aeroflex.com

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