

Multiple Source Mode

Scorpion®

Introduction

The multiple source mode is a powerful utility within the MS462x that allows almost arbitrary control of the frequency sweep of the internal sources, the external sources (up to 2-3), and the receiver. This flexible control can be very useful when some of the more unconventional measurements are performed that are not addressed by the built-in applications. Multiple source mode is not required for most intermodulation distortion measurements, prosaic harmonic measurements, mixer NF and most general mixer measurements as long as the parameters are simple. The requirements for non-multiple source control measurements of mixers are:

- **Single Conversion**
- **Either Fixed IF or Fixed LO**
- **Looking at Standard Conversion Products**
($IF = |RF \pm LO|$ or No Conversion)

<pre> - BAND 1 DEFINITION SUMMARY - DISPLAYED FREQUENCY RANGE BAND START F BAND STOP F 13.000000000 GHz 15.000000000 GHz SYSTEM EQUATIONS FREQUENCY = (MULTIPLIER/DIVISOR) * (F+OFFSET FREQ) SOURCE 1 = (1/1) * (F-12.000000000 GHz) SOURCE 2 = (1/1) * (F-11.993000000 GHz) SOURCE 3 = (1/1) * (12.000000000 GHz C.W.) SOURCE 4 = (1/1) * (F+0.000000 MHz) RECEIVER = (1/1) * (F-12.000000000 GHz) RCVR SRC = (1/1) * (F+0.000000 MHz) - INSTRUCTIONS - 1. SET BAND FREQUENCIES. EXCEPT FOR BAND 1, ALL START FREQS FOLLOW PREVIOUS BAND'S STOP FREQ. EDIT SOURCE 1 THRU 4, RECEIVER EQUATIONS AND RCVR SOURCE, THEN SELECT <STORE BAND>. 2. ALTERATIONS TO A BAND'S DEFINITION PLACE THE MULTIPLE SOURCE MODE IN THE DEFINE STATE. IF A BAND IS ALTERED, IT AND ANY DESIRED BAND FOLLOWING IT NEED TO BE STORED AGAIN. </pre>	<pre> DEFINE BANDS ▶BAND 1 BAND START FREQ 13.000000000 GHz BAND STOP FREQ 15.000000000 GHz EDIT SYSTEM EQUATIONS STORE BAND 1 BANDS STORED: (1) CLEAR ALL DEFINITIONS RETURN </pre>
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Orchestrate Up to Four Sources and the Receiver to Perform User-Defined Measurements

While this does cover the majority of measurements, there are cases where the additional control offered by multiple source mode will help:

- Measuring Fractional Harmonics (e.g., 1/2, 1/3, 3/2, ...)
- Multiple Conversion Devices
- Mixer Harmonics (2nd Harmonic of LO on IF, 3rd Harmonic of IF, ...)
- Spurs or Other Unusual Mixer Products
- Using the System in a Harmonic Mode for Elevated Frequency Measurements
- Using the System with Block Converters on Input and Output
- Second Order Intermodulation Measurements (for Some of the Products)

The remainder of this document will focus on how to setup multiple source control for a significant number of these more unusual applications and to establish the principles of operation so that a user can configure the instrument for many other measurements. The discussion here will focus entirely on operation in T/R mode although the programming concepts will be the same, where allowed, in other modes. The actual behavior of the instrument in IMD with multiple source is somewhat complex and will be discussed in an example section (3.6). Multiple source cannot be used in harmonic mode (because of the difficulty of interpreting user intent in that mode with multiple source in place) and mixer mode (which was intended as a simplified subset of multiple source control). There is an additional feature, simultaneous internal sources, that allows both internal sources to drive their ports when in multiple source control.

There are a few key concepts to understanding how multiple source mode operates: “bands” and source equations. Several side issues related to the mechanics of controlling external sources via dedicated GPIB will also be addressed.

Using Multiple Source

To setup multiple source control, one defines segments of frequency space, termed bands, and within each band, one defines how all of the sources and the receiver will behave. Often one may only define a single band because the setup is relatively simple. Other times multiple bands may be needed. As an example, one may want to invoke third harmonic mixing up to frequency f1 and use fifth harmonic mixing between f1 and f2. It is important to note that the band edges are not limited to the 3, 6 or 9 GHz range of the instrument; the only requirement is that the sources and the receiver not be programmed

outside their valid range. An example of this situation is when external block converters are used.

With that definition in place, a general procedure for setting up multiple source can be defined:

1. Clear all equations (to remove previous definitions)
2. Define Band 1 (f1-f2)
3. Define source behavior for operation in band 1 (i.e., set the equations for sources 1 to 4 and the receiver, a given equation does not need to be defined if that source is not being used. The programmed frequencies for each connected and active source must be in a valid range for that source.)
4. Store the band and its equations
5. More bands to define? If so, define band 2 (f2-f3) and its equations. Repeat as necessary
6. When done with all bands, turn on multiple source control from the upper level menu.

What Sources to Use?

The first question to ask is what sources need to be programmed. Source 1 is always the internal source driving ports 1 and 2. If the optional second source was ordered (Option 3X), this will always be source 2. Both internal sources are always active. If option 3X was not ordered, source 2 will be an external source. Sources 3 and 4 will always be external sources (Anritsu synthesizers). The external source identity is tied to the GPIB address; one can look under config/source/source X to find or change the GPIB address tied to a given source X. By default source 3 is GPIB address 9 and source 4 is GPIB address 10 but these relationships can be changed if necessary. If a given external source is not connected and active, it does not matter how that source’s behavior is defined since the system will not try to program it and will not error-check against it. It is important to note, however, that the internal sources will **always** be programmed so it is important that their behaviors be properly defined.

It is often asked which external sources can be used with multiple source control. Presently, only Anritsu sources in the MG3690x series may be employed. All will be controlled via the dedicated GPIB bus (bottom connector on the MS462x). For some measurements, other synthesizers can be used but only if they are at a fixed frequency (CW) or they are being controlled by an external computer or other instrument.

One common question is how to get the system to recognize an external source once it has been connected. If the source was turned on, and at a proper GPIB address when the MS462x booted, the external source will automatically be recognized. If not, when entering the multiple source menu, the system will check again.

There are at least two ways to check to see if the system has recognized an external source:

- Go to **config/source/source X** and see if the **active** selection is enabled, if so the system has recognized that source and enabled it. If one is planning on disconnecting a source, it is good practice to render it inactive here before disconnecting. Otherwise one may get a series of error messages as the system continues to try to program a now non-existent source. If the source is inactive when behavior definition is being performed, no error checking will be performed. If multiple source mode is then turned on and the suspect source later activated, bogus programming may be sent to that source. Usually, that source will ignore such spurious requests but the results may be unexpected.
- Go to **Utility/Instrument State Parameters/System**. In the lower half of this table is a listing of all currently connected GPIB instruments.

When an external source has been recognized and is being programmed, one may see messages on the MS462x such as “External Sources” and changes on the synthesizer display. Due to the possible elaborate external source programming that may occur, the MS462x will not update the frequency displays on the external synthesizers. This does not mean that the source is not being programmed correctly.

Assuming the desired external source is present and active, it is now meaningful to define its behavior. As an aside, if one is using an external source it is generally required to synchronize the 10 MHz references of the system and the external source. Connect the 10 MHz out from the external synthesizer to the system and use **Utility/Rear Panel** to enable the external reference. This synchronization is required for almost all measurement scenarios. Since all internal sources are fully synthesized (unlike in previous VNAs), the frequency accuracy is uniquely defined by this timebase.

The receiver is, of course, always present and is based on the internal LO.

Defining Source Behavior

Source and receiver behavior is defined through the use of equations. About the only requirements are that the sources be defined in their respective valid ranges and that the frequencies **MUST** be linearly related (i.e., source X frequency = $m(\text{source Y frequency}) + b$ where m and b are real numbers). All sources and the receiver are defined relative to a runner variable f , which is always displayed on the X-axis of the screen. It will hence be termed the screen frequency. Upon default, all sources and the receiver are defined to be equal to f .

$$\text{Source 1} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 2} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 3} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 4} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Receiver} = (1/1) * (f + 0.000000 \text{ MHz})$$

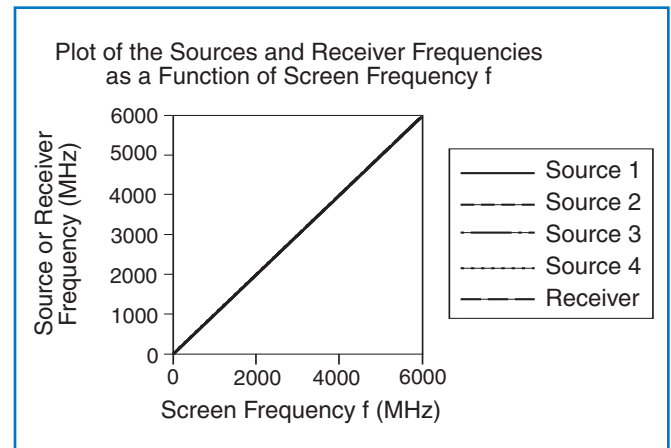


Figure 1. Relationships of the various source frequencies for the default equations and assuming a band definition of 10 MHz to 6 GHz are shown here. This is the simplest case when all sources and the receiver match the screen frequency.

Thus if start and stop are set to 10 MHz and 6 GHz respectively (so that the screen frequency f runs from 10 MHz to 6 GHz) and multiple source is turned on, then all sources will be programmed to sweep from 10 MHz to 6 GHz (using whatever number of data points was selected on the **config/data points menu**) and the receiver will sweep looking for signals from 10 MHz to 6 GHz (internal LO will sweep an IF away from 10 MHz to 6 GHz). Once an equation set is defined (like the above) for a given band, it must be stored. Once at least one band and its equations are stored, multiple source can be turned on. A maximum of five bands can be defined and the end of band k must be the beginning of band $k+1$. If a band is altered, it and any subsequent bands must be restored to take effect.

The previous example is not particularly useful, but it does explain the equation structure. As an aside, it may appear that everything is being programmed as if multiple source is off in this example. For some detailed architectural reasons, the physical programming is actually slightly different and some slight differences in parameters such as high-level noise may be observed.

One can define each source to be almost anything linearly related to the screen frequency. By turning CW mode ON for a given source, one can also set a given source to be at a constant frequency (independent of f). The receiver equation can be slightly confusing since the equation defines what the receiver will be looking for, not exactly where the system LO will be tuned. In most cases, the user need not worry about it since the difference is the simple addition or subtraction of the system IF. The only case where it is an issue is when one wants to use the system in a harmonic mixing mode (i.e., the LO will physically be tuned to f_1 but one is interested in the mix product corresponding to $N*f_1 - RF$). This case will be covered later in an example.

Examples

The best way to illustrate the use of these equations is through some examples.

Multiple Conversion (Example 3.1)

Suppose one wants to measure a converter with the following properties:

- RF swept from 2 to 2.5 GHz
- First LO swept from 2.3 to 2.8 GHz for a fixed first IF of 300 MHz
- Second LO fixed at 321 MHz for a second IF of 21 MHz
- Measure the IF out as the RF sweeps from 2 to 2.5 GHz

Because of the two conversions involved, the usual mixer control panel cannot be used here. Define source 1 to be the RF drive, define source 2 (suppose it is internal) to be the 1st LO and define source 3 to be the second LO. We will not use source 4 and will leave its equation at the default. Since no harmonic conversions are involved, the leading rational number on all equations will remain at 1/1. Since the receiver and 2nd LO are constant frequency, we will use the CW mode to define those two equations. We will define the screen frequency f to be the RF (2 to 2.5 GHz). One could also define it to be the 1st LO frequency but one COULD NOT define it to be the

IF since there would not be a method of defining a sweep in that case. One workable set of equations is shown below.

Define Band 1 2 to 2.5 GHz

Source 1 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 2 = $(1/1) * (f + 300.000000 \text{ MHz})$

Source 3 = $(1/1) * (321.000000 \text{ MHz C.W.})$

Source 4 = $(1/1) * (f + 0.000000 \text{ MHz})$

Receiver = $(1/1) * (21.000000 \text{ MHz C.W.})$

With the frequencies chosen, source 1, source 2 and the receiver are within instrument bounds. It is assumed that source 3 can produce 321 MHz and that source 4 (if connected) could produce 2 to 2.5 GHz. If the latter is not true, one can always put source 4 to CW mode and choose some appropriate frequency since that source is not being used.

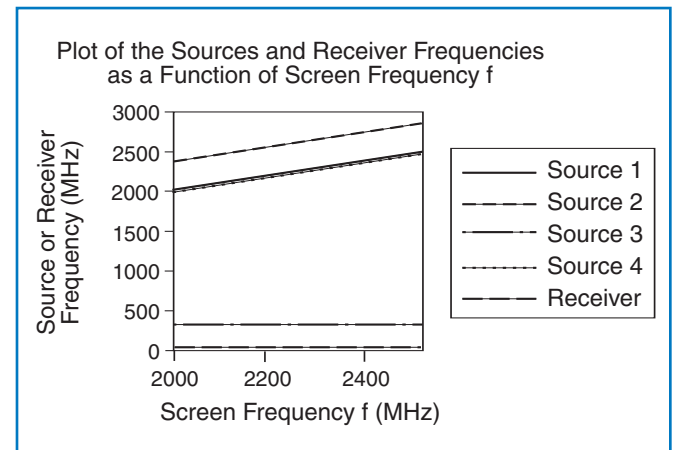


Figure 2. Source and receiver frequencies for example 3.1 are shown here. Source 4, which is not being used, is left in its default state of being equal to the screen frequency f . Source 3 and the receiver are tuned CW.

Fractional Harmonics (Example 3.2)

Suppose one is measuring a doubler circuit prone to producing excessive third harmonic of input among other spurious products. To measure the amplitude of that product (be sure to normalize properly and use a b1/1 measurement parameter), one can use the equations quite simply. Define source 1 to be the driving source running from 1-1.5 GHz. Source 2 to 4 will not be used and the desired product is 3. Define the screen frequency to be the DUT input.

Define Band 1 1 to 1.5 GHz

Source 1 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 2 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 3 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 4 = $(1/1) * (f + 0.000000 \text{ MHz})$

Receiver = $(3/1) * (f + 0.000000 \text{ MHz})$

One could have used the harmonic mode for this measurement but the display might not be what the user desires. Suppose one wanted the screen frequency to be the desired output product (2 times the input frequency), and then one could use the following.

Define Band 1 2-3 GHz

$$\text{Source 1} = (1/2) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 2} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 3} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 4} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Receiver} = (3/2) * (f + 0.000000 \text{ MHz})$$

Hence this is often called a 3/2 harmonic measurement since it is 1.5x the desired OUTPUT frequency.

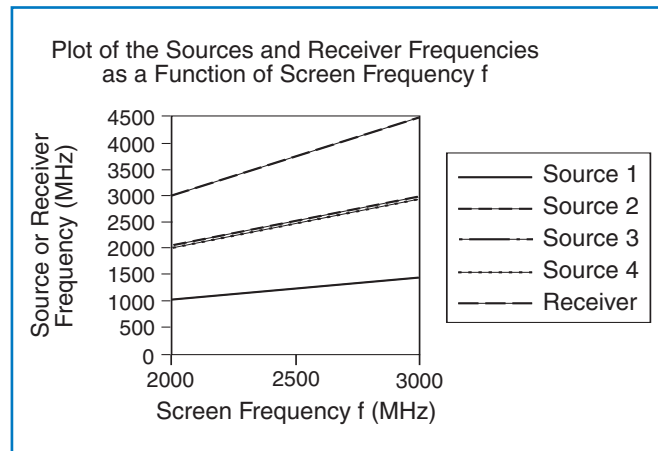


Figure 3. Source and receiver frequencies for example 3.2 using the second definition are shown here. Sources 2 to 4 are not used and are set to the default equations. The receiver is tuned to look at the 3/2 harmonic output of the doubler under test.

Spur Hunting (Example 3.3)

In a mixer measurement, suppose the RF (to be source 2) runs from 800-1000 MHz and the LO is fixed at 1100 MHz (to be source 4) for an IF running from 100-300 MHz. Further suppose that a problem spur with this particular mixer is the $6*rf-5*lo$ product. The measurement is somewhat complicated since a 0 beat crossing spur occurs at $rf=916.6667$ MHz and a spur below 10 MHz cannot be measured with this system. To get around this problem, three bands will be defined. The low band ($6*rf < 5*lo$) is band 1, the middle band (where the spur will be below 10 MHz and cannot be measured) is band 2, and the upper band ($6*rf > 5*lo$) is band 3. When setting start and stop for the measurement, one should stay in bands 1 and 3 for meaningful results. To measure this spur amplitude (again assuming a proper normalization has been done and an appropriate parameter is being measured):

Define Band 1 800-915 MHz

$$\text{Source 1} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 2} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 3} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 4} = (1/1) * (1100.000000 \text{ MHz C.W.})$$

$$\text{Receiver} = (-6/1) * (f - 916.666667 \text{ MHz})$$

Define Band 2 915.000001-918.333332 MHz

$$\text{Source 1} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 2} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 3} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 4} = (1/1) * (1100.000000 \text{ MHz C.W.})$$

$$\text{Receiver} = (1/1) * (f + 0.000000 \text{ MHz})$$

Define Band 3 918.333333-1000 MHz

$$\text{Source 1} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 2} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 3} = (1/1) * (f + 0.000000 \text{ MHz})$$

$$\text{Source 4} = (1/1) * (1100.000000 \text{ MHz C.W.})$$

$$\text{Receiver} = (6/1) * (f - 916.666667 \text{ MHz})$$

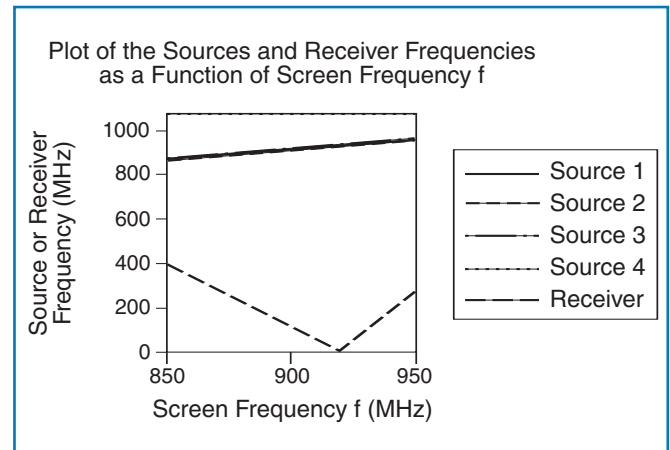


Figure 4. Source and receiver frequencies for example 3.3 are shown here. Sources 1 and 3 are not used. Band definitions are used to allow the search for a particular spur hit.

The user should be cautioned that internal spur avoidance routines are greatly curtailed when in multiple source mode and there may be spurs on the internal sources that could affect some low-level measurements.

Block Conversion (Example 3.4)

Suppose the system is sweeping source 1 from 1 to 5 GHz and the receiver is moving over the same range. An upconverter and downconverter are placed at ports 1 and 2, respectively with a fixed LO of 72 GHz (driving both converters via a splitter) coming from source 3. One wants the screen frequency to run from 73 to 77 GHz to simplify the user interface. This type of setup can be used for direct measurement of millimeter-wave components assuming the converters are carefully constructed. Then one can define:

```
Define Band 1 73 to 77 GHz
Source 1 = (1/1)* (f - 72000.000000 MHz)
Source 2 = (1/1)* (f - 72000.000000 MHz)
Source 3 = (1/1)* (72000.000000 MHz C.W.)
Source 4 = (1/1)* (f + 0.000000 MHz)
Receiver = (1/1)* (f - 72000.000000 MHz)
```

Note that a definition was entered for source 2 even though it was not being used. The equation shown places the frequency in range for an internal source so that it will be valid (internal sources are always active).

For improved calibrations in extended frequency situations see Anritsu Application Note “Extended Receiver Calibrations in MS462xx VNAs,” pn: 11410-00351.

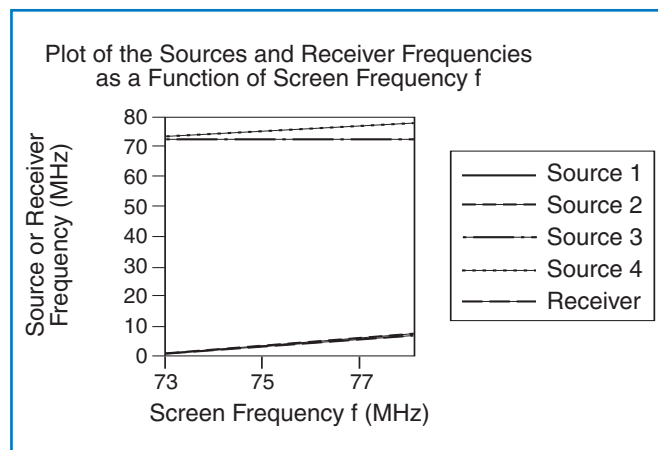


Figure 5. Source and receiver frequencies for the block conversion measurement of example 3.4 are shown here. Source 4 is assumed to not be connected (or is capable of mm-wave operation) and source 3 is the CW shared LO. Source 1, 2 and the receiver are all operating from 1 to 5 GHz.

Harmonic Mixing (Example 3.5)

Since the system uses a doubly balanced mixer of reasonable design, it is possible to use the system to elevated frequencies with somewhat degraded performance as a receiver. Suppose you are using a 6 GHz Scorpion and want to use it as a receiver to 9 GHz. Suppose that an external synthesizer is being used and one wanted to make unratiod measure-

ments using the system operating in third harmonic mixing mode. This means that the internal LO will only run to about 3 GHz and we will rely on the internal non-linearities of the mixer to boost the LO (using a third order spur in effect). Suppose further that the system should fundamentally mix as far as it can (to 6 GHz) and then harmonically mix from 6 to 9 GHz. Sources 1 and 2, even though they are not being used, will be defined so that the programming will be valid. When operating in the harmonic mixing mode, one must be careful about the receiver equation. The system will program the LO to be whatever the receiver equation dictates + 1 IF (125 kHz in this case) but the mixer physics will cause an additional tripling. Suppose we want the receiver to look for frequency X MHz ≥ the final LO frequency must be X+0.125. This must be equal to three times what the system programs the LO to be. So:

$$X+0.125 = 3(0.125 + 1/3(f+???))$$

$$X-0.250 = f + ???$$

Since the screen frequency is the signal we are looking for, $f=X$ and $??? = -0.250$

```
Define Band 1 30 to 6000 MHz
Source 1 = (1/1)* (1000.000000 MHz C.W.)
Source 2 = (1/1)* (1500.000000 MHz C.W.)
Source 3 = (1/1)* (f + 0.000000 MHz)
Source 4 = (1/1)* (f + 0.000000 MHz)
Receiver = (1/1)* (f + 0.000000 MHz)
```

```
Define Band 2 6000 to 9000 MHz
Source 1 = (1/1)* (1000.000000 MHz C.W.)
Source 2 = (1/1)* (1500.000000 MHz C.W.)
Source 3 = (1/1)* (f + 0.000000 MHz)
Source 4 = (1/1)* (f + 0.000000 MHz)
Receiver = (1/3)* (f - 0.250000 MHz)
```

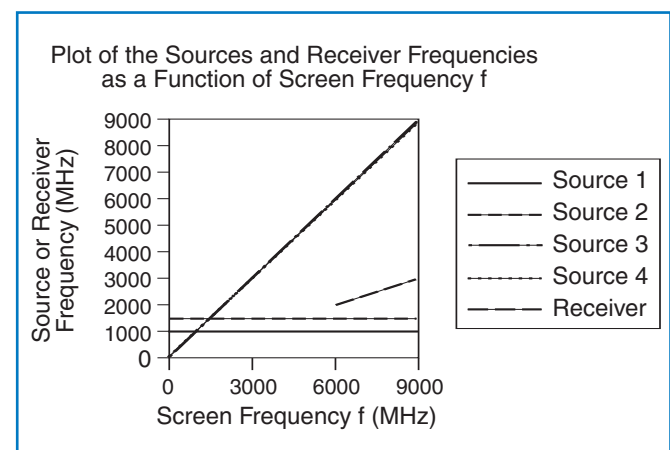


Figure 6. Source and receiver frequencies for the harmonic mixing of example 3.5 are shown here. Sources 1 and 2 are not used but are programmed to valid CW frequencies. The receiver enters harmonic mixing mode above 6 GHz.

This type of setup can be used for Nth harmonic mixing as well. The general receiver equation for operation in the Nth harmonic mode is given by:

$$\text{Receiver} = \frac{1}{N} [f(N-1) * 0.125000 \text{ MHz}]$$

A common application is to perform harmonic measurements using harmonic mixing mode. If one defines the screen frequency to be the mth harmonic frequency, then this is particularly easy. Define the receiver equation as above and define the driving source to be $1/m * (f + 0.000000 \text{ MHz})$.

Multiple Tone IMD (Example 3.6)

Consider the case of a four tone IMD measurement with a tone spacing of 12 MHz and the first tone sweeping from 1800 to 1900 MHz. The first product on the low side is of primary interest for this first measurement. The screen frequency and source 1 will be defined as the first tone. It is assumed a proper combining network has been provided for the measurement.

Define Band 1 1800 to 1900 MHz

Source 1 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 2 = $(1/1) * (f + 12.000000 \text{ MHz})$

Source 3 = $(1/1) * (f + 24.000000 \text{ MHz})$

Source 4 = $(1/1) * (f + 36.000000 \text{ MHz})$

Receiver = $(1/1) * (f - 12.000000 \text{ MHz})$

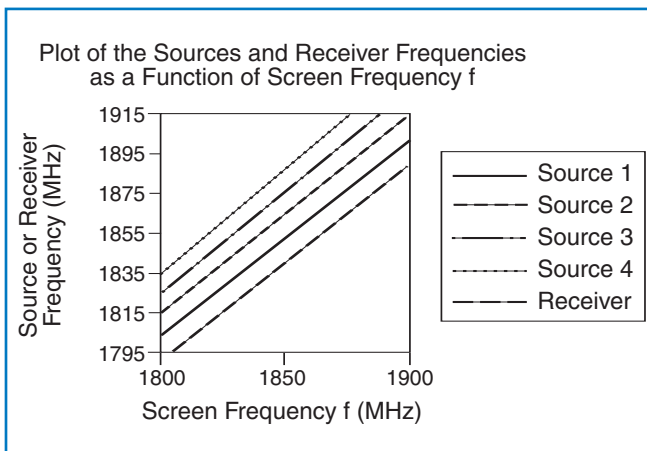


Figure 7. Source and receiver frequencies for the multitone IMD measurement of example 3.6 are shown here.

Multiple source mode can be activated within the IMD application as well. This may be useful for two-tone measurements on a mixer with a complicated or unusual frequency conversion scheme. The important thing to remember within this application is that the system automatically makes at least 4 measurements at every frequency sweep point (two main tones and the two IMD products if third order IMD is selected, more IMD products if multiple order IMD products are to be displayed).

On the surface, this seems to complicate the multiple source algorithm. The system will behave properly if the user defines the receiver equation to look for tone 1 and ensures that the offset value on the IMD menu is set to the correct tone separation (as defined within multiple source).

Second Order IMD Measurements (Example 3.7)

While not as common as third order intercept measurements, second order IMD measurements are sometimes helpful in predicting mixer performance on the 2x2 spur, wideband amplifier behavior as well as in other scenarios. When two tones (A and B) are applied to a DUT, there are of course four second order products: A+B, A-B, 2A, and 2B. For this example, we will focus on the A+B product. Suppose that the first tone will sweep from 1 to 2 GHz and the second tone will be offset by 300 MHz. It is assumed that a proper combining network has been assembled (combining sources 1 and 2) and that all proper normalizations have been performed. In this case, the equations could be:

Define Band 1 1000 to 2000 MHz

Source 1 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 2 = $(1/1) * (f + 300.000000 \text{ MHz})$

Source 3 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 4 = $(1/1) * (f + 0.000000 \text{ MHz})$

Receiver = $(2/1) * (f + 150.000000 \text{ MHz})$

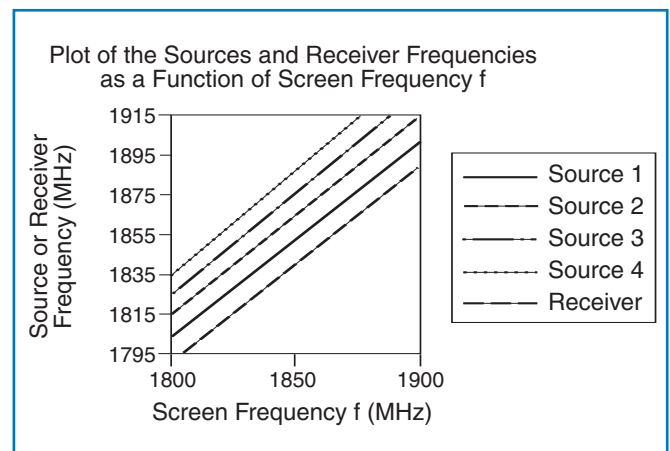


Figure 8. Source and receiver frequencies for the second order IMD measurement of example 3.7 are shown here.

Note that the receiver equation must be constructed with the parentheses as drawn. The other second order products can be constructed in a similar fashion. As an example, the equations for the difference product are shown below.

Define Band 1 1000 to 2000 MHz

Source 1 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 2 = $(1/1) * (f + 300.000000 \text{ MHz})$

Source 3 = $(1/1) * (f + 0.000000 \text{ MHz})$

Source 4 = $(1/1) * (f + 0.000000 \text{ MHz})$

Receiver = $(1/1) * (300.000000 \text{ MHz C.W.})$

Some of these measurements could be constructed using mixer mode but it may be convenient to get all of the products using a series of multiple source invocations.

Conclusions

The general procedure for setting up multiple source mode has been described here and illustrated by a number of examples. One may setup multiple frequency bands and, within each band, define the frequencies of the internal and external sources (if any), and the receiver to be almost anything linearly related to the screen frequency (within hardware limits). The multiple source programming will override the source programming of a given application but the same measurements will be performed. The flexibility of this technique is particularly appropriate for more elaborate mixer measurements, extended frequency measurements, and other less-common measurements.

Information on using the receiver source equation (RCVR SRC) is available in Anritsu's Application Note "Extended Receiver Calibrations in MS462xx VNAs" pn: 11410-00351.

Some Additional Points:

–Only frequency control has been addressed in this document since that is basically the sole function of multiple source control. Power control of internal and external sources is allowed via the power menu and control of the external sources is allowed as long as they are active. Note that error-checking of the power values is performed for both internal and external sources. Initial versions of power sweep mode do not include a multiple source component to allow power sweep of external sources although that may be added in the future.

–Although it was addressed earlier in this document, some care must be exercised when controlling external sources to ensure that communication is established and that time bases are synchronized. To ensure communication linkage, the best practice is to turn on the external synthesizer prior to turning on the MS462x (assuming all GPIB cables are connected and addresses are set correctly). If connecting a source later, make sure that it is recognized and active. The 10 MHz timebases must usually be linked for good measurements. Frequency accuracy is uniquely established by the accuracy of the controlling 10 MHz timebase since all internal sources are fully synthesized.

–If saving and recalling setups when in multiple source mode, any external sources that were connected at the time of the save must be present during the recall. This is because source-specific information is a part of the setup and used for programming purposes, the absence of the source or presence of a different one may render the stored programming invalid.

–Care must be exercised with calibrations so that the system states during calibration and measurement match. Normalization-type cals are always allowed and most other calibration types still function but some care is required. As an example, the receiver calibration is intelligent enough to calibrate against the receiver frequency (not the screen frequency) even if the calibration was performed when multiple source mode was not active.

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