

# GSM/EDGE Remote Programming for the Agilent N9020A MXA Signal Analyzer

## I. Introduction:

This document is written to demonstrate the GSM/EDGE measurement capabilities of the N9020A MXA signal analyzer using VEE Pro 8. It focuses on three areas of interest: GSM measurement application, EDGE measurement application, and data recording to an Excel file.

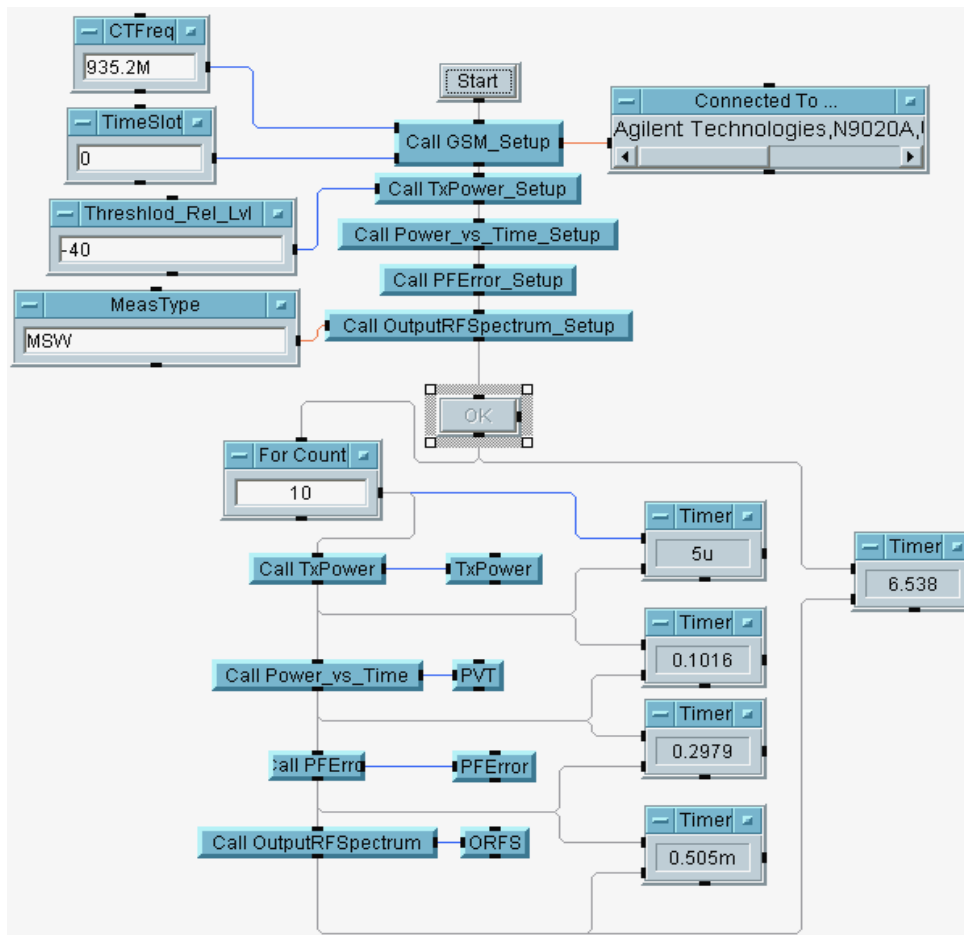
To remotely control N9020A MXA with VEE Pro8, two different measurement settings can be setup independently.

- **Measurement Specific Settings** are parameters that are located under the MeasSetup key. The SCPI syntax has the form *SENSE:<Measurement>:<Parameter>*. For example, *SENSE:ACP:AVER:STATE OFF* refers to turn the average off for the Adjacent Channel (ACP) measurement.
- **Measurement Global Settings** refers to the settings that are global to the application, such as the attenuator settings located under AMPTD key.

## II. GSM Measurement Application:

[Figure1](#) below describes the settings and recommendations to optimize the throughput for making GSM measurements.





**Figure1. GSM Measurement Test Flow Diagram**

It is recommended to setup majority of the settings prior to the actual measurement in order to achieve the fastest measurement speed. All the “*XX\_Setup*” functions prior to the **OK** button need to be run once only provided the Application Mode has not been preset. All tests after the **OK** button will be run on each DUT once or multiple times. The **For Count** window controls the number of tests MXA will perform. In the case shown above, MXA will perform the measurements ten times. The Timer window shows the time it takes to finish the measurement.

**GSM Setup:**

Figure2 shows the recommended GSM/EDGE application settings for the fastest throughput. It’s recommended to send these commands to the instrument once only to prevent spending extra time on setting up the instrument because these settings will be retained throughout the test process as long as the Application Mode has not been preset.



```

LinsMXA (agn9020a @TCPIP0:192.168.0.4::inst0::INSTR)
WRITE TEXT "**IDN?" EOL
READ TEXT IDNSTRING STR
WRITE TEXT "INST:SEL EDGE GSM" EOL
WRITE TEXT "*RST" EOL
WRITE TEXT "*CLS" EOL
WRITE TEXT "FORMAT:DATA REAL,32" EOL
WRITE TEXT "SENSE:RAD:STAN:BAND PGSM" EOL
WRITE TEXT "SENSE:RAD:DEV:BTS" EOL
WRITE TEXT "SENSE:RAD:DEV:BASE:TYPE NORM" EOL
WRITE TEXT "SENSE:FREQ:CENT ", CTFreq EOL
WRITE TEXT "SWE:EGATE:STATE ON" EOL
WRITE TEXT "SENSE:WAV:TRIG:SOUR RFB" EOL
WRITE TEXT "SENSE:CHAN:BURST NORM" EOL
WRITE TEXT "SENSE:CHAN:SLOT ", TimeSlot EOL
WRITE TEXT "SENSE:POW:ATT 10dB" EOL
WRITE TEXT "INIT:CONT OFF" EOL
WRITE TEXT "display:enable off" EOL
WRITE TEXT "CAL:AUTO:ALERT TTEM" EOL
WRITE TEXT ".:DISP:MON:VIEW:WIND:TRAC:Y:COUP OFF" EOL
WRITE TEXT "POW:RANGE:AUTO OFF" EOL
< Double-Click to Add Transaction >

```

**Figure2.** GSM Application Optimum Settings

The above functions perform the following:

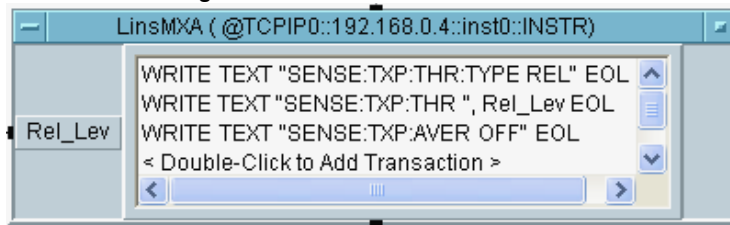
- Identify the instrument's connection.
- Return the name of connected instrument to make sure that it is the right one.
- Select GSM/EDGE application.
- Set the instrument to Mode Preset in Single measurement state.
- Clear the error queue and status register byte.
- Set the data format to Real32 since data input/output is faster using the 32-bit binary format.
- Select the Radio Standard to be used in the GSM application to be P-GSM.
- Select the type of radio device, Base Station Transmitter (BTS), to be tested.
- Set the BTS type to be normal.
- Enter the center frequency of the GSM signal.
- Set the Gate function to be ON.
- Select the trigger source.
- Select the burst type to be Normal.
- Enter the Timeslot number at which the GSM signal is on.
- Set the attenuator setting to be 10dB. It is recommended to avoid automatic attenuator setting whenever possible to prevent additional time on change in attenuation value from measurement to measurement.
- Set the instrument to single sweep.
- Turn the display off for the fastest throughput.



- Set the auto alignment to alert so that they do not automatically initiate during a measurement.
- Set the Auto Scaling to OFF since the default is ON. When it's on, the Scale/Div value is automatically determined by the measurement result, which required a longer data acquisition time.
- Set the RF port power range to OFF rather than to automatic to speed up the measurement.

**TxPower Setup:**

Transmit power is the measure of in-channel power for GSM/EDGE systems. GSM systems use dynamic power control to ensure that each link is maintained with minimum power consumption to prevent power leaking into other frequency channels or timeslots, but the power transmitted must be sufficient enough to maintain an acceptable quality. [Figure3](#) shows the recommended settings for the Transmit Power measurement.

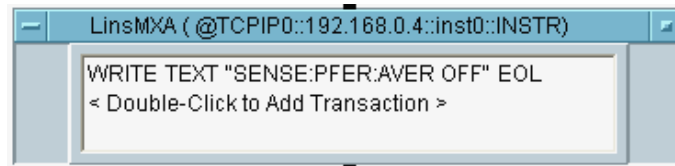


**Figure3.** Transmit Power Optimum Settings

The first two lines of commands set the threshold level relative to the reference power level. Therefore, we'll know exactly how much power is transmitted above the threshold level. The last command turns off the averaging to prevent averaging the measurements during each sweep, thus a faster measurement time.

**Power vs Time Setup:**

*Power vs. Time* (PVT) measures the mean transmit power during the "useful part" of bursts. In GSM/EDGE systems, transmitter must power up and down within a predefined time division mask to prevent adjacent timeslot interference and loss of data. Therefore, PVT measurement also verifies whether the power ramp fits within the *Spectrum Emission Mask* (SEM).



**Figure4.** Power vs. Time Optimum Setting

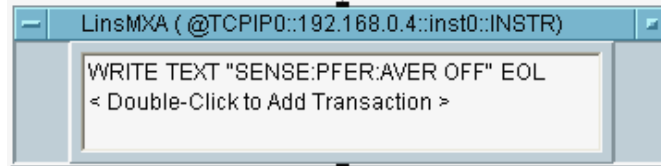
[Figure4](#) shows the recommended setting for the PVT measurement. The averaging is turned off to achieve a faster measurement speed. If the power burst of the GSM/EDGE signal in the time domain fits within the defined mask and the threshold level of the *TxPower\_Setup*



is set properly, then the result of the PVT measurement should be pretty closed to the Transmit Power measurement.

#### **PFError\_Setup:**

*Phase and Frequency Error* (PFER) measures the modulation accuracy for GSM systems. It equivalents to the Error Vector Magnitude (EVM) measurement used in EDGE. A poor phase error can reduce the ability of a receiver to correctly demodulate a signal. A poor frequency error may cause the transmitter to interfere with each other or a receiver to be unable to synchronously demodulate a signal.



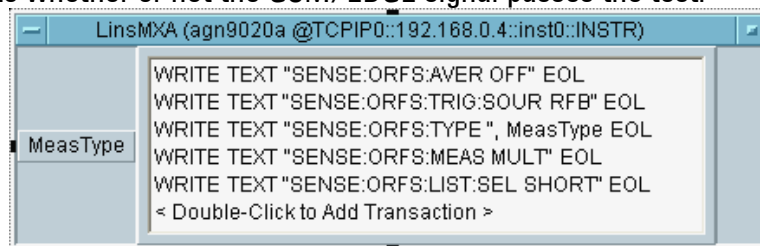
**Figure5.** Phase and Frequency Error Optimum Settings

Figure5 shows the recommended setup for the PFER measurement. The averaging is turned off to shorten the measurement time. Since the N9071A GSM/EDGE application offers a one-button PFER test, no further instrument setting is necessary.

#### **OutputRFSpectrum\_Setup:**

The *Output RF Spectrum* (ORFS) measurement is equivalent to the *Adjacent Channel Power* (ACP) measurement. It is a measurement of how much energy spills over to the adjacent channels. The two main causes are:

- *Modulation and Wideband Noise:* Since the modulation process and wideband noise in a transmitter causes the carrier wave to spread spectrally, the excessive spectral spread may interfere with the other users who are operating on different frequencies. The ORFS measurement is used to ensure that the modulation process does not cause excessive spectral spread.
- *Switching Transients:* During the PVT measurement, the power burst in the time domain must fit within the SEM mask to prevent interference with the adjacent Timeslots. Therefore, it needs to ramp up or down fast enough to match the predefined the SEM mask. However, if the burst ramps up or down too fast, it may cause *spectral splatter*, which is the additional power at frequency offsets from the carrier. The ORFS measures the power level at different frequency offsets and indicate whether or not the GSM/EDGE signal passes the test.



**Figure6.** Output RF Spectrum Optimum Settings

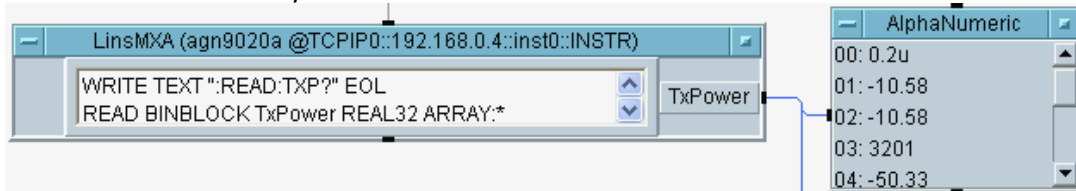
Figure6 shows one example of how to setup the ORFS measurement to achieve fastest throughput. There are four ORFS measurement types to choose from as an input:

- ORFS due to modulation and wideband noise (SCPI: MOD)
- ORFS due to switching (SCPI: SWIT)
- ORFS due to modulation and switching (SCPI: MSW)
- Full frame modulation (SCPI: FFM)

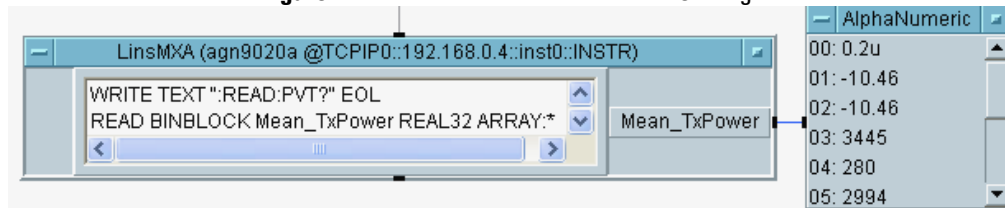
MULT is selected to measure multiple offsets and the Frequency List is set to SHORT. The results are listed as the power levels at different frequency offsets relative to the carrier frequency.

**Measurements:**

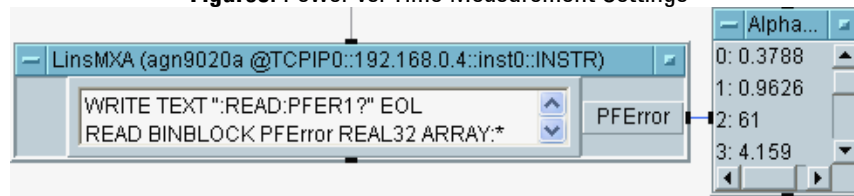
Figure7 to Figure10 display the measurement settings and the corresponding results for each test. Notice that they all follow a similar format, “:READ:<MEASUREMENT>?”



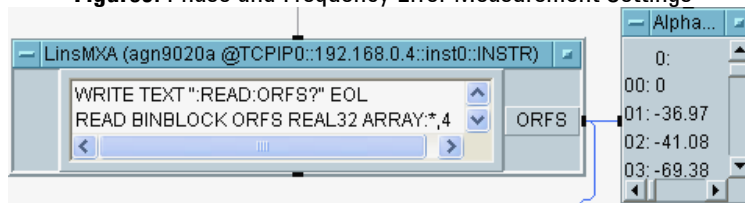
**Figure7.** Transmit Power Measurement Settings



**Figure8.** Power vs. Time Measurement Settings



**Figure9.** Phase and Frequency Error Measurement Settings



**Figure10.** Output RF Spectrum Measurement Settings

So far, the best measurement result is 6.538 second for ten measurement sets, which is about 0.653 second for four tests in each measurement set. Figure1 also shows the time spent on each individual test.



### III. EDGE Measurement Application:

Figure11 shows the test flow for the EDGE application. Similar to the GSM measurements, all settings are set prior to the actual measurements before the **OK** button. Three tests are conducted for the EDGE application: *Power vs. Time* (PVT), *Error Vector Magnitude* (EVM) and *Output RF Spectrum* (ORFS). The time that takes to finish a single set of measurement is around 0.467 second. Figure11 also shows the time for each individual test.

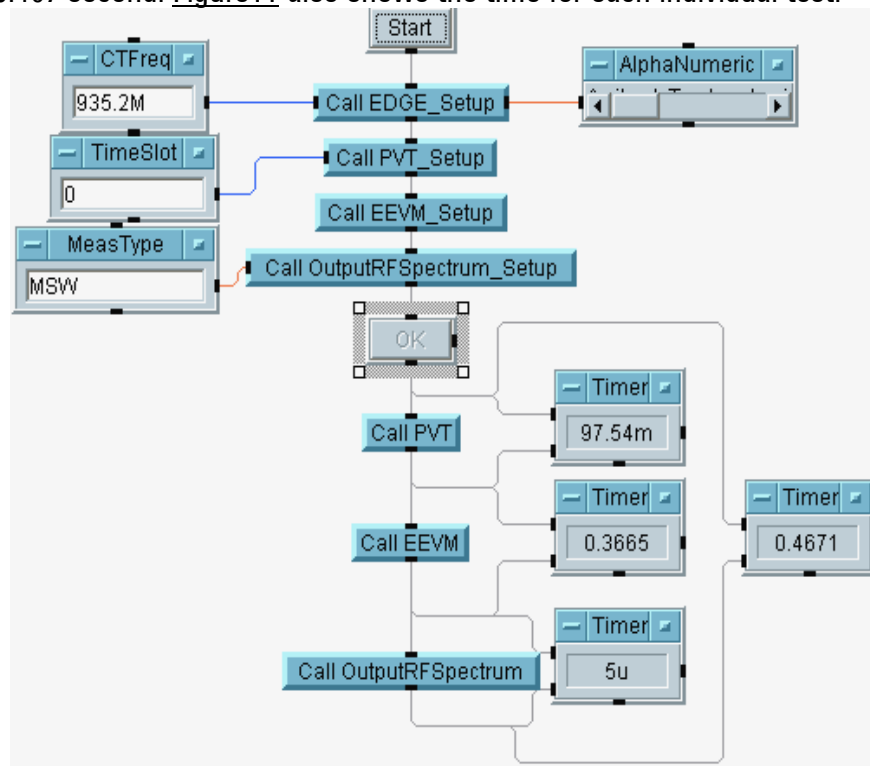
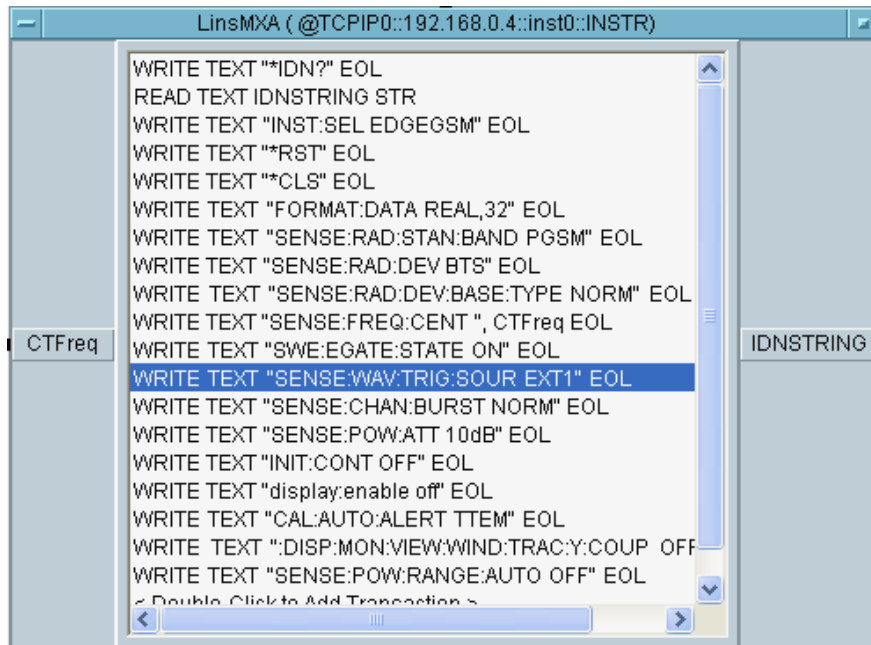


Figure11. EDGE Measurement Test Flow Diagram

#### **EDGE Setup:**

The *EDGE\_Setup* is similar to the *GSM\_Setup* except the trigger source and the Timeslot. Conventional GSM mobiles use a single timeslot on the uplink and downlink. Therefore, the default RF Burst trigger that has automatic level control for periodic burst signals is used as the trigger source. However, unlike GSM, EDGE allows multiple users to transmit on multiple timeslots at varying power levels, so an external trigger source is used, as highlighted in [Figure12](#).

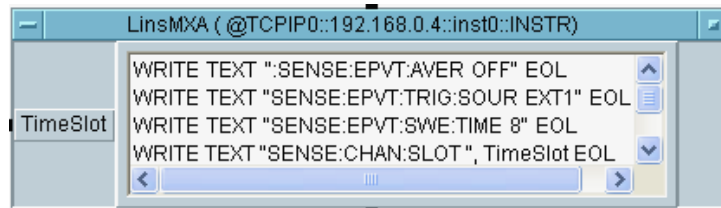




**Figure12.** EDGE Application Optimum Settings

**PVT Setup:**

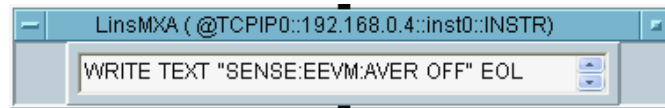
Since the EDGE application allows users to transmit multiple timeslots at different power levels, the *Power vs. Time* (PVT) measurement is able to perform multi-slot power measurement. Consequently, the number of slots which are used in each data acquisition is set to 8 because GSM/EDGE has 8 timeslots, as shown in [Figure13](#). The PVT measurement also allows us to examine the power level at a selected timeslot for a detail examination.



**Figure13.** Power vs. Time Optimum Settings

**EEVM Setup:**

EDGE uses  $3\pi/8$  rotated 8PSK modulation scheme, which is a non-constant amplitude modulation. Therefore, a transmitter's phase, frequency and amplitude accuracy are all critical to the system's performance. Therefore, Error Vector Magnitude (EVM) is used for EDGE as opposed to PFER measurement used for GSM. As shown in [Figure14](#), averaging is turned off for a faster EEVM measurement.



**Figure14.** Error Vector Magnitude Optimum Setting

**OutputRF Spectrum Setup:**





The ORFS measurement settings for EDGE are similar to the settings for GSM (Figure15). The only difference is the trigger source, which is switched to external triggering. In order to distinguish the measurements from EDGE to GSM, SCPI command, EORF, is used to present the Output RF Spectrum (ORFS) measurement for EDGE.

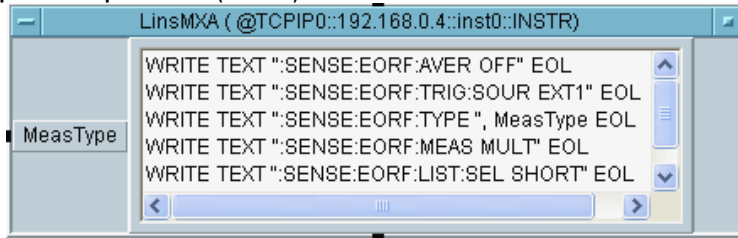


Figure15. Output RF Spectrum Optimum Settings

**Measurements:**

As mentioned above, the PVT measurement for EDGE can measure different power levels at multiple timeslots, as well as a single power level at a selected timeslot. In Figure16, the first output "EPVT" returns the power levels at all 8 timeslots and the second output "EPVT1" returns a more detailed power level measurement at the timeslot set in Figure 13.

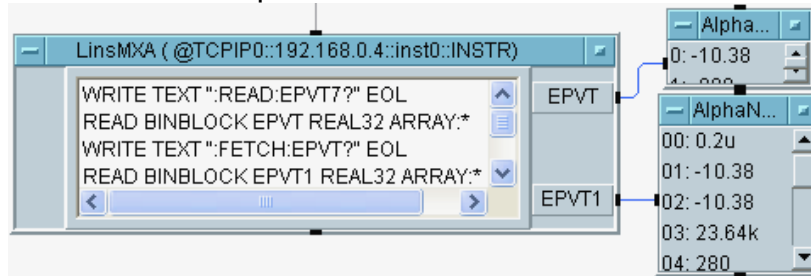


Figure16. Power vs. Time Measurement Settings

Figure 17 and Figure 18 display the EVM and ORFS measurement settings for EDGE and the corresponding results.

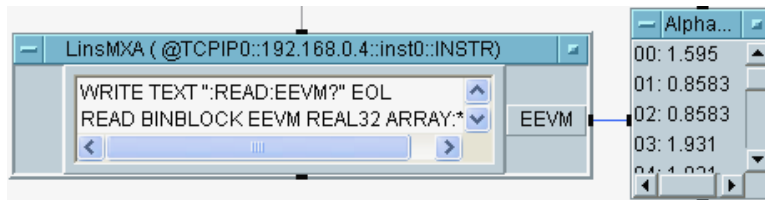


Figure17. Error Vector Magnitude Measurement Settings

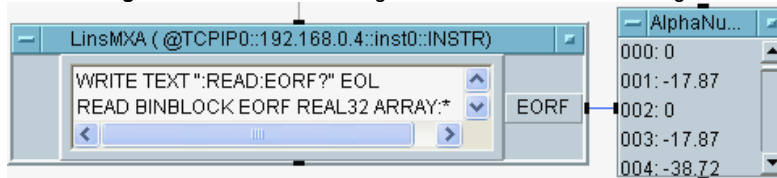
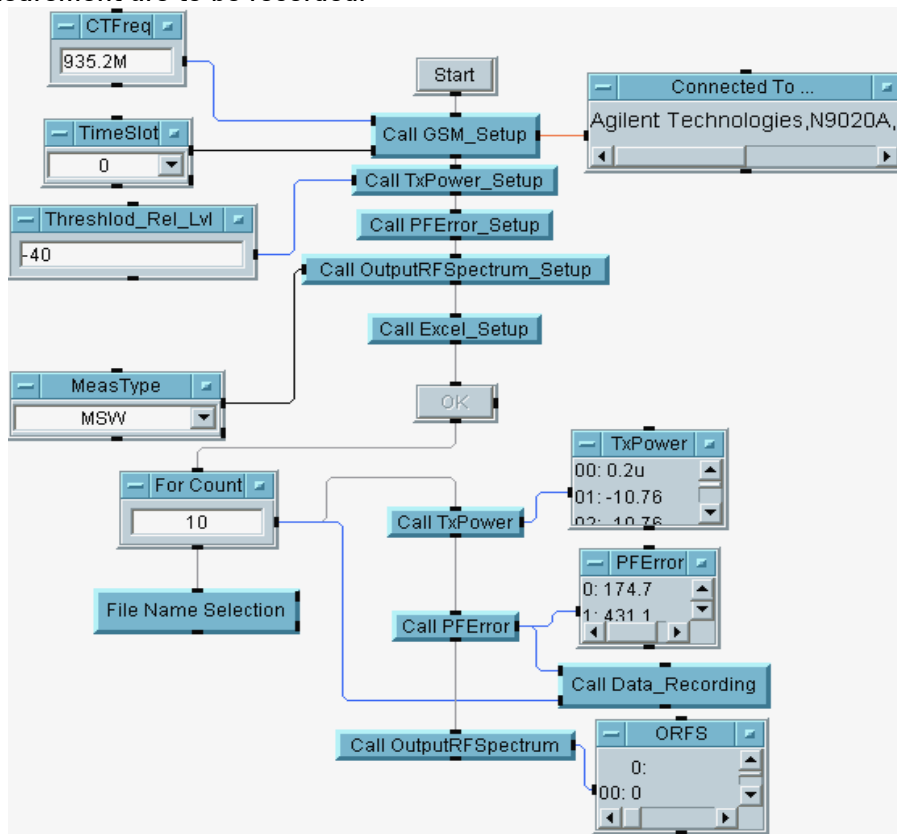


Figure18. Output RF Spectrum Measurement Settings



#### IV. Data Recording:

Data can be transferred and recorded into an Excel file after the measurement. [Figure19](#) shows the test flow of the GSM application with add-in Excel library. The PFER results from each measurement are to be recorded.



**Figure19.** Test Flow for GSM Application with Add-in Excel Library

The *Excel\_Setup* function opens up an Excel file. The *Data\_Recording* function transfers and records the “*PFError*” data to the Excel file as soon as the data are available. For details about how to setup the *Excel\_Setup* and *Data\_Recording*, please refer to the Appendix. [Figure20](#) shows the data that has been recorded to an Excel file.

	A	B	C	D	E	F	G	H	I	J	K
1	Test1	Test2	Test3	Test4	Test5	Test6	Test7	Test8	Test9	Test10	
2	190.9304	115.6709	205.0025	167.4687	90.62344	228.4904	167.4299	190.5666	221.28	174.6686	
3	533.933	240.0001	514.9585	334.6838	224.7318	545.1454	351.9237	430.7089	448.5943	431.1335	
4	88.8	1.9	59.2	139.9	106.6	61.5	86.1	96.5	5.5	86	
5	-420.334	-11335.9	-7125.51	-20071.7	-7704.81	-2271.98	3201.088	-2131.97	-14487.8	-812.227	
6	-15.2279	-19.447	-13.4225	-24.0038	-11.7738	-21.8075	-8.90357	-25.7897	-17.4721	-20.3885	
7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
9	61	61	61	61	61	61	61	61	61	61	
10	4E-07	4E-07	4E-07	4E-07	4E-07	4E-07	4E-07	4E-07	4E-07	4E-07	
11	0.000279	0.00028	0.000281	0.000279	0.00028	0.00028	0.00028	0.00028	0.00028	0.00028	
12											
13											

Figure20. Data Recorded into an Excel File

**APPENDIX:**

**Excel\_Setup** (Figure21): The first three functions are under the Excel Tab; and the last one is a Call function.

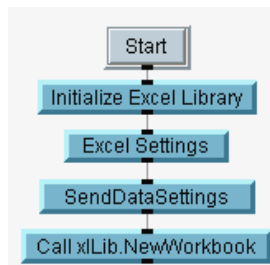


Figure21. Excel Settings to open an Excel file

**Data\_Recording** (Figure21):

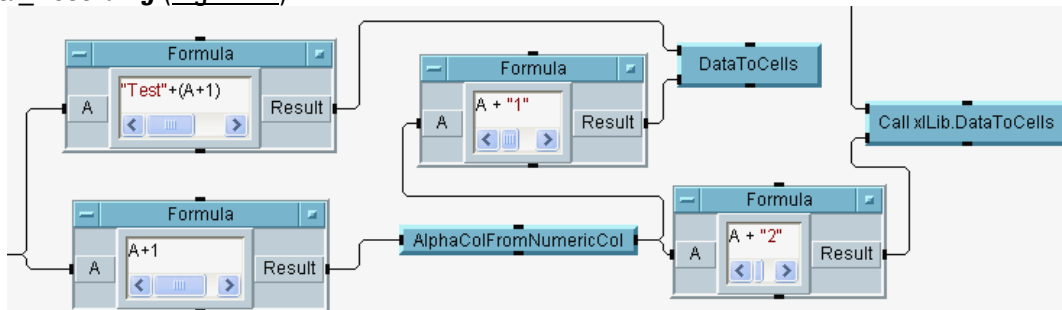


Figure22. Data are recorded column by column

The first row is used as headers for each test, such as "Test 1", "Test 2" and etc. Starting from the second row are the actual data transferred from the N9020A MXA signal analyzer. The *DataToCells* and *AlphaColFromNumericCol* functions are the add-in Excel functions that can be found under the Excel tab.

**REFERENCE:**



1. GSM and EDGE User's and Programmer's Guide,  
<http://cp.literature.agilent.com/litweb/pdf/E4406-90306.pdf>
2. MXA/EXA Signal Analyzer N9071A GSM with EDGE Measurement Application,  
Technical Overview with Self-Guided Demonstration.

