

MATRIX GSM MODULE

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About Comrex

Comrex has been building reliable, high quality broadcast equipment since 1961. Our products are used daily in every part of the world by networks, stations and program producers.

Every product we manufacture has been carefully designed to function flawlessly, under the harshest conditions, over many years of use. Each unit we ship has been individually and thoroughly tested. Most items are available off-the-shelf, either directly from Comrex or from our stocking dealers.

Comrex stands behind its products. We promise that if you call us for technical assistance, you will talk directly with someone who knows about the equipment and will do everything possible to help you.

Our toll free number in North America is 800-237-1776. Product information along with engineering notes and user reports are available on our website at <http://www.comrex.com>. Our Email address is info@comrex.com.

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All equipment manufactured by Comrex Corporation is warranted by Comrex against defects in material and workmanship for one year from the date of original purchase, as verified by the return of the Warranty Registration Card. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you obtain return authorization from Comrex and return the product, shipping prepaid, to Comrex Corporation, 19 Pine Road, Devens, MA 01432 USA. For return authorization, contact Comrex at 978-784-1776 or fax 978-784-1717.

This Warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification performed by anyone other than Comrex Corporation.

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SECTION 1.**INTRODUCTION***ABOUT THE GSM MODULE*

When Comrex introduced the Matrix, the concept was to build the world's most versatile audio codec, one able to work over a variety of present and future digital networks. We certainly had our own ideas about what types of digital networks would gain wide acceptance, but since one can never be sure about these things, we left the ability for the product to expand into the unknown by including an accessory port for future upgrades.

Wireless audio transmission (with enhanced quality) has been our number one demand for years, and we've tried lots of techniques for providing it. The Matrix was designed with the thought of connecting external phones to the "multi-purpose" serial port and transmitting audio over the serial connection. This did work, but we found it to be cumbersome and complex, and the low data channel available on the wireless networks really stressed our existing audio coding algorithms to their limits. And phone models kept changing, with different models providing different connection issues, especially when used as data modems.

The GSM Module overcomes these limitations in two ways. First, by providing our own GSM phone built into the system, we can be sure the hardware is the very best suited to the task. The GSM modem within the module is a vastly superior design to handheld phones for this purpose. Secondly, we've enabled the Matrix to use a new coding algorithm in GSM Mode. This algorithm is uniquely suited to coding voice at the ridiculously low bitrates available on the GSM data channel. With these enhancements, we feel the application has finally "arrived" and become much more useful to many broadcasters.

When adapting an existing infrastructure (like a cellular network) for strange uses (like audio codecs), there will always be some technical limitations, and some of these limitations remain, even with the GSM Module. While the voice codec is the absolute best available at this data rate, it is not transparent and artifacts do remain. Also, while the codec system itself introduces only a small audio delay (~1/8 second), the GSM network typically adds substantial delay, to the tune of 1/2 second or more in each direction. Finally, any wireless codec will be susceptible to the same problems of interference, congestion, and signal strength as a normal cellphone.

Our hope is you will understand these limitations and choose the appropriate applications for the GSM Module. We at Comrex will be hard at work on the next Matrix "accessory." Stay Tuned!

ABOUT GSM

Second generation digital cellular networks come in several flavors. The most common network available internationally is known as GSM (Global System for Mobile Communication). There is also a large deployment of AMPS (analog), TDMA, and CDMA networks, especially in North America. Our testing has determined GSM to be the best network for transmission of real-time audio from both a data availability and stability standpoint. GSM also has the advantage of subscription via Smart Card (SIM) so a GSM account can easily be moved from phone to phone (or phone to codec).

ABOUT GSM DATA

When you use the Matrix GSM Module, you are actually “piggybacking” on the digital stream normally used for wireless voice calls. The difference is that instead of converting the wireless data to analog and routing it down a POTS line, the GSM network is feeding this data into a normal analog modem. This modem resides somewhere in the GSM network, possibly thousands of miles away from both ends of the link. The modem then places a call to the destination and negotiates a data link over the phone line. As shown in Figure 1, there are actually three “daisy chained” digital links: The first is the wireless link between the GSM Module and the tower, the second is the circuit from the digital tower to the network modem pool, and the last is the normal modem connection between the modem pool and the POTS side of the call.

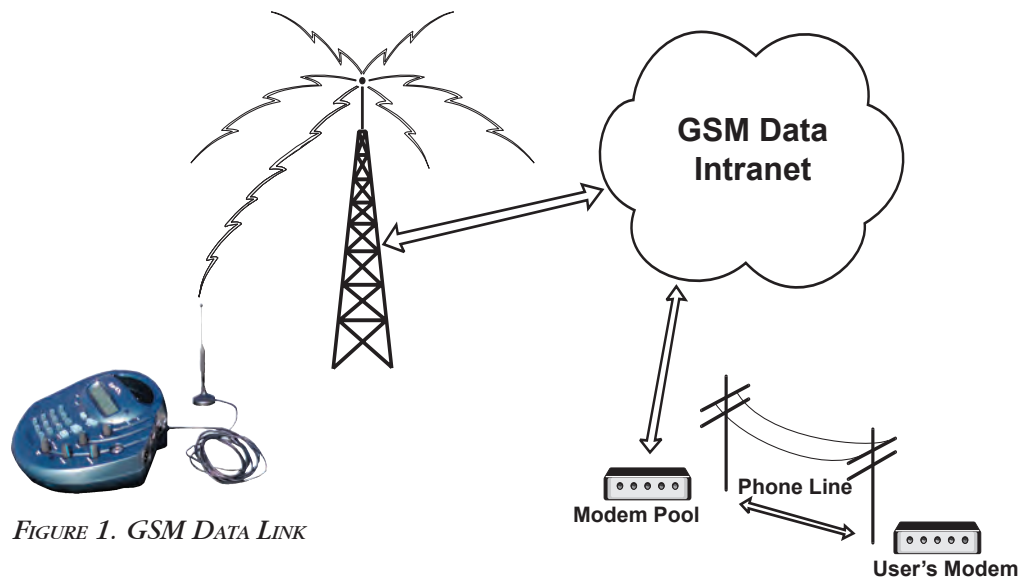


FIGURE 1. GSM DATA LINK

This type of connection is called Circuit Switched Data (CSD), because an actual physical circuit is established and kept open throughout the call, much like a normal phone call is.

*OTHER TYPES OF WIRELESS
DATA*

GSM (and most other types of digital wireless service) have newer generations of data offerings. In the GSM world, the most common is known as GPRS (usually some spiffy marketing name is applied to it). GPRS boasts data speeds much higher than those available via CSD. But GPRS, being designed primarily for web traffic, has serious deficiencies where real-time audio is desired. GPRS is a web-based connection, meaning that rather than dialing a remote point; you are connected directly to the carrier's web server. Any connections to remote locations must be virtual and packet-based along the public Internet, with all the congestion and delays associated with that. Also, deployed GPRS systems typically provide a wider download speed than upload, and remote broadcasting relies on the upload path in a wireless environment. So for now, "state of the art" wireless broadcasting will rely on the older, thinner, circuit switched data connections provided by GSM. The same limitations apply to high-speed offerings by CDMA systems, typically known as "1X" networks.

GSM MODULE FEATURES

The Comrex Matrix GSM Module provides operation on GSM networks, converting your Matrix into a full featured audio codec or a standard mobile phone. Here's a list of the Matrix's GSM Module features:

- GSM wireless phone contained in the module.
- Since the module is not handheld, RF power output isn't limited by radiation concerns, allowing for higher power output (up to 2 watts).
- Low bit-rate algorithm delivers 7 kHz frequency response with reduced artifacts for the challenging GSM data rates (9600 or lower baud).
- External mag-mount antenna, proven to increase stability and range.
- Accepts a SIM card from GSM providers — simply insert a valid card to activate the module.
- Offers quicker recovery from errors, avoiding the stuttering effect often found with handheld phones.
- Available in 900/1900 MHz for North American use or 900/1800 MHz for use in the rest of the world.

*WHAT COMES WITH A GSM
MODULE?*

Please make sure the following items were received with your shipment:

- (1) Comrex Matrix GSM Module — either 900/1900 MHz (North America only) or 900/1800 MHz
- (1) Mag-mount GSM antenna
- (1) 12V power accessory connector
- (1) Operating manual
- (1) Warranty card (please complete and return)

Note: A GSM SIM card with CSD enabled is required but not included.

UPGRADES

This module may be used in any portable Matrix to call into another Matrix or BlueBox on a land line. However, it is possible that your Matrix may need to be upgraded in order to work with this module. The Matrix or BlueBox used to receive a GSM codec call may also require upgrades. Please contact Comrex Technical Support at 978-784-1776 or email techies@comrex.com for details on your particular Matrix or BlueBox.

*OPERATIONAL
CONSIDERATIONS*

The GSM Module may only be used in a portable Matrix and GSM SIM card is required for operation (not included). A Matrix Portable, Matrix Rackmount or BlueBox on a POTS (Plain Old Telephone Service) is required at the other end of the connection.

SECTION 2. MATRIX GSM MENU SELECTION TREE

PORTABLE

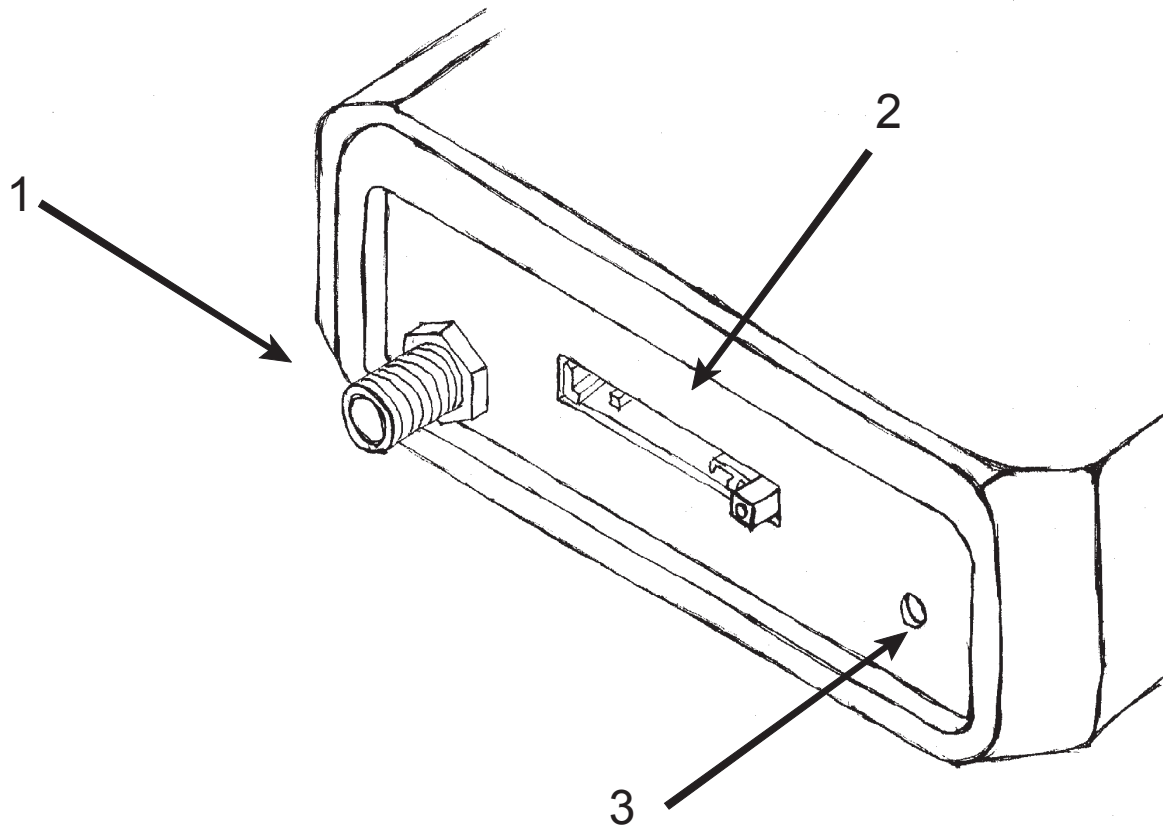
Enter	Configure	Program Qdial	Enter Qdial#: 00-19	Enter Phone Number:
	Dial	Dial Number	Dialing	
	Dial Voice Call	Dial Number	Dialing	
Qdial	Enter Qdial#: 00-19 (Note: for last number redial, enter 00)			

RACKMOUNT

Enter	Dial	Keypad	Dial Number:		
		Ext Phone	Dial with Ext Phone <Enter> when Ringing		
	Answ	connecting...			
Test		Voice	33.6 - 9.6 kb/s	Loopback Active	
		Music	33.6 - 9.6 kb/s	Loopback Active	
		Hotline	33.6 - 12 kb/s	Loopback Active	
		GSM	13.2 - 7.2 kb/s	Loopback Active	
Config		Pgm Qdial	Enter Qdial#:01-19	Enter Phone Number	
		Codec	Voice Mode	Algorithm Selected	
			Music Mode	Algorithm Selected	
			GSM	Algorithm Selected	
		Max Rate	33.6 - 9.6 kb/s	Maximum Rate Selected	
		More	Auto Ans	On	
				Off	
				6 Rings	
		Dialing	Tone Dialing		
			Pulse Dialing		
ModMon	Modem Monitor On				
	Modem Monitor Off				
Levels	Input	0dBu, +4dBu, -10 dBu			
	Output	0dBu, +4dBu, -10 dBu			
	Store/Fwd	Menus not enabled for GSM operation			
Qdial	Enter Qdial #:01-19... (Note: For last number redial, enter 00)				

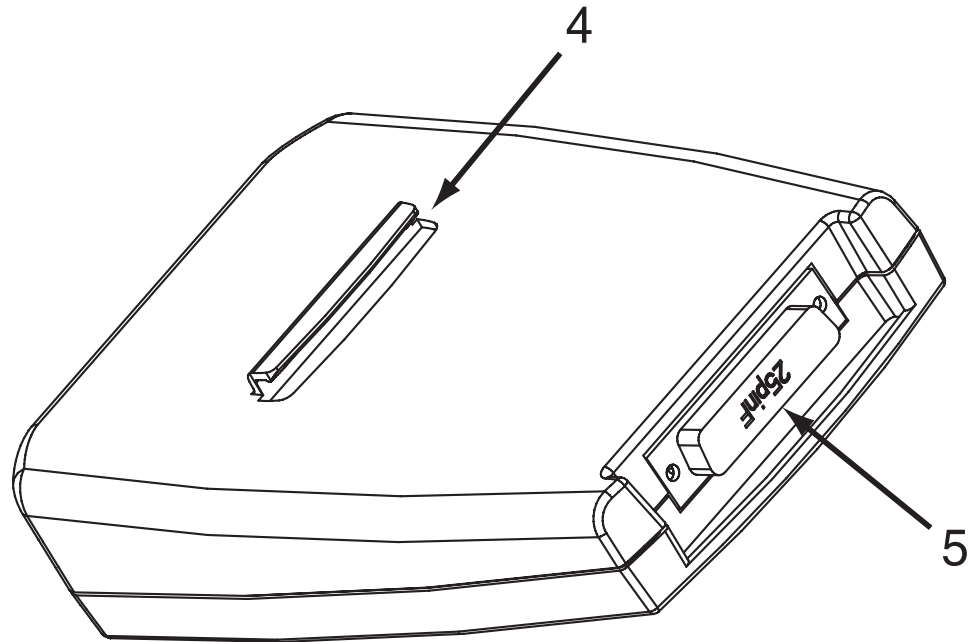
SECTION 3. DIAGRAMS AND DESCRIPTIONS OF CONTROLS AND CONNECTORS

GSM MODULE - FRONT DIAGRAM



- | | |
|--|--|
| <p>1 <i>SMA JACK</i></p> <p>2 <i>SIM CARD HOLDER</i></p> <p>3 <i>STATUS INDICATOR</i></p> | <p>This SMA style connector is for attaching the antenna.</p> <p>This slot houses the SIM card drawer which is used to insert a SIM card into the module.</p> <p>This red LED indicates the connection status between the GSM Module and the GSM Network:</p> <ul style="list-style-type: none">Blinking Quickly — online.Blinking Slowly — registered with the network but offline.Steady — no network found. |
|--|--|

GSM MODULE - TOP/FRONT DIAGRAM



4 HOOK FOR MODULE ATTACHMENT

This hook ensures secure attachment of the module to the portable unit. It aids in proper alignment and helps to hold the module firmly in place.

5 DB25 CONNECTOR

The female DB25 connects the module to the male DB25 on the portable unit. Make sure that the unit is fully inserted and that the connections are seated properly.

GSM MODULE - INSERTION DIAGRAMS

Unit must be powered OFF prior to insertion of module.

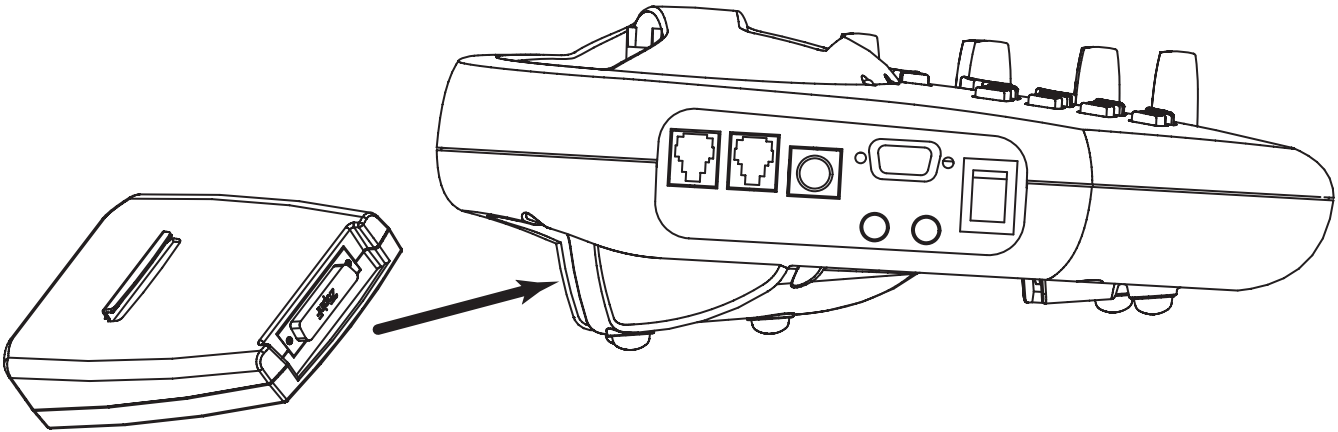


FIGURE 2. GSM MODULE - INSERTION INTO PORTABLE HOUSING

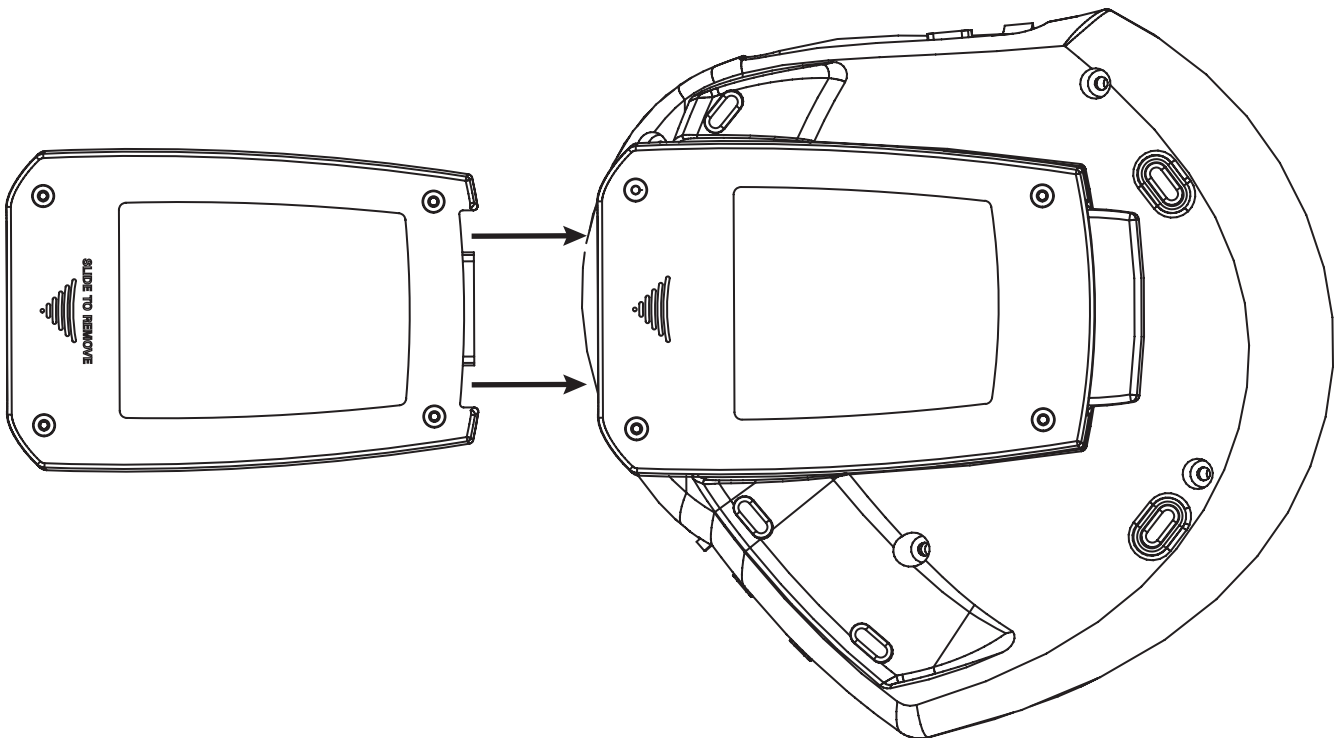


FIGURE 3. GSM MODULE - INSERTION INTO PORTABLE HOUSING (AS SEEN FROM BELOW)

SECTION 4.

PREPARING THE MATRIX FOR GSM OPERATION

*INSTALLING THE SIM CARD
- PORTABLE*

Insert a valid SIM card into the GSM Module. To do this, press the small button on the side of the SIM card holder (protruding from the back panel) and remove the SIM card drawer completely. Put the SIM card into the drawer with the contacts exposed (the back of the SIM card should be against the drawer). The drawer fits back into the holder right side-up, with the SIM card contacts oriented toward the top of the unit (see Figure 4). Please make sure that the drawer is properly aligned. Extreme pressure is not required. If the drawer does not slide easily, double check the drawer alignment.

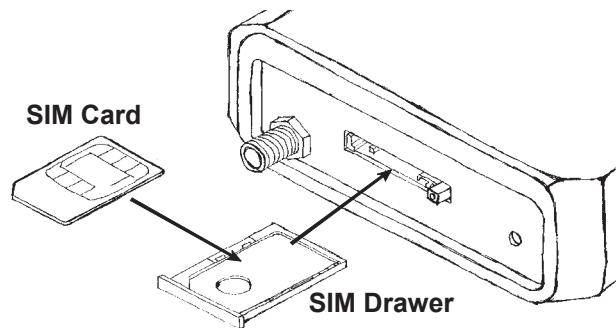


FIGURE 4.

*ATTACHING THE GSM
MODULE - PORTABLE*

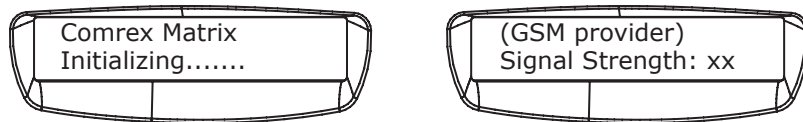
Make sure that your Matrix portable is powered OFF before inserting the GSM Module. Then slide the module into the channel on the bottom surface of the Matrix, paying attention that the DB25 connectors align properly and attach securely. The plastic “hook” on the top surface of the module should insert into the slot on the portable chassis. When the pins on the DB25’s are aligned, apply gentle pressure until module is seated securely. When the module is correctly inserted, the fit will be very snug and some effort will be required to disconnect the module from the unit — Figures 2 & 3.

*CONNECTING THE ANTENNA
- PORTABLE*

Attach the GSM antenna to the SMA style connector on the rear panel of the GSM module. **The antenna should always be attached before powering up the Matrix.** Place the antenna in a location where it’s relatively free from interference and obstructions. For best results make sure that the antenna is secured to a metal/steel ground plane. In order to maintain the highest signal strength, it may be advantageous to keep the antenna away from people.

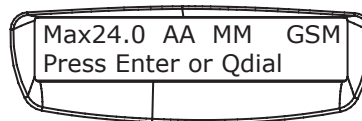
*POWER UP SEQUENCE -
PORTABLE*

When the Matrix portable is connected to power (either via the power supply, battery kit or 12V power accessory connector) and turned on with the GSM Module installed, the unit automatically boots up as a GSM codec. During the boot up process, the “Initializing” screen appears for approximately five seconds. It then attempts to read the SIM card settings and lock onto a locally available GSM network. The Matrix will display the name of the GSM network, along with a signal strength reading as shown below. If this process fails, power the unit off and check the seating and orientation of the SIM card. Also be sure you are in a location where a valid GSM network has sufficient signal strength. The signal strength scale is from 0 (lowest) to 32 (highest). We recommend a reading of at least 20 for codec operation.



RACKMOUNT PREPARATION

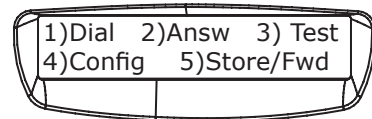
To prepare the Matrix Rackmount for GSM operation, simply attach a phone line to the jack on the rear panel labeled “Tel Line” and apply power to the unit. After the “Initializing” screen, make sure it shows the following settings:



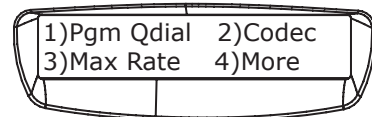
The Matrix Rack **cannot** automatically adapt between GSM mode and normal POTS codec mode. If the display does not indicate “GSM” change it using the following steps:

1. Press *ENTER* from the *MAIN STATUS DISPLAY*.

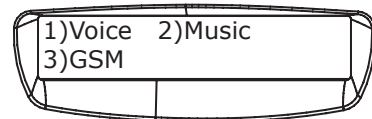
2. Then select “4” for *CONFIG*.



3. Next press “2” for *CODEC*.



4. Select “3” for *GSM*. Press the *CANCEL* key twice to return to the *WIRELESS STATUS DISPLAY*. It should now indicate “GSM” in the upper right hand corner of the display.



SECTION 5.

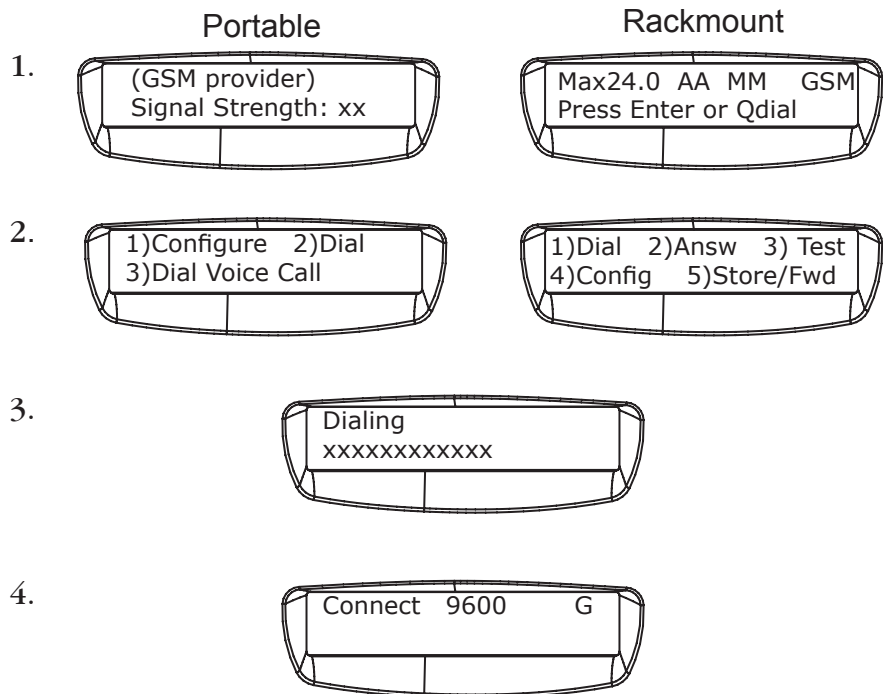
PLACING A CALL FROM THE MATRIX

MANUALLY DIAL

It is now time to place a call from your Matrix. We will assume that all the proper connections have been made. You can either dial manually or use the Quick Dial option for automatic dialing. You may also initiate a call from either end.

To place a call from the keypad (*the manual dialing procedure is slightly different on the Portable than the Rackmount*):

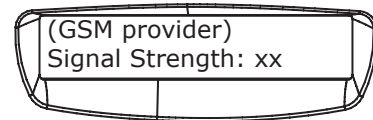
1. Press the *ENTER* key form the *WIRELESS STATUS DISPLAY*.
2. Portable — Press “2” for *DIAL*.
Rackmount — Press “1” for *KEYPAD*.
3. Enter the phone number to be dialed. If you make a mistake, press the *CANCEL* key to backspace. The *HANG UP* key will abort the call.
4. The Matrix will dial your call. GSM calls can take 30 seconds or more to complete, and you may not be able to hear any call progress. When the *READY* light illuminates the codec is successfully synced with the codec at the other end and you are ready to communicate. Press the *HANG UP* key to terminate the call.



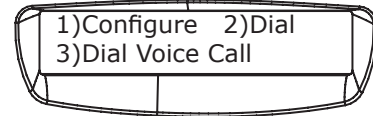
*GSM VOICE CALL -
PORTABLE ONLY*

The Matrix portable GSM system has the capability of dialing ordinary voice calls (to non-codec users). However, "GSM Voice" calls cannot be received by the portable Matrix.

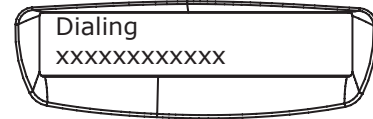
1. Press *ENTER* from the *WIRELESS STATUS DISPLAY*.



2. Select "3" for *DIAL VOICE CALL*.



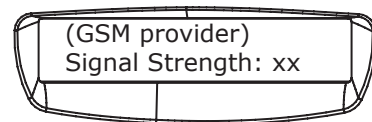
3. Key in the number you wish to call and press the *ENTER* key to dial the number. (Pressing the *HANG UP* key disconnects the call.)



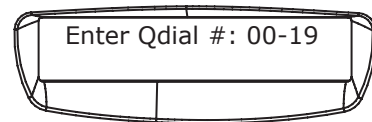
PLACING A QDIAL CALL

The QDial dialing procedure is the same whether you dial from the field or studio unit.

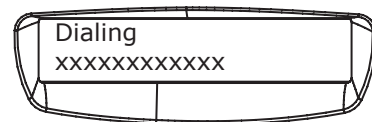
1. Press the *QDIAL* key from the *WIRELESS STATUS DISPLAY*.



2. Input the two digit index (01-19) of the programmed number you wish to dial. Pressing *QDIAL 00* will redial the last number dialed.



3. The unit will automatically dial the programmed number and connect.



PROGRAMMING QDIAL

The Matrix has 20 memory locations allowing you to preprogram up to 19 numbers and dial it quickly using the *QDIAL* button. QDial memory location 00 holds the last number dialed. These numbers will remain in memory even when power is turned off.

QDial numbers programmed in the portable Matrix with the last digit as a “pause” will be saved as a “GSM Voice Call.” Insert a pause by pressing the *QDIAL* key, a comma will appear on the display. It will also remember the last number dialed whether if it was a codec or voice call, and dial it the same way.

1. Press *ENTER* from the *WIRELESS STATUS DISPLAY*.
2. Portable - select “1” for *CONFIGURE*.
Rackmount - select “4” for *CONFIG*.
3. Now select “1” for *PGM QDIAL*.
4. The screen will display “Enter Qdial #: 01-19.” Enter a number from 01 to 19 to correspond to the QDial position.
5. Key in the phone number to be dialed, including any country, area or other codes. To insert the portable voice call indication, press the *QDIAL* key. If you make a mistake, press the *CANCEL* key to backspace. The *HANG UP* key will exit this operation.
6. Press *ENTER* to store the number. Next, press *CANCEL* to return to the *WIRELESS STATUS DISPLAY*.

SECTION 6.**TROUBLESHOOTING***“SEARCHING...”*

If the display shows “Searching...” and does not go further this is an indication that the Matrix is unable to communicate with a GSM tower. There are three reasons that the Matrix may be unable to “see” the tower:

- A) The SIM card may be missing or improperly inserted. Check that a valid SIM card is inserted into the drawer on the back of the module and that the drawer is carefully and properly installed into the module (see page 11).
- B) If the SIM card was purchased with a phone, the card may be “locked” to that phone. Some GSM providers do this to help protect against misuse in the event the card is lost or stolen. Your service provider should be able to tell if the SIM card is locked and unlock it for you.
- C) You may be out of range of a functioning GSM tower. To check if this is the case, you may move to an area that you know has good coverage or you may try a standard GSM phone. If a GSM phone works, than the Matrix with GSM will work. Note: be sure that your phone is a GSM only phone and not a tri-band that can “see” a CDMA or analog tower.

FAILURE TO CONNECT

If you are unable to complete a call with your Matrix wireless system, it may be that the circuit switched data (CSD) services are not supported on your account. The best test is to place a GSM voice call with you Matrix portable (see page 14 for details). If you are able to complete a voice call, the SIM card is valid but data service is not enabled, contact your wireless service provider to activate circuit switched data.

INSTABILITY

Instability of wireless calls will typically take the form of audio drop-outs or a “skipping” sound as encoded audio frames get repeated. This typically indicates a halt in data getting to the decoder, caused by one of the following factors:

- A) Low RF signal strength between the phone and the local mobile phone cell has caused data errors. In this case you should attempt to find a location with higher signal strength. We recommend at least a signal strength of 20 for proper codec operation. Sometimes movement of several feet can make a large difference in signal strength. Providing a ground plane for the antenna may help. (Even something as simple as a steel pie plate.)
- B) Change in channel/site – Mobile phones by their nature can change radio channels and even base stations during a call, even if the phone is not actually moving. To some extent this cannot be avoided, but a high signal strength will improve your odds.
- C) Interference - Try to make sure that no other mobile phones of any type are in close proximity to the Matrix with GSM or antenna.
- D) Noise in telephone channels – This is less likely than issues with the radio link, but phone line problems can cause stability issues. Make sure the lines in your studio are the best you can get.