MIX-MINUS BRIDGE

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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 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 01434 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

YOU NEED MIX MINUS

Broadcast studio consoles must do more than send audio to the transmitter. Remote feeds or listener calls are important program sources, and the people on the air need to hear the station's audio. It is easy to mix a lot of different source material together with a studio console, but challenging to send the correct audio back to the correct user.

Mix-minus feeds are usually required when audio programming originates outside the studio. Most radio stations take programming from ISDN, POTS or IP codecs, and TV stations are now using digital ENG gear. The problem is that most digital codecs have substantial processing delays, in the order of 5-500 ms. This usually precludes off-air monitoring, because the air talent will not be able to tolerate the delay of their own voice in their ear. The delay is of course doubled if the codec return channel is used for talent monitoring. The solution is to feed a mix of all needed audio, minus the remote talent, back to the remote site.

Telephone calls having their own audio sent back to them are susceptible to feedback and may sound strange. Additionally, wireless calls are subject to significant coding delays. So every telephone hybrid in your studio requires at least one feed with all telephone audio removed. If callers are to be conferenced, each may require a custom mix minus feed unless your studio telephone system handles this internally. This is because each caller must hear the other, but not themselves.

If you need more information on the uses of the Mix-Minus Bridge, turn to page 14. Otherwise, read on for installation and set-up instructions.

FEATURES

- The MMB takes one mix minus feed from the console, and creates 6 feeds for remote or telephone use.
- MMB's can be stacked for 12, 18 or more feeds.
- Separate level controls are provided for each input to the bridge.
- IFB (interruptible fold-back) allows cues to be sent to individuals or the whole group.
- IFB can be set for "ducking" or complete muting of the program audio.

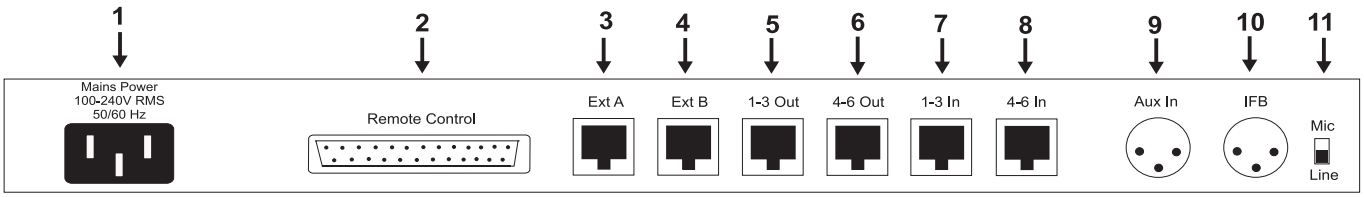
WHAT COMES WITH MMB

The following items are shipped with a new Mix-Minus Bridge:

(1) Mix-Minus Bridge (MMB), ready for 120 or 240 V operation.
(1) AC power cord for North American use.
(1) Operating manual.
(1) Warranty card (Please fill out and return).

SECTION 2 DIAGRAMS AND INSTALLATION

Figure 1 - Rear Panel Diagram and Descriptions



1) AC INPUT — IEC-320 connector for AC power. The MMB works worldwide with AC power from 100 to 260 VAC, 50-60 Hz. Just use the appropriate cord for your area.

2) REMOTE CONTROL — 25 pin female "D" connector for remote switching of channel and IFB functions. See details on page 7.

3) EXT A — 8 pin modular connector to allow stacking of MMB's. The cross-connect cable should be pinned for standard Ethernet use. See page 6.

4) EXT B — Second 8 pin modular connector for stacking MMB's.

5) 1-3 OUT — 8 pin modular connector for the Channel 1, 2 and 3 outputs. Balanced or unbalanced connections may be used for all outputs. See pinout on page 6.

6) 4-6 OUT — 8 pin modular connector for the Channel 4, 5 and 6 outputs. See pinout on page 6.

7) 1-3 IN — 8 pin modular connector for the Channel 1, 2 and 3 inputs. Balanced or unbalanced connections may be used for all inputs. See pinout on page 6.

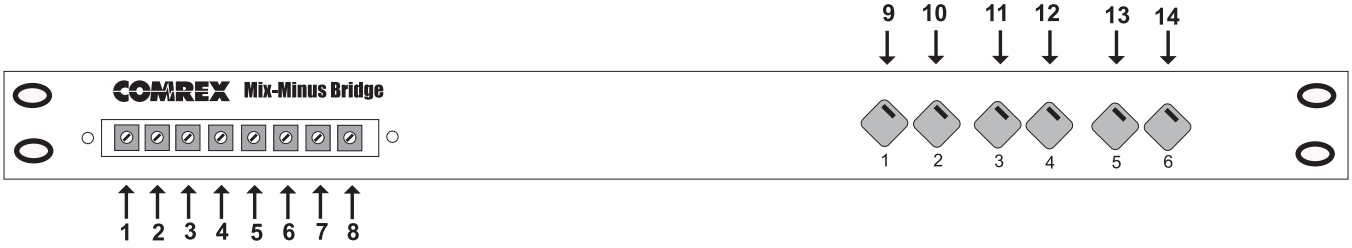
8) 4-6 IN — 8 pin modular connector for the Channel 4, 5 and 6 inputs. See pinout on page 6.

9) AUX IN — 3-pin XLR female jack to accept a single line-level mix-minus feed from the console. This feed will be fed to all outputs on the MMB.

10) IFB — 3-pin XLR female jack for interruptible fold-back (IFB) audio. This audio will be fed to channels selected by the IFB pins on the Remote Control connector. See details on page 6.

11) MIC/LINE — Switch to select microphone or line level for the IFB jack.

Figure 2 - Front Panel Diagram and Descriptions



1) Input 1 Level Channel 1 input level control. “1:00” is unity gain.

2) Input 2 Level Channel 2 input level control.

3) Input 3 Level Channel 3 input level control.

4) Input 4 Level Channel 4 input level control.

5) Input 5 Level Channel 5 input level control.

6) Input 6 Level Channel 6 input level control.

7) Aux Input Level Auxiliary input level control for single mix-minus feed from console.

8) IFB Input Level IFB input level. Select microphone or line level with the rear panel switch.

9) Channel 1 On/Off Pushbutton with LED indicator to enable/disable Channel 1.

10) Channel 2 On/Off Pushbutton with LED indicator to enable/disable Channel 2.

11) Channel 3 On/Off Pushbutton with LED indicator to enable/disable Channel 3.

12) Channel 4 On/Off Pushbutton with LED indicator to enable/disable Channel 4.

13) Channel 5 On/Off Pushbutton with LED indicator to enable/disable Channel 5.

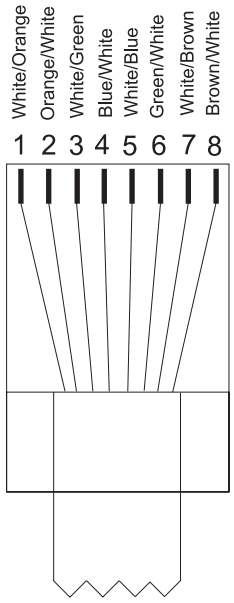
14) Channel 6 On/Off Pushbutton with LED indicator to enable/disable Channel 6.

AUDIO CONNECTOR PINOUTS

The RJ-45 connectors labeled **1-3 Out**, **4-6 Out**, **1-3 In** and **4-6 In** are wired in the same manner, using cables pinned out for CAT5 Ethernet connections. Looking down at the top of a plug with the gold pins visible, the wires connect as follows:

Table 1 - Audio Connector Pinout

Pin #	Colors	1-3 In/Out	4-6 In/Out
1	White/Orange	#2 +	#5 +
2	Orange/White	#2 -	#5 -
3	White/Green	#3 +	#6 +
4	Blue/White	#1 -	#4 -
5	White/Blue	#1 +	#4 +
6	Green/White	#3 -	#6 -
7	White/Brown	Ground	Ground
8	Brown/White	Ground	Ground



Following standard broadcast practice, connections will usually be made to balanced inputs and outputs. The CAT5 pinout above may be brought out to punch blocks to allow connection to other wire types. Use of the ground pins is optional; they will probably not be necessary for balanced wiring. If you need to connect unbalanced equipment, jumper selections are available on the MMB main board. Just remove the top cover, and you will notice a long row of input and output jumper plugs near the rear of the unit. The choices for balanced and unbalanced connections are marked on the board; just move the plugs accordingly. If an unbalanced connection is created, the "+" pin becomes "hot", and the "-" pin becomes ground.

The XLR connectors for the **Auxiliary Input** and **IFB Input** are wired in the usual fashion:

Table 2 - XLR Pinout

Pin 1	Ground
Pin 2	+
Pin 3	–

The **EXT A** and **EXT B** jacks are wired to accept straight-through CAT5 Ethernet cables to interconnect with other Mix-Minus Bridges. Use pre-made cables, or follow the standard CAT5 pinout.

Remote Control Pinout

The 25 pin "D" connector controls 5 VDC relays in the MMB. Functions are executed by bringing a pin to ground, and the current through each pin will be 27 mA.

Table 3 - Remote Control Pinout

Pin	Function
1	Channel 1 Off (grounding this pin disables the Channel 1 Input)
2	Channel 2 Off (grounding this pin disables the Channel 2 Input)
3	Channel 3 Off (grounding this pin disables the Channel 3 Input)
4	Channel 4 Off (grounding this pin disables the Channel 4 Input)
5	Channel 5 Off (grounding this pin disables the Channel 5 Input)
6	Channel 6 Off (grounding this pin disables the Channel 6 Input)
7	IFB 1 (grounding this pin substitutes IFB for regular audio on Channel 1)
8	IFB 2 (grounding this pin substitutes IFB for regular audio on Channel 2)
9	IFB 3 (grounding this pin substitutes IFB for regular audio on Channel 3)
10	IFB 4 (grounding this pin substitutes IFB for regular audio on Channel 4)
11	IFB 5 (grounding this pin substitutes IFB for regular audio on Channel 5)
12	IFB 6 (grounding this pin substitutes IFB for regular audio on Channel 6)
13	Master IFB (grounding this pin switches all channels to IFB – note 144 mA current)
14-25	Grounds

SECTION 3 SET-UP AND OPERATION

CONNECTING MMB INTO YOUR STUDIO

The Mix-Minus Bridge connects across the output of any remote audio device. In other words, any source which requires mix-minus on its input will have its output routed to the mix minus bridge as well as to the console.

The MMB uses the output audio from each device to create its mix-minus buses. The incoming level from each device is controllable via a front panel level control.

With the MMB, you only need to create a single mix-minus feed from your console. This will be everything you wish to send to all remote sites. The MMB will add in audio from all of its selected inputs, creating a custom mix-minus feed to each location. This will usually be done via the audition or auxiliary bus on your console, but some consoles may have a dedicated mix-minus feature. This single feed will enter the bridge at the **Aux In** connector, and the level into the Mix-Minus Bridge is adjustable.

Figure 3 is a sample studio hook-up for two audio codecs, a telephone hybrid, a mixing console and the Comrex Mix-Minus Bridge.

In this example, the telephone hybrid's caller audio is wired to the console **Tel** pot, and the **#1 Input** of the MMB. Codec #1's output is wired to the **RM1** pot, and the **#2 Input** of the MMB. Codec #2 feeds the **RM2** console pot, and the MMB **#3 Input**. The two console mixing channels are labeled **Program** and **Audition**. This may correspond to **Channel 1** and **Channel 2** on other consoles. The **Program** or **Channel 1** audio would typically leave the studio to feed a radio station's air chain, or a network's distribution system. Audio from **Audition** or **Program 2** is used to form the mix-minus feed to the audio codecs. Your console may have a programmable mix-minus bus that can be customized via DIP switches or a network interface.

Notice that all of the console modules are switched to both **Audition** and **Program** except the telephone and two remote modules. They are switched to feed **Program** only. This means that the **Audition** output of the console has all of the audio available, except for the hybrid and the codecs. This **Audition** circuit is then fed to the Comrex Mix-Minus Bridge **Aux In** jack, where it is sent to all outputs.

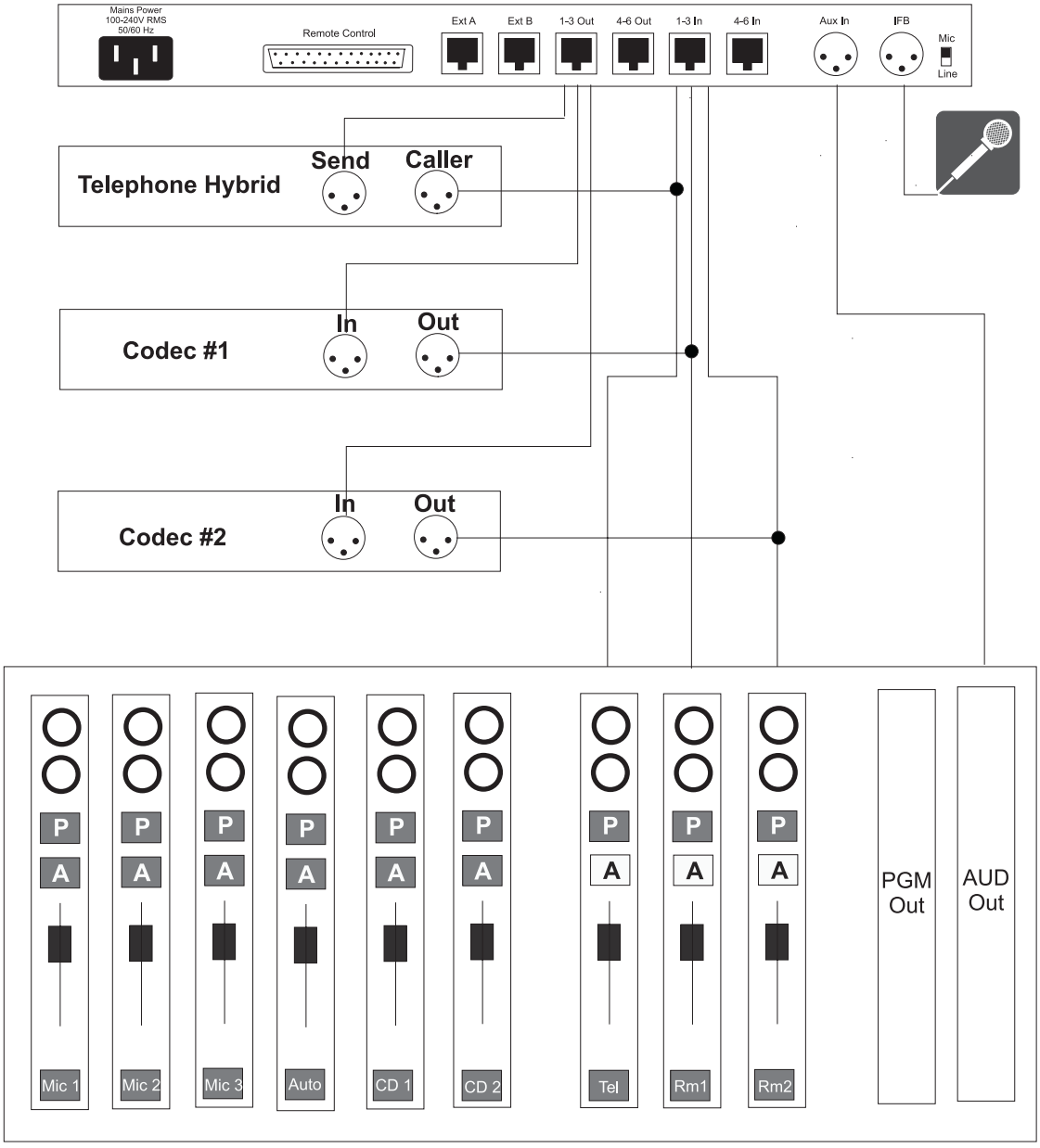


Figure 3 - Sample Studio Hook-up

Here is something important to check: Your console may have one or two modules dedicated to telephone hybrids, and there may be an additional module to control the internal mix-minus feeds for those hybrids. Make sure that this setup is able to feed the **Audition** and **Program** channels simultaneously, while feeding **Program** audio to the callers. Some of the older console designs may not support this setup, and simple modifications to the console may be required. Check your console manual, or contact the manufacturer.

Audio from the MMB output jacks is then fed directly to the hybrid **Send** jack and the codec inputs. Assuming that you are not disabling any inputs via the **Remote Control** port, audio from each device will be sent to the others, but not to itself.

The front panel **Pushbuttons** and the **Remote Control** connector allow you to prevent one or more inputs from being fed out to other users. This can be very useful if a show involving a codec or hybrid is on the air, and the host of the next show calls in. The **Channel Off** function will keep any pre-show chatter from distracting the people currently on the air. This may be done by alternately pushing the front panel buttons, or via the **Remote Control** jack with external switches or relay closures from tally outputs of console modules. Use of a tally closure would neatly isolate any input unless its console module was turned-on. The pin-out of the **Channel Off** functions is given on page 7.

IFB WIRING

Use of IFB is optional, but it is an effective way to communicate with talent in the field. See page 13 for background information on IFB. The wiring of the **IFB** input must be tailored to the individual studio setup. The drawing shows a microphone plugged into the **IFB Input** jack, with the **Mic/Line** switch in the **Mic** position. Some users mount a gooseneck mike near the studio operator's position, keeping the talk-back audio completely separate from the on-air audio. Another approach would be to wire the **IFB Input** directly across the operator's mike at the console. The impedance of the MMB's mike input is high enough not to load the mike. Alternatively, some consoles provide patch point feeds from their microphone modules. Such points are usually unbalanced, and work somewhere between mike and line level, so plan the wiring accordingly. If there is a mike processor between the microphone and the console, you may have an unused mike-level or line-level output from that. For all of these options, make sure the **Mic/Line** switch is set appropriately. IFB control is via the **Remote Control** connector, as described on page 7. You can provide a single master IFB pushbutton to talk to all remote sites, or individual buttons to restrict the conversation to single locations. Simple diode logic can be used to talk with combinations of remote sites with a single pushbutton.

Adjustments

With some connections made to the Mix-Minus Bridge, you can proceed with the set-up. Here's the good news: you should only have to make these adjustments once!

The Mix-Minus Bridge is pre-set for unity gain at the factory. This usually results in the eight **Gain** controls being set at "1:00." You may not need to change these settings, particularly if your line level inputs and outputs are standardized within the studio.

Start with the **Aux In**, which is probably connected to your **Audition** or **Program 2** channel in the studio. Set up some program audio or tone at normal level on the console. This will be automatically fed to each codec or other device connected to the **1-3 Out** and **4-6 Out** jacks on the MMB. The **Aux In** gain control on the MMB front panel will control the aux level to all codecs and hybrids. Use it only if you need to scale all of the output levels up or down.

The **Gain** controls for **Inputs 1-6** on the MMB adjust the feed from that codec or hybrid to the other devices. Just feed program audio through **Input 1**, and use the **Gain** control for **Input 1** to set the levels into **Outputs 2-6**. All you need to do is match the level you previously established for the **Aux Bus** feed to the codecs. Make sure the front panel **On/Off** button is engaged to send that channel to the other outputs.

Jump pins 13 and 25 on the **Remote Control** jack. This will interrupt all **Aux Bus** and other feeds and send the IFB audio to each output. You will probably have to adjust the **IFB Input Level** control to match this level up with the ones you have previously set. If you have trouble with this, make sure that the **Mic/Line** switch on the rear panel is set to the correct position. If the IFB audio is very loud and distorted, the switch should be changed to the **Line** setting. On the other hand, if the audio is very weak, try the **Mic** position.

OPERATION

Once set up, operating the Mix-Minus Bridge is easy. There are three things to consider:

• **Console:** Make sure that the console modules carrying codec outputs, etc., are set to **Program** only. There is something about weekend and overnight people that makes them play with buttons on consoles. Some clear labeling will help here. If you use the console's **Audition** or **Program 2** output for recording or other functions, be sure that your operators are aware of the need to put things back to normal.

• **On/Off Switches:** The six lighted pushbuttons on the MMB front panel control audio being fed to other codecs, hybrids or remote sites. For many applications, you may just leave the buttons engaged, and pay no further attention to them. However, if you have a situation where closed circuit audio should not be sent to a remote, these switches will be handy. Here is an example: You are broadcasting a remote via a POTS audio codec. A traffic report via ISDN is scheduled at 8:10 A.M. The traffic person calls in at 8:09, and needs to exchange some information with the board operator at the studio. The operator can have the ISDN feed in cue on the console, and can use an **IFB** button to chat with the traffic person. However, the audio from the traffic service should not be sent to the remote until they are ready to chat on the air at 8:10. The operator only needs to release the button for the ISDN codec channel, and turn it on again when the report is scheduled to go on the air. We have provided remote connections for this on/off switching. If you use the remote control feature, just leave the **On/Off** buttons on the MMB depressed. If your setup allows, you might want to remote the *Off* function to follow the **Off** button on your console module.

• **IFB:** Pressing a customer-provided **IFB** button momentarily interrupts the audio fed to one or all codecs or other devices connected to the Mix-Minus Bridge, and sends audio from a microphone circuit as described on page 10. We anticipate that users will take advantage of the individual IFB circuits on the **Remote** connector of the MMB. This allows you to talk to an individual site without disturbing any others. Since pushing a button will mute (all or partially) the regular audio, work out some rules in advance with the people at remote sites.

SECTION 4 USEFUL STUFF

WHAT IS INTERRUPTIBLE FOLD-BACK (IFB)?

TV people probably don't need to read this section, as they use IFB all of the time, both in and out of the studio. Radio, Internet and professional audio people may not have encountered the concept, so read on…

Think of IFB as a push-to-talk intercom system. The idea is to interrupt the normal audio to one or more of the outputs, and substitute audio from the **IFB Input** jack. This is done by wiring one or more pushbuttons to the IFB pins on the MMB's **Remote Control** connector. You can use multiple buttons to target specific remote sites, or one master button to talk with everyone. IFB is a great way to converse with talent in the field before a program or during a commercial break. It also allows you to send a cue to the field during a live program. Just make sure that everyone involved is warned in advance about the "mystery voices" that may come down the line! Another tip: The operator at the studio should not hold the button longer than necessary during a live broadcast – just give the cue and let go.

The MMB has two IFB modes. As shipped, the normal audio will be completely cut off and replaced by the IFB feed. There is also a "ducking" mode which drops the regular audio by about 10 dB, and sends the IFB signal through at normal level. This may be less distracting to the remote talent if cues are to be fed during a live broadcast. The "ducking" feature may be selected by removing the MMB's top cover and moving the jumpers in the center of the board from *Mute* to *Duck*. Each channel has its own jumper, so you are free to customize the setup as needed.

STACKING

If you need more than the standard six channels, additional MMB's may be stacked to provide 12, 18 or more mix-minus feeds. Each MMB has **Ext A** and **Ext B** jacks to connect with another unit via straight-through CAT5 cables. Those cables will send and receive a mix of the six inputs plus the feed from the other **Ext** jack to the next MMB. Just use one cable to connect the **Ext A** jack on one MMB to the **Ext B** jack on the other. There is no priority to the stacking. You will have to provide the **Aux In** and **IFB** audio connections externally, as some users may not want to send the same sources to those inputs. The remote control connections are not changed by stacking – you will have to provide external contact closures for each needed channel.

USES

Back in the good old days, radio and TV talent could be sent out into the field with a link back to the studio and the ability to monitor the station's off-air signal. The fact that they heard their own voices in headphones or ear pieces was not distracting, as there was no delay between speaking and hearing. Goodbye analog, hello digital! Todays remote feeds are usually done through digital audio codecs, and there can be considerable processing time for audio in both directions. Your brain can only handle a relatively short echo of your voice while speaking. It has become absolutely necessary to keep the remote audio from being sent back to the remote site. This is done with mix-minus: A mix of all needed audio, except from the remote.

It is usually easy to create one mix-minus feed on a broadcast console. Most consoles have an audition or auxiliary bus, which allows the creation of an additional mix of certain console sources, without affecting the main or program mix. If a telephone hybrid is fed this mix, and a codec feed is required later, the console must be reconfigured for each mix-minus. This can be confusing and cause program delay. Also, if the hybrid and codec need to be on-air simultaneously, a single mix-minus is insufficient. Newer consoles may provide for more than one mix-minus feed, but you always seem to need one more!

With the Mix-Minus Bridge (MMB), each remote source has a dedicated, full time feed. No configuration is necessary before airing single or multiple remote sources. The MMB will still require that you configure an audition or auxiliary bus on your console, but it will remain permanently configured.

The MMB can be expanded to 12, 18 or more channels by stacking units interconnected by CAT5 cables.

There may be instances where you will be adding sources to the mix-minus bridge at different times. Perhaps you're conducting a telephone interview, and the remote crew dials in to test the ISDN link for a broadcast later that day. You don't necessarily want audio from the remote crew fed to the telephone caller. So each input to the mix-minus can be selected on or off via front panel buttons or remote control. While these buttons select what gets sent into the mix-minus buses, all outputs are always active and everyone still receives audio as soon as they are connected.

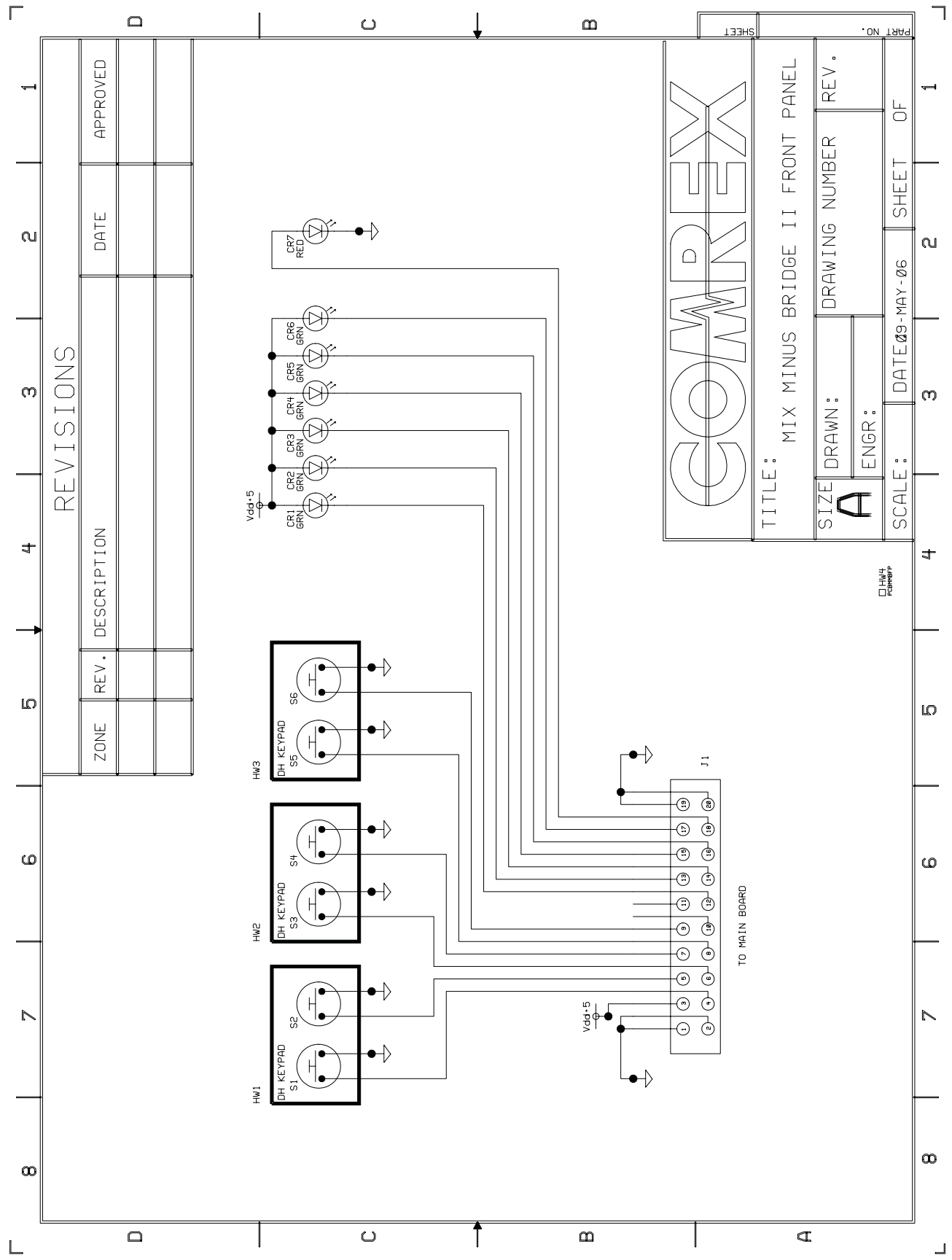
Another common requirement for remote broadcasting is the ability to interrupt the feed sent to the remote talent to send cue information or special instructions. This ability is called interruptible fold-back, or IFB for short. The MMB has the ability to send a separate audio signal to all sources requiring mix-minus. Remote control connections are available to control the IFB function, allowing cues to individual sites or to everyone on the system. The **IFB Input** to the MMB is adjustable and switchable between a microphone or line level signal.

Because IFB is so useful, and most users won't require a full 6 mix-minus channels, unused mix-minus outputs may be fed into other cueing sources, like listen-line telephone couplers or subcarrier generators. Although these feeds are not contributing to the mix-minus buses, the program and IFB audio will be available to them.

One tip: If you run a PA system at your remotes, you already know how difficult it can be to control feed-back from your microphones. If your PA feed comes from an air-monitor receiver, you have been "fighting" the audio processing in your air chain. However, if you use a mix-minus feed (through a codec, a return RPU, a telco coupler, etc.) your PA feed will include unprocessed remote microphone audio. This will make it much easier to control feedback.

SECTION 5 SPECIFICATIONS

CONNECTIONS	*Inputs 1-6:* RJ-45 jack, wired according to CAT5 pinout for three pairs. *Outputs 1-6:* RJ-45 jack, wired according to CAT5 pinout for three pairs. *Auxiliary Input:* 3-pin XLR female. *IFB In:* 3-pin XLR female. *Remote Control:* DB25 female.
AUDIO INPUTS	*1-3 In, 4-6 In* and *Aux In*: 50K ohm balanced bridging, -10 to +10 dBu, adjustable (unity gain as supplied) *IFB Input:* *Mic Level:* 15K balanced bridging, -35 to -70 dBu adjustable (-50 as supplied) *Line Level:* 100K balanced bridging, -10 to +10 dBu adjustable (unity as supplied)
AUDIO OUTPUTS	*1-3 Out* and *4-6 Out:* Balanced line level, for 600 ohm or greater load, +4 dBu as supplied, +23 dBu maximum
REMOTE CONTROL	[6] Channel Off pins to remove each channel from the mix remotely (27 mA DC each pin) [6] IFB pins to talk to each channel individually (27 mA DC each pin) [1] Master IFB to talk to all channels (144 mA total) [12] Common ground pins Remote control is by an external contact closure or open collector pull-down on a 5 VDC relay.
POWER	100 – 260 VAC, 50/60 Hz, IEC-320 connector, automatically switched. A power cord is supplied for North American operation.
SIZE	19" W x 8" D x 1.75" H 48 cm x 20 cm x 4.5 cm
WEIGHT	4 lbs 8 oz; 2 Kg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S3
S4
HW1
DH KEYPAD
S1
S2
J1
TO MAIN BOARD
HW4 PCBMBFP