

This application guide is the first of a series which aims to explain how the Soundcraft Vi series handles MADi audio channels, clocking, redundancy and control so that users can best understand how to manipulate the protocol to expand their systems. It also covers the various option cards and connection options available.

## Soundcraft Vi Series MADi Fundamentals

### What is MADi?

**Multichannel Audio Digital Interface, MADi or AES10** is an Audio Engineering Society (AES) standard electronic communications protocol that defines the data format and electrical characteristics of an interface that carries multiple channels of digital audio. The AES first documented the MADi standard in AES10-1991, and updated it in AES10-2003 and AES10-2008. The MADi standard includes a bit-level description and has features in common with the two-channel format of AES3. It supports serial digital transmission over coaxial cable or fibre optic lines of 28, 56, or 64 channels; and sampling rates of up to 96 kHz with resolution of up to 24 bits per channel.<sup>1</sup>

### MADi and Vi

The Vi series primarily uses MADi to send 64 channels of bi-directional audio between consoles and peripheral devices such as 3rd party recording devices or Soundcraft's own range of stage boxes.

**Connection Basics** - The connection type is either optic or CAT5 (further information about the cables & connectors is toward the end of this document). You will notice that, with the optical versions of the MADi cards, there is an 'IN' & 'OUT' for both the 'MAIN' & 'AUX' connection. This is due to there being a separate MADi link in both directions for bi-directional communication (to and from the device). These two MADi links are combined on the CAT5 versions.

**Clocking Basics** - Clock information is sent from sender to receiver which, in a basic point to point system, means that the peripheral device can simply clock to its incoming MADi stream. This allows that peripheral device to distribute the master console clock (from the console) to all of its internal cards (such as the A-D converters in a mic card).

**Control/Status Basics** - A key feature of MADi is that serial data transmission is possible. Soundcraft uses this serial link to send and receive control & status information to & from the range of Soundcraft stage boxes.

- The control information (sent from console to stage box) includes the head amp gain control, phantom power (+48v) & HPF (high pass filter) of the individual microphone cards loaded into a stage box.
- The status information (sent from stage box to console) first tells the console which stage box type is connected, which cards are loaded into the various slots in the stage box (microphone input cards, AES/EBU I/O cards, output cards etc) and lets the console know the health status of the stage box such as 'PSU1/2 active', 'MAIN/AUX MADi connection valid', 'Fan/Temperature', 'discovered cards active' etc... Any errors will be reported on screen (in red). The operator can also access this status information from the consoles 'system' menu.

<sup>1</sup> MADi Wikipedia webpage - <http://en.wikipedia.org/wiki/MADi>

## Vi MADI Cards



\*not to scale

There are 2 categories of Vi MADI cards. The **standard MADI** card and the **MADI HD LINK** card.

The **standard MADI** card is available in one form factor (D21M size) but in two connection types (optical or CAT5). The optical card is available as multimode or single mode (more on this later)

The **MADI HD LINK** card is available in two form factors (D21M & Vi Stage Box size) and two connection types (optical or CAT5). The optical card is available as multimode or single mode.

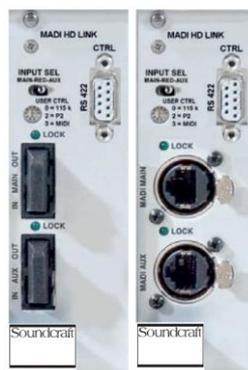
MADI Card Description	Order Code
Standard MADI (D21M) - CAT5	RS2409
Standard MADI (D21M) - Optical Multimode	RS2426
Standard MADI (D21M) - Optical Singlemode	RS2563
MADI HD Link (D21M) - CAT5	A949.049032
MADI HD Link (D21M) - Optical Multimode	A949.049032
MADI HD Link (D21M) - Optical Singlemode	A949.049132
MADI HD Link (Vi Stage Box Size) - CAT5	RS2448SP
MADI HD Link (Vi Stage Box Size) - Optical Multimode	RS2448SP
MADI HD Link (Vi Stage Box Size) - Optical Singlemode	RS2562SP

### What is D21M?

Soundcraft is part of Harman Professional's 'Mixer Group' which also includes the super premium broadcast mixer brand STUDER. When Soundcraft was developing the Vi series of digital consoles it became apparent that technology already present in the STUDER digital mixing/distribution systems could be utilised in the Vi series. In fact the DSP core of the Vi series is actually a STUDER core (another great benefit of the Vi series!). D21M is a digital I/O system from STUDER. Many of the cards Soundcraft uses to load the local rack & stage boxes are from this STUDER D21M system and as such have the same form factor which are sometimes labelled 'D21M type'.

### What is MADI HD?

**MADI HD Link** cards have been mentioned a couple of times so far in this document. So how do they differ from standard MADI cards?



Two versions exist - CAT5 or Optical

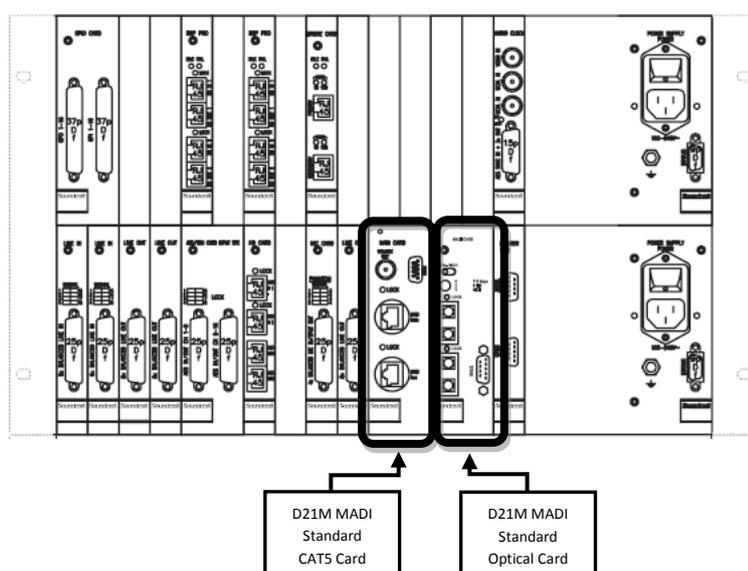
The *MADI HD Link* card will only ever be loaded into a stagebox. It provides the link to the local rack's Standard MADI card. It also operates as the stageboxes 'intelligent detection system'. The I/O cards slotted into the stagebox have connections to its backplane, when the 'reconfig' button is pressed it detects the card type, confirms the configuration of the system and allows their audio signals to feed to the MADI link.

The card operates in a 'sync' mode extracting the system clock from the incoming MADI feed (from the console). This clock is then distributed to the various I/O cards loaded onto its backplane. It operates at 48kHz.

### Where can the MADI cards be used in Vi systems?

The **Standard MADI** card is only available in the D21M type and this card can be loaded into the Vi2,4 & 6 local rack, Vi1 option card slot or Compact Stage Box D21M option slot. This card is 'double sized' and takes up 2 x D21M slots.

### **Vi2, 4 & Local Rack**



In its standard configuration the Vi2,4 & 6 local rack comes loaded with two of these MADI cards. The first is defined by the connection type selected at the time of order (either optical or CAT5) as seen in the above image. This card is used to connect the local rack to the stage box. The second card is, as standard, an optical MADI card. This card is provided to allow connection to additional MADI equipment such as multi track recording/playback devices or additional Soundcraft stage boxes.

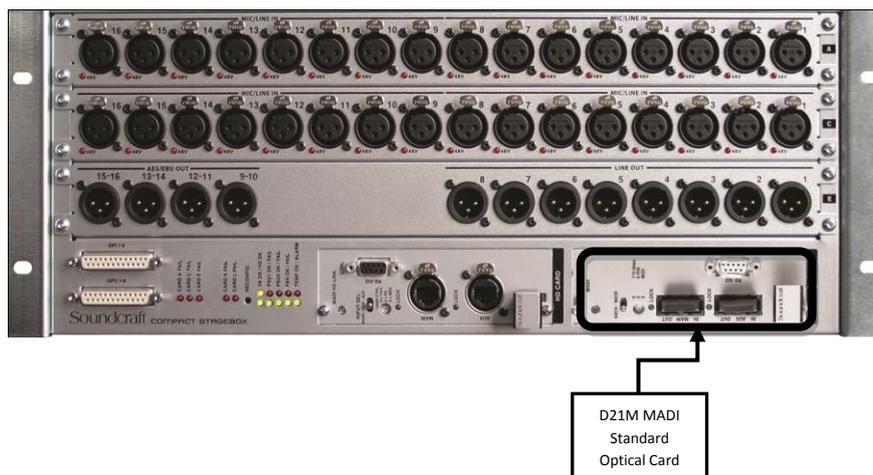
The local rack provides 12 'usable' slots for inserting D21M form factor I/O cards (3 additional slots are loaded with cards mandatory to the operation of the system). This means that a maximum of 6 standard MADI cards can be loaded into the local rack (as each card is a double width card). The Vi system has a maximum I/O channel count of 192 in & 192 out, therefore the various cards loaded into these 12 slots need to be optimised to not push this 192 channel limit. See the section below '**How to limit the channel count of a MADI card**' for more information regarding this.

For advanced reconfiguring of the local rack see the application guide '**Guide to Reconfiguring the Vi IO Racks**' found on the Soundcraft Knowledge-Base site.



The 'two card width' option slot on the rear of the Vi1 accepts a number of optional cards. The most common card used is the standard MADI card (both optical & CAT5) - Remember the MADI card takes up both card slots as it is 'double sized'. This card allows connection to external MADI equipment such as multi track recording/playback devices or Soundcraft stage boxes.

### Compact Stage Box

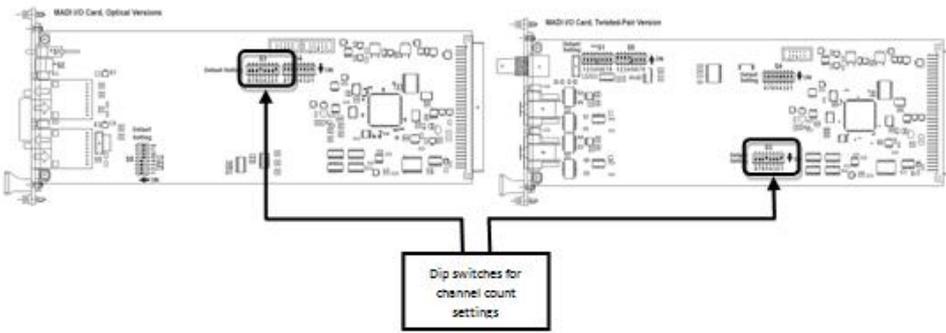


The 'two card width' option slot (slots L & K) on the Compact Stage Box can be loaded with the various D21M type cards. If a standard MADI card is placed here, additional I/O can be provided at the stage. This is commonly used to feed a playback or recording device. The sources from this card are 'loaded' onto available channels on the MADI HD card which connects to the console. The main link between the MADI HD card in the Compact Stage Box and Console has a maximum of 64x64 channels. With a standard configuration of the Compact Stage Box this additional MADI card would need to be limited to 32 input channels (32 Mic/Line inputs provided as standard & 32 additional MADI inputs 'loaded' onto the MADI HD card). The outputs on this additional card would be limited to 48 out (8 analogue outs, 8 AES/EBU provided as standard & 48 MADI from the additional card 'loaded' onto the MADI HD card).

**NOTE:** No control/status data passes from/to this card from the main MADI HD card. Therefore this additional MADI card will only ever operate as 'dummy' MADI channels (It is not possible to daisy chain an additional, fully functional, stage box from this card).

## How to limit the channel count of a MADi card

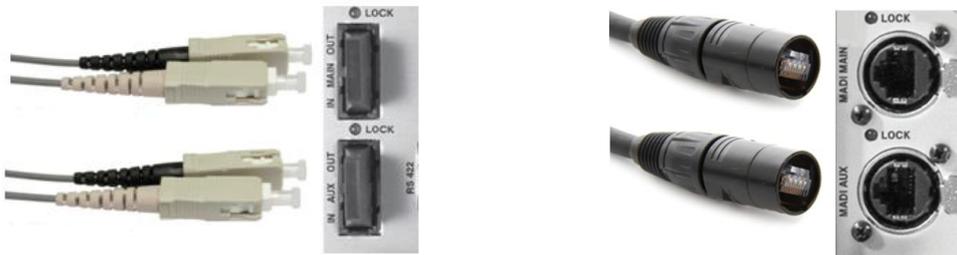
S3 DIP switch for D21m channel count setting:



1	2	3	4	5	6	7	8	Number of Channels
ON	ON	ON	ON	-	-	-	-	0 inputs
ON	ON	ON	OFF	-	-	-	-	8 inputs
ON	ON	OFF	ON	-	-	-	-	16 inputs
ON	ON	OFF	OFF	-	-	-	-	24 inputs
ON	OFF	ON	ON	-	-	-	-	32 inputs
ON	OFF	ON	OFF	-	-	-	-	40 inputs
ON	OFF	OFF	ON	-	-	-	-	48 inputs
ON	OFF	OFF	OFF	-	-	-	-	56 inputs
OFF	ON	ON	ON	-	-	-	-	64 inputs (factory default)
OFF	ON	ON	OFF	-	-	-	-	NOT ALLOWED
OFF	ON	OFF	ON	-	-	-	-	NOT ALLOWED
OFF	ON	OFF	OFF	-	-	-	-	NOT ALLOWED
-	-	-	-	ON	ON	ON	ON	0 outputs
-	-	-	-	ON	ON	ON	OFF	8 outputs
-	-	-	-	ON	ON	OFF	ON	16 outputs
-	-	-	-	ON	ON	OFF	OFF	24 outputs
-	-	-	-	ON	OFF	ON	ON	32 outputs
-	-	-	-	ON	OFF	ON	OFF	40 outputs
-	-	-	-	ON	OFF	OFF	ON	48 outputs
-	-	-	-	ON	OFF	OFF	OFF	56 outputs
-	-	-	-	OFF	ON	ON	ON	64 outputs (factory default)
-	-	-	-	OFF	ON	ON	OFF	NOT ALLOWED
-	-	-	-	OFF	ON	OFF	ON	NOT ALLOWED
-	-	-	-	OFF	ON	OFF	OFF	NOT ALLOWED

The channel count which is actively sending & receiving on the card can be adjusted using the dip switches above in banks of 8 (up to 64) using the table shown.

## Connecting Up

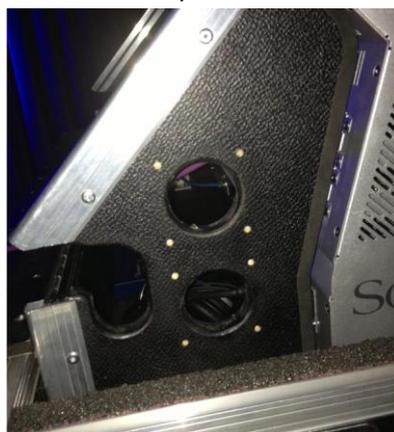


The various MADi cards which can be loaded into the Vi series products feature either SC optical connectors or Ethercon RJ45 CAT5 connectors (as shown in the images above). For some purposes these connection types are suitable (such as installation or light touring use) but for heavy touring use a more rugged connector is preferred.

The Vi2,4 & 6 stagebox and local rack have a 2U break out panel which provides heavy duty Amphenol (CAT5) or Fibrecast (Optical) connections for use with the Soundcraft CAT5 or Optic MADi cable reels.



As the Vi1 has its 'local rack' built internally to the console, the flight case that can be purchased feature pre-cut holes at the rear on both sides for panel mount Fibrecast connectors. A part which consists of the heavy duty panel mount Fibrecast connector, link cable & optic SC connector is available for purchase to allow use of a Vi1 with a Vi stagebox (The part order number is BF10.947010). Two would be required for a redundant link.



When using CAT5 Vi1's with Compact Stagebox's most users are happy connecting directly to the EtherCon connectors on the two devices using a CAT5 reel terminated with EtherCon.



CAT5 MADI Card Loaded Into Vi1



CAT5 MADI HD Card Loaded Into Compact Stagebox

**Available Cables**

There are various cable options available from Soundcraft for use with the Vi series.

Cable Description	Part Number
<b>CAT5</b>	
Medium length <b>50m</b> cable reel terminated with Neutrik <b>Ethercon</b> connectors	5018009
Long Length <b>100m</b> (maximum cabling distance recommended) cable reel terminated with Neutrik <b>Ethercon</b> connectors. As can be seen in the image above.	RZ2682
Long Length <b>100m</b> (maximum cabling distance recommended) cable reel terminated with <b>Amphenol</b> connectors. As can be seen in the image above.	RZ2746
<b>Optical</b>	
Short length <b>5m</b> multimode optical cable with ' <b>Fibreicast</b> ' connectors. NOT on reel.	RZ2709
Medium length <b>50m</b> multimode optical cable with ' <b>Fibreicast</b> ' connectors. Supplied on reel.	RZ2714
Long length <b>150m</b> multimode optical cable with ' <b>Fibreicast</b> ' connectors. Supplied on reel. As can be seen in the image above.	RZ2702
Extra Long length <b>200m</b> multimode optical cable with ' <b>Fibreicast</b> ' connectors. Supplied on reel.	RZ2701

With CAT5 links the maximum distance we recommend is 100m but this only when using high quality shielded cable such as is used in the available Soundcraft reels. If using lesser grade cable, reduce this distance by at least 20m.



**Multi-Mode vs Single-Mode Fibre**

In the majority of applications multimode cables and hardware are used. Multi-Mode fibre is best for communication over 'short' distances up to 2km. This, of course, is classed as a long distance within most pro-audio applications. Multimode fibre is less expensive than singlemode due to its larger core diameter. This larger core simplifies connections and allows the use of lower cost electronics in the senders and receivers. Because of its high precision, smaller former core, the bandwidth over distance of singlemode is higher than multimode although cost of hardware and cabling is much higher but distances up to 15km can be achieved! *Note: Soundcraft do not provide Single-Mode cable options.*