Doug Hall Electronics

Voter Chassis

The card cage used with the 4RV voting system is 3 rack units tall (5.25”) and mounts in a standard 19” rack. This rack mountable card cage has room for 8 modules, and can house up to 16 channels of voting, or up to 12 channels with power supply. Larger systems can include multiple card cages.

The following modules are compatible with the DHE voting system.

DHE-M-4RV/2
This is the current production voting comparator. It can be identified by the four switches on the faceplate, along with a single row of LED's labeled Voted / Active.

DHE-M-4RV/1
This is the older styled 4RV comparator card. It can be identified by the two rows of LED's. The green row is labeled Voted. The Red row labeled Active. The 4RV did not include switches for select / disable.

DHE-M-VLC
The VLC is used when your linking method only provides 600 ohm audio, and no signaling. This module provides four channels of idle tone circuitry. It looks for the absence of idle tone and applies CORs to the voter, depending on the idle tone status. Other circuitry includes 600 ohm i/o, 3 minute failed timers, and a notch filter. The older style VLCs used an LC tank circuit for the notch, and can be retrofitted with an active notch filter. Current production VLC's include the active notch filter. There is not yet a field upgrade documentation available, so VLC's must be sent back to the factory for this upgrade.

DHE-M-MLC
This module is basically a very stripped down VLC. This Microwave line card provides transformer inputs and a line driver on the output, allowing the comparator to have balanced 600 ohm i/o. This module currently ships with out switches, and has no marking on the front.

DHE-M-VSM
This module consists of simply four switches. This was used with the older style 4RV voter, to add the convenience of select and disable switches. It was used in place of the VLC when using RF links. Early models were manufactured using the VLC printed circuit board.

DHE-M-PS
The 13.8 VDC 1.7 Amp Linear power supply is wired for 110V AC 60 Hz input. There is a 1 amp fuse located inside the module. While there is no on/off switch on the power supply, or elsewhere in the system, the voter modules should not be plugged in while power is applied.

The power supply is housed in the standard 2" module, but the transformer protrudes too far to allow a module to be installed in the slot immediately to the right of the power supply.

Battery Backup

There are no provisions for battery backup. If your application requires a battery backup, we recommend you delete the power supply option when ordering, and treat the DHE voting system as a 12V device. The recommended supply voltage for the voting system is between 12 and 15 volts. The circuitry has been optimized for 13.8 V, but the voter will operate at lower voltages with reduced specs, as the batteries drain. Setup the voter at the lowest voltage it is expected to operate at, and set audio levels while operating at the lower voltage.

The supplier of the card cage changed in the mid 90's. The modules use to be held in place with a thumbscrew. The newer style card cage uses a small screw and plastic bushing. The module without the bushing will still accommodate a thumbscrew, to remain compatible with the old cage design. At this time, handles were also added to the individual modules.

Backplane Installation

Each of the backplane segments used with this chassis, connect only two of these modules together. Multiple backplanes are used when the system capacity is greater than four channels. Generally, the Master Voter is located in the second slot from the left, and the first backplane is positioned all the way to the left, behind slots one and two.

Ribbon Cable

A ribbon cable connects the first backplane (with a master comparator), to all additional backplanes, (with slave voters). A ribbon cable is not required when the system contains only one comparator card. The ribbon cable has 10 conductors, and the 10 position IDC connectors have keying pins inserted in positions 9 and 10. The ribbon cable plugs into the 8 pin header labeled J1L of the backplanes.

Expanding past four channels

Up to 4 backplanes can be used in the card cage, and multiple card cages can be used together to form voting systems with 32 or more inputs..

When expanding past four channels, the first voter in the system is a Master. Any additional cards are slaves. The master and all slave voter cards used in a system must be of the same revision. All 4RV or all 4RV/2. For more information regarding the differences between different vintages of cards, see the section titled 4RV vs 4RV/2

4RV vs 4RV/2

The card cage, backplane, and option cards are compatible with either vintage comparator card. Only minor differences exist. See Remote Voted Indicators, and Select and Disable Switches.

Select and Disable Switches

The original 4RV comparator card (sometimes referred to as 4RV/1) did not have the select and disable switches. These switches were available on the optional Voter Switch Card, Microwave Line Card, Or Voter Line Card. With the release of the newer style 4RV/2 comparator in 1993, the switches were now located on the voter card itself, and were no longer provided on these option cards. Other than the switches, these card can

be mixed with earlier or later vintage comparators. This can lead to a system with two sets of select/disable switches, or without any select disable switches.

The 4RV and 4RV/2 comparator cards, contain all the circuitry to do 4 channels of voting for many applications. If a balanced 600 Ohm i/o or idle tone function is required, then the comparator card is paired up with an option card. The backplane connects the 4 channel voter to one of its option cards. The slot on the left is for the optional card, the slot on the right is for the 4RV comparator.

Audio Out

The audio out of the voter is available on Pin 1 of J3. Labeled A Out, the audio is unbalance, high impedance. The backplane also routes this audio over to the option card. The MLC Microwave Line Card will provide a balanced 600 Ohm line driver. audio at J4 pins 9 and 10. Labeled TT and TR (Transmit Tip and Transmit Ring). The VLC Voter Line Card includes a 1950Hz (or 2175 Hz) notch filter, before the line driver.

, before the line driver that also provides balanced audio at these points, and includes, before the line driver. The gain of the line driver, in both the MLV and VLC are fixed gain. Output level is controlled by the Master Out control on the comparator, which adjusts the level being sent to this

In order to make use of the notch filter built into the VLC voter line card, this VLC module must be paired up with the master voter module. The audio out of the master comparator, is jumpered, via the backplane, back to the VLC module. Here, it goes through a notch filter, and a 600 ohm line driver. Every VLC has the notch filter and line driver, but it will not be used if that card is paired with a slave voter. Only one notch filter is required per system, when using an idle tone.

Early VLC cards had a notch filter using a tank circuit. This model can be easily recognized by the large toroid. Later models of the VLC had this toroid replaced with an active notch filter. The greatly improved specs provide a deeper and much narrower notch.

When using the MLC or VLC, there are two places where you can get transmit audio out of the voter. The first point is directly from the comparator. This is an unbalanced, high impedance audio source. It is not notched, and is available from the terminals on J3 labeled A Out and Ground. The second place to get transmit audio, is from the terminals on J4 labeled TT and TR. This stands for Transmit Tip and Transmit Ring. This is a balance 600 Ohm output, after the notch filter. When using the idle tones, the notch filter will greatly reduce the chirp at the end of the transmission. When the user unkeys the radio, the idle tone generator starts sending the tone down the line to the voter. The tone detect circuitry is fast, but not instantaneous. It must see a few cycles of the tone before it decodes. Once it sees the idle tone again, it removes the COR from the voter, and the transmitter drops. Meanwhile, the chirp snuck through.

J1 Left and Right

8 pin header for connection to adjacent backplanes. Only the left connector is in place. This connector is used to expand the voting system past four channels. An 8 conductor ribbon cable connects all backplanes in a system.

Calibrate Buss 1	**	2 Audio Mixer
+5V DC 3	**	4 +5V DC
Ground 5	**	6 Ground
Comparator Buss 7	**	8 COR Out (PTT)

J2 Left and Right

Pads only, no connector installed

1 COR Out
2 Audio Mixer

J3 Comparator Connections

1	A Out	Audio Out
2	A1	Audio In Chan 1
3	A2	Audio In Chan 2
4	A3	Audio In Chan 3
5	A4	Audio In Chan 4
6	C4	COR In Chan 4
7	C3	COR In Chan 3
8	C2	COR In Chan 2
9	C1	COR In Chan 1
10	COR Out	PTT To Repeater
11	+12 VDC	
12	Ground	

J4 Line Connections

1	RR1	Line 1 Ring
2	RT1	Line 1 Tip
3	RR2	Line 2 Ring
4	RT2	Line 2 Tip
5	RR3	Line 3 Ring
6	RT3	Line 3 Tip
7	RR4	Line 4 Ring
8	RT4	Line 4 Tip
9	TT	Transmit Tip
10	TR	Transmit Ring
11	Ground	
12	Ground	

J5 Remote Jack

This 26pin header is used with standard ribbon cable IDC connectors. This provides connection for Select and Disable inputs and Remote voted indicators.

Calibrate Buss	1	**	2	Comparator Buss
Test Point 1	3	**	4	+12 VDC
Test Point 2	5	**	6	Test Point 4
Spare	7	**	8	Test Point 3
Select 1	9	**	10	Disable 3
Select 2	11	**	12	Disable 4
Select 3	13	**	14	Voted 2
Select 4	15	**	16	Voted 1
Spare	17	**	18	Disable 2
Spare	19	**	20	Voted 4
Spare	21	**	22	Disable 1
Ground	23	**	24	Voted 3
Ground	25	**	26	Audio Mixer In

There are two versions of this backplane. The model that was shipped from 1985 through Sept of 2005, does not have the select lines connected to J5 remote jack. Model number visible from rear of rack is 4VLMB. The new style 4 channel backplane is labeled DHE BPL2 and has the select lines to J5.

Select – Ground the input to force select that channel. If that channel is not active, that channel will still be selected.. You will get a PTT out, and whatever audio is present at the input of the voter will be passed to the output. If you are using RF links, then squelch noise will be heard. This is assuming your source of audio is prior to the squelch gate of the receiver (Recommended). When using the VLC, force selecting an idle channel will cause the repeater to key up and you will hear the idle tone. (1950 or 2175 Hz) If more than one channel is selected at a time, audio from all selected channels will be passed to the output.

Disable – Ground the input to disable that channel. With the 4RV/2, if you provide both a select and disable input at the same time, the channel will be disabled. Do not apply select and disable at the same time, to the older style 4RV voter.

Voted – The voted outputs provide an indication when that channel is currently voted. With the 4RV/1, this is a 12V CMOS High when voted. For the 4RV/2, this line goes to ground via an optocoupler, when voted.

Left Edge Connector

When viewed from the front of the rack, the left slot of each backplane segment is where the optional module is inserted.

Blank Cover. No module is required when using the 4RV/2 voter with RF links.
VSC Voter Switch Card. When using 4RV/1 voter with RF links
MLC Microwave Line Card. Adds balanced 600 Ohm i/o
VLC Voter Line Card. Adds 600 Ohm i/o and 1950 Hz Idle Tone Detect

VLC Voter Line Card Pinout

Component Side			Solder Side
Failed 1	A	1	Audio Out
Failed 2	B	2	Receiver 3 COR Out
Failed 3	C	3	Receiver 1 Ring
Failed 4	D	4	Receiver 2 COR Out
+24 VDC	E	5	Receiver 1 Tip
Blanking	F	6	Receiver 1 COR Out
Speaker Out	H	7	Receiver 1 Audio Out
Lock	J	8	Receiver 2 Ring
Ground (Analog –V)	K	9	Ground
+5 VDC (Analog Ground)	L	10	Receiver 2 Tip
Clock	M	11	Receiver 2 Auio Out
Data Out	N	12	Earth Ground
Strobe	P	13	Receiver 3 Audio Out
RD/WR	R	14	Receiver 3 Ring
Reset	S	15	Receiver 3 Tip
Data In	T	16	Receiver 4 Audio Out
COR Out	U	17	Receiver 4 COR Out
Disable 4	V	18	Receiver 4 Ring
Disable 3	W	19	Transmit Ring
Disable 2	X	20	Transmit Tip
Disable 1	Y	21	Receiver 4 Tip
+12 VDC	Z	22	+12 VDC

Note – Pin numbers G, I, O, Q not used.

Right Edge Connector

When viewed from the front of the rack, the right slot of each backplane segment is for the 4RV or 4RV/2 comparator card.

4RV/2 Voting Comparator Pinout

Component Side			Solder Side
Blanking	A	1	Vote Lock Enable
Audio Out	B	2	Calibrate Buss
Receiver 2 Audio In	C	3	Receiver 1 Audio In
Receiver 4 Audio In	D	4	Receiver 3 Audio In
+5 VDC (Analog Ground)	E	5	+5 VDC (Analog Ground)
Receiver 2 Test Point	F	6	Receiver 1 Test Point
Ground (Analog –V)	H	7	Receiver 2 Select
Comparator Buss	J	8	Receiver 1 Select
+12 VDC	K	9	+12 VDC
Reserved	L	10	Reserved
Reserved	M	11	Reserved
Reserved	N	12	+5 VDC (Logic VCC)
Receiver 4 Test Point	P	13	Receiver 3 Select
Receiver 3 Test Point	R	14	Receiver 4 Select
Receiver 3 Disable	S	15	Receiver 4 COR In
Receiver 4 Disable	T	16	Receiver 3 COR In
Receiver 2 COR	U	17	Receiver 2 Voted
Receiver 1 COR	V	18	Receiver 1 Voted
Receiver 2 Disable	W	19	Receiver 4 Voted
Receiver 1 Disable	X	20	Receiver 3 Voted
COR Out (PTT)	Y	21	Audio Mixer In
Ground	Z	22	Ground

Note – Pin numbers G, I, O, Q not used.