

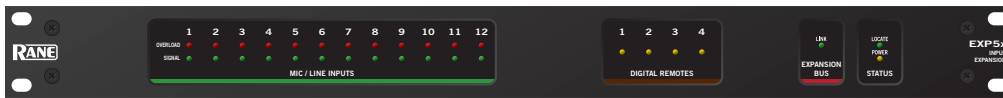
HAL1x Multiprocessor



EXP1x Remote Audio Expansion for the HAL1x



EXP3x Zone Output Expansion for the HAL1x



EXP5x Input Expansion for the HAL1x



EXP7x AEC Expansion for the HAL1x

General Description

HAL is more than just another DSP drag-and-drop system. It has revolutionized system design and installation.

HAL is an expert in room combining, paging and distributed audio systems. This groundbreaking architecture is dimensions beyond any other solution. HAL easily guides even novice users through what used to be complex tasks in just minutes. No intricate matrix mixing or presets are required for room combining and paging. No virtual wiring required to distribute pages and background music to multiple zones.

Seamlessly interface HAL to your application with a broad variety of peripheral devices including smart Digital Remotes, Remote Audio Devices (RADs), portable or rack automixers, audio I/O and logic expansion devices, wall sensors, ambient sensing mics, small remote amplifiers, and an advanced Paging Station.

In addition, the HAL Multiprocessor and Halogen™ software check the status, location, CAT 5 wiring integrity, and that audio is flowing in all peripheral devices, so you know your system is properly connected and ready to go.

HAL is more than just another DSP drag-and-drop system. It has revolutionized system design and installation.

Four HAL multiprocessors provide various audio I/O and control options for both large and small installations.

- HAL1x supports 16 in x 16 out audio, which may be increased an additional 512 in x 512 out by adding EXP1x, EXP3x or EXP5x Expanders. Up to 32 Expanders can be daisy-chained to a single HAL1x. Add more mic inputs with AM Automixers. Add AEC with the new EXP7x (Oct. 2013).

- HAL2 supports 18 in x 18 out audio, of which 2 x 2 come from AES3 on XLR connections.
- HAL3 supports 4 in x 8 out audio, of which 2 “Line-Plus” Inputs accept balanced line, or mono left/right unbalanced lines.
- HAL4 supports 2 in x 2 out audio, of which 2 “Mic/Line-Plus” Inputs accept balanced mic, line, or mono left/right unbalanced lines. (Oct. 2013).

See all four in the HAL System Data Sheet.

Halogen™ software includes Ethernet control support for third-party control systems. Standard TCP/IP set and get ASCII text messages control levels, selectors, presets and toggle actions within Halogen. Since the same Halogen software code runs on both Windows® and within HAL hardware, third-party control developers can test all their code using only the Halogen Windows software. Use only software to test your control systems software code and buy the hardware only when the install date arrives. See the HAL System Data Sheet for screenshots and processing block descriptions.

Download Halogen and design a system now!

rane.com/hal

Well-documented example programs for AMX, Crestron and Stardraw Control ease programming headaches. These Support Packages are installed with Halogen software, or available as separate downloads.

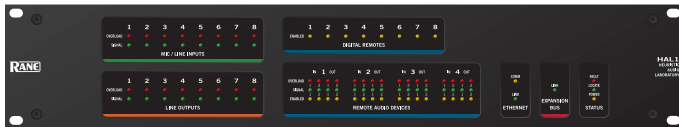


Expansion Bus in HAL1x Supports 32 Daisy-chained EXPs in Any Combination

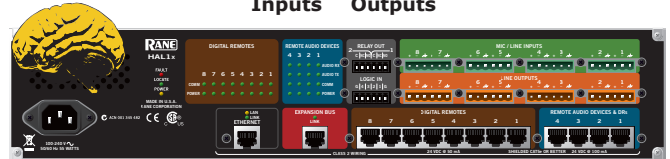
- Connects with shielded CAT 5e or better cable and RJ-45s; Maximum distance between units = 100 meters (300 feet).
- Supports Gigabit Ethernet Media Converters: Multimode max = 2 km (1.2 miles); Singlemode max = 12 km (7.5 miles).

HAL1x Multiprocessor

- 16 in x 16 out - 8x8 analog & 8x8 digital (RAD ports).
- Up to 4 RADs (without EXP1x), up to 260 RADs (with 32 EXP1s).
- Up to 12 Digital Remotes (without EXPs), up to 268 (with EXPs).
- Four logic inputs, Two relay outputs (more with DR4 or DR5).



Analog Mic / Line Inputs 8	8 Analog Line Outputs
Digital RAD Port Inputs 8	8 Digital RAD Port Outputs
Digital Expansion into HAL1x 512	512 Digital Expansion from HAL1x
Total in the HAL1x DSP Brain 528	528



Inputs Outputs

Daisy-chain up to 32 EXPanders

EXP1x Remote Audio Expander for HAL1x

- Adds 16 in x 16 out digital (8 more RAD ports) to HAL1x.
- Up to 8 Digital Remotes or RADs in any combination.
- Chain up to 32 EXP1x units to a HAL1x for 512 in x 512 out.



More Inputs	More Outputs
Digital RAD Port Inputs 16	16 Digital RAD Port Outputs

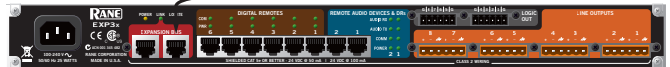


EXP3x Zone Output Expander for HAL1x

- Adds 8 analog line outputs and 8 logic outputs to a HAL1x.
- Adds 6 Digital Remote ports & 2 RAD ports to a HAL1x.
- Chain up to 32 EXP3x units to a HAL1x for 256 outputs.



More Inputs	More Outputs
Digital RAD Port Inputs 4	8 Analog Line Outputs
	4 Digital RAD Port Outputs

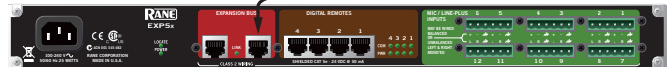


EXP5x Input Expander for HAL1x

- Adds 12 analog mic / line/ line-plus* inputs to a HAL1x.
- Adds 4 Digital Remote ports to a HAL1x.
- Chain up to 32 EXP5x units to a HAL1x for 384 analog outputs.



More Inputs
Mic / Line / Line-Plus Inputs 12



*"Line-Plus" Inputs accept a balanced line, or mono left & right unbalanced lines.

NEW! EXP7x AEC Expander for HAL1x

- Adds 8 channels of Acoustic Echo Cancelling DSP to a HAL1x.
- Chain up to 32 EXP7x units to a HAL1x for 256 AEC channels.



The EXP7x AEC Expander will ship October 2013.

HAL1x Expansion Bus

The HAL1x Expansion Bus supports up to 32 daisy-chained Expanders in any combination. The Expansion Bus requires shielded CAT 5e (or better) cable with RJ-45 connectors.

The bus supports 512 channels in and 512 out, although designers need not worry about wiring channels along the bus — this is automatically done within Halogen software. The Resources window in Halogen displays the number of channels in use and updates as you draw the audio wiring. Latency hops on the bus are 750 nanoseconds per hop. Thus, daisy-chaining 32 Expanders provides a maximum latency of 22.4 microseconds. See the Latency graphic below to add up the latency of any given path through the HAL1x, EXPs, RADs, the DSPs and converters.

Thirty-two Expanders maximum, in any order can be daisy-chained. For example, 16 EXP3x and 16 EXP5x Expanders daisy-chained, provides 128 outputs (8 out times 16), plus 192 mic/line/line-plus inputs (12 in times 16).

Some examples max out the Expansion Bus:

- If you need 256 RADs, daisy-chain 32 EXP1x Expanders. This is 8 RAD ports times 32 Expanders, 8 x 32 = 256 RADs. This still leaves 4 RAD ports available on the HAL1x.
- For 256 output zones, daisy-chain 32 EXP3x Expanders.
- For 384 mic/line inputs, daisy-chain 32 EXP5x Expanders.

Each Expansion Bus cable can be 100 meters long (300 feet). This permits spreading Expanders across different locations or equipment rooms. Yet only a single HAL1x is required at the

head-end of the daisy-chain. Star topologies are not supported — do not use Ethernet switches, they will not work. And since the EXP3x & EXP5x contain their own DSP, no DSP resources in the HAL1x device are used; thus adding these devices adds DSP resources to the HAL1x System.

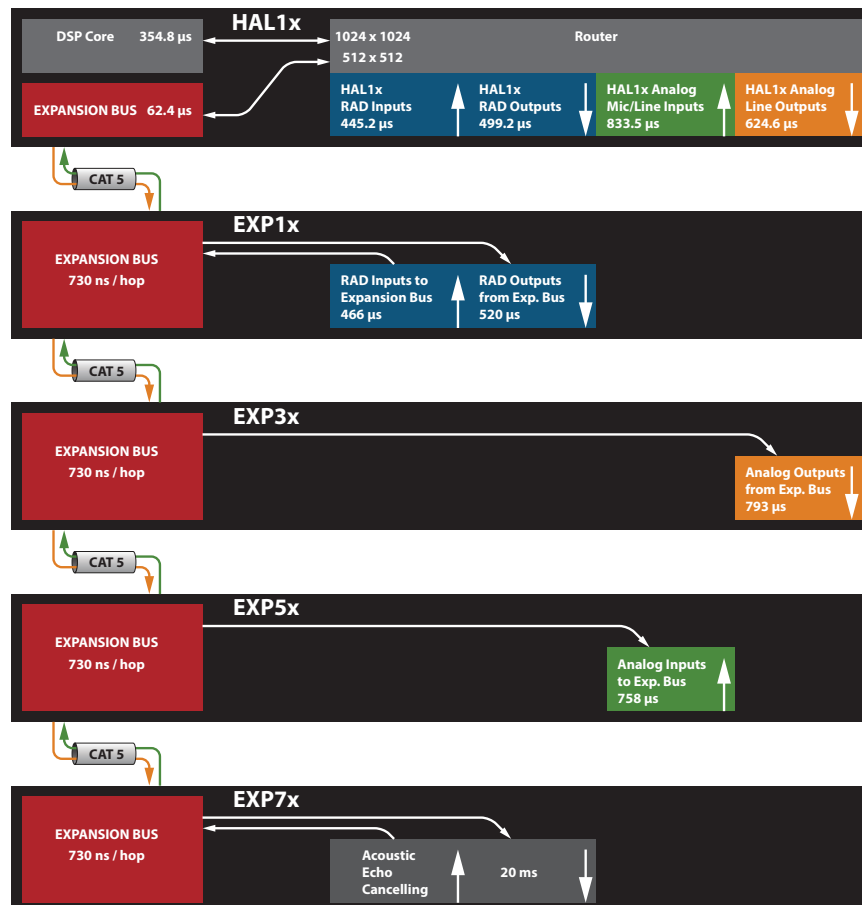
Gigabit Ethernet Media Converts *are* supported. Thus, using multimode fiber, one can separate Expanders up to 2 kilometers (1.2 miles). Singlemode fiber distance goes up to 12 km (7.5 miles). The Expansion Bus is Ethernet Layer 1 only — there are no MAC and no IP addresses involved.

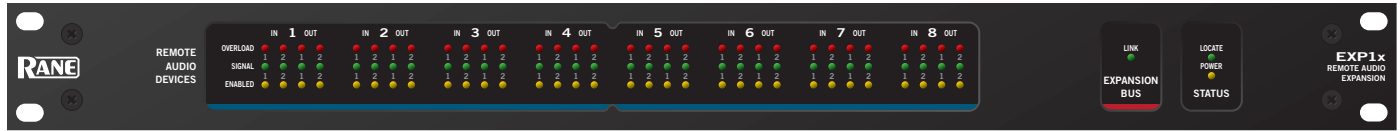
Applications

The new 512 x 512 HAL1x Expansion Bus greatly expands the HAL System's capabilities with support for 32 daisy-chained Expanders. The maximum quantity of RADs and DRs supported jumps from 36 to 256 using the EXP1x — that's over 700% more for the same price as the original EXP1.

The new HAL1x's analog audio I/O capabilities have also increased with the addition of the EXP3x and EXP5x Expanders. The EXP3x adds eight Zone outputs per Expander for a total of 256 analog outputs, a 3200% increase in HAL analog outputs. Each EXP3x also adds 6 DR and 2 RAD ports to support each 8 zone cluster. The EXP5x adds 12 Mic/Line/Line-plus inputs per Expander for a total of 384 additional analog inputs, a 4800% increase in HAL analog inputs.

Latency

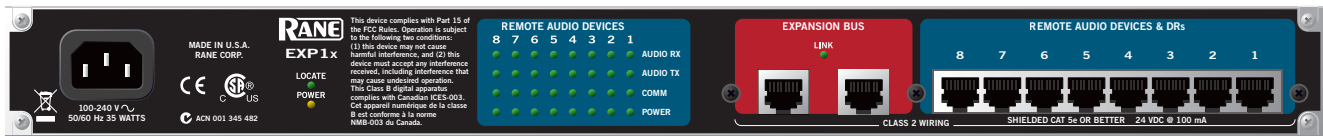




EXP1x Remote Audio Expander Description

The EXP1x adds eight RAD ports to a HAL1x via the Expansion Bus. The EXP1x requires a HAL1x to operate. Keep in mind that DR remotes are also supported on any RAD port, so the EXP1x also adds support for additional DR remotes when needed.

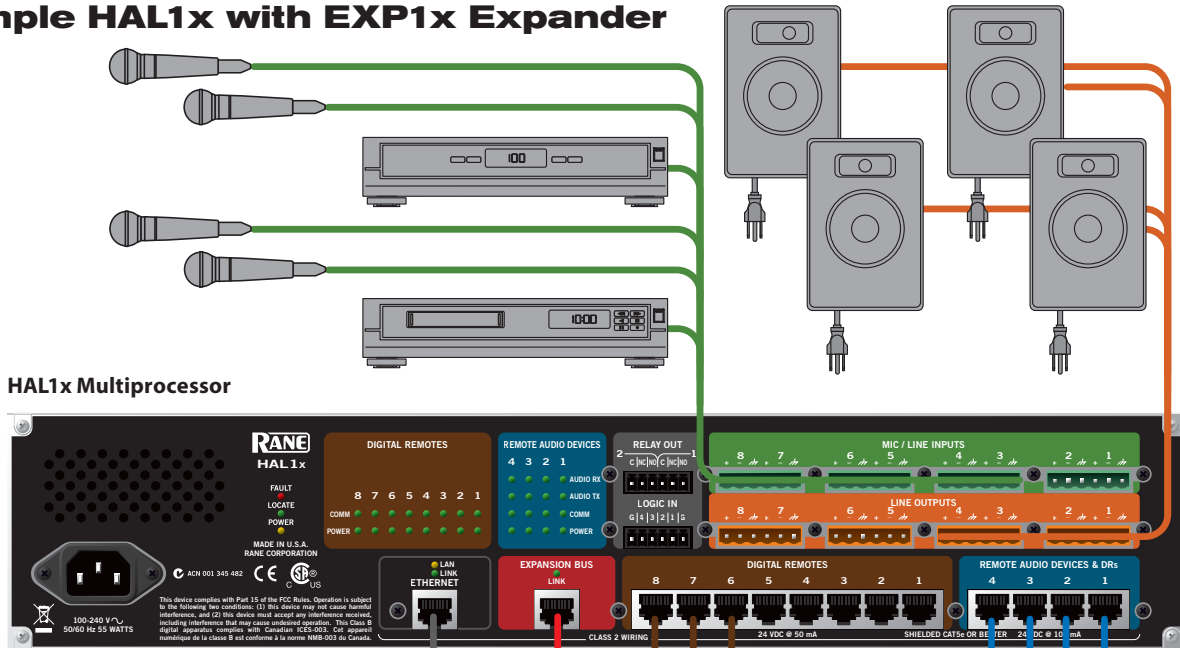
Up to 32 Expanders, in any combination, may be daisy-chained to a single HAL1x. 512 inputs and 512 outputs are possible if all 32 are EXP1s.



EXP1x Specifications

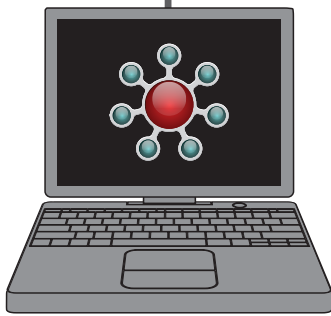
Parameter	Specification	Limit	Conditions/Comments
Expansion Bus	HAL1x is required		Shielded CAT 5e cable with RJ-45 connectors
...Audio Channels	512 in x 512 out of HAL1x	max	Plus control channel
...Maximum EXP1x Units	32	max	Daisy-chain with shielded CAT 5e or better
...Maximum Cable Length	100 meters / 300 feet	max	
RAD / DR Ports	8		RJ-45 connectors
...RAD Audio Channels	16 in x 16 out		Each port 2 in x 2 out, plus control channel, 24-bit, 48 kHz
...RAD Cable Length	150 meters / 500 feet	max	Shielded CAT 5e cable or better
...DR Cable Length	300 meters / 1000 feet	max	Shielded CAT 5e cable or better
...Power	24 VDC @ 100 mA	max	Each port
Wiring	Class 2		All rear panel terminals
Power Requirement	100 to 240 VAC		50/60 Hz, 35 W max
Conformity: Safety			
...NRTL (USA)	UL 60065		cCSAus (CSA file #247105)
...CSA (Canada)	CAN/CSA 60065		cCSAus (CSA file #247105)
...EU Directive 2006/95/EC	EN 60065		CB Certificate (Nemko)
Unit Size	1U, 1.75" x 19" x 8.25"		(4.4 x 48.3 x 20.9 cm)
...Weight	4 lb 6 oz		(2.0 kg)
Shipping Size	6.5" x 20.3" x 13.75"		(11.5 x 52 x 35 cm)
...Weight	8 lb		(4.5 kg)

Example HAL1x with EXP1x Expander

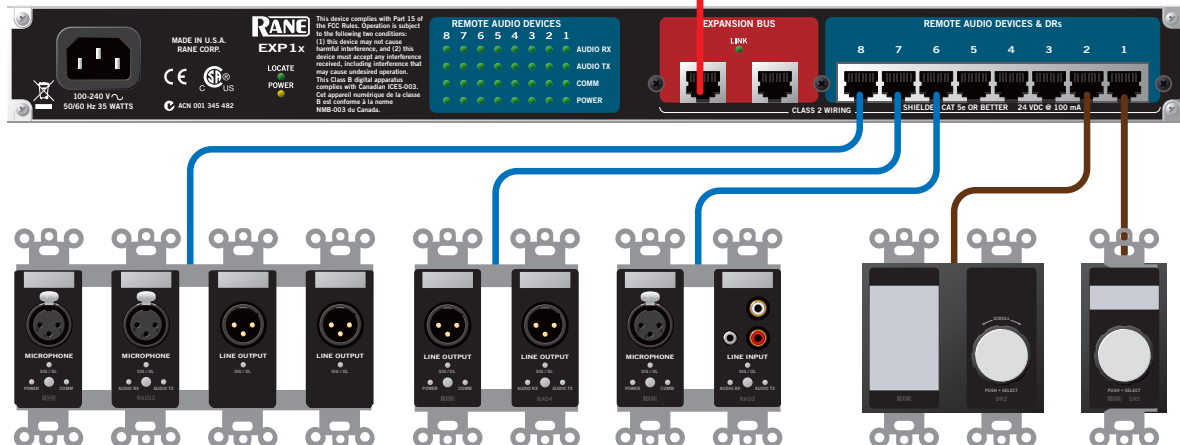


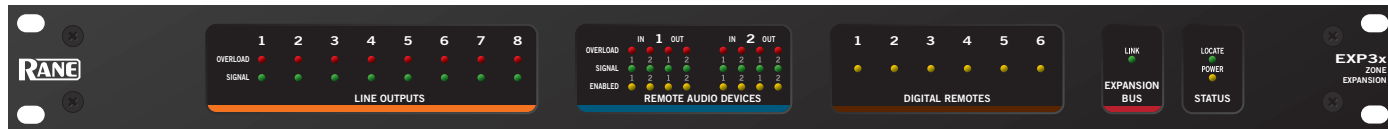
HAL1x Multiprocessor

Halogen Software for System Setup



EXP1x Remote Audio Expansion (up to 32 to a HAL1x)

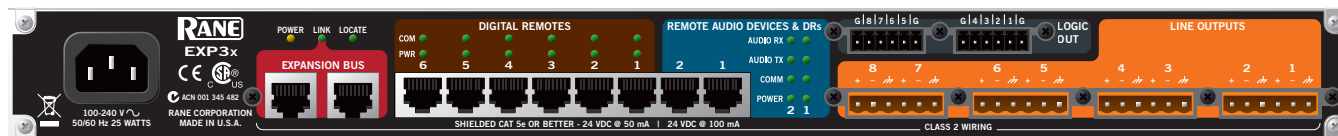




EXP3x Zone Output Expander Description

The EXP3x is an 8-channel analog output & DSP expander for the HAL1x, which is required for operation. It also sports 8 logic outputs, 6 DR remote ports and 2 RAD ports making a 4-input, 12-output audio device — depending on which two RADs are connected. Thus, 32 daisy-chained EXP3x Expanders provide 256 discrete zone outputs maximum, including output compression, parametric EQ, two levels of paging and background music. These 32 EXP3x Expanders would also provide 64 RAD ports, 192 DR ports and 256 logic outputs.

The dedicated DSP for each of the 8 analog outputs offers two signal processing choices independently selectable, per output. When you need background music, paging and emergency paging on an output, select the Zone Output processing set. This provides a Zone Processor block, an Emergency Zone in addition to a Compressor and a 5-band parametric EQ with high- and low-cut filters. When Line Output is selected, the compressor and parametric EQ are available without the zone processing block and emergency paging blocks.



EXP3x Application Example

Each EXP3x provides full support for an 8-zone cluster without consuming HAL1x DSP, DR or RAD resources. All of the DSP required for paging, distributed background music selection, PEQ, dynamics and Level control is included in the device. DR and RAD resource also scale with the device with provision for 6 DR ports and 2 RAD ports.

For example, a single DR3 remote in a manager’s office or rack room can provide independent level for all 8 outputs from the EXP3x. Selection and level within 5 different zones is available using 5 DR3 remotes. The first RAD port allows local zone sources such as a page or podium mic, plus a laptop feed when using a RAD2. Or, as shown on the facing page, a Rane PAGER1 Paging Station (A) instead supplies paging throughout many zones. Perhaps the weekend DJ or band needs to plug a mixer into the wall and automatically or manually override the background music with a DR remote. A RAD3 in the second EXP3x’s RAD port (B) provides balanced XLR line-level inputs to the system for the DJ or band mixer.

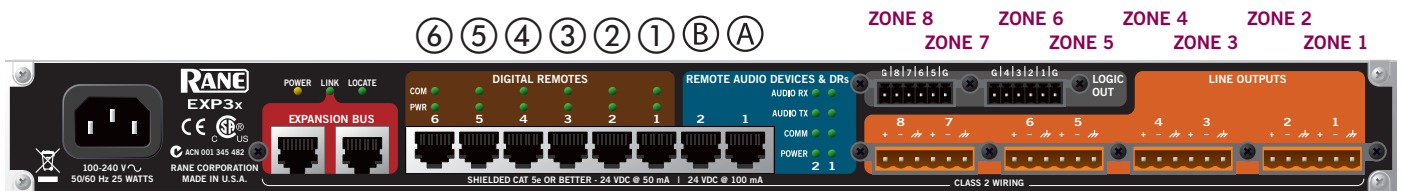
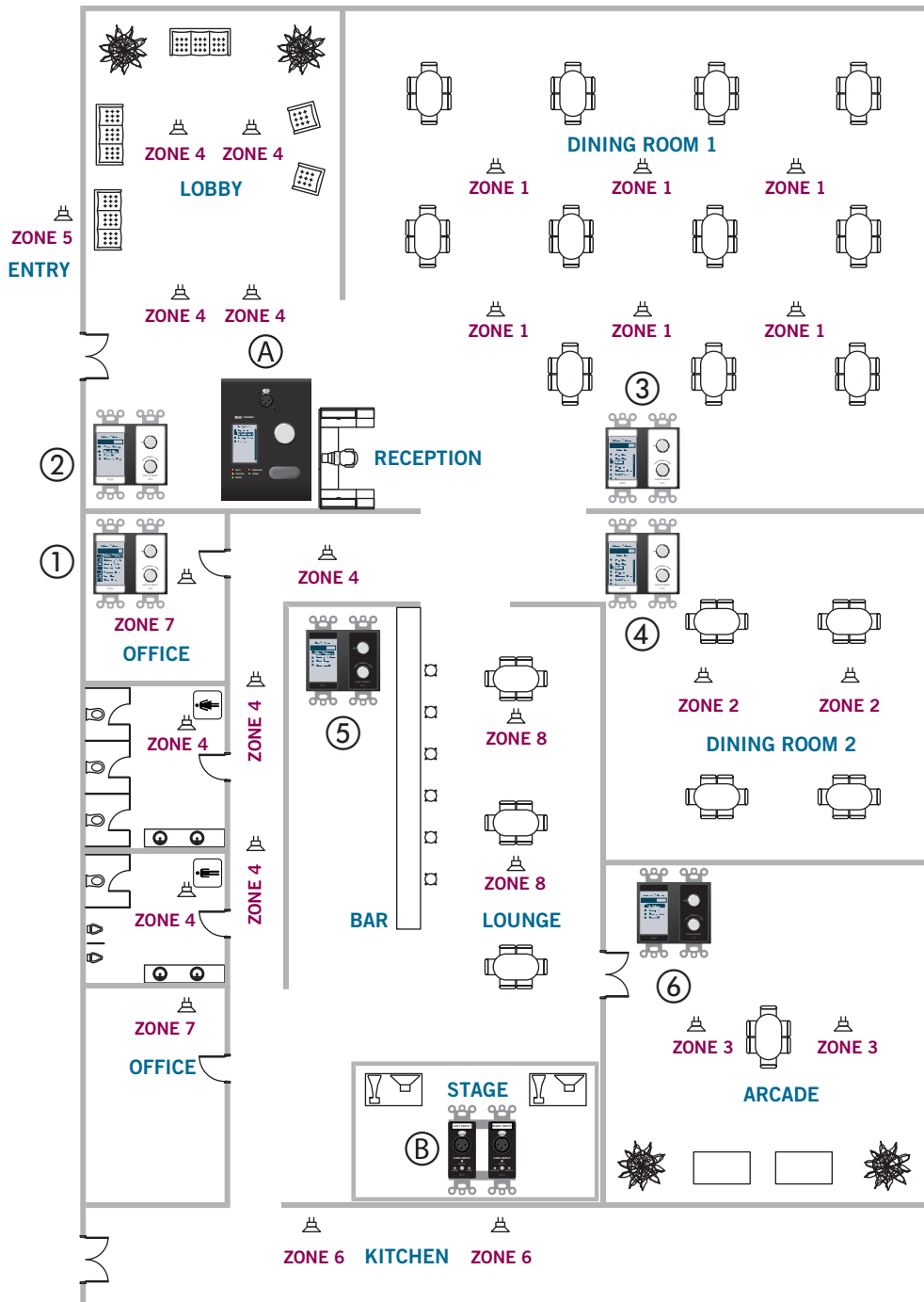
The logic outputs on the EXP3x are suited for legacy paging systems where relays within each zone’s 70/100 volt volume controls must be tripped during a page. Simply link the Logic Out to a Page Active in the Paging Manager, and use a Logic Out to drive a relay. This turns up the remote’s volume during pages. With 8 logic outputs, 8 zones of old-school constant voltage paging are supported.

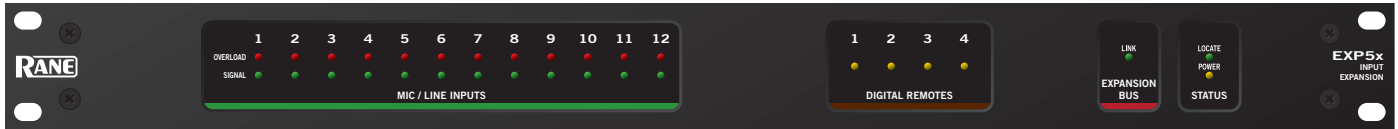
Pushing the EXP3x Zone Output Expander

If your application requires eight floors of combined retail and office space, where each floor contains 8 zones, the EXP3x is clearly a winning solution with one HAL1x. This would support 64 zones, a handful of building-wide global background music channels connected to the HAL1x directly, paging via Pager1s within individual or even across a few floors, plus a couple local-only audio sources per floor. Add up to 58 DR remotes, one or two RADs per floor and you’re done. You can even spread the EXP3x devices across different equipment rooms using dedicated, CAT 5e or better cable runs as long as they don’t exceed 100 meters (300 feet). Use standard Ethernet Gigabit Media Converters within the daisy-chained Expansion Bus to achieve distances up to 12 kilometers, or 7.5 miles.

In existing room combine facilities, the EXP3x slots ahead of the amplifiers to upgrade existing facilities.

EXP3x Background Music and Paging Application Example

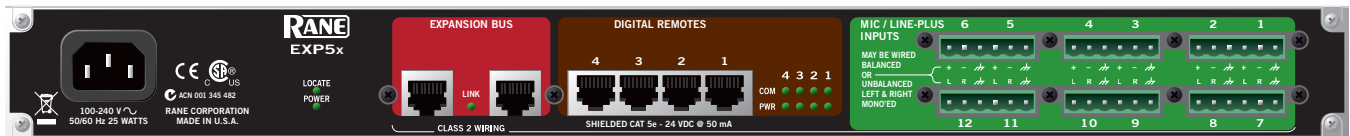




EXP5x Input Expander Description

The EXP5x is a 12 Mic/Line/Line-Plus input & DSP expander for the HAL1x, which is required for operation. It also supplies four DR ports useful for adding source selection and/or volume control remotes such as the DR3. Each of the 12 inputs independently supports either dynamic mic, phantom mic, +4 dBu line-level, or Rane’s new Line-Plus input. Line-Plus accepts

-10 dBV unbalanced Left/Right Monoed together on the + and - ports, respectively. For stereo unbalanced sources, Line-Plus allows connecting the stereo RCA left tip conductor to the + terminal, the RCA right tip to the - terminal, and both RCA shields to the shield on the EXP5x Euroblock. Select Line-Plus and you get a properly monoed audio channel.



EXP5x Application Example

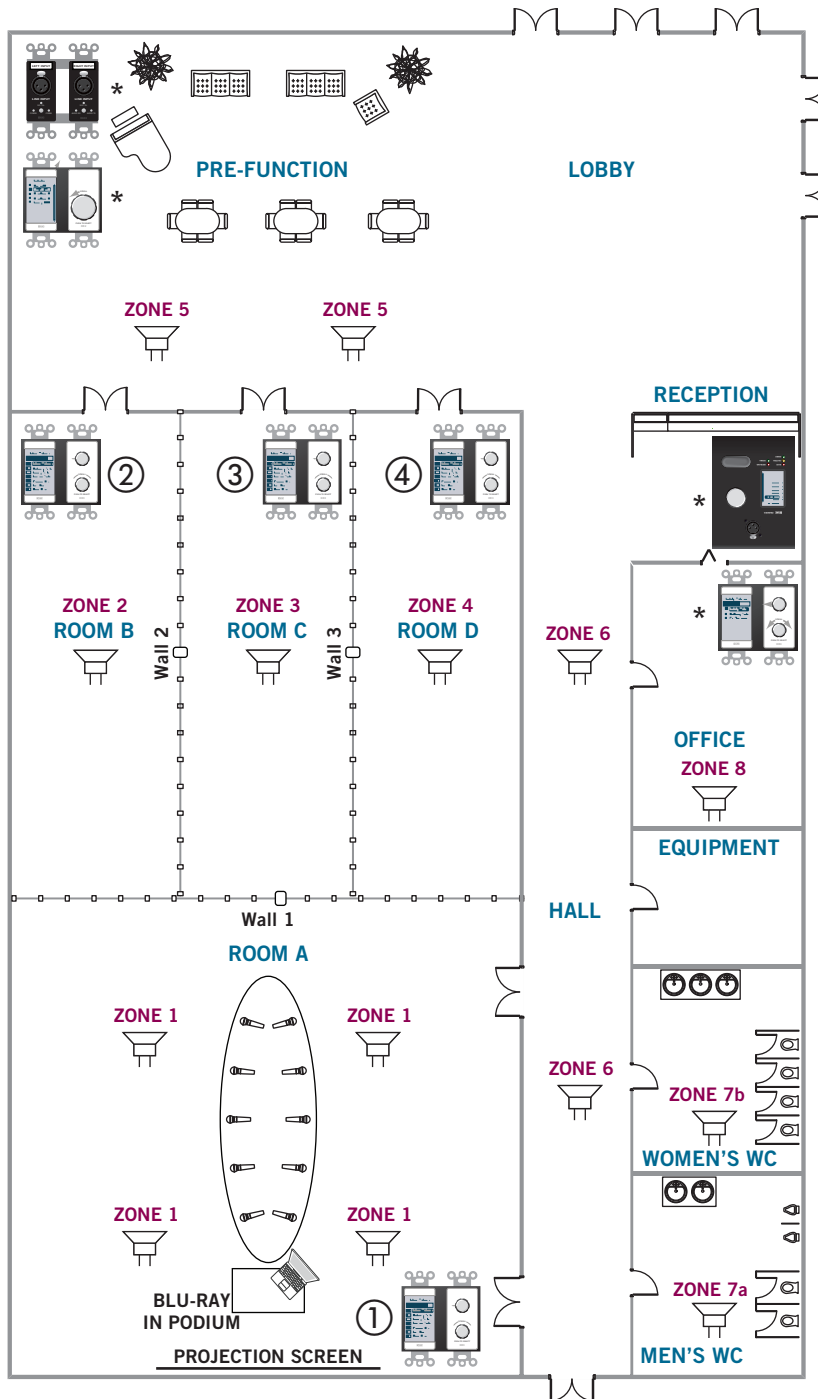
The EXP5x is perfectly suited to expand a HAL1x’s analog audio inputs. Control is also expanded given its 4 DR ports. Each of the 12 inputs can independently accept mic, line, or Line-Plus audio — the ultimate in flexible input topologies. Also worth noting is the performance enhancement achieved since the mic input topologies automatically compensate for the sensitivity difference between condenser and dynamic mics.

In a meeting room with ten microphones (see facing page), one audio source (e.g., blu-ray) and a laptop on the podium, all these channels can connect directly to one EXP5x. A single DR3 in the room can select the audio source (blu-ray or laptop) and adjust the room volume. Or, the DR3 can be programmed as a mixer allowing independent level adjustment of all 12 sources in the room: 10 mics, blu-ray and laptop. If the podium location moves from the north to the east wall, duplicate remotes can provide multiple control locations. Use a preset recalled from a switch closure, DR2 remote or 3rd-party Ethernet control system to “spin” the room or disable any DR remote in a room.

There are equipment placement options. If the HAL1x lives in the equipment room, the EXP5x can live in the podium along with the blu-ray, and a single CAT 5 returns to the HAL1x. However, if you are upgrading an existing facility, the EXP5x connects at the end of the existing analog conduit feeds in one or more equipment rooms.

If you had 12 such meeting rooms, use 12 daisy-chained EXP5x Expanders and a single HAL1x. The figure on the next page shows only four such rooms. There would be plenty of spare DR ports available for adding control locations. The four RAD ports on the HAL1x support the addition of page sources (e.g., PAGER1) or portable 8-channel AM2 Automixers. AM mixers can be added to larger rooms - even during a meeting - to add 8 more gain-shared mixed mics to the 10 in any given room. Review the cascading feature of the Gain-sharing Auto Mixer or the Room Combine Processing blocks within Halogen for details.

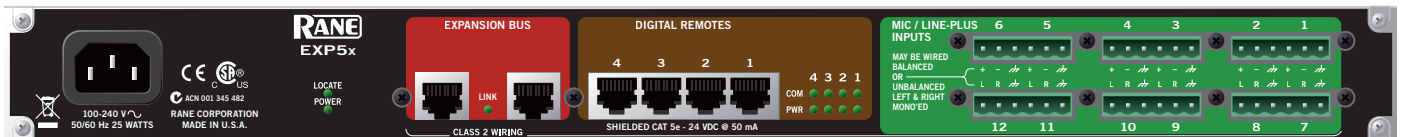
EXP5x Meeting Room Combine Application Example

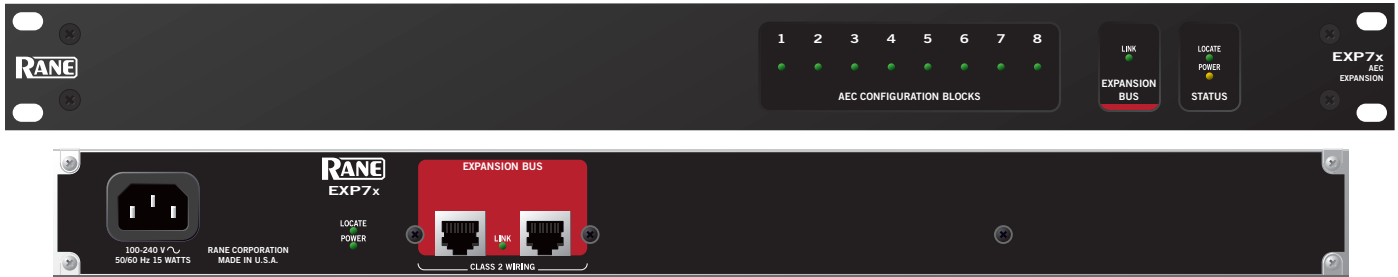


* These RADs and DRs connect to the main HAL1x.
Zones are fed by the main HAL1x.



ROOM A, MICS 1-10, LAPTOP, BLU-RAY





NEW! EXP7x AEC Expander

The Rane EXP7x Expander for the HAL1x provides 8 channels of full-featured, drag and drop Acoustic Echo Cancellation (AEC). Each channel of AEC can be added to any HAL1x system input and route to any Halogen DSP block, including the gain-sharing automixer, manual mixer, regular Room Combine block, new Conference Room Combine block.

The Rane EXP7x in combination with HAL1x and Halogen software provides a conferencing solution including far more than high-performance AEC.

Processing blocks to enhance the AEC system solution:

- Revolutionary Conference Room Combine block with intrinsic support for conferencing.
 - Independent Far End mixers and AEC Reference selection per room.
 - Far End gain-sharing mixer inputs and AEC reference automatically change with room combinations.
- Multi-channel and Tracking processing blocks mirror local room processing in the AEC Reference signal path
 - Included are the Multichannel Shelving Filter, Multichannel PEQ, Tracking Ambient Noise Compensation and Tracking Side-chain Compressor.

Each AEC channel includes:

- Mic and Reference Inputs with Level control & metering.
- AEC on/off, plus adjustable AEC Threshold.
- Soft / loud talker AGC & 5-band parametric EQ, plus high- and low-cut filters.
- Full bandwidth AEC with adjustable non-linear processing.
- Ambient Noise Reduction (dynamic & steady-state) & howling prevention.
- Complete metering: Input, Reference, Echo Return Loss (ERL), Echo Return Loss Enhancement (ERLE) & Total Echo Return Loss (TER).
- 20 to 20 kHz Bandwidth, 200 ms tail length.
- <20 ms propagation delay, 100 dB/sec convergence rate.

Because EXP7x AEC channels are not associated with a particular hardware input, preset recall can re-assign an AEC resource across inputs / rooms as required. Drag and drop AEC supports the typical one-AEC-per-microphone configuration. With optimum acoustics, mic and loudspeaker placement, or with rarely used mics (such as audience mics) it allows mixing more than one mic into a single AEC channel, significantly reducing cost.



What's unique about HAL's AEC?

- Flexible drag-and-drop placement
 - Use it where you need it.
- Intrinsic support for conferencing
 - Advanced supporting processing blocks.
- Multi-channel processing blocks mirror room processing in the reference signal path.

Specifications

- 20 to 20 kHz bandwidth.
- 200 ms tail length.
- <20 ms Propagation delay.
- 100 dB/sec convergence rate.
- Supports Preset re-routing — Re-use across rooms.
- High-Level, inherent conferencing support through.
- Full specifications will be published close to the ship date.

The EXP7x AEC Expander will ship October 2013.

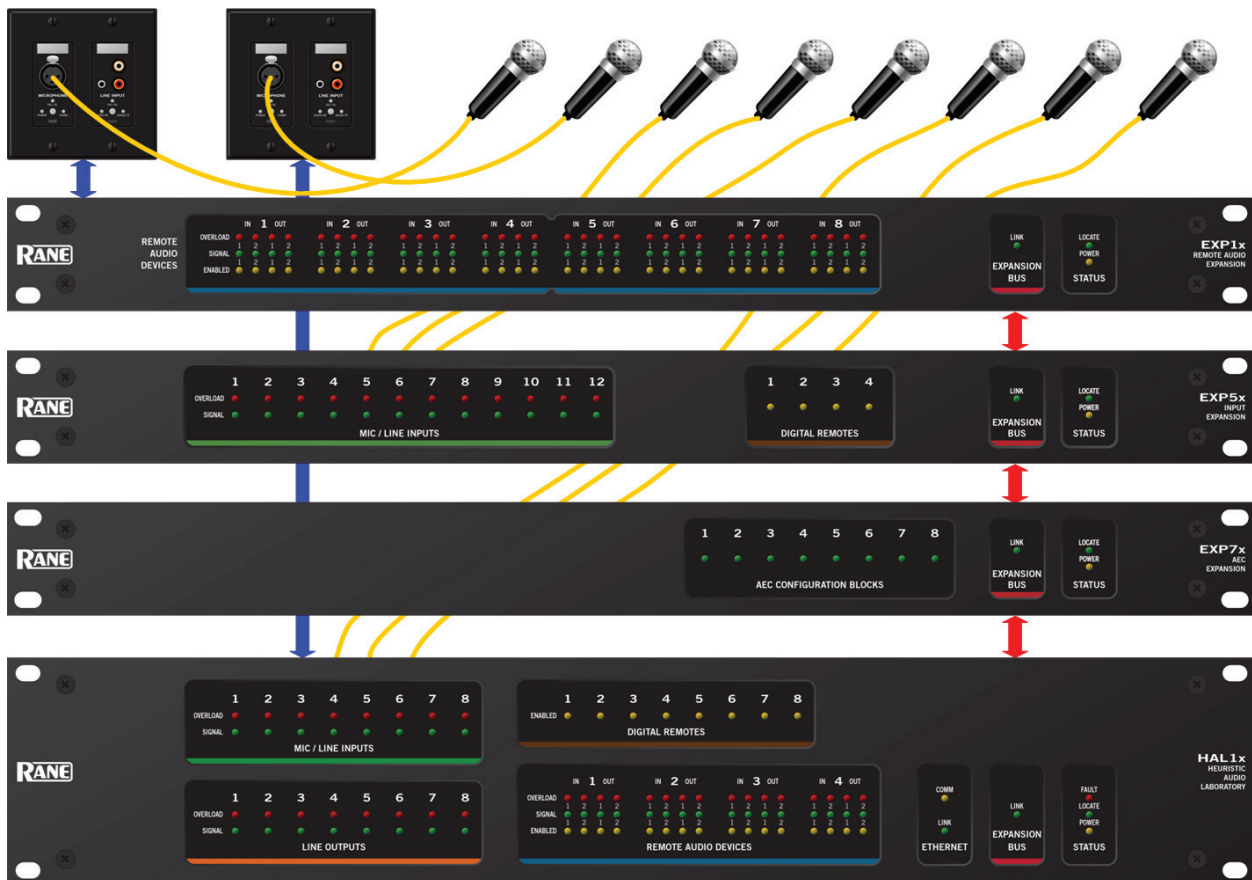
This device has not been authorized as required by the rules of the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased, until authorization is obtained.

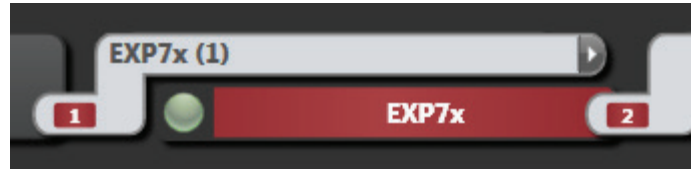
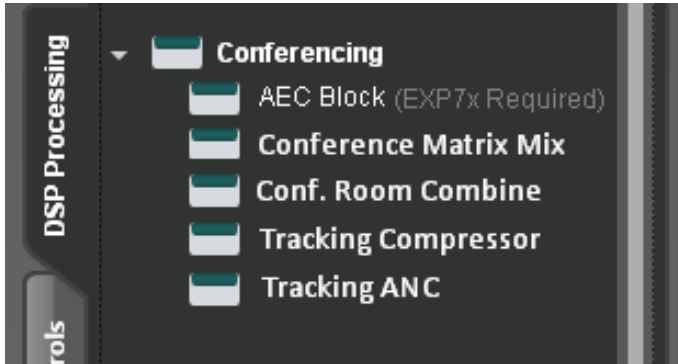


Conferencing Application

This application has a number of microphones used in a room with overhead sound reinforcement. In this type of system, sound reinforcement is typically strengthened and delay compensation added as a loudspeaker gets further from the original source.

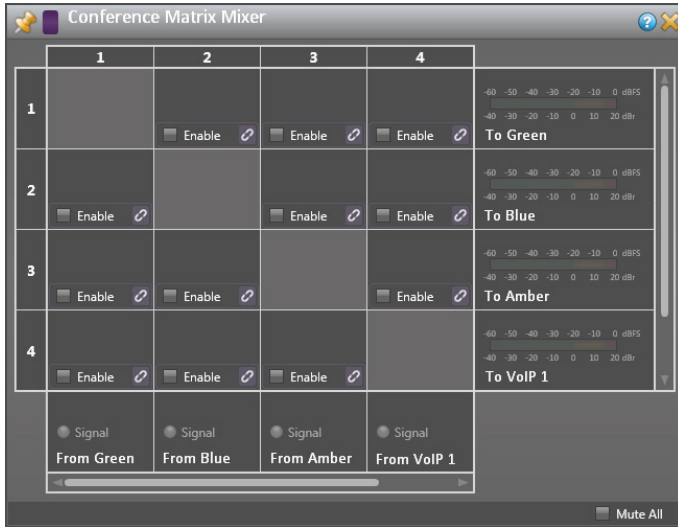
In this scenario, if room acoustics are good, it is possible to use a single AEC processing block for more than one microphone by combining microphones in a common reinforcement zone. The drag-and-drop flexibility of EXP7x AEC blocks lets you add AEC to any Halogen system input.





After adding an EXP7x to a HAL1x, under the DSP Processing tab, new Conferencing blocks are offered. With the EXP7x added, eight AEC blocks may be placed. When these are used up, the offering is grayed out with the hover-tool-tip indicating a need to add another EXP7x to acquire more AEC blocks.





Conference Matrix Mixer

The Conference Matrix Mixer block supports dynamic routing of Far End Audio sources. This block is useful when more than one room must share a single VoIP or Video Conference resource. It's also useful when a room needs to access one or more remote rooms on a campus in order to include them in a conference. In some cases a combination of these scenarios is required.

The function of the Conference Matrix Mixer could be accomplished using a standard matrix mixer, but that would require a user to avoid disallowed routing (like 1:1 or 2:2 etc.), and ensure that To and From Far End pairs are correctly wired. This Conference Matrix Mixer simplifies the process.

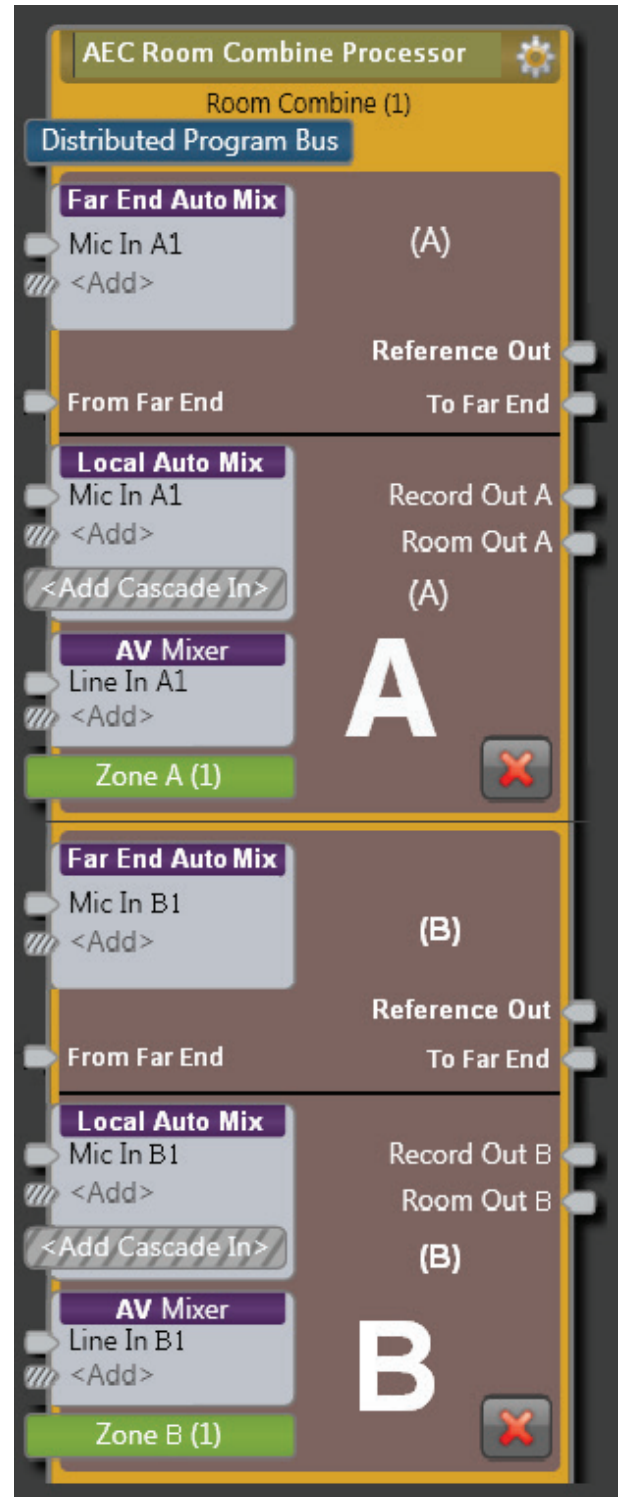
Multi-Channel Processing Blocks

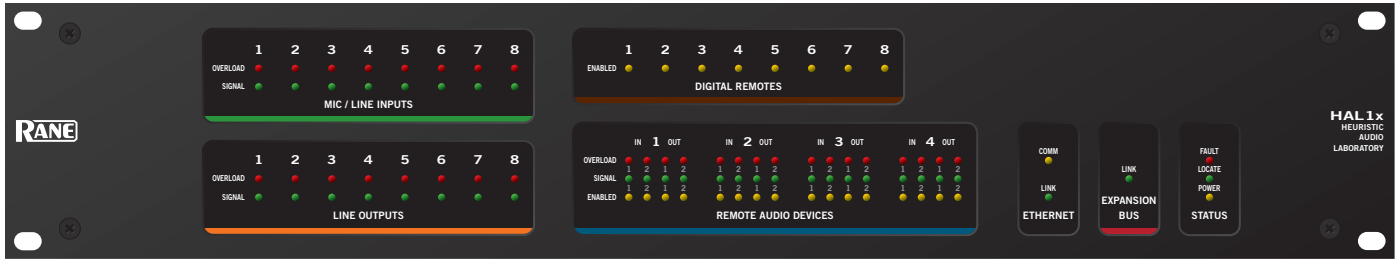
In order to get the best performance from an AEC application, the signal processing used in a room must be applied to the AEC reference signal as well. To simplify this process, special blocks that mirror the processing for room and reference channels include:

- Tracking Compressor
- Tracking ANC
- Multi-Channel PEQ
- Multi-Channel Shelf

Conference Room Combine

Conferencing in a room combine environment is a complex task without a specialized Room Combine Processor designed to handle room mix, far-end mix and reference routing. Halogen's unique ability to do conferencing within a room combine scenario without complex wiring and routing makes it easy.



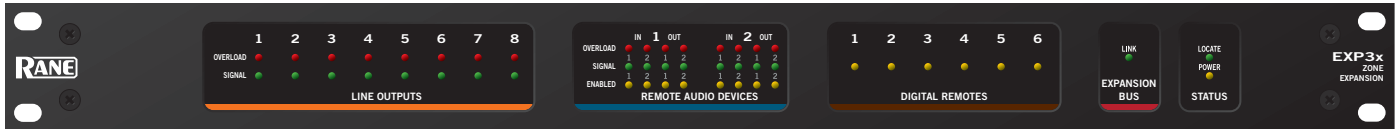


HAL1x Specifications

Parameter	Specification	Limit	Conditions/Comments
Analog I/O	8 x 8		
...Connectors	Euroblock		4 x 6-pin, 5 mm pitch, Green = Inputs, Orange = outputs
...CODEC	24-bit, 48 kHz		
Mic Inputs	Active Balanced		
...Gain Settings	+10 to +60 dB		1 dB steps
...Input Impedance	2.6 kΩ	1%	1 kHz, each leg to ground
...Phantom Power	+48 VDC		10 mA max per input
...Equivalent Input Noise	-127 dBu	max	20-20k Hz, 150 Ω source, 60 dB gain, A-weighted
...THD+N	< 0.008 %	typ	20-20k Hz, +4 dBu, +10 dB gain, 20 kHz BW
...Maximum Input	3 dBV (1.4 Vrms)	typ	Input gain at +10 dB, 1 kHz, < 1% THD+N
Line Inputs	Active Balanced		
...Gain Settings	Unity & +10 to +20 dB		1 dB steps from +10 to +20
...Input Impedance	5.1 kΩ	1%	1 kHz, each leg to ground
...THD+N	< 0.008 %	typ	20-20k Hz, +4 dBu, unity gain, 20 kHz BW
...Maximum Input	20.8 dBu	typ	Input gain at 0 dB, 1 kHz, <1% THD+N
...Frequency Response	20-20k Hz, +0, -.05 dB		+4 dBu, unity gain
...Dynamic Range	109 dB	max	re +20 dBu, 20 kHz BW, A weighted, Rs = 150 Ω
...Interchannel Isolation	104 dB	max	20-20k Hz, +20 dBu, unity gain, channel-to-channel
Outputs	Active Balanced		
...Impedance	200 Ω	1%	Each leg
...Maximum Output	+20.9 / +16.4 dBu	typ	1 kHz, 100 kΩ / 600 Ω load
...Frequency Response	20-20k Hz, +0.1 / -0.3 dB		+4 dBu, unity gain, 100 kΩ load
...Dynamic Range	109 dB	max	re +20 dBu, 20 kHz BW, A-weighted, 100 kΩ load
...Interchannel Isolation	110 dB	typ	20-20k Hz, +20 dBu, channel-to-channel, 100 kΩ load
Indicators			
...Signal	-50 dBFS	typ	Green LED, peak-reading
...Overload	-0.5 dBFS	typ	Red LED, peak-reading
Propagation Delays			See the graphic on page page 4.
...RAD In to RAD Out	1.71 ms	typ	Tested with RAD23
...RAD In to Analog Out	1.85 ms	typ	
...Analog In to RAD Out	2.25 ms	typ	
...Analog In to Analog Out	2.39 ms	typ	
DSP			
...HAL1x Processing Power	9600 MIPS	max	4 DSPs @ 300 MHz each with up to 8 instructions / cycle
...Word Length	32 / 64-bit Floating Point		
...HAL1x Delay Memory	80 seconds	max	
Computer Interface: Type	Ethernet 1000 base-T		Zeroconf service discovery protocol for easy set up
...Cable	Shielded CAT 5e or better		RJ-45 connector
...Length	100 meters / 300 feet	max	Standard Ethernet cable length limit

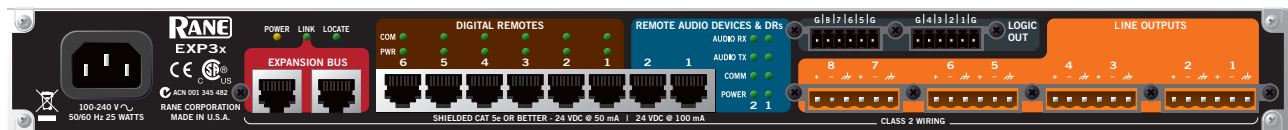


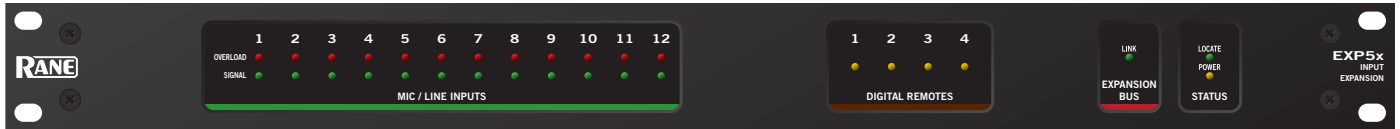
Parameter	Specification	Limit	Conditions/Comments
HAL1x Expansion Bus	Not on other HAL models		Shielded CAT 5e cable with RJ-45 connectors
...Audio Channels	512 in x 512 out of HAL1x	max	Plus control channel
...Maximum EXP Units	32	max	Daisy-chain
...Maximum Cable Length	100 meters / 300 feet	max	
...Propagation Delay "hop"	730 ms	typ	In and Out of Expansion Unit – 22.4 μ s across 32 EXPs.
RAD Ports	4		RJ-45 connectors
...Audio Channels	8 in x 8 out		Each port 2 in x 2 out, plus control channel, 24-bit, 48 kHz
...Power	24 VDC @ 100 mA	max	Each port
...Length	150 meters / 500 feet	max	Shielded CAT 5e cable or better
HAL1x DR Ports	8		RJ-45 connectors
...Power	24 VDC @ 50 mA	max	Each port
...Length	300 meters / 1000 feet	max	Shielded CAT 5e cable or better
Relay Outputs	2		
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, Black
...Type	COM, NC & NO		
...Limit	2 A, 48 V	max	60 W max switching power
Logic Inputs	4		
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, Black
...Type	Internal passive pull-up		Protected to +24 V
...Vin High	> 2.2 V	min	Normal state
...Vin Low	< 1.0 V	max	External circuit sinks > 22 μ A to assert
Wiring	Class 2		All rear panel terminals
Power Requirement	100 to 240 VAC		50/60 Hz, 50W max
Ambient Room Temp.	40 °C	max	Maximum external loading
Conformity: Safety			
...NRTL (USA)	UL 60065		cCSAus (CSA file no. 247105)
...CSA (Canada)	CAN/CSA 60065		cCSAus (CSA file no. 247105)
...EU Directive 2006/95/EC	EN 60065		CB Certificate (Nemko)
Conformity: EMC			
...EU Directive 2004/108/EC	EN 55103-1, EN 55103-2		Environment E2
Unit: Size	2U, 3.5"H x 19"W x 8.25"D		(8.9 cm x 48.3 cm x 20.9 cm)
...Weight	7 lb		(3.2 kg)
Shipping: Size	6.5" x 20.3" x 13.75"		(11.5 cm x 52 cm x 35 cm)
...Weight	10 lb		(4.5 kg)



EXP3x Specifications

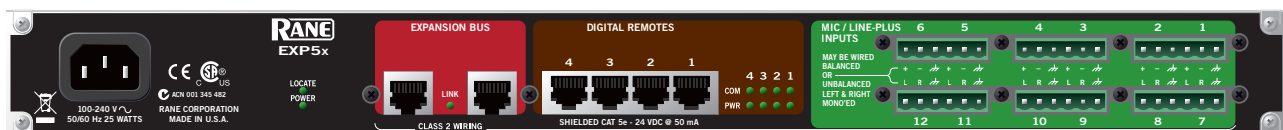
Parameter	Specification	Limit	Conditions/Comments
Expansion Bus	HAL1x is required		Shielded CAT 5e cable with RJ-45 connectors
...Audio Channels	512 in x 512 out of HAL1x	max	Plus control channel
...Maximum EXP3x Units	32	max	Daisy-chain with shielded CAT 5e or better
...Maximum Cable Length	100 meters / 300 feet	max	
Line Outputs	8 Balanced Outputs		Euroblock, 4 x 6-pin, 5 mm pitch, orange
...DAC	24-bit, 48 kHz		
...Maximum Output	+20 dBu / +16 dBu		10 kΩ / 600 Ω, 1 kHz
...Dynamic Range	107 dB	typ.	A-weighted
...Frequency Response	20 Hz to 20 kHz, +0.1 / -0.3 dB		+4 dBu, unity gain, 10 kΩ load
...Impedance	200 Ω / leg	typ.	@ 1 kHz
...Inter-channel Isolation	>100 dB	typ.	@ 1 kHz
...Signal Indicators	-50 dBFS	typ.	Green LED
...Overload Indicators	-0.5 dBFS	typ.	Red LED
Propagation Delays			
...Exp. Bus to Line Out	793 μs		
...RAD In to Exp Bus	466 μs		
...Exp. Bus to RAD Out	520 μs		
RAD / DR Ports	2 RAD / 6 DR		RJ-45 connectors
...RAD Audio Channels	4 in x 4 out		
...RAD Cable Length	150 meters / 500 feet		Shielded CAT 5e or better
...RAD Power	24 VDC @ 100 mA	max	Each Port
...DR Cable Length	300 meters / 1000 feet		Shielded CAT 5e or better
...DR Power	24 VDC @ 50 mA		
Logic Output Port			Mini Euroblock x 2, 6-pin, 3.81 mm pitch, black
...Internal Pull-up	1.0 kΩ, 5.0 V		Protected to +30 V, reverse polarity protected
...Sink Current	200 mA	max	Output FET on
...LED Drive Current	LED Drive Current 2 mA		Output FET off, Vf = 2.0 V
...Logic High Output Voltage	4.7 V	min	Output FET off, Output Current 0.0 mA
...Logic Low Output Voltage	0.1 V	max	Output FET on, Sink Current < 200 mA
Power Requirement	100 to 240 VAC		50/60 Hz, 25 W max
Conformity: Safety			
...NRTL (USA)	UL 60065		cCSAus (CSA file #247105)
...CSA (Canada)	CAN/CSA 60065		cCSAus (CSA file #247105)
...EU Directive 2006/95/EC	EN 60065		CB Certificate (Nemko)
Conformity: EMC			
...EU Directive 2004/108/EC	EN 55103-1, EN 55103-2		Environment E2
Unit Size	1U, 1.75" x 19" x 8.25"		(4.4 x 48.3 x 20.9 cm)
...Weight	4 lb 10 oz		(2.1 kg)
Shipping Size	6.5" x 20.3" x 13.75"		(11.5 x 52 x 35 cm)
...Weight	8 lb		(4.5 kg)





EXP5x Specifications

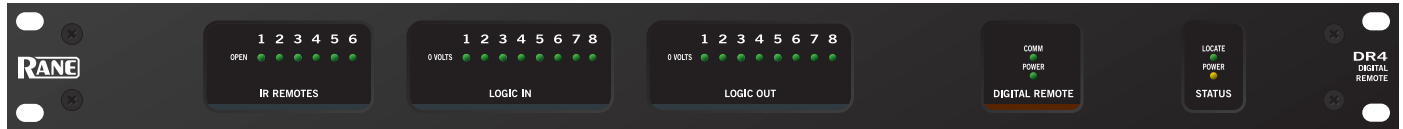
Parameter	Specification	Limit	Conditions/Comments
Expansion Bus	HAL1x is required		Shielded CAT 5e cable with RJ-45 connectors
...Audio Channels	512 in x 512 out of HAL1x	max	Plus control channel
...Maximum EXP5x Units	32	max	Daisy-chain with shielded CAT 5e or better
...Maximum Cable Length	100 meters / 300 feet	max	
Mic / Line / Line+ Inputs	12 Balanced Inputs		Euroblock, 4 x 6-pin, 5 mm pitch, green
...ADC	24-bit, 48 kHz		
...Line Input	4 Vrms / 12 dBV	min	1 kHz
...Line-Plus Input (L+R Mono)	4 Vrms / 12 dBV	min	1 kHz, Sum of Left and Right
...Condenser Mic Input	500 mVrms / -6 dBV	min	1 kHz, 48 V phantom power
...Dynamic Mic Input	127 mVrms / -18 dBV	min	1 kHz
...Dynamic Range	101 dB	typ.	A-weighted
...Frequency Response	20 Hz to 20 kHz, +0.1 / -0.3 dB		+4 dBu, unity gain, 10 kΩ load
...Input Impedance	5.766 kΩ / 2.9 kΩ	typ.	Balance / Each leg, @ 1 kHz
...Inter-channel Isolation	>100 dB	typ.	@ 1 kHz
...Signal Indicators	-50 dBFS	typ.	Green LED
...Overload Indicators	-0.5 dBFS	typ.	Red LED
Propagation Delay	758 μs		Analog In to Exp Bus
DR Ports	2		RJ-45 connectors
...DR Cable Length	300 meters / 1000 feet		Shielded CAT 5e or better
...DR Power	24 VDC @ 50 mA		
Wiring	Class 2		
Ambient Room Temperature	45°C	max	
Power Requirement	100 to 240 VAC		50/60 Hz, 25 W max
Conformity: Safety			
...NRTL (USA)	UL 60065		cCSAus (CSA file #247105)
...CSA (Canada)	CAN/CSA 60065		cCSAus (CSA file #247105)
...EU Directive 2006/95/EC	EN 60065		CB Certificate (Nemko)
Conformity: EMC			
...EU Directive 2004/108/EC	EN 55103-1, EN 55103-2		Environment E2
Unit Size	1U, 1.75" x 19" x 8.25"		(4.4 x 48.3 x 20.9 cm)
...Weight	4 lb 10 oz.		(2.1 kg)
Shipping Size	6.5" x 20.3" x 13.75"		(11.5 x 52 x 35 cm)
...Weight	8 lb		(4.5 kg)



DR4 Logic I/O Expander

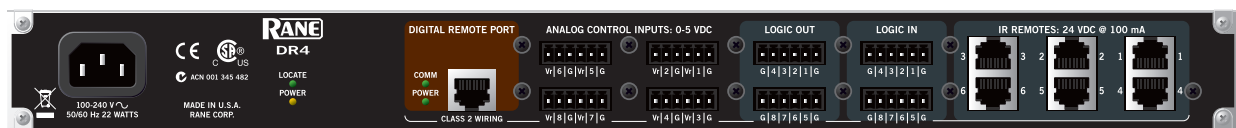
The DR4 Digital Remote adds additional logic input and output ports to any HAL, enabling simple analog level and logic I/O controls plus IR2 remotes for wall sensing. The DR4 offers eight

logic ins and outs, six IR ports and eight analog input ports for pot-on-a-wall level control. Multiple DR4's can connect to Digital Remote Ports on any HAL, up to 300 meters (1000 feet) away.



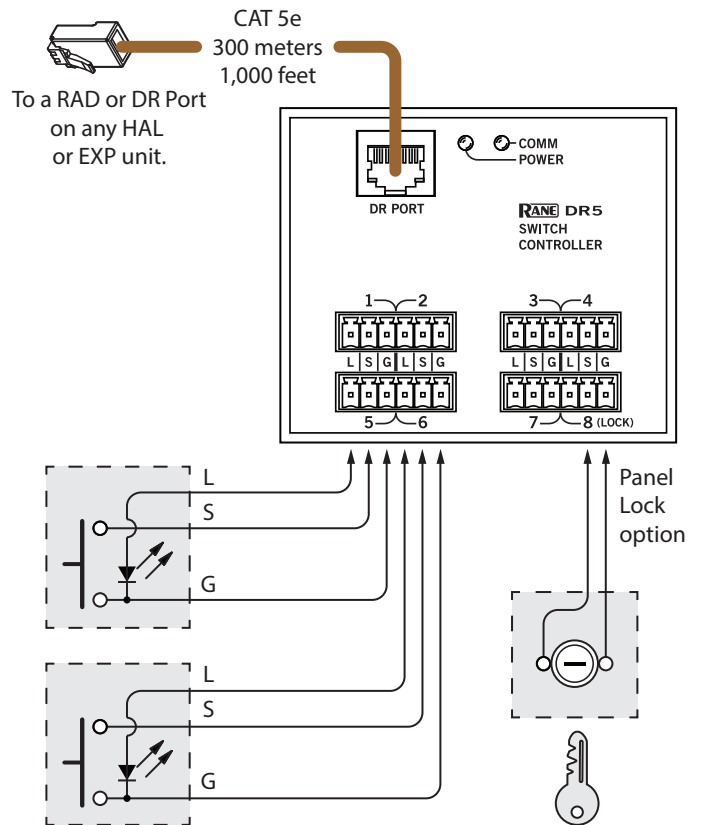
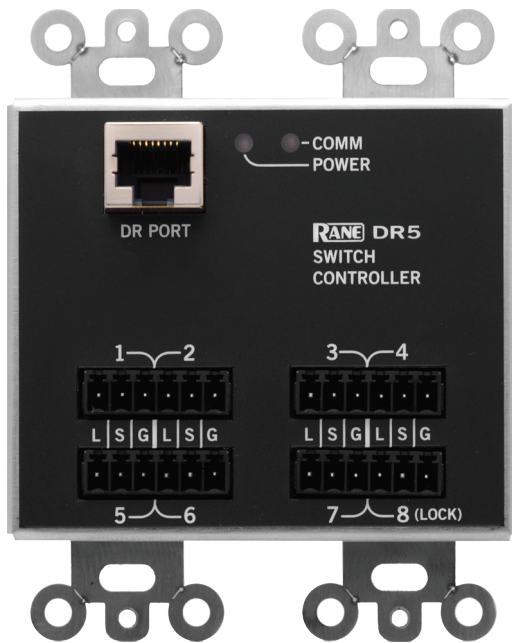
DR4 Specifications

Parameter	Specification	Limit	Conditions/Comments
IR Remote Ports	6		RJ-45 connectors
...Type	Compatible with IR2 remote		Protected to +24 V, reverse polarity protected
...Power	24 VDC @ 100 mA	max	Normal state
...Length	300 meters / 1000 feet	max	Shielded CAT 5e cable or better
Logic Inputs	8		
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, black
...Internal Pull-up	51.1 kΩ, 5.0 V		Protected to +24 V
...Logic High Input Level	> 2.0 V	min	Normal state
...Logic Low Input Level	< 0.9 V	max	External circuit must sink > 80 μA to assert
Logic Outputs	8 Relay drive, LED or logic level output		
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, Black
...Internal Pull-up	1.0 kΩ, 5.0 V		Protected to +30 V, reverse polarity protected
...Sink Current	200 mA	max	Output FET on
...LED Drive Current	2 mA		Output FET off, Driving an LED with Vf = 2.0 V
...Logic High Output Level	4.7 V	min	Output FET off, Output Current = 0 mA
...Logic Low Output Level	0.1 V	max	Output FET on, Sink Current < 200 mA
Analog Control Input	8 ADC inputs for potentiometer control		
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, black
...Control Voltage Range	0-5 V / Normal = 5 V	typ	Protected to +24V, reverse polarity protected
...Internal Pull-up	51.1 kΩ		10-20 kΩ, linear taper potentiometer recommended
...A/D Converter	8-bit, 2 kHz sample rate		
Wiring	Class 2		All rear panel terminals
Power Requirement	100 to 240 VAC		50/60 Hz, 18 W max
Ambient Room Temperature	104 °F / 40 °C	max	Maximum external loading
Conformity: Safety			
...NRTL (USA)	UL 60065		cCSAus (CSA file no. 247105)
...CSA (Canada)	CAN/CSA 60065		cCSAus (CSA file no. 247105)
...EU Directive 2006/95/EC	EN 60065		CB Certificate (Nemko)
Conformity: EMC			
...EU Directive 2004/108/EC	EN 55103-1, EN 55103-2		Environment E2
Unit Size	1.73"H x 19"W x 8.25"D		(4.4 cm x 48.3 cm x 20.9 cm)
...Weight	4.5 lb		(2 kg)
Shipping: Size	6.5" x 20.3" x 13.75"		(9.5 cm x 52 cm x 35 cm)
...Weight	7.5 lb		(3.5 kg)



DR5 Switch Controller

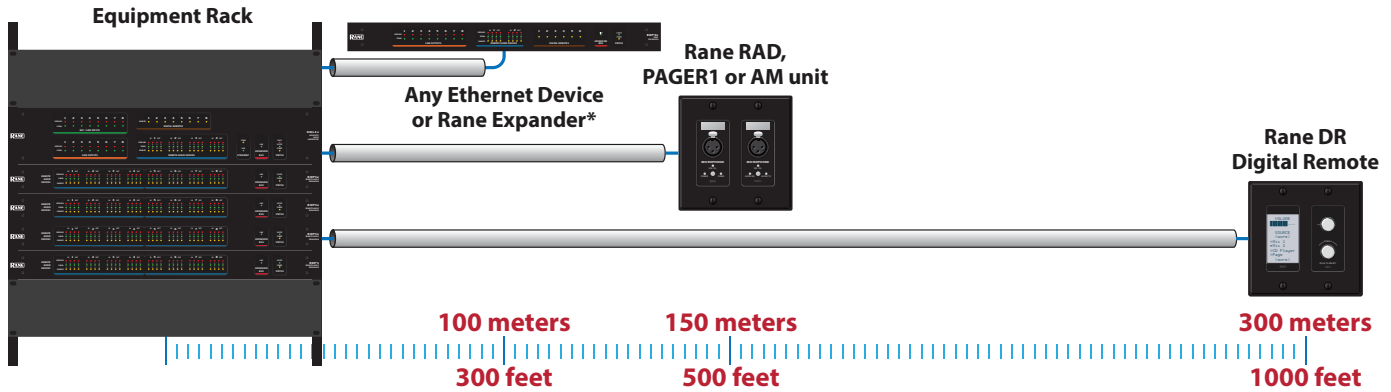
The DR5 Digital Remote offers additional logic input and output ports, enabling the use of simple analog switch controls in any HAL system. Lighted switch panels for room combine applications are easily integrated into a HAL system using the eight switch inputs and eight LEDs outputs on the DR5. Unlike the HAL and DR4 Logic I/O, the DR5 Logic Out is intended to drive the LED indicator on a room combine panel, and is a writable parameter. The DR5 is designed to fit in a standard US dual-gang electrical box, or mount directly near a room combine panel.



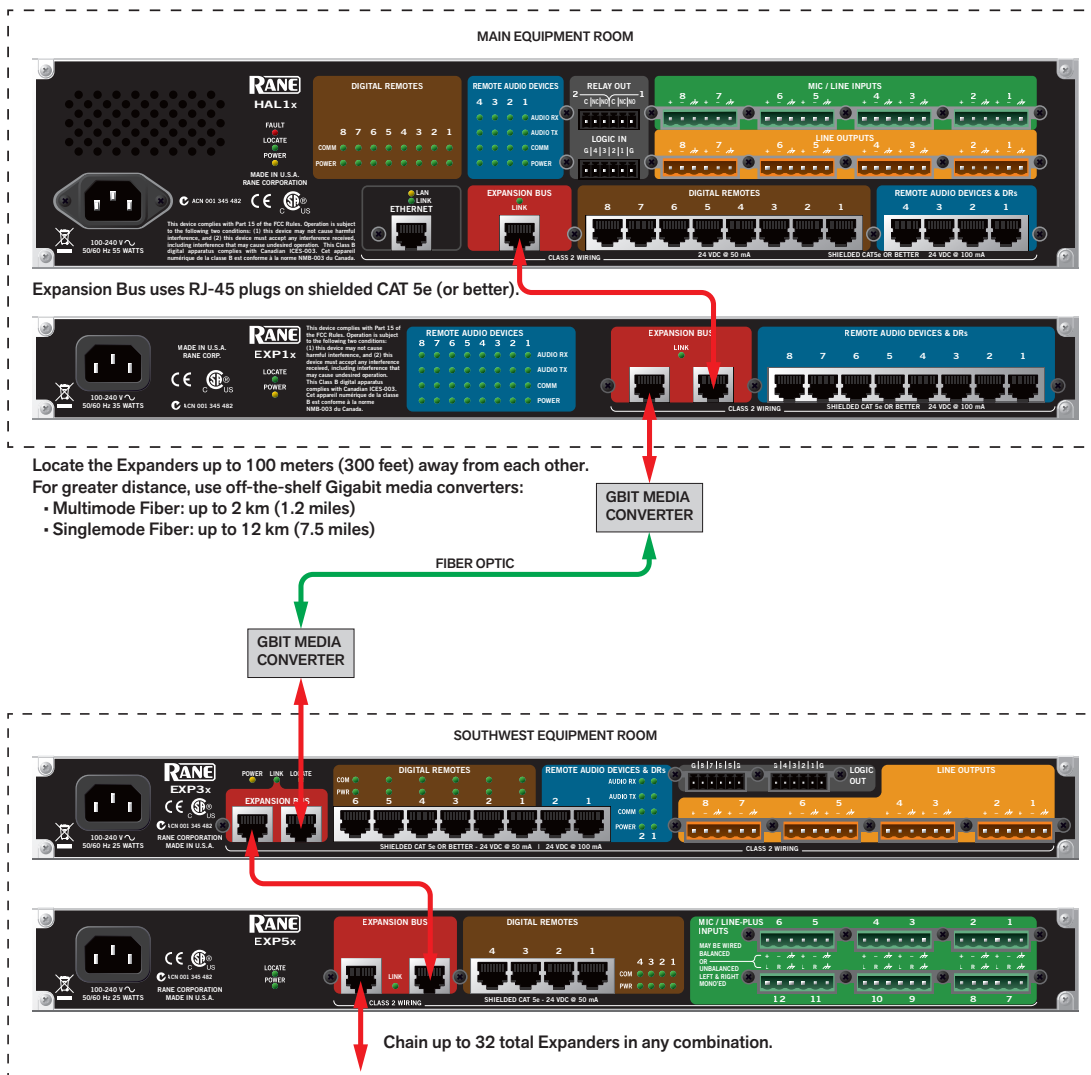
DR5 Specifications

Parameter	Specification	Limit	Conditions/Comments
Switch Inputs	8		Small capsule
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, black
...Internal Pull-up	51.1 kΩ, 5.0 V		Protected to +24V, reverse polarity protected
...Vin High	> 2.0 V	min	Normal state
...Vin Low	< 0.9 V	max	External circuit must sink > 80 μA to assert
LED Outputs	8		
...Connector	Mini Euroblock		6-pin, 3.81 mm pitch, black
...LED Drive Current	5 mA	typ	Driving an LED with Vf = 2.0 V
...Output High Voltage	5 V	typ	Output On, Current out = 0 mA
Ambient Room Temperature	104 °F / 40 °C		Maximum external loading
Unit Size	4.0"H x 3.3"W x 0.9"D		10.2 x 8.4 x 2.3 cm (fits in 2-gang US electrical box)

Ethernet, RAD and DR Cable Lengths



*Gbit Ethernet media converters are supported.



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