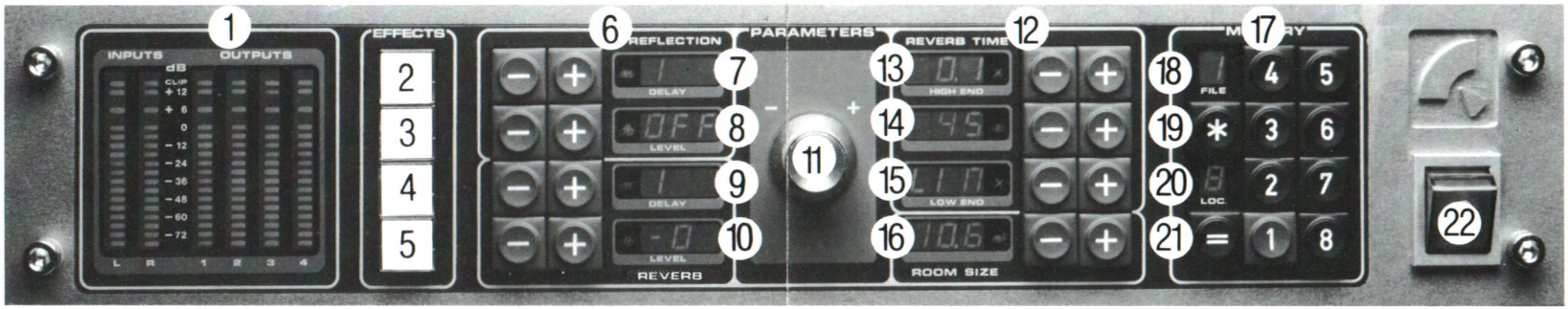
QUANTEC-QRS
MANUAL

The QUANTEC Room-Simulator - a computer-technology-based system for the generation of acoustical effects simulating variable-sized rooms. A new technical concept enables emulating the acoustical behaviour common to spaces of any volume or size, so that acoustical impressions ranging from a tin can to a columned cathedral may be synthesized and created at fingertip command. Contrary to standard reverberators, the QRS enables the reproduction of the selected space's inherent resonances, which are a function of its basic enclosed volume, in that their density and distribution are precisely established. In conjunction with the legendary "first reflection" this is the effect which enables the ear to establish spatial volume and size of a percepted room. Besides this, the QRS has two additional built-in programmes: "FREEZE-Effect" and "ENHANCE-Effect".

1	*BAR GRAPH INDICATOR*	VU meter for input and output for dynamic range 90 dB
2	*ENTER*	Loading the Freeze room
3	*MUTE*	...mutes outputs and erases reverb memory
4	*FREEZE*	Operating mode that sustains the sound for infinity
5	*ENHANCE*	Operating mode for room simulation without reverberation
6	*1ST REFLECTION*	First reflection / single echo, independent of any parameter or program-mode
7	*DELAY*	Delay of the first reflection
8	*LEVEL*	Level of the first reflection
9	*DELAY*	Predelay before the start of reverberation
10	*LEVEL*	Level of the simulated room
11	*ROTARY KNOB*	...quickly modifies the selected parameter
12	*REVERB TIME*	The three characteristics of the reverberation time
13	*HIGH*	...defines the absorption degree towards high frequencies
14	*TIME*	Standard reverberation time (-60 dB)
15	*LOW*	...defines the absorption degree towards low frequencies
16	*ROOM SIZE*	Definition of room size in *FREEZE* and *REVERB* mode Distance to sound source in *ENHANCE* mode.
17	*MEMORY*	nonvolatile storage for 64 reverberation programs and additional editing keys
18	*FILE*	File number indicator
19	*	File changing
20	*LOC*	Location (memory address) (1-8) in a file
21	=	Copying data to allocated locations
22	*POWER SWITCH*	



QUANTEC

room simulator

QRS

Operating instructions

MANUAL

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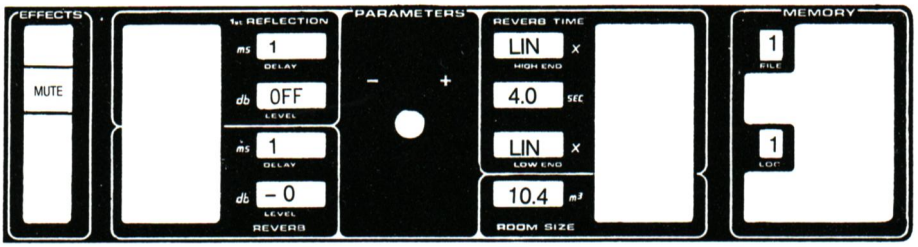
Example position:



1. Define room size → *ROOM SIZE*
2. Enter standard reverberation time (-60 dB)
   → *REVERB TIME*
3. Reverberation time, frequency-dependent
   → *HIGH END* → *LOW END*
   (depending on program-material)

Additional settings:

4. Modifying reverberation level,
   or "OFF" position → *REVERB LEVEL*
5. Additional delay time between original
   signal and the eventual room behaviour
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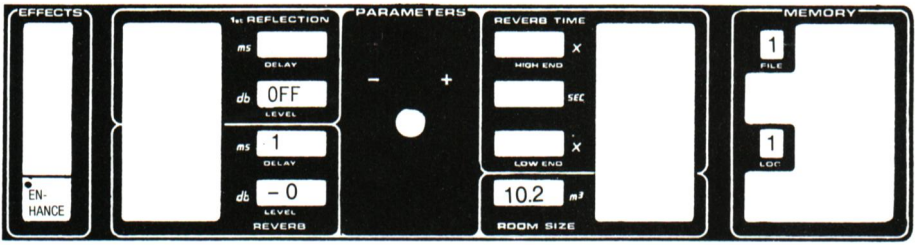
6. Terminate reverberation by
   pushing-a-button → *MUTE*
7. Add a separate independent echo,
   → *1ST REFLECTION DELAY*
   → *1ST REFLECTION LEVEL*

B. ENHANCE MODE

Example position:



(Turn off direct signal at the mixing console)

1. Define effect characteristic:

   Using headphones, the following artificial head impressions are obtainable, e.g.:

   " 1 " = Sound event in the head, between the eardrums.

   " 10 " = Sound event at the outer ears.

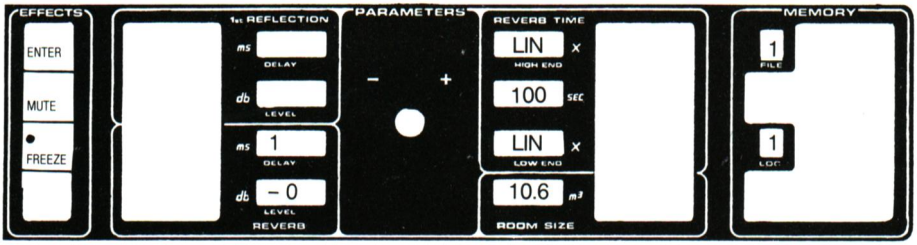
   " 10.2 " = Sound event outside, but near the head.

   " 10.3 " = Sound event outside of the head, but inside an imaginary room.
   - Perception of distance -

2. During the *ENHANCE* program the three *REVERB TIME* parameters are inactive.

C. FREEZE MODE

Example position:



1. Touch *FREEZE* (LED indicator)
2. Touch *MUTE* (Memory will be cleared)
3. Press *ENTER* and hold until the sound event is entered and release afterwards (The sound event is held indefinitely.)
4. Touch *MUTE* (the sound event is erased immediately.)

Additional settings:

5. Do not touch *MUTE* as described in 4., but turn off FREEZE by pressing *FREEZE* again. The room simulator passes over to the three predefined *REVERB TIME* values and the sound dies away.

   You can switch between FREEZE and REVERB as desired.

Note: *CLICKFREE SWITCHING IS ONLY POSSIBLE AT HIGH END REVERBERATION TIMES.*

6. Using *ROOM SIZE* parameters < 10.6, the *FREEZE* room sounds more and more compressed. At 1 m^3 "space-ship"-impressions are experienced.

D. MEMORY ORGANISATION

The memory of the QRS stores up to 64 reverberation programs. It is structured into 8 files with 8 locations (loc) each. All modifying is done in the "loc 1" of each file. "loc 2" to "loc 8" are safe in the memory for further recall.

1. Selecting a file (e.g. "file 1")

   Press [*] (red point in file number)
   Press [1] (file number)

2. Setting desired values

   Set the desired values for all 8 parameters, these values will be stored in memory (except *ENHANCE* and *FREEZE*).

3. Move data to protected locations (e.g. "loc 2")

   The formula is: [1] [=] [2]

   Tap [=] (red point in loc number illuminates for half a second)
   Press immediately [2] (while the red point is visible)

   CAUTION: Don't press [=] and [2] simultaneously!

4. Data modification of protected location data

   Protected locations become accessible by copying their data to "loc 1".

- Press (e.g. "loc 5") [5] [=] [1]
  (while the red point is visible)
- Do your modifications
- You can now copy the modified data back to "loc 5" (if desired) by pressing [1] [=] [5]

Without any modification you can also copy locations (grouping), e.g. "loc 4" to "loc 7" by pressing [4] [=] [7]

5. File copying (e.g. to "file 7")

You can only copy to "loc 1" of the desired file directly.

- Press [*] (red point in file number)
- Tap [=] (red point in loc number illuminates for half a second)
- Tap immediately [7] (while the red point is visible)

The data has now reached "loc 1" of "file 7". If desired, you can copy from "loc 1" to any desired protected location (see 3.)

THE THREE OPERATING MODES OF THE QRS AND THEIR PARAMETERS

The QRS works in three operating modes, the parameters of which can be varied as desired. On switching on, the internal logic of the equipment automatically sets the *REVERB* - mode. The *FREEZE*- and *ENHANCE*-modes are called up by pressing butttons.

REVERB-MODE

The natural acoustics of a room are simulated with the 8 parameters of the reverberation program. Each parameter is activated by touching the associated [+] and [-] keys and is immeditately varied by one step. At the same time, the central rotary knob is activated, so that more extensive changes can be carried out at any desired speed. A slight flickering of the relevant indicator signals the parameter on which the central rotary knob is operative at the time. The parameters can be stored in the *MEMORY*.

Parameters:

1. Room size
2. Reverberation time with deviations towards the high and low frequencies
   Level and additional delay of the reverberation onset.
3. Level and delay of the first reflection.

1. Room size *ROOM-SIZE*

   The character of the reverberation does not only depend on the construction of a room, but also on its volume. Small rooms sound restricted, while in large rooms the reverberation can spread out freely. The QRS is the first digital reverberation system, in which these criteria are taken into account.

The room size can be selected from seven values, in decade steps from 1 m^3 to 1,000,000 m^3:

Indication		room volume		
1	=	10^0 m^3	=	1 m^3
10	=	10^1 m^3	=	10 m^3
10.2	=	10^2 m^3	=	100 m^3
10.3	=	10^3 m^3	=	1,000 m^3
10.4	=	10^4 m^3	=	10,000 m^3
10.5	=	10^5 m^3	=	100,000 m^3
10.6	=	10^6 m^3	=	1,000,000 m^3

With the *ROOM-SIZE* parameter, the following simulation values are affected at the same time:

1. Delay time until start of reverberation (Delay)
2. The reverberation rise time of the room (Attack)
3. The reflection density of the echo (Echo Density)
4. The density and distribution of the natural resonances of the room (Normal Modes)

On changing from one room size to another, the reverberation signal is muted for half a second.
Since the acoustics of a room depend not only on the volume, but also on the length, width and height of a room, the room-sizes from 1 m^3 to 10^6 m^3 are to be regarded as guide-line values.
For example, a rectangular room with dimensions of 5 x 4 x 3 m has the same cubic capacity as a long narrow room of 15 x 2 x 2 m. The rectangular room will, however, show more uniform resonances than the long narrow one, since the latter has a single, strongly pronounced low natural resonance, which could in some circumstances simulate a considerable larger room.

Typical features of the various simulated room sizes:

Room size	Delay time	Rise time	Echo density	Natural resonances
1 m^3	Not perceptible	Sudden	Extremely high	From 300 Hz upwards, Ø every 25 Hz (sounds thin and, with reverb times > 0,3 s, very distorted.)
10^1 m^3	Not perceptible	Sudden	Extremely high	From 150 Hz upwards, Ø 12.5 Hz
10^2 m^3	Not perceptible	Sudden	Extremely high	From 80 Hz upwards, Ø every 6.5 Hz
10^3 m^3	Very short	Very short	Extremely high	From 40 Hz upwards, Ø every 3.3 Hz
10^4 m^3	Short	Short	High (with steep transients at the start of the echo, just perceptible)	In the entire frequency spectrum, Ø every 1.6 Hz
10^5 m^3	Medium	Medium	Medium	In the entire frequency spectrum, Ø every 0.6 Hz
10^6 m^3	Long	Long	Low	In the entire frequency spectrum, Ø every 0.3 Hz

With all room sizes, the Echo density increases approximately with the square of the elapsed time.

2. Reverb Time *REVERB TIME*

Depending on the *ROOM SIZE* parameter, the reverberation times can be set in an extremely wide range from 0.1 to 100 seconds. In paricular, reverberation times under 0.6 seconds are not actually perceived as an echo, but are important for the simulation of small and very small rooms. With long reverberation times, the signal remains lively and shows neither tonal variations nor periodicities. The following table illustrates the limiting values of the reverberation times, related to the room size:

Room Size	Minimum reverberation time	Maximum reverberation time	Maximum reverberation time for low notes (40 Hz)
1 m^3	0.1	1	Not definable, since
10^1 m^3	0.1	2	no resonances at
10^2 m^3	0.1	5	40 Hz
10^3 m^3	0.1	10	40 seconds
10^4 m^3	0.2	20	80 seconds
10^5 m^3	0.5	50	200 seconds
10^6 m^3	1.9	100	400 seconds

For each decade, 20 different values are available, the next value in each case being 12 % ($\sqrt[20]{10}$) greater than the preceding one. The reverberation time can be varied during operation, "click-free" and without interruption of the echo signal.

2.1. Reverberation time for low frequencies (*LOW END*)

Prolongation or curtailment of the reverberation at low pitches, where frequencies around 500 Hz die away slightly, frequencies around 40 Hz die away at a rate which is varied by the set factor. The sound spectrum is thus not split at a given cut-off frequency and fed to separate reverberation generators, or so to say rooms, but, as in natural rooms, dies away more slowly the lower the pitch and the faster the higher the pitch.

The factor related to the fundamental reverberation time is reached at about 40 Hz and can be selected between 0.1 and 10 in eleven steps, the next step in each case being 60 % ($\sqrt[5]{10}$) greater than that which precedes it.

For technical reasons, the maximum reverberation time at 40 Hz is limited to four times the maximum possible reverberation time for the particular room size. The Table "Limit values of the reverberation time" states the effective limits.

This parameter can also be varied "without clicks" and without interruption during operation.

2.2 Reverberation time for high frequencies (*HIGH END*)

With the prologation or curtailment of the reverberation at high pitches, frequencies around 1 kHz die away slightly, frequencies around 8 kHz die away at a rate which is varied by the set factor

in each case. Here too, as with the low end, the intensity of the room resonances is boosted or attenuated.

The factor related to the fundamental reverberation time is reached at about 8 kHz and can be defined "without clicks" in eight steps between 0.1 and 2.5. In each case, the next step is approx. 60 % greater than that which precedes it.

Because of the absorption characteristic of the air, the maximum reverberation time in natural rooms - irrespective of their size - is approximately 3 seconds at 5 kHz and only 1.2 seconds at 10 kHz. Therefore do not hesitate to select the factor 0.1 with long reverberation times.

2.3. Delay of the start of reverberation (*REVERB DELAY*)

The *ROOM SIZE* parameter already includes the necessary delay time for a natural transient build-up of the echo. With *REVERB DELAY* , an additional waiting time of 1 - 200 ms, adjustable in 1 ms steps, is inserted before the reverberation onset. If the delay time is varied while the programme is running, slight clicks can occur because of the phase jump or chopping during switching. It is therefore advisable to await short intervals in the programme.

2.4. Reverb Level *REVERB LEVEL*

Naturally, the level of the reverberation can also be controlled on the "Return" channels of the mixing desk. However, two important reasons make it desirable to carry out this setting in the QRS itself.

a) Together with the level of the first reflection, the mixing ratio between descrete echo and reverberation can be defined at a fixed value.

b) When several reverberation programs are used in quick succession, the desired reverb levels can also be stored and thus condiderably simplify the mixing process.

The reverberation level can be set in 1 dB steps between ± 0 dB and -30 dB (related to the original signal) with an additional switch-off or muting facility (OFF). Since, because of the 1 dB steps, the amplitude of the phase-angle click is only approx. 10 % of the signal amplitude, practically no switching noises occur.

The level of the reverb. component can only be defined with pink noise or 1/3 octave noise, since with sinusoidal tones, because of the room resonances , severe break-up of the frequency response occurs. The frequency of occurance of the amplitude maxima, the so-called natural frequency density, depends on the set room size.

3. *1ST REFLECTION*

3.1. *1ST REFLECTION DELAY*

This setting is possible both in connection with the reverberation program, and also indepedently thereof. It then relates to a discrete stereo echo. The parameter can be varied in 1 ms steps between 1 and 200 ms. Changes while the programme is running can cause more or less disturbing clicking noises, because of the phase-shift or chop on switching the transit time. It is therefore advisable to make use of short pauses in the program.

The indicated delay values are accurate, the delay offset which is otherwise customary does not need to be added on. Since the delay offset is anavoidable in principle, we have dispensed with the meaningless setting "0 ms" and, for all other values, have included the transit times which are always present, e. g. the transit time of the image frequency filter.

3.2. *1ST REFLECTION LEVEL*

This parameter defines the mixing ratio between the original signal and first reflection. The level can be varied in 1 dB steps from $\pm$ 0 to -30 dB, related to the original signal, with an additional facility for switching off or muting the first reflection (OFF). Since the amplitude of the phase-angle click is only about 10 % of the signal amplitude, because of the 1 dB steps, practically no switching noises occur.

FREEZE - MODE

The concept of the *FREEZE* program is similar to that of the reverberation program. With *FREEZE*, the reflectivity of the walls of a simulated room is varied. While, with reverberation, it is always less than 100 % and is frequency-dependent if required, with *FREEZE* it is exactly 100 % for all frequencies.

In such a room, which is only possible in theory, the sound event is trapped and is held for any desired length of time between the walls, while new superimpositions form continuously and release further reflections because of built-in diffusors. If the walls bounding the room are not arranged parallel to one another, repetitions are no longer perceptible and the sound event blends into a continuous cluster. Thus, so to say, the "time" factor is taken out of the sound event.

Of course, any desired numer of further sounds can be played successively into the *FREEZE* room, without affecting those already trapped there. Furthermore, a smooth transition is possible to a normal, possibly frequency-dependent reverberation programme and, after a certain decay time, the reverberation can be "frozen" again. In order to be able to change over with absolute freedom from clicks, reverberation times at the upper end of the range should always be used.

The following keys and parameters decide the operation of the *FREEZE* mode:

FREEZE * *ROOM SIZE* * *MUTE* * *ENTER* * *REVERB LEVEL*

The *FREEZE* mode is called up by brief pressure on the *FREEZE* button and is confirmed by the lighting of the LED.

ROOM SIZE This parameter determines the character of the room in which the "frozen" signal is to oscillate. Small rooms give a constricted effect, large rooms permit a free spread of the sound.

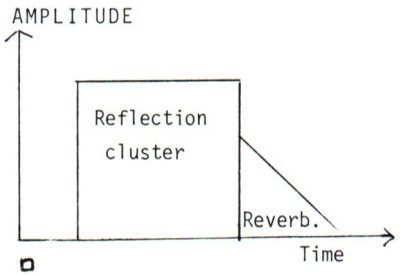
MUTE This key erases the contents of the reverberation memory. The output of the QRS is muted briefly and the *FREEZE* room can be loaded with an new acoustic event.

ENTER In order not continuously to add up all extraneous noises, the *FREEZE* room is only loaded, as long as the *ENTER* key is pressed. Care is to be taken, that *ENTER* is pressed before the sound event and only released again after it, in order not to load switching clicks, caused through the phase-angle step when the *ENTER* gate is opened and closed, which would appear as unwanted noises.

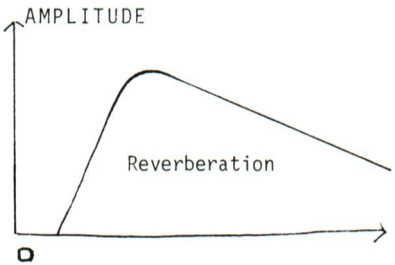
REVERB LEVEL With this control, the same level functions can be set as in the reverberation programme.

ENHANCE MODE

In contrast to the reverberation programs, the *ENHANCE* effect shows a different time-distribution of the reflections. It consists of a number of reflections of equal strength, on which there is superimposed a decreasing sequence of denser, but quite perceptibly discrete reflections. The sequence of the individual reflections in the cluster is fixed so that there are definable periodicities and thus no discolourations.



ENHANCE EFFECT



REVERBERATION PROGRAMME

The time interval, in which the reflection cluster occurs, depends on the *ROOM SIZE* parameter, the numerical values of which only serve here as reference points for the stage of the effect which is switched on. With headphone operation, the following impression is obtained:

1	=	Sound event in the head
10	=	Sound event directly at the ears
10.2	=	Sound event outside the head

The slight left-hand weighting with smaller rooms is due to software reasons and must be corrected for at the mixing desk.

The *ENHANCE* effect is particularly impressive, if the original signal is fully switched off at the mixing desk and only the stereo signal generated by the QRS is audible.

Fields of application:

Spatial spreading of a mono signal

Compression and intensification of speech, singing and instrumental music

Generation of synthetic "artificial head" effects in the headphones

Spatial effects without consciously perceptible reverberation.

INSTALLATION – CONNECTION
BALANCING

INSTALLATION

The QRS Room Simulator is designed for installation in 19"-racks. In normal studio operation, the four bolts on the front panel provide adequate stability. For mobile use (e.g. OB Van), the equipment should be additionally supported, e.g. by slide runners or the like.

Heat dissipation takes place by convection, therefore it is essential to note the following points when installing the unit:

a) The distance from adjacent units should be at least 25 mm to the base and top plates, so that the air can circulate without obstruction.

b) The internal temperature of the unit, when in operation, must not exeed 70°C.

c) If the front panel is installed horizontally, the cover plates should be removed, since the air ducts are no longer vertical.

Each unit is tested by the manufacturer in a 48-hour burn-in at 70°C. With the normal ambient temperature of 20°C, an interior temperature of 45°C is completely non-critical.

The heat dissipation from the power pack is led away to the front panel, i.e. a temperature rise in the area of the mains switch is absolutely normal.

CONNECTION

1. Power supply

1.1. Operating voltage

Check whether the voltage stated on the unit corresponds to the local mains voltage:

"220 V" version for voltages from 190 to 260 V
"110 V" version for voltages from 95 to 130 V.

Modifications to the power pack may only be carried out by the manufacturer.

On enquiry, a modified power supply for operation at 24 V DC (max. 40 V DC) can be supplied.

1.2. Earthing

The ORS complies with the regulations of VDE 550, protection class I. The earth conductor - not detachable from the exterior - is connected to the casing. Disconnection of the earth conductor is not permissible and, for example in case of condensation, can have potenially lethal consequences. The power supply for the input and output boards is derived from the operating voltage of the digital section (+5 V, with negative to ground/earth conductor) and is produced as a floating supply through DC/DC converters. Only the serial information from the remote control is related to the casing earth/earth conductor

1.3. Fuses

The main fuse (0.5 A, slow-action for 220 V; 1 A, slow-action for 110 V) is combined with the appliance plug on the rear. A spare fuse is located in the fuse slide of the appliance plug. The secondary fuse (4 A, slow action) is accessible after removal of the cover plate.

2. Audio section

The inputs and outputs of the QRS are eletrically isolated from one another, are eletronically balanced and non-grounded.

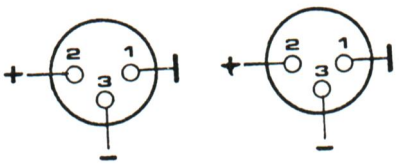
The unit is suitable both for balanced and for unbalanced operation. The QRS has been balanced by the manufacturer to the nominal level of + 6 dBu (0 dBu = 0,775 V). See "Balancing of the Input-Output level".

2.1. Pin allocation of the input sockets (Type SLR 3 F)

Pin 1 Internal ground of the A/D converter, isolated from the other parts of the equipment and from the other input.

Pin 2 Positive signal (+)

Pin 3 Negative signal (-)



Ground connection isolated

The QRS is designed for stereo throughout. If, however, the unit is driven with one "Reverb-Send-Line" only, both inputs of the QRS must be connected parallel, since otherwise the reflection and resonance densities are halved.

Reverb-Send L ⟶ Input L
Reverb-Send R ⟶ Input R
or
Reverb-Send ⟶ Input L
Reverb-Send ⟶ Input R

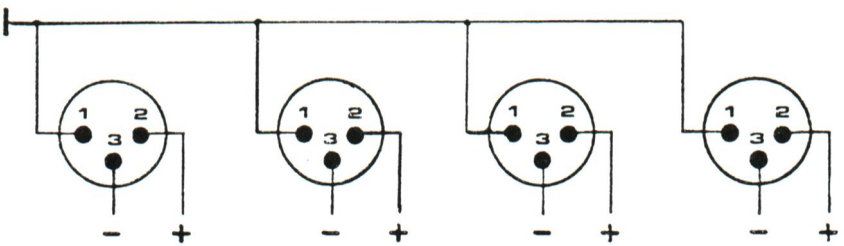
2.2. Pin allocation of the output sockets (Type XLR 3M)

Pin 1 Internal ground of the D/A converter isolated from the other parts of the equipment, but connected together for all 4 outputs.

Pin 2 Positive signal (+)

Pin 3 Negative signal (-)

Ground connections floating, but connected together



The outputs of the QRS are suitable for quadrophonic applications. In addition the *1ST REFLECTION* ist mixed into outputs 1 and 2.

STANDARD CONFIGURATION

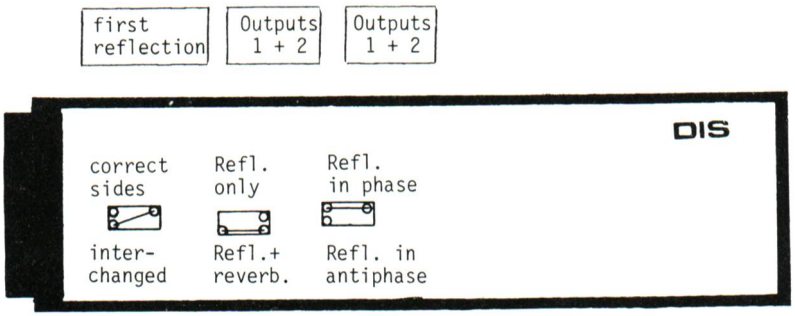
Output 4	Output 3	Output 2	Output 1
Reverb, rear R	Reverb, rear L	Reverb, Front R Reflecion R	Reverb, Front L Reflection L

OPTION

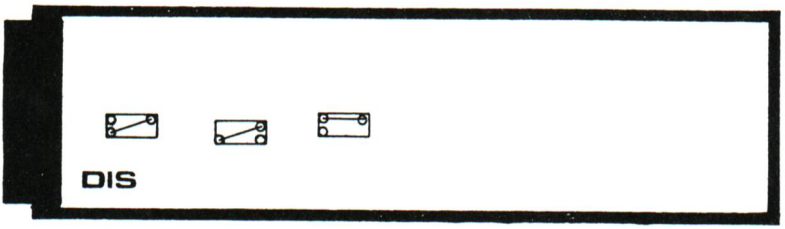
Output 4	Output 3	Output 2	Output 1
Reverb, R	Reverg, L	Reflection R	Reflection L

For the modification, the following operations are necessary:
Release cover plate and remove DIS board. For this purpose release both knurled screws and pull out board. Now fit the links as shown:

STANDARD CONFIGURATION



OPTION



With mono mixtures, use one Reverb output only. As in nature, the mixing together of several reverb outputs causes phase cancellations. In the QRS, the degree of correlation between outputs is 50 %. In the extreme case, with unintentional mixing of two outputs, half of all reflections and half of all room resonances can be cancelled.

3. Balanced operation

Pin 1 Screen and mixing desk ground
Pin 2 Signal + (positive)
Pin 3 Signal - (negative)

4. Unbalanced operation

Pin 1 Screen and mixing desk ground
Pin 2 Signal, or not used
Pin 3 Not used, or signal

ATTENTION: The UNUSED output pins must neither be connected together nor to the ground pin 1.

The outputs correspond to a transformer configuration, in which the centre taps of all four output transformers are connected together.

Note: *PAY CAREFUL ATTENTION TO "FLOATING" SCREENS, THEY COULD CAUSE MASSIVE INTERFERENCE THROUGH STATIC CHARGES.*

5. Remote control unit

The inputs and indications of the remote control unit are identical with those of the QRS basic equipment. Dialog with the control processor takes place through with a serial bidirectional data line, which also permits simultaneous operation of several control panels.

Version 1	Cable length up to 10 m
Version 2	Cable length up to 200 m

Connection of the remote control socket (Type XLR 4M)

QRS Basic unit		cable 3 x 1.5 mm^2 (up to 10 m)	cable 2 x 0.5 mm^2 (up to 200 m)
Pin 1	Equipment ground, not floating	Screen	Screen
Pin 2	Equipment ground, not floating	Core 1	------
Pin 3	+ 5V/2Amp with superimposed 2.56 MHz clock pulse and sync. pulse	Core 2	Core 1
Pin 4	Serial bi-directional data line	Core 3	Core 2

Please take care, that the remote control line is correctly terminated. If you are wiring serveral remote control units, insert the plug of each further remote control unit into the output of the preceding unit. A termination resistor of 100 Ohms/1%(1/4W) must be fitted to the output plug of the last remote control unit, i.e. at the end of the line, in order to suppress line reflections.

Because of the various types and makes of cable, it can happen, that one or other of the remote controls does not synchronise correctly (e.g. confused values, or none at all, are displayed). The operating point of the synchronisation can be corrected with the trimming potentiometer on the TE board of the relevant remote control unit. See "Balancing the sync. operating point".

BALANCING

No special measuring instruments are necessary for matching the QRS to a mixing desk. After removal of the top cover and base plate, the level controls are easily accessible.

1. Input level

The sensitivity can be regulated from -20 dBu to +6 dBu (0 dBu = 0.775 V). The sensitivity has been set by the manufacturer at +6 dBu.

The level controls are located on the A/D boards near the input sockets. They must not be confused with the "Zero Set" controls (in the middle of the board). The board turned toward the rear of the unit is associated with the right-hand channel.

1.1. Feed levelling tone approx. 1 kHz on the "Reverb-Send" line of the mixing desk. Bring the "Reverb-Send" level on the mixing desk to full modulation (0 dB).

1.2. Adjust the level control of the QRS, so that the 0 dB bar of the LED display lights up. The full right-hand stop position gives approx. +6.2 dBu.

2. Output level

The output levels can be adjusted from -6 dBu to +6 dBu, related to 0 dBu modulation of the QRS.

+6 dBu has been set by the manufacturer. Sinusoidal tones are not suitable for the levelling of reverberation signals; nevertheless, you can balance the QRS with levelling tones as follows:

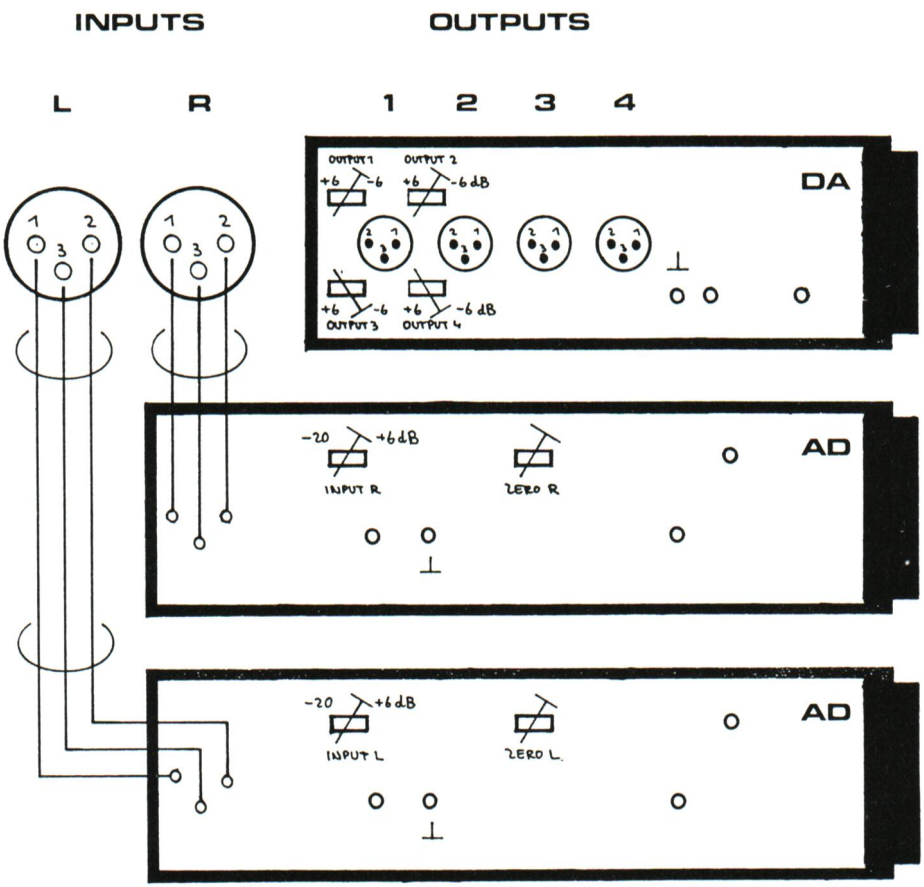
2.1. *REVERB* Level to *OFF*
1ST REFLECTION Level to -0 dB

2.2. Apply levelling tone (approx. 1 kHz), so that the 0 dB bar of the LED display just lights up.

2.3. Set the desired output level by means of trimmers 1 and 2. The maximum level is reached, when the trimmer arrows point toward the input sockets (+ 6.2 dBu).

2.4. For CH3 and CH4, bring the trimmer arrows to the same direction.

The level controls for CH1 and CH2 are located at the top of the D/A board, those for CH3 and CH4 below.

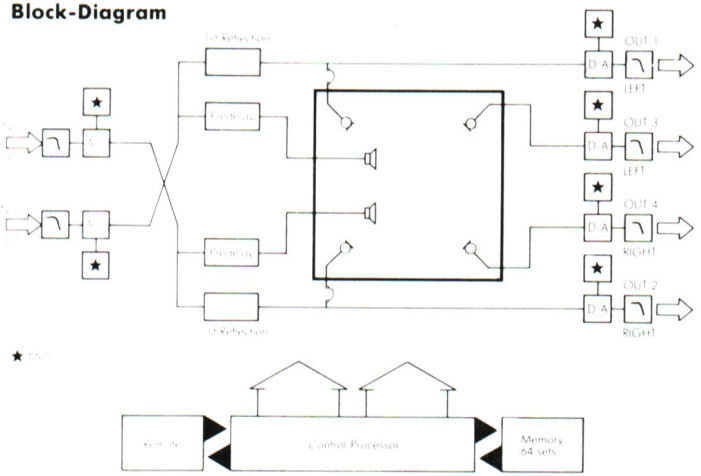


FUNCTIONAL PRINCIPLE OF THE QRS

The QUANTEC Room Simulator is made up of two modules: The three processor-controlled *REVERB*, *FREEZE* and *ENHANCE* programs - the main feature of the QRS, and a delay unit, indepedent of other programs, for discrete echos.

The equipment is fully stereophonic throughout.

Block-Diagram



The block diagram shows, that the two inputs are digitalised, separately from one another, and are only mixed in the simulated room itself. Thus each input is assigned its own "loudspeaker" in the "room".

Thus the QRS is the only digital reverberation processor known to us, which is compatible with AB-stereophony, artificial head, ambiance and holophony systems.

A few explanations on this point:

With pure intensity stereophony, both inputs could be driven in parallel with mono, without altering the reverberation result, since, as is well known, the sound energy in an ideal reverberation chamber is equal at every point, provided that the band width of the signal is large in comparison with the resonance density of the reverberation chamber. On the other hand, the conditions are quite different with artificial head stereophony or other non-mono-compatible recording processes, with which the transit time between the left and right-hand channels is the decisive factor for perception of direction or room orientation (e.g. mono → synthesiser).

Since the two signals, left and right, are not coherent, unwanted phase cancellations occur with the channel coupling at the input of the reverberation equipment, which is otherwise customary, so that certain information is missing from the useful signal to be processed. In addition, the signal is falsified by comb-filter effects. These are unfavourable pre-conditions for true-to-life reverberation.

If, on the other hand, both channels are processed separately and are only linked through the complex frequency, phase and propagation time performance of the reverberation chamber, then the signal remains

undiscoloured and, considered over the entire room, free from cancellations. Each frequency has its own location in the room. Thus the transparency of the spatial impression is considerably increased. In addition, the reverberation should be generated outside the "Haas-window". Thus the room information of the dry signal, imaged by transit times, remains free from location displacements and blurring.

In the QRS, this circuit principle is followed consistently. The left- and right-hand input signals are digitalised by the A/D converters assigne to each of them and are then converted, purely mathematically, into a reverberation signal. The character of the reverberation chamber, for example, the room size and the quality and structure of the walls, is defined with the push-buttons on the front panel of the unit.

The signal is picked up at four locations in the reverberation chamber and is converted, through four D/A converters, into four analog reverberation signals. The degree of correlation between any two outputs is 50 %. This gives clean spatial information without a "hole in the middle". The particular configuration of the outputs in the QRS generates reverberation signals for mono, stereo and quadrophonic applications.

With pure head-phone application (artificial head (binaural) stereophony), only two outputs are necessary, even for the 3-dimensional impression. The mixing of several reverberation channels gives no improvemant. Through the 50 % correlation, half of the reverberation signal could even be cancelled out.

Indepedently of the paricular reverb program, the two input signals, after the A/D converters, are led through two separately adjustable delay units and appear, exchanged side for side, as a stereo echo at the outputs 1 and 2. Through the inter-changing of the two channels, the transparency of this *1ST REFLECTION* is considerably increased.

Dynamic range

The dynamic range of the A/D and D/A converters amounts to 90 dB and is represented by a linear 16-bit code (15 bits + sign). However, since resonances occur in the simulated rooms, the dynamic range to be handled by the processer must be considerably greater. This also applies, even if a given resonance peak is compensated for at other points in the room. In order that the processor cannot be overloaded by sine-wave tones which are tuned very precisely to the room resonances, ten further overflow bits have been provided, so that the internal dynamic range is about 150 dB.

Attempts are often made, to reduce technical costs, by slightly modulating the clock frequency of the processor, so that it is no longer possible for the tones to "latch on" to the resonances. However, this causes disturbing frequency modulations, which give problems, especially with keyboard music. In order that the resonances, excited by sine-wave tones, which still pass through singly to the DA converter, do not appear with too disturbing an effect, a "gentle" overlow characteristic has been provided. These overloads are also detected by the output level indicators.

Overflow characteristic of D/A converter

Fully modulated Slightly overloaded Heavily overloaded

Remote control

The QRS can be equipped with any desired number of remote control units, which all work in parallel. Since the processor only registers the first push-button instruction in each case, contradictory inputs from different remote control units will be ignored.

The internal power supply of the QRS is designed for a maximum of two complete displays including modulation indication. The remote control unit can only be fed from the QRS, if the connecting cable is not longer than 10 m and has a cross-section of 3 x 1.5 mm^2. If the remote control unit is fed from its own power pack (5 V/2 Amp), a distance of at least 200 m can be spanned by means of normal microphone cable (2 x 0.5 mm^2).

With the aid of an appropriate interface, the QRS can also be controlled through en external computer, since not only all parameters and modulation values (i.e. the instantaneous status of the processor), but also all input instructions are transmitted in serial form

at the remote operation connection. The QRS front panel could also be simulated with all its indications on a video display terminal.

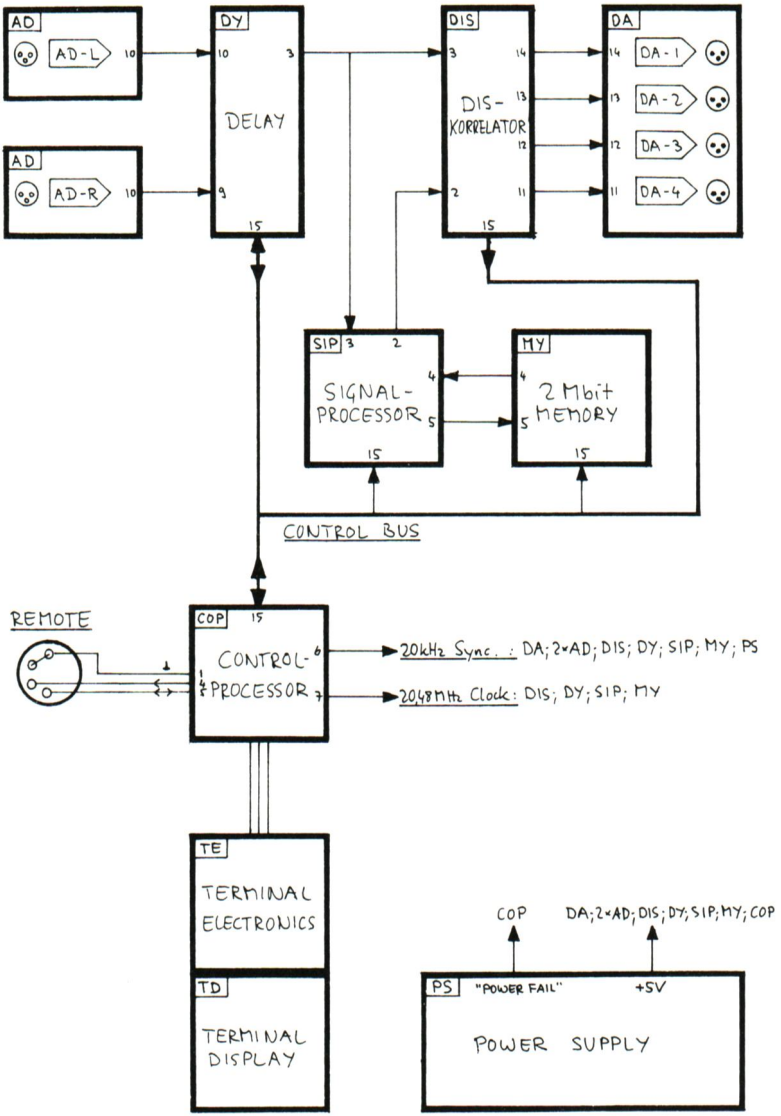
TECHNICAL APPENDIX

Room situations programmed by the manufacturer:

MEMORY			*PARAMETER*			
FILE	*LOC*	*PROGRAM*	*HIGH*	*TIME*	*LOW*	m^2
7	1	For allocation as desired				
	2	EMT 140	0.63	3.2	0.63	10.2
	3	Chamber music studio	0.63	2.2	1.6	10.3
	4	Concert hall, full	0.4	2.8	*LIN*	10.4
	5	Concert hall, empty	0.63	3.2	1.6	10.4
	6	Church	0.25	4.5	2.5	10.5
	7	St. Peter's Cathedral	0.16	12.5	1.6	10.6
	8	Taj Mahal	0.1	45	*LIN*	10.6
8	1	For allocation as desired				
	2	Wardrobe, full	0.1	0.16	0.1	1
	3	Wardrobe, empty	0.4	0.25	0.1	1
	4	1,000 l Oiltank	0.1	0.5	10	1
	5	Ship/submarine	0.1	1.0	10	10.2
	6	Living room, furnished (curtain closed)	0.16	0.4	0.16	10.2
	7	Living room, furnished (curtain open)	0.63	0.4	0.16	10.2
	8	Living room, unfurnished	*LIN*	0.63	2.5	10.2

Loudspeakers

Headphones



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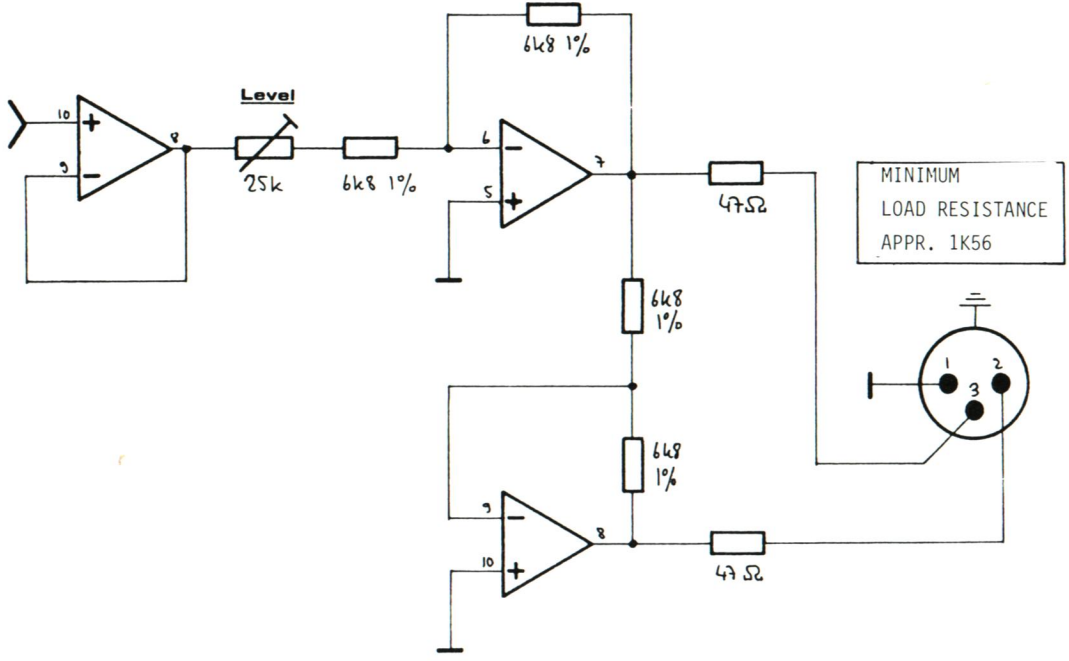
				Norm			
							Blatt
							Bl.
Zust.	Änderung	Datum	Name	(Urspr.)		(Ers. f.:)	(Ers. d.:)



D/A CONVERTER ANALOG OUTPUT				Maßstab:	Quantec GmbH, München	
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			Norm			
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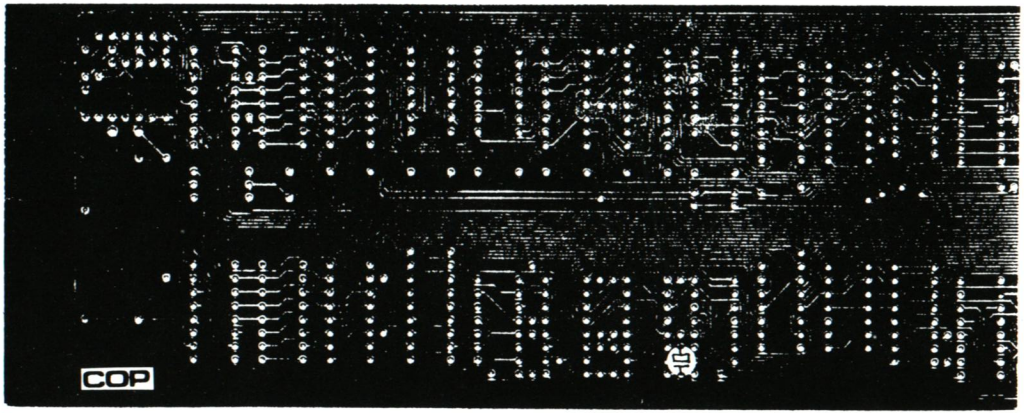

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VERDOPPELUNG DER "COPY"-ZEIT				Maßstab:	Quantec GmbH München
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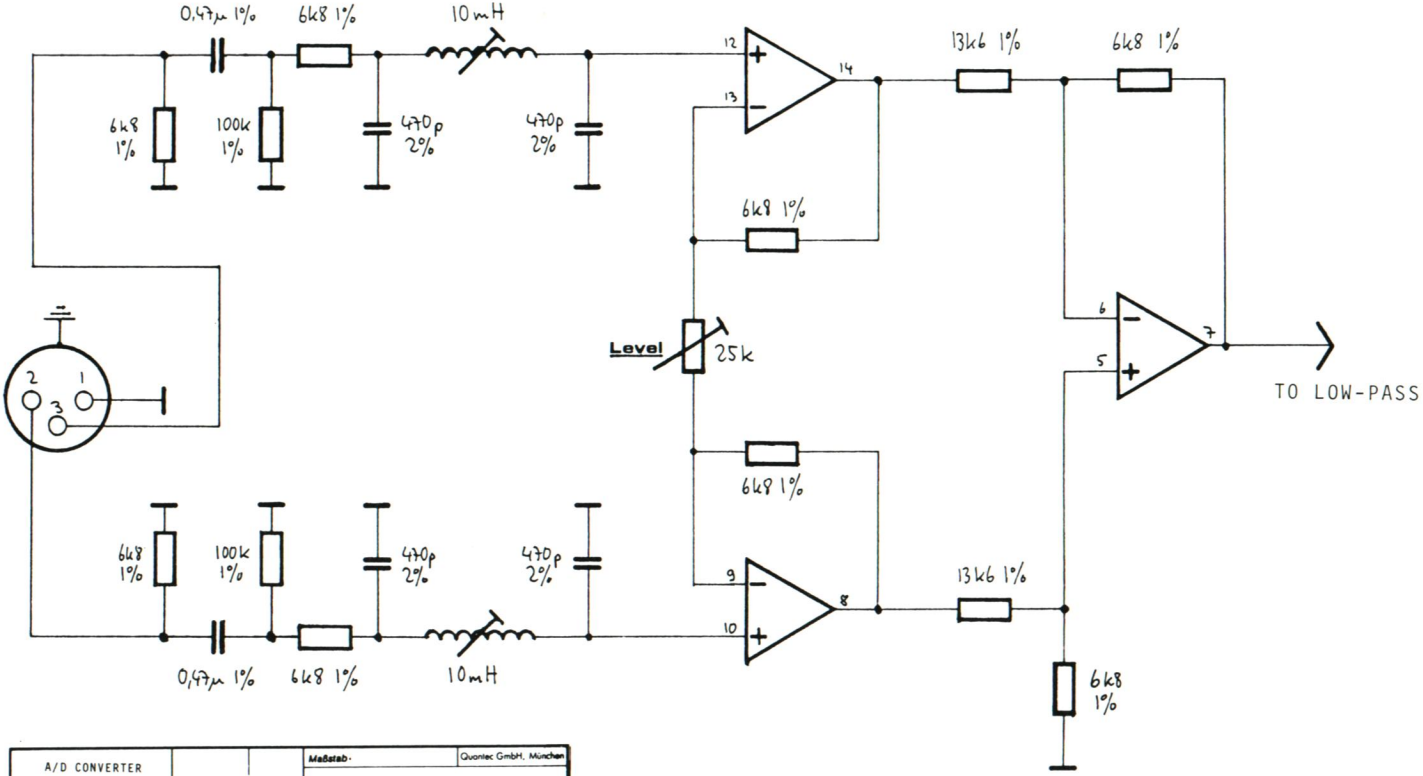
		Gepr			
		Norm			
Zust. Änderung	Datum Name	(Ursp.)	(Ers. f.)	(Ers. d.) SCHWARZ	Blatt Bl



A/D CONVERTER ANALOG INPUT				Maßstab:	Quantec GmbH, München
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				Gepr.	
				Norm	
				QUANTEC QRS SERIEN 100+200	
					Blatt
					Bl
Ers. für:	Ersetzt durch:	Datum	Name(Kürzel)	(Ers. f.:)	(Ers. d.:)

Specifications

Programmes

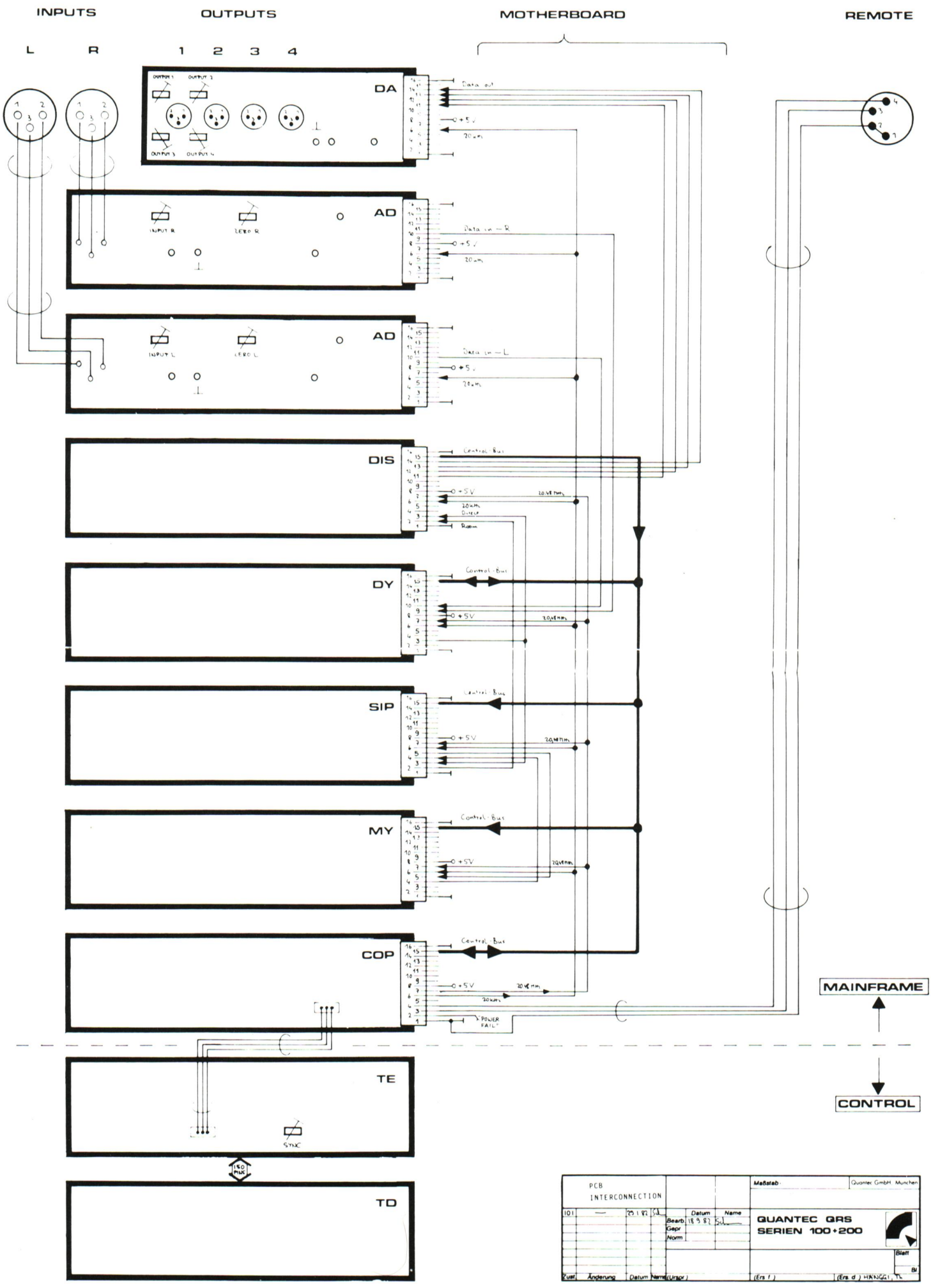
a) Reverberation programmes	
Room sizes	1 m^3–10^6 m^3 with 7 steps
Decay time	0.1 sec to 100 sec (up to 400 sec at 40 Hz)
Decay time at low frequencies	Coefficient of 0.1 to 10 with 11 steps in relation to selected decay time
Decay time at high frequencies	Coefficient of 0.1 to 2.5 with 8 steps related to selected decay time
Reverberation density	More than 10,000 per sec depending on room size, average of 3 per Hz of bandwidth depending on room size
Prereverb delay	1ms–200ms in steps of 1ms (optional 800ms in steps of 4ms), level –30dB to 0dB in steps of 1dB 'OFF' Function
1st Reflection	1ms–200ms in steps of 1ms (optional 800ms in steps of 4ms), level –30dB to 0dB in steps of 1dB, 'OFF' Function
b) Enhance-programme	Simulation of rooms without perceptible reverberation
Number of programmes	7
c) Freeze-programme	Special loop programme with infinite decay time to add any number of acoustical entries

Digital Specs

a) A/D converter code	16 Bit
Sampling rate	20 kHz
Distortion	0.1% typ.
b) Processor	26 Bit
Clock frequency	20.48 MHz
c) Memory	approx. 2 Megabit of RAM

Analog Circuit Specs

a) Inputs	2 of, balanced, isolated by digital optocouplers
	Input impedance 13.2 kOhms balanced 6.8 kOhms unbalanced
	Level adjustable –20 dBm to +6 dBm
	Headroom 12dB above nominal level
	RF-filter 18dB/Octave beyond 100 kHz
b) Outputs	4 of, balanced
	Outputs 1 and 2 reverb plus 1st reflection
	Outputs 3 and 4 for quadrophonic use
	Output Impedance 100 Ohms balanced 50 Ohms balanced
	Minimum load 1 kOhm
	Nominal level adjustable –6 dBm to +6 dBm
c) Dynamics	Better than 85dB unweighted typ. 90dB (valid for all decay times)
d) Frequency response	20Hz–8 kHz +0/–3dB
e) Power supply	220V, 50/60Hz, 80VA (option 117V)
Connectors	XLR-3
Dimensions	Standard 19" width 2 height units, 260 mm
Weight	5.5 kg
Remote control	Identical to front panel, display and operation simultaneously
Remote cable	Twin, sreened cable up to 30 feet (optional up to 600 feet)
Protection circuits	a) prevention of dicks of external fine transitions b) save against power supply overvoltage c) in case of mains fault, programmes are safe



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				Norm			
Zust.	Änderung	Datum	Name	(Ursp.)	(Ers. f.)	(Ers. d.) HANNGG1, TL	Blatt 81

Quantec GmbH, Sollnerstr. 7a, D-8000 München 71, Tel. 089 / 7 91 40 41, Telex 5 23 793