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1. INTRODUCTION The basic information necessary to allow a recording engineer to operate the SQN-2S audio mixer is permanently displayed on its baseplate and cannot be lost. The aim of these instructions is to explain the mixer’s facilities and functions in more detail to those who are already familiar with the microphones and techniques that are employed by professional sound recordists.

2. POWERING THE MIXER

1. INTERNAL BATTERY. The SQN-2S should be powered by Mallory Type MN 1500 or another manufacturer's equivalent AA size alkaline cells. The quiescent consumption of the mixer is approximately 140mA at 9V and with dynamic microphones about 10 hours of continuous operation can be expected from fresh cells.

   Rechargeable nickel cadmium or preferrably the higher capacity NiMH cells may be employed for maximum economy. If all cells are good they may be recharged in series using an external charger unit, which can be connected to the 4-way connector [P] on the end panel.

   For maximum life, lithium cells giving 3 volts per cell can be used, since the power supply will accept inputs up to 18 volts. The use of ordinary 'dry cell' carbon zinc cells, which may leak and cause extensive damage, is definitely not recommended. In any case, when used in the SQN-2S they give a small fraction (about one fifth) of the life of alkaline cells, so they are a false economy. If discharged cells are left in the mixer they may leak corrosive liquid and cause expensive damage. Cells must also be removed from the mixer if it is to be stored for any length of time or transported, particularly by air.

   To fit the cells, slide the battery door catch on the right side of the mixer towards the front panel to release the door and insert two rows of four cells in series, so that the lower tube has the positive poles facing the door and the upper tube the negative poles, as is indicated on the door itself. If the cells are inserted with incorrect polarity the mixer will not function; an internal protection circuit prevents damage to the mixer power supply. When operating from the internal battery supply, toggle the power selector switch, situated at the right hand end of the mixer, to the [BAT] position to power the mixer. Green LEDs in the meters light up, indicating that the mixer is switched on.

The right channel meter doubles as a voltmeter for the power supply when the adjacent [BATT] push button switch is depressed. The mixer is guaranteed to work down to a battery voltage of 4 volts, so that as long as the battery meter reads on scale, performance will be to specification. If the voltage is allowed to fall lower then eventually the internal power rails will fall. This will affect the headroom of the output and monitor amplifiers and the setting of the Line-Up tone; ultimately the performance of the whole mixer will be degraded. It is worth noting that as the battery voltage falls, the current drawn by the power supply will increase to maintain the required power input. The battery voltage is, therefore, likely to fall quite quickly as the cells become exhausted.

2. EXTERNAL POWER SOURCE. A direct current supply in the range 5 to 18 volts can be connected to the 4-Way connector [P] on the side panel. In order not to restrict the usable types of powered microphones, the power supply must be capable of delivering 2.5W while maintaining an output voltage in the required range.

   The mixer's power input terminals float with respect to the SQN-2S ground, so a supply which does not share a ground with the SQN-2S may be used, e.g. a camera battery. The power supply input of the SQN-2S is protected against connection of an external voltage with reversed polarity. If it is desired to power the SQN-2S from an external DC supply at higher voltage than 18V, reference should be made to the manufacturers

   To power the SQN-2S from an external supply the Power Selector Switch on the right hand panel must be toggled to the [EXT] position.

3. OUTPUTS The mixer is provided with two balanced line driver amplifiers of substantial capacity. Additionally, unbalanced feeds of the two outputs are available at a nominal line level of -10dBu (-8dBu if Nordic Norm meters are fitted) with 200 Ohm source resistance. These signals are made available on the connectors at the end of the mixer. The output level at the multi-way connector may be attenuated by 50dB to provide a nominally microphone level feed using the toggle switch set into the mixer baseplate. The connection lists for the multi-way connectors are given in section 17.

4. LINE-UP TONE A calibration Tone of 1kHz with distortion below 0.1% may be injected into both output channels by setting the 3-way front panel [T/MIC] switch to the left. The form that the tone takes depends on the setting of the [GANG 1-2] switch. When this switch is in the unganged [O] position the tone is continuous in both channels. Either of the other two positions gives an EBU coded tone signal (the left channel interrupted for 250ms every 3s) to indicate that the recording which follows is true stereophony. The tone mutes and replaces the main audio. The calibration level for a given meter reading is indicated on the baseplate of the mixer and, unless specially requested, it will be at the Nominal Line Level (next section).

5. CALIBRATION OF THE RECORDER The recorders that are used with the SQN-2S are almost invariably fitted with some form of input gain control. In these circumstances the absolute calibration levels of both the mixer and the recorder become irrelevant: what must be considered are the relative calibration points Nominal Line Level (0VU) and Nominal Peak Level on the meters of both instruments and how they are to be related.

The basic calibration used at SQN is to place the Nominal Line Level at PPM4, 'TEST' or 0VU and then to treat the Nominal Peak Level as being 8dB above this, in the case of the PPM or VU meter or 6dB above in the case of the Nordic type of meter. The limiter is then set to come into operation on a steady tone at 1dB below the Nominal Peak Level. This ensures that

the mixer output will not exceed the Nominal Peak Level when measured using a Peak Programme Meter. The Line-Up tone is then usually set to the Nominal Line Level. The calibration points, including the limiter setting, are shown on the individual mixer baseplate.

When interfacing to an analogue recorder with its typical slow overload characteristic, what is required is to place the mixer's Nominal Peak Level at the correct point which will ensure that the recorder will not be overloaded by a limited transient output from the mixer. Most of the ENG recorders use VU meters, with which the Peak Level is off scale. The reference point we use, therefore, is the Nominal Line Level - the level to which the mixer's Line-Up tone is set. Experience has shown that most of the usual ENG recorders are calibrated so that their Nominal Line Level or 0VU is only 6dB below the level at which distortion is beginning to increase. Accordingly, it has become the practice to adjust the recorder's gain control to place the mixer's Line-Up tone at -2dB on the recorder's VU meter. Some recordists prefer to go further and leave themselves a little more headroom on the recorder by placing the line up tone at -4dB on the recorder's meter.

Interfacing to a digital recorder with its much more sudden and unforgiving overload characteristic requires that the Nominal Peak Level of the mixer be placed below the peak level of the recorder. This is because the limiting, as carried out on the mixer assumes that the following recorder is tolerant of some degree of overload for periods up to 1ms, hence the emphasis on the measurement using a Peak Programme Meter in the paragraph above. Fortunately, digital recorders, because of their clipping characteristics, are almost always fitted with fast peak meters, reading on a sample by sample basis. It is easy to set the matching between the mixer and the recorder experimentally using limited transients such as sharp handclaps. Typically, the Line-Up tone should be placed 12dB below the allowed peak level.

6. MONITOR RETURN INPUTS The SQN-2S features twin auxiliary inputs on its 12-way [MAIN] connector [A] which are intended to accept a return signal from whatever recorder the mixer is feeding. The input sensitivity is set by adjusting the screwdriver-operated potentiometer marked [RET] recessed into the left hand side panel of the mixer. It can usually be fixed with sufficient accuracy by ear by operating the [MIXER RET] switch situated above the [PHONES] switch to and fro with the line-up tone on and adjusting for parity of loudness. This feature allows before/after comparison of off-tape monitoring, or when used with a recorder that lacks off tape monitoring, it can be used as a check that mixer outputs are at least reaching the recording inputs. The [MIXER RET] switch affects only the headphone signals.

There is an additional sensitivity switch for each channel of the monitor return inputs, accessible by removing the baseplate. These slide switches, located on the vertical board allow the sensitivity to be reduced by 10dB and can usefully be set if it is known that the mixer will only be used with recorders having line-level returns.

Many ENG recorders feature an 'Earphone Monitor' output on a 3.5mm jack, intended for the cameraman's use. This often carries audio warning of tape end or other errors, but because it is fed from the recording head the practice has grown of using it for audio confidence monitoring even though it is usually Dolby encoded, contaminated by time-code noise, unbalanced and at very low level (typically -16dBu). Cable looms incorporating quad stereo leads in a single flexible cable of only 7mm diameter have been developed at SQN for use in interfacing such recorders with the 12-way [MAIN] socket [A] of the mixer. They are available in straight or coiled formats.

7. MICROPHONES The channels 1 & 2 XLR-3F microphone input connectors are wired to conform with the IEC standard (Pin 1 ground, Pin 2 in phase and positive for T-powering). These channels are designed to accommodate all professional microphones and assume a source impedance for dynamic microphones in the range 150-600 Ohms. Condenser

microphones, of course, will present source impedances much lower than this but because of the absence of input transformers in the mixer, the frequency response will be unaffected. It is outside the scope of this manual to describe in any detail the various types of microphone which may be employed, but the type will determine the settings of switches set into the baseplate of the mixer. While the SQN-2S has sufficient current capacity to supply any make of condenser microphone, the use of microphones which have a particularly large current drain with battery-powered equipment will need careful consideration. Some marked improvement in performance or special tonal characteristic should be required as compensation for the reduced battery life.

The primary purpose of the Microphone Attenuators [ATTEN] is to provide a rough level match between the input signals from microphones of varying sensitivities so as to allow comfortable handling of the gain controls. The ‘attenuators’ are, in fact, switched gain controls so that there is no need to fear a worsening of noise performance from their use.

It is, of course, not good practice to rely on attenuators (or gain controls) when using sensitive condenser microphones close to loud sounds, such as motor sports or pop music, since such signals may well overload the microphone’s own first stage. In those conditions the ambient noise level can even prevent such a disaster being detected on your headphones. The use of dynamic microphones may be more appropriate in these cases.

Rotary faders were selected for the SQN-2S because of their inherently better environmental sealing and because they provide more mechanical movement in a small space than a slider. The specially designed control knobs incorporate some of the advantages of the slider in that they can be pushed from the side and their position is unequivocally seen and felt. Turning over a wide arc is achieved with the tip of the finger or thumb resting on the point of the arrow design..

7a. AUX MICROPHONES The channels 3 & 4 XLR-3F microphone input connectors are wired to conform with the IEC standard (Pin 1 ground, Pin 2 in phase) These channels are intended to work with self-powered microphones, in particular Radio Microphones. They have no powering, a 10dB lower gain than the primary channels and a single step of attenuation. In effect, they will behave as the primary channels with attenuations 2 & 3. There is also a fixed 40dB attenuator so that they can accommodate line level sources.

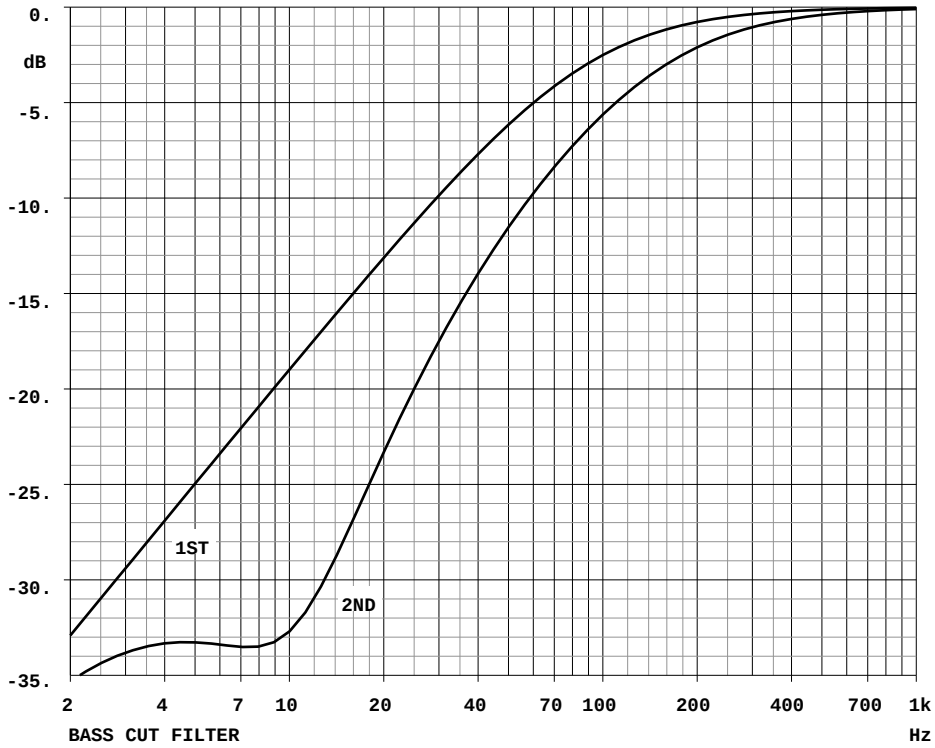
The fader knobs for these channels are physically smaller. In their intended use with Radio Mics, this should not be a problem. Since the distance between a radio mic and its source does not vary in typical use, repeated setting of levels is not required.

8. LINE INPUTS Channels 3 & 4 microphone inputs may be individually switched for use as balanced line inputs. This is achieved simply by switching a fixed 40dB attenuator in front of the microphone amplifier. The attenuator and fader controls operate as before.

9. MASTER GAIN CONTROL The Master fader, located on the connector side panel controls the gain of the two output channels simultaneously. There is a reserve of gain of 3dB above the 0dB calibration point (which is located by a mechanical detent), so that this control can be used to raise the overall level of a mix as well as to fade in and out.

10. BASS CUTS A Bass Cut switch for each of channels 1 & 2 is situated next to its fader allowing for bass attenuation of the signal with cutoff frequency that depends on the setting as shown in the accompanying graph. These are employed for a variety of purposes, such as reduction of ‘boominess’ in hard or ‘live’ acoustic locations, or from deep voices, as well as reducing extraneous traffic rumble, ‘mains hum’ from electrical appliances and so on. Perhaps

the most common use for bass cuts is to assist in the reduction of wind noise outdoors, but a suitable windgag on the microphone will also be essential.



11. AUDIO LEVEL METERS The basic type of metering employed on the SQN-2S is the Peak Programme Meter (PPM). This was chosen as providing the maximum information about the relationship between the signal level and the overload point of the recorder. Admittedly, peak meters do not necessarily give a true representation of the loudness of the signal and some recordists prefer the VU type of meter which we can also provide. The meters can only give a useful indication of the recording level when the combination of mixer and recorder has been calibrated. Each meter is permanently illuminated while the mixer is switched on, allowing operation at in dim light. The illumination requires minimal current from the batteries.

For those unfamiliar with the BSI (BBC style) PPM scale, the intervals between scale graduations represent a 4dB difference, so that with the nominal Line Level (0dBu) represented by 4, the nominal Peak Output Level of the mixer (+8dBu) occurs at 6 on the scale. This 'Nominal Peak' is a simplification of the arguments, since in practice the BBC has adopted various preferred peak levels for different sound sources and even individual musical instruments. Other PPM scales have not followed the BBC design and are all expressed in decibels, which makes them more readily intelligible. They also usually feature a TEST arrow at 0dBu (0.775V) for calibration purposes. The 'nominal peak' level referred to above tends to be seen as +6dB where the scale is calibrated in 3dB steps (e.g. the 'Nordic Norm' pattern adopted by the Scandinavian Broadcasting Consortium) or +8dB where calibration is in 4dB increments (e.g. the SMPTE 'preferred' scale published in 1989 where this peak level is scaled as '0').

VU meters also vary in their calibration. The original VU measured zero at zero dBm in a 600 Ohm system. Modern practice, based originally on the improved high level performance of analogue recording tape, is to place zero VU at +4dBm. Either calibration can be provided and will be noted on the mixer baseplate.

12. OUTPUT LIMITERS Location recording frequently puts the recording engineer in a situation in which he or she has no control over the ambient sound level. Accordingly, the SQN-2S has been provided with a pair of output peak limiters that may be confidently employed at all times. Coming into operation just below peak level, they accommodate overloads of up to 20dB with an attack time of half a millisecond and a release time of 100ms.

Peak limiting is an extremely non-linear process that relies on the masking characteristics of the ear to render the effect essentially inaudible when executed properly and used in moderate amounts. It is bad practice to make a habit of 'riding' the limiters: the LEDs should only light on the occasional unexpected peak if the levels are correctly set. Allowing the limiters to be operated by low frequency or sub-audio rumbles will cause modulation of the more audible midrange and high frequency audio. In the worst case this may manifest itself as apparently random audible clicks. The bass cuts should be used to remove dominant low frequency signals so that the limiters are operated only by signals in the wanted audible range.

The Limiters are actuated by a switch [LIM] towards the right of the front panel and in the [M]ono position each output channel is separately limited, with actual limiting being indicated by an LED for each channel, placed between the meters. With stereo recording, limiting can introduce a further problem since, if only one channel of a stereo pair is subjected to limiting, the effect is to shift the stereo image. The [LIM] switch, therefore, has a third [S]tereo position in which the degree of limiting is governed by the higher of the two output channel levels. This setting should be used when the mixer output is stereo, of either type AB or MS.

13. MONITORING HEADPHONES The quarter inch jack [PHONES] of the SQN-2S will accept any standard stereo plug. Headphones of any impedance may be employed although impedances of around 25-200 Ohms will make best use of battery power. For location work, it is advisable to employ headphones with good ear sealing even though they can be uncomfortable when worn for long periods of time. Increasing the headphone level to drown the directly audible sound in noisy situations could prove fatiguing or even damaging to the hearing in the long term, particularly if the limiters are not used. The control knob next to the jack on the left hand side panel allows the headphone output level to be adjusted - down to zero if desired.

A rotary [PHONES] switch on the front panel allows the operator to select various sources for the monitored signals, including the output of an MS matrix which will allow an MS signal output from the mixer to be monitored as the equivalent AB signal. The switch functions are:

- S Stereo
- R Right Channel
- L Left Channel
- MS MS Matrix (MS heard as AB stereo)
- L+R Sum of Left & Right Channels
- O Mute

Below the rotary [PHONES] switch is a three position toggle switch which allows the selection for monitoring of the mixer output [MXR], the return signal from the recorder [RET] or a pre-fade listen signal from channel 4 [PFL4]. The latter position is sprung to return to centre when released.

14. MIXING & MATRIXING CONTROLS The SQN-2S mixer is intended to work in various modes and particularly to accommodate the use of Mid-Side microphones and Mid-Side recording. The CH1/CH2 pair is treated as a potential Stereo Channel, with or without MS

matrixing This is in addition to the usual routing of individual channels to either or both outputs.

The operation of the CH1/CH2 pair is controlled by the [GANG 1-2] and [PHASE] switches as follows:

1. TWIN MONO with the [GANG 1-2] switch at [0]. The CH1/CH2 faders operate independently. The routing switches at the end of the mixer can direct the signals to either or both of the two mixing busses.

2. STEREO with the [GANG 1-2] switch at [S]. The input and output from the pair are treated as an AB stereo signal. The gains of both channels are controlled by the CH1 fader. The channels should be routed; CH1 to Left, CH2 to Right.

   MS USE of the STEREO MODE: If an MS signal is passed through the mixer with the [GANG 1-2] switch at [S], the CH2 fader can be used as a width control.

3. MID-SIDE with the [GANG 1-2] switch at [MS]. The input to the pair is treated as an MS stereo signal which may be matrixed into AB stereo. The gains of both channels are controlled by the CH1 fader. **Both input channels should be routed to both output channels (routing switches centred).** The CH2 fader acts as an MS width control by altering the relative level of the CH2 side signal: a setting of 10 will give a relative level of 100% or normal width.

   Selecting MS an introduces an inversion into the signal from CH2 that is routed to the Right output. When both input channels are routed to both output channels (routing switches centred), the two mixer outputs thus become

   - CHL = CH1 + CH2
   - CHR = CH1 - CH2

   which are the conditions for matrixing MS to AB

The [PHASE] switch (on the right hand end panel) acts on CH2, independently of the settings of the other switches. When it is moved downwards, it inverts the phase of the signal. This has the incidental effect of interchanging left and right in an MS encoded input. This can be useful when the MS mic is rigidly fixed to a boom and rotated from being above the subject to below, when left and right will become interchanged.

The controls available for the CH3/CH4 pair are the routing switches on the end panel of the mixer. These allow either of the channels to be routed directly to either or both output channels.

15. SLATING MICROPHONE A microphone is mounted behind the front panel near the centre of the mixer. This microphone, brought into use by moving the [T/MIC] switch on the front panel to the right, is intended for recording identification announcements and slating marks on the output channels. The output of the microphone is levelled by a compressor and overrides the main audio, appearing on the mixer outputs and in the monitoring system. If the monitoring mode is set to [RET] at the time the button is pressed, it automatically reverts to the internal or [MXR] setting. This is so that the recordist, if working with a recorder equipped with off-tape monitoring will not have to talk over a delayed version of the announcement. The inclusion of the compressor means that a usable recording can be made by speaking in a normal voice over a range of 1.5m to 250mm from the mixer, depending upon the ambient noise level.

16. WARRANTY & SERVICE The SQN-2S is guaranteed for a period of 24 months from the date of purchase. This guarantee covers defects in manufacture, workmanship and materials and includes the cost of parts, labour and return carriage. The full terms of the guarantee are given in the printed copy of this document delivered with the mixer.

17. CONNECTOR WIRING

SQN-2S Connectors & Wiring

MULTI-WAY I/O CONNECTOR WIRING (12W)

MAIN I/O [A]

- A Live, B Return — Balanced Output CHL
- C Live, D Return — Balanced Output CHR
- E Live, F Return — Monitor Return Input CHL
- G Live, H Return — Monitor Return Input CHR
- J Gnd
- K Gnd
- L Unbalanced Output CHL
- M Unbalanced Output CHR

UNBALANCED OUT [UB]

- Tip CHL Unbal. Out
- Ring CHR Unbal. Out
- Sleeve Gnd

POWER INPUT [P]

- 1, 2 — External Power and Battery Negative (−)
- 3 Battery Positive (+)
- 4 Ext. Power In Positive (+)

5 WAY XLR OUT

1 Ground
CH1 2 Live 3 Return
CH2 4 Live 5 Return

18. CONNECTOR LIST

The following is a list of the manufacturers part numbers for connectors to mate with those on the mixer

MIXER CONNECTOR	MATING CONNECTOR	MANUFACTURER
MAIN I/O [A]	PRC05P12M	Tajimi
MAIN I/O [A] (SCREW)	RM15PD10P	Hirose
POWER INPUT [P]	HR10A7P4P	Hirose