

square
one
graphic

operator
manual

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OPERATOR MANUAL

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Square ONE Graphic Equaliser - Operator Manual
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In line with the company's policy of continual improvement, specifications and function may be subject to change without notice. This Operators Manual was correct at the time of writing. E&OE.



IMPORTANT SAFETY INSTRUCTIONS



The lightning flash with arrowhead symbol within an equilateral triangle, is intended to alert the user to the presence of uninsulated "Dangerous Voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle, is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with a dry cloth.
7. Do not block any of the ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
11. Only use attachments/accessories specified by the manufacturer.
12. Unplug this apparatus during lightning storms or when unused for long periods of time.
13. Refer all servicing to qualified personnel. Servicing is required when the apparatus has been damaged in any way, such as power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
14. Use the mains plug to disconnect the apparatus from the mains.
15. "WARNING - TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPARATUS TO RAIN OR MOISTURE."
16. "DO NOT EXPOSE THIS EQUIPMENT TO DRIPPING OR SPLASHING AND ENSURE THAT NO OBJECTS FILLED WITH LIQUIDS, SUCH AS VASES, ARE PLACED ON THE EQUIPMENT"
17. "THE MAINS PLUG OF THE POWER SUPPLY CORD SHALL REMAIN READILY OPERABLE"



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EU DECLARATION OF CONFORMITY

We, **Telex Communications (UK) Limited** of Klark Teknik Building, Walter Nash Road, Kidderminster, Worcestershire, DY11 7HJ, declare that a sample of the following product:

Product Type Number	Product Description	Nominal Voltage(s)	Current	Freq.
Square ONE Graphic	Graphic Equaliser	115V AC 230V AC	312mA 156mA	50/60Hz

to which this declaration refers, is in conformity with the following directives and/or standards:

Directive(s)	Test Standard(s)
89/336/EEC Electromagnetic Compatibility Directive amended by 92/31/EEC & 93/68/EEC 73/23/EEC, Low Voltage Directive, amended by 93/68/EEC	
Generic Standard Using EN55103 Limits and Methods	EN50081/1
Class B Conducted Emissions PAVI	EN55103
Class B Radiated Emissions PAVI	EN55103
Fast Transient Bursts at 2kV	EN61000-4-4
Static Discharge at 4kV	EN61000-4-2
Electrical Stress Test	EN60204
Electrical Safety	EN60065 7 th Edition

Signed: Date: 31st October 2005
Name: Simon Harrison

Authority: Research and Development Director, Telex Communications (UK) Limited

Attention!

Where applicable, the attention of the specifier, purchaser, installer or user is drawn to special limitations of use which must be observed when these products are taken into service to maintain compliance with the above directives. Details of these special measures and limitations to use are available on request and are available in product manuals.



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Welcome!

Thank you for purchasing a Klark Teknik Square ONE Graphic graphic equaliser.

Klark Teknik has conceived the Square ONE range to offer audio professionals a range of easily accessible, high-performance audio equipment, designed to provide no-compromise sonic quality with a feature set which offers all essential facilities.

Your Square ONE Graphic equaliser represents the very best of British design and engineering, combined with contemporary, efficient manufacturing methods, and will give you many years of reliable service.

The Square ONE Graphic is a dual, 30-band, third octave graphic equaliser. It incorporates long throw 45 mm faders and has high and low pass filters on each channel.

All backed up, of course, by the standard Klark Teknik three year warranty.

Please take the time to complete and return the registration card or fill in the Warranty Registration Form online by visiting our website at www.ktsquareone.com and, to obtain the best results with a minimum of effort, also read this operators manual.

Finally, enjoy your Klark Teknik Square ONE Graphic!



Safety precautions

Before installing, setting up or operating this equipment please ensure that you have read and fully understand all of this section and the "IMPORTANT SAFETY INSTRUCTIONS" at the front of this manual.

This equipment is supplied by a mains voltage that can cause electric shock injury!

The following special limitations must be observed in order to maintain safety and electromagnetic compatibility performance.

Safety warnings

This equipment is fitted with a 3-pin power socket. For safety reasons the earth lead must not be disconnected.

Signal OV is connected internally to the chassis.

To completely disconnect this equipment from the AC mains, unplug the mains lead from the power outlet.

Do not expose this equipment to dripping or splashing and ensure that no objects filled with liquids, such as vases, are placed on the equipment.

To prevent shock or fire hazard, do not expose the equipment to rain or moisture. To avoid electrical shock do not remove covers. Refer servicing to qualified personnel only.

The power supplies - even the DC ones - have a high current!

General precautions

The following information gives basic safety precautions that should be observed to reduce the risk of fire, electric shock and personal injury:

- Only properly trained service personnel familiar with this manual and with the generally applicable safety regulations should service the equipment.
- Safety instructions detailed in the manual should be understood and properly implemented.
- In the event of ground loop problems, disconnect the signal screen at one end of the connecting cables. Note that this can only be done when the equipment is used within a balanced system.
- Never operate damaged equipment and never operate equipment with damaged cables.
- Any part that is damaged should be properly repaired or replaced. This must be done by a fully trained and authorised service engineer.
- Observe all warnings, cautions etc. on any part of the equipment.
- Do not remove, hide or deface any warnings or cautions.



Power

THE POWER SUPPLY SHOULD NEVER BE OPERATED WITH THE MAINS EARTH DISCONNECTED!

This unit should only be operated with the power supply connected to ground via the ground in the mains connector.

The internal power supply is a switch mode type that automatically senses the incoming mains voltage and will work where the nominal voltage is in the range 100-240 VAC.

A single, fused IEC mains inlet is provided on the rear panel. The correct lead for connection in the area to which the unit was shipped is supplied with the unit. The equipment should only be plugged into the mains outlet using the supplied lead.

Please note that the power supply contains LETHAL VOLTAGES greatly in excess of the mains voltage and that its rails can produce extremely large currents that could burn out equipment and wiring if shorted. All testing and servicing must ONLY be carried out by approved service engineers.

We strongly recommend that, for safety and to optimise the life and performance of the equipment, the mains cable plug is removed from the power outlet when the equipment is not to be used for extended periods of time or during electrical storms.

When removing the equipment's electric plug from an outlet, always hold the plug itself and not the cable. Pulling out the plug by the cable can damage it.

Never insert or remove an electric plug with wet hands.

Handling the equipment

Completely isolate the equipment electrically and disconnect all cables from the equipment before moving it.

When lifting or moving the equipment, take its weight into consideration.

Do not insert your fingers or hand in any gaps or openings on the equipment, for example, vents.

Avoid inserting or dropping foreign objects, such as paper, plastic, metal etc., into any gaps or openings on the equipment, for example, vents. If this happens, turn off the power immediately and unplug the power from the AC outlet. Then have the equipment inspected by the manufacturer's qualified service personnel.



Installation

Before installing the equipment:

- Make sure the equipment is correctly connected to the protective earth conductor of the mains voltage supply of the system installation through the mains lead.
- Power to the equipment must be via a fused spur.
- The power plug must be inserted in a socket outlet provided with a protective earth contact. The electrical supply at the socket outlet must provide appropriate over-current protection.
- Both the mains supply and the quality of earthing must be adequate for the equipment.
- Before connecting up the equipment, check that the mains power supply voltage rating corresponds with the local mains power supply and that the mains fuse is of the correct type and rating.

Location

- Ideally a cool area is preferred not in close proximity to power distribution equipment or other potential sources of interference.
- Do not install the equipment in places of poor ventilation.
- Do not install this equipment in a location subjected to excessive heat, dust or mechanical vibration. Allow for adequate ventilation around the equipment, making sure that its fans and vents are not obstructed. To prevent excessive heating of the equipment, avoid mounting it directly above power amplifiers or other devices that radiate significant amounts of heat such as, radiators and heaters. Keep the equipment out of direct sunlight. Where necessary use fan cooled racks.
- Do not place equipment in an unstable condition where it might accidentally fall over.
- Make sure that the mains voltage and fuse rating information of the equipment will be visible after installation.
- Do not use the equipment in the vicinity of electrical devices, such as computer monitors or mobile phones, which may generate electrical noise.

Audio connections

To ensure the correct and reliable operation of your Square ONE Graphic, only high quality balanced, screened, twisted pair audio cable should be used.

XLR connector shells should be of metal construction so that they provide a screen when connected to the unit and should have Pin 1 connected to the cable screen.

Radio frequency interference

Class B device

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to



radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help.

Electric fields

Caution:

In accordance with Part 15 of the FCC Rules & Regulations, "... changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

Should this product be used in an electromagnetic field that is amplitude modulated by an audio frequency signal (20Hz to 20kHz), the signal to noise ratio may be degraded. Degradation of up to 60dB at a frequency corresponding to the modulation signal may be experienced under extreme conditions (3V/m, 90% modulation).

Operation

To avoid electrical shock, never operate the equipment with the covers removed.

Safety equipment

Never remove, for example, covers, housings or any other safety guards. Do not operate the equipment or any of its parts if safety guards are ineffective or their effectiveness has been reduced.

Optional equipment

Unless advised otherwise, optional equipment must only be installed by service personnel and in accordance with the appropriate assembly and usage regulations.

Special accessories

To comply with part 15 of the FCC Rules, any special accessories (that is, items that cannot be readily obtained from multiple retail outlets) supplied with this equipment must be used with this equipment; do not use any alternatives as they may not fulfil the RF requirement.



Features

The Square ONE Graphic 1/3 octave, analogue equaliser performs graphic equalisation and filtering, and has the following features:

- Two channels.
- 30 bands of proportional-Q equalisation per channel via long throw, 45 mm faders.
- Electrically balanced input and output per channel via female and male XLR connectors, respectively.
- 1/4" TRS-balanced jack socket for each input and output.
- Level metering per channel is provided by SIGNAL and CLIP LEDs.
- Gain control per channel for continuous adjustment of channel gain.
- Fixed 80Hz high pass filter per channel.
- Fixed 12kHz low pass filter per channel.
- Input gain, filters and graphic equalisation on each channel can be bypassed.
- Power-off bypass relays to avoid audible thumps when unit is switched off or if a power rail fails.
- Pushbutton switch operation for high and low pass filters and bypass.
- LEDs for power, high and low pass filters, and bypass that provide on/off status indication.
- Mains supplied via an IEC socket on rear panel.
- Fuse drawer contains easily replaceable mains fuse with a compartment for a spare.



Getting started

Observing the guidelines in "Safety precautions" on page 2, carry out the following to get your Square ONE Graphic unit fully operational.

Unpacking

Carefully unpack your Square ONE Graphic equipment package.

Then please inspect the Square ONE Graphic unit carefully for any signs of damage that may have occurred during transit and notify the courier immediately if you discover any.

Check the contents of your Square ONE Graphic equipment package. If there are any parts missing, incorrect or faulty, please contact your local distributor or Klark Teknik at the address at the front of this manual.

Please retain the original packing in case you should need to return the equipment to the manufacturer or supplier, or transport or ship the unit later.

Checking the mains fuse

Before installing the equipment you need to make sure that the mains fuse fitted is of the correct type and rating for your unit. To do this follow the instructions in "Checking/replacing the mains fuse" on page 36.

Installation

This unit is designed for mounting in any 19" EIA standard rack. Four rack-mount holes in the front panel are provided for rack mounting and are designed to fully support the weight of the unit in the rack.

The position of the unit will depend upon how it is to be used. However, when positioning the unit, avoid placing it where the faders may be damaged by being accidentally knocked or snapped off. Also, try to avoid placing the unit directly near or on any power distribution units or power amplifiers.

Connecting the power cable

Making sure that the mains power at the power outlet is off, connect the mains cable supplied with your Square ONE Graphic to the mains power outlet and then to the mains socket at the rear of your unit.

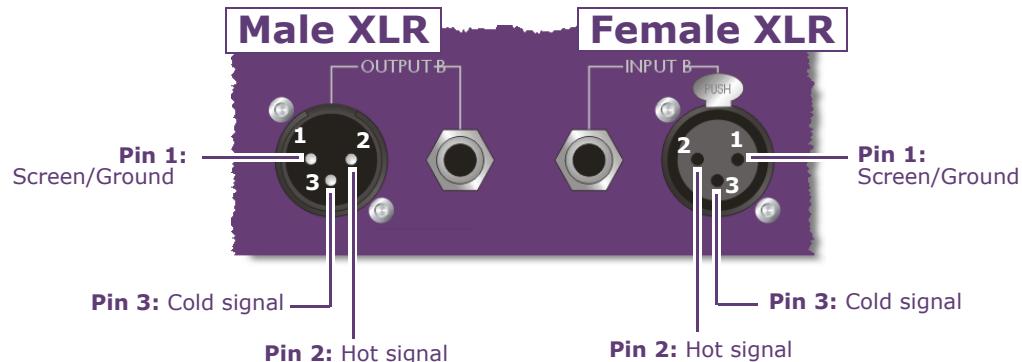


Connecting the audio cables

This section gives the connection details for balanced/unbalanced I/O and unbalanced inserts. For more details on balancing, see "Balanced/unbalanced audio" on page 30.

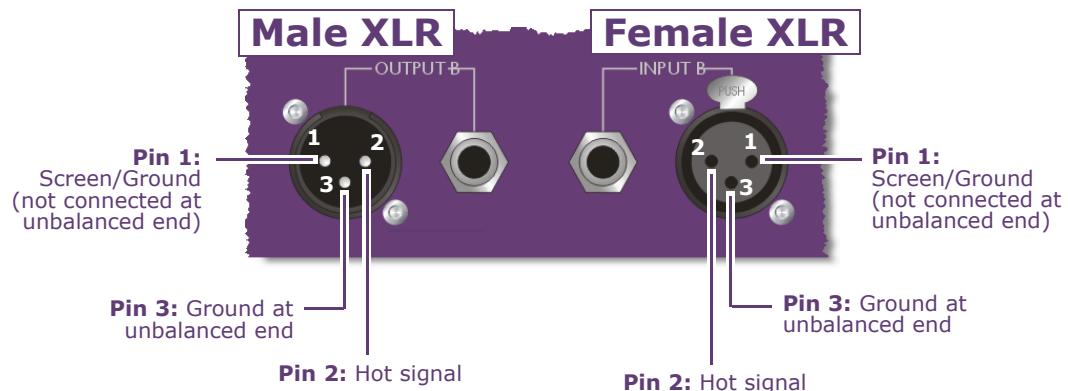
Balanced I/O

For balanced I/O, connect the audio cables as shown below.



Unbalanced I/O

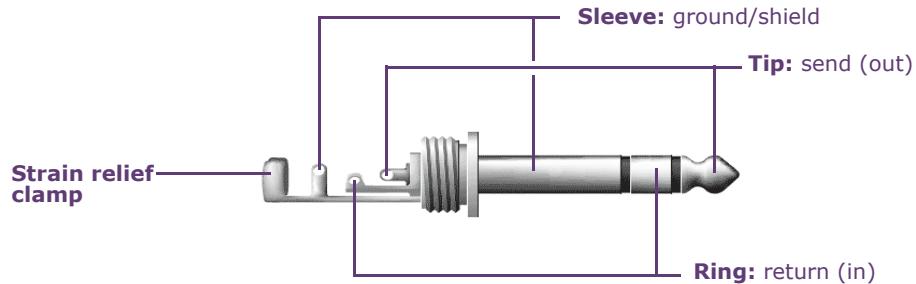
For unbalanced I/O, connect the audio cables as shown below.





Unbalanced inserts

For unbalanced inserts, connect the audio cables as shown in Figure 2, below. Figure 1 shows the construction of a 1/4" TRS connector.



Note: Connect insert send with input and insert return with output of effects device.

Figure 1: Insert send/return 1/4" TRS connector details

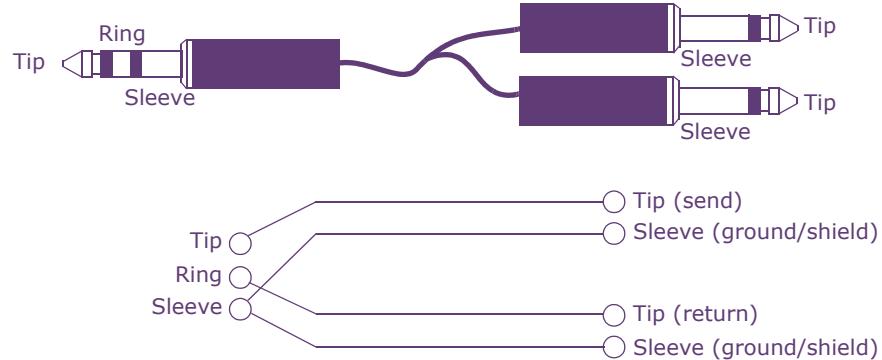


Figure 2: Insert send/return 1/4" TRS connectors - wiring details



Connecting to unbalanced equipment

Ideally, you will be making the best use of the Square ONE Graphic's low-noise high-headroom balanced inputs by connecting to similarly balanced equipment. However, if you do have to connect to unbalanced devices, the following wiring is recommended for best results (see Figure 3):

- Connect the +ve (pin 2) of the balanced connection to the +ve terminal on the unbalanced connector.
- Connect the -ve (pin 3) of the balanced connection to the common (ground) terminal on the unbalanced connector.
- Connect the ground (pin 1) of the balanced connection, to the common (ground) terminal on the unbalanced connector.

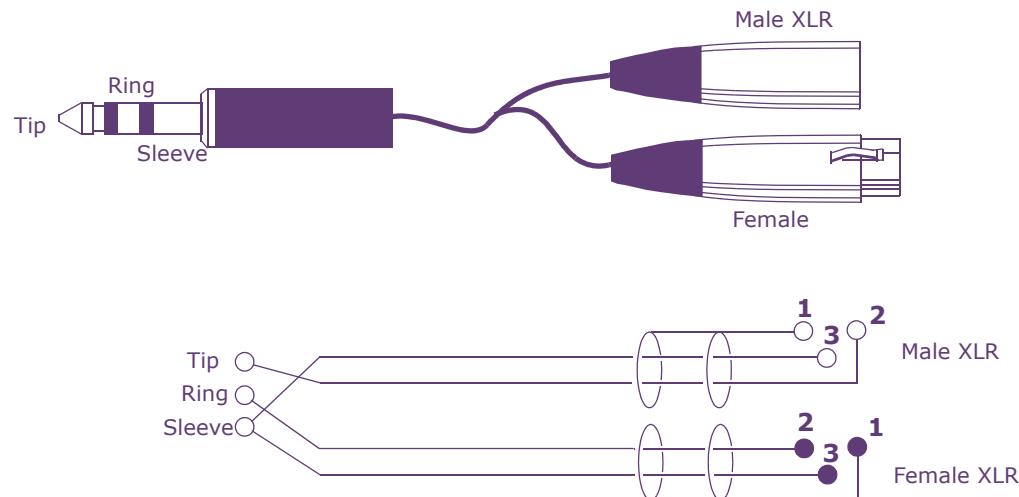


Figure 3: Insert send/return 1/4" TRS connector/XLRs - wiring details

Powering up the unit

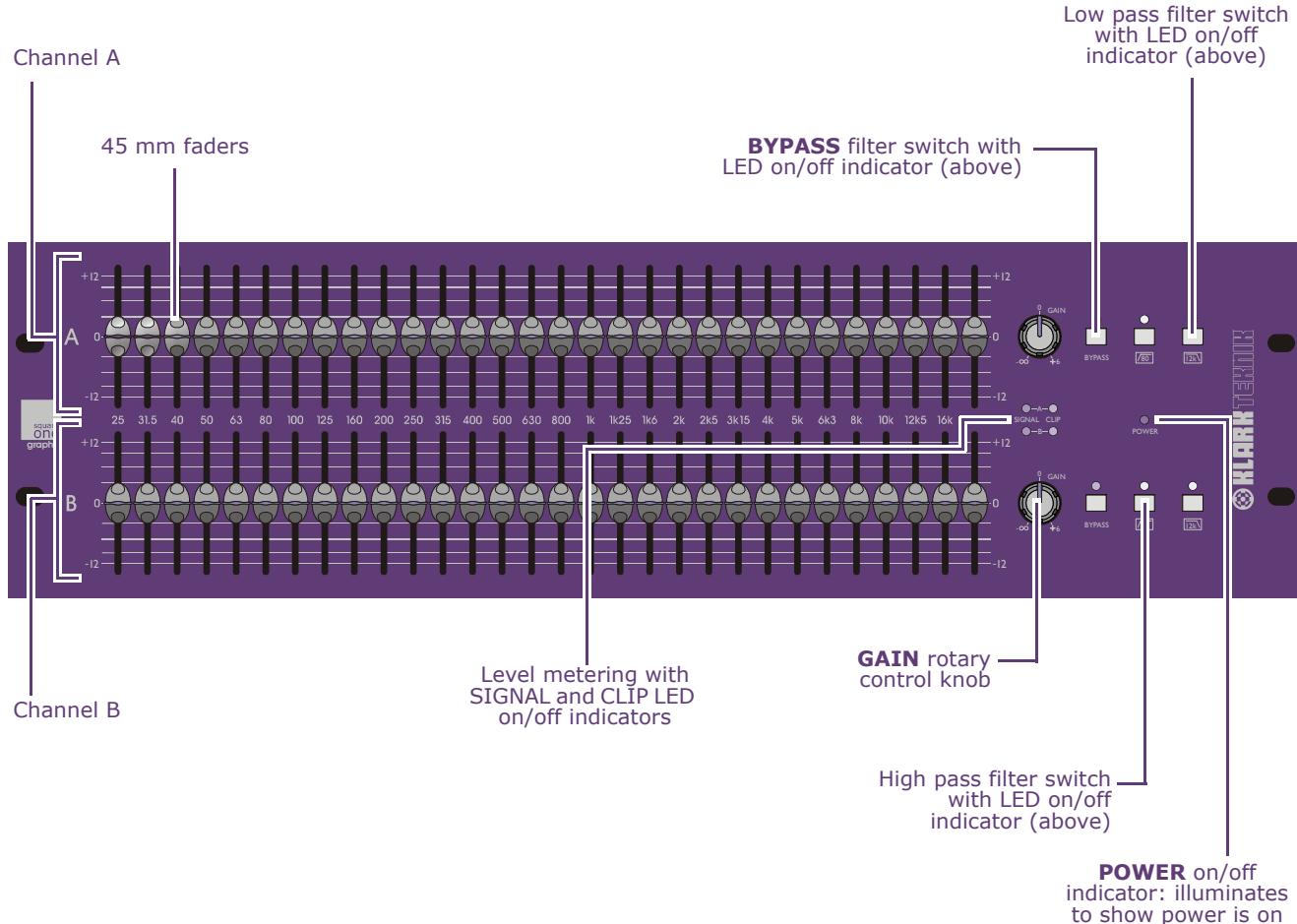
To power up the unit, switch on the power at the mains power outlet. The POWER LED on the front of the unit will illuminate to indicate that power is on.

Your unit is now ready to operate.



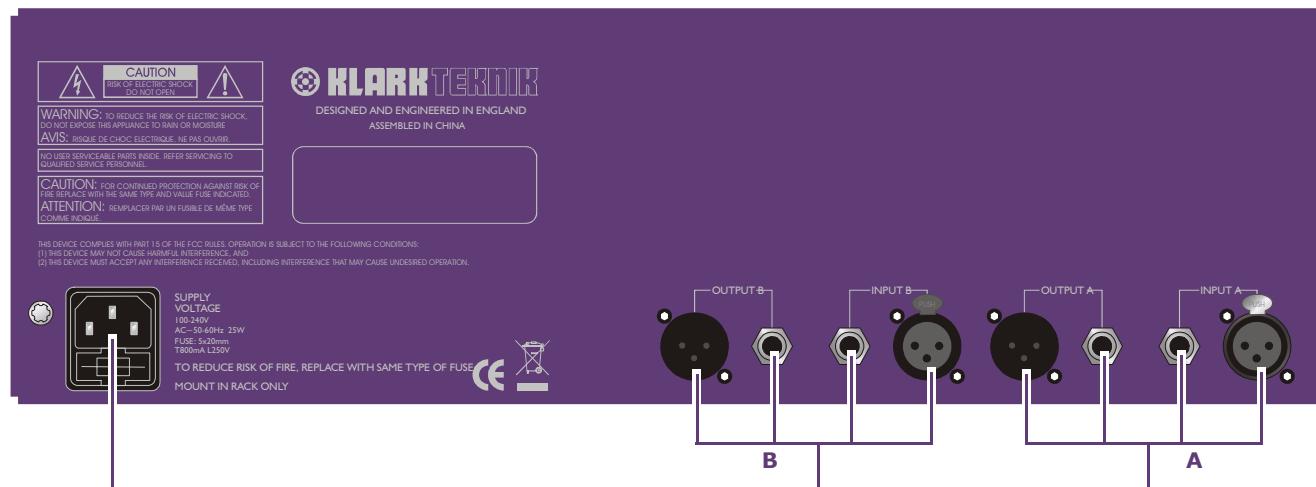
Front panel quick reference

The Klark Teknik Square ONE Graphic is a dual, 30-band, third octave graphic equaliser.





Rear panel quick reference



Mains power socket
and fuse compartment

Channels A and B: input and output
audio connections, comprising a male
and a female XLR socket each with a
1/4", TRS-balanced jack socket



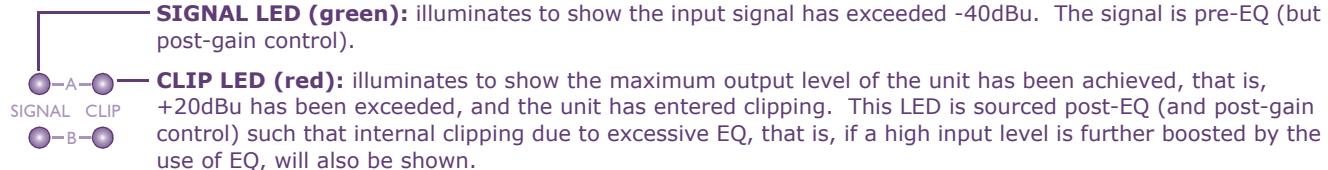
Front panel features

The Klark Teknik Square ONE Graphic is a dual-channel, 30-band, third octave analogue graphic equaliser. In addition to the graphic equaliser itself, high and low pass filters are provided per channel and an equaliser in/out switch to bypass the effect of the equaliser and filter stages. Power is supplied to the unit via the rear panel; an LED on the front panel provides power on/off indication.

Signal level

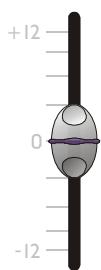
The Square ONE Graphic provides a SIGNAL and a CLIP LED per channel for the purpose of level metering. The levels are as follows:

- SIGNAL (Green): -40dBu
- CLIP (Red): +20dBu



Graphic EQ section

The graphic EQ section of the Square ONE Graphic features long throw 45 mm faders to allow fine adjustment of each frequency band. Each fader has a centre detent ('click stop') to denote the 0dB (unity gain of the band) point of the scale. The Square ONE Graphic uses standard ISO third octave standard frequency centres.



The range of the faders is $\pm 12\text{dB}$. Placing the fader of any band at the extreme upwards position will apply 12dB gain to the frequencies in that band. While, conversely, placing the fader of any band at the extreme downwards position will apply 12dB attenuation to the frequencies in that band.

Gain control



The gain control provides continuous adjustment of the channel gain from minus infinity (off) to +6dB with a centre detent at 0dB (unity gain). When using EQ with large amounts of cut or boost, it may be necessary to use the gain to make up or attenuate the signal.

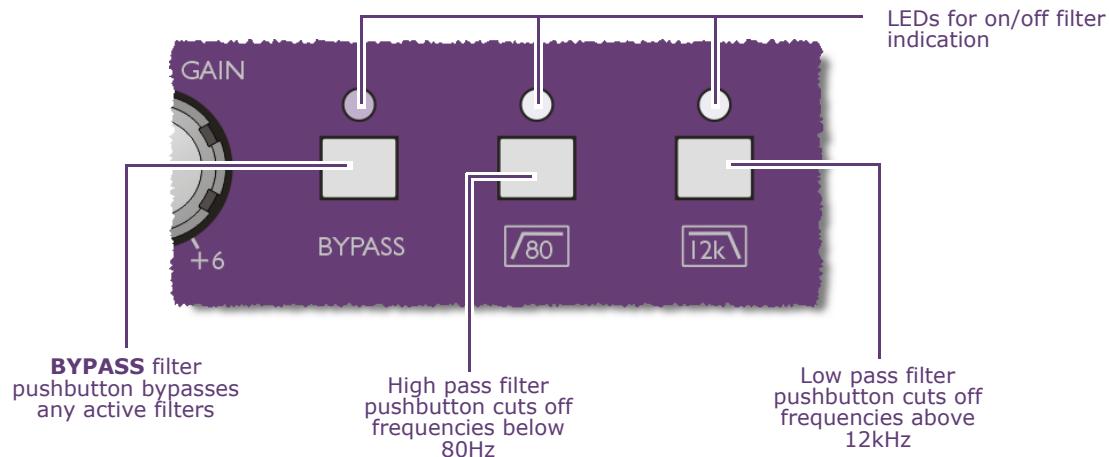


Filters

The high and low pass filters on each channel both have an on/off pushbutton switch and yellow LED that illuminates to indicate that the filter is in operation. Both filters are fixed and have a 12 dB/octave roll-off characteristic.

The corner frequencies of the filters, that is, 80Hz on the high pass filter and 12kHz on the low pass filter, have been selected to match the typical low- and high-end responses, respectively, of monitor wedges in applications where they are being driven full-range to aid intelligibility and allow higher gain before feedback.

To audition the effect of the filters, just switch them on or off and note the effect.



BYPASS switch

Each channel has BYPASS pushbutton on/off switch with red LED that illuminates to indicate a bypass condition.

When switched on, the BYPASS switch bypasses the input gain and graphic equalisation.

POWER on/off LED

The blue POWER LED on the front panel illuminates to indicate that mains power is applied to the unit.

The unit does not have a power on/off switch.



Rear panel features

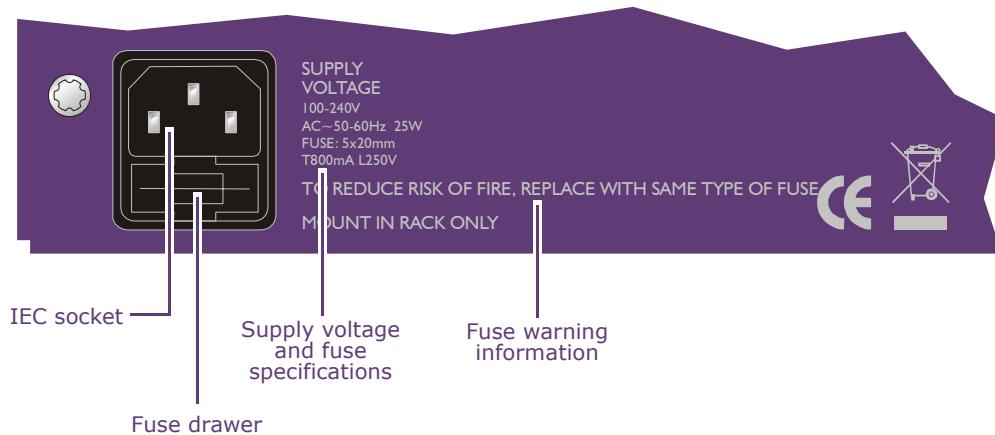
The rear panel provides the power and audio connections to the Square ONE Graphic. You will also find important information, such as warnings and cautions, power supply and fuse specifications, safety and compliance standards markings etc., printed on the rear panel.

Mains supply

Mains power is supplied to the Square ONE Graphic by a fused IEC socket on the rear of the unit. The Square ONE Graphic contains an auto voltage sensing switching mode power supply that will operate where the nominal mains voltage is in the range 100VAC to 240VAC.

The correct mains lead for the country to which the unit was shipped is supplied with the unit.

The mains fuse is located in a fuse drawer, directly underneath the mains socket. The drawer has two compartments, the rear containing the working fuse while the front provides room for a spare. Always replace the mains fuse with the same type and rating; see "Checking/replacing the mains fuse" on page 36 for details.

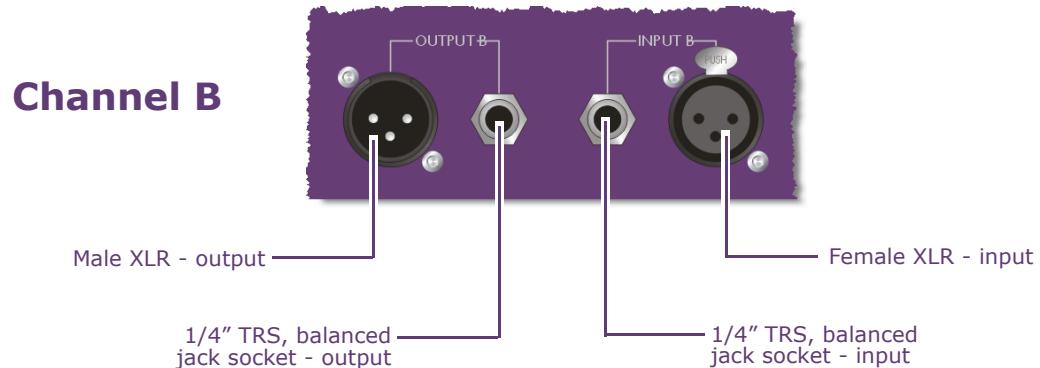




Audio connections

Audio input and output connections to the two channels, A and B, are electronically balanced and clearly labelled.

The audio connections for channel B are shown below; please refer to "Audio connections" on page 4 for pin assignments.



Audio inputs

The audio inputs comprise two parallel connected, series AA, female XLR chassis connectors and two 1/4" TRS, balanced jack sockets.

Audio outputs

The audio outputs comprise two parallel connected, series AA, male XLR chassis connectors and two 1/4" TRS, balanced jack sockets.

Other features

Power-off bypass relays

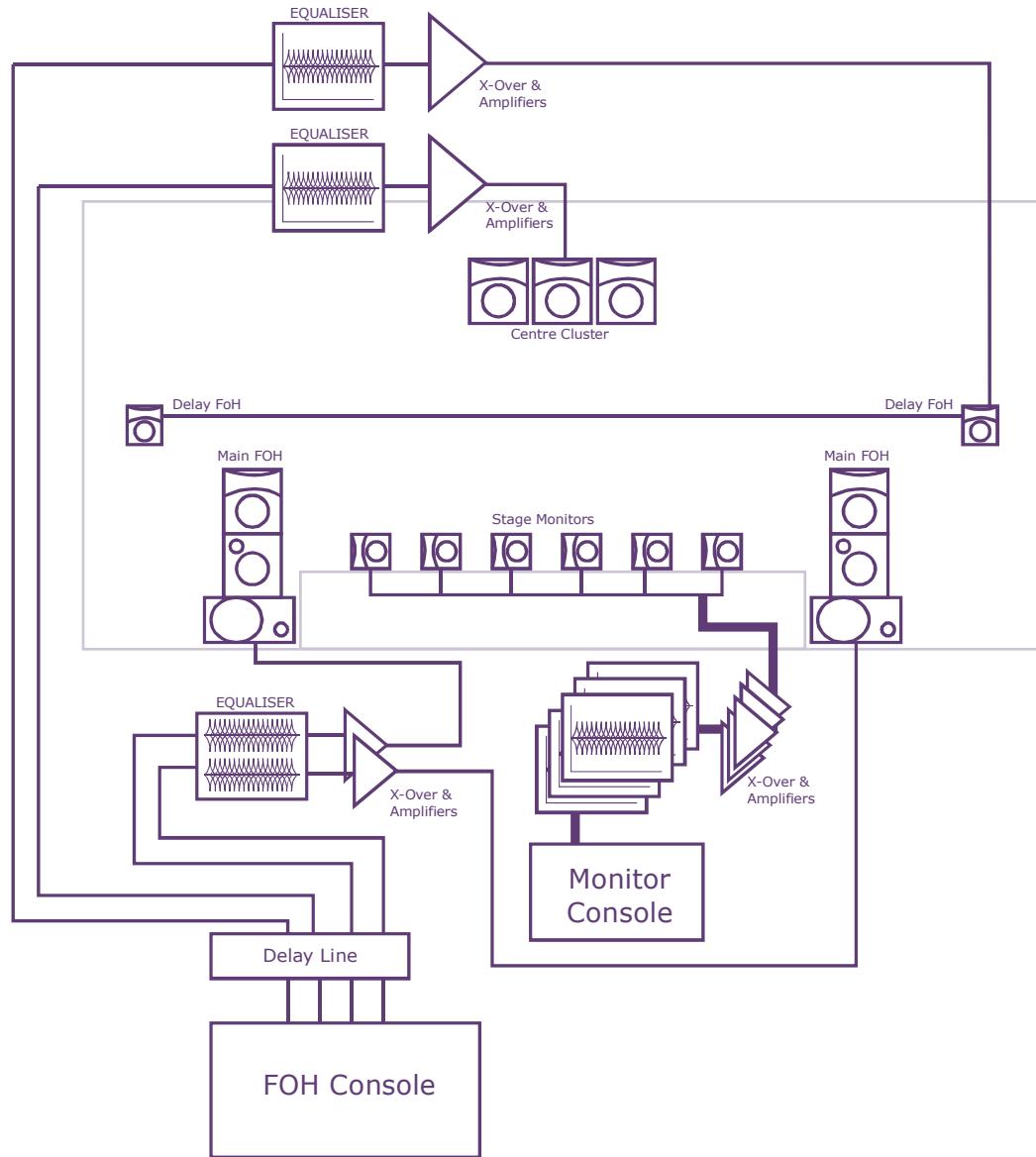
The Square ONE Graphic incorporates a fail-safe hardware bypass to prevent audible thumps when the unit is switched off or if any of its internal power rails should fail.

The bypass comprises relays that directly connect the inputs and outputs of each channel. The relays disconnect the outputs and switch to bypass every time the unit is switched off or on power rail failure.

On power up, the unit waits for about one second before the relays are switched. This gives enough time for the power rails to rise and the circuits to stabilise to allow normal operation of the unit.



Example of system connection





Using the Square ONE Graphic

The Square ONE Graphic is a graphic equaliser that utilises premium quality, low tolerance components to achieve a high degree of accuracy and control. Graphic equalisers may be used for corrective or creative purposes depending upon whether they are to be used live - as monitors or for front of house FOH - or in the studio for broadcasting or recording.

Studio and creative use

In the control room, a graphic equaliser may be used to remove problem frequencies and improve deficiencies in room acoustics. This is commonly achieved with the use of a real time analyser (RTA). As the frequency centres of the Square ONE Graphic conform to ISO standards, corrections can be made by sight directly from the RTA to the graphic.

However, it is important to mention that graphic equalisers can only compensate a limited amount for a room with severe acoustic problems, in which case further remedial treatment work may be required. Graphic equalisers can only help to reduce the audible effects of standing waves and resonances and cannot overcome the loss of clarity due to rooms with long reverberation times.

The Square ONE Graphic can be used to create filter effects, for example, the effect of someone speaking on the telephone, using the 30 equaliser bands and the high and low pass filters in conjunction with a compressor to create a de-esser for tonal correction of instruments or vocals and many other creative uses.

Live use - front of house (FOH)

It is often desirable to add equalisation to a venue to remove any frequency deficiencies in the room before trying to engineer using the system. Again, it is common to use an RTA and measurement microphone to set up the equaliser using additive and subtractive equalisation to correct problems in the room. It is recommended to attenuate peaks in the room's response to the level of the surrounding frequencies rather than boost the lower bands to meet the highest. This will help to retain headroom in the equaliser and slight dips in frequency response are less noticeable than large peaks. If an overall reduction in volume is observed, the gain make-up can be used to return the output of the equaliser to the desired level.

However, please beware of excessive equalisation by, for example, using large amounts of boost at lower frequencies to compensate for poorly performing bass enclosures. This will use up large amounts of system headroom that could cause the system amplifiers to clip, thus damaging loudspeaker HF components and introducing high frequency harmonics, which may sound unpleasant. Using large amounts of low frequency boost may also cause the over-excursion of bass drivers and result in their mechanical and electrical breakdown.

Also, many sound reinforcement systems are only capable of adequately producing frequencies up to around 18kHz. Providing high levels of boost at 20kHz to extend the frequency response of the system is likely to result in a reduction in the life of high frequency components in the loudspeaker, while not achieving a significant improvement in the frequency response.

There are occasions where deficiencies in room acoustics cannot be corrected by equalisation. For example, bass reduction due to phase cancellation or the cancellation around the crossover point of a loudspeaker must be corrected before the use of equalisation.



Live use - monitors

Monitors used on stage often need equalisation to remove any peaks in their frequency response in order to prevent feedback from on-stage microphones where those frequencies exceed the maximum gain before feedback level. Further equalisation may be required to remove similar peaks from the characteristics of the microphones in use.

A monitor engineer may use an RTA to detect these peaks but, more often than not, monitor engineers have a developed sense of hearing that enables them to remove these frequencies by ear. The Square ONE Graphic's 30 EQ bands allow a majority of feedback to be removed from the monitors. High and low pass filters are provided that can be used to remove high frequency feedback and bass rumble or over-excitation of bass drivers. It may also be undesirable to have large amounts of bass in the on-stage monitors. In vocal monitors, bass does not assist projection of vocals and can make the stage sound unbearable, hence, the bass element can be rolled off at the desired frequency. The fundamentals of vocals are transmitted in a narrow audible range and will appear unaffected.



Equalising a system

As discussed before, the fundamental benefits of equalisation are:

- **Improved intelligibility and natural sound of the sound system.**
- **An increase in the gain available in the system before feedback.**

In some circumstances, it may not be possible to achieve a natural sounding system that is completely intelligible due to poor acoustics or high levels of background noise. In such cases, a compromise must be struck by the engineer depending upon the use to which the system will be put. It may be argued that in the case of a vocalist, intelligibility must be sought at all costs. However, for dance music reproduction a more natural approach, with no real concern for intelligibility of the individual lyrics, may be preferred.

Please remember, the equaliser is not a 'cure all' device and will not solve the problems of a poor sound system, installation or venue acoustics but, when used carefully, can bring out significant improvements in the quality of reproduction of a system.

Preparing for equalisation

Before starting to equalise the system, it is worthwhile checking that the system is performing correctly. Listening to the system without any equalisation may reveal underlying distortion or artefacts of the room, for example, lengthy reverberation, which may need to be rectified before trying to equalise the room.

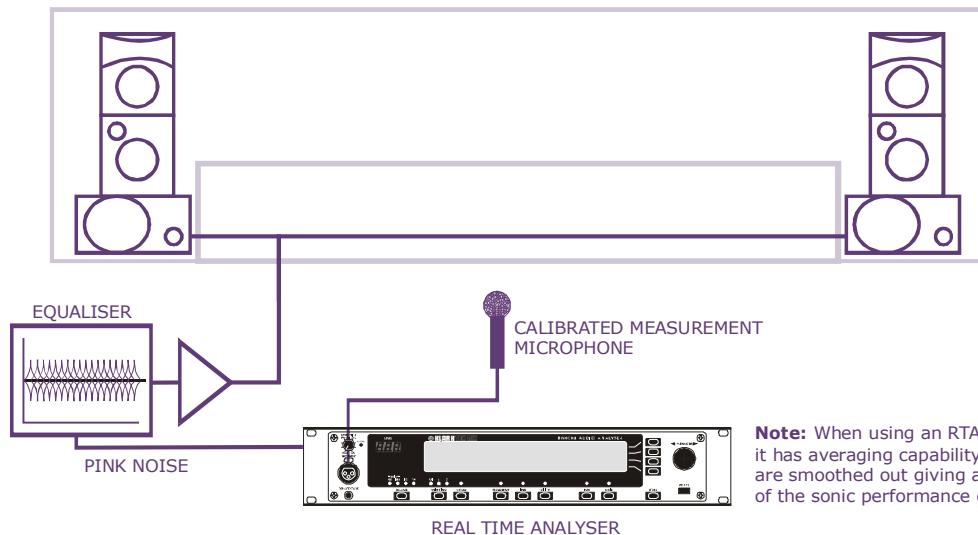
It may also be worthwhile using a sine tone sweep so that problems at certain frequencies, which may not be immediately noticeable with pink noise, can be detected and corrected before equalisation. Especially, check the system's crossover points as these may reveal problems with the system. Note that poor coverage cannot be rectified through the use of equalisation.

When you are satisfied with the basic system performance, equalisation can begin.

Equalisation using an RTA

The measurement microphone should, ideally, have a flat response or be calibrated to the RTA and placed in a sensible position where it will not be affected by nearby objects that may interfere with the local acoustics, such as within one metre of a rear or side wall, or in a balcony opening.

Using the RTA and a pink noise source, adjust the level of the frequency bands on the graphic equaliser inversely to that shown on the RTA display. Do it so that the peaks in frequency response are reduced to the level of the other bands and, conversely, the deficient bands are increased. You will need to perform the test at a reasonable level approaching normal usage volume so that the equalisation can take into account the response of the loudspeakers at normal operating level (versus low level). It may also be desirable to take measurements at points throughout the area. Although it may not be possible to get perfect equalisation throughout an entire area, it may be preferable to obtain a good equalisation of the whole area rather than a perfect equalisation at a single point with poor performance at all other points. A compromise may need to be made in an effort to equalise the sound for the whole area rather than just the centre FOH position.



Note: When using an RTA, ensure that it has averaging capability so that fluctuations are smoothed out giving a good representation of the sonic performance of the system.

When equalising the room, bear in mind the effect upon the electronics and mechanics of the system caused by the equalisation process. If excessive equalisation is required at certain bands, consider the effect upon amplifier headroom and loudspeaker driver excursion that will result. It may not be possible to produce the response required within the limitations of the system. Excessive equalisation should act as a warning that there may be an underlying problem which may rectify first, for example, phase cancellation, blown drivers etc.

During the performance, the FOH or monitor engineer may want to have a microphone or solo signal feed for the RTA so that feedback may be easily detected and rectified.



Effects of equalisation

Effects of equalisation on voice reproduction

1/3 Octave Centre Frequency	Effect On Voice
40, 50, 63, 80, 100, 125	Sense of power in some outstanding bass singers.
160, 200, 250	Voice fundamentals.
315, 400, 500	Important for voice quality.
630, 800, 1k	Important for voice naturalness. Too much boost in the 315 to 1k range produces a telephone-like quality.
1k25 to 4k	Vocal fricatives. Accentuation and clarity of voice. Important to speech intelligibility. Too much boost between 2kHz and 4kHz can mask certain speech sounds, for example, 'm', 'b' and 'v', which can become indistinguishable. Too much boost anywhere between 1kHz and 4kHz can produce listener fatigue. Vocals can be highlighted by slightly boosting vocals at 3kHz whilst simultaneously slightly cutting instruments at that frequency.
5, 6k3, 8k	Accentuation and clarity of voice.
10, 12k5, 16k	Too much boost causes sibilance ('sss').



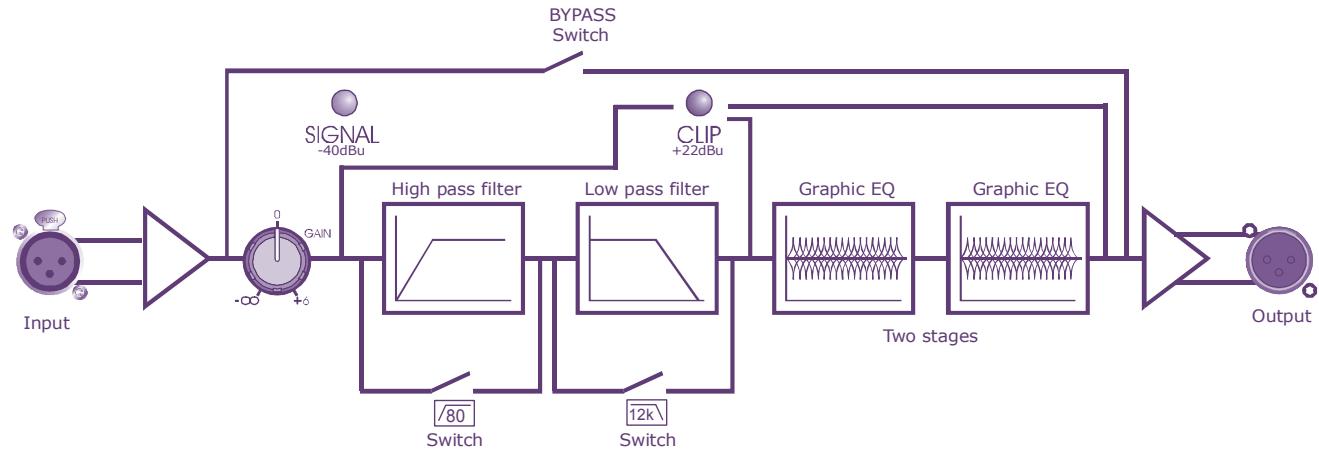
Effects of equalisation on music reproduction

1/3 Octave Centre Frequency	Effect On Voice
31, 40, 50, 63	Fundamentals of bass drum, tuba, bass and organ. These give music a sense of power but excessive use can leave the sound 'muddy'. Mains Hum (50-60Hz).
80, 100, 125	Too much boost produces 'boom'. (Fundamentals of tympani and toms.) Higher harmonics of mains hum (100-120Hz).
160, 200, 250	Drum and lower bass. Too much boost produces 'boom'. 3rd Harmonics of Mains Hum.
315, 400, 500	Fundamentals of strings and percussion.
630, 800, 1k	Fundamentals and harmonics of strings, keyboards and percussion. Boosting 600-1kHz range can make instruments sound horn-like.
1k25 to 4k	Drums, guitar, accentuation of vocals, strings and brass. Excessive boost around 1-2kHz can make instruments sound 'tinny'. Excessive boost around 1-4kHz can produce 'listening fatigue'.
5k, 6k3, 8k	Accentuation of percussion, cymbals and snare drum. Reduction at 5kHz makes overall sound more distant and transparent. Reduction of tape hiss and system noise. 1k25 to 8k governs overall clarity and definition.
10k, 12k5, 16k	Cymbals and overall brightness. Too much boost causes sibilance. Reduction of tape hiss and system noise.



Audio signal path

The following diagram shows the path of the audio signal for each channel.





Proportional-Q filter response

The most important design decision for the Square ONE Graphic was determining the equaliser response. Proportional-Q equalisation, as used on previous Klark Teknik analogue graphic equalisers, offers some key advantages over the more numerous Constant-Q equalisers on the market. Namely, at low amounts of cut or boost, the width of the filter is relatively broad and becomes narrower as the amount of boost or cut is increased, giving a more 'focused' response. This differs from a Constant-Q response, which boosts or cuts an increasingly wide band of frequencies. This is an important consideration in applications, such as cutting particular problem frequencies, as more of the frequency spectrum is scooped out when using Constant-Q equalisation. Whereas, Proportional-Q equalisers are much better at cutting just the problem frequency band. On Constant-Q equalisers the Q is measured 3dB up from the point of maximum attenuation when in cut, rather than the correct definition of 3dB down from the point of maximum gain (0dB when cutting), which results in a notch filter response.

In all types of graphic equalisers, one of the key issues is how the summing of adjacent EQ bands alters the frequency response. Lower-Q filters will blend together more smoothly, but higher-Q filters provide more selective control of problems - at the expense of more frequency response ripple. A weakness of the Constant-Q approach is that for small amounts of boost and cut (a very typical situation), the EQ bands have to be comparatively broad to blend smoothly so as to avoid excessive ripple in the frequency response. However, as the Q of the EQ bands remains constant, larger amounts of boost or cut will affect an increasingly wide range of frequencies, thus limiting the precision and usefulness of the equaliser.

Figure 4 and Figure 5 show the responses of a leading Constant-Q equaliser in both its 'wide' and 'narrow' modes of operation for 2dB of boost and cut, which is typical of the small adjustments made in corrective EQ applications. The 'wide' response gives a very smooth combined response for the three bands shown. However, the 'narrow' response shows significant ripple in the combined response which will lead to audible artefacts such as phase distortion.

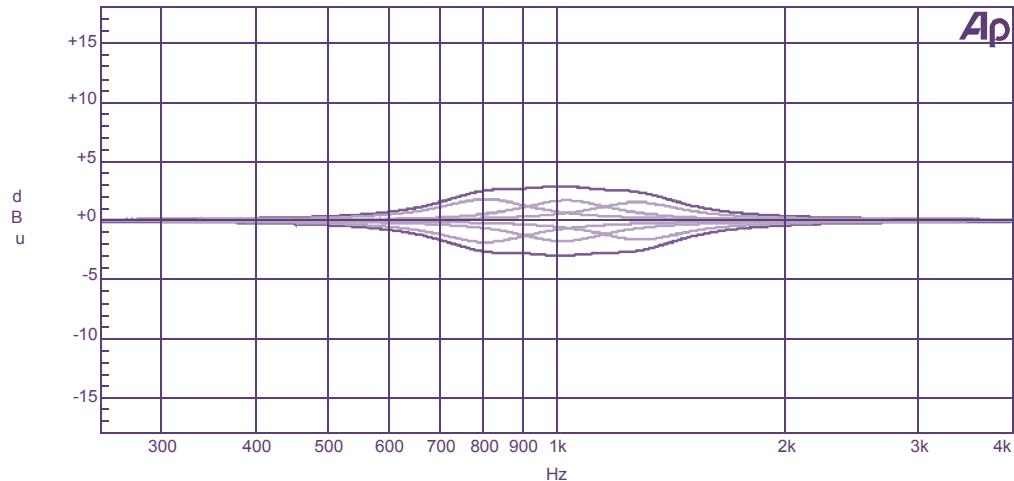


Figure 4: Constant-Q equaliser 'wide' mode $\pm 2\text{dB}$ boost and cut

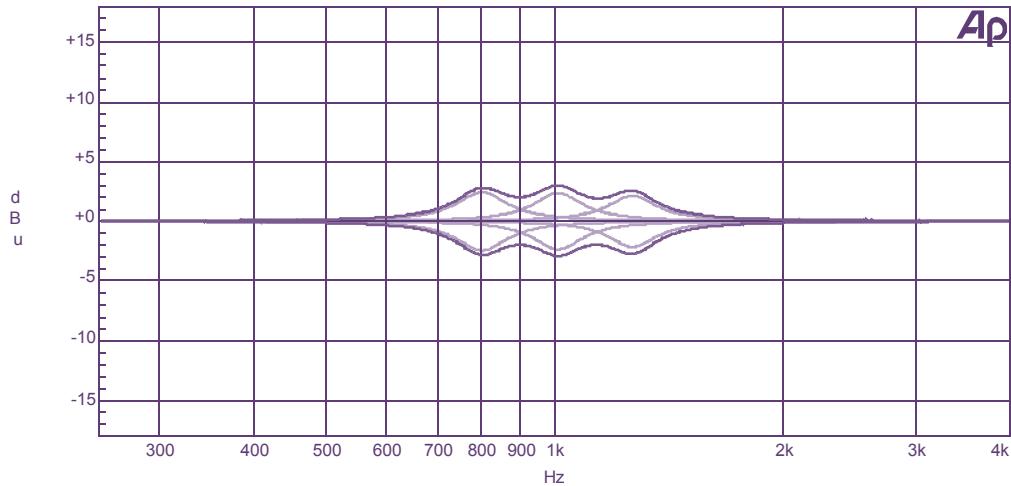


Figure 5: Constant-Q equaliser 'narrow' mode $\pm 2\text{dB}$ boost and cut

While the 'wide' response is obviously preferable for small amounts of boost and cut, Figure 6 and Figure 7 show the problem that occurs with using this response for full boost and cut. Here, far more of the audio spectrum is affected due to each band being broader as a consequence of maintaining the same Q value.

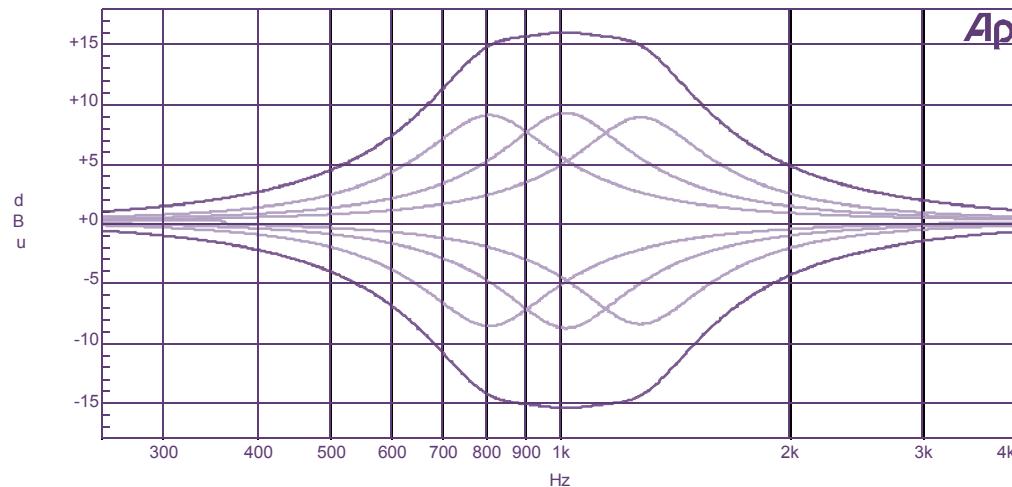


Figure 6: Constant-Q equaliser 'wide' mode full boost and cut

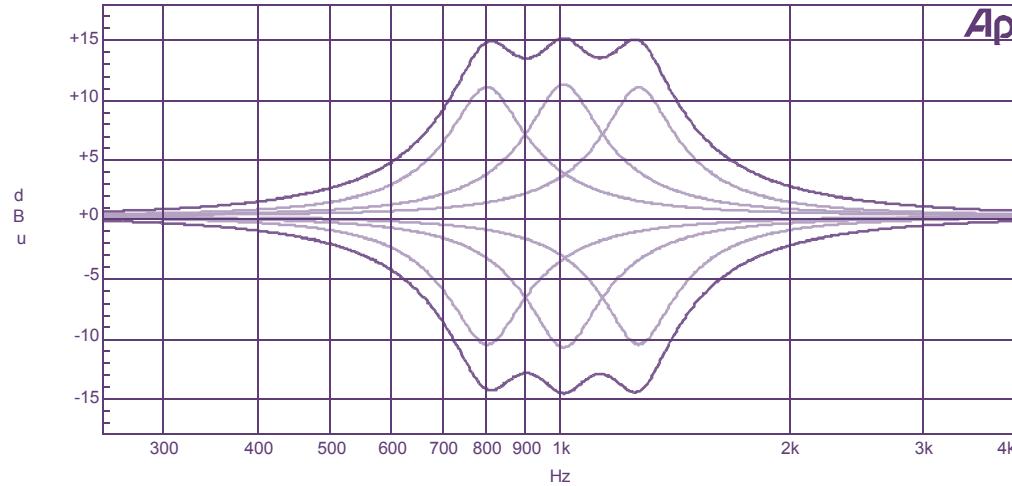


Figure 7: Constant-Q equaliser 'narrow' mode full boost and cut

The advantage of Proportional-Q equalisation is that the EQ bands are wider at lower amounts of boost and cut. They become narrower as greater amounts are applied, thus giving the optimum balance of smoothness



and accuracy over the entire fader travel. Extensive listening tests were carried out during the development of the Square ONE Graphic to obtain the optimum response. This has resulted in a very musical sounding equaliser that maintains the highest level of accuracy without ever sounding harsh.

Figure 8 and Figure 9 show the Square ONE Graphic responses for both 2dB and full scale boost and cut. Note that the smooth combining of the bands for small amounts of boost and cut is very similar to that of the Constant-Q equaliser in its 'wide' mode. However, as more boost or cut is applied the response becomes sharper, giving much more precise control of problem frequencies.

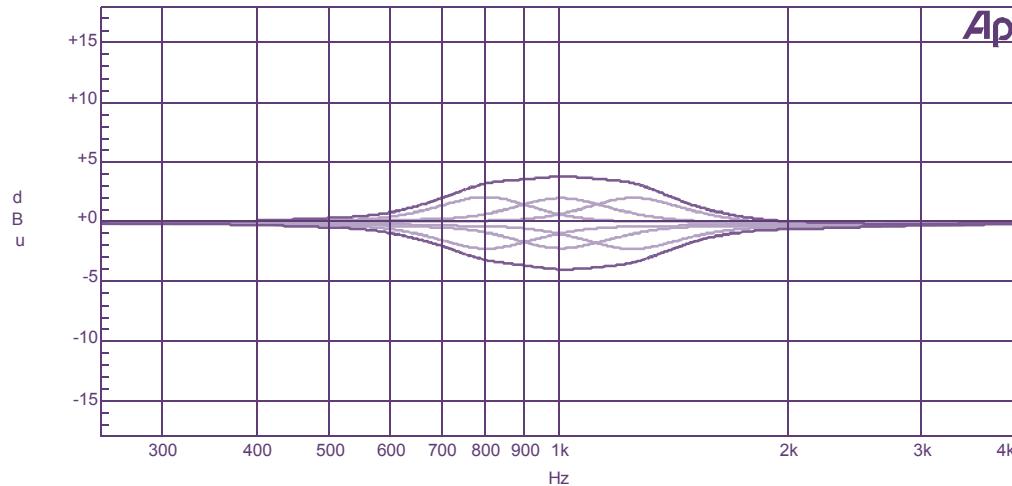


Figure 8: Square ONE Graphic response $\pm 2\text{dB}$ boost and cut

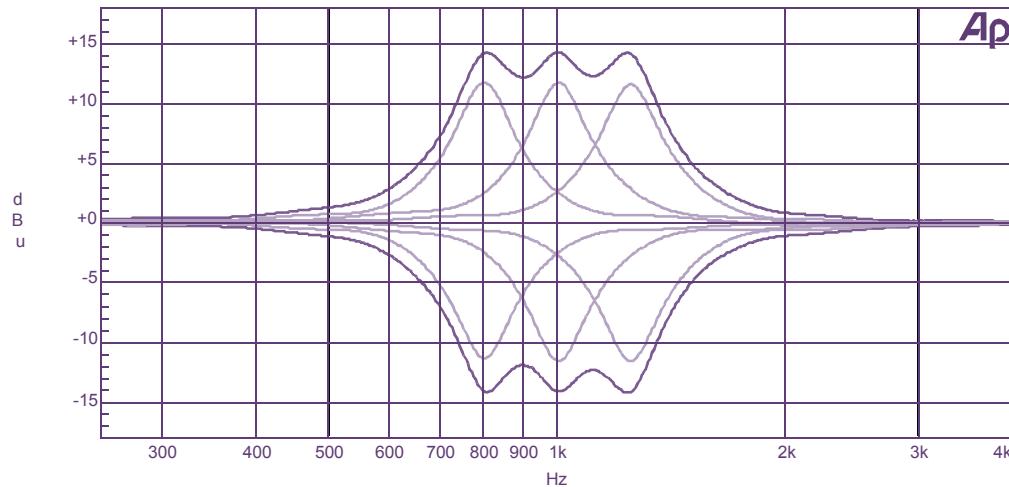


Figure 9: Square ONE Graphic response full boost and cut

In addition to the graphic equaliser section, the Square ONE Graphic also provides high pass and low pass filters. These can be used to enhance the intelligibility of wedge monitors by cutting out extraneous low and high frequency noise and therefore allowing higher SPLs to be used.



Balanced/unbalanced audio

The electronically balanced input and output connections of the Square ONE Graphic have the benefit of common mode rejection (CMR), which eliminates externally induced interference such as mains hum etc. Balancing is especially useful when long cable runs are used between pieces of equipment.

CMR is the ability of a balanced input to reject the part of the incoming signal that has the same amplitude and opposite phase on both input terminals, referenced to ground. As a specification, CMR is usually stated as a dB ratio at a given frequency.

Balanced audio

Balancing refers to the type of input or output signal connection. An unbalanced connection has two signal carrying conductors; one of these is the cable shield or ground, which is used for signal return. A balanced connection has three conductors, two for signals and a shield that is connected to earth. Neither of the signal wires is grounded and each is driven with equal voltage but of opposite polarity; it is important that each of these wires has the same source impedance. Because the signal conductors on the balanced connection are at the same impedance and of opposite polarity they are better able to cancel, and therefore reject, interference and noise pick-up. It is standard practice to use balanced connections for long cable runs, for example, to amplifiers, or for cables carrying sensitive or low level signals, for example, microphones.

A balanced line requires electronics and typically employs connectors of the XLR and 1/4" TRS jack plug types.

No actual circuit can ever be perfectly balanced due to inherent differences in the signal paths caused by the fact that no two resistors or transistors are identical and the signal paths cannot exactly mirror one another. So, each circuit can only be balanced to a certain degree. However, the difference between a balanced and an unbalanced circuit is that the unbalanced circuit can never be balanced whereas, the circuit designed to be balanced can be improved by careful component selection and layout.

In conclusion, unbalanced lines are more susceptible to noise so that cable runs should be short. Whereas, balanced circuits offer good rejection of noise induced equally on both wires, that is, they offer high common mode rejection, and allow long cable runs.

Principles of balanced audio

A balanced audio signal comprises three components:

- **Hot wire:** contains positive voltages.
- **Cold wire:** contains negative voltages.
- **Ground wire:** at zero volts and surrounds hot and cold wires.

A single-ended (unbalanced) signal must be converted into a balanced one. This is done by splitting the signal in two, passing one half through the hot wire while the other is phase reversed into a negative mirror image before being sent through the cold wire. After passing through the balanced cable, the balanced signal is converted back using a CMR circuit. This reverses the phase of the cold (-ve) signal back to normal (+ve) before being mixed with the hot (+ve) signal. Since any noise picked up by the cable will have the same polarity in both the hot and cold signal wires, it will cancel itself out when the cold signal is phase reversed back and mixed with the hot.



Connecting balanced and unbalanced equipment

For a balanced cable to work as required it must be connected between a 'sender' circuit that splits and phase reverses a single ended audio signal, and a 'receiver' circuit that first switches the phase of the negative signal back to normal and then mixes it with the positive. If the signal entering a balanced cable is not balanced, the cable itself can still be used - if you don't use a CMR circuit afterwards - but it will take up noise just like any ordinary cable. An unbalanced audio signal entering a CMR circuit, for example, a mixer input, will be cancelled out.

To turn a balanced signal into an unbalanced one without using a CMR circuit, short the cold (-ve) signal to ground. However, the resulting audio signal will be a little weaker than normal as it is only made up of the positive signal half.

Note: On balanced circuits, the "hot" signal is also known as "+ve", "send" and "in phase", while the "cold" signal is also known as "-ve ", "return" and "out of phase".



Square ONE Graphic application notes

Front-of-house

The graphic EQ filters of the Square ONE Graphic have been carefully selected to allow tonal correction with a minimum of ripple between adjacent bands. While, at the same time the proportional-Q nature of the filters ensures that in the event of acoustic feedback a tightly-focussed cut response is instantly available just by moving the fader.

The ±12dB, 45 mm long-throw faders provide superb control resolution and excellent visibility of control settings. The high and low-pass filters allow the frequency extremes to be matched to the capabilities of the loudspeaker system in use, leaving all the graphic EQ faders available for acoustic management of the music. Positive in/out switching for all the filter sections is combined with LEDs to give instant 'at a glance' status indication.

Monitors

The design of the graphic filters with carefully selected Proportional-Q responses ensures that problem frequencies can be attenuated quickly and effectively. Long-throw faders allow excellent control resolution even when using all of the available 12dB of attenuation. Interaction with adjacent bands is minimised, ensuring that more of the musical content is preserved. The filter pushbutton switches allow the filters to be switched easily in and out, for example, when an artist is using different instruments during a show. LEDs above the filter pushbuttons ensure that the filter status is always visible at a glance. High and low pass filters allow the frequency limits to be accurately controlled for each output. This last feature, while very useful for conventional wedge monitors, really comes into its own when combining in-ear and wedge monitors, allowing the response of each monitor subsystem to be tailored to the artist's requirements.

High pass filter (HPF)

High pass filters (HPFs) on graphic equalisers are used to remove unwanted subsonic frequencies (traditionally about 30Hz). The HPF on the Square ONE Graphic is set at 80Hz. If using your Square ONE Graphic with a large speaker system, you will almost certainly be using an active crossover, which should provide appropriate subsonic protection. In this case, leave the HPF out of circuit.

When using more compact loudspeakers, use the 80Hz knee of the Square ONE Graphic's HPF for maximising their headroom and efficiency. If using your Square ONE Graphic with monitor (foldback) loudspeakers that have an extended bass response, the HPF can still be used; in fact, useful results can be obtained by "bending" the knee of the HPF by boosting the 63Hz fader on the Square ONE Graphic.

Low pass filter (LPF)

The Square ONE Graphic's low pass filter (LPF) is fixed at 12Hz. This is optimal for stage monitoring applications - both loudspeaker and in-ear monitor (IEM) systems - and will increase available headroom as well as providing high frequency (HF) drivers with some thermal protection against ultrasonic frequencies.

When engaged simultaneously, the Square ONE Graphic's HPF and LPF give optimal control of the operating bandwidth of most foldback (floor wedge and IEM) transducer systems.



Technical specification

Inputs	Two (A and B) Type Impedance Maximum input level Common mode rejection	Analogue, electronically balanced (Pin 2 hot) 20k Ohms +22dBu >80dB at 1kHz, >60dB at 10kHz
Outputs	Two (A and B) Type Minimum load impedance Source impedance Maximum output level Signal drive capability	Analogue, electronically balanced (Pin 2 hot) 2k Ohms <60 Ohms +22dBu <3dB drop in level relative to open circuit voltage when driving 200 Ohms
Performance	Frequency response Dynamic range Noise floor Gain	±0.5dBu (input to output), 20Hz to 20kHz >112dB (22Hz to 22kHz unweighted) Lower than -90dBu (22Hz to 22kHz unweighted) -infinity (off) to +6dBu, with centre detent at 0dB
Equalisation	30 Bands Centre Frequencies Tolerance Maximum Boost/Cut High Pass Filter Slope Low Pass Filter Slope	To BS EN ISO 266:1997 25Hz to 20kHz, 1/3 octave ±5% ±12dB 12dB/octave 12dB/octave
Terminations	Audio Power	3-pin XLRs (male and female) and 1/4" TRS balanced jack sockets 3-pin IEC
Power Requirements	Voltage Frequency Consumption	100VAC to 240VAC ±10% 50Hz to 60Hz <25W
Dimensions	Height Width Depth	133 mm (5.25"), 3U high 483 mm (19") 200 mm (7 7/8")
Weight	Net Shipping	4.4 kg 5.4 kg

BS EN ISO 266:1997 Frequency Centres:

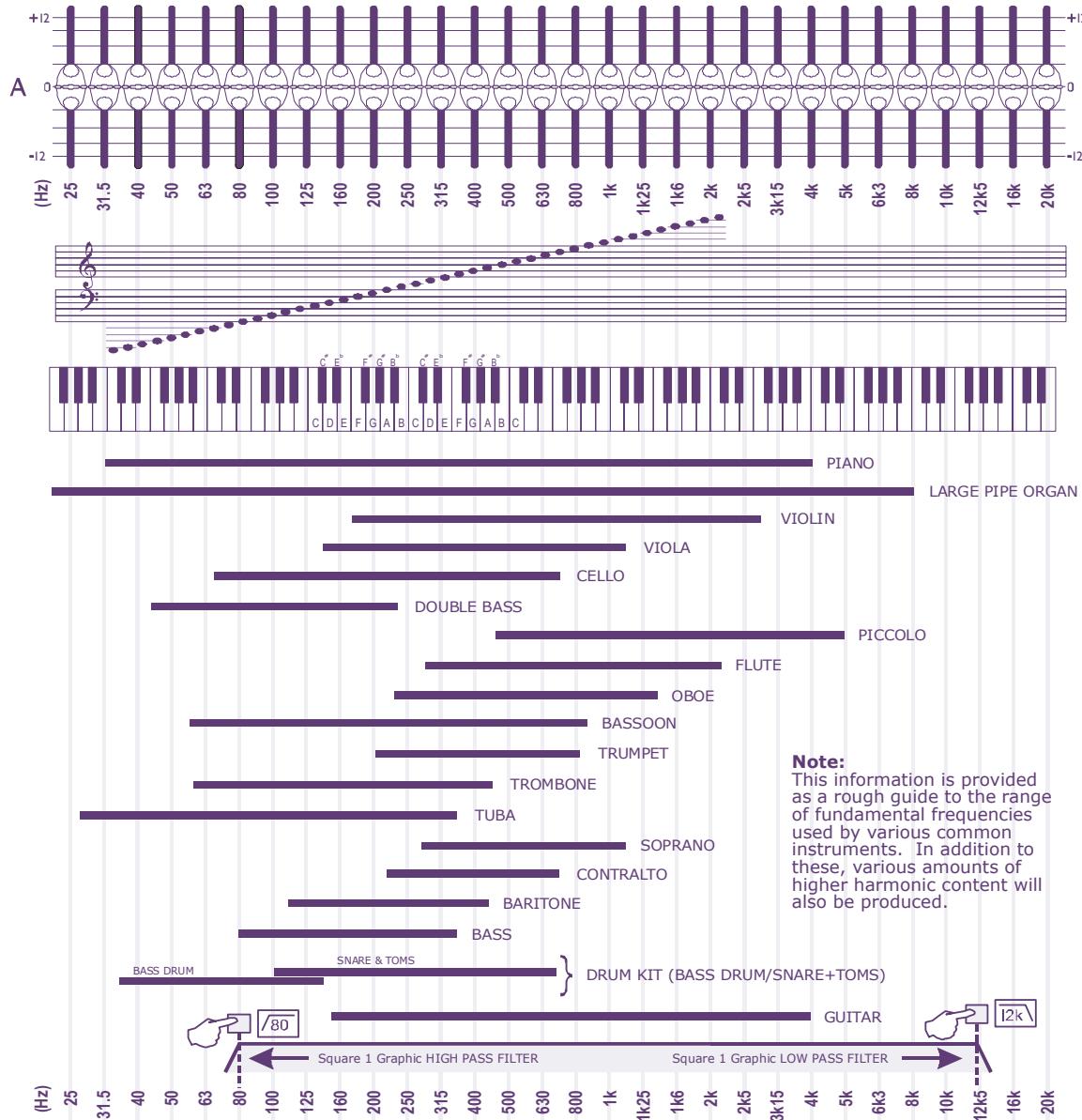
The ISO standard frequencies (Hz):

25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200,
250, 315, 400, 500, 630, 800, 1.00k, 1.25k, 1.60k, 2.00k,
2.50k, 3.15k, 4.00k, 5.00k, 6.30k, 8.00k, 10.0k, 12.5k, 16.0k, 20.0k

Due to a policy of continual improvement, Klark Teknik reserves the right to alter the function or specification at any time without notice.

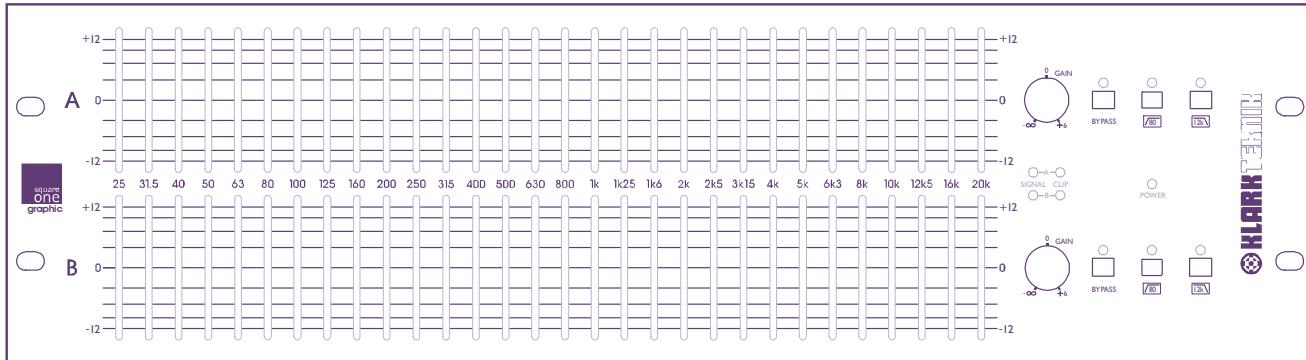


Frequency chart

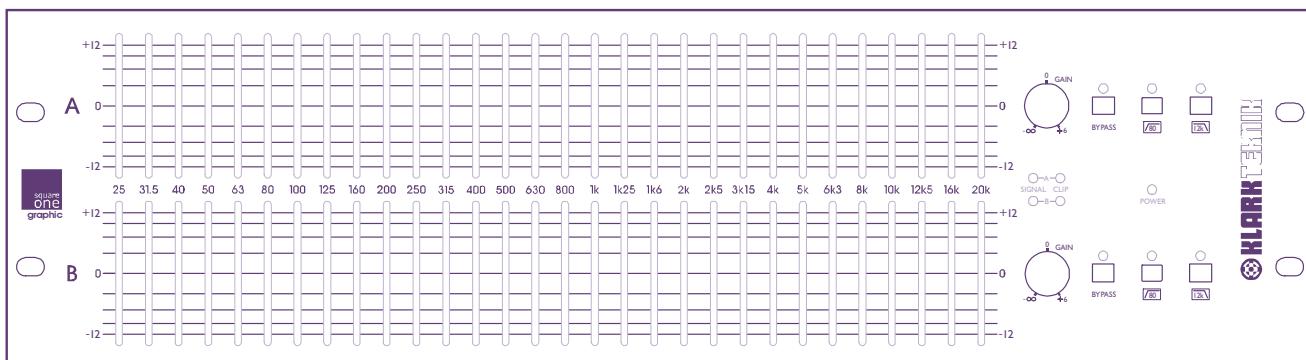




Crib sheet



Location: _____ Date: _____
Application: _____



Location: _____ Date: _____
Application: _____



Service information

The service manual for this equipment is available for purchase. Please contact your local distributor for details.

Routine maintenance

To help keep your Square ONE Graphic unit in good working order and to make sure it gives you optimum performance, we recommend that you carry out the following about once every month:

- Clean the unit, as detailed in "Cleaning the unit" on page 36.
- Check controls for freedom of operation. As the controls are 'self-cleaning', this operation will help to prevent them from sticking.
- Check functionality of all controls, that is, faders, pushbuttons, LEDs etc.
- Check functionality of equipment.

Cleaning the unit

Switch off the unit and electrically isolate it from the mains before cleaning.

Clean the unit using a dry, lint-free cloth. Do not use harsh abrasives or solvents. When cleaning the unit, take great care not to damage faders, pushbuttons etc.

Checking/replacing the mains fuse

The equipment must be independently isolated from the mains voltage supply before any attempt is made to change or check the protective fuse. The fuse and its cover must always be replaced before the equipment is reconnected to the mains voltage supply.

Only use the correct replacement type when changing the fuse. Fuse specification is printed on the rear cover.

To remove the fuse, pull out the fuse drawer (see "Mains supply" on page 15). Then, prise out the fuse from the furthest compartment (the nearest compartment is for a spare fuse); a small, flat-bladed screwdriver may be useful for this.

Insert new or existing fuse in the furthest fuse compartment and close drawer.

After replacing a fuse, check that the unit is working properly.



KLARK TEKNIK
SIGNAL PROCESSING BY DEFINITION

Klark Teknik

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