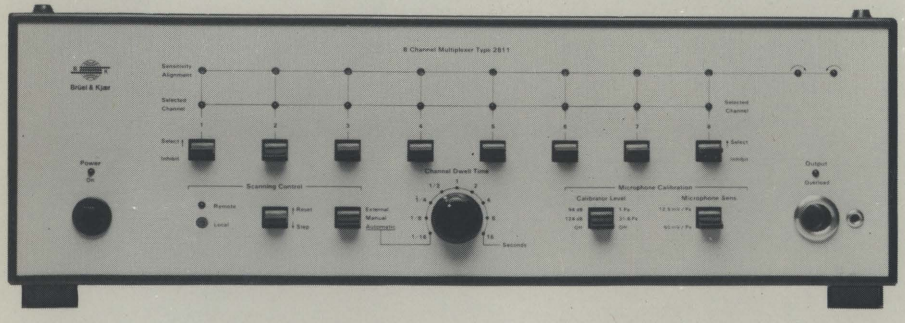
2811

Instruction Manual

8 Channel Multiplexer Type 2811



A versatile electronic switch unit for scanning up to eight input channels under manual, automatic or remote control. Up to four 2811's may be cascaded to scan up to 32 channels. The internal clock provides nine dwell times from 1/16 s to 16 s for automatic scanning. External control of scanning by a suitable clocking device is also possible. The 2811 incorporates an IEC 625–1/IEEE Std. 488 digital interface allowing remote control of the scanning functions by, for example, a suitable desktop calculator or personal computer. A Subsidiary Multiplexer with its own output and cascading facilities is controlled from the Interface Bus, and independently scans the same eight inputs as the Main Multiplexer.

Brüel & Kjær

8 CHANNEL MULTIPLEXER
TYPE 2811

From serial number 1137240

Revision August 1985

SAFETY CONSIDERATIONS

This apparatus has been designed and tested according to Class II of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in safe condition. The present Instruction Manual contains information and warnings which should be followed by the user to ensure safe operation and to retain the apparatus in safe condition. Special note should be made of the following:

APPLICATION OF POWER

Before each use of the apparatus, check that it is set to match the available mains voltage and that the correct fuse is installed.

SAFETY SYMBOLS

⚠ The apparatus will be marked with this symbol when it is important that the user refer to the associated warning statements given in the Instruction Manual.

⊥ Chassis terminal ⏚ Safety earth terminal Hazardous voltage

WARNINGS

Switch all instruments' POWER "Off" before connecting or disconnecting INTERFACE BUS cables.

Whenever it is likely that the correct function or operating safety of the apparatus has been impaired, the apparatus must be made inoperative and be secured against unintended operation.

Any adjustment, maintenance and repair of the open apparatus under power must be avoided as far as possible and, if unavoidable, must be carried out only by trained service personnel.

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8 Channel Multiplexer

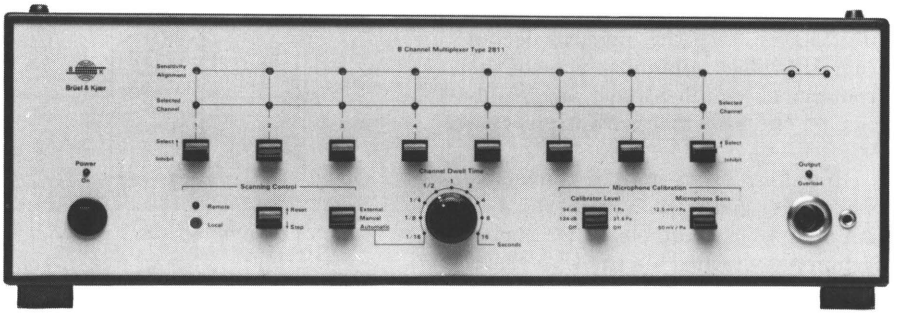
FEATURES:

- Dual 8-channel system (Main and Subsidiary Multiplexers)
- Scanning of Main Multiplexer under manual, automatic or external control
- Both multiplexers controllable from IEC 625–1/ IEEE–488 bus interface
- By-passing or selection of individual channels
- Standard 7-pin B&K microphone socket inputs
- Dual-function input/output sockets
- Choice of 0V, 28V or 200V polarization voltages
- Individual ± 3dB channel sensitivity adjustment
- Dual LED tuning indicator for calibration with Pistonphone or Microphone Calibrator
- Frequency response 2Hz to 200kHz ± 0,5dB
- Crosstalk less than –80dB up to 20kHz, less than –60dB up to 200kHz

USES:

- Building acoustics measurements with the Building Acoustics Analyzer Type 4418
- Sound power measurements with the Digital Frequency Analyzer Type 2131
- Reverberation time measurements with the Digital Frequency Analyzer Type 2131
- Multi-channel noise monitoring
- Multi-channel sound, vibration and electrical measurements

The Type 2811 is a dual 8-channel multiplexer intended mainly for acoustics applications. Its microphone inputs are standard B&K 7-pin sockets which provide the power for microphone preamplifiers and a choice of polarizing voltages for condenser microphones. The 2811 provides transient-free electronic switching between channels under automatic, manual or external control, and switches the selected channel to output connectors on both the front and rear panels. A digital interface complying with IEC 625-1 and compatible wih IEEE–488 permits the 2811 to be used in a variety of advanced acoustic, monitoring and automatic test applications.



Description

Scanning Characteristics

Scanning can be controlled manually using the front-panel switches, or automatically using the built-in clock, external clock control or the IEC/ IEEE interface. Each channel is provided with its own three-position "Select – Inhibit" switch. The upper, spring-loaded setting enables the corresponding channel to be selected (for calibration, for example), overriding any scan which may be in progress. The lower setting inhibits the corresponding channel, causing it to be bypassed during a scan.

For manual scanning, a single "Reset – Step" switch is provided. When pressed upwards this switch resets the Multiplexer to the channel with the lowest number which is not inhibited. When pressed downwards, it steps the Multiplexer to the next (higher numbered) channel which is not inhibited.

The built-in clock generator provides 9 scan rates, with channel dwell times from 1/16s to 16s in a binary sequence. It may be stopped and reset using the "Reset – Step" switch. When this switch is released again, the generator starts on a whole new dwell period with the channel selected.

An external clock and reset timing generator can be connected to the "External Scanning" Input. When the manual mode is selected, both the external clock generator and the "Reset – Step" switch can control the scanning. If the external mode has been selected, only the external clock generator can control the scanning. Typical external clock generators include the Building Acoustics Analyzer Type 4418 or another 2811 ("External Scanning" Out socket).

The scan may also be controlled through the digital interface of the 2811, which conforms with the re-

quirements of IEC 625–1 and is compatible with the IEEE–488 interface bus. A 5-digit switch on the rear panel enables the device address to be selected by the user. The bus interface may be used to exercise full control of the scanning, i.e., selection of a specified channel, selection of the output of another, cascaded 2811 ("From Extension"), step to next channel or reset to first channel.

To minimise the risk of problems with ground loops, the common line (ground) of the digital circuitry of the 2811 is permanently connected to the chassis. This is separated from the analogue signal common (screen) by a non-linear link, which offers a high resistance to induced noise currents, but a low resistance to fault currents. The two common lines may also be linked by a metal strap on the rear panel.

When the 2811 is connected to the IEC/IEEE bus, a Subsidiary Multiplexer is available in the same cabinet. This Subsidiary Multiplexer operates on the same eight inputs as the Main Multiplexer, with the output selected using IEC bus commands. None of the front panel switches have any influence on the Subsidiary Multiplexer.

Up to four 2811's may be connected in cascade, giving a multiplexer system of up to 32 channels. When such a system is controlled via the IEC/IEEE bus only one address need be used, or each 2811 can have its own address. When only one bus address is used, interface control of scanning functions is limited to stepping and resetting the Main Multiplexers.

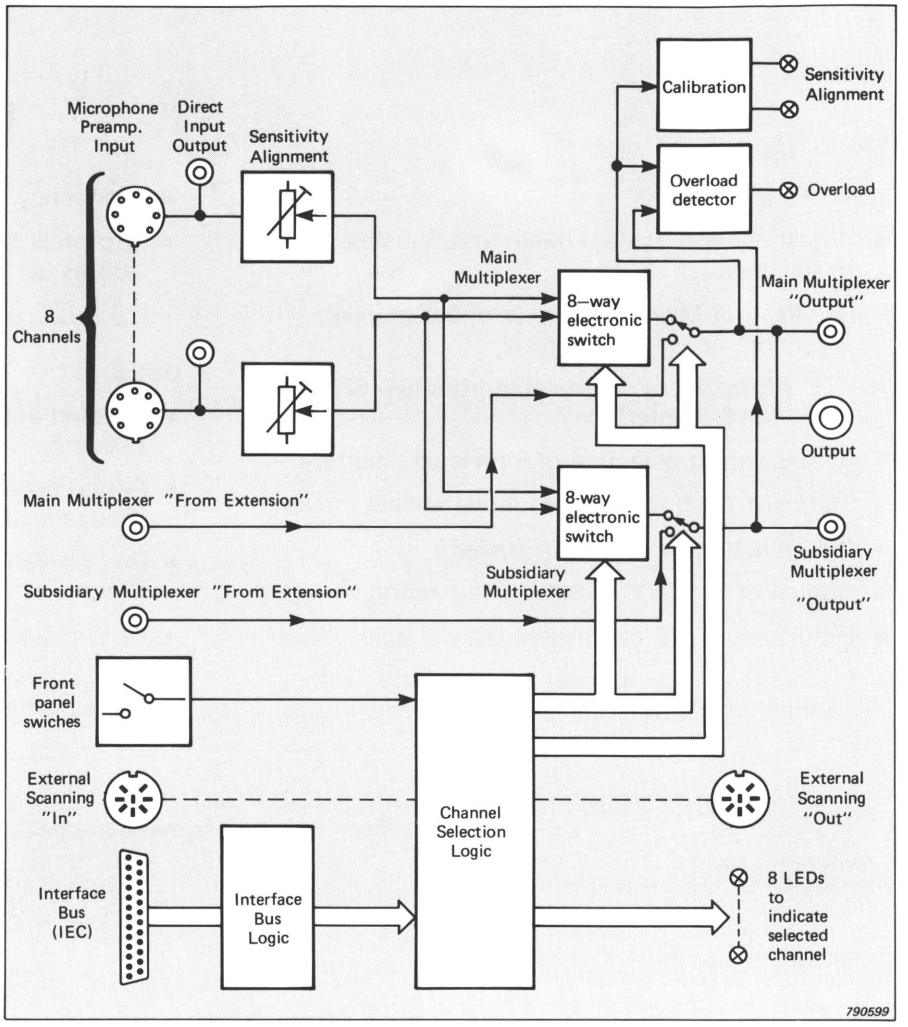


Fig. 1. Block diagram of the Type 2811

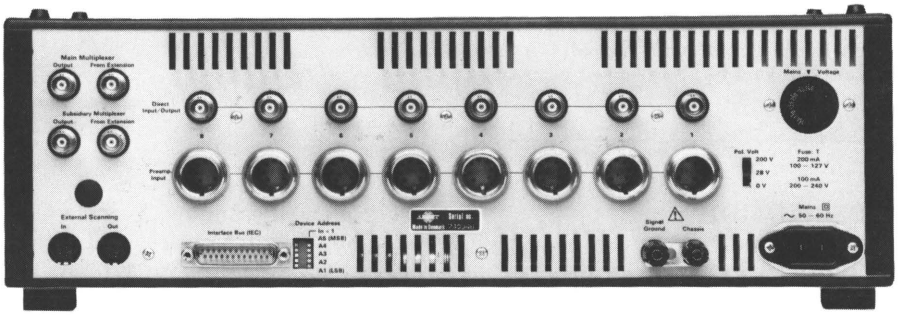


Fig. 2. Rear panel of the Type 2811

Signal Characteristics

Microphone input to the 2811 is by eight B&K standard 7-pin preamplifier sockets, which also carry power supply lines for B&K microphone preamplifiers (Types 2633, 2639 and 2645) and polarizing voltages for condenser microphones. A single switch on the rear panel selects polarizing voltages of 0 V, 28 V or 200 V. Each channel is provided with a BNC Direct Input/Output socket, which may be used either for monitoring or recording individual microphone outputs, or as an input for non-acoustic signals (such as vibration or general instrumentation signals) to the multiplexer.

Each channel input is provided with ± 3 dB sensitivity adjustment, for easy calibration with Pistonphone Type 4220 or Sound Level Calibrator Type 4230 when the Multiplexer is being used in sound measurement systems. A two-LED Sensitivity Alignment indicator permits easy adjustment of all eight channels.

The Main Multiplexer has signal output connections on both the front and rear panels. The Subsidiary Multiplexer signal output is present only on the rear panel

The maximum output level in both multiplexers is 5 V peak; when this is exceeded, an LED lights to indicate overload. The input limits are from 3,5 V to 7 V peak, depending on the Sensitivity Alignment setting. The extended frequency response of the

Type 2811 — ± 0,5 dB from 2 Hz to 200 kHz — allows its use with a wide variety of transducers. Over the audio frequency range of 20 Hz to 20 kHz, for which it is primarily intended, the response is flat within ± 0,1 dB.

IEC/IEEE Interface

The 2811's interface commands select output of individual channels or the extension input in the main and subsidiary multiplexers; "Reset" and "Step" of the main multiplexer; and a Start/Stop logic signal on the External Scanning Control connector.

The Start/Stop facility can be used to control instruments associated with the 2811 which do not themselves have interface control. For example instruments such as the Type 1405 Noise Generator, the Type 4205 Sound Power Source and the Type 4224 Sound Source may be stopped and started via a control cable connected to the External Scanning Control connector of the 2811.

Applications

Building Insulation Measurements

For investigations into noise transmission paths in large buildings, one or two Type 2811 Multiplexers can be connected directly to the Type 4418 Building Acoustics Analyzer (or the earlier Type 4417) to facilitate measurements of sound pressure levels in different parts of the structure. Up to three more Type 2811's can be cascaded with those connected directly to the 4418 allowing up to 32 microphones to be used for each of the 4418's two input channels.

A typical measurement arrangement is shown in Fig. 3. Multiplexers are used in both source and receiving rooms to obtain spatial averaging of sound pressure level and measure re-

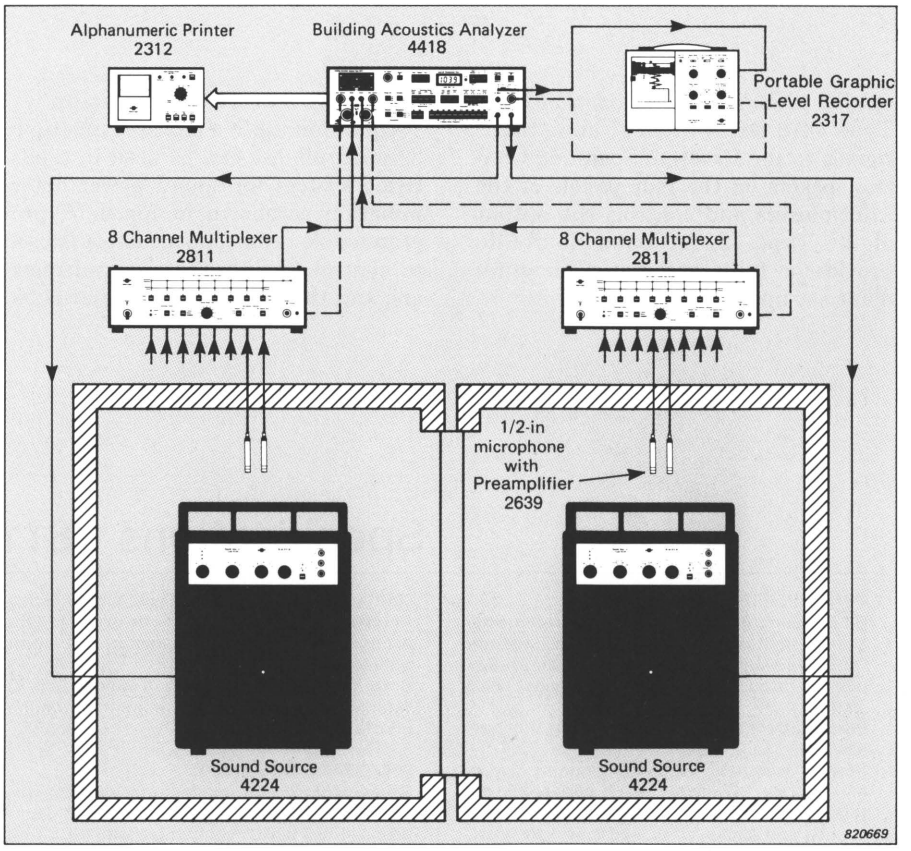


Fig. 3. A typical arrangement for building acoustics analysis, showing two Type 2811's in use with a Type 4418 Building Acoustics Analyzer and two Type 4224 Sound Sources. The Type 4418 provides all the necessary remote control signals to the Multiplexers and to the other instruments in the set-up to make this a fully automatic system for sound power and reverberation time measurement

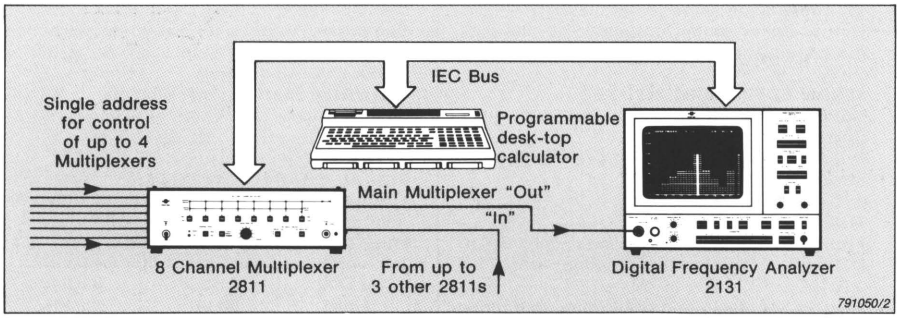


Fig. 4. Use of the Type 2811 in frequency analysis or sound power measurement, showing control of up to four 2811s from a single IEC/IEEE bus address

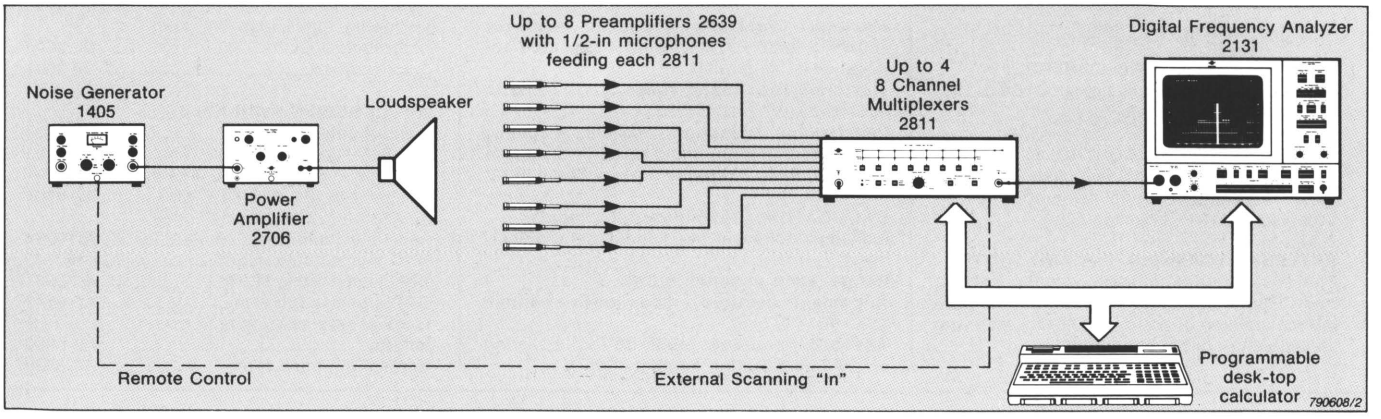


Fig. 5. An automated system for reverberation time measurements

ceiving room reverberation time. The Type 4418 sends "Reset" and "Step" signals to the External Scanning Control sockets on the rear panels of the Multiplexers and controls the output of the Type 42224 Sound Source to provide a fully automatic measurement set-up.

Sound Power Determination

Up to four 2811's multiplexing up to 32 microphones can be used in a bus-based system for sound power determination as shown in Fig. 4. A programmable desk-top calculator is used to control scanning in the multiplexers, and the multiplexed output is fed to a Digital Frequency Analyzer Type 2131.

Reverberation Time Measurements

The 2811 may be combined with a Real Time Analyzer and a calculator for automated reverberation time measurements, as shown in Fig. 5.

Specifications 2811

PREAMPLIFIER INPUTS:
B & K standard 7-pin Microphone Preamplifier socket, mates with Plug JP 0715. Adaptor DB 2609 is supplied to allow use with Preamplifiers fitted with the earlier, longer Plug JP 0701
Input Impedance: (Signal line) 300 kΩ in parallel with 50 pF
Power Supplies: +6,3 V DC heater supply and +12,6 V DC supply (each supply 480 mA total for all eight sockets); +150 V DC (2 mA) supply; and choice of 0, +28 V or +200 V DC polarization voltage
Maximum signal: 3,5 V to 7 V Peak depending on setting of Sensitivity Alignment

DIRECT INPUT/OUTPUTS:
Standard BNC sockets, mating with Plug JP 0035
Input Impedance: 300 kΩ in parallel with 50 pF, as for Preamplifier Inputs (corresponding sockets are wired in parallel)
Output Impedance: Corresponds to the output impedance of the Preamplifier used

"FROM EXTENSION" INPUTS:
Standard BNC sockets, mating with Plug JP 0035
Impedance: Matches Multiplexer "Output"
Maximum Signal: 5 V Peak

MULTIPLEXER OUTPUTS:
Front Panel: (Main Multiplexer only) B & K standard coaxial socket, mating with Plug JP 0101
Rear Panel: (Main and Subsidiary Multiplexer) Standard BNC connectors, mating with Plug JP 0035
Output Impedance: Less than 20 Ω.
Output Loading: Minimum resistive load, 5 kΩ; maximum capacitive load, 1 nF
Maximum signal: 5 V Peak

AUTOMATIC SCANNING CONTROL:
9 switch-selectable dwell times, 1/16 s to 16 s. Accuracy ± 1%

MANUAL SCANNING CONTROLS:
Facilities: Selection of any channel, inhibition of any channel during scanning, stepwise scanning, reset to beginning

EXTERNAL SCANNING "IN" AND "OUT":
Pair of standard 8-pin DIN sockets accepting Plug JP 0802 and Cable AQ 0034, for cascade interconnection of up to four 2811's, carrying all scanning control signals
"In" interfaces fully to the Type 4418 Building Acoustics Analyzer, and may be used for other combinations (open-collector TTL-compatible)
Both "In" and "Out" carry a signal (pin 5) which may be set (low) and reset (high) via the Interface Bus

INTERFACE BUS (IEC):
Connector: 25-pin connector accepting Cables AO 0184, AO 0194 and AO 0264. Conforms to IEC 625-1, compatible with IEEE Std. 488/ANSI MC1.1
Functions Implemented:
Acceptor Handshake — AH 1
Listener — L 2
Remote/Local — RL 1
All other functions — no capability
Main Multiplexer Facilities: Selection of a specified channel, Selection of "From Extension" input. Step to next channel, Reset to first channel
Subsidiary Multiplexer Facilities: Selection of a specified channel (1 to 8), Selection of "From Extension" input
Start/Stop instructions: Commands to another instrument via External Scanning sockets (pin 5)

SIGNAL CHARACTERISTICS:
Frequency Response: 2 Hz to 200 kHz ± 0,5 dB, 20 Hz to 20 kHz ± 0,1 dB
Max. Total Harmonic Distortion:

Sine Output Level	2 Hz to 20 kHz	2 Hz to 200 kHz
1 V RMS	0,03%	0,2%
3,5 V RMS	0,1%	0,3%

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Maximum Crosstalk: –80 dB, 2 Hz to 20 kHz; –60 dB, 2 Hz to 200 kHz (with 50 Ω source impedance at all inputs)
Maximum Broadband Noise: 12 μV, 2 Hz to 20 kHz; 30 μV, 2 Hz to 200 kHz
Interference Rejection: 100 A/m magnetic field increases broadband noise in the audio range (20 Hz to 20 kHz) to not more than 20 μV

CALIBRATION (Sensitivity Alignment):
Individual, channel-by-channel gain adjustment
Range, each channel: ± 3 dB
Alignment Accuracy, channel-to-channel: ± 0,1 dB
Absolute Accuracy: ± 0,25 dB (not including errors in calibration source)

TEMPERATURE RANGE:
Operating: 5°C to 40°C (41°F to 104°F)
Storage: –25°C to 70°C (–13°F to 158°F)

HUMIDITY RANGE:
0 to 90% relative humidity, non-condensing at 30°C

DIMENSIONS:
Height: 132,6 mm (5,22 in)
Width: 430 mm (16,9 in)
Depth: 200 mm (7,87 in)

WEIGHT:
6,5 kg (14,3 lb)

CABINET:
Supplied as model A (light-weight metal cabinet), B (mahogany cabinet), or C (as A, with flanges for standard 19 in. rack mounting)

POWER SUPPLY:
100, 115, 127, 200, 220, 240 V single phase AC mains 50/60 Hz. Approximate power ratings are 13 VA alone, 21 VA with 8 Microphone Preamplifiers Type 2639, and 28 VA with 8 Microphone Preamplifiers Type 2645
Complies with Safety Class II of IEC Publication 348, and with requirements for U.S. FCC Class B Computing Device in respect of electromagnetic compatibility

ACCESSORIES INCLUDED:
1 mains cable ..... AN 0020
4 BNC plugs ..... JP 0035
1 B & K coaxial plug ..... JP 0101
2 8-pin DIN plug JP0802
2 100 mA fuses ..... VF 0026
3 200 mA fuses ..... VF 0012
2 4 mm banana plugs ..... JB 0002
1 IEC Bus connector kit (25-pin) ..... UA 0793
8 Preamp. Input adaptors (long plug/short socket) ..... DB 2609
1 screwdriver ..... QA 0001

ACCESSORIES AVAILABLE:
Control cable ..... AQ 0034
IEC 625-1 interface cable (2m) ..... AO 0194
Adaptor to convert IEEE–488 instrument to IEC 625-1 (25 pin) ..... AO 0195
IEC 625–1 (25 pin) to IEEE–488 interface cable (2 m) ..... AO 0264
BNC signal cable (0,6 m) ..... AO 0133
BNC signal cable (1,2 m) ..... AO 0087
BNC signal cable (3 m) ..... AO 0142
Coaxial screened cable in free length ..... AC 0002
Screened 7-core cable ..... AC 3029

2. CONTROLS

2.1. FRONT PANEL

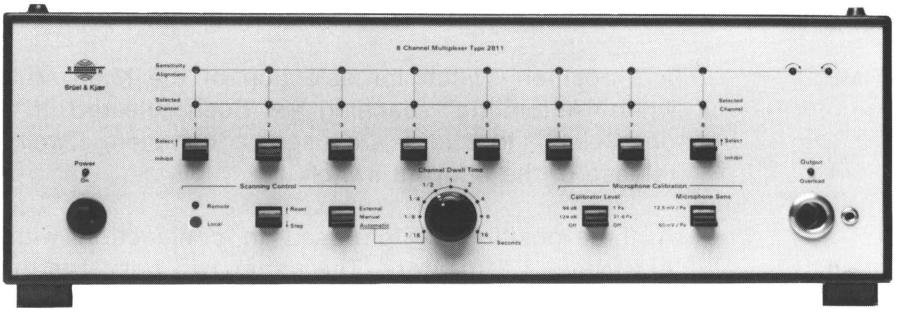

Fig. 2.1. Front Panel of the 2811

POWER: Power is applied to the 2811 when this switch is in the upper position. The "On" condition is indicated by the red LED above the switch.

SENSITIVITY ALIGNMENT: Eight slotted screw-heads allow individual adjustment of the sensitivity of each channel. In conjunction with the MICROPHONE CALIBRATION switches and a suitable external calibration source, this allows matching of sensitivity across all eight channels. Two LED's at the right-hand end of the panel indicate the appropriate direction (clockwise or anti-clockwise) for adjustment. See section 3.2 for details of calibration procedures.

SELECTED CHANNEL: One of eight LED's indicates the channel currently switched to the Main Multiplexer's OUTPUT.

SELECT/INHIBIT: Eight three-position switches, one for each channel. In the "Inhibit" position, the channel is bypassed during scanning by the Main Multiplexer. The centre position selects a channel for scanning. In the "Select" position—which is spring-loaded to return to centre when released—the chosen channel is output continuously, overriding the Main Multiplexer scan. Main Multiplexer scanning restarts at this channel when the switch is released.

SCANNING CONTROL: **"Remote"**: LED which, when on, indicates that the 2811 is being controlled via the IEC 625–1/IEEE 488 Interface Bus. See section 3.6 for further information on IEC/IEEE bus functions.

"Local": A push-button switch which may be used to terminate IEC 625–1/IEEE 488 interface control of the 2811, returning it to Local (i.e., front panel) control. It will not operate if the LLO (Local Lock-out) function in the 2811's interface has been set.

"Reset/Step": A three-position, centre-biased switch for manual control of the Main Multiplexer scanning sequence. "Reset" switches the Main Multiplexer's OUTPUT to the lowest non-inhibited channel."Step" switches the scan to the next non-inhibited channel in the scan sequence.

"External/Manual/Automatic": Selects the method by which Main Multiplexer scanning is to be controlled. In the "External" position scanning is controlled via the EXTERNAL SCANNING IN socket. In the "Manual" position, scanning may be controlled either by the "Reset/Step" switch or via the EXTERNAL SCANNING IN socket. When set to the "Automatic" position, the scanning rate is determined by the CHANNEL DWELL TIME control, but may be overridden by use of the "Reset/Step" switch or the individual channel "Select" function.

CHANNEL DWELL TIME:

A 9-position switch for selection of the Main Multiplexer dwell time when "Automatic" scanning has been selected. If the "Reset", "Step" or "Select" functions are used, a complete Dwell Time will start on release of the relevant switch.

CALIBRATOR LEVEL:
(Microphone Calibration)

A three-position switch used in conjunction with the SENSITIVITY ALIGNMENT indicators. The upper two positions match the Sensitivity Alignment threshold to the calibration source: "94 dB–1 Pa" for use with Microphone Calibrator Type 4230, and "124 dB–31,6 Pa" for use with Pistonphone Type 4220. In the bottom position, SENSITIVITY ALIGNMENT is switched off.

MICROPHONE SENS.:
(Microphone Calibration)

Selects the SENSITIVITY ALIGNMENT threshold to suit the microphones in use. Sensitivities of "12,5 mV/Pa" or "50 mV/Pa" may be selected.

OUTPUT:

The front-panel OUTPUT socket is the output of the Main Multiplexer, and mates with B&K coaxial plug JP 0101. Adjacent to the OUTPUT socket is a 4 mm socket (mating with 4 mm plug JB 0002), which is connected to signal ground. For a discussion of grounding considerations refer to Section 3.1.

OVERLOAD:

An LED immediately above the OUTPUT socket indicates an output overload in either the Main Multiplexer or the Subsidiary Multiplexer. An overload occurs if the voltage at either output exceeds 5 V peak.

2.2. REAR PANEL

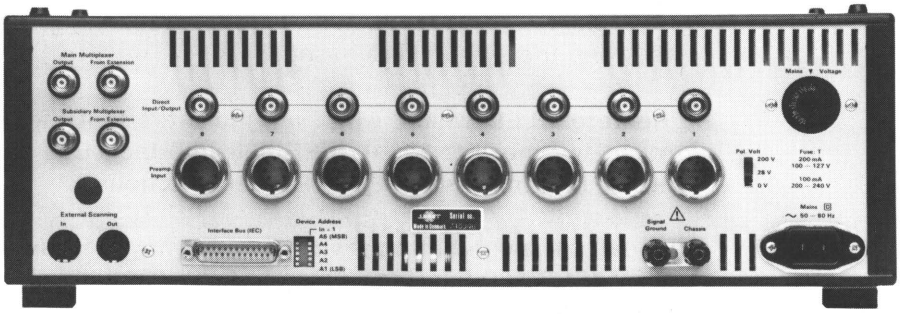

Fig. 2.2. Rear Panel of the 2811

MAINS INPUT:

A two-pin socket accepting Mains Cable AN 0020, for connection to a single phase AC mains supply.

MAINS VOLTAGE:

A six-position switch incorporating the Mains Fuse. Before connecting the 2811 to a mains supply, the mains voltage setting and fuse rating should be checked and necessary adjustments made in accordance with the instructions given in section 3.1.

CHASSIS–SIGNAL GROUND:

A pair of clamping terminals with captive link for connecting or disconnecting SIGNAL GROUND and CHASSIS of the 2811 in accordance with the grounding considerations given in Chapter 3. Connections to both terminals can be made using a 4 mm Wonder plug, B&K no. JB 0002.

CHASSIS is permanently connected to both the instrument chassis and INTERFACE BUS (IEC) ground. SIGNAL GROUND is permanently connected to the screens of the input, output and "From Extension" sockets (signal ground). When the two terminals are disconnected internal clamping circuitry limits the voltage difference between CHASSIS and SIGNAL GROUND to 1 V maximum.

⚠ **WARNING:** The 2811 is designed to be operated with its CHASSIS and SIGNAL GROUND at, or near, earth potential. For proper operation the voltage between CHASSIS and SIGNAL GROUND should never be allowed to exceed ±0,3 V.

MAIN MULTIPEXER OUTPUT:

A standard BNC socket (mating plug B&K no. JP 0035) connected to the output of the Main Multiplexer. This duplicates the signal at the front panel OUTPUT socket. The output impedance is less than 20 Ω; load resistance should not be less than 5 kΩ, load capacitance not greater than 1 nF.

MAIN MULTIPLEXER FROM EXTENSION:

A standard BNC socket for input of the multiplexed signal (MAIN MULTIPLEXER OUTPUT) from a subsequent 2811 in a cascade system.

SUBSIDIARY MULTIPLEXER OUTPUT:

A standard BNC socket connected to the output of the Subsidiary Multiplexer. The OVERLOAD indicator on the front panel lights if the output signal exceeds 5 V peak. The output impedance is less than 20 Ω; load resistance should not be less than 5 kΩ, load capacitance not greater than 1 nF.

SUBSIDIARY MULTIPLEXER FROM EXTENSION:

A standard BNC socket for input of the multiplexed signal (SUBSIDIARY MULTIPLEXER OUT) from a subsequent 2811 in a cascade system.

Note: The Subsidiary Multiplexer can only be operated from the IEC/IEEE Interface.

POL. VOLT.:

POLarization VOLTage switch selects suitable polarization voltages for microphones connected to the PREAMP. INPUTS: "0 V", "28 V" or "200 V".

Note: Always set the POL. VOLT. switch for the required Polarization Voltage before applying power to the 2811. If the polarization voltage is changed after the 2811 has been switched on, it is necessary to

allow approximately ten minutes to allow the new polarization voltage to settle at the correct value.

PREAMP. INPUT:

Eight B&K standard Microphone Preamplifier sockets (mating plug B&K no. JP 0715), including power supplies for preamplifiers and polarization voltages for condenser microphones. Pin connections are shown in Fig. 2.3.

Note: For connecting microphone preamplifiers, adaptors and other accessories which have the earlier 7-pin plug JP 0701 (long type), the Adaptor DB 2609 is included which slides over the front of the plug.

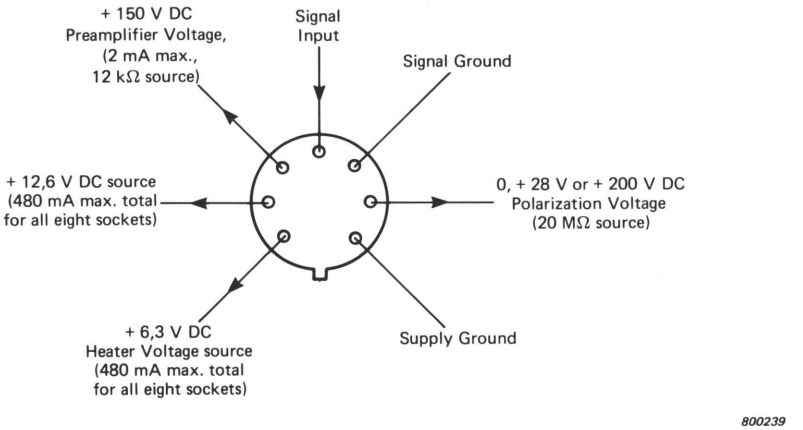

Fig. 2.3. PREAMP. INPUT socket connections (external view)

DIRECT INPUT/OUTPUT:

Eight standard BNC sockets connected to the signal input line of the corresponding PREAMP. INPUT. If the PREAMP. INPUTS are used, these sockets can be used to monitor individually the input signals. Alternatively, if the PREAMP. INPUTS are not used these sockets can be used as direct inputs to the Multiplexers, with an input impedance of 300 kΩ paralleled by approximately 50 pF.

EXTERNAL SCANNING:

"In–Out": A pair of standard 8-pin DIN sockets (mating plug B&K no. JP 0802) for external control of Main Multiplexer scanning. In a cascade system EXTERNAL SCANNING "In" is connected to the EXTERNAL SCANNING "Out" socket of the preceding 2811. Alternatively, a suitable clocking signal at the EXTERNAL SCANNING "In" socket can be used to control Main Multiplexer scanning when "External" or "Manual" SCANNING CONTROL has been selected on the front panel.

Connections to the EXTERNAL SCANNING sockets are shown in Fig. 2.4.

INTERFACE BUS (IEC):

A 25-pole connector for connection of the 2811 to the IEC 625–1/IEEE Std. 488 Interface Bus. For further information on the use of this connector, see section 3.6. The bus ground is connected to CHASSIS.

DEVICE ADDRESS:

A set of five miniature switches used to select the Device Address for IEC/IEEE Interface Bus applications. See section 3.6.2.

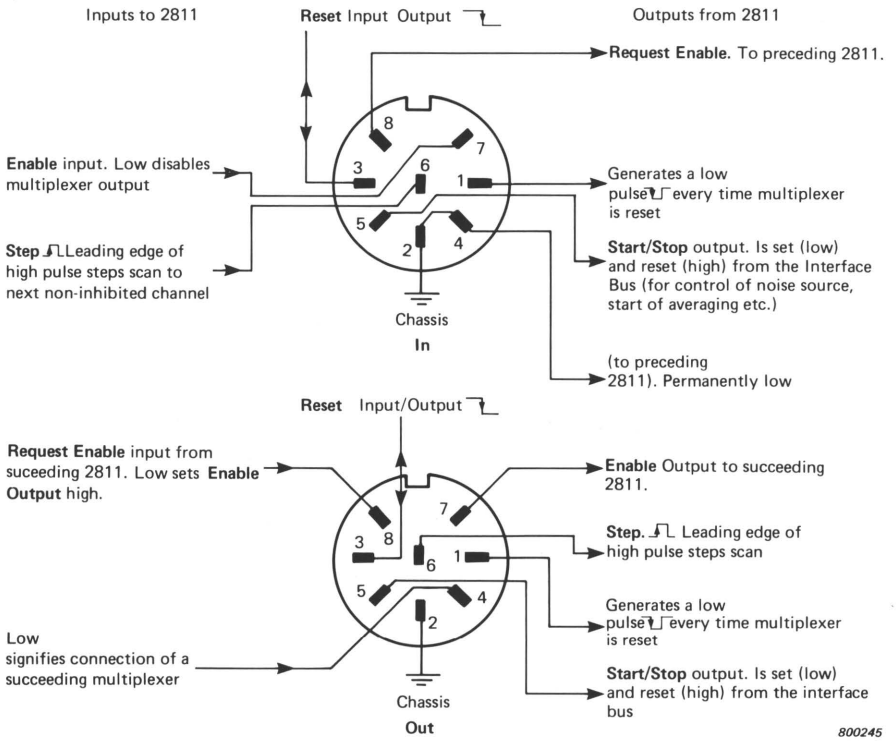

Fig. 2.4. EXTERNAL SCANNING socket connections. All inputs and outputs are TTL and CMOS-logic compatible. Outputs are open-collector TTL type. Unconnected inputs will assume a logic HIGH level

3. OPERATION

3.1. PRELIMINARY

3.1.1. Environment and Handling

The 8 Channel Multiplexer Type 2811 is designed to be operated in an ambient temperature in the range +5°C to 40°C (+41°F to +104°F) and up to 90% relative humidity (non condensing) at 30°C. Other than ensuring proper connection of the mains supply, no special handling precautions are necessary.

3.1.2. Mounting

The 2811 may be used free standing on its four plastic feet, or, for easier viewing, the front may be raised by folding down the flanges attached to the front feet. Except where the 2811 is to be placed on top of other B&K instruments of similar width, it is advisable to fit non-slip inserts DF 7033 at least to the rear feet. These inserts will give the instrument a better grip on smooth surfaces.

A Mahogany Case KA 0027 is available to protect the 2811 during transportation. Also available are flanges KS 0038 to adapt the 2811 for mounting in a standard 19-inch rack. Tapped holes (covered by removable plastic plugs) near the front edge of the 2811's side panels provide fixing points for the flanges.

3.1.3. Connecting the Mains Supply

Before connecting a mains supply the following checks and adjustments should be carried out to ensure safe operation of the instrument.

Mains Voltage Setting

The 2811 may be operated from a 50 to 60 Hz single phase AC mains supply at 100, 115, 127, 200, 220 or 240 V ±10%. The MAINS VOLTAGE switch on the rear panel must be set to the local supply voltage before power is applied.

To change the mains voltage setting it is first necessary to remove the fuse holder in the centre of the MAINS VOLTAGE switch. Use a wide-bladed screwdriver (or a large coin) to turn the switch to the correct voltage. Before replacing the fuse holder, check that a correctly rated fuse is fitted.

Fuse Rating

For operation from 100/115/127 V supplies a 20 mm, 200 mA slow-blow fuse (B&K no. VF 0012) should be used. For 200/220/240V supplies, a 20 mm, 100 mA slow-blow fuse (no. VF 0026) is required.

Note: For continued protection and safe operation of the 2811 only the correct type and rating of fuse should be used. The use of mended fuses and the short-circuiting of fuse holders reduces the safety of the instrument and may result in damage to it.

Supply Connections

Once the mains voltage setting and fuse have been checked, the mains supply may be connected to the MAINS INPUT using the Power Cable AN0020 provided with the instrument.

The 2811 has a high standard of safety insulation in accordance with Safety Class II of IEC 348 and therefore need not be connected to the protective earth contact of a mains supply outlet.

3.1.4. Grounding Considerations

Indiscriminate grounding of instruments can introduce ground-loop interference. Ground loops are created where multiple ground paths exist between two or more points in a measuring system, for instance where two separate signal lines interconnect two instruments. Circulating currents in these ground loops generate noise voltages in the measurement system resulting in less accurate measurements.

To assist in eliminating ground loops from measurement systems incorporating the Type 2811 without reducing the operating safety of the system, the following guidelines are offered. Before connecting or disconnecting any cables switch off the mains power of all the instruments in a system. This will avoid damage to the instruments when connectors with different voltage levels come into contact.

1. Connect the signal ground lines of all instruments together. This is done automatically through the screens of input and output cables used to interconnect the instruments.

2. If any two instruments are interconnected with more than one signal cable, or with a combination of signal cables and remote control cables containing signal ground lines, either:

   (*a*) Disconnect the signal ground lines of all but one of the interconnecting cables; or

   (*b*) Bunch all the cables together, keeping them as short as possible.

3. All instruments which have a ground connection in their mains supply connector should have their chasses connected to mains ground. In one, and only one of these instruments the signal ground should be connected to the chassis and thus to mains ground.

4. When instruments without a mains ground connection are used free-standing (not mounted in an instrumentation rack) ensure that metal instrument cabinets do not touch each other and connect the chassis of each such instrument to signal ground.

5. When instruments are mounted in a metal instrumentation rack, the rack provides a ground path between the chasses of the instruments. Isolating flanges can be used to mount the instruments in the rack, or the following procedures may be considered:

   (*a*) If the system includes both instruments with mains ground and instruments without mains ground, disconnect signal ground from the chasses of all but one of

the instruments which do not have a mains ground connection. Check that signal ground is connected to the chassis of one, and only one of the instruments whose chassis is connected to mains ground.

(*b*) If none of the instruments in the system has a mains ground connection, ensure that signal ground is connected to chassis in only one of the instruments. The metal rack will provide the ground connection to the chasses of the remaining instruments.

6. Ensure that the grounds of the INTERFACE BUS (IEC) connectors on all the instruments equipped with them are connected together only via the cable of the interface bus itself. Control cables between bus-connected instruments normally provide ground connections, and should be disconnected if they are not actually required for correct operation of the system. On no account disconnect any of the lines in the interface bus cable.

7. Isolate the housings of all measurement transducers from grounded surfaces. This is a particularly important procedure with a multi-channel instrument like the 2811, to prevent ground loops occuring at the input to the system.

The 2811 is an IEC 348 Safety Class II instrument. For correct grounding in accordance with the above requirements, its signal ground line may be connected to, or disconnected from, its chassis using the link bar on the rear panel.

⚠ **WARNING:** The 2811 is designed to be operated with its CHASSIS and SIGNAL GROUND at, or near, earth potential. For proper operation the voltage between CHASSIS and SIGNAL GROUND should never be allowed to exceed ±0,3 V.

3.1.5. Preamplifier Inputs

Before applying power and making connections to any of the PREAMP. INPUT sockets, check that the POL. VOLT switch is set to the value of polarization voltage appropriate to the transducers in use. If the polarization voltage is changed after power has been applied to the 2811 it will be necessary to wait for up to ten minutes before the preamplifiers settle at the new voltage and accurate measurements can be made.

The connection diagram for the preamplifier sockets is given in Chapter 2.

3.2. CALIBRATION

Before the 2811 is used, the channel sensitivities should be aligned to ensure either that they are equal, or that they compensate for variations between the sensitivities of the transducers in use, depending on the application. ±3 dB of adjustment is available in each channel.

The SENSITIVITY ALIGNMENT facilities on the 2811 are designed for the calibration of one-inch and half-inch condenser microphones of standard sensitivities using a Pistonphone Type 4220 or a Sound Level Calibrator Type 4230. If a suitable calibration source is available, the facilities may also be used to calibrate the system for signals from other devices. The deviation between channels calibrated by the method described below will be better than ±0,1 dB. The absolute accuracy, referred to the OUTPUT, of the 2811's SENSITIVITY ALIGNMENT indicator is better than ±0,25 dB (calibrator tolerances not included).

3.2.1. Calibration for Sound Measurement

The following procedure can be used if a single Type 2811 is to be calibrated.

1. Connect the Microphone Preamplifiers to the PREAMP. INPUT sockets of the 2811.

2. Set CALIBRATOR LEVEL to "94 dB–1 Pa" for the Sound Level Calibrator Type 4230, or "124 dB–31,6 Pa" for the Pistonphone Type 4220.

3. Set MICROPHONE SENS. to the sensitivity appropriate to the microphone in use.

4. Set SCANNING CONTROL to "Manual" and switch the Main Multiplexer to the required channel. This can be done by pressing "Step" repeatedly until the required channel is indicated by SELECTED CHANNEL, or by using the appropriate channel "Select" switch.

5. Fit the calibration source over the microphone in accordance with its Instruction Manual, and switch it on.

6. Turn the SENSITIVITY ALIGNMENT screw for the selected channel in the direction indicated by the arrow above the illuminated SENSITIVITY ALIGNMENT LED, until neither of the LED's are lit. A miniature screwdriver such as the B&K Type QA 0001 can be used to carry out this adjustment.

7. Repeat steps 4 to 6 for each channel of the 2811.

When calibration of all the channels in use is complete, switch the CALIBRATOR LEVEL back to "Off."

Where the measurement system incorporates more than one 2811, as in Fig. 3.2 for example, the SENSITIVITY ALIGNMENT indicator on the final 2811 (No. 1 in Fig. 3.2) should be used to obtain the closest alignment of all channels. If the other multiplexers are controlled externally, as described in section 3.5, their channels may be selected for

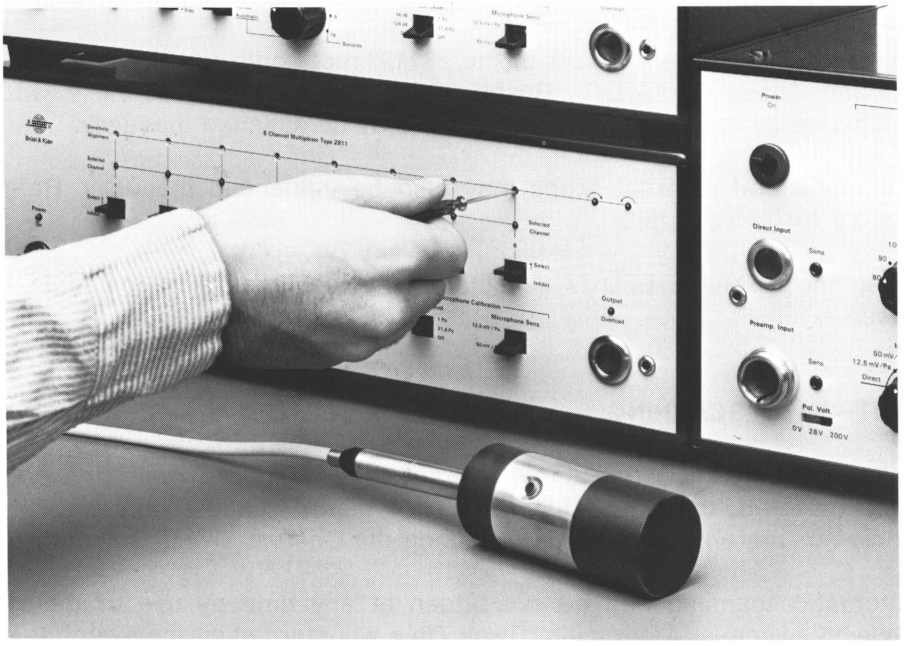

Fig. 3.1. Calibration of the 2811 for sound measurement

calibration by setting the SCANNING CONTROL of the final 2811 to "Manual" and stepping the scan by means of the "Step" switch until the channel to be calibrated is reached. For channel selection under interface bus control, refer to section 3.6.

3.2.2. Calibration of Non-Acoustic Signal Inputs

The 2811's SENSITIVITY ALIGNMENT facilities can be used to calibrate vibration and other analogue measurement transducers. The calibration signal generated by the transducer (the voltage input to the 2811) must match the SENSITIVITY ALIGNMENT threshold voltage. The signal should be sinusoidal with a frequency in the range 250 Hz to 1 kHz.

The CALIBRATOR LEVEL and MICROPHONE SENS. switches are used to set the threshold voltage for the SENSITIVITY ALIGNMENT indicators. The four threshold voltages available are found from the product of the CALIBRATOR LEVEL (in Pa) and MICROPHONE SENS. switch settings. Table 3.1 lists the different threshold voltages for which calibration is possible.

Microphone Sensitivity	Calibrator Level	
	1 Pa	31,6 Pa
12,5 mV/Pa	12,5 mV	395 mV
50 mV/Pa	50 mV	1,58 mV

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Table 3.1. SENSITIVITY ALIGNMENT indicator threshold voltages

If a calibration signal meeting the above requirements is not available, a voltmeter can be connected to the Main Multiplexer OUTPUT to check the alignment. Each channel can then be adjusted to a selected reference level on the meter.

3.3. MANUAL CONTROL OF SCANNING

Three functions give the user of the 2811 direct control of the Main Multiplexer scanning function. These are "Step", "Reset" and "Select". The use of these switches is explained in Chapter 2. Only the Main Multiplexer may be scanned manually.

Automatic and external scans may also be influenced manually. Refer to sections 3.4 and 3.5 for more details.

When the REMOTE LED is illuminated, manual control of the Main Multiplexer is not possible.

3.4. AUTOMATIC CONTROL OF SCANNING

With SCANNING CONTROL set to "Automatic" and an appropriate CHANNEL DWELL TIME selected, the Main Multiplexer operates under the control of the 2811's internal clock. For more information on selecting the Channel Dwell Time, refer to Chapter 4.

Automatic scanning can be overridden at any time by use of the "Reset", "Step" or "Select" switches. A complete Dwell Time will start when the switch is released.

3.5. EXTERNAL CONTROL OF SCANNING

External control of scanning is possible with the SCANNING CONTROL switch set to either "Manual" or "External".

"External" SCANNING CONTROL:

When "External" SCANNING CONTROL is selected, the only manual control of channel selection which remains available is the "Inhibit" function of each channel.

"Manual" SCANNING CONTROL:

With "Manual" SCANNING CONTROL selected, the externally controlled scan may be "Reset" from the front panel and one or more channel shifts may be added using the "Step" switch. Scanning can also be directed to a specific channel using the appropriate "Select" switch.

Most connections between other B&K instruments and the EXTERNAL SCANNING sockets on the 2811 may be made using Control Cable AQ 0034. This control cable is wired with pin 1 on one plug connected to pin 1 on the other plug, pin 2 to pin 2 and so on. Where the distance between instruments exceeds 1,5 m, an alternative control cable may be made with a suitable length of 8-core cable AD 0007 terminated at each end with a standard 8-pin DIN plug JP 0802. Connection diagrams for the EXTERNAL SCANNING "In" and "Out" sockets are given in Chapter 2.

For a discussion of the factors which need to be considered when selecting suitable scanning rates, refer to Chapter 4.

3.5.1. Use of More 2811's to Make a Multiplexer System

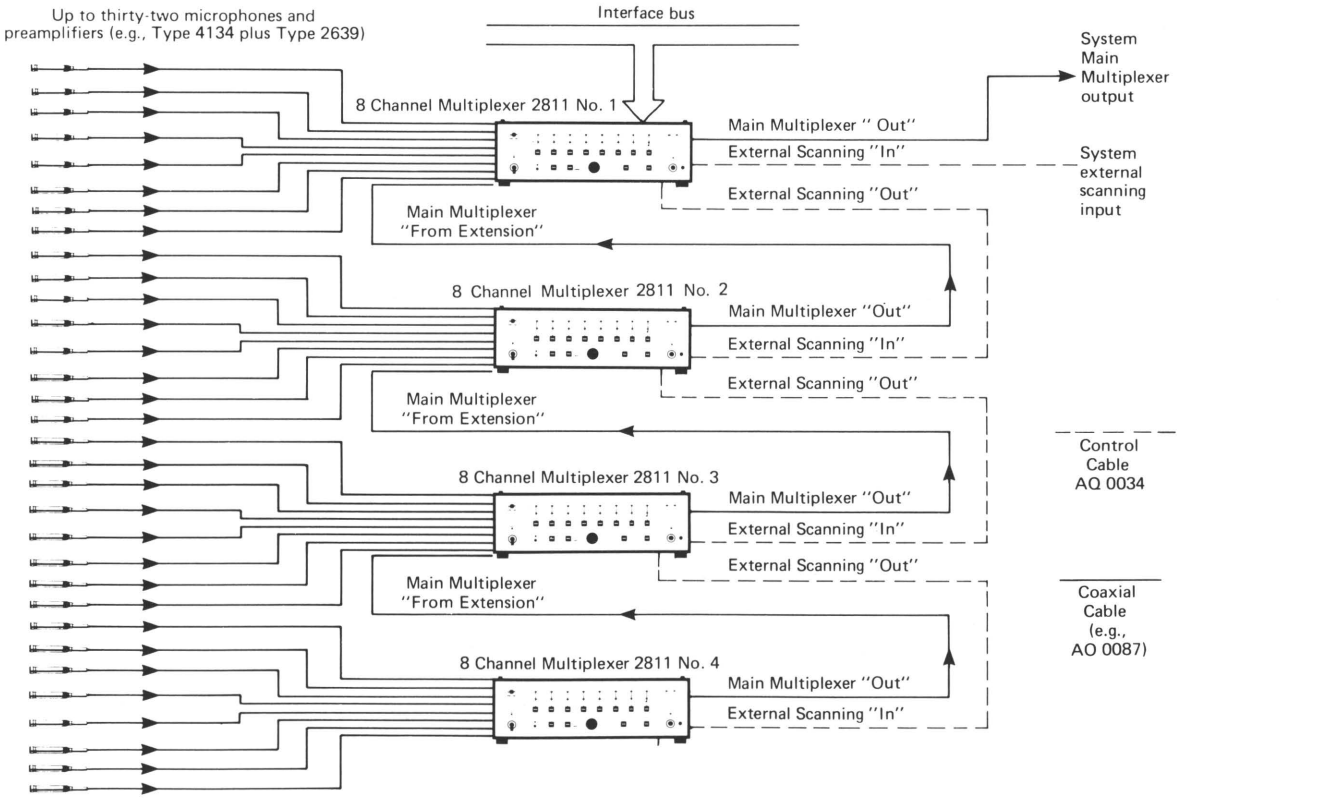

Fig. 3.2. Multiplexing 32 channels using the Main Multiplexers of four 2811's

Up to four 2811's may be operated together as shown in Fig. 3.2. The upper 2811 (No. 1) in this illustration controls the system. Its Main Multiplexer OUTPUT is the system output, and its EXTERNAL SCANNING "In" socket is the control input to the system. Thus the system acts as if it were an extended 32-channel Type 2811. The whole system in Fig. 3.2 may be operated under "Manual", "Automatic" or "External" control from or through the upper 2811 (no. 1 in the figure). As implied by the illustration, it may also be controlled by an interface bus; this possibility is dealt with in section 3.6. For the lower 2811's (Nos. 2 to 4), "Manual" or "External" SCANNING CONTROL may be selected. If "Manual" is selected on all the 2811's, selection of any channel in the system is possible using its "Select" switch. If the system as shown in Fig. 3.2 is controlled from an external source, the SCANNING CONTROL switches may be set to "External" to prevent accidental manual interference with the scan. The scan sequence follows the ascending numerical order of the 2811's (i.e., No. 1, No. 2, No. 3, No. 4).

3.5.2. Use with Type 4418 Building Acoustics Analyzer

The Type 4418 Building Acoustics Analyzer (or the earlier Type 4417) can be used with one or two 2811's, as shown in Fig. 3.3. One 2811 is used with up to eight microphones in the receiving room. A second may be connected at the same time to up to eight microphones in the source room.

The 2811's EXTERNAL SCANNING "In" socket is connected to the appropriate REMOTE CONTROL input of the 4418 (Channel A Input or Channel B Input) using a control cable AQ 0034. The Main Multiplexer OUTPUT of the 2811 is connected to the DIRECT Input of the appropriate channel. SCANNING CONTROL on the Multiplexers should be set to "External" or "Manual".

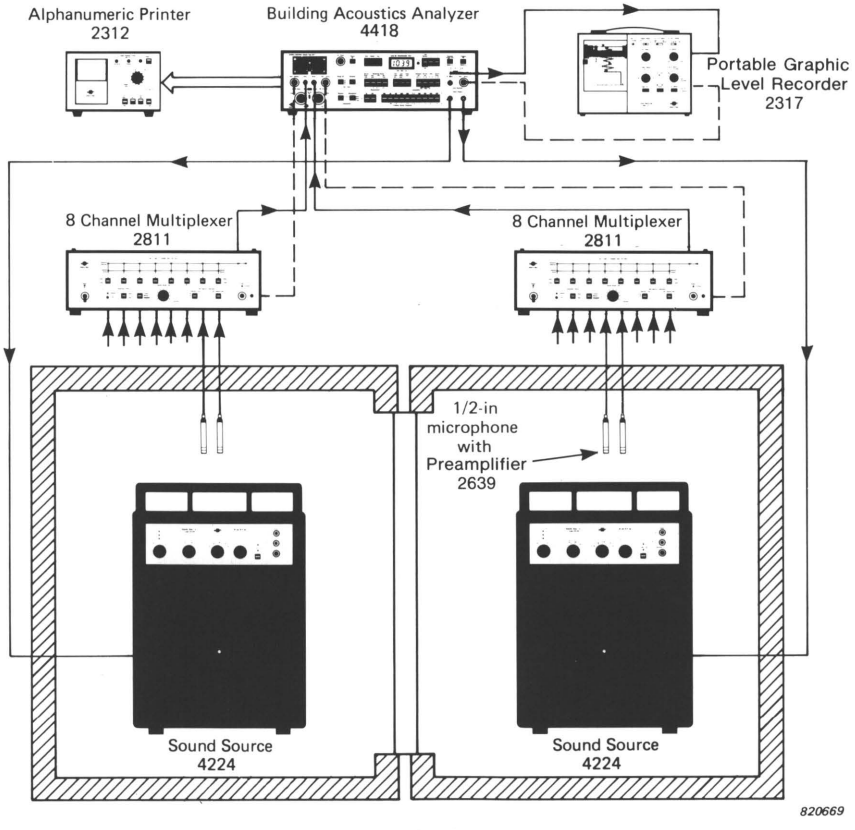

Fig. 3.3. Two Type 2811's in use with the Building Acoustics Analyzer Type 4418

3.6. CONTROL OF THE 2811 VIA THE INTERFACE BUS

The digital interface of the Type 2811 is designed according to IEC Publication 625–1, "An Interface System for Programmable Measuring Instruments (Byte Serial, Bit Parallel)". Since the only significant difference between this and IEEE Std. 488–1978/ANSI MC1.1–1975 is in the type of connector specified, compatibility with these standards is only a question of which connecting cable is used. Connection of the Type 2811 to an IEC 625–1 interface bus system is made from the INTERFACE BUS (IEC) connector on the rear panel of the 2811 using Cable AO 0194. Connection to an IEEE/ANSI interface bus system is made from the same connector using Cable AO 0264 (or Cable AO 0194 with Adaptor AO 0195). Connection to earlier B&K instruments fitted with a female, slide-lock connector is made using Cable AO 0184. For further details of instrument interconnections, refer to the B&K publication *Interfacing Brüel & Kjær Instruments.*

It is important to note that although the 2811 interface is designed according to the IEC standard, absolute compatibility with IEC or IEEE/ANSI interfaces designed by other manufacturers cannot be unconditionally guaranteed, since differences can occur within the limits of the specifications. Any problems encountered, however, will be of a software rather than a hardware nature. Where compatibility is in doubt, contact your local Brüel & Kjær representative for further information.

3.6.1 IEC Functions Implemented

The interface of the Type 2811 implements the following functions, as specified by the IEC standard. The clauses referred to are the relevant sections of the IEC Std. 625–1 which specify the functions. The equivalent sections in the IEEE/ANSI standard are given in parentheses.

Clause 7, Acceptor Handshake (AH) Interface Function, (Section 2,4)
AH 1—complete capability

Clause 9, Listener (L) Interface Function, (Section 2,6)
L 2 —basic listener

Clause 11, Remote Local (RL) Interface Function, (Section 2,8)
RL 1—complete capability

All other functions no capability.

For further details of the above functions, refer to the relevant sections of the IEC or IEEE/ANSI standards.

3.6.2. Addressing the 2811

The Type 2811 uses one Listen address—it has no Talk capability. The address is user-selectable and is set using the rear panel DEVICE ADDRESS switch. The usable addresses are shown in Table 3.2.

On delivery the instrument address is set to 00111 (i.e., device number 7). This is the address used for the instrument in B&K software, unless another code is specified in the software description.

ASCII Address Characters		ADDRESS SWITCH					Address Code	
Listen	Talk	A5	A4	A3	A2	A1	decimal	octal
SP	@	0	0	0	0	0	0	0
!	A	0	0	0	0	1	1	1
"	B	0	0	0	1	0	2	2
#	C	0	0	0	1	1	3	3
$	D	0	0	1	0	0	4	4
%	E	0	0	1	0	1	5	5
&	F	0	0	1	1	0	6	6
'	G	0	0	1	1	1	7	7
(	H	0	1	0	0	0	8	10
)	I	0	1	0	0	1	9	11
*	J	0	1	0	1	0	10	12
+	K	0	1	0	1	1	11	13
,	L	0	1	1	0	0	12	14
–	M	0	1	1	0	1	13	15
.	N	0	1	1	1	0	14	16
/	O	0	1	1	1	1	15	17
0	P	1	0	0	0	0	16	20
1	Q	1	0	0	0	1	17	21
2	R	1	0	0	1	0	18	22
3	S	1	0	0	1	1	19	23
4	T	1	0	1	0	0	20	24
5	U	1	0	1	0	1	21	25
6	V	1	0	1	1	0	22	26
7	W	1	0	1	1	1	23	27
8	X	1	1	0	0	0	24	30
9	Y	1	1	0	0	1	25	31
:	Z	1	1	0	1	0	26	32
;	[	1	1	0	1	1	27	33
<	\	1	1	1	0	0	28	34
=	]	1	1	1	0	1	29	35
>	^	1	1	1	1	0	30	36

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Table 3.2. Address Switch settings for the IEC/IEEE interface. Note that the 2811 has no Talk capability and will not respond to a Talk address. The shaded line is the address set on delivery.

3.6.3. Data Format

The 2811's interface recognises twenty-one instructions, each in the form of a single byte of data. The decimal values of these bytes and their ASCII equivalent characters are given in Table 3.3.

Sixteen of the instructions direct the Main or Subsidiary Multiplexers to specific channels, and two further instructions are used to switch the Main and Subsidiary Multiplexers to their respective "From Extension" inputs. For more details about using the "Extension Enable" commands ("H" for the Main Multiplexer and "X" for the Subsidiary Multiplexer) refer to section 3.6.4. Two instructions replace the "Reset" and "Step" functions of the front-panel switch; these act only on the Main Multiplexer.

The final instruction generates a trigger signal on pin 5 of the EXTERNAL SCANNING "In" and "Out" sockets. This may be used to start or stop other external devices, such

as the Type 1405 Noise Generator or the Type 4205 Sound Power Source. See section 3.6.5 for more details.

Note that the "Reset" ("O") and "Step" ("K") instructions will not switch the Multiplexer to channels which have been set to "Inhibit", if the SELECT/INHIBIT switch was set before the 2811 was addressed on the bus. After control of the 2811 has passed to the IEC/IEEE bus controller, altering the setting of the SELECT/INHIBIT switches will have no effect on the Multiplexer.

FUNCTION		Instruction Code	
		decimal	ASCII
Main Multiplexer	Channel 1	64	@
	Channel 2	65	A
	Channel 3	66	B
	Channel 4	67	C
	Channel 5	68	D
	Channel 6	69	E
	Channel 7	70	F
	Channel 8	71	G
	Extension Enable	72	H
	Reset	79	O
	Step	75	K
Subsidiary Multiplexer	Channel 1	80	P
	Channel 2	81	Q
	Channel 3	82	R
	Channel 4	83	S
	Channel 5	84	T
	Channel 6	85	U
	Channel 7	86	V
	Channel 8	87	W
	Extension Enable	88	X
External Scanning Control	Start/Stop	73	I

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Table 3.3. Instruction codes for interface control of the 2811

3.6.4. Interface Bus Control of a 2811 System

Two options are available for Interface Bus control of a system comprising more than one 2811. The more versatile option is to connect each 2811 individually to the bus, and address each one as a separate device. Alternatively, only one 2811 need be connected to the bus and the remainder may be accessed via this one.

Single Address

If only only one of the 2811's is to be connected to the bus, the system should be connected as shown in Fig. 3.2. With single addressing, the whole system may be controlled via the interface of the upper 2811 (No. 1 in Fig. 3.2). In this case control is limited to:

1. Selection of a channel number in 2811 No. 1, codes "@" to "G".

2. Reset to the non-inhibited channel of 2811 No. 1 with the lowest number (from any channel of the system), code "O".

3. Step to the next non-inhibited channel (scanning), code "K".

Stepped scanning is always in ascending order of the numbers of channels and multiplexers (i.e., 1, 2, 3 etc.), and is possible only for the Main Multiplexers.

Multiple Addresses

With multiple addressing, each of the 2811's is connected to the Interface Bus as shown in Fig. 3.4, and each has its own address. Each 2811 will respond to any of the codes given in Table 3.3. To select a channel on one of the higher level multiplexers (no.'s 2, 3 or 4) it is first necessary to set "Extension Enable" in all the preceding 2811's by addressing each one in turn and sending the code "H".

In a multiple-address system, where each 2811 is addressed individually, control cables should not be connected to the EXTERNAL SCANNING sockets as they would form ground loops with the interface bus ground.

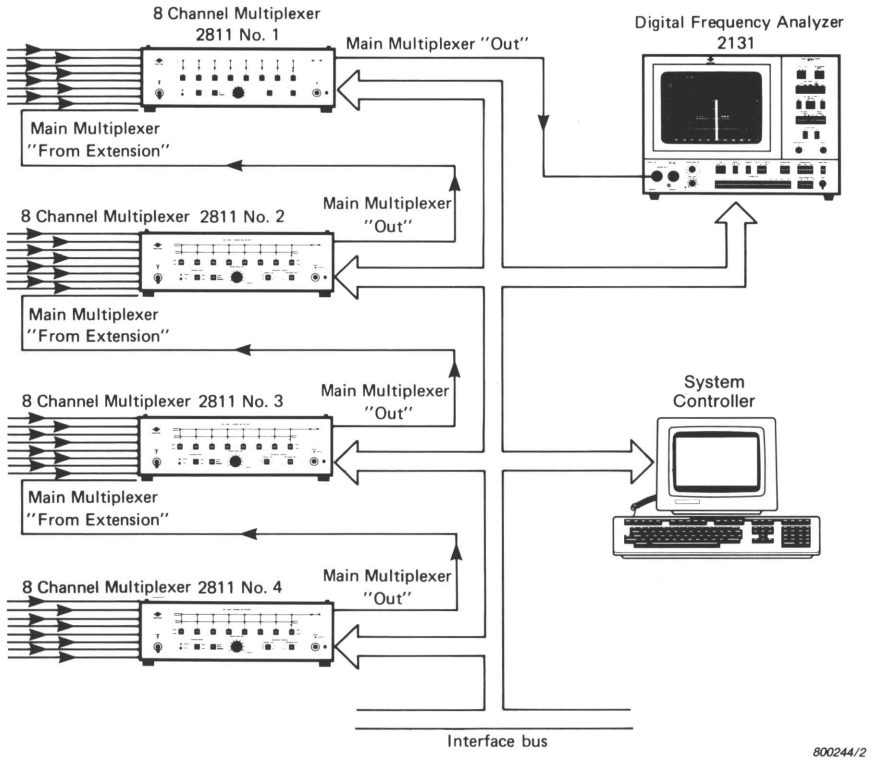

Fig. 3.4. An IEC/IEEE bus based system with four 2811's addressed individually

3.6.5. Start/Stop

The Start/Stop facility included in Table 3.3 can be used to provide bus control of one function in one or more other instruments. When this code is received, pin 5 of both EXTERNAL SCANNING sockets is set low (true). When any of the codes "@" to "G" (inclusive) is received, pin 5 is reset high (false).

This facility may be used to stop and start the noise source for reverberation-time measurements using Type 4205 Sound Power Source or Type 1405 Noise Generator, as described below.

Type 4205

Connect the REMOTE CONTROL socket on Type 4205 and either of the EXTERNAL SCANNING sockets on the 2811 using a standard Control Cable AQ 0034. The SOUND POWER switch on the 4205 should be set to "On". Refer to the Instruction Manual for the 4205 for guidance on its use. Only 4205's whose serial numbers are higher than 807886 may be controlled in this way.

Type 1405

Make up a control cable consisting of a standard 8-pin DIN plug JP 0802, a standard 7-pin DIN plug JP 0703 and a suitable length of cable AP 2008 or any convenient 2-conductor cable. Connect the pins as shown in Fig. 3.5. Plug the 7-pin connector into the REMOTE CONTROL socket on the 1405 and the 8-pin connector into either of the EXTERNAL SCANNING sockets on the 2811. Refer to the Instruction Manual for the 1405 for guidance on its use.

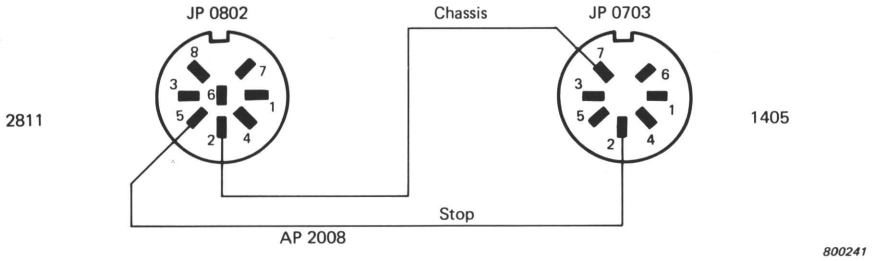

Fig. 3.5. Connection details for remote control of the Type 1405 Noise Generator from a bus-controlled 2811

3.6.6. A Bus Based System for Sound Power Measurements

Software Package Type WW 9041 has been developed to allow easy determination of airborne noise and sound power output from business machines (e.g. typewriters, printers) and similar sources. It uses a desktop calculator, HP 9816, 9817, 9826 or 9836 to control up to four 2811's (up to 32 microphone inputs) and a Type 2131 Digital Frequency Analyzer. The basic instrument set-up is shown in Fig. 3.6. The Software Package uses only one address for the multiplexing, so if more than eight channels are needed the Single Address connection method described in section 3.6.4 and illustrated in Fig. 3.2 should be used.

Sound power levels are determined from sound pressure measurements in an essentially free field over a reflecting plane in accordance with ECMA–74 and ISO 3744. Software Package WW 9041 can also be used to calculate sound pressure levels at operator and bystander positions according to ECMA–74 and ISO 6081, and for impulsive noise testing and pure tone rating. Background noise measurements are taken into account and in situations where there is reflected noise in the measurement room, the environmental correction factor can be entered manually or tested for using the Sound Source Type 4204.

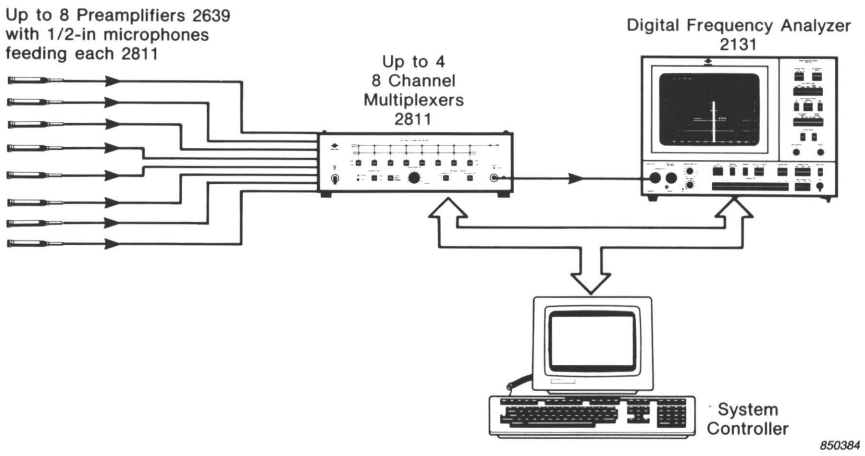

Fig. 3.6. Basic system for sound power calculation using software package WW9041

3.7. THE SUBSIDIARY MULTIPLEXER

The Subsidiary Multiplexer in the 2811 is an independent multiplexer which uses the same inputs as the Main Multiplexer. The Subsidiary Multiplexer can be controlled only via the INTERFACE BUS connector. When more than eight channels are required, a scheme like the one shown in Fig. 3.4 should be used. The Subsidiary Multiplexer FROM EXTENSION and OUTPUT sockets should be connected together in a similar way to those of the Main Multiplexer. For clarity these connections are not shown in Fig. 3.4.

4. SELECTION OF SCANNING RATES

The process of multiplexing generates frequencies which may not have been present in the input signals. The additional signals generated are known as sidebands, and the presence of these can give rise to errors in measurement (multiplexing errors). This chapter discusses ways of reducing these errors.

4.1. INTERRUPTED AVERAGING

With some instruments with which the 2811 may be used the averaging period for RMS measurement can be interrupted, allowing time for filters to stabilize before measurements are made. This is a very effective way of reducing errors, and should be used wherever possible—for example when the 2811 is used with the Type 2131 Digital Frequency Analyzer and both instruments are controlled via the IEC/IEEE Interface Bus.

For a six-pole filter (such as a 1/3 octave ANSI Class III) with a bandwidth of B Hz, a stabilization time of 3,2/B seconds will normally be sufficient. Usually the bandwidth of the filter with the lowest frequency within the analysis range will determine the common stabilization time.

4.2. THE EFFECT OF SIDEBANDS ON ANALYSIS

The multiplexing process has the effect of spreading the spectrum of all signals applied to the multiplexer inputs. An example of the spectrum produced for a four-channel multiplexer and a sinusoidal input signal of frequency f_0 is shown in Fig. 4.1. T_d is the channel dwell time and T_s is the time for a complete scan—in this case $4T_d$. Notice that the sidebands are separated at $1/T_s$, but fall in groups which are spaced at $1/T_d$. This grouping depends only on T_d. This is true for any number of channels (that is, any value of T_s). As the width of this spectrum is constant and is independent of the input frequency f_0, its effects are most marked in the narrowest analysis channel, which for a 1/3 octave analysis is the lowest channel. Therefore only samples in and below this channel need be considered.

Measurement errors will occur only if a significant proportion of the sideband power lies in frequencies outside the passband of the analysis filter. Table 4.1 shows the percentages of power lying within various bandwidths centred on the frequency of a single sinusoidal signal at a multiplexer input, and the corresponding measurement errors in dB if the power outside their bandwidth is not taken into consideration in a measurement. As the spectrum produced by a single sinusoid is symmetrical around the frequency of the original sinusoid (with the limitations covered in section 4.3) allowance may also be made for signals not in the centre of a measurement band.

Table 4.1 may be used to determine the maximum scan rate for a given measurement accuracy. For example, suppose it is required to scan eight channels using "Automatic" SCANNING CONTROL and analyze the multiplexed signal in 1/3 octaves with centre

frequencies over the range 25 Hz to 20 kHz with not more than 0,25 dB error due to sideband generation for a signal centred in the lowest analysis channel.

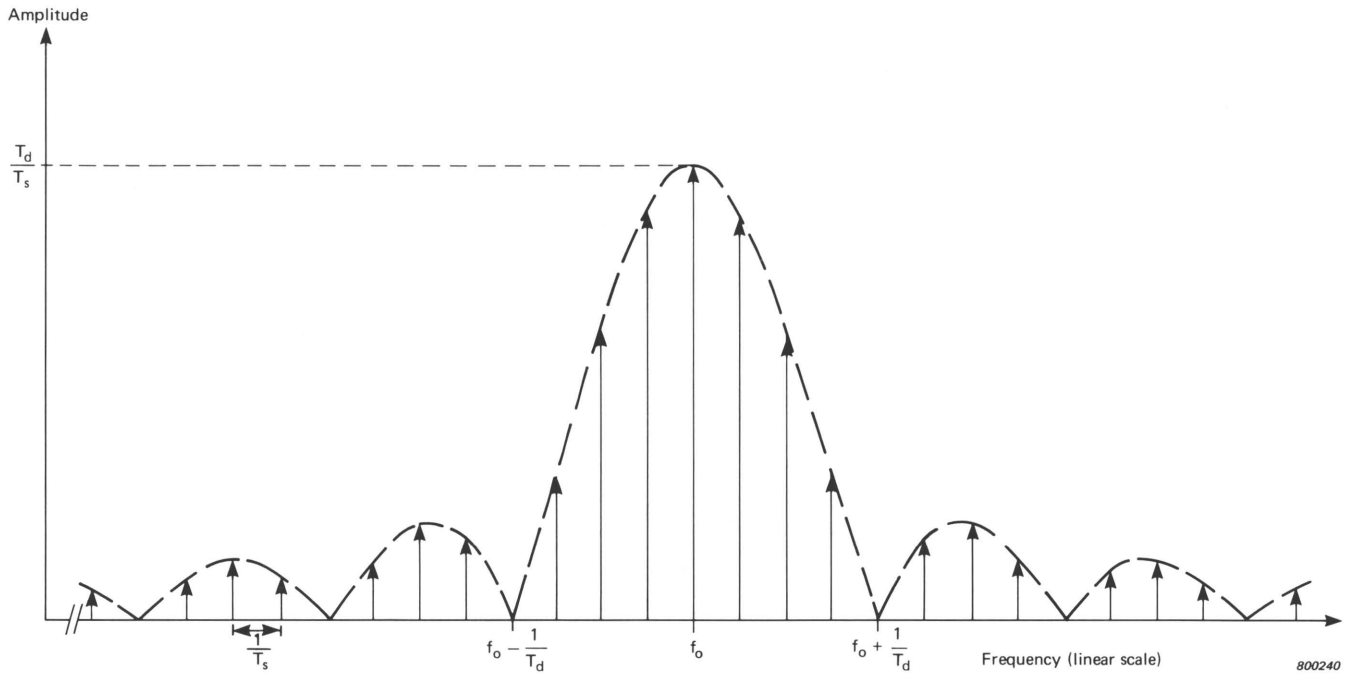

Fig. 4.1. Frequency spectrum of multiplexed signal, drawn with linear amplitude and frequency scales

The bandwidth of the lowest channel is 23% of 25 Hz, i.e. 5,8 Hz. The spectrum produced must cause less than 0,25 dB error, so from Table 4.1 the bandwidth must be at least $4/T_d$, i.e. T_d greater than or equal to 4/(5,8 Hz) or 0,7 s. Thus a dwell time of at least 1 s should be selected, as the next largest available.

Bandwidth	Power (%)	Error (dB)
$4/T_d$	95,0	0,22
$8/T_d$	97,5	0,11
$12/T_d$	98,3	0,0745
$16/T_d$	98,7	0,0568

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Table 4.1. Percentage of power lying within the passband, and the corresponding measurement errors due to sideband generation, for various analysis filter bandwidths expressed as a function of T_d

Ignoring the effects of filter shape, the errors for a signal not centred in the filter bandwidth can be estimated as follows. Take a filter bandwidth of $4/T_d$ at the signal frequency at $1/T_d$ from the centre of the bandwidth. 90,5% of the power falls in the central $2/T_d$ of the spectrum and thus in the filter bandwidth, with 3,1% falling in the remaining $2/T_d$ to one side of the central $2/T_d$, i.e., 93,6% falls in the analysis bandwidth, carrying an error of 10 log 0,936 or 0,287 dB.

The power leaked is not lost, but will appear in the adjacent analysis bandwidth, so that a single tone is a worst case. For more complex signals there will be relatively little effect as leakage from one band will be offset by leakage into it.

4.3. THE EFFECT OF FREQUENCIES BELOW THE ANALYSIS RANGE

Signals outside the analysis band, in practical cases only at low frequencies, can be spread into the analysis band as noise. The effect is made slightly worse by the fact that components which would fall below zero frequency if the pattern of Fig. 4.1. were followed are "reflected", as shown in Fig. 4.2 for $T_s/T_d = 4$. A sidelobe at $f_0 - f$ becomes a sidelobe of the same amplitude at $|f_0 - f|$.

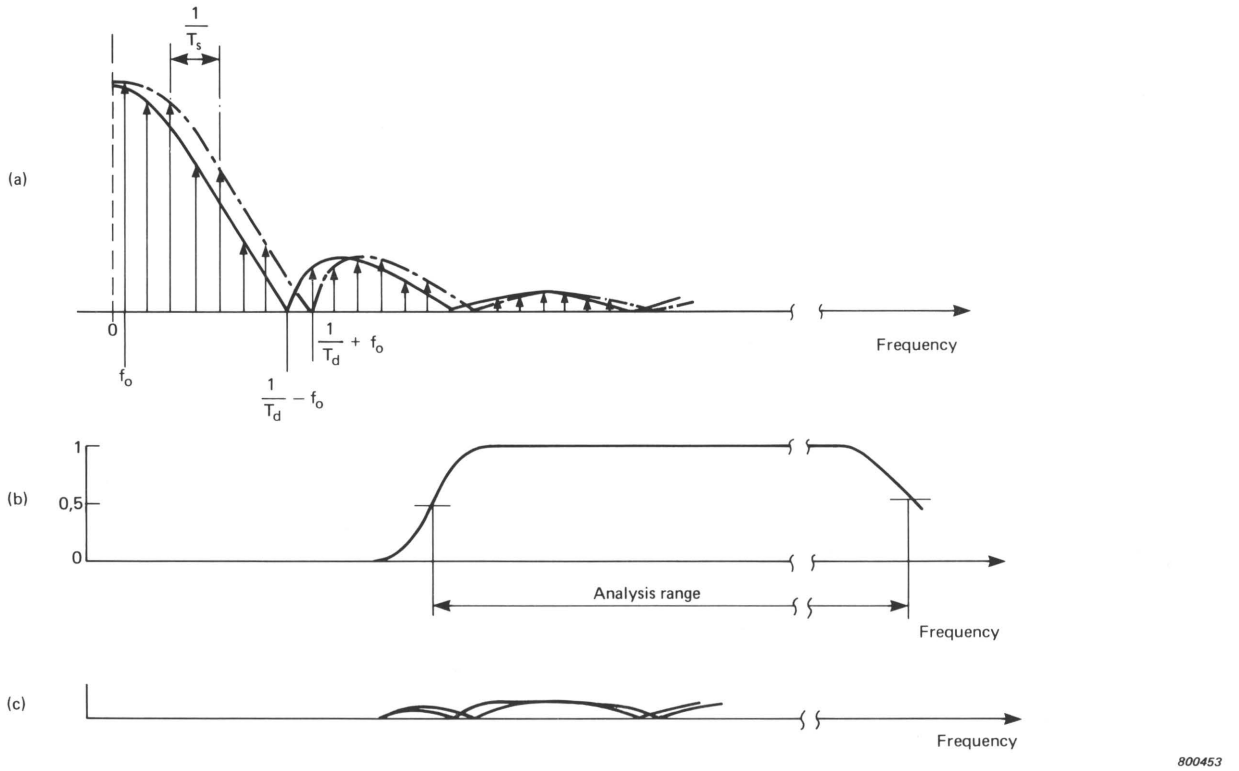


Fig. 4.2. Frequency spectrum (a) of a multiplexed signal whose frequency is very low, shown alongside (b) the measurement passband and (c) the resulting spectral contribution to the measurement. Amplitude and frequency scales are linear

Fig. 4.2 has been drawn with both its frequency and amplitude scales linear. The same signal spectrum is shown with logarithmic frequency and amplitude scales in Fig. 4.3. Frequency is expressed relative to T_s. The envelope of the spectrum maxima exhibits a –6 dB/octave slope at higher frequencies, and a horizontal asymptote at lower frequencies. The vertical scale is in power-at-the-analyzer-input relation to the low frequency input signal, and the horizontal asymptote is $20 \log (T_d/T_s)$—12 dB in the example chosen. The response of the analyzer must take into account the analyzer bandwidth. But even for a bandwidth of $1/T_s$ or less the reflected signal can produce a response 3 dB higher than the 6 dB/octave slope as f_0 comes close to zero. This is shown by the broken line in Fig. 4.2.

The sidelobes produced by the low-frequency signal, as shown in Fig. 4.3, raise the noise floor of the analysis at frequencies higher than this signal. Thus Fig. 4.3 can be interpreted as a relative noise floor graph.

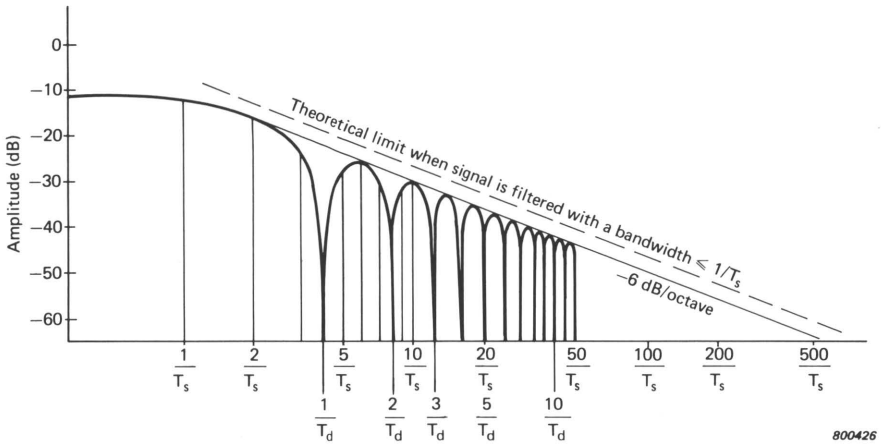


Fig. 4.3. Frequency spectrum of the same signal as in Fig. 4.2, drawn with logarithmic frequency and amplitude scales

The envelope of the spectrum in Fig. 4.3 is redrawn in Fig. 4.4, along with the envelopes for various other $T_s/T_d = n$ values. Also shown in Fig. 4.4 are plots of the theoretical maximum output signal obtainable when that signal is analyzed in different bandwidths relative to $1/T_s$.

Fig. 4.4 may be used to determine how much a low-frequency signal will influence a given measurement. How to do this is best shown by example. Suppose a 1/3 octave analysis of the multiplexed outputs of eight microphones is to be made in the range 100 Hz to 10 kHz. The measurement specimen emits a 2 Hz tone at a Sound Pressure Level of 1 Pa (94 dB). The influence of this tone on measurements made with a dwell time of 1/4 s is calculated as follows:

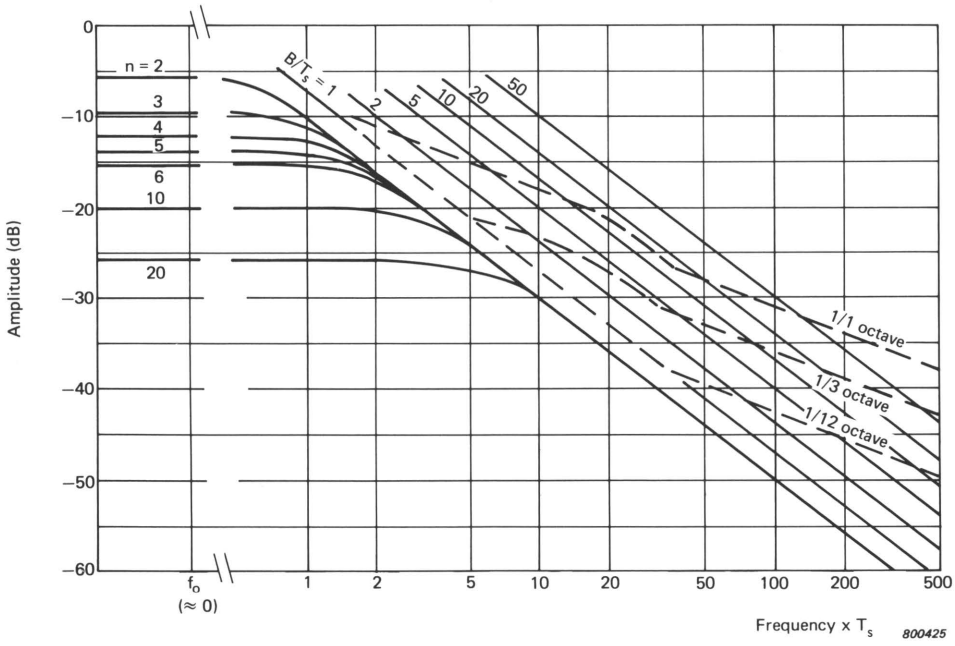


Fig. 4.4. Plots of the frequency analysis noise floor due to a single sinusoidal tone at a frequency below the analysis frequency range

At 100 Hz ($200/T_s$) Fig. 4.4 shows that the 1/3 octave level may be as much as 39 dB below the level of the 2 Hz tone, i.e., (94 – 39) dB, 55 dB. In other words, the presence of the tone at one microphone position raises the noise floor to 55 dB. If the tone was present at all the microphone positions, with random phasing, the noise floor would be multiplied by $\sqrt{8}$ (an increase of 9 dB). This raises the noise floor to 64 dB. Fig. 4.4 is applicable to up to thirty-two channels.

If interruption of averaging (section 4.1) cannot be used to reduce undesirable effects of this nature, three possible alternatives are described in sections 4.3.1 to 4.3.3.

4.3.1. Choice of More Favourable Channel Dwell Time

Choosing a longer channel dwell time results in a greater value of T_s. Every time T_s is doubled, the 1/3 octave noise floor is reduced by 3 dB. This may to some extent conflict with the availability of averaging times in the analyzer.

4.3.2. Use of a Pre-Multiplexer Filter

A separate filter may be provided for each channel to filter out the low-frequency content of the signals **before the Multiplexer.** The filter will reduce the noise floor by the same amount as it reduces the corresponding low frequency.

4.3.3. Modification of the 2811

The low-frequency 3 dB cut-off of the 2811 is approximately 0,6 Hz. This may be altered by changing the value of capacitors C111 to C118, which are mounted on one of the circuit boards of the 2811. Table 4.2 gives the attenuation at 2 Hz, and the 3 dB, 1 dB and 0,2 dB cut-off frequencies, for various capacitor values. For further details on the location of these components, consult the Service Manual.

WARNING! This modification should only be carried out by a B & K Service Representative or by skilled service personnel. The Type 2811 should be disconnected at the mains, and all other inputs and outputs disconnected, before any of its panels are removed. Internal adjustments with mains power connected should be carried out only by skilled persons who are aware of the hazards of dealing with live circuitry.

Only components with suitable mechanical properties should be used. If electrolytic capacitors are used, care should be taken to connect them with the correct polarity. Such capacitors should have a working voltage of at least 10 V.

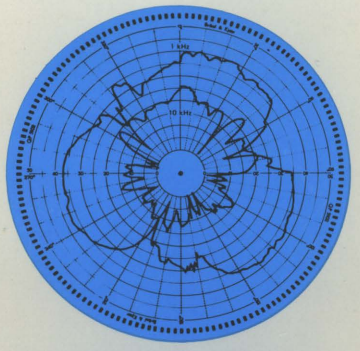
Value of C111 to C118 (μF)	Attenuation at 2 Hz (dB)	Frequency (in Hz) at which the attenuation is:		
		3 dB	1 dB	0,2 dB
22	0,6	0,76	1,5	3,5
10	1,8	1,7	3,3	7,7
4,7	6,2	3,6	7	14
2,2	12	7,6	15	35
1	18	17	33	77
0,47	25	36	70	140
0,22	32	76	150	350

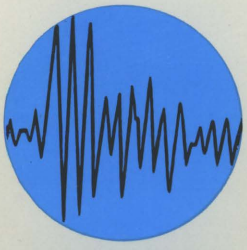
800147

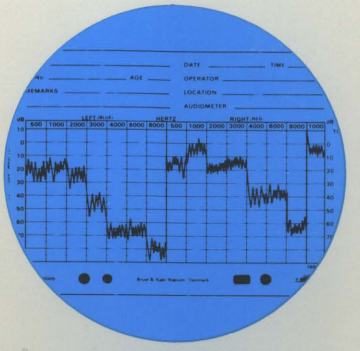
Table 4.2. Selection of capacitors C111 to C118 for modifying the 2811 Input channel low frequency cut-off, showing the corresponding attenuation at 2 Hz and the corresponding lower frequencies at which the attenuation is 3, 1 and 0,2 dB respectively

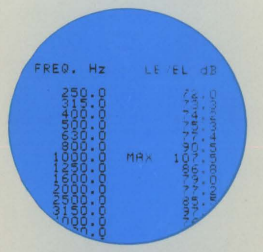
5. SERVICE AND REPAIR

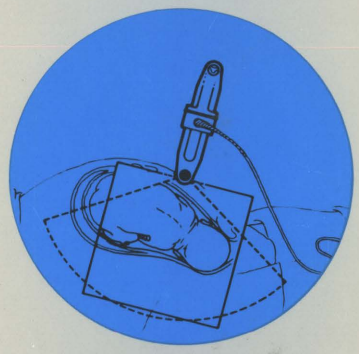
The 8 Channel Multiplexer Type 2811 is designed and constructed to provide the user with many years of safe, trouble-free operation. However, should a fault occur which impairs its correct function and operating safety, then it should be immediately disconnected at the mains source and secured against unintended operation. For repair consult the separate Service Instruction Manual available for the 2811 or contact your local B&K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

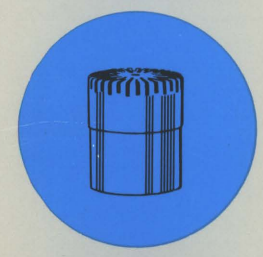


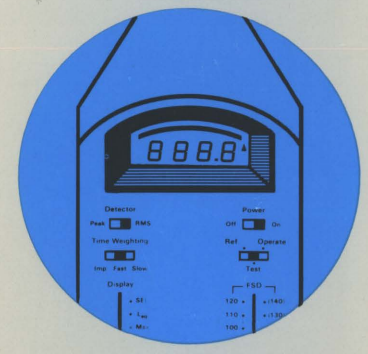


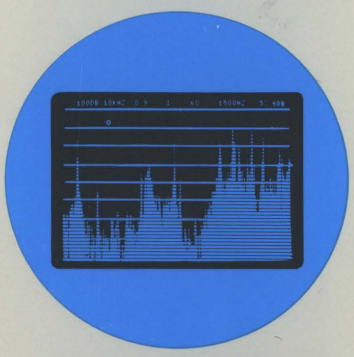


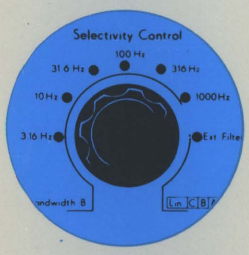


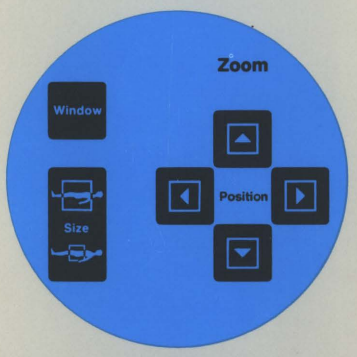


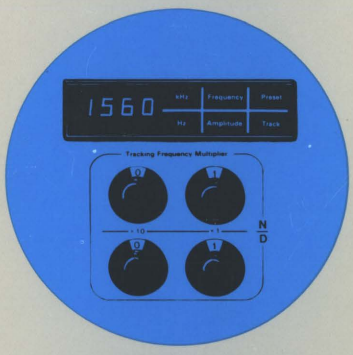


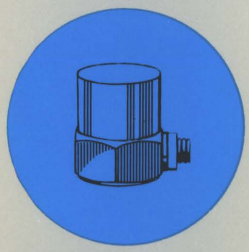


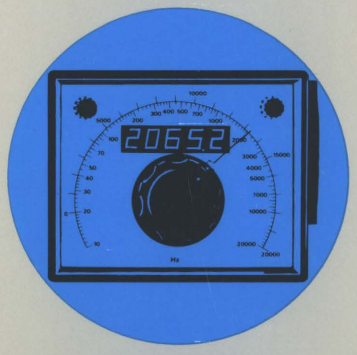


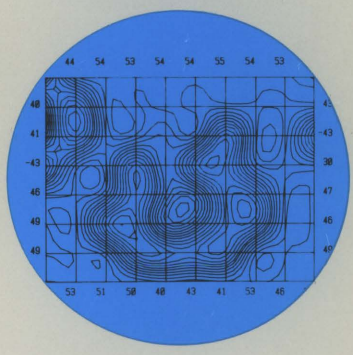


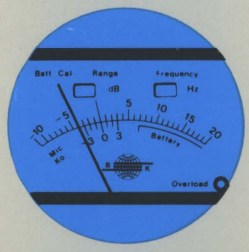


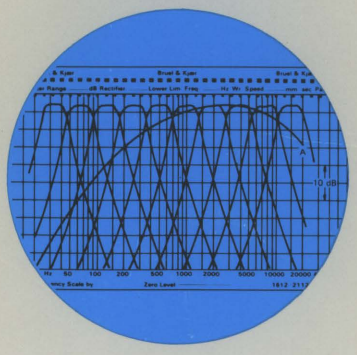












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