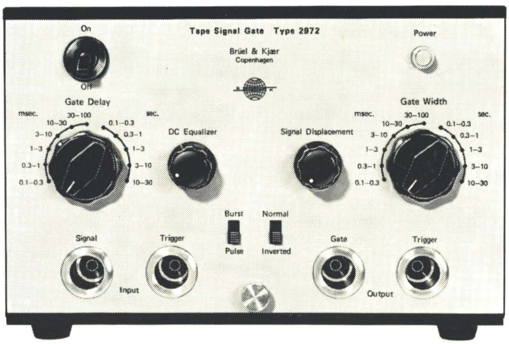
2972

Instructions and Applications



Tape Signal Gate
Type 2972

A mains operated instrument for the elimination of tape splice noise or other unwanted signals on pre-recorded tape loops. Although primarily intended for use with multi-track tape recorders it may also be used with digital recorders. For the analysis of recorded signals it will be found especially useful for ensuring that only the desired part of the signal is analyzed.

BRÜEL & KJÆR

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TAPE SIGNAL GATE
TYPE 2972

November 1972

CONTENTS

1. INTRODUCTION

The Tape Signal Gate Type 2972 is a mains operated instrument for the elimination of tape splice noise or other unwanted signals on prerecorded tape loops. Although primarily intended for use on multitrack tape recorders such as the B & K Type 7001 it may also be used with digital recorders. For frequency analysis of recorded signals it will be found essential for ensuring that only the desired part of the signal is analyzed.

The 2972 has a frequency response from DC to 40 kHz and a dynamic range of 50 dB. It is capable of gating a signal so that only the part of interest is passed to its output, whilst unwanted signals or noise are rejected by more than 50 dB. The length of the signal passed to the output (gate window) as well as its relative position in relation to the rest of the signal may be adjusted from 0.1 msec. to 30 sec. using the GATE WIDTH and GATE DELAY controls provided. To accurately set the position of the gate window, the 2972 has two trigger modes whereby it may be triggered from a sinusoidal signal burst recorded on a tape loop or a TTL pulse from a digital recorder. For monitoring the output of the 2972 in order to see that the correct part of the recorded signal is gated, a separate output is available for triggering an oscilloscope.

2. CONTROLS

2.1. FRONT PANEL

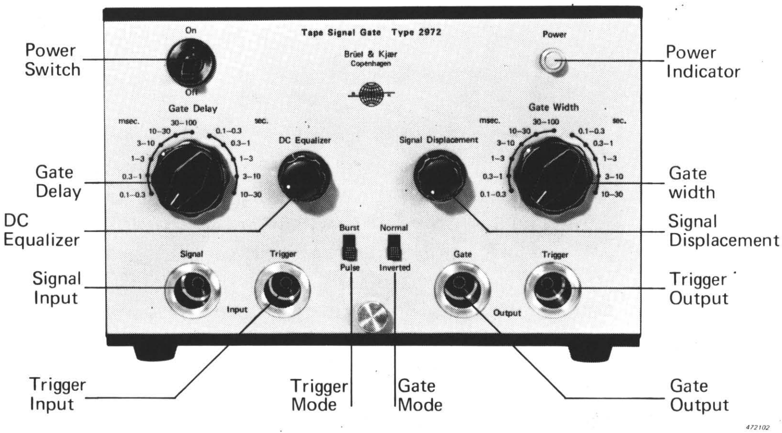

Fig.2.1. Front panel of the 2972

POWER SWITCH: On/Off switch for the internal connection of a mains supply connected at the POWER INPUT socket.

POWER INDICATOR: An opal indicator lamp which lights when the instrument is connected to an AC mains supply and the POWER SWITCH is set to "On".

GATE DELAY: Two controls, one switched (outer knob), the other continuously variable (inner knob) providing gate delays (time taken for gate to be triggered after an external trigger signal has been applied to the TRIGGER INPUT socket) of 0.1 msec. to 30 seconds.

The inner control provides continuous adjustment of the gate delay over the delay range selected using the outer control.

DC EQUALIZER: Potentiometer control for adjustment of the DC level of the gated signal (outside gate window, only) available at the GATE OUTPUT socket. The range of adjustment is ± 2 V referred to 0 V chassis level.

SIGNAL INPUT: Coaxial input socket accepting the B & K plug JP 0101 for application of the signal to be gated. The socket is connected to the BNC SIGNAL INPUT socket on the rear panel of the instrument and has an input impedance of 1 MΩ in parallel with 50 pF. The maximum input voltage is 2 V peak.

TRIGGER INPUT: Coaxial input socket for application of an external trigger signal (burst or pulse depending on setting of TRIGGER MODE switch) to trigger the gate. The trigger signal is delayed internally for the time selected using the GATE DELAY controls.

The TRIGGER INPUT has an input impedance of approximately 18 kΩ and accepts the B & K plug JP 0101.

TRIGGER MODE: Two position switch with the following functions:

"Burst". With this mode selected a sinusoidal signal burst with amplitude of 0.3 to 10 V and length greater than 30 msec. may be applied to the

TRIGGER INPUT socket to trigger the gate.

"Pulse". In this mode a TTL (transistor-transistor logic) compatible pulse (i.e. 0 to 0.5 V for logical 0, and 2.5 to 5 V for logical 1) with length greater than 20 μsec. may be applied to the TRIGGER INPUT socket to trigger the gate.

GATE WIDTH:

Two controls, one switched (outer knob), the other continuously variable (inner knob) providing gate widths (period for which gate is open when the GATE MODE switch is set to "Normal" or period for which gate is closed when the GATE MODE switch is set to "Inverted") of 0.1 msec. to 30 seconds.

The inner control provides continuous adjustment of the gate width over the gate width range selected using the outer control.

SIGNAL DISPLACEMENT:

Potentiometer control for adjustment of the DC level of the gated signal (within gate window only) available at the GATE OUTPUT socket. The range of adjustment is ± 2 V referred to 0 V chassis level.

GATE MODE:

Two position switch governing the gate mode. The modes are:

"Normal". In this mode the gate is open for the period selected using the GATE WIDTH controls i.e. the signal applied at the GATE INPUT socket during this period is passed to the GATE OUTPUT socket. During the period immediately before and after the gate is opened the input signal is blocked.

"Inverted". In this mode the gate is closed for the period selected using the GATE WIDTH controls i.e. the signal applied to the GATE INPUT socket during this period is blocked. During the period immediately before and after the gate is closed the input signal is passed to the GATE OUTPUT socket.

TRIGGER OUTPUT:

B & K coaxial output socket producing a + 14 V to −14 V pulse with period corresponding to the GATE DELAY selected. By using the positive and negative slopes of the pulse to trigger an oscilloscope the gate window and delay may be monitored.

The TRIGGER OUTPUT accepts the B & K plug JP 0101 and has an output impedance of less than 200 Ω, but should not be loaded by less than 10 kΩ.

GATE OUTPUT:

Coaxial output socket for the gated signal. The socket accepts the B & K plug JP 0101 and is connected in parallel with the BNC GATE OUTPUT socket on the rear panel of the instrument. It has an output impedance of 10 Ω, but should not be loaded by less than 2 kΩ. The maximum output voltage is 2 V peak.

2.2. REAR PANEL

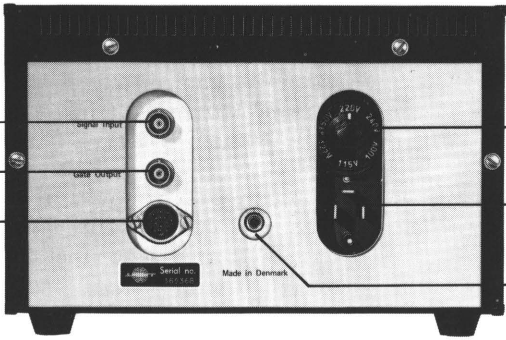

Fig.2.2. Rear panel of the 2972

SIGNAL INPUT:

Coaxial input socket accepting a BNC plug (B & K Type JP 0035) for application of the signal to be gated. The socket is connected to the B & K coaxial SIGNAL INPUT socket on the front panel of the instrument and has an input impedance of 1 MΩ in parallel with 50 pF. The maximum input voltage is 2 V peak.

GATE OUTPUT:

Coaxial output socket for the gated signal. The socket accepts BNC plug (B & K Type JP 0035) and is connected in parallel with the B & K coaxial GATE OUTPUT socket on the front panel of the instrument. It has an output impedance of 10 Ω, but should not be loaded by less than 2 kΩ. The maximum output voltage is 2 V peak.

AUXILIARY OUTPUT:

8-pin DIN socket accepting the B & K plug JP 0802 for connection of a peak reset facility to a 2607 Measuring Amplifier or a 2114 Third-Octave and Octave Spectrometer. Also available at the socket are gate width and gate delay pulses and a + 14 V supply rail. For connections see section 3.4.

VOLTAGE SELECTOR AND FUSE:

Voltage selector for selection of the correct mains voltage. The central knob of the selector contains a 200 mA fuse.

To remove the fuse or to set the selector to the correct mains voltage refer to section 3.1.2.

POWER INPUT:

Input socket accepting European or American power cables (B & K Types AN 0005 and AN 0006 respectively), for connection of an AC mains supply.

CHASSIS GROUND:

Socket accepting a Banana plug (B & K Type JB 0002) for grounding the chassis of the 2972 to the earth of a mains supply.

3. OPERATION

3.1. PRELIMINARY

3.1.1. Mounting

The Type A metal cabinet of the 2972 is the Modular Unit KK 0025. The unit may be used free standing, or with the Metal Frame KK 0014 for rack mounting or with the Mahogany Case KA 0027 it may be mounted with a number of other KK modular units. For further information on the Brüel & Kjær Module System refer to the KA, KK, KQ, KS Assembly Instructions.

3.1.2. Mains Voltage Selection

Before each use of the 2972 check that the VOLTAGE SELECTOR on the rear panel of the instrument corresponds to the mains voltage to be used. If not, remove the central knob of the selector containing a 200 mA fuse, by simply pressing the knob in and turning it counter clockwise. Half a turn should be sufficient to release the knob which may then be pulled straight out. Behind the knob are some slots which with the aid of a coin may be used to turn the selector so that the white line points to the correct voltage indication.

3.2. OPERATION WITH TAPE RECORDER

The 2972 is primarily designed for use with the B & K FM Tape Recorder Type 7001, but may also be used with most other types of multi-channel tape recorder which like the 7001 may be fitted with tape loops. However, because of the dissimilarities between various types of recorder this section gives separately operation with the 7001 and other types of recorder.

3.2.1. Use With The B & K Tape Recorder Type 7001

The B & K Tape Recorder Type 7001 has four tape speeds ranging from 1.5 to 60 inches/sec, as well as two FM recording channels and one direct recording voice channel. The FM channels have a frequency response ranging from DC up to 20 kHz depending on the tape speed selected, and are used for recording signals for measurements or analysis at a later date.

The voice channel has a frequency response ranging from 300 Hz up to 3 kHz and is used for recording comments and identifications of recordings made using the measurement channels. For triggering the 2972, so as to ensure that the opening of the signal gate can be accurately positioned, the recorder's 440 Hz marker signal may be recorded on the voice channel.

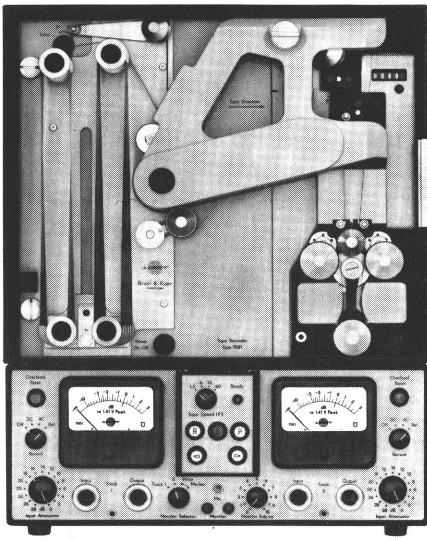

Fig.3.1. Controls of the FM Tape Recorder Type 7001

The controls of the 7001 are shown in Fig.2.1. To gate signals recorded with the 7001 using the 2972 proceed as follows:

1. With the 7001 set up for reel to reel operation, locate the portion of tape on which the signal to be gated has been recorded.

2. Erase any information which has been previously recorded on the voice track of the portion of tape selected. The voice track may be monitored by setting the recorder's MONITOR SELECTOR switch to "Voice" and connecting the dynamic microphone supplied with 7001 to the MIC socket of the instrument. On play-back with the MONITOR VOLUME control turned fully clockwise the microphone will act as a small loudspeaker. To erase the voice track press the push-button on the microphone. Whilst erasure is in progress the microphone's diaphragm should be muffled to prevent any back ground noise from being recorded.

3. Form the portion of tape selected into a tape loop and fit it to the 7001 using the Tape Loop Adaptor UD 0011 or WA 0030. The adaptor UD 0011 is adjustable and accepts tape loops of between 8 and 25 ft. (2.4 and 7.5 m) in length. Adaptor WA 0030 accepts short tape loops of 14 ±0.25 inches (362 ±5 mm) in length. Instructions for mounting the Adaptor UD 0011 and fitting tape loops to it are given in the Instruction manual for the 7001. Those for the Adaptor WA 0030 are given in Chaper 6 of this manual.

4. Check that the tape loop is fitting properly by selecting a suitable low tape speed and setting the recorder to play back. If necessary adjust the tape tension.

5. Using the 440 Hz marker facility of the recorder, record a short marker burst on the voice track of the tape for triggering the 2972. The marker facility is activated by momentarily turning the MONITOR SELECTOR switch from "Voice" to its "Marker" position.

   The marker burst should be recorded so that on replay at the tape speed to be used for analysis, the portion of signal to be gated occurs between 25 msec. and 25 sec. later. The length of the marker burst should be kept as short as possible.

   In order that the marker burst may be correctly positioned, on the tape, it can be recorded at one tape speed setting lower than that which is to be used for analysis of the gated signal.

6. Reset the recorder for play-back at the tape speed at which the gated signal is to be analyzed and calculate the approximate repetition time of the tape loop using the relation:

$$T_r = \frac{X}{T_s}$$

where T_r, is the repetition time (sec.), X is the length of the loop (inches, or mm x 0.0394 to convert to inches) and T_s is the tape speed selected (inches/sec.).

7. With the MONITOR OUTPUT sockets of the recorder connected to the TRIGGER INPUT socket of the 2972, connect the TRIGGER OUTPUT socket of the 2972 to an oscilloscope as shown in Fig.3.2.

8. Set the time base of the oscilloscope so that the length of the trace on the display screen corresponds to a value equal to or less than the repetition time of the tape loop calculated in item 6.

9. Set the remaining controls on the oscilloscope to:

CHANNEL SENSITIVITY	"10 V/division"
CHANNEL COUPLING	"DC"
TRIGGER MODE	"External"
TRIGGER COUPLING	"DC"
TRIGGER SLOPE	"Negative"

10. On the 2972 set the TRIGGER MODE switch to "Burst" and adjust the GATE DELAY controls to give a delay time which with the TIME BASE setting selected in item 8 corresponds approximately to two divisions on the oscilloscope display screen.

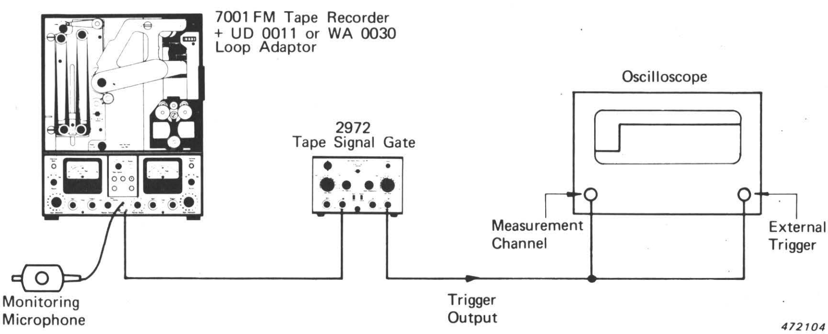

Fig.3.2. Instrument arrangement for checking that the 2972 is correctly triggered by a marker burst recorded on the 7001 Tape Recorder

11. With the MONITOR SELECTOR on the recorder still set to "Voice" and the dynamic microphone connected to the MIC socket, set the MONITOR VOLUME control fully clockwise and then gradually turn it counter clockwise until the signal burst only just triggers the 2972. When correctly triggered the oscilloscope will display the output waveform of the gate delay monostable of the 2972. The waveform should appear as a single rectangular pulse and will be displayed once (and only once) every time the 2972 is triggered by the signal burst, which may be monitored using the dynamic microphone of the 7001. The position of the pulse on the display screen should remain constant.

12. With the TIME BASE of the oscilloscope set to approximately 0,1 msec/division, check to see if the 2972 remains triggered when the GATE DELAY controls are set to 0.1 msec. If not then readjust the MONITOR VOLUME.

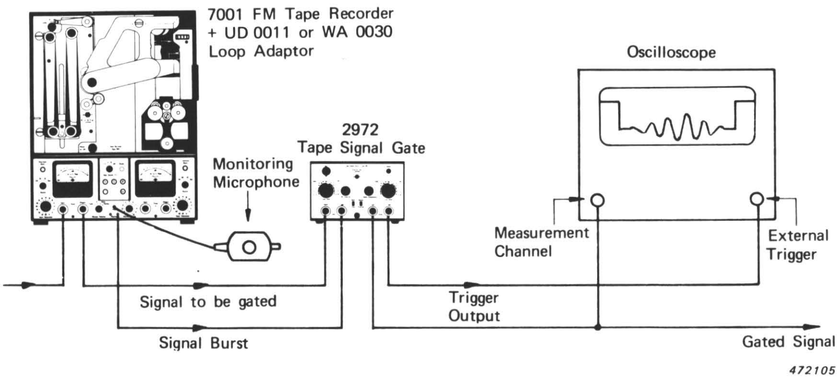

Fig.3.3. Instrument arrangement for gating a signal recorded on the 7001 Tape Recorder using the 2972

13. Once correctly triggered reconnect the instrumentation as shown in Fig.3.3 and set the controls on the 2972 to:

TRIGGER MODE	"Burst"
GATE MODE	"Normal"
DC EQUALIZER	fully counterclockwise
SIGNAL DISPLACEMENT	central position

14. With the CHANNEL SENSITIVITY of the oscilloscope set to 1 V/division and the TIME BASE set as in item 8 adjust the GATE DELAY and GATE WIDTH controls of the 2972 so that the waveform displayed on the oscilloscope is as shown in Fig.3.4.

15. On the 2972 set the GATE WIDTH controls to the approximate width of the signal portion of interest (if this is sufficiently long then it should be seen in the gate window) and set the TRIGGER SLOPE selector of the oscilloscope to "Positive". The oscilloscope will now be triggered at the end of each gate delay period so only the gate window will de displayed.

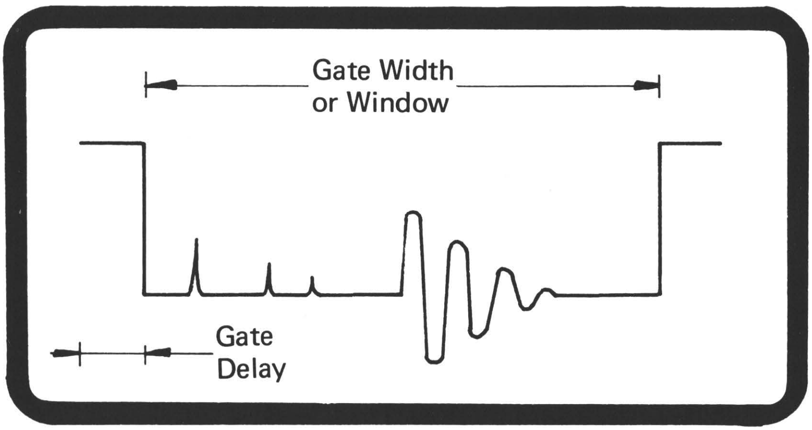

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Fig.3.4. Oscilloscope display of the output from the GATE OUTPUT socket of the 2972 when the "Normal" GATE MODE is selected and the oscilloscope is triggered from the start of the gate delay pulse (negative slope), which is available at the TRIGGER OUTPUT socket of the 2972

16. Set the Time Base of the oscilloscope so that the gate window almost entirely fills the display screen. The displayed waveform should now appear as shown in Fig.3.5.

17. From the "0.1 msec." position, adjust the GATE DELAY controls so that the signal portion of interest appears in the gate window. If necessary readjust the GATE WIDTH controls if the gate window is

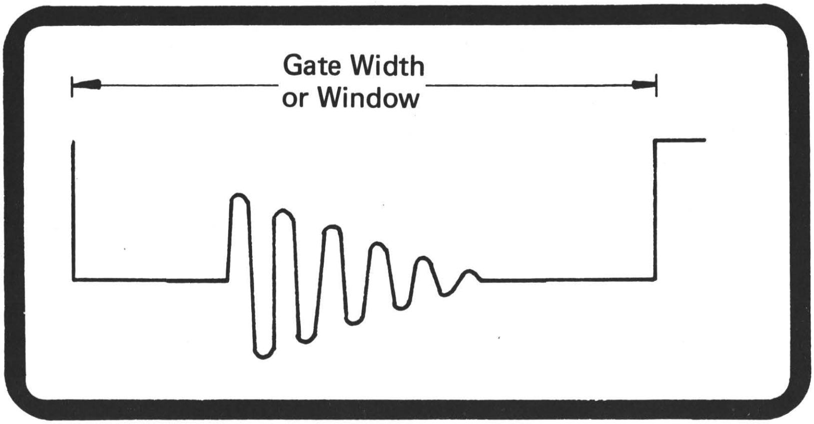

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Fig.3.5. Oscilloscope display of the output from the GATE OUTPUT socket of the 2972 when the "Normal" GATE MODE is selected and the oscilloscope is triggered by the positive reset slope of the gate delay pulse available at the TRIGGER OUTPUT of the 2972

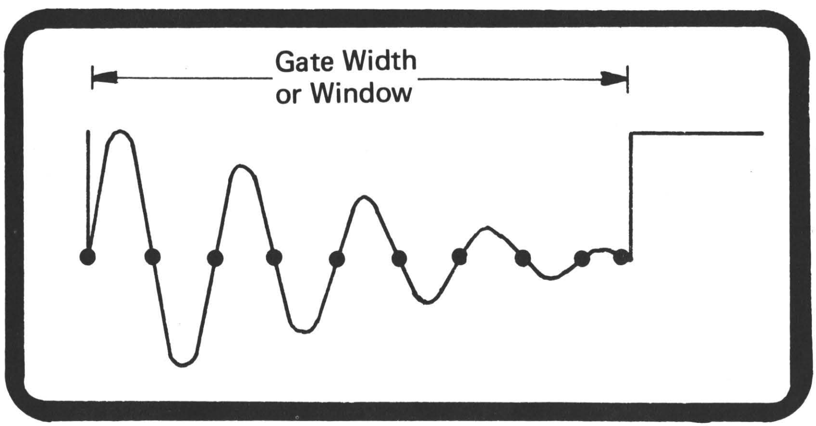

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Fig.3.6. Oscilloscope display of the output from the GATE OUTPUT socket of the 2972 when an oscillatory waveform with an exponential decay is gated. The zero crossing of the signal where the opening and closing of the gate window must be set for correct gating are shown as dots on the waveform

too wide. In order to prevent the rise and decay slopes of the gate window from causing errors when the gated signal is analyzed the opening and closing of the gate window should be adjusted to coincide with the zero crossing of the signal as shown in Fig.3.6.

18. Finally adjust the DC EQUALIZER and SIGNAL DISPLACEMENT controls so that the DC level outside the gate window and zero level of the gated signal are at zero volts.

3.2.2. Use With Other Types of Tape Recorder

To use the 2972 with other types of multi-channel tape recorders, which like the B & K Tape Recorder Type 7001 may be fitted with a tape loop, a similar operating procedure to that described in section 3.2.1 may be followed. For types of recorder which are not provided with a marker facility, a sinusoidal signal burst for triggering the 2972 may be obtained by connecting an audio frequency signal generator to a separate recording channel of the recorder and momentarily recording the sinusoidal output of the generator. On playback at the tape speed to be used for analysis of the signal to be gated, the frequency of the burst recorded should be between 200 Hz and 10 kHz. The amplitude of the burst should be between 0.3 and 10 V and should preferably be adjustable so that when applied to the TRIGGER INPUT of the 2972 it may be set at the minimum level for correct triggering to take place. Also the period of the burst should be kept as short as possible, but not shorter than 20 msec.

3.3. OPERATION WITH DIGITAL RECORDERS

Although primarily designed for gating tape recorded signals, the 2972 may also be used to gate signals which have been recorded digitally for playback as a repetitive analogue signal. However, a condition of this use is that the recorder provides a separate TTL (Transistor-Transistor Logic) compatible logic 1 pulse for triggering the 2972 on each repetition of the signal to be gated. With the B & K Digital Event Recorder a separate SYNC TRIGGER output is made available especially for this purpose. For simplicity, operation of the 2972 in this section will be confined to this recorder. For other types of digital recorders a similar procedure may be followed.

3.3.1. Use With The B & K Digital Event Recorder Type 7502

The Digital Event Recorder Type 7502 is designed to capture single events and to reproduce them with almost any speed transformation ratio. For recording it has a frequency response ranging from DC up to 50 kHz depending on the input sampling rate which may be switched between 0.1 and 100 kS/sec. For frequency transformation of $5 \; 10^{-3}$ to $5 \; 10^{3}$ of the recorded signal the output sample rate may be switched between 0.5 and 500 kS/sec. For a slower read-out rate the output sample rates may be divided by 1000 to give frequency transformations down to $5 \; 10^{-6}$.

The controls of the 7502 are shown in Fig.3.7. To gate signals recorded with the 7502 using the 2972 proceed as follows:

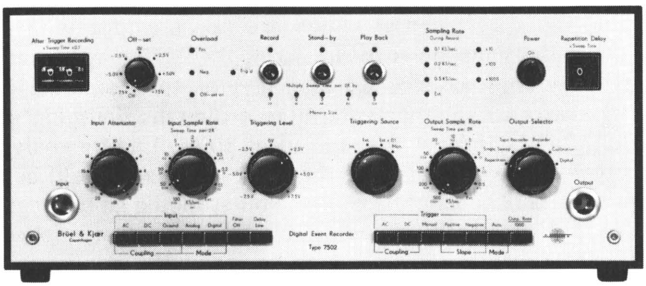

Fig.3.7. Controls of the Digital Event Recorder Type 7502

1. Record the signal to be gated using the 7502.

2. With the 7502 set for repetitive playback, set sweep time and repetition delay of the instrument to give a suitable repetition time for analysis of the recorded signal. The repetition time can be calculated using the following relation:

$$R_T = M_S \; S_T \; (1 + R_D)$$

where R_T is the repetition time in seconds

M_S is a multiple given by the MEMORY SIZE INDICATORS

S_T is the sweep time (per 2k memory) setting in seconds given by the OUTPUT SAMPLE RATE CONTROL.

If the $\frac{\text{OUTPUT RATE}}{1000}$ push button is depressed multiply this by a 1000 to obtain S_T.

and R_D is a multiple given by the REPETITION DELAY CONTROL.

Since with the 7502 the repetition delay is produced before each sweep of the recorded signal, care must be taken to ensure that the portion of signal to be gated does not occur more than 30 sec. after the start of each repetition cycle. If this period is exceeded it will not be possible to gate the signal portion as it will be outside the range of the GATE DELAY CONTROLS of the 2972.

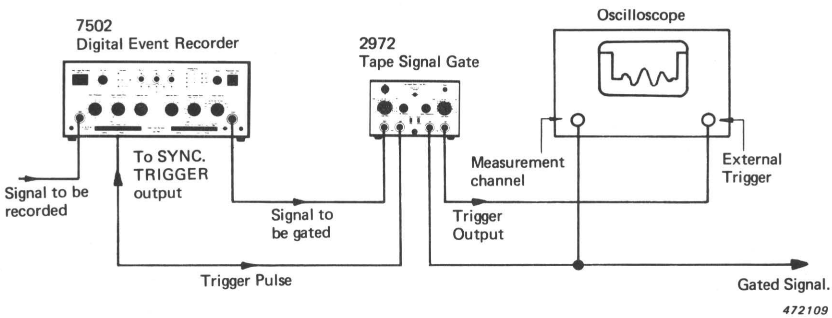

Fig.3.8. Instrument arrangement for gating the analogue output of a 7502 Digital Event Recorder using a 2972 Tape Signal Gate

3. To gate the recorded signal connect the 7502 to the 2972 as shown in arrangement given in Fig.3.8, which includes an oscilloscope for monitoring the gated signal.

4. Set the time base on the oscilloscope so that the length of the trace on the display screen corresponds to a value equal to or less than the repetition time of the recorded signal calculated in item 2. The remaining controls on the oscilloscope should be set as follows:

CHANNEL SENSITIVITY	"1 V/division"
CHANNEL COUPLING	"DC"
TRIGGER MODE	"External"
TRIGGER COUPLING	"DC"
TRIGGER SLOPE	"Positive"

5. Set the controls on the 2972 to:

TRIGGER MODE	"Pulse"
DC EQUALIZER	fully clockwise
SIGNAL DISPLACEMENT	central position
GATE DELAY	"0.1 msec."
GATE WIDTH	"0.1 msec."

With the "Pulse" trigger mode selected the 2972 will automatically be correctly triggered by the SYNC TRIGGER output of the 7502. Triggering of the oscilloscope should occur at the end of each gate delay period when the oscilloscope's "Positive" trigger slope mode is selected. Correct triggering of both the 2972 and the oscilloscope is indicated by the oscilloscope producing one trace sweep for each repetition of the recorded signal

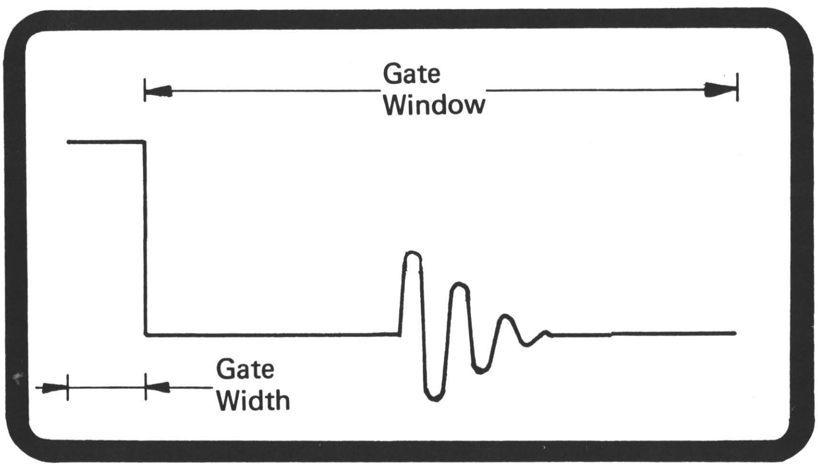

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Fig.3.9. Oscilloscope display of the output from the GATE OUTPUT socket of the 2972 when the "Inverted" GATE MODE is selected and the oscilloscope is triggered by the positive reset slope of the gate delay pulse which is available at the TRIGGER OUTPUT socket of the 2972

6. On the 2972 set the GATE MODE switch to "Inverted" so that recorded signal occuring outside the gate width period is displayed as shown in Fig.3.9.

7. Using the GATE DELAY controls increase the gate delay period so that the start of the recorded signal coincides with the end of the gate width period.

8. Using the TIME BASE control of the oscilloscope "expand" the displayed signal so that the portion of the recorded signal to be gated can be located.

9. Readjust the GATE DELAY controls of the 2972 so that the start of the signal portion to be gated coincides with the end of the gate width period.

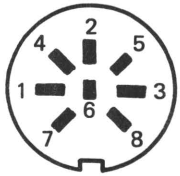
10. Set the GATE MODE switch to "Normal" and adjust the GATE WIDTH controls so that the portion of signal to be gated appears in the gate window. With the TIME BASE of the oscilloscope readjusted so that the gate window almost entirely fills the display screen the displayed signal should appear as shown in Fig.3.5.

11. Using the GATE DELAY and GATE WIDTH controls, fine adjust the position and width of the gate window so that only the required part of the signal is gated. In order to prevent the rise and decay slopes of the window causing errors when the gated signal is analyzed, the opening and closing of the gate window should be set to coincide with the zero crossing of the signal as shown in Fig.3.6.

12. Finally adjust the DC EQUALIZER and SIGNAL DISPLACEMENT controls so that the DC level outside the gate window and the zero level of the gated signal are at zero volts.

3.4. USES OF AUXILIARY OUTPUT

The main use of the AUXILIARY OUTPUT socket on the rear panel of the 2972 is as a remote peak reset facility for a 2607 Measuring Amplifier or a 2114 Octave and Third Octave Spectrometer. The socket also serves as an output for TTL (Transistor-Transistor Logic) compatible gate pulses and for a + 14 Volt (160 mA) power line for connection to external circuitry. The pin identities of the socket are shown in Fig.3.10.



2972
DIN
Socket

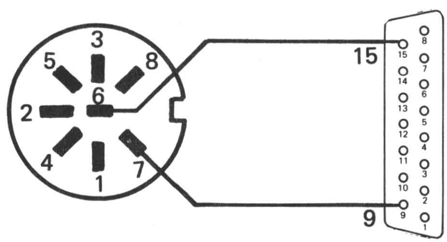
Pin	Identity
1	Gate Width TTL Pulse
3	0 Volt
4	+ 14 Volt
5	Gate Delay TTL Pulse
6	Peak Reset for 2607 or 2114
7	

472051

Fig.3.10. The AUXILIARY OUTPUT socket of the 2972

3.4.1. Remote Reset Facility

The remote reset facility is available at pins 6 and 7 of the AUXILIARY OUTPUT socket which are automatically short circuited for the period set on the GATE DELAY controls when the 2972 is triggered by a signal burst or pulse applied at the TRIGGER INPUT socket. It is used to reset the peak rectifier of the 2607 Measuring Amplifier or 2114 Octave and Third Octave



2972
AUXILIARY OUTPUT
Socket

2607 or 2114
REMOTE CONTROL
Socket

472050

Fig.3.11. Connection of the remote reset facility of the 2972 to the peak rectifier circuit of a 2607 Measuring Amplifier or 2114 Octave and Third Octave Spectrometer

Spectrometer when the peak response of a filter is measured to obtain a Fourier analysis of a shock or impulse. The necessary connections between the AUXILIARY OUTPUT and the 2607 or 2114 are shown in Fig.3.11.

3.4.2. TTL Gate Pulses

For control of external digital equipment two TTL (Transistor-Transistor Logic) compatible pulses corresponding to the gate delay and gate width are available at the AUXILIARY OUTPUT (see Fig.3.10). Both pulses have a logic 0 level (i.e. voltage level of between 0 and 0.4 Volts) and each is produced once every time the 2972 is triggered by a signal burst or pulse applied at the TRIGGER INPUT socket. The time relation between the two pulses and the triggering signal is shown in Fig.3.12.

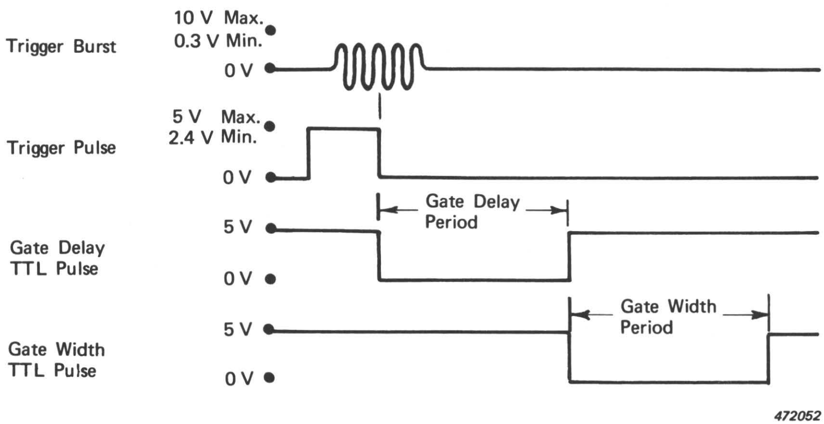


Fig.3.12. Time relation between the two TTL gate pulses available at the AUXILIARY OUTPUT, when the 2972 is triggered by a signal burst or pulse

For analysis of a recorded signal using a 3347 Real Time Analyzer, the gate width TTL pulse may be used to "strobe" the spectrum displayed on the 3347 by activating the "Auto-Store" mode of the analyzer at predetermined points in the signal's development. This type of analysis is called spectrum strobing and is discussed in section 5.2. The necessary connections for activating the "Auto-Store" mode of the 3347 using the gate width TTL pulse are shown in Fig.3.13.

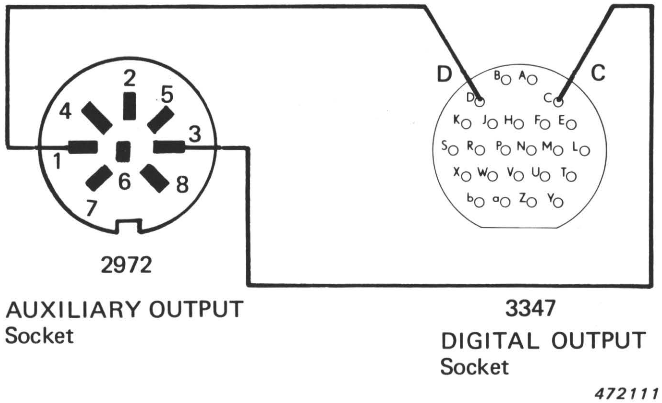


Fig.3.13. Connections for activating the "Auto-Store" mode of the 3347 Real Time Analyzer using the gate width TTL pulse of the 2972 Tape Signal Gate

4. OPERATING CHARACTERISTICS

A problem associated with the analysis of recorded signals of an impulsive nature is that usually the portion of signal to be analyzed is only a small part of total information recorded. The Tape Signal Gate Type 2972 is designed to gate tape recorded as well as digitally recorded signals so that only the signal portion of interest is passed to its output, whilst tape splice noise and other unwanted signals, which would otherwise interfere with an analysis are rejected.

The principle of operation of the 2972 will be described with reference to the block diagram of the instrument given in Fig.4.1 and its control sequence illustrated in Fig.4.2.

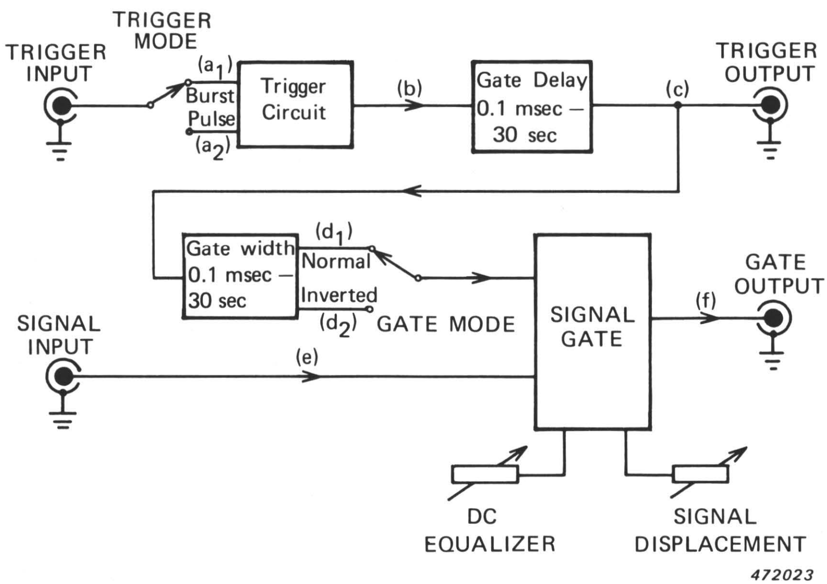


Fig.4.1. Block diagram of the 2972

4.1. TRIGGERING

The control sequence of the 2972 is initiated by applying an external trigger signal to the TRIGGER INPUT socket of the instrument. The socket leads to the trigger circuit which has an input impedance of approximately 18 kΩ. The type of signal which may be applied to the socket to trigger the trigger circuit is governed by the TRIGGER MODE switch which has "Burst" and "Pulse" positions. With the "Burst" mode selected a 200 Hz to 10 kHz sinusoidal signal burst of 0.3 to 10 V amplitude and minimum duration of 20 msec. may be used to trigger the circuit (see (a_1) of Fig.4.2),

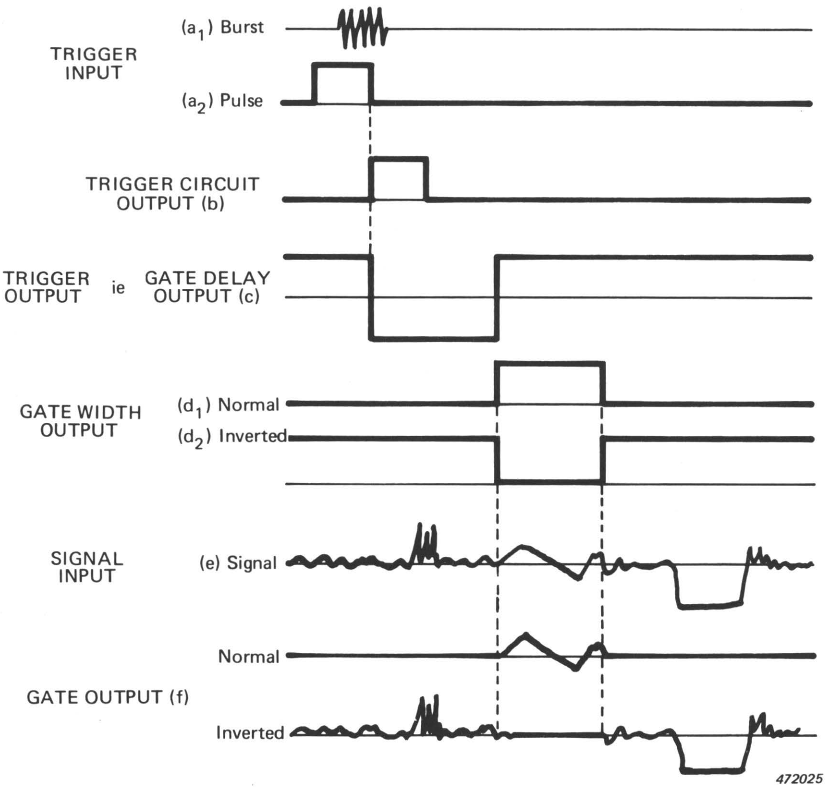


Fig.4.2. Control sequence of the 2972. To indicate at which point in the instrument a particular control waveform is developed, each waveform is lettered according to the block diagram given in Fig.4.1

which after the third or fourth cycle of the burst will produce a positive step function (see (b) for Fig.4.2) for triggering the gate delay circuit. With the "Pulse" mode selected a TTL (Transistor-Transitor Logic) compatible logical 1 pulse of 2.4 to 5.0 V amplitude and minimum duration of 20 μsec. may be used to trigger the circuit. In this case, however, the trigger circuit will produce a positive step function on the reset slope of the applied pulse.

Since for analysis, the signal to be gated has to be repeated (see APPLICATIONS, chapter 5) either by recording it on a tape recorder fitted with a tape loop for repetitive play back, or by recording it digitally using a digital recorder for repetitive playback as an analogue signal, the control sequence must also be repeated and therefore the external trigger signal must be synchronized with the signal to be gated. For gating tape recorded signals this is most easily achieved by recording the trigger signal on a separate track of the tape loop. On playback, the recorded trigger signal may be used to trigger the 2972 so that the control sequence is repeated once for each repetition of the signal to be gated and that triggering occurs at precisely the same instant in each repetition. Because of relatively slow response of the "Burst" trigger mode of the 2972 and therefore its reduced sensitivity to tape splice noise the trigger signal recorded on the tape should be a signal burst.

For gating digitally recorded signals the trigger signal should take the form of a TTL pulse synchronized with the signal to be gated. With the B & K Digital Event Recorder Type 7502 a separate SYNC. TRIGGER output is provided especially for this purpose.

4.2. GATE DELAY

The gate delay circuit sets the laspe time after the trigger circuit has been triggered at which the gate opens, thereby allowing the relative position (on a time axis only) of the gate opening to be shifted in order for it to coincide with the required part of the input signal. It consists of a bistable multivibrator and a separate timing circuit, which together function as a monostable multivibrator. When triggered by a positive step (see (b) of Fig.4.2) from the output of the trigger circuit the bistable produces a pulse (see (c) of Fig.4.2), which is applied to the TRIGGER OUTPUT socket and gate width circuit of the instrument. The period of the pulse is the gate delay which is controlled by the timing circuit and may be adjusted from 0.1 msec. to 30 sec. using the GATE DELAY controls of the instrument. The amplitude of the pulse is + 14 V to −14 V and is suitable for triggering an oscilloscope, which can be connected for monitoring the gated signal.

For triggering external TTL (Transistor-Transistor Logic) circuitry the gate delay circuit also produces a logic 0 pulse which is available at the AUXILIARY OUTPUT socket (see Fig.3.10) of the instrument. The time relation of this pulse and the gate delay pulse available at the TRIGGER OUTPUT socket is identical. An output is also taken from the bistable to close an electronic switch for the duration of the gate delay period. The switch is connected to the AUXILIARY OUTPUT socket and is used as a remote peak reset facility for the peak rectifier of a 2607 Measuring Amplifier or 2114 Octave and Third Octave Spectrometer when analysis of the gated signal is carried out.

The advantages of using a separate bistable and timing circuit to function as a monostable multivibrator in order to provide gate delays, is that the arrangement has better time keeping properties than conventional monostable circuits and that faster switching times can be achieved. Also the use of diodes in the arrangement prevents it from being falsely triggered before the gate delay period has expired.

4.3. GATE WIDTH

The Gate Width circuit controls the Gating Circuit and sets the time the gate remains open, thereby allowing only the required portion of the input signal to be passed to the output of the gate.

As with the Gate Delay circuit it consists of a bistable multivibrator and separate timing circuit which functions as a monostable multivibrator. When triggered by a positive step (reset slope of gate delay pulse, see (c) of Fig.4.2) from the gate delay circuit, the bistable changes state producing two pulses of opposite polarities (d_1 and d_2 of Fig.4.2) which are applied to the signal gate. The time relation of the two pulses is identical. Each has a period corresponding to the gate width, which is controlled by the timing circuit and may be adjusted from 0.1 msec. to 30 sec. using the GATE WIDTH controls of the instrument.

For triggering external TTL circuitry the gate width circuit also produces a logic 0 gate width pulse which is available at the AUXILIARY OUTPUT socket (see Fig.3.10). A major application of this pulse is in spectrum strobing (see section 5.2) where it is used to activate the "Auto Store" mode of a Real Time Analyzer such as the B & K Type 3347.

4.4. SIGNAL GATE

The input for the signal to be gated is via the SIGNAL INPUT socket of the 2972. The socket leads to the signal gate which consists of two FET (Field effect transistor) electronic switches and an integrated circuit differential amplifier. The switches connect the input of the amplifier to both the SIGNAL INPUT socket and the chassis of the 2972 and are controlled by the two outputs (d_1 and d_2 of Fig.4.2) of the gate width circuit. With the "Normal" mode of the GATE MODE switch selected and before the 2972 is triggered, the two gate width circuit outputs bias the switches so that the gate is closed (i.e. SIGNAL INPUT socket open circuit and the input to the differential amplifier grounded). The net effect is that a signal applied to the SIGNAL INPUT is blocked and thus prevented from being passed to the output of the gate. When the 2972 is triggered the two gate width pulses produced by the gate width circuit, bias the switches so that the gate opens (i.e. the SIGNAL INPUT socket is connected to the input of the differential amplifier and the switch grounding the input of the amplifier is open circuited) for the period set by the GATE WIDTH controls of the instrument. A signal applied at the SIGNAL INPUT socket is therefore applied via the switches to the differential amplifier which amplifies it to compensate for the small attenuation of the switches when the gate is open. After the gate width period has expired the gate width circuit biases the switches so that the input signal is blocked until the next gate width pulse is transmitted.

With the "Inverted" mode of the GATE MODE switch selected the connections between the two gate width circuit outputs and the switches are reversed. Consequently the gate will remain open until a gate width pulse is transmitted which will then close the gate for the gate width period.

The use of FET switches in the gate and the switch configuration used gives the gate (when closed) a rejection of greater than 50 dB for a maximum input signal of 2 V peak. To enable signals from DC to 40 kHz to be gated, the gate is DC coupled. The DC level of the signal appearing within the gate window, which is passed by the gate to the GATE OUTPUT socket, may be adjusted ±0.5 Volts by regulating the bias to the auxiliary input of the differential amplifier with the SIGNAL DISPLACEMENT control.

A similar control termed DC EQUALIZER is also available for adjustment of the DC level at the GATE OUTPUT socket when the gate is closed. The maximum output voltage from the GATE OUTPUT is 2 V peak, whilst the output impedance is approximately 10 Ω. However, the GATE OUTPUT should not be loaded by less than 2 kΩ.

4.5. POWER SUPPLY

The power supply of the 2972 is designed for operation from any 100 – 115 – 127 – 150 – 220 – 240 Volt, 50 to 400 Hz mains supply. The correct mains voltage may be selected using the VOLTAGE SELECTOR on the rear panel of the instrument, which connects the supply to the appropriate voltage tap on a mains transformer. The transformer produces two 20 V outputs which are subsequently rectified and stabilized using a full wave rectifier and two voltage regulator circuits to give ± 14 V to supply the signal gate and control circuitry of the instrument. To supply external equipment a + 14 V, 160 mA output is available at the AUXILIARY OUTPUT socket (see Fig.3.10) on the rear panel of the instrument. The maximum power consumption of the 2972 is approximately 7.5 Watts.

4.6. EFFECT OF GATING

The 2972 is primarily intended for gating short complete signals such as shocks or impulses which have been recorded using a tape or digital recorder. If continuous signals, or only small parts of complete signals are gated using the rectangular window of the 2972 then important side band

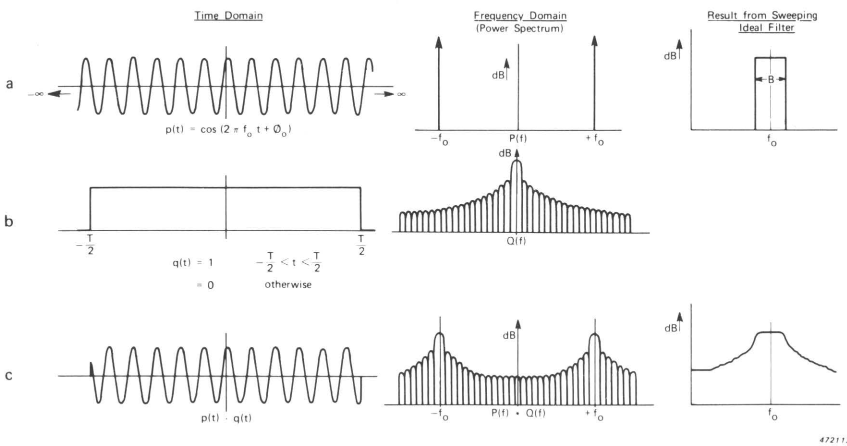


Fig.4.3. Effect of the Tape Signal Gate Type 2972 on a continuous cosine wave
a) Continuous cosine wave
b) Rectangular gate window of the 2972
c) Cosine wave gated with rectangular window of the 2972

components of the signal which for analysis have to be present if a true frequency description of the signal is to be obtained, could be removed.

To illustrate the effect of the rectangular window of the 2972 on a continuous signal the time domain description of a continuous cosine wave p (t) is shown in Fig.4.3a along with its power spectrum (double sided) in the frequency domain P (f), which is a pair of spectral lines (delta functions) situated at $\pm f_0$ the frequency of the cosine signal. The one sided spectrum obtained by analyzing the signal using an ideal filter of bandwidth B is also shown.

Fig.4.3c shows the effect of multipling the continuous cosine signal p (b) by the time domain description of the gate's rectangular window q (t) which is shown in Fig.4.3b. This results in the convolution P (f) * Q (f) in the frequency domain. The further convolution obtained by sweeping the ideal filter across the true spectrum is also shown which results in the side lobes and thus causes a considerable reduction in resolution.

A better method of gating a continuous signal is to use the Gaussian Impulse Multiplier Type 5623 shown in Fig.4.4. This was originally designed to allow accurate analysis of an instantaneous spectrum with the 3347 Real Time Analyzer and generates a gaussian shaped impulse which it multiplies with the original signal. In its present context it may be triggered by a marker signal recorded on a tape recorder and the gaussian impulse delayed so that it starts immediately after the tape splice which will then in effect be rejected. The length of the gaussian impulse may then be adjusted to slightly less than the length of the tape loop.

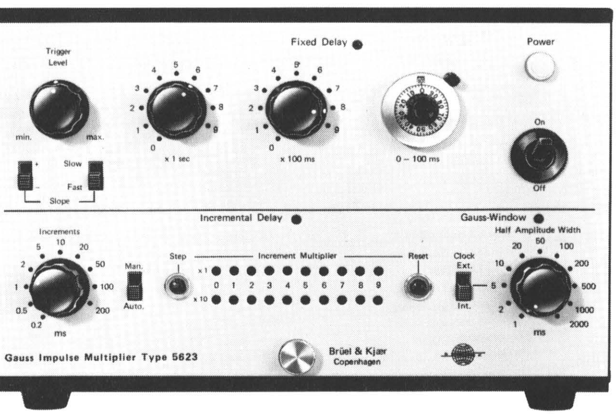


Fig.4.4. The Gaussian Impulse Multiplier Type 5623

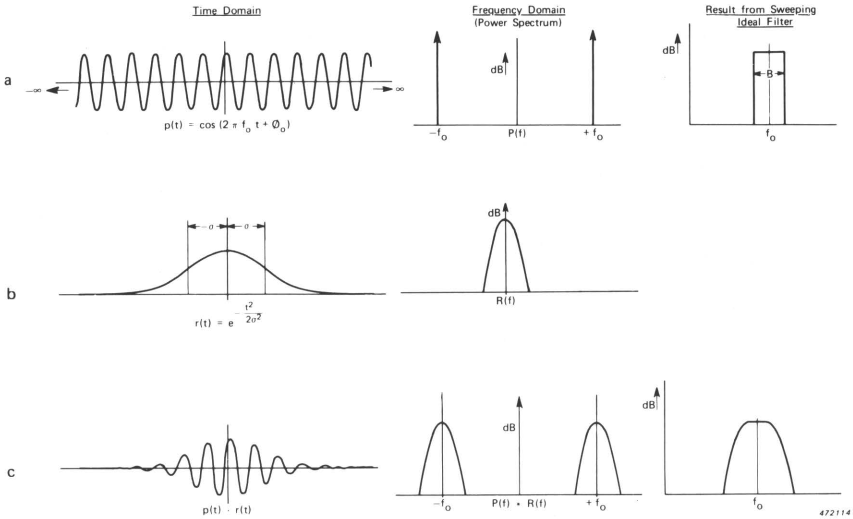


Fig.4.5. Effect of Gaussian Impulse Multiplier Type 5623 on a continuous cosine wave
a) Continuous cosine wave
b) Gaussian shaped impulse of 5623
c) Cosine wave multiplied with Gaussian impulse using 5623

The effect on a continuous signal when multiplied by the gaussian impulse is shown in Fig.4.5, which in order that it may be compared with the effect of the rectangular window of the 2972 is again given with reference to a continuous cosine wave. As can be seen the effect of sweeping the actual multiplied spectrum of the cosine signal and the impulse (see Fig.4.5c) is to cause a slight broadening near the top of the spectrum, but a considerable improvement in the shape factor compared with the rectangular window.

For further information on the use of the 5623 the B & K Application Note "Frequency Analysis of Stationary Signals Recorded on Tape Loops" is available on request.

5. FREQUENCY ANALYSIS

For the analysis of non-periodic signals such as shocks or impulses the use of a tape or digital recorder is essential as it provides a means of repeating non-periodic signals in order that they may be analyzed using a filter set or tuneable filter. Further if the signal contains very low frequency components, a recorder may be used to provide a frequency transformation of the signal in order to bring it into the pass-band of the analyzing filters. However, one difficulty in analyzing recorded signals is that usually the signal of interest is only a small part of the information recorded. For this purpose the 2972 will be found ideal for selecting the required part of the signal and for rejecting other unwanted signals or noise on the recording that would otherwise interfere with analysis.

The types of analysis which may be carried out on non-periodic signals such as shocks or impulses are discussed in the following sections. For simplicity they are given with reference to the B & K Tape Recorder Type 7001, however, other types of tape or digital recorders may also be used.

5.1. IMPULSE ANALYSIS

The simplest method of describing a shock or impulse is to obtain a graphic record of the phenomena in the time domain as shown in Fig.5.1. However, the information provided by such a description is extremely limited. Often a better method is to obtain a description of the signal in the frequency domain. This has the advantage that the individual frequency components making up the signal are given, thus enabling frequency components which could cause destructive reasonances in a specimen to be readily identified. Further, response calculations in the frequency domain are simplified, since normally only multiplication is involved and not convolution as in the case of a time domain descriptions.

One way of describing a signal function in the frequency domain is to apply the Fourier transform, which is defined mathematically by:

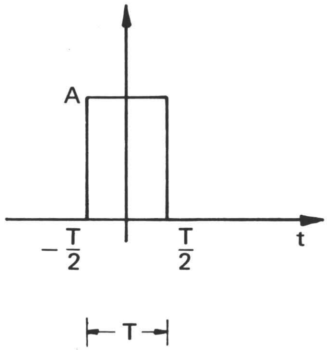


Fig.5.1. Time domain description of a rectangular pulse of amplitude A and duration T

$$F(f) = \int_{\infty}^{\infty} f(t) \exp(-j2\pi ft)\, dt \qquad 5.1$$

with the additional requirement that

$$\int_{-\infty}^{+\infty} |f(t)|\, dt < \infty$$

i.e. f (t) is finite, which for a shock or impulse is automatically fulfilled.

By applying the Fourier transform to the rectangular pulse shown in Fig.5.1 the expression for the Fourier spectrum of the pulse can be derived as:

$$F(f) = AT \left| \frac{\sin \pi Tf}{\pi Tf} \right| \qquad 5.2$$

from which the frequency spectra given in Fig.5.2 are plotted.

Although the expression given in equation 5.2 can easily be calculated and is readily obtainable from most mathematical text books this is not usually the case with more complicated types of shock or impulse, which are often met in practice. One method of obtaining the Fourier spectrum of such a signal which avoids complicated mathematical treatment is to record the signal on a tape loop so it may be converted to a repetitive signal for analysis using a constant bandwidth, narrow band frequency analyzer as shown in Fig.5.3. The frequency functions of such repetitive signals are not continuous spectra, but are line spectra consisting of frequencies $n \times f_o = \frac{n}{T_r}$ where T_r is the repetition time of the signal. Provided that bandwidth of the analyzer is narrow compared to $1/T_r$ in order to resolve each of the spectral

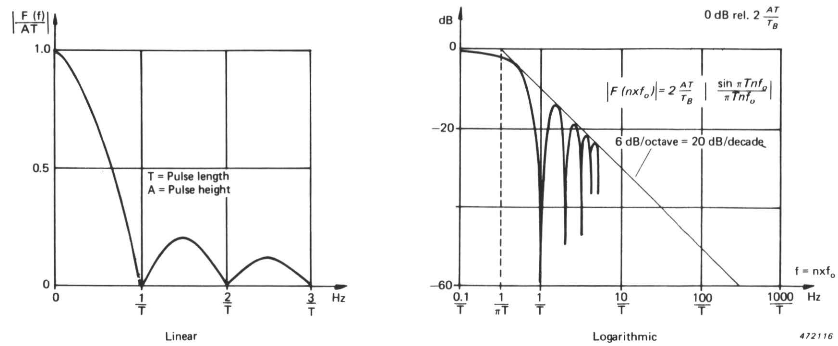


Fig.5.2. Linear and logarithmic representation of the Fourier spectrum of the rectangular pulse shown in Fig.5.1

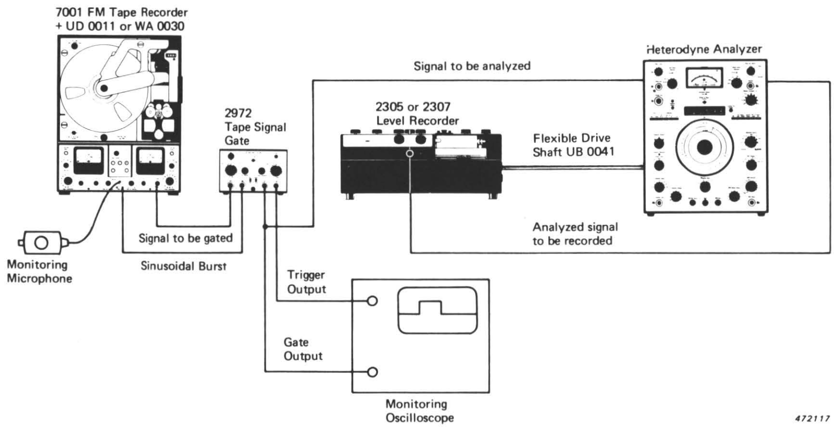


Fig.5.3. Instrument arrangement for measuring the Fourier line spectrum of a shock or impulse

lines, then analysis of the periodic signal will yield the line spectrum shown in Fig.5.4 in which the amplitude of each spectral line is a measure of the Fourier spectrum with successive minima at intervals of 1/T (T is the signal width).

To be able to resolve each of the successive minima, the ratio T_r/T which sets the number of spectral lines between each minima must be made as high as possible. However, if made too large it will cause a reduction in the dynamic range available. As a practical compromise a T_r/T ratio of between 3 and 5 is recommended.

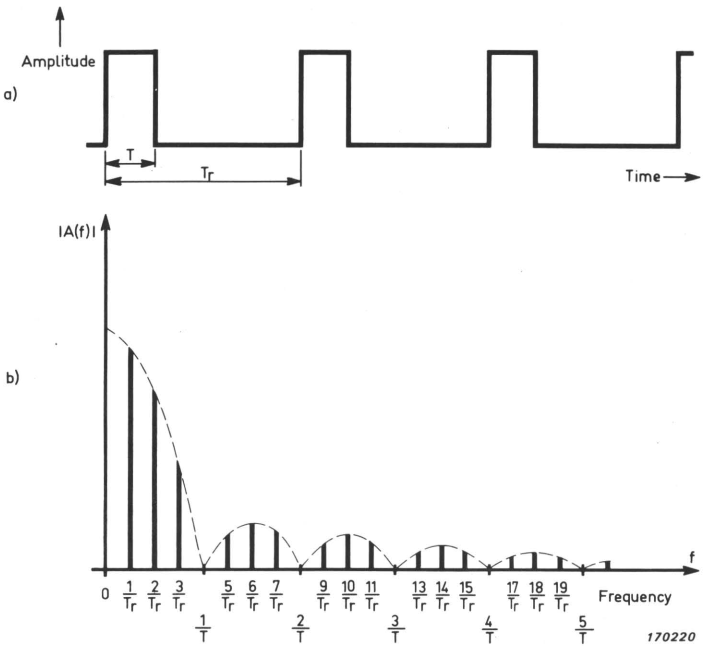


Fig.5.4. A pulse train and its Fourier line spectrum

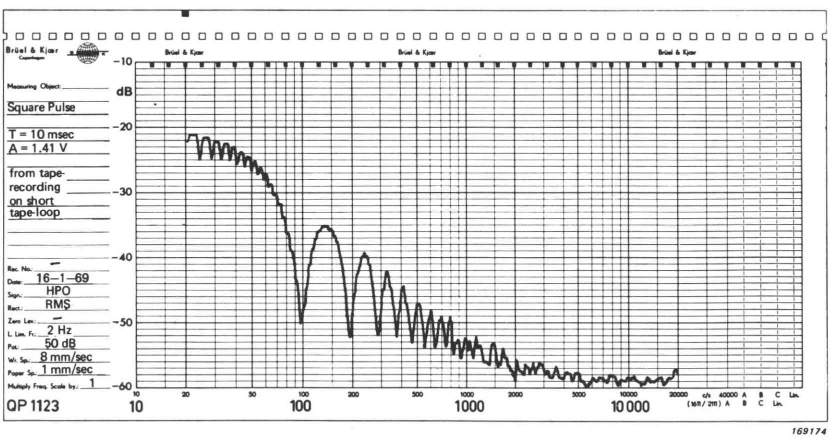


Fig.5.5. Fourier line spectrum of a 10 msec. square pulse made using the arrangement shown in Fig.5.3

The Fourier line spectrum of a 10 m sec. square pulse made using the instrument arrangement shown in Fig.5.3 is given in Fig.5.5. The theoretical Fourier spectrum F(f) at frequency $f = n f_o$ is obtained by multiplying the measured RMS value C_{RMS} with the repetition period T_r and dividing by $\sqrt{2}$. i.e.

$$F(f) = \frac{T_r}{\sqrt{2}} C_{RMS} \qquad 5.3$$

Another method of determining the Fourier spectrum is to measure the peak response of a filter to the shock or impulse. The theory of this method is contained in the B & K Technical Review 1970 No.3 for the pulse response of an idealized narrow band filter. It shows that provided the filter bandwidth Δf and the duration of the impulse T satisfy the condition $\Delta f \ll {}^1/T$, measurement of the peak response of the filter to the impulse F(f) will be proportional to the Fourier spectrum of the impulse according to:

$$F_{max}(f) = 2\Delta f \, F(f) \qquad 5.4$$

The Fourier spectrum can therefore be built up in a series of narrow bandwidth steps for peak measurements of the filter output at various tuning frequencies as illustrated in Fig.5.6.

A practical measuring arrangement for this type of analysis is shown in FIg.5.7, where the peak response of a 2020 Heterodyne Slave Filter, which has almost ideal narrow band filter characteristics is measured using the

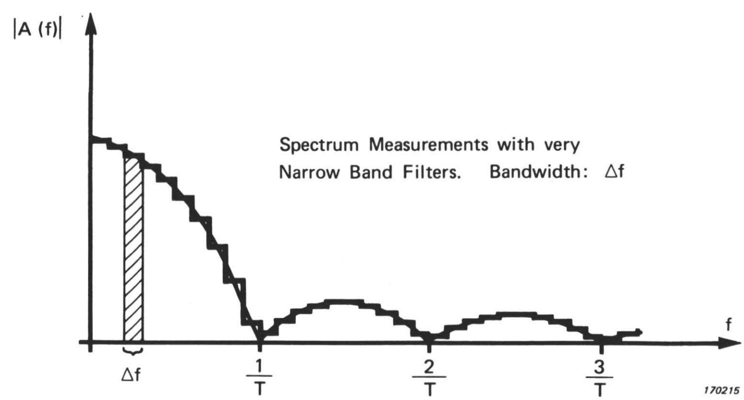


Fig.5.6. Fourier spectrum obtained by measuring the peak response of a narrow bandwidth filter

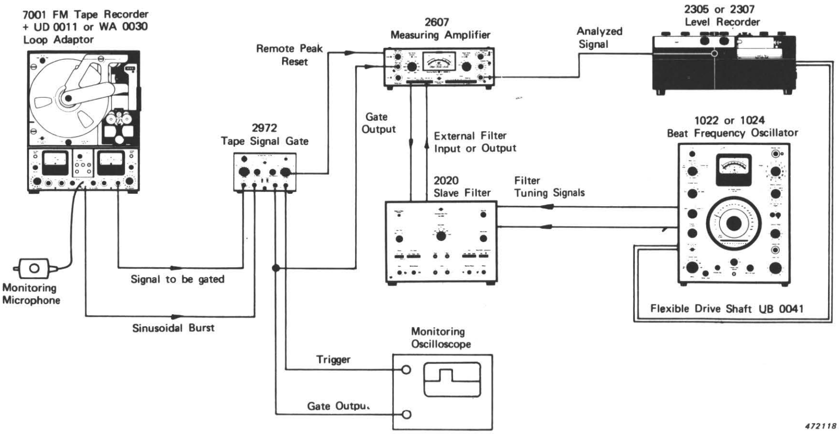


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Fig.5.7. Instrument arrangement for measurement of the peak response of a 2020 Heterodyne Slave Filter to an impulse in order to obtain the Fourier spectrum of the impulse

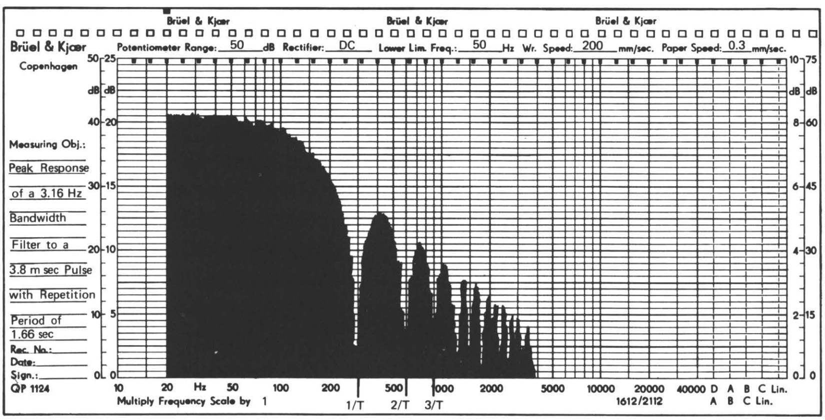

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Fig.5.8. Peak response of the 3.16 Hz filter bandwidth mode of the 2020 Heterodyne Slave Filter to an impulse of width $T = 3.8$ msec. and repetition period $T_r = 1.66$ sec.

Peak Rectifier of a 2607 Measuring Amplifier. The impulse is recorded on a tape loop and on play back using the 7001 Tape Recorder is applied to the 2607 and 2020 via the 2972 Tape Signal Gate. The 2972 not only serves to eliminate tape splice noise and other unwanted signals on the tape, but also serves to reset the peak rectifier of the 2607 after each cycle of the tape loop (see section 3.4.1 for remote peak reset connections). In order that the peak filter response to very short duration impulses can be measured, the "Peak Hold" mode of the Measuring Amplifier is used.

A typical peak response for the 3.16 Hz filter bandwidth of the 2020 to a pulse of width T = 3.8 msec. and repetition period T_r = 1.66 sec. is shown in Fig.5.8. To convert the peak response to the Fourier spectrum of the impulse, divide the peak response by twice the filter bandwidth as follows:

$$F(f) = \frac{F_{max}(f)}{2\Delta f} \qquad 5.5$$

For further information on the measurement of the Fourier spectrum of an impulse consult the B & K Technical Reviews 1969 No.3 and 1970 No.3.

5.2. SPECTRUM STROBING

For some applications it is useful to examine the frequency spectrum of a signal as it changes with time in order to obtain a three dimensional picture of the spectrum's development. One method of doing this is to use the 2972 Tape Signal Gate together with the 3347 Real Time Analyzer in the measuring arrangements shown in Fig.5.9.

In the arrangement the signal to be analyzed is recorded on magnetic tape and formed into a tape loop which is then fitted to the 7001 Tape Recorder using a loop adaptor. The signal is then played back and applied to the 3347 to give an almost instantaneous display and read-out of the signal's frequency spectrum. At the same time a signal burst recorded on the voice track of the tape loop is used to trigger the 2972, which after a delay set by the GATE DELAY controls of the instrument activates the "Auto-Store" mode of the Analyzer using a TTL gate width pulse (see Fig.3.13 for necessary connections). This causes the Analyzer to store the spectrum displayed at the particular instant the "Auto-Store" mode is activated. The storage period is set by the GATE WIDTH controls of the 2972,which,if made long enough, will permit the read-out mode of the analyzer to be manually selected. Once selected, the Analyzer will hold the stored spectra for sufficient time for a readout to a Level Recorder to take place. After the gate width period has expired, or after a readout has taken place if readout has been selected, the Analyzer will automatically reset causing the displayed spectrum to up-date until the next gate width pulse is transmitted. The entire effect is equivalent to strobing the frequency spectrum at a

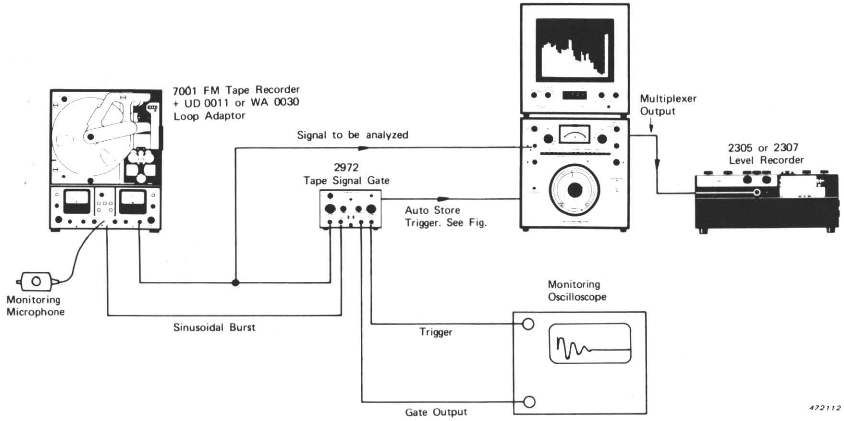

Fig.5.9. Measuring arrangement for spectrum strobing

particular point in the signal's development. By adjustment of the GATE DELAY controls other points in the signal's development may be chosen, allowing the spectrum's development to be observed as a function of time.

An example of this type of analysis is given in Fig.5.10, which shows the frequency, amplitude, time model of the English word "is". At the beginning of the word recordings were made at 10 msec. intervals on the time axis (i.e. gate delay set in 10 msec. steps) and subsequent portions at 20 msec., 40 msec. and 80 msec. intervals. The total length of the analyzed word is 830 msec. For analysis, the word was recorded on the tape loop and the marker pulse recorded just before it on the voice track. This enabled the short gate delay periods of 10 msec. to be accurately set using the lower ranges of the GATE DELAY controls. The positioning of the end of the gate delay period was monitored at the GATE OUTPUT socket of the 2972 using an oscilloscope. To prevent the decay of the tape splice's frequency spectrum on the Analyzer from interfering with the spectrum of the word, the word was recorded well away from the tape splice. For display of the spectrum on the analyzer the short time constants of the Analyzer's "Sine Mode" were used.

Another method which is available to obtain an analysis similar to that obtained by spectrum strobing is to use the "Max. Store" mode of the 3347 and to gate the signal at different points in its development before analyzing it. This has the advantage that interference from tape splice noise or other unwanted signals is completely eliminated. However, when the 2972 is used for this purpose it does have an overriding disadvantage that side-band

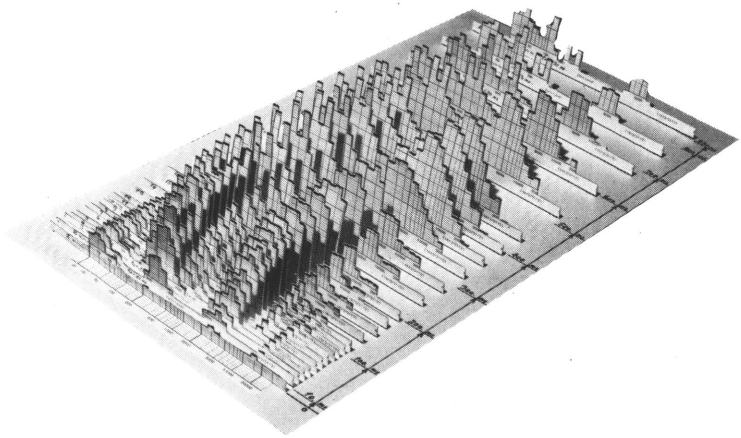

Fig.5.10. Frequency, amplitude time model of the English word "is" obtained by spectrum strobing using the instrument arrangement in Fig.5.9

components (see Section 4.6) of the signal will be removed when only a small part of a complete signal is gated and this will result in an incorrect analysis. For this purpose it is therefore recommended to use the Gaussian Impulse Multiplier Type 5623 to gate the signal.

For further information on the use of the 2972 together with the 3347 Real Time Analyzer for spectrum strobing, a B & K Application Note, titled "The Real Time Analyzer Type 3347" is available on request.

6. SHORT TAPE LOOP ADAPTOR TYPE WA 0030

The Short Tape Loop Adaptor Type WA 0030 is available as an accessory for fitting very short tape loops, 14 ±0.25 inches (362 ±5 mm) in length, to the B & K FM Tape Recorder Type 7001. This will enable short, non-repetitive signals, such as shocks or impulses (which have been recorded) to be converted to a pseudo-periodic signal for analysis using a filter set or tuneable filter. The minimum signal repetition time obtainable with the short tape loop length of the Adaptor is 225 msec, which is sufficient for the Fourier line spectra measurements discussed in section 5.1. The 2972 Splice Noise Eliminator is essential for meaningful results using this Adaptor.

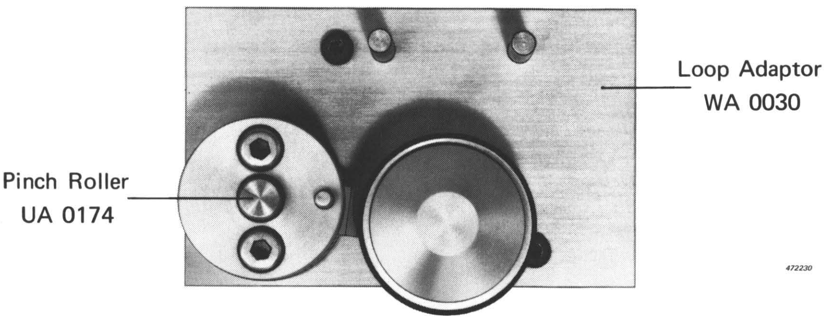

Fig.6.1 The Short Tape Loop Adaptor WA 0030 fitted with the Pinch Roller UA 0174

6.1. FITTING THE SHORT TAPE LOOP ADAPTOR

The Short Tape Loop Adaptor mounts onto the 7001 when the tape tension regulator of the recorder has been removed, and is ready for use when the automatic tape speed sensing circuit has been disconnected. To carry out these operations proceed as follows:

1. Using the two screw threaded holes on the mounting boss of the Adaptor fit the Pinch Roller UA 0174 (provided with the 7001) as shown in Fig.6.1.

2. With the power supply to the 7001 disconnected, unplug the cover of the tape sensing lamp (see Fig.6.2) and remove the lamp by pushing it in and turning it anti-clockwise. Removal of the lamp will allow the recorder to function by preventing the tape presence sensor from falsely detecting a tape breakage when the Short Tape Loop Adaptor has been fitted.

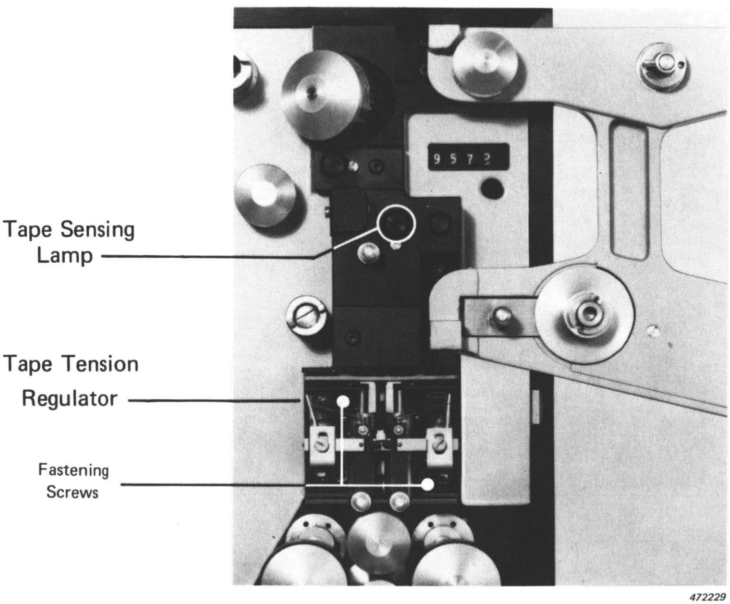

Fig.6.2 Part of the tape transport mechanism of the 7001 FM Tape Recorder

3. Remove the cover from the tape tension regulator of the recorder and unscrew the two fastening screws indicated in Fig.6.2.

4. Unplug the tape tension regulator from the main frame of the recorder by pulling it forward, gripping the right-hand end of its top and bottom lips.

5. Using the two screw threaded holes, by which the tape tension regulator was fixed (see Fig.6.2), mount the Short Tape Loop Adaptor as shown in Fig.6.2. The two screws on the Adaptor should then be tightened with one of the hexagon keys provided with the 7001.

6. Set the toggle switch on the rear panel so that the automatic tape speed sensor is to "Off" (if the Adaptor is being used with the recorder for the first time then this switch has to be fitted as described in section 6.2).

The 7001 is now ready for operation with short tape loops of 14 ± 0.25 inches (362 ± 5 mm) in length which may be fitted as shown in Fig.6.3.

Note. When the Short Tape Loop Adaptor is removed for reel to reel operation, or operation using the Tape Loop Adaptor UD 0011 (provided with the recorder), the tape sensing lamp and the tape tension regulator should be replaced. It is also important to ensure that the rear panel toggle switch is set "On" so that the automatic speed sensing circuit is connected.

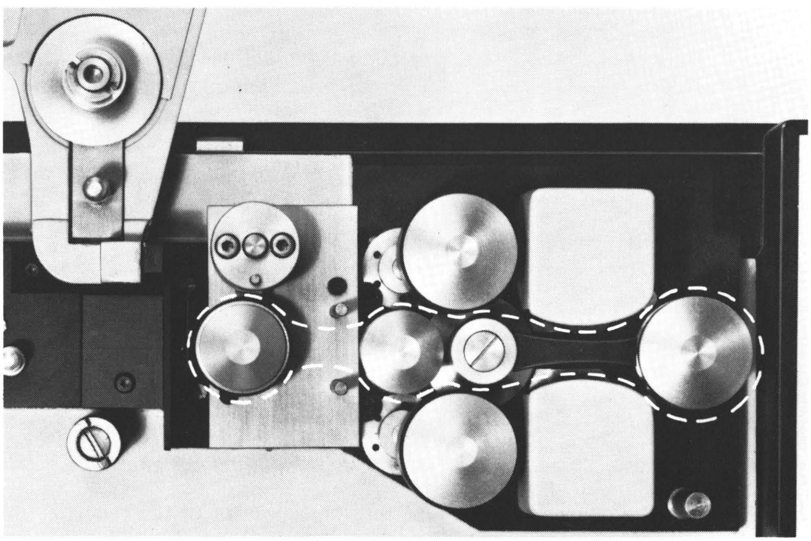

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Fig.6.3 The Short Tape Loop Adaptor WA 0030 mounted on the 7001 FM Tape Recorder. The method of fitting short tape loops is also indicated

6.2. FITTING AUTOMATIC SPEED SENSING ON-OFF SWITCH

When the Short Tape Loop Adaptor WA 0030 is used for the first time, and On-Off switch (provided with the Adaptor on delivery) must be fitted to the automatic speed sensing circuit of the 7001. For reel to reel operation of the recorder, or for operation with the long Tape Loop Adaptor UD 0011, the circuit ensures that the tape is not subject to severe strain by delaying engagement of the recorder's pinch rollers until the tape is brought up to the correct recording or playback speed. For operation using the Short Tape Loop Adaptor this feature is not required and the circuit must be disconnected with the switch before the recorder will function correctly.

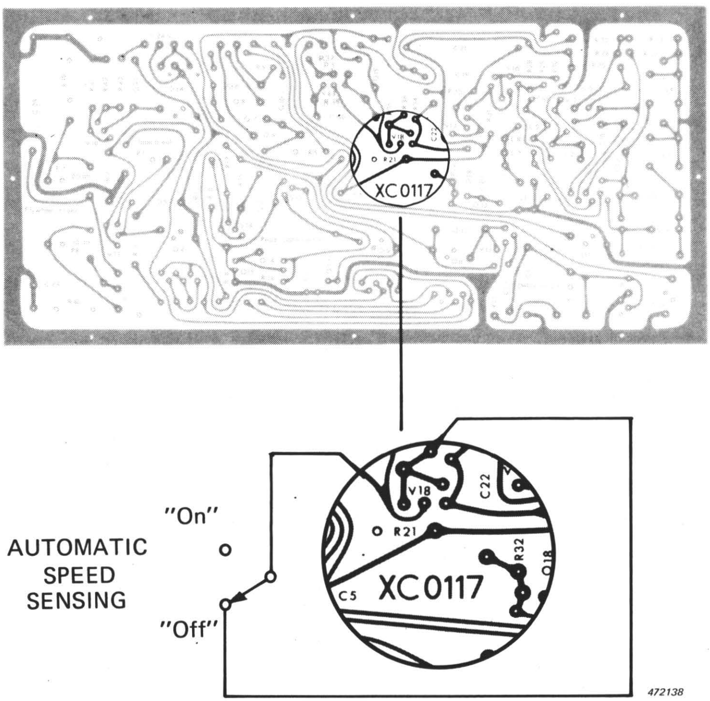

Fig.6.4 The printed relay board XC 0117 of the 7001 FM Tape Recorder, showing the switch connections to be made for operation of the recorder with the Short Tape Loop Adaptor WA 0030

To fit the switch proceed as follows:

1. Turn the 7001 upside down and remove the rear panel of the instrument by unscrewing to four rear panel fastening screws.
   The part of the automatic speed sensing circuit to which the switch has to be connected is situated on the printed relay board XC 0117 which is on top chassis (when the recorder is in its normal upright position). The board is shown in Fig.6.4.

2. Take two pieces of stranded wire cable about 1 ft. (30.5 cm) in length and twist them together.

3. Solder one end of the twisted cable to the switch and the other to the collector and emitter of transistor V 18 (see Fig.6.4) of the printed relay board XC 0117. Care should be taken to ensure that the transistor is not overheated and that the soldered connections do not short other printed connections.

4. Drill a 12 mm hole in the rear panel of the 7001 and fit the switch to it using the nut and locking washer provided.

5. Replace the rear panel and label the open circuit switch position "Automatic Speed Sensing On" and the short circuit switch position "Automatic Speed Sensing Off".

7. SPECIFICATIONS

Frequency Range:	DC to 40 kHz
Gain:	approximately 0 dB
Dynamic Range:	50 dB
Rejection:	50 dB
Gate Delay:	0.1 msec. to 30 sec. Continuously adjustable over 11 ranges.
Gate Width:	0.1 msec. to 30 sec. Continuously adjustable over 11 ranges.
Signal Input:	
Input Impedance	1 MΩ in parallel with 50 pF.
Max. Input Voltage	2 V peak
Gate Output:	
Output Impedance	10 Ω
Min. Load Impedance	2 kΩ
Max. Output Voltage	2 V peak
Trigger Input:	
Trigger Mode	
Burst	200 Hz to 10 kHz sinusoidal signal burst of 0.3 to 10 V amplitude and length not less than 20 msec.
Pulse	TTL (Transistor-Transistor Logic) compatible pulse of length not less than 20 μsec.
Input Impedance	18 kΩ approx.

Trigger Output:

Output Impedance	<200 Ω.
Min. Load impedance	10 kΩ.
Output Voltage	+ 14 V to −14 V at start of delay −14 V to + 14 V at end of delay.

Auxiliary Outputs:

Gate Delay	TTL (Transistor-Transistor Logic) compatible Logic 0 gate delay pulse.
Gate Width	TTL compatible Logic 0 gate width pulse.
Remote Reset	Remote peak reset facility for use with a 2607 Measuring Amplifier, or 2114 Octave and Third Octave Spectrometer.
Supply Line	+ 14 V, 160 mA output for powering external circuitry.

Power Supply:

Voltage	100 – 115 – 127 – 150 – 220 – 240 V, 50 to 400 Hz AC.
Power Consumption	7.5 Watts approx.

Dimensions and Weight:

Cabinet Type A	Height 132.6 mm (5.2 in) Width 210 mm (8.3 in) Depth 200 mm (7.9 in) Weight 2.6 kg (6.0 lbs.)

Accessories Supplied:

1 AN 0005	Power Cable, European
or 1 AN 0006	(or American) type.
1 JP 0101	B & K coaxial plug
1 JP 0802	8 pin DIN socket
1 VF 0012	200 mA mains fuse

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Sine-Random Generators
Artificial Voices
Artificial Ears
Artificial Mastoids
Hearing Aid Test Boxes
Audiometer Calibrators
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Audio Reproduction Test Equipment
Tapping Machines
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