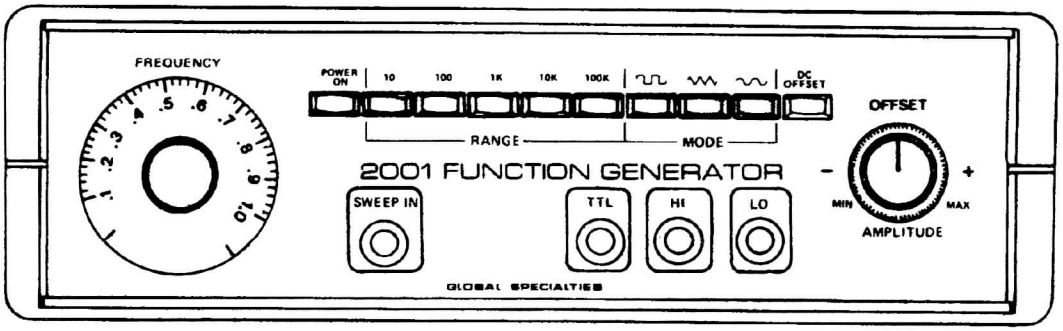
2001 SWEEPABLE FUNCTION GENERATOR



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8/90 REV A.

GLOBAL SPECIALTIES®
An Interplex Electronics Company
70 Fulton Terrace P.O. Box 1942
New Haven Connecticut 06512

SPECIFICATIONS

OUTPUTS

Three outputs, HI, LO, and TTL; DC-coupled, BNC connectors.
High Output Impedance: Constant 600 Ω short circuit proof
Amplitude: 0.1-10 V_{pp} into open circuit, 0.05-5.0 V_{pp} driving 600 Ω. Flat within ± 0.5 dB over frequency range. DC Offset: Zero when feature is not selected; variable −5 VDC to +5 VDC into open circuit when selected; total AC (signal) plus DC (offset) output limited to ± 10 V_{pp} into open circuit, ± 5 V_{pp} into 600 Ω.
Low Output Impedance: Constant 600 Ω, short-circuit proof.
Amplitude: -40 dB of HI output, 1-100 mV into open circuit, 0.5-50 mV into 600 Ω. Flat within ± 0.5 dB over frequency range.
DC Offset: ± 50 mV max.
TTL Output Drive: Standard TTL-level square wave (in all modes), buffered to drive 10 TTL loads. Rise/fall time less than 25 ns, synchronous with HI, LO outputs.

SWEEP INPUT

Sweep Input: DC-coupled, BNC connector.
Impedance: 30,000 Ω
Sensitivity: 0 to ± 10 V input sums with voltage at Frequency vernier to sweep output frequency up to 100:1. Linear sweep range 10:1; max in ± 12 V.

MODES

Frequency Range in all modes is 1 Hz to 100 kHz, set with a continuously variable 10:1 Frequency vernier, marked in 45 divisions, and 5 decade Range Select pushbuttons. Dial calibrated to ± 5% of full scale setting at 10 Hz, 100 Hz, 1 kHz, 10 kHz.
Square: ± 1% typical time symmetry square wave (calibrated to 1.5%). Rise/fall time less than 100 ns (into 600 Ω + 20 pF).
Triangle: Linearity better than 1%
Sine: <1% THD typical. Calibrated to <2% over the full range.

CONTROLS

Power On, Five Range Decade Selectors, Sine/Square/Triangle Mode Selectors, DC Offset Feature Selector, Frequency Vernier Dial, Variable Offset Level, Variable Amplitude.

POWER

105-135 VAC, 50-60 Hz, 6 VA maximum
(215-250 VAC, 50-60 Hz version available)

DIMENSIONS

3 x 10 x 7 inches H x W x D (76 x 254 x 178mm)

OP TEMP

0 °C-50 °C (calibrated at 25 °C ± 5%) 32 °F-122 °F (calibrated at 77 °F ± 5%)

INCLUDES

Instruction manual, plug in power supply.

STOCK NO

105-2001

WEIGHT

3.6 lbs (1.6 kg)

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INTRODUCTION

The Global Specialties Model 2001 Sweepable Function Generator is a multiple waveform signal generator, capable of producing precision sine, square or triangle waveforms. The 2001 offers these features:

Separate TTL output

Variable DC offset control

DC-coupled output

600 ohm output impedance

VCO and sweep capabilities

Separate HI and LO outputs, with 40 dB amplitude ranges

GENERAL DESCRIPTION

Switch-selectable sine, square and triangle waveforms are continuously adjustable, using a 10:1 calibrated vernier, over five decade ranges from 1 Hz to 0.1 MHz. In addition, a ± 10 V sweep input can vary the frequency over a 100:1 range with a highly linear characteristic. A switch-selected variable DC offset can shift the waveform at the HI output up to ± 5 V.

The 2001 offers three main outputs: the HI output provides 0.1 to $10V_{pp}$ into an open circuit, and 0.05 to 5.0 V into a matching load: the LO output delivers 1-100 mV into an open circuit, 0.5 to 50 mV into 600 ohms. The output waveform amplitude is flat within ± 0.5 dB over the entire frequency range. The TTL output provides a constant-amplitude TTL square wave, with frequency and phase identical to the main outputs and buffered to drive up to 10 TTL loads.

FRONT PANEL CONTROLS, SWITCHES AND CONNECTORS

Location

Refer to Figure 1 for the location of all front panel features. (These numbers will be referred to throughout the text)

NOTE

All pushbutton switches are push-to-activate switches. The RANGE and MODE groups of switches are interlocked, allowing only one switch within each group of switches to be activated at any one time.

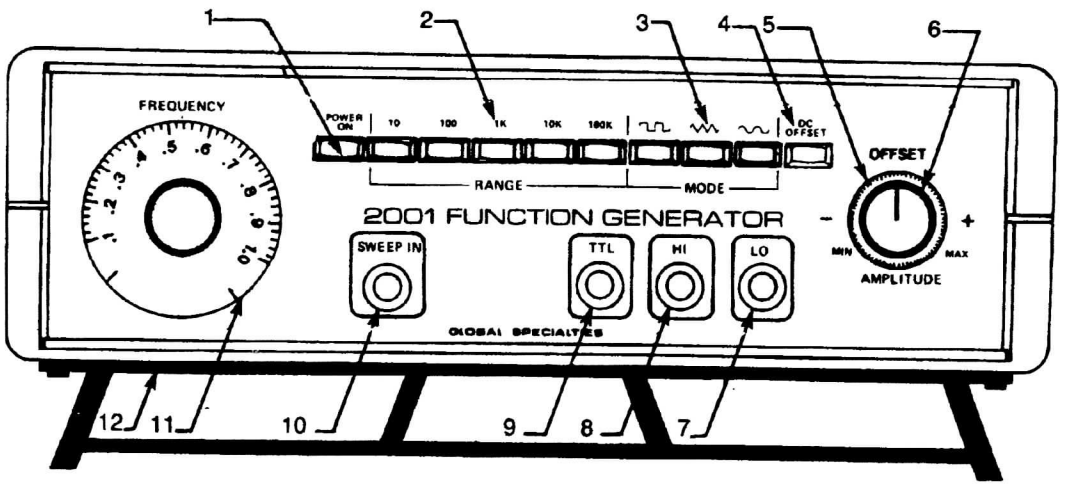


FIGURE 1. Location of front panel controls, switches and connectors

DESCRIPTION

POWER Switch and LED Indicator: (1)

Power is supplied to the 2001 when the Power switch is pressed in.

RANGE Switches: (2)

Pushbutton RANGE switches act as multipliers for the FREQUENCY vernier. Example: If the frequency dial is set to 0.5 with the 1 K RANGE switch depressed, the frequency at every output is 500 Hz.

MODE Switches: (3)

Pushbutton switches select square, sine or triangle wave function. The associated waveform appears at the output terminals (except TTL).

DC OFFSET Switch (4)

When pressed in, the DC OFFSET pushbutton activates the DC offset feature. The centerline of the waveform at the HI output can then be offset from its calibrated zero to ±5 Volts at no load, ±2.5 Volts at 600 ohms. When the DC OFFSET switch is released, DC offset is removed from the output waveform, leaving it symmetrically centered with reference to ground.

DC OFFSET Control: (5)

The DC OFFSET control is enabled when the DC OFFSET pushbutton is pressed in.

This control is coupled to the outer ring of the dual concentric pair, the AMPLITUDE control being coupled to the inner shaft.

With the control fully counterclockwise, − 5 VDC offset is added to the output signal (no load). As the control is turned clockwise, the amount DC offset varies linearly through zero (at the midpoint) to + 5 VDC offset in its full clockwise setting.

AMPLITUDE Control: (6)

The AMPLITUDE control is a linear potentiometer that varies the DC-coupled level up to 10 V (with no output load), up to 5 V with a 600 ohm load.

This control is the inner shaft of a dual concentric control. The outer ring is the OFFSET control.

LO Output BNC: (7)

The LO output is 40 dB below the HI output (8), features a constant 600 ohm output impedance and is capable of a maximum 100 mV_{p-p} amplitude (unloaded, maximum 50 mV_{p-p} driving 600 ohms).

HI Output BNC: (8)

The HI output BNC is intended as the main signal output of the 2001. Its output impedance is a constant 600 ohms at any amplitude, to a maximum 5 V_{p-p} driving a 600 ohm load (maximum 10 V_{p-p} unloaded). The output signal characteristics are determined by the settings of the MODE switch,FREQUENCY vernier, RANGE switch and DC OFFSET controls.

TTL Output BNC: (9)

The TTL output BNC produces a TTL-compatible square wave output capable of driving 10 TTL loads. The TTL output wave frequency and phase are identical to those of the square-wave signal at the HI (8) and LO (9) outputs.

SWEEP Input BNC: (10)

An external linear voltage change applied to the sweep input BNC will produce a linear frequency change at all the outputs. A positive voltage will cause an increase in frequency, a negative voltage a decrease. The change in frequency from that indicated on the dial is given by the formula.

$$\Delta f = 0.093 \times Vi \times R$$

where Δ = change of frequency (Hz).

Vi = input voltage (volts)

R = multiplier indicated by RANGE switch (2) setting

NOTE

While it is possible to obtain very low frequencies with the application of negative sweep voltages it is inevitable that accuracy will deteriorate at these frequencies. The 2001 determines frequency within a RANGE switch (2) setting by summing with the setting of the FREQUENCY vernier (11) which divides a carefully calibrated internal voltage with the voltage applied at the SWEEP input BNC (10). Maximum linear sweep range is achieved with the FREQUENCY vernier (11) near 0.9; but while linearity suffers when the sum of these voltages reaches the end of the usable sweep range, no damage to the 2001 will occur as long as the SWEEP input (10) does not exceed ±12 V.

FREQUENCY Vernier: (11)

The FREQUENCY vernier acts as a continuous fine-tuning adjustment for setting the output frequency. The vernier is marked with nine major divisions, 0.1-1.0, subdivided into five minor divisions. Example: To set the 2001 to 50 kHz:

Set the FREQUENCY vernier to 0.5
Depress the 100 K RANGE pushbutton
The output frequency should now be 50 kHz

FLIP-UP Leg: (12)

Easily raised or folded. Elevates the front of the generator 1 inch.

CHECKING OUT THE 2001

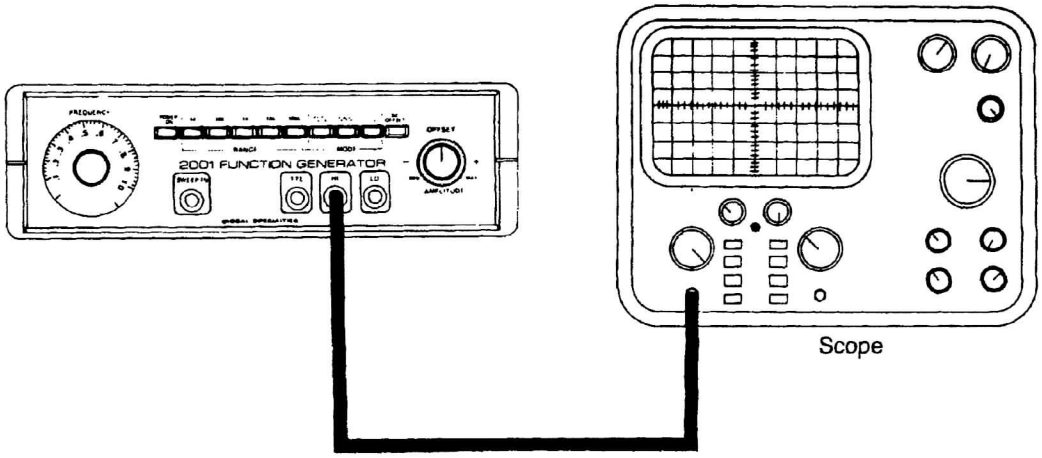


FIGURE 2. Checkout configuration

In order to acquaint the user with all the functions of the 2001, the following checkout procedure is recommended:

EQUIPMENT:
Oscilloscope, Tektronix Model 455 or equivalent.
10: 1 attenuator probe with shunt capacity of 15 pF or less.

Set the oscilloscope as follows:

CONTROL	POSITION
Sweep time	0.2 ms/div.
Vertical display	0.5 V/div. (centered on screen)
Trigger mode	Normal
Trigger slope	+
Input	Normal, DC

Set the controls on the 2001 as follows:

PUSHBUTTON	POSITION
Power	on (in)
Range	1 K
Mode	∿
DC Offset	off (out)

Set the frequency vernier to 1.0.

Set the amplitude control to MAX. Connect the oscilloscope to the 2001 as shown in Figure 3 to the HI output.

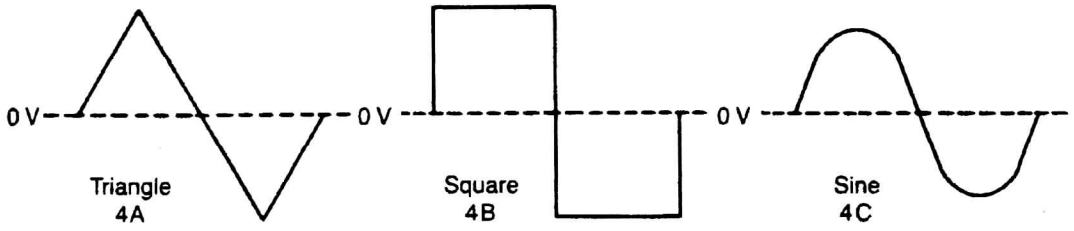


FIGURE 3. Waveforms

CHECKING WAVEFORMS

Figure 4 shows the various waveforms as they will be observed.
3A is the waveform with the ∿ pushbutton in.
3B is the waveform with the ⎍ pushbutton in.
3C is the waveform with the ∿ pushbutton in.
All waveforms are 10 V_{p-p} with no DC component in the waveform.

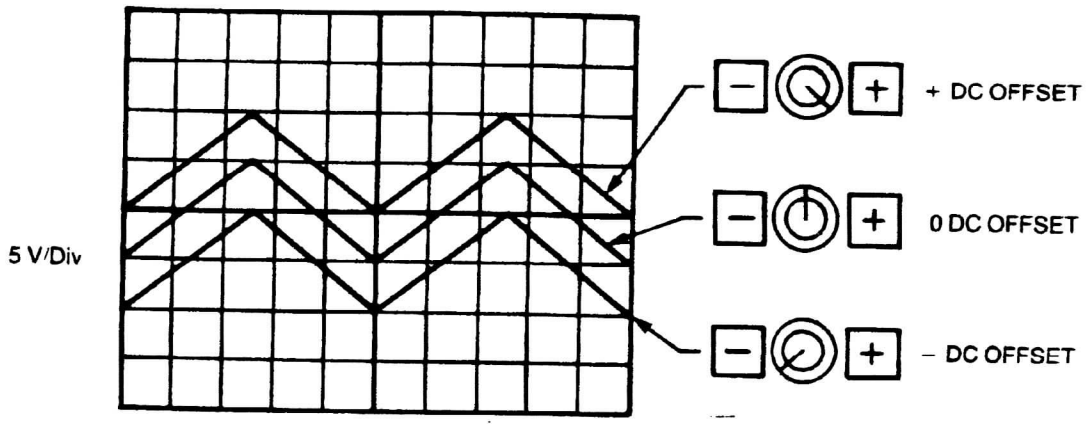


FIGURE 4. Operation of DC offset

Checking DC OFFSET

Figure 5 shows the triangle with DC offset added (ref Figure 4). The DC OFFSET pushbutton (4) must first be pushed in to activate the DC offset feature, then the DC OFFSET control will vary the vertical position of the waveform trace on the oscilloscope. With the AMPLITUDE control (6) set at MAX, maximum DC offset will result, as shown in Figure 5.

FIGURE 5. TTL output .

Checking the TTL OUTPUT

Connect the scope probe to the TTL OUTPUT (9). Figure 6 shows the waveform on the scope.

The TTL output (9) produces a fast risetime 0-4 V square wave capable of driving 10 TTL loads.

The TTL output is independent of the MODE switches (3), DC OFFSET (4) and AMPLITUDE (6) controls. Its frequency and phase are the same as that of the main outputs.

APPLICATIONS

The 2001 Sweepable Function Generator with its large voltage range, low distortion and 5-decade frequency response is ideal for audio testing. The 600 ohm output impedance of the 2001 matches the Volume Unit (VU) standard for audio testing. In the VU system zero VU equals one milliwatt of 1 kHz sinusoidal power across a 600 ohm load. Figure 7 shows a simple scheme for checking the calibration of a VU meter. Begin by checking the VU meter at zero dBm (0.7746 V RMS at 1 kHz).

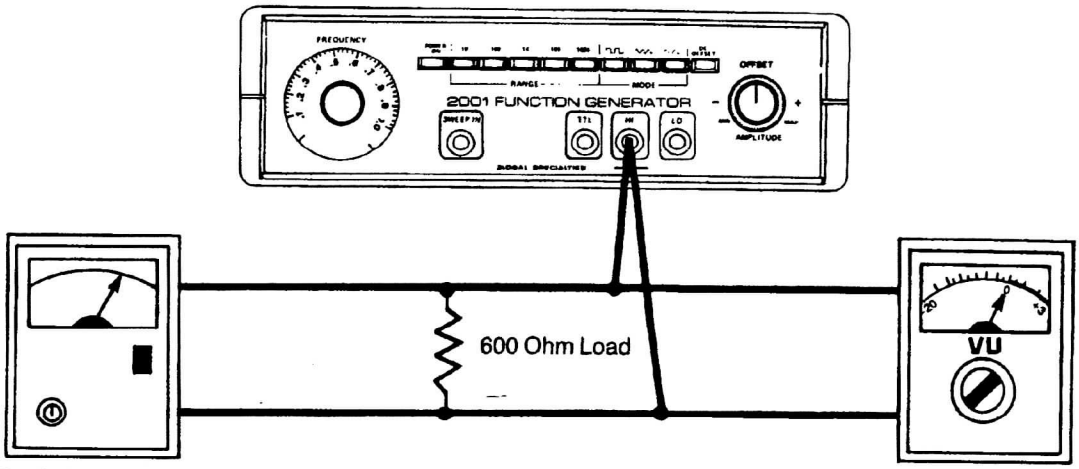


FIGURE 6. VU meter calibration check

Adjust the voltage output of the 2001 to the values in Table 1, where possible, to check the VU meter's accuracy over its entire range (typically —20 dB to + 3 dB).

RMS Voltage	VU Level (dBm)
1.094	+ 3
0.975	+ 2
0.869	+ 1
0.774	0
0.6904	− 1
0.6152	− 2
0.5484	− 3
0.3882	− 6
0.2449	−10
0.07746	−20

TABLE 1. RMS voltage and VU level relationships

POWER AMPLIFIER FREQUENCY RESPONSE TESTING

Figure 8 shows a basic amplifier frequency response test circuit.

Most power amplifiers require an input level between − 20 dBm and 0 dBm. At these levels, the 2001 HI output (8) should be used. The cable connecting the 2001 to the amplifier input should be shielded, and if necessary, the load matched with a 600 ohm resistor at its input terminals. The amplifier's output terminals should be monitored by an oscilloscope, and both input and output terminals should be monitored by an AC voltmeter with a dB or dBm scale. The oscilloscope will then display any hum, noise or oscillation appearing on the signal.

Care should be taken with the input and output leads: they should be as short as possible, and kept far enough apart to prevent coupling.

To perform the frequency response test, first set the 2001 to its 1 K range (2), FREQUENCY vernier (11) to 1, and the MODE switch (3) to sine (∿).

Next, attach the AC voltmeter across the load at the amplifier output terminals.

Then, adjust the 2001 AMPLITUDE control (6) to a level 10 dB below the maximum rated output of the amplifier. This establishes a zero dB reference level, against which other readings will be compared.

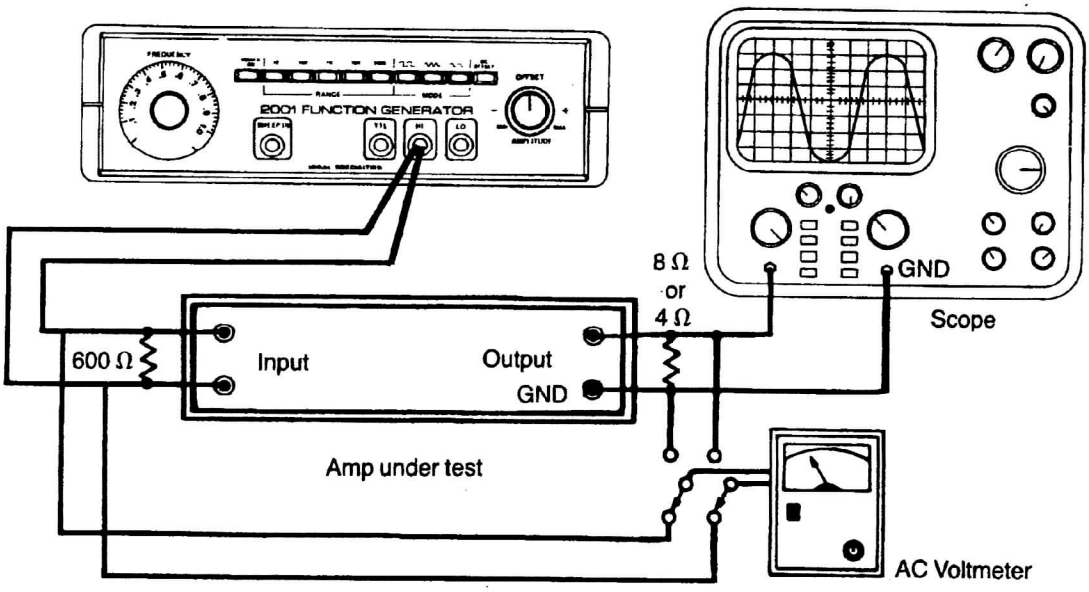


FIGURE 7. Amplifier frequency response test

Table 2 shows a convenient table of power and voltage relationships for 4 ohm and 8 ohm speakers. It also lists the voltage level 10 dB below the maximum output levels at different power ratings. Choose the rating closest to the amplifier under test. Testing at 10 dB below maximum output ensures that the amplifier output will not saturate. This level is approximately 1/10 of the full power output.

Starting from the amplifier's lowest specified frequency (in most cases 20 Hz), increase the 2001 output frequency to the amplifier's highest specified frequency (typically 20 kHz), noting changes in the dB reading on the AC voltmeter, and monitoring waveform changes on the oscilloscope. These readings, when drawn on semilog graph paper, pilot the amplifier's frequency response curve.

Power Ratings (RMS)			Output (RMS)	
8 Ω	4 Ω	E^2	Full Output	10 dB Below Max. Output
1 W	2 W	8 V	2.8 V	0.89 V
5 W	10 W	40 V	6.3 V	2.0 V
10 W	20 W	80 V	8.9 V	2.8 V
20 W	40 W	160 V	12.6 V	4.0 V
50 W	100 W	400 V	20.0 V	6.3 V
100 W	200 W	800 V	28.0 V	8.9 V

TABLE 2. Power/Output relationships

POWER AMPLIFIER SQUARE WAVE RESPONSE TESTING

Square waves are used in audio testing to display a wide range of frequencies simultaneously. Mathematically, a square wave can be considered as a fundamental frequency summed with a series of its odd harmonics, which serve to square off the waveshape. For an amplifier to reproduce a square wave, it must have a flat frequency response from 0.1 f to 10 f, where f represents the fundamental frequency of the square wave.

The traditionally-used frequencies are 50 Hz for the low frequency test and 10 kHz for the high frequency test.

Table 3 shows the typical square wave patterns and an interpretation of these shapes.

Waveform	LF Gain	LF Delay	HF Gain	HF Delay	Damping
	OK	OK	OK	OK	OK
	L	OK	H	OK	H
	H	OK	L	OK	H
	OK	H	OK	L	H
	OK	L	OK	H	H
	H	H	L	L	H
	H	L	L	H	H
	L	H	H	L	H
	OK	OK	H	OK	OK*
	OK	OK	H	OK	L
	OK	OK	H	OK	LL
	OK	OK	*	OK	L

* = Sharp cutoff or peaked
L = Low
LL = Very low
H = High
OK = Suitable, proper

TABLE 3. Typical square wave patterns and interpretation

PREAMPLIFIER TESTING

The basic circuit in Figure 8 (omitting the 4, 8, or 600 ohm resistors) can also be used for testing preamps. Before testing, adjust all tone controls for a flat response. The following are the tests for the various types of preamplifiers.

PHONO PREAMP.

Set the 2001 LO output (7) to 10 mV (unloaded) by setting its HI output (8) to 1 V (unloaded). Connect the preamp input to the (LO) output (7).

Figure 9 shows the RIAA equalization curve, along with the correct dB values at 23 different frequencies. Your actual measurements should fall within ± 2 dB of RIAA equalization.

Other equalization curves may similarly be matched.

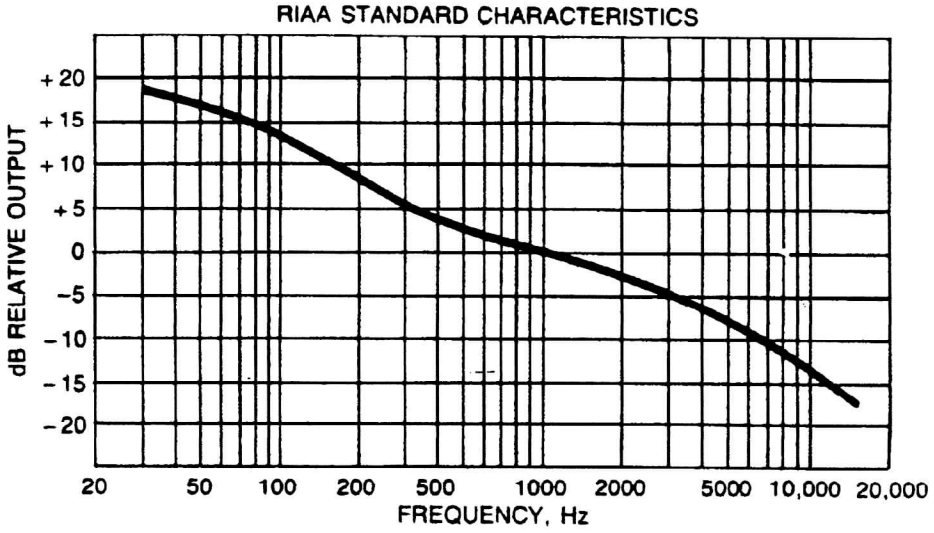


FIGURE 8. RIAA equalization curve

Standard RIAA Reproducing Characteristic			
Hz	dB	Hz	dB
30	+18.61	5,000	-8.23
50	+16.96	6,000	-9.62
70	+15.31	7,000	-10.85
100	+13.11	8,000	-11.91
200	+8.22	9,000	-12.88
300	+5.53	10,000	-13.75
400	+3.81	11,000	-14.55
700	+1.23	12,000	-15.28
1,000	0.00*	13,000	-15.95
2,000	-2.61	14,000	-16.64
3,000	-4.76	15,000	-17.17
4,000	-6.64		

* based on standard 1000 Hz tone.

TABLE 4. RIAA standard characteristics

MICROPHONE PREAMP.

Since microphone output levels are generally −70 dB (approximately 245 μV), extra care in connecting the input is recommended.

To set the 2001 for a −70 dB output, first set the HI output (8) to 0 dBm. Next, connect a 20 ohm resistor across the LO output (7). This will bring the LO output down to −70 dBm and provide a source impedance of 20 ohms.

Before making the frequency run, set all tone controls for a flat response.

FILTER FREQUENCY RESPONSE TESTING AND DISPLAY

Figure 10 shows an audio sweep circuit for testing filter characteristics.

The SWEEP input of the 2001 is driven by a triangle waveform. This waveform also drives the "X" axis of the oscilloscope.

Since a triangular waveform exhibits a linear change of voltage with time, the frequency of the 2001 will increase at a linear rate as the oscilloscope trace sweeps from left to right and back again. This allows calibration of the oscilloscope face in linear increments.

First set the sweep voltage to zero and adjust the scope so that it is at center screen. This allows the "X" axis to display both (+) and (−) sweep voltages.

Next, to set the 2001 to the middle of the sweep range press in the 10 K RANGE pushbutton (2), and set the FREQUENCY vernier (11) to 0.55. Adjust the sweep voltage to 9 $V_{p\text{-}p}$. This will sweep the frequency of the 2001 from 1 kHz to 10 kHz. Set the "X" axis gain of the oscilloscope to 1.0 V/cm.

The oscilloscope will then graphically display the bandpass characteristic of the filter.

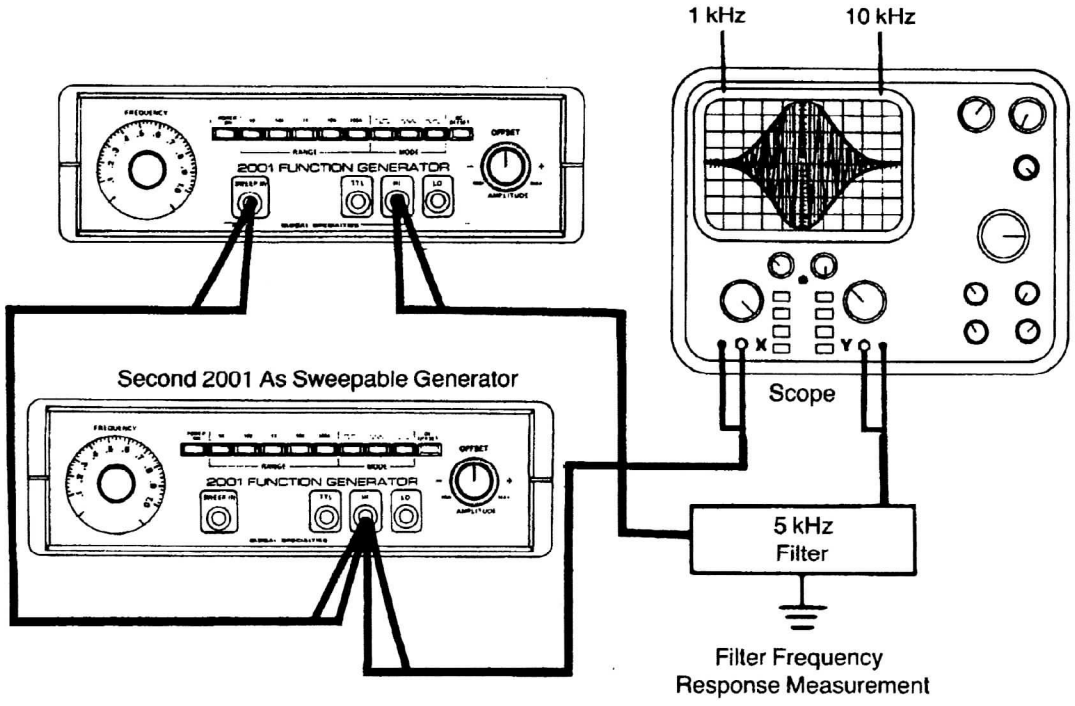


FIGURE 9. Audio sweep circuit

CIRCUIT DESCRIPTION

The heart of the 2001 is the waveform generator IC A3 (ICL8038). This IC produces all three waveforms. The RANGE switches (2) select tuning capacitors C-5 through C-9. These five capacitors set the decade frequency range from 1 Hz to 100 kHz. (See Figure 13).

FREQUENCY Vernier and SWEEP Input

The FREQUENCY vernier R12 provides continuous frequency adjustment within a preselected decade. High and low end frequencies are calibrated by trimmers R10 and R13. The voltage at R12 is buffered by A1-C, then fed to A1-A, where it is summed with the SWEEP input. This combined voltage is then fed to the VCO input pin A3.

Power Supply

The 2001 requires three regulated supplies. + 12 volts is created by a 12 V !C regulator (A4). A1-B and Q3 form a − 12 V tracking regulator, slaved to the regulated + 12 V output.

A +5 V regulator is formed by voltage driver R1, R2, A1-D and Q1. This regulator powers the TTL circuitry.

Square Wave

The square wave output of A3 drives Q2, which in turn drives A2, the TTL output buffer.

Main Amplifier and DC OFFSET

The selected output of A3 is first buffered by Q4 and Q5. It is then fed through the amplitude control to the main amplifier input. Q6 and Q7 are a differential input amplifier for the output drivers. This differential amplifier drives the complimentary push-pull output pair Q9/Q10 through Q8, a common emitter driver.

Feedback resistors R37 and R38 establish the overall voltage gain of the amplifier at $\frac{V_o}{V_i} = 10.1$.

The summing junction at the base of Q7 is also fed current from the DC OFFSET through R34 and R57. When the DC OFFSET (4) switch is off, the amplifier control is zeroed by potentiometer R30.

Outputs

Since the output impedance at the junction of R42 and R41 is very low, a series resistor matches the HI output to 600 ohms. This resistor also isolates the main amplifier and its feedback loop from the load.

An attenuator network, R45 and R46, provides a LO output level 40 dB below the HI output.

RECALIBRATION PROCEDURES

Case Disassembly and Assembly

To open the case, turn the unit upside down with the feet facing up. (See Figure 11) Remove the four rubber pads from the square feet. Remove the screws from the center recess of each of the four feet.

> **NOTE**
>
> The flip leg will automatically come free with the front feet.

Carefully separate the two halves of the case.

To close the case, lower the case bottom and guide the front and rear panels into their slots. Position the feet as illustrated and screw the two halves of the case together. Do not overtighten screws. Install the four rubber pads.

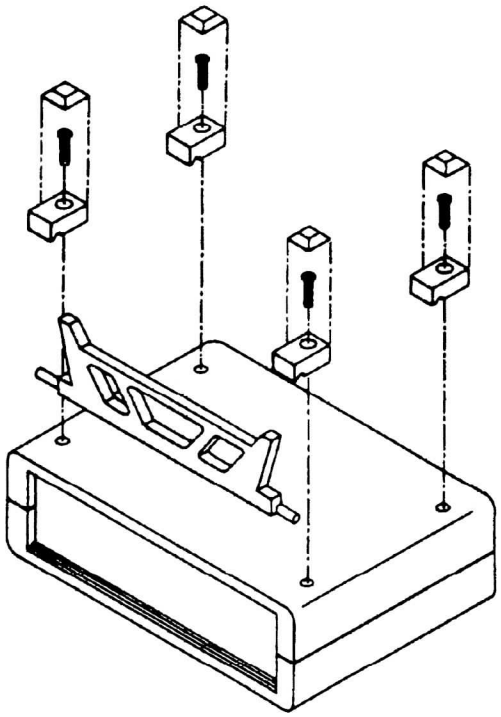


FIGURE 10. Case disassembly and assembly

Recalibration Procedure

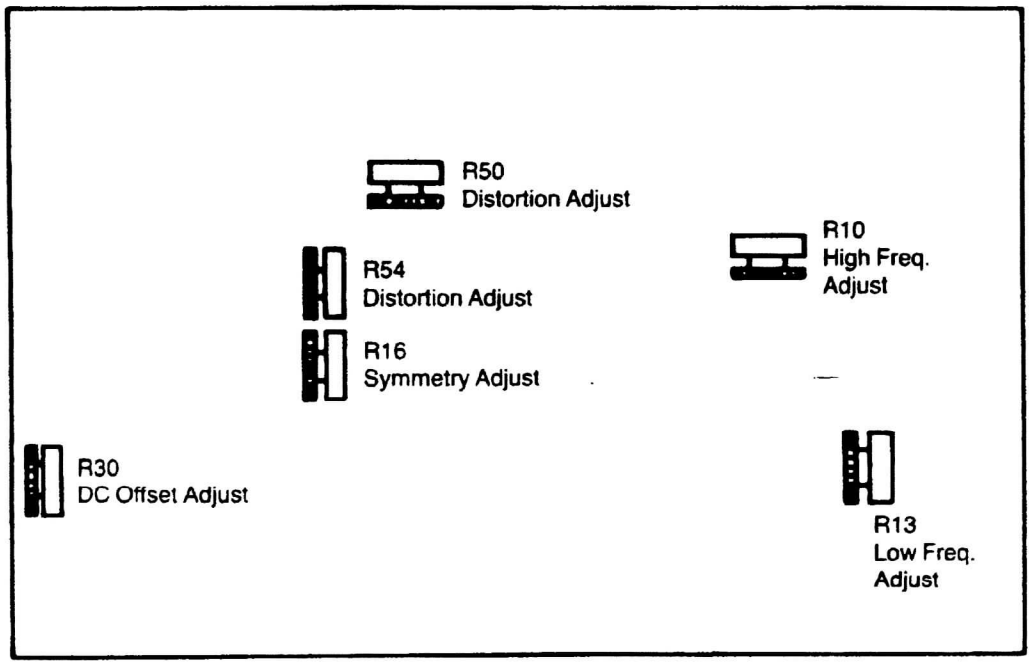
Before being shipped to you, your 2001 Sweepable Function Generator went through a very thorough series of tests and calibration. If recalibration becomes necessary, follow the instructions outlined below carefully. Do not attempt to recalibrate this unit unless you have experience in the use of the equipment listed in Table 5. See warranty (back cover) for limits of liability.

(1) Oscilloscope	e.g. Hewlett – Packard Model 1725A or equivalent
(1) Frequency Counter	e.g. Global Specialties MAX-100
(1) Distortion Analyzer	e.g. Hewlett-Packard 333A or equivalent

TABLE 5. Equipment needed for recalibration

During this recalibration procedure, refer to Figure 1, control locations, and Figure 12 for the trimpot locations.

FIGURE 11. Trimpot locations



WARNING

Touching the fuse or the transformer while the line cord is plugged in could be lethal, since the full line voltage is present. Be especially careful when adjusting the distortion trimpot, which is very close to the fuse holder. Even though the power button may be off, potentially lethal voltages are still present.

1. Remove the 2001 case as outlined above.
2. Place the 2001 on a soft insulated surface to protect both you and the 2001. Plug the line cord into a convenient wall outlet.
3. Checking amplitude

Set up the 2001 as follows:

CONTROL	SETTING
POWER (1)	On (in)
MODE (3)	Square Wave
RANGE (2)	1 kHz
FREQUENCY vernier (11)	1.0
AMPLITUDE (6)	Maximum
DC OFFSET (4)	Off (out)

Then set the oscilloscope as follows:

Amplitude	5 V/div
Sweep	100 µs/div
Coupling	AC

Attach the oscilloscope input to the HI output (8) of the 2001. The amplitude of the square wave should be a minimum of 10 volts peak-to-peak.

4. Adjust DC Offset Set up the 2001 as follows:

CONTROL	SETTING
POWER (1)	On (in)
MODE (3)	Square wave
RANGE (2)	1 kHz
FREQUENCY vernier (11)	0.5
AMPLITUDE (6)	Minimum
DC OFFSET (4)	Off (out)

Then set the oscilloscope as follows:

GND	Center Scale
Amplitude	2 V/div
Coupling	DC

Adjust trimpot R30 until the scope trace is zeroed at center scale.

5. Symmetry Adjust Set up the 2001 as follows:

CONTROL	SETTING
POWER (1)	On (in)
MODE (3)	Square Wave
RANGE (2)	1 kHz
FREQUENCY vernier (11)	0.5
AMPLITUDE (6)	Maximum
DC OFFSET (4)	Off (out)

Then set the oscilloscope as follows:

Amplitude	2 V/div
Coupling	AC
Sweep	100 μS/div.

Adjust trimpot R16 and Frequency vernier together to view one cycle on the oscilloscope.

NOTE

This step is very important since the sine wave distortion is dependent upon the symmetry of the square wave.

6. Adjusting the Frequency

Disconnect the oscilloscope and attach the MAX-100 Frequency Counter or equivalent to the HI output (8). Set up the 2001 as follows:

CONTROL	SETTING
POWER (1)	On (in)
MODE (3)	Square Wave
RANGE (2)	10 kHz
FREQUENCY vernier (11)	1.0
AMPLITUDE (6)	Maximum
DC OFFSET (4)	Off (out)

Adjust R10 for exactly 10,000 Hz.

7. Set up the 2001 as follows:

CONTROL	SETTING
POWER (1)	On (in)
MODE (3)	Square Wave
RANGE (2)	10 kHz
FREQUENCY vernier (11)	0.1
AMPLITUDE (6)	Maximum
DC OFFSET (4)	Off (out)

Adjust R13 for 1,000 Hz.

8. Repeat steps 6 and 7 until the frequency measures 1,000 Hz with the FREQUENCY vernier set at 0.1 and 10,000 Hz with the FREQUENCY vernier set at 1.0. The frequency should be calibrated to within ±5% of the full range setting. This means the frequency could vary between 500 Hz and 1500 Hz for the 1000 Hz setting or between 9500 Hz and 10,500 Hz for the 10,000 Hz setting, and still be within specifications. Similarly, check the endpoint frequencies on all ranges to be sure they are within ±5% of the full range setting.

9. Checking distortion Connect the 2001 HI output (8) to the input of the distortion analyzer. Set the 2001 as follows:

CONTROL	SETTING
POWER (1)	On (in)
MODE (3)	Sine wave
RANGE (2)	1 kHz
FREQUENCY vernier (11)	1.0
AMPLITUDE (6)	Maximum
DC OFFSET (4)	Off (out)

Adjust R50 and R54 for minimum distortion level. Distortion should be less than 3% over the full range. If greater, go back to step 5 and recheck and readjust the symmetry, which affects the distortion considerably. Should this be necessary, repeat the succeeding steps as well.

If you have difficulty recalibrating your 2001, refer to the Warranty and Customer Service section of this manual.

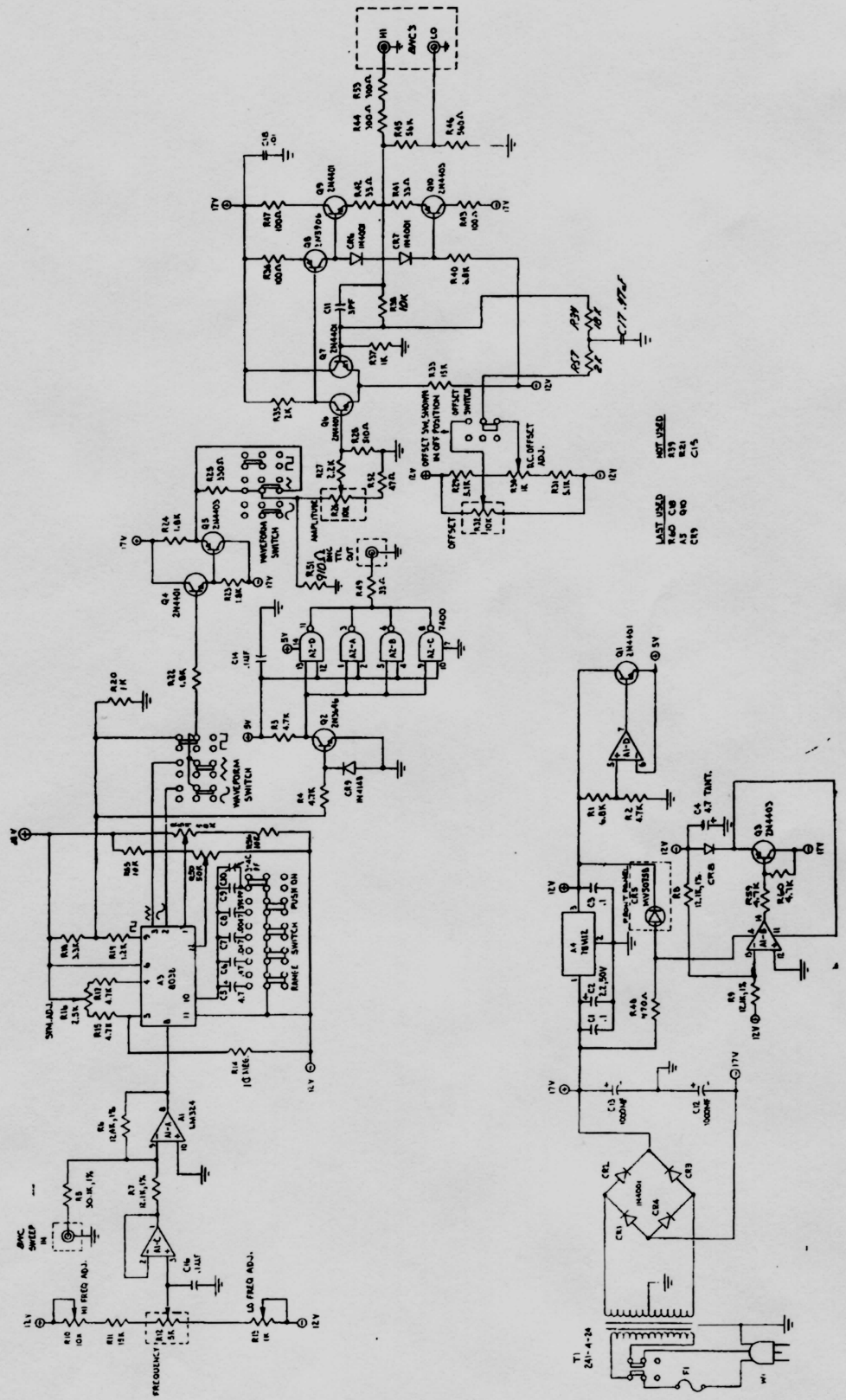


FIGURE 12. 2001 function generator schematic

SERVICE AND WARRANTY INFORMATION

FACTORY SERVICE AND REPAIR

Global Specialties will service and repair this instrument free of charge for a period of one full year; subject to the warranty conditions below.

To obtain a return merchandise authorization (RMA) required for all returns, phone our Customer Service Department for an RMA and all shipping instructions. Tel. 800-572-1028 or write:

GLOBAL SPECIALTIES
70 FULTON TERRACE, P.O. BOX 1942
NEW HAVEN, CONNECTICUT 06512
ATTN: CUSTOMER SERVICE DEPT.
1-800-572-1028

CANADIAN AUTHORIZED SERVICE CENTER

BCS ELECTRONICS, LTD.
980 ALNESS ST.
DOWNSVIEW, ONTARIO M3J 2S2
(416) 661-5585

WARRANTY

Global Specialties warrants this device to be free from defective material or workmanship for a period of one full year from date of original purchase.

Global Specialties under this warranty is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within one full year from date of original purchase.

Units returned to Global Specialties that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Global Specialties, or that have been repaired by unauthorized persons will not be covered by this warranty.

Global Specialties reserves the right to discontinue models, change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Global Specialties is authorized to assume any other obligation in connection with the sale and purchase of this device.

BREADBOARDING SOCKETS LIFETIME GUARANTEE

All Global breadboarding sockets are guaranteed for life. If a socket ever fails to meet your requirements, return it and we will replace it, NO QUESTIONS ASKED.

Specifications subject to change without notice.