

Table 1—Vibrational Analysis of the Observed Bands of 2, 5-Dibromoaniline Vapour

Wavenumber (cm ⁻¹)	Separation from (0, 0) band	Assignment	Mode of vibration
33022 (w)	724		
33746 (vvs)	(0, 0)	(0, 0)	
33974 (s)	228	0+228	v-v Transition
34016 (s)	270	0+270	C-Br i.p. bending
34064 (ms)	318	0+318	C-Br i.p. bending
34145 (ms)	399	0+399	C-C-C o.p. ring def.
34202 (s)	456	0+456	C-C-C i.p. ring def.
34393 (ms)	647	0+647	C-Br stretching
34476 (s)	730	0+270+456	
34538 (ms)	792	0+792	C-H o.p. bending
34580 (ms)	834	0+834	C-C ring breathing
34745 (w)	999	0+2×270+456	
34783 (w)	1037	0+2×318+399	
34809 (ms)	1063	0+1063	N-H twisting
35018 (w)	1272	0+1272	C-N stretching
35051 (w)	1305	0+318+456+647	
35183 (vw)	1437	0+270+318+834	
35210 (vw)	1464	0+399+1063	
35236 (w)	1490	0+647+834	
35460 (vw)	1714	0+647+1063	

The corresponding intensity is given in the parentheses: vvs = very very strong; vs = very strong; s = strong; ms = medium strong; w = weak; vw = very weak. Also, i. p. = in-plane; o.p. = out-of-plane and def. = deformation.

ed though 9 excited state frequencies, viz. 280, 318, 393, 456, 647, 792, 831, 1063, and 1272 cm⁻¹, have been identified and assigned to different modes. The observed bands along with their proposed assignments are given in Table 1. The assignments of the bands are made with the help of infrared data of the 2, 5-isomer⁵ and of UV spectra of bromoanilines, aniline and dibromobenzenes^{6,7}.

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Frequency-independent Constant Amplitude Ramp Generation Employing a Controlled Current Source

The design principles as well as the performance details of a closed loop circuit that generates constant amplitude ramp voltage independent of the frequency of the input square wave, have been discussed. The circuit developed essentially employs a controlled single transistor current source charging a capacitor; the controlling action is effected by the use of the period information of the square wave within the feedback loop.

IN A VOLTAGE controlled phase shifter^{1,2} for square waves, to introduce necessary phase shift as a function of voltage, independent of frequency, it is essential to generate a constant amplitude ramp voltage independent of frequency. In order to have constant amplitude, the rate of increase of the ramp in one period of the square wave has to vary as a function of the frequency, such that the peak value, say V_p volts, is always reached in one period. In this note, a feedback circuit for the purpose, comprising a current source charging a capacitor and controlled by the period information of the square wave, has been described. This technique is not complicated and does not use any bistable circuit³ that will hover between conduction and cutoff while correcting the slope of the ramp, and also does not employ a separate clock in a D/A converter⁴. It employs a single transistor current source instead of an operational amplifier⁵.

Circuit configuration and theory—The circuit developed is shown in Fig. 1. The transistor Q_1 (2N995) works as the current source. R_1 is a variable resistor (10 k Ω) and the capacitor C_1 (2000 pF) is charged by the current source. The capacitor C_1 is periodically and momentarily shorted by the transistor switch Q_2 (CIL 701), by the application of positive-going pulses to its base. These pulses are derived by differentiating the square wave. The voltage across the capacitor C_1 is taken via an emitter follower Q_3 (CIL 522) and rectified by the combination D_1 (CD 21), C_2 (25 μ F) and R_4 (10 k Ω) to give the peak voltage V_p of the ramp $V(t)$. The peak voltage V_p is fed to the non-inverting input of the difference amplifier A and the reference voltage V_r derived from V_p with the use of a potentiometer

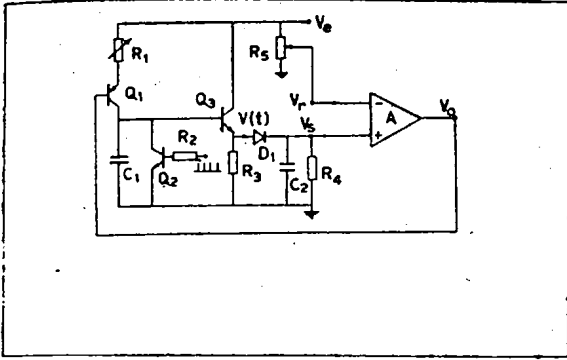


Fig. 1—Circuit diagram of the constant amplitude ramp voltage generator

R_5 (10 k Ω) to the inverting input. The output V_o of the amplifier is fed back to the base of the transistor Q_1 to control the current.

$$\text{Let } V_r = K_1 V_e \quad \dots(1)$$

where K_1 is the constant of proportionality, its value always being less than 1. Let the gain of the amplifier be A .

Then

$$(V_p - K_1 V_o) A = V_o \quad \dots(2)$$

The current I in the current source is proportional to $(V_e - V_o)$ as:

$$I = K_2 (V_e - V_o) \quad \dots(3)$$

where K_2 is another constant of proportionality for a given current source, having the dimensions of conductance. Normally K_2 is the inverse of the emitter resistance of the current source.

Also, the peak voltage V_p reached by the ramp after one period T of the square wave, in this case is given by:-

$$V_p = \frac{K_2 (V_e - V_o) T}{C_1} \quad \dots(4)$$

Substituting for V_o from Eq. (2)

$$V_p = K_2 T [V_e - A (V_p - K_1 V_e)] \quad \dots(5)$$

when $K_2 T A \gg C_1$

$$\frac{V_p}{V_e} \approx \left(\frac{1}{A} + K_1 \right) \quad \dots(6)$$

and also, since $A \gg 1$,

$$\frac{V_p}{V_e} \approx K_1 \quad \dots(7)$$

and from Eq. (1),

$$V_p \approx V_r \quad \dots(8)$$

Thus, once V_r is set, the peak value V_p of the ramp is also set, and automatically the feedback action changes the rate of charging of the capacitor to keep V_p equal to V_r whenever the frequency of the square wave changes.

Results and discussion—Fig. 2 shows the ramp waveforms generated without feed back and with feedback. When the current source is not controlled, the voltage $V(t)$ across the capacitor increases linearly with time as shown in Fig. 2(a). The peak-voltages V_{p1} , V_{p2} and V_{p3} for square waves of three different periods, viz. T_1 , T_2 and T_3 are respectively indicated. The slope in all the three cases remains the same. However, when the current source is controlled through feedback, the voltage waveforms will be as shown in Fig. 2(b). In this case, the slopes of the ramp waveforms, for the same square waves are different but their peak values remain the same.

In Fig. 1, the value of R_1 is set to about 5 k Ω and a certain constant potential is applied to the base of the transistor Q_1 , without the feedback. The values of the peak voltages V_p for different periods of the input square waves have been read. These are plotted and shown in Fig. 3. As can be seen from the figure, V_p linearly increases with the period. Now, the constant potential applied to the base of Q_1 is removed and the voltage output V_o of the amplifier is fed back. The value of V_r is set to 4 V. The experiment is repeated. No sensible change in the value of V_p has occurred for different periods as shown by the dotted line in Fig. 3. It is also found on an oscilloscope that the slope of the ramp changes with the period, to keep V_p constant. Under the locked condition, it has been found that only V_r can change the value of V_p and not the variation in R_1 .

The circuit fabricated has been tested for frequencies ranging from 5 to 15 kHz, and the peak voltage of the ramp generated in each case has been found to be constant equal to that of the reference set point voltage. It may be necessary to select, through a rotary switch, appropriate values of the components for using the circuit for a wide frequency

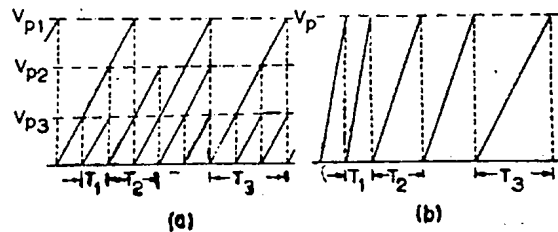


Fig. 2—Ramp waveform generated: (a), without feedback; and (b), with feedback

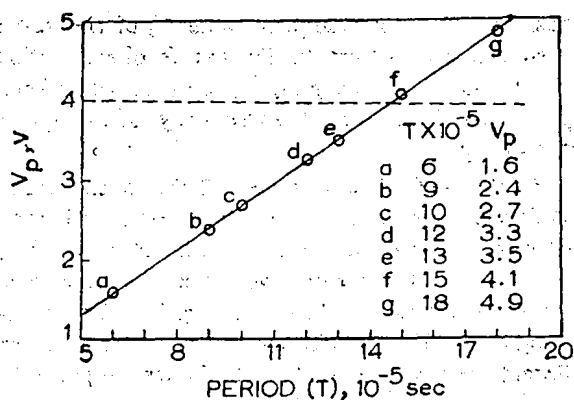


Fig. 3—Performance curve of the circuit

range. The circuit works independent of the marks-space ratio of the input square wave.

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Study of Grain-size Distribution-Parameters in Ilford G-5 Emulsions

A comparative study of size distribution of AgBr grains in unprocessed and Ag grains in processed Ilford G-5 emulsion is made, and the distribution parameters are evaluated. The statistical analysis shows a highly skewed and leptokurtic distribution of grains of silver along the tracks of minimum ionization π^- beam particles (momentum = 4 GeV/c). The peakiness and skewness are also explained.

ON THE BASIS of the work of various workers¹⁻⁴ it can be concluded that the sizes of microcrystals of AgBr in G-5 emulsions have approximately Gaussian distribution.

When a relativistic π^- -beam particle traverses the AgBr grain of emulsion, the magnitude of energy loss per grain at such high momentum is very small and so we assume that the secondary-ionization is negligible. As the AgBr grains in emulsion are randomly distributed, the grains after processing also become randomly distributed along the path of a charged particle. Their sizes also develop proportionately.

To confirm the size-distribution of developed grains along the tracks of π^- -beam ($p = 4$ GeV/c), we have made measurements of grain sizes on a Cooke microscope using 9 × 5 objective and 15 × eyepiece attached to goniometer. The goniometer carries a vernier scale attached with a small drum with 100 divisions on its circular scale. Each division of circular scale is equivalent to 0.0625 μ m. Several thousands of grains along the tracks of π^- -beam were examined and the size of each individual grain/grain-group was measured along 2 or 3 directions. From this data the mean size was calculated in each case, most of the grains were observed to be circular and as a single entity to our best judgement. The details of the size distribution are shown in Table 1 and Fig. 1.

From Tables 1 and 2 we can draw the following conclusions :

Table 1—Values of different statistical parameters of size-distribution of the AgBr grains

Parameter	Calculated value		Inference
	(a)	(b)	
1. Mean size (\bar{X}) (μ m)	0.31	0.566	For standard normal distribution $\bar{X} = \hat{X} = \tilde{X}$ and $a_3 = 0, a_4 = 3$.
2. Mode value (\hat{X}) (μ m)	0.315	0.517	The distribution (a) can therefore, be regarded as normal distribution but the distribution (b) is leptokurtic and highly skewed towards right.
3. Median (\tilde{X}) (μ m)	0.31	0.5387	
4. Standard deviation (σ) (μ m)	0.0561	0.1873	
5. Moment coeff. of skewness (a_3)	0.1361	1.575	
6. Moment Coeff. of kurtosis, a_4	4.26	7.56	

(a), values are for unprocessed emulsion grains [calculations made on the basis of data of Pick-up⁴ given in Fig. 2]; (b), for processed emulsion grain [calculations made on the basis of present work (see Fig. 1)]