COMMITTEE T1
CONTRIBUTION

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| STANDARDS PROJECT: | Analog Interface Performance Specifications for Digital Video Teleconferencing/Video Telephony Service |
| TITLE: | VTC Hypothetical Reference Circuit Bandwidth Measurements |
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| SOURCE: | National Telecommunications and Information Administration<br>Institute for Telecommunication Sciences<br>(Coleen Jones) |
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## 1. Introduction

The bandwidth (as measured using traditional analog test waveforms) was mentioned in a recent meeting of the Objective Test Ad Hoc Group as a candidate objective video quality measurement. Inclusion of this traditional bandwidth measurement in the data analysis will provide a useful baseline against which the other proposed objective measurements can be compared. Therefore, the Institute for Telecommunication Sciences has measured the bandwidth of the twenty five hypothetical reference circuits (HRCs). This contribution discusses the method of measurement used to obtain the bandwidth values and reports the bandwidth found for each of the twenty five HRCs.

## 2. Method of Measurement

The bandwidth was measured using the static zone plate objective waveform submitted by Tektronix. The zone plate was edited on the master tape, and was therefore processed by all twenty five HRCs. The first active video line that was passed by the HRC was used for the bandwidth measurement because this line contains a swept frequency from DC to 4.5 MHz. This video line was selected using a video line selector as seen in Figure 1.

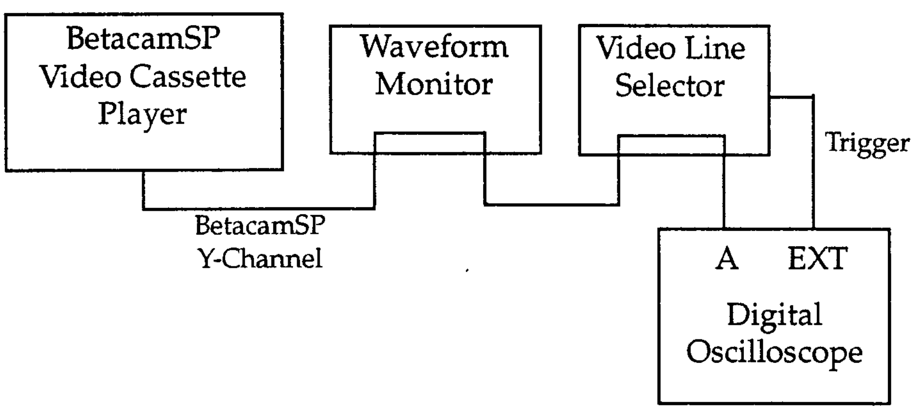


Figure 1 Laboratory test configuration.

The peak voltage ($V_p$) was measured as the DC voltage at the center of the top line of the zone plate on HRC 1. Because the oscilloscope referenced the sync pulse (-286 mV) as 0V, all voltage measurement were taken with the measured amplitude of the sync pulse subtracted off. This references the voltages to the video blanking voltage, $V_b$, (back porch). $V_b$ varied from HRC to HRC, so it was measured for each HRC and subtracted from voltage measurements accordingly. Thus, for HRC 1, $V_p = 807\ mV - 266\ mV = 541$

$mV$ ($V_b = 266\ mV$). The half-power (-3 dB) voltage, $V_h$, (referenced to $V_b$) is

$$V_h = \frac{541mV}{\sqrt{2}} = 382mV \qquad (1)$$

The frequency at which the measured voltage equals $V_h + V_b$ is defined as the bandwidth of the HRC. The frequency is calculated by inverting the time between two consecutive voltage peaks.

The oscilloscope was set as follows:

200 ns/div ~ 256 MHz (512 samples over 10 divisions)
200 mV/div
DC coupling
Ext Trigger
Trigger Delay - variable

The trigger delay was adjusted until the segment of the video line which contained the voltage level $V_h + V_b$ was acquired.

## 3. Results

The data shown in Table 1 are the bandwidth of each HRC. The footnote for HRC 15 gives a second measured bandwidth. Even though the zone plate is static, this codec output was dynamic. At times it exhibited the larger bandwidth given in the footnote. At other times, it exhibited the lower bandwidth given in the Table 1. The lower bandwidth was reported in the table because it is a minimum performance level.

**Table 1: HRC Bandwidth**

| HRC | Bandwidth (MHz) |
|---|---|
| 1[1] | 4.57 |
| 2 | 2.75 |
| 3 | 4.46 |
| 4 | 1.63 |
| 5 | 1.66 |
| 6 | 2.39 |
| 7 | 2.09 |
| 8 | 2.1 |
| 9 | 3.29 |

**Table 1: HRC Bandwidth (Continued)**

| HRC | Bandwidth (MHz) |
|---|---|
| 10 | 3.18 |
| 11[2] | 1.67 |
| 12[2] | 1.36 |
| 13 | 1.33 |
| 14 | 1.73 |
| 15[3] | 2.30 |
| 16 | 3.17 |
| 17 | 2.46 |
| 18[2] | 2.89 |
| 19 | 1.76 |
| 20 | 3.26 |
| 21 | 3.18 |
| 22 | 3.31 |
| 23 | 3.06 |
| 24[2] | 3.09 |
| 25 | 3.00 |

1. This bandwidth is less than the actual -3 dB bandwidth. This was the highest frequency contained in the zone plate and occurred at the end of the video line.

2. This bandwidth is less than the actual -3 dB bandwidth. Higher frequencies contained in the zone plate were rapidly attenuated by the HRC.

3. This is the minimum bandwidth measured for this HRC. The maximum bandwidth measured was 2.84 MHz.