

# TEPAC PUBLICATION

TEP105-14

## Measurement of Phosphor Persistence of CRT Screens

### TEP105-14

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## MEASUREMENT OF PHOSPHOR PERSISTENCE OF CRT SCREENS

This publication was formulated under the cognizance of the JT-31 Committee on Optical Characteristics of Display Devices and approved by the Tube Engineering Panel Advisory Council (TEPAC).

The TEP105 series of publications comprises a set of test methods developed for industrial cathode ray tubes. They are intended to be useful in evaluating cathode ray tubes with respect to parameters, which are of interest to users of these devices.

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## MEASUREMENT OF PHOSPHOR PERSISTENCE OF CRT SCREENS

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MEASUREMENT OF PHOSPHOR PERSISTENCE OF CRT SCREENSI. Scope

This specification will outline test methods suitable for measuring persistence of CRT screens. This data will be used primarily for registration of phosphors in the WTDS system. This data may also be used as a general guideline to the suitability of a phosphor to a particular application. Since the relationship between measured persistence and perceived flicker is very poorly understood, published persistence data alone will not be sufficient to determine if a phosphor meets ergonomic criteria. Normally, the only way to determine the suitability of a phosphor is by direct experiment under identical conditions the end user will encounter.

II. Equipment

The basic equipment problem related to the measurement of persistence is insuring the frequency response of all equipment used is high enough. Normally, 10 MHZ response is fast enough to test all phosphors that will be used for human viewing. Specialized applications, such as flying spot scanner phosphors, may require even higher frequency response. Figure I is a diagram of the various pieces of equipment necessary to measure persistence of phosphors.

1. HV Supply, Focus Supply, Scanner and Yoke

This equipment should be suitable to drive the tube under test. No special frequency response requirements are imposed on this equipment. The scanner and yoke are not required for the pulsed spot method, although they make it easier to set the proper pulse conditions.

2. Pulse Generator

The pulsed spot persistence method (see Section IV) is the most demanding of the pulse generator. To use this method, the pulse generator must be able to pulse the tube on with rise and fall times of 50 nS and pulse widths of .1 - 1  $\mu$ S. In order to pulse the tube properly, the generator must normally produce 50V pulses into the CRT load.

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## II. Equipment (cont'd.)

### 3. Photodetector and Amplifier

Traditionally, photomultipliers with S-20 type response have been used as a photodetector. Recent experiments with silicon photodiodes have shown the high speed devices are fully satisfactory and, in some aspects, superior to PMT's. In any event, the photodetector must be eye-corrected so it matches the CIE  $\bar{Y}$  curve. Serious and unrecognized errors have resulted in the past when non eye-corrected photodetectors have been used to measure persistence. Normally, fast phosphors that require the full 10 MHz of detector frequency response have relatively high peak light output, and photodetector sensitivity is not a serious problem. If a photomultiplier is used, a relatively small load resistor, often as little as 100 ohms, will convert the photocurrent into a usable voltage. Slow phosphors, on the otherhand, normally have a low peak light output and PMT sensitivity is increased by increasing the load resistance. The person measuring persistence must insure that the speed of the photodetector is at all times at least 10 times faster than the decay of the phosphor to be measured.

If an external amplifier is used, as is frequently the case with a solid state photodetector, this unit must also have at least a 10 MHz bandwidth. Since a silicon photocell in the photo voltaic mode is non-linear unless it operates into very low load resistance, the amplifier must be a current to voltage converter, rather than a simple voltage amplifier. This problem can be overcome by using the photocell in the photo conductive mode with a reverse bias, typically 20-100V. Then a load resistor may be used, in the same way a load resistor is used on a PMT.

Another approach to the photodetector speed problem is to purchase an integrated/photodetector amplifier combination where the manufacturer has built in the required speed and sensitivity.

### 4. Data Display and Recording

A convenient way to display and record persistence curves is on a high speed digital oscilloscope, waveform recorder or oscilloscope plug-in to a personal computer. A system must have a digitization

