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Application Bulletin

CONSIDERATIONS IN ERASING UV—ERASABLE PROMS

Bits may begin to erase when chips are exposed to wavelengths less than 400nm, but erasure proceeds more rapidly as the energy of the photons increases at shorter wavelengths. It is possible to erase EPROMS by exposure to sunlight or fluorescent fixtures, but the time required is on the order of days. The wavelength of ultraviolet used for erasure in conveniently short times is 253.7nm, provided by low pressure mercury lamps such as those found in Memorase® EPROM erasers.

ERASURE METHODS

The energy required to erase EPROMS varies by manufacturer and may even vary from lot to lot in chips from a given maker. Most manufacturers specify an integrated dose of 15 watt-seconds per square centimeter, but some chips do not require this much energy for complete erasure.

The most intense emitters are C-25, C-50, C-600, and C-91, all of which provide 15mW/cm² at the chip surface. For applications where fewer chips are to be erased or where speed of erasure is less critical, the C-25, C-50 or DE-4 erasers are more appropriate.

ON-BOARD ERASURE

It is sometimes desirable to erase chips while still C-600 in place on printed circuit boards, either to adhere to mil specs or for convenience. This can be done with the use of the C-600, with drawer dimensions of 27.5″ by 20″ or with the C-91, with drawer dimensions of 9″ by 8.75″. In both units the depth of the drawer is one inch. Typical operating temperatures of 63 degrees centigrade inside the units are not warm enough to damage components.

FACTORS WHICH MAY AFFECT ERASE TIMES

A number of variables can influence erasure time. Lamp intensity decreases with age, and time necessary to erase all bits increases with repeated erasures. Chips which are in far corners of the C-25, C-50 and DE-4 may erase more slowly than those directly under the tube due to the greater distance from the lamp. Dirt and grease on the EPROM quartz window and on the lamp can lengthen erase times but can be removed with alcohol and a lint-free cloth.

MONITORING THE EFFECTIVENESS OF EPROM ERASING ULTRAVIOLET LIGHTS

If a radiometer is used to monitor the effectiveness of EPROM erasers as the tube ages, a radiometer must be used which is line calibrated to the 253.7nm line of mercury lamps and a radiometer with excellent cosine response is necessary. Narrow bandpass radiometers have poor cosine response which results in a measurement that may understate the amount of energy present by up to 80% when used close to an extended source.

The excellent cosine response and line calibration of UVX radiometers with line calibrated UVX-25 sensors renders them an excellent choice for monitoring the aging of EPROM erasing lamps. Instructions for this procedure can be found on the reverse of this page.

MANUFACTURERS' RECOMMENDED ERASE ENERGIES

Erase energies required for most EPROMS do not exceed 15 w-sec/cm², and some chips may be erased by as little as 6 w-sec/cm² of short wave UV. The following manufacturers make chips which require 15 w-sec/cm² for complete erasure: Fairchild, Harris, Hitachi, Intel, Mostek, National Semiconductor, and Texas Instruments. American Micro Devices EPROMS require six or ten w-sec/cm², depending on the part, and all current Intersil EPROMS require ten w-sec/cm². Fujitsu parts require 15 w-sec/cm² for the most part, but some older parts require only six w-sec/cm² or 15 w-sec/cm², RCA recommends 25 to 30 minutes in Ultra-Violet Products, Inc. Model C-25 or C-50 for complete erasure.

Figure 1: Time required for various integrated UV doses*

	15 w-sec/cm²	12.5 w-sec/cm²	6 w-sec/cm²	
C-91, C-600	16.7 minutes	13.9 minutes	11.2 minutes	6.7 minutes
C-25, C-50	33.4 minutes	27.8 minutes	22.3 minutes	13.4 minutes
DE-4	50.0 minutes	41.7 minutes	33.4 minutes	20.0 minutes

*Times based on 15,000 μw/cm² for C-90, C-91, S-52T, 7500 μw/cm² for UVS-54T, 5000 μw/cm² for UVS-11E

PERFORMANCE VALUE IS ASSURED WHEN YOU CHECK YOUR MEMORASE® PERIODICALLY —

Do it with the UVX Radiometer - Here's how:

For maximum efficiency in large-scale EPROM erasing, it is necessary to monitor lamp intensity over time. The lamp aging curve given in the C-600 and C-91 instruction booklets is representative of grid lamps used in these devices, but specific information on a given unit can only be obtained by measurement. Use of the intensity data obtained will enable the user to calculate suitable erase times, plus a safety factor, without over-erasing or under-erasing.

Variations of ± 2 to ± 3 percent can be expected in the readings if the sensor is located directly under a loop or is located between loops in the grip lamp. To account for these differences, take an average of a number of readings under each grid lamp.

The number which a radiometer actually indicates will be a function of the spectral response of the radiometer, coupled with the spectral output of the emitter, and taking into account the radiometer spatial response. The UVX-25 is designed and calibrated to measure 254nm radiation from low pressure mercury acr lamps such as the lamps used in the C-600 and C-91 Memorase® EPROM Erasing Systems. Therefore, there are no complexities in the measurement that involve the spectral characteristics of either the lamp or the radiometer.

MEASUREMENT TECHNIQUE

1) Plug the EPROM Erasing System to be tested into a wall outlet.
2) Turn on the unit by closing the tray and setting up the timer (if so equipped) to some value greater than 10 minutes.
3) Allow 10 minutes for the lamps to warm up.
4) Plug the UVX-25 Sensor into the radiometer. (Note: the connector goes through two 'snap' positions before it is fully engaged)
5) Turn the radiometer on.
6) Set the range switch to 20 mW/cm².
7) Zero the meter if necessary. (see the UVX Radiometer Manual)
8) Open the tray and place the UVX-25 Sensor face up on the tray at the point to be measured (a little masking tape on the sensor cable will hold the sensor in place)
9) Close the tray until the unit comes on.
10) After the erasing unit comes on, wait one or two minutes for the reading to stabilize.
11) To get absolute values at the sensor surface, the readings should be multiplied by 1.17. To get the absolute values at the surface of the EPROM, the readings should be multiplied by 1.15. The reason for multiplication factors is noted below.

WHY THE CORRECTION FACTOR?

The term spatial response is used to describe how completely a sensor measures energy incident upon it from all directions. The irradiance from a small light source onto a point on a sensor surface depends on the angle between the light source and the plane of the surface. If the light source is kept at a constant distance from the center of the sensor surface, the irradiance is greatest when the source is perpendicularly above the sensor irradiated, and decreases as the angle with the perpendicularly is increased (refer to the UVX Radiometer Manual "Application Techniques" section).

A perfect sensor irradiated by a small light source moving in a semi-circle around the sensor would yield readings proportional to the cosine of the angle of incidence of the normal. This is why the term cosine response is frequently used to describe the spatial response of the sensor.

The spatial response of the radiometer becomes extremely important when measuring the ultraviolet intensity at the surface near to an extended emitter such as the grid lamps used in EPROM Erasing Systems. That is, most all sensors will give accurate measurement for point sources or for sources that are small in comparison with distance, as long as the sensor is oriented correctly.

All sensors will give low irradiance measurement when used to measure extended sources at relatively small distances, and the error will be greatest for sensors deviating the most from a perfect cosine response. Radiometers with narrow bandpass interference filters may have acceptance angles as small as 15 to 20 degrees. Due to the factors outlined above, these instruments will greatly understate the amount of energy present and therefore are not suitable in this application.

When measuring the C-600 and C-91 grid lamp intensities as described above, the UVX-25 will read about 17% low. This is because there remains a small amount of irradiance that escapes being detected when the sensor is only ½" away from the lamps, due to its spatial response. Under these operating conditions, we therefore recommend multiplying the displayed reading by 1.17 in order to obtain actual irradiance on the sensor surface. Other sensors which have cosine responses further away from the ideal cosine response will be correspondingly low, and some instruments with poor cosine response may understate irradiance by as much as 75%.

If the irradiance on the surface of the EPROM is needed, then the sensor reading should be multiplied by 1.15, a slightly lower multiplication factor due to the different geometric view factors between the location of the sensor surface and the EPROM surface. Using the 1.15 factor allows an immediate check on the performance specifications of the EPROM Erasing System which state that the irradiance on the EPROM shall be 15,000 microwatts per square centimeter.