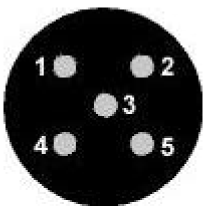
Using the Vivitar 283's light sensor socket

When the light sensor module on a Vivitar 283 is removed, a 5-hole socket is revealed as shown in Figure 1. Connections can be made directly to this socket to a) discharge the flash unit and b) control the flash duration. These connections will be described below. In order to simplify the discussion, the 5 holes will be referred to by number as shown in the diagram below.



a) Discharging the flash unit

Holes 1 and 3 of the socket are the positive and negative terminals respectively of the flash unit's trigger circuit. Shorting from one hole to the other with a wire will discharge the flash unit. The output of a sound trigger or photogate could be connected to the flash unit this way as an alternative to using a PC cord.

b) Controlling the flash duration

Holes 2 and 5 are the connections to the auto-exposure circuit. Normally, the photocell of the sensor module would bridge these holes. The photocell provides the equivalent of a variable resistor whose resistance decreases as the light intensity on the cell increases. The lower the resistance, the shorter the flash duration will be. Thus, if the photocell is replaced with a wire-wound variable resistor, the same function can be obtained with the turn of the resistor dial. By turning down the resistance, the flash duration will be shorter.

In many cases for high-speed photography, the minimum possible duration is desired. This is achieved simply by shorting across holes 2 and 5. In cases where the motion to be photographed is not particularly fast and greater light intensity is desired, the resistance can be increased in order to achieve that intensity. One example is in photographing splashes of liquid drops, a relatively low-speed phenomenon compared to, say, bullets and balloon bursts. Since the subject is quite small, one has to work at close range with a macro lens in order to achieve good photographic results. Depth-of-field is problematic at these close distances, and small lens apertures are needed. This requires more sensitive film and/or more light on the subject. If one wants to work with a fine-grain low-speed film, then boosting the light output of the flash unit makes sense.

If one does adjust flash duration/intensity using a variable resistor, determining the lens aperture for correct exposure of the film is not as simple as when the Vivitar's sensor is used. (The automatic-exposure circuit is calibrated to provide correct exposure when the flash unit is used according to manufacturer's instructions.) Here are some ways to select the lens aperture when a variable resistor is used in place of the sensor.

i. *exposure testing*: Take a series of photographs of the same subject under the same conditions using a series of aperture settings. Develop the film and select the aperture that gives the best exposure. This can then be used as a starting point for photographs taken under different conditions.
ii. *metering*: If a flash meter is available, this is the easiest way to determine the correct aperture. It's a good idea to use an aperture one stop larger (smaller f-number) than the flash meter indicates. Flash meters are calibrated for situations where the background and surroundings have high reflectivity. This is just the opposite of the conditions under which high-speed photographs are usually taken.
iii. *rule of thumb*: The rule given below is based on some measurements taken with a flash meter.

With ISO 100 film and a flash-to-subject distance of 1 meter, the lens f-stop is found simply by adding 2 to the value of the resistance (in units of kilohms). This empirical relationship holds well up to 6 kΩ.

Having adjusted the intensity with the variable resistor, one also wants to know that the flash duration is not too long for the subject being photographed. Here's a rule of thumb for estimating the flash duration, given the resistance, R. (See the article given in the footnotes[1] for a description of how this rule was determined.)

For R = 2 to 100 kΩ, the flash duration is given simply by $t = 17 \cdot R$, where R is given in kilohm and the flash duration, t, is given in microseconds. Below 2 kΩ, the duration falls less rapidly, reaching a minimum value of about 20 μs.[2]

Example: If R = 6 kΩ, then an aperture of f/8 could be used with ISO 100 film at 1 meter from the subject. For this resistance, the flash duration would be about 100 microseconds.

[1] See the Appendix of this article: "High-Speed Photography with Sound Triggers," L.M. Winters, *The Physics Teacher 28*, 12 (1990).
[2] These measurements were taken with the flash head in the horizontal position. If the head were in a bounce position, C would be about a third greater. This is due to the fact that in any of the bounce positions, the capacitance of the exposure control circuit is increased by about 30% to provide the extra light output needed for bounce illumination. Reference: Vivitar Service Manual, Automatic Electronic Flash Model 283, pub. no. 3746059, revision C (1984), p. 5.