



Dead-time

When real radiation events are not counted either because the system is busy processing a previous pulse or if the system input is “closed” due to transferring of buffered data the system is said to have dead-time. Different manufacture will define dead-time slightly different and include only some of the elements when the dead time is displayed, typically as a percentage. It doesn't really matter if the system is not counting because it takes a long time to process each pulse, because the system is inactive due to data transfer or because the system is rejecting pulses due to pulse pile-up rejections and we prefer to define dead-time as the effective count loss expressed as a percent. If the true input count rate for a dead-time free system is R_T then the dead-time DT is equal to

$$DT = \frac{R_T - R_O}{R_T} \cdot 100\% \text{ where } R_O \text{ is the observed count rate by the system. The dead-time}$$

corrected count rate can be found by solving the equation for R_T , $R_T = \frac{R_O}{1 - DT/100\%}$.

What are the implications of dead-time?

The general opinion is that after a dead-time correction as described above the corrected count rate is truly representing the count rate for the equivalent dead-time free system. This is true but there is a small but important caveat, probably best illustrated through an example. Let system 1 have a dead-time of 50% and system 2 have half the detector size and zero dead-time. With a 50% dead-time System 1 will have an observed count rate of $R_1 = R_T/2$ and system 2 will with half the detector size have an identical count rate of $R_2 = R_T/2$. Both systems need to be corrected by a times two in order to derive the corrected count rate. The example shows that system 2 with half the detector size is performing exactly the same as the larger system with 50% dead-time. A 50% dead-time would not be seen on a good system under normal operation. But even at 12.5% dead time an 8 Xtal system effectively only operates as a 7 Xtal system.