CRA-100 SPECIFICATIONS

Maximum Count rate	: 100MHz
Input pulses	: TTL [at least 5 ns wide]
Counter size	: 10 bit or 14 bit. Switch selectable
Time base	: 10µs, 100µs, 1ms, 10ms, 100ms, 1Sec.
Time base stability	: 100ppm
Synchronization	: Negative TTL Pulse or GND [Normally unused or open]
Analog Output Signal	: 0V to +10V low impedance
Max. Output Current	: 5 mA
Output voltage/1count	: 10mV for 10 bit range, 0.625mV for 14bit range
Dead time	: 300ns

THEORY OF OPERATION

The CRA-100 is a free running counter/timer continuously updating a Digital to Analog Converter [DAC] after each time base period. The major difference between the CRA-100 and a conventional rate meter is that while the conventional rate meter's output reads counts per second [CPS] the CRA-100 outputs an analog signal representing counts per selected time base. Only the one (1) second time base will produce voltage directly corresponding to CPS. This time base will produce the 10 V output for 1024 CPS at the 10 bit range or 16,384 CPS for the 14 bit range. The other time bases will produce an analog output proportional to the input's count rate.

The proportionality constant is equal to 1/time base. For example: 500 counts acquired at the 0.1s time base corresponds to 500 x 10 = 5 kcps. A 500 counts acquired at the 10µs time base corresponds to 500 x 10^5 = 5 x 10^7 cps or 50 Mcps.

OPERATION

An overload indicator lights up every time the maximum count is reached to warn the user that the analog output has reached it's limit, meaning that the acquired count per time base has reached the limit of the counter and does not accurately represent the actual incoming count rate. To remedy this saturation problem the time base needs to be reduced to the next shorter value. If the CRA-100 is employed to monitor and display an intensity spectrum in spectroscopy applications, the saturation indicated by the overload light will result in cutting the most intense peaks of the spectra as flat tops.

Time base	Max. Count rate 10bit [1024 counts]	Max. Count rate 14bit [16384 counts]
1Sec.	1.024 kcps	16.38 kcps
100ms	10.24 kcps	163.8 kcps
10ms	102.4 kcps	1.638 Mcps
1ms	1.024 Mcps	16.38 Mcps
100µs	10.24 Mcps	100 Mcps=6.1V
10µs	102.4 Mcps	100 Mcps=0.61V

Fig.1. Maximum count rate allowed for each time base to avoid saturation of the counter.

The overload LED will light at this (or a higher) count rate. To avoid the saturation, the maximum count rate must be kept below these limits or, as an alternative, a shorter time base must be selected.

Note: In some applications, a dominant peak in the spectrum may be of no special interest while some of the smaller peaks carry the desired information. In this case, the overload may be ignored, resulting in cutting off the dominant peaks, while the smaller ones will be enhanced.

The saturation, or overload, is a harmless condition for the rest of the data and can be safely used to enhance the rest of the spectrum. The only lost information is in the saturation points.

A graphical illustration of input/output function of CRA-100 is depicted in fig.2. The sampling period or the time base here is 10millisecond and the range is 10 bits. Since the 10 bit range corresponds to 1024 counts/10 V output, the 10 ms time period would require about 100 kcps [1024 or just approximately 1000 counts per 10 milliseconds or 100kcps] to produce 10V output. Alternatively, a 100 cps would produce 10 mV and 50 cps 5 mV.

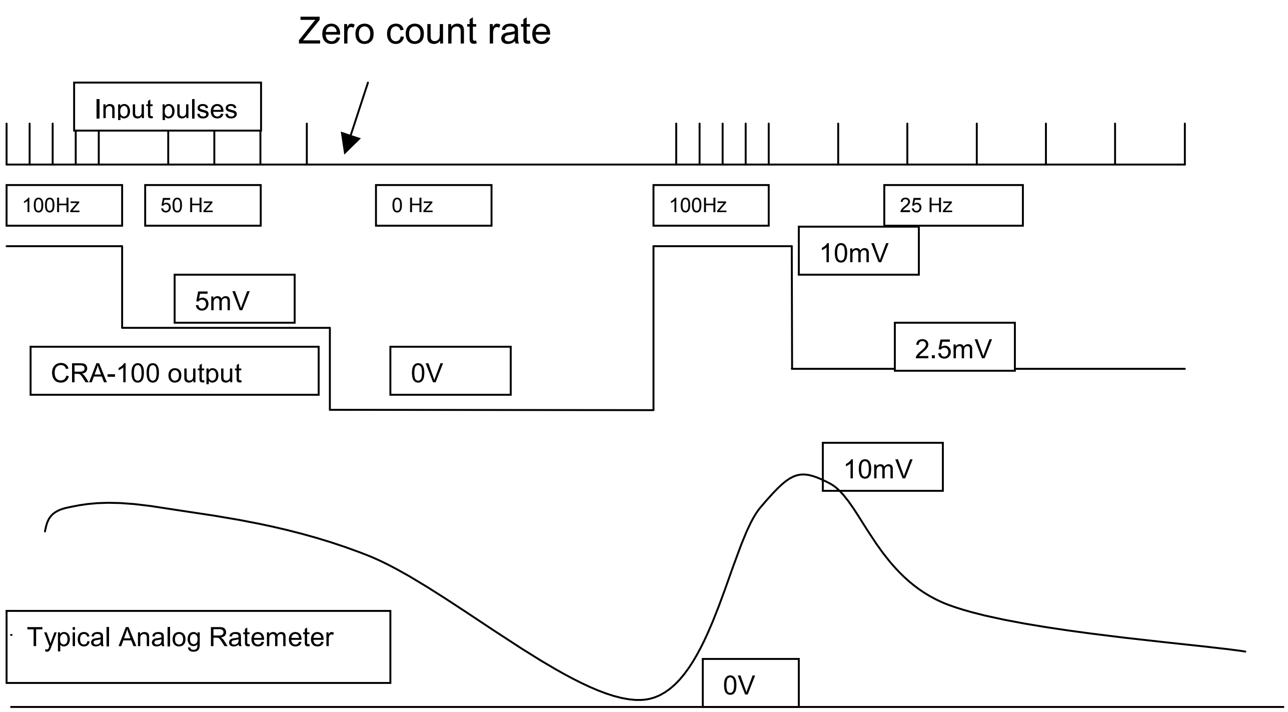

Fig.2. Input/Output relationship of CRA-100. Comparison between CRA-100 and a typical analog ratemeter.

A typical analog ratemeter is based on a low pass filter that integrates the pulses area and obviously the more pulses, the greater the area and the greater the output signal. The analog ratemeter is inherently slow to respond to a sudden increase in the signal and slow to drop to zero in a sudden drop of the signal.

The fig.2 illustrates also a total lack of a memory effect among time periods of the CRA-100 that is so typical of analog ratemeters. Note in the fig. 2 how long does it take for the analog ratemeter to reach zero output from the instance the input count rate drops to zero.

Synchronization

In some applications, it is imperative to synchronize the beginning of the time base with some external signal. A negative going 0V pulse applied to the synchronization input, will cancel current time base [remember, it's a free running system] and start a new one. From this period, all the time periods are related to the synchronization pulse.

Typical synchronization applications include:

- 60 Hz interference reduction
- Horizontal/vertical imaging sync.
- Light chopper sync.