REFLEX® MODEL 246 RATIO CALCULATOR
PART NUMBER 12M03-00136-01
APPLICATION NOTES

1. The Ratio Calculator is a single quadrant divider with inputs to both numerator and denominator a positive 10 volts maximum. The Ratio Calculator can be applied wherever precision division of DC signals is required. The numerator input resistance is a constant 50K Ohms, within 1%.

   The denominator input resistance varies with the scale factor set by the DIP switches. The following values are assigned to each of the DIP switches.

   SW 1 - 1
   SW 2 - 2
   SW 3 - 4
   SW 4 - 8

   These switches are set to provide different scale factors for the Ratio Calculator, depending on how it is being used. Input resistance, within 1%, can be calculated by the following formula, where "S" is the sum of the values shown above for all switches that are positioned in the "on" position.

   $$\text{Input resistance} = \frac{400}{S+2} \text{ K Ohms}$$

   This value is useful when calculating voltage dividers for inputs greater than 10 volts. In a specific application, the scale factor cannot be changed without also changing the voltage divider that feeds the denominator input. If it is necessary to change scale factors, a buffer operational amplifier is recommended. The Reflex Model 235 Voltage/Current Follower is ideal for this purpose. It provides filtering and polarity reversing and can be used with an AC or DC tach.

2. To calibrate the Ratio Calculator, connect both numerator and denominator inputs to the positive 6 volt terminal, set all DIP switches to the "off" position, and adjust the calibration potentiometer for exactly 5.0 volts output. This gives an output as follows:

   $$Z = \frac{5X}{Y}$$

   Where: X is numerator signal in volts
   Y is denominator signal in volts
   Z is output in volts

When the DIP switches are moved to different positions, the output becomes:

$Z = \frac{10X}{(S+2)Y}$ where S is the sum of the values assigned to each switch in the "on" position.

3. The output does not continuously follow the input ratios, but is up-dated periodically, depending on the magnitude of the denominator signal, and the settings of the DIP switches. For the usual range of operation the up-dates per second vary from a high of about 450 to a low of about 10. This means that, in most systems, the output needs to be filtered only slightly to obtain a signal that is continuous for all practical purposes. In many cases no filtering will be required.

   The frequency by which the output is up-dated is given by the formula:

   $f=44Y(S+2)$ times per second

4. The output can be locked at its most current up-date by applying a logic "1" from TTL logic, or any signal of positive 5 to 15 volts by a relay contact, to the "LOCK" terminal.12, if desired. The output can be preset to any desired value by applying independent input to establish the output, and then locking it at this value, if desired. This is one means of establishing "Stall Tension" on a winder. Alternately, "Pre-Set" inputs can be switched to "running" inputs.

5. Application to Winders or Unwinders. One of the most useful applications of the Ratio Calculator is in measuring the diameter of rolls that are driven from their center. When tension control of a roll being wound or unwound is desired, it is very helpful if the diameter of the roll can be measured, since the torque required to produce a specific tension in the material being wound is directly proportional to the roll diameter. If signals proportional to the lineal speed that the material is moving through the machine, and also the speed of the center shaft of the roll, are the variables and scaled properly, the Ratio Calculator can determine the diameter very accurately.

   To accomplish this, a signal proportional to lineal speed is applied to the numerator input, with a magnitude of 10.0 volts at the maximum line speed. This numerator signal may come from the signal reference that establishes line speed. It may come from a tach generator that provided feedback for a drive that establishes line speed, or it may come from a separate tach generator or other device that measures line speed. In any event, it must be 10.0 volts at the maximum line speed.

Similarly, a signal proportional to the winder or unwinder shaft speed and with 10.0 volts magnitude at maximum shaft speed, is connected to the denominator input. The DIP switches are then set so that the total, "S+2" of the "on" switches equals the ratio between the maximum diameter to be wound or unwound and the diameter of the core when there is no material on it. Since this ratio will probably be a fractional number, round it off to the next whole number to determine the setting on the DIP switches. With no switches closed, this ratio or build-up is 2:1; with all switches closed, the build up is 17:1.

6. Digital inputs in the form of pulses from TTL or CMOS logic can be applied to the digital input terminals. These pulses should be logic 1 and of a duration at least 100 NSec and no more than 2 Micro seconds. With digital inputs, the output voltage will be :

$$E_{out} = \frac{\text{Frequency of numerator}}{\text{Frequency of denominator}} \times .044$$

The numerator frequency must be greater than the denominator frequency for meaningful results. The upper frequency limit on the numerator is 125KHZ nominal.

7. When used in a Winder Drive, some type of "Stall Tension" circuit should be used. This compensates for the fact that no divider can operate with a denominator value of zero.