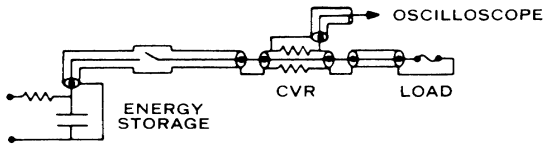
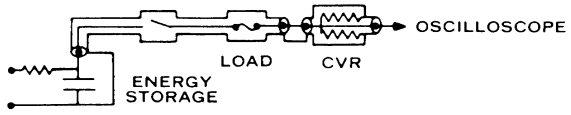
CURRENT VIEWING RESISTORS

CVR's are rugged high frequency resistors designed to sustain the very high peak power and current inputs generated by capacitor banks, pulse generator systems, and steady state current loads. Their broad, flat frequency response provides an accurate indication of current magnitude free from inductive components.

INLINE CVR



TERMINATING CVR



Inherent in CVR design is a coupling between the major electrical parameters of resistance, bandpass, energy capacity, and wattage rating. This interdependence led T & M to provide an improved series of standard units covering a broad range of specifications.

CVR ELECTRICAL CHARACTERISTICS

For most applications terminating CVR's have been found to be most satisfactory and thus are offered in an extensive series of standard units.

For systems where CVR's must be inserted between the source and load, T & M offers an additional series of inline CVR's, Series L and VL. The Series VL is a combination CVR and voltage divider to permit the simultaneous measurement of current and voltage across the load.

ENERGY CAPACITY

A convenient criteria for selection of a CVR is provided by its pulse energy capacity. This rating is defined as:

$$E_{max} = R_{CVR} \left[\int i^2 dt\right]_{max}$$

Thus by definition the pulse energy capacity is the maximum recommended energy that should be dissipated in the CVR over a period so short that losses are negligible.

When a square wave current pulse is utilized, the energy input (E) into the CVR is equal to $R_{CVR} i^2 t$, and any unit in which E_{max} greater than E can be used.

Capacitor bank systems present a more difficult problem since a major fraction of the initial stored energy is dissipated external to the CVR, i.e.,

$$E_{CVR} = E_{stored} \frac{R_{CVR}}{(R_{CVR} + R_{external})}.$$

Prior to measurement, the effective system resistance is generally unknown. However, from consideration of peak current, CVR resistance, and a practical CVR output voltage, the ratio of E_{CVR}/E_{stored} is about 1/10 in typical underdamped capacitor systems.

Consider a system in which L = .5uh, C = 500uf, V = 20kv, and E = 25 kilojoules. Assume an effective resistance of 1/10 critical. That is,

$$R_{eff} = 1/5 \sqrt{L/C} = .0063.$$

IF $R_{CVR} = .001$ ohms,

THEN $E_{CVR} = E_{stored} \frac{R_{CVR}}{R_{eff}} = 4$ kilojoules,

a value well within the capacity of our 5-kilojoule F-5000-20 model.

The E_{max} (joule) value tabulated for each resistor model is conservative, and all CVR's will sustain limited use at energy inputs up to 1.5 E_{max} without destruction. If a resistor is continuously operated at energy overload, its DC resistance should be checked frequently, since some permanent variations may result.

WATTAGE RATING

Although most CVR's are designed primarily for surge current measurements, their rugged construction and their low temperature coefficient resistive elements have made them ideally suited to a number of steady state applications. An average wattage rating applicable to continuous current loading is thus quoted for each resistor series. Care should be taken in circuitry involving either AC or high duty cycle pulse currents that this rating not be exceeded, since CVR damage by overheating can result. If requested T & M can supply resistors with special construction which will increase the standard wattage rating to a high value depending on the model.

FREQUENCY RESPONSE

Bandpass of a CVR is essentially flat from DC to an upper limit determined primarily by skin effect in the resistive element. Associated bandpass is based on a measured 10% to 90% risetime response to a step function of current produced by a coaxial line pulse generator. The di/dt of the test pulse exceeded 10^{12} amps/sec.

RESISTANCE VALUES

Unless otherwise specified, resistors are supplied with resistance tolerance of ±4% of nominal value. In addition, a Kelvin Bridge determination of its exact resistance, accurate to ±0.2% is supplied with each unit. A wide range of special resistance values for any of our standard units can be supplied.

MECHANICAL DESIGN

Case constructioin of all coaxial CVR's is silver-plated brass. Standard output signal connector is BNC with other connectors available. Large coaxial CVR's utilize a high current flange and coaxial threaded stud input connections. T & M's flat configuration CVR's, the Series W, originally developed for flat plate transmissioin line installation, are available in a wide range of unit widths and input configurations and have been found to be particularly useful in applications requiring resistors with extreme energy and wattage ratings.

CURRENT VIEWING PROBES

For many systems the direct determination of di/dt can provide important process information. Very often important effects, though difficult to discern, in current waveforms are readily detected in the current rate of change. To meet this need T & M offers an extensive line of flexible, Rogowski wound, current viewing probes. In addition the probe output can be electronically integrated with T & M's passive integrators to provide current measurements with complete isolation from the test circuit. Available in a wide range of mechanical and electrical characteristics, current viewing probes provide an important complement to CVR monitors.

CIRCUIT APPLICATIONS

Insertion of a CVR into existing circuitry is straight forward and poses no new problems. As in all surge curciuts, unnecessary ground loops should be avoided. If both voltage and current at the load are monitored, the CVR and voltage divider ground points should be physically close to avoid sheath currents in the oscilloscope cables. The isolation of T & M current viewing probes greatly simplifies their inclusion in most surge circuits. Applications involving large electrical fields can induce errors and should be avoided by utilizing probe versions incorporating electrostatic shielding.

SPECIAL CURRENT MONITOR DESIGNS

Because of the extremely diverse nature of surge current circuits, custom probe and resistor designs may offer definite advantages in your particular applications. Probes and resistors with special electrical and mechanical characteristics can be supplied.

SUGGESTED USES

- SCR current measurement
- Current control of automatic welders
- Measure output of automotive alternators
- Fault current detection to determine bearing wear of steam turbine generators
- EBW testing
- Current detection in detonation systems
- Three-phase fault testing in power transmission substations
- Fault detection in modulators
- Measurement of laser system currents
- Chopper current control in electric cars
- Circuit breaker testing

Members of our staff have had extensive experience in surge discharge circuitry and will be happy to supply additional information on your specific problems.

For additional technical specifications and price information, direct your inquiries to:

Ing. Büro Markus Billmann
Lerchensteige 10
D – 91448 Emskirchen

Tel.: +49-(0)-9104-8235-88
Fax.: +49-(0)-9104-8235-89
Mobil: +49-(0)-171-9987802
Email: shunt@ib-billmann.de