MOTOR OVERLOAD AND PHASE-OVERCURRENT PROTECTION

TIME-CURRENT CURVES

Types IC2824-34, CR124-A2 and CR124K Thermal Overload Relays Coordinated with Type EJ-2 Current-limiting Power Fuses

IC7160 Limitamp® Control

COORDINATION OF LIMITAMP CONTROL

Overcurrent protective devices in Limitamp control consist of (1) thermal-overload relays that provide protection up to approximately ten times motor full-load current and (2) current-limiting power fuses that provide protection from that point to rated interrupting capacity of the equipment.

To coordinate operation of Limitamp control with protective devices closer to the source in the power system, it is necessary to know how the control devices operate and to identify their specific characteristics.

Thermal-overload Relays

Overload relays provided in Limitamp control have inverse-time characteristics and are ambient compensated. Limitamp control utilizes either the IC2824-34 inductive-type relay or the CR124-A2 and CR124K thermal-type relays. These relays, operating from current transformers in the control equipment, carry current proportional to the motor-circuit current. When motor overloads occur, the relay operates to open the power contactor. The time required for operation varies inversely with the magnitude of the overload.

As can be seen from curve GES-7200 enclosed, IC2824-34 relays are supplied in three operating types: fast, medium, and slow. The CR124-A2 and CR124K relays have one operating characteristic as seen on curve GES-7201A. The particular relay or type furnished on a given installation will depend on the anticipated motor-starting time.

Minimum tripping current for IC2824-34, CR124-A2, and CR124K relays with operating tolerance equals 0.9 to 1.0 multiples of relay current rating in a 40 C ambient. Tripping is approached at some time beyond the 1000 seconds illustrated on the curve. Relay current settings can be readily adjusted over a range of 90 to 110 percent of the coil rating for the IC2824-34 relay and 85 to 115 percent of nominal heater trip rating for the CR124-A2 and CR124K relays.

For relay data, see GEA-7861 for CR124K, GEH-1199 for IC2824-34, and PGEI-1255 for CR124-A.

Power Fuses

Power fuses are EJ-2 current-limiting type. Coordination between fuses and thermal-overload relays is such that the latter open the contactor on all overcurrents that would otherwise melt the fuses in 100 seconds or longer and the fuses interrupt all overcurrents of magnitude greater that intended for contactor interruption.

The power fuse curves included in this folder show the characteristics for the minimum melting time, GES-8100A, and the maximum total-clearing time, GES-8101A.

For more complete data on EJ-2 fuses, see GET-2664.

COORDINATION OF IC7160 LIMITAMP CONTROL

Composite Characteristic Curve

To prepare a composite time-current characteristic curve for coordination purposes proceed as follows:

(1) Determine the type of overload relay, the relay coil number (for IC2824-34 type) or heater number (for CR124-A2 and CR124K types), the relay setting in percent (for IC2824-34 type), the current-transformer ratio, and the fuse designation (2R, 3R, etc.) from the equipment.

(2) Identify the rated tripping current of the relay coil from Table I or heater from Table II. Multiply by the current-transformer ratio and the relay setting in percent. The resulting relay current in amperes will correspond to the 1.0 multiples of relay setting on the applicable relay curve.

(3) Using General Electric Form FN-522Z (or Keuffel & Esser Company Form No. 336E) log-log scale tracing paper as a work sheet, fix the relay current in amperes on the work sheet. Place the work sheet over the applicable relay curve, aligning the relay current in amperes with 1.0 multiples of relay setting, and trace the curve.

(4) Placing the work sheet in turn over the designated fuse minimum melting time curve and maximum total-clearing time curve, trace the fuse characteristic on the work sheet.

The resulting composite curve shows the complete time-current characteristics and establishes the upper boundary for coordination with other system protective devices in series with the Limitamp control.

EXAMPLE WITH IC2824-34 RELAY

(1) A given IC7160 Limitamp control contains the following:
Thermal-overload relay IC2824-34L
Relay coil 1D5G27
Current transformer ratio 200/5
Relay setting 103%
Fuse designation 9R

(2) The rated tripping current of relay coil 1D5G27 is found in Table I to be 4.68 amp. Multiplying by the current-transformer ratio of 200/5 or 40/1 and the relay setting in per cent gives the effective relay setting in amperes—$4.68 \times 40 \times 103\% = 193$ amp.

(3) Aligning 193 amp on the work sheet with 1.0 multiple of relay setting on the curve for Form L relays (fast time), a curve is traced as shown in Fig. 1.

(4) Tracing minimum melting time and maximum total-clearing time curves for the 9R fuse on the work sheet results in a fuse operating curve as shown in Fig. 1.

Power system protective devices ahead of the Limitamp control can then be set to operate beyond the time-current boundaries shown in Fig. 1.

TABLE I

Coil Numbers		Coil Current Rating in Amperes at 40 C	CT Secondary Amp for 40 C Rise Continuous-rated Motor Full-load Amp (1.15 Service Factor)
Slow Time (Forms C, V) Medium Time (Forms H, N)	Fast Time (Forms L, T)		
1D5G22	....	2.65	2.12–2.3
1D5G23	1D5G22	2.92	2.34–2.58
1D5G24	1D5G23	3.20	2.59–2.82
1D5G25	1D5G24	3.52	2.83–3.10
1D5G26	1D5G25	3.87	3.11–3.40
1D5G27	1D5G26	4.25	3.41–3.74
1D5G28	1D5G27	4.68	3.75–4.12
....	1D5G28	5.15	4.13–4.47

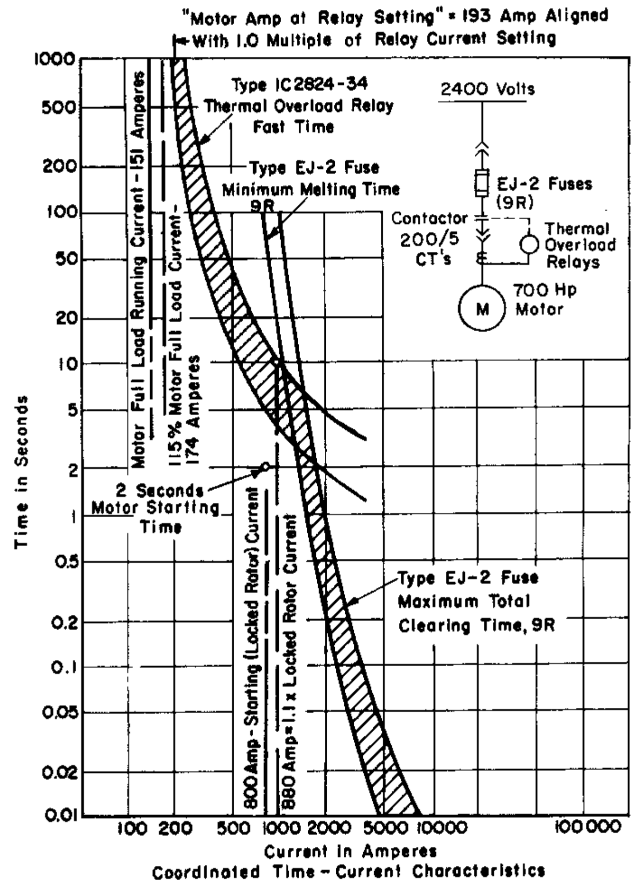

Fig. 1. Example of composite time-current curve. The cross-hatched portion shows the composite characteristic. The motor full-load current, service factor, starting time and locked-rotor current are added for orientation purposes. In application a 1.1 times locked-rotor-current line is intended to intersect the overload-relay curve at a point lower in current than the fuse minimum-melting time curve, as shown. The use of 1.1 times locked-rotor current provides for variations in system voltage.

IC2824-34 RELAY SETTINGS

The preceding example constructs the composite time-current characteristic for a relay setting of 103%. Normally, the factory ships the relay with a setting of 100%. The relay selected by the factory and the 100% setting provides adequate motor protection. However, if necessary, the relay can be set at a higher or lower setting. The setting for which the relay minimum tripping current coincides with a particular value of current in the motor circuit is:

$$\text{Relay setting (\%)} = \frac{\text{Motor Circuit Amperes} \times 100\%}{\text{CT ratio} \times 0.9 \times \text{relay current rating}}$$

Example:

Assume the motor of the preceding example had a full-load current of 143 amperes, a service factor of 1.15 and it is desired to set the relay minimum tripping current equal to the full-load current times service factor.

$$\text{Relay setting (\%)} = \frac{(143 \times 1.15) \times 100\%}{40 \times 0.9 \times 4.68} = 98\%$$

The composite time-current characteristic can be constructed as before, using this new relay setting.

CURVE INDEX

Time-current Curves	Publication No.
Type IC2824-34 Thermal Overload Relay	GES-7200
Type CR124-A2 and CR124K Thermal Overload Relays	GES-7201A
Type EJ-2 Minimum Melting Time	GES-8100A
Type EJ-2 Maximum Total-clearing Time	GES-8101A

EXAMPLE WITH CR124-A2 RELAY*

(1) A given IC7160 Limitamp control contains the following:
- Thermal-overload relay CR124-A2
- Relay heater CR123C4.66A
- Current transformer ratio 150/5
- Relay setting 100% (set for shipment)
- Fuse designation 9R

(2) The rated tripping current of relay heater CR123C4.66A from Table II is 4.83 amps. Multiplying by the current-transformer ratio of 150/5 or 30/1 and the relay setting in percent gives the effective relay setting in amperes—4.83 × 30 × 100% = 145 amperes.

(3) Aligning 145 amperes on the work sheet with 1.0 multiple of relay current setting on the curve for CR124-A2 relays (Curve GES-7201A), a curve is traced as shown in Fig. 2.

(4) Tracing minimum melting time and maximum total-clearing time curves for the 9R fuse on the work sheet results in a fuse operating curve as shown in Fig. 2.

Power system protective devices ahead of the Limitamp control can then be set to operate beyond the time-current boundaries shown in Fig. 2.

* Follow similar step-by-step procedure with CR124K relay.

TABLE II

Heater Number CR123		Heater Current Rating in Amperes at 40 C		Maximum CT Secondary Amperes for 40 C Rise Continuous-Rated Motor Full-load Amperes (1.15 Service Factor)	
CR124K Relay	CR124-A2 Relay	CR124K Relay	CR124-A2 Relay	CR124K Relay	CR124-A2 Relay
K3.29A	C3.26A	3.29	3.26	2.89	2.84
K3.62A	C3.56A	3.62	3.48	3.17	3.02
K3.98A	C3.79A	3.98	3.84	3.49	3.34
K4.38A	C4.19A	4.38	4.27	3.82	3.72
K4.79A	C4.66A	4.79	4.83	4.21	4.20

For additional information on this equipment and on ground overcurrent protection, refer to your nearest General Electric Sales Representative.

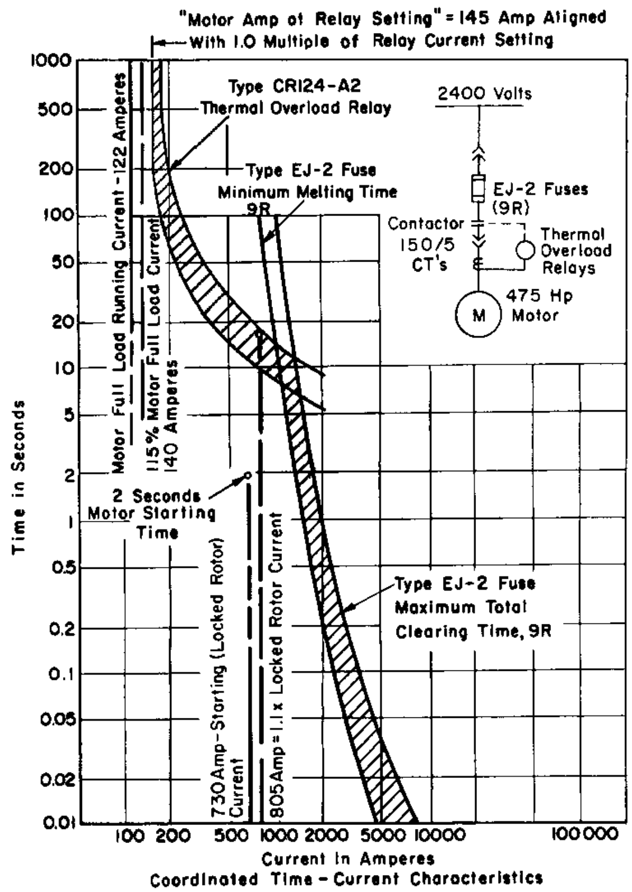

Fig. 2. Example of composite time-current curve. The cross-hatched portion shows the composite characteristic. The motor full-load current, service factor, starting time and locked-rotor current are added for orientation purposes. In application a 1.1 times locked-rotor-current line is intended to intersect the overload-relay curve at a point lower in current than the fuse minimum-melting time curve, as shown. The use of 1.1 times locked-rotor current provides for variations in system voltage.

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GENERAL ELECTRIC

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PRINTED IN U.S.A.