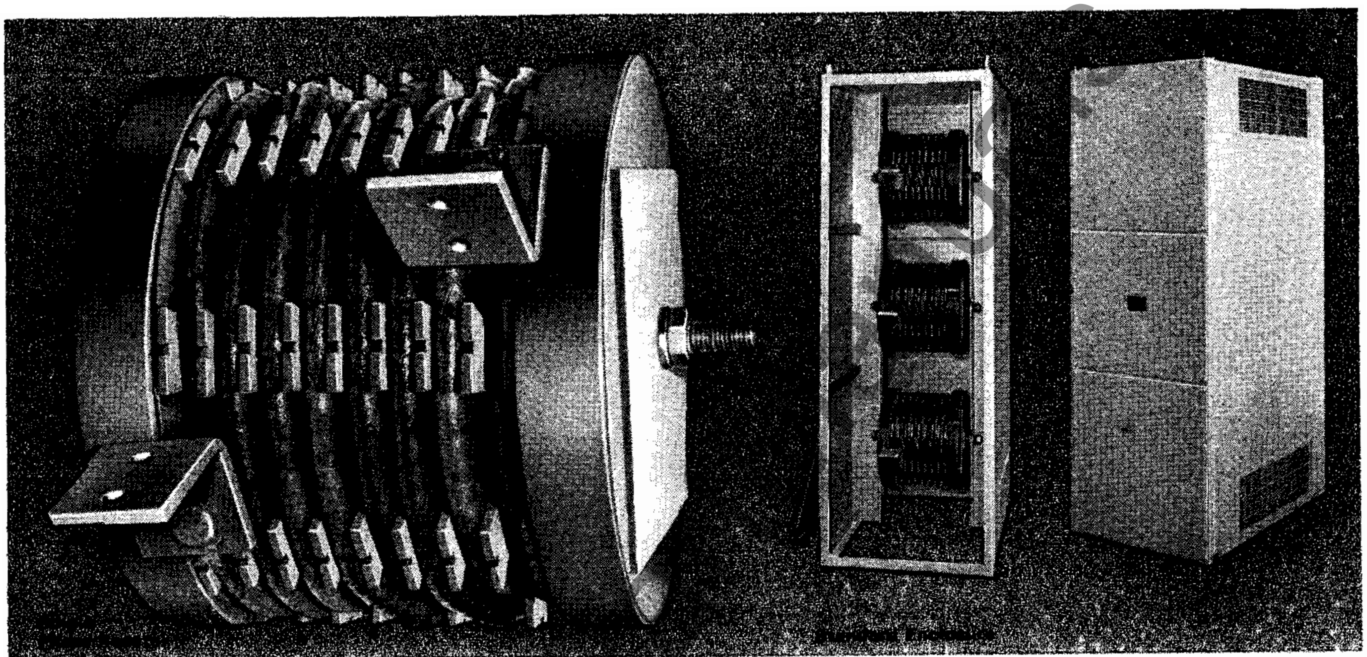
Westinghouse

Aluminum Wound Current Limiting Reactors

Type MSP, Shielded Dry Type
600 Volts and Below

Single Phase (to 16 Kva), Three Phase (to 48 Kva) 60 Hertz, 105°C Rise, Class B Insulation



Application

Type MSP magnetically self-shielded, current limiting reactors are designed to provide adequate short-circuit protection for low-voltage industrial power systems. Better regulation and circuit flexibility are obtained by the use of these reactors in individual feeder circuits rather than in the main bus.

Rugged and compact in construction, these reactors permit a wide variety of single and three-phase mountings. Hipercrete end shields effectively control the flux path so that these reactors may be mounted inside metalclad switchgear without danger of local heating or sparking from enclosure joints, hinges and latches. Both ends of the reactor stud should be supported for any reactor which weighs over 75 lbs., and in all cases, the mounting stud must be horizontal for cooling air flow.

The standard line of aluminum wound type MSP reactors, including 16 designs, are available in continuous current ratings of 225, 400, 600 and 800 amperes with four standard impedance values (0.01, 0.015, 0.020 and 0.025 ohm) in each range. Ratings are as follows:

Kva: Up to 16 kva per phase at 60 Hertz

Continuous Current: Up to 800 amperes
Phase: Single or three phase

Frequency: 60 Hertz – for any frequency (f) below 60 Hertz the impedance will vary directly as the frequency, or (f/60) times the standard impedance – order equivalent standard impedance ratings if possible.

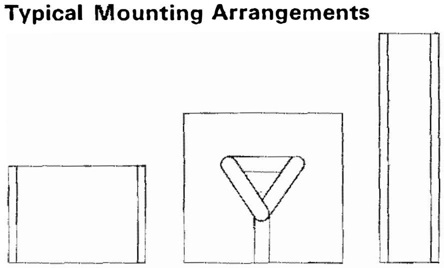
Voltage: Up to 600 volts (control class insulation) special units can be supplied up to 5000 volts with a 60 Hertz test voltage to ground and a high frequency induced test of 14,000 volts.

Temperature Rise: 105°C by resistance.

Special units can be supplied up to 2000 amperes by using copper windings if necessary with a max. equivalent single phase rating of about 25 kva at 60 Hertz. These units cannot be supplied as three phase assemblies if the max. weight per phase is over 215 lbs.

Type MSP reactor is designed mechanically for 25,000 amperes short-circuit current to meet the upper limit of interrupting capacity of molded-frame, low-voltage circuit breakers and motor starters.

Typical Mounting Arrangements



Advantages

Lower System Investment: Application of type MSP reactor on existing low voltage distribution systems permits the use of lower rated protective apparatus. Also, in the event of feeder changes, completely new protective equipment need not be purchased because the reactor will limit short-circuit current to the maximum interrupting capacity of the existing protective apparatus on branch circuits.

Better Service: Since delays and outages are eliminated, the continuity of control equipment operation is greatly increased.

Safety: The effective flux confinement achieved by the Hipercrete shields provides the greatest possible protection to operating personnel.

Assured Protection and Wider Application of the Breaker: The strong mechanical design of type MSP reactor readily withstands the upper limit of interrupting capacity of the molded-frame circuit breaker providing maintenance-free protection. Electrically, within ratings listed, short-circuit currents are limited to a value within the breaker range thereby permitting wider breaker application.

Enclosures

Standard indoor housings with 3 single phase reactors mounted one above the other are available. Refer to Price List 45-425, page 2, for further details.

May, 1969
Supersedes DB 45-455, pages 1 to 4, dated February, 1963
E, D, C/2051/DB

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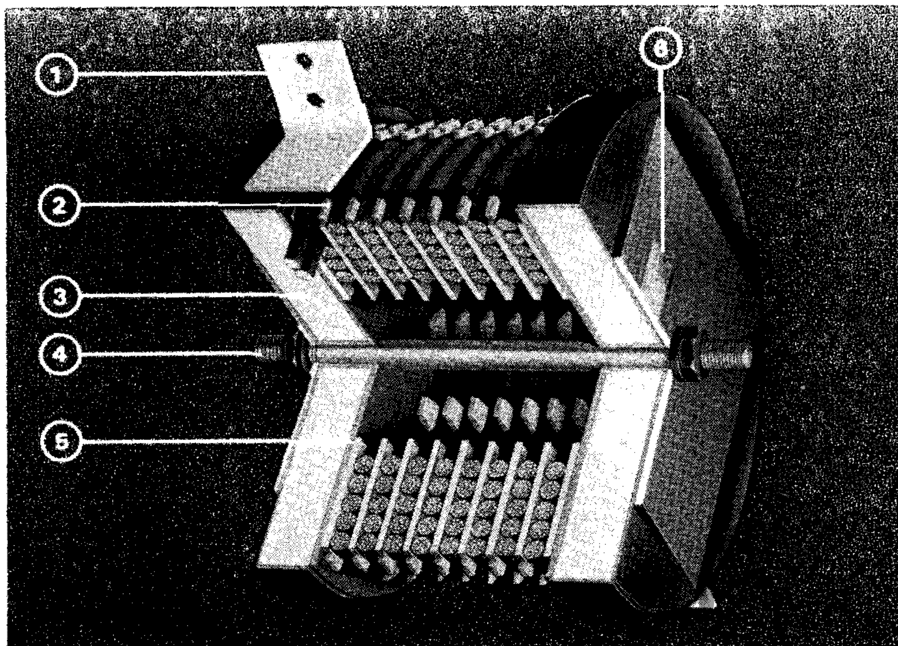
Design Features



Type MSP reactor is wound as a continuous disc-type coil using glass-insulated aluminum conductors. Coil layers are separated by polyester-glass radial spacers with the complete coil placed between two fiberboard insulating washers. On each end of the coil are located the reactor shields. The complete unit is clamped together with a stud which serves as the mounting device.

1 Terminals

Silver-plated aluminum terminals have identical drilling dimensions. This facilitates "change outs".

2 Spacers

Polyester-glass radial spacers, separating each coil layer, provide optimum insulation and mechanical strength.

3 Shields

End shields are made of a Micarta ring with a fiberboard bottom backed up by a steel plate and filled with Hipercrete, a mixture of ferromagnetic material and high-strength hydralic cement. The shields serve to confine the stray flux common to reactor fields and straighten flux-leakage paths in the winding which lowers winding eddy-current loss.

4 Mounting Stud

A high resistance, non-magnetic mounting stud (one inch in diameter, eight threads per inch) is used in all units. Stud must be mounted horizontally to insure proper cooling of reactor.

5 Insulation

Fiberboard insulating washers confine Hipercrete and increase electrical creepage distance. Strong, moisture-proof, high surge strength class B insulation is used throughout.

6 Nameplate

Complete reactor identification on the nameplate simplifies reordering.

Selection Factors

In the past there have been certain problems involved in providing adequate short-circuit protection for low-voltage power systems by means of breakers and fuses. Even with the advent of high interrupting capacity current limiting fuses, there are still certain limitations to this type of protective system:

Fuses may be damaged under partial fault conditions so that normal or overload current causes them to go out.

Fuses will permit single phasing which is undesirable on motor drive circuits.

Fixed current-time characteristics of fuses make selective fault clearing of fuses and breakers extremely difficult, if not impossible. Fuses are not designed to clear a fault where the fault is within the breaker rating, but this sometimes occurs.

Fuses must be replaced after each operation.

Current limiting reactors are the obvious answer to many of these problems, but careful consideration must be given to their location in the system in order to achieve desired results. When current limiting reactors are applied to the main feeder bus to limit the fault current to the interrupting capacity of the small branch circuit breakers, certain disadvantages are also presented:

The normal current capacity would have to be sufficient to accommodate the ultimate number of branches in the system which would put the reactor and its cell into the power switchgear class.

A fault on any branch would pull the voltage down equally on all branches and probably cause low voltage releases to operate.

Under overload and short-circuit conditions, the stray flux from the reactor field can produce extremely high induced currents with resultant mechanical stresses and heating in the metal cell walls and adjacent equipment.

A careful analysis of all of the requirements necessary to protect these circuits properly culminated in the development of the type MSP reactor. Used in control apparatus and designed to control class insulation standards, these reactors can be applied to the branch circuits protecting a group of small breakers. Each branch then is essentially independent of the others and the installation is independent of future changes in load

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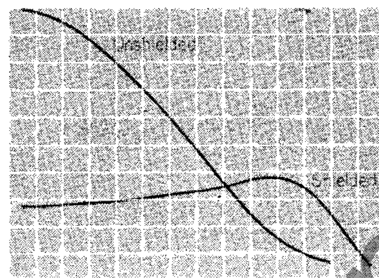
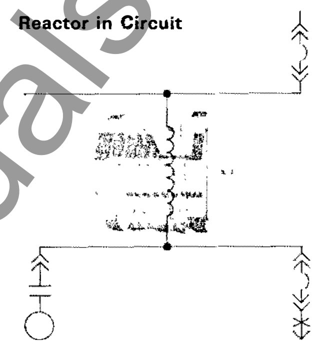
capacity of the feeder bus. Small and lightweight they adapt themselves readily to circuit requirements and are adequately shielded for mounting in metal compartments. To illustrate the extent to which the type MSP self-shielded reactor effectively confines stray flux, the following curve is presented.





Calculator①

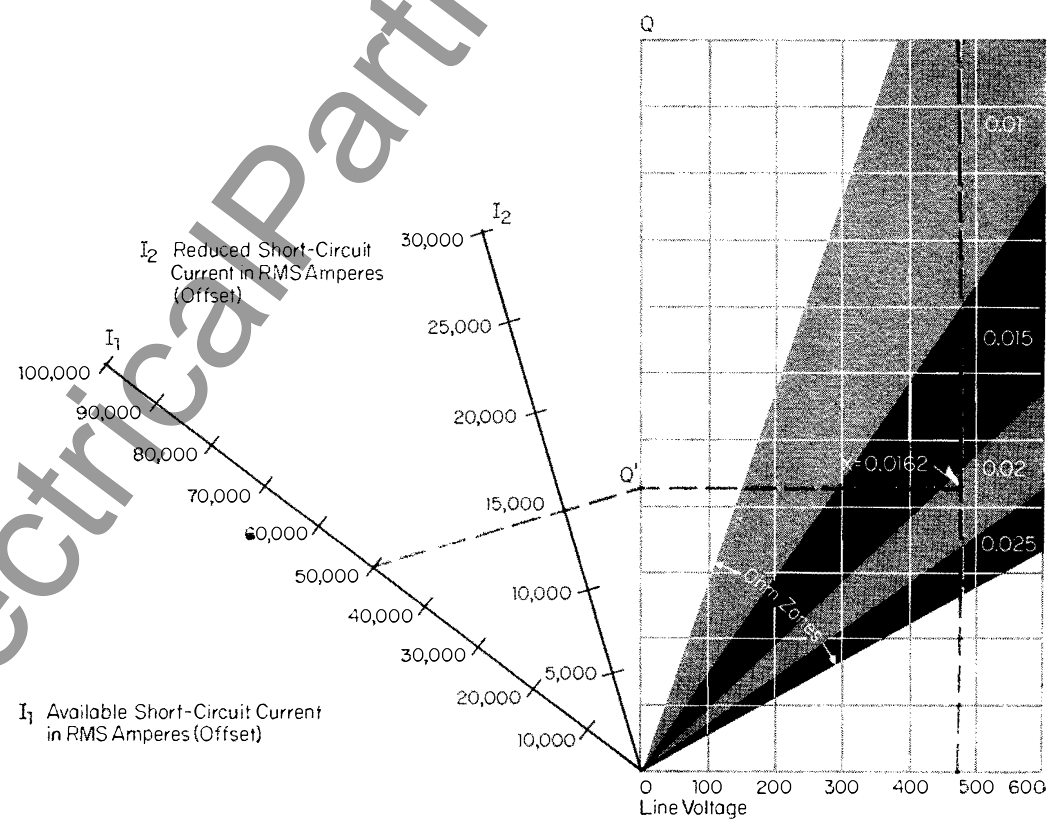
Current Limiting Reactors

Proper application of type MSP reactors can be facilitated by the use of this calculator chart which provides quick and easy determination of reactance in ohms per phase required in a three-phase circuit to reduce the available short-circuit current to a definite value. The calculator chart is based on following Formula and Assumptions:

$$X = \frac{1.25\,V}{\sqrt{3}}\left[\frac{1}{I_2} - \frac{1}{I_1}\right]$$

A. that the maximum short-circuit current corresponds to that obtainable on a three-phase fault, including a factor of 1.25 to account for the dc component.

B. that the resistance of the circuit is negligible.



The following example illustrates how this chart can be used to determine the additional reactance in ohms (X) per phase required to reduce the short-circuit current from a value (I_1) to a value (I_2).

Given: Available offset short-circuit current at a 480-volt bus is 50,000 amperes. That current must be reduced to a value that can be handled by a circuit breaker having an interrupting capacity of 15,000 amperes.

Solution: Draw line from the 50,000 ampere point on the I_1 scale through the 15,000 ampere point on the I_2 scale to a point Q' on reference line Q. Draw a horizontal line from point Q' to a point intersecting a vertical line originating from the 480-volt point on the line voltage scale. Close examination of this point (X equaling 0.0162 ohm) reveals that it lies within the 0.02 ohm zone. Therefore, a standard 0.02 ohm reactor should be applied in this sample installation.

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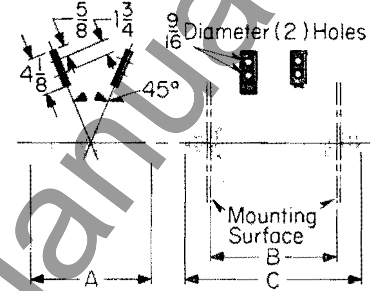
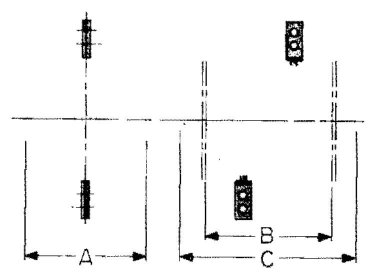
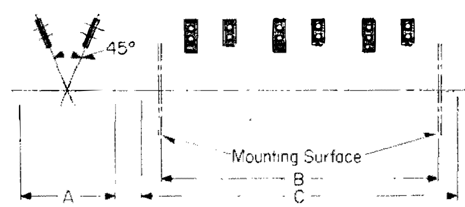
Dimensions and Weights

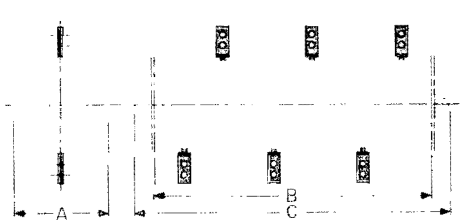
Outline and Mounting Dimensions in Inches. Terminal Dimensions Shown Identical for All Reactors

Type	Ohms at 60 Hz	Cont. Curr. Amps	Style Number	Dimensions: Inches A	B	C	Weight: Lbs. Net	Ship
Single Phase 45° Terminal Setting	.010	225	339B101H01	12	8¾	12¼	58	85
	.010	400	339B101H02	13	9¾	13	70	100
	.010	600	339B101H03	15	12	15¼	115	145
	.010	800	339B101H04	15	12⅞	16¼	125	155
	.015	225	339B101H05	12	8⅞	12⅜	60	90
	.015	400	339B101H06	14	10¼	13½	95	125
	.015	600	339B101H07	15	12⅛	15½	130	160
	.015	800	339B101H08	16	13½	16¾	150	180
	.020	225	339B101H09	13	9	12¼	70	100
	.020	400	339B101H10	15	10½	13¾	110	140
	.020	600	339B101H11	16	14⅜	17¾	150	180
	.020	800	339B101H12	16	15	18½	170	200
	.025	225	339B101H13	14	9½	12¾	85	115
	.025	400	339B101H14	16	10¾	14¼	130	160
	.025	600	339B101H15	16	15	18¼	160	190
	.025	800	339B101H16	18	15½	19	225	255
Single Phase 180° Terminal Setting	.010	225	339B101H17	12	8¾	12¼	58	85
	.010	400	339B101H18	13	9¾	13	70	100
	.010	600	339B101H19	15	12	15¼	115	145
	.010	800	339B101H20	15	12¾	16¼	125	155
	.015	225	339B101H21	12	8⅞	12¼	60	90
	.015	400	339B101H22	14	10¼	13½	95	125
	.015	600	339B101H23	15	12⅛	15⅝	130	160
	.015	800	339B101H24	16	12⅞	16⅜	160	190
	.020	225	339B101H25	13	9	12¼	70	100
	.020	400	339B101H26	15	10½	13¾	110	140
	.020	600	339B101H27	16	14½	17¾	155	185
	.020	800	339B101H28	16	15	18½	170	200
	.025	225	339B101H29	14	9½	12¾	85	115
	.025	400	339B101H30	16	10¾	14	130	160
	.025	600	339B101H31	17	14¾	18¼	187	215
	.025	800	339B101H32	18	15½	19	210	240
	.010	600	339B101H35①	15	12¼	18½	120	150
	.010	800	339B101H36①	15	12⅞	18½	125	155
	.015	600	339B101H39①	15	12⅛	18½	130	160
	.015	800	339B101H40①	16	13	18½	160	190
	.020	600	339B101H43①	16	14½	18½	155	185
	.020	800	339B101H44①	16	15	18½	170	200
	.025	600	339B101H47①	16	14½	18½	155	185
Three Phase 45° Terminal Setting	.010	225	339B103H01	12	25	28½	175	265
	.010	400	339B103H02	13	27¾	31¼	210	300
	.010	600	339B103H03	15	34⅝	38	345	435
	.010	800	339B103H04	15	37⅛	40⅝	375	465
	.015	225	339B103H05	12	25⅛	28¾	170	260
	.015	400	339B103H06	14	29¼	32¾	275	365
	.015	600	339B103H07	15	36	39½	375	465
	.015	800	339B103H08	16	39¼	42½	450	540
	.020	225	339B103H09	13	25½	29	210	300
	.020	400	339B103H10	15	30	33½	330	420
	.020	600	339B103H11	16	41½	44⅞	455	545
	.020	800	339B103H12	16	44	47½	500	590
	.025	225	339B103H13	14	27	30½	255	345
	.025	400	339B103H14	16	30¾	34¼	390	480
	.025	600	339B103H15	16	43⅝	47	465	555
	.025	800	339B103H16	18	45¾	49	675	765
Three Phase 180° Terminal Setting	.010	225	339B103H17	12	25	28½	175	265
	.010	400	339B103H18	13	28	31¼	210	300
	.010	600	339B103H19	15	34¾	38	360	450
	.010	800	339B103H20	15	36⅞	40⅜	375	465
	.015	225	339B103H21	12	24⅞	28⅝	180	270
	.015	400	339B103H22	14	29¼	32¾	290	380
	.015	600	339B103H23	15	34⅝	38	390	480
	.015	800	339B103H24	16	39¼	42½	460	550
	.020	225	339B103H25	13	25½	29	210	300
	.020	400	339B103H26	15	30	33½	330	420
	.020	600	339B103H27	16	42⅛	45½	450	540
	.020	800	339B103H28	16	44	47½	500	590
	.025	225	339B103H29	14	27	30½	255	345
	.025	400	339B103H30	16	30¾	34¼	390	480
	.025	600	339B103H31	16	43⅝	47	500	590
	.025	800	339B103H32	18	45¾	49	640	730









① For application in standard control center structure with 18½ inch long mounting stud.

Note: All dimensions and weights are approximate and subject to change without notice. Contact Westinghouse for final dimensions for construction, on each order.

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