DELPHI INTERIOR AND LIGHTING

TIAGENE VAN DOOR MOTOR SPECS

No Load Speed:	75 RPM
Stall Torque Clockwise:	37 Nm
Stall Torque Counter-Clockwise:	34 Nm
Stall Current:	40 Amps
All specs at 12 Vdc.	

Tiagene Motors are used in 1999 GM Minivans including the Chevy Venture, Pontiac Transport, and Oldsmobile Silouette. If you wish to purchase an additional Tiagene motor, you must buy the entire "Power Sliding Door unit". Great care must be taken when removing the motor from the front door unit. The retaining clips must be removed from the output shaft or damage will occur to the shaft.

FISHER-PRICE MOTOR INFORMATION

The following are approximate performance data for the Fisher-Price motor/gearbox sets supplied in the kits. The motor used is a Mabuchi model RS-550PF-6534.

Motor no-load speed	15,000 RPM
Motor stall current	57 A
Motor stall torque	0.363 N-m
Gearbox ratio	147:1
No-load speed w/gearbox	100 RPM (estimated)
Stall torque w/gearbox	34.7 N-m (estimated)

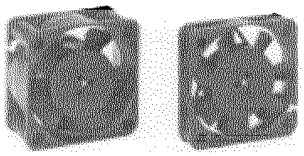
GLOBE MOTOR

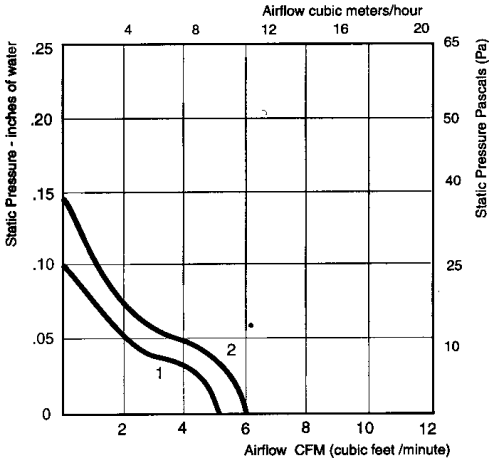
GLOBE MOTOR AND DRIVE ASSEMBLY SPECS

	Motor with Drive Assembly	Motor Only
No Load Speed:	87 RPM ± 1	97 RPM
Stall Torque:	150 In-lb	30 oz-in
Stall Current:	18.5 Amps	18.5 Amps
No Load Current	0.820 Amps	0.820 Amps
	All specs at 10 Vdc.	

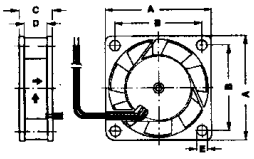
Warning: The Globe Motor can not support side loads.

40 x 10 or 20 mm (1.6" X 0.4 or 0.8"") Brushless DC — 400 Series





DIMENSIONS



Part Number	DIMENSIONS inch (mm) A	B	C	D	E
412F / 414F	1.57	1.26	.39	.24	.138
	(40)	(32)	(10)	(6)	(3.5)
412 / 414	1.57	1.26	.79	.63	.169
	(40	(32)	(20)	(16)	(4.3)

1.57" X 1.57" X .39 or .79" Brushless DC, Plastic, Air Exhaust – Over Struts

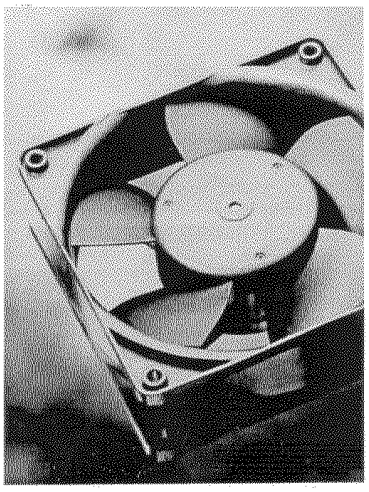
Curve	PART NUMBER	Type of Bearing	DC Volts	Voltage Range	Watts	CFM @ 0"	dBA	Temp. Max °C	Wgt. (oz)	Features	Approvals* UL	CSA	VDE
1	**412F**	Sleeve	12	10.2 - 13.8	0.7	5	26	70	.6	28 AWG 12.2" Leads	√	√	√
2	**412FH**	Sleeve	12	10.2 - 13.8	0.8	6	28	70	.6	28 AWG 12.2" Leads	√	√	√
1	**414F**	Sleeve	24	20.4 - 27.6	0.7	5	26	70	.6	28 AWG 12.2" Leads	√	√	√
2	**412**	Sleeve	12	10.2 - 13.8	0.9	6	26	70	1.0	28 AWG 12.2" Leads	√	√	√
2	**414**	Sleeve	24	20.4 - 27.6	0.9	6	26	70	1.0	28 AWG 12.2" Leads	√	√	√

* UL yellow card E38324, CSA file 27697, VDE file 3072

HIGH PERFORMANCE
SINTEC
SLEEVE BEARING SYSTEM

CONSTRUCTION MOUNTING & CONNECTION	**Mounting:**	From either face using four holes	**Connection:**	Lead wires color coded, red (+), blue (-)
	Weight:	F models: 0.6 oz (17g); 1.0 oz (27g)		
	Housing:	Plastic with plastic impeller		

28 Call **ebm/Papst** at 860-674-1515 • Fax 860-674-8536 • E-mail: sales@ebm.com for Technical Assistance



PAPST

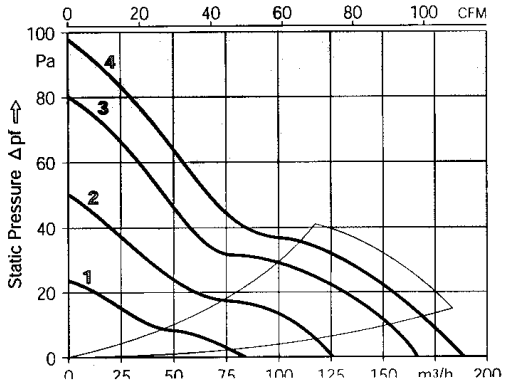
- DC fans with electronically commutated external rotor motor. Fully integrated commutation electronics.
- With electronic protection against reverse polarity, blocking and overloading by PTC-resistor; partially impedance protected.
- Fan of fibreglass reinforced plastic. PBTP housing, PA impeller.
- Air exhaust over struts. Rotational direction CCW looking at rotor.
- Electrical connection via 2 leads AWG 22, TR 64. Stripped and tinned ends
- Mass 290 g.

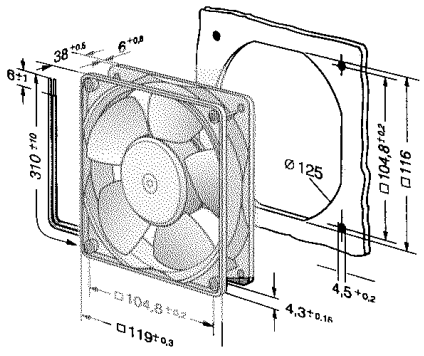
SERIES 4200

119x119x38mm

Air flow	Air flow	Nominal Voltage	Voltage Range	Noise		Sintec-Sleeve Bearings / Ball Bearings	Power Input	Nominal Speed	Temperature Range	Service Life L_{10} at 40 °C / at $t_{max.}$	Curve	Type
m³/h	CFM	V DC	V DC	dB(A)	bels	○/●	Watt	min⁻¹	°C	Hours	Hours		
86	50.6	12	7...14.5	29	4.2	●	1.2	1600	-20...+75	80000 / 35000		1	4212L
127	74.7	12	7...14.5	38	4.9	○	2.2	2350	-20...+75	70000 / 30000		2	4212GM
127	74.7	12	7...14.5	38	4.9	●	2.2	2350	-20...+75	70000 / 30000		2	4212M
165	97.1	12	7...14.5	45	5.6	●	4.3	3050	-20...+75	62500 / 27500		3	4212
184	108.3	12	7...14.5	49	5.9	●	5.3	3400	-20...+65	60000 / 32500		4	4212H
86	50.6	24	12...28	29	4.2	●	1.2	1600	-20...+75	80000 / 35000		1	4214L
165	97.1	24	12...28	45	5.6	○	4.3	3050	-20...+75	62500 / 27500		3	4214G
165	97.1	24	12...28	45	5.6	●	4.3	3050	-20...+75	62500 / 27500		3	4214
184	108.3	24	12...28	49	5.9	○	5.3	3400	-20...+65	60000 / 32500		4	4214GH
184	108.3	24	12...28	49	5.9	●	5.3	3400	-20...+65	60000 / 32500		4	4214H
165	97.1	48	36...56	45	5.6	●	4.3	3050	-20...+75	62500 / 27500		3	4218
184	108.3	48	36...56	49	5.9	●	5.6	3400	-20...+65	60000 / 32500		4	4218H

Attention:
In the forseeable future the 4200 fan series will be removed from the range and replaced by the products of the new series 4200N.

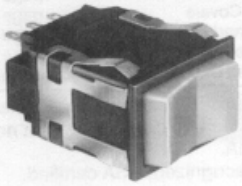




Manual Switches
Electronic Control Rocker

AML24 Series

INCANDESCENT OR NON-LIGHTED DISPLAY



Rocker operators ordered separately.

FEATURES

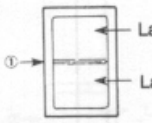
- Silver or gold contacts.
- 2 or 3 position operation.
- UL recognized, CSA certified.
- Lamps can be furnished installed or ordered separately.
- Lamp circuit independent of switch circuit.

*AML24 Series: 1 pole and 2-pole only.

AML24 ORDER GUIDE

AML24 E | B | A | 2 | AA | 01

Housing Type	Bezel Color	Incandescent Lamp Type	Terminal Type	Circuitry Codes	Operating Action
AML24 E Rectangular Non-Lighted **AML24 F** Rectangular 1 Lamp Ckt. (A) **AML24 G** Rectangular 2 Lamp Ckts.	**B** Black	**A** No Lamp Installed **B** 6 V Lamp* **C** 14 V Lamp* **E** 28 V Lamp*	**2** .110 × .020 (Solder or Quick-Connect) **3** .025 × .025 (Printed Ckt., or Push-on)	Insert Code letters as shown in Circuitry Chart	Insert Code numbers from Operating Action Chart



① The "MICRO SWITCH" identification is shown on this side of the switch housings.

* Lamps will be installed per each lamp circuit specified in the Housing Type.

Example: **AML24EBA2AA01**
Rectangular non-lighted rocker switch housing; black bezel; .110 × .020 terminals; with one circuit ON and one circuit OFF in each extreme operator position (maintained).

CIRCUITRY

Silver Contacts	Gold Contacts	2-Position	3-Position
AA	BA		
AC	BC		
(Non-illuminated switches only)			
CA	DA		
CC	DC		
(Non-illuminated switches only)			

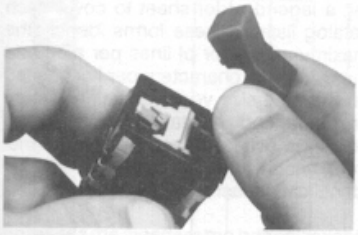
OPERATING ACTION

2-Position:		
Maint.	**01** None	Maint.
Mom.	**02** None	Maint.
Maint.	**03** None	Mom.
3-Position:		
Maint.	**04** Maint.	Maint.
Mom.	**05** Maint.	Mom.
Maint.	**06** Maint.	Mom.
Mom.	**07** Maint.	Maint.

Manual Switches
Rocker Switch Operators

AML54/56 Series

COLOR DISPLAY OPTIONS



Rocker operators are assembled to the switches by simply snapping them into recesses in the switch operator sockets.

Transmitted color — Color is displayed whether lamp is On or Off. Choice of 1-piece rockers (types 10 or 20) or rockers with clear cap and colored translucent insert (types 11 or 12).

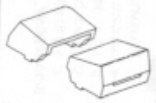
Dead front hidden color/hidden legend — Rocker appears black with lamp Off. Legend and color appear when illuminated (types 30 or 40).

Projected color — Translucent white rocker with transparent colored insert (types 50 or 60). White rocker appears colored when illuminated.

AML54 ROCKER OPERATOR ORDER GUIDE (All possible color combinations may not be available.)

For AML14, AML24, AML34 incandescent or non-lighted display.

AML54-F | **10** | **R**

Rocker Operator Type	Display/Legend Type	Rocker Color – See Note Below	
		Full rocker, 1/2 rocker, or one side of two-piece rockers	Other side of two-piece rockers
AML54-F  Full Rocker **AML54-E**  1/2 Rocker **AML54-T**  Two-Piece Rocker	**Transmitted Color** **10** No legend **20** With legend on cap **Transmitted Color** (Clear cap and color insert) † **11** No legend **21** With legend on insert **Dead Front †** (Smoky gray cap and color insert) **30** No legend **40** With legend on insert ***Projected Color † (White cap and color insert) **50** No legend **60** With legend on cap	**R** Red **Y** Yellow **G** Green **B** Blue ***W** White **K*** Black **L*** Gray **A**** Amber	**R** Red **Y** Yellow **G** Green **B** Blue ***W** White **K*** Black **L*** Gray **A**** Amber

*Not for lighted display.
**Not available with projected color or dead front.
***Insert is clear for projected color when "W" is used.
† Not available for use with AML34 power switches.

NOTE: AML54-F10 and AML54-F20 are one-piece, one-color full rockers. Thus only one color code letter is necessary when ordering. Include a two letter code for all other AML54-E (and AML54-T) catalog listings.

Example: **AML54-F10R**
Full rocker; with transmitted color, no legend; red.

AML56 ROCKER OPERATOR ORDER GUIDE

For AML36 neon display.

AML56-N | **10** | **R** | **Y**

Rocker Operator Type	Display/Legend Type	Lens Color	Rocker Color
AML56-N  Full Rocker with Colored Lens	**Transmitted Color** **10** No Legend **20** With Legend	**T** Clear **R** Red **Y** Yellow	**R** Red **Y** Yellow **G** Green **B** Blue **W** White **K** Black

AML56-N rockers have a colored lenticular lens window which extends over the neon lamp.

Example: **AML56-N10RY**
Full rocker; with transmitted color, no legend; yellow rocker and red lens.

Basic Switches
Miniature

V7 Series

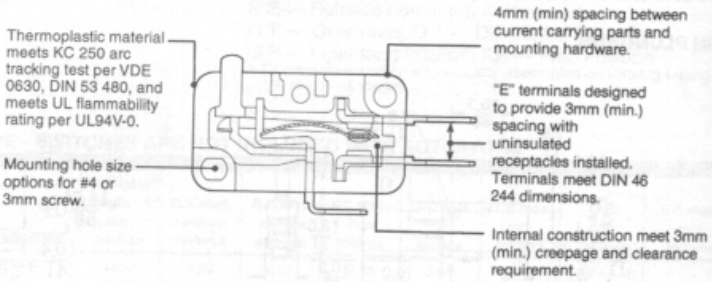
FEATURES

- Quick-connect and printed wiring board termination
- Proven V3 switching mechanism
- Physically interchangeable with existing V3 switches
- All existing V3 lever options available
- UL recognized File # E12252; CSA certified File # LR41370
- International listings carry VDE approval
- Power load switching capability up to 21 amps
- Temperature tolerance –40° to 185°F (–40° to 85°C)
- High temperature construction available—350°F

APPLICABLE EUROPEAN SYMBOLS

μ = microgap construction. (The measurement between open contacts is less than 3mm).**
~ = alternating current (used with value of voltage source: 250V ~).
T = maximum rated use temperature; followed by the temperature value in °C (example T 85).
+++ = switch is rated for at least 50,000 cycles at its rated current. (Sometimes referred to as "frequent" operation.)
10(3) = first number represents resistive rating. Second number represents inductive (motor) rating.

CUTAWAY V7 MINIATURE BASIC SWITCH



GENERAL INFORMATION

The V7 Series is UL recognized and CSA certified. Internationally approved catalog listings are shown on page 42. The International V7 provides VDE approval in addition to UL recognition and CSA certification.

The V7 offers a choice of four quick-connect and two printed wiring board terminal types. Three quick-connect types are offset to meet international 3mm spacing requirements and one is designed for use with molded connectors. Contact material choice includes gold alloy, silver alloy or silver for handling various electrical loads. There are two mounting hole sizes available. Standard .114" or 3mm to meet European design requirements.

Terminal variations and switch dimensions of the European designed version conform to applicable DIN standards. These V7s mate with both standard domestic and international industry standard receptacles and connectors. The plastic enclosure meets VDE KC250 arc tracking requirement and is approvable under the Refrigeration Industry Taste and Odor test.

OPERATING FORCES

175 grams (V rating only)
150 grams (Not applicable to Electrical Rating V)
75 grams (Not applicable to Electrical Rating C or V)
50 grams (Not applicable to Electrical Rating B, C, V)
25 grams (Not applicable to Electrical Rating B, C, E, V)
15 grams (Not applicable to Electrical Rating A, B, C, E, S, V)

Mounting Torque:
2 inch pounds min.
5 inch pounds max.

ELECTRICAL RATINGS

A	B	C*	D	E	F	S	V
5 amps, 125, 250 or 277 VAC; ⅙ hp, 250 VAC	11 amps and ⅓ hp, 125, 250 or 277 VAC; ½ amp, 125 VDC; ¼ amp, 250 VDC; 4 amps, 125 VAC "L"	15.1 amps and ⅓ hp, 125, 250 or 277 VAC; ½ amp, 125 VDC; ¼ amp, 250 VDC; 5 amps, 120 VAC "L"	1 amp, 125 VAC	10 amps and ⅓ hp 125 or 250 VAC; ½ amp, 125 VDC; ¼ amp, 250 VDC; 4 amps, 125 VAC "L"	3 amps, 125, 250 or 277 VAC; ⅙ hp, 250 VAC	.1 amp, 125 VAC	21 amps 125, 250 or 277 VAC, 1 HP 125, 250, 277 VAC; 2 HP, 250, 277 VAC

W	X
15.1 amps, 125, 250 or 277 VAC	6 amps; ⅛ HP 125, 250 or 277 VAC

International Series Only

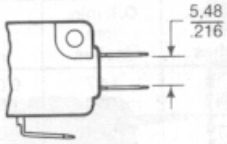
	10 (3) +++ 250V ~ T 85 μ			5 (2) +++ 250V ~ T 85 μ		+++	16 (4) 250V ~ T 85 μ 50E3 SPNO only

* Available only when specifying 150 gram operating force.
NOTE: "L" denotes lamp load.

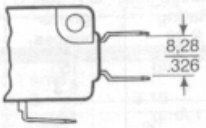
** The microgap construction (M) means contact gap is less than 3mm. Therefore, these products are suitable for secondary circuit use but not primary circuit use which requires a 3mm gap.

AVAILABLE TERMINALS

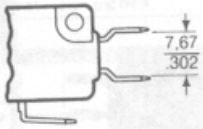
Quick-connect



D8*
.187 Wide ×
.020 Thick



E8
.187 Wide ×
.020 Thick



E9
.250 Wide ×
.032 Thick

NOTE: D8 and E8 terminals are European approved when used with electrical ratings B, D, or E. E9 terminals are European approved when used with electrical ratings B, C, D, or E.

* International approving agencies will require that switches with these terminals have insulated receptacles or connector.

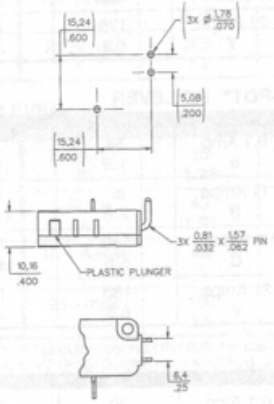
Printed Wiring Board

Printed wiring board terminals interface with snap-on receptacles and other components from AMPMODU interconnection system.

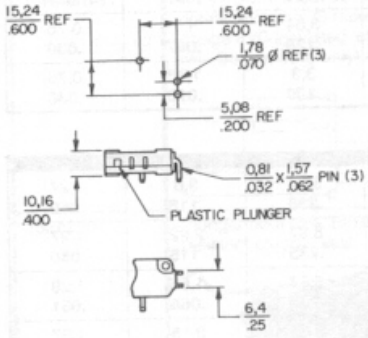
Dimensions shown are for reference only.

Key: 0,0 = mm / 0.00 = inches

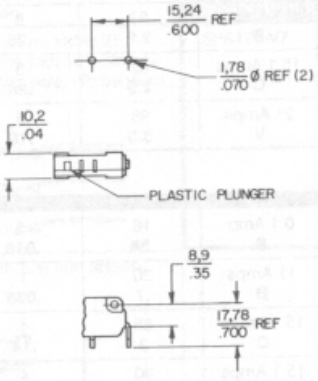
PO1



PO2



PO7



This section covers only **41** of our most popular V7 Series catalog listings. If you don't find what you're looking for, it's likely one of the approximately **300** other active V7 listings will meet your needs. Contact the 800 number.

Basic Switches
Miniature

V7 Series

PIN PLUNGERS

Dim. Dwg. Fig. 1

ORDER GUIDE - SPDT*

Characteristics: O.F. – Operating Force; R.F. – Release Force; P.T. – Pretravel; O.T. – Overtravel; D.T. – Differential Travel.

Catalog Listing	Elect. Rating P. 38	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches
V7-1S17D8	0.1 Amp S	150 5.3	25 .88	1,19 .047	1,27 .050	0,05-0,25 .002-.010
V7-3S17E9	0.1 Amp S	50 1.75	5 .175	1,19 .047	1,27 .050	0,05-0,25 .002-.010
V7-3A17E9	5 Amps A	50 1.75	5 .175	1,19 .047	1,27 .050	0,05-0,25 .002-.010
V7-2B17D8	11 Amps B	75 2.63	10 .35	1,19 .047	1,27 .050	0,05-0,25 .002-.010
V7-2B17E9	11 Amps B	75 2.63	10 .35	1,19 .047	1,27 .050	0,05-0,25 .002-.010
V7-1C17D8	15.1 Amps C	150 5.3	25 .88	1,19 .047	1,27 .050	0,05-0,25 .002-.010
V7-9W1AE9	15.1 Amps W (350°F)	300 10.6	25 .88	1,19 .047	1,27 .050	0,25 .010 max.
V7-1V19E9	21 Amps V	175 6.1	20 .70	1,19 .047	1,27 .050	0,05-0,25 .002-.010

STRAIGHT LEVERS

Dim. Dwg. Fig. 2

ORDER GUIDE - SPDT* .87" LEVER

V7-3S17D8-002	0.1 Amp S	54 1.9	3 .11	1,52 .060	0,89 .035	0,33 .013
V7-2B17D8-002	11 Amps B	80 2.8	5 1.76	1,52 .060	0,89 .035	0,38 .015
V7-1C17E9-002	15.1 Amps C	160 5.6	17 .60	1,52 .060	0,89 .35	0,36 .014
V7-1V19E9-002	21 Amps V	185 6.5	13 .5	1,65 .065	0,89 .035	0,38 .015

1.40" LEVER

Dim. Dwg. Fig. 5

V7-3S17D8-022	0.1 Amp S	30 1.05	1 0.035	3,04 .120	2,16 .085	0,76 .030
V7-1X2AD8-022	6 Amps X (350°F)	185 6.5	15 .53	1,40 .055	0,76 .030	0,38 .015
V7-1B17D8-022	11 Amps B	82 2.9	8 .28	3,04 .120	1,7 .067	0,68 .027
V7-1C17E9-022	15.1 Amps C	82 2.9	8 .28	3,04 .120	1,7 .067	0,76 .030
V7-1V19E9-022	21 Amps V	95 3.3	5 .18	3,3 .130	1,78 .070	0,76 .030

2.34" LEVER

V7-3S17D8-048	0.1 Amp S	16 .56	.5 .018	5,97 .235	3,0 .118	1,27 .050
V7-2B17D8-048	11 Amps B	20 .7	1 .035	5,97 .235	2.92 .115	1,27 .050
V7-1C17E9-048	15.1 Amps C	85 3	4 .14	5,97 .235	1,65 .065	1,29 .051
V7-9W1AE9-048	15.1 Amps W (350°F)	90 3.2	4 .14	6,35 .250	3,15 .124	1,37 .054

* For SPST (N.O. & N.C.) circuitry, contact the 800 number.

NOTE: Catalog listings in V7 Order Guides have standard .114" mounting holes. For 3mm size holes, contact the 800 number.

40 Honeywell • MICRO SWITCH Sensing and Control • 1-800-537-6945 USA • +1-815-235-6847 International • 1-416-293-8111 Canada

Innovation First — FIRST Victor 883

November 2000 — **Data Sheet**

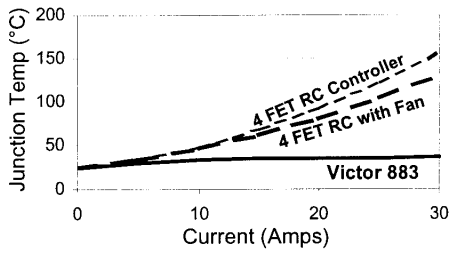
General Description:

The Victor 883 is a speed controller specifically engineered for robotic applications. The high current capacity, low voltage drop, and peak surge capacity make the Victor 883 ideal for drive systems while its braking options and precise control meet the demanding needs of arms and lift systems. Innovative FET switching architecture and an integral cooling fan ensures cool FET junction temperatures. The low voltage drop and high switching speed ensures the motor receives maximum power, providing significant improvements in acceleration, direction changes, and lifting torque.

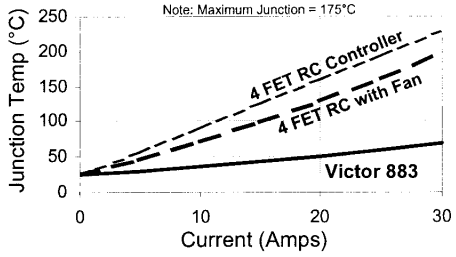
Features:

- 12 low Rds(on) FETs, 6 forward and 6 reverse
- extremely fast FET rise/fall time
- brake or coast option (used while in neutral)
- simplified calibration procedure
- pre-calibrated for the FIRST control system
- identifies absence of PWM input
- integral fan to provide optimized cooling
- sturdy high current screw terminal connections
- high visibility LED
- rugged construction
- two mounting hole for secure installations

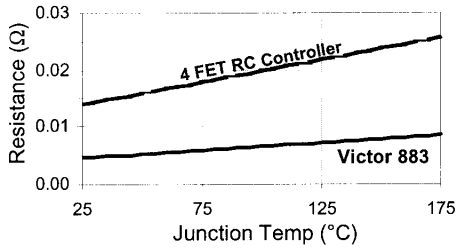
Junction Temp Vs. Current at Full Throttle



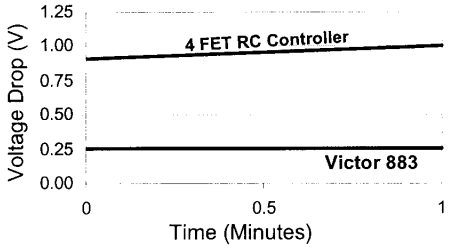
Junction Temp Vs. Current at Low Throttle

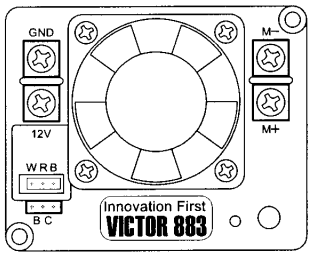


FET On-Resistance Vs. Temperature



Voltage Drop Vs. Run Time

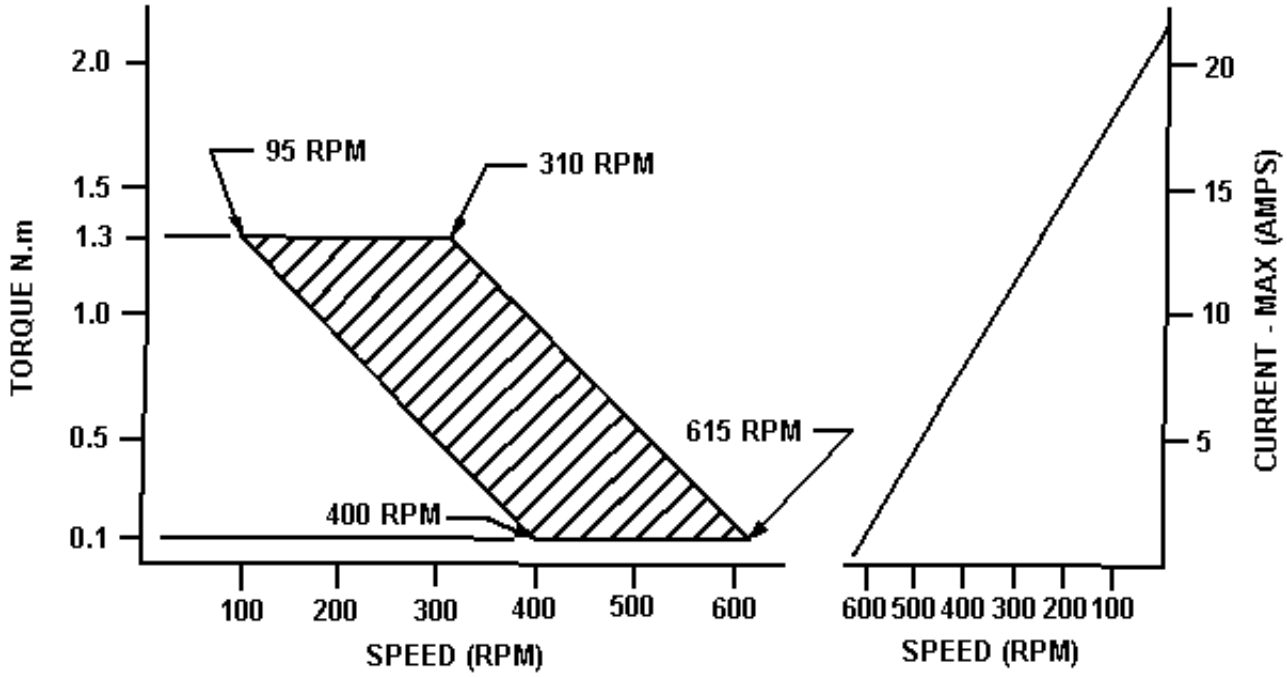




Parameter	Conditions	Min	Typ	Max	Units
DC Input Voltage		7	12	15	V
Forward On-Resistance	Measured at 30A		.0148		Ω
Reverse On-Resistance	Measured at 30A		.0148		Ω
3 FET On-Resistance	Use for comparison	.0037		.0051	Ω
Switching Frequency			2000		Hz
Recommended for Continuous Use				40	A
Current, Low Throttle	FET Thermal Limit			105	A
Current, Full Throttle	FET Thermal Limit			420	A
Current, Continuos	Electrical Limit			348	A
Current, Pulse	<300 µS			1200	A

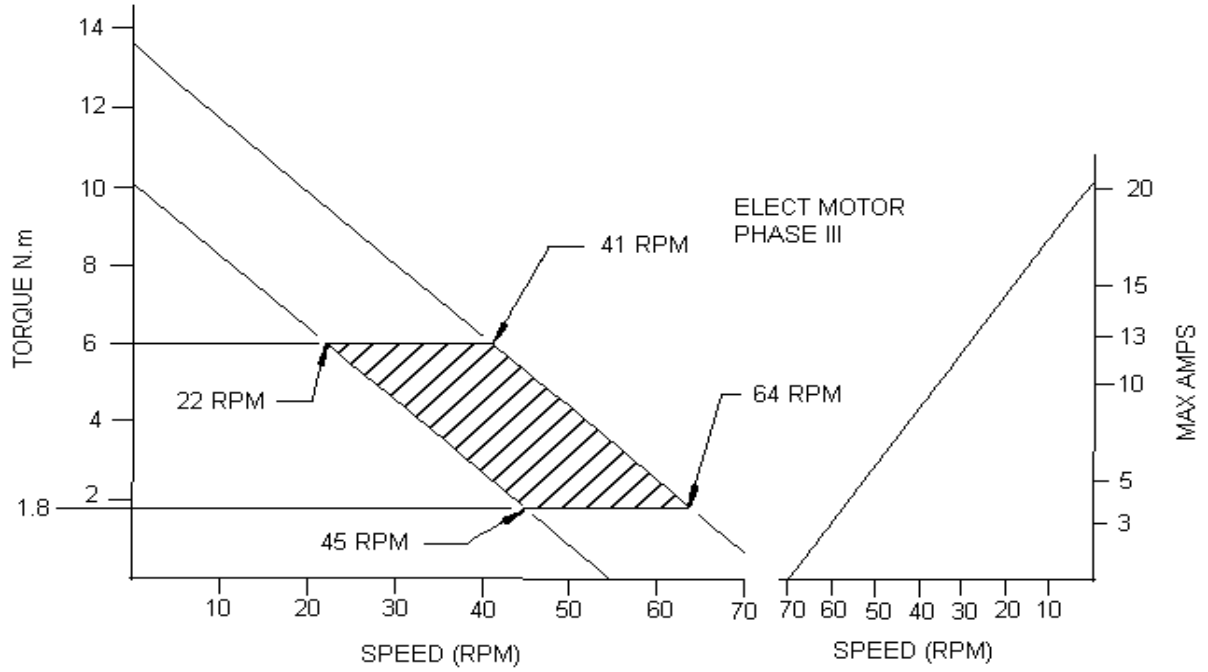
KEYANG

SEAT MOTOR SPEED-TORQUE CURVE

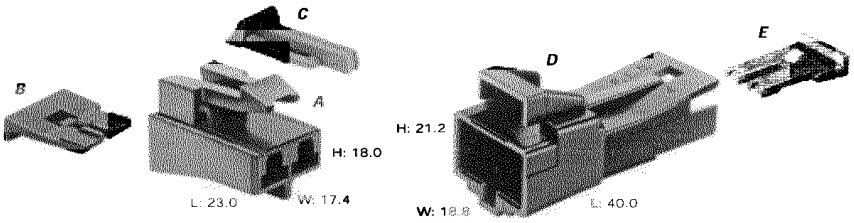


ITT AUTOMOTIVE

WINDOW LIFT MOTOR SPEED-TORQUE CURVE



480 • Metri-Pack Series



Total Mated Length: 53.9mm

A PART NO: **12064749**
DESCRIPTION: Connector 2F
SIZE: 23.0L x 18.0H x 17.4W
COLOR: Black
MATERIAL: PA66 HS IM
TERMINALS: See Page 92

B PART NO: **12059860**
DESCRIPTION: TPA
COLOR: Md. Gray
MATERIAL: PA66 HS IM

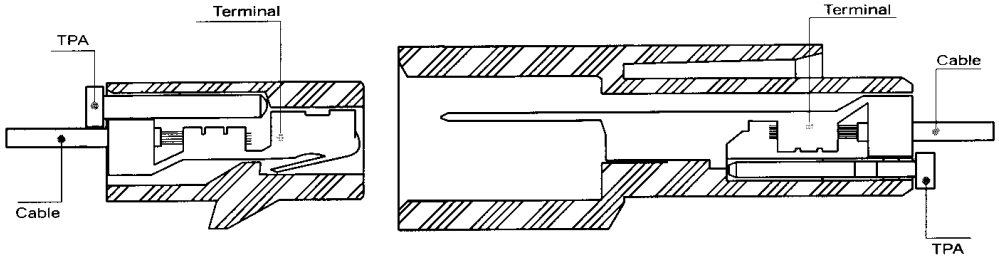
C PART NO: **12052834**
DESCRIPTION: CPA
COLOR: Green
MATERIAL: PP

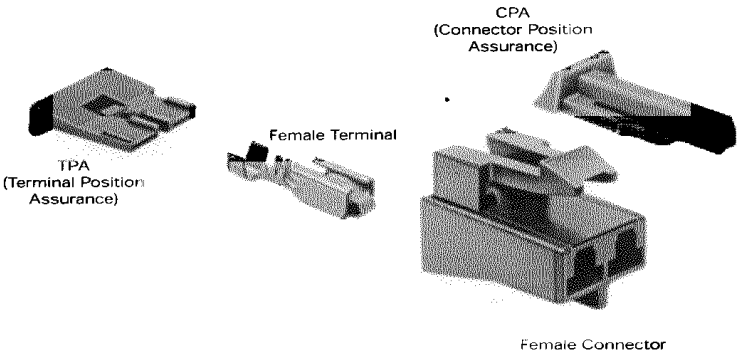
D PART NO: **12064750**
DESCRIPTION: Connector 2M (Clip Slot)
SIZE: 40.0L x 21.2H x 18.8W
COLOR: Black
MATERIAL: PA6
TERMINALS: See Page 93

E PART NO: **12064751**
DESCRIPTION: TPA
COLOR: Natural
MATERIAL: PA66 HS IM

Metri-Pack Series • 480

Cross Sectional View





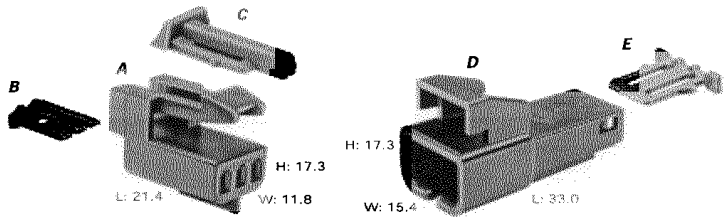
480 FEMALE TERMINALS UNSEALED

Part #	Cable Range (mm²)	Material	Plating
12084595	5.0	Tin Brass	Tin
12052221	3.0	Tin Brass	Tin
12124304	2.0-1.0	Tin Brass	Tin
12015860	0.80	Tin Brass	Tin
12052219	0.50-0.35	Tin Brass	Tin
12020366	1.0-0.50 (1 Req'd.) 0.80-0.50 (1 Req'd.)	Tin Brass	Tin

480 FEMALE CONNECTORS UNSEALED

# Cavities	Connector	Color	Material	TPA
1	12015952	Md. Gray	PA66 HS IM	–
2	12064749	Black	PA66 HS IM	12059860

Metri-Pack Series •150



Total Mated Length: 47.1mm

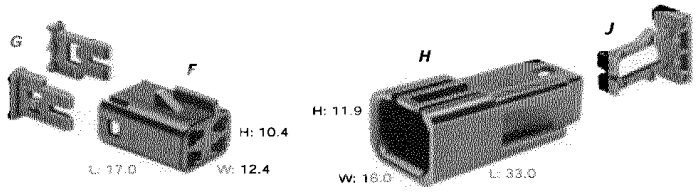
A PART NO: 12064758
DESCRIPTION: Connector 3F
SIZE: 21.4L x 17.3H x 11.8W
COLOR: Black
MATERIAL: PA66 HS IM
TERMINALS: See Page 54

B PART NO: 12047783
DESCRIPTION: TPA
COLOR: Md. Gray
MATERIAL: PA66 HS IM

C PART NO: 12052834
DESCRIPTION: CPA
COLOR: Green
MATERIAL: PP

D PART NO: 12064759
DESCRIPTION: Connector 3M (Clip Slot)
SIZE: 33.0L x 17.3H x 15.4W
COLOR: Black
MATERIAL: PBT
TERMINALS: See Page 55

E PART NO: 12047784
DESCRIPTION: TPA
COLOR: Gray
MATERIAL: PBT



Total Mated Length: 42.2mm

F PART NO: 12047785
DESCRIPTION: Connector 4F
SIZE: 17.0L x 10.4H x 12.4W
COLOR: Black
MATERIAL: PA66 HS IM
TERMINALS: See Page 54

G PART NO: 12047664
DESCRIPTION: TPA
NUMBER REQ: 2
COLOR: Md. Gray
MATERIAL: PA66 HS IM

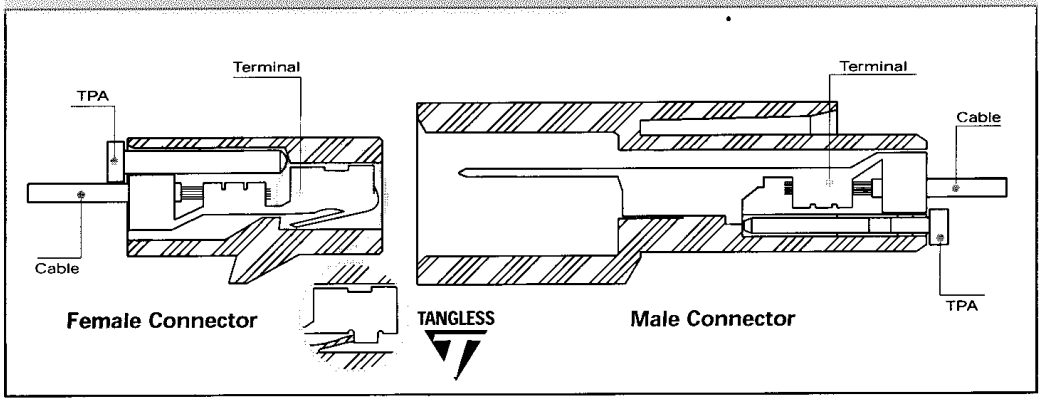
H PART NO: 12047786
DESCRIPTION: Connector 4M (Clip Slot)
SIZE: 33.0L x 11.9H x 16.0W
COLOR: Black
MATERIAL: PA66 HS IM
TERMINALS: See Page 55

J PART NO: 12047787
DESCRIPTION: TPA
COLOR: Blue
MATERIAL: PBT

Metri-Pack Series •150

UNSEALED

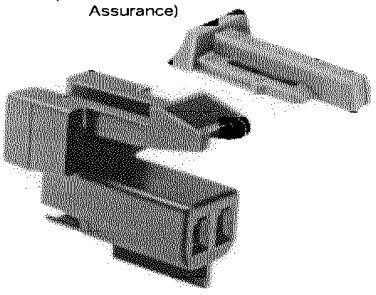
Cross Sectional View



TPA
(Terminal Position Assurance)

Female Terminal

CPA
(Connector Position Assurance)



Female Connector

150 FEMALE TERMINALS UNSEALED

Part #	Cable Range (mm²)	Material	Plating
12047767	1.0-0.80	Silicon Bronze	Tin
12064971	0.50-0.35	Silicon Bronze	Tin

TANGLESS

150 TANGLESS FEMALE TERMINALS UNSEALED

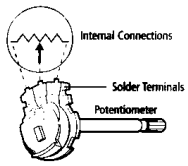
Part #	Cable Range (mm²)	Material	Plating
12129484	1.0-0.80	Silicon Bronze	Tin
12129373	0.5-0.35	Silicon Bronze	Tin

150 FEMALE CONNECTORS UNSEALED

# Cavities	Connector	Color	Material	TPA
1	12047682	Black	PA66 HS IM	–
2	12047662	Black	PA66 HS IM	12047664
2	12052832	Black	PA66 HS IM	12047664
3	12047781	Black	PA66 HS IM	12047783
3	12064758	Black	PA66 HS IM	12047783
4	12047785	Black	PA66 HS IM	12047664
4	12064760	Black	PA66 HS IM	12047664
4	12092162	Black	PA66 HS IM	12092164
6	12064762	Gray	PBT	12064764
8	12047886	Black	PA66 HS IM	12045689
8	12064766	Blue	PBT	12064768
10	12064769	Natural	PBT	12064771

RadioShack Potentiometer

Resistance: 100K ohms ±20% tolerance
Rated power: .25 watts
Sliding noise: <47mV
Total rotation: 300° ±5°
Mounting hole: 5/16" (8.2mm)

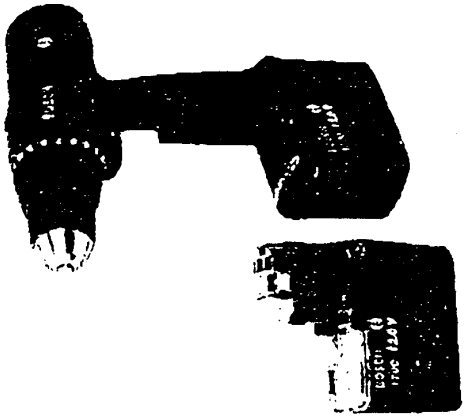


An optional switch (271-1740) may be added to this potentiometer.

Bosch

BOSCH

PRODUCT SUMMARY



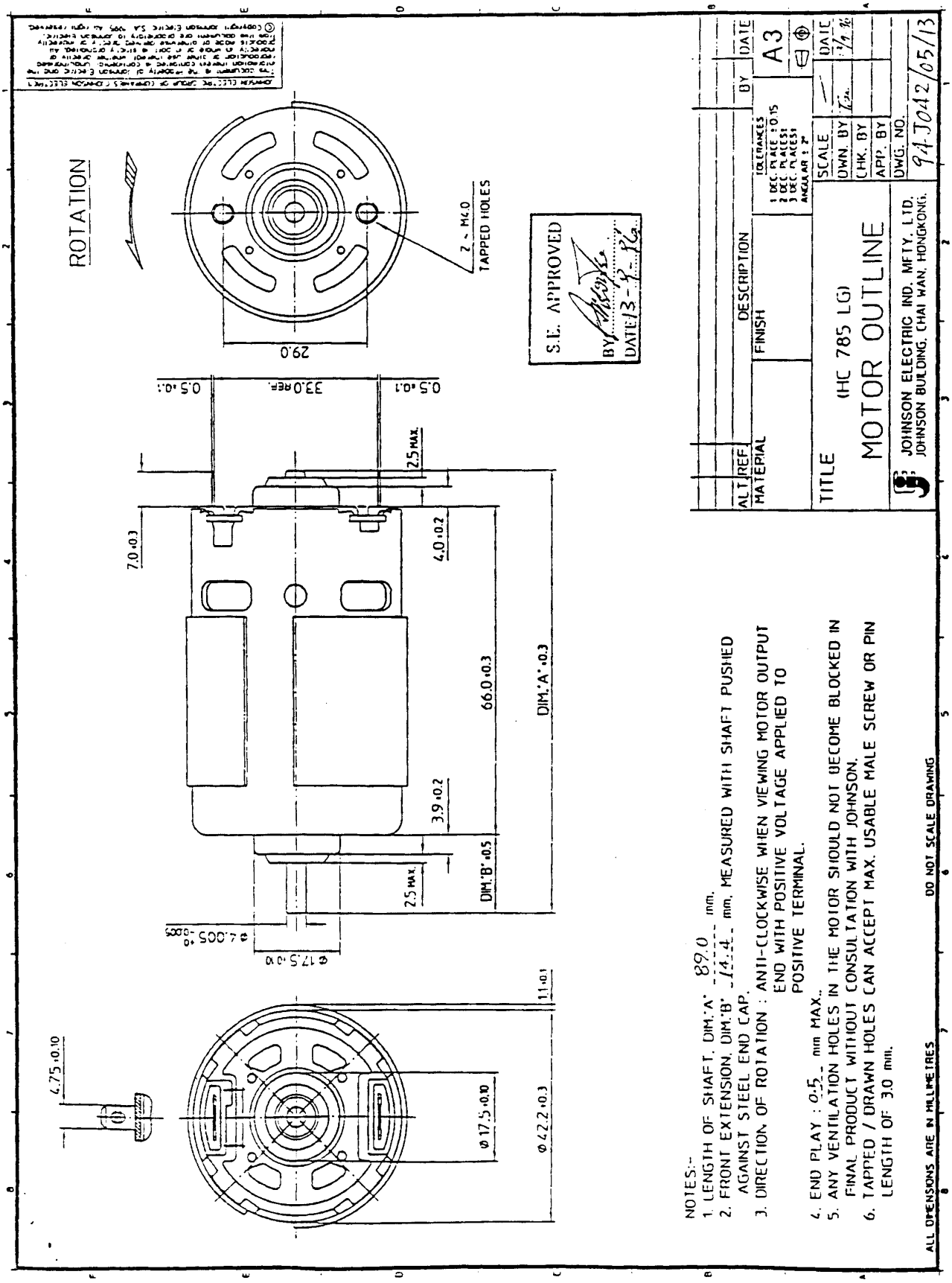
MODEL: 3310K-10

PRODUCT: 12 Volt Drill Driver

UPC CODE: 000 346 301960

KEY PRODUCT FEATURES:

- 12 Volt Power
- 225 Inch Lbs Torque
- T-Handle Styling and Balance
- VSR Switch 0-400 / 0-1200 RPM
- Clutch with 15 Torque Settings


ROTATION
2 - M4.0 TAPPED HOLES
29.0
S.E. APPROVED
BY
DATE 13-2-02
33.0 REF.
0.5 ±0.1
0.5 ±0.1
2.5 MAX.
7.0 ±0.3
4.0 ±0.2
66.0 ±0.3
DIM. 'A' ±0.3
3.9 ±0.2
2.5 MAX.
DIM. 'B' ±0.5
ø 4.005 +0.000 -0.005
ø 17.5 ±0.0
4.75 ±0.10
11 ±0.1
ø 17.5 ±0.10
ø 42.2 ±0.3
NOTES:-
1. LENGTH OF SHAFT, DIM. 'A' 89.0 mm.
2. FRONT EXTENSION, DIM. 'B' 14.4 mm. MEASURED WITH SHAFT PUSHED AGAINST STEEL END CAP.
3. DIRECTION OF ROTATION : ANTI-CLOCKWISE WHEN VIEWING MOTOR OUTPUT END WITH POSITIVE VOLTAGE APPLIED TO POSITIVE TERMINAL.
4. END PLAY : 0.5 mm MAX..
5. ANY VENTILATION HOLES IN THE MOTOR SHOULD NOT BECOME BLOCKED IN FINAL PRODUCT WITHOUT CONSULTATION WITH JOHNSON.
6. TAPPED / DRAWN HOLES CAN ACCEPT MAX. USABLE MALE SCREW OR PIN LENGTH OF 3.0 mm.
ALL DIMENSIONS ARE IN MILLIMETRES
DO NOT SCALE DRAWING
ALT. REF.
MATERIAL
DESCRIPTION
FINISH
BY
DATE
TOLERANCES
1 DEC. PLACE ±0.15
2 DEC. PLACES ±
3 DEC. PLACES ±
ANGULAR ± 2°
A3
TITLE
(HC 785 LG)
MOTOR OUTLINE
SCALE 1/1
DWN. BY
CHK. BY
APP. BY
DWG. NO. 94J042/05/13
JOHNSON ELECTRIC IND. MFTY. LTD.
JOHNSON BUILDING, CHAI WAN, HONGKONG.

JOHNSON ELECTRIC

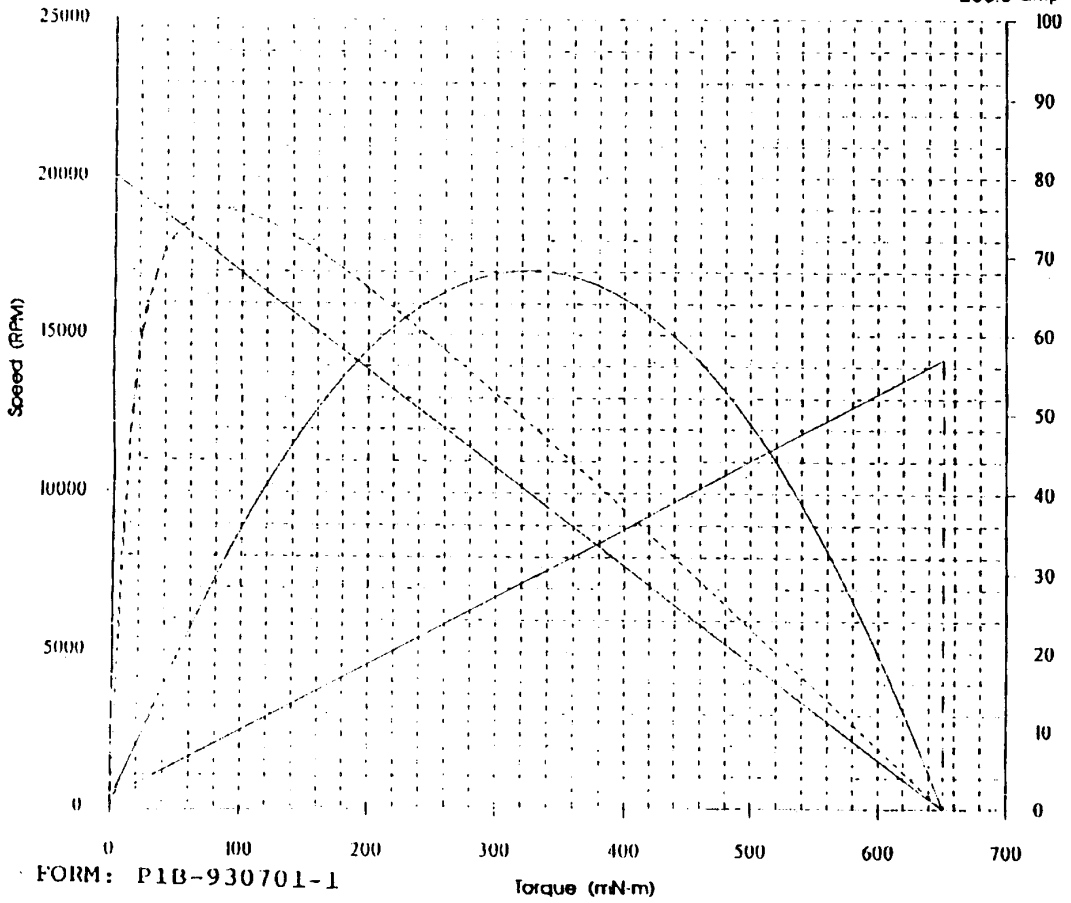
JOHNSON ELECTRIC INDUSTRIAL MANUFACTORY LTD.

35 years of exellence in micromotors

Johnson Building, 14 -16 Lee Chung Street, Hong Kong

SOF NO : 28189 94J042/05/13 Date : 10/09/96
Winding : 80- 10.0
Motor test reference no : HC785LG/ES/35060/3E1/F

Full scale : —·—·— 100 % eff
- - - - - - 500.0 watt
——— 200.0 amp



FORM: P1B-930701-1

Performance (In an ambient temperature of 25-30 °C)

Motor tested rapidly to prevent significant temperature rise.

At a constant voltage of	:	12.00	Volts
With a circuit resistance of	:	0.000	Ohms

At NO LOAD

Speed	:	20023	RPM
Current	:	2.450	AMPS

At stall (Extrapolated)

Torque	:	650.982	mN-m
Current	:	114.002	AMPS

At maximum efficiency

Efficiency	:	75.84	%
Torque	:	84.628	mN-m
Speed	:	17420	RPM
Current	:	16.952	AMPS

At maximum Power output

Output	:	341.02	Watts
Torque	:	325.491	mN-m
Speed	:	10012	RPM
Current	:	58.226	AMPS

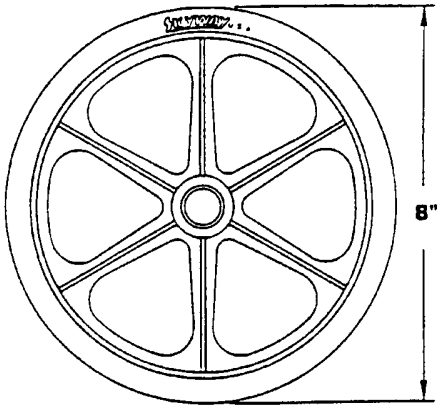
Characteristics

Torque constant	:	5.836	mN-m/AMP
E.M.F. constant	:	5.836	mV/rad/sec
Dynamic resistance	:	0.105	Ohms
Motor regulation	:	30.759	RPM/mN-m

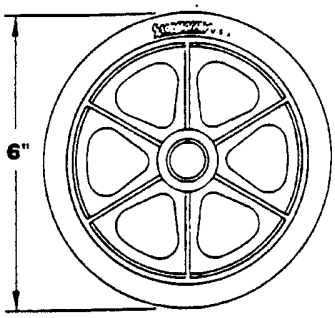
Skyway

SKYWAY
4451 Caterpillar Rd., Redding, CA 96003
916/243-5151 (FAX 916/243-5104)

STANDARD UTILITY WHEELS
WHEELCHAIR WHEEL ACCESSORIES
WHEELCHAIR WHEELS
CASTER WHEELS

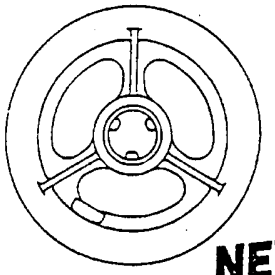


8" CASTER NON-PNEUMATIC



6" CASTER NON-PNEUMATIC

SKYWAY 6" and 8" Non-Pneumatic caster wheels feature a molded DuPont ZYTEL® nylon wheel with a coinjected Monsanto Santoprene® thermoplastic rubber molded-on tire.



NEW

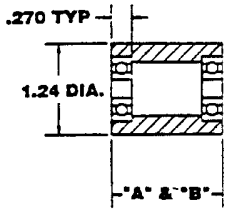
5" CASTER PNEUMATIC OR NON-PNEUMATIC

Accepts 6" x 1-1/4" Pneumatic Tires. Also Accepts Various 5" & 6" Non-Pneumatic Snap-On Tires. Available Only In Hub #1. 1" Precision Bearing.

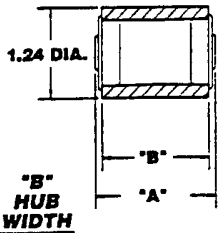
CASTER HUB SPECIFICATIONS

Hub configurations shown are SKYWAY standards, however, if you require a custom design, we stand ready to work with you to create a special hub to suit your needs.

5" Caster Only Available with Standard Hub #1, 1" Overall Width.



HUB #1
Precision Bearing Hub
7/8" O.D. Maximum x 5/16" and 3/8" I.D.'s



HUB #2
Unground, Flanged Bearing Hub
.906 O.D. Maximum x 1/4", 5/16", 3/8" and 7/16" I.D.'s

	BASIC OVERALL	"A" ACROSS BEARING REFERENCE	"B" HUB WIDTH
PRECISION BEARING			
HUB #1 For 5", 6" & 8" casters only	1"	.99	.98
HUB #1 For 6" & 8" casters only	1-1/2"	1.50	1.48
HUB #1 For 6" & 8" casters only	2-3/16"	2.18	2.17
UNGROUND, FLANGED BEARING			
HUB #2 For 6" & 8" casters only	1"	1.23	.98
HUB #2 For 6" & 8" casters only	2-3/16"	2.43	2.17
HUB #2 For 6" & 8" casters only	1-1/2"	1.73	1.48

MODEL VB3: USED WITH THE SAME CONFIDENCE AS A FUSE.

YESTERDAYS TECHNOLOGY

FUSE: Locating a blown plastic incased fuse in the panel is difficult since visual detection can only be made by its removal. Replacement fuses are usually packaged in groups of various ratings which you do not need, or all of the same ratings in anticipation of the need for continuous replacement. The fuse is a very inconvenient, antiquated means of protection.

CIRCUIT BREAKERS: Little improvement has been made in this field in the last 30 to 40 years. In the cycling type the sensoring elements lose contact pressure as the current increases, promotes arcing, tacking and may stick causing the breaker to fail. The non-cycling breakers with the same type sensor, use a heater wire to prevent the contacts from closing, generating excessive heat that can effect the calibration of other breakers, which contribute to the extensive use of the fuse.

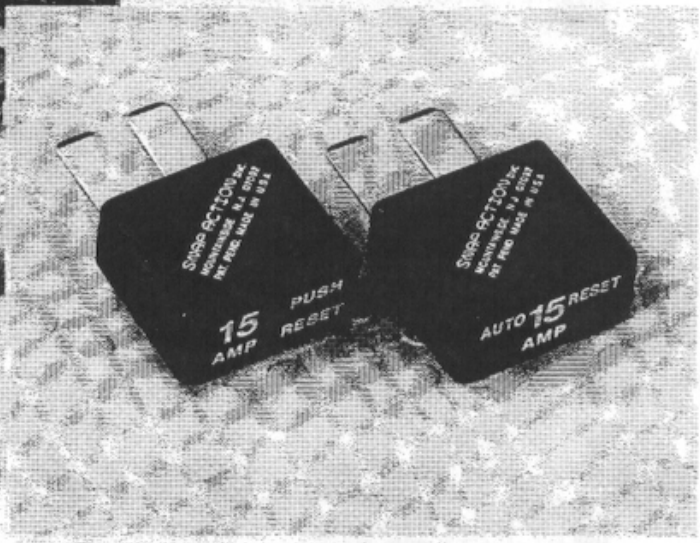
DESIRED OBJECTIVES

PROVIDE:

- Calibrated snap acting sensor which opens with significant amplitude, due to maximum current and contact pressure being reached simultaneously.
- Convenient visible evidence of an over-load condition (VB3-M).
- Mechanical means of holding the open circuit condition (SAE Type II).
- Manual means of resetting.
- SAE Type I cycling unit with a well defined timed open/close cycle.
- A small cross-section area of the sensor for a fail-safe condition.
- A size and configuration for fuse replacement.

ELIMINATE:

- Sensors with decreasing contact pressure that tend to arc, tack and weld.
- Heater wires that generate significant heat to maintain an open circuit condition (SAE Type II).
- The large mass of the sensor that will not provide a fail-safe condition.



TO FUSE OR NOT TO RE-FUSE? NO LONGER THE QUESTION.

Locating the cause of overload can take many blown fuses. **ONE MODEL VB3 IS THE ANSWER.**

CAPABLE OF WITHSTANDING NUMEROUS HIGH OVERLOADS YET SENSITIVE ENOUGH TO ULTIMATELY FAIL SAFE.

Model VB3-M (left) & VB3-A (right), shown above with standard terminal configuration.

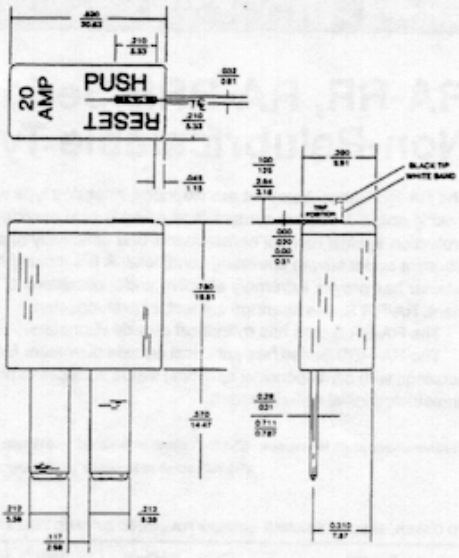
TOMORROWS STANDARD – AVAILABLE TODAY

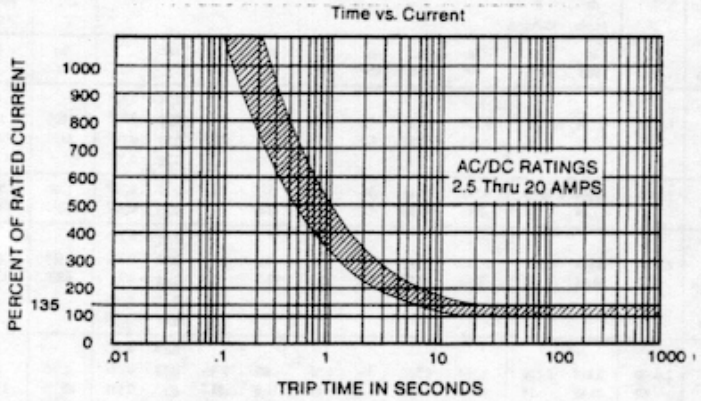
QUALITY:

- Snap Action sensor provides increasing contact pressure to effect trip, and promotes wiping action of contacts.
- Trip time of 2.6 to 6.5 seconds with 200% overload for all ratings.
- Precise correlation of trip time to rating in any unit.
- Must hold 100% — must trip 135%
- Withstands normal start-up and short duration surges without nuisance tripping.
- Fast response time.
- Unusual tolerance to vibration and shock environment.
- 100% final inspection test before the name goes on.

FEATURES:

- Housed in engineering plastic (non-corrosive - U.L. rated 94VO).
- Visual trip indicator is push to rest (Model VB3-M).
- SAE Type (self-resetting) has well defined open/close cycle on over-load. (Model VB3-A)
- Cannot be held manually closed (trip free).
- Ambient compensated (to 40°C).
- Introduces new convenience and quality to circuit protection.





SPECIFICATIONS

MODELS: VB3-A Cycling (SAE Type I), VB3-M Manual, reset non-cycling new concept (SAE Type II)

VOLTAGE: Up to 50 V.D.C.

RATINGS: 3 thru 20 AMPS

TEMPERATURE COMPENSATION: To 40°C

CALIBRATION: Must carry rated current at 25°C & 40°C. Must trip 135% of rating within ten minutes.

RESET TIME: Less than 15 seconds.

3,4,5,6,7.5,10,12.5,15,20 & 25 & 30 AMPS. NOW AVAILABLE

ORDERING INFORMATION

EXAMPLE: VB3- M20 -F57

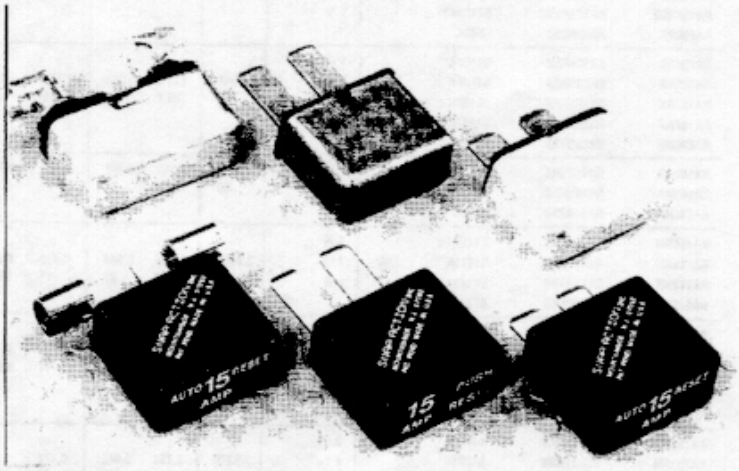
SERIES NUMBER:

TYPE RESET: A (automatic), M (manual)

AMP RATING: 3 thru 20

TERMINAL CONFIGURATION: F57 standard (flat .570x.110x.032). Consult factory for other terminal designs and modifications.

AUTO – TRUCK – RV's
AVIATION – MARINE
GENERATORS – BATTERY CHARGES
AND MANY OTHER
AC OR DC APPLICATIONS



MODEL VB3 REPLACES SENSORS WHICH LOSE CONTACT PRESSURE.

Terminal configuration can be provided to fit nearly any application.

QOU
Miniature Circuit Breakers and Switches

Part 1
QOU Miniature Circuit Breakers and Switches

This part of the catalog introduces QOU miniature circuit breakers and switches. QOUs are individually mounted with lugs on both the line and load end of the circuit breaker or switch. This section covers:

- Construction standards
- Ratings and tripping characteristics
- Catalog numbers used when ordering (to specify the circuit breaker and accessories used with it)
- Return and exchange policies

Part 2, Application Information, provides application information on QOU miniature circuit breakers and switches. They are presented in sections based on their voltage ratings as shown below:

Sections by Voltage Ratings

Section	Voltage Rating	Page
1	120/240Vac and 240Vac	9
2	277Vac	16

Part 3, Accessories, lists the accessories used with QOU miniature circuit breakers and switches. Ordering information for the accessories is also provided.

The **Glossary** defines terms used in this catalog.

Introduction

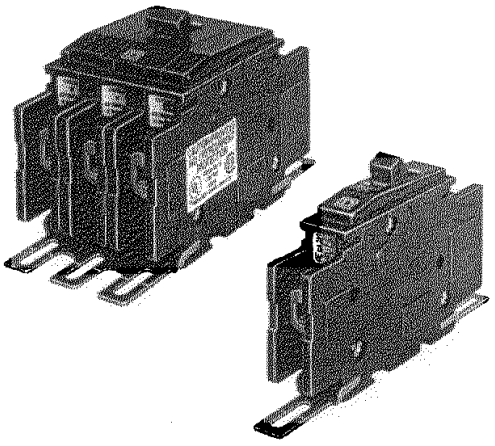
A circuit breaker is defined by the National Electrical Manufacturers Association (NEMA) as, "a device designed to open and close a circuit by non-automatic means, and to open the circuit automatically on a predetermined overcurrent, without damage to itself when properly applied within its rating." A molded case circuit breaker is "one that is assembled as an integral unit in a supportive and enclosing housing of insulating material." Miniature molded case circuit breakers are intended for use in residential and commercial applications, and are tested and listed according to UL 489 Standard for molded case circuit breakers and enclosures.

Square D manufactures thermal-magnetic, magnetic only, and electronic trip molded case circuit breakers. QOU miniature circuit breakers and switches are described in this catalog. Molded case thermal-magnetic and magnetic only circuit breakers, along with molded case switches are described in Catalog Class 601. Electronic trip circuit breakers are described in Catalog Class 602. Insulated case electronic trip circuit breakers are described in Catalog Class 603. Catalogs Class 601, 602 and 603 are separate publications available from Square D.

QOU Miniature Circuit Breaker Types

This catalog discusses the following types of miniature circuit breakers:

- QOU Thermal-magnetic circuit breakers
- QOU Non-Automatic Switches



QOU Thermal-Magnetic Circuit Breakers

Thermal-magnetic circuit breakers are the most common overcurrent protection devices. Their primary functions are to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. Thermal-magnetic circuit breakers use bimetals and electromagnetic assemblies to provide overcurrent protection. Their characteristic inverse time response to overload conditions is ideally suited for many different residential and commercial applications.

QOU Non-Automatic Switches

QOU Non-Automatic switches are intended for use as disconnect devices only. UL Standard 1087 requires switches to be protected by a thermal-magnetic circuit breaker (or fuse) of equivalent rating. QOU switches are UL listed for use on circuits capable of delivering not more than 10,000 amperes when protected by an equivalent rated circuit breaker or fuse.

QOU switches contain no automatic tripping mechanisms and **do not provide overcurrent protection.**

QOU switches are available in two- and three-pole, 60, 100, and 125 ampere construction for 240Vac.

Tripping Mechanisms

A tripping mechanism is an assembly within the circuit breaker molded case that causes the circuit breaker to open automatically under sustained overload or short-circuit conditions.

The tripping mechanisms in two- and three-pole circuit breakers operate such that an overcurrent on any given pole of the circuit breaker will cause all poles of the circuit breaker to open simultaneously. Thermal and magnetic factory calibration (with current) is performed on each pole of every circuit breaker manufactured by Square D.

QOU
Miniature Circuit Breakers and Switches

The following mechanisms operate to trip the circuit breaker:

- Thermal trip
- Magnetic trip
- Optional shunt trip accessory

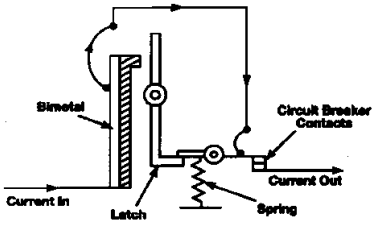
NOTE: Shunt trip is described in **Part 3, Accessories.**

The sensing system of a thermal-magnetic circuit breaker is an integral part of the circuit breaker that continually monitors the current flowing through the circuit breaker. It detects abnormal current conditions and, depending on the magnitude of the current, initiates an inverse-time or an instantaneous tripping response. This action causes the tripping mechanism to open the circuit breaker contacts and interrupt current flow. The speed of the tripping process must be controllable and inversely matched to the severity of the overcurrent. The QOU miniature circuit breaker has an over-center toggle mechanism for quick-make, quick-break action with positive handle indication. The handle assumes a position between ON and OFF when the circuit breaker has tripped.

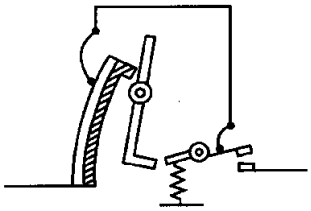
Thermal-magnetic circuit breakers have two tripping elements.

Thermal Trip: The circuit breaker thermal trip element is an rms (root mean squared) current sensing device. The thermal element or bimetal is constructed from metals of dissimilar rates of expansion bonded together. The thermal element responds to overloads by reacting to the heat generated both by the current flowing through the circuit breaker and by the heat contribution from ambient conditions. The bending force of the bimetal causes the circuit breaker to trip. *(See Figure 1.)* The deflection of the bimetal is predictable as a function of current and time. This is the inverse time tripping characteristics of the thermal element (i.e., the tripping time decreases as the magnitude of the current increases).

Square D calibrates the thermal elements and they are not field adjustable. The thermal trip elements are calibrated for 40°C ambient temperature per UL Standard 489.



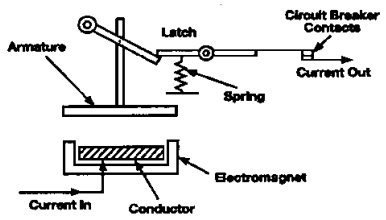
Normal Condition



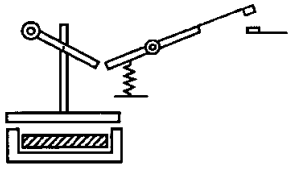
Thermal Trip Condition

Figure 1

Magnetic Trip: The magnetic (instantaneous) trip element uses an electromagnetic assembly to trip the circuit breaker instantaneously (with no intentional delay) at or above a predetermined current value. During a short circuit of sufficient magnitude, the high-level current passing through the conductor rapidly increases the magnetic field of the electromagnet which attracts the armature. As the armature is drawn toward the electromagnet, it initiates an unlatching action and opens the circuit breaker contacts. *(See Figure 2.)*



Normal Condition



Magnetic Trip Condition

Figure 2

Line and Load Connections

QOU miniature circuit breakers are supplied with two types of lug configurations as standard, depending on the continuous current rating.

- 10 - 70 ampere one- and two- pole - reversible lugs
- 10 - 60 ampere three pole - reversible lugs
- Other ampere ratings - forward lugs only

These circuit breakers are provided with box-type lugs that are UL listed to accept copper or aluminum wire. Optional terminations, such as quick connectors are also available. **See Section 3 - Accessories** for more information on terminations.

Mounting Provisions

QOU miniature circuit breakers are supplied with mounting brackets for both line and load side support. Mounting brackets are field installable and can be attached to the front or back of the circuit breaker molded case. **See Section 3 - Accessories** for more information on mounting brackets.

10 - 70 ampere one- and two-pole, and 10 - 60 ampere three-pole QOU's are also supplied with slots in the molded case for DIN rail mounting. These miniature circuit breakers are designed for use with a 7.5 mm X 35 mm DIN mounting rail.

The DIN rail mounting feature will be available on 80-100A one-pole, 80-125A two-pole, and 70-125A three-pole QOUs beginning January 1995.

Trip Indicator

When the QOU miniature circuit breaker is tripped, the handle assumes a position between ON and OFF (the tripped position) and the red VISI-TRIP® indicator appears in a window in the circuit breaker case. The circuit breaker and VISI-TRIP indicator is reset by pushing the handle to OFF and then to ON.

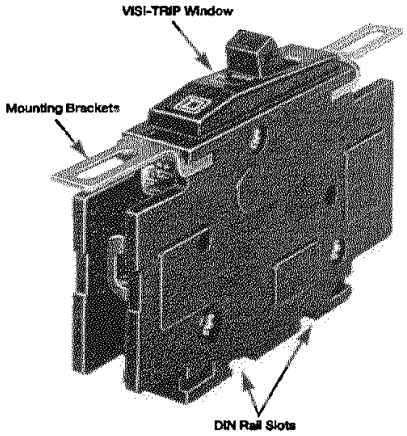


Figure 3

Circuit Breaker Tripping Characteristics

The tripping characteristics of thermal-magnetic circuit breakers are represented by a characteristic tripping curve. The curve shows the amount of time required for a circuit breaker to trip for overcurrent levels through the entire tripping range of the circuit breaker.

Thermal Tripping Characteristics

The top portion of the characteristic tripping curve displays the circuit breaker's thermal response. On overcurrent levels, up to the instantaneous tripping level, thermal tripping occurs when the bimetal in the circuit breaker responds to heat associated with the overcurrent. The larger the overcurrent, the faster the circuit breaker operates to open the circuit (inverse time).

Magnetic (Instantaneous) Tripping Characteristics

The bottom portion of the tripping curve displays the instantaneous tripping response of the circuit breaker. This takes place when overcurrents of sufficient magnitude operate the magnetic tripping mechanism. Magnetic tripping occurs with no intentional delay.

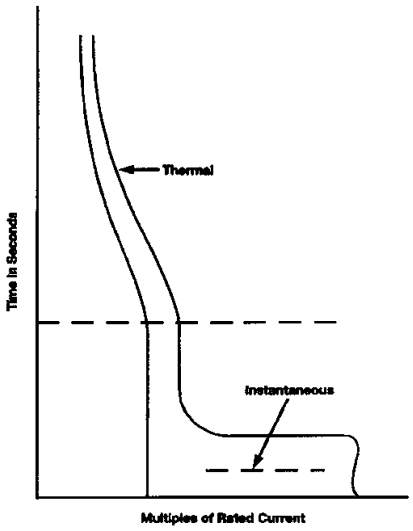


Figure 4

Construction

Square D QOU miniature circuit breakers are manufactured and tested according to the following standards:

- UL Standard 489
- NEMA Standard AB-1
- Canadian Standards Association CSA C22.2 No. 5.1

QOU switches comply with:

- UL Standard 1087
- Canadian Standards Association CSA C22.2 No. 5.2

NOTE: Circuit breakers are to be applied by guidelines detailed in the NEC and other applicable electrical codes.

Specifications

Cases for QOU miniature circuit breakers and switches are constructed of a glass-reinforced insulating material that provides high dielectric strength. Current carrying components are isolated from the handle. The handle position indicates whether the circuit breaker is OFF, ON, or tripped.

QOU miniature circuit breakers:

- have common tripping of all poles
- have a VISI-TRIP® trip indicator
- can be flush, surface, or DIN rail mounted
- operate in any position
- are fully tested, UL Listed, and CSA certified for reverse connection without restrictive line/load markings

QOU
Miniature Circuit Breakers and Switches

Tripping System
QOU miniature circuit breakers have a permanent trip unit that contains a factory preset thermal and magnetic trip element in each pole. The thermal trip element is rms sensing.

Terminations
The box-type lugs supplied on QOU miniature circuit breakers are UL listed to accept solid or stranded, aluminum or copper conductors. These lugs are UL listed to be used with wire rated at 60°C, 75°C and 90°C (sized according to the NEC 75°C temperature rating). See **Section 3 - Accessories** for more information on terminations.

UL Requirements
A UL label on the QOU miniature circuit breaker indicates that the circuit breaker meets the requirements of UL Standard 489 for molded case circuit breakers.

A UL label also means the production procedure is monitored by UL inspectors for continuing conformance to UL performance requirements. These requirements are based on sound engineering principles, research, records of test and field experience, and information gathered from users and inspection authorities.

UL HACR Type
Fifteen through sixty (15 - 60) ampere one-, two-, and three-pole QOU miniature circuit breakers are UL listed as HACR type. HACR is a term used to designate circuit breakers which have been certified to be used on heating, air conditioning and refrigeration loads. This means that these circuit breakers can be used to meet the requirements of Sections 430 and 440 of the NEC. Article 430-53(c) indicates that each circuit breaker must be of the inverse-time type and be approved for group installation. Section 440 lists the requirements for application and selection of the branch circuit overcurrent protective device for air conditioning and refrigeration equipment.

High Magnetic
QOU-HM circuit breakers are recommended for area lighting (athletic fields, parking lots, outdoor signs, etc.) when using lamps of inherent high inrush current or individual dimmer applications. These circuit breakers are available in 15 and 20 amperes only.

QOU-HM circuit breakers are manufactured with the magnetic trip point calibrated at a higher level than standard QOU circuit breakers. The table below lists the magnetic trip levels to which high magnetic circuit breakers are calibrated.

Circuit Breaker	Maximum Full Cycle Magnetic Hold Level
15 ampere	315 to 525 amperes
20 ampere	322 to 537 amperes

UL 489 Test Procedures

Limited Available Fault Current Tests
UL requires a series of tests on a single set of sample circuit breakers for compliance with UL Standard 489. The tests for thermal-magnetic circuit breakers are described below.

Since QOU switches are derivatives of QOU miniature circuit breakers, some testing of switches is identical to that for circuit breakers. These tests include a 600% overload performance test.

200% Thermal Calibration
Each pole of the circuit breaker must trip within a specified time limit when carrying 200% of its ampere rating.

135% Thermal Calibration
With all poles connected in series, the circuit breaker must trip within a specified time limit when carrying 135% of its ampere rating.

Overload
The circuit breaker is operated making and breaking 600% of its ampere rating, but not less than 150A.

For circuit breakers through 100A, the number of 600% operations is 35 manual open and close and 15 manual close and automatic open. For 125A circuit breakers, the number of operations is 50 manual open and close.

Temperature Rise
While carrying 100% of rated current at a 40°C ambient temperature and mounted in open air, the circuit breaker is checked for temperature rise on a wiring terminal. The temperature rise must not exceed a 50°C rise above ambient temperature and must be within specified limits.

Endurance
The circuit breaker must successfully complete the number of switching operations shown in the following table. One switching operation includes a motion to turn the circuit breaker "ON", and a motion to turn the circuit breaker "OFF".

Amperes	Full Load Operations	No Load Operations
0-100	6,000	4,000
125	4,000	4,000

Switching Duty
The switching duty (SWD) listing applies only to 15A and 20A circuit breakers rated at 277Vac or less. The circuit breakers are subjected to specified temperature rise tests at predetermined periods during the endurance operations.

Calibration Retest
Both the 200% and 135% thermal calibration tests are repeated.

Short Circuit
For circuit breakers rated 240V, two short-circuit tests per pole and one test with all poles connected in series are performed.

For example, a 3-pole circuit breaker receives seven short circuit tests.

For circuit breakers rated 120/240V, three tests are made with all poles connected in series.

The circuit breaker is connected to the test circuit using wire correctly sized for the rating of the circuit breaker. The line leads are not more than 4 feet in length and the load leads are not more than 10 inches in length

An additional short-circuit bus connected test is required for frame sizes or construction groups below 100 amperes.

NOTE: Successful testing requires that the current be interrupted while maintaining the integrity of all conductors and connections.

Trip Out
The 200% thermal calibration test is repeated following the short circuit tests.

Dielectric
The circuit breaker must withstand, for one minute, twice its rated voltage plus 1000V:

- Between line and load terminals with the circuit breaker open, that is, with the circuit breaker either tripped or OFF,
- Between terminals of opposite polarity with the circuit breaker closed, and
- Between live parts and the overall enclosure with the circuit breaker both open and closed.

No conditioning of the circuit breaker can take place during or between tests. There also can be no failure of functional parts at the conclusion of the sequences.

High Available Fault Current Tests

After qualifying a set of circuit breakers to the standard tests, a manufacturer can have additional circuit breaker samples tested on higher than standard available fault currents.

The following performance requirements apply:

200% Thermal Calibration
Each pole of the circuit breaker must trip within a specified time limit when carrying 200% of its continuous current rating.

Short Circuit
With the load side terminals connected by 10 inch lengths of specified wire, the circuit breaker is exposed to a short-circuit current. After successful interruption the circuit breaker is reset and closed again on the short circuit.

Trip Out
Each pole of the circuit breaker must trip within a specified time limit when carrying 250% of its continuous current rating.

Dielectric Withstand
The circuit breaker is subjected to twice its rated voltage, but not less than 900V.

Ratings for QOU Miniature Circuit Breakers

QOU circuit breakers are selected by their ratings. The ratings must meet or exceed the parameters of the electrical system on which they are used.

Voltage Rating
A circuit breaker can be rated for alternating current (ac) or direct current (dc) or both. The established voltage rating of a circuit breaker is based on design parameters such as clearance of current carrying parts and dielectric withstand tests both through air and over surfaces. Voltage ratings indicate the maximum voltage for the electrical system on which the circuit breaker can be applied. QOU miniature circuit breakers are available in the following voltages:

- 120/240Vac
- 240Vac
- 48Vdc
- 60Vdc
- 277Vac available as UL 1077 recognized supplementary protector only (not a branch circuit breaker).

Continuous Current Rating
The continuous current rating (or handle rating) of a circuit breaker is defined by NEMA as: "The maximum direct current or rms current, in amperes, at rated frequency which a device or assembly will carry continuously without exceeding the specified limits of observable temperature rise." QOU circuit breakers are available in the following continuous current ratings: 10A, 15A, 20A, 25A, 30A, 35A, 40A, 45A, 50A, 60A, 70A, 80A, 90A, 100A, and 125A.

UL Standard 489 states that circuit breakers must carry 100% of their continuous current rating indefinitely (without tripping) at 40°C in free air. QOU circuit breakers are rated, per the NEC, to carry 80% of their continuous current ratings in the intended enclosure. The continuous current rating is indicated on the handle of each circuit breaker.

Interrupting Ratings
The interrupting rating of a circuit breaker is the highest current at rated voltage that the circuit breaker is intended to interrupt under standard test conditions. Circuit breakers must be chosen with interrupting ratings equal to or greater than the available short circuit current at the point where the circuit breaker is applied in a system.

Circuit Breaker Type	Number of Poles	Ampere Rating	UL Listed Interrupting Rating RMS Sym. Amps.			
			ac Volts		①dc Volts	
			120/240	240	48	60
QOU	1	10-70	10 kA	NA	5 kA	NA
		80-100	10 kA	NA	NA	5 kA
	2	10-70	10 kA	NA	5 kA	NA
		80-125	10 kA	NA	NA	5 kA
	3	10-70	NA	10 kA	5 kA	NA
		80-100	NA	10 kA	NA	5 kA
QOU-H	2	15-30	NA	5 kA	NA	NA

① dc ratings do not apply to circuit breakers rated for 10 amperes
NA = Not applicable

QOU
Miniature Circuit Breakers and Switches

Ambient Temperature Rating

To meet the requirements of UL Standard 489 and CSA, thermal-magnetic circuit breakers are designed, built and calibrated for use on 50/60 Hertz (Hz) AC systems in a 40°C ambient temperature.

The ambient temperature is the temperature of the air surrounding a circuit breaker. Thermal-magnetic circuit breakers are temperature sensitive devices, and their rated continuous current carrying capacity is based on a UL specified 40°C calibration temperature. The ambient temperature can affect the thermal (overload) tripping characteristics of thermal-magnetic circuit breakers. When applying the circuit breaker at a temperature other than 40°C, it may be necessary to rerate the circuit breaker to compensate for ambient conditions. Conductors are sized using the ampacity rerating factors shown on the bottom of NEC Table 310-16 when designing systems for ambient temperatures other than 40°C.

Thermal-magnetic circuit breakers use bimetal strips that bend in response to temperature changes. Current flowing through the circuit breaker creates most of the heat that causes the tripping action. The ambient temperature surrounding the circuit breaker either adds to or subtracts from this available heat.

Rerating of Thermal-Magnetic Circuit Breakers for Ambient Conditions

Square D thermal-magnetic circuit breakers are to be applied in ambient temperatures within a range of -10°C to +60°C. Use the following rerating guidelines:

1. At ambient temperatures between 25°C and 40°C, no rerating is necessary.
2. At ambient temperatures between -10°C and +25°C, thermal-magnetic circuit breakers carry more than their continuous current rating without tripping. Wire and equipment damage can result if they are not in the same low ambient environment as the circuit breaker.

   If closer protection of the equipment and wire is required, the increased current carrying capacity of the circuit breaker at the lower ambient temperature should be taken into consideration.
3. At ambient temperatures between 41°C and 60°C thermal-magnetic circuit breakers carry less than their continuous current rating and must be carefully selected to prevent nuisance tripping.

The following procedure is used to determine the continuous current carrying capacity of a thermal-magnetic circuit breaker at an ambient temperature other that 40°C:

1. Refer to the ambient rerating curve, *Figure 5*.
2. Select the curve for the specific amperage rating of the circuit breaker involved. Note that the curve crosses the 40°C ambient temperature line at the circuit breaker's UL Listed continuous current rating (handle rating).
3. Follow the curve to the ambient temperature in which the circuit breaker will be installed.
4. Read the continuous current carrying capacity at the left axis point.
5. Apply any other applicable factors, such as 80% loading per the NEC.

For example, *Figure 5* shows the ambient rerating curves for QOU miniature circuit breakers. Determine the continuous current carrying capacity of an 80A circuit breaker applied at 50°C by finding 50 on the horizontal axis and reading up to the 80A curve and over to the vertical axis on the left-hand side. The circuit breaker is rerated to carry 75A when applied at 50°C. If the circuit breaker is used on a continuous load (three hours or more), Paragraph 220-3(a) of the NEC requires that loading not exceed 80% of the rating (75A x .80 = 60A).

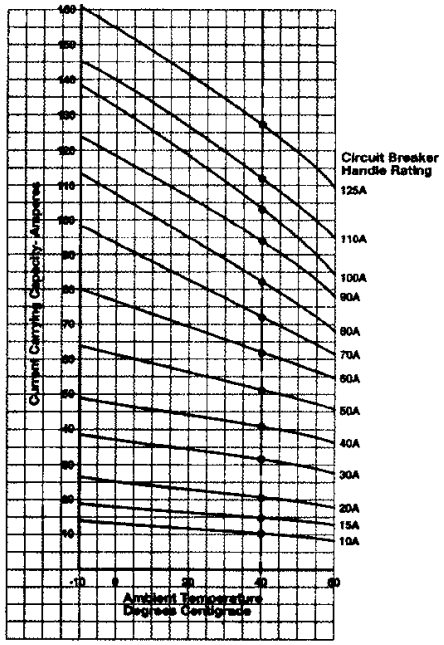


Figure 5

Frequency Rating

The standard rated frequency for circuit breakers is 60 Hz, but Square D circuit breakers can be applied on 50 Hz systems without thermal or magnetic rerating. Other frequencies can affect the thermal, magnetic and short-circuit tripping characteristics of circuit breakers.

Applying thermal-magnetic circuit breakers at frequencies above 50/60 Hz requires special consideration of the effects of high frequency on circuit breaker tripping characteristics. Thermal and magnetic operations must be treated separately.

Thermal Tripping Performance

At frequencies below 60 Hz, the thermal rerating of thermal-magnetic circuit breakers is negligible. However, at frequencies above 60 Hz, thermal rerating is required. High frequency operation causes abnormal heat rise in the current carrying parts because of the skin effect. One of the most common frequency applications is at 400 Hz.

See *Figure 6*. For example , when applying a 100A QOU circuit breaker on a 400 Hz system, the circuit breaker's current carrying capacity is as follows:

- Non-continuous loads (less than three hours): The QOU circuit breaker may be applied at .78 of its rating, or 78A.
- Continuous loads (three hours or more): Paragraph 220-3(a) of the NEC requires that circuit breaker loading does not exceed 80% of its rating when used for continuous loads. Therefore the current carry capacity of a 100A QOU circuit breaker operating under continuous load at 400 Hz would be 100 x .78 x .80 = 62A.

At frequencies above 60 Hz, the interrupting rating of thermal-magnetic circuit breakers is less than the 60 Hz interrupting rating. Unless specifically marked for use on 400 Hz systems, the interrupting rating of Square D circuit breakers is reduced to 1/10th of the 60 Hz interrupting rating.

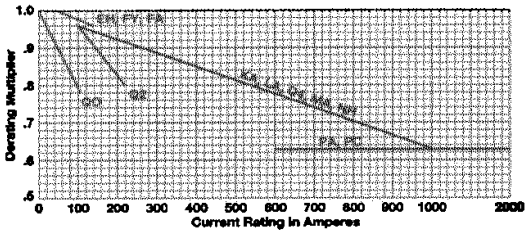


Figure 6: 400 Hz Thermal Rerating Multiplier

Magnetic Tripping Performance

At frequencies above 60 Hz, more current is necessary to magnetically trip a circuit breaker than at 60 Hz. *Figure 7* shows the multipliers of 60 Hz current that it takes to magnetically trip a circuit breaker when applied at various frequencies. For example, at 60 Hz it takes 700 amperes or more to magnetically trip a 100A QOU circuit breaker. At 400 Hz it takes 1820 amperes (2.6 multiplier) or more to magnetically trip the same circuit breaker.

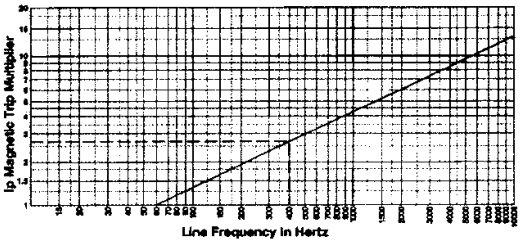


Figure 7: 60 Hz Current Multipliers

