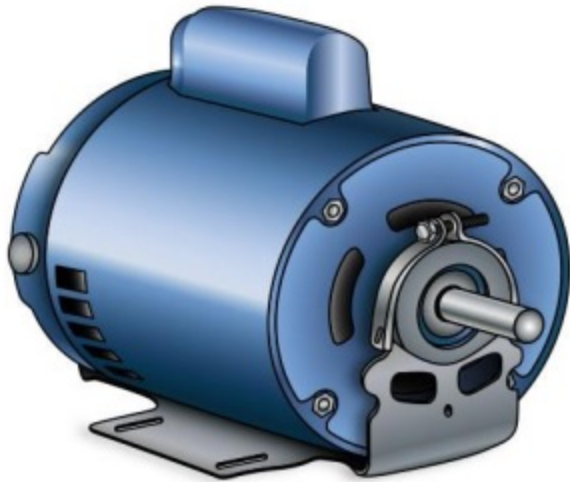


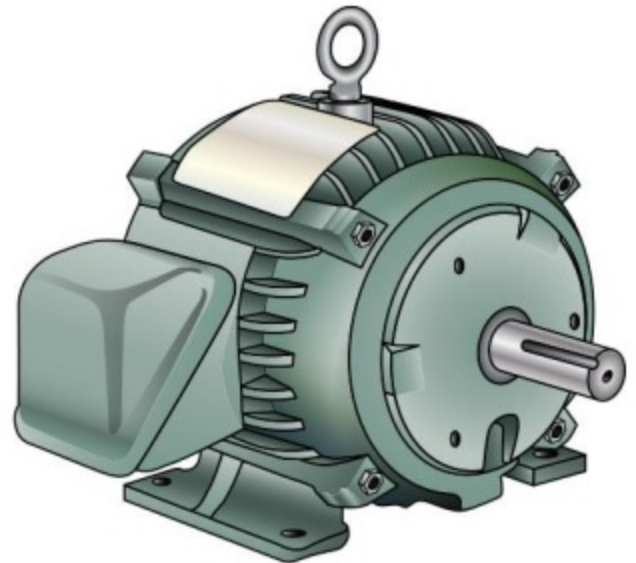
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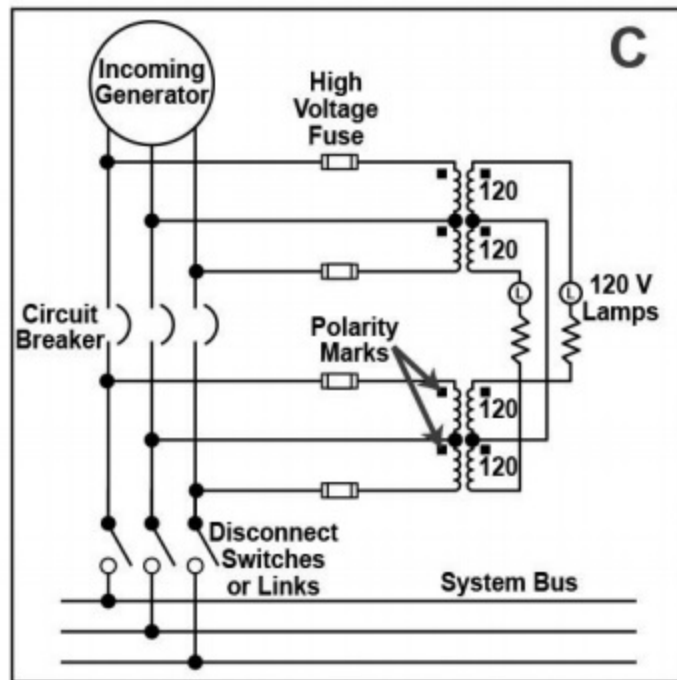
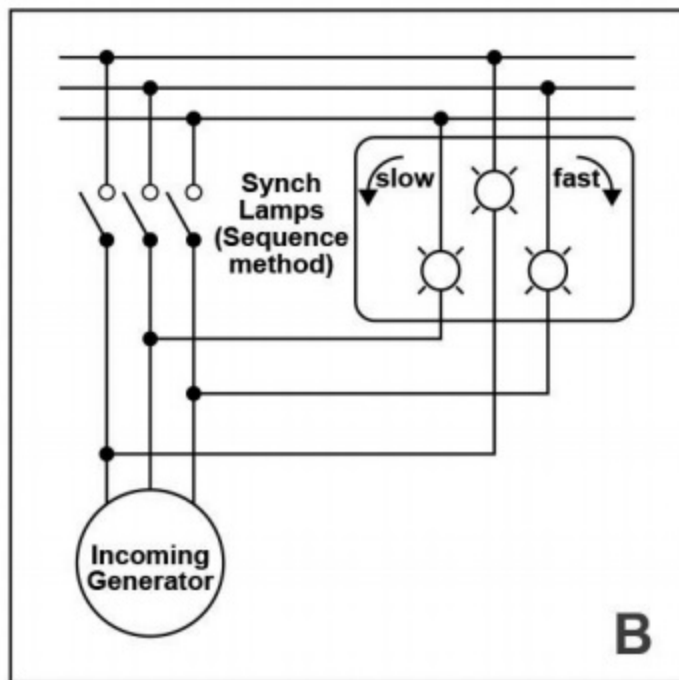
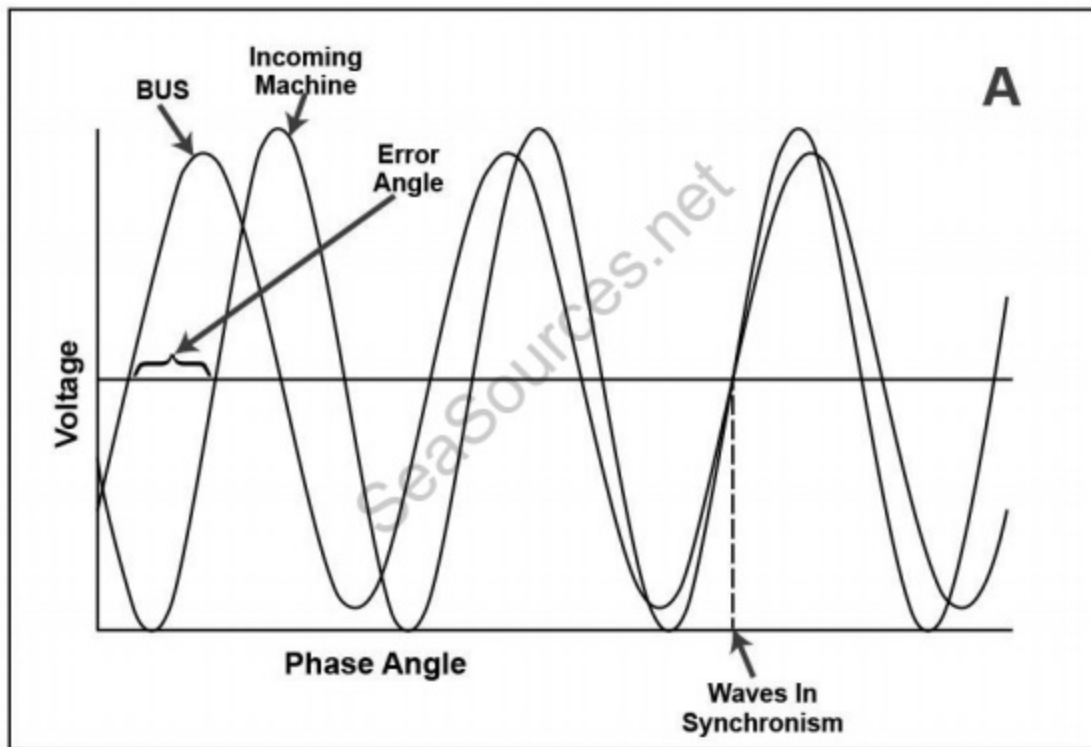
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C



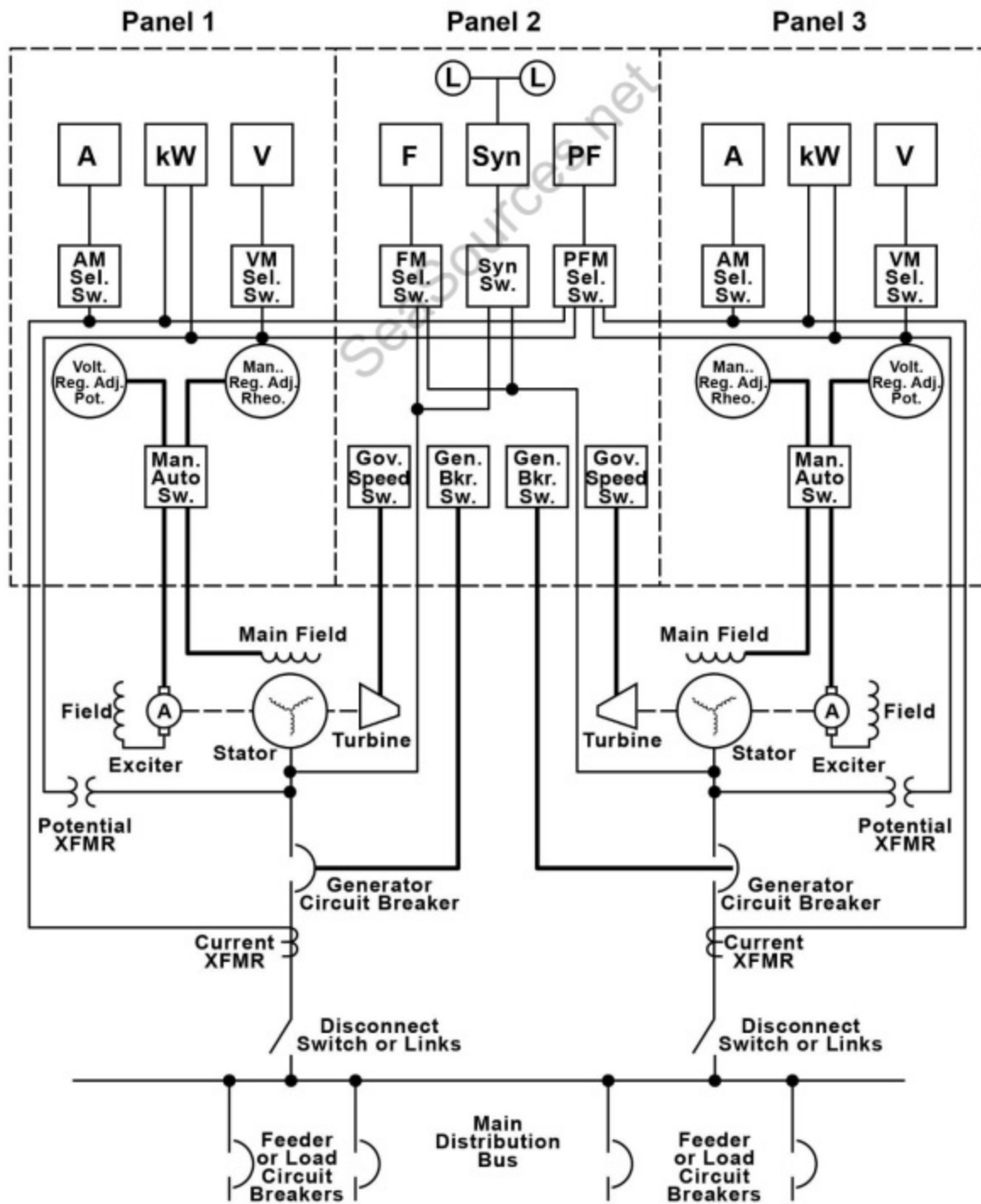
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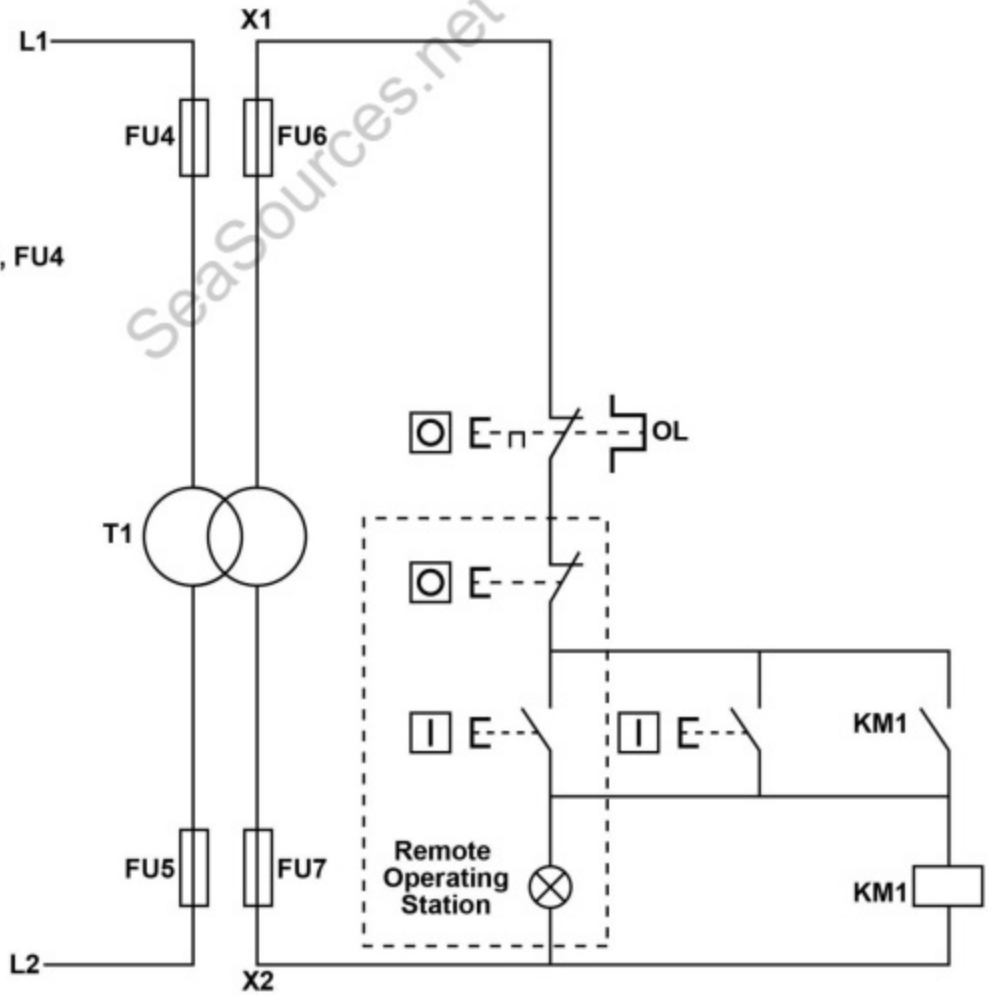
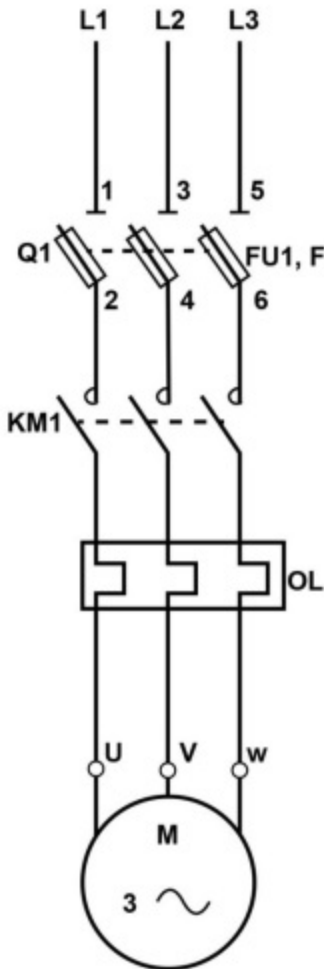
Figures A and C

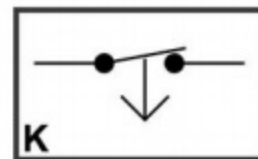
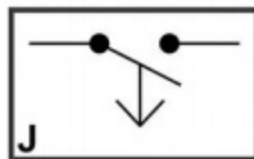
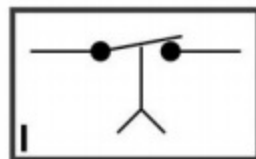
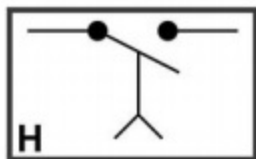
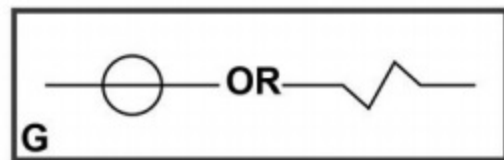
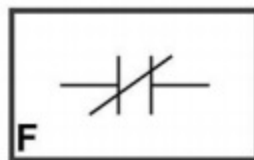
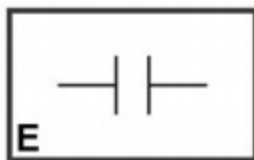
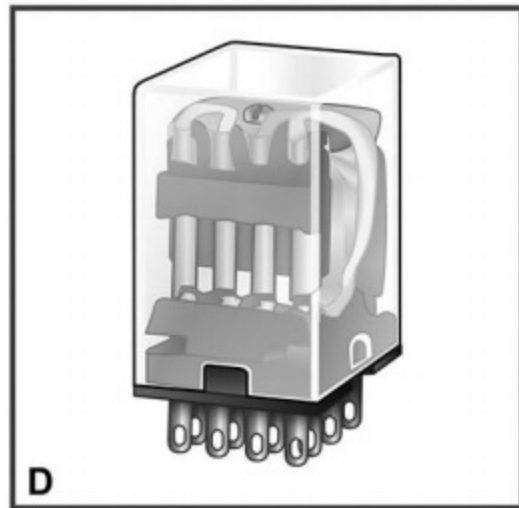
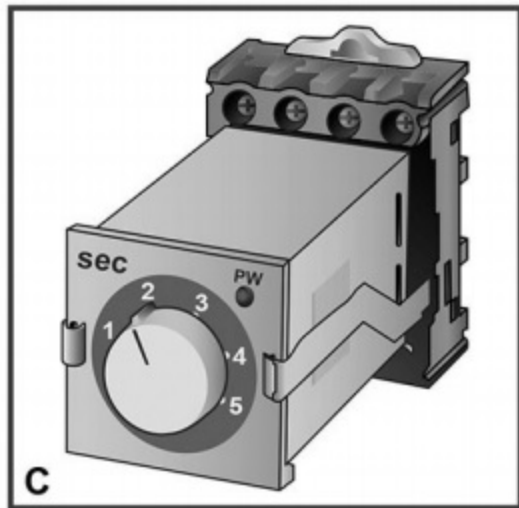
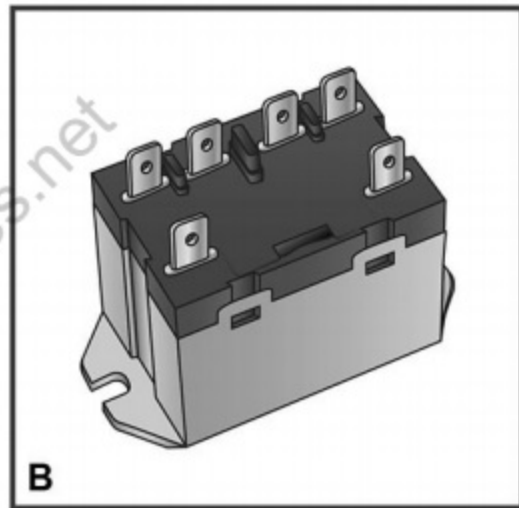
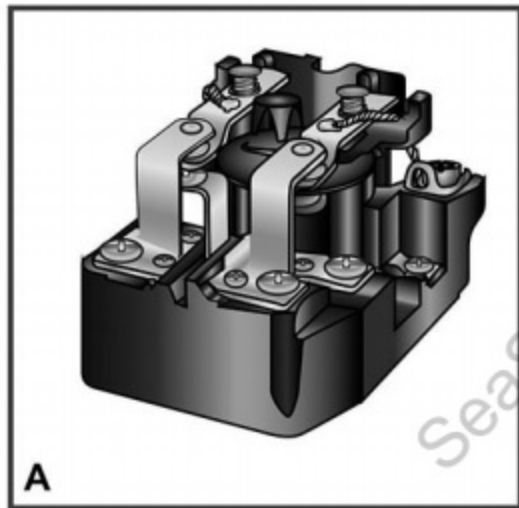
Figure B

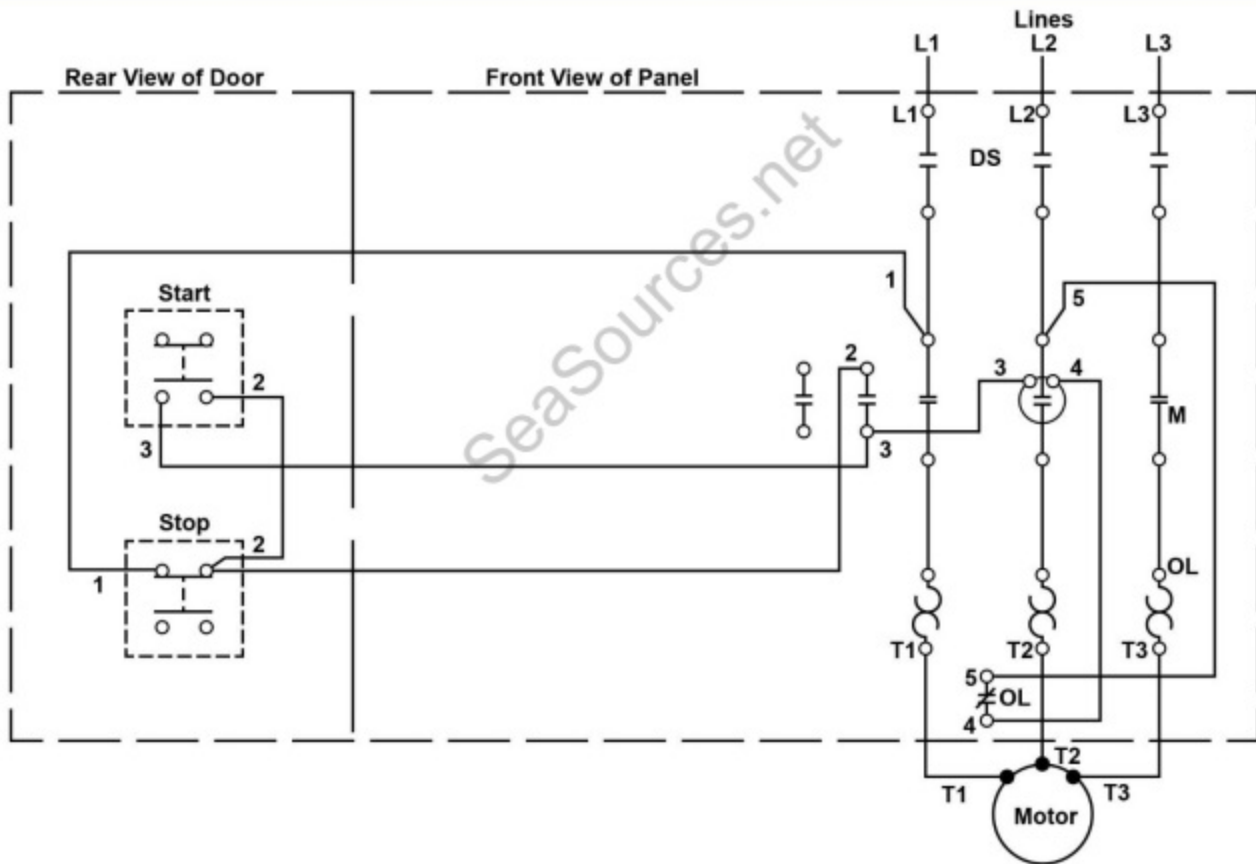
EL-0003



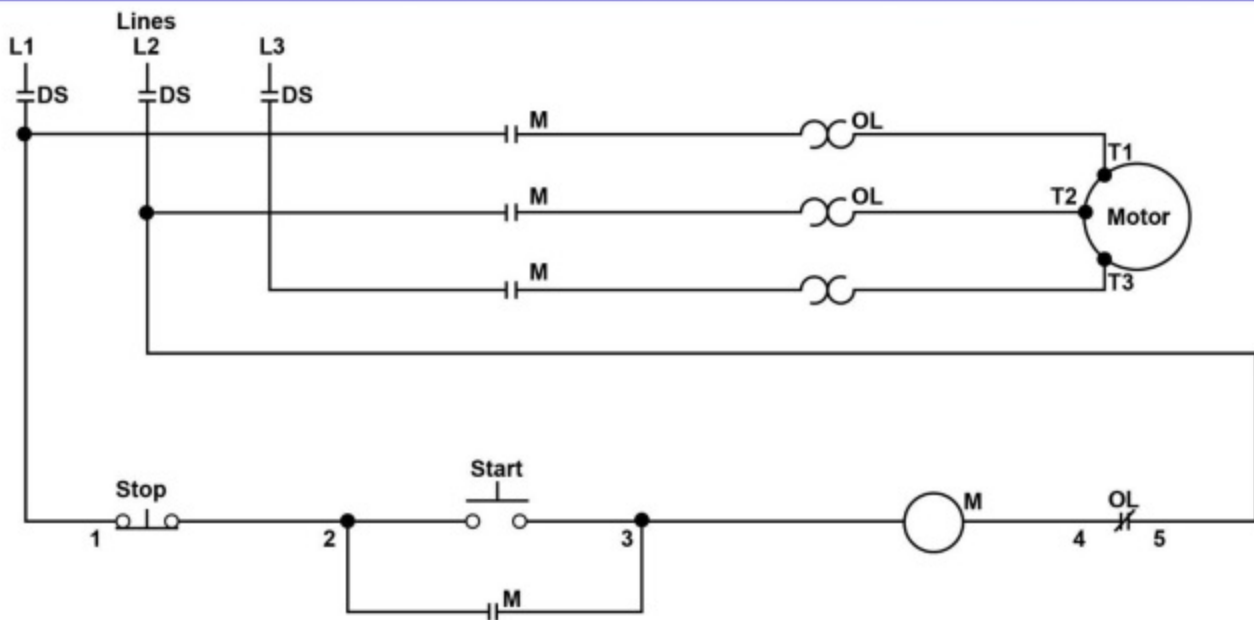
EL-0004





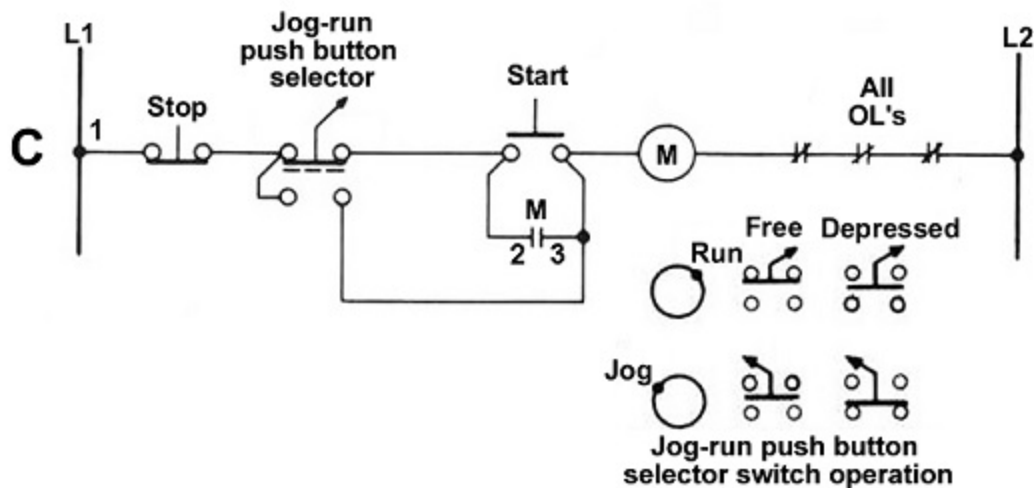
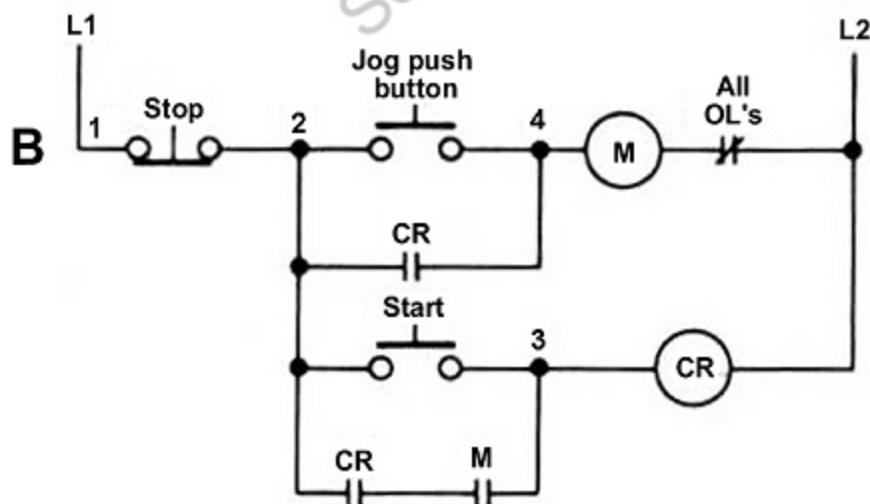
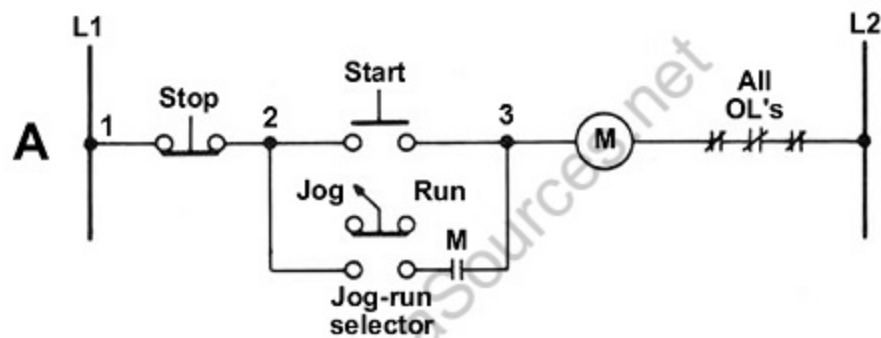


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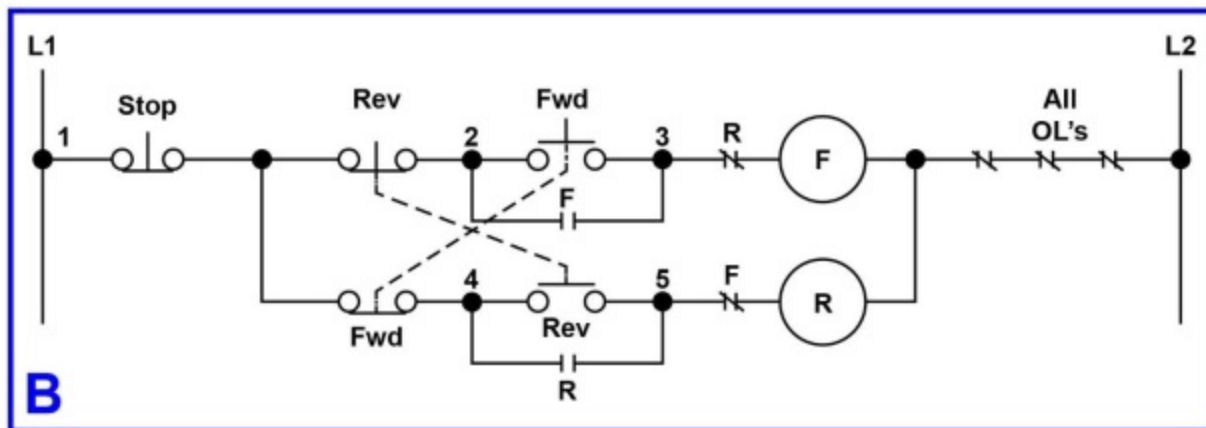
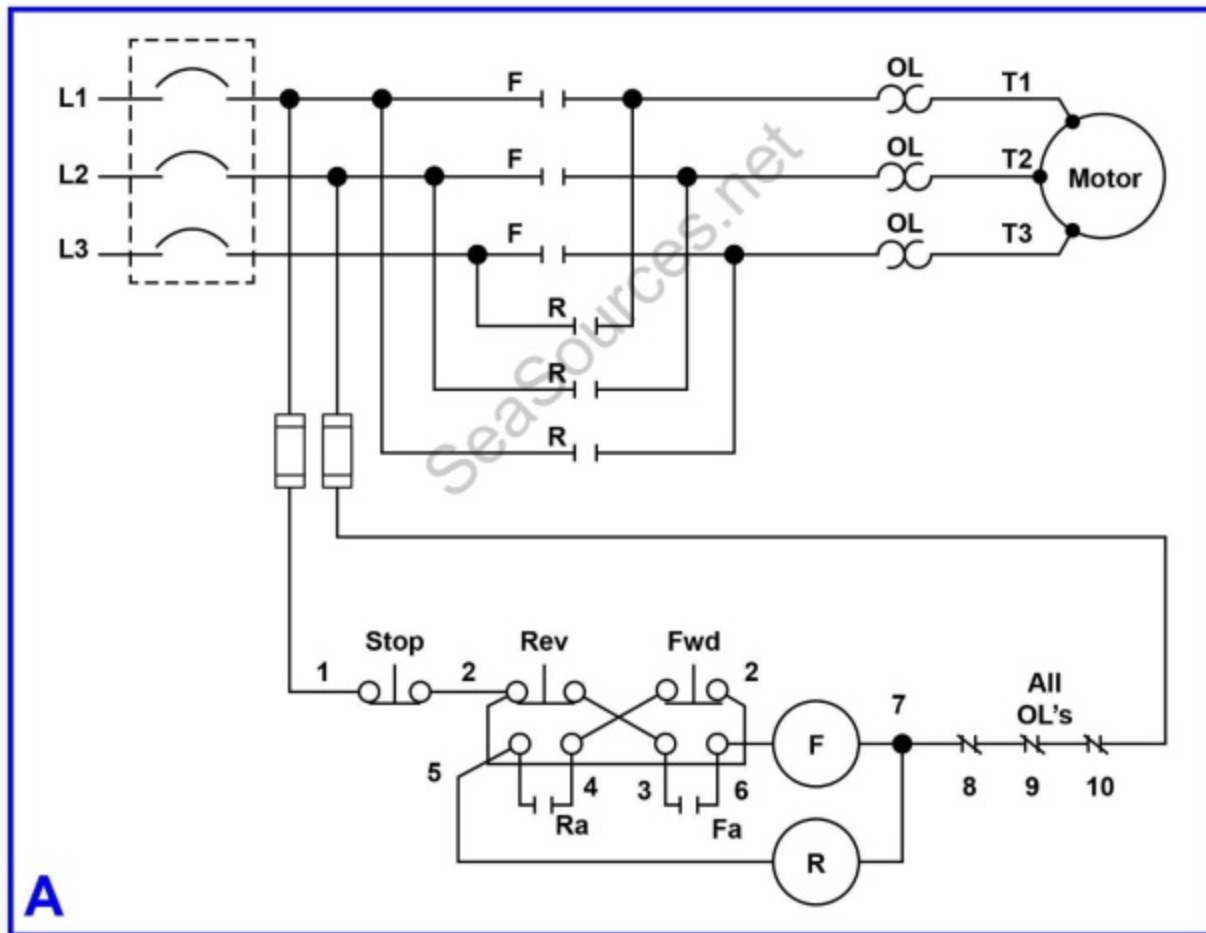


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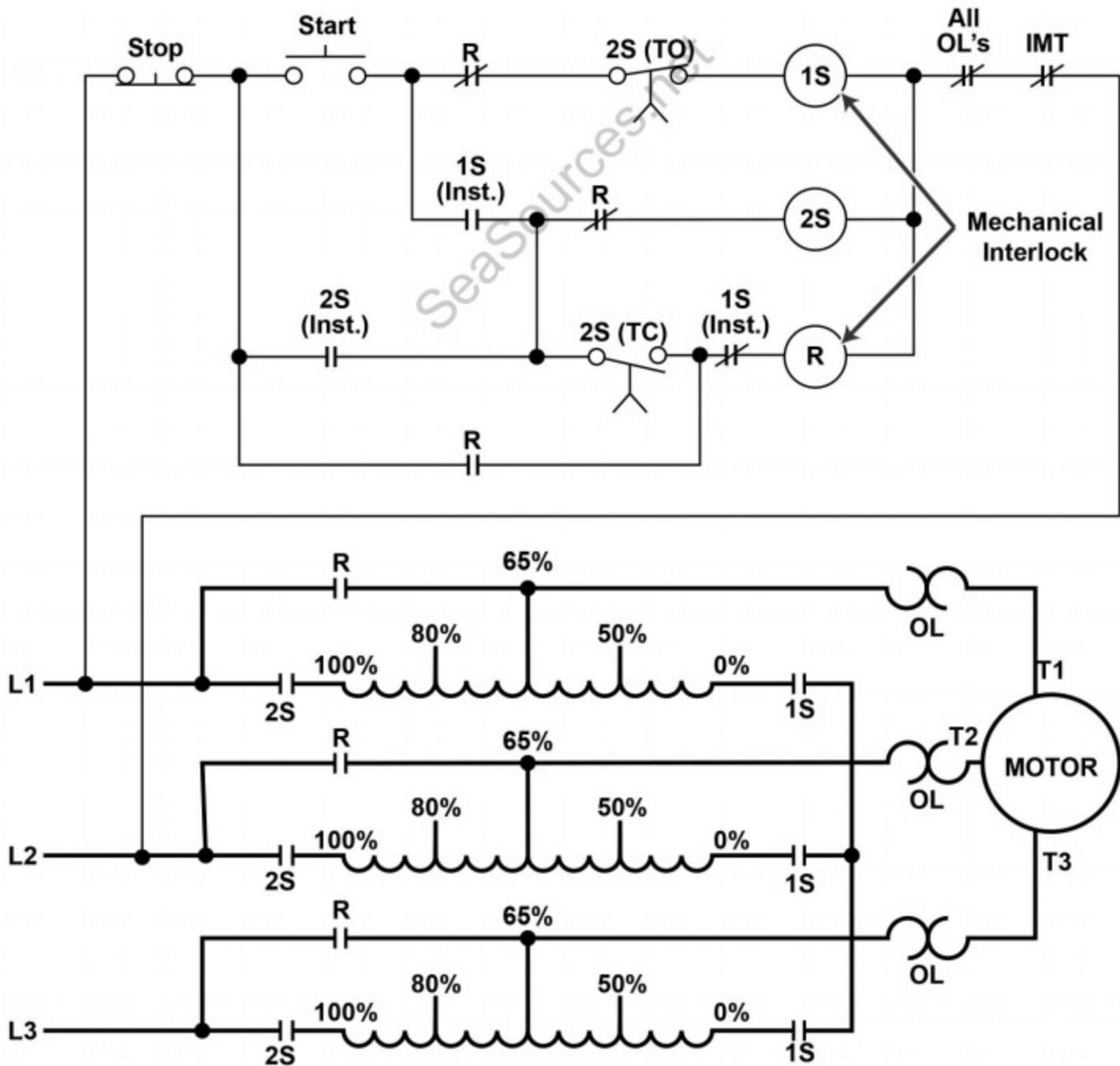
EL-0010

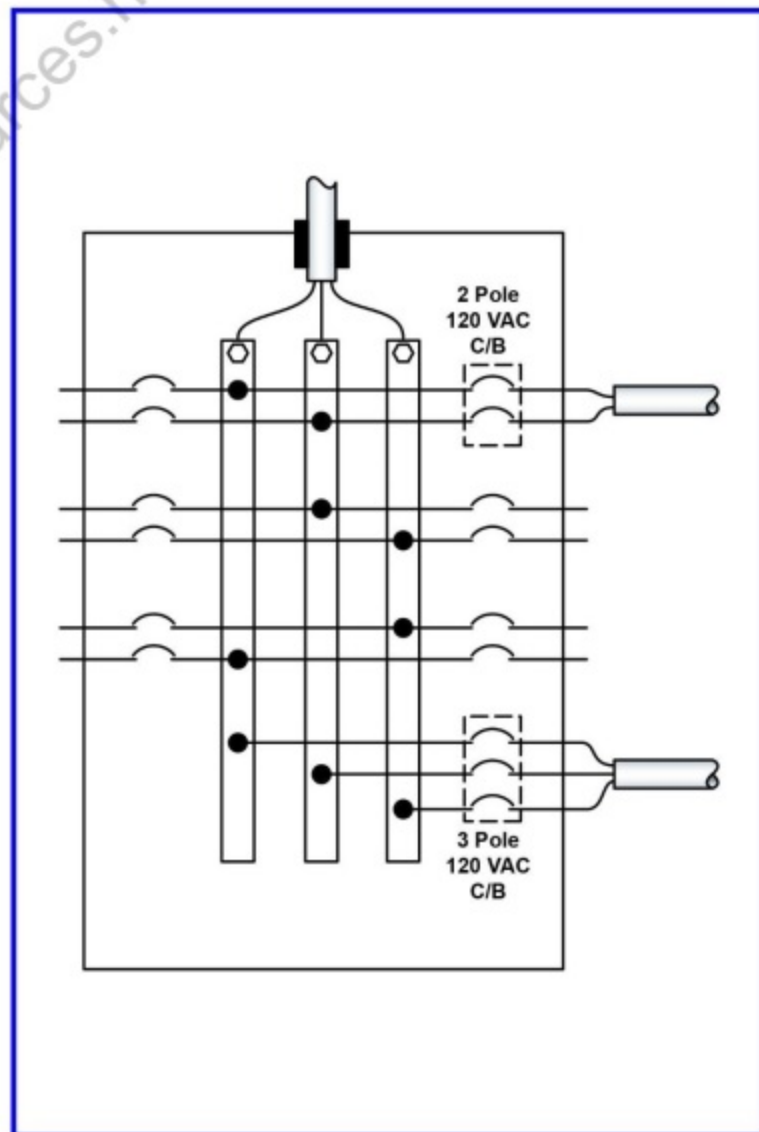
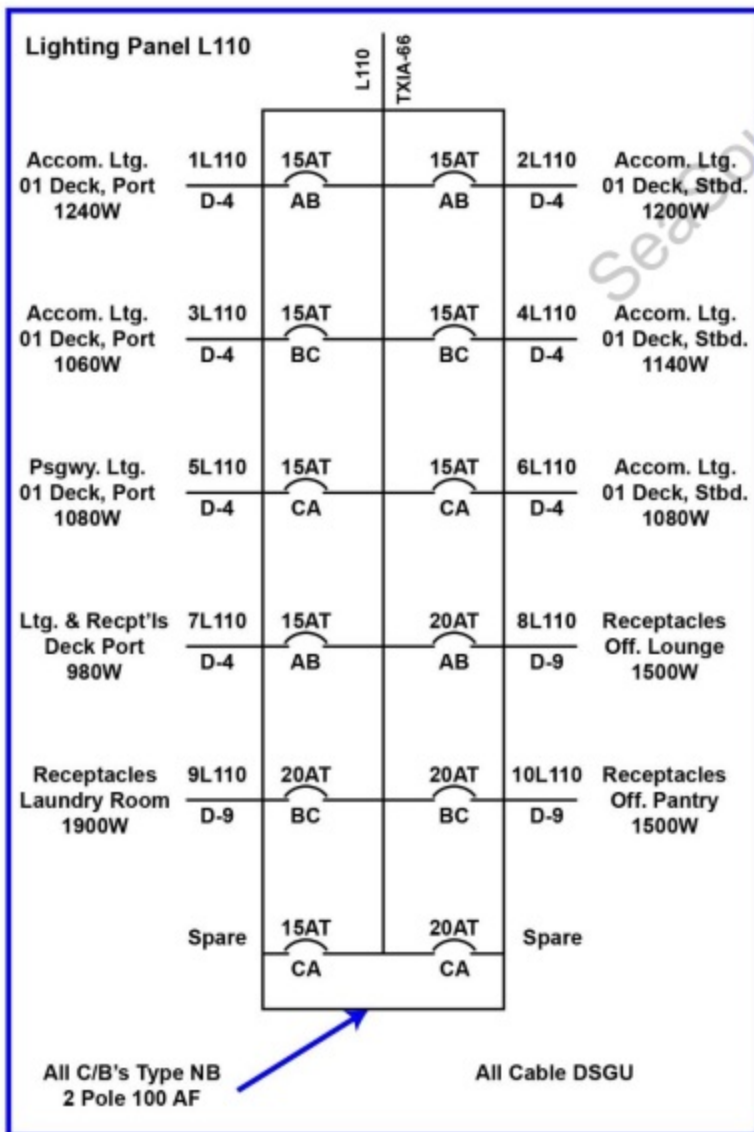


EL-0011

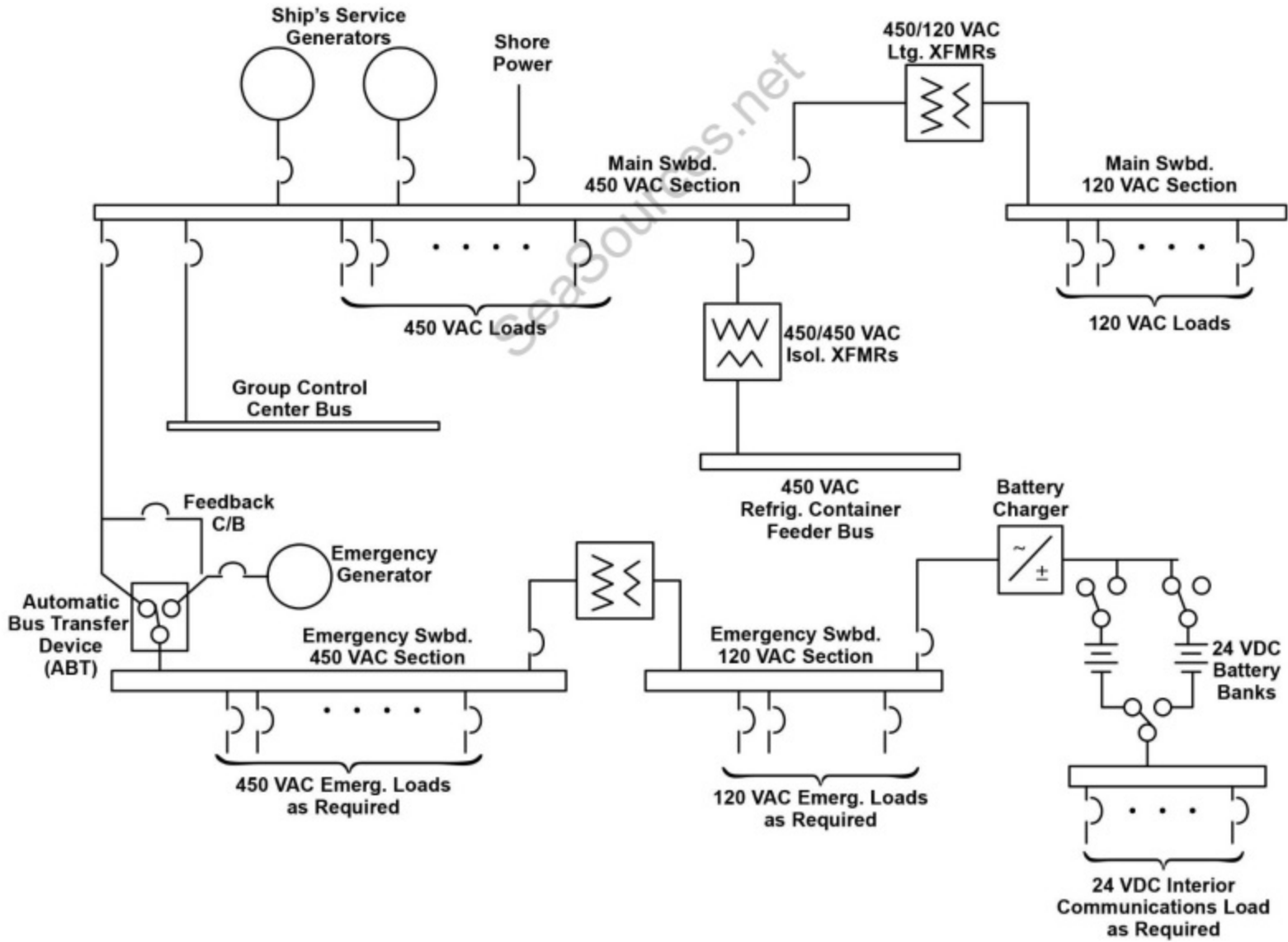


EL-0012



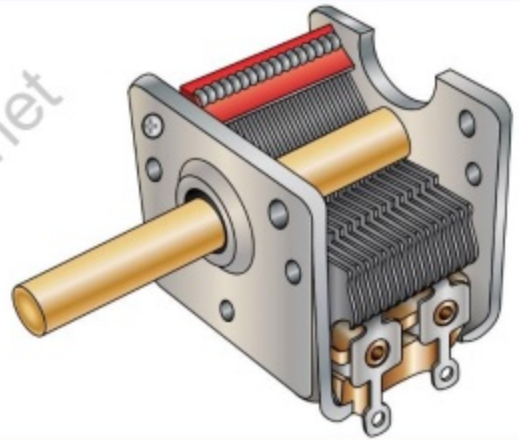


EL-0014

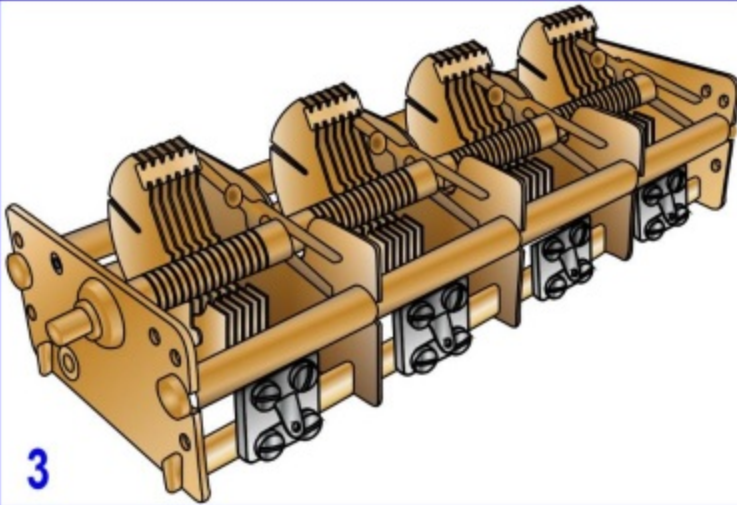




1



2



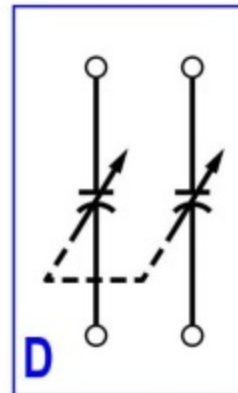
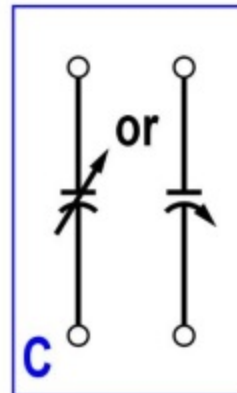
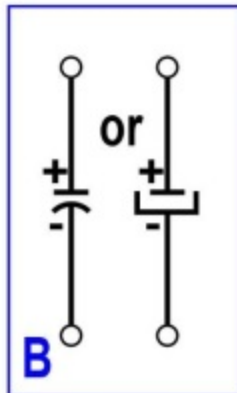
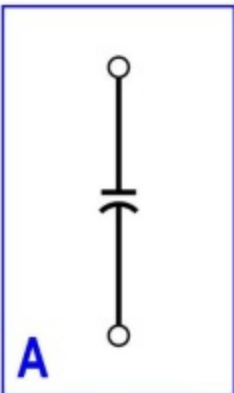
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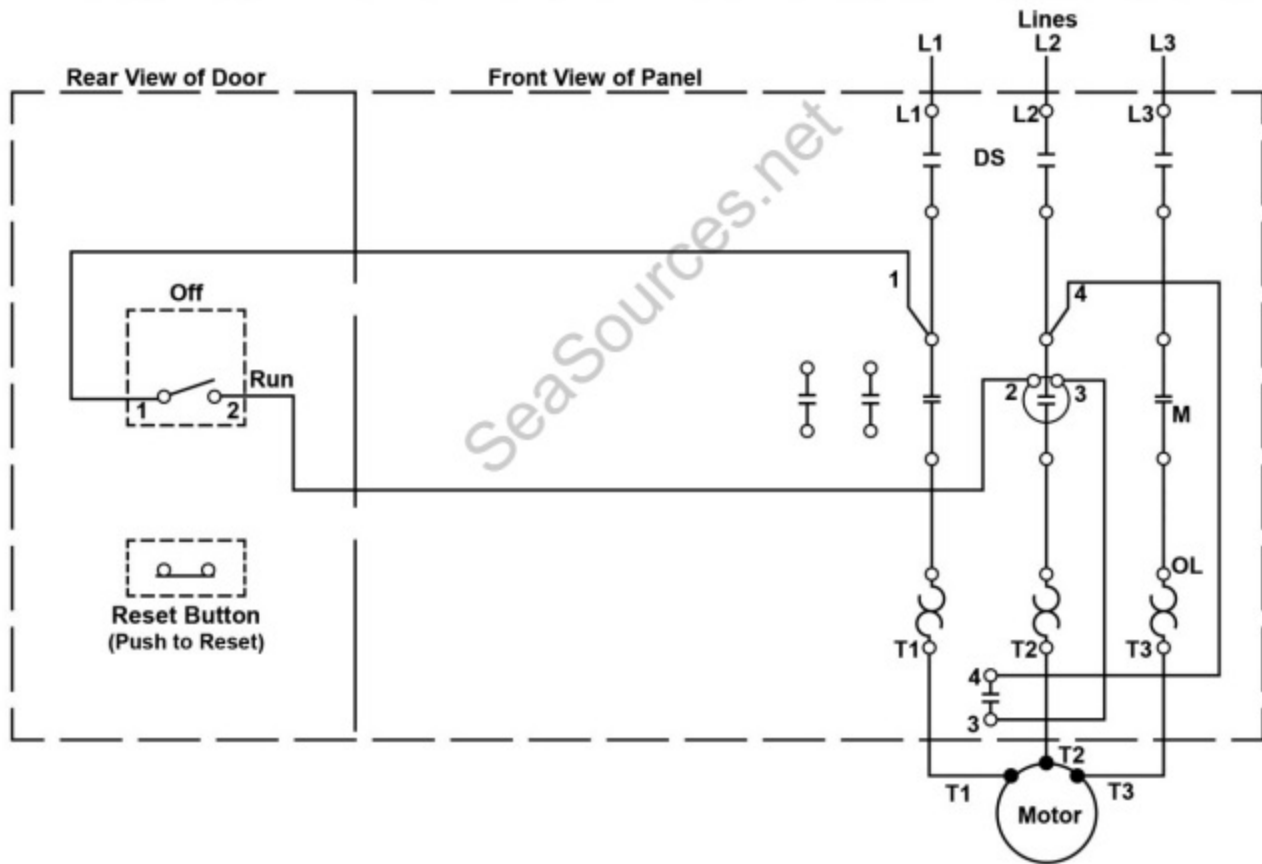


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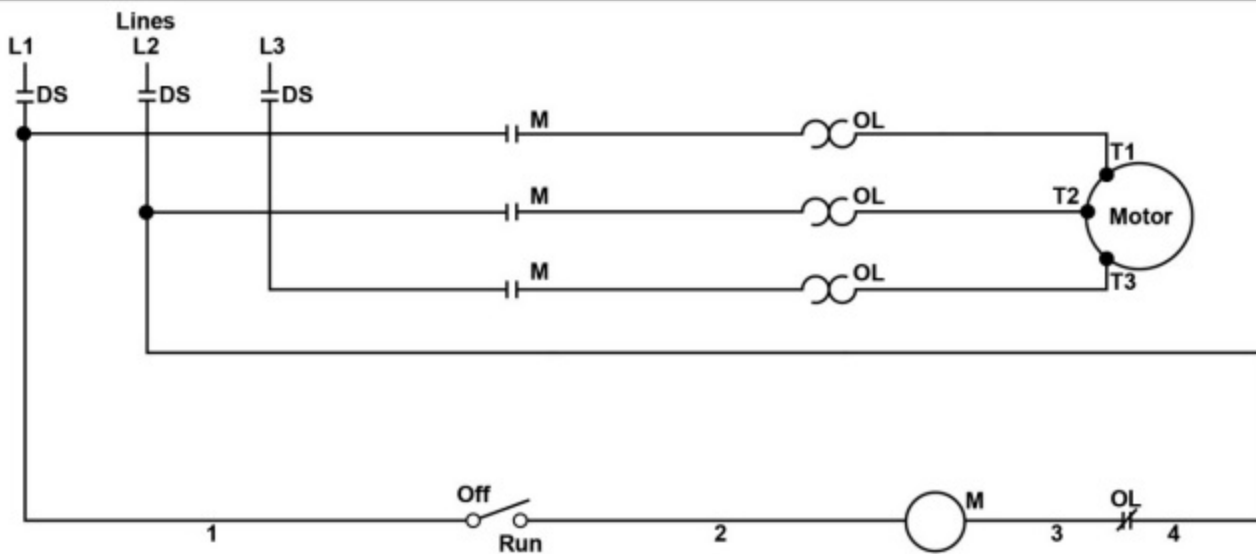


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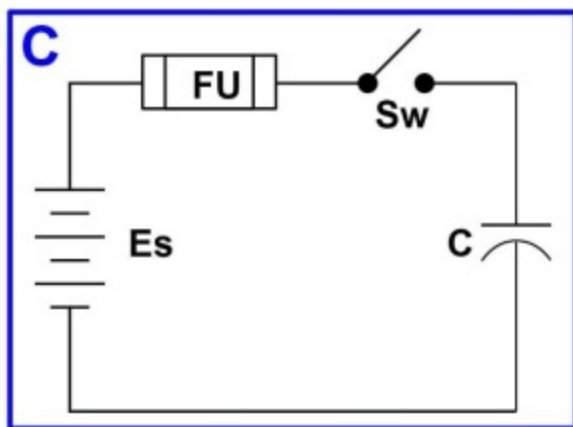
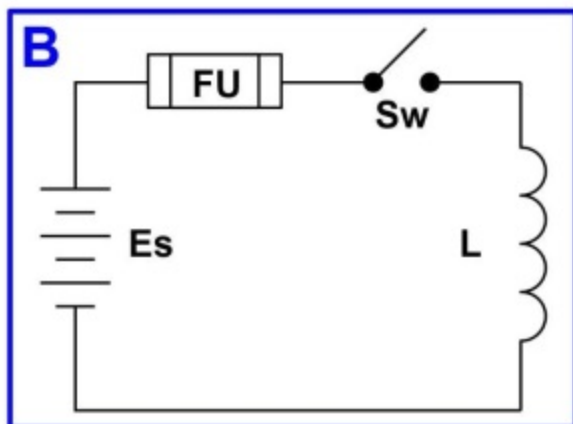
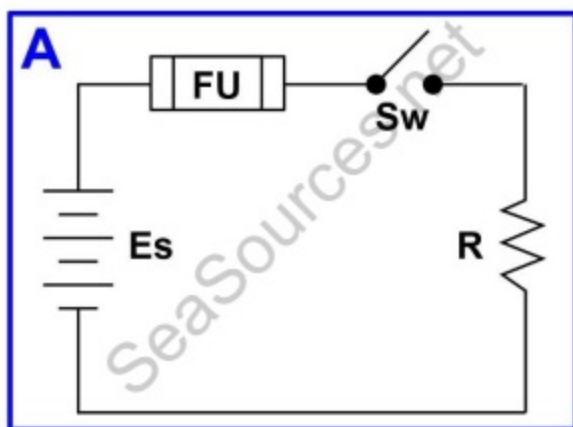


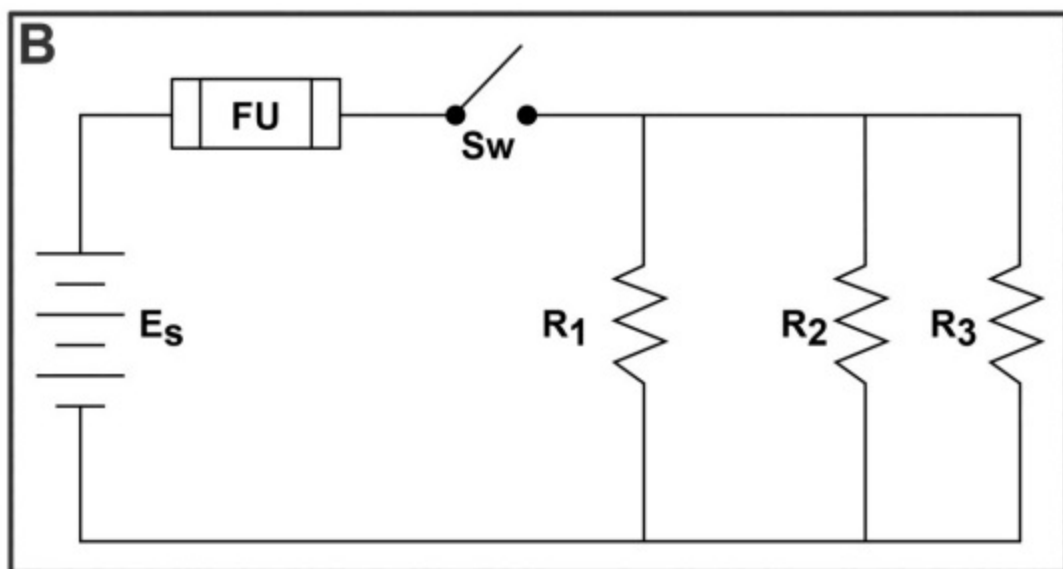
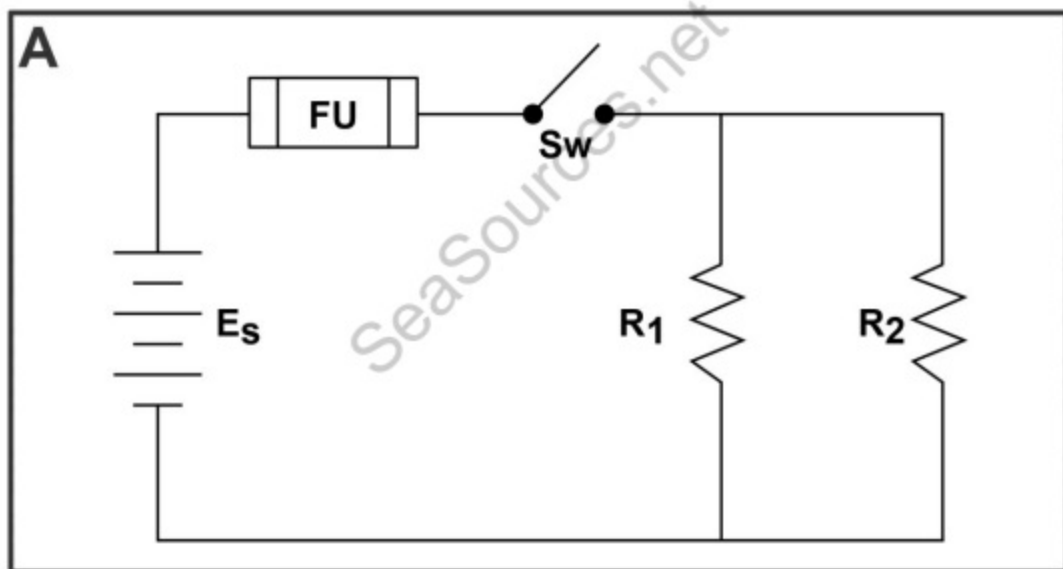


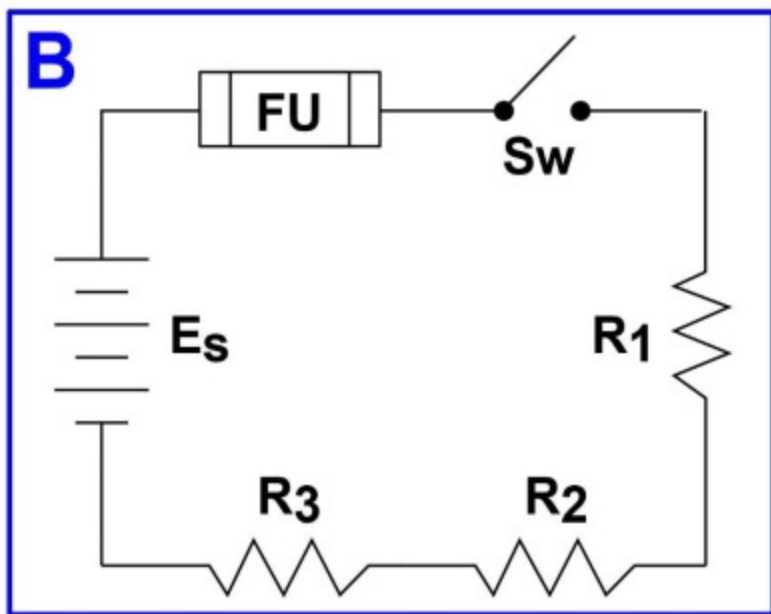
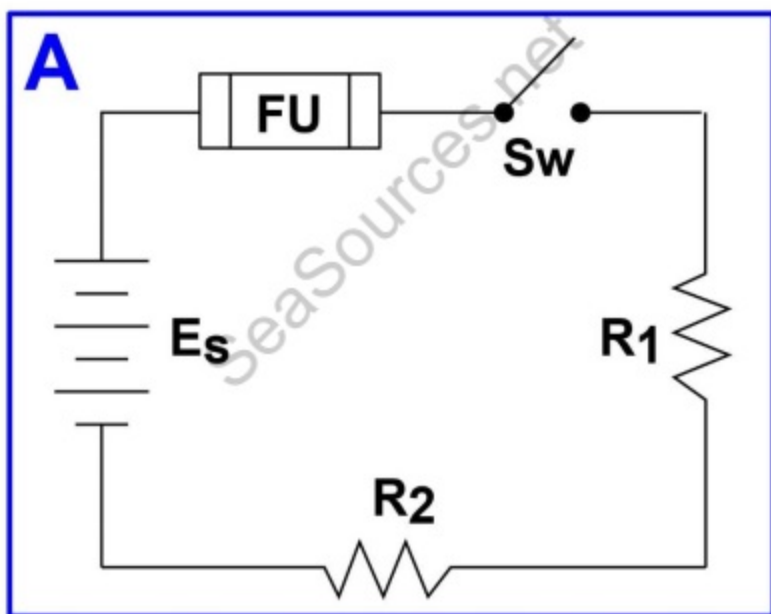
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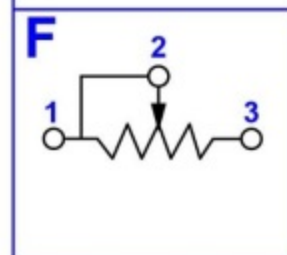
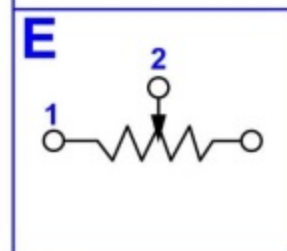
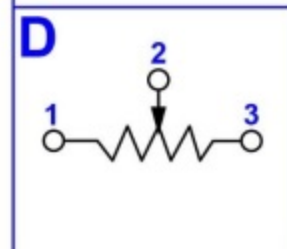
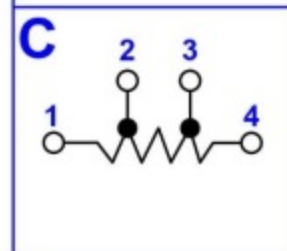
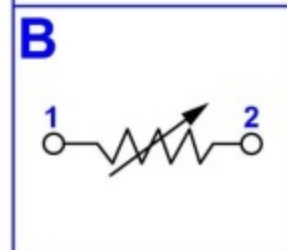
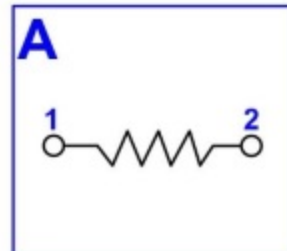
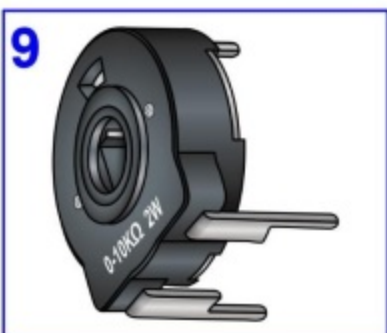
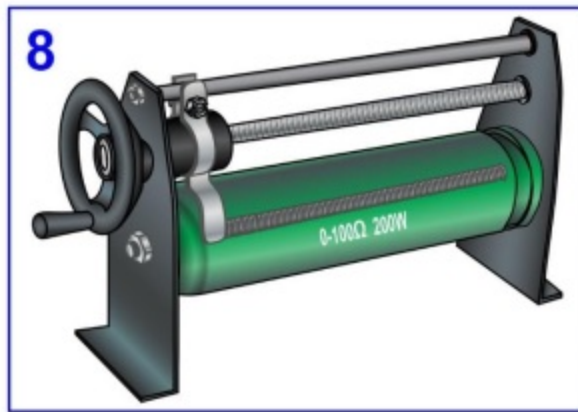
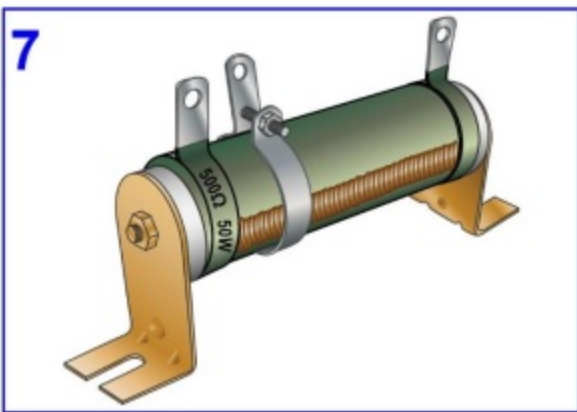
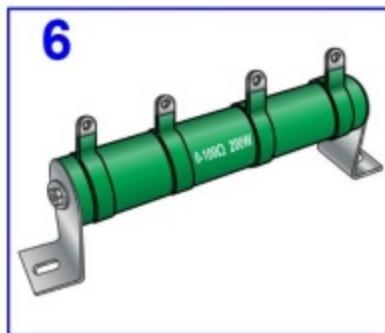
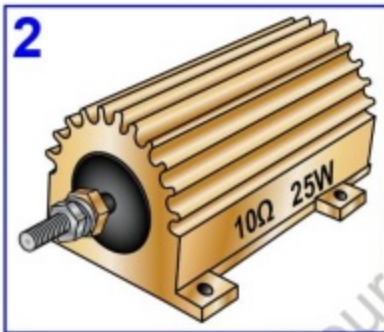
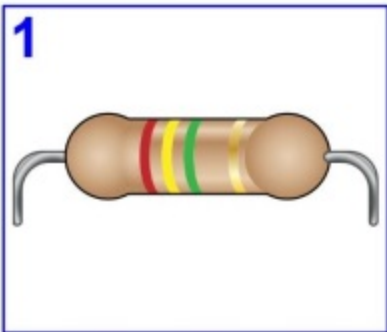


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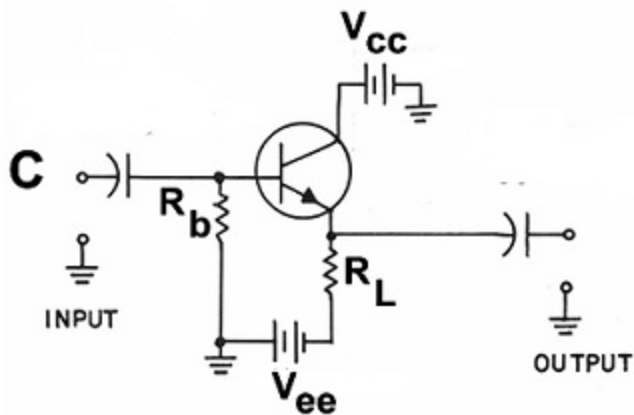
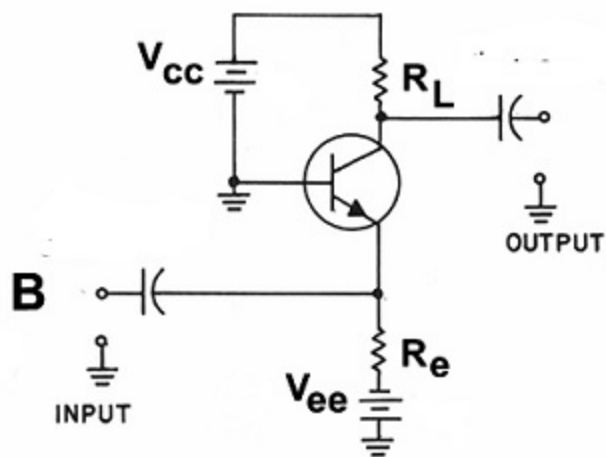
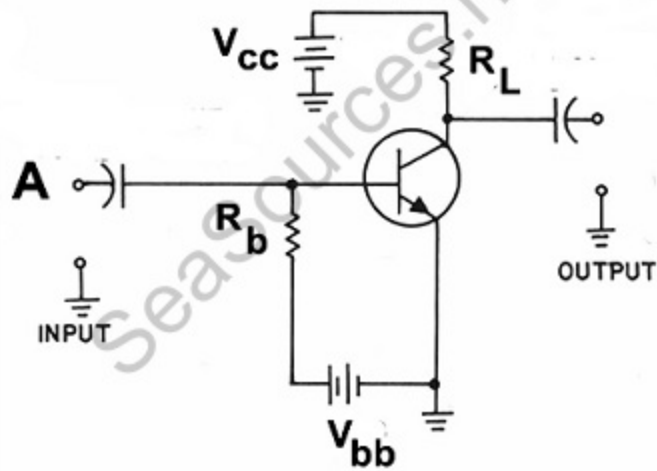




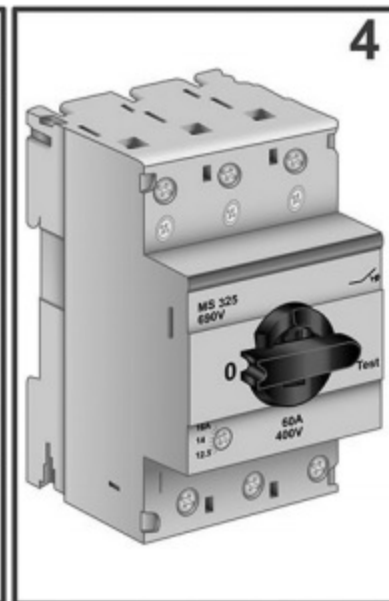
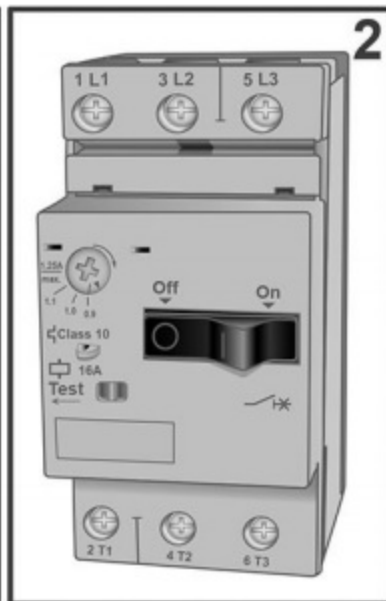
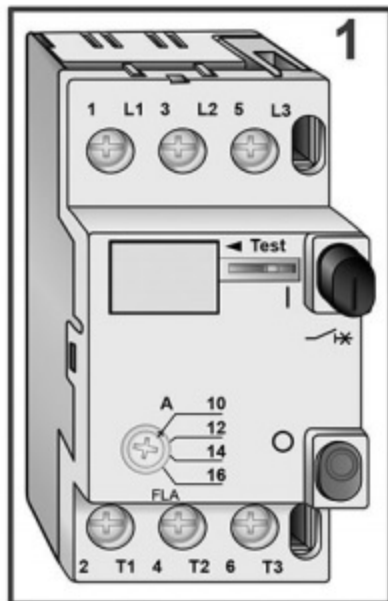
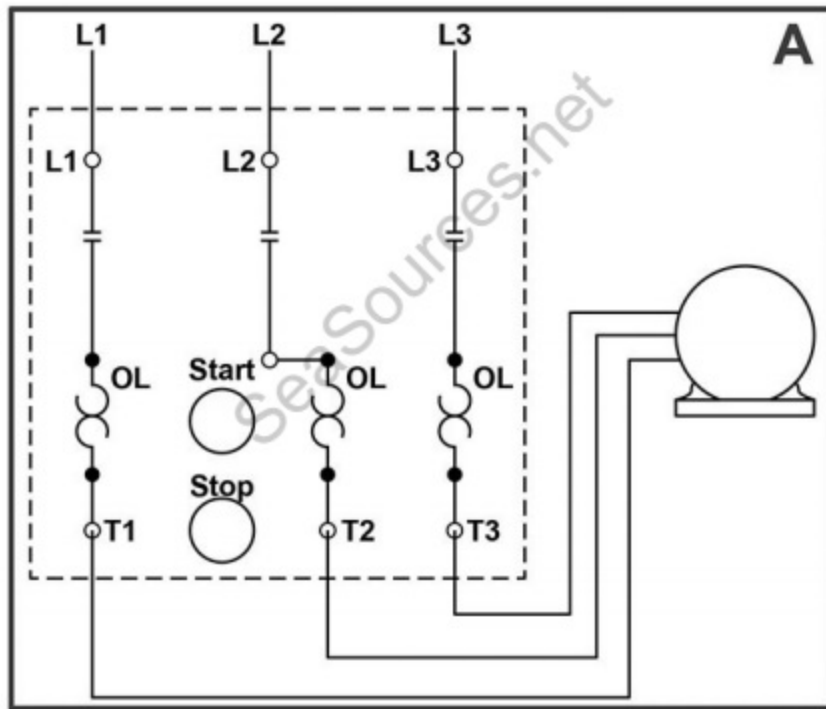




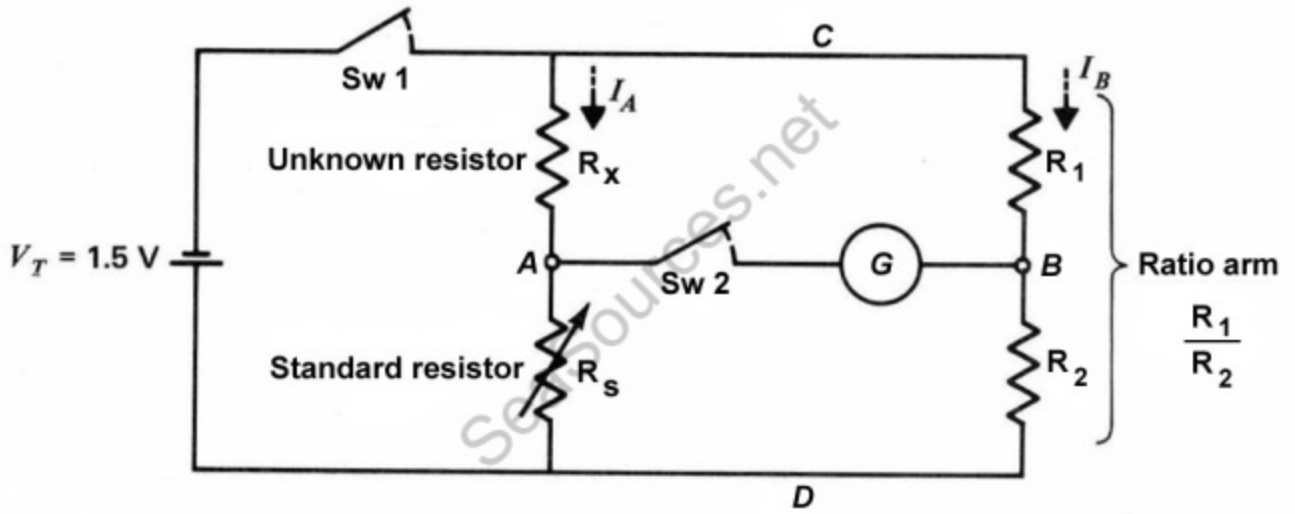
EL-0022



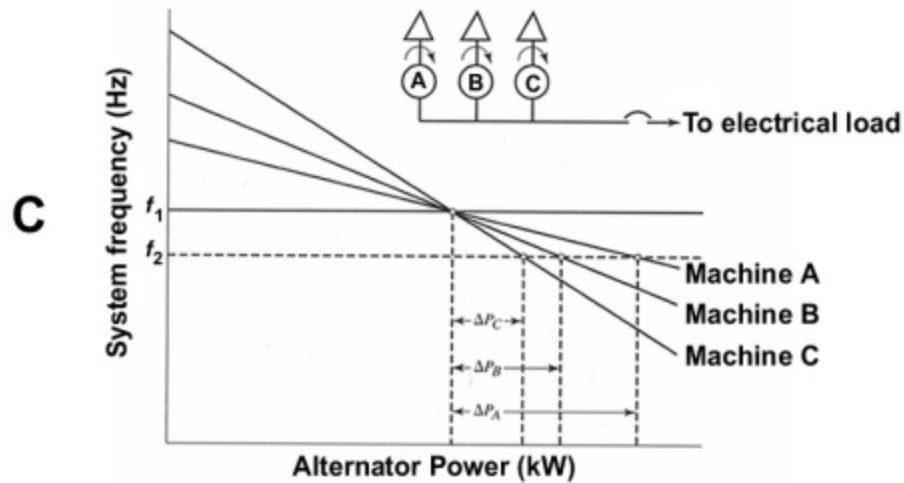
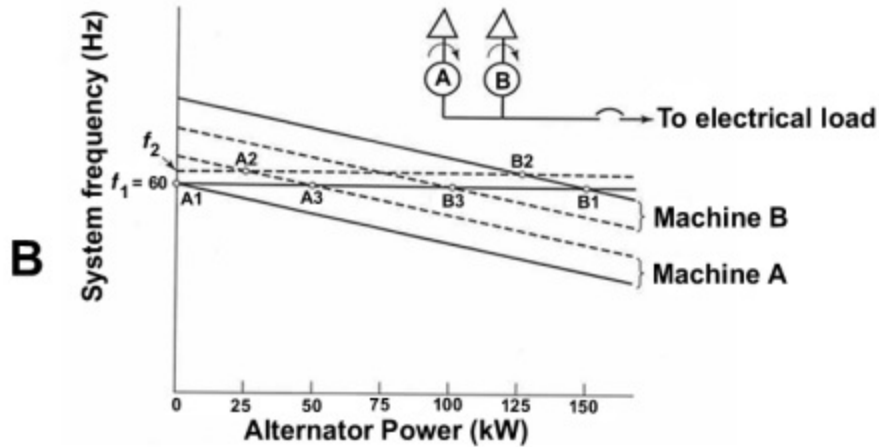
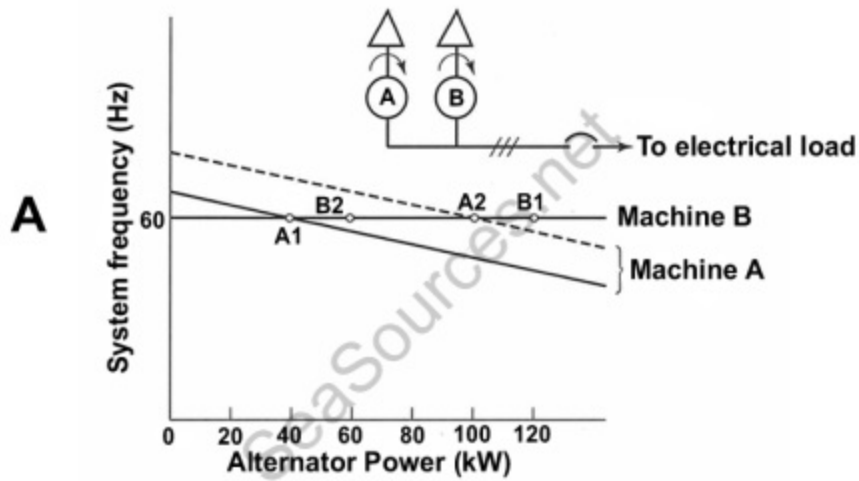
EL-0023



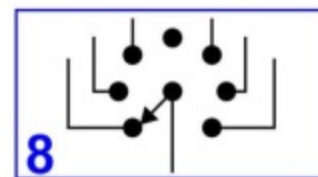
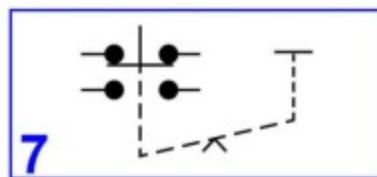
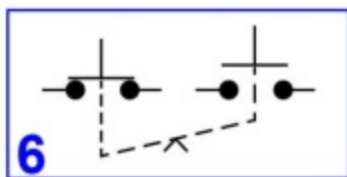
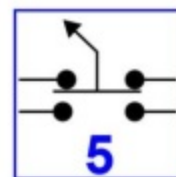
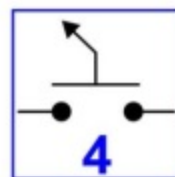
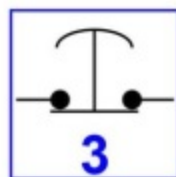
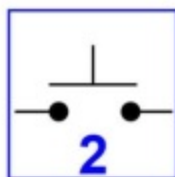
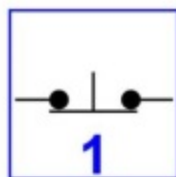
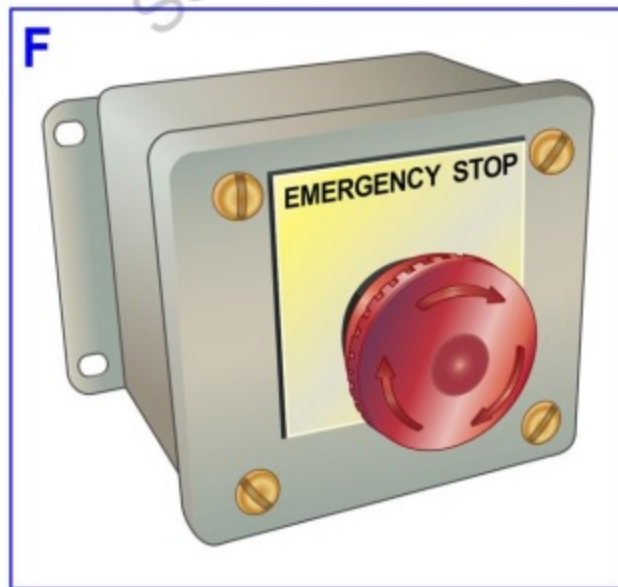
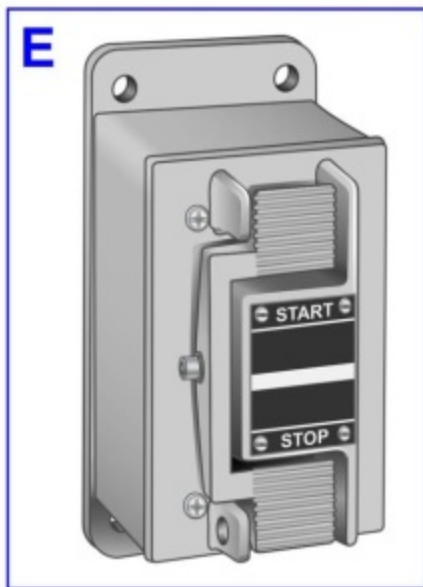
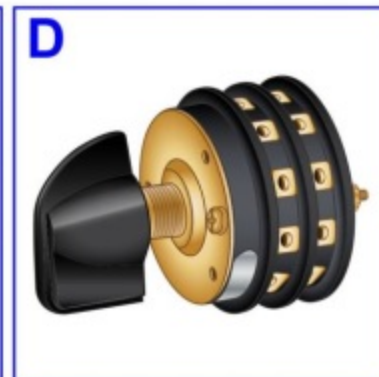
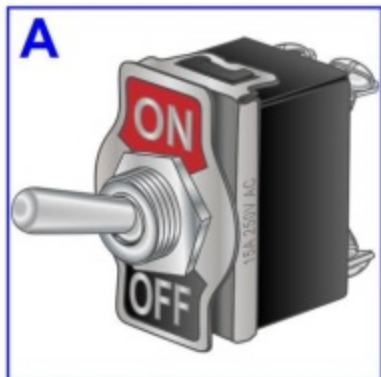
EL-0024



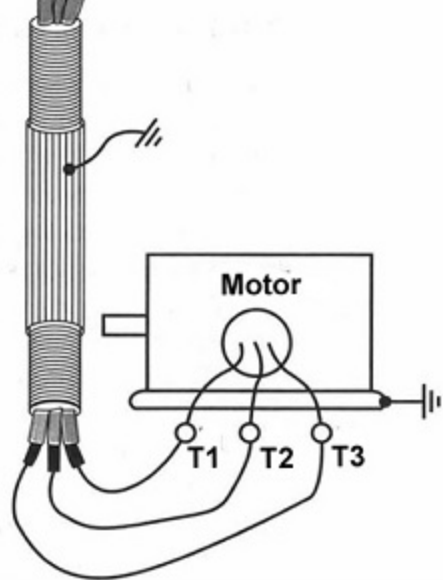
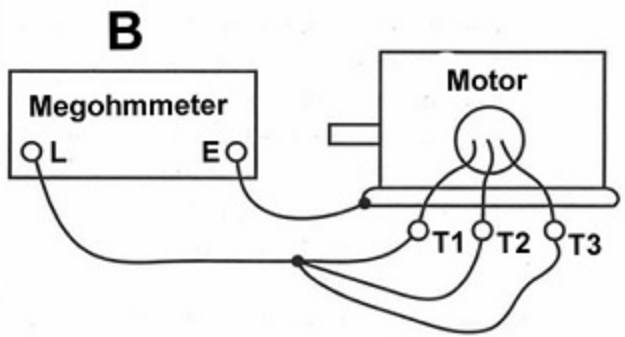
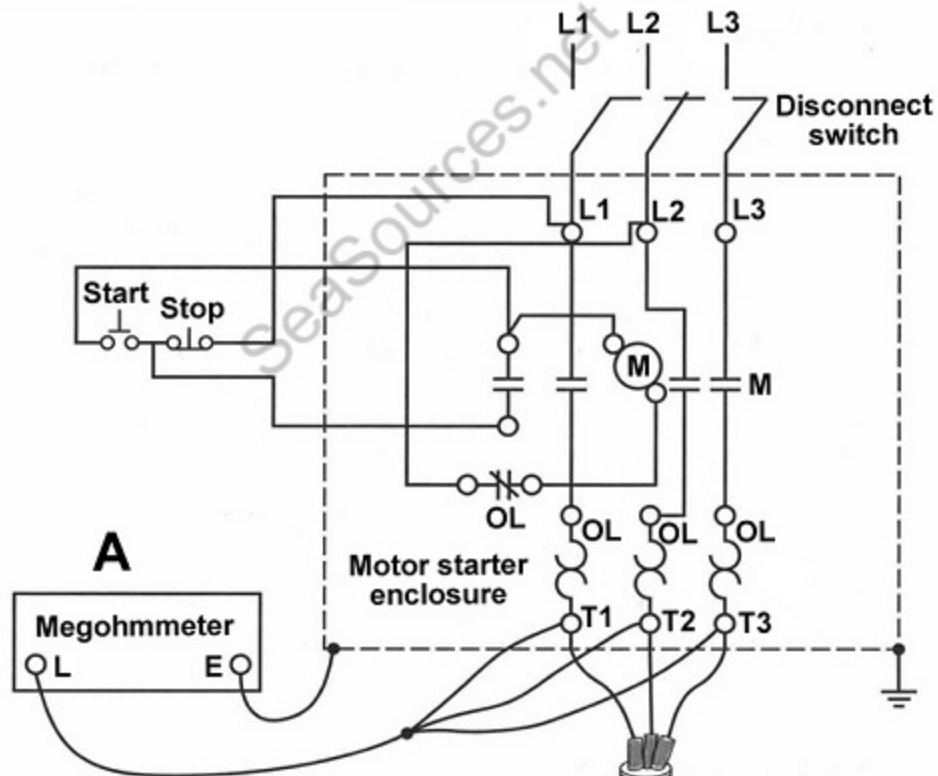
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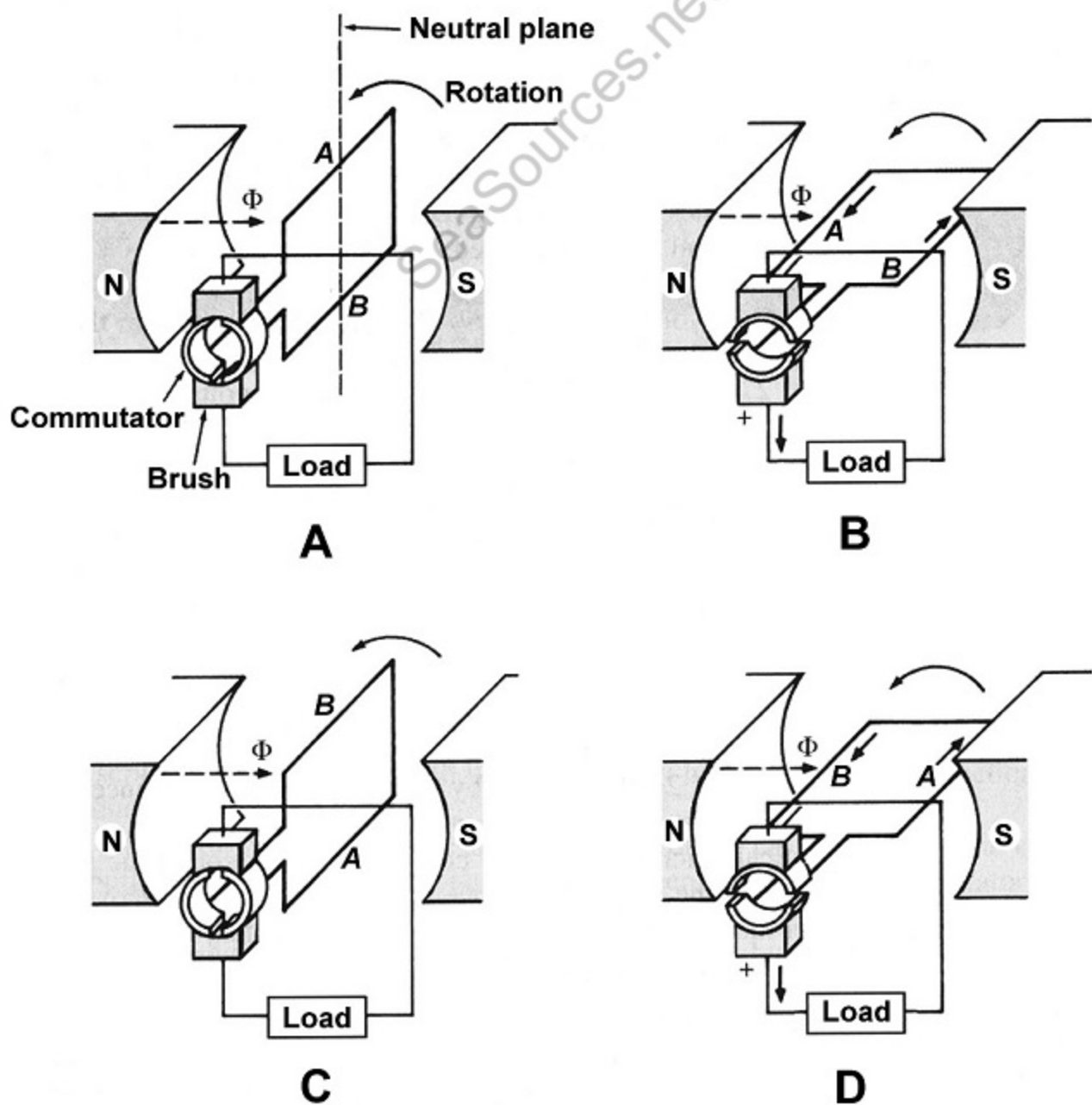


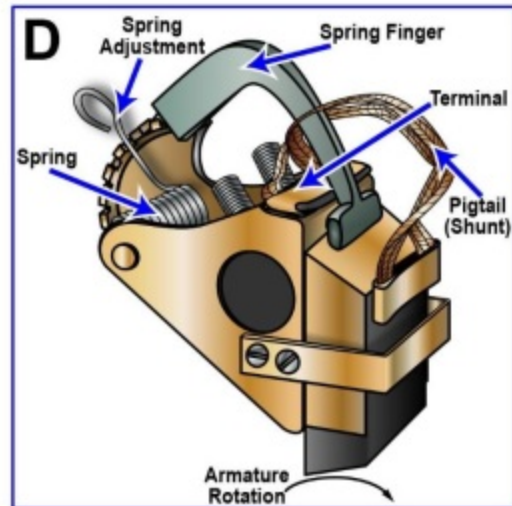
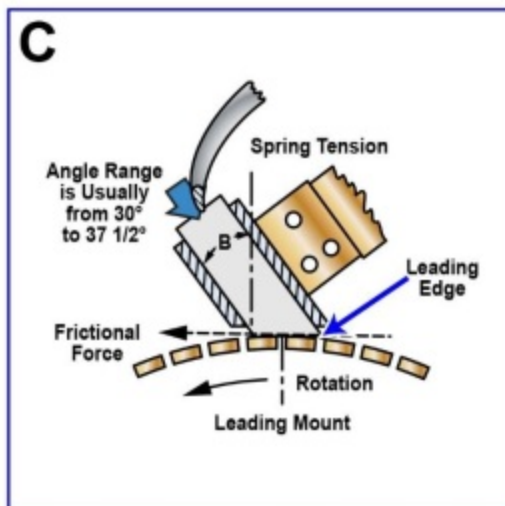
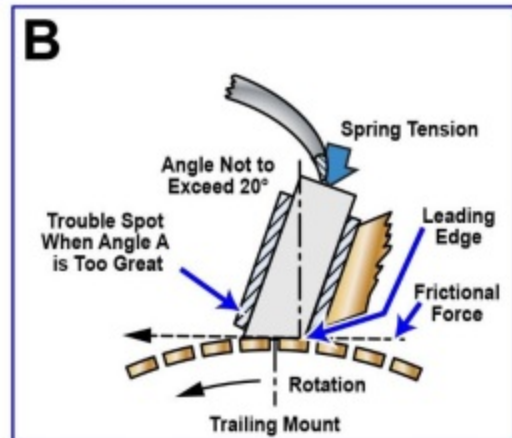
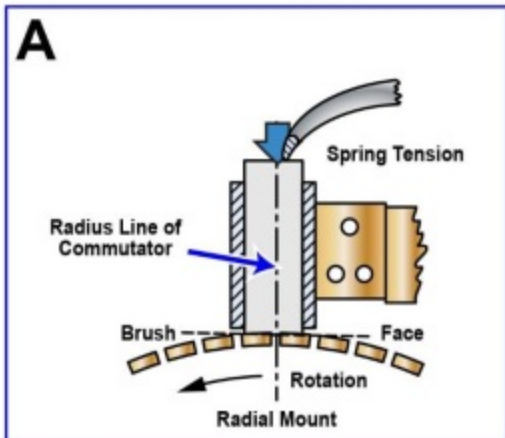
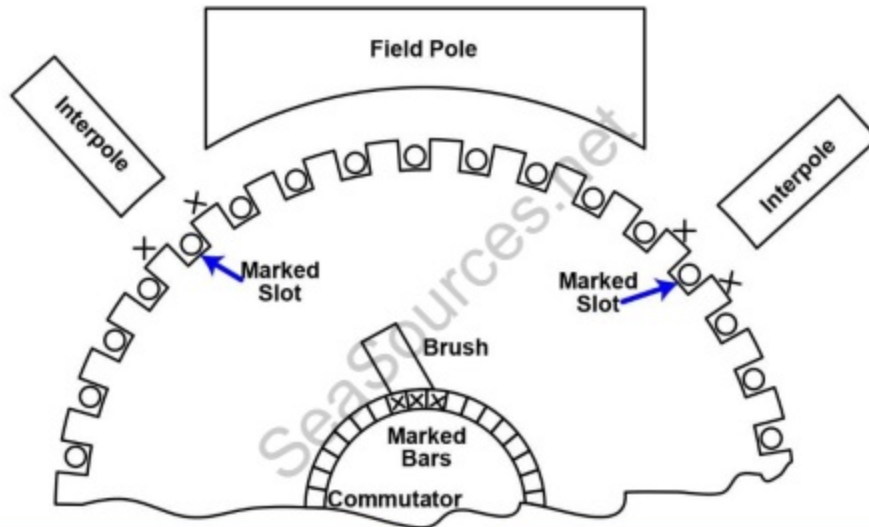
EL-0026



EL-0027

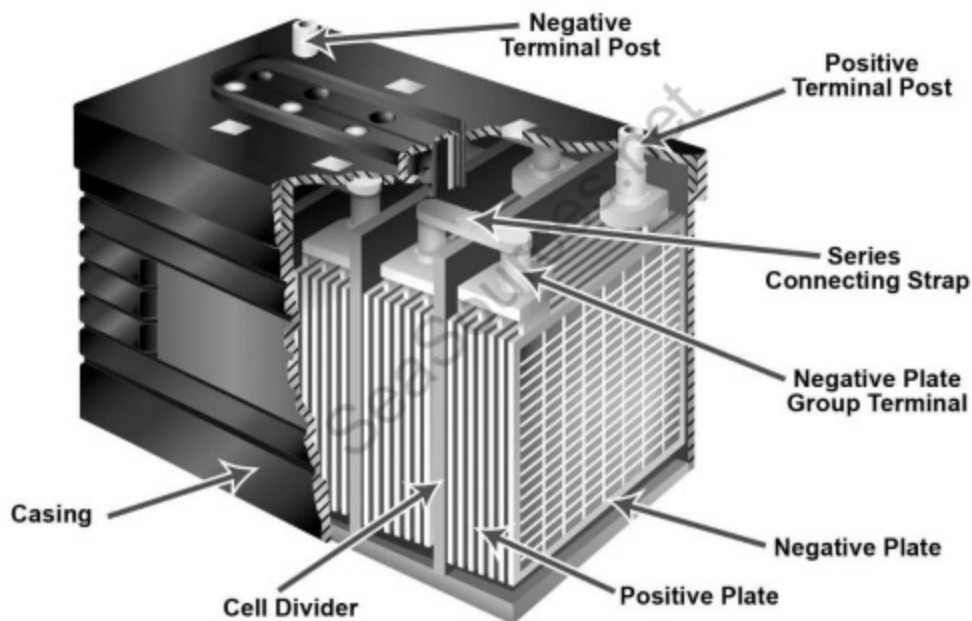




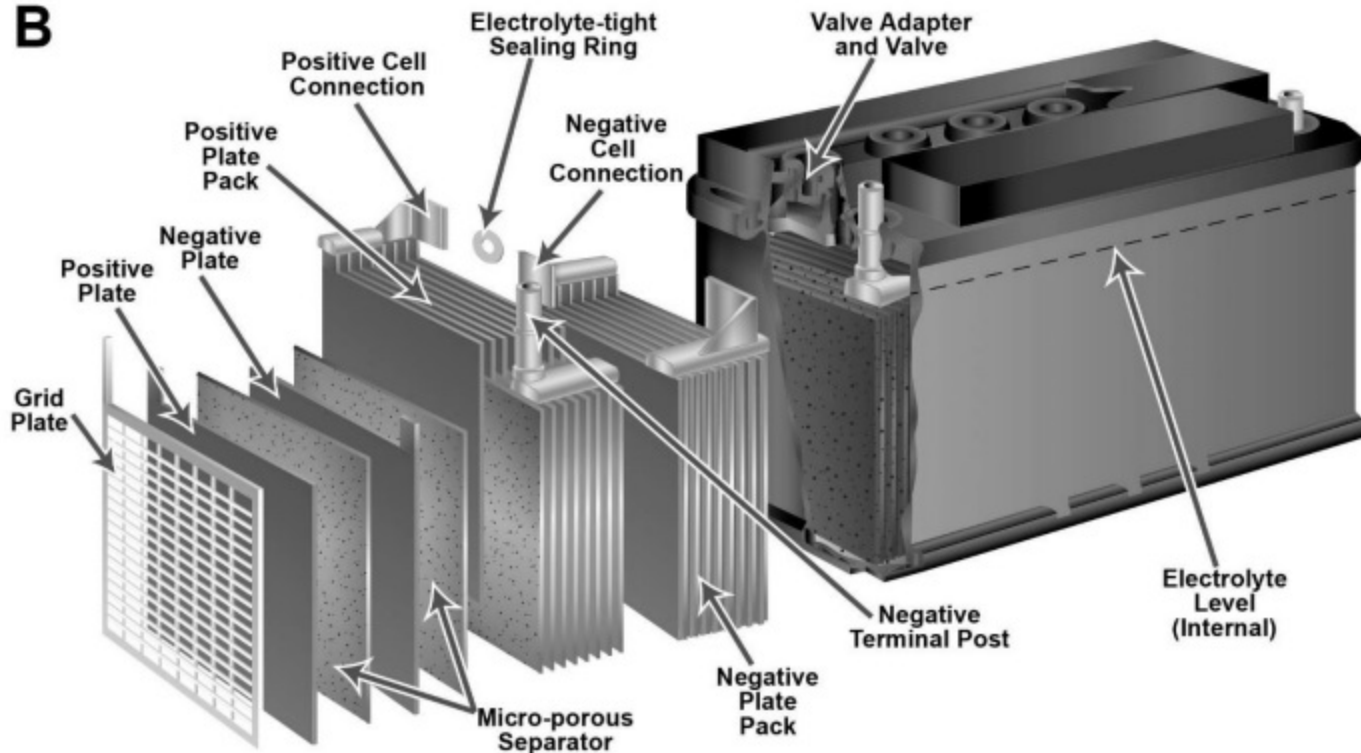


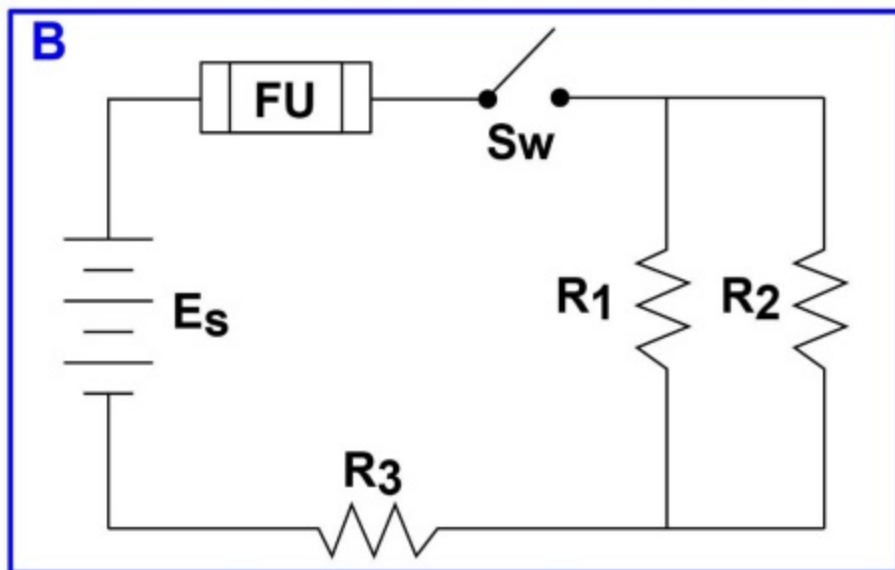
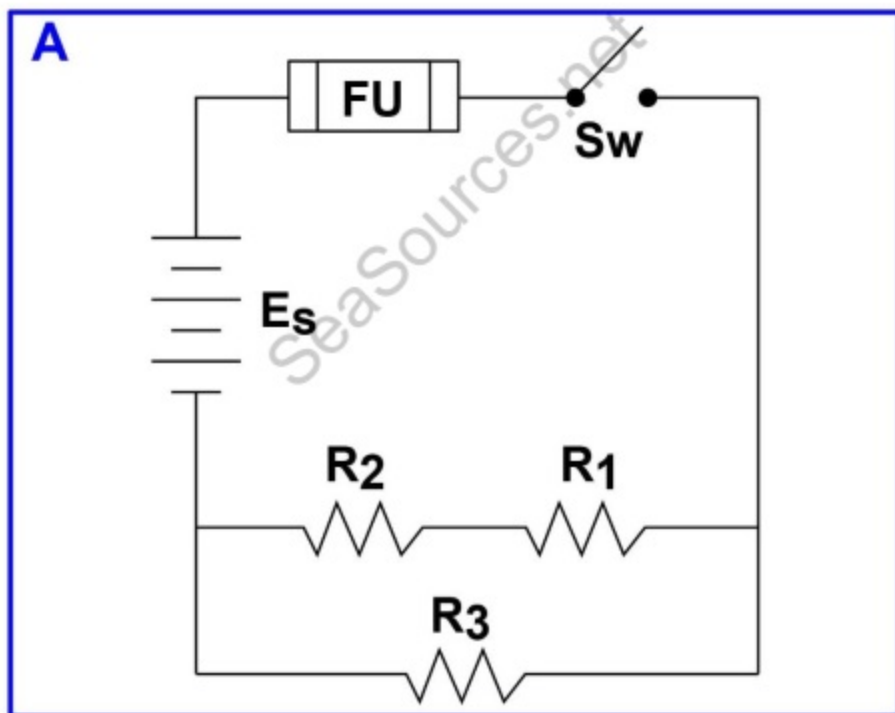
EL-0031

A



B





A



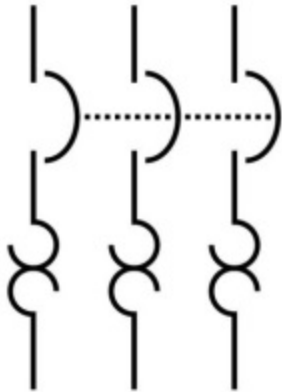
B



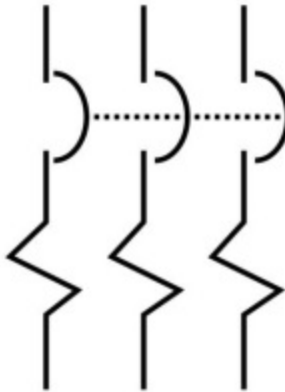
C



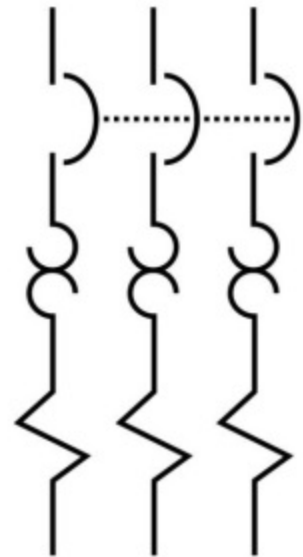
1



2



3



EL-0034



A



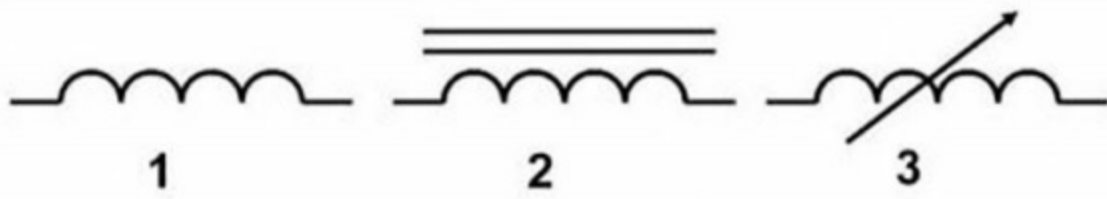
B

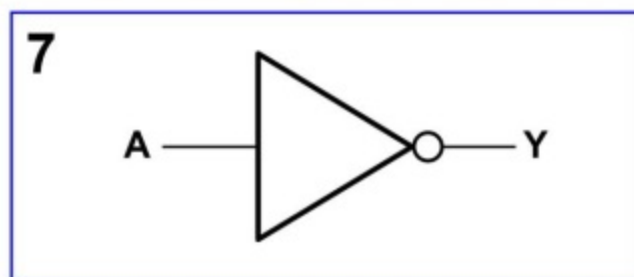
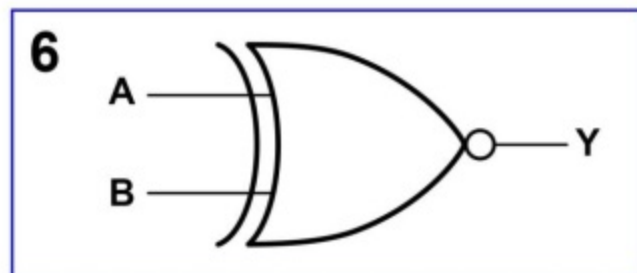
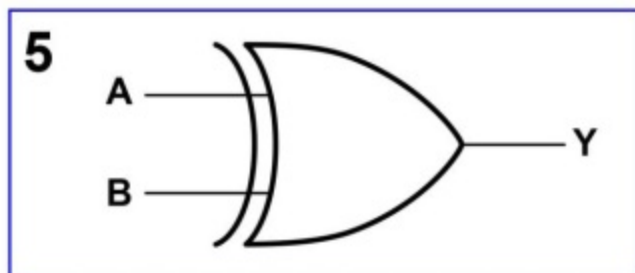
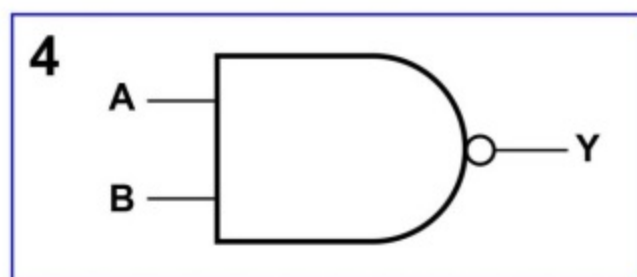
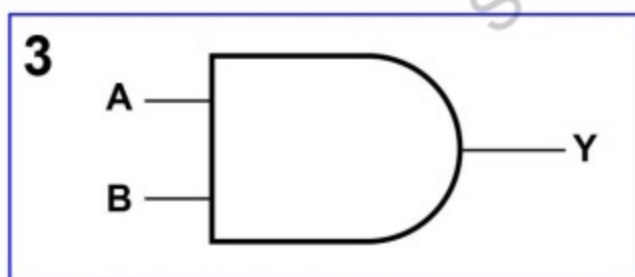
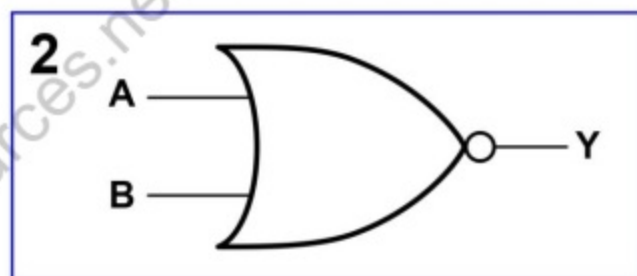
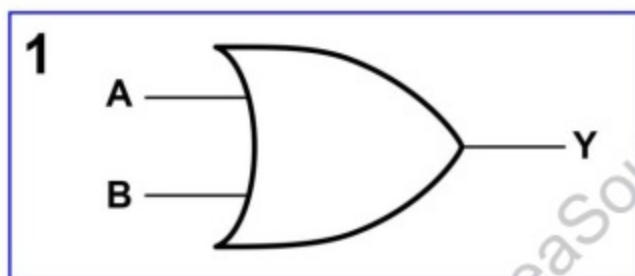


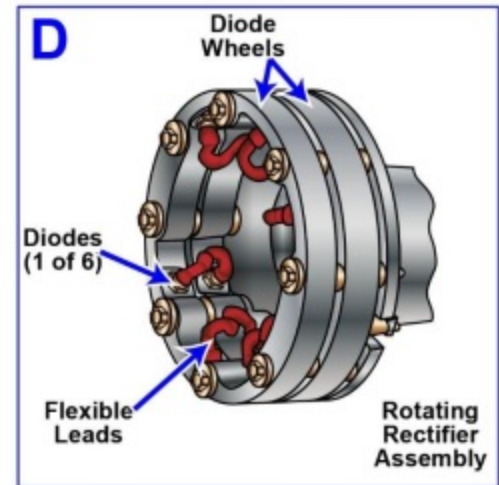
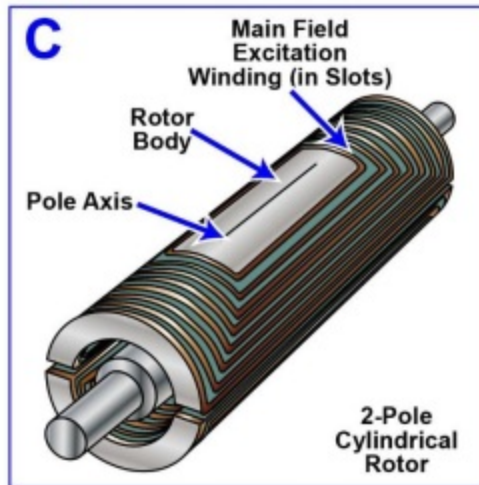
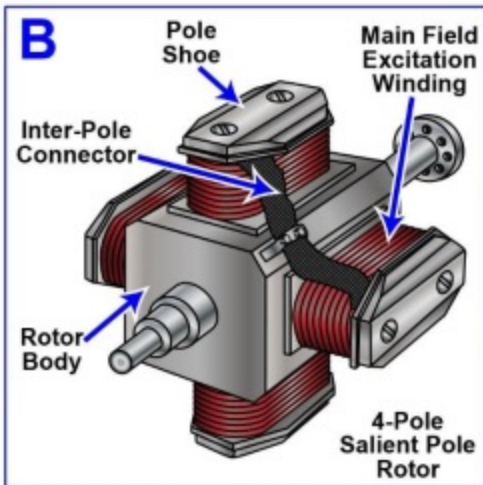
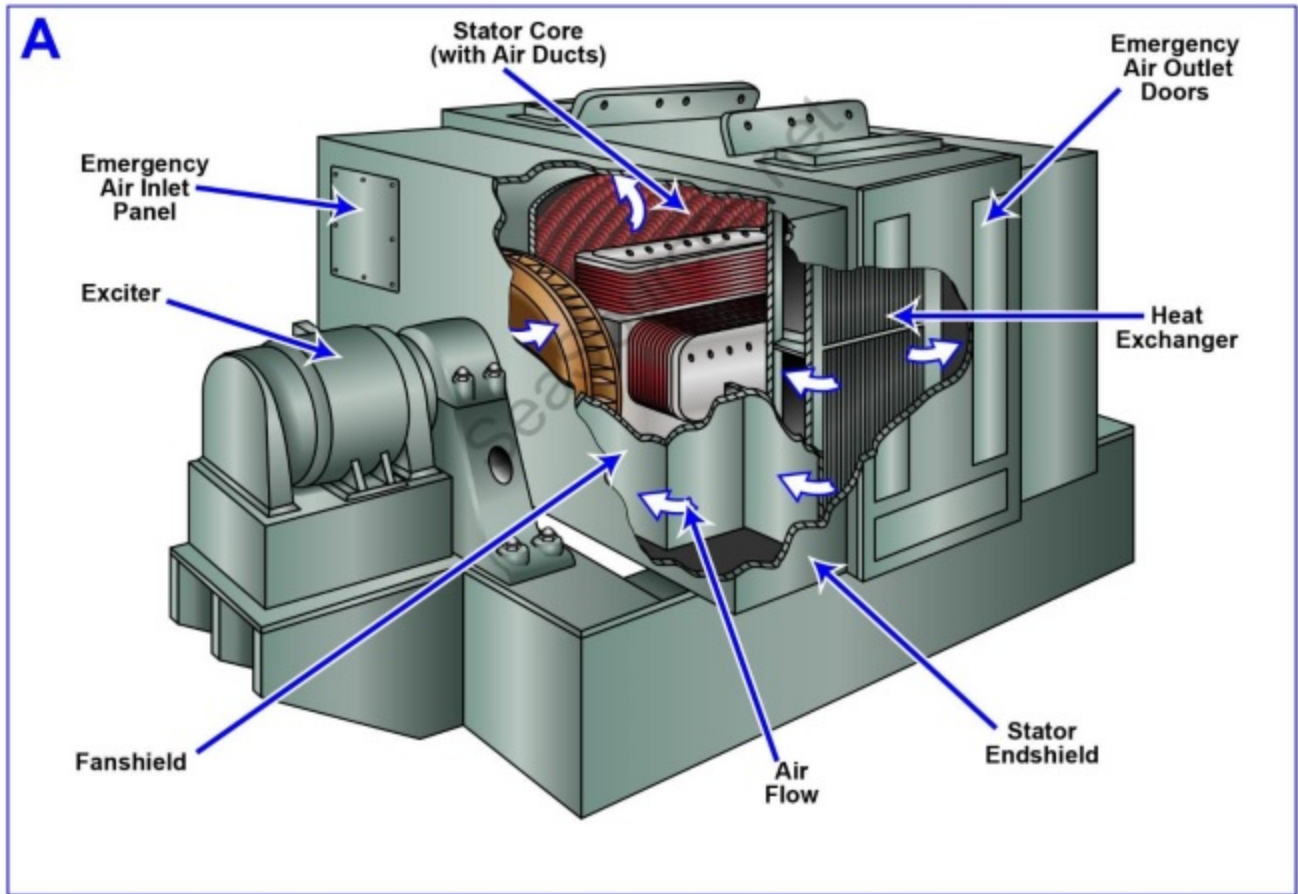
C

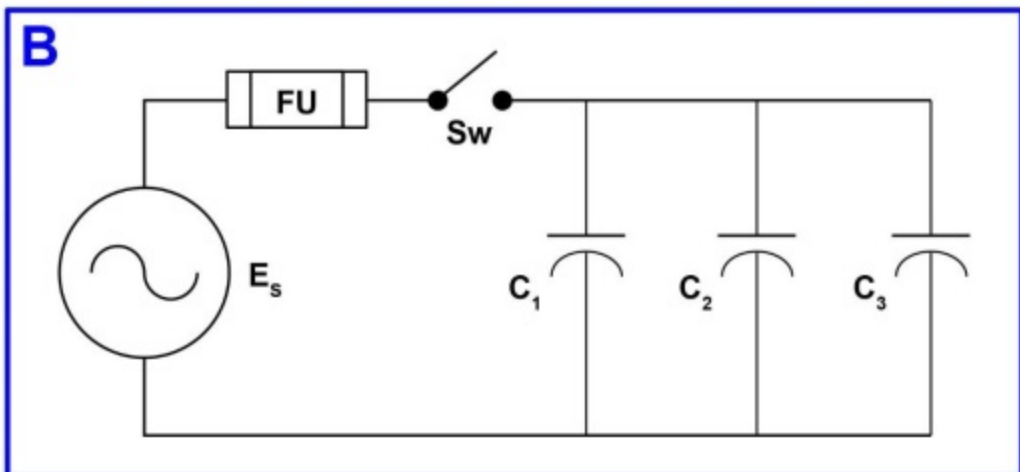
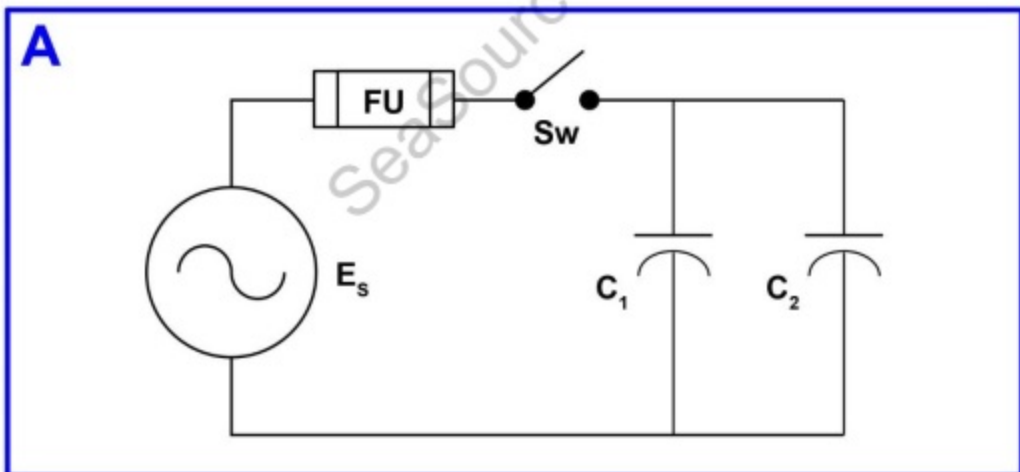


D

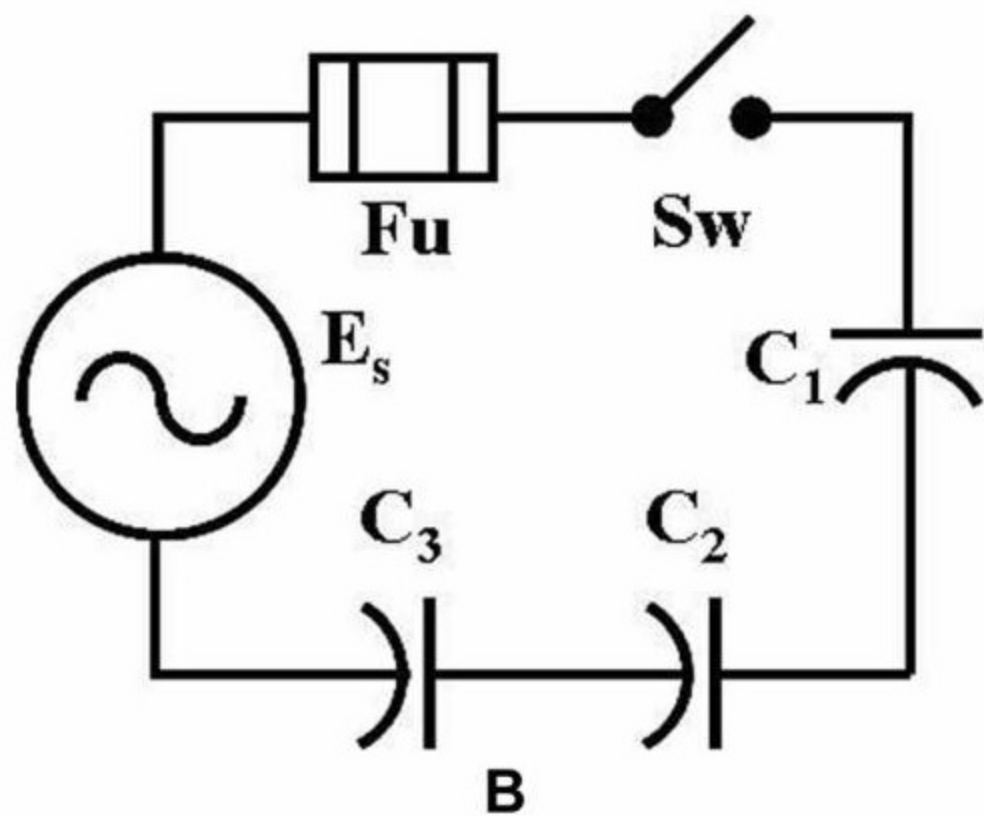
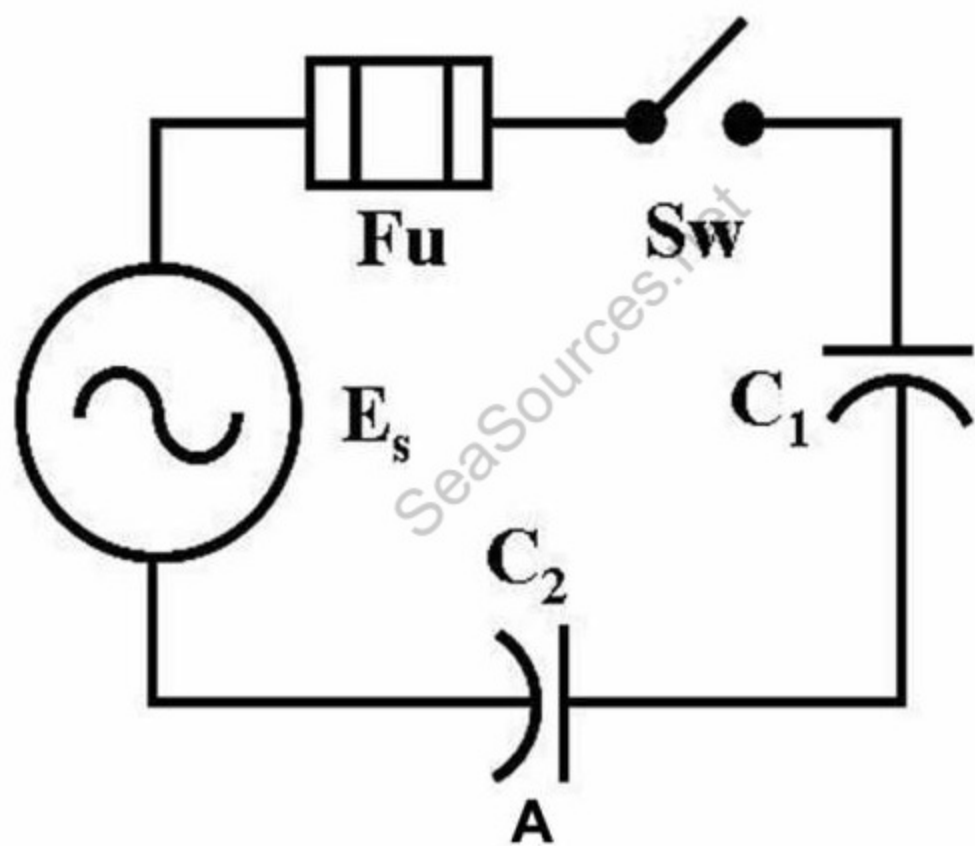




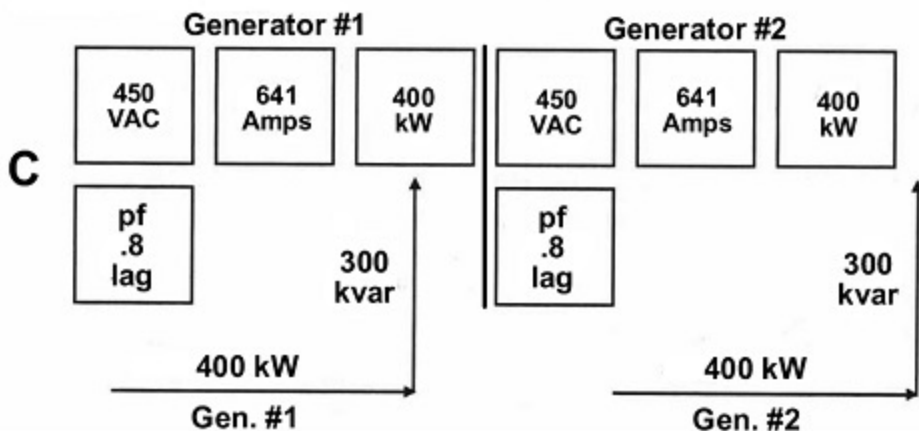
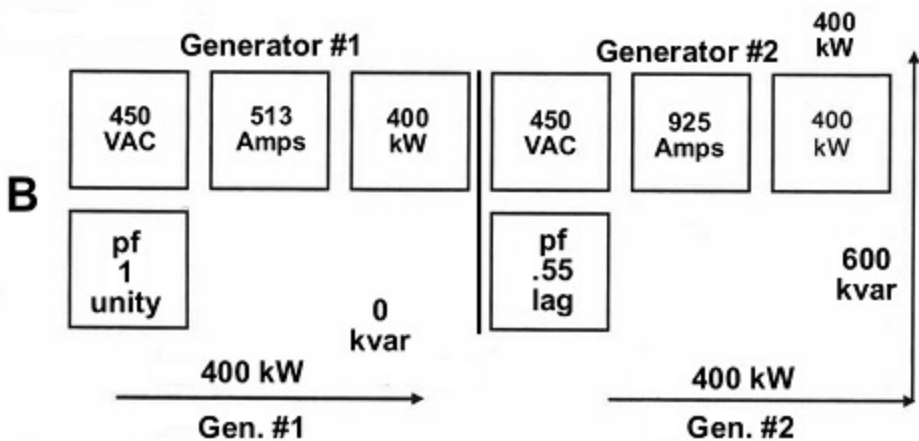
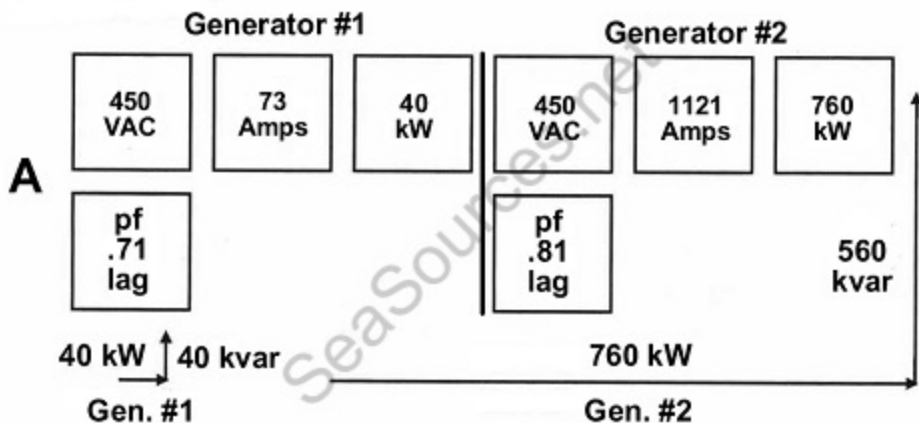




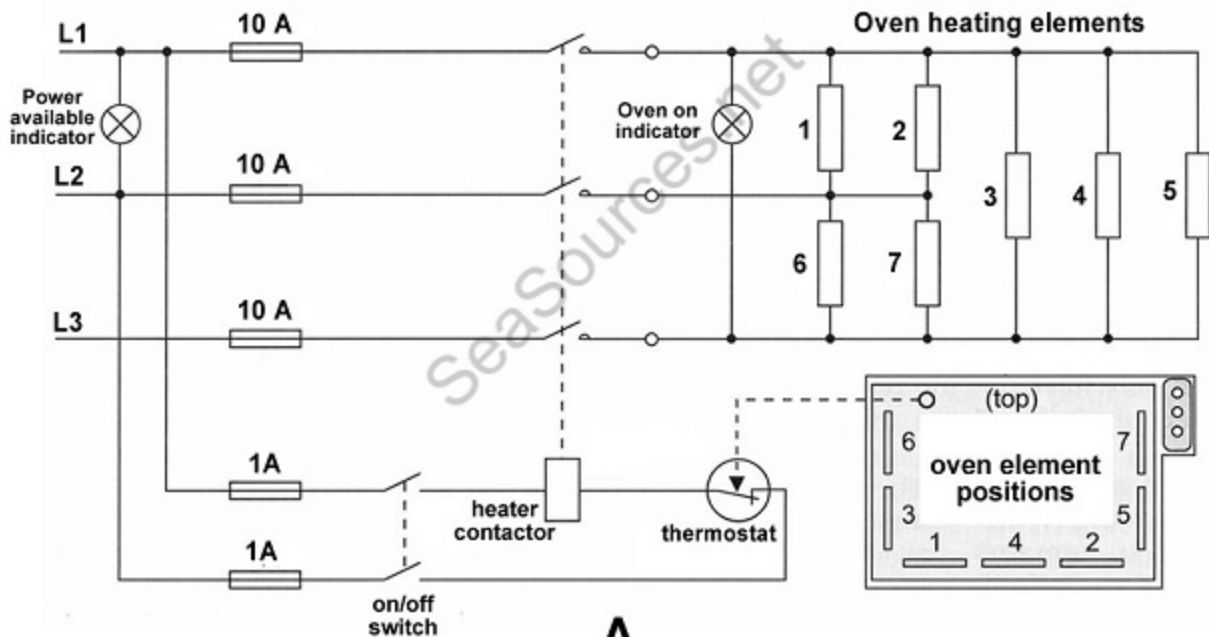
EL-0039



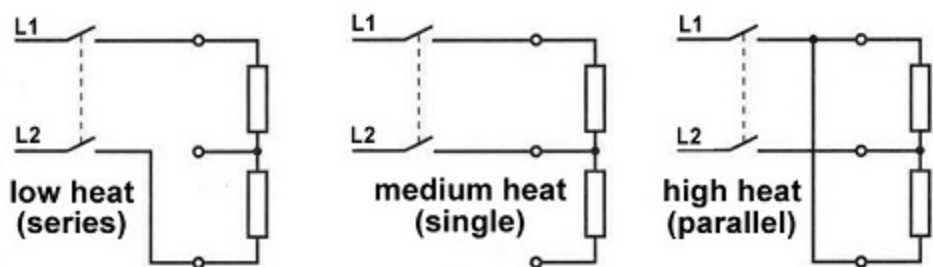
EL-0040



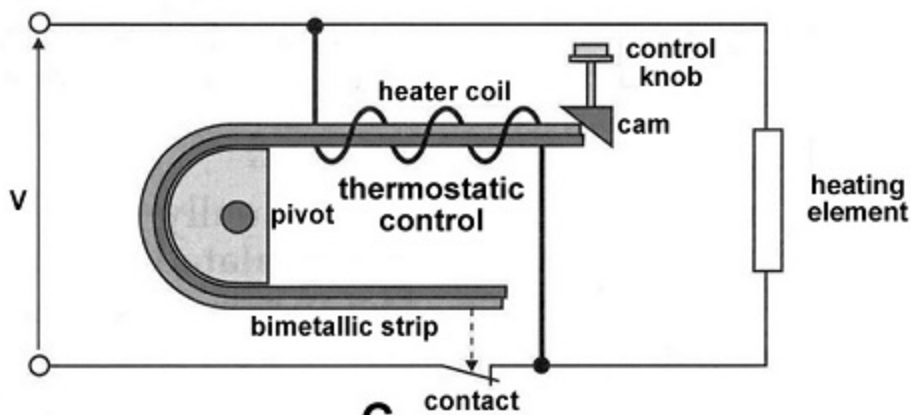
EL-0041



A

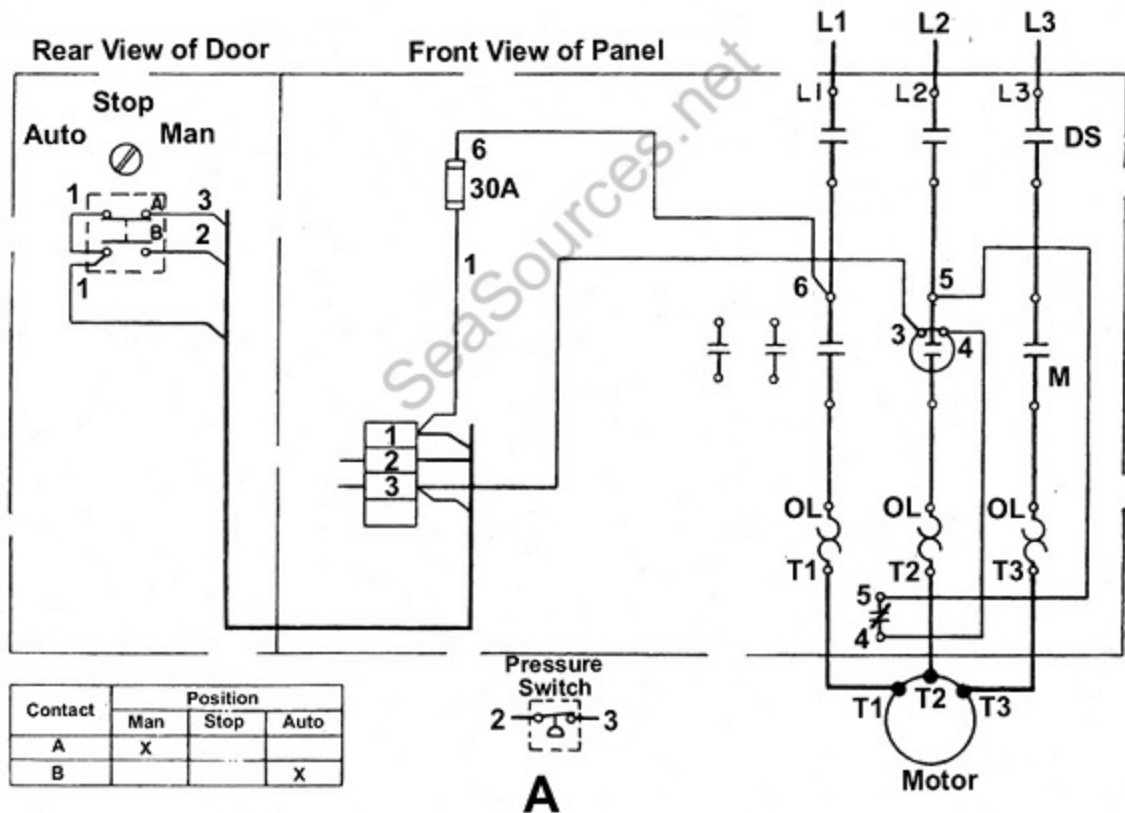


B

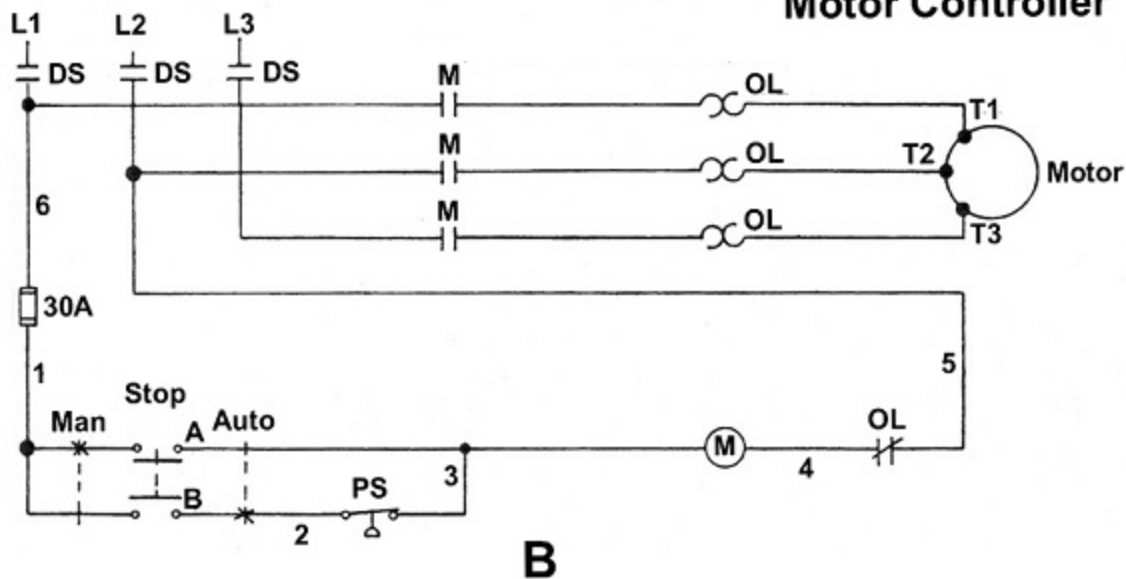


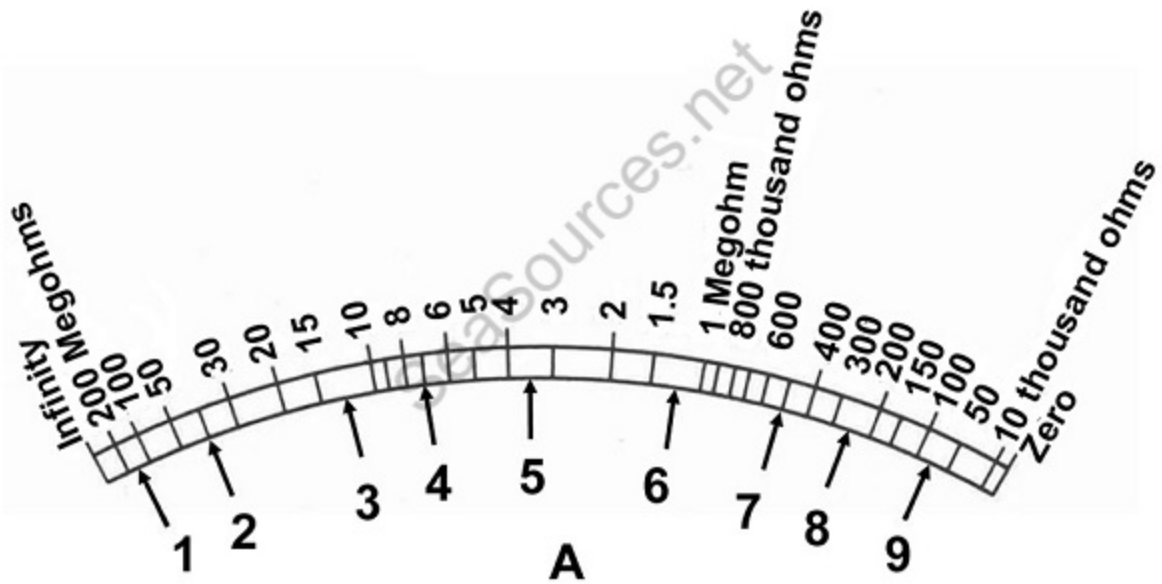
C

EL-0043



Potable Water Pump Motor Controller



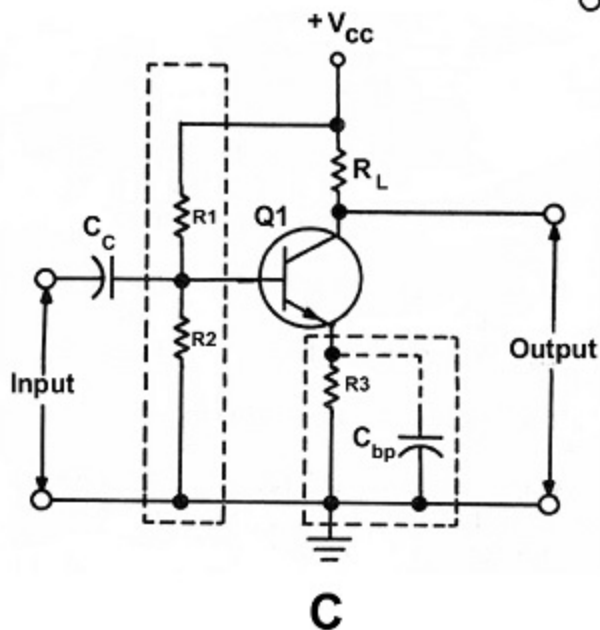
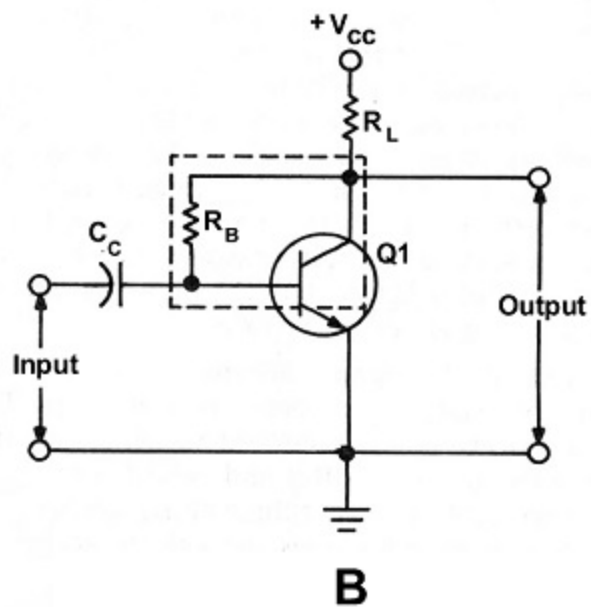
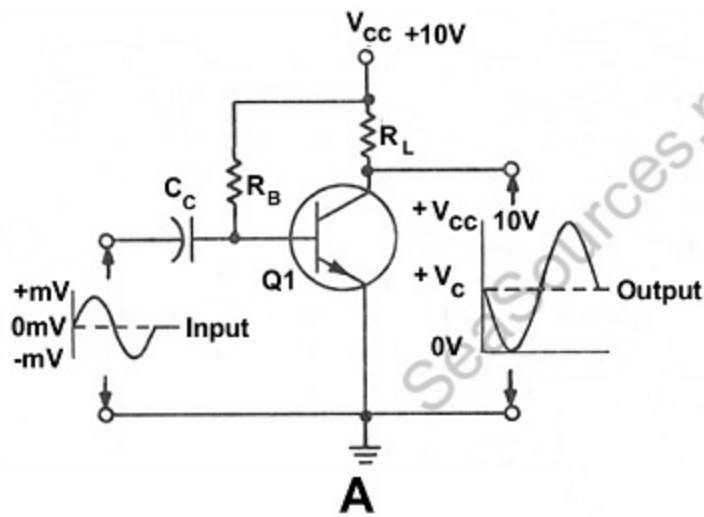


Insulation Resistance Test Record
for use with "Megger" Insulation Testers up to 200 Megohms

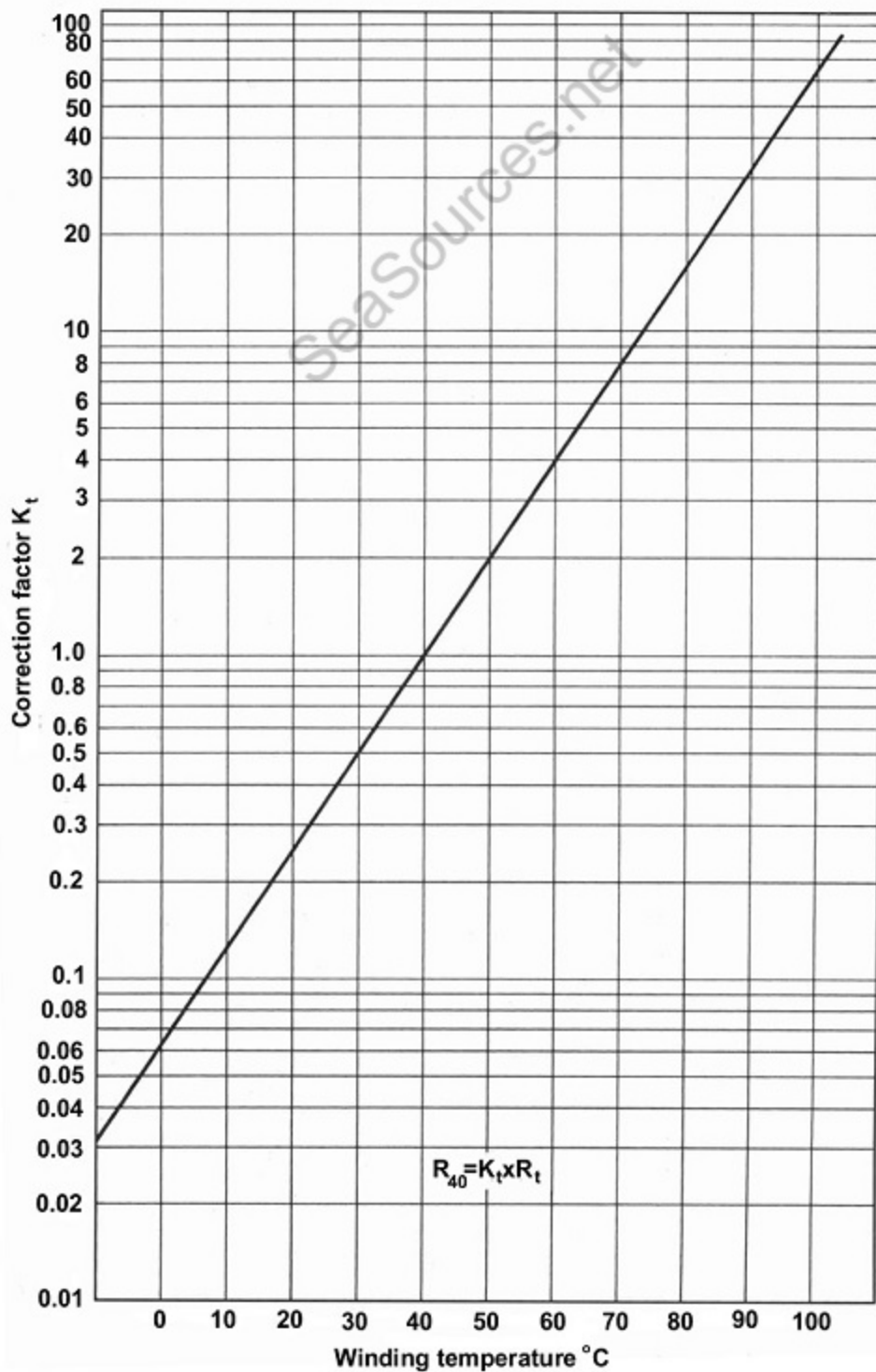
Apparatus _____ No. _____ Location _____
Date Installed/Refurbished _____ Corrected Resistance _____

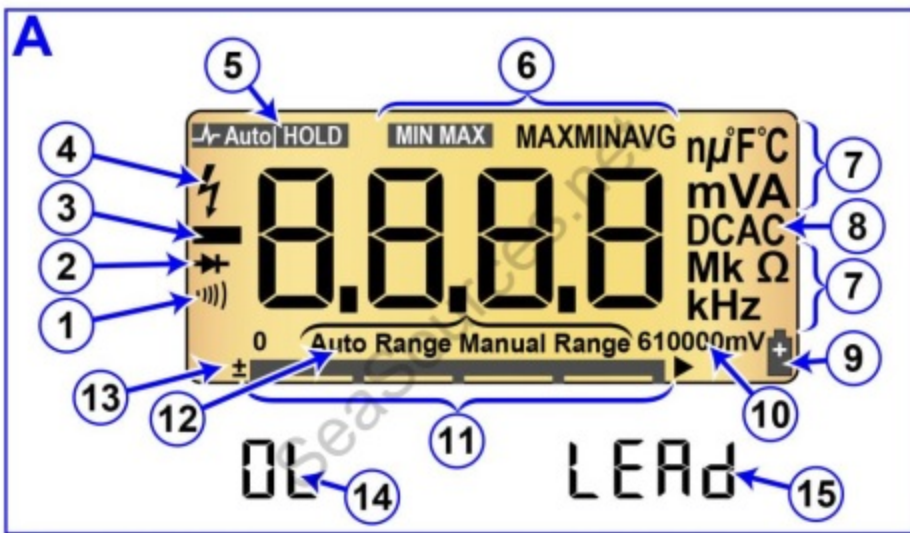
		Date	2005	2006	2007	2008	2009	2010
Insulation Resistance	Megohms	Infinity						
		200						
		100						
		50						
		30						
		20						
		15						
		10	•	•	•	•	•	
		8						
	6							
	5							
	4							
	3							
	2							
	1.5							
Ohms	1 Megohm							
	800k							
	600k							
	500k							
	400k							
	300k							
	200k							
	150k							
	100k							
	50k							
10k								
Zero						•		

EL-0045



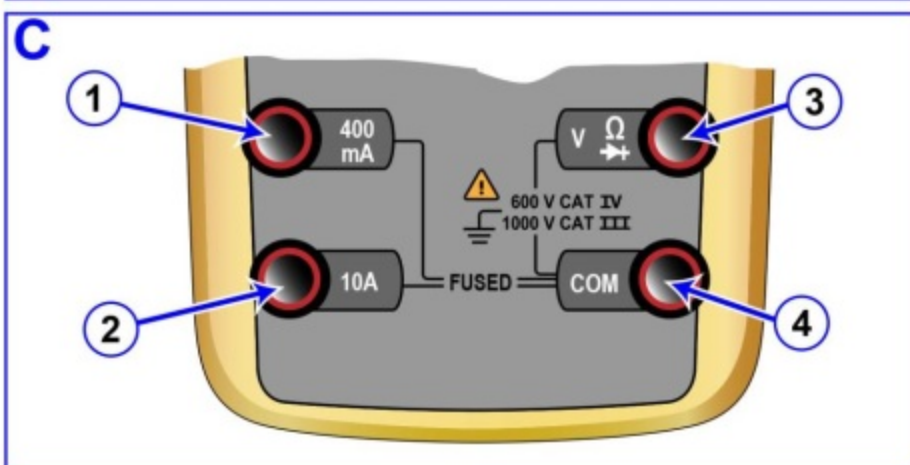
EL-0046



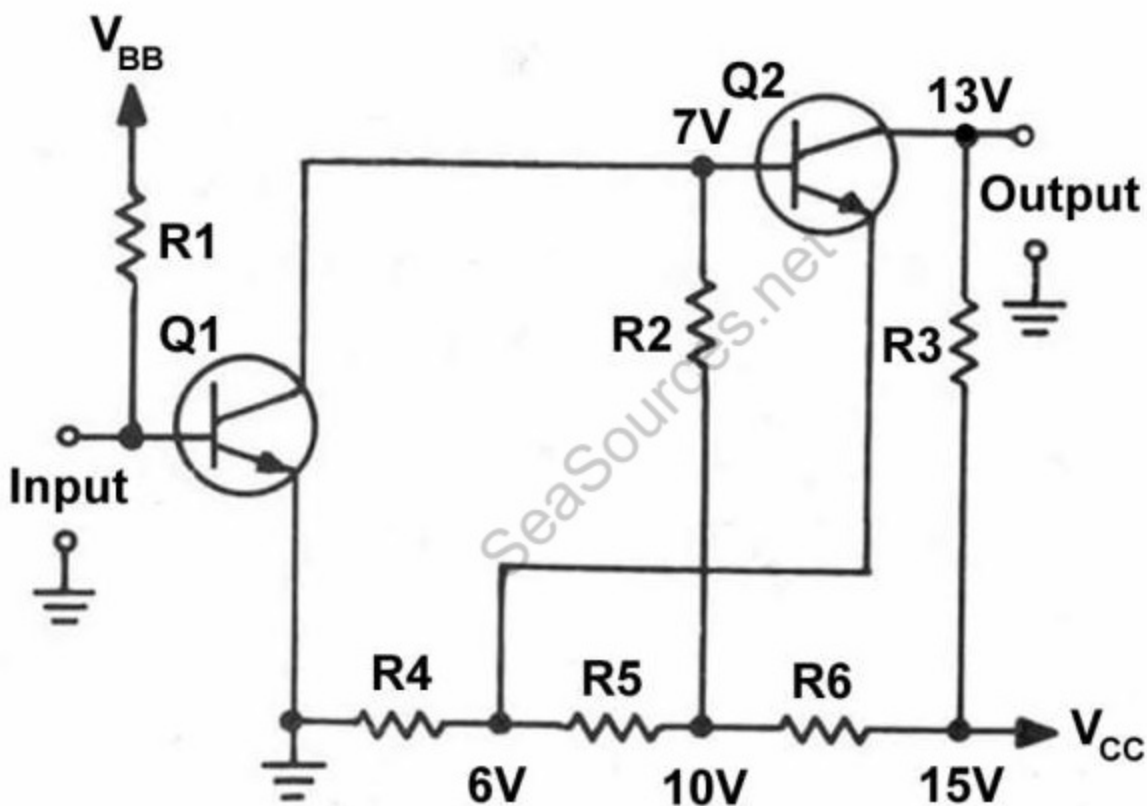


B

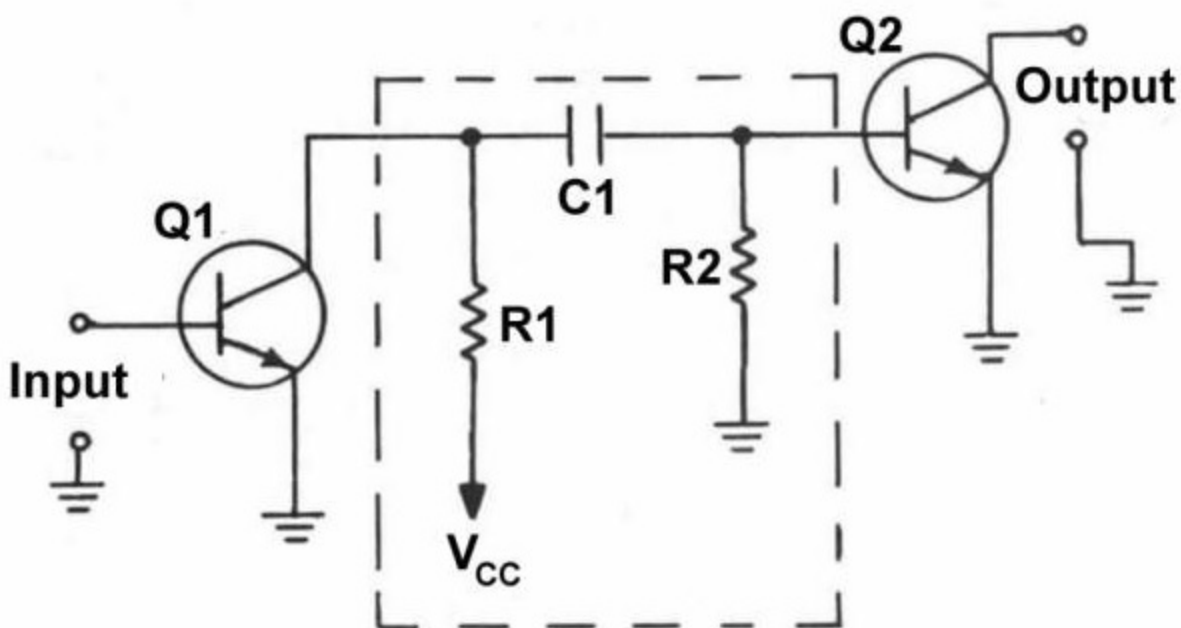
Switch Position	Measurement Function
\bar{V} Hz	1
\bar{V}	2
m \bar{V}	3
Ω - C	4
)))	5
$\bar{\sim}$ mA	6
$\bar{\sim}$ ~A	7



EL-0048

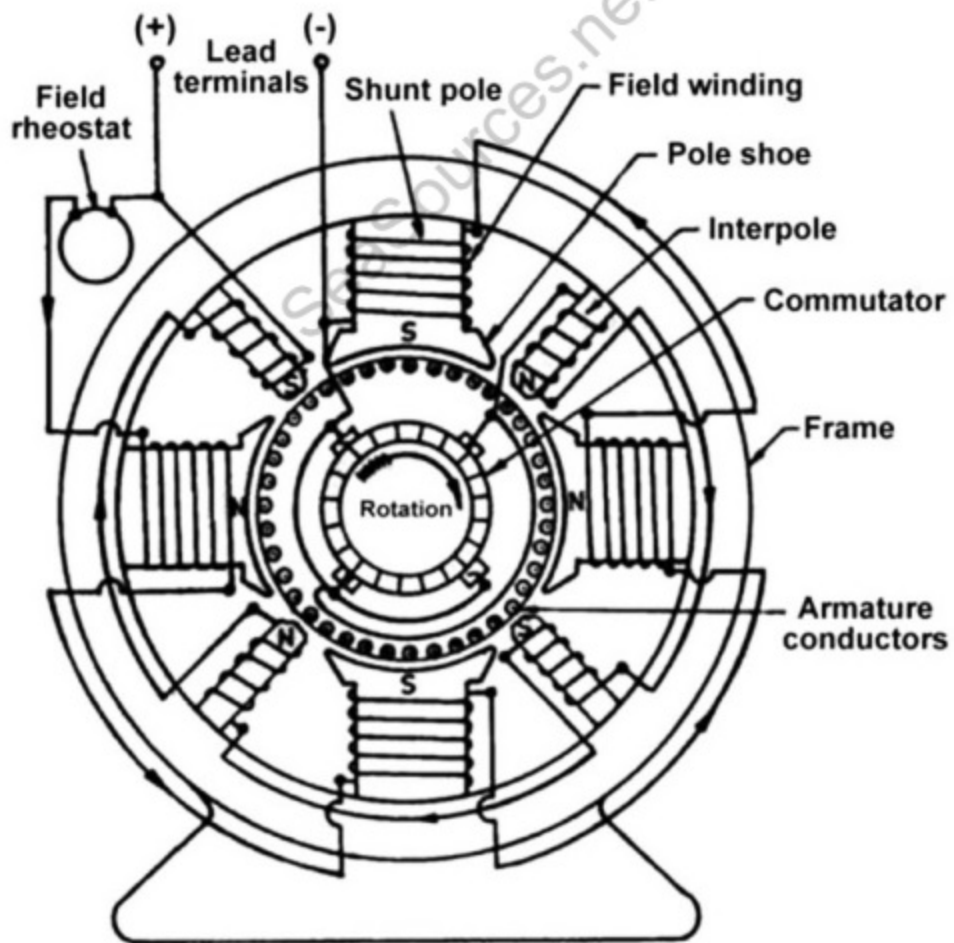


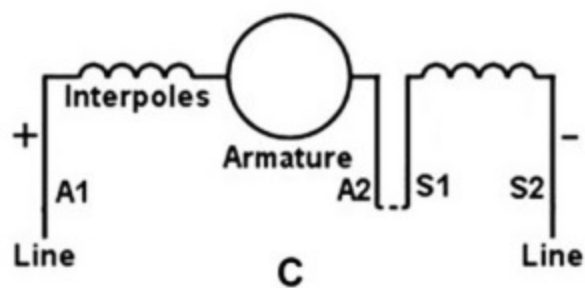
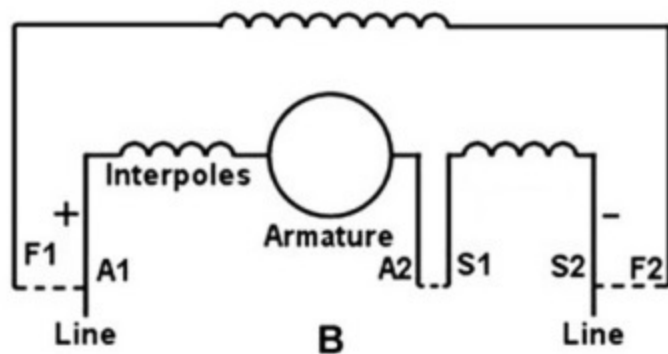
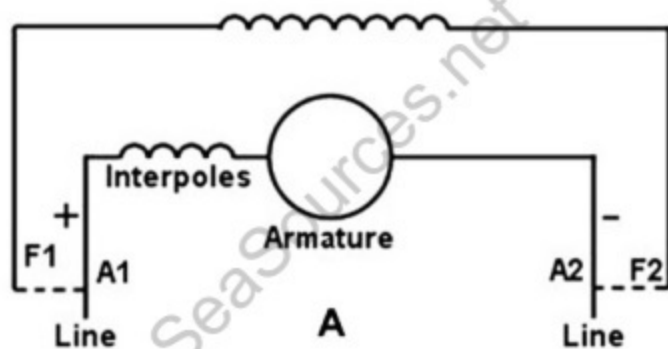
A

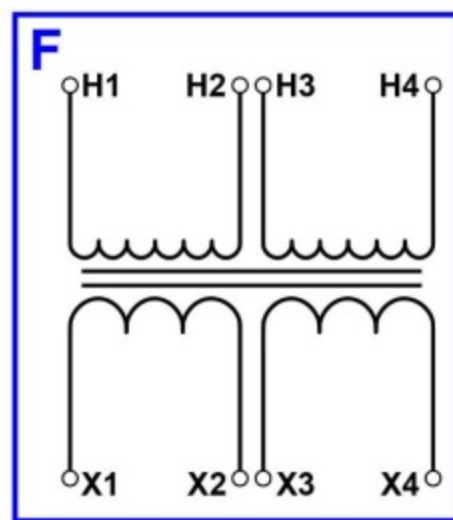
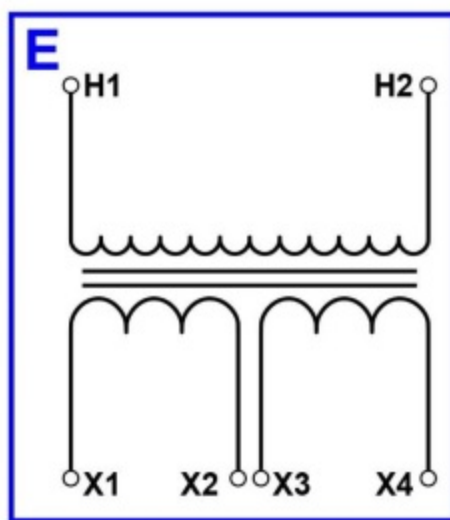
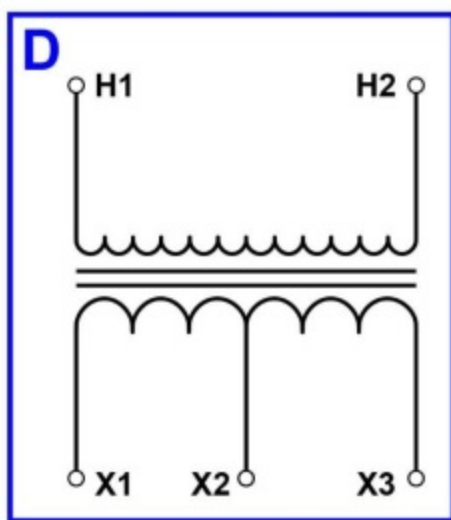
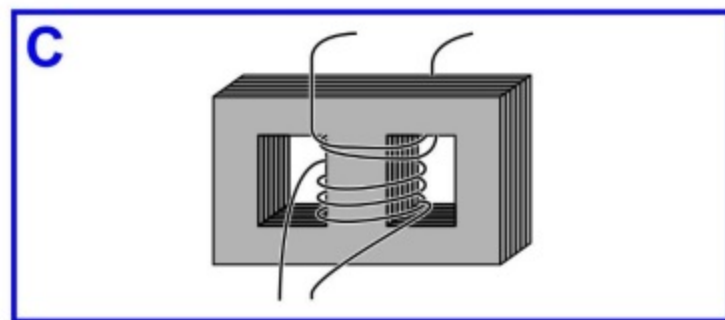
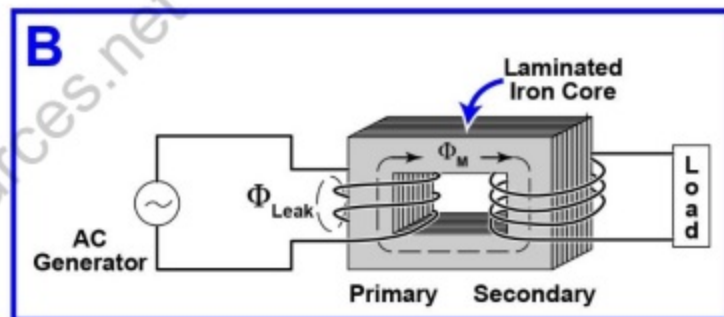
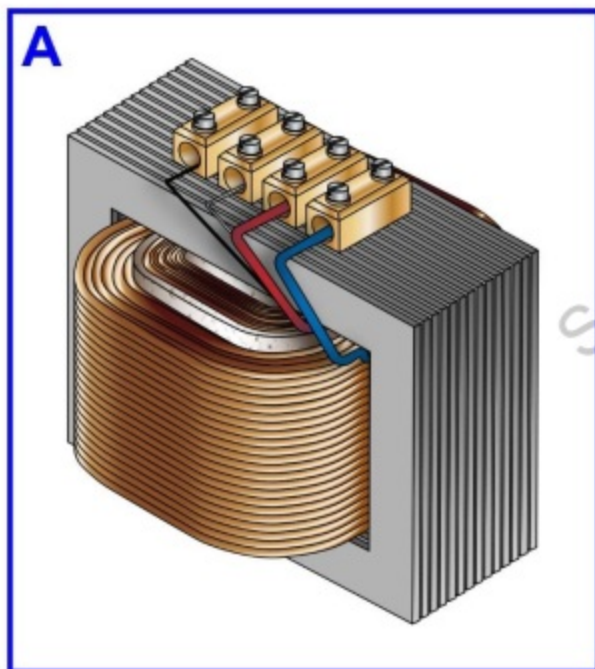


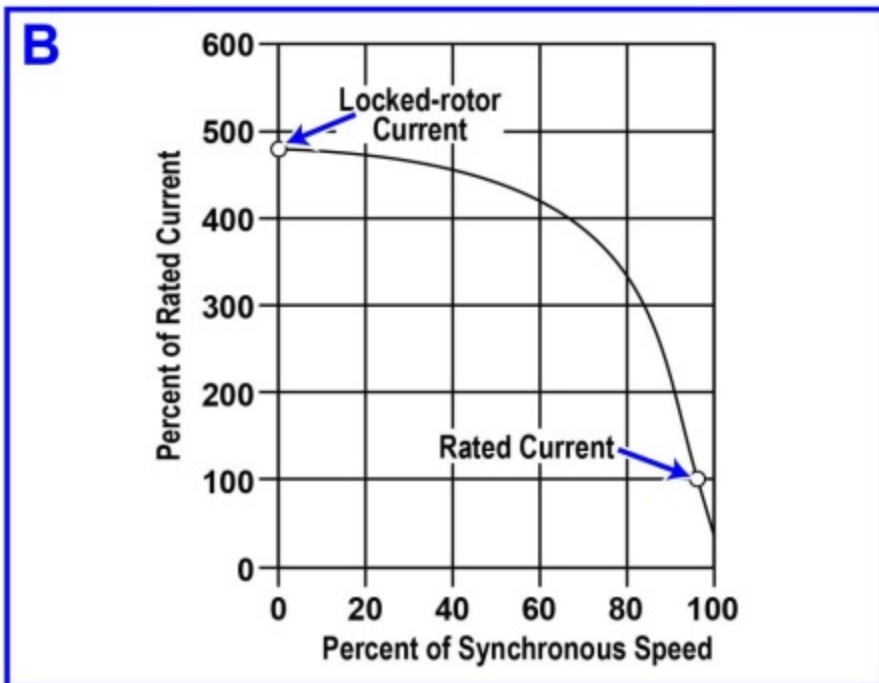
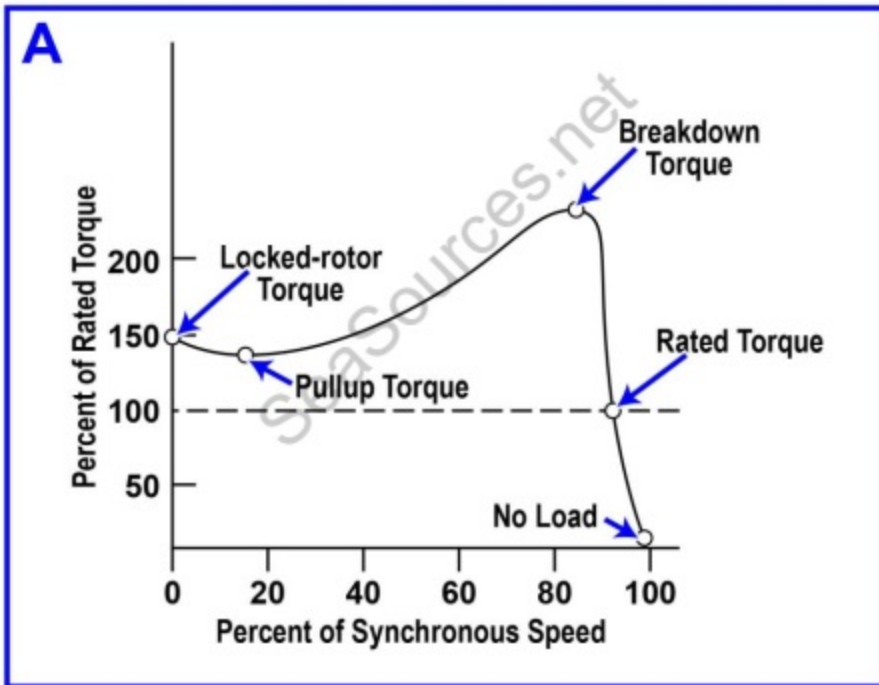
B

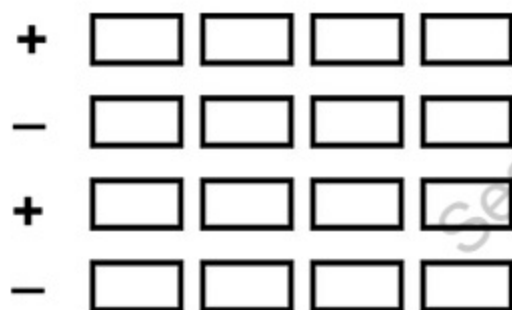
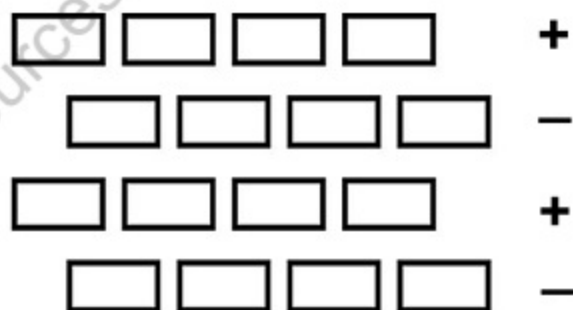
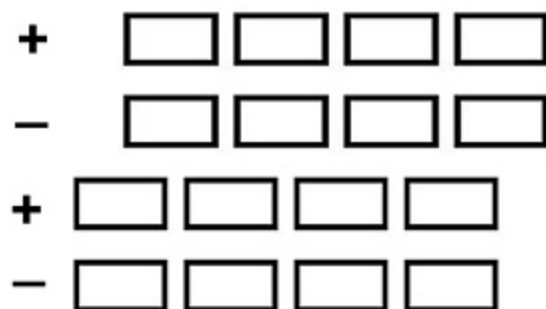
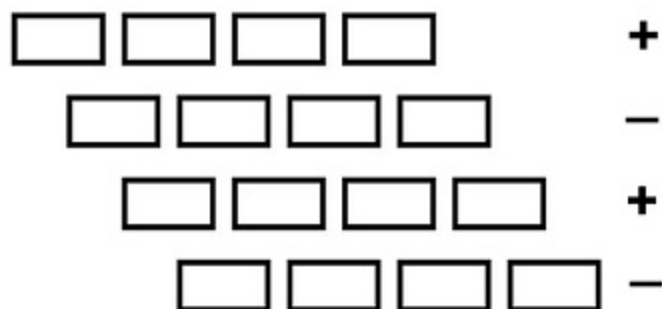
EL-0052



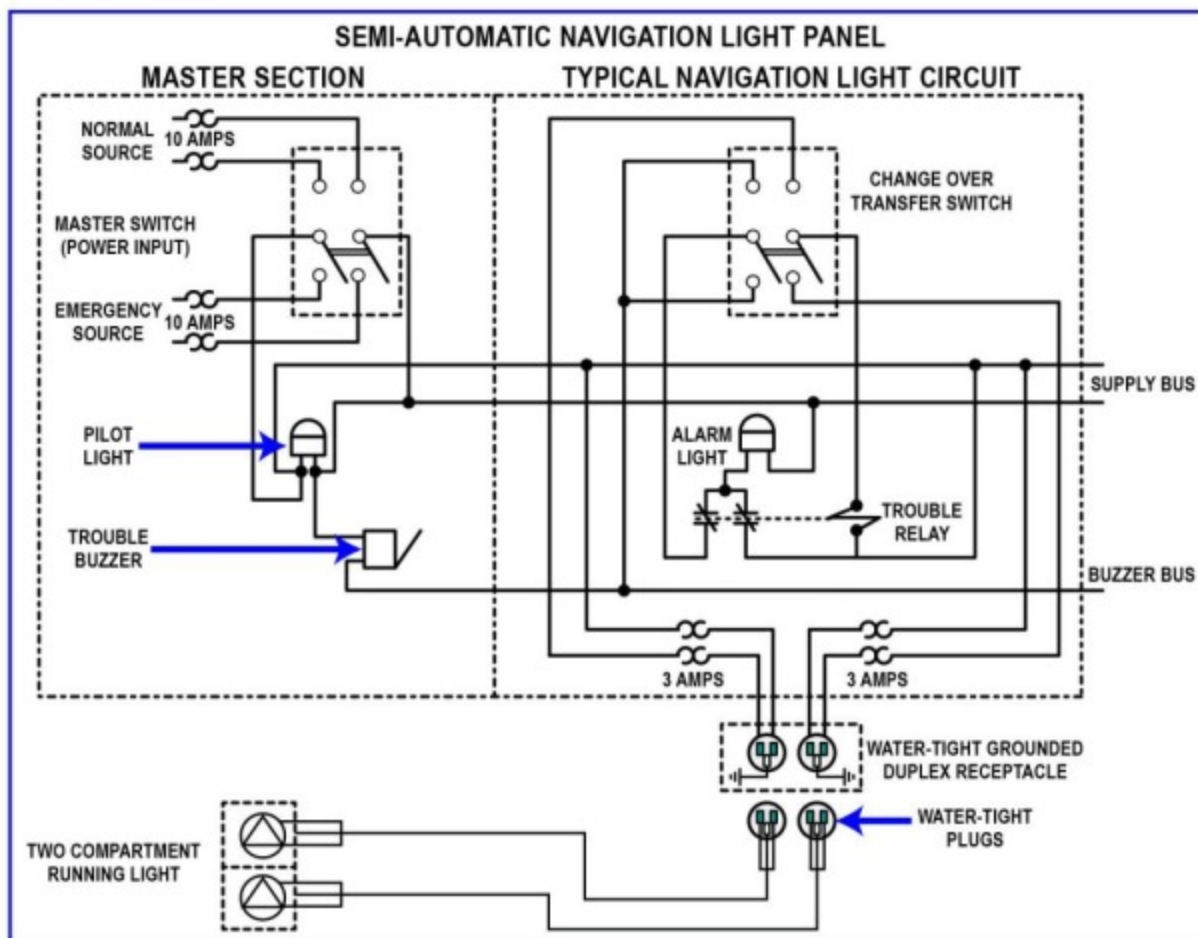




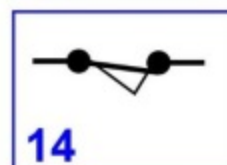
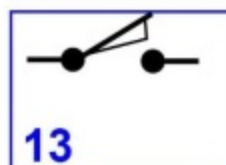
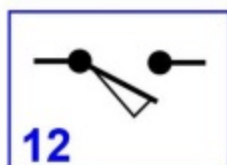
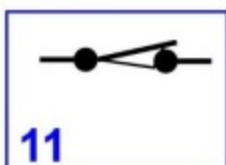
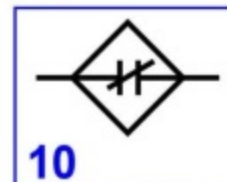
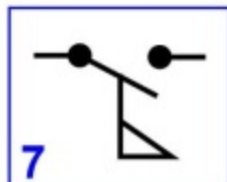
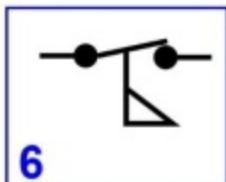
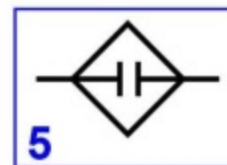
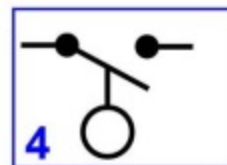
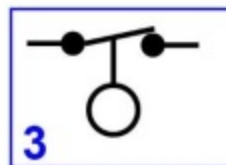
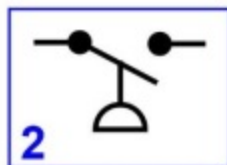
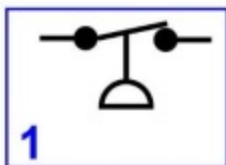
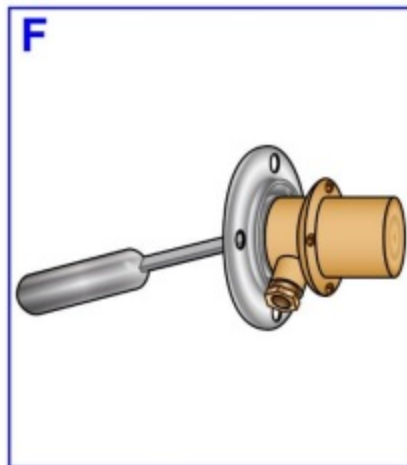
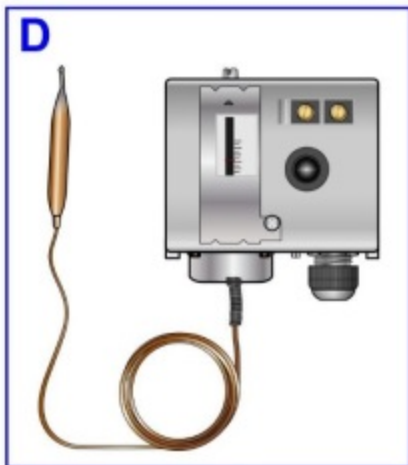
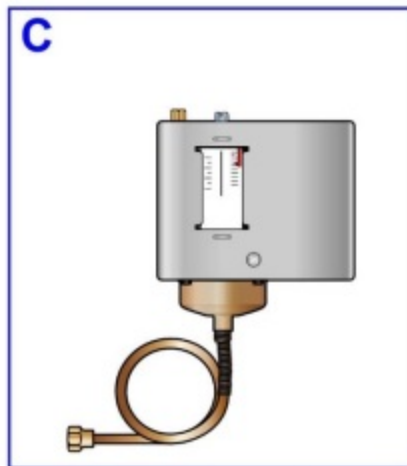
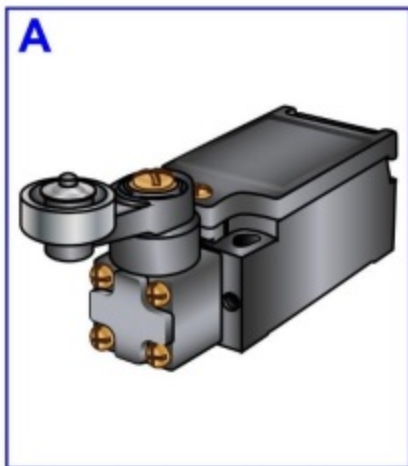


**A****B****C****D**

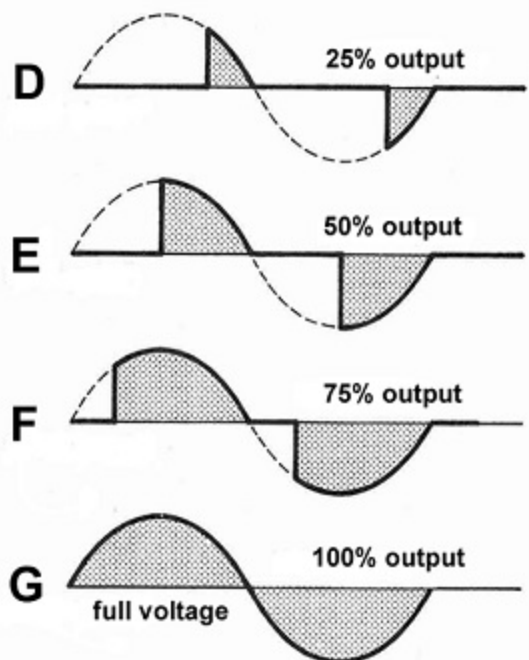
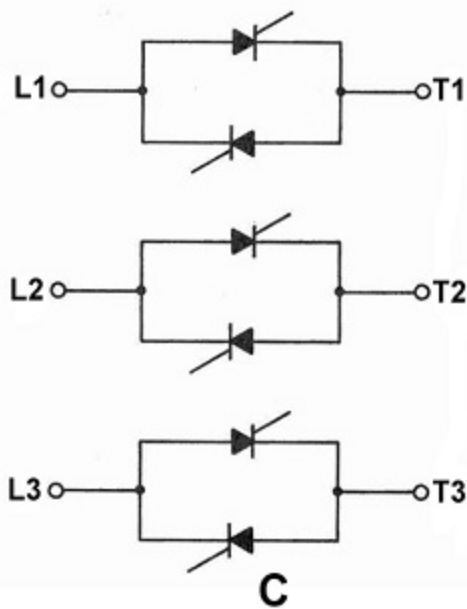
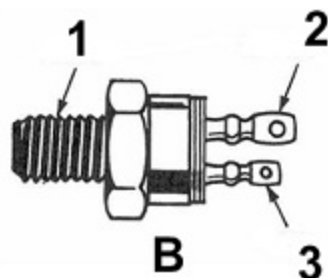
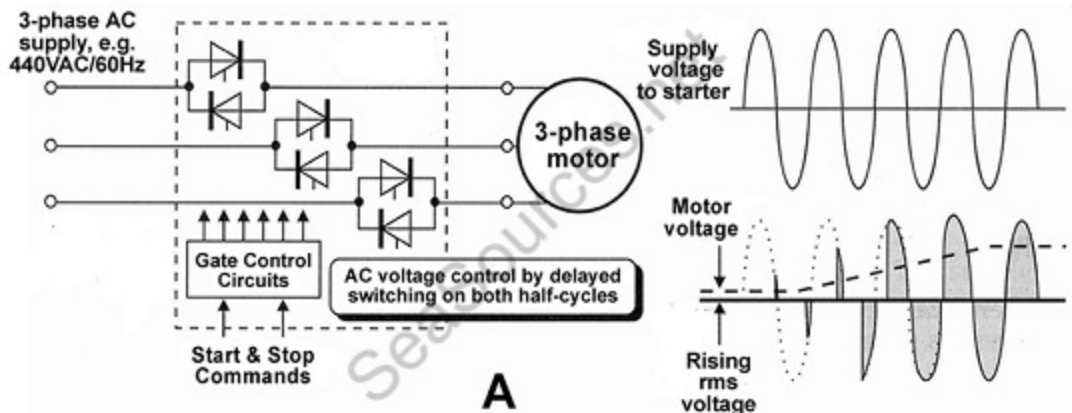
EL-0058



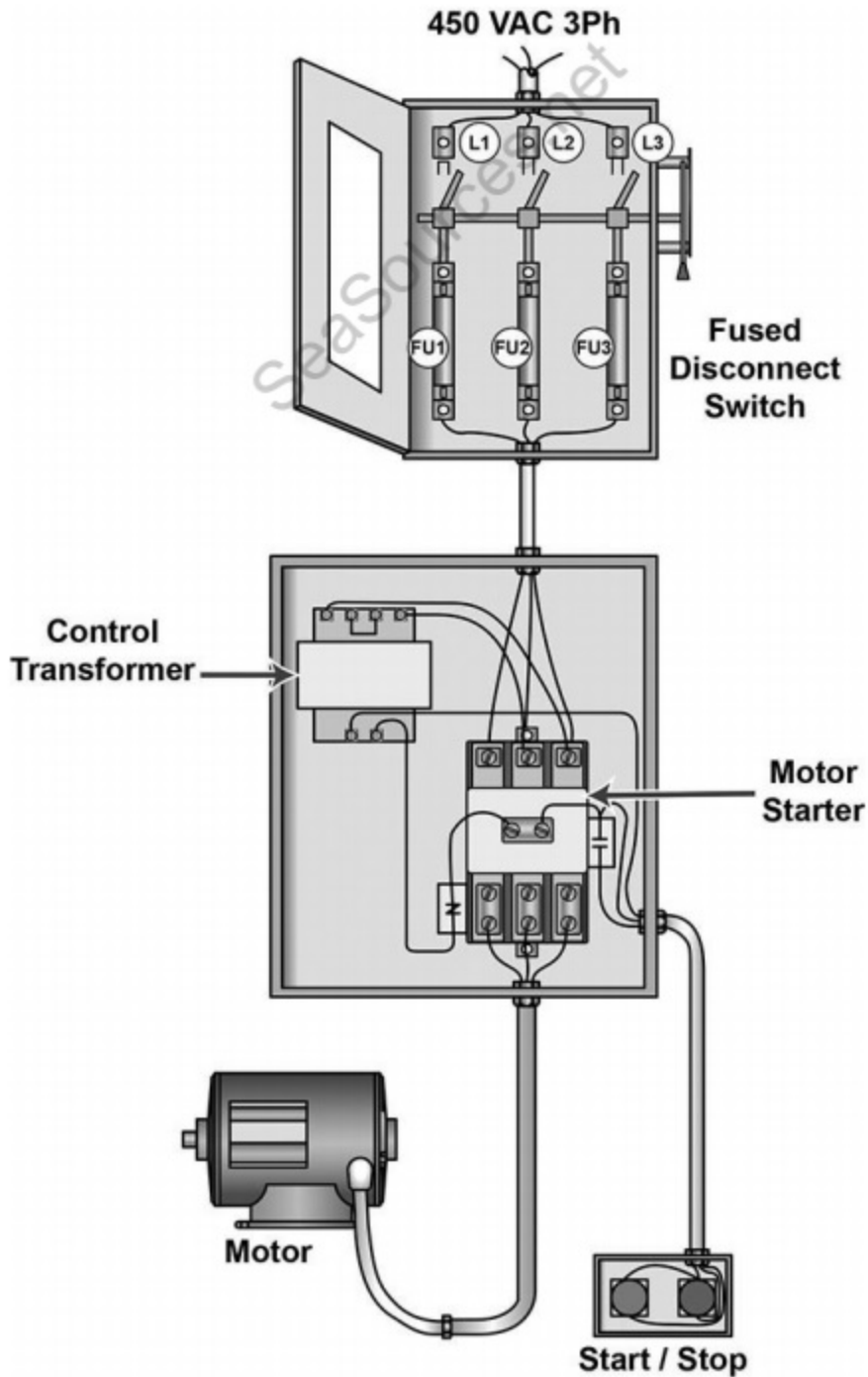
EL-0059



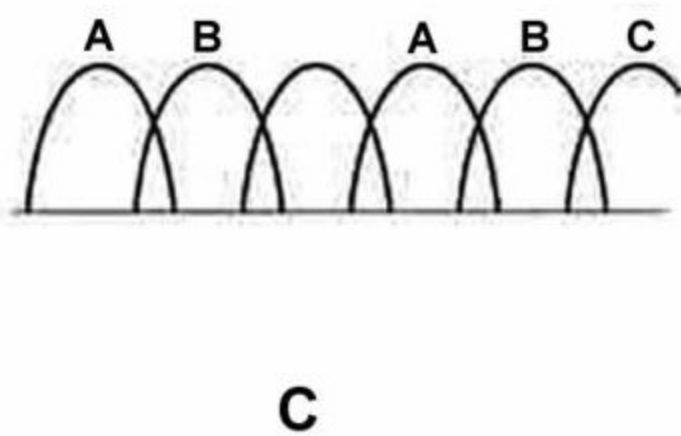
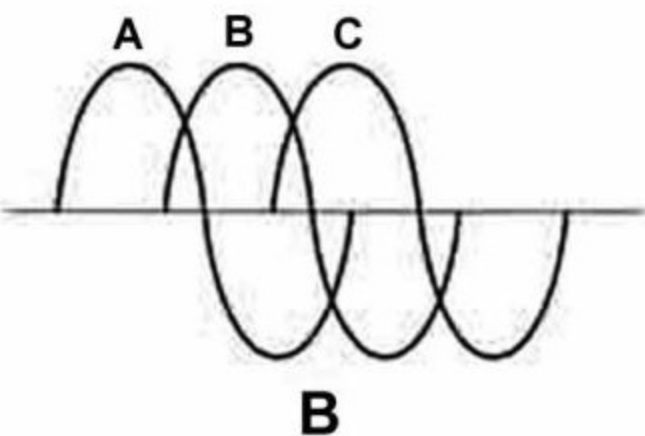
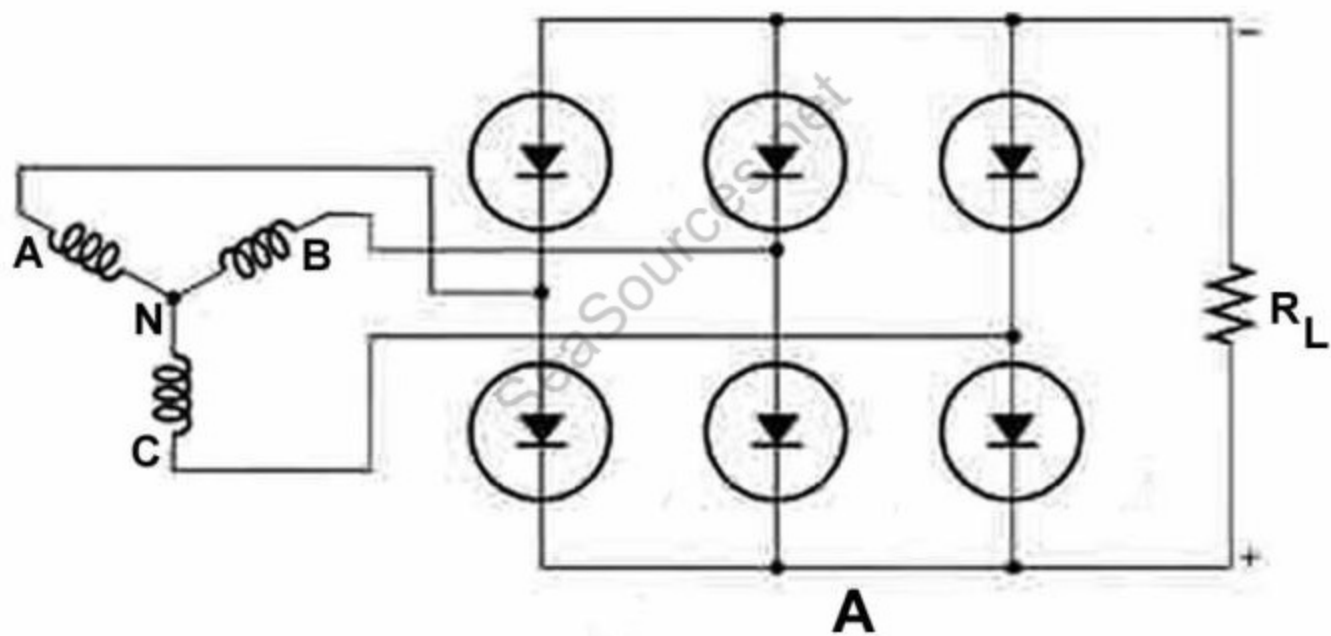
EL-0060

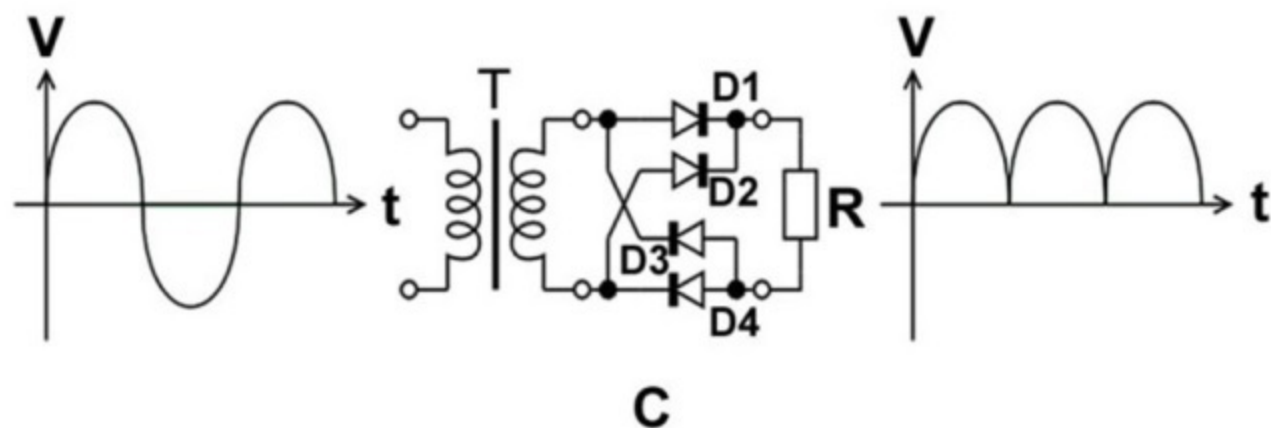
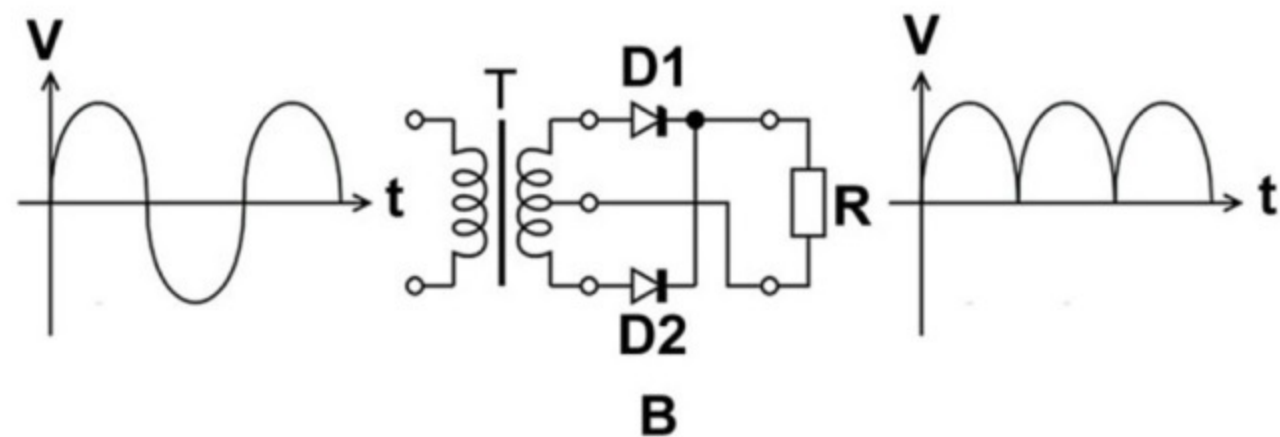
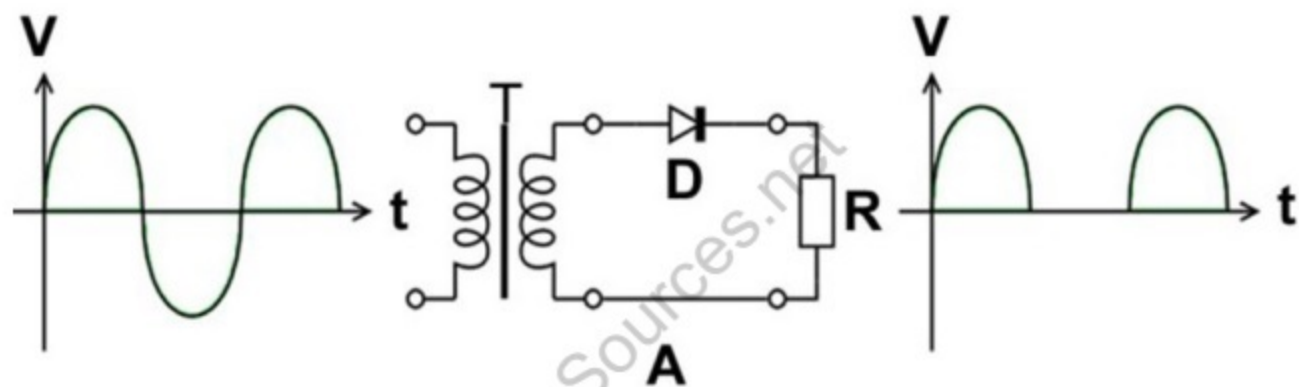


EL-0062

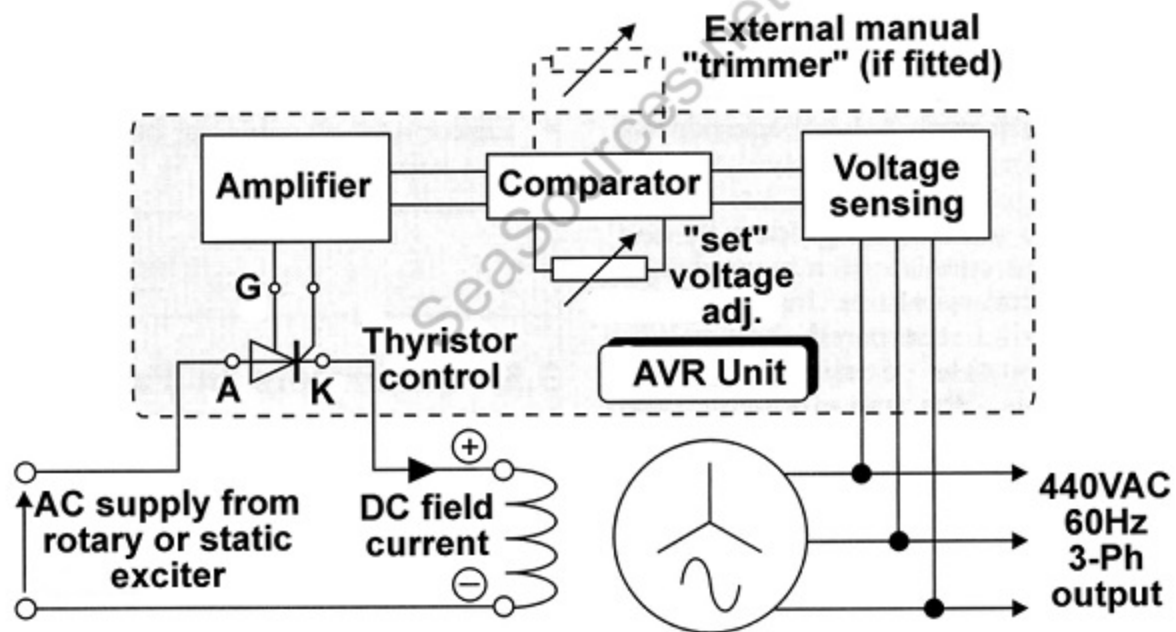


EL-0063

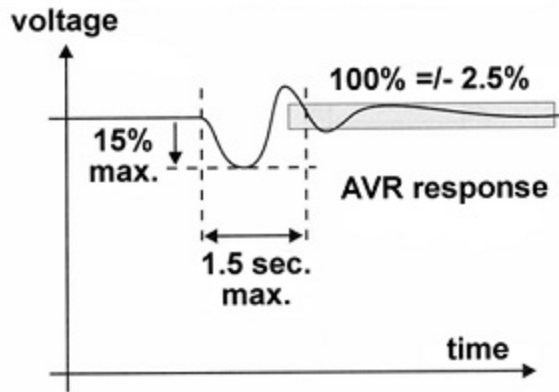
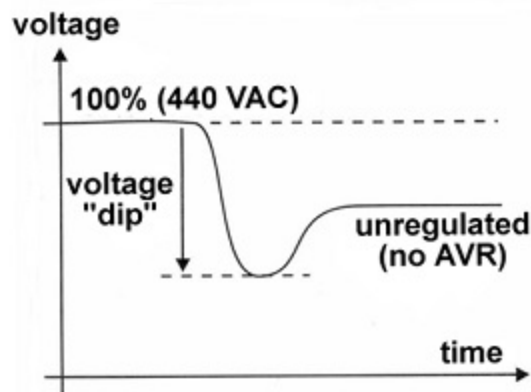




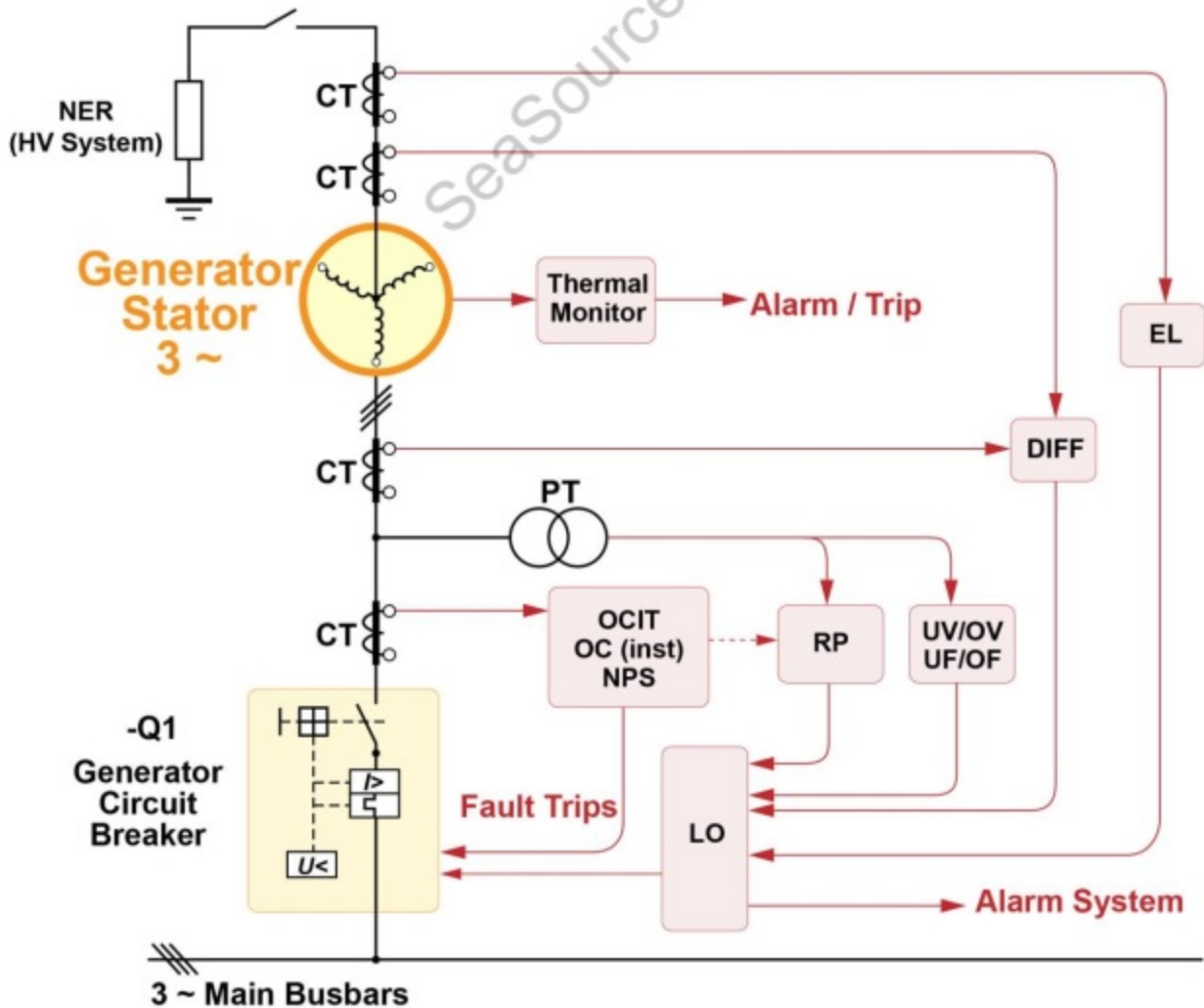
EL-0066



A



B



EL-0068

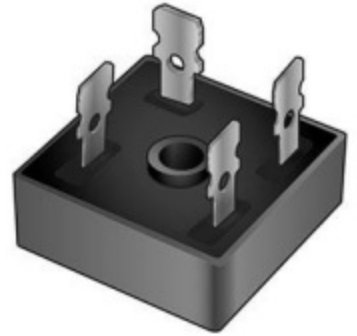
1



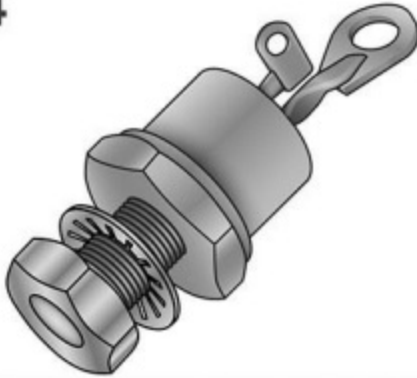
2



3



4



5



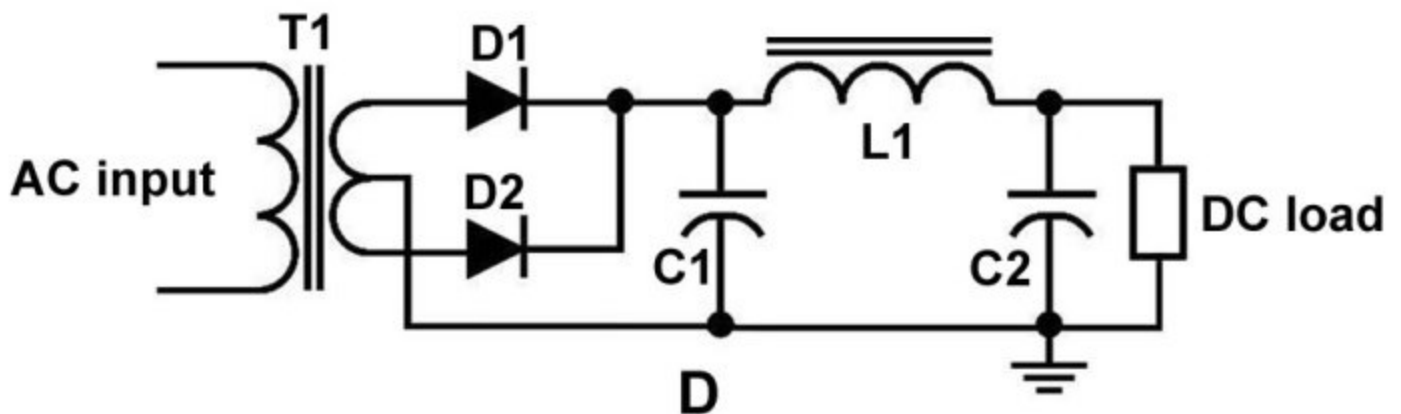
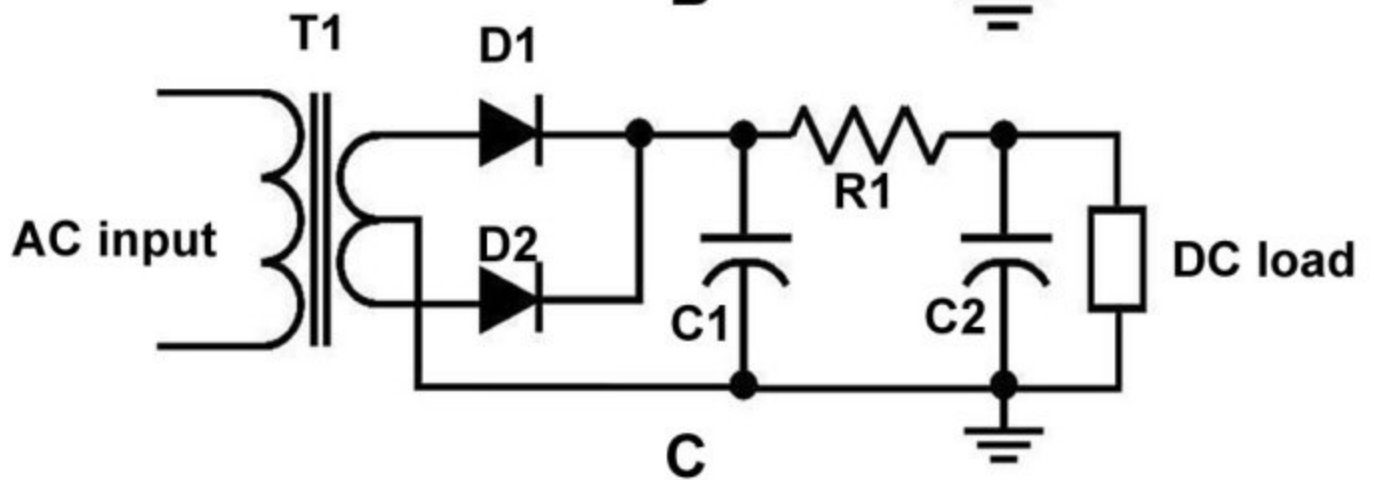
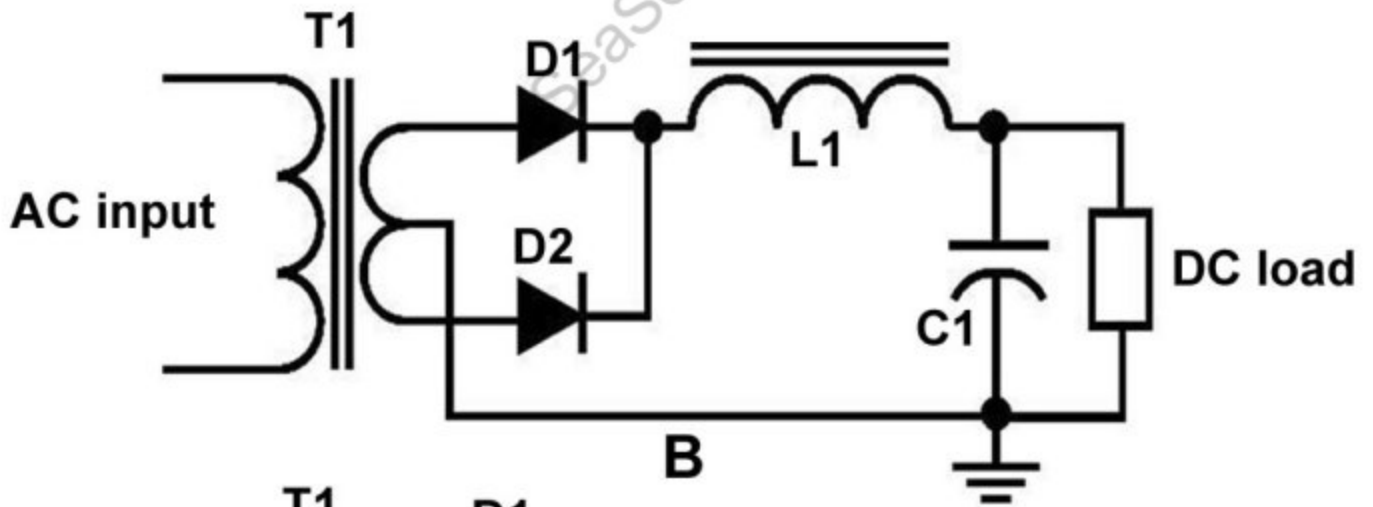
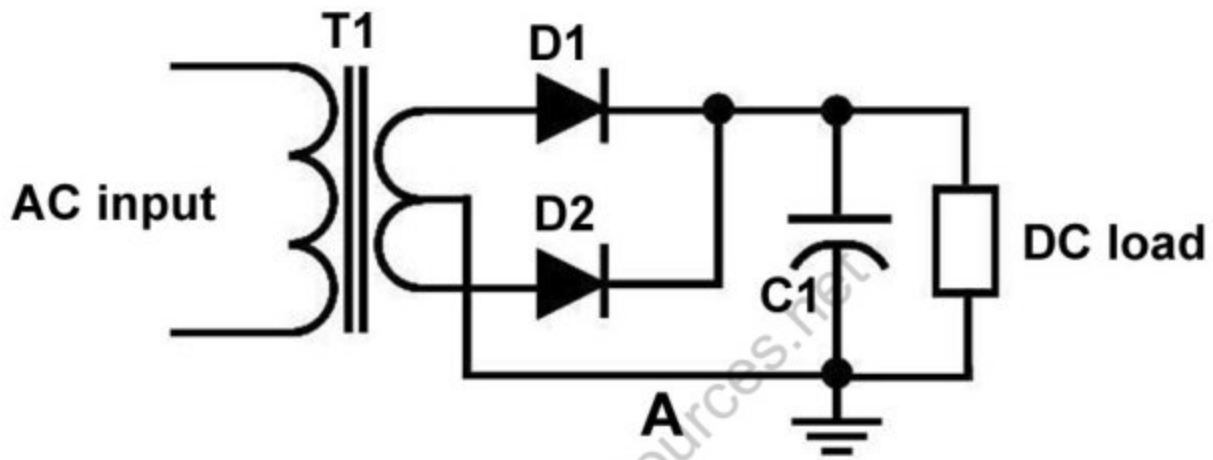
6



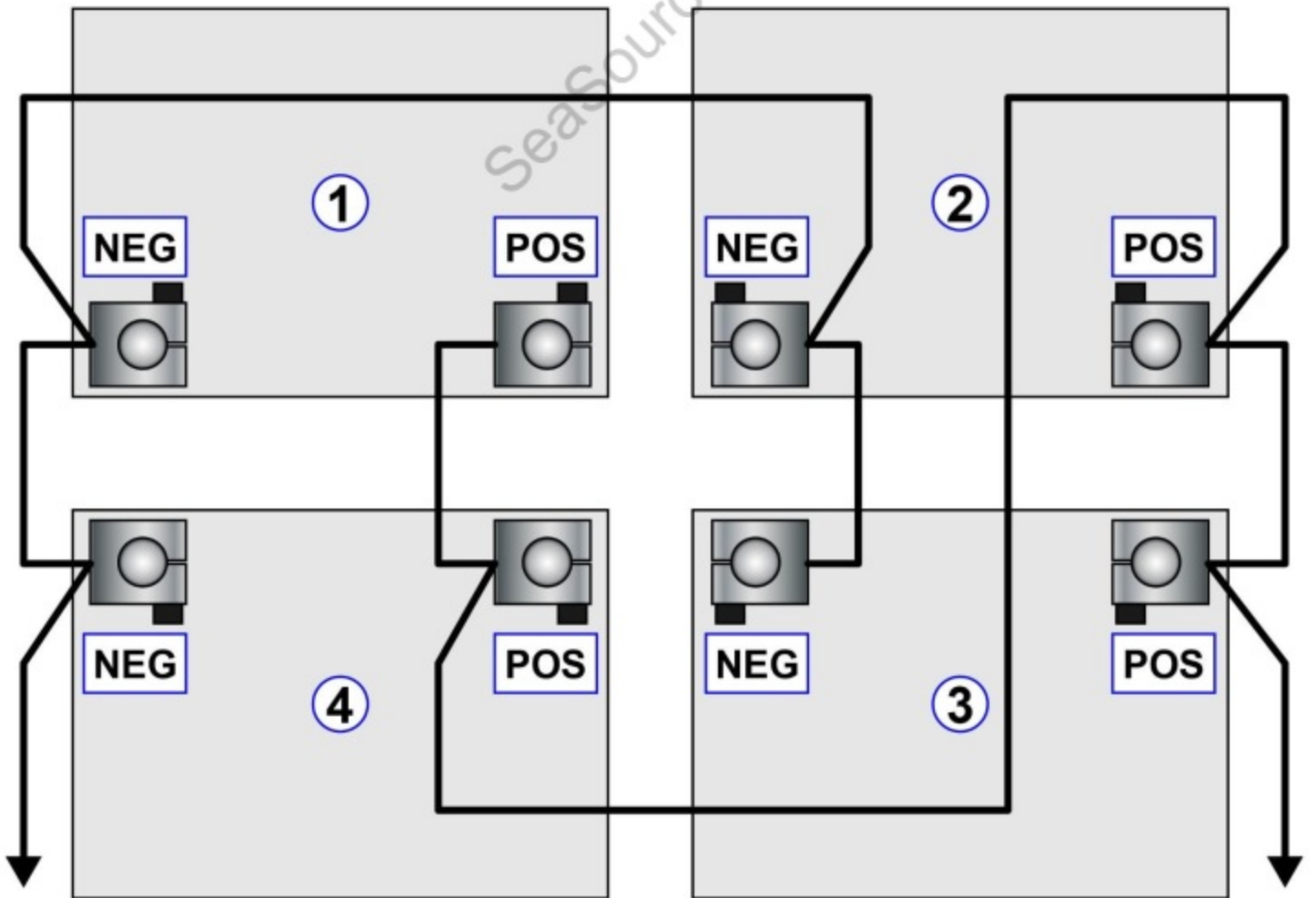
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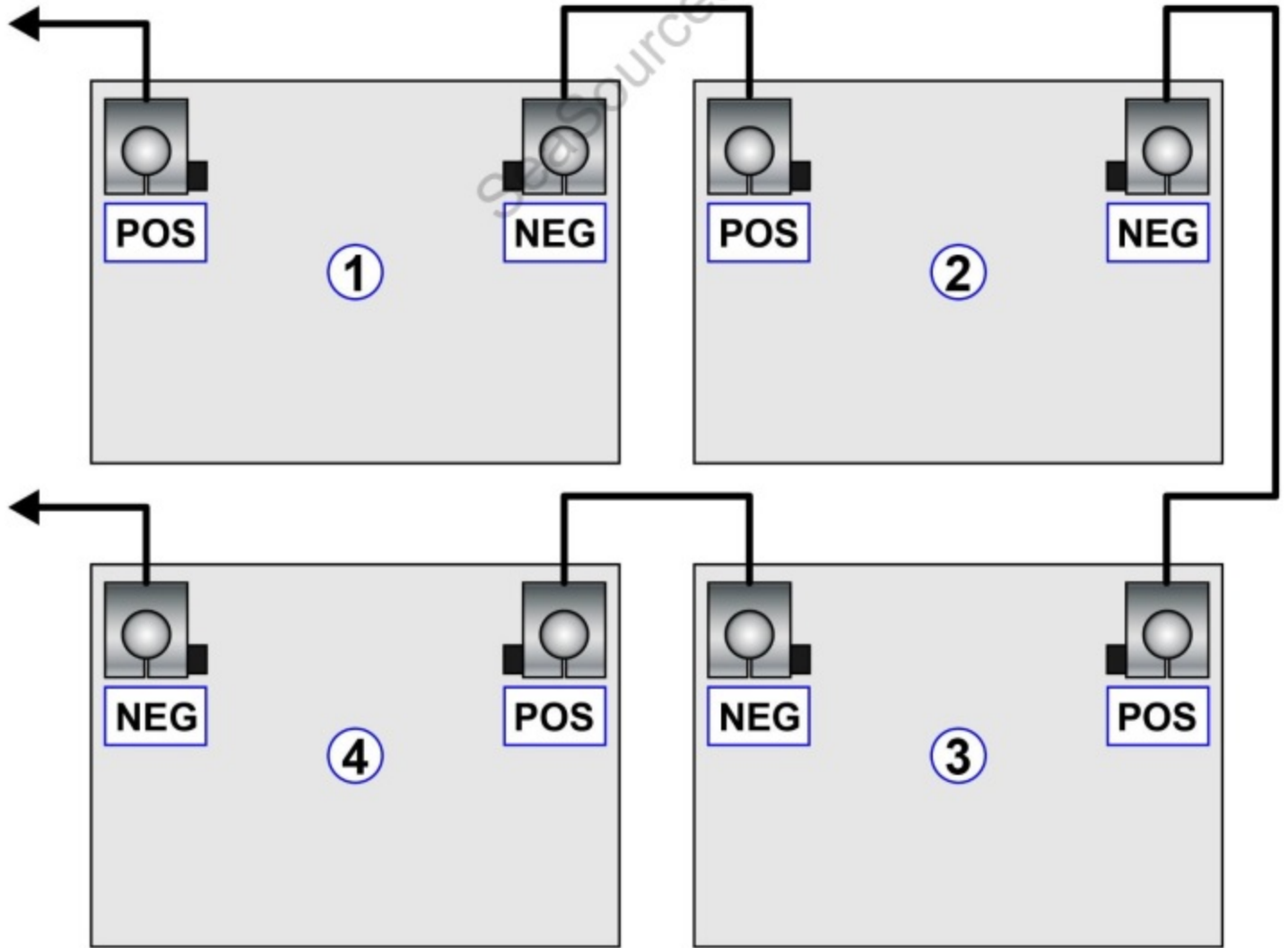
EL-0069



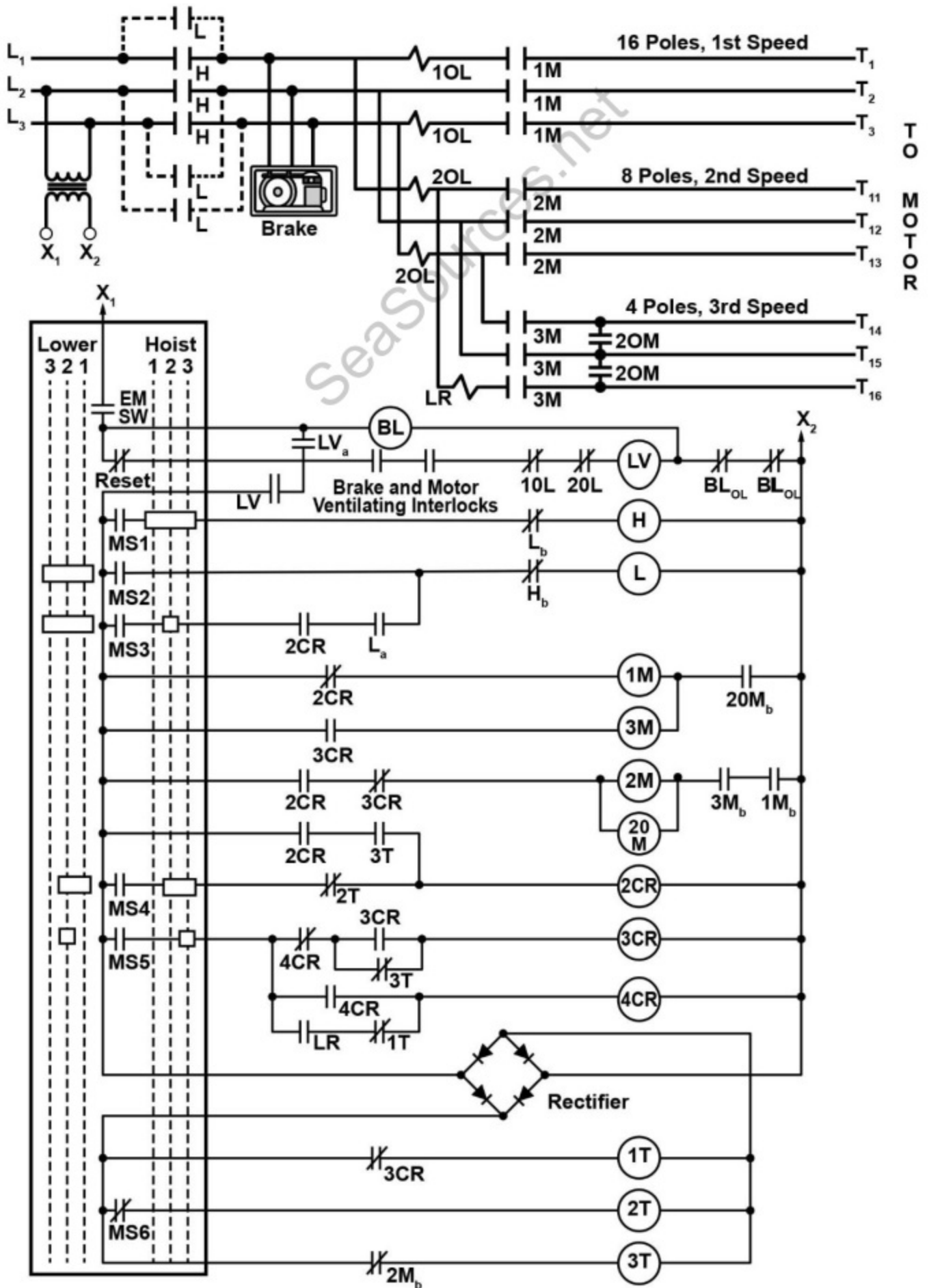
SeaSources.net



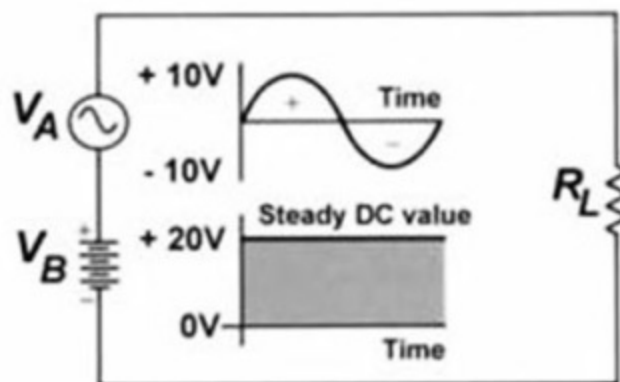
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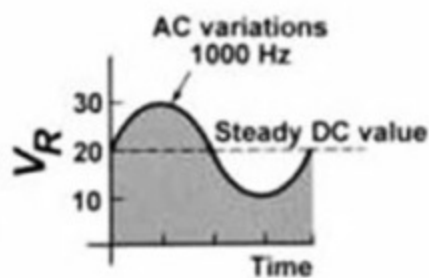
EL-0073



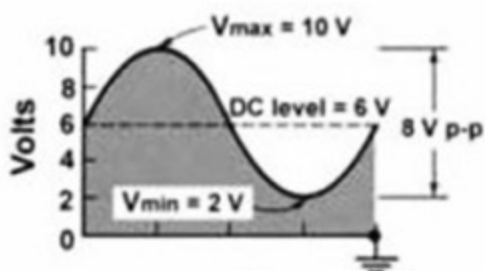
EL-0075



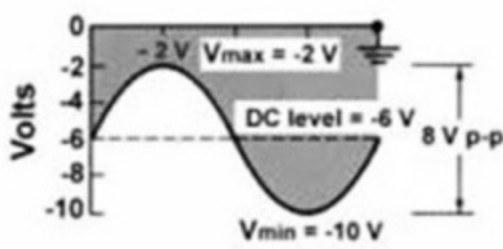
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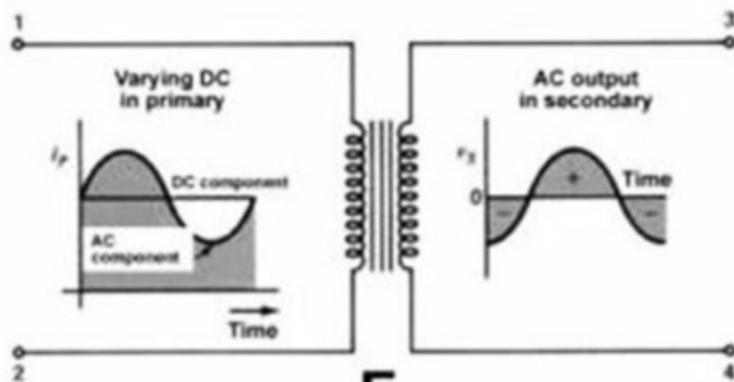
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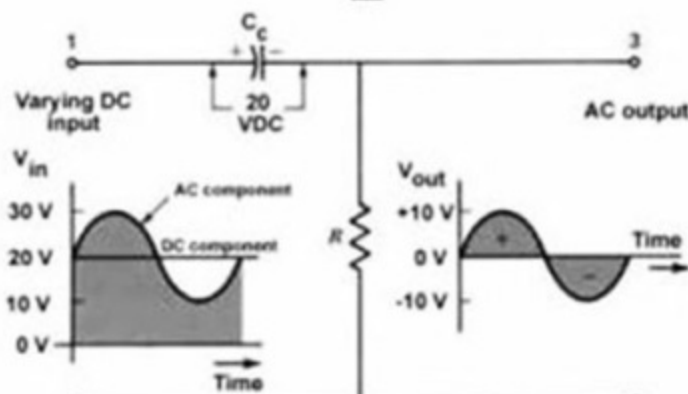
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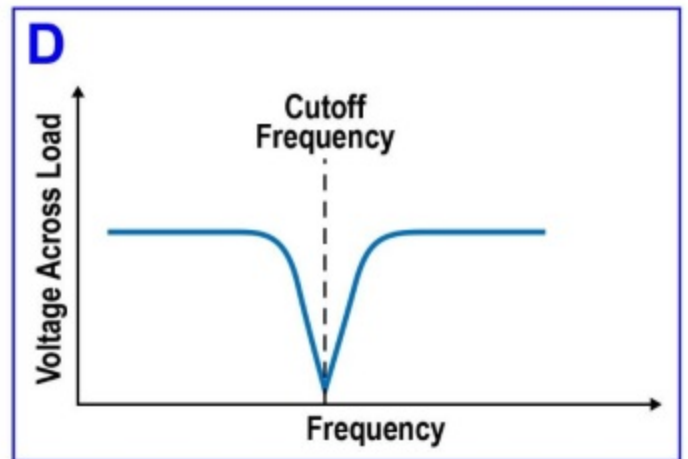
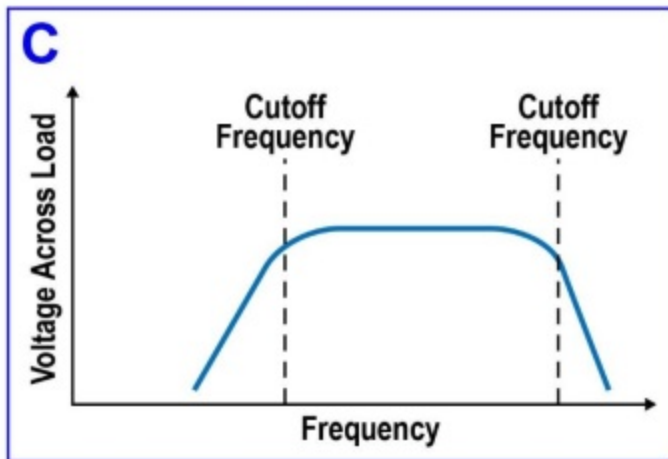
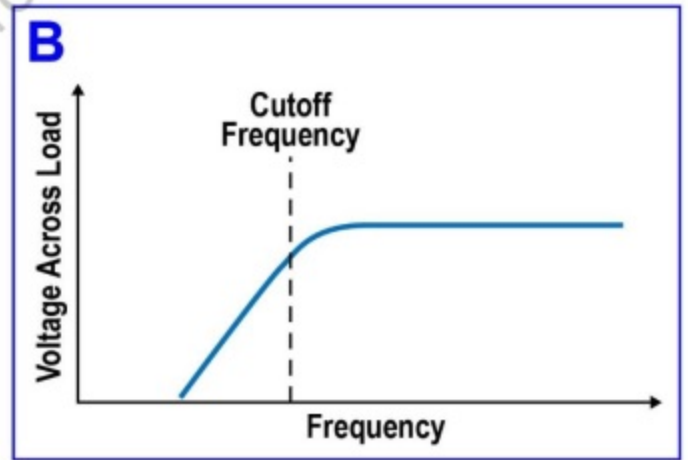
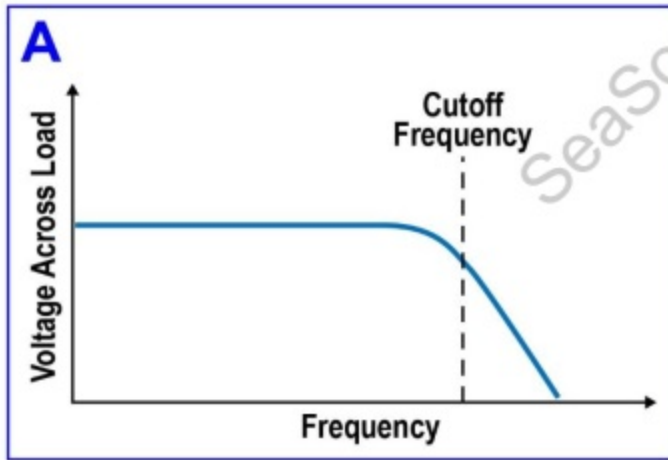
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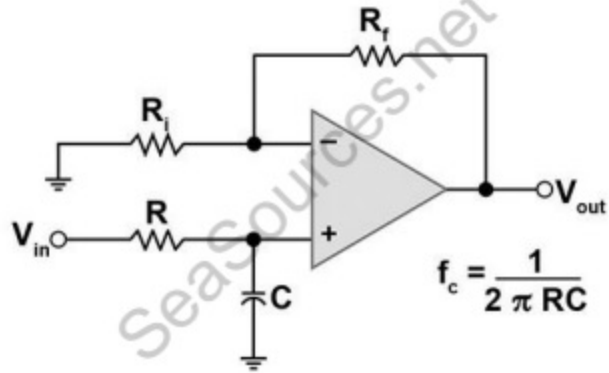


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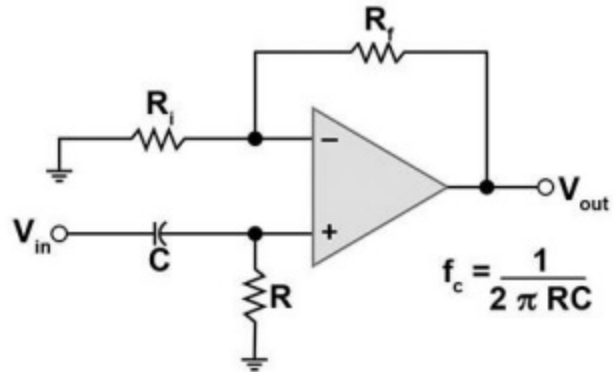


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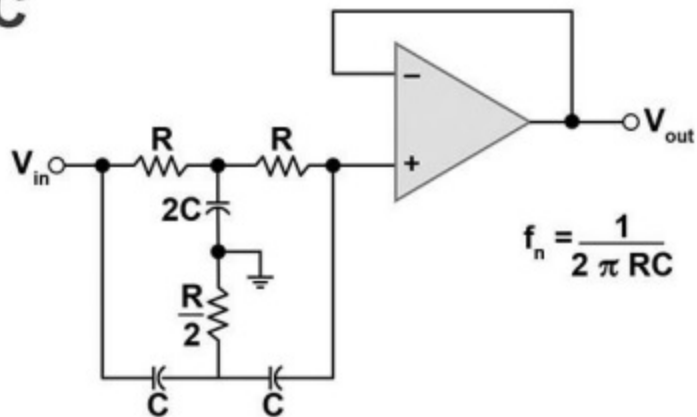
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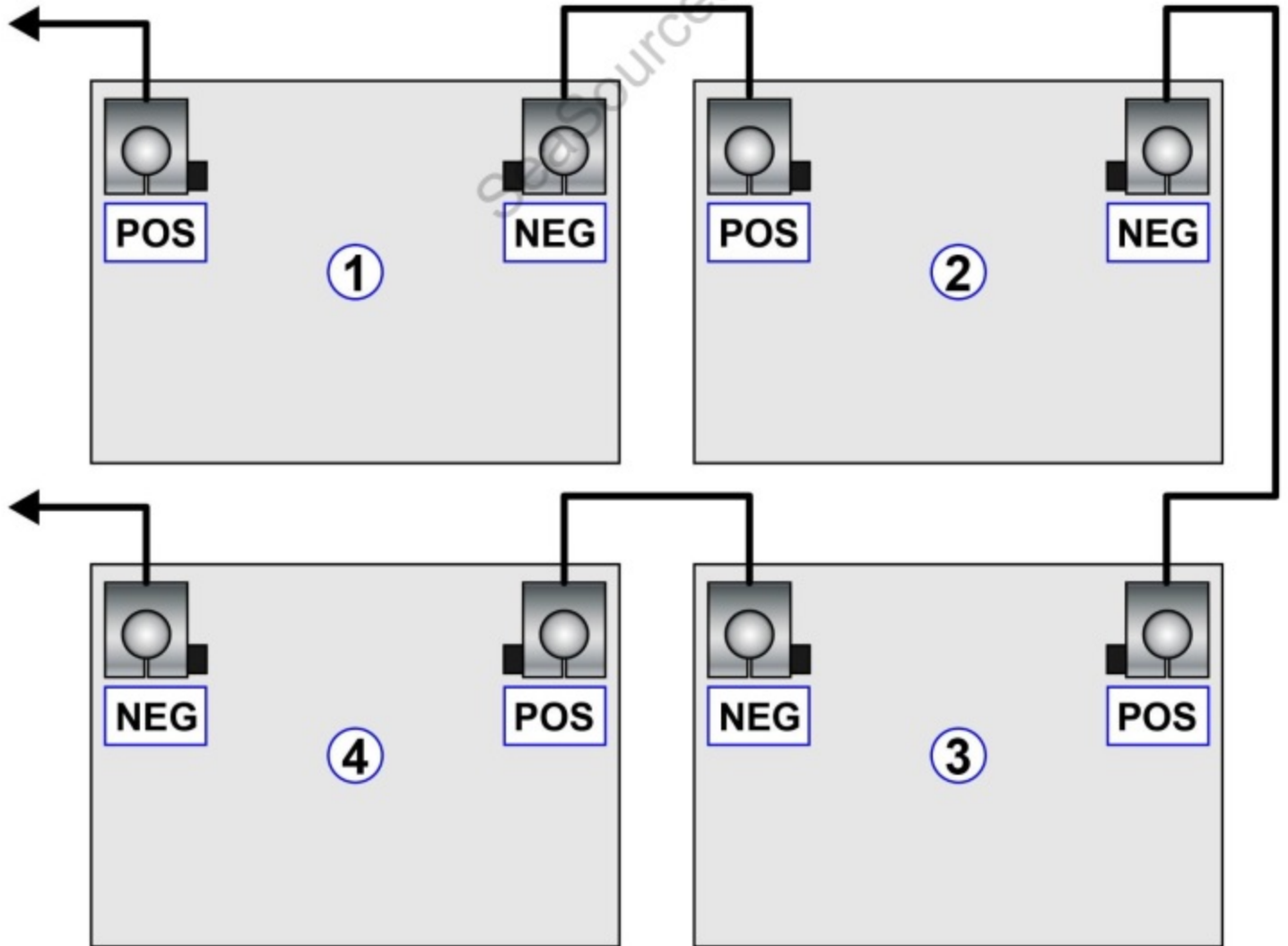
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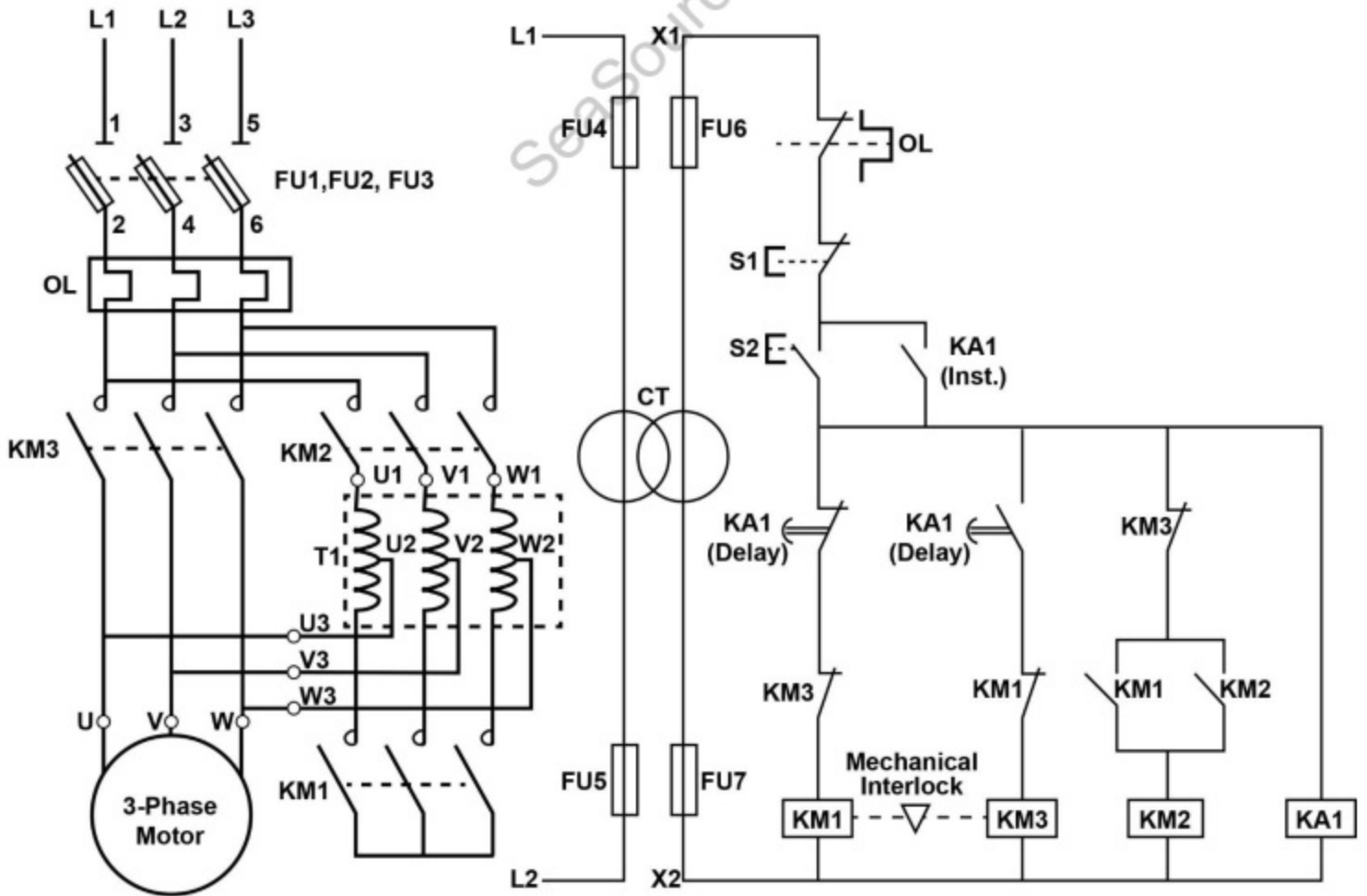
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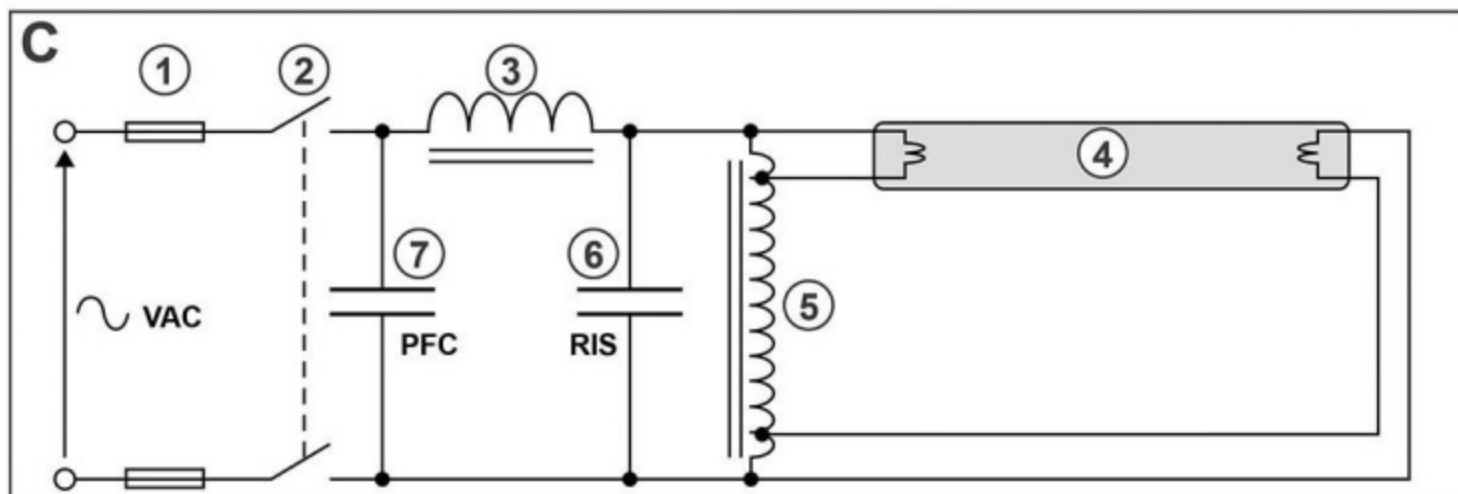
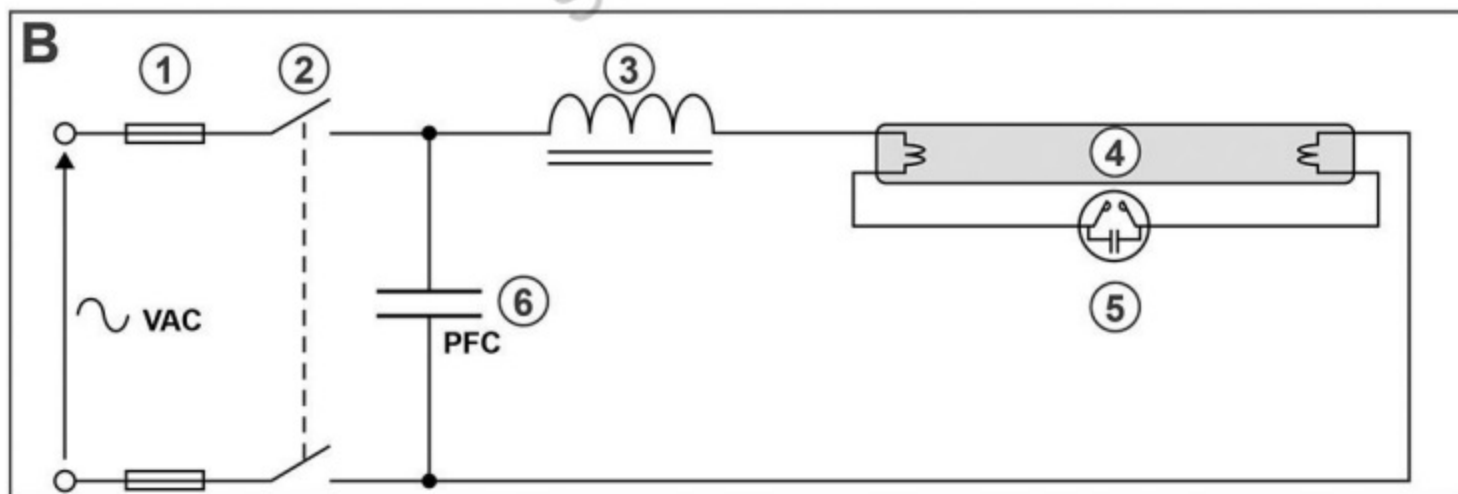
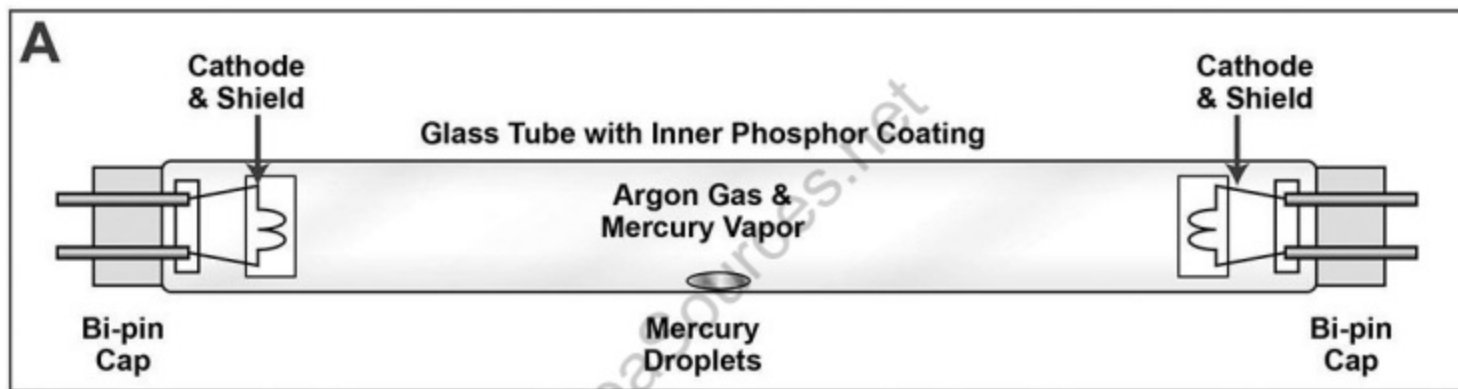
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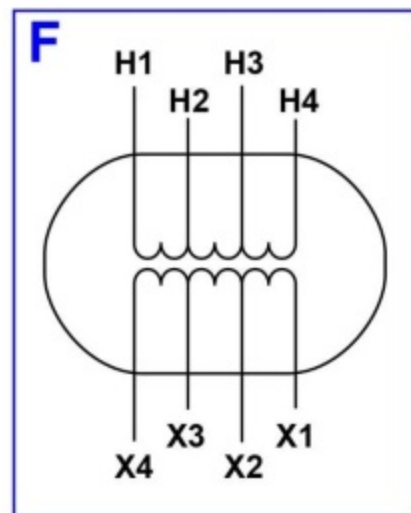
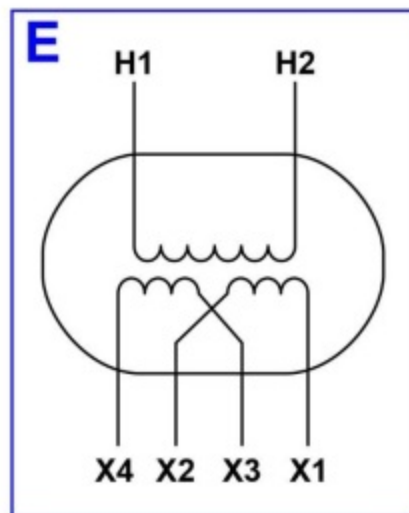
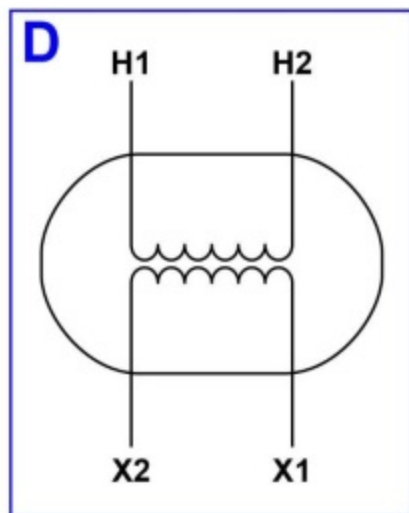
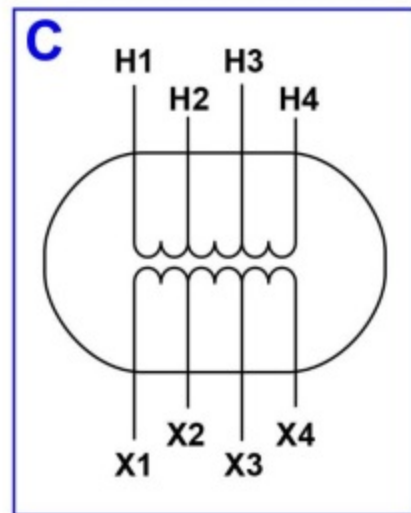
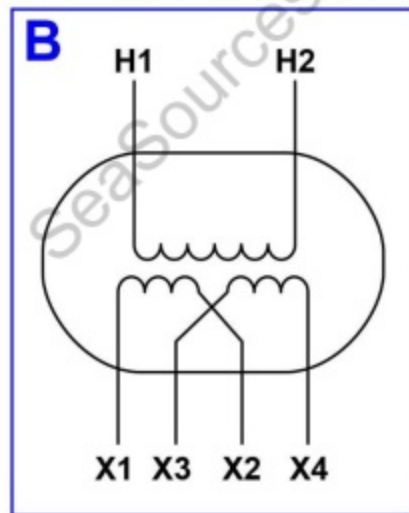
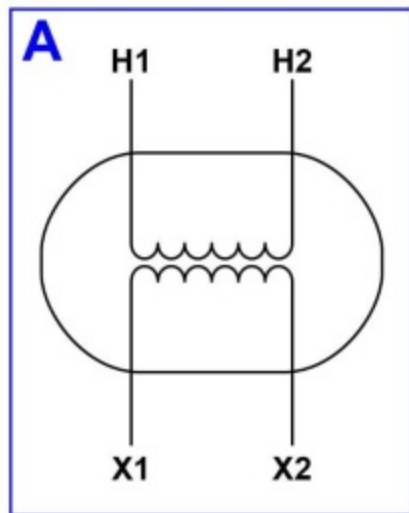


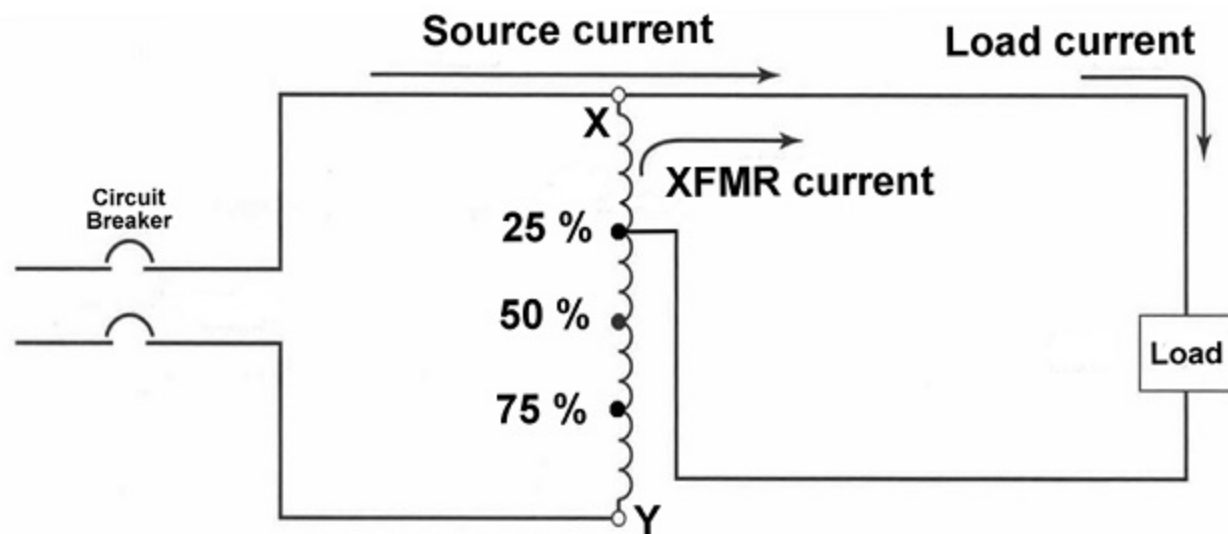
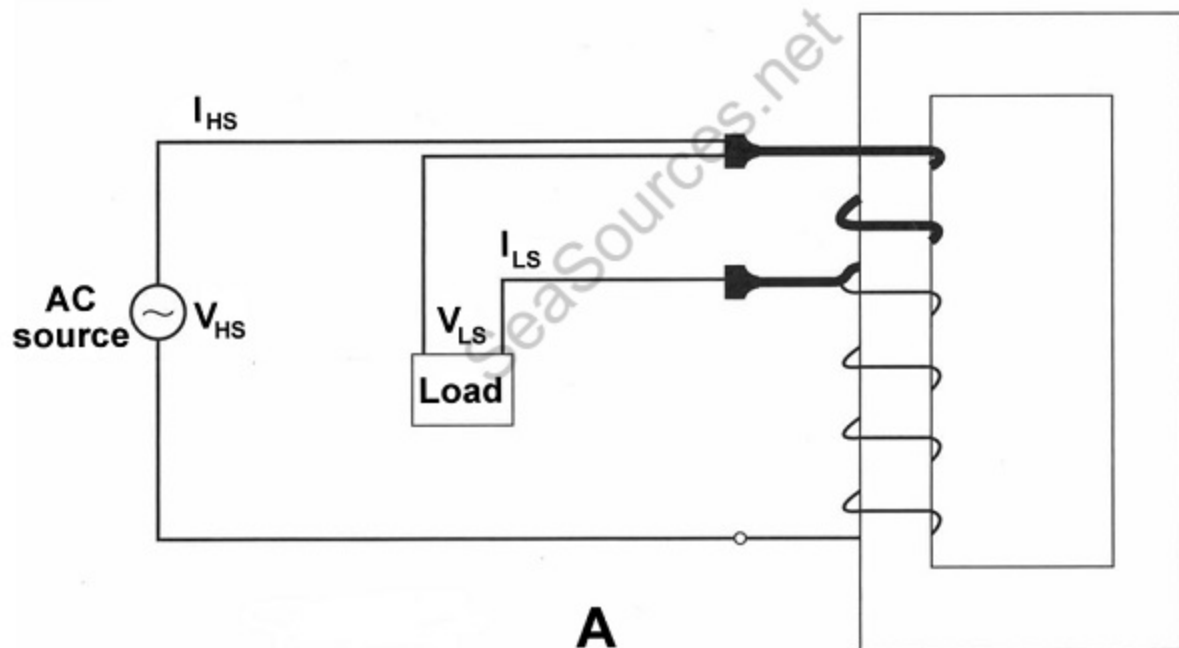
EL-0080



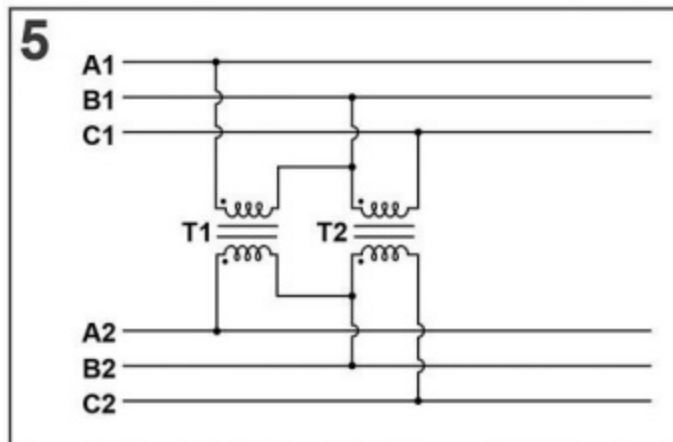
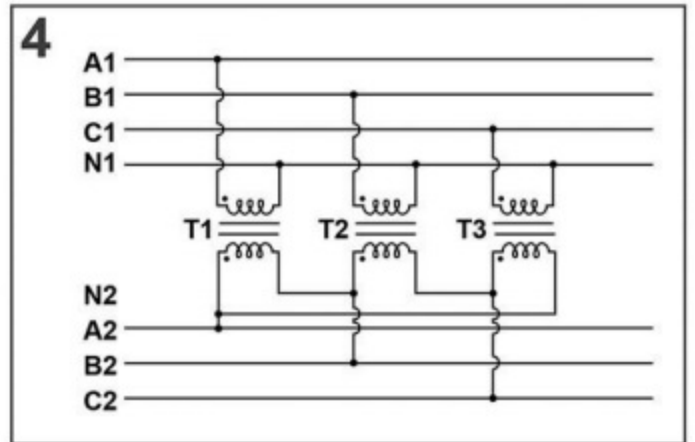
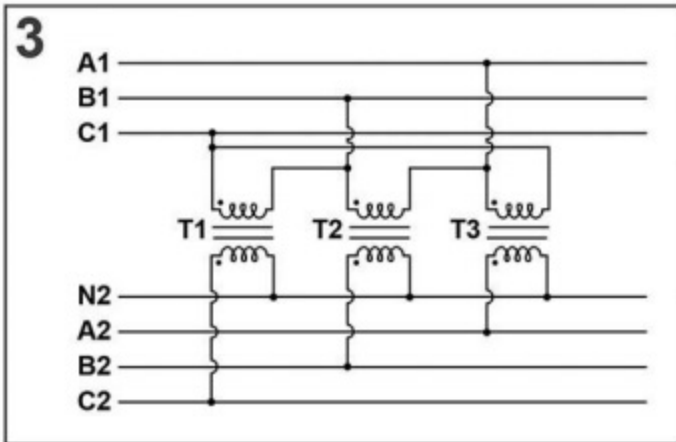
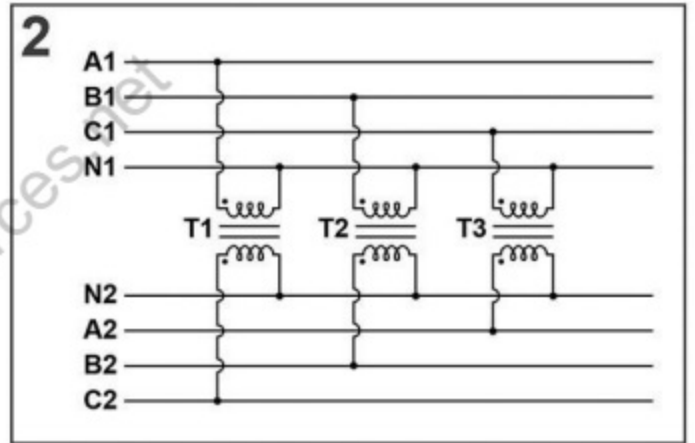
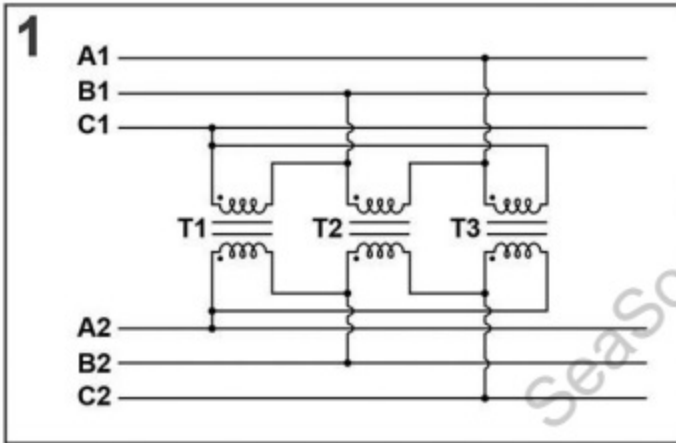
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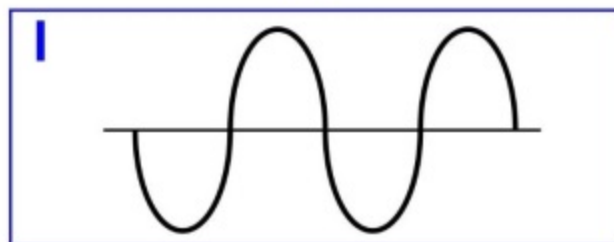
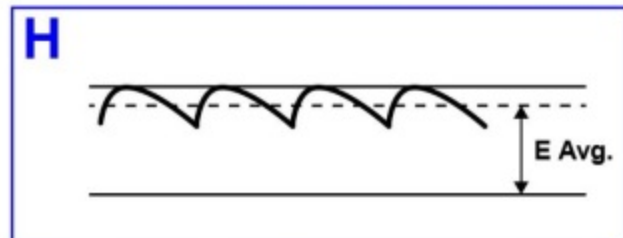
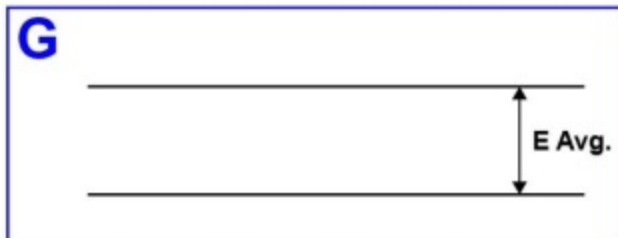
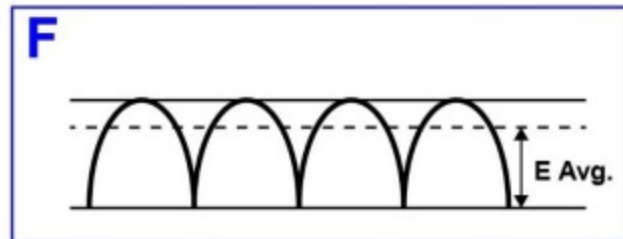
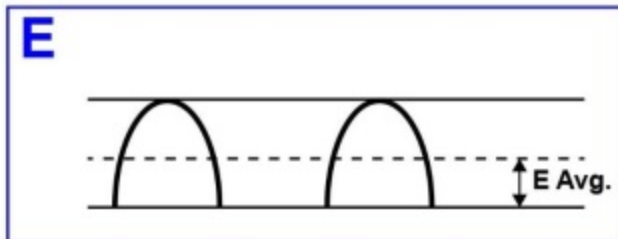
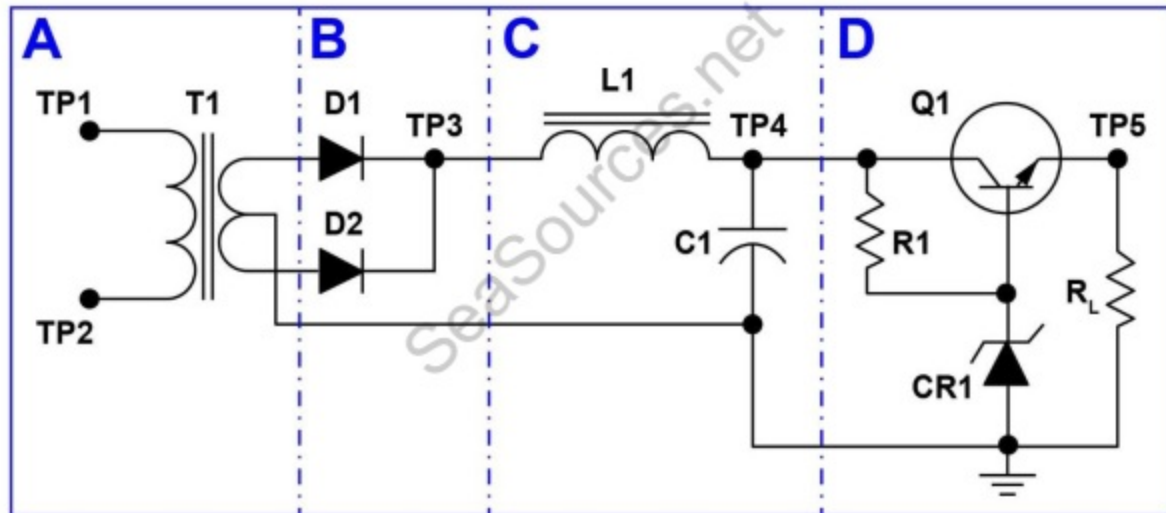


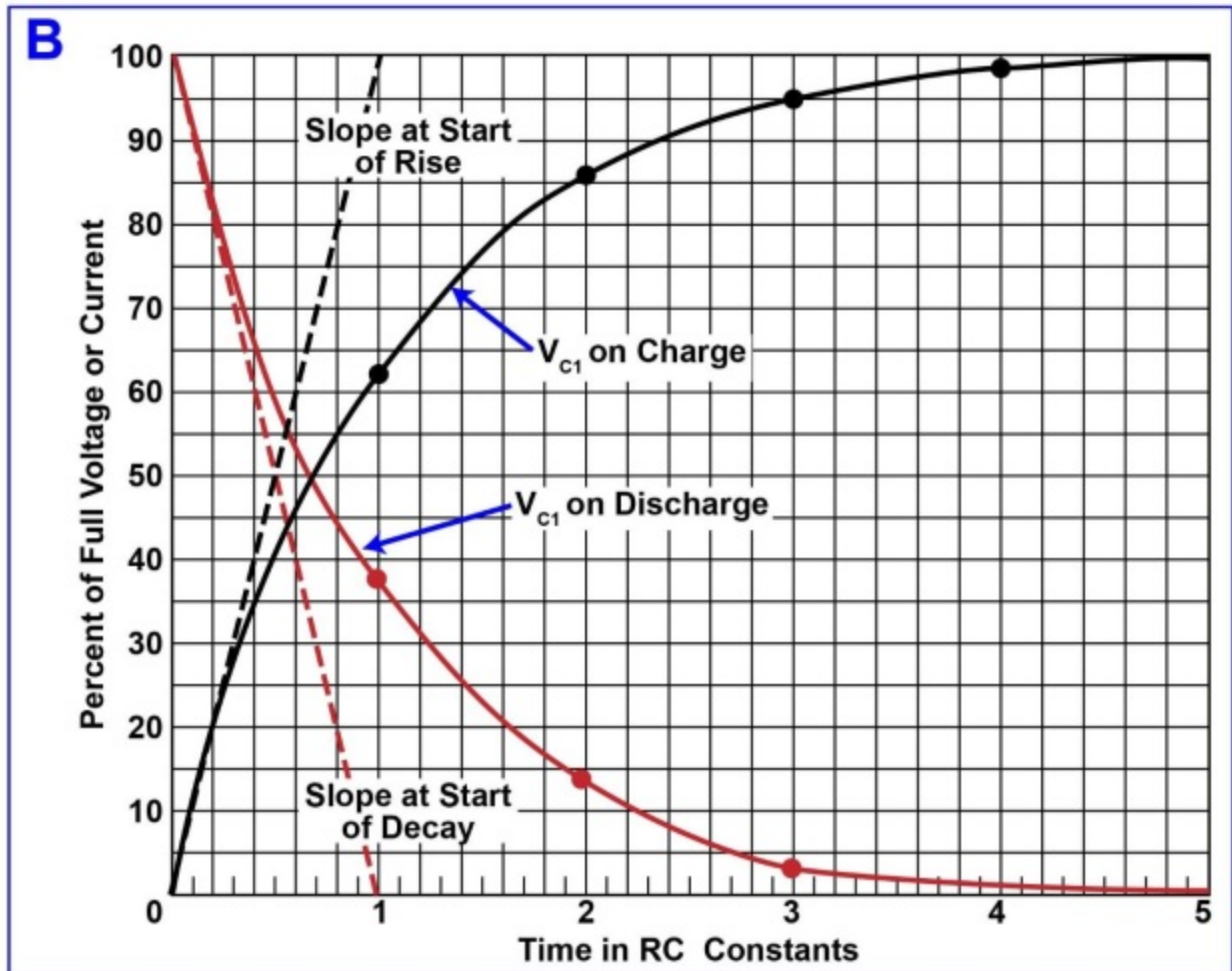
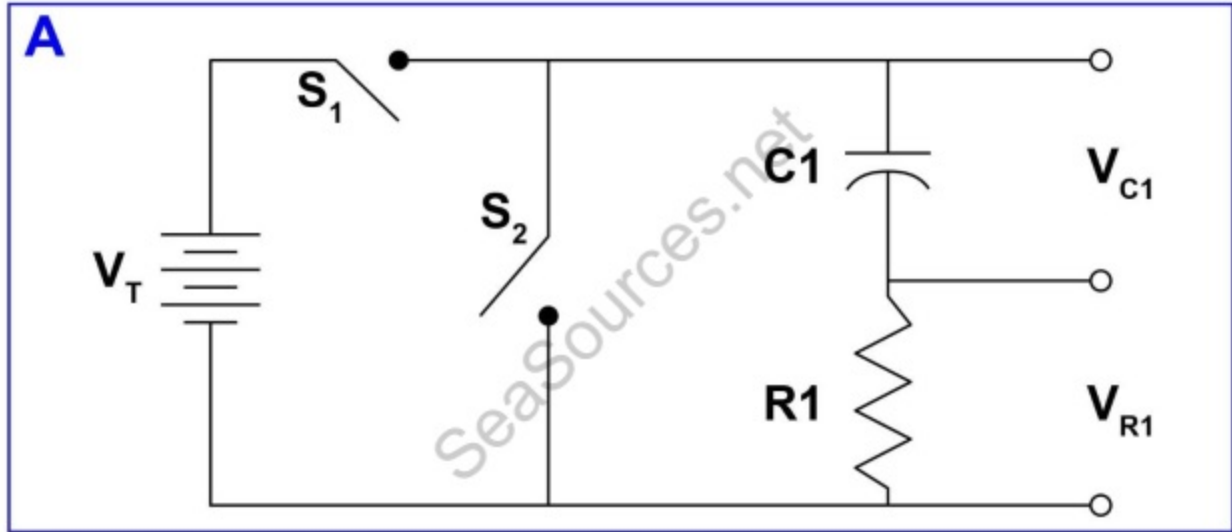




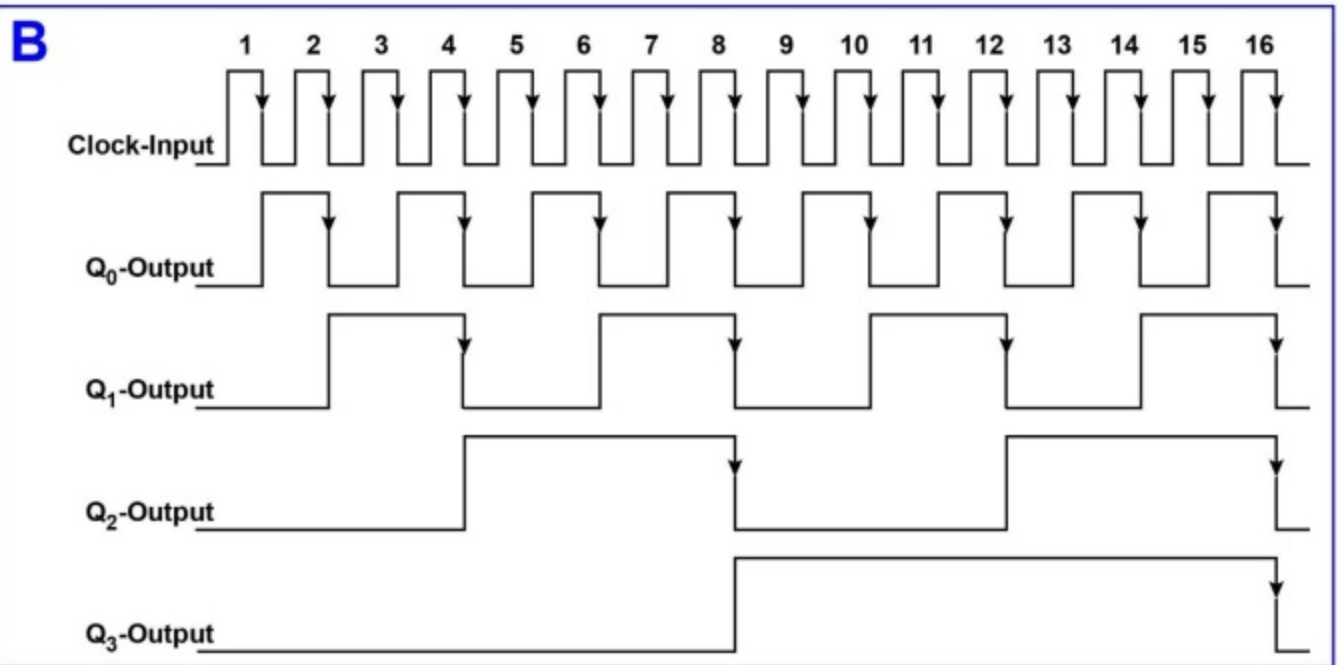
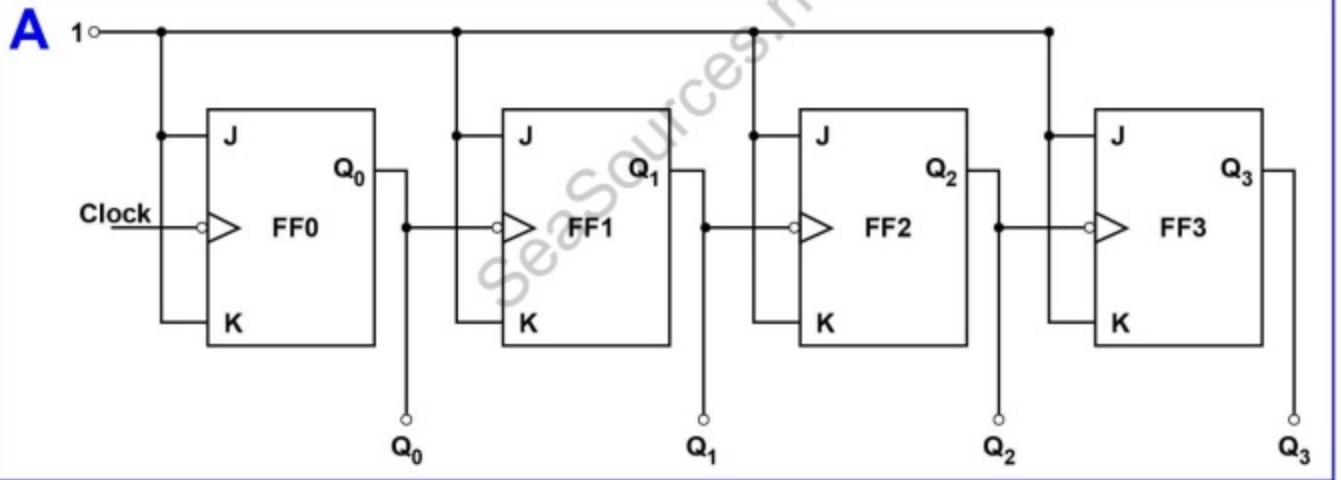
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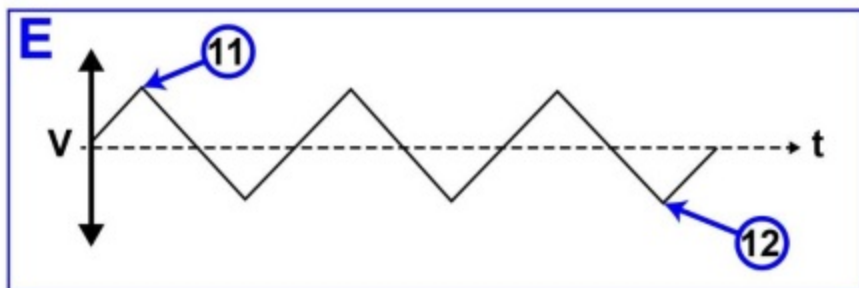
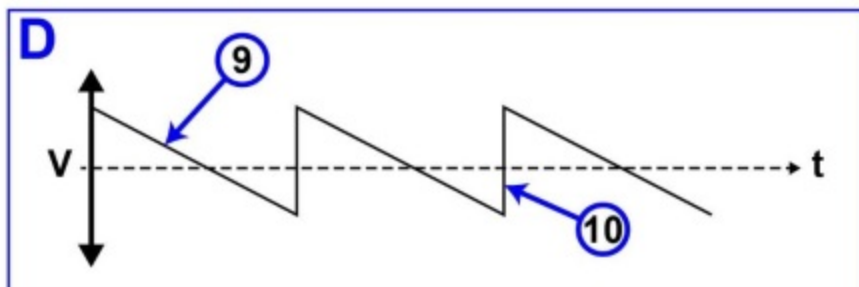
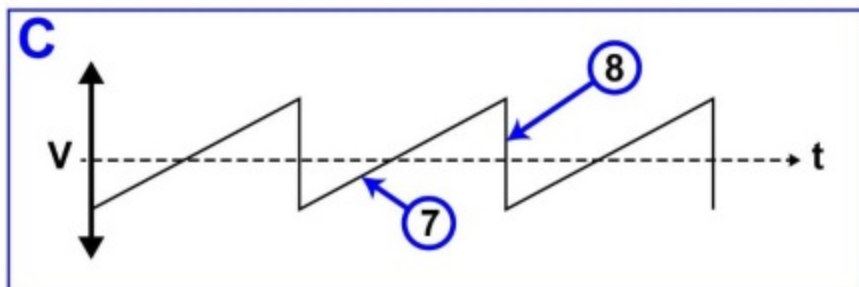
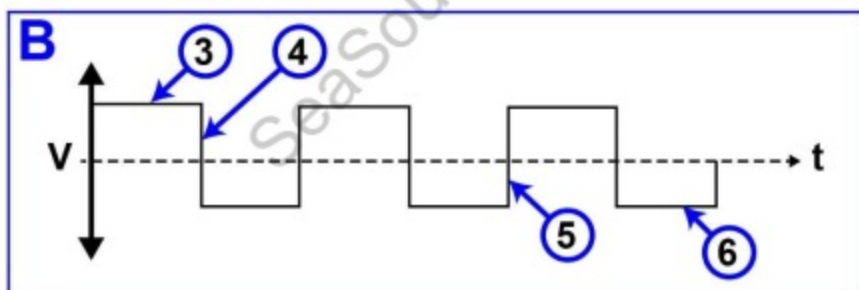
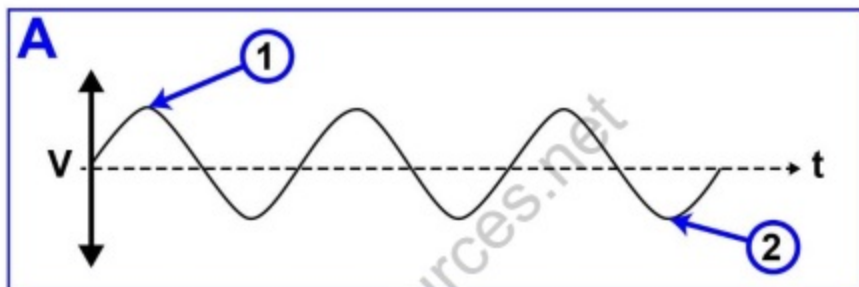




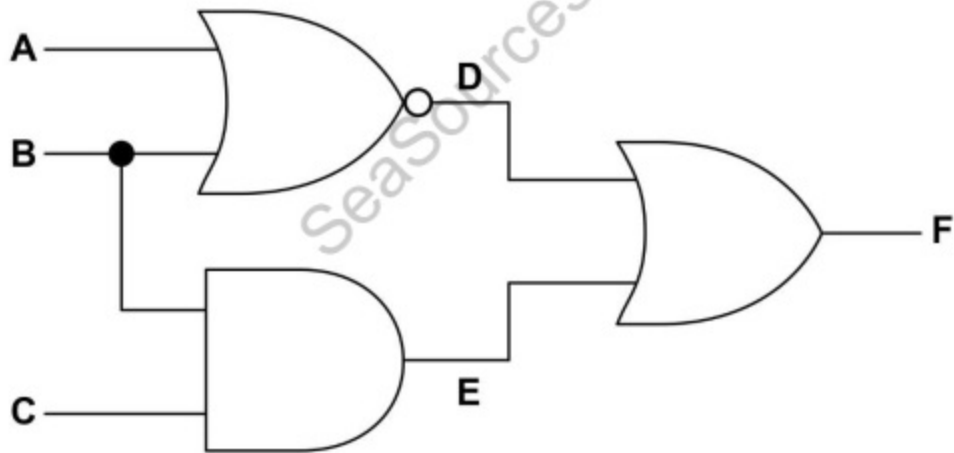


EL-0087

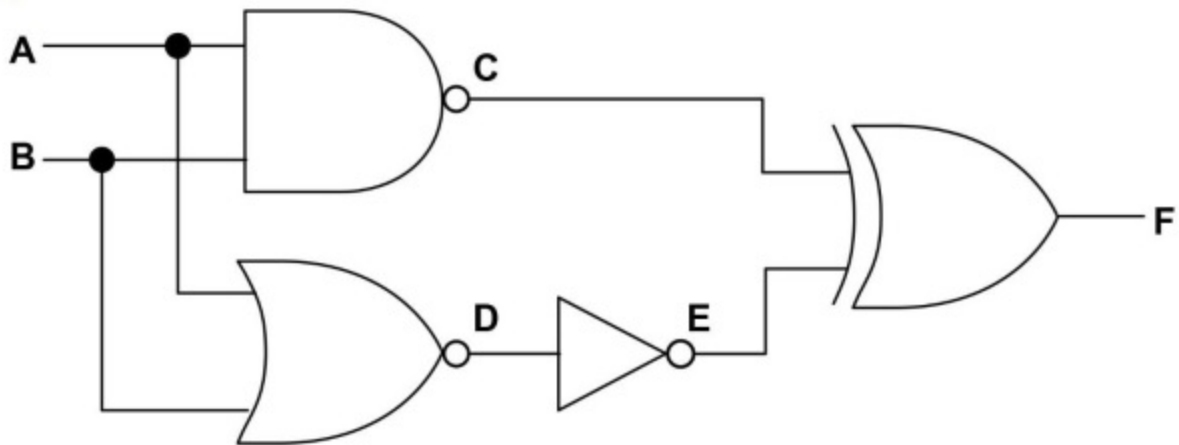




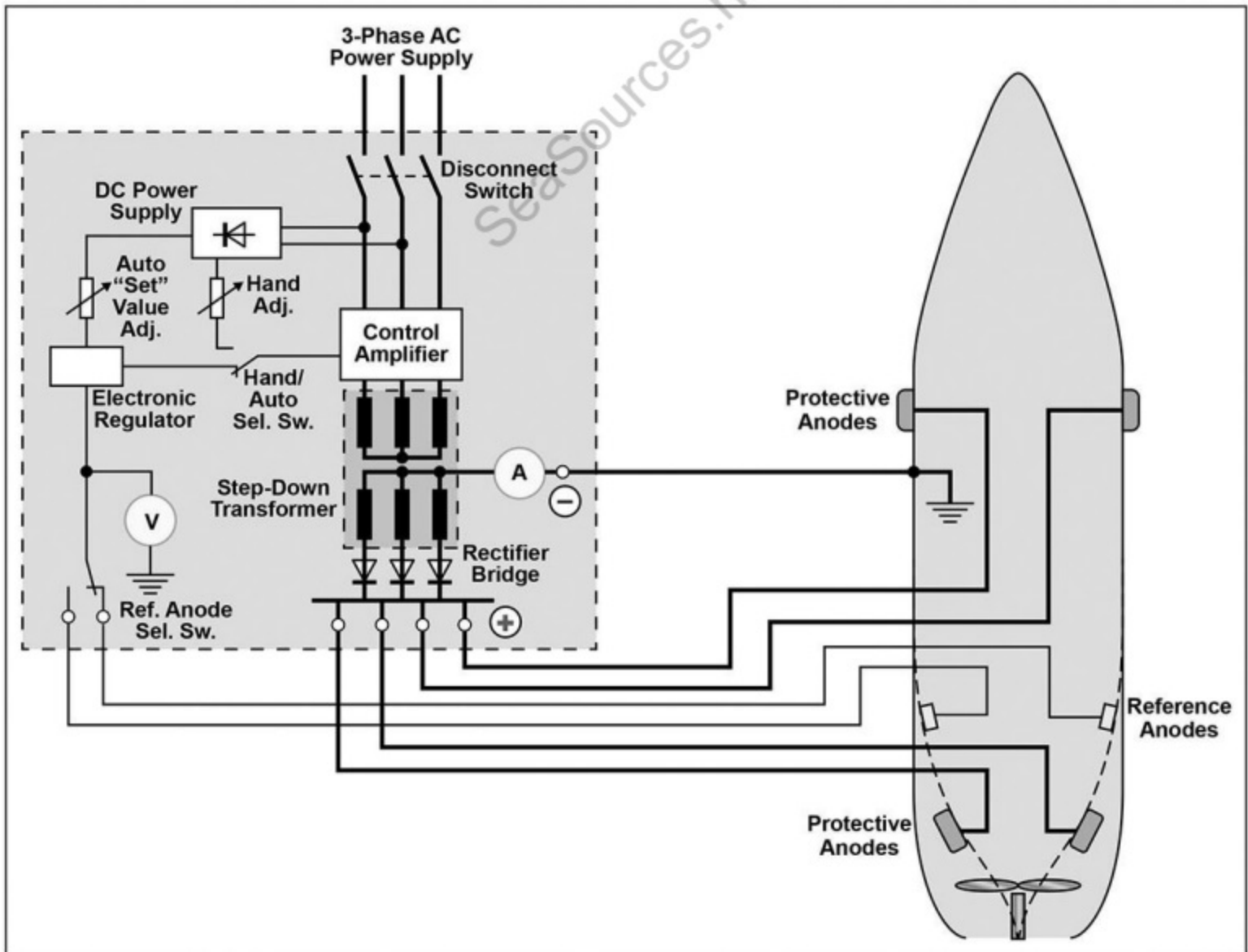
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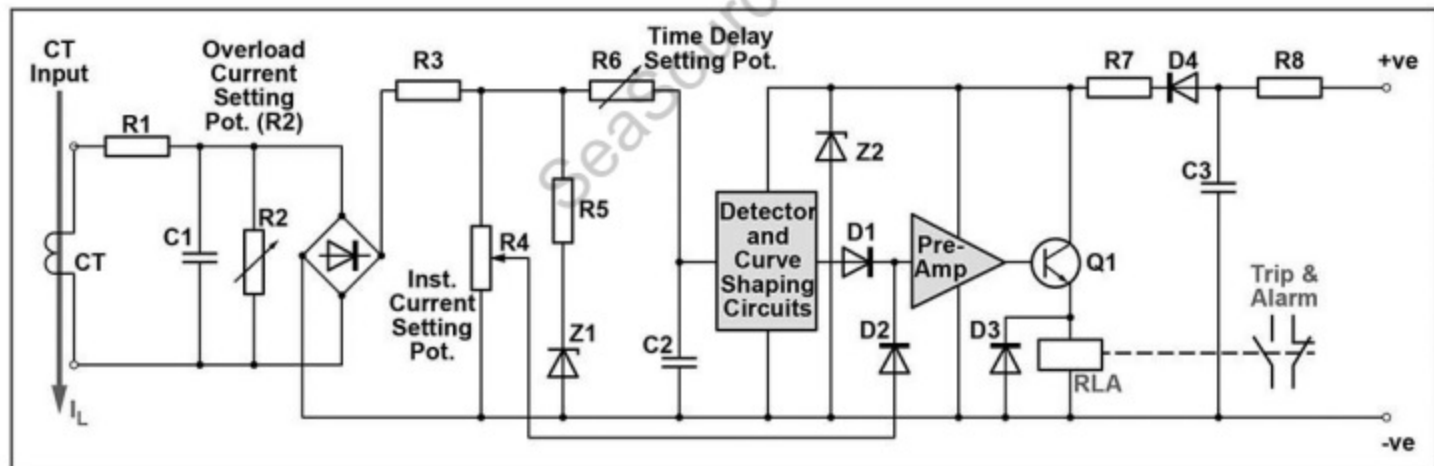
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EL-0090



EL-0091

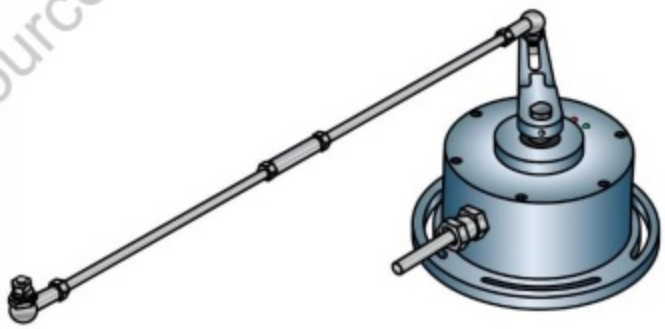


EL-0092

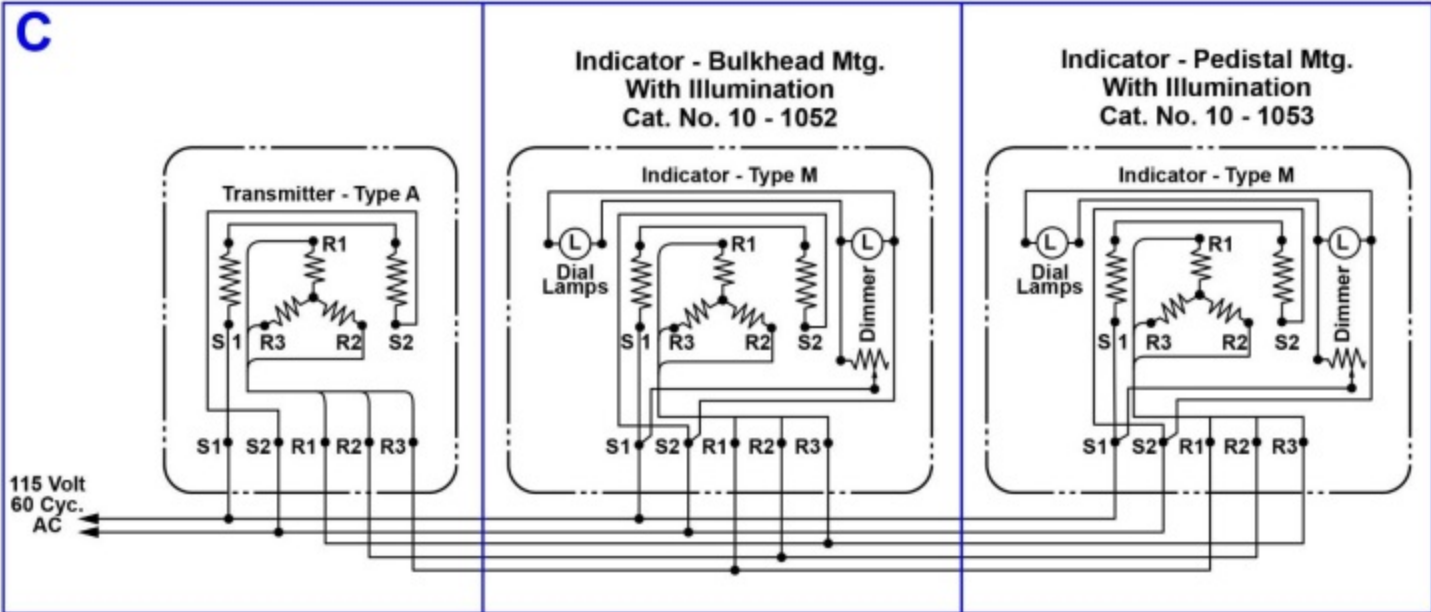
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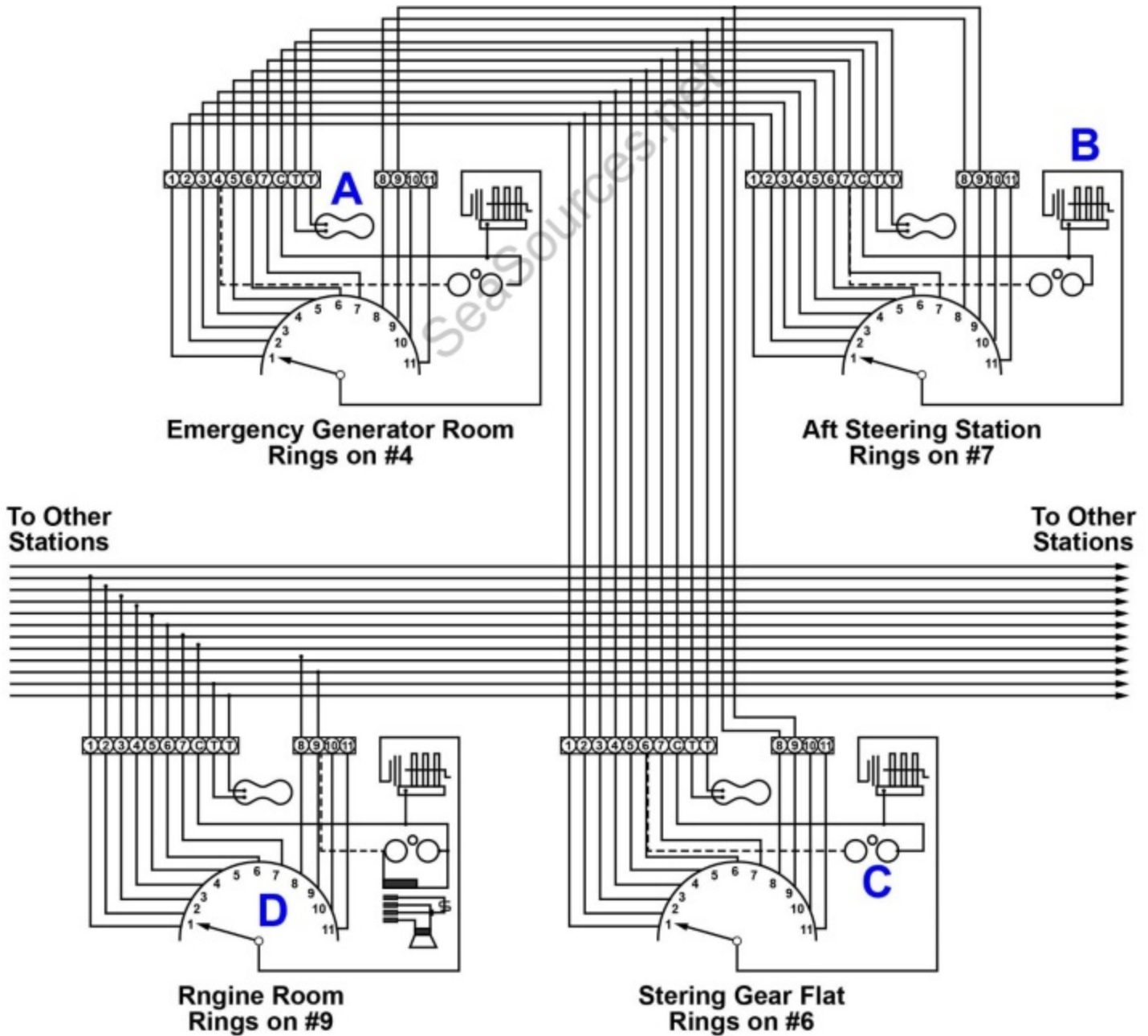
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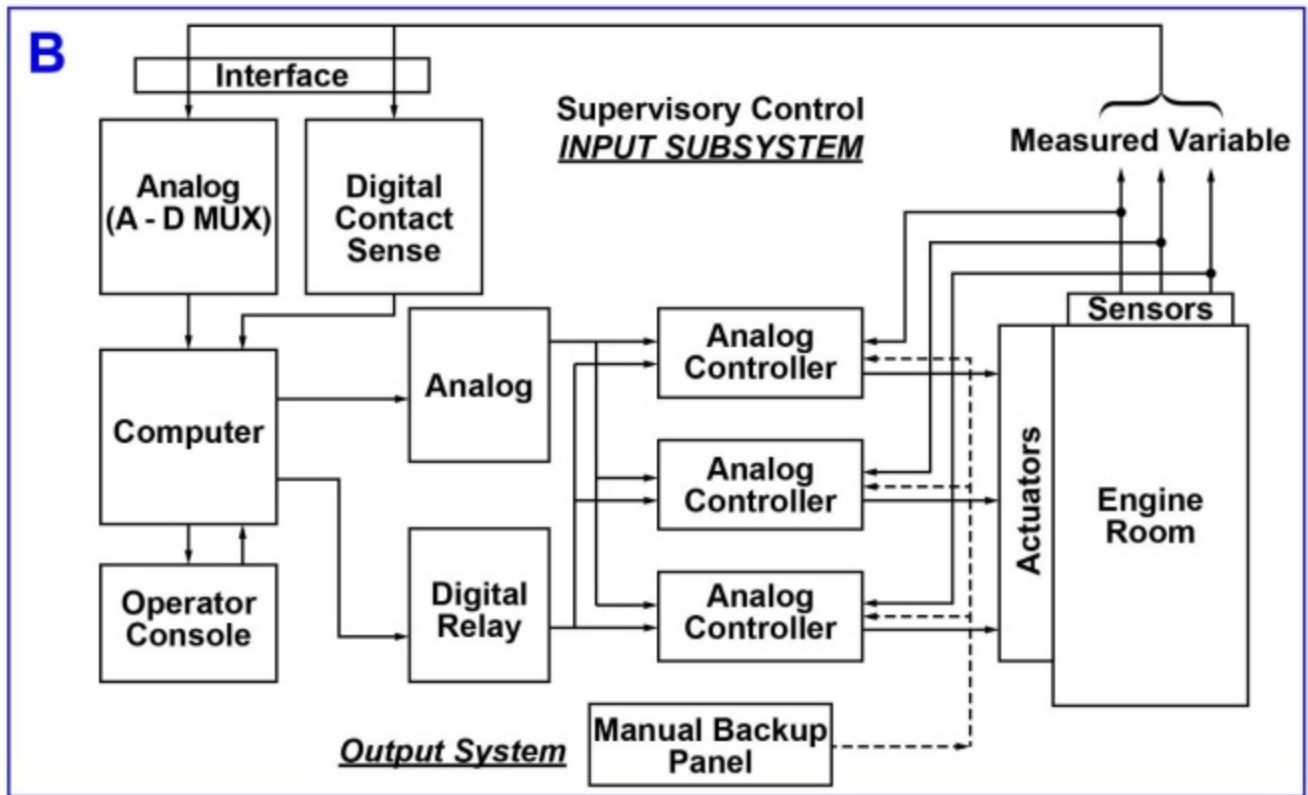
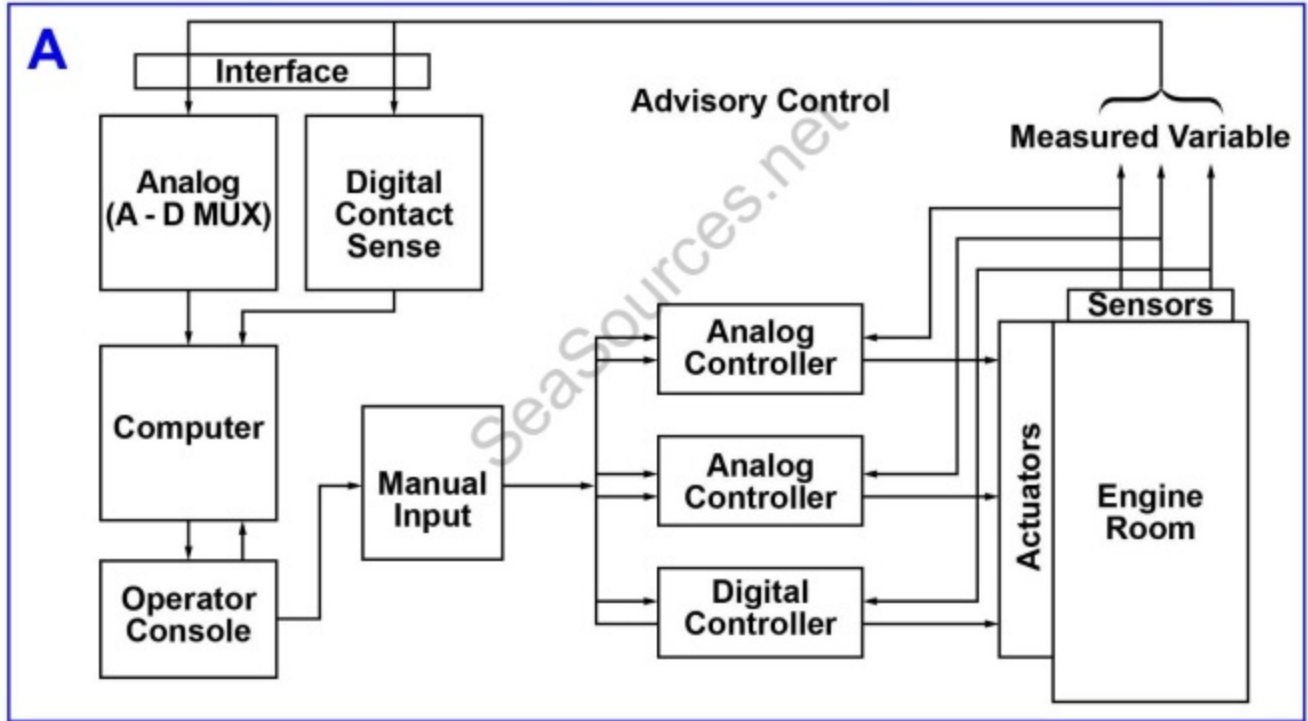


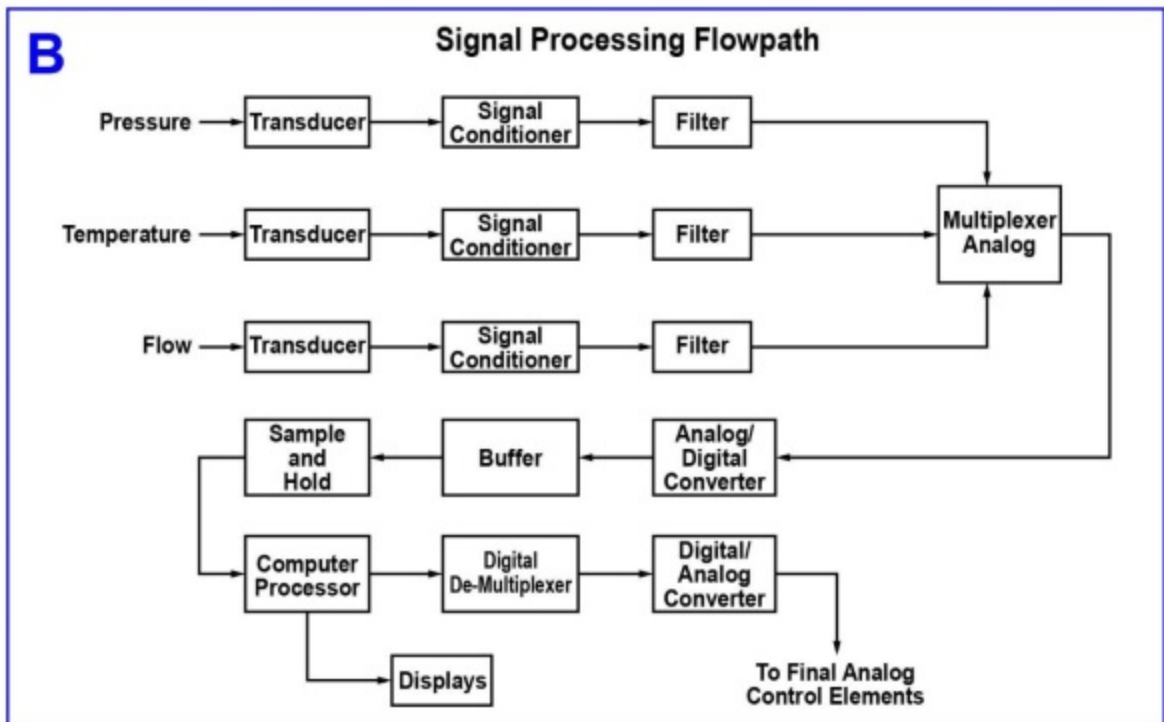
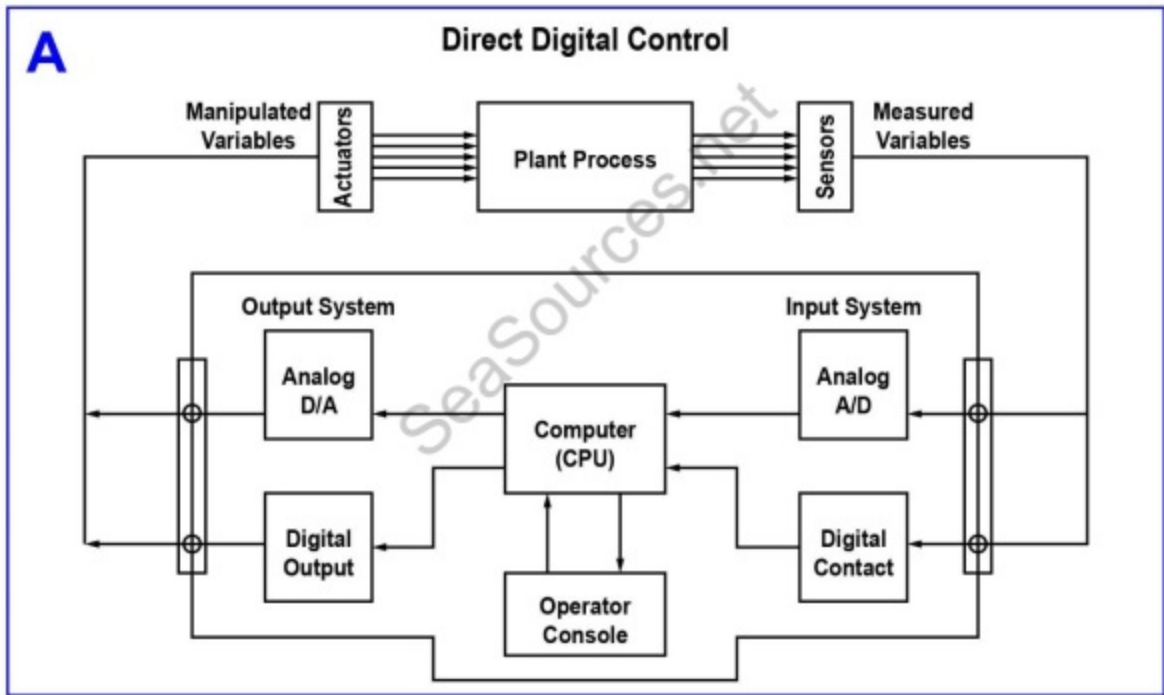
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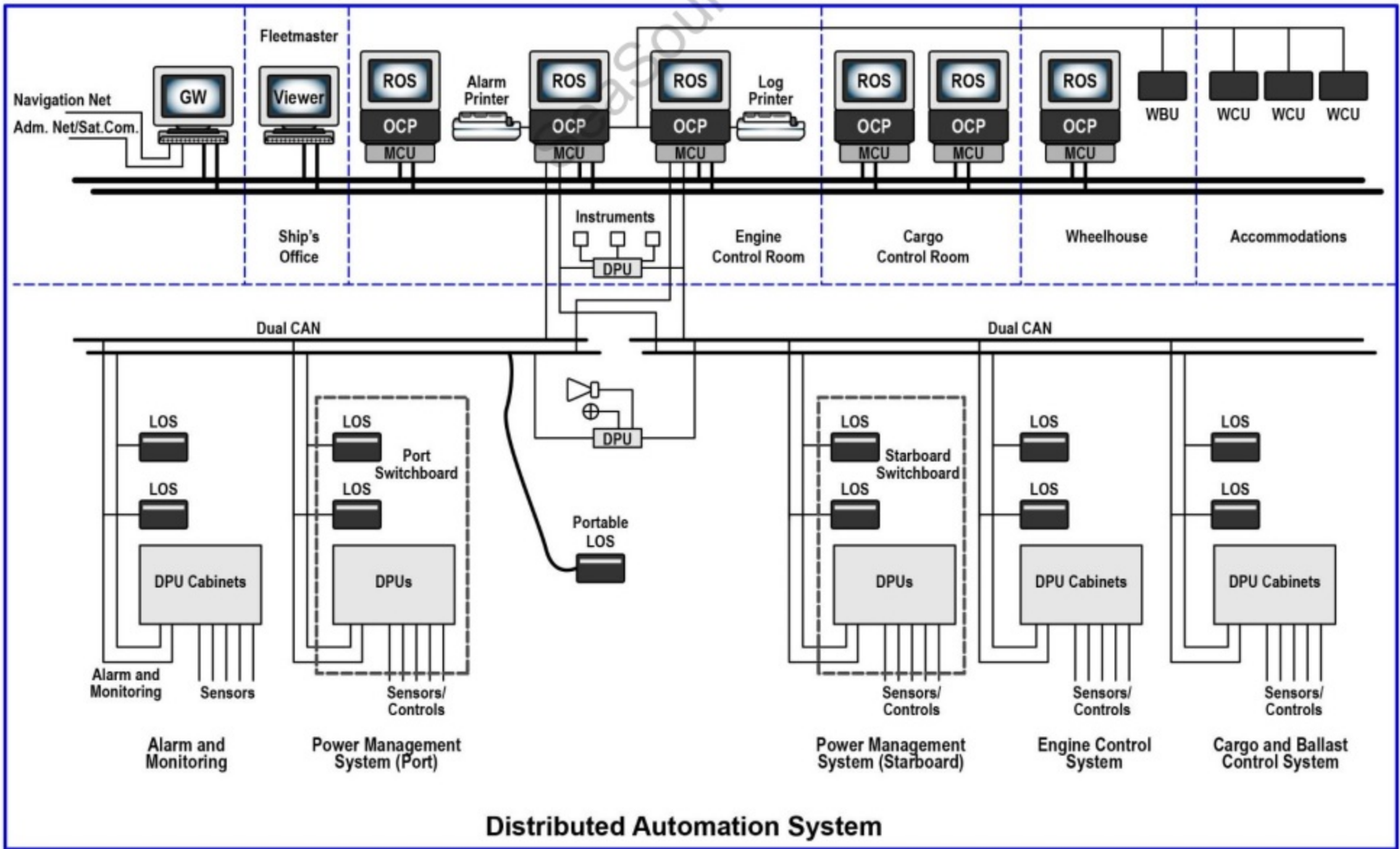


EL-0093



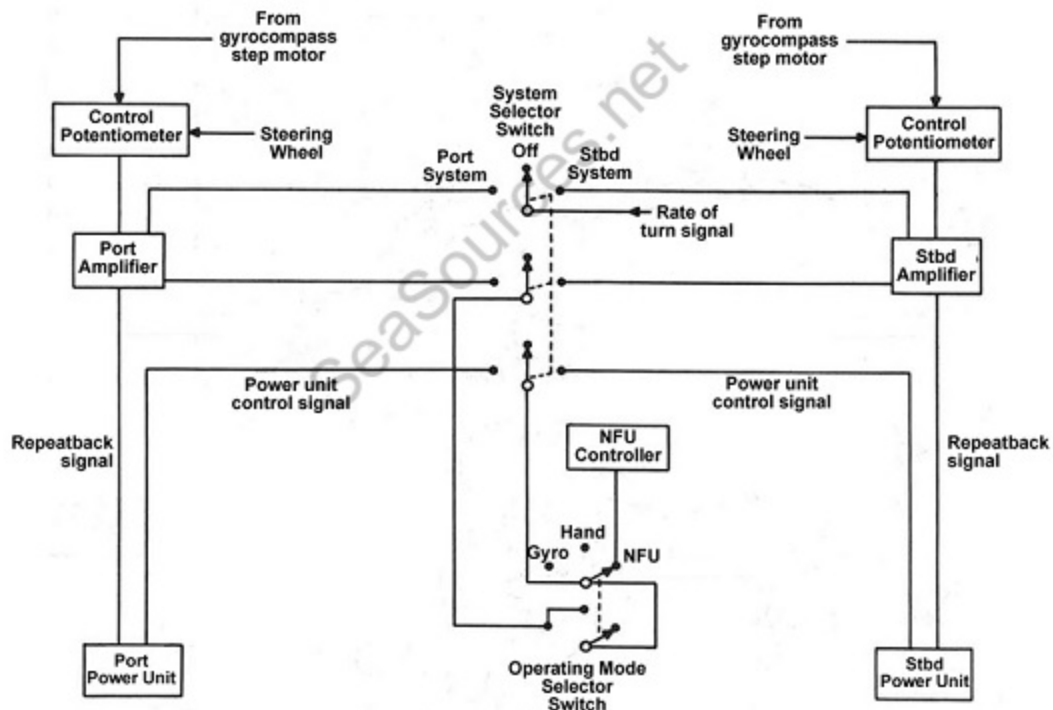




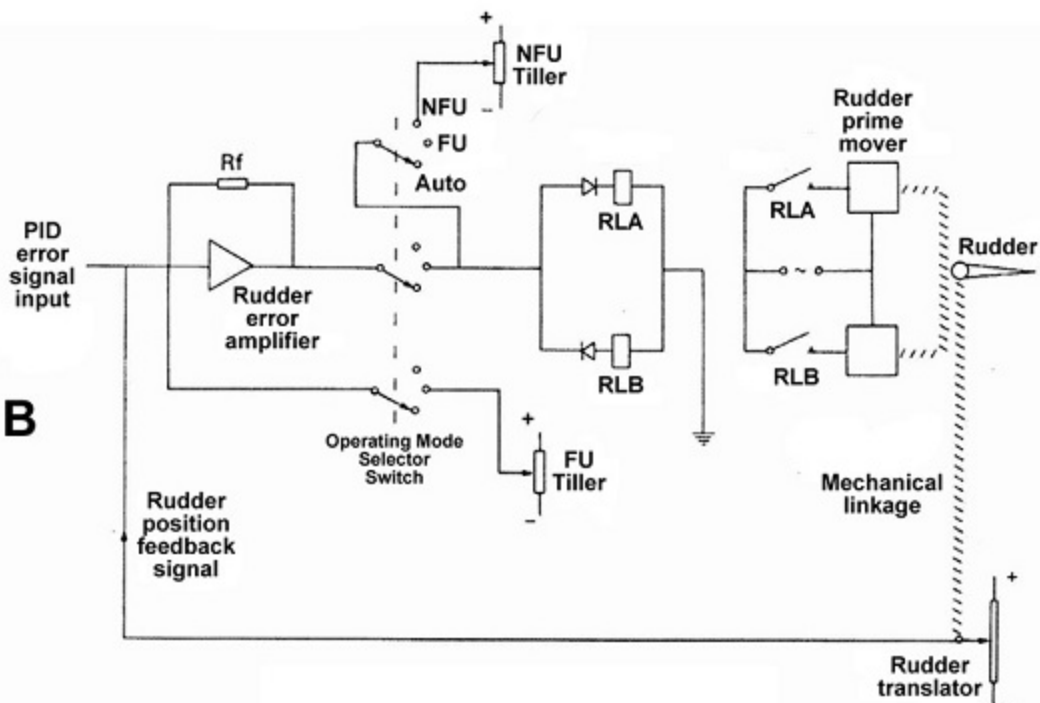


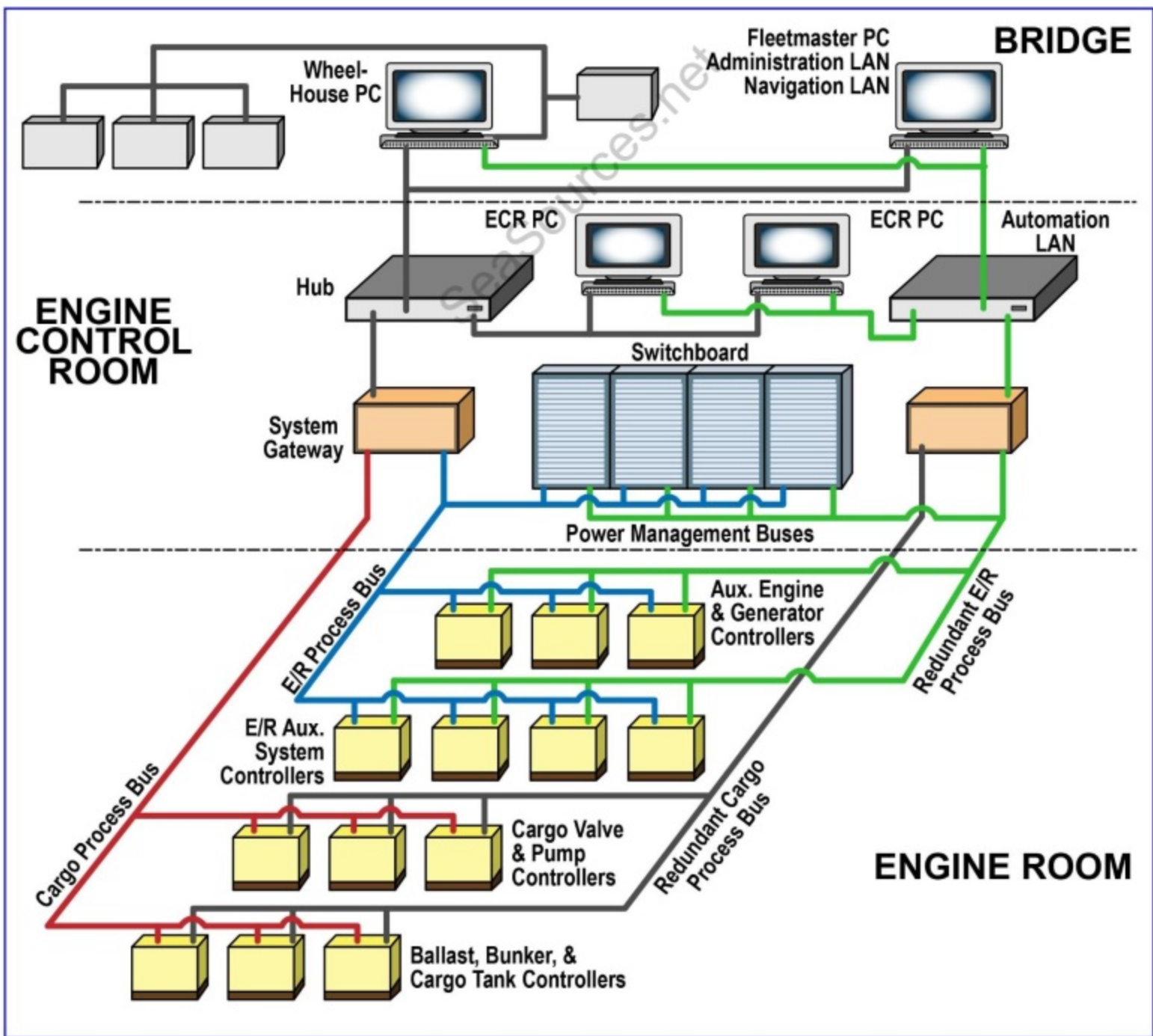
EL-0097

A

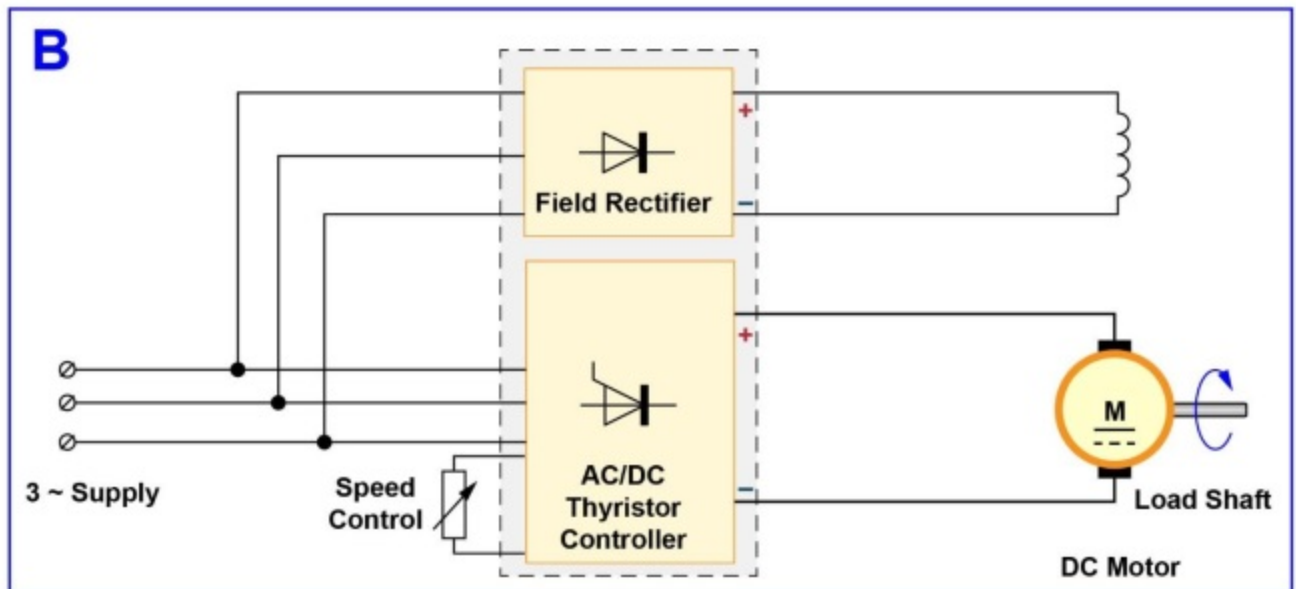
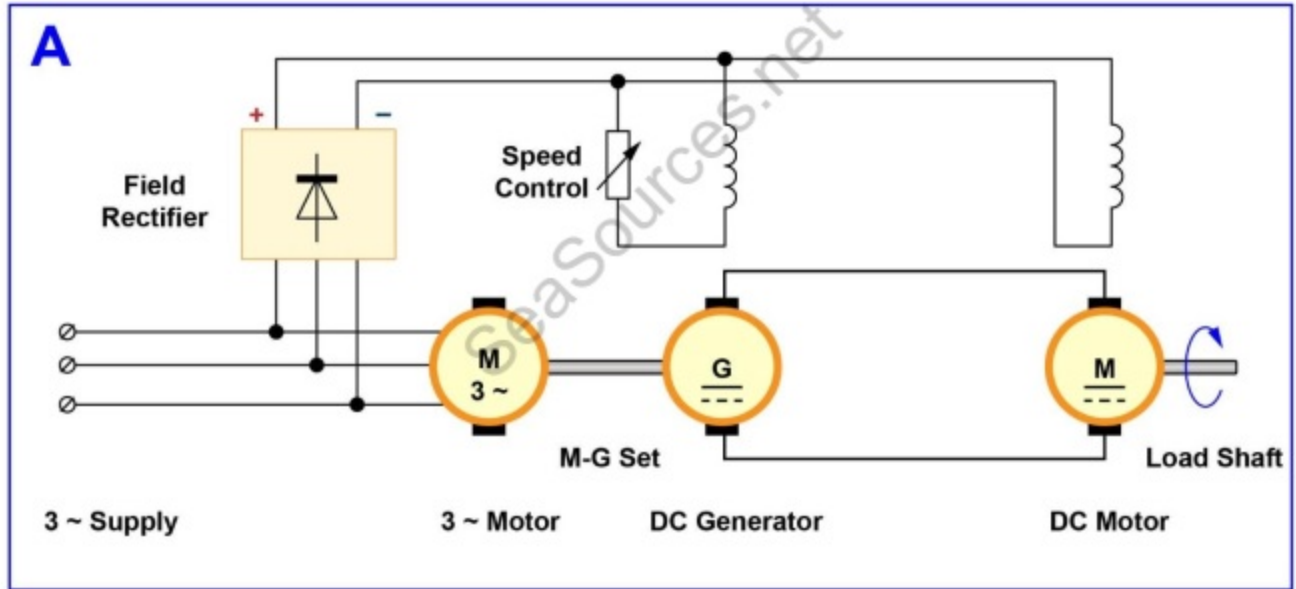


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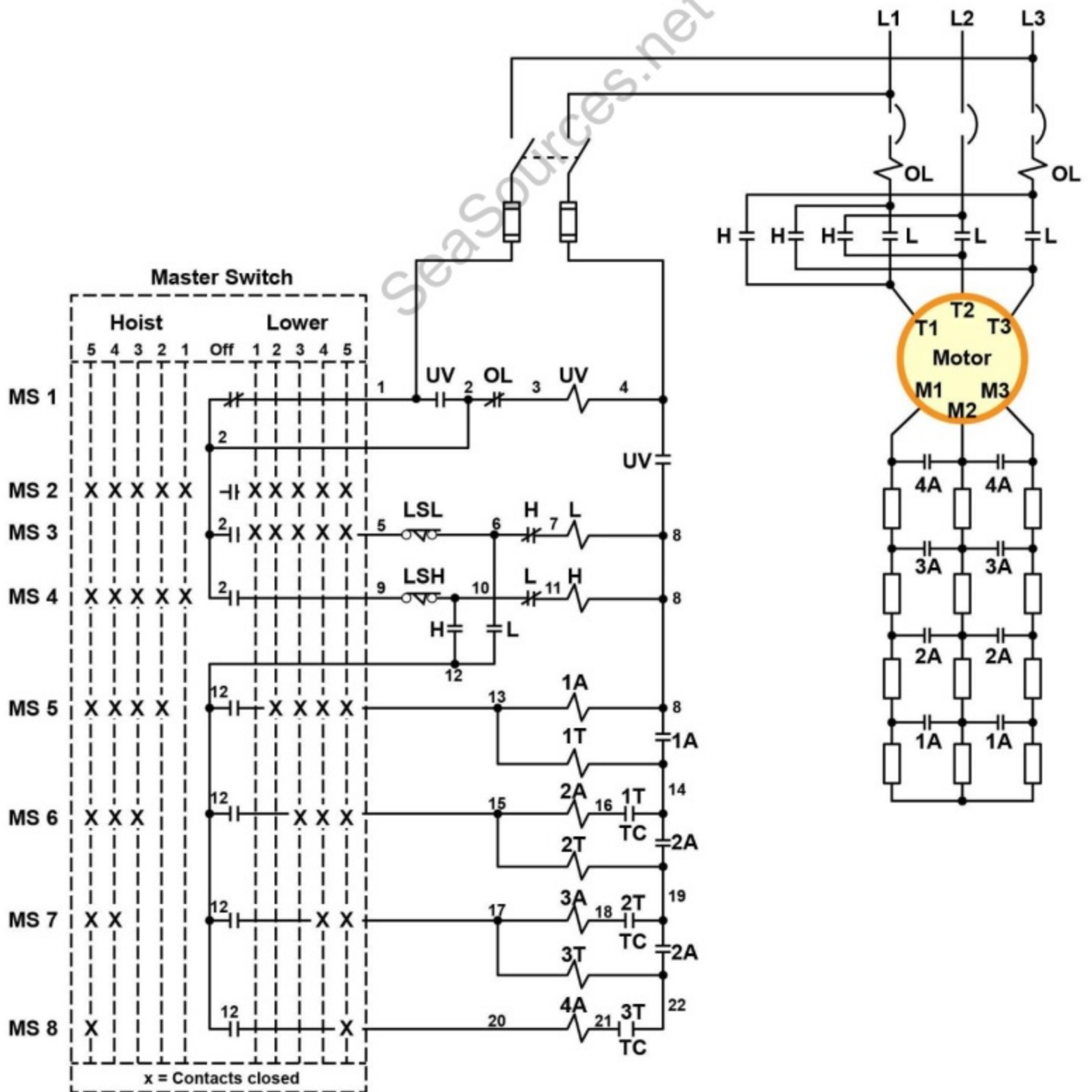




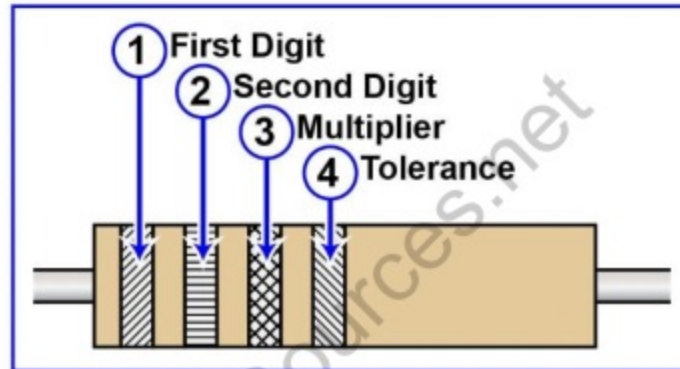
EL-0101



EL-0102



A

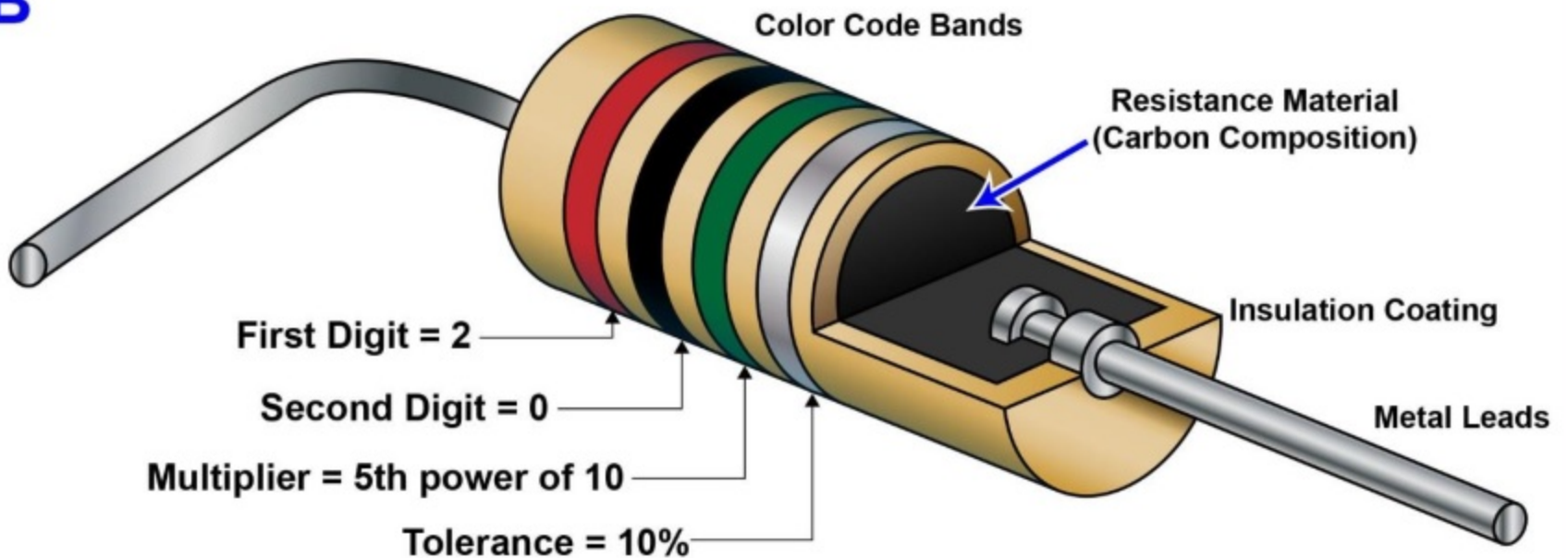


Color	1st Digit	2nd Digit	Multiplier	Tolerance (percent)
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Violet	7	7	10,000,000	
Gray	8	8	100,000,000	
White	9	9	1,000,000,000	
Gold			.1	5
Silver			.01	10
No Color				20

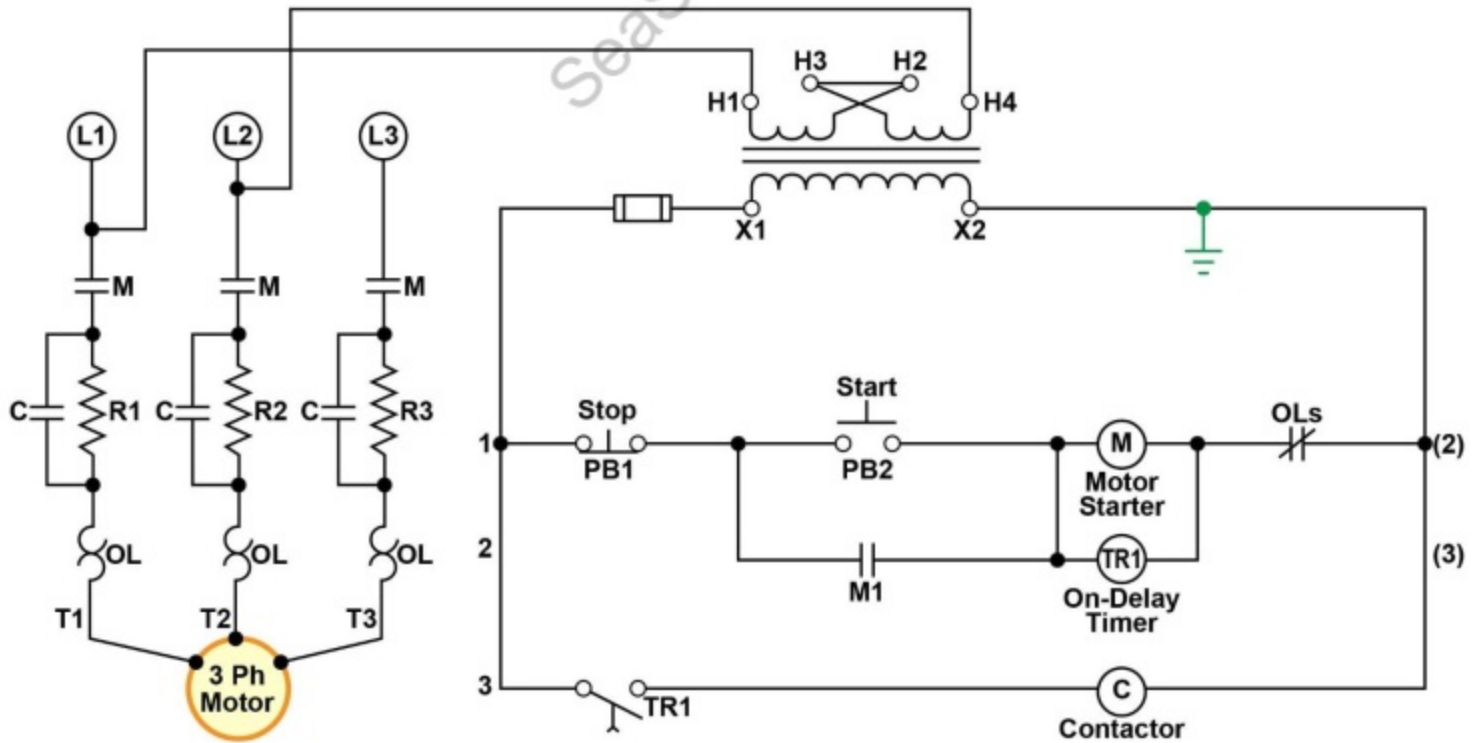
Resistors for military use may have a fifth band to indicate reliability in terms of failure rate as follows:

No Color: No Test Made
 Brown: 1.0 Percent Per 1000 Hours
 Red: 0.1 Percent Per 1000 Hours
 Orange: 0.01 Percent Per 1000 Hours
 Yellow: 0.001 Percent Per 1000 Hours

B

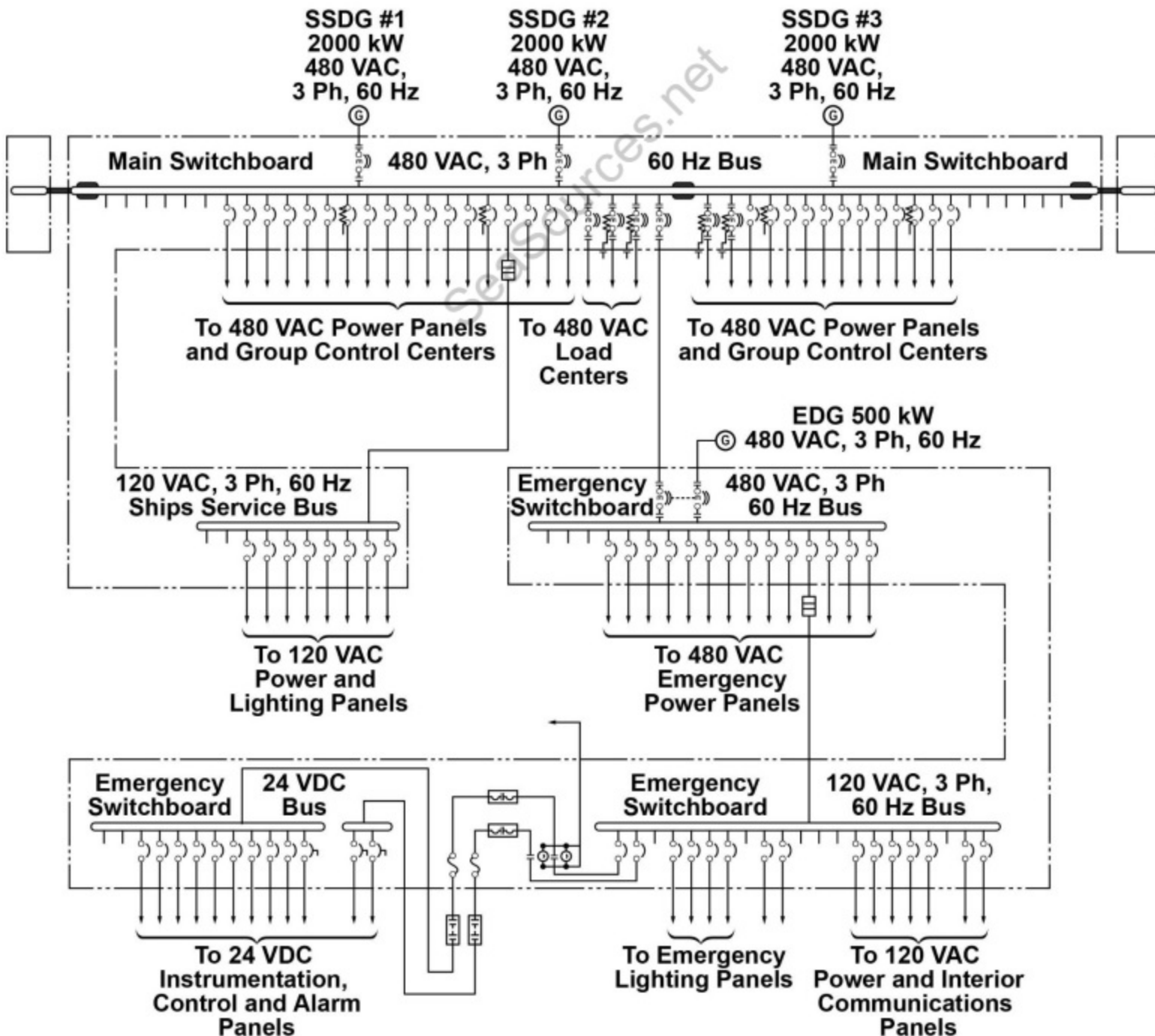


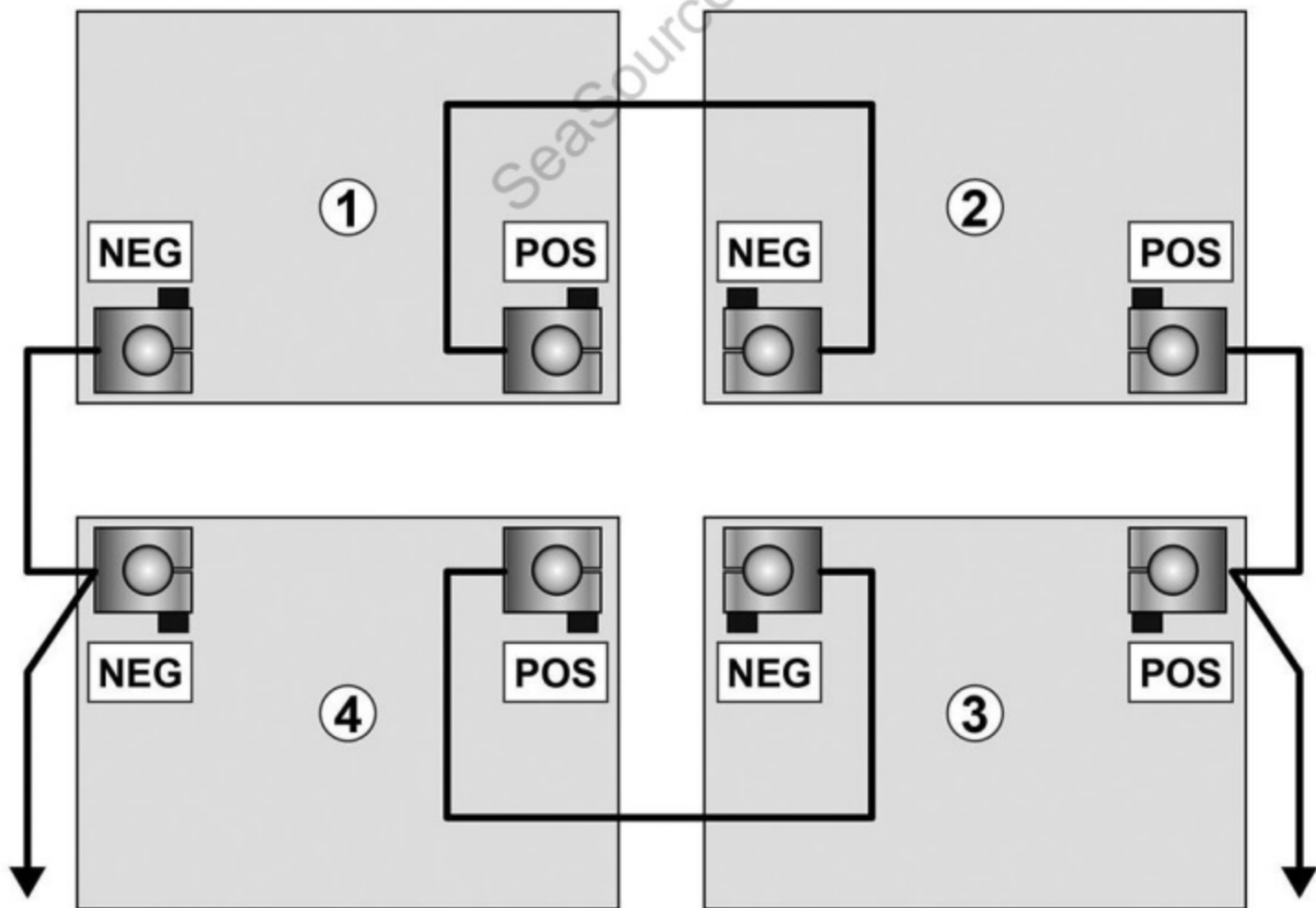
EL-0104



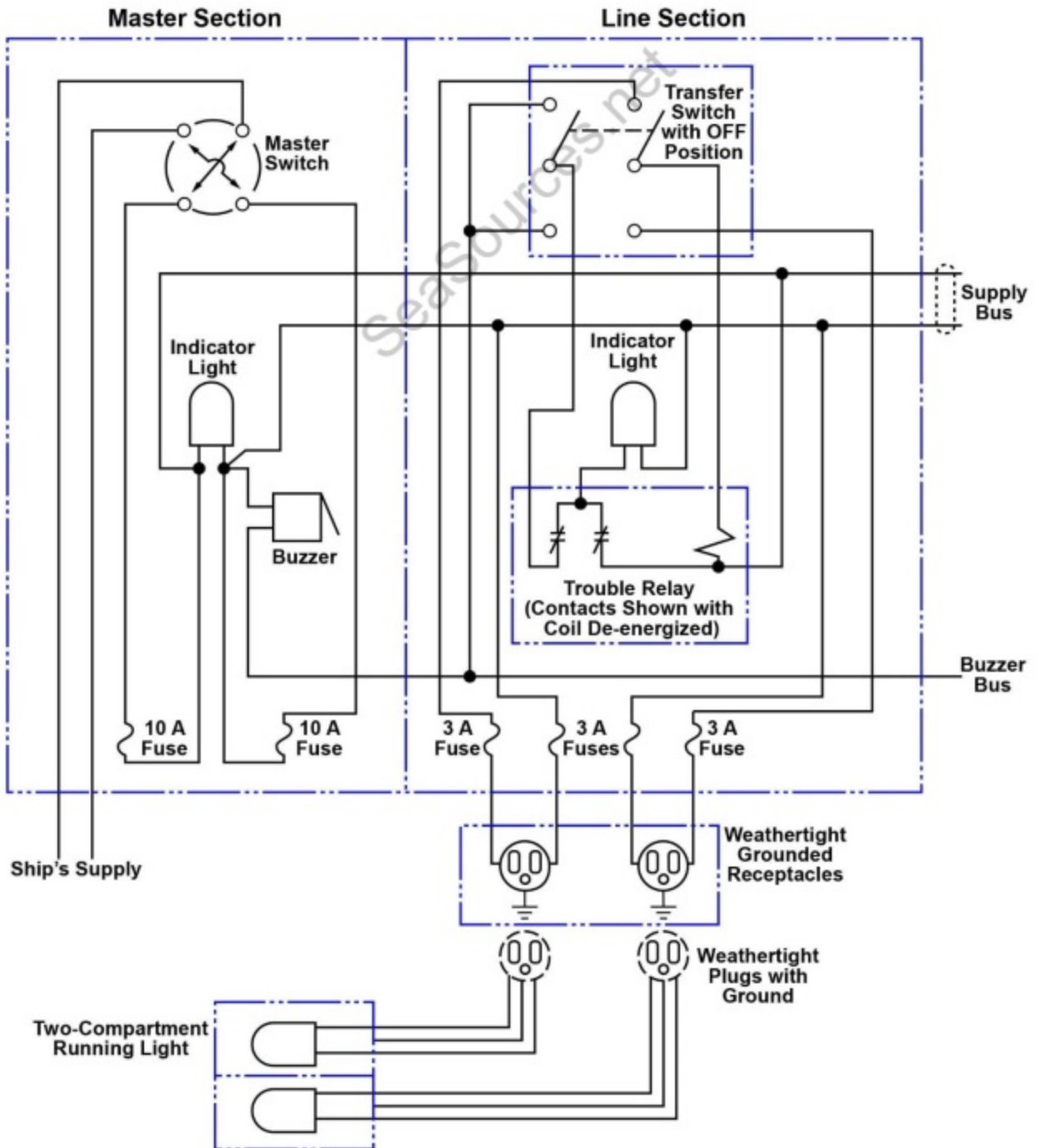
EL-0106

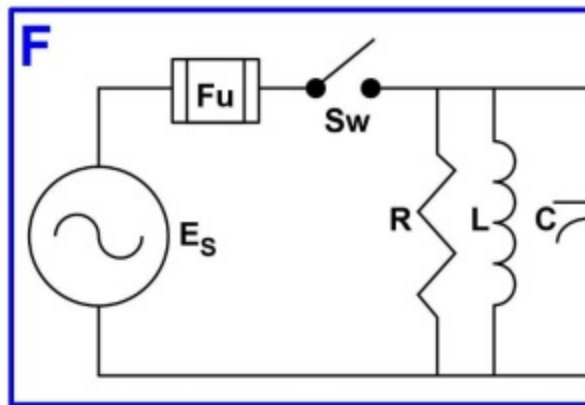
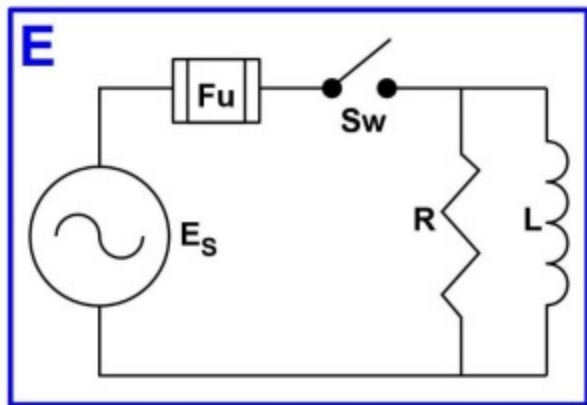
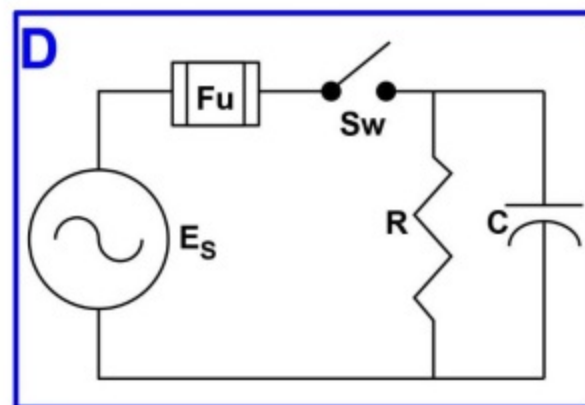
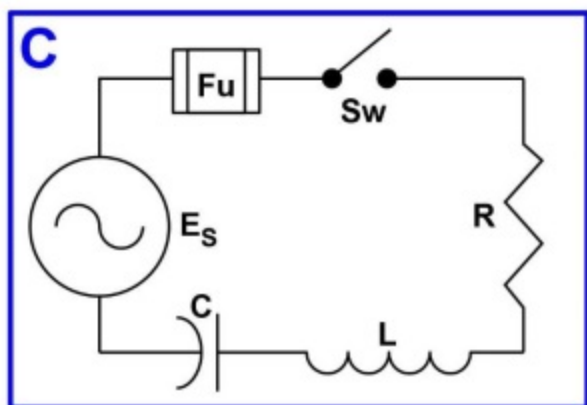
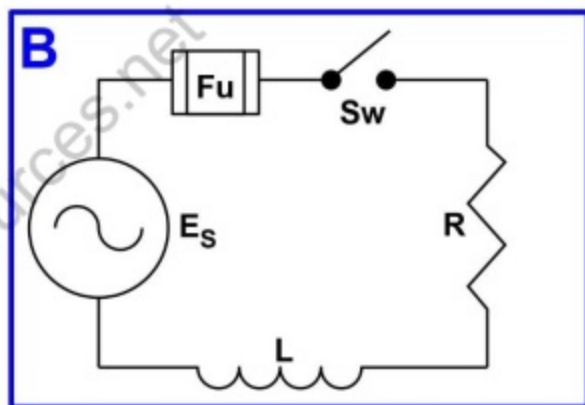
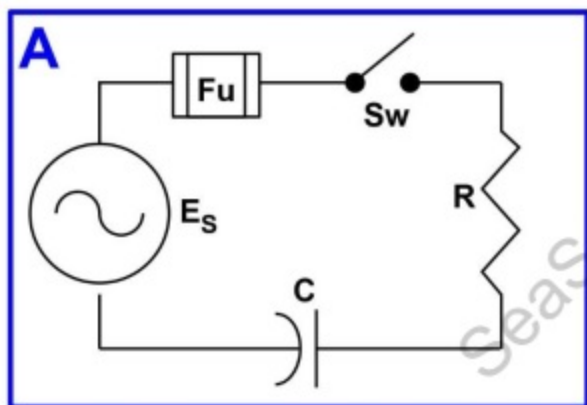
One Line Distribution Diagram





EL-0108

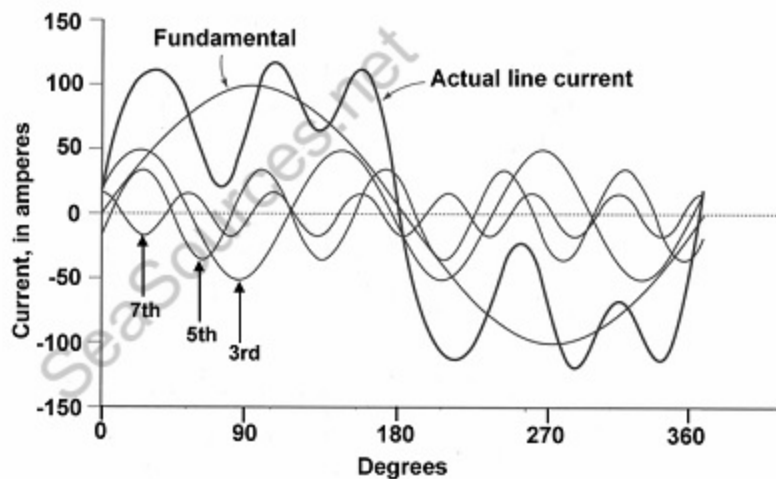




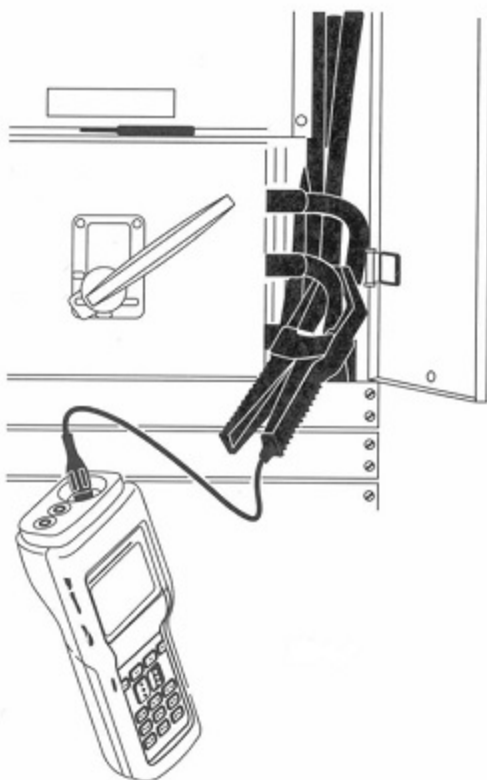
EL-0110



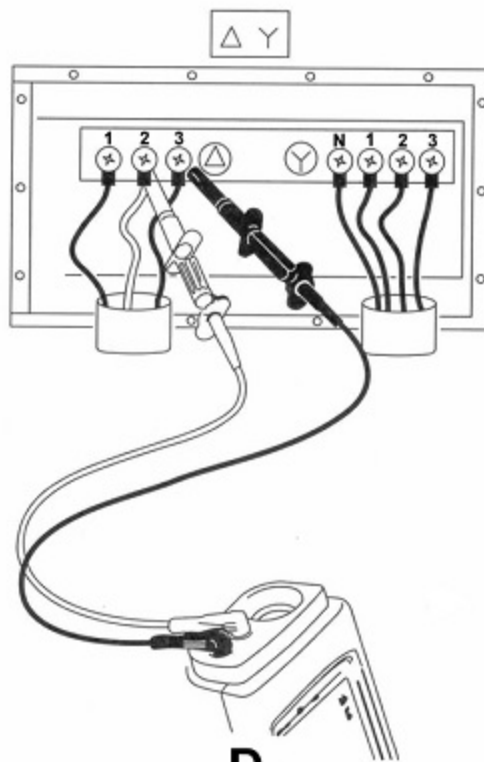
A



B

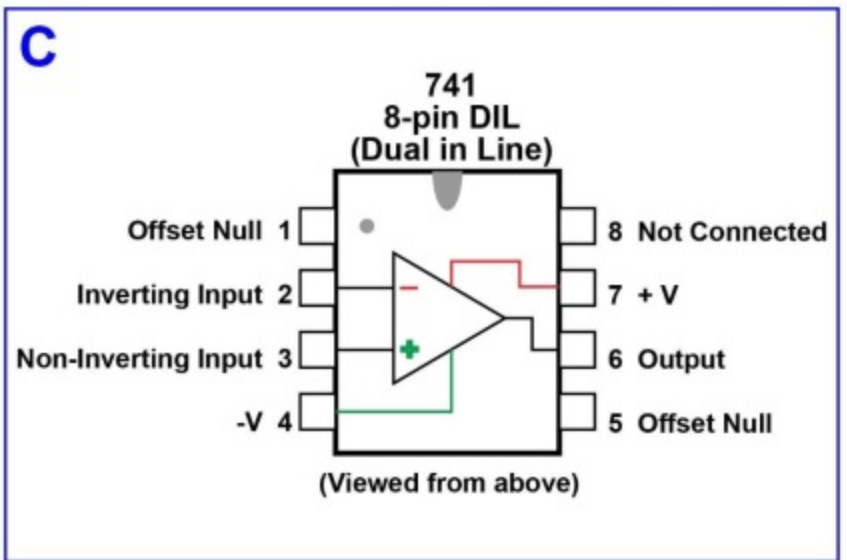
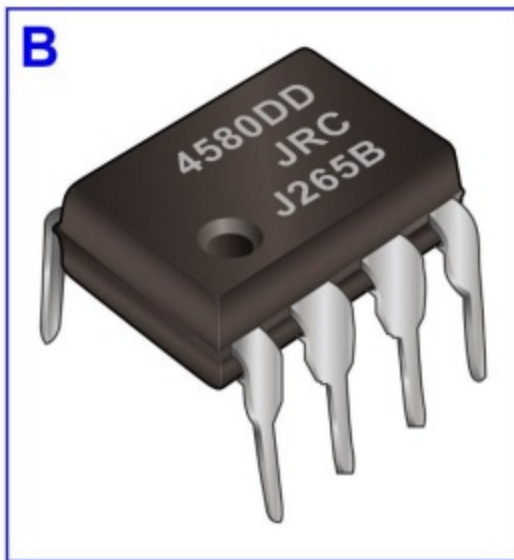
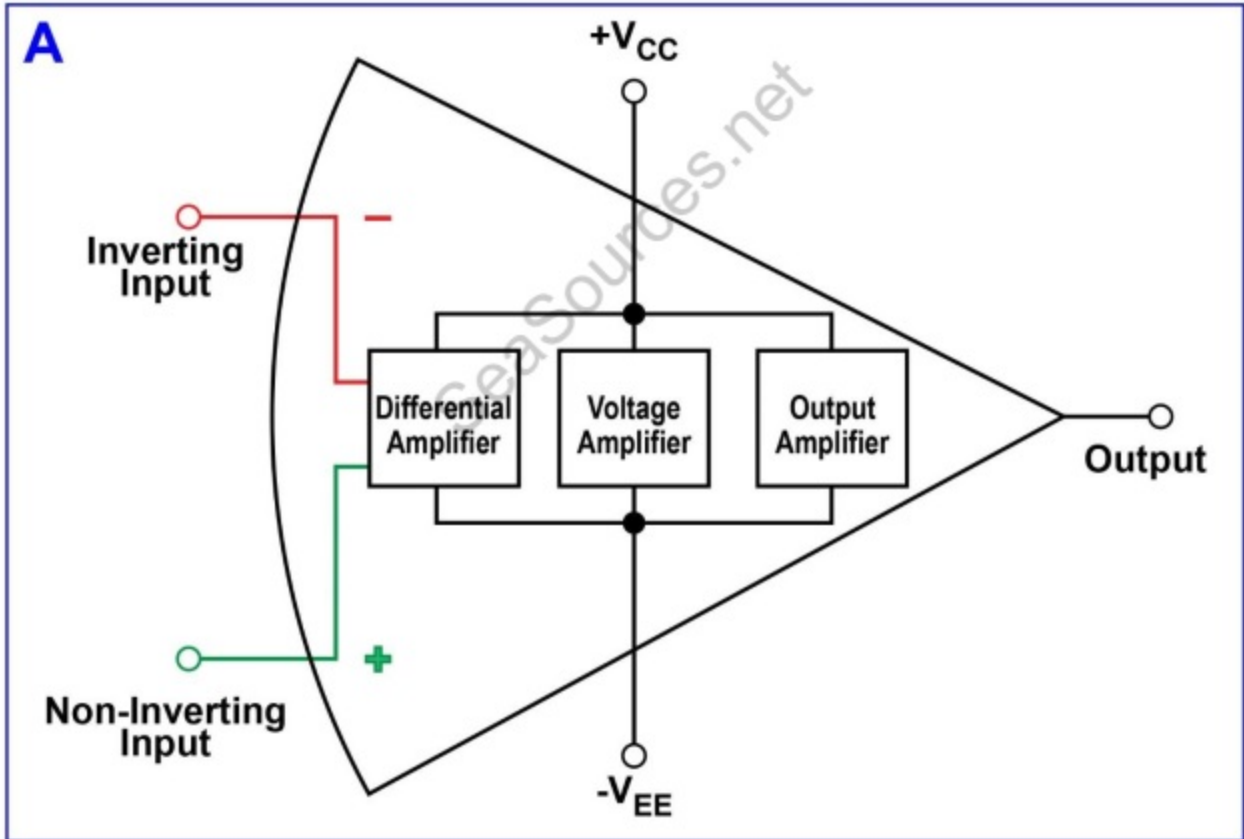


C



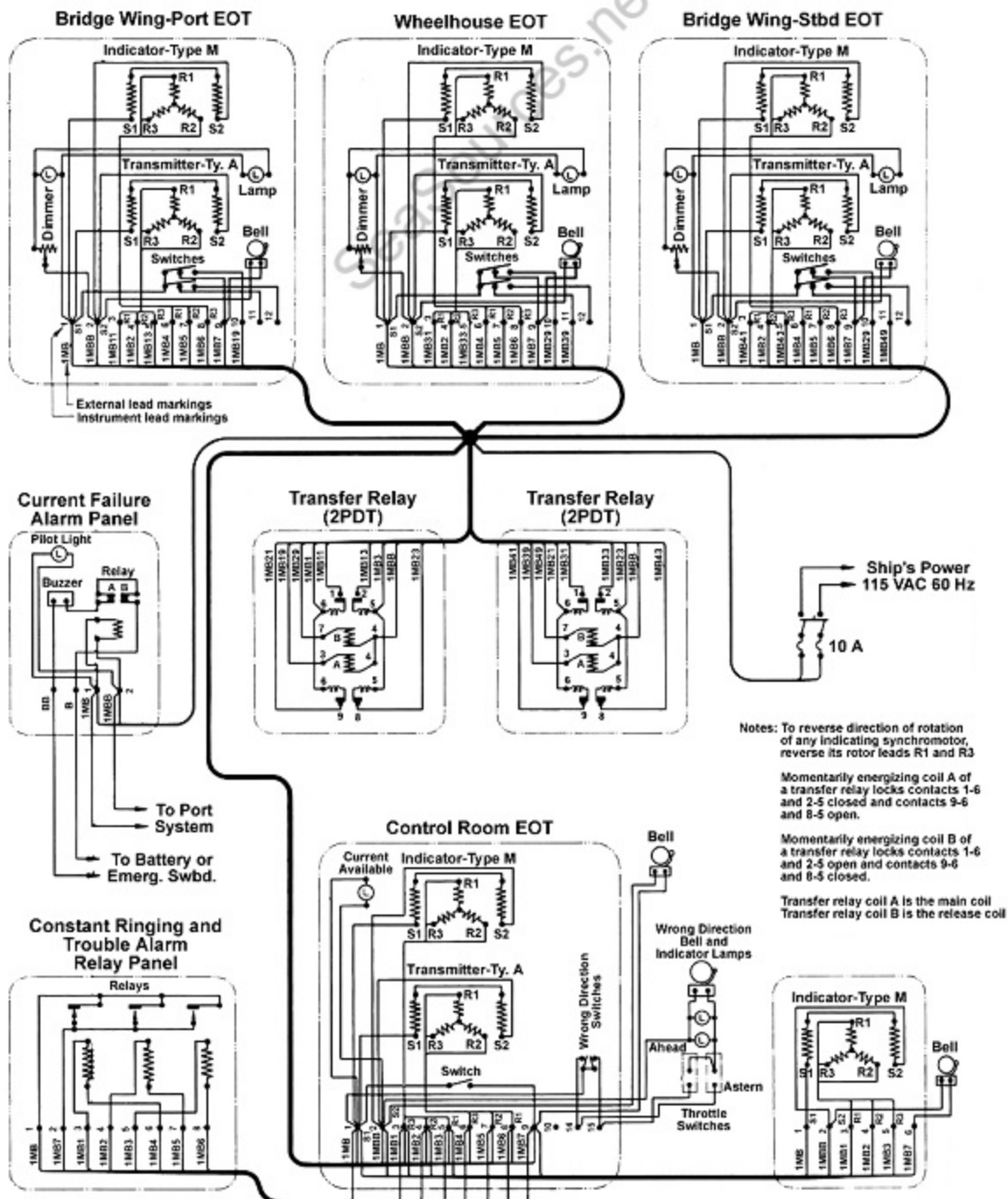
D

EL-0111

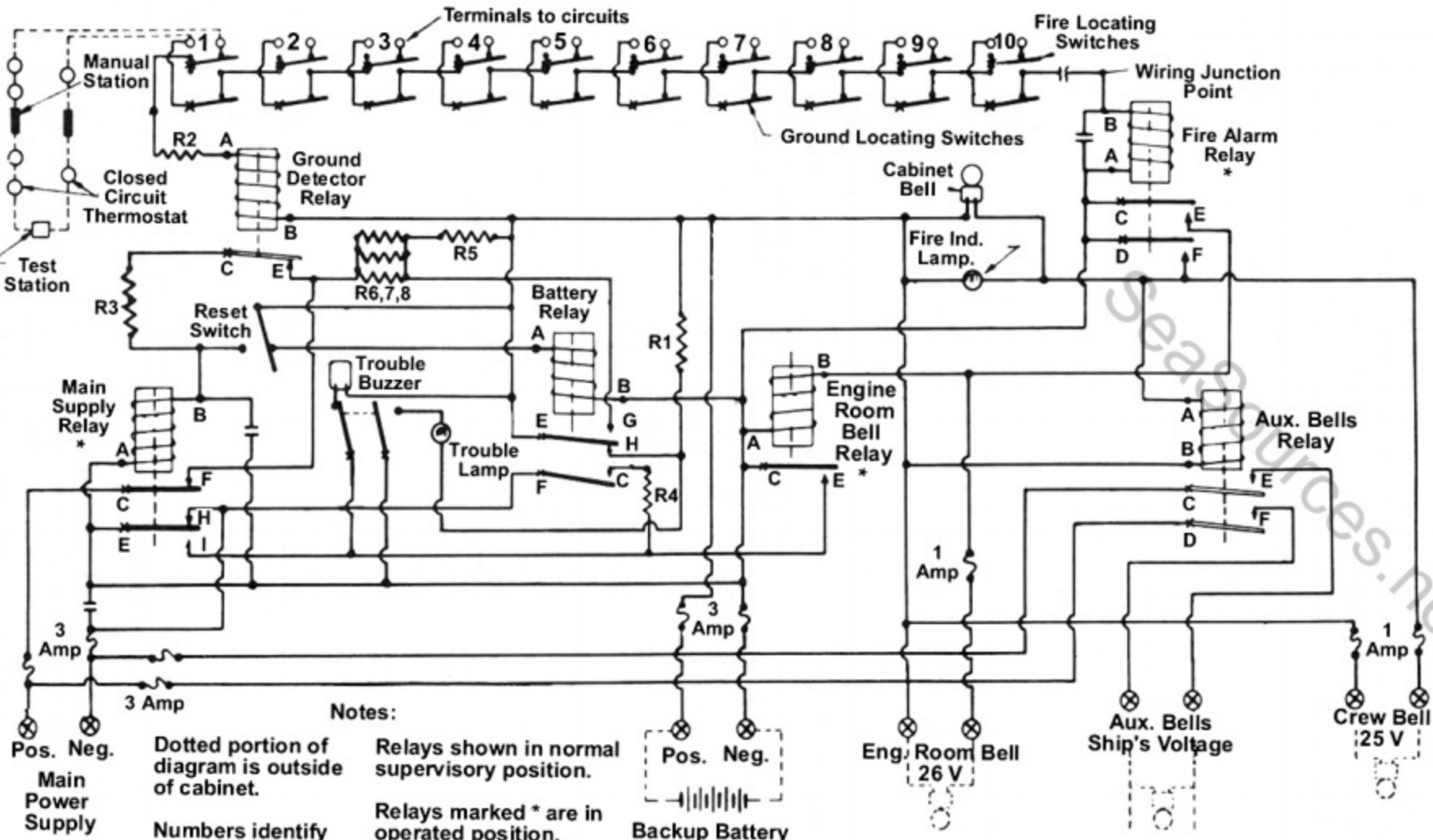


EL-0113

Engine Order Telegraph System



Fire Detection and Alarm System



Notes:

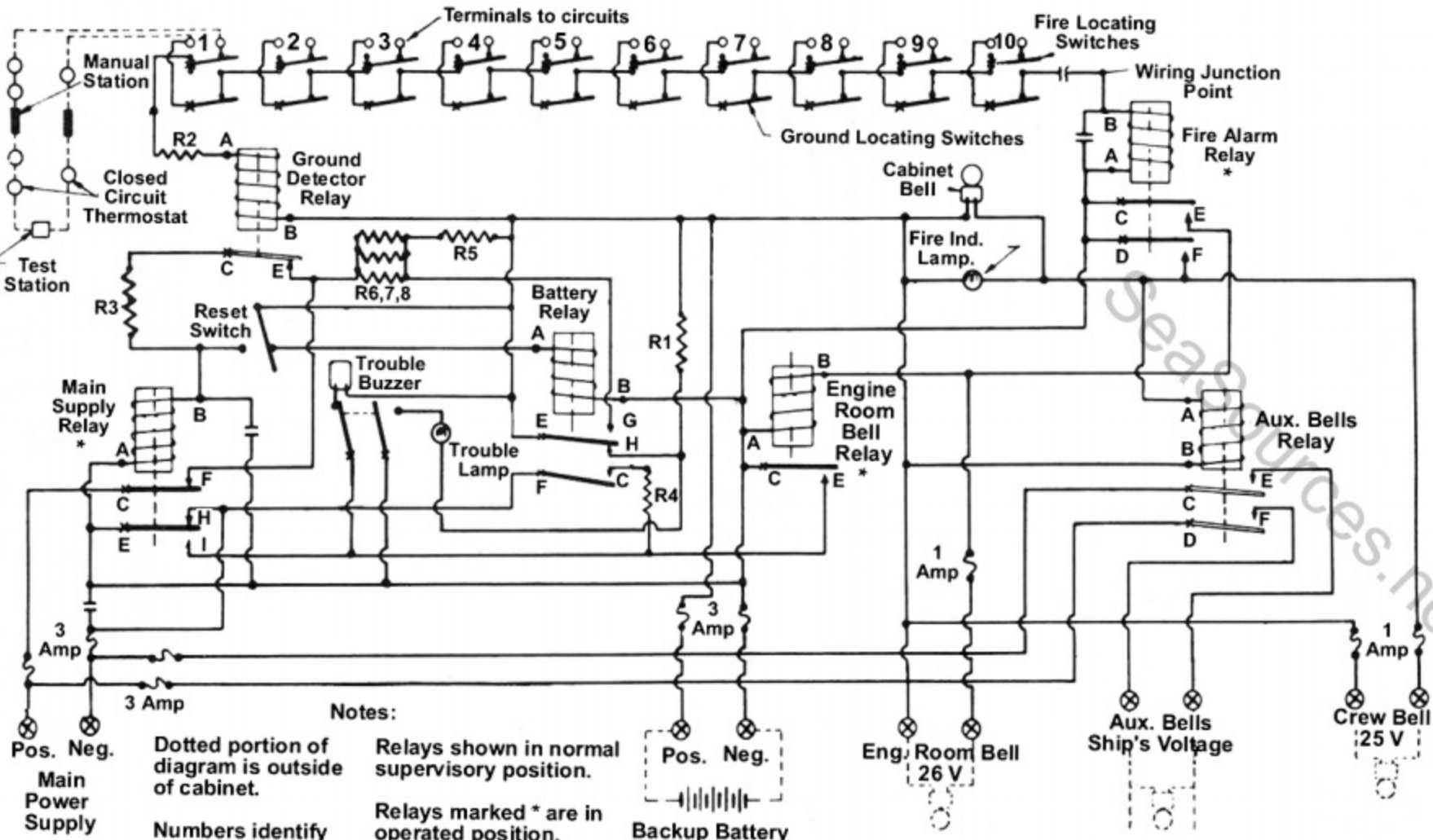
- Relays shown in normal supervisory position.
- Relays marked * are in operated position.
- Main panel terminal.

Pos. Neg. Backup Battery Power Supply

Pos. Neg. Main Power Supply

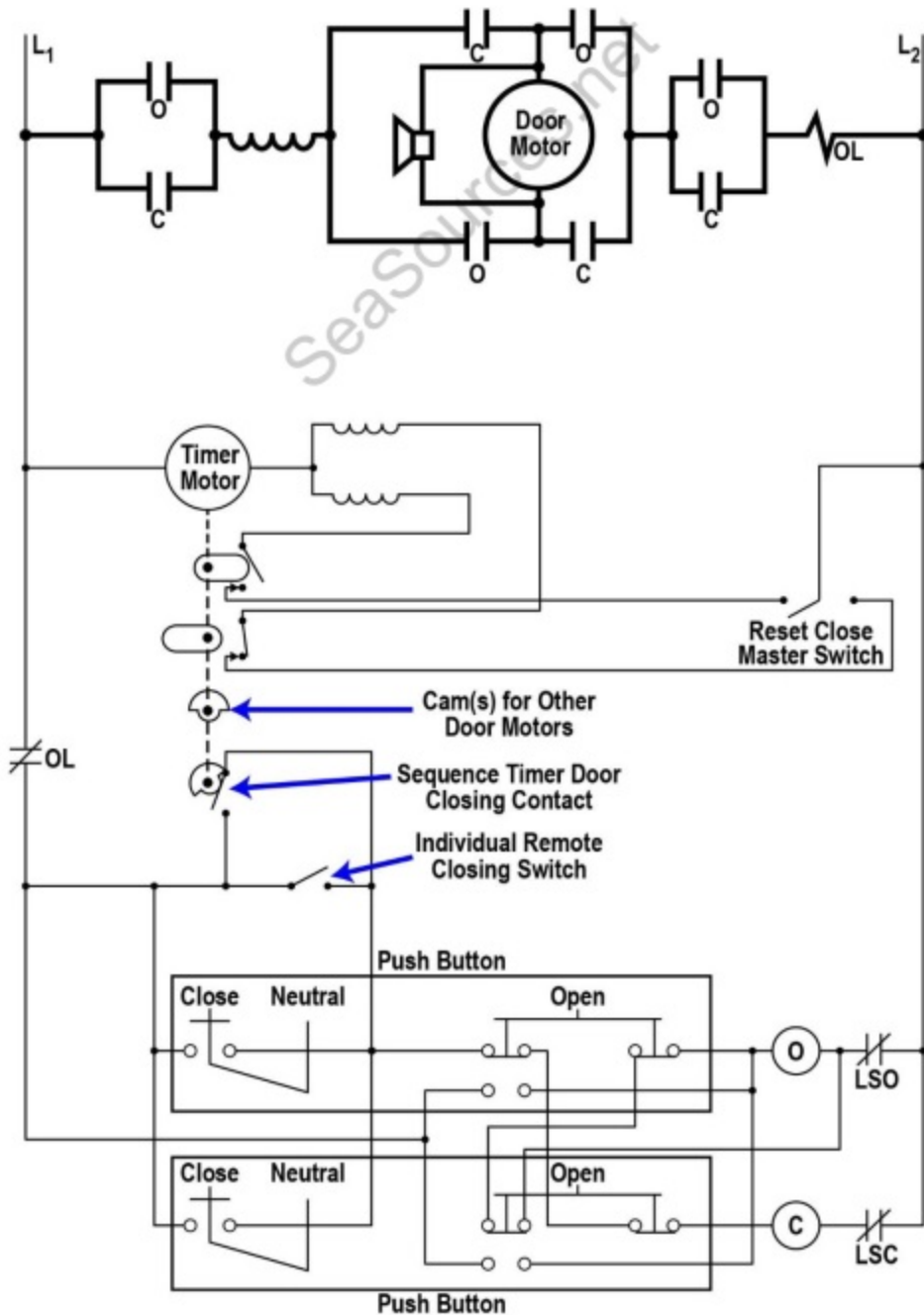
Dotted portion of diagram is outside of cabinet.

Numbers identify wire coloring.

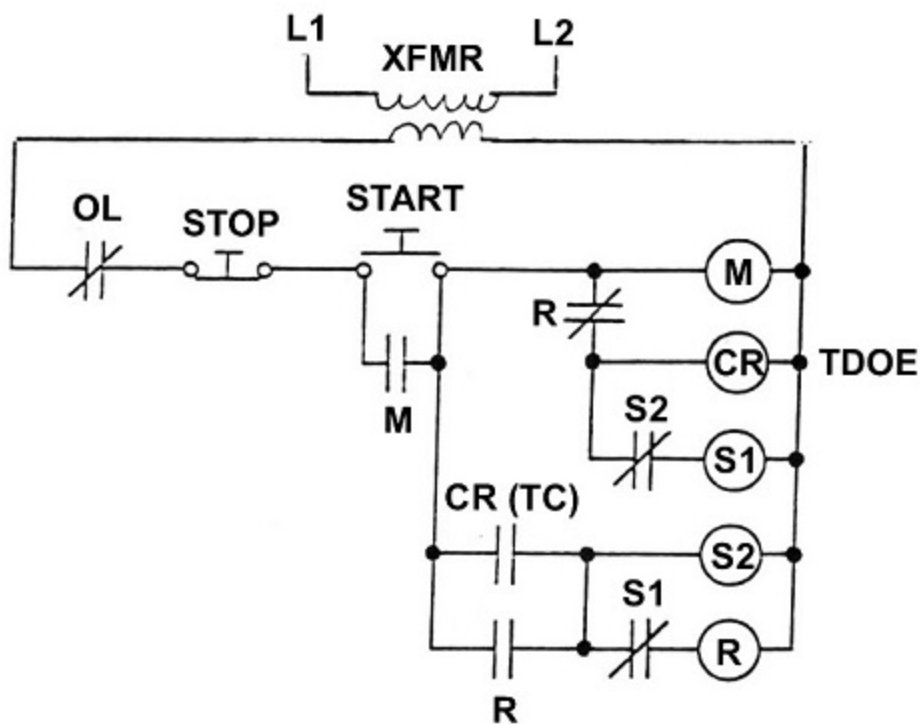
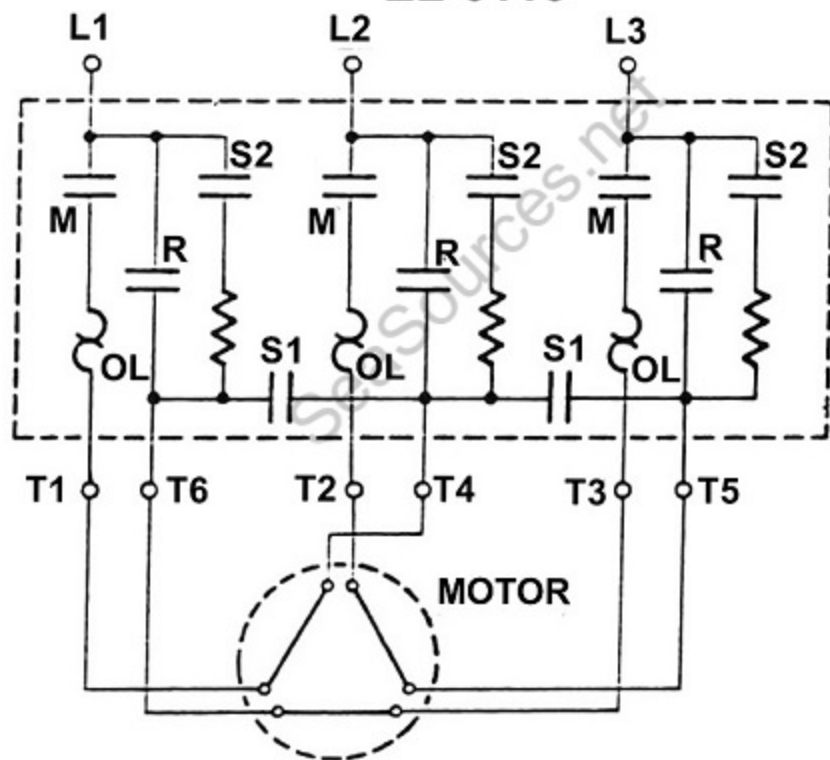


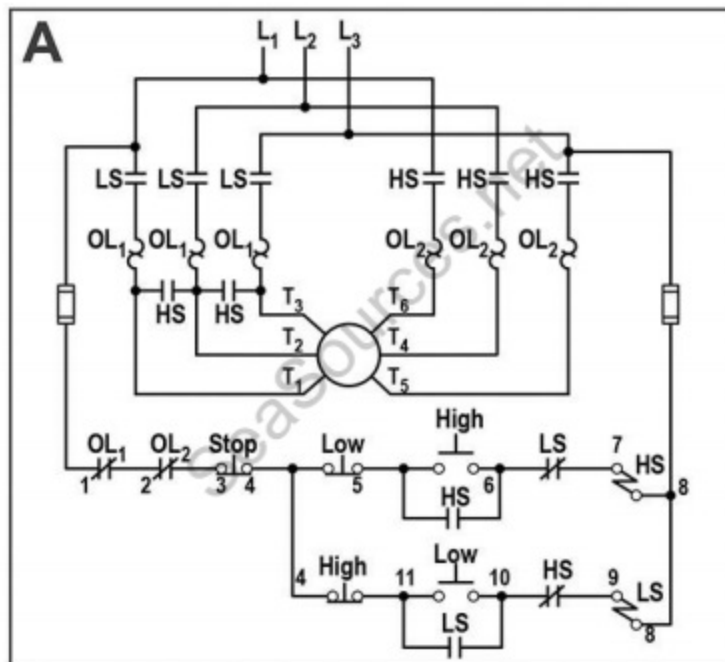
EL-0115

Watertight Door Controller

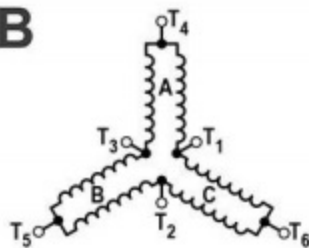


EL-0116





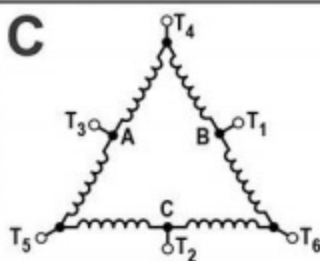
B



Two-speed single-winding
(constant torque)

Speed	L ₁	L ₂	L ₃	Tie together
Low	T ₁	T ₂	T ₃
High	T ₆	T ₄	T ₅	T ₁ T ₂ T ₃

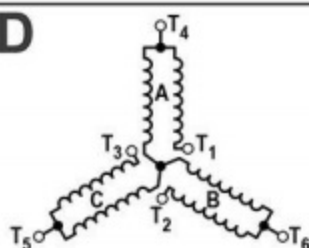
C



Two-speed single-winding
(variable torque)

Speed	L ₁	L ₂	L ₃	Tie together
Low	T ₁	T ₂	T ₃
High	T ₆	T ₄	T ₅	T ₁ T ₂ T ₃

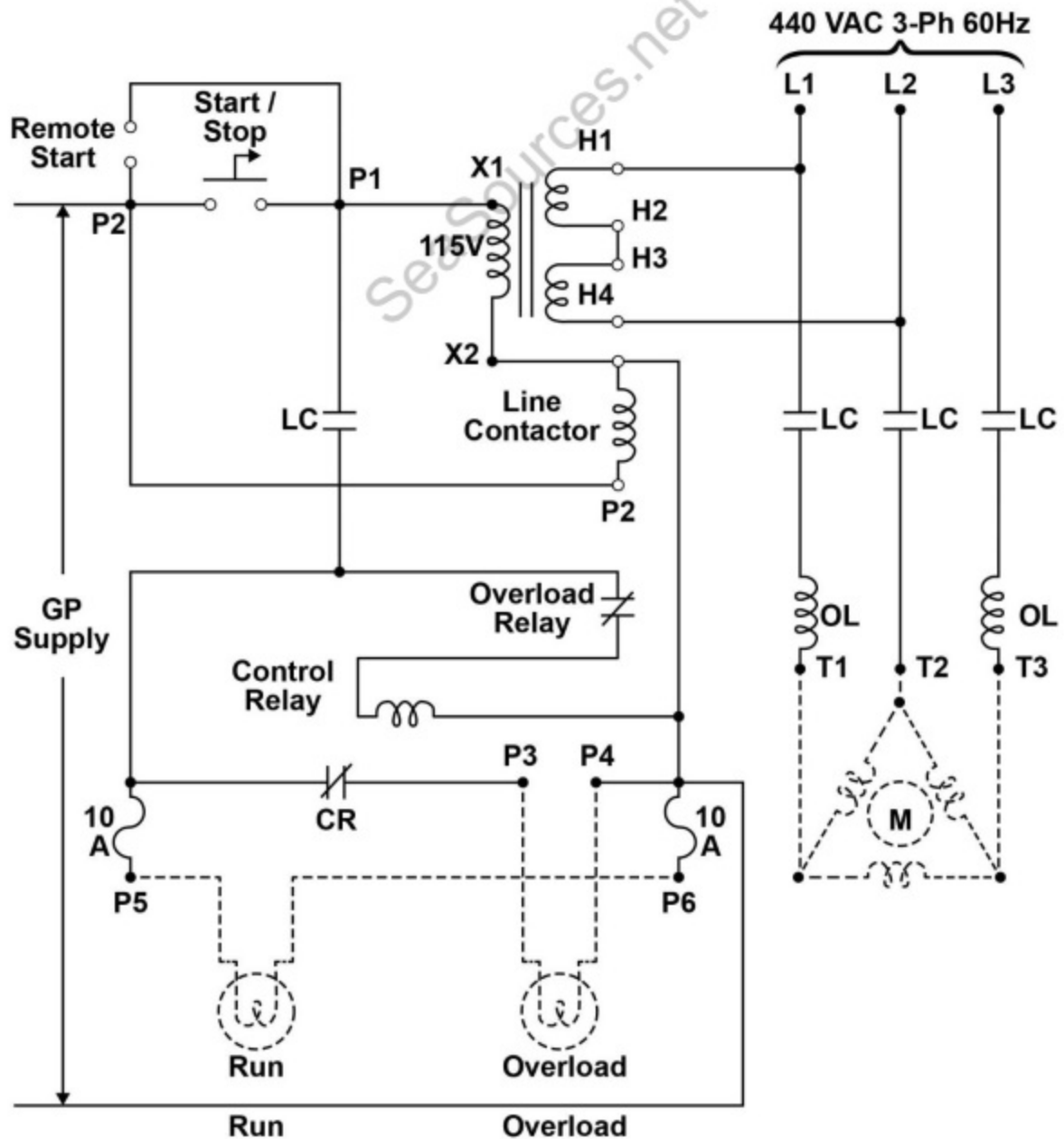
D



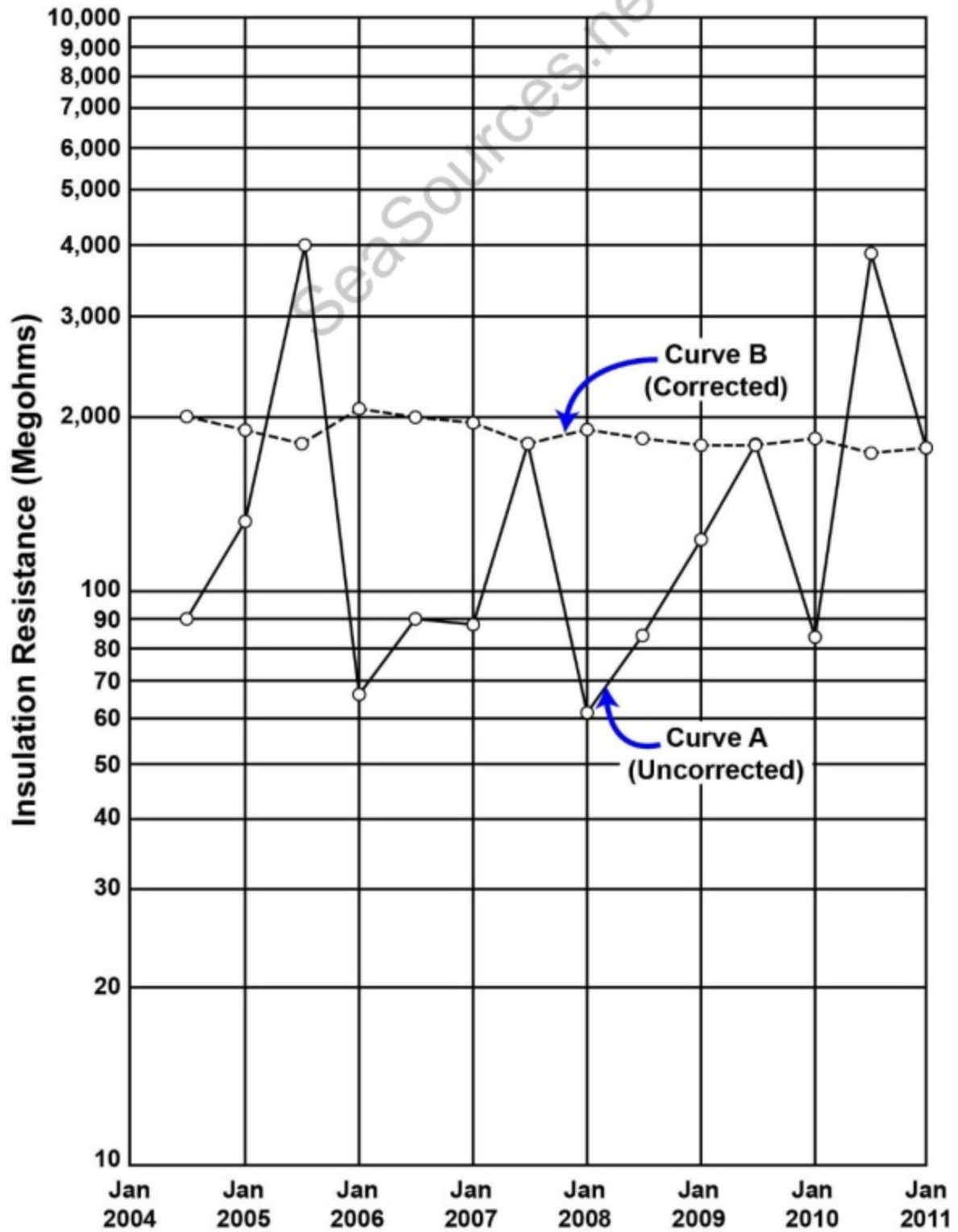
Two-speed single-winding
(constant horsepower)

Speed	L ₁	L ₂	L ₃	Tie together
Low	T ₁	T ₂	T ₃	T ₆ T ₄ T ₅
High	T ₆	T ₄	T ₅

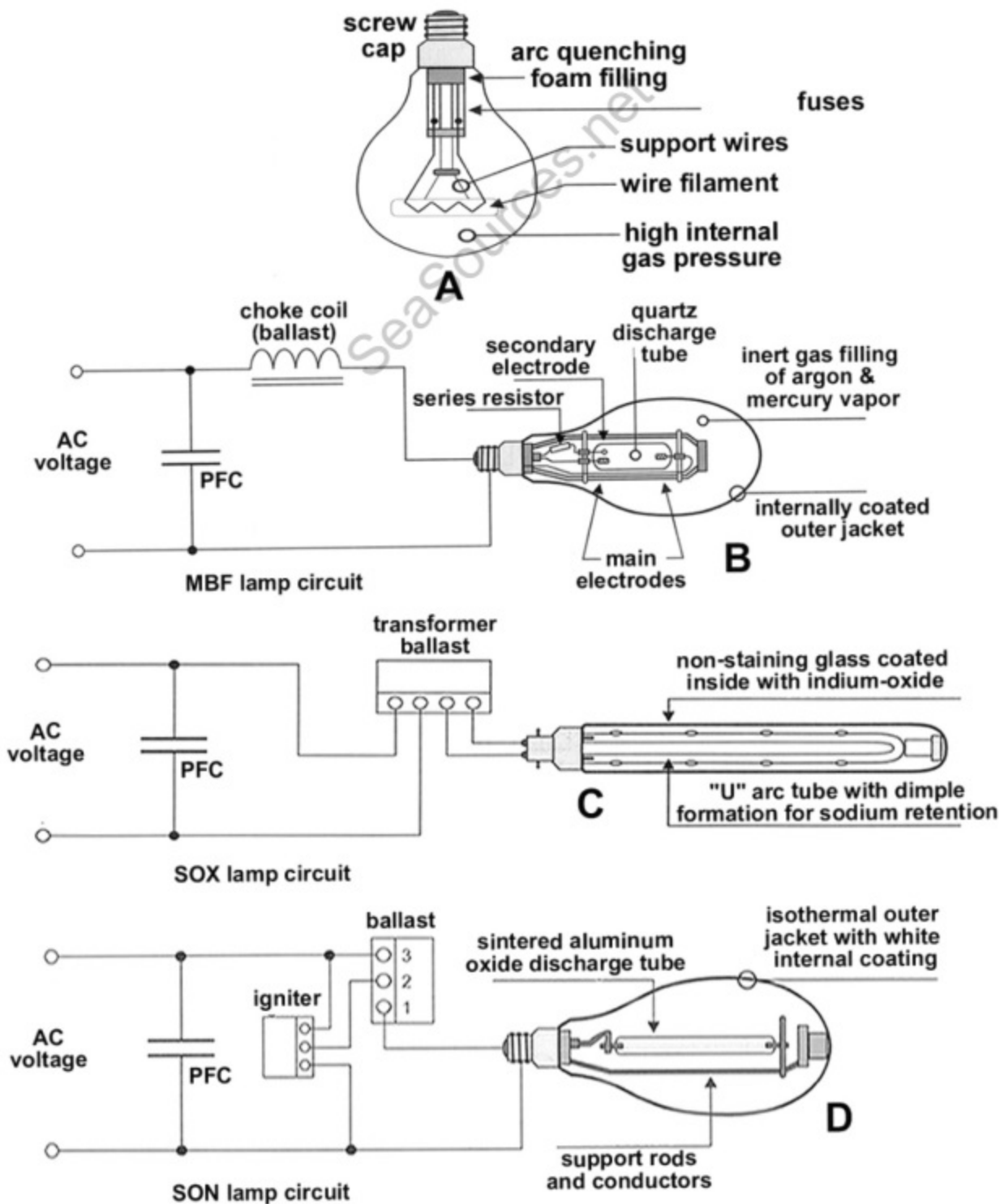
EL-0119



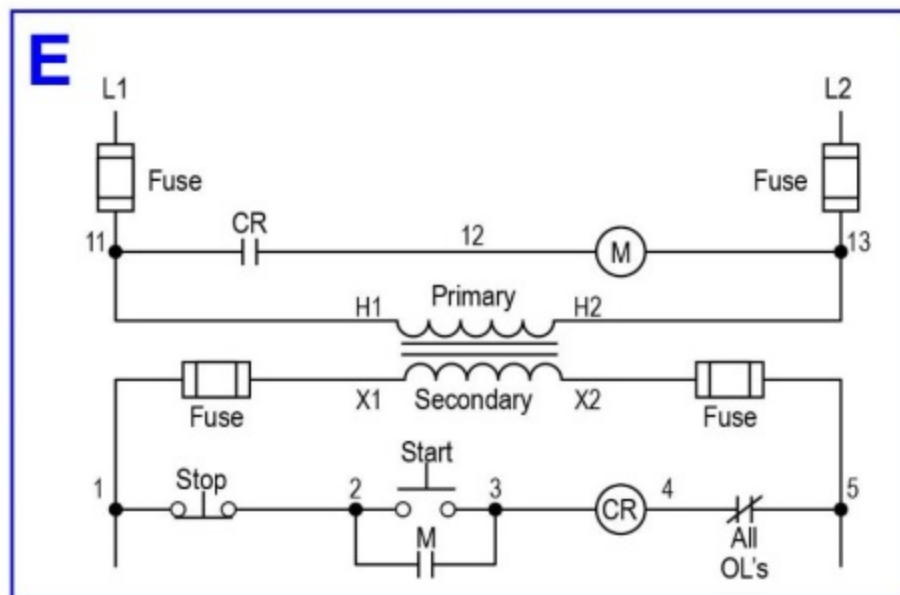
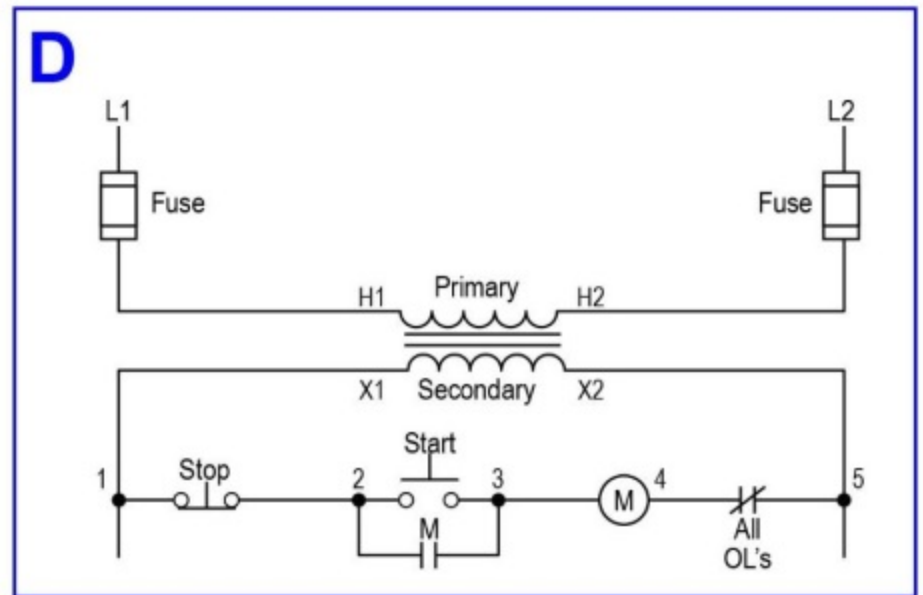
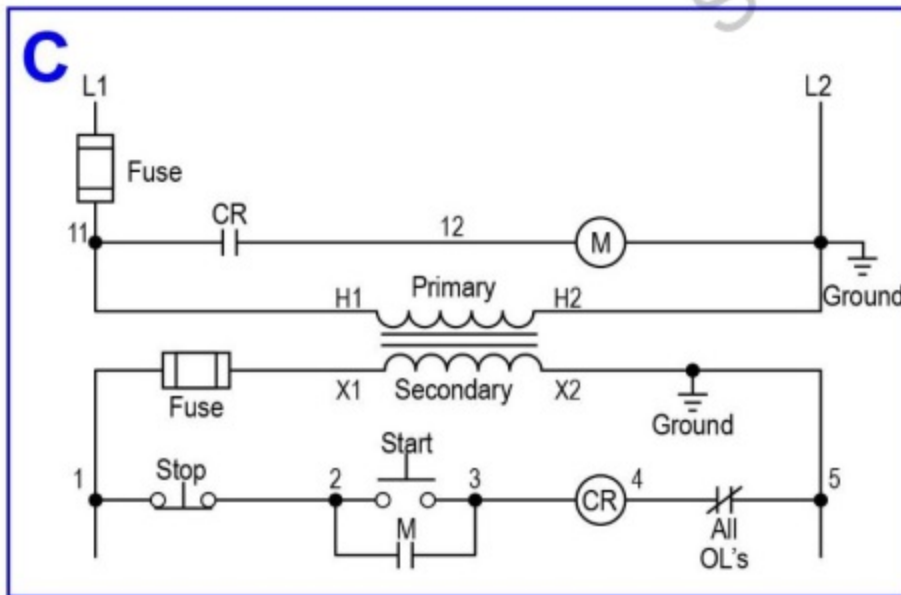
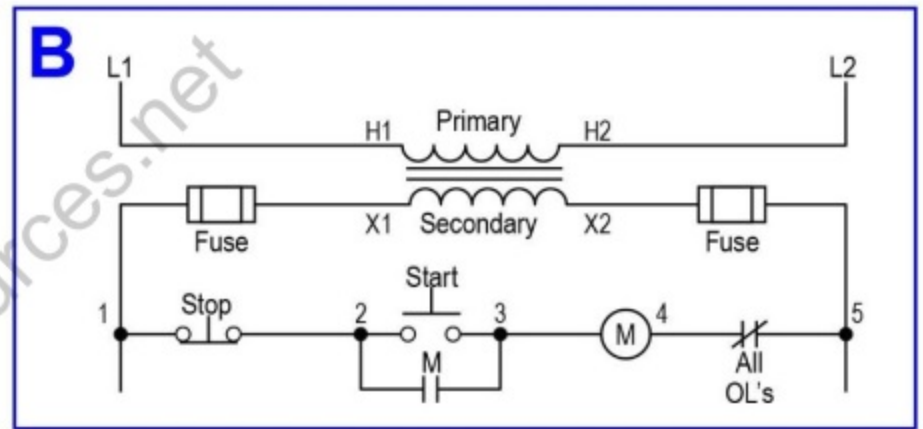
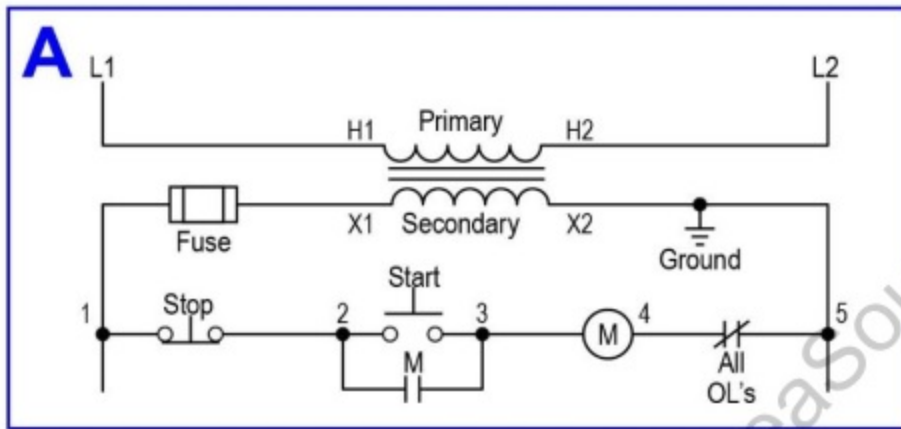
EL-0120



EL-0122

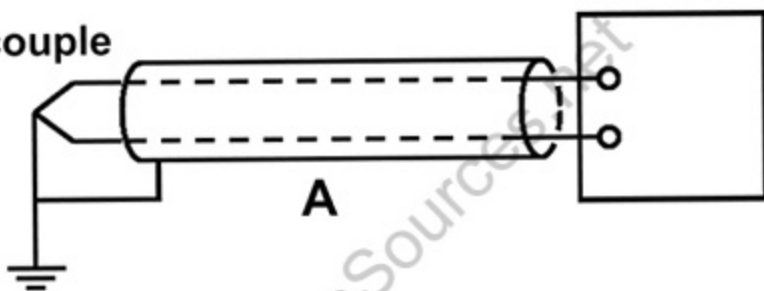


EL-0123

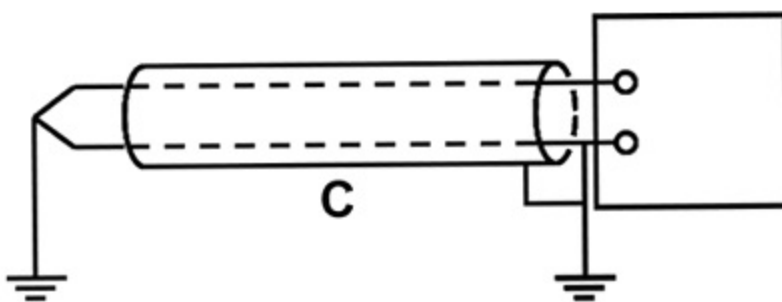
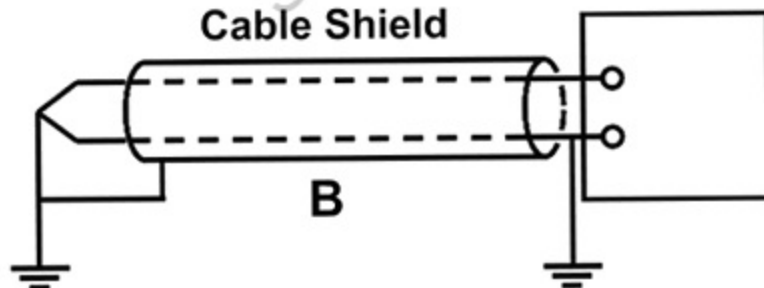


EL-0124

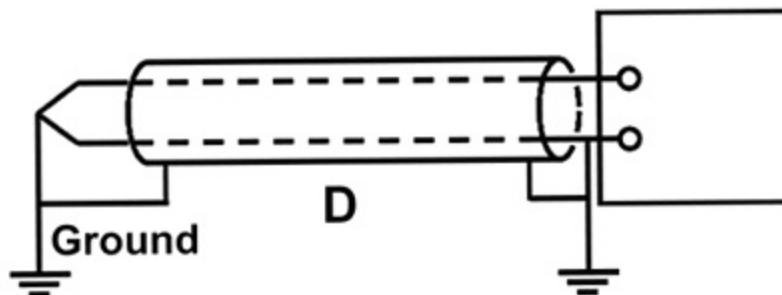
Thermocouple



Cable Shield

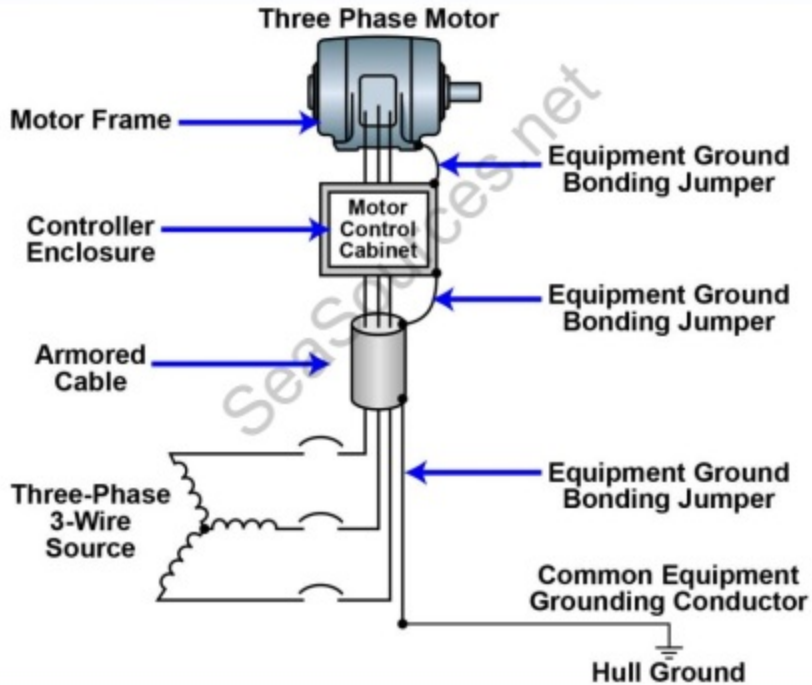


Computer
Analog Input
Multiplexer

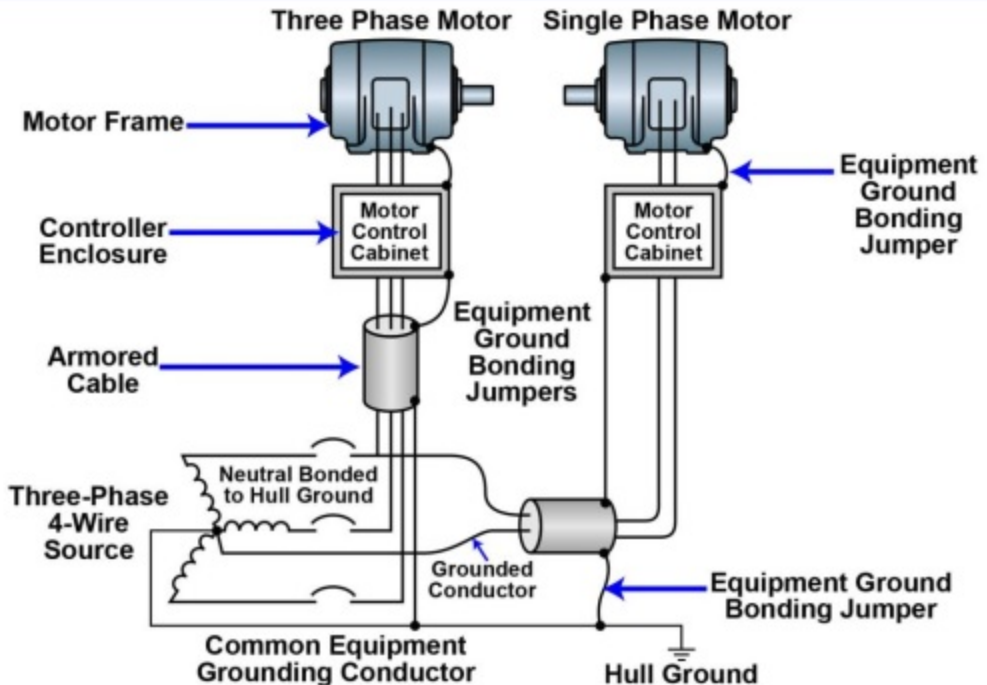


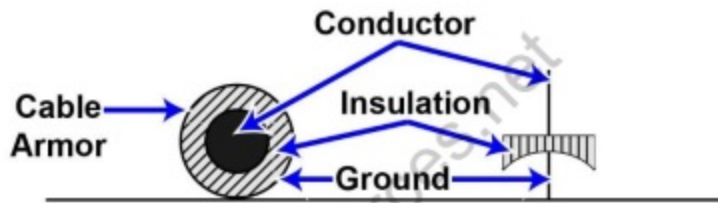
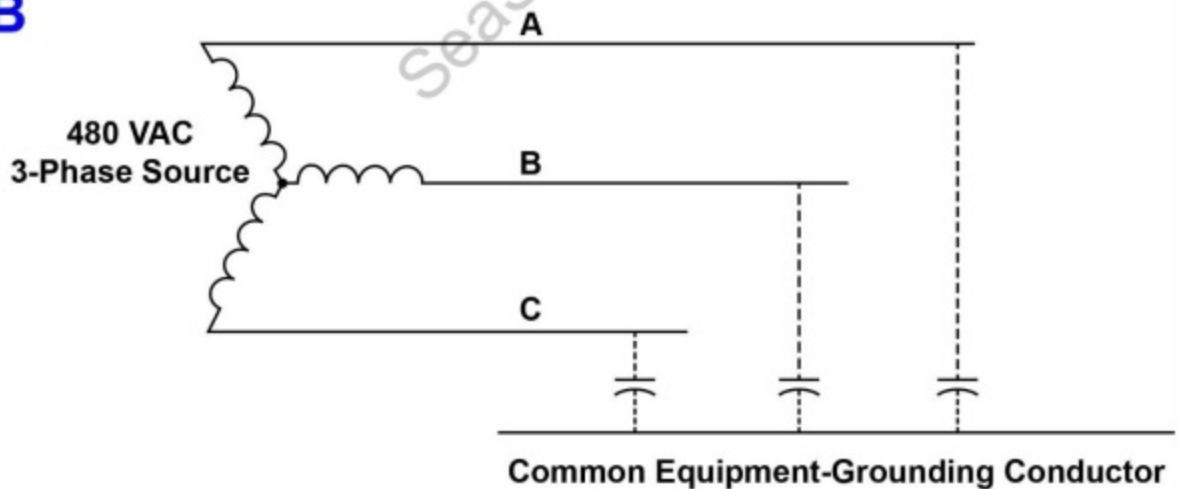
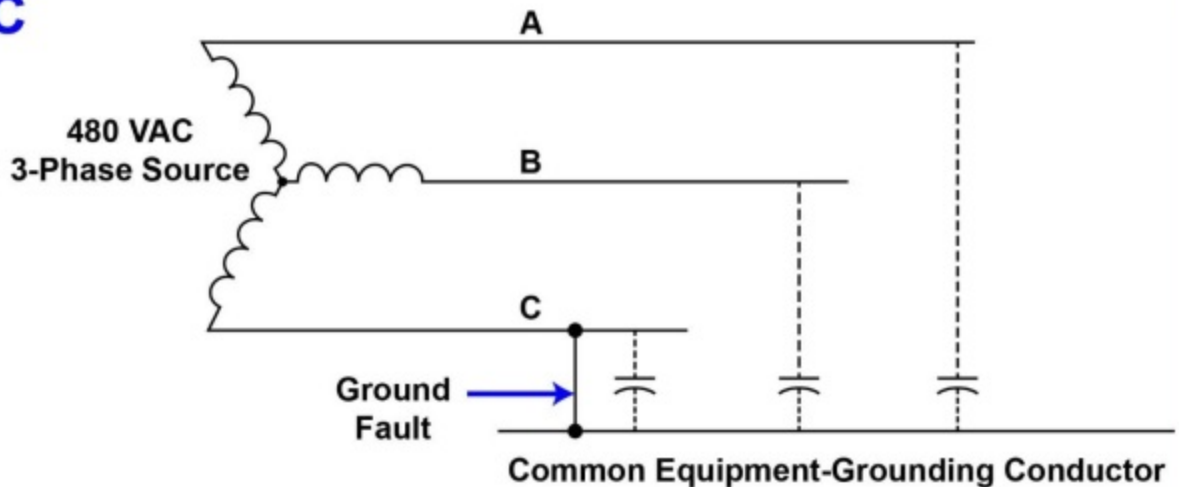
EL-0125

A

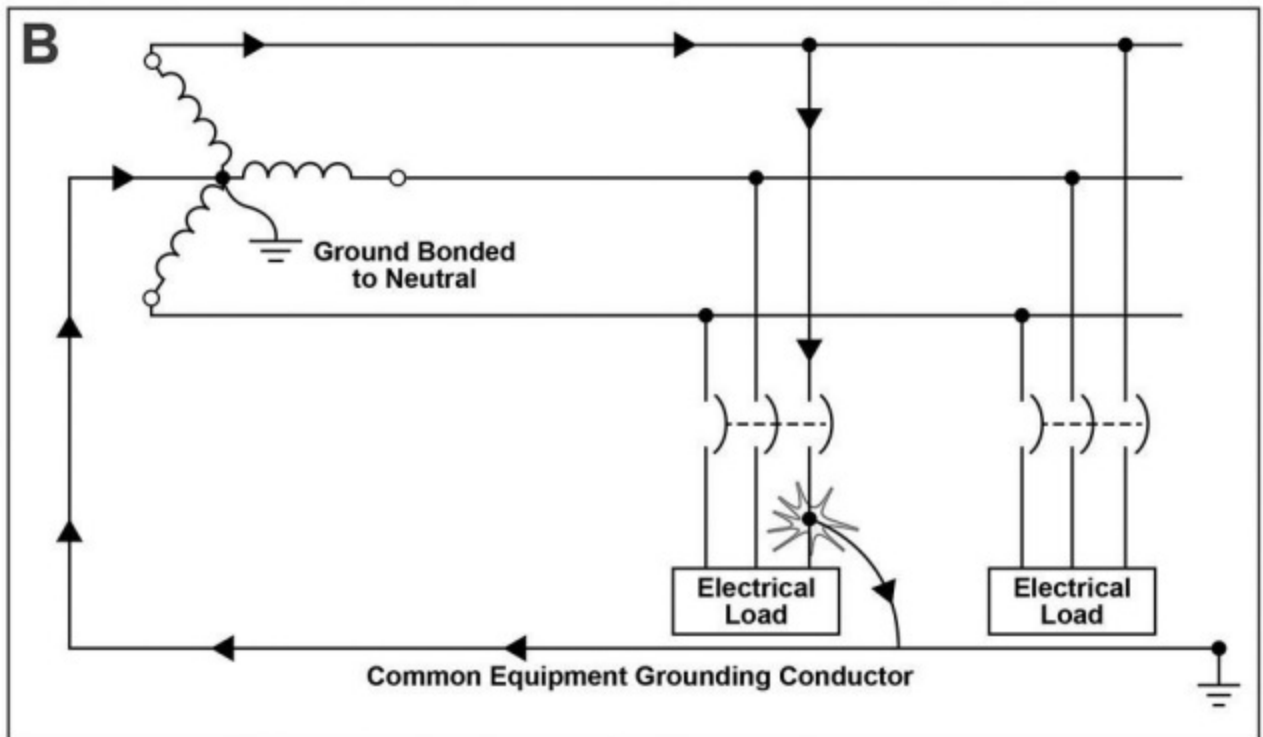
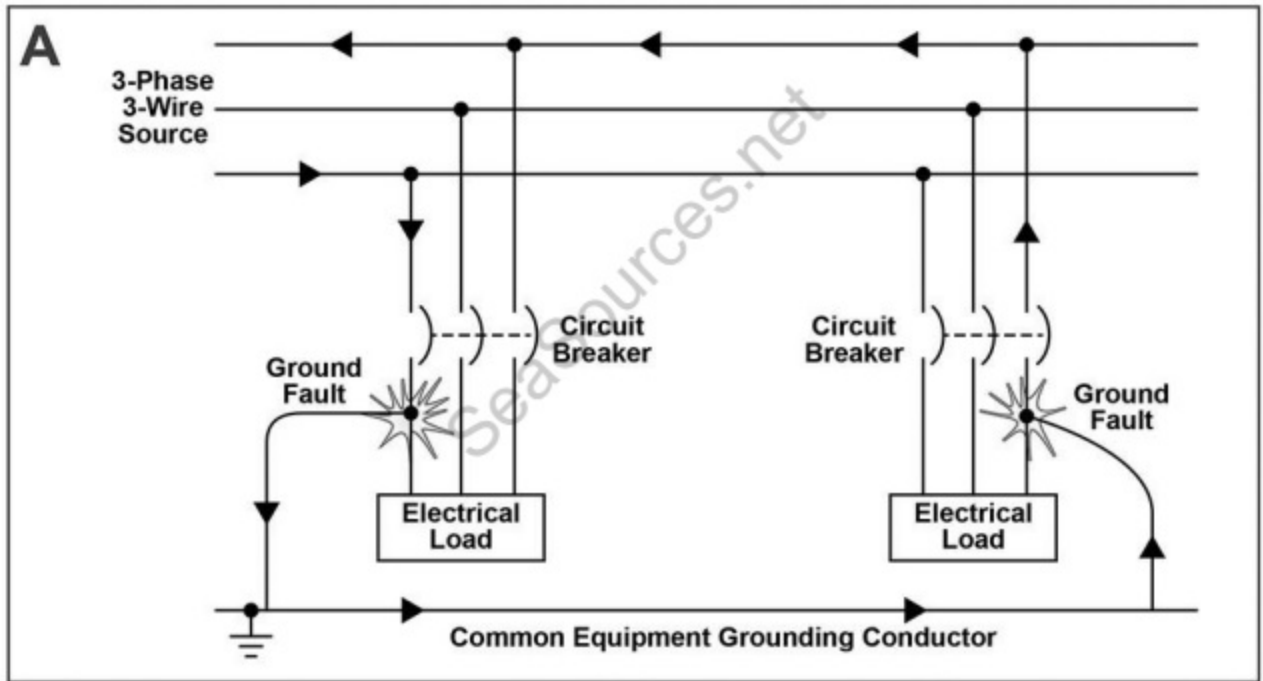


B

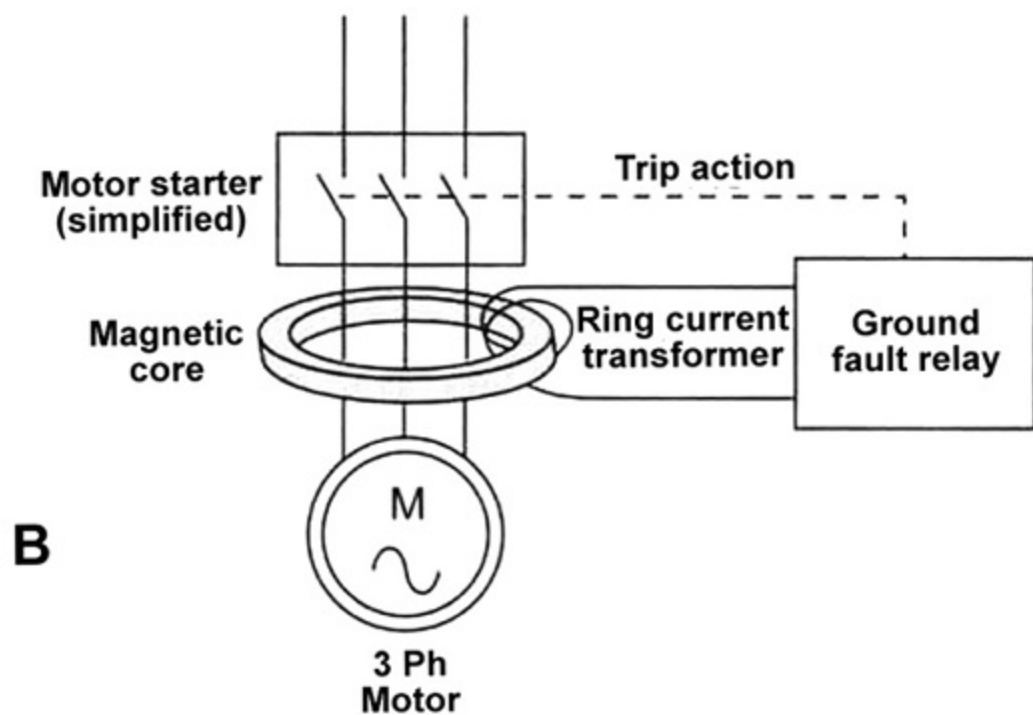
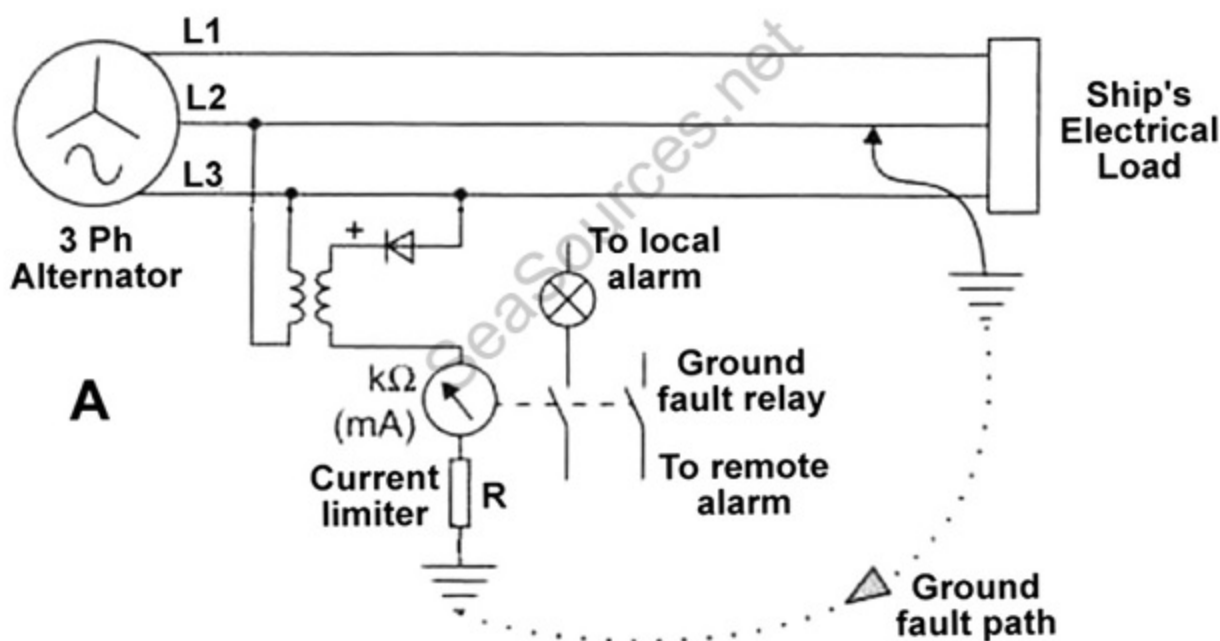


A**B****C**

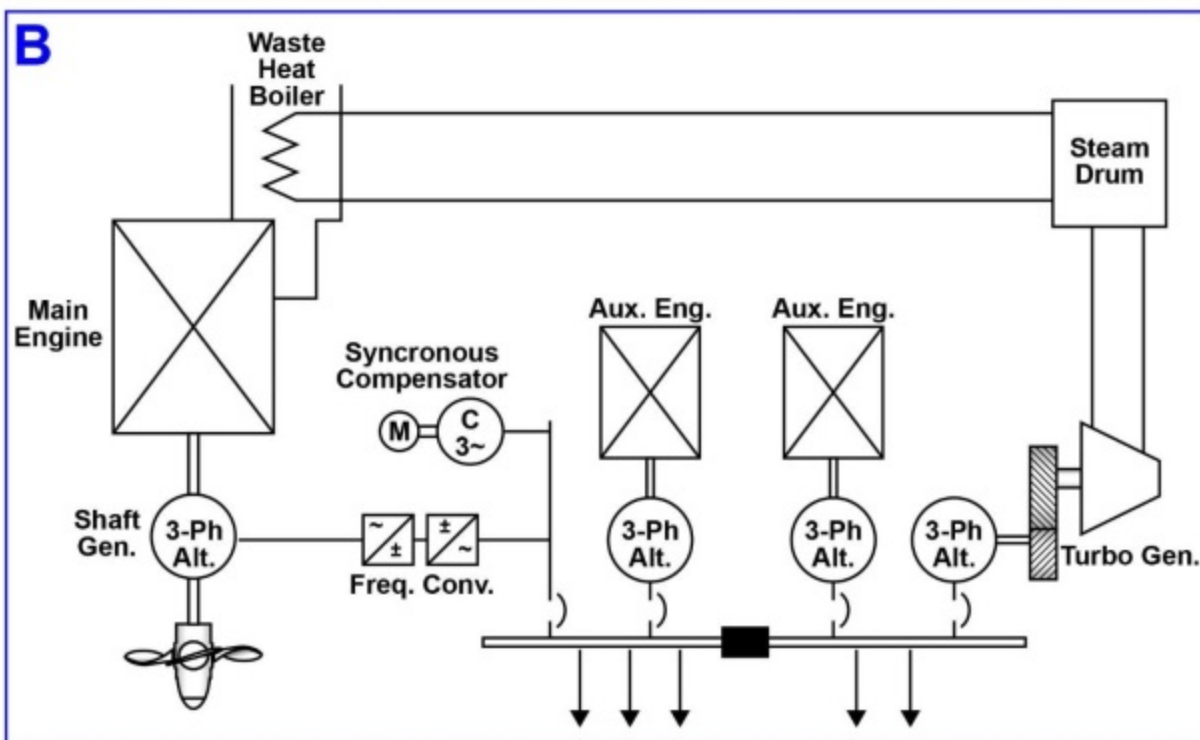
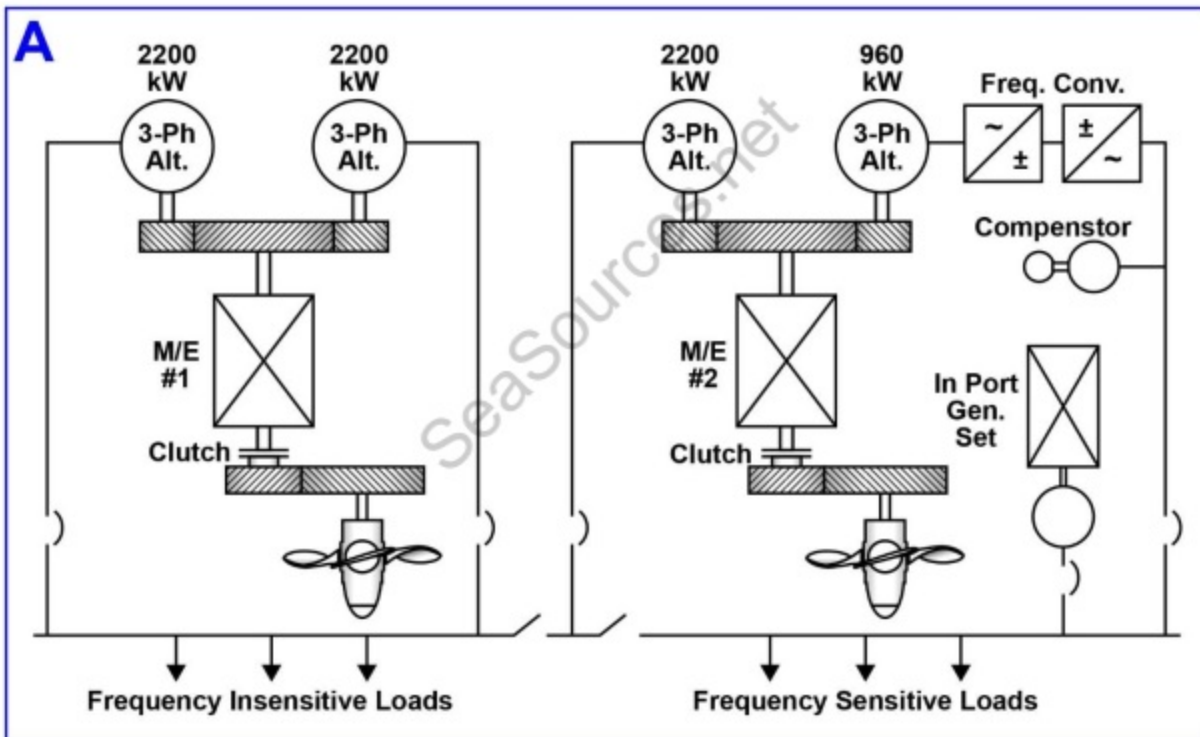
EL-0129



EL-0132

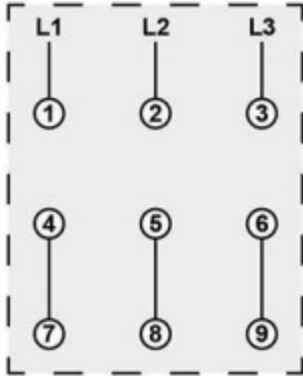


EL-0133

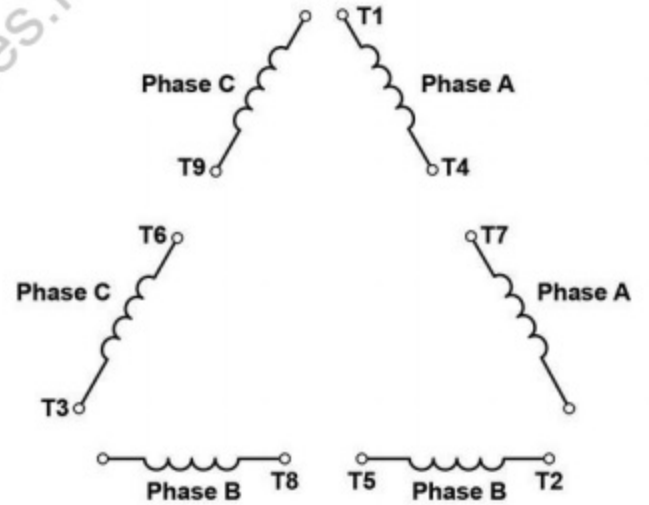
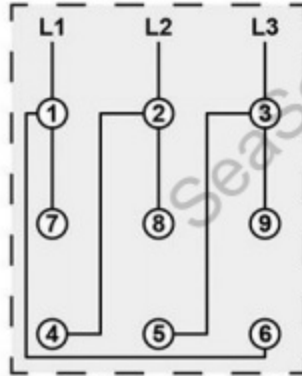


Dual Voltage Nine Lead Delta Connected Motor

High Voltage Connections

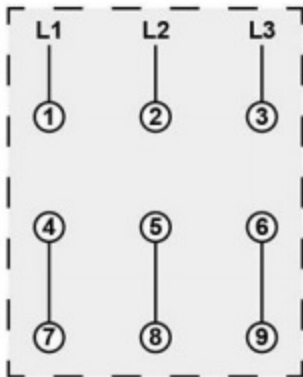


Low Voltage Connections

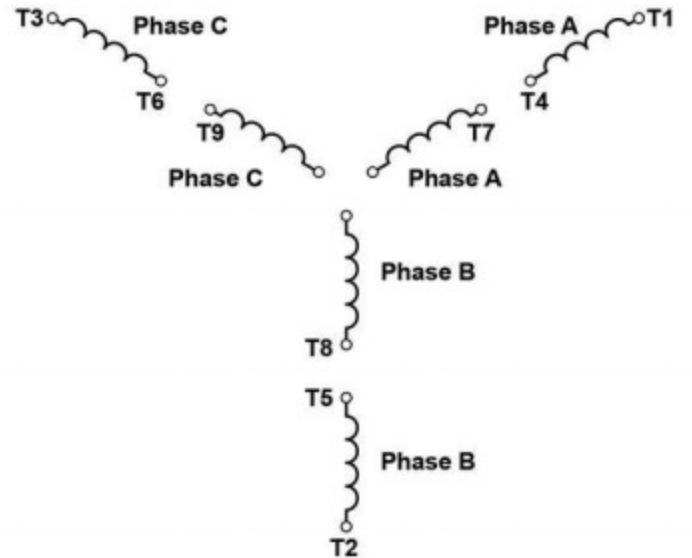
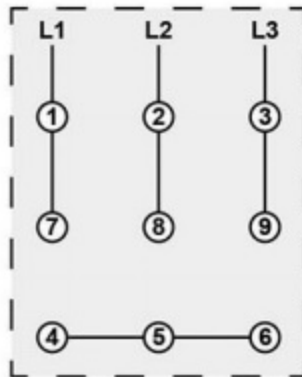


Dual Voltage Nine Lead Wye Connected Motor

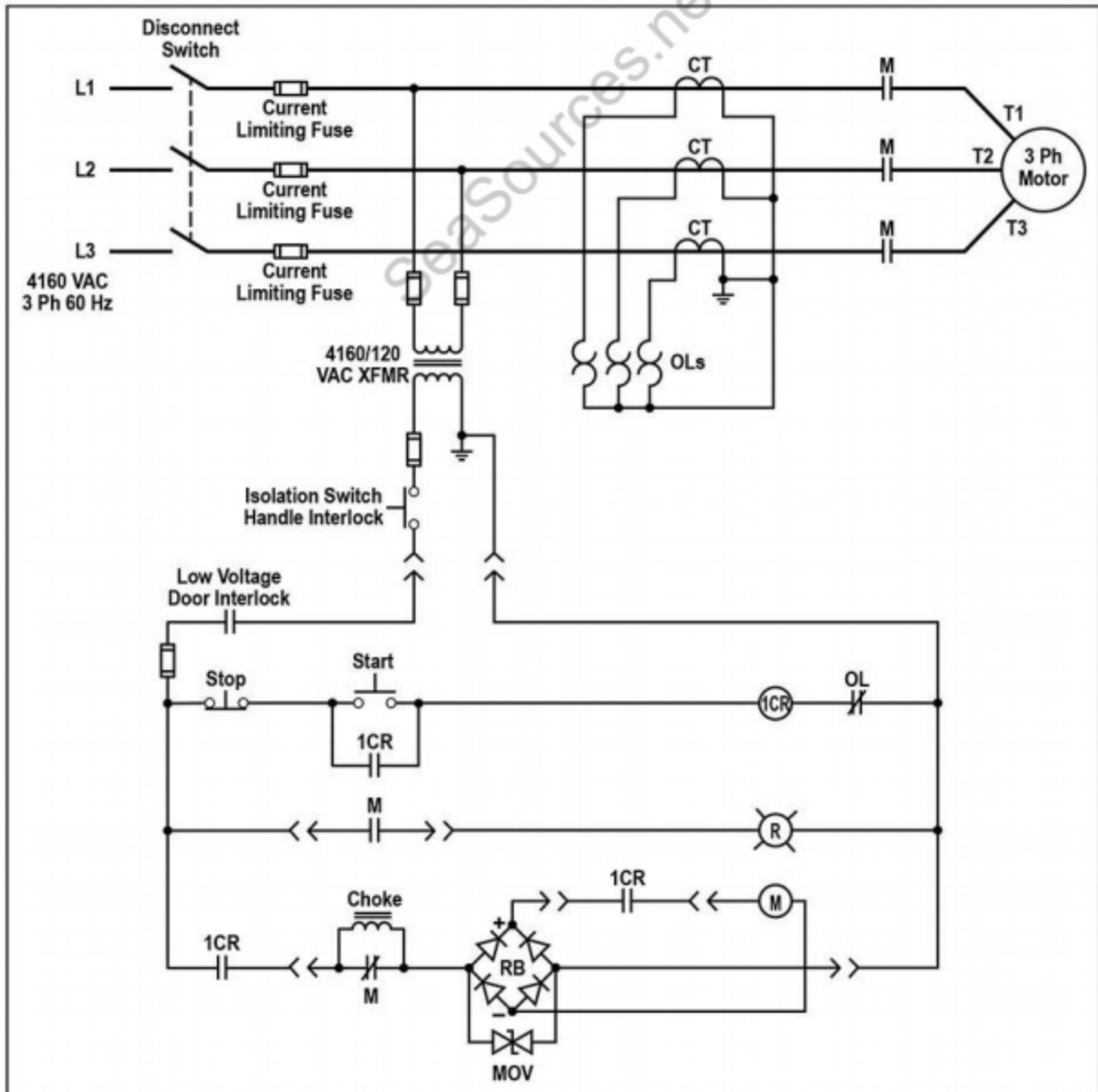
High Voltage Connections



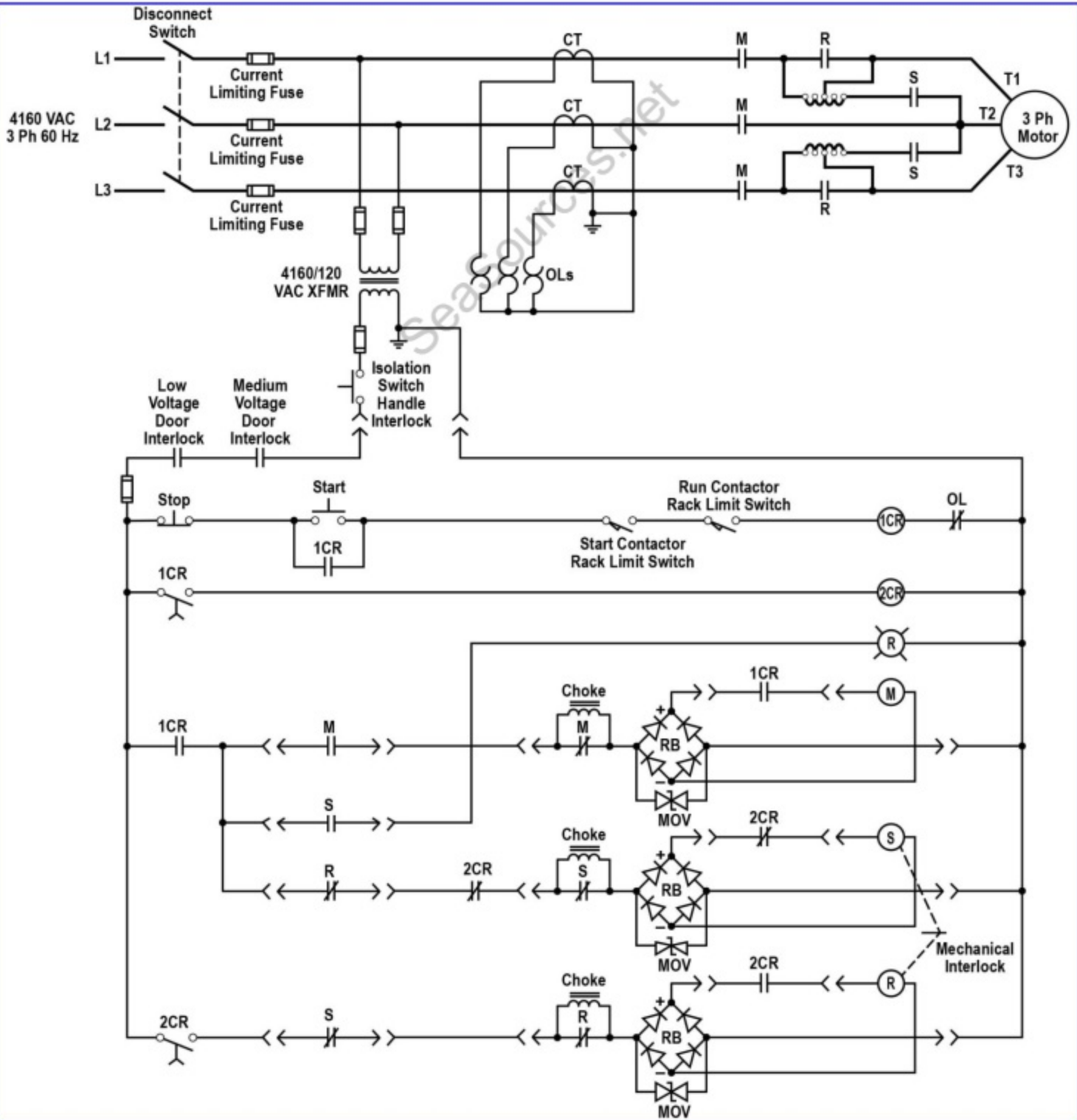
Low Voltage Connections



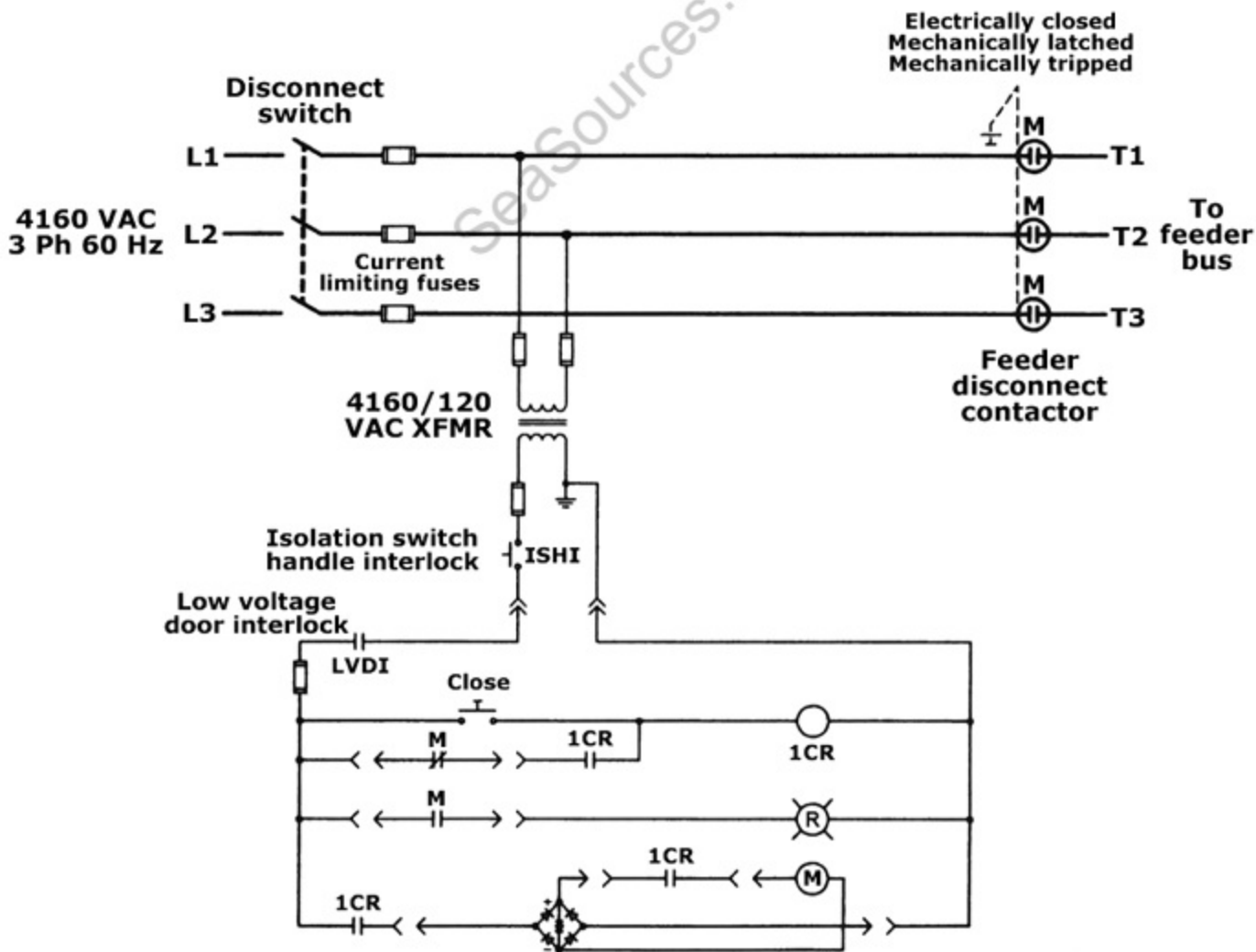
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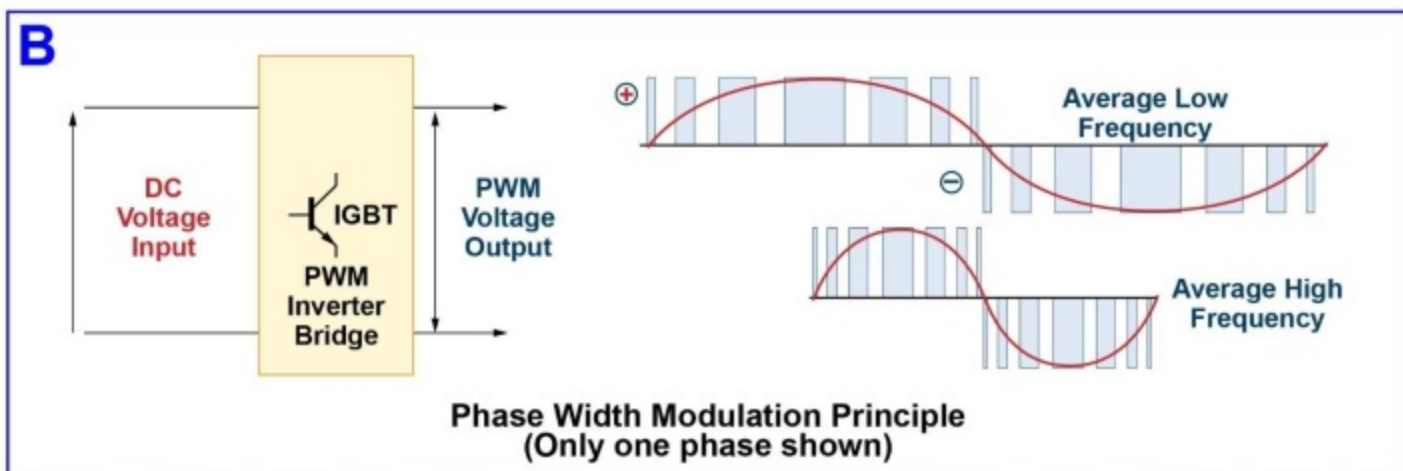
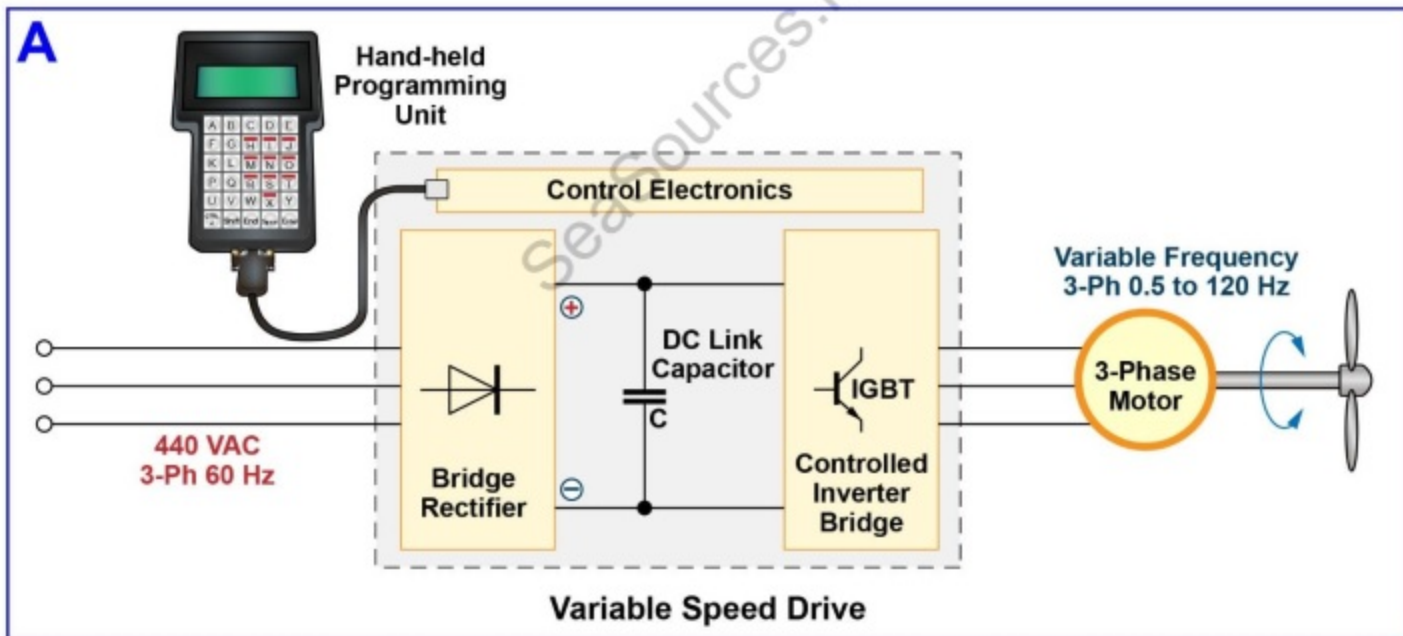


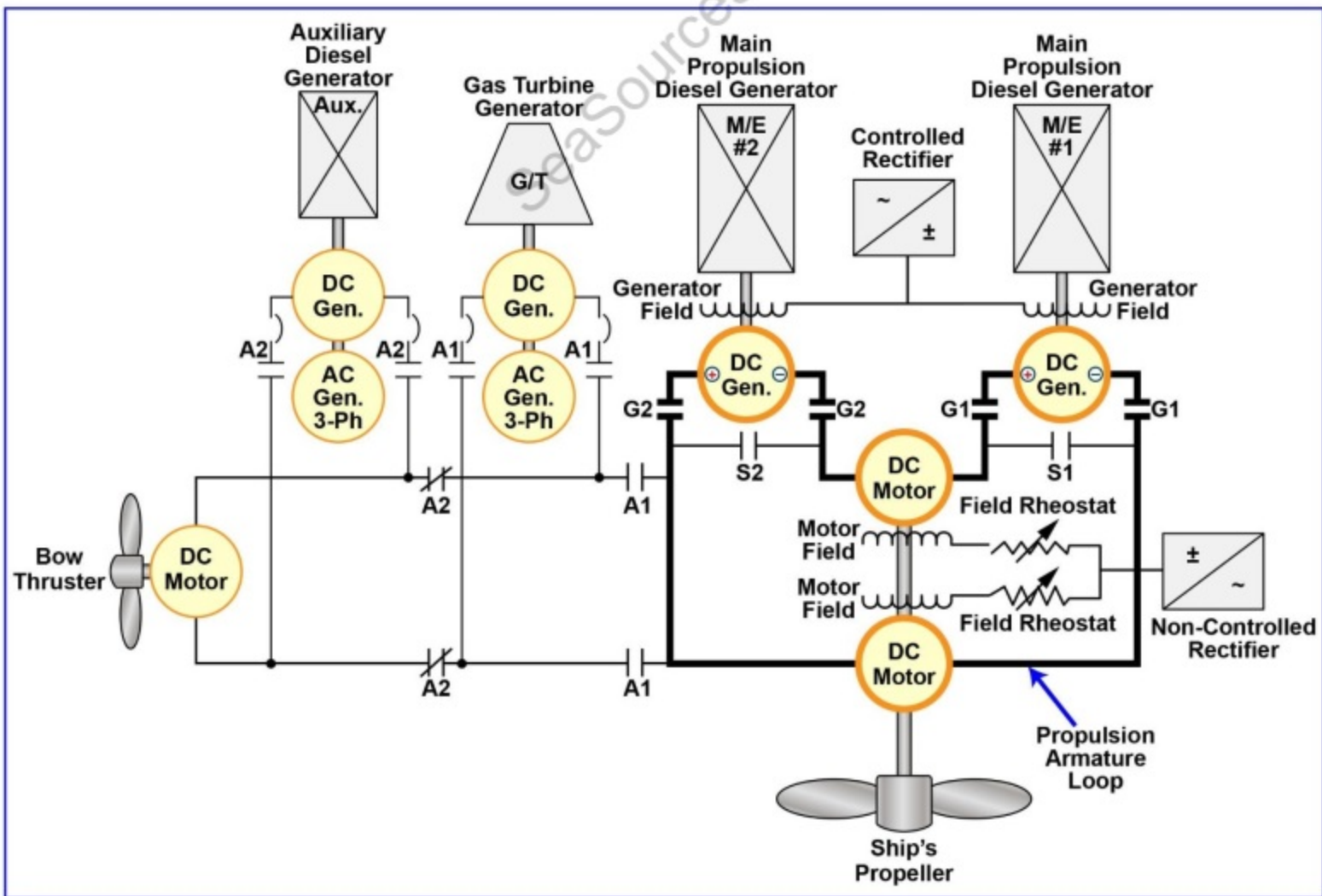
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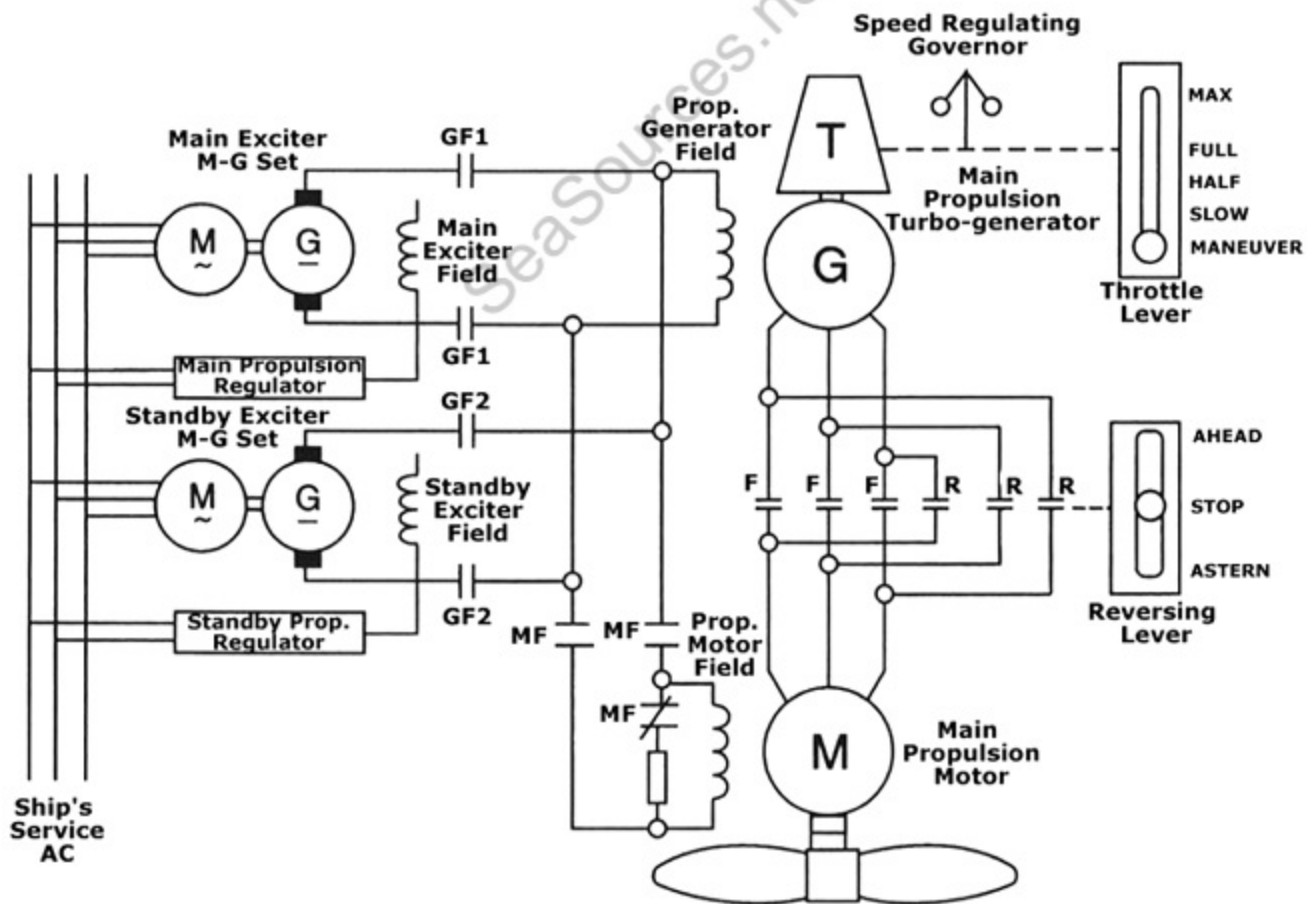
EL-0138



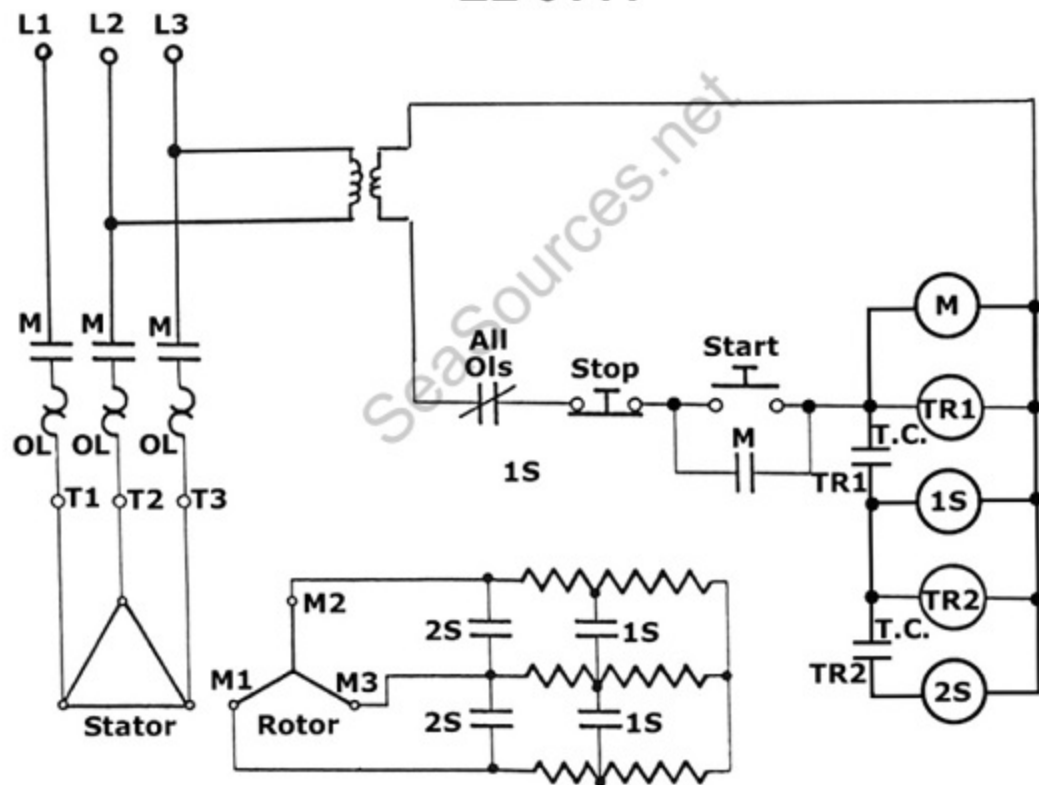




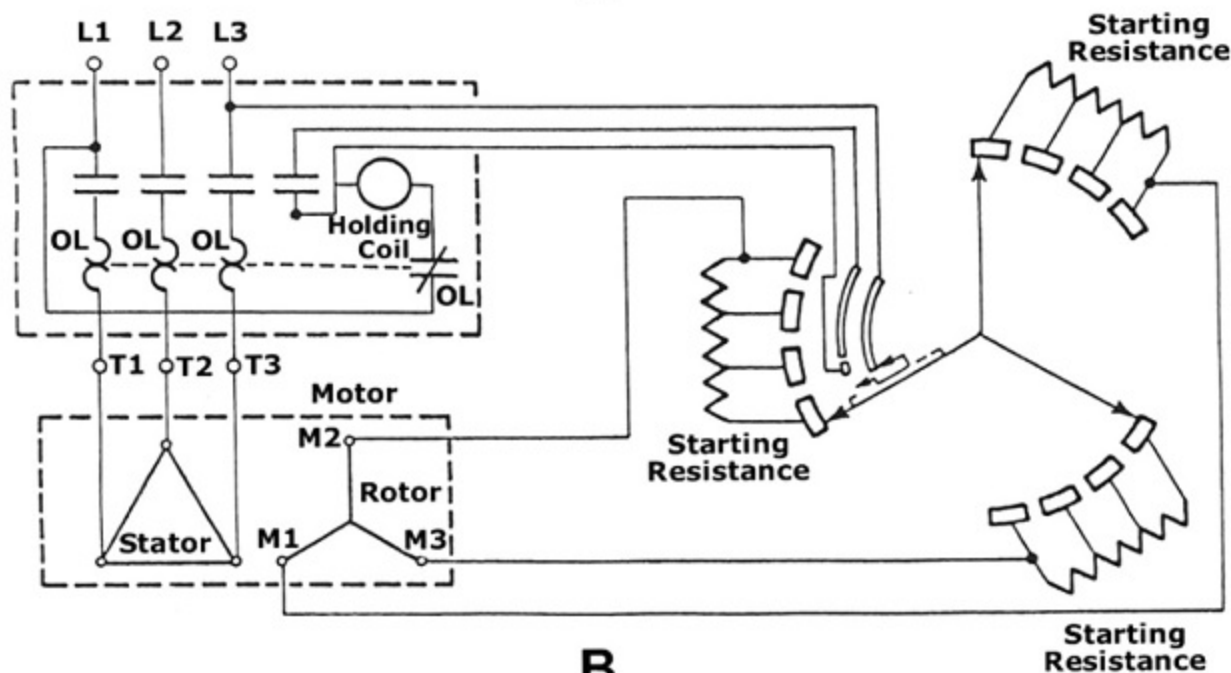
EL-0142



EL-0144



A



B

EL-0146



A



B

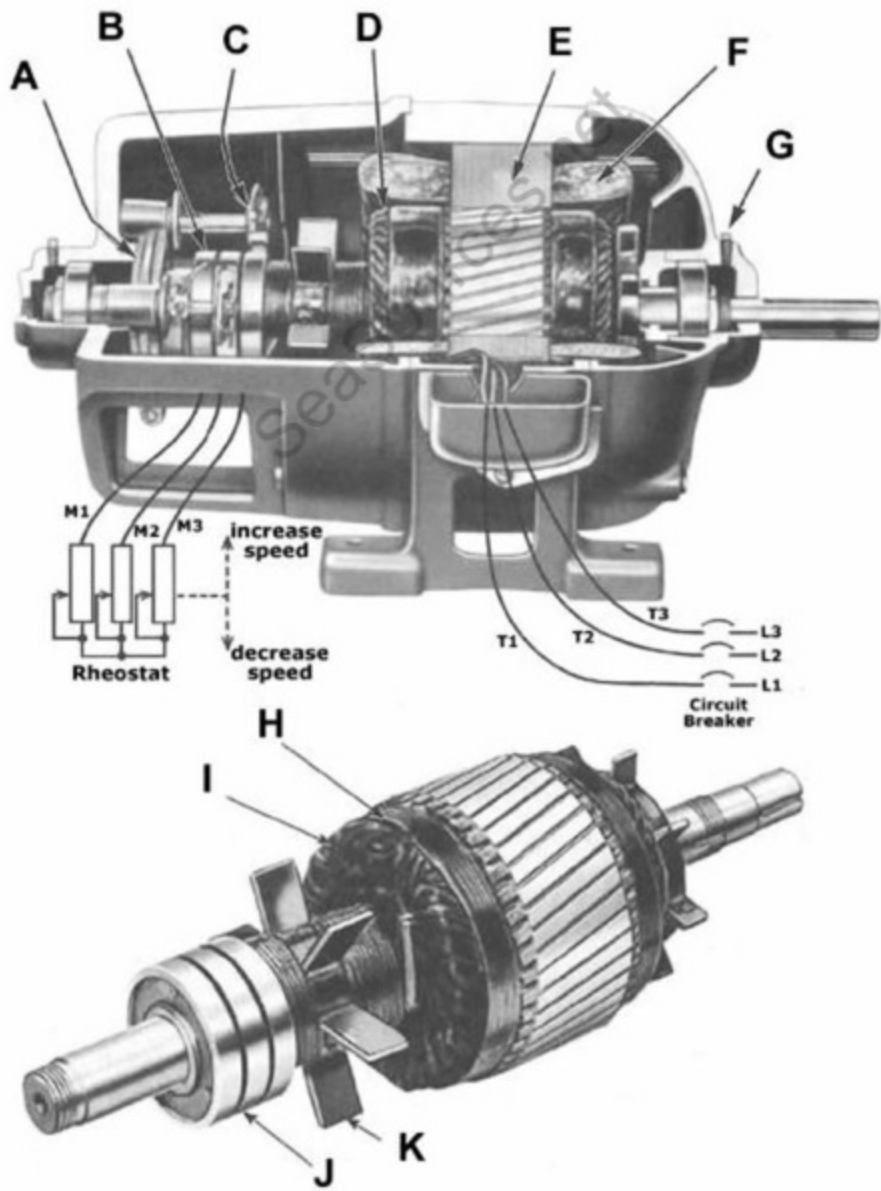


C

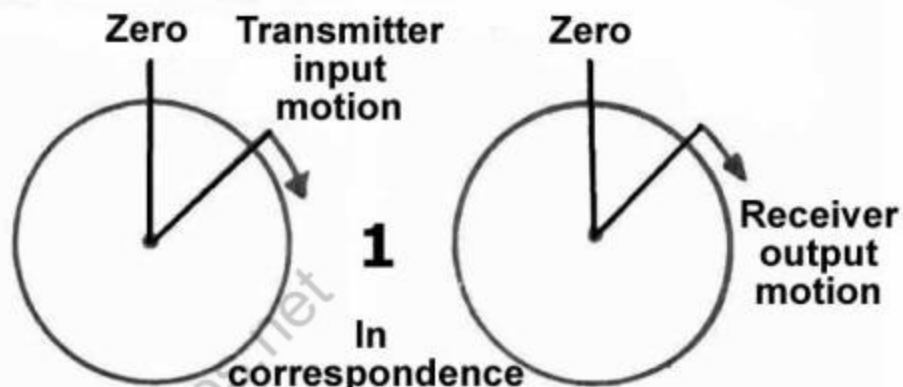
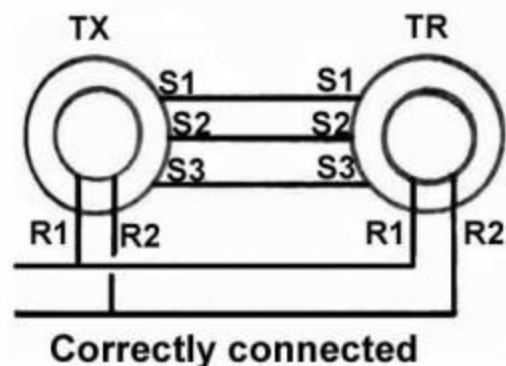


D

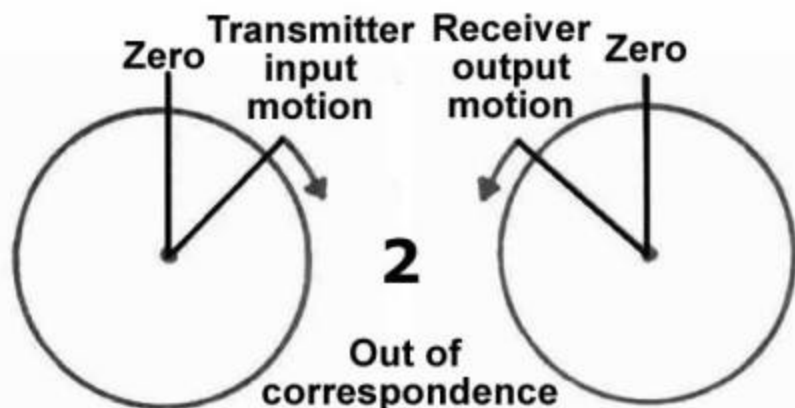
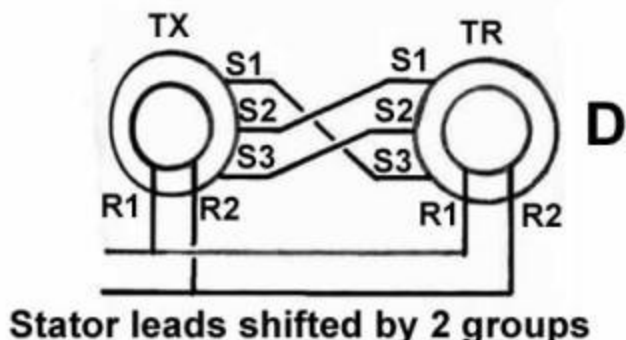
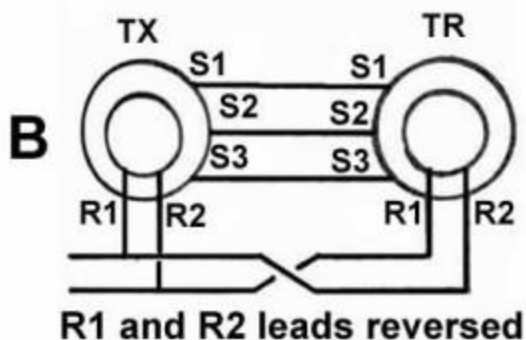
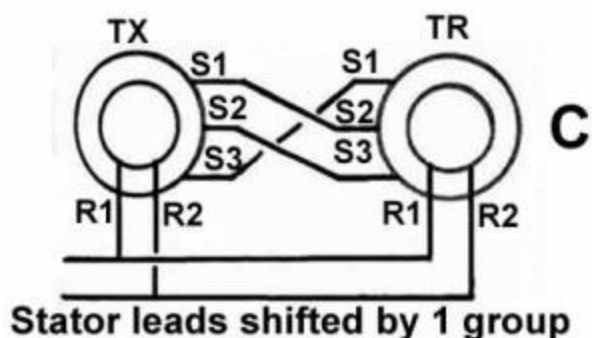
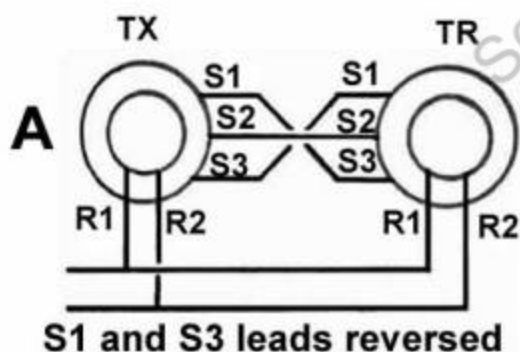
EL-0148



EL-0149

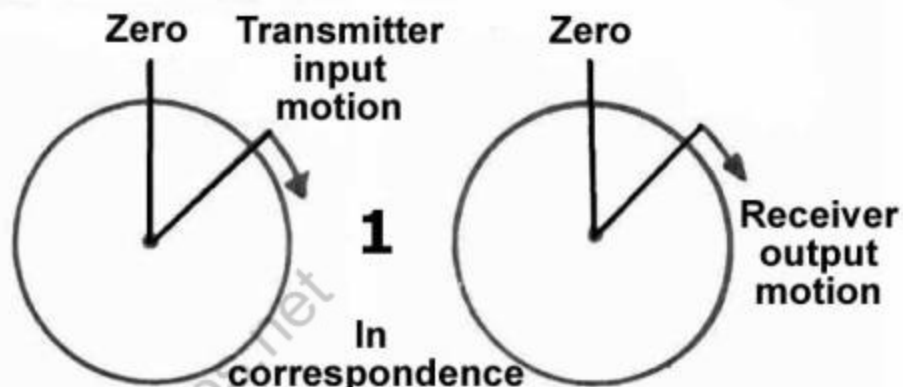
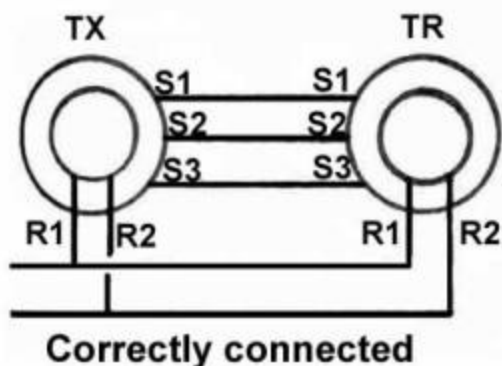


Correctly connected system causes receiver to be in correspondence with the transmitter

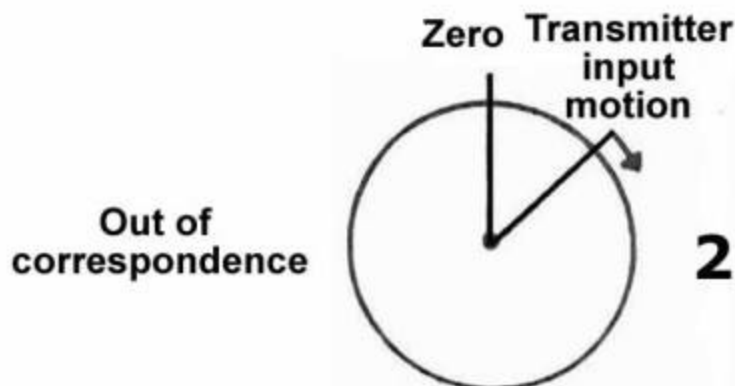
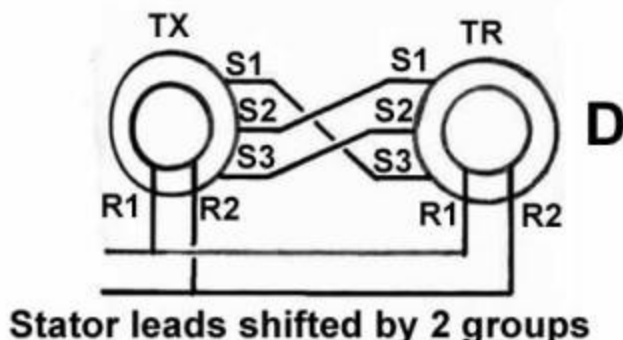
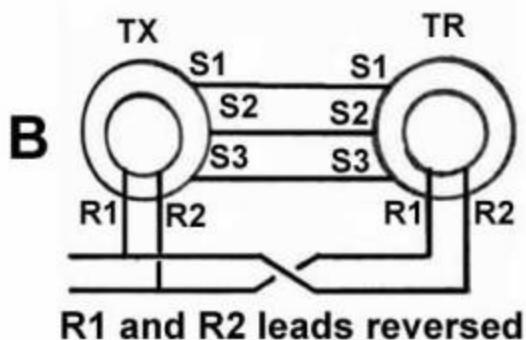
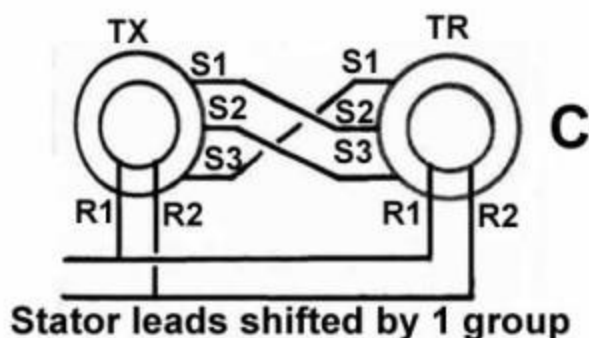
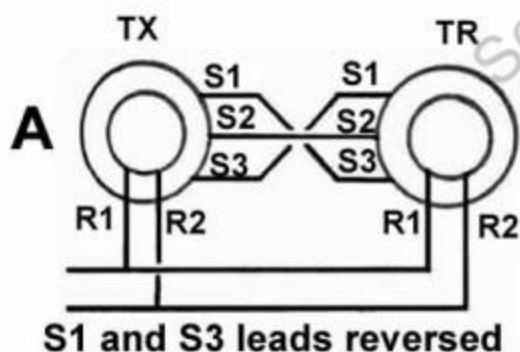


Incorrect connections:
properly zeroed,
but torque direction reversed

EL-0150



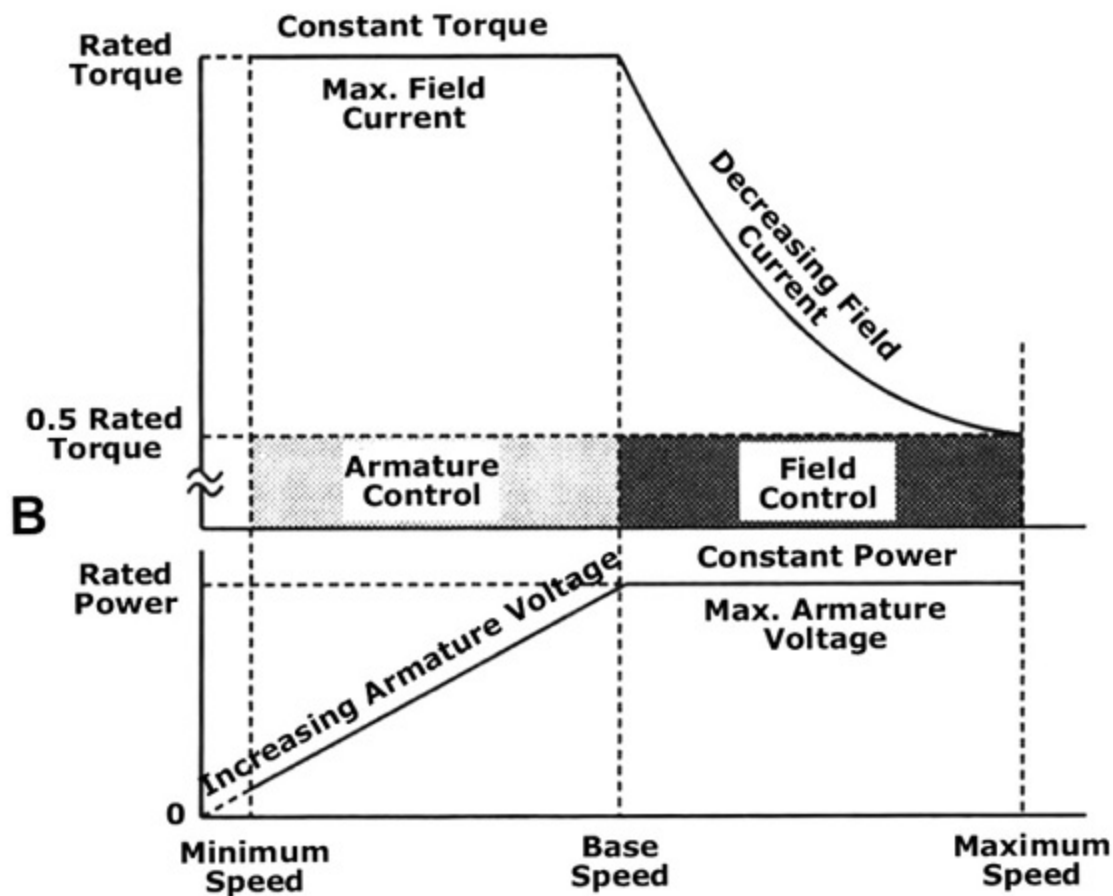
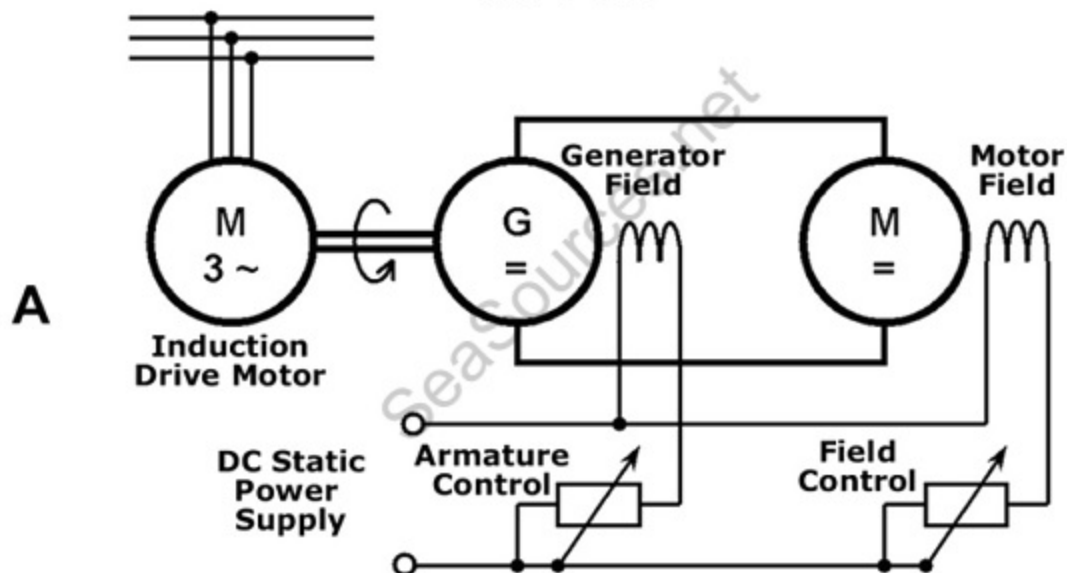
Correctly connected system causes receiver to be in correspondence with the transmitter

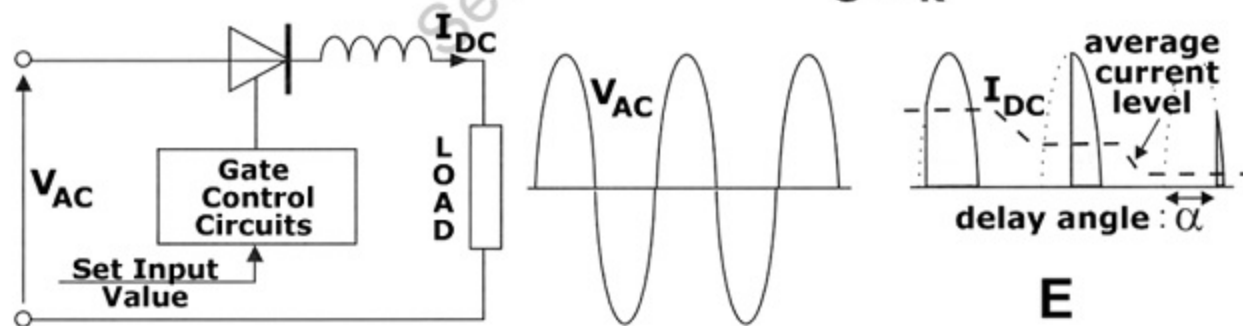
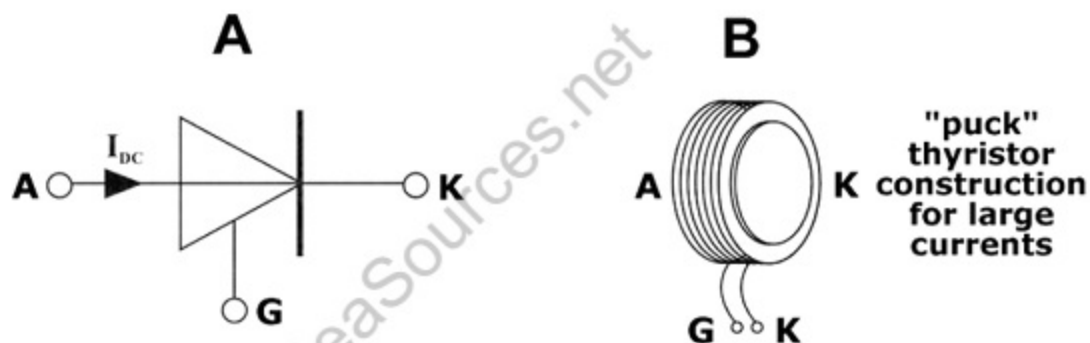
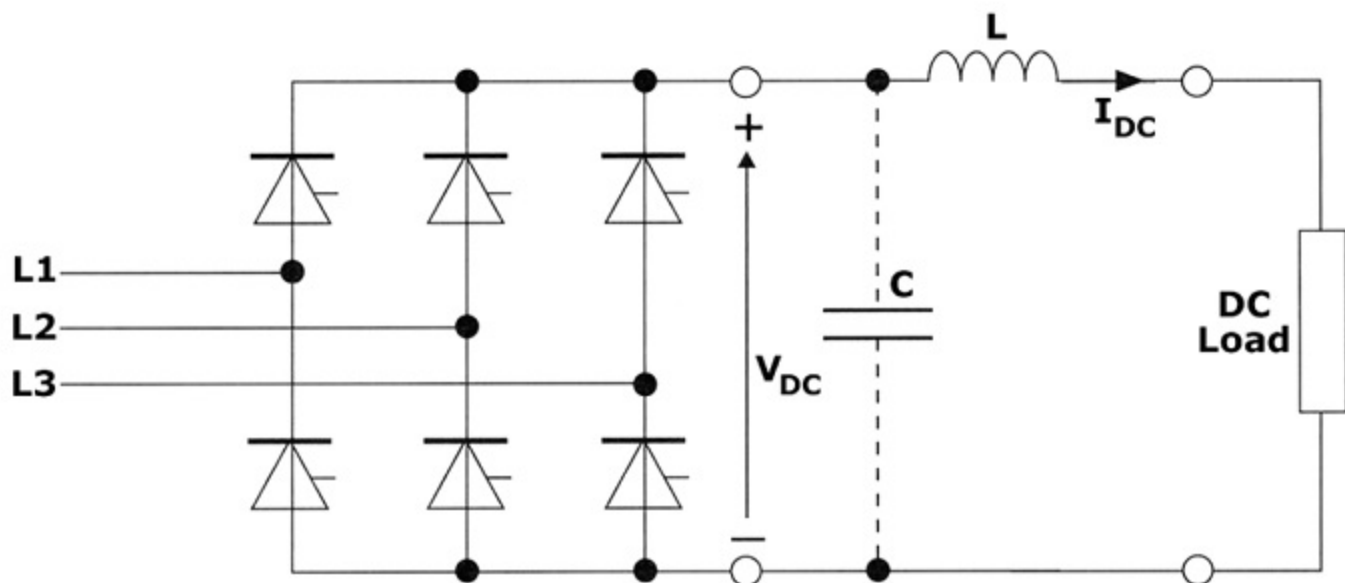


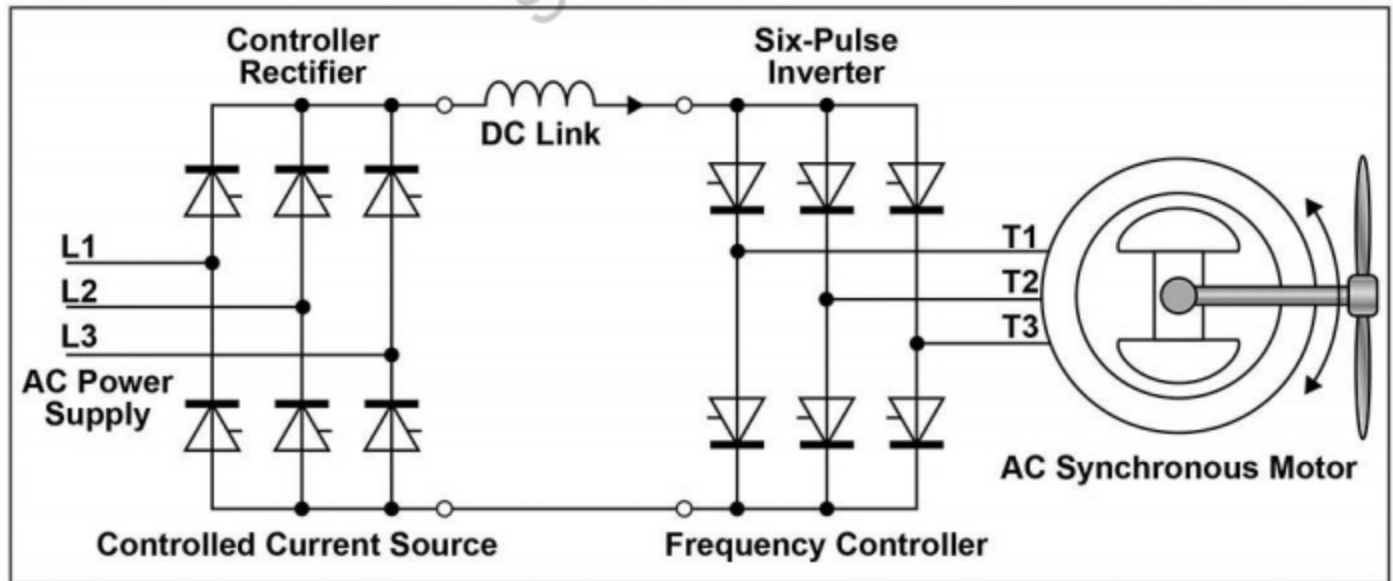
Incorrect connections:
180 degrees out of zero, but
torque direction correct

Receiver output Zero motion

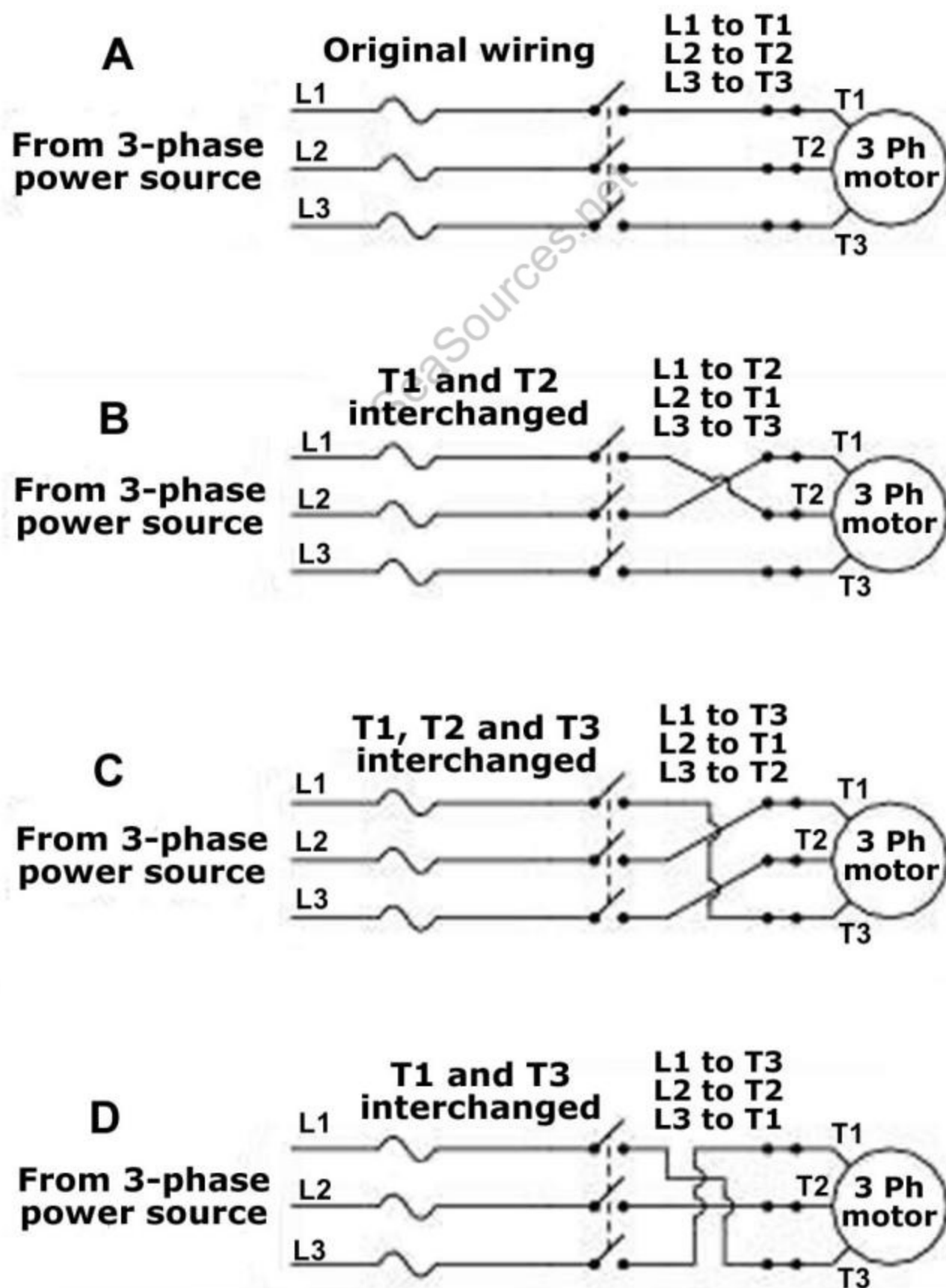
EL-0153



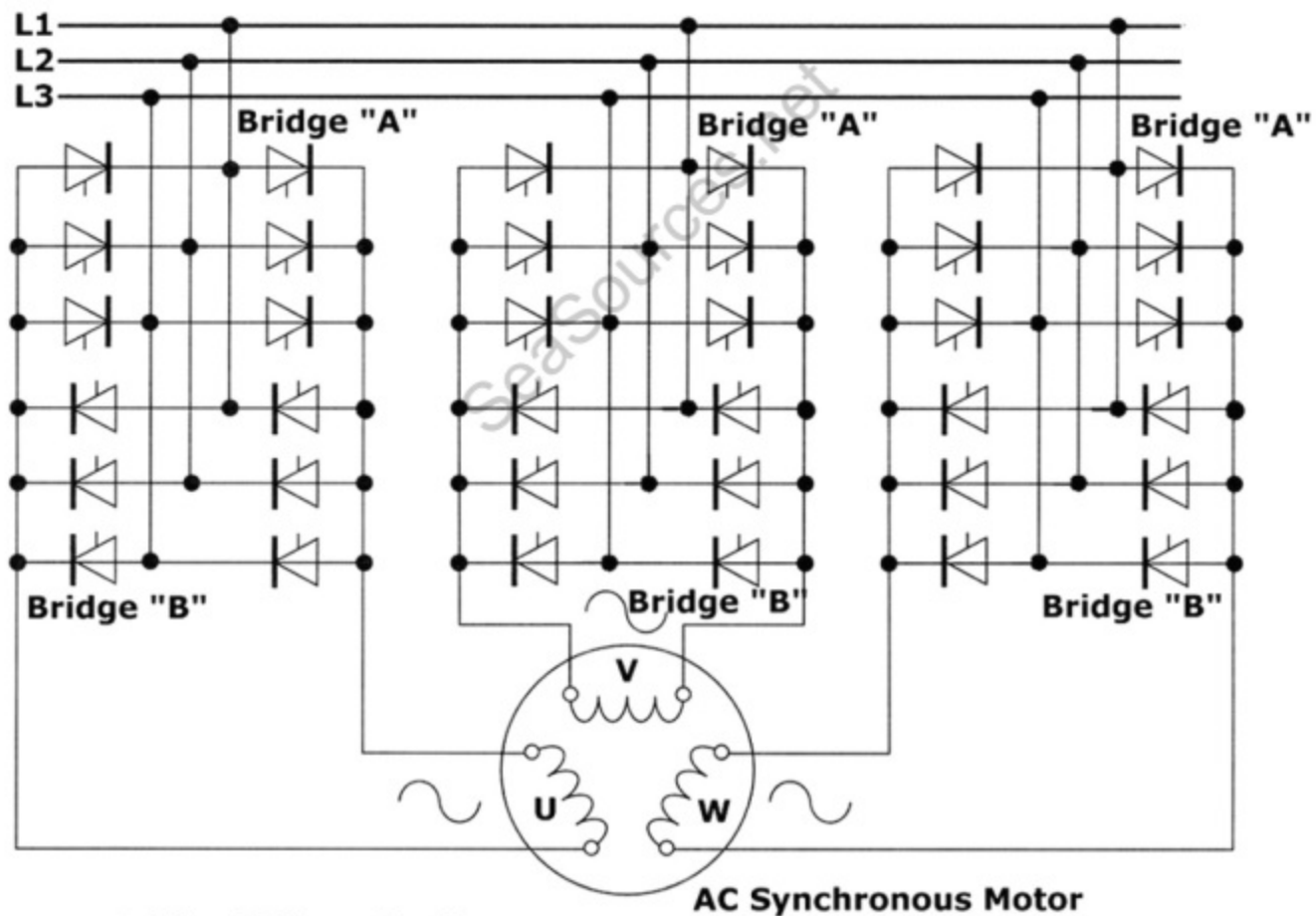
**C****D****E****F**



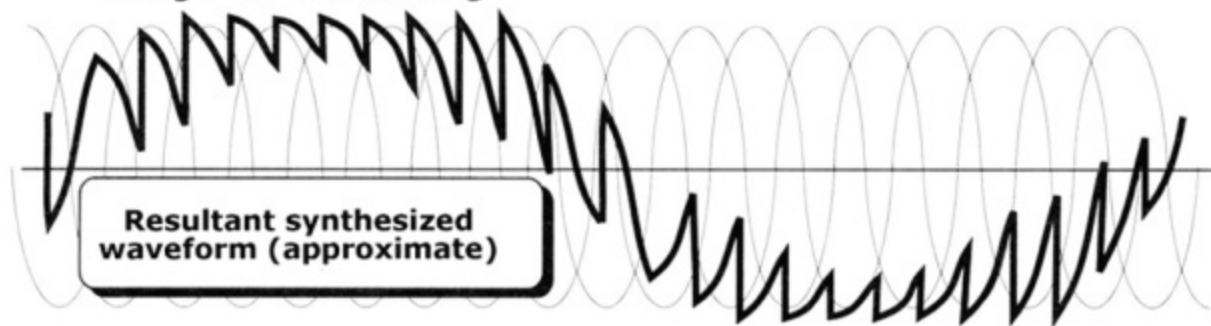
EL-0156



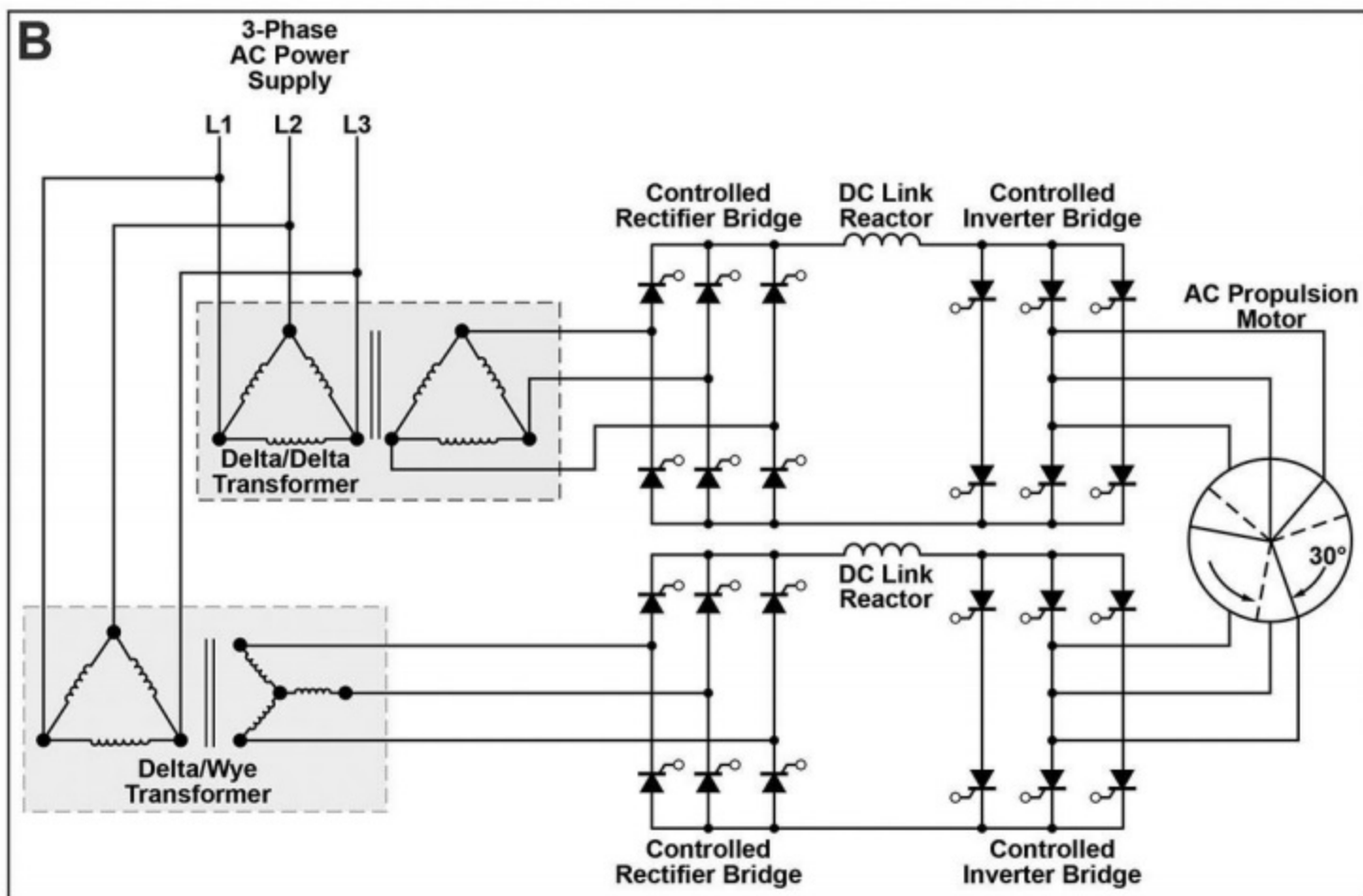
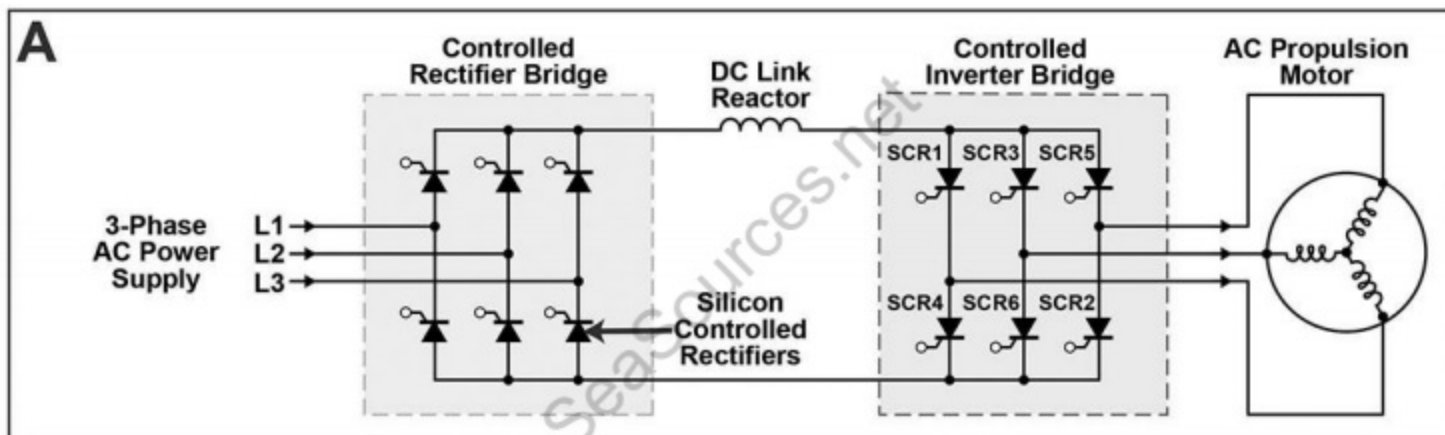
EL-0157



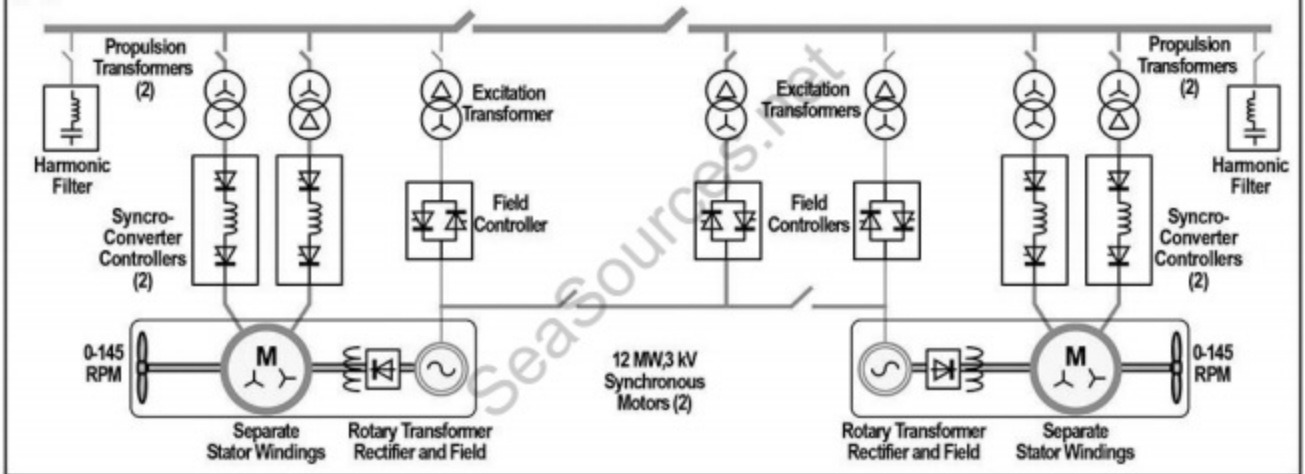
Bridge "A" conducting



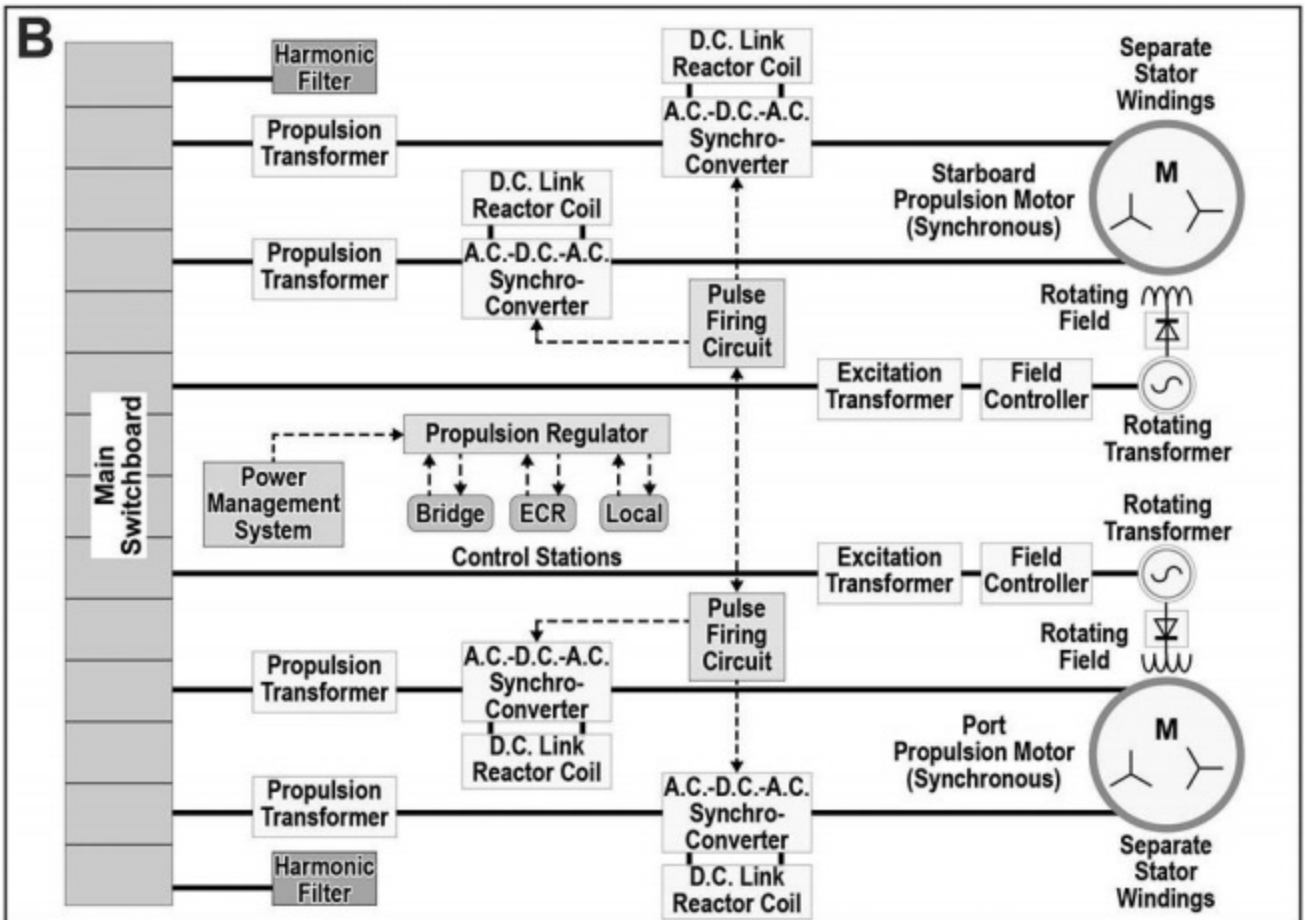
Bridge "B" conducting



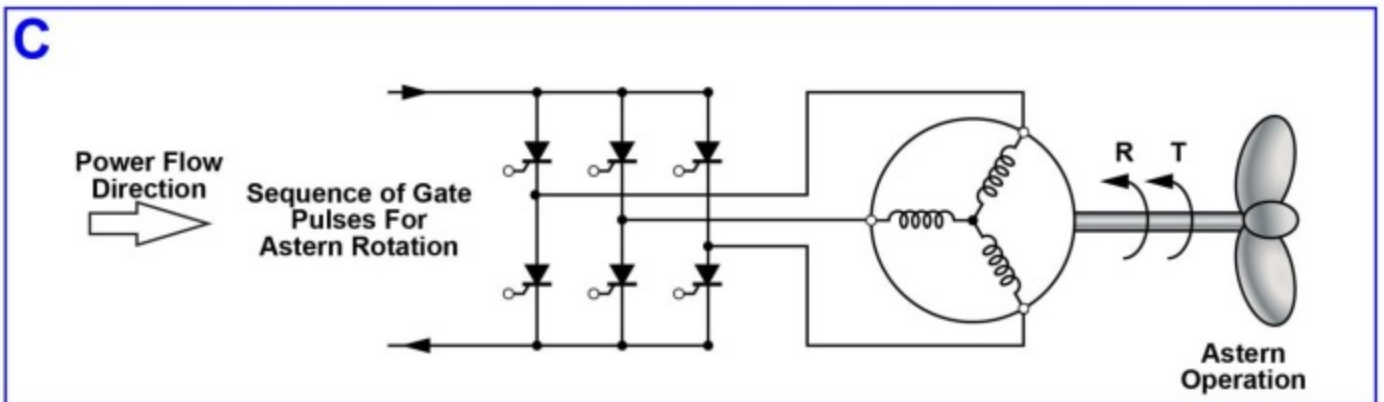
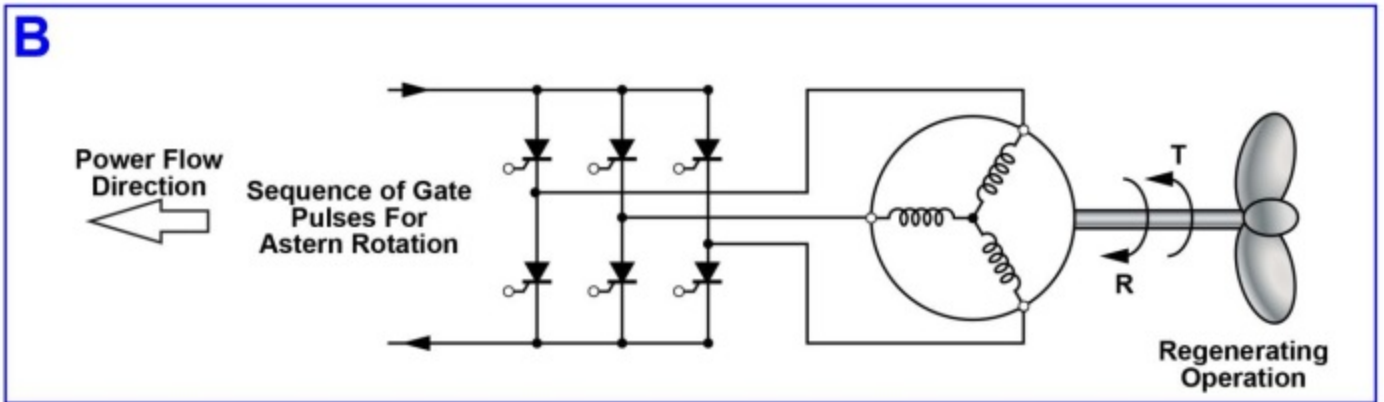
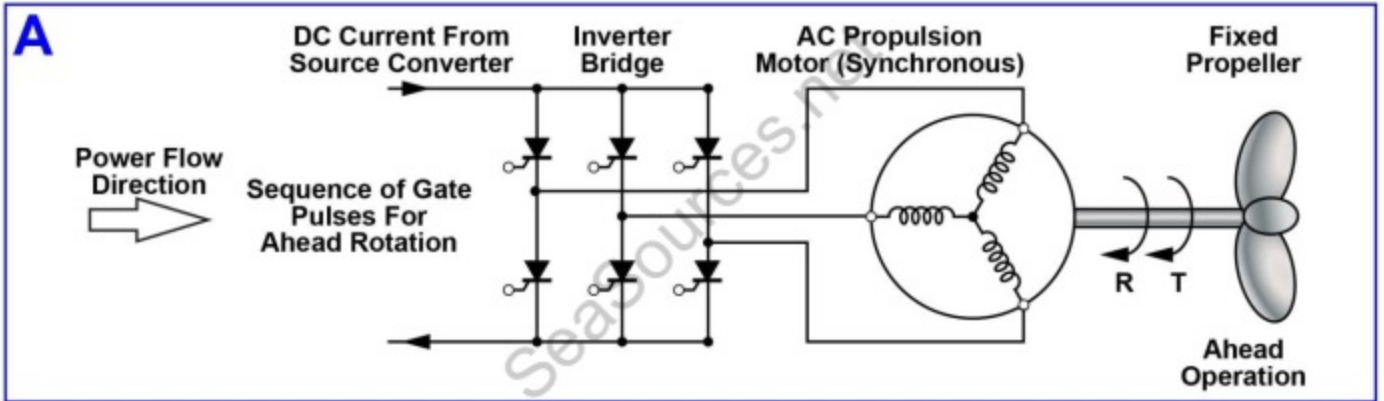
A



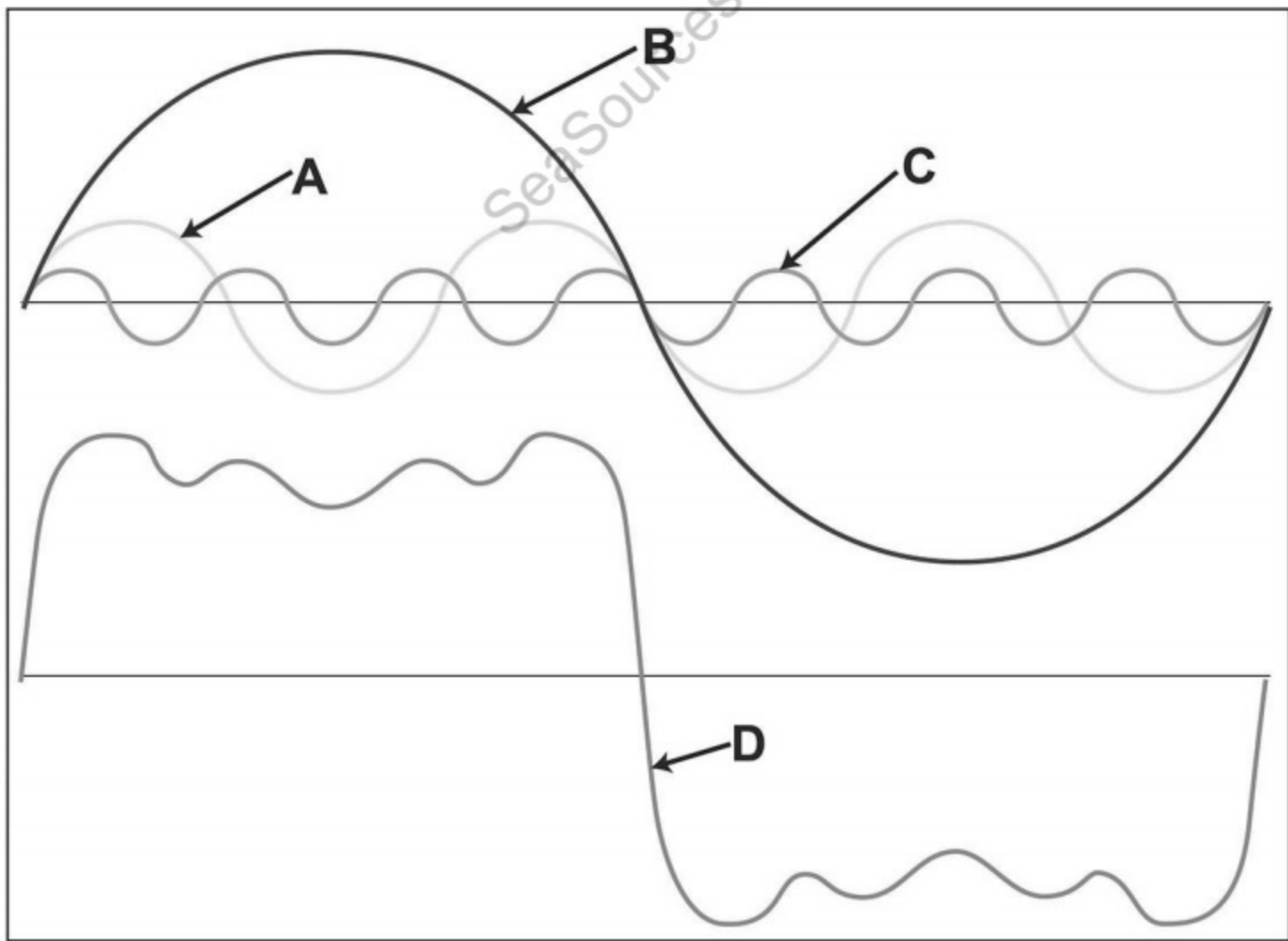
B



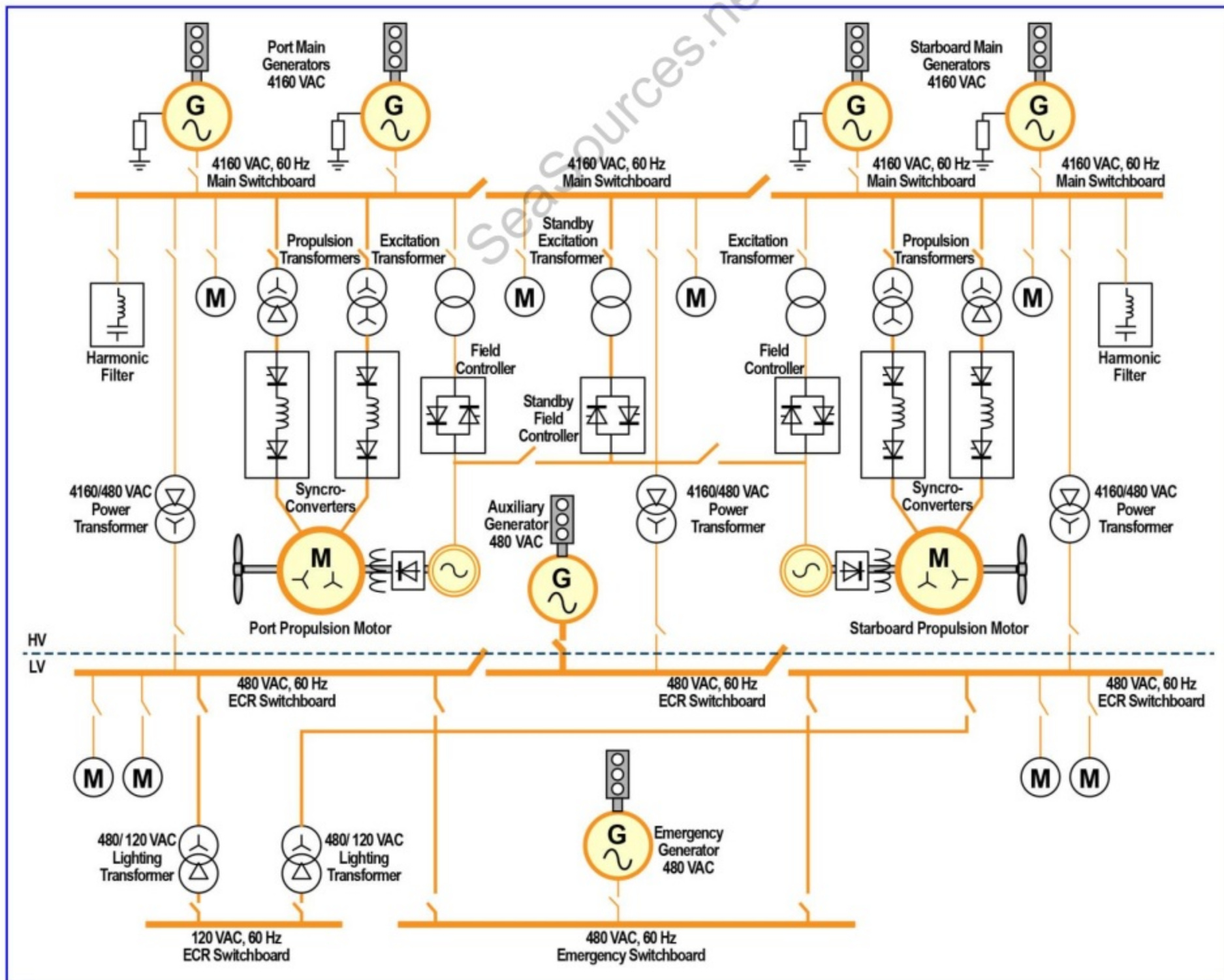
EL-0162

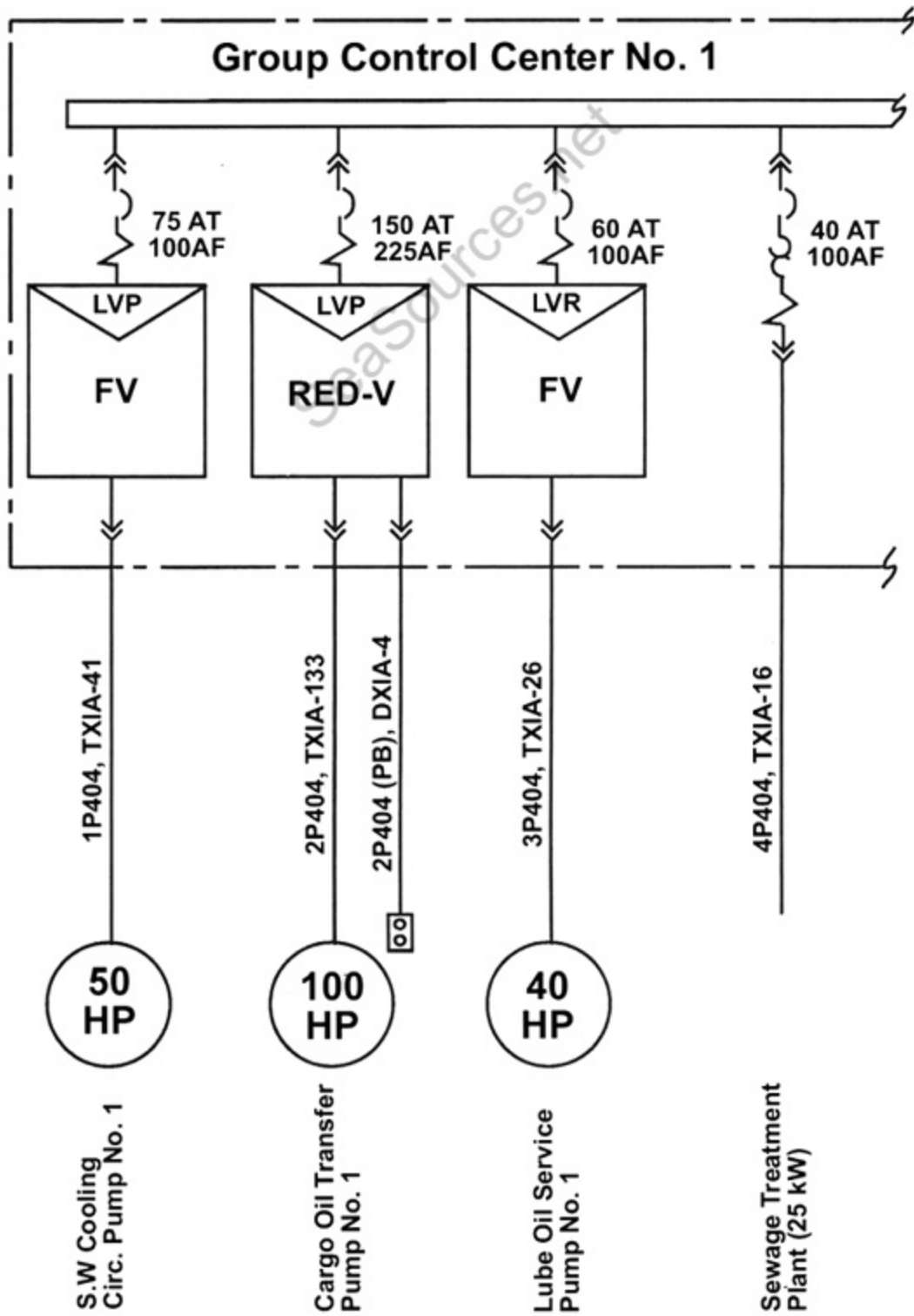


Where R = Direction of Actual Rotation
T = Direction of Applied Torque

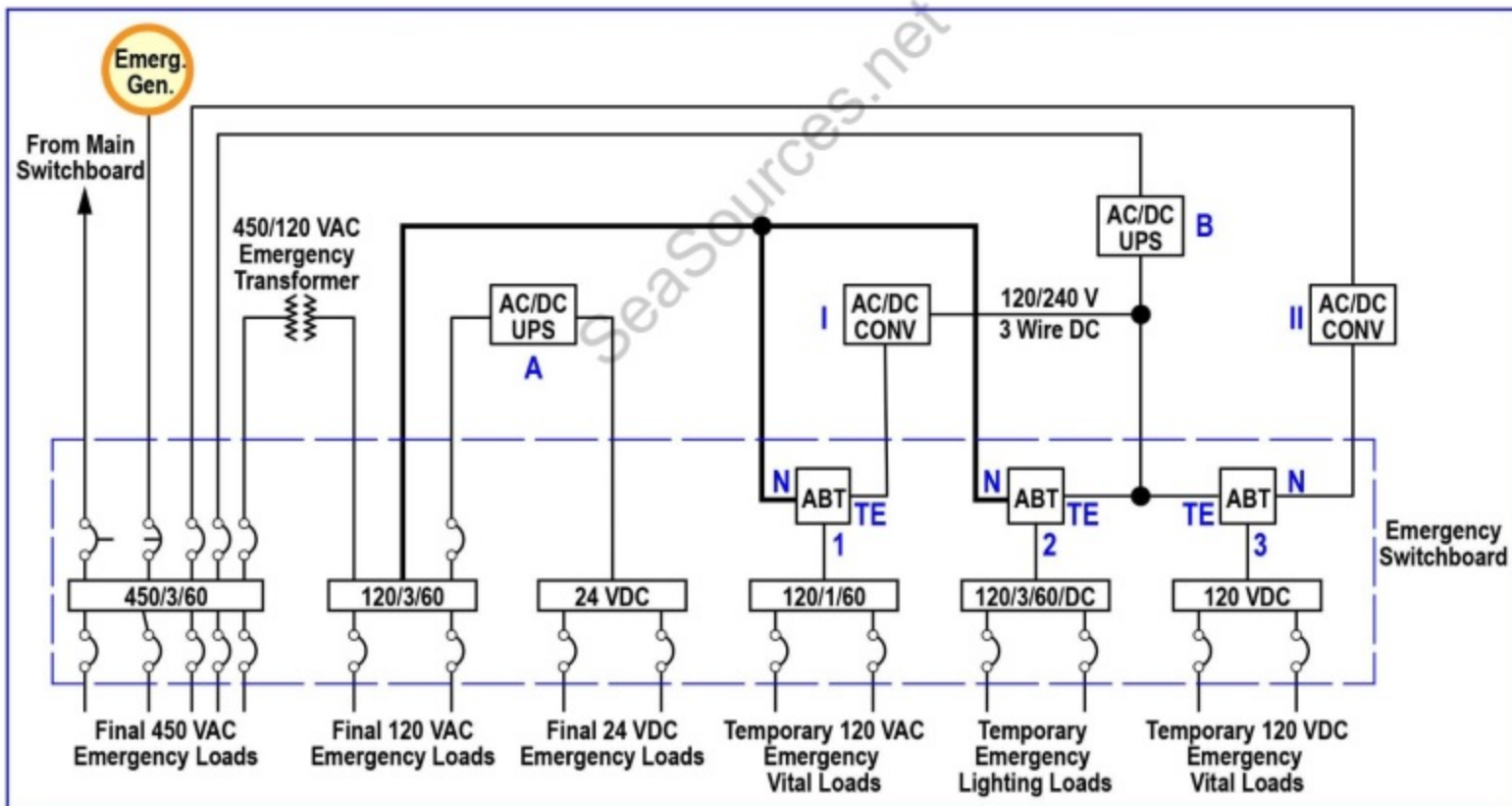


EL-0164





EL-0166



Legend:

UPS: Uninterruptible Power Supply (Including Battery)

A - 120 VAC to 24 VDC

B - 450 VAC to 120/240 VDC

ABT: Automatic Bus Transfer Switch

1 - Transfers Vital AC Loads to UPS (B) via DC/AC Converter (I)

2 - Transfers Temporary Emergency Lighting to UPS (B)

3 - Transfers Vital DC Loads to UPS (B)

CONV: Converters

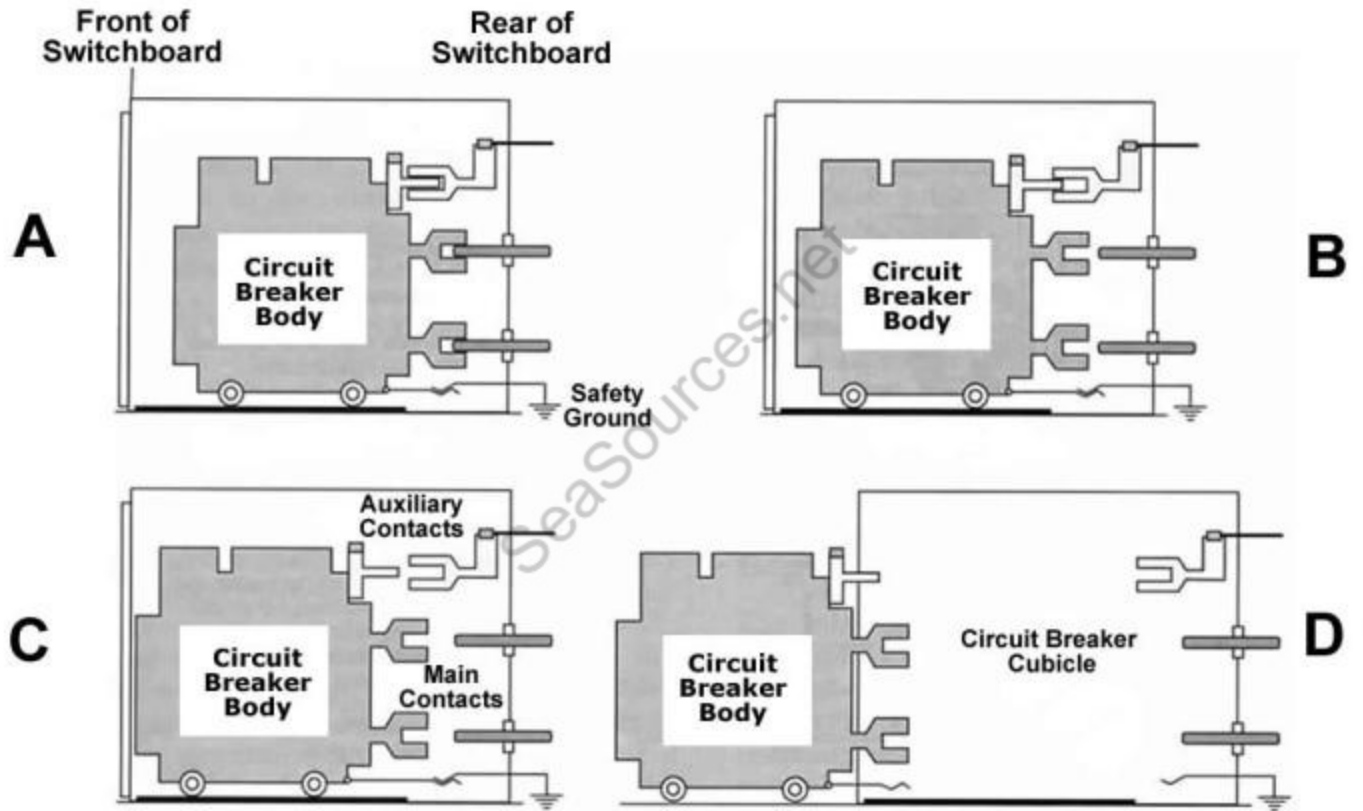
I - 240 VDC to 120 VAC

II - 450 VAC to 120 VAC

N - Normal & Final Emergency Power Source

TE - Temporary Emergency Power Source

EL-0167

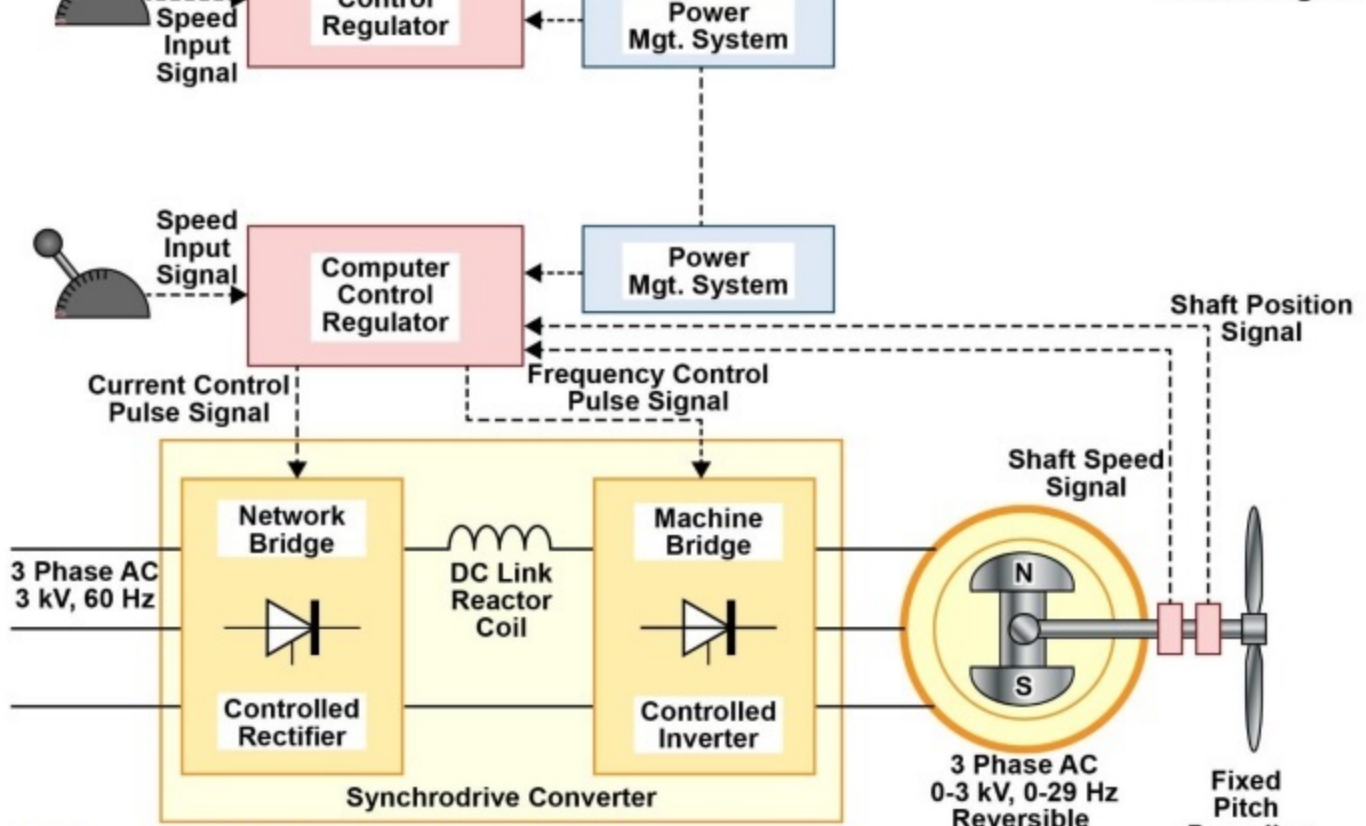
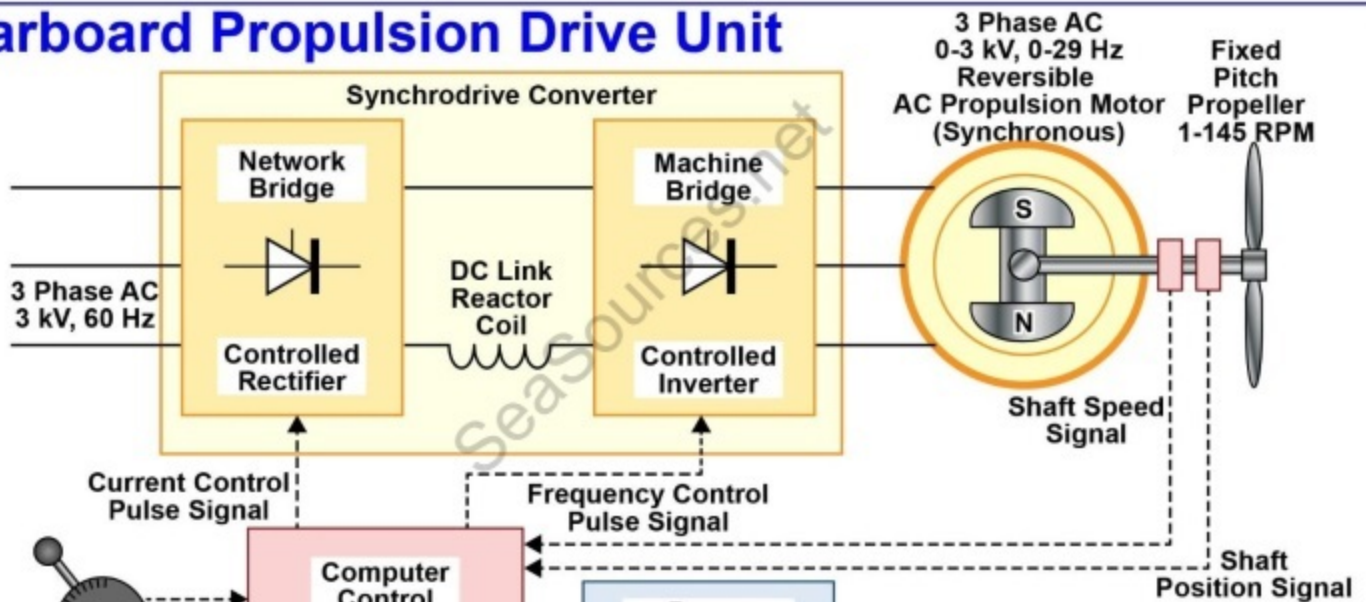


E



F

Starboard Propulsion Drive Unit



Port Propulsion Drive Unit

EL-0171

Standard Overload Relays

General Instructions for Selection of Overload Relay Heater Elements:

1. Obtain full load current and service factor from motor nameplate of from motor manufacturer. Do not estimate full-load motor current from horsepower tables.
2. Determine if 1, 2, or 3 overload relays are needed.
3. Select proper heater from appropriate table according to class, size, type of enclosure and number of overload relays being used. Full load motor currents should be within the Min.-Max. ratings shown for the number of overload relays being used.
4. The tables apply only to standard, open type or totally enclosed fan-cooled, continuous duty motors (with a service factor of 1.15 and rated for 40 degrees C rise) in applications where motor and starter are located in the same ambient temperature. For applications of other motors with a service factor of 1, 50-55 degrees C rise, totally enclosed non-ventilated, explosion proof, or for installations where ambient temperatures of motor and starter are different, refer to Chart "A" for selection of overload heater units.

Chart A: Variations by Operating Conditions

Motor continuous rating °C rise	Ambient temperature same at starter and motor	Ambient temperature higher at starter than at motor	Ambient temperature lower at starter than at motor
1.5 service factor 40° C rise	As specified from tables	One size larger than specified for each 15° C difference	One size smaller than specified for each 15° C difference
1.0 service factor 50-55° C rise	One size smaller than for 1.15 service factor as above	One size smaller than for 1.15 service factor as above	One size smaller than for 1.15 service factor as above

**Table 24: NEMA Size 6 for all Standard Enclosures
Three Overload Relays per Starter**

Heater Cat. No	Motor Current	
	Min.	Max.
G30T19	142	157
G30T20	158	171
G30T21	172	188
G30T22	189	207
G30T23	208	229

Heater Cat. No	Motor Current	
	Min.	Max.
G30T24	230	252
G30T25	253	277
G30T26	278	306
G30T27	307	336
G30T28	337	368

Heater Cat. No	Motor Current	
	Min.	Max.
G30T29	369	405
G30T30	406	459
G30T31	460	480

ENERGY EFFICIENT

MADE IN U.S.A.

XE

**DUTY MASTER
A-C MOTOR**

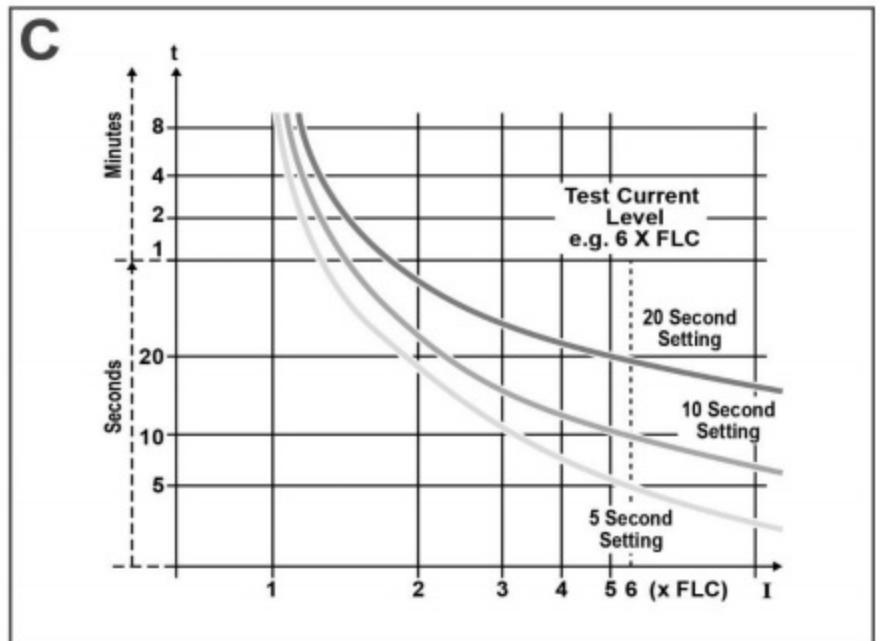
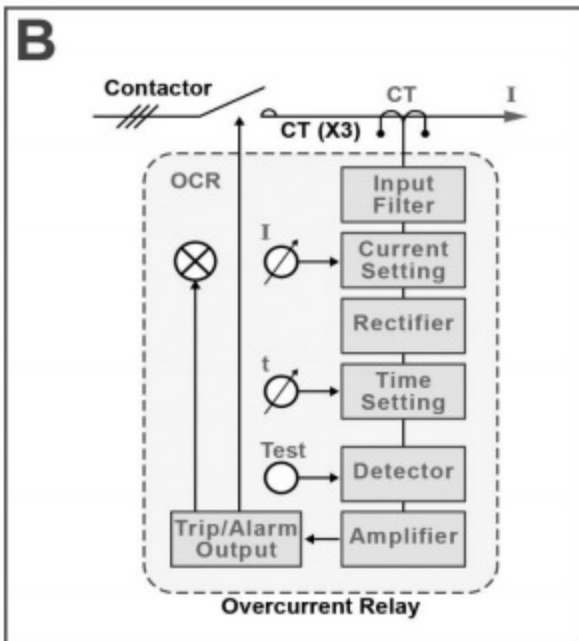
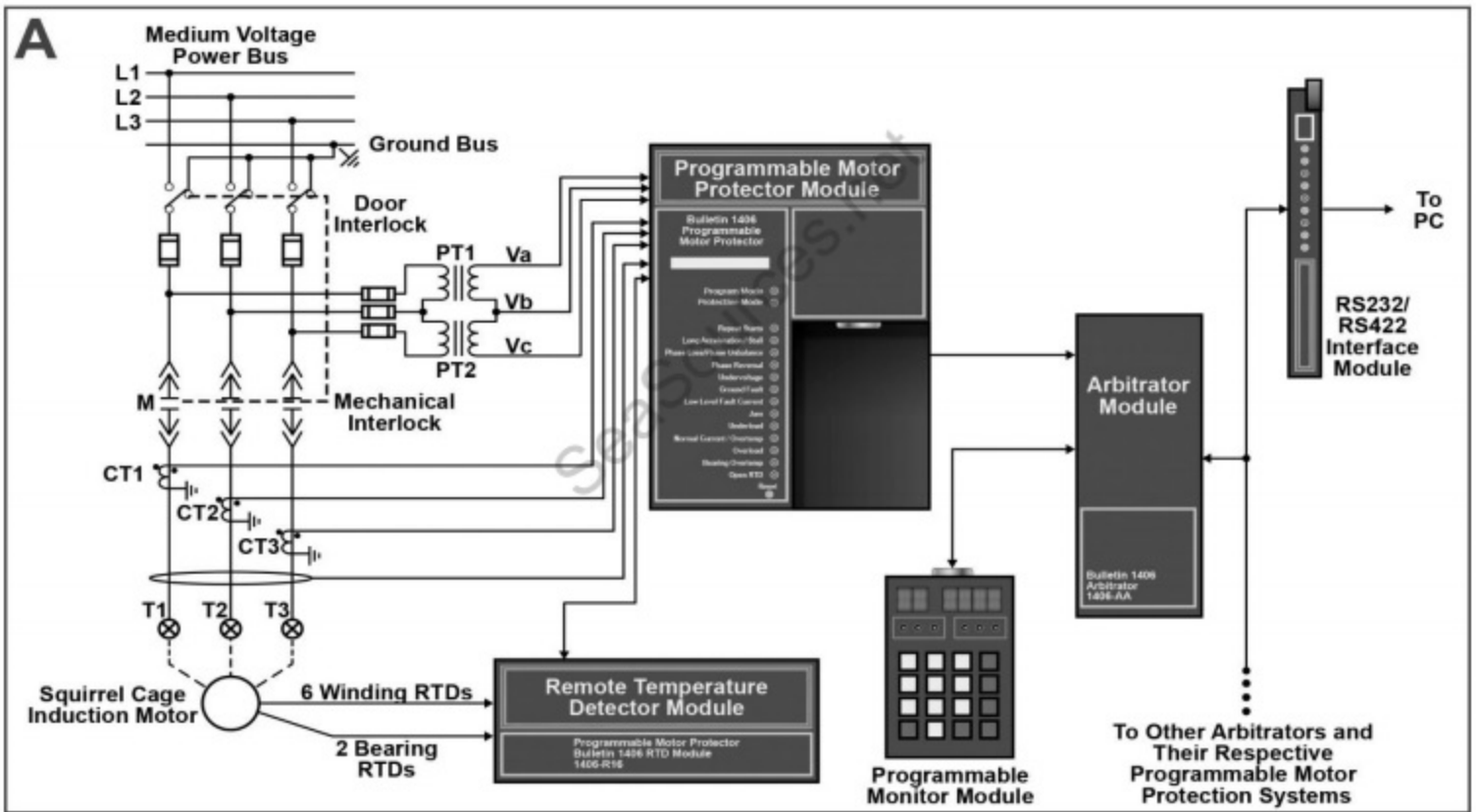
NEMA NOM. EFFICIENCY	96.2 %
GUARANTEED EFFICIENCY	95.8 %
POWER FACTOR	89.7
MAX. CORR. KVAR.	17.5

RELIANCE

FRAME		TYPE		DESIGN
445T		P	B	
IDENT. NO. P44G520A-G1-XJ				
HP 150	VOLTS	460		
RPM 1785	AMPS	163		
AMB 40 °C	DUTY	CONT		
HZ 60	ALTERNATIVE RATING			
	AMB °C	S.F.	ALTITUDE	
S.F. 1.15	40	1.00	9000	
ENCL. TEFC	50	1.00	3300	
PHASE 3	CODE G	INS. CLASS	F	
		90BC03X30X26		
OPP. D.E. BEARING		90BC03X30X26		

RELIANCE ELECTRIC COMPANY/CLEVELAND, OHIO 44117

613-6-GZ



EL-0175

Code Letters for Locked-Rotor kVA-Nameplate Marking*

Letter Designation	kVA per Horsepower	Letter Designation	kVA per Horsepower
A	0-3.15	K	8.0-9.0
B	3.15-3.55	L	9.0-10.0
C	3.55-4.0	M	10.0-11.2
D	4.0-4.5	N	11.2-12.5
E	4.5-5.0	P	12.5-14.0
F	5.0-5.6	R	14.0-16.0
G	5.6-6.3	S	16.0-18.0
H	6.3-7.1	T	18.0-20.0
J	7.1-8.0	U	20.0-22.4
		V	22.4 and up

*Locked kVA per horsepower range includes the lower figure up to, but not including, the higher figure. For example, 3.14 is designated by letter A and 3.15 by letter B.


To determine kVA per HP, use the following formula:

kVA/HP where:

$$\text{kVA} = (\text{Rated volts} \times \text{inrush current} \times 1.732 \text{ (square root of 3)}) / 1000$$

HP = Nameplate HP

This is a better way to compare the inrush current of different manufacturer's motors than % inrush current; the reason being that if a motor has a high full load current, the % inrush will be lower than a motor with the same inrush current but a lower full load current.

• WESTINGHOUSE •								
TYPE CSP		 INDUCTION MOTOR			CLASS 1			
FRAME	254				60 CYCLE		LOCKED KV-A CODE H	
H. P.	5				STYLE 1442438		SERIAL 6406	
3 PHASE								
60 CYCLE		50 CYCLE		CONNECT FOR HIGHER VOLTAGE		CONNECT FOR LOWER VOLTAGE		
220/440	VOLTS			T4 T7 T5 T8 T6 T9	T4 T5 T6			
13.8/6.9	AMPS. PER LINE			↓ ↓ ↓	↓ ↓ ↓			
1750	R. P. M.			T1 T2 T3	T1 T7 T2 T8 T3 T9			
55	"C" RISE CONT.				↑ ↑ ↑			
				LINE		LINE		
45577-B		WESTINGHOUSE ELECTRIC CORPORATION			MADE IN U. S. A.			

EL-0176



A



B



C

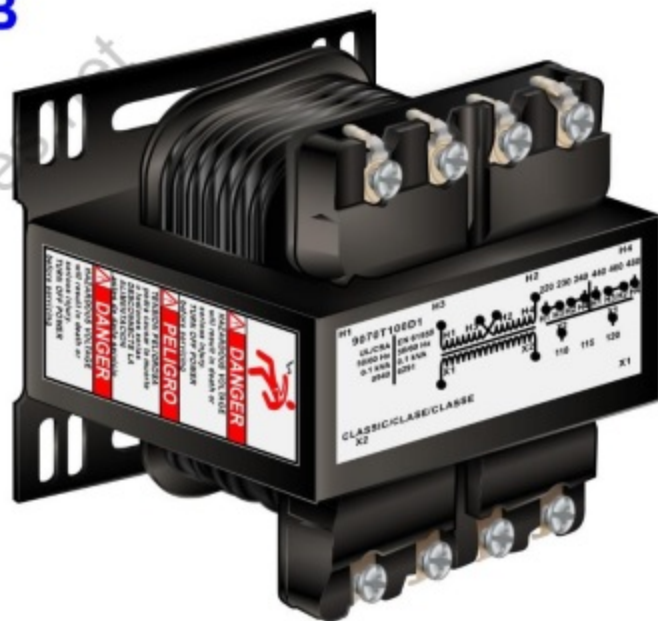


D

A



B



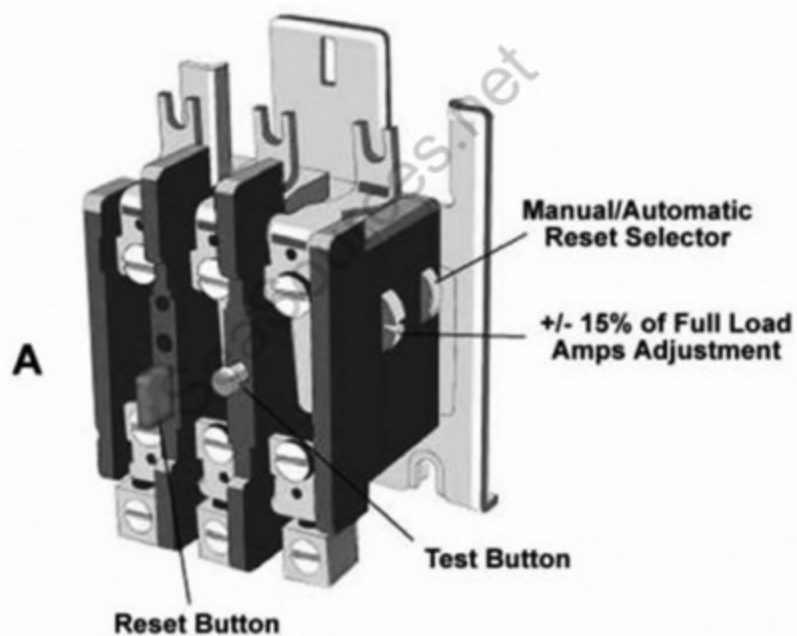
C



D



EL-0178

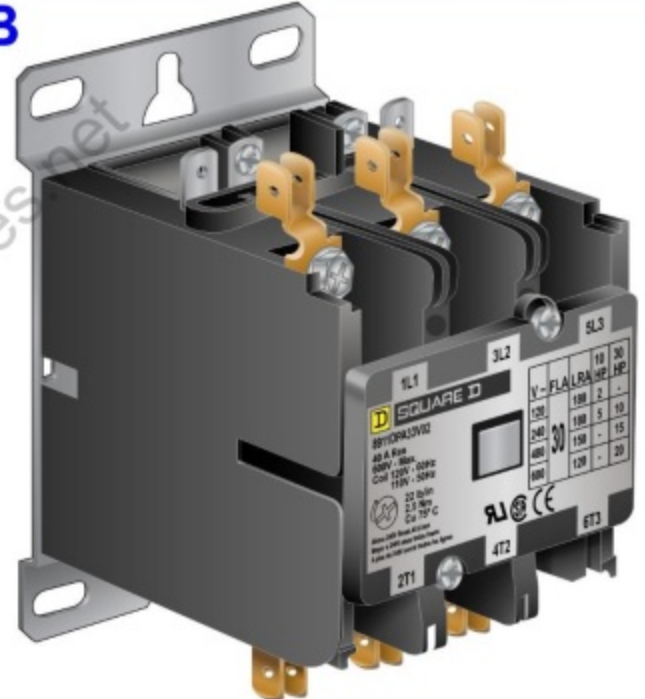


EL-0179

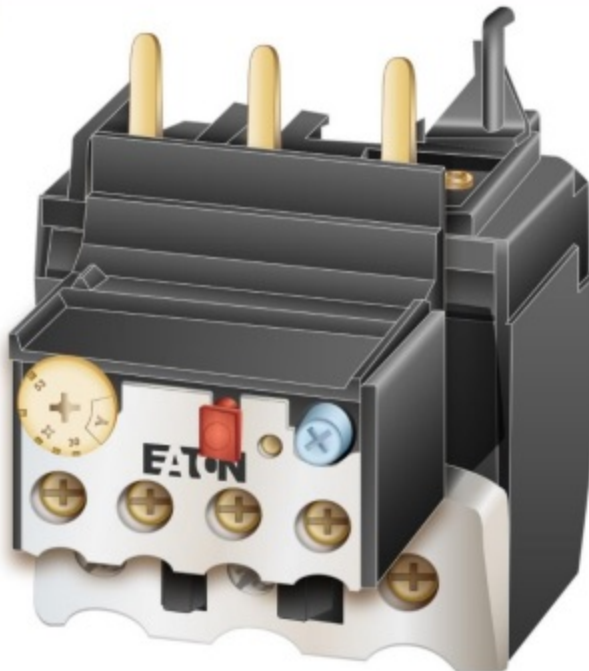
A



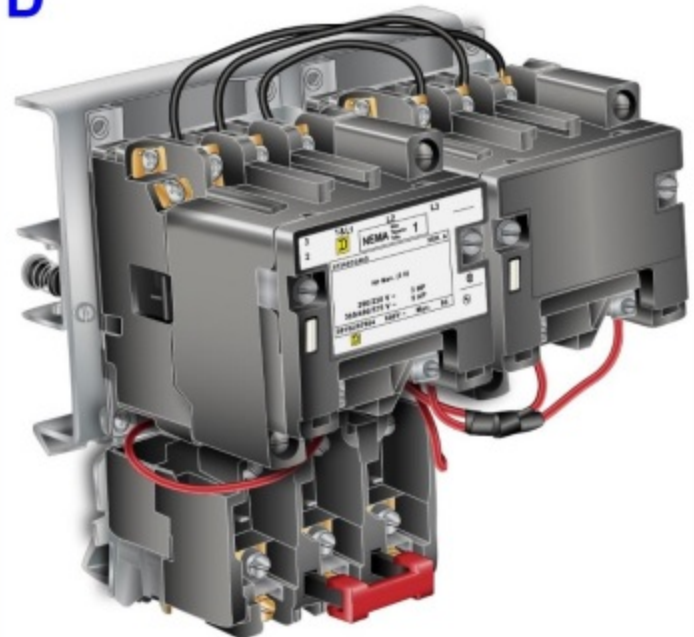
B



C



D

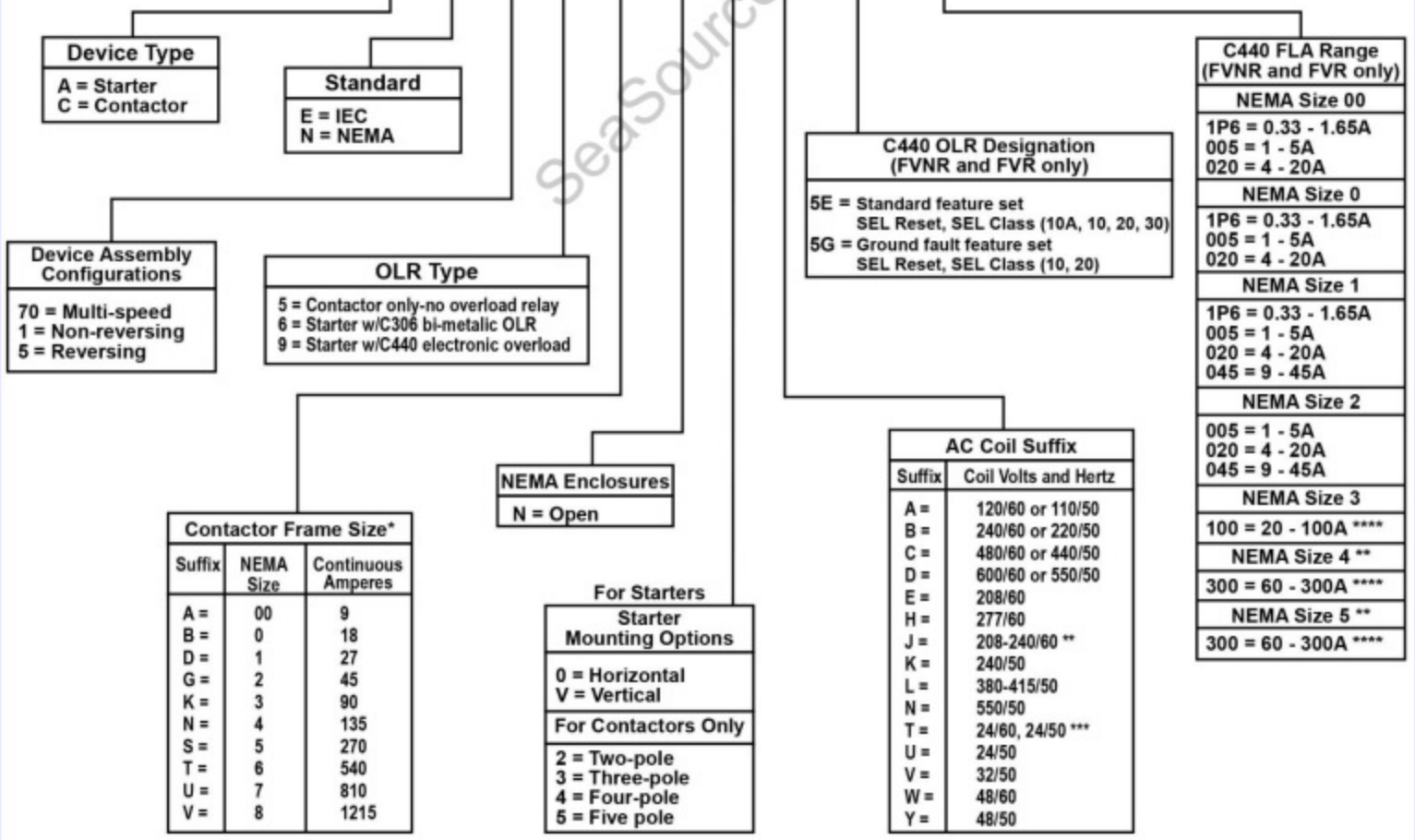


EL-0180

Catalog Number Selection Chart

Example Catalog Number

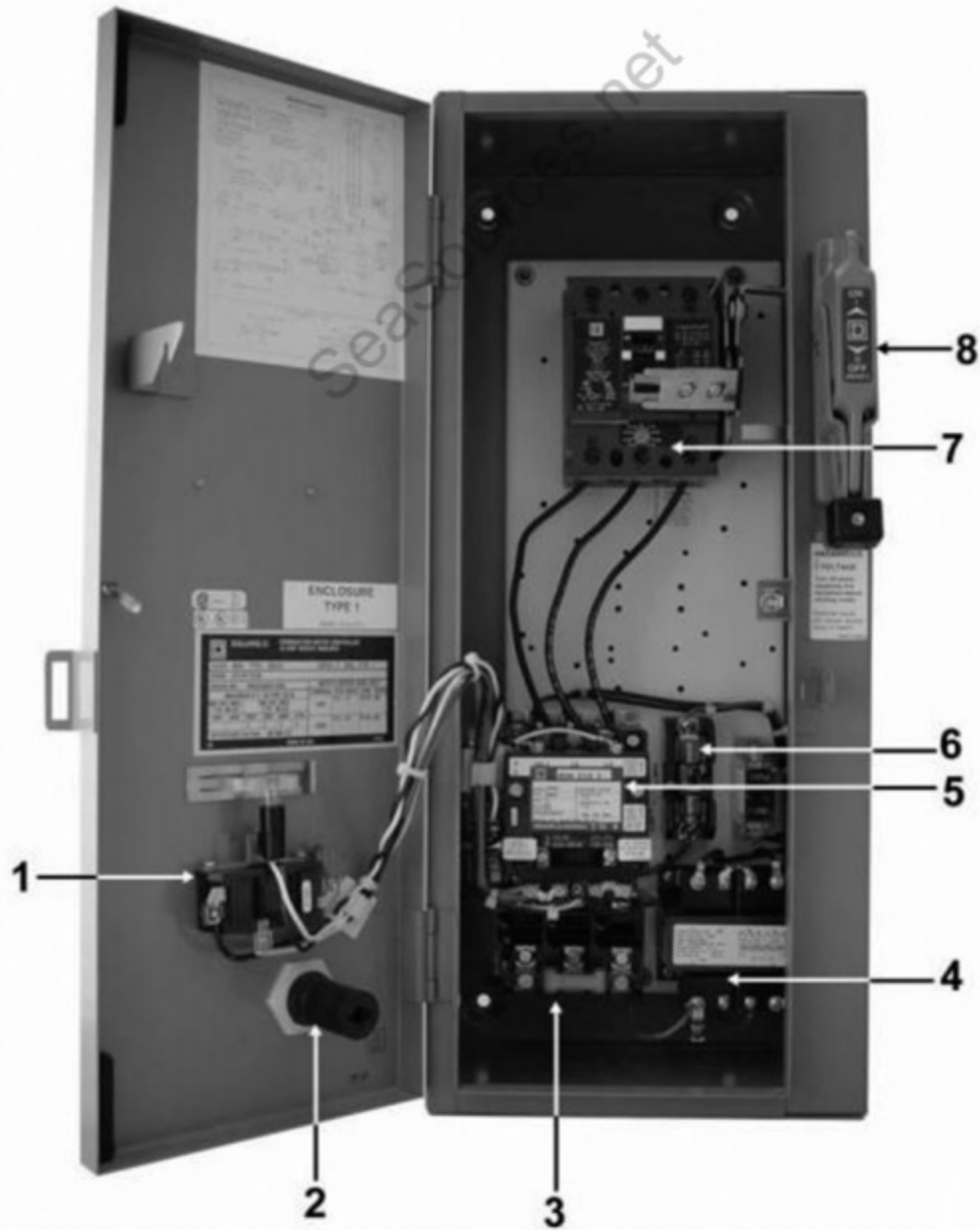
A N 1 9 A N 0 A 5E 005

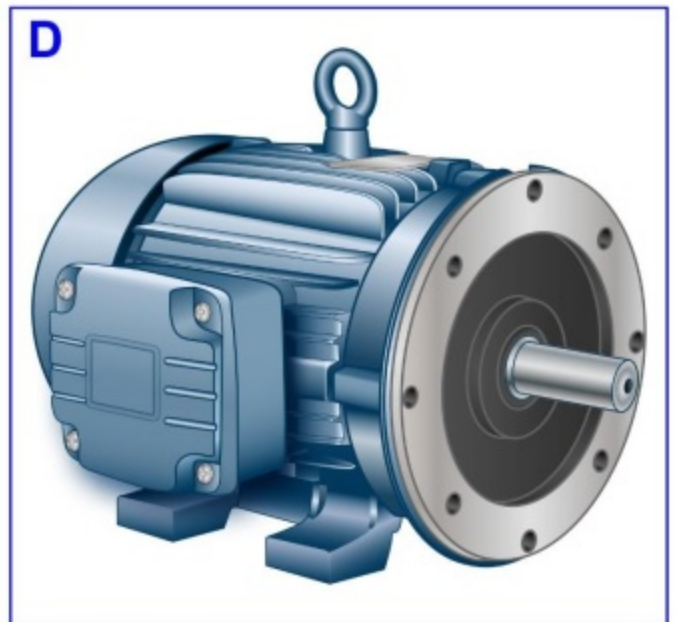
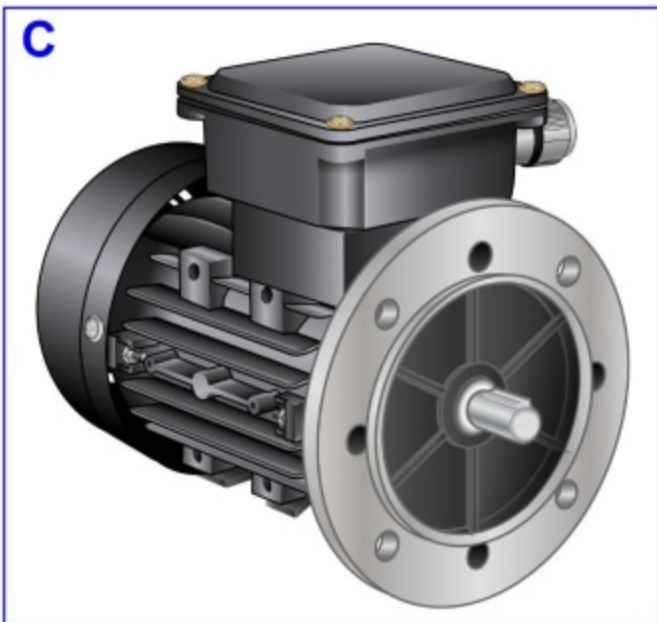
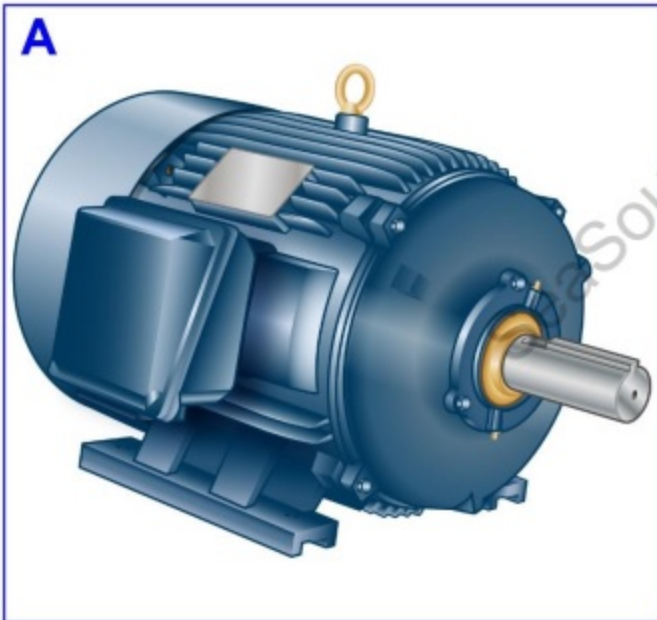


NOTES:

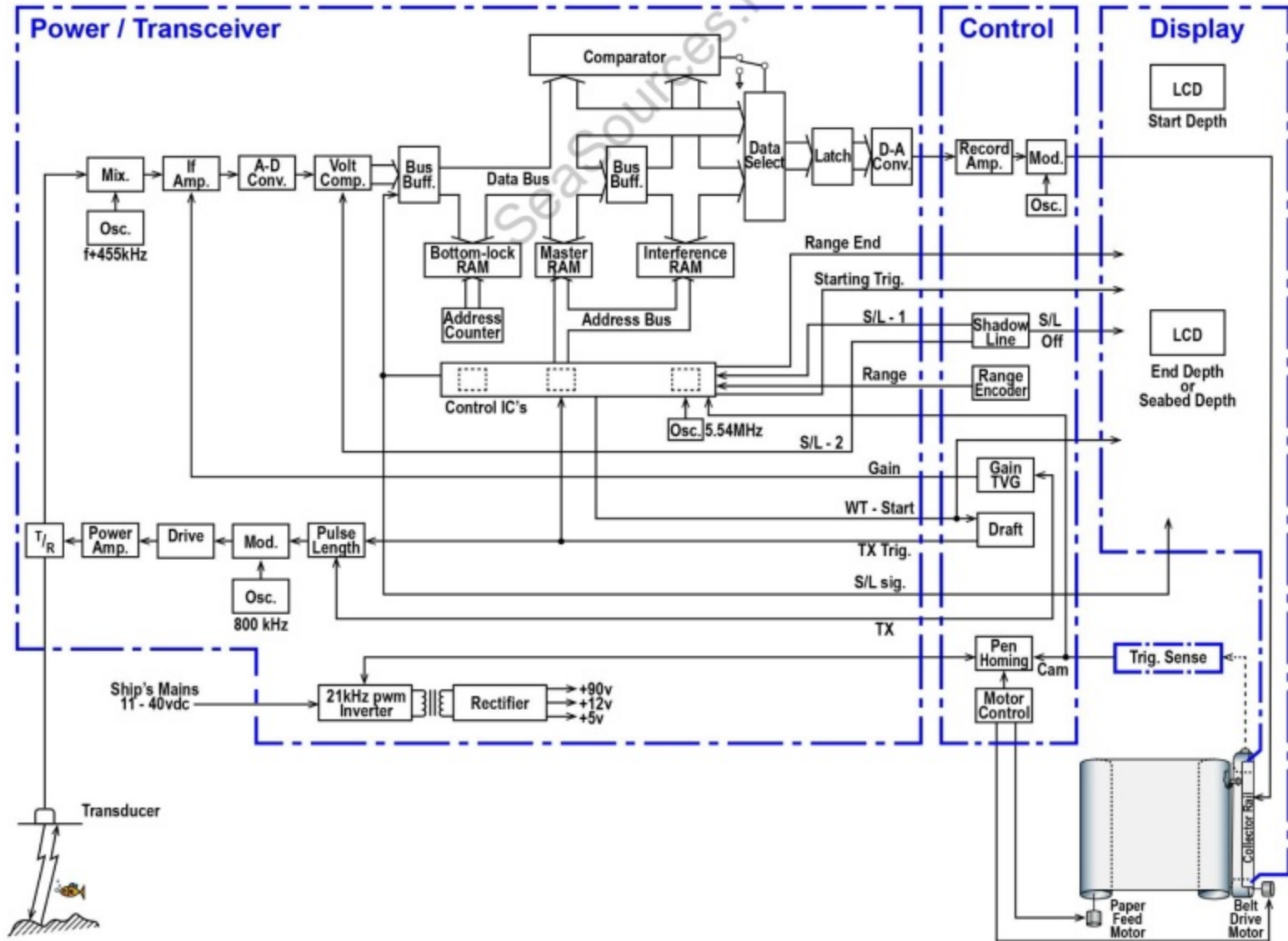
- * For contactor only orders, add B to end of catalog number if NEMA size 00-2, 6.
- ** NEMA sizes 00 and 0 only.
- *** NEMA sizes 00 and 0 only. Sizes 1-8 are 24/60 only.
- **** NEMA sizes 4 and 5 require the use of CTs with 1 - 5A OL relay. Size 4 starters are not shipped as assembled units. Order CN15NN01 contactor 1 - 5A OL (C440A1A005SAX or C440A2A 005SAX) with 60 - 300A CTs (ZEB-XCT300).

EL-0181

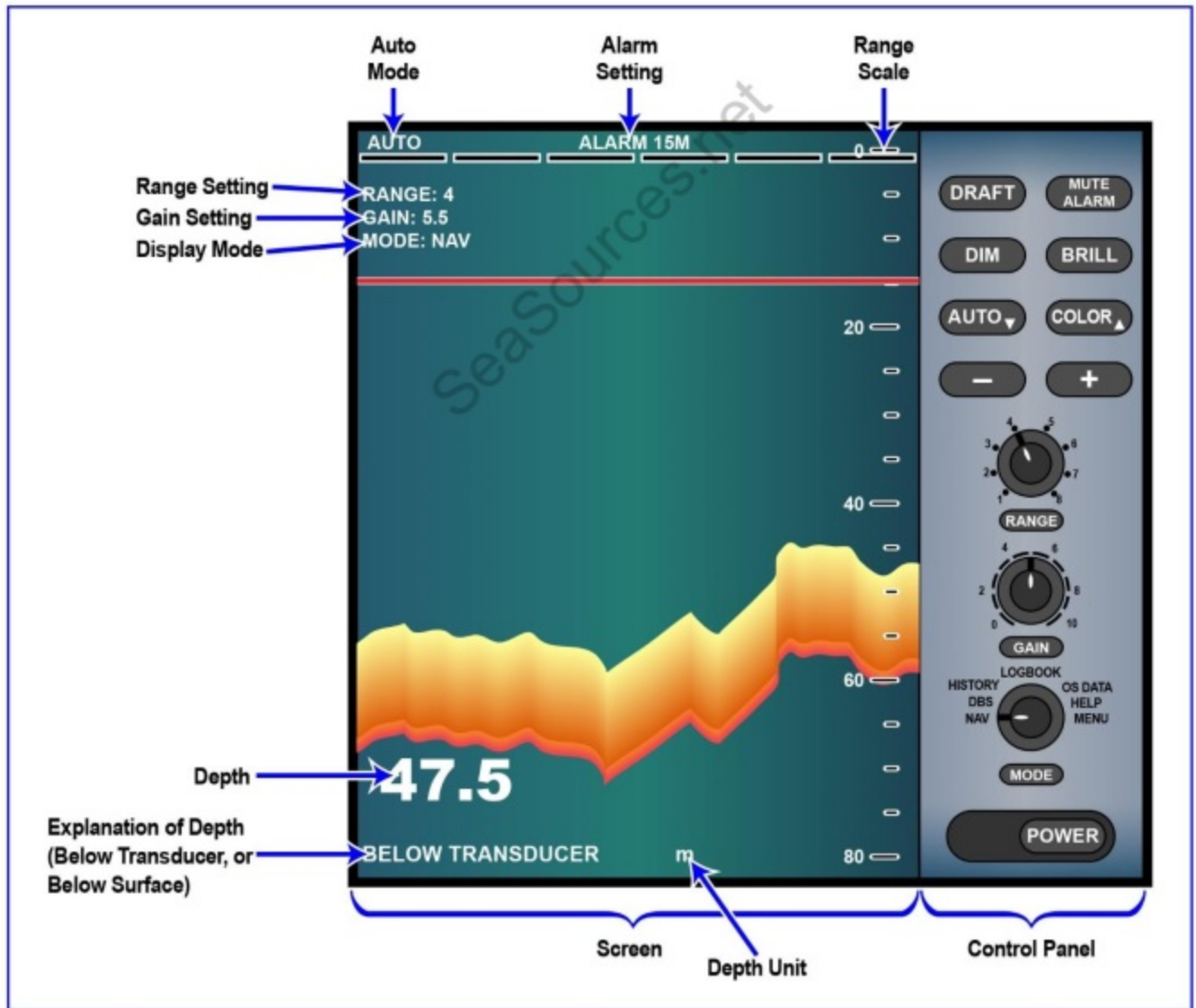




EL-0185 Digitized Echo Sounding System



EL-0186



Echo Sounder Range vs. Pulse Length vs. PRF

Depth (Meters)	Pulse Length (ms)	PRF (Pulses Per Minute)
5, 10 and 20	0.25	750
40	0.38	375
100	1.00	160
200	2.00	75
400 and 800	3.60	42

Sea Bed Consistency and Attenuation

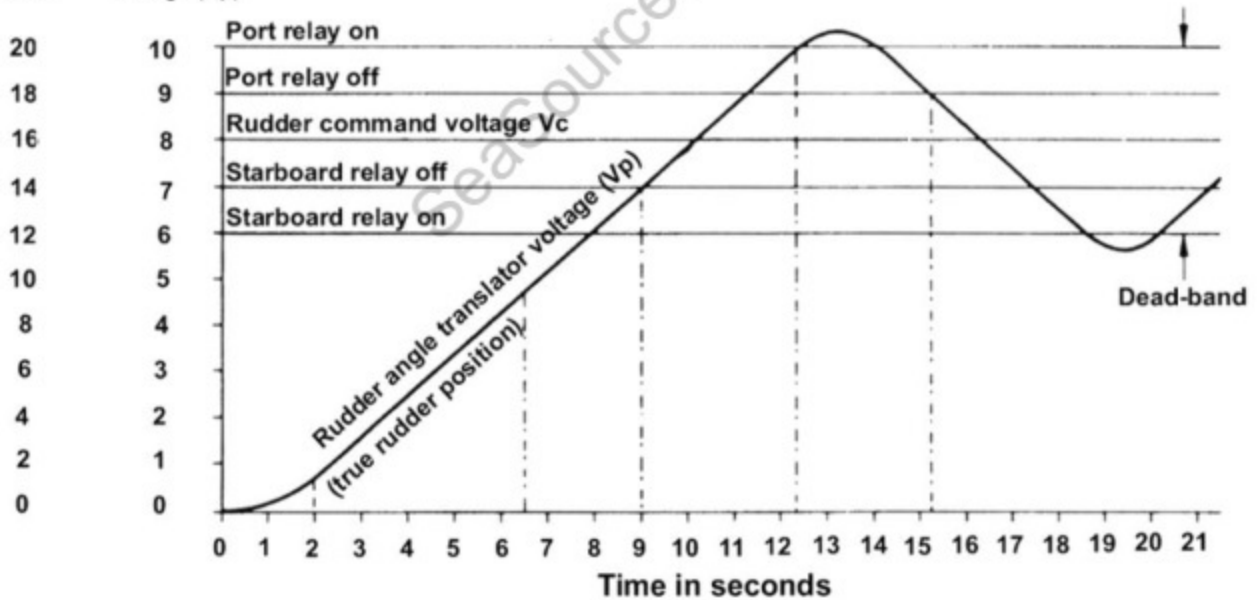
Consistency	Attenuation (dB)
Soft mud	15
Mud / sand	9
Sand / mud	6
Sand	3
Stone / rock	1

EL-0188

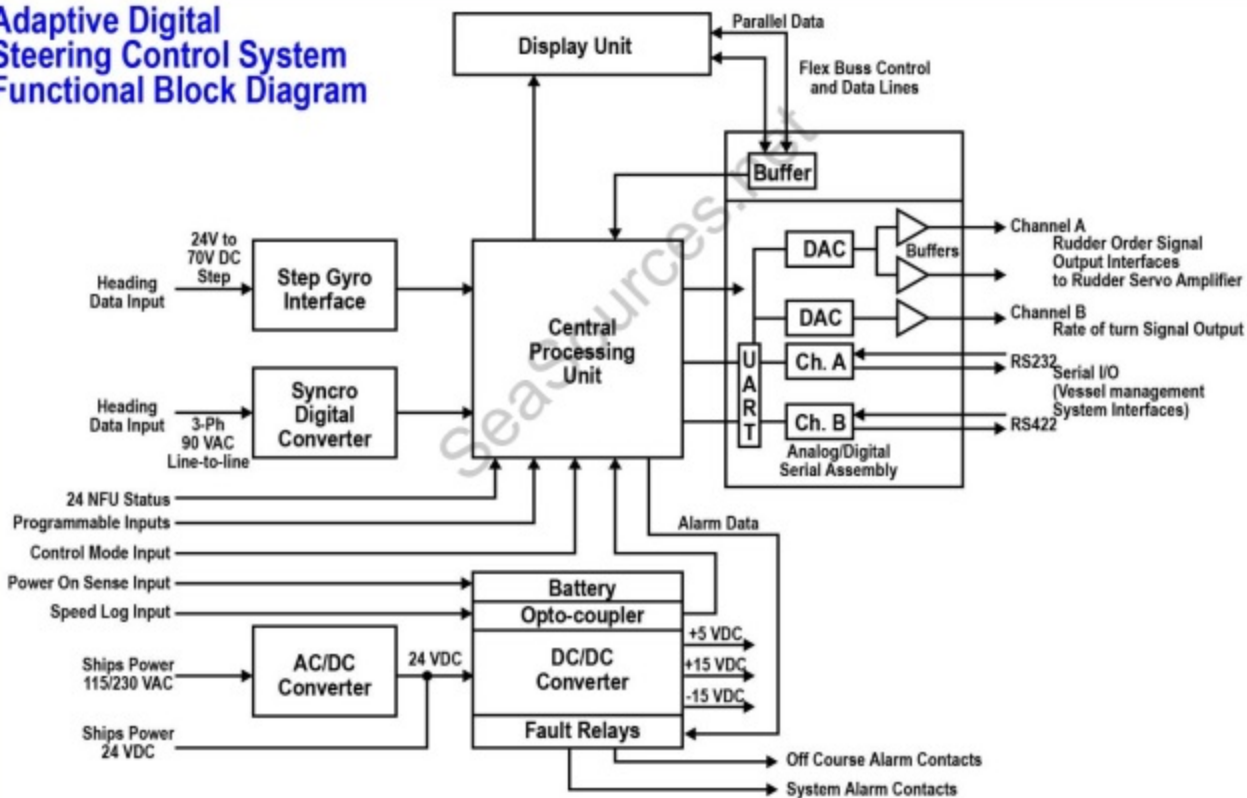
Rudder angle in degrees with respect to midships position

Corresponding rudder angle translator voltage (V_p)

Effect of Overshoot on Control System Stability



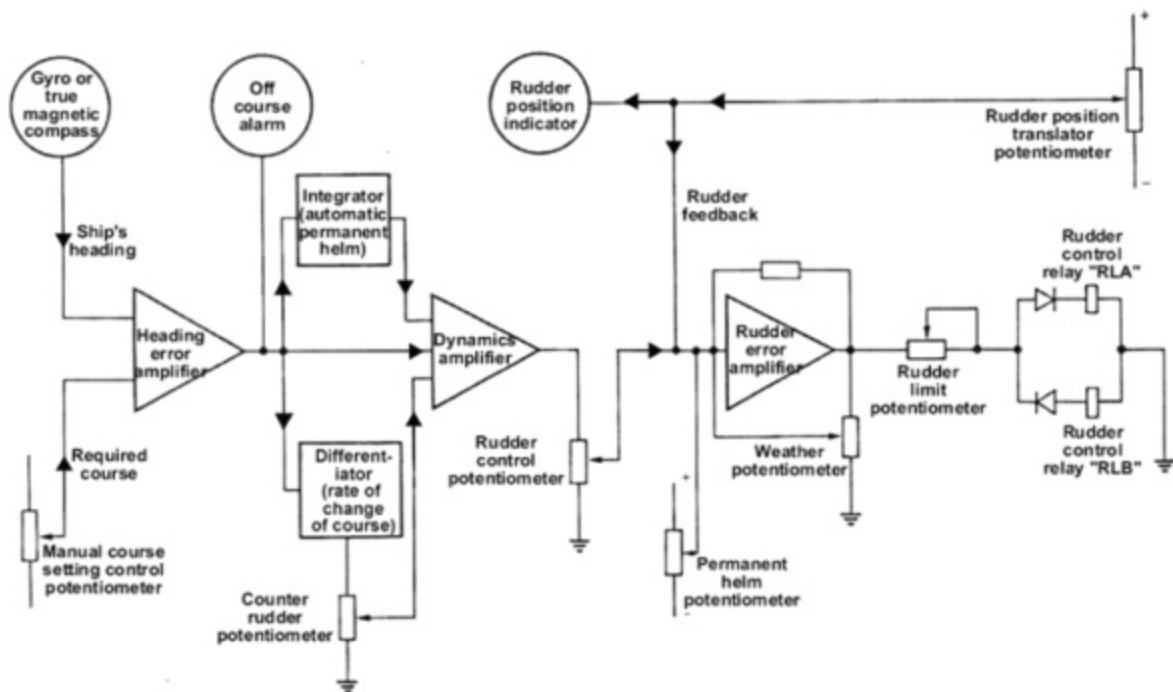
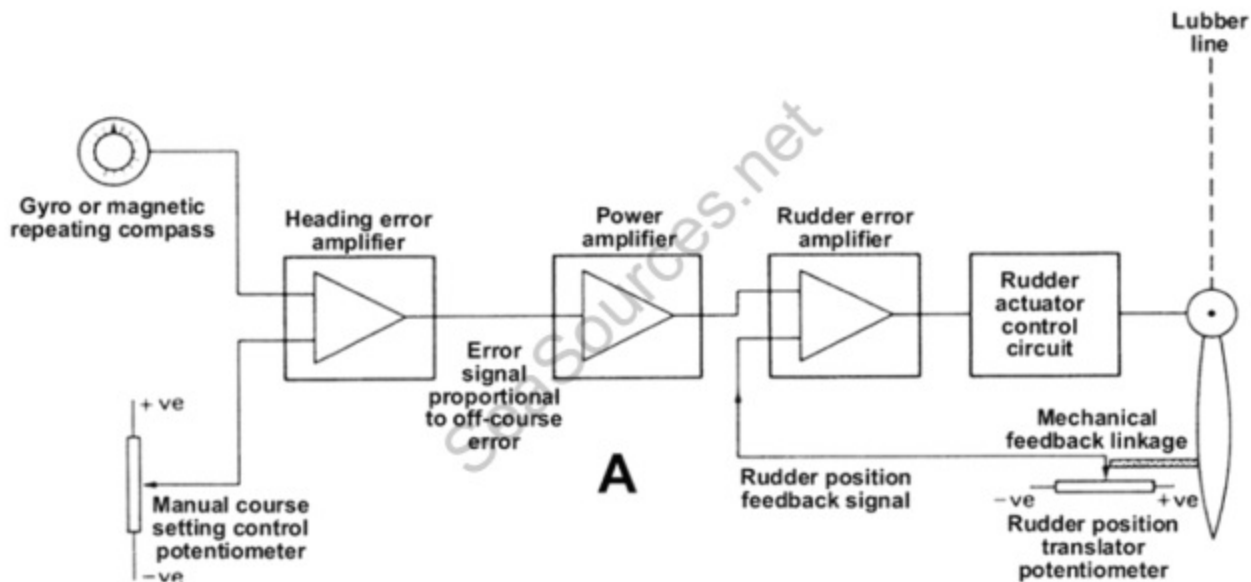
Adaptive Digital Steering Control System Functional Block Diagram



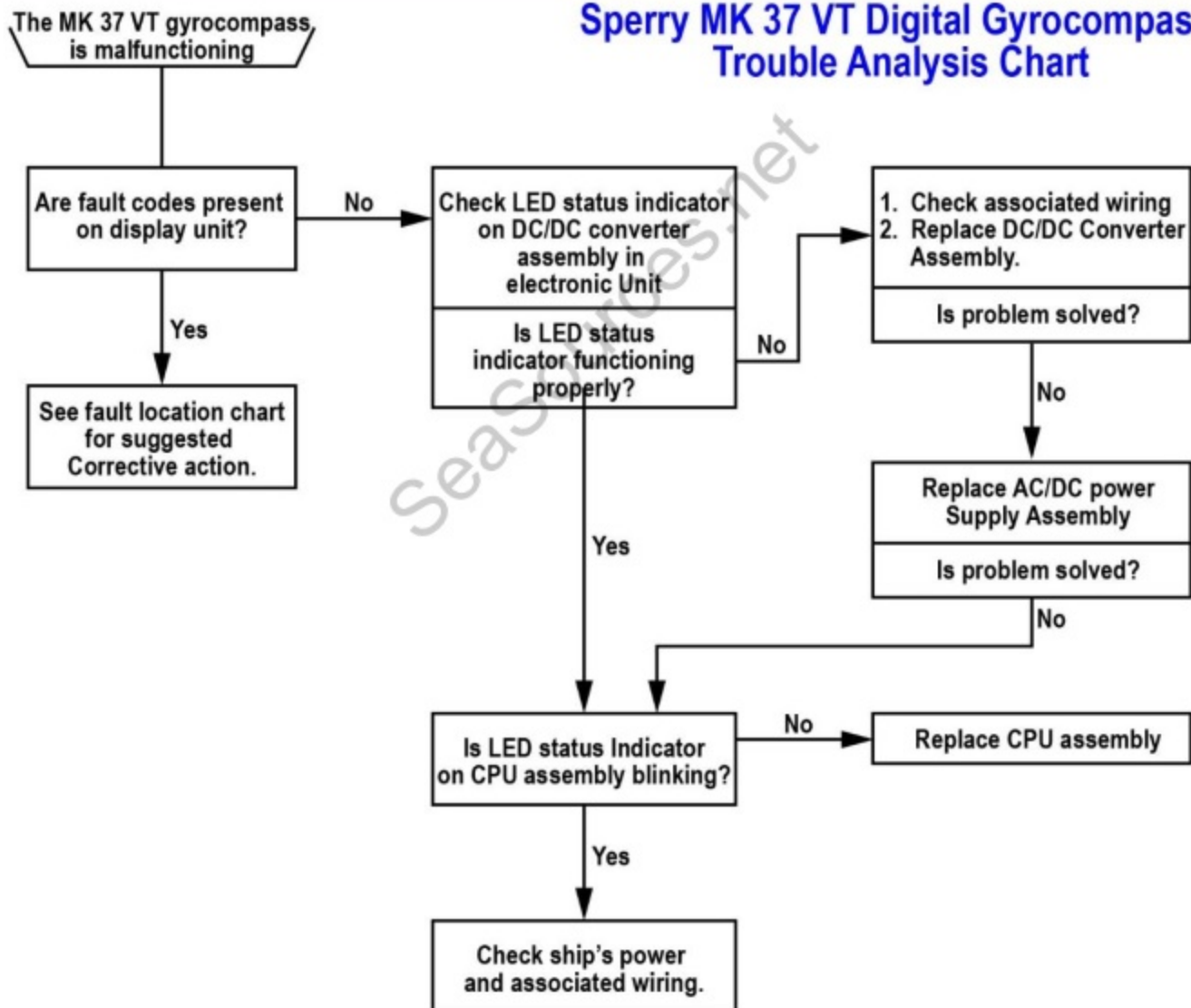
Adaptive Digital Steering System Interface Signals

Inputs	
Speed log input Pulsed Serial	200 pulse nautical mile (PPNMI) format (contact closure) RS-232 (channel A or C) or RS-422 (channel B) communications in NMEA 0183 format, \$VBW, \$VHW
Navigator (vessel management system) input	Serial data for heading order, rate order, and cross track error information in RS-232 or RS-422 communication on channel A, B or C, in NMEA format \$APB, \$HSC, \$HTR, \$HTC or \$XTE
Compass Step data Syncro	Positive or negative step data (24 or 70 V) 1X, 90X or 360X
Data Serial data	\$HDT (on channels A, B or C)
Mode switch sense contact	External switched opened or closed to inform autopilot to change from Standby mode to an automatic mode
NFU sense contacts Power failure circuits	External contacts to indicate when the NFU Controller is active Closed contacts on external power switch to activate power failure alarm
Outputs	
Interface to external rudder Servo control amplifiers	Bipolar analogue voltage proportional to the rudder order. ± 11.25 V (maximum limit) equal to $\pm 45^\circ$ or rudder
Rate of turn interface	Bipolar analogue voltage proportional to a turn rate indicator. ± 4.5 V (Max) equal to $\pm 90^\circ$ turn/min. Resolution equal to 0.5° /min.

EL-0192

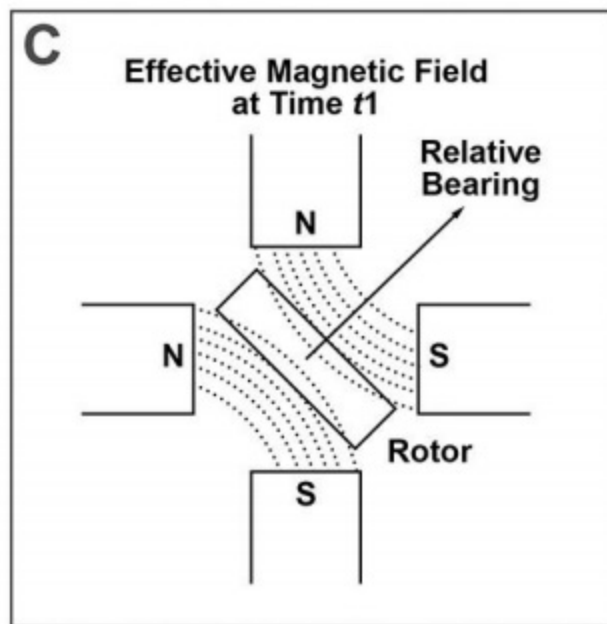
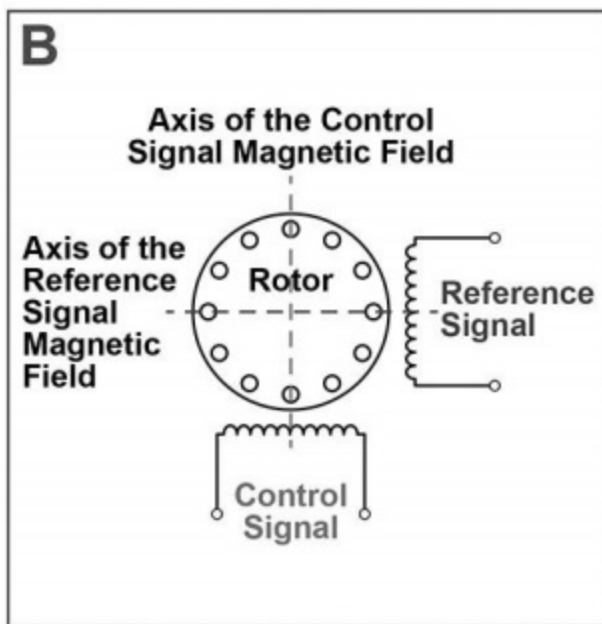
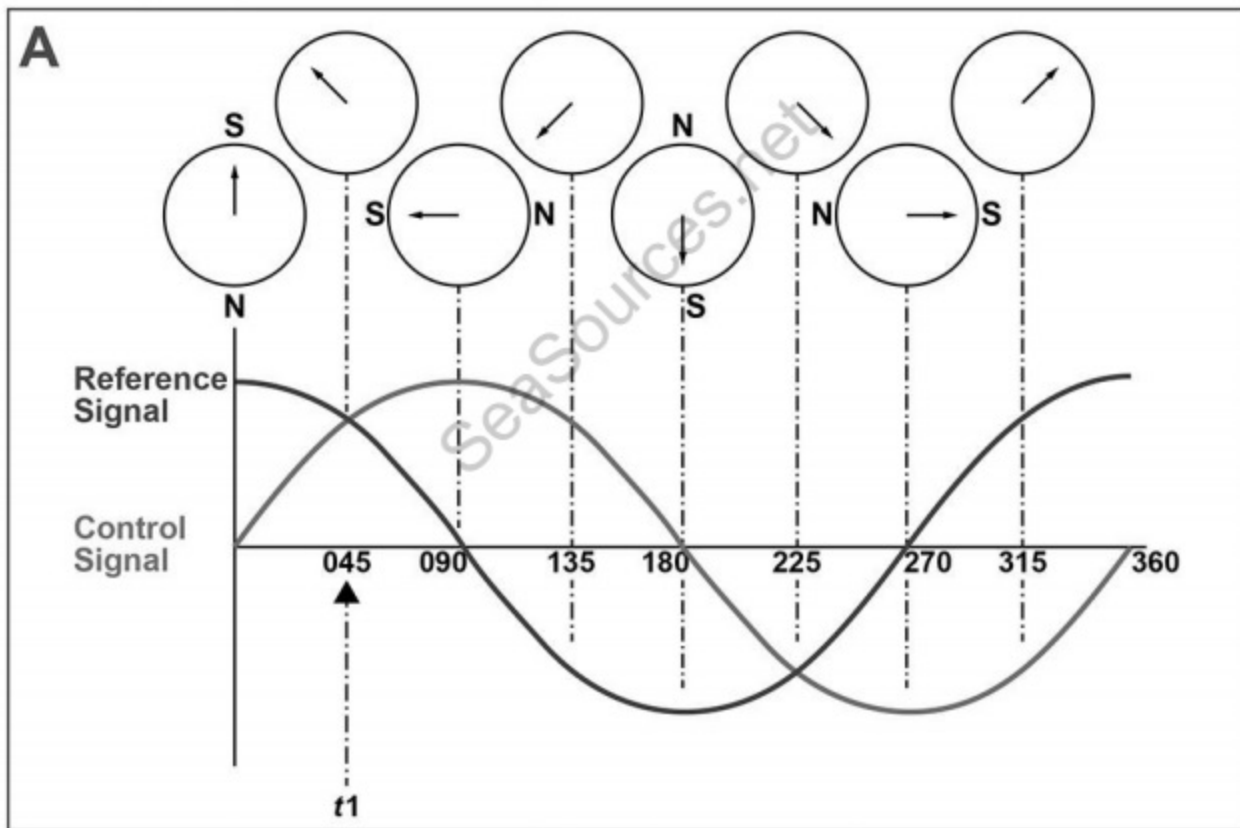


Sperry MK 37 VT Digital Gyrocompass Trouble Analysis Chart

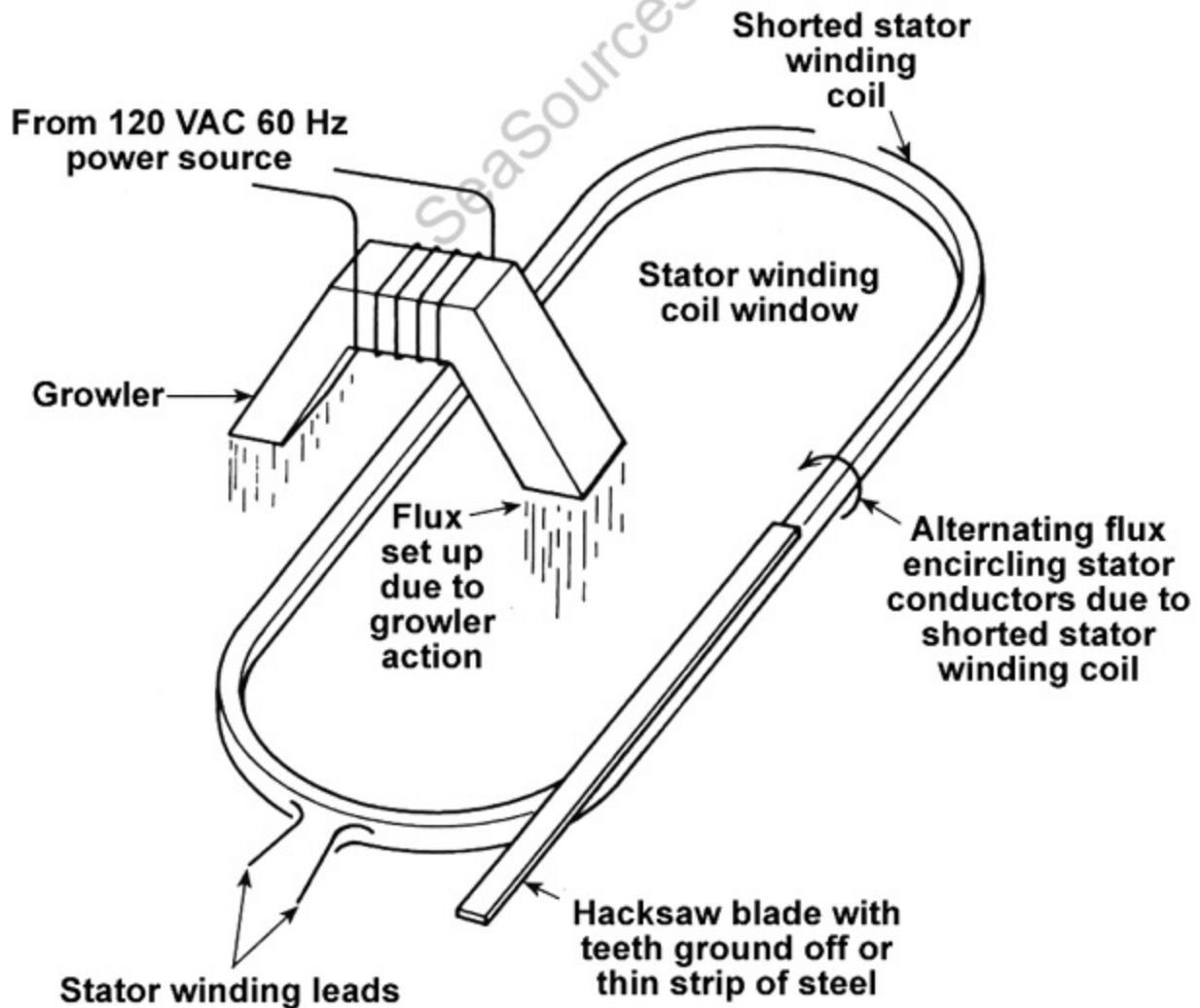


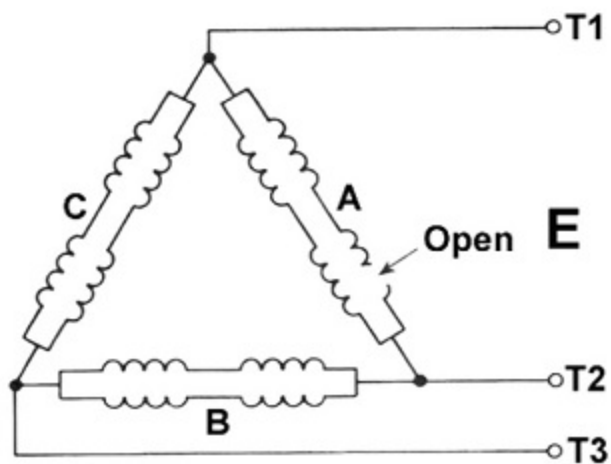
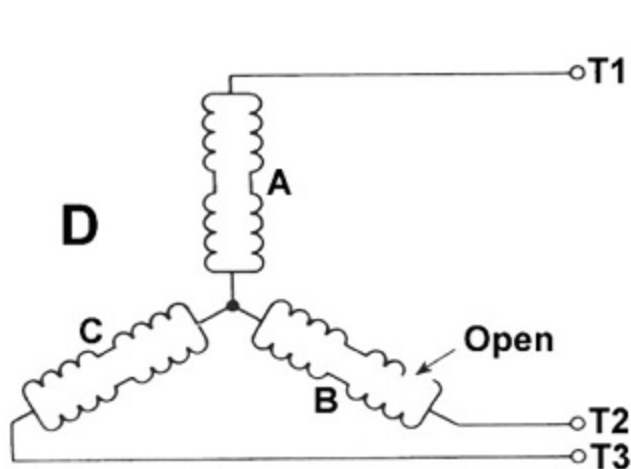
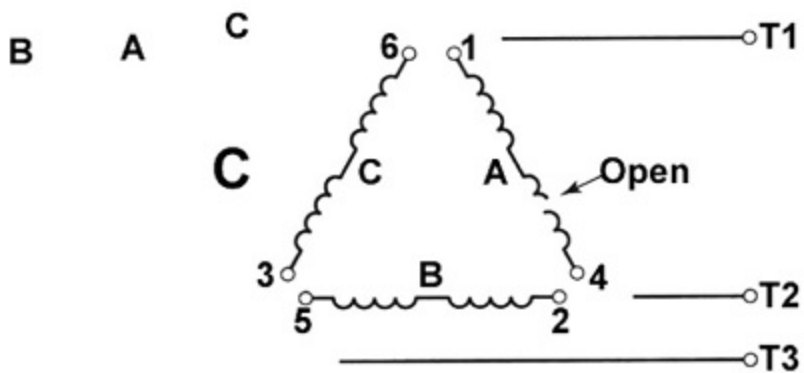
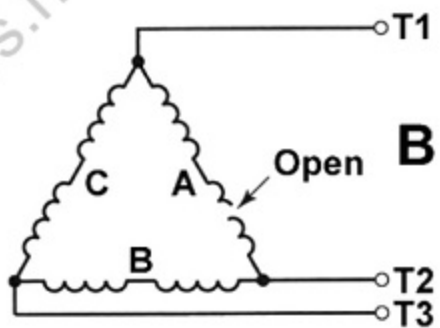
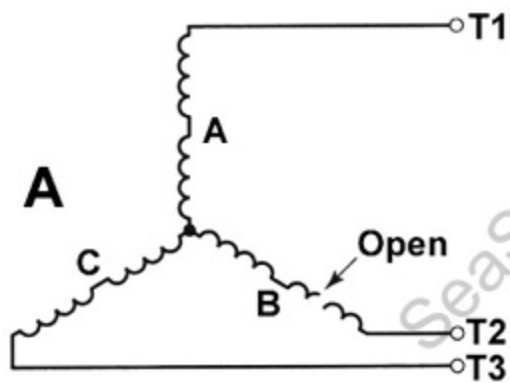
Partial List of Sperry MK 37 VT Digital Gyrocompass Faults

Symptom	Probable Cause	Remedy
Course recorder leaves a blank page every 8-10 inches or has paper feed problems	Printer paper-release lever not in the middle, push-tractor position	Place level in the middle position for push-tractor installation
Repeater does not follow MK 37 VT heading	Repeater channel may not be on or not synchronized to the MK 37 VT Heading	Check repeater switch on step driver assembly. Make sure repeater is synchronized to the MK 37 VT gyrocompass
Speed value does not change	Speed selection may not be in Auto	Verify that speed menu selection is in Auto. Check for faults on serial channel
Latitude value does not change	Latitude selection may not be in Auto	Verify that latitude menu selection is in Auto. Check for faults on serial channel
Manual transfer (dual system) does not occur	Other system may not be powered, attached, or may have a critical fault. Manual transfer must be initiated from the primary compass only	Verify that other system is powered, attached, and does not have a critical fault
Unit makes buzzing sound for at least 15 min after being switched on	If sound persists longer than 15 min, the AC/DC power supply assembly relay is bad	Replace AC/DC power supply assembly



EL-0200





EL-0202

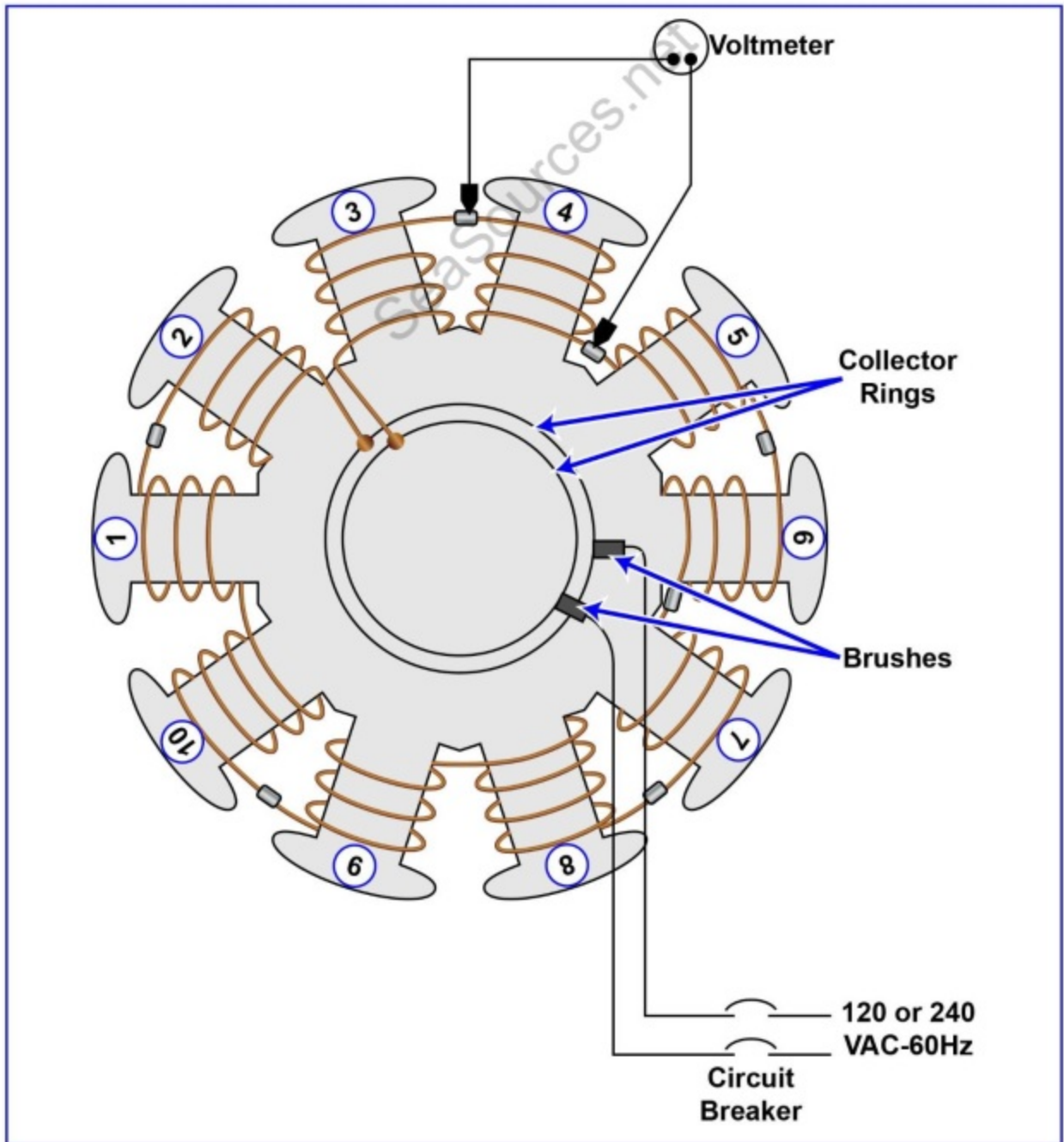
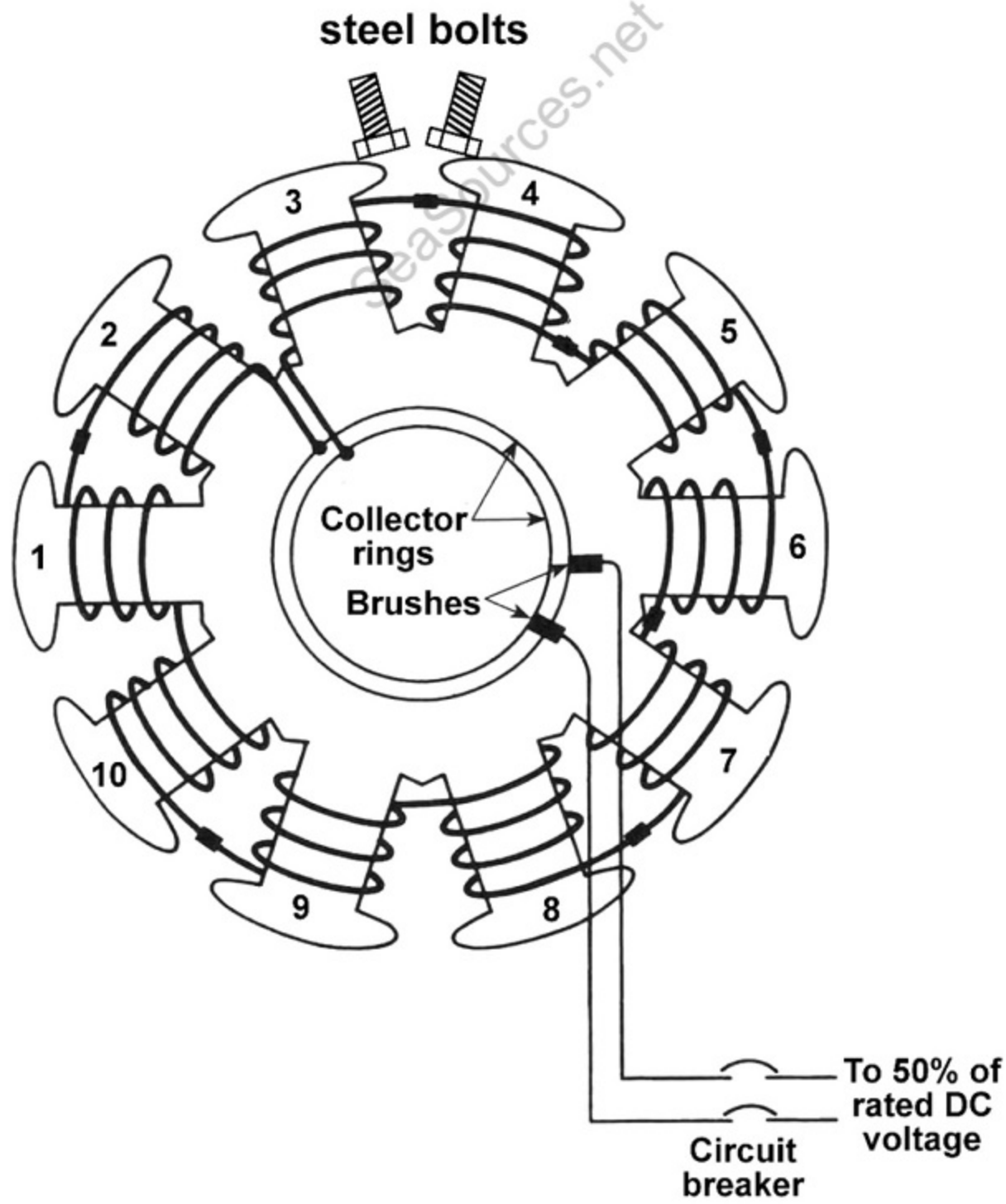


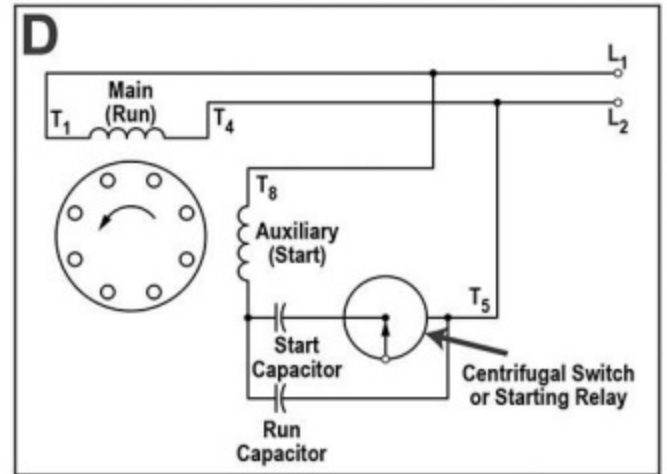
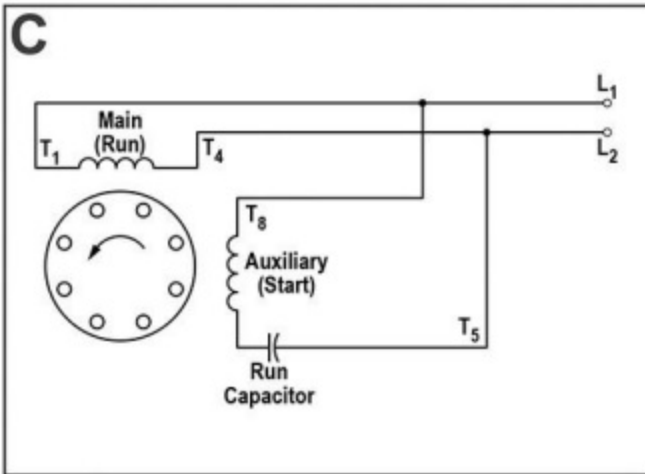
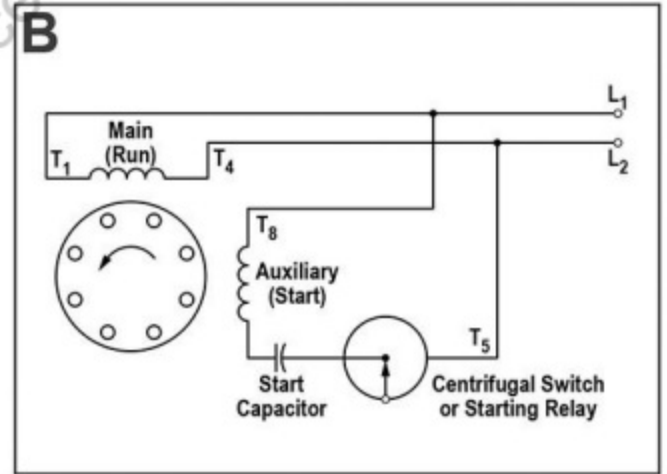
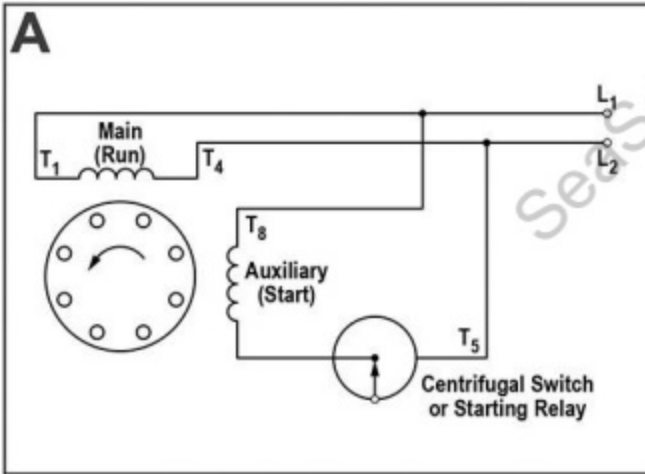
Table 3 Sample sheet of a typical "List of Motors and Controls"

Application		Motor											Control								
IT No.	Auxiliary	Qty	Hp	Volt	Ph	F L Amp	NEMA Dsgn.	Rpm	Amb. Temp	Encl	Duty	Mtg	Remarks	Starter				Cont SW		Remarks	
														Function	UV	LCT	ENCL	Opn	Type		LCT
51	Main eng piston cooling water pump	2	25	460	3	28.9	B	3535	50	DP	Cont	Vert		X-Line ST-SP	LVR	See note (1)	DP	Man	-	-	Remote PB ST-SP, ST-SP IND LTS, SEL SW-Stby & Alm at MCC. PB ST-SP at pump. Remote press SW.
52	Main eng sea water cooling pump	2	150	460	3	173	B	1188	50	DP	Cont	Vert		X-Line ST-SP	LVR	See note (1)	DP	Man	-	-	Remote PB ST-SP, ST-SP IND LTS, SEL SW Stby & Alm at MCC. PB ST-SP at pump. Remote press SW.
53	Mn fuel oil transfer pump	1	30	460	3	38.7	B	885	50	DP	Cont	Vert		X-Line ST-SP	LVP	See note (1)	DP	Man	PB ST-SP	Cont Door	Remote PB ST-SP at pump emer stop at fuel sta. P & S. emer stop at fire fighting sta.
54	Mooring winch (amidship)	4	75	460	3	79.6	B	3575	40	TE, WT, EXP PRF	Cont	Vert		X-Line ST-SP	LVP	Remote	DP	Man	-	-	Triplex controller remote PB ST-SP at pump thermostats in motor. MTR SP HTR.
55	Mooring winch brake (amidship)	4	2	460	3	3.1	B	1750	40	TE, WT, EXP PRF	Cont	Hor		X-Line	LVP	Remote	DP	Man	-	-	Triplex controller. See mooring winch (amidship). Thermostats in motor. MTR SP HTR.
56	Mooring winch fan (amidship)	4	1	460	3	1.5	-	1725	40	EXP PRF NV	Cont	F-1		X-Line	LVP	Remote	DP	Man	-	-	Triplex controller. See mooring winch (amidship). Thermostats in motor. MTR SP HTR.

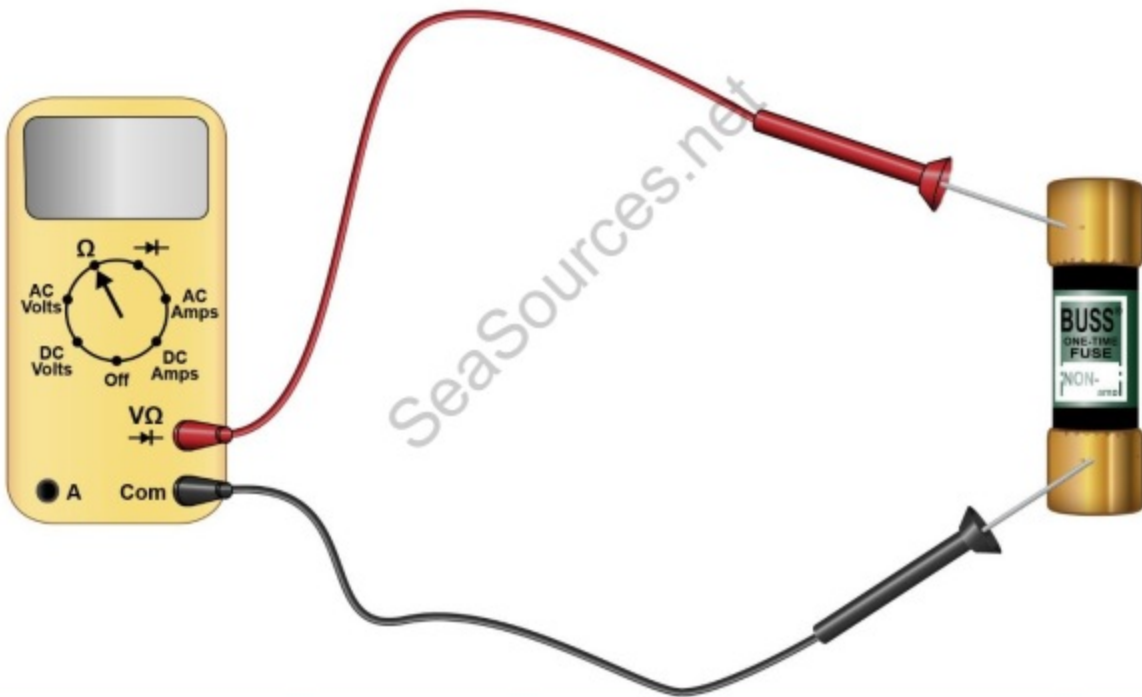
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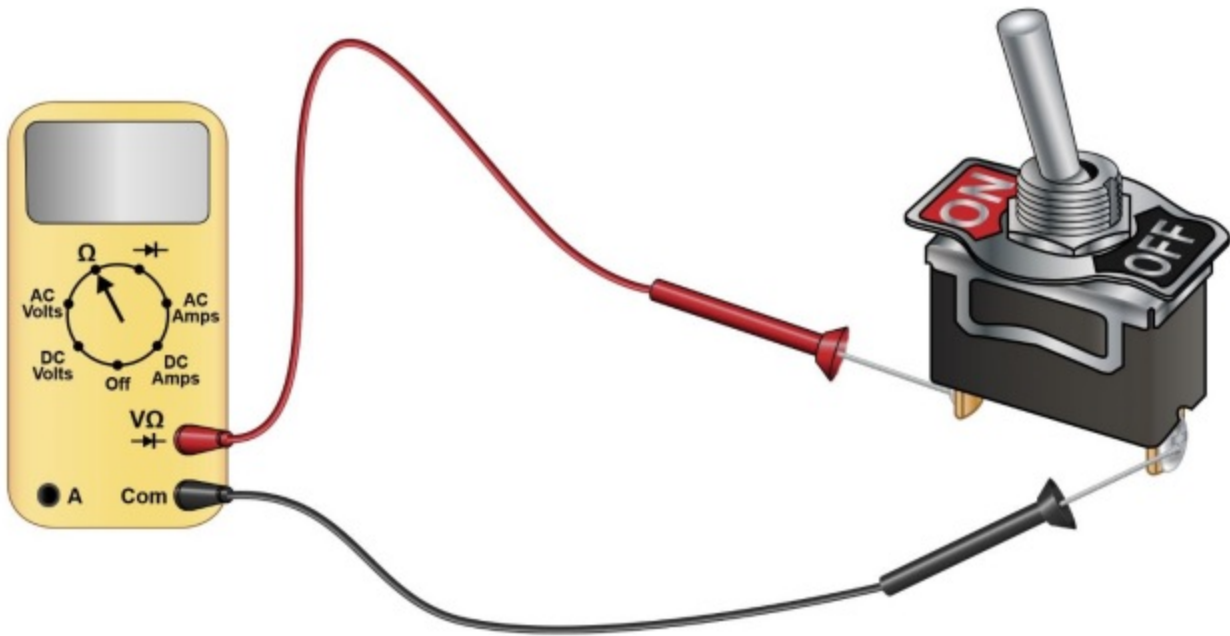
SeaSources.net

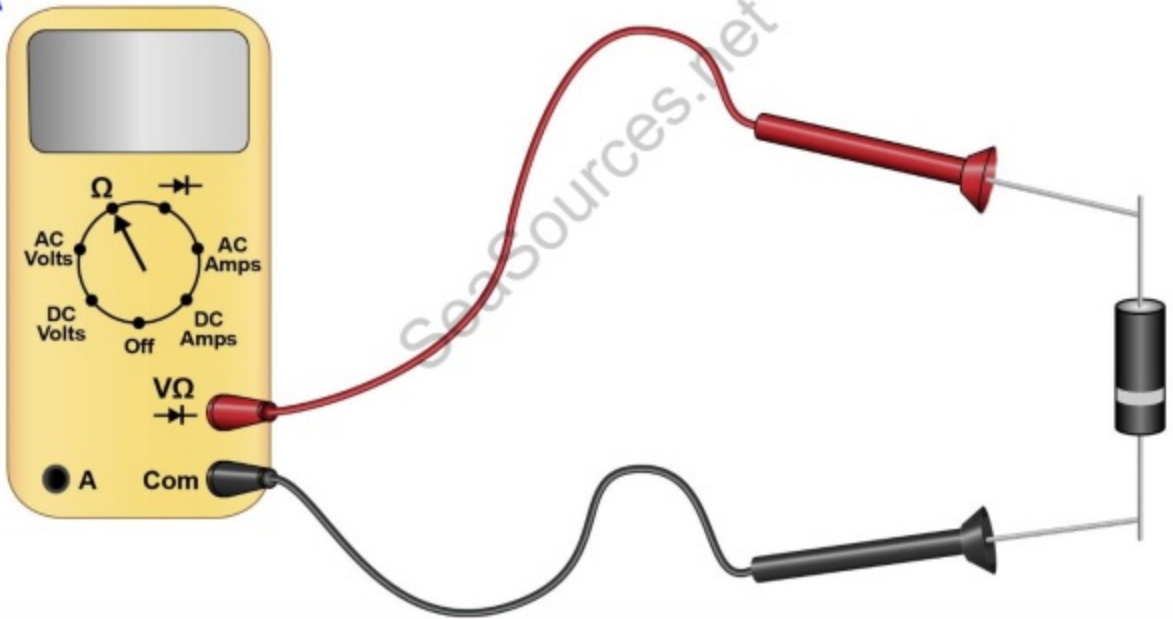
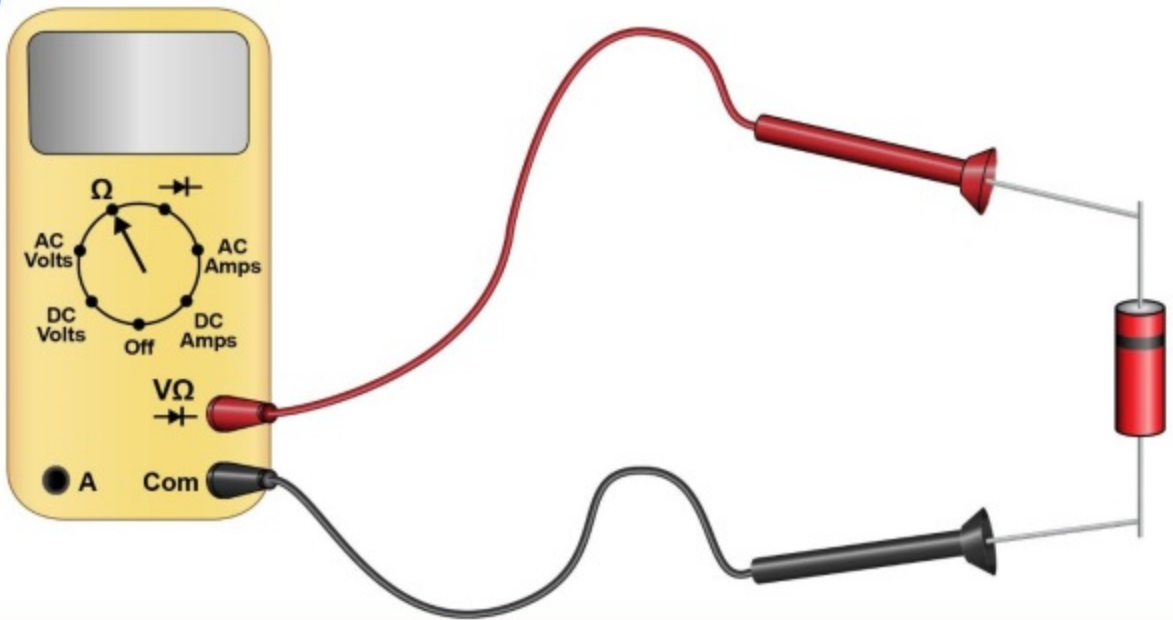


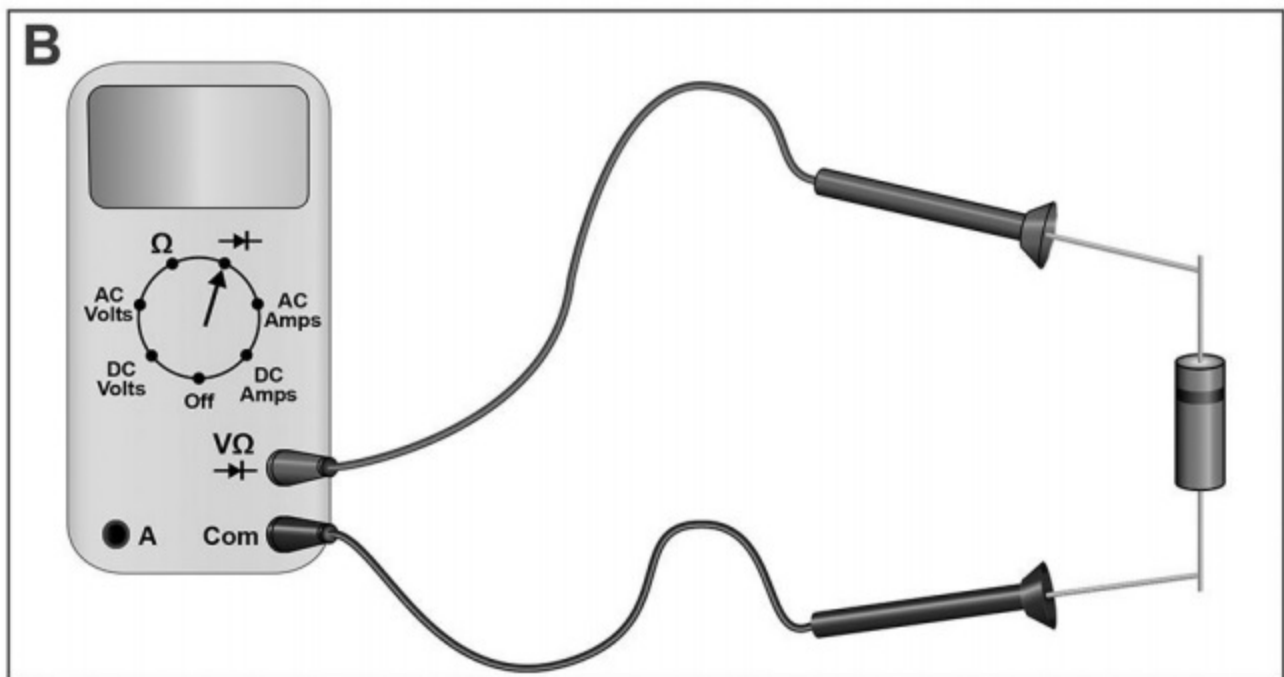
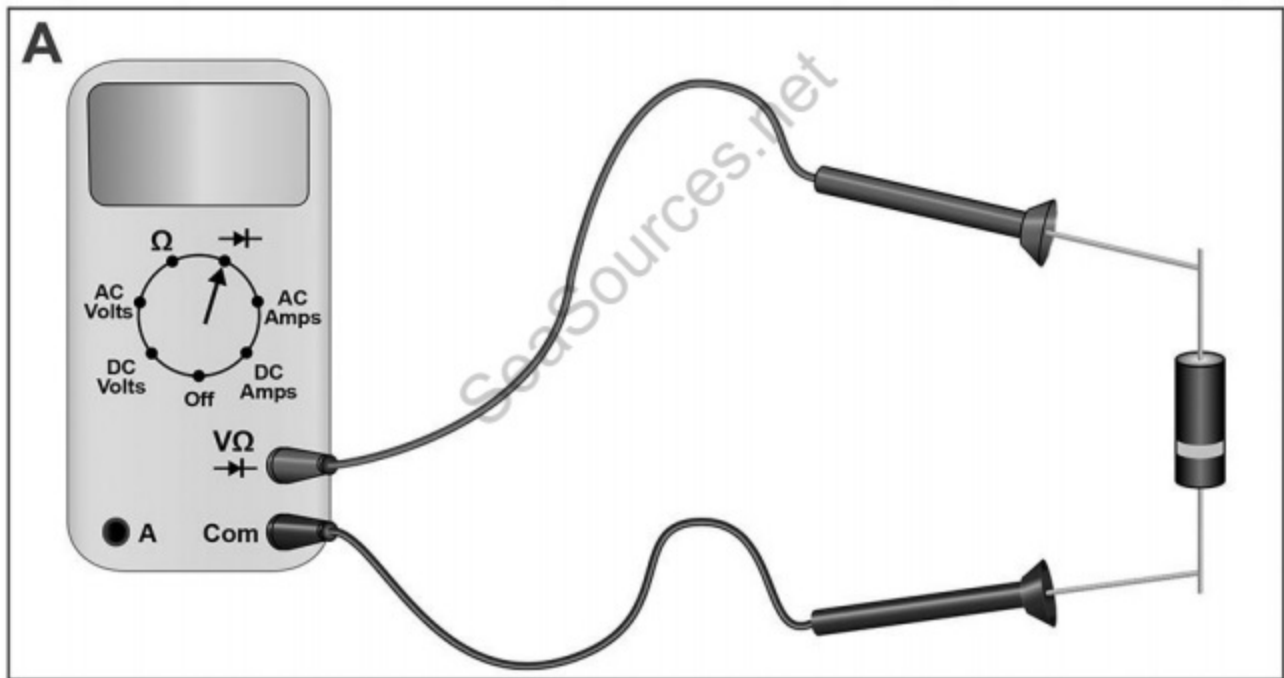
A



B



A**B**



A



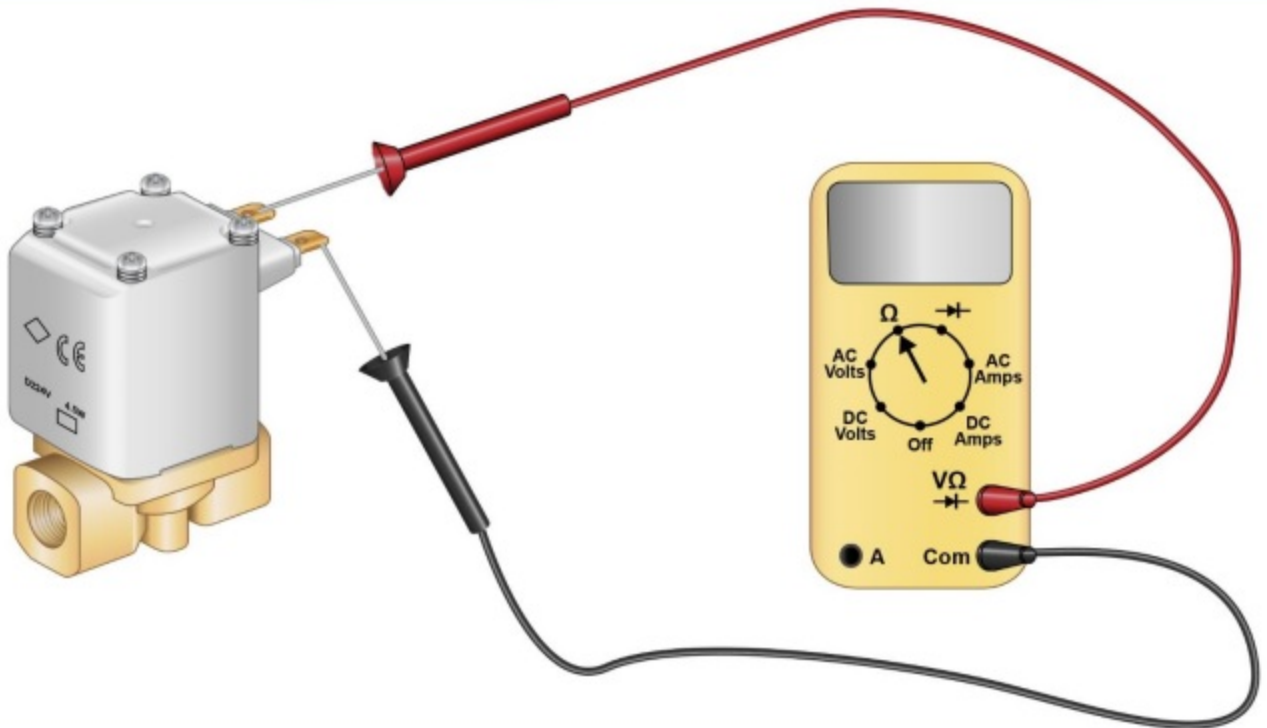
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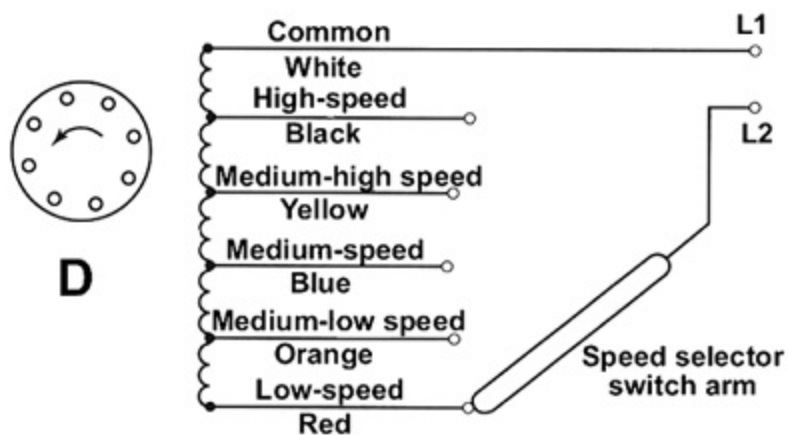
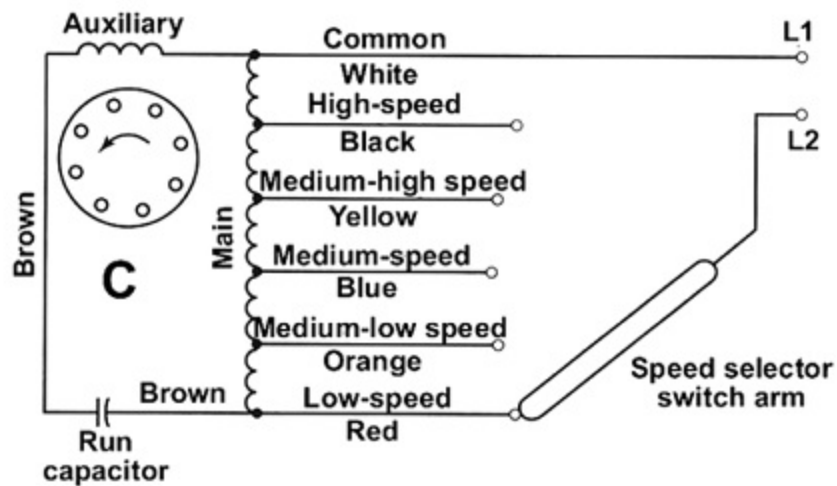
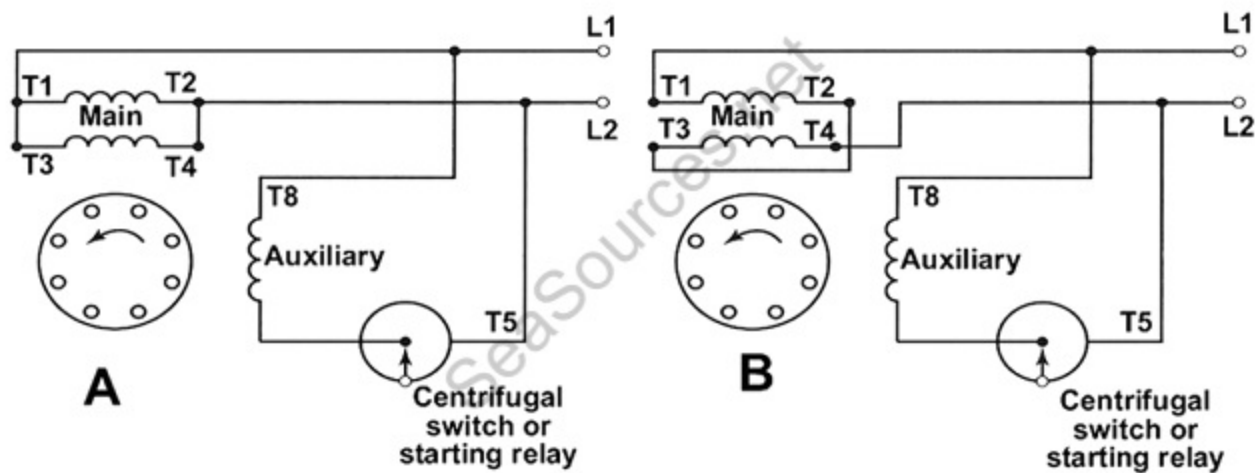
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B

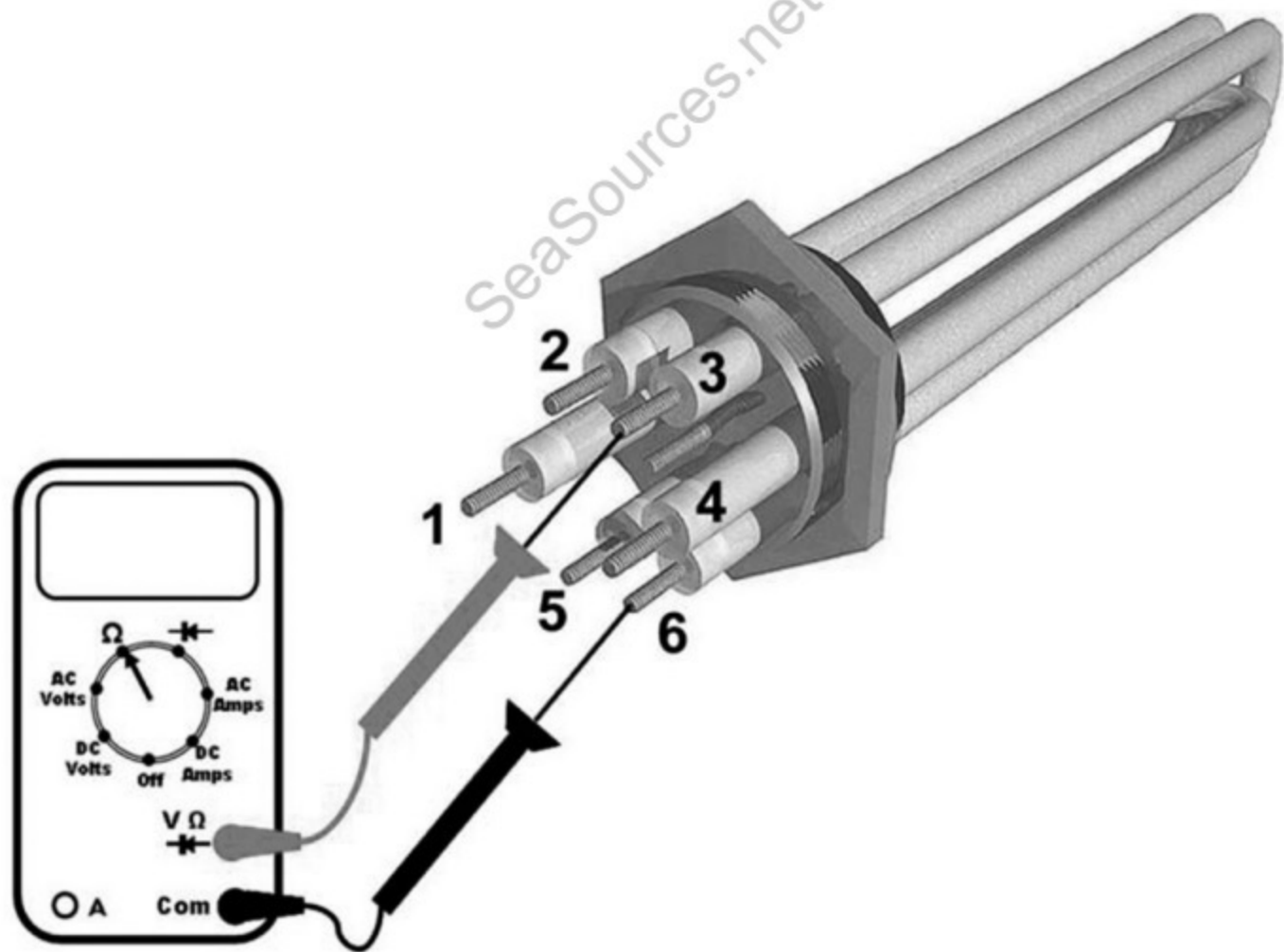


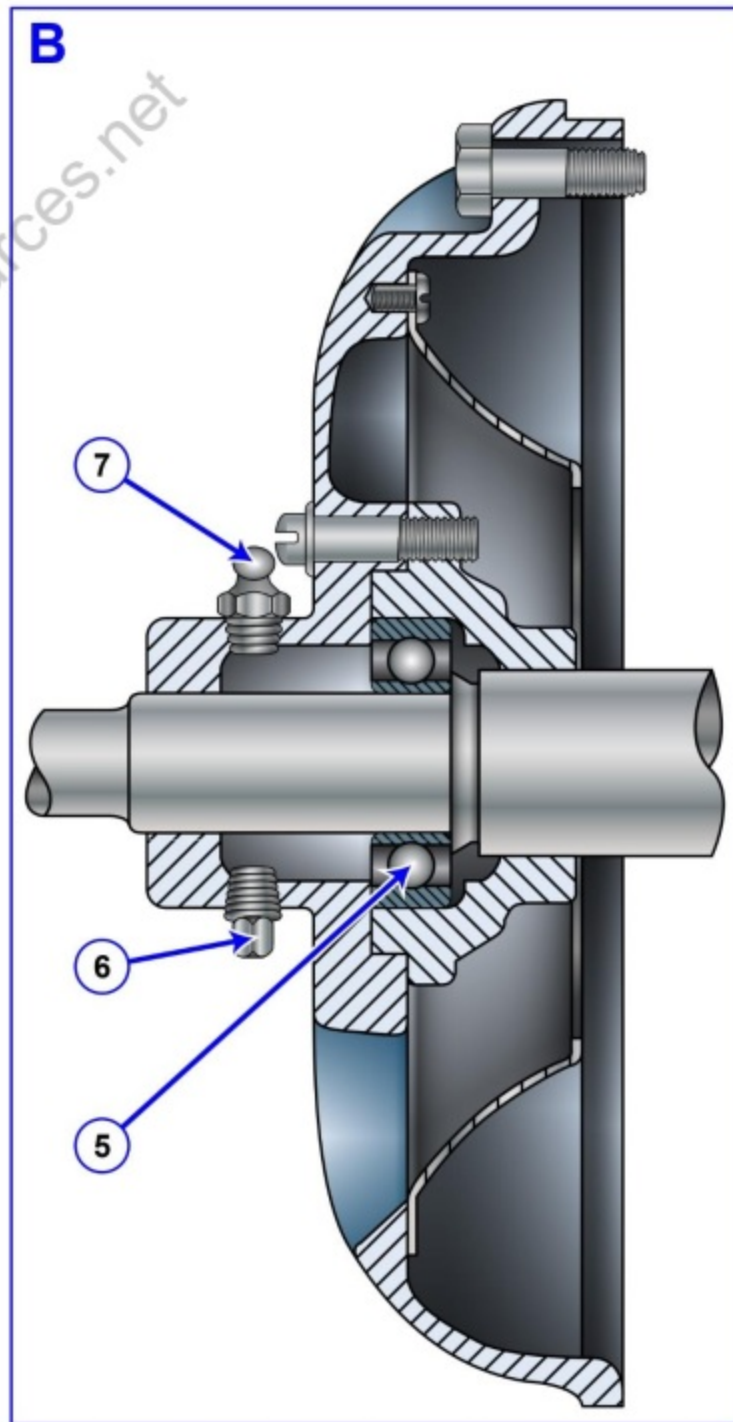
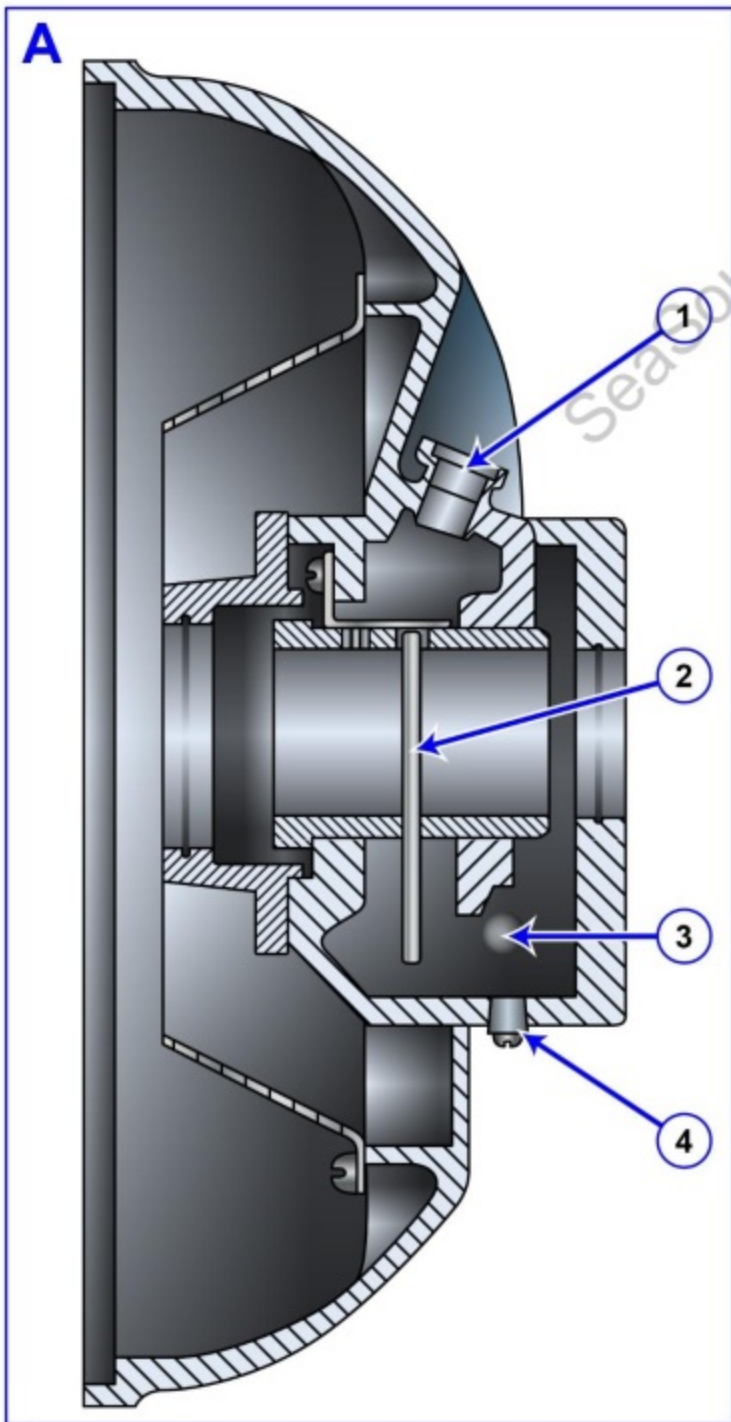
EL-0215



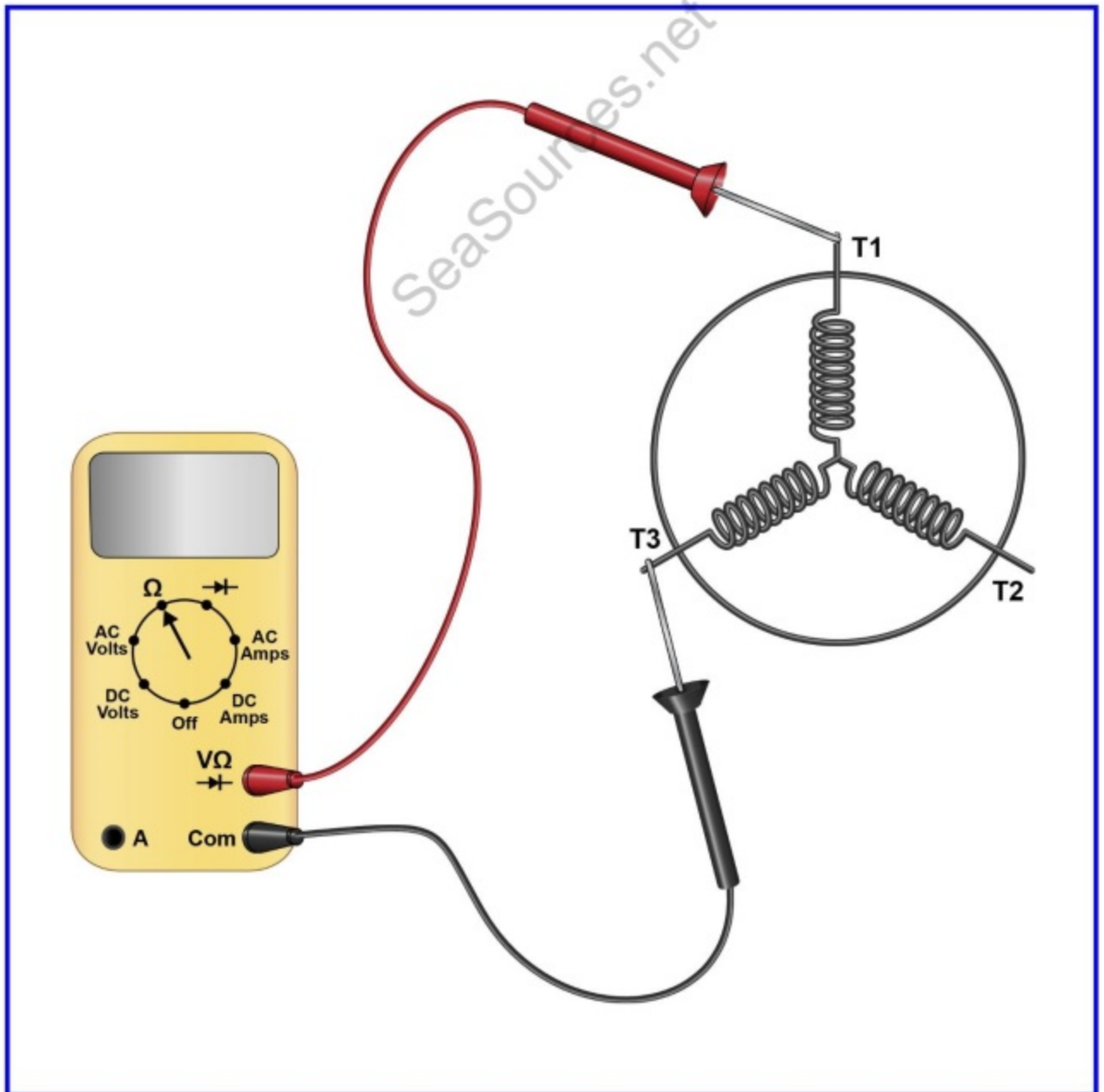
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SeaSources.net

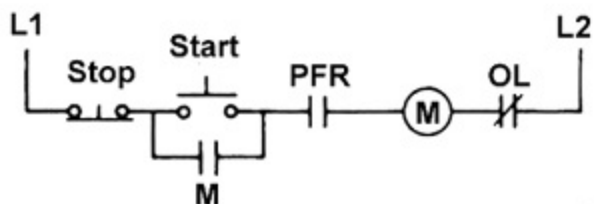




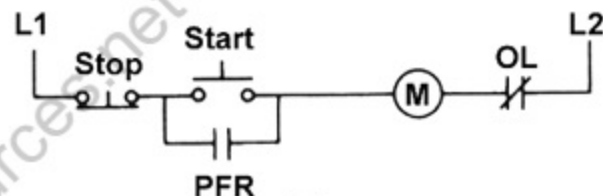
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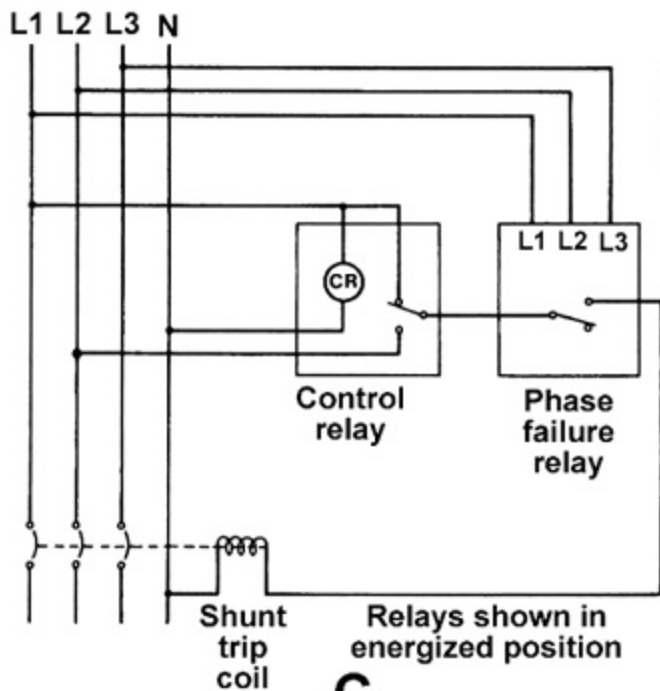
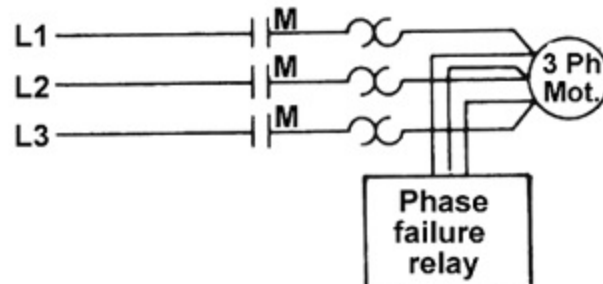
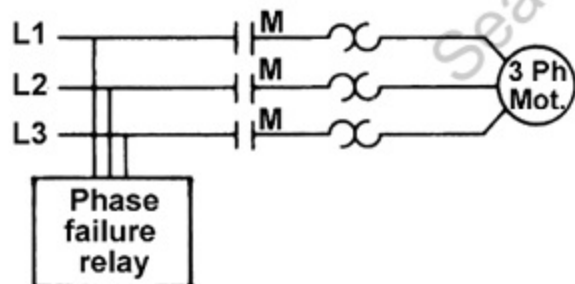
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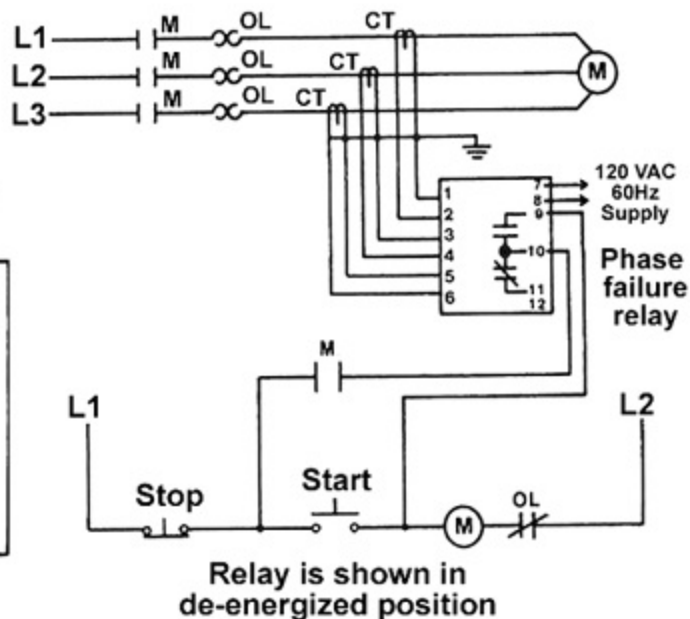
A



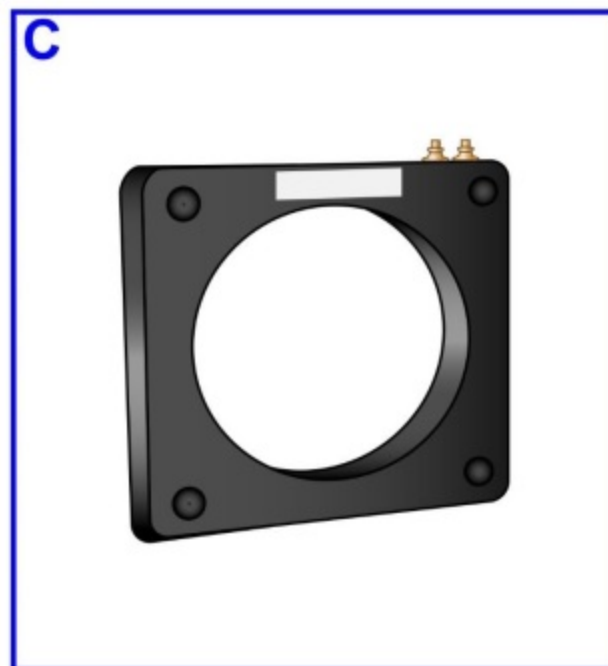
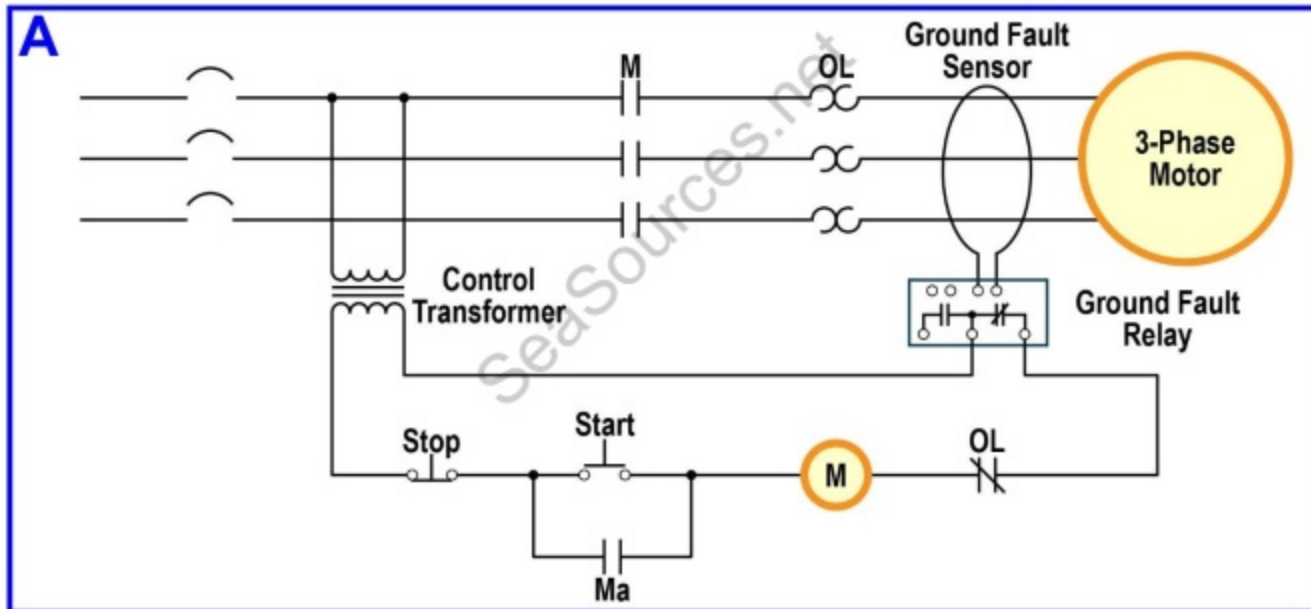
B



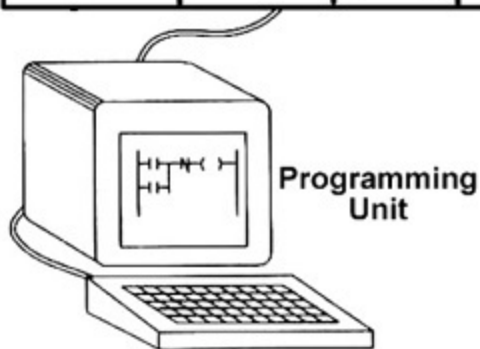
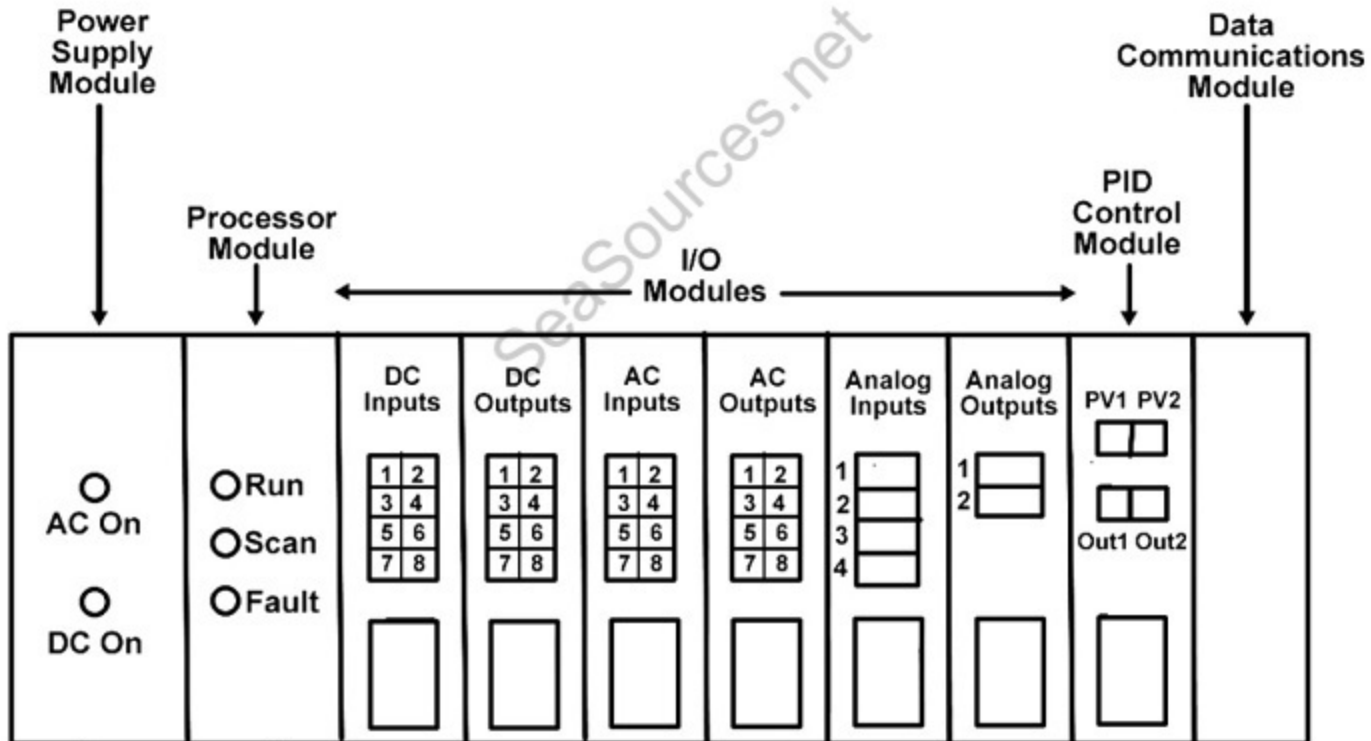
C



D



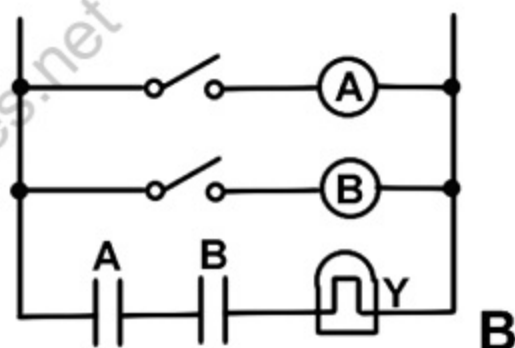
EL-0225



A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

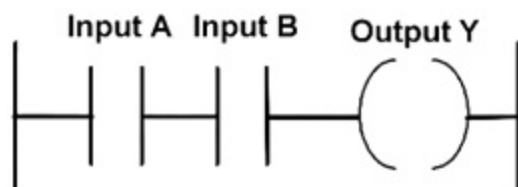
A

Truth Table

Equivalent Relay
Circuit Diagram

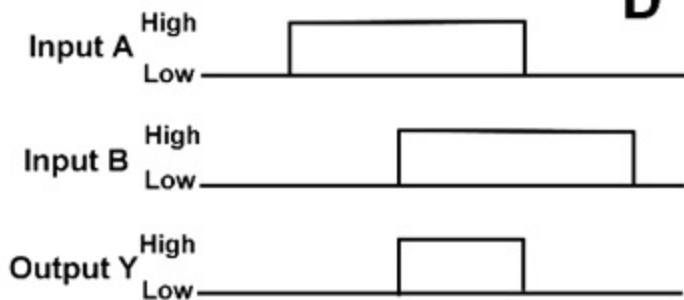
Relay and PLC Logic Compared

C



PLC Ladder Diagram

D



PLC Input/output Diagram

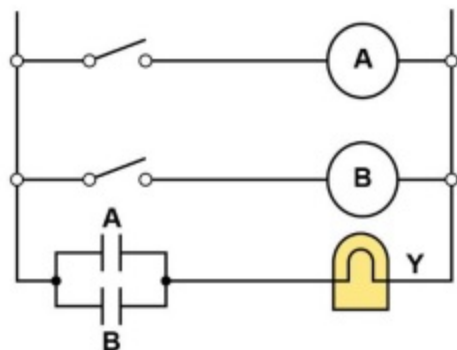
EL-0227

Relay and PLC Logic Compared

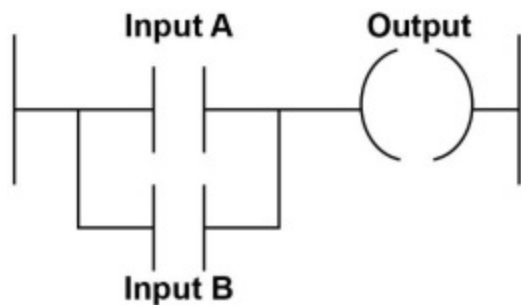
A

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Truth Table For Two-Input OR Gate

B

Equivalent Relay Circuit
For an OR Gate

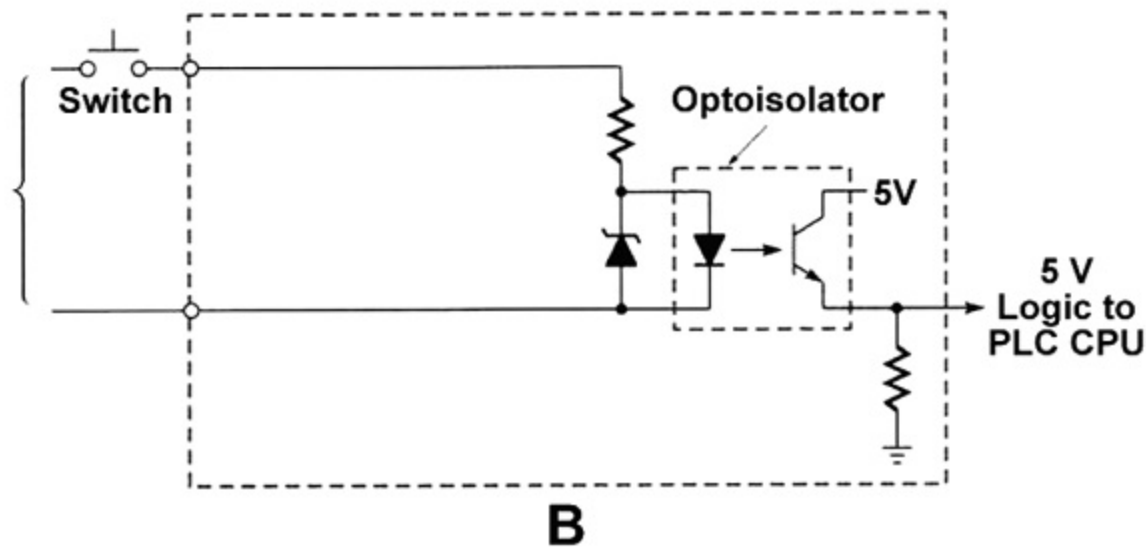
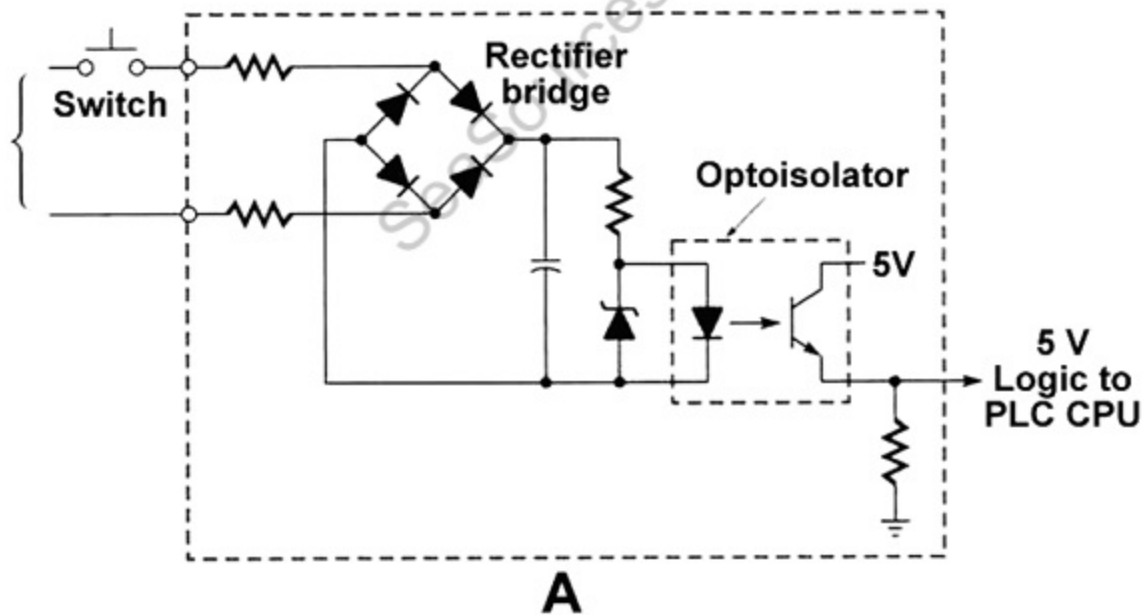
C

An OR Gate

D

An OR Gate Ladder Diagram

Discrete PLC Input Modules



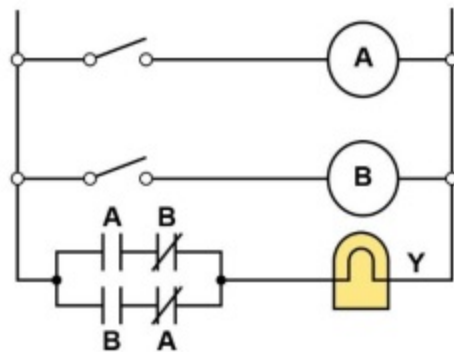
EL-0231

Relay and PLC Logic Compared

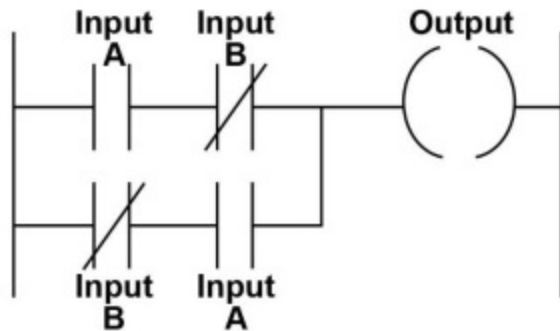
A

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

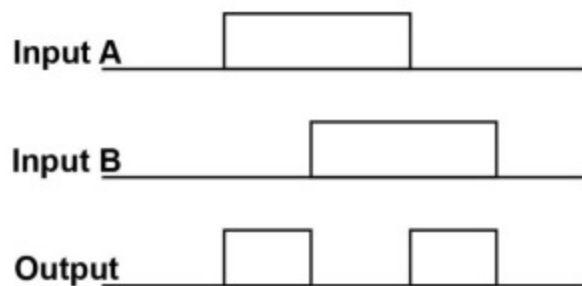
Truth Table For EXCLUSIVE OR (XOR) Gate

B

Equivalent Relay Circuit For EXCLUSIVE OR (XOR) Gate

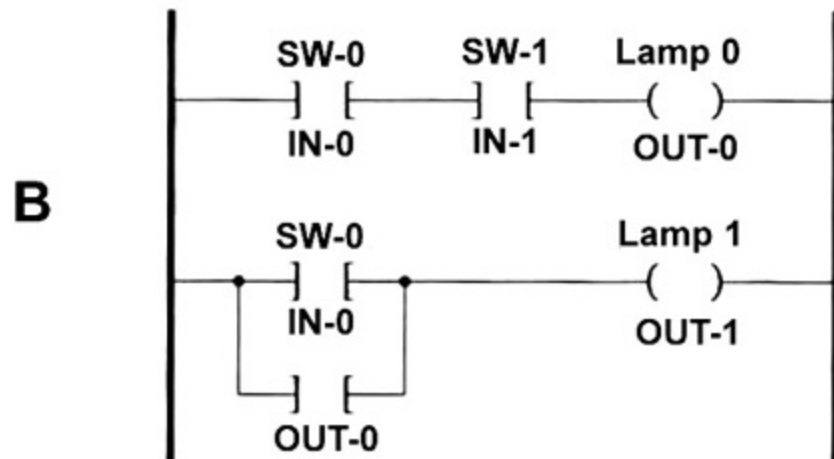
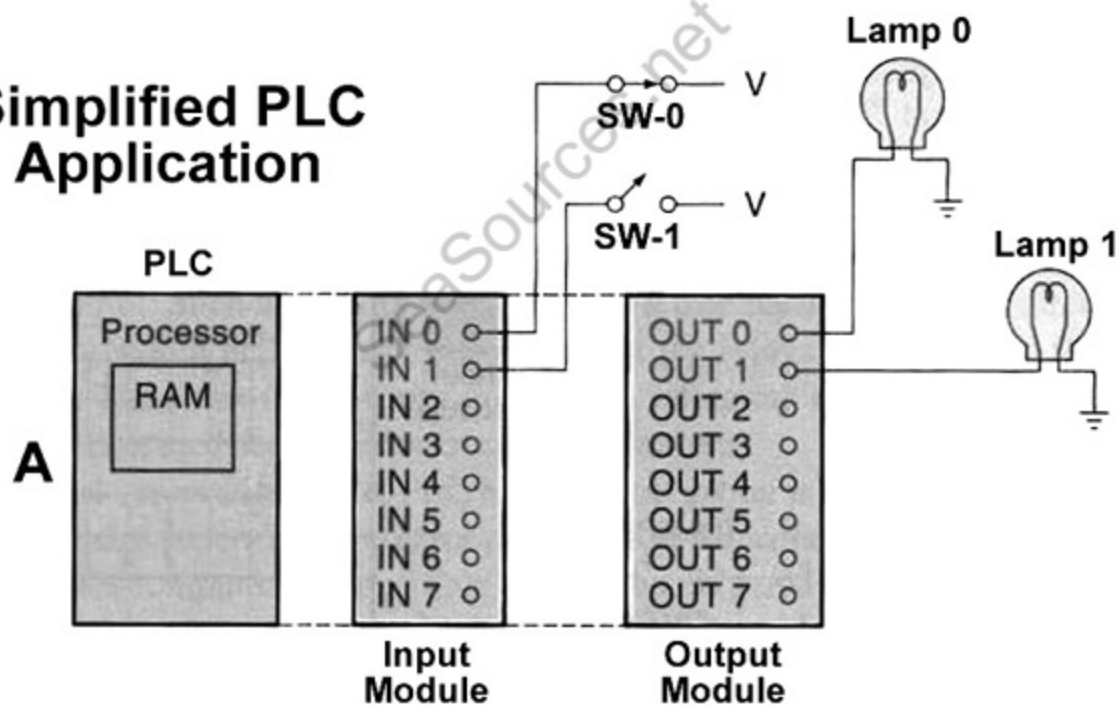
C

An EXCLUSIVE OR (XOR) Gate

D

An EXCLUSIVE OR (XOR) Gate Ladder Diagram

Simplified PLC Application



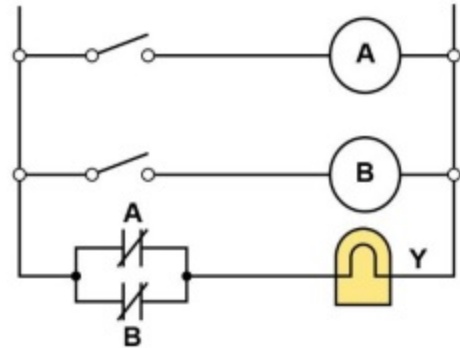
EL-0233

Relay and PLC Logic Compared

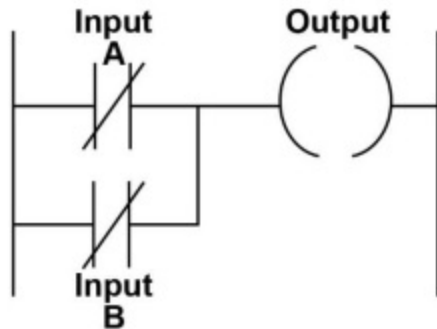
A

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

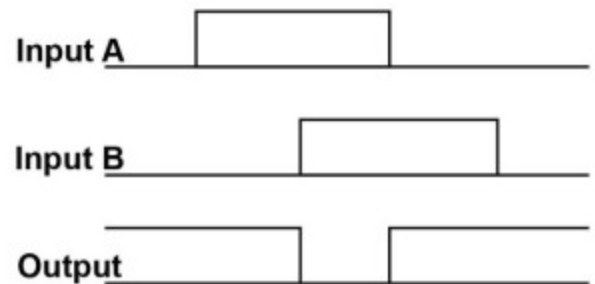
Truth Table For
Two-Input NAND Gate

B

Equivalent Relay Circuit
For Two-Input NAND Gate

C

An Two-Input NAND Gate

D

An Two-Input NAND
Gate Ladder Diagram

EL-0234

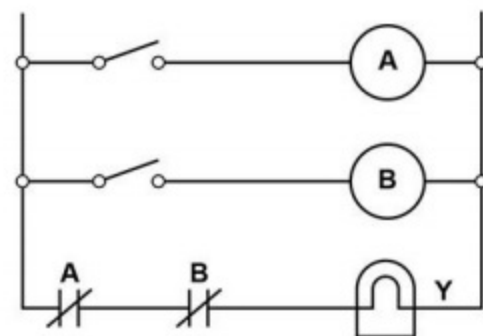
Relay and PLC Logic Compared

A

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

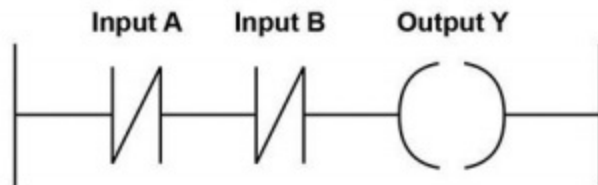
Truth Table

B



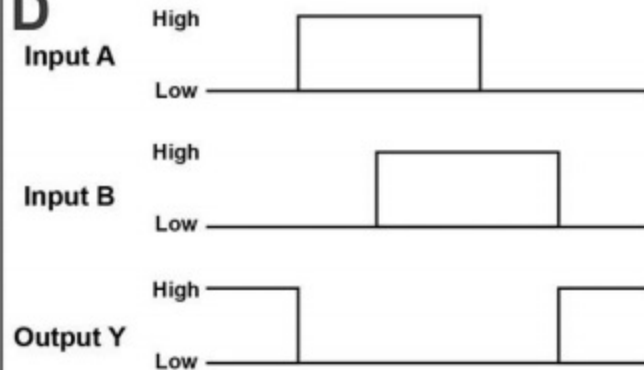
Equivalent Relay
Circuit Diagram

C



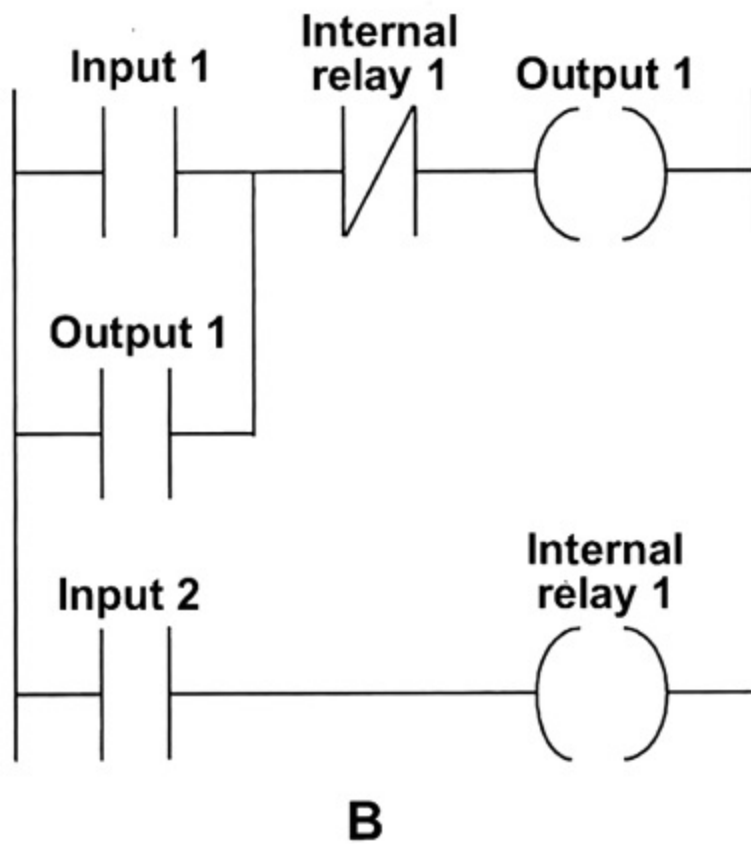
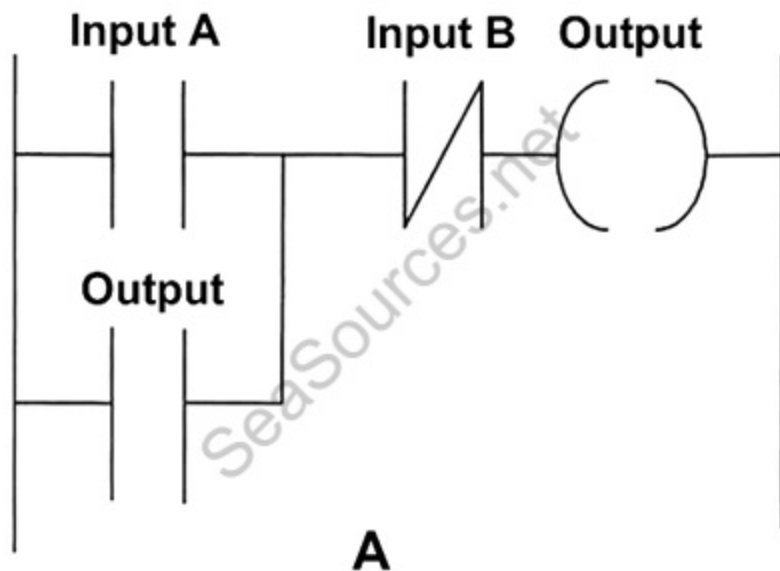
PLC Ladder Diagram

D

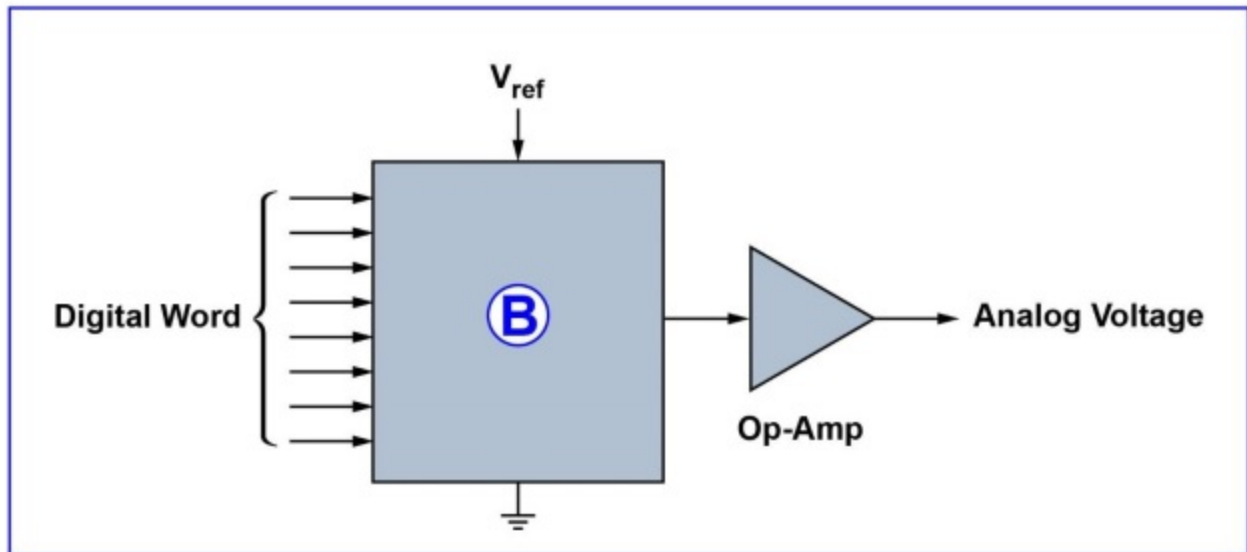
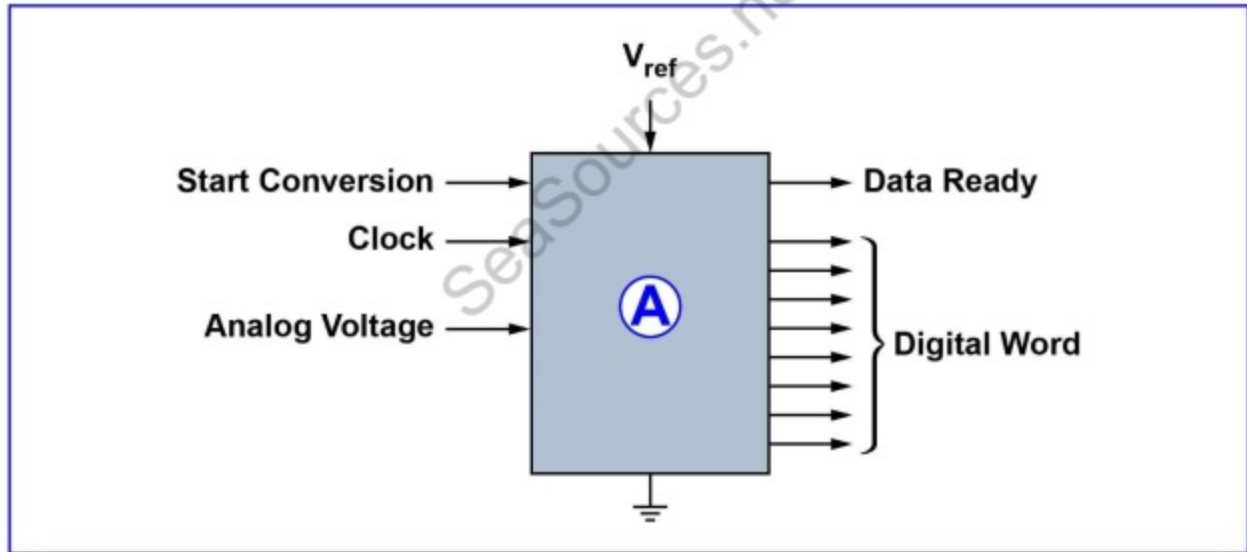


PLC Input/Output Diagram

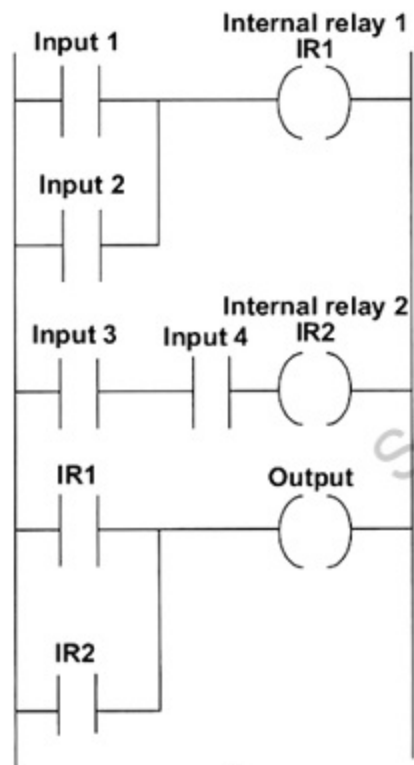
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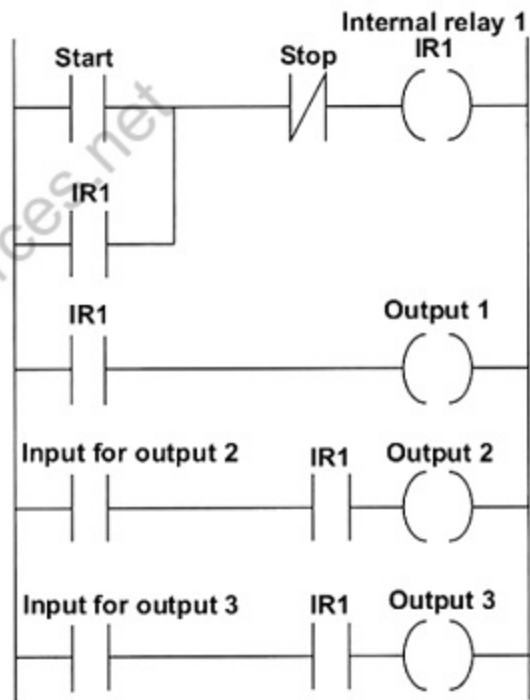
EL-0240



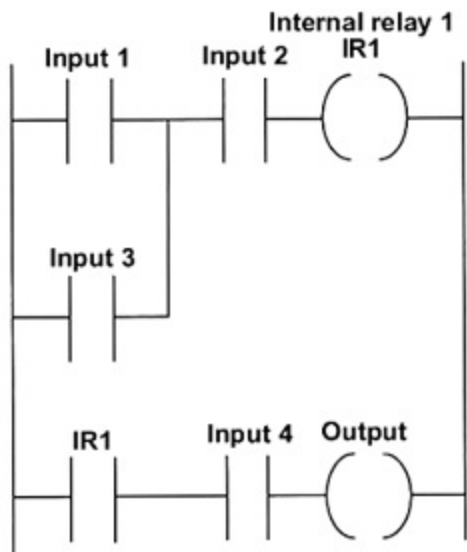
EL-0241



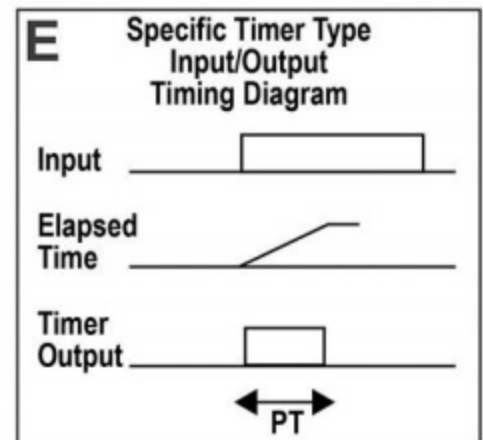
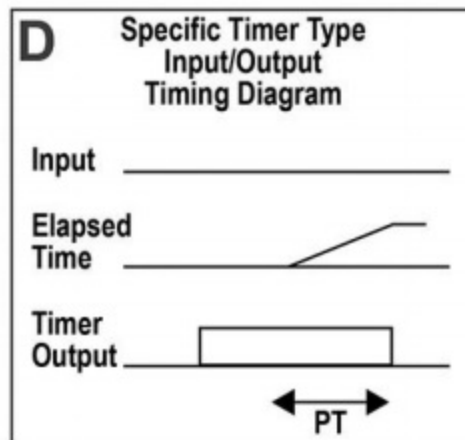
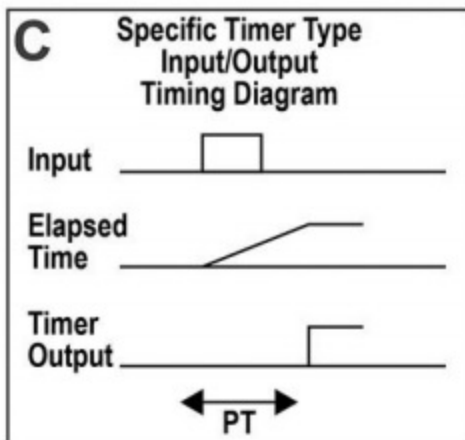
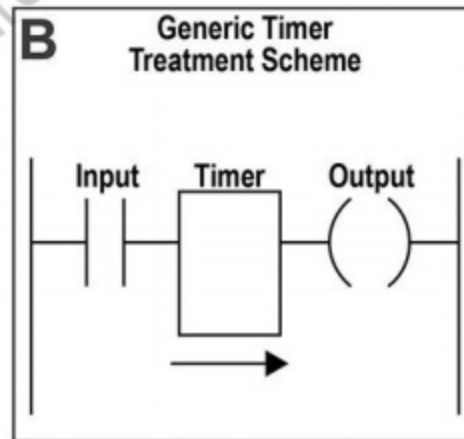
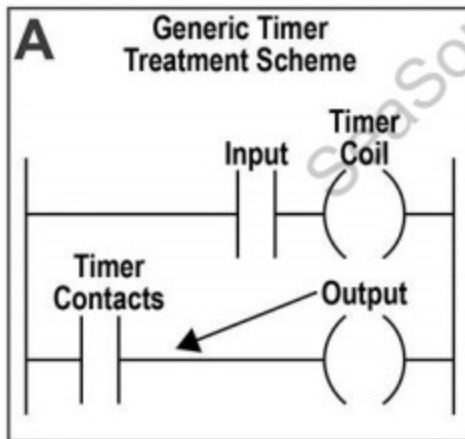
A



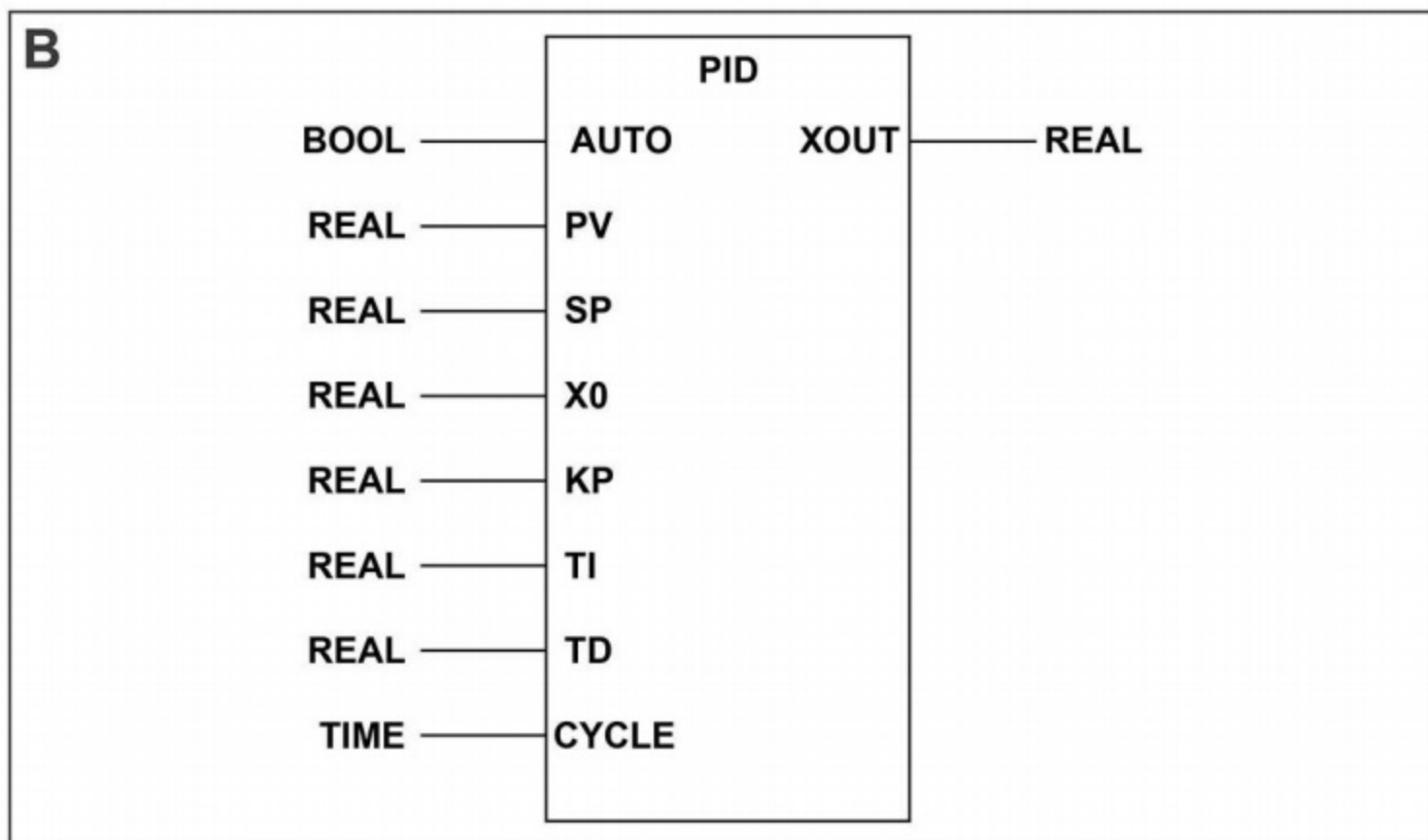
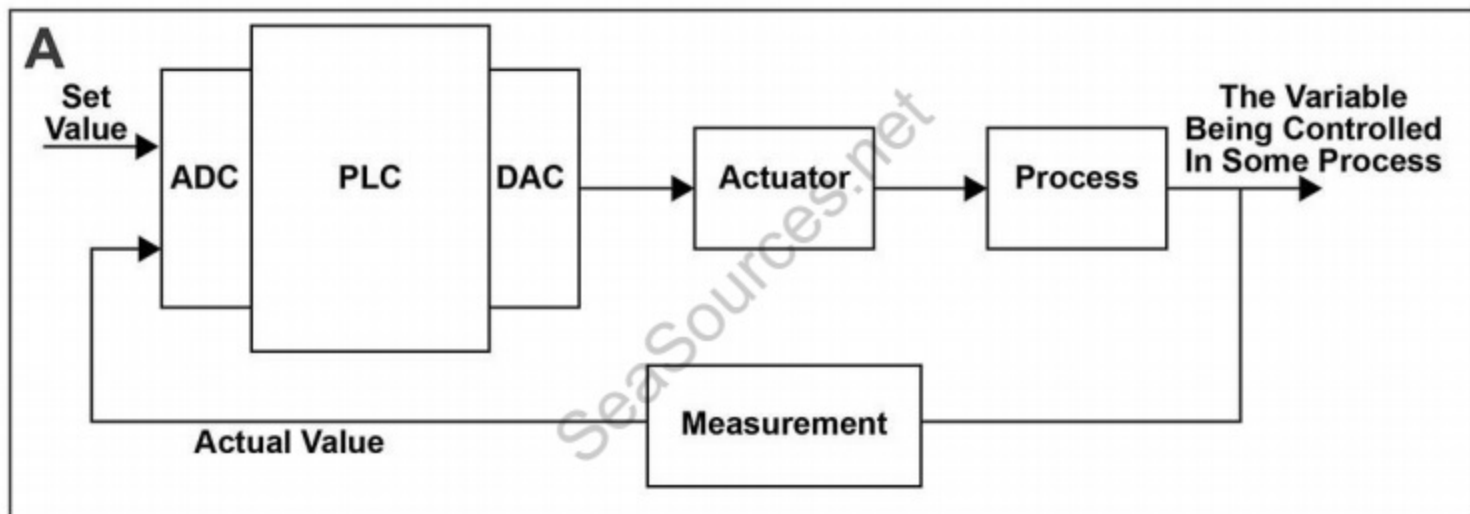
B

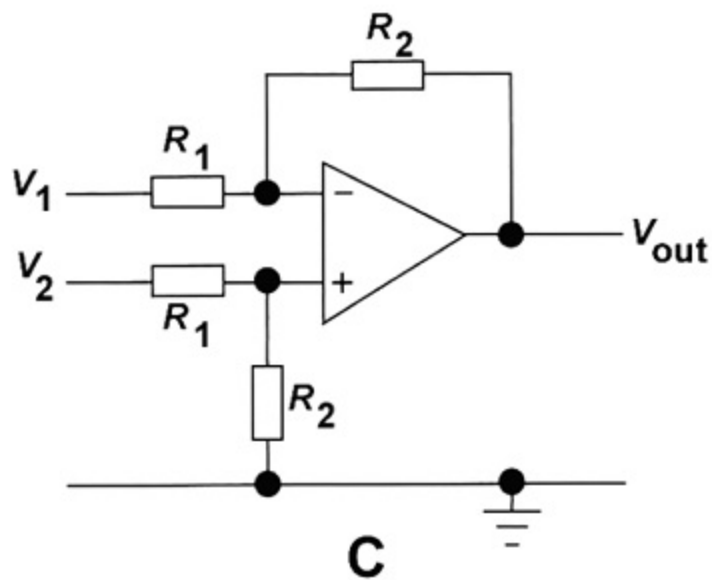
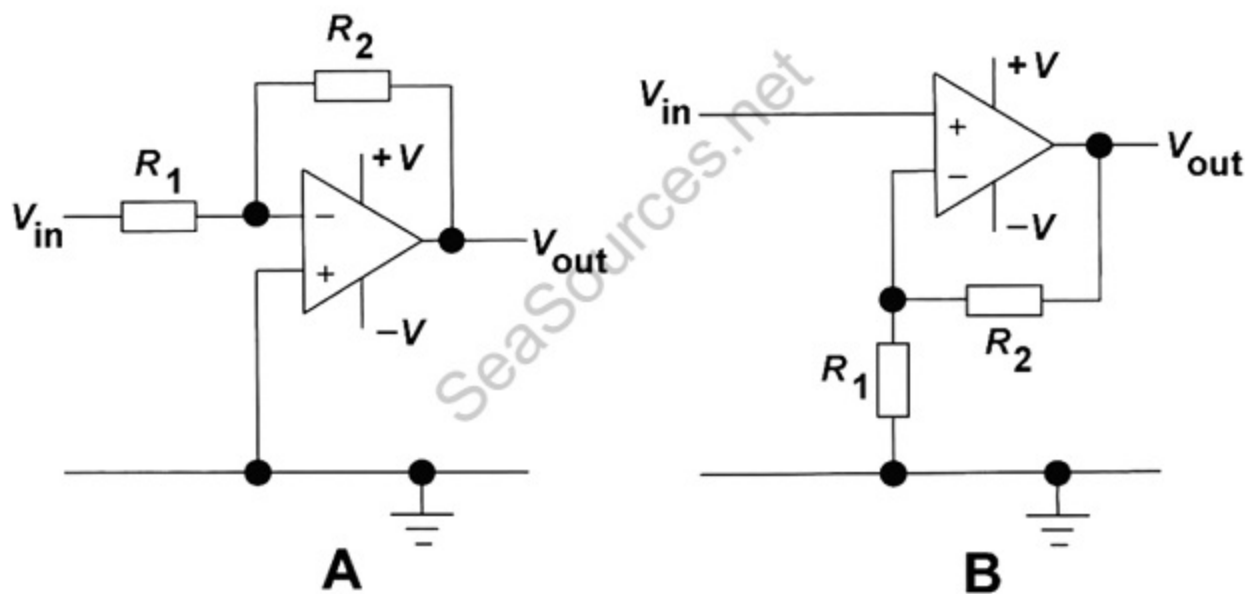


C



EL-0251





EL-0256

