U.S.C.G. Merchant Marine Exam

Chief Engineer – Limited

Q604 Electrical – Electronic – Control Engineer

(Sample Examination)

Choose the best answer to the following Multiple-Choice Questions:

1. In figure "B" of the illustrated circuit, if the resistance of R1 is 10 ohms, R2 is 10 ohms, and R3 is 10 ohms, what is the total resistance? Illustration EL-0032

   A. 15 ohms
   B. 20 ohms
   C. 25 ohms
   D. 30 ohms

   Correct answer: A

2. What is the maximum current allowed to be drawn from the secondary of a 2 kVA step-down transformer with a turns ratio of four to one if connected across a 440 volt line?

   A. 1.1 amps
   B. 4.5 amps
   C. 18.1 amps
   D. 22.7 amps

   Correct answer: C

3. As shown in figure "D" of the illustrated digital power meter, what type of single-phase load is under test for power measurement? Illustration EL-0256

   A. a resistive-capacitive load
   B. a purely inductive load
   C. an inductive-resistive load
   D. a purely resistive load

   Correct answer: C

4. While troubleshooting a circuit in an engine room central control console, a resistor is suspected of being faulty. Which of the following precautions must be observed if an analog or digital multimeter set up as an ohmmeter is to be used to check its value?

   A. The correct polarity must be observed because reverse bias will damage the component.
   B. The meter case must be grounded prior to attaching the leads.
   C. The resistor's circuit must be de-energized and at least one end of the resistor isolated by disconnecting.
   D. The meter leads must not be twisted so as to cancel out the individual magnetic fields.

   Correct answer: C

5. Prior to using an analog multimeter set up as an ohmmeter, the leads are purposely shorted together. Which of the following actions should be taken if, when adjusting to "zero" ohms, the indicating needle cannot be returned to "zero" on the scale?

   A. The lead clips should be replaced.
   B. The test reading should be added to each final reading.
   C. The test reading should be subtracted from each final reading.
   D. The batteries should be replaced.

   Correct answer: D

6. In what situation would an electrical phase sequence indicator be useful?

   A. connecting lighting branch circuits
   B. troubleshooting DC motors
   C. preparing to parallel alternators
   D. connecting shore power lines to the ship

   Correct answer: D

7. As shown in the illustration, what type of motor and motor starter are featured? Illustration EL-0137

   A. non-reversing squirrel cage induction motor with reduced voltage primary reactor starting
   B. reversing squirrel cage induction motor with reduced voltage autotransformer starting
   C. reversing squirrel cage induction motor with across-the-line starting
   D. non-reversing squirrel cage induction motor with reduced voltage autotransformer starting

   Correct answer: D

8. A three-phase, induction-type motor experiences an open in one phase. Which of the listed automatic protective devices will prevent the motor from being damaged?

   A. Magnetic blowout coil
   B. Three-pole safety switch
   C. Thermal overload relay
   D. Overspeed trip

   Correct answer: C

9. Which of the following describes the action when the handle is moved to the "start" position of a drum-type motor controller used with a compound wound DC motor?

   A. Full line voltage is supplied to the shunt field, series field, and armature.
   B. Full line voltage is supplied to the shunt field, and reduced voltage is supplied to the series field and the armature.
   C. Full line voltage is supplied to the shunt and series fields, and reduced voltage is supplied to the armature.
   D. Reduced voltage is supplied to the shunt field, series field, and armature.

   Correct answer: B

10. Using the catalog selection chart shown in Illustration EL-0180, determine the correct catalog number for a motor starter that meets the following criteria:

NEMA	Open enclosure
3-pole	Rated at 45 continuous amperes
Vertically mounted	Electronic overload relay-Ground fault feature set;
Reversing starter	Operating coil rated at 24 VAC/60 Hz

   A. AE19GNVB5G045
   B. AN19AN0A5E005
   C. AN59GNVT5G045
   D. CN16GNVT5G045

   Correct answer: C

11. By what means should motor controller contacts be routinely cleaned?

    A. blowing with compressed air
    B. dressing with crocus cloth
    C. filing with a bastard file
    D. wiping with a clean dry cloth

    Correct answer: D

12. What may cause magnetic controller contacts to become welded together during operation?

    A. low contact pressure
    B. excessive magnetic gap
    C. excessive ambient temperature
    D. an open coil

    Correct answer: A

13. As shown in the illustration, what is the purpose of the Time Delay (TR) coil in the circuit? Illustration EL-0104

    A. Allows the motor to come up to speed before placing the starting resistors in the circuit.
    B. Ensures the motor cannot be started until the accelerating coil is energized.
    C. Ensures the motor cannot be started until the overload relays are reset.
    D. Allows the motor to come up to speed at reduced voltage before bypassing the starting resistors.

    Correct answer: D

14. If the motor of the illustrated circuit fails to start and gives a loud hum when the start button is pushed, what is most likely the problem? Illustration EL-0007

    A. an open overload "OL" relay contact
    B. an open main contactor "M" coil
    C. the disconnect switch "DS" is open
    D. an open overload "OL" heater

    Correct answer: D

15. As shown in the illustration of a cycloconverter for an AC synchronous propulsion motor, what statement is true concerning the operating motor frequency? Illustration EL-0157

    A. The operating motor frequency is generally limited to less than one-third of mains line frequency.
    B. The operating motor frequency is generally limited to three times the mains line frequency.
    C. The operating motor frequency is generally limited to that equal to the mains line frequency.
    D. The operating motor frequency is generally not limited regardless of the mains line frequency.

    Correct answer: A

16. Which of the following statements is true concerning a large polyphase synchronous main propulsion motor as used in an electric propulsion drive system?

    A. Resistance is gradually added to the rotor circuit.
    B. The field winding is energized for starting purposes only.
    C. The starting current is held below the rated current.
    D. The motor is started as an induction motor.

    Correct answer: D

17. Which of the following is a disadvantage of electric drive propulsion systems?

    A. Main propulsion power may also be directed to ships electrical service distribution.
    B. The propeller speed and direction of rotation are easily controllable.
    C. Propulsion motors are required along with electrical power generation machinery.
    D. Location of electric power generation machinery is flexible.

    Correct answer: C

18. As shown in figure "B" of the illustration, what statement is true concerning "regenerating" operation? Illustration EL-0162

    A. by applying torque in the opposite direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly speeds up the motor
    B. by applying torque in the same direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly slows down the motor
    C. by applying torque in the same direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly speeds up the motor
    D. by applying torque in the opposite direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly slows down the motor

    Correct answer: D

19. How is the direction of rotation of the main propulsion motor in a modern AC propulsion drive system reversed?

    A. reversing the direction of current flow in the armature
    B. changing the direction of current flow in the motor's field winding
    C. power directional relays
    D. electronically changing the phase sequence of the voltages generated by the power converter

    Correct answer: D

20. How is the speed of the propeller shaft directly coupled to an AC synchronous drive motor changed when powered by either a dedicated or integrated constant frequency alternator in an AC diesel-electric drive system?

    A. Varying the number of motor poles
    B. Varying the field strength of the generator
    C. Varying the generator speed
    D. Varying the output frequency of the power converter

    Correct answer: D

21. Referring to the illustration of a twin-screw diesel-electric AC propulsion drive system, what is the purpose of the shaft position signal? Illustration EL-0168

    A. The shaft position signal is used when changing the direction of rotation of the shaft and is used to determine the exact instant reversal of rotation takes place after reversing torque direction.
    B. The shaft position signal senses shaft vibration due to shaft bearing wear or propeller blade damage and provides data for the predictive maintenance system.
    C. The shaft position signal detects axial movement of the shaft due to thrust bearing wear and provides data for the predictive maintenance system.
    D. The shaft position signal is used when in the shaft-synchronizing mode to momentarily accelerate or decelerate the shafts to align the propeller blades of the two shafts to reduce vibration.

    Correct answer: D

22. Propulsion AC generators creating 4160 VAC use transformers to provide nominally 120 VAC to the automatic voltage regulator. What is the turns ratio of this step-down transformer?

    A. 1:4
    B. 4:1
    C. 35:1
    D. 40:1

    Correct answer: C

23. An AC diesel-electric drive ship with synchronous propulsion motors has the capability for power factor correction. If the power factor associated with the main power distribution including all motors is 0.7 leading, what statement is true?

    A. The synchronous propulsion motors are over-excited.
    B. The synchronous propulsion motors are normally excited.
    C. The synchronous propulsion motors are under-excited.
    D. The excitation status of the synchronous motor cannot be determined.

    Correct answer: A

24. What type of motor is generally used in DC propulsion drive systems?

    A. permanent magnet
    B. shunt wound
    C. series wound
    D. differentially compounded

    Correct answer: B

25. How is reversal of a DC propulsion motor achieved?

    A. the use of a 12-pulse converter
    B. the use of a shunt field regulator
    C. reversing the direction of current flow in the motor field windings
    D. reversing the phase sequence of the incoming voltage

    Correct answer: C

26. On DC diesel-electric drives, how is the speed of the DC propulsion motor primarily controlled?

    A. changing the generator engine speed
    B. changing the motor field excitation current
    C. changing the generator field excitation current
    D. changing the polarity of the generator field

    Correct answer: A

27. Power conversion for use in DC propulsion drive motors is accomplished by what type of converter?

    A. silicon-controlled rectifier converters
    B. cycloconverters
    C. load commutated converters
    D. pulse width modulated converters

    Correct answer: A

28. Refer to the two-generator, two-motor, DC diesel-electric drive propulsion system simplified schematic shown in the illustration. While in two-generator, two-motor operation, which of the following conditions would cause the propulsion shaft speed to be approximately one-half the desired speed? Illustration EL-0141

    A. The armature winding of one of the propulsion motors is open-circuited.
    B. The armature winding of one of the propulsion generators is open-circuited.
    C. The field winding of one of the propulsion generators is open-circuited.
    D. The field winding of one of the propulsion motors is open-circuited.

    Correct answer: C

29. As shown in the illustration of a DC diesel-electric propulsion drive system, what would be the set-up contactor configurations if #1 M/E is to be secured, so that only #2 M/E diesel-generator is set up to supply both propulsion motors? Illustration EL-0141

    A. contactors G2 and S2 pulled in; contactors G1 and S1 dropped out
    B. contactors G2 and S2 dropped out; contactors G1 and S1 pulled in
    C. contactors G2 and S1 dropped out; contactors G1 and S2 pulled in
    D. contactors G2 and S1 pulled in; contactors G1 and S2 dropped out

    Correct answer: D

30. Due to the operating characteristics of the system, time lag fuses (or dual-element fuses) are necessary for use in what types of circuits?

    A. emergency lighting circuits
    B. motor starting circuits
    C. main lighting circuits
    D. general alarm circuits

    Correct answer: B

31. As shown in figures "E" and "F" of the pictured high voltage rack mounted circuit breaker, which figure represents the circuit breaker position when in the open or tripped position? Illustration EL-0167

    A. A
    B. B
    C. C
    D. D

    Correct answer: C

32. What is the greatest single cause of electrical failures?

    A. high inductance
    B. too frequent testing
    C. overcurrent
    D. the breakdown of insulation

    Correct answer: D

33. What type of circuit is represented by the diagram shown in the illustration? Illustration EL-0058

    A. common fluorescent lighting circuit
    B. dual speed, 2-winding motor controller circuit
    C. uninterruptible power supply circuit
    D. navigation running light circuit

    Correct answer: D

34. What are the operating characteristics of a step-down potential transformer in terms of the secondary load?

    A. reduced voltage and reduced current
    B. reduced current and increased voltage
    C. reduced power (kVA)
    D. reduced voltage and increased current

    Correct answer: D

35. What is the purpose of the device labeled "Man-Auto Sw." in the illustrated switchboard? Illustration EL-0003

    A. to enable the operator to read the field voltage on device "Volt. Reg. Adj. Pot." or device "Man. Volt. Adj. Rheo."
    B. to shift the governor control from manual to automatic/zero droop or vice versa
    C. to supply regulated control power to the switchboard
    D. to shift from the automatic voltage regulator to manual voltage control or vice versa

    Correct answer: D

36. As shown in figure "A" of the illustration, with respect to the common equipment grounding conductor, what statement is true? Illustration EL-0125

    A. The common equipment grounding conductor is solidly-grounded at the source and this is the most common arrangement onboard merchant vessels.
    B. The common equipment grounding conductor is solidly-grounded at the source and this is the least common arrangement onboard merchant vessels.
    C. The common equipment grounding conductor is insulated from the source and this is the least common arrangement onboard merchant vessels.
    D. The common equipment grounding conductor is insulated from the source and this is the most common arrangement onboard merchant vessels.

    Correct answer: D

37. Why is it necessary to perform periodic testing of correctly rated and properly installed circuit breakers?

    A. to insure they can trip faster as they increase in age
    B. to insure they will continue to provide the original degree of protection
    C. to insure they do not exceed their interrupting capacity
    D. to insure they will be able to withstand at least 125% of applied voltage

    Correct answer: B

38. Which of the following procedures should be used to maintain a large electric motor during periods of inactivity?

    A. A thin layer of air-drying varnish should be applied on the windings.
    B. Compressed air should be blown over areas where dust is deposited.
    C. Spraying a solvent periodically to remove carbon dust.
    D. Space heaters should be used to prevent condensation of moisture.

    Correct answer: D

39. To check the three-line fuses protecting a three-phase motor using a multimeter set up as a voltmeter, what should be done FIRST?

    A. place the starter in the "stop" position
    B. make sure the motor is operating at full load to guard against a false reading
    C. place the leads across the "hot" ends of the fuses
    D. place the leads across the bottom ends of the fuses

    Correct answer: A

40. If a digital multimeter is set up as shown in figure "A" of the illustration, what would be displayed on the screen if the fuse being tested is blown? Illustration EL-0210

    A. OL volts
    B. 0.001 ohms
    C. 470 ohms
    D. OL ohms

    Correct answer: D

41. In the lighting distribution circuit shown in the illustrated lighting panel L110 of the illustration, if all circuit breakers are closed and due to a problem with the relevant feeder circuit breaker, there is a loss of power on the incoming phase A, which of the following statements is true? Illustration EL-0013

    A. All of the accommodation lighting circuits on the 01 deck, starboard side would lose power.
    B. Half of the accommodation lighting circuits on the 01 deck, port side would lose power.
    C. All of the receptacles in the laundry would lose power.
    D. Half of the passageway lighting circuits on the 01 deck would lose power.

    Correct answer: B

42. Which of the following expresses the relationship of the AC input frequency and DC ripple output frequency in a full wave rectifier?

    A. The output ripple frequency is the same as input frequency.
    B. The output ripple frequency is twice the input frequency.
    C. The output ripple frequency is one-half the input frequency.
    D. The output ripple frequency is four times the input frequency.

    Correct answer: B

43. On a digital numerical display readout, what would be the minimum number of LED segments required to form and display any digit 0 through 9?

    A. 6
    B. 7
    C. 8
    D. 9

    Correct answer: B

44. As shown in figure "B" of the illustrated function block for a PLC PID controller, to what input is the actual analog signal of the measured value delivered? Illustration EL-0251

    A. KP
    B. PV
    C. SP
    D. XO

    Correct answer: B

45. As shown in figures "A", "B", and "C" of the illustration, what is the purpose of the differential amplifier segment of the 741 operational amplifier? Illustration EL-0111

    A. detect and amplify the voltage difference between the inputs at pins 1 and 2
    B. detect and amplify the voltage difference between the inputs at pins 1 and 5
    C. detect and amplify the voltage difference between the inputs at pins 2 and 3
    D. detect and amplify the voltage difference between the inputs at pins 3 and 5

    Correct answer: C

46. In process control terminology, continuously variable values which change without distinct increments, such as temperature, pressure, or level are correctly referred to as what type of values?

    A. analog values
    B. bumpless values
    C. digital values
    D. binary values

    Correct answer: A

47. What does the electronic symbol of figure "9" represent? Illustration EL-0065

    A. zener diode
    B. triac thyristor
    C. diac trigger diode
    D. diode rectifier

    Correct answer: B

48. Which of the listed conditions describes the effect on intrinsic semiconductor operation as a result of a temperature increase?

    A. Inductive reactance will decrease
    B. Resistivity will increase
    C. Capacitive reactance will decrease
    D. Conductivity will increase

    Correct answer: D

49. What is the functional purpose of a heat sink, as frequently used with transistors?

    A. to compensate for excessive doping
    B. to prevent excessive temperature rise
    C. to increase the reverse current
    D. to decrease the forward current

    Correct answer: B

50. What does the circuit shown in the illustration represent? Illustration EL-0091

    A. voltage regulator
    B. oscillator
    C. electronic overload relay
    D. function generator

    Correct answer: C

51. What should be done with a capacitor that is obviously discolored due to excessive heat?

    A. calibrated using a capacitance Wheatstone bridge
    B. cooled with a spray can of refrigerant approved for this purpose
    C. replaced and the reason for the overheating found
    D. resoldered with care taken to ensure that the original cold solder joint is repaired

    Correct answer: C

52. An ohmmeter used to test for front-to-back resistance of a PN junction diode should produce roughly what ratio?

    A. 100:1
    B. 500:1
    C. 1000:1
    D. 5000:1

    Correct answer: A

53. In order to check the performance of a transistor removed from its circuit, what meter or tester should be used?

    A. impedance meter
    B. ohmmeter or transistor tester
    C. voltmeter or transistor tester
    D. sensitive potentiometer

    Correct answer: B

54. When using an ohmmeter to test a semiconductor diode, you find a low resistance in both the forward and reverse bias directions. What condition does this indicate?

    A. a short
    B. an open
    C. good resistive quality
    D. good capacitive quality

    Correct answer: A

55. What problem with a printed circuit board may resolve itself once a board is removed from its edge card connector and then reinstalled?

    A. Corroded pin connectors
    B. Leaking components
    C. Discolored or darkened components
    D. Open traces or broken connections

    Correct answer: A

56. When troubleshooting a printed circuit board, one technique that can be used is component substitution. Upon what basis would a suspected defective component be substituted with a known good component?

    A. Methodical substitution of components starting at one end of the board and working towards the opposite end.
    B. Component substitution is not recommended as a troubleshooting technique.
    C. Visual inspection of components or the use of live signal tracing with test instruments.
    D. Random substitution of components in no particular pattern.

    Correct answer: C

57. What is the most common and reliable type of circuit breaker used for high voltage practice aboard ship?

    A. air-break
    B. oil-break
    C. vacuum-break
    D. gas-break

    Correct answer: C

58. For the purposes of shipboard practice, voltages above what threshold would be considered high voltage?

    A. 440 VAC
    B. 1000 VAC
    C. 4160 VAC
    D. 6600 VAC

    Correct answer: B

59. As shown in the illustrated block diagram for a digitized echo sounding system, what statement is true concerning the transmission and reception of acoustical energy? Illustration EL-0185

    A. The acoustical energy is produced as rapid, short high intensity pulses and transmitted from the transducer and the reflected acoustical energy is received by the same transducer.
    B. The acoustical energy is produced as a continuous wave and transmitted from the transducer and the reflected acoustical energy is received by the same transducer.
    C. The acoustical energy is produced as a continuous wave and transmitted from one transducer and the reflected acoustical energy is received by a second transducer.
    D. The acoustical energy is produced as rapid, short high intensity pulses and transmitted from one transducer and the reflected acoustical energy is received by a second transducer.

    Correct answer: A

60. As shown in the illustrated digital gyrocompass functional block diagram and the associated communication protocols table, what would the rate of turn signal voltage be if the rate of turn is 30 degrees per minute to port? Assume that the rate of turn to port signal voltage is negative in polarity and that the rate of turn to starboard signal voltage is positive in polarity. Illustration EL-0194

    A. -0.5 VDC
    B. -1.0 VDC
    C. -1.5 VDC
    D. +1.5 VDC

    Correct answer: C

61. As shown in the illustrated adaptive digital steering control system functional block diagram and listed system interface signals table, what would the rudder order signal output voltage to the rudder servo amplifier be for a rudder order of 20 degrees left rudder, assuming left rudder signals are negative and right order signals are positive in polarity? Illustration EL-0191

    A. -2.25 VDC
    B. -4.0 VDC
    C. -5.0 VDC
    D. +5.0 VDC

    Correct answer: C

62. As shown in the illustrated echo sounding display unit and control panel and pertinent operating characteristic tables, what situation would require increasing the unit gain? Illustration EL-0186

    A. transitioning from a stone/rock seabed to a sand seabed
    B. transitioning from a sand seabed to a stone/rock seabed
    C. transitioning from a sand/mud seabed to a sand seabed
    D. transitioning from a soft mud seabed to a mud/sand seabed

    Correct answer: A

63. What statement is true concerning random access memory (RAM)?

    A. RAM is volatile memory and the contents of RAM are not lost when the power is removed.
    B. RAM is volatile memory and the contents of RAM are lost when the power is removed.
    C. RAM is non-volatile memory and the contents of RAM are lost when the power is removed.
    D. RAM is non-volatile memory and the contents of RAM are not lost when the power is removed.

    Correct answer: B

64. If an 8-bit digital to analog converter (DAC) produces an analog output voltage with a range of 10 volts (0-9 volts), what is the smallest incremental step in voltage that can be generated at the output?

    A. 0.03 volts
    B. 0.04 volts
    C. 0.625 volts
    D. 1.25 volts

    Correct answer: B

65. What computer network device maintenance procedure is recommended to be increased in frequency when the equipment is located in areas of high vibration?

    A. Periodically blowing out equipment enclosures with compressed air
    B. Periodically testing network connections with network analyzers
    C. Periodically cleaning or replacing equipment enclosure air filters
    D. Periodically checking the connections between devices and components

    Correct answer: D

66. A very useful Windows utility for discovering or verifying IP addressing information of a network is "ipconfig". How is this utility program launched?

    A. It is run by clicking on the TCP/IP shortcut icon on the desktop.
    B. It is run from the command prompt screen by default by simply bringing up the command prompt.
    C. It is run from the command prompt screen by typing "ipconfig/all".
    D. It is run by clicking on the "ipconfig" icon in start menu or under programs.

    Correct answer: C

67. When a high voltage system insulation test value is suspect or recorded during an annual survey, a polarization index test is performed. What is the polarization index?

    A. The polarization index is the ratio of the insulation resistance taken at one minute to the insulation resistance taken at ten minutes.
    B. The polarization index is the ratio of the insulation resistance taken at thirty minutes to the insulation resistance taken at one minute.
    C. The polarization index is the insulation resistance taken at ten minutes.
    D. The polarization index is the ratio of the insulation resistance taken at ten minutes to the insulation resistance taken at one minute.

    Correct answer: D

68. In order for a live-line tester to be used to test and prove dead a high voltage circuit, what must be done to verify the ability of the tester to detect a voltage?

    A. The live-line tester need not be checked prior to testing the circuit to be worked upon as long as it has not been declared inoperative.
    B. The live-line tester should be checked by connecting to a known high voltage source only before testing the circuit to be worked upon.
    C. The live-line tester should be checked by connecting to a known high voltage source before and after the circuit to be worked upon is tested.
    D. The live-line tester should be checked by connecting to a known high voltage source only after testing the circuit to be worked upon.

    Correct answer: C

69. Without the benefit of a specially designed enclosure window for thermographic analysis, what must be done to obtain accurate, but safe readings using infrared thermographic techniques?

    A. The infrared camera recording is taken before de-energizing and isolating in accordance with safety procedures.
    B. The infrared camera recording is taken while energized with the enclosure door open in accordance with safety procedures.
    C. The infrared camera recording is taken immediately after de-energizing and isolating in accordance with safety procedures.
    D. The infrared camera recording is taken after waiting a suitable period of time after de-energizing and isolating in accordance with safety procedures.

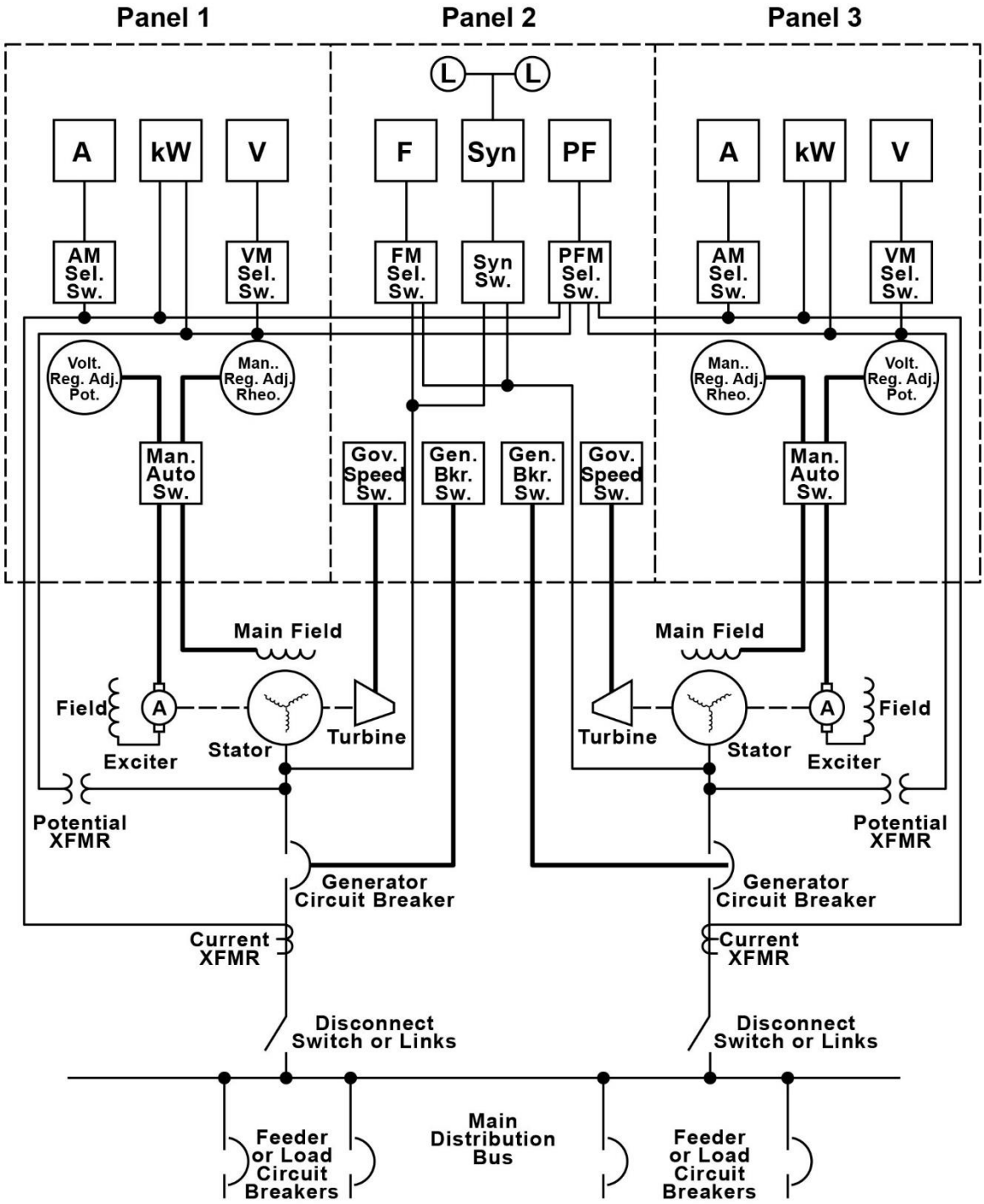
    Correct answer: C

70. How should the shunt used in an ammeter be connected?

    A. in parallel with the load and in parallel with the meter movement
    B. in series with the load and in parallel with the meter movement
    C. in parallel with the load and in series with the meter movement
    D. in series with the load and in series with the meter movement

    Correct answer: B

EL-0003



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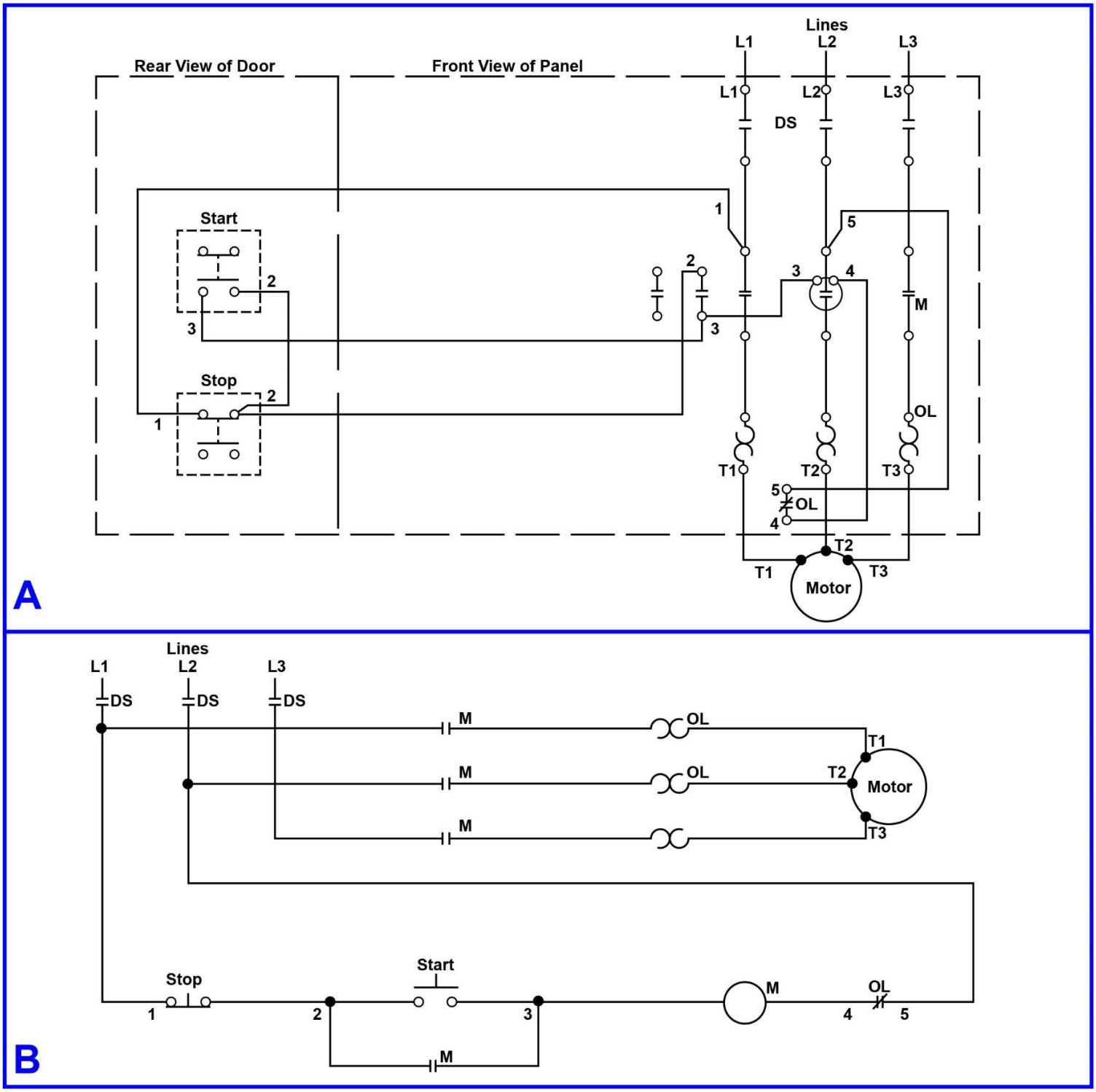

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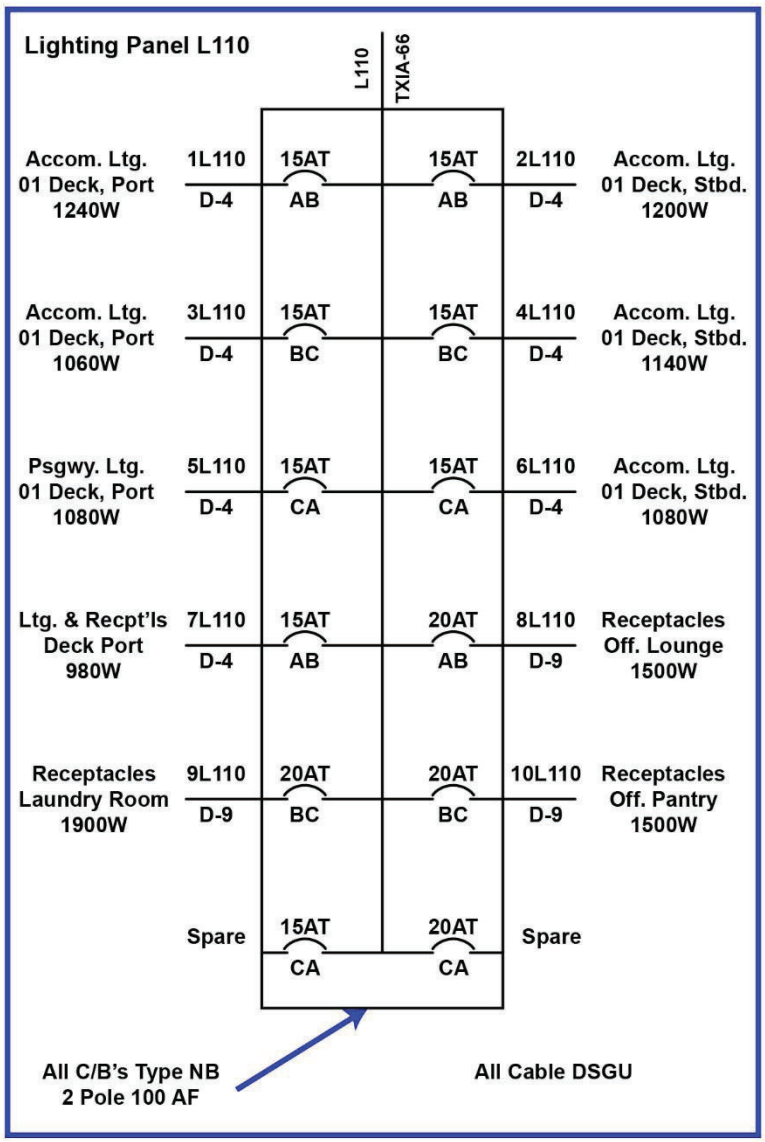

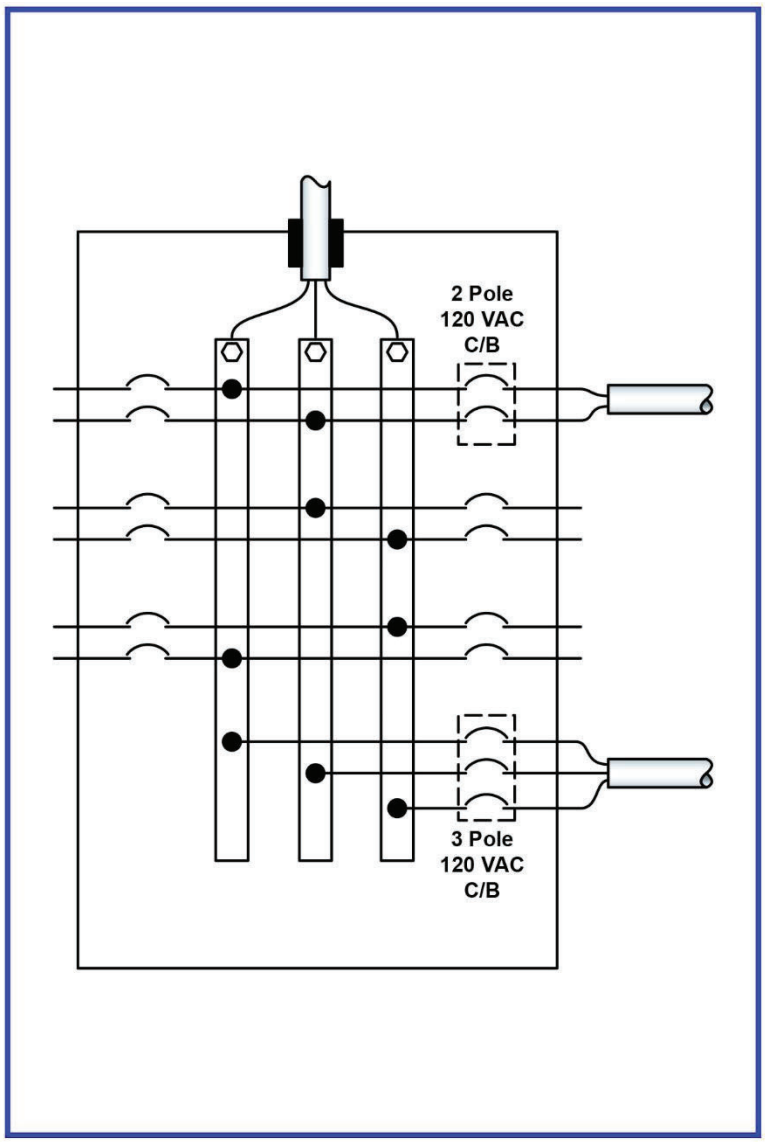

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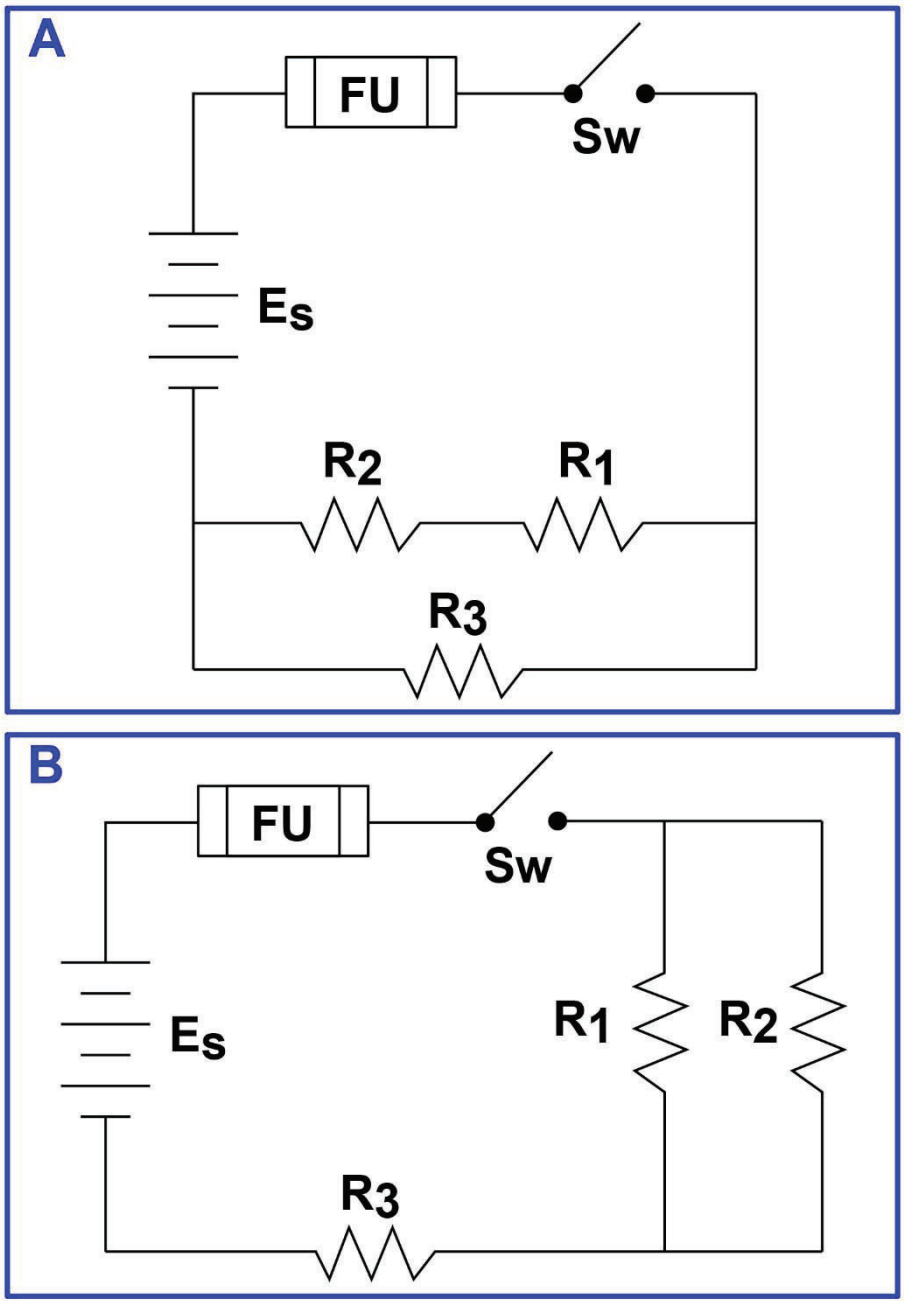
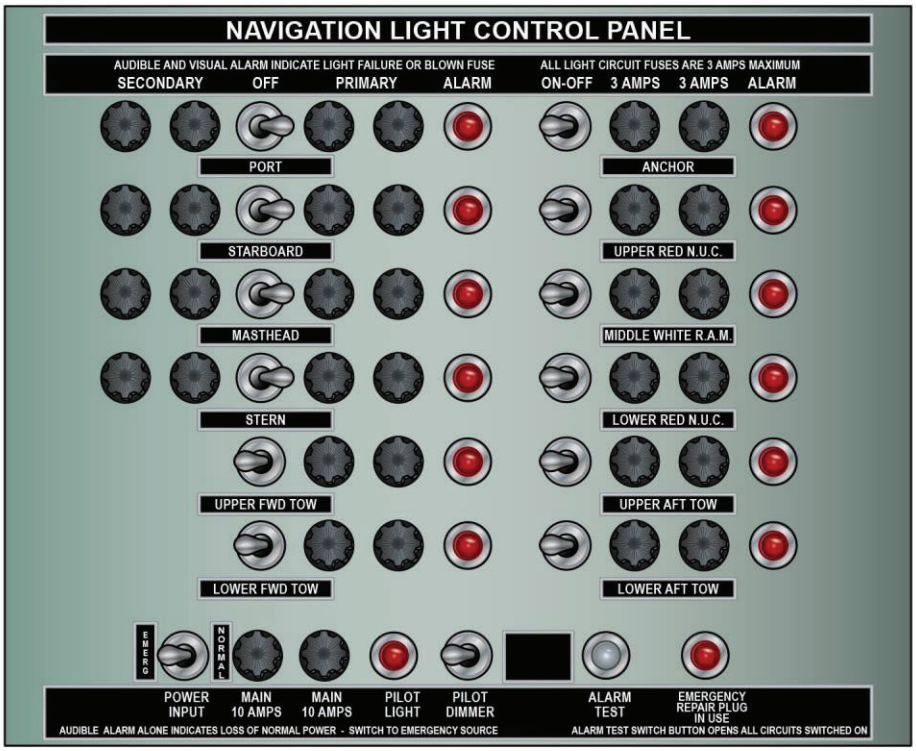
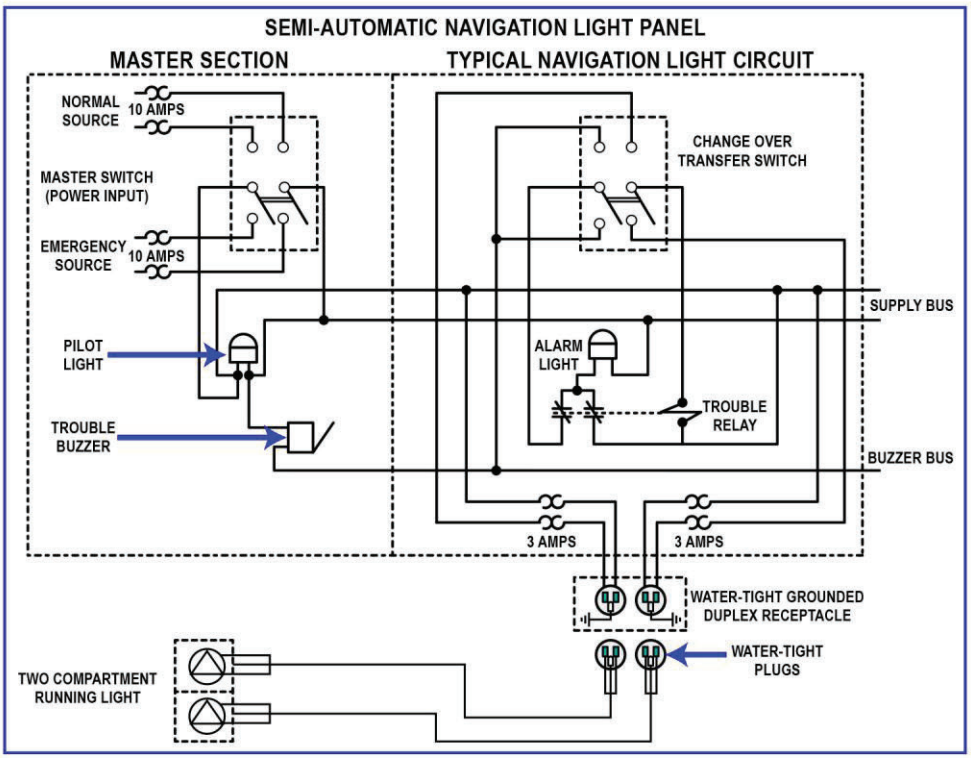


EL-0058





EL-0065

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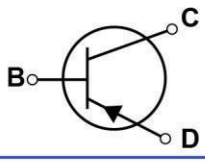

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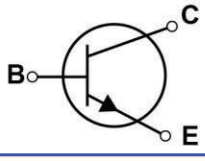

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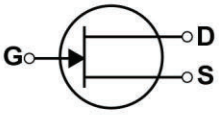

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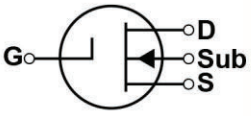

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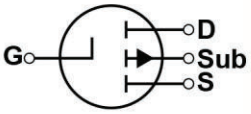

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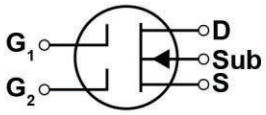

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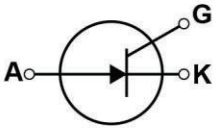

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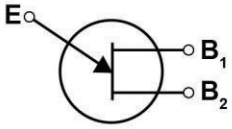

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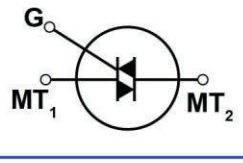

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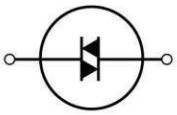

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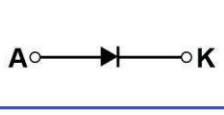

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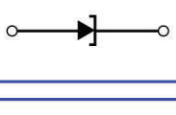

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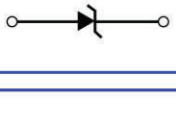

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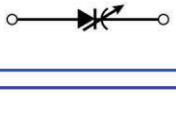

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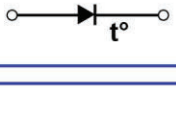

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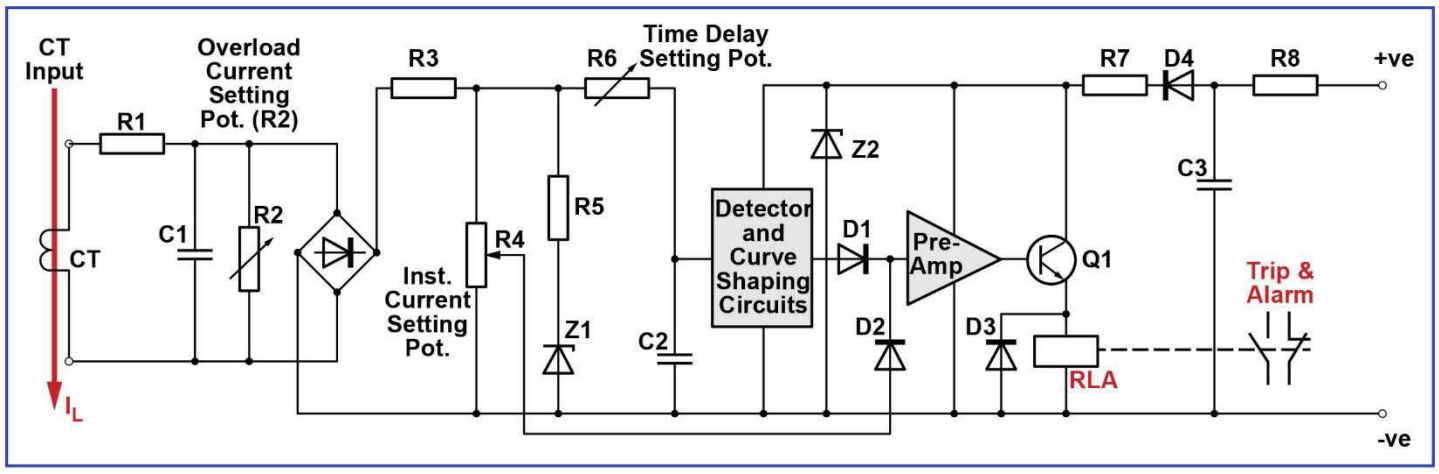
EL-0091



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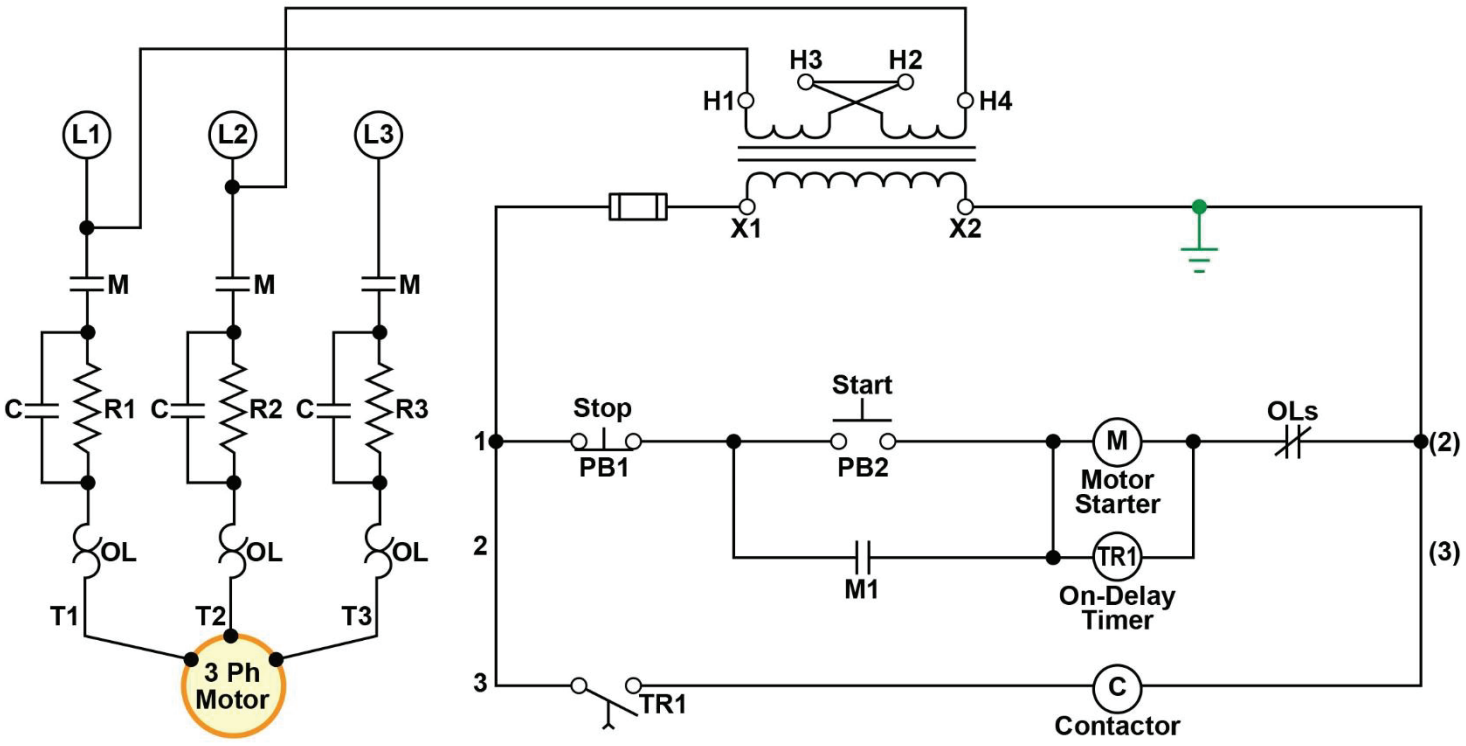

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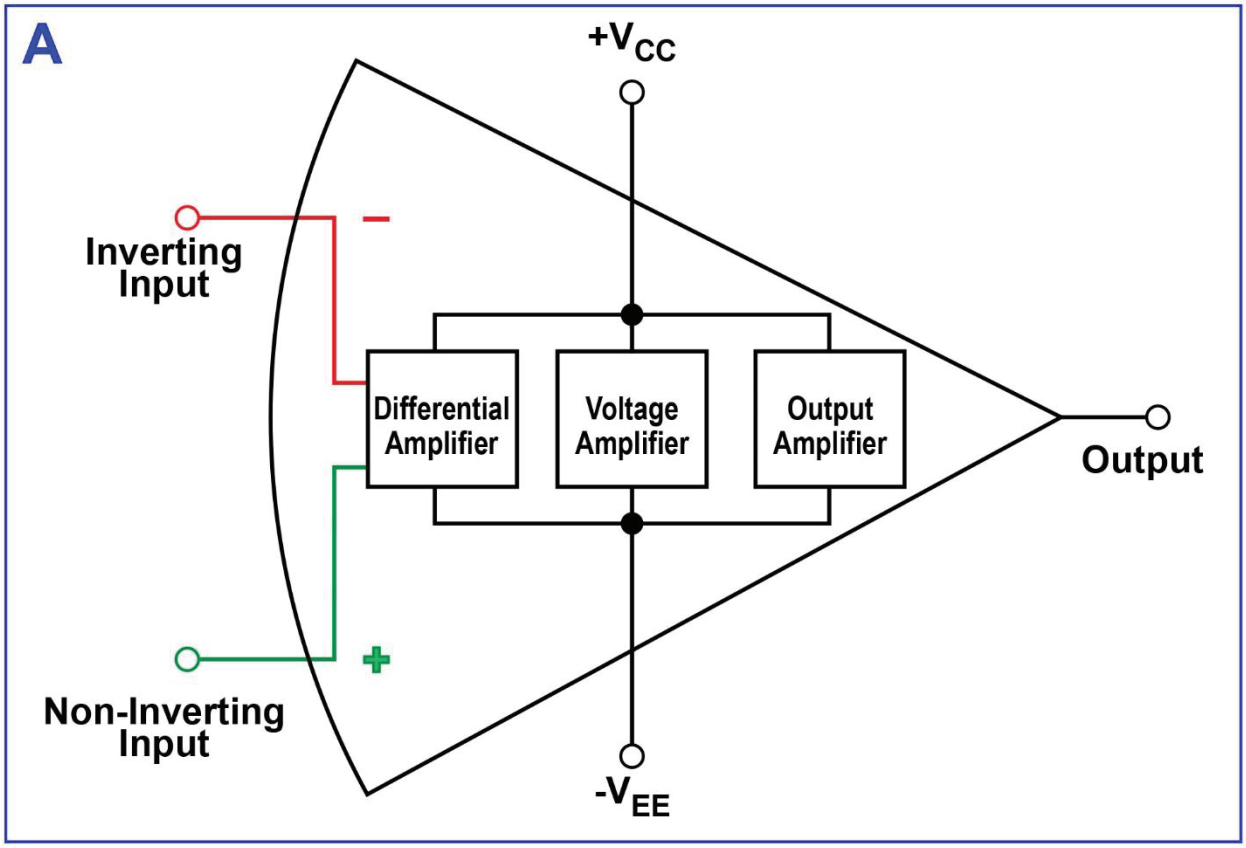

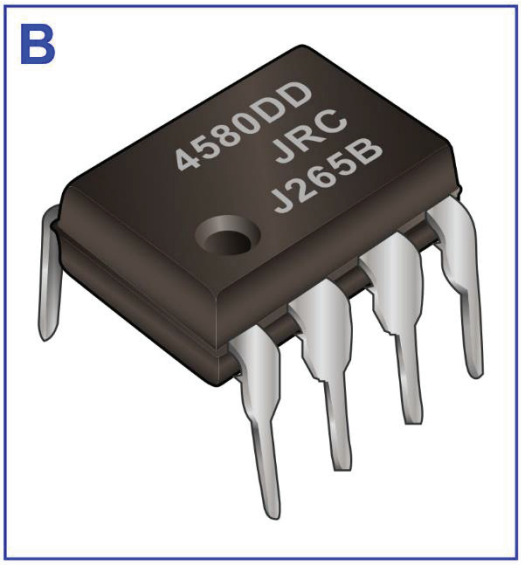

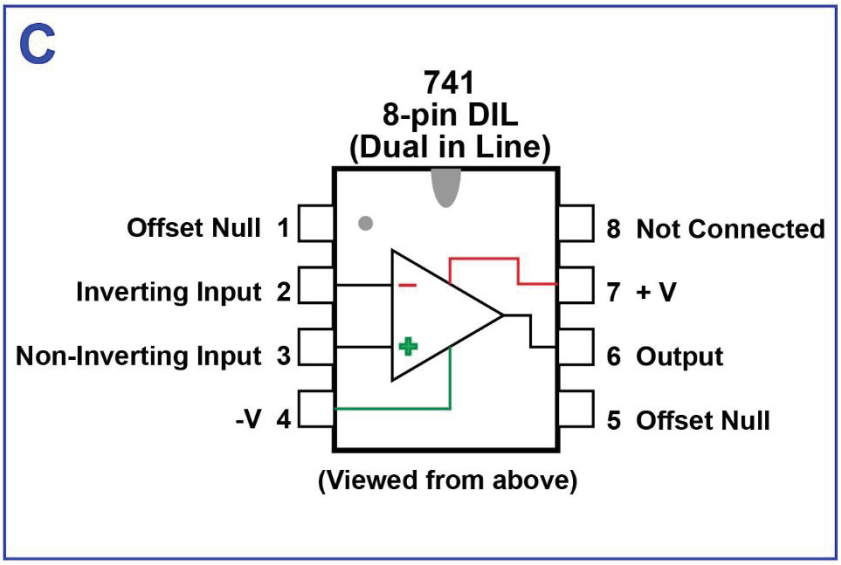

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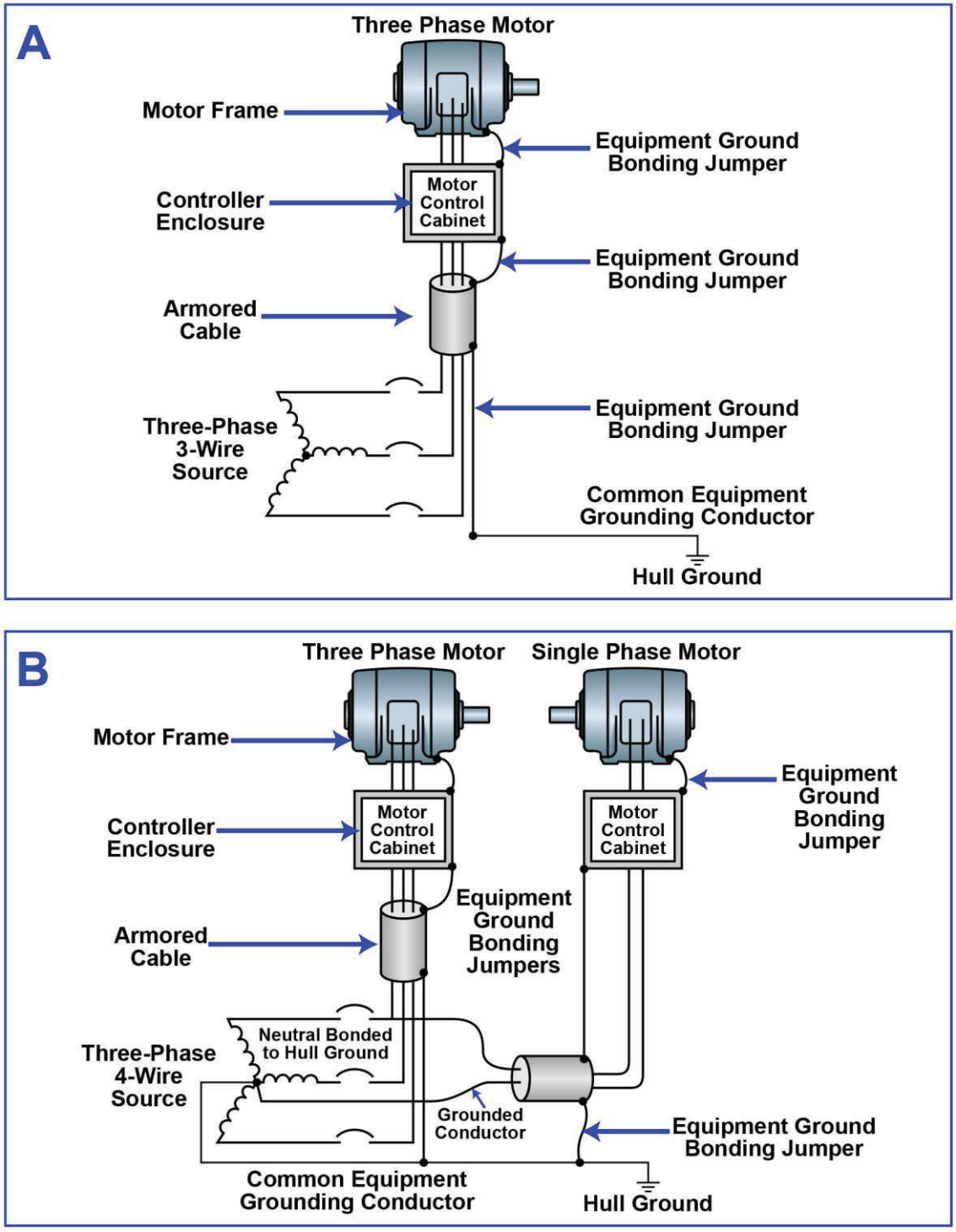

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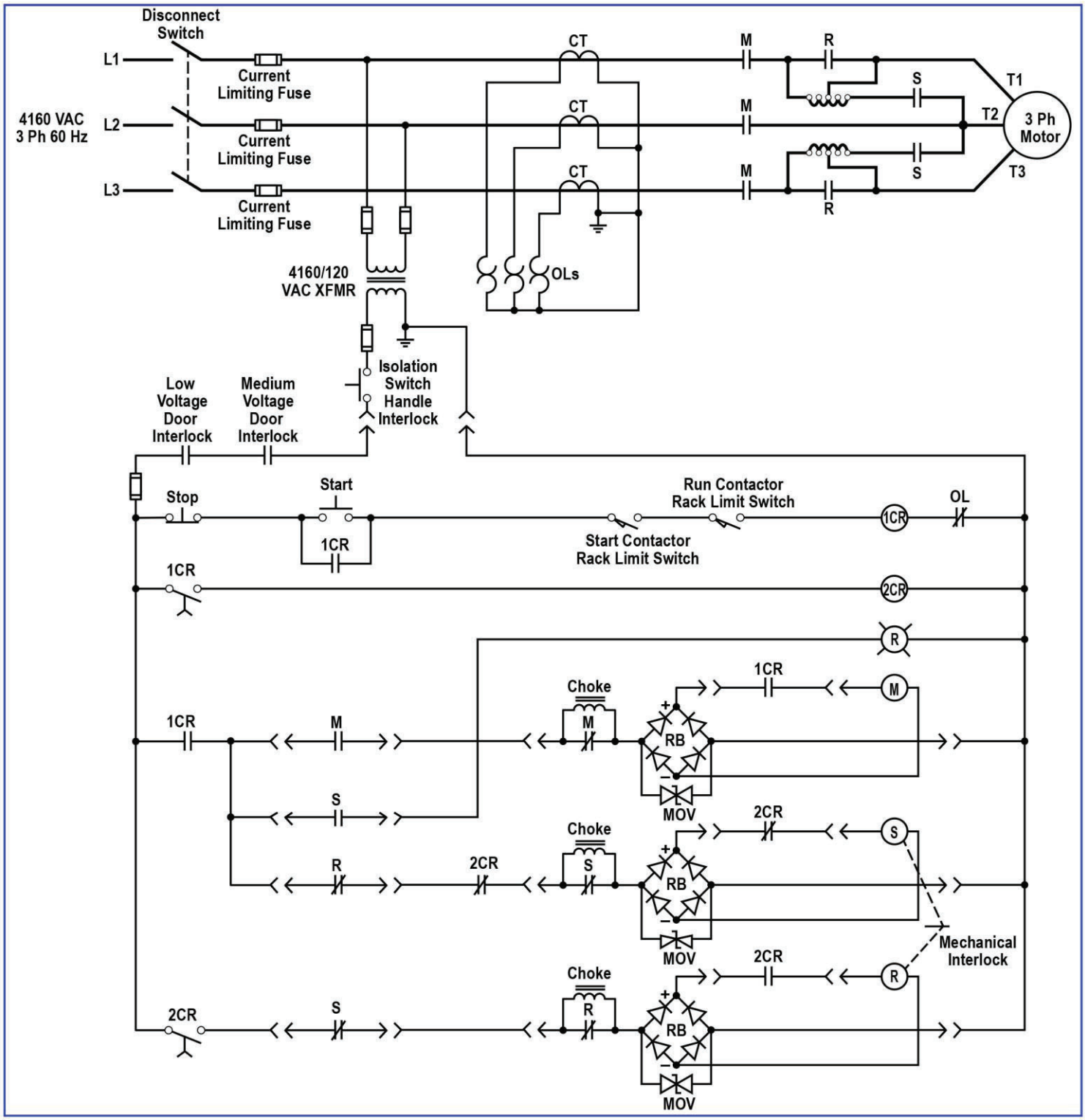

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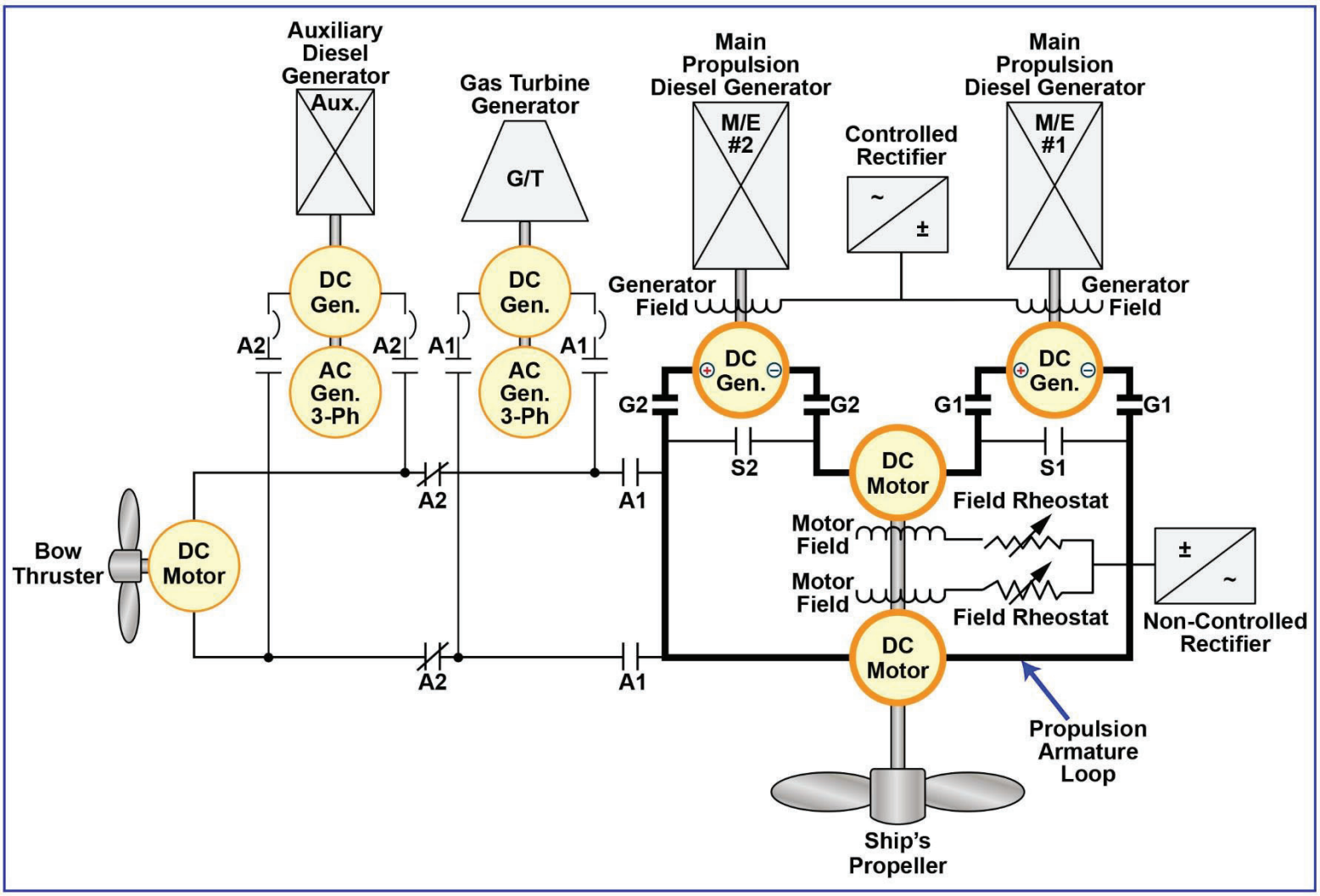

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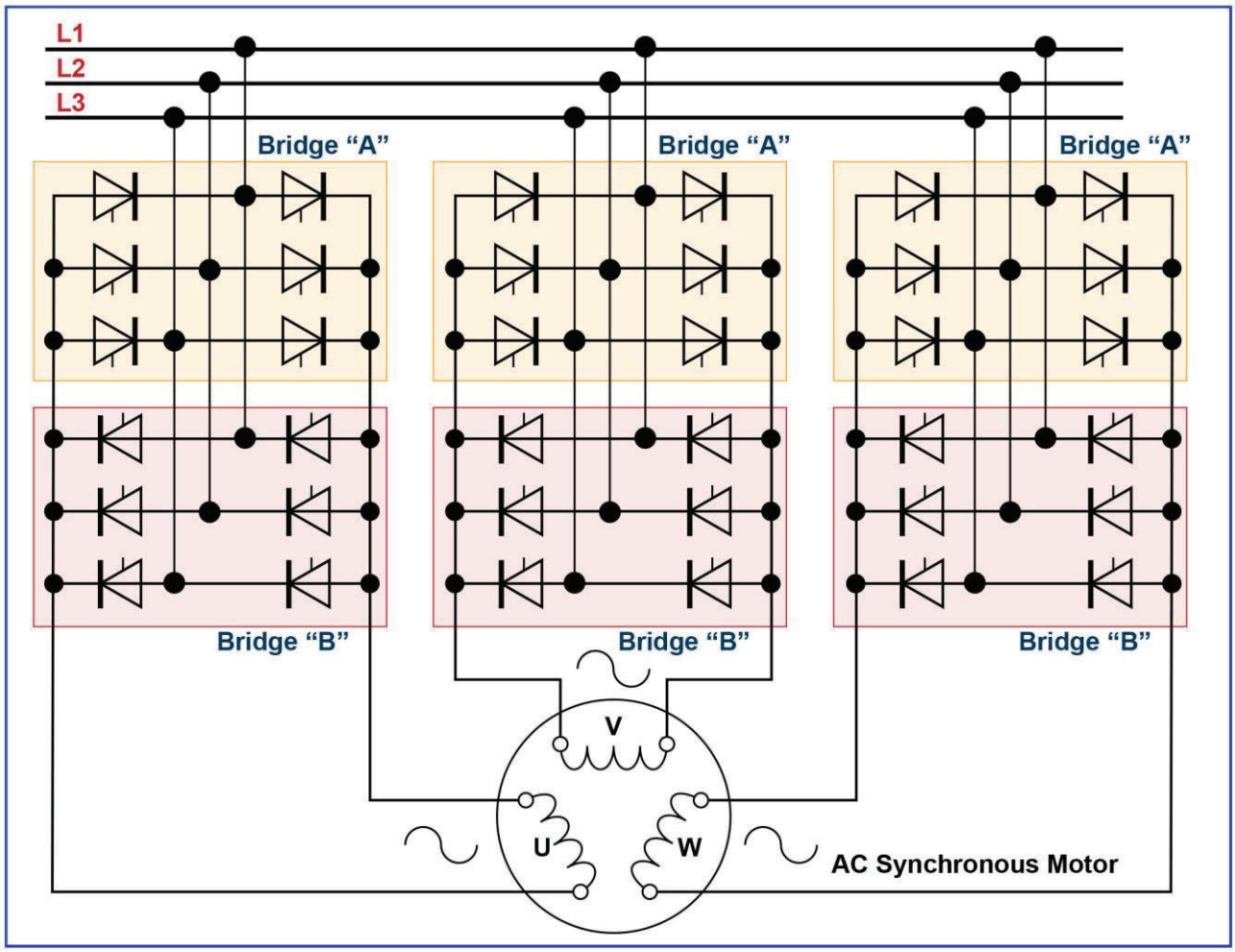

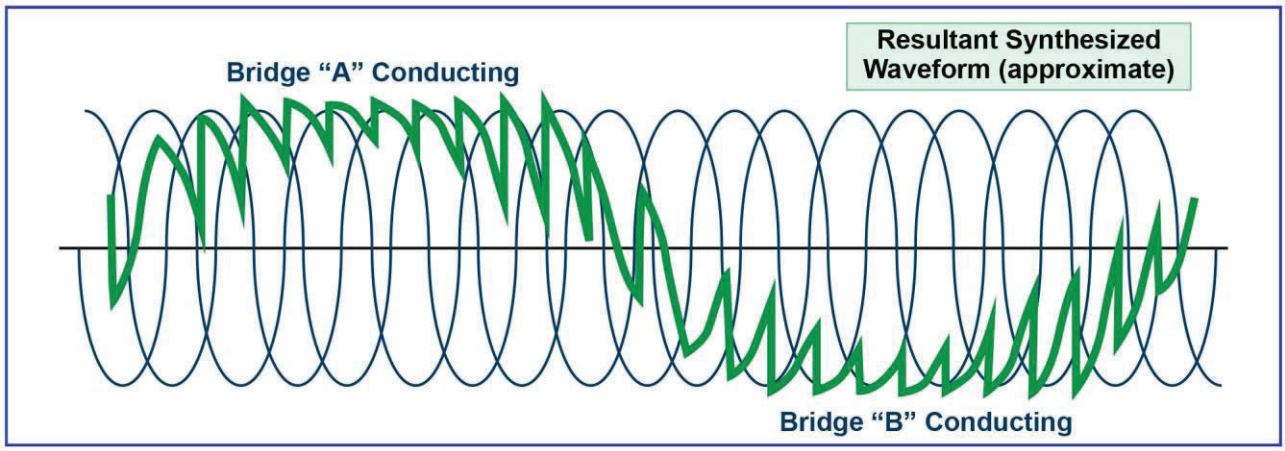

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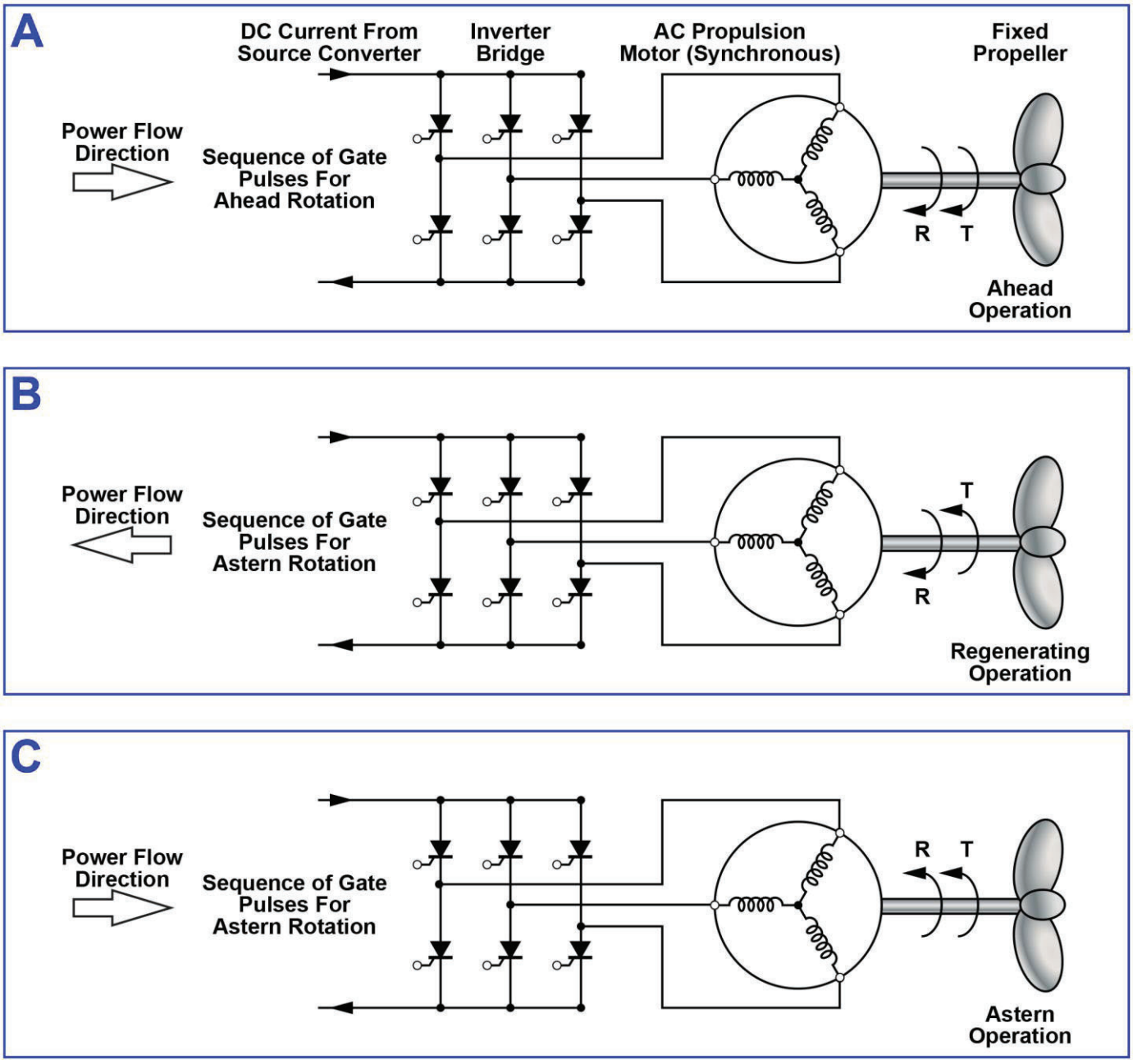
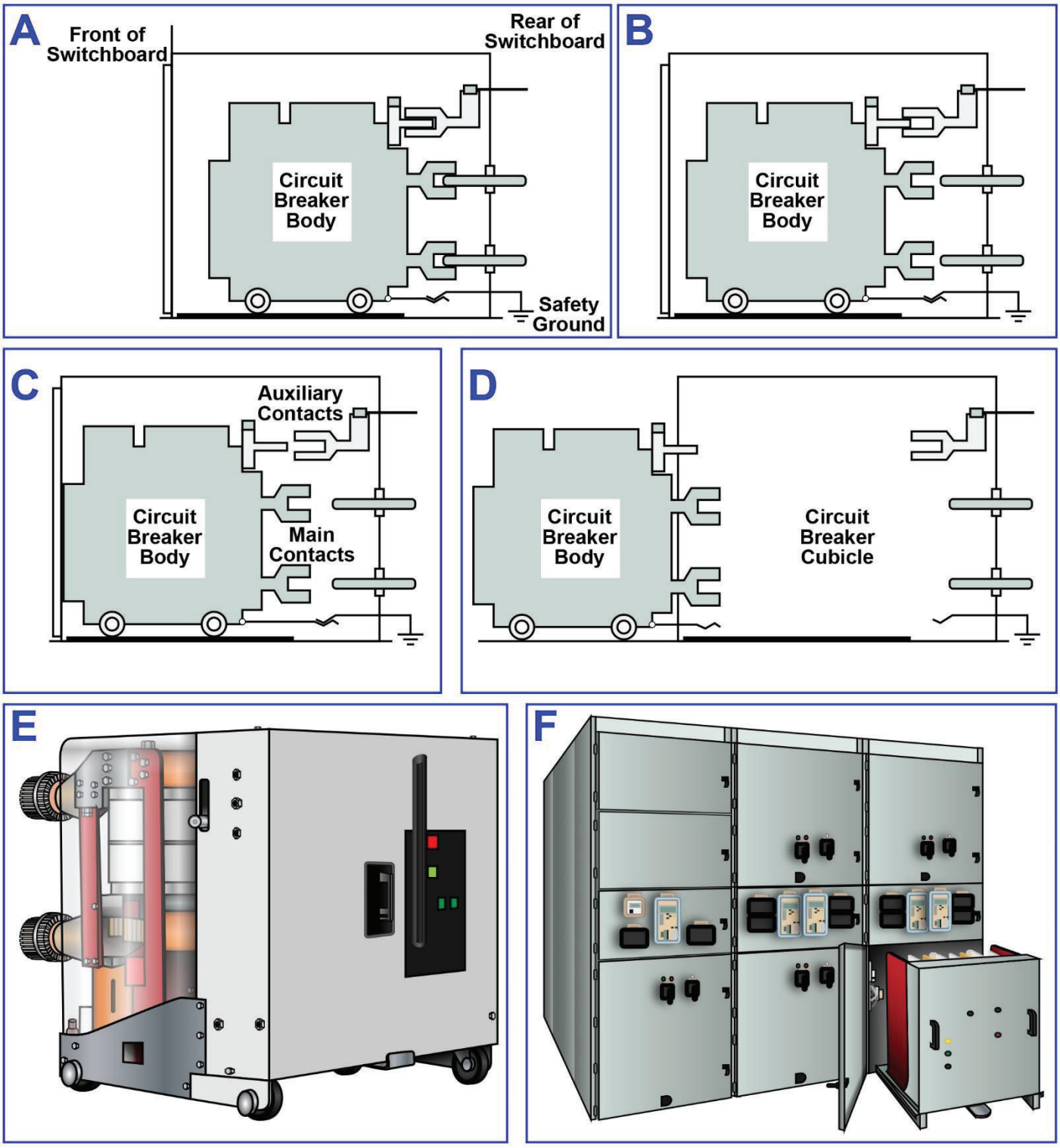
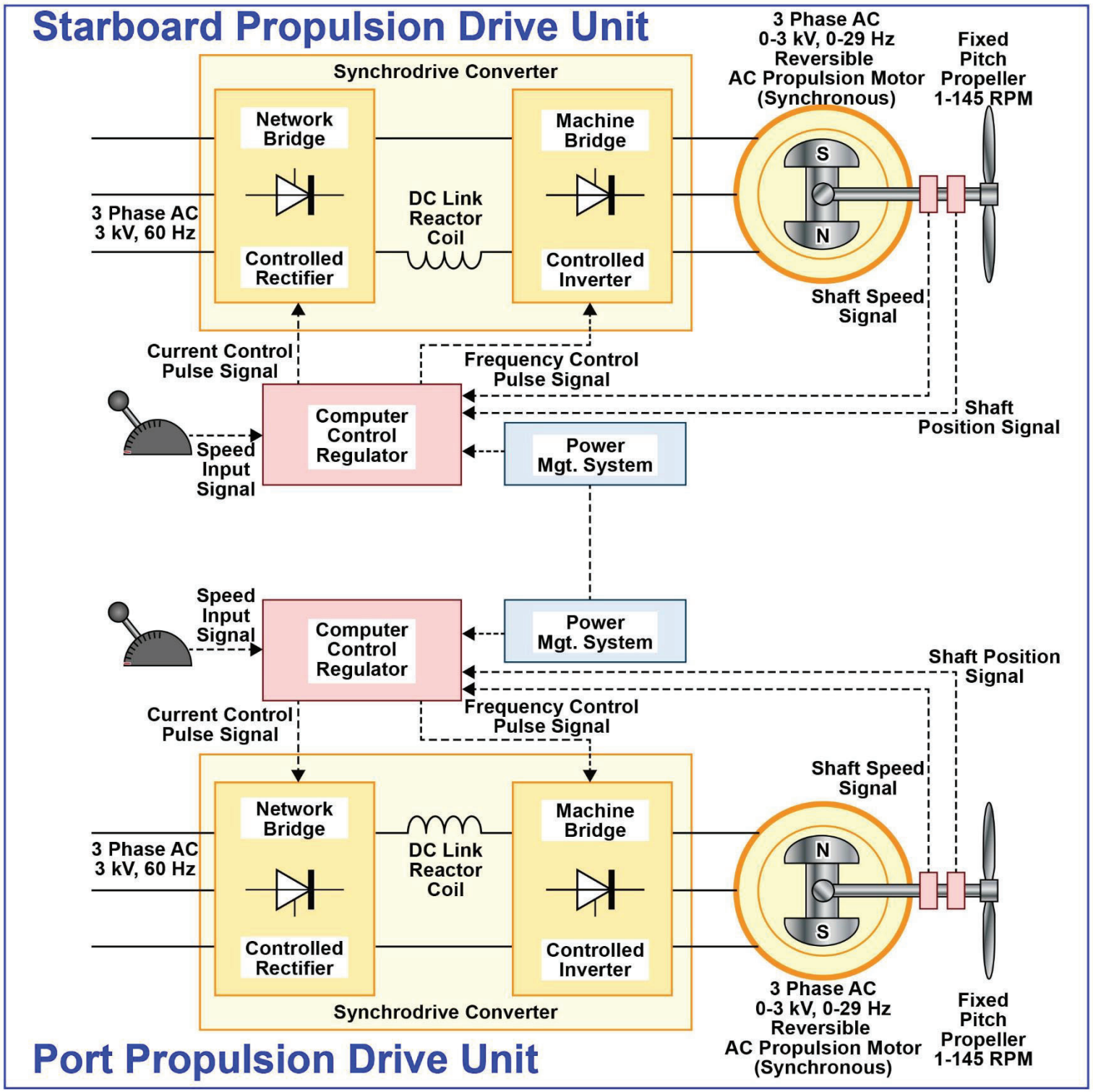


Where R = Direction of Actual Rotation
T = Direction of Applied Torque

EL-0167



EL-0168



EL-0180
Catalog Number Selection Chart

Example Catalog Number

A N 1 9 A N 0 A 5E 005

Device Type
A = Starter
C = Contactor

Standard
E = IEC
N = NEMA

Device Assembly Configurations
70 = Multi-speed
1 = Non-reversing
5 = Reversing

OLR Type
5 = Contactor only-no overload relay
6 = Starter w/C306 bi-metalic OLR
9 = Starter w/C440 electronic overload

C440 OLR Designation (FVNR and FVR only)
5E = Standard feature set
SEL Reset, SEL Class (10A, 10, 20, 30)
5G = Ground fault feature set
SEL Reset, SEL Class (10, 20)

C440 FLA Range (FVNR and FVR only)

NEMA Size 00
1P6 = 0.33 - 1.65A 005 = 1 - 5A 020 = 4 - 20A
NEMA Size 0
1P6 = 0.33 - 1.65A 005 = 1 - 5A 020 = 4 - 20A
NEMA Size 1
1P6 = 0.33 - 1.65A 005 = 1 - 5A 020 = 4 - 20A 045 = 9 - 45A
NEMA Size 2
005 = 1 - 5A 020 = 4 - 20A 045 = 9 - 45A
NEMA Size 3
100 = 20 - 100A ****
**NEMA Size 4 ** **
300 = 60 - 300A ****
**NEMA Size 5 ** **
300 = 60 - 300A ****

AC Coil Suffix

Suffix	Coil Volts and Hertz
A =	120/60 or 110/50
B =	240/60 or 220/50
C =	480/60 or 440/50
D =	600/60 or 550/50
E =	208/60
H =	277/60
J =	208-240/60 **
K =	240/50
L =	380-415/50
N =	550/50
T =	24/60, 24/50 ***
U =	24/50
V =	32/50
W =	48/60
Y =	48/50

NEMA Enclosures
N = Open

Contactor Frame Size*

Suffix	NEMA Size	Continuous Amperes
A =	00	9
B =	0	18
D =	1	27
G =	2	45
K =	3	90
N =	4	135
S =	5	270
T =	6	540
U =	7	810
V =	8	1215

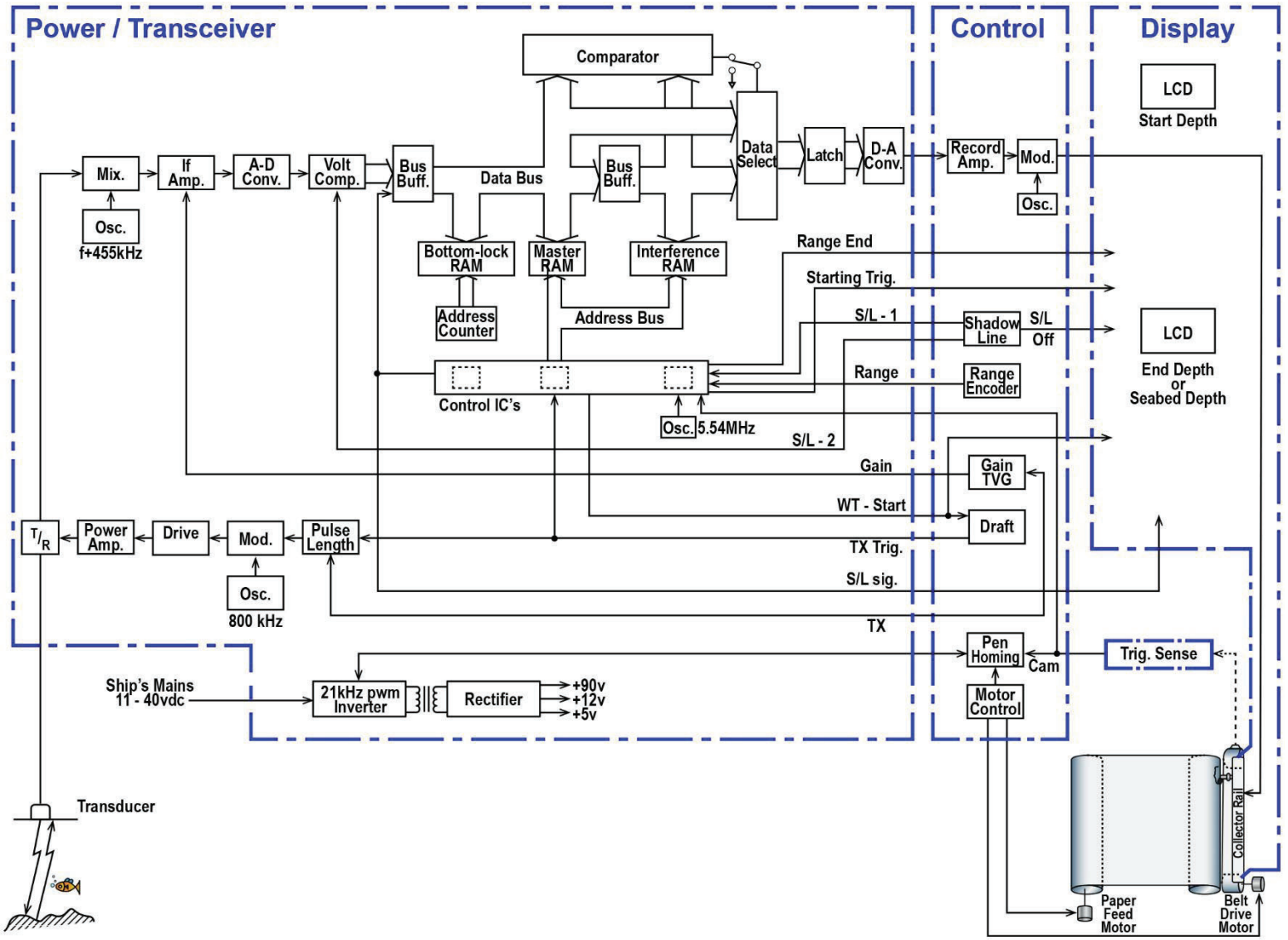
For Starters

Starter Mounting Options
0 = Horizontal
V = Vertical

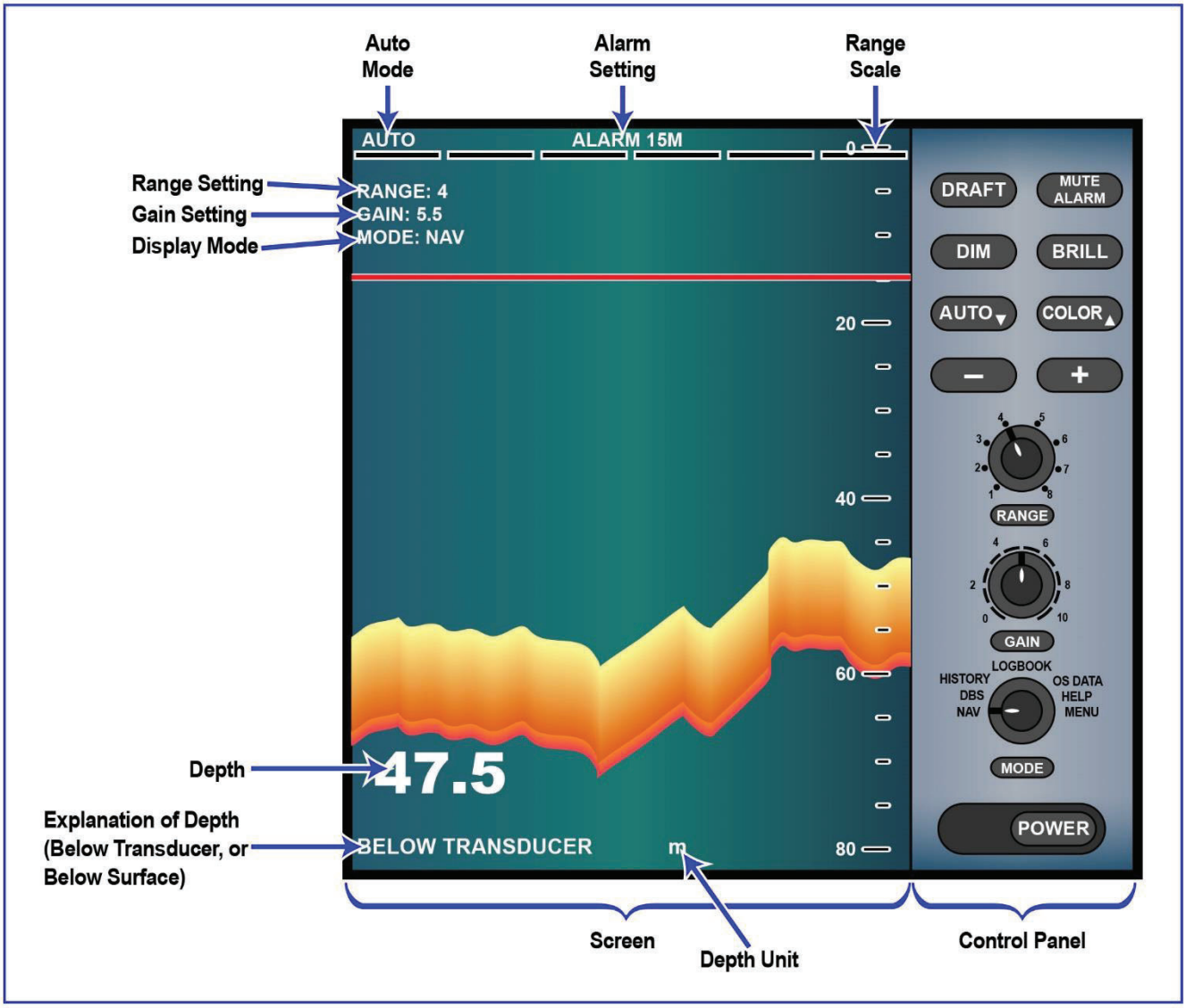
For Contactors Only
2 = Two-pole
3 = Three-pole
4 = Four-pole
5 = Five pole

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-0185
Digitized Echo Sounding System



EL-0186



Echo Sounder Range vs. Pulse Length vs. PRF

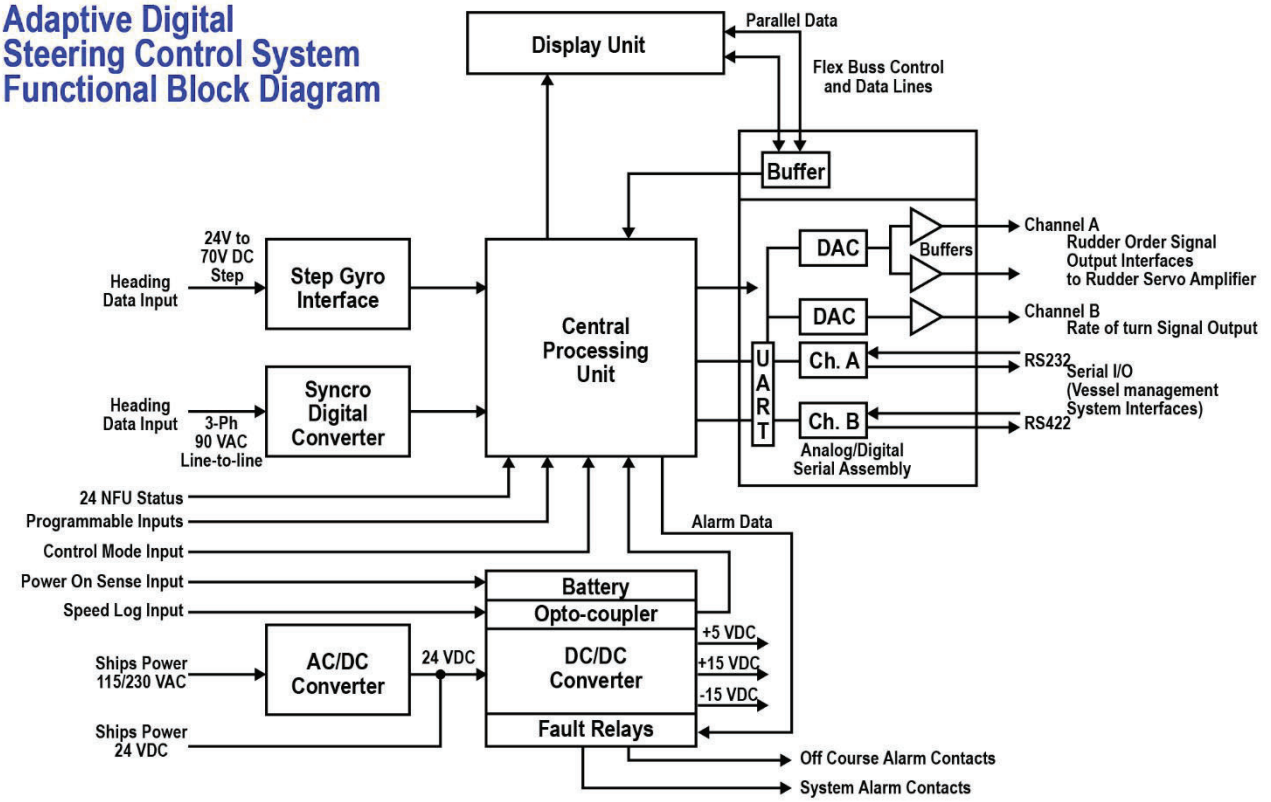
Depth (Meters)	Pulse Length (ms)	PRF (Pulses Per Minute)
5, 10 and 20	0.25	750
40	0.38	375
100	1.00	150
200	2.00	75
400 and 800	3.60	42

Sea Bed Consistency and Attenuation

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

EL-0191

Adaptive Digital Steering Control System Functional Block Diagram

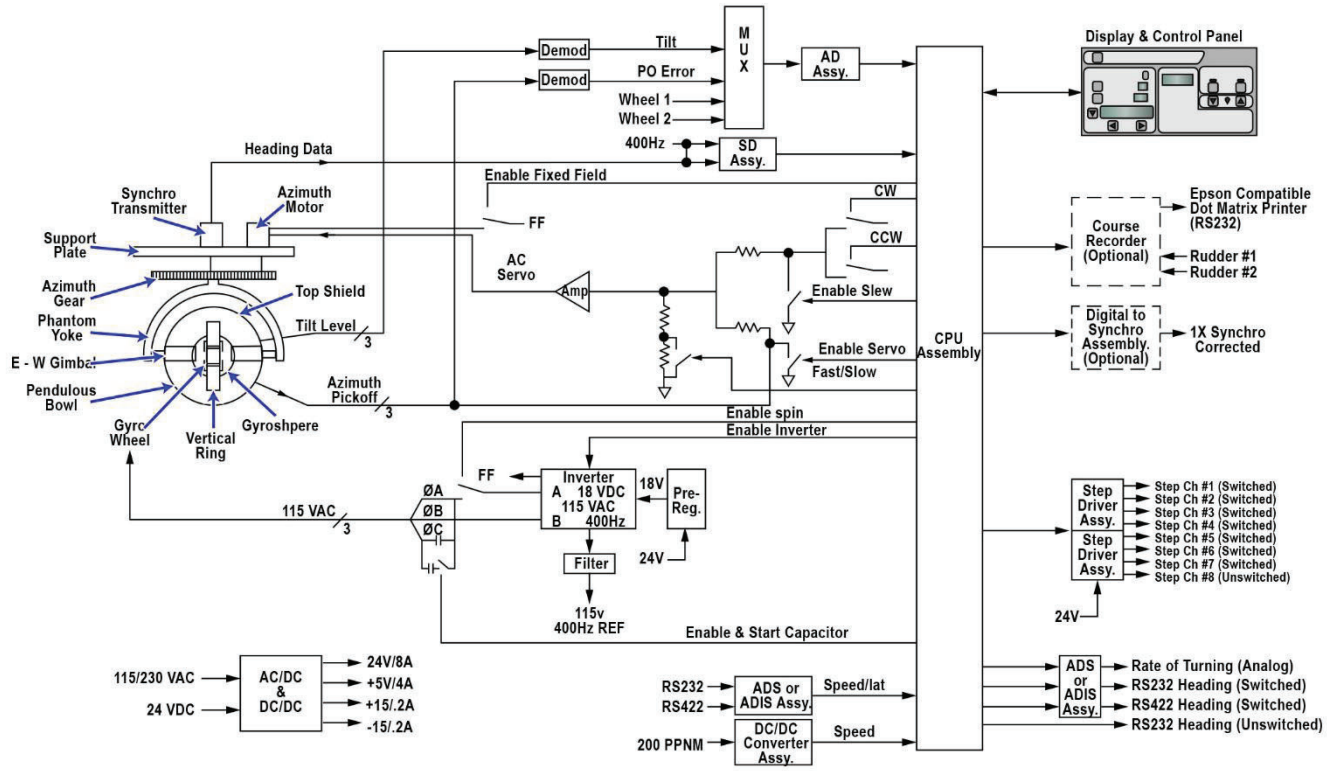


Adaptive Digital Steering System Interface Signals

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	External contacts to indicate when the NFU Controller is active
Power failure circuits	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 ± 45° or rudder
Rate of turn interface	Bipolar analogue voltage proportional to a turn rate indicator. ± 4.5 V (Max) equal to ± 90° turn/min. Resolution equal to 0.5°/min.

EL-0194

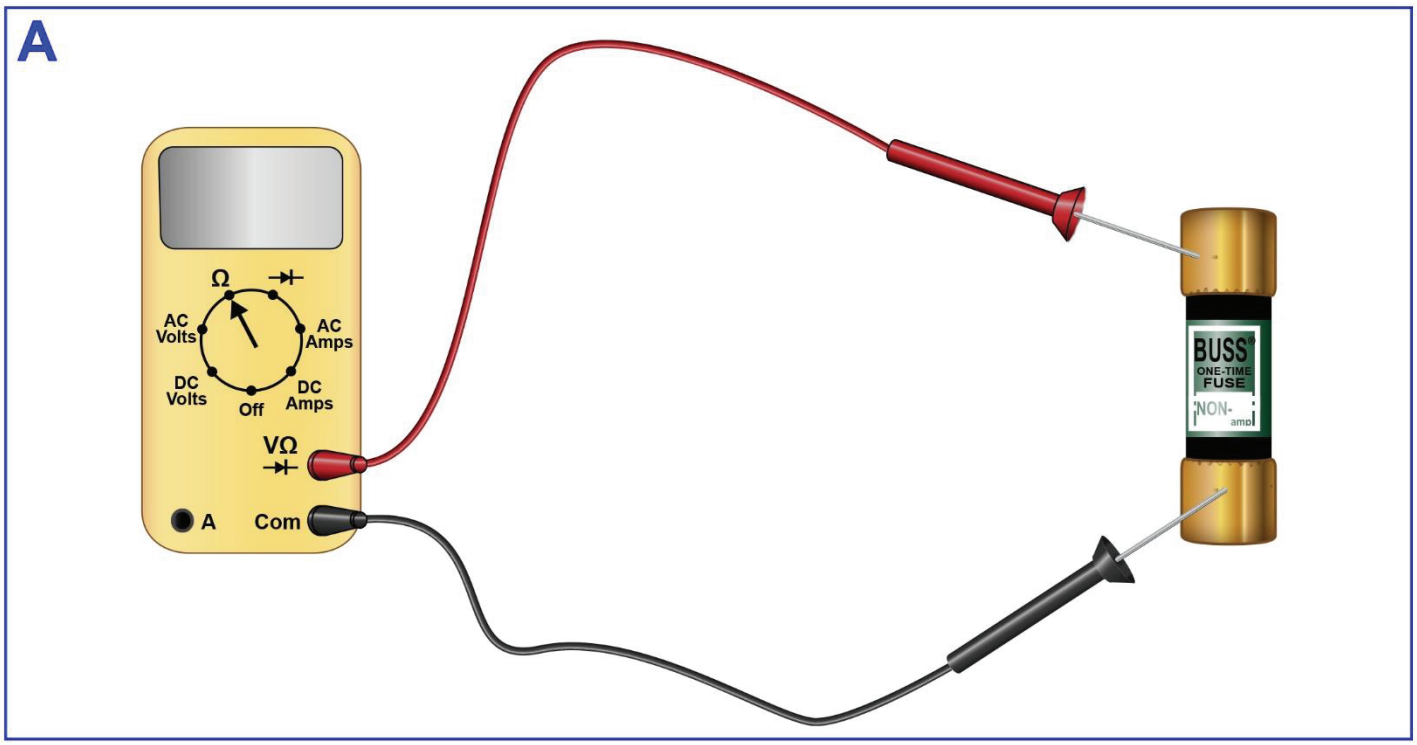
Digital Gyrocompass Functional Block Diagram

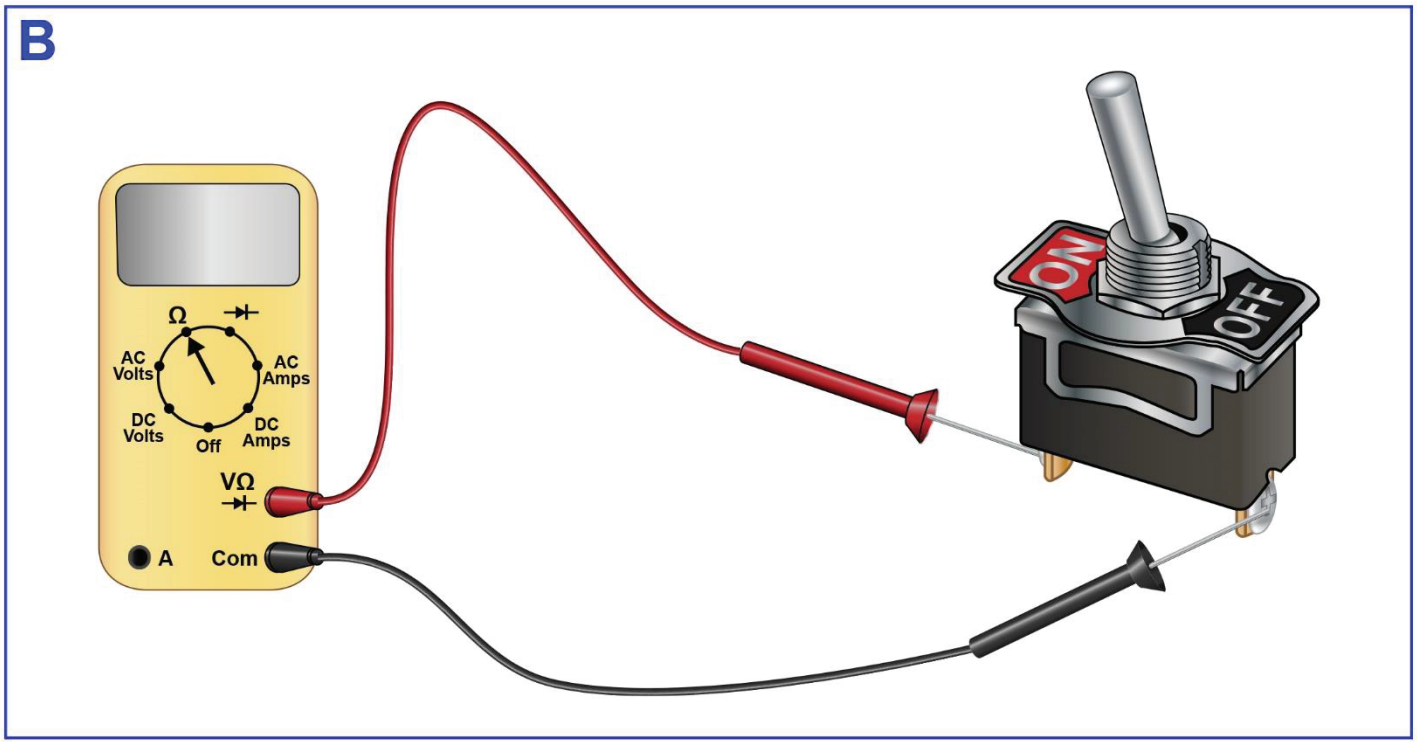


Digital Gyrocompass Communication Protocols

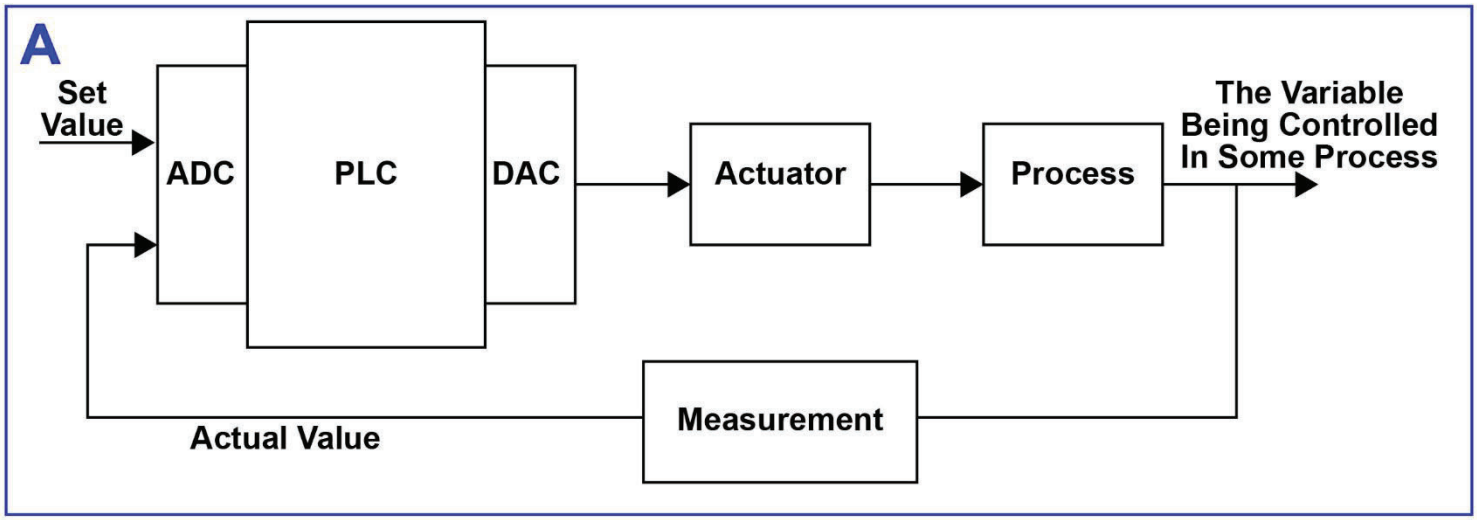
Inputs	
Speed: Pulsed Serial Manual	Automatic: 200 ppnm Automatic from digital sources, RS-232/422 in NMEA 0183 format $VBW, $VHW, $VTG Manually via the control panel
Latitude	Automatic from the GPS via RS-232/422 in NMEA format $GLL, $GGA Automatic from digital sources via RS-232/422 in NMEA 0183 format $GLL Manually via the control panel
Outputs	
Rate of Turn	50 mV per deg/min (± 4.5 VDC full scale = ± 90°/min) NMEA 0183 format $HEROT, X.XXXX, A*hh<CR><LF> 1 Hz, 4800 baud
Step Repeaters	Eight 24 VDC step data outputs. (An additional 12-step data output at 35 VDC or 70 VDC from the optional transmission unit) 7 — switched, 1 — unswitched
Heading Data	One RS-422, capable of driving up to 10 loads in NMEA 0183 format $HEHDT, XXX.XXX, T*hh<CR><LF> Two RS-232, each capable of driving one load in NMEA 0183 format $HEHDT, XXX>XXX, T*hh<CR><LF> 10 Hz, 4800 baud 1 — 232 switched, 1 — 232 unswitched, 1 — 422 switched
Alarm Outputs	A relay and a battery-powered circuit activates a fault indicator and audible alarm during a power loss. Compass alarm NO/NC contacts. Power alarm — NO/NC contacts
Course Recorder	(If fitted) RS-232 to dot matrix printer
Synchro Output	(If fitted) 90 V line-to-line with a 115 VAC 400 Hz reference. Can be switched or unswitched

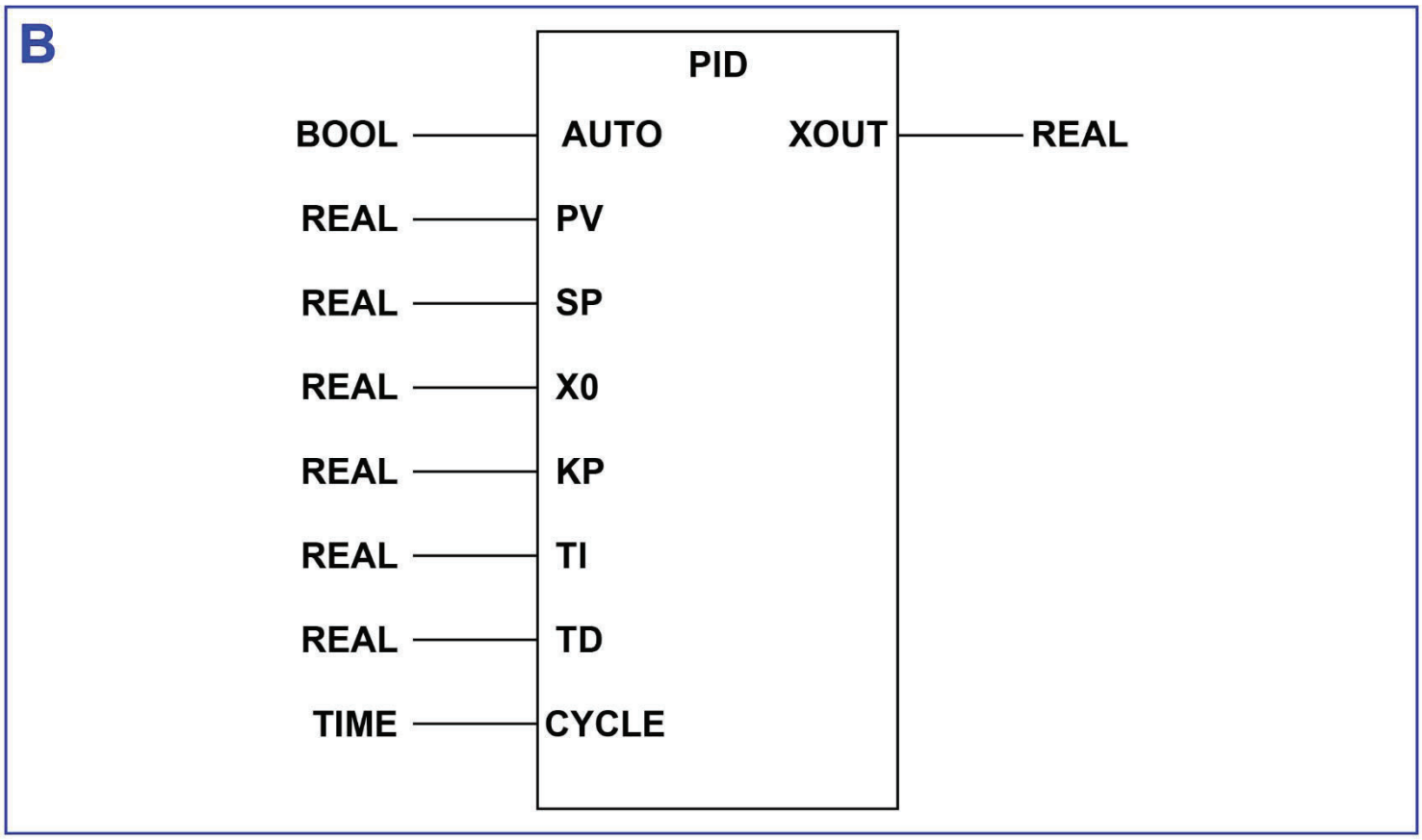
EL-0210





EL-0251

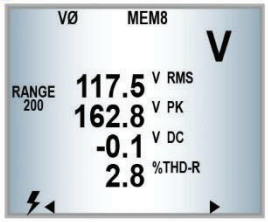




EL-0256

A

B



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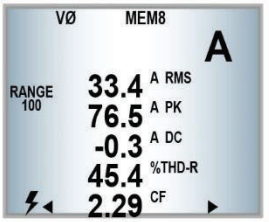

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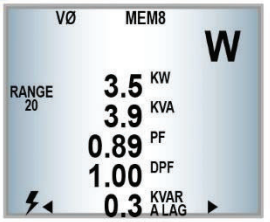

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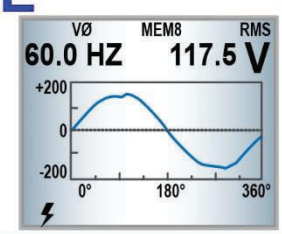

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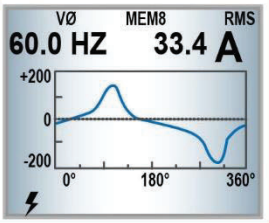

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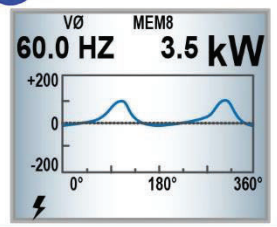

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