7

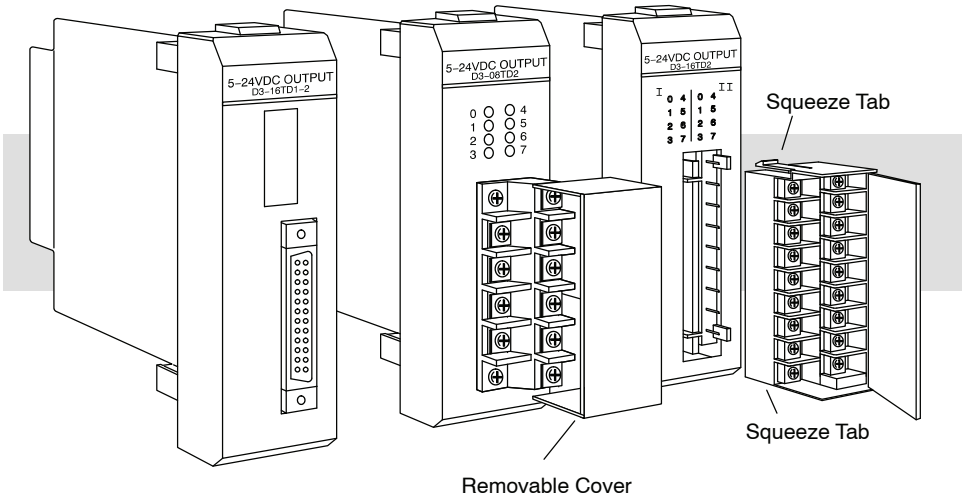
Discrete Output Modules

In This Chapter. . . .

Discrete Output Module Identification and Terminology

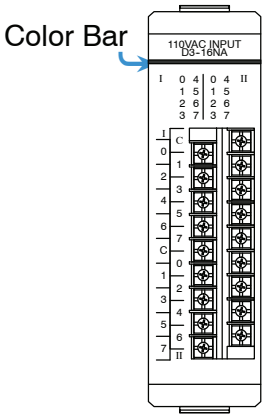
Discrete Output Module Status Indicators

This chapter contains I/O specification sheets for the DL305/FL305 discrete output modules. The following diagram shows the status indicator location for some of the most common discrete output modules.



Color Coding of I/O Modules

The DL305 family of I/O modules has a color coding scheme to help you identify whether the module is an input module, an output module or a special module. This is done through a color bar indicator located on the front of each module below the part number. The following color scheme is used.



Module Type	Color Code
Discrete/Analog Output	Red
Discrete/Analog Input	Blue
Other	White

Output Modules Selection

Your output module selection depends on the field devices used and system performance requirements. The output module specifications in this chapter list the information which is needed for choosing the correct module for a field device and to assure it meets the system requirements. The following list defines the specifications listed in this chapter.

Outputs Per Module	Indicates number of output points per module and designates current sinking, current sourcing, or either.
Commons Per Module	Number of commons per module and their electrical characteristics.
Operating Voltage	The operating voltage range of the output circuit.
Output Type	The output circuit can be a transistor, a triac, or a relay. The NPN or PNP transistor outputs are normally used in low voltage or high speed DC applications. Triac outputs are used in AC voltage applications. The Form A or C relay outputs are normally used where a wide voltage range is needed. Relay output modules are capable of carrying more current than a transistor or a triac output and can pass AC or DC voltages. The disadvantage of a relay module is the internal power consumption and the relay life expectancy.
Peak Voltage	Maximum voltage the output circuit can control.
AC Frequency	AC modules are designed to operating within a specific frequency range. 60 Hz is the standard AC frequency in the U.S., 50 Hz is common in other countries.
ON Voltage Drop	The voltage between the output point and common during an active ON with a load.
Maximum Current (Resistive)	The maximum current for an output with a resistive load.
Maximum Leakage Current	The maximum current of the output circuit during an OFF state.
Maximum Inrush Current	The maximum current over a short period of time during the OFF to ON transition of a output point. It is greater than the normal ON state current and depends on the field device electrical characteristics.
Minimum Load	The minimum load across the output's circuit for the circuit to operate properly.
Base Power Required	Power from the base power supply is used by the DL305 output modules and varies between different modules. The guidelines for using module power is explained in the power budget configuration section in chapter 4.
OFF to ON Response Time	The processing time the module requires to transition from an OFF to ON state.
ON to OFF Response Time	The processing time the module requires to transition from an ON to OFF state.
Terminal Type	Indicates whether the terminal type is a removable or non-removable connector or terminal.
Status Indicators	LEDs indicate the ON/OFF status of an input point. These LEDs are electrically located on either the logic side or the field device side of the output circuit.
Fuses	Indicates the current rating of the replaceable or non-replaceable fuse(s).
Relay Life	Amount of closures typical for a relay point before failure.
Weight	Indicates the weight of the module.

Relay Arc Suppression - DC and AC Applications

FL305 High Current Relay Output Module Arc Suppression

This application note describes the addition of external contact protection to high current isolated relay output modules. It supplements the wiring information for the F3-08TRS-1 and F3-08TRS-2 relay output modules.

Adding external contact protection may extend a relays life beyond the number of operations listed. High current inductive loads such as clutches, brakes, motors, direct acting solenoid valves, and motor starters will benefit the most from external contact protection.

Resistor and Capacitor Selection

$C\ (\mu F) = I^2 / 10$

$R\ (\Omega) = V / 10\ I^x$ where $x = (1 + 50 / E)$

Use peak AC values for I and V, see "Peak Voltage and Current" below.
Where I = Amperes of load current immediately prior to opening of contacts.
Where E = Source voltage immediately prior to closing of contacts.

R minimum = 0.5 Ω, 1/2 W

C minimum = 0.001 μF, the voltage rating of C must be ≥ E

Resistor Tolerance

For E < 70V, R may be 3 times indicated value.
For 70V < E < 100V, R may be ± 50% indicated value.
For 100V < E < 150V,R may be ± 10% indicated value.
For E > 150V, R may be ± 5% indicated value.

Peak Voltage and Current

The following equations can be used to determine I_{peak} and V_{peak}:

$I_{peak} = I_{rms} / .707$ Alternating Current

$V_{peak} = V_{rms} / .707$

$I_{peak} = I_{ave} / .636$ DC Rectified Alternating Current

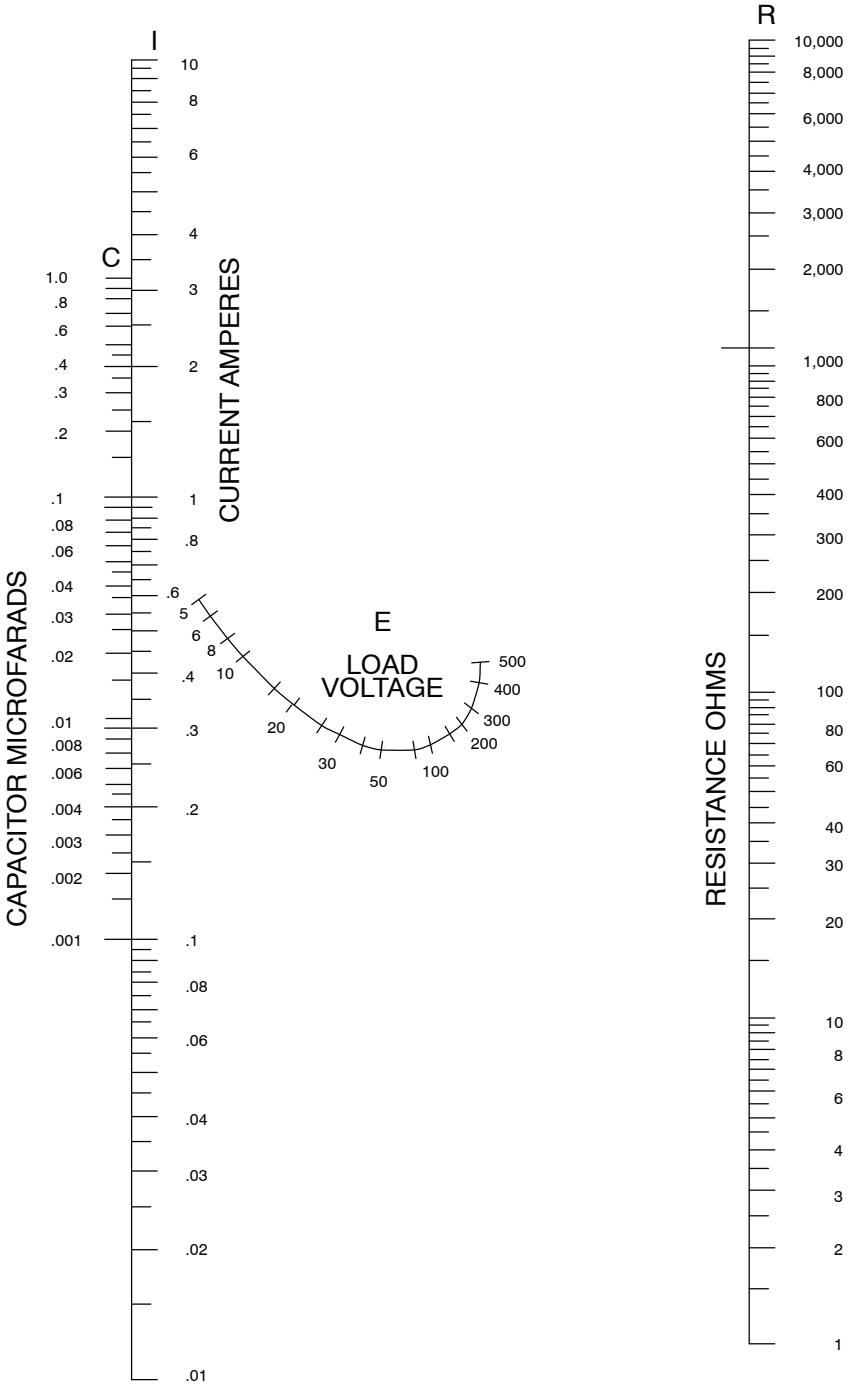
Adding Contact Protection

If the contact is switching a DC inductive load, add a diode across the load as near to load coil as possible. Add the RC network across the relay contacts as close to the relay as possible.

Resistor and Capacitor Nomogram

The nomogram shown below affords a convenient method of selecting the proper contact protection for P & B relays used in F3-08TRS-1 and F3-08TRS-2 modules.
Example: Use a current (1) of 1.0 ampere and a voltage (E) of 50 volts.

Capacitance (C) in microfarads is found directly on the left side scale, opposite 1.0 amperes as 0.1. Resistance (R) in ohms is obtained using a straight edge. Locate 1.0 amperes (I) on the left side scale and 50 volts (E) on the center scale. Place the straightedge on these points. The junction of the straight edge and the right side determines R. In this example R is equal to 5.0 ohms.



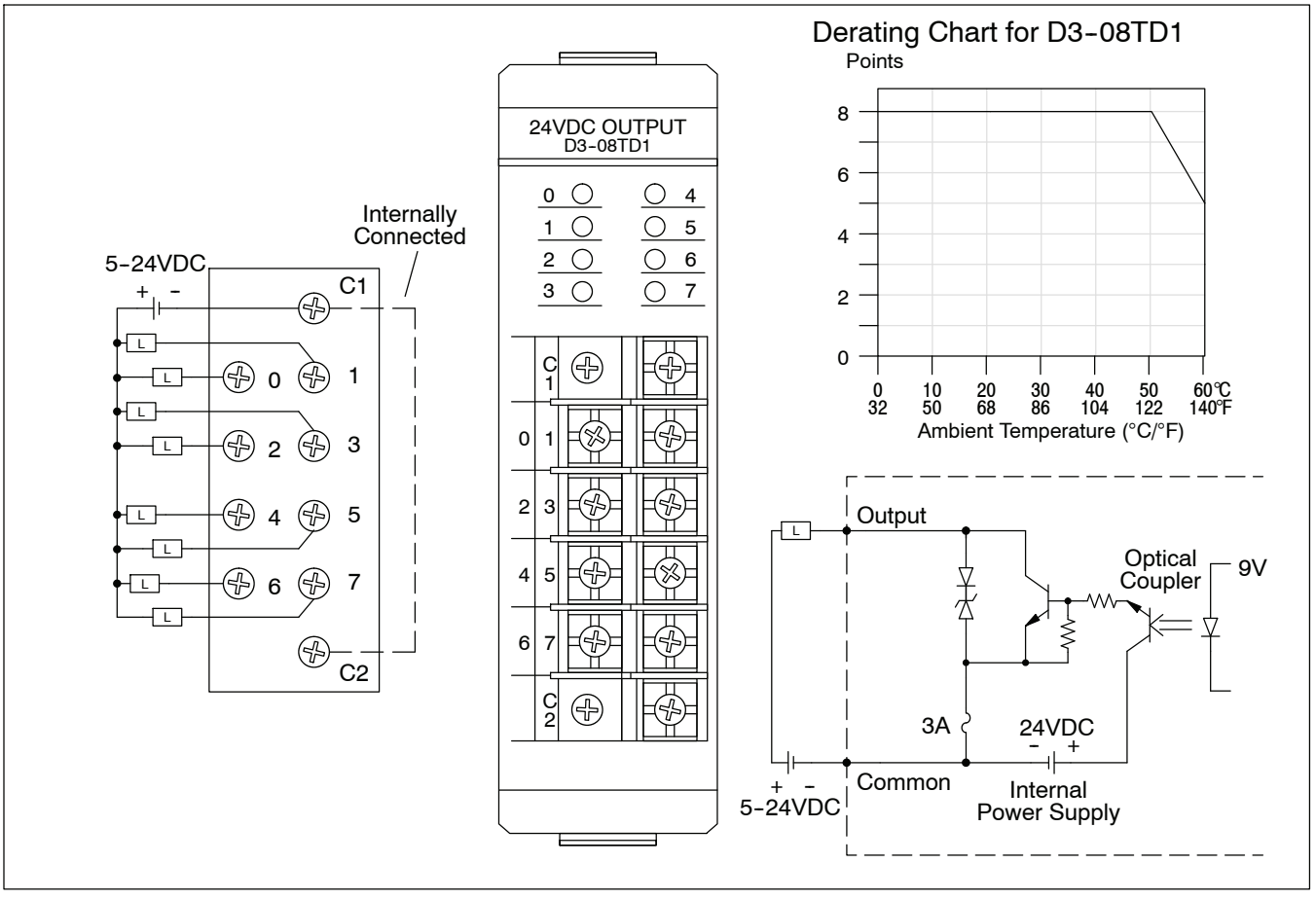
(1) $C = 1^2 / 10$ microfarads
(2) $R = E / 10 I^x$ ohms

For DC. For AC, use peak values
Where x = (1 + 50/E)

D3-08TD1, 24 VDC Output Module

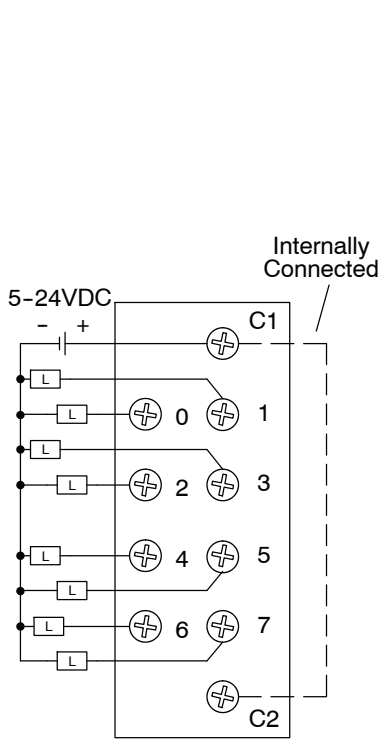
Outputs per module	8 (current sinking)
Commons per module	2(internally connected)
Operating voltage	5-24VDC
Output type	NPN (open collector)
Peak voltage	45VDC
AC frequency	N/A
ON voltage drop	0.8V @ 0.5A
Max current	0.5A / point 1.8 / common
Max leakage current	0.1 mA @ 40VDC
Max inrush current	3A / 20ms 1A / 100ms

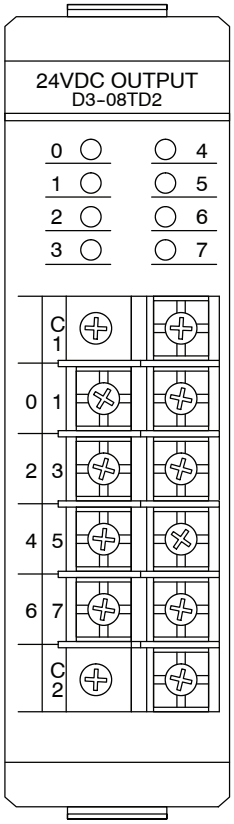
Minimum load	1 mA
Base power required	9V 20 mA Max 24V 3mA/pt. (24mA Max)
OFF to ON response	0.1 ms
ON to OFF response	0.1 ms
Terminal type	Non-removable
Status indicators	Logic Side
Weight	4.2 oz. (120 g)
Fuses	(2) One 3A per common Non-replaceable

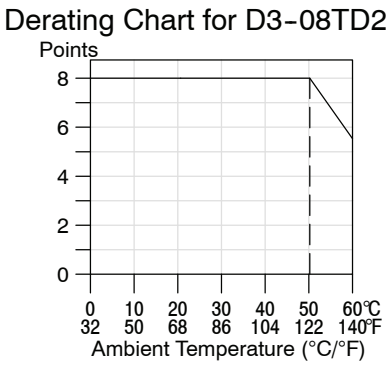


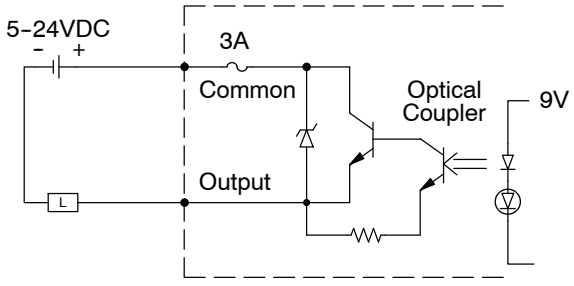
D3-08TD2, 24 VDC Output Module

Outputs per module	8 (current sourcing)		Minimum load	1 mA
Commons per module	2 (internally connected)		Base power required	9V 30 mA Max 24V N/A
Operating voltage	5-24VDC			
Output type	NPN Transistor (emitter follower)		OFF to ON response	0.1 ms
			ON to OFF response	0.1 ms
Peak voltage	40VDC		Terminal type	Non-removable
AC frequency	N/A		Status indicators	Logic Side
ON voltage drop	1V @ 0.5A		Weight	4.2 oz. (120 g)
Max current	0.5A / point 1.8A/ common		Fuses	(2) One 3A per common Non-replaceable
Max leakage current	0.1 mA @ 24VDC			
Max inrush current	3A / 20ms 1A / 100ms			



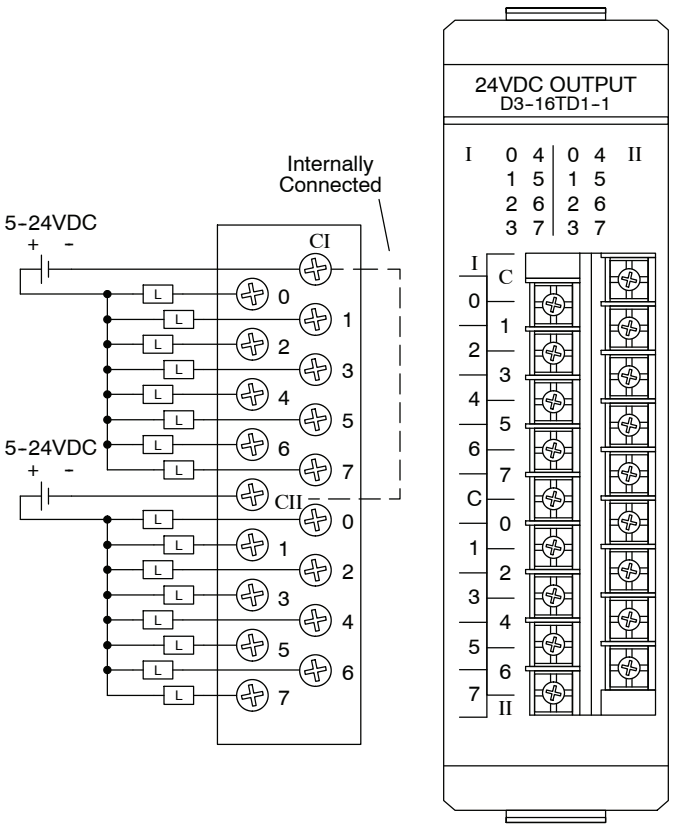


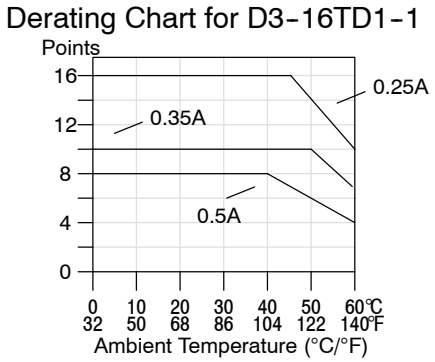


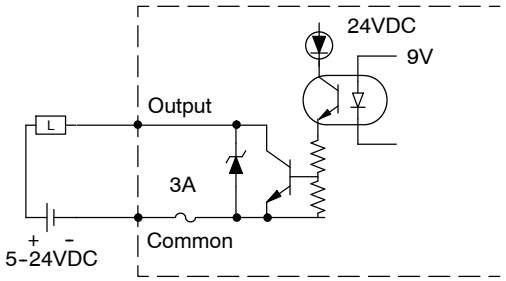


D3-16TD1-1, 24 VDC Output Module

Outputs per module	16 (current sinking)		Minimum load	1 mA
Commons per module	2 (internally connected)		Base power required	9V (40 mA Max) 3mA+2.3mA/ON pt. 24V 6 mA/ON pt. (96 mA Max)
Operating voltage	5-24VDC			
Output type	NPN transistor (open collector)			
Peak voltage	45VDC		OFF to ON response	0.1 ms
AC frequency	N/A		ON to OFF response	0.1 ms
ON voltage drop	2V @ 0.5A		Terminal type	Removable
Max current	0.5A/ point 2A/ common		Status indicators	Logic Side
			Weight	5.6 oz. (160 g)
Max leakage current	0.1mA @ 40VDC		Fuses	(2) One 3A per common Non-replaceable
Max inrush current	3A / 20 ms 1A / 100 ms			



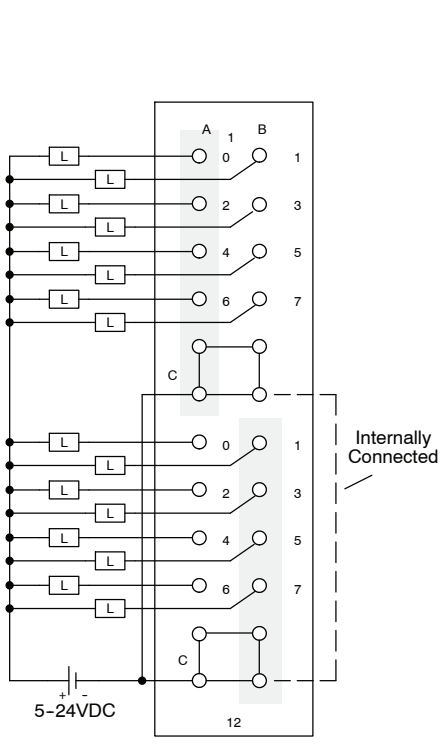


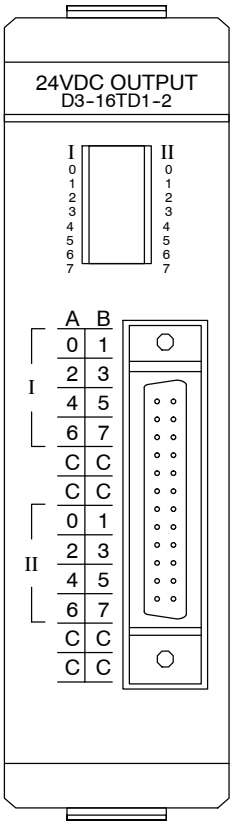


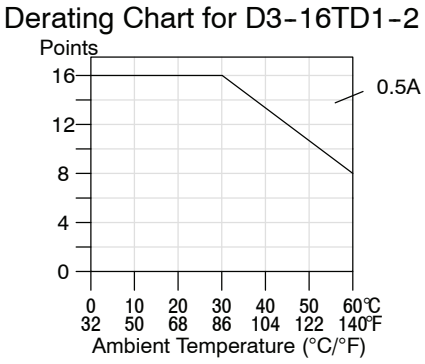
D3-16TD1-2, 24 VDC Output Module

Outputs per module	16 (current sinking)
Commons per module	4 (internally connected)
Operating voltage	5-24VDC
Output type	NPN transistor (open collector)
Peak voltage	45VDC
AC frequency	N/A
ON voltage drop	2.0V @ 0.5A
Max current	0.5A / point 1.8A common
Max leakage current	0.3 mA @ 40VDC
Max inrush current	3A / 20ms 1A / 100ms

Minimum load	1 mA
Base power required	9V (40mA Max) 3mA+2.3mA/ON pt. 24V 6mA/ON pt. (96mA Max)
OFF to ON response	0.1 ms
ON to OFF response	0.1 ms
Terminal type	Removable connector
Status indicators	Logic Side
Weight	5.6 oz. (160 g)
Fuses	(4) One 3A per common Non-replaceable

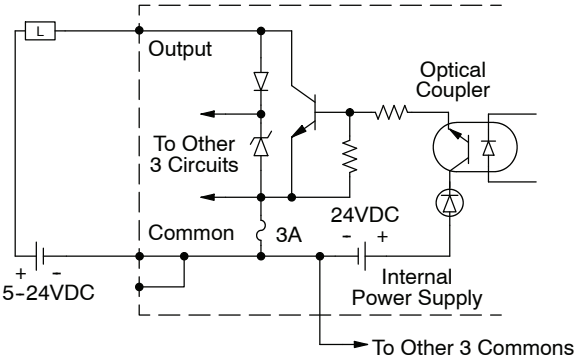






Output 0, 2, 4, 6 (FUSED with 3A on Common)
Same circuit as shown below

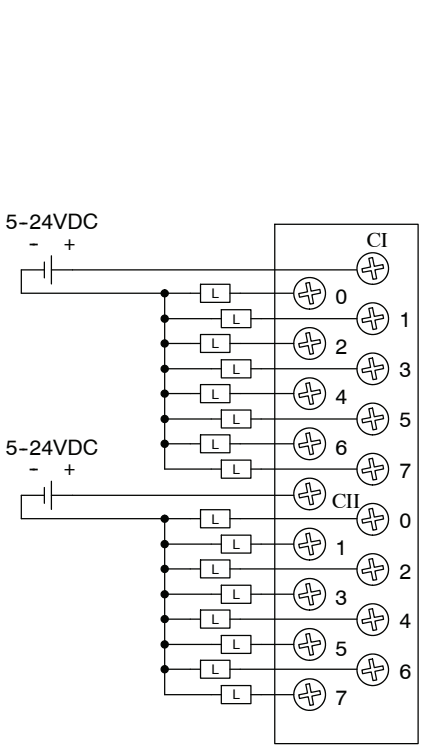
Output 1, 3, 5, 7 (FUSED with 3A on Common)
Same circuit as shown below

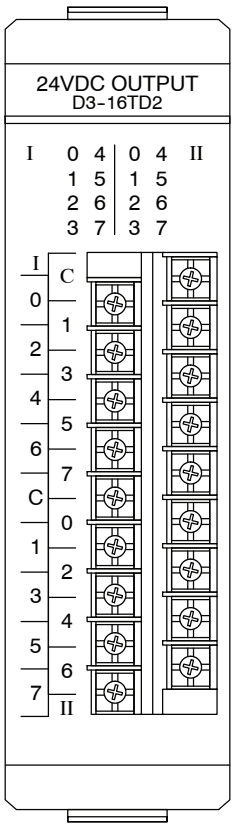


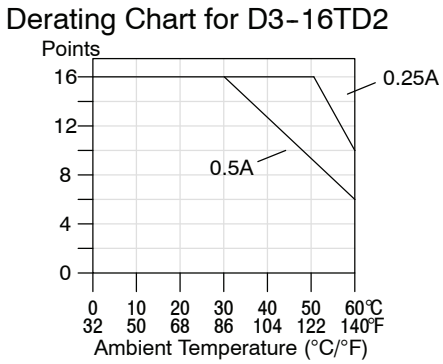
D3-16TD2, 24 VDC Output Module

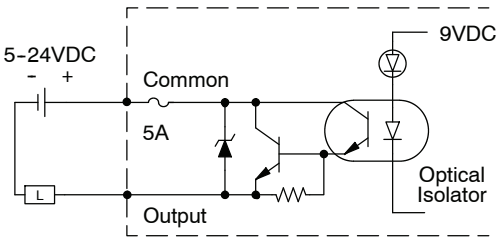
Outputs per module	16 (current sourcing)
Commons per module	2 (isolated)
Operating voltage	5-24VDC
Output type	NPN transistor (emitter follower)
Peak voltage	40VDC
AC frequency	N/A
ON voltage drop	1.5V @ 0.5A
Max current	0.5A / point 3A common
Max leakage current	0.01 mA @ 40VDC
Max inrush current	3A / 20ms 1A / 100ms

Minimum load	1 mA
Base power required	9V 7.5 mA/ON pt. (180 mA Max) 24V N/A
OFF to ON response	0.1 ms
ON to OFF response	1 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	7.1 oz. (210 g)
Fuses	(2) One 5A per common Non-replaceable





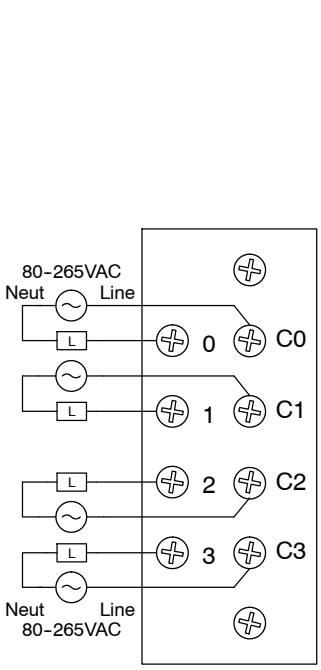


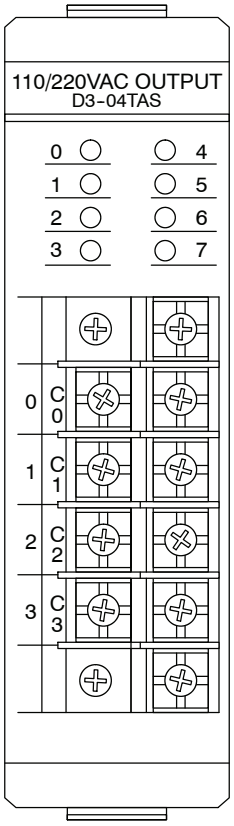


D3-04TAS, 110-220 VAC Output Module

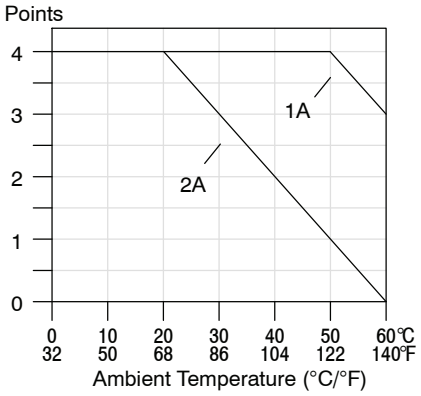
Outputs per module	4
Commons per module	4 (isolated)
Operating voltage	80-265VAC
Output type	Triac
Peak voltage	265 VAC
AC frequency	47-63 Hz
ON voltage drop	1.5 VAC @ 2A
Max current	2A / point 2A / common
Max leakage current	7 mA @ 220VAC 3.5 mA @ 110VAC
Max inrush current	20A for 16 ms 10A for 100 ms

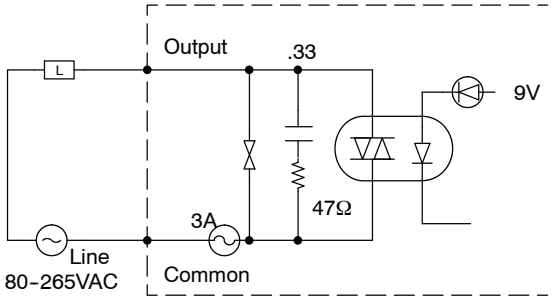
Minimum load	10 mA
Base power required	9V 12 mA Max 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	10 ms Max
Terminal type	Non-removable
Status indicators	Logic Side
Weight	6.4 oz. (180 g)
Fuses	(4) One 3A per common User replaceable





Derating Chart for D3-04TAS

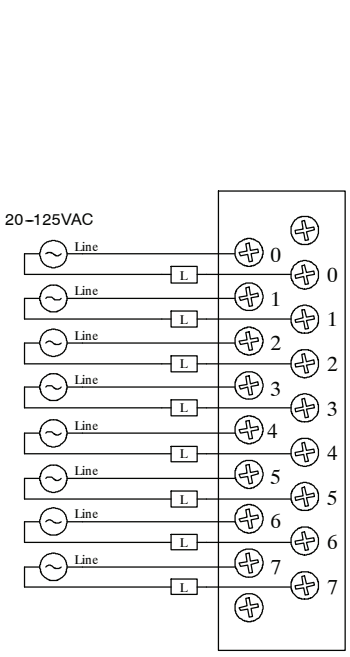


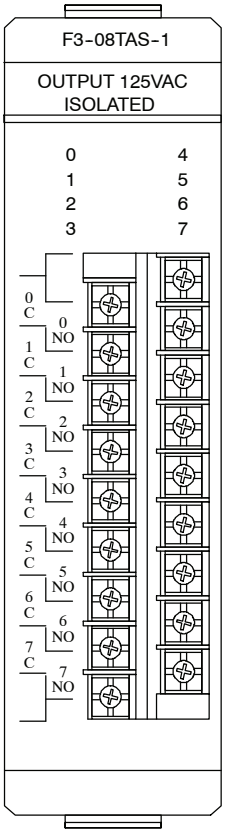


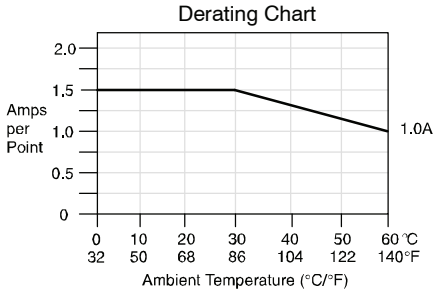
F3-08TAS, 250 VAC Isolated Output Module

Outputs per module	8 (500V point-to-point isolation)
Commons per module	8 (isolated)
Operating voltage	12–125 VAC 125–250 VAC requires external fuses
Output type	SSR Array (TRIAC)
Peak voltage	400 VAC
AC frequency	47 – 440 Hz
ON voltage drop	1 VAC @ 1A
Max current	1A / point
Max leakage current	10 μA @ 240 VAC
Max inrush current*	20A for 16 ms 3A for 100 ms
Minimum load	0.5 mA

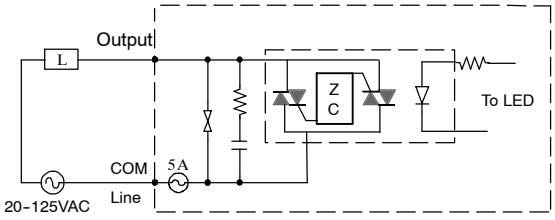
Base power required	9V 10mA / ON pt. 80mA Max. 24V N/A
OFF to ON response	8 ms Max
ON to OFF response	8 ms Max
Terminal type	Removable
Status indicators	Logic Side
Weight	6.3 oz. (177g)
Fuses BK/PCE-5 Bussman (One spare fuse included)	(8) fast blow One 5A (125V fast blow) per each circuit User replaceable







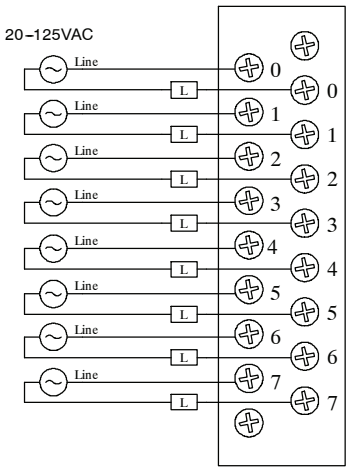
Derating Note: All outputs can be run at the current per point shown.

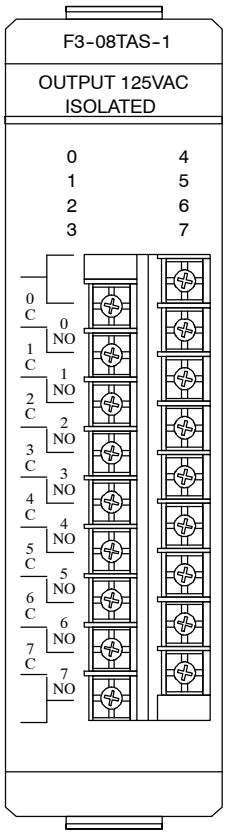


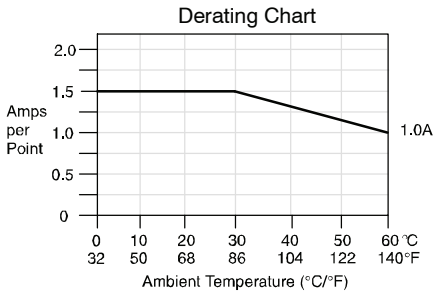
F3-08TAS-1, 125 VAC Isolated Output Module

Outputs per module	8 (1500V point-to-point isolation)
Commons per module	8 (isolated)
Operating voltage	20–125VAC
Output type	SSR (TRIAC with zero cross-over)
Peak voltage	140VAC
AC frequency	47 – 63 Hz
ON voltage drop	1.6V(rms) @ 1.5A
Max current	1.5A/point
Max leakage current	0.7mA (rms)
Max inrush current*	15A for 20 ms 8A for 100 ms
Minimum load	50mA

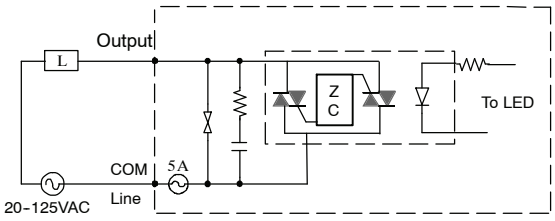
Base power required	9V 25mA/ON pt. (200mA Max), 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	9 ms Max
Terminal type	Removable
Status indicators	Logic Side
Weight	6.3 oz. (177g)
Fuses	8 (1 per common) 5A, 125V fast blow Order D3-FUSE-4 (5 per pack)





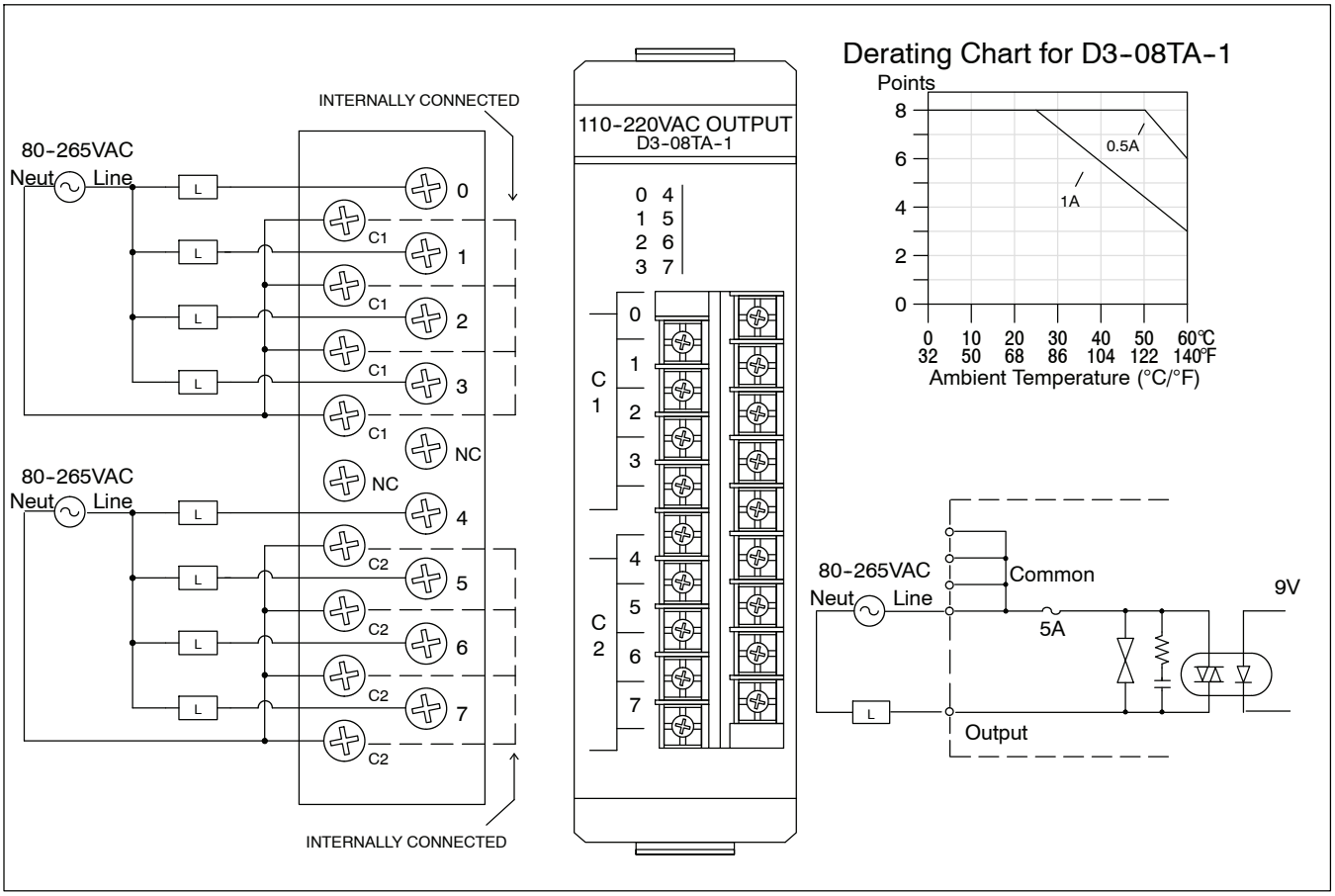


Derating Note: All outputs can be run at the current per point shown.



D3-08TA-1, 110-220 VAC Output Module

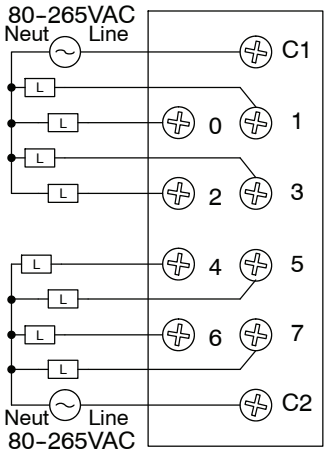
Outputs per module	8		Minimum load	25 mA
Commons per module	2 (isolated)		Base power required	9V 20mA/ON pt. (160 mA Max) 24V N/A
Operating voltage	80-265VAC			
Output type	Triac			
Peak voltage	265VAC		OFF to ON response	1 ms Max
AC frequency	47-63 Hz		ON to OFF response	8.33 ms Max
ON voltage drop	1.5 VAC @ 1A		Terminal type	Removable
Max current	1A / point 3A / common		Status indicators	Logic Side
			Weight	7.4 oz. (210 g)
Max leakage current	1.2 mA @ 220VAC 0.52 mA @ 110VAC		Fuses	(2) One 5A per common Non-replaceable
Max inrush current	10A for 16 ms 5A for 100 ms			

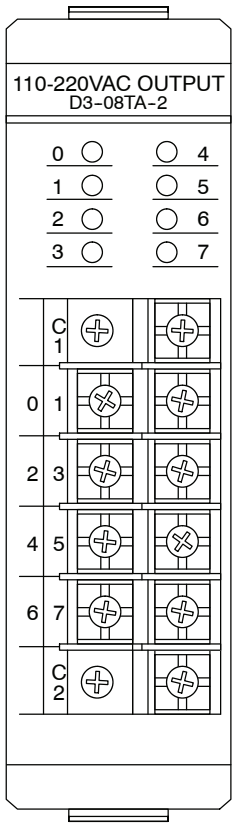


D3-08TA-2, 110-220 VAC Output Module

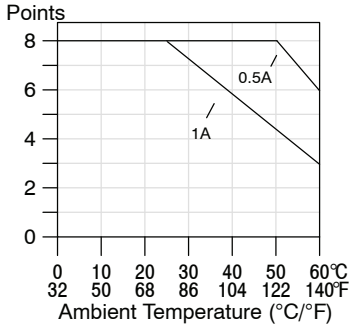
Outputs per module	8
Commons per module	2 (isolated)
Operating voltage	80-265VAC
Output type	Triac
Peak voltage	265VAC
AC frequency	47-63 Hz
ON voltage drop	1.5 VAC @ 1A
Max current	1A / point 3A / common
Max leakage current	1.2 mA @ 220VAC 0.52 mA @ 110VAC
Max inrush current	10A for 16 ms 5A for 100 ms
Minimum load	25 mA

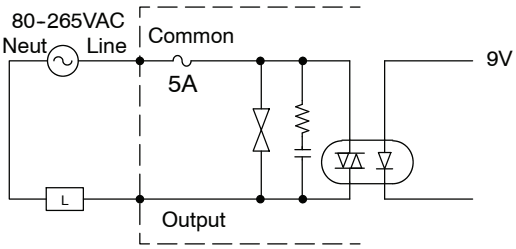
Base power required	9V 20mA/ON pt. (160 mA Max) 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	8.33 ms Max
Terminal type	Non-removable
Status indicators	Logic Side
Weight	6.4 oz. (180 g)
Fuses	(2) One 5A per common Non-replaceable





Derating Chart for D3-08TA-2

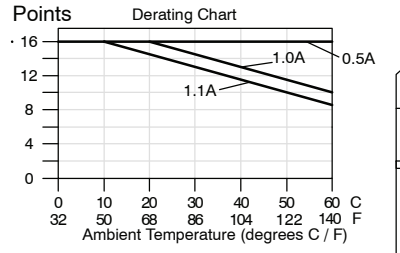




F3-16TA-2, 20-125 VAC Output Module

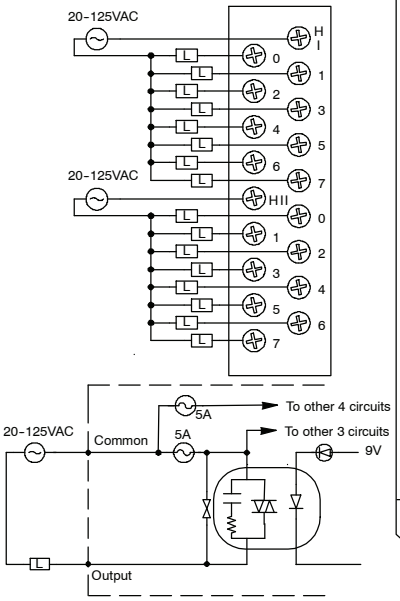
Outputs per module	16
Commons per module	2 (isolated)
Operating voltage	20 – 125VAC
Output type	SSR Array (TRIAC)
Peak voltage	140 VAC
AC frequency	47 – 63Hz
ON voltage drop	1.1VAC @ 1.1A
Max current	1.1A / point
Max leakage current	0.7mA @ 125VAC
Max inrush current*	15A for 20ms 8A for 100ms

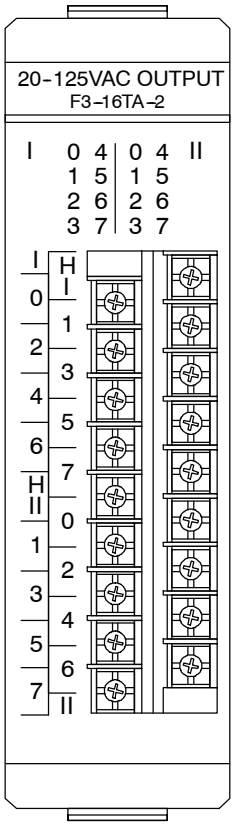
Minimum load	50mA
Base power required	9V 14mA / ON pt. 250mA Max. 24V N/A
OFF to ON response	8ms Max.
ON to OFF response	8 ms Max.
Terminal type	Removable
Status indicators	Logic Side
Weight	7.7oz. (218g)
Fuses (One spare fuse included)	4 (One 5A 125V fast blow per each group of four outputs) Order D3-FUSE-4 (5 per pack)



*Fuse blows at 20 Amp surge

Motor starters up to and including a NEMA size 3 can be used with this module.

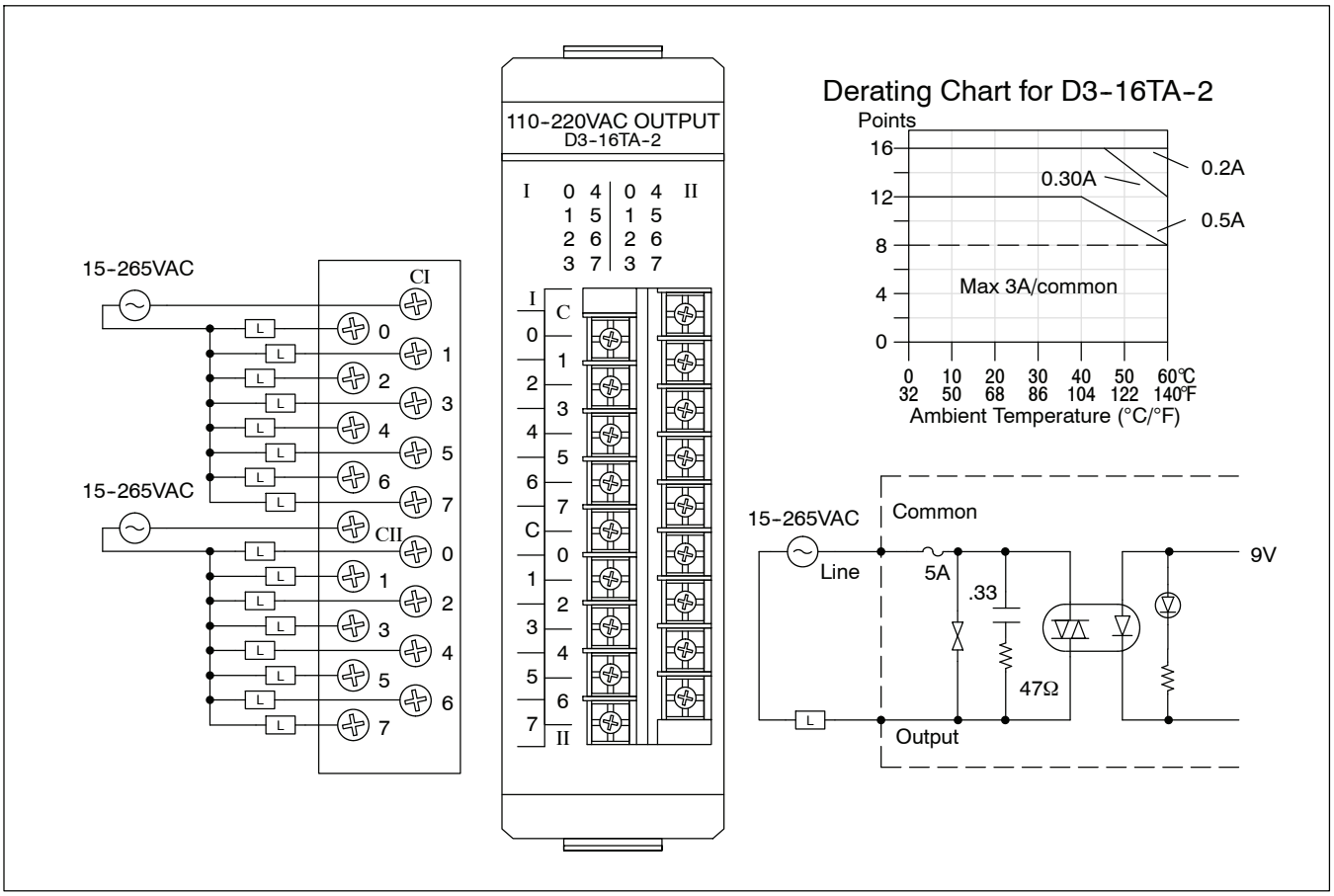




D3-16TA-2, 110-220 VAC Output Module

Outputs per module	16		Minimum load	10 mA @ 15VAC
Commons per module	2 (isolated)		Base power required *	9V 25mA Max /ON pt. 400 mA Max 24V N/A
Operating voltage	15-265 VAC		OFF to ON response	1 ms Max
Output type	Triac		ON to OFF response	9 ms Max
Peak voltage	265 VAC		Terminal type	Removable
AC frequency	47-63 Hz		Status indicators	Logic Side
ON voltage drop	1.5 VAC @ 0.5A		Weight	7.2 0z. (210 g)
Max current	0.5A / point 3A / common 6A / per module		Fuses	(2) One 5A per common Non-replaceable
Max leakage current	4 mA @ 265 VAC			
Max inrush current	10A for 10 ms 5A for 100 ms			

* 9V typical values 17mA/ON pt., 272 mA total

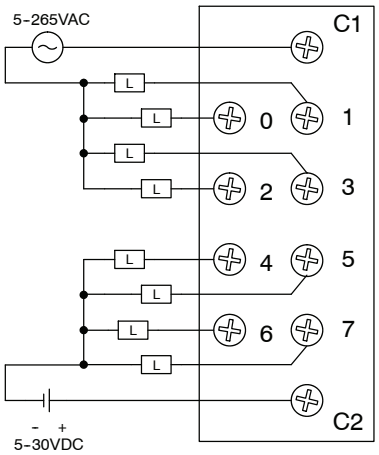


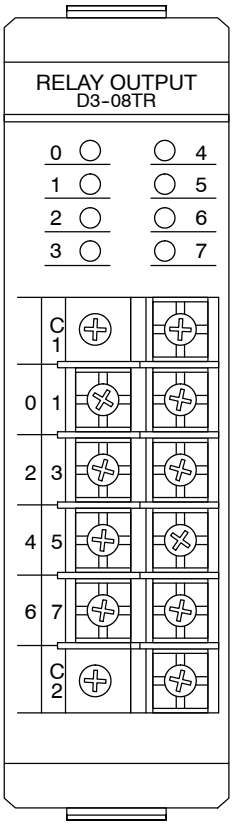
D3-08TR, Relay Output Module

Outputs per module	8		Minimum load	5 mA @ 5v
Commons per module	2 (isolated)		Base power required	9V 45 mA/ON pt. (360 mA Max) 24V N/A
Operating voltage	5-265VAC 5-30VDC			
Output type	Form A (SPST)		OFF to ON response	5 ms
Peak voltage	265VAC / 30VDC		ON to OFF response	5 ms
AC frequency	47-63 Hz		Terminal type	Non-removable
ON voltage drop	N/A		Status indicators	Logic Side
Max current	4A / point AC 5A / point DC 6A / common		Weight	7 oz. (200 g)
			Fuses	(2) One 10A per common User replaceable
Max leakage current	1 mA @ 220VAC			
Max inrush current	5A			

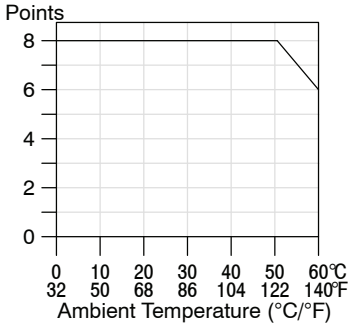
Typical Relay Life (Operations)

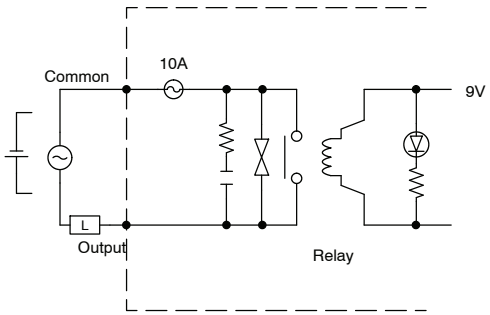
Voltage	Resistive	Solenoid	Closures
220VAC	4A	0.5A	100k
220VAC		0.05A	800k
110VAC	4A	0.5A	100k
110VAC		0.1A	650k
24VDC	5A	0.5A	100k





Derating Chart for D3-08TR



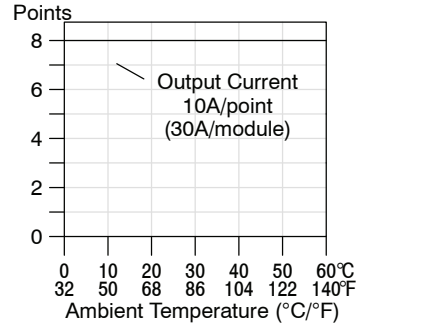


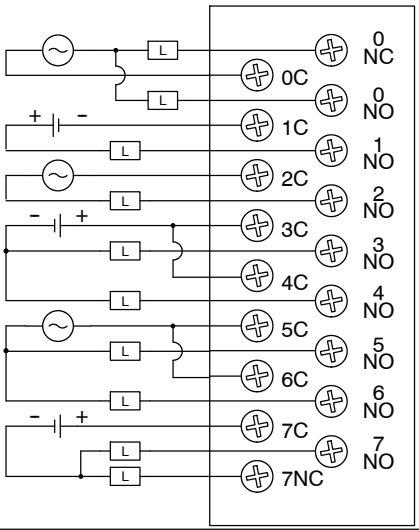
F3-08TRS-1, Relay Output Module

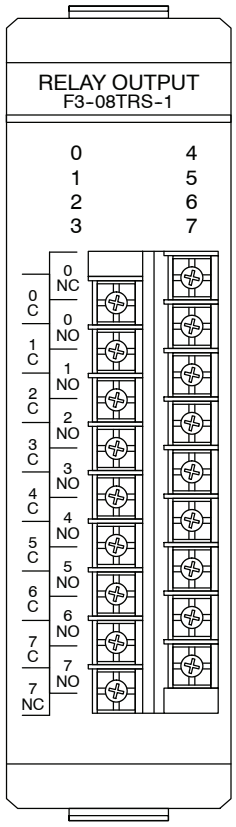
Outputs per module	8		Max leakage current	N/A
Commons per module	8 (isolated)		Max inrush current	10A Inductive
Operating voltage*	12-125 VAC 125-250 VAC requires external fuses 12-30 VDC		Minimum load	100 mA @12VDC
			Base power required	9V 37mA / ON pt. (296 mA Max) 24V N/A
Output type	6 Form A (SPST) 2 Form C (SPDT)		OFF to ON response	13 ms Max
			ON to OFF response	9 ms Max
Peak voltage	265 VAC / 120 VDC		Terminal type	Removable
AC frequency	47-63 Hz		Status indicators	Logic Side
ON voltage drop	N/A		Weight	8.9 oz. (252 g)
Max current (resistive)	10A / point AC/DC 30A / module AC/DC		Fuses	(8) One 10A (125V) per common Non-replaceable

NOTE: Contact life may be lengthened beyond those values shown by the use of an appropriate arc suppression. This technique is discussed earlier in this chapter.

Derating Chart for F3-08TRS-1

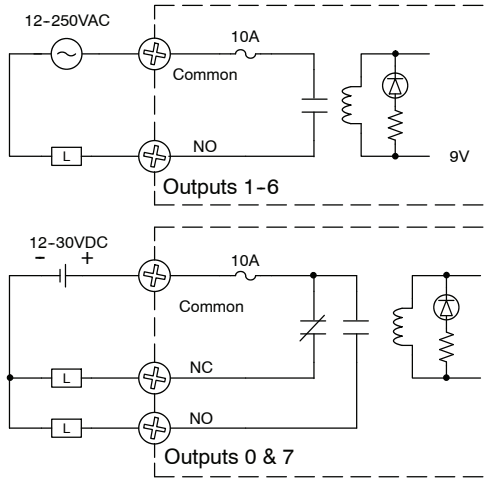






Typical Relay Life (Operations)

Maximum Resistive or Inductive Inrush Load Current	Operating Voltage		
	28VDC	120VAC	240VAC
1/4HP		25K	
10.0A	50K	50K	
5.0A	200K	100K	
3.0A	325K	125K	50K
.05A	>50M		



*Maximum DC voltage rating is 120 VDC at .5 Amp, 30,000 cycles typical

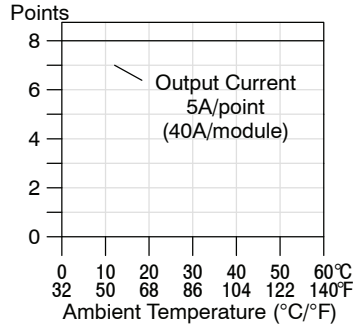
Motor starters up to and including a NEMA size 4 can be used with this module.

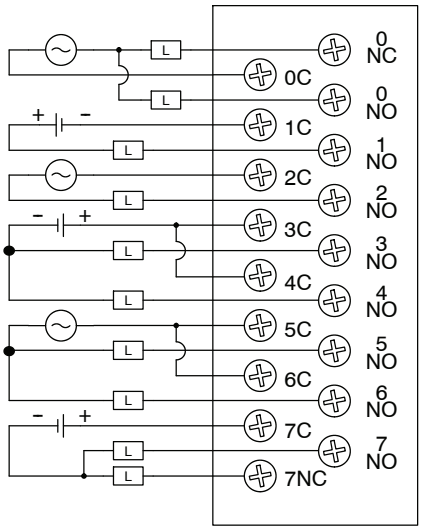
F3-08TRS-2, Relay Output Module

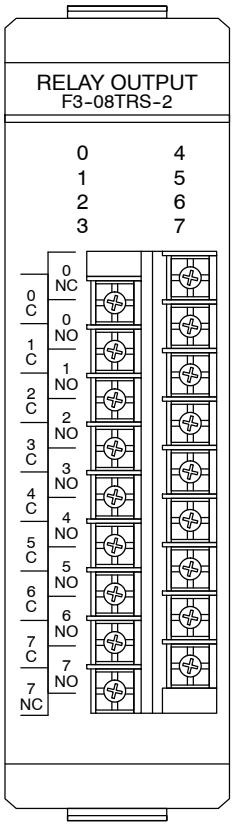
Outputs per module	8		Max leakage current	N/A
Commons per module	8 (isolated)		Max inrush current	10A Inductive
Operating voltage*	12-125 VAC 125-250 VAC requires external fuses 12-30 VDC		Minimum load	100 mA @12VDC
			Base power required	9V 37mA / ON pt. (296 mA Max) 24V N/A
Output type	6 Form A (SPST) 2 Form C (SPDT)		OFF to ON response	13 ms Max
			ON to OFF response	9 ms Max
Peak voltage	265 VAC / 120 VDC		Terminal type	Removable
AC frequency	47-63 Hz		Status indicators	Logic Side
ON voltage drop	N/A		Weight	9 oz. (255 g)
Max current (resistive)	5A / point AC/DC 40A / module AC/DC		Fuses 19379-K-10A Wickman	(8) One 5A (125V) per common User replaceable

NOTE: Contact life may be lengthened beyond those values shown by the use of an appropriate arc suppression. This technique is discussed earlier in this chapter.

Derating Chart for F3-08TRS-2



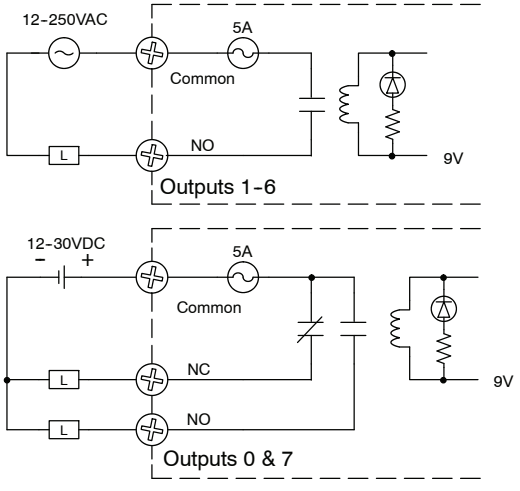




Typical Relay Life (Operations)

Maximum Resistive or Inductive Inrush Load Current	Operating Voltage		
	28VDC	120VAC	240VAC
5.0A	200K	100K	
3.0A	325K	125K	50K
.05A	>50M		

Expected mechanical relay life is 100 million operations.



*Maximum DC voltage rating is 120 VDC at .5 Amp, 30,000 cycles typical

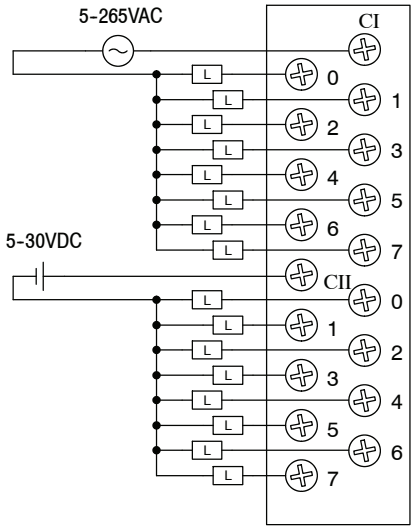
Motor starters up to and including a NEMA size 3 can be used with this module.

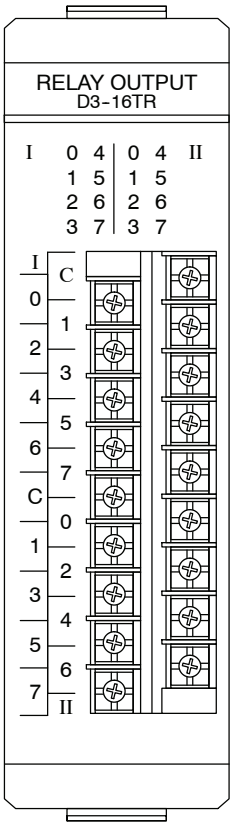
D3-16TR, Relay Output Module

Outputs per module	16		Minimum load	5 mA @ 5v
Commons per module	2 (isolated)		Base power required	9V 30 mA/ON pt. (480 mA Max) 24V N/A
Operating voltage	5-265 VAC 5-30 VDC		OFF to ON response	12 ms
Output type	16 Form A (SPST)		ON to OFF response	12 ms
Peak voltage	265 VAC / 30 VDC		Terminal type	Removable
AC frequency	47-63 Hz		Status indicators	Logic Side
ON voltage drop	N/A		Weight	8.5 oz. (248g)
Max current	2A / point AC/DC (resistive) 8A / common AC/DC		Fuses	None
Max leakage current	0.1mA @ 220 VAC			
Max inrush current	2A			

Typical Relay Life (Operations)

Voltage	Resistive	Solenoid	Closures
220VAC	2A	0.25A	100k
220VAC		0.03A	800k
110VAC	2A	0.25A	100k
110VAC		0.05A	650k
24VDC	2A	0.25A	100k





Derating Chart for D3-16TR