

Discrete Output Modules

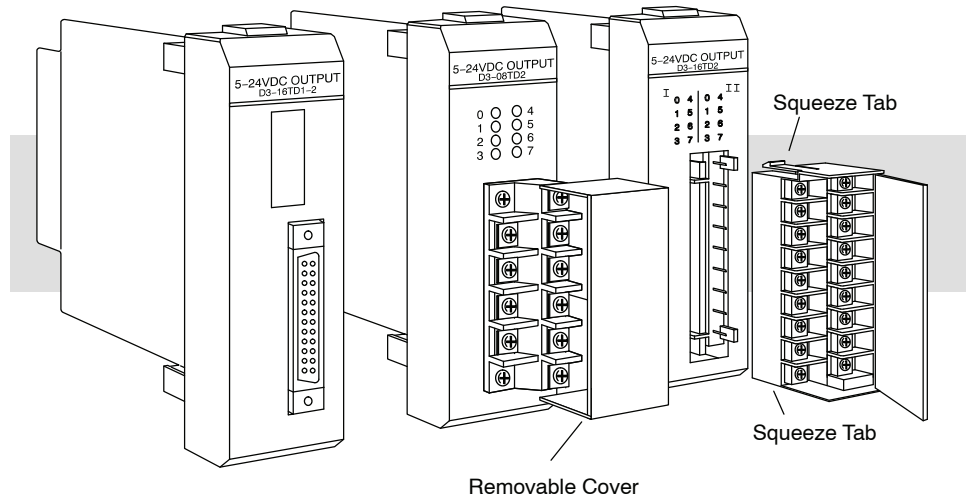
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Discrete Output Module Identification and Terminology

Discrete Output Module Status Indicators

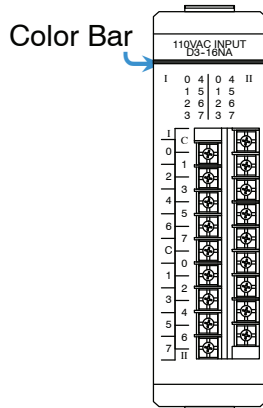
This chapter contains I/O specification sheets for the DL305/FL305 discrete output modules. The following diagram shows the status indicator location for some of the most common discrete output modules.



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

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

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

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.

$$R \text{ minimum} = 0.5 \Omega, 1/2 \text{ W}$$

$$C \text{ minimum} = 0.001 \mu\text{F}, \text{ the voltage rating of } C \text{ must be } \geq E$$

Resistor Tolerance For $E < 70\text{V}$, R may be 3 times indicated value.
For $70\text{V} < E < 100\text{V}$, R may be $\pm 50\%$ indicated value.
For $100\text{V} < E < 150\text{V}$, R may be $\pm 10\%$ indicated value.
For $E > 150\text{V}$, R may be $\pm 5\%$ indicated value.

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

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

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

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

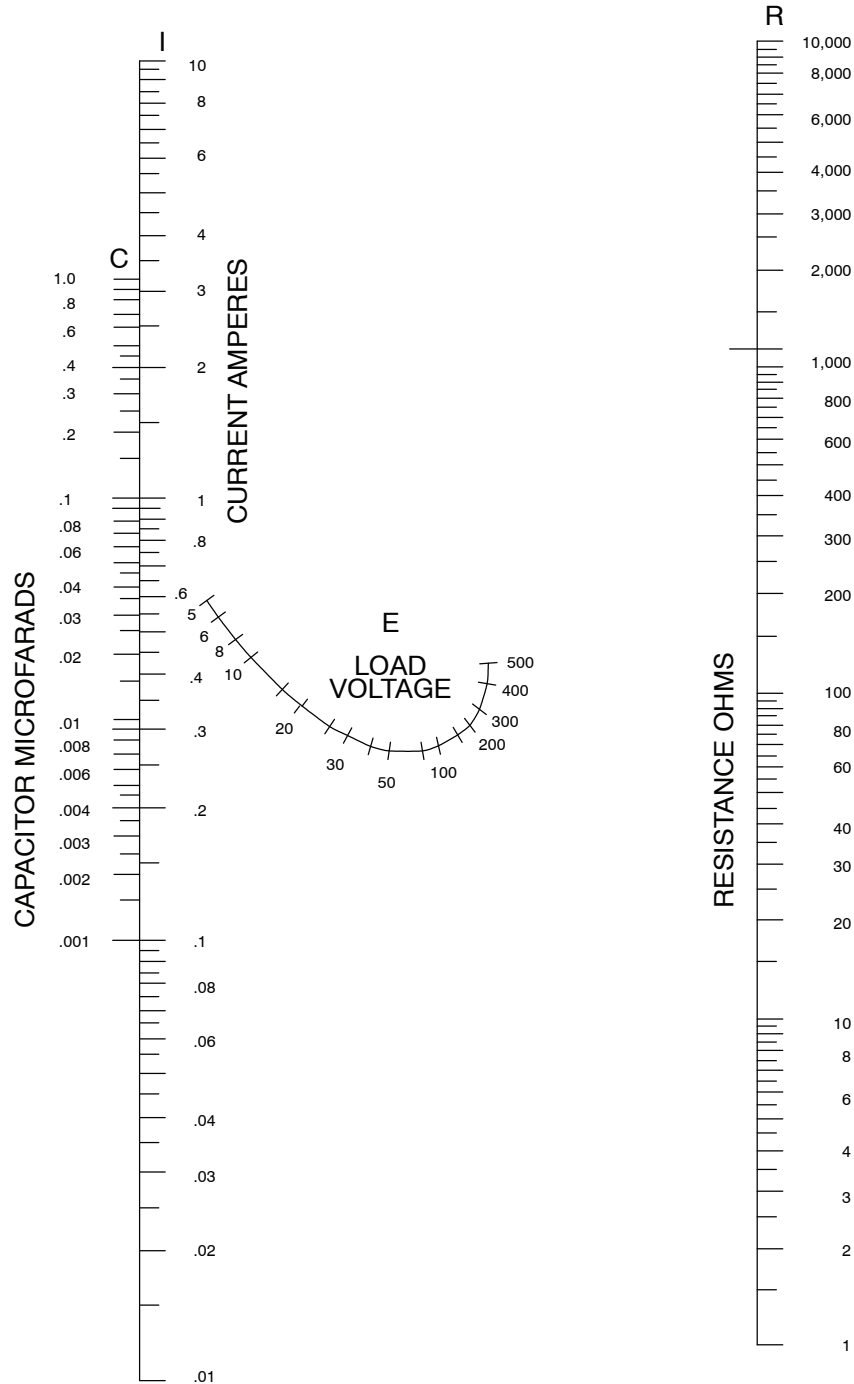
Adding Contact Protection If the contact is switching a DC inductive load, add a diode across the load as near to load coil as possible. Add the RC network across the relay contacts as close to the relay as possible.

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 (I) 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) $C = I^2 / 10$ microfarads For DC. For AC, use peak values
- (2) $R = E / 10^x$ ohms Where $x = (1 + 50/E)$

D3-08TD1, 24 VDC Output Module

Outputs per module	8 (current sinking)	Minimum load	1 mA
Commons per module	2 (internally connected)	Base power required	9V 20 mA Max 24V 3mA/pt. (24mA Max)
Operating voltage	5-24VDC	OFF to ON response	0.1 ms
Output type	NPN (open collector)	ON to OFF response	0.1 ms
Peak voltage	45VDC	Terminal type	Non-removable
AC frequency	N/A	Status indicators	Logic Side
ON voltage drop	0.8V @ 0.5A	Weight	4.2 oz. (120 g)
Max current	0.5A / point 1.8 / common	Fuses	(2) One 3A per common Non-replaceable
Max leakage current	0.1 mA @ 40VDC		
Max inrush current	3A / 20ms 1A / 100ms		

Discrete Output Modules

5-24VDC

Internally Connected

C1

C2

**24VDC OUTPUT
D3-08TD1**

0	1	2	3	4	5	6	7
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Derating Chart for D3-08TD1

Points

Ambient Temperature (°C/°F)	Points
0 / 32	8
10 / 50	8
20 / 68	8
30 / 86	8
40 / 104	8
50 / 122	8
60 / 140	5

Ambient Temperature (°C/°F)

Output

Optical Coupler

9V

3A

24VDC

Internal Power Supply

Common

5-24VDC

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	OFF to ON response	0.1 ms
Output type	NPN Transistor (emitter follower)	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		

Discrete Output Modules

5-24VDC

Internally Connected

C1

C2

**24VDC OUTPUT
D3-08TD2**

0	○	○	4
1	○	○	5
2	○	○	6
3	○	○	7

Derating Chart for D3-08TD2

Ambient Temperature (°C)	Ambient Temperature (°F)	Points
0	32	8
10	50	8
20	68	8
30	86	8
40	104	8
50	122	8
60	140	0

5-24VDC

3A

Common

Output

Optical Coupler

9V

D3-16TD1-2, 24 VDC Output Module

Outputs per module	16 (current sinking)	Minimum load	1 mA
Commons per module	4 (internally connected)	Base power required	9V (40mA Max) 3mA+2.3mA/ON pt. 24V 6mA/ON pt. (96mA Max)
Operating voltage	5-24VDC	OFF to ON response	0.1 ms
Output type	NPN transistor (open collector)	ON to OFF response	0.1 ms
Peak voltage	45VDC	Terminal type	Removable connector
AC frequency	N/A	Status indicators	Logic Side
ON voltage drop	2.0V @ 0.5A	Weight	5.6 oz. (160 g)
Max current	0.5A / point 1.8A common	Fuses	(4) One 3A per common Non-replaceable
Max leakage current	0.3 mA @ 40VDC		
Max inrush current	3A / 20ms 1A / 100ms		

Discrete Output Modules

24VDC OUTPUT
D3-16TD1-2

Internally Connected

Derating Chart for D3-16TD1-2

Ambient Temperature (°C/°F)	Points
0 / 32	16
10 / 50	16
20 / 68	16
30 / 86	16
40 / 104	14
50 / 122	12
60 / 140	8

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)	Minimum load	1 mA
Commons per module	2 (isolated)	Base power required	9V 7.5 mA/ON pt. (180 mA Max) 24V N/A
Operating voltage	5-24VDC	OFF to ON response	0.1 ms
Output type	NPN transistor (emitter follower)	ON to OFF response	1 ms
Peak voltage	40VDC	Terminal type	Removable
AC frequency	N/A	Status indicators	Logic Side
ON voltage drop	1.5V @ 0.5A	Weight	7.1 oz. (210 g)
Max current	0.5A / point 3A common	Fuses	(2) One 5A per common Non-replaceable
Max leakage current	0.01 mA @ 40VDC		
Max inrush current	3A / 20ms 1A / 100ms		

Discrete Output Modules

5-24VDC
- +

5-24VDC
- +

CI
0 1 2 3 4 5 6 7

CII
0 1 2 3 4 5 6 7

24VDC OUTPUT
D3-16TD2

I	0	4	0	4	II
	1	5	1	5	
	2	6	2	6	
	3	7	3	7	

I C II

0 1 2 3 4 5 6 7

0 1 2 3 4 5 6 7

C

0 1 2 3 4 5 6 7

II

Derating Chart for D3-16TD2

Points

16
12
8
4
0

0 10 20 30 40 50 60°C
32 50 68 86 104 122 140°F

Ambient Temperature (°C/°F)

0.25A

0.5A

5-24VDC
- +

Common

5A

Output

9VDC

Optical Isolator

D3-04TAS, 110-220 VAC Output Module

Outputs per module	4	Minimum load	10 mA
Commons per module	4 (isolated)	Base power required	9V 12 mA Max 24V N/A
Operating voltage	80-265VAC	OFF to ON response	1 ms Max
Output type	Triac	ON to OFF response	10 ms Max
Peak voltage	265 VAC	Terminal type	Non-removable
AC frequency	47-63 Hz	Status indicators	Logic Side
ON voltage drop	1.5 VAC @ 2A	Weight	6.4 oz. (180 g)
Max current	2A / point 2A / common	Fuses	(4) One 3A per common User replaceable
Max leakage current	7 mA @ 220VAC 3.5 mA @ 110VAC		
Max inrush current	20A for 16 ms 10A for 100 ms		

Discrete Output Modules

80-265VAC Line
Neut

0 C0
1 C1
2 C2
3 C3

Neut 80-265VAC

110/220VAC OUTPUT
D3-04TAS

0	4
1	5
2	6
3	7

Derating Chart for D3-04TAS

Ambient Temperature (°C/°F)	1A Points	2A Points
0 (32)	4	4
20 (68)	4	4
30 (86)	3.5	3.5
40 (104)	3	3
50 (122)	2.5	2.5
60 (140)	2	2

Output .33 9V

Line 80-265VAC Common 3A 47Ω

F3-08TAS, 250 VAC Isolated Output Module

Outputs per module	8 (500V point-to-point isolation)	Base power required	9V 10mA / ON pt. 80mA Max. 24V N/A
Commons per module	8 (isolated)	OFF to ON response	8 ms Max
Operating voltage	12-125 VAC 125-250 VAC requires external fuses	ON to OFF response	8 ms Max
Output type	SSR Array (TRIAC)	Terminal type	Removable
Peak voltage	400 VAC	Status indicators	Logic Side
AC frequency	47 - 440 Hz	Weight	6.3 oz. (177g)
ON voltage drop	1 VAC @ 1A	Fuses BK/PCE-5 Bussman (One spare fuse included)	(8) fast blow One 5A (125V fast blow) per each circuit User replaceable
Max current	1A / point		
Max leakage current	10 μ A @ 240 VAC		
Max inrush current*	20A for 16 ms 3A for 100 ms		
Minimum load	0.5 mA		

Discrete Output Modules

F3-08TAS-1
OUTPUT 125VAC ISOLATED

0	4
1	5
2	6
3	7

Derating Chart

Ambient Temperature (°C/°F)	Amps per Point
0 / 32	1.5
10 / 50	1.5
20 / 68	1.5
30 / 86	1.5
40 / 104	1.25
50 / 122	1.1
60 / 140	1.0

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)	Base power required	9V 25mA/ON pt. (200mA Max), 24V N/A
Commons per module	8 (isolated)	OFF to ON response	1 ms Max
Operating voltage	20-125VAC	ON to OFF response	9 ms Max
Output type	SSR (TRIAC with zero cross-over)	Terminal type	Removable
Peak voltage	140VAC	Status indicators	Logic Side
AC frequency	47 - 63 Hz	Weight	6.3 oz. (177g)
ON voltage drop	1.6V(rms) @ 1.5A	Fuses	8 (1 per common) 5A, 125V fast blow Order D3-FUSE-4 (5 per pack)
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		

Discrete Output Modules

20-125VAC

Line 0 1 2 3 4 5 6 7

0 1 2 3 4 5 6 7

0 C 1 NO 2 C 3 NO 4 C 5 NO 6 C 7 NO

Derating Chart

Ambient Temperature (°C/°F)	Current per Point (Amps)
0 (32)	1.5
10 (50)	1.5
20 (68)	1.5
30 (86)	1.5
40 (104)	1.25
50 (122)	1.1
60 (140)	1.0

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

Output

Line

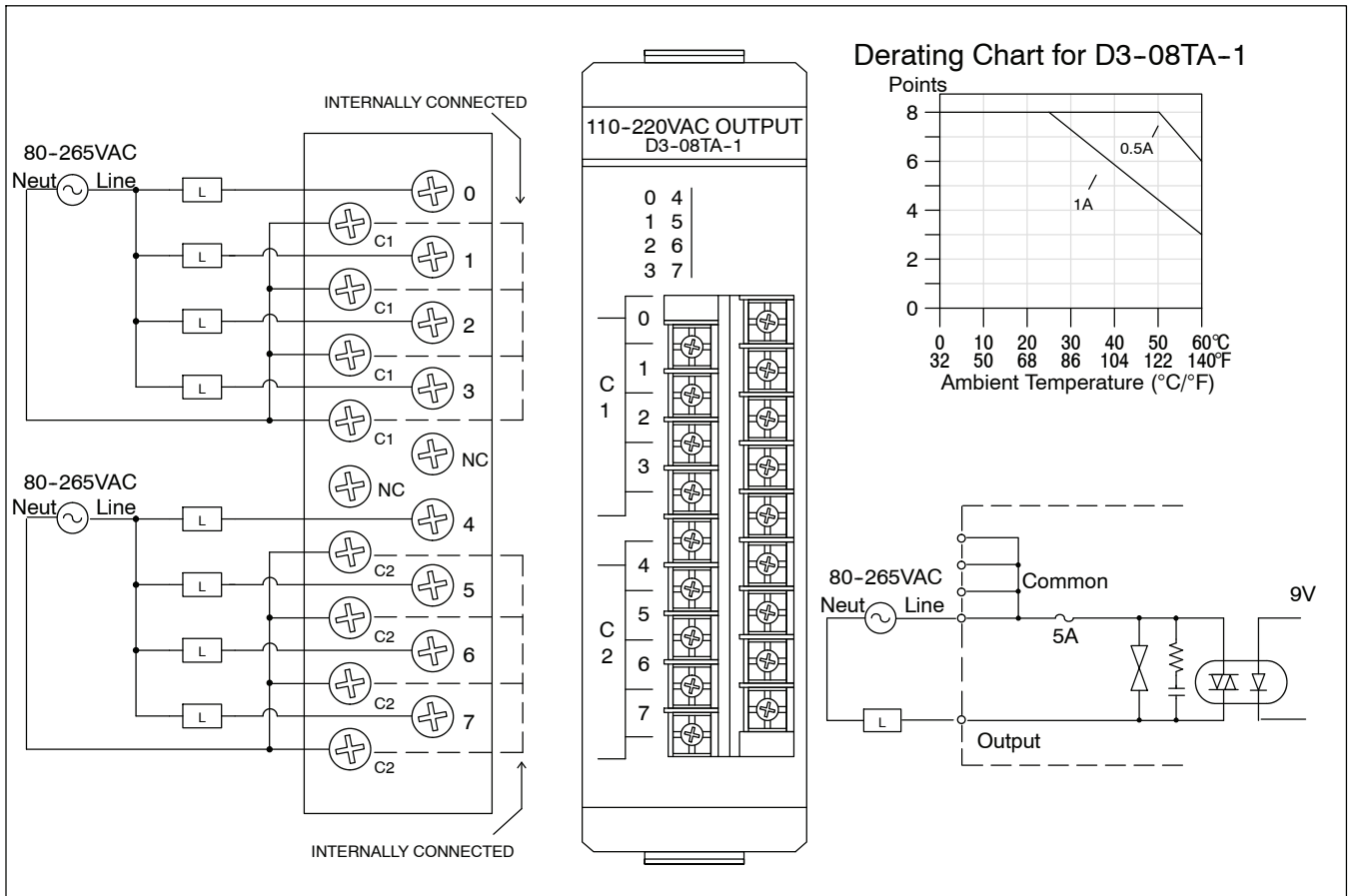
COM

5A

To LED

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	OFF to ON response	1 ms Max
Output type	Triac	ON to OFF response	8.33 ms Max
Peak voltage	265VAC	Terminal type	Removable
AC frequency	47-63 Hz	Status indicators	Logic Side
ON voltage drop	1.5 VAC @ 1A	Weight	7.4 oz. (210 g)
Max current	1A / point 3A / common	Fuses	(2) One 5A per common Non-replaceable
Max leakage current	1.2 mA @ 220VAC 0.52 mA @ 110VAC		
Max inrush current	10A for 16 ms 5A for 100 ms		



Discrete Output Modules

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

Outputs per module	8	Base power required	9V 20mA/ON pt. (160 mA Max) 24V N/A
Commons per module	2 (isolated)		OFF to ON response
Operating voltage	80-265VAC	ON to OFF response	8.33 ms Max
Output type	Triac	Terminal type	Non-removable
Peak voltage	265VAC	Status indicators	Logic Side
AC frequency	47-63 Hz	Weight	6.4 oz. (180 g)
ON voltage drop	1.5 VAC @ 1A	Fuses	(2) One 5A per common Non-replaceable
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		

Discrete Output Modules

80-265VAC
Neut Line

80-265VAC
Neut Line

C1

0 1
2 3
4 5
6 7

C2

Derating Chart for D3-08TA-2

Points

8
6
4
2
0

0 10 20 30 40 50 60°C
32 50 68 86 104 122 140°F

Ambient Temperature (°C/°F)

0.5A
1A

80-265VAC
Neut Line

Common

5A

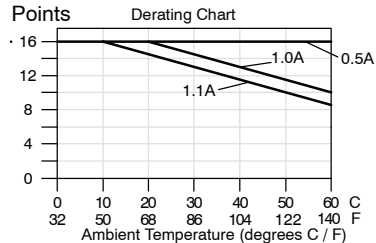
Output

9V

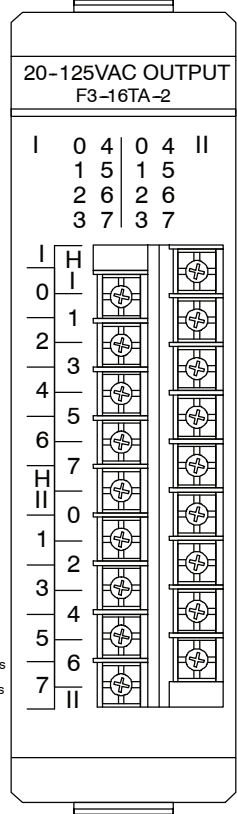
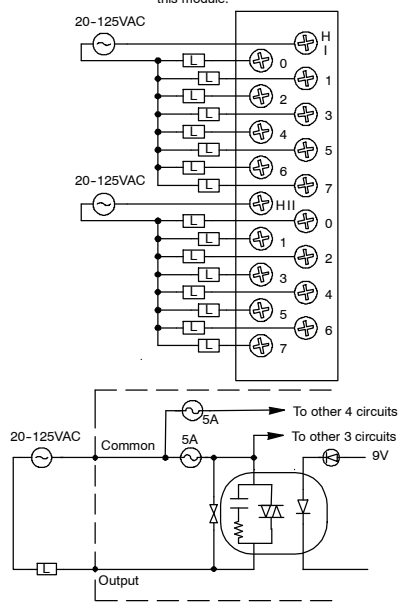
F3-16TA-2, 20-125 VAC Output Module

Outputs per module	16	Minimum load	50mA
Commons per module	2 (isolated)	Base power required	9V 14mA / ON pt. 250mA Max. 24V N/A
Operating voltage	20 - 125VAC	OFF to ON response	8ms Max.
Output type	SSR Array (TRIAC)	ON to OFF response	8 ms Max.
Peak voltage	140 VAC	Terminal type	Removable
AC frequency	47 - 63Hz	Status indicators	Logic Side
ON voltage drop	1.1VAC @ 1.1A	Weight	7.7oz. (218g)
Max current	1.1A / point	Fuses (One spare fuse included)	4 (One 5A 125V fast blow per each group of four outputs) Order D3-FUSE-4 (5 per pack)
Max leakage current	0.7mA @ 125VAC		
Max inrush current*	15A for 20ms 8A for 100ms		

Discrete Output Modules



*Fuse blows at 20 Amp surge
Motor starters up to and including a NEMA size 3 can be used with this module.

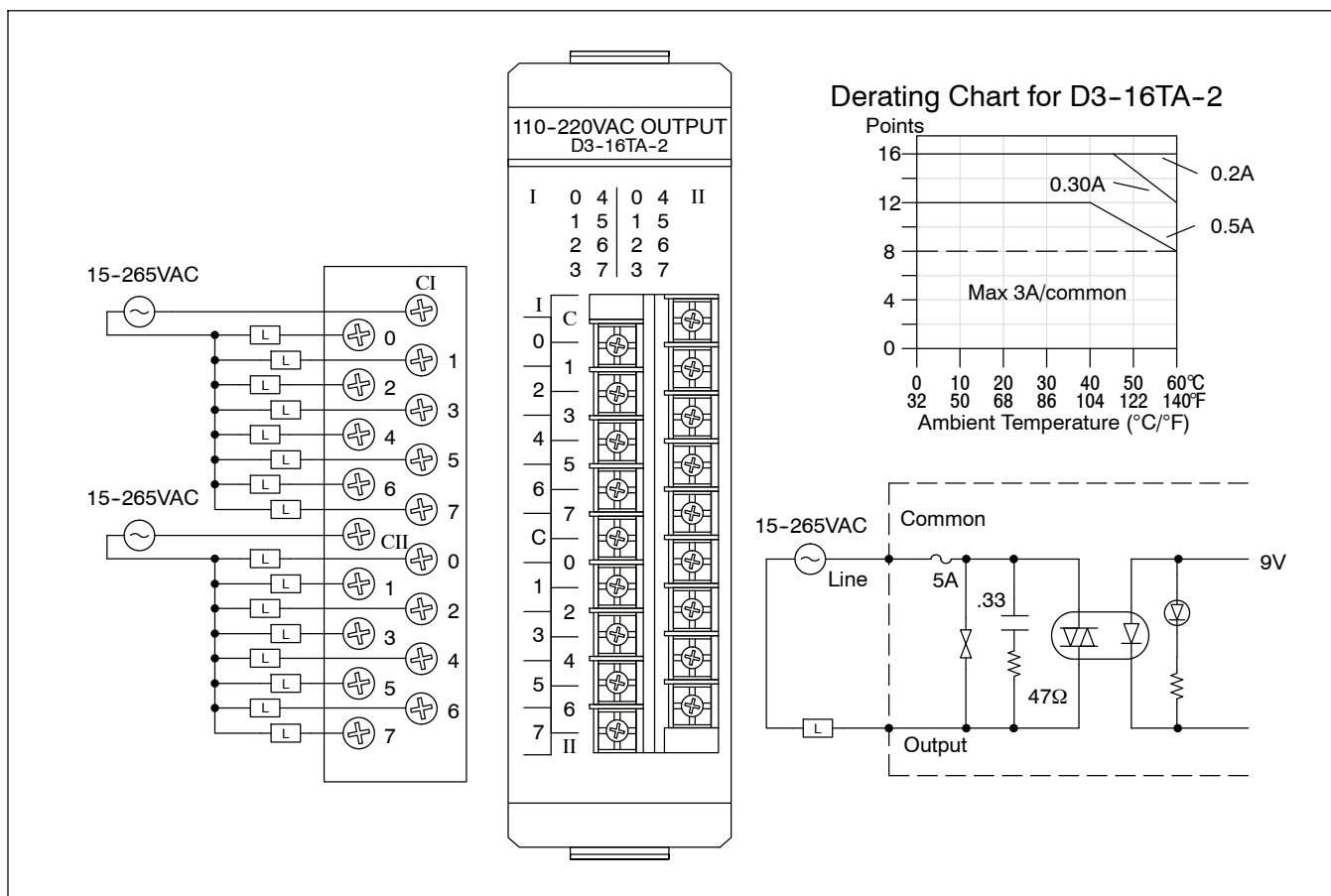


D3-16TA-2, 110-220 VAC Output Module

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 Oz. (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

Discrete Output Modules

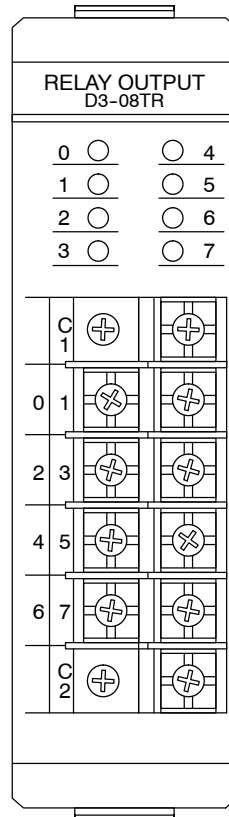
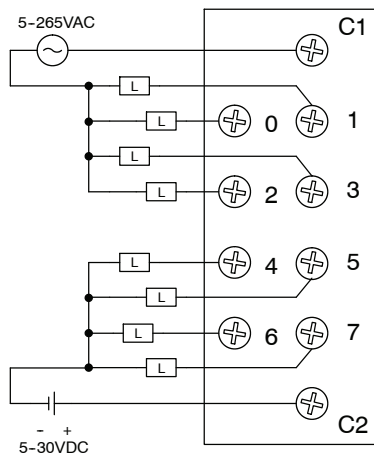


D3-08TR, Relay Output Module

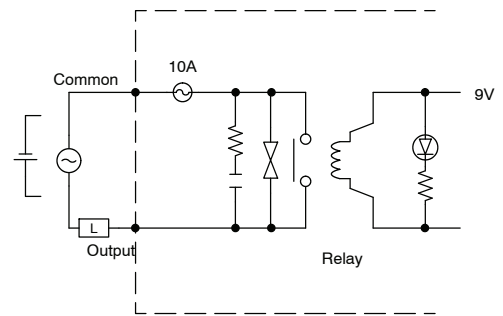
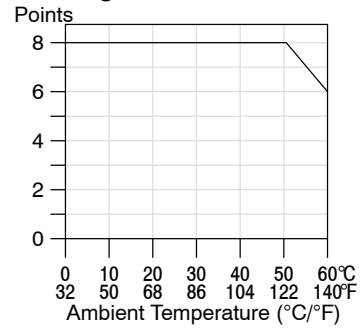
Outputs per module	8	Minimum load	5 mA @ 5v
Commons per module	2 (isolated)	Base power required	9V 45 mA/ON pt. (360 mA Max) 24V N/A
Operating voltage	5-265VAC 5-30VDC	OFF to ON response	5 ms
Output type	Form A (SPST)	ON to OFF response	5 ms
Peak voltage	265VAC / 30VDC	Terminal type	Non-removable
AC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



Discrete Output Modules

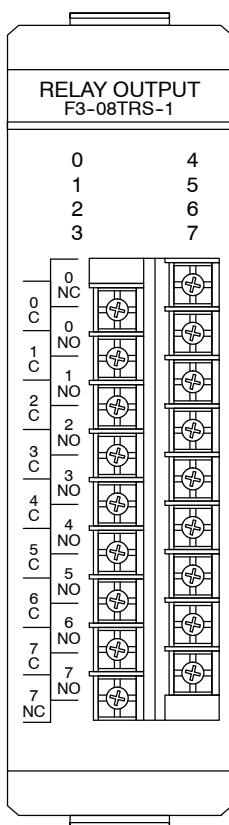
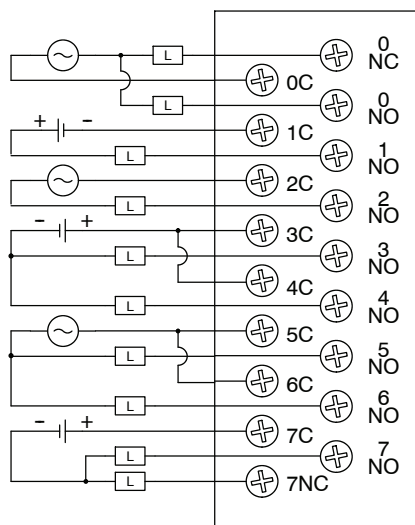
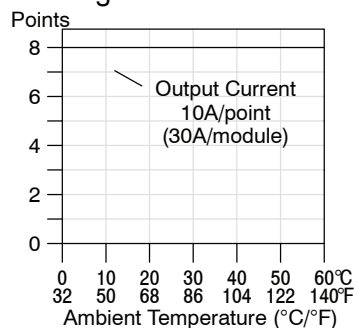
F3-08TRS-1, Relay Output Module

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
Output type	6 Form A (SPST) 2 Form C (SPDT)	Base power required	9V 37mA / ON pt. (296 mA Max) 24V N/A
Peak voltage	265 VAC / 120 VDC	OFF to ON response	13 ms Max
AC frequency	47-63 Hz	ON to OFF response	9 ms Max
ON voltage drop	N/A	Terminal type	Removable
Max current (resistive)	10A / point AC/DC 30A / module AC/DC	Status indicators	Logic Side
		Weight	8.9 oz. (252 g)
		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.

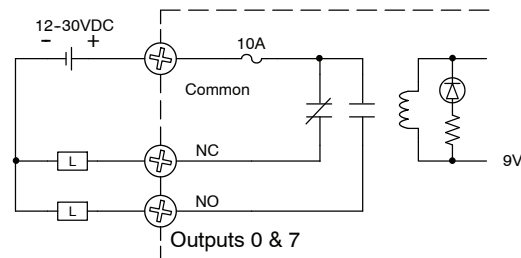
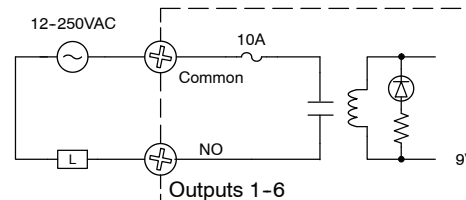
Discrete Output Modules

Derating Chart for F3-08TRS-1



Typical Relay Life (Operations)

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



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

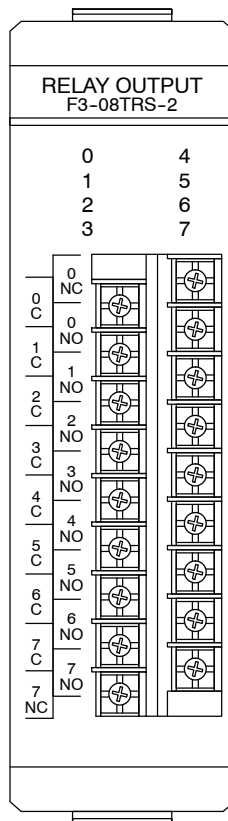
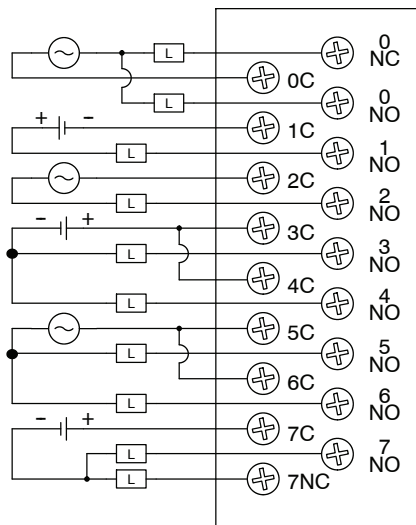
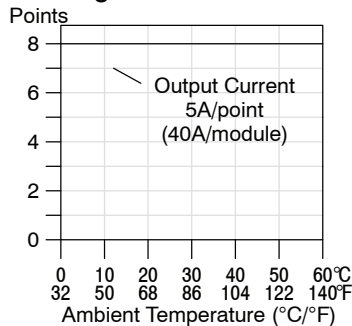
Motor starters up to and including a NEMA size 4 can be used with this module.

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
Output type	6 Form A (SPST) 2 Form C (SPDT)	Base power required	9V 37mA / ON pt. (296 mA Max) 24V N/A
Peak voltage	265 VAC / 120 VDC	OFF to ON response	13 ms Max
AC frequency	47-63 Hz	ON to OFF response	9 ms Max
ON voltage drop	N/A	Terminal type	Removable
Max current (resistive)	5A / point AC/DC 40A / module AC/DC	Status indicators	Logic Side
		Weight	9 oz. (255 g)
		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.

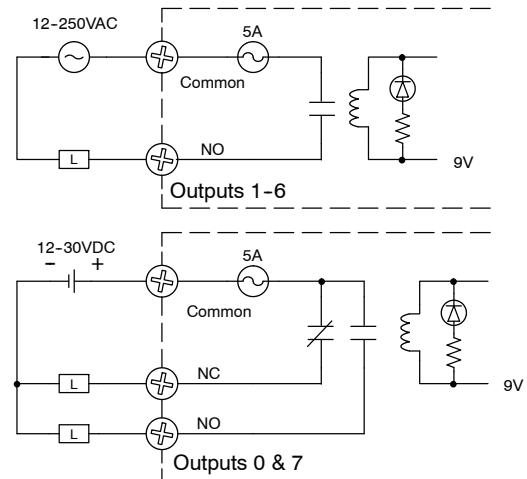
Derating Chart for F3-08TRS-2



Typical Relay Life (Operations)

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

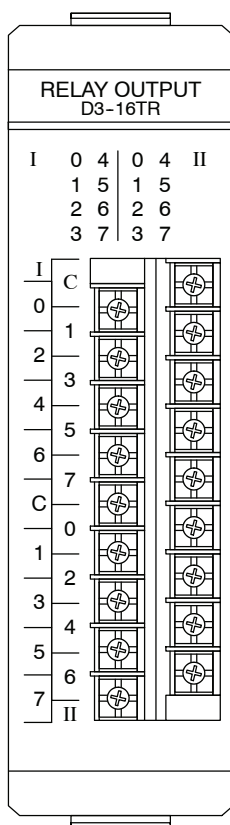
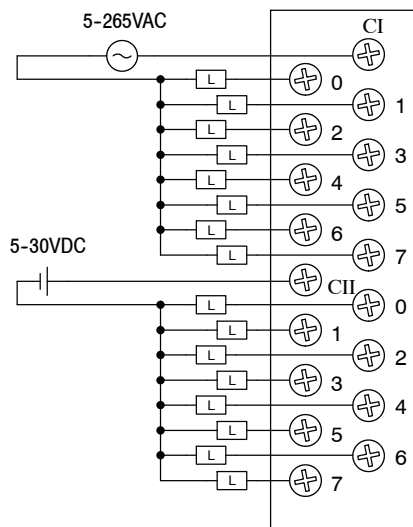
Outputs per module	16	Minimum load	5 mA @ 5v
Commons per module	2 (isolated)	Base power required	9V 30 mA/ON pt. (480 mA Max) 24V N/A
Operating voltage	5-265 VAC 5-30 VDC	OFF to ON response	12 ms
Output type	16 Form A (SPST)	ON to OFF response	12 ms
Peak voltage	265 VAC / 30 VDC	Terminal type	Removable
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		

Discrete Output Modules

Typical Relay Life (Operations)

Voltage Resistive Solenoid Closures

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

