TC00893B

Description

The Harmony Input/Output (I/O) System utilizes a variety of input and output blocks to interface process signals to the Symphony ™ Enterprise Management and Control System. Digital input/output (DIO) blocks have input channels to read the states of switches, relay contacts, solenoids, etc. and output channels used in AC/DC switching applications. Digital output (DOT) blocks provide output channels for AC/DC switching applications. The digital outputs can be used to drive annunciators such as buzzers and lamps and to drive two-state final control elements such as actuators, relays, and solenoids. Digital switching of current loads up to ten amperes can be achieved by using auxiliary relay assemblies (RLY) with DIO blocks. These digital blocks along with other types of blocks for analog and control I/O interface and remote I/O communication combine to create a complete I/O system (Fig. 1). Refer to the *Harmony Input/Output System* overview for a complete system description.
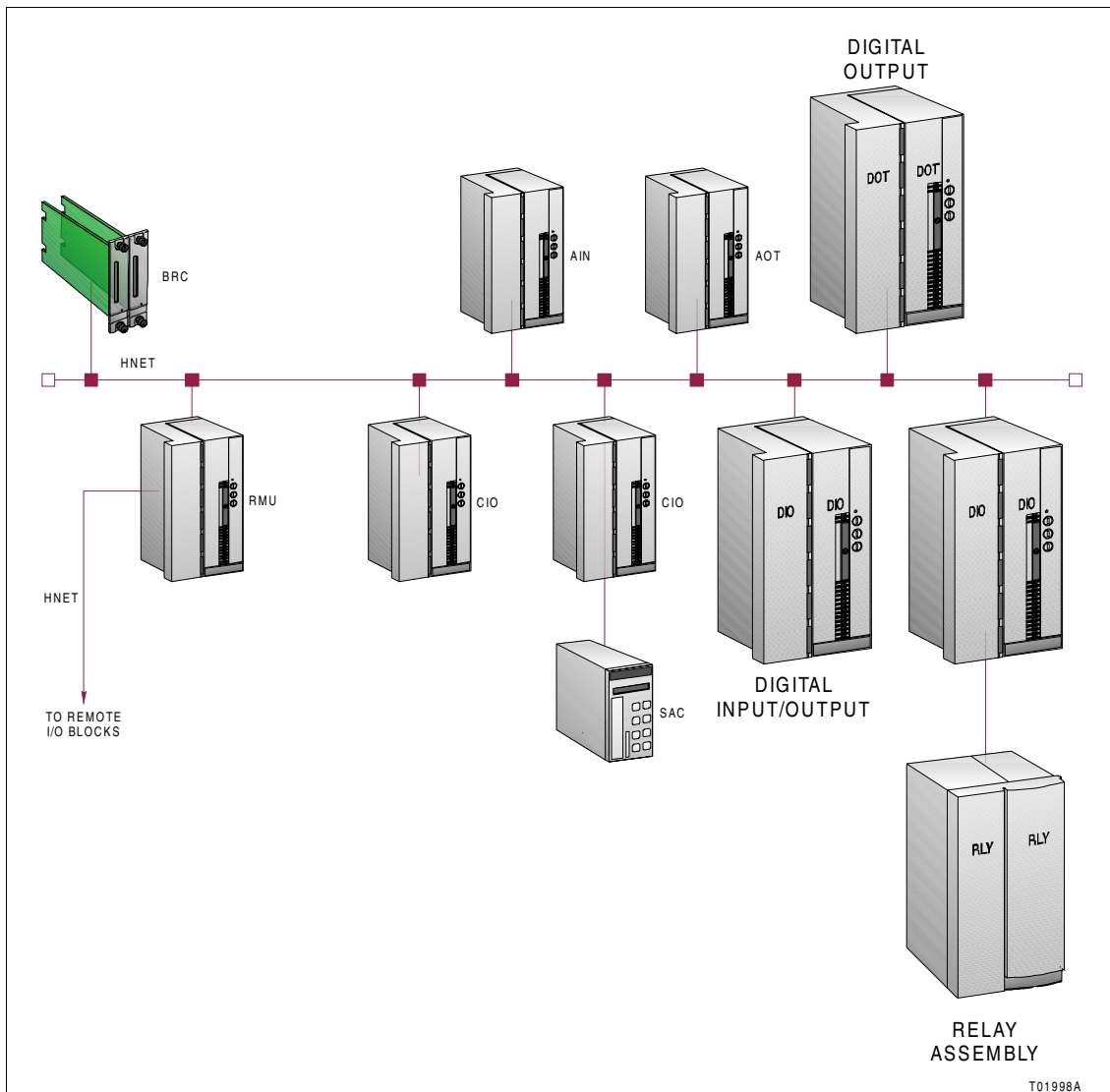
Figure 1. Harmony I/O System

Operation

Each digital I/O block has an onboard microprocessor which controls and performs the following functions for the block:

- Hnet communication.
- Digital input/output processing.
- Redundancy link communication.
- Block diagnostics.
- Status reporting.

Along with these functions, the microprocessor is also responsible for executing the I/O block portion of the control configuration. The complete control configuration made up of linked function codes resides and is retained in the Harmony controller at all times. The controller only off loads a portion of the configuration to be executed by the individual I/O blocks.

Function codes are predefined, fixed function algorithms. The controller uses the following function codes to interface to a digital I/O block:

- I/O device definition (FC 221).
- Digital in/channel (FC 224).
- Digital out/channel (FC 225).

Specifications are set on a per channel basis rather than on an I/O group basis. The function codes provide addressing, and start-up, execute (i.e., run time), override, simulation, and failure mode operation specifications. The I/O channel function codes are exception reporting function codes.

Digital Input

The Harmony I/O System supports 24 VDC, 48 VDC, 125 VDC, 120 VAC, and 240 VAC digital inputs through DIO-400 blocks. Each DIO block supports 16 input channels. The DIO can accept all input ranges which are jumper selectable on a per channel basis. Debounce time for digital inputs is software selectable.

The DIO block reads voltage levels at its input channels, converts the voltages to boolean logic states (0 or 1), then reports the input states to the controller. The block provides channel status information along with each reported input.

The digital input channels provide onboard current limiting for short circuit protection. The current limiting prevents circuit damage that can result from excessive current levels at an input channel caused by field input faults. A channel will recover to full function after correcting the fault condition. The DIO blocks have optically isolated input channels.

Digital Output

The Harmony I/O System supports digital outputs through DIO-400 blocks and DOT-100 and DOT-120 blocks.

The output channels of the DIO-400 block are open-collector outputs that can switch 24 VDC and 48 VDC with a maximum load current of 250 milliamperes. User selectable default states of 0, 1, or hold are provided. The outputs are optically isolated channels. Optionally, the 24 VDC outputs of the DIO block can be used to drive either DPDT electromechanical relays of an RLY-100 block or solid state relays of an RLY-200 block. Depending on the RLY block type, the relay outputs can switch voltages up to 240 VAC with a maximum load current of ten amperes.

The I/O system supports 24 VDC, 48 VDC, 125 VDC, 120 VAC, and 240 VAC digital outputs through DOT blocks. The output channels of DOT blocks are SPDT electromechanical relay outputs. These outputs can switch voltages up to 240 VAC with a maximum load current of three amperes.

The DOT-120 output channels are fused and monitored through readback circuitry on the block. The block constantly monitors readback from the output contacts to verify and insure hardware and field wiring integrity. The block also reports the readback values to the controller.

Digital Input/Output Blocks

The DIO block interfaces digital input and output signals used to read on or off device states and to switch DC voltages. A DIO block can cable connect to an auxiliary relay block (i.e., RLY-100 and RLY-200) to provide relay outputs. The DIO block supports redundant I/O electronics. A DIO block can be ordered with either a screw terminal (S type), cable/clamp terminal (C type), or relay connector (R type) base. The relay connector base and cable (HRM-RLY) are required to connect the digital outputs to an RLY block.

DIO-400

Universal In, 24 or 48 VDC Out

The DIO-400 block supports 16 isolated input channels and eight isolated output channels. Input channels are individually hardware configurable for input voltage: 24 VDC, 48 VDC, 125 VDC, 120 VAC, and 240 VAC. Open-collector (NPN) output channels can switch voltages of 24 or 48 VDC with a maximum load current of 250 milliamperes.

Digital Output Blocks

The DOT block interfaces digital output signals and is used in AC/DC switching applications. The block supports redundant I/O electronics. A DOT block can be ordered with either a screw terminal (S type) or cable/clamp terminal (C type) base.

DOT-100

Onboard Electromechanical Relay Out

The DOT-100 block supports 16 isolated output channels (i.e., relay contacts). Each channel can be wired as either a normally open or normally closed output. Output channels can switch voltages up to 240 VAC with a maximum load current of three amperes. Relays are individually replaceable with the I/O module removed.

DOT-120

Onboard Monitored Electromechanical Relay Out (with Fusing)

The DOT-120 block is the same as the DOT-100 block, but provides readback circuitry for digital output verification and provides output channel fusing. The readback checks the contact side of the relay to ensure proper relay operation. Front panel fuses are provided for each output.

Auxiliary Relay Assemblies

RLY-100

Electromechanical Relay Assembly

The RLY-100 block connects eight electromechanical relay sockets for use with any DIO block. The RLY block comes populated with eight DPDT electromechanical relays.

RLY-200

Solid State Relay Assembly

The RLY-200 block connects eight solid state relay sockets for use with any DIO block. The RLY block can be populated with 24 VDC, 125 VDC, 120 VAC, and 240 VAC solid state relays in any combination. Relays are ordered separately.

Power Options

The DIO and DOT blocks use two types of power:

- 24 VDC block logic power.
- 24 VDC, 48 VDC, 125 VDC, 120 VAC, and 240 VAC field power.

Each I/O block develops its own operating voltages from redundant 24 VDC block logic power (BLP). The field power operates field devices and some I/O channel circuitry depending on the block type. Both internally powered (i.e., I/O system powered) and externally powered field devices are supported (Figs. 2 and 3).
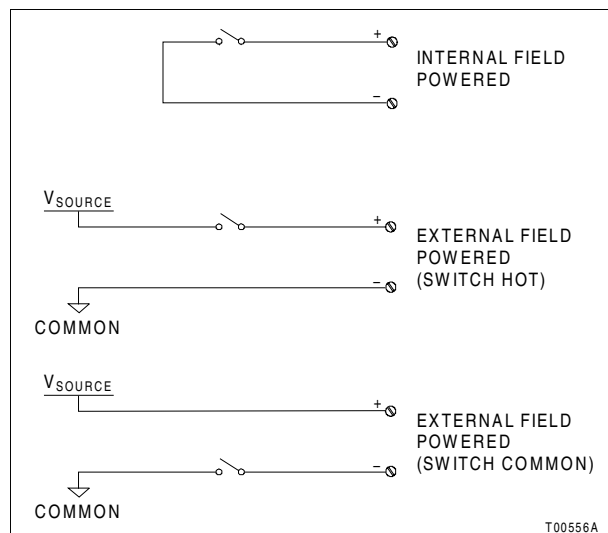

Figure 2. Digital Input

The field power can be supplied in three different forms: Internal field power (IFP), external local field power (LFP), and external remote field power (RFP). 24 VDC IFP power is distributed to the I/O blocks through the block mounting columns, LFP power is wired to each I/O block, and RFP power is wired to individual I/O channels.

The choice of using IFP or LFP power is jumper selectable for each I/O block. This selection affects all I/O channels of a block. The digital output IFP/LFP field power select jumpers are located on the back of the I/O module. The digital input IFP/LFP field power select jumpers are located on the I/O board inside the I/O module.

The choice of using IFP/LFP power or RFP power is selectable on a per channel basis where appropriate. The channel field power select jumpers are located inside the I/O module.

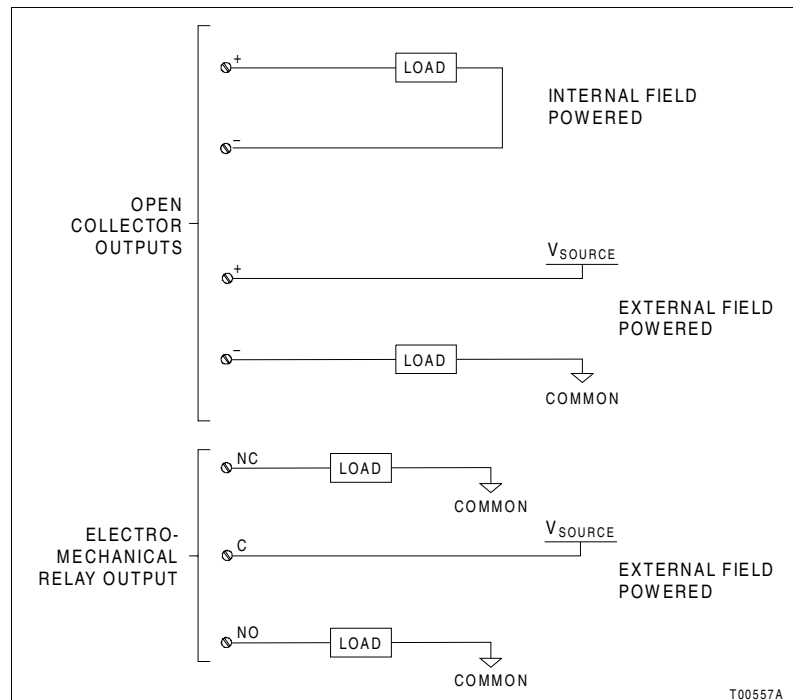Table 1 summarizes the DIO and DOT blocks field power options.

Figure 3. Digital Output

Table 1. Field Power Options Summary

Block	I/O Type	Field Power		
		IFP	LFP	RFP
DIO-400	24 VDC in	•	•	•
	48 VDC in		•	•
	125 VDC in		•	•
	120 VAC in		•	•
	240 VAC in		•	•
	24 VDC out	•	•	•
	48 VDC out		•	•
DOT-100	VDC/VAC	•[1]	•[1]	
DOT-120	VDC/VAC	•[1]	•[1]	

NOTE:
1. 24 VDC to power onboard relay coils.

Redundancy

Redundancy allows backup electronics to read digital inputs and to drive digital outputs in the event of a primary failure. As a background diagnostic task, the backup is continuously monitoring its ability to read field inputs and to drive field outputs. Redundancy requires a redundant base and two I/O modules. The input and output channels are connected in parallel.

Related Documents

Number	Document Title
WBPEEUD240001??	Harmony Analog Input/Output, Data Sheet
WBPEEUD240003??	Harmony Control Input/Output, Data Sheet
WBPEEUD240004??	Harmony Input/Output System, Data Sheet
WBPEEUS240008??	Harmony Input/Output System, Overview

I/O Specifications

Property	Characteristic/Value[1]

I/O blocks
  DIO-400
  DOT-100
  DOT-120
	Universal in, 24/48 VDC out
	Onboard SPDT electromechanical relay out
	Onboard monitored SPDT electromechanical relay out
	(with readback and fusing)

Microprocessor	16-bit processor running at 16 MHz
Memory	64 kb SRAM 512 kb Flash RAM
Redundancy link data rate	1 Mbaud
Block logic power (BLP) - refer to *I/O Power Requirements*	21.6 VDC minimum 24.0 VDC nominal 28.0 VDC maximum
Field power (IFP/LFP) - refer to *I/O Power Requirements*	24.0 VDC nominal 48.0 VDC nominal 125.0 VDC nominal 120.0 VAC nominal 240.0 VAC nominal
Common mode isolation Tested	300 VDC/V_{RMS} at 60 Hz 1,400 V_{RMS} at 60 Hz for 2 sec
Input protection[2]	Continuous short to ground
Dimensions	(see table below)

Overvoltage (installation) category	ANSI/ISA-S82.01-1994 and IEC 1010-1
	  I for circuits above 150 V
	  II for circuits below 150 V

Environmental	Refer to the Harmony I/O System data sheet for environmental specifications and design standards including certification and CE mark directives.
Design standards	

Type	Height		Width		Depth	
	mm	in.	mm	in.	mm	in.
I/O module	266	10.5	76	3.0	162	6.4
Nonredundant base	267	10.5	138	5.4	169	6.7
Redundant base	267	10.5	217	8.5	169	6.7

NOTES:
1. All specification values are maximums unless stated otherwise.
2. The DOT-120 block provides channel fuses for output protection. Other digital outputs may require some type of external output protection.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Auxiliary I/O Specifications

Property	Characteristic/Value[1]					

Auxiliary blocks
  RLY-100
  RLY-200
	DPDT electromechanical relay assembly
	Solid state relay assembly					

Channels	8					
Relays	Refer to Tables 3 and 4.					
Field power (IFP/LFP)[2] - refer to *I/O Power Requirements*	24.0 VDC nominal					
Dimensions		**Height**		**Width**		**Depth**
		mm	**in**	**mm**	**in**	**mm**	**in**
		266	10.5	144	5.7	169	6.7
Environmental	Refer to the Harmony I/O System data sheet for environmental specifications and design standards including certification and CE mark directives.					
Design standards						

NOTES:
1. All specification values are maximums unless stated otherwise.
2. 24 VDC from DIO block to power relay coils.

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I/O Power Requirements

Property[1]			DIO-400
24 VDC BLP current	Typ		200 mA
	Max		220 mA
24 VDC IFP current	DI	Typ[2]	70 mA
	DO[3,4]	Typ[2]	600 mA
	DI	Max[5]	145 mA
	DO[3,6]	Max[5]	2.0 A
	DI[7]	Fault	500 mA
24 VDC LFP current	DI	Typ[2]	70 mA
	DO[3,4]	Typ[2]	600 mA
	DI	Max[5]	145 mA
	DO[3,6]	Max[5]	2.0 A
	DI[7]	Fault	500 mA
48 VDC LFP current	DI	Typ[2]	50 mA
	DO[3,4]	Typ[2]	600 mA
	DI	Max[5]	100 mA
	DO[3,6]	Max[5]	2.0 A
	DI[7]	Fault	130 mA
125 VDC LFP current	DI	Typ[2]	70 mA
	DI	Max[5]	135 mA
	DI[7]	Fault	220 mA
120 VAC LFP current	DI	Typ[2]	75 mA
	DI	Max[5]	140 mA
	DI[7]	Fault	225 mA

Property[1]			DIO-400
240 VAC LFP current	DI	Typ[2]	75 mA
	DI	Max[5]	140 mA
	DI[7]	Fault	230 mA
Heat dissipation[8] 24 VDC DI, 24 VDC DO	Typ		7.2 W
	Max		9.8 W
Heat dissipation[8] 48 VDC DI, 24/48 VDC DO	Typ		7.6 W
	Max		10.6 W
Heat dissipation[8] 125 VDC DI, 24/48 VDC DO	Typ		12.4 W
	Max		21.4 W
Heat dissipation[8] 120 VAC DI, 24 VDC DO	Typ		12.3 W
	Max		20.8 W
Heat dissipation[8] 240 VAC DI, 24/48 VDC DO	Typ		19.1 W
	Max		34.5 W

NOTES:
1. For redundant DIO blocks (i.e., redundant base and two I/O modules), calculate power requirements as 2 × BLP and 2 × IFP/LFP for digital inputs and 2 × BLP and 1 × IFP/LFP for digital outputs.
2. 66 percent channel activity with no faults.
3. When using an RLY block with a DIO block, replace DO current requirements with RLY current requirements.
4. 100 mA digital outputs.
5. All channels active with no faults.
6. 250 mA digital outputs.
7. 16 digital input faults.
8. Heat dissipation values include both BLP and IFP/LFP power and include the base and one I/O module.

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Output Power Requirements

Property[1]		DOT-100	DOT-120	RLY-100	RLY-200
24 VDC BLP current	Typ	190 mA	200 mA	—	
	Max	210 mA	220 mA	—	
24 VDC IFP/LFP current	Typ[2]	215 mA	215 mA	300 mA	100 mA
	Max[3]	350 mA	350 mA	445 mA	150 mA
	Fault[4]	215 mA	215 mA	—	—
Heat dissipation[5] 24 VDC DO	Typ	9.4 W	10.0 W	—	—
	Max	13.9 W	13.0 W	—	—
Heat dissipation[5] 48 VDC DO	Typ	9.4 W	10.4 W	—	—
	Max	13.9 W	13.8 W	—	—
Heat dissipation[5] 125 VDC DO	Typ	9.4 W	12.2 W	—	—
	Max	13.9 W	17.1 W	—	—
Heat dissipation[5] 120 VAC DO	Typ	9.4 W	12.0 W	—	—
	Max	13.9 W	16.8 W	—	—
Heat dissipation[5] 240 VAC DO	Typ	9.4 W	15.8 W	—	—
	Max	13.9 W	23.2 W	—	—

NOTES:
1. For redundant DOT blocks (i.e., redundant base and two I/O modules), calculate power requirements as 2 × BLP and 2 × IFP/LFP.
2. 66 percent channel activity with no faults.
3. All channels active with no faults.
4. DOT - faults on 66 percent of channels.
5. Heat dissipation values include both BLP and IFP/LFP power and include the base and one I/O module.

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Input Specifications

Property[1]	DIO-400
24 VDC - 19.5 to 28 VDC	Yes
48 VDC - 39 to 56 VDC	Yes
125 VDC - 95 to 144 VDC	Yes
120 VAC - 85 to 138 VAC	Yes
240 VAC - 190 to 265 VAC	Yes
Input channels	16
Isolation	Opto-isolated
Response time[2]	1 msec

Turn on voltage (minimum)
    24 VDC
    48 VDC
    125 VDC
    120 VAC
    240 VAC
	19.5 VDC
	39 VDC
	95 VDC
	85 VAC
	190 VAC

Turn off voltage
    24 VDC
    48 VDC
    125 VDC
    120 VAC
    240 VAC
	12 VDC
	18 VDC
	58 VDC
	40 VAC
	87 VAC

On current (typical)	4.6 to 7.3 mA
Off leakage current	<1.5 mA
AC frequency	47 to 63 Hz

Channel fault currents (nominal):
    24 VDC
    48 VDC
    125 VDC
    120 VAC
    240 VAC
	31 mA
	8.1 mA
	14 mA
	15 mA
	15 mA

Supports redundant I/O electronics	Yes

NOTES:
1. All specification values are maximums unless stated otherwise.
2. Software selectable in 1-msec increments up to 255 msec (debounce period).

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Output Specifications

Property[1]	DIO-400	DOT-100	DOT-120
24 VDC out	Yes	Yes	Yes
48 VDC out	Yes	Yes	Yes
125 VDC out	No	Yes	Yes
120 VAC out	No	Yes	Yes
240 VAC out	No	Yes	Yes
Channels	8	16	16
Isolation	Opto-isolated	Isolated (relay contacts)	Isolated (relay contacts)
Relay outputs (refer to Table 2)	—	SPDT EM	SPDT EM

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Property[1]	DIO-400	DOT-100	DOT-120

Open collector outputs:
  24 VDC   off
              on
  48 VDC   off
              on
  Load current
	28 VDC
	2.5 VDC
	56 VDC
	2.5 VDC
	250 mA
		—	—

Switching speed	<0.25 msec	15 msecs	15 msecs
Off leakage current	<1 mA	—	3 mA
Supports redundant I/O electronics	Yes	Yes	Yes

NOTE:
1. All specification values are maximums unless stated otherwise.

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Relay Specifications

Table 2. DOT-100/120 Electromechanical Relays

Property	Characteristic/Value				
Type	Magnacraft miniature epoxy sealed PC board EM relay				
Part number	1949002A3				
Coil voltage	24 VDC nominal				
Contact configuration	SPDT				
Contact material	Silver cadmium oxide				
Contact resistance	100 mΩ				
Cycle rate	30 operations per minute at rated load				
Minimum switching load	10 VDC at 10 mA				
Switching speed	15 msecs				
Bounce time	1.2 msecs (average)				
No. of operations	150,000				
Relay currents	**Property**	**24 VDC**	**48 VDC**	**125 VDC**	**120 VAC**	**240 VAC**
	Make	6.0 A	6.0 A	6.0 A	6.0 A	3.0 A
	Carry	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A
	Resistive break	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A
	Inductive break	1.0 A	1.0 A	1.0 A	1.0 A	0.5 A
	NOTE: L/R = 7.0 msecs; pf = 40%					

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Table 3. RLY-100 Electromechanical Relays

Property	Characteristic/Value				
Type	Systems control output EM relay (MSD type 283 with blowout magnets)				
Part number	1949562A1				
Coil voltage	24 VDC nominal				
Contact configuration	DPDT				
Contact material	Silver cadmium oxide, gold flashed				
Contact resistance	50 mΩ				
Cycle rate	30 operations per minute at rated load				
Minimum switching load	24 VDC at 10 mA				
Switching speed	15 msecs				
Bounce time	15 msecs (average)				
No. of operations	100,000				
Relay currents	**Property**	**24 VDC**	**48 VDC**	**125 VDC**	**120 VAC**	**240 VAC**

Property	24 VDC	48 VDC	125 VDC	120 VAC	240 VAC
Make	30 A	30 A	30 A	30 A	30 A
Carry	10 A	10 A	10 A	10 A	10 A
Resistive break	10 A	7 A	3 A	10 A	10 A
Inductive break	10 A	5 A	1 A	3 A	1 A

NOTE: L/R = 20 msecs; pf = 80%

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Table 4. RLY-200 Solid State Relays

Property	Characteristic/Value			
	24 VDC	**125 VDC**	**120 VAC**	**240 VAC**
Output range	5 to 60 VDC	10 to 200 VDC	12 to 280 VAC	24 to 280 VAC
Output current[1]: 0° to 30°C (32° to 86°F) 15° to 25°C (59° to 77°F) 70°C (158°F)	— 3.0 A 1.2 A	— 1.0 A 0.4 A	— 3.0 A 1.2 A	3.5 A — 1.8 A
Load frequency	—	—	47 to 63 Hz	47 to 63 Hz
Off leakage current[1]	0.01 mA	0.01 mA	0.75 mA	4.00 mA
One cycle surge[2]	5.0 A	1.5 A	85.0 A	80.0 A
Part number	1947685A31	1947685A32	1947684A32	1947803A1

NOTES:
1. AC_{RMS} current.
2. AC_P current.

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Fuse Specifications

Fuse	Rating	Part Number	Description	Note 1	DOT-120	RLY-200
24 VDC relay (solid state)	3.15 A, 250 V	1949438A3151	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)			•
125 VDC relay (solid state)	1.0 A, 250 V	1949438A1001	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)			•
Block power (A and B)	1.6 A, 250 V	1949438A1601	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)	•	•	
Channel	6.3 A, 250 V	1949532A6301	5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)		•	
Field power	3.15 A, 250 V	1949438A4001	5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)	•	•	
120/240 VAC relay (solid state)						•

NOTE:
1. Used in all DIO and DOT blocks.

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