

# DOM1

## Digital Output Module

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The DOM1 Digital Output Module offers 16 channels of optically isolated digital output. These channels are factory configured as TTL compatible voltage outputs. By removing resistors and jumpers, output may be configured as switches. Functioning as switches, the output channels can control loads up to +28V.

Digital output channels are grouped into two ports of eight channels; each port treated as a single byte from software. This grouping allows simultaneous updating of up to eight channels, and enables communication with 4 and 8-bit TTL devices.

Digital Output Modules can be installed in any slot of the Series 500. To install the module, remove the top cover and install the board with the components facing the power supply.

**CAUTION: Always turn off the mainframe power before installing or removing modules. To minimize the possibility of EMI radiation, never operate the system with the top cover removed.**

### User-Configured Components

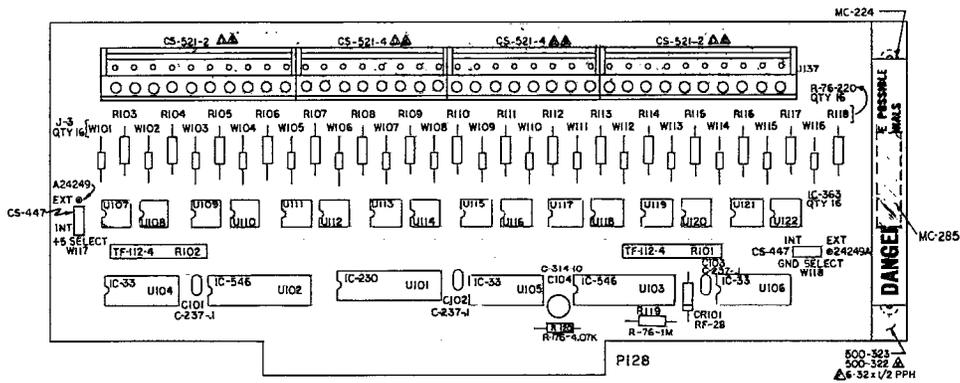
The DOM1 is factory configured to provide isolated TTL-compatible outputs. In this configuration, external +5V and ground wires must be connected to respective module terminals. By moving the positions of two jumpers (W117 and W118), The module can also be used in a non-isolated TTL-compatible configuration that uses the module's own +5V and ground connections.

Resistors to ground and wire jumpers to +5V may be removed to configure individual outputs as switches, thus allowing circuits with potentials as high as 28V to be controlled.

Connections to the module are made to screw terminals located along the top edge of the module. Each terminal accepts 16-24 gauge wire leads. Used-configurable components are summarized in Table 1.

**Table 1. User-Configured Components**

Component	Designation	Function
Resistors 103-118	R103-R118	Configured output for TTL
Jumpers 101-116	W101-W116	Configures output for TTL
Screw Terminals	J137	Positive and negative output connections
Internal +5V, Ground	Part of J137	Connects to module supply
External +5V, Ground	Part of J137	Connect to external supply
Jumpers 117-118	Q117, W118	Sets module for external (isolated) or internal (non-isolated) operation



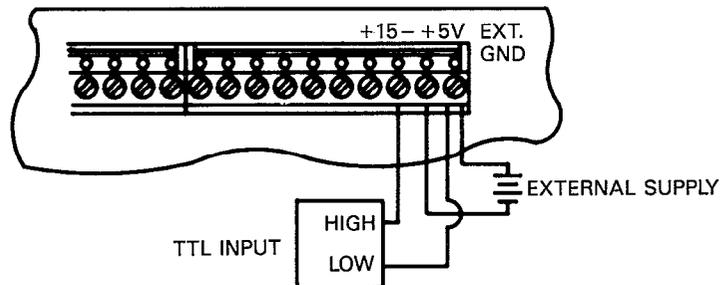
**Figure 1. DOM1 Module Configuration**

## Connections

A terminal strip containing all module connecting points is located at the top of the board. In addition to (+) and (-) connections for each of the 16 channels, there are also terminals for both internal and external +5V ground connections. These terminals are marked on the board. A typical connecting scheme is illustrated in Figure 2.

**CAUTION:** Use shielded cable to minimize EMI radiation. Connect one end of the shield to internal or external ground depending on module configuration as described below.

**WARNING:** User-supplied lethal voltages may be present on the terminals.



**Figure 2. Connections for Isolated TTL Outputs**

As shipped, the DOM1 module is configured for isolated TTL outputs. With this configuration, external +5V and ground must be connected to the appropriate terminals. See Figure 2 for typical connections. Note that signal high is connected to the (-) channel of the output, while signal low is connected to external ground.

By moving W117 and W118 to the internal positions, the module can be converted for use with the Series 500 system supply. With this configuration, signal high would be connected to the (-) terminal of the channel in question, while signal low would be connected to module ground.

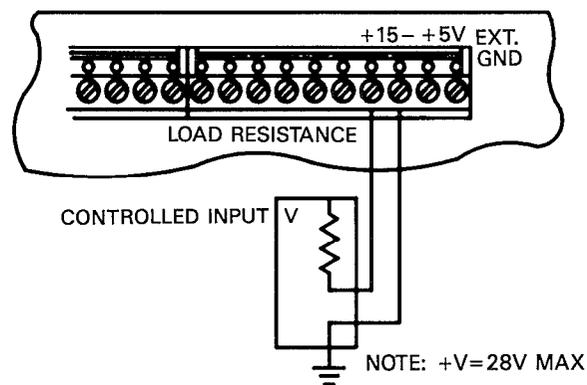
Note that the module draws 600mA when configured to operate in the internal mode. This factor may be reduced to about 350mA when operating from an external supply.

## Conversion to Switching Outputs

Each channel on the DOM1 module may be individually converted into a switching output that will control up to 28V. To convert a channel, remove the 220 $\Omega$  resistor and

jumper wire associated with that channel. The load and power source should then be connected as shown in Figure 3. Be sure to observe proper polarity (plus to +, minus to -). When a "1" is written to the channel through software, the output switch will close, and power will be applied to the load. When a "0" is written to the channel, the switch will be turned off, and power will be removed.

**NOTE: RESISTOR AND JUMPER MUST BE REMOVED**



**Figure 3. Connections for Switching Output**

## Commands

DOM1 module commands are listed in Table 2. Table 3 summarizes the locations for slot-dependent commands.

**Table 2. Commands Used with the DOM1 Module**

Command	Location
DIGITAL A	Slot-dependent CMDA
DIGITAL B	Slot-dependent CMDB

**Table 3. Locations for Slot-Dependent Commands**

<b>Slot</b>	<b>CMDA</b>	<b>CMDB</b>
Slot 1	CFF80	CFF81
Slot 2	CFF82	CFF83
Slot 3	CFF84	CFF85
Slot 4	CFF86	CFF87
Slot 5	CFF88	CFF89
Slot 6	CFF8A	CFF8B
Slot 7	CFF8C	CFF8D
Slot 8	CFF8E	CFF8F
Slot 9	CFF90	CFF91
Slot 10	CFF92	CFF93

### **DIGITAL A**

Location: Slot-dependent CMDA

The command location DIGITAL A is used to set the status of channels 0-7 (Port A) on the DOM1 module. This location should always be written to, and not read. Note that this command affects all eight channels of Port A simultaneously.

The value written to the DIGITAL A location should be the equivalent of an 8-bit binary number, with the status of the 8 bits (1 or 0) representing the status of the 8 channels (on or off). Table 4 describes the bit configuration of values written to DIGITAL A.

**Table 4. Bit Configuration for DIGITAL A**

<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
Ch7	Ch6	Ch5	Ch4	Ch3	Ch2	Ch1	Ch0
128	64	32	16	8	4	2	1

Ch7-Ch0 = Channels 7 through 0

128, 64, etc. = Decimal bit values

To change the status of one output channel while leaving the rest unchanged, the status of all the channels must be known. Because this location cannot be read, a variable in the controlling program should be assigned to the current status of Port A and updated each time the status of a channel is changed. When the current status of all bits (channels) is known, the value of the variable can be changed in status for one or more channels, and this new number written to the DIGITAL A location.

In assembly language, this modification can be made using the logical AND and logical OR statements. When turning a single channel on, the variable value representing the current port status should be ORed with a number equivalent to an 8 bit binary value, with 0's in the bit positions affecting channels to remain the same, and a 1 in the position affecting the channel to be turned on.

When turning a single channel off, the variable value should be ANDed with a number equivalent to an 8-bit binary value, with 1's in the bit positions of all channels to be unchanged, and a 0 in the position of the channel being turned off.

From BASIC, the decimal value of the bit to be turned on or off should be added to (off to on), or subtracted from (on to off) decimal number that represents the current port status. For example, to turn channel 2 off, it would be necessary to subtract 4 from the decimal value representing the port status. To turn channel 6 on, it would be necessary to add 64.

## DIGITAL B

Location: Slot-dependent CMDB

DIGITAL B is the equivalent of DIGITAL A, operating in exactly the same manner, but addressing Port B of the DOM1 (Channels 8-15). See Table 5.

**Table 5. Bit Configuration for DIGITAL B**

D7	D6	D5	D4	D3	D2	D1	D0
Ch15	Ch14	Ch13	Ch12	Ch11	Ch10	Ch9	Ch8
128	64	32	16	8	4	2	1

Ch15-Ch8 = Channels 15 through 8

128, 64, etc. = Decimal bit values

## Theory of Operation

Refer to schematic number 500-246 for the following discussion.

Data from the system data bus arriving at the DOM1 module is first buffered by octal buffer U101 (74LS244), and latched into U102 and U103, two transparent octal D-type latches (74LS373). The latches are refreshed by the negative transition of commands lines CMDA and CMDB, respectively. The output of latches U102 and U103, buffered by U104, U105 and U106 (7407 hex inverters used as current drivers), drives the LED transmitters in optical isolators U107-U122. An independent isolator is provided for each output channel. The receiver of the isolator is a high-gain Darlington transistor pair, which is connected across the positive and negative output terminals of the channel. The inputs of the isolator are pulled up to +5V through resistors R101 and R102.

Resistor locations R103-R118 are factory installed 220Ω resistors between the emitter terminal of each output channel and ground. Jumpers W101-W116 connect the isolator collector terminals to +5V. With these resistors and jumpers installed, the outputs are configured to be TTL compatible. Meanwhile, jumpers W117 and W118 allow the selection of internal or external +5V and ground connections.

## DOM1 Specifications

Output channels: 16

Output characteristics:

TTL-compatible

Logic 0 output: 0.4V max at 1.6mA sink

Logic 1 output: 3.75V min at 1mA source

Transition time: 100 $\mu$ sec

User configurable characteristics:

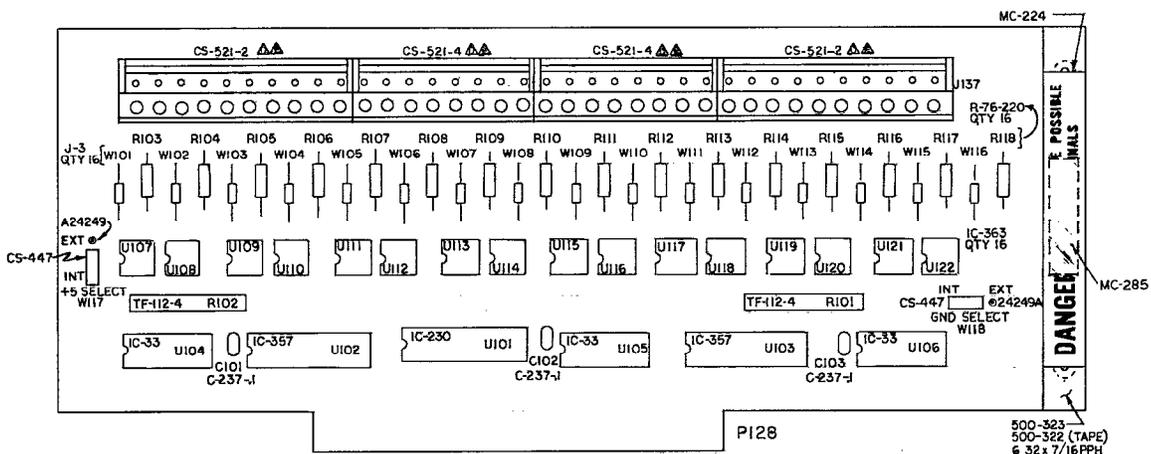
Output voltage: 28V max (user supplied source)

Output current: 50mA max (user supplied source)

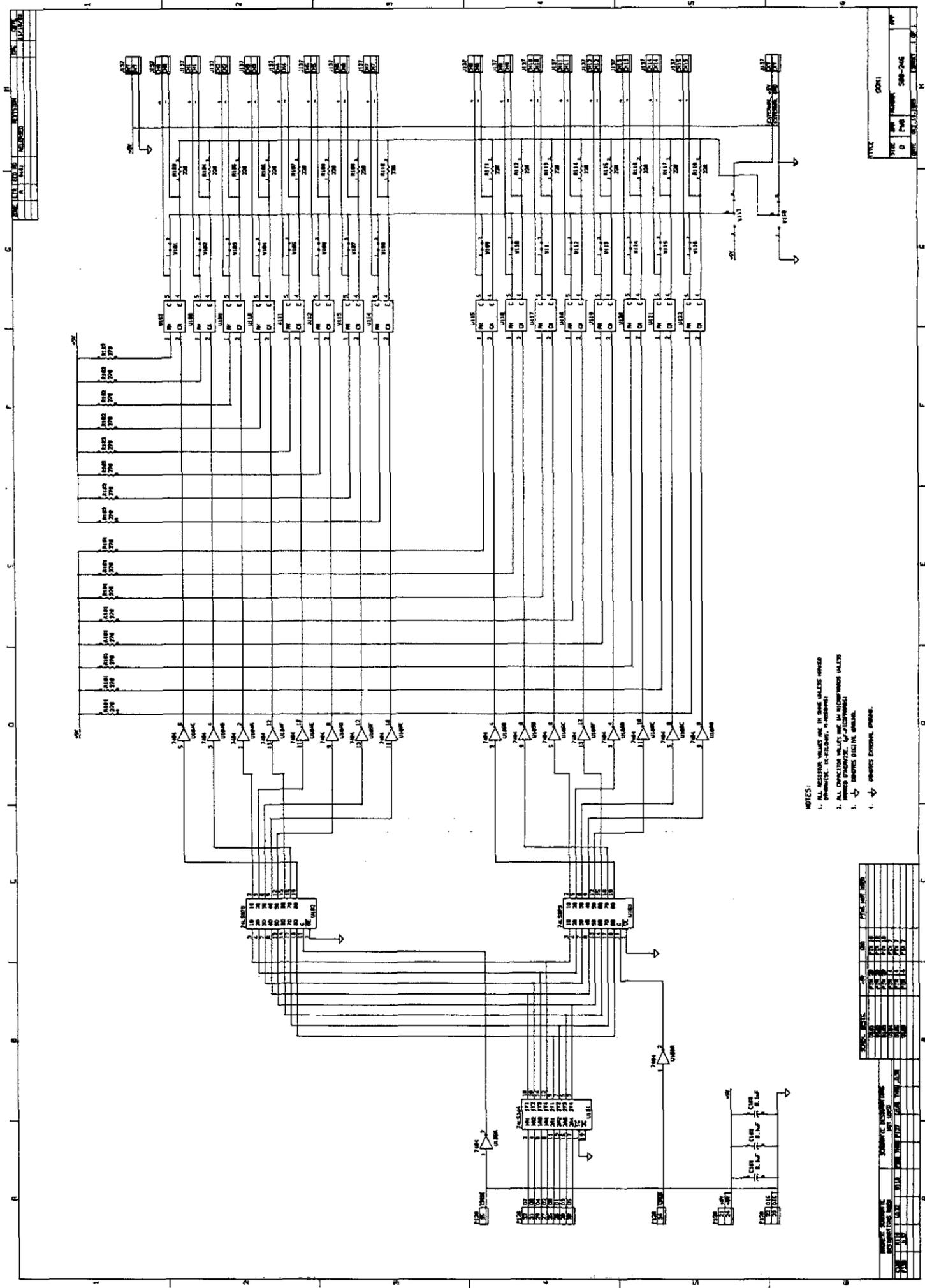
Isolation:

Technique: optical

Channel-to-channel or channel-to-ground: 500V peak



### DOM1 COMPONENT LAYOUT



- NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS UNLESS NOTED OTHERWISE. IN-CIRCUIT RESISTANCE!
  2. ALL CONNECTOR VALUES ARE IN MICROAMPERES UNLESS OTHERWISE SPECIFIED IN PARENTHESES.
  3.  $\nabla$  DENOTES ELECTRICAL GROUND.
  4.  $\rightarrow$  DENOTES CONTROL SIGNAL.

NO.	DESCRIPTION	QTY	UNIT	REMARKS
1	RELAY R111	1	PCB	
2	RELAY R112	1	PCB	
3	RELAY R113	1	PCB	
4	RELAY R114	1	PCB	
5	RELAY R115	1	PCB	
6	RELAY R116	1	PCB	
7	RELAY R117	1	PCB	
8	RELAY R118	1	PCB	
9	RELAY R121	1	PCB	
10	RELAY R122	1	PCB	
11	RELAY R123	1	PCB	
12	RELAY R124	1	PCB	
13	RELAY R125	1	PCB	
14	RELAY R126	1	PCB	
15	RELAY R127	1	PCB	
16	RELAY R128	1	PCB	
17	SOLENOID S111	1	PCB	
18	SOLENOID S112	1	PCB	
19	SOLENOID S113	1	PCB	
20	SOLENOID S114	1	PCB	
21	SOLENOID S115	1	PCB	
22	SOLENOID S116	1	PCB	
23	SOLENOID S117	1	PCB	
24	SOLENOID S118	1	PCB	
25	SOLENOID S121	1	PCB	
26	SOLENOID S122	1	PCB	
27	SOLENOID S123	1	PCB	
28	SOLENOID S124	1	PCB	
29	SOLENOID S125	1	PCB	
30	SOLENOID S126	1	PCB	
31	SOLENOID S127	1	PCB	
32	SOLENOID S128	1	PCB	