Westinghouse

numa·logic

REGISTER OUTPUT MODULE

(16 bit)

Catalog No. NL-753-H

PERFORMANCE DATA

Circuits Per Module	16
I/O Rack Positions Req'd.	2
Ratings as TTL Output Fanout	100 standard TTL Loads
Rating as Open Collector Current Sinking Output:	
• Voltage Range	−0.5 to +30 VDC min. and max.
• Current Range	0 to 160 mA
HI Output Voltage Level	4.3 to 30 VDC
LO Output Voltage Level	0 to 0.8 VDC
Turn ON Time	≤1 ms
Turn OFF Time	≤1 ms
Power Requirement	1 unit, Logic Power Supply 4 units, Output Power Supply 1 external power supply
Terminal Ratings	300 V
Opto Isolation	2500 V
Temperature Rating	0° to 60°C 32° to 140°F
Humidity Rating	0 to 95% noncondensing
Wire Size	AWG No. 14 max.
Keying Slots	Between pins: 11 and 13 25 and 27

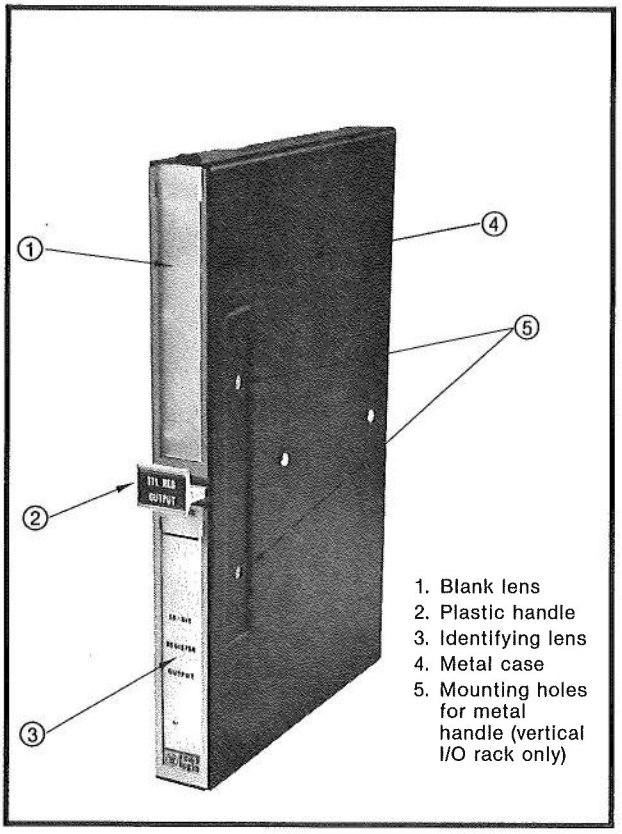

Figure 1 — 16-bit Register Output Module

INTRODUCTION

The function of the 16-bit Register Output Module is to provide 16 outputs capable of driving user-provided low-voltage DC signals to such devices as TTL units, other similar logic families, and low-voltage relays and signal lights. The module accepts and stores the program-determined ON/OFF states of bits in an output register of the processor. In response, it directs the high/low states of the output signals to the application's devices. Output data may be BCD or binary in form. (BDC-to-binary or binary-to-BCD conversion can be done in the processor, if necessary.) The module's 16 outputs are isolated but share a single ground connection (signal return).

The module is a "double-height" type. Field wiring to it is through terminals on the I/O rack. Each circuit uses 3 terminals:

- +5.7 VDC, or external power supply input
- D1 thru D16, or TTL signal outputs
- DC COM, or signal return for the device and supply

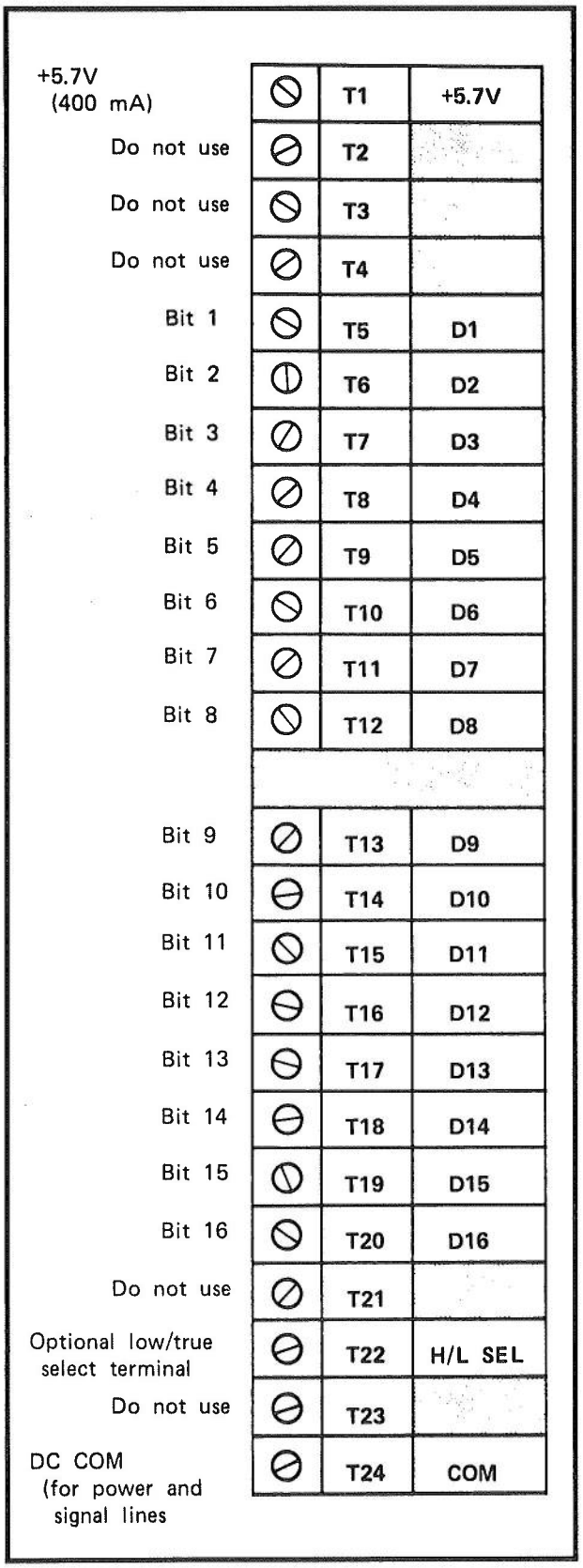

Figure 2 — Terminal Identification

Although the module is basically a TTL output unit, it is designed to be used with many other logic families, including LP TTL, LS TTL, HTL and B series CMOS. The module is provided with high/true logic, but a user-installed jumper quickly changes it to low/true, thereby eliminating the need for external inverters.

For proper operation of the module, an external power supply is required. (See Application Note 7.)

The module includes 2 pictorial lenses; the upper is blank, the lower identifies the module.

Also supplied with the module is a user Terminal Identification Strip which is to be filled in with wire numbers and applied to the I/O rack next to the terminals. (See Figure 2.)

INSTALLATION — VERTICAL RACK

Proper Sequences — This installation procedure is divided into two distinct parts. First, connect field wiring to the I/O rack but **do not** install the module. Second, after AC power can **safely** be applied to the whole system, voltage measurements must be taken **before** installing the Register Output and Input Modules. (This phase can be part of the start-up procedures.)

CAUTION

Install the Register Output Modules **only** after AC line power can be **safely** applied to the entire system and after the electrical measurements, described here, have been made. Equipment damage can result if this sequence is not followed.

Wiring — Connect the field wiring to the I/O rack terminals according to the application's wiring diagrams. In most cases, it will be necessary to use twisted conductors. In some cases, it may be necessary to use shielded cable and provide a ground connection. Follow the techniques noted in the typical connection diagram in Figure 3.

The DC COM (T24) terminal functions as the signal return for the 16 output terminals **and** the external power supply. Thus, the external power supply's DC common terminal and the negative terminal of the supply powering the TTL device **must** be connected. (See Figure 3.)

It may be necessary to place a jumper between the H/L SEL (output polarity select) terminal and the DC COM terminals. (If used, the system wiring diagrams should show it.) Use an insulated wire at least AWG No. 22, but smaller than No. 14.

Physical Placement — Only after AC line power can safely be applied to the entire application should preparations be made to install the Register Output Module(s) in the I/O rack. It is a simple process, but certain electrical measurements must be made first. A voltmeter is required.

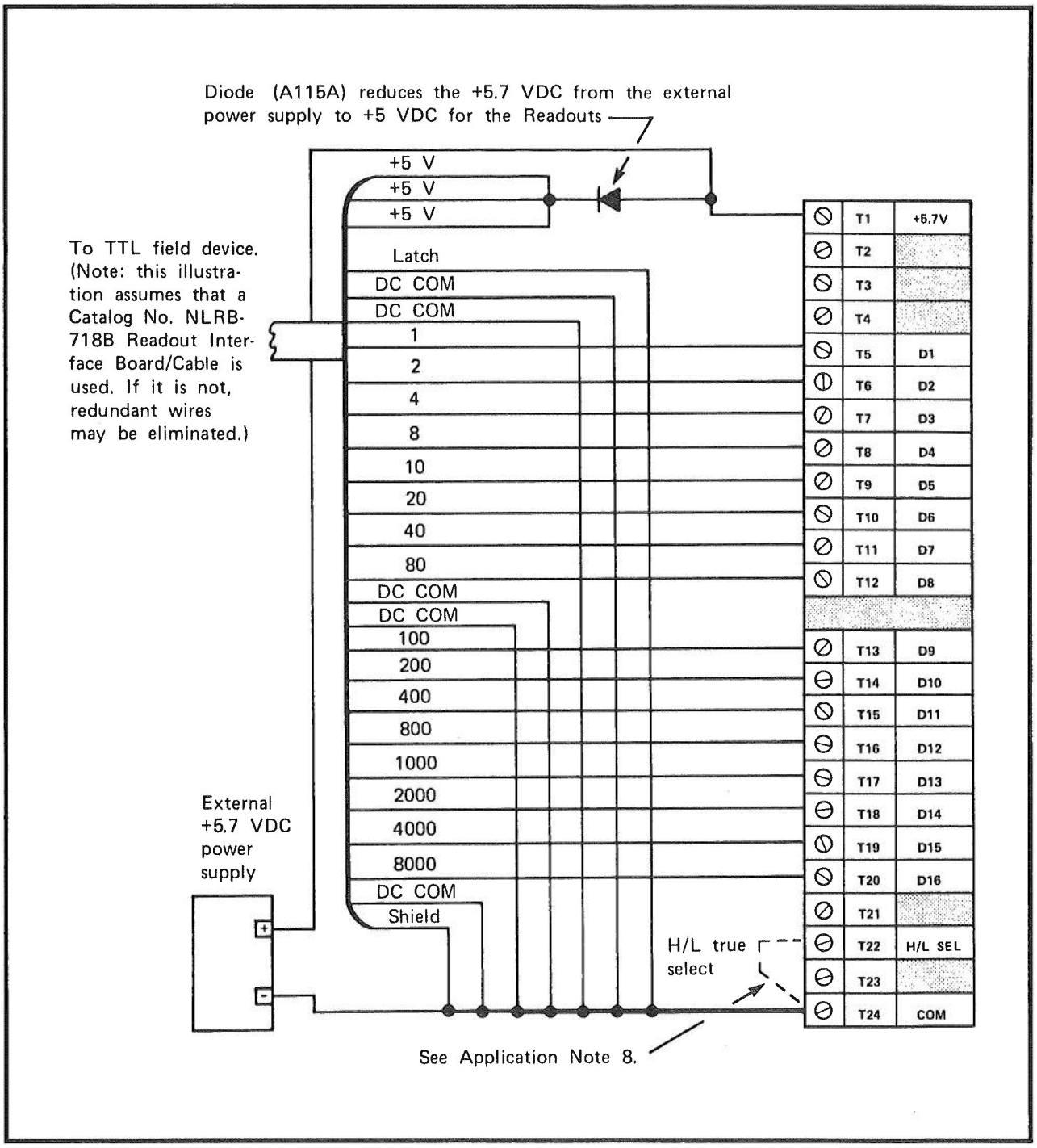

Figure 3 — Connection Diagram (typical)

Step 1 — Apply AC power to the entire application, and verify that the voltage between the + 5.7 VDC terminal (+) and the DC COM (–) terminal is within the required range of 4.75 and 5.95 VDC. Measure at all I/O rack terminals used for Register Output and Input Modules.

Step 2 — If necessary, adjust the external power supply's output to the required voltage range.

Step 3 — Remove AC power from the application.

Step 4 — Refer to system drawings and determine which I/O rack and which position in the rack the module is to be placed. (Although a module can be placed in either the upper 2 positions or the lower 2 positions, it may not straddle positions B and C. See Figure 5.) Also, it is important that it be placed according to the user program reference scheme.

Step 5 — Move the locking bar on the I/O rack's built-in terminal block to the left in order to uncover the guide slots on the block. (See Figure 4.)

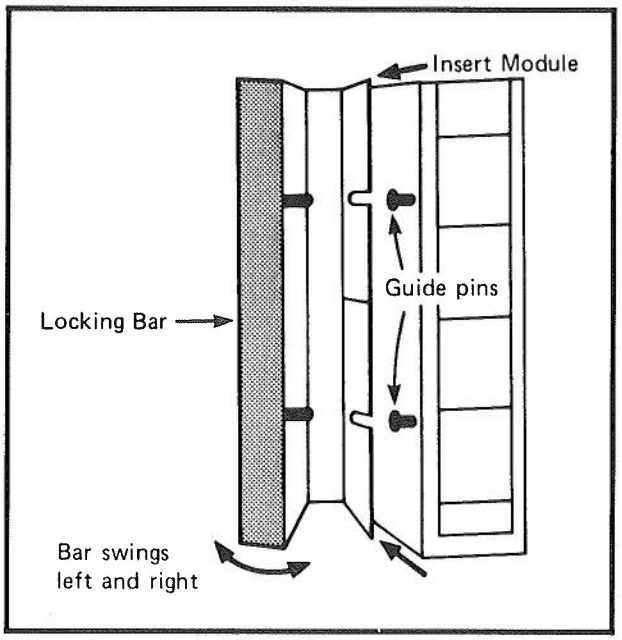

Figure 4 — Guide Slots

Step 6 — Align both of the module's guide pins with corresponding slots on the I/O rack. Gently press the module into the edge connector on the rack. Make sure the edge pins on the module align and mate with the rack connector.

Step 7 — When the module is properly seated, snap the rack's locking bar over the module's guide pins in order to hold it in place.

Step 8 — Write the wire number, or other identifying information, on the Terminal Identification Strip for subsequent use. Wiring practices to the terminals on the I/O rack are described in the "PC-700/900 Systems Manual."

Switch Settings — In order to complete installation of the Register Output Module, it is necessary to physically set 3 individual rocker switches on the I/O rack. Their combined function is to electrically identify each terminal in the rack with a reference number required for programming. This explanation is detailed only to the level required by the installation team. (For further details, see the "PC-700/900 Systems Manual" and Instruction Leaflet 15718.)

Step 1 — Locate the list that relates wire numbers at each terminal with directly coresponding reference numbers. The system drawings should show them. If not, contact the design engineer or programmer. The switches **cannot** be set correctly without a list.

Step 2 — Locate the first-used 16-bit Register Output Module on the system drawings and on the I/O rack. This may be anywhere in the layout and will probably be grouped together with other Output Modules of the same type.

Step 3 — Identify the reference number for the first output terminal on **that** module. It will be a number like OR0001.

Step 4 — At the top right-hand side of **that** I/O rack, locate the rack switch assembly. (See Figure 5.) Note that it is divided into 3 groups of 4 rocker switches each. Locate those that make up the GSEL area.

It is necessary to set 1 of the 4 switches to ON according to the specific reference number. Relate the number to Table A for the first module and for all other Output Modules of this type in subsequent I/O racks.

Table A
RACK SWITCH GSEL SETTING

If the Reference Number is:	Press ON GSEL Switch:
OR0001 thru 0008	1
OR0009 thru 0016	2
OR0017 thru 0024	3
OR0025 thru 0032	4

Step 5 — As indicated on Table A's right column, set the proper switch to ON.

Step 6 — Set the remaining 3 switches in GSEL to the OFF position. (The 4 switches may be thought of as a type of selector switch.)

Step 7 — Set 1 of the 8 rocker switches in the TOP and BOTT areas to ON. To determine which to press, locate the reference number of the top output terminal (fifth down) on the module. (Use the list described earlier in this publication.) For example: OR0001. Relate this number to Table B and read across.

Table B
RACK SWITCH TOP/BOTT SETTINGS [1]

If the Reference Number is:	Press ON: Group	Press ON: Switch	Affects Position:
OR0001, 0009, 0017, 0025	TOP	1	AB
OR0002, 0010, 0018, 0026	BOTT	1	CD
OR0003, 0011, 0019, 0027	TOP	2	AB
OR0004, 0012, 0020, 0028	BOTT	2	CD
OR0005, 0013, 0021, 0029	TOP	3	AB
OR0006, 0014, 0022, 0030	BOTT	3	CD
OR0007, 0015, 0023, 0031	TOP	4	AB
OR0008, 0016, 0024, 0032	BOTT	4	CD

[1] In a correctly written program, the reference numbers will be related to the positions as shown here. (Thus, OR0002 will **never** be in position AB.)

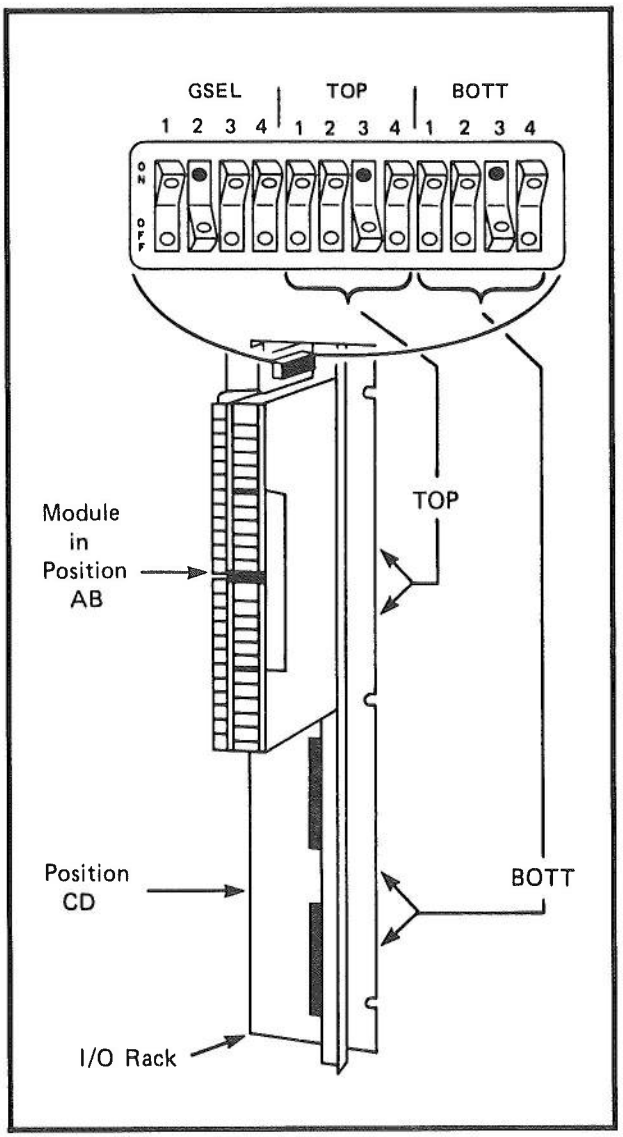

Figure 5 — Vertical Rack Switch Location

Step 8 — As indicated on Table B's center column, set the proper switch to ON.

Example: What are the proper settings for a Register Output Module placed in Position CD if it has a first terminal reference number of OR0008? Answer: GSEL 1 and BOTT 4 are set ON.

Step 9 — Place all remaining 10 switches in the OFF position. (As an aid to future troubleshooting, mark the rocker switch settings on a piece of tape and place it near the assembly.)

Step 10 — Apply AC power to the application and again measure the voltage at the same terminals noted earlier. Measure at all I/O rack positions used for Register Output Modules. Under these load conditions the level must be within the range of 4.75 and 5.95 VDC.

Step 11 — If necessary, readjust the power supply's output to the required voltage.

Step 12 — Apply the self-adhesive terminal identification strip, supplied with the module, to the terminal block's face.

INSTALLATION — HORIZONTAL RACK

Physical Placement — Connect all field wiring to the horizontal I/O rack's terminals. Follow the typical connection diagrams in Figure 3. Installing the module is a simple process — Slide it into one of the four or eight positions on an I/O rack. To do so, follow these steps:

Step 1 — Slide the plastic pull handle into the slot between lenses on the front of the module. Fix the color-coded adhesive label to the front of the plastic pull handle. (Do not install the metal pull handle — it is designed for use with the vertical I/O rack only.) See Figure 1.

Step 2 — Refer to system drawings and determine in which I/O rack the module is to be installed. Set the rack switch (Figure 6) to the proper position for a Register Input Module (Table C).

Step 3 — Pull the terminal raceway for the appropriate I/O rack module slot forward until it stops; lock the raceway in the extended position (Figure 7) using the top and bottom slide latches.

Table C
HORIZONTAL RACK REGISTER FUNCTION SWITCH SETTINGS

Set left rack switch to position:	Registers automatically assigned to rack slots:				Set right rack switch to position:	Registers automatically assigned to rack slots:			
	1	2	3	4		1	2	3	4
1	0001	0002	0003	0004	1	0005	0006	0007	0008
2	0009	0010	0011	0012	2	0013	0014	0015	0016
3	0017	0018	0019	0020	3	0021	0022	0023	0024
4	0025	0026	0027	0028	4	0029	0030	0031	0032

4-slot Rack

8-slot Rack

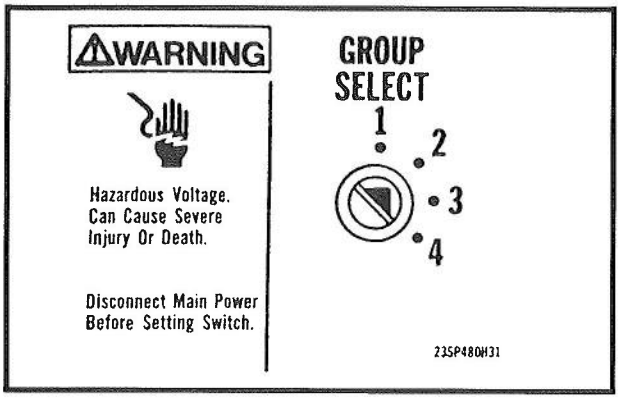

Figure 6 — Horizontal Rack Switch

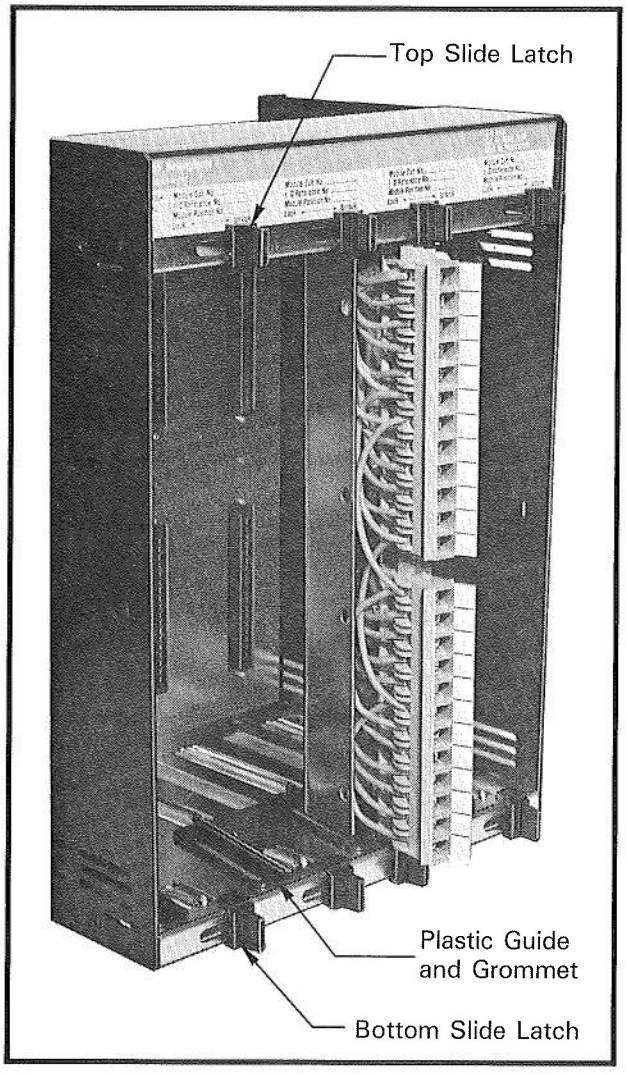

Figure 7 — 4-Slot Horizontal Rack with Terminal Raceway in Extended Position

Step 4 — Insert the module into the rack, to the right of the extended terminal raceway. Ensure that the board edge tabs at the top and bottom of the module mate with the slots in the I/O rack. Use the module pull handle to seat the two sets of board edge pins at the back of the module into the two edge-connectors in the back wall of the I/O rack.

Step 5 — Unlock the slide latches and push in the terminal raceway; ensure that the slots in the terminal block mate with the four pins extending from the left side of the module board. Lock the terminal raceway in with the slide latches.

APPLICATION NOTES

1. The module's outputs, when used as a TTL buffer/driver, are capable of driving 100 standard TTL loads.

2. The module's outputs, when used as an open collector type device, will sink 160 mA, continuous, for voltages up to 30 VDC.

3. If the lengh of the wire run between the Register Output Module and the TTL device does not exceed 100 ft (30 m), use insulated, twisted conductors not larger than AWG No. 14 nor smaller than No. 22. For runs over 100 ft, it may be necessary to use a twisted conductor, shielded cable. Choose the specific type according to the number of output signal lines required. Ground the shield **only** at the module end. Use the I/O rack mounting bolt for the ground connection.

4. The outputs use passive pull-up resistors. Thus multiple outputs can be tied together as wired OR (low/true) logic, as wired AND (high/true) logic, or on a data bus.

5. If the processor shuts down, but the external power supply voltage to the module is maintained, the outputs change to the OFF (false) state. However, logic selection affects the situation: with high/true, the outputs go low; with low/true, the outputs go high.

6. If the external power supply voltage to the module is lost, but the processor continues to operate, the outputs assume an intermediate level. When power is restored to specification levels, the outputs return to the proper logic/voltage levels.

7. An external DC power supply is required to operate the circuits of the Register Output Module. The Catalog No. NLPS-315, rated at 1.5 amperes, is acceptable and able to power 3 modules. (For larger loads the –330 and –360 supplies provide 3 and 6 amperes, respectively.) It must be connected to the **same** AC power line as the processor.

If another type of supply is chosen, it must be capable of providing a current of 450 mA at 5.7 VDC (±0.25 V).

In instances where the TTL device has sufficient additional power to meet these requirements, the external power supply can be deleted. (See Application Note 10.)

8. The logic of the module must be set according to the required logic of the TTL device. The module is factory-

shipped as a high/true device. Users may optionally change the logic to low/true by means of a jumper placed between the I/O rack terminals marked H/L SEL (output polarity select) and DC COM. (See Figure 3.)

When high/true logic is selected, a high-level output voltage of ≥4.3 VDC is considered the ON or high state. A low-level output voltage of ≤0.8 VDC is considered the OFF or low state. A summary of the state relationships is shown in Table D.

Table D
LOGIC STATE RELATIONSHIPS

Selected Logic	Output Register Bit	Output Transistor State [1]	Output Terminal (VDC)
High/ true	"0"	ON	0
	"1"	OFF	4.3
Low/ true	"0"	OFF	4.3
	"1"	ON	0

[1] Outputs are sinking type.

9. Since there are no status indicators on the module, in order to determine the status of an output, measure the voltage at the I/O rack's terminals or monitor the output register with a program panel.

10. A typical connection diagram for TTL, LP TTL, LS TTL and CMOS devices operating at 5 VDC is shown in Figure 8. Typical connections for HTL, CMOS or other devices — such as annunciators or computer inputs — that operate at 5 to 30 VDC are shown in Figure 9. Note that in both Figures the DC common (–) terminal of the external power supply

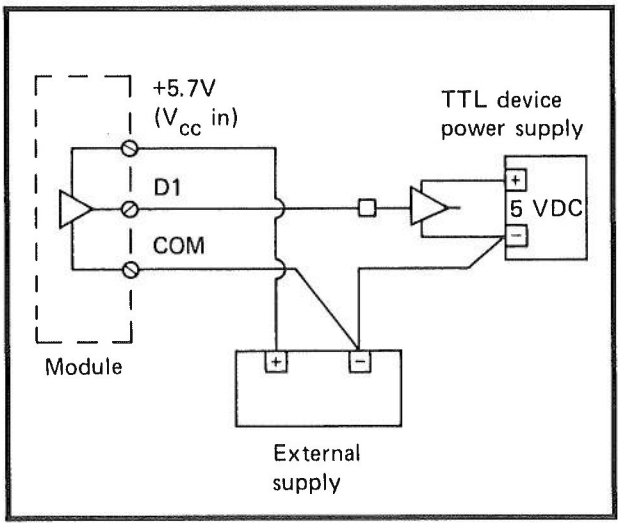

Figure 8 — TTL, LP TTL, LS TTL, CMOS Connections

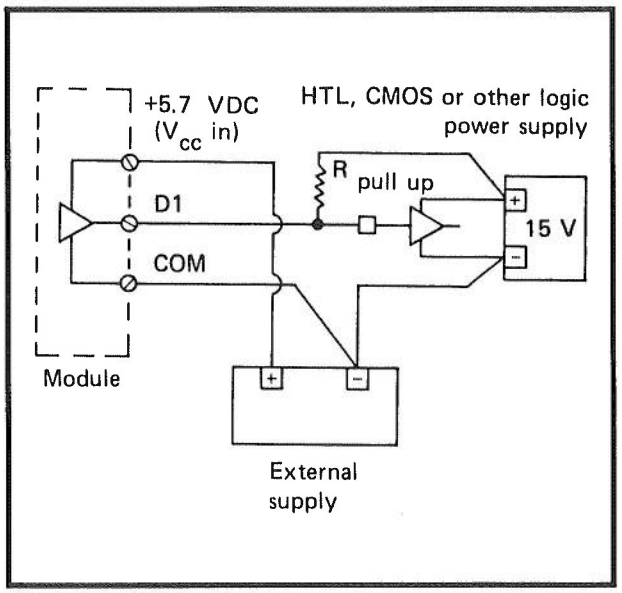

Figure 9 — 5 to 30 VDC HTL, CMOS Connections

must be connected to the output device supply's DC common terminal. This provides a return path for the output current from the module.

In Figure 8, if the 5 VDC output device power supply can also provide the additional 450 mA required by the module, the external 5.7 VDC power supply can be eliminated. The + Vcc IN at the + 5.7 VDC terminal on the module can connect directly to the + terminal on the output device supply.

In Figure 9, note that the pull-up resistor is used to pull the module's output to a voltage high enough to meet the device's high-level voltage and current input requirements. (A 5K ohm resistor should be adequate for either HTL or CMOS.)

11. A typical connection diagram for low-voltage (5 to 30 VDC) lamps and relays is shown in Figure 10. Note that the DC common (–) terminal of the external power supply must be connected to the output device supply's DC common terminal. In this type of application, it is usual to select low/true logic so that the lamp or relay is energized when the output bit in the processor is energized (Logic "1"). (The contact sinks on this module.)

When the module is used as a current sinking output, the rating for each output is 160 mA (max.) continuous at 30 VDC (max.). As many as 16 different device power supplies can be used providing the common (–) terminal of each is connected to the common terminal of the external power supply.

When driving an inductive load, some form of overvoltage protection must be provided for the module's output transistor. See Figure 10 where a diode is placed across the relay in a typical arrangement. Here the component suppresses the "opposite polarity" spike induced by the coil of the relay.

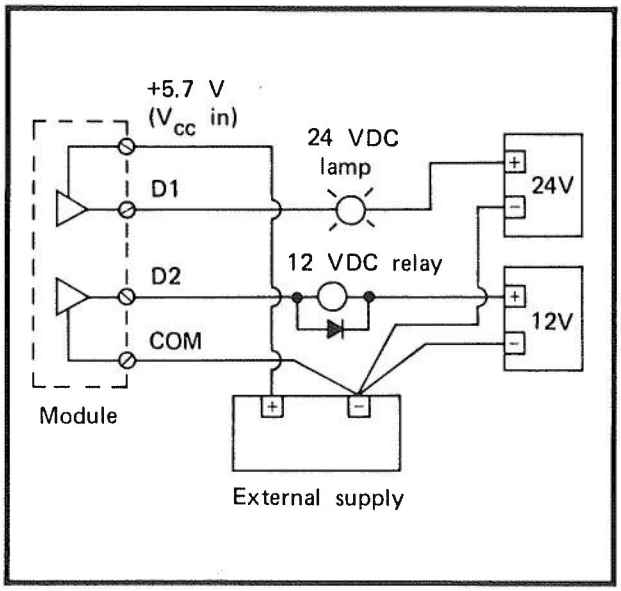

Figure 10 — Low-Voltage Lamp, Relay Connections

PROGRAMMING NOTES

1. The distinction between output circuit response time and output update must be kept in mind. The circuits can respond to a change ⩽1 ms, but output changes controlled by the processor occur once each program scan. A typical scan is about 10 ms for each 1000 words. Thus, to determine the "effective" response time, estimate the program scan time and add 1 ms.

2. The turn ON and OFF times can be thought of as output delays which, for this module, are both 1 ms, nominal. Because of component differences, it is not possible to assume that all outputs will change state at exactly the same time.

In most applications, this situation is of no concern. If timing is critical, there are methods to minimize the differences.

For example, a discrete TTL Output Module (Catalog No. NL-723) can be used. The user program can output a signal from it one scan **after** the register's contents are changed. (In this way, there is the assurance that the data has stabilized.) The output signal triggers the storing of the correct data in the output device's latches, or to a buffering data latch.

3. The Register Output Module can be used to transfer data to a computer or other type of system that requires a "write" strobe. One method uses a discrete output — as outlined in Note 2 — and runs the system under program control.

The program may be typically written in this manner. (See Figure 11 where high/true logic is assumed.) During the first scan, place the desired data in the output register. On the second scan, energize the strobe output on the discrete TTl Output Module. On the third scan, de-energize the strobe output. Wait for the fourth scan to be completed before changing the output register's contents.

Obviously, this method requires 4 scans to complete a data transfer. It can be accomplished in 1 scan with the addition of certain external hardware. (Contact Westinghouse.)

CIRCUIT DESCRIPTION

A highly simplified circuit of a single data output is shown in Figure 12. The output transistor ratings are

- Rated voltage for data output:
  0 to 30 VDC
- Collector-emitter breakdown voltage:
  +40 VDC
- Rated output current:
  I_{sink} = 160 mA continuous
- Output voltage at I_{sink}
  0.4 VDC

Note that the data output can be pulled higher because of the output diode.

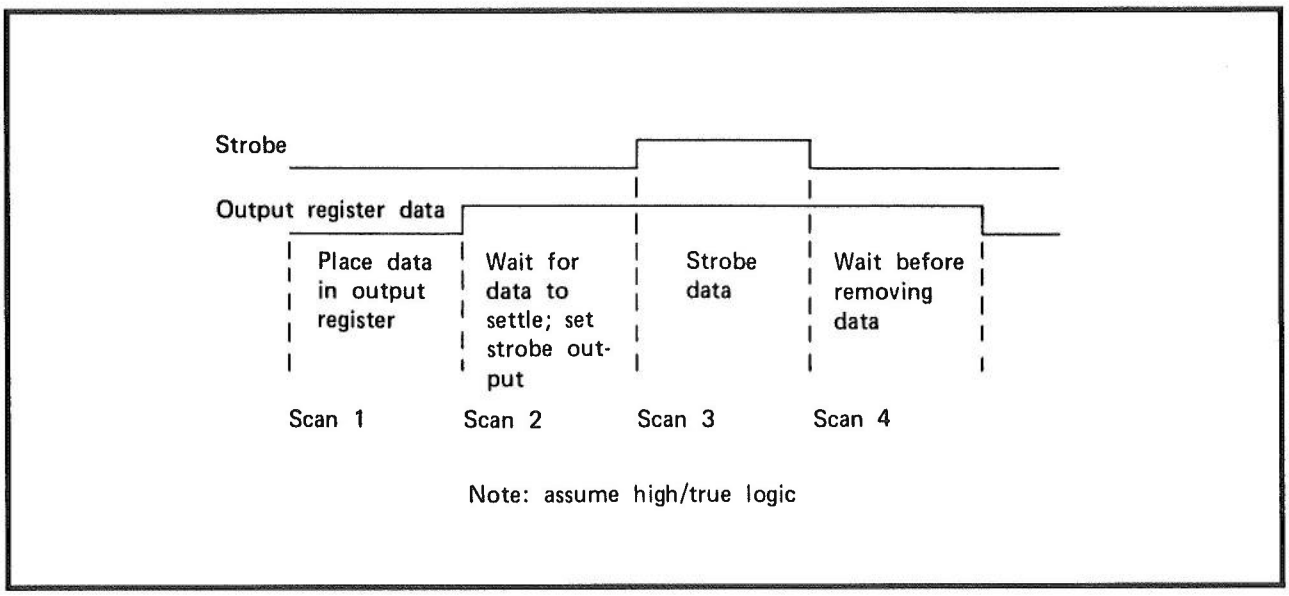

Figure 11 — Data Stabilization by Strobing

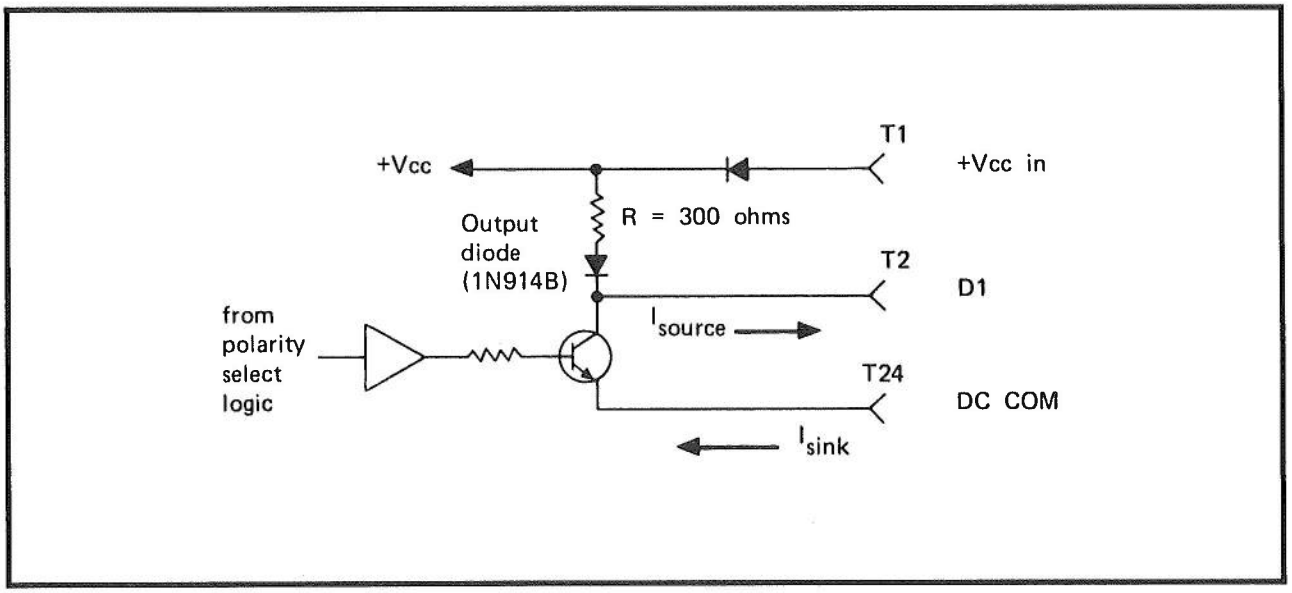

Figure 12 — Input Circuit Schematic (simplified)

Westinghouse Electric Corporation
Automation Division
200 Beta Drive
Pittsburgh, PA 15238