Autotech Controls
M8000-D360T Resolver Decoder Input Module
Instruction & Operation Manual

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MAN-M8000-D360T
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Resolver Input Module with Position and Tachometer Decoding

Instruction Manual

1. Introduction

The M8000-D360T Single-Turn Resolver Decoder Input Module uses state-of-the-art CMOS circuits to provide high noise immunity and a low backplane current requirement. These modules are used to decode resolver signals and provide decoded digital position and tachometer data to an Allen-Bradley PLC.

The Autotech M8000-D360T single-turn Decoder Input Module provides decoded BCD position and RPM data from any Autotech resolver to the Allen-Bradley 1771 Rack. The M8000-D360T module has following features:

- It occupies two slots in the I/O rack and should be installed such that both slots are in the same module group.
- Either position or RPM may be displayed on the module.
- The module can provide position or RPM or both, to the back plane. When required to read both RPM as well as position, the user can configure the module to provide position (or RPM)data once, and the RPM (or position) N times, where N can be selected from 0 to 399. Thus data type on the bus will repeat every N+1 module read cycles.
- The module is configured by 12 position DIP switches, which are inaccessible after installation of the module.
- The most significant bit of the input word is a marker that indicates the data type: if the bit is 0 the input word is position, otherwise the input word is RPM.

In order to obtain fast tachometer update times, the tachometer is functional only above 42 RPM. The tachometer update time is inversely proportional to resolver shaft speed. At 120 RPM, the tachometer updates approximately every millisecond while at 999 RPM, the update time is approximately 120 microseconds.

Fully Absolute Rugged Encoder

The M8000-D360T decoder in conjunction with Autotech's resolvers provides a fully absolute encoder. Even if a machine moves during power outage the resolver always knows its true position when the power is restored. The NEMA 13 resolver can withstand hostile environments such as mechanical shock, vibration, extreme humidity & temperature changes, oil mists, coolants, solvents and can be mounted 2500 feet away from the decoder. The ratiometric converter assures high tracking speed of 1800 RPM and very high noise immunity.

2. Specifications

Customer Power Input Requirements:	8 to 28VDC; 0.14 Ampere @ 28VDC input, 0.43 Ampere @ 8VDC input typical
Chassis Power Requirements:	0.17 Ampere Typical
Number of Digits:	3-digits (3/4 full word)
Remote Display Bus:	BCD 5VDC logic (TTL Level), positive true logic, for each digit. Compatible with Autotech 1855 BUS and 1855D remote display.
Tachometer Update Time:	Varies with resolver shaft RPM. Approximately 1 ms. @ 120 RPM, 120 us. @ 999 RPM. Update time = 60 / (RPM X 512)
Front Panel Thumbwheel Offsets:	Full scale thumbwheel programmable.
Rotor Excitation Voltage:	2.5 VAC at 2.5 KHz Typical
Stator Signals:	2.0 VAC sine-cosine Typical
Ambient Temperature:	0° to 55° C
Humidity:	5 to 95% noncondensing

3. Installation

The I/O modules from Autotech are slotted so that they can only be inserted in the I/O slots (backplane edge connectors) in the Allen-Bradley 1771 I/O rack. The I/O modules may be used in any I/O slot.

After deciding which slots the module will be used in, it is recommended that the selected I/O slots (backplane edge connectors) be keyed to prevent accidental insertion of any other type of module. Each printed circuit card of the resolver module is slotted in two places at the rear edge which are unique to this type of input/output module. Two keys are inserted in the upper, 36-contact backplane edge connector corresponding to the slots in the I/O module. These keys may be removed and placed at a different position if a different type of module must be inserted in the slot.

The plastic keys are supplied in a packet taped to the module Needle nose pliers may be used to place the keys in desired position

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As shown in Illustration 1, below, keying requires the insertion of keys in the gap between designated contact pairs in the backplane edge connectors. The Table 1: Key Table gives the key locations for the resolver modules.

Before inserting the module in the rack, set the DIP switches on the card for desired display and position/RPM read ratios.

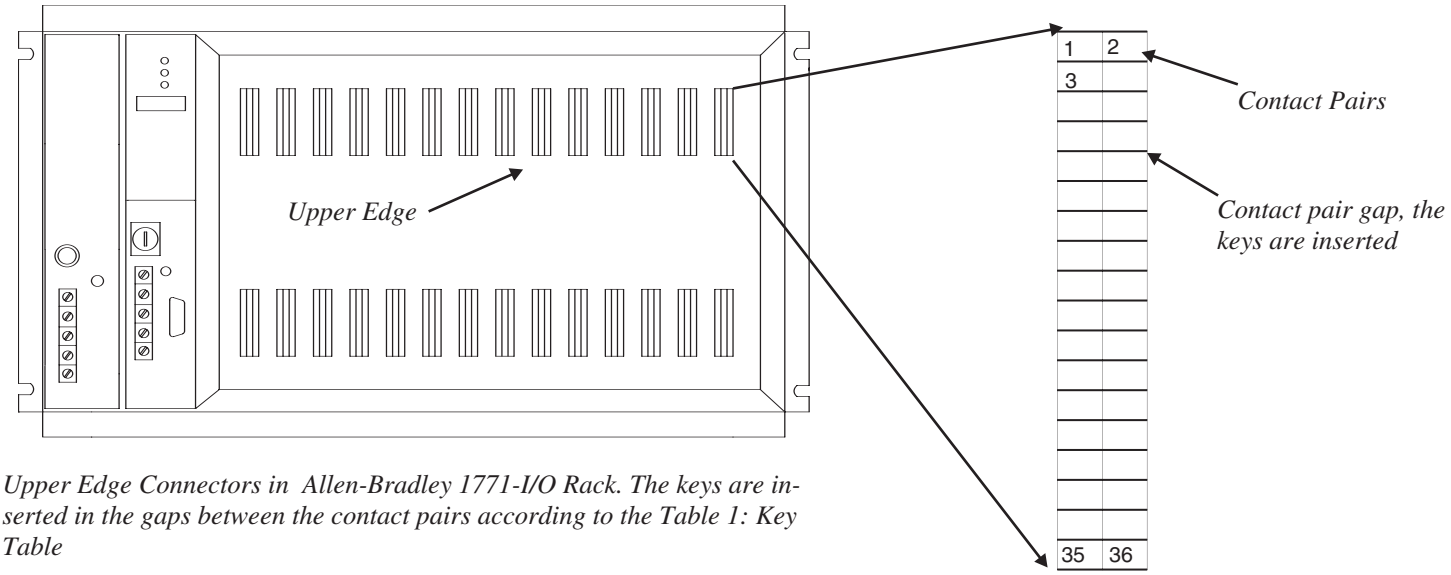
CAUTION

I/O modules *MUST NEVER* be removed or inserted into the chassis while the system power is "ON". Failure to observe this may result in damage to module circuitry.

Table 1: Key Table

Module(s)	***Slot (Connector)***	***Key #1***	***Key #2***
M8000-D360T	Left	#3,4 and #5,6	#25,26 and #27,28
	Right	#3,4 and #5,6	#31,32 and #33,34

The keys are inserted in the gap between the contact-pairs of the backplane edge connector, indicated in the above table.



Upper Edge Connectors in Allen-Bradley 1771-I/O Rack. The keys are inserted in the gaps between the contact pairs according to the Table 1: Key Table

Illustration 1. Key Insertion in the Edge Connector

Wiring

The user must wire a resolver and DC power to the resolver input module. Two quick disconnect connectors are provided on the front of the module for this purpose as shown in Illustration 2. Tables 1 and 2 list the pin designations and the functions of these pins on the resolver input module.

If the 1855 bus is being used to drive a remote display, two more connectors are to be wired according to the table shown. The M8000-360T module has two 9-pin quick disconnect connectors for this purpose.

The mating connectors in all cases are provided by the factory and are keyed according to the tables shown here to prevent improper insertion.

Illustration 2 — Front View of M8000-D360T Module

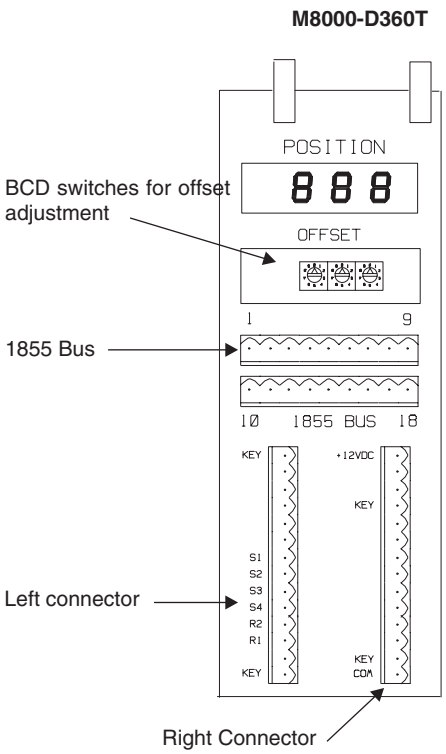


Table 2. Resolver Input Module Connections

M8000-D360T	
Left	Right
Key	Vs+ (+12 VDC)
NC	NC
NC	NC
NC	Key
NC	NC
NC	NC
S1	NC
S2	NC
S3	NC
S4	NC
R2	NC
R1	NC
NC	Key
Key	Vs– (Sig Ref)

Notes:

1. Left column indicates connection to the left connector. Right column indicates connection to the right connector of the module.
2. NC = Not Connected

Table 3. 1855 Bus Pinout

Pin #	M8000-D360T
1	NC
2	Bit 1
3	2
4	4
5	8
6	10
7	20
8	40
9	NC
10	NC
11	80
12	100
13	200
14	400
15	800
16	Fault
17	Sig Ref
18	NC

Grounding and Shielding

It is essential to properly ground and shield during initial installation. Wiring should be completed and thoroughly checked before applying power. The following are general guidelines for grounding and shielding:

General Rules:

1. The resolver and PLC Earth Ground planes **MUST BE** held to the same RF potential by metallic connentions (e.g., building frame, conduit, wire trays).

2. All shielded cable **MUST BE** continuous (no splices).

3. Variable DC or AC motor drive wiring, including motor wiring, **MUST BE** kept at least 12 inches away from all signal cable conduits (resolver or PLC).

4. **NEVER** connect or disconnect cables with power "ON".

Resolver Connections:

1. The resolver housing must have a good continuous metallic RF connection (resolver Earth Ground plane), we recommend using Autotech mounting bracket MMB-EN359-010 for RL100 resolvers.

2. The resolver connection to the Resolver Decoder Input Module must be done with twisted-pair shielded cable, we recommend using Autotech cable CBL-10T22-xxxx or CBL-RL210-xxxx.

3. The shielded drain wire at the resolver end must be connected to Earth Ground on the resolver housing (green screw).

4. The shielded resolver cable must not be routed with any high voltage, high current or inductive wiring. The resolver cable should be run in its own conduit.

PLC Connections:

1. The PLC housing **MUST HAVE** a good metallic RF connection to the PLC panel (PLC Earth Ground plane tied to a good Earth Ground).

2. The shielded drain wire at the PLC **MUST BE** connected to Earth Ground.

3. There must be a minimum of 100k ohms of resistance between PLC Sig Ref (Common) and Earth Ground.

4. Setup and Operation

Display

The bright LED display on the Resolver Decoder Input Module displays either position or tachometer information. The position information displayed is the resolver position plus the static offset entered through the front panel offset switches. This position is also sent to the processor module.

Static Offset

The BCD switches on the front provide a means of offsetting the indicated resolver shaft position without mechanically adjusting the actual position of the resolver shaft at the machine. The displayed position equals the actual position plus the static offset.

The resolver input module offers an offset switch for each displayed digit

Example:

Unit: M8000-D360T (360 Counts per Turn)
Actual Position = 350
Static Offset = 020
Total = 370
Displayed Postion = 010 (370–360)

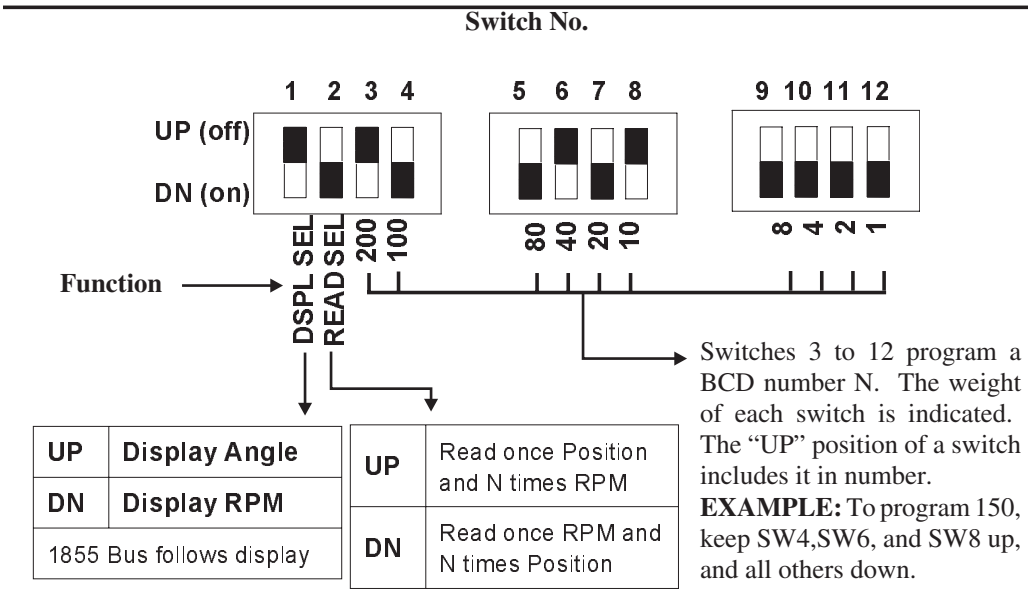
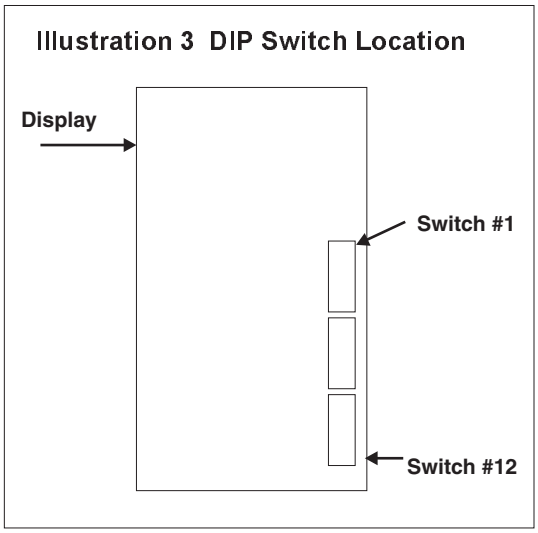


Illustration 4
Setting BCD to N DIP Switches



Setting the DIP Switches
There are three 4-position DIP switches (total of 12 switches) on the module. These switches are used to configure of the module for desired operation. The switches are numbered from 1 to 12. Viewing the M8000-D360T Module from rack connector side, switch 1 is at the top, while the module is in normal standing position (see Illustration 3). The function of these switches are described in Illustration 4.

5. Programming

Addressing Modes and Reading of Module

The resolver modules are used as an interface between a resolver and an Allen-Bradley processor in a 1771 I/O rack. The processor reads the I/O slots during every scan. If the most significant bit of module word is set, the data being furnished to the processor is RPM, otherwise the data is resolver position. The I/O information is saved in memory words with addresses corresponding to those of the I/O slots.

The way that data from a module slot are stored depends on the Allen-Bradley processor and the Allen-Bradley addressing mode selected: 2-slot, 1-slot, or 1/2-slot. In 2-slot addressing, each module group (2 slots) is saved in one input image table word. If other addressing modes are selected, input image table addresses will be skipped because the M8000-D360T recognizes only the 2-slot mode. In 1-slot addressing, each I/O rack slot is a full 16-bit word in both the input and output image tables. In 1/2-slot addressing, each I/O rack slot has two words (32 bits) of data devoted to it in the input/output image tables.

The M8000-D360T resolver input module occupies two slots in the 1771 I/O rack.

For example, if the module is placed in slots 3 and 4 of the 1771 I/O rack, and if 2-slot addressing is used, the data will appear in module group 1 (Input image table address 111). To continue the example, if 1-slot addressing is used, the least significant eight bits of data will appear in module group 2 (Input image table address 112) and the most significant 8 bits will appear as the lower 8 bits in module group 3 (Input image table address 113) and the most significant bits of addresses 112 and 113 will be 0. Similarly, when using 1/2-slot addressing, the least significant eight bits of data will appear in module group 4 (Input image table address 114) and the most significant 8 bits will appear as the lower 8 bits in module group 6 (Input image table address 116) and the most significant bits of addresses 114 and 116 as well as all of addresses 115 and 117 will be 0. The data address position is illustrated in the following table. If the most significant bit of the information sent by the M8000-D360T to the processor is set, the data represents BCD RPM.

Addressing Modes	Address						
	111	**112**	**113**	**114**	**115**	**116**	**117**
2 Slot	0123	x	x	x	x	x	x
1 Slot	x	0023	0001	x	x	x	x
½ Slot	x	x	x	0023	0000	0001	0000

The tachometer data is updated 512 times per revolution. Any instability in machine rotational speed will be transmitted almost instantly to the processor and to the display. In some applications, the tachometer display will appear to "blur out" because of rotating speed fluctuations. For these kinds of applications, the raw speed sent by the M8000-D360T should be averaged in ladder software before sending the RPM data to a visual display.

Example Ladder Logic

Assumptions:

- 1-slot addressing
- Module in slots 3 and 4 of I/O rack (addresses 113 and 114)
- Decoder Input Module has its Position/Tach update switches set such that Position and RPM data alternate on successive processor module reads of the Module.

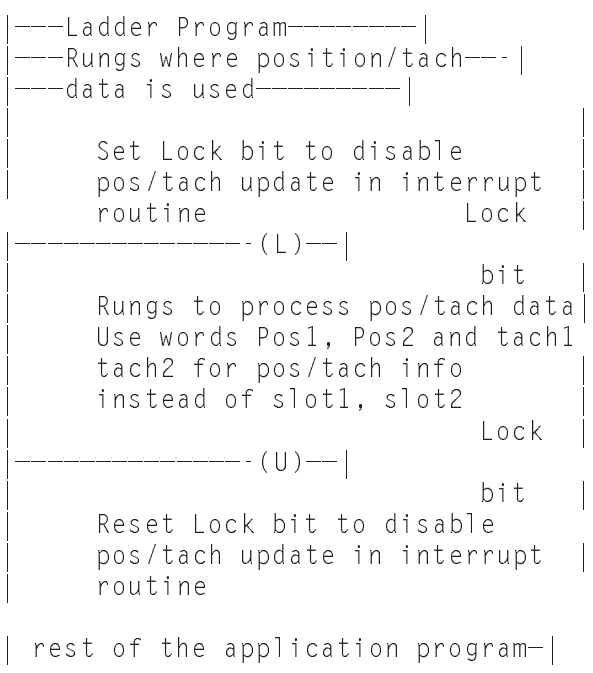
The Immediate Input instruction fetches the RPM or position. RPM data has bit 113/07 set.

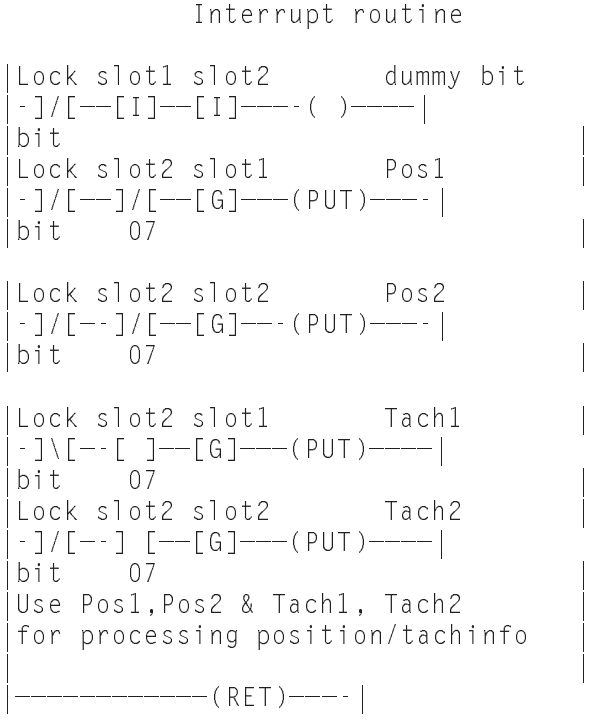
```
| 113    112                    200    |
|-][---[G]---------(PUT)-|
| 07         If  true,  store RPM      |
| 113    113                    210    |
|-][---[G]---------(PUT)-|
| 07                                   |
| 113    112                    201    |
|-]/[--[G]---------(PUT)-|
| 07         If false store position   |
| 113    113                    211    |
|-[/]--[G]---------(PUT)-|
| 07                                   |
| 112    113                    200    |
|-[I]---[I]----------( )-|
|             Immediate In       14    |
| 113    112                    200    |
|-][---[G]---------(PUT)-|
| 07         If true store RPM         |
| 113    113                    210    |
|-][---[G]---------(PUT)-|
| 07                                   |
| 113    112                    201    |
|-][---[G]---------(PUT)-|
| 07         If false store position   |
| 112    113                    211    |
|-]/[--[G]---------(PUT)-|
```

An approach to use interrupt routine to read the module correctly

There are potential pitfalls in receiving position and tachometer data from a timed interrupt routine because the data could change while the ladder program is operating on the same data. To avoid such a potential conflict, update the position and the tach data memory locations during the interrupt only when the ladder program is not operating on that data. Use the following ladder diagram to avoid this potential problem. Also, when using timed interrupts, do not transfer data from the image table to another location anywhere except for the timed interrupt routine. One-slot addressing is assumed.

Notes:
Pos1, Pos2, Tach1 and Tach2 are memory words.Slot1 and Slot2 are the physical slot addresses for the two cards of the module.Slot 2/07 is the bit that distinguishes between RPM and Position data.Lock/Bit is a scratch bit.





6. How to Order

Allen-Bradley Compatible Resolver Position and RPM Input Module

For use in an Allen Bradley 1771-I/O rack to decode signals from a single turn resolver

ASY-M8000-D360T	3-digit with a resolution of 360 counts per turn of Resolver shaft. Includes fast update tachometer.

Remote Display and Limit Modules

SAC-M1855-DISP:	Display module
SAC-M1855-L :	Limit module.

Position Transducers

Select one of the resolver models RL100, E6R, E7R, E8R or RL101. See Autotech Controls catalog, position transducer section, for How to Order information on these transducers and appropriate accessories.

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