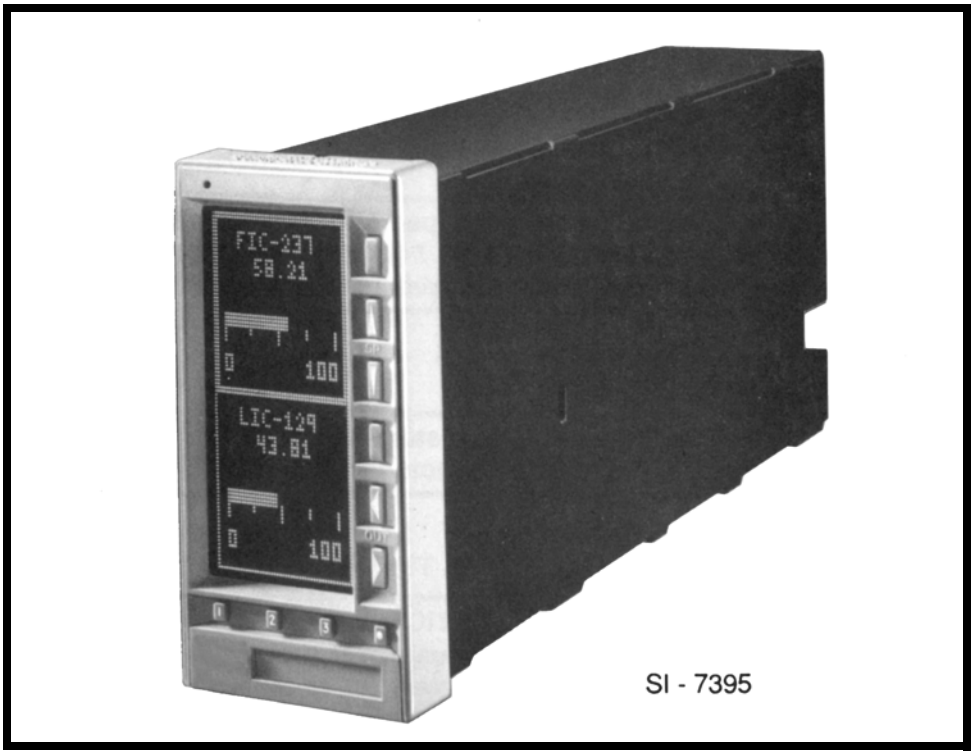
Supplement to
Instruction Bulletin
Micro-DCI®
53ML5100A

53ML5100 MANUAL LOADING STATION REV. 1 FIRMWARE



PN24698 Rev. 1

MicroMod
AUTOMATION

MicroMod Automation, Inc.

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We are committed to teamwork, high quality manufacturing, advanced technology and unrivaled service and support.
The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

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Caution. An instruction that draws attention to the risk of the product, process, or surroundings.	**i Information. Further reference for more detailed information or technical details.**

Although Warning hazards are related to personal injury, and Caution hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all Warning and Caution notices.

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To ensure that our products are safe and without risk to health, the following points must be noted.
The relevant sections of these instructions must be read carefully before proceeding.

1. Warning Labels on containers and packages must be observed.
2. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given or injury or death could result.
3. Normal safety procedures must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
4. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
5. When disposing of chemicals, ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual may be obtained from the Company address on the back cover, together with servicing and spares information.

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1.0 APPLICABLE DOCUMENTATION

The information contained in this supplement is applicable to the Micro-DCI® Instruction Bulletin 53ML5100A, *Manual Loading Station*.

1.1 SCOPE OF CHANGES

The 53ML5100 Manual Loading Station now has Datalink capabilities as a result of Revision 1 to the firmware EPROM. In a Datalink network, nodes communicate as responders to host personal computer queries. The host personal computer functions as the interrogator and acts as the central control point for the Datalink network. A maximum of 32 addressable nodes can be connected to a Datalink network. With this firmware revision, a 53ML5100 Manual Loading Station can function as a node instrument on the Datalink network.

✎ **Note** Numbers used in this document that are expressed in **hexadecimal notation (base 16) are identified with a subscript $_H$ after the number**.

2.0 INSTALLATION PROCEDURES

Reference Micro-DCI Instruction Bulletin 53ML900, *Upgrading the 53ML5100 Manual Loading Station*, for instructions on installing the new EPROM on the main board.

Datalink is an interrogator/responder serial interface capable of supporting 32 instruments on a single network. It uses an RS485 physical interface. See the Datalink wiring diagram for this instrument in Figure 2-1.

The interface for connecting the 53ML5100 Manual Loading Station to a Datalink network is via the rear terminal board (TB1), pins 19 through 22 (T+, T-, R+, and R-).

The Datalink interface requires four conductors: a transmit pair (T+, T-) and a receive pair (R+, R-). The voltage levels of each conductor pair conform to the EIA RS-422/485 standard. In accordance with this standard, the overall Datalink network distance is limited to 4000 feet when #24 AWG twisted pair wire is used to interconnect the nodes. Adapters are available to convert RS-422/485 to RS-232 or 20 mA current loops.

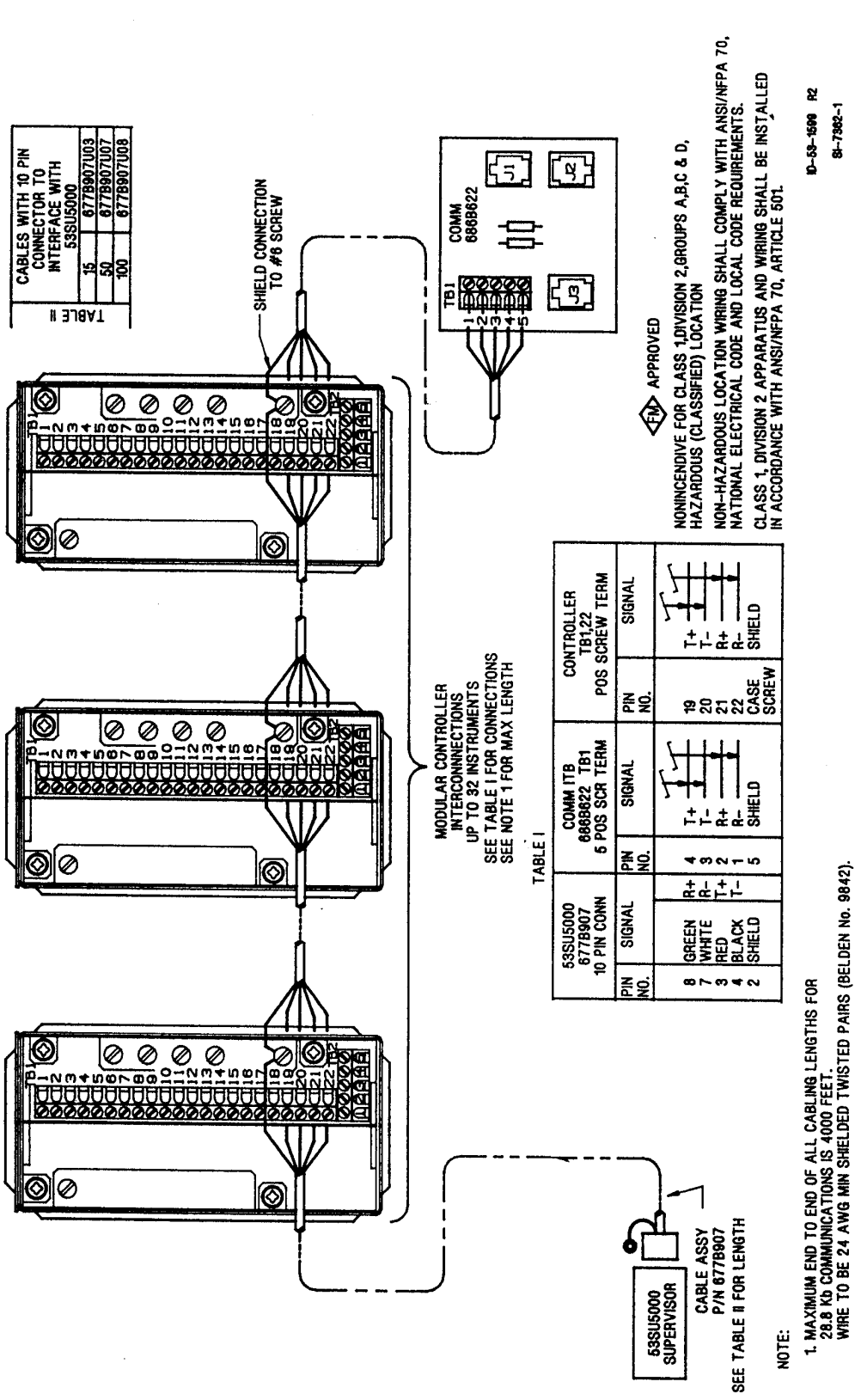

Figure 2-1. Datalink Installation Diagram

3.0 CONFIGURATION REQUIREMENTS

See Table 3-1, Communication Module, Column 3 (Set Up) for the appropriate configuration values.

Table 3-1. Communication Module

Title	Data-point	Set Up	Default	Attribute
Address	B01	***Select Address***	0	It identifies the address of this instrument on the Datalink network. Each unit connected to the Datalink network must have its own unique address. Valid addresses are from 0-31.
Baud Rate	B02	***Select a Baud Rate***	253	This datapoint value designates the baud rate of the Datalink network. The baud rate must be the same for all of the instruments connected to the same Datalink network. Datapoint values and their corresponding baud rates are as follows: **Value** **Baud Rate** **OR** **Value** **Baud Rate** 255 28800 9 28800 254 14400 8 14400 N/A N/A 7 19200 253 9600 6 9600 250 4800 5 4800 244 2400 4 2400 232 1200 3 1200 208 600 2 600 160 300 1 300 N/A N/A 0 110
No Parity	L256	***0***	0	This datapoint indicates if parity generation and checking should be turned on or off. It is set to ***0*** for even parity serial byte protocol. It is set to ***1*** for no parity protocol.
No Byte Stuffing	L258	***0***	0	When set to a ***1***, this datapoint disables the standard MicroMod communication protocol feature which inserts a 00 (NUL) byte after every $7E_H$ (SOH) that is not the beginning of a message. (This permits user-written communications software to determine the number of bytes to expect in a response message.) It must be set to ***0*** when using MicroMod communications software or equipment.
Datalink Disable	L257	***0***	0	When set to ***0***, it permits full Datalink communication capabilities. When set to ***1***, it disables Datalink communication capabilities.

4.0 DATALINK COMMUNICATIONS

Datalink communications capabilities are now provided in the 53ML5100 Manual Loading Station.

Datalink Information in this supplement can also be applied to the existing configuration port binary mode as follows:

1. The configuration port data rate is still 9600 baud, with 8 data bits, and no parity.
2. The configuration port powers up in standard mode suitable for use with the HHC, but is switched to binary mode by sending the following four character sequence:

Sent	03_H	$1B_H$	$0E_H$	15_H
Echoed	$0D_H$ $0A_H$	$1B_H$ 20_H	$0E_H$ 20_H	15_H

✎ **Note** Numbers used in this section that are expressed in hexadecimal notation (base 16) are identified with a subscript $_H$ after the number.

After echoing the 15_H character, the instrument switches to binary mode and is able to process binary communications messages from that time on. (Characters sent after the 15_H and before the 15_H echo are ignored.)

3. Once the configuration port switches to binary mode, it remains in that mode as long as the connection is maintained. The connection is maintained by sending a character at least once every 30 seconds. If 30 seconds elapse without a character being received by the instrument through the configuration port, the port returns to standard mode.
4. When in binary mode, the configuration port responds to all messages regardless of the address to which they are directed.

4.1 Protocol

The Datalink protocol requires the host personal computer to initiate all transactions. There are two basic categories for all of the Datalink message types: ***Interrogate***, which is used to read data from an addressed instrument, and ***Change***, which is used to alter a value in an addressed instrument. The addressed instrument decodes the message and provides an appropriate response. The protocol definitions for the Datalink message types are provided in Table 4-1.

Table 4-1. Message Field Definitions

Symbol	Title	Definition
SOH	Start of Header	This character, 7E, denotes the beginning of a message.
CMD	Command	Is the operation to be performed or a description of the message that follows the Command-I.A. byte. The Command-I.A. byte has two fields: the Command field (3 bits), and the I.A. field (5 bits). There are five commands: Interrogate, Change, Change Bits, Acknowledge, Response. The commands are covered in Section 4.1.1, Message Types.
I.A.	Controller Address	The address of the instrument responding to the transaction. It must be within a range of 00-1F (00-31 decimal).
NUM	Number	The number of data bytes transferred or requested. The NUM must be in a range of 00-32 decimal.
LO-ADD	Lower Address Bits	The least significant 8 bits of a 16 bit instrument address.
HI-ADD	Higher Address Bits	The most significant 8 bits of a 16 bit instrument address.
DATA		An 8 bit data byte.
XXXX		Represents a variable number of data bytes.
MASK		An 8 bit byte where each bit, called a flag, is dedicated to an event that is permitted or prohibited, depending on the flag setting. If the flag is set to ***0***, the event is permitted. If the flag is set to ***1***, the event is prohibited.
STATE		Represents the bit settings of a particular byte: which bits are set to ***1***, and which bits are set to ***0***.
LRC	Longitudinal Redundancy Character	Is a character written at the end of the message that represents the byte content of the message and is checked to ensure data was not lost in transmission. It is the sum of all bytes Modulo 256 of the message not including the SOH character or its own bit settings (LRC).

4.1.1 Message Types

The types of messages that are sent between the host personal computer and a Datalink network instrument are formatted as follows:

HOST PERSONAL COMPUTER TO INSTRUMENT:

1. ***INTERROGATE*** - This message requests up to 20_H (32 decimal) consecutively stored bytes, beginning at the specified memory address location of the addressed instrument.

   01111110 $E0_H$ + I.A. NUM LO ADD HI ADD LRC

2. ***CHANGE*** - This message sends up to 20_H (32 decimal) bytes of new data to the addressed instrument.

   01111110 $A0_H$ + I.A. NUM LO ADD HI ADD Data 1 XXXXXXXXX Data N LRC

3. ***CHANGE BITS*** - This message alters only the specified bits of the specified bytes in the addressed instrument. (NUM = 2n)

   01111110 $C0_H$ + I.A. NUM LO ADD HI ADD Mask 1 State 1 XXXX Mask N State N LRC

4. ***ACKNOWLEDGE*** - This message signals the addressed instrument that its last echoed change message was received correctly; the instrument then performs the change requested.

   01111110 80_H + I.A.

INSTRUMENT TO HOST PERSONAL COMPUTER:

1. ***RESPONSE*** - This message furnishes the data requested by the ***INTERROGATE*** command of the host personal computer. It is also used to echo back the previous CHANGE message of the host personal computer.

   01111110 20_H + I.A. NUM LO ADD HI ADD Data 1 XXXXX Data N LRC

4.1.2 COMMUNICATION TRANSACTION EXAMPLES

Transaction A Example

Host personal computer requests 9 bytes of data beginning at hexadecimal memory address 1000_H from the instrument which has Datalink address 03.

1. Host personal computer sends ***INTERROGATE*** message.

   01111110 11100011 00001001 00000000 00010000 11111100

   SOH Command + I.A. NUM LO ADD HI ADD LRC

2. Instrument sends ***RESPONSE*** message.

   01111110 00100011 00001001 00000000 00010000 XXXXX XXXXX XXXXX LRC

   SOH Command + I.A. NUM LO ADD HI ADD Data 1.....Data 9

Transaction B Example

Host personal computer sends two bytes of new data to be loaded into the instrument at Datalink address 03 beginning at hexadecimal memory address 1000_H.

1. Host personal computer sends ***CHANGE*** message.

   01111110 10100011 00000010 00000000 00010000 00001000 00001100 11001001

   SOH Command + I.A. NUM LO ADD HI ADD Data 1 Data 2 LRC

2. Instrument sends ***RESPONSE*** message.

   01111110 00100011 00000010 00000000 00010000 00001000 00001100 01001001

   SOH Command + I.A. NUM LO ADD HI ADD Data 1 Data 2 LRC

3. Host personal computer sends ***ACKNOWLEDGE*** message.

   01111110 10000011

   SOH Command + I.A.

4. Instrument performs the change requested at end of the current program scan.

4.2 CALCULATING DATA ADDRESSES

If communications software must be generated to accommodate unique Datalink applications requirements, then the instrument memory address scheme must be known for proper data bit (e.g., L datapoints) and data byte (e.g., B, C, H, and A datapoints) memory location determination.

✎ **Note** Hexadecimal (base 16) numbers used in this section are identified with a subscript $_H$ after the number.

This memory address scheme applies only if a ***6*** is in memory address location 8002_H. Memory address location 8002_H must be read and if it contains a ***6***, then the address scheme that is described in Table 4-2 should be applied for this instrument.

Table 4-2. Controller Memory Address Scheme

Data Type	Base Memory Address	Byte Size	Data Format	Address Calculation Algorithm
B	200_H	1	Represents a positive integer with values from 0 to 255.	Address = B Base + (B Number) = 200_H + (B Number) Address example: B012 location = $200_H + 12_D = 200_H + C_H = 20C_H$
L	500_H	1 Bit	A single binary bit with a logical value of 0 or 1. L datapoints are packed 8 to a byte.	Address = L Base + (L Number/8) = 500_H + (L Number/8) Remainder = bit position in byte Address example: L014 location = $500_H + 14/8 = 501_H$, bit 6 (remainder).
C	600_H	3	Represents floating point values that have a resolution of one part in 32,768 (15 bits) and a dynamic range of $\pm 10^{38}$. The first two bytes represent a 2's complement notation in fractional form (2^{-n}) whose absolute value is between 0.5 and 0.9999. The third byte is the power of 2 in 2's complement notation. Floating point example: 64_H 00_H $07_H = 100_D$ (Decimal) 64_H = 0110 0100, fractional binary weights left to right are 0 = 2's complement positive, $1 = 2^{-1} = 1/2 = 0.5$, $1 = 2^{-2} = 1/4 = 0.25$, 0=0, 0=0, $1 = 2^{-5} = 1/32 = 0.03125$, 0=0, and 0=0. $64_H = 0.5+0.25+0.03125 = 0.78125.07_H = 128_D$. 128_D X $0.78125_D = 100$.	Address = C Base + (3 X C Number) = 600_H + (3 X C Number) Address example: C011 location 600_H + (3 X 11) = $600_H + 33_D$ $= 600_H + 21_H = 621_H$.

Table 4-2. Controller Memory Address Scheme (Continued)

Data Type	Base Memory Address	Byte Size	Data Format	Address Calculation Algorithm
H	$F00_H$	5	Represents high precision floating point values that have a resolution of one part in 2 billion (31 bits) and a dynamic range of $\pm 10^{38}$. The first four bytes represent a 2's complement notation in fractional form (2^{-n}) whose absolute value is between 0.5 and 0.9999. The fifth byte is the power of 2 in 2's complement notation. Floating point example: $9C_H\ 00_H\ 00_H\ 00_H\ 07_H$ = -100. The 2's complement notation bit in the 9 = 1 (1001) indicating a negative number; therefore, 9C must be re-complemented. 9C = 1001 1100, change 1's to 0's and 0's to 1's = 0110 0011 and add 1= 0110 0100 (64_H). Fractional binary weights left to right for 0110 0100 are 0 = 2's complement positive, $1 = 2^{-1} = 1/2 = 0.5$, $1 = 2^{-2} = 1/4 = 0.25$, 0=0, 0=0, $1= 2^{-5}= 1/32 = 0.03125$, 0=0, 0=0. $6_H = 0.5 + 0.25 + 0.03125 = 0.78125$. $07_H=128_D$, 128_D X $0.78125_D = 100$. A negative sign is assigned (-100) because the original 2's complement binary bit in the 9 (1001) of 9C was set indicating a negative number.	Address = $_H$ Base + (5 X $_H$ Number) = $F00_H$ + (5 X $_H$ Number) Address example: H001 location $F00_H + (5 X 1) = F00_H + 5_D = F00_H + 5_H = F05_H$.
A (F)*	1400_H	10 (A) 5 (F)*	The ***A*** data format represents text strings that are 10 characters long. The ***F*** data format represents text strings that are 5 characters long.	Address = A Base + (10 X Number) = 1400_H + (10 X Number) Address example: A015 location $1400_H + (10 X 15) = 1400_H + 150_D = 1400_H + 96_H$ 1496_H. (For A data type.) Address = F Base + (5 X Number) = 1400_H + (5 X Number) (For F data type within A database.)
*__F__ data types are 5 bytes long and are mapped onto __A__ data types.				

4.3 SOFTWARE CHARACTERISTICS

1. Transparency Rule - whenever 7E hexaecimal is transmitted as anything other than SOH, a 00 byte will be inserted directly following it (byte stuffing).
2. All transactions are initiated by the host personal computer.
3. All instruments begin their response within 10 ms after the end of the transmission by the host personal computer; otherwise, a faulty transmission may be assumed.
4. Illegal messages received by the instruments are ignored.
5. The maximum number of data bytes per message is 20_H (32 decimal).

4.4 HARDWARE CHARACTERISTICS

1. Transmission Speed - standard rates are 110 - 28800 baud.
2. Asynchronous by character.
3. A character is:

   1 Start bit.
   8 Data bits - the Least Significant Bit (LSB) is transmitted first.
   1 Even Parity bit.
   1 Stop bit.

4. The line is 4-wire, shielded twisted pair, type RS-422/485.

4.5 INITIALIZATION MESSAGE

If datapoints A188 and A189 are configured to NON-NULL values, their contents will be transmitted onto the Datalink network at reset/power-up. Prior to transmitting, a delay based on the unit's instrument address is observed. There is a one second delay between the transmission of datapoint A188 and datapoint A189 contents. Datapoints A188 and A189 can be configured as two NULL TERMINATED strings up to 10 characters each. For example, to initialize a Hayes-compatible modem to Auto Answer, datapoint A188 would be configured through the faceplate push buttons to appear as follows:

A188 $_L$ATS0=4^C_R

This seven-character string is an Auto Answer command that directs the modem to respond to calls on the fourth ring. It is an ***AT*** command that loads the modem ***S0*** register with a ***4*** to indicate a modem response on the fourth ring. Any value other than ***0*** in this modem register activates Auto Answer. The NULL TERMINATING values are automatically propagated into the remainder of the datapoint field by the controller. Datapoint A189 can be left at all NULL VALUES for this operation.

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