Tap Position Indicator

Model : FE-2201

User Manual

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Brief Description:

Every transformer consists of a primary and secondary winding through which voltage is either stepped up at generation side or is stepped down at distribution side. At distribution side delivering the load, gradual loading, overloading or unbalanced loading causes the line voltage to vary. To counter with this varying voltage every distribution transformer is equipped with OLTC (On Load Tap Changer).

OLTC consists of tapped windings of primary side. To change the taps the contacts of OLTC are driven across all three phases simultaneously with a motor as per command received through an AVR (Automatic Voltage Regulating Relay) in Remote Mode or through Raise and Lower Switch in Manual Mode and thus, voltage is regulated.

Every tap in OLTC consists of a particular resistor in-between, called as "step resistance". This resistance is useful to know the position of the present tap the transformer is working on.
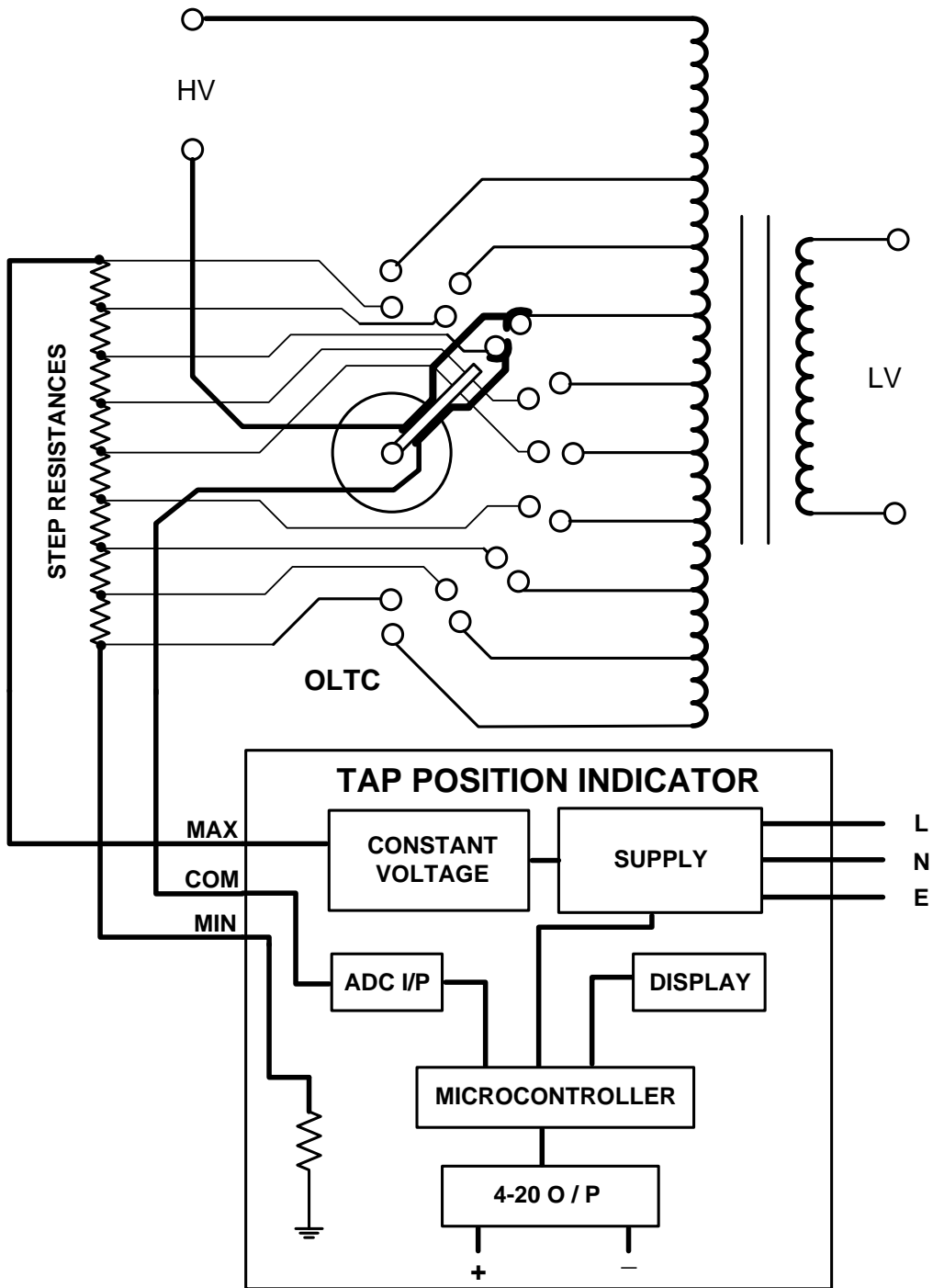
Function:

TPI's (Tap position indicator) purpose is to read, indicate, count and transmit the present tap which transformer is working on. From OLTC three output terminals are extended up to TPI named as Max, Com and Min. To read present tap, the TPI measures the step resistance between its Com and Min terminals. To know the total number of taps TPI reads the resistance across Max and Min Terminals.

After measuring the resistances, TPI processes them as per user given step resistance value and displays the present tap number on display. Along with display TPI can also count the number of times tap changed. To transmit the tap position to other indicators at RTUs TPI's have 4-20 mA current loop outputs and RS-485 communication working on MODBUS Protocol for SCADA based systems.

The FE-2201 displays the current tap after powered up. As the tap changes in OLTC the present tap is reflected on TPI after a user set time delay has been passed out. Along side with display it also has output capability.

When the tap is open the display will indicate at the display.

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HV

STEP RESISTANCES

LV

OLTC

TAP POSITION INDICATOR

MAX

COM

MIN

| CONSTANT VOLTAGE | SUPPLY |

L
N
E

ADC I/P

DISPLAY

MICROCONTROLLER

4-20 O / P

+   —

Block diagram of TPI

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Features:

- Automatic maximum tap detection.
- In-built compatibility for different step resistances including 10E, 12.5E, 100E, 300E and 1K. User can switch between step resistances in the control settings.
- Bright red 0.56-inch 2-character 7 segment LED display.
- User settable Time Delay. 2-99 secs.
- Up to 4 opto-isolated 4-20 mA outputs. The outputs are fully programable for digital calibration of zero and span settings. The outputs are calibrated in the control settings.
- Reverse polarity protected outputs with ESD and EFT protection.
- Digital Calibration for both present and maximum tap positions is given. The user can calibrate taps in the control settings.
- I/P protected from static discharge and EFT surge by TVS diode.
- Embedded with a powerful microcontroller for fast & enhanced processing.
- Easy and flawless control settings for setting parameters by user.

Technicalities:

- Maximum tap position   : 35
- Input type   : Tap Resistance or 4-20 mA I/P
- Step / Tap Resistance   : 10E, 12.5E, 100E, 300E, 1k (All compatible
  user programable in module), other available
  as per user requirement.
- Display   : 2-character, 0.56-inch, 7 Segment LED Display
- Supply   : Universal Supply, 85-265V AC/DC
- Power consumption   : 5W
- Number of Outputs   : 4 / 2 / None, 4-20mA O/P, optically isolated from
  measurement system, 700 ohms max burden.
- RS 485 Output   : Available as per user need.
- Panel Cut-Out   : 92 X 92 mm
- Enclosure Dimensions   : 96 X 96 X 85 mm (H x W x D)
- Working Temperature   : 0 - 60° C
- Weight   : 300 grams approx.

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Control Settings:

To enter the control settings first press **SET** button. After that you enter the parameter selection menu. The menu consists of three fields as follows:

- Input Parameter Menu   :

- Output Parameter Menu   :

- Tap Calibration Menu   :

To change between different menus, press **INC** or **DEC** buttons to move forward or backward. To enter a menu press **SET**. To escape a menu press **ESC**. Press **ESC** again to escape control settings.

Note: In case of inactivity for more than 10 seconds the TPI will escape control settings automatically with saved parameters.

Input Parameter Menu:

In this menu the parameters and their values will blink synchronously. To increase or decrease the respective value of a parameter press **INC** or **DEC.** Press **SET** to save and move on to next parameter. Press **ESC** to escape input parameter menu.

- **Tap Resistance Selection :**

    This parameter indicates the respective code for tap resistance shown below which the user can select as per his need.

Code	Tap Resistance
01	10 Ω
02	12.5 Ω
03	100 Ω
04	300 Ω
05	1000 Ω

- **Time Delay Selection :**

    This parameter indicates the time delay which is provided by TPI in between the instance of actual tap change in OLTC and the instance tap change is reflected on TPI display. The user can set this time delay from 2 to 99 ± 0.5% seconds as per his need.

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- **Maximum Tap Selection / Indication :**

  This parameter is just for indication and read-only in the resistive tap input model. It shows the maximum number of taps in OLTC. This parameter is programmable in the 4-20 I/P model. In that model you can change the tap number up-to 35 positions.

- **Device ID Selection :**

  This parameter is only available in RS485 enabled model. Here user can set the slave ID of the TPI used in communication from 01 to 99.

- **Baud Rate Selection :**

  This parameter is only available in RS485 enabled model. Here user can set the baud rate for MODBUS communication. The respective code for different baud rates is shown below which the user can select as per his need.

Code	Baud Rate
01	2400
02	4800
03	9600
04	19200
05	38400
06	57600
07	115200

  Note : After changing the Baud Rate it is mandatory to restart the TPI. Only then communication will proceed at selected baud rate.

- **Parity Bit Selection :**

  This parameter is only available in RS485 enabled model. Here user can set the parity bit for MODBUS communication. The respective code for different parity bits is shown below which the user can select as per his need.

Code	Parity Bit
1	Even
2	Odd
3	No bit

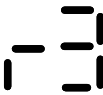To know more about us and our products, visit finityelectronics.com.
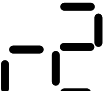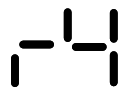
Output Parameter Menu:

This menu is only available for models having 2 or 4 4-20 mA outputs. In this menu the parameters and their values will blink synchronously. To increase or decrease the respective value of a parameter press **INC** or **DEC.** Press **SET** to save and move on to next parameter. Press **ESC** to escape output parameter menu.

Note : To set the parameters here, user is instructed to use multimeter in mA mode and connect it across the + and – terminals of the particular output he wishes to calibrate. For good calibration it is mandatory to set the **zero before span** for an output.

- **Zero Setting :**
  Entering this setting, the particular selected output will be at **4 mA** ideally. But if it is not then user can calibrate it by himself. When user will increase or decrease the value associated to parameter, then corresponding change in output current will be seen. The parameter value can be changed from 0 to 40. Calibrating the current at **4 mA** will set the zero correctly.

Zero for Output 1 : `r1`   **Zero for Output 3 :** `r3`

Zero for Output 2 : `r2`   **Zero for Output 4 :** `r4`

- **Span Setting :**
  Entering this setting, the particular selected output will be at **20 mA** ideally. But if it is not then user can calibrate it by himself. When user will increase or decrease the value associated to parameter, then corresponding change in output current will be seen. The parameter value can be changed from 0 to 40. Calibrating the current at **20 mA** will set the span correctly.

Span for Output 1 : `P1`   **Span for Output 3 :** `P3`

Span for Output 2 : `P2`   **Span for Output 4 :** `P4`

If the zero and span are set for exact 4mA and 20mA current output, then the 4-20mA output will be precise as per tap value.

Tap Calibration Menu:

Generally, the TPI is well tap calibrated and is rarely needed to calibrate. But sometimes due to in-accurate tap resistances or due interference the present tap may fluctuate between its present value and ±1 of present value. To solve the above issue this menu is provided.

In this menu the parameters and their respective tap values will blink synchronously. To increase or decrease the respective value of a parameter press **INC** or **DEC.** Press **SET** to save and move on to next parameter. Press **ESC** to escape tap calibration menu.

Note : It is mandatory to calibrate the present tap first and then max tap.

- **Present Tap Calibration :**

- **Maximum Tap Calibration :**

  In this user can alter the maximum or present tap by increasing or decreasing the corresponding value for the parameter using INC and DEC buttons. Here the fluctuation of tap value will be instantly recognized as the time delay in this mode will be set to 1 sec momentarily. User should change the values until the tap stops fluctuating at desired tap. That value will be selected as the ideal value of calibration for maximum tap or present tap.

RS-485 (Modbus RTU) Output :

TPI FE-2201 supports RS-485 Modbus RTU **2-wire** output. The TPI contains communication line terminated **120 Ω** load and TVS protection diodes for ESD and EFT surges. The communication line requires opposite end to be terminated at 120 Ω too. For connection use twisted pair shielded cable daisy chained together. The permissible slave address range for TPI is from **1-99**. Broadcast Mode (0 Address) is not allowed.

Here the messages start with a silent interval of at least **3.5 character** times. The allowable character transmitted for all fields are **0-9**, **A-F**. Networked devices should monitor the bus continuously. When the address is received in the bus, TPI begins matching its slave address. To mark the end of a message, the master should observe a silent interval of **3.5 character** times.

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If a silent interval of more than **1.5 character** times occurs within a frame then TPI will flush the earlier frame and will start receiving new frame with assuming coming byte as an address byte. The received bytes is then **parity** checked as selected by user and then the whole frame is **CRC** checked for any errors and then request is processed..

Byte Format :

1 start bit	8 data bits (LSB 1st)	1 bit for odd or even parity.1st stop bit if no parity used	1 stop bit if parity used. 2nd stop bit if no parity used

Data Format : 2 bytes (16 bits) per parameter, Hexadecimal, MSB first

Function Codes supported by TPI :

03	Read Holding Registers	Read content of read/write location 4X
04	Read Input Registers	Read content of read only location 3X
06	Pre-set Single Register	Set single register of read/write location 4X
16(10 Hex)	Pre-set Multiple Registers	Set Multiple registers of read/write location 4X

Exception Codes :

01	Illicit Function	Requested function not supported by TPI
02	Illicit Data Address	Attempt to read/write at an illicit data address
03	Illicit Data Value	Attempt to set data register with an out of range value

Function code 04 (Read Input Register 3X) Example:

Query : Get Present Tap, Maximum Tap

01(Hex)	04(Hex)	00(Hex)	00(Hex)	00(Hex)	02(Hex)	71(Hex)	CB(Hex)
Device Address	Function Code	Start Address(H)	Start Address(L)	No. of Registers requested (H)	No. of Registers requested (L)	CRC (L)	CRC (H)

Response : Present Tap (15), Maximum Tap (17)

01(Hex)	04(Hex)	04(Hex)	00(Hex)	0F(Hex)	00(Hex)	11(Hex)	0B(Hex)	8B(Hex)
Device Address	Function Code	Byte Count	Data Reg. 1 (H)	Data Reg. 1 (L)	Data Reg. 2 (H)	Data Reg. 2 (L)	CRC (L)	CRC (H)

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Function code 03 (Read Holding Register 4X) Example:

Query : Get Step Resistance, Time Delay

01(Hex)	03(Hex)	00(Hex)	01(Hex)	00(Hex)	02(Hex)	95(Hex)	CB(Hex)
Device Address	Function Code	Start Address(H)	Start Address(L)	No. of Registers requested (H)	No. of Registers requested (L)	CRC (L)	CRC (H)

Response : Step Resistance (code 01),Time Delay (02)

01(Hex)	03(Hex)	04(Hex)	00(Hex)	01(Hex)	00(Hex)	02(Hex)	2A(Hex)	32(Hex)
Device Address	Function Code	Byte Count	Data Reg. 1 (H)	Data Reg. 1 (L)	Data Reg. 2 (H)	Data Reg. 2 (L)	CRC (L)	CRC (H)

Function code 06 (Pre-Set Holding Register 4X) Example:

Query : Pre-set Time Delay to 6 seconds.

01(Hex)	06(Hex)	00(Hex)	02(Hex)	00(Hex)	06(Hex)	A8(Hex)	08(Hex)
Device Address	Function Code	Register Address(H)	Register Address(L)	Pre-Set Data (H)	Pre-Set Data (L)	CRC (L)	CRC (H)

Response : Response is echoed just same as query shown above.

Function code 10(Hex) (Multiple-Set Holding Register 4X) Example:

Query: Pre-Set Step Resistance to 2, Time Delay to 6

Device Address   : 01
Function   : 10
Start Address High   : 00
Start Address Low   : 01
Number of Registers High : 00
Number of Registers Low   : 02
Byte Count   : 04
Data Register 1 High   : 00
Data Register 1 Low   : 02
Data Register 2 High   : 00
Data Register 2 Low   : 06
CRC Low   : 13
CRC High   : A1

Response : Pre-Set Step Resistance to code 2, Pre-set Time Delay to 6 seconds.

01(Hex)	10(Hex)	00(Hex)	01(Hex)	00(Hex)	02(Hex)	10(Hex)	08(Hex)
Device Address	Function Code	Register Address(H)	Register Address(L)	No. of Registers Pre-Set (H)	No. of Registers Pre-Set (L)	CRC (L)	CRC (H)

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3X Register Addresses :

Address	Parameter	Start Address High Byte	Start Address Low Byte
30001	Present Tap No.	00	00
30002	Maximum Tap No.	00	01

Note: When TPI input terminals is open then both Parameters will show 50 as value.

4X Register Addresses :

Important : After writing registers it is mandatory to set register 4000D to 1, to save values in EEPROM of the microcontroller, else values will be flushed if restarted. Also EEPROM has 100000 write/erase cycles. So, load EEPROM wisely.

Resistive tap I/P, 4 (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Max Tap Calibration	0-40	00	00
2	40002	Step Resistance	1-5	00	01
3	40003	Time Delay	2-99	00	02
4	40004	O/P 1 zero calibration	0-40	00	03
5	40005	O/P 1 span calibration	0-40	00	04
6	40006	O/P 2 zero calibration	0-40	00	05
7	40007	O/P 2 span calibration	0-40	00	06
8	40008	O/P 3 zero calibration	0-40	00	07
9	40009	O/P 3 span calibration	0-40	00	08
10	4000A	O/P 4 zero calibration	0-40	00	09
11	4000B	O/P 4 span calibration	0-40	00	0A
12	4000C	Present Tap Calibration	0-40	00	0B
13	4000D	EEPROM Load	0 or 1	00	0C

Resistive tap I/P, 2 (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Max Tap Calibration	0-40	00	00
2	40002	Step Resistance	1-5	00	01
3	40003	Time Delay	2-99	00	02
4	40004	O/P 1 zero calibration	0-40	00	03
5	40005	O/P 1 span calibration	0-40	00	04
6	40006	O/P 2 zero calibration	0-40	00	05
7	40007	O/P 2 span calibration	0-40	00	06
8	4000C	Present Tap Calibration	0-40	00	0B
9	4000D	EEPROM Load	0 or 1	00	0C

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Resistive tap I/P, No (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Max Tap Calibration	0-40	00	00
2	40002	Step Resistance	1-5	00	01
3	40003	Time Delay	2-99	00	02
4	4000C	Present Tap Calibration	0-40	00	0B
5	4000D	EEPROM Load	0 or 1	00	0C

4-20 mA Current Loop I/P, 4 (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Time Delay	2-99	00	00
2	40002	Maximum Tap	1-35	00	01
3	40003	O/P 1 zero calibration	0-40	00	02
4	40004	O/P 1 span calibration	0-40	00	03
5	40005	O/P 2 zero calibration	0-40	00	04
6	40006	O/P 2 span calibration	0-40	00	05
7	40007	O/P 3 zero calibration	0-40	00	06
8	40008	O/P 3 span calibration	0-40	00	07
9	40009	O/P 4 zero calibration	0-40	00	08
10	4000A	O/P 4 span calibration	0-40	00	09
11	4000B	Present Tap Calibration	0-40	00	0A
12	4000C	EEPROM Load	0 or 1	00	0B

4-20 mA Current Loop I/P, 2 (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Time Delay	2-99	00	00
2	40002	Maximum Tap	1-35	00	01
3	40003	O/P 1 zero calibration	0-40	00	02
4	40004	O/P 1 span calibration	0-40	00	03
5	40005	O/P 2 zero calibration	0-40	00	04
6	40006	O/P 2 span calibration	0-40	00	05
7	4000B	Present Tap Calibration	0-40	00	0A
8	4000C	EEPROM Load	0 or 1	00	0B

4-20 mA Current Loop I/P, No (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Time Delay	2-99	00	00
2	40002	Maximum Tap	1-35	00	01
3	4000B	Present Tap Calibration	0-40	00	0A
4	4000C	EEPROM Load	0 or 1	00	0B

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Connection Diagram :

1	2	3	4	5	6	7	8	9
Max	Com	Min	O/p 1 (+)	O/p 1 (-)	O/p 2 (+)	O/p 2 (-)	A	B

10	11	12	13	14	15	16	17	18
L	N	E	O/p 3 (+)	O/p 3 (-)	O/p 4 (+)	O/p 4 (-)		Gnd

Connection Diagram for Resistive Tap Input TPI

1	2	3	4	5	6	7	8	9
	I/P (+)	I/P (-)	O/p 1 (+)	O/p 1 (-)	O/p 2 (+)	O/p 2 (-)	A	B

10	11	12	13	14	15	16	17	18
L	N	E	O/p 3 (+)	O/p 3 (-)	O/p 4 (+)	O/p 4 (-)		Gnd

Connection Diagram for 4-20 mA Current Loop Input TPI

Warranty :

On this purchase of TPI FE-2201 from FINITY ELECTRONICS you get a warranty against defects in materials or technical abnormalities found in the product for a period of 12 months from the date of dispatch to the consumer. If in warranty period FINITY ELECTRONICS will repair or replace the product, provided that product was used with care and in accordance with user manuals provided.

This warranty will not be applied for defects from transit resulting from mishandling or misuse by carrier agencies. Any malfunctioning by modifications or repairs done in other vicinity will not be covered in this warranty. Also damages due to in-appropriate site conditions, electrical parameters, or any abnormal accident from user end will not be covered in this warranty. Warranty period will not extend if product is replaced or repaired while in warranty.

For warranty repair or replacement, product must be returned to FINITY ELECTRONICS with good packing and freight paid with product purchase documents, company note for replacement, product failure details and fault conditions. Return of product can be arranged on payment of packing and delivery charges and any other miscellaneous expenses incurred. In case the product fails outside the warranty period, the user can send the product for repair and the expenses must be fully paid.

As we develop and improve our products consistently, we have the right to change any product parameters or details in this user manual without any prior notice. User should communicate us before making any purchase after reading this manual.

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