



**THREE-PHASE THYRISTOR MODULE DRIVER**  
**3phTMD – 6-DIN**

**TECHNICAL DESCRIPTION**

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Three-phase thyristor module driver 3phTMD -6-DIN is intended for controlling of power thyristor modules M1, M8, M24, M26 and in common with it allows building the following types of three-phase converters for three-phase AC circuit operation of frequency 50 Hz.

1 Three-phase controlled six-pulse rectifier (in common with thyristor module M24 or three thyristor modules M1);

2 Three-phase controlled six-pulse rectifier with primary winding control of power transformer (in common with thyristor module M26 or three thyristor modules M8, connected to primary winding of transformer and modules M6 (three modules M4.1), connected to secondary winding of transformer);

3 Three-phase power regulator for operation to active load or transformer (in common with thyristor module M26 or three thyristor modules M8 that are connected to primary winding of the transformer).

The driver provides protection of thyristors modules at maximum current (version CP1 and CP2). The driver can be also performed without maximum-current protection (version CP0).

### Application field

- 1 Rectifiers for IGBT invertors supply with capability of smooth capacitor bank charge;
- 2 Rectifiers for accumulator battery charge;
- 3 Rectifiers of cathode corrosion-inhibiting protection devices;
- 4 Rectifiers for DC drive supply (including reversing);

### Principle of operation

In 3phTMD -6-DIN vertical-pulse regulation method of load voltage average value is used, whereby average value change is carried out by on state thyristor time change during the corresponding half-period of line voltage.

Functional circuit of 3phTMD -6-DIN is shown on Figure 1.

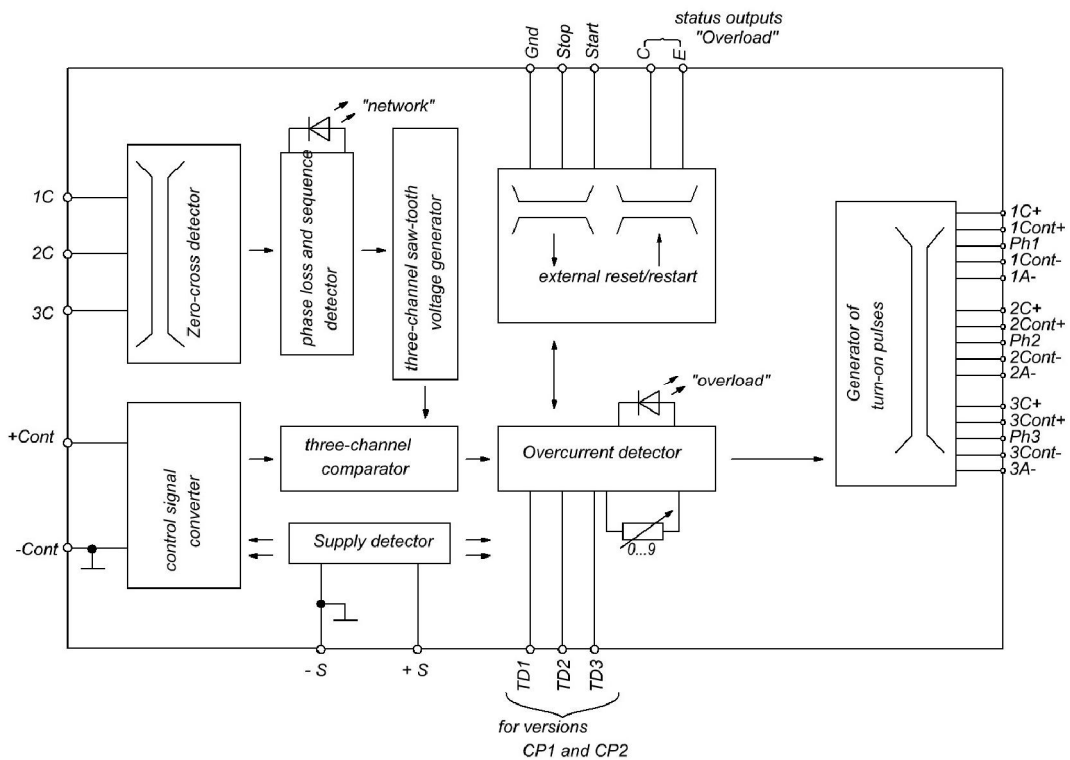


Figure 1 – Functional circuit

Table 1 – 3phTMD-6-DIN outputs function

Output	Symbol	Function
X1	Stop	«Stop» input (for version with external rerun)
X2	Start	«Start» input (for version with external rerun)
X3	Gnd.	General output for «Start» and «Stop» signals (for version with external rerun)
X4	E	Status optocoupler emitter (for version with status optocoupler)
X5	C	Status optocoupler collector (for version with status optocoupler)
X6	Not used	
X7	TD1	Current sensor input of phase 1
X8	TD2	Current sensor input of phase 2
X9	TD3	Current sensor input of phase 3
X10	- Supply	Supply 5 V
X11	+ Supply	
X12	+ Cont	Control
X13	- Cont	
X14	3 Cont-	Control thyristor electrode of anode group of phase 3
X15	3 A-	Thyristor anode of anode group of phase 3
X16	3 C+	Thyristor cathode of cathode group of phase 3
X17	3 Cont +	Control thyristor electrode of cathode group of phase 3
X18	Ph3	Phase 3 input of power mains
X19	2 Cont-	Control thyristor electrode of anode group of phase 2
X20	2 A-	Thyristor anode of anode group of phase 2
X21	2 C+	Thyristor cathode of cathode group of phase 2
X22	2 Cont +	Control thyristor electrode of cathode group of phase 2
X23	Ph 2	Phase 2 input of power mains
X24	1 Cont -	Control thyristor electrode of anode group of phase 1
X25	1 A-	Thyristor anode of anode group of phase 1
X26	1 C+	Thyristor cathode of cathode group of phase 1
X27	1 Y +	Control thyristor electrode of cathode group of phase 1
X28	Ph 1	Phase 1 input of power mains
X29	Ph 3 s	Inputs of network synchronization
X30	Ph 2 s	
X31	Ph 1 s	

A unit of network synchronization forms pulses at the moment of zero line voltage transient which synchronize sawtooth voltage generator. In three-channel comparator voltage of sawtooth generator and control signal  $U_{cont}$  are compared, that is got from input signal converter circuit. When STG reaches value  $U_{cont}$ , pulse of external thyristor connection is generated. Changing the control signal value, equality of STG and  $U_{cont}$  varies and, accordingly, thyristor connection angle. Thereby you reach regulation of root-mean-square load voltage value.

3phTMD-6-DIN includes smooth start mode of supply connection, synchronizing signal delivery and when recovering from mode «Current Overload» (for version CP1 and CP2) into operating mode, exclusive big leakage launch current, that allows decreasing leakage current when operation, ( three-phase power regulator) or when capacitor filter charge (three-phase regulated rectifier).

3phTMD-6-DIN with version CP1 and CP2 is provided for current inputs for current sensor connection, which ensure module protection M1, M8, M24, M26 against overload. When load current value is more than it is possible, 3phTMD-6-DIN will transfer to «Current Overload» state, status LED is turned on (with red emission color) or status optocoupler transistor opens (depending on version), on control outputs thyristors form signals which correspond to its off-state. In 300 ms protection will be removed. Status LED will be turned off (or status optocoupler transistor will be closed), on thyristor control outputs will be the signals formed that perform smooth start from zero to average value of load voltage, which is determined by control signal value. If emergency is not eliminated the above described process will continue until malfunction removes. 3phTMD-6-DIN may be also made in the performance when return from mode “Current Overload” to operating mode is carried out by external signals, which are given to input “Launch”, for instance, from drive controller board. 3phTMD-6-DIN may be transferred forcibly to mode “Overload” by means of signal delivery to input “Stop”.

There is ten-position switch for version CP1 and CP2 under cover of 3phTMD-6-DIN (0 ... 9), that makes it possible for a user to set necessary protection operation current when 3phTMD-6-DIN break-in, cover of 3phTMD-6-DIN should be taken off and the switch should be set to the necessary position (when delivering to a consumer the switch is set in position "0"). The current value for version CP1 and CP2 is given in Table 1.

Besides current overload protection 3phTMD-6-DIN has protection that makes it possible to drive the voltage at all three phases, which are connected to thyristor converter, as well as right order of phase interlacing. The indicator "Network" is green if there is voltage at all three phases and with correct order of phase interlacing; the indicator "Network" will not light if there is loss of phase as well as the order of it interlacing broken, there are signals that correspond to its off-state on thyristor control outputs.

3phTMD-6-DIN operates in complete with control devices (off-site manufacturer), which has standard analogue output DC signal.

Depending on version 3phTMD-6 control signal converter transforms control signal of five types (0...5 V; 0...10 V; 0...5 mA; 0...20mA; 4...20 mA) into signal «U<sub>cont</sub>» for two control characteristic types. Thyristor conduction angle (time during which thyristors conduct current) from the relative value of control signal is represented at Figure 2.

Table 2 – Current value for version CP1 and CP2

Switch position		0	1	2	3	4	5	6	7	8	9
Version CP1	Protection operation current, A	20	40	60	80	100	120	140	160	180	200
	Protection operation input load current of input DT Pha, DT Phb, DT Phc, mA	14	28	42	56	70	84	98	112	126	140
Version CP2	Protection operation current, A	200	220	240	260	280	300	320	340	360	380
	Protection operation input load current of input DT Pha, DT Phb, DT Phc, mA	140	154	168	182	196	210	224	238	252	266

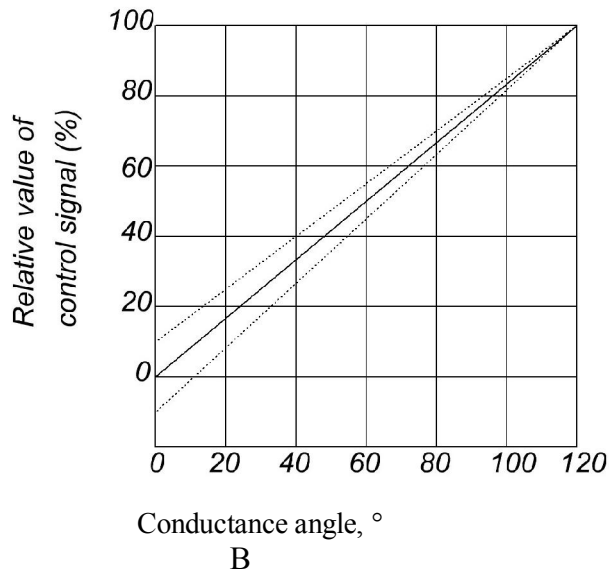
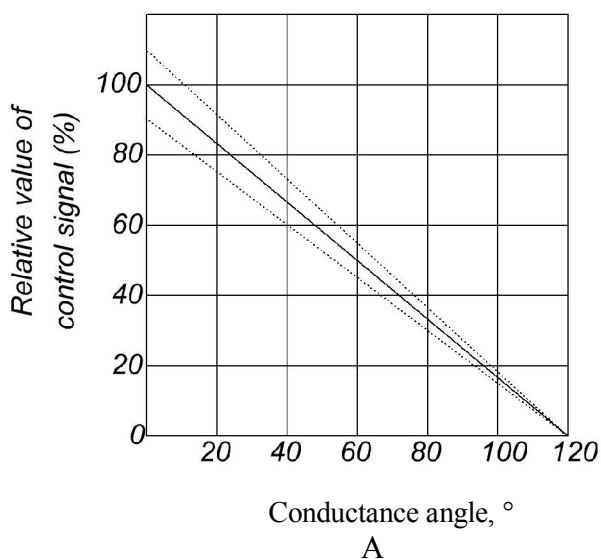


Figure 2 – Control characteristic

### Specification

Table 2 – Basic specification

#### 1 Supply

Characteristic name	Unit	Value	Note
1. Supply voltage	V	5	DC
2. Supply voltage value fluctuation, max	%	10	
3. Consumption current, max	mA	150	

2 Input circuit characteristic

Characteristic name	Unit	Symbol of input circuit types 3phTMD-6										Note
		A-1	A-2	A-3	A-4	A-5	B-1	B-2	B-3	B-4	B-5	
1 Control signal value, corresponding to the minimum power	V	5±0.5	10±1	-	-	-	0÷0.5	0÷1	-	-	-	
	mA	-	-	20±2	5±0.5	20±2	-	-	4±0.4	0÷0.5	0÷2	
2 Control signal value, corresponding to the minimum power	V	0÷0.5	0÷1	-	-	-	5±0.5	10±1	-	-	-	
	mA	-	-	4±0.4	0÷0.5	0÷2	-	-	20±2	5±0.5	20±2	
3 Input circuit resistance of control signal, $R_{BX, \max}$	kΩ	2.5	1.1	0.062	0.2	0.05	2.5	1.1	0.062	0.2	0.05	

3 Output circuit characteristic

Characteristic name	Unit	Value	Note	
1 Peak voltage value on inputs «Ca», «CB», «Cc», $U_{in,peak}$	max	V	1200	$T_p \leq 10$ ms
2 Output current of control output	max	A	1	$t_p \leq 10$ ms
3. Commutation voltage rms, $U_{com,rms}$	min	V	100	
	max	V	400	

4 Status circuit characteristic

Characteristic name	Unit	Value	Note
1 Collector current	max	mA	50
2 Collector-emitter voltage	max	V	40

5 Characteristic of external rerun circuit («Start», «Stop»)

Characteristic name	Unit	Value	Note
1. Rerun pulse voltage magnitude	max	V	5
2. Rerun pulse time	min	ms	10

6 Characteristics of synchronization circuits

Characteristic name	Unit	Value	Note
1. Synchronization voltage	V	100÷440	
2. Current consumption of synchronization input	min	mA	10

7 Isolation Characteristic

Characteristic name	Unit	Value	Note	
1 Electric isolation strength of supply circuits, input circuits, status circuits, external rerun circuits relative to output circuits	max	kV	2.5	AC 50 Hz
4 Electric isolation strength of supply circuits, input circuits, status circuits, external rerun circuits relative to output circuits when normal conditions	min	MΩ	40	DC test voltage 1000 V

8 Weight overall rate

Characteristic name	Unit	Value	Note	
1 Weight	max	kg	-	
2 Overall dimensions	max	mm	90x140	version 01
			91x160	version 02

9 Service conditions

Characteristic name		Unit	Value	Note
1 Air temperature		°C	-45 ÷ + 65	
2 Relative humidity	max	%	80	

**Notation**

Notation:  $\frac{3\text{phTMD} - 6 - \text{A} - 1 - \text{CP2} - \text{A} - 1 - \text{DIN} - 01}{\begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{matrix}}$

- 1 Driver name;
- 2 Control characteristic:  
A - 100% control signal corresponds to zero power;  
B - 100% control signal corresponds to total power;
- 3 Control signal type:  
1 - 0...5 V;  
2 - 0...10 V;  
3 - 4...20 mA;  
4 - 0...5 mA;  
5 - 0...20 mA;
- 4 Current protection range  
CP1 - 20...200 A;  
CP2 - 200...380 A;  
CP0 – without current protection
- 5 Rerun type of protection current operation  
A - automatic  
E - external
- 6 Indication type when current protection operation  
1 – Status LED  
2 – Status optocoupler;
- 7 Fastening to DIN-rail 35 mm.
- 8 The design version is determined by supplier

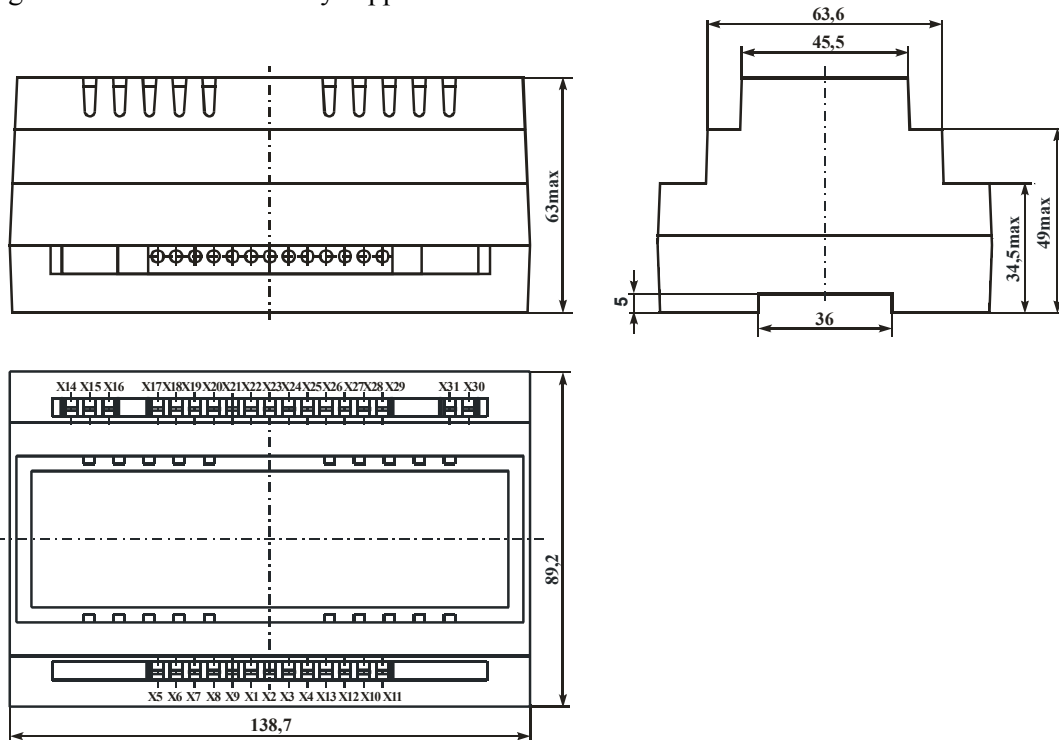


Figure 3.1 – Overall drawing - version 1  
\*only for status LED indication type

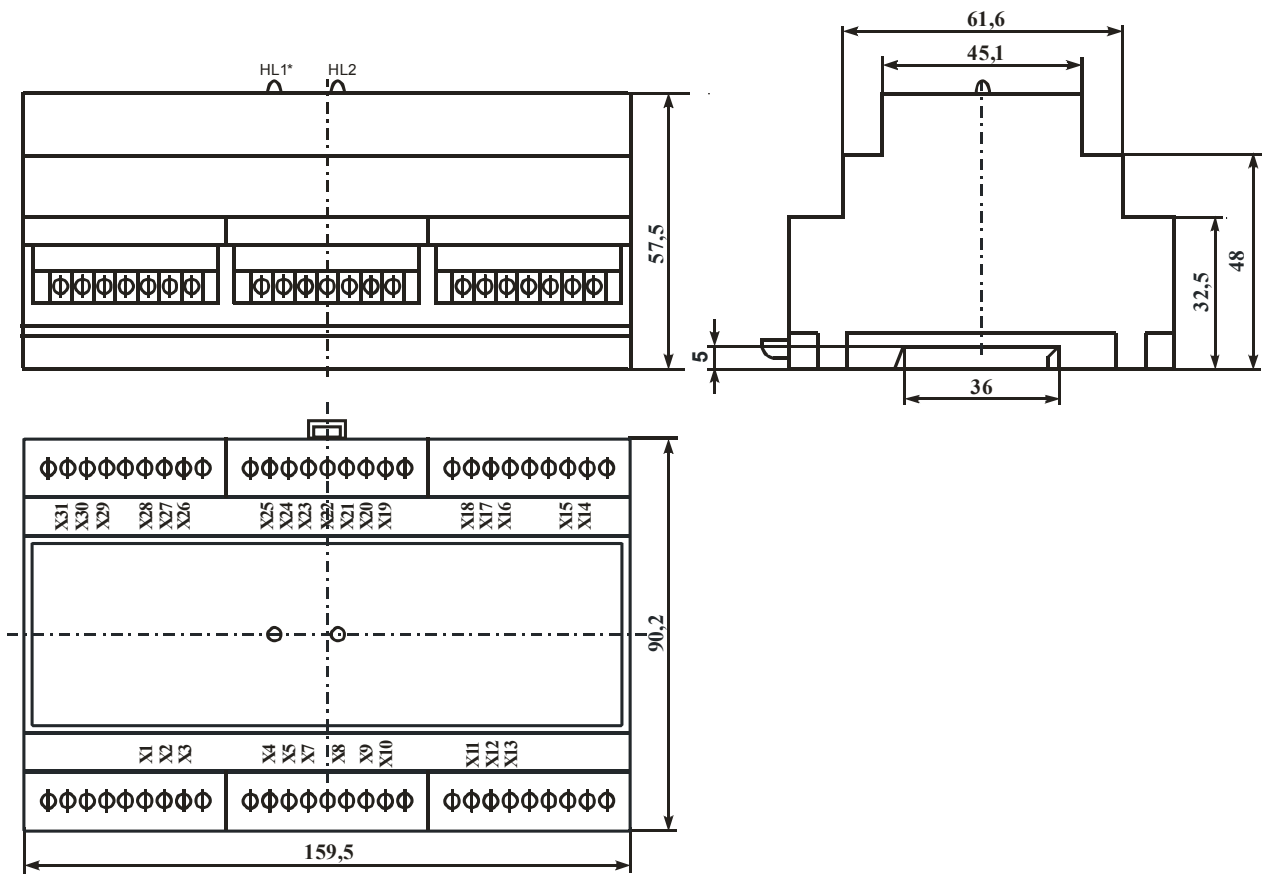


Figure 3 – Overall drawing - version 2  
\*only for status LED indication type

### SERVICE RECOMMENDATIONS

It is not allowable when mounting to lay field line wires and control circuits in one bundle or general tube (box). Avoid loops in connecting wires of control and supply circuits. Connecting wires should be made as twisted pairs to provide noise immunity.

Figure 4 gives connection circuits of 3phTMD

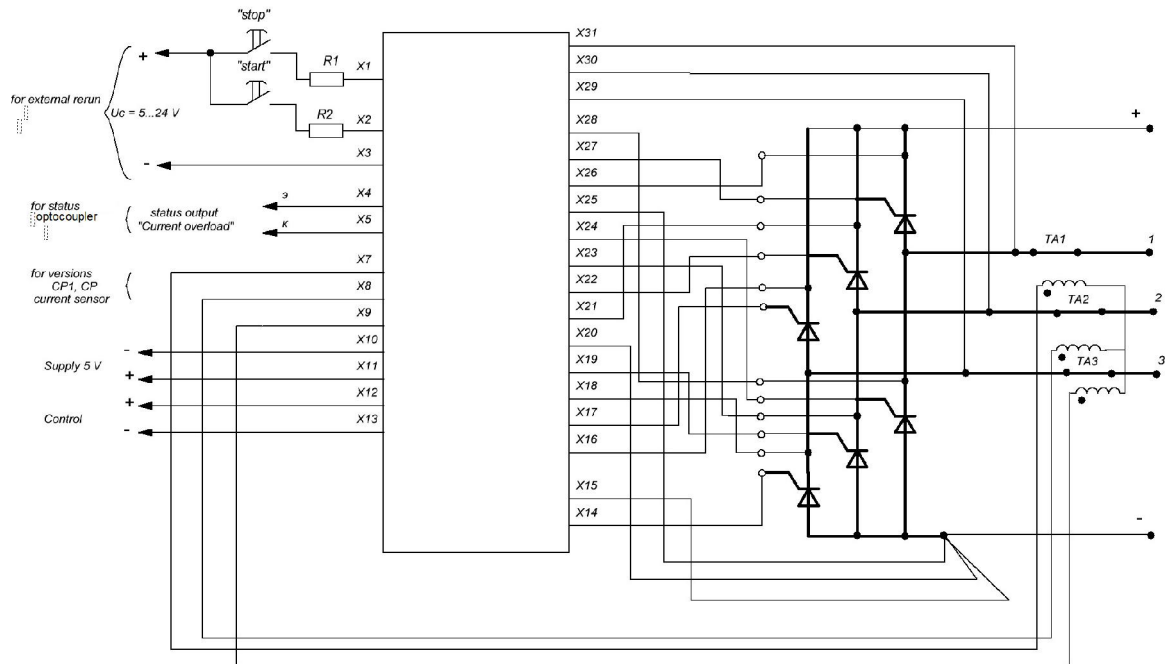


Figure 4 – Connection circuit

$$\text{Where } R1, R2 = \frac{U_s - 5}{0.01} (\Omega)$$

**SUPPLY SET**

1. 3phTMD-6-DIN

2. Current sensor 1:2000±2%

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\_\_\_\_\_ pcs

\_\_\_\_\_ pcs

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