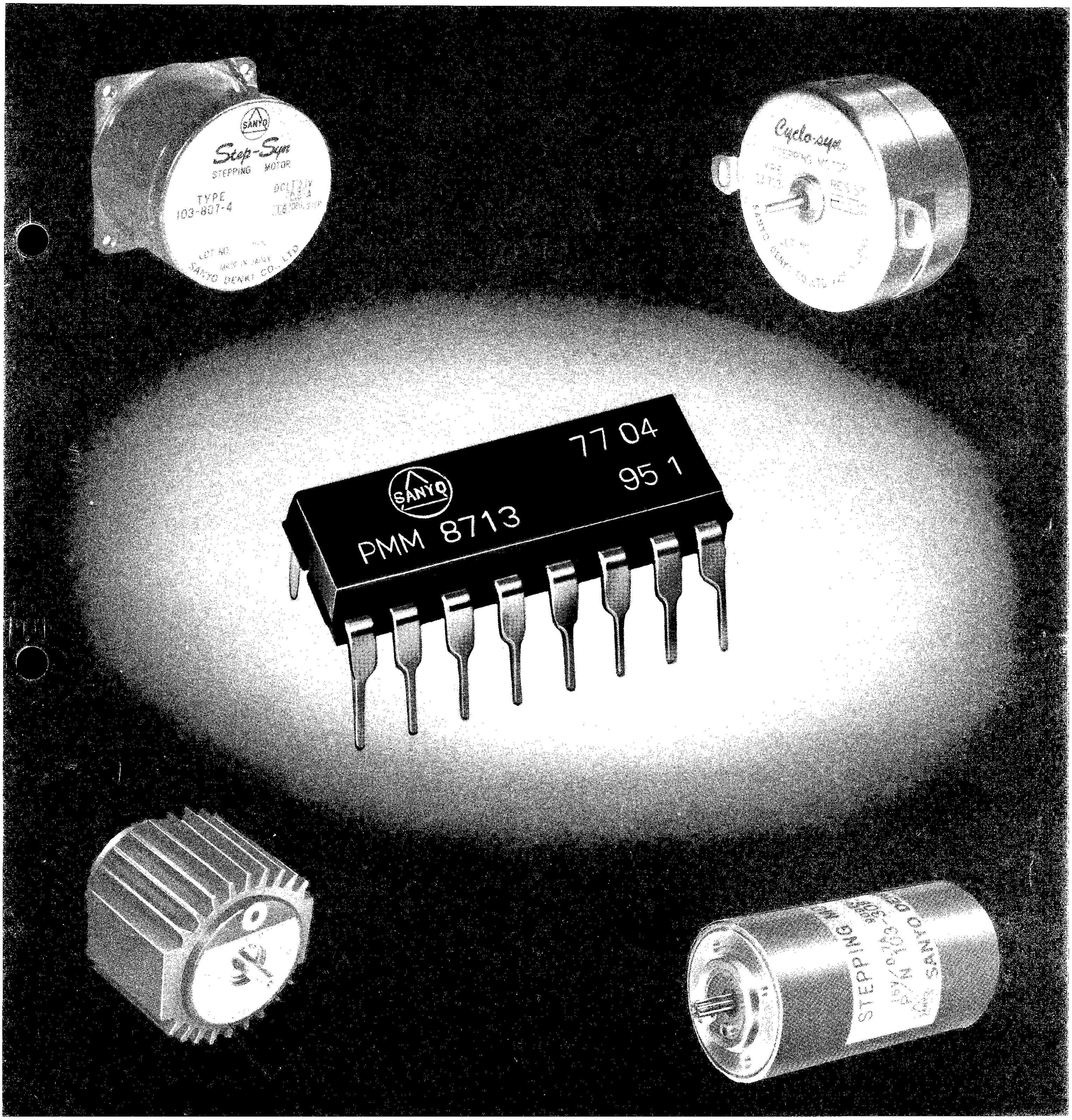
UNIVERSAL CONTROLLER

for Stepping Motor Driving

PMM8713



SANYO DENKI CO.,LTD.

❶ GENERAL

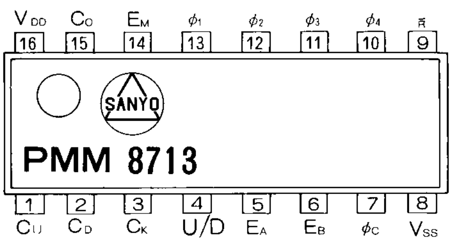
The universal controller PMM8713 for driving SANYO stepping motor is a C-MOS monolithic type IC designed for controlling stepping motors of three-phase and four-phase type.
The Sanyo's PMM8713 is designed to control either of 3 phase and 4 phase stepping motors in any mode of 1 phase excitation, 2 phase excitation or 1−2 phase excitation.
In addition to that, when darlington type transistors are only inserted in the output lines, it can work on switching of higher current ratings of stepping motors.
PMM8713 has been developed for the purpose of simplifying the utilization of stepping motors and it permits to easily compose a stepping motor drive unit by preparing a pulse oscillator (pulse input signal), power switching transistors and DC power supply.
It is advantageous that it affords cost savings in parts inventory, purchasing, handling, assembly labor, circuit test and design.

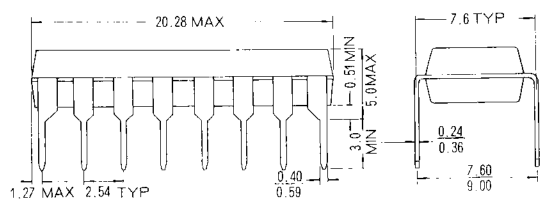
❷ FEATURES

★ Universal controller:	The following 6 types of mode can be selected by means of a excitation mode change-over terminal: ● 4 phase 1 excitation ● 3 phase 1 excitation ● 4 phase 2 excitation ● 3 phase 2 excitation ● 4 phase 1−2 excitation ● 3 phase 1−2 excitation
★ Wider range of power supply voltage:	V_{DD} = +4V ~ +18V
★ High output current:	20mA min. for both sink and source
★ High noise margin:	All input terminals have built-in schmitt circuit
★ 2 types of pulse input:	2 input terminal system } selectable 1 input, 1 change-over terminal system } selectable
★ Excitation detecting monitor:	Outputs monitor signal showing operating condition of controller

❸ PIN CONNECTION (16 LEAD PLASTIC DUAL IN LINE PACKAGE)

(Fig.-1)





PIN NO.		
1 C_U	Input pulse, UP clock	
2 C_D	Input pulse, DOWN clock	
3 C_K	Input pulse, clock	
4 U/D	Change-over of rotation direction "0" DOWN, "1" UP	
5 E_A	Exitation-mode change over	See Table -1
6 E_B	Exitation-mode change over	See Table -1
7 ϕc	3, 4 phase-change	See Table -1
8 V_{SS}	(GND)	See Table -1

PIN NO.		
9 $\bar{R}$	Reset	
10 $\phi 4$	Output	4 phase
11 $\phi 3$	Output	3 phase / 4 phase
12 $\phi 2$	Output	3 phase / 4 phase
13 $\phi 1$	Output	3 phase / 4 phase
14 E_M	Excitation monitor	
15 C_O	Input pulse monitor	
16 V_{DD}	(+4 ~ +18V)	

❹ FUNCTION TABLE

(Table-1)

		Input								Output					
Excitation Mode		ϕ_C	E_A	E_B	C_U	C_D	C_K	U/D	$\bar{R}$	C_O	E_M	ϕ_1	ϕ_2	ϕ_3	ϕ_4
3 phase	1−2 excitation	O	1	1	×	×	×	×	O	−	1	1	O	1	O
	2 excitation	O	O	O	×	×	×	×	O	−	1	1	O	1	O
	1 excitation	O	O/1 OR	1/O	×	×	×	×	O	−	O	1	O	O	O
4 phase	1−2 excitation	1	1	1	×	×	×	×	O	−	1	1	O	O	1
	2 excitation	1	O	O	×	×	×	×	O	−	1	1	O	O	1
	1 excitation	1	O/1 OR	1/O	×	×	×	×	O	−	O	1	O	O	O

×; not considered −; not defined

❺ EXCITATION SEQUENCE (Table-2)

4 Phase 2 Excitation (a)

Pulse / Phase	0 (Reset)	1	2	3	4
ϕ_1	1	1	0	0	1
ϕ_2	0	1	1	0	0
ϕ_3	0	0	1	1	0
ϕ_4	1	0	0	1	1
UP	⟶				
DOWN	⟵				

3 Phase 2 Excitation(b)

Pulse / Phase	0 (Reset)	1	2	3
ϕ_1	1	1	0	1
ϕ_2	0	1	1	0
ϕ_3	1	0	1	1
UP	⟶			
DOWN	⟵			

4 Phase 1-2 Excitation (c)

Pulse / Phase	0 (Reset)	1	2	3	4	5	6	7	8
ϕ_1	1	1	1	0	0	0	0	0	1
ϕ_2	0	0	1	1	1	0	0	0	0
ϕ_3	0	0	0	0	1	1	1	0	0
ϕ_4	1	0	0	0	0	0	1	1	1
UP	⟶								
DOWN	⟵								

3 Phase 1-2 Excitation (d)

Pulse / Phase	0 (Reset)	1	2	3	4	5	6
ϕ_1	1	1	1	0	0	0	1
ϕ_2	0	0	1	1	1	0	0
ϕ_3	1	0	0	0	1	1	1
UP	⟶						
DOWN	⟵						

4 Phase 1 Excitation (e)

Pulse / Phase	0 (Reset)	1	2	3	4
ϕ_1	1	0	0	0	1
ϕ_2	0	1	0	0	0
ϕ_3	0	0	1	0	0
ϕ_4	0	0	0	1	0
UP	⟶				
DOWN	⟵				

3 Phase 1 Excitation (f)

Pulse / Phase	0 (Reset)	1	2	3
ϕ_1	1	0	0	1
ϕ_2	0	1	0	0
ϕ_3	0	0	1	0
UP	⟶			
DOWN	⟵			

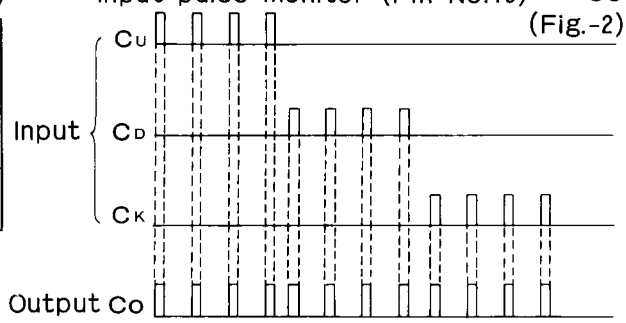
❻ FUNCTION OF EXCITATION MONITOR (PIN NO.14) AND INPUT PULSE MONITOR (PIN NO.15)

Excitation monitor (Pin No.14) —E_M (Table-3)

Input Pulse / Mode	0 (Reset)	1	2	3	4	5	6	7	8
3, 4 phase 1 excitation	0	0	0	0	0	0	0	0	0
3, 4 phase 2 excitation	1	1	1	1	1	1	1	1	1
3, 4 phase 1-2 excitation	1	0	1	0	1	0	1	0	1

1. When output mode is set at 2 phase excitation, transmits "1" level.
2. And when at 1 phase excitation, transmits "0" level.

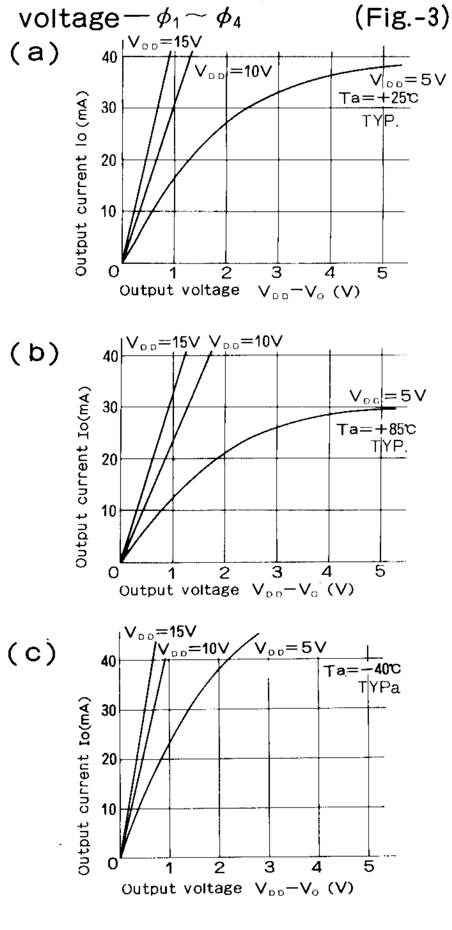
Input pulse monitor (Pin No.15)——Co (Fig.-2)



❼ MAXIMUM RATINGS (Table-4)

Parameter	Symbol	Ratings	Units
Supply Voltage	V_{DD}	−0.5 ~ +18	V
Input Voltage	V_{IN}	−0.5 ~ V_{DD}+0.5	V
Operating temperature range	T_A	−40 ~ +85	℃
Storage temperature range	T_{STG}	−65 ~ +150	℃
Power Dissipation	P_D	280 (T_A= −40℃ ~ +60℃) 160 (T_A= +60℃ ~ +85℃)	mW
Output current	I_O	35	mA

Characteristic of output current vs voltage— ϕ_1 ~ ϕ_4 (Fig.-3)



❽ ELECTRICAL CHARACTERISTICS

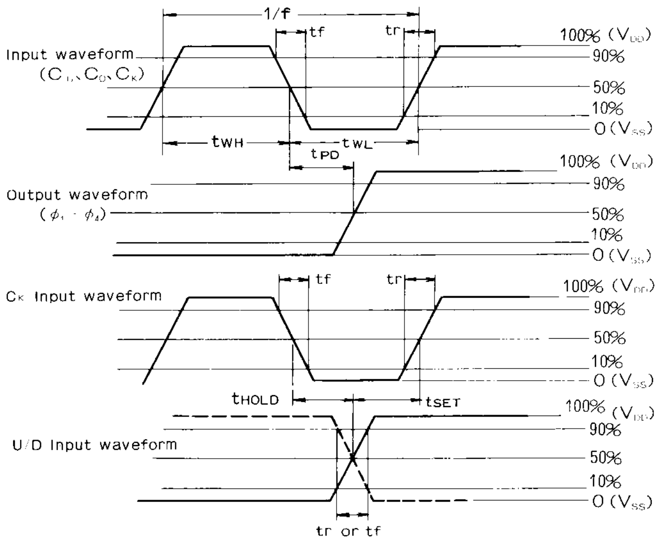
DC characteristics T_A=−40℃ ~ +85℃ (Table-5)

Parameter			Symbol	V_{DD}	Test Conditions	Min.	Typ.	Max.	Units
Input voltage		"H" level	V_{IH}	5V		3.5			V
				15V		11			
		"L" level	V_{IL}	5V				1.5	
				15V				4.0	
Output voltage		"H" level	V_{OH}	5V	V_{IH}=5V V_{IL}=0V I_{OH}=0	4.9			V
				15V	V_{IH}=15V V_{IL}=0V I_{OH}=0	14.9			
		"L" level	V_{OL}	5V	V_{IH}=5V V_{IL}=0V I_{OL}=0			0.1	
				15V	V_{IH}=15V V_{IL}=0V I_{OL}=0			0.1	
Output current	ϕ_1 ~ ϕ_4 Output	"H" level	I_{OH}	5V	V_{IH}=5V V_{IL}=0V V_{OUT}=2V	−20			mA
				15V	V_{IH}=15V V_{IL}=0V V_{OUT}=12V	−20			
		"L" level	I_{OL}	5V	V_{IH}=5V V_{IL}=0V V_{OUT}=3V	20			
				15V	V_{IH}=15V V_{IL}=0V V_{OUT}=3V	20			
	Co. Em Output	"H" level	I_{OH}	5V	V_{IH}=5V V_{IL}=0V V_{OUT}=2.5V	−0.8			
				15V	V_{IH}=15V V_{IL}=0V V_{OUT}=12.5V	−1.6			
		"L" level	I_{OL}	5V	V_{IH}=5V V_{IL}=0V V_{OUT}=0.4V	1.8			
				15V	V_{IH}=15V V_{IL}=0V V_{OUT}=0.4V	3.6			
Input current			I_I	15V			10		μA
Stand by current			I_{DD}	15V	V_{IH}=15V V_{IL}=0V		1		mA

AC characteristics (Table-6)

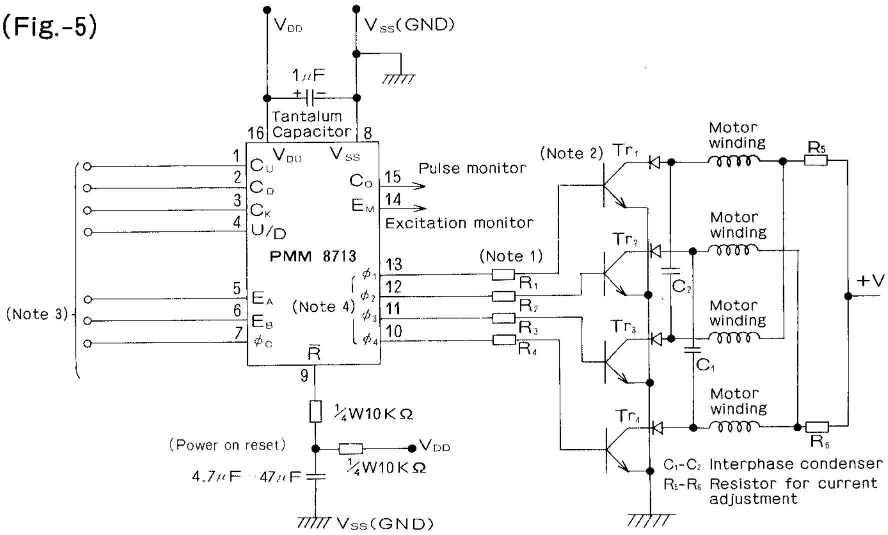
Parameter	Symbol	Test Condition		Limits			Units
		V_{DD}		Min.	Typ.	Max.	
Max. clock frequency	f_{MAX}	5 V	tr=tf=20ns	1			MHz
		15V	C_L=50PF	2			
Min. clock pulse width	t_{WL} t_{WH}	5 V	tr=tf=20ns			500	ns
		15V	C_L=50PF			250	
Min. reset pulse width	t_{WR}	5 V	tr=tf=20ns			1000	
		15V	C_L=50PF			500	
Propagation delay time (from clock input to ϕ output)	t_{PD}	5 V	tr=tf=20ns			2000	
		15V	C_L=50PF			1000	
Set up time	t_{SET}	5 V	tr=tf=20ns	0			
		15V	C_L=50PF	0			
Hold time	t_{HOLD}	5 V	tr=tf=20ns	250			
		15V	C_L=50PF	125			

Input, output waveforms (Fig.-4)



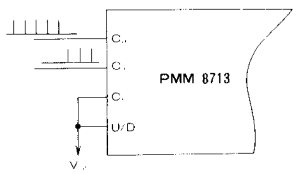
9 APPLICATION EXAMPLE

(Fig.-5)



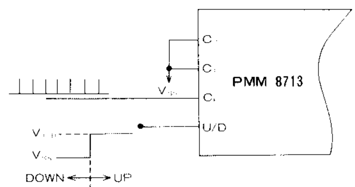
(Fig.-6)

2 input terminal system



(Fig.-7)

1 input, 1 change-over terminal system



(Note 1) Recommended the followings be used for output resistors

R_1 to R_4 : ½W 100Ω ±5% when V_{DD} = 5V
1 W 300Ω ±5% when V_{DD} = 10V
1 W 500Ω ±5% when V_{DD} = 15V

The output current at this time will be about I_{OH} = 15 ~ 27mA. (with Tr $V_{BE(SAT)}$ = 1.2V).
In case I_{OH} larger than this value is required, please design a unit in accordance with Fig. 3-(a), 3-(b) and 3-(c).

(Note 2) It is recommended that darlington type transistors ($V_{BE(SAT)}$ is less than 2V, h_{FE} is more than 500) be used as switching transistors (Tr_1 ~ Tr_4).

(Note 3) Please select proper input terminals depend on the type of mode to be used and input system and connect them in accordance with this catalog (Table-1, Fig.-6, Fig.-7) for use.

(Note 4) As for the excitation sequence of ϕ1 to ϕ4, please refer to Par. 5, excitation sequence, of this catalog.

PMM8713 has a built-in protective circuit at its input to prevent it from being damaged by high voltage and static electricity. However, it is very high in impedance, therefore, it should be used with great care exercised not to apply a voltage higher than its maximum rating. Especially in operation, it is required to be kept within such a range as $V_{SS} \leqq (V_{IN}, V_{OUT}) \leqq V_{DD}$.
Input terminals not in use should be connected to V_{SS} or V_{DD}.

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