Stepping Motor Drivers

Low Voltage Stepping Motor Drivers

BD6380EFV, BD6381EFV

No.12009EAT01

●Description

This series can drive the bipolar stepping motor used for paper feed carriages. It is a low power consumption bipolar PWM constant current-drive driver. It is suitable for the mobile devices of a battery drive by power save function. It contributes also to reduction of mounting area by ultra-thin and high heat-radiation (exposed metal type) HTSSOP package.

●Feature

1) Low ON resistance DMOS output
2) PWM constant current control (self oscillation)
3) Built-in spike noise cancel function (external noise filter is unnecessary)
4) Power save function
5) Built-in logic input pull-down resistor
6) Power-on reset function
7) Thermal shutdown circuit (TSD)
8) Over current protection circuit (OCP)
9) Under voltage lock out circuit (UVLO)
10) Malfunction prevention at the time of no applied power supply (Ghost Supply Prevention)
11) Electrostatic discharge: 4kV (HBM specification)
12) Adjacent pins short protection
13) Microminiature, ultra-thin and high heat-radiation (exposed metal type) HTSSOP package

●Application

Mini printer, Handy printer, Monitoring camera, WEB camera, Scanner, Toy, and Robot etc.

●Absolute maximum ratings(Ta=25℃)

Item	Symbol	BD6380EFV	BD6381EFV	Unit
Supply voltage VCC	V_{CC}	-0.2～+7.0	-0.2～+7.0	V
Supply voltage VM	V_M	-0.2～+15.0	-0.2～+15.0	V
Power dissipation	Pd	1.1※1	1.1※1	W
		4.0※2	4.0※2	W
Input voltage for control pin	V_{IN}	-0.2～(V_{CC} +0.3)	-0.2～(V_{CC} +0.3)	V
RNF maximum voltage	V_{RNF}	0.5	0.5	V
Maximum output current	I_{OUT}	0.8※3	1.2※3	A/ch
Operating temperature range	T_{opr}	-25～+75	-25～+75	℃
Storage temperature range	T_{stg}	-55～+150	-55～+150	℃
Junction temperature	T_{jmax}	150	150	℃

※1 70mm×70mm×1.6mm glass epoxy board. Derating in done at 8.8mW/℃ for operating above Ta=25℃.
※2 4-layer recommended board. Derating in done at 32.0mW/℃ for operating above Ta=25℃.
※3 Do not exceed Pd, ASO and Tjmax=150℃.

●Operating conditions (Ta=-25～+75℃)

Item	Symbol	BD6380EFV	BD6381EFV	Unit
Supply voltage VCC	V_{CC}	2.5～5.5	2.5～5.5	V
Supply voltage VM	V_M	4.0～13.5	6.0～13.5	V
Input voltage for control pin	V_{IN}	0～V_{CC}	0～V_{CC}	V
Output current (DC)	I_{OUT}	0.5※4	0.8※4	A/ch

※4 Do not exceed Pd, ASO

●Electrical characteristics

Applicable to BD6380EFV,BD6381EFV(Unless otherwise specified Ta=25℃, VCC=3.3V, VM=6.0V)

Item	Symbol	Limit			Unit	Conditions
		Min.	Typ.	Max.		
Whole						
VCC current at standby	I_{CCST}	-	0	10	μA	PS=L
VCC current	I_{CC}	-	1.6	3.0	mA	PS=H, VLIMX=0.5V
VM current at standby	I_{VMST}	-	0	10	μA	PS=L
VM current	I_{VM}	-	0.08	0.50	mA	PS=H, VLIMX=0.5V
Control input (PS, IN1A, IN1B, IN2A, IN2B)						
H level input voltage	V_{INH}	2.0	-	3.3	V	
L level input voltage	V_{INL}	0	-	0.8	V	
H level input current	I_{INH}	15	30	60	μA	V_{IN} =3V
L level input current	I_{INL}	-10	0	-	μA	V_{IN} =0V
Output (OUT1A, OUT1B, OUT2A, OUT2B)						
Output ON resistance (BD6380EFV)	R_{ON}	-	1.2	1.5	Ω	I_{OUT} =±0.3A, VM=6V Sum of upper and lower
Output ON resistance (BD6381EFV)	R_{ON}	-	1.0	1.25	Ω	I_{OUT} =±0.6A, VM=7.2V Sum of upper and lower
Output leak current	I_{LEAK}	-	-	10	μA	
Current control						
RNFX input current	I_{RNF}	-40	-20	-	μA	RNFX=0V
SENSEX input current	I_{SENSE}	-2.0	-0.1	-	μA	SENSEX=0V
VLIMX input current	I_{VLIM}	-2.0	-0.1	-	μA	VLIMX=0V
VLIMX input voltage range	V_{VLIM}	0	-	0.5	V	
Comparator offset voltage	V_{OFS}	-10	-	10	mV	
Noise cancel time	t_n	0.3	0.7	1.2	μs	R=39kΩ, C=1000pF
VREF voltage	V_{VREF}	0.97	1.00	1.03	V	I_{VREF}=0~1mA

●Terminal function・Block diagram・Application circuit diagram

1) BD6380EFV / BD6381EFV

Pin No.	Pin name	Function	Pin No.	Pin name	Function
1	GND	Ground terminal	13	RNF2	Connection terminal of resistor for output current detection
2	PS	Power save terminal			
3	VLIM1	Output current limit setting terminal	14	OUT2B	H bridge output terminal
4	SENSE1	Input terminal of current limit comp.	15	OUT2A	H bridge output terminal
5	CR1	Connection terminal of CR for setting PWM frequency	16	VM2	Power supply terminal for motor
			17	NC	Non connection
6	IN1A	Logic input terminal	18	IN2B	Logic input terminal
7	IN1B	Logic input terminal	19	IN2A	Logic input terminal
8	NC	Non connection	20	CR2	Connection terminal of CR for setting PWM frequency
9	VM1	Power supply terminal for motor			
10	OUT1A	H bridge output terminal	21	SENSE2	Input terminal of current limit comp.
11	OUT1B	H bridge output terminal	22	VLIM2	Output current limit setting terminal
12	RNF1	Connection terminal of resistor for output current detection	23	VREF	Reference voltage output terminal

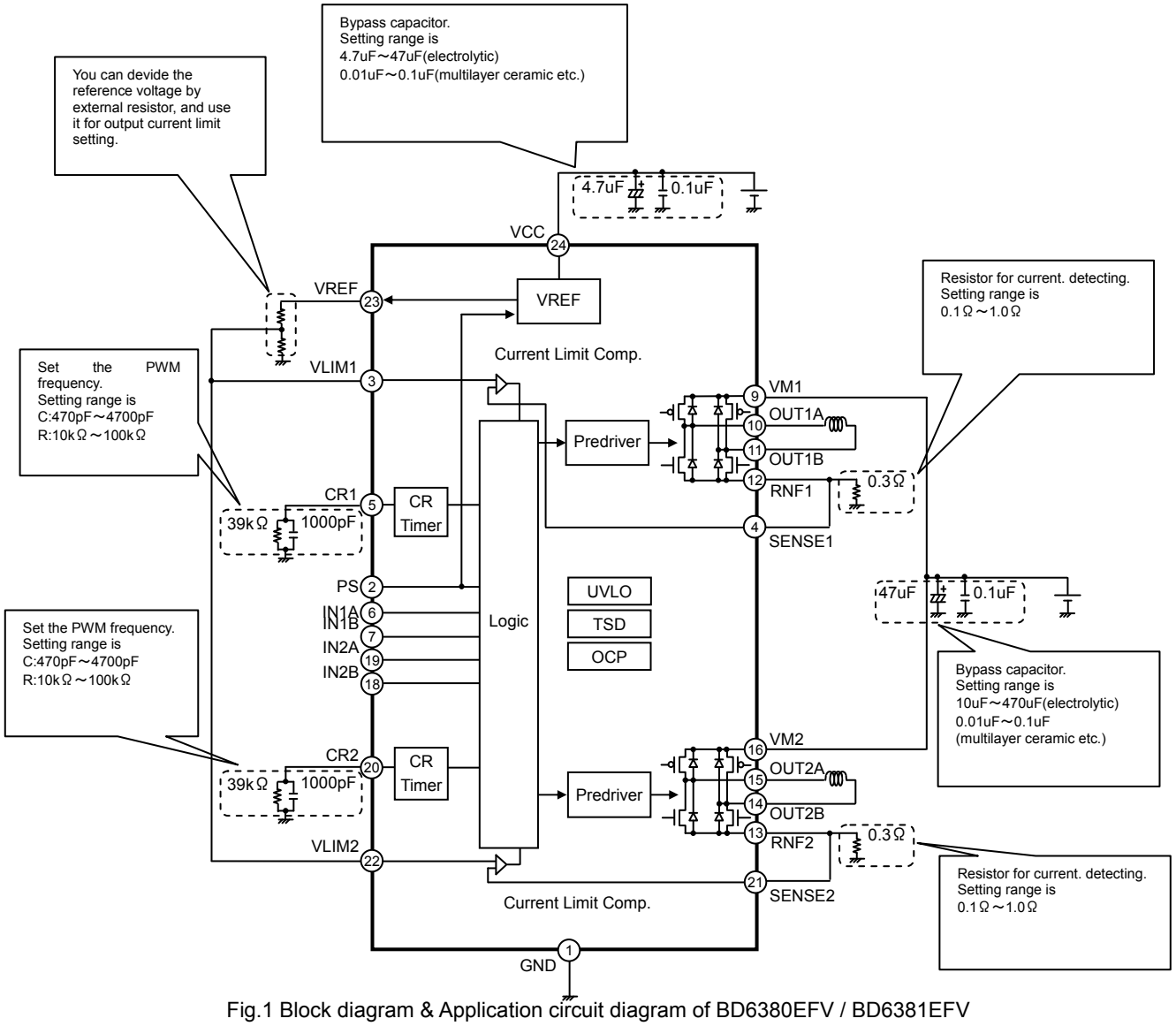


Fig.1 Block diagram & Application circuit diagram of BD6380EFV / BD6381EFV

●Points to notice for terminal description

○PS／Power save terminal

PS can make circuit standby state and make motor output OPEN. Please be careful because there is a delay of 40μs(max.) before it is returned from standby state to normal state and the motor output becomes ACTIVE at PS=L→H.
If you don't use power save mode, you may short PS terminal to VCC.

PS	State
L	Standby state (RESET)
H	ACTIVE

○IN1A,IN1B,IN2A,IN2B／Logic input terminal

These pins decide output state.

	Input		Output		
PS	IN1A IN2A	IN1B IN2B	OUT1A OUT2A	OUT1B OUT2B	
L	X	X	OPEN	OPEN	Standby state (RESET)
H	L	L	OPEN	OPEN	Standby
H	H	L	H	L	Forward
H	L	H	L	H	Reverse
H	H	H	L	L	Brake

X: H or L

●Protection Circuits

○Thermal Shutdown (TSD)

This IC has a built-in thermal shutdown circuit for thermal protection. When the IC's chip temperature rises above 175℃ (typ.), the motor output becomes OPEN. Also, when the temperature returns to under 150℃ (typ.), it automatically returns to normal operation. However, even when TSD is in operation, if heat is continued to be added externally, heat overdrive can lead to destruction.

○Over current Protection (OCP)

This IC has a built in over current protection circuit as a provision against destruction when the motor outputs are shorted each other or VCC-output or motor output-GND is shorted. This circuit latches the motor output to OPEN condition when the regulated threshold current flows for 4μs (typ.). It returns with VCC power reactivation or a reset of the PS terminal. The over current protection circuit's only aim is to prevent the destruction of the IC from irregular situations such as motor output shorts, and is not meant to be used as protection or security for the set. Therefore, sets should not be designed to take into account this circuit's functions. After OCP operating, if irregular situations continues and the return by power reactivation or a reset of the PS terminal is carried out repeatly, then OCP operates repeatly and the IC may generate heat or otherwise deteriorate. When the L value of the wiring is great due to the wiring being long, after the over current has flowed and the output terminal voltage jumps up and the absolute maximum values may be exceeded and as a result, there is a possibility of destruction. Also, when current which is over the output current rating and under the OCP detection current flows, the IC can heat up to over Tjmax=150℃ and can deteriorate, so current which exceeds the output rating should not be applied.

○Under voltage lock out (UVLO)

This IC has a built-in under voltage lock out function to prevent false operation such as IC output during power supply under voltage. When the applied voltage to the VCC terminal goes under 1.95V (typ.), the motor output is set to OPEN. This switching voltage has a 0.25V (typ.) hysteresis to prevent false operation by noise etc. Please be aware that this circuit does not operate during power save mode.

○False operation prevention function in no power supply (Ghost Supply Prevention)

If a logic control signal is input when there is no power supplied to this IC, there is a function which prevents the false operation by voltage supplied via the electrostatic destruction prevention diode from the logic control input terminal to the VCC, to this IC or to another IC's power supply. Therefore, there is no chance of malfunction of the circuit even when voltage is supplied to the logic control input terminal while there is no power supply.

●Power dissipation

○HTSSOP-B24 Package

HTSSOP-B24 has exposed metal on the back, and it is possible to dissipate heat from a through hole in the back. Also, the back of board as well as the surfaces has large areas of copper foil heat dissipation patterns, greatly increasing power dissipation. The back metal is shorted with the back side of the IC chip, being a GND potential, therefore there is a possibility for malfunction if it is shorted with any potential other than GND, which should be avoided. Also, it is recommended that the back metal is soldered onto the GND to short. Please note that it has been assumed that this product will be used in the condition of this back metal performed heat dissipation treatment for increasing heat dissipation efficiency.

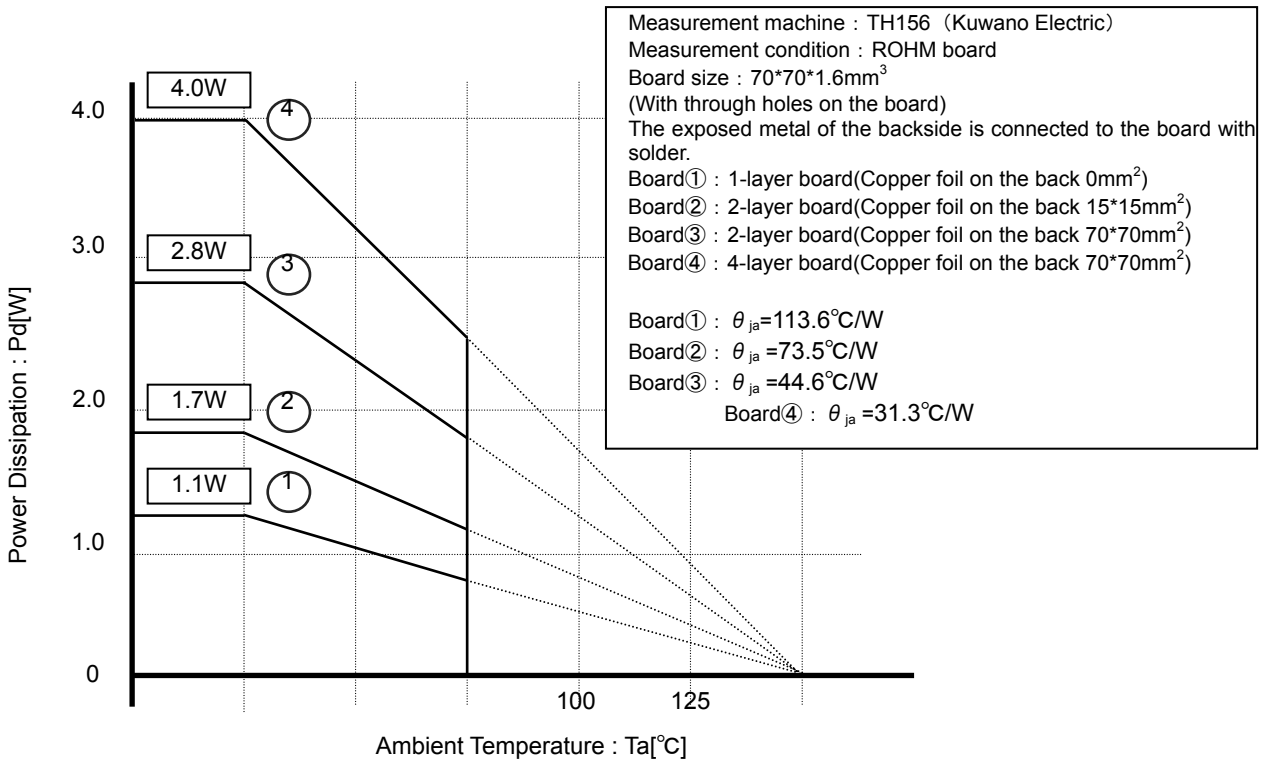


Fig.2 HTSSOP-B24 Derating curve

●Usage Notes

(1) Absolute maximum ratings

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

(2) Connecting the power supply connector backward

Connecting of the power supply in reverse polarity can damage IC. Take precautions when connecting the power supply lines. An external direction diode can be added.

(3) Power supply Lines

Design PCB layout pattern to provide low impedance GND and supply lines. To obtain a low noise ground and supply line, separate the ground section and supply lines of the digital and analog blocks. Furthermore, for all power supply terminals to ICs, connect a capacitor between the power supply and the GND terminal. When applying electrolytic capacitors in the circuit, not that capacitance characteristic values are reduced at low temperatures.

(4) GND Potential

The potential of GND pin must be minimum potential in all operating conditions.

(5) Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions. Users should be aware that BD6380EFV and BD6381EFV have been designed to expose their frames at the back of the package, and should be used with suitable heat dissipation treatment in this area to improve dissipation. As large a dissipation pattern should be taken as possible, not only on the front of the baseboard but also on the back surface.

(6) Inter-pin shorts and mounting errors

When attaching to a printed circuit board, pay close attention to the direction of the IC and displacement. Improper attachment may lead to destruction of the IC. There is also possibility of destruction from short circuits which can be caused by foreign matter entering between outputs or an output and the power supply or GND.

(7) Operation in a strong electric field

Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

(8) ASO

When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

(9) Thermal shutdown circuit

The IC has a built-in thermal shutdown circuit (TSD circuit). If the chip temperature becomes Tjmax=150℃, and higher, coil output to the motor will be open. The TSD circuit is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect or indemnify peripheral equipment. Do not use the TSD function to protect peripheral equipment.

TSD ON Temperature [℃] (typ.)	Hysteresis Temperature [℃] (typ.)
175	25

(10) Inspection of the application board

During inspection of the application board, if a capacitor is connected to a pin with low impedance there is a possibility that it could cause stress to the IC, therefore an electrical discharge should be performed after each process. Also, as a measure again electrostatic discharge, it should be earthed during the assembly process and special care should be taken during transport or storage. Furthermore, when connecting to the jig during the inspection process, the power supply should first be turned off and then removed before the inspection.

(11) Input terminal of IC

This IC is a monolithic IC, and between each element there is a P+ isolation for element partition and a P substrate.
This P layer and each element's N layer make up the P-N junction, and various parasitic elements are made up.
For example, when the resistance and transistor are connected to the terminal as shown in figure 3,

○When GND＞(Terminal A) at the resistance and GND＞(Terminal B) at the transistor (NPN),
the P-N junction operates as a parasitic diode.

○Also, when GND＞(Terminal B) at the transistor (NPN)
The parasitic NPN transistor operates with the N layers of other elements close to the aforementioned parasitic diode.

Because of the IC's structure, the creation of parasitic elements is inevitable from the electrical potential relationship. The operation of parasitic elements causes interference in circuit operation, and can lead to malfunction and destruction. Therefore, be careful not to use it in a way which causes the parasitic elements to operate, such as by applying voltage that is lower than the GND (P substrate) to the input terminal.

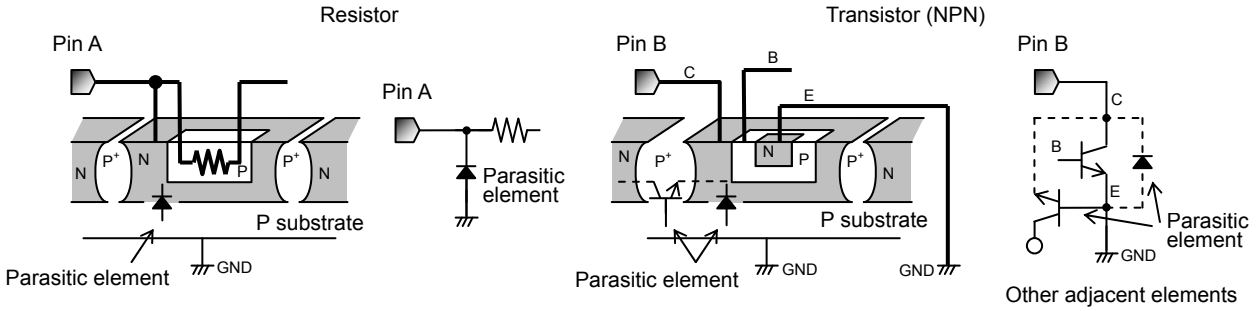


Fig.3 Pattern Diagram of Parasitic Element

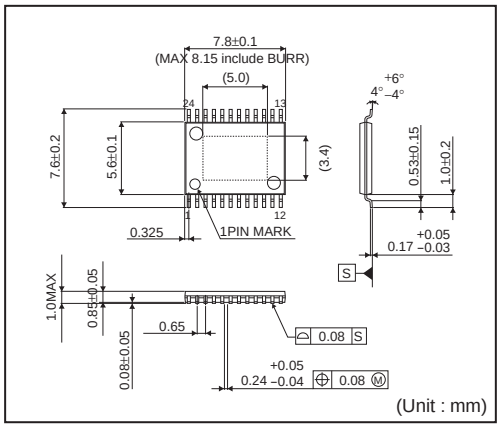
(12) Ground Wiring Patterns

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern potential of any external components, either.

●Ordering part number

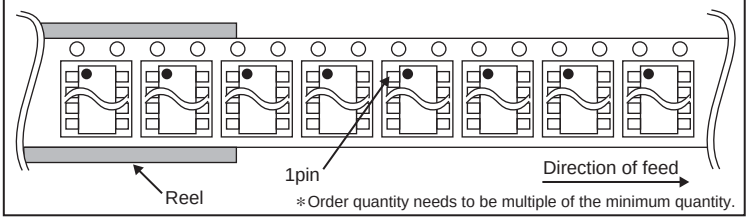
B D 6 3 8 0	E F V	-	E 2
形名	パッケージ EFV=HTSSOP-B24		包装、フォーミング仕様 E2: リール状エンボステーピング

HTSSOP-B24



<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

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