

SN11085 USB1.1 Flash memory Controller

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ver 0.97

1 General Description

SN11085 is a high-performance integrated circuit to bridge USB 1.1 interface and Flash memory. It provides a flexible and cost efficient single chip solution for external storage applications that intend to utilize the convenience of USB. Several special features are implemented for an efficient and low cost USB storage device solution. The embedded translation table eliminates external SRAM cost. The Sonix proprietary randomization algorithm effectively extends the lifetime of flash memory and ensures the product robustness. Embedded real time ECC correction keeps the data integrity while maintains the high data transfer rate.

The external serial EEPROM provides customized USB vendor ID, product ID, and string flexibility. In addition, the EEPROM can contain a serial number which helps the system manufacturers to track down every single device they made even the design and PID/VID are all the same. SN11085 also provides in system programming (ISP) capability of the EEPROM. Products can be assembled without programming the EEPROM in advance, which saves both the production cost and time. Device and manufacturer's string can be saved in the flash instead of the external EEPROM for further total cost reduction.

The USB Mass Storage Class compliance capability of SN11085 makes it a truly "plug-and-play" device without vendor drivers under Windows 2000/ME/XP and Mac OS 9/10. SN11085 provides PC boot up and data security function, which makes it an ideal replacement for the legacy floppy disk.

With many of its advanced features and high performance, SN11085 is an ideal choice for building a portable USB to flash storage system.

2 Features

- USB 1.1 full-speed compatible
- USB 1.1 Mass Storage Class compliant
- USB Mass Storage Class Bulk-Only Transport 1.0 supported
- USB Mass Storage Class SCSI transparent command set supported
- Customized VID, PID, serial number, and 28 characters of Vendor/Product/Revision string supported with external EEPROM
- EEPROM in system programmable (ISP) capability
- 28 characters of Vendor/Product/Revision string can be stored in flash for external EEPROM cost reduction
- Support Samsung and Toshiba NAND-type flash memory, from 4Mbytes to 128 Mbytes
- Real-time ECC correction circuit for data integrity and memory access speed acceleration
- Embedded SRAM for logical-to-physical address translation of NAND-type flash
- Up to 8 NAND type flash memories are supported
- Embedded FIFO for upstream and downstream data transfer
- Data transfer rate up to 1.5 MB/s (burst), 1.1 MB/s (read average),
- LED indicator pin
- PC boot up capability (host BIOS with USB ZIP boot up support is necessary)
- Flash disk security function provided, up to 12 characters of password for high sensitive data protection from illegally access
- ROM-type flash disk capability provided (permanent write protect)
- No Driver needed under Microsoft Windows ME/2000/XP, Mac OS 8.6/9.x/10.x
- Sonix Driver for Microsoft Windows 98
- Single 3.3V operation
- 48 pin LQFP package

3 Pin Assignment

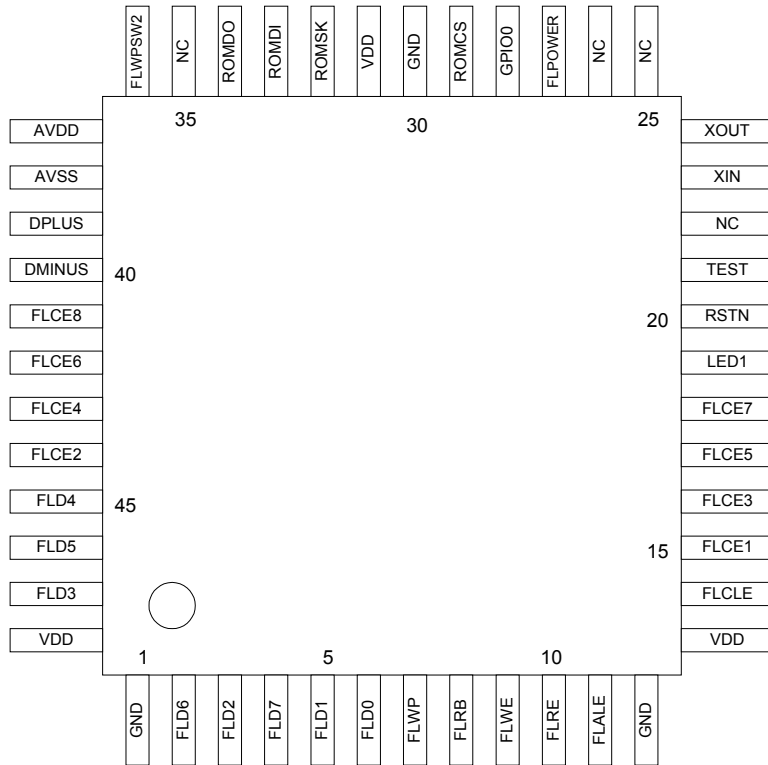


Table 1 SN11085 pin list

#	pin name	type	drive	special	description
1	GND	PWR			Digital ground
2	FLD6	DIO	8mA	PD	Flash memory I/O port bit 6
3	FLD2	DIO	8mA	PD	Flash memory I/O port bit 2
4	FLD7	DIO	8mA	PD	Flash memory I/O port bit 7
5	FLD1	DIO	8mA	PD	Flash memory I/O port bit 1
6	FLD0	DIO	8mA	PD	Flash memory I/O port bit 0
7	FLWP	DO	8mA		Flash memory write protect
8	FLRB	DI			Flash memory ready/busy
9	FLWE	DIO	8mA	PD	Flash memory write enable
10	FLRE	DIO	8mA	PD	Flash memory read enable
11	FLALE	DO	8mA		Flash memory address latch enable

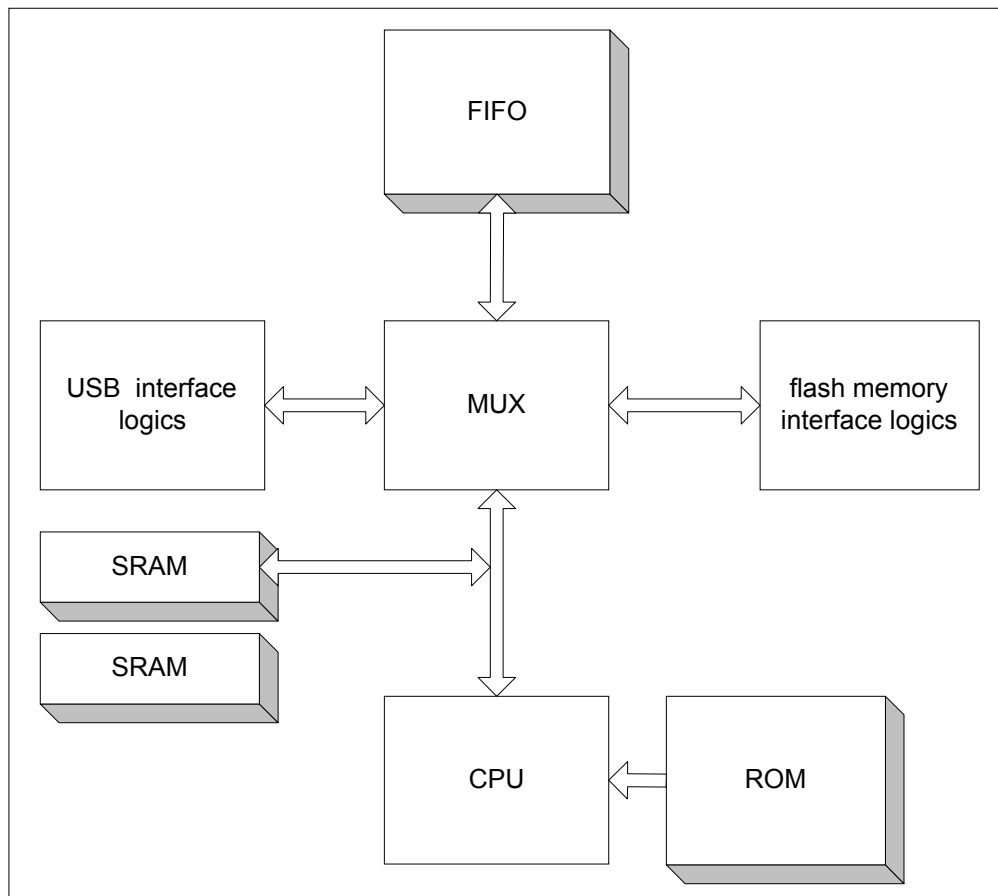
12	GND	PWR			Digital ground
13	VDD	PWR			Digital 3.3V
14	FLCLE	DO	8mA		Flash memory command latch enable
15	FLCE1	DO	8mA		Flash memory chip enable 1
16	FLCE3	DO	8mA		Flash memory chip enable 3
17	FLCE5	DO	8mA		Flash memory chip enable 5
18	FLCE7	DO	8mA		Flash memory chip enable 7
19	LED1	DIO	8mA	PD	LED1 lighter
20	RSTN	DI		PU	Chip reset, connected to external RC circuit
21	TEST	DI		PD	Test pin, NC in normal operation
22	NC	-	-		No Connect
23	XIN	I	-	-	Crystal input or oscillator input
24	XOUT	O	-	-	Crystal output or no connection
25	NC	-		-	No Connect
26	NC	-		-	No Connect
27	FLPOWER	DO	8mA	OC	Flash power control Normal mode – output L Power down mode – open collector, pull up externally
28	GPIO0	DIO	8mA		General Purpose Input/Output for internal test Always pull up for normal operation
29	ROMCS	DO	4mA		Chip select for external EEPROM
30	GND	PWR			Digital ground
31	VDD	PWR			Digital 3.3V
32	ROMSK	DO	4mA		Clock for external serial EEPROM
33	ROMDI	DO	4mA		Serial data to external EEPROM
34	ROMDO	DO	4mA		Serial data from external EEPROM, pull up externally if no EEPROM is connected
35	NC	-	-	-	No Connect
36	FLWPSW2	DI		PU	Flash write protect switch
37	AVDD	PWR			Analog 3.3V
38	AVSS	PWR			Analog ground
39	DPLUS	AIO	-	-	USB D+ signal
40	DMINUS	AIO	-	-	USB D- signal
41	FLCE8	DO	8mA		Flash memory chip enable 8

42	FLCE6	DO	8mA		Flash memory chip enable 6
43	FLCE4	DO	8mA		Flash memory chip enable 4
44	FLCE2	DO	8mA		Flash memory chip enable 2
45	FLD4	DIO	8mA	PD	Flash memory I/O port bit 4
46	FLD5	DIO	8mA	PD	Flash memory I/O port bit 5
47	FLD3	DIO	8mA	PD	Flash memory I/O port bit 3
48	VDD	P	-	-	Digital 3.3V

Note:

1. P: power pin; AI: analog input pin, AIO: analog input/output pin; DI: digital input pin; DO: digital output pin; DIO: digital input/output pin.
2. TTL: TTL compatible input pin; PD: pull down; PU: pull up.
3. All pads are Schmitt triggered and with slew rate control

4 Block diagram



5 Functional description

5.1 flash memory connection

Up to 8 NAND type flash memories from Samsung or Toshiba can be connected to SN11085, which automatically detects the number of flash memory and set up the related translation table upon power on. All flash memory shares the same I/O data pins and control pins except chip enable. Every flash memory must have its own independent chip enable control signal path (FLCE 1 to FLCE8). All flash memories connected to SN11085 must be of the same capacity, and it is suggested to connect

them with concatenated ascending order from FLCE1 to FLCE8. There is no special rule for the number of flash memory. (e.g. not necessarily to be the multiples of 2 or 4).

5.2 EEPROM format

An optional 93C46 EEPROM can be connected to SN11085 to override the default USB vendor ID and product ID. In addition, strings for vendor name and product name; and serial number (defined in mass storage device class) can be customized with this EEPROM content. It should be noted that the VID and PID values cannot be set to 0x0000 or 0xFFFF.

If 93C46 EEPROM is not detected by SN11085 after power on, default USB vendor ID (hex 0C45) and product ID (hex 1060) are returned to the host. In such case, ROMDO must be pulled high. (ROMDO pull high – no serial number, PID = hex 1060; ROMDO pulled low – with serial number, PID = hex 1030, default serial number = 0). Default string will be returned unless this information is replaced by the setting in flash memory. Writing string into the flash memory space is done by Sonix mass production tool software.

Table 2 EEPROM data format

Address Offset	Field	length	Value	Description
0	VID	Word	By customer	USB Vendor ID
1	PID	Word	By customer	USB Product ID (all 0s or all 1s are not allowed)
2	Serial Number 1 ~ 4	Word	By customer	USB Mass Storage Serial Number nibble 1 to 4
3	Serial Number 5 ~ 8	Word	By customer	USB Mass Storage Serial Number nibble 5 to 8
4	Serial Number 9 ~ 12	Word	By customer	USB Mass Storage Serial Number nibble 9 to 12
5 ~ 8	Vendor Name	8 bytes	By customer	The name of the manufacturer in ASCII format
9 ~ 16	Product Name	16 bytes	By customer	The name of the product in ASCII format
17 ~ 18	Firmware version	2 bytes	By customer	

The serial number format in the Mass Storage Class device descriptor is described in section 5.1.1.1 of the spec. If an external EEPROM is used, the following table

defines the relationship between the EEPROM value and the USB serial number string. If no EEPROM is connected, ROMDO must be pulled high to set “no serial number”.

Table 3 USB serial number data format

EEPROM nibble	USB Serial Number String	ASCII
0 through 9	0030H through 0039H	“0” through “9”
A through F	0041H through 0046H	“A” through “F”

Value of the lowest nibble (nibble 12) of the serial number is limited from 0 to 7. If the MSB of the lowest nibble (nibble 12) is 1, the serial number feature will be disabled and no serial number will be shown in the USB descriptor.

For a USB Mass Storage Class compliant device, the name of the manufacturer and product can be shown in the device manager of the OS (use Windows as an example) to distinguish products of the same type. The default vendor string of the SN11085 is “USB NAND”. The default product string is “FLASH DISK”. Therefore, the Windows will show “USB NAND FLASH DISK” when the default string is used. If the system manufacturers need strings other than default ones, they can put the strings they want in the EEPROM’s word 5 to 16, as shown in the table of first page.

5.3 software support

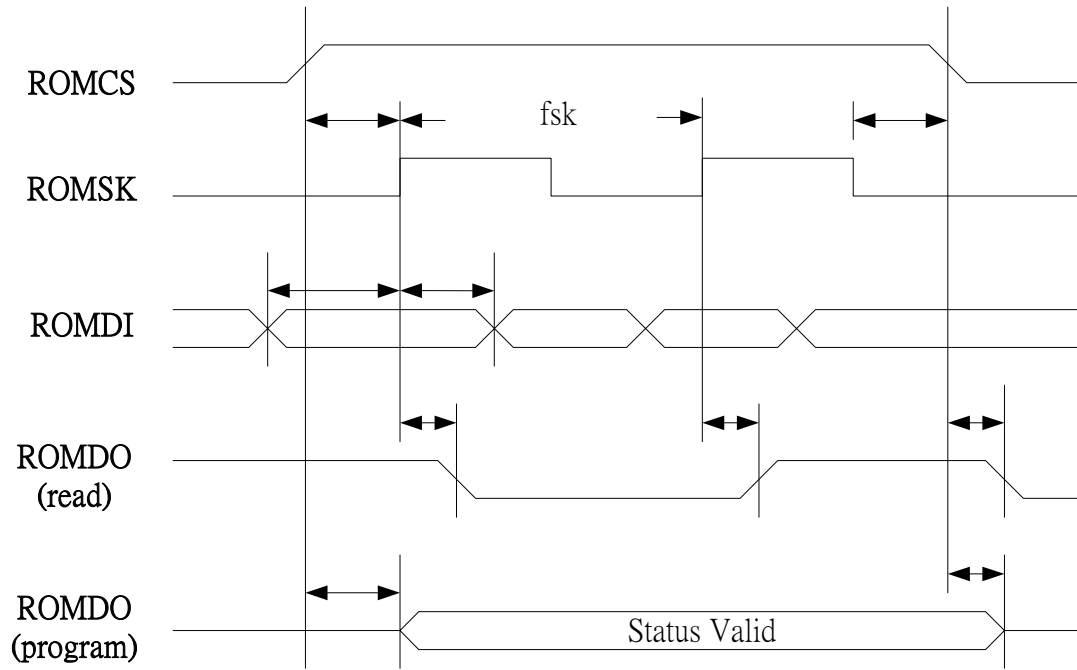
Sonix provides the following softwares to customers

- 1) Security driver for Win98/2000/Me/XP; boot up utility is included for Win98/Me
- 2) Mass production tool which provides the following function
 - i) Flash memory format
 - ii) File copy/compare for data validation
 - iii) Copying files into the flash memory which are to be delivered with the flash disk
 - iv) ISP of 93C46
 - v) Copying USB string into flash memory for customization

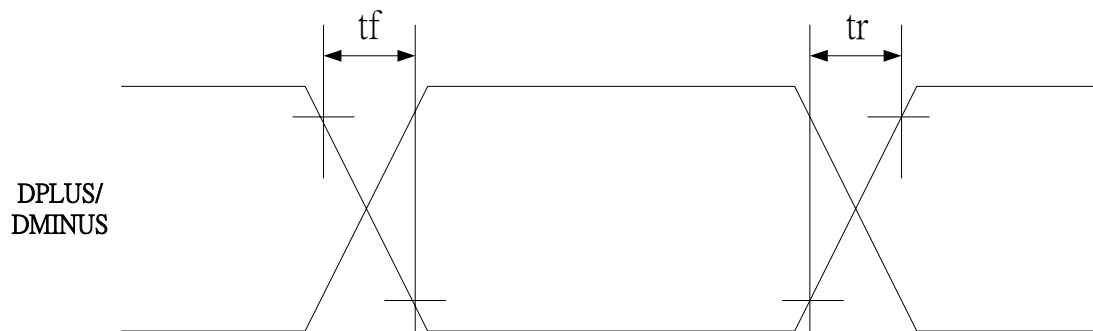
Security reset tool is only released to the manufacturers but not end users. The Security reset tool will need a dedicated username and password to activate.

6 Timing

6.1 EEPROM Interface



6.2 USB Interface



7 Operating rating and electrical characteristics

6.1 Absolute maximum rating

Table 4

symbol	parameter	Value	unit
Dvmin	min digital supply voltage	DGND – 0.3	V
Dvmax	max digital supply voltage	DGND + 4.6	V
Avmin	min analog supply voltage	AGND – 0.3	V
Avmax	max analog supply voltage	AGND + 4.6	V
Dvinout	voltage on any digital input or output pin	DGND –0.3 to 5.5	V
Avinout	voltage on any analog input or output pin	AGND –0.3 to Avdd + 0.3	V
T _{stg}	storage temperature range	-40 to +125	°C
ESD (HBM)	ESD human body mode C=100pF, R=1.5KΩ	5000	V
ESD (MM)	ESD machine mode	200	V
I _{off}	leakage current	10	uA
I _{latch}	minimum latch up current	100	mA

6.2 Operation conditions

Table 5

symbol	parameter	value	unit
DVdd	digital supply voltage	+3 to +3.6	V
Avdd	analog supply voltage	+3 to +3.6	V
T _A	operating ambient temperature range	0 to 70	°C
T _J	operating junction temperature range	0 to 115	°C

6.3 DC electrical characteristics

Table 6

symbol	parameter	test condition	value	unit
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V_{DI}	USB differential input sensitivity	$ (D+) - (D-) $	0.2 (min)	V
V_{CM}	USB differential common mode range	Included V_{DI} range	0.8 (min) 2.5 (max)	V
V_{SE}	USB single ended receiver threshold		0.8 (min) 2.0 (max)	V
V_{IH}	high level input voltage		2.0 (min)	V
V_{IL}	low level input voltage		0.8 (max)	V
V_{OH}	high level output voltage	$I_{OH} = -4$ mA	2.3 (min)	V
V_{OL}	low level output voltage	$I_{OL} = 4$ mA	0.5 (max)	V
I_{IL}	low level input current	$V_I = 0$ V	RSTN pin : - 50.0 (max) the other pins : - 3.0 (max)	μ A
I_{IH}	high level input current	$V_I = 3.6$ V	3.0 (max)	μ A
I_{DD}	input supply current		20 (max)	mA
$I_{suspend}$	supply current in suspend		20 (max)	μ A

6.4 AC electrical characteristics

6.4.1 USB transceiver signal (full speed mode)

Table 7

symbol	parameter	test condition	min	max	unit
T_r	transition rise time for DP or DM		4	20	ns
T_f	transition fall time for DP or DM		4	20	ns
T_{rfm}	rise / fall time matching	$(T_r / T_f) * 100$	90	110	%
$V_{o(crs)}$	signal crossover voltage		1.3	2.0	V

6.4.2 Operation clocks

Table 8

symbol	parameter	value	unit
USBCLKin	XI/XOUT crystal value	6 (typ)	MHz
	USBCLKin duty cycle	50 ± 2	%

6.4.3 External EEPROM interface

Table 9

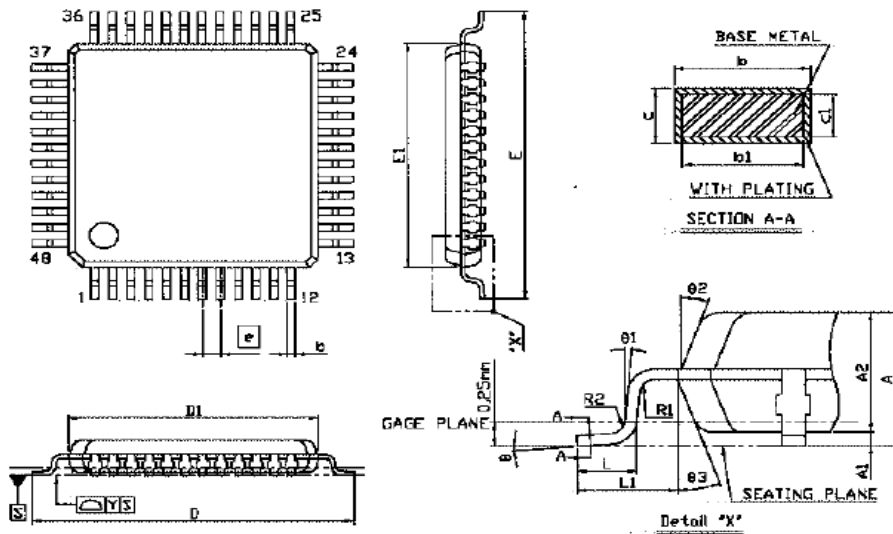
symbol	parameter	value	unit
Fsk	ROMSK pin clock frequency	200	kHz

6.5 Power consumption

Table 10

symbol	parameter	value	unit
Io_max	Max current in operation	20	mA
Is_max	Max current in suspend mode	TBD	uA

7. Packaging dimension



SYMBOL	DIMENSION (MM)			DIMENSION (MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A			1.60			63
A1	0.05		0.15	2		6
A2	1.35	1.40	1.45	53	55	57
b	0.17	0.22	0.27	7	9	11
b1	0.17	0.20	0.23	7	8	12
c	0.09		0.20	4		8
c1	0.09		0.16	4		6
D	9.00 BSC			354 BSC		
D1	7.00 BSC			276 BSC		
E	9.00 BSC			354 BSC		
E1	7.00 BSC			276 BSC		
e	0.50 BSC			20 BSC		
L	0.45	0.60	0.75	18	24	30
L1	1.00 REF			39 REF		
R1	0.08			3		
R2	0.08		0.20	3		8
Y			0.075			3
θ	0°	3.5°	7°	0°	3.5°	7°
$\theta 1$	0°			0°		
$\theta 2$	11°	12°	13°	11°	12°	13°
$\theta 3$	11°	12°	13°	11°	12°	13°

NOTE:

- REFER TO JEDEC MS-026/BBC
- DIMENSION D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE D1 AND E1 ARE MAXIMUM PLASTIC BODY SIZE DIMENSION INCLUDING MOLD MISMATCH.
- DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08mm.
- ALL DIMENSIONS IN MILLIMETERS.



8 Version Control

Draft	Apr-29-2002	
0.1	June-17-2002	
0.2	Dec-25-2002	modify the EEPROM content description



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