

1

USB

&

渡辺 明植

USB

USB 1 (1 2) ()

가 USB

가

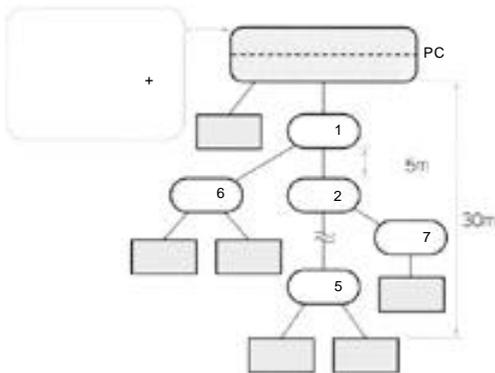
가

USB

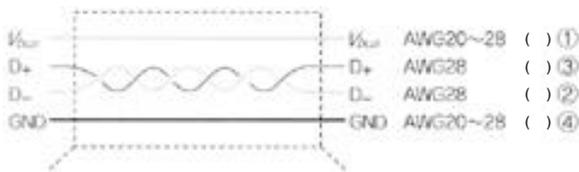
127

USB

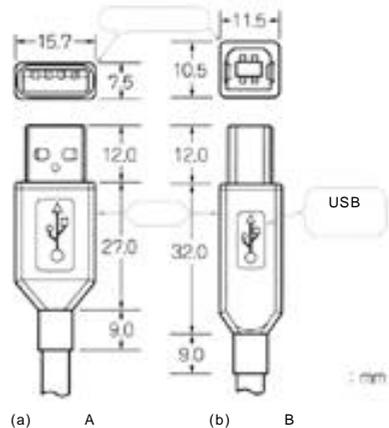
USB 2 1 (D₊ D₋) (V_{bus}), (GND) 4



1. USB



2. USB



3. USB

D₊ D₋

USB

가

가 3m

+5V

500mA

3 USB

()

A

가

B

()

)

USB

가

CPU

USB

가

6

4 USB

5

6

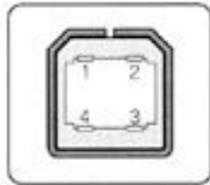
FIFO

USB

가



(a) A

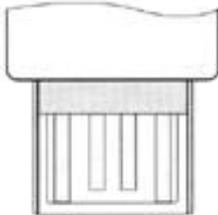


(b) B

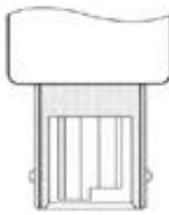
1	Vbus
2	D-
3	D+
4	GND

(c)

4. USB

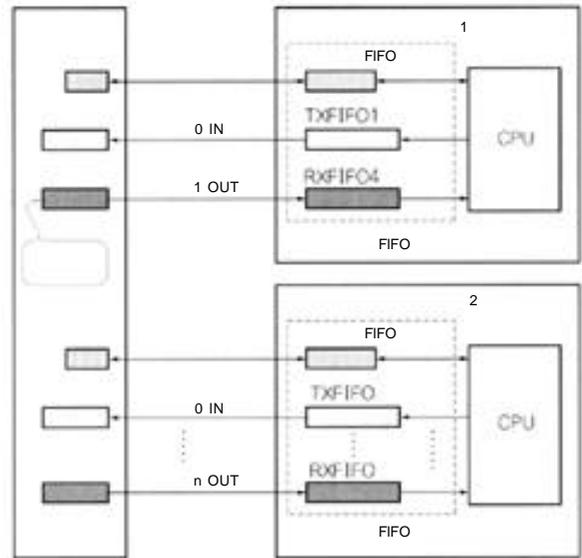


(a) A



(b) B

5. USB



6.

USB

가 (USBN 9602)

가

0

가

8

가

FIFO

OUT ()

), IN

IN

FIFO

OUT

()

가

USB

가

USB

가

7 USB

(OUT)



가

6

OUT

USB

FIFO가

가

가

FIFO

가

, ACK()

1 1

(FIFO가

가

)

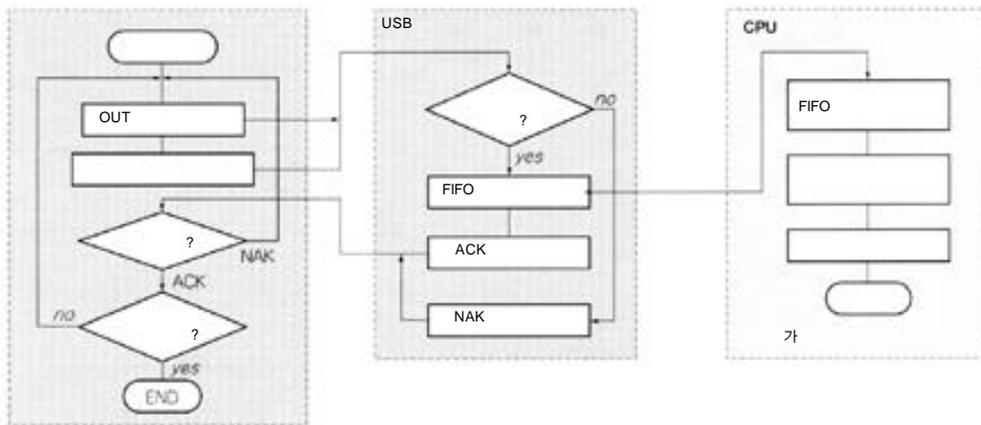
가

가

NAK

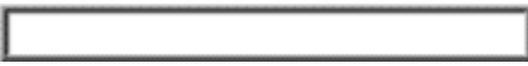
0

()



7.

ACK 가
 가 가
 NAK
 USB 가
 CPU가
 USB 가
 CPU FIFO
 CPU FIFO
 [/s]
 가 가
 USB 가
 가
 SOF(Start Of Frame)
 , CRC(Cyclic Redundancy Check)
 USB
 (10^{-10})
 -USB
 가



USB 4

2.

USB

1.

	△	○	○
	○	○	△
	○	○	○

2.

	12 Mbps	12 Mbps	1.5 Mbps/12 Mbps	1.5 Mbps/12 Mbps
	1 ms ()		$Nms(N=1-255)$	
1	1-1023	8/16/32/64	1 64 () 1 8 ()	1 64 () 1 8 ()

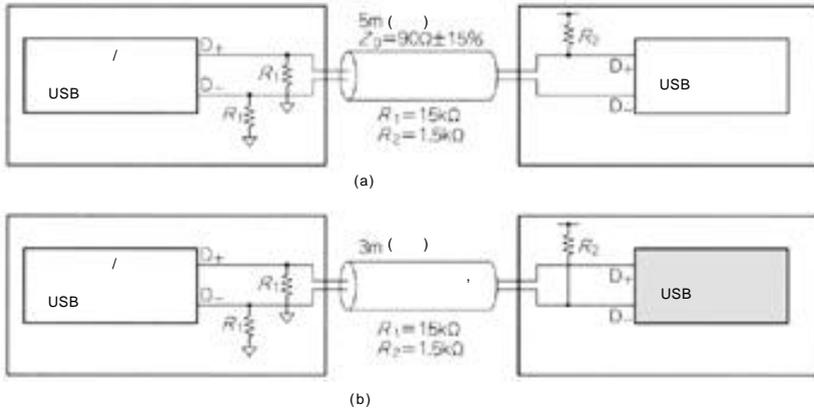
3.

	(USB2.0)	(USB1.1)	(USB1.1)
[Mbps]	480	12	1.5
[]	1~64	1~64	1~8
	1~3072	1~64	1~8
	1~512	1~64	-
	1~3070	1~1023	-

4.

"1"	$D_+ - D_- > 200\text{ mV}$
"0"	$D_- - D_+ > 200\text{ mV}$
J	: "0" : "1"
K	: "1" : "0"
(Idle)	: $D_- > V_{\text{thz(Idle)}}, D_+ < V_{\text{thz(Idle)}}$: $D_+ > V_{\text{thz(Idle)}}, D_- < V_{\text{thz(Idle)}}$
SOP ()	K Idle → K

8.



가

가

가

USB1.1

가

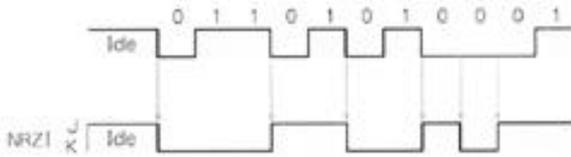
3.

4.

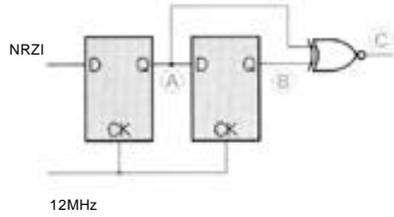
)

(
USB

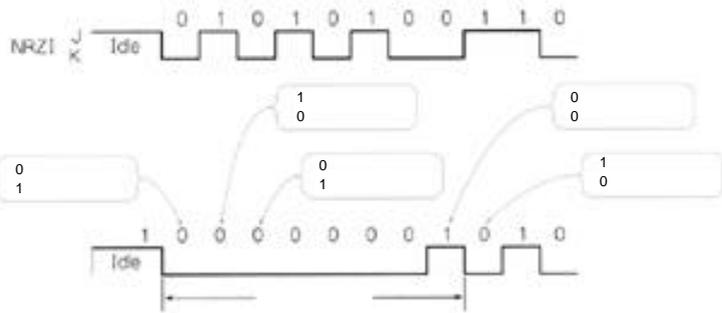
9. NRZI



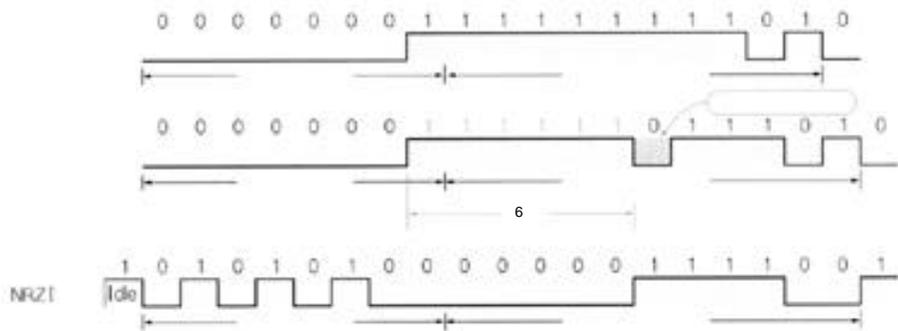
11. NRZI



10.



13.



가

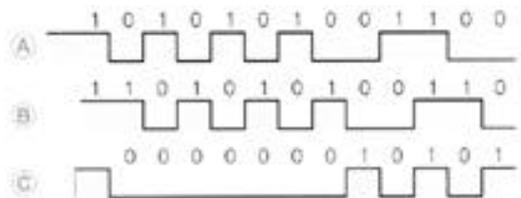


USB1.1

2가 가

가

3



12.

1.5Mbps

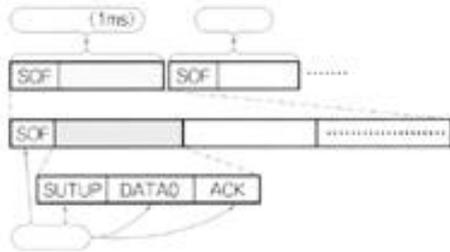
가

8 USB

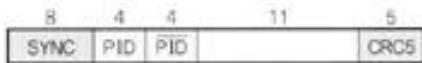
D_+, D_- 15k

D_+ 1.5k D_- 3.0 3.6V

3V 가



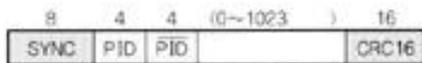
14. / /



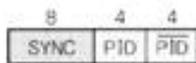
(a) SOF



(b)



(c)



(d)

15.



USB , 4

D_+, D_-

D_+ 가 0.2V

"1"

D_+

D_-

J

K

J

"0"

"1"

가

9

NRZI

(Non Return to Zero Invert)

NRZI

가 "1"

가 "0"

NRZI

10

()

NRZI가 "0"

"1" "0"

"1"

"0"

"0"

"0"

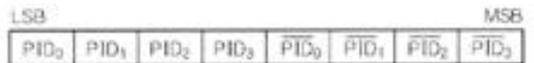
"1"

"0"

80h가

5. PID

PID	PID	PID(3:0)	
	OUT	0001	
	IN	1001	
	SOF	0101	
	SETUP	1101	
	DATA0	0011	PID
	DATA1	1011	PID
	ACK	0010	
	NAK	1010	가
	STALL	1110	
	PRE	1100	



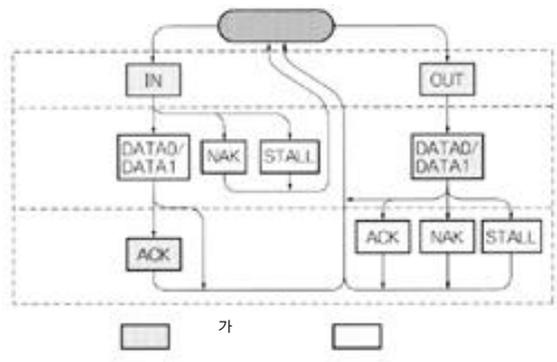
16. PID

11
 가
 "1" 가
 (slit)
 13 "1" 6
 "0" NRZI
 "1" 6
 "0" "1" 7
 가



USB 14
 USB

1ms
 SOF
 가 SOF



17. /

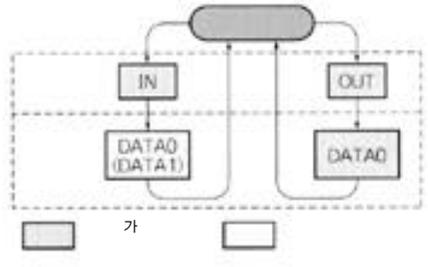
1. USB
 15 SYNC ((種別)
) (定型)
 PID(ID:Packet Identifier)
 , 80h가
 PID 3가
 PID 4 5 10 가
 , 16 PID 8 4
 4 "1" "0"
 가

CRC가 가
 가

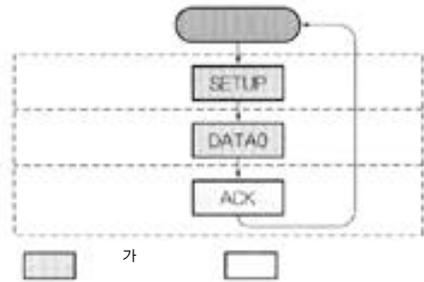
(1) SOF(Start Of Frame)
 . SOF 1ms 가

15(a) SOF . PID(A5h)
 11 (0 7FFh) 가 . CRC

5
 (2)



18.



19. SETUP

OUT, IN, SETUP 15(b)
 SYNC, PID, ADDR, ENDP, CRC5 5가

IN ADDR, ENDP

, OUT

. SETUP

SETUP

(3)

15(c) SYNC, PID, DATA, CRC16

4가

0 1023

PID DATA0, DATA1 2 가

가

(4)

15(d) SYNC PID ,

. PID ACK,

NAK, STALL 3 가 .

ACK

IN 가, OUT ,

가 .

NAK 가

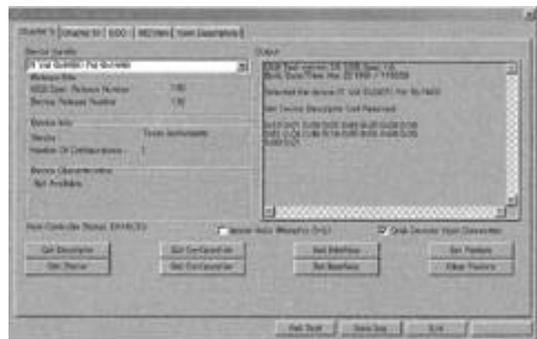
가 OUT

IN

NAK

6.

Audio Interface	0x00	0x01
	0x02	---
HID	0x00	0x03
	0x09	0x09
	0x00	0x08
	HID	HID
	---	0x07



20. USBCheck. exe

NAK

STALL

IN OUT

가 가 가 .

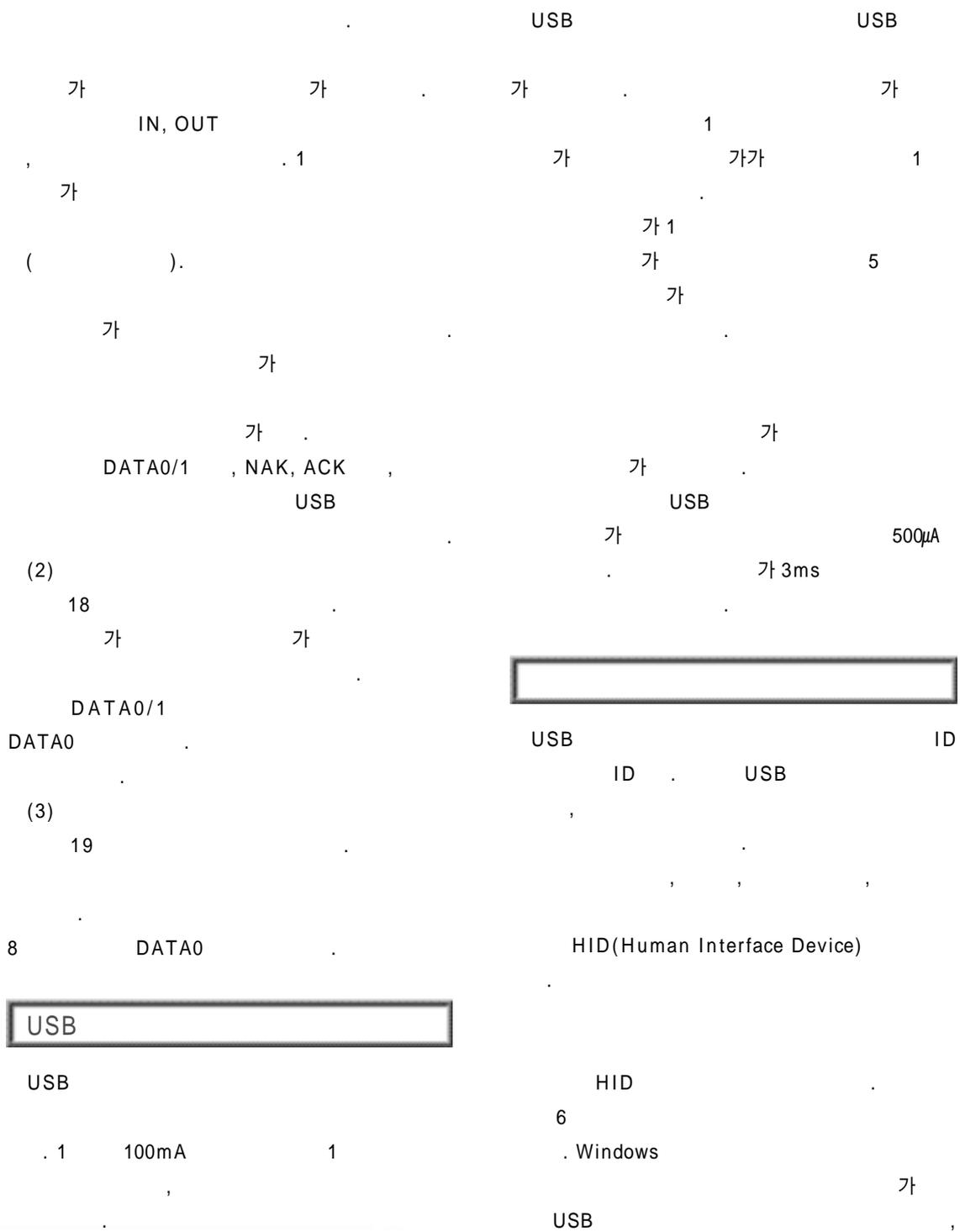
, 가 .

2.

, , 4 가 .

(1) /

17



HDD,

Windows

[Empty box]

USB2.0

가 USB

가, () 가 가

USB

20 USBCheck Version 2.0

Version 3.2, Windows98

SE

Get

Descriptor

가

USB

USB

가

가

USBCheck

USB

가

USBCheck

가

, USB

가

가

USB

가

USBCheck OS

OS

USB

ON/OFF,

가

(USB

)

USB2.0 1999 10

480Mbps()

USB1.1

USB1.1

1. USB2.0

USB1.1

USB1.1

가

480Mbps USB1.1

12Mbps 1.5Mbps

가

2.

125µs

가

512

3072

3.

“ Ping Flow Control ”, “ Split Transaction ” 가 . 2000 PDK

(Peripheral Development Kit)

가

USB2.0

가



게재된 기사는 본지의 웹사이트를 통해서도 보실 수 있습니다.

<http://www.chomden.co.kr>