

# SoC Robot Brain Board – uClinux

*System Design Innovation & Application Research Center*

- I. SoC Brain Board **개발환경**
- II. **개발환경** 세팅
- III. **개발** Tools **설치**
- IV. OS Porting
- V. Device drivers
- VI. Application SW

# Intelligent SoC Robot Algorithm

**SDIA**

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Wearable Computer,  
and Bio/Health!

**ROBOTWAR**

**adc**

**ALTERA**

**MINI ROBOT** (주)미니로봇

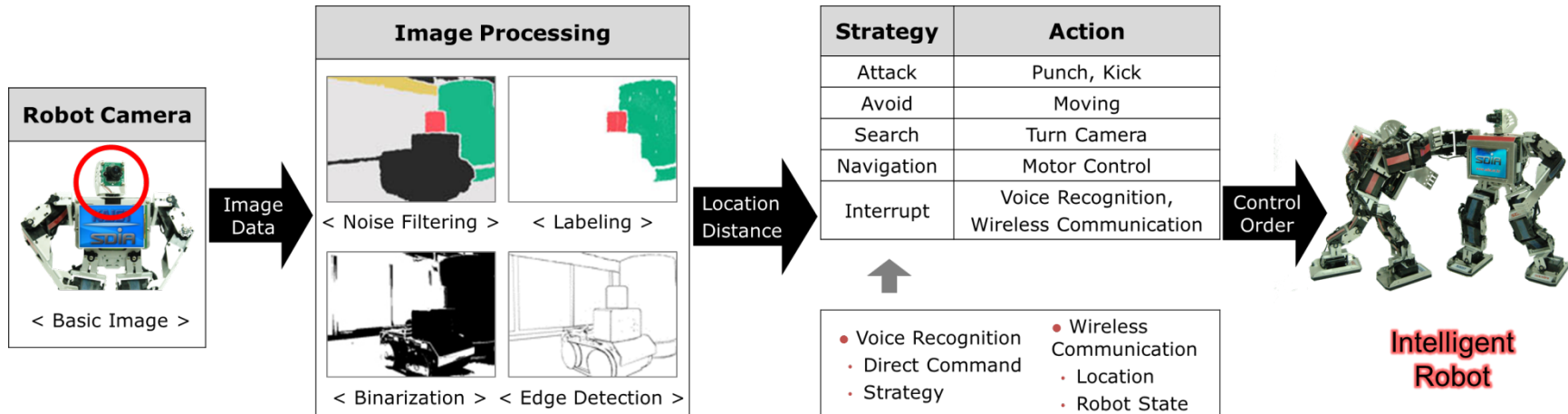
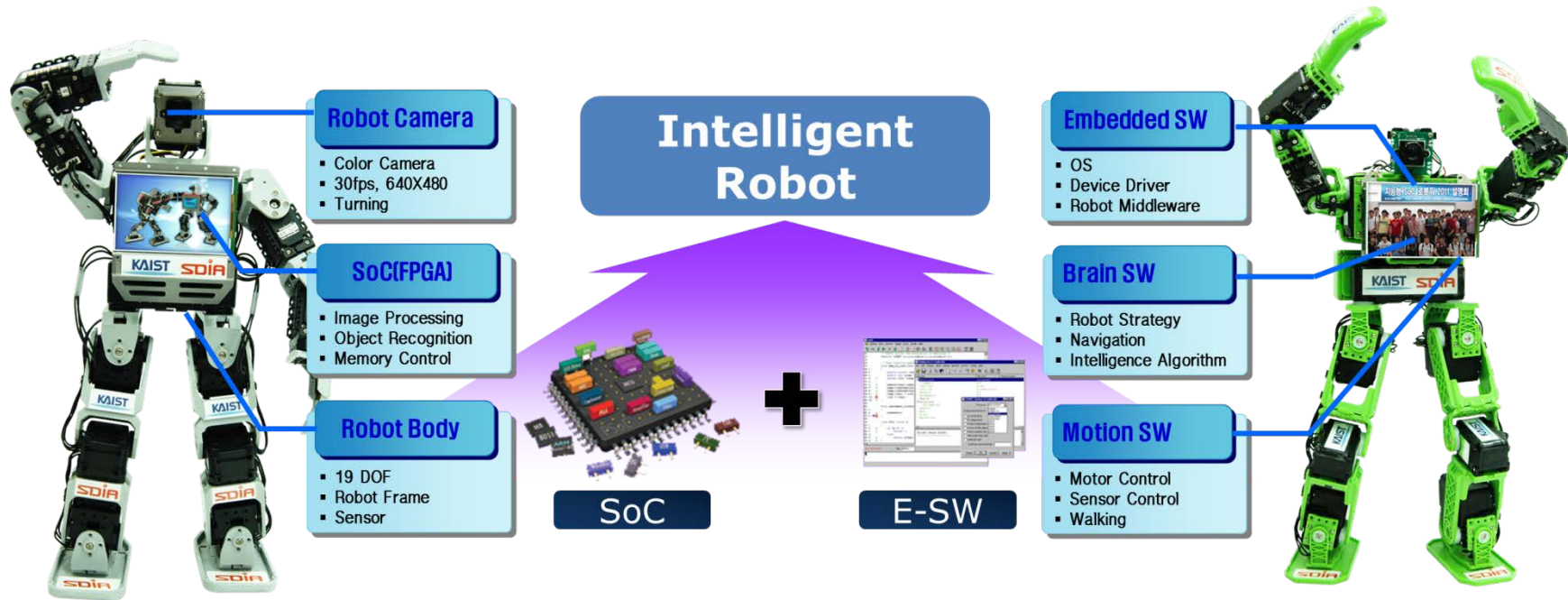
**ROBOTIS**

**DS7 Robot**  
디에스티로봇

**인터보드**

**IDEC** 반도체설계교육센터  
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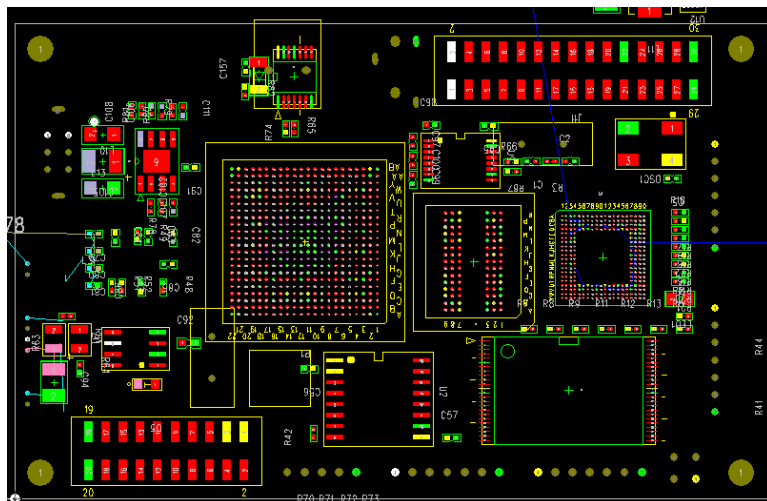
DS7 Robot 디에스티로봇

인터보드

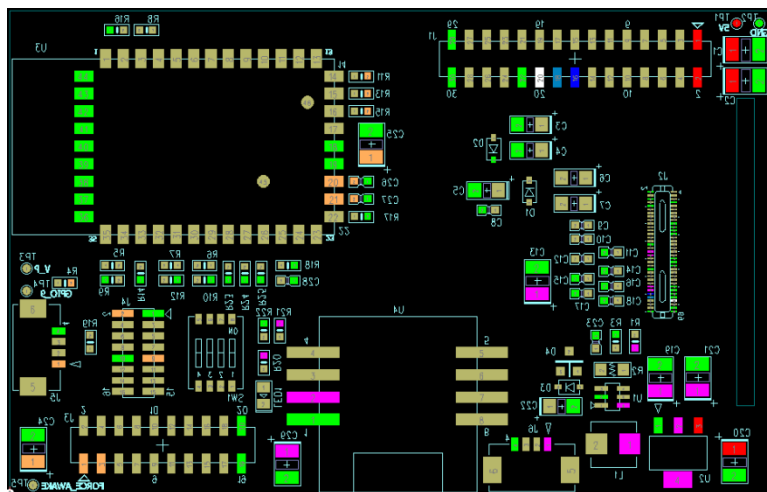
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Main Board



LCD/RF Module



Item	Specification
MCU	ADChips Eagle (EISC CPU)
Memory	SDRAM - 64MB NAND Flash - 64MB
FPGA	Altera Cyclone □ – EP4CE75 Altera EPCS64
Video Decoder	SAA7111A
UART	1 Port RS232C – PC 1 Port TTL Level – Robot
USB	1 Port – Mini USB
Camera Input	1 Port – 3Pins
Display	3.5Inch TFT- LCD (320 X 480)
WIFI	G2 micro systems
Bluetooth	Option
GPIO	10Pins (Sensor Interface)
Size	87mm X 55mm

# Brain Board (Main Board)

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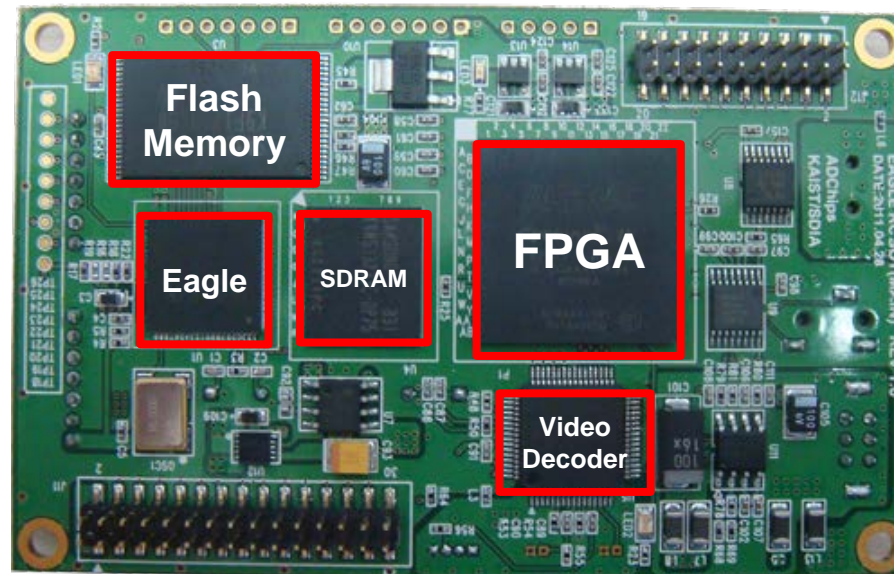
**DS7 Robot**  
디에스티로봇

**인터보드**

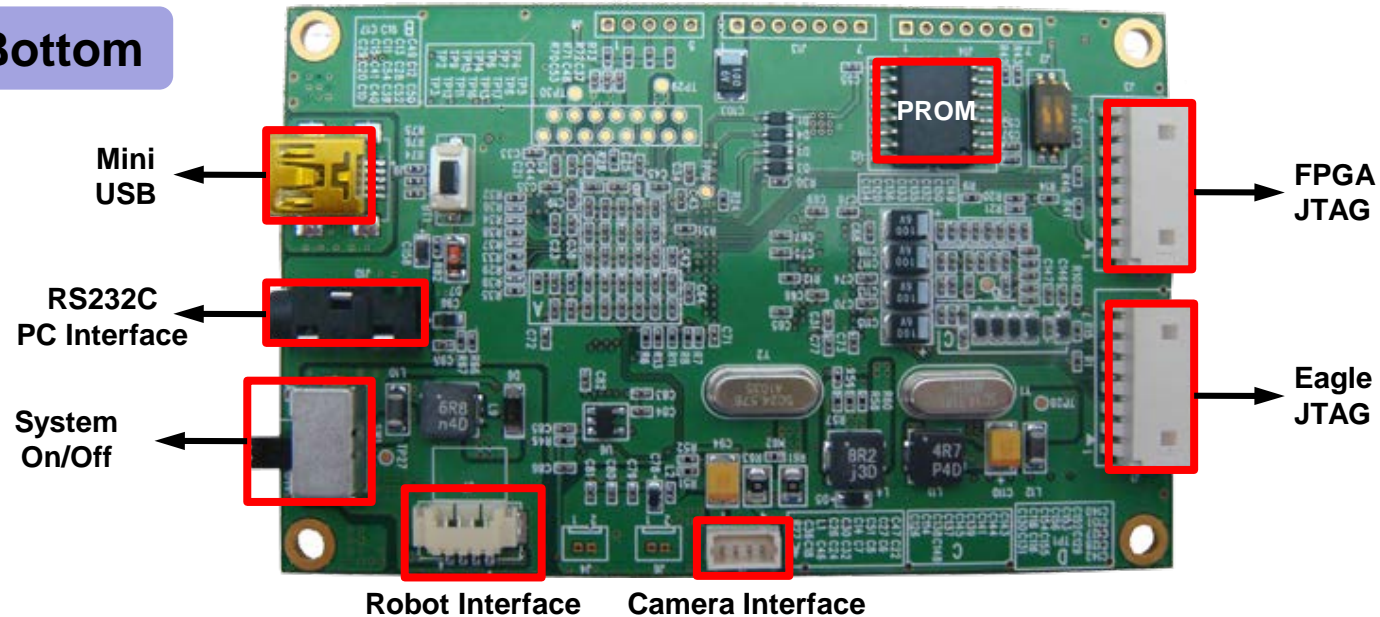
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**Top**



**Bottom**







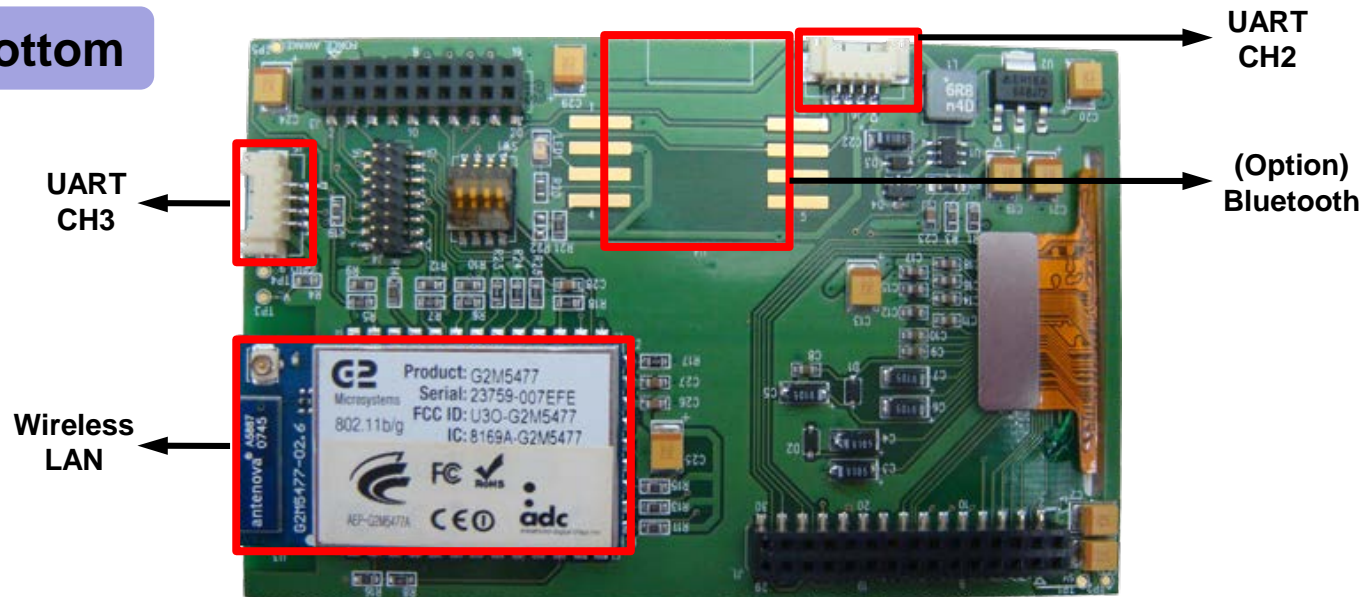
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Top



Bottom



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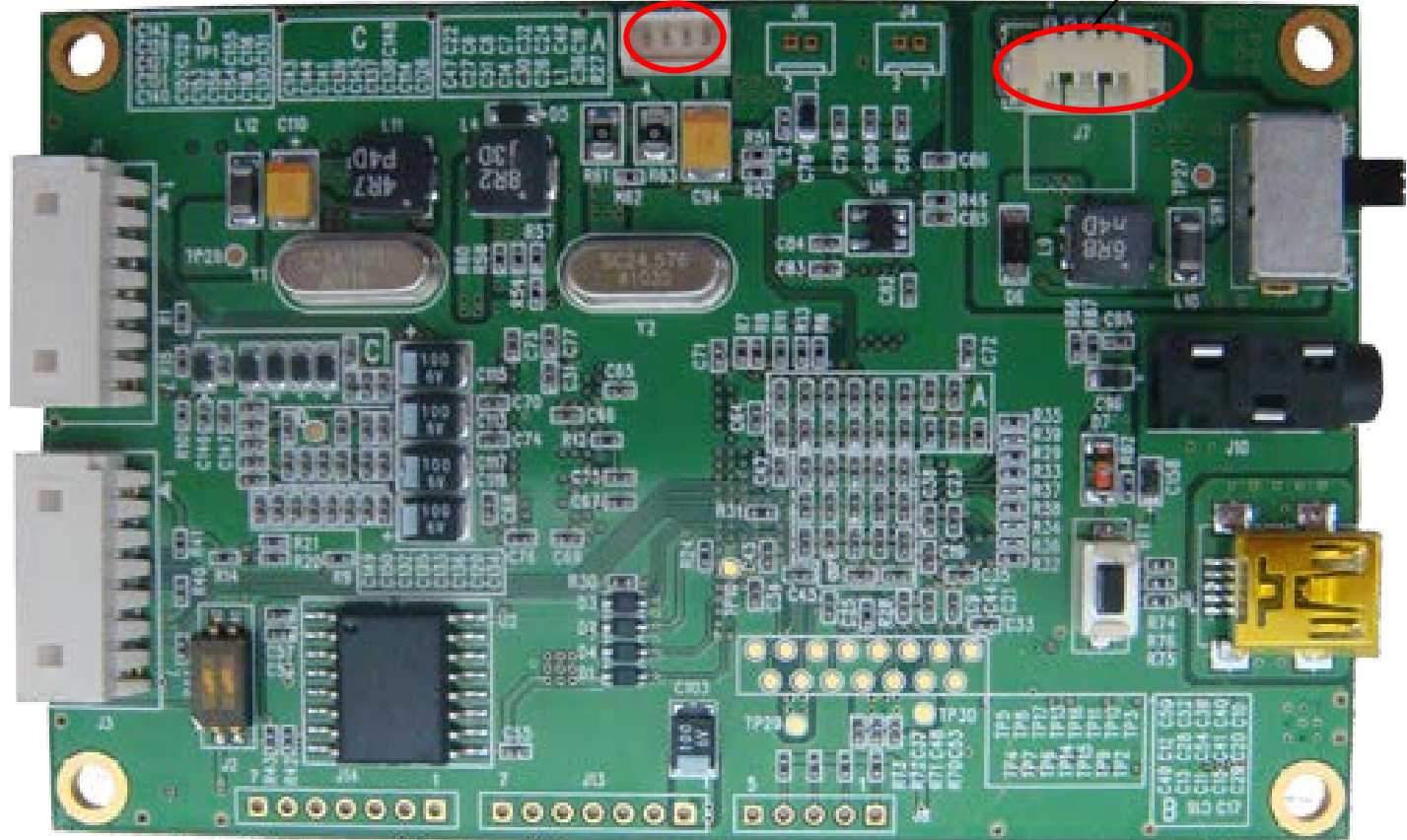
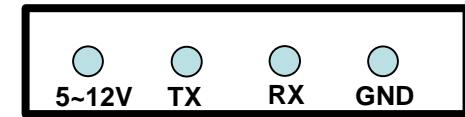
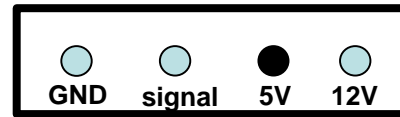
**DS7 Robot**  
디에스티로봇

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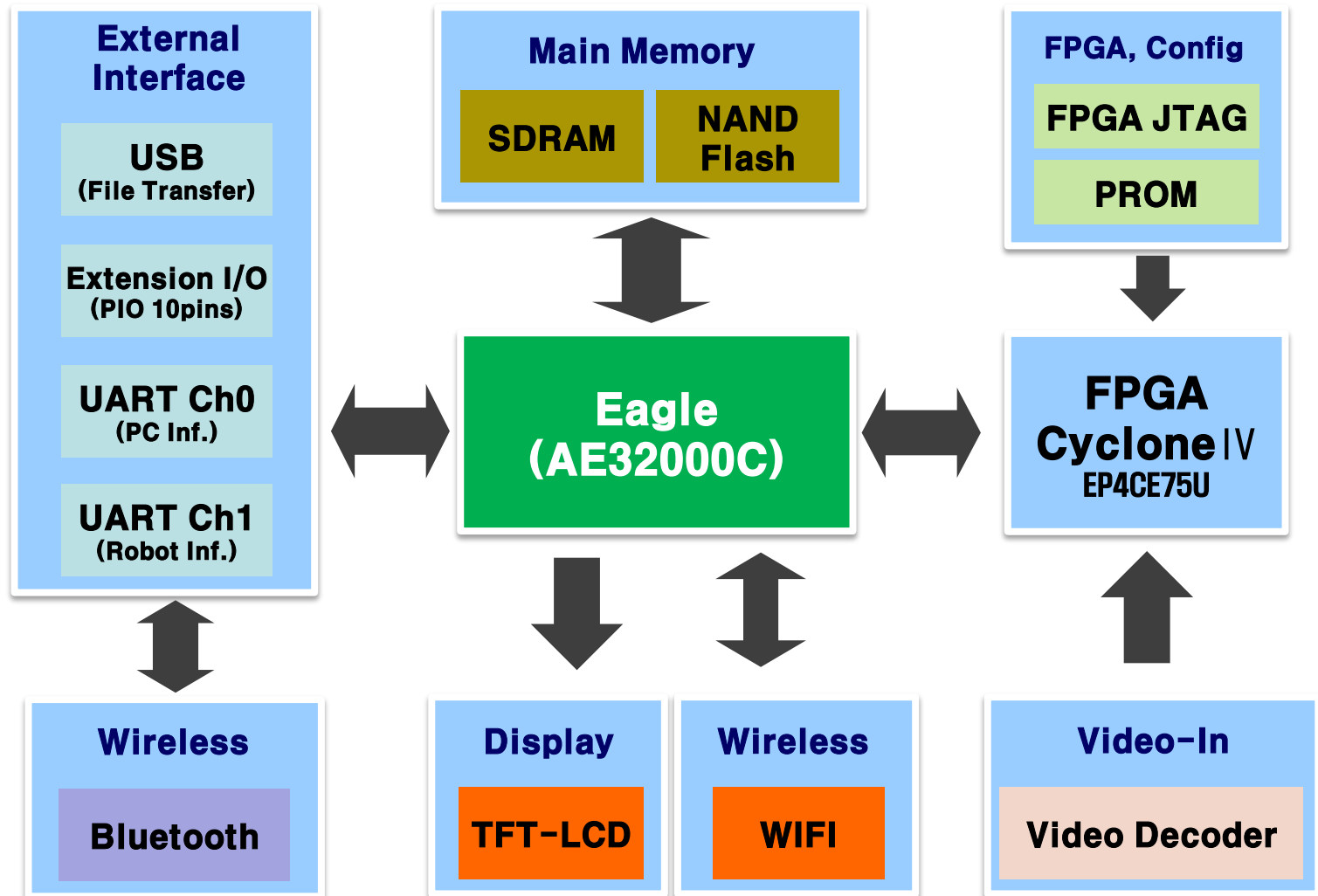
## 커넥터 핀정보



# Brain Board Block Diagram



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## Hardware

- PC
- SoC Brain Board
- RS-232C Cable(Serial Cable)
- USB Cable
- DC 5V Power Adapter (2A)
- NTSC 출력 Camera (12V)

## Software

- OS: Windows XP, 7, 8
- Cygwin (gcc operation environment)
- ECOMI (AE32000 Compiler)
- USB Download Program, USB Driver
- Hyper Terminal



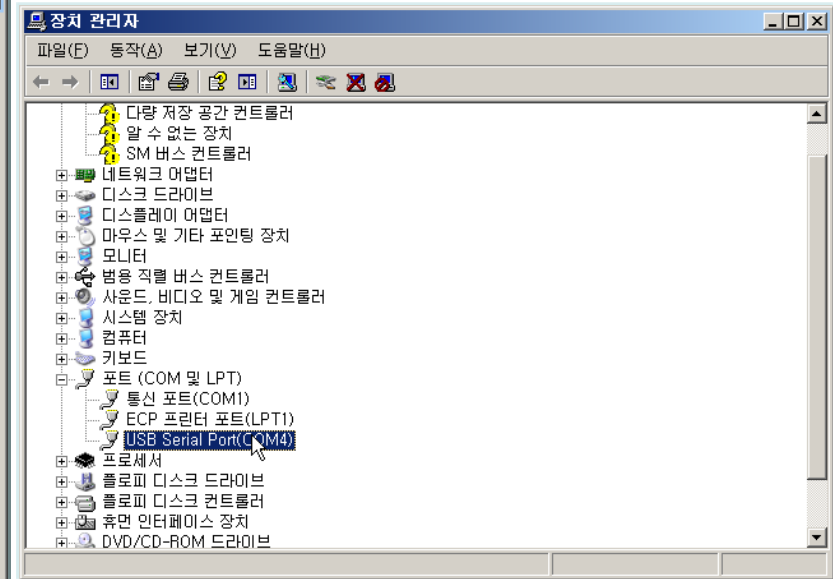
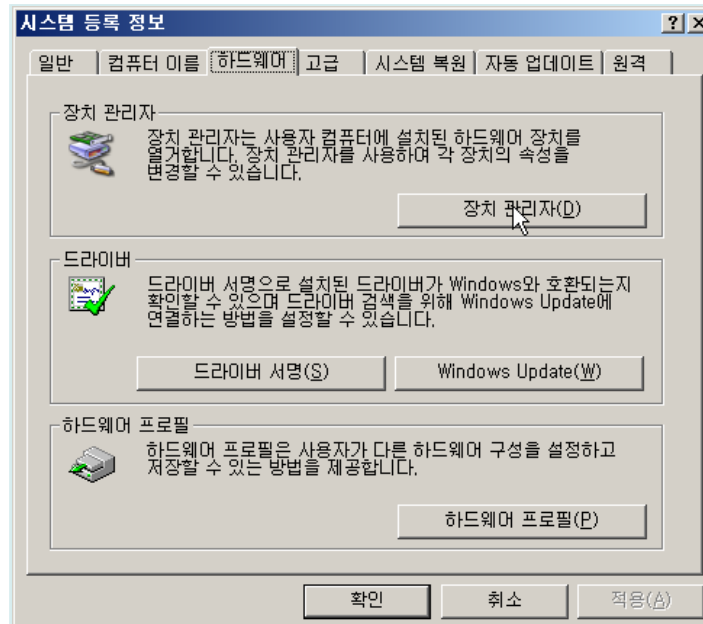


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## Port 설정

- USB-to-Serial Cable PC 연결 (Drive 설치)
- USB-to-Serial 포트 설정  
내컴퓨터 -> 등록정보 -> 하드웨어 -> 장치관리자 -> 포트



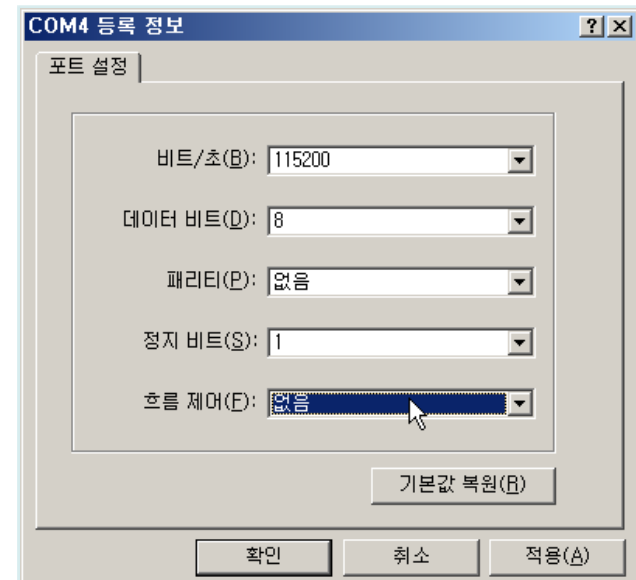
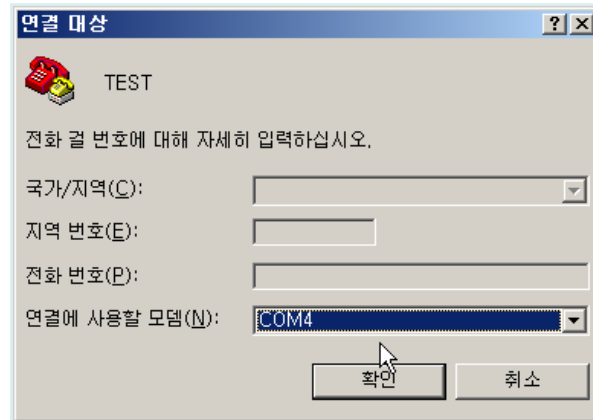


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## Port 설정

- 비트/초: 115200
- 데이터 비트: 8
- 패리티: 없음
- 정지 비트: 1
- 흐름 제어: 없음





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## Cygwin download

- ADChips 홈페이지 자료실 접속  
<http://www.adc.co.kr/support/data.asp>
- Cygwin 설치파일 저장

자료실

SUPPORT

대한민국의 에이다칩스(adc)가 뜨거운 열정으로 세계 반도체산업 중심이 되겠습니다.

ADC advanced digital chips inc.

제목	Cygwin 설치 파일 (08/06/19 updated)		
글쓴이	관리자	[2006-08-29 오후 2:24:38]	TOP ▲
파일저장	파일없음		

Items	Descriptions	Etc.	Download
Cygwin Source	Cygwin installation file	2008/06/19 updated	Download

원 글:

EISC-Studio (통합개발환경)(2011/03/08 Re-Updated)

목록보기

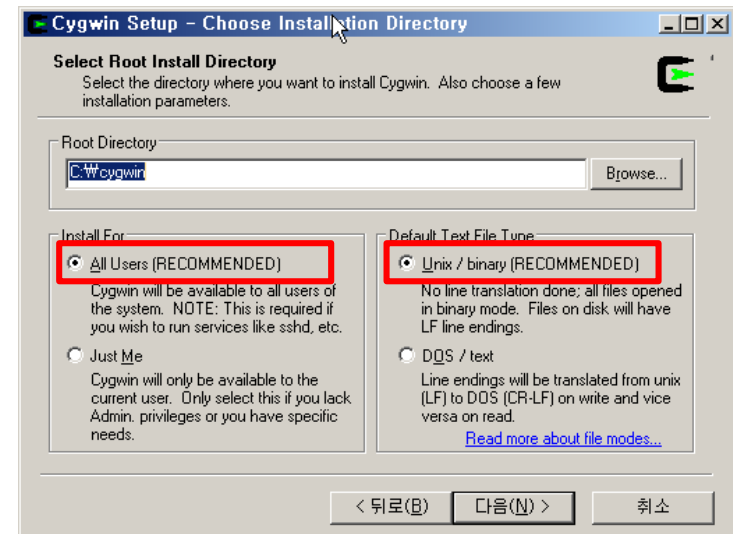
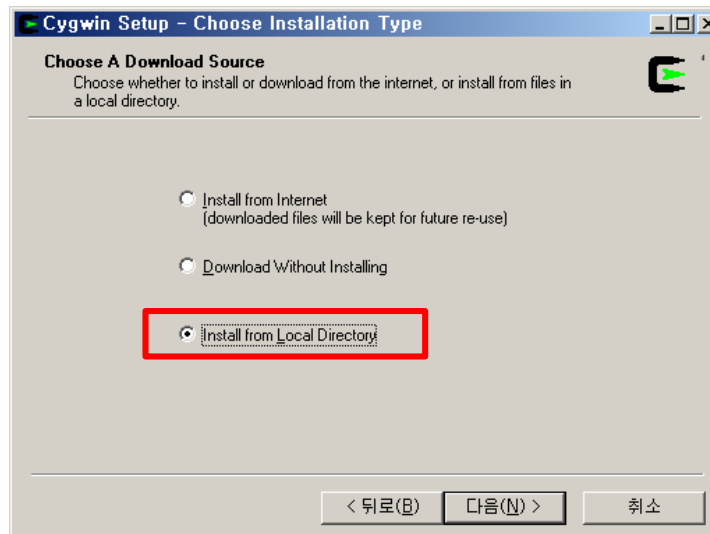


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## Cygwin 설치

- 압축풀기 => cygwin\_source 폴더 setup.exe 실행
- Install from Local Directory Check => 다음
- Root Directory: C:\Wcygwin
- Install For: All Users
- Default Text File Type: Unix / binary Check => 다음





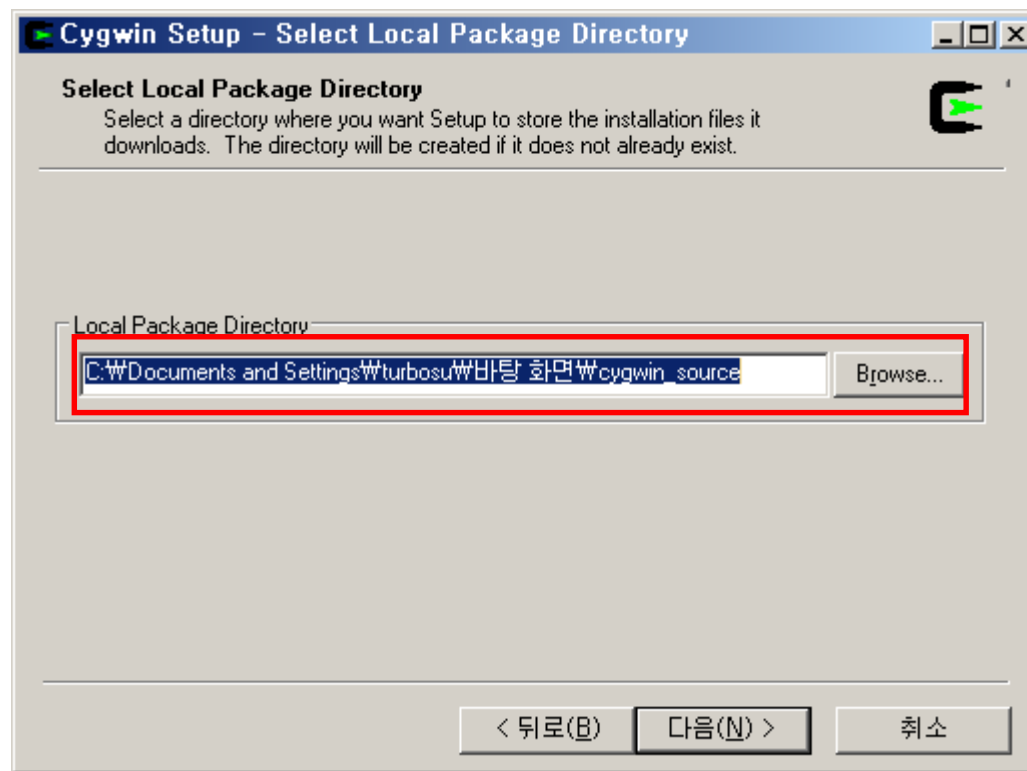


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## Cygwin 설치

- Local Package Directory: cygwin\_source 폴더 => 다음



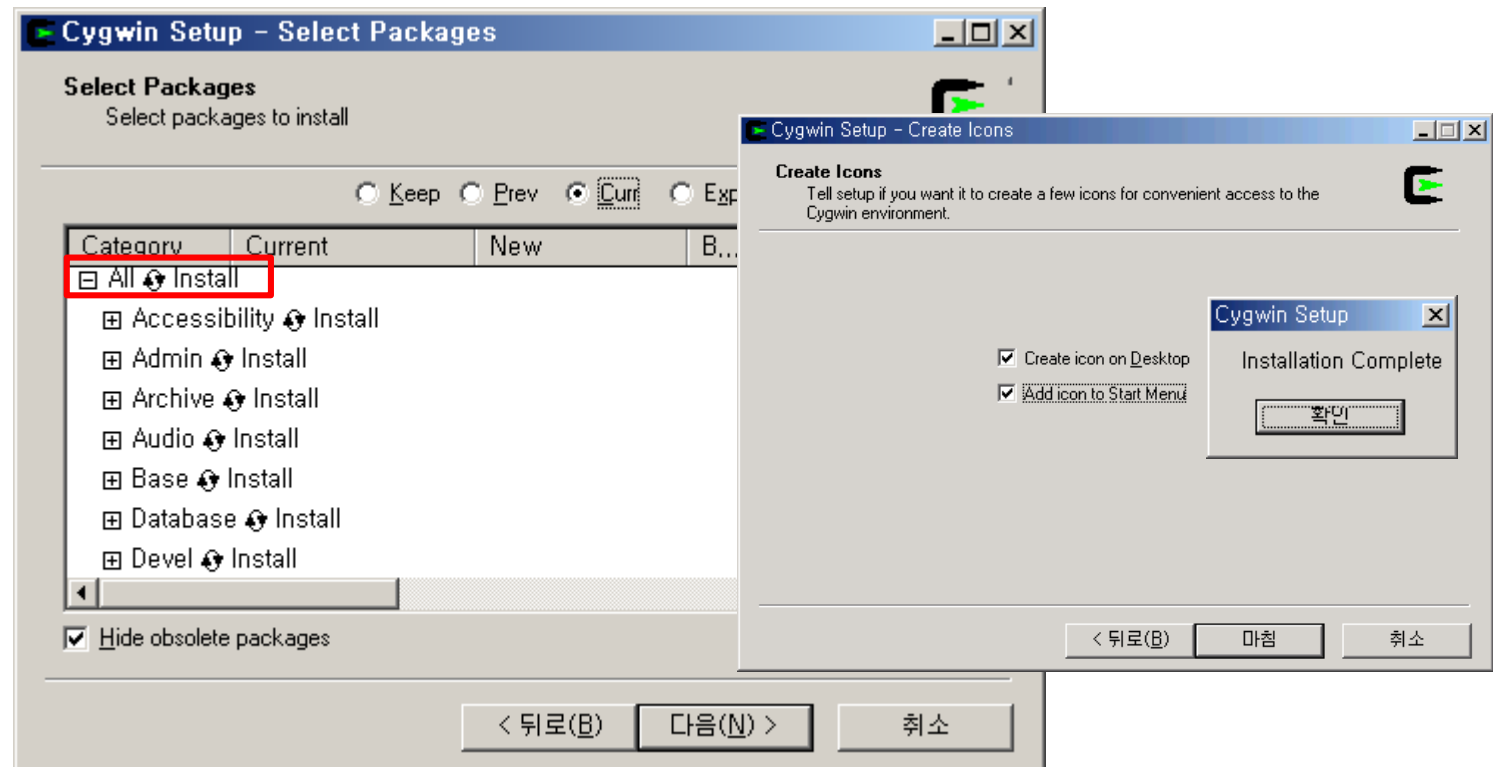


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## Cygwin 설치

- Select Package: All Install 선택 => 다음
- Installation Complete, 설치완료





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## Source download

- 로봇워 대회 홈페이지 접속 => 소스자료, 2013, 두뇌보드 uClinux, Compiler
- SoC\_Robot\_SW.tar.gz
- ae32000-elf-uclibc-tools-AE32000C-v2.6.4.tar.gz

### 소스자료

> Home > 자료실 > 소스자료

2013년, 두뇌보드 uClinux, Compiler	2013-06-20 12:11:37
대회담당자 (143, 248, 146, 153)	조회 : 44
Download : SoC_Robot_SW.tar.gz (135, 7M), Down:26	
Download : ae32000-elf-uclibc-tools-AE32000C-v2,6,4.tar.gz (30, 2M), Down:24	

2013년, 두뇌보드 관련 소스

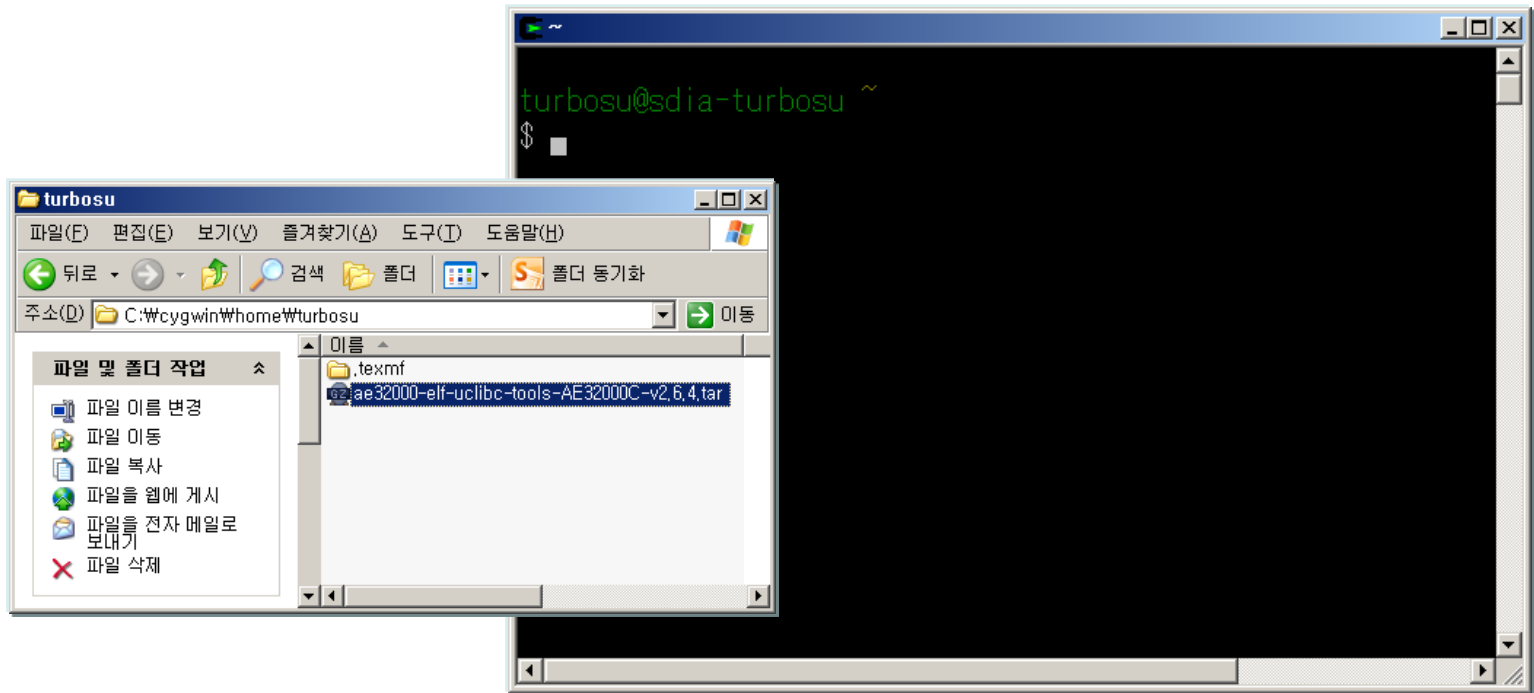


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## Compiler 설치

- Ae32000-elf-uclibc-tools-AE32000C-v2.6.4.tar.gz
- Directory 복사: C:\Wcygwin\home\W<user ID>







## Linux 명령어

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명령어	의미
ls	파일과 디렉토리의 목록을 출력
cd	디렉토리 이동
cp	파일이나 디렉토리를 복사
mv	파일이나 디렉토리 이름을 변경하거나 다른 디렉토리로 이동
mkdir	디렉토리 생성
cat	텍스트 파일의 내용을 출력
tar	파일 묶기, 풀기
pwd	현재 작업중인 디렉토리를 확인
chmod	파일에 대한 허가권을 변경
clear	화면지우기
date	현재시간 보기



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## Compiler 설치

- Cygwin 실행
  - \$ cp ae32000-elf-uclibc-tools-AE32000C-v2.6.4.tar.gz /usr/local
  - \$ cd /usr/local
  - \$ tar xzf ae32000-elf-uclibc-tools-AE32000C-v2.6.4.tar.gz

```
/usr/local

turbosu@sdia-turbosu ~
$ cp ae32000-elf-uclibc-tools-AE32000C-v2.6.4.tar.gz /usr/local

turbosu@sdia-turbosu ~
$ cd /usr/local

turbosu@sdia-turbosu /usr/local
$ tar xzf ae32000-elf-uclibc-tools-AE32000C-v2.6.4.tar.gz

turbosu@sdia-turbosu /usr/local
$
```

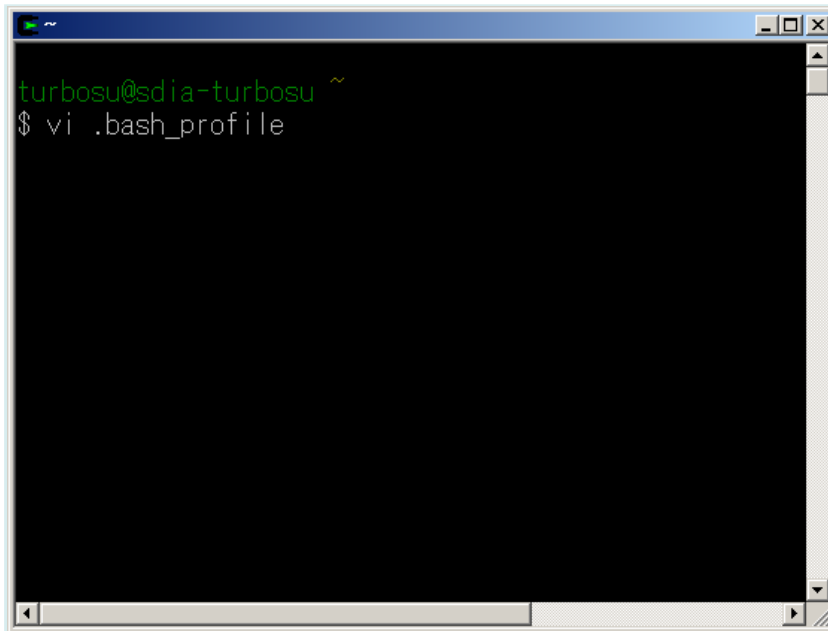


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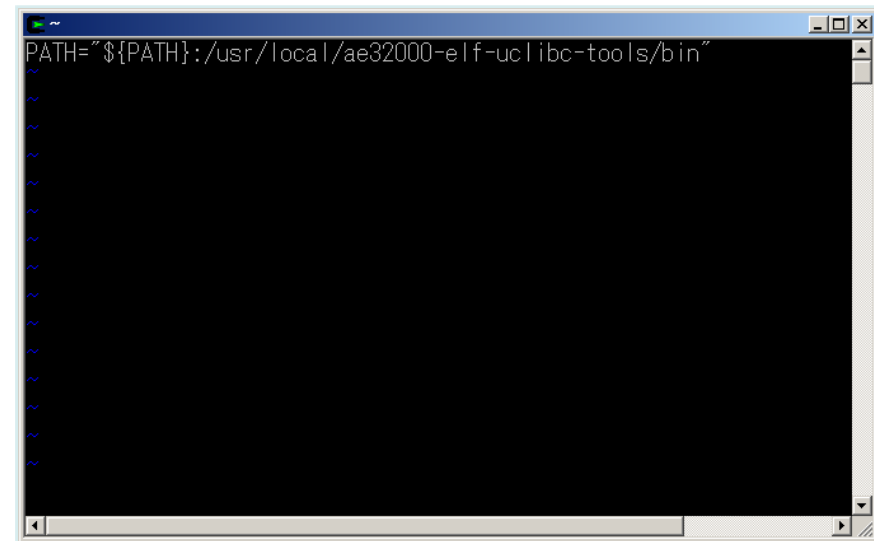


## Compiler 설치

- Shell 파일 만들기
  - \$ vi .bash\_profile
- vi 편집기에 다음의 PATH 추가 후 저장  
PATH="\$PATH:/usr/local/ae32000-elf-uclibc-tools/bin"



```
turbosu@sdia-turbosu ~  
$ vi .bash_profile
```



```
PATH="$PATH:/usr/local/ae32000-elf-uclibc-tools/bin"
```



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## Compiler 설치

- Shell 적용 및 설치 확인
  - \$ source .bash\_profile
  - \$ ae32000-elf-uclibc-gcc -v

```
turbosu@sdia-turbosu ~
$ source .bash_profile

turbosu@sdia-turbosu ~
$ ae32000-elf-uclibc-gcc -v
Reading specs from /usr/local/ae32000-elf-uclibc-tools/lib/gcc/ae32000-elf-uclibc/3.4.5/specs
Configured with: /d/AE32000-uClinux/AE32000-uClibc/uClinux_Compiler-6.4/toolchain_build_ae32000/gcc-3.4.5-ae32000c-uclibc-v080829/configure --target=ae32000-elf-uclibc --enable-languages=c,c++ --with-gcc-ld=/usr/local/ae32000-elf-uclibc-tools/ae32000-elf-uclibc/bin/ld --with-gcc-ar=/usr/local/ae32000-elf-uclibc-tools/ae32000-elf-uclibc/bin/ar --with-gcc-ranlib=/usr/local/ae32000-elf-uclibc-tools/ae32000-elf-uclibc/bin/ranlib --enable-target-optspace --with-gnu-ld --disable-__cxa_atexit --enable-target-optspace --with-gnu-ld --disable-nls --enable-sjlj-exceptions
Thread model: single
gcc version 3.4.5 (AE32000 Compiler v2.6.4 | binutils-2.14 | gdb_7.7)
(LDI Code motion / Separated GCCLIB / mulsi3 / Mem index)

turbosu@sdia-turbosu ~
```





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## SoC Robot SW 복사

- 대회 홈페이지 소스자료 게시판: SoC\_Robot\_SW.tar.gz Download
- C:\Wcygwin\home/<User\_ID>에 파일 복사 후 압축풀기
  - \$ tar xvzf SoC\_Robot\_eagle.tar.gz

```
turbosu@sdia-turbosu ~  
$ tar xvzf SoC_Robot_SW.tar.gz
```



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## Boot loader 컴파일

- Bootloader 폴더로 이동
- \$ cd SoC\_Robot\_SW/bootloader

```

~/SoC_Robot_SW/bootloader
$ cd SoC_Robot_SW

turbosu@turbosu-PC ~/SoC_Robot_SW
$ ls
Eagle_Downloader  bootloader  kernel      nand_boot  user_app
USB_Driver        dev_module  logo_make   ramdisk

turbosu@turbosu-PC ~/SoC_Robot_SW
$ cd bootloader/

turbosu@turbosu-PC ~/SoC_Robot_SW/bootloader
$ ls
CHANGELOG                SI-Eagle_Robot      drivers             rtc
COPYING                  System.map           dtt                 tags
CREDITS                   ae32000b_config.mk  fs                  tools
EConMan_jtagspeed-800K.exe ae32000c_config.mk  include             u-boot
FTCJTAG.dll              board                lib_ae32000b        u-boot-eagle.bin
MAINTAINERS               common               lib_ae32000c        u-boot.map
MAKEALL                   config.mk            lib_generic          u-boot_down.bat
Makefile                  cpu                  mkconfig
README                    disk                 net
Revision_NAND_UBOOT.log   doc                  post
turbosu@turbosu-PC ~/SoC_Robot_SW/bootloader
$
    
```



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## Boot loader 컴파일

- Bootloader 컴파일
  - \$ make mrproper //Linux의 make clean 과 동일 기능
  - \$ make eagle\_config //eagle MCU에 맞게 구성
  - \$ make // 컴파일 (Build)

```
~/SoC_Robot_SW/u-boot-1.1.1-NAND-AE32000-Rev2
-Map u-boot.map -o u-boot
ae32000-elf-ucLibc-objcopy --gap-fill=0xff -O binary u-boot u-boot-eagle.bin

turbosu@sdia-turbosu ~/SoC_Robot_SW/u-boot-1.1.1-NAND-AE32000-Rev2
$

turbosu@sdia-turbosu ~/SoC_Robot_SW/u-boot-1.1.1-NAND-AE32000-Rev2
$ ls
CHANGELOG      Revision_NAND_UBOOT.log  cpu      lib_ae32000b  tags
COPYING        System.map              disk     lib_ae32000c  tools
CREDITS        ae32000b_config.mk      doc      lib_generic   u-boot
MAINTAINERS    ae32000c_config.mk      drivers  mkconfig      u-boot-eagle.bin
MAKEALL        board                   dtt      net           u-boot.map
Makefile       common                  fs        post
README        config.mk               include   rtc
```

```
turbosu@sdia-turbosu ~/SoC_Robot_SW/u-boot-1.1.1-NAND-AE32000-Rev2
$
```



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## Kernel 컴파일

- Kernel 컴파일
  - \$ cd
  - \$ cd SoC\_Robot\_SW/kernel/EISC-uClinux-2.4.31-kernel
  - \$ cp eagle-robot\_config .config
  - \$ make oldconfig
  - \$ make dep
  - \$ make

```

~/SoC_Robot_SW/kernel/EISC-uClinux-2.4.31-kernel
ae32000-elf-uclicb-objcopy linux -O binary linux-eagle.bin

turbosu@sdia-turbosu ~/SoC_Robot_SW/kernel/EISC-uClinux-2.4.31-kernel
$ ls
4mb-rd-ae32000c.img.gz  ae32000_uclinux_change.log  lib
COPYING                 arch                        linux
CREDITS                 crypto                     linux-eagle.bin
Documentation           drivers
MAINTAINERS             eagle_robot_2011          mm
Makefile                fs                          net
README                 include                    scripts
REPORTING-BUGS         init                       tags
Rules.make             ipc
System.map             kernel
    
```



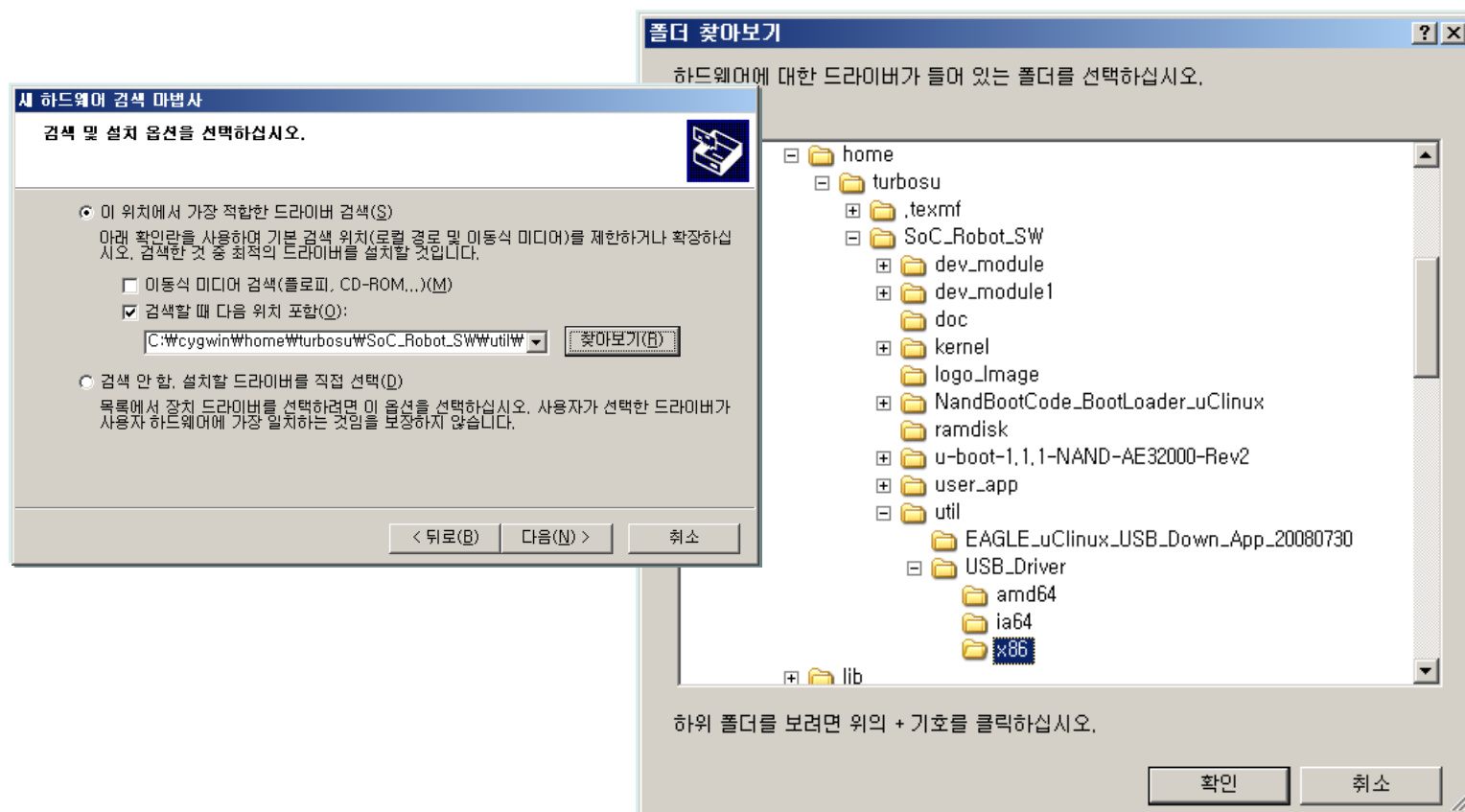


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## usb driver 설치

- SoC 두뇌보드 mini USB Cable 연결 => 보드 전원 ON
- 새하드웨어 검색마법사 (목록 또는 특정 위치에서 설치)
- SoC\_Robot\_SW\util\USB\_Driver\Winx86 폴더 선택 후 확인



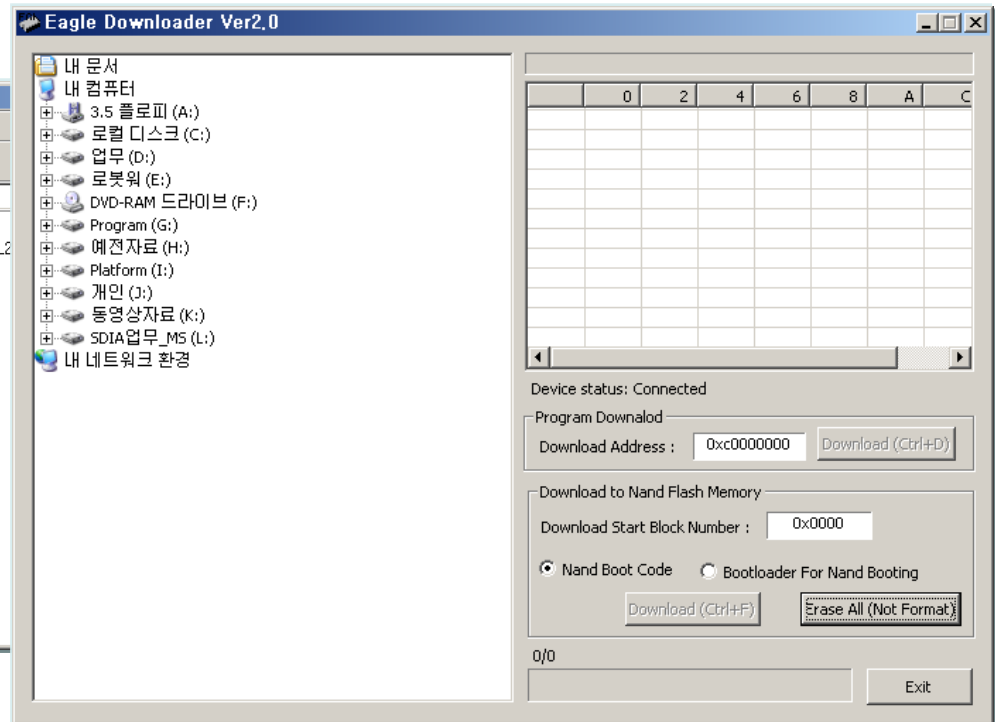
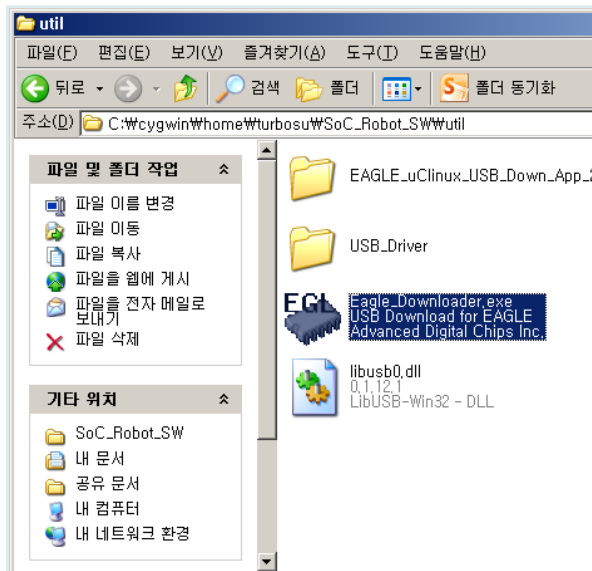


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## Eagle Downloader 2.0

- SoC\_Robot\_SWUtil 폴더에 Eagle\_Downloader.exe 실행



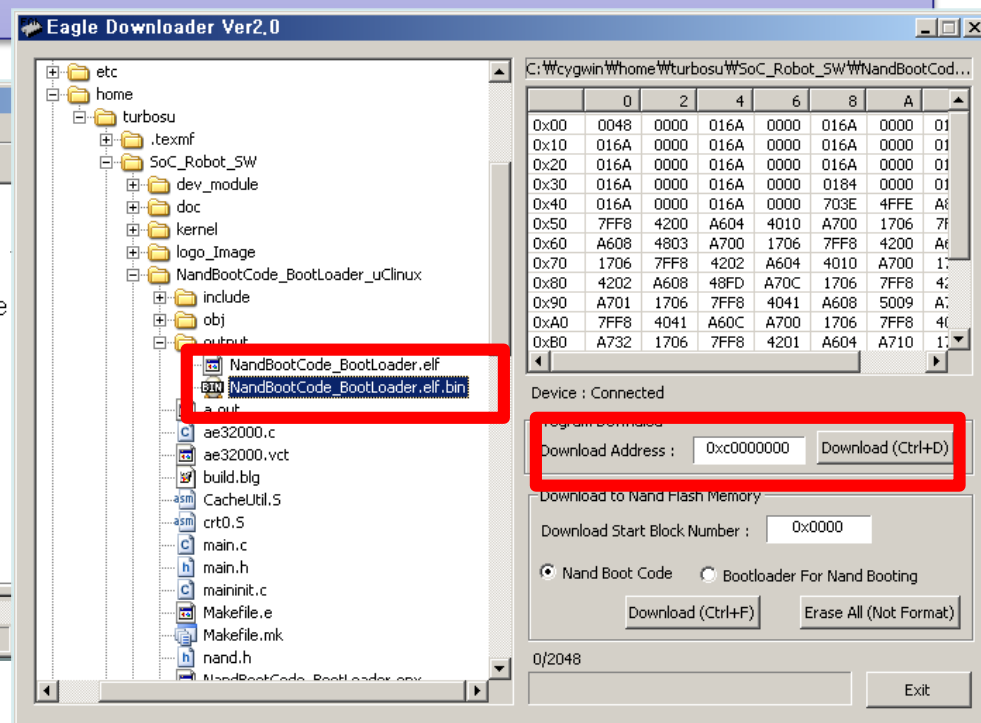
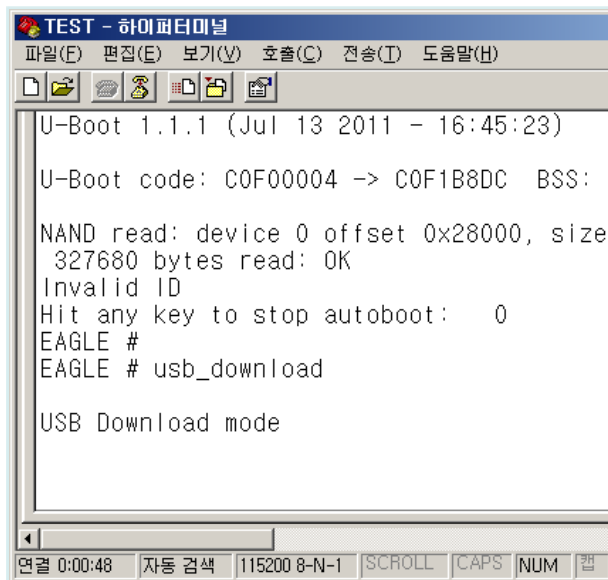


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## nand Boot Code download

- 두뇌보드 전원 ON
- 하이퍼터미널 => 엔터  
# usb\_download
- Eagle Downloader Ver2.0
- NandBootCode\_BootLoader.elf.bin 선택
- Program Download [Download Address 0xc0000000] Download



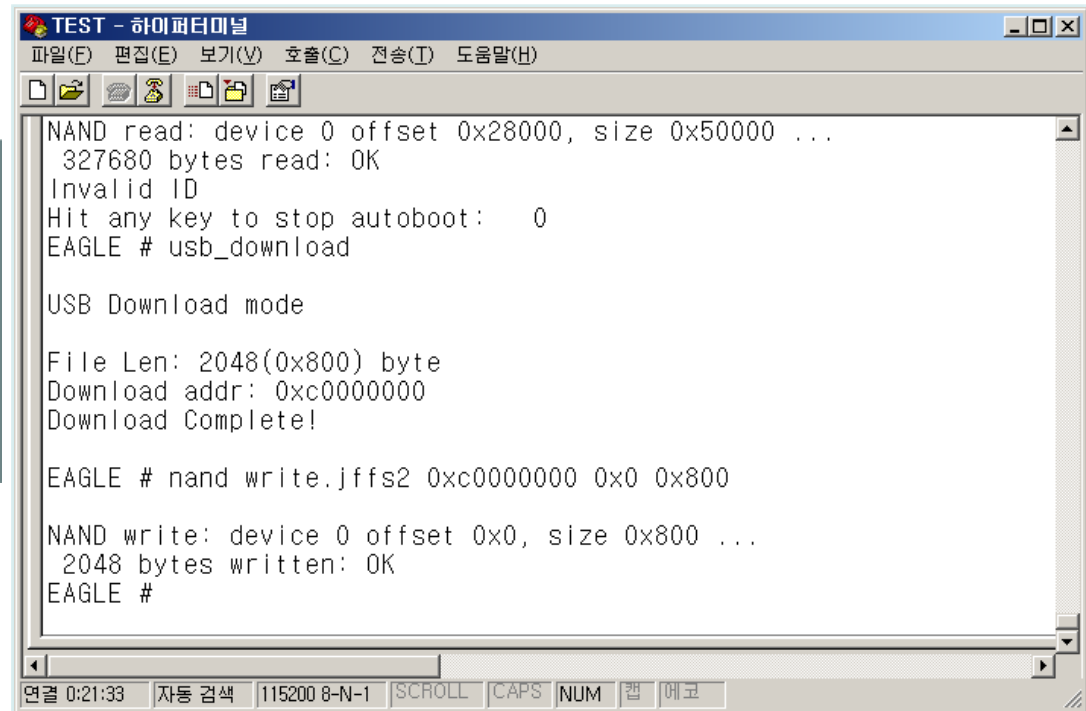
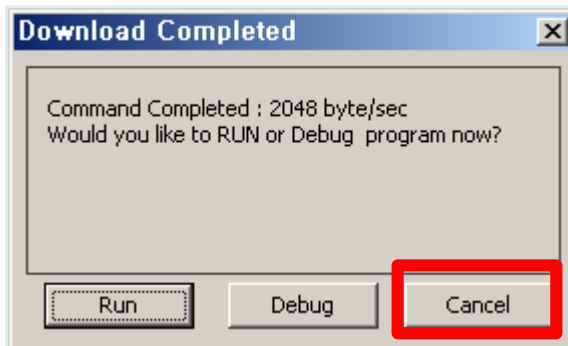


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## nand Boot Code download

- Download Completed => Cancel
- 하이퍼터미널  
#nand write.jffs2 0xc0000000 0x0 0x800





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## Boot Loader download

#usb\_download

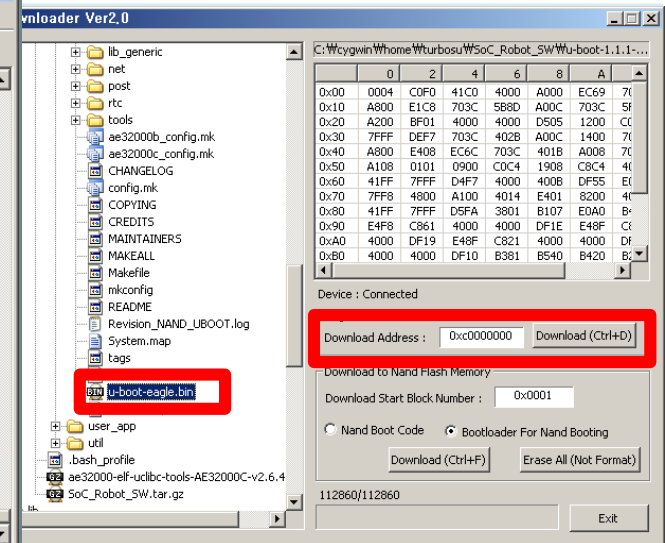
- Eagle Downloader Ver2.0
- u-boot-eagle.bin 선택
- Program Download [Download Address 0xc0000000] Download
- #nand write.jffs2 0xc0000000 0x4000 0x1c000
- 두뇌보드 전원 OFF => ON

```

TEST - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

EAGLE # nand write.jffs2 0xc0000000 0x0 0x800
NAND write: device 0 offset 0x0, size 0x800 ...
2048 bytes written: OK
EAGLE # usb_download
USB Download mode
File Len: 112860(0x1b8dc) byte
Download addr: 0xc0000000
Download Complete!

EAGLE # nand write.jffs2 0xc0000000 0x4000 0x1c000
NAND write: device 0 offset 0x4000, size 0x1C000 ...
114688 bytes written: OK
EAGLE #
    
```



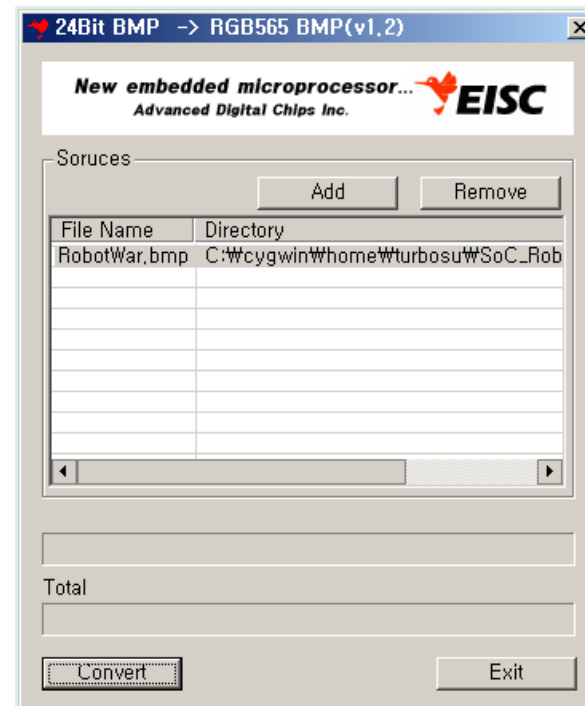
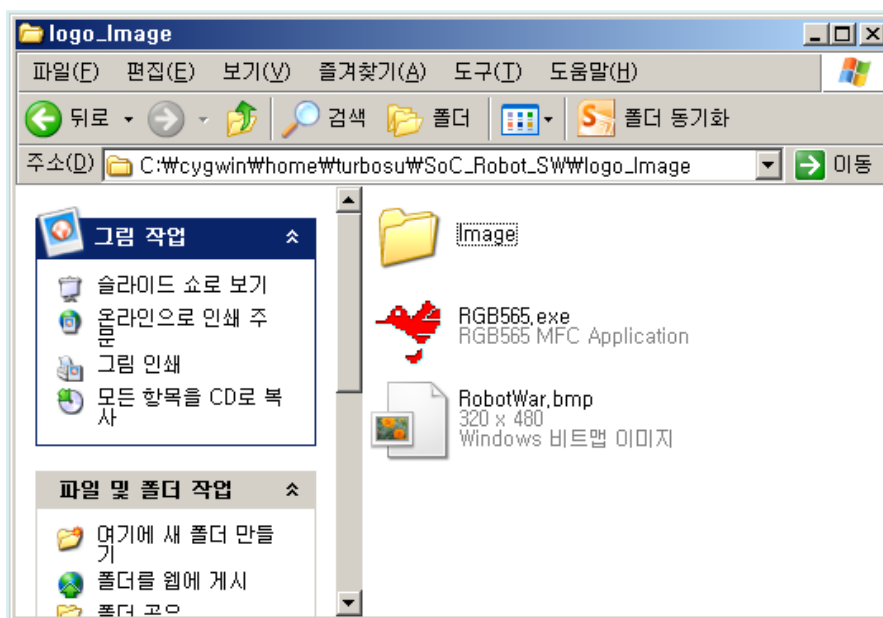


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## LOGO Image 포맷 변환

- SoC\_Robot\_SW\logo\_Image 폴더 =>
- RGB565.exe 실행
- Convert





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## LOGO Image Download

#usb\_download

- Eagle Downloader Ver2.0
- RobotWar.bmp 선택
- Program Download [Download Address 0xc0000000] Download  
#nand write.jffs2 0xc0000000 0x28000 0x50000
- 두뇌보드 전원 OFF => ON

```

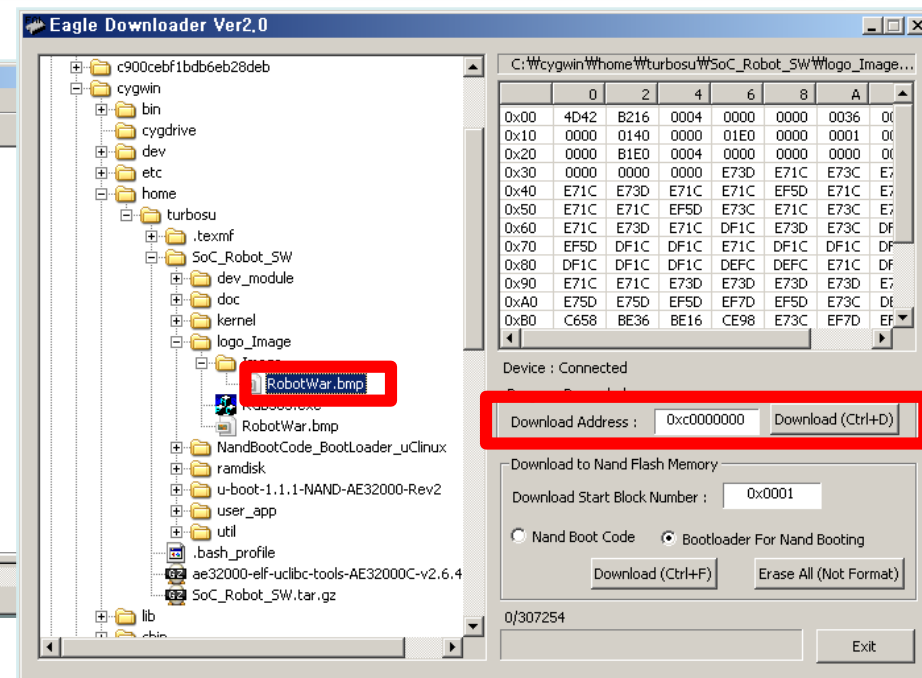
TEST - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)
[Icons]
NAND read: device 0 offset 0x28000, size 0x50000 ...
327680 bytes read: OK
Invalid ID
Hit any key to stop autoboot: 0
EAGLE # usb_download

USB Download mode

File Len: 307254(0x4b036) byte
Download addr: 0xc0000000
Download Complete!

EAGLE # nand write.jffs2 0xc0000000 0x28000 0x50000

NAND write: device 0 offset 0x28000, size 0x50000 ...
327680 bytes written: OK
EAGLE #
    
```







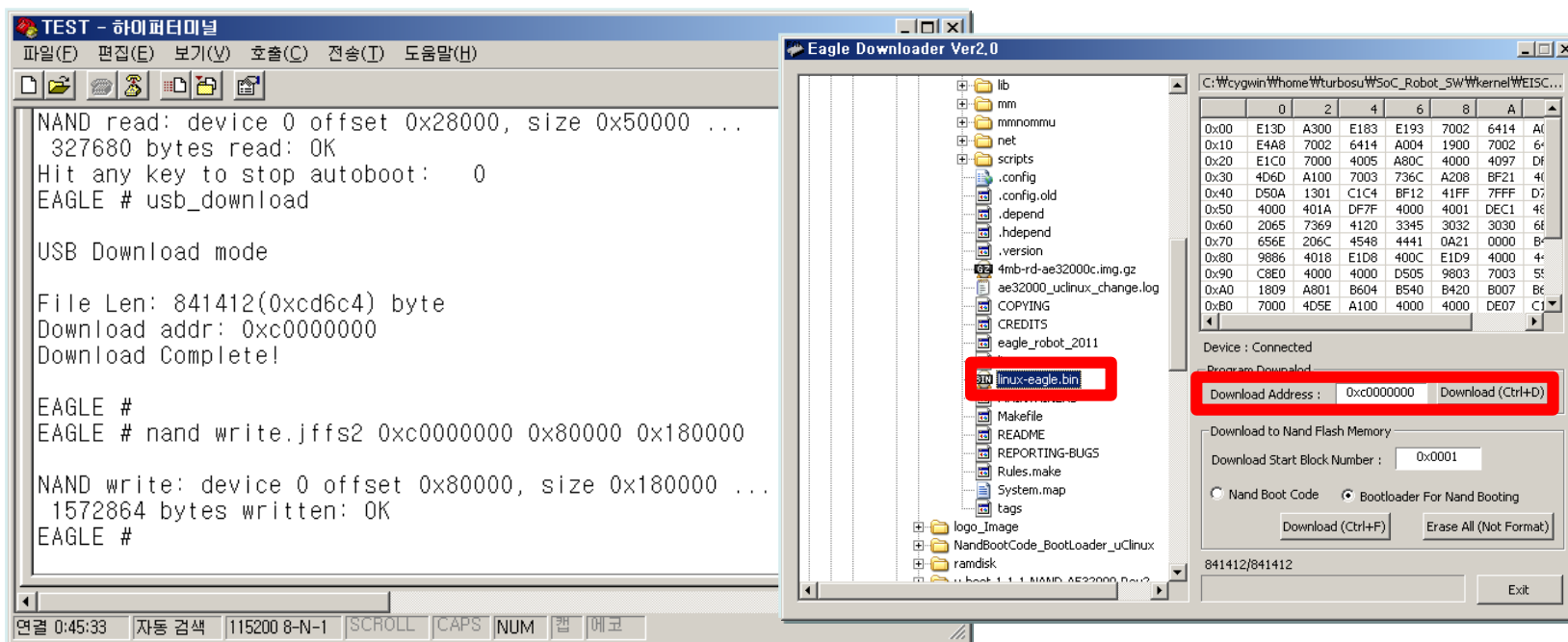
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## Kernel download

# usb\_download

- Eagle Downloader Ver2.0
  - linux-eagle.bin 선택
  - Program Download [Download Address 0xc0000000] Download
- #nand write.jffs2 0xc0000000 0x80000 0x180000





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## Ramdisk download

# usb\_download

- Eagle Downloader Ver2.0
- 4mb-rd-ae323000c.img.gz 선택
- Program Download [Download Address 0xc0000000] Download  
#nand write.jffs2 0xc0000000 0x200000 0x100000

The screenshot shows a terminal window titled 'TEST - 하이퍼터미널' and a window titled 'Eagle Downloader Ver2.0'.

**Terminal Output:**

```
EAGLE # nand write.jffs2 0xc0000000 0x80000 0x180000
NAND write: device 0 offset 0x80000, size 0x180000 ...
1572864 bytes written: OK
EAGLE # usb_download
USB Download mode
File Len: 381524(0x5d254) byte
Download addr: 0xc0000000
Download Complete!

EAGLE # nand write.jffs2 0xc0000000 0x200000 0x100000
NAND write: device 0 offset 0x200000, size 0x100000 ...
1048576 bytes written: OK
EAGLE # _
```

**Eagle Downloader Ver2.0 Interface:**

- The file list on the left shows '4mb-rd-ae323000c.img.gz' selected.
- The 'Download Address' field is set to '0xc0000000'.
- The 'Download Start Block Number' is set to '0x0001'.
- The 'Download' button is highlighted with a red box.



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## OS Booting

- 두뇌보드 전원 OFF => ON
- Login  
ae32000c login: root

```

TEST - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

yaaffs: dev is 7936 name is "1f:00"
yaaffs: Attempting MTD mount on 31.0, "1f:00"
/mnt/f0/user_init: cannot open

ae32000c login: root

=====
Welcome to uClinux for AE32000C !!!!
http://www.adc.co.kr/
=====

Jan  1 00:00:07 login[24]: root login  on `ttyS0'

BusyBox v1.1.0-pre1 (2007.04.20-06:59+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.

#
    
```

연결 0:00:17 자동 검색 115200 8-N-1 SCROLL CAPS NUM 캡 예코



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## Driver 설치 및 세팅

```
#cd /mnt/f0
#mkdir dev_module // dev_module 디렉토리 생성 명령
#ls //현재 위치에서의 폴더 및 파일 List 보기
```

```
TEST - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

ae32000c login: root

=====
Welcome to uClinux for AE32000C !!!!
http://www.adc.co.kr/
=====

Jan  1 00:00:07 login[24]: root login  on `ttyS0'

BusyBox v1.1.0-pre1 (2007.04.20-06:59+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.

# cd /mnt/f0
# mkdir dev_module
# ls
dev_module  lost+found
#
```



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## Driver 설치 및 세팅

- Module File Download  
#cd dev\_module  
#usb\_download image\_process.o
- Eagle Downloader에서
- SoC\_Robot\_SW\dev\_module\Image\_Process\_Module 폴더
- image\_process.o 파일 선택 => Download

```

~
# cd dev_module
# usb_download image_process.o

USB BULK Download program

OK, Version command
OK, START command
File Len: 11020

START data downloading...
Download Complete!

#
    
```



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## Driver 설치 및 세팅

- Module File Download
- 동일한 방식으로 eagle-timer\_led.o, eagle\_led.o Download
- Module 추가

```
#mknod led c 248 0
#mknod timer_led c 250 0
#mknod imgproc c 244 0
#mknod saa7111 c 10 170
#mknod uart123 c 60 0
```

```
TEST - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

START data downloading...
Download Complete!

#
#
# mknod led c 248 0
# mknod timer_led c 250 0
# mknod imgproc c 244 0
# mknod saa7111 c 10 170
# mknod uart123 c 60 0
# ls
eagle-timer_led.o  image_process.o  led          timer_led
eagle_led.o       imgproc          saa7111      uart123
#
```

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## Driver 설치 및 세팅

- 상위 디렉토리 이동  
#cd ..
- user\_init 파일 생성 및 생성 (user\_init 파일: 부팅되면서 바로 실행)  
#vi user\_init
- 아래 그림과 같이 입력
- 저장방법: Esc 선택후 :wq! 엔터

The screenshot shows a terminal window with the title bar "hiouh - 하이퍼터미널". The menu bar includes "파일(F)", "편집(E)", "보기(V)", "호출(C)", "전송(T)", and "도움말(H)". Below the menu is a toolbar with icons for file operations. The main area displays the following text:

```
#!/bin/sh
/sbin/insmod /mnt/f0/dev_module/image_process.o
/sbin/insmod /mnt/f0/dev_module/eagle_led.o
/sbin/insmod /mnt/f0/dev_module/eagle-timer_led.o_
~
~
~
~
~
~
~
~
~
~
```

A vertical cursor is visible on the right side of the terminal.





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## Driver 설치 및 세팅

- user\_init 파일 권한 변경  
#chmod 777 user\_init  
#ls
- user\_init 파일 실행  
#./user\_init

```
hiouh - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

# chmod 777 user_init
# ls
lost+found user_init
# ./user_init
```



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## Application SW-led test

- cygwin에서 SoC\_Robot\_SW\user\_app\led\_test 폴더로 이동
- \$make clean; make
- 하이퍼터미널

```
#cd /mnt/f0
#usb_download led_test
#chmod 777 led_test
#./led_test
```

```
atest - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

# chmod 777 led_test
# ./led_test
Usage 1 : ledtest -on <led on>
Usage 2 : ledtest -off <led off>
Usage 3 : ledtest -r <led status Read>
Usage 4 : ledtest -w [led on/off Count Number]
# ./led_test -on
# ./led_test -off
# ./led_test -r
-> OFF
# ./led_test -w 5
#
```



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## Application SW-Image Load

- cygwin에서 SoC\_Robot\_SW\user\_app\ImageLoad 폴더로 이동
- \$make clean; make
- 하이퍼터미널

```
#cd /mnt/f0
#usb_download ImageLoad_Test
#chmod 777 ImageLoad_Test
#./ImageLoad_Test
```

```
atest - 하이퍼터미널
파일(F) 편집(E) 보기(V) 호출(C) 전송(T) 도움말(H)

# chmod 777 ImageLoad_Test
# ./ImageLoad_Test
Usage 1 : imgproc_test -rd      <Read Image Data>
Usage 2 : imgproc_test -dp      <Display to Monitor>
Usage 3 : imgproc_test -xy      [x coordinate] [y coordinate]
# ./ImageLoad_Test -dp
Video Output : <RGB565 Format> Complete!

Press Enter Key to STOP the test !!!

Test is Stopped
#
```