Software

# APAX-5522PE Embedded Linux

## User Manual

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# About This Manual

Thank you for using Advantech products. This manual is a supplementation to APAX-5522 user manual, and it emphasizes on Linux for APAX-5522, other detail information about APAX-5522 hardware, jumper setting, serial port connection and so on, please refer to the APAX-5522 Hardware manual.

Edition 1

October 2012

# Contents

# Chapter 1

## APAX-5522 features overview

## 1.1 Hardware features

- CPU: XScale PXA270, 520 MHz
- Memory: Flash 32M bytes, SDRAM 64M bytes
- Diagnostics LEDs: 1xPower, 1xRun, 1xError, 1xBattery, 2xLAN link/activity/ speed
- Real-time Clock: Yes
- Watchdog Timer: Yes
- Power Consumption: 5 W @ 24 VDC (typical)
- USB Ports: 1 (USB 1.1)
- LAN Ports: 2 (10/100 Mbps)
- Serial Ports: 2 (RS-232)
- Serial Baud Rate: 9600 ~ 115200 bps
- Storage: 1 x Type II Compact Flash card slot (internal)

## 1.2 Software features

- Boot loader: U-boot-1.1.6
- Kernel version: Linux 2.6.25.8-rt7
- C library: glibc version: 2.8
- OS boot up time: <= 40 seconds
- Flash partition:

| | |
|---|---|
| Boot loader | 512k |
| Kernel | 2.3 M |
| Root file system | 25.8 M |

- Root files system: JFFS2

# Chapter 2

# APAX-5522 embedded Linux configuration and usage

## 2.1 Basic Linux command

### 2.1.1 ls: list the file information

Example:
# ls –l
list detailed information of file.
# ls –a
list all files including hidden files.
# ls –t
list the files that are arranged by time.

### 2.1.2 cp: copy file or directory

Example:
# cp test.c /home/user/
copy test.c file to /home/user/
# cp –a mywork /home/user/
copy mywork directory to /home/user/

### 2.1.3 mv: move or rename file/directory

Example:
# mv test.c main.c
rename file test.c to main.c
#mv workspace/ backup/
rename directory workspace as backup

### 2.1.4 rm: delete file or directory

Example:
# rm test.c
delete file test.c
# rm –r workspace
delete directory workspace

### 2.1.5 mkdir: create directory

Example:
# mkdir workspace
create workspace directory

### 2.1.6 rmdir: remove directory

Example:
# rmdir workspace
remove workspace directory

### 2.1.7 pwd: show the current path

Example:
# pwd
/home/user

### 2.1.8 chmod: change file mod bit

```
Example:
# chmod 754 test
# ls –l test
-rwxr-xr--  1 adv  adv   8004 Jan 1 1970 test

A combination of the letters controls which user can access to the file.
754 means: 111(read, write, execute) 101(read, write, execute) 100(read, write, execute).
The first number 7 is owner can read and write and execute file. The second number 5 is
group can only read and execute file. The third number 4 is all users can only read file.
```

### 2.1.9 ./ : execution of your program

```
Example:
# ls –l test
-rwxr-xr--  1 adv  adv   8004 Jan 1 1970 test

# ./test
This is my test program!!
```

### 2.1.10 ps : report a snapshot of the current process

```
Example:
# ps
  PID  Uid     VmSize Stat Command
    1 root       544 S    init [5]
    2 root           SW< [kthreadd]
    3 root           SW< [ksoftirqd/0]
    4 root           SW< [watchdog/0]
    5 root           SW< [events/0]
    6 root           SW< [khelper]
    …
    …
1309 root       904 S    -sh
 1571 root       896 S    sh
 1593 root       320 R    ./test
 1594 root       728 R    ps
```

### 2.1.11 kill -9 PID: kill the process

```
Example:
# kill -9 1593
   kill the running test program. the PID is 1593
```

### 2.1.12 cd: change directory

### 2.1.13 clear: clear the screen

### 2.1.14 reboot: reboot the APAX-5522

## 2.2 Connecting the APAX-5522 Linux

Users can check the RUN LED lights when the APAX-5522 is powered on. Then can use Telnet to connect to the APAX-5522's console if you have known the IP address. Once you connect to the APAX-5522 you can proceed to configure network settings, as described in the next section. Telnet can be used locally by using a crossover Ethernet cable to connect your computer to the APAX-5522, or over a LAN or the Internet. The default IP address and netmask are shown below. To login, type the Login name and password as requested. The default login name is root and no password.

| | Default IP Address | Default netmask |
|---|---|---|
| LAN1(eth0) | 10.0.0.1 | 255.255.255.0 |
| LAN2(eth1) | 10.0.0.2 | 255.255.255.0 |

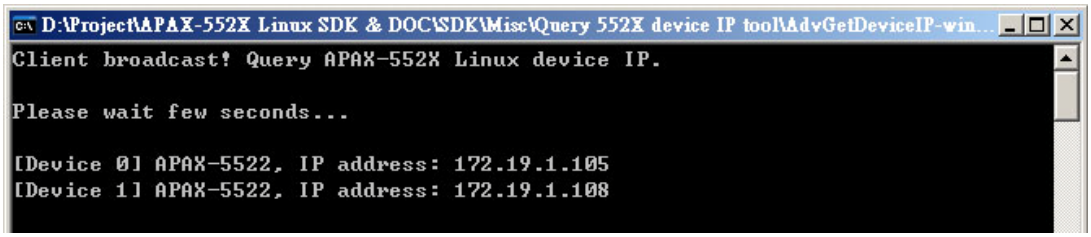
```
# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:D0:C9:F0:49:91
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1139 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:132363 (129.2 KiB)  TX bytes:0 (0.0 B)
          Interrupt:157 Base address:0xc000

eth1      Link encap:Ethernet  HWaddr 00:D0:C9:F0:49:92
          inet addr:10.0.0.2  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Interrupt:158

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

# _
```

In addition, we also provide a PC-side client tool that users can use it to get the IP address of all the APAX-5522 devices. Please plug the network cable to the LAN (eth0) port of the APAX-5522 devices.



## 2.3 Configure IP

Users can configure IP and change LAN physical address in “/etc/rc”, OS then will execute the shell script automatically when booting up. The default setting for Ethernet is static IP address.

```
ifconfig lo 127.0.0.1
ifconfig eth0 10.0.0.1 netmask 255.255.255.0
ifconfig eth1 10.0.0.2 netmask 255.255.255.0
ip rule add from 10.0.0.1 lookup 10
ip route add table 10 default src 10.0.0.1 dev eth0
ip rule add from 10.0.0.2 lookup 11
ip route add table 11 default src 10.0.0.2 dev eth1
route add default gw 10.0.0.254 eth1
route add default gw 10.0.0.254 eth0
inetd &
cat /etc/motd
```

If user wants to get the eth0 IP by dhcp, please mask and modify the “/etc/rc” file as follows:

```
ifconfig lo 127.0.0.1
if [ -e /var/run/dhcpcd-eth0.pid ]; then
rm -f /var/run/dhcpcd-eth0.pid
fi
if [ -e /var/run/dhcpcd-eth1.pid ]; then
rm -f /var/run/dhcpcd-eth1.pid
fi
dhcpcd eth0 &
dhcpcd eth1 &
inetd &
cat /etc/motd
```

Sometimes, you may need to modify the IP routing table by manually that can route to the correct LAN port out. Please refer to the following case, and manually modify the rules of the IP routing table when the system startup. The red color words depend on the routing table. You can type “route” instruction to know the current setting.

```
# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.0.0        *               255.255.255.0   U     0      0        0 eth0
10.0.0.0        *               255.255.255.0   U     0      0        0 eth1
default         10.0.0.254      0.0.0.0         UG    0      0        0 eth0
default         10.0.0.254      0.0.0.0         UG    0      0        0 eth1
#
```

For example, I just use LAN2 case therefore, I need to remove the routing rules of the LAN1(eth0) from the routing table. Type following instructions:

```
# route del –net 10.0.0.0 netmask 255.255.255.0 dev eth0
# route del default gw 10.0.0.254 eth0
```

Now I can route to the correct LAN port out.

```
# route
Kernel IP routing table
Destination     Gateway     Genmask       Flags  Metric  Ref    Use Iface
10.0.0.0        *           255.255.255.0   U     0      0        0  eth1
default         10.0.0.254    0.0.0.0         UG    0      0        0  eth1
#
```

- IP routing table rules

| System startup | Typing the Linux instructions |
|---|---|
| Just use LAN1 (eth0) | route del -net 10.0.0.0 netmask 255.255.255.0 dev eth1<br>route del default gw 10.0.0.254 eth1<br>[Note]<br>If you reinsert the network cable to LAN2, please type the following commands to create the LAN1 routing table rules.<br>route add -net 10.0.0.0 netmask 255.255.255.0 dev eth1<br>route add default gw 10.0.0.254 eth1 |
| Just use LAN2 (eth1) | route del -net 10.0.0.0 netmask 255.255.255.0 dev eth0<br>route del default gw 10.0.0.254 eth0<br>[Note]<br>If you reinsert the network cable to LAN1, please type the following commands to create the LAN1 routing table rules.<br>route add -net 10.0.0.0 netmask 255.255.255.0 dev eth0<br>route add default gw 10.0.0.254 eth0 |
| Both use LAN1&LAN2 | No need to modify |

## 2.4 Configure RTC

You may use the “date” command to print or set the system date.

SYNOPSIS:

date MMDDhhmmYYYY.SS

MM = Month

DD = Date

hhmm = hour and minute

YYYY = Year

SS = second

For example, Fri Apr 03 18:54:12 UTC 2009

```
# date 040318542009.12
Fri Apr 3 15:54:12 UTC 2009
```

In order to maintain the correct time when powering off, users should use the hwcolck to write the current time to real time clock.

```
# hwclock —systohc
```

Now if you reboot the APAX-5522, the time is still correct.

## 2.5 Serial port

APAX-5522 has two serial ports; the device node is /dev/ttyAP0 and /dev/ttyAP1. For serial port test, APAX-5522 has built-in test program called st (serialtest) for user test serial port functionality. Please see below example:

```
Use serial port to receive data at the Baud Rate of 115200.
# st /dev/ttyAP0 –r –b 115200
```

```
Use serial port to send data at the Baud Rate of 115200.
#st /dev/ttyAP0 –s –b 115200
```

## 2.6 Mount the CF card

CF card is usually identified as hard disk, the device is /dev/mmcblk0, and the user can use the mount command to mount the CF card to a folder. For example:

```
# mount /dev/hda1 /mnt
```

The system now support ext2, ext3 and fat32 file system. If your CF card's file system is FAT32, you should mount it as follow

```
# mount –t vfat /dev/hda1 /mnt
```

## 2.7 Mount the USB storage device

Users also can mount the USB storage device to the APAX-5522, before they can access the USB storage device. The steps are as follows:

List the partition tables for the specified devices and then exit.

```
#fdisk –l
```

USB storage device is usually identified as SCSI device, the device is /dev/sda1, and the user can use the mount command to mount the USB device to a folder.

Mount USB Storage device

```
# mount /dev/sda1 /mnt
```

Unmount USB Storage device

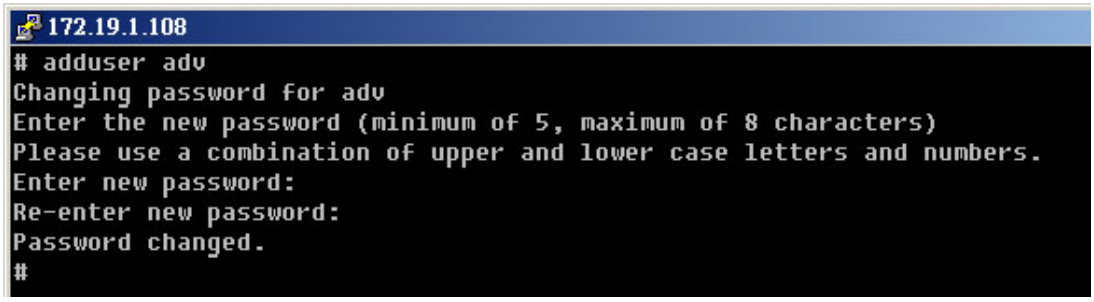
```
#umount /mnt
```

## 2.8 Telnet service

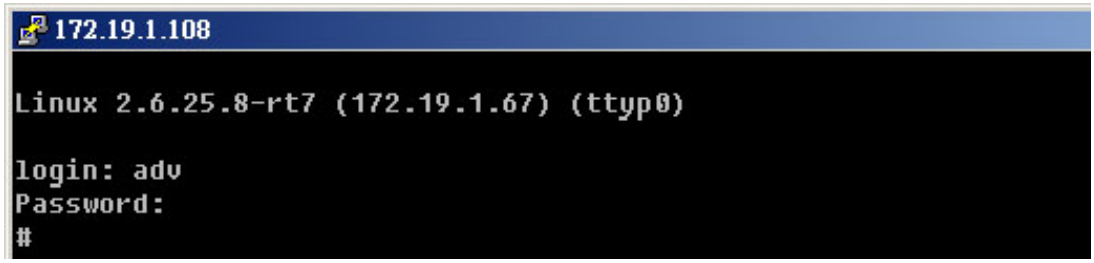
When you boot up the APAX-5522, the telnet service is already started by default. The users can telnet to APAX-5522 by telnet client in another computer. When you first telnet the APAX-5522, you should create a user and set password, then you can use the user as username and the password you set as password.

- Create user

You may use the adduser command to create user account and password.




After setting, you can telnet to APAX-5522 by new user account.




- Remove user

Use root id login to APAX-5522, The steps are as follows:

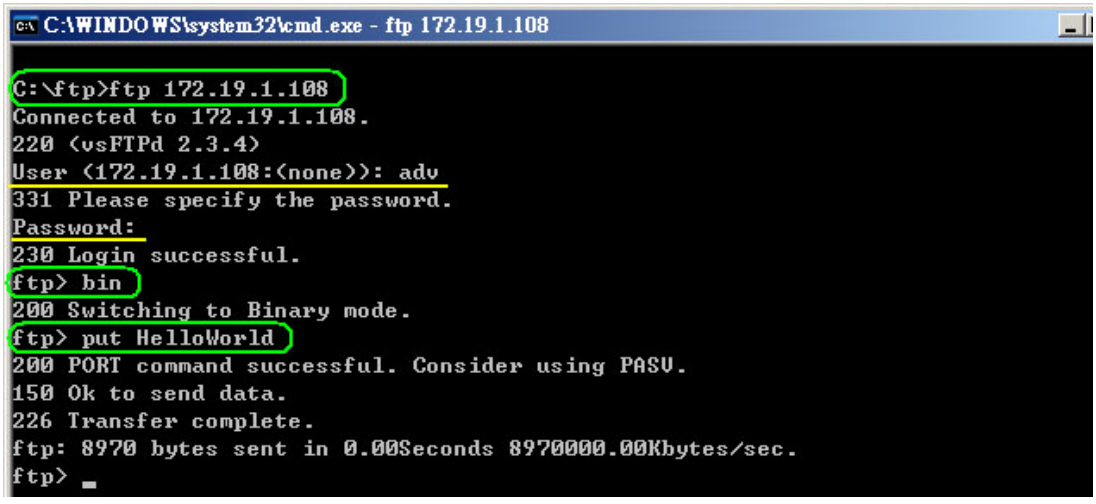
1. Delete user
   # deluser adv
2. Remove user home directory
   # rm –r /home/adv

## 2.9 FTP service

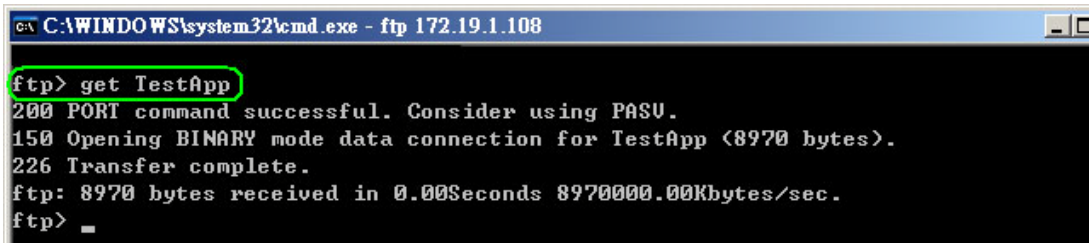
When you boot up the APAX-5522, the ftp service is already started by default. The user can use the ftp client to connect APAX-5522, then download files from APAX-5522 or upload files to APAX-5522 through network.

Example:

- Upload file to APAX-5522



- Download file from APAX-5522




Basic FTP command:

| |
|---|
| !: exit FTP back to pc temporarily<br>bin: transfer files in “Binary” mode<br>ascii: transfer files in “ASCII” mode<br>get: download file from APAX-5522<br>put: upload file from PC to APAX-5522<br>bye: exit FTP |

# Chapter 3

## Development guide

## 3.1 Establish develop environment

To install cross compile tool, you should have the Linux distribution pre-installed in your host computer, for example: Ubuntu Linux distribution. Then put the cross compile tool, arm-unknown-linux-gnueabi-4.2.2.tar.bz2, to the "/" folder and use root permission to execute the following command to install it:

```
# tar jxvf arm-unknown-linux-gnueabi-4.2.2.tar.bz2
```

After the installation, the development environment will be established.

You may execute “arm-unknown-linux-gnueabi-gcc –v” to check the development environment is successfully installed if you can see a similar message as below:


Up till now, user can use cross compile to compile your applications. Information about how to develop applications will be introduced in later sections.

***Note!*** *The cross tool chain is tested on following Linux distributions:*

*Fedora: Fedora10 Fedora11 Fedora12 Fedora13 Fedora14 Fedora15 Fedora16*

*Ubuntu: Ubuntu8.04 Ubuntu8.10 Ubuntu9.04 Ubuntu9.10 Ubuntu10.04 Ubuntu10.10 Ubuntu11.04 Ubuntu11.10*

*Debian: Debian5.0 Debian6.0*

## 3.2 Quick start to develop application

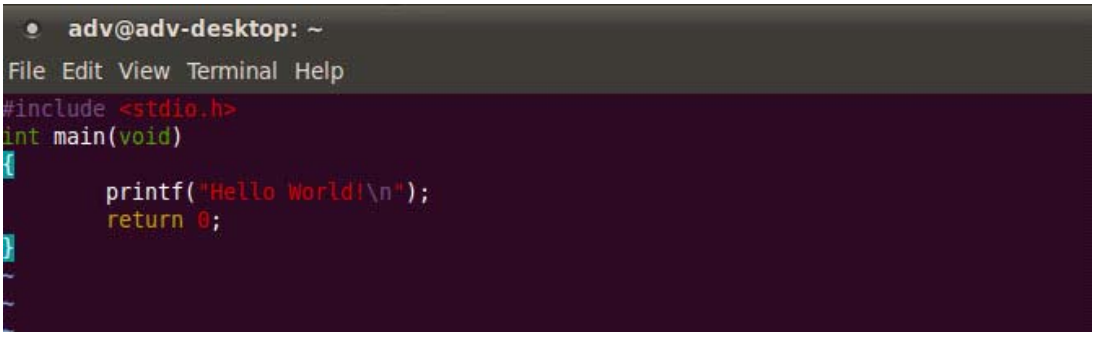
Here we will give an example to show how to develop an application and transfer your application to the APAX-5522 by using FTP or USB storage device.

The example is HelloWorld.c, the source code of this example is as follows:

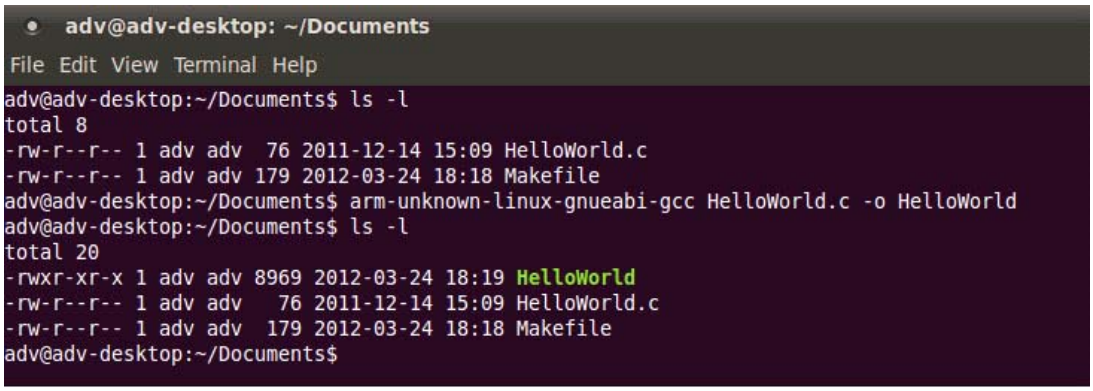
```
#include <stdio.h>
int main(void)
{
   printf(“Hello World!\n”);
   return 0;
}
```

### 3.2.1 Compile HelloWorld.c

1. Create HelloWorld.c on your Linux PC (for example: Ubuntu)



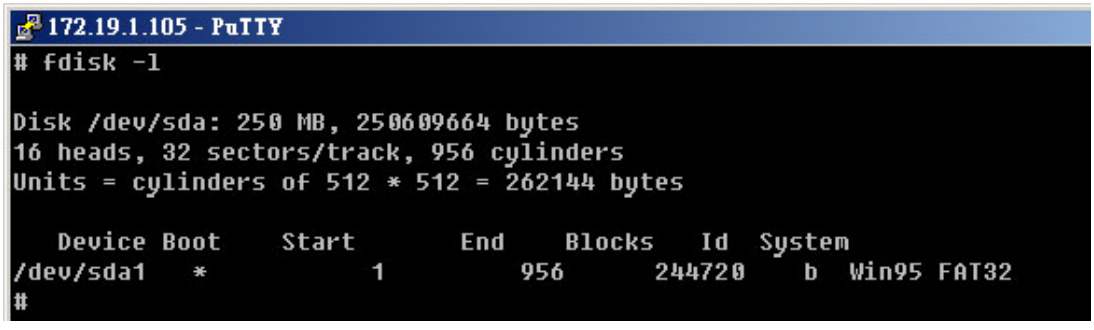

2. Use “arm-unknown-linux-guneabi-gcc” command to compile HelloWorld.c to HelloWord



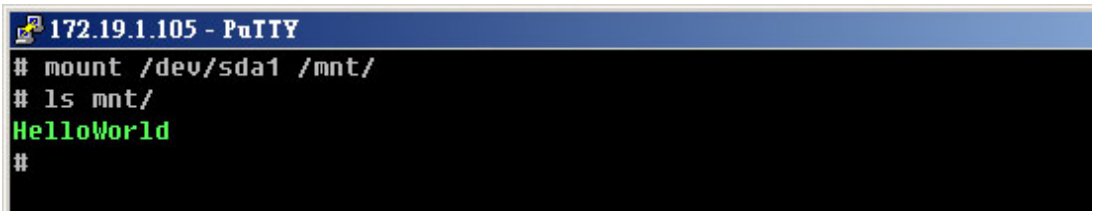

### 3.2.2 Upload “HelloWorld” to the APAX-5522

1. Upload HelloWorld to APAX-5522 by using FTP
   Please refer to the above section 3.9 FTP service.

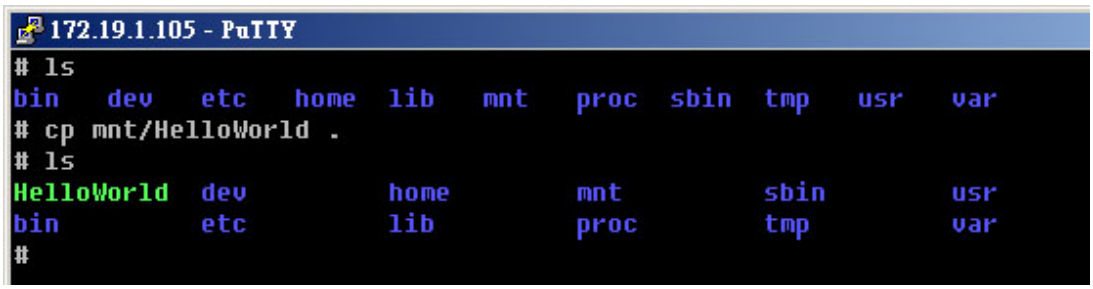
2. Upload HelloWorld to APAX-5522 by using USB storage device.
   a. List the partition tables. This USB storage device node is “/dev/sda1”.




   b. Mount USB storage device.

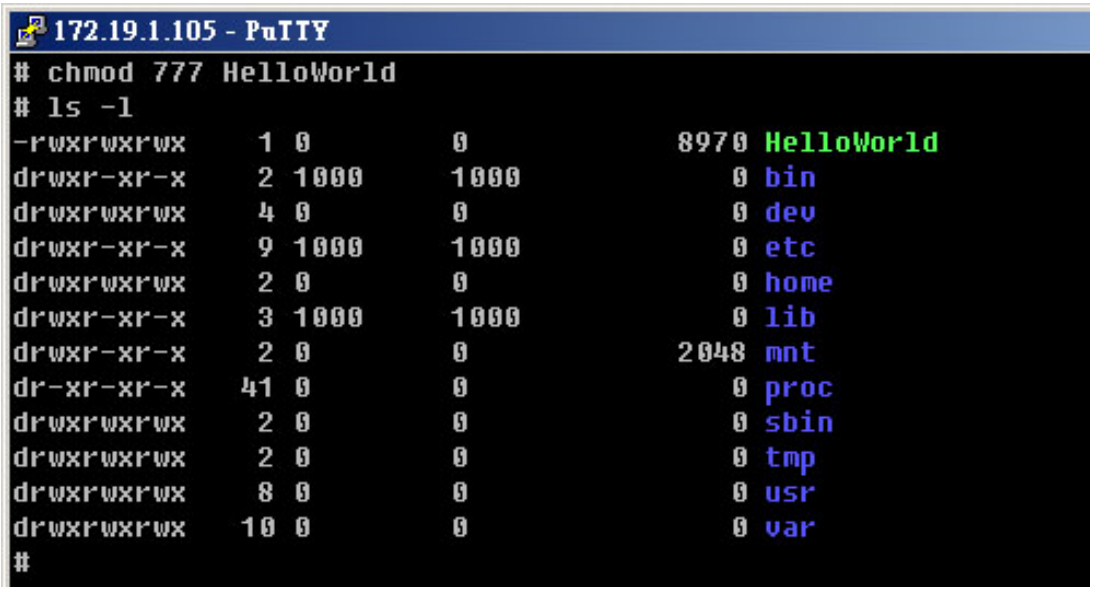


c. Copy HelloWorld to APAX-5522.

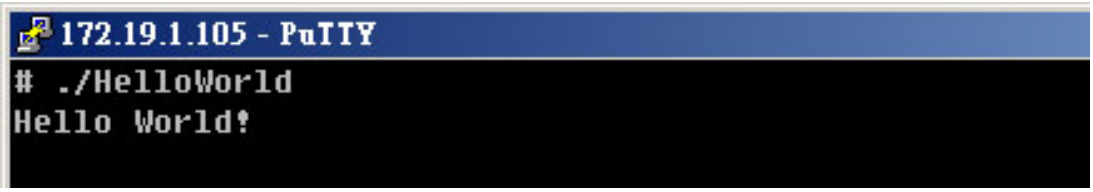



### 3.2.3 Execute “HelloWorld” on the APAX-5522

1. Change HelloWorld file mode bit as 755.




2. Execute HelloWorld program on APAX-5522.




### 3.2.4 Sample Makefile of HelloWorld.c

The following example codes are the sample Makefile of HelloWorld.c.

For example, user can modify the Makefile on demand and put it on your host computer and enter that folder in the host computer, then execute “make” command. The HelloWorld.c will be built.

```
# make
```

Execute “make clean” command will delete the HelloWorld program.

```
# make clean
```

Makefile sample for HelloWorld program

```
CC=arm-unknown-linux-guneabi-gcc
CFLAGS= -O
BINS=HelloWorld

$(BINS): % : %.c
$(CC) $(CFLAGS) -o $@ $<

clean:
rm -f *.o $(BINS)
```

When compiling, if message similar to “cannot find xxx.h files” appears, please make sure the file is under the search directory. If not, please add the file through “-I path”. Path means the path of the header file.

If “undefined reference to XXX” appears, this means the library of this function may not be linked. Please make sure the library file is under the search directory. If not, please add the file through “-L path”. Path means the path of the library.

# Chapter 4

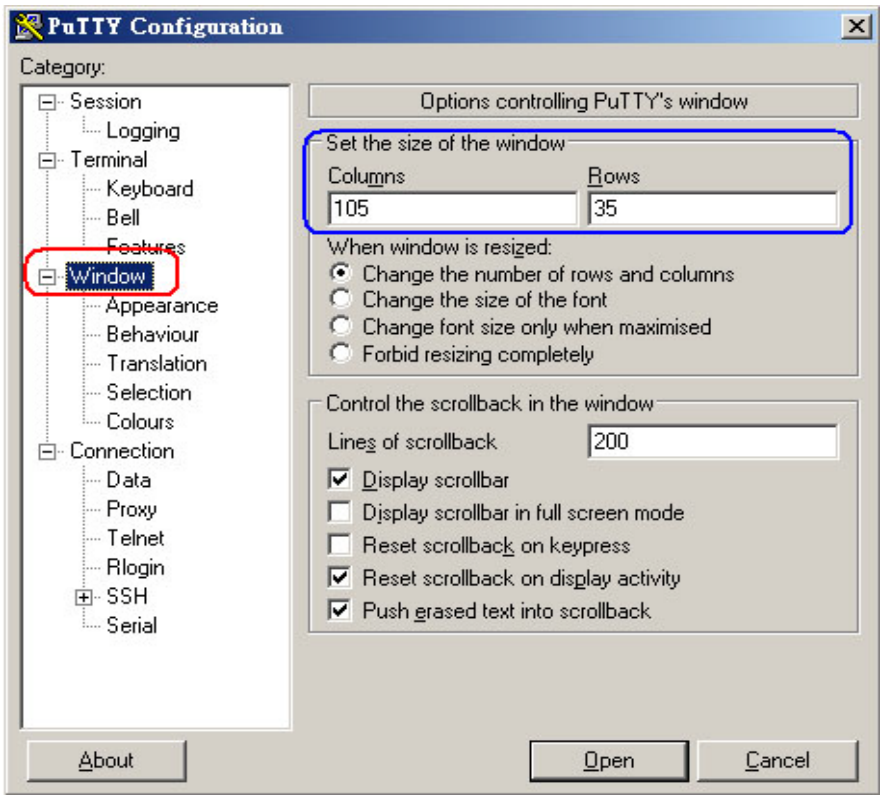
# APAX utility tool kit for Linux

The APAX utility tool kit provides eleven instructions that make it convenient for users to access the APAX-5000 I/O modules. They are located in the path: “/bin”. Please see the description as following.

## 4.1 Overview

| Instruction | Function description |
|---|---|
| apax_UtilityInfo | Display the utility version and support modules |
| apax_GetModuleList | Discovery the APAX-5000 modules |
| apax_GetModuleInfo | Get the APAX-5000 modules information |
| apax_GetChannelInfo | Get the APAX-5000 modules channel information |
| apax_SetChannelValue | Set the APAX-5000 modules channel output |
| apax_SetChannelRange | Set the APAX-5000 modules channel range |
| apax_SetDoConfig | Set the APAX-5000 DO modules configuration |
| apax_SetAoConfig | Set the APAX-5000 AO modules configuration |
| apax_SetCntConfig | Set the APAX-5000 CNT modules configuration |
| apax_TimeStampAI | Get the APAX-5017PE AI module channel with timestamp |
| apax_TimeStampDI | Get the APAX-5040PE DI module channel with timestamp |

***Note!*** *We recommend that when you use command apax_GetChannelInfo which is periodically update function to show the APAX-5000 IO modules channel information, please use Putty or Pietty tool to connect to the APAX-5522 and set the window size of columns and rows as follows for a good display on channel information updating.*




- PuTTY download page

http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

- PieTTY download page

http://ntu.csie.org/~piaip/pietty/

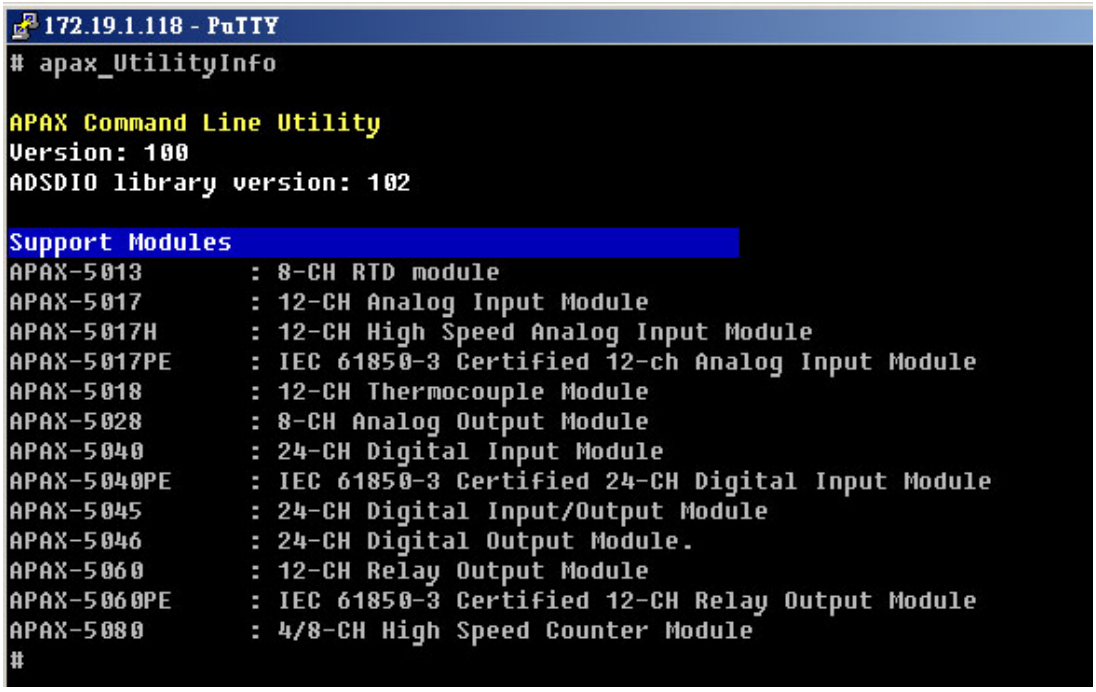
## 4.2 Command introduction

This section includes important information for users to use APAX utility tool kit. Please refer to the parameters of each command in order to correctly use.

### 4.2.1 Display APAX utility information

| Instruction | Function description |
|---|---|
| apax_UtilityInfo | Display the utility version and support modules |
| Usage:<br>apax_UtilityInfo | |
| ■ Parameters:<br>None.<br>■ Result:<br>Display the utility version and support modules | |

#### 4.2.1.1 Demo

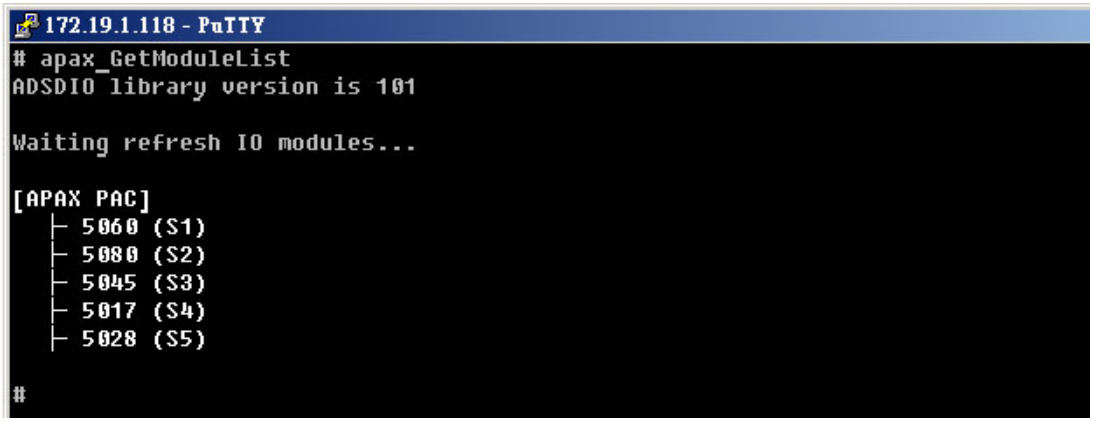



### 4.2.2 Get module list

| Instruction | Function description |
|---|---|
| apax_GetModuleList | Discovery the APAX-5000 modules. |
| Usage:<br>apax_GetModuleList | |

- Parameters:
  None.
- Result:
  Found that the APAX-5000 module name and slot ID.
  **[APAX PAC]**
  **├ Module Name (Slot ID)**
  **…**
  **…**

#### 4.2.2.1 Demo: Discovery the APAX-5000 modules




### 4.2.3 Get module information

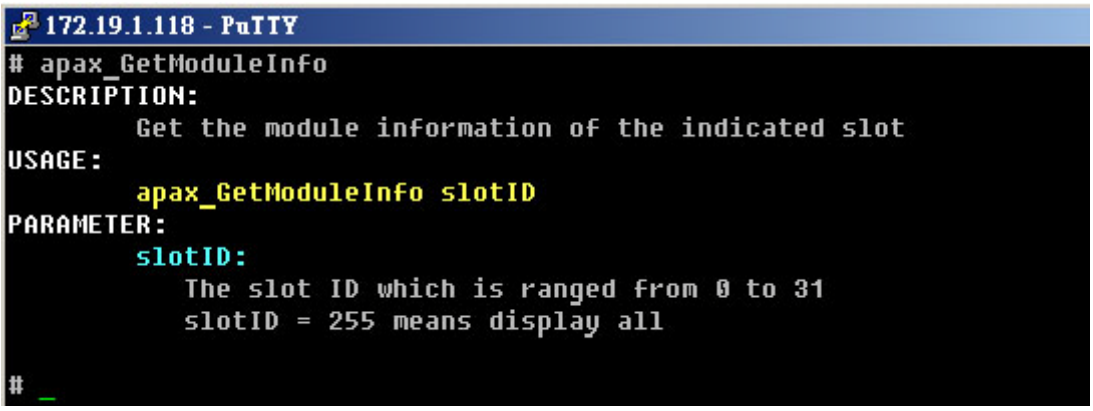
| Instruction | Function description |
|---|---|
| apax_GetModuleInfo | Get the module information of the indicated slot. |

Usage:
apax_GetModuleInfo SlotID

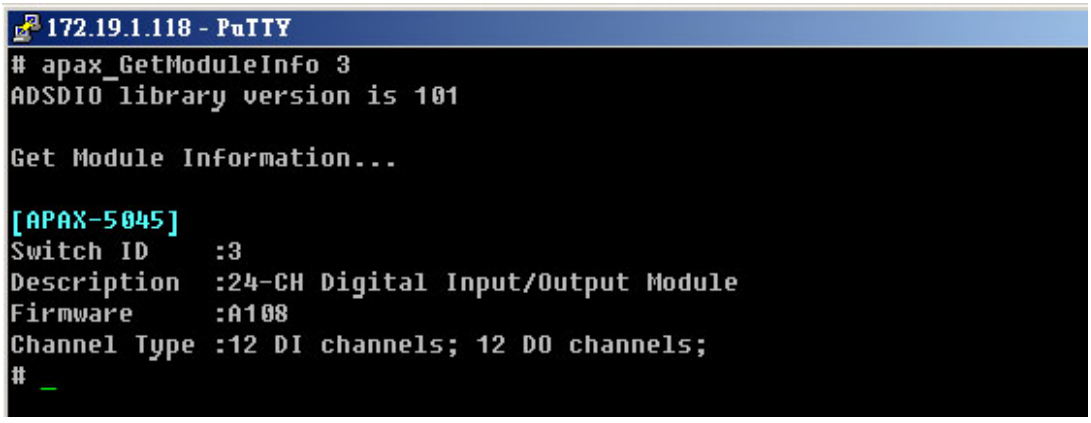
- Parameters:
  None = Display online help
  Slot ID:
  The slot ID which is ranged from 0 to 31
  Slot ID = 255, show all found the APAX-5000 modules.
- Result:
  Found that the APAX-5000 module name and slot ID.
  **[Module Name]**
  **Switch ID :**
  **Description :**
  **Firmware :**
  **Channel Type :**

#### 4.2.3.1 Demo: Get the module information

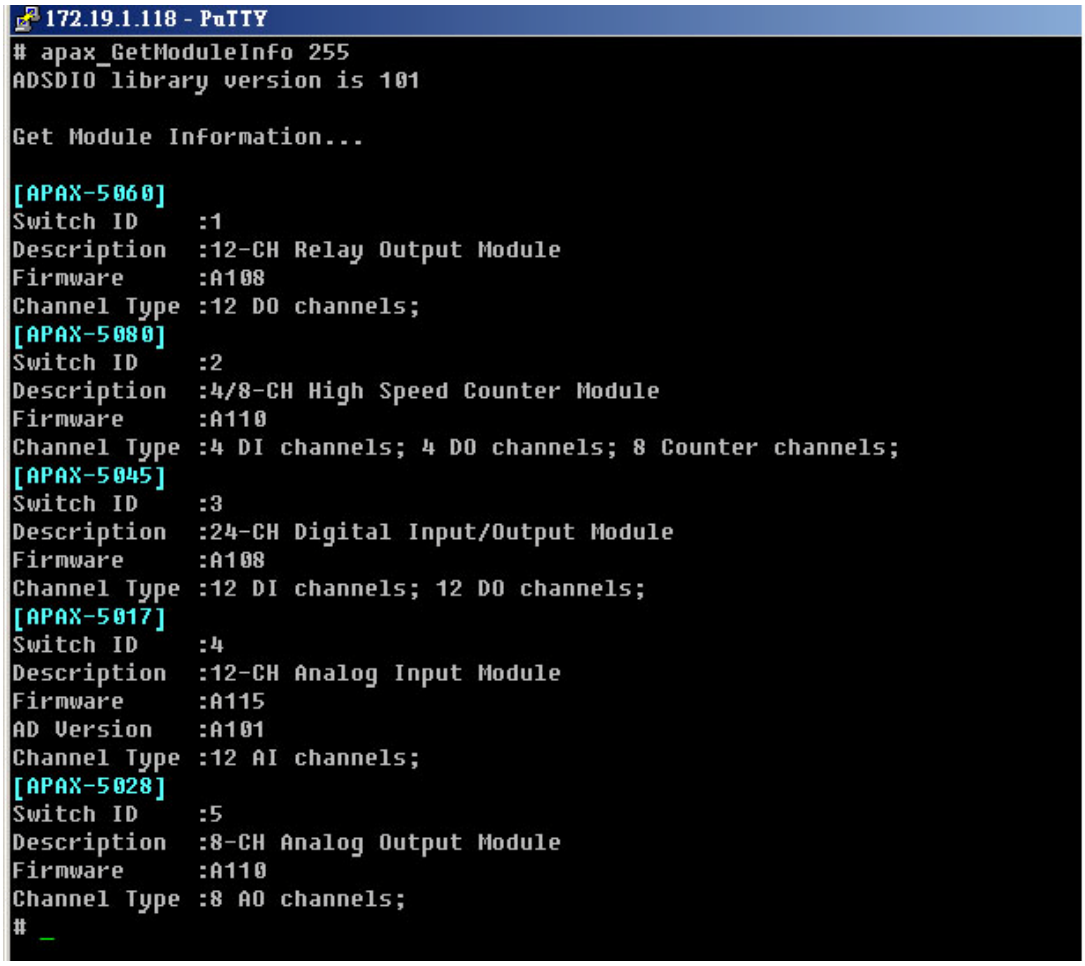
Online help:




Get the one module information:




Get all found the module information: SlotID = 255




### 4.2.4 Get channel information

| Instruction | Function description |
|---|---|
| apax_GetChannelInfo | Periodically update the channel information of the indicated slot ID and channel type. |

Usage:
apax_GetChannelInfo slotID channelType [-p msec] [-n]

- Parameters:
  None = Display online help
  Slot ID:
  The slot ID which is ranged from 0 to 31
  Channel type:
  1 = DI
  2 = DO
  3 = AI
  4 = AO
  5 = COUNTER
  option:
  -p, --Polling interval (msec); default is no delay
  -n, --No polling. Get data once
- Result:
  for example AI module
  **Module Name(Slot ID)**

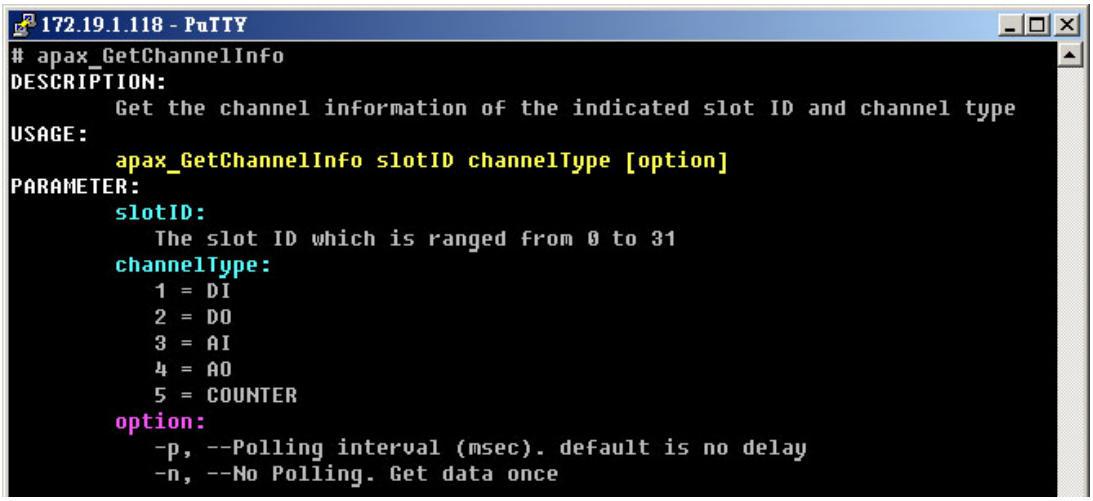
| | Channel Type | Channel ID | Channel value | Channel status | Channel Range |
|---|---|---|---|---|---|

[Note]

Press Esc key to exit the program.

#### 4.2.4.1 Demo: Get DI/DO/AI/AO/CNT channel values

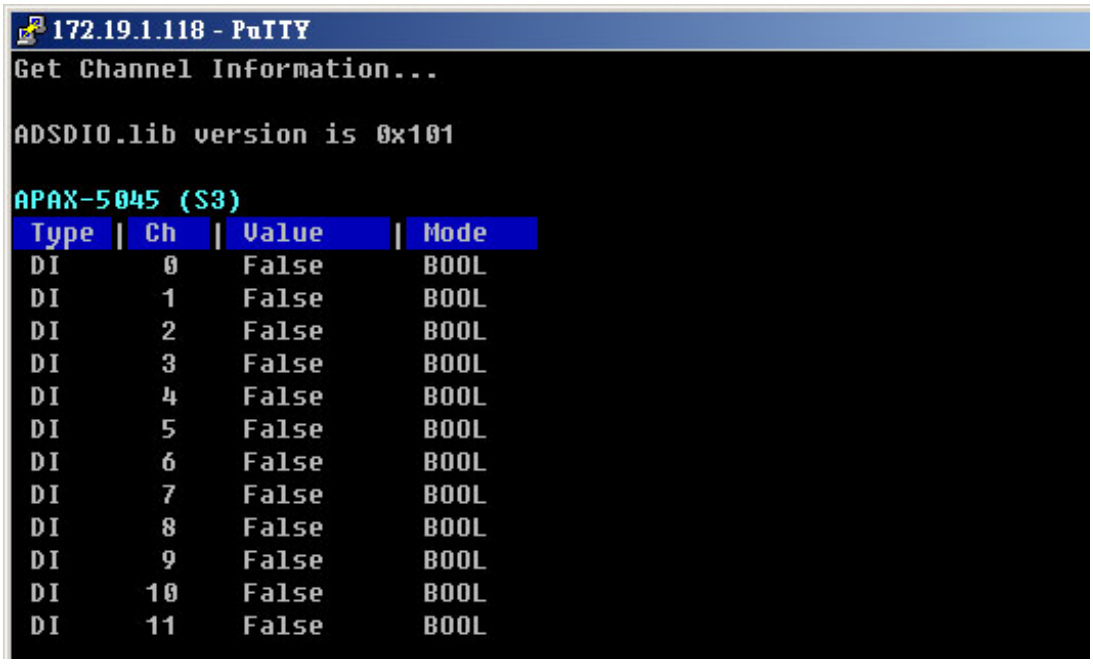
Online help:




For example: APAX-5045 24-CH Digital Input / Output Module

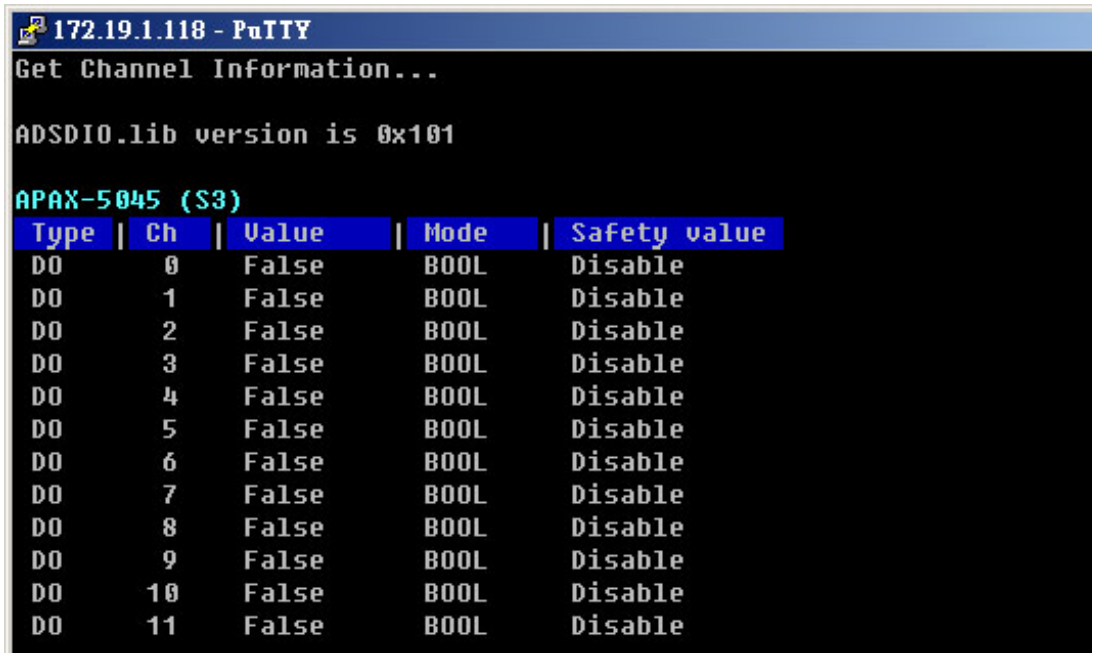
- Get DI channel info

```
# apax_GetChannelInfo 3 1
```



- Get DO channel info

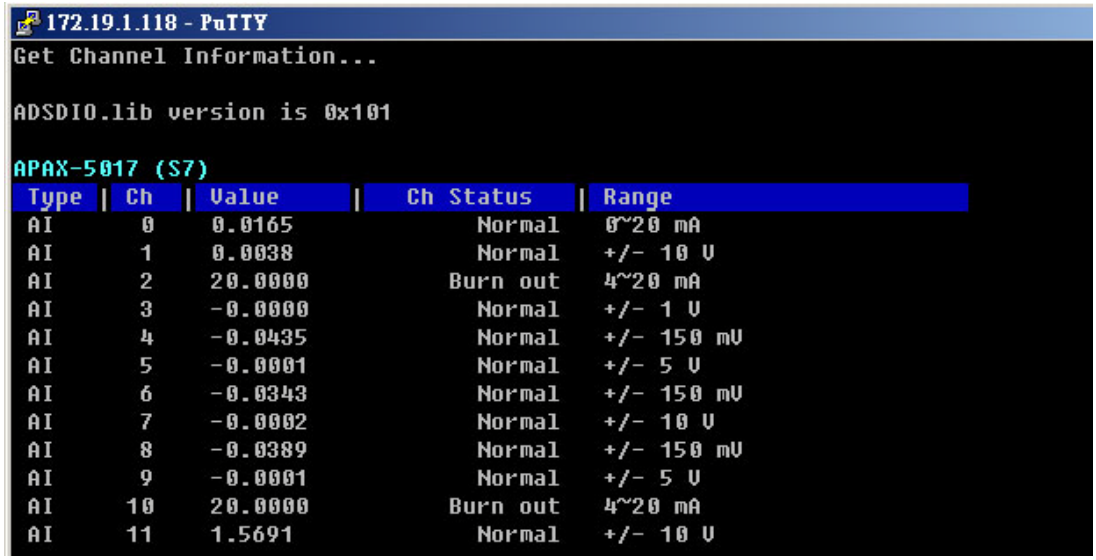
```
# apax_GetChannelInfo 3 2
```




For example: APAX-5017 12-CH Analog Input Module

- Get AI channel info

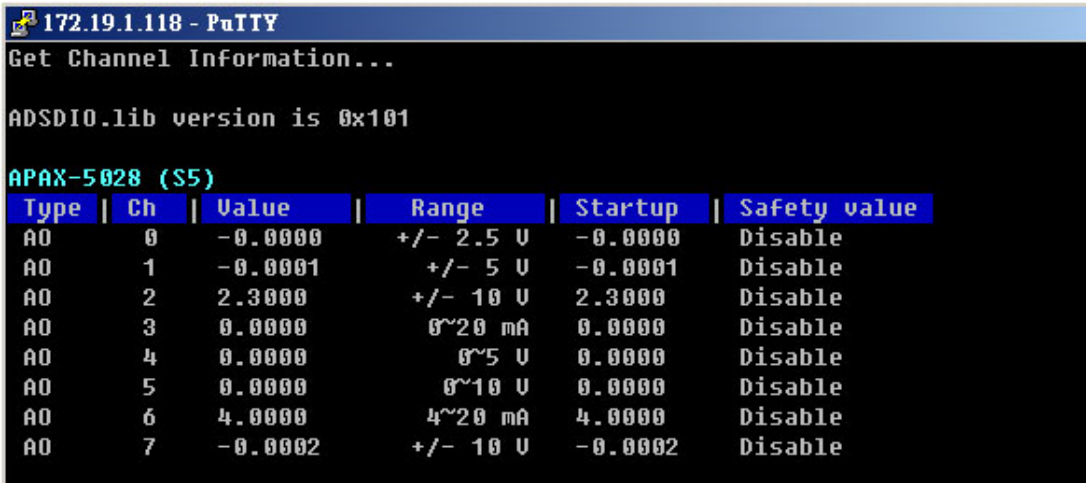
```
# apax_GetChannelInfo 4 3
```



For example: APAX-5028 8-CH Analog Output Module

- Get AO channel info

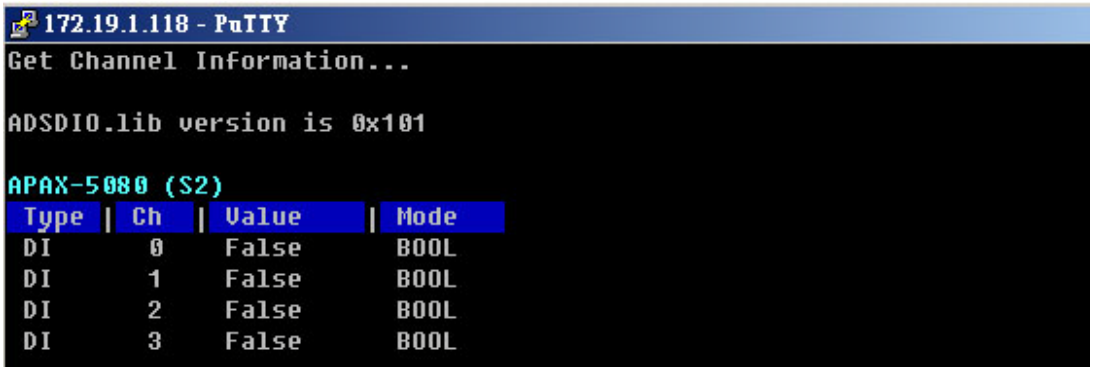
```
# apax_GetChannelInfo 5 4
```




For example: APAX-5080 4/8-CH High Speed Counter Module

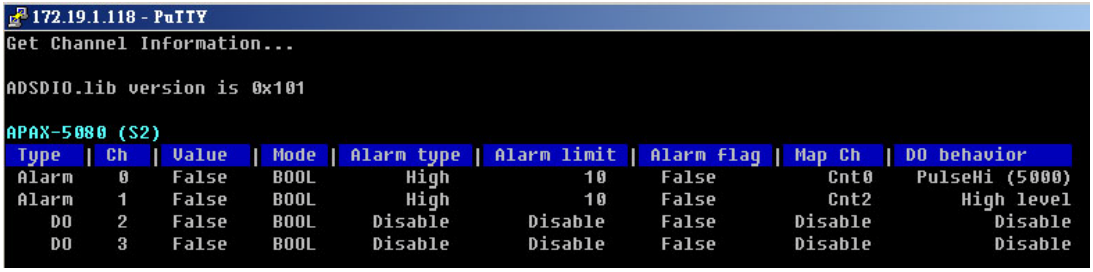
- Get DI channel info

```
# apax_GetChannelInfo 2 1
```



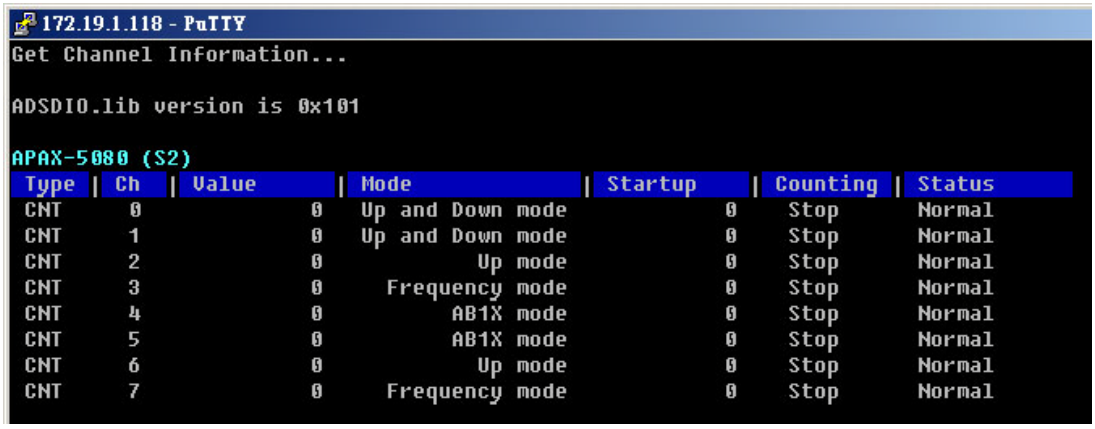

- Get DO channel info

```
# apax_GetChannelInfo 2 2
```



- Get CNT channel info

```
# apax_GetChannelInfo 2 5
```




### 4.2.5 Set channel value

| Instruction | Function description |
|---|---|
| apax_SetChannelValue | Set the module output value of the indicated slot. |

**Set single channel value**

Usage:

apax_GetChannelInfo slotID channelType [-p msec] [-n]

- Parameters:

  None = Display online help

  Slot ID:

  The slot ID which is ranged from 0 to 31

  FuncType:

  1 = set single DO value

  3 = set single AO value

  Channel ID:

  The channel ID starts from 0

  Value:

  The channel value of the indicated channel

  [DO module]

  1 = High

  0 = Low

  [AO module]

  The channel value specified by the channel range.

- Result:

  Show set channel output done or failed message.

**Set multi channel values**

Usage:

apax_SetChannelValue slotID funcType DataLen param0 param1 …

- Parameters:

  None = Display online help

  Slot ID:

  The slot ID which is ranged from 0 to 31

  FuncType:

  2 = set multi DO values

  4 = set multi AO values

  Data length:

  The total of the parameter count.

  if data length is 3, followed by 3 data (param0 param1 param2)

  param0:

  [DO module]

  The DO values from channel 0 to 31 to be set.

  It is DWORD value indicates the channel 0 to 31.

  [AO module]

  The channels mask. From LSB to MSB of the value indicate.

  If the bit is 1, it means that the channel must change value.

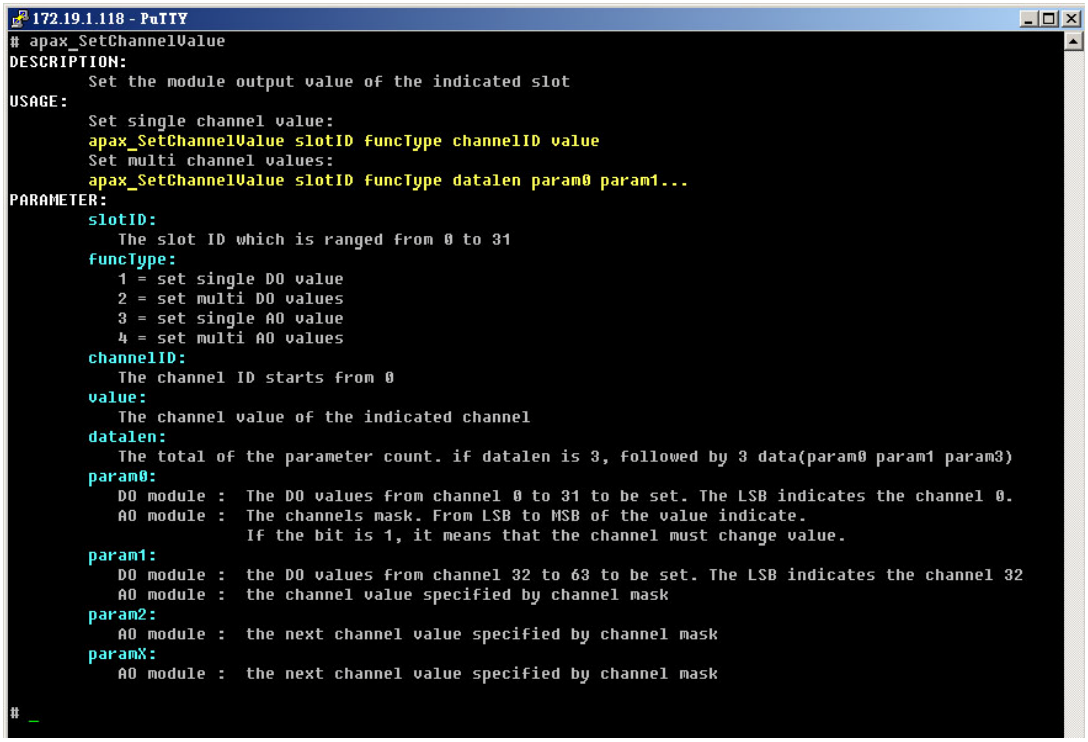
  For example: 11110000(0xf0) means the channel 4 to 7 must change value.

- param1:
  - [DO module]
    - The DO values from channel 32 to 63 to be set.
      It is DWORD value indicates the channel 32 to 63.
      Bit 0 indicates the channel 32 and bit 31 indicates the channel 63.
  - [AO module]
    - The channel value specified by the channel range.
- param2:
  - [AO module]
    - The next channel value specified by channel range.
- paramX:
  - [AO module]
    - The next channel value specified by channel range.

- Result:
  Show set channel output done or failed message.

#### 4.2.5.1 Demo: Set DO/AO channel output

Online help:

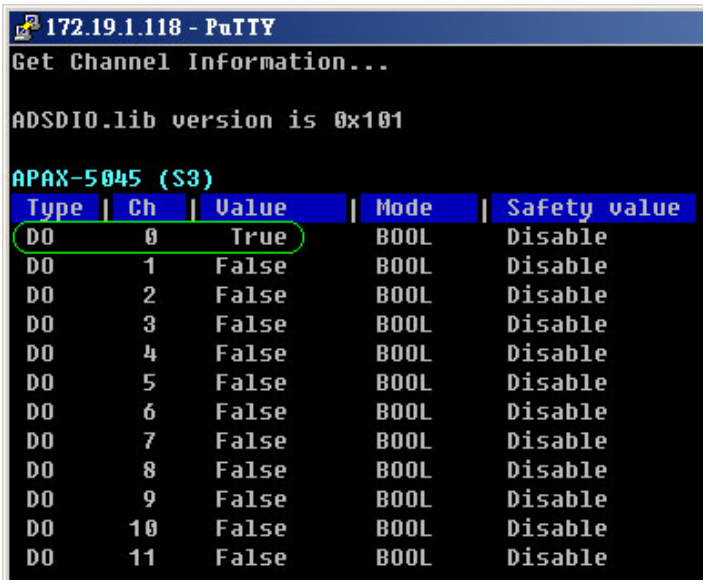



For example: APAX-5045 24-CH Digital Input / Output Module

- Set single DO channel output: set channel 0 as HIGH

```
# apax_SetChannelValue 3 1 0 1
```

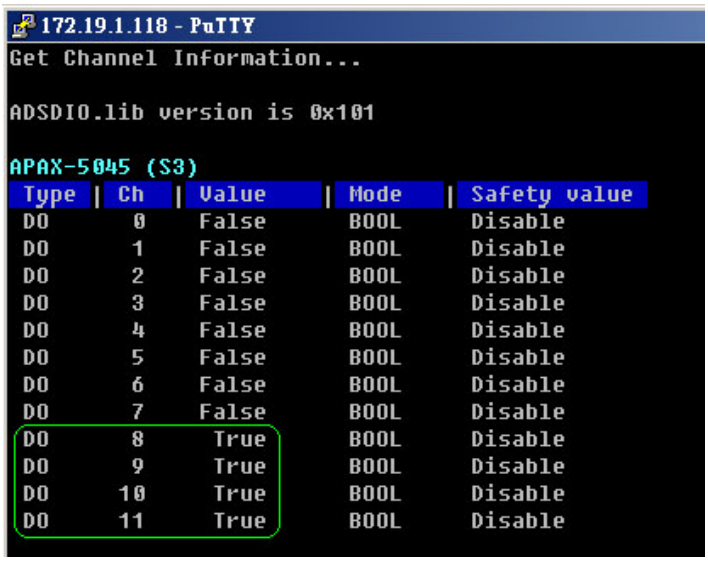
User can use the apax_GetChannelInfo command to check the result:




- Set multi DO channels output:
  Set channel 8 to 11 as HIGH
  The DO values will be 111100000000 (0xf00)

```
# apax_SetChannelValue 3 2 1 0xf00
```

User can use the apax_GetChannelInfo command to check the result:

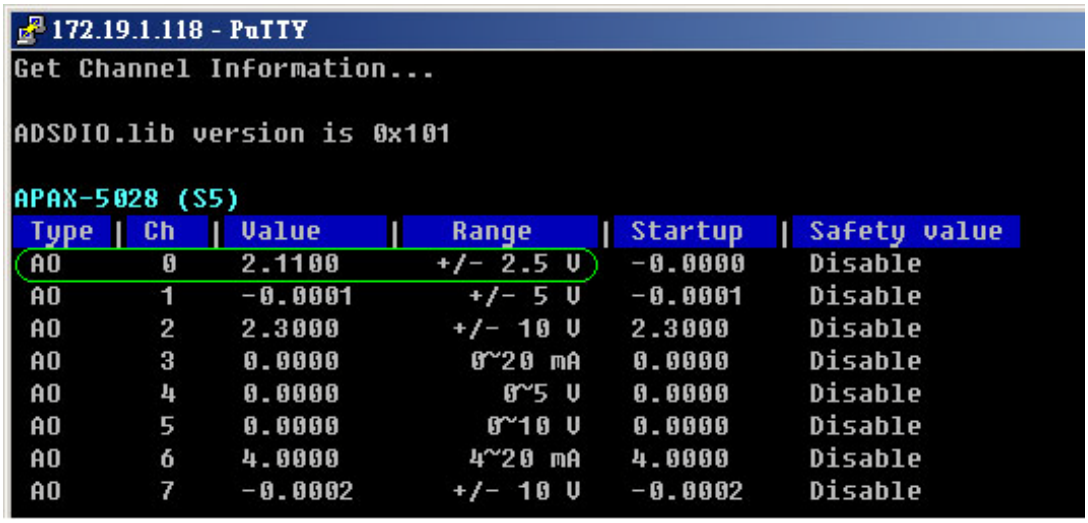



For example: APAX-5028 8-CH Analog Output Module

- Set single AO channel output: set channel 0 output as 2.11 volts

```
# apax_SetChannelValue 5 3 0 2.11
```

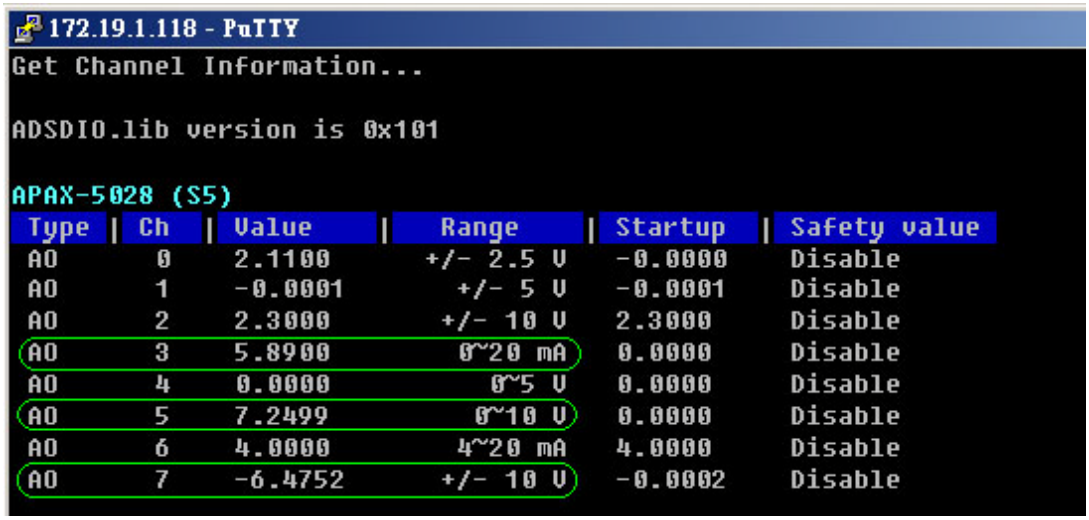
User can use the apax_GetChannelInfo command to check the result:




- Set multi AO channels output:
  Set channel 3 output as 5.89 mA
  Set channel 5 output as 7.25 volts
  Set channel 7 output as - 6.475 volts
  The channel mask will be 10101000 (0xA8)

```
# apax_SetChannelValue 5 4 4 0xA8 5.89 7.25 -6.475
```

User can use the apax_GetChannelInfo command to check the result:



- Get DO channel info

```
# apax_GetChannelInfo 2 2
```

## 4.2.6 Set channel range

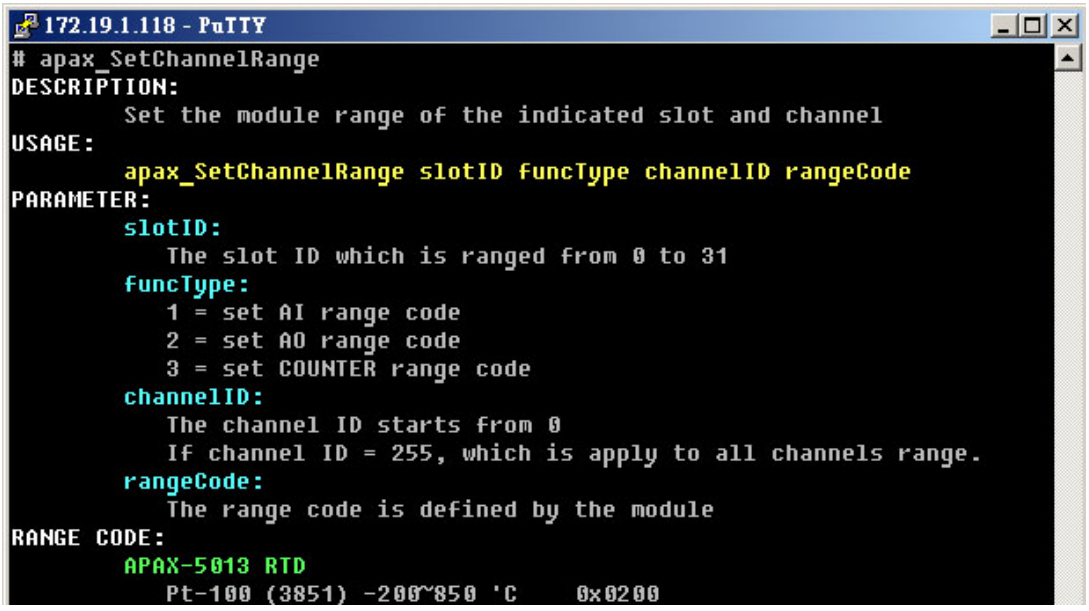
| Instruction | Function description |
|---|---|
| apax_SetChannelRange | Set the channel range of the indicated slot and channel |

Usage:
apax_SetChannelRange slotID funcType channelID rangeCode

- Parameters:
  None = Display online help
  Slot ID:
  The slot ID which is ranged from 0 to 31
  FuncType:
  1 = set AI range code
  2 = set AO range code
  3 = set COUNTER range code
  Channel ID:
  The channel ID starts from 0
  If channel ID = 255, which is apply to all channels range.
  Range Code:
  The range code is defined by the module.
  Please refer to the online help or section of appendix A.
- Result:
  Show set channel range done or failed message.

### 4.2.6.1 Demo: Set AI/AO/CNT channel range

Online help:

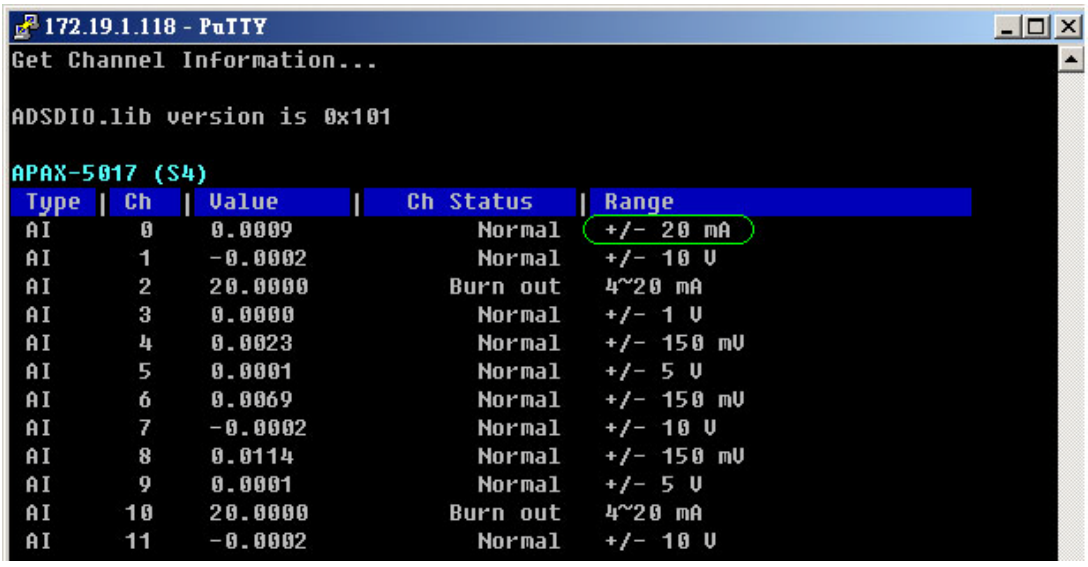



For example: APAX-5017 12-CH Analog Input Module

- Set AI channel range: set channel 0 range code as 0x0181(+/- 20 mA)

```
# apax_SetChannelRange 4 1 0 0x0181
```

User can use the apax_GetChannelInfo command to check the result:

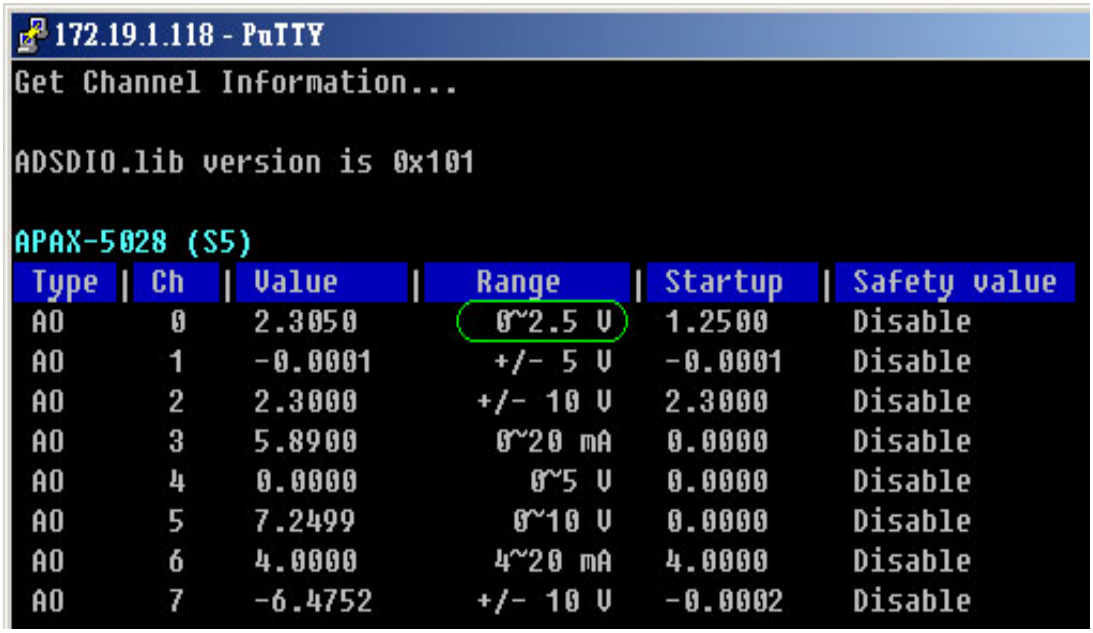



For example: APAX-5028 8-CH Analog Output Module

- Set AO channel range: set channel 0 range code as 0x0146(0~2.5 V)

```
# apax_SetChannelRange 5 2 0 0x0146
```

User can use the apax_GetChannelInfo command to check the result:

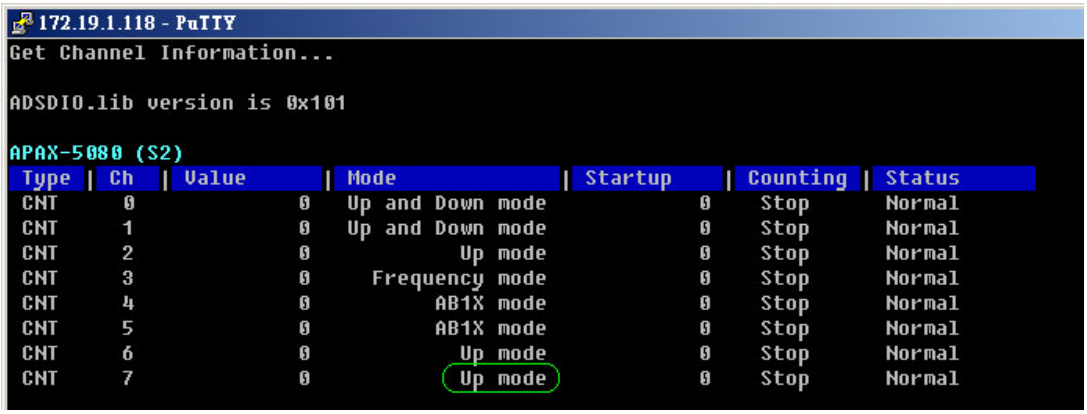



For example: APAX-5028 4/8-CH High Speed Counter Module

- Set CNT channel range: set channel 7 range code as 0x01c2 (Up mode)

```
# apax_SetChannelRange 2 3 7 0x01c2
```

User can use the apax_GetChannelInfo command to check the result:

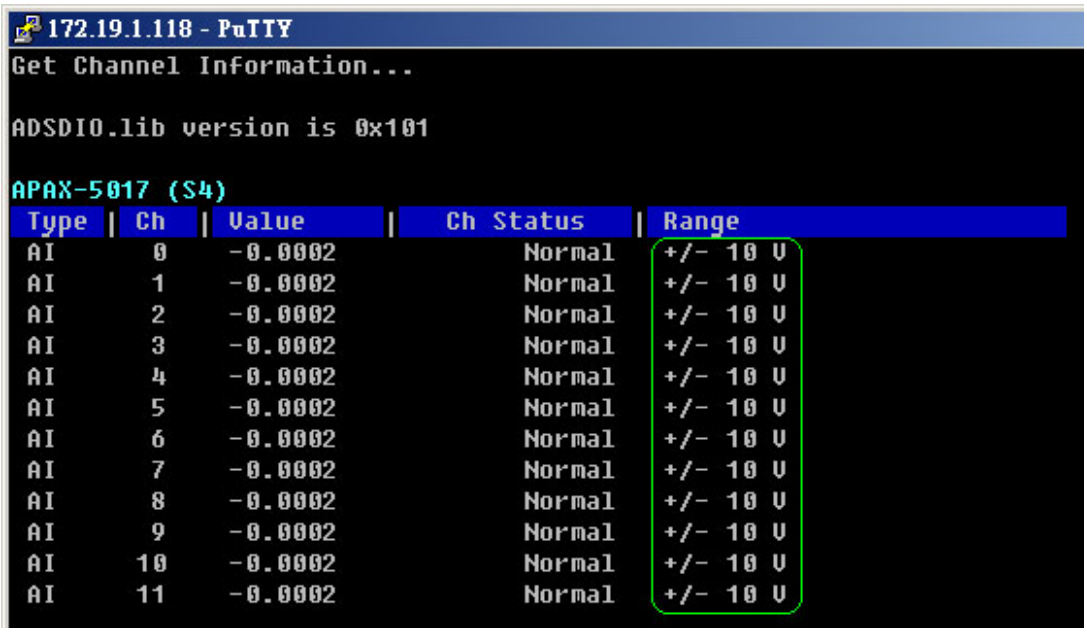



For example: APAX-5017 12-CH Analog Input Module

- Set all channel range code as 0x0143 (+/- 10 V)

```
# apax_SetChannelRange 4 1 255 0x0143
```

User can use the apax_GetChannelInfo command to check the result:



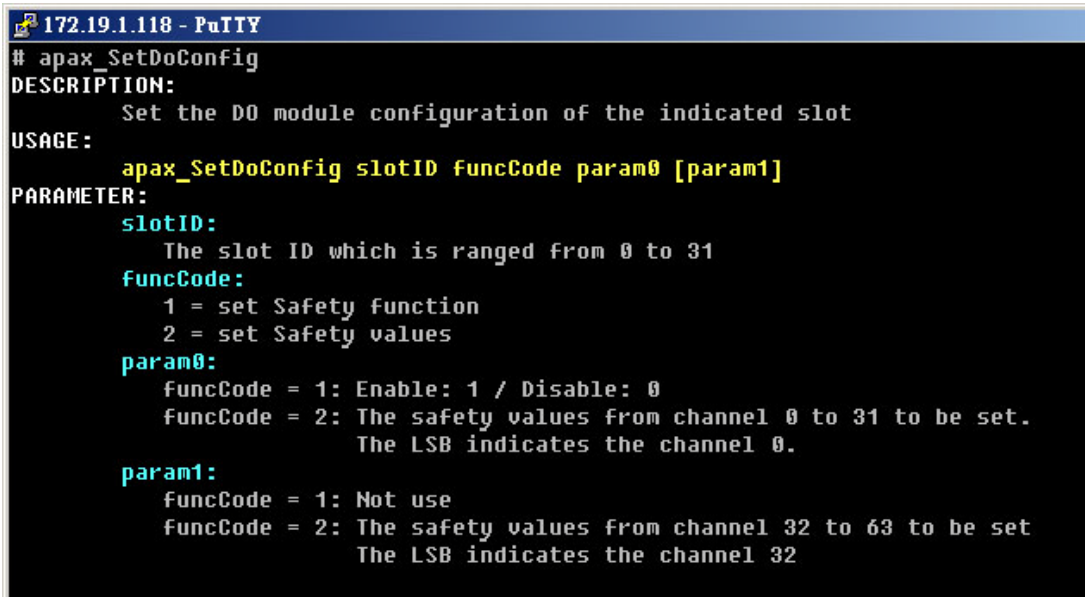

### 4.2.7 Set DO module configuration

| Instruction | Function description |
|---|---|
| apax_SetDoConfig | Set the DO module configuration of the indicated slot |
| Usage:<br>apax_SetDoConfig slotID funcCode param0 [param1] | |

- Parameters:
  None = Display online help
  Slot ID:
  The slot ID which is ranged from 0 to 31
  FuncCode:
  1 = set Safety function
  2 = set Safety values
  Parm0:
  funcCode = 1: Enable: 1 / Disable: 0
  funcCode = 2: The safety values from channel 0 to 31 to be set.
  The LSB indicates the channel 0.
  Param1:
  funcCode = 1: Not use
  funcCode = 2: The safety values from channel 32 to 63 to be set
  The LSB indicates the channel 32
- Result:
  Show set DO configuration done or failed message.

#### 4.2.7.1 Demo: Set DO configuration

Online help:




For example: APAX-5060 12-CH Relay Output Module

- Set safety function enable

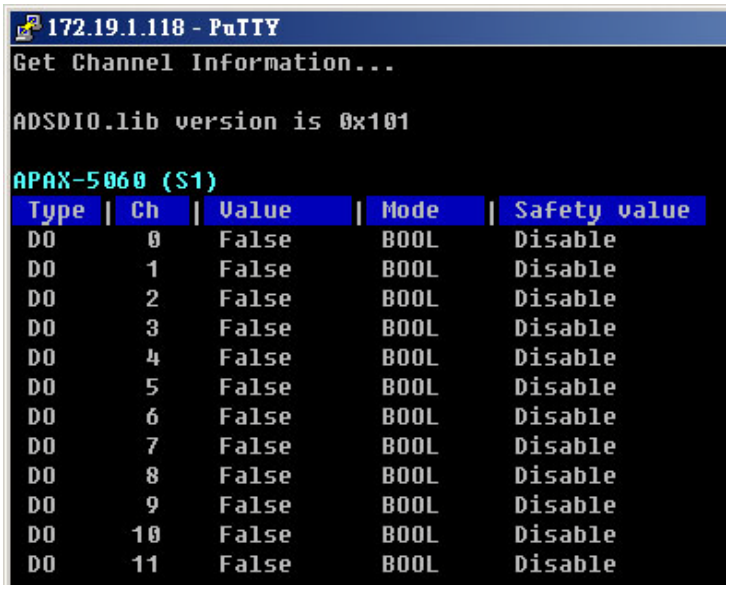
```
# apax_SetDoConfig 1 1 1
```

For example: APAX-5028 4/8-CH High Speed Counter Module

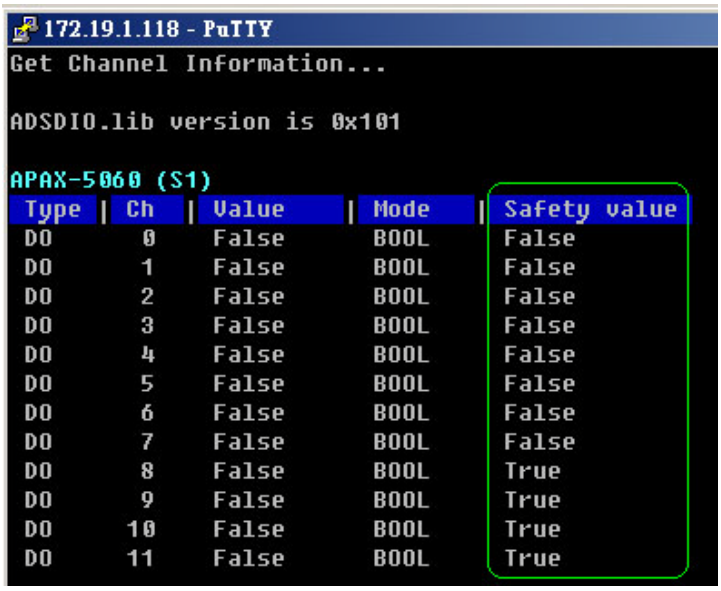
- Set channel 8 to 11 safety value as HIGH

```
# apax_SetDoConfig 1 2 0xf00
```

User can use the apax_GetChannelInfo command to check the result:
Before:




After:




### 4.2.8 Set AO module configuration

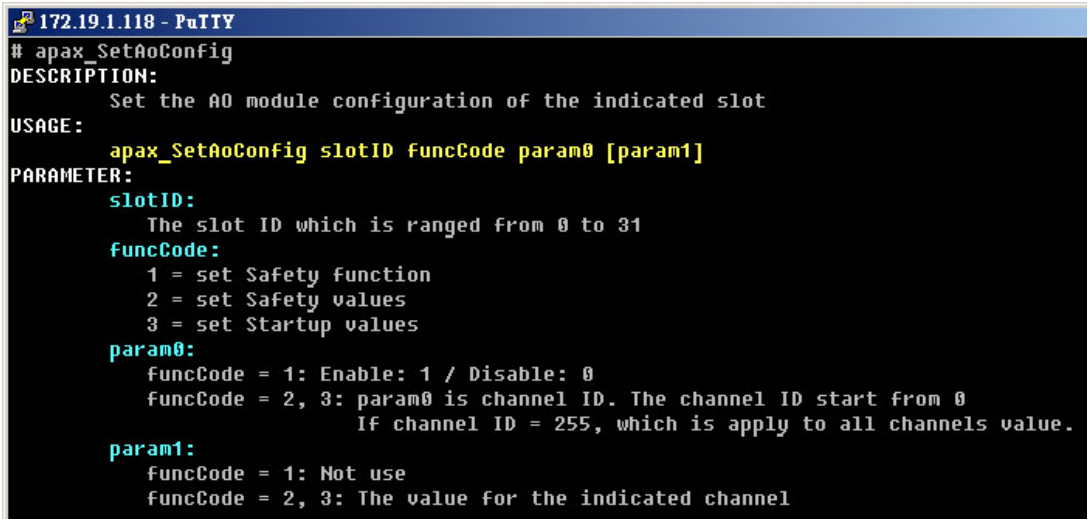
| Instruction | Function description |
|---|---|
| apax_SetAoConfig | Set the AO module configuration of the indicated slot |
| Usage:<br>apax_SetAoConfig slotID funcCode param0 [param1] | |

- Parameters:
  None = Display online help
  Slot ID:
  The slot ID which is ranged from 0 to 31
  FuncCode:
  1 = set Safety function
  2 = set Safety values
  3 = set Startup values
  Parm0:
  funcCode = 1: Enable: 1 / Disable: 0
  funcCode = 2, 3: param0 is channel ID. The channel ID start from 0
  If channel ID = 255, which is apply to all channels value.
  Param1:
  funcCode = 1: Not use
  funcCode = 2: The value for the indicated channel

- Result:
  Show set AO configuration done or failed message.

#### 4.2.8.1 Demo: Set AO configuration

Online help:




For example: APAX-5028 8-CH Analog Output Module

- Set safety function enable

```
# apax_SetAoConfig 5 1 1
```

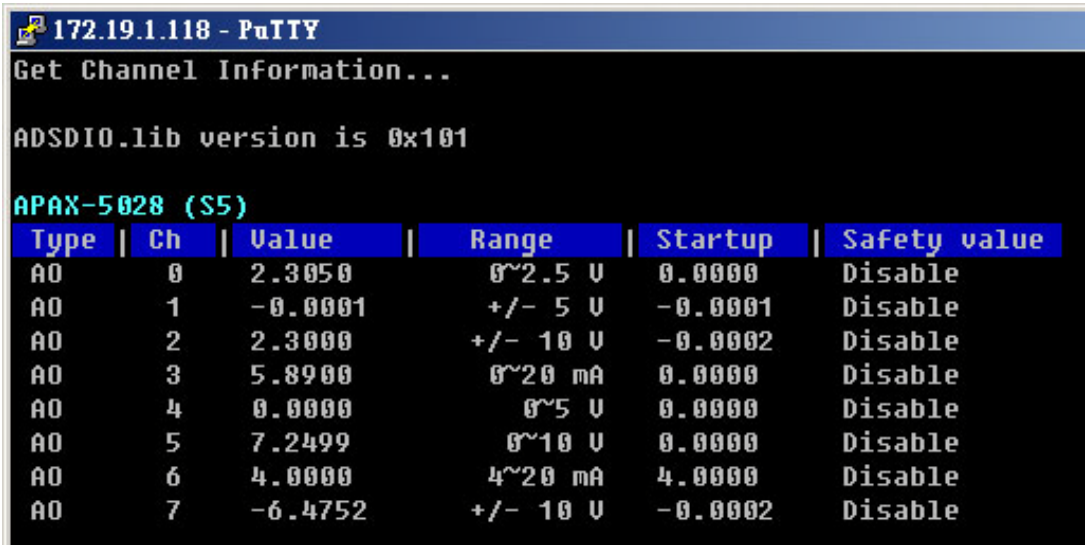
- Set channel 0 safety value as 2.3 volts

```
# apax_SetAoConfig 5 2 0 2.30
```

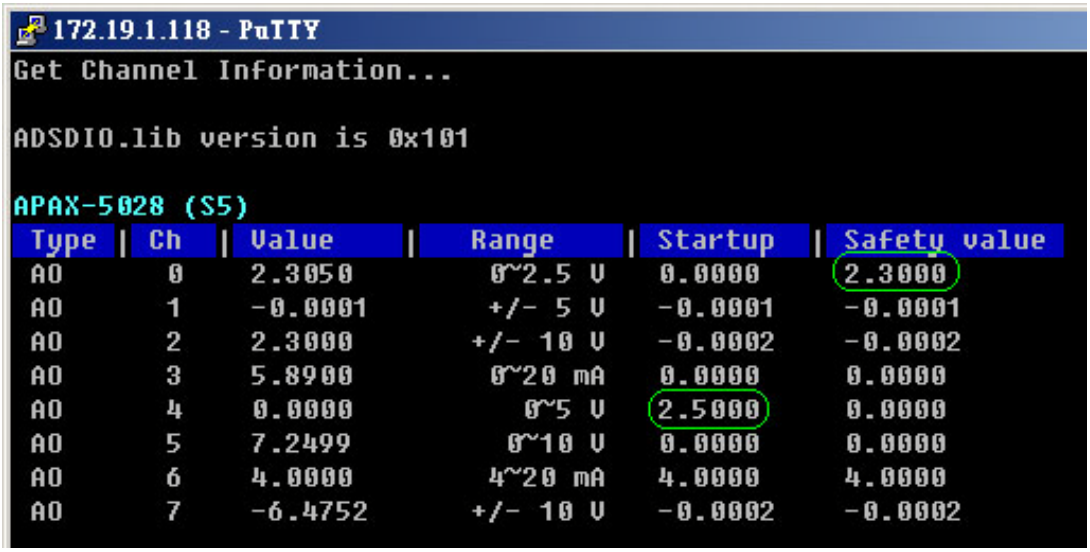
- Set channel 4 startup value as 2.5 volts

```
# apax_SetAoConfig 5 3 4 2.5
```

User can use the apax_GetChannelInfo command to check the result:
Before:




After:




### 4.2.9 Set CNT module configuration

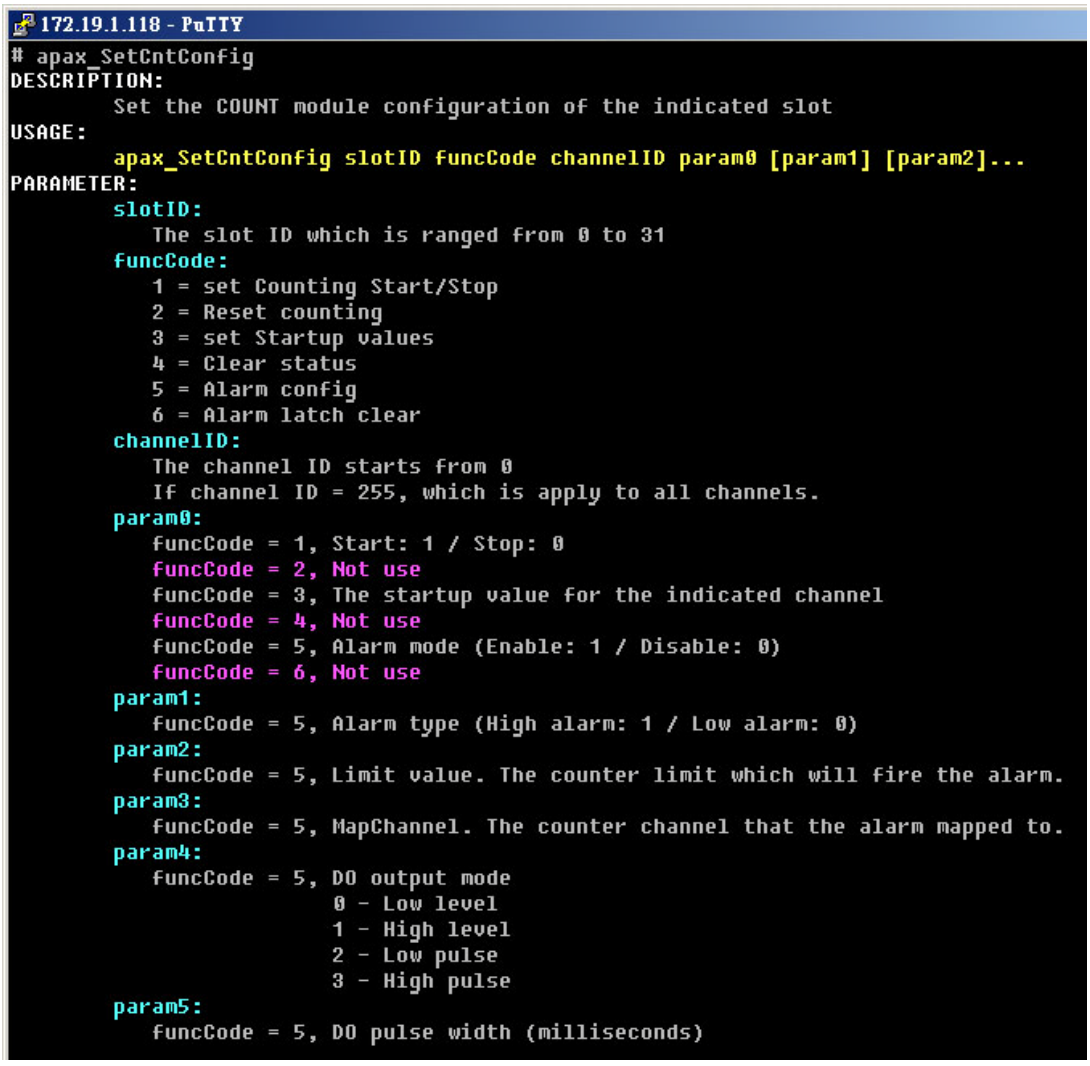
| Instruction | Function description |
|---|---|
| apax_SetCntConfig | Set the CNT module configuration of the indicated slot |
| Usage:<br>apax_SetCntConfig slotID funcCode channelID param0 [param1]… | |

- Parameters:
  None = Display online help
  Slot ID:
  The slot ID which is ranged from 0 to 31
  FuncCode:
  1 = set Counting Start/Stop
  2 = Reset counting
  3 = set Startup values
  4 = Clear status
  5 = Alarm config
  6 = Alarm latch clear
  Channel ID:
  The channel ID starts from 0
  If channel ID = 255, which is apply to all channels.
  Parm0:
  funcCode = 1, Start: 1 / Stop: 0
  funcCode = 2, Not use
  funcCode = 3, The startup value for the indicated channel
  funcCode = 4, Not use
  funcCode = 5, Alarm mode (Enable: 1 / Disable: 0)
  funcCode = 6, Not use
  Param1:
  funcCode = 5, Alarm type (High alarm: 1 / Low alarm: 0)
  Param2:
  funcCode = 5, Limit value. The counter limit which will fire the alarm.
  Param3:
  funcCode = 5, MapChannel. The counter channel that the alarm mapped to.
  Param4:
  funcCode = 5, DO output mode
  0 - Low level
  1 - High level
  2 - Low pulse
  3 - High pulse
  Param5:
  funcCode = 5, DO pulse width (milliseconds)

- Result:
  Show set CNT configuration done or failed message.

#### 4.2.9.1 Demo: Set CNT configuration

Online help:




For example: APAX-5028 4/8-CH High Speed Counter Module

- Set channel 0 startup value as 10. --------(1)

```
# apax_SetCntConfig 2 3 0 10
```

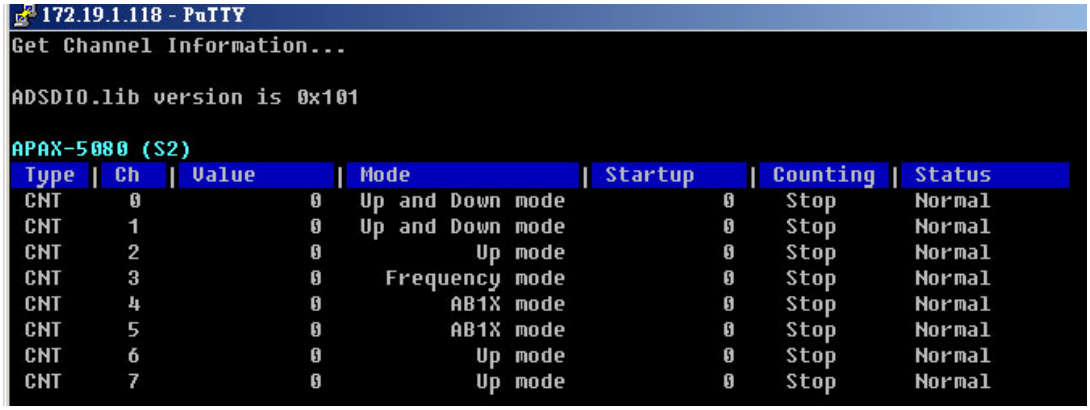
- Reset channel 0 counter value. --------(2)

```
# apax_SetCntConfig 2 2 0
```

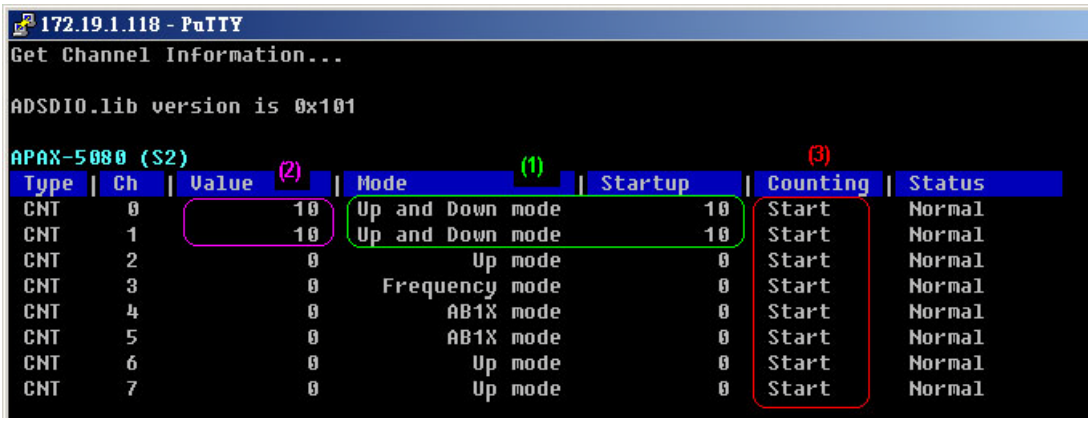
- Set all channel counting start. --------(3)

```
# apax_SetCntConfig 2 1 255 1
```

User can use the apax_GetChannelInfo command to check the result:
Before:




After:



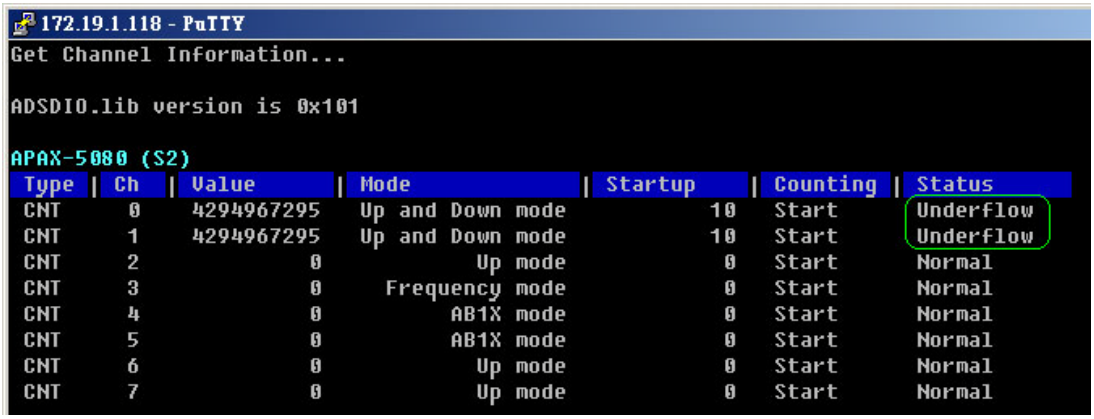

If the count status abnormal. The counting will stop. Users can clear the status as following command:

- Clear channel 0 count status.

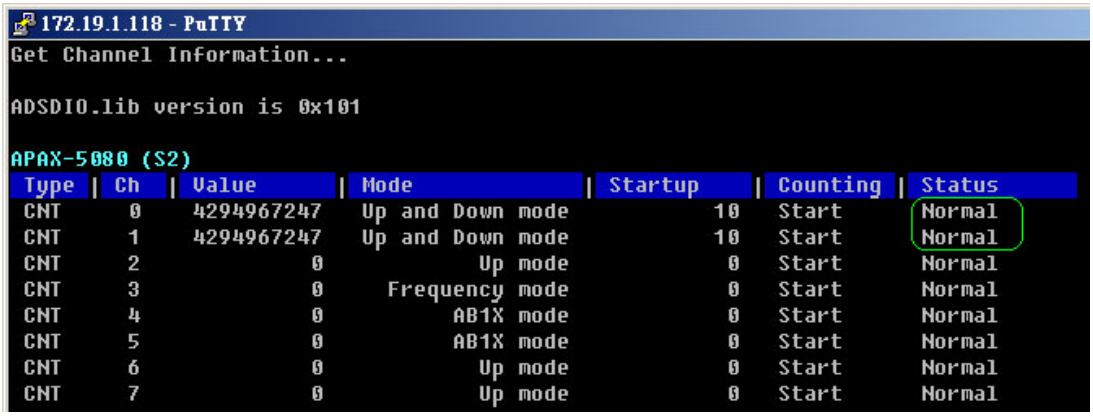
```
# apax_SetCntConfig 2 4 0
```

User can use the apax_GetChannelInfo command to check the result:

Before:



After:

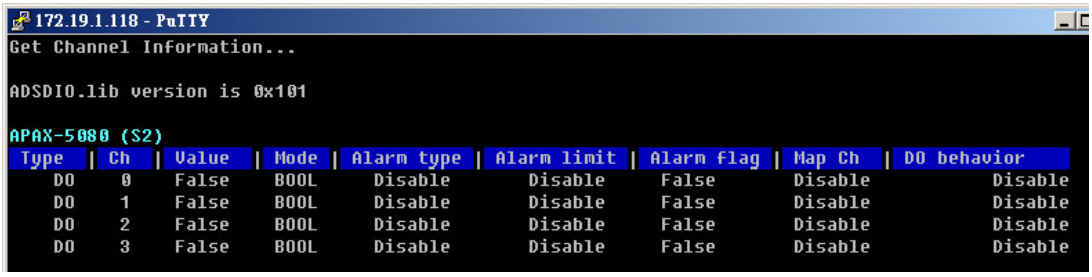



The APAX-5028 DO channel can be configured as an alarm channel. When the count value exceeds the limit, the alarm will occur.

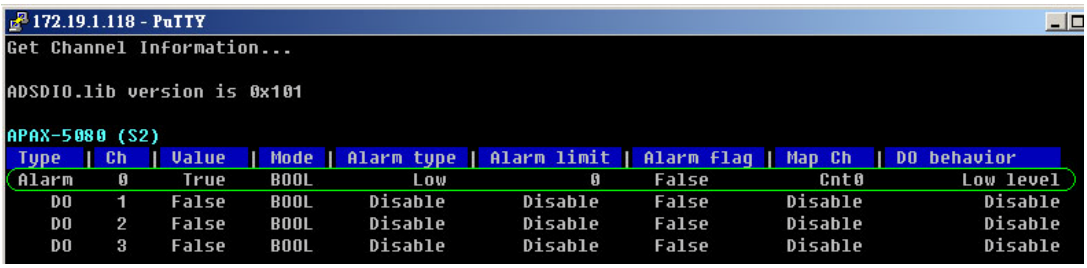
- Set DO channel 0 as an alarm channel. You can us below command to enable alarm mode.

```
# apax_SetCntConfig 2 5 0 1
```

User can use the apax_GetChannelInfo command to check the result:
Before:



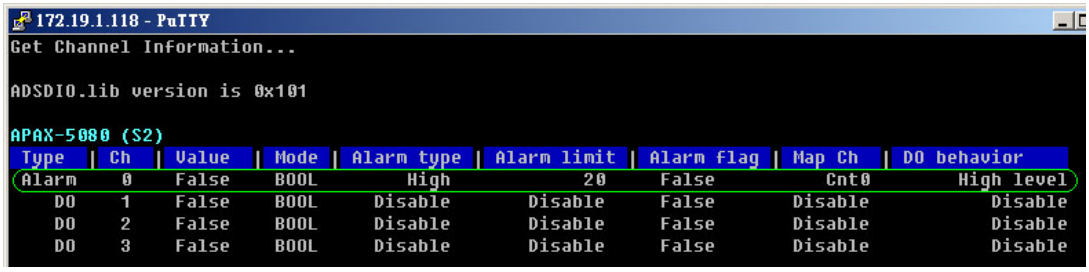

After:



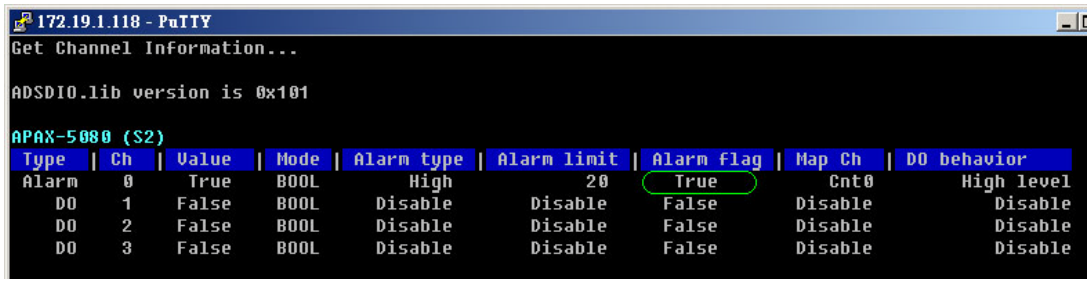

- Set the channel 0 alarm configuration.
  Set Alarm type as High trigger.
  Set Alarm limit as 20.
  Set Alarm mapping channel as CNT channel 0.
  Set DO output behavior as high level.

```
# apax_SetCntConfig 2 5 0 1 1 20 0 1
```

User can use the apax_GetChannelInfo command to check the result:

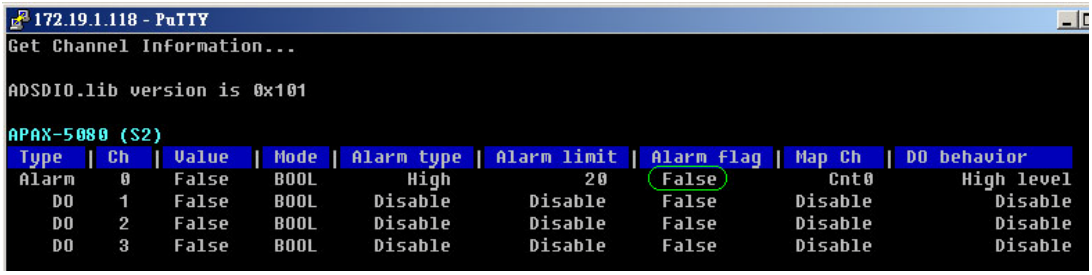



When the count value exceeds the limit, the alarm will occur and the DO channel 0 will remain at high level until the alarm flag is cleared to 0.




- Clear channel 0 alarm flag

```
# apax_SetCntConfig 2 6 0
```




### 4.2.10 Get the APAX-5017PE AI module with timestamp

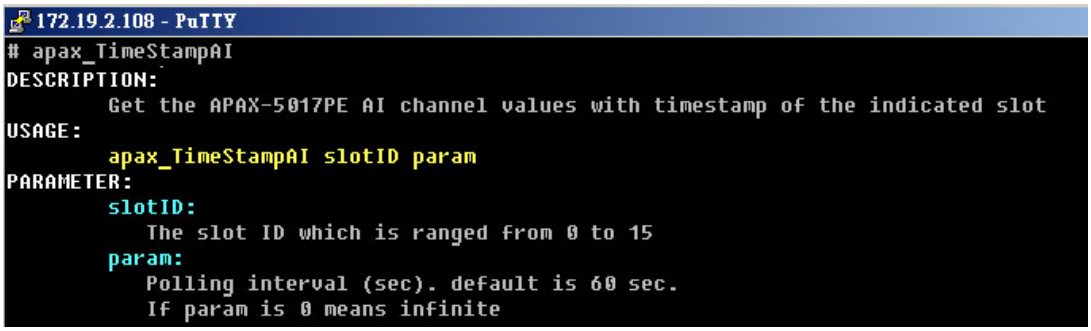
| Instruction | Function description |
|---|---|
| apax_TimeStampAI | Get the APAX-5017PE AI channel values with timestamp |
| Usage:<br>apax_TimeStampAI slotID param | |

- Parameters:
  Slot ID:
  The slot ID which is ranged from 0 to 31
  Param:
  Polling interval (sec). default is 60 sec.
  If param is 0 means infinite

- Result:
  Show the AI channel value with timestamp.
  Single AI Data [Range code]
  Channel index
  Time offset (ms)

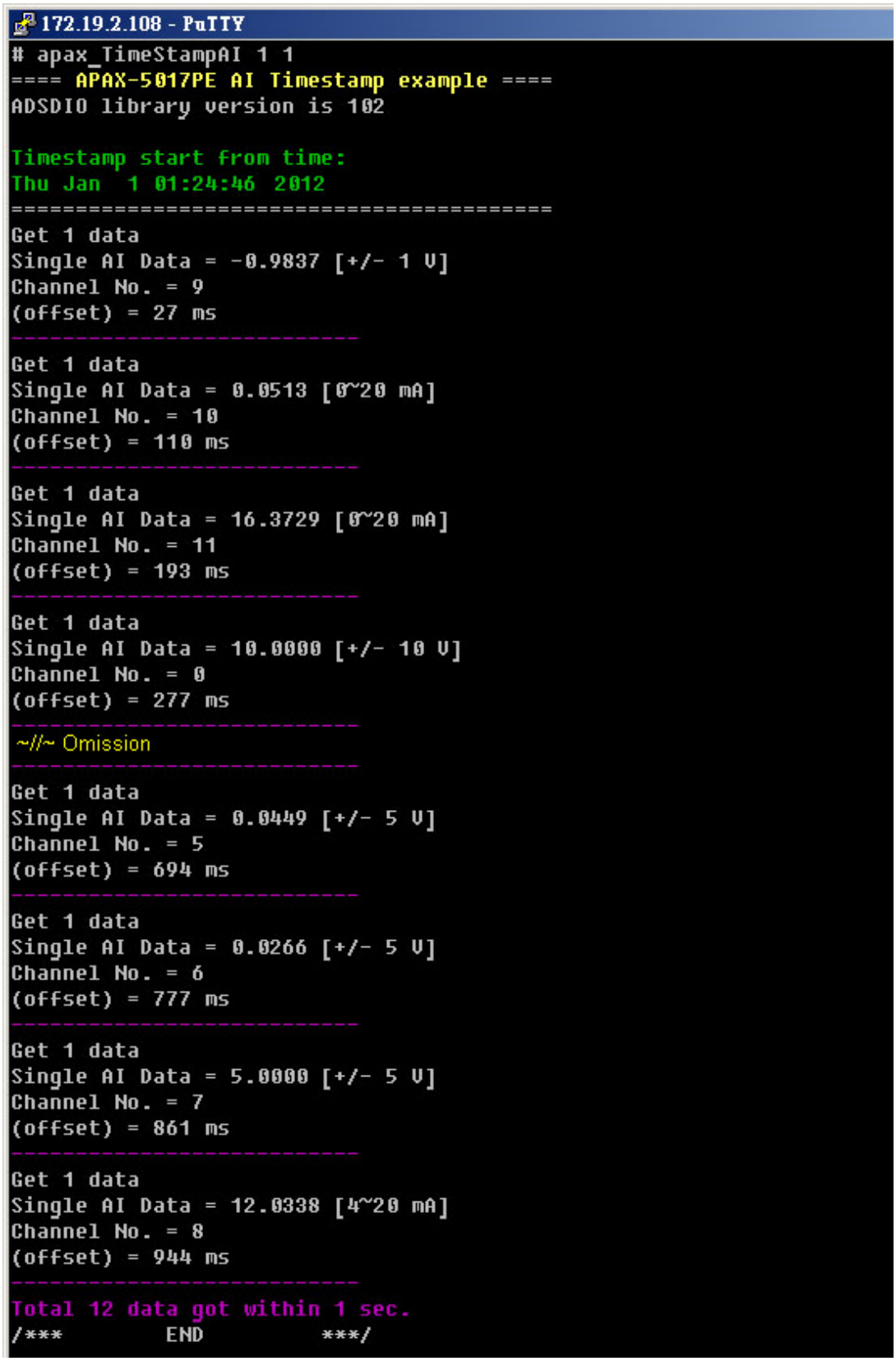
#### 4.2.10.1 Demo

Online help:




For example: Get APAX-5017PE AI channel data within 1 second. (Slot id is 1)

```
# apax_TimeStampAI 1 1
```


172.19.2.108 - PuTTY
# apax_TimeStampAI 1 1
==== APAX-5017PE AI Timestamp example ====
ADSDIO library version is 102
Timestamp start from time:
Thu Jan  1 01:24:46 2012
========================================
Get 1 data
Single AI Data = -0.9837 [+/- 1 V]
Channel No. = 9
(offset) = 27 ms
---
Get 1 data
Single AI Data = 0.0513 [0~20 mA]
Channel No. = 10
(offset) = 110 ms
---
Get 1 data
Single AI Data = 16.3729 [0~20 mA]
Channel No. = 11
(offset) = 193 ms
---
Get 1 data
Single AI Data = 10.0000 [+/- 10 V]
Channel No. = 0
(offset) = 277 ms
---
~//~ Omission
---
Get 1 data
Single AI Data = 0.0449 [+/- 5 V]
Channel No. = 5
(offset) = 694 ms
---
Get 1 data
Single AI Data = 0.0266 [+/- 5 V]
Channel No. = 6
(offset) = 777 ms
---
Get 1 data
Single AI Data = 5.0000 [+/- 5 V]
Channel No. = 7
(offset) = 861 ms
---
Get 1 data
Single AI Data = 12.0338 [4~20 mA]
Channel No. = 8
(offset) = 944 ms
---
Total 12 data got within 1 sec.
/***        END         ***/

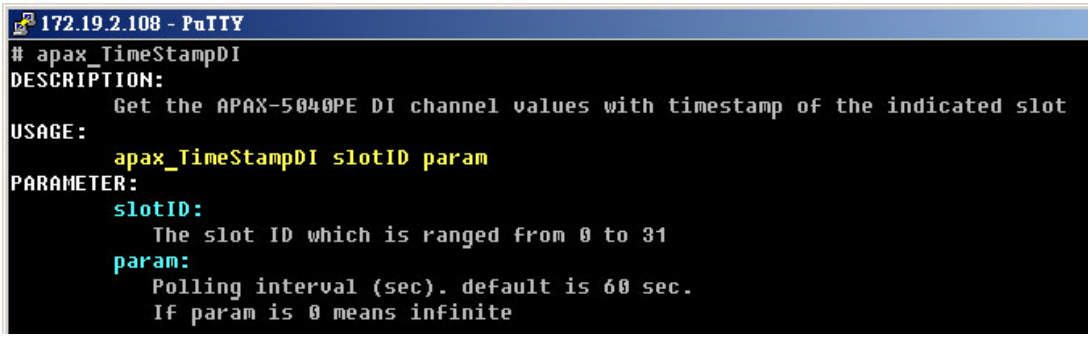
### 4.2.11 Get the APAX-5040PE DI module with timestamp

| Instruction | Function description |
|---|---|
| apax_TimeStampDI | Get the APAX-5040PE DI channel values with timestamp |
| Usage:<br>apax_TimeStampDI slotID param | |

- Parameters:
  Slot ID:
  The slot ID which is ranged from 0 to 31
  Param:
  Polling interval (sec). default is 60 sec.
  If param is 0 means infinite
- Result:
  Show the DI channel values with timestamp.
  DI Hex Data (32 bits): The LSB is channel 0, MSB is channel 31
  Time offset (ms)

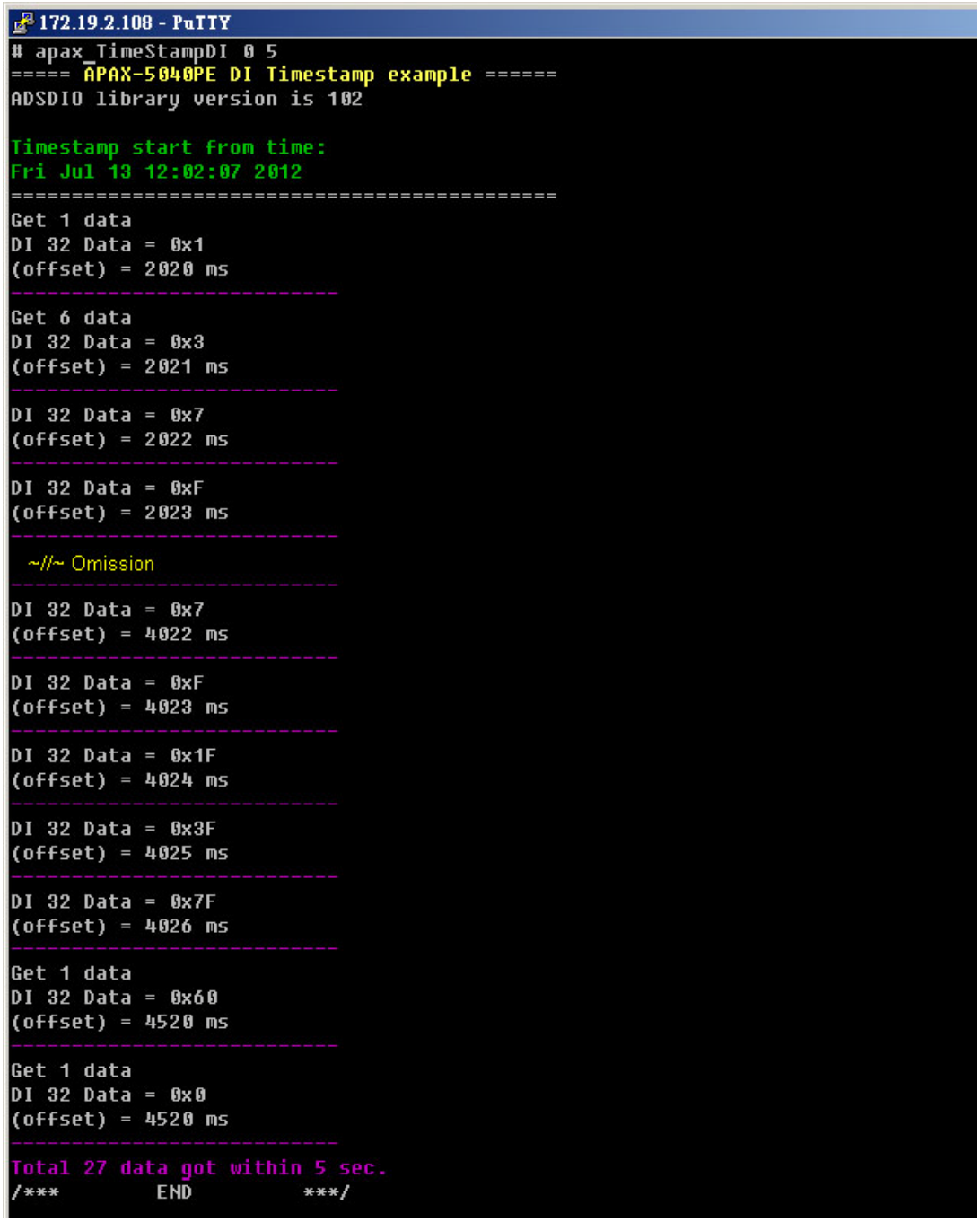
#### 4.2.11.1 Demo

Online help:




For example: Get APAX-5040PE DI channel data within 5 second. (Slot id is 0)

```
# apax_TimeStampDI 0 5
```




The APAX-5040PE has 24 DI channels. If the DI 32 Data is 0x01 that means channel 0 is high level and the rest of channel 1 to 23 is low level.

# Appendix A

## APAX 5000 I/O module range code settings

# A.1 ADAM/APAX .NET Utility General Window

These ranges are provided for reference. Not all boards support all ranges. Please see hardware manual for valid ranges for a particular board.

| | Setting Type | Value (Hex) |
|---|---|---|
| Millivolts DC (mV) | +/- 15mV | 0x0100 |
| | +/- 50mV | 0x0101 |
| | +/- 100mV | 0x0102 |
| | +/- 150mV | 0x0103 |
| | +/- 500mV | 0x0104 |
| | 0~150mV | 0x0105 |
| | 0~500mV | 0x0106 |
| Milliamps (mA) | 4~20mA | 0x0180 |
| | +/-20mA | 0x0181 |
| | 0~20mA | 0x0182 |
| Counter settings | Pulse/DIR | 0x01C0 |
| | Up/Down | 0x01C1 |
| | Up | 0x01C2 |
| | Frequency | 0x01C3 |
| | AB 1X | 0x01C4 |
| | AB 2X | 0x01C5 |
| | AB 4X | 0x01C6 |
| Pt-100 (3851) | Pt-100 (3851) -200~850 'C | 0x0200 |
| | Pt-100 (3851) -120~130 'C | 0x0201 |
| | Pt-100 (3851) -200~200 'C | 0x0202 |
| | Pt-100 (3851) -100~100 'C | 0x0203 |
| | Pt-100 (3851) -50~150 'C | 0x0204 |
| | Pt-100 (3851) 0~100 'C | 0x0205 |
| | Pt-100 (3851) 0~200 'C | 0x0206 |
| | Pt-100 (3851) 0~400 'C | 0x0207 |
| | Pt-100 (3851) 0~600 'C | 0x0208 |
| Pt-200 (3851) | Pt-200 (3851) -200~850 'C | 0x0220 |
| | Pt-200 (3851) -120~130 'C | 0x0221 |
| Pt-500 (3851) | Pt-500 (3851) -200~850 'C | 0x0240 |
| | Pt-500 (3851) -120~130 'C | 0x0241 |
| Pt-1000 (3851) | Pt-1000 (3851) -200~850 'C | 0x0260 |
| | Pt-1000 (3851) -120~130 'C | 0x0261 |
| | Pt-1000 (3851) -40~160 'C | 0x0262 |

| | | |
|---|---|---|
| Pt-100 (3916) | Pt-100 (3916) -200~850 'C | 0x0280 |
| | Pt-100 (3916) -120~130 'C | 0x0281 |
| | Pt-100 (3916) -200~200 'C | 0x0282 |
| | Pt-100 (3916) -100~100 'C | 0x0283 |
| | Pt-100 (3916) -50~150 'C | 0x0284 |
| | Pt-100 (3916) 0~100 'C | 0x0285 |
| | Pt-100 (3916) 0~200 'C | 0x0286 |
| | Pt-100 (3916) 0~400 'C | 0x0287 |
| | Pt-100 (3916) 0~600 'C | 0x0288 |
| Pt-200 (3916) | Pt-200 (3916) -200~850 'C | 0x02A0 |
| | Pt-200 (3916) -120~130 'C | 0x02A1 |
| Pt-500 (3916) | Pt-500 (3916) -200~850 'C | 0x02C0 |
| | Pt-500 (3916) -120~130 'C | 0x02C1 |
| Pt-1000 (3916) | Pt-1000 (3916) -200~850 'C | 0x02E0 |
| | Pt-1000 (3916) -120~130 'C | 0x02E1 |
| | Pt-1000 (3916) -40~160 'C | 0x02E2 |
| Balco 500 | Balcon(500) -30~120 | 0x0300 |
| Ni 518 | Ni(518) -80~100 'C | 0x0320 |
| | Ni(518) 0~100 'C | 0x0321 |
| Ni 508 | Ni(508) 0~100 'C | 0x0340 |
| | Ni(508) -50~200 'C | 0x0341 |
| Thermistor 3K | Thermistor 3K 0~100 'C | 0x0360 |
| Thermistor 10K | Thermistor 10K 0~100 'C | 0x0380 |
| | Thermistor 10K -50~100 'C | 0x0381 |
| T/C TypeJ | T/C TypeJ 0~760 'C | 0x0400 |
| | T/C TypeJ -200~1200 'C | 0x0401 |
| T/C TypeK | T/C TypeK 0~1370 'C | 0x0420 |
| | T/C TypeK -270~1372 'C | 0x0421 |
| T/C TypeT | T/C TypeT -100~400 'C | 0x0440 |
| | T/C TypeT -270~400 'C | 0x0441 |
| T/C TypeE | T/C TypeE 0~1000 'C | 0x0460 |
| | T/C TypeE -270~1000 'C | 0x0461 |
| T/C TypeR | T/C TypeR 500~1750 'C | 0x0480 |
| | T/C TypeR 0~1768 'C | 0x0481 |
| T/C TypeS | T/C TypeS 500~1750 'C | 0x04A0 |
| | T/C TypeS 0~1768 'C | 0x04A1 |
| T/C TypeB | T/C TypeB 500~1800 'C | 0x04C0 |
| | T/C TypeB 300~1820 'C | 0x04C1 |

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