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THE INTERNATIONAL UNIVERSITY
SCHOOL OF ELECTRICAL ENGINEERING

Internship Report:

**AT COMMAND SET FOR “BG2-PIC32-232
APPLICATION KIT”**

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Ho Chi Minh City, Vietnam

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ACKNOWLEDGMENTS

Wonderfully, I have had many challenging as well as joyful moments for this internship period of time and I believe I have learnt a lot during these weeks.

At first, I sincerely thank to the internship company- R&P in generally and Mr. Doan Hiep – my good instructor in particularly who gives the internship opportunity for me to practise the academic knowledge and instructs me the general operations of the company.

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I am very grateful to my working group at R&P company, especially Mr. Vi and Mr. Huy have been the persons who enthusiastically guide me to understand clearly how to develop BG2-PIC32-232 Application Kit as well as explain me some new knowledge in reality.

I would like to express my greatest gratitude to my family – daddy, mom and younger sister who dedicate all the life to me, always listen and share all things together with me. Actually, the family is my spiritual wall for me to face in this life and to go ahead on my chosen road in the life.

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I. Introduction

1. *R&P Trading & Forwarding Co., Ltd.*

R&P Trading & Forwarding Co., Ltd. is an authorized distributor of Microchip and also the representative of Cinterion in Vietnam. The products which are sold by R&P include pic microcontrollers (8-bit, 16-bit, 32-bit), Development Tools (Starter Kits, Explorer 16 Kit, PIC32 USB Starter Board, In-Circuit Emulators and Debuggers, Software...), RF products (IEEE 802.15.4 / ZigBee RF Transceivers, MiWi...) as well as all products at microchipsdirect.com with the prices which are nearly equal to manufacturer's ones. Besides selling Microchip products, R&P also research and develop in order to make their own products for serving education and applying practice (BG2-PIC32-232__CINTERION, UART2ETHERNET, USB2UART...).

2. *Internship Work*

The objectives of this internship to accomplish the following problems:

- Understanding the fundamental knowledge of CINTERION BG2 wireless module.
- Learning and testing the “BG2-PIC32-232 Application Kit” by AT Command Set.

II. BG2-PIC32-232 Application Kit

1. General features

The CINTERION BG2 wireless module is the latest generation of 2G products offering full voice capabilities and high speed GPRS data transmission and is your all-rounder of choice for machine-to-machine including metering, security, vending, POS, and many more applications.

The innovative and integrated antenna connection together with a highly flexible mounting concept allowing screwless mounting reduces significantly the total cost of ownership (TCO) at customer's application. This module packs a Quad-Band GSM/GPRS baseband and TCP/IP connectivity based on GPRS Class 10 data transmission into a compact form factor. BG2 supports industrial interfacessuch as two serial interfaces, 10 GPIO's, as well as I2C and is already prepared for Component SIM. Alongside highest reliability and quality the BG2 offers an easy start for M2M market entrants and comes along in two flavors as Quad-Band with GPRS Class 10 (BG2-W) and Dual-Band version with GPRS Class 8 (BG2-E). Like all CINTERION modules, the BG2 comes with full type approval (FTA) enabling use across the globe. It has even been certified by the largest carriers worldwide, including US operators.



BG2-PIC32-232 Application Kit

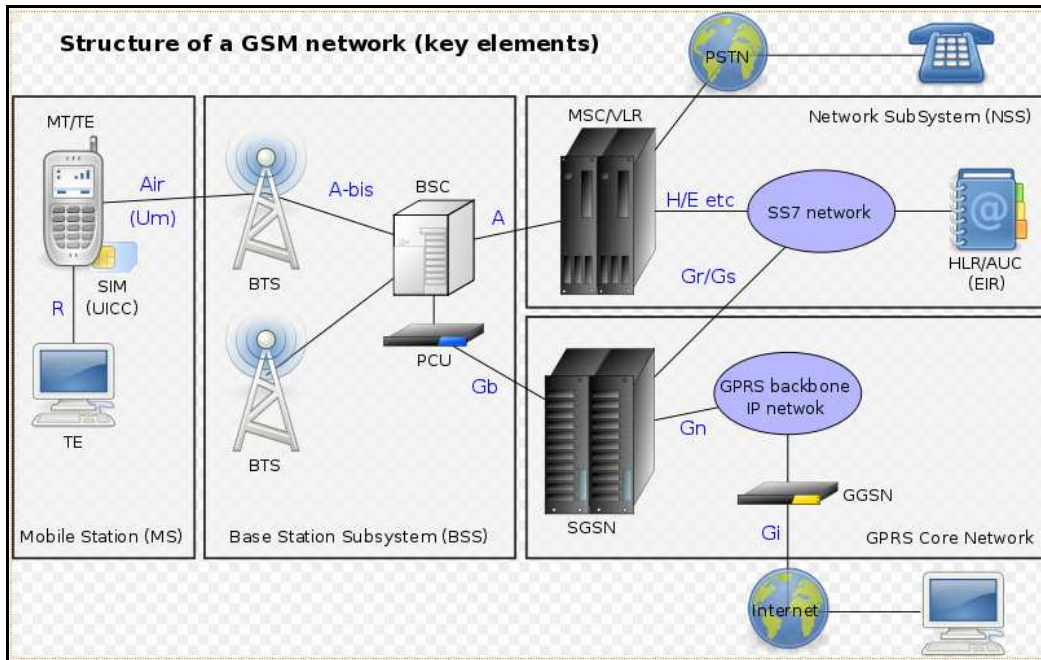
❖ Specifications:

- Dual-Band: GSM 900 / 1800 MHz (BG2-E)
- 3GPP release 99
- GPRS multi-slot Class 8
 - DL: max. 85.6 kbps,
 - UL: max. 21.4 kbps
- SMS text and PDU mode, cell broadcast
- Antenna onboard
- PIC 32 microcontrollers (programming and application immediately)
- uSD Card
- RS232 (communicate directly with the computer or with other microcontrollers for applications expand)
- USB device (enables installed CDC to emulate RS232 or USB interface can use to configure or control directly from your computer)

2. *Applications*

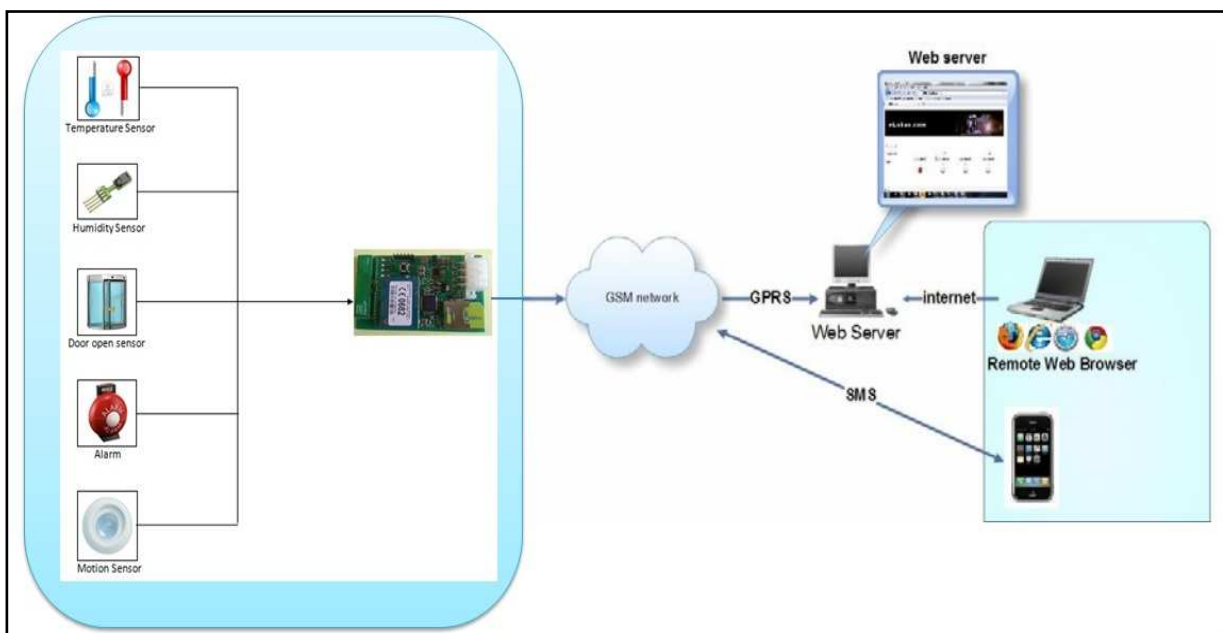
GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe technologies for second generation (or "2G") digital cellular networks. Developed as a replacement for first generation analog cellular networks, the GSM standard originally described a digital, circuit switched network optimized for full duplex voice telephony. The standard was expanded over time to include first circuit switched data transport, then packet data transport via GPRS.

The GSM Association estimates that technologies defined in the GSM standard serve 80% of the world's population, encompassing more than 5 billion people across more than 212 countries and territories, making GSM the most ubiquitous of the many standards for cellular networks.



Structure of a GSM network (key elements)

BG2-PIC32-232 Application Kit allows you to deploy applications that monitor and control based on SMS or GPRS technology allows Web-based monitoring is extremely convenient.



Applications of BG2-PIC32-232 Application Kit

III. AT Command Set for “BG2-PIC32-232 Application Kit”

“Advanced Serial Port Terminal” software is used to send AT Command from computer to kit and “Hercules” software is used to simulate virtual server.

1. *Call related Commands*

Making phone calls

ATD 0974482797; <ENTER>

When a user originates a second voice call while there is already an active voice call, the first call will automatically be put on hold. The second call attempt is acknowledged with "OK" immediately after dialing with ATD has completed, without relation to a successful call setup. In case of failure, the additional result codes "NO CARRIER", "NO DIALTONE", "BUSY".

Redial last number used

ATDL; <ENTER>

This command redials the last voice and data call number used in the ATD command. If terminated with semicolon ";" ATDL dials the last voice call number stored in the "LD" phonebook. Otherwise, the last dialed data or fax number will be used (not contained in the "LD" phonebook).

Connect to Incoming Call

ATA; <ENTER>

If AT+FCLASS setting is 1, all incoming calls will be answered as fax calls, when ATA is issued on ASC0. For calls explicitly signalled as voice or data calls, this procedure will fail with result code "NO CARRIER", but the call in question will continue to ring.

It is possible to change the setting for AT+FCLASS to 0 while the call is ringing, and accept the call normally afterwards with ATA.

Disconnect existing connection

ATH; <ENTER>

ATH clears any active PDP context or terminates any existing PPP connection, but only if issued on the same interface where GPRS is used and if there is no pending network request for PDP context activation. It does not affect PDP contexts and PPP connections on other interfaces.

2. Short Message Service (SMS) Commands

a. Send SMS

Some advanced GSM modems like CINTERION BG2, support the SMS text mode. This mode allows you to send SMS messages using AT commands, without the need to encode the binary PDU field of the SMS first. This is done by the GSM modem

Check if your GSM phone or modem supports SMS text mode

To check if your modem supports this text mode, you can try the following command:

AT+CMGF=1 <ENTER>

If the modem responds with "OK" this mode is supported. Please note that using this mode it is only possible to send simple text messages. It is not possible to send multipart, Unicode, data and other types of messages.

Setting up the modem

If the modem contains a SIM card with is secured with a PIN code, we have to enter this pin code first:

AT+CPIN="0000" <ENTER> (replace 0000 with your PIN code).

Please note that in most cases you have only 3 attempts to set the correct PIN code. After setting the PIN code, wait some seconds before issuing the next command to give the modem some time to register with the GSM network.

In order to send a SMS, the modem has to be put in SMS text mode first using the following command:

AT+CMGF=1 <ENTER>

In text mode there are some additional parameters that can be set. Using the following command we can read the current values:

AT+CSMP? <ENTER>

The modem will reponse with a string like this:

+CSMP: 1,169,0,0OK

The first value is a combination of some option bits:

bit 7	RP	Reply path, not used in text mode
bit 6	UDHI	User Data Header Information
bit 5	SRR	Set this bit to request a delivery report
bit 3,4	VPF	Validity Period, set b4=1 if a VP value is present
bit 2	RD	Reject Duplicates, do not return a message ID when a message with the same destination and ID is still pending
bit 0,1	MTI	Message Type Indicator b1=0 & b0=0 -> SMS-DELIVER b1=0 & b0=1 -> SMS-SUBMIT

Bit 0 of the message is always set when sending messages (SMS-SUBMIT). So the first value should be 1 or higher. The second parameter sets the Validity Period of the message. This value is encoded as follows:

0 - 143	(VP + 1) x 5 minutes
144 - 167	12 Hours + ((VP-143) x 30 minutes)
168 - 196	(VP-166) x 1 day
197 - 255	(VP-192) x 1 week

The third parameter contains the PID (Protocol Identifier). This parameter is only used for advanced messaging. The fourth parameter contains the DCS (Data Coding Scheme). This parameter is used to select the charset/message type. When setting the DCS parameter to '0' standard 7 bit text is send. When setting this parameter to '16' the message is sent as a flash message.

To send a message with a validity period of 1 day, the parameters have to be set like this:

Bit 0 and 4 of the first field has to be set, so the first value will become $1 + 16 = 17$.

Send the following command to the modem to set this parameters:

AT+CSMP=17,167,0,16 <ENTER>

If the modem responds with "OK" ,the modem is ready to send (flash) text messages with a validity period of 1 day.

Sending the message

To send the SMS message, type the following command:

AT+CMGS="+0974482797" <ENTER>

Replace the above phone number with your own cell phone number. The modem will respond with:

>

You can now type the message text and send the message using the <CTRL>-<Z> key combination:

Hello World ! <CTRL-Z>

After some seconds the modem will respond with the message ID of the message, indicating that the message was sent correctly:

+CMGS: 62

The message will arrive on the mobile phone shortly.

Sending an Unicode SMS message

Some modems also have the capability to send Unicode or UCS2 messages without encoding a PDU. You can send Unicode messages by only converting the Unicode data to a HEX string and send this string to the modem.

To check whether your modem supports this mode, just type the following command:

AT+CSCS=?

This command displays the codepages supported by the modem. The modem will respond like this:

+CSCS: ("GSM","PCCP437","CUSTOM","HEX")

If this string contains "HEX" or "UCS2", Unicode seems to be supported. To specify that you will use an HEX string to send the message, set the codepage to "HEX" or "UCS2" depending on the modem response. In our example we will set the modem to "HEX" :

AT+CSCS="HEX" <ENTER>

Next, we have to specify the correct DCS (Data Coding Scheme) for Unicode messages, which is 0x08. We can set this value by changing the fourth parameter of the AT+CSMP command to '8':

AT+CSMP=1,167,0,8 <ENTER>

The modem is now ready to send messages as Unicode. Now is the time to send the actual message:

AT+CMGS="+841297894476" <ENTER>

Replace the above phone number with your own cell phone number. The modem will respond with:

>

The only thing you have to program by yourself is a simple routine which converts the Unicode string to a hexadecimal string like this:

Hello

Which is 'Hello' will be converted like this:

"06450631062D06280627"

You can send this hexadecimal string to the modem:

06450631062D06280627 <CTRL-Z>

After some seconds the modem will respond with the message ID of the message, indicating that the message was sent correctly:

+CMGS: 63

The message will arrive on the mobile phone shortly.

b. Receive SMS

Introduction

Some advanced GSM modems like WaveCom and Multitech, support the SMS text mode. This mode allows you to send and receive SMS messages using AT

commands, without the need to decode the binary PDU field of the SMS first. This is done by the GSM modem.

To send the commands discussed in this tutorial, you can use a terminal program, for instance Hyperterminal.

To check if your modem supports this text mode, you can try the following command:

AT+CMGF=1 <ENTER>

If the modem responds with "OK" this mode is supported. Please note that using this mode it is only possible to send simple text messages. It is not possible to send multipart, Unicode, data and other types of messages.

Setting up the modem

If the modem contains a SIM card with is secured with a PIN code, we have to enter this pin code first:

AT+CPIN="0000" <ENTER> (replace 0000 with your PIN code).

Please note that in most cases you have only 3 attempts to set the correct PIN code. After setting the PIN code, wait some seconds before issuing the next command to give the modem some time to register with the GSM network.

In order to send a SMS, the modem has to be put in SMS text mode first using the following command:

AT+CMGF=1 <ENTER>

If the modem responds with error, either the modem does not support SMS text mode, or the SIM card is not ready. In this case please check that the SIM card is inserted and the pincode is entered. You can also turn on extended error reports by using the following command:

AT+CMEE=1 <ENTER>

Instead of just an "ERROR" the modem will now respond with "+CMS ERROR: xxx" or "+CME ERROR: xxx". For a list of possible error codes please check this list.

Selecting the preferred message storage

A GSM phone or modem receives messages automatically. Basically you are just retrieving the messages from the memory of the device or SIM card. To select the

message storage used to read the messages from, you have to use the "AT+CPMS" command. You can select one of the following message storages, not all storages are supported on every device.

Storage ID	Description
SM	Read SMS messages from the SIM card. This storage is supported on every GSM phone, because a SIM card should always be present. Usually a SIM card can store up to 15 messages.
ME	Read SMS messages from the modem or mobile phone memory. The number of messages that can be stored here depends on the size of the phones memory.
MT	Read SMS messages from all storages on the mobile phone. For instance when the phone supports "ME" and "SM", the "MT" memory combines the "ME" and "SM" memories as if it was a single storage.
BM	This storage is only used to read stored incoming cell broadcast messages. It is normally not used to store SMS messages.
SR	When you enable status reports when sending SMS messages, the status reports that are received are stored in this memory. These reports can read the same way as SMS messages.

To find out which storages are supported by your mobile phone, use the command line below:

AT+CPMS=?

The modem will respond with a list of supported storages, for instance:

+CPMS: (("SM","BM","SR"),("SM"))

The storage can be selected using the following command:

AT+CPMS=<read>[,<send>,<receive>] <ENTER>

The first parameter sets the storage to read from the second optional specifies the storage to send messages from and the last optional parameter tells the device where to store newly received messages.

For example, to read messages from the SIM card use:

AT+CPMS="SM" <ENTER>

The modem should respond with the following string:

+CPMS: <used_space>,<max_space> <ENTER>

The used_space indicates the number of messages currently in this memory, the max_space the number of messages that can be stored.

Listing the messages

Once you have successfully set the messages storage, you can list the messages available using the list command:

AT+CMGL="ALL" <ENTER>

Please note that "ALL" has to be sent in uppercase on some modems. The modem will respond with a list of decoded SMS messages:

+CMGL: 1,"REC UNREAD","+841297894476",,"22/08/11,09:55:16+08"

Test message 1

+CMGL: 2,"REC UNREAD","+841297894476",,"22/08/11,09:56:03+08"

Test message 2

OK

The response messages are formatted like this:

+CMGL: <index>,<status>,<from_address>,<mr>,<scts><CRLF><data>

index	The memory index number, use this index to read or delete this message.
status	The status of this message. For received messages this can be "REC READ" or "REC UNREAD" depending on whether the messages has been read or listed before.
from_address	The subscriber number of the person who sent the message.
mr	The reference number of this message. Most modems keep this field empty.
scts	The time the message was forwarded to this phone or modem.
data	The actual message data in plain text

Reading a message

To list a single message, you have to use the read command. You must use the list command first, so you know the indexes of the messages in the storage. For instance, to read the message on memory location '2' use:

AT+CMGR=2 <ENTER>

The modem will list the single message:

+CMGR: "REC READ", "+841297894476", "22/08/11,09:56:03+08"

Test message 2

OK

Please note that the status of the message is now "REC_READ" instead of "REC_UNREAD" because we read the message.

Deleting a message

Once you have read a message, you can free the memory by deleting the message from the storage. For instance, to delete the message on memory location '2' use:

AT+CMGD=2 <ENTER>

The modem will delete the single message.

3. GPRS Commands

Network registration

AT+CREG=1 <ENTER>

Enable URC +CREG:<stat> to report status of network registration.

Store AT Command Settings to User Defined Profile

AT&W <ENTER>

AT&W stores the current AT command settings to a user defined profile in non-volatile memory of BG2-E. The AT command settings will automatically be restored from the user defined profile during power-up or if ATZ is used.

Check operator

AT+COPS? <ENTER>

Internet Connection Setup Profile

AT^SICS=1,conType,GPRS0<ENTER>

Setup Profile 1 connector type as GPRS.

AT^SICS=1,alphabet,1 <ENTER>

Setup profile 1 alphabet string parameter as International Reference Alphabet.

AT^SICS=1,apn,INTERNET <ENTER>

Access point name string as "INTERNET".

Internet Service Setup Profile

AT^SISS=1,svType,socket <ENTER>

Setup profile 1 internet service type as socket , BG2-E acting as client or server (listener) for TCP or UDP.

AT^SISS=1,alphabet,1 <ENTER>

Internet service alphabet string parameter as International Reference Alphabet.

AT^SISS=1,conId,1 <ENTER>

Internet connection profile 1 to be used

AT^SISS=1,address,socktcp://1.53.103.255:2207 <ENTER>

Set URL for the specific service.

Internet Service Write Data

AT^SISW=1,50,0 <ENTER>

Send 50 byte to server.

Internet Service Read Data

AT^SISR=1,50 <ENTER>

Requests to read 50 byte.