G-4513 系列

3G Power Saving PAC with Solar Charger

操作手冊 **V1.0.1**

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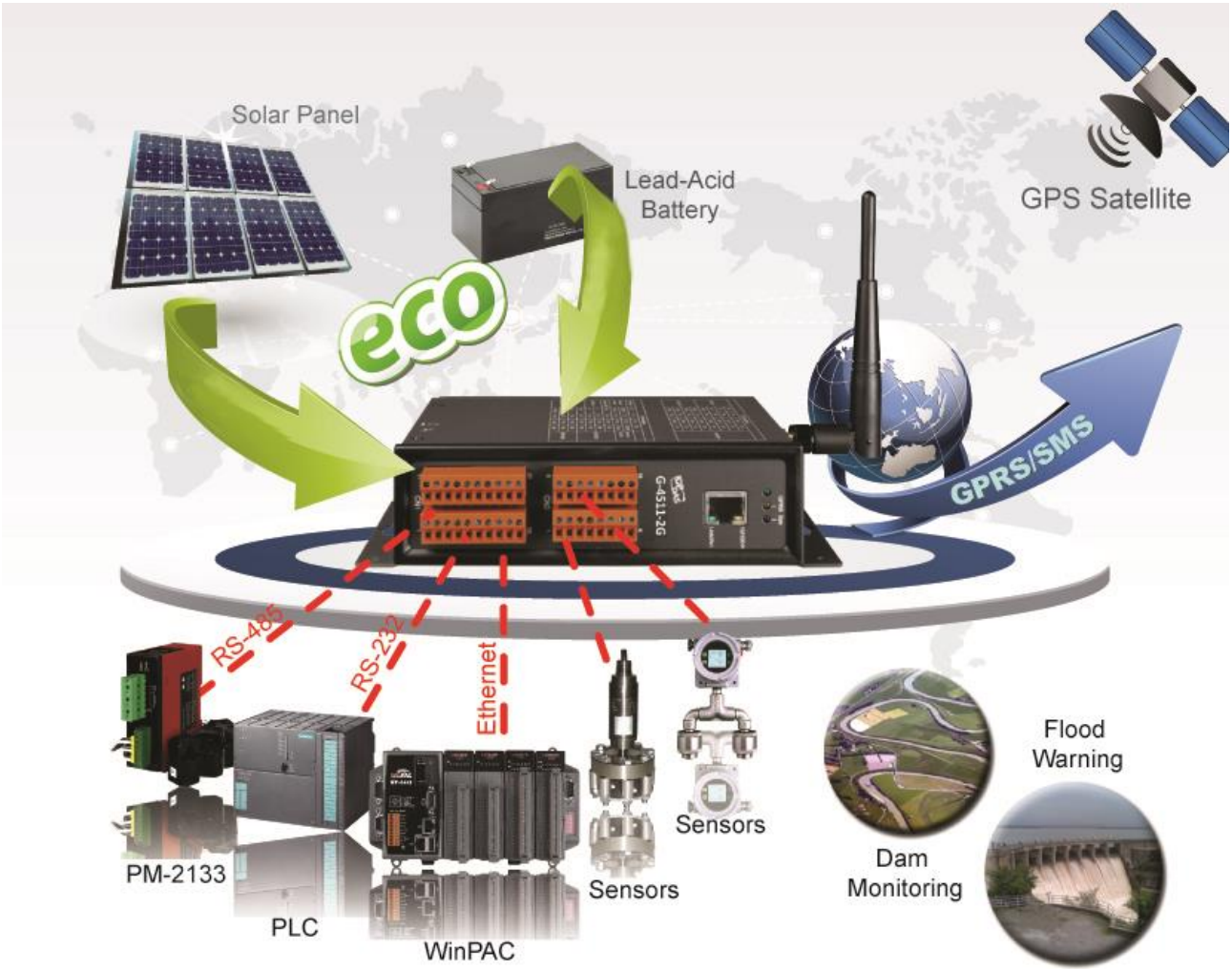
1. 簡介

G-4513 系列為 M2M 省電型 PAC 產品，其內建太陽能/鉛酸電池之充電器。G-4513 極適合用於水文監控、土石流監控領域，或是不便取得電源，需要使用太陽能的應用。若配合其 GPS 功能(選購)，更可以應用於車載，河川船泊監控之領域。

G-4513 系列擁有太陽能充電器、3G 模組、GPS 模組(選購)、乙太網路、3 DI、3 DO、8 AI、1 Relay、1 RS-232 和 1 RS-485。可用於各種需要 3G、GPRS、SMS、乙太網路或串列埠的領域。其內建的 MiniOS7 提供與 I-7188/I-7186 系列相同的開發環境，對於 I-7188/I-7186 的用戶來說，G-4513 系列屬於熟悉的開發環境，較容易上手。



2. 硬體規格

2.1 G-4513-3GWA 系列

G-4513-3GWA	G-4513D-3GWA	G-4513P-3GWA	G-4513PD-3GWA
			

2.2 G-4513-3GWA 系列規格

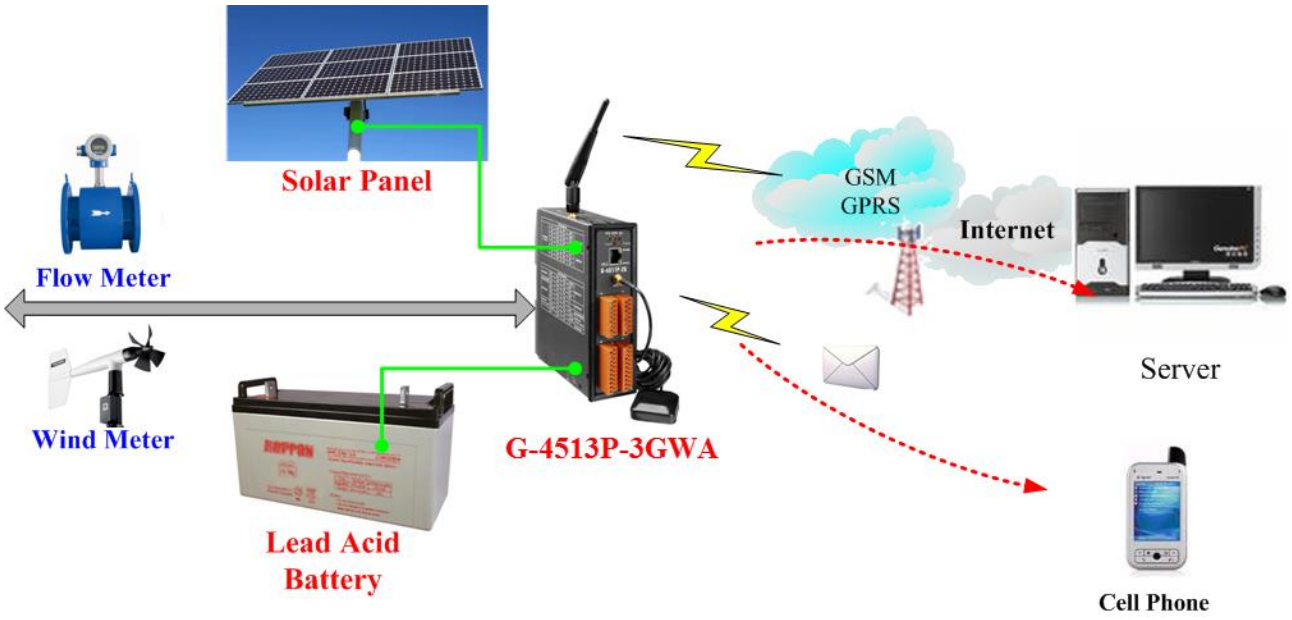
Item	G-4513-3GWA	G-4513D-3GWA	G-4513P-3GWA	G-4513PD-3GWA
CPU	80 MHz internal microprocessor			
SRAM/Flash	512K/512K , real time clock, watchdog timer			
NVRAM	31 bytes, battery backup, data valid up to 10 years			
EEPROM	16 KB, retention > 40 years. 1,000,000 erase/write cycles			
Comm. Interface				
COM ports	COM1:5-wire RS-232; COM2: RS-485			
Ethernet	10/100 Base-TX Ethernet controller			
GSM Interface				
Frequency Band	GSM 850/900/1800/1900 MHz			
GPRS connectivity	GPRS class 10/8; GPRS station class B			
SMS	MT, MO, CB, Text and PDU mode			
3G Interface				
Frequency Band	WCDMA 850/900/1900/2100 MHz			
Power Class	Class 3 (250mW @ WCDMA/HSPA)			
Digital Input				
Input Channel	3			
Input Type	Source(Dry Type), Common Ground			
Off Voltage Level	+1 V max.			
On Voltage Level	+3.5 ~ +30 V			
Isolated Voltage	Non-isolated			
Digital Output				
Output Channel	3			
Output Type	3 Open Collector (Sink/NPN)			
Load Voltage	+30 VDC max.			
Load Current	100 mA max.			
Isolated Voltage	Non-isolated			
Analog Input				
Input Channel	8			
Resolution	12 - bit			
Input Range/Type	0 ~ 20 mA			
Sample Rate	1 KHz max. (Read one channel)			
Accuracy	+/- 2 LSB (+/- 0.0097 mA)			
Isolated Voltage	2500Vrms 3000Dc to DC			
Relay				
Output Channel	1			
Type	Form C			

Input Range		2A@30 Vdc ; 0.25 A @250 Vac			
Mechanical endurance		typ. 10^8 operations			
GPS Interface					
Support Channels		-		32	
Sensitivity		-		Tracking = up to -159 dBm (with external LNA)	
				Cold start = up to -146 dBm (with external LNA)	
Acquisition Time		-		Hot start (Open Sky) = 2 s(typical)	
				Cold start (Open Sky) = 36 s(typical)	
Protocol Support		-		NMEA 0183 version 3.01	
LCD Interface					
General	Effective display area	-	80.61 mm x 14.37 mm (W x H)	-	80.61 mm x 14.37 mm (W x H)
	Module Dimension	-	93 mm x 70 mm x 1.6 mm (W x H x T)	-	93 mm x 70 mm x 1.6 mm (W x H x T)
Life Time		-	Expected life is more than 100,000 hours under normal operation	-	Expected life is more than 100,000 hours under normal operation
Power (Solar Input)					
Protection		Power reverse polarity protection			
Frame Ground Protection		ESD, Surge, EFT, Hi-Pot			
Power Requirement		+10 V_{DC} ~ +30 V_{DC} , (Max. Voltage of Solar Panel must less +30V)			
Power Consumption		Deep Sleep: < 10 mA@12V_{DC}; Deep Sleep(With LCD): < 11 mA@12V_{DC}; Sleep: < 15 mA@12V_{DC}; Idle: 77 mA @ 24 V_{DC}; Data Link: 150 ~ 400 mA (peak) @ 24 V_{DC}			
Lead Acid Battery Requirement					
Battery		12V Lead-Acid Battery			
Charging Voltage		Voltage of Power Input must be over +16V			
Low Voltage Protect		Low Voltage disconnect = 11.1V / Low Voltage reconnect = 12.6V			
LED Indicators					
System		Red			

3G	Yellow			
GPS	-		Green	
Charging / Fault	Green / Red			
Mechanical				
Casing	Metal			
Dimensions	47 mm x 142 mm x 168 mm (W x L x H)			
Installation	DIN-Rail and Wall mount			
Environment				
Operating Temperature	-20 ~ +70 °C	-15 ~ +55 °C	-20 ~ +70 °C	-15 ~ +55 °C
Storage Temperature	-40 ~ +80 °C	-20 ~ +70 °C	-40 ~ +80 °C	-20 ~ +70 °C
Humidity	5~90% RH, non-condensing			

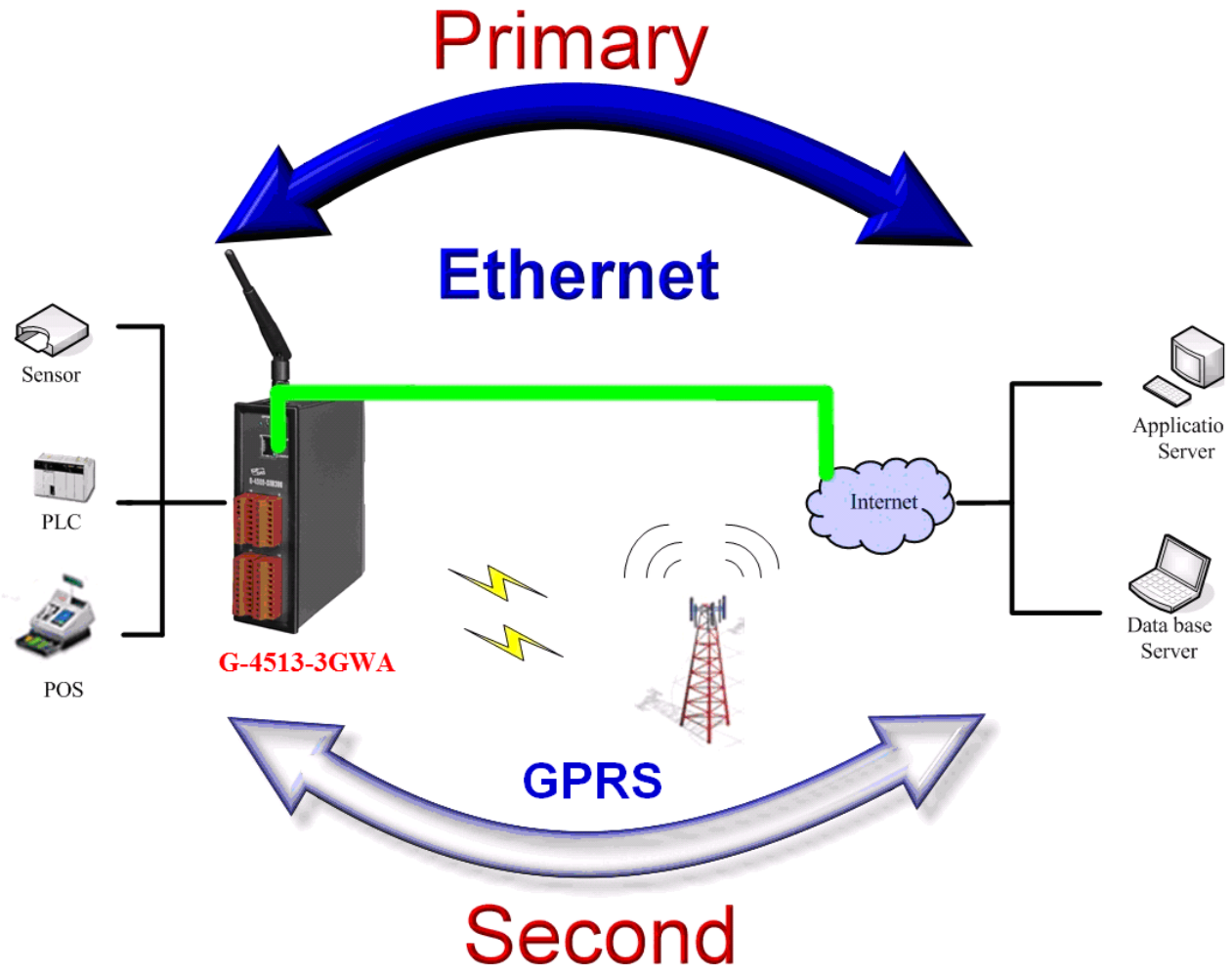
3. 應用架構

3.1 水文/風場監測應用



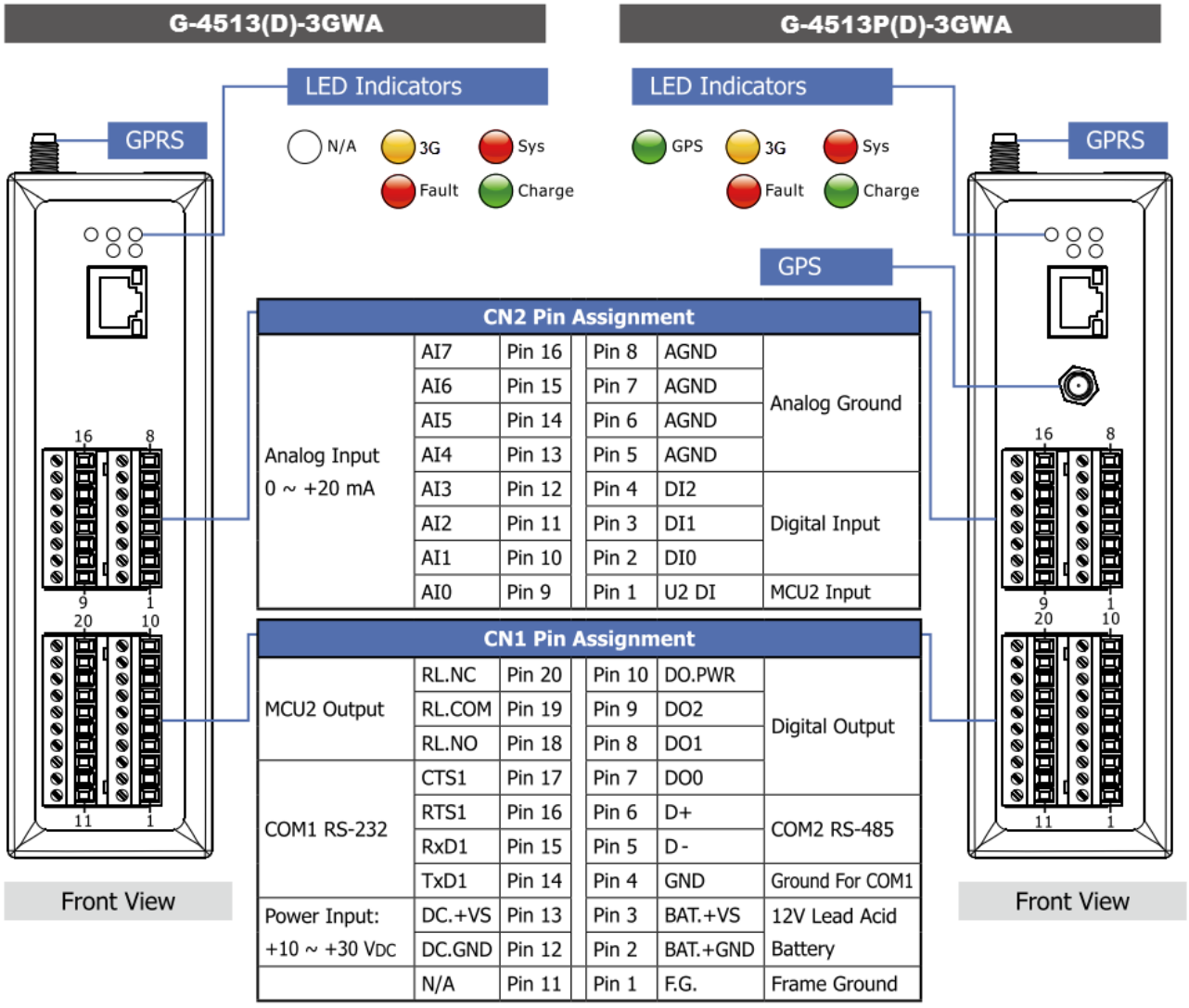
3.2 車輛監測/追蹤系統

3.3 備援通訊系統


Primary
Ethernet
Sensor
PLC
POS
G-4513-3GWA
Internet
Applicatio
Server
Data base
Server
GPRS
Second

4. 硬體

4.1 腳位配置

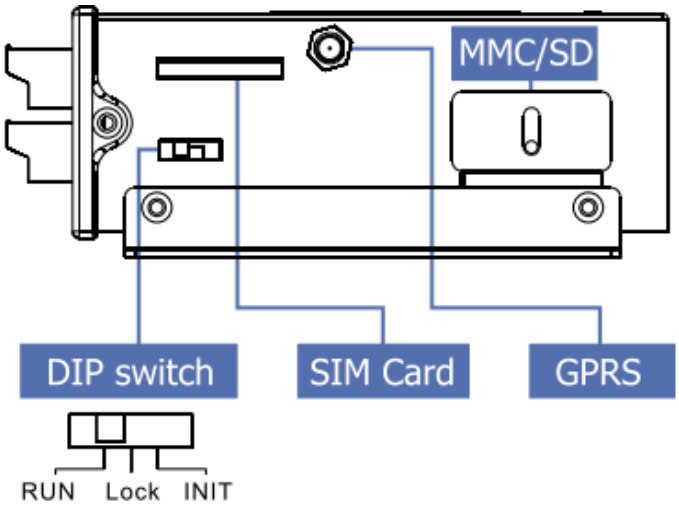


CN2 Pin Assignment

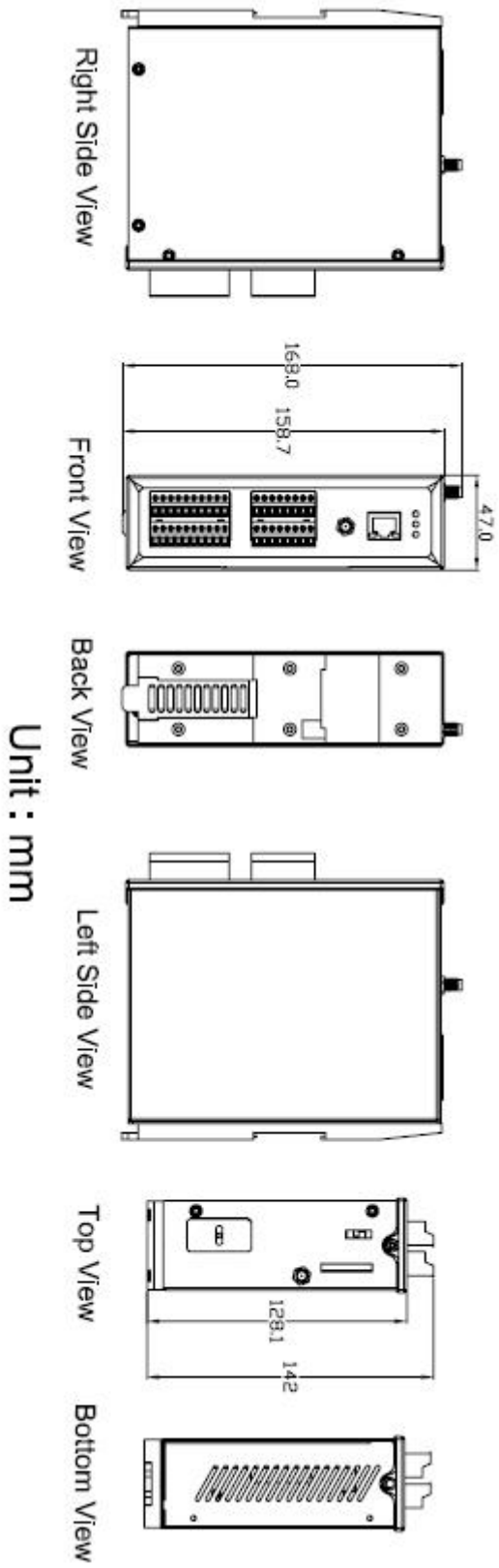
Analog Input 0 ~ +20 mA	AI7	Pin 16	Pin 8	AGND	Analog Ground
	AI6	Pin 15	Pin 7	AGND	
	AI5	Pin 14	Pin 6	AGND	
	AI4	Pin 13	Pin 5	AGND	
	AI3	Pin 12	Pin 4	DI2	Digital Input
	AI2	Pin 11	Pin 3	DI1	
	AI1	Pin 10	Pin 2	DI0	
	AI0	Pin 9	Pin 1	U2 DI	MCU2 Input

CN1 Pin Assignment

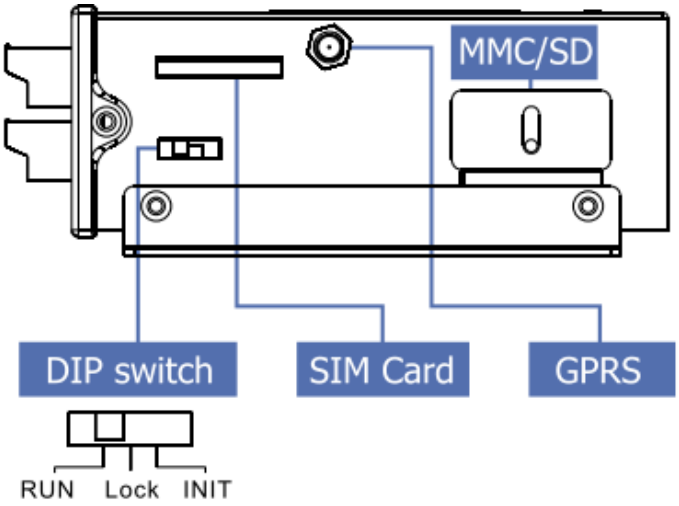
MCU2 Output	RL.NC	Pin 20	Pin 10	DO.PWR	Digital Output
	RL.COM	Pin 19	Pin 9	DO2	
	RL.NO	Pin 18	Pin 8	DO1	
COM1 RS-232	CTS1	Pin 17	Pin 7	DO0	
	RTS1	Pin 16	Pin 6	D+	COM2 RS-485
	RxD1	Pin 15	Pin 5	D-	
	TxD1	Pin 14	Pin 4	GND	Ground For COM1
Power Input: +10 ~ +30 VDC	DC.+VS	Pin 13	Pin 3	BAT.+VS	12V Lead Acid Battery
	DC.GND	Pin 12	Pin 2	BAT.+GND	
	N/A	Pin 11	Pin 1	F.G.	Frame Ground



4.2 尺寸

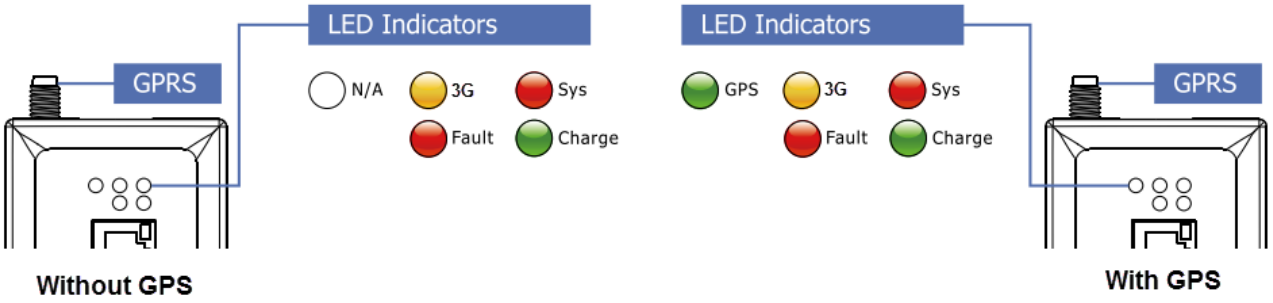

Right Side View
Front View
163.0
158.7
47.0
Back View
Left Side View
Top View
128.1
142
Bottom View
Unit : mm

4.3 作業模式切換



作業模式切換	
RUN	OS 可執行 autoexec.bat
	Flash 可被讀/寫
LRun	OS 可執行 autoexec.bat
	Flash 只能被讀取(Lock)
INIT	OS 不可執行 autoexec.bat
	Flash 可被讀/寫

4.4 LED 指示燈



G-4513 有 5 顆 LED 指示燈，幫助使用者判斷系統目前的狀態，其說明如下：

A. Sys (紅色)：System LED 是可編程的

B. 3G (黃色)：可判斷 3G 模組是否正常(模組註冊後才會開始閃爍)

	3G 模組正常	3G 模組異常
2G 模式	約 2 秒閃一次	不亮或閃爍頻率不對
3G 模式	約 2 秒閃兩次	

C. GPS (綠色)(選購)：可判斷 GPS 模組是否正常

GPS 異常	GPS 定位中	GPS 正常
不亮	恆亮	1 秒閃爍一次

D. Charging (綠色)：顯示充電狀態

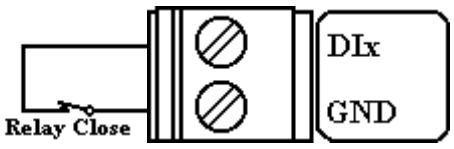
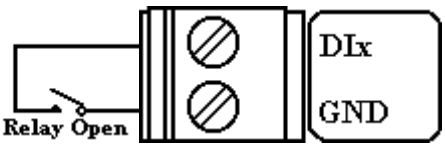
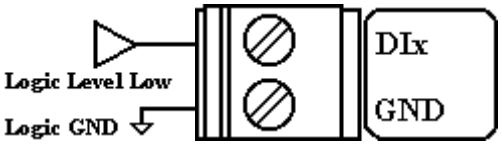
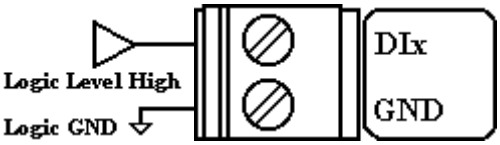
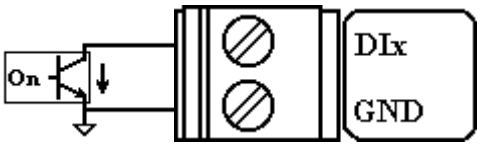
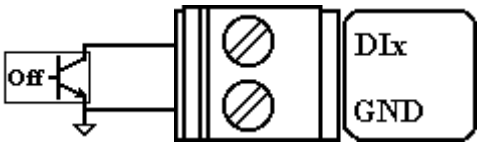
充電中	充電停止
恆亮	不亮

E. Fault (紅色)：充電錯誤指示燈

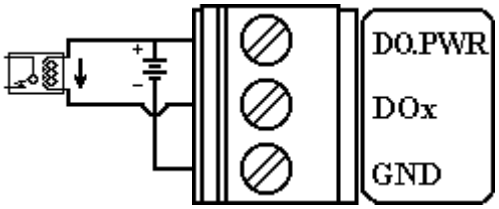
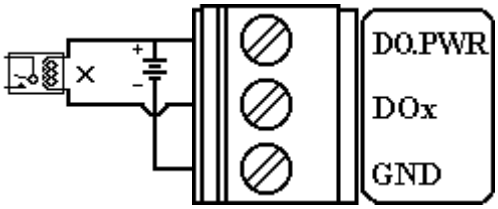
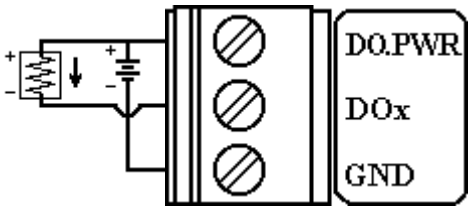
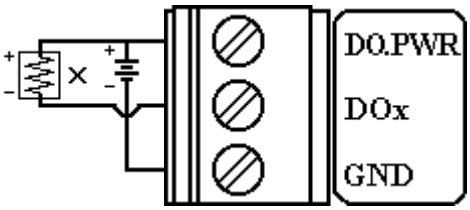
正常	錯誤
不亮	恆亮

4.5 I/O 接線圖

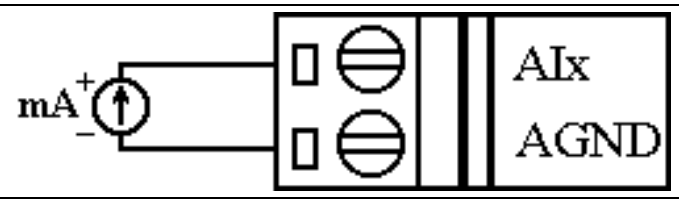
➢ DI 接線說明

Input Type	ON State DI value as 0	OFF State DI value as 1
Relay Contact		
TTL/CMOS Logic		
Open Collector		

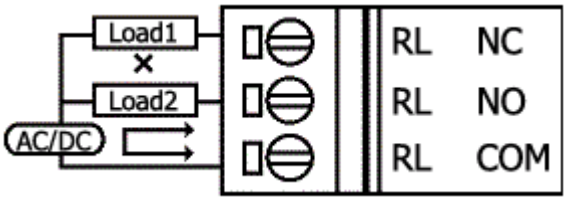
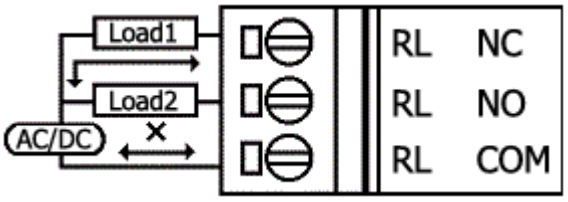
➢ DO 接線說明

Input Type	ON State DO value as 1	OFF State DO value as 0
Drive Relay		
Resistance Load		

- AI 接線說明

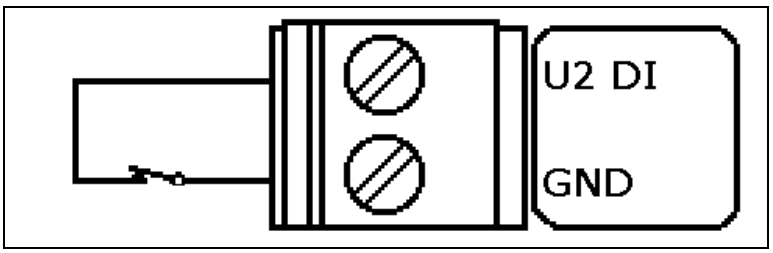
Input Type	

- Relay 接線說明

Relay Output ON	Relay Output OFF
	

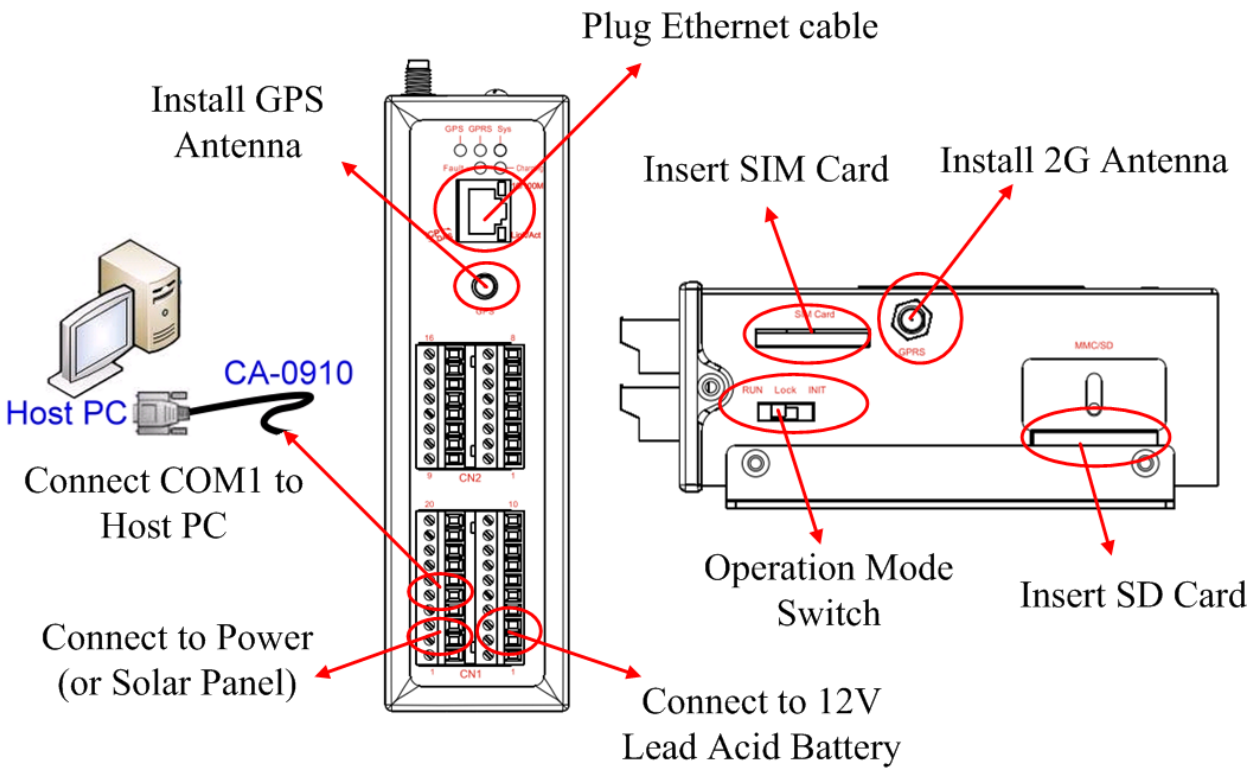
4.6 從睡眠模式中喚醒

1. 當 G-4513 處於睡眠模式時，將“U2 DI” (MCU2 DI)接至 GND，藉此將 G-4513 從睡眠中喚醒
2. 當“U2 DI” 被連接至 GND 時，讀取“U2 DI”會是 0



4.7 啟動 G-4513 系列

1. 安裝 2G/3G 天線
2. 插入已確認正常的 SIM 卡(可先用手機測試)
3. 連接 DC.+VS 和 DC.GND 到電源供應器或太陽能板
4. 連接 BAT.+VS 和 BAT.GND 到 12V 鉛酸電池



警告! 表面發燙，請勿碰觸

產品外殼可能處於高溫狀態，在外殼冷卻以前，請勿觸摸，否則可能會被燙傷。

安全指令說明

此裝置的電源輸入腳位(DC.+VS/DC.GND)與直流電源(SELV，有限電源)連接時，應該要符合 EN60950-1 的要求。請務必確認接線是否正確。

5. 省電模式與充電保護

5.1 省電模式

睡眠模式

此模式會關閉 7186 CPU，所有 I/O(3DI, 3DO, 8AI, 除了 MCU2 I/O)和 GPS，但 3G 模組會持續運作

- 功耗：14~15 mA@12V
- 如何喚醒 G-4513：
  (1) 睡眠時間到
  (2) 觸發 U2_DI (連接 U2_DI 至 GND.; 讀取 U2_DI 的值為 0)
  (3) 撥電話給 G-4513

深層睡眠模式

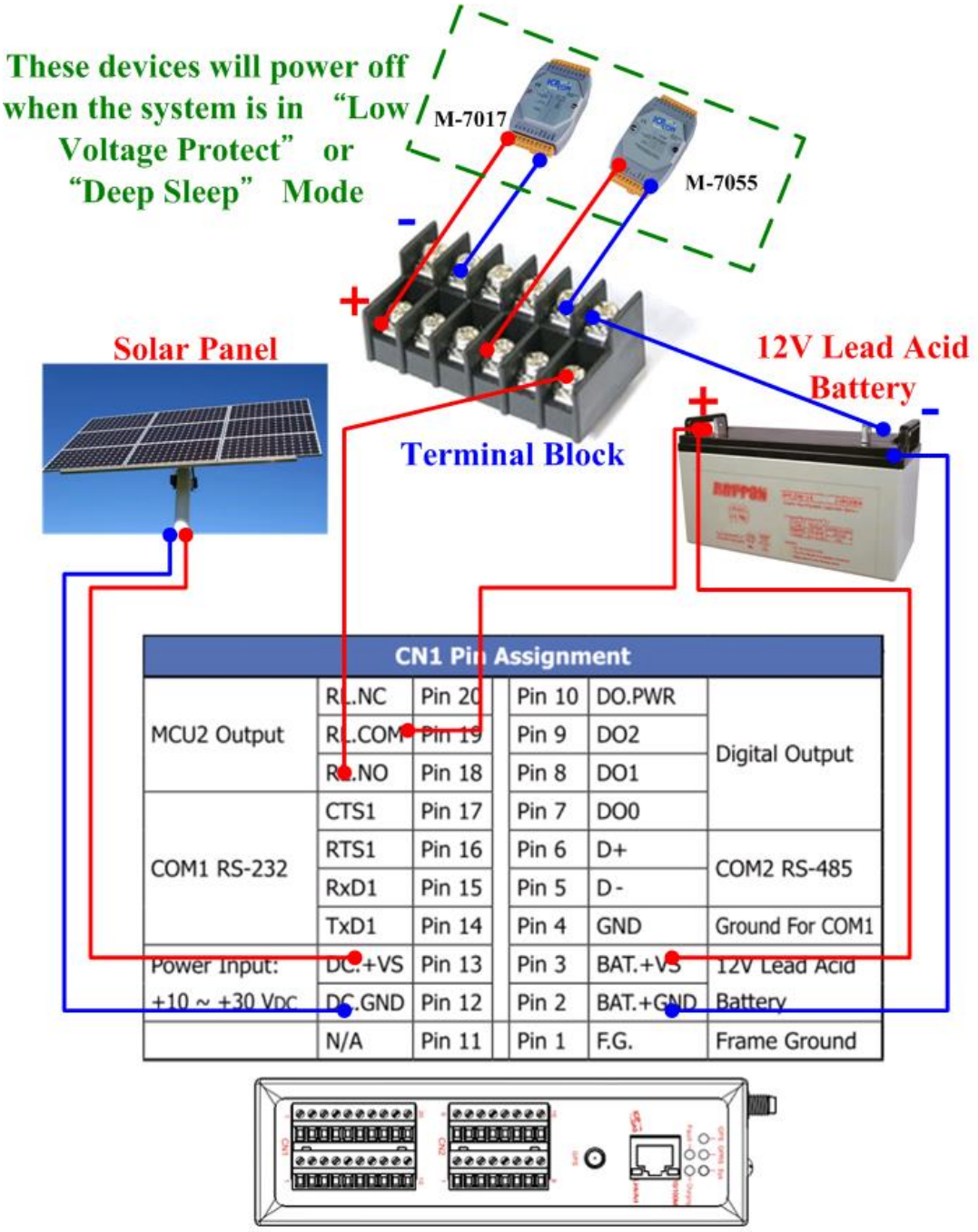
此模式會關閉所有介面，除了 MCU2 的 I/O

- 功耗：9~10 mA@12V
- 如何喚醒 G-4513：
  (1) 睡眠時間到
  (2) 觸發 U2_DI (連接 U2_DI 至 GND.; 讀取 U2_DI 的值為 0)

低電壓保護

預設是關閉的，可在程式內透過函式開啟低電壓保護的功能。此功能可避免電池過放電，當電池電壓低於 11.1V 時，G-4513 會進入低電壓保護模式並關閉系統電源。直到電池電壓到達 12.6V，G-4513 才會醒來開始工作

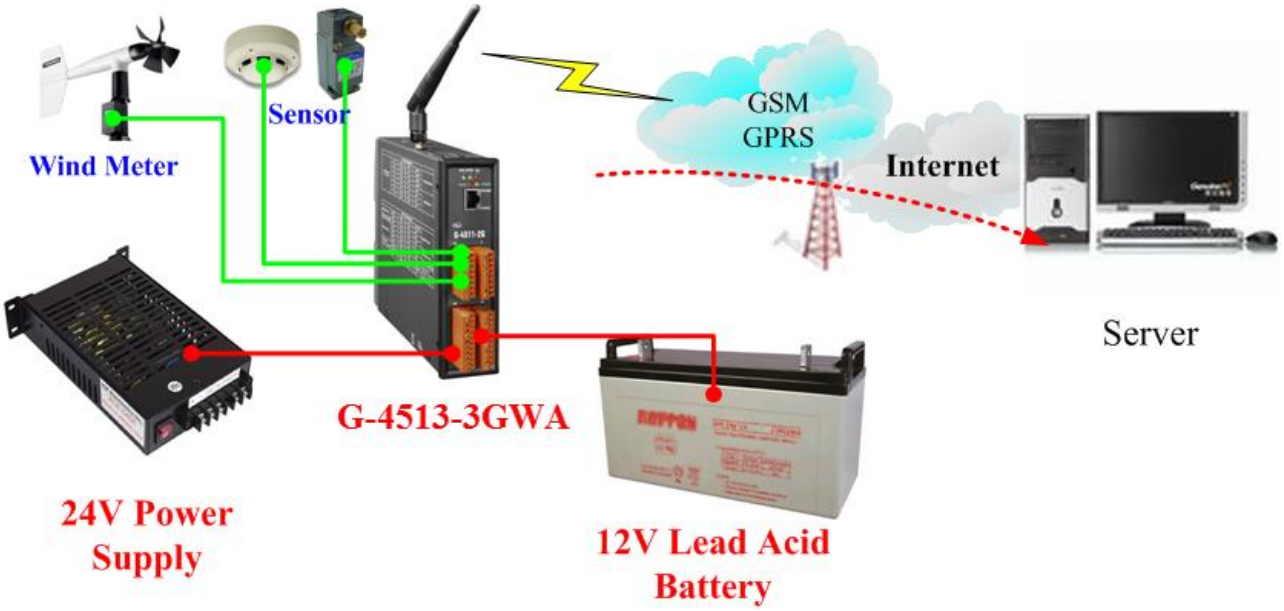
- 低電壓斷開電壓 = 11.1 V
- 低電壓重新連接電壓 = 12.6 V
- 如何使用：請參考下圖接線方式及 MCU2 的 demo 程式



5.2 如何選擇電池

此章節討論如何選擇適合您系統的電池，由於系統的存活時間取決於系統功耗及電池容量，以下範例將針對不同情況做說明

➢ **範例 1：**



條件：

- 系統接 24V 外部電源
- 當外部電源關閉，必須要能持續工作兩個星期
- 系統每 10 分鐘傳輸一次資料到伺服器 (工作 1 分鐘，睡眠 9 分鐘)
- 深層睡眠的功耗：7.2 mA@12V
- 全功能運作下的平均功耗：245 mA@12V

計算：

- 平均功耗 = 245 x (1/10) + 7.2 x (9/10) = 31 (mA)
- 31 (mA) x 24 (hours) x 14 (days) = 10416 mAh
- 我們可能選擇 “12V, 14Ah Lead Acid Battery”
- 由於 10%的電池容量是屬於低電壓的狀況，G-4513 不在該狀態下工作，故使用 90%電池容量來做計算
- 再次確認電池容量是否符合：
  14Ah x 90% x 1000 = 12600 mAh > 10416 mAh
  → 我們將選擇 **“12V, 14Ah Lead Acid Battery”**

不同的回報頻率該選擇的電池請參考表 5.2.1：

表 5.2.1

回報資料頻率	平均功耗	14 天的功耗 (mAh @12V)
每分鐘 (不睡眠)	245	82320
每 10 分鐘	31	10416
每小時	11.2	3763.2
每天	7.4	2486.4
每月	7.2	2419.2

➢ **範例 2：**

條件：

- 系統接 24V 外部電源
- 當外部電源關閉，必須要能持續工作兩個星期
- 系統每 10 分鐘傳輸一次 3 台 Modbus 裝置的資料到伺服器 (工作 1 分鐘，睡眠 9 分鐘)
- 當 G-4513 進入深層睡眠模式時，系統會透過 “MCU2 Relay Output” 關閉所有 Modbus 裝置的電源
- 深層睡眠的功耗：7.2 mA@12V
- 全功能運作下的平均功耗：424 mA@12V

計算：

- 平均功耗 = 424 x (1/10) + 7.2 x (9/10) = 49 (mA)
- 424 (mA) x 24 (hours) x 14 (days) = 16430.4 mAh
- 我們可能選擇 “12V, 22Ah Lead Acid Battery”
- 由於 10%的電池容量是屬於低電壓的狀況，G-4513 不在該狀態下工作，故使用 90%電池容量來做計算
- 再次確認電池容量是否符合：
  22Ah x 90% x 1000 = 19800 mAh > 16430.4 mAh
  → 我們將選擇 **“12V, 22Ah Lead Acid Battery”**

不同的回報頻率該選擇的電池請參考表 5.2.2：

表 5.2.2

回報資料頻率	**平均功耗**	**14 天的功耗 (mAh @12V)**
每分鐘 (不睡眠)	424	142464
每 10 分鐘	48.9	16430.4
每小時	14.1	4737.6
每天	7.5	2520
每月	7.2	2419.2

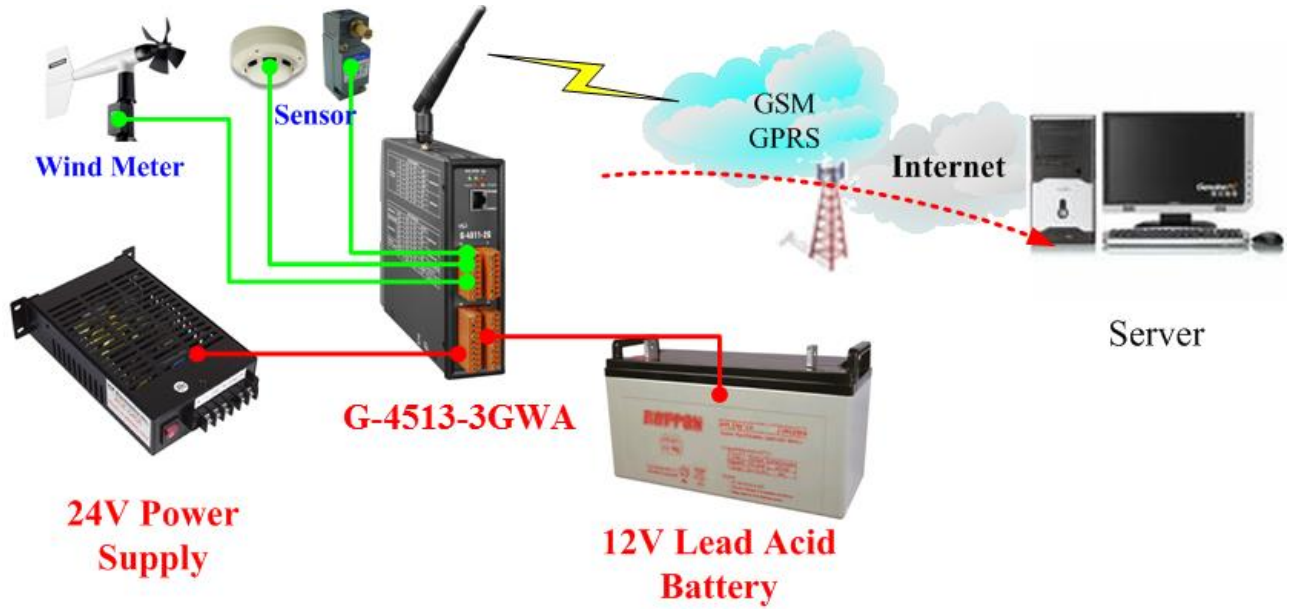
5.3 如何選擇太陽能板

此章節討論如何選擇適合您系統的太陽能板，太陽能板的功率必須大於系統的功耗，以下範例將以模擬條件做說明

在計算前您必須知道的事情

充電電壓：必須大於+16V
最大充電電流：2A
日照時數：取平均值。如果該區域的平均太陽輻射是 3 kW/m2，那麼該區域的日照時數為 3 小時

➢ **範例：**



條件：

- 深層睡眠的功耗： 7.2 mA@12V
- 全功能運作下的平均功耗：245 mA@12V
- 系統每 10 分鐘傳輸一次資料到伺服器 (工作 1 分鐘，睡眠 9 分鐘)
- 日照時數為 4 小時/天
- 使用 10W 的太陽能板

計算：

- 太陽能板最大電流 = 10 (w) / 12 (V) = 0.833 (A) = 833 (mA)
- 充電電流會被很多因素所影響，例如：擺放角度、建築或其他環境因素…等
- 我們使用最大電流的一半來做計算
- 1/2 最大電流 = 833/2 = 416 mA
- 平均電流 = 416 x 4 / 24 = 69 (mA/hr)
- 請參閱表 5.3.2，我們可以得知“平均功耗”是 31 mA (請參考表 5.3.2 或 5.2 節)
  → **10W 太陽能板可用於系統**，因為 69 > 31

表 5.3.1

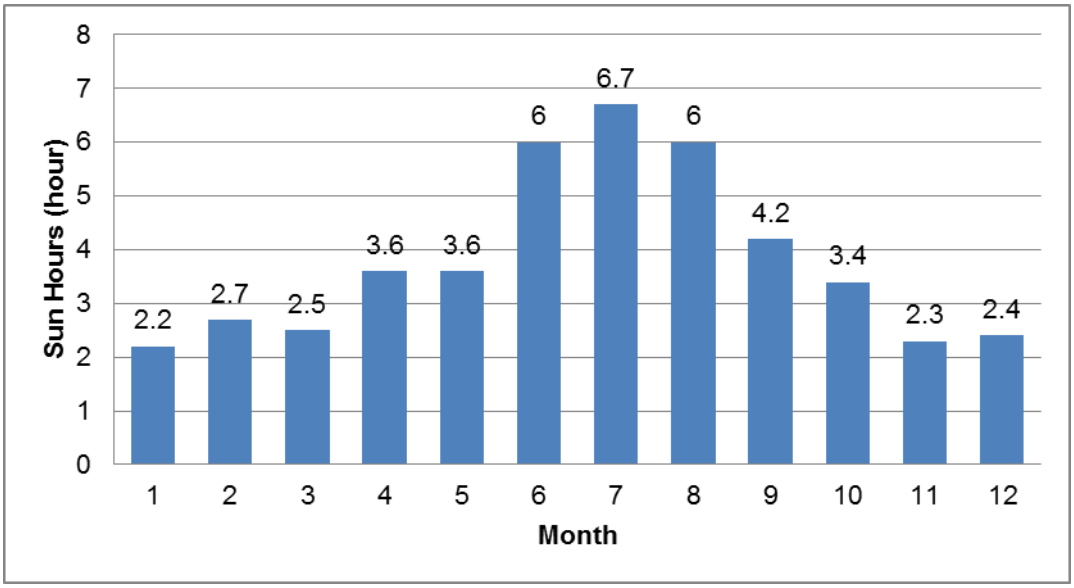
太陽能板功率 (W)	**最大電流 (mA)**	**1/2 電流 (mA)**	**日照時數**	**一天的平均電流 (mA/hr)**
10	833	416	4	69
20	1666	833	4	138
30	2500	1250	4	208
40	3333	1666	4	277
50	4166	2083	4	347

表 5.3.2

回報資料頻率	**平均功耗**	**14 天的功耗 (mAh @12V)**
每分鐘 (不睡眠)	245	82320
每 10 分鐘	31	10416
每小時	11.2	3763.2
每天	7.4	2486.4
每月	7.2	2419.2

關於“日照時數”您必須知道的事

“日照時數”是隨著季節變動的，必須使用最小的日照時數值來計算與選擇太陽能板及電池。例如：每月的日照時數如下表所示，需以 2.2 小時來計算，而不是選擇 6.7 小時來做計算。



6. API 與範例程式參考

6.1 用於 I/O 的 API

函式定義	功能說明
X305IO_Init	Initial I/O
X305IO_GetLibVersion	Get X305IO_LIB Version
X305IO_Read_AD_CalibrationGain	Read AD Calibration Gain
X305IO_Read_AD_CalibrationOffset	Read AD Calibration Offset
X305IO_AnalogIn	Read value from assign AI channel
X305IO_Read_All_DI	Read All DI
X305IO_Read_One_DI	Read the value form assign DI channel
X305IO_Write_All_DO	Write All DO
X305IO_Write_One_DO	Write the value to the assign DO channel
X305IO_Read_All_DO	Read All DO state
X305IO_Read_One_DO	Read the DO state form the assign DO channel.
X305IO_AnalogIn_SetChannel	Set the AI channel that users want to read.
X305IO_AnalogIn_Hex	Read the value from the specific A/D channel (12 bits)
X305IO_AnalogIn_HexToFloat	Transfer the AI value from 12 bits to float

6.1.1 X305IO_Init

Initial X305IO.

Syntax

```
int X305IO_Init(void);
```

Parameters

None

Return values

0：success
<>0：error

6.1.2 X305IO_GetLibVersion

Get X305IO_Lib Version.

Syntax

```
unsigned X305IO_GetLibVersion(void);
```

Parameters

None

Return values

Version Number

6.1.3 X305IO_Read_AD_CalibrationGain

Read the A/D Calibration Gain.

Syntax

```
float X305IO_Read_AD_CalibrationGain(void);
```

Parameters

None

Return values

Calibration Gain of the AD channels

6.1.4 X305IO_Read_AD_CalibrationOffset

Read the A/D Calibration Offset.

Syntax

```
float X305IO_Read_AD_CalibrationOffset(void);
```

Parameters

None

Return values

Calibration Offset of the AD channels

6.1.5 X305IO_AnalogIn

Read the value from the assign AI channel.

Syntax

```
float X305IO_AnalogIn(
    int iChannel
);
```

Parameters

iChannel

0：channel 0
1：channel 1
2：channel 2
3：channel 3
4：channel 4
5：channel 5
6：channel 6
7：channel 7

Return values

0.0mA ~ 20.0mA

6.1.6 X305IO_Read_All_DI

Read all DI values of the G-4513 series.

Syntax

```
int X305IO_Read_All_DI(void);
```

Parameters

None

Return values

0x00~0x07

Example

When DI0 Ground
DI1 Open
DI2 Open

value = X305IO_Read_All_DI( );

value = 0x6

6.1.7 X305IO_Read_One_DI

Read the value from the assign DI channel.

Syntax

```
int X305IO_Read_One_DI(
    int iChannel
);
```

Parameters

iChannel

0：channel 0

1：channel 1

2：channel 2

Return values

1：open

Logic high level (+3.5V ~ +30V)

0：close to GND

Logic low level (0V ~ +1V)

6.1.8 X305IO_Write_All_DO

Write to all DO values of the G-4513 series.

Syntax

```
void X305IO_Write_All_DO(
    int iOutValue
);
```

Parameters

iOutValue
0x0~0x7

Return values

None

Example

X305IO_Write_All_DO(6);

After function execute：
DO0 OFF
DO1 ON
DO2 ON

6.1.9 X305IO_Write_One_DO

Write the specific value to the assign DO channel.

Syntax

```
void X305IO_Write_One_DO(
    int iChannel, int iStatus
);
```

Parameters

iChannel

0：channel 0
1：channel 1
2：channel 2

iStatus

0：Status is OFF
1：Status is ON

Return values

None

6.1.10 X305IO_Read_All_DO

Read all DO values of the G-4513 series.

Syntax

```
int X305IO_Read_All_DO(void);
```

Parameters

None

Return values

0x0~0x7

Example

When DO0 OFF
DO1 ON
DO2 ON

Value = X305IO_Read_All_DO( );

Value = 0x6

6.1.11 X305IO_Read_One_DO

Read the state from the assign DO channel.

Syntax

```
int X305IO_Read_One_DO(
    int iChannel
);
```

Parameters

iChannel

0：channel 0

1：channel 1

2：channel 2

Return values

0：OFF

1：ON

6.1.12 X305IO_AnalogIn_SetChannel

Set the specific AI channel that users want to read.

Syntax

```
int X305IO_AnalogIn_SetChannel(
    unsigned iChannel
);
```

Parameters

iChannel

0：channel 0
1：channel 1
2：channel 2
3：channel 3
4：channel 4
5：channel 5
6：channel 6
7：channel 7

Return values

0：Set up success
-1：Set iChannel number error

6.1.13 X305IO_AnalogIn_Hex

Read the value of the assign AI channel assigned by X305IO_AnalogIn_SetChannel function.

Syntax

```
int X305IO_AnalogIn_Hex(void);
```

Parameters

None

Return values

After Read assign AI channel value.

Example

```
X305IO_AnalogIn_SetChannel(0);      // Set channel 0
X305IO_AnalogIn_Hex( );
```

6.1.14 X305IO_AnalogIn_HexToFloat

Set the AI value from 12 bits to float format.

Syntax

```
float X305IO_AnalogIn_HexToFloat(
    int iValue
);
```

Parameters

iValue
A value want to 12 bits transform float.

Return values

The transferred AI value by float format.

Example

Set the channel 0 to read, and then transform the value to float.

```
float AdValue;

X305IO_AnalogIn_SetChannel(0);
AdValue=X305IO_AnalogIn_HexToFloat(X305IO_AnalogIn_Hex( ));
```

6.2 用於 MMC/SD 的 API

所需函式庫與標頭檔:
SD_Vnnn.LIB and microSD.h

函式定義	功能說明
pc_init	Initializes the SD socket library
pc_open	1. Open an existing file and return a file handle 2. Creates a new file
pc_close	Closes a file and release a file handle.
pc_read	Reads the specified file
pc_write	Writes the specified file
pc_seek	Moves the file pointer to relative offset from the current offset
pc_tell	Gets current offset of the file pointer
pc_eof	Checks whether the end-of-file is reached
pc_format	Formats the SD card as FAT (FAT32)
pc_mkdir	Creates a directory or subdirectory
pc_rmdir	Removes an existing directory
pc_move	Renames an existing file or a directory, including the subdirectory
pc_del	Deletes the specified file
pc_deltree	Deletes the specified directory or subdirectory
pc_isdir	Checks whether the file is a directory
pc_isvol	Checks if is a volume
pc_size	Gets the size of the specified file

pc_set_cwd	Sets the current working directory
pc_get_cwd	Gets the pathname of the current working directory
pc_gfirst	Moves the pointer to the first element
pc_gnext	Moves the pointer to the next element
pc_gdone	Moves the pointer to the last element
pc_get_freeSize_KB	Gets the free space of the SD memory card
pc_get_usedSize_KB	Gets the used space of the SD memory card
pc_get_totalSize_KB	Gets the total size of the SD memory card
pc_get_attributes	Gets the file attributes
pc_set_attributes	Sets the file attributes
pc_get_errno	Gets the error number

開始使用 SD 之 API

1. pc_init()
   使用 SD 功能前，需呼叫 pc_init() 來初始化 SD

啟用/關閉 SD 之 API

2. pc_open()
   在寫入／讀取資料至 SD 卡之前，需呼叫 pc_open() 來開啟檔案

3. pc_close()
   完成寫入／讀取資料至 SD 卡後，需呼叫 pc_close() 依檔案控制代碼 (File Handle) 來關閉檔案

寫入資料至 SD 之 API

4. pc_write()
   此函式可添加一個指定數量之同等大小的資料項目於 SD 裡的檔案中

範例－寫入資料至 microSD 卡：

```
#include <string.h>
#include <stdio.h>
#include "upac5000.h"
#include "microSD.h"
void main(void)
{
    int fd, iRet;
    InitLib();
    if(pc_init())
        Print(“Init microSD ok\r\n”);
    else
    {
        Print(“Init microSD failed\r\n”);
        iRet=pc_get_errno();
        switch(iRet)
        {
            case PCERR_BAD_FORMAT: //1
                Print("Error 01: format is not FAT\r\n");
                break;
            case PCERR_NO_CARD: //2
                Print("Error 02: no microSD card\r\n");
                break;
            default:
                Print("Error %02d: unknow error\r\n", iRet);
                break;
        }
    }
    fd=pc_open("test.txt", (word) (PO_WRONLY|PO_CREAT|PO_APPEND),
    (word) (PS_IWRITE|PS_IREAD));
    if(fd>=0)
    {
        pc_write(fd, "1234567890", 10); /* write 10 bytes */
        pc_close(fd);
    }
}
```

從 SD 卡中讀取資料之 API

5. pc_read()
使用 pc_open() 開啟檔案後，需呼叫 pc_read() 來讀取 SD 中的資料

範例－讀取 microSD 中的資料：

```
#include <string.h>
#include <stdio.h>
#include "upac5000.h"
#include "microSD.h"
void main(void)
{
    int fd, iRet;
    unsigned char Buffer[80];
    InitLib();
    if(pc_init())
        Print("Init microSD ok\r\n");
    else
    {
        Print("Init microSD failed\r\n");
        iRet=pc_get_errno();
        switch(iRet)
        {
            case PCERR_BAD_FORMAT: //1
                Print("Error 01: format is not FAT\r\n");
                break;
            case PCERR_NO_CARD: //2
                Print("Error 02: no microSD card\r\n");
                break;
            default:
                Print("Error %02d: unknow error\r\n", iRet);
                break;
        }
    }
    fd=pc_open("test.txt", (word) (PO_RDONLY), (word) (PS_IWRITE|PS_IREAD));
    if(fd>=0)
    {
```

```
        iRet=pc_read(fd, Buffer, 10);    /* reads 10 bytes */
        Buffer[10]=0; /* adds zero end to the end of the string */
        pc_close(fd);
        Print("%s", Buffer);
    }
}
```

請參閱下列位置，取得關於 microSD 的範例程式：

CD:\napdos\g-4513-3gwa\software\demo\basic\microSD\

http://ftp.icpdas.com/pub/cd/usbcd/napdos/g-4513-3gwa/software/demo/basic/microsd/

6.3 用於 LCD 的 API

函式定義	功能說明
LCD_Init	Initialize the library
LCD_BackLight_On	Turn on the LCD backlight
LCD_BackLight_Off	Turn off the LCD backlight
LCD_ShowText	Display one character on the LCD panel
LCD_ClrScrn	Clear the LCD panel
LCD_StandByMode	Enter the stand by mode
LCD_NormalMode	Restore the LCD to normal mode
LCD_GotoPosition	Move the cursor to the specified position
LCD_CursorDisplay	Set the Cursor display status
LCD_LineReverse	Select one of four line and reverse the display
LCD_LineRestore	Select one of four line and restore the display
LCD_GetLibDate	Gets the create date of funciton library
LCD_GetLibVersion	Gets the version number of function library

6.3.1 LCD_Init

Initialize parameters about LCD functions in the library.

Syntax

```
void LCD_Init(void);
```

Parameters

None

Return values

None

6.3.2 LCD_BackLight_On

Turn on the LCD backlight.

Syntax

```
void LCD_BackLight_On(void);
```

Parameters

None

Return

None

6.3.3 LCD_BackLight_Off

Turn off the LCD backlight.

Syntax

```
void LCD_BackLight_Off(void);
```

Parameters

None

Return values

None

6.3.4 LCD_ShowText

Display one character on the LCD panel, and the cursor will right-shifted by one character position automatically.

Syntax

```
void LCD_ShowText(
    uchar Text
);
```

Parameters

Text

Display character

Return values

None

6.3.5 LCD_ClrScrn

Clear the LCD panel.

Syntax

```
void LCD_ClrScrn(void);
```

Parameters

None

Return values

None

6.3.6 LCD_StandByMode

Enter the stand by mode, and it can be terminated by either LCD_NormalMode() or other function.

Syntax

```
void LCD_StandByMode(void);
```

Parameters

None

Return values

None

6.3.7 LCD_NormalMode

Restore the LCD to normal mode when it is in the stand by mode.

Syntax

```
void LCD_NormalMode(void);
```

Parameters

None

Return values

None

6.3.8 LCD_GotoPosition

Move the cursor to the specified position.

Syntax

```
void LCD_GotoPosition(
    int Line,
    int Offset
);
```

Parameters

Line

One of four line numbers (1 to 4)

Offset

Cursor position (1 to 8)

Return values

None

6.3.9 LCD_CursorDisplay

Set the Cursor display status.

Syntax

```
void LCD_CursorDisplay(
    int Display,
    int Blink
);
```

Parameters

Display

Cursor display on/off

1: Display on

0: Display off

Blink

Character blink on/off

1: Display on

0: Display off

Return values

None

6.3.10 LCD_LineReverse

Select one of four line and reverse the display.

Syntax

```
void LCD_LineReverse(int Line);
```

Parameters

Line

One of four line numbers (0 to 4)

Return values

None

6.3.11 LCD_LineRestore

Select one of four line and restore the display.

Syntax

```
void LCD_LineRestore(
    int Line
);
```

Parameters

Line

One of four line numbers (0 to 4)

Return values

None

6.3.12 LCD_GetLibDate

Gets the create date of funciton library.

Syntax

```
void LCD_GetLibDate(
    unsigned char *LibDate
);
```

Parameters

LibDate

Gets the create date of funciton library

Return values

None

6.3.13 LCD_GetLibVersion

Get the version number of function library.

Syntax

```
unsigned LCD_GetLibVersion(void);
```

Parameters

None

Return values

Return the current version number.

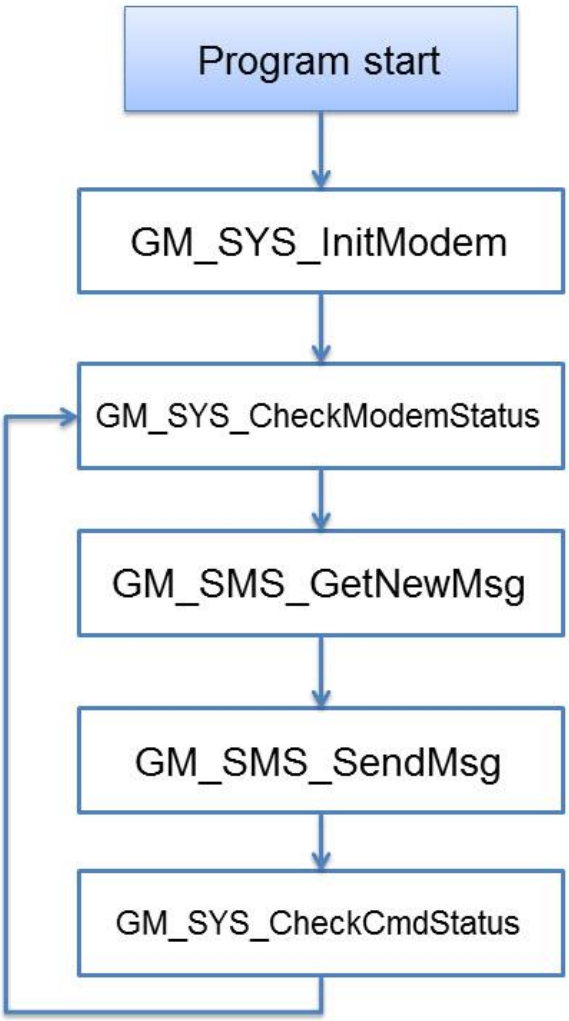
6.4 用於 GSM 的 API

更多 GSM API 相關資訊，請至官網下載、參考 GSM_U2_Library_User's Manual

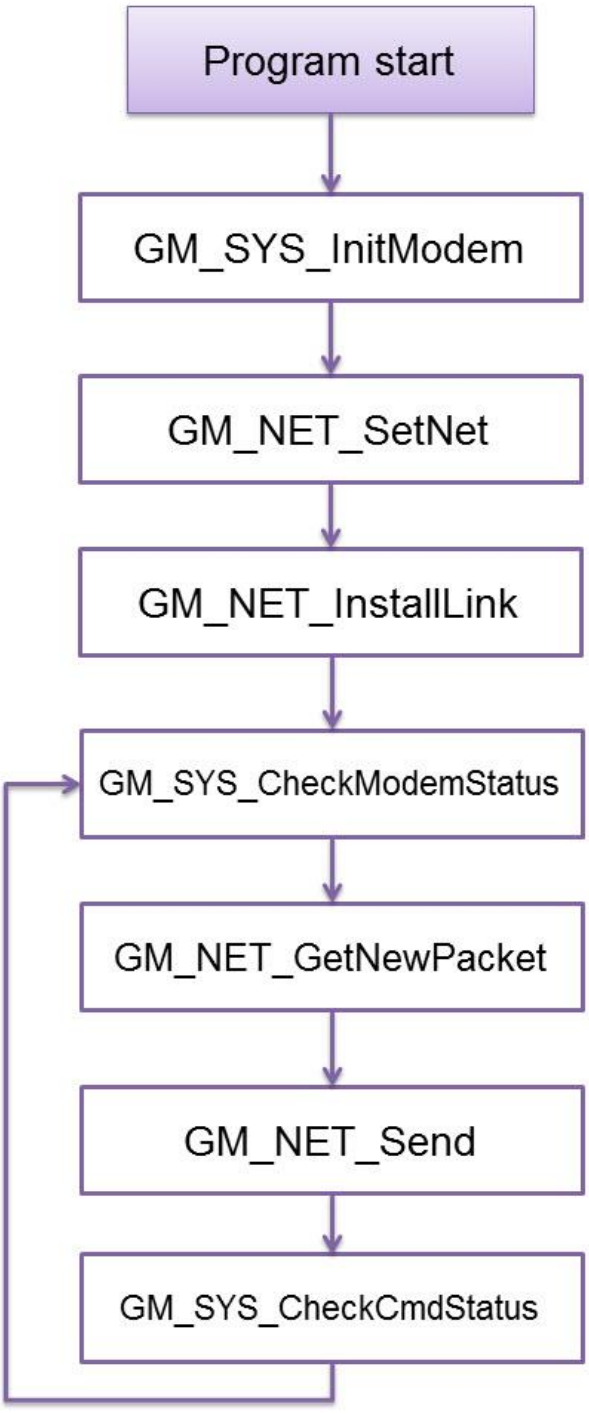
Function definition	Description
GM_SYS_InitModem	Initialize Modem
GM_SYS_CloseModem	Close the modem
GM_SYS_CheckModemStatus	Check modem status, and suggest you check it in your loop every time
GM_SYS_CheckSignal	Check signal quality
GM_SYS_CheckReg	Check register
GM_SMS_SendMsg	Send a message
GM_SMS_GetNewMsg	Get a new sms message
GM_NET_SetNet	Set Net profile data
GM_NET_InstallLink	Built TCP/UDP link
GM_NET_CloseNet	Close Network
GM_NET_CloseLink	Close client link[n]
GM_NET_Send	Send a packet
GM_NET_GetNewPacket	Get the new packet

6.4.1 GSM Design Flowchart

SMS Design Flowchart



GPRS Design Flowchart



6.4.2 GM_SYS_InitModem

Initialize Modem.

**must use GM_SYS_CheckModemStatus() to check modem status later

Syntax

```
int GM_SYS_InitModem(
    SYSProfile sysProfile
);
```

Parameters

sysProfile
set system profile

Return values

GM_NOERROR：success
GM_COMERROR：comport error
GM_INITERROR：init fail error

6.4.3 GM_SYS_CloseModem

Close the modem.

**Please call GM_SYS_InitModem() to wake up modem after using GM_SYS_CloseModem(1) to shut down the modem.

Syntax

```
int GM_SYS_CloseModem(
    int mode
);
```

Parameters

mode

0：close modem, but maintain it power on

1：close modem and set it power off

Return values

GM_NOERROR：no error

GM_CMDERROR：command error

6.4.4 GM_SYS_CheckModemStatus

Check modem status, and suggest you check it in your loop every time.

Syntax

```
int GM_SYS_CheckModemStatus(void);
```

Parameters

None

Return values

GM_NOERROR：modem register success, can service
GM_NOREG：modem not registered, can't service

6.4.5 GM_SYS_CheckSignal

Check signal quality.

Syntax

```
int GM_SYS_CheckSignal(void);
```

Parameters

None

Return values

signal quality

0	-113 dBm or less
1	-111 dBm
2...30	-109... -53 dBm
31	-51 dBm or greater

6.4.6 GM_SYS_CheckReg

Check register.

Syntax

```
int GM_SYS_CheckReg(void);
```

Parameters

None

Return values

Register flag

0：not registered
1：registered, home network
2：not registered, and searching...
3：registration denied
4：unknown
5：registered, roaming

6.4.7 GM_SMS_SendMsg

Send a message.

**must use "GM_SYS_CheckCmdStatus()" to check status later

Syntax

```
int GM_SMS_SendMsg(
    strEncode_Msg* strMsg
);
```

Parameters

strMsg
the message that will be sent.

Return values

GM_NOERROR：no error
GM_NOREG：not registered, or can't service
GM_BUSY：modem busy

6.4.8 GM_SMS_GetNewMsg

Get a new sms message.

Syntax

```
int GM_SMS_GetNewMsg(
    strEncode_Msg* msg
);
```

Parameters

msg
new sms message

Return values

0：no new message
1：new message coming

6.4.9 GM_NET_SetNet

Set Net profile data.

Syntax

```
int GM_NET_SetNet(
    NetProfile netProfile
);
```

Parameters

netProfile
Net profile data

Return values

GM_NOERROR：no error
GM_CMDERROR：command error

6.4.10 GM_NET_InstallLink

Built TCP/UDP link.

Syntax

```
int GM_NET_InstallLink(
    int n,
    int tcp,
    char* serverIP,
    unsigned int serverPort
);
```

Parameters

n

link number (0~6)
3G (G-4513 series)：0~6
2G (G-4511 series)：0

tcp

client type, tcp=1 for TCP client ; tcp=0 for UDP client

serverIP

IP or Domain name of the server, ex: "61.111.222.333", "test.com.tw"

serverPort

TCP/UDP Port of the server (1~65535), ex: 1234

Return

GM_NOERROR：correct parameter to install TCP/UDP link
GM_CMDERROR：command error

6.4.11 GM_NET_CloseNet

Close Network.

Syntax

```
int GM_NET_CloseNet(void);
```

Parameters

None

Return values

GM_NOERROR：no error
GM_CMDERROR：command error
GM_BUSY：modem busy

6.4.12 GM_NET_CloseLink

Close client link[n].

Syntax

```
int GM_NET_CloseLink(
    int n
);
```

Parameters

n

3G (G-4513 series)：0~6
2G (G-4511 series)：0

Return values

GM_NOERROR：no error
GM_CMDERROR：command error
GM_BUSY：modem busy

6.4.13 GM_NET_Send

Send a packet.

**must use "GM_SYS_CheckCmdStatus()" to check status later

Syntax

```
int GM_NET_Send(
    char link,
    char* data,
    int dataLen
);
```

Parameters

link

link number
3G (G-4513 series)：0~6
2G (G-4511 series)：0

data

data that will be sent

dataLen

data length, Max.=1000

Return values

GM_NOERROR：no error
GM_CMDERROR：command error
GM_BUSY：modem busy

6.4.14 GM_NET_GetNewPacket

Get the new packet.

Syntax

```
int GM_NET_GetNewPacket(
    GPRSData* gprsData
);
```

Parameters

gprsData
new data packet

Return values

0：no new packet
1：new packet coming

6.4.15 GSM Demo References

For example, send and receive sms message

```
#include <conio.h>
#include <stdio.h>
#include <malloc.h>
#include <stdlib.h>
#include <string.h>
#include "../lib/G4500.h"
#include "../lib/GSM_U2.h"
#include "../lib/OS7_COM.h"
#include "../lib/MCU2LIB.h"

int main(void)
{
	int iAction=1, quit=1;
	int i, j, tmp;
	int Result=0;
	strEncode_Msg RecMsg, SendMsg;
	char sendNumber[20];
	int send_n;
	int sendStatus = 0;
	SYSProfile sysProfile;

	//-- init
	InitLib();

	/*---- init modem----*/
	strcpy(sysProfile.PINCode, "0000"); /*The pin code of SIM card, ex: "0000"*/
	sysProfile.modemPort = 4;   /*modem port number. G-4500 = 4, uP-5000 = 11*/
	sysProfile.hardware = 0;       /*hardware type. 1: G-4500, 2: uPAC-5000, 0: Other*/
	GM_SYS_SetPowerFunction(powerFunction); /*set power-control function*/


	if((Result = GM_SYS_InitModem(sysProfile)) == GM_NOERROR)
		Print("init_modem success!!\r\n");
	else
	{
		Print("init_modem fail!! return value is %d\r\n", Result);
```

```
        return 1;
}

/*--check Could the modem service? --*/
while(GM_SYS_CheckModemStatus() != GM_NOERROR)
{
        Print("wait modem register...\r\n");
        DelayMs(1000);
}
Print("modem registered!!\r\n");

while(iAction!=0)
{
        iAction=0;
        quit=0;
        Print("1) Send ASCII messages\r\n");
        Print("2) check signal quality\r\n");
        Print("3) check registered?\r\n");
        Print("0) Quits demo program\r\n");
        Print("Choose an option and press [Enter]: ");
        Scanf("%d", &iAction);

        switch(iAction)
        {
        case 1:       /*Send ASCII messages*/
                Print("Send ASCII messages\r\n");

                Print("Please Input Phone Number =");
                Scanf("%s", sendNumber);

                Print("How many message do you want to send?\r\n");
                Scanf("%d", &send_n);
                i = 0;
                Print("== start to send sms, please press <ESC> to exit ==\r\n");
                while(1)
                {
                        /* press "ESC" to exit */
                        if(Kbhit())
                        {
                                tmp = Getch();
```

```
            if( tmp == 27 || tmp == 'q')
                break;
        }

/*--(1) check that could the modem service, if it can't, skip operating the modem below --*/
        if(GM_SYS_CheckModemStatus() != GM_NOERROR)
            continue;

        /*--(2) send messages, when the modem can service--*/
        if(i<send_n)
        {
            switch((sendStatus=GM_SYS_CheckCmdStatus()))
            {
            case GM_READY:
                Print("sending message(%d)....\r\n", i);

                strcpy(SendMsg.phoneNumber, sendNumber);
                SendMsg.mode = GSM_7BIT;
                sprintf(SendMsg.msg, "GSM_Test(%2d)", i);
                SendMsg.dataLen = strlen(SendMsg.msg);
                GM_SMS_SendMsg(SendMsg);
                break;
            case GM_NOERROR:
                Print("send success!!\r\n");
                i++;
                break;
            case GM_BUSY:  //sending, and waiting reply
                break;
            default:
                Print("send error, and skip this one, error code=%d\r\n",
                sendStatus);
                i++;
                break;
            }
        }
        /*--(3) if any sms message come in, print it --*/
        if( GM_SMS_GetNewMsg(&RecMsg) != 0)
        {
            printMsg(RecMsg);
        }
```

```
                }
                break;

        case 2://check signal quality
                Result = GM_SYS_CheckSignal();
                Print("signal value = %d\r\n", Result);
                break;

        case 3://check register value
                Result = GM_SYS_CheckReg();
                Print("register value = %d    (0:no register, 1:registered, 2:registering)\r\n",
                Result);
                break;

        case 0:
        default:
                quit=1;
                break;

        }//end switch()

        if(!quit)
        {
                Print("Press any key to continue...\r\n");
                Getch();
        }
    }   /*end while(1)*/

    /*must close before program ending to release you resource*/
    /*-- Close the modem, 0:not turn off modem, 1:turn off modem*/
    GM_SYS_CloseModem(0);

    Print("Please press ENTER to exit...\r\n");
    Getch();
    return 0;
}
```

For example, TCP client Demo

```
#include <conio.h>
#include <stdio.h>
#include <malloc.h>
#include <stdlib.h>
#include <string.h>
#include "../lib/G4500.h"
#include "../lib/GSM_U2.h"
#include "../lib/OS7_COM.h"
#include "../lib/MCU2LIB.h"

int main(void)
{
   int iAction=1, quit=1;
   int i, j,tmp;
   int Result=0;
   int send_n;
   NetProfile netProfile;
   SYSProfile sysProfile;
   GPRSData gprsData;
   char serverIP[16];
   int serverPort;
   long socket_n;
   int netSendStatus = 0;
   char myIP[16];

   InitLib();

   /*---- init modem ----*/
   strcpy(sysProfile.PINCode, "0000");     /*The pin code of SIM card, ex: "0000"*/
   sysProfile.modemPort = 4;     /*modem port number. G-4500 = 4, uP-5000 = 11*/
   sysProfile.hardware = 0;        /*hardware type. 1: G-4500, 2: uPAC-5000, 0: Other*/
   GM_SYS_SetPowerFunction(powerFunction); /*set power-control function*/

   if( (Result = GM_SYS_InitModem(sysProfile)) == GM_NOERROR)
         Print("init_modem success!!\r\n");
   else{
         Print("init_modem fail!! return value is %d\r\n", Result);
         return 1;
```

```
}

/*-- check Could the modem service? --*/
while(GM_SYS_CheckModemStatus() != GM_NOERROR)
{
    Print("wait modem register...\r\n");
    DelayMs(1000);
}
Print("modem registered!!\r\n");

while(iAction!=0)
{
    iAction=0;
    quit=0;
    Print("1) TCP client demo\r\n");
    Print("0) Quits demo program\r\n");
    Print("Choose an option and press [Enter]: ");
    Scanf("%d", &iAction);
    Print("\r\n");

    switch(iAction)
    {
      case 1:    //TCP client demo
      Print("TCP client demo start\r\n");

        /* set Network profile */
        /* APN for network provided by your cellular provider*/
        strcpy(netProfile.APN, "INTERNET");
        /*username for network provided by your cellular provider */
        strcpy(netProfile.pw, "guest");
        /*password for network provided by your cellular provider */
        strcpy(netProfile.user, "guest");
        /* The most basic task of DNS is to translate hostnames such as
        www.icpdas.com to IP address such as 96.9.41.131 */.
        strcpy(netProfile.DnsServerIP, "");       /*empty string = system default value*/
        GM_NET_SetNet(netProfile);

        /*set ip, port of server */
        Print("please input server IP:(ex: 74.125.227.48)\r\n");
        Scanf("%s", serverIP);
```

```
            Print("please input server Port:(ex: 80)\r\n");
            Scanf("%d", &serverPort);

            /*--(1) install link[0], GM_NET_InstallLink(0, 0, serverIP, serverPort) for UDP--*/
            GM_NET_InstallLink(0, 1, serverIP, serverPort);
            Print("linking...\r\n");
            socket_n = 0;    //count for the packets

            while (1)
            {
                /* press "ESC" to exit */
                if(Kbhit())
                {
                    tmp = Getch();
                    if( tmp == 27 || tmp == 'q')
                        break;
                }

/*-- (2) check that could the modem service, if it can't, skip operating the modem below --*/
                if(GM_SYS_CheckModemStatus() != GM_NOERROR)
                    continue;

                if(GM_NET_GetLinkStatus(0)!=1)
                    continue;
                else
                    GM_NET_GetIP(myIP);

                /*--(3) send the data to server, and when LinkStatus[1]=1 --*/
                switch((netSendStatus=GM_SYS_CheckCmdStatus()))
                {
                  case GM_READY:
                    Print("sending package[%8ld]..., myIP = %s\r\n", socket_n, myIP);
                    gprsData.link = 0;
                    sprintf(gprsData.data, "-<%8ld>-TCP send test!!", socket_n);

                    gprsData.dataLen = strlen(gprsData.data);
                    if(GM_NET_Send(gprsData.link,gprsData.data,gprsData.dataLen)!=G
                    M_NOERROR)
                        Print("can't send package[%8ld]\r\n");
                    break;
```

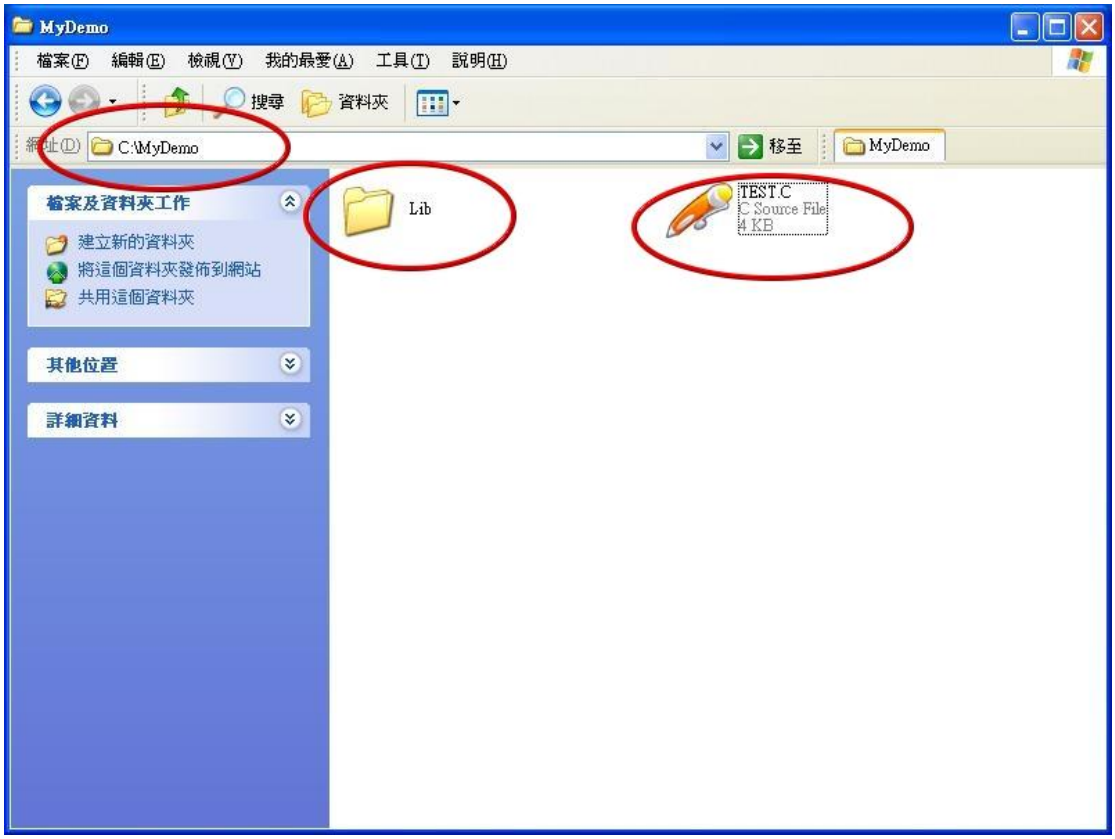
```
                    case GM_NOERROR:
                        Print("send success!!\r\n");
                        socket_n++;
                        break;
                    case GM_BUSY:  /*sending, and waiting reply*/
                        break;
                    default:
                        Print("send error, and re-send again, error code=%d\r\n",
                        netSendStatus);
                        break;
            }

            /*-- (4) if any new data packet come in, print it --*/
                if(GM_NET_GetNewPacket(&gprsData) != NULL)
                {
                    Print("\n== new data packet come in\r\n");
                    printPacket(gprsData);
                }
        }
        GM_NET_CloseLink(0); /*--Close client link[n], 3G:0~6, 2G:0 --*/
        DelayMs(1000);
        GM_NET_CloseNet();
        DelayMs(1000);

        break;
    }

}
```

7. 程式編譯與下載步驟

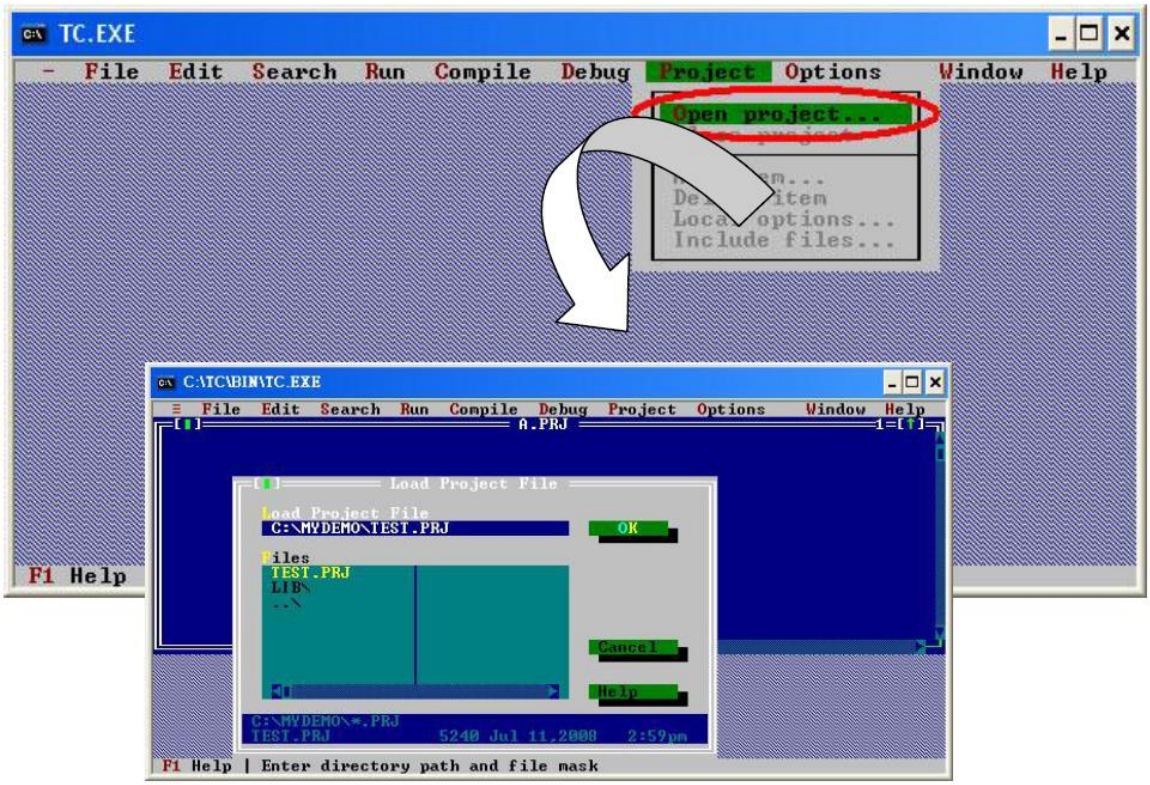
此章節將介紹如何編譯與執行 G-4513 的程式

Library	Description
G4500.LIB	G-4513 and DI/O、AI functions
GSM_U2.LIB	GPRS functions
SD_Vnnn.LIB	MMC/SD functions
TCP_DM32.LIB	Ethernet functions
LCD.LIB	LCD functions

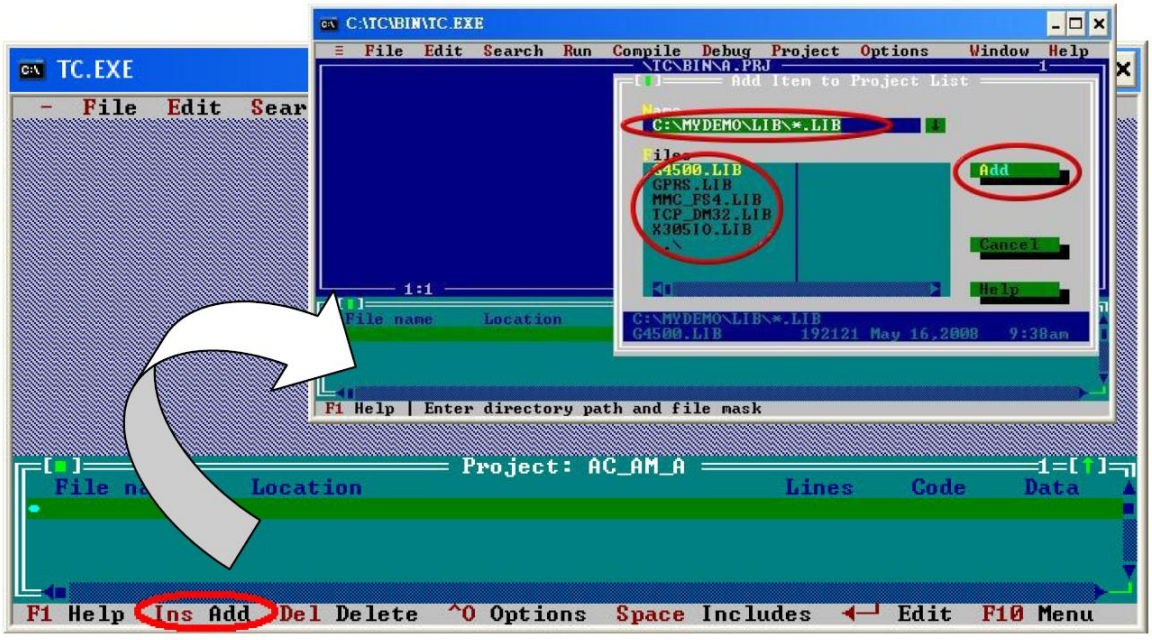
步驟 1：在 C 槽建立資料夾並取名為“MyDemo”，複製 lib 及程式到 MyDemo 資料夾內



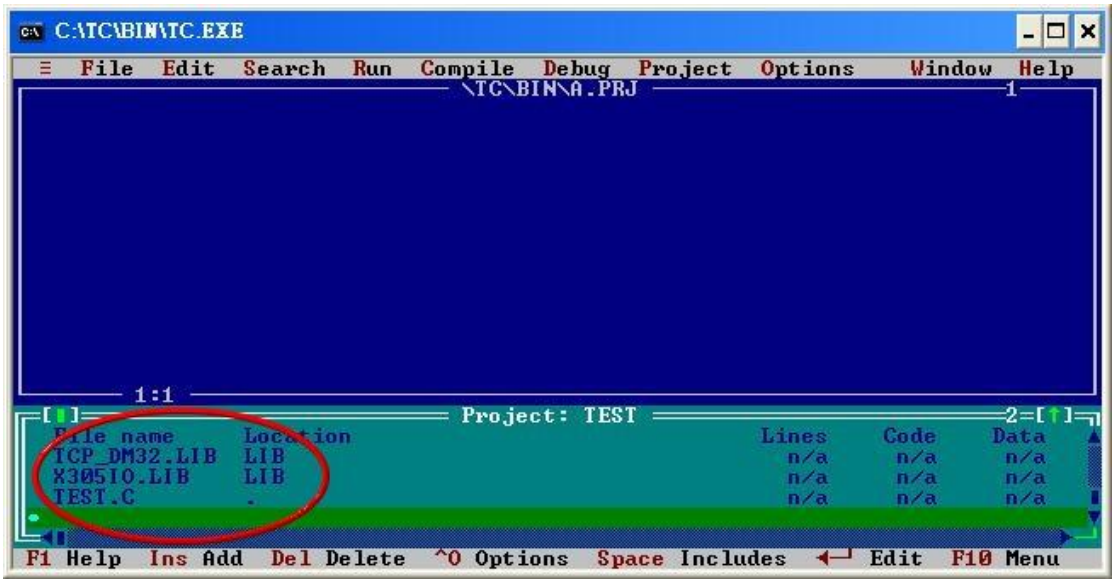
步驟 2：執行 TC++ 1.0，按下 “Project\Open project…” 建立新的專案檔並取名為 “TEST.PRJ”



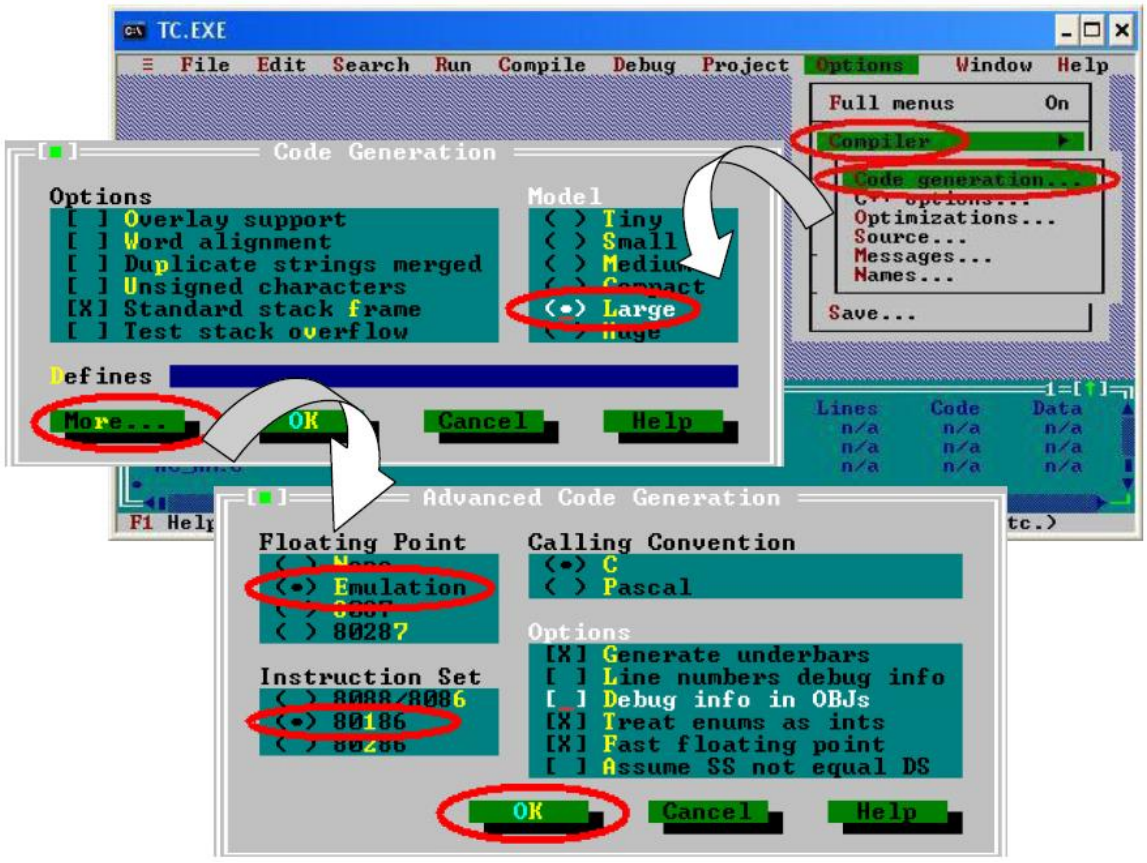
步驟 3：使用 “Add” 功能加入編譯需用到的函式庫檔案到 MyDemo 資料夾



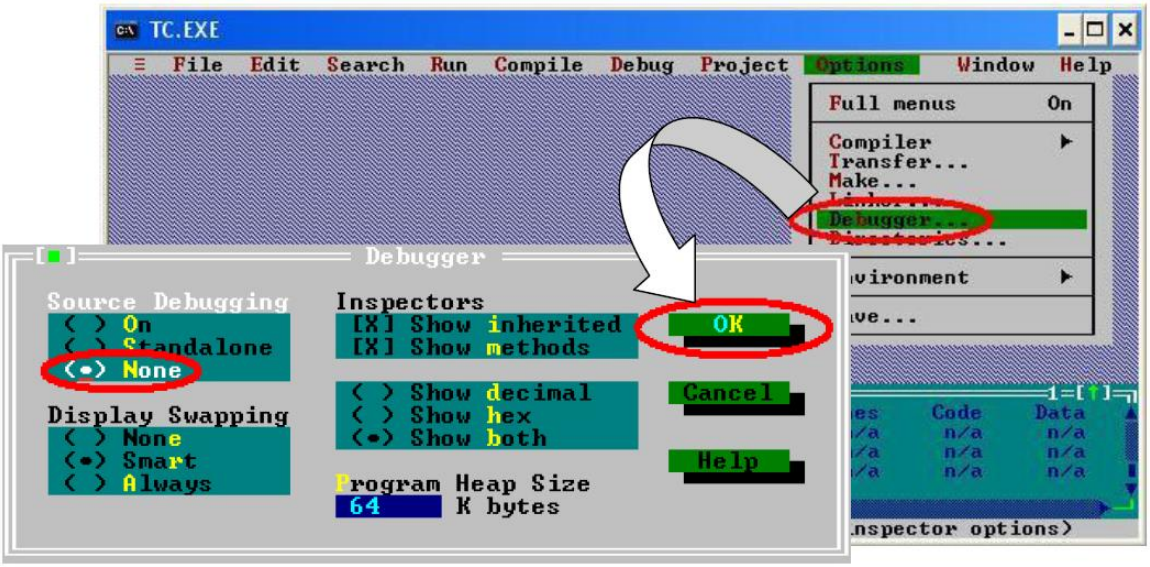
步驟 4：參照步驟 3，加入其它函式庫檔案及 TEST.c 到 MyDemo 資料夾



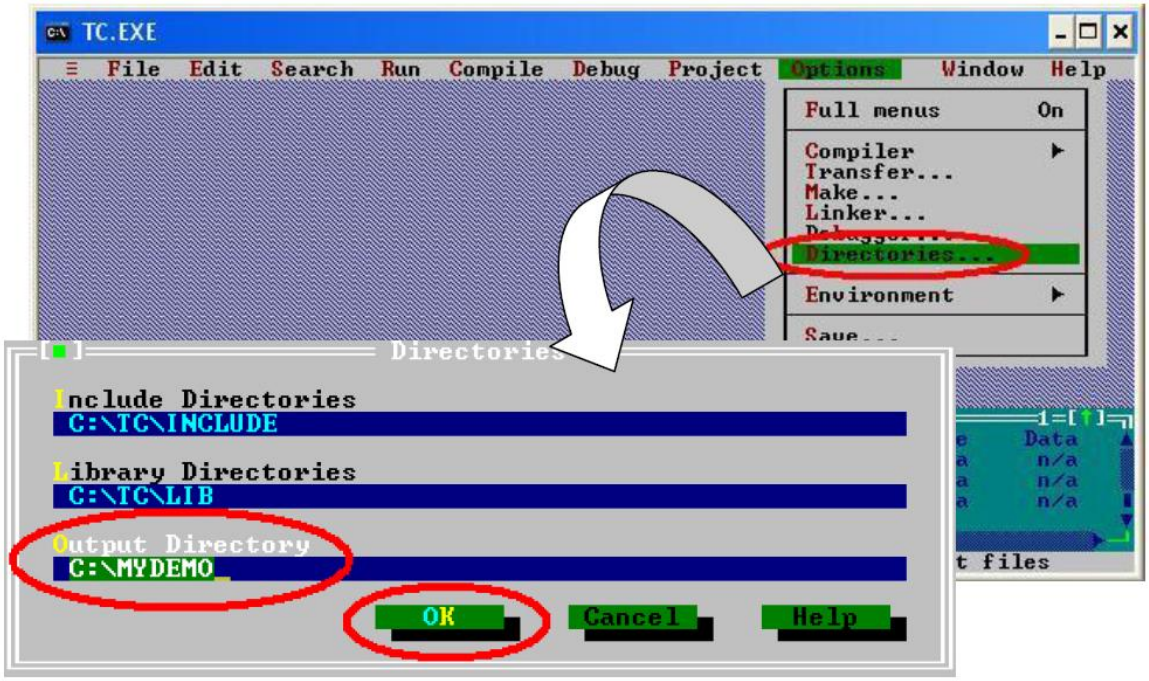
步驟 5：點選 “Options/Compiler/Code generation…” 將編譯模式設為 Large，接著點選 “More…” 分別設定 “Floating point” 和 “Instruction Set” 參數為 Emulation 和 80186。設定完後按 OK 儲存設定。



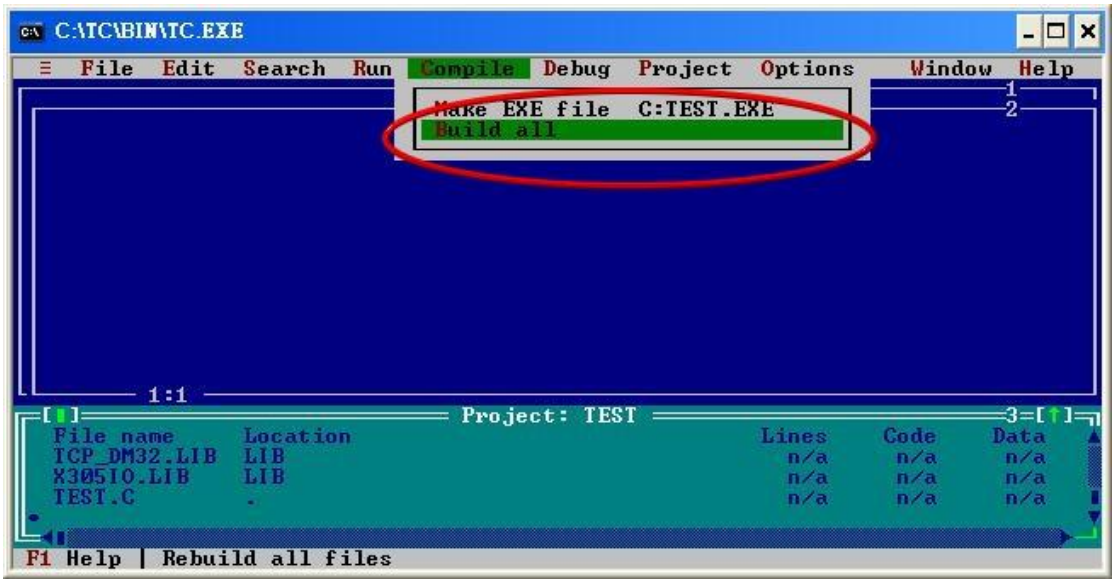
步驟 6：點選“Option/Debugger... ”將“Source Debugging”參數設定為“None”



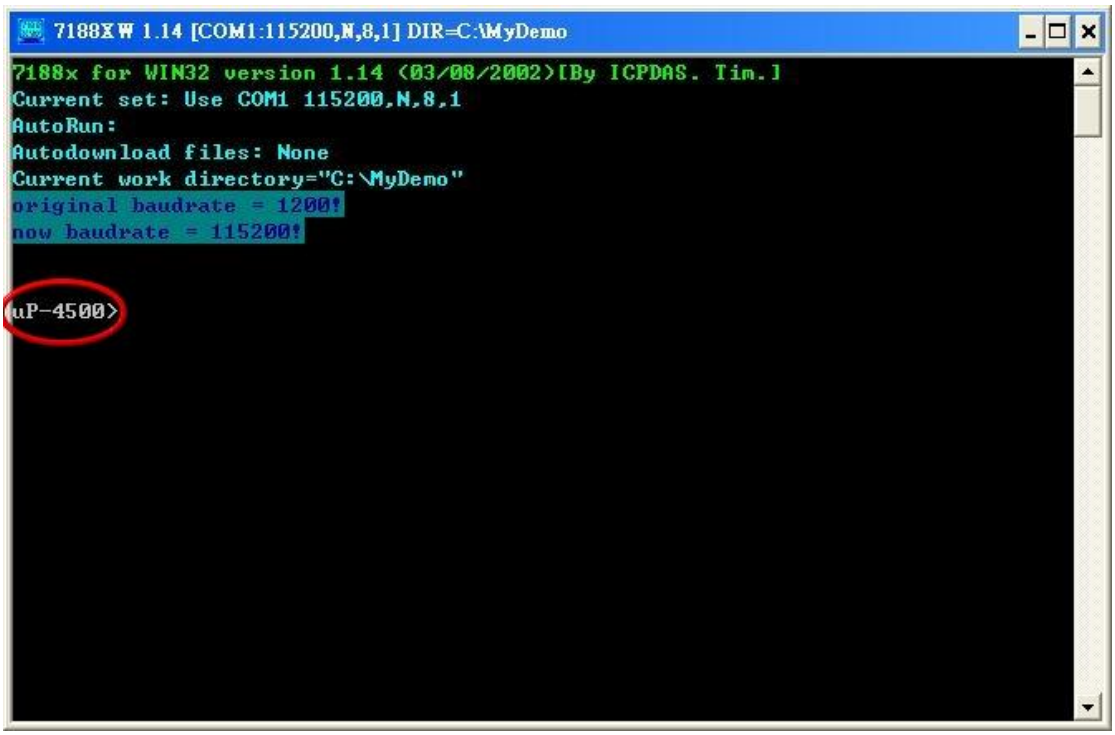
步驟 7：點選“Option/Directories... ”設定“Output Directory”輸出目錄為“C:\MyDemo”



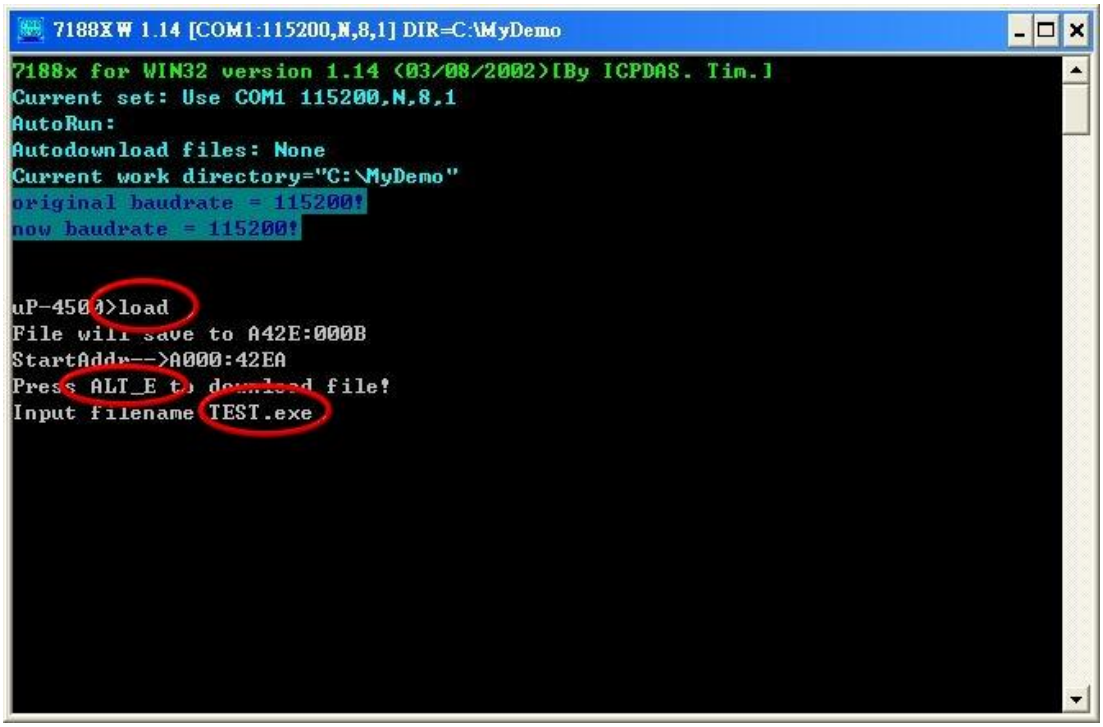
步驟 8：設定完所有參數後，按下“Compile/build all”產生執行檔“TEST.exe”



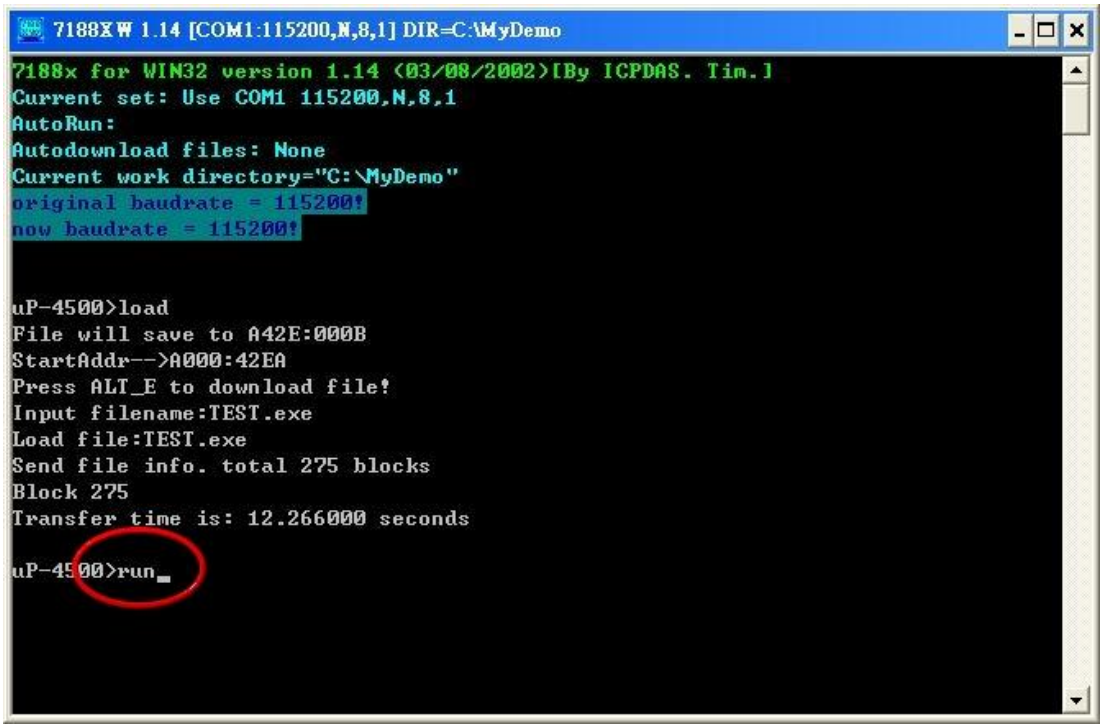
步驟 9：複製 7188XW.exe 到 MyDemo 目錄，然後雙擊左鍵執行 7188XW.exe，並將 G-4513 系列的 COM1 連接至 PC 的 RS-232



步驟 10：在 7188xw.exe 輸入指令“load”，按下“Alt+E”並輸入“TEST.exe”後，開始下載程序



步驟 11：下載完成後，輸入“run”開始執行“TEST.exe”



8. 版本記錄

版本	日期	作者	說明
1.0.0	2014/09/01	William	第一版
1.0.1	2015/06/15	William	1. 修改第六章 API 與範例程式參考內容 2. 修改規格表中的功耗資訊