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go anywhere communication and data transfer



# The Smart SAM3S User Guide



## Document history

11th Feb 2013:	Start	Version 1.0
08 <sup>th</sup> Oct. 2013	added new packaging and label	Version 1.1
21 <sup>st</sup> July 2014	added SAMMODE	Version 1.2
02 Sep 2014	added DDNS, security features	Version 1.3
29 Sep 2014	added AT\$UDPONLINE,AT\$SMSTOSERIALON	Version 1.4
29 Oct 2014	removed AT\$UDPONLINE,added AT\$TCPCONNECT,AT\$UDPCONNECT	Version 1.5



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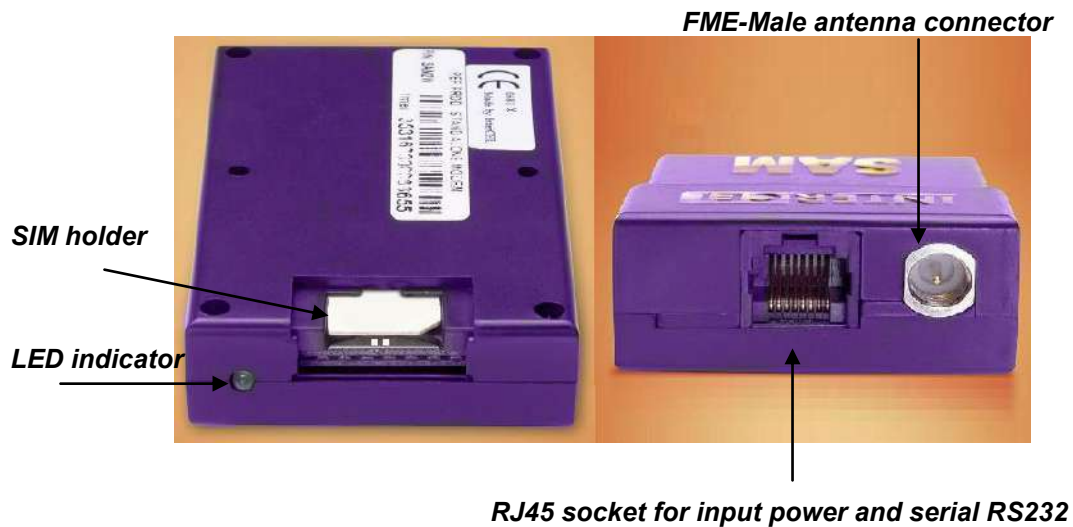
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## 1. Introduction

The Smart SAM3S is a compact, light-weight, GSM/GPRS/EDGE/UMTS/HSPA+ based modem. It provides GSM, GPRS, UMTS and HSPA+ connectivity.

The Smart SAM3S is designed for both mobile and fixed M2M applications. It has an RJ45 socket for input voltage and the serial RS232 signals, an FME-male for antenna connection, a SIM holder and an LED indicator.

The Smart SAM3S is capable of sending/receiving SMS; Circuit switched data and Packet-switched data.



Mobile station engine  
 EU approval  
 3GPP  
 A-tick

PHS8-P  
 CE-0682  
 Release 6, 7



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## 2. Safety Precautions

The following safety precautions must be observed whenever the Smart SAM3S modem is in operation or in service. Failure to comply with these precautions violates the safety standards of the design, manufacture and intended use of the product

- Switch off the Smart SAM3S modem :
  - In hospitals or places where medical equipments may be in use.
  - In an aircraft
  - Refuelling points
  - Explosive areas
- Restricted use of the Smart SAM3S modem
  - Near any chemical plant
  - Near any Fuel depot
  - Areas with mobile phone warning signs

Respect national regulations on the use of cellular devices. Road safety always comes first

The Smart SAM3S modem receives and transmit radio frequency energy while switched on, therefore interference can occur if the Smart SAM3S is near TVs, radios, PCs or any inadequately shielded equipment.

## 3. Radio frequency exposure - SAR

The Smart SAM3S modem is a low-power transceiver, similar to a typical handheld GSM/GPRS/UMTS mobile phone. When it is turned on, it will emit low-level radio frequency energy.

There are different guidelines and standards around the world that govern the permitted levels of radio frequency exposure for general population. The levels include a safety margin to a human body.

The Specific Absorption rate (SAR) is a measure of the rate at which radio frequency energy is absorbed by the body when exposed to radio frequency electromagnetic field. The SAR value is determined at the highest certified power level in the laboratory conditions, but the actual SAR level of the transceiver while operating can be well below this value. This is because the transceiver is designed to use minimum power to connect to the network.

The Smart SAM3S modem is approved to use in applications where the **antenna is placed more than 21cm from the body.**

For other applications, the integrator is responsible for the local SAR requirements.



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**4. WEEE directive 2002/96/EC, disposal of old electronic equipment**



This symbol on the product indicates that this product shall not be treated as household waste. It must be placed at an appropriate collection point for the recycling of electrical and electronic equipments.

By ensuring the correct disposal of this equipment, it will help the environment and human’s health. The recycling will help to conserve the natural resources.

***The Smart SAM3S product is RoHS compliant***



## 5. Packaging

### 5.1 Contents

The Smart SAM3S package consists of:

- A Smart SAM3S modem
- A Smart SAM3S User Guide
- A data/power cable



### 5.2 The packaging box

The carton box dimensions are 230mm x 155mm x 70mm

The Data cable is 2m long

The Label size is 50mm x 33mm

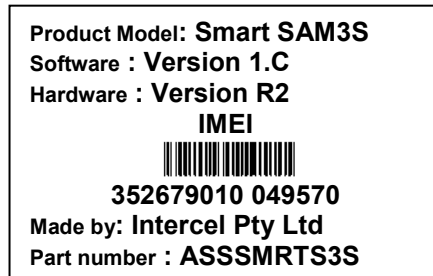
The Power supply is available on request. It is recommended that the Smart SAM3S is powered using a 12Vdc/1A power supply.

Antennas are also available on request. Please make sure the correct antenna is used to get optimised performance from the Smart SAM3S.



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### 5.3 The production label



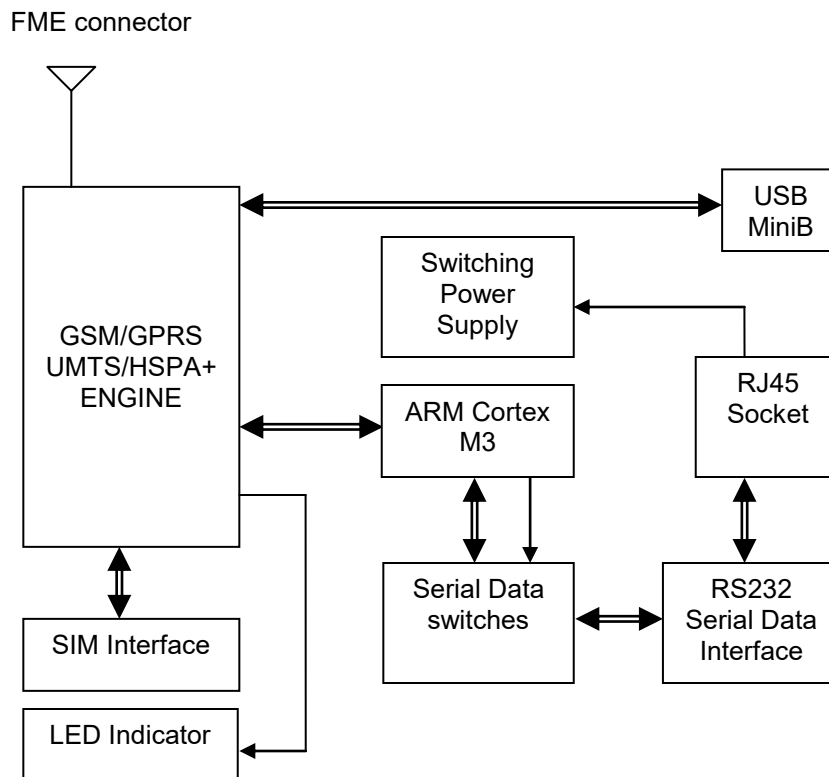
The production part number is located at the back of the Smart SAM3S, which includes:

- The product model
- The software Version
- The Hardware Version
- The IMEI number
- The manufacturer
- The part number

## 6. Functionality

### 6.1 General

The Smart SAM3S modem consists of an RJ45 socket for serial port and input power, an FME male antenna connector and a SIM holder. The LED indicator, located next to the SIM holder, indicates the Smart SAM3S operating status. It also has a USB port to download firmware.



*The SAM3S Functional Block Diagram*





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## 6.2 The RJ45 socket

Pin	Signals	Description
1	VIN	Input voltage 5Vdc - 32Vdc
2	DCD	Data Carrier Detect
3	DTR/RI	Data terminal Ready/Ring Indicator
4	GND	Common Ground
5	RXD	Serial Data out of the Smart SAM3S
6	TXD	Serial Data into the Smart SAM3S
7	CTS	Clear to Send
8	RTS	Ready to Send

## 7.1 The FME-Male 50Ω antenna connector

The FME male antenna connector is a 50Ω impedance antenna connector. The antenna used for the Smart SAM3S must have 50Ω impedance.

## 6.4 The SIM holder

The SIM holder is designed to accommodate a mini-SIM card. The SIM card can either be 3V or 1V8 SIM. To insert the SIM card, remove the door by sliding it back toward the end. Make sure the SIM card faces the right way as indicated on the box. Voltage levels over this SIM interface complies with 3GPP standards

## 6.5 The LED status

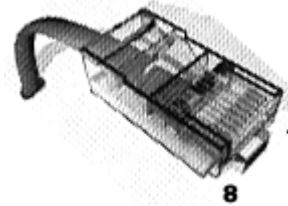
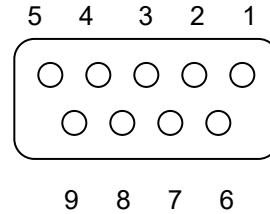
The LED indication has the following status:

Note: the LED status can be changed using AT^SLED command.

Status	Mode 1	Mode 2	Mode 3
GSM CS data call in progress or established GSM voice call in progress or established UMTS voice call in progress or established UMTS CS data call in progress	Permanently on	10ms on 990ms off	<flash>ms on 990ms off
GSM PS data transfer UMTS data transfer	Permanently on	10ms on 1999ms off	<flash>ms on 1999ms off
UE registered to a network. No call, no data transfer	Permanently on	10ms on 3999ms off	<flash>ms on 3999ms off
Limited Network Service (e.g. because no SIM/ USIM, no PIN or during network search)	500ms on 500ms off	500ms on 500ms off	500ms on 500ms off

## 6.6 The data cable

The data cable is 2m long. It consists of an RJ45 plug, a DB9-female connector and a 2-wire input power.



DB9	Signals		RJ45	Description
1	DCD	↔	2	Data Carrier Detect
2	RXD	↔	5	Serial Data out of the Smart SAM3S
3	TXD	↔	6	Serial Data into the Smart SAM3S
4	DTR	↔	3	Not used
5	GND	↔	4	Common Ground
6	DSR			
7	RTS	↔	8	Ready to Send
8	CTS	↔	7	Clear to Send
9	RI	Not used		
			1	RED wire: Input voltage from 5Vdc to 32Vdc
			4	BLACK wire: Power Ground

## 7. Electrical characteristics



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### 7.1 Power consumption (TBC)

Idle mode	<0.225W
Sleep mode	0.15W
GSM mode	1.2W – 2.4W
GPRS Mode	1.2W – 2.4W
3G Mode	1.6W – 2.73W
Peak	3.7W

### 7.2 Receive sensitivity

Band	Typical Rx Sensitivity (dBm)	Maximum Rx Sensitivity (dBm)
GSM/GPRS (2% ber) CS	-102	-109
UMTS (2% ber) CS	-104	-110

Note:  
 - Bit error rate < 2.4%

### 7.3 Conducted Transmit Power

Parameter	Min	Typical	Max
GSM900	+31dBm	+33dBm	+35dBm
DCS1800	+24dBm	+26dBm	+28dBm
UMTS 800/850	+21dBm	+24dBm	+25dBm
UMTS 900/2100	+21dBm	+24dBm	+25dBm



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#### 7.4 Main antenna specifications

Max cable loss	0.5dBm
Impedance	50Ω
Max allowed VSWR	3:1

The maximum antenna gain recommended, for consideration against RF exposure and ERP/EIRP limits, is:

- In Cellular band : 5dBi
- In PCS band : 4dBi

#### 7.5 Environmental characteristics

Operating temperature	-30°C to +85°C
Storage temperature	-40°C to +95°C
Humidity	90% relative humidity (non-condensing)



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## 8. THE SAM3S TCP/IP Operation

The SAM3S has a MCU (Microcontroller) to control the 3G module PHS8-P, the SAM3S can be operating in there different modes, defined by parameter SAMMODE:

-SAMMODE=0, modem is in dumb mode, when power on the MCU turn on the 3G module, check its baud rate, turn on LED and release control of the 3G module to the connecting device, AT commands can be send from serial port here after, the MCU keep monitor the 3G module Rx pin for AT\$ commands and check time in the POLLPERIOD parameter (to reset itself and the 3G module).

-SAMMODE=1, modem is in GPRS or PSD (Packet Switch Data) smart mode, the MCU is in total control of the 3G module, on power up the software reads all parameters from flash and activates a GPRS connection, it then creates an UDP and a TCP socket to listen for data transfer connection, opens an UDP and a TCP socket to listen for remote AT commands connection, if programmed as TCP client it will tries to connect to a remote TCP server, the modem then stays in GPRS online idle state waiting for CSD call, SMS, UDP data or TCP connection, the software maintains GPRS connectivity by the mean of IP TRACE using POLLPERIOD parameter stored in flash.

-SAMMODE=2, modem is in CSD (Circuit Switch Data) smart mode, this mode is used if SIM card is not setup for GPRS, MCU is in total control of the 3G module, modem is always in waiting for CSD call or SMS.

The reason for using SAMMODE=1 for PSD and SAMMODE=2 for CSD is because it is not possible to configure the SAM3S for simultaneous operation of PSD and CSD, when the SAM3S (3G) is connected to PSD (IP mode), the modem status is busy when one try to make a data call to it, this is the behaviour the of the 3G network.

The modem supports DDNS, for SIM card that has dynamic public IP address the software can performs **dynamic DNS updating** to a DNS server (supporting **dyndns.com** and **noip.com**).

The modem provides security for remote management by keeping a list of SMS sending mobile numbers, a list of CSD calling numbers, a list of PSD sending IP addresses and username and password login, password data is encrypted for remote transaction.

### 8.1 Communication Sockets

**TCP Data:** Socket connection allows transparent data to pass through from host computer to the modem serial port and vice versa, this operation is similar to the CSD data communication, in TCP server mode the socket will be disconnected after 5 minutes of no data transfer.

**UDP Data:** Socket connection allows transparent data to pass through from host computer to the modem serial port and vice versa, this operation is similar to the CSD data communication, a block of data received from a remote UDP server will open a 2 minutes window for data to be transfer from the serial port.



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TCP AT Command: Socket connection allows a user from the host computer to send AT commands to the modem and receive its responses, socket will be disconnected after 5 minutes of no activity, and socket also can be used for remote firmware update.

UDP AT Command: Socket connection allows a user from the host computer to send AT commands to the modem and receive its responses, and socket also can be used for remote firmware update.

## **8.2 TCP/IP AT\$ Commands**

Communications parameters are stored in Flash using AT\$PARAMETERS.

Parameters are defined as:

APN=Access Point Name

USERNAME=Username that may required with GPRS login

PASSWORD=Password that may required with GPRS login

LTCPPORT=Local TCP listening port

RTCTIP=Remote TCP server IP

RTCTPORT= Remote TCP server port

TCPMODE=0 or 1 (0 disable modem TCP client, 1 enable modem TCP client)

LUDPPORT=Local binding UDP port (modem listen for UDP data on this port)

RUDPIP=Remote binding UDP IP (modem only accept data from this IP)

RUDPPORT=Remote binding UDP port (modem send UDP data to this port)

POLLPERIOD=Modem use this time to send TRACE packet to check for GPRS connectivity.

SBREAKTIME=Serial port break time, modem will wait for this break in serial port transmission before packetize the data and send.

MBREAKTIME=Modem or GSM module serial break time, use to adjust the way the modem rebuild long IP packet from fragments of CMUX frames.

BAUDRATE=Serial port baud rate.



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DATALEN=Serial port data bits 7 or 8

PARITY= NONE or ODD or EVEN

SAMMODE=0 for standard modem, 1 for PSD mode, 2 for CSD mode.

All parameters can be programmed all at once.

```
AT$PARAMETERS=APN=telstra.extranet,USERNAME=intercel,PASSWORD=mach,LTCPPORT=10000,
RTCPPIP=203.45.1.236,RTCPPORT=10000,TCPMODE=,LUDPPORT=20000,RUDPIP=203.45.1.236,RU
DPPORT=20000,POLLPERIOD=60,SBREAKTIME=100,MBREAKTIME=5,BAUDRATE=115200,DATALE
N=8,PARITY=NONE,SAMMODE=0
```

Saved parameters to flash...

OK

Or a few parameters or one at a time.

```
AT$PARAMETERS=APN=telstra.extranet,USERNAME=intercel,PASSWORD=mach
```

Saved parameters to flash...

OK

```
AT$PARAMETERS=LTCPPORT=10000,RTCPPIP=203.45.1.236,RTCPPORT=10000,TCPMODE=,LUDP
PORT=20000,RUDPIP=203.45.1.236,RUDPPORT=20000
```

Saved parameters to flash...

OK

```
AT$PARAMETERS=POLLPERIOD=60,SBREAKTIME=100,MBREAKTIME=5,BAUDRATE=115200,DAT
ALEN=8,PARITY=NONE
```

Saved parameters to flash...

OK

```
AT$PARAMETERS=SAMMODE=0
```

Saved parameters to flash...

OK



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AT\$PARAMETERS?  
\$PARAMETERS:  
APN: telstra.extranet  
USERNAME: intercel  
PASSWORD: mach  
LTCPPORT: 10000  
RTCCIP: 203.45.1.236  
RTCCPORT: 10000  
TCPMODE: 0  
LUDPPORT: 20000  
RUDPIP: 203.45.1.236  
RUDPPORT: 20000  
BAUDRATE: 115200  
DATALEN: 8  
PARITY: NONE  
POLLPERIOD: 60  
SBREAKTIME: 100  
MBREAKTIME: 5  
SAMMODE: 0  
OK

### **AT\$UDPCONNECT**

If modem is already allocated an IP address, this command will put the modem in UDP data mode, modem DCD pin go high, data from serial will be packetized into UDP packet and send to remote UDP server (UDP settings must be set prior), modem will return to AT Command mode if it receiving no UDP data in 30 seconds.

If modem has no IP address (CSD mode or SAMMODE=2), the modem will connect to PSD and go into UDP data mode, modem DCD pin go high, data from serial will be packetized into UDP packet and send to remote UDP server (UDP settings must be set prior), modem will reset and return to CSD mode if it receiving no UDP data in 30 seconds.

### **AT\$TCPCONNECT**

If modem is already allocated an IP address, this command will make a TCP client connection to the remote TCP server, modem will return to AT Command mode if it receives no TCP ACK in 30 seconds.

If modem has no IP address (CSD mode or SAMMODE=2), the modem will connect to PSD and make a TCP client connection to the remote TCP server, modem will reset and return to CSD mode if it receives no TCP ACK in 30 seconds.





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## AT\$DDNS

Use to setup parameters required for Dynamic DNS updating.

Parameters are defined as:

DDNSENABLE= 0 or 1 (0 disable, 1 enable)

DDNSHOST=Host name

DDNSUSERNAME=DDNS account name

DDNSPASSWORD=DDNS account password

DDNSSERVER=DDNS server

DDNSSTRING: Only need to change from default in some circumstances with Intercel support

DDNSAUTH: Only need to change from default in some circumstances with Intercel support

DDNSAGENT: Only need to change from default in some circumstances with Intercel support

PDNSIP=Primary DNS, leave blank if not using your own DNS server, not a requirement for DDNS.

SDNSIP=Secondary DNS, leave blank if not using your own DNS server, not a requirement for DDNS

DNSTTL= DNS Time To Live in minutes before updating of DNS entries, not a requirement for DDNS.

AT\$DDNS=PDNSIP=8.8.8.8,SDNSIP=8.8.4.4,DNSTTL=240,DDNSENABLE=0,DDNSHOST=intercelau.d  
dns.net,DDNSUSERNAME=intercelau,DDNSPASSWORD=123456789,DDNSSERVER=dynupdate.noip.  
com,DDNSSTRING=GET/nic/update?hostname=%s&myip=%sHTTP/1.0,DDNSAUTH=Authorization:  
Basic%s,DDNSAGENT=User-Agent:SAM3S/1.0 [intercel@intercel.com.au](mailto:intercel@intercel.com.au)

Saved parameters to flash...

OK

AT\$DDNS?

\$DDNS:

DDNSENABLE: 0

DDNSHOST: intercelau.ddns.net

DDNSUSERNAME: van.phamus@yahoo.com

DDNSPASSWORD: 123456789



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DDNSSERVER: dynupdate.no-ip.com  
DDNSSTRING: GET /nic/update?hostname=%s&myip=%s HTTP/1.0  
DDNSAUTH: Authorization: Basic %s  
DDNSAGENT: User-Agent: SAM3S/1.0 intercel@intercel.com.au  
PDNSIP: 8.8.8.8  
SDNSIP: 8.8.4.4  
DNSTTL: 240

OK

### **AT\$DDNSTEST**

Use to force a manual updating of IP to the DDNS server, all required parameters must be set beforehand.

AT\$DDNSTEST

\$DDNSTEST: Starting....

\$DDNSTEST: Resolving dynupdate.no-ip.com....

Connecting to DDNS dynupdate.no-ip.com ....

Connected to DDNS dynupdate.no-ip.com  
HTTP/1.1 200 OK  
Date: Tue, 02 Sep 2014 00:33:32 GMT  
Server: Apache/2  
Content-Location: update.php  
Vary: negotiate  
TCN: choice  
Content-Length: 19  
Connection: close  
Content-Type: text/plain; charset=UTF-8

good 123.209.169.62  
DDNS host intercelau.ddns.net updated with 123.209.169.62

OK

### **AT\$ACCESS**

Use to setup parameters required for remote access.

Parameters are defined as:

IPBLOCK=0 or 1 (0 disable, 1 enable remote IP access from REMOTEIP1-REMOTEIP4)

REMOTEIP1= nnn.nnn.nnn.nnn



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REMOTEIP2= nnn.nnn.nnn.nnn

REMOTEIP3= nnn.nnn.nnn.nnn

REMOTEIP4= nnn.nnn.nnn.nnn

SMSBLOCK=0 or 1 (0 disable, 1 enable remote SMS access from REMOTESMS1-REMOTESMS4)

REMOTESMS1= ccnnnnnnnnn cc for country code

REMOTESMS2= ccnnnnnnnnn

REMOTESMS3= ccnnnnnnnnn

REMOTESMS4= ccnnnnnnnnn

DIALBLOCK= 0 or 1 (0 disable, 1 enable remote dialling access from REMOTEDIAL1-REMOTEDIAL4)

REMOTEDIAL1= acnnnnnnnnn ac for area code

REMOTEDIAL2= acnnnnnnnnn

REMOTEDIAL3= acnnnnnnnnn

REMOTEDIAL4= acnnnnnnnnn

AT\$ACCESS=IPBLOCK=1,REMOTEIP1=10.64.24.2,REMOTEIP2=,REMOTEIP3=,REMOTEIP4=,SMSBLOCK=1,REMOTESMS1=0413586218,REMOTESMS2=,REMOTESMS3=,REMOTESMS4=,DIALBLOCK=1,REMOTEDIAL1=0395612959,REMOTEDIAL2=,REMOTEDIAL3=,REMOTEDIAL4=

Saved parameters to flash...

OK

AT\$ACCESS?

\$ACCESS:  
IPBLOCK: 1  
REMOTEIP1: 10.64.24.2  
REMOTEIP2:  
REMOTEIP3:  
REMOTEIP4:  
SMSBLOCK: 1  
REMOTESMS1: 0413586218  
REMOTESMS2:  
REMOTESMS3:



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Ph : 61 3 9239 2000 Fax : 61 3 9561 2614

REMOTESMS4:  
DIALBLOCK: 1  
REMOTEDIAL1: 0395612959  
REMOTEDIAL2:  
REMOTEDIAL3:  
REMOTEDIAL4:

OK

### **AT\$LOGIN**

Use to setup login details for remote sending of AT commands, parameters and software updating; password is encrypted so remote login required PC software SAM3S Terminal.

### **AT\$LOGOFF**

Use to log off remote access instantly; modem will lock out remote access that has been idled for 120 seconds.

### **AT\$IP**

Use to return the allocated IP address of the current GPRS connection

AT\$IP

\$IP: 123.209.157.9

OK

### **AT\$VERSION**

This command returns the TCP/IP software version.

AT\$VERSION

SAM3S V2.2 29/10/14 17:05

OK



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## AT\$RESET

Use to remotely reset the modem, normally after sending of new parameters

AT\$RESET

SAM Reset...

OK

## AT\$SMSTOSERIALON

This command allows the connecting device to receive SMS notification for 300s: e.g. "+CMTI: "SM",1" , the connecting device must send AT+CMGR to read SMS and AT+CMGD to delete it, during this 300s period, modem will not able to decode AT\$ commands sending to it over SMS.

### 8.3 CSD Call Escape Sequence

During CSD call to the Smart SAM3S modem, send three consecutive EscEscEsc or hex number sequence 0x1B 0x1B 0x1B to switch the modem between data mode and remote AT commands mode.

### Notices

-In SAMMODE=0, after power on the MCU turns on the 3G module, checks its baud rate, turns on LED before releases control of the 2G module to the connecting device, all this take between 5 to 10 seconds, so the modem is only ready for AT commands here after.

-In SAMMODE=1, the modem take 30 to 60 seconds to connect to GPRS, modem only response to AT commands from serial port once it is connected to GPRS or after it has failed , if it failed to connect it will reset after 120 seconds.

-In SAMMODE=2, the MCU take about 20 seconds to set up the 3G module , the modem only response to AT commands from serial port after setting up is finished.

-In SAMMODE 1 and 2 if the SAM3S modem is powered up without a SIM card it will go into AT command mode after 20 seconds.

The parameter POLLPERIOD which keep the time in minute which when expired will reset the modem if SAMMODE=0 or SAMMODE=2, if SAMMODE=1 for PSD mode the modem will use this time to send TRACE IP packet to check for network connectivity.

-In SAMMODE=1 and 2 the modem can be reset remotely by calling the voice number.



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## **9.Firmware upgrade**

### **9.1 Firmware upgrade for the 3G module**

The module's firmware can be upgraded over the serial or USB port using the dedicated Upgrade Program running on PC, if using USB ,the 3G module's driver must be installed on the PC beforehand.

### **9.2 Firmware upgrade for the Cortex M3 ARM processor**

The processor's firmware can be upgraded over the serial port or JTAG port using the LM Flash Programmer running on PC.

Firmware and parameters can be upgraded over the serial port, GPRS, CSD or SMS (parameters only) using SAM3S Terminal program running on PC.