

The GSM/GPRS Stand Alone Modem

SAM USERGUIDE



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1. Overview

The Stand Alone modem, SAM, is designed to be a compact modem, easy to use for both mobile and fixed machine to machine applications. It has an RJ45 socket for serial data and input power, an FME male antenna connector, a SIM holder and an LED indicator.

The SAM is a Quad-band 850/900/1800/1900MHz GSM/GPRS modem, capable of Circuit Switched Data, Packet Switched data, SMS and Fax.

The RJ45 socket includes an RS232 serial port and input voltage signals. The LED is located next to the SIM holder, which allows users to monitor the status of the modem in operation.

The SAM is controlled using a set of standard AT commands.

2. Safety Precautions

The following safety precautions must be observed whenever the SAM 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 SAM modem :
 - In hospitals or places where medical equipments may be in use
 - In an aircraft
 - Refueling points
 - Explosive areas
- Restricted use of the SAM modem
 - Near any chemical plant
 - Near any Fuel depot
 - Areas with mobile phone warning sign

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

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

3. Radio frequency exposure - SAR

The SAM2W modem is a low-power transceiver, similar to a typical handheld GSM/GPRS mobile phone. When it is turned on, it will emit low-level radio frequency energy.

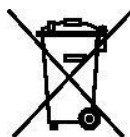
There are different guidelines and standards around the world that govern the permitted levels of radio frequency exposure for general population. The levels include a safety margin to a human body.

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 SAM2W modem is approved to use in applications where the antenna is placed more than 20cm from the body. Refer to the SAR calculations in the Appendix A.

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

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.

5. Packaging

The SAM package consists of :

- A SAM modem
- A data cable
- A one-page Specification of the SAM and its pinouts
- A SAM2W User Guide



The carton box diameter is 120mm x 95mm x 60mm

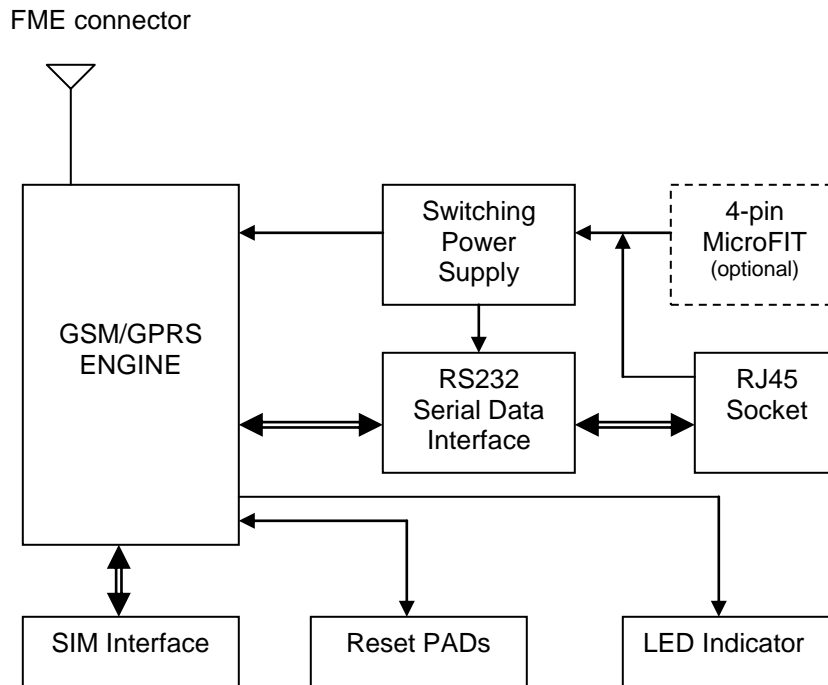
The Data cable is 2m long

The Label diameter is 50mm x 33mm

6. Functionality

a. General

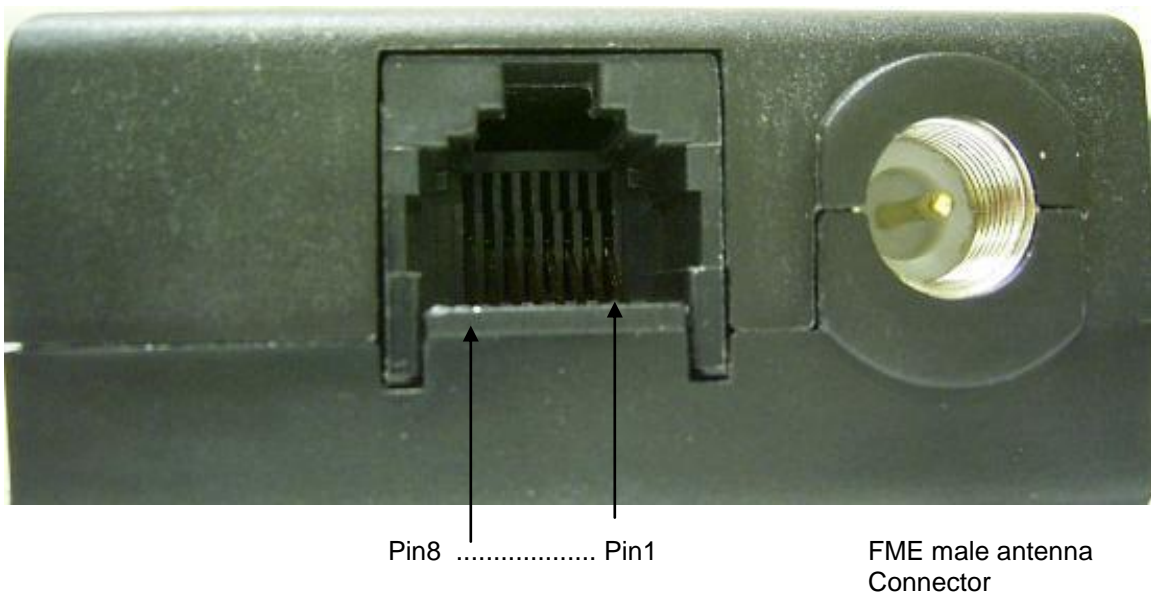
The SAM modem is a Quad band 850/900/1800/1900MHz GSM/GPRS modem. It consists of an RJ45 connector for serial port and input power, an FME male antenna connector and a SIM holder. The LED located near the SIM holder indicates the SAM operating status.



The SAM Functional Block Diagram

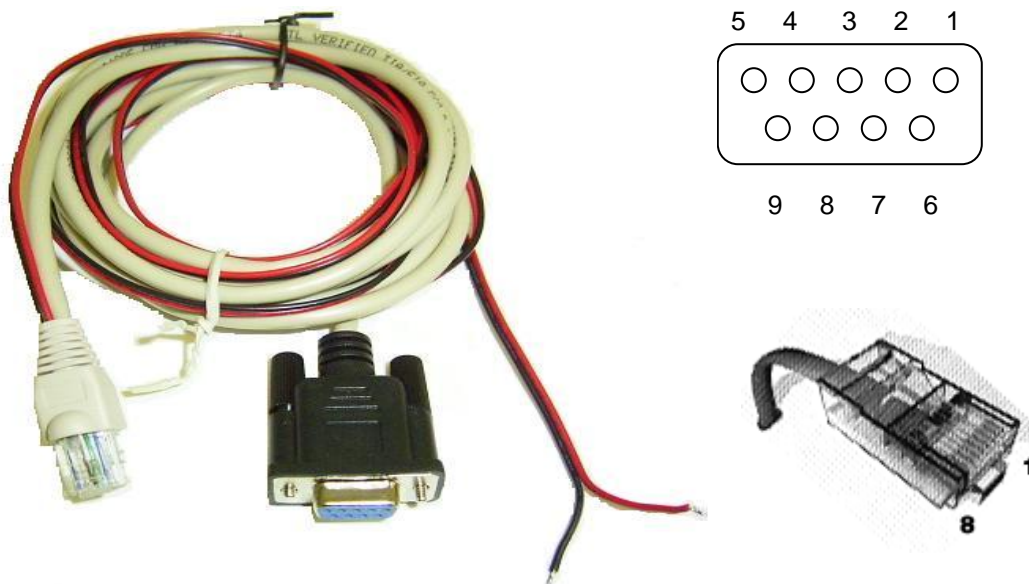
b. The RJ45 connector

<i>Pin</i>	<i>Signals</i>	<i>Description</i>
1	VIN	Input voltage 5Vdc - 32Vdc
2	DCD	Data Carrier Detect
3	DTR	Data Terminal Ready
4	GND	Common Ground
5	RXD	Serial Data out of the SAM
6	TXD	Serial Data into the SAM
7	RTS	Ready to Send
8	CTS	Clear to Send



c. The Data cable

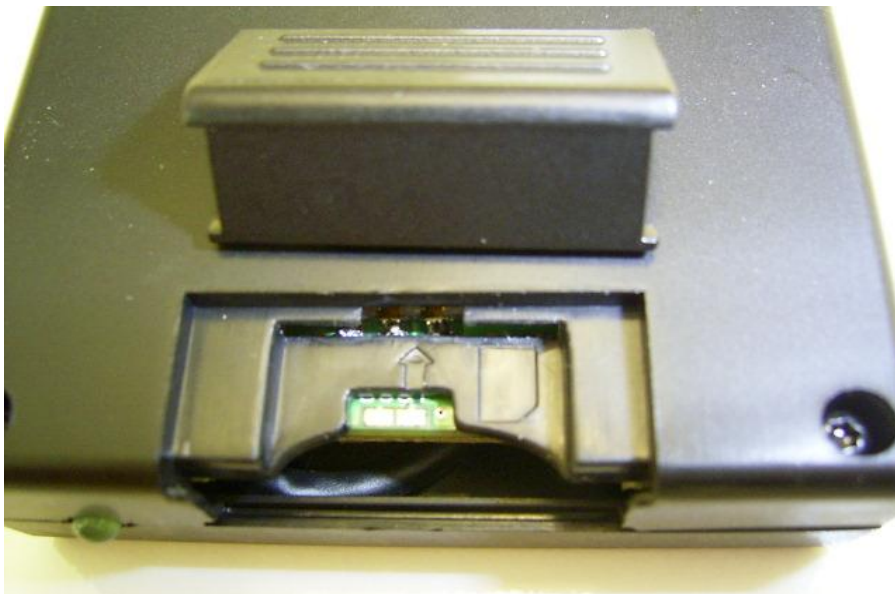
The data cable is 2m long. It consists of an RJ45 plug, a DB9-female connector and a 2-wire input power.



<i>DB9</i>	<i>Signals</i>	<i>RJ45</i>	<i>Description</i>
1	DCD	2	Data Carrier Detect
2	RXD	5	Serial Data out of the SAM
3	TXD	6	Serial Data into the SAM
4	DTR	3	Data Terminal Ready
5	GND	4	Common Ground
6	Not Used		
7	RTS	7	Ready to Send
8	CTS	8	Clear to Send
9	Not used		
		1	RED wire : Input voltage from 5Vdc to 32Vdc
		4	BLACK wire : Power Ground

d. The SIM holder

The SIM holder takes the 3V mini SIM card only. 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.



e. The LED status

The LED indication has the following status :

- LED on steady : The SAM is on but not ready
- LED flashes slowly : The SAM is on and ready
- LED flashes rapidly : The SAM is in use
- LED is off : No power

7. Operation

a. Preparation

Before power up the SAM, make sure the SIM card is inserted, the antenna is connected properly and the data cable is in place.

The default factory setting for the SAM is :

- Terminal Data speed : 115200bps
- Data format : 1 start bit, 8 data bits and one stop bit, no parity
- Flow control : RTS/CTS hardware flow control

After the SAM is powered up, wait until the LED starts flashing before issuing any AT command.

b. Setting up

Use a PC with a terminal program (like Windows HyperTerminal) to set up the SAM for a particular application. The following AT commands can be used as a guide. For the complete set of AT commands, refer to the AT command manual.

The AT command to the SAM always starts with AT and ends with <CR> (Carriage Return). The response from the SAM starts and ends with <LF><CR> (LineFeed+Carriage Return)

- SIM card related commands :

AT+CPIN?	Ask SIM status
AT+CPIN=xxxx	Enter SIM PIN xxxx

- Network related commands :

AT+CREG?	Check the SAM's GSM network registration status
AT+CGREG?	Check the SAM's GPRS network registration status
AT+CSQ	Check the SAM's received signal strength

- Terminal data speed/format related commands :

AT+IPR=speed	Set the terminal data speed (ex. =9600)
AT+ICF=x,y	Set the data format
AT+IFC=a,b	Set the local flow control option

- GSM data call related commands :

ATS0=2	Set to auto-answer incoming call after 2 rings
ATDn...nn	Make an outgoing data call to number n...nn
ATA	Answer the incoming call

- GPRS related commands

AT+CGDCONT=1,"IP","APN"	Set the GPRS context 1
AT+CGQREQ	Set up the quality of service
AT+CGATT	GPRS attach/detach
AT+CGACT	GPRS context activate/deactivate

c. How to :

- Send an SMS in text mode :

AT+CMGF=1 Set TEXT mode
AT+CSCA? Check Service centre address
AT+CMGS= Destination phone number
 ➤ Enter text here, ends with <Control-Z> to send
+CMGS: 44 Text message is sent
OK

- Receive an SMS in Text mode

+CMTI: "SM",4 Message received, stored in location 4
AT+CMGR=4 Command to read it

- Make an outgoing data call

ATDn...nn<cr> Make a data call to a data number
CONNECT 115200 Connected
Data transfer back and forth
+++ Back to command mode
ATH Hang up data call

- Receive a data call

RING Incoming call received
ATA Take it
CONNECT 115200 Call connected
NO CARRIER Call terminated

- Connect to GPRS (packet data) network

Use HyperTerminal to set this AT command :

AT+CGDCONT=1,"IP","APN" Set Access Point Node

(Example AT+CGDCONT=1,"IP","telstra.internet")
Exit HyperTerminal

For Windows XP : Select Control Panel -> Select Phone/Modem options -> Add Standard 19200bps modem -> Set modem maximum port speed to 115200, select COM port.

In Windows Dial-up networking, create a new connection -> Select connect using the Standard 19200bps modem -> Configured to 115200, hardware flow control
Select phone number : ***99**1#**

Click Dial.

8. Electrical characteristics

a. Power supply :

		GSM850/900	GSM1800/1800
Maximum Input current	@ 5V	2.1A	1.88A
Power=33.10dBm GSM850/900			
During 2Tx bursts @ Pcl5	@ 13.2V	1.4A	1.1A
Power=33.0dBm DCS1800/1900			
During 2Tx bursts @ Pcl0	@ 32V	610mA	390mA
Average Input current	@ 5V	500mA	390mA
Power=33.10dBm GSM850/900			
Average 3Rx/2Tx @ Pcl5	@ 13.2V	400mA	160mA
Power=33.0dBm DCS1800/1900			
Average 3Rx/2Tx @ Pcl0	@ 32V	95mA	80mA
Average input current in idle mode, where RF active	@ 5V	34mA	34mA
Modem synchronized with Network but there is no communication	@ 13.2V	18mA	18mA
	@ 32V	9mA	9mA

b. RF band

	EGSM900	DCS1800	GSM850	PCS1900
Tx Frequency	880-915MHz	1710-1785MHz	824-849MHz	1850-1910MHz
Rx Frequency	925-960MHz	1805-1880MHz	869-894MHz	1930-1990MHz
Rx sensitivity	-104dBm	-102dBm	-104dBm	-102dBm
Linear dynamic range	63dB	63dB	63dB	63dB
Co-channel rejection	≥9dBc	≥9dBc	≥9dBc	≥9dBc
Max Output Power	33dBm±2dB	30dBm±2dB	33dBm±2dB	30dBm±2dB
Min Output Power	5dBm±5dB	0dBm±5dB	5dBm±5dB	0dBm±5dB

c. External antenna

The recommended dual-band or quad-band antenna used with the SAM should have the following characteristics :

- Frequency range : Quad band GSM 850/900/1800/1900MHz
- Impedance : 50Ω
- VSWR : Rx Max = 1.5 : 1, Tz Max = 1.5 : 1
- Typical radiated Gain : 0dBi

d. Temperature :

- Operating temperature : -20°C to +55°C
- Storage temperature : -25°C to 70°C

e. Conformity :

- Safety standard : EN60950
- Efficient use of radio spectrum : EN301 419 (Ver 4.1.1)
EN301 511 (Ver 7.0.1)
- EMC : EN 301 489-1, EN301 489-7
- Global Certification Forum- Certification Criteria : GCF-CC 3.13

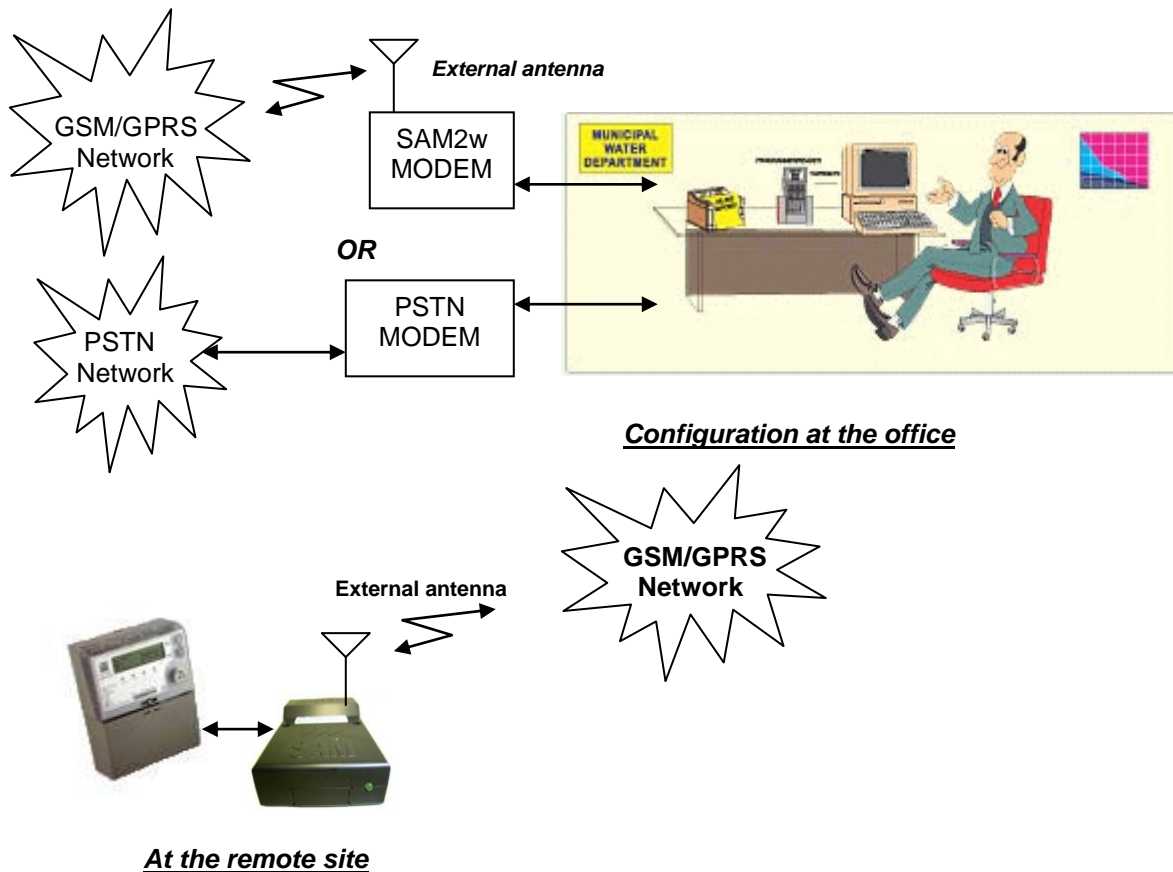
9. A typical application - Remote meter reading

In this application, the SAM2W modem is connected to an electricity meter, which is located at a remote site, and the area is covered by the GSM/GPRS network.

At the office, the Operator is equipped with a computer, connected to a landline (PSTN) modem, or another SAM2W modem.

To read the remote meter, the Operator uses the computer and the connected modem, and calls the SAM2W at the remote site. The SAM2W modem will answer and provide a transparent data path from the remote meter to the computer at the office.

After all data is read from the remote meter, the operator will instruct the computer to hang up the call, which causes the remote SAM2W modem to terminate the call.



10. Trouble shooting

a. The modem does not respond to AT command

- Check power supply : The input voltage must be from 5Vdc to 30Vdc. The supply current must be capable of 1.7A @ 5Vdc
- Check the serial data cable : Make sure the serial data cable is configured correctly according to the diagram on section 6.c above
- Check that the terminal program on your PC is configured correctly : communication port, data speed, data format, flow control.
- Check that there is no conflict on the selected serial communication port.

b. The modem always returns “ERROR” to AT commands

Issue AT+CMEE=1 to modem and check the returned error code. The following table indicates some common errors :

Error code	Error meaning	Hint
0	Modem failure	Call technical support
3	Operation not allowed	
4	Operation not supported	
10	SIM not inserted	Check SIM card, clean contacts
11	SIM PIN required	Enter SIM PIN
12	SIM PUK required	Call the network operator
13	SIM failure	Check the SIM validity
16	Incorrect password	
17	SIM PIN2 required	
18	SIM PUK2 required	
26	Dialed number exceeds 20 digits	
30	No network service	

See other error codes in the AT command manual

c. The modems always returns “NO CARRIER” when making an outgoing call.

After the modems returns “NO CARRIER”, issue AT+CEER to check the error code.

Error code	Error meaning	Hint
1	Unallocated phone number	
16	Normal call clearing	
17	Called party busy	
18	No response from the called party	
19	Called party alerting, no answer	
21	Call rejected	
22	Number changed	
31	Normal, unspecified	
50	Requested facility not subscribed	Check with the network
68	ACM ≥ Max ACM	No credit on prepaid SIM
252	Call barring on outgoing calls	
253	Call barring on incoming calls	

See other error codes in the AT command manual.

d. Other considerations

- Check the antenna : proper connection, correct 50Ω type, correct frequency range 850/900/1800/1900MHz.
- Check Rx signal strength : Use AT+CSQ to check the Rx signal strength. General rule of thumb, signal greater than 12 is sufficient.

e. Care and maintenance

The GSM modem is an advanced piece of engineering equipment and should be treated with care. The suggestion below will help to prolong the modem's life:

- Do not expose the modem to extreme temperature and/or high humidity.
- Do not attempt to disassemble the modem. There is no serviceable part inside.
- The modem is not water-proof
- Handling the modem with care
- Do not operate the modem next to any magnetic media such as computer disks, credit cards... The magnetic information may be affected by the RF.
- The modem is not a toy, please keep out of reach of children. Use authorized service centres only.

APPENDIX A : SAR CALCULATIONS FOR THE SAM2W

a. Norminal antenna gain

Tx Frequency in MHz	EGSM-900		DCS-1800	
	Min	Max	Min	Max
	880	915	1710	1785
Max power density $S=f/200$ (W/m ²)	4.400	4.575	8.550	8.925
Power to the antenna (W)	2	2	1	1
Norminal antenna gain dB	0	0	0	0
Norminal antenna gain G	1	1	1	1
Distance from the antenna to POI : $R=[(PG/4\pi S)]^{1/2}$	19.02cm	18.65cm	9.65cm	9.44cm

b. Maximum antenna gain

Tx Frequency in MHz	EGSM-900		DCS-1800	
	Min	Max	Min	Max
	880	915	1710	1785
Max power density $S=f/200$ (W/m ²)	4.400	4.575	8.550	8.925
Power to the antenna (W)	2	2	1	1
Norminal antenna gain dB	0.5	0.5	0.5	0.5
Norminal antenna gain G	1.122	1.122	1.122	1.122
Distance from the antenna to POI : $R=[(PG/4\pi S)]^{1/2}$	20.15cm	19.76cm	10.22cm	10.00cm

Based on the calculations the minimum distance for the user to keep away from the SAM2W modem is 202 mm. Therefore a distance of 203mm for the compliance boundary is used and stated in the User Manual.

Appendix B

SAR STATEMENT FOR THE SAM2W CE-CERTIFICATION APPLICATION

To whom it may concern

The SAM2W is a GSM/GPRS modem, that sends/receives data over the GSM/GPRS network. This modem is designed for Machine-to-Machine applications. This modem does not have an integral antenna.

Depending on customers' requests, the SAM2W modem may/may not be supplied with an antenna. In the cases of customers wanting to acquire the antennas themselves, the antenna specification is included in the User Guide.

A typical application will require the SAM2W to be connected to an external dual-band 900/1800MHz antenna , as described in the User Guide.

Based on the standards EN50385 and EN50383, a minimum safety operating distance has been calculated and stated in the User Guide

Safety distance requirement :

The SAM2W modem should NOT be operated when a person is within 203mm (8 inches) of the modem.

On behalf of InterCEL

Sang Vu
Technical Director