The 80350 Module Integration Guide

Version 0.02

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Contents

Safety Precautions

Before you use the 80350 module, please carefully read this section to understand the correct method of use and ensure the safety of the holder, others and properties.

- Do not expose the 80350 module to open flames.
- Ensure that liquids do not spill onto the 80350 module.
- Do not use the 80350 module in an environment of extremely high or low temperature, otherwise, malfunctions may be caused.
- Using the 80350 module in an environment of moist or high humidity may cause malfunctions of the product.
- Do not drop or strongly impact the 80350 module; otherwise, malfunctions may be caused and the product cannot be used.
- Do not use the 80350 module near any electronic device vulnerable to interference. Otherwise, malfunctions of electronic device may result. Such electronic devices include medical electronic devices, such as hearing aids and pacemaker, fire alarms, auto doors and other automatic equipment. If you have to use the 80350 module near such devices, please first consult the manufacturers and dealers of these devices to avoid interference.
- Do not dispose the 80350 module as urban waste. For details, please refer to the local regulations for proper disposal of waste electronics.
- Do not attempt to disassemble the 80350 module; doing so will void the warranty. With the exception of the Subscriber Identification Module (SIM), this product does not contain consumer-serviceable components.
- The specifications of this product are subject to change due to improvement of its functionality without notice.

Overview

This document is intended to offer the application developer a reference to the 80350 module's hardware and software specifications and interfaces.

Document History

Version	Date	Author	Comments
0.00	09/05/2008	PPD	Draft
0.01	10/29/2008	PPD	Revised per TNL's comments and other comments
0.02	11/25/2008	PPD	FCC/IC/CE compliance declaration wording revised

Regulatory Compliance

Declaration of Conformity

This device meets the FCC Radiofrequency Emission Guidelines and is certified with the FCC as:
Model number: 80350
FCC ID number: JUP80350000A.
Industry Canada ID number: 1756A-8035000A
Identification mark: 1588 (Notified Body) CE.

Person responsible for making this declaration: Brian Jackson, Trimble Navigation Ltd., 935 Steward Dr., Sunnyvale, CA 94085, USA.

Compliance with CE Rules and Regulations

For compliance purposes, the label must show the CE Mark and Notified Body number. The product must be correctly installed in order to maintain compliance.. The RF safety has been based on an MPE calculation; therefore, the device must be used at more than 20 cm (or 7.9 in.) from the body. Also, the compliance of the host product (containing the module) is the responsibility of the integrator who puts the host product on the market, and further testing may be required, with this module installed in the host device.

Compliance with FCC/IC Rules and Regulations

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference, and that this device must accept any interference received, including interference that may cause undesired operation.

Caution
Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

When incorporating the 80350 module in a host product, the integrator must ensure that the host product comply with relevant FCC requirements and regulations.

For mobile or fixed applications (with the device at least 20 cm or 7.9 in. distance from the body), the integrator is authorized to use the FCC/IC Grants and Certificates of this module for their host product if the module is integrated and installed in accordance with the conditions under which the module has been tested and certified. In this case the FCC label of the module shall be visible from the outside, or the host product shall bear a label making reference to the module inside (the label should state "Contains FCC ID JUP80350000A" or something to the effect). FCC RF safety regulations require a warning label prompting the user to keep the antenna of a device in operation at least 20 cm or 7.9 in. distance from the body.

Important
For portable applications (with the device less than 20 cm or 7.9 in. distance from the body), the integrator are required to have their host product certified to obtain its own FCC/IC Grants and Certificates. This is mandatory to meet the SAR requirements for portable wireless devices. See www.fcc.gov/oet/rfsafety for more information on RF exposure safety and product labeling requirements.

Disclaimer

The 80350 module and the information and statement in this document, at the time of its publication, are in compliance with FCC, PTCRB, IC and CE rules and regulations. Liability from any usage that violates these rules and regulations is the sole responsibility of the user.

It is strongly recommended that the installation and tuning of the 80350 module be only undertaken by RF specialists with adequate experience and credentials. The reference design and suggested methods for installing and tuning the module shall not be deemed applicable under all possible environments and conditions of application; the manufacturer shall not be held liable for incorrect parameters or measurements as a result of egression from the range of environments and conditions considered by the manufacturer.

The manufacturer shall not be held responsible for bodily injuries or property damages as a result of installing and using the 80350 module.

1. Introduction

1.1 Product Overview

The 80350 module is a highly integrated GSM/GPRS module, which has built-in support for RF, voice, power management, among other functionalities, and is in compliance with GSM/GPRS wireless communication standards.

1.2 Key Features

The following table summarizes the main features of the 80350 module.

Interface	Data input/output interface	80-pin connector
	Primary serial port	full 9-pin, UART implementation
	PCM Port	Only support salve (only for Audio PCM)
	Voice	Support 2 Audio In and 2 Audio out
	Antenna Interface	Ultra-miniature coaxial connector
	Command protocol	GSM AT command set (80350 GSM/GPRS Modem Module AT Command Specification)
	Subscriber Identification Module (SIM)	Optional 1.8/3 V mini-SIM carrier and interface on-board with SIM detect
Power	Electrical power	3.55V to 4.2V (VBATT)
	Peak currents and average power dissipation	Refer to the Operating Power table in the summary of features for peak currents and average power dissipation for various modes of operation.
Radio Features	Frequency bands	EGSM 900, GSM1800, GSM 850 and GSM 1900 capability.
	GSM/GPRS features supported	Provides for all GSM/GPRS authentication, encryption, and frequency hopping algorithms. GPRS Coding Schemes CS1-CS4 supported. Multi-Slot Class 10 (4RX/2TX, Max 5 Slots)
Regulatory	Agency approvals	• GCF Type Approval • PTCRB Type Approval • FCC Certification • CE (*Conformité Européenne*) • IC (Industry Canada) Approval

GSM/GPRS Functionality	• Mobile-originated and mobile-terminated SMS messages: up to 140 bytes or up to 160 GSM 7-bit ASCII characters. • Reception of Cell Broadcast Messages • SMS Receipt acknowledgement • Circuit Switched Data (Transparent & Non-transparent up to 9.6 Kbps) • Voice (EFR, FR, HR, and AMR) • Supports Unstructured Supplementary Service Data (USSD) • Multi-Slot Class 10 Supported (4Rx/2TX, 5 Slot Max) • PBCCH/PCCCH supported
Audio Features	• Microphone biasing • 2 Analog Audio Input • 2 Analog Audio Output
SIM	1.8/3 V Mini-Subscriber Identity Module (SIM) compatible

1.3 Providing Multi-Band Operation

The 80350 module supports quad-band GSM operation: 850/900/1800/1900MHz.

1.4 Summary of Features

Mechanical:

Dimensions	45.7 mm x 34.1 mm x 3.5 mm (not including mounting tabs)
Weight	8.1 g

Packet Data Transfer:

Protocol	GPRS Release 97
Coding Schemes	CS1-CS4
Multi-Slot Capability: (Demonstrated @MS10)	MS10 (4RX/2TX, Max 5 Slots)
Packet Channel Support	PBCCH/PCCCH

Circuit Switched Data Transfer:

V110	300 bps/1200 bps/2400 bps/4800 bps/9600 bps/14,400 bps
Non-Transparent	300 bps/1200 bps/2400 bps/4800 bps/9600 bps/14,400 bps

Short Message Services:

GSM SMS	MO, MT, CB, Text and PDU Modes
GPRS SMS	MO, MT, CB, Text and PDU Mode

Voice Capability:

Speech Codec	EFR, FR, HR, and AMR

GSM/GPRS Radio Performance Multi-Band:

Radio Frequencies	850 MHz, 900 MHz, 1800 MHz and 1900 MHz
Sensitivity	<-102 dBm (Typical GPRS CS1)
850 & 900 MHz Transmit Power	Class 4 (2 W)
1800 & 1900 MHz Transmit Power	Class 1 (1 W)

System Requirements:

Host Interface	Serial Interface
DC Voltage	3.55 to 4.2 V

Application Interface:

Host Protocol	AT Commands
Internal Protocols	UDP stack, TCP/IP stack, PPP, PAD and CMUX
Physical Interface	1 serial (primary) and I^2C
Audio Interface	• Microphone biasing • 2 Analog Audio Input • 2 Analog Audio Output

SIM Interface:

Remote SIM Option	1.8/3-Volt SIM Capability

Environmental:

Compliant Operating Temp	-20 °C to 60 °C (Fully GSM Spec Compliant)
Operating Temperature	-20 °C to 70 °C
Storage Temperature	-40 °C to 85 °C
Humidity	5 to 95% non-condensing

EMC:

Emissions	FCC Parts 15 Class B & 22 & 24, IC & CE

Operating Power (Typical):
GSM Operation

GSM 850/900 (1 RX/1 TX, full power)	66 mA min, 221 mA average, 1.23 A peak
GSM 1800 (1 RX/1 TX, full power)	59 mA min,170 mA average, 775 mA peak
GSM 1900 (1 RX/1 TX, full power)	58 mA min,161 mA average, 711mA peak
Idle	<5 mA Average
Shutdown	<1mA

GPRS Operation Power

EGSM 850/900 (4 RX/1 TX, full power)	146 mA min, 247 mA average, 1.28 A peak
EGSM 850/900 (2 RX/2 TX, full power)	71 mA min, 370 mA average, 1.28 A peak
GSM 1800 (4 RX/1 TX, full power)	159mA min, 193 mA average, 796 mA peak
GSM 1800 (2 RX/2 TX, full power)	112 mA min, 259 mA average,786 mA peak
GSM 1900 (4 RX/1 TX, full power)	154 mA min, 185 mA average, 751mA peak
GSM 1900 (2 RX/2 TX, full power)	60 mA min, 246 mA average, 736mA peak
Idle	<5 mA average
Shutdown	<1mA

GSM Transmit Power:

1800/1900 MHz	GSM Power Class 1 (30 dBm ± 2 dB @ antenna connection
850/900 MHz	GSM Power Class 4 (33 dBm ± 2 dB @ antenna connection)

GSM/GPRS Receiver Sensitivity (Typical):

1800/1900 MHz	<-102 dBm, GPRS Coding Scheme 1 (CS1)
850/900 MHz	<-102 dBm, GPRS Coding Scheme 1 (CS1)

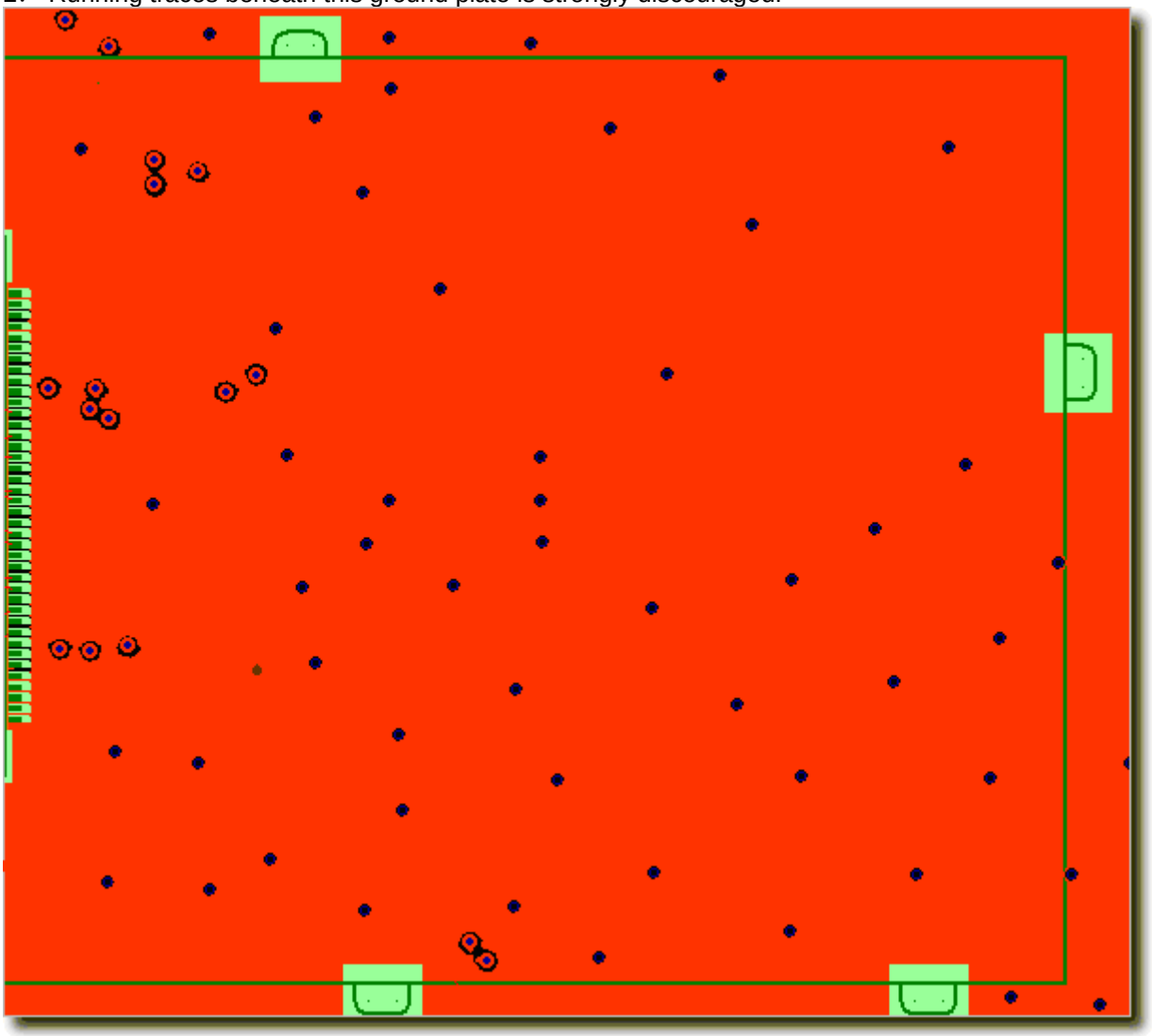
1.5 General Design Guidelines

1.5.1 Advanced tips for an RF friendly layout

1.5.1.1 Ground Plane

When designing the 80350 module into the host application, special care must be taken regarding the design of grounding on the host PCB. Proper grounding of the module' is an essential part of any good application, as it can very effectively keep EMI in check and ensure good heat dissipation. An example is shown in the drawing below:

1. It is recommended that the entire board space underneath the 80350 module be made the ground plate with sufficient ground vias, and this ground be adequately connected to the mounting tab ground. In doing so, good connectivity can be achieved between the module's ground and that of the host board.
2. Running traces beneath this ground plate is strongly discouraged.

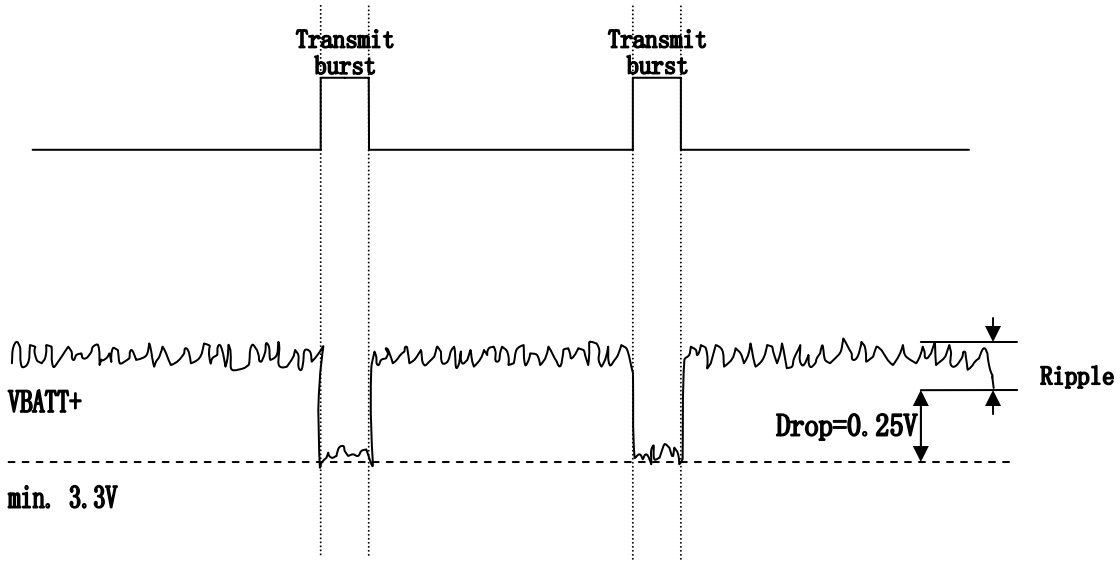


1.5.1.2 Antenna and RF Signal Trace

For best antenna performance, please ensure that the antenna's RF trace be designed to be 50 ohm special impedance line, and that there are a sufficient number of ground holes around the antenna impedance line and connector. Keep other traces of the module and the host board as far from this impedance line as possible. It should be avoided that other traces run in parallel to or cross the antenna impedance line. The antenna should be kept away metallic components.

1.5.1.3 Vbatt Input

The power supply of the 80350 module is of critical importance to the module's stability and safety. The 80350 module encompasses all working elements of GSM. It is recommended that the width of power trace be greater than 2 mm, and that a sufficiently large capacitor be placed in the nearest vicinity of the Power pin (two 1000uF capacitors, preferably, low ESR Tantalum capacitors) in order to cope with bursts during GSM operation (such bursts cause voltage transients as shown in the figure below).



The following picture shows an example of the power supply trace for the module. The trace covers the entire power pin of the module. The wide trace is intended to minimize voltage drop over the trace.

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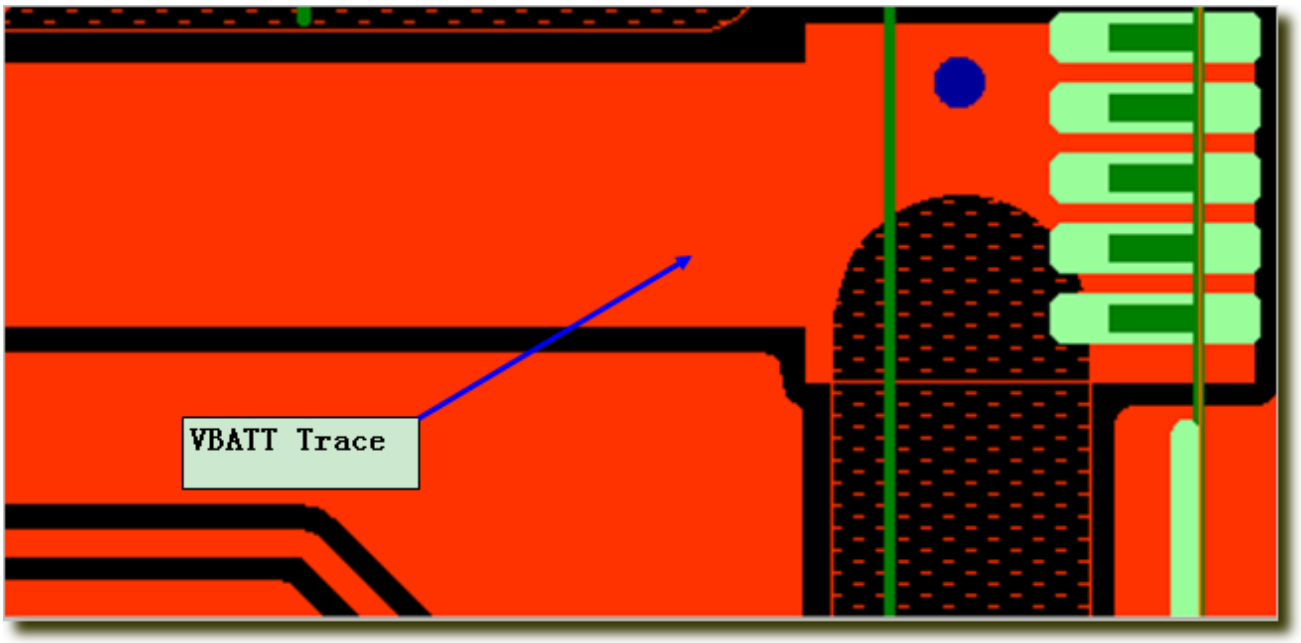
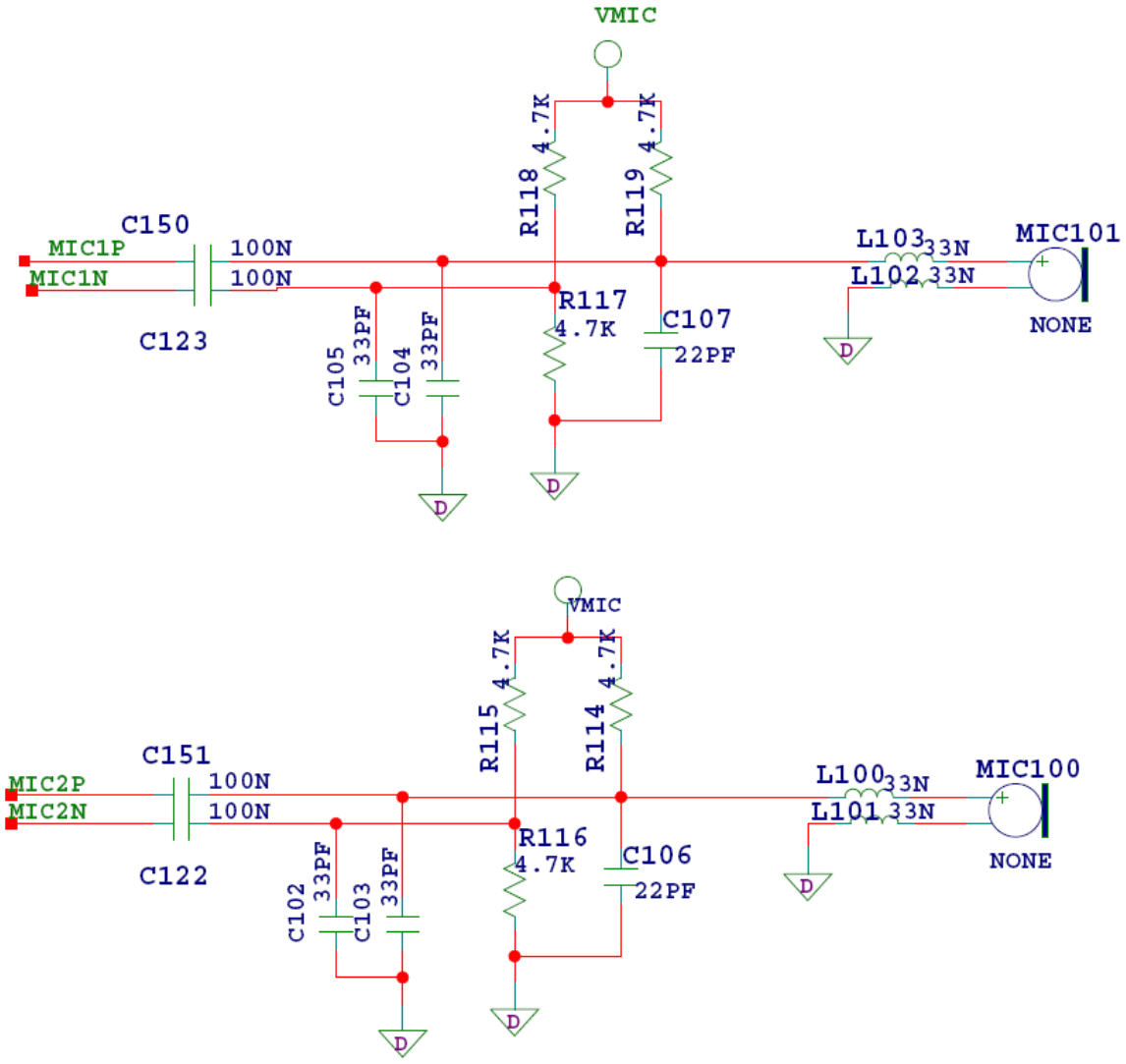


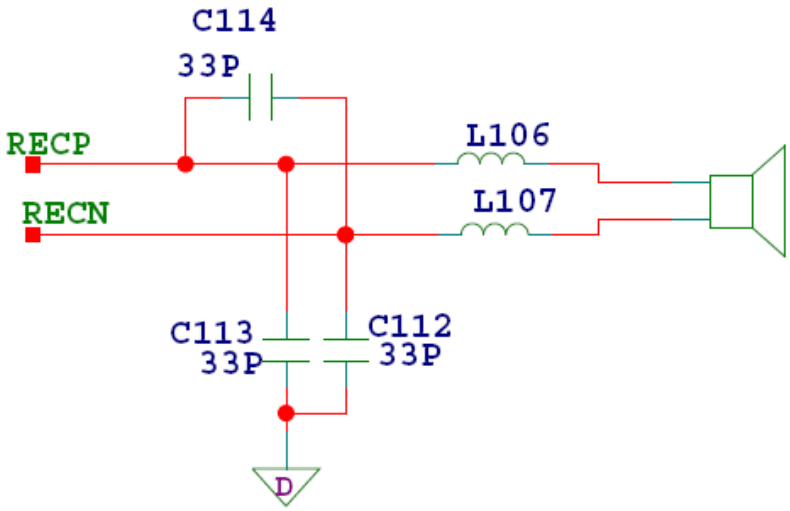
1.5.2 Audio Reference Design

1.5.2.1 Audio schematics

The audio quality is very much dependent on the circuit design and layout. As an aid to obtaining good audio quality, a reference design has been included below.

1. Please serially place a Bead on Audio In/Out (see in the following circuit: L100, L101, L102, L103, L106 and L107) in order to reduce GSM TDD noise. Bead (100MHz, R>=1K ohm) is recommended.
2. Add a small capacitor on each audio trace. This small capacitor is for further reducing the TDD noise. The typical value of capacitance is 10pF to 100pF. The actually value needs to be tuned based on the location and layout of the audio circuitry.
3. The suggested locations of the capacitors and Bead are in the vicinity of Microphone and Receiver, rather than the module.
4. Maintain proper separation of the Audio In reference ground from the Audio Out reference ground so as to minimize ECHO coupling in the circuitry.
5. Microphone and Receiver should be physically separated from one another, e.g., on the two far ends of the evaluation board, as the spatial coupling of voice signal may occur, resulting in ECHO or screeching sound.



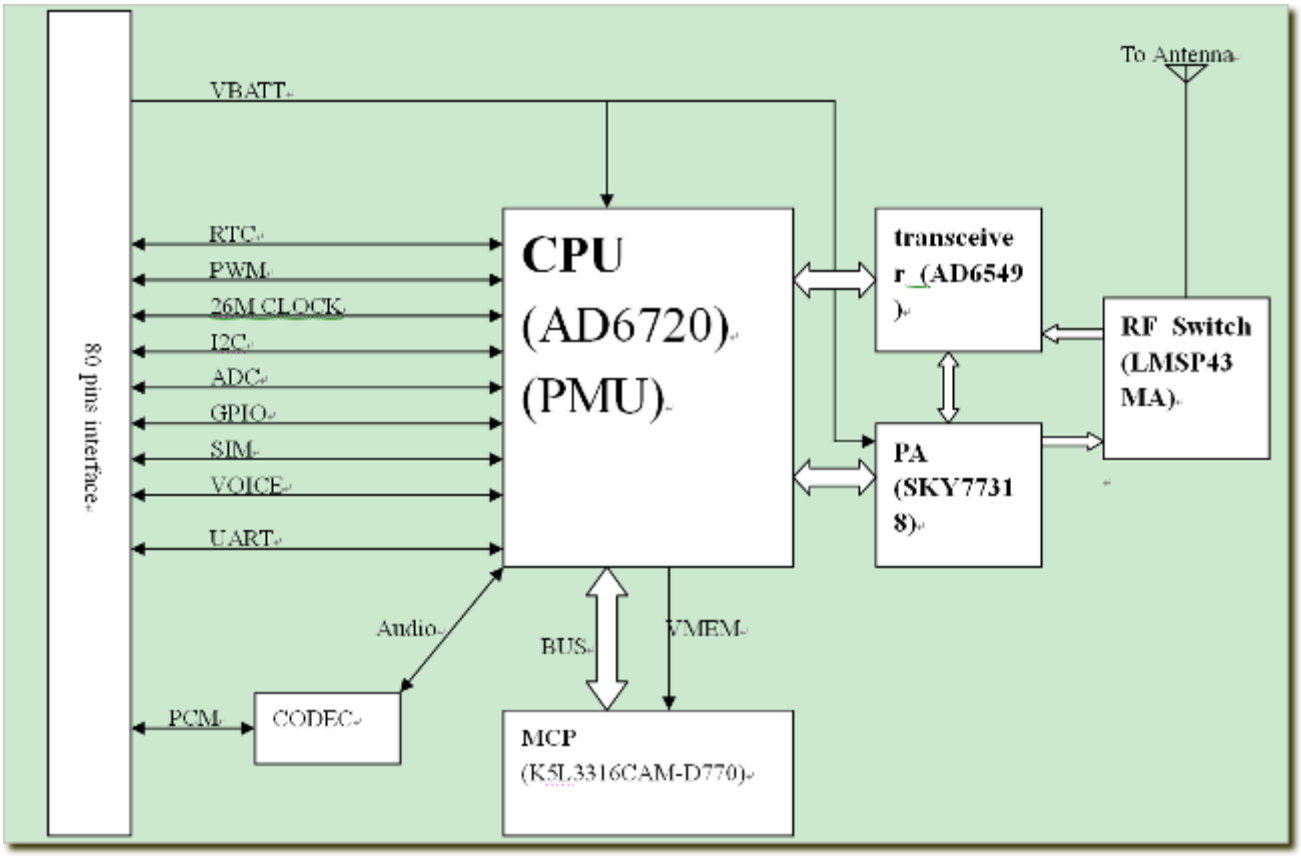


1.5.2.2 Audio Layout

Audio signals are very weak and are in the category of weak analog signals; they are extremely susceptible to interference from digital signals. Therefore, it is suggested that audio signal traces follow the same layer differential trace layout method, and be kept far away from strong digital signals (e.g., power signal, RF related signal, CLK signal and high-speed Bus).

2. Technical Specification

2.1 Block Diagram



2.2 Hardware Key Parts

Part	Description
CPU	IC-CPU,AD6720ABCZ-RL,GP,BGA,TAP,39MHZ,289PIN,ADI
Memory	IC-MEMORY,K5L3316CAM-D770,GP,FBGA,TRAY,SAMSUNG
Transceiver	IC-RF,AD6549BCPZ,GP,LFCSP,TAP,32PIN,GSM850/900 DCS/PCS,ADI
RF Switcher	IC-RFSW,LMSP43MA-271TEMP,GP,QFN,TAP,16PIN,GSM,MURATA
SAW-Filter	FILTER,SAFED881MFL0F05R00,GP,881.5MHZ,5P,MURATA
SAW-Filter	FILTER,SAFED1G96FA0F00R00-GP,GP,1.96GHZ,5P,MURATA
SAW-Filter	FILTER,SAFED942MFM0F00R00-GP,GP,942.5MHZ,5P,MURATA
SAW-Filter	FILTER,SAFED1G84FB0F00R00-GP,GP,1842.5MHZ,5P,MURATA
Oscillator	XTAL,MC-146,GP,32.768KHZ,20PPM,12.5PF,EPS
TCXO	XTAL,TTS18VSG-A5,GP,26MHZ,10PPM,3.5PF,TOKYO
RF-PA	IC-RF,SKY77318,GP,TAP,20PIN,GSM900/GSM850,SKYWORKS
B2B Connector	CONN,AXK880125WG,GP,80PIN,SMD,TAP,FPC,MA
RF Connector	CONN,CL331-0471-0-10,GP,ML,2PIN,SMD,TAP,HRS

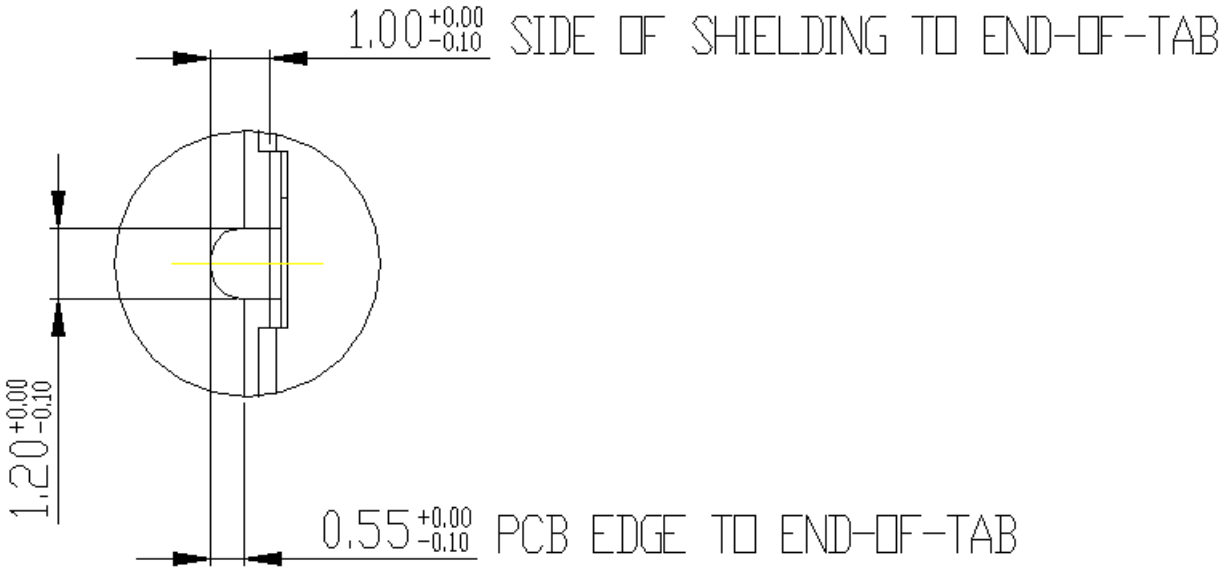
2.3 Absolute Maximum Ratings

The absolute maximum ratings stated in following Table are stress ratings under any conditions. Stresses beyond any of these limits will cause permanent damage to the 80350 module.

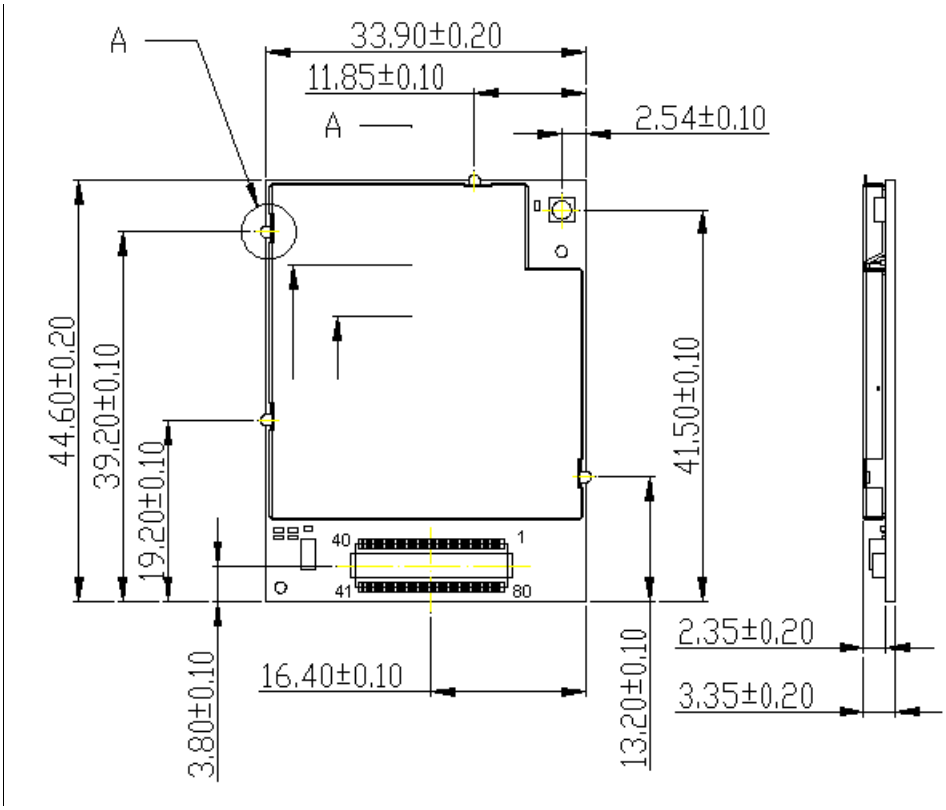
Parameter	Min	Max	Unit
Supply Voltage BATT	-0.3	5.5	V
Voltage at digital pins in POWER DOWN mode	-0.3	0.3	V
Voltage at digital pins in normal operation	-0.3	3.05 or VEXT+0.3	V
Voltage at analog pins in POWER DOWN mode	-0.3	0.3	V
Voltage at VCHARGE pin	-0.3	5.5	V
VSENSE		5.5	V
ISENSE		5.5	V
VRTC	-0.3	5.5	V

Operating Rating: -20°C to +70°C
Storage Temperatures: -40°C to +85°C

3. Physical Interfaces



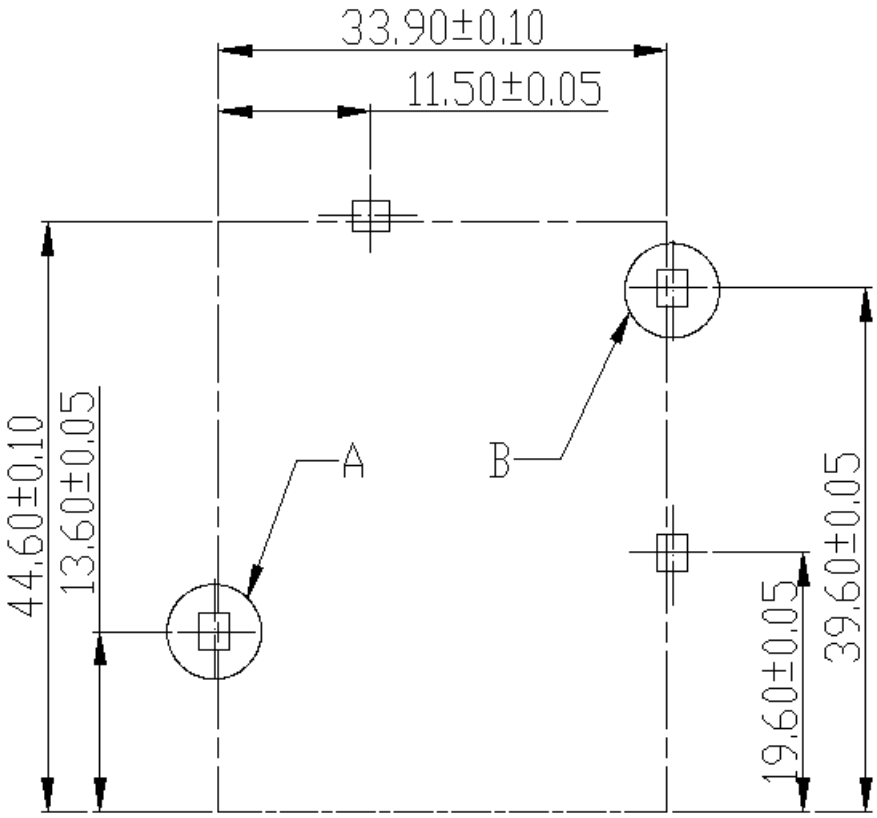
Mounting Tabs



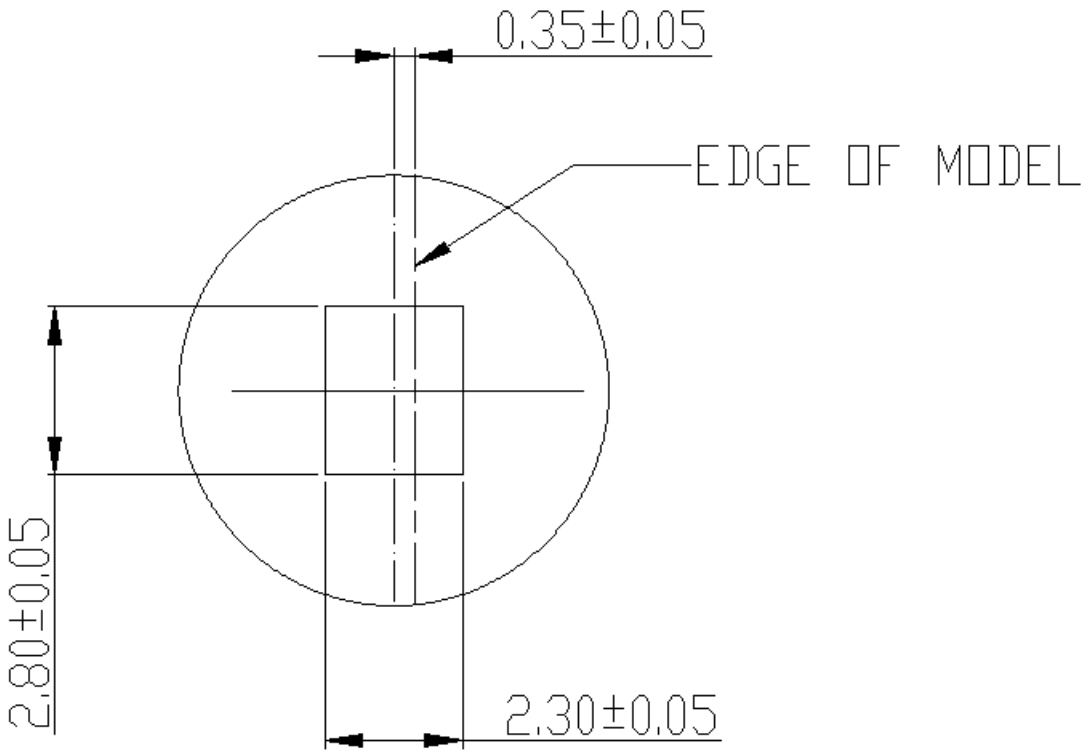
80350 Dimension (mm)

3.1 Module Mounting to Host Board (Reference)

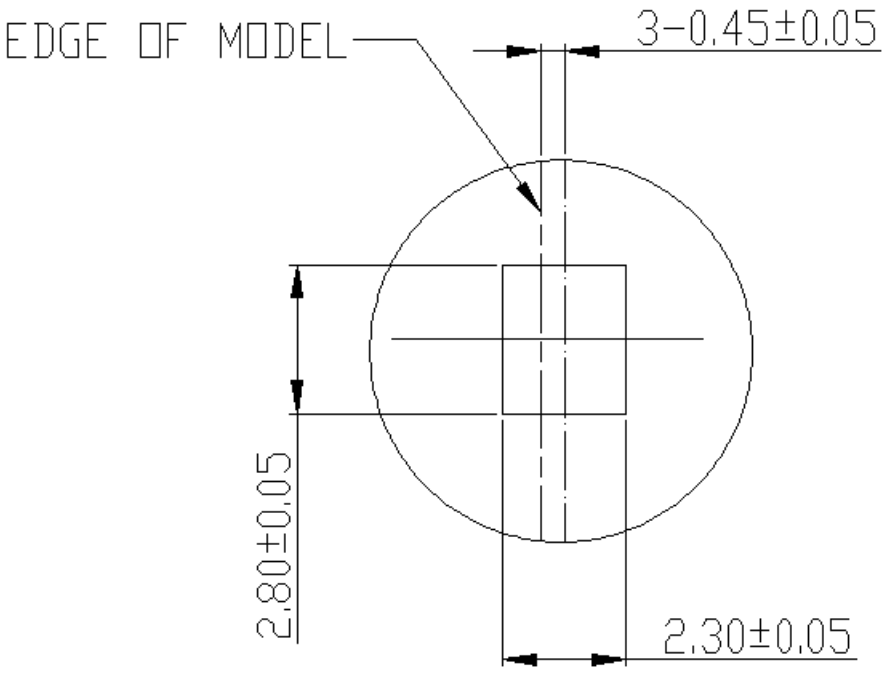
The module provides mounting tabs that needs to be soldered to a PCB. These tabs provide circuit grounding for the module.



Host Board Layout



A Type Pad



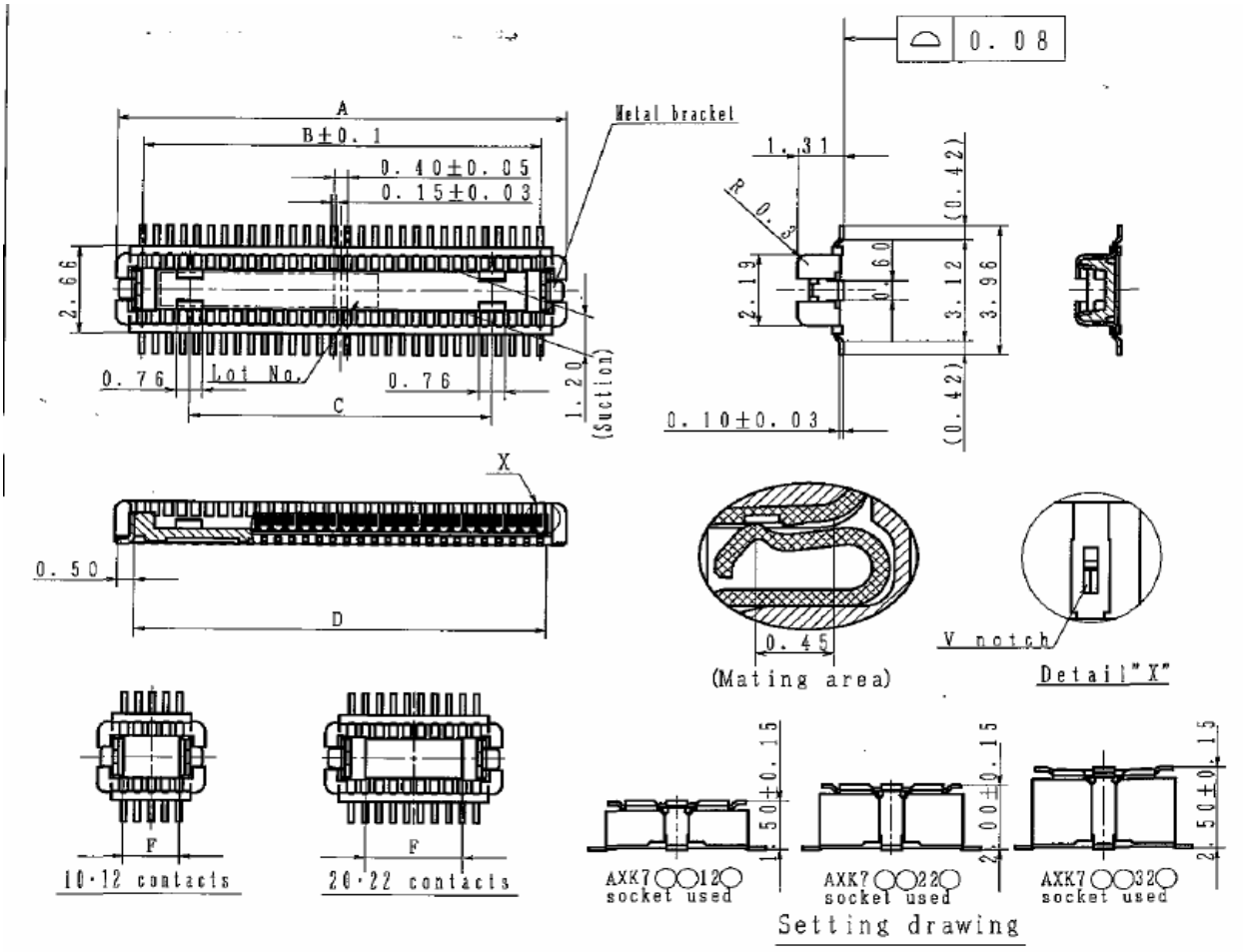
B Type Pad

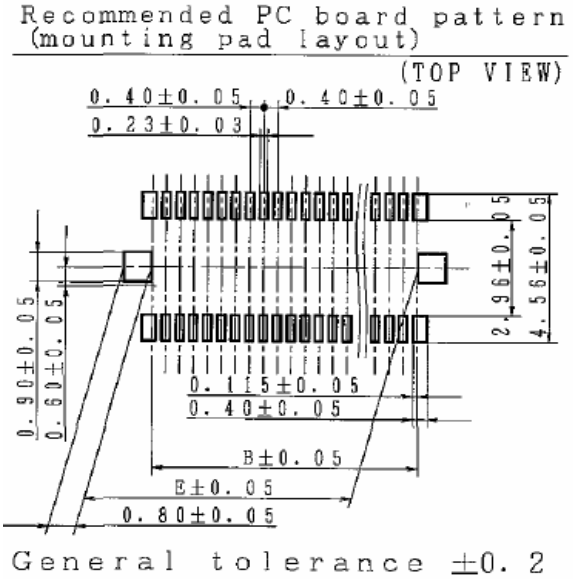
3.2 Connectors

On the 80350 module: CONN,AXK880125WG,GP,80PIN,SMD,TAP,FPC,MAT

Modem module manufacturer Part Number is 6012A0190101.

MATSUSHITA Part Number is AXK880125WG



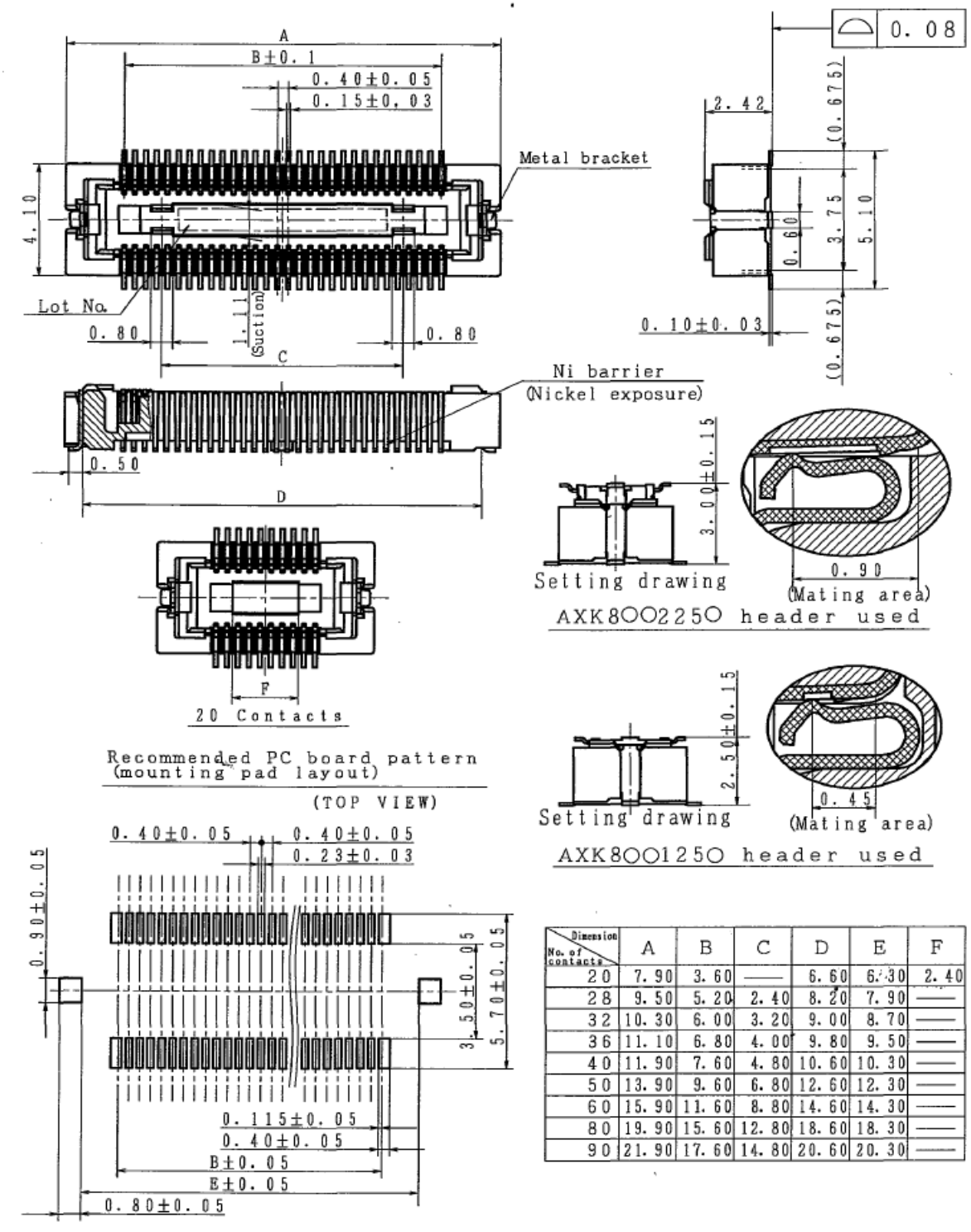


No. of contacts \ Dimention	A	B	C	D	E	F
10	3.10	1.60	——	1.94	1.64	1.64
12	3.50	2.00	——	2.34	2.04	2.04
20	5.10	3.60	——	3.94	3.64	2.80
22	5.50	4.00	——	4.34	4.04	3.20
24	5.90	4.40	1.60	4.74	4.44	——
28	6.70	5.20	2.40	5.54	5.24	——
30	7.10	5.60	2.80	5.94	5.64	——
32	7.50	6.00	3.20	6.34	6.04	——
34	7.90	6.40	3.60	6.74	6.44	——
40	9.10	7.60	4.80	7.94	7.64	——
44	9.90	8.40	5.60	8.74	8.44	——
46	10.30	8.80	6.00	9.14	8.84	——
50	11.10	9.60	6.80	9.94	9.64	——
60	13.10	11.60	8.80	11.94	11.64	——
80	17.10	15.60	12.80	15.94	15.64	——
90	19.10	17.60	14.80	17.94	17.64	——
100	21.10	19.60	16.80	19.94	19.64	——

On the Host: CONN,AXK780327G,GP,x,80PIN,SMD,TAP,FPC,MAT

Modem module manufacturer Part Number = 6012A0190001

MATSUSHITA Part Number is AXK780327G



Dimension / No. of contacts	A	B	C	D	E	F
20	7.90	3.60	——	6.60	6.30	2.40
28	9.50	5.20	2.40	8.20	7.90	——
32	10.30	6.00	3.20	9.00	8.70	——
36	11.10	6.80	4.00	9.80	9.50	——
40	11.90	7.60	4.80	10.60	10.30	——
50	13.90	9.60	6.80	12.60	12.30	——
60	15.90	11.60	8.80	14.60	14.30	——
80	19.90	15.60	12.80	18.60	18.30	——
90	21.90	17.60	14.80	20.60	20.30	——

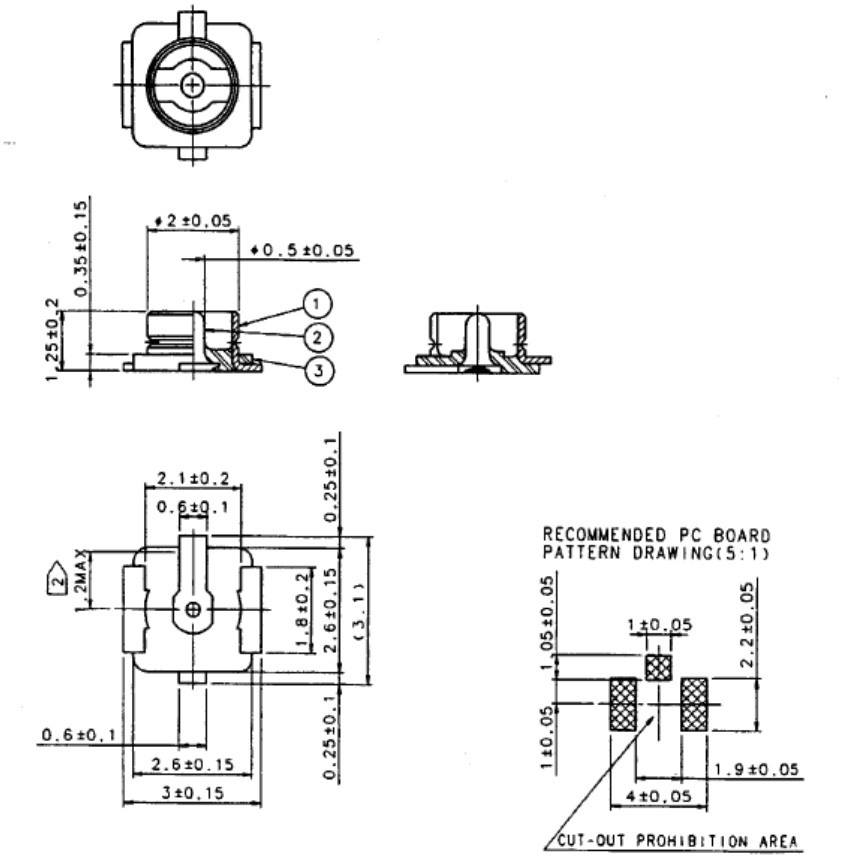
General tolerance ±0.2

Note: The above information regarding the connector and mating connector are taken from the pertinent manufacturer specifications; for more details, please refer to the specifications of the part manufacturer

3.3 RF Connection

3.3.1 Coaxial Connector Option

On the module: GP,ML,2PIN,SMD,TAP
Internal Part Number = 6012A0189501
HIROSE: CL331-0471-0-10



3.3.2 Note: The above information regarding the connector and mating connector are taken from the pertinent manufacturer specifications; for more details, please refer to the specifications of the part manufacturer.

I/O Connector Pin Assignment

The following table shows the pin assignment on the input/output connector.

Pin	I/O	80350 Define	Description (Default function / secondary function)
1	Ground	DGND	Ground
2		Reserved	Floating
3		NC	No connect
4	Ground	DGND	Ground
5		Reserved	Floating
6		Reserved	Floating
7		Reserved	Floating
8		Reserved	Floating
9		Reserved	Floating
10		DBGTX	Debug TX
11		Reserved	Floating
12		NC	No connect
13		NC	No connect
14		Reserved	Floating
15		NC	No connect
16		SIM_CLK	SIM interface clock
17		SIM_VCC	SIM interface vcc
18		SIM_DAT	SIM interface data
19		SIM_RST	SIM interface reset
20		NC	No connect
21		NC	No connect
22		NC	No connect
23		PCM_CLK	PCM interface clock
24		PCM_SYNC	PCM interface sync
25		PCM_RXD	PCM interface RXD
26		PCM_TXD	PCM interface TXD
27		Reserved	Floating
28		Reserved	Floating
29		Reserved	Floating
30	UART	RXD0	Serial data input
31	UART	DBGRX	Debug RXD
32	UART	TXD0	Serial data output
33		Reserved	Floating
34		Reserved	Floating
35		Reserved	Floating
36	Ground	DGND	Ground
37	Ground	DGND	Ground
38	Ground	DGND	Ground
39	Ground	DGND	Ground
40	Ground	DGND	Ground
41	Power	VBATT	Power
42	Power	VBATT	Power
43	Power	VBATT	Power
44	Power	VBATT	Power
45	Power	VBATT	Power

46		Reserved	Floating
47	UART	RING0	ring indicate
48	UART	DSR0	Data set ready
49	UART	RTS0	Ready to send
50	UART	DTR0	Data terminal ready0
51		Reserved	Floating
52	UART	CTS0	Clear to Send
53		Reserved	Floating
54	UART	DCD0	Data carrier detect
55	I	/RESET	External Reset input
56	O	POWER_KEY	Power Key
57	Ground	AGND	Ground
58	Analog	MIC1N	Auxiliary Audio input
59	Analog	MIC1P	Auxiliary Audio input
60	Analog	MIC2P	Auxiliary Audio input
61	Analog	MIC2N	Auxiliary Audio input
62	Analog	SPKN	Auxiliary Audio output
63	Analog	SPKP	Auxiliary Audio output
64	Analog	RECP	Auxiliary Audio output
65	Analog	RECN	Auxiliary Audio output
66		Reserved	Floating
67	Power	Reserved	Floating
68		NC	No connect
69		NC	No connect
70		Reserved	Floating
71		NC	No connect
72		NC	No connect
73		NC	No connect
74		Reserved	Floating
75		Reserved	Floating
76		Reserved	Floating
77		NC	No connect
78		Reserved	Floating
79		NC	No connect
80	Ground	DGND	Ground

I = Input;
O = Output;
NC = No connect

3.4 Antenna

The 80350 module has an RF antenna interface; for its specification, please refer to Section 3.3.1. Note that this RF connector is a connector only, and is not a switch. Through this connector, various RF performance parameters of the module can be measured.

3.5 Control Connector Signal Descriptions and Functions

3.5.1 Module Power (Pins 41, 42, 43, 44 & 45)

The 80350 module requires a single power supply and no additional working power supply is required. The relevant parameters are defined in the following table.
The module has multiple LDOs (Low Drop Linear Voltage Regulators) inside, which support various different working units, including internal memory, GSM RF, CPU, IO ports, audio, etc. Therefore, the 80350 module depends heavily on external power supply, which directly impacts, the stability and RF performance parameters of the module. Please carefully follow the description of power supply and ground in Sections 1.5.1 and 1.5.3.

The 80350 module uses a single voltage source of VBATT = +3.55V to 4.2V.

VBATT	**Parameters/Conditions**	Min.	Typ.	Max.	Units
Main Battery Supply	Voltage In Regulation	3.55	3.8	4.2	Vdc

Minimizing Power Loss

The measurement network monitors outburst and inburst values. The drop is the difference of both values. The maximum drop (Dmax) since the last start of the module will be saved. In IDLE and SLEEP mode, the module switches off if the minimum battery voltage (V_{batt}min) is reached.
Example:
$V_I$min = 3.3V
Dmax = 0.25 V
V_{batt}min = $V_I$min + Dmax
V_{batt}min = 3.3V + 0.25V = 3.55V
For Example:

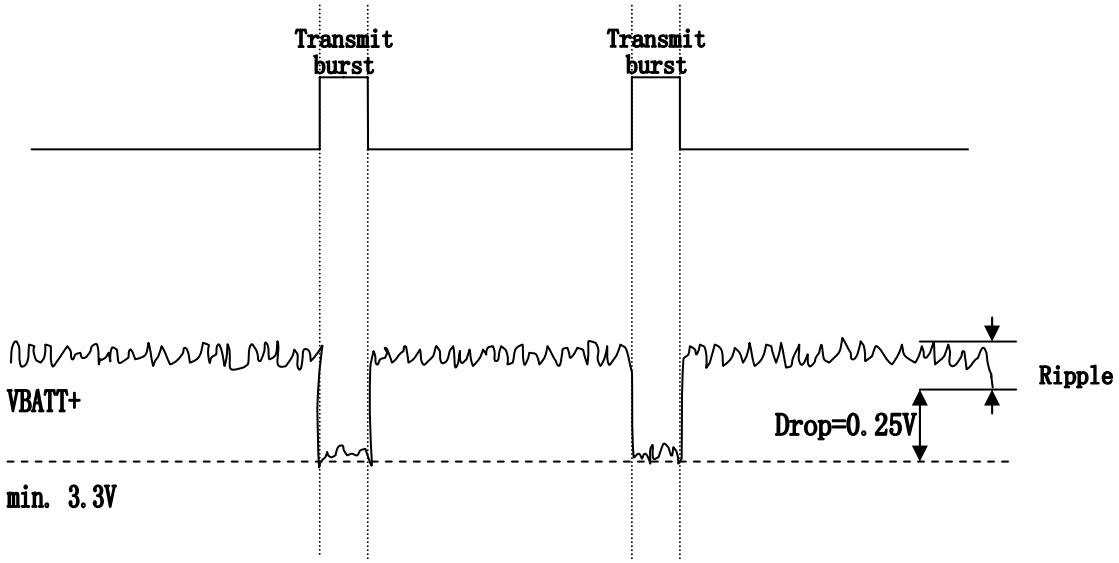


Figure : Power supply limits during transmit burst

3.5.2 Reset Signal (Pin 55)

The Reset signal is an input to the 80350 module. It is used to reset the module during emergency situations; the signal is Low active..

When the module is running in a undefined or uncontrollable state, it can be reset by forcefully pulling Low the RESET signal port. It should be noted that all pending processes will be aborted, and hence, will need to be restarted.
Note: During normal module operation, please do not operate on the RESET signal pin. The following diagram shows the relevant signal timings in the module during its Power-On/Power-Off

Power-On / Power-Off and RESET Scenarios

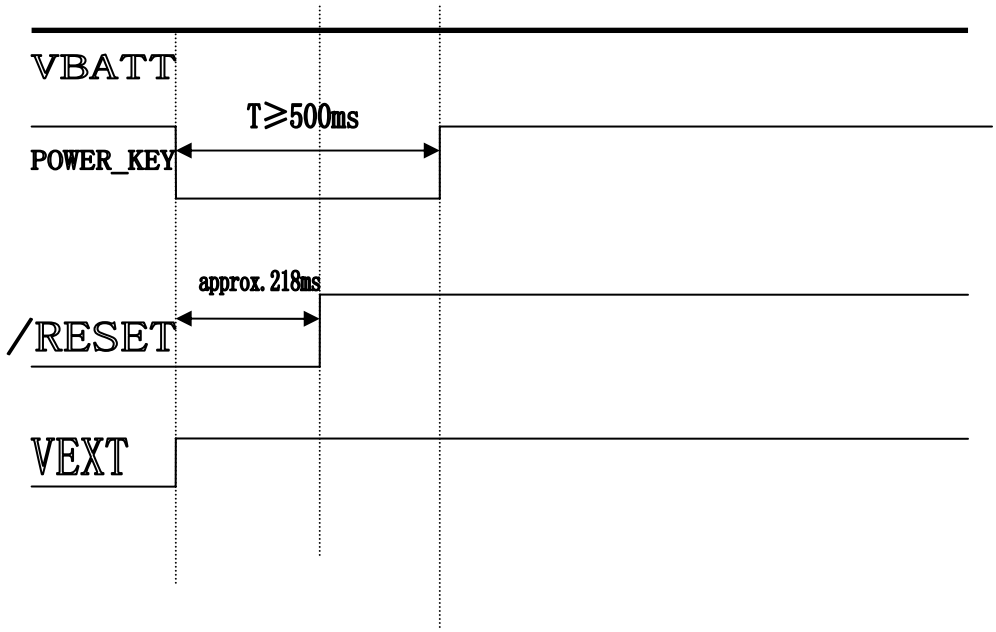


Figure : Power-on and reset with operating voltage at VBATT

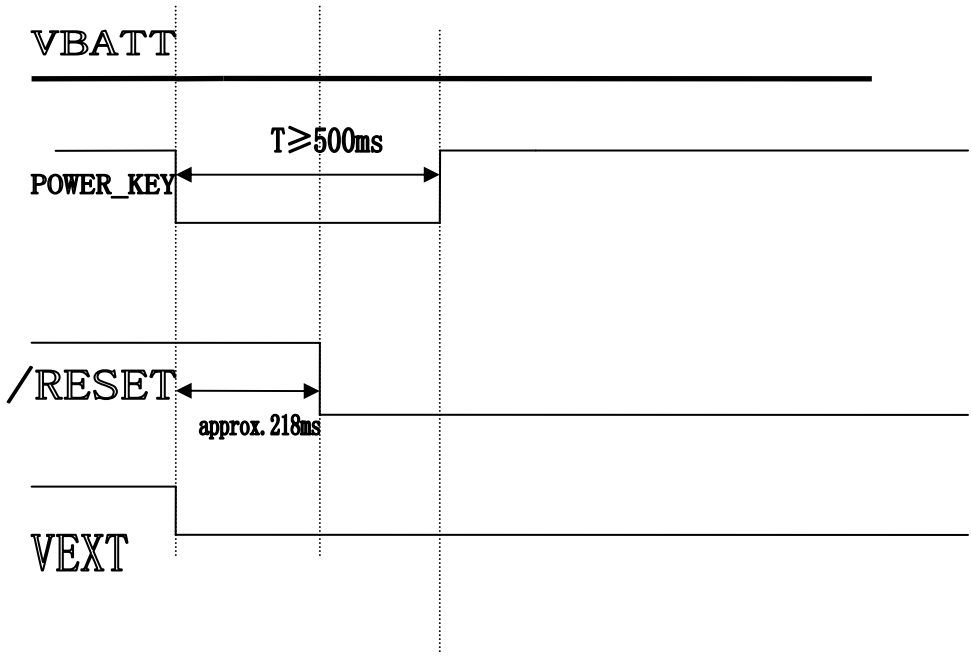


Figure : Power-Off and RESET with operating voltage at VBATT

3.5.3 Power Control (pin 56)

The input is equivalent to a “phone ON-button”. A falling-edge on this Active-Low input will switch-ON the module or switch-OFF the module after a delay.
Please see the “**Power-On / Power-Off and RESET Scenarios”**

3.5.3.1 Power On

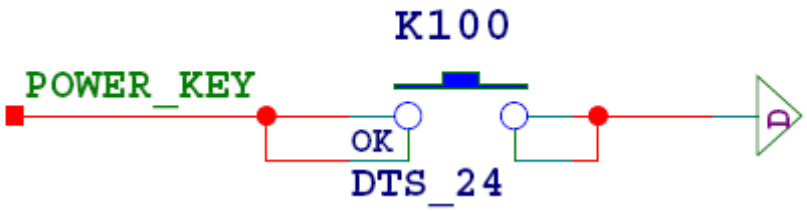
Pulling the POWER_KEY line on the module LOW for at least 500 msec (after Vbatt is applied and stabilized) is required to turn it ON.

3.5.3.2 Power Off

The module can be turned off by a low pulse on the POWER_KEY pin.

3.5.3.3 Using the Power Control Signal

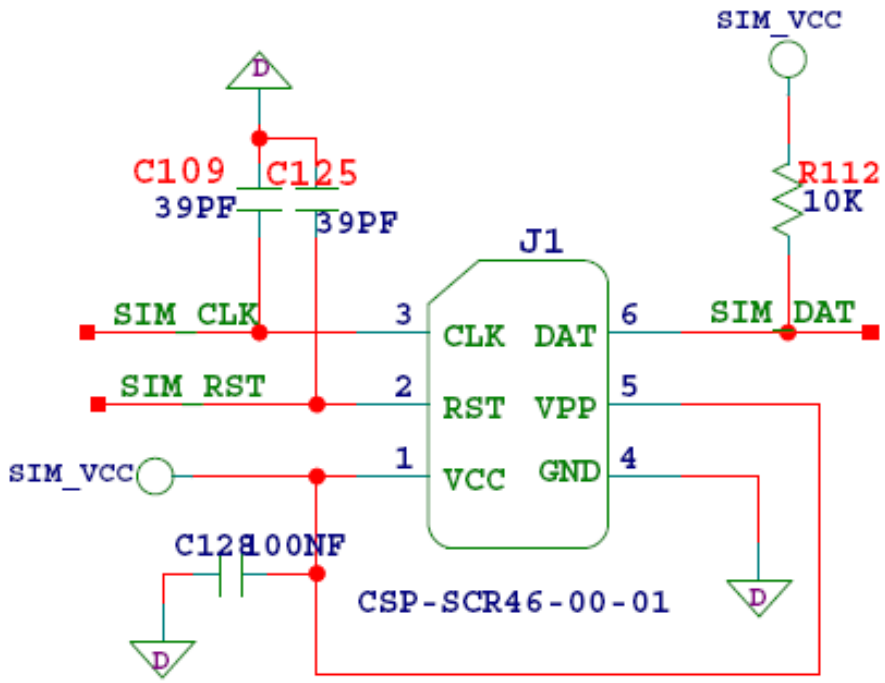
Typical use powering module on/off with a switch:



3.5.4 SIM Interface (pins 16, 17,18 &19)

The 80350 module's built-in baseband processor has SIM card interface support compatible with ISO7816 IC card standard. Each of the SIM card pins is connected to the corresponding pins of the baseband processor; please refer to pin assignment defined in a preceding section. The following figure shows a reference connection scheme of the SIM card slot, where C109,C125 and R112 are reserved, and are only used when tuning to reduce EMI The user is free to disregard these optional components.

The SIM card interface supports 3V and 1.8V SIM cards.



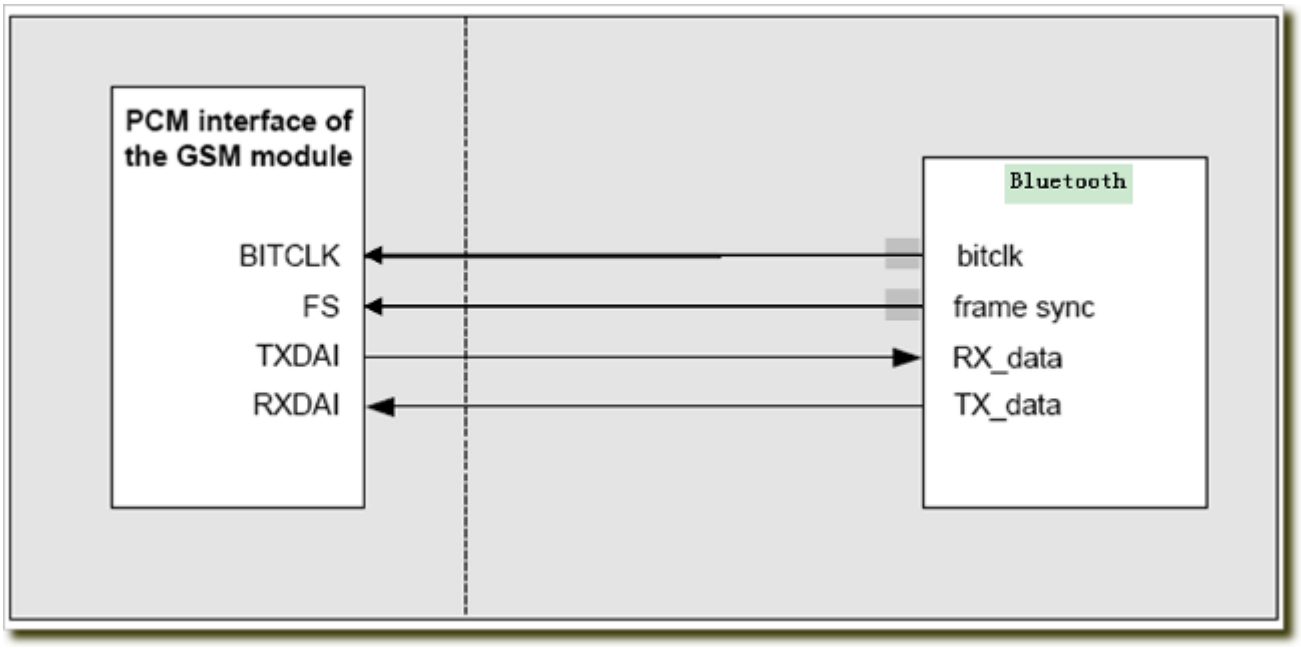
3.5.5 PCM Interface (pins 23, 24, 25 & 26)

The PCM can be used to connect the 80350 module with audio devices capable of PCM (Pulse Code Modulation).

Interface Name	Function	Input/Output
PCM_TXD	TXDAI	Output
PCM_RXD	RXDAI	Input
PCM_SYNC	Frame SYNC	Output
PCM_CLK	Bit Clock	Output

For the PCM signal pins, please pay attention to the direction of I/O pinout. The 80350 module's PCM codec does not generate any clock signals, but only receive external PCM clock signal; hence, the module can act as a slave PCM device, but not as a master device.

Next, more details on parameters and timing of PCM signal are presented. (Excerpts taken from the datasheet of the PCM codec IC)



PCM interface timing and parameters

PCM INTERFACE **(Long Frame, Short Frame)**

All timing parameters of the output pins are measured at VOH = 0.8VDD and VOL = 0.4V. Input pins are measured at VIH = 0.7VDD and VIL = 0.3VDD.

AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
FS Frequency	f_{PF}	-1.0%	8	+1.0%	kHz
BCLK Frequency	f_{PB}	-	$f_{PF} \times 8N$ (N=1~32)	-	kHz
BCLK Duty Cycle	t_{WB}	40		60	%
Rising/Falling Time: (BCLK,FS, DX,DR)	t_{RB} t_{FB}			40	ns
Hold Time: BCLK Low to FS High	t_{HBF}	60			ns
Setup Time: FS High to BCLK Low	t_{SFB}	60			ns
Setup Time: DR to BCLK Low	t_{SDB}	60			ns
Hold Time: BCLK Low to DR	t_{HBD}	60			ns
Delay Time: BCLK High to DX valid Note1)	t_{DBD}	0		60	ns
Delay Time: (A) BCLK High to DX High-Z or (B) FS Low to DX High-Z or (C) BCLK High to DX High-Z Note1)	t_{DZC}	0		60	ns
Long Frame					
Hold Time: 2nd period of BCLK Low to FS Low	t_{HBFL}	60			ns
Delay Time: FS or BCLK High, whichever is later,to DX valid 注1)	t_{DZFL}			60	ns
FS Pulse Width Low	t_{WFSL}	1			BCLK
Short Frame					
Hold Time: BCLK Low to FS Low	t_{HBFS}	60			ns
Setup Time: FS Low to BCLK Low	t_{SFBS}	60			ns

Note1) Measured with 50pF load capacitance and 0.2mA drive.

Figure 1: Long Frame timing

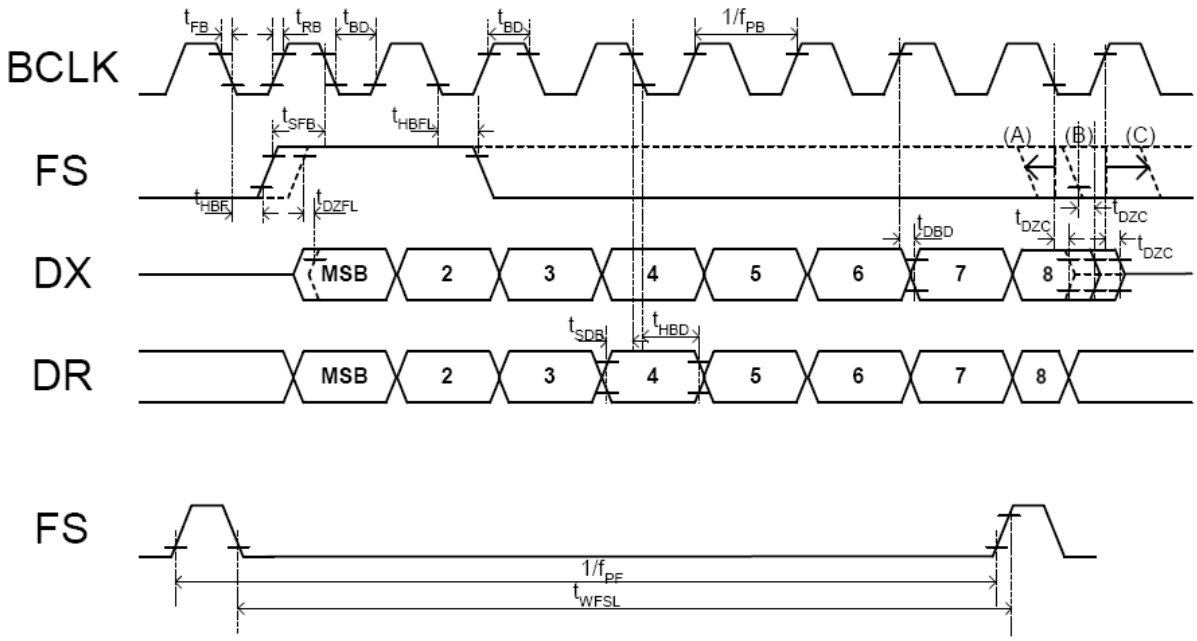
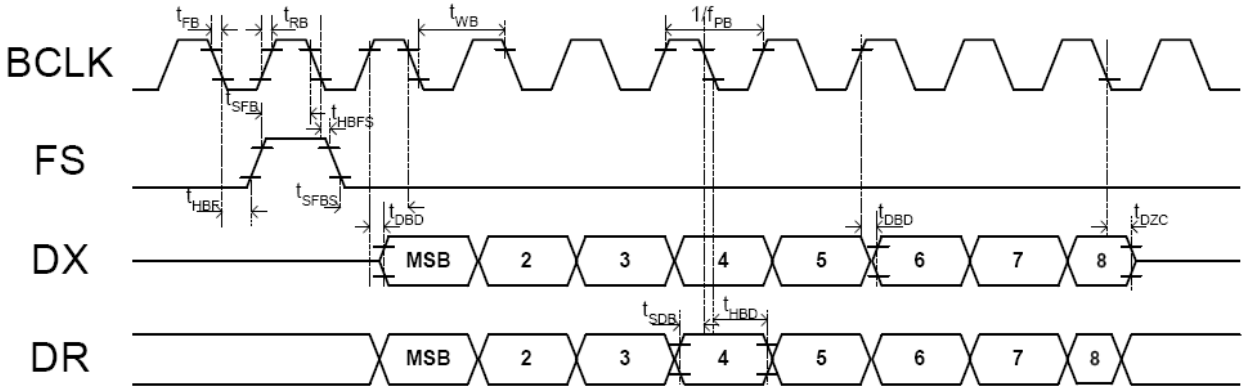


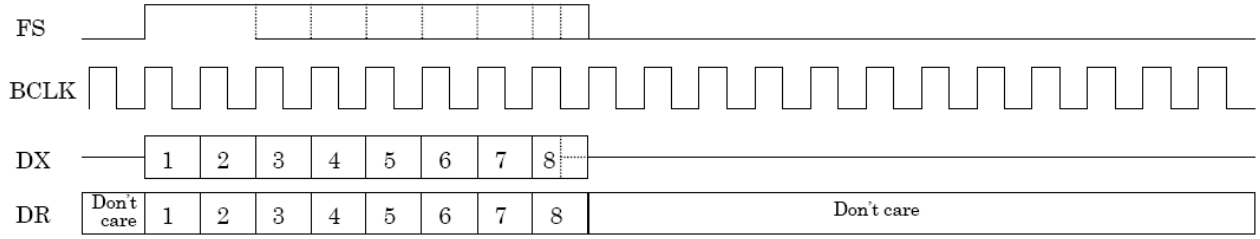
Figure 2: Short Frame timing



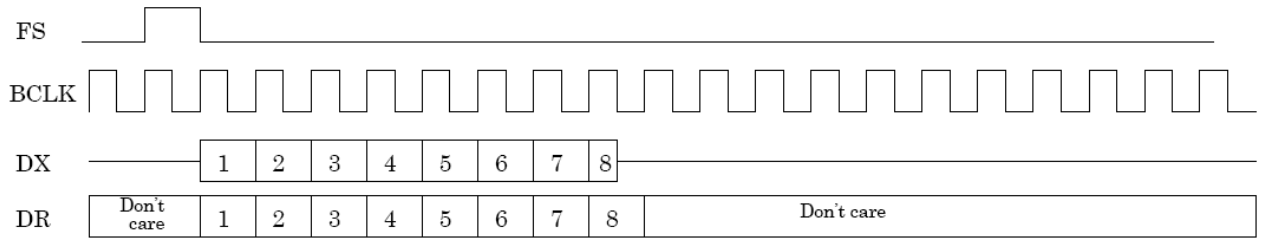
- Frame sync signal（FS）
8kHz reference signal. This signal indicated the timing and the frame position of 8kHz PCM interface.
All the internal clock of the LSI is generated based on this FS signal.

-Bit clock（BCLK）
BCLK defines the PCM data rate. BCLK rate is 64kHz × N (N=1~32). This clock must be synchronized with FS.

LongFrame



ShortFrame



Important notice!

Please don't stop feeding FS with out power down mode.
FS is used as the internal reference clock. LSI does not work when the FS is not provided.

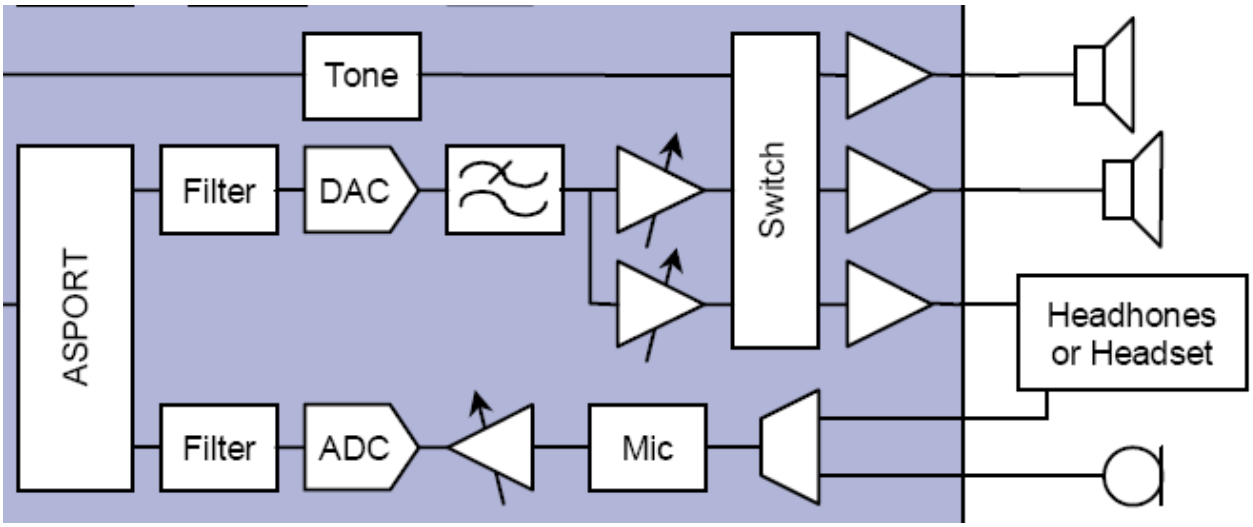
3.5.6 Auxiliary Audio Interface

The 80350 module allows four analog audio channels with physical interfaces on the board-to-board connector; these channels are programmable by software:

• Two Auxiliary audio input interfaces, both with balanced or single-ended inputs.

• Two Auxiliary audio output interfaces, both with balanced or single-ended outputs.

This means that you can connect up to four different audio devices, although only one interface can be operated at any given time. Using software command you can easily switch back and forth among the channels.



3.5.6.1 Auxiliary Audio output interface (Pins 62, 63, 64 & 65)

The analog output interface has two channels switchable by software. Specially,

A. SPKP/SPKN(pin62,63) Normal Differential Audio Output Specifications

Specification	Min	Typ	Max	Units
Operating Conditions				
External Load Resistance	7.5	8		Ω
External Load Capacitance			100	pF
Performance				
PGA Gain Step Size		1.9		dB
PGA Gain Step Size Error		± 0.25		dB
PGA Gain corresponding to minimum PGA Gain Setting		-44		dB
PGA Gain corresponding to maximum PGA Gain Setting		11.8		dB
Mute Attenuation		-80		dB
Output Bias Voltage		V_{SPWR} / 2		V
Maximum Output Level (THD ≤ -30 dB, PGA = +12 dB)		6.0		Vpp (differential)
Full-Scale Output Level (PGA = +12 dB)		6.0		Vpp (differential)
Full-Scale Output Level (PGA = 0 dB)		1.573		Vpp (differential)
Nominal Output Level: 0 dBm0 (PGA = 0 dB)		1.092		Vpp (differential)
Power Supply Rejection[1] (PGA = 0 dB)		-65		dBm0

† Performance specifications are based on operation with a 7.5 Ω load resistor and SPWR = 3.6 V.

‡ The PGA exhibits monotonic behavior.

[1] The test signal for performance measurement is a 217 Hz, 100 mV peak-to-peak sine wave, applied to the SPWR terminal in addition to the nominal SPWR supply potential.

B. RECP/RECN(Pin64,65), Normal Differential Audio Output Specifications

Specification	Min	Typ	Max	Units
Operating Conditions				
External Load Resistance	27	32		Ω
External Load Capacitance			100	pF
Performance				
PGA Gain Step Size		1.9		dB
PGA Gain Step Size Error		± 0.25		dB
PGA Gain corresponding to minimum PGA Gain Setting		-44.9		dB
PGA Gain corresponding to maximum PGA Gain Setting		11.6		dB
Mute Attenuation		-80		dB
Output Bias Voltage		V_{REF}		V
Full-Scale Output Level (PGA = 0 dB)		1.525		Vpp (differential)
Nominal Output Level: 0 dBm0 (PGA = 0 dB)		1.062		Vpp (differential)
Power Supply Rejection[1] (PGA = 0 dB)		-95		dBm0

† Performance specifications are based on operation with a 27 Ω load resistor.

‡ The PGA exhibits monotonic behavior.

[1] The test signal for performance measurement is a 217 Hz, 100 mV peak-to-peak sine wave, applied to the VBAT terminal in addition to the nominal VBAT supply potential.

Note: For guidelines on the layout of Audio Output circuitry. please refer to Section 1.5.2.2.

3.5.6.2 Auxiliary Audio input interface (Pins 58, 59, 60 & 61)

There are two reserved channels for analog audio input:

Specification	Typ.	Units
Full-scale Input Voltage	2.0	Vpp
Input Resistance	10	Kohm

Comments:
A. For voice call, MIC1P/MIC1N interface is recommended as Audio Input.
B. On the 80350 module, only Audio Input interface is reserved. Except for the utility for microphone bias voltage, the 80350 board possesses no specific microphone support circuitry; therefore, such needs to be taken into account in the host board design.
C. For microphone circuitry layout, please refer to Section 1.5.2.2.

3.5.7 Serial Interface UART0

The module offers an 8-wire unbalanced, asynchronous modem interface ASC0.

The module is designed for use as a DCE. Based on the conventions for DTE-DCE connections it communicates with the customer application (DTE) using the following signals:

• Port TXD @ application sends data to the module's TXD0 signal line

• Port RXD @ application receives data from the module's RXD0 signal line

Pin Name	Pin Number	Signal Direction	Description
RXD0	30	I	Serial data input (DTE <-- DCE)
TXD0	32	O	Serial data output (DTE → DCE)
RTS0	49	O	Request to send (DTE → DCE)
CTS0	52	I	Clear to Send (DTE <-- DCE)
DCD0	54	I	Data carrier detect (DTE <-- DCE)
DTR0	50	O	Data terminal ready (DTE → DCE)
DSR0	48	I	Data set ready (DTE <-- DCE)
RING0	47	I	Ring detect output (DTE <-- DCE)

Note:

Pin Name and Signal Direction from HOST(DTE) Confirm, not the module.

3.5.8 Debug communication(Pins 10, 31)

The module can be calibrated by software through there two pins.

PINS	Assignment	Description	Input/Output
10	DBGTX	Debug transmitter	Output
31	DBGRX	Debug receiver	Input

4. GSM/GPRS Services

The 8035 module supports the following GSM/GPRS services:

- Short Message Services (SMS)
- Class B GPRS Functionality
- Voice communication
- Circuit-switched data

4.1 Transmission Modes for the GSM/GPRS Services

Each of the GSM/GPRS services has two modes that can be enabled separately:

- Mobile-originated (MO): allows the making of a service request (such as making a telephone call or sending an SMS)
- Mobile-terminated (MT): allows receiving a service request (such as receiving a telephone call or an SMS)

Note: Contact your local GSM operator to ensure that the services and modes have been provisioned for the SIM card.

4.2 Voice Communication

The 80350 module supports voice functions. On the 80-pin board-to-board connector, there are reserved pins for microphone and earphone hardware interfaces. When these are connected with microphone and earphone hardware, the desired voice functions can be executed by invoking relevant commands in the AT Command set (please refer to 80350 GSM/GPRS Modem Module AT Command Specification).

The 80350 module supports the following four audio coding formats:

1. Full-Rate (FR)
2. Enhanced Full-Rate (EFR)
3. Half-rate (HR)
4. Adaptive Multi-rate (AMR)

4.3 Circuit-Switched Data

In this mode, the 80350 module supports both of the connection modes of transmission that are provided by GSM:

- Non-Transparent mode delivers a constantly low error rate but with a non-guaranteed throughput or delay. The Non-Transparent service provides a performance that is closest to using a modem over a fixed Public Switched Telephone Network (PSTN) line.

Note: All GSM service providers may not support transparent mode. In those cases, the 80350 module can be configured to switch automatically to Non-Transparent mode. This capability depends on the settings in the AT+CBST command.

4.4 Short Message Services(SMS)

The 80350 module can perform the following tasks for the GSM Short Message Services:

- Sending and receiving binary messages of up to 160 characters (7-bit characters)
- Sending and receiving text messages of up to 140 bytes (8-bit data)
- Submitting a SMS Protocol Data Unit (PDU) to a SMSC (Short Message Service Center) and storing a copy of the PDU until either a report arrives from the network or a timer expires
- Receiving a SMS PDU from a SMSC
- Returning a delivery report to the network for a previously received message
- Receiving a report from the network
- Notifying the network when the module has sufficient memory capacity available to receive one or more SMS messages (after the module had previously rejected a message because its memory capacity was exceeded)

5. SIM Operation

5.1 Provisioning the SIM

The SIM card is configurable. To most users, the basic requirement on the SIM card is the ability to configure and use voice call and SMS Receive services, while some users may further need SMS Send and GPRS data services. The 80350 module can meet the MO (Mobile-Originated) and MT (Mobile-Terminated) usage requirements, and can configure the relevant services of the SIM card through AT commands (this will need support from the application layer software).

5.2 GSM Supported Services

The 80350 module supports the following services:

- Voice calls (MO and MT): requires a telephone number
- SMS (MO and MT): requires a telephone number
- Circuit-switched data calls (MO and MT): requires a telephone number
- The GSM SIM can have multiple telephone numbers.

Note: The services depend on the actual network; please contact the network operator in order make sure that the services are enabled.

5.3 GPRS Supported Services

The 80350 module supports the following GPRS (modes of operation) that must be enabled by the operator:

- GPRS Packet Connectivity (MO and MT) with Both Dynamic and Static IP option
- GPRS SMS (MO and MT): uses the IP (Dynamic or Static) set by the operator
- Multiple APN Setting
- Quality of Service Options
- Multi-slot 10 Class of Service

5.4 GSM Modes of Operation

When provisioning the SIM for the 80350 module, enable the following modes of operation:

- Voice calls: configure the SIM for both MO and MT service (to send and receive)
- SMS: configure the SIM either for MT alone (to receive) or for both MO and MT (to send and receive)
- Circuit Switched Data: configure the SIM either for MO alone (to send) or for both MO and MT (to send and receive)

Voice	SMS	CS Data	GPRS	Function
MO/MT	MT	MO		Voice calls, receive SMS, make data calls
MO/MT	MO/MT	MO		Voice calls, receive / send SMS, make data calls
MO/MT	MO/MT	MO/MT		Voice calls, receive / send SMS, make / receive data calls (requires an additional data telephone number)

6. Software Interface

6.1 API Interface

The 80350 module's default startup mode is the AT command mode. In this mode, PC Super Terminal or other serial port communication tools may be used to issue AT commands to the module.

The 80350 module's default serial communication is set at 115200 baud, no parity, 8 data bits, 1 stop bit, and no flow control. A user can send/receive AT commands, data, or response to/from the module via one of the two methods:

- Straight serial communication via HyperTerminal or similar application

Straight serial communication provides the user with the following capabilities:

- Send AT commands and receive response
- Receive SMS notification
- Make a voice, data or fax call
- Receive any unsolicited message

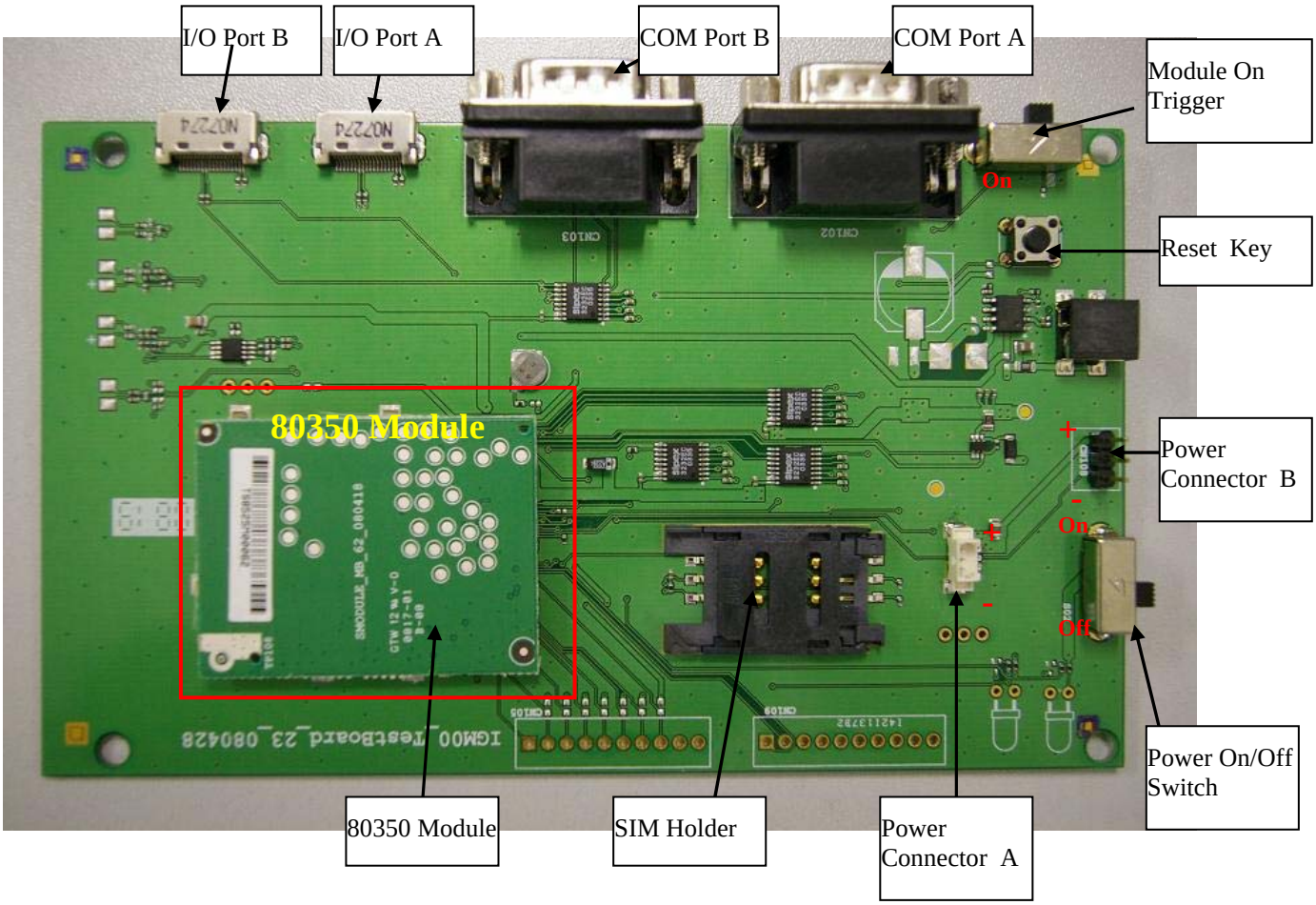
6.2 AT Command Set

This is addressed separately in the document "80350 GSM/GPRS Modem Module AT Command Specification".

7. Setup and Initialization

The 80350 module can be controlled by AT command through the COM Port A on the 80350 motherboard.

80350 Motherboard Outline:



80350 Motherboard

Parts:

Item	Function	Comments
I/O Port A	Reserved	
I/O Port B	Reserved	
COM Port A	COM port to communicate with PC	DB9 Connector
COM Port B	Reserved	
Power Connector A	Connect with power supply	DC 3.55 to 4.2 V
Power Connector B	Connect with power supply	DC 3.55 to 4.2 V
Power On/Off Switch	On/Off the power	
Module On Trigger	Power On the module	
Reset Key	Reset the module	
80350 Module	The 80350 Module	
SIM Holder	Using for SIM card	

Steps for setting up the testing hardware environment:

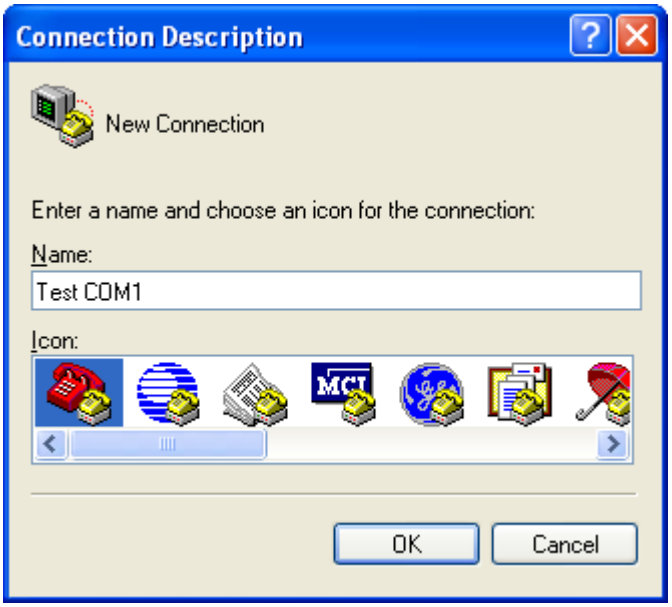
1. Install the 80350 module to the 80350 motherboard
2. Put the SIM card into the SIM Holder
3. Plug the power supply to any one of the Power Connector.
4. Power on the 80350 module by switch the GSM On Trigger to “On”.

7.1 Initialization

7.1.1 Start HyperTerminal

On Windows XP, click on:
Start>Programs>Accessories>Communications>HyperTerminal

1. You should see the following screen.



2. Enter a name for the **Connection**. In this example, the **Name** is **Test COM1**.

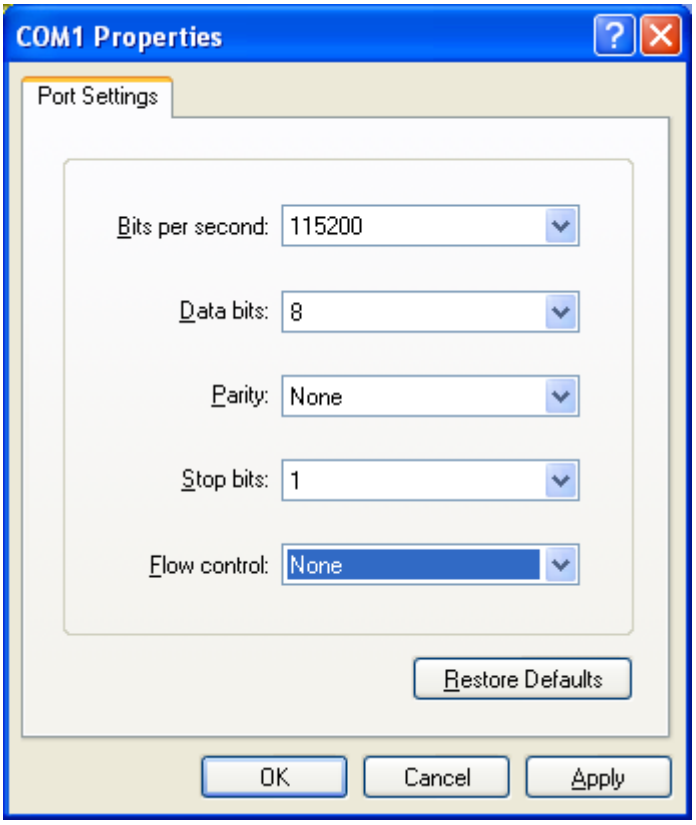
3. Click **OK**.

4. The next window that will appear is the **Connect To** window.

5. Change the **Connect Using** setting to the Com port that was determined in **Step 2**.

6. Click **OK**.

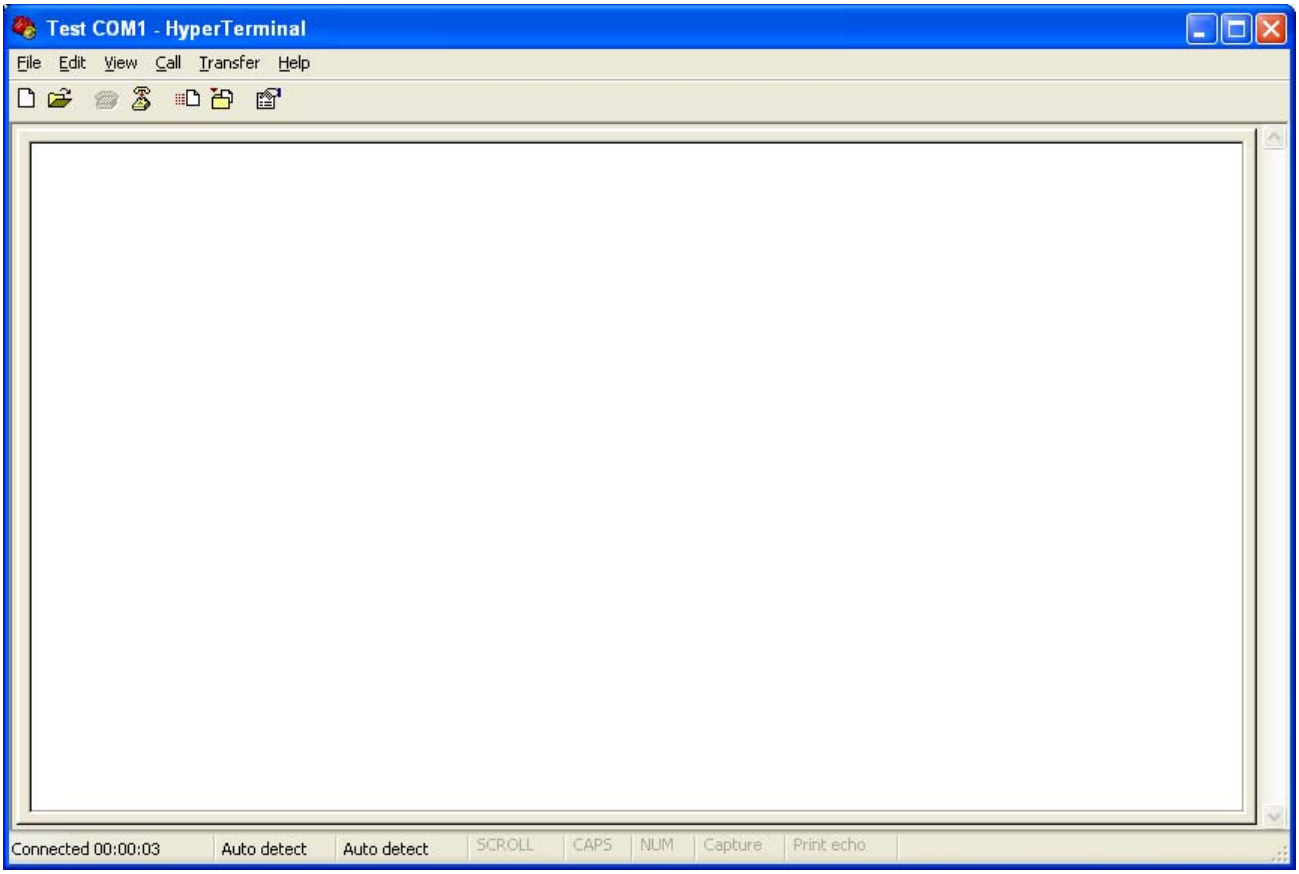
7. The next window is the **Port Settings** window.



8. Make sure the settings match the example.

9. Click **OK**.

10. Now the **Main Program Window** should appear.



11. Terminal Setup Testing.
    a. Make sure the cursor is in the main window.
    b. Type "**AT**" and press "Enter"
    c. You should see the module responds back with "**OK**" in the Main Window
    d. If this happens, the COM port is configured correctly.
    e. At this point you are ready to configure and test the 80350 with AT commands.

7.1.2 Initialization Command

After the module power on, user can initialize the module by following AT commands

Unsolicited	*TSYSSTART	System start
Unsolicited	+CFUN: 1	Full functionality (Default)
Entry	ATE1	Echo mode on
Response	OK	Command is valid
Entry	AT&D1	ON->OFF on DTR: Change to command mode with call remaining connected
Response	OK	Command is valid
Entry	ATS0=0	automatic answering is disabled
Response	OK	Command is valid
Entry	AT+CMEE=1	enable result code and use numeric values
Response	OK	Command is valid
Entry	AT+CRC=1	the extended format of incoming call indication is used
Response	OK	Command is valid
Entry	AT+CREG=1	enable network registration unsolicited result code +CREG: <stat>
Response	OK	Command is valid
Entry	AT+COPS=3,2	set only <format> (for read command +COPS?) – not shown in Read command response and short format alphanumeric <oper>
Response	OK	Command is valid
Entry	AT+VTD=3	duration of the tone in 1/10 seconds
Response	OK	Command is valid
Entry	AT+CCWA=1	enable presentation of an unsolicited result code
Response	OK	Command is valid
Entry	AT+CLIP=1	display unsolicited result codes
Response	OK	Command is valid
Entry	AT+CMUT=0	mute off
Response	OK	Command is valid

7.2 Send SMS Example

Entry	AT+CMGF=1	Select SMS format is text
Response	OK	Command is valid
Entry	AT+CNMI=2,2,2,0,0	New SMS unsolicited result code: +CMT:
Response	OK	Command is valid
Entry	AT+CSCS="IRA"	Select international reference alphabet
Response	OK	Command is valid
Entry	AT+CSCA="987654321"	Select SMS Service Centre Address
Response	OK	Command is valid
Entry	AT+CMGS="123456789"	Send a message to 123456789
Response	>	Ready to enter a message.
Entry	This is a test message^Z	Enter the text message “This is a test message”. End the message with Control Z.
Response	+CMGS: 1 OK	Successful transmission. The number will increment with each SMS sent.
Entry	AT+CMGL= "ALL"	List All messages from preferred store
Response	+CMGL:1,"REC READ","+123456789",,"08/08/08,18:02:15+32" M OK	List all message
Entry	AT+CMGR=1	Read SMS message in preferred store 1
Response	+CMGR: "REC READ","+987654321",,"08/08/08,18:02:15+32" M OK	Read 1 message
Entry	AT+CMGD= 1	Delete SMS message in preferred store 1.
Response	OK	Successful delete

7.3 Voice Call Example

7.3.1 MO

The call is OK:

Entry	ATD10086;	Make a call
Unsolicited	+WIND: 5,1	The call (id =1) has been established
Response	OK	Command is valid
Unsolicited	+WIND: 2	The MT is ringing
Unsolicited	+WIND: 9,1	The call is connected
Entry	ATH	End the call
Unsolicited	+WIND: 6,1	The call is disconnected
Response	OK	Command is valid

MT is busy:

Entry	ATD10086;	Make a call
Unsolicited	+WIND: 5,1	The call (id =1) has been established
Response	OK	Command is valid
Unsolicited	+WIND: 6,1	The call is disconnected
Unsolicited	BUSY	MT is busy

MT can't be connected:

Entry	ATD10086;	Make a call
Unsolicited	+WIND: 5,1	The call (id =1) has been established
Response	OK	Command is valid
Unsolicited	+WIND: 6,1	The call is disconnected
Unsolicited	NO CARRIER	MT cannot be connected

7.3.2 MT

Unsolicited	+WIND: 5,1	The call (id =1) has been established
Unsolicited	RING	The MT is ringing
Entry	ATA	Accept the call
Response	OK	Command is valid
Unsolicited	+WIND: 9,1	The call is connected

7.4 GPRS Packet Examples

After the module register on a GSM network:

Entry	AT+CGATT=1	AT command to start the ATTACH sequence
Response	OK	Successfully Attached

If the network is a transparent network, then you can activate using HyperTerminal. If it is non transparent, you have to use a PPP link to activate:

Entry	AT+CGDCONT=1,"IP","CMWAP","",0,0	CMWAP value will be provided by carrier
Response	OK	Command is valid
Entry	AT+CGACT=1,1	Request context activation.
Response	OK	Successful context activation.

GPRS detach and deactivate:

Entry	AT+CGACT=0,1	AT command to deactivate.
Response	OK	Successful deactivation.
Entry	AT+CGATT=0	AT command to detach.
Response	OK	Successful detach.

References

1. AT Command Set Reference [80350 GSM/GPRS Modem Module AT Command Specification]

2. GSM 07.05: “Digital cellular telecommunications systems (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)”.

3. GSM 07.07: “Digital cellular telecommunications systems (Phase 2+); AT command set for GSM Mobile Equipment (ME)”.

4. ITU-T Draft new Recommendation V.25ter: “Serial asynchronous automatic dialing and control”.

5. AD6720 Technical Data (REV. OCTOBER 18,2005)

6. NARROW-PITCH CONNECTORS Specifications (Jul.13, 2006)

7. U.FL-R-SMT (10) Specifications (Apr.17, 1997)

8. AK2301-MS0416-1-00 Specifications (Aug 31, 2005)

Abbreviation

Abbreviation	Description
ADC	Analog-to-Digital Converter
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ANSI	American National Standards Institute
ARFCN	Absolute Radio Frequency Channel Number
ARP	Antenna Reference Point
ASC0 / ASC1	Asynchronous Serial Controller. Abbreviations used for first and second serial interface of MC55i
ASIC	Application Specific Integrated Circuit
B	Thermistor Constant
B2B	Board-to-board connector
BER	Bit Error Rate
BTS	Base Transceiver Station
CB or CBM	Cell Broadcast Message
CE	Conformité Européene (European Conformity)
CHAP	Challenge Handshake Authentication Protocol
CPU	Central Processing Unit
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DAI	Digital Audio Interface
dBm0	Digital level, 3.14dBm0 corresponds to full scale, see ITU G.711, A-law
DCE	Data Communication Equipment (typically modems, e.g. Siemens GSM engine)
DCS 1800	Digital Cellular System, also referred to as PCN
DRX	Discontinuous Reception
DSB	Development Support Box
DSP	Digital Signal Processor
DSR	Data Set Ready
DTE	Data Terminal Equipment (typically computer, terminal, printer or, for example, GSM application)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
DUN	Dial-Up Networking

EFR	Enhanced Full Rate
EGSM	Enhanced GSM

Abbreviation	Description
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HiZ	High Impedance
HR	Half Rate
I/O	Input/Output
IC	Integrated Circuit
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LED	Light Emitting Diode
Li-Ion	Lithium-Ion
Mbps	Mbits per second
MMI	Man Machine Interface
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MSISDN	Mobile Station International ISDN number
MT	Mobile Terminated
NTC	Negative Temperature Coefficient
OEM	Original Equipment Manufacturer
PA	Power Amplifier
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCM	Pulse Code Modulation

PCN	Personal Communications Network, also referred to as DCS 1800
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit

Abbreviation	Description
PLL	Phase Locked Loop
PPP	Point-to-point protocol
PSU	Power Supply Unit
R&TTE	Radio and Telecommunication Terminal Equipment
RAM	Random Access Memory
RF	Radio Frequency
RMS	Root Mean Square (value)
ROM	Read-only Memory
RTC	Real Time Clock
Rx	Receive Direction
SAR	Specific Absorption Rate
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SMS	Short Message Service
SRAM	Static Random Access Memory
TA	Terminal adapter (e.g. GSM engine)
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
Tx	Transmit Direction
UART	Universal asynchronous receiver-transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio