PIML-900/1800 HW Specification
Revision: V6.01.01
Date: February 7,2004

Document Information

Revision	Date	History of the evolution
Draft vision	Dec 2003	Creation as “Draft”
P4_01.01	February 7, 2004	Update as “Preliminary”
V6.01.01	June 8, 2004	Add hardware reset pin and update illustration

Overview

This document defines and specifies the CENTEL PIML-900/1800 module with 32 Mb of Flash memory and 4 Mb of SRAM (32/4), which support GSM/GPRS function.

Contents

Caution

Information furnished herein by CENTEL are accurate and reliable. However no responsibility is assumed for its use. Please read carefully the safety precautions for a terminal based on CENTEL PIML-900/1800 module.

Trademarks

Some mentioned products are registered trademarks of their respective companies.

1 General description

1.1 General information

PIML-900/1800 module is a self-contained GSM 900/1800 GPRS dual band module including the following features:

- **58 x 32 x 3.9 mm**
- **2 Watts EGSM 900 radio section running under 3.8 Volts**
- **1 Watt GSM1800 radio section running under 3.8 Volts**
- **3V SIM interface**
- **Real Time Clock with calendar**
- **Battery charger**
- **Echo Cancellation + noise reduction**
- **Full GSM or GSM/GPRS software stack**
- **Hardware GPRS class 10 capable**
- **Complete shielding**
- **Complete interfacing:**
  - **o Power supply**
  - **o Serial link**
  - **o Audio**
  - **o SIM card**
  - **o Keyboard**
  - **o LCD (not available with AT commands)**

PIML-900/1800 module has two external connections:

- **RF interface**
- **General Purpose Connector (GPC) to Digital, Keyboard, Audio and Supply**

CENTEL PIML-900/1800 module is designed to fit in very small terminals and only some custom functions have to be added to make a complete bi-band solution:

- **Keypad and LCD module**
- **Earpiece and Microphone**
- **Base connector**
- **Battery**
- **Antenna**
- **SIM connector**

1.2 Functional description

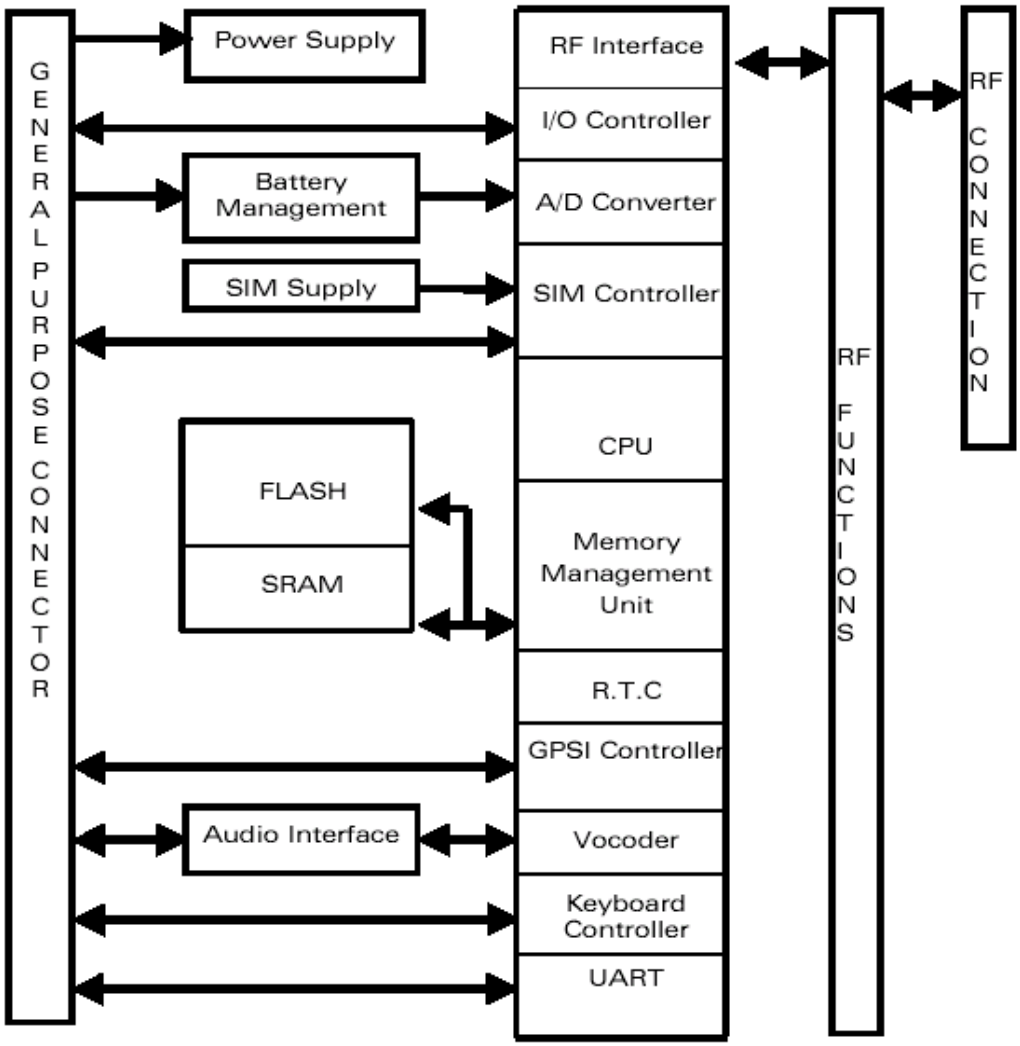


Figure 1 : Functional architecture

1.2.1 RF functionalities

The RF functionalities comply with the Phase II recommendation. The frequencies are :

- **Rx (EGSM 900): 925 to 960 MHz Rx (GSM 1800): 1805 to 1880 MH**
- **Tx (EGSM 900): 880 to 915 MHz Tx (GSM 1800): 1710 to 1785 MHz**

The RF part is based on a specific dual band chip including:

- **Low-IF Receiver**
- **Dual RF synthesizer**
- **Digital IF to Baseband Converter**
- **Offset PLL transmitter**
- **Dual band PA module**

1.2.2 Baseband functionalities

The digital part of the CENTEL PIML-900/1800 module is composed of a PHILIPS-VLSI chip (ONE C GSM/GPRS Kernel). This chipset is using a 0,25 µm mixed technology CMOS, which allows massive integration as well as low current consumption.

1.3 Firmware

CENTEL PIML-900/1800 module is designed to be integrated into various types of applications such as handsets or vertical applications (telemetry, multimedia, …).

For vertical applications, the firmware offers a set of AT commands to control the module. With this standard software, some interfaces of the module are not available since they are dependent on the peripheral devices connected to the module. They are the LCD interface and the I^2C bus.

2 Interfaces

2.1 General Purpose Connector (GPC)

A 60 pins connector[1] is provided to interface the PIML-900/1800 module with a board containing either a LCD module, or a keyboard, or a SIM connector, or a battery connection... The interfaces available on the GPC are described in the next paragraphs.

· Please be aware that some of these interfaces can not be handled when using the PIML-900/1800 module driven by AT commands : LCD interface.

This symbol is used to indicate the interfaces not available with AT commands.

These functions have then to be managed externally i.e using the main processor of the application.

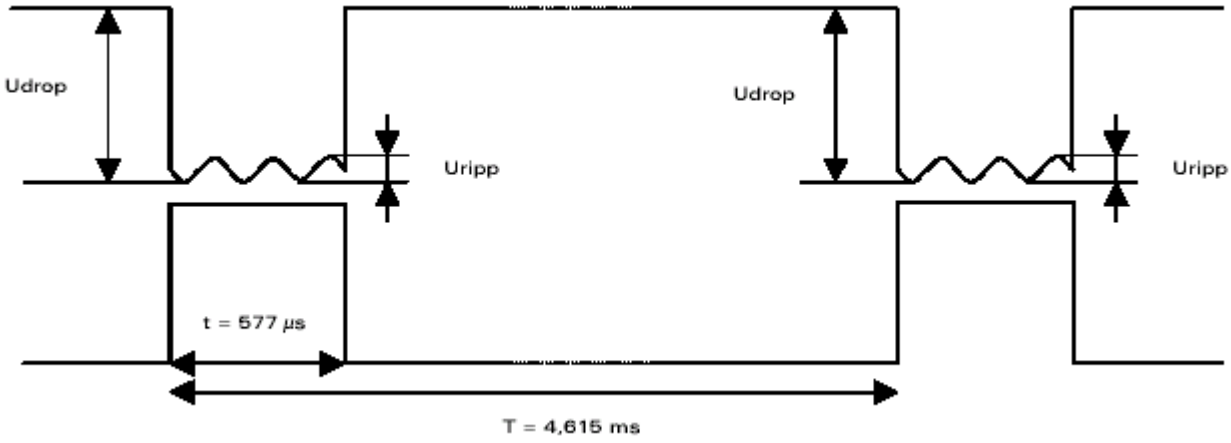
[1] The communication interface connector is a 60 pins connector with 0.5mm pitch from KYOCERA / AVX group with the following reference (see chapter connectors reference for further details):
14 5087 060 930 861.
The matting connector has the following reference :
24 5087 060 X00 861.
X = 2 or 9

2.2 Power supply

2.2.1 Power supply description

The power supply is one of the key issues in the design of a GSM terminal. Due to the bursted emission in GSM / GPRS, the power supply must be able to deliver high current peaks in a short time. During these peaks the ripple (U_{ripp}) and the drop (U_{drop}) on the supply voltage must not exceed a certain limit.

· In transmission mode, a GSM/GPRS class 2 terminal emits (1Tx) 577µs radio bursts every 4.615ms.



In communication mode, a GPRS class 10 terminal emits 1154µs radio bursts every 4.615ms.

VBATT is used to supply the RF part and the base band part.

Notes :
VBATT : supplies directly the RF components with 3,6 V. It is essential to minimize the voltage ripple at this connection in order to avoid any phase error.
The RF Power Amplifier current (2.0A peak in GSM /GPRS mode) flows with a ratio of 1/8 of the time, around 577µs every 4.615ms for GSM /GPRS cl 2. The rising time is around 10µs.

The CENTEL PIML-900/1800 module shielding case is the grounding. The ground has to be connected on the motherboard through a complete layer on the PCB.

Power Supply Voltage

	V_{MIN}	V_{NOM}	V_{MAX}	Ripple max (U_{ripp})
VBAT	3.4V(*)	3.6V	4.2V(**)	50mVpp for freq<200kHZ

(*) : This value has to be guarantied during the burst (with 2.0A Peak in GSM or GPRS mode)

(**): max operating Voltage Stationary Wave Ratio (VSWR) 2:1

When supplying the module with a battery, the total impedance (battery + protections + PCB) should be <150 mOhms

2.2.2 Power consumption

Following information are given assuming a 50Ω RF output.

Power consumption in OFF mode
(module supplied, OFF state, no software running)

	Conditions	I_{NOM}	I_{MAX}
Overall consumption	OFF	5uA	10uA

Power consumption in EGSM/GPRS 900 MHz mode classe 10

	Conditions	I_{NOM}	I_{MAX}
VBATT+	During TX bursts @ PCL5*	1.7A peak	2.0A peak
VBATT+	During RX bursts	75mA peak	80mA peak
VBATT+	Average 1RX/1TX@PCL5*	270mA	320mA
VBATT+	Average 1RX/1TX@PCL8*	180mA	200mA
VBATT+	Average idle mode	100uA	300uA
VBATT+	Average GPRS Cl 10 (3Rx/2Tx) @Pcl5	540mA	640mA
VBATT+	Average GPRS Cl 10(3Rx/2Tx) @Pcl8	360mA	400A
VBATT+	Average Idle mode	2.2mA	3mA

(*) : PCL : Power Control Level. PCL5 : 2W emission requested (max.power)
PCL8 : 0.5W emission requested

Power consumption in GSM/GPRS 1800 MHz mode classe 10

	Conditions	I_{NOM}	I_{MAX}
VBATT+	During TX bursts @ PCL0*	1.3A peak	1.7A peak
VBATT+	During RX bursts	75mA peak	80mA peak
VBATT+	Average 1RX/1TX@PCL0*	240mA	270mA
VBATT+	Average 1RX/1TX@PCL3*	150mA	180mA
VBATT+	Average idle mode	100uA	300uA
VBATT+	Average GPRS Cl 10 (3Rx/2Tx) @PCL0	480mA	540mA
VBATT+	Average GPRS Cl 10 (3Rx/2Tx) @Pcl3	300mA	360mA
VBATT+	Average Idle mode	2mA	3mA

(*) : PCL : Power Control Level. PCL0 = 1W typ. PCL3 = 0.25W typ.

Power Supply Pinout

Signal	Pin number
VBATT+	55,57,58,59,60
GND	Shielding

The grounding connection is done through the shielding → the four legs have to be soldered to the ground plane.

2.3 Electrical information for digital I/O

All digital I/O comply with 3Volts CMOS.

Operating conditions

Parameter	I/O type	Min	Max	Condition
V_{IL}	CMOS	-0.5 V	0.8 V	
V_{IH}	CMOS	2.1V	3.0 V	
V_{OL}	1X		0.2 V	I_{OL} = -1 mA
	2X		0.2 V	I_{OL} = - 2 mA
	3X		0.2 V	I_{OL}= - 3mA
V_{OH}	1X	2.6 V		I_{OH}= 1mA
	2X	2.6 V		I_{OH}= 2mA
	3X	2.6 V		I_{OH}= 3mA

To interface the PIML-900/1800 module digital signals with other logics:

- 3V logic: some serial resistors (between 2.2K and 4.7Kohms) can be added on the lines
- For higher voltage logics, a resistor bridge or a level shifter IC can be added.

2.4 LCD interface

The PIML-900/1800 module can be connected to a LCD module driver through I^2C bus interface.

The PIML-900/1800 Series can be connected to a LCD module driver through the IIC interface.

2.4.1 I^2C interface

The I^2C BUS consists of a data line SDA and a clock line SCL. The data transport,clock generation,address recognition and bus arbitration of this interface are all controlled directly by hardware. The IIC-interface can operate according to two baud rate modes:

- **Standard mode: The maximum baud rate is 100kbit/s. (standard IIC)**
- **Fast mode: The maximum baud rate is 400kbit/s. (Fast IIC)**

Note: Devices with a 0 to 100kbit/s IIC-interface cannot be incorporated in the IIC-bus system, if the 400kbit/s fast mode is chosen. Unpredictable states of these devices would occur, since they cannot follow the higher transfer rate.

Pin description

Signal	Pin number	I/O	I/O TYPE	Description
SCL	10	O	1X	Serial clock
SDA	8	I/O	CMOS /1X	Data

2.5 Keyboard interface

Warning:
This interface is not FULLY available with AT commands:
An AT commands allows getting the input key code (see +CMER command description).
This code has then to be processed by the application.

This interface provides 8 connections: 4 rows (ROW0 to ROW3) and 4 columns (COL0 to COL3).
The scanning is a digital one , and the debouching is done in the CENTEL PIML-900/1800 Series. No discrete components like R, C (Resistor, Capacitor) are needed.

Pin description

Signal	Pin number	I/O	I/O type	Description
ROW0	13	I/O	COMS/1X	Row scan
ROW1	15	I/O	COMS/1X	Row scan
ROW2	17	I/O	COMS/1X	Row scan
ROW3	19	I/O	COMS/1X	Row scan
COL0	23	I/O	COMS/1X	Column scan
COL1	25	I/O	COMS/1X	Column scan
COL2	27	I/O	COMS/1X	Column scan
COL3	29	I/O	COMS/1X	Column scan

The Keyboard Scanner(KBS) implements all the logic necessary to interface matrix keyboard with up to 28 keys(see figure 3 of below) to the System Controller.

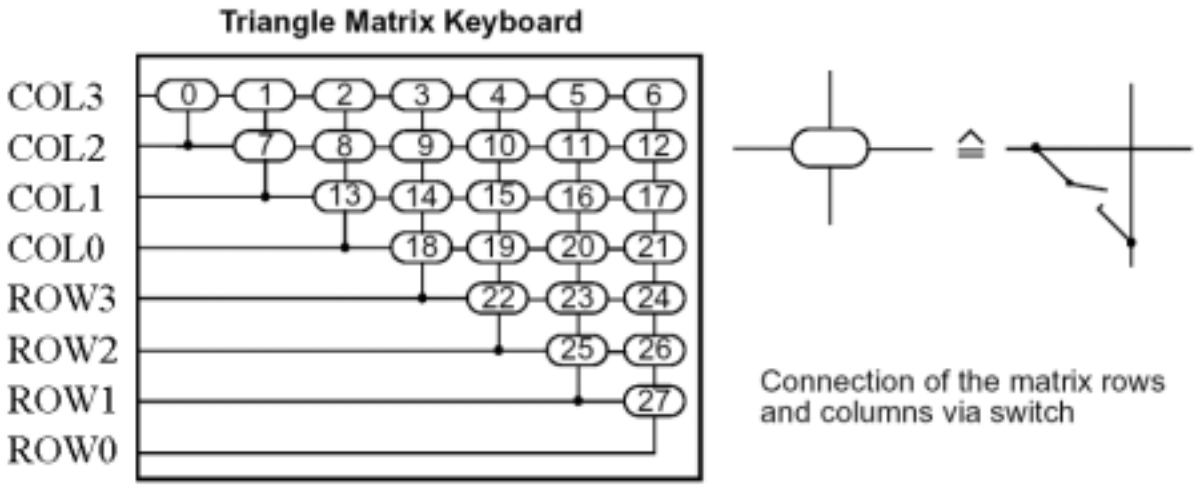


Figure 3 Connecting a Triangle Matrix Keyboard with 28 keys

Keyboard define:

Key number	define	Key number	define
5	Digital key “1”	11	Digital key “2”
16	Digital key “3”	4	Digital key “4”
10	Digital key “5”	15	Digital key “6”
3	Digital key “7”	9	Digital key “8”
14	Digital key “9”	8	Digital key “0”
2	“*”	13	“#”
0	“SEND”	6	“CLEAR”
12	“MENULEFT”	17	“MENURIGHT”
21	“RIGHT”	24	“OK”
22	“UP”	23	“DOWN”
25	“LEFT”	19	“SIDEDOWN”
18	“SIDEUP”		

Additional comments on Keyboard:

The exemplify keys are defined, that keys that unmentioned in table, can be defined anon.

2.6 Main Serial link (UART1)

A flexible 6 wires serial interface is available complying with V24 protocol signaling but not with V28 (electrical interface) due to a 2.8 Volts interface.

The signals are TX data (CT103/TX), RX data (CT104/RX), Request To Send (CT105/RTS), Clear To Send (CT106/CTS), Data Terminal Ready (CT108-2/DTR) and Data Set Ready (CT107/DSR).

The set of RS232 signals can be required for GSM DATA services application and is generated by the general purpose I/O provided by the Q24x6 series. The 2 additional signals are Data Carrier Detect (CT109/DCD) and Ring Indicator (CT125/RI).

The signals are TX data (TXD0), Rx data (RXD0), Request To Send (RTS0), Clear To Send (CTS0), Data Terminal Ready (DTR0) and Data Set Ready (DSR0).

Pin description

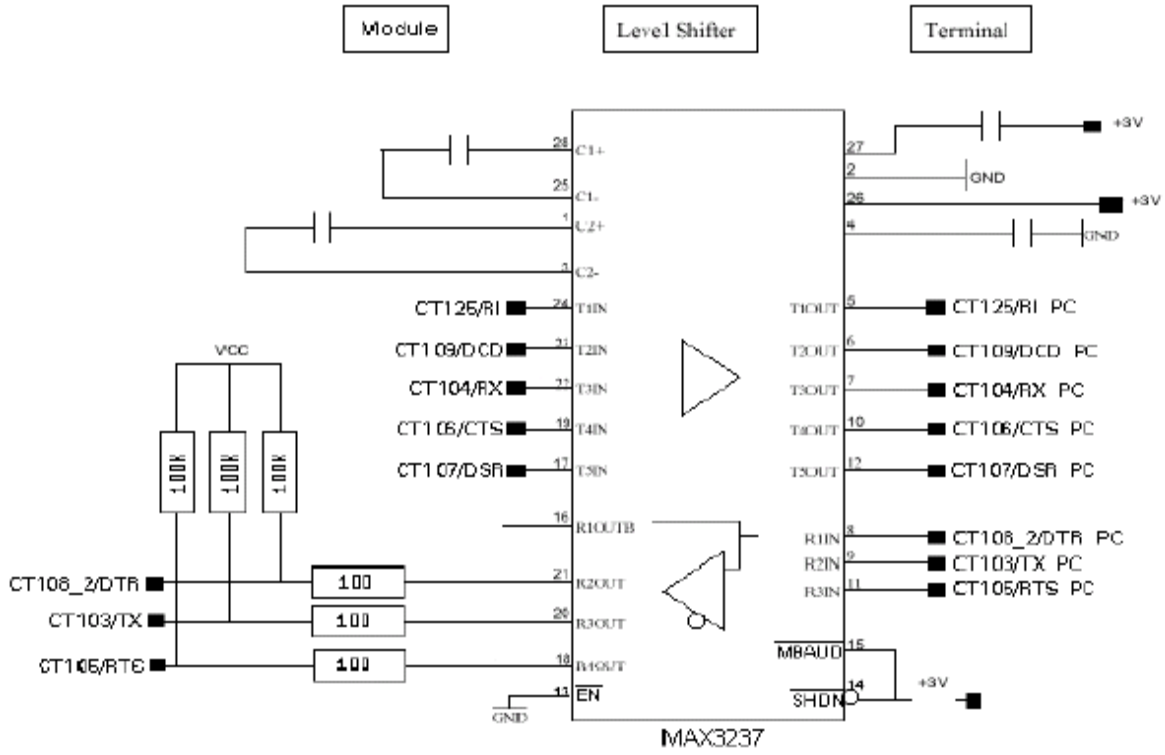
Signal	Pin number	I/O	I/O TYPE	Description
CT103/TXD1	39	I	CMOS	Transmit serial data
CT104/RXD1	32	O	1X	Receive serial data
CT105/RTS1	30	I	CMOS	Ready to Send
CT106/CTS1	37	O	1X	Clear to send
CT107/DSR1	36	O	1X	Data set ready
CT108/DTR1	34	I	CMOS	Data terminal ready
CT109/DCD1	51	O	CMOS/2x	Data carrier detect
CT125/RI1	54	O	CMOS/2x	Ring indicator
GND	Shielding legs			Ground

The rising time and falling time of the reception signals (mainly CT103) have to be less than 200 ns.

The PIML-900/1800 module have been designed to be operated using all the serial interface signals. In particular, it is necessary to use RTS1 and CTS1 for hardware flow control in order to avoid data corruption during transmission.

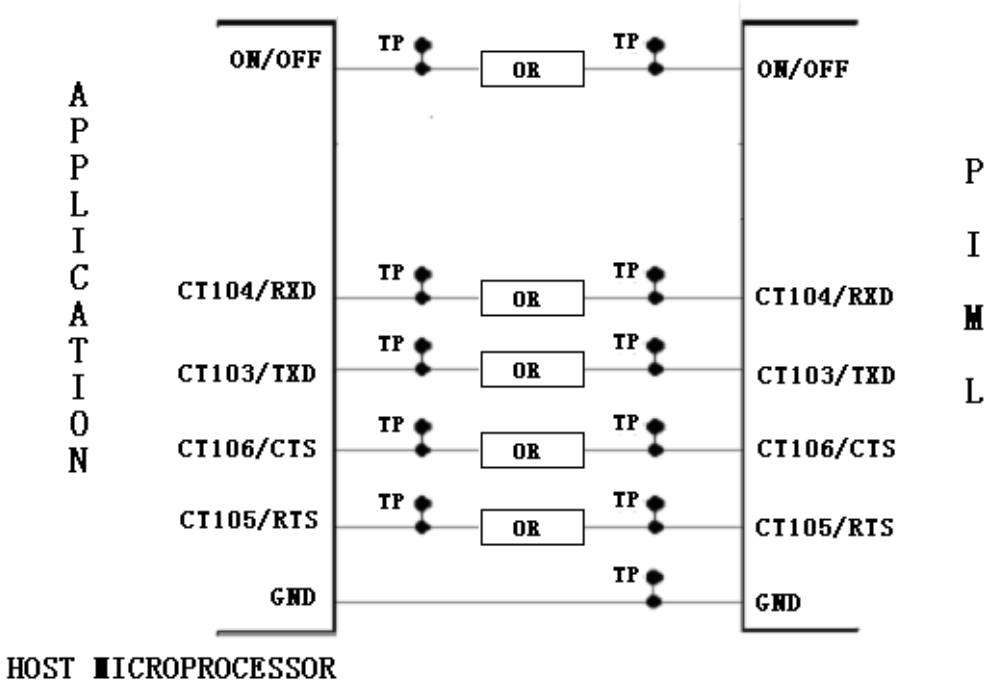
2.6.1 Typical implementation with a RS232 Terminal

The figure above shows a typical implementation when the PIML-900/1800 Module is connected to a RS232 Terminal.



2.6.2 Typical implementation with a microprocessor

The figure above shows a typical implementation when the PIML-900/1800 Module is connected to a host microprocessor which is 2,8 V tolerant on the serial port signals.



2.7 SIM interface

2.7.1 General Description

5 signals exist:

- **SIMVCC: SIM power supply.**
- **SIMRST: reset.**
- **SIMCLK: clock.**
- **SIMDATA: I/O port.**
- **SIMPRES: SIM Card detect.**

The SIM Interface (SIMI) controls the activation- and deactivation sequences of the SIM card and provides the driver circuits for the SIM card. The protocol handling is not part of this module.

The SIM Interface controls a 3V SIM. This interface complies with the ETSI GSM 11.11,GSM 11.12 and GSM 11.18 requirements. Note that these specifications refer to ISO7813-3 for the "Operation Procedures" That define the activation and deactivion sequences.

It is recommendations concerning SIM functions. It is recommended to add Transient Voltage Suppressor diodes on the signal connected to the SIM socket in order to prevent any Electrostatic Discharge. TVS diodes with low capacitance (less than 10pF) have to be connected on SIMCLK and SIMDATA to avoid any disturbance of the rising and falling edge. These types of diodes are mandatory for the Full Type Approval. They shall be Placed as close as possible to the SIM socket.

The following references can be used:

Pin description

Signal	Pin number	I/O	I/O type	Description
SIMCLK	3	O	2X	SIM Clock
SIMRST	5	O	2X	SIM reset
SIMDATA	7	I/O	CMOS/3X	SIM DATA
SIMVCC	9	O	Supply	SIM Power supply
SIMPRES		O	1X	SIM card detect

Electrical Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
SIMDATA V_{IH}	I_{IH} = ±20uA	0.7 x SIM_VCC			V
SIMDATA V_{IL}	I_{IL} = 1mA			0.3xSIM_VCC	V
SIMRST SIMDATA SIMCLK V_{OH}	Source current =20uA	SIM_VCC-0.1V			V
SIMRST SIMDATA SIMCLK V_{OL}	Sink current = 200uA			0.1	V
SIMVCC Output Voltage	ISIM_VCC<=6mA	2.70	2.80	2.85	V
SIMCLK Rise/Fall Time	Loaded with 30pF			50	nS
SIMRST, SIMDATA Rise/Fall Time	Loaded with 30pF			1	uS
SIMCLK Frequency	Loaded with 30pF			3.25	MHz

(*) : given for the 3V interface.

Notes:

When not used SIMPRES cannot be connected.

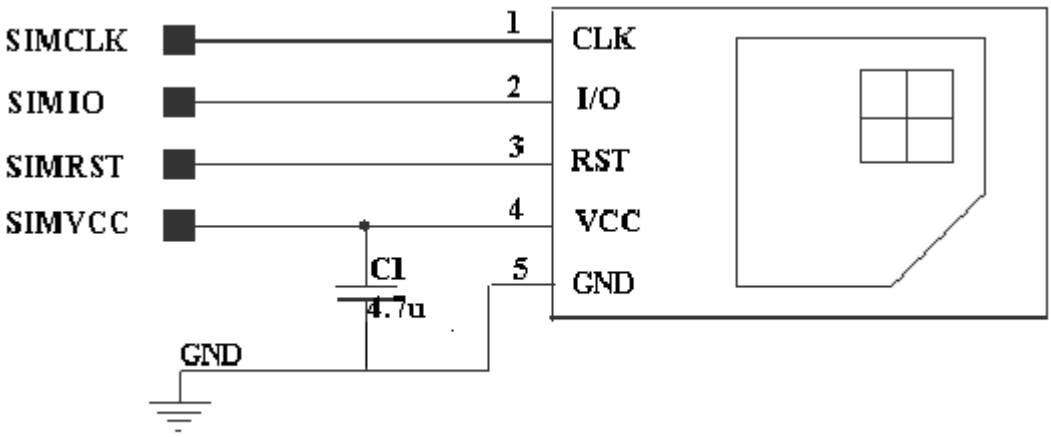
When used, a low to high transition means that the SIM card is inserted and a high to low transition means that the SIM card is removed.

2.7.2 SIM socket connection

SIM socket pin description

Signal	Pin number	Description
CLK	1	SIMCLK
I/O	2	SIMDATA
REST	3	SIMRST
VCC	4	SIMVCC
GND	5	GND

Typical implementation:



SIM socket

2.8 General Purpose Input/Output

The CENTEL PIML-900/1800 module provides 7 General Purpose I/O, 1 General Purpose Output. They are used to control any external device such as a LCD or a Keyboard backlight.

Pin description

Signal	Pin number	I/O	Description	Multiplexed with
GPIO0	24	I/O	General Purpose I/O	
GPIO2	53	I/O	General Purpose I/O	
GPO0	26	O	General Purpose output	
GPO1	22	O	General Purpose output	
GPO2	20	O	General Purpose output	
GPO3	28	O	General Purpose output	
GPO4	52	O	General Purpose output	
GPI0	18	I	General Purpose input	
GPI1	35	I	General Purpose input	

The following GPIOs are not available (reserved) in case of module running with the AT commands firmware :

Signal	Pin number	I/O	Description	Multiplexed with
GPO4	52	O	General Purpose output	FLASH LED (*)
GPO3	28	O	General Purpose output	
GPI0	18	I	General Purpose input	
GPI1	35	I	General Purpose output	
GPO0	26	O	General Purpose output	
GPO1	22	O	General Purpose output	
GPO2	20	O	General Purpose output	
GPO3	28	O	General Purpose output	

(*)The FLASH LED signal can be used to drive a LED through an open-collector transistor according to the module activity status.

LED status	PIML-900/1800 module status	
OFF	Module OFF	
ON	Permanent	Module switch ON, not registered on the network

	Flash LED on for 1s, off for 1s	Module switch on, registered on the network, communication in progress

2.9 Analog to Digital Converter

An Analog to Digital Converter (ADC) input is provided by the CENTEL PIML-900/1800 module. This ADC section is specified for voltage and temperature measurements. Its input channel required for △T and △V measurement, as well as battery type recognition. This converter is a 12 bits one, ranging from 0 to 2.8V.

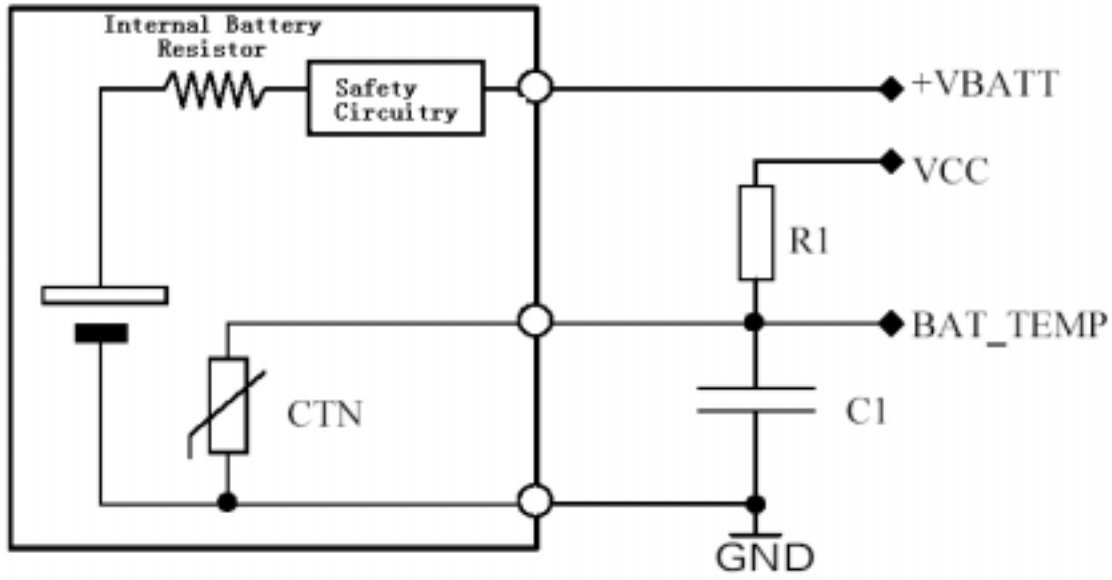
Pin description

Signal	Pin number	I/O	I/O type	Description
AUXV0	33	I	Analog	A/D converter

Electrical characteristics

Parameter	Min	Max	Unit
Resolution	12		bits
Input signal range	0	2.8	V
ADC Reference Accuracy	0.22	0.25	%

PIML900-1800 module also monitors the temperature of the battery through the AUXV0 pin that has to be connected to a temperature sensor inside the battery (a NTC resistor for instance).



2.9.1 How to define R1 and C1

How to choose R1

R1 has to be chosen to have a full range of BAT-TEMP (from 0V to 2.8V) when the CTN value changes from the minimum to the maximum temperature

How to choose C1

C1 has to be chosen to have a RC filter with a time constant lower than 2ms.

Calculation examples

CTN(25℃) = 47K

CTN(55℃) = 10K

CTN(-10℃) = 300K

CTN(-10℃) x VCC = (CTN(-10℃) + R1) x BAT-TEMP (full range)

R1= 47K ⇨ BAT-TEMP(-20℃) = 2.42V

BAT-TEMP(55℃) = 0.49V

R(-20℃) = R1//CTN(-10℃) = 40K

R(+55℃) = 8K

With C= 10nF ::

RC(-20℃) = 400us

RC(+55℃) = 80us

2.10 Audio interface

The CENTEL PIML-900/1800 module's audio interface supports two different microphone inputs （MIC1、MIC2）and two different speaker outputs (SPK1、SPK2). The MIC2 inputs already include the biasing for an electret microphone allowing an easy connection to a handset.
The interface also includes an echo cancellation feature, which allows handsfree function.

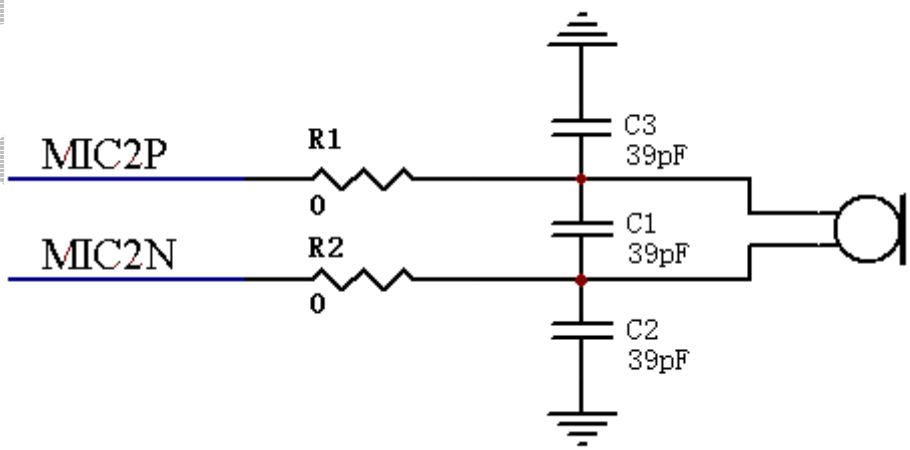
2.10.1 Main audio interface

Main audio interface consists of MIC2 (MIC2P, MIC2N) and SPK2 (SPK2P, SPK2N). The connection can be either differential or single-ended but using a differential connection in order to reject common mode noise and TDMA noise is strongly recommended. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.

2.10.1.1 Main Microphone Inputs (MIC2)

The MIC2 already include the convenient biasing for an electret microphone . This electret microphone can be directly connected on these inputs. These inputs are the standard ones used for an external headset or a handsfree kit

Typical implementation (differential connection):



MIC2 input connect

C1 = C2= C3 = 39pF

R1 = R2 = 0 ohm

C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

R1, R2, C2 and C3 has to be put near the PIML-900/1800 Series connector and can be removed according to their environment (ground plane, shielding, etc). The best way is to plan all the components and to remove those that are not necessary to filter out the TDMA noise on the audio path.

Recommended characteristics for the microphone:

- **3V 0.5mA**
- **2.2 K ohms**
- **Sensitivity -40 to 50dB**
- **SNR > 58dB**
- **Frequency response compatible with the GSM specifications**

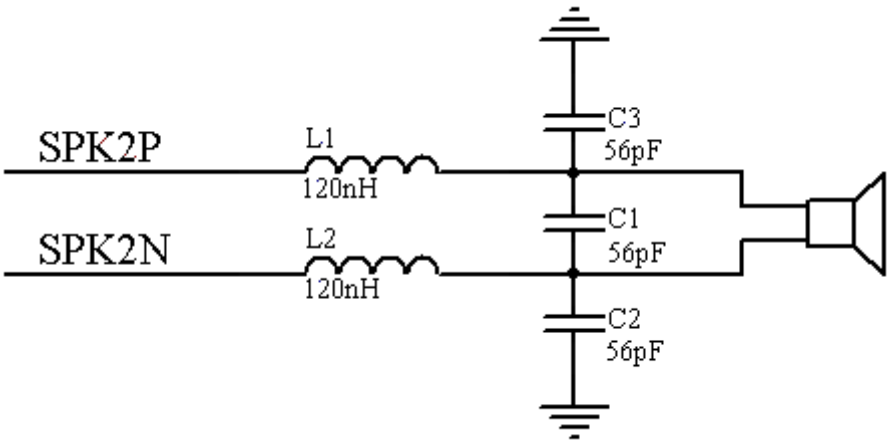
Pin description

Signal	Pin number	I/O	I/O type	Description
MIC2P	46	I	Analog	Microphone 2 positive intput
MIC2N	48	I	Analog	Microphone 2 negative intput

2.10.1.2 Main speaker outputs (SPK2)

The main speaker outputs SPK2 includes SPK2P and SPK2N.

Typical implementation (differential connect):



SPK2 connector

C1=C2=C3=56pF;
L1=L2=120nH

Recommended characteristics for the speaker:

- Type : 50 mW, electro-magnetic
- Impedance : 32 Ohm
- Sensitivity : 110 dB SPL min.
- Frequency response compatible with the GSM specifications

Pin description

Signal	Pin number	I/O	I/O type	Description
SPK2P	45	O	Analog	SPK 2 positive output
SPK2N	47	O	Analog	SPK 2 negative output

2.10.2 Auxiliary audio interface

The auxiliary audio interface consists of MIC1 (MIC1P, MIC1N) and SPK1 (SPK1P, SPK1N).

Pin description

Signal	Pin number	I/O	I/O type	Description
MIC1P	42	I	Analog	MIC1 positive input
MIC1N	44	I	Analog	MIC1 negative input
SPK1P	41	O	Analog	SPK 1 positive output
SPK1N	43	O	Analog	SPK 1 negative output

2.10.2.1 Auxiliary Microphone Inputs (MIC1)

The MIC1 inputs are differential and do not include internal bias. To use these inputs with an electret microphone, bias has to be generated outside the PIML-900/1800 module according to the characteristic of this electret microphone. These inputs are the standard ones used for an external headset or a handsfree kit.
AC coupling is already embedded in the module.

2.10.2.1.1 Differential connection

Impedance of the microphone input in differential mode :

Module ON : Rin = 10KΩ +/-10%

Module OFF : Rin >1MΩ +/-10%

Typical implementation:

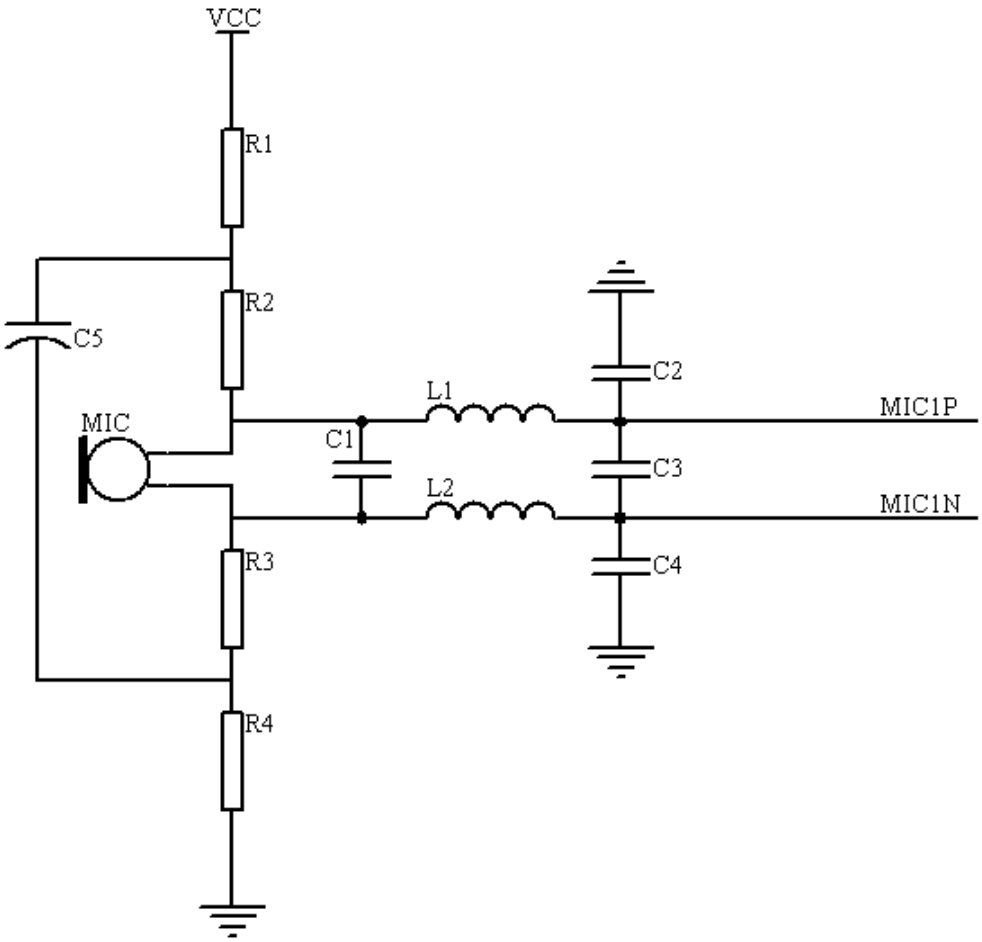


Figure 4 : MIC1 inputs (differential connection)

R1 = R4 = from 100 to 330Ω

R2 = R3 = usually between 1KΩand 3.3K Ω as per the microphone characteristics

C1 = 10pF to 33pF

C2 = C3 = C4 = 47pF to 100pF

C5 = 47uF

L1 = L2 = 100nH

R1 and R4 are used as a voltage supply filter with C5.

C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone. C2 has to be very close to the PIML-900/1800 connector.

L1, L2, C3 and C4 has to be put near the PIML-900/1800 connector and can be removed according to their environment (ground plane, shielding ...etc). The best way is to plan all the components and to remove those which are not necessary to filter out the TDMA noise on the audio path.

2.10.2.1.2 Single-ended connection

Typical implementation:

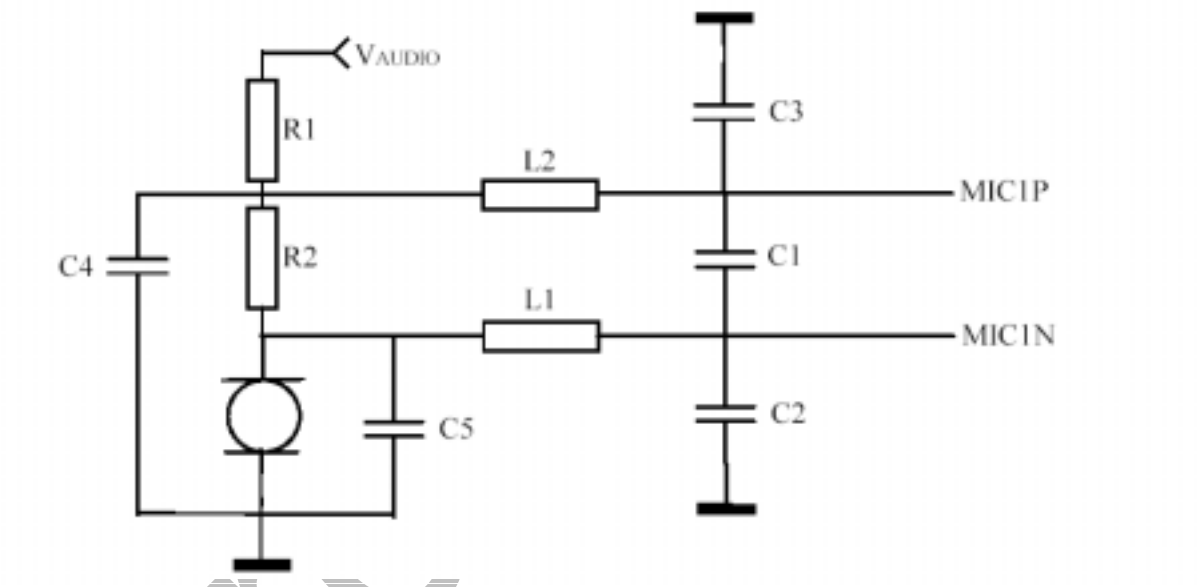


Figure 5 : MIC1 inputs (single-ended connection)

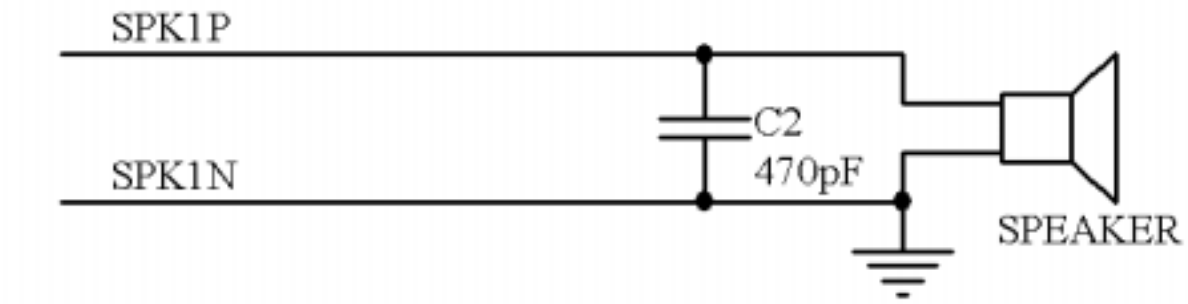
Note : VAUDIO must be very "clean"in single-ended connection (for example, VCC plus filter cell like RC or LC).

R1 = from 100 to 330Ω
R2 = usually between 1KΩand 3.3KΩas per the VAUDIO voltage level and the microphone characteristics
C1 = 10pF to 33pF
C2 = C3 = C5 = 47pF to 100pF
C4 = 47uF
L1 = L2 = 100nH
R1 is used as a voltage supply filter with C4.
C5 has to be the nearest possible to the microphone. Microphone manufacturers provide

this capacitor directly soldered on the microphone.
C1, C2, C3 have to be very close to the PIML-900/1800 connector. L1, and L2 has to be put near the PIML-900/1800 module connector and can be removed according to their environment (ground plane, shielding ...etc).
The best way is to plan all the components and to remove those which are not necessary to filter out the TDMA noise on the audio path.

2.10.2.1.3 Auxiliary speaker outputs characteristics

Single-ended connection
Typical implementation:



2.10.3 Main or Auxiliary audio selected

Main audio and auxiliary audio can not be working at the same time. They can be selected by the first general inputs status. It shoud be pull-up to VCC.

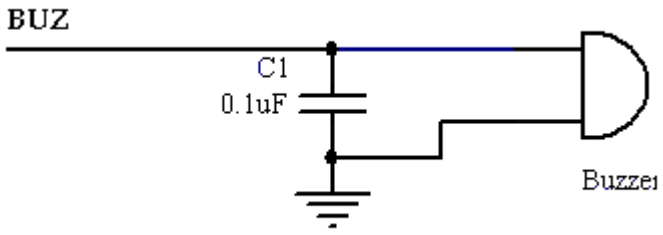
The 35pin GPI5 default is high level. SPK2 output also defaults.

GPI1	Main audio	Auxiliary audio
High level	Output	
Low level		Output

2.10.4 Buzzer Output

The buzzer output is a digital one. A buzzer can be directly connected between this output and VBAT. The maximum current is 80 mA (PEAK). A diode against transient peak voltage must be connected as described below.

Typical implementation:



C1=0.1uF

Recommended characteristics for the buzzer:

- **Type : electro-magnetic**
- **Impedance : 7 to 30 ohm**
- **Sensitivity : 90 dB SPL min @ 10 cm**

Pin description

Signal	Pin number	I/O	I/O type	Description
BUZ	49	O	Analog	BUZ positive output

2.11 Battery charging interface

The PIML-900/1800 module supports one battery charging circuit for Li-Ion batteries. This circuit uses an interface, which consists of a current source inputs (CHG_IN) where the constant current has to flow in order to charge the battery. This current value depends on the battery capacity. It is recommended to provide a current equal to the value of the capacity plus 50mA. For a 550mA battery the current will be 600mA. The maximum current is 800mA.

A specific AT command (+WCBM), available from 4.3 level, allows to manage the charge battery (start and stop the charge, enable or disable unsolicited Battery Charge Indications and set the battery charge parameters).

The PIML-900/1800 Series module monitors the battery voltage to detect the end of the charge.

Pin description

Signal	Pin number	I/O	I/O type	description
CHG_IN	1,2,4	I/O	Supply	Current source input

Electrical Characteristics

Parameter	Min	Max	Type	Unit
CHARGE IN voltage (for I=Imax)	+VBAT max+0.7V	5.5		V
CHARGE IN Current		800		mA

*** To be parameterized as per battery manufacturer**

2.11.1 Li-ion charging procedure

Charge the Li-ion battery During this procedure the voltage of the battery is accurately monitored.

The Li-ion charging involves two phases. During the first phase, the battery is charged with a constant current until its voltage reaches 4.1V*. During the second phase the constant current is pulsed by the module. The width and the frequency of the pulse change during this phase in order to ensure a safety charge. The battery is considered as fully charged when, after a pulse, the voltage remains at a 4.1V* during more than 10s. The Li-ion battery must have an included safety circuit to avoid any discharge or overcharge. The manufacturer inside the battery delivers this circuit pack. The impedance of this safety circuit has to be the lowest possible in order to reduce the drop-out of the voltage. This drop-out is due to the RF Power Amplifier current (up to 2.0A). A maximum of 150ma is required.

(*): To be parameterized as per battery manufacturer

2.12 ON / OFF

This input is used to switch ON or OFF the PIML-900/1800 Series module. A low level signal, that more than 14ms, has to be provided on the pin ON/~OFF to swith ON the module. The level of the voltage of this signal has to be maintained between 0V and 0.7v. To be able to switch OFF the module, the pin ON/OFF has to be keeping low level signal during a minimum of 1000ms. Through the firmware, the module can be switched off (using the CPOF command).

Pin description

Signal	Pin number	I/O	I/O type	Description
ON/OFF	6	I	CMOS	Module Power ON/OFF

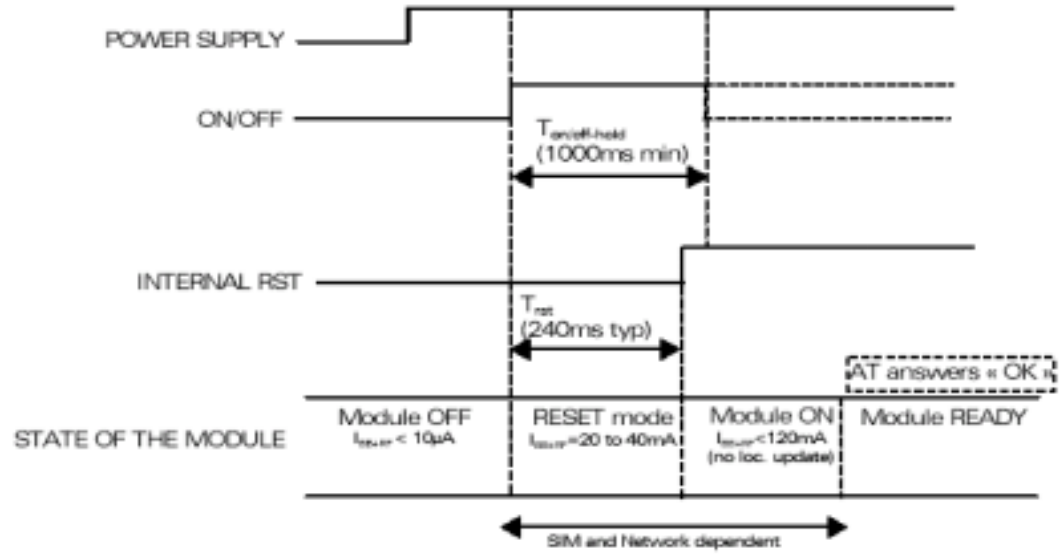
Operating conditions

Parameter	I/O Type	Min	Max	Unit
VIL		0	0.3	V
VIH		2.4	VBATT	V

2.12.1 Operating sequences

2.12.1.1 Power ON

Once the module supplied, the application must set the ON/OFF signal to high to start the module power ON sequence. The ON/OFF signal must be hold for 1000ms minimum. After this time, an internal mechanism keeps it on hold. During the power ON sequence, an internal reset is automatically performed by the module for 240ms (typical). During this phase, any external reset should be avoided. Once the initialisation is complete (timing is SIM and network dependent) the AT interface answers 《OK》to the application[3]. For further details, please check the AT commands manual (+WIND, +WAIP)



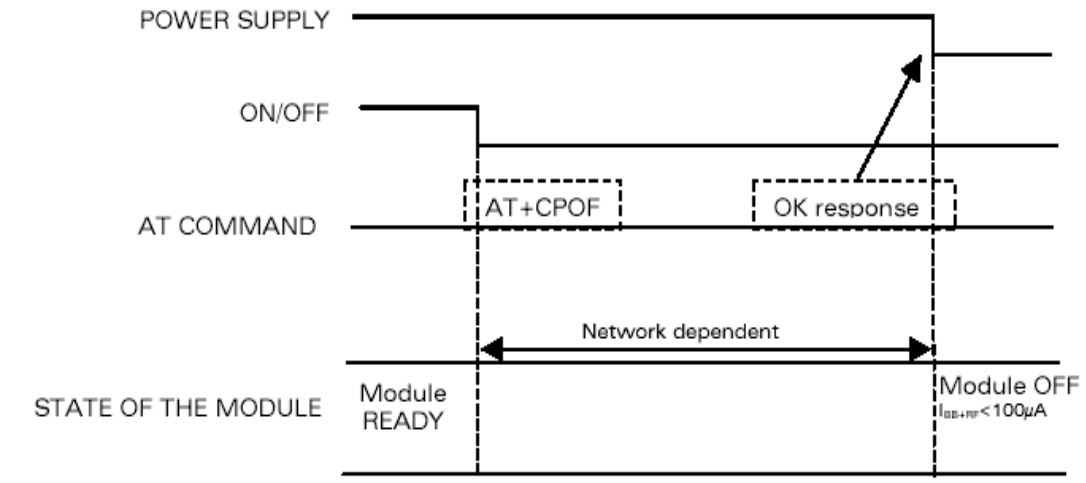
I_{BB+RF} = overall current consumption (Base Band + RF part)

Power-ON sequence

[3] **For this, the application has to send AT↙.If the application manages hardware flow control, the AT commands can be sent during the initialization phase. Another solution is to use the +WIND command to get on unsolicited status from the module.**

2.12.1.2 Power OFF

To properly power OFF the module, the application must set the ON/OFF signal to low and then send the AT+CPOF command to de-register from the network and switch off the module. Once the « OK » response is issued by the module, the power supply can be switched off.



I_{BB+RF} = overall current consumption (Base Band + RF part)

Power-OFF sequence

2.12.2 Reset signal (~RST)

This signal is used to force a reset procedure by providing low level during at least 500us. This signal has to be considered as an emergency reset only. A reset procedure is already driven by an internal hardware during the power-up sequence.
This signal can also be used to provide a reset to an external device. It then behaves as an output. If no external reset is necessary this input can be left open. If used (emergency reset), it has to be driven by an open collector or an open drain.

Pin description

Signal	Pin number	I/O	I/O type	Description
~RST	14	I		Module Reset

Electrical Characteristics

Parameter	Min	Max	Unit
Input Impedance (R)	4.7		Kohm
Input Impedance (C)		10	nF

Operating conditions

Parameter	Min	Max	Conditions
*V_{T-}	1.1V	1.2V	
*V_{T+}	1.7V	1.9	
V_{OL}		0.4V	I_{OL}=-50uA
V_{OH}	2.0V		I_{OH}=50uA

*V_{T-}、V_{T+} : Hysterisis Level

Additional comments on RESET:

The RESET process is activated either by the external ~RST signal OR by an internal signal (coming from a RESET generator). This automatic reset is activated at Power-up.

The module remains in reset mode as long as the RST signal is held low. This signal should be used only for "emergency" resets.

A software reset will be preferred to a HW reset.

2.12.2.1 Reset sequence

To activate the "emergency" reset sequence, the ~RST signal has to be set to low for 500us minimum. As soon as the reset is complete, the AT interface answers "OK" to the application[4].

2.13 External Interrupt (~INTR)

The PIML-900/1800 Series provides an external interrupt input (not managed in the standard AT commands firmware). This input is very sensitive and an interrupt is activated on high to low edge. If this signal is not used it can be left open. If used this input has to be driven by an open collector or an open drain.

This input is used for instance to power OFF automatically the module.

Pin description

Signal	Pin number	I/O	I/O type	Description
~INTR	16	I	CMOS	Active low

[4] For this, the application has to send AT . If the application manages hardware flow control, the AT command can be sent during the initialisation phase. Another solution is to use the +WIND command to get an unsollicited status from the module.

2.14 VCC output

This output can be used to power some external functions. VDD has to be used as a digital power supply. This power supply is available programmed.

Pin description

Signal	Pin number	I/O	I/O type	Description
VCC	40	O	Supply	Digital supply

Operating conditions

	Output voltage (V)		Output current (mA)
	Min	Max	Max
VCC	1.35	3.45	150

2.15 VCC_RTC (REAL TIME CLOCK SUPPLY)

2.15.1 Interface description

This pin is used as a back-up power supply for the internal Real Time Clock. The RTC is supported by the module when powered on but a back-up power supply is needed to save date and hour when the module is switched off.

If the RTC is not used this pin can be left open.

Pin Description

Signal	Pin number	I/O	I/O type	Description
VCC_RTC	56	I/O	Supply	RTC BACK-UP SUPPLY

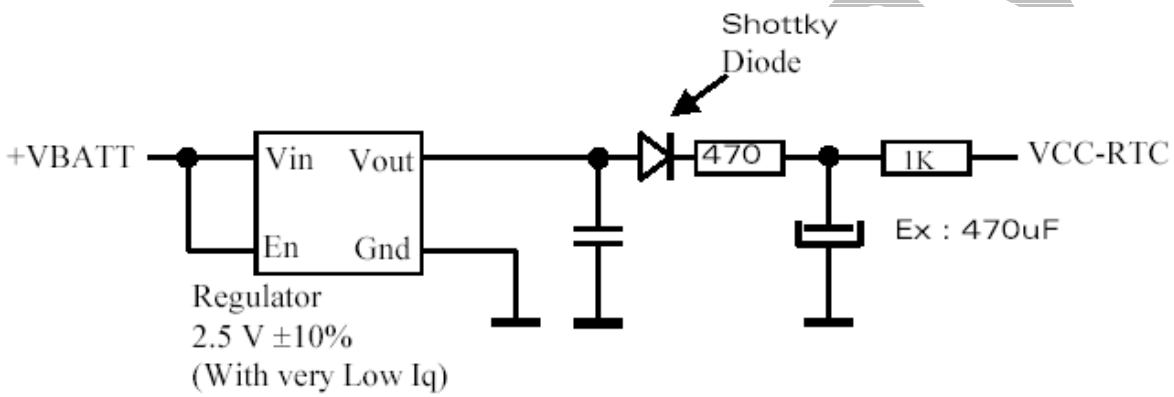
Operating conditions

Parameter	Condition	Min	Max	Unit
Input voltage		-0.5	6.5	V

Input Current	$V_{BACK} < V_{BAT}$ - 0.5V		1	uA
Output voltage		2.4	3.09	V
Output current			2	mA

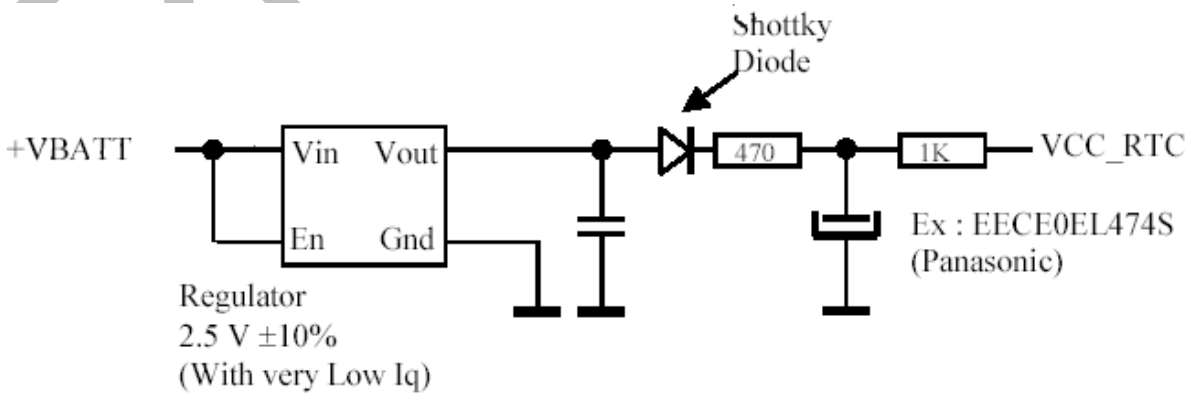
2.15.2 Typical implementation:

2.15.2.1 Capacitor



Estimated range with 470 uF Capacitor : ~30 seconds.

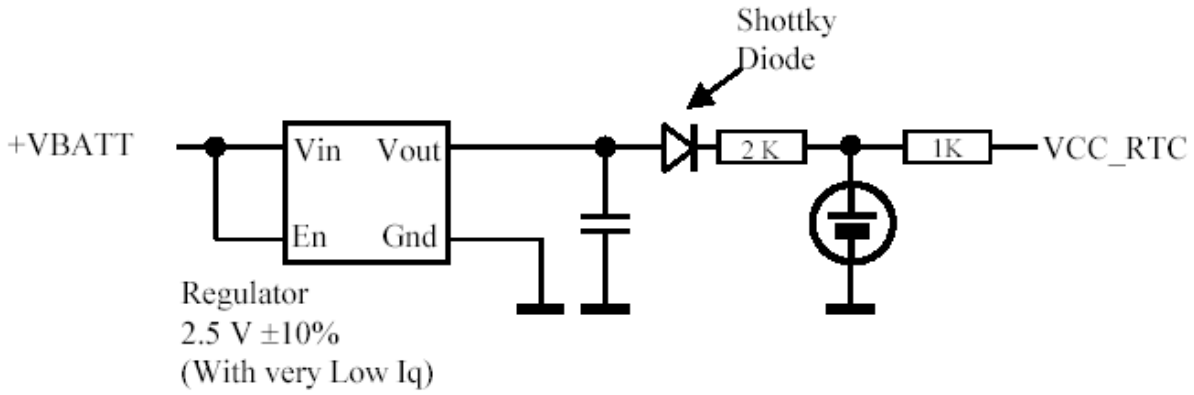
2.15.2.2 Super Capacitor



Estimated range with 0.47 Farad Gold Cap : 2 hours min.

Note : the Gold Capacitor maximum voltage is 2.5 V.

2.15.2.3 Battery cell with regulator

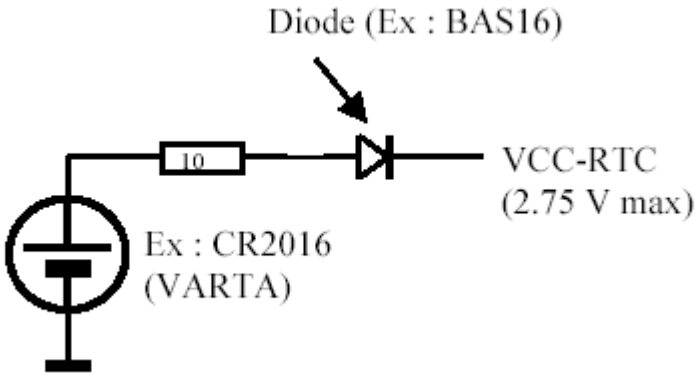


Estimated range with 2 mAh battery rechargeable battery : ~3 days.

> **Warning :**
>
> **Before battery cell assembly insure that cell voltage is lower than 2,75V to avoid any damage to the PIML module.**

2.15.2.4 Non Rechargeable battery

This is the less recommended solution.



Estimated range with 85 mAh battery : 4000 h minimum

Note : The "non rechargeable battery" is always active, except when the module is ON.

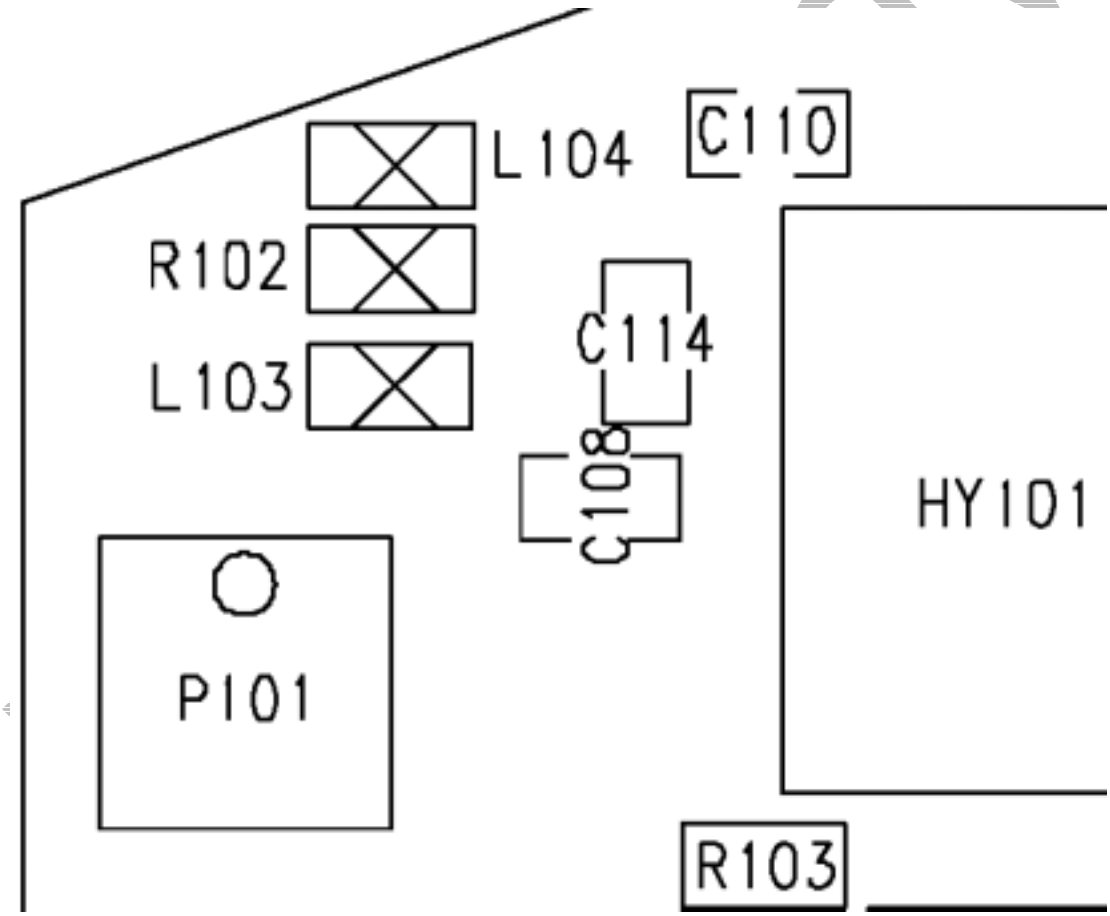
2.16 RF interface

Three types of RF connection are available:

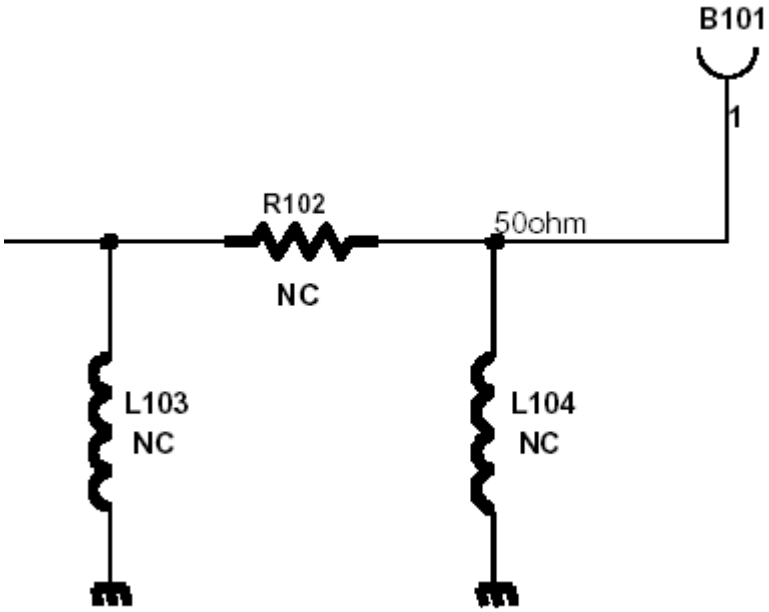
2.16.1 RF connection

Two land patterns and one connector set on the PCB to support the module connecting with antenna and application board.

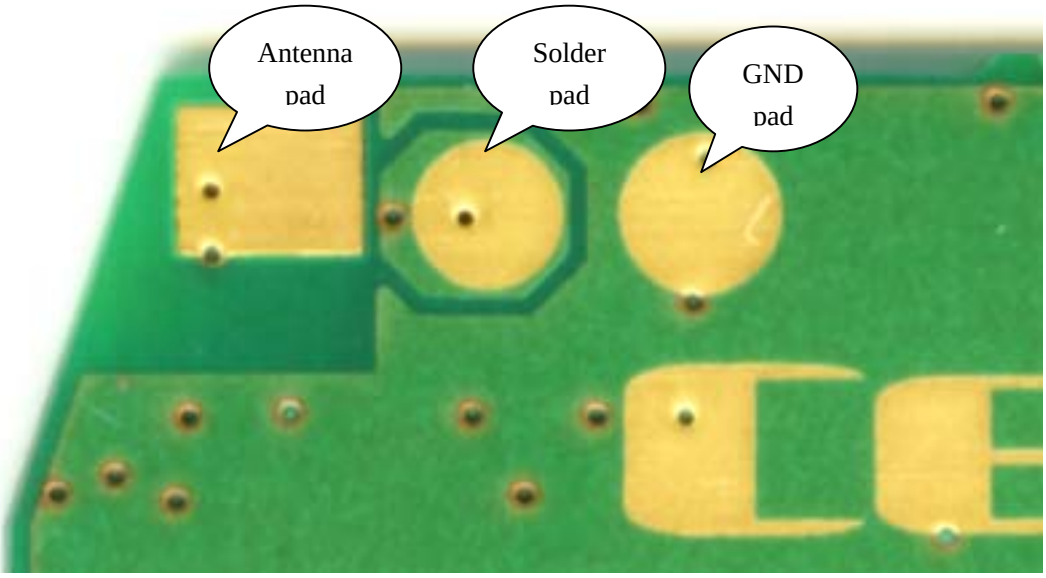
1) Through RF connector P101 connects to application board with matching RF cable. This cable can be used muRata's MXTK92XXXX, which has one or two connectors, also the length can be changed.



2) Connect to Antenna pad with an antenna directly. Below is the antenna matching circuit.



3) Through soldering RF cable to other application board. Soldered cable corn to solder pad and GND to GND pad.



Notes:

- The antenna cable and connector should be chosen in order to minimise losses in the frequency bands used for GSM 900MHz and GSM1800MHz.
- 0.5dB can be considered as a maximum value for insert loss between the module and an external connector.

2.16.2 RF performances

RF performances are compliant with the ETSI recommendation 05.

The main parameters for Receiver are:

- **·EGSM/900 Sensitivity: < -102 dBm Static & TUHigh**
- **·GSM1800 Sensitivity: < -102 dBm Static & TUHigh**
- **·Selectivity @ 200 kHz: > +9 dBc**
- **·Selectivity @ 400 kHz: > +41 dBc**
- **·Dynamic range: 63 dB**
- **·Co-channel rejection: >= 9 dBc**

And for Transmitter:

- **· Maximum output power (EGSM): 33 dBm +/- 2 dB at ambient temperature**
- **· Maximum output power (GSM1800): 30 dBm +/- 2 dB at ambient temperature**
- **· Minimum output power (EGSM): 5 dBm +/- 5 dB at ambient temperature**
- **· Minimum output power (GSM1800): 0 dBm +/- 5 dB at ambient temperature**
- **· H2 level: < -30 dBm**
- **· H3 level: < -30 dBm**
- **· Noise in 925 - 935 MHz: < -67 dBm**
- **· Noise in 935 - 960 MHz: < -79 dBm**
- **· Noise in 1930 - 1990 MHz (GSM1900 band): < -71 dBm**
- **· Phase error at peak power: < 5 ° RMS**
- **· Frequency error: +/- 0.1 ppm max**

2.16.3 Antenna specifications

The antenna must fulfill the following requirements:

- **· Frequency bands: dual band E-GSM 900MHz – GSM 1800 MHz**

	EGSM 900	GSM 1800
Frequency RX	925 to 960 MHz	1805 to 1880 MHz
Frequency TX	880 to 915 MHz	1710 to 1785 MHz

- **· Impedance: 50Ω**

3 Technical specifications

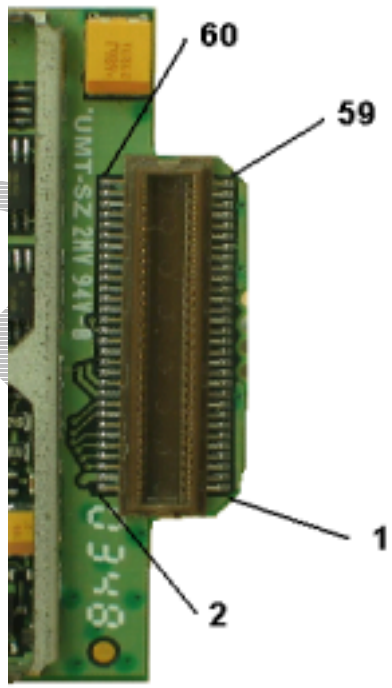
3.1 Interface

Pin #	Name	I/O	I/O type	Description	Comment
1	CHG_ IN	I	Supply	Supply for battery charging	High current
2	CHG_IN	I	Supply	Supply for battery charging	High current
3	SIMCLK	O	2X	Clock for SIM interface	
4	CHG_IN	I	Supply	Supply for battery charging	High current
5	SIMRST	O	2X	Reset for SIM interface	
6	ON/OFF	I	CMOS	Power ON/OFF control	
7	SIMDATA	I/O	CMOS/3X	I/O for SIM Interface	
8	SDA	I/O	CMOS/1X	I^2C Interface data	
9	SIMVCC	O	Supply	SIM card supply	6mA max
10	SCL	O	1X	I^2C interface clock	
11	NOP				
12	NOP				
13	ROW0	I/O	CMOS/1X	Keyboard ROW	
14	~RST	I	SCHMITT	Module reset	Active low
15	ROW1	I/O	CMOS/1X	Keyboard ROW	
16	~INTR	I	INTR	External interrupt	Active low.
17	ROW2	I/O	CMOS/1X	Keyboard Row	
18	GPI0	I	CMOS	General purpose input	
19	ROW3	I/O	CMOS/1X	Keyboard Row	
20	GPO2	O	CMOS	General purpose output	
21	NOP				
22	GPO1	O	CMOS	General purpose output	

23	COL0	I/O	CMOS/1X	Keyboard column	
24	GPIO0	I/O	CMOS	General purpose I/O	
25	COL1	I/O	CMOS/1X	Keyboard column	
26	GPO0	O	CMOS	General Purpose output	
27	COL2	I/O	CMOS/1X	Keyboard column	
28	GPO3	O	CMOS	General Purpose output	
29	COL3	I/O	CMOS/1X	Keyboard column	
30	CT105/RTS1	I	CMOS	RS232 interface Request to send	
31	NOP				
32	CT104/RXD1	O	1X	RS232 interface Receiver	
33	AUXV0	I	Analog	Auxiliar ADC input	Can be as ADC input for battery temperature measurement
34	CT108/DTR1	I	CMOS	RS232 Interface Data Terminal Ready	
35	GPI1	I	CMOS	General purpose input	
36	CT107/DSR1	O	1X	RS232 Interface Data Set Ready	
37	CT106/CTS1	O	1X	RS232 interface Clear to sent	
38	NOP				
39	CT103/TXD1	I	CMOS	RS232 interface transmit	
40	VCC	O	Supply	2.8V digital supply output	150mA max
41	SPK1P	O	Analog	SPK1 positive output	
42	MIC1P	I	Analog	MIC1 Positive input	
43	SPK1N	O	Analog	SPK1 negative output	
44	MIC1N	I	Analog	MIC1 negative output	
45	SPK2P	O	Analog	SPK2 positive output	
46	MIC2P	I	Analog	MIC 2 positive input	
47	SPK2N	O	Analog	SPK2 negative output	

48	MIC2N	I	Analog	MIC2 negative input	
49	BUZ	O	Analog	BUZ OUTPUT	Analog audio output
50	SIMPRES	O	CMOS	SIM card detect	
51	CT109/DCD1	O	CMOS	RS232 DATA carrier detect	
52	GPO4 FLASH LED	O	CMOS	General Purpose I/O	
53	GPIO2	I/O	CMOS	General purpose I/O	
54	CT125/RI1	O		RS232 ring indicator	
55	+VBATT		Supply	Battery input	High current
56	VCC_RTC	I/O	Supply	RTC Back-up battery	
57	+VBATT		Supply	Battery input	High current
58	+VBATT		Supply	Battery input	High current
59	+VBATT		Supply	Battery input	High current
60	+VBATT		Supply	Battery input	High current

CENTEL PIML-900/1800 module pin position (bottom view)



PIML-900/1800 module pin bottom view

3.2 Environmental Specifications

Conditions	Temperature range
Operating / Full GSM specification compliant	- 20℃ to + 55℃
Storage	- 30℃ to + 85℃

CENTEL PIML-900/1800		ENVIRONNEMENTAL CLASSES		
TYPE TEST	Standards	Storage class 1.2	Transportation class 2.3	Operating (port use) class 7.3
Cold	IEC 68-2.1 Ab test	-25℃ 72h	-40℃ 72h	-20℃(GSM900) 16h -10℃(GSM1800/1900) 16h
Dry heat	IEC 68-2.2 Bb test	+70℃ 72h	+70℃ 72h	+55℃ 16h
Change of temperature	IEC 68-2.14 Na/Nb test		-40 ℃ /+30 ℃ 5cycles t1=3h	-20/30℃(GSM900) 3cycles -10/+30℃(GSM1800/1900): 3cycles t1=3h
Damp heat cyclic	IEC 68-2.30 Db test	+30℃2cycles 90%-100% RH variant 1	+40℃ 2cycles 90%-100% RH variant 1	+40℃ 2cycles 90%-100% RH variant 1
Damp heat	IEC 68-2.56 Cb test	+30℃ 4days	+40℃ 4days	+40℃ 4days
Sinusoidal vibration	IEC 68-2.6 Fc test	5-62Hz: 5mm/s 62-200Hz: 2m/s2 3x5 sweep cycles		
Random vibration wide band	IEC 68-3.36 Fdb tes		5-20Hz:0.96m2/s3 20-500Hz:-3dB/oct 3X10 min	10-12Hz: 0.96m2/s3 12-150Hz: -3dB /oct 3 x 30 min

3.3 Mechanical specifications

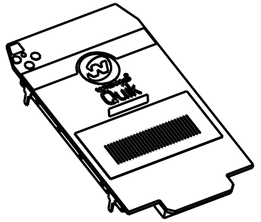
3.3.1 Physical characteristics

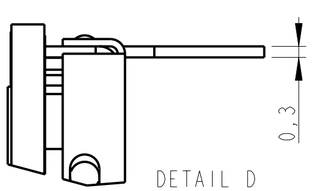
The PIML-900/1800 module has a complete self-contained shield.

- **Dimensions : 58 x 32 x 3.9 mm external dimensions (except shielding pins)**
- **Weight : <11 g**

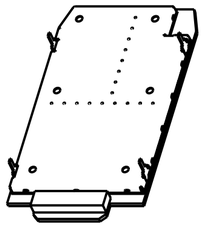
3.3.2 Mechanical drawings

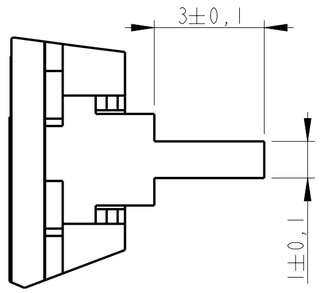
The follow gives the mechanical specifications of PIML-900/1800 module.

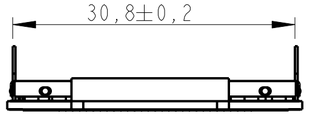


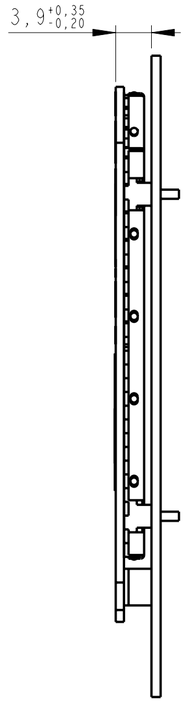


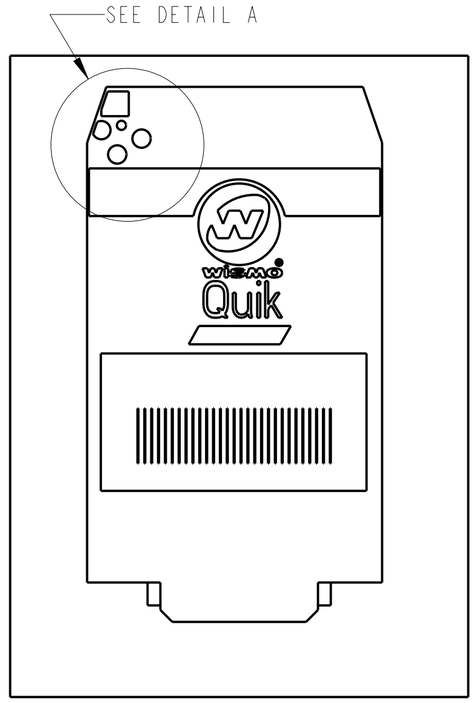
SCALE 1,000

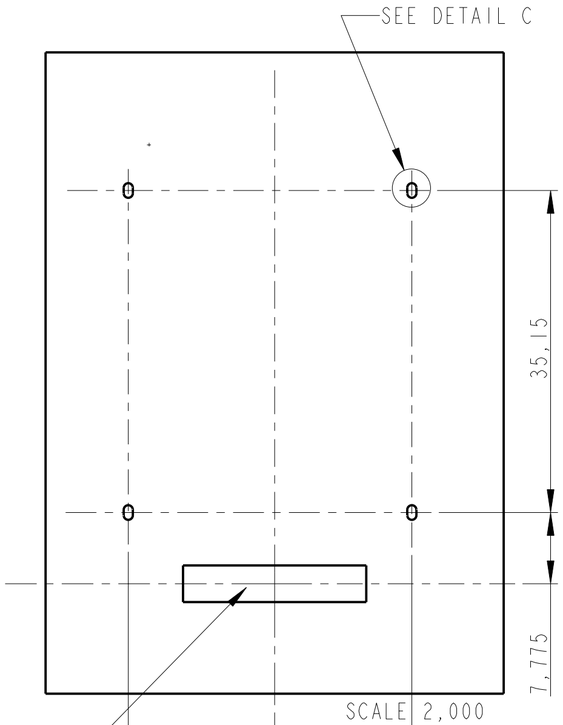




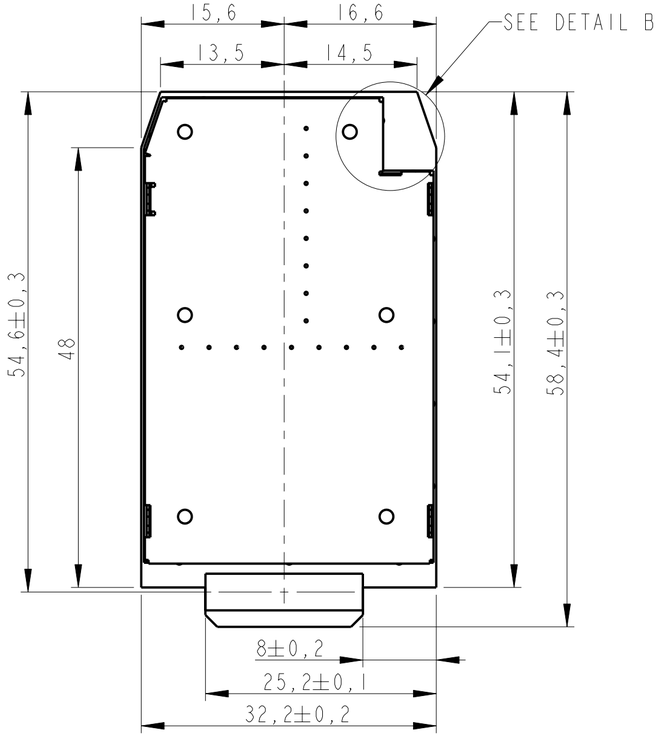


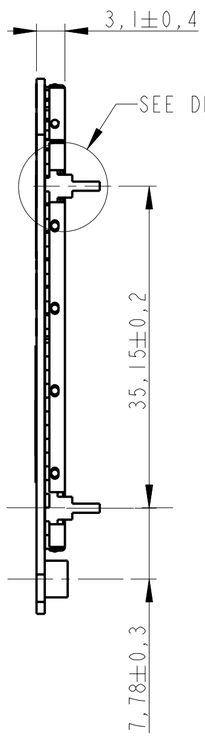


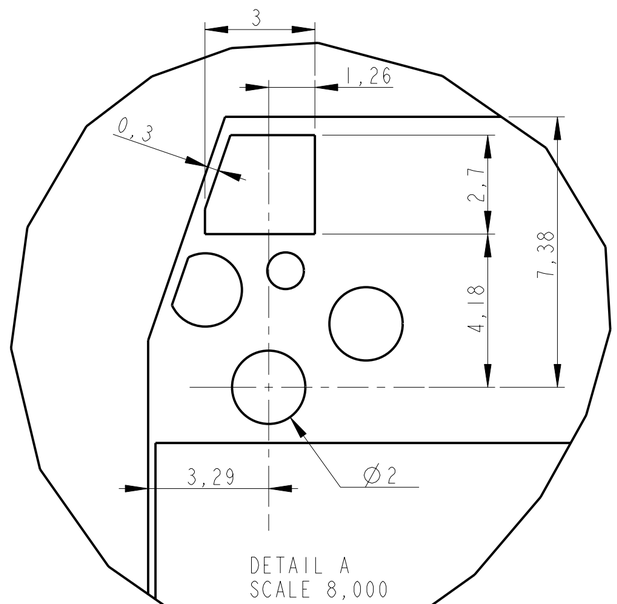




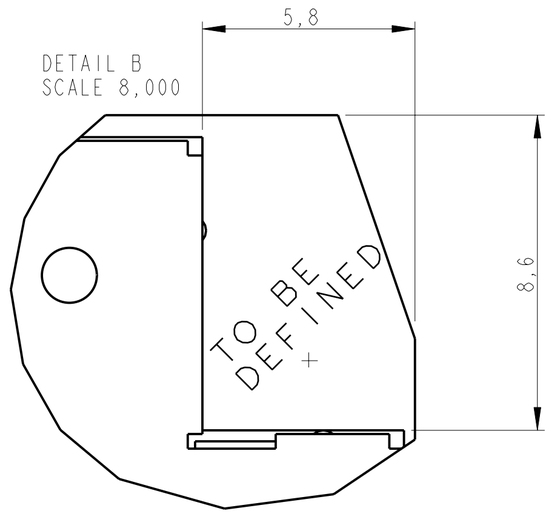
SCALE 2,000



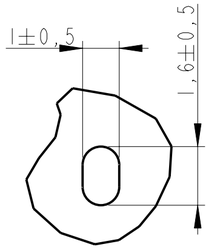




DETAIL A
SCALE 8,000



DETAIL B
SCALE 8,000



DETAIL C
SCALE 8,000

4 Connectors and peripheral devices references

4.1 General Purpose Connector

The GPC is a 60 pins connector with 0.5mm pitch from KYOCERA / AVX group with the following reference:

14 5087 060 930 861.

The matting connector has the following reference:

24 5087 060 X00 861. [5]

The stacking height is 3.0 mm.

For further details see GPC data sheets in appendix. More information is also available from http://www.avxcorp.com

4.2 SIM Card Reader

Possible suppliers:

- **ITT CANNON CCM03 series (see http://www.ittcannon.com)**
- **JAE (see http://www.jae.com)**
- **AMPHENOL C707 series (see http://www.amphenol.com)**

Drawer type :

MOLEX 99228-0002 (connector) / MOLEX 91236-0002 (holder) (see http://www.molex.com)

4.3 Microphone

Possible suppliers:

- **PANASONIC**
- **HOSIDEN**

[5] **X=2 or 9**

4.4 Speaker

Possible suppliers:

- **PHILIPS**
- **SANYO**
- **HOSIDEN**
- **PRIMO**

4.5 Antenna Cable

The following cable reference has been qualified for being mounted on PIML-900/1800 :

- **MuRata MXTK92XXXX series RF cable.**

4.6 GSM antenna

GSM antennas and support for antenna adaptation can be obtained from manufacturers such as:

- **Galtronics**
- **Centurion**
- **Amphenol**

5 Design Guidelines

The purpose of the following paragraphs is to give design guidelines.

5.1 Hardware and RF

5.1.1 EMC recommendations

The EMC tests have to be performed as soon as possible on the application to detect any possible problem.
When designing, special attention should be paid to:

- **Possible spurious emission radiated by the application to the RF receiver in the receiver band**
- **ESD protection on SIM (if accessible from outside), serial link**
- **EMC protection on audio input/output (filters against 900MHz emissions)**
- **Bias of the Microphone inputs**
- **Length of the SIM interface lines (preferably <10cm)**
- **Ground plane : CENTEL recommends to have a common ground plane for analog / digital / RF grounds.**
- **Metallic case or plastic casing with conductive paint are recommended**

Note:
The module does not include any protection against over voltage.

5.1.2 Power Supply

The power supply is one of the key issues in the design of a GSM terminal.
A weak power supply design could affect in particular :

- **EMC performances**
- **the emissions spectrum**
- **the phase error and frequency error**

Warning:
Careful attention should be paid to:

- **Quality of the power supply : Low ripple, PFM or PSM systems should be avoided (PWM converter preferred).**
- **Capacity to deliver high current peaks in a short time (pulsed radio emission).**

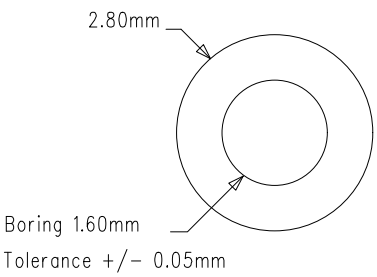
5.1.3 Layout requirement

CHIPS & BORING DIAMETER

of the WISMO QUIK mechanical insertion pins

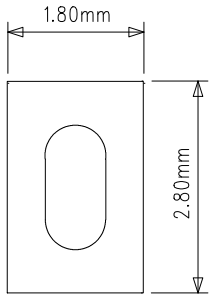
CASE N 1

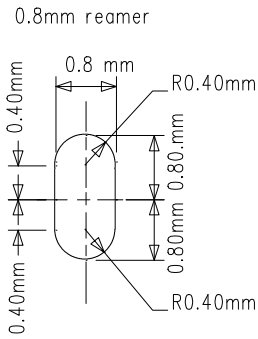
To be used in priority



CASE N 2

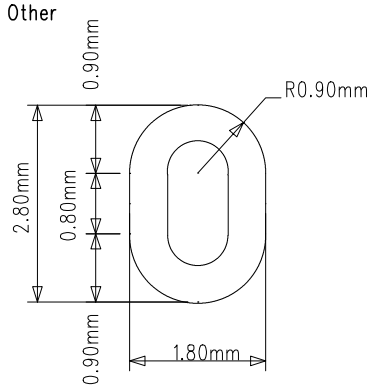
on specific request



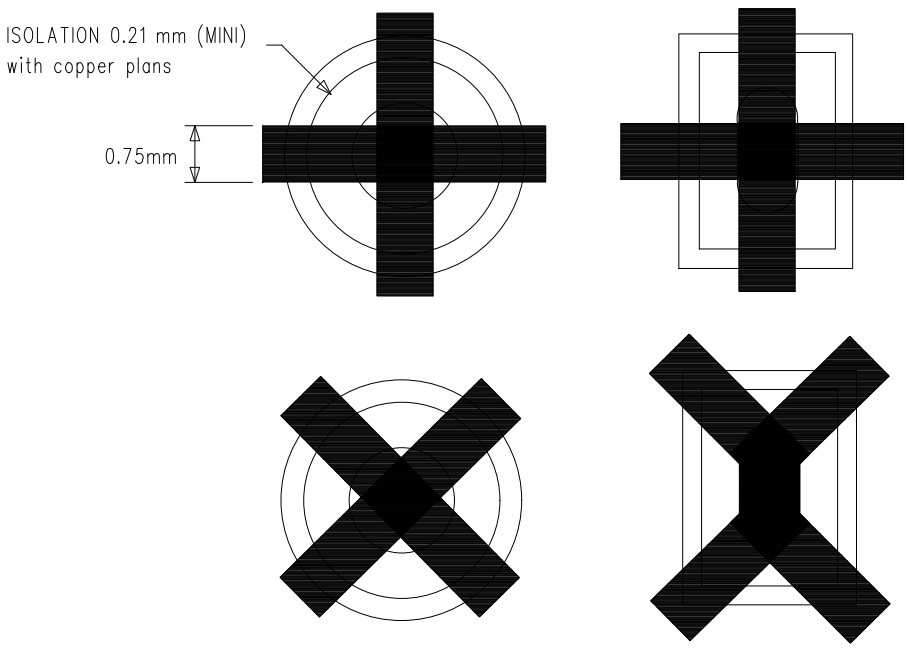


CASE N 3

Other



THERMAL BRAKES DEFINITION



NORMALISATION INDUSTRIELLE	ETABLI : HER	DATE : 03/04/02

5.1.4 Antenna

Warning:
PIML-900/1800 strongly recommends to work with an antenna manufacturer either to develop an antenna adapted to the application or to adapt an existing solution to the application. The antenna adaptation (mechanical and electrical adaptation) is one of the key issues in the design of a GSM terminal.

5.2 Mechanical integration

Attention should be paid to :

- **Antenna cable integration (bending, length, position, etc)**
- **Legs of the module to be soldered on the Ground plane**

5.3 Firmware upgrade

The PIML-900/1800 module firmware is stored in flash memory and it can easily be upgraded.

In order to follow the regular evolutions of the GPRS standard and to offer state of the art software, CENTEL recommends that the application designed around a PIML-900/1800 (or PIML-900/1800 based product) allows easy firmware upgrades on the module via the standard Xmodem protocol. Therefore, the application shall either allow a direct access to the PIML-900/1800 serial link through an external connector or implement any mechanism allowing the PIML-900/1800 firmware to be downloaded via Xmodem.

Two upgrade procedures are available:
PC Loader Vision 2.0.4

5.3.1 Nominal upgrade procedure

The firmware file can be downloaded into the modem using the Xmodem protocol.
To enter this mode, the AT+WDWL command (see description in the AT command manual) has to be sent.
The necessary serial signals to proceed with the Xmodem downloading are:
Rx, Tx, RTS, CTS and GND.

5.3.2 Backup procedure

In case the nominal upgrade mode is not possible (due to critical corruption on the flash memory), a backup procedure is also available. It requires a CENTEL specific software to download the firmware file into the modem.
This tool has to run on a PC connected to the serial bus of the modem.
The necessary signals to proceed with the downloading are: Rx, Tx, RTS, CTS and GND.
Prior to running the CENTEL downloader, the modem has to be set in download mode.

Advise: To reduce the time of the download, it's possible to change the speed of the serial link at 115200 bits/s. for that, you have to execute the AT command below :

1) AT+IPR=115200
2) AT+WDWL
3) file transfer
4) AT+CFUN=1 (reset of the module)

Make attention that after the last command, the serial link will be by default at 9600 bits/s.

6 Appendix

6.1 CENTEL acceptance test

These tests are CENTEL internal qualification tests. They are performed on a CENTEL evaluation platform (module on test board).

Test	Applied standard	Acceptance criteria
Performance test	Mobile station (MS) conformance specification; Part 1: Conformance specification (release 5). 3GPP TS 51.010 v5.0.0 (2002-09)	Full conformity to the recommendation regarding the main RF parameters.
Cooking test		The test continues even after the Cooking Test milestone has been reached
Stress test	Therma shocks IEC 68-2-14	Full conformity to the recommendation regarding the main parameters.

Vibration test	**Sinusoidal vibration IEC 68-2-6**	**No performance degradation or mechanical degradation is allow after test.**
Shock test	**IEC 68-2-27**	**No performance degradation or mechanical degradation is allowed after test**
Bump test	**IEC 68-2-29**	**No performance degradation or mechanical degradation is allowed at after test**
Humidity test	**Corrosion test IEC 68-2-3**	**No visible degradation of the product, both visual and functional. The unit is tested at room temperature and must be fully operative for the main RF parameters.**
Warehouse test	**Low temperance IEC 68-2-1**	**Under normal condition (room temperature) after the test, the unit must behave in full conformity with the main RF parameters specification.**
Warehouse test	**High temperature IEC 68-2-2**	**Under normal condition (room temperature) after the test, the unit must behave in full conformity with the main RF parameters specification.**
Dust test1	**MIL-STD-810D, method 510-3.**	**No visible dust in the visible areas. No more than 50 dust particules in the cabinet of the product. The unit, tested at room temperature must be fully operative.**
Light test 1	**UV radiation and temperature EDF HN60E03.**	**Visual inspection on the discoloration and other degradation effects such as cracks in the material of the unit after the test.**
Fall test 1	**IEC 68-2-32**	**Only minor casing degradation is allowed, with a maximum dimension change of 1mm. The unit must remain fully operative and full specification for the main RF parameters.**

Electro static discharge test	IEC 1000-4-2 or EN 61000-4-2 / A1 Edition 1998 /A2 edition 2001	No performance degradation allowed after the test.
Salt mist test	IEC 68-2-11	After the test, visual inspection on the unit.
Atmosphere test	Flowing mixed gas corrosion. IEC 68-2-60	After the test, visual inspection on the unit and inside.
Marking test	EN 60950:2000 (safety tests standard)	After test, visual inspection on the unit. No degradation is allowed on the marking.

6.2 Standards and Recommendations

GSM ETSI, 3GPP, GCF and NAPRD03 recommendations for Phase II.

Specification reference	Title
3GPP TS 45.005 v5.5.0 (2002-08) Release 5	Technical specification group GSM/EDGE. Radio Access network; radio transmission and reception
GSM 02.07 v8.0.0 (1999-07)	Digital cellular telecommunications system (phase 2+); Mobile station features (GSM) 02.07 version 8.0.0 Release 1999
GSM 02.60 v8.1.0 (1999-07)	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description, stage 1 (GSM 02.60 version 8.1.0 Release 1999)
GSM 03.60 V7.9.0 (2002-09)	Technical specification group services and system aspects; Digital cellular telecommunications system (phase 2+); GPRS ; service description ; stage 2 (release 1998)
3GPP TS 43.064 V5.0.0(2002-04)	Technical specification group geran; digital cellular telecommunications system (phase 2+); general packet radio service ;overall description of the GPRS radio interface; Stage 2 (release 5)
3GPP TS 03.40 V7.5.0 (2001-12)	Technical specification group terminals; technical realization of the short message service (SMS) (Release 1998)
3GPP TS 03.41 V7.4.0 (2000-09)	Technical Specification Group terminals; Technical realization of Cell broadcast service (CBS) (Release 1998)
ETSI EN 300 903 V8.1.1(2000-11)	Digital cellular telecommunications system (phase 2+); transmission planning aspects of the speech service in the GSM Public Land Mobile Network (PLMN) system (GSM) 03.50 version 8.1.1 (Release 1999)
3GPP TS 04.06 V8.2.1(2002-05)	Technical specification Group GSM/EDGE Radio Access Network; Mobile station – base station system (MS - BSS) interface; Data Link (DL) layer specification (release 1999)
3GPP TS 04.08 V7.18.0(2002-09)	Technical specification group core network;digital cellular telecommunications system (phase 2+); Mobile radio interface layer 3 specification (release 1998)
3GPP TS 04.10 V7.1.0 (2001 - 12)	Technical specification group core network; mobile radio interface layer 3 supplementary services specification; general aspects (release 1998)
3GPP TS 45.005 V5.5.0 (2002-08)	echnical Specification Group GSM/EDGE. Radio (2002-08) Access Network; Radio transmission and reception (Release 5)
3GPP TS 45.008 V5.8.0 (2002-08)	Technical Specification Group GSM/EDGE Radio Access Network; Radio subsystem link control

	(Release 5)
3GPP TS 45.010 V5.1.0 (2002-08)	Technical Specification Group GSM/EDGE Radio Access Network; Radio subsystem synchronization (Release 5)
3GPP TS 46.010 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Transcoding (Release 5)
3GPP TS 46.011 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Substitution and muting of lost frames for full rate speech channels (Release 5)
3GPP TS 46.012 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Comfort noise aspect for full rate speech traffic channels (Release 5)
3GPP TS 46.031 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Discontinuous Transmission (DTX) for full rate speech traffic channels (Release 5)
3GPP TS 46.032 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Voice Activity Detector (VAD) for full rate speech traffic channels (Release 5)
TS 100 913V8.0.0 (1999-08)	Digital cellular telecommunications system (Phase 2+); General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS) (GSM 07.01 version 8.0.0 Release 1999)
GSM 09.07 V8.0.0 (1999-08)	Digital cellular telecommunications system (Phase 2+); General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN) (GSM 09.07 version 8.0.0 Release 1999)
3GPP TS 51.010-1 v5.0.0(2002-09)	Technical specification group GSM/EDGE; Radio Access Network; Digital cellular telecommunications system (phase 2+);Mobile station (MS) conformance specification; Part 1: Conformance specification(release 5)
3GPP TS 51.011 V5.0.0 (2001-12)	echnical Specification Group Terminals; Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface (Release 5)
ETS 300 641 (1998-03)	Digital cellular telecommunications system (Phase 2); Specification of the 3 Volt Subscriber Identity Module - Mobile Equipment (SIM-ME) interface (GSM 11.12 version 4.3.1)
GCF-CC V3.7.1 (2002-08)	Global Certification Forum ?Certification criteria

6.3 Safety recommendations (for information only)

IMPORTANT
FOR THE EFFICIENT AND SAFE OPERATION OF
YOUR GSM APPLICATION BASED ON CENTEL PIML-900/1800 Series
PLEASE READ THIS INFORMATION CAREFULLY

6.3.1 RF safety

6.3.1.1 General

Your GSM terminal[6] is based on the GSM standard for cellular technology. The GSM standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard.

Your GSM terminal is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your GSM application, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular modem.

6.3.1.2 Exposure to RF energy

There has been some public concern about possible health effects of using GSM terminals. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was fitted for use.

If you are concerned about exposure to RF energy there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular terminal efficiently by following the below guidelines.

[6] based on PIML-900/1800

6.3.1.3 Efficient terminal operation

For your GSM terminal to operate at the lowest power level, consistent with satisfactory call quality :

If your terminal has an extendible antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However your GSM terminal operates more efficiently with the antenna fully extended.

Do not hold the antenna when the terminal is <IN USE > Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

6.3.1.4 Antenna care and replacement

Do not use the GSM terminal with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace a damaged antenna immediately. Consult your manual to see if you may change the antenna yourself. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

Use only the supplied or approved antenna. Unauthorized antennas, modifications or attachments could damage the terminal and may contravene local RF emission regulations or invalidate type approval.

6.3.2 General safety

6.3.2.1 Driving

Check the laws and the regulations regarding the use of cellular devices in the area where you have to drive as you always have to comply with them. When using your GSM terminal while driving, please :

- **give full attention to driving,**
- **pull off the road and park before making or answering a call if driving conditions so require.**

6.3.2.2 Electronic devices

Most electronic equipment, for example in hospitals and motor vehicles is shielded from RF energy. However RF energy may affect some improperly shielded electronic equipment.

6.3.2.3 Vehicle electronic equipment

Check your vehicle manufacturer representative to determine if any on-board electronic equipment is adequately shielded from RF energy.

6.3.2.4 Medical electronic equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc...) to determine if they are adequately shielded from external RF energy.

Turn your terminal OFF in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

6.3.2.5 Aircraft

Turn your terminal OFF before boarding any aircraft.

- Use it on the ground only with crew permission.
- Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you to have permission from a crew member to use your terminal while the aircraft is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

6.3.2.6 Children

Do not allow children to play with your GSM terminal. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the modem, or make calls that increase your modem bills.

6.3.2.7 Blasting areas

To avoid interfering with blasting operations, turn your unit OFF when in a <blasting area > or in areas posted : <turn off two-way radio> Construction crew often use remote control RF devices to set off explosives.

6.3.2.8 Potentially explosive atmospheres

Turn your terminal OFF when in any area with a potentially explosive atmosphere. It is rare, but your modem or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations ; below decks on boats ; fuel or chemical transfer or storage facilities ; and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

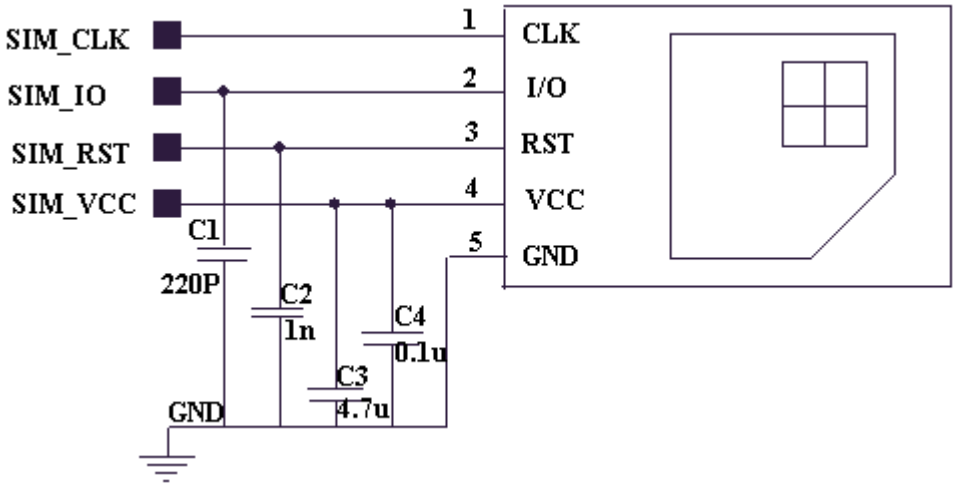
Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle which contains your terminal or accessories.

Before using your terminal in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is to be used.

6.4 Application notes for the SIM interface

The next pages are application notes to interface the module with SIM cards:

- application note: interface with 3V SIMs



SIMs interface layout:

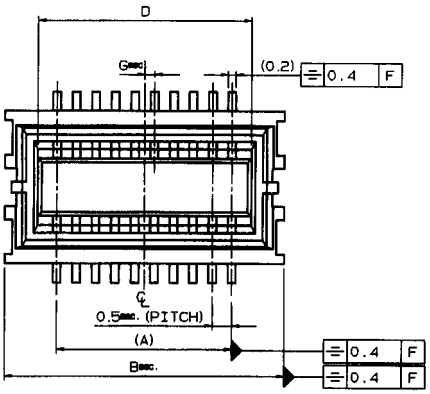
- C1,C2,C3,C4 be closed with SIM socket as possible.
- add ESD protect component between all signals and GND.

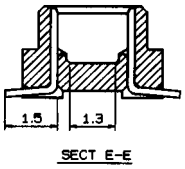
6.5 General Purpose Connector data sheet

The next 6 pages are the KYOCERA/ELCO data sheets for the GPC (also available from http://www.avxcorp.com.

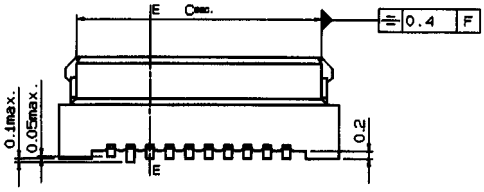
0,5 mm Spacing SERIES 5087

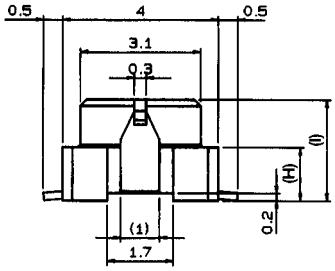
Surface Mount Vertical Plug

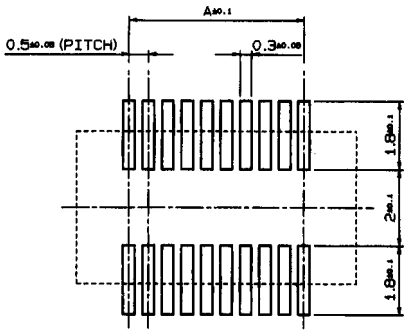




Specifications:
- 1000 per Tape and Reel
- Voltage - 50 V
- Current Rating - 0.4 A
- Dielectric Withstanding Voltage - 500 V
- Operating Temperature - (-25°C ~ +85°C)
- Contact Material - phosphor bronze
- Insulator Material - PPS (UL 94 V-0)







MOUNTING LAYOUT

No. of Pos.	P/N	A	B	C	D	G
20	10 5087 020 XX0 861	4.5/.177	7.2/.283	6.2/.244	5.5/.217	0.25/.0098
30	10 5087 030 XX0 861	7.0/.276	9.7/.382	8.7/.343	8.0/.315	0.50/.0196
36	10 5087 036 XX0 861	8.5/.335	11.2/.441	10.2/.402	9.5/.374	0.25/.0098
40	10 5087 040 XX0 861	9.5/.374	12.2/.480	11.2/.441	10.5/.414	0.25/.0098
50	10 5087 050 XX0 861	12.0/.472	14.7/.579	13.7/.539	13.0/.512	0.50/.0196
60	10 5087 060 XX0 861	14.5/.571	17.2/.677	16.2/.638	15.5/.610	0.25/.0098

Dimensions millimeters/inches

ORDERING CODE

Typical Example	14	5087	0XX	2XX	861

14: PLUG - Tape and Reel

NUMBER OF CONTACTS:

40, 60 : 3.0mm Stack
36, 40, 50 : 3.5mm Stack
20, 30, 36, 50, 60 : 4.0mm Stack

2: Without Adhesive Tape
9: Adhesive Cover Tape

VARIATION CODE:

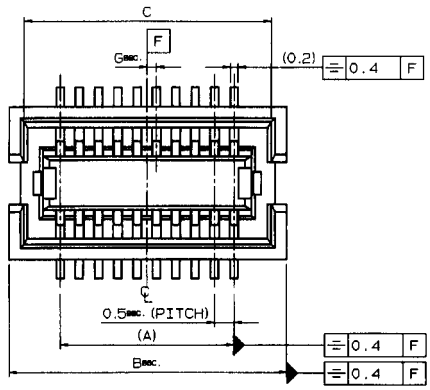
	H	I
30	.9	2.15
35	1.4	2.7
40	1.9	3.2

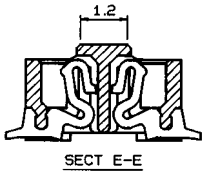
PLATING VARIATION:

861: 15 microinches of gold with gold flash tails

Consult factory for other sizes

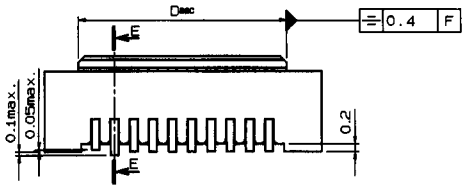
0,5 mm Spacing SERIES 5087

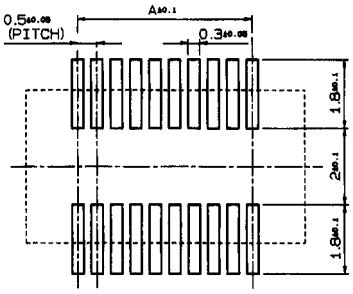




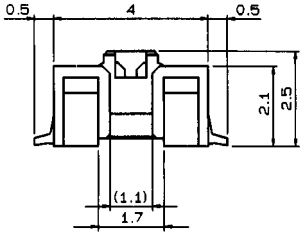
Surface Mount Vertical Receptacle

Specifications:
- 1000 per Tape and Reel
- Voltage - 50 V
- Current Rating - 0.4 A
- Dielectric Withstanding Voltage - 500 V
- Operating Temperature - (-25°C ~ +85°C)
- Contact Material - phosphor bronze
- Insulator Material - PPS (UL 94 V-0)





MOUNTING LAYOUT



No. of Pos.	P/N	A	B	C	D	G
20	20 5087 020 x00 861	4.5/.177	7.2/.283	6.4/.252	5.4/.213	0.25/.0098
30	20 5087 030 x00 861	7.0/.276	9.7/.382	8.9/.350	7.9/.311	0.50/.0196
36	20 5087 036 x00 861	8.5/.335	11.2/.441	10.4/.409	9.4/.370	0.25/.0098
40	20 5087 040 x00 861	9.5/.374	12.2/.480	11.4/.449	10.4/.409	0.25/.0098
50	20 5087 050 x00 861	12.0/.472	14.7/.579	13.9/.547	12.9/.508	0.50/.0196
60	20 5087 060 x00 861	14.5/.570	17.2/.677	16.4/.646	15.4/.606	0.25/.0098

Dimensions millimeters/inches

ORDERING CODE

Typical Example	24	5087	0XX	200	861

24: Receptacle - Tape and Reel

NUMBER OF CONTACTS:
20, 30, 36, 40, 50, 60

2: Without Adhesive Tape
9: Adhesive Cover Tape

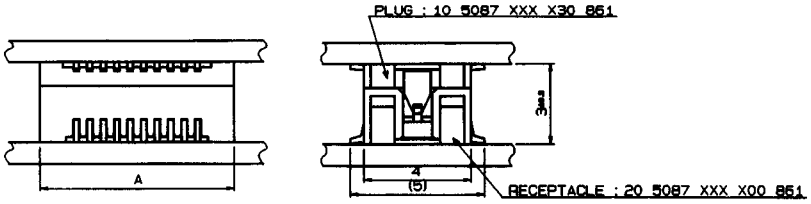
PLATING VARIATION:
861: 15 microinches of gold with gold flash tails

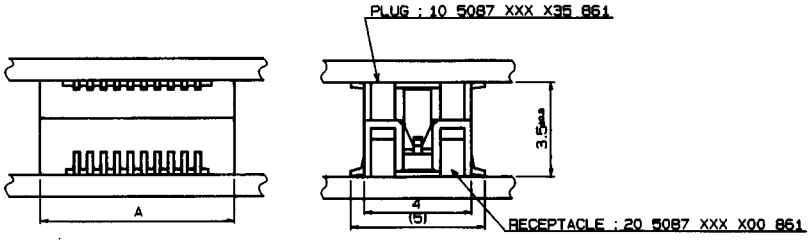
Consult factory for other sizes

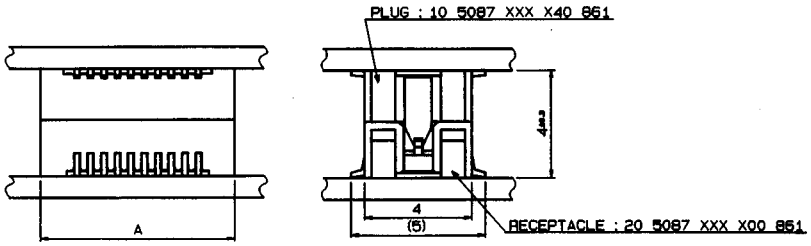
0,5 mm Spacing Applications

	P/N	Stacking Height
PLUG	10 5087 xxx x30 861	3.0
RECE.	20 5087 xxx x00 861	
PLUG	10 5087 xxx x35 861	3.5
RECE.	20 5087 xxx x00 861	
PLUG	10 5087 xxx x40 861	4.0
RECE.	20 5087 xxx x00 861	

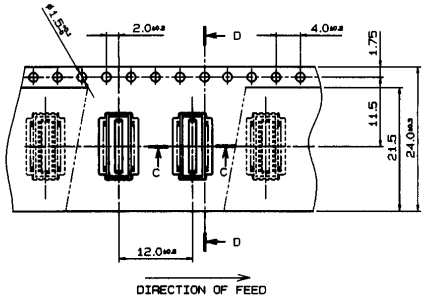
No. of Pos.	A
20	7.2/.283
30	9.7/.382
36	11.2/.441
40	12.2/.480
50	14.7/.579
60	17.2/.677

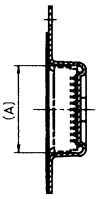


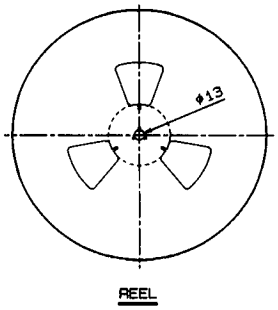


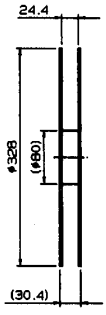


0,5 mm Spacing Tape and Reel



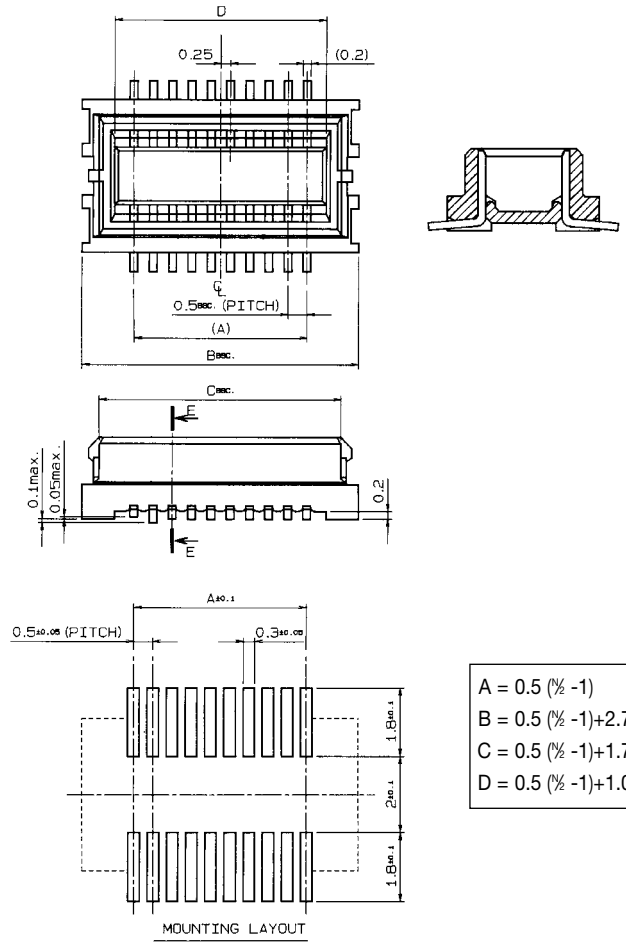






Super Micro Connectors 0.5mm Pitch

Series 5087 Plug



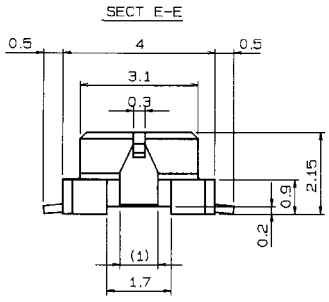
A = 0.5 (N -1)
B = 0.5 (N -1)+2.7
C = 0.5 (N -1)+1.7
D = 0.5 (N -1)+1.0

ORDERING CODE

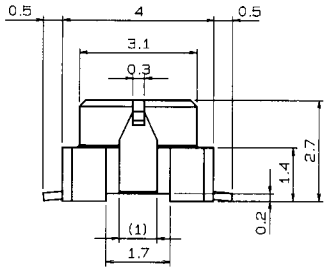
14 5087 0XX X XX 8XX

- FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.
- VARIATION
  - 30 : H = 3.0mm
  - 35 : H = 3.5mm
  - 40 : H = 4.0mm
- TYPE 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (20, 30, 32, 36, 40, 50, 60)
- SERIES
- TAPE AND REEL
  - 14 = Plug

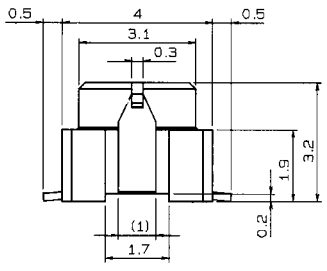
H = 3.0mm Type



H = 3.5mm Type

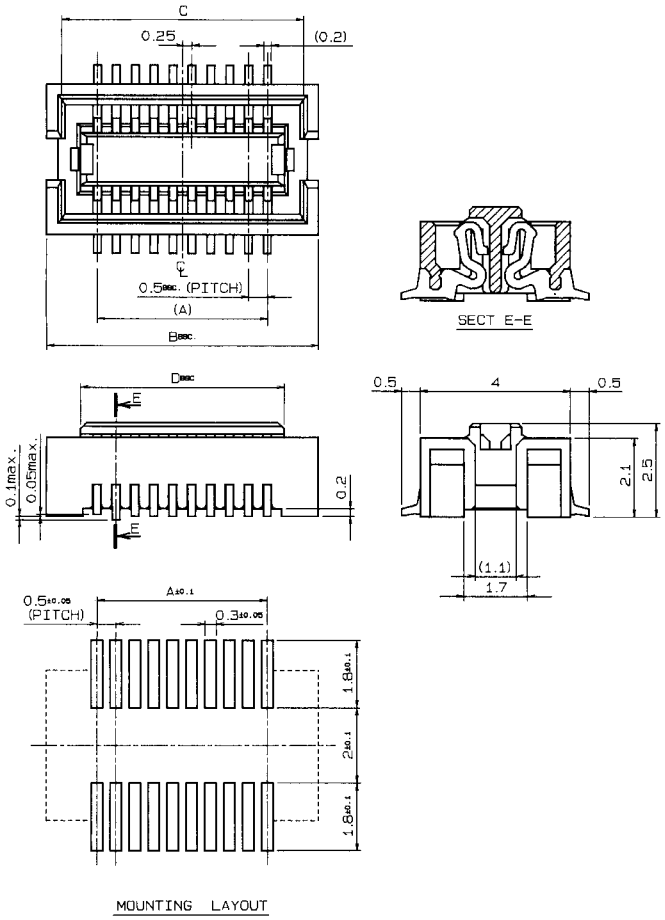


H = 4.0mm Type



Super Micro Connectors 0.5mm Pitch

Series 5087 Receptacle H = 3.0 ~ 4.0mm Type



ORDERING CODE

24 5087 0XX X 00 8XX

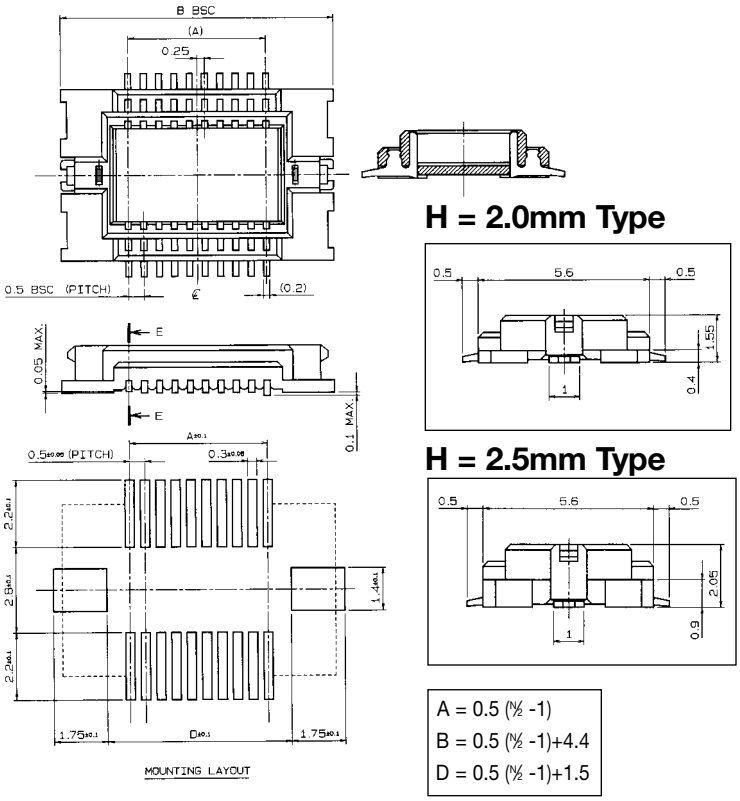
- 24 = TAPE AND REEL, Receptacle
- 5087 = SERIES
- 0XX = NUMBER OF POSITIONS (20, 30, 32, 36, 40, 50, 60)
- X = TYPE
  - 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- 00 = VARIATION, H = 3.0 ~ 4.0mm
- 8XX = FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.

A = 0.5 (½ -1)
B = A +2.7
C = A +1.9
D = A +0.9

Additional information on this product is available from AVX's catalog or AVX's FAX Service.
Call 1-800-879-1613 and request document **#270**. Visit our website http://www.avxcorp.com

Super Micro Connectors 0.5mm Pitch

Series 5087 Plug



H = 2.0mm Type

H = 2.5mm Type

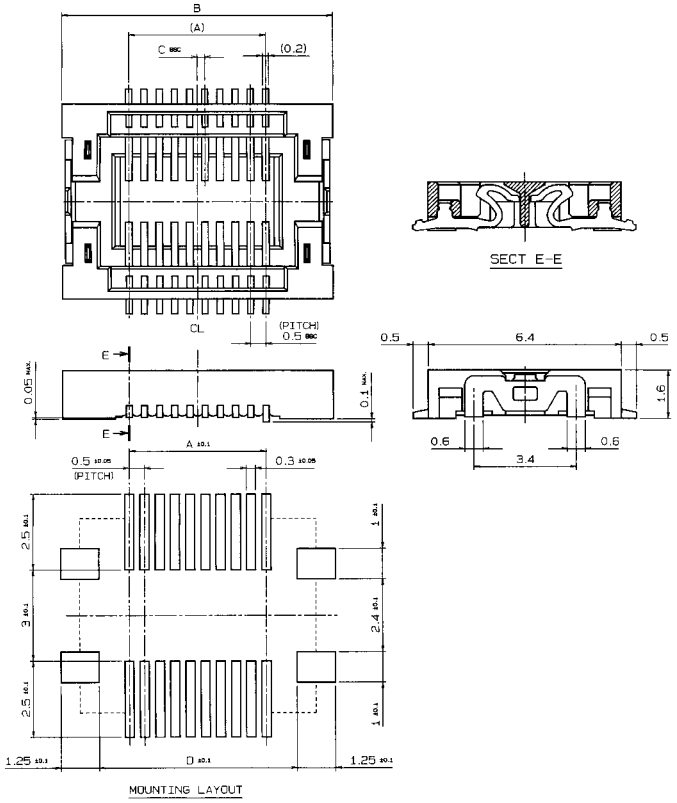
A = 0.5 (N -1)
B = 0.5 (N -1)+4.4
D = 0.5 (N -1)+1.5

ORDERING CODE

14 5087 0XX X XX 8XX

- FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.
- VARIATION
  - 20 : H = 2.0mm
  - 25 : H = 2.5mm
- TYPE 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (10*, 20, 30, 40, 50, 60) *2.0mm H only
- SERIES
- TAPE AND REEL
  - 14 = Plug

Series 5087 Receptacle H = 2.0 ~ 2.5mm Type



ORDERING CODE

24 5087 0XX X 01 8XX

- FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.
- VARIATION
  - H = 2.0 ~ 2.5mm
- TYPE 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (10, 20, 30, 40, 50, 60)
- SERIES
- TAPE AND REEL
  - 24 = Receptacle

Additional information on this product is available from AVX's catalog or AVX's FAX Service. Call 1-800-879-1613 and request document **#271.** Visit our website http://www.avxcorp.com