UC864-E-AUTO
UC864-AWS-AUTO

Hardware User Guide

1vv0300795 Rev. 11 – 2010/11/18

Making machines talk.

This document is relating to the following products:

PRODUCT
UC864-E-AUTO
UC864-AWS-AUTO

Disclaimer

Contents

1. Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit UC864-E-AUTO and UC864-AWS-AUTO modules. In this document all the basic functions of a mobile phone will be taken into account; for each one of them a proper hardware solution will be suggested and eventually the wrong solutions and common errors to be avoided will be evidenced. Obviously this document cannot embrace the whole hardware solutions and products that may be designed. The wrong solutions to be avoided must be considered as mandatory, while the suggested hardware configurations must not be considered mandatory, instead the information given must be used as a guide and a starting point for properly developing your product with the Telit UC864-E-AUTO & UC864-AWS-AUTO modules. For further hardware details that may not be explained in this document refer to the Telit UC864-E–AUTO & UC864-AWS-AUTO Product Description document where all the hardware information is reported.

NOTICE:

(EN) The integration of the GSM/GPRS/EGPRS/WCDMA/HSDPA UC864-E-AUTO & UC864-AWS-AUTO cellular module within user application must be done according to the design rules described in this manual.

(IT) L’integrazione del modulo cellulare GSM/GPRS/EGPRS/WCDMA/HSDPA UC864- E-AUTO e UC864-AWS-AUTO all’interno dell’applicazione dell’utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.

(DE) Die Integration des UC864- E-AUTO & UC864-AWS-AUTO GSM/GPRS/EGPRS/WCDMA/HSDPA Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Kunstruktionsregeln erfolgen

(SL) Integracija GSM/GPRS/EGPRS/WCDMA/HSDPA UC864- E-AUTO & UC864-AWS-AUTO modula v uporabniški aplikaciji bo morala upoštevati projektna navodila, opisana v tem piročniku.

(SP) La utilización del modulo GSM/GPRS/EGPRS/WCDMA/HSDPA UC864- E-AUTO & UC864-AWS-AUTO debe ser conforme a los usos para los cuales ha sido deseñado descritos en este manual del usuario.

(FR) L’intégration du module cellulaire GSM/GPRS/EGPRS/WCDMA/HSDPA UC864- E-AUTO & UC864-AWS-AUTO dans l’application de l’utilisateur sera faite selon les règles de conception décrites dans ce manuel.

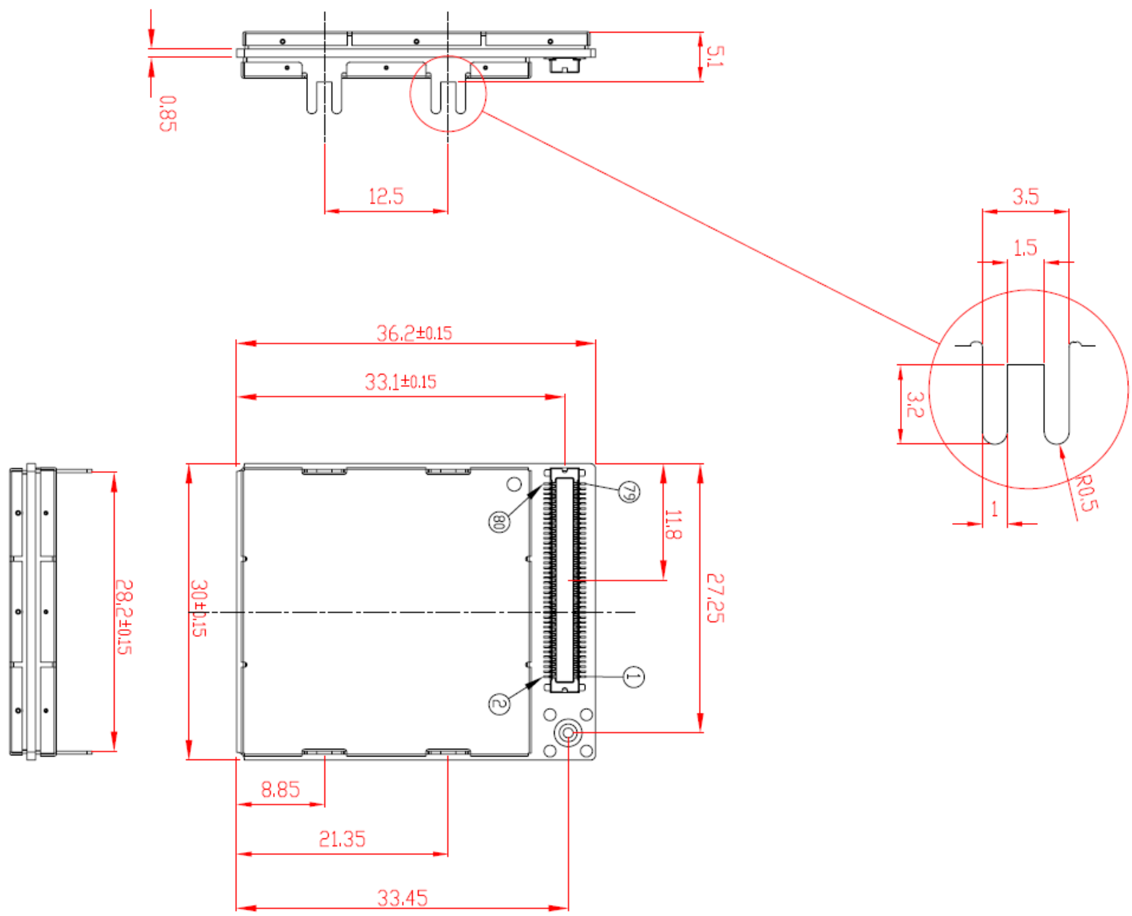
(HE) האינטגרטור מתבקש ליישם את ההנחיות המפורטות במסמך זה בתהליך האינטגרציה של המודם הסלולרי UC864- E-AUTO / AWS עם המוצר.

2. Mechanical Dimensions

2.1. UC864-E-AUTO / AWS-AUTO Mechanical Dimensions

The Telit UC864-E-AUTO / AWS-AUTO module overall dimensions are:

- Length: 36.2 mm
- Width: 30.0 mm
- Thickness: 5.1mm



3. UC864-E-AUTO / AWS-AUTO Module Connections

3.1. PIN-OUT

UC864-E-AUTO / AWS-AUTO uses an 80 pin Molex p.n. 53949-0878 male connector for the connections with the external applications. This connector matches the 54150-0878 models.

Pin	Signal	I/O	Function	Internal Pull up	Type
Power Supply					
1	VBATT	-	Main power supply		Power
2	VBATT	-	Main power supply		Power
3	VBATT	-	Main power supply		Power
4	VBATT	-	Main power supply		Power
5	GND	-	Ground		Power
6	GND	-	Ground		Power
7	GND	-	Ground		Power
Audio					
8	AXE	I	Hands-free switching		CMOS 2.6V
9	EAR_HF+	AO	Hands-free ear output, phase +		Audio
10	EAR_HF-	AO	Hands-free ear output, phase -		Audio
11	EAR_MT+	AO	Handset earphone signal output, phase +		Audio
12	EAR_MT-	AO	Handset earphone signal output, phase -		Audio
13	MIC_HF+	AI	Hands-free microphone input; phase +		Audio
14	MIC_HF-	AI	Hands-free microphone input; phase -		Audio
15	MIC_MT+	AI	Handset microphone signal input; phase+		Audio
16	MIC_MT-	AI	Handset microphone signal input; phase-		Audio
SIM Card Interface					
18[1]	SIMVCC	-	External SIM signal – Power supply for the SIM		1.8 / 3V
19	SIMRST	O	External SIM signal – Reset		1.8 / 3V
20	SIMIO	I/O	External SIM signal - Data I/O		1.8 / 3V
21	SIMIN	I	External SIM signal - Presence (active low)		CMOS 2.6V
22	SIMCLK	O	External SIM signal – Clock		1.8 / 3V
Trace					
23	RX_TRACE	I	RX Data for debug monitor		CMOS 2.6V
24	TX_TRACE	O	TX Data for debug monitor		CMOS 2.6V

[1] On this line a maximum of 10nF bypass capacitor is allowed

Pin	Signal	I/O	Function	Internal Pull up	Type
Prog. / Data + Hw Flow Control					
25	C103/TXD	I	Serial data input (TXD) from DTE	Pull-Down	CMOS 2.6V
26	C104/RXD	O	Serial data output to DTE	Pull-Up	CMOS 2.6V
27	C107/DSR	O	Output for Data set ready signal (DSR) to DTE	Pull-Down	CMOS 2.6V
28	C106/CTS	O	Output for Clear to send signal (CTS) to DTE	Pull-Up	CMOS 2.6V
29	C108/DTR	I	Input for Data terminal ready signal (DTR) from DTE	Pull-Up	CMOS 2.6V
30	C125/RING	O	Output for Ring indicator signal (RI) to DTE	Pull-Up	CMOS 2.6V
31	C105/RTS	I	Input for Request to send signal (RTS) from DTE	Pull-Down	CMOS 2.6V
32	C109/DCD	O	Output for Data carrier detect signal (DCD) to DTE	Pull-Up	CMOS 2.6V
Miscellaneous Functions					
35	USB_ID	AI	Analog input used to sense whether a peripheral device is connected, and determine the peripheral type, a host or a peripheral		Analog
36	PCM_CLOCK	I/O	PCM clock out	Pull-Down	CMOS 2.6V
DAC and ADC					
37	ADC_IN1	AI	Analog/Digital converter input		A/D
38	ADC_IN2	AI	Analog/Digital converter input		A/D
39	ADC_IN3	AI	Analog/Digital converter input		A/D
40	DAC_OUT	AO	Digital/Analog converter output		D/A
Miscellaneous Functions					
45	STAT_LED	O	Status indicator led		CMOS 1.8V
46	GND	-	Ground		Ground
48	USB_VBUS	AI /AO	Power supply for the internal USB transceiver. This pin is configured as an analog input or an analog output depending upon the type of peripheral device connected.	47KΩ *pull-down*	4.4V ~5.25V
49	PWRMON	O	Power ON Monitor	1KΩ	CMOS 2.6V
50	VAUX1	-	Power output for external accessories		
51	CHARGE	AI	Charger input	10KΩ *pull-down*	Power
52	CHARGE	AI	Charger input		Power
53	ON/OFF	I	Input command for switching power ON or OFF (toggle command).		Pulled up on chip
54	RESET	I	Reset input	10KΩ	
55	VRTC	AO	Power supply for RTC block		Power
Telit GPIOs					
56	GPIO_19	I/O	GPIO19 Configurable GPIO		CMOS 2.6V
57	GPIO_11	I/O	GPIO11 Configurable GPIO		CMOS 2.6V
58	GPIO_20	I/O	GPIO20 Configurable GPIO		CMOS 2.6V
59	GPIO_04	I/O	GPIO4 Configurable GPIO		CMOS 2.6V
60	GPIO_14	I/O	GPIO14 Configurable GPIO		CMOS 2.6V
61	GPIO_15	I/O	GPIO15 Configurable GPIO		CMOS 2.6V

Pin	Signal	I/O	Function	Internal Pull up	Type
62	GPIO_12	I/O	GPIO12 Configurable GPIO		CMOS 2.6V
63	GPIO_10/ PCM_TX	I/O	GPIO10 Configurable GPIO / PCM Data Output	Pull-Down	CMOS 2.6V
64	GPIO_22	I/O	GPIO22 Configurable GPIO		CMOS 1.8V
65	GPIO_18/ PCM_RX	I/O	GPIO18 Configurable GPIO / PCM Data input	Pull-Down	CMOS 2.6V
66	GPIO_03	I/O	GPIO3 Configurable GPIO		CMOS 2.6V
67	GPIO_08	I/O	GPIO8 Configurable GPIO		CMOS 2.6V
68	GPIO_06 / ALARM	I/O	GPIO6 Configurable GPIO / ALARM		CMOS 2.6V
70	GPIO_01	I/O	GPIO1 Configurable GPIO		CMOS 2.6V
71	GPIO_17/ PCM_SYNC	I/O	GPIO17 Configurable GPIO / PCM Sync	Pull-Down	CMOS 2.6V
72	GPIO_21	I/O	GPIO21 Configurable GPIO		CMOS 2.6V
73	GPIO_07/ BUZZER	I/O	GPIO7 Configurable GPIO / Buzzer		CMOS 2.6V
74	GPIO_02	I/O	GPIO02 I/O pin		CMOS 2.6V
75	GPIO_16	I/O	GPIO16 Configurable GPIO		CMOS 2.6V
76	GPIO_09	I/O	GPIO9 Configurable GPIO		CMOS 2.6V
77	GPIO_13	I/O	GPIO13 Configurable		CMOS 2.6V
78	GPIO_05/ RFTXMON	I/O	GPIO05 Configurable GPIO / Transmitter ON monitor		CMOS 2.6V
USB Interface					
79	USB_D+	I/O	USB differential Data (+)		3.0V ~3.6V
80	USB_D-	I/O	USB differential Data (-)		3.0V ~3.6V
RESERVED					
17		-			
33					
34					
41		-			
42		-			
43		-			
44		-			
47		-			
69		-			

NOTE: RESERVED pins must not be connected

RTS must be connected to the GND (on the module side) if flow control is not used

Note:

If not used, almost all pins must be left disconnected. The only exceptions are the following:

Pin	Signal	Function
1	VBATT	Main power supply
2	VBATT	Main power supply
3	VBATT	Main power supply
4	VBATT	Main power supply
5	GND	Ground
6	GND	Ground
7	GND	Ground
46	GND	Ground
25	C103/TXD	Serial data input (TXD) from DTE
26	C104/RXD	Serial data output to DTE
31	C105/RTS	Input for Request to send signal (RTS) from DTE
53	ON/OFF	Input command for switching power ON or OFF (toggle command).
54	RESET	Reset input

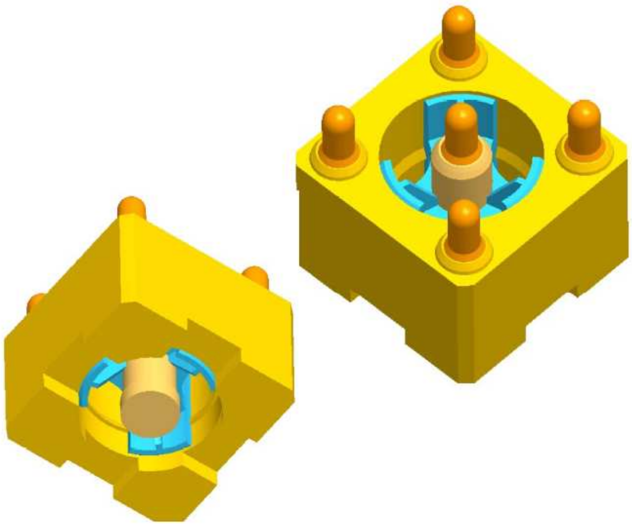
4. TEMPERATURE RANGE

The UC864-E-AUTO / AWS-AUTO Temperature ranges are:

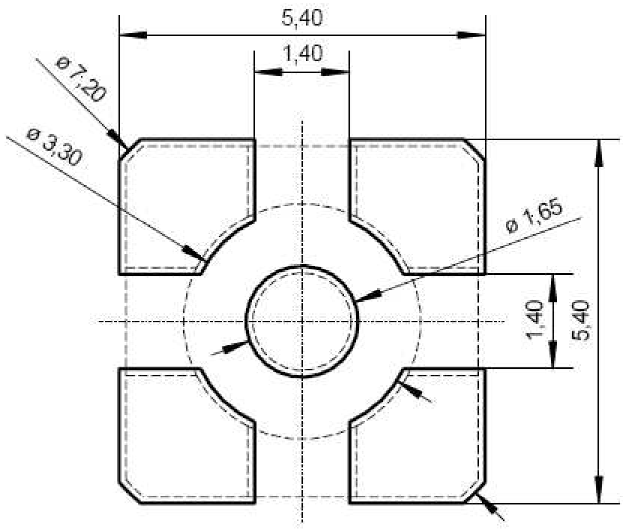
Reference Ambient Temperature	
Normal Operating	-10°C to +55°C
Extended Operating	-20°C to +70°C
Extreme Range	-30°C to +85°C
Storage	-40°C to +85°C

4.1. Antenna Connector(s)

The UC864-E-AUTO / AWS-AUTO module is designed with a 50 Ohm RF PAD that permits to interface it with an application equipped by a Rosenberger coaxial Board to board connector.
The counterpart suitable is a Rosenberger 99CI106-030L5.



Suggested footprint on the application side:



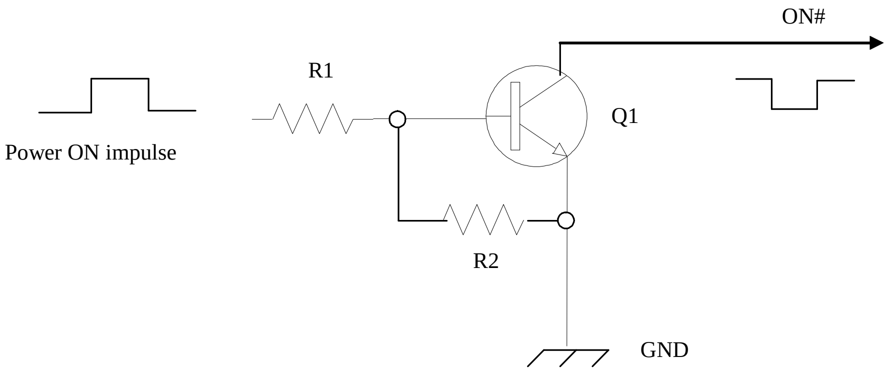
5. Hardware Commands

5.1. Turning ON the UC864-E-AUTO / AWS-AUTO

To turn on UC864-E-AUTO / AWS-AUTO, the pad ON# must be tied low for at least 1 second and then released.

The maximum current that can be drained from the ON# pad is 0,1 mA.

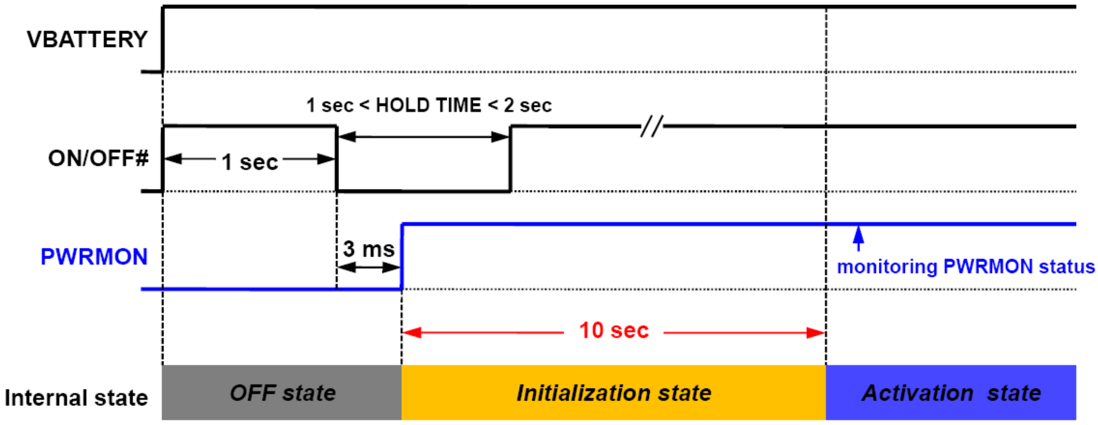
A simple circuit to do it is:



5.2. Initialization and Activation state

Upon turning on UC864-E-AUTO / AWS-AUTO, the module is not activated yet because the boot sequence of UC864-E-AUTO / AWS-AUTO is still going on internally. It takes about 10 seconds to complete the initializing the module internally.

For this reason, it would be useless to try to access UC864-E-AUTO/ AWS-AUTO during a *Initialization state* as below. To get the desirable stability, UC864-E-AUTO / AWS-AUTO needs at least 10 seconds after the PWRMON goes High.



During the *Initialization state*, any kind of AT-command is not available. DTE must be waiting for the *Activation state* to communicate with UC864-E-AUTO / AWS-AUTO.

NOTE:

To check if the UC864-E-AUTO / AWS-AUTO has powered on, the hardware line PWRMON must be monitored. When PWRMON goes high, the module has powered on.

NOTE:

Do not use any pull up resistor on the ON/OFF# line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the UC864-E-AUTO / AWS-AUTO power regulator and improper power on/off of the module. The line ON/OFF# must be connected only in open collector configuration.

NOTE:

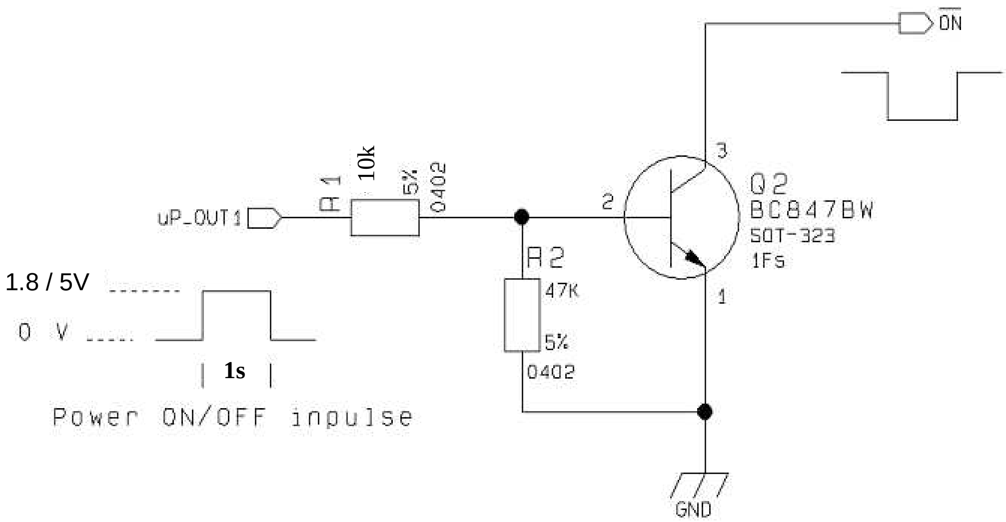
In this document all the lines are inverted. Active low signals are labeled with a name that ends with a "#" or with a bar over the name.

NOTE:

UC864-E-AUTO / AWS-AUTO turns fully on also by supplying power to the Charge pad (provided there is a battery on the VBATT pads).

For example:

1- Let us assume you need to drive the ON/OFF# pad with a totem pole output of a +1.8/5 V microcontroller (uP_OUT1):



5.3. Turning OFF the UC864-E-AUTO / AWS-AUTO

Turning off the device can be done in three ways:

- by software command (see UC864-E-AUTO / AWS-AUTO Software User Guide)
- by hardware shutdown
- by Hardware Unconditional Restart

When the device is shut down by software command or by hardware shutdown, it issues to the network a detach request that informs the network that the device will not be reachable any more.

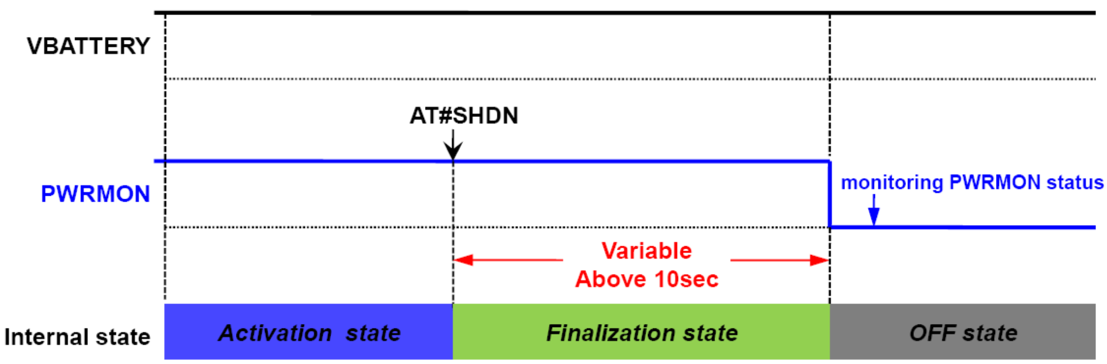
5.3.1. Shutdown by Software Command

UC864-E-AUTO / AWS-AUTO can be shut down by a software command.

When a shut down command is sent, UC864-E-AUTO / AWS-AUTO goes into the finalization state and finally will shut down PWRMON at the end of this state.

The period of the finalization state can differ according to the situation in which the UC864-E-AUTO / AWS-AUTO is so it cannot be fixed definitely.

Normally it will be above 10 seconds later from sending a shut down command and DTE should monitor the status of PWRMON to see the actual power off.



TIP:

To check if the device has powered off, hardware line PWRMON must be monitored. When PWRMON goes low, the device has powered off.

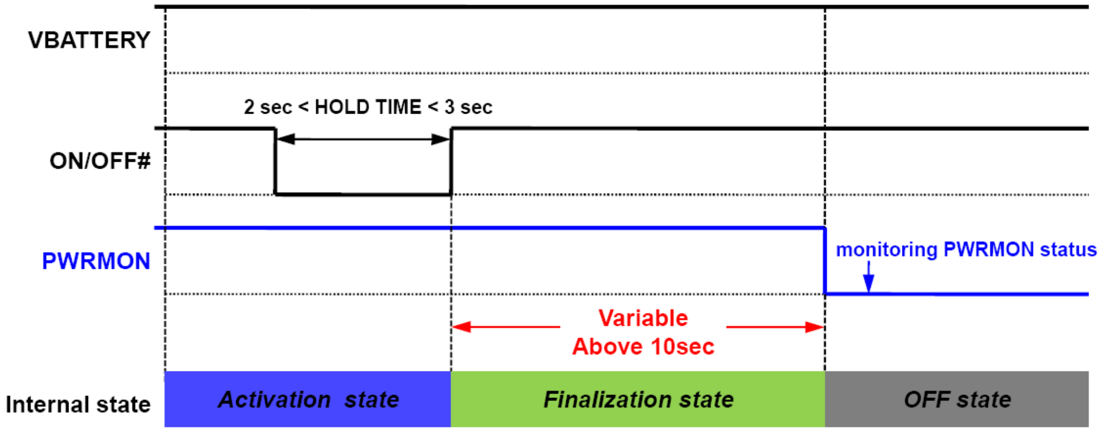
5.3.2. Hardware Shutdown

To turn OFF UC864-E-AUTO / AWS-AUTO the pad ON/OFF# must be tied low for at least 2 seconds and then released. Same circuitry and timing for the power on must be used.

When the hold time of ON/OFF# is above 2 seconds, UC864-E-AUTO / AWS-AUTO goes into the finalization state and finally will shut down PWRMON at the end of this state.

The period of the finalization state can differ according to the situation in which the UC864-E-AUTO / AWS-AUTO is so it cannot be fixed definitely.

Normally it will be above 10 seconds later from releasing ON/OFF# and DTE should monitor the status of PWRMON to see the actual power off.



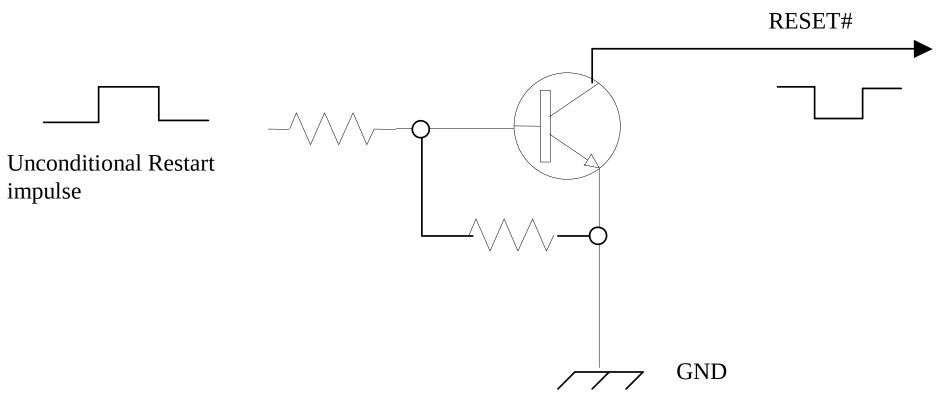
TIP:

To check if the device has powered off, hardware line PWRMON must be monitored. When PWRMON goes low, the device has powered off.

5.3.3. Hardware Unconditional Restart

To unconditionally restart UC864-E-AUTO / AWS-AUTO, the pad RESET# must be tied low for at least 200 milliseconds and then released.

A simple circuit to do it is:



NOTE:

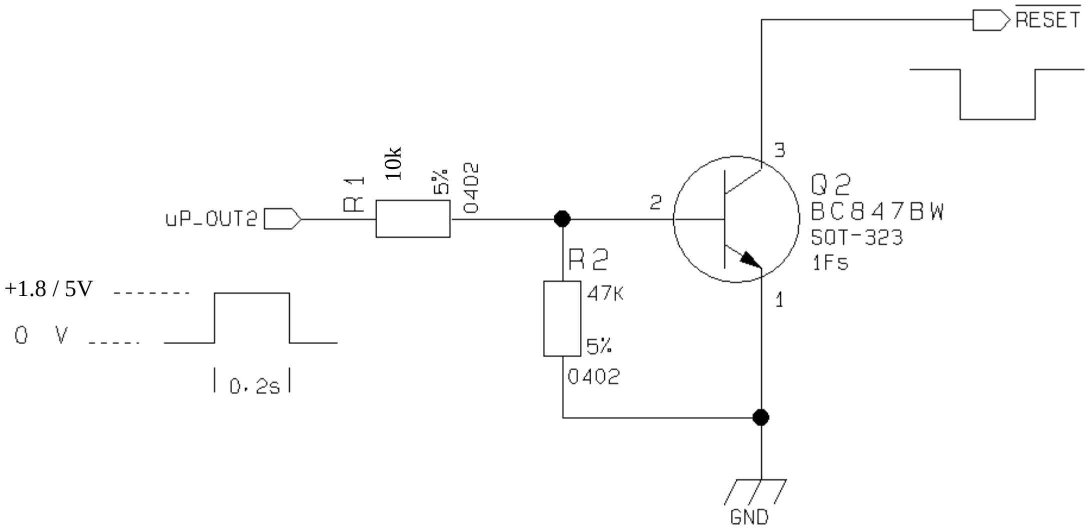
Do not use any pull up resistor on the RESET# line or any totem pole digital output. Using pull up resistor may bring to latch up problems on the UC864-E-AUTO / AWS-AUTO power regulator and improper functioning of the module. The line RESET# must be connected only in open collector configuration.

TIP:

The unconditional hardware Restart must always be implemented on the boards and the software must use it as an emergency exit procedure.

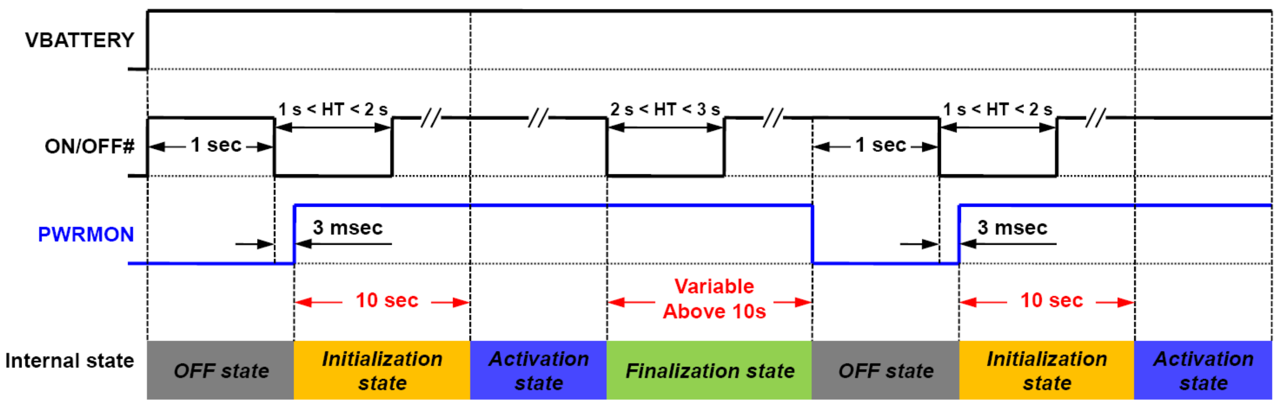
For example:

1- Let us assume you need to drive the RESET# pad with a totem pole output of a +1.8/5 V microcontroller (uP_OUT2):



5.4. Summary of Turning ON and OFF the module

Below chart describes the overall sequences for Turning ON and OFF.



6. Power Supply

The power supply circuitry and board layout are a very important part in the full product design and they strongly reflect on the product overall performances. Read carefully the requirements and the guidelines that will follow for a proper design.

6.1. Power Supply Requirements

The UC864-E-AUTO / AWS-AUTO power requirements are:

Power Supply	
Nominal Supply Voltage	3.8V
Max Supply Voltage	4.2V
Supply Voltage Range	3.4V – 4.2V

UC864-E-AUTO/ AWS-AUTO			
Mode		Average(mA)	Mode Description
IDLE mode			Stand by mode; no call in progress
AT+CFUN=1	WCDMA	22.0	Normal mode; full functionality of the module
	GSM	15.0	
AT+CFUN=4	WCDMA	17.8	Disabled TX and RX; modules is not registered on the network
	GSM	17.8	
AT+CFUN=0 or AT+CFUN=5	WCDMA	4.1 / 1.3*	Power saving; CFUN=0 module registered on the network and can receive voice call or an SMS; but it is not possible to send AT commands; module wakes up with an unsolicited code (call or SMS) or rising RTS line. CFN=5 full functionality with power saving; Module registered on the network can receive incoming call sand SMS
	GSM	3.3 / 1.3*	
WCDMA TX and RX mode			
WCDMA Voice	690		WCDMA voice channel
WCDMA data	680		WCDMA data channel
HSDPA	730		HSDPA data channel
GSM TX and RX mode			
GSM Voice	320		GSM voice channel
GPRS Class12	650		GPRS data channel
EDGE Class12	430		EDGE data channel

* Worst/best case depends on network configuration and is not under module control.

In GSM/GPRS mode, RF transmission is not continuous and it is packed into bursts at a base frequency of about 216 Hz, and the relative current peaks can be as high as about 2A. Therefore the power supply has to be designed in order to withstand these current peaks without big voltage drops; this means that both the electrical design and the board layout must be designed for this current flow. If the layout of the PCB is not well designed, a strong noise floor is generated on the ground; this will reflect on all the audio paths producing an audible annoying noise at 216 Hz; if the voltage drops during the peak, current absorption is too much. The device may even shut

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TIP:

The electrical design for the Power supply must be made ensuring that it will be capable of a peak current output of at least 2A.

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down as a consequence of the supply voltage drop.

6.2. General Design Rules

The principal guidelines for the Power Supply Design embrace three different design steps:

- the electrical design
- the thermal design
- the PCB layout

6.2.1. Electrical Design Guidelines

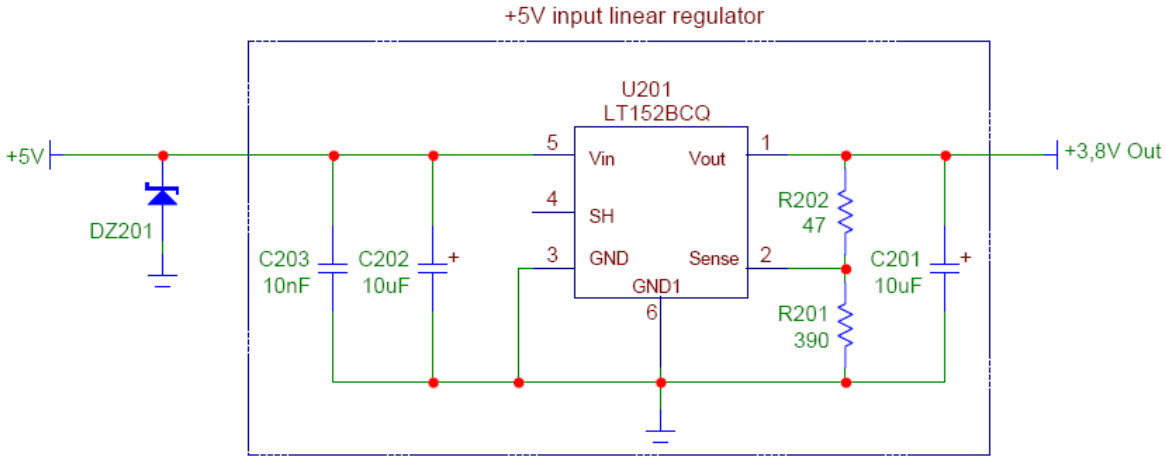
The electrical design of the power supply depends strongly on the power source where this power is drained. We will distinguish them into three categories:

- +5V input (typically PC internal regulator output)
- +12V input (typically automotive)
- battery

6.2.1.1. + 5V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence there is not a big difference between the input source and the desired output and a linear regulator can be used. A switching power supply will not be suited because of the low drop-out requirements.
- When using a linear regulator, a proper heat sink must be provided in order to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks close to UC864-E-AUTO / AWS-AUTO, a 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input, in order to save UC864-E-AUTO / AWS-AUTO from power polarity inversion.

An example of linear regulator with 5V input is:

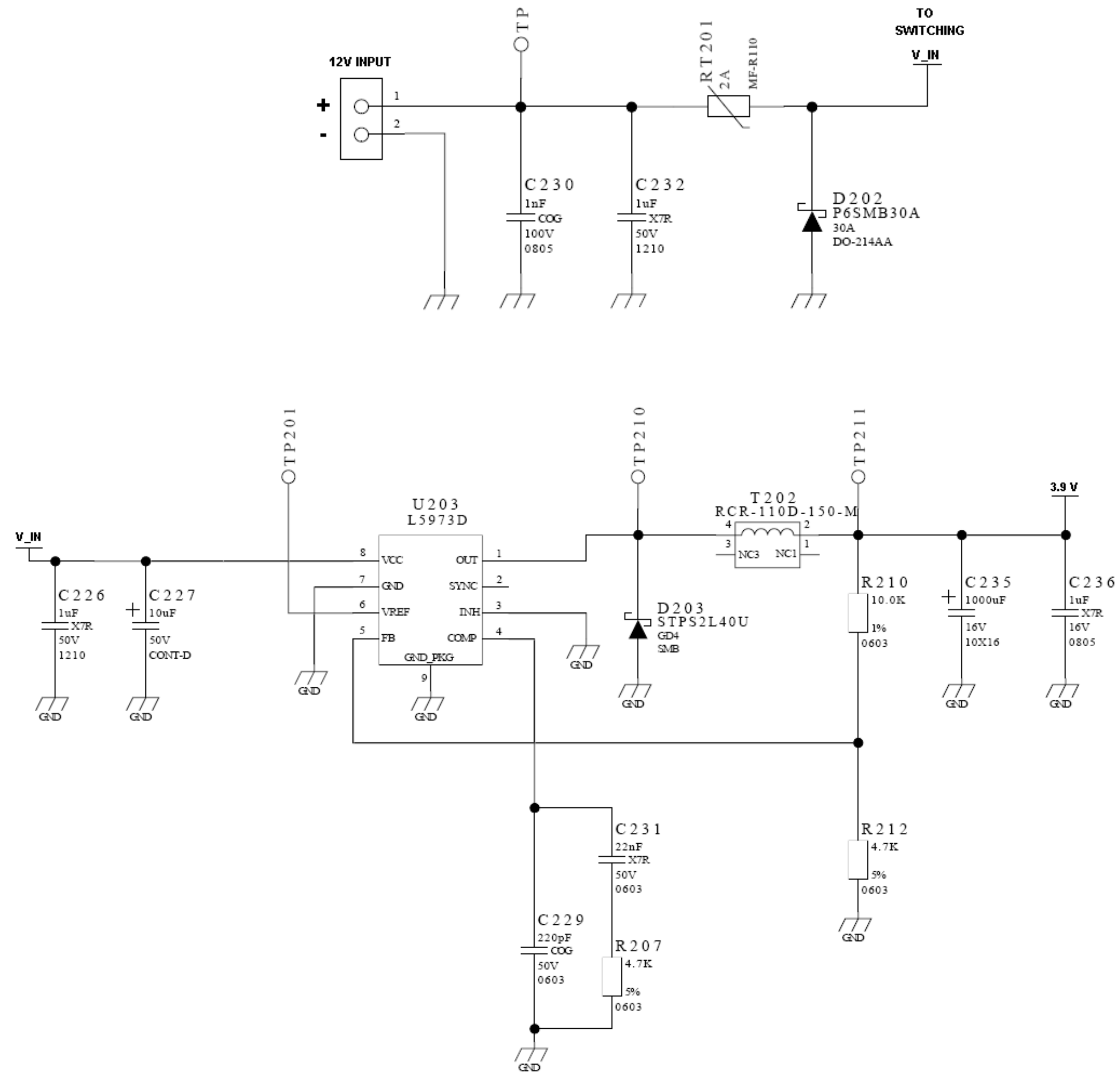


6.2.1.2. + 12V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence due to the big difference between the input source and the desired output, a linear regulator is not suited and must not be used. A switching power supply will be preferable because of its better efficiency especially with the 2A peak current load represented by UC864-E-AUTO / AWS-AUTO.
- When using a switching regulator, a 500kHz or more switching frequency regulator is preferable because of its smaller inductor size and its faster transient response. This allows the regulator to respond quickly to the current peaks absorption.
- In any case, the frequency and Switching design selection is related to the application to be developed due to the fact the switching frequency could also generate EMC interferences.
- For car PB battery the input voltage can rise up to 15.8V and this must be kept in mind when choosing components: all components in the power supply must withstand this voltage.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks. A 100μF tantalum capacitor is usually suited for this.

- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode must be inserted close to the power input, in order to clean the supply from spikes.
- A protection diode must be inserted close to the power input, in order to save UC864-E-AUTO / AWS-AUTO from power polarity inversion. This can be the same diode as for spike protection.

An example of switching regulator with 12V input is in the below schematic (it is split in 2 parts):



SWITCHING REGULATOR

6.2.1.3. Battery Source Power Supply Design Guidelines

- The desired nominal output for the power supply is 3.8V and the maximum allowed voltage is 4.2V, hence a single 3.7V Li-Ion cell battery type is suited for supplying the power to the Telit UC864-E-AUTO / AWS-AUTO module. The three cells Ni/Cd or Ni/MH 3.6 V Nom. battery types or 4V PB types must not be used directly since their maximum voltage can rise over the absolute maximum voltage for UC864-E-AUTO / AWS-AUTO and damage it.

NOTE:

Do not use any Ni-Cd, Ni-MH, and Pb battery types directly connected with UC864-E-AUTO / AWS-AUTO. Their use can lead to overvoltage on UC864-E-AUTO / AWS-AUTO and damage it. Use only Li-Ion battery types.

- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks, a 100μF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input, in order to save UC864-E-AUTO / AWS-AUTO from power polarity inversion. Otherwise the battery connector must be done in a way to avoid polarity inversions when connecting the battery.
- The battery capacity must be at least 500mAh in order to withstand the current peaks of 2A; the suggested capacity is from 500mAh to 1000mAh.

6.2.1.4. Battery Charge Control Circuitry Design Guidelines

The charging process for Li-Ion Batteries can be divided into 4 phases:

- qualification and trickle charging
- fast charge 1 - constant current
- final charge - constant voltage or pulsed charging
- maintenance charge

The qualification process consists of a battery voltage measure, indicating roughly its charge status. If the battery is deeply discharged, meaning its voltage is lower than the trickle charging threshold, then charging must start slowly, possibly with a current limited to the pre-charging process. The current must be kept very low with respect to the fast charge value.

During trickle charging the voltage across the battery terminals rises; when it reaches the fast charge threshold level the charging process goes into a fast charge phase.

During the fast charge phase the process proceeds with a current limited for charging; this current limit depends on the required time for completing the charge and on battery pack capacity. During this phase the voltage across the battery terminals still raises but at a lower rate. Once the battery voltage reaches its maximum voltage the process goes into its third state: Final charging. The voltage measure to change the process status into final charge is very important. It must be ensured that the maximum battery voltage is never exceeded, otherwise the battery may be damaged and even explode.

Moreover, for constant final chargers, the voltage phase (final charge) must not start before the battery voltage has reached its maximum value, otherwise the battery capacity will be slightly reduced. The final charge can be of two different types: constant voltage or pulsed. UC864-E-AUTO / AWS-AUTO uses constant voltage.

The constant voltage charge proceeds with a fixed voltage regulator (very accurately set to the maximum battery voltage) and the current will decrease while the battery is becoming charged. When the charging current falls below a certain fraction of the fast charge current value, the battery is considered fully charged, the final charge stops and eventually starts the maintenance.

The pulsed charge process has no voltage regulation, instead charge continues with pulses. Usually the pulse charge works in the following manner: the charge is stopped for some time, let us say few hundreds of ms, then the battery voltage will be measured and when it drops below its maximum value, a fixed time length charging pulse is issued. As the battery approaches its full charge, the off time will become longer and the duty-cycle of the pulses will decrease. The battery is considered fully charged when the pulse duty-cycle is less than a threshold value, typically 10%. When this happens, the pulse charge stops and eventually the maintenance starts.

The last phase is not properly a charging phase, since the battery at this point is fully charged and the process may stop after the final charge. The maintenance charge provides an additional charging process to compensate the charge leak typical of a Li-Ion battery. It is done by issuing pulses with a fixed time length, again few hundreds of ms, and a duty-cycle around 5% or less.

This last phase is not implemented in the UC864-E-AUTO / AWS-AUTO internal charging algorithm so once-charged battery is left discharging down to a certain threshold. It is cycled from full charge to slight discharge even if the battery charger is inserted. This guarantees that the remaining charge in the battery is a good percentage and that the battery is not damaged by keeping it always fully charged (Li-Ion rechargeable batteries usually deteriorate when kept fully charged).

Last but not least, in some applications, it is highly desired that the charging process restarts when the battery is discharged and its voltage drops below a certain threshold. This is typical for the UC864-E-AUTO / AWS-AUTO internal charger.

As you can see, the charging process is not a trivial task to do; moreover all these operations must start only if battery temperature is inside charging range, usually 5°C - 45°C.

The UC864-E-AUTO / AWS-AUTO measures the temperature of its internal component in order to satisfy this last requirement. This not exactly the same as the battery temperature but in common use, the two temperatures must not differ too much and the charging temperature range must be guaranteed.

NOTE:

For all the threshold voltages, inside UC864-E-AUTO / AWS-AUTO, all thresholds are fixed in order to maximize Li-Ion battery performances and do not need to be changed.

NOTE:

In this application the battery charger input current must be limited to less than 400mA. This can be done by using a current limited wall adapter as the power source.

NOTE:

When starting the charger from Module powered off, the startup will be in CFUN4; to activate the normal mode a command AT+CFUN=1 has to be provided.

There is also the possibility to activate the normal mode using the ON_OFF* signal.

In this case, when HW powering off the module with the same line (ON_OFF*) and having the charger still connected, the module will go back to CFUN4.

NOTE:

It is important to have a 100ųF Capacitor to VBAT in order to avoid instability of the charger circuit if the battery is accidentally disconnected during the charging activity.

6.2.2. Thermal Design Guidelines

The thermal design for the power supply heat sink must be done with the following specifications:

- Average current consumption during HSDPA transmission @PWR level max in UC864-E-AUTO / AWS-AUTO : 730mA
- Average current consumption during class12 GPRS transmission @PWR level max: 650mA

NOTE:

The average consumption during transmissions depends on the power level at which the device is requested to transmit via the network. The average current consumption hence varies significantly.

NOTE:

The thermal design for the Power supply must be made keeping an average consumption at the max transmitting level during calls of 730mA rms.

Considering the very low current during idle, especially if Power Saving function is enabled, it is possible to consider from the thermal point of view that the device absorbs current significantly only during calls.

If we assume that the device stays in transmission for short periods of time (let us say few minutes) and then remains for quite a long time in idle (let us say one hour), then the power supply has always the time to cool down between the calls and the heat sink could be smaller than the calculated for 730mA maximum RMS current. There could even be a simple chip package (no heat sink).

Moreover in average network conditions the device is requested to transmit at a lower power level than the maximum and hence the current consumption will be less than 730mA (being usually around 250mA).

For these reasons the thermal design is rarely a concern and the simple ground plane where the power supply chip is placed can be enough to ensure a good thermal condition and avoid overheating.

For the heat generated by the UC864-E-AUTO / AWS-AUTO, you can consider it to be during transmission 2W max. This generated heat will be mostly conducted to the ground plane under the UC864-E-AUTO / AWS-AUTO; you must ensure that your application can dissipate heat

In the WCDMA/HSDPA mode, since UC864-E-AUTO / AWS-AUTO emits RF signals continuously during transmission, you must pay special attention how to dissipate the heat generated.

The current consumption will be up to about 730mA in HSDPA (680mA in WCDMA) continuously at the maximum TX output power (24dBm). Thus, you must arrange the PCB area as large as possible under UC864-E-AUTO / AWS-AUTO which you will mount. You must mount UC864-E-AUTO / AWS-AUTO on the large ground area of your application board and make many ground vias to dissipate the heat.

The peak current consumption in the GSM mode is higher than that in WCDMA. However, considering the heat sink is more important in case of WCDMA.

As mentioned before, a GSM signal is bursty, thus, the temperature drift is more insensible than WCDMA. Consequently, if you prescribe the heat dissipation in the WCDMA mode, you don't need to think more about the GSM mode.

6.2.3. Power Supply PCB Layout Guidelines

As seen in the electrical design guidelines, the power supply must have a low ESR capacitor on the output to cut the current peaks and a protection diode on the input to protect the supply from spikes and polarity inversion. The placement of these components is crucial for the correct working of the circuitry. A misplaced component can be useless or can even decrease the power supply performances.

- The Bypass low ESR capacitor must be placed close to the Telit UC864-E-AUTO / AWS-AUTO power input pads, or in the case the power supply is a switching type, it can be placed close to the inductor to cut the ripple if the PCB trace from the capacitor to UC864-E-AUTO / AWS-AUTO is wide enough to ensure a drop-less connection even during the 2A current peaks.
- The protection diode must be placed close to the input connector where the power source is drained.
- The PCB traces from the input connector to the power regulator. IC must be wide enough to ensure no voltage drops to occur when the 2A current peaks are absorbed. Note that this is not made in order to save power loss but especially to avoid the voltage drops on the power line at the current peaks frequency of 216 Hz that will reflect on all the components connected to that supply (also introducing the noise floor at the burst base frequency.) For this reason while a voltage drop of 300-400 mV may be acceptable from the power loss point of view, the same voltage drop may not be acceptable from the noise point of view. If your application does not have audio interface but only uses the data feature of the Telit UC864-E-AUTO, then this noise is not so disturbing and power supply layout design can be more forgiving.
- The PCB traces to UC864-E-AUTO / AWS-AUTO and the Bypass capacitor must be wide enough to ensure no significant voltage drops to occur when the 2A current peaks are absorbed. This is a must for the same above-mentioned reasons. Try to keep this trace as short as possible.
- The PCB traces connecting the Switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the diode very close to the power switching IC (only for switching power supply). This is done in order to reduce the radiated field (noise) at the switching frequency (usually 100-500 kHz).
- The use of a good common ground plane is suggested.

- The placement of the power supply on the board must be done in a way to guarantee that the high current return paths in the ground plane are not overlapped to any noise sensitive circuitry as the microphone amplifier/buffer or earphone amplifier.
- The power supply input cables must be kept separately from noise sensitive lines such as microphone/earphone cables.

7. Antenna(s)

The antenna connection and board layout design are the most important parts in the full product design and they strongly reflect on the product's overall performances. Read carefully and follow the requirements and the guidelines for a proper design.

7.1. GSM/WCDMA Antenna Requirements

As suggested on the Product Description, the antenna for a Telit UC864-E-AUTO / AWS-AUTO device must fulfill the following requirements:

GSM /WCDMA ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth	**UC864-E-AUTO**
	80 MHz in GSM900, 170 MHz in DCS 250 MHz in WCDMA2100 band
	UC864-AWS-AUTO
	70 MHz in GSM850, 140 MHz in PCS 455 MHz in WCDMA1700(AWS) band WCDMA AWS band : TX = 45MHz, RX = 45MHz TX-RX freq. separation = 400MHz
Gain	Gain < 7.18 dBi (GSM 850), 2.78 dBi (PCS 1900) and 1.43 dBi (FDD IV)
Impedance	50 Ohm
Input power	> 33dBm(2 W) peak power in GSM > 24dBm Average power in WCDMA
VSWR absolute max	<= 10:1
VSWR recommended	<= 2:1

Furthermore if the device is developed for the US market, it must comply to the FCC approval requirements:

This device is to be used only for mobile and fixed application. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-Users must be provided with transmitter operation conditions for satisfying RF exposure compliance. OEM integrators must ensure that the end user has no manual instructions to remove or install the UC864-AWS-AUTO module. Antennas used for this OEM module must not exceed 7.18 dBi (GSM 850), 2.78 dBi (PCS 1900) and 1.43 dBi (FDD IV) gain for mobile and fixed operating configurations.

7.2. GSM/WCDMA Antenna - Installation Guidelines

- Install the antenna in a place covered by the GSM/WCDMA signal.
- The Antenna must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter;
- Antenna must not be installed inside metal cases;
- Antenna must be installed also according Antenna manufacturer instructions.

8. Logic Level Specifications

Where not specifically stated, all the interface circuits work at 2.6V CMOS logic levels. The following table shows the logic level specifications used in the Telit UC864-E-AUTO / AWS-AUTO interface circuits:

NOTE:

Do not connect UC864-E-AUTO / AWS-AUTO's digital logic signal directly to OEM's digital logic signal of with level higher than 3.0V.

For 2.6V CMOS signals:

Absolute Maximum Ratings -Not Functional

Parameter	UC864-E-AUTO / AWS-AUTO	
	Min	Max
Input level on any digital pin when on	-0.3V	+3.0V
Input voltage on analog pins when on	-0.3V	+3.0 V

Operating Range - Interface levels

Level	UC864-E-AUTO / AWS-AUTO	
	Min	Max
Input high level	2.0V	2.9 V
Input low level	-0.3V	0.6V
Output high level	2.15V	2.6V
Output low level	0V	0.45V

For 1,8V signals:

Operating Range - Interface levels (1.8V CMOS)

Level	UC864-E-AUTO / AWS-AUTO	
	Min	Max
Input high level	1.5V	2.1V
Input low level	-0.3V	0.5V
Output high level	1.35V	1.8V
Output low level	0V	0.45V

8.1. Reset Signal

Signal	Function	I/O	PIN Number
RESET	Phone reset	I	54

RESET is used to reset the UC864-E-AUTO / AWS-AUTO module. Whenever this signal is pulled low, UC864-E-AUTO / AWS-AUTO is reset. When the device is reset it stops all operations. After the release of the reset UC864-E-AUTO / AWS-AUTO is unconditionally shut down, without doing any detach operations from the network where it is registered. This behavior is not a proper shutdown because the device is requested to issue a detach request on turn off. For this reason, the Reset signal must not be used for normally shutting down the device, but only as an emergency exit in the rare case the device remains stuck waiting for some network response.

The RESET is internally controlled on start-up to achieve always a proper power-on reset sequence. There is no need to control this pin on start-up. It may only be used to reset a device already on, that is, not responding to any command.

NOTE:

Do not use this signal to power off UC864-E-AUTO / AWS-AUTO. Use the ON/OFF signal to perform this function or the AT#SHDN command.

Reset Signal Operating levels:

Signal	Min	Max
RESET Input high	2.0V*	2.6V
RESET Input low	0V	0.2V

* This signal is internally pulled up so the pin can be left floating if not used.

If unused, this signal may be left unconnected. If used, it must always be connected with an open collector transistor to permit the internal circuitry the power on reset and under voltage lockout functions.

9. USB Port

UC864-E-AUTO / AWS-AUTO includes an integrated universal serial bus (USB) transceiver, compatible with USB 2.0 specifications and supporting the USB Full-Speed (12 Mb/s) mode. In HSDPA (High Speed downlink Packet Access) mode, the downlink data speed rates up to 7.2Mbps. Hence OEMs need to interface UC864-E-AUTO / AWS-AUTO to applications in full-speed (12Mbits/s) mode.

This is the main communication port suggested for the OEM application.

Signal	UC864-E-AUTO / AWS-AUTO Pad No.	Usage
USB_VBUS	48	Power supply for the internal USB transceiver. This pin is configured as an analog input or an analog output depending upon the type of peripheral device connected.
USB_D-	80	Minus (-) line of the differential, bi-directional USB signal to/from the peripheral device
USB D+	79	Plus (+) line of the differential, bi-directional USB signal to/from the peripheral device
USB_ID (for future use)	35	Analog input used to sense whether a peripheral device is connected and if connected, to determine the peripheral type, host or slave

NOTE:

UC864-E-AUTO / AWS-AUTO does NOT support host device operation at the moment, that is, it works as a slave device. Consequently USB_ID must be opened (not connected).

9.1. USB transceiver specifications

This is the on-chip USB transceiver specifications

Parameter	Comments	Min	Typ	Max	Unit
USB_VBUS :					
Supply Voltage		4.5	5.0	5.25	V
Supply Current				25	mA
Input Levels for Low-/full-speed :					
Receiver Threshold (single-end)		0.8		2.0	V
Differential Input Sensitivity	|D+ - D-|, V_{IN} = 0.8V to 2.5V	0.2			V
Differential Common-mode Range	Includes V_{DI}	0.8		2.5	V
Output Levels for Low-/full-speed :					
Low	R_L = 1.5 kΩ to 3.6 V			0.3	V
High	R_L = 15 kΩ to GND	2.8		3.6	V
Output Signal Crossover Voltage		1.3		2.0	V
Terminations :					
Internal pull-up resistor	V_{TRM} to D+, V_{TRM} to D-	1.425	1.5	1.575	kΩ
Internal pull-down resistor	D+ to GND, D- to GND	14.3	15	24.8	kΩ
High-Z state output impedance	0 V < V_D < 3.6V; measured at D+ and D- pins to GND	300			kΩ
Termination Voltage	An internal supply voltage, V_{TRM}	3.0	3.3	3.6	V
Driver characteristics – Full speed					
Transition time : Rise time Fall time	 C_L = 50 to 125 pF C_L = 50 to 125 pF	 4 4		 20 20	 ns ns
Rise/fall time matching		90		111	%
Series output resistance	D+, D-	28	33	44	Ω
Driver characteristics – Low speed					
Transition time : Rise time Fall time	 C_L = 50 to 600 pF C_L = 50 to 600 pF	 75 75		 300 300	 ns ns
Rise/fall time matching		80		125	%
USB_ID (for future use only)					
ID pin pull-up resistance		108	140	182	kΩ
A device detection threshold	t_{delav} < 1 us, V_{hvs} = 50mV		0.15*V_{TRM}		V
B device detection threshold	t_{delav} < 1 us, V_{hvs} = 50mV		0.8*V_{TRM}		V

10. Serial Ports

The serial port on the Telit UC864-E-AUTO / AWS-AUTO is another possible interface between the module and OEM hardware.

2 serial ports are available on the module:

- MODEM SERIAL PORT;
- MODEM SERIAL PORT 2 (DEBUG).

10.1. Modem Serial Port

Several configurations can be designed for the serial port on the OEM hardware. The most common are:

- RS232 PC com port;
- microcontroller UART @ 2.6V – 2.9V (Universal Asynchronous Receive Transmit) ;
- microcontroller UART @ 5V or other voltages different from 2.6V .

Depending on the type of serial port on the OEM hardware, a level translator circuit may be needed to make the system work. The only configuration that does not need a level translation is the 2.6V UART.

The serial port on UC864-E-AUTO / AWS-AUTO is a +2.6V UART with all the 7 RS232 signals. It differs from the PC-RS232 in signal polarity (RS232 is reversed) and levels.

The levels for UC864-E-AUTO / AWS-AUTO UART are the CMOS levels:

Absolute Maximum Ratings - Not Functional

Parameter	Min	Max
Input level on any digital pin when on	-0.3V	+3.0V
Input voltage on analog pins when on	-0.3V	+3.0 V

Operating Range - Interface Levels

Level	Min	Max
Input high level	2.0V	2.9 V
Input low level	-0.3V	0.6V
Output high level	2.15V	2.6V
Output low level	0V	0.45V

The signals of the UC864-E-AUTO / AWS-AUTO serial port are:

Pin	Signal	I/O	Function	Internal Pulls Up/Dn	Type
25	C103/TXD	I	Serial data input (TXD) from DTE	Pull-Down	CMOS 2.6V
26	C104/RXD	O	Serial data output to DTE	Pull-Up	CMOS 2.6V
27	C107/DSR	O	Output for Data set ready signal (DSR) to DTE	Pull-Down	CMOS 2.6V
28	C106/CTS	O	Output for Clear to send signal (CTS) to DTE	Pull-Up	CMOS 2.6V
29	C108/DTR	I	Input for Data terminal ready signal (DTR) from DTE	Pull-Up	CMOS 2.6V
30	C125/RING	O	Output for Ring indicator signal (RI) to DTE	Pull-Up	CMOS 2.6V
31	C105/RTS	I	Input for Request to send signal (RTS) from DTE	Pull-Down	CMOS 2.6V
32	C109/DCD	O	Output for Data carrier detect signal (DCD) to DTE	Pull-Up	CMOS 2.6V

Internal pull-up or pull-down resistance is not a fixed value and it may differ from case by ca se.
The resistance can be calculated from the DC characteristics considering a level of 2.6V DC.
In this case I_ILPU(input low leakage current with pull-up) is between -60 and -10uA.

Then the resistance can be calculated as V/I=2.6/60u ~ 2.6/10u = 43.3K ~ 260K.
In case of pull-down, it can be calculated in the same way.

NOTE:

According to V.24, RX/TX signal names are referred to the application side, therefore on the UC864-E-AUTO / AWS-AUTO side these signal are on the opposite direction: TXD on the application side will be connected to the receive line (here named TXD/ rx_uart) of the UC864-E-AUTO / AWS-AUTO serial port and vice versa for RX.

TIP:

For minimum implementation, only the TXD and RXD lines can be connected, the other lines can be left open provided a software flow control is implemented.

10.2. RS232 Level Translation

In order to interface the Telit UC864-E-AUTO / AWS-AUTO with a PC com port or a RS232 (EIA/TIA-232) application a level translator is required. This level translator must:

- invert the electrical signal in both directions;
- change the level from 0/2.6V to +15/-15V .

Actually, the RS232 UART 16450, 16550, 16650 & 16750 chipsets accept signals with lower levels on the RS232 side (EIA/TIA-562), allowing a lower voltage-multiplying ratio on the level translator. Note that the negative signal voltage must be less than 0V and hence some sort of level translation is always required.

The simplest way to translate the levels and invert the signal is by using a single chip level translator. There are a multitude of them, differing in the number of drivers and receivers and in the levels (be sure to get a true RS232 level translator not a RS485 or other standards).

By convention the driver is the level translator from the 0-2.6V UART to the RS232 level. The receiver is the translator from the RS232 level to 0-2.6V UART.

In order to translate the whole set of control lines of the UART you will need:

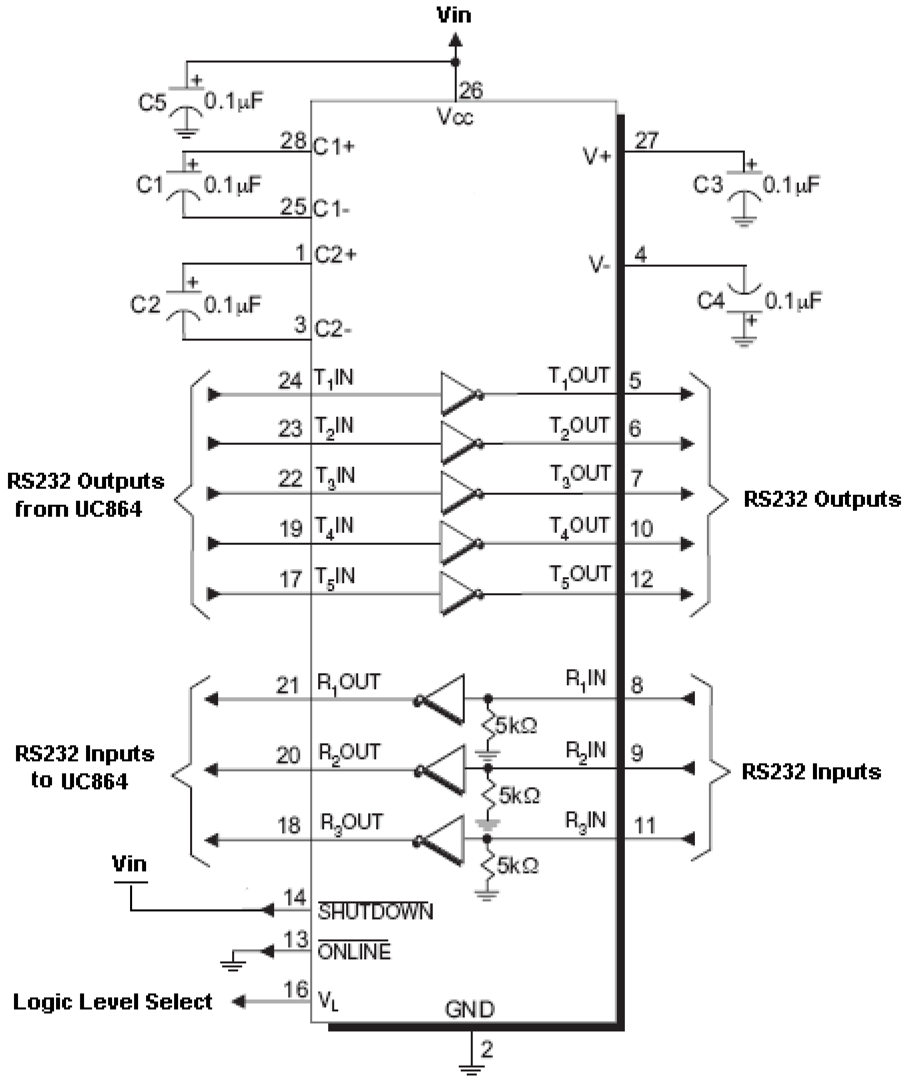
- 5 drivers
- 3 receivers

NOTE:

The digital input lines working at 2.6V CMOS have an absolute maximum input voltage of 3.0V; therefore the level translator IC shall not be powered by the +3.8V supply of the module. Instead, it must be powered from a +2.6V / +2.9V (dedicated) power supply.

This is because in this way the level translator IC outputs on the module side (i.e. UC864-E-AUTO / AWS-AUTO inputs) will work at +3.8V interface levels, damaging the module inputs.

An example of level translation circuitry of this kind is:

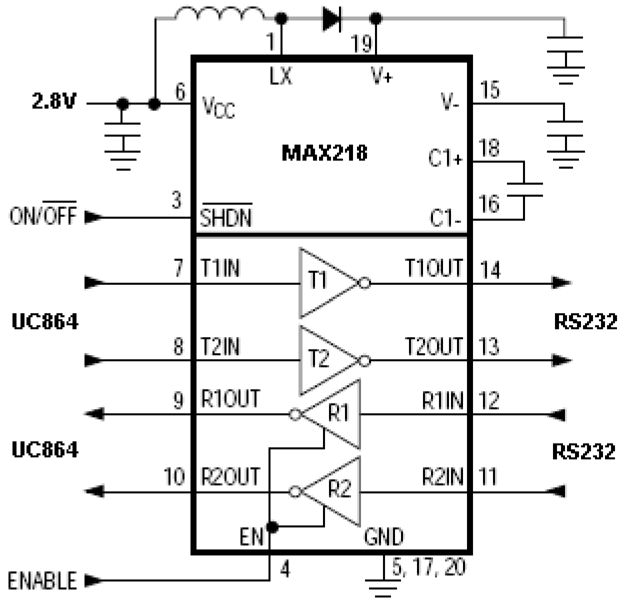


The example is done with a SIPEX SP3282EB RS232 Transceiver that could accept supply voltages lower than 3V DC.

NOTE:

In this case Vin has to be set with a value compatible with the logic levels of the module. (Max 2.9V DC). In this configuration the SP3282EB will adhere to EIA/TIA-562 voltage levels instead of RS232 (-5 ~ +5V)

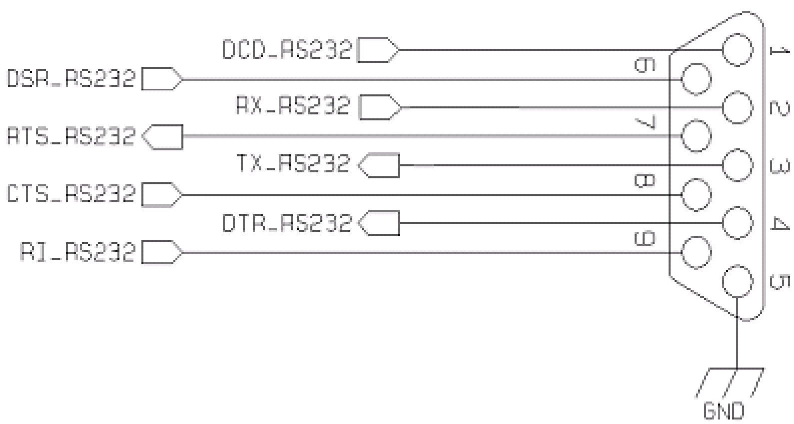
Second solution could be done using a MAXIM transceiver (MAX218) In this case the compliance with RS232 (+-5V) is possible.



Another level adapting method could be done using a standard RS232 Transceiver (MAX3237EAI) adding some resistors to adapt the levels on the UC864 Input lines.

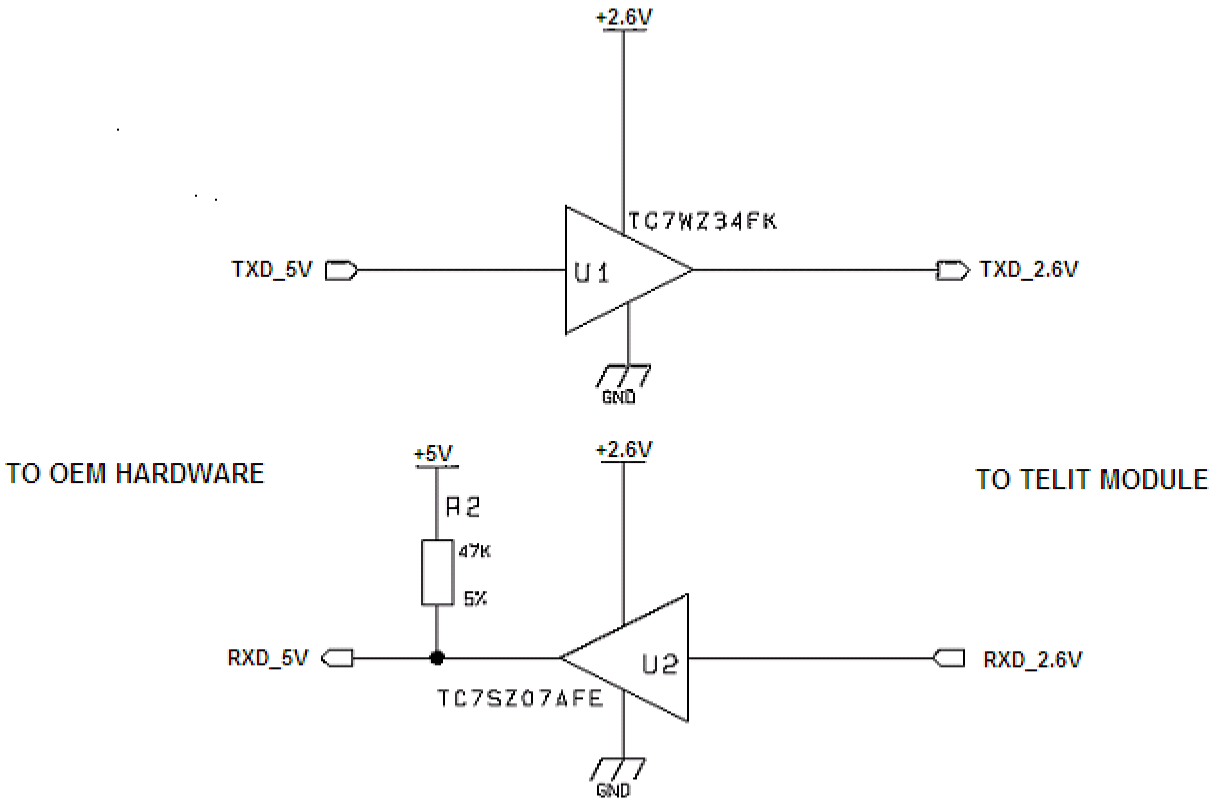
NOTE: In this case has to be taken in account the length of the lines on the application to avoid problems in case of High-speed rates on RS232.

The RS232 serial port lines are usually connected to a DB9 connector with the following layout: signal names and directions are named and defined from the DTE point of view.



10.3. 5V UART Level Transition

If the OEM application uses a microcontroller with a serial port (UART) that works at a voltage different from 2.6 – 2.9V, then a circuitry has to adapt the different levels of the two signal sets. As for the RS232 translation, there are a multitude of single chip translators. For example a possible translator circuit for a 5V TRANSMITTER/RECEIVER can be:



TIP:

This logic IC for the level translator and 2.6V pull-ups (not the 5V one) can be powered directly from PWRMON line of UC864-E-AUTO / AWS-AUTO. Note that the TC7SZ07AE has open drain output; therefore the resistor R2 is mandatory.

A power source of the internal interface voltage corresponding to the 2.6V CMOS high level is available at the VAUX pin on the connector.

A maximum of 9 resistors of 47 KΩ pull-up can be connected to the VAUX pin, provided no other devices are connected to it and the pulled-up lines are UC864-E-AUTO / AWS-AUTO input lines connected to open collector outputs in order to avoid latch-up problems on UC864-E-AUTO / AWS-AUTO.

Careful approach is needed to avoid latch-up on UC864-E-AUTO / AWS-AUTO and the use of this output line to power electronic devices must be avoided, especially for devices that generate spikes and noise such as switching level translators, micro controllers, failure in any of these condition can severely compromise the UC864-E-AUTO / AWS-AUTO functionality.

NOTE:

The input lines working at 2.6VCMOS can be pulled-up with 47KΩ resistors that can be connected directly to the VAUX line. It is a must that they are connected as in this example.

The preferable configuration is having external supply for the buffer.

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11. Audio Section Overview

The *Baseband* chip was developed for the cellular phones, which needed two separated amplifiers both in *RX* and in *TX* section.
A couple of amplifiers had to be used with internal audio transducers while the other couple of amplifiers had to be used with external audio transducers.
To distinguish the schematic signals and the Software identifiers, two different definitions were introduced, with the following meaning:

- internal audio transducers → ***HS/MT*** (from ***H****and****S****et* or ***M****icro****T****elephone*)
- external audio transducers → ***HF*** (from HandsFree)

Actually the acronyms have not the original importance.
In other words this distinction is not necessary, being the performances between the two blocks like the same.
Only if yhe customer needs higher output power to the speaker , he has a constraint. Otherwise the choice could be done in order to overcome the PCB design difficulties.

For these reasons we have not changed the *HS* and *HF* acronyms, keeping them in the Software and on the schematics.
The Base Band Chip of the UC864-E-AUTO / AWS-AUTO Telit Module maintains the same architecture.

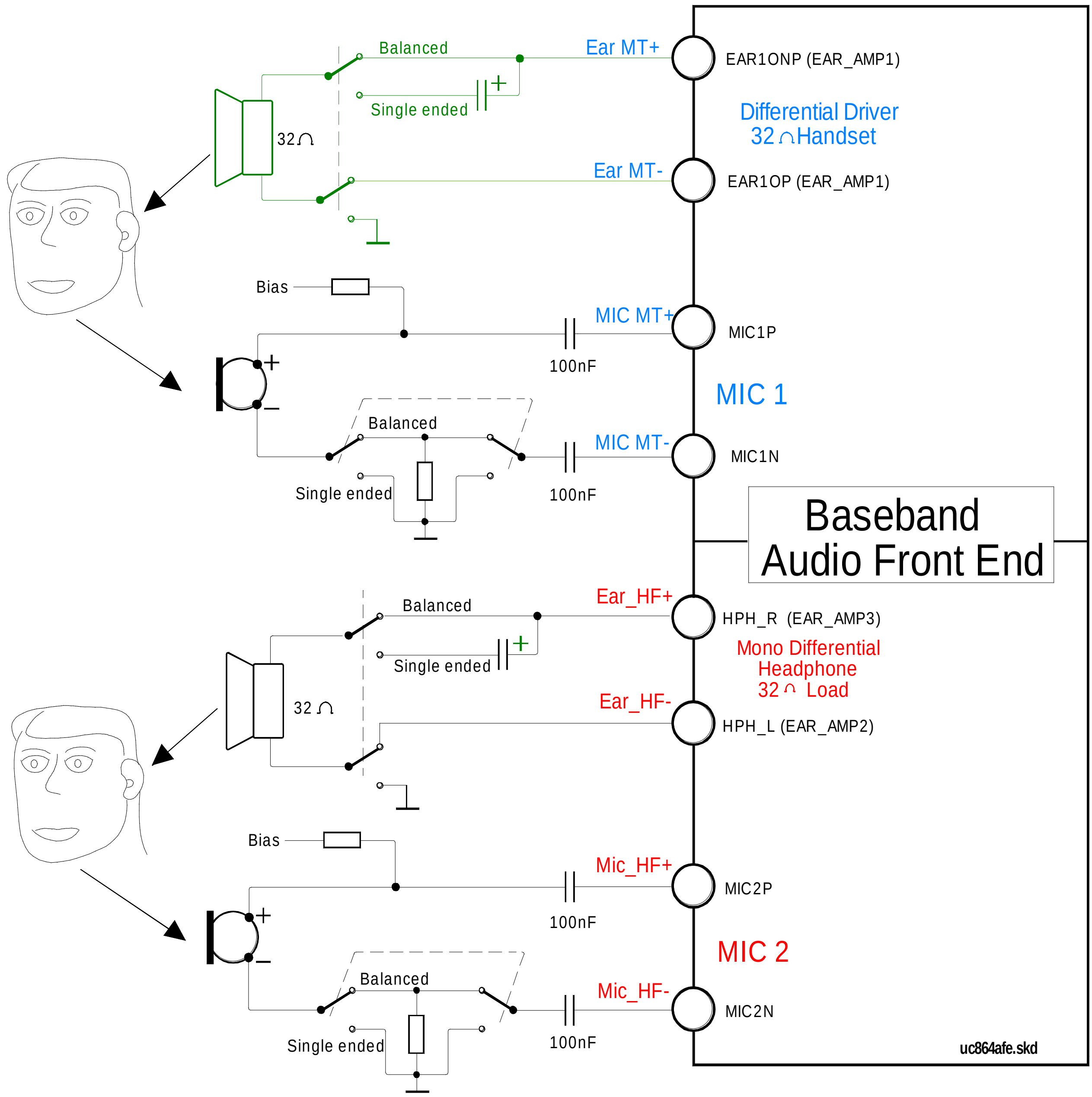
For more information refer to Telit document:

„***80000NT10025a UC864 Audio Settings Application Note***“ .

11.1. Selection mode

Only one block can be active at a time, and the activation of the requested audio path is done via hardware by ***AXE*** line or via software by ***AT#CAP*** command.

Moreover the ***Sidetone*** functionality could be implemented by the amplifier fitted between the transmit path and the receive path, enabled at request in both modes.



UC864-E-AUTO / AWS-AUTO Audio Front End (*AFE*)

11.2. Electrical Characteristics

TIP: Being the microphone circuitry the more noise sensitive, its design and layout must be realized with particular care. Both microphone paths are balanced and the OEM circuitry must be balanced designed to reduce the common mode noise typically generated on the ground plane. However the customer can use the unbalanced circuitry for particular application..

11.2.1. Input Lines (*MIC1 and MIC2*) Characteristics

Line coupling	AC (*)
Line type	Balanced / Unbalanced
Coupling capacitor	>=100nF
Differential input impedance	20Kohm
Differential input voltage	$908mV_{rms}$ ($\leq 1290mV_{rms}$) @ MicG=0dB

"Mic_MT" and "Mic_HF" microphone paths

(*) WARNING : AC means that the signals from the microphone have to be connected to input lines of the module through capacitors which value has to be • 100nf. not respecting this constraint, the input stages will be damaged.

WARNING: when particular OEM application needs a *Single Ended Input* configuration, it is forbidden connecting the unused input directly to Ground, but only through a 100nF capacitor. Don't forget that thus the useful input signal will be halved.

11.3. OUTPUT LINES (*Speaker*)

We suggest driving the load differentially from both output drivers, thus the output swing will double and the need for the output coupling capacitor avoided.
If a particular OEM application needs a *Single Ended Output* configuration the output power will be reduced four times.
The OEM circuitry shall be designed to reduce the common mode noise typically generated on the ground plane and to get the maximum power output from the device (low resistance tracks).

(*) WARNING:

Using single ended configuration, the unused output line must be left open.

Not respecting this constraint, the output stage will be damaged.

11.3.1. Output Lines Characteristics

Line coupling	differential	DC
	single-ended	AC
Output load impedance	differential	32 ohm (≤ 26)
Differential output impedance		≤ 01 ohm @1.02kHz
Signal bandwidth		150 - 4000 Hz @ -3 dB
Differential output voltage (typ.)		1060 mV_{rms}/32 ohm
Max Output Power		70mW @ 32 ohm
Max load capacitance		500pF

"Ear_MT" Output (*EAR_AMP1* differential amplifier)

Line coupling	differential	DC
	single-ended	AC
Output load impedance	differential	32 ohm (≤ 26)
	single-ended	16 ohm (≤ 12)
S.E. output impedance		≤ 0,5 ohm @ 1.02kHz
signal bandwidth		150 - 4000 Hz @ -3 dB
Differential output voltage (typ.)		833 mV_{rms}/32 ohm
Max Output Power	@ 32 ohm	44mW differential
	@ 16 ohm	22mW single-ended
Max load capacitance		1000pF

"Ear_HF" Output (*EAR_AMP2 + EAR_AMP3* amplifiers)

12. General Purpose I/O

The general-purpose I/O pads can be configured to act in three different ways:

- input
- output
- alternate function (internally controlled)

Input pads can only be read and report the digital value (high or low) present on the pad at the read time; output pads can only be written or queried and set the value of the pad output; an alternate function pad is internally controlled by the UC864-E-AUTO / AWS-AUTO firmware and acts depending on the function implemented.

The following GPIOs are available on the UC864-E-AUTO / AWS-AUTO:

PIN	Signal	I/O	Function	Type	Drive strength	Default State	ON_OFF State	Reset State	Note
70	GPIO_01	I/O	GPIO01 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
74	GPIO_02	I/O	GPIO02 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
66	GPIO_03	I/O	GPIO03 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
59	GPIO_04	I/O	GPIO04 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	Alternate Function (RF Transmission Control)
78	GPIO_05	I/O	GPIO05 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	Alternate Function (RFTXMON)
68	GPIO_06	I/O	GPIO06 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	Alternate function (ALARM)
73	GPIO_07	I/O	GPIO07 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	Alternate function (BUZZER)
67	GPIO_08	I/O	GPIO08 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
76	GPIO_09	I/O	GPIO09 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
63	GPIO_10	I/O	GPIO10 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
57	GPIO_11	I/O	GPIO11 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
62	GPIO_12	I/O	GPIO12 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
77	GPIO_13	I/O	GPIO13 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
60	TGPIO_14	I/O	GPIO14 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
61	GPIO_15	I/O	GPIO15 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
75	GPIO_16	I/O	GPIO16 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
71	GPIO_17	I/O	GPIO17 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
65	GPIO_18	I/O	GPIO18 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	

56	GPIO_19	I/O	GPIO19 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
58	GPIO_20	I/O	GPIO20 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
72	GPIO_21	I/O	GPIO21 Configurable GPIO	CMOS 2.6V	2mA	INPUT	HIGH	HIGH	
64	GPIO_22	I/O	GPIO22 Configurable GPIO	CMOS 1.8V (not 2.6V)	2mA	INPUT	LOW	HIGH	

Not all GPIO pads support all these three modes:

- GPIO4 supports all three modes and can be input, output, RF Transmission Control (Alternate function)
- GPIO5 supports all three modes and can be input, output, RFTX monitor output (Alternate function)
- GPIO6 supports all three modes and can be input, output, alarm output (Alternate function)
- GPIO7 supports all three modes and can be input, output, buzzer output (Alternate function)

Some alternate functions for UC864-E-AUTO / AWS-AUTO may be added if needed.

12.1. Logic Level Specifications

Where not specifically stated, all the interface circuits work at 2.6V CMOS logic levels.

The following table shows the logic level specifications used in the UC864-E-AUTO / AWS-AUTO interface circuits:

Absolute Maximum Ratings -Not Functional

Parameter	UC864-E-AUTO / AWS-AUTO	
	Min	Max
Input level on any digital pin when on	-0.3V	+3.0V
Input voltage on analog pins when on	-0.3V	+3.0 V

For 2.6V CMOS signals;

Operating Range - Interface levels

Level	UC864-E-AUTO / AWS-AUTO	
	Min	Max
Input high level	2.0V	2.9 V
Input low level	-0.3V	0.6V
Output high level	2.15V	2.6V
Output low level	0V	0.45V

For 1.8V signals:

Operating Range - Interface levels (1.8V CMOS)

Level	UC864-E-AUTO / AWS-AUTO	
	Min	Max
Input high level	1.5V	2.1V
Input low level	-0.3V	0.5V
Output high level	1.35V	1.8V
Output low level	0V	0.45V

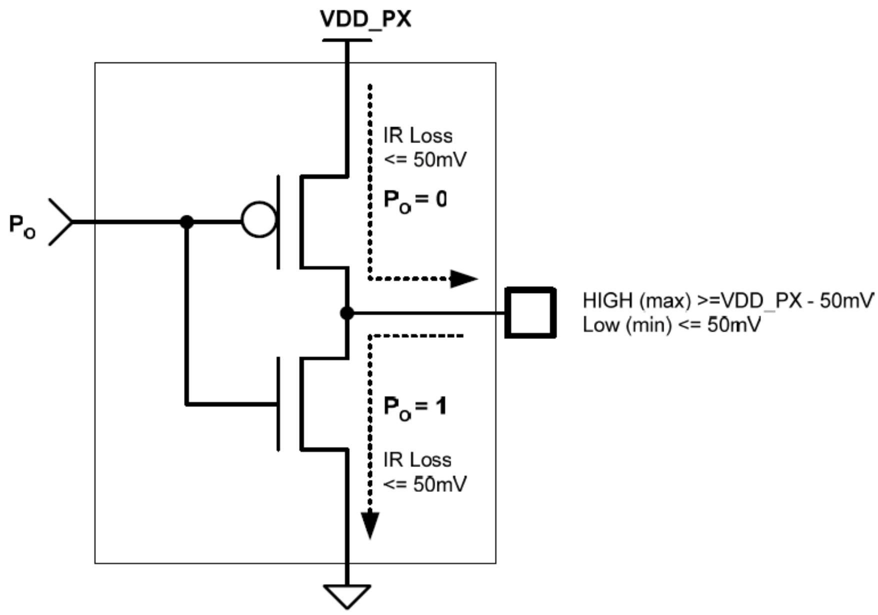
12.2. Using a GPIO Pad as Input

The GPIO pads, when used as inputs, can be connected to a digital output of another device and report its status, provided this device has interface levels compatible with the 2.6V CMOS levels of the GPIO.

If the digital output of the device is connected with the GPIO input, the pad has interface levels different from the 2.6V CMOS. It can be buffered with an open collector transistor with a 47KΩ pull-up resistor to 2.6V.

12.3. Using a GPIO Pad as Output

The GPIO pads, when used as outputs, can drive 2.6V CMOS digital devices or compatible hardware. When set as outputs, the pads have a push-pull output and therefore the pull-up resistor may be omitted.



output PAD equivalent circuit

12.4. Using the RF Transmission Control GPIO4

The GPIO4 pin, when configured as RF Transmission Control Input, permits to disable the Transmitter when the GPIO is set to Low by the application. In the design it is necessary to add a pull up resistor (47K to PWRMON).

12.5. Using the RFTXMON Output GPIO5

The GPIO5 pin, when configured as RFTXMON Output, is controlled by the UC864-E-AUTO / AWS-AUTO module and will rise when the transmitter is active and fall after the transmitter activity is completed.

For example, if a call is started, the line will be HIGH during all conversations and it will be again LOW after hanged up.

The line rises up 300ms before first TX burst and will become again LOW from 500ms to 1sec after last TX burst.

12.6. Using the Alarm Output GPIO6

The GPIO6 pad, when configured as Alarm Output, is controlled by the UC864-E-AUTO / AWS-AUTO module and will rise when the alarm starts and fall after the issue of a dedicated AT command.

This output can be used to power up the UC864-E-AUTO / AWS-AUTO controlling microcontroller or application at the alarm time, giving you the possibility to program a timely system wake-up to achieve some periodic actions and completely turn off either the application or the UC864-E-AUTO / AWS-AUTO during sleep periods. This will dramatically reduce the sleep consumption to few µA.

In battery-powered devices this feature will greatly improve the autonomy of the device.

NOTE:

During RESET the line is set to HIGH logic level.

12.7. Using the Buzzer Output GPIO7

As Alternate Function, the GPIO7 is controlled by the firmware that depends on the function implemented internally.

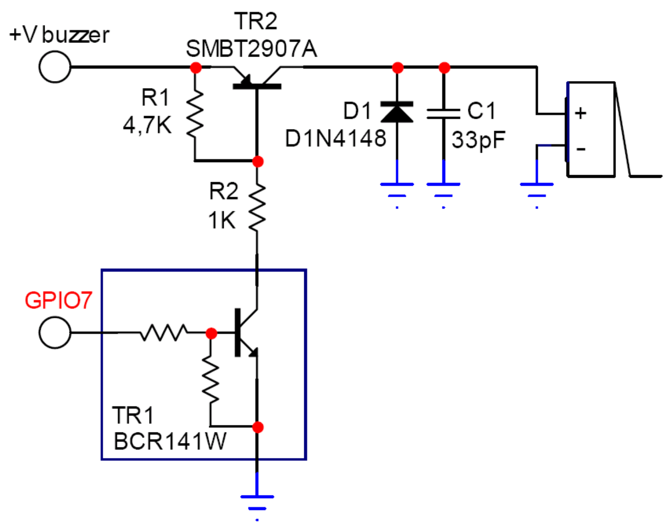
This setup places always the GPIO7 pin in OUTPUT direction and the corresponding function must be activated properly by AT#SRP command (refer to AT commands specification).

Also in this case, the *dummy value* for the pin state can be both “0” or “1”.

send the command	AT#GPIO=7, 1, 2<cr>:
wait for response	OK
send the command	AT#SRP=3

The GPIO7 pin will be set as *Alternate Function* pin with its dummy logic status set to *HIGH* value.

The "Alternate function" permits your application to easily implement Buzzer feature with some small hardware extension of your application as shown in the next sample figure.



Example of Buzzer’s driving circuit.

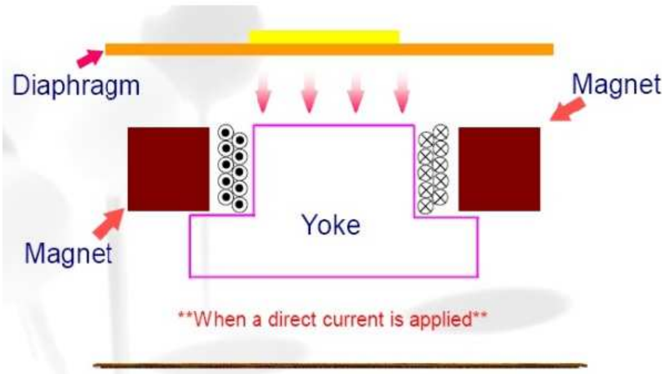
NOTE:

To correctly drive a buzzer, a driver must be provided. its characteristics depend on the buzzer. Refer to your buzzer vendor.

12.8. Magnetic Buzzer Concepts

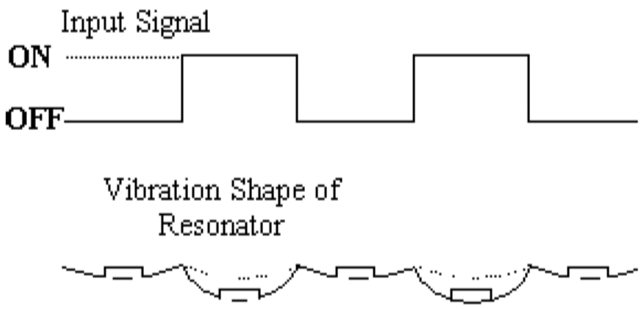
12.8.1. Short Description

A magnetic Buzzer is a sound-generating device with a coil located in the magnetic circuit consisting of a permanent magnet, an iron core, a high permeable metal disk and a vibrating diaphragm.



Drawing of the Magnetic Buzzer.

The disk and diaphragm are attracted to the core by the magnetic field. When an oscillating signal is moved through the coil, it produces a fluctuating magnetic field, which vibrates the diaphragm at a frequency of the drive signal. Thus the sound is produced as relative to the frequency applied.



Diaphragm movement.

12.8.2. Frequency Behavior

The frequency behavior represents the effectiveness of the reproduction of the applied signals. Because its performance is related to a square driving waveform (whose amplitude varies from 0V to Vpp), if you modify the waveform (e.g. from square to sinus) the frequency response will change.

12.8.3. Power Supply Influence

After applying a signal with a different amplitude from suggested by the manufacturer, a performance change will follow, according to the rule "*if resonance frequency* f_0 *increases, amplitude decreases*".

Because resonance frequency depends on acoustic design and lowering the amplitude of the driving signal, the response bandwidth tends to become narrow, and vice versa.

Summarizing: *Vpp* ↑ → f_0 ↓ *Vpp* → f_0 ↑

The risk is that the f_0 could easily fall outside of new bandwidth; consequently the SPL could be much lower than the expected.

WARNING:

It is very important to respect the sense of the applied voltage: never apply to the "-" pin a voltage more positive than "+" pin. If this happens, the diaphragm vibrates in the opposite sense with a high probability to be expelled from its physical position. This damages the device permanently.

12.8.4. Working Current Influence

In the component data sheet you will find the value of MAX CURRENT: this represents the maximum average current that can flow at nominal voltage without current limitation.

In other words it is not the peak current, which could be twice or three times higher. If driving circuitry does not support these peak values, the SPL will never reach the declared level or the oscillations will stop.

12.9. Using the Temperature Monitor Function

12.9.1. Short Description

The Temperature Monitor is a function of the module that permits to control its internal temperature and if properly set (see the #TEMPMON command on AT Interface guide) it raises to High Logic level a GPIO when the maximum temperature is reached.

12.9.2. Allowed GPIO

The AT#TEMPMON set command could be used with one of the following GPIO:

Signal	Function	Type	Drive strength	Note
GPIO_01	GPIO01 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_03	GPIO03 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_08	GPIO08 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_09	GPIO09 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_10	GPIO10 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_11	GPIO11 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_12	GPIO12 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_13	GPIO13 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_14	GPIO14 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_15	GPIO15 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_16	GPIO16 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_17	GPIO17 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_18	GPIO18 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_19	GPIO19 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_20	GPIO20 Configurable GPIO	CMOS 2.6V	2mA	
GPIO_22	GPIO22 Configurable GPIO	CMOS 1.8V (not 2.6V)	2mA	

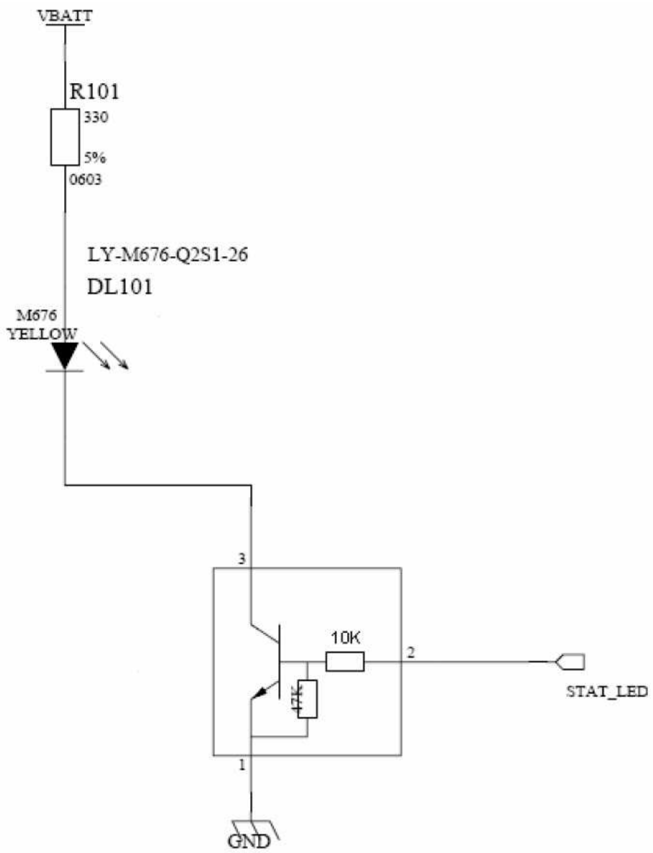
The set command could be used also with one of the following GPIO but in that case the alternate function is not usable:

Signal	Function	Type	Drive strength	Note
GPIO_02	GPIO02 Configurable GPIO	CMOS 2.6V	2mA	Alternate function(JDR)
GPIO_04	GPIO04 Configurable GPIO	CMOS 2.6V	2mA	Alternate Function (RF Transmission Control)
GPIO_05	GPIO05 Configurable GPIO	CMOS 2.6V	2mA	Alternate Function (RFTXMON)
GPIO_07	GPIO07 Configurable GPIO	CMOS 2.6V	2mA	Alternate function (BUZZER)

12.10. Indication of Network Service Availability

The STAT_LED pin status shows information on the network service availability and Call status. In the UC864-E-AUTO / AWS-AUTO modules, the STAT_LED usually needs an external transistor to drive an external LED. Because of the above, the status indicated in the following table is reversed with respect to the pin status:

LED status	Device Status
Permanently off	Device off
Fast blinking (Period 1s, Ton 0,5s)	Net search / Not registered / turning off
Slow blinking (Period 3s, Ton 0,3s)	Registered full service
Permanently on	a call is active



12.11. RTC Bypass Out

The VRTC pin brings out the Real Time Clock supply, which is separate from the rest of the digital part, allowing having only RTC going on when all the other parts of the device are off. To this power output a backup capacitor can be added in order to increase the RTC autonomy during power off of the battery.

NOTE: NO devices must be powered from this pin.

12.12. VAUX1 Power Output

A regulated power supply output is provided in order to supply small devices from the module. This output is active when the module is ON and goes OFF when the module is shut down. The operating range characteristics of the supply are:

Operating Range – VAUX1 power supply

	Min	Typical	Max
Output voltage	2.6V	2.65V	2.7V
Output current			100mA
Output bypass capacitor (Inside the module)			2.2µF

13. DAC and ADC section

13.1. DAC Converter

13.1.1. Description

The UC864-E-AUTO / AWS-AUTO module provides a Digital to Analog Converter. The signal (named DAC_OUT) is available on pin 40 of the UC864-E-AUTO / AWS-AUTO module and on pin 17 of PL102 on EVK2 Board (KS101C).

The on board DAC is a 16-bit converter, able to generate an analogue value based on a specific input in the range from 0 up to 65535 but recalibrated in the range from 0 to 1023. However, an external low-pass filter is necessary.

	Min	Max	Units
Voltage range (filtered)	0	2.6	Volt
Range	0	1023	Steps

The precision is 1023 steps, so if we consider that the maximum voltage is 2V, the integrated voltage could be calculated with the following formula:

Integrated output voltage = 2 * value / 1023

DAC_OUT line must be integrated (for example with a low band pass filter) in order to obtain an analog voltage.

13.1.2. Enabling DAC

An AT command is available to use the DAC function. The command is:AT#DAC[=<enable>[,<value>]]

<value> - scale factor of the integrated output voltage (0..1023 - 10 bit precision)

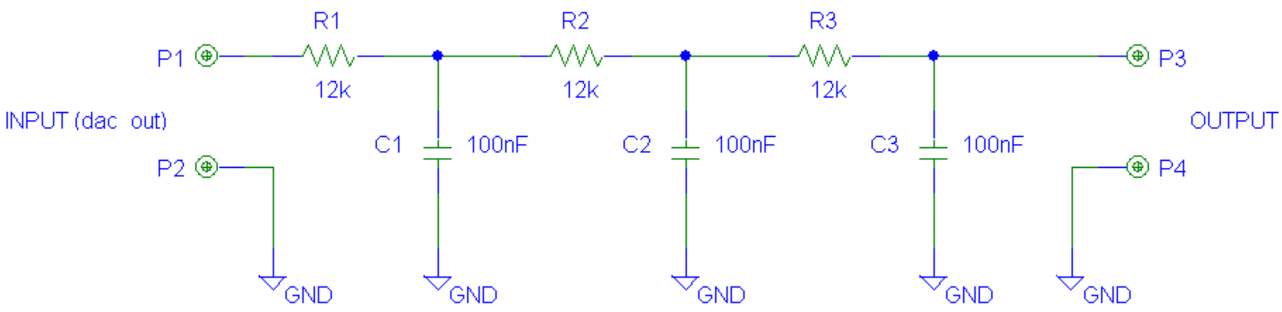
it must be present if <enable>=1

Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.

NOTE:

The DAC frequency is selected internally. D/A converter must not be used during POWERSAVING.

13.1.3. Low Pass Filter Example



13.2. ADC Converter

13.2.1. Description

The on board ADCs are 8-bit converters. They are able to read a voltage level in the range of 0-2 volts applied on the ADC pin input and store and convert it into 8 bit word.

	Min	Max	Units
Input Voltage range	0	2	Volt
AD conversion	-	8	bits
Resolution	-	< 10.2	mV

The UC864-E-AUTO / AWS-AUTO module provides 3 Analog to Digital Converters. The input lines are:

ADC_IN1 available on Pin 37 and Pin 19 of PL102 on EVK2 Interface.

ADC_IN2 available on Pin 38 and Pin 20 of PL102 on EVK2 Interface.

ADC_IN3 available on Pin 39 and Pin 21 of PL102 on EVK2 Interface.

13.2.2. Using ADC Converter

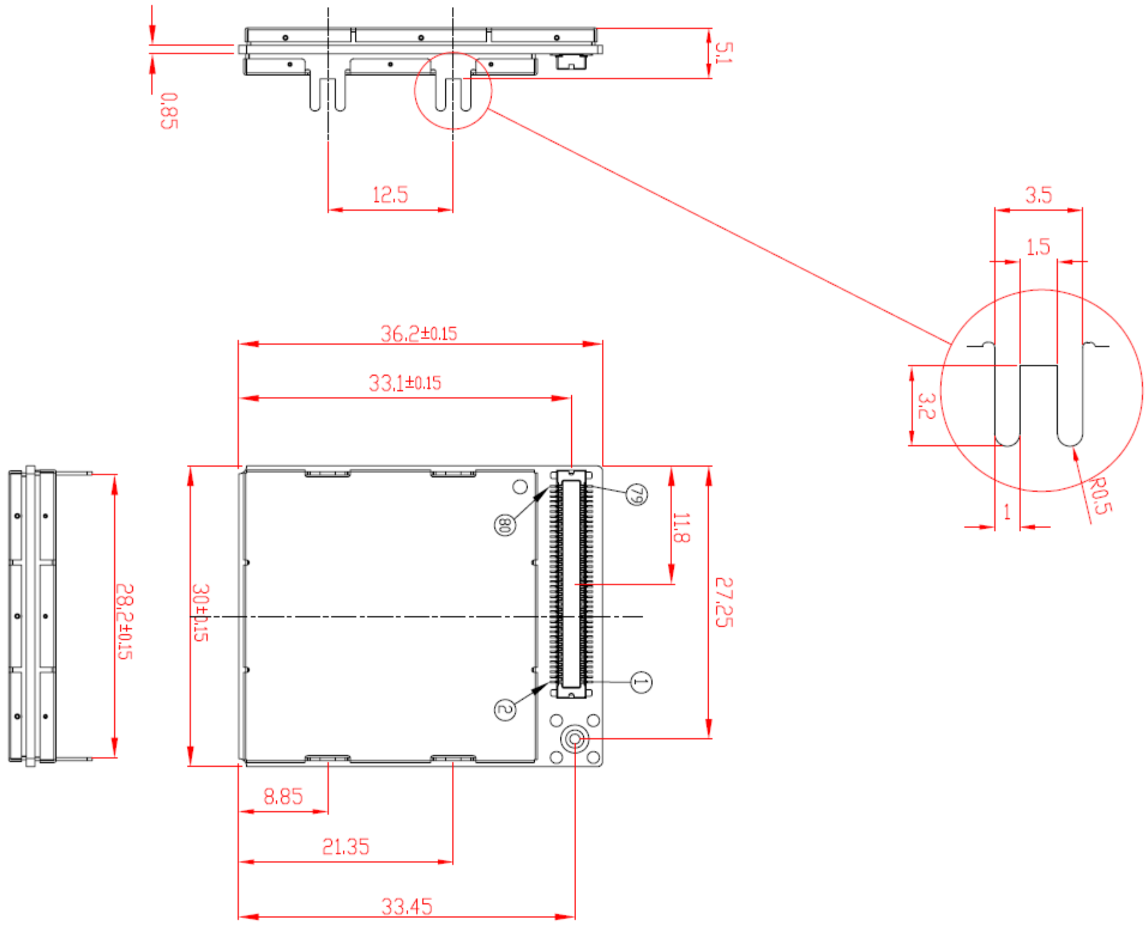
An AT command is available to use the ADC function.

The command is AT#ADC=1,2 The read value is expressed in mV

Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.

14. Mounting the module on your board

The position of the Molex board-to-board connector and pin 1 are shown in the following picture.



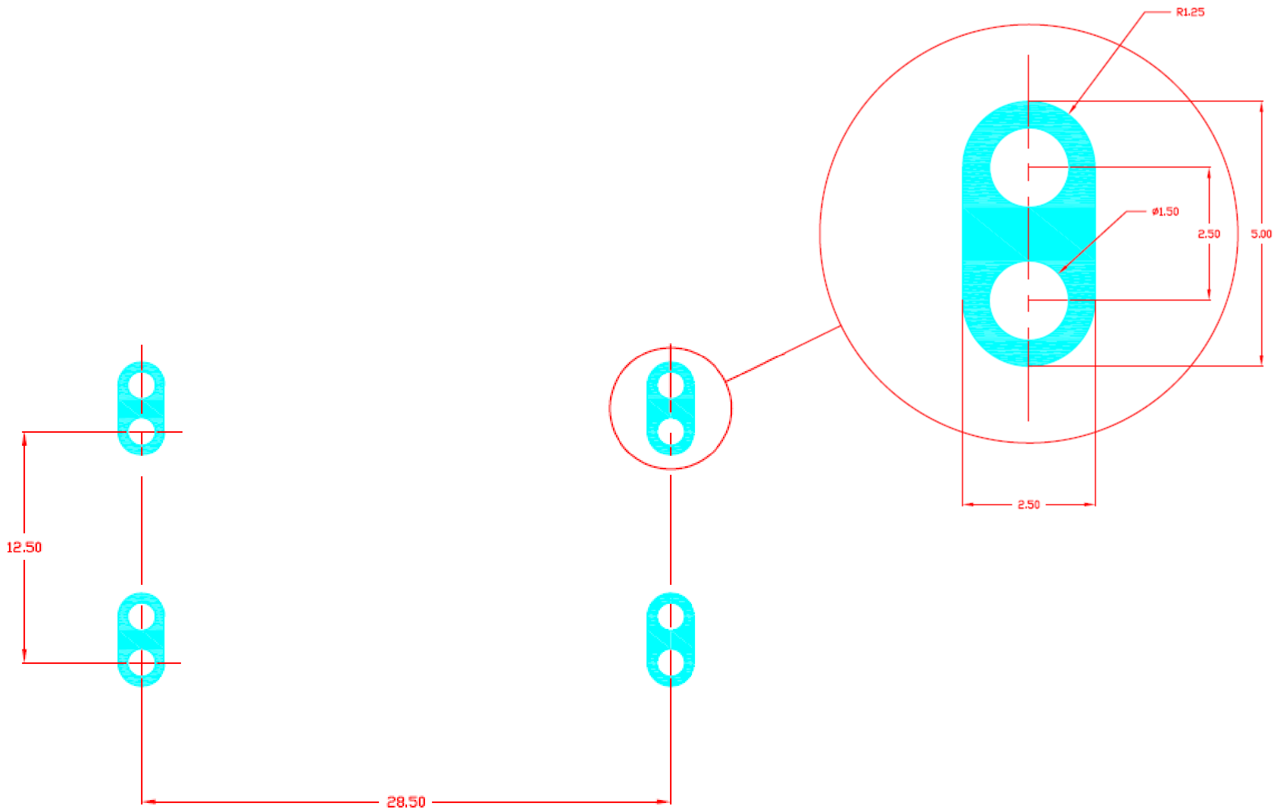
NOTE:

The Metal taps present on UC864-E-AUTO / AWS-AUTO must be connected to GND

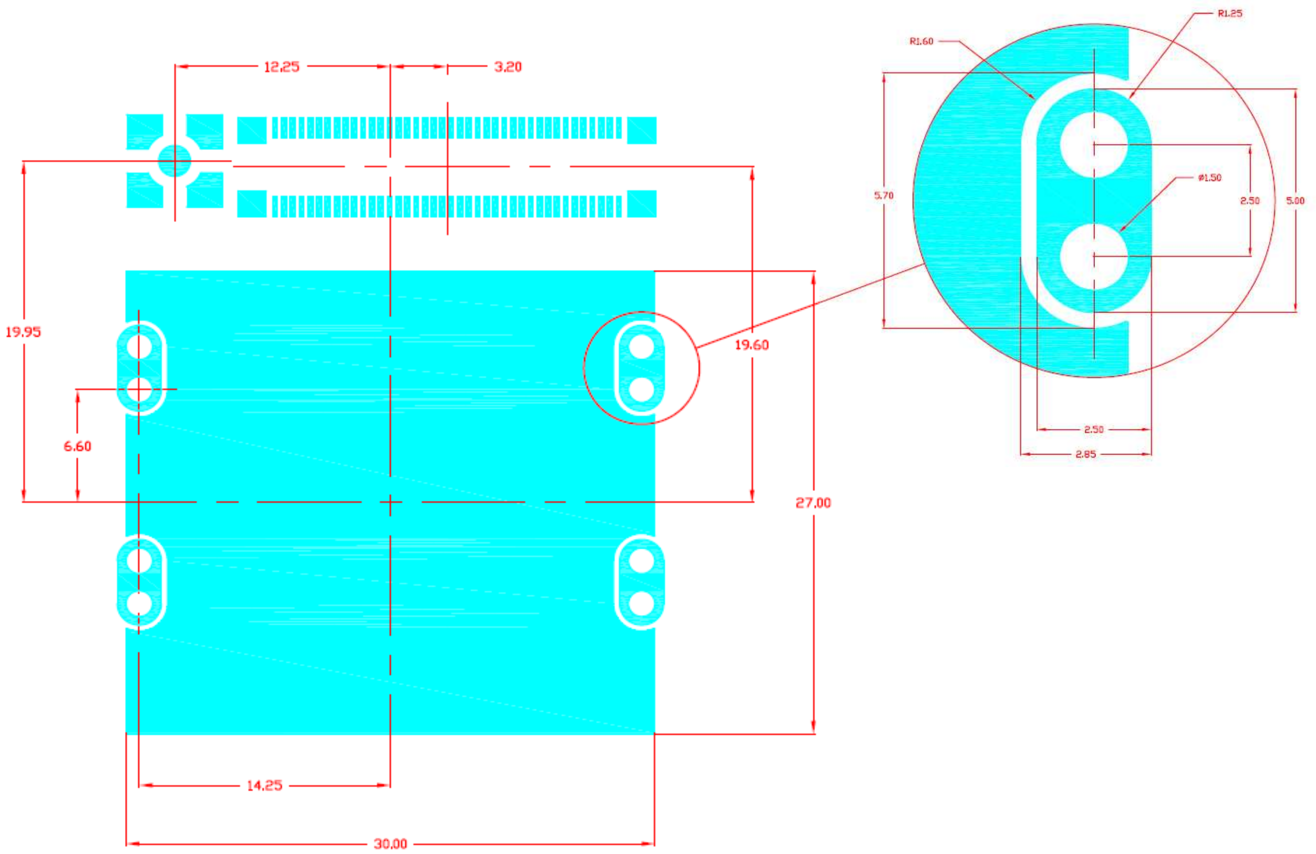
This module could not be processed with a reflow

14.1. Application PCB Layout

To obtain the best thermal dissipation it is suggested to design the host PCB as in the below image where a Ground area has been created below the module.

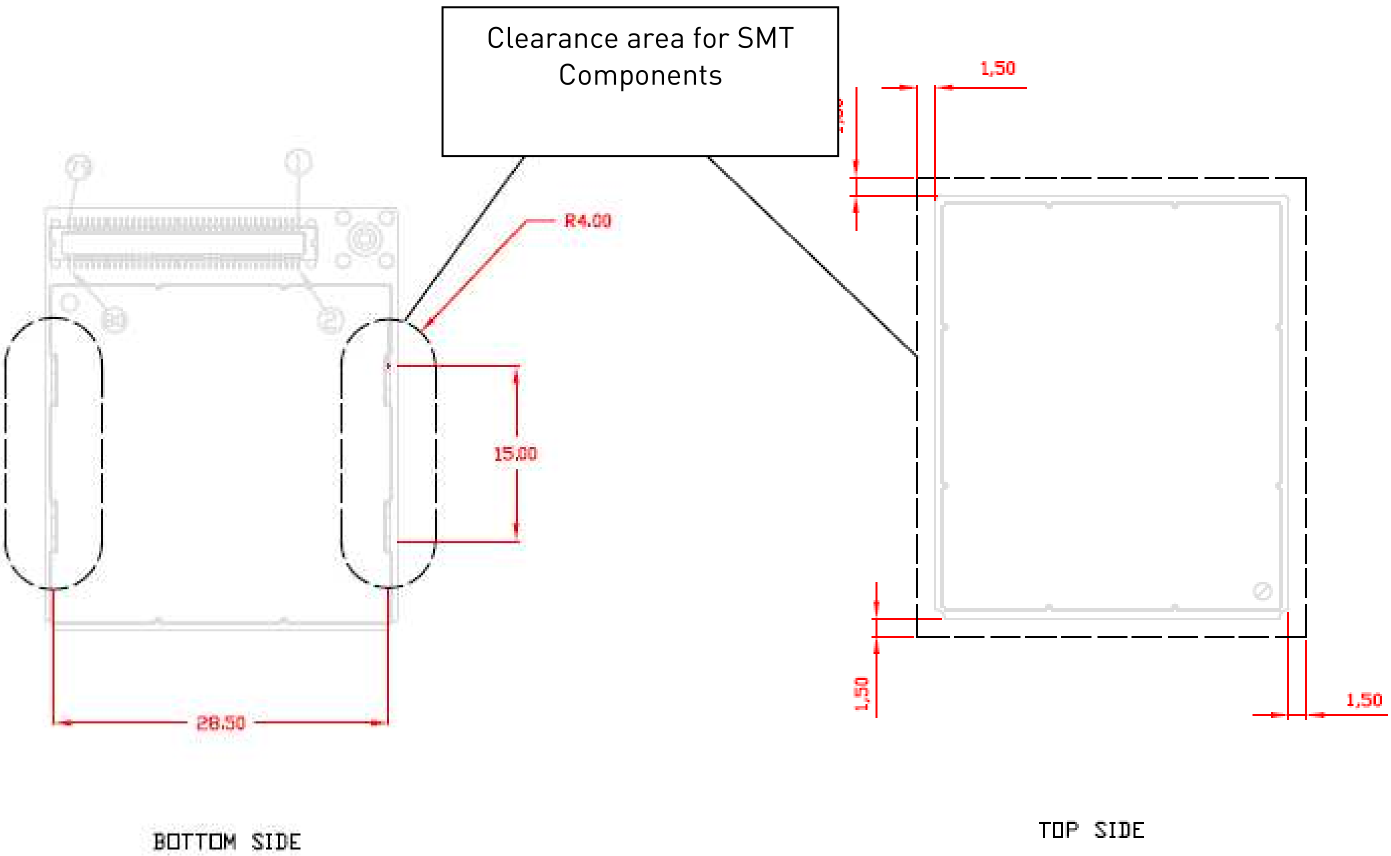


Bottom side
Top View



Top side
Top View

14.2. Clearance Area



14.3. Thermal Dissipation

To permit a better thermal dissipation it is suggested to use a Thermal conductive material between the module and the application PCB.

Suggested types are Bergquist (Two parts) GAP filler 3500 or GAP Filler 1500

14.4. Module Soldering

The module could be soldered on the application in different kind of ways. Typical processes are follows:

- Manual Soldering
- Automatic Selective soldering
- Wave soldering

We suggest respecting necessary Clearance area in the design to permit a proper soldering process as shown in previous chapter.

15. Application guide

15.1. Debug of the UC864-E-AUTO / AWS-AUTO in production

To test and debug the mounting of UC864-E-AUTO / AWS-AUTO, we strongly recommend to foresee test pads on the host PCB, in order to check the connection between the UC864-E-AUTO / AWS-AUTO itself and the application and to test the performance of the module connecting it with an external computer. Depending on the customer application, these pads include, but are not limited to the following signals:

- TXD
- RXD
- ON/OFF
- RESET
- GND
- VBATT
- TX_TRACE
- RX_TRACE
- PWRMON
- USB_VBUS
- USB_D+
- USB_D-

15.2. Bypass capacitor on Power supplies

When a sudden voltage is asserted to or cut from the power supplies, the steep transition makes some reactions such as the overshoot and undershoot.

This abrupt voltage transition can affect the device not to work or make it malfunction.

The bypass capacitors are needed to alleviate this behavior and it can be affected differently according to the various applications. The customers have to pay special attention to this when they design their application board..

The length and width of the power lines need to be considered carefully and the capacitance of the capacitors need to be selected accordingly.

The capacitor will also avoid the ripple of the power supplies and the switching noise caused in TDMA system like GSM.

Specially the suitable bypass capacitor must be mounted on the Vbatt (Pin 1,2,3,4) and USB_VBUS (Pin 48) lines in the application board.

The recommended values can be presented as;

- 100uF for Vbatt
- 10uF for USB_VBUS

But the customers still have to consider that the capacitance mainly depends on the conditions of their application board.

Generally more capacitance is required as the power line is longer.

15.3. SIM interface

The resistor value on SIMIO pulled up to SIMVCC should be defined accordingly in order to be compliant to 3GPP specification.

6.8kohm can be recommended but it may depend on the application design..

Refer to the following document for the detail;

- Telit_SIM_interface_and ESD_protection_Application_note_r1

15.4. EMC recommendations

UC864-E-AUTO / AWS-AUTO signals are provided by some EMC protections. In any case the accepted levels are different on the pins. The characteristics are described in the following Table:

Pin	Signal	I/O	Function	Contact	Air
Power Supply					
1,2,3,4	VBATT	-	Main power supply	± 8KV	± 15KV
SIM Card Interface					
18	SIMVCC	-	External SIM signal – Power supply for the SIM	± 8KV	± 15KV
19	SIMRST	O	External SIM signal – Reset	± 8KV	± 15KV
20	SIMIO	I/O	External SIM signal - Data I/O	± 8KV	± 15KV
22	SIMCLK	O	External SIM signal – Clock	± 8KV	± 15KV
Miscellaneous Functions					
35	USB_ID	AI	Analog input used to sense whether a peripheral device is connected	± 8KV	± 15KV
Miscellaneous Functions					
48	USB_VBUS	AI	Power supply for the internal USB transceiver.	± 8KV	± 15KV
50	VAUX1	-	Power output for external accessories	± 8KV	± 15KV
51, 52	CHARGE	AI	Charger input	± 8KV	± 15KV
53	ON/OFF	I	Input command for switching power ON or OFF (toggle command).	± 8KV	± 15KV
54	RESET	I	Reset input	± 8KV	± 15KV
55	VRTC	AO	Power supply for RTC block	± 8KV	± 15KV
Antenna					
PAD	Antenna Pad	AI	Antenna pad for Rosenberger connector	± 8KV	± 15KV

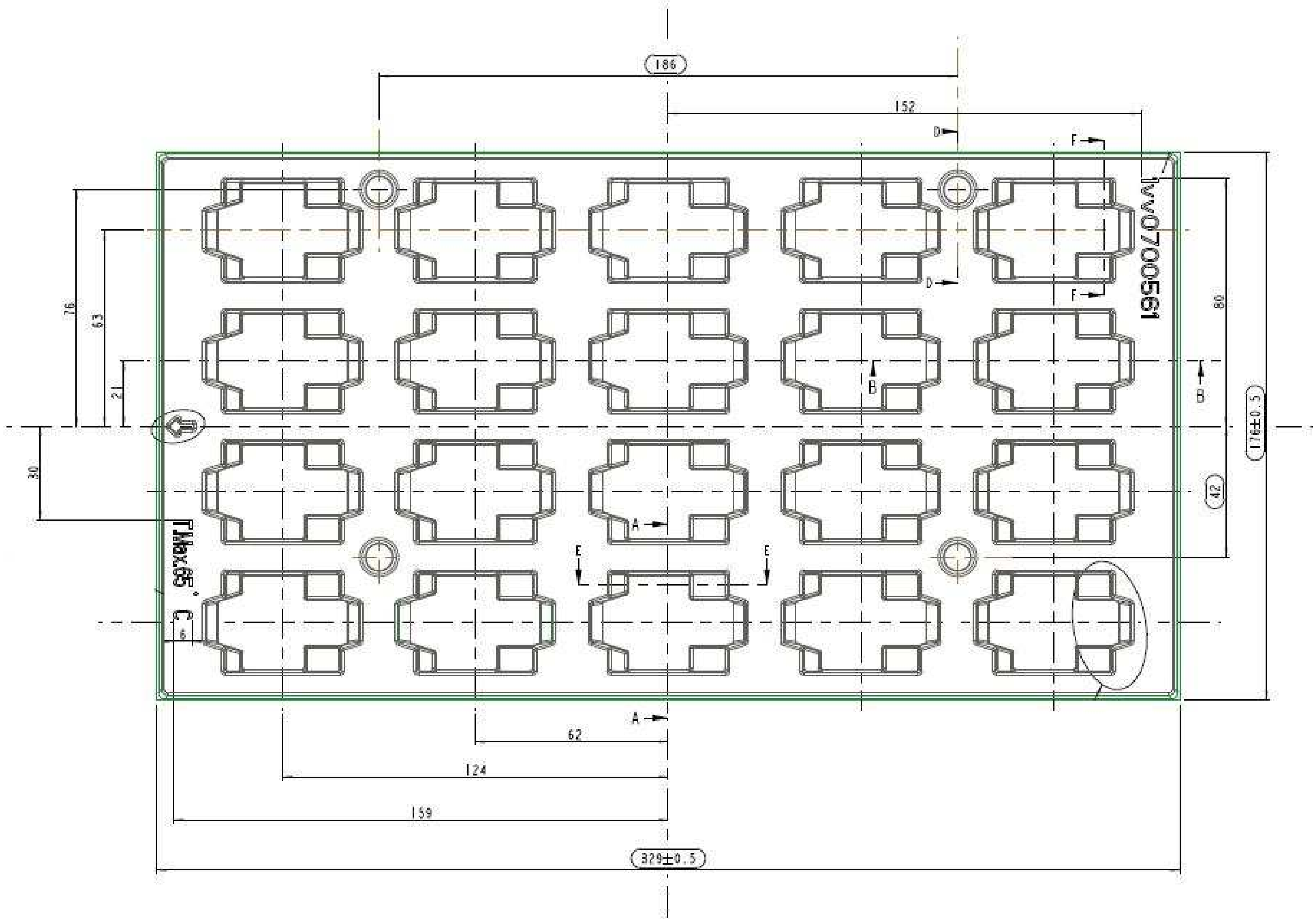
All other pins have the following characteristics:
HBM JESD22-A114-B ± 2000 V
CDM JESD22-C101-C ± 500 V

The Board to Board connector has to be considered as NO TOUCH area.

Appropriate Series resistors has to be considered to protect the input lines from overvoltage.

16. Packing system

The Telit UC864-E-AUTO / AWS-AUTO is packaged on trays. Each tray contains 20 pieces with the following dimensions:



NOTE:

Trays can withstand the maximum temperature of 65° C.

17. Conformity Assessment Issues

The Telit UC864-E-AUTO module has been assessed in order to satisfy the essential requirements of the R&TTE Directive 1999/05/EC (Radio Equipment & Telecommunications Terminal Equipments) to demonstrate the conformity against the harmonized standards with the final involvement of a Notified Body.

If the module is installed in conformance to the Telit installation manuals, no further evaluation under Article 3.2 of the R&TTE Directive and do not require further involvement of a R&TTE Directive Notified Body for the final product.

In all other cases, or if the manufacturer of the final product is in doubt, then the equipment integrating the radio module must be assessed against Article 3.2 of the R&TTE Directive.

In all cases the assessment of the final product must be made against the Essential requirements of the R&TTE Directive Articles 3.1(a) and (b), Safety and EMC respectively, and any relevant Article 3.3 requirements.

This Hardware User Guide contains all the information you may need for developing a product meeting the R&TTE Directive.

The Telit UC864-AWS-AUTO module is FCC Approved as module to be installed in other devices. This device is to be used only for fixed and mobile applications. If the final product after integration is intended for portable use, a new application and FCC is required.
The UC864-AWS-AUTO Module is conforming to the following US Directives:

• Use of RF Spectrum. Standards: FCC 47 Part 22 (GSM 850), Part 24 (PCS 1900) and Part 27 (FDD IV)

• EMC (Electromagnetic Compatibility). Standards: FCC47 Part 15

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

To meet the FCC's RF exposure rules and regulations:

- The system antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
- The system antenna(s) used for this module must not exceed 7.18 dBi (GSM 850), 2.78 dBi (PCS 1900) and 1.43 dBi (FDD IV) for mobile and fixed or mobile operating configurations.
- Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

Manufacturers of mobile, fixed or portable devices incorporating this module are advised to clarify any regulatory questions and to have their complete product tested and approved for FCC compliance.

The FCC requires that you be notified that any changes or modifications made to the UC864-AWS-AUTO module that are not expressly approved by Telit Communications S.p.A. may void your authority to operate the equipment.

18. Safety Recommendations

Read carefully!

Be sure about that the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.
- Where there is risk of explosion such as gasoline stations, oil refineries, etc.

It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity.

We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations.

The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue, because the risk of disturbing the GSM network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force.

Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to be installed with the guarantee of a minimum 20 cm distance from the body. In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments introduced on the market. All the relevant information are available on the European Community website:

http://europa.eu.int/comm/enterprise/rtte/dir99-5.htm

The text of the Directive 99/05 regarding telecommunication equipments is available, while the applicable Directives (Low Voltage and EMC) are available at:

http://europa.eu.int/comm/enterprise/rtte/dir99-5.htm

19. Document Change Log

Revision	Date	Changes
Rev.0	2008/10/22	Initial release
Rev.1	2009/04/02	Updated with new HW design of solder tags, added info on Pull up/down values on I/O lines, added soldering info Updated ESD data
Rev.2	2009/06/11	Updated with new Module Drawings, updated ESD data, pinout.
Rev.3	2009/07/08	Updated Drawings of the module Updated Turning ON/OFF Updated Power supply : Consumption for GPRS/EDGE Class 12 Updated Audio section Added Buzzer concept Updated Application guide Updated Packaging Tray dimensions
Rev.4	2009/10/29	Updated On Off timings
Rev.5	2009/11/09	Corrected Note on Chapter 4.2 (was related to E version and not to E-AUTO)
Rev. 6	2010/05/06	Updated digital operating levels; added UC864-AWS-AUTO product Updated GSM/WCDMA Antenna requirement Updated 9 USB Port
Rev. 7	2010/07/02	Added section on Temperature Ranges
Rev. 8	2010/10/14	Conformity Assessment Issues section updated
Rev. 9	2010/10/25	Conformity Assessment Issues section updated
Rev. 10	2010/11/10	Section 7.1 and Conformity Assessment Issues updated
Rev. 11	2010/11/18	Section 7.1 and Conformity Assessment Issues updated