



**UC864-E/G/WD/WDU Hardware User Guide**  
1v0300766a Rev.4 - 03/02/09

This document is relating to the following products:

PRODUCT	PART NUMBER
UC864-E	4990250031
UC864-G	4990250030
UC864-WDU	4990250051
UC864-WD	4990250050







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# 1. Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit UC864-E/G/WD/WDU module.

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/G/WD/WDU module. For further hardware details that may not be explained in this document refer to the Telit UC864-E/G/WD/WDU Product Description document where all the hardware information is reported.



**NOTICE:**

(EN) The integration of the GSM/GPRS/EGPRS/WCDMA/HSDPA UC864-E/G/WD/WDU 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/G/WD/WDU all'interno dell'applicazione dell'utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.

(DE) Die Integration des UC864- E/G/WD/WDU GSM/GPRS/EGPRS/WCDMA/HSDPA Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Konstruktionsregeln erfolgen

(SL) Integracija GSM/GPRS/EGPRS/WCDMA/HSDPA UC864- E/G/WD/WDU 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/G/WD/WDU debe ser conforme a los usos para los cuales ha sido diseñado descritos en este manual del usuario.

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

(HE) האנטגרציה מתבקש ליישם את ההנחיות המפורטות במסמך זה בתהליך האינטגרציה של המודם הסלולרי UC864- E/G/WD/WDU עם המוצר.

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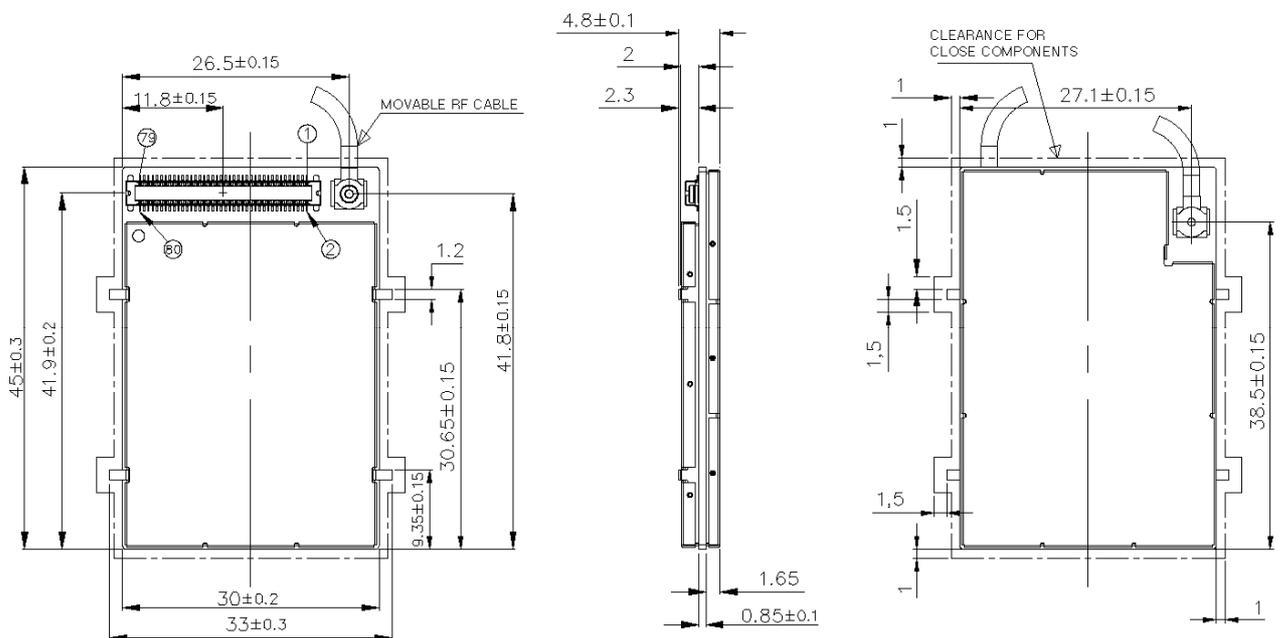




## 2.2. UC864-G Mechanical Dimensions

The Telit UC864-G module overall dimensions are:

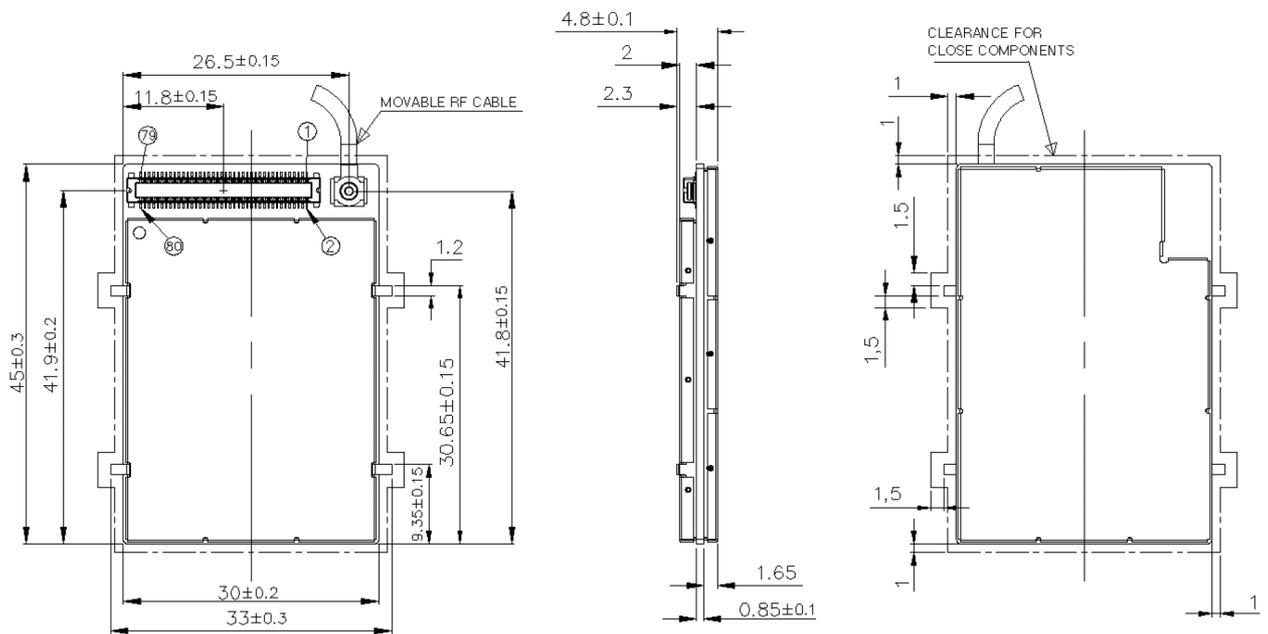
- Length: 45 mm
- Width: 30 mm
- Thickness: 4.8mm



## 2.3. UC864-WD/WDU Mechanical Dimensions

The Telit UC864-WD/WDU module overall dimensions are:

- Length: 45 mm
- Width: 30 mm
- Thickness: 4.8mm





Pin	Signal	I/O	Function	Internal Pull up	Type UC864-E/G/WD/WDU
21	SIMIN	I	External SIM signal - Presence (active low)		1.8 / 3V
22	SIMCLK	O	External SIM signal – Clock		1.8 / 3V
<b>Trace</b>					
23	RX_TRACE	I	RX Data for debug monitor		CMOS 2.6V
24	TX_TRACE	O	TX Data for debug monitor		CMOS 2.6V
<b>Prog. / Data + Hw Flow Control</b>					
25	C103/TXD	I	Serial data input (TXD) from DTE		CMOS 2.6V
26	C104/RXD	O	Serial data output to DTE		CMOS 2.6V
27	C107/DSR	O	Output for Data set ready signal (DSR) to DTE		CMOS 2.6V
28	C106/CTS	O	Output for Clear to send signal (CTS) to DTE		CMOS 2.6V
29	C108/DTR	I	Input for Data terminal ready signal (DTR) from DTE		CMOS 2.6V
30	C125/RING	O	Output for Ring indicator signal (RI) to DTE		CMOS 2.6V
31	C105/RTS	I	Input for Request to send signal (RTS) from DTE		CMOS 2.6V
32	C109/DCD	O	Output for Data carrier detect signal (DCD) to DTE		CMOS 2.6V
<b>Miscellaneous Functions</b>					
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		CMOS 2.6V
<b>DAC and ADC</b>					
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
<b>Miscellaneous Functions</b>					
45	STAT_LED	O	Status indicator led		CMOS 1.8V
46	GND	-	Ground		Ground



Pin	Signal	I/O	Function	Internal Pull up	Type UC864-E/G/WD/WDU
48	USB_VBUS	AI /A O	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.	47K $\Omega$ pull-down	4.4V ~5.25V
49	PWRMON	O	Power ON Monitor	1K $\Omega$	CMOS 2.6V
50	VAUX1	-	Power output for external accessories		
51	CHARGE	AI	Charger input	10K $\Omega$ pull-down	Power
52	CHARGE	AI	Charger input		Power
53	ON/OFF	I	Input command for switching power ON or OFF (toggle command). The pulse to be sent to the UC864-E/G/WD/WDU must be equal or greater than 1 second.		Pulled up on chip
54	RESET	I	Reset input	10K $\Omega$	
55	VRTC	AO	VRTC Backup capacitor		Power
<b>Telit GPIOs</b>					
56	TGPIO_19	I/O	Telit GPIO19 Configurable GPIO		CMOS 2.6V
57	TGPIO_11	I/O	Telit GPIO11 Configurable GPIO		CMOS 2.6V
58	TGPIO_20	I/O	Telit GPIO20 Configurable GPIO		CMOS 2.6V
59	TGPIO_04	I/O	Telit GPIO4 Configurable GPIO		CMOS 2.6V
60	TGPIO_14	I/O	Telit GPIO14 Configurable GPIO		CMOS 2.6V
61	TGPIO_15	I/O	Telit GPIO15 Configurable GPIO		CMOS 2.6V
62	TGPIO_12	I/O	Telit GPIO12 Configurable GPIO		CMOS 2.6V
63	TGPIO_10/ PCM_TX	I/O	Telit GPIO10 Configurable GPIO / PCM Data Output		CMOS 2.6V
64	TGPIO_22	I/O	Telit GPIO22 Configurable GPIO		CMOS 1.8V
65	TGPIO_18/ PCM_RX	I/O	Telit GPIO18 Configurable GPIO / PCM Data input		CMOS 2.6V
66	TGPIO_03	I/O	Telit GPIO3 Configurable GPIO		CMOS 2.6V
67	TGPIO_08	I/O	Telit GPIO8 Configurable GPIO		CMOS 2.6V
68	TGPIO_06 /	I/O	Telit GPIO6 Configurable GPIO / ALARM		CMOS



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Pin	Signal	I/O	Function	Internal Pull up	Type UC864-E/G/WD/WDU
	ALARM				2.6V
70	TGPIO_01	I/O	Telit GPIO1 Configurable GPIO		CMOS 2.6V
71	TGPIO_17/ PCM_SYNC	I/O	Telit GPIO17 Configurable GPIO / PCM Sync		CMOS 2.6V
72	TGPIO_21	I/O	Telit GPIO21 Configurable GPIO		CMOS 2.6V
73	TGPIO_07/ BUZZER	I/O	Telit GPIO7 Configurable GPIO / Buzzer		CMOS 2.6V
74	TGPIO_02	I/O	Telit GPIO02 I/O pin		CMOS 2.6V
75	TGPIO_16	I/O	Telit GPIO16 Configurable GPIO		CMOS 2.6V
76	TGPIO_09	I/O	Telit GPIO9 Configurable GPIO		CMOS 2.6V
77	TGPIO_13	I/O	Telit GPIO13 Configurable		CMOS 2.6V
78	TGPIO_05/ RFTXMON	I/O	Telit GPIO05 Configurable GPIO / Transmitter ON monitor		CMOS 2.6V
<b>USB Interface</b>					
79	USB_D+	I/O	USB differential Data (+)		3.0V ~3.6V
80	USB_D-	I/O	USB differential Data (-)		3.0V ~3.6V
<b>RESERVED</b>					
17		-			
33					
34					
41		-			
42		-			
43		-			
44		-			
47		-			
69		-			





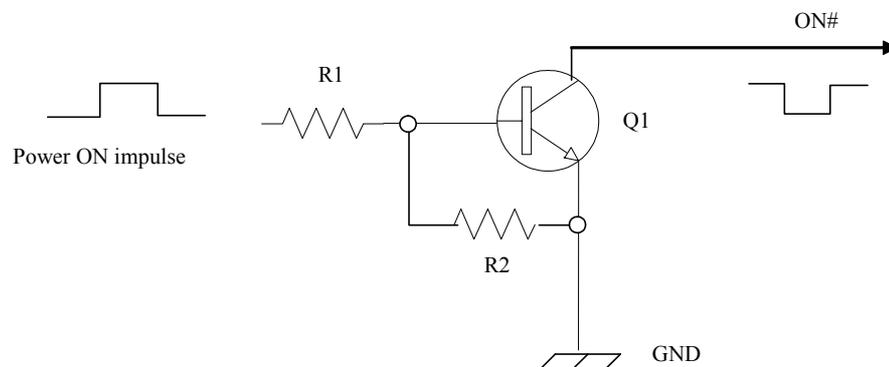
## 4. Hardware Commands

### 4.1. Turning ON the UC864-E/G/WD/WDU

To turn on UC864-E/G/WD/WDU, 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.

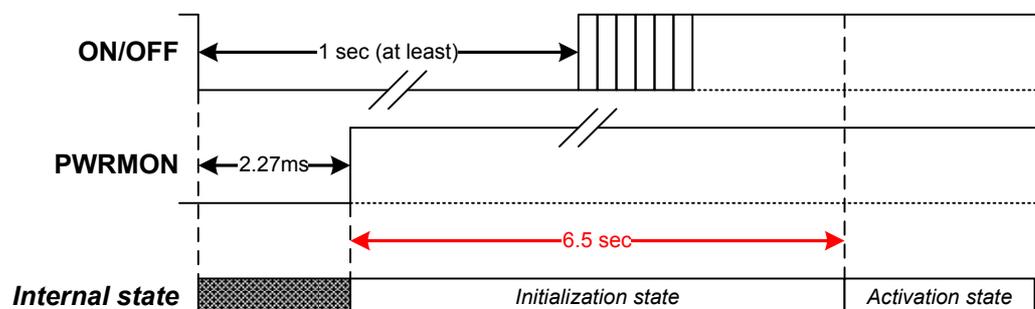
A simple circuit to do it is:



### 4.2. Initialization and Activation state

Upon turning on UC864-E/G/WD/WDU, UC864-E/G/WD/WDU is not activated yet because the boot sequence of UC864-E/G/WD/WDU is still going on internally. It takes about 6.5 seconds to complete the initializing the module internally.

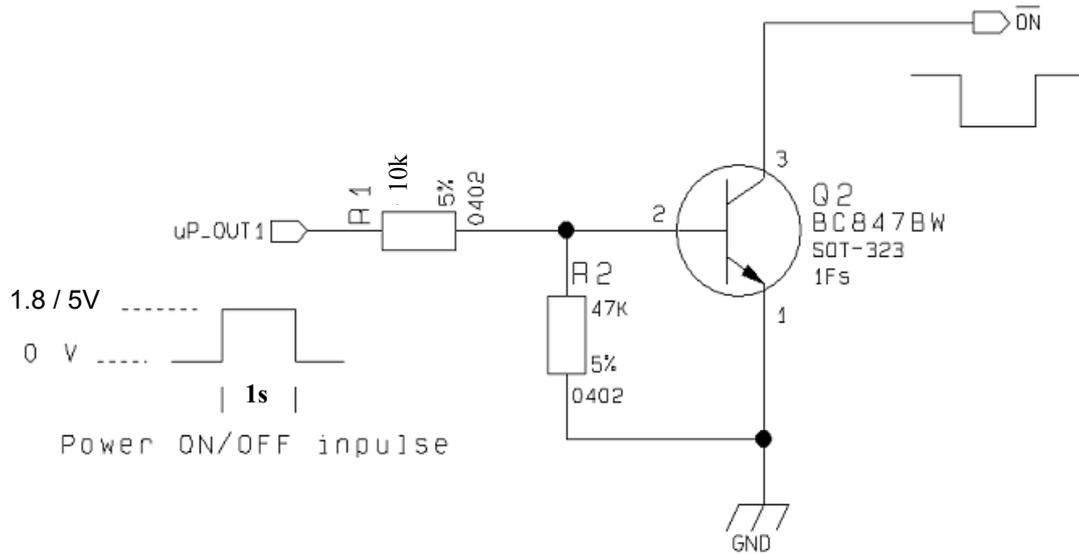
For this reason, it would be useless to try to access UC864-E/G/WD/WDU during a *Initialization state* as below. To get stability, UC864-E/G/WD/WDU needs at least 6.5 seconds after the PWRMON goes High





For example:

- 1- Let us assume you need to drive the ON# pad with a totem pole output of a +1.8/5 V microcontroller (uP\_OUT1):







**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/G/WD/WDU power regulator and improper functioning of the module. The line RESET# must be connected only in open collector configuration.



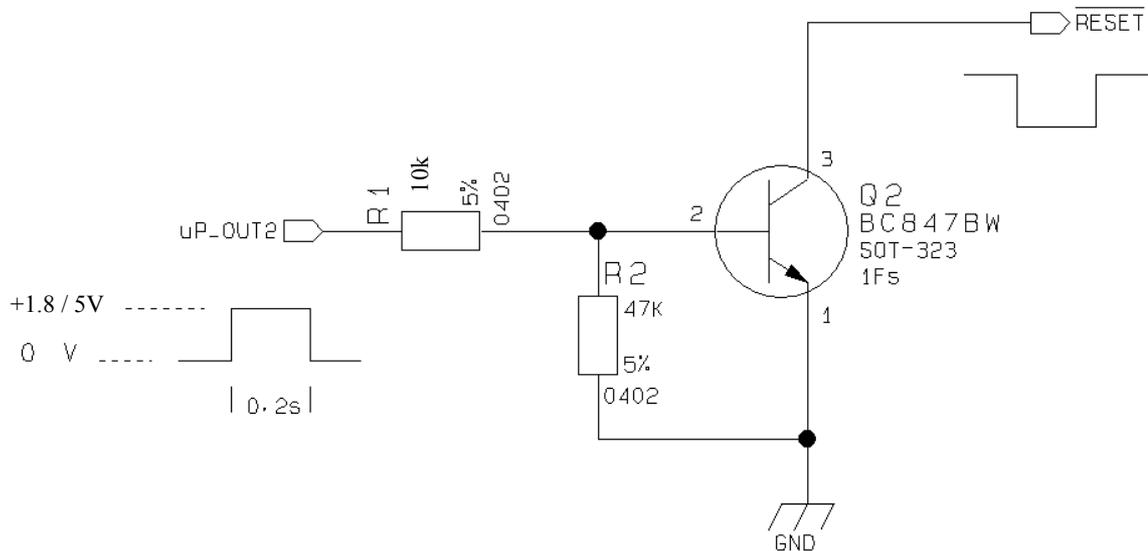
**TIP:**

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. 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.

### 5.1. Power Supply Requirements

The UC864-E/G/WD/WDU power requirements are:

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

UC864-E/G/WD/WDU			
Mode		Average(mA)	Mode Description
IDLE mode with GPS OFF			Stand by mode; no call in progress; GPS OFF (in UC864-G)
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	





WCDMA	775	WCDMA data channel
HSDPA	825	HSDPA data channel
GSM TX and RX mode with GPS ON full power mode*		
GSM Voice	410	GSM voice channel
GPRS Class12	880	GPRS data channel
EDGE Class12	650	EDGE data channel

\* except external active GPS antenna

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 down as a consequence of the supply voltage drop.



**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.

## 5.2. 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

### 5.2.1. 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



### 5.2.1.1. + 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/G/WD/WDU, a 100 $\mu$ F 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/G/WD/WDU from power polarity inversion.



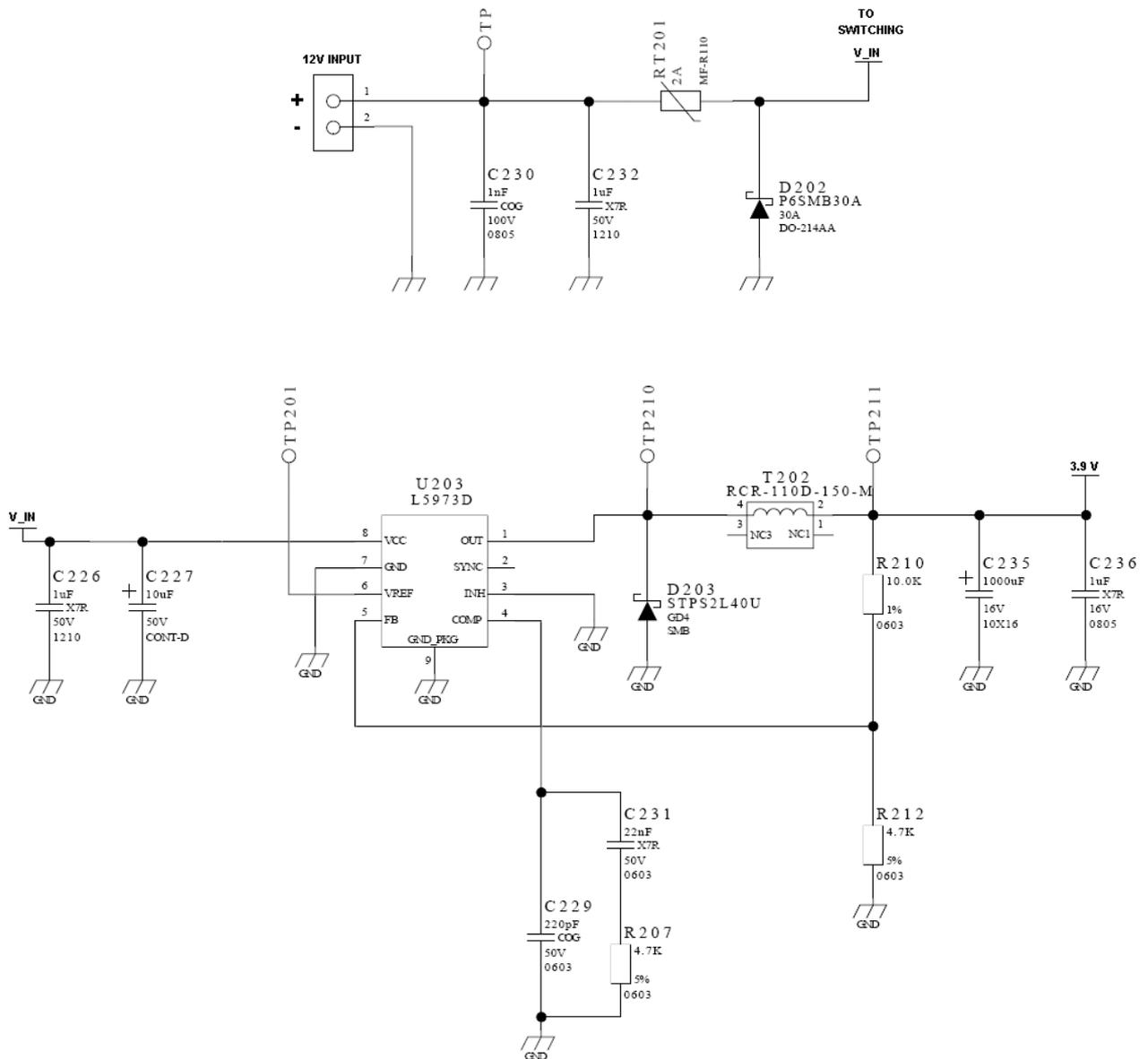


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- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode must be inserted close to the power input, in order to clean the supply from spikes.
- A protection diode must be inserted close to the power input, in order to save UC864-E/G/WD/WDU 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











**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 790mA rms plus 90mA rms for GPS in tracking mode in UC864-G.

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 790mA 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 790mA (being usually around 150mA).

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/G/WD/WDU, you can consider it to be during transmission 1W max during CSD/VOICE calls and 2W max during class12 GPRS upload. This generated heat will be mostly conducted to the ground plane under the UC864-E/G/WD/WDU; you must ensure that your application can dissipate heat

In the WCDMA/HSDPA mode(HSDPA for UC864-E/G only), since UC864-E/G/WD/WDU 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/WEDGE) continuously at the maximum TX output power (23dBm). Thus, you must arrange the PCB area as large as possible under UC864-E/G/WD/WDU which you will mount. You must mount UC864-E/G/WD /WDU 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.







*/WDU module. Antennas used for this OEM module must not exceed 3dBi gain for mobile and fixed operating configurations.*

## 6.2. 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.

## 6.3. GPS Antenna Requirements (UC864-G only)

The use of combined GPS antennas is NOT recommended; this solution could generate an extremely poor GPS reception and also the combination antenna requires additional diplexer and adds a loss in the RF route. The UC864-G module is provided with an internal LNA amplifier.

The module is provided of an Antenna supply circuit with the following characteristics:

- The supply voltage is 3.0 V DC;
- Supply enable controlled internally by the BB.

As suggested in the Product Description, the external active antenna for a Telit UC864-G device must fulfill the following requirements:

ACTIVE GPS Antenna Requirements	
<b>Frequency range</b>	1575.42 MHz(GPS L1 band)
<b>Bandwidth</b>	+/- 2 MHz
<b>Gain</b>	1.5 dBi < Gain < 4.5 dBi
<b>Impedance</b>	50 ohm
<b>Amplification</b>	Typical 14dB (max 15dB)
<b>Supply voltage</b>	3.0V
<b>Current consumption</b>	Typical 20 mA (30mA max)

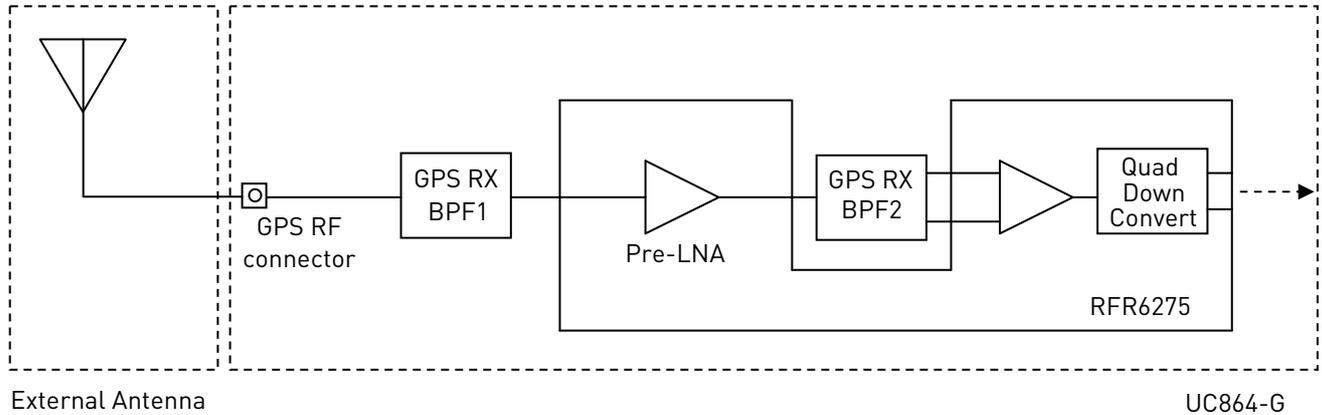


### NOTE:

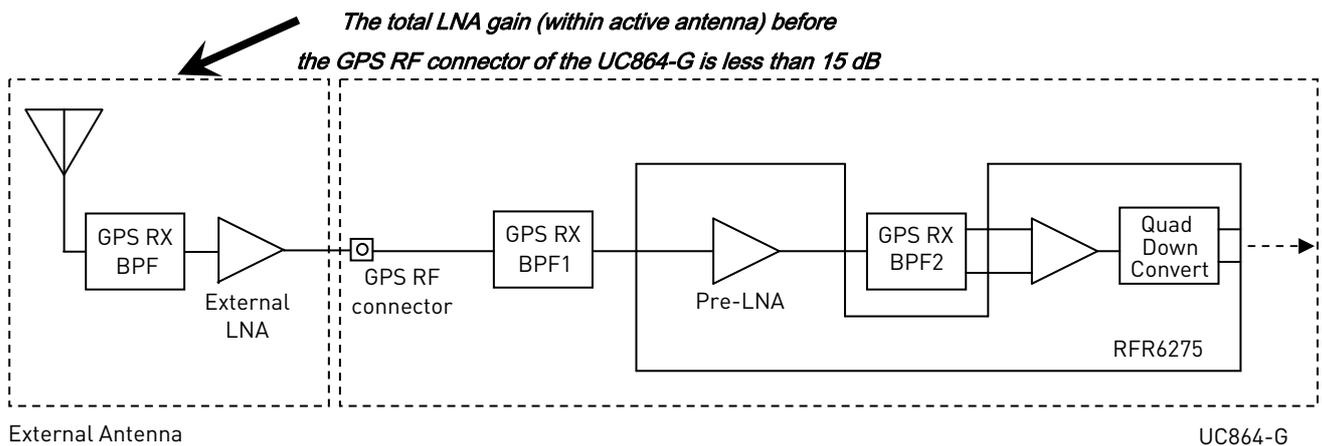
Ensure that the total LNA gain(within active antenna) before the GPS RF connector of the UC864-G is less than 15 dB. Total LNA gain includes antenna cable loss, BPF insertion loss and RF pattern loss. Excessive LNA gain (>15 dB) can introduce jamming spurs, degrade 3IP, and saturate the GPS receiver.



**Method 1 : Passive GPS Antenna**



**Method 2 : Active GPS Antenna**



If the device is developed for the US and/or Canada market, it must comply to the FCC and/or IC approval requirements:

*This device is to be used only for mobile and fixed application.*

## 6.4. GPS Antenna - Installation Guidelines (UC864-G only)

- The UC864-G due to its characteristics of sensitivity is capable to perform a Fix inside the buildings. (In any case the sensitivity could be affected by the building characteristics i.e. shielding).
- The Antenna 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.







## 7.1. Reset Signal

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

RESET is used to reset the UC864-E/G/WD/WDU module. Whenever this signal is pulled low, UC864-E/G/WD/WDU is reset. When the device is reset it stops all operations. After the release of the reset UC864-E/G/WD/WDU 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/G/WD/WDU. Use the ON/OFF signal to perform this function or the AT#SHDN command (To turn off UC864-E, first of all, you MUST cut off supplying power to the USB\_VBUS, or the module does not turn off).

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.





The signals of the UC864-E/G/WD/WDU serial port are:

RS232 Pin Number	Signal	UC864-E/G/WD/WDU Pad Number	Name	Internal Pulls (On Chip)	Usage
1	DCD - dcd_uart	32	Data Carrier Detect	Pull-Up	Output from the UC864-E/G/WD/WDU that indicates the carrier presence
2	RXD - Tx_uart	26	Transmit line *see Note	Pull-Up	Output transmit line of UC864-E/G/WD/WDU UART
3	TXD - Rx_uart	25	Receive line *see Note	Pull-Down	Input receive of the UC864-E/G/WD/WDU UART
4	DTR - dtr_uart	29	Data Terminal Ready	Pull-Up	Input to the UC864-E/G/WD/WDU that controls the DTE READY condition
5	GND	5,6,7	Ground	-	ground
6	DSR - dsr_uart	27	Data Set Ready	Pull-Down	Output from the UC864-E/G/WD/WDU that indicates the module is ready
7	RTS - rts_uart	31	Request to Send	Pull-Down	Input to the UC864-E/G/WD/WDU that controls the Hardware flow control
8	CTS - cts_uart	28	Clear to Send	Pull-Up	Output from the UC864-E/G/WD/WDU that controls the Hardware flow control
9	RI - ri_uart	30	Ring Indicator	Pull-Up	Output from the UC864-E/G/WD/WDU that indicates the Incoming call condition



**NOTE:**

According to V.24, RX/TX signal names are referred to the application side, therefore on the UC864-E/G/WD/WDU 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/G/WD/WDU serial port and vice versa for RX.



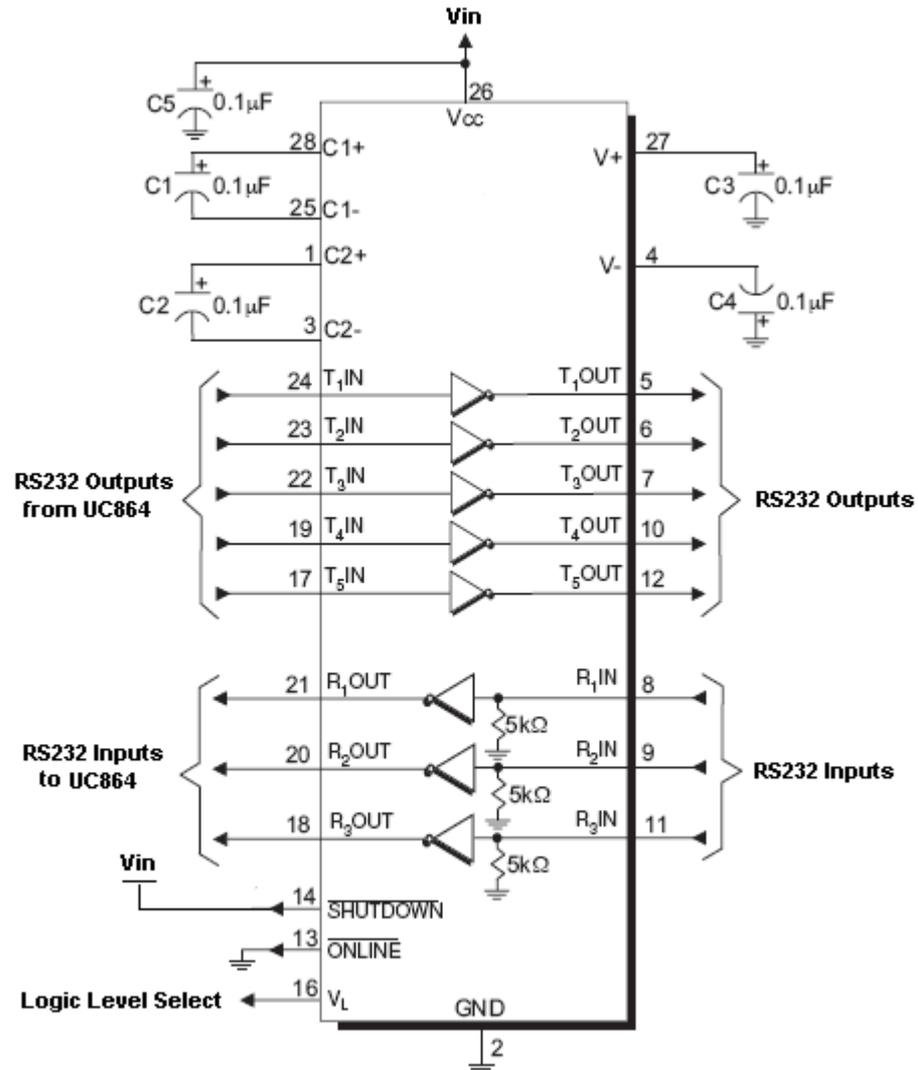
**TIP:**

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.





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.

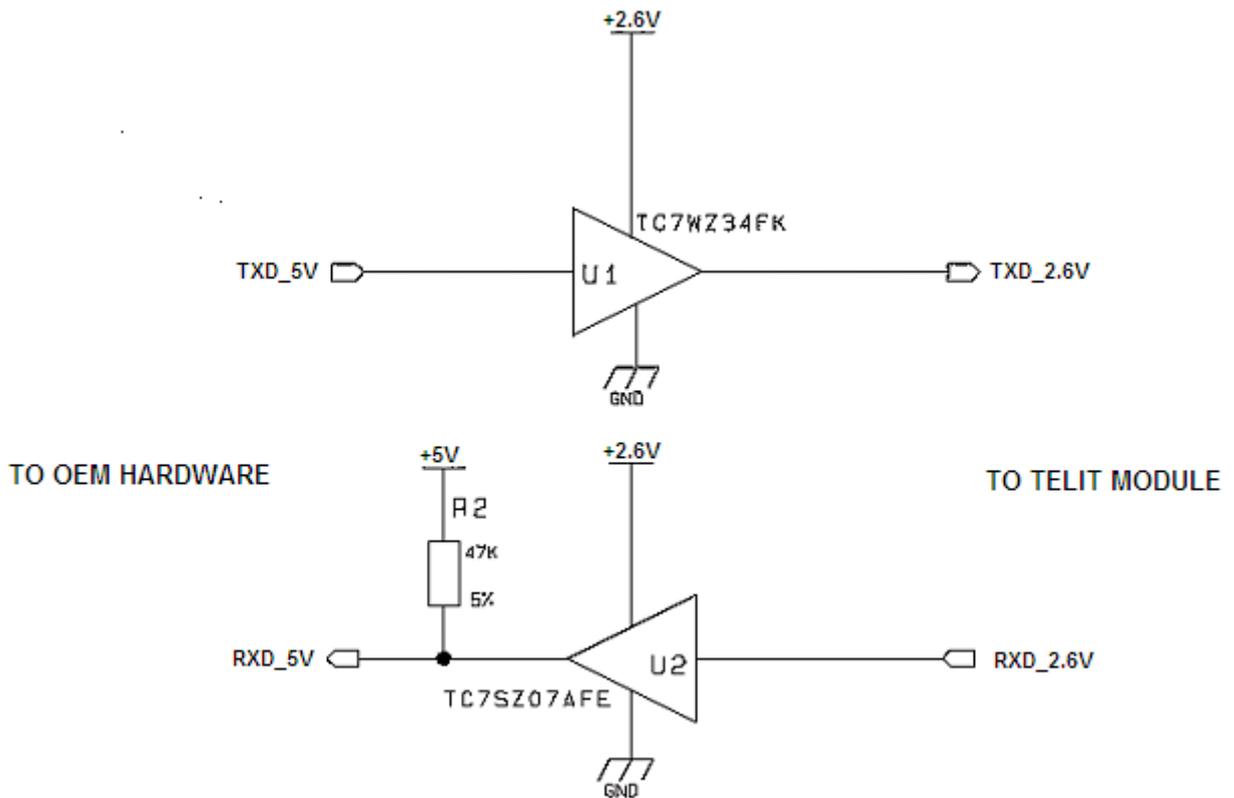
**NOTE:**

In this case  $V_{in}$  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)









**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/G/WD/WDU. 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/G/WD/WDU input lines connected to open collector outputs in order to avoid latch-up problems on UC864-E/G/WD/WDU.



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Careful approach is needed to avoid latch-up on UC864-E/G/WD/WDU 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/G/WD/WDU functionality.



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**NOTE:**

The input lines working at 2.6VCMOS can be pulled-up with 47K $\Omega$  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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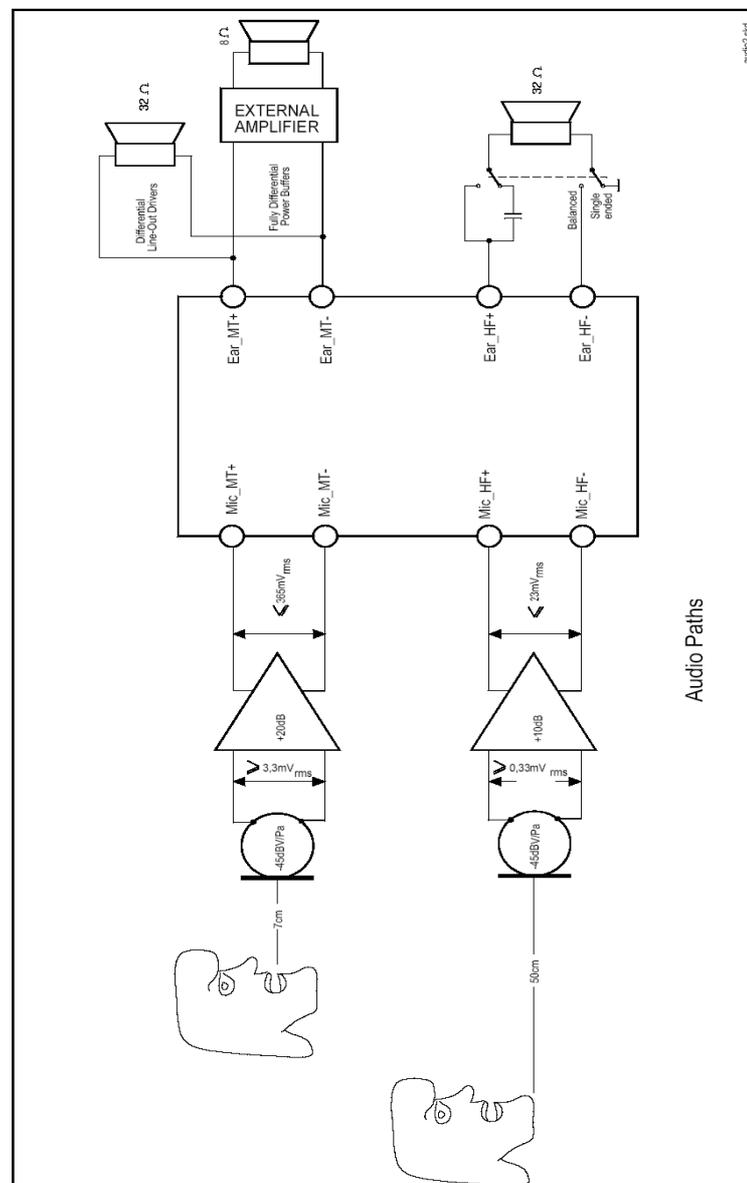
## 10. Audio Section Overview

The Base Band Chip of the UC864-E/G/WD/WDU Telit Module provides two different audio blocks; both in transmit (Uplink) and in receive (Downlink) direction:

“MT lines” should be used for handset function,

“HF lines” is suited for hands -free function (car kit).

Only one block can be active at a time, selectable by AXE hardware line or by AT command. The audio characteristics are equivalent in transmit blocks, but are different in receiving. This should be kept in mind when designing.







Both receiver outputs are B.T.L. type (Bridged Tie Load) and the OEM circuitry shall be designed bridged to reduce the common mode noise typically generated on the ground plane and to get the maximum power output from the device; however also a single ended circuitry can be designed for particular OEM application needs.

### 10.2.2. Output Lines Characteristics

#### “Ear\_MT” Differential output path

- |  |                       |
|--|-----------------------|
| • line coupling                            | DC                    |
| • line type                                | differential          |
| • output load resistance                   | 32 Ω                  |
| • max. load capacitance                    | 500pF(max.)           |
| • differential output impedance            | 1 Ω (max) @1.02KHz    |
| • signal bandwidth                         | 150 - 4000 Hz @ -3 dB |
| • differential output voltage (typ.)@0dBm0 | 1060mVrms             |
| • SW volume level step                     | 2dB                   |
| • number of SW volume steps                | 10                    |

#### “Ear\_HF” differential output path

- |  |                       |
|--|-----------------------|
| • line coupling                            | DC                    |
| • line type                                | differential          |
| • output load resistance                   | 32 Ω                  |
| • max. load capacitance                    | 500pF(max.)           |
| • differential output impedance            | 1 Ω (max) @1.02KHz    |
| • signal bandwidth                         | 150 - 4000 Hz @ -3 dB |
| • differential output voltage (typ.)@0dBm0 | 833 mVrms             |
| • SW volume level step                     | 2dB                   |
| • number of SW volume steps                | 10                    |



## 11. 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/G/WD/WDU firmware and acts depending on the function implemented.

The following GPIOs are available on the UC864-E/G/WD/WDU.

PIN	Signal	I/O	Function	Type	Drive strength	Default State	ON_OFF State	Reset State	Note
70	TGPIO_01	I/O	GPIO01 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
74	TGPIO_02	I/O	GPIO02 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
66	TGPIO_03	I/O	GPIO03 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
59	TGPIO_04	I/O	GPIO04 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	Alternate Function (RF Transmission Control)
78	TGPIO_05	I/O	GPIO05 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	Alternate Function (RFTXMON)
68	TGPIO_06	I/O	GPIO06 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	Alternate function (ALARM)
73	TGPIO_07	I/O	GPIO07 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	Alternate function (BUZZER)
67	TGPIO_08	I/O	GPIO08 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
76	TGPIO_09	I/O	GPIO09 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
63	TGPIO_10	I/O	GPIO10 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	



57	TGPIO_11	I/O	GPIO11 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
62	TGPIO_12	I/O	GPIO12 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
77	TGPIO_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	TGPIO_15	I/O	GPIO15 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
75	TGPIO_16	I/O	GPIO16 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	HIGH	
71	TGPIO_17	I/O	GPIO17 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
65	TGPIO_18	I/O	GPIO18 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
56	TGPIO_19	I/O	GPIO19 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
58	TGPIO_20	I/O	GPIO20 Configurable GPIO	CMOS 2.6V	2mA	INPUT	LOW	LOW	
72	TGPIO_21	I/O	GPIO21 Configurable GPIO	CMOS 2.6V	2mA	INPUT	HIGH	HIGH	
64	TGPIO_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/G/WD/WDU may be added if needed.

## 11.1. 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/G/WD/WDU interface circuits:

### Absolute Maximum Ratings -Not Functional

Parameter	UC864-E/G/WD/WDU	
	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/G/WD/WDU	
	Min	Max
Input high level	2.0V	2.9 V
Input low level	-0.3V	0.6V
Output high level	2.2V	2.6V
Output low level	0V	0.35V

For 1.8V signals:

### Operating Range - Interface levels (1.8V CMOS)

Level	UC864-E/G/WD/WDU	
	Min	Max
Input high level	1.5V	2.1V
Input low level	-0.3V	0.5V
Output high level	1.4V	1.8V
Output low level	0V	0.35V



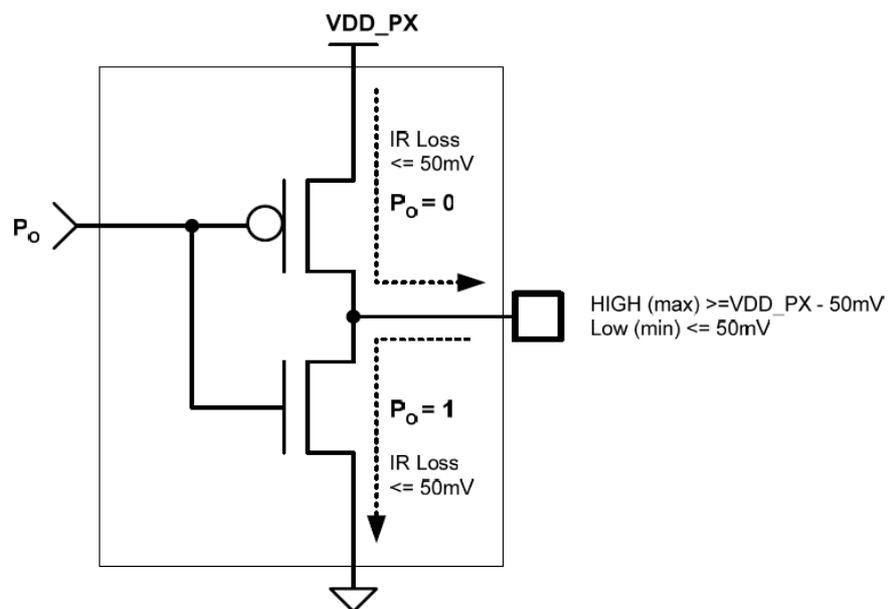
## 11.2. Using a GPIO Pad as Input

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.

## 11.3. 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



## 11.4. 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).

## 11.5. Using the RFTXMON Output GPIO5

The GPIO5 pin, when configured as RFTXMON Output, is controlled by the UC864-E/G/WD/WDU 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.

## 11.6. Using the Alarm Output GPIO6

The GPIO6 pad, when configured as Alarm Output, is controlled by the UC864-E/G/WD/WDU 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/G/WD/WDU 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/G/WD/WDU during sleep periods. This will dramatically reduce the sleep consumption to few  $\mu$ A.

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.

## 11.7. 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).









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01	GPIO	2.6V		
TGPIO_03	GPIO03 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_08	GPIO08 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_09	GPIO09 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_10	GPIO10 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_11	GPIO11 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_12	GPIO12 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_13	GPIO13 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_14	GPIO14 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_15	GPIO15 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_16	GPIO16 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_17	GPIO17 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_18	GPIO18 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_19	GPIO19 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_20	GPIO20 Configurable GPIO	CMOS 2.6V	2mA	
TGPIO_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:

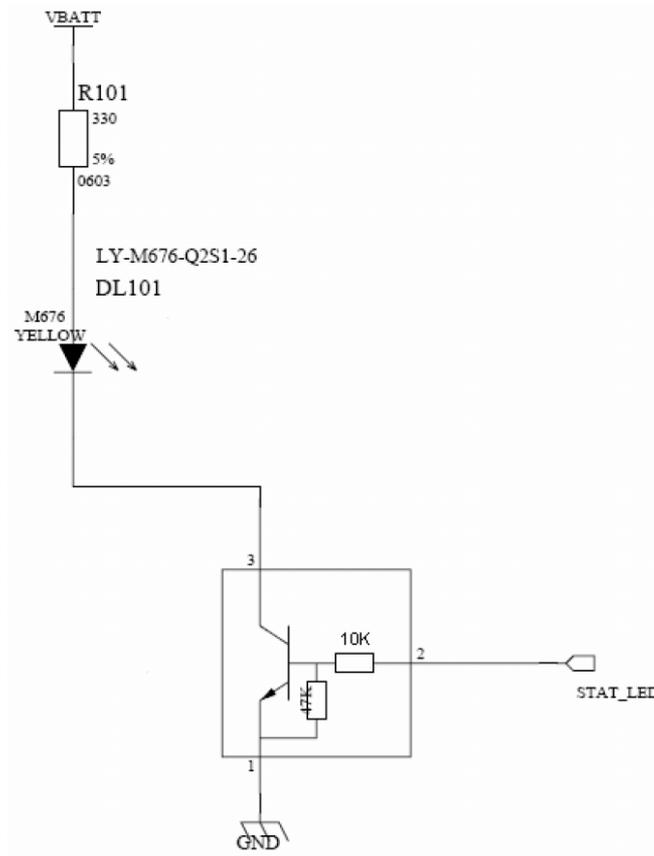
Signal	Function	Type	Drive strength	Note
TGPIO_02	GPIO02 Configurable GPIO	CMOS 2.6V	2mA	Alternate function(JDR)
TGPIO_04	GPIO04 Configurable GPIO	CMOS 2.6V	2mA	Alternate Function (RF Transmission Control)
TGPIO_05	GPIO05 Configurable GPIO	CMOS 2.6V	2mA	Alternate Function (RFTXMON)
TGPIO_07	GPIO07 Configurable GPIO	CMOS 2.6V	2mA	Alternate function (BUZZER)



## 11.10. Indication of Network Service Availability

The STAT\_LED pin status shows information on the network service availability and Call status. In the UC864-E/G/WD/WDU 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



## 11.11. 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.

## 11.12. 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
<b>Output voltage</b>	2.6V	2.65V	2.7V
<b>Output current</b>			100mA
<b>Output bypass capacitor (Inside the module)</b>			2.2 $\mu$ F



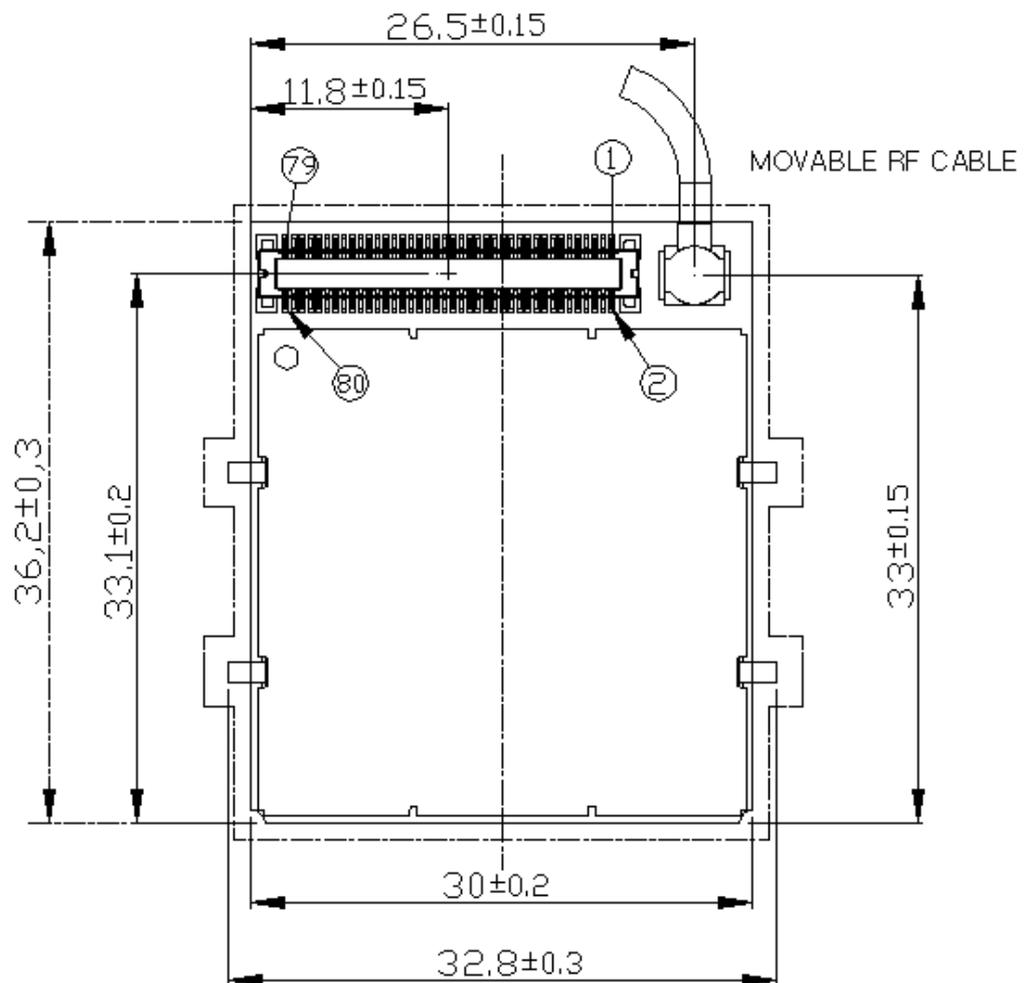




## 12.3. Mounting UC864 on your board

### 12.3.1. Mounting UC864-E on the Board

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



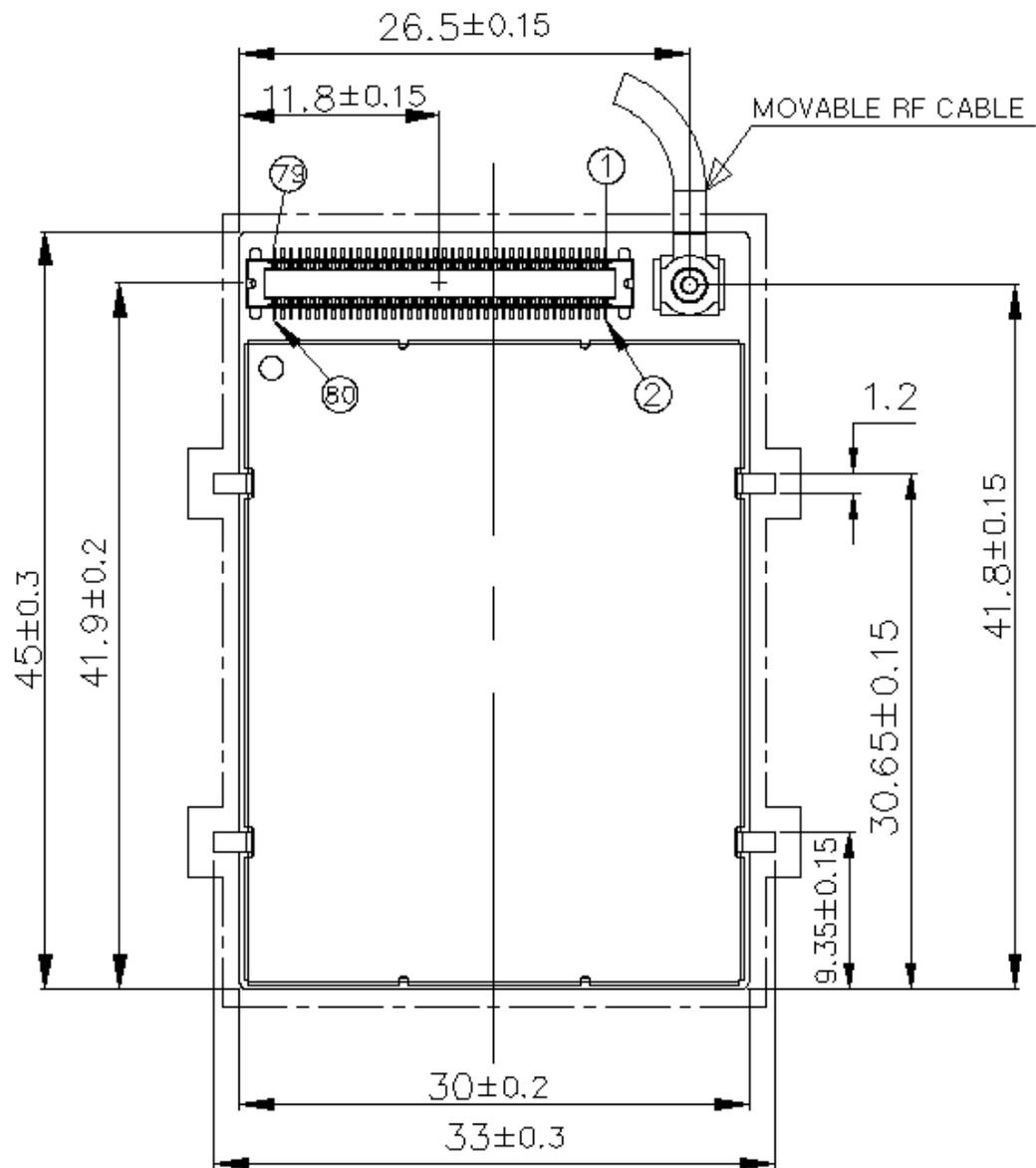
**NOTE:**

The Metal taps present on UC864-E must be to GND  
This module could not be processed with a reflow



### 12.3.2. Mounting UC864-G/WD/WDU on the Board

The position of the Molex board with board connector and pin 1 is shown in the following picture.



**NOTE:**

The Metal taps present on UC864-G/WD/WDU must be to GND

This module could not be processed with a reflow



### 12.3.3. Debug of the UC864-E/G/WD/WDU in Production

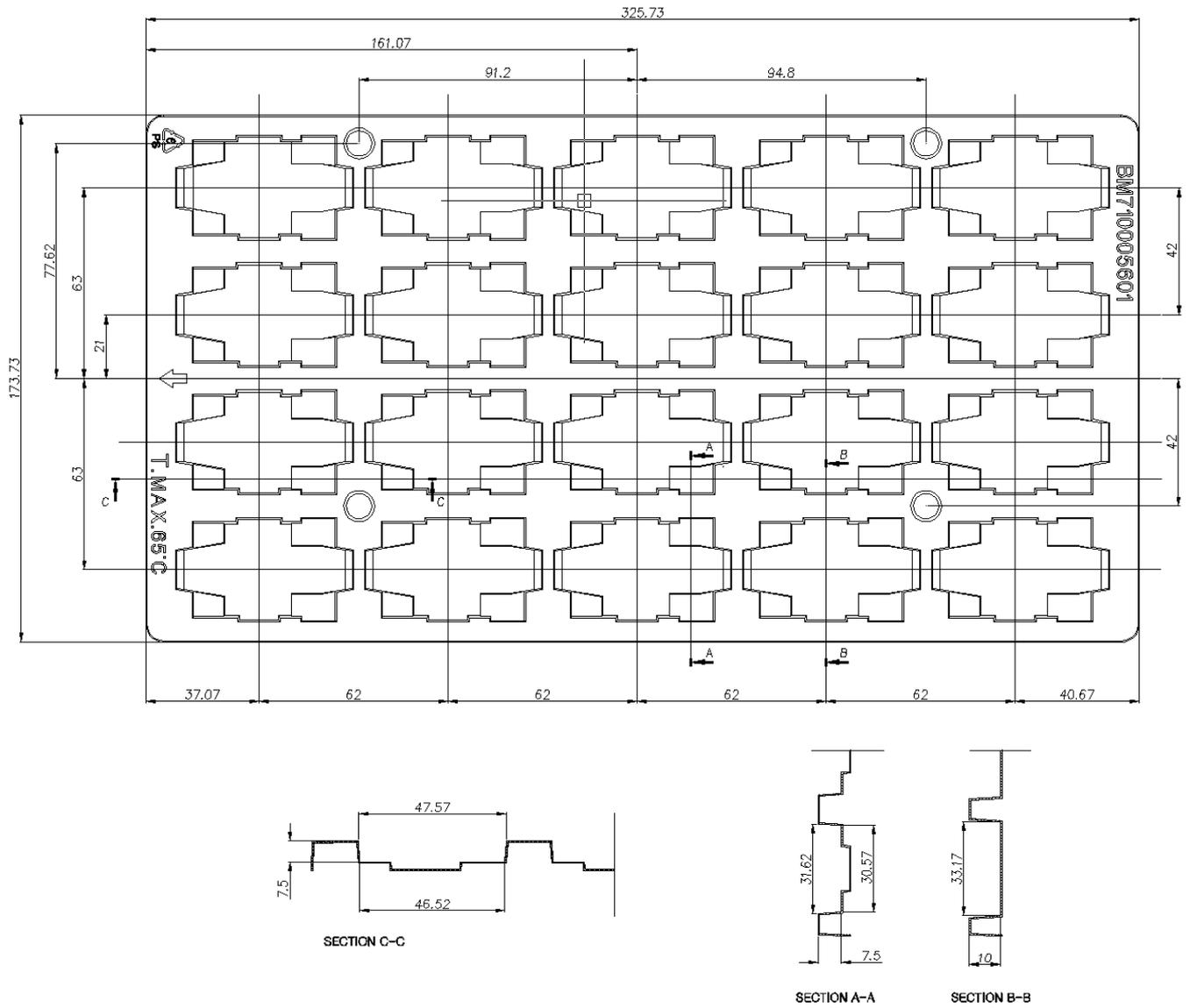
To test and debug the mounting of UC864-E/G/WD/WDU, we strongly recommend to foresee test pads on the host PCB, in order to check the connection between the UC864-E/G/WD/WDU itself and the application and to test the performance of the module connecting it with an external computer. Depending on the 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



## 12.4. Packing System

The Telit UC864-E/G/WD/WDU is packaged on trays. of Each tray contains 20 pieces with the following dimensions:



Size of the tray is: 325.73 x 173.73mm



**NOTE:**

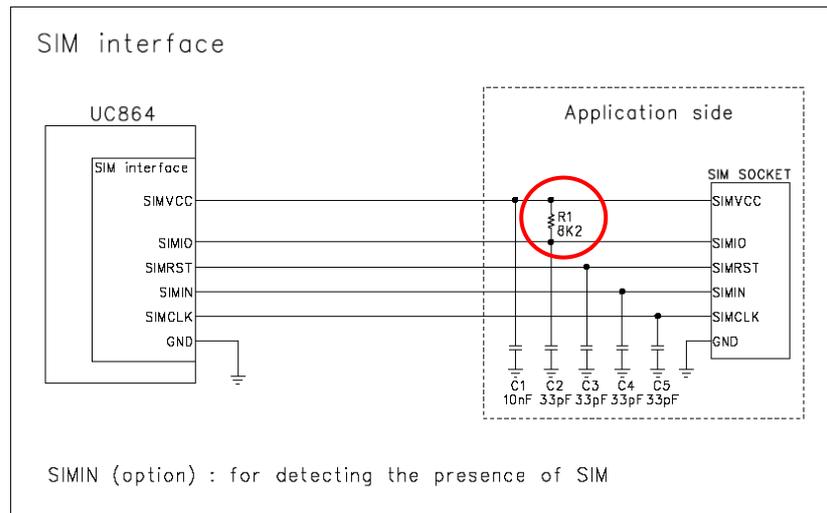
Trays can withstand the maximum temperature of 65° C.





### 13. Application guide for SIM interface

When designing SIM interface on the application boards, the following schematics are recommended.



All the components in the application side (dotted line above) should be included into the application board and the recommended values should be referred as well.

Special attention should be paid to the value of Resistor R1.

3GPP specifications define that the rise time and the fall time of the IO signal shall not exceed 1 us.

Resistor R1 is very closely related to the rise time and the fall time of the SIMIO signal. It can differ depending on the application board therefore it should be considered at the customer point of view. Telit highly recommends that the customers should verify the relating specification when they design.

To make it easy to understand, Telit presents the following results which is based on the UC864-E/G/WD/WDU with Telit EVK.

This result represents the deviation by R1 regarding the rise time and the fall time of SIMIO signal.

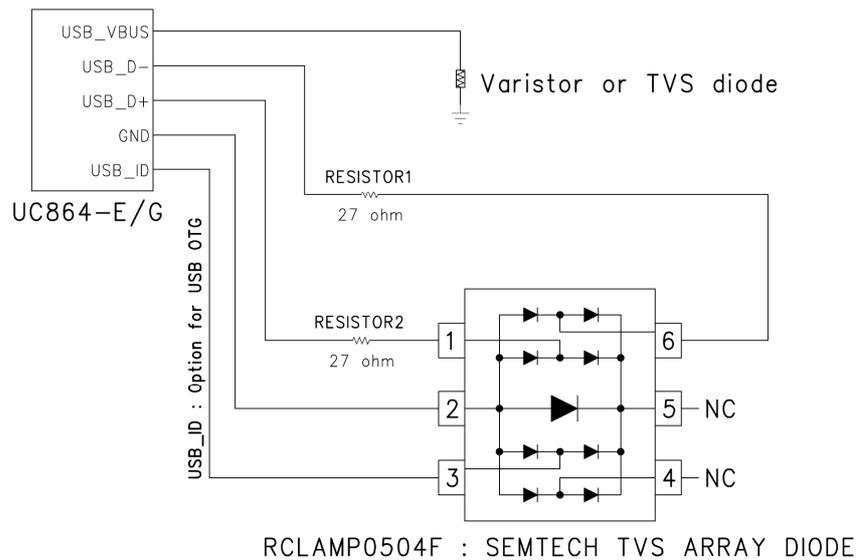
	Resistor R1	1.8V		3.0V	
		Rising time max. [us]	Falling time max. [us]	Rising time max. [us]	Falling time max. [us]
3gpp spec		1.000	1.000	1.000	1.000
1	15K	1.225	0.026	1.295	0.150
2	10K	1.008		1.058	
3	8K2	0.900		0.903	
4	6K8	0.793	0.025	0.795	0.015





## 14.2. ESD Protection for USB interface

The following schematics are recommended for USB interface.



The single TVS diode or varistor can be used on the respective pins. Additionally Telit recommend that suitable resistors should be used to protect the USB D+/D- signal from ESD.

## 14.3. ESD Protection for Power Supplies

Telit recommend that the single TVS diode or varistor should be used to protect UC864-E/G/WDU from ESD for the following lines.

- Vbatt : Pin 1,2,3,4
- VAUX1 : Pin 50
- CHARGE : Pin 51,52
- ON/OFF: Pin 53
- VRTC : Pin 55



## 15. Conformity Assessment Issues

The UC864-E/G module is assessed to the R&TTE Directive as stand-alone products, so if the module is installed in conformance with TELIT installation instructions require 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 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.

The UC864-E/G module is in conform with the following European Union Directives:

- R&TTE Directive 99/05/EC (Radio Equipment & Telecommunications Terminal Equipments);
- Low Voltage Directive 73/23/EEC and product safety;
- Directive 89/336/EEC for conformity for EMC.

In order to satisfy the essential requisite of the R&TTE 99/05/EC directive, the UC864-E/G module is compliant with the following standards:

- Radio Spectrum, Standard: EN 301 511, EN 301 908-1 and EN 301 908-2 ;
- EMC (Electromagnetic Compatibility). Standards: EN 301 489-1, EN 301 489-7 and EN 301 489-24;
- LVD (Low Voltage Directive) Standards: EN 60950-1:2001+A11:2004.

In this document and the Hardware User Guide, Software User Guide all the information you may need for developing a product meeting the R&TTE Directive is included.

The Telit UC864-G modules are FCC Approved as module to be installed in other devices.

These devices have 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 ID is required.

The Telit UC864-G modules are also conforming to the following US Directives:

- Use of RF Spectrum. Standards: FCC 47 Part 22;
- Use of RF Spectrum. Standards: FCC 47 Part 24;



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

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

- 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;
- The antenna(s) used for this module must not exceed 3 dBi 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.

Interference statement:

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.





