Cellular Engine TC35

The extra compact module for voice and data transmission

Application Note:	**Battery Pack**
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1 Introduction

This document describes additionally to TC35_HW_Interface_description the usage of an special Li-Ion battery pack with the Siemens GSM engine TC35.

Specifications subject to change without notice. This product is an original Siemens product protected by US, European and other patents.

1.1 History

Issue	Changes
20-03-2001	Released

1.2 References

TC35_HW_Interface_description

1.3 Terms and Abbreviations

FFC	Flat Flexible Cable
PCB	Printed Circuit Board
ZIF	Zero Insertion Force
VSWR	Voltage Standing Wave Ratio
GSM	Global System for Mobile Communication
Li-Ion	Lithium Ion

2 Recommendation for low resistance to ground

2.1 Low resistance connection to ground

In case of using the FFC in a max. length of 200 mm it could be necessary to avoid supply voltage drop out during the GSM burst.
Use an additional cable fixed under the mounting hole for the TC35 and solder the other side on your application to battery ground.

2.2 General

Some special notes must be given to run the TC35 with a Li-Ion battery pack. The reason is the relative high internal resistance of the Li-Ion battery and its protection elements inside the battery package.

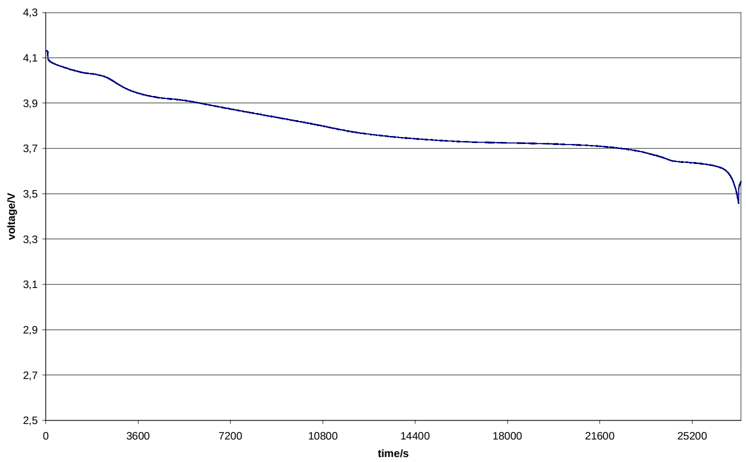


Figure 1: Discharging with power level 19

The discharge characteristic of a typical Li-Ion battery is shown in Figure 1

This application note explains the parasitics in the power supply lines and gives the reader an idea of how to use the typicall capacity from his battery.

2.3 Resistance of the power supply lines

The standard set up of an application of the TC35 is made with the module itself connected via the FFC to the power supply unit. This power supply unit might be an AC/DC-adapter, a voltage regulator or a Li-Ion battery pack.
Due to the low voltage difference between the full charged battery compared to an almost discharged, care must be taken to keep the series resistance of all connectors and lines as low as possible. By this, the usable battery capacity can be increased significantly.
The following figure explains our application set up.

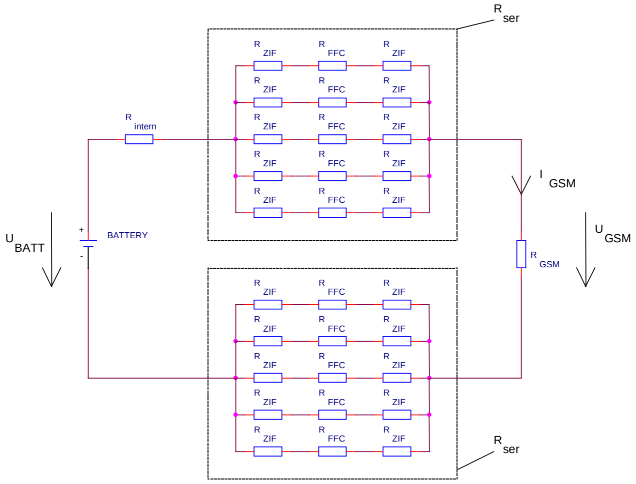


Figure 2: Schematic of a typical applications set up

The values of the devices sketched in the above printed figure are listed in the following table.

Parameter	Value	Unit	Remark
R_{ZIF}	max. 50	mOhm	typical values are in the range of 33 mOhm
R_{FFC}	typ. 146	mOhm	for a 200 mm cable
$R_{ser} = (R_{ZIF}*2 + R_{FFC}) / 5$	typ. 49.2	mOhm	
R_{intern}	typ.120	mOhm	AC impedance of battery at time of delivery (including wire and contact resistant)
R_{intern}	max.160	mOhm	AC impedance of battery after 500 discharge/charge cycles (including wire and contact resistant)

Table 1: Values of elements drafted in Figure 2

Since the FFC is inserted into the ZIF on both sides, the overall series resistance is 49.2 mOhm in the positive and the negative power line, each.

2.4 Typical battery voltage at normal operation (discharging)

Due to the GSM specific operation of the TC35 at high rf-power levels the discharge current of the battery is modulated by approx. 1.8 A pulses with a duration time of 0.577 ms. During the low current time period the current consumption is approx. 70 mA. This current profile is depicted in the following figures. The measurements are made in the GSM band at 900 MHz at maximum power level (PL 5) and minimum power level (PL 19).

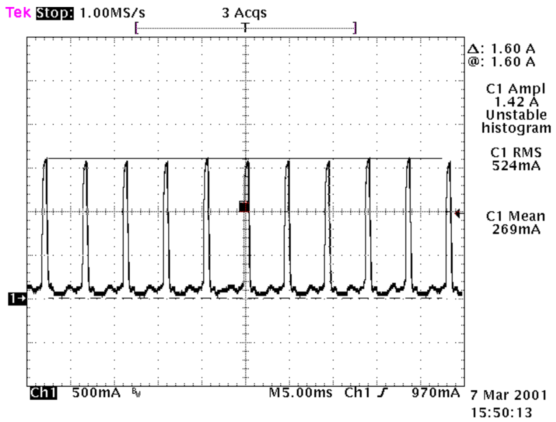


Figure 3: Current at Power Level 5

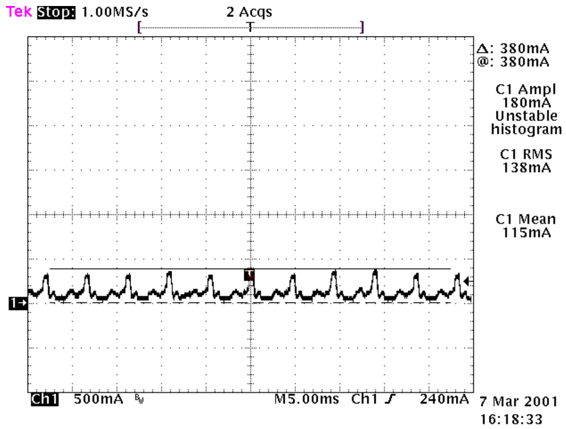
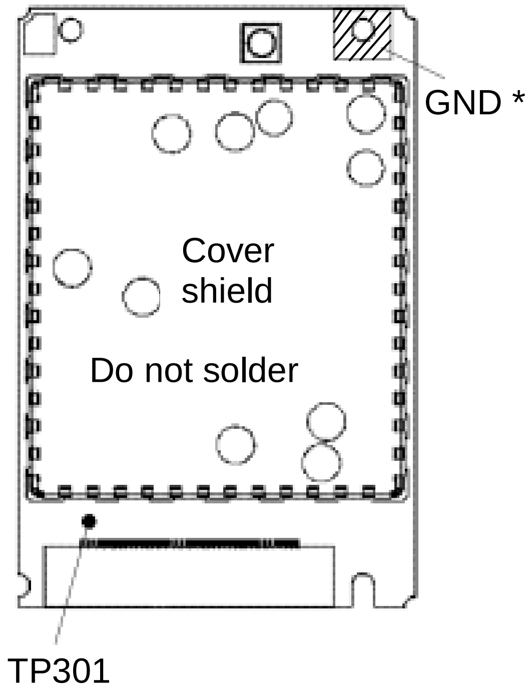


Figure 4: Current at Power Level 19

As one can see and calculate by Ohms law, especially at high power levels a significant voltage drop is induced between the battery contact and the PCB of the TC35.
Since the battery condition is monitored by a tracking of the onboard voltage U_{GSM} of the TC35 (see Figure 2) the overall voltage drops over any connecting cable and connectors must be made as low as possible. And this means, that the highest usable battery capacity might be achieved for parasitic series resistors as low as possible.
Since not all of the series resistors of Figure 2 can be shortened, but at least a short between the negative contact of the battery to a ground pad on the TC35 PCB might improve and cut the sum of all resistors.

In case of using the FFC in a max. length of 200 mm it could be necessary to avoid supply voltage drop out during the GSM burst.
Use an additional cable fixed under the mounting hole for the TC35 and solder the other side on your application to battery ground.



*** for low GND resistance connect TC35 GND to application ground battery**

Figure 5: Sketch of the module TC35 (top view)

In Figure 5 you will find the position of the mentioned ground pad. This pad is usable for contacting with a spacer or screw. The user might sample the PCB onboard voltage U_{GSM} in the same manner as the battery condition monitor does by connecting a voltage probe to test point TP301. This is equivalent to the BATT+ signal of the module as written in published descriptions of the TC35.

2.5 ZIF-Connector and FFC

Use the FFC in your application as short as possible.

3 Peak current in various of the antenna load

The following figures show the typical peak current in depending of load mismatch during a transmit burst with the power control level for maximum RF power (PL5).
The current is almost independent from the supply voltage value and the temperature.
For a good performance the return loss of an antenna should be better than 10dB (within the concerning frequency range).

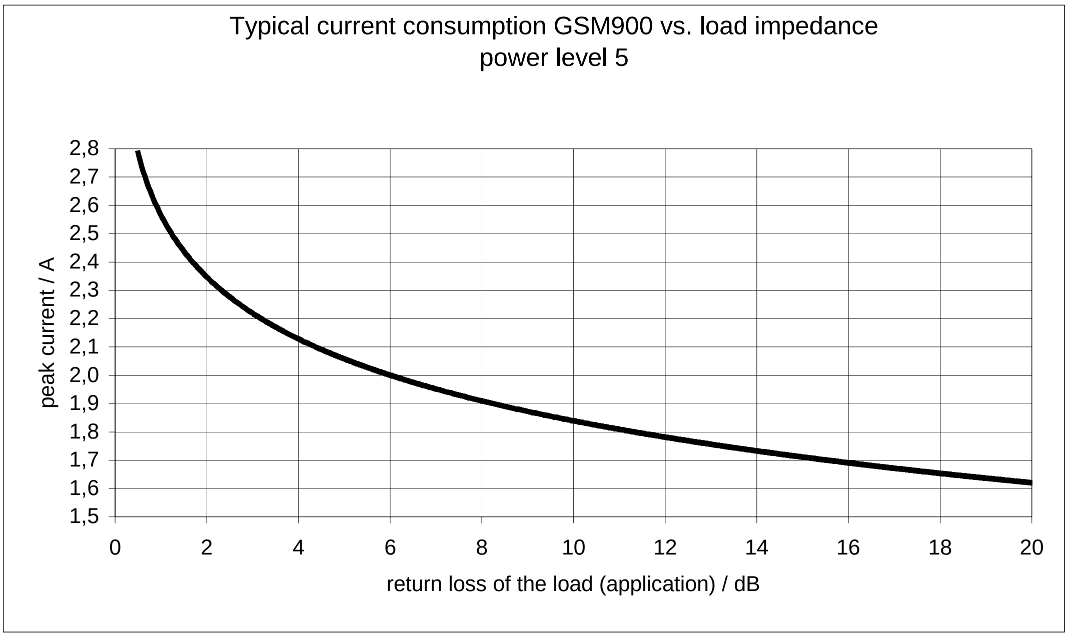


Figure 6: Typical current consumption for GSM 900, power level 5

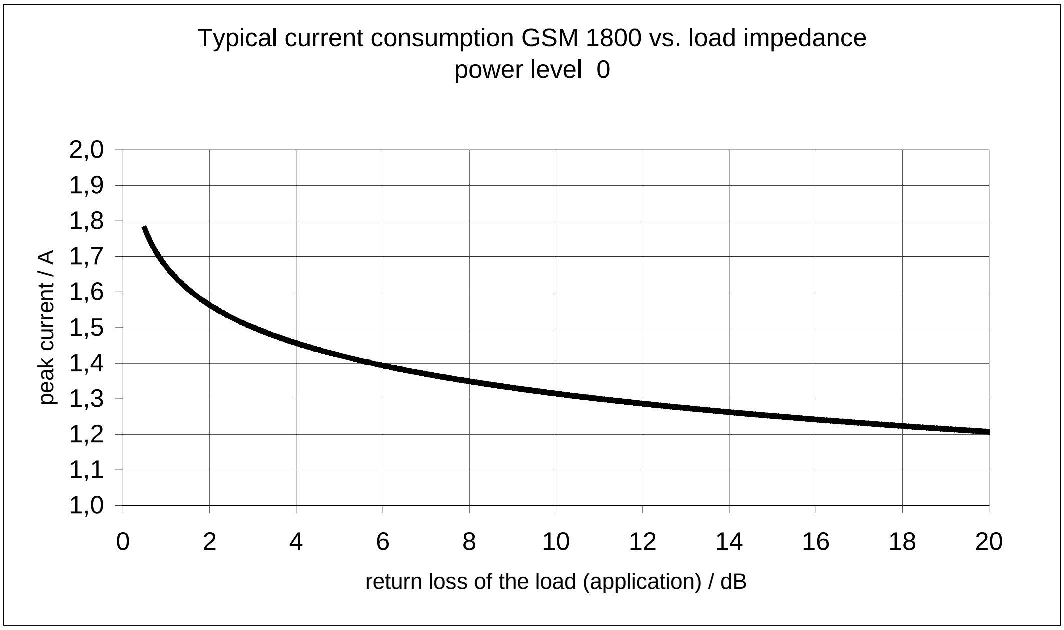


Figure 7: Typical current consumption for GSM1800, power level 0

3.1.1 Typical peak current values for antenna load matching

Peak current during transmit burst at max. power level. Values for current and return loss in reference to Figure 6 and Figure 7

Typ	return loss	VSWR (approx.)
1600 mA	20 dB	1.20
1800 mA	11 dB	1.75
2000 mA	6 dB *)	3.00
2300 mA	2.5 dB **)	9.00

Table 2 : GSM 900, power level 5

Typ	return loss	VSWR (approx.)
1200 mA	20 dB	1.20
1300 mA	11 dB	1.75
1400 mA	6 dB *)	3.00
1500 mA	2.5 dB **)	9.00

Table 3 : GSM 1800, power level 0

Hint : Typical value of a dual band antenna is in the range of VSWR < 2
*) mismatched antenna e.g. caused by bad dielectric or a mistuned antenna
**) short cut at the GSC connector or broken (destroyed) antenna

4 Power supply

Table 4 : Power supply

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{BATT+}	Supply voltage	Reference point on the module (TP301), voltage must stay in the min/max values, including voltage drop, ripple, spikes	3.3	4.2	5.5	V
	Voltage drop during transmit burst	Normal condition, power control level for Pout max			400	mV
I_{BATT+}	Average supply current	Power Down-mode		50	100	µA
		SLEEP-mode		3	3.5	mA
		IDLE -mode		20		mA
		TALK-mode		300	400	mA
	Peak supply current (during 577µs transmission slot every 4.6ms)	power control level for Pout max		see Table 2 Table 3		mA
I_{CHARGE}	Charging current	Li-Ion battery pack			500	mA
	Trickle charging				9.0	mA