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White Paper

SIM cards and how they are used for testing

What is a SIM card, and what does it contain?

The GSM phone is a mass product with no personalised data except for its serial number. All the information required to address the phone or for the phone to identify itself in the network, is contained on the subscriber identity module (SIM). The SIM card is a small piece of plastic with a chip on it; it is the key to the mobile phone. The card must be plugged into the phone before use, otherwise the mobile cannot access any network (except for emergency calls).

A personal identification number (PIN) is used to authorise the user and to protect the chip against unauthorised access. Once the correct PIN has been entered, the phone will try to register with a network and can be used for calls or to access information residing on the SIM card, such as a personal phone directory. The card may also identify network options to which the user might have subscribed. Additional fields have been added over the last few years to support new features, such as the parameters for GPRS access.

The most important parameter held in the memory of the tiny chip is the mobile's number in the form of its international mobile subscriber identity (IMSI). The IMSI is not identical with the phone number you dial to call the phone; the network maintains a translation table between the two types of identity. As the name implies, the IMSI is an internationally recognised number that uniquely identifies the subscriber, no matter in which of the more than 400 GSM networks worldwide the mobile registers with the network. The format is as follows: aaa bb cccccccccc

Each character above stands for a digit from 0 through 9. aaa represents the mobile country code, for example 234 for the United Kingdom or 310 for the US. bb is the network identifier within the country, so aaa-bb fully represents the mobile phone's home network (although North American operators use three-digit MNCs). British operator Vodafone, for example, has the MCC-MNC code 234-15. Finally, the string cccccccccc identifies the user within the network.

Modern mobile phones and SIM cards operate at a voltage of 3 V. SIM cards older than four years, however, may require 5 V; you will never see this voltage with a modern handheld phone.
The reverse situation – old phone does not work with new SIM card – should not be a problem as modern SIM cards are designed to work with both voltages.

A new generation of SIM cards also supporting an operating voltage of 1.8 V has already been specified.

Why do I need a special SIM for test purposes?

A GSM phone tester typically simulates a network, hence a SIM card is required. Although some tests can be done without a special test SIM or even without a SIM card at all, the test SIM has several advantages:

- Each phone can be tested under the same conditions.

- It is not an active SIM card, therefore no phone calls can be made on a real network and the phone only registers with the tester.

- The subscriber can keep his SIM card and make phone calls with another phone while keeping his identity.

- The tester can originate a call to the mobile phone because its number (IMSI) is known to the tester. Most test SIM cards and virtually all GSM testers use the IMSI number 001-01-0123456789. The number on the SIM card can be verified with a call from the mobile to the tester, as most testers display the IMSI of the calling phone.

- Originating a call from the tester with a known SIM card also saves considerable test time on those GSM testers not requiring a preceding registration.

- The test SIM holds parameters needed for receiver testing, allowing the phone to close a test loop which is required for bit error rate (BER) measurements.

  The last point is the most important one – most phones only support the loopback function for BER measurements if a test SIM is inserted. Older SIM cards may not contain the specific fields for GPRS and hence full GPRS transmitter and receiver testing may not be possible with some types of phone.

How long can I use a test SIM card?

The memory of the chip allows approximately 100,000 read/write cycles e.g. to write a new or read an existing phone book entry. This is more than sufficient for the lifetime of a mobile phone. However, it is possible that the chip is damaged by improper use, e.g. by removing the battery without properly switching off the phone. Although this damage of the chip (i.e. the electronics) is unlikely nowadays as phone manufacturers are aware of this problem, it could still happen.

The biggest problem for a SIM card in a service environment is that it is inserted into and removed from phones many times a day. The body of a SIM card is made of plastic which wears off over the time. This of course also means that after a while, the contacts will not contact in the right position anymore and that therefore the SIM has to be replaced by a new SIM card. Experience shows that a SIM card is good for approximately 2000 insertions/removals from a mobile phone.

Looking at a real SIM card you will notice that the contacts are very close to each other. After many insertions, the contacts wear off, changing the outer dimensions. This effect moves the contacts of the SIM towards the contacts in the phone itself which will then cause malfunctions.
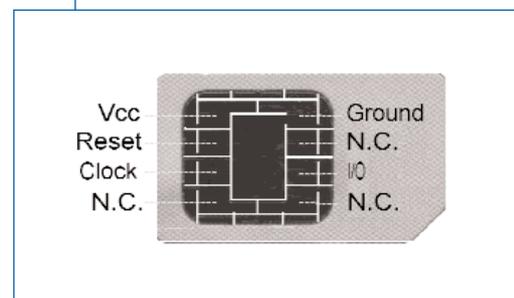It is then time to replace the SIM card!

SIM card–related problems when testing

1. You have run your transmitter tests and turn to receiver tests, but the test will not start.

- Check that your SIM card is a test SIM. This allows the mobile phone to close its test loop, which is necessary for receiver testing.

- Check that the power level at which you have started receiver testing is higher than 90 dBm. If you are too close to the sensitivity level, the phone might not understand the closed loop command properly.

2. You have inserted a SIM card in your phone, but the phone still requests you to "Insert SIM".

- Check that your SIM card is a 3 V SIM. Newer phones might only support 3 V SIM cards and do not support the older and higher voltage level of 5 V.

- Your SIM card might be worn out, so that the contacts no longer match. Throw your SIM card in the bin and replace it with a new one.

3. You have inserted a SIM card in your phone, but the phone returns a SIM error message.

- The SIM may be damaged by improper use, e.g. by removing the battery before switching the phone off. Replace the SIM.

- There may be a short-circuit caused by a worn-off SIM card, for example where a phone's SIM connector connects with two pads at the same time. Replace the SIM.

Hint for no–fault–found situations

Sometimes a customer complains that his new mobile phone does not work and that he never had such problems with his old one. Measurements on the phone itself, carried out with a test SIM, usually do not reveal any problems. The real problem lies with an incompatibility of the old SIM card with the new phone.

Willtek recommends to contact the network provider and explain the compatibility problem. The provider will usually ship a new card at no or low cost.

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