Telit Cinterion

# Signal Strength Bar Configuration

## User Guide

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Technical Documentation

# Contents

# 1 Introduction

## 1.1 Scope

This document presents implementation hints how to calculate and implement the signal strength indication bar displayed on a UI for the different network access technologies available in Telit modules.

## 1.2 Contact Information, Support

For technical support and general questions, e-mail:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com
- TS-ONEEDGE@telit.com

Alternatively, use: https://www.telit.com/contact-us/

Product information and technical documents are accessible 24/7 on our website: https://www.telit.com

## 1.3 Conventions

**Note:** Provide advice and suggestions that may be useful when integrating the module.

**Danger:** This information MUST be followed, or catastrophic equipment failure or personal injury may occur.

**ESD Risk:** Notifies the user to take proper grounding precautions before handling the product.

**Warning:** Alerts the user on important steps about the module integration.

All dates are in ISO 8601 format, that is YYYY-MM-DD.

## 1.4 Terms and conditions

Refer to https://www.telit.com/hardware-terms-conditions/.

## 1.5 Disclaimer

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# 2 Background

For GSM networks, the number of signal strength indication bars displayed on the UI is recommended to be calculated based on the Received Signal Strength Indication (RSSI) value. RSSI is defined as the received signal strength by the receiving antenna. Larger RSSI implies stronger received signal strength.

For WCDMA networks, the number of signal strength indication bars displayed on the UI should be dependent on both Received Signal Code Power (RSCP) and Channel Signal to Interference ratio (Ec/No) levels.

RSCP represents power measured by a receiver on a particular physical communication channel.

Ec/No represents the ratio between the average energy per bit and noise spectral density.

For LTE networks, the number of signal strength indication bars displayed on the UI should be calculated based on both Reference Signal Receive Power (RSRP) and Reference Signal Receive Quality (RSRQ) values.

RSRP is measured as the linear average power of the downlink reference signals across the channel bandwidth. Higher RSRP value represents higher reference signal (RS) strength. This RSRP information helps to rank the signal strength within different cells and thus contributes to the cell handoff decision. Although RSRP measures the signal strength within a cell, it does not give full information regarding the signal quality.

Reference Signal Received Quality (RSRQ) is defined as the ratio NxRSRP/(E-UTRA carrier RSSI), where N is the number of resource blocks of the E-UTRA carrier RSSI measurement bandwidth which even includes unwanted power such as interference and noise. RSRQ is internally used for handoff decision-making.

The following chapter present example values for the different value ranges used to record the minimum threshold values for a five bar strength indicator in GSM, WCDMA, and LTE networks. Below the mentioned values for “1” bar condition, the UI may show “0” bars and the device might still be registered in the network.

Of course customers have the ability to adapt these example values according special needs.

Also the maximum number of signal strength bars available on the UI must be taken into consideration.

# 3 GSM Network

Following table show example RSSI threshold values to reach a corresponding RSSI signal bar level.

| RSSI (dBm) | Signal bar condition (bars) |
|---|---|
| RSSI ≥ -80 | 5 |
| -80 > RSSI ≥ -89 | 4 |
| -89 > RSSI ≥ -98 | 3 |
| -98 > RSSI ≥ -104 | 2 |
| -104 > RSSI ≥ -106 | 1 |

# 4 WCDMA Network

Two different values can be used to define the signal strength bar for WCDMA networks,

RSCP + Ec/No or RSCP Only.

## 4.1 RSCP + Ec/No

The number of signal bars displayed on the UI is determined based on the minimum of either RSCP or the Ec/No signal bar condition number.

## 4.2 RSCP Only

Using this approach, only RSCP value defines the bar value.

| RSCP (dBm) | RSCP signal bar condition (bars) |
|---|---|
| RSCP ≥ -80 | 5 |
| -80 > RSCP ≥ -90 | 4 |
| -90 > RSCP ≥ -100 | 3 |
| -100 > RSCP ≥ -106 | 2 |
| –106 > RSCP ≥ -125 | 1 |

| $E_c/N_o$ (dB) | $E_c/N_o$ signal bar condition (bars) |
|---|---|
| $E_c/N_o$ ≥ -9 | 5 |
| -9 > $E_c/N_o$ ≥ -11 | 4 |
| -11 > $E_c/N_o$ ≥ -13 | 3 |
| -13 > $E_c/N_o$ ≥ -15 | 2 |
| -15 > $E_c/N_o$ ≥ -19 | 1 |

# 5 LTE and CAT-M Networks

Two different settings can be used to define the signal strength bar for LTE and CAT-M networks,

RSRP + RSRQ or RSRP Only.

## 5.1 RSRP + RSRQ

The number of signal bars displayed on the UI is determined based on the minimum of either RSRP or the RSRQ signal bar condition number.

## 5.2 RSRP Only

Using this approach, only the RSRP value defines the bar value.

| RSRP (dBm) | RSRP signal bar condition (bars) |
|---|---|
| RSRP ≥ -70 | 5 |
| -70 > RSRP ≥ -80 | 4 |
| -80 > RSRP ≥ -90 | 3 |
| -90 > RSRP ≥ -100 | 2 |
| -100 > RSRP ≥ -140 | 1 |

| RSRQ (dB) | RSRQ signal bar condition (bars) |
|---|---|
| RSRQ ≥ -7 | 5 |
| -7 > RSRQ≥ -10 | 4 |
| -10 > RSRQ ≥ -13 | 3 |
| -13 > RSRQ ≥ -16 | 2 |
| -16 > RSRQ ≥ -20 | 1 |

# 6 CAT -NB Networks

Two different settings can be used to define the signal strength bar for CAT-NB networks,

NRSRP + NRSRQ or NRSRP Only.

The reporting of NRSRP and NRSRQ has a wider value range compared to RSRP and RSRQ, but in general, the same mapping signal bar for can be used as described in Chapter 5.2.

| | NRSRQ | RSRQ |
|---|---|---|
| Min. Value | -34 dB | -19.5 dB |
| Max. Value | -3 dB | -3 dB |

| | NRSRP | RSRP |
|---|---|---|
| Min. Value | -156 dBm | -140 dBm |
| Max. Value | -44 dBm | -44 dBm |

Please check if AT Command specification set of your product supports the extended value range reporting for NRSRQ and NRSRP.

# 7 Acronyms and Abbreviations

**Table 1: Acronyms and Abbreviations**

| Acronym | Definition |
|---|---|
| ADC | Analog – Digital Converter |
| CLK | Clock |
| CMOS | Complementary Metal – Oxide Semiconductor |
| CS | Chip Select |
| DAC | Digital – Analog Converter |
| DTE | Data Terminal Equipment |
| ESR | Equivalent Series Resistance |
| GPIO | General Purpose Input Output |
| HS | High Speed |
| HSDPA | High-Speed Downlink Packet Access |
| HSIC | High-Speed Inter Chip |
| HSUPA | High-Speed Uplink Packet Access |
| I/O | Input Output |
| MISO | Master Input – Slave Output |
| MOSI | Master Output – Slave Input |
| MRDY | Master Ready |
| PCB | Printed Circuit Board |
| RTC | Real-Time Clock |
| SIM | Subscriber Identification Module |
| SPI | Serial Peripheral Interface |
| SRDY | Slave Ready |
| TTSC | Telit Technical Support Centre |
| UART | Universal Asynchronous Receiver Transmitter |
| UMTS | Universal Mobile Telecommunication System |
| USB | Universal Serial Bus |
| VNA | Vector Network Analyzer |
| VSWR | Voltage Standing Wave Radio |
| WCDMA | Wideband Code Division Multiple Access |

# 8 Related Documents

Refer to https://dz.telit.com/ for current documentation and downloads.

**Table 2: Related Documents**

| S.no | Book Code | Document Title |
|---|---|---|
| 1 | 1VV123456 | Document Title 1 |
| 2 | 1VV123456 | Document Title 2 |
| 3 | 1VV123456 | Document Title 3 |

# 9 Document History

**Table 3: Document History**

| Revision | Date | Changes |
|---|---|---|
| 1 | 2023-10-11 | Default Access Level set to Confidential<br>Updated styles<br>• TC . List Paragraph<br>• TC Balloon Text<br>• TC. Caption<br>• TC Closing<br>• TC Comment subject<br>• TC . Comment Text<br>• TC Code update<br>• TC . Hyperlink<br>• TC . Heading 4 |
| 0 | 2023-05-25 | Initial release |

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