R&S®SMM-K89
NFC A/B/F
User Manual

1179203102
Version 05

ROHDE&SCHWARZ
Make ideas real

This document describes the following software option:

- R&S®SMM-K89 NFC A/B/F (1441.1160.xx)

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMM100A.

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1179.2031.02 | Version 05 | R&S®SMM-K89

The following abbreviations are used throughout this manual: R&S®SMM100A is abbreviated as R&S SMM; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

Contents

1 Welcome to the NFC/EMV digital standard

The R&S SMM100A-K89 is a firmware application that adds functionality to generate signals in accordance with the NFC/EMV.

The R&S SMM100A-K89 NFC features:

- Supports NFC- A, NFC- B and NFC- F.
- Supports poll and listen transmission mode.
- Offers a quick frame configuration through a selection of predefined sequences for the poll transmission mode.
- Offers a flexible configuration of the frame sequence.
- Supports all relevant command types.

The R&S SMM100A-K89 EMV features:

- Supports EMV Type A and EMV Type B.
- Supports PICC to PCD and PCD to PICC transmission mode.
- Offers a quick frame configuration through a selection of predefined sequences for the PCD to PICC transmission mode.
- Offers a flexible configuration of the frame sequence.
- Supports all relevant command types.

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMM100A user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMM100A

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMM100A service manual.

1.1 Accessing the NFC dialog

To open the dialog with NFC settings

► In the block diagram of the R&S SMM100A, select "Baseband > NFC/EMV".

A dialog box opens that displays the provided general settings.

The signal generation is not started immediately. To start signal generation with the default settings, select "State > On".

1.2 What's new

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMM100A.

Compared to the previous version, it provides the new features listed below:

- Time-based triggering, see "Time Based Trigger" on page 27 and "Trigger Time" on page 27.
- Editorial changes

1.3 Documentation overview

This section provides an overview of the R&S SMM100A user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/smm100a

1.3.1 Getting started manual

Introduces the R&S SMM100A and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.3.2 User manuals and help

Separate manuals for the base unit and the software options are provided for download:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S SMM100A is not included.

The contents of the user manuals are available as help in the R&S SMM100A. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

All user manuals are also available for download or for immediate display on the Internet.

1.3.3 Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.3.4 Instrument security procedures

Deals with security issues when working with the R&S SMM100A in secure areas. It is available for download on the internet.

1.3.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.3.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S SMM100A. It also lists the options and their order numbers and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smm100a

1.3.7 Release notes and open source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smm100a

1.3.8 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/smm100a

1.3.9 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

On the menu bar, search for your product to find related videos.

Figure 1-1: Product search on YouTube

1.4 Scope

Tasks (in manual or remote operation) that are also performed in the base unit in the same way are not described here.

In particular, it includes:

- Managing settings and data lists, like saving and loading settings, creating and accessing data lists, or accessing files in a particular directory.
- Information on regular trigger, marker and clock signals and filter settings, if appropriate.
- General instrument configuration, such as checking the system configuration, configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S SMM100A user manual.

1.5 Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Required options

The basic equipment layout for generating NFC signals includes:

- Baseband Generator(R&S SMM-B9)
- Baseband real-time extension (R&S SMM-K520)
- Frequency option (e.g. R&S SMM-B1006)
- Digital standard NFC A/B/F (R&S SMM-K89)

You can generate signals via play-back of waveform files at the signal generator. To create the waveform file using R&S WinIQSIM2, you do not need a specific option.

To play back the waveform file at the signal generator, you have two options:

- Install the R&S WinIQSIM2 option of the digital standard, e.g. R&S SMM-K255 for playing LTE waveforms
- If supported, install the real-time option of the digital standard, e.g. R&S SMM-K55 for playing LTE waveforms

For more information, see data sheet.

3 About the NFC digital standard

The following description is taken from the R&S White Paper 1MA182: "Near Field Communication (NFC) Technology and Measurements" which contains further practical hints.

Near Field Communication (NFC) is a new, short-range wireless connectivity technology that evolved from a combination of existing contactless identification and interconnection technologies. It was jointly developed by Sony and NXP Semiconductors (formerly Philips).

NFC is designed to enable the exchange of various types of information, such as telephone numbers, pictures, MP3 files or digital authorizations between two NFC enabled devices like mobile phones, or between an NFC enabled mobile phone and a compatible RFID chip card or reader that are held close to each other. NFC is intended to be used as an access key to contents and for services such as cashless payment, ticketing and access control.

NFC operates in a frequency range centered on 13.56 MHz and offers a data transmission rate of up to 424 kbit/s within a distance of approximately 10 centimeters. In contrast to the conventional contactless technology in this frequency range (only active-passive communications), communications between NFC-capable devices can be active-active (peer-to-peer) as well as active-passive, NFC therefore represents a link to the RFID world. NFC is backwards compatible with the widely used Smart Card infrastructure based on ISO/IEC 14443 A (e. g. NXP's MIFARE technology) and ISO/IEC 14443 B as well as with the Sony FeliCa card (JIS X 6319-4). For the exchange of information between two NFC devices, a new protocol was developed which is defined in the standards ECMA-340 and ISO/IEC 18092.

To guarantee the function of NFC devices conforming to the standards as well as comprehensive protocol tests, a number of RF tests also have to be carried out. An NFC generator is an essential part of these tests. The option R&S SMM-K89 enables you to generate signals in accordance with the NFC standard.

The NFC specific abbreviations used in this manual as well as the different types of tag platforms/protocols (e.g. Type 4A Tag, NFC-DEP) are described in the NFC Digital Protocol Technical Specification. All mentioned standards are available under www.nfc-forum.org.

3.1 Basics of data transmission with NFC

Like the RFID Standards 14443 and FeliCa NFC uses an inductive coupling. Similar to the transformer principle, the magnetic near-field of two conductor coils is used to couple the polling device (initiator) and listening device (target).

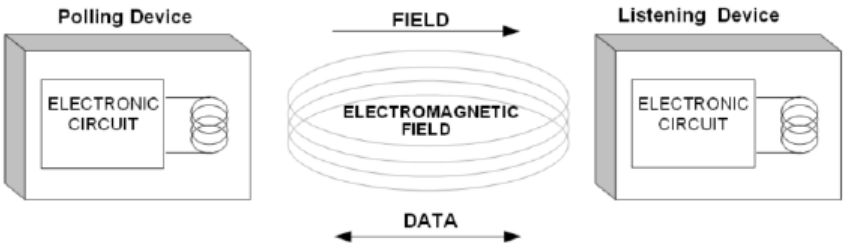


Figure 3-1: Polling device (initiator) and listening device (target) configuration

The operating frequency is 13.56 MHz, and a bitrate of 106 kbit/s (partly also 212 kbit/s and 424 kbit/s) is used. Modulation schemes are amplitude on/off keying (OOK) with different modulation depth (100 % or 10 %) and BPSK.

3.1.1 Power transmission and data transmission from a polling device

For transmission to a passive system such as an NFC phone in passive card emulation mode, the passive system uses the 13.56 MHz carrier signal of the polling device as energy source. Modulation scheme of the polling device is ASK. For NFC peer-to-peer mode, both directions are modulated and coded like a polling device. However less power is necessary because both NFC devices use their own power supply and the carrier signal is switched off after end of transmission.

3.1.2 Data transmission from a listening device

Due to the coupling of the coils of a polling and a listening device, a passive listening device also affects the active polling device. A variation in the impedance of the listening device causes amplitude changes to the antenna voltage of the polling device, detected by the polling device. This technique is called load modulation. Load modulation is carried out in listening mode (as with ISO/IEC 14443) using an auxiliary carrier at 848 kHz which is modulated by the baseband and varies the impedance of the listening device. The Figure 3-2 shows the spectrum with load modulation. Modulation spectra of carrier and auxiliary carriers are indicated with triangles (Modulation spectra of carrier and of auxiliary carriers do not appear at the same time because NFC uses time division multiplexing). The modulation scheme is ASK (as with ISO/IEC 14443 A PICC's) or BPSK as with 14443 B PICC's. There is a third passive mode which is compatible to FeliCa where the load modulation is without an auxiliary carrier directly as ASK on the 13.56 MHz carrier.

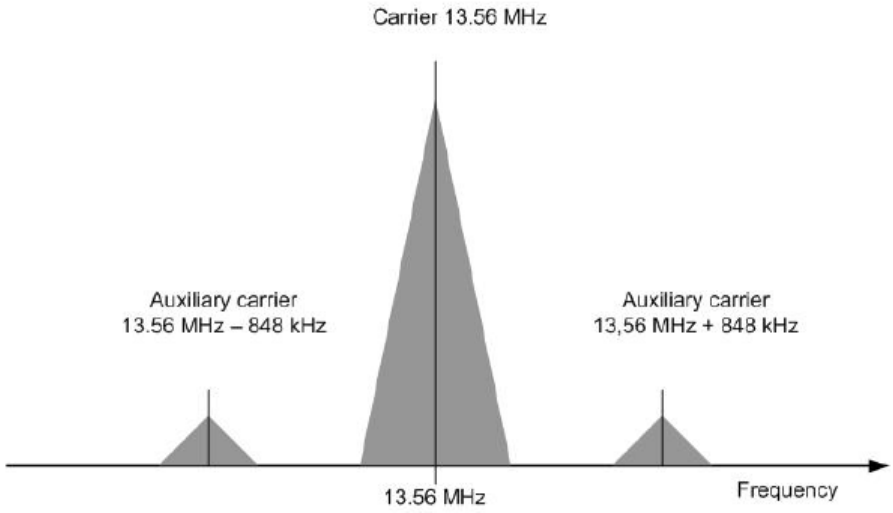


Figure 3-2: Load modulation on a 13.56 MHz carrier with 848 kHz auxiliary carrier.

3.1.3 Modulation scheme and coding

Amplitude shift keying (OOK) with different modulation depths (100% or 10%) or BPSK (as with ISO/IEC 14443 B PICC's) is used.

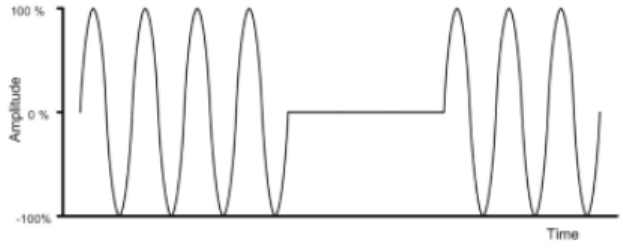


Figure 3-3: ASK with 100% modulation depth

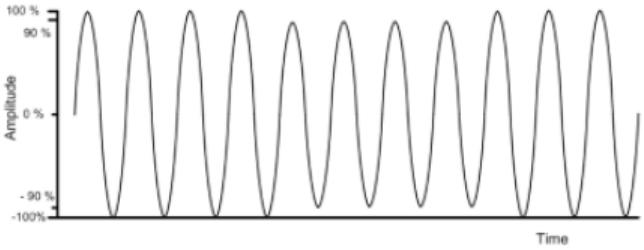


Figure 3-4: ASK with 10% modulation depth

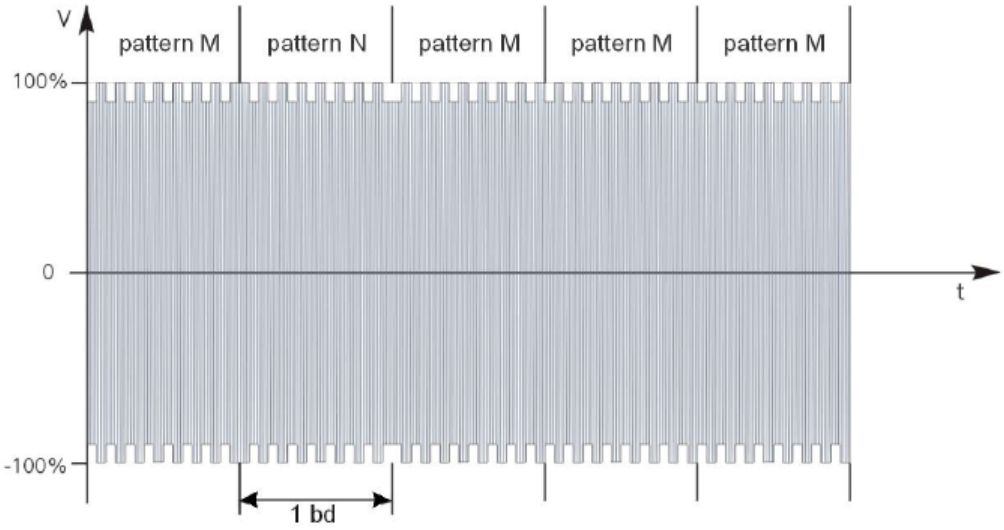


Figure 3-5: NRZ-L Coding with BPSK

NRZ-L, Modified Miller and Manchester Coding are used by NFC.

- With NRZ-L a “high”-state during a bit duration indicates a logic 1, a “low”-state a logic 0.
- With Manchester Coding the first half of a bit will be set to “high”-state at a logic 1, and the second half to “low state”. With a logic 0, the fist half of a bit is set to “low”-state and the second half to “high”-state.
- With Modified Miller Coding with a logic 1 a “low” pulse occurs after half of the bit duration. With a logic 0 a “low”-pulse occurs at the beginning of a bit. Exception: If a logic 0 follows a 1 no pulse occurs, the signal remains high.

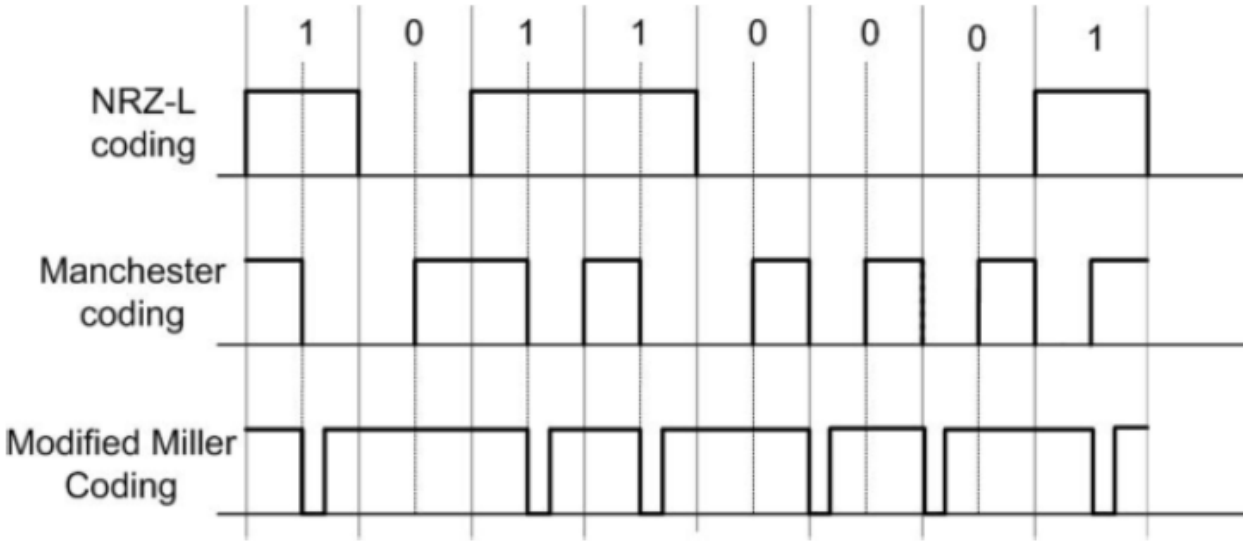


Figure 3-6: Coding with NFC is either NRZ_L, Modified Miller or Manchester

In Figure 3-7 load modulation is visualized for ASK modulation with Manchester Coding (14443 A PICC or NFC-A device in passive card emulation mode, see Chapter 3.1.4, "NFC operating modes, modulation and coding", on page 14)

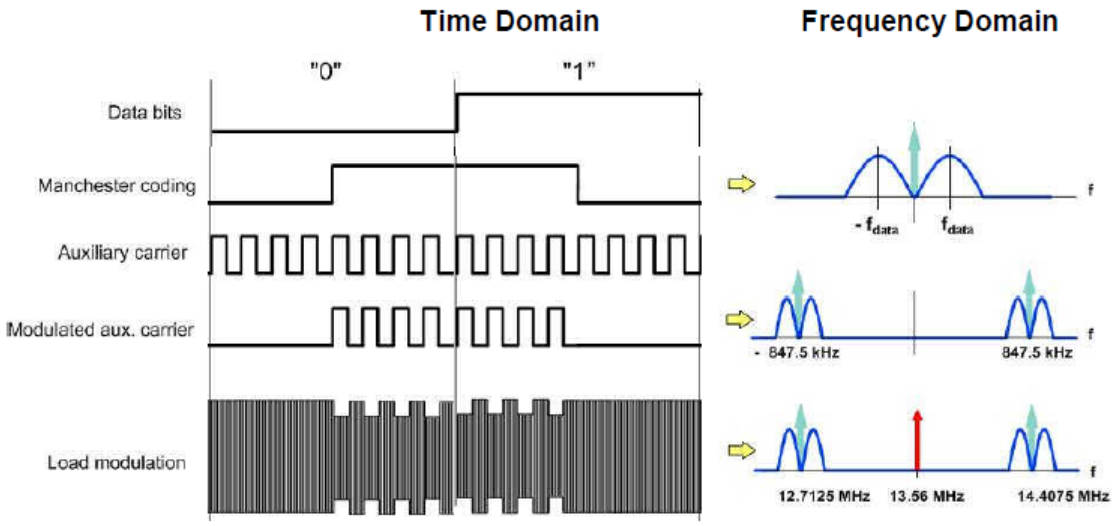


Figure 3-7: Visualization of load modulation with auxiliary carrier in time and frequency domain

3.1.4 NFC operating modes, modulation and coding

There are three main operating modes for NFC:

- Card emulation mode (passive mode): the NFC device behaves like an existing contactless card conforming to one of the legacy standards
- Peer-to-peer mode: two NFC devices exchange information. The initiator device (polling device) requires less power compared to the reader/writer mode because the target (listener) uses its own power supply.
- Reader/writer mode (active mode): the NFC device is active and reads or writes to a passive legacy RFID tag.

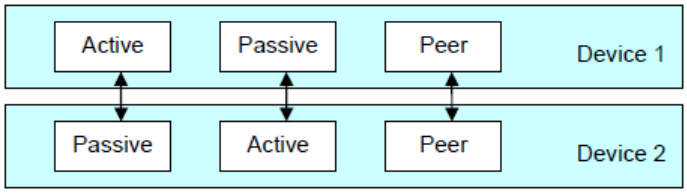


Figure 3-8: NFC operating modes

Every mode (card emulation, peer-to-peer, reader/writer mode) can be combined with one of the following transmission technologies:

- NFC-A (backward compatible to ISO/IEC 14443 A)
- NFC-B (backward compatible to ISO/IEC 14443 B)
- NFC-F (backward compatible to JIS X 6319-4)

To support all the different technologies, an NFC device in polling mode first attempts to get responses from NFC-A, NFC-B and NFC-F tags with the according request signals. When getting a response from a compatible device, the NFC device sets up the corresponding communication mode (NFC-A, NFC-B or NFC-F mode).

Coding and modulation varies depending on active or passive communication mode, NFC-A, -B, -F communication, and bitrate.

The Table 3-1 shows coding, modulation and data rates for NFC-A, -B or -F communication.

Table 3-1: NFC RF standards overview

NFC forum Standard	Polling / Listening	Coding	Modulation	Data rate	Carrier frequency
NFC-A	Polling	Modified Miller	ASK 100%	106 kb/s	13.56 MHz
	Listening	Manchester	Load modulation (ASK subcarrier)	106 kb/s	13.56 MHz +-848kHz subcarrier
NFC-B	Polling	NRZ-L	ASK 10%	106 kb/s	13.56 MHz
	Listening	NRZ-L	Load modulation (BPSK subcarrier)	106 kb/s	13.56 MHz+-848kHz subcarrier
NFC-F	Polling	Manchester	ASK 10%	212 / 424 kb/s	13.56 MHz
	Listening	Manchester	Load modulation (APSK)	212 / 424 kb/s	13.56 MHz (without subcarrier)

3.2 Timing aspects

The NFC specification defines the duration of the individual commands as a number of bits. This instrument generates the signal as sample sequence where the applied sample rate is user-defined. Depending on the selected sampling rate it may be that the duration of a command expressed in samples does not result in an integer number of samples. In this implementation however the length of the sequence is always an integer number of samples, i.e. the software rounds up the number of samples to the next integer value. The rounding up procedure is applied on command basis, even if a command is repeated.

The Figure 3-10 shows this principle as an example.

Example:

The Figure 3-9 shows an example of a sequence with the following settings:

- Sample Rate = 20.1 Msps
- Technology > "NFC-A"
- Transmission Mode > "Poll"

Command Type	Rep.	Duration (µs)
"SENS_REQ"	1	(calculated and displayed automatically)
"IDLE"	1	0.05

Command Type	Rep.	Duration (µs)
"ALL_REQ"	2	(calculated and displayed automatically)
"BLANK"	1	0.1

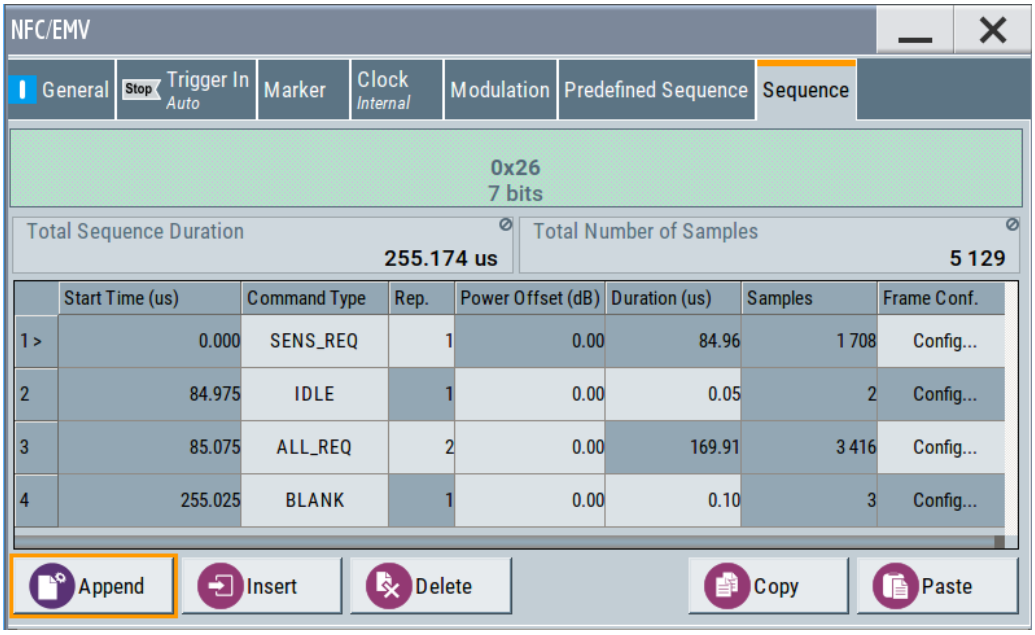


Figure 3-9: Example of sequence configuration settings

The Figure 3-10 illustrates the calculation of the Start Time per command and the parameters Total Sequence Duration and Total Number of Samples.

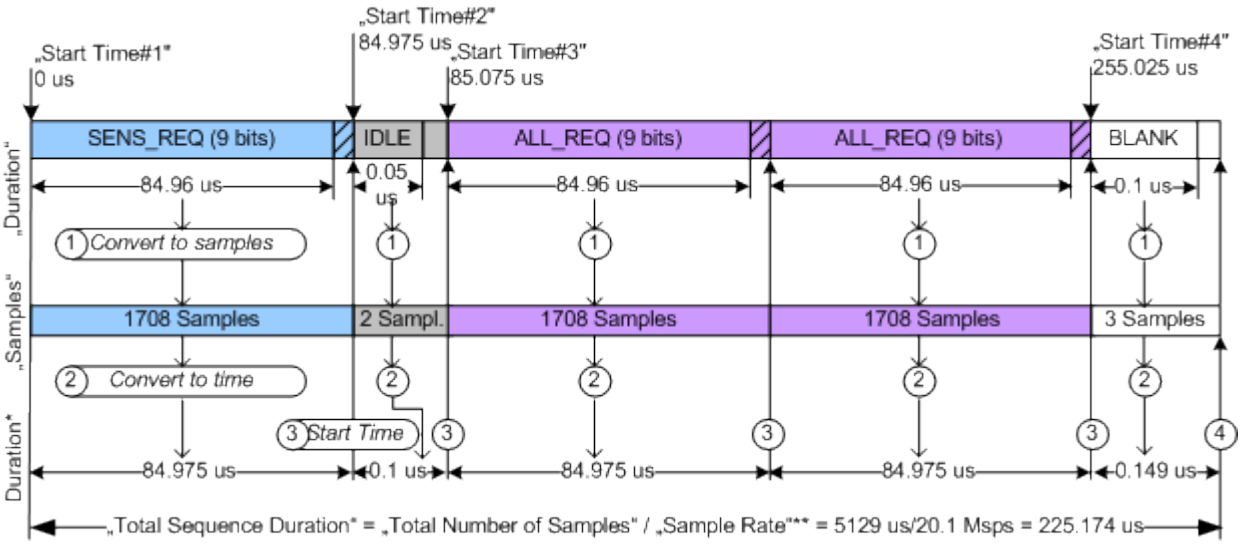


Figure 3-10: Calculation of duration and number of samples for Sample Rate = 20.1 Msps

1 = "Duration" * "Sample Rate" = # Samples, "Samples" = Cell (# samples)
2 = Duration* = "Samples"/"Sample Rate"
3 = "Start Time"$_N$ = (Duration*$_1$ + .. + Duration*$_{N-1}$) = ("Samples"$_1$ + ... + "Samples"$_{N-1}$)/"Sample Rate"
4 = "Total Number of Samples" = "Samples"$_1$ + ... + "Samples"$_N$

For some modulation settings, especially for those that cause very smooth signal edges, it might be necessary that the implementation not only rounds up to the next integer number of samples, but also that it enlarges the commands even more, in order to prevent a sharp cutting of the last signal edge of the command.

3.3 Leveling aspects

This chapter describes general leveling aspects.

3.3.1 Interpretation of "RF level" indication

This chapter describes the interpretation of the RF Level.

The "RF Level" indication of the generators does not display the RMS signal level!

The "RF Level" indication in the header of the instrument refers to the power during the unmodulated parts of the signal, i.e. the part where the relative signal voltage is 100% (outside of overshoots) and the "Power Offset" is 0 dB (see Figure 3-11).

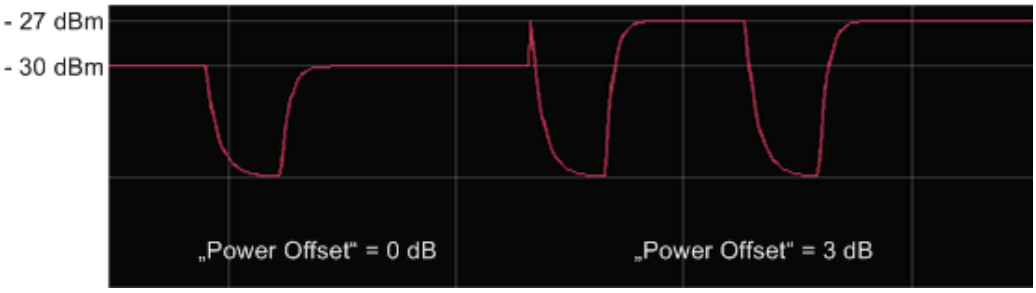


Figure 3-11: Signal leveling of a sequence build from two commands with "Power Offset" of 0 dB and 3 dB respectively, "RF Level" = -30dBm and "PEP" = -27 dBm

3.3.2 Desired voltage of the unmodulated signal

Several test cases require a listener test signal prior to the modulation on the RF carrier. This test signal is then supplied to the reference listener antenna. Three leveling parameters are provided to calculate the settings to reach the required voltage of the unmodulated signal automatically.

These parameters are available for "Transmission Mode > Listen" and "NFC State > On", for details see "Unmodulated Parts Voltage To Peak Voltage Ratio" on page 24 ,

"Desired Voltage In Unmodulated Signal parts" on page 24 and "Update Analog I/Q Settings For Desired Voltage" on page 24.

To use these leveling parameters...

1. Define the "Desired Voltage In Unmodulated Signal Parts".
2. Select "Update Analog I/Q Settings For Desired Voltage" to automatically adjust the settings at the I/Q output connectors ("I/Q Level Vp (EMF)").

Parameter "Unmodulated Parts Voltage To Peak Voltage Ratio" displays the ratio of the voltage in the unmodulated parts of the signal to its peak value.

4 About the EMV contactless digital standard

EMV is a standard that defines the interaction between an integrated circuit (IC) cards and IC cards processing devices for payments. EMV stands for Europay, MasterCard and Visa, the companies that initiated the development of the EMV specifications in the mid 1990s. Over the years the initiator companies were joint by JCB, American Express and China Union Pay. Today the EMV standard is defined by the EMVCo LLC corporation.

The EMV Contactless is based on ISO/IEC 14443 "Identification cards -- Contactless integrated circuit cards-- Proximity cards" . It sets a standard for the usage of contactless systems for contactless payments.

In 2012 the EMVCo and NFC Forum agreed to work in collaboration on establishing a framework for the synchronization of the NFC Forum and EMVCo Specificitions and the management of contactless product certification. The option R&S SMM-K89 enables you to generate signals in accordance with the NFC standard and the EMV Contactless standard thus allowing you to perform the tests needed to guarantee the proper performance of your devices.

The EMV specific abbreviations used in this manual as well as the different types of tag platforms/protocols are described in the EMV Contactless Specifications for Payment Systems. The specifications are available under www.emvco.com.

4.1 Basics of data transmission with EMV contactless

A contactless system consists of two basic components: a contactless reader (PCD) and a transponder (PICC). The EMV contactless uses the electromagnetic near field of two conductor coils (a primary coil of the PCD and a secondary coil of the PICC) to couple the contactless reader and the transponder, see Figure 4-1.

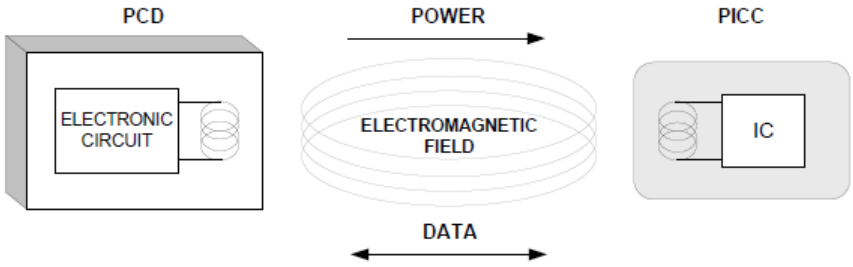


Figure 4-1: PCD (contactless reader) and PICC (transponder) configuration

The operating frequency is 13.56 MHz, and a bitrate of 106 kbit/s is used. Modulation schemes are amplitude shift keying (ASK) with different modulation depth (100 % or 10 %), amplitude on/off keying (OKK) and BPSK.

4.2 EMV contactless transmission technologies, modulation and coding

The EMV contactless has two main communication signal interfaces (based on ISO/IEC 14443):

- Type A
- Type B

The Table 4-1 shows coding and modulation for the EMV Type A and the EMV Type B communication.

Table 4-1: EMV contactless standards overview

Standard	PCD-PICC / PICC-PCD	Coding	Modulation
Type A	PCD-PICC	Modified Miller	ASK 100%
	PICC-PCD	Manchester	Load modulation (OOK subcarrier)
Type B	PCD-PICC	NRZ-L	ASK 10%
	PICC-PCD	NRZ-L	Load modulation (BPSK subcarrier)

Refer to Chapter 3.1.3, "Modulation scheme and coding", on page 12 for a description of the used modulation schemes and coding.

5 NFC configuration and settings

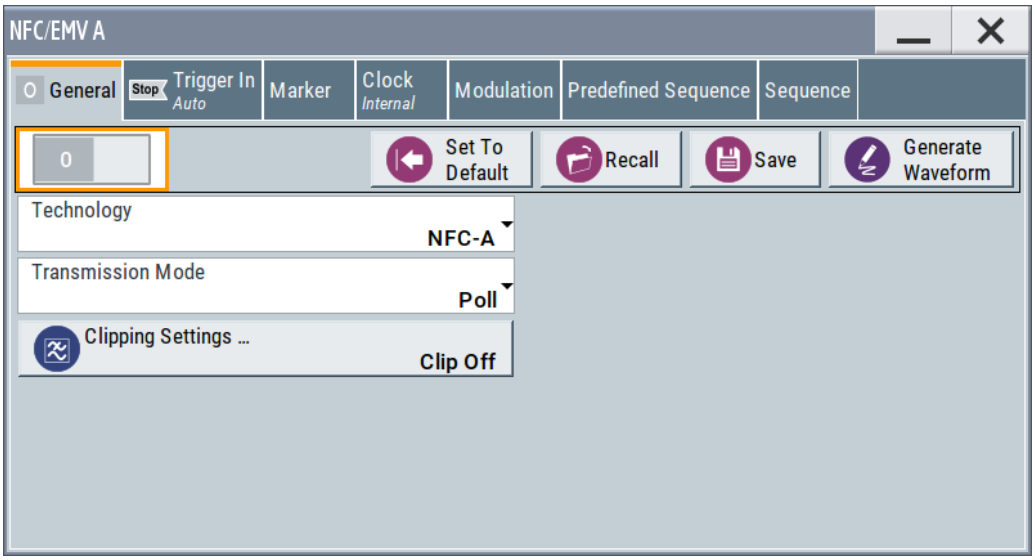
Access:

► Select "Baseband" > "NFC/EMV".

The remote commands required to define these settings are described in Chapter 7, "Remote-control commands", on page 67.

5.1 General settings

This tab provides access to the default and the "Save/Recall" settings. The selected technology and transmission mode determine the available parameters.



State
Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Remote command:
[:SOURce<hw>]:BB:NFC:STATe on page 71

Set to Default
Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
State	Not affected by "Set to default"
Technology	NFC A
Transmission mode	Poll
Clipping	Off
Command type (in "Sequence" dialog)	for NFC-A, Poll: SENS_REQ for NFC-B, Poll: SENSB_REQ for NFC-F, Poll: SENSF_REQ

Remote command:
[:SOURce<hw>]:BB:NFC:PRESet on page 71

Save/Recall ...
Calls the "Save/Recall" dialog.

From this dialog the "Save/Recall Settings" windows for saving and recalling NFC configurations and the "File Manager" can be accessed.

NFC configurations are stored as files with the predefined file extension `*.nfc`. Their file name and directory are user-definable.

The complete settings in the "NFC" dialog are saved and recalled.

"Recall NFC Setting" — Opens the "Recall Settings" window for loading a saved NFC configuration.
The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.

"Save NFC Setting" — Opens the "Save Settings" window for saving the current NFC signal configuration.
The name of the file is specified in the file name entry field, the directory selected in the save into field. The file is saved by pressing the "Save" button.

"File Manager" — Calls the "File Manager".
The "File Manager" is used to copy, delete and rename files and to create directories.

Remote command:
[:SOURce<hw>]:BB:NFC:SETTing:CATalog? on page 73
[:SOURce<hw>]:BB:NFC:SETTing:LOAD on page 73
[:SOURce<hw>]:BB:NFC:SETTing:STORe on page 73
[:SOURce<hw>]:BB:NFC:SETTing:DELete on page 73

Data List Management...
Calls the "Data List Management" dialog. This dialog is used to create and edit a data list.

All data lists are stored as files with the predefined file extension `*.dm_iqd`. Their file name and directory are user-definable.

The data lists must be selected as a data source from the subsection under the individual function.

Note: All data lists are generated and edited with the `SOURce:BB:DM` subsystem commands. Files containing data lists usually end with *.dm_iqd. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA` on page 89
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:DSELection` on page 89

Generate Waveform File...
With enabled signal generation, triggers the instrument to save the current settings of an arbitrary waveform signal in a waveform file with predefined extension `*.wv`. You can define the filename and the directory, in that you want to save the file.

Using the ARB modulation source, you can play back waveform files and/or process the file to generate multi-carrier or multi-segment signals.

Remote command:
`[:SOURce<hw>]:BB:NFC:WAVeform:CREate` on page 72

Technology
Selects the NFC/EMV technology.

"NFC-A, NFC-B, NFC-F"
NFC technology. For details, see the NFC digital protocol technical specification.

"EMV Type A, EMV Type B"
EMV technology. For details, see the EMV technical specification.

Remote command:
`[:SOURce<hw>]:BB:NFC:TECHnology` on page 71

Divisor (Bit Rate)
Available for "Technology > NFC-F", this parameter selects the used divisor (2 or 4) and determines the increased resulting bit rate of 212 Kbit/s or 424 Kbit/s respectively.

Remote command:
`[:SOURce<hw>]:BB:NFC:DIVisor` on page 70

Transmission Mode
Selects the transmission mode.

"Poll / Listen" Available for "Technology > NFC-A /NFC-B/ NFC-F"
For details, see Figure 3-1.

"PICC to PCD / PCD to PICC"
Available for "Technology > EMV Type A / EMV Type B"
For details, see Chapter 3, "About the NFC digital standard", on page 10 and Chapter 4, "About the EMV contactless digital standard", on page 19.

Remote command:
`[:SOURce<hw>]:BB:NFC:TMODe` on page 71

Clipping Settings...
Accesses the dialog to configure clipping, see Chapter 5.10, "Clipping settings", on page 63.

Unmodulated Parts Voltage To Peak Voltage Ratio
Available only for "Transmission Mode > Listen / PICC to PCD" and "State > On".

Displays the ratio of the voltage in the unmodulated parts of the signal to its peak value.

Remote command:
`[:SOURce<hw>]:BB:NFC:UPVoltage?` on page 72

Desired Voltage In Unmodulated Signal parts
Available only for "Transmission Mode > Listen / PICC to PCD" and "State > On".

Defines the desired voltage in unmodulated signal parts.

The displayed "Unmodulated ... Ratio" depends only on the signal and is not changed by the input of a "Desired Voltage".

See Chapter 3.3, "Leveling aspects", on page 17.

Remote command:
`[:SOURce<hw>]:BB:NFC:DVOLtage` on page 70

Update Analog I/Q Settings For Desired Voltage
Available only for "Transmission Mode > Listen / PICC to PCD" and "State > On".

Automatically adjusts the related parameters of the analog I and Q outputs to the desired voltage.

For a detailed description of all parameters, refer to section "I/Q analog output settings" in the manual of the R&S SMx.

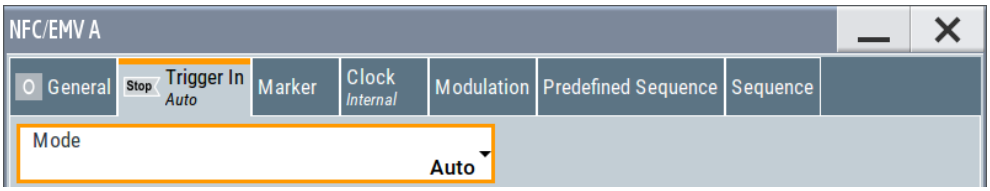
See Chapter 3.3, "Leveling aspects", on page 17.

Remote command:
`[:SOURce<hw>]:BB:NFC:UAISetting` on page 71

5.2 Trigger settings

Access:

► Select "Baseband" > "NFC/EMV" > "Trigger In".



This tab provides settings to select and configure the trigger, like trigger source, trigger mode and trigger delays, and to arm or trigger an internal trigger manually. The header of the tab displays the status of the trigger signal and trigger mode. As in the tabs "Marker" and "Clock", this tab provides also access to the settings of the related connectors.

Routing and activating a trigger signal

1. Define the effect of a trigger event and the trigger signal source.
   a) Select "Trigger In" > "Mode".
   b) Select "Trigger In" > "Source".
2. For external trigger signals, define the connector for signal input. See Chapter 5.5, "Local and global connectors settings", on page 33.
   You can map trigger signals to one or more User x or T/M connectors.

   Local and global connectors settings allow you to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMM100A starts baseband signal generation after the configured trigger event.

About baseband trigger signals

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMM100A user manual.

Settings:

Mode
Selects trigger mode, i.e. determines the effect of a trigger event on the signal generation.

- "Auto"
  The signal is generated continuously.
- "Retrigger"
  The signal is generated continuously. A trigger event (internal or external) causes a restart.
- "Armed Auto"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously.
  An "Arm" stops the signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Armed Retrigger"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
  An "Arm" stops signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Single"
  The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".
  Every subsequent trigger event (internal or external) causes a restart.

Remote command:
`[:SOURce<hw>]:BB:NFC[:TRIGger]:SEQuence` on page 112

Signal Duration Unit
Available in "Single Trigger" mode. Defines the unit for describing the length of the signal sequence to be output.

Remote command:
`[:SOURce<hw>]:BB:NFC:TRIGger:SLUNit` on page 111

Signal Duration
Requires trigger "Mode" > "Single".

Enters the length of the trigger signal sequence.

Use this parameter, for example, for the following applications:

- To output the trigger signal partly.
- To output a predefined sequence of the trigger signal.

Remote command:
`[:SOURce<hw>]:BB:NFC:TRIGger:SLENgth` on page 111

Running/Stopped
With enabled modulation, displays the status of signal generation for all trigger modes.

- "Running"
  The signal is generated; a trigger was (internally or externally) initiated in triggered mode.
- "Stopped"
  The signal is not generated and the instrument waits for a trigger event.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:RMODe? on page 111

Time Based Trigger
Requires trigger "Mode" > "Armed Auto"/"Single".

Activates time-based triggering with a fixed time reference.

The R&S SMM100A triggers signal generation when its operating system time ("Current Time") matches a specified time trigger ("Trigger Time"). As trigger source, you can use an internal trigger or an external global trigger.

How to: Chapter "Time-based triggering" in the R&S SMM100A user manual.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:TIME[:STATe] on page 113

Trigger Time
Requires trigger "Mode" > "Armed Auto"/"Single".

Sets date and time for a time-based trigger signal.

Set a trigger time that is later than the "Current Time". The current time is the operating system time of the R&S SMM100A. If you set an earlier trigger time than the current time, time-based triggering is not possible.

How to: Chapter "Time-based triggering" in the R&S SMM100A user manual.

"Date" Sets the date of the time-based trigger in format YYYY-MM-DD.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:TIME:DATE on page 112

"Time" Sets the time of the time-based trigger in format hh:mm:ss.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:TIME:TIME on page 113

Arm
Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:ARM:EXECute on page 110

Execute Trigger
Available only with internal trigger source and a trigger mode other than "Auto". Executes the trigger manually.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:EXECute on page 110

Source
The following sources of the trigger signal are available:

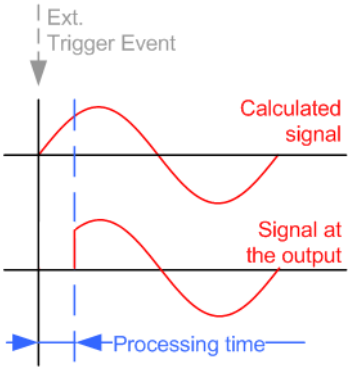
- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "External Global Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the User x connectors.
- "Baseband Sync In"
  In primary-secondary instrument mode, secondary instruments are triggered by the active edge of the synchronization signal.

How to: "Routing and activating a trigger signal" on page 25

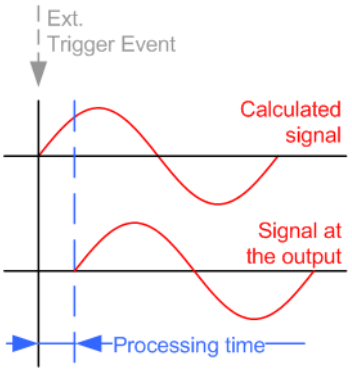
Remote command:
`[:SOURce<hw>]:BB:NFC:TRIGger:SOURce` on page 112

Sync. Output to External Trigger/Sync. Output to Trigger
Enables signal output synchronous to the trigger event.

- "On"
  Corresponds to the default state of this parameter.
  The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



- "Off"
  The signal output begins after elapsing of the processing time. Signal output starts with sample 0. The complete signal is output.
  This mode is recommended for triggering of short signal sequences. Short sequences are sequences with signal duration comparable with the processing time of the instrument.



Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger:EXTernal:SYNChronize:OUTPut
on page 111

External Inhibit/Trigger Inhibit
Delays the trigger event of the signal from:

- The external trigger source

Use this setting to:

- Synchronize the instrument with the device under test (DUT) or other external devices

For more information, see chapter "Basics on ..." in the R&S SMM100A user manual.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger[:EXTernal<ch>]:DELay on page 110

External Delay/Trigger Delay
Available on external triggering.

Sets the duration for inhibiting a new trigger event subsequent to triggering.

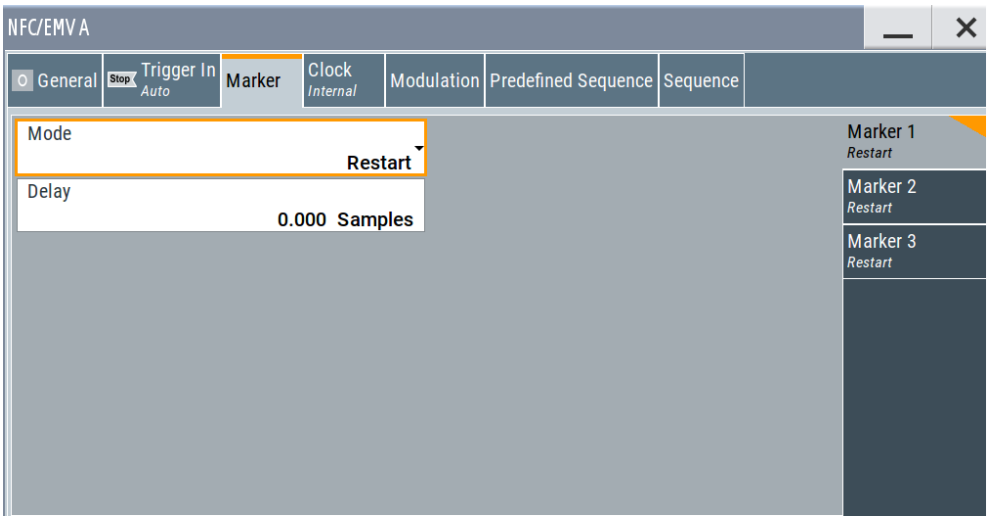
In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified duration.

Remote command:
[:SOURce<hw>]:BB:NFC:TRIGger[:EXTernal<ch>]:INHibit on page 110

5.3 Marker settings

Access:

► Select "Baseband" > "NFC/EMV" > "Marker".



This tab provides settings to select and configure the marker output signal including marker mode and marker delay.

Routing and activating a marker signal

1. To define the signal shape of an individual marker signal "x", select "Marker" > "Marker x" > "Mode".
2. Optionally, define the connector for signal output. See Chapter 5.5, "Local and global connectors settings", on page 33.
   You can map marker signals to one or more User x or T/M connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMM100A adds the marker signal to the baseband signal. Also, R&S SMM100A outputs this signal at the configured User x connector.

About marker output signals

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMM100A user manual.

Settings:

Mode
Marker configuration for up to 3 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

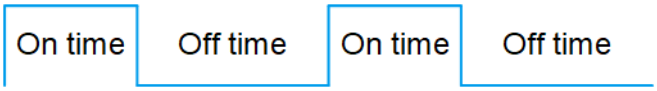
How to: "Routing and activating a marker signal" on page 30

"Restart" A marker signal is generated on every repetition of the complete frame sequence.

"Pulse" A regular marker signal is generated. The frequency is derived by dividing the sample rate by the divider. The input box for the divider opens when "Pulse" is selected, the resulting pulse frequency is displayed below it.

"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 64 bits and is defined in an input field which opens when pattern is selected.

"On/Off Ratio"
Generated is a regular marker signal that is defined by an on/off ratio. A period lasts one on and off cycle.
The "ON Time" and "OFF Time" are each expressed as several samples.



Remote command:
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:MODE` on page 114
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 115
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 115
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PATTern` on page 115
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:ONTime` on page 115
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:OFFTime` on page 115

Delay
Delays the marker signal at the marker output relative to the signal generation start.

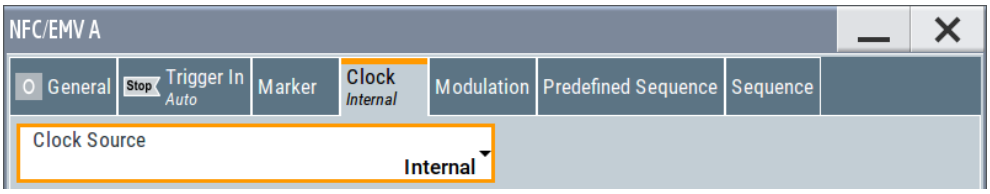
Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:
`[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:DELay` on page 116

5.4 Clock settings

Access:

► Select "Baseband" > "NFC/EMV" > "Clock".



This tab provides settings to select and configure the clock signal, like the clock source and clock mode.

Defining the clock

1. Select "Clock" > "Source" to define the source of clock signal.
2. For external clock signals, define the connector for signal input. See Chapter 5.5, "Local and global connectors settings", on page 33.
   You can map clock signals to one or more User x or T/M connectors.

   Local and global connectors settings allow you to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMM100A starts baseband signal generation with a symbol rate that equals the clock rate.

About clock signals

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMM100A user manual.

Settings:

Clock Source
Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.

How to: "Defining the clock" on page 32

Remote command:
`[:SOURce<hw>]:BB:NFC:CLOCk:SOURce` on page 116

5.5 Local and global connectors settings

Accesses a dialog to configure local connectors or global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs that are accessible via the "Baseband" block in the block diagram.

See also chapter "Local and global connectors settings" in the user manual.

5.6 Modulation settings

Access:

► Select "Baseband" > "NFC/EMV" > "Modulation".

The dialog provides common settings and slope settings to configure the signal modulation. Available parameters depend on the selected NFC technology and transmission mode. Some settings require active slope and RLC curve.

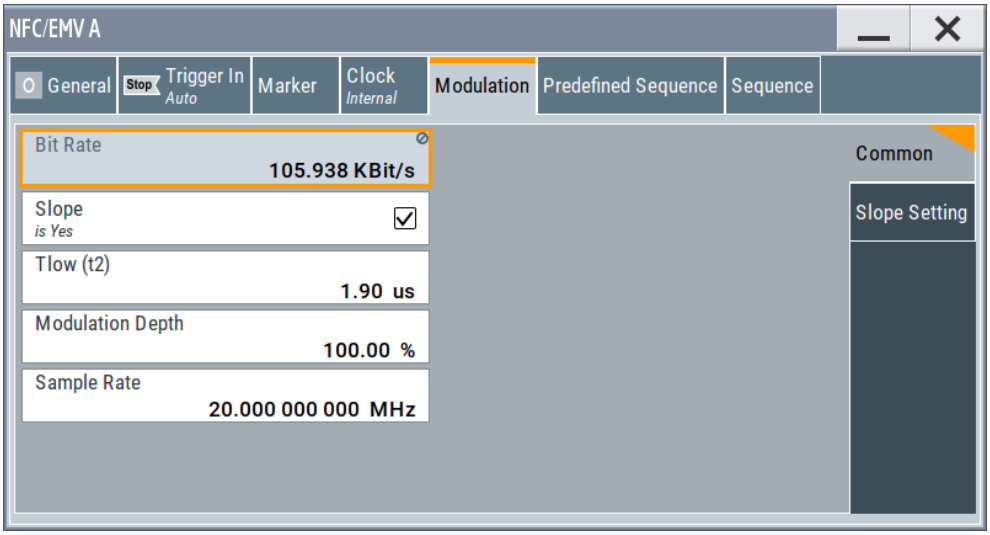
Settings:

5.6.1 Common settings

Access:

1. Select "NFC/EMV" > "Modulation".

2. Select "Common".



The dialog provides common settings to configure the signal modulation.

Settings:

Bit Rate
Indicates the current resulting bit rate in kbit/s.

Remote command:
`[:SOURce<hw>]:BB:NFC:MSET:BRATe?` on page 106

Modulation Index
Defines the signal's modulation index in %.

The modulation index represents the power drop during the low state transitions as a ratio of voltages at defined locations of the low state transition.

$$m_i = \frac{V_a - V_b}{V_a + V_b}$$

V_a is the nominal high voltage and V_b is the nominal low voltage.

Remote command:
`[:SOURce<hw>]:BB:NFC:MSET:MINDex` on page 107

Slope
Determines the transition between the modulated and unmodulated parts.

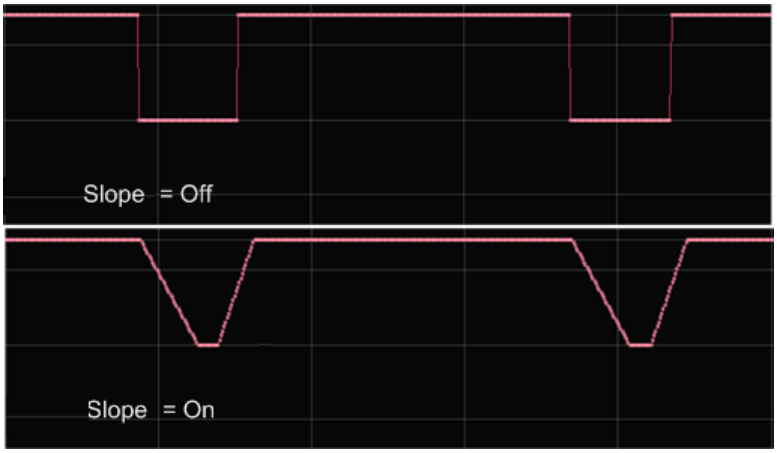


Figure 5-1: Impact of the "Slope" parameter ("RLC Curve" = Off)

"Off" A bursted signal with pulse like shape is generated. The transition time from high to low or low to high is only one sample.

"On" A longer transition time is used.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:SLOPe on page 106

Tlow (t2)
Available only for NFC-A in "Transmission Mode > Poll" and EMV A in "Transmission Mode > PCD to PICC".

Defines the signals low time (below 5%) in µs.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:TLOW on page 108

Inverse Modulation
Requires "NFC-B > Listen" and "NFC-F > Listen".

Activates inverse modulation.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:IMODulation on page 107

Modulation Depth
Requires NFC-A in "Transmission Mode > Poll" and EMV A in "Transmission Mode > PCD to PICC".

Sets the ASK modulation depth. The modulation depth indicates the magnitude of the voltage drop during the low state transition. The modulation depth is a percentage relative to the voltage of the carrier signal (V_1).

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:MDEPth on page 107

Baseband Output
Requires "Listen" and "PICC to PCD" modes.

The default state is "On". When activated the signal at the baseband output changes between 0% and 100% voltage to be able to control the Reference Listeners. When deactivated baseband output delivers the envelope of the RF signal.

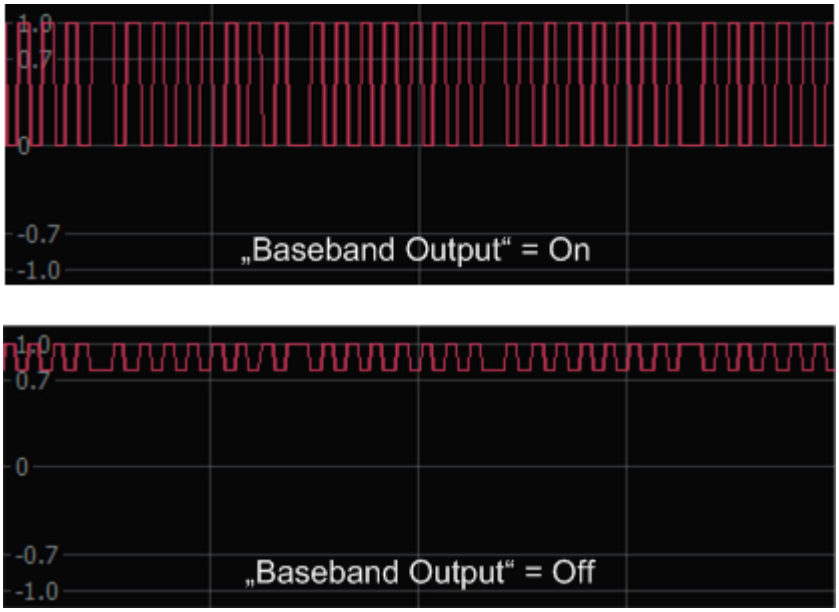


Figure 5-2: Impact of the parameter "Baseband Output"

Remote command:
`[:SOURce<hw>]:BB:NFC:MSET:BOUTput` on page 106

Sample Rate
In contrast to mobile radio standards (where this parameter is the "Sample Rate Variation"), the NFC standard does not prescribe a sample- or chiprate, but defines requirements, for example, for edge steepness.

At mobile radio standards, a change of the "Sample Rate Variation" does not change the number of samples per slot/frame/superframe etc., but rather plays the signal "faster" or "slower".

At NFC, the "Sample Rate" parameter changes the time resolution of signal generation, e.g. of how many samples an NFC-A bit duration is formed.

The 20 MSamples/s default value is a good trade-off between signal quality and required calculation time.

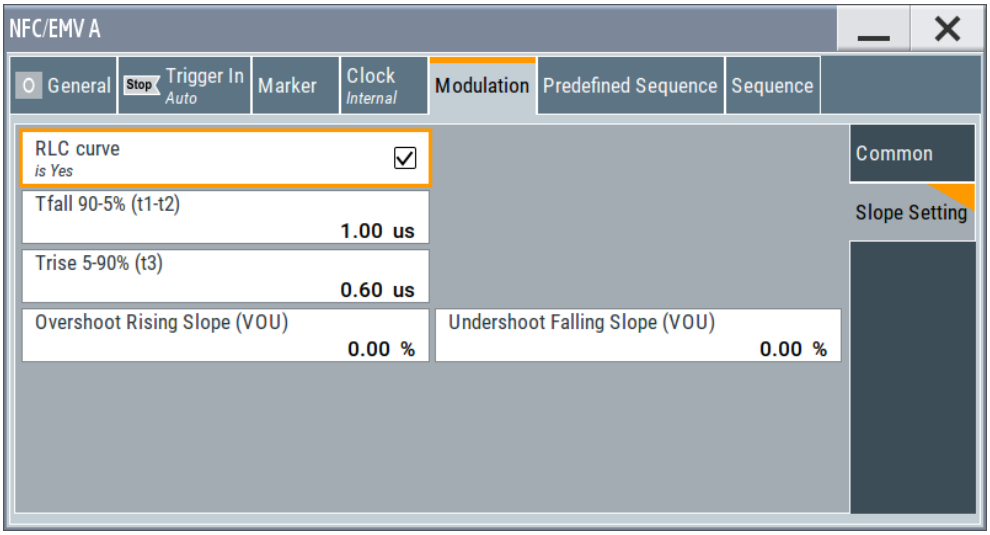
Remote command:
`[:SOURce<hw>]:BB:NFC:MSET:SRATe` on page 108

Slope Setting
Access:

5.6.2 Slope settings

Access:

1. Select "NFC/EMV" > "Modulation".
2. To display the slope settings, select "Common" > "Slope" > "On".
3. Select "Slope Setting".



The dialog provides slope settings to configure the signal modulation.

Settings:

RLC curve
Determines if an RLC curve (= discharge/charge curve of an RLC-circuit) is applied to the signal.

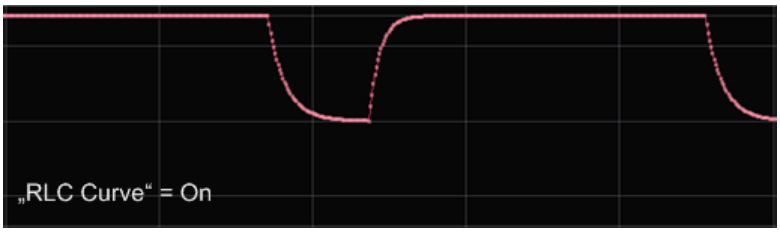


Figure 5-3: Impact of the "RLC Curve" parameter ("RLC Curve" = On)

"On" An "RLC curve" is applied to the signal.

"Off" A linear ramp is used.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:RCURve on page 108

Tfall 90-10%/Tfall 90-5% (t1-t2)
Defines the signals fall time (90 % to 5 % or 90% to 10%) in µs.

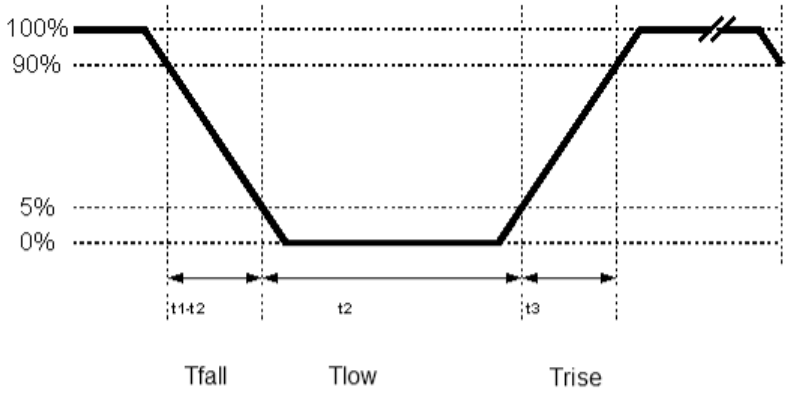


Figure 5-4: Tfall, Trise, Tlow at an NFC-A polling device to listening device

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:TFALl on page 108

Trise 10-90%/Trise 5-90% (t3)
Defines the signals rise time (5 % to 90 % or 10 % to 90 %) in µs, see also "Tfall 90-10%/Tfall 90-5% (t1-t2)" on page 38.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:TRISe on page 108

Overshoot Rising Slope (VOU)
Determines the size of the overshoot after the rising slope. The parameter corresponds to the value V_{OU} in the NFC Analog Technical Specification. Overshoot Rising Slope is in percent of the difference between the nominal high voltage to the nominal low voltage, according to the following formula:

Overshoot in Volts = V_{OU} x (V_a - V_b),

V_a is the nominal high voltage and V_b is the nominal low voltage.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:OSRise on page 107

Undershoot Falling Slope (VOU)
Determines the size of the undershoot (ringing) after the falling slope. The parameter corresponds to the value V_{OU} in the NFC Analog Technical Specification. Undershoot Falling Slope is in percent of the difference between the nominal high voltage to the nominal low voltage, according to the following formula:

Undershoot in Volts = V_{OU} x (V_a - V_b),

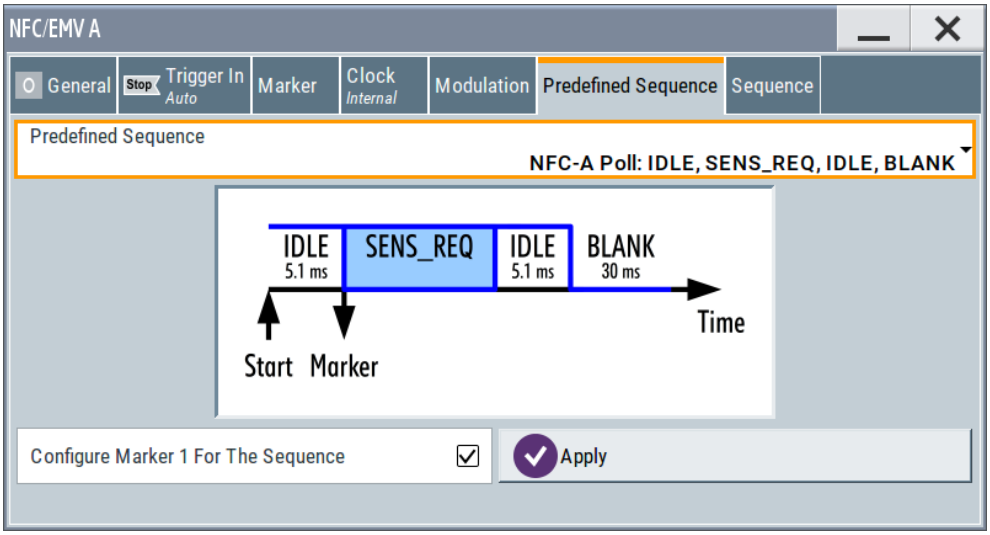
V_a is the nominal high voltage and V_b is the nominal low voltage.

Remote command:
[:SOURce<hw>]:BB:NFC:MSET:USFall on page 109

5.7 Predefined sequence

This tab provides access to the sequence configuration.

► To access the predefined sequence tab, select "Baseband > NFC/EMV > Predefined Sequence".



This dialog contains the parameters to define a predefined sequence for transmission modes "Poll" and "PCD to PICC".

Predefined Sequence
Selects a predefined sequence.

Remote command:
[:SOURce<hw>]:BB:NFC:PRED:SEQuence on page 74

Configure Marker 1 For The Sequence
Note: Available for signal generators only.

Enables Marker 1 as shown in the picture of the dialog.

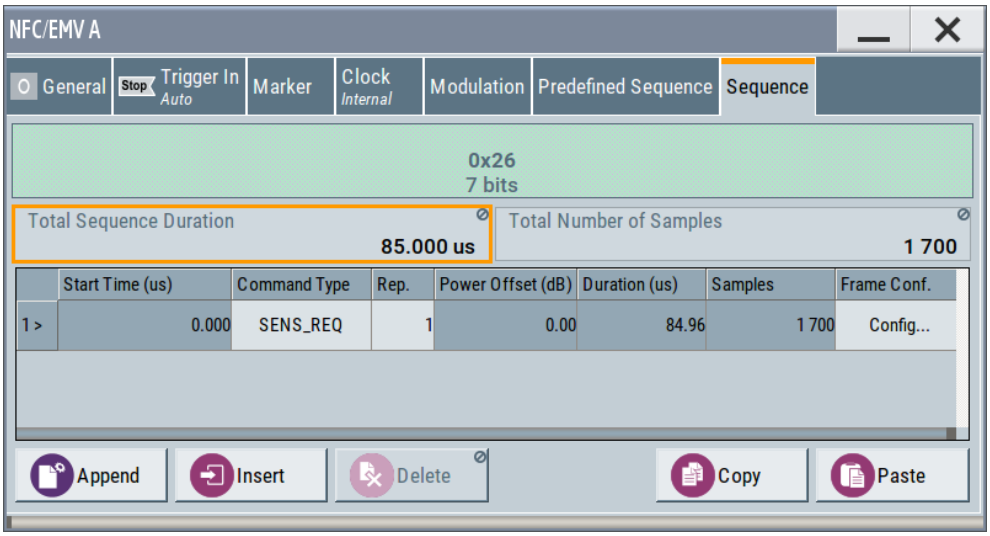
Remote command:
[:SOURce<hw>]:BB:NFC:PRED:CNFMarker on page 74

Apply
Activates the selected "Predefined Sequence" and marker status.

Remote command:
[:SOURce<hw>]:BB:NFC:PRED:APPLy on page 74

5.8 Sequence configuration settings

► To access the sequence configuration settings, select "Baseband > NFC/EMV > Sequence".



In this dialog you can define elements of the frame sequence, (e.g. start time, repetition, frame duration, power offset) for each command block.

The example in the screenshot shows some available command types for "Technology > NFC-A", "Transmission Mode > Poll".

For each command block selected, the resulting frame content of the frames of the command block appears on top of the dialog. The content depends not only on the selected command type, but for some command types also on the parameters set in the "Frame Configuration" dialog.

For available command types see Table 5-1.

Total Sequence Duration
Displays the overall sequence duration.

Total Sequence Duration = Total Number of Samples / Sample Rate

For an example, see Figure 3-10.

Remote command:
`[:SOURce<hw>]:BB:NFC:SCONfiguration:TSDuration?` on page 78

Total Number of Samples
Displays the total number of samples allocated to the current sequence configuration. The displayed value is the sum of the samples of the individual commands.

Total Number of Samples = $Samples_1$ + ... + $Samples_N$

For an example, see Figure 3-10.

Remote command:
[:SOURce<hw>]:BB:NFC:SCONfiguration:TNSamples? on page 78

Sequence Table
Contains the elements of the command sequence.

The first table column shows the successive command block number.

Start Time ← Sequence Table
Displays the exact start time of the corresponding command (in µs). The value is calculated as the sum of the samples of all preceding commands converted to time.

$Start\ Time_N = (Samples_1 + ... + Samples_{-1}) / Sample\ Rate$

For an example, see Figure 3-10.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:STIMe? on page 78

Command Type ← Sequence Table
Determines the command type for each command block.

For the different technologies and transmission modes you can select command types as listed in Table 5-1.

The different types of tag platforms (used in the table header) are described in the NFC Digital Protocol Technical Specification.

Table 5-1: Available command types for "Technology > NFC-A" and the corresponding SCPI-command parameters (in brackets).

"Transmission Mode"	Platform / Protocol				
	General command type	**Type 1 Tag**	**Type 2 Tag**	**Type 4A Tag**	**NFC-DEP**
"Poll"	"ALL_REQ" (ALAQ) "SENS_REQ" (SNAQ) "SDD_REQ" (SDAQ) "SEL_REQ" (SLAQ) "SLP_REQ" (SPAQ) "GENERIC" (GENE) "BLANK" (BLNK) "IDLE" (IDLE)	"RID" (RDAQ) "RALL" (RLAQ) "READ"(T1RQ) "WRITE-E" (WREQ) "WRITE-NE"(WNEQ) "RSEG" (RSGQ) "READ8" (RD8Q) "WRITE-E8" (WE8Q) "WRITE-NE8" (WN8Q)	"READ" (T2RQ) "WRITE" (T2WQ) "SECTOR SELECT" (SSLQ)	"RATS" (RATQ) "DATA" in "ISO-DEP" (T4AD)	"ATR_REQ" (ATRQ) "PSL_REQ" (PSLQ) "DEP_REQ" (DEPQ) "DSL_REQ" (DSLQ) "RLS_REQ" (RLSQ)
"Listen"	"SENS_RES" (SNAS) "SDD_RES" (SDAS) "SEL_RES" (SLAS) "BLANK" (BLNK) "IDLE" (IDLE)	"RID" (RDAS) "RALL" (RLAS) "READ" (T1RS) "WRITE-E" (WRES) "WRITE-NE" (WNES) "RSEG" (RSGS) "READ8" (RD8S) "WRITE-E8" (WE8S) "WRITE-NE8" (WN8S)	"READ" (T2RS) "ACK" (ACK) "NACK" (NACK)	"ATS" (ATSS) "DATA" in "ISO-DEP" (T4AD)	"ATR_RES" (ATRS) "PSL_RES" (PSLS) "DEP_RES" (DEPS) "DSL_RES" (DSLS) "RLS_RES" (RLSS)

Table 5-2: Available command types for "Technology > NFC-B" and corresponding SCPI-command parameters (in brackets).

"Transmission Mode"	General command type	Platform / Protocol
		Type 4 B Tag
"Poll"	"ALLB_REQ" (ALBQ) "SENSB_REQ" (SNBQ) "SLOT_MARKER" (SMAR) "SLPB_REQ" (SPBQ) "GENERIC" (GENE) "BLANK" (BLNK) "IDLE" (IDLE)	"ATTRIB" (ATBQ) "DATA" in "ISO-DEP" (T4BD)
"Listen"	"SENSB_RES" (SNBS) "SLPB_RES" (SPBS) "BLANK" (BLNK) "IDLE" (IDLE)	"ATTRIB" (ATBS) "DATA" in "ISO-DEP" (T4BD)

Table 5-3: Available command types for "Technology > NFC-F" and corresponding SCPI-command parameters (in brackets).

"Transmission Mode"	General command type	Platform / Protocol	
		Type 3 Tag	NFC-DEP
"Poll"	"SENSF_REQ" (SNFQ) "GENERIC" (GENE) "BLANK" (BLNK) "IDLE" (IDLE)	"CHECK" (CHKQ) "UPDATE" (UPDQ)	"ATR_REQ" (ATRQ) "PSL_REQ" (PSLQ) "DEP_REQ" (DEPQ) "DSL_REQ" (DSLQ) "RLS_REQ" (RLSQ)
"Listen"	"SENSF_RES" (SNFS) "BLANK" (BLNK) "IDLE" (IDLE)	"CHECK" (CHKS) "UPDATE" (UPDS)	"ATR_RES" (ATRS) "PSL_RES" (PSLS) "DEP_RES" (DEPS) "DSL_RES" (DSLS) "RLS_RES" (RLSS)

Table 5-4: Available command types for "Technology >EMV Type A" and corresponding SCPI-command parameters (in brackets).

"Transmission Mode"	General command type
"PCD to PICC"	"WUPA" (ALAQ) "REQA" (SNAQ) "ANTICOLLISION" (SDAQ) "SELECT" (SLAQ) "HLTA" (SPAQ) "RATS" (RATQ) "DATA_Type_A" (T4AD) "BLANK" (BLNK) "IDLE" (IDLE)
"PICC to PCD"	"ATQA" (SNAS) "ANTICOLLISION" (SDAS) "SAK" (SLAS) "ATS" (ATSS) "DATA_Type_A" (T4AD) "BLANK" (BLNK) "IDLE" (IDLE)

Table 5-5: Available command types for "Technology >EMV Type B" and corresponding SCPI-command parameters (in brackets).

"Transmission Mode"	General command type
"PCD to PICC"	"WUPB" (ALBQ) "REQB" (SNBQ) "HLTB" (SPBQ) "ATTRIB" (ATBQ) "DATA_Type_B" (T4BD) "BLANK" (BLNK) "IDLE" (IDLE)
"PICC to PCD"	"ATQB" (SNBS) "HLTB" (SPBS) "ATTRIB" (ATBS) "DATA_Type_B" (T4BD) "BLANK" (BLNK) "IDLE" (IDLE)

Note: The IDLE command produces an unmodulated signal part of a configurable length while the BLANK command produces a signal part without any output signal.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:CTYPe` on page 76

Rep. ← Sequence Table
Determines the number of times to repeat the generation of a frame.

See also Figure 3-10.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:REPetition` on page 77

Power Offset (dB) ← Sequence Table
Determines the value of the power offset in dB.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:POFFset` on page 77

Duration (µs) ← Sequence Table
For "Command Type > BLANK/IDLE", determines the frame period in µs. For all other commands, the duration is displayed as defined in the standard.

For an example, see Figure 3-10.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:DURation` on page 76

Samples ← Sequence Table
Displays the number of the samples used for the command. For the calculation of the value, the Duration (µs) is converted to samples and rounded up.

Samples = ceiling (Duration * Sample Rate)

For an example, see Figure 3-10.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SAMPles?` on page 77

Frame Configuration ← Sequence Table
Accesses the "Frame Configuration " dialog for each command block, see Chapter 5.9, "Frame configuration settings", on page 46.

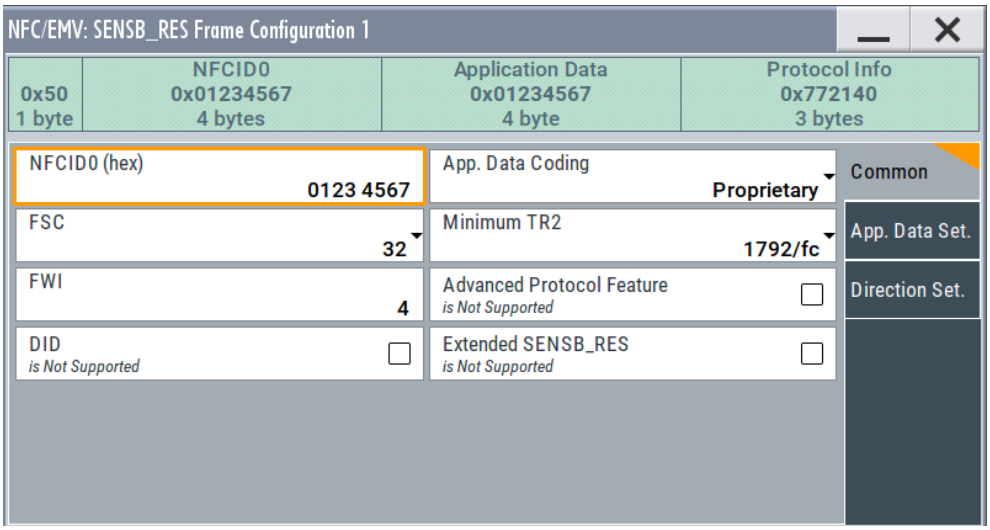
Append, Insert, Delete, Copy, Paste
General functions for editing the sequence configuration, as append, insert, delete, copy or paste a command block.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock:APPend` on page 75
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:INSert` on page 76
`[:SOURce<hw>]:BB:NFC:ICBLock` on page 76
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:DELete` on page 76
`[:SOURce<hw>]:BB:NFC:DCBLock` on page 76
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:COPY` on page 75
`[:SOURce<hw>]:BB:NFC:CCBLock` on page 75
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:PASTe` on page 77
`[:SOURce<hw>]:BB:NFC:PCBLock` on page 77

5.9 Frame configuration settings

For each "Command Type" listed in the Table 5-1 a "Frame Configuration" dialog is available.

1. Select "General > Technology > NFC-B".
2. Select "General > Transmission Mode > Listen".
3. To access the frame configuration dialog, select "Config..." in the corresponding row in the "Sequence Configuration" table.



The top of the "Frame Configuration" dialog shows the resulting frame content for the current settings. The parameters and functions in the "Frame Configuration" dialog depend on the "Command Type" selected in the sequence configuration.

For the following command types only the bit value of the frame is displayed because the value is fixed:

ALL_REQ, ACK, SENS_REQ, SLP_REQ, RID

5.9.1 Parameters of the frame configuration dialog

In the following chapter the settable parameters of all command types are listed alphabetically. Each command type uses only some of these parameters. The availability of some settings depends on other settings in the same dialog and on the selected "Technology" and "Transmission Mode".

Some parameters have the same functionalites for the NFC and the EMV technologies, but are named differently for the specific technology. In the following chapter the equivalent parameters are described only once. The parameter names for both technologies are contained in the parameter title and both names are devided by a "/". The parameter name for the NFC tecnology is written on the first place.

Example:

"NFCID1 (hex) / UID (hex)", where "NFCID1 (hex)" is the parameter name for the NFC technology and "UID (hex)" the parameter name for the EMV technology.

ACK, NACK
Available only for "PDU Type > ACK-NACK" or "Block Type > R-block".

Selects ACK or NACK.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:ANSelection` on page 82

Advanced Protocol Features supported
Enables/disables the support of advanced protocol features.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:APFSupported` on page 82

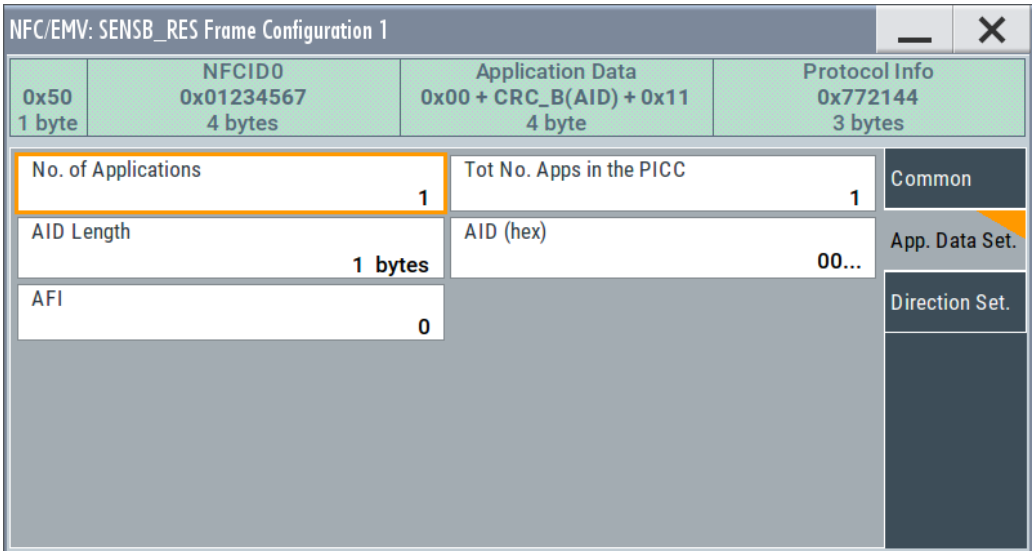
App. Data Set.
Access:

Select "General > Technology > NFC-B".

Select "General > Transmission Mode > Listen".

Select the "Sequence" tab.

For "Command Type > SENSB_RES", select "Frame Conf. > Config... > App. Data Set.".



Application Data ← App. Data Set.
If "Application Data Coding > Proprietary" is used, enters the application data in hex format.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ADATa on page 81

AID Length ← App. Data Set.
For "Application Data Coding > CRC-B", determines the length of AID.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ALENgth on page 82

AID (hex) ← App. Data Set.
Determines the value of AID.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:AID on page 82

AFI ← App. Data Set.
Sets the application family being selected.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:AFI on page 82

Application Data Coding
Determines the way the application data is coded: with a "Proprietary" code or using a "CRC-B" compressing method.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ADCoding on page 81

ATN or Timeout
Available only for "PDU Type > Supervisory".

Determines whether a "ATN" (Attention) or "Timeout" supervisory PDU type is used.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ATIMeout on page 85

BCC Error
Used for error detection. If enabled, an error is added intentionally to the BCC (Block Check Character) by adding 1 to the BCC Byte.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BCCError on page 85

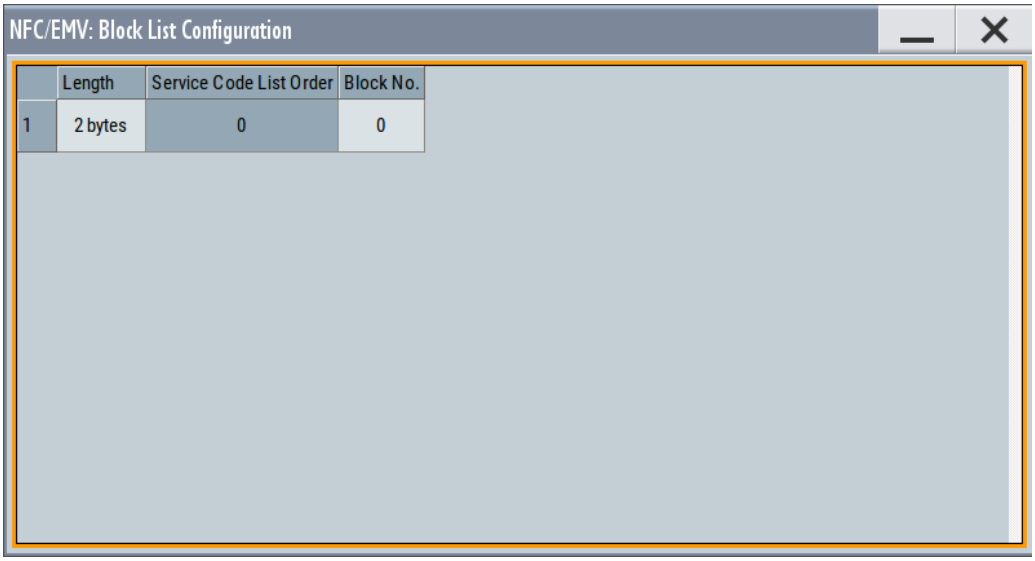
Bit Frame SDD / Bit Frame Anticollision
Determines the Bit frame SDD / Anticollision.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BFSDd on page 86
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BFANticollision on page 85

Block List, Block Data, Block List Configuration
Available with "Command Type > CHECK". Accesses the "Block List Configuration" dialog.

The available functions in the "Block List Configuration" dialog depend on the selected "Transmission Mode".

With "Transmission Mode > Poll" the block list appears.



The number of rows in the block list is determined by the parameter Number of Blocks.

With "Transmission Mode > Listen" the block data appears.

"Length" Sets the block length in bytes.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:LEN`
on page 86

"Service Code List Order" Sets the service code list order.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:SLORder`
on page 87

"Block Number" Sets the block number.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:BNUMber on page 86

"Block Data" Enters the block data in hex format.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:BDATa on page 86

Block Number (BNo)
Selects the block number to be read or written.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BNO on page 87

Block Number (for I-block type or R-block type)
Available for I-block type or R-block type. Indicates if a valid I-block or a valid R (ACK) block is received.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:IBNumber on page 94

Block or Byte Selection (ADD)
Selects a block/byte to be read or written.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLKSelection on page 86
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BYTSelection on page 88

Block Type
Determines the used block type.

"I-block" Used to convey information for use by the application layer.

"R-block" Used to convey positive or negative acknowledgements. An R-block never contains an INF field. The acknowledgement relates to the last received block.

"S-block" Used to exchange control information between the reader/writer and the card emulator.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BTYPe on page 87

Chaining
Available only for "Block Type > I-block".

Determines if chaining is applied.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:CHAining on page 88

Configuration Type
Only used in case NFCID1 is not completed.(Cascade bit == “On”).

Determines what platform or protocol the device in Listen mode is configured for.

"Type 2 Tag" This platform uses the following characteristics of NFC-A:

- synchonization mechanism
- bit level coding
- transmits Commands and Responses in NFC-A standard frames, except for the ACK and NACK Response.

"Type 4A Tag" This platform uses the following characteristics of NFC-A:

- synchonization mechanism
- bit level coding
- transmits commands and responses in NFC-A standard frame format.

"NFC-DEP" This protocol uses the following characteristics of NFC-A or NFC-F, depends on the configuration :

- sequence format
- bit level coding
- frame format.

"NFC-DEP&Type 4A Tag"
Used for devices capable of both, NFC-DEP and Type 4A Tag.
For more details see the NFC Digital Protocol Technical Specification.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:CFGType` on page 88

Data (hex)
Sets the data for the corresponding frame.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:BOData` on page 83
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:SHData` on page 83
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STData` on page 84
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:BPGeneric:DATA` on page 84
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:FPGeneric:DATA` on page 84

Data Length
Determines the length of the transmitted user data / general data.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:LENGth` on page 89

Data Source (Data)
Determines the data source type for the frame.

"All 0 / All 1" Generates 0 or 1 data.

"PN9 / 11 / 15 / 16 / 20 / 21 / 23"
Generates PRBS data in accordance with ITU-T with period lengths between 2^9-1 and 2^{23}-1.

"Data List" Uses data from a programmable data list. The data can be generated with the binary editor in the instrument or externally with any editor. Data list files are selected from the "Select Data List" dialog.

"Pattern" Defines a bit pattern. For Pattern input select "Data Pattern".

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA on page 89
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:DSELection on page 89
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:PATTern on page 89

DESELECT or WTX
Available only for "Block Type > S-block".

Determines whether a "DESELECT" or a "WTX" (waiting) is sent.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DWSelection on page 93

DID Supported / CID Supported
Determines if DID / CID is supported.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DSUPported on page 93
[:SOURce<hw>]:BB:NFC:CBLock<ch>:CSUPported on page 89

DID (DID field)/ CID (CID field)
Determines the value of DID (Device Identification Number) / CID (Cryptogram Information Data).

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DID on page 90
[:SOURce<hw>]:BB:NFC:CBLock<ch>:CID on page 88

DID following (I-block type, R-block type or S-block type)
Determines if a DID is following.

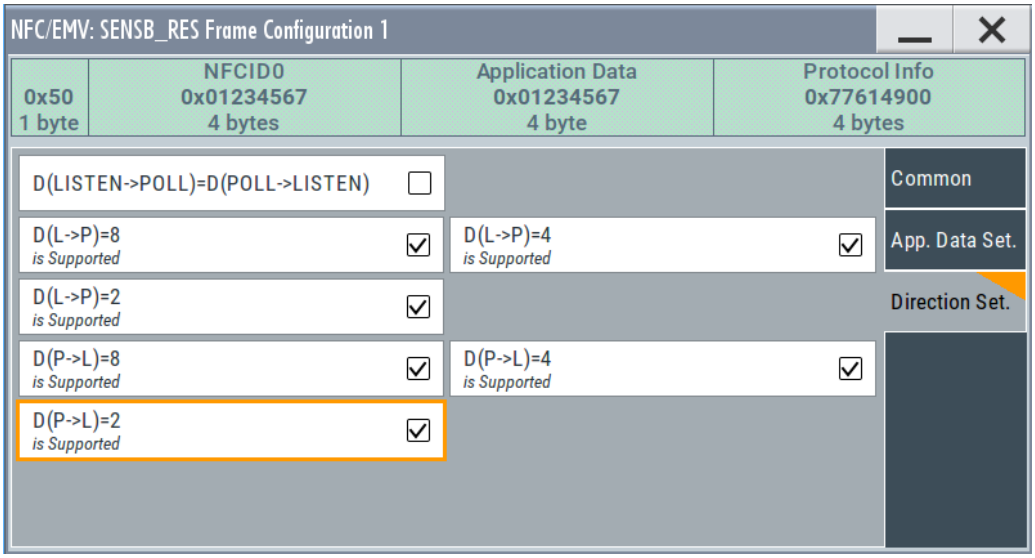
Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DFOLlowing on page 90

Direction Set.
Select "General > Technology > NFC-B".

Select "General > Transmission Mode > Listen".

Select the "Sequence" tab.

For "Command Type > SENSB_RES", select "Frame Conf. > Config... > Direction Set.".



D(LISTEN->POLL)=D(POLL->LISTEN) / D(PICC->PCD)=D(PCD->PICC) ← Direction Set.
Determines if the same bit rate divisor for both directions is supported.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DEQD on page 90

D(L->P=8), D(L->P=4), D(L->P=2) ← Direction Set.
In the transmission direction listen to poll, indicate support of the corresponding divisor, i.e. determine the bit rate capability.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLP8 on page 91
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLP4 on page 91
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLP2 on page 90

D(P->L=8), D(P->L=4), D(P->L=2) ← Direction Set.
In the transmission direction poll to listen, indicate support of the corresponding divisor, i.e. determine the bit rate capability.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPL8 on page 92
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPL4 on page 91
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPL2 on page 91

Divisor (LISTEN to POLL), Divisor (POLL to LISTEN) / Divisor (PCD to PICC), Divisor (PICC to PCD)
Available for "Command Type > ATTRIB".

Set the divisor in the corresponding transmission direction.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLTPoll on page 91
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPTListen on page 92

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPPicc on page 92
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPPCd on page 92

DRI
Selects the divisor (1, 2, 4, 6, 8, 16, 32, 64) in communication direction from target to initiator. The divisor determines the bit rate.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DRI on page 92

DSI
Selects the divisor (1, 2, 4, 6, 8, 16, 32, 64) in communication direction from initiator to target. The divisor determines the bit rate.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:DSI on page 93

EoD (CRC)
Selects if the EoD is present or not. The EoD contains a 2-byte CRC.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STEPresent on page 85

Extended SENSB_RES / Extended ATQB
Determines if "Extended SENSB_RES" / "Extended ATQB" is supported.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ESSupported on page 93
[:SOURce<hw>]:BB:NFC:CBLock<ch>:EASupported on page 93

Frame Type
Selects a frame type for "Command Type > GENERIC".

"Short Frame"	Used to initiate communication. A short frame consists of an SoF, up to 7 data bits and an EoF.
"Standard Frame"	Used for data exchange. A standard frame consists of an SoF, n*(8 data bits + odd parity bit) where n≥1 and for the case of a Poll - Listen communication an EoF.
"Bit Oriented SDD Frame"	Used for collision resolution. A bit oriented SDD frame results from a standard frame of 7 bytes that is divided into two parts.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:FTYPe on page 83

FSC
Selects the maximum frame size in bytes.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FSC on page 93
[:SOURce<hw>]:BB:NFC:CBLock<ch>:MFSize on page 95

FWI
Determines the FWI (Frame Waiting time Integer) which is needed to calculate the FWT (Frame Waiting Time).

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FWI on page 94

General Data
Determines if the bytes with General Data are available.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:GDAVailable on page 94

Global Block Selection (ADD)
Selects 8-byte block to be read or written.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:GBSelection on page 94

k
Determines the number of historical bytes to be used. To set the bytes T_1 to T_k themself, use the parameter T1 to Tk.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:KPARameter on page 95

Length Reduction
According to the NFC specification, the length reduction bits (LR) are used to restrict the payload size.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:LREDuction on page 95

Lock Control or Status
Enables/disables status information on lock for the corresponding block ("BLOCK-1" to "BLOCK-C").

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:LOCKed on page 87

MBLI
Determines the Maximum Buffer Length Index (MBLI).

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:MBLI on page 95

MI (more information) Chaining
If enabeld, the More Information (MI) bit indicates chaining. Chaining indicates that a larger data block is split into several PDUs and the current PDU contains only a part of the data.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:MICHaining on page 95

Minimum TR0, TR1, TR2
Indicates the minimum value of TR0/TR1/TR2 supported. The fc stands for the carrier frequency.

"1008/fc, 768/fc, 256/fc"
Minimum supported TR0

"1254/fc, 1024/fc, 256/fc"
Minimum supported TR1

"1792/fc, 3328/fc, 5376/fc, 9472/fc"
Minimum supported TR2.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:MTR0 on page 96
[:SOURce<hw>]:BB:NFC:CBLock<ch>:MTR1 on page 96
[:SOURce<hw>]:BB:NFC:CBLock<ch>:MTR2 on page 96

NACK
Determines the value of NACK.

"0 / 1 / 4 / 5" Value of NACK in hex.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NACK on page 96

NAD
Available only for "NAD following > On".

Determines the value of NAD.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NAD on page 97

NAD following
Determines if NAD is following.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NFOLlowing on page 97

NAD Supported
Enables/disables the support of NAD.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NSUPported on page 99

NFCID0 (hex) / PUPI (hex)
Determines the entire value of NFCID0/ PUPI. The length of NFCID0 /PUPI is fixed to 4 in octet.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NID0 on page 97
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PUPI on page 100

NFCID1 (hex) / UID (hex)
Determines the entire value of NFCID1/ UID.

The length of NFCID1/ UID is configurable to up to 10 bytes.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NID1 on page 97
[:SOURce<hw>]:BB:NFC:CBLock<ch>:UID on page 105

NFCID1 not complete / UID not complete
Determines whether NFCID1 / UID is complete or not.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NNComplete on page 98
[:SOURce<hw>]:BB:NFC:CBLock<ch>:UNComplete on page 105

NFCID1 Size / UID Size
Determines the size of NFCID1/ UID.

"Single " The size is 4 bytes.

"Double" The size is 7 bytes.

"Triple" The size is 10 bytes.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NSIZe on page 98
[:SOURce<hw>]:BB:NFC:CBLock<ch>:USIZe on page 105

NFCID2 Format Type
Indicates if the NFCID2 format is for NFC-DEP Protocol or Tag Type 3 platform.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:N2FType on page 96

NFCID2 (hex)
Determines the entire value of NFCID2. The value of Byte 2 in NFCID2 is fixed to “FE”, except at command type 3.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NID2 on page 97

Number of Applications
Determines the number of applications.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NOAPplications on page 98

Number Of Bits
Sets the length of a short frame.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:SHLength on page 84

Number Of Bits For Part 1
Sets the length of the first part of a bit oriented SDD frame.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:BOLength on page 83

Number of Blocks
Determines the number of blocks.

Select the Block List, Block Data, Block List Configuration to access the dialog with further settings.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NBLocks on page 97

Number Of Data Bytes
Shows the total length of a frame in bytes.

The length for the different NFC technologies is calculated as follows:
- NFC A: the sum of the "Number Of Payload Bytes" and if "EoD (CRC)" is present, 2 additional bytes are added
- NFC B: the sum of the "Number Of Payload Bytes" and 2 additional bytes added for "EoD (CRC)"
- NFC F: the sum of the "Number Of Payload Bytes", 2 additional bytes added for "EoD (CRC)" and 1 additional byte added for SoD

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STDLength? on page 84
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BPGeneric:DLENgth? on page 84
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FPGeneric:DLENgth? on page 84

Number Of Payload Bytes
For "Technology > NFC A" sets the length of a standard frame.

For "Technology > NFC B /NFC F" sets the length of a frame.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STPLength on page 85
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BPGeneric:PLENgth on page 85
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FPGeneric:PLENgth on page 85

Number of Services
Sets the number of services. The value determines the row numbers in the "Service Code List Configuration" dialog.

To access this dialog, select Service Code List....

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NSERvices on page 98

Number of Slots
Determines number of slots (1, 2, 4, 8 or 16).

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:NOSLots on page 98

Number of Time Slots
Determines how many time slots are used. The coding of the Time Slot Number TSN byte is performed accordingly.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:TSN on page 105

A,B,E Parameter for MRTI (CHECK) or (UPDATE)
Sets the value of the corresponding parameter, i.e. determines the format of the Maximum Response Time Information $MRTI_{CHECK}$ and $MRTI_{UPDATE}$.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ACHK on page 81
[:SOURce<hw>]:BB:NFC:CBLock<ch>:AUPD on page 81
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BCHK on page 81
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BUPD on page 81
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ECHK on page 81
[:SOURce<hw>]:BB:NFC:CBLock<ch>:EUPD on page 81

Packet Selection
Selects if the first or second packet of the SECTOR_SELECT command is transmitted.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PSELection on page 100

PAD0, PAD1, PAD2
Sets the value of PAD0/PAD1/PAD2 (hex).

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PAD0 on page 99
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PAD1 on page 99
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PAD2 on page 99

PDU Type
Selects the type of PDU (Protocol Data Unit).

"Information" Used to convey Application Layer Data in the transport data bytes. Application Layer Data is information for use by the adjacent upper layer.

"ACK/NACK" Used to convey positive or negative acknowledgements. This PDU never contains transport data bytes. The acknowledgement relates to the last received PDU.

"Supervisory" Used to exchange control information between the initiator and the target. Two different types of "Supervisory" PDUs are defined.
For more details refer to the NFC Digital Protocol Technical Specification.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PDUType on page 99

PNI
Only used with "PDU Type > Information". Determines Packet Number Information (PNI).

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PNI on page 100

Power Level Indication
Determines the Power Level Indication.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PLIN on page 99

Power Level Indicator
Power Level Indicator.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PLIR on page 99

RC
Determines the Request Code (RC) ("No System Code info requested", "System Code info requested", "Advanced Protocol features supported") used to retrieve additional information.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:RC on page 100

RTOX
With seleted "PDU Type > Supervisory" and "ATN/Timeout > Timeout", sets the response timeout extension (RTOX) request value.

With a RTOX request, a target indicates that more time than the defined RWT is required to process the received PDU.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:RTOX on page 100

SC
Sets the System Code.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SCODe on page 101

Segment Selection (ADD)
Selects a segment to be read.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SEGSelection on page 101

SEL_CMD / SEL
Selects the cascade level (CL) of the NFCID1 / UID requested by the device.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SCMD on page 101
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SEL on page 101

SEL_PAR_UPPER
Together with SEL_PAR_LOWER, the parameter SEL_PAR_UPPER determines where the NFC-A Bit oriented SDD Frame is split into the SDD_REQ and SDD_RES parts. Therefore this parameter influences the lengths of the SDD_REQ or SDD_RES commands. SEL_PAR_UPPER determines the number of full bytes of the SDD_REQ part.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SPUPper on page 103

SEL_PAR_LOWER
Together with SEL_PAR_UPPER, the parameter SEL_PAR_LOWER determines where the NFC-A Bit oriented SDD Frame is split into the SDD_REQ and SDD_RES parts. Therefore this parameter influences the lengths of the SDD_REQ or SDD_RES commands. SEL_PAR_LOWER determines the number of those bits of the SDD_REQ part, which are not part of full bytes.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SPLower` on page 103

Service Code List...
Accesses the "Service Code List Configuration" dialog.

The number of rows corresponds to the value selected for the paramter Number of Services.

"Access Attributes" Determines whether the attributes are "Read/Write" or "Read Only".

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SERVice<st>:AATTributes` on page 102

"Service Code" The "Service Code" is an element of the type 3 tags. Services are similar to files in a file system. Each service has a number of memory blocks associated with it. Services can be addressed using their service code, which must be unique inside each type 3 tag.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SERVice<st>:SNUMber` on page 102

SFGI
Determines the Start-up Frame Guard Time (SFGT).

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SFGI` on page 103

Slot Number
Determines the slot number ("Slot Number 2" to "Slot Number 16"), i.e defines the start of the response time slot during collision resolution.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SNUMber` on page 103

SNo
For "Packet Selection > Packet 2", determines the sector number.

Remote command:
`[:SOURce<hw>]:BB:NFC:CBLock<ch>:SNO` on page 103

Status Flag 1, Status Flag 2
Sets the status flags to specify a Type 3 tag's error condition. A value of 0 signals a successful execution, values different from 0 indicate errors.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SF1 on page 102
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SF2 on page 102

Suppression of EoS,SoS Not Required
Determines whether a suppression of EoS (End of Sequence)/SoS (Start of Sequence) is required or not.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SENRequired on page 102
[:SOURce<hw>]:BB:NFC:CBLock<ch>:SSNRequired on page 104

T1 to Tk
For number of historical bytes k greater than 0, sets the historical bytes T_1 to T_k.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:T1TK on page 104

Type 1 Tag Platform Configured
Determines whether Type 1 Tag platform is configured or not.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:T1TConfigured on page 104

Total No. Apps in the PICC
Sets the total number of applications in the PICC (Proximity Inductive Coupling Card), i.e. in the NFC Forum Device in listener mode.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:TAIPicc on page 104

WT
Sets the Waiting Time (WT) that codes the Response Waiting Time (RWT). The "WT" value determines the least significant bits (b4 to b1) of the TO field in the ATR_RES command.

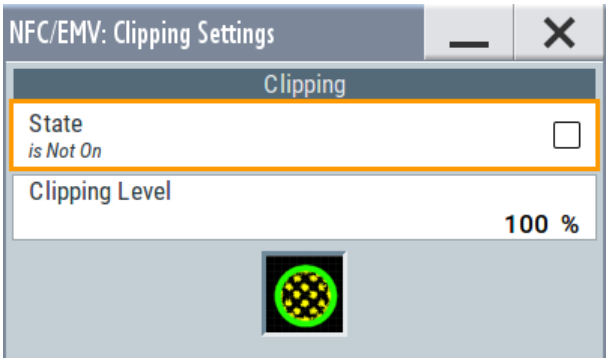
Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:WT on page 105

WTXM (INF field of S(WTX) request, response)
Only used when "DESELCT/WTX > WTX" is set. Sets the value of the WTXM in a waiting time extension request/response command.

Remote command:
[:SOURce<hw>]:BB:NFC:CBLock<ch>:WTXM on page 105

5.10 Clipping settings

► To access this dialog, select "General > Clipping Settings".



The dialog comprises the settings, necessary to configure the baseband filter, sample rate variation and clipping.

Clipping State
Switches baseband clipping on and off.

Baseband clipping is a simple and effective way of reducing the crest factor of the signal. Since clipping is done before to filtering, the procedure does not influence the spectrum. The EVM however increases.

With baseband clipping, the signal level is limited to a settable value ("Clipping Level"). This level is specified as a percentage of the highest peak value.

Remote command:
`[:SOURce<hw>]:BB:NFC:CLIPping:STATe` on page 109

Clipping Level
Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote command:
`[:SOURce<hw>]:BB:NFC:CLIPping:LEVel` on page 109

6 How to generate signals with the NFC A/B/F option

The section provides examples on test setups for testing NFC enabled devices in polling and listening mode.

6.1 How to generate a signal for test of an NFC device in polling mode

A test setup for an NFC enabled mobile phone in polling mode, for testing carrier frequency, power level, modulation waveform and load modulation sensitivity requires a listener test signal ("Transmission Mode" = "Listen").

This is generated by the R&S SMM100A with option R&S SMM-K89.

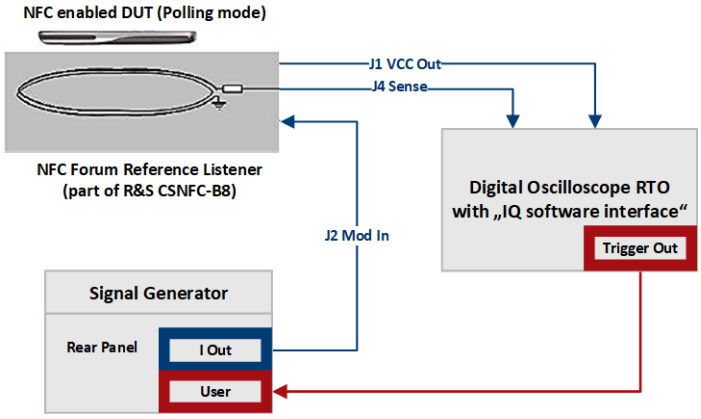


Figure 6-1: Test setup for an NFC mobile phone in polling mode (simplified schematic).

To generate the listener test signal proceed as follows:

1. Connect the I Out connector of the R&S SMM100A to the XJ2 (MOD IN) connector of the NFC Forum reference listener, see Figure 6-1.
2. Provide an external trigger signal to the R&S SMM100A:
   Connect the trigger out connector of the measuring equipment (R&S RTO) to the input connector used for external triggering of digital modulations, standards and ARB of the R&S SMM100A.
3. Press the [Preset] hardkey at the R&S SMM100A.
4. Select the technology, for example NFC-B ("NFC/EMV > Technology > NFC-B").
5. Select the listen transmission mode ("NFC/EMV > Transmission Mode > Listen").

6. Select external triggering ("NFC/EMV > Trigger/Marker... > Trigger In > Mode > Single " and "NFC/EMV > Trigger/Marker... > Trigger In > Source > External Global Trigger").
7. Select the command type, for example "SENSB_RES" ("NFC/EMV> Sequence Configuration > Command Type > SENSB_RES"), see Table 5-1 .
8. Activate the NFC signal ("NFC/EMV > State > On") .

If settings other than the default settings are required, add the following operating steps:

1. Set the modulation settings ("NFC/EMV > Modulation Settings"), see Chapter 5.6, "Modulation settings", on page 33.
2. Configure the frame ("NFC/EMV> Sequence Configuration > Frame Conf."), see Chapter 5.9, "Frame configuration settings", on page 46.
3. Set the clipping settings ("NFC/EMV > Clipping Settings"), see Chapter 5.10, "Clipping settings", on page 63.
4. Set the marker and clock settings ("NFC/EMV > Trigger/Marker..."), see Chapter 5.2, "Trigger settings", on page 25 and Chapter 5.3, "Marker settings", on page 30.
5. Set the parameter for "Desired Voltage in Unmodulated Signal parts" e.g. to 1.5 V ("NFC/EMV > Desired Voltage In Unmodulated Signal parts > 1.5 "), see Chapter 3.3, "Leveling aspects", on page 17.

6.2 How to generate a signal for test of an NFC device in listener mode

A test setup for an NFC enabled mobile phone in listener mode for test of load modulation, frame delay time etc., requires a poller test signal ("NFC A/B/F > Transmission Mode > Poll"). This is generated by the R&S SMM100A with option R&S SMM-K89.

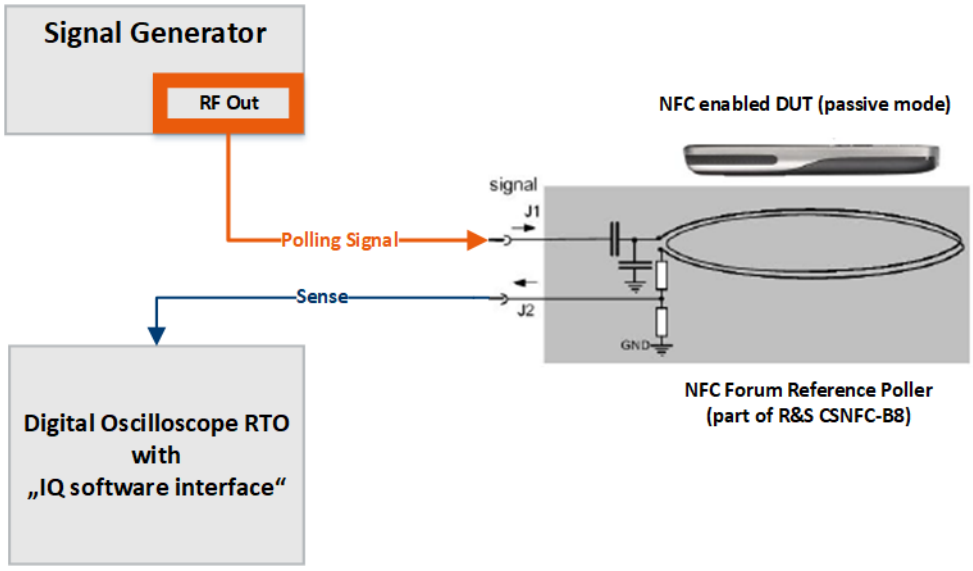


Figure 6-2: Test setup for an NFC mobile phone in listening mode (simplified schematic).

To generate the poller test signal proceed as follows.

1. Connect the RF Out connector of the R&S SMM100A to the X1 connector of the NFC Forum reference poller, see Figure 6-2.
2. Press the [Preset] hardkey at the R&S SMM100A.
3. Select the technology, for example NFC-B ("NFC/EMV > Technology > NFC-B").
4. Select the poll transmission mode ("NFC/EMV > Transmission Mode > Poll").
5. Select the command type, for example "ATTRIB" ("NFC/EMV > Sequence Configuration > Command Type > ATTRIB"), see Table 5-1.
6. Activate the NFC signal ("NFC/EMV > State > On") .

If settings other than the default settings are required, add the following operating steps:

1. Set the modulation settings ("NFC/EMV > Modulation Settings"), see Chapter 5.6, "Modulation settings", on page 33.
2. Configure the frame ("NFC/EMV > Sequence Configuration > Frame Conf."), see Chapter 5.9, "Frame configuration settings", on page 46.
3. Set the clipping settings ("NFC/EMV > Clipping Settings"), see Chapter 5.10, "Clipping settings", on page 63.
4. Set the marker and clock settings ("NFC/EMV > Trigger/Marker..."), see Chapter 5.2, "Trigger settings", on page 25 and Chapter 5.3, "Marker settings", on page 30.

7 Remote-control commands

The following commands are required to perform signal generation with the NFC option in a remote environment. We assume that the R&S SMM100A has already been set up for remote operation in a network as described in the R&S SMM100A documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

Conventions used in SCPI command descriptions

For a description of the conventions used in the remote command descriptions, see section "Remote Control Commands" in the R&S SMM100A user manual.

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
SOURce<hw>	1	available baseband signals
OUTPut<ch>	1 to 3	available markers
CBLock<ch>	1 .. 100	successive number of the command block in the sequence configuration table
BLOCk<st>	1 .. 100	Index of the entry in the "Block List Table"
SERVice<st>	1 .. 100	Index of the entry in the "Service List Table"

The following commands specific to the NFC are described here:

7.1 Programming example

The settings have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

At the beginning of most remote control programs, an instrument (p)reset is recommended to set the R&S SMM100A to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` resets the status registers and clears the output buffer.

In the example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

Example: Generate a listener test signal

The following example generates a listener test signal.

If settings other than the default settings are required, add the following operating steps:

```
// ****************************************************************
// Set modulation settings
// Activate slope
// Set risetime to 0.25 us, other modulation settings stay default
// For signal generators only: Set the "desired voltage in unmodulated
// signal parts"
// ****************************************************************
SOURce:BB:NFC:MSET:SLOPe 1
SOURce:BB:NFC:MSET:TRISe .25

// ****************************************************************
// Configure the frame (for command type SENSB_RES)
// Set application data to "2345 ABCD" (Hex)
// ****************************************************************
SOURce:BB:NFC:CBLock1:ADATa #H2345ABCD, 32

// ****************************************************************
// For signal generators only:
// Set the "Desired Voltage in Unmodulated Signal parts" to 1.5 Volts.
// Cause the instrument to automatically adjust the related parameters
// of the analog I and Q outputs
// ****************************************************************
SOURce:BB:NFC:DVOLtage 1.5
SOURce:BB:NFC:UAISetting
```

Example: Generate a poller test signal

The following example generates a poller test signal.

```
// ****************************************************************
// Set technology to NFC-B
// Set transmission mode to poll
// Select command type ATTRIB and activate NFC signal
// ****************************************************************
*RST
*CLS
SOURce:BB:NFC:TECHnology NFCB
SOURce:BB:NFC:TMODe POLL
SOURce:BB:NFC:CBLock1:CTYPe ATBQ
SOURce:BB:NFC:STATe ON

// Alternatively set the predefined NFC-A sequence APA
// (IDLE, ALL_REQ, IDLE, BLANK)
// For signal generators only: position marker1 after first idle
// Activate the sequence and marker (if applicable)
*RST
*CLS
SOURce:BB:NFC:TMODe POLl
SOURce:BB:NFC:PRED:SEQuence APA
SOURce:BB:NFC:PRED:CNFMarker ON
SOURce:BB:NFC:PRED:APPLy

// ****************************************************************
// Set technology to NFC-B
// Set transmission mode to poll
// Select command type ATTRIB and activate NFC signal
// ****************************************************************
*RST
*CLS
SOURce:BB:NFC:TECHnology NFCB
SOURce:BB:NFC:TMODe POLL
SOURce:BB:NFC:CBLock1:CTYPe ATBQ
SOURce:BB:NFC:STATe ON

// Alternatively set the predefined NFC-A sequence APA
// (IDLE, ALL_REQ, IDLE, BLANK)
// For signal generators only: position marker1 after first idle
// Activate the sequence and marker (if applicable)
*RST
*CLS
SOURce:BB:NFC:TMODe POLl
SOURce:BB:NFC:PRED:SEQuence APA
SOURce:BB:NFC:PRED:CNFMarker ON
SOURce:BB:NFC:PRED:APPLy
```

If settings other than the default settings are required, add the following operating steps to the set predefined NFC-A sequence:

```
// ****************************************************************
// Configure the sequence and the frame:
// Set command type of first sequence-command to "DATA_Type4A"
// Set the block type to I-Block
// Set the data length to 2 bytes
// Set the data pattern 0110 0101 0011 1100
// ****************************************************************
SOURce:BB:NFC:CBLock1:CTYPE T4AD
SOURce:BB:NFC:CBLock1:BTYPe TPI
SOURce:BB:NFC:CBLock1:DATA:LENGth 2
SOURce:BB:NFC:CBLock1:DATA:PATTern #B0110010100111100, 16
```

7.2 Primary settings

[:SOURce<hw>]:BB:NFC:DIVisor <DivForMod>

Selects the divisor and thus the datarate for technology NFC-F.

Parameters:

<DivForMod> DIV2 | DIV4
*RST: DIV2

Manual operation: See "Divisor (Bit Rate)" on page 23

[:SOURce<hw>]:BB:NFC:DVOLtage <DVoltage>

Sets the desired voltage in unmodulated signal parts.

Parameters:

<DVoltage> float
Range: 0.020 to 1.5
Increment: 0.001
*RST: 1

Example: See Chapter 7.1, "Programming example", on page 67
.

Manual operation: See "Desired Voltage In Unmodulated Signal parts" on page 24

[:SOURce<hw>]:BB:NFC:PRESet

Sets the parameters of the digital standard to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command `SOURce<hw>:BB:NFC:STATe`.

Example: See Chapter 7.1, "Programming example", on page 67

Usage: Event

Manual operation: See "Set to Default" on page 22

[:SOURce<hw>]:BB:NFC:STATe <State>

Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Chapter 7.1, "Programming example", on page 67

Manual operation: See "State" on page 21

[:SOURce<hw>]:BB:NFC:TECHnology <Protocol>

Selects the NFC/EMV technology.

Parameters:

<Protocol> NFCA | NFCB | NFCF | EMVA | EMVB

*RST: NFCA

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Technology" on page 23

[:SOURce<hw>]:BB:NFC:TMODe <Transmission>

Selects the transmission mode.

Parameters:

<Transmission> POLL | LISTen

*RST: POLL

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Transmission Mode" on page 23

[:SOURce<hw>]:BB:NFC:UAISetting

Triggers the instrument to automatically adjust the related parameters of the analog I and Q outputs.

Example: See Chapter 7.1, "Programming example", on page 67
.

Manual operation: See "Update Analog I/Q Settings For Desired Voltage" on page 24

[:SOURce<hw>]:BB:NFC:UPVoltage?

Displays the ratio of the voltage in the unmodulated parts of the signal to its peak value.

Return values:
<UPVoltage> integer

Range: 0 to 100
*RST: 0

Usage: Query only

Manual operation: See "Unmodulated Parts Voltage To Peak Voltage Ratio" on page 24

[:SOURce<hw>]:BB:NFC:VERSion?

Queries the version of the NFC-Forum and EMVCo specifications used for the signal generation.

Return values:
<Version> string

Example: See Chapter 7.1, "Programming example", on page 67.

Usage: Query only

[:SOURce<hw>]:BB:NFC:WAVeform:CREate <Filename>

Stores the current NFC signal as ARB signal in a waveform file with the filename given in the parameter.

Setting parameters:
<Filename> string

Usage: Setting only

Manual operation: See "Generate Waveform File..." on page 23

7.3 Save/recall operations

[:SOURce<hw>]:BB:NFC:SETTing:CATalog?

Catalog settings file name.

Return values:
<Catalog> string

Usage: Query only

Manual operation: See "Save/Recall ..." on page 22

[:SOURce<hw>]:BB:NFC:SETTing:DELete <Filename>

Deletes the NFC settings file with the filename given in the parameter.

Setting parameters:
<Filename> string

Usage: Setting only

Manual operation: See "Save/Recall ..." on page 22

[:SOURce<hw>]:BB:NFC:SETTing:LOAD <Filename>

Loads the NFC setting file with the name given in the parameter.

Setting parameters:
<Filename> string

Usage: Setting only

Manual operation: See "Save/Recall ..." on page 22

[:SOURce<hw>]:BB:NFC:SETTing:STORe <Filename>

Stores current NFC settings in a file with the name given in the parameter.

Setting parameters:
<Filename> string

Usage: Setting only

Manual operation: See "Save/Recall ..." on page 22

7.4 Predefined sequence

[:SOURce<hw>]:BB:NFC:PRED:SEQuence <Sequence>

Available only for "Transmission Mode > Poll" and "Transmission Mode > PCD to PICC".

Selects a predefined sequence.

Parameters:

<Sequence> FPS | BPA | BPS | APA | APS

FPS
Predefined NFC-F sequence with the elements: IDLE, SENSF_REQ, IDLE, BLANK

BPA
Predefined NFC-B sequence with the elements: IDLE, ALL_REQ, IDLE, BLANK or a predefined EMV Type A sequence with the elements: IDLE, WUPB, IDLE, BLANK

BPS
Predefined NFC-B sequence with the elements: IDLE, SENS_REQ, IDLE, BLANK or a predefined EMV Type B sequence with the elements: IDLE, REQB, IDLE, BLANK

APA
Predefined NFC-A sequence with the elements: IDLE, ALL_REQ, IDLE, BLANK or a predefined EMV Type A sequence with the elements: IDLE, WUPA, IDLE, BLANK

APS
Predefined NFC-A sequence with the elements: IDLE, SENS_REQ, IDLE, BLANK or a predefined EMV Type A sequence with the elements: IDLE, REQA, IDLE, BLANK

*RST: APS

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Predefined Sequence" on page 39

[:SOURce<hw>]:BB:NFC:PRED:CNFMarker <Conf>

Available for signal generators only.

If enabled marker 1 is positioned after the first idle.

Parameters:

<Conf> 1 | ON | 0 | OFF

Example: See Chapter 7.1, "Programming example", on page 67
.

Manual operation: See "Configure Marker 1 For The Sequence" on page 39

[:SOURce<hw>]:BB:NFC:PRED:APPLy

Activates the selected "Predefined Sequence" and marker.

Example: See Chapter 7.1, "Programming example", on page 67
.

Usage: Event

Manual operation: See "Apply" on page 39

7.5 Sequence configuration

[:SOURce<hw>]:BB:NFC:CBLock:APPend

Appends a command block to the end of the command sequence.

Usage: Event

Manual operation: See "Append, Insert, Delete, Copy, Paste" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:COPY
[:SOURce<hw>]:BB:NFC:CCBLock <CcBlock>

Copies a command block for later use.

Setting parameters:

<CcBlock> integer

Range: 1 to 100
*RST: 1

Usage: Setting only

Manual operation: See "Append, Insert, Delete, Copy, Paste" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:CTYPe <Cmd>

Selects the command type.

Parameters:

<Cmd> ALAQ | SNAQ | SDAQ | SLAQ | SPAQ | RDAQ | RLAQ | T1RQ | WREQ | WNEQ | RSGQ | RD8Q | WE8Q | WN8Q | T2RQ | T2WQ | SSLQ | RATQ | T4AD | ATRQ | PSLQ | DEPQ | DSLQ | RLSQ | ALBQ | SNBQ | SMAR | SPBQ | ATBQ | T4BD | SNFQ | CHKQ | UPDQ | SNAS | SDAS | SLAS | RDAS | RLAS | T1RS | WRES | WNES | RSGS | RD8S | WE8S | WN8S | T2RS | ACK | NACK | ATSS | ATRS | PSLS | DEPS | DSLS | RLSS | SNBS | SPBS | ATBS | SNFS | CHKS | UPDS | GENE | IDLE | BLNK

*RST: SNAQ

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Command Type" on page 41

For command types and the corresponding SCPI-command parameters see the overview in Table 5-1.

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DELete
[:SOURce<hw>]:BB:NFC:DCBLock <DcBlock>

Removes a command block from the command sequence.

Setting parameters:

<DcBlock> integer

Range: 1 to 100

Usage: Setting only

Manual operation: See "Append, Insert, Delete, Copy, Paste" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DURation <Duration>

Determines the frame period in µs.

Parameters:

<Duration> float

Range: 0 to 1E6
Increment: 0.01
*RST: 84.9557522

Manual operation: See "Duration (µs)" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:INSert
[:SOURce<hw>]:BB:NFC:ICBLock <IcBlock>

Inserts a default command block before the selected command block. The command block with this position must be existing, otherwise an error is returned.

Setting parameters:
<IcBlock> integer
Range: 1 to 99

Usage: Setting only

Manual operation: See "Append, Insert, Delete, Copy, Paste" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PASTe
[:SOURce<hw>]:BB:NFC:PCBLock <PcBlock>

Pastes a command block (which was copied before) at the given position into the command sequence.

Setting parameters:
<PcBlock> integer
Range: 1 to 99

Usage: Setting only

Manual operation: See "Append, Insert, Delete, Copy, Paste" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:POFFset <OFFSet>

Determines the power offset value in dB.

Parameters:
<OFFSet> float
Range: -20 to 20
Increment: 0.01
*RST: 0

Manual operation: See "Power Offset (dB)" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:REPetition <Repet>

Determines the number of times to repeat the generation of a frame.

Parameters:
<Repet> integer
Range: 0 to 9999
*RST: 1

Manual operation: See "Rep." on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SAMPles?

Queries the total number of samples in a selected command block.

Return values:
<Samples> float

Usage: Query only

Manual operation: See "Samples" on page 45

[:SOURce<hw>]:BB:NFC:CBLock<ch>:STIMe?

Queries the exact start time of the corresponding command.

Return values:
<STime> float

Usage: Query only

Manual operation: See "Start Time" on page 41

[:SOURce<hw>]:BB:NFC:SCONfiguration:TNSamples?

Queries the total number of samples allocated to the current frame.

Return values:
<TNSamples> integer

Usage: Query only

Manual operation: See "Total Number of Samples" on page 40

[:SOURce<hw>]:BB:NFC:SCONfiguration:TSDuration?

Queries the total sequence duration for the current settings.

Return values:
<TSDuration> float

Usage: Query only

Manual operation: See "Total Sequence Duration" on page 40

7.6 Frame configuration

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ACHK <ACheck>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:AUPD <AUpdate>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BCHK <BCheck>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:BUPD <BUpdate>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:ECHK <ECheck>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:EUPD <EUpdate>

Determines the format and value of the Maximum Response Time Information $MRTI_{CHECK}$ and $MRTI_{UPDATE}$.

Parameters:

<EUpdate> integer

Range: 0 to 3
*RST: 0

Manual operation: See "A,B,E Parameter for MRTI (CHECK) or (UPDATE)" on page 59

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ADATa <AData>

Application data input (hex value).

Parameters:

<AData> integer

Example: See Chapter 7.1, "Programming example", on page 67
.

Manual operation: See "Application Data" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ADCoding <ADCoding>

Determines if application is proprietary or CRC-B.

Parameters:
<ADCoding> PROP | CRCB
*RST: PROP

Manual operation: See "Application Data Coding" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:AFI <Afi>

Sets the application family being selected.

Parameters:
<Afi> integer
Range: 0 to 255
*RST: 0

Manual operation: See "AFI" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:AID <Aid>

Determines the value of AID.

Parameters:
<Aid> integer

Manual operation: See "AID (hex)" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ALENgth <ALength>

Determines the length of AID.

Parameters:
<ALength> integer
Range: 1 to 16
*RST: 1

Manual operation: See "AID Length" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ANSelection <ANSelection>

Available only for "PDU Type > ACK-NACK" or "Block Type > R-block".

Selects ACK or NACK.

Parameters:
<ANSelection> ACK | NACK
*RST: ACK

Manual operation: See "ACK, NACK" on page 47

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APFSupported <APFS>

Determines if Advanced Protocol Features are supported.

Parameters:
<APFS> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Advanced Protocol Features supported" on page 47

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:BOData <BoFrameData>

Sets the data for a bit oriented SDD frame.

Parameters:
<BoFrameData> integer
*RST: #H0000

Example: `:BB:NFC:CBL1:APG:BOL 18`
sets the length of the standard frame to 18 bits
`:BB:NFC:CBL1:APG:BOD #H3FFFF,18`
sets the data

Manual operation: See "Data (hex)" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:BOLength <BoFrameLen>

Sets the length of the first part of a bit oriented SDD frame.

Parameters:
<BoFrameLen> integer
Range: 16 to 55
*RST: 16

Manual operation: See "Number Of Bits For Part 1" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:FTYPe <FrameType>

Selects a frame type for "Command Type > GENERIC".

Parameters:
<FrameType> SHORt | STANdard | BOSDd
*RST: SHORt

Manual operation: See "Frame Type" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:SHData <ShortFrameData>

Sets the data bits of a short frame.

Parameters:
<ShortFrameData> integer
*RST: #H00

Example: `:BB:NFC:CBL1:APG:SHL 7`
sets the length of the short frame to 7 bits
`:BB:NFC:CBL1:APG:SHD #H26,7`
sets the data

Manual operation: See "Data (hex)" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:SHLength <ShortFrameLen>

Sets the length of a short frame in bits.

Parameters:
<ShortFrameLen> integer
Range: 1 to 7
*RST: 7

Manual operation: See "Number Of Bits" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BPGeneric:DATA <Data>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FPGeneric:DATA <Data>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STData <StdFrameData>

Sets the data for a standard frame in hexadecimal values.

Parameters:
<StdFrameData> integer

Example: `:BB:NFC:CBL1:APG:STPL 4`
sets the length of the standard frame to 4 bytes
`:BB:NFC:CBL1:APG:STD #H01234567,32`
sets the data

Manual operation: See "Data (hex)" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BPGeneric:DLENgth? <DataLength>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FPGeneric:DLENgth? <DataLength>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STDLength?
<StdFrameDataLen>

Shows the total length of a standard frame in bytes.

Parameters:
<StdFrameDataLen> integer
Range: 1 to 10
*RST: 3

Usage: Query only

Manual operation: See "Number Of Data Bytes" on page 58

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BPGeneric:PLENgth <PayloadLength>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:FPGeneric:PLENgth <PayloadLength>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STPLength <StdFramePayLen>

Sets the length of a standard frame.

Parameters:
<StdFramePayLen> integer
Range: 1 to 8
*RST: 1

Manual operation: See "Number Of Payload Bytes" on page 58

[:SOURce<hw>]:BB:NFC:CBLock<ch>:APGeneric:STEPresent
<StdFrameEodPres>

Selects if the EoD is present or not.

Parameters:
<StdFrameEodPres> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "EoD (CRC)" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ATIMeout <ATimeout>

Only used with PDU type "supervisory". Determines whether an "ATN" (Attention) or "Timeout" supervisory PDU type is used.

Parameters:
<ATimeout> ATN | TOUT
*RST: ATN

Manual operation: See "ATN or Timeout" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BCCError <BCCError>

If enabled, an error is added intentionally to the BCC (checksum).

Parameters:
<BCCError> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "BCC Error" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BFANticollision <BFANticol>

Determines the bit frame Anticollision.

Parameters:
<BFANticol> SDD0 | SDD2 | SDD1 | SDD4 | SDD8 | SDD16

Manual operation: See "Bit Frame SDD / Bit Frame Anticollision" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BFSDd <BFSdd>

Determines Bit frame SDD.

Parameters:
<BFSdd> SDD0 | SDD2 | SDD1 | SDD4 | SDD8 | SDD16
*RST: SDD1

Manual operation: See "Bit Frame SDD / Bit Frame Anticollision" on page 48

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:BDATa <BData>

Sets the value of "Block Data" .

Parameters:
<BData> integer

Manual operation: See "Block List, Block Data, Block List Configuration" on page 49

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLKSelection <BlockSel>

Selects a block to be read/written.

Parameters:
<BlockSel> integer
Range: 0 to 14
*RST: 1

Manual operation: See "Block or Byte Selection (ADD)" on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:BNUMber <BNumber>

Sets the block number in the block list.

Parameters:
<BNumber> integer
Range: 0 to depends on block list length
*RST: 0

Manual operation: See "Block List, Block Data, Block List Configuration" on page 49

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:LEN <BLLength>

Sets the block length.

Parameters:
<BLLength> LEN2 | LEN3
*RST: LEN2

Manual operation: See "Block List, Block Data, Block List Configuration" on page 49

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:LOCKed <LControl>

Enables/disables status information on lock for the corresponding block ("BLOCK-1" to "BLOCK-C").

Parameters:
<LControl> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Lock Control or Status" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BLOCk<st>:SLORder <SCLOrder>

Sets the service code list order.

Parameters:
<SCLOrder> integer
Range: 0 to dynamic
*RST: 0

Manual operation: See "Block List, Block Data, Block List Configuration" on page 49

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BNO <BNo>

Selects the block number to be read/write.

Parameters:
<BNo> integer
Range: 0 to 255
*RST: 1

Example: BB:NFC:CBLock<CH>:BNO 78
Selects the block number 78 to be read/written

Manual operation: See "Block Number (BNo)" on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BTYPe <BType>

Selects the block type to be sent.

Parameters:
<BType> TPI | TPR | TPS
*RST: TPI

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Block Type" on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:BYTSelection <ByteSel>

Selects a byte to be read/written.

Parameters:
<ByteSel> integer
Range: 0 to 7
*RST: 1

Manual operation: See "Block or Byte Selection (ADD)" on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:CFGType <ConfType>

Determines what platform or protocol the device in listen mode is configured for.

Parameters:
<ConfType> T2 | T4A | NDEP | DT4A | OFF | 0 | ON | 1
*RST: T2

Manual operation: See "Configuration Type " on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:CHAining <Chaining>

Determines if chaining is applied.

Parameters:
<Chaining> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Chaining" on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:CID <CID>

Determines the value of CID.

Parameters:
<CID> float
*RST: 1

Manual operation: See "DID (DID field)/ CID (CID field)" on page 52

[:SOURce<hw>]:BB:NFC:CBLock<ch>:CIl4 <ConfType>

Determines what platform or protocol the device is configured for.

Parameters:
<ConfType> T2 | T4A | NDEP | DT4A | OFF | 0 | ON | 1

[:SOURce<hw>]:BB:NFC:CBLock<ch>:CSUPported <CSupported>

Determines if CID is supported.

Parameters:
<CSupported> 0 | 1 | OFF | ON

Manual operation: See "DID Supported / CID Supported" on page 52

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA <Data>

Selects the data source type.

Parameters:
<Data> ZERO | ONE | PATTern | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

*RST: PN9

Manual operation: See "Data List Management..." on page 23
See "Data Source (Data)" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:DSELection <DSelection>

Selects a Data List.

Parameters:
<DSelection> string

Manual operation: See "Data List Management..." on page 23
See "Data Source (Data)" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:LENGth <Length>

Determines the length of the transmitted user data / general data.

Parameters:
<Length> integer

Range: 0 to 65536
*RST: 0

Example: See Chapter 7.1, "Programming example", on page 67
.

Manual operation: See "Data Length" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DATA:PATTern <Pattern>, <BitCount>

Defines a bit pattern.

Parameters:
<Pattern> numeric

*RST: #H0,1

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Data Source (Data)" on page 51

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DEQD <DivEqDiv>

Determines if the same bit rate divisor for both directions is supported.

Parameters:
<DivEqDiv> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "D(LISTEN->POLL)=D(POLL->LISTEN) / D(PICC->PCD)=D(PCD->PICC)" on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DFOLlowing <DFollowing>

Determines if a DID is following.

Parameters:
<DFollowing> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "DID following (I-block type, R-block type or S-block type)" on page 52

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DID <DID>

Determines the value of DID (Device Identification Number).

Parameters:
<DID> integer

Range: 0 to 14
*RST: 1

Manual operation: See "DID (DID field)/ CID (CID field)" on page 52

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLP2 <TaDlp2>

Enables support of divisor 2 for LISTEN to POLL (Bit Rate Capability).

Parameters:
<TaDlp2> 1 | ON | 0 | OFF

*RST: 1

Manual operation: See "D(L->P=8), D(L->P=4), D(L->P=2) " on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLP4 <TaDlp4>

Enables support of divisor 4 for LISTEN to POLL (Bit Rate Capability).

Parameters:
<TaDlp4> OFF | ON | 1 | 0
*RST: ON

Manual operation: See "D(L->P=8), D(L->P=4), D(L->P=2) " on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLP8 <TaDlp8>

Enables support of divisor 8 for LISTEN to POLL (Bit Rate Capability).

Parameters:
<TaDlp8> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "D(L->P=8), D(L->P=4), D(L->P=2) " on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DLTPoll <Dltp>

In ATTRIB command, sets the divisor in the corresponding transmission direction.

Parameters:
<Dltp> DIV1 | DIV2 | DIV4 | DIV8
*RST: DIV1

Manual operation: See "Divisor (LISTEN to POLL), Divisor (POLL to LISTEN) / Divisor (PCD to PICC), Divisor (PICC to PCD)" on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPL2 <TaDpl2>

Enables support of divisor 2 for POLL to LISTEN (Bit Rate Capability).

Parameters:
<TaDpl2> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "D(P->L=8), D(P->L=4), D(P->L=2) " on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPL4 <TaDpl4>

Enables support of divisor 4 for POLL to LISTEN (Bit Rate Capability).

Parameters:
<TaDpl4> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "D(P->L=8), D(P->L=4), D(P->L=2) " on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPL8 <TaDpl83>

Enables support of divisor 8 for POLL to LISTEN (Bit Rate Capability).

Parameters:
<TaDpl83> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "D(P->L=8), D(P->L=4), D(P->L=2) " on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPPCd <DPPCd>

In ATTRIB command, sets the divisor in the corresponding transmission direction.

Parameters:
<DPPCd> DIV1 | DIV2 | DIV4 | DIV8

Manual operation: See "Divisor (LISTEN to POLL), Divisor (POLL to LISTEN) / Divisor (PCD to PICC), Divisor (PICC to PCD)" on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPPicc <Dpp>

In ATTRIB command, sets the divisor in the corresponding transmission direction.

Parameters:
<Dpp> DIV1 | DIV2 | DIV4 | DIV8

Manual operation: See "Divisor (LISTEN to POLL), Divisor (POLL to LISTEN) / Divisor (PCD to PICC), Divisor (PICC to PCD)" on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DPTListen <Dptl>

In ATTRIB command, sets the divisor in the corresponding transmission direction.

Parameters:
<Dptl> DIV1 | DIV2 | DIV4 | DIV8
*RST: DIV1

Manual operation: See "Divisor (LISTEN to POLL), Divisor (POLL to LISTEN) / Divisor (PCD to PICC), Divisor (PICC to PCD)" on page 53

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DRI <Dri>

Sets DRI.

Parameters:
<Dri> D1 | D2 | D8 | D4 | D16 | D32 | D64
*RST: D1

Manual operation: See "DRI" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DSI <Dsi>

Sets DSI.

Parameters:
<Dsi> D1 | D2 | D8 | D4 | D16 | D32 | D64
*RST: D1

Manual operation: See "DSI" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DSUPported <DSupported>

Determines if DID is supported.

Parameters:
<DSupported> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "DID Supported / CID Supported" on page 52

[:SOURce<hw>]:BB:NFC:CBLock<ch>:DWSelection <DWSelection>

Selects DESELECT or WTX.

Parameters:
<DWSelection> DSEL | WTX
*RST: DSEL

Manual operation: See "DESELECT or WTX" on page 52

[:SOURce<hw>]:BB:NFC:CBLock<ch>:EASupported <EAtqb>

Determines if Extended ATQB is supported.

Parameters:
<EAtqb> 0 | 1 | OFF | ON

Manual operation: See "Extended SENSB_RES / Extended ATQB" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:ESSupported <ESensbres>

Determines if Extended SENSB_RES is supported.

Parameters:
<ESensbres> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Extended SENSB_RES / Extended ATQB" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:FSC <Fsc>

Selects the maximum frame size in bytes.

Parameters:
<Fsc> F16 | F24 | F32 | F40 | F48 | F64 | F96 | F128 | F256
*RST: F32

Manual operation: See "FSC" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:FWI <Fwi>

Determines the FWI which is needed to calculate Frame Waiting Time (FWT).

Parameters:
<Fwi> integer
Range: 1 to 8
*RST: 4

Manual operation: See "FWI" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:GBSelection <GBSelection>

Selects 8-byte block to be read/written.

Parameters:
<GBSelection> integer
Range: 0 to 255
*RST: 1

Example: `BB:NFC:CBLock<CH>:GBSelection 122`
Selects GB number 122.

Manual operation: See "Global Block Selection (ADD)" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:GDAVailable <GDAvailable>

Determines if General data is available.

Parameters:
<GDAvailable> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "General Data" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:IBNumber <IBNumber>

Indicates if a Valid I-block or a Valid R(ACK) block is received.

Parameters:
<IBNumber> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Block Number (for I-block type or R-block type)" on page 50

[:SOURce<hw>]:BB:NFC:CBLock<ch>:KPARameter <KParameter>

Determines the number of historical bytes (T1 to Tk).

Parameters:

<KParameter> integer

Range: 0 to 15
*RST: 0

Manual operation: See "k" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:LREDuction <LReduction>

Selects the length reduction (LR).

Parameters:

<LReduction> LR64 | LR128 | LR192 | LR254

*RST: LR64

Manual operation: See "Length Reduction" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:MBLI <Mbli>

Determines the Maximum Buffer Length Index (MBLI).

Parameters:

<Mbli> integer

Range: 0 to 15
*RST: 1

Manual operation: See "MBLI" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:MFSize <MFSize>

Selects the maximum frame size in bytes.

Parameters:

<MFSize> F16 | F24 | F32 | F40 | F48 | F64 | F96 | F128 | F256

Manual operation: See "FSC" on page 54

[:SOURce<hw>]:BB:NFC:CBLock<ch>:MICHaining <MChaining>

Determines if more information (MI) is chained.

Parameters:

<MChaining> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "MI (more information) Chaining" on page 55

[:SOURce<hw>]:BB:NFC:CBLock<ch>:MTR0 <MTr0>

Sets the minimum value of TR0 supported.

Parameters:
<MTr0> TR00 | TR01 | TR02
*RST: TR00

Manual operation: See "Minimum TR0, TR1, TR2" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:MTR1 <MTr1>

Sets the minimum value of TR1 supported.

Parameters:
<MTr1> TR10 | TR11 | TR12
*RST: TR10

Manual operation: See "Minimum TR0, TR1, TR2" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:MTR2 <MTr2>

Sets the minimum value of TR2 supported.

Parameters:
<MTr2> TR20 | TR21 | TR22 | TR23
*RST: TR20

Manual operation: See "Minimum TR0, TR1, TR2" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:N2FType <NFType>

Determines which protocol or platform the NFCID2 format is for.

Parameters:
<NFType> NDEP | TT3
*RST: NDEP

Manual operation: See "NFCID2 Format Type" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NACK <Nack>

Determines the value of NACK.

Parameters:
<Nack> NCK1 | NCK0 | NCK4 | NCK5
*RST: NCK0

Manual operation: See "NACK" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NAD <Nad>

Determines the value of NAD.

Parameters:
<Nad> integer

Manual operation: See "NAD" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NBLocks <NBlock>

Determines the number of blocks.

Parameters:
<NBlock> integer
Range: 1 to dynamic
*RST: 1

Manual operation: See "Number of Blocks" on page 58

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NFOLlowing <NFollowing>

Determines if NAD is following.

Parameters:
<NFollowing> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "NAD following" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NID0 <Nfcid0>

Determines the entire value of NFCID0.

Parameters:
<Nfcid0> integer

Manual operation: See "NFCID0 (hex) / PUPI (hex)" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NID1 <Nfcid1>

Determines the entire value of NFCID1.

Parameters:
<Nfcid1> integer

Manual operation: See "NFCID1 (hex) / UID (hex)" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NID2 <Nfcid2>

Determines the entire value of NFCID2. Is a virtual parameter for SCPI to set the NFCID2 either in NFC-DEP or Type 3 Tag mode.

Parameters:
<Nfcid2> integer

Manual operation: See "NFCID2 (hex)" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NNComplete <Nfcid1NotCom>

Determines whether NFCID1 is complete or not.

Parameters:
<Nfcid1NotCom> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "NFCID1 not complete / UID not complete" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NOAPplications <NOApplication>

Determines the number of applications.

Parameters:
<NOApplication> integer
Range: 0 to 15
*RST: 1

Manual operation: See "Number of Applications" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NOSLots <NOSlots>

Determines the number of slots.

Parameters:
<NOSlots> S1 | S2 | S4 | S8 | S16
*RST: S1

Manual operation: See "Number of Slots" on page 58

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NSERvices <NService>

Sets the number of services.

Parameters:
<NService> integer
Range: 1 to 16
*RST: 1

Manual operation: See "Number of Services" on page 58

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NSIZe <Nfcid1sz>

Determines the size of NFCID1.

Parameters:
<Nfcid1sz> SINGle | DOUBle | TRIPle
*RST: SINGle

Manual operation: See "NFCID1 Size / UID Size" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:NSUPported <NSupport>

Determines if NAD is supported.

Parameters:
<NSupport> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "NAD Supported" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PAD0 <Pad0>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PAD1 <Pad1>
[:SOURce<hw>]:BB:NFC:CBLock<ch>:PAD2 <Pad2>

Sets the value of PAD0/PAD1/PAD2 (hex).

Parameters:
<Pad2> integer
*RST: #H00

Manual operation: See "PAD0, PAD1, PAD2" on page 59

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PDUType <PDUType>

Selects the type of PDU.

Parameters:
<PDUType> INFO | ANACk | SUPer

Manual operation: See "PDU Type" on page 59

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PLIN <PLIndication>

Only used when DESELCT/WTX is set to WTX. Determines Power Level Indication.

Parameters:
<PLIndication> integer
Range: 0 to 3
*RST: 1

Manual operation: See "Power Level Indication" on page 59

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PLIR <PLIndicator>

Sets the Power Level Indicator.

Parameters:
<PLIndicator> integer
Range: 0 to 3
*RST: 1

Manual operation: See "Power Level Indicator" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PNI <Pni>

Only used with PDU type Information. Determines Packet Number Information (PNI).

Parameters:
<Pni> integer
Range: 0 to 3
*RST: 1

Manual operation: See "PNI" on page 59

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PSELection <PSelection>

Selects if the first or second packet of the SECTOR_SELECT command is transmitted.

Parameters:
<PSelection> PCK1 | PCK2
*RST: PCK1

Manual operation: See "Packet Selection" on page 59

[:SOURce<hw>]:BB:NFC:CBLock<ch>:PUPI <PUPI>

Determines the entire value of PUPI.

Parameters:
<PUPI> integer

Manual operation: See "NFCID0 (hex) / PUPI (hex)" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:RC <Rc>

Indicates the Request Code (RC).

Parameters:
<Rc> NSCI | SCIR | APFS
*RST: NSCI

Manual operation: See "RC" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:RTOX <Rtox>

Determines the response timeout extension request value (RTOX).

Parameters:
<Rtox> integer
Range: 1 to 59
*RST: 1

Manual operation: See "RTOX" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SCMD <SCmd>

Selects the cascade level (CL) of the NFCID1 requested by the NFC Forum Device in Poll Mode.

Parameters:
<SCmd> CL1 | CL2 | CL3
*RST: CL1

Manual operation: See "SEL_CMD / SEL" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SCODe <SCode>

Sets the System Code.

Parameters:
<SCode> integer
*RST: #Hffff

Manual operation: See "SC" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SEGSelection <SegmentSel>

Selects a segment to be read.

Parameters:
<SegmentSel> integer
Range: 0 to 15
*RST: 1

Manual operation: See "Segment Selection (ADD)" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SEL <SELect>

Selects the cascade level (CL) of the UID.

Parameters:
<SELect> CL1 | CL2 | CL3

Manual operation: See "SEL_CMD / SEL" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SENRequired <SENRequired>

Determines whether a suppression of EoS (End of Sequence)/SoS (Start of Sequence) is required or not.

Parameters:
<SENRequired> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Suppression of EoS,SoS Not Required" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SERVice<st>:AATTributes <AAttributes>

Enables the Service Code List Configuration.

Parameters:
<AAttributes> AARW | AARO
*RST: AARW

Manual operation: See "Service Code List..." on page 61

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SERVice<st>:SNUMber <SNumber>

Determines the number of services.

Parameters:
<SNumber> integer
Range: 0 to 1023
*RST: 0

Manual operation: See "Service Code List..." on page 61

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SF1 <SFlag1>

Sets the status flag 1 to specify a Type 3 tag's error condition. A value of 0 signals a successful execution, values different from 0 indicate errors.

Parameters:
<SFlag1> integer

Manual operation: See "Status Flag 1, Status Flag 2" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SF2 <SFlag2>

Sets the status flag 2 to specify a Type 3 tag's error condition. A value of 0 signals a successful execution, values different from 0 indicate errors.

Parameters:
<SFlag2> integer

Manual operation: See "Status Flag 1, Status Flag 2" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SFGI <Sfgi>

Determines the Start-up Frame Guard Time (SFGT).

Parameters:

<Sfgi> integer

Range: 0 to 8
*RST: 0

Manual operation: See "SFGI" on page 61

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SNO <SNO>

Only available when packet selection is set to Packet2. Determines the sector number.

Parameters:

<SNO> integer

Range: 0 to 254
*RST: 1

Manual operation: See "SNo" on page 61

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SNUMber <SNumber>

Determines the slot number.

Parameters:

<SNumber> SN2 | SN3 | SN4 | SN5 | SN6 | SN7 | SN8 | SN9 | SN10 | SN11 | SN12 | SN13 | SN14 | SN15 | SN16

*RST: SN2

Manual operation: See "Slot Number" on page 61

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SPLower <SPLower>

Determines the bit count.

Parameters:

<SPLower> integer

Range: 0 to 7
*RST: 0

Manual operation: See "SEL_PAR_LOWER" on page 61

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SPUPper <SPUpper>

SEL_PAR_UPPER determines the number of full bytes of the SDD_REQ part.

Parameters:
<SPUpper> integer
Range: 2 to 6
*RST: 2

Manual operation: See "SEL_PAR_UPPER" on page 60

[:SOURce<hw>]:BB:NFC:CBLock<ch>:SSNRequired <SSNRequired>

Determines whether a suppression of EoS (End of Sequence)/SoS (Start of Sequence) is required or not.

Parameters:
<SSNRequired> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Suppression of EoS,SoS Not Required" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:T1TConfigured <T1TPConfigured>

Determines whether Type 1 Tag platform is configured or not.

Parameters:
<T1TPConfigured> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Type 1 Tag Platform Configured" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:T1TK <T1totk>

For number of historical bytes k greater than 0: sets the historical bytes T1 to Tk.

Parameters:
<T1totk> integer

Manual operation: See "T1 to Tk" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:TAIPicc <TNAIPicc>

Sets the total number of applications in the PICC (Proximity Inductive Coupling Card), i.e. in the NFC Forum Device in listener mode.

Parameters:
<TNAIPicc> integer
Range: 0 to 15
*RST: 1

Manual operation: See "Total No. Apps in the PICC" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:TSN <Tsn>

Indicates the TSN (Time Slot Number).

Parameters:

<Tsn> TSN1 | TSN2 | TSN4 | TSN8 | TSN16
*RST: TSN4

Manual operation: See "Number of Time Slots" on page 58

[:SOURce<hw>]:BB:NFC:CBLock<ch>:UID <UID>

Determines the entire value of UID.

Parameters:

<UID> integer

Manual operation: See "NFCID1 (hex) / UID (hex)" on page 56

[:SOURce<hw>]:BB:NFC:CBLock<ch>:UNComplete <UIDNotCom>

Determines whether UID is complete or not.

Parameters:

<UIDCom> 0 | 1 | OFF | ON

Manual operation: See "NFCID1 not complete / UID not complete" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:USIZe <UIDsz>

Determines the size of UID.

Parameters:

<UIDsz> SINGle | DOUBle | TRIPle

Manual operation: See "NFCID1 Size / UID Size" on page 57

[:SOURce<hw>]:BB:NFC:CBLock<ch>:WT <Wt>

Sets the Waiting Time (WT) that codes the Response Waiting Time (RWT).

Parameters:

<Wt> integer
Range: 0 to 8
*RST: 1

Manual operation: See "WT" on page 62

[:SOURce<hw>]:BB:NFC:CBLock<ch>:WTXM <Wtxm>

Determines the WTXM. - Only used when DESELCT/WTX is set to WTX.

Parameters:
<Wtxm> integer
Range: 1 to 59
*RST: 1

Manual operation: See "WTXM (INF field of S(WTX) request, response) " on page 62

7.7 Modulation settings

[:SOURce<hw>]:BB:NFC:MSET:BOUTput <BOutput>

When activated the signal at the baseband output changes between 0% and 100% voltage to be able to control the Reference Listeners.

Parameters:
<BOutput> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "Baseband Output" on page 36

[:SOURce<hw>]:BB:NFC:MSET:BRATe?

Returns the resulting bitrate for the current settings.

Return values:
<BRate> float

Usage: Query only

Manual operation: See "Bit Rate" on page 34

[:SOURce<hw>]:BB:NFC:MSET:SLOPe <ESlope>

Determines the transition between the modulated and unmodulated parts (Edge/ Slope).

Parameters:
<ESlope> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "Slope" on page 35

[:SOURce<hw>]:BB:NFC:MSET:IMODulation <IModulation>

When selected, inverse modulation will be used.

Parameters:
<IModulation> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Inverse Modulation" on page 35

[:SOURce<hw>]:BB:NFC:MSET:MDEPth <MDepth>

Sets the modulation depth in %.

Parameters:
<MDepth> float
Range: 0 to 100
Increment: 0.01
*RST: 100

Manual operation: See "Modulation Depth" on page 35

[:SOURce<hw>]:BB:NFC:MSET:MINDex <MIndex>

Defines the signal's modulation index in %.

Parameters:
<MIndex> float
Range: 0 to 100
Increment: 0.01
*RST: 12

Manual operation: See "Modulation Index" on page 34

[:SOURce<hw>]:BB:NFC:MSET:OSRise <ORise>

Determines the size of the overshoot after the rising slope.

Parameters:
<ORise> float
Range: 0 to 42
Increment: 0.01
*RST: 0

Manual operation: See "Overshoot Rising Slope (VOU)" on page 38

[:SOURce<hw>]:BB:NFC:MSET:RCURve <RCurve>

When activated an "RLC curve" is applied to the signal, otherwise a linear ramp is used.

Parameters:

<RCurve> 1 | ON | 0 | OFF

*RST: 1

Manual operation: See "RLC curve" on page 37

[:SOURce<hw>]:BB:NFC:MSET:SRATe <SRate>

Enters the sample rate, i.e. the time resolution of the generated signal.

Parameters:

<SRate> float

Range: depends on protocol mode to dynamic
Increment: 0.001
*RST: 20E6

Manual operation: See "Sample Rate" on page 36

[:SOURce<hw>]:BB:NFC:MSET:TFALl <TFall>

Defines the fall time (90 to 5 %) in µs.

Parameters:

<TFall> float

Range: 0 to dynamic
Increment: 0.01
*RST: 1

Manual operation: See "Tfall 90-10%/Tfall 90-5% (t1-t2)" on page 38

[:SOURce<hw>]:BB:NFC:MSET:TLOW <TLow>

Defines the signals low time (below 5%) in µs.

Parameters:

<TLow> float

Range: 0.4 to dynamic
Increment: 0.01
*RST: 1.9

Manual operation: See "Tlow (t2)" on page 35

[:SOURce<hw>]:BB:NFC:MSET:TRISe <TRise>

Defines the signals rise time (5 to 90 %) in µs.

Parameters:

<TRise> float

Range: dynamic to dynamic
Increment: 0.01
*RST: 0.6

Example: See Chapter 7.1, "Programming example", on page 67.

Manual operation: See "Trise 10-90%/Trise 5-90% (t3)" on page 38

[:SOURce<hw>]:BB:NFC:MSET:USFall <OFall>

Determines the size of the undershoot (ringing) after the falling slope.

Parameters:

<OFall> float

Range: 0 to 42
Increment: 0.01
*RST: 0

Manual operation: See "Undershoot Falling Slope (VOU)" on page 38

7.8 Clipping settings

[:SOURce<hw>]:BB:NFC:CLIPping:LEVel <Level>

Sets the limit for clipping.

Parameters:

<Level> integer

Range: 1 to 100
*RST: 100

Manual operation: See "Clipping Level " on page 63

[:SOURce<hw>]:BB:NFC:CLIPping:STATe <State>

Switches baseband clipping on and off.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "Clipping State" on page 63

7.9 Trigger settings

[:SOURce<hw>]:BB:NFC:TRIGger:ARM:EXECute

Stops signal generation; a subsequent internal or external trigger event restarts signal generation.

Usage: Event

Manual operation: See "Arm" on page 27

[:SOURce<hw>]:BB:NFC:TRIGger:EXECute

Executes trigger manually.

Usage: Event

Manual operation: See "Execute Trigger" on page 27

[:SOURce<hw>]:BB:NFC:TRIGger[:EXTernal<ch>]:DELay <Delay>

Sets the trigger signal delay in samples on external triggering or on internal triggering via the second path (if applicable).

Parameters:

<Delay> float

Range: 0 to 65535
Increment: 0.01
*RST: 0

Manual operation: See "External Inhibit/Trigger Inhibit" on page 29

[:SOURce<hw>]:BB:NFC:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in samples.

Parameters:
<Inhibit> integer
Range: 0 to 67108863
*RST: 0

Manual operation: See "External Delay/Trigger Delay" on page 29

[:SOURce<hw>]:BB:NFC:TRIGger:EXTernal:SYNChronize:OUTPut <Output>

Enables signal output synchronous to the trigger event.

Parameters:
<Output> 1 | ON | 0 | OFF
*RST: 1

Manual operation: See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 28

[:SOURce<hw>]:BB:NFC:TRIGger:RMODe?

Queries the status of signal generation.

Return values:
<RMode> STOP | RUN

Usage: Query only

Manual operation: See "Running/Stopped" on page 26

[:SOURce<hw>]:BB:NFC:TRIGger:SLENgth <Slength>

Defines the length of the signal sequence to be output in the `SINGle` trigger mode.

Parameters:
<Slength> integer
Range: 1 to 4294967295.0
*RST: 1

Manual operation: See "Signal Duration" on page 26

[:SOURce<hw>]:BB:NFC:TRIGger:SLUNit <Slunit>

Defines the unit for the entry of the signal sequence length.

Parameters:
<Slunit> SEQuence | SAMPle
*RST: SEQuence

Manual operation: See "Signal Duration Unit" on page 26

[:SOURce<hw>]:BB:NFC:TRIGger:SOURce <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the local or global connectors
  - `EGT1|EGT2`: External global trigger
  - `EGC1|EGC2`: External global clock
- In primary-secondary instrument mode, the external baseband synchronization signal (`BBSY`)
- `OBASeband|BEXTernal|EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators.
  The R&S SMM100A accepts these values and maps them automatically as follows:
  `EXTernal = EGT1`, `BEXTernal = EGT2`, `OBASeband = INTA`

Parameters:

<Source> INTernal|EGT1|EGT2|EGC1|EGC2|EXTernal|BBSY

*RST: INTernal

Example: `BB:NFC:TRIG:SOUR INT`
Selects an internal trigger source.

Manual operation: See "Source" on page 28

[:SOURce<hw>]:BB:NFC[:TRIGger]:SEQuence <Sequence>

Selects a requlat trigger mode.

Parameters:

<Sequence> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Manual operation: See "Mode" on page 26

[:SOURce<hw>]:BB:NFC:TRIGger:TIME:DATE <Year>, <Month>, <Day>

Sets the date for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this date via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Year> integer

Range: 1980 to 9999

<Month> integer

Range: 1 to 12

<Day> integer
Range: 1 to 31

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMM100A user manual.

Manual operation: See "Trigger Time" on page 27

[:SOURce<hw>]:BB:NFC:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>

Sets the time for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this time via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:
<Hour> integer
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 0 to 59

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMM100A user manual.

Manual operation: See "Trigger Time" on page 27

[:SOURce<hw>]:BB:NFC:TRIGger:TIME[:STATe] <State>

Activates time-based triggering with a fixed time reference. If activated, the R&S SMM100A triggers signal generation when its operating system time matches a specified time.

Specify the trigger date and trigger time with the following commands:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:DATE`

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:TIME`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:
<State> 1 | ON | 0 | OFF

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMM100A user manual.

Manual operation: See "Time Based Trigger" on page 27

7.10 Marker settings

[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:MODE <Mode>

Parameters:

<Mode> PULSe | RESTart | PATTern | RATio

PULSe
A regular marker signal is generated. The frequency is derived by dividing the sample rate by the divider, which is input with the command `[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 115.

RESTart
A marker signal is generated on every repetition of the complete frame sequence.

PATTern
A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 64 bits and is defined with the command `[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PATTern` on page 115

RATio
A marker signal corresponding to the Time Off / Time On specifications in the commands `[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:ONTime` on page 115 and `[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:OFFTime` on page 115

*RST: RESTart

Manual operation: See "Mode" on page 31

[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:ONTime <OnTime>
[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:OFFTime <OffTime>

Sets the number of sampels in a period (ON time + time, during which the marker signal on the marker output is OFF) for marker `RATio`.

Parameters:

<OffTime> integer
Range: 1 to 16777215
*RST: 1

Manual operation: See "Mode" on page 31

[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PATTern <Pattern>, <BitCount>

A marker signal that is defined by a bit pattern is generated.

Parameters:

<Pattern> numeric
*RST: #H2

<BitCount> integer
Range: 1 to 64
*RST: 2

Manual operation: See "Mode" on page 31

[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

Sets the divider for the pulsed marker signal.

Parameters:

<Divider> integer
Range: 2 to 1024
*RST: 2

Example:
```
BB:NFC:TRIG:OUTP2:PULS:DIV 2
```

Manual operation: See "Mode" on page 31

[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:PULSe:FREQuency?

Queries the pulse frequency of the pulsed marker signal.

Return values:

<Frequency> float
Range: 0.0 to max

Example:
```
BB:NFC:TRIG:OUTP2:MODE PULS
BB:NFC:TRIG:OUTP2:PULS:DIV 4
BB:NFC:TRIG:OUTP2:PULS:FREQ?
```
Response: 600.000 Hz

Usage: Query only

Manual operation: See "Mode" on page 31

[:SOURce<hw>]:BB:NFC:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of the signal units.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 1
*RST: 0
Default unit: Samples

Manual operation: See "Delay" on page 31

7.11 Clock settings

[:SOURce<hw>]:BB:NFC:CLOCk:SOURce <Source>

Selects the clock source:

- `INTernal`: Internal clock reference
- `ELCLock`: External local clock
- `EXTernal = ELCLock`: Setting only
  Provided for backward compatibility with other Rohde & Schwarz signal generators

Parameters:

<Source> INTernal

*RST: INTernal

Example: `BB:NFC:CLOC:SOUR INT`
Selects an internal clock reference.

Manual operation: See "Clock Source" on page 32

Glossary: List of terms and abbreviations

A

Active Communication: A communication mode in which each device generates its own RF field to send a message to another device.

Activity: A process within an NFC Forum Device with well defined pre-conditions and post-conditions, as defined in [ACTIVITY]. An Activity can only start when its pre-conditions are fulfilled. When an Activity ends, its post-conditions are fulfilled.

AID: Application ID

ASK: Amplitude Shift Keying

ATN: Attention.

B

BCC: UID CLn check byte for NFC-A

bd: Bit Duration

BPSK: Bi Phase Shift Keying

C

Card Emulator: A role of an NFC Forum Device, reached when an NFC Forum Device in Listen Mode has gone through a number of Activities and in which the NFC Forum Device behaves as one of the Technology Subsets.

CID: Cryptogram Information Data

CLn: Cascade Level n (1<=n<=3)

Command: An instruction from one device to another device in order to move the other device through a state machine.

Connectionless Transport: An unacknowledged data transmission service with minimal protocol complexity.

Correct Frame: A frame without Transmission Error.

CRC: Cyclic Redundancy Check, a checksum appended within the data segment before transmission, and verified afterwards by the recipient to detect transmission errors

CRC_A: CRC error detection code for NFC-A.

CRC_B: CRC error detection code for NFC-B.

CRC_F: CRC error detection code for NFC-F.

CT: Command type.

D

DID: Device Identification Number.

DRI: Codes the bit rate in communication direction from Target to Initiator.

DSI: Codes the bit rate in communication direction from Initiator to Target.

E

EoD: End of Data.

EoF: End of Frame.

EoS: End of sequence.

F

fc: Carrier frequency.

FSC: Maximum frame size (in bytes).

FWI: Frame waiting time integer.

FWT: Frame waiting time.

I

IC: Integrated Circuit

Initiator: A role of an NFC Forum Device reached when an NFC Forum Device in Poll Mode has gone through a number of Activities; in this mode the NFC Forum Device communicates using the NFC-DEP Protocol.

ISO-DEP Protocol: Half-duplex block transmission protocol defined in Section 13 and based on [ISO/IEC_14443] and [EMV_CLESS].

L

Listen Frame: A frame sent by an NFC Forum Device in Listen Mode.

Listen Mode: Initial mode of an NFC Forum Device when it does not generate a carrier; in this mode the NFC Forum Device listens for the RF field of another device.

lsb: least significant bit

LSB: Least Significant Byte

M

MBL: Maximum Buffer Length

MBLI: Maximum Buffer Length Index

MRT: Maximum response time

MRTI: Maximum response time information

msb: Most Significant Bit

MSB: Most Significant Byte

N

NAD: Node Addressing

NDEF: NFC data exchange format.

NFC: Near Field Communication

NFC Forum Device: A device that supports the following Modus Operandi: Initiator, Target, and Reader/Writer. It may also support Card Emulator.

NFC Tag: A contactless tag or (smart) card supporting NDEF over Passive Communication.

NFC-A: Near Field Communication - Type A Technology

NFC-B: Near Field Communication - Type B Technology

NFC-DEP Protocol: Half-duplex block transmission protocol defined in Section 14 and based on [ISO/IEC_18092].

NFC-F: Near Field Communication - Type F Technology

NFCID0: NFC-B identifier of the NFC Forum Device.

NFCID1: NFC-A identifier of the NFC Forum Device in the passive communication mode.

NFCID2: NFC-F identifier of the NFC Forum Device in the passive communication mode.

NFCID3: NFCIP-1 identifier of the NFC Forum Device. NFCID3 is always 10 byte long.

NFCIP-1: Near field communication interface and protocol as specified in [ISO/IEC_18092].

NRZ-L: Non-Return to Zero (L for Level)

O

OOK: On-Off Keying

Operating Field: The magnetic field created by an NFC Forum Device in poll mode within the operating volume.

Operating Volume: The three-dimensional space, as defined by the NFC Forum, in which an NFC Forum Device in Poll Mode can communicate with an NFC Forum Device in Listen Mode.

P

Passive Communication: A communication mode in which one device generates an RF field and sends Commands to a second device. To respond, this second device uses load modulation (i.e., it does not generate an RF field but it draws more or less power from the RF field).

PCB: Protocol Control Byte.

PCD: Proximity Coupling Device.

PDU: Protocol Data Unit.

PICC: Proximity Inductive Coupling Card

Poll Command: A Command to query an NFC Forum Device in Listen Mode or an NFC Forum Tag:
- ALL_REQ or SENS_REQ Command for NFC-A
- ALLB_REQ or SENSB_REQ Command for NFC-B
- SENSF_REQ Command for NFC-F

Poll Frame: A frame sent by an NFC Forum Device in Poll Mode.

Poll Mode: Initial mode of an NFC Forum Device when it generates a carrier and probes (“polls”) for other devices.

Protocol Error: A Semantic Error or Syntax Error.

PUPI: Pseudo-Unique PICC Identifier available for EMV Type B.

R

Reader/Writer: Role of an NFC Forum Device reached when an NFC Forum Device in Poll Mode has gone through a number of Activities. In this mode, the NFC Forum Device behaves like a legacy contactless reader and uses Commands from one of the Technology Subsets.

Response: Information sent from one device to another device upon receipt of a Command. The information received by the other device should allow this other device to continue the data exchange.

RRDD: Reader-Reader Data Delay

RWT: Response Waiting Time

S

SDD: Single Device Detectiond

Semantic Error: A Correct Frame with no Syntax Error is received when it is not expected.

SFGI: Start-up Frame Guard Time Integer.

SFGT: Start-up Frame Guard Time

SoD: Start of Data

SoF: Start of Frame

SoS: Start of Sequence

Syntax Error: A Correct Frame is received with an invalid content. In this case, the coding of the Command or the block within the frame is not consistent with this specification.

T

Target: Role of an NFC Forum Device, reached when the NFC Forum Device has gone through a number of Activities in which the NFC Forum Device communicates using the NFC-DEP Protocol.

Technology: A group of transmission parameters defined by the NFC standard that make a complete communication protocol. A non-exhaustive list of transmission parameters is: RF carrier, communication mode, bit rate, modulation scheme, bit level coding, frame format, protocol, and Command set. NFC defines three groups and therefore three Technologies: NFC-A, NFC-B, and NFC-F. The three Technologies use

the same RF carrier (13.56 MHz). Each Technology uses its own modulation scheme, bit level coding and frame format, but may have the same protocol and Command set.

Technology Subset: A legacy platform supporting a subset of a Technology. A Technology Subset supports at least the Poll Command of the Technology. The four Technology Subsets described in the NFC Digital Protocol Technical Specification are:
- Type 1 Tag platform, which uses a particular subset of NFC-A, excluding anti-collision.
- Type 2 Tag platform, which uses a particular subset of NFC-A, including anti-collision.
- Type 3 Tag platform, which uses a particular subset of NFC-F, including anti-collision.
- Type 4 Tag platform, which uses a particular subset of NFC-A or NFC-B, including anti-collision.

Timeout Error: No Response has been received within the Response Waiting Time (RWT).

Transmission Error: An incorrect frame is received. In this case, the signal modulation, the bit coding, the frame format, the timing, or the checksum is not consistent with this specification.

U

UID: Unique IDentifier available for EMV Type A.

V

Valid Block, Valid PDU: A block or PDU without Protocol Error within a Correct Frame.

Valid Command, Valid Response: A Command or Response without Protocol Error within a Correct Frame.

W

WT: Waiting Time, parameter to code RWT

WTX: Waiting Time Extension, containing 1 byte long INF field.

List of commands

Index

S

T

U

V

W