

Inhalt

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PRELIMINARY

1 Overview

1.1 *Pin configuration*

1.2 *Quick start*

PRELIMINARY

2 TN9000 user interface

2.1 Data transmission

Transmitting data from a local device to a remote device is in general accomplished by writing

- a header (operator) specifying the destination (and the source),
- the data to be transmitted and
- a CRC_CCITT checksum of header and data

The CRC checksum and the header can be omitted under certain circumstances.

2.1.1 Source-/Destination Header (Operator)

The general form of the source-/destination header is:

`sa#sp>>da#dp` for transmitting data from device sa, port sp to device da, port dp
 (Data enter the local unit (TN9000) via the user port (hardware) which is divided into several software ports. Data leave the remote unit (e.g. TN9040) via the user port (hardware) which is also divided into several software ports.)

or

`sa#sp>da` for transmitting data/commands from device sa, port sp to device da
 (Data/Commands enter the local unit (TN9000) via the user port (hardware) which is divided into several software ports. The data/commands are destined for the command interpreter of the remote unit itself.)

sa: source address. This has to be the address of the local device
 sp: source port (software port), default: 00
 da: destination address, default: 00 (for TN9000)
 dp: destination port (software port), default: 00

The four parameters sa, sp, da, dp are 8 bit hexadecimal numbers written in 2 characters (00...ff)
 Each parameter can be omitted. In this case default values are used instead. The following table gives an overview over several abbreviated headers and it's full representation

Shortcut	Equivalent full header	Comment
<code>sa>>da#dp</code>	<code>sa#00>>da#dp</code>	
<code>>>da#dp</code>	<code>sa#00>>da#dp</code>	
<code>>>da</code>	<code>sa#00>>da#00</code>	
<code>>>#dp</code>	<code>sa#00>>00#dp</code>	
<code>#sp>>dp</code>	<code>sa#sp>>00#dp</code>	
<code>#sp>></code>	<code>sa#sp>>00#00</code>	
<code>>da</code>	<code>sa#00>da</code>	
<code>#sp></code>	<code>sa#sp>00</code>	

Example:

Write:	<code>>>01#07 Test</code>	Send the text "Test" to device 01, port 07
Read:		No reply, if handshake is disabled

Write:	<code>>>01 Test</code>	Send the text "Test" to device 01, port 00
Read:		No reply, if handshake is disabled

2.1.2 CRC

A16 bit CRC (Cyclic Redundancy Check) can be used to detect transmission errors at the user interface. The TN9xxx uses the CRC_CCITT with the generator polynomial $X^{16}+X^{12}+X^5+1$.

You may append a CRC, which runs over header and data, surrounded by squared bracket to every transmit sequence. In case of a transmission error you get an error message and no data are transmitted. The CRC has to be written as a 16 bit hexadecimal number using 4 characters (0000...ffff).

Example:

Write:	>>01 Test[0fd8]	Send the text "Test" to device 01 (port 00), using the CRC 0fd8
Read:		No reply, if handshake is disabled
Write:	>>01 Test[1234]	Send the text "Test" to device 01 (port 00), using the wrong CRC 1234
Read:	Error 110: CRC wrong	No data are sent

2.1.3 Handshake

When data are transmitted to the TN9000 user port you may get a handshake from the TN9000 (local unit) and/or the target unit (remote unit, e.g. TN9040). The handshake contains the CRC of the received data. The type of handshake can be selected using the command

Write:	Config Userport HdShk <n>	n = 0: No handshake n = 1: Only handshake from the local unit n = 2: Only handshake from the remote unit n = 3: Handshake from local and remote unit
Read:	OK	

Example (local and remote handshake enabled):

Write:	>>01 Test	Send the text "Test" to device 01 (port 00)
Read:	00> Recvd 0fd8	Handshake from local unit (address: 00)
Read:	01> Recvd 0fd8	Handshake from remote unit (address: 01)

2.1.4 SrcDest header when receiving data

Received data are output at the user port. In front of the data a SrcDest header is generally added. The type of header which is added at received data can be selected using the command

Write:	Config Userport HeaderOut <n>	0: No header 1: Short source-/destination header (defaults omitted) 2: Full source-/destination header (xx#xx>>xx#xx) 3: Full source-/destination header plus receiver info and decode info 4: Automatic: Use setting in received datasets
Read:	OK	

Each dataset contains the information of a default output header. If you use the HeaderOut option 4 (automatic) the type of header which is proposed in the dataset is added. If you use another HeaderOut option (0..3) you may override the default setting which is included in the received dataset.

Example:

If you receive the text "Test" your output at the (local) user port may be one of the following depending on your setting of the HeaderOut option

Read:	Test	HeaderOut = 0
Read:	01>> Test	HeaderOut = 1
Read:	01#00>>00#00 Test	HeaderOut = 2
Read:	01#00>>00#00 {cb50 0 31.12.2007 23:59:59 f0 s} Test	HeaderOut = 3

2.1.5 SrcDest header at the receiving (remote) unit

When you transmit data to a remote unit (base station) the dataset contains the information which type of SrcDest header should be added at the receiving unit. You select this default header using the command

Write:	Config Userport HeaderOutRmt <n>	0: No header 1: Short source-/destination header (defaults omitted) 2: Full source-/destination header (xx#xx>>xx#xx) 3: Full source-/destination header plus receiver info and decode info 4: Automatic: Same as 1
Read:	OK	

If the HeaderOut option of the receiving unit is set to 4 (automatic) the header proposed in the dataset is added to the received data.

2.2 Configuration: The commands

2.2.1 Overview

Q	: Query
LOGIN <Level> <Password>	: Login at accesslevel <Level>
LOGOUT	: Logout
CHGP <Level> <NewPassword> <NewPassword>	: Change password
RESTART	: Restart TN9040 (Software Reset)
SAVE <what to save>	: Save (e.g. settings) to flash
LOAD <what to read>	: Load (e.g. settings) from flash
RESET <what to reset>	: Reset something (e.g. settings)
T	: Set Time
?T	: Query Time
D	: Set Date
?D	: Query Date
CONFIG <Type> <Param> <Data>	: Configure system setup
?CONFIG <Type> <Param>	: Show configure system
FSH <Addr> <Param> <Data>	: Configure FSH setup
?FSH <Addr> <Param> <Data>	: Show FSH setup
FSHC <Addr> <Byte1><Byte2><Byte3><Byte4>	: FSH command
UPDATE:	: Start Update
SECURITY	: Some security settings
TEST	: For test purpose only

2.2.2 Description

Command	">" or ">>"
Description	Transmit operator (header) for transmitting commands or data to a target unit
AccLevel	0
Parameters	-
Note	

Command	"Q"
Description	Query
AccLevel	0
Parameters	-
Reply	TN9000 v2.0 14 xx xx xx xx xx xx tt xx: Bytes of serial number tt: Hardware type code (10)

Command:	"LOGIN <Level> <Code>"		
Description	Login with access level <Level>		
AccLevel	0		
Parameters	- Level: accesslevel		
	- Code:password (max. 10 characters)		
	Parameter	Valid data	Description
	Level	1..3 (5)	Access level

	Code	Password for access level <Level>
Reply	- "Hi ! - "access denied !"	
e.g.	"Login 2 MyPassword "	
Note	Default password is "123" for Level 1 and 2	

Command	"LOGOUT"
Description	Logout (set access level to 0)
AccLevel	0
Parameters	-
Reply	"OK"

Command:	"CHGP <Level> <NewPassword> <NewPassword>"		
Description	Change password for access level <Level>		
AccLevel	At least <Level>		
Parameters	- Level: Access level		
	- NewPassword: New password for access level <Level> (max. 10 characters)		
	Parameter	Valid data	Description
	Level	1..3	Access level
	NewPassword	Up to 10 characters	New password for access level <Level>
Reply	- "password changed		
	- "access denied !"		
Note	Changes are NOT saved to flash. Use Command "SAVE <settings>"		
e.g.	"Chgp 2 potato potato"		

Command	"RESTART"
Description	Restart TN9000 (Software Reset)
AccLevel	0
Parameters	-
Reply	"Bye Bye"

Command:	"SAVE <what to save>"		
Description	Save something from RAM to flash		
AccLevel	3		
Parameters	- Param: What to save		
	Parameter	Valid data	Description
	Param	"settings"	Save some settings of the TN9000
Reply	- "OK" - "error flash read", "error flash write"		
e.g.	"Save settings"		

Command:	"LOAD <what to read>"		
Description	Load something from flash to RAM		
AccLevel	3		
Parameters	- Param: What to load		
	Parameter	Valid data	Description
	Param	"settings"	Load some settings of the TN9000
Reply	- "OK" - "Reset" - "error flash read", "error flash write"		
e.g.	"Load settings"		

Command:	"RESET <Param>"		
Description	Reset something (in RAM)		
AccLevel	4		
Parameters	- Param: What to reset		
	Parameter	Description	
	Settings	Reset some settings of the TN9000	
	Data	Erase data	
Reply	"OK"		
Note	Changes to settings are NOT saved to flash. Use Command "SAVE <..>"		
e.g.	"RESET settings"		

Command	"T <hh.mm.ss>"
Description	Set Time
AccLevel	?
Parameters	- hh: hour - mm:minute -ss:second
Reply	"Parameters changed" (or "out of range")
Note	

Command	"?T"
Description	Query Time
AccLevel	0
Parameters	-
Reply	"hh.mm.ss"

Command	"D <dd.mm.yyyy>"
Description	Set Date
AccLevel	?
Parameters	- dd: day - mm: month - yyyy: year
Reply	"Parameters changed" (or "out of range")
Note	

Command	"?D"
Description	Query Date
AccLevel	0
Parameters	-
Reply	"dd.mm.yyyy"

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Command:	"FSH <Addr> <Param> <Data>"		
Description	Configure FSH setup		
AccLevel	?		
Parameters	- Addr: FSH Address (hexadecimal) (01..ff) or "ALL"		
	- Param: Parameter to configure		
	- Data: Value		
	Addr	Param	Data
01..FF	Log	"ON/OFF" or "1/0"	
ALL	Log	"ON/OFF" or "1/0"	
Reply	"OK"		
Note	Changes are NOT saved to flash. Use Command "SAVE Settings"		
e.g.	Command		Reply
	"FSH 10 Log on"		"OK"
	"FSH all log on"		"OK"

Command:	"?FSH <Addr> <Param> <Data>"			
Description	Show FSH setup			
AccLevel	?			
Parameters	- Addr: FSH Address (hexadecimal) (01..ff) or "ALL"			
	- Param: Parameter to configure			
	- Data: Value			
	Addr	Param	(Returned) data	Description
	01..FF	Log	1/0	
ALL	Log	1/0		
	Active	1/0		
Reply	"OK"			
Note				
e.g.	Command		Reply	
	"?FSH 10 log"		10 LOG 1	
	"?FSH all log"		01 LOG 0 02 LOG 1 03 LOG 1 04 LOG 0 ...	
	"?FSH all log on"		02 03 10	

Command:	"FSHC <Addr> <Cmd> <DataByte1> <DataByte2> <DataByte3> <DataByte4>"			
Description	Send FSH command			
AccLevel	?			
Parameters	- Addr: FSH Address (hexadecimal) (01..ff)			
	Addr	Param	Data	Description
	01..FF			
Reply	"OK"			
Note				
e.g.	Command			Reply
	"FSHC 10 20 1 2 3 4"			"OK"

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Command:	"CONFIG <Type> <Param> <Data>"		
Description	Configure system setup		
AccLevel	4		
Parameters	- Type: Type of control - Param: Parameter to configure - Data: Value		
	Type	Param	Data
	Tools	MonitorPort	Off, 0,1,2 Enable/disable monitor function: 0 or OFF: Monitor function disabled 1: Output on monitor port 2: Output on user port
	UART	Baud	48..1152 Set baud rate of the user port [100bit/s]
		Echo	1/0 or On/Off Switch automatic echo at the user port on or off
	TRX	Channel	1..49, 51..84 Set transceiver channel. Valid settings are: In the USA: 1(902.265 MHz)...49(927.543 MHz), In Europe: 51(868.034 MHz)... 84(869.840 MHz)
		Datarate	300,600, 1200,2400, 4800 9600, 19200, 38400 Set data rate of the transceiver [bit/s] Always use 38400 baud. No changes should be made
		PowerBm	-20...0...5 Set output power of the transceiver [dBm]
		TTL	1/0 (OFF)
	GEN	DeviceAddr	8 bit hex 8-Bit-Device-Address
		BaseAddr	16 bit hex 16-Bit-Baseaddress of FSB/FSH
		Country	0,1 0: USA 1: Europe
		User	Set user
	Userport	HdShk	0,1,2,3 Select type of handshake at the user port 0: No handshake 1: Only handshake from the local unit 2: Only handshake from the remote unit 3: Handshake from local and remote unit
		HeaderIn	0,1 Select, whether an header, e.g. specifying the destination address, is required for transmitting data. 0: No header required (Incomming date that are not commands are transmitted to the standard destination) 1: Header required
		HeaderOut	0,1,2,3,4 Select the type of header which is output in front of the data at the (local, TN9040) userport. 0: No header 1: Short source-/destination header (defaults omitted) 2: Full source-/destination header (xx#xx>>xx#xx) 3: Full source-/destination header plus receiver info and decode info 4: Automatic: Use setting in received datasets
		HeaderOutRmt	0,1,2,3,4 Select the type of header which is output in front of the data at the userport of the receiving unit (remote, base station). 0: No header 1: Short source-/destination header (defaults omitted) 2: Full source-/destination header (xx#xx>>xx#xx) 3: Full source-/destination header plus receiver info and decode info 4: Automatic: Same as 1 (Default)
	Options	Encrypt	0,1 Disable/Enable data encryption (128bit AES)

		ConfigInfo	0,1,2	Define answer to an “?Config aaa bbb”-command: 0: Reply is: ”<value>” 1: Reply is: ”bbb <value>” 2: Reply is: “aaa bbb <value>”
	Sec	Key	16byte hex	Define 128bit data encryption key
Reply	“OK” (“invalid value”, ”out of range”)			
Note	Changes are NOT saved to flash. Use Command “SAVE Settings” Some settings require an access level of 3 (trx datarate, gen country) Some settings require an restart of the system (after saving the changes !)			
e.g.	Command		Reply	
	“CONFIG GEN FSHADDR 10”		“OK”	

PRELIMINARY

Command:	"?CONFIG <Type> <Param>"		
Description	Show system setup		
AccLevel	4		
Parameters	- Type: Type of control - Param: Parameter to show		
	Type	Param	Returned Data
	Tools	MonitorPort	0,1,2 0: Monitor function disabled 1: Output on monitor port 2: Output on user port
	UART	Baud	48..1152 Baud rate of user port [100bit/s]
		Echo	1/0 Automatic Echo at the user port on or off
	TRX	Channel	1..49, 51..84 Transceiver channel.
		Datarate	300,600, 1200,2400, 4800 9600, 19200, 38400 Data rate of the transceiver [bit/s]
		PowerdBm	-20...0...5 Output power of the transceiver [dBm]
		TTL	1/0
	GEN	DeviceAddr	8 bit hex 8-Bit-Device-Address
		BaseAddr	16 bit hex 16-Bit-Baseaddress of FSB/FSH
		Country	0,1 0: USA 1: Europe
		User	User code
	Userport	HdShk	0,1,2,3 Type of handshake at the user port 0: No handshake 1: Only handshake from the local unit 2: Only handshake from the remote unit 3: Handshake from local and remote unit
		HeaderIn	0,1 Requirement for an header for transmitting data. 0: No header required (Incoming date that are not commands are transmitted to the standard destination) 1: Header required
		HeaderOut	0,1,2,3,4 Type of header which is output in front of the data at the (local, TN9040) userport. 0: No header 1: Short source-/destination header (defaults omitted) 2: Full source-/destination header (xx#xx>>xx#xx) 3: Full source-/destination header plus receiver info and decode info 4: Automatic: Use setting in received datasets
		HeaderOutRmt	0,1,2,3,4 Type of header which is output in front of the data at the userport of the receiving unit (remote, base station). 0: No header 1: Short source-/destination header (defaults omitted) 2: Full source-/destination header (xx#xx>>xx#xx) 3: Full source-/destination header plus receiver info and decode info 4: Automatic: Same as 1 (Default)
	Options	Encrypt	0,1 Data encryption disabled/enabled (128bit AES)
		ConfigInfo	0,1,2 Define answer to an "?Config aaa bbb"-command: 0: Reply is: "<value>" 1: Reply is: "bbb <value>" 2: Reply is: "aaa bbb <value>"
	Sec	Key	16 byte hex 128bit key for data encryption (AES)
Reply	"<Type> <Param > <Data>",		

	"<Param > <Data>" or "<Data>", depending on the parameter "options configinfo"						
Note	The reply depends on the parameter "options configinfo"						
e.g.	<table border="1"> <thead> <tr> <th>Command</th> <th>Reply</th> </tr> </thead> <tbody> <tr> <td>"?CONFIG gen deviceaddr"</td> <td>"GEN DEVICEADDR 99"</td> </tr> <tr> <td>"?CONFIG gen baseaddr"</td> <td>"GEN BASEADDR cb50"</td> </tr> </tbody> </table>	Command	Reply	"?CONFIG gen deviceaddr"	"GEN DEVICEADDR 99"	"?CONFIG gen baseaddr"	"GEN BASEADDR cb50"
Command	Reply						
"?CONFIG gen deviceaddr"	"GEN DEVICEADDR 99"						
"?CONFIG gen baseaddr"	"GEN BASEADDR cb50"						

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Command	"UPDATE"
Description	Start update manager software
AccLevel	4
Parameters	-
Note	You should know what you are doing !

Command:	"SECURITY <Parameter> <Data>"		
Description	Security settings		
AccLevel	1		
Parameters	- Parameter		
	- Data		
	Parameter	Valid data	Description
	HWKey	Hardware key	Define hardware key This command can only be executed once !
	ERASE	Erase key	Erase flash memory
Reply	"OK"		
Note	You should know what you are doing !!!		
e.g.	-		

Command	"TEST"
Description	For test purpose only
AccLevel	4
Parameters	-
Note	You should know what you are doing !

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2.3 Error messages

Error message	Comment
Error 001: Syntax error	Syntax error
Error 002: Too few parameters	
Error 003: Out of range	
Error 004: Invalid value	
Error 005: Not available	
Error 006: Password too long	
Error 007: This value is not possible for your country.	
Error 010: Access denied !	
Error 011: Invalid key	
Error 031: EEPROM read	
Error 032: EEPROM write	
Error 041: Flash read	
Error 042: Flash write	
Error 043: Verify	
Error 050: Error in ow device	
Error 060: Transceiver error	Error in transceiver unit
Error 100: UART collision	A collision occurred when reading data on a half duplex interface. Please retry reading.
Error 101: UART buffer overflow	Overflow in user port input buffer
Error 102: UART string too long	Input string at the user port is too long
Error 110: CRC wrong	Appended CRC is wrong. No data are transmitted.
Error 120: Target address not available	
Error 121: Target unit not logged in	
Error 130: TX queue overflow	Overflow in dataset transmit queue. Refer to the specifications for the maximum number of datasets (strings) in the queue.
Error 131: Command queue overflow	
Error 140: Key mismatch	Data are transmitted with data encryption, but the receiving unit is not able to decrypt the data because the encryptions keys of sender and receiver do not match.

3 Usefull features

3.1 Encryption (AES 128 bit)

Transmitted data may be encrypted using a 128bit AES encryption.
You enable/disable this feature with the command

Write:	Config options Encrypt 1/0	Enable/Disable encryption
Read:	OK	

The 128 bit (16 byte) encryption key can be set or read with the commands

Write:	Config Sec Key <16 byte hexadecimal>	Set 128 bit encryption key
Read:	OK	

Write:	?Config Sec key	Read encryption key
Read:	SEC KEY 11223344556677889900112233445566	

When using data encryption make sure, that transmitting and receiving units use identical keys.
If the keys do not match and you try an encrypted data transmission you get an error message.

Example: Try to transmit the text "Test" with encryption enabled, but with different keys on transmitter side and receiver side.

Write:	>>00 Test	Send the text "Test" to device 00 (port 00)
Read:	01> Recvd 0bf3	Handshake from local unit (address: 01)
Read:	00> Error 140: Key mismatch	Error message from remote unit (address: 00)

3.2 Date and time

Every base station (e.g. TN9000) has an internal real time clock (RTC). The time information of this clock is continuously transmitted to every remote unit (TN9040) which is logged into the base station. Therefore every TN9040 has the same reliable time information which can be read using the commands

Write:	?d	Read date
Read:	31.12.2007	

Write:	?t	Read time
Read:	23:59:59	

4 Specifications

Electrical characteristics:

Symbol	Parameter	Condition	Standard			Unit
			Min	Typ	Max	
V _{CC}	Supply voltage		5		24	V
I _{CC}	Power supply current @ V _{CC} = 9V			tbd		mA

Timing characteristics:

Symbol	Parameter	Condition	Standard			Unit
			Min	Typ	Max	

Userport specification:

Symbol	Parameter	Condition	Standard			Unit
			Min	Typ	Max	
f(UART)	Datarat in UART mode (asynchronous)		4800	38400	115200	bit/s
N	Maximum number of datasets in transmit queue				1	-
	Input string size				80	characters
	Output string size				120	characters

5 Revision history

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