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TTP/C Controller AS8202NF User Constraints Document

Document edition 1.3.2-69326 of 11-July-2014
Document number AN153

TTP As Dependable as Time

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Legal notice Document number AN153

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Contents

1 Glossary of Terms and Acronyms **1**
- 1.1 Glossary of Terms . . . 1
- 1.2 Acronyms . . . 1

2 Introduction **3**
- 2.1 Classification of Requirements by Primary Target Audience . . . 3

3 System User Requirements **5**

4 Hardware User Requirements **7**

5 Software User Requirements **9**

6 Hardware Constraints Resulting from Problem Reports **15**

7 Software Constraints Resulting from Problem Reports **19**

8 Appendix **21**
- 8.1 Communication Settings Parameters . . . 21
- 8.2 Receiving Frames in AS8202NF . . . 21
- 8.3 Transmitting Frames in AS8202NF . . . 21
- 8.4 Host Paged Access in AS8202NF . . . 22
- 8.5 List of AS8202NF Application and Technical Notes . . . 23

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List of Figures

5.1 Multiplexed Slot Assignment 12

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List of Tables

8.1 List of AS8202NF Application and Technical Notes 26

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History of Changes

Version 1.0

19-May-2006 **VMO** issue20474: Created

23-May-2006 **VMO** issue20474: Typo fixed, chapters added

24-May-2006 **DCI** issue20474: Typo fixed, requirements text completed

26-May-2006 **DCI** issue20474: chapters updated; history updated

31-May-2006 **DCI** issue20474: software constraints and hardware constraints updated; history updated

31-May-2006 **DCI** issue20474: sdd user requirements added; history updated

31-May-2006 **DCI** issue20474: SDD InitMsgArea user requirement added; history updated

14-Jun-2006 **RHI** issue20474: List of All Applications and Technical Notes concerning AS8202NF added

16-Jun-2006 **RHI** issue20474: List of All Applications and Technical Notes concerning AS8202NF reworked

19-Jun-2006 **RHI** issue20474: Appendix reworked

21-Jun-2006 **RHI** issue20474: Requirements classified by primary target audience

05-Jul-2006 **WHN** issue20474: MinMacrotick requirement corrected

Version 1.1

14-Aug-2006 **IRA** issue21207: Corrected the Requirements: User: ReadAhead SUser and User: ReadAhead SUser5A

17-Aug-2006 **VLU** issue21207: Corrected the User: ReadAhead SUser1A requirement

Version 1.2

05-Sep-2006 **WHN** issue20474: Typos fixed

29-Sep-2006 **RHI** issue20474: Typos fixed

27-Jul-2007 **HAN** issue25101: removed ”obsolete” from AN134 and AN136

30-Jan-2008 **HAN** issue25583: moved AN137 to ”obsolete” status

06-Feb-2008 **HAN** issue25583: updated AN145 to new version

06-Feb-2008 **HAN** issue25583: moved internal AN149 to ”obsolete” status because of same content as official AN150. Not the content is ”obsolete” but the application note itself

Version 1.3

30-May-2014 **CMI** issue63438: Update for TASM 2.05, AS8202B and additional application notes; Added HW constraints based on issues 43613, 55500, 38071; Removed obsolete SW issues 7724, 10716; Added SW issue 9253; Added Application Notes D-151-AN-05-002, D-CHIP-AN-10-001, D-001-AN-05-002, D-CHIP-AN-10-002, D-151-AN-01-001; Added Technical Note H-151-TN-10-001

11-July-2014 **CMI** issue64463: Peer Review

1 Glossary of Terms and Acronyms

The following sections provide a list of technical terms and acronyms that are used throughout this document.

1.1 Glossary of Terms

Actiontime is a time reference point within a TDMA slot. In the implementation actiontime is a trigger to start time-triggered actions at the controller.

Macrotick is the basic time slot used to build TDMA windows.

Channel AS8202NF internal module handling communication for a data bus. AS8202NF can communicate on 2 buses simultaneously.

Frame Data stream with known length and known data structure as defined by the communication protocol implemented in AS8202NF firmware.

1.2 Acronyms

AS8202NF TTP Communication Controller chip.

BG Bus guardian

CCF Concurrency control field

CNI Communication network interface

CPU Central processing unit

CRC Cyclic redundancy check

I/O Input / output

MEDL Message descriptor list

PCU Protocol control unit

PLL Phase-locked loop

PRP Post receive phase

PSP Pre send phase

RAM Random access memory

ROM Read-only memory

RPV Remote pin voting

RPVD Remote pin voting decision

RUP Roundup issue

TASM TTP assembler
TDMA Time division multiple access
TP Transmission phase
TTP Time-triggered protocol
VHDL VHSIC hardware description language
VHSIC Very high speed integrated circuit

2 Introduction

This document provides an overview of the limitations (constraints) which have to be taken into account when using AS8202NF or AS8202B together with TASM 2.05.

Chapter 4 on page 7 presents the Hardware User Requirements as described in TTP/C Controller C2NF Requirements Description [TTC05c] and TTP/C Controller AS8202NF Conceptual Design Document [TTC05b].

Chapter 5 on page 9 presents the Software User Requirements as described in TTP/C Controller AS8202NF Software Requirements Document [TTC05e] and TTP/C Controller AS8202NF Software Design Document [TTC05d].

Chapter 6 on page 15 presents the Hardware Constraints Resulting from problem reports as described in TTP/C Controller AS8202NF Hardware Accomplishment Summary [TTC14].

Chapter 7 on page 19 presents the Software Constraints Resulting from problem reports as described in TTP/C Controller AS8202NF Software Accomplishment Summary [TTC13].

Chapter 8 on page 21 presents some implementation details related to the presented user requirements.

The information presented in this application note relies on the *AS8202NF TTP-C2NF Communication Controller Data Sheet, rev 2.1* [AMS09] and the *AS8202B TTP-C2NF Communication Controller Data Sheet, rev 1.0* [AMS13].

The devices AS8202NF and AS8202B are functionally and die-wise identical. AS8202B is the lead free packed version of the TTP Controller. Within this document AS8202NF and AS8202B are synonyms. Any difference in the datasheets only reflects the constraints listed in this document and the lead-free transition of the chip package. All references to AS8202NF Datasheet Rev. 1.6 or higher are also covered in AS8202B Datasheet Rev. 1.0 or higher.

2.1 Classification of Requirements by Primary Target Audience

The user requirements are classified according to:

- **T** = TASM Programmer
- **M** = MEDL Designer
- **A** = Application Programmer
- **S** = System Engineer
- **B** = PCB Designer

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3 System User Requirements

This chapter lists the System User Requirements for the TTP Controller. The Requirements are described in greater detail in Time-Triggered Protocol TTP/C Requirements Document ([TTC05a]).

User: DataFaults (**A**) The application shall deal with faults that do not become manifest as communication faults (e.g. by using end-to-end checksums, agreement protocols, or other techniques).

User: AssumptionCoverage (**S**) The user shall ensure that assumption coverage of the end system with respect to the fault assumptions provided in Time-Triggered Protocol TTP/C Requirements Document [TTC05a] meets the safety requirements of the application.

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4 Hardware User Requirements

This chapter lists the AS8202NF user requirements related to the hardware implementation. The requirements are described in more details in TTP/C Controller C2NF Requirements Description ([TTC05c]) and TTP/C Controller AS8202NF Conceptual Design Document ([TTC05b]).

User: BUFifoDataZeroLengthNoHeader (**T**) The bus unit shall not be configured to receive zero length frames with header. This means value of 0x0001 must not be written to $recbytes register prior to a frame reception. Section 8.2 on page 21 describes the steps to configure the AS8202NF for frame receive.

User: BUTXMIIFrameNoHeader2 (**T**) The controller shall not be programmed to send MII frames without header.

User: PostedWrite SCon1 (**T**) The TASM software shall perform at most two consecutive memory accesses, followed by at least one clock period without a memory access.

User: ReadAhead SUser1 (**A**) When performing consecutive read accesses to AS8202NF the host shall separate two read accesses by a minimum of 1.5 internal clock cycles (37.5 ns at 40MHz internal clock cycle).

See the asynchronous DPRAM interface timing parameters from the AS8202NF Datasheet Rev.1.6.

User: ReadAhead SUser1A (**A**) The host shall not access the last word in a page.

Note: If one of the workarounds proposed in paragraph 6 on page 17 is implemented, this requirement can be considered to be fulfilled.

See section 8.4 on page 22 for details of host paged mode access to AS8202NF memory space.

User: ReadAhead SUser2 (**A**) The host shall expect a read request to be delayed until the prefetch is completed. That is, in some cases when AS8202NF internal PCU performs accesses in the same time, the host access is acknowledged with delay.

See the interface timing parameters from the AS8202NF Datasheet Rev.1.6 for the guaranteed maximum access time.

User: ReadAhead SUser5A (**A**) The host shall be prepared that there can be cases when a host read access does not return the correct data written by a preceding host write access to the same address. That is, when the host performs a read from address **A** followed by a write to address **A+1** and then a read from address **A+1**, due to read ahead mechanism, the returned value of the second read is the previous value to the write.

If the user constraint User: ReadAhead SUser1A paragraph 4 on the preceding page is fulfilled (e.g. by means described in paragraph 6 on page 17) this requirement can be considered to be obsolete.

User: SynchrReadybGen User1 (**B, A**) The user shall set *USE_RAM_CLK* to the preferred value only while the hardware reset is applied. This input pin is used to construct the *READYB* signal and must be set during reset to avoid wrong behavior on *READYB*.

5 Software User Requirements

This chapter lists the AS8202NF user requirements related to the software protocol implementation. The requirements are described in greater detail in TTP/C Controller AS8202NF Software Requirements Document ([TTC05e]) and TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: ArmDelay (**M**) The value of the *Receiver Arm Delay* shall be respected according to application note AN134 when computing the receiver and sender transmission timings.

Arm delay cannot be computed by TTP-Verify because the properties of the physical layer and topology are not known.

User: BusGuardianParameters (**M**) The bus guardian parameters of the MEDL shall be computed according to the formulae given in section 11.3.1 on page 101 from the TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: CNI-AreasMsgAreaBasic D2 (**M**) The basic message area shall start at 16 bit word address 0x50 and shall end at 16 bit word address 0x7FF (1968 words size).

User: ColdStartState-BothCh D3 (**M**) The *Timeout Dead Window* in MT parameter of the MEDL's schedule/protocol parameters section shall ensure that the bus guardian will be armed at least 1 PCU microtick + 3 BG microticks before the transmission phase (action time) starts.

User: ControllerOnDelay (**A**) Having set the *Controller On* flag the host shall not access the CNI for a duration of at least 8 clock cycles (200 ns @40 MHz internal C2NF clock).

The application has to consider this when manually switching the controller on.

User: ControllerWriteAccess1 (**M**) The *RAM Write Access Controller* parameter shall prohibit write access to pages that do not contain messages (according to the schedule).

User: ControllerWriteAccess2 (**M**) The *RAM Write Access Controller* parameter shall allow write access to all pages that contain messages (according to the schedule).

User: CRCSeedValue (**M**) The MEDL designer shall use the algorithm outlined in chapter 14 on page 119 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d]) to compute the value of the initialization CRC MEDL field from the schedule ID.

User: EOCFlag (**M**) The *End of Cluster Cycle (EOC)* flag shall be set only in the last slot of the cluster cycle.

User: FrameAddressIFrame (**M**) For I-frames the *Frame CNI Address* parameter shall be set to 0.

User: HostWriteAccess1 (**M**) The *RAM Write Access Host* parameter shall allow write access to pages containing messages that are to be sent by the controller.

User: HostWriteAccess2 (**M**) The *RAM Write Access Host* parameter shall prohibit write access to pages that host input messages containing RPV data evaluated by the controller. The MEDL designer needs to take care that output messages and input messages containing RPV data are located in distinct memory pages in order to meet both of these requirements.

User: IFGDuration (**M**) The *Round SlotDuration - Transmission Phase Length* parameter shall be computed according to the formula given in section 11.1 on page 95 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: InitControlArea (**A**) The host computer shall initialize the fields of the Control Area before turning the controller on.

User: InitMsgArea (**A**) The host shall initialize the message data part of the message area as needed before turning the controller on.

User: InitMsgAreaCCF (**A**) The host shall initialize the CCF fields to an even value before the message area entry is used.

User: IntegrationDurations (**M**) The contents of the *Listen Integrate Durations Macrotick* and the *Listen Integrate DurationsMicrotick* fields shall not exceed the real I-frame transmission and processing duration. Taking the transmission duration of an I-frame at the specific bus speed is a good value for this field (see section 11.2.3 on page 101 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d])).

User: ListenTOCheck (**M**) The *Listen Timeout Check Unobserved* parameter shall be computed according to the formula given in section 11.2 on page 98 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: MCRTiming (**A**) The host computer shall issue mode change requests outside the pre send phase of the node's sending slot only.

User: MeasureRange (**M**) The parameter $n_{measure}$ shall be in the range $0 < n_{measure} < \frac{n_{oversample}}{2}$. If the *MAN* flag is set, Manchester bus encoding is selected. If the *RS485* flag is set, the logical level 0 is accepted as IDLE. This should be set for unbiased RS485 physical layers. If the measure and oversample are both set to 0x0 and the MAN flag is cleared, the C2NF uses its synchronous MII interface. See Functional Description of the AS8202NF ([TTC03]) for more details.

User: MEDLBaseAddress (**A**) The host computer shall set the value of the *MEDL Base Address* field of the CNI's Control Area before turning the controller on.

User: MEDLBaseAddressValue (**A**) The value provided by the host in the *MEDL Base Address* field of the CNI's control area shall be the same as the value of the start address of the Global Entry Table field of the MEDL's Global Entry Table.

User: MEDLEntryTableReference (**M**) The first table reference shall point to the global entry table itself.

User: MEDL-GenReqErrMethodDesign D1 (**M**) Every MEDL entry shall be protected by a 16 bit CRC generated using the same 16 bit polynominal as the C2NF controller and using a seed value of 0xFFFF.

User: MEDLStructureRevision (**M**) The *MEDL Structure Revision Number* field of the MEDL shall be set to 0x0202.

User: MinIntegrationCount (**M**) The *Minimum Integration Count (MIC)* paramenter shall be set to 2.

User: MinMacrotick (**M**) The value of the *Microticks/Macrotick Integer Part* shall be at least 20. This results in a minimum macrotick duration is 0.5 us using a C2NF clock rate of 40 MHz.

User: MinOversampling (**M**) When using Manchester or MFM encoding the oversample parameter shall have a value of at least 4. The measure parameter measure specifies the edge jitter tolerance for receiving in the MFM and Manchester mode.

User: NFrameLength (**M**) For N-frames the *Application Data Length* parameter shall have a value greater than 0.

User: PreambleCutoff1 (**M**) The *Asynchronous Preamble Cut-off* parameter shall be computed according to the guidelines given in the application note AN136.

User: PreambleCutoff2 (**M**) Manchester encoding shall be selected for both channels in case the *Asynchronous Preamble Cut-off* parameter contains a value other than 0.

User: PSPDuration (**M**) The *Pre-Send Phase (PSP) Duration* parameter shall be computed according to the formula given in section 11.1.3 on page 98 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: RPVAtEndOfCycle (**M**) The *Remote Pin Voting Decision (RPVD)* shall be set in the last round slot of a cluster cycle if Remote Pin Voting is performed.

User: SetStartupCommand (**A**) The host computer shall set the *Startup Command* field of the CNI's Control Area to 0xBA95 before turning the controller on.

User: StartupTimeout (**M**) The value for the *Startup Timeout* parameter shall be computed according to the formula given in section 11.2.2 on page 100 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: SynchronizedOperation-ToActive3 D3 (**M**) The *Pre-Send Phase (PSP) Duration* parameter of the MEDL's Schedule/Protocol Parameters section shall ensure that the bus guardian will be armed at least 1 PCU microtick + 3 BG microticks before the transmission phase (action time) starts.

User: TimeoutDeadWindow (**M**) The *Timeout Dead Window* parameter shall be computed according to the formula given in section 11.2 on page 98 of the TTP/C Controller AS8202NF Software Design Document ([TTC05d]).

User: TransferMEDL (**A**) The host computer shall load the MEDL data to the CNI before turning the controller on.

User: TransferProtocol (**A**) The host computer shall load the protocol binary to pages 0x10-0x11 before turning the controller on.

User: UnusedMEDLFields (**M**) Unused (gray-shaded in the tables to be presented in this chapter) parts of the MEDL fields shall contain zero-bits.

User: ExtActionTimeEnable (**M**) The external action time notification shall be enabled / disabled by a MEDL parameter.

Guidance: If the C-state of a controller has become valid, the controller will continue to execute the TDMA scheme until it is powered off, switched off by the host or it detects a situation causing it to transit to freeze state.

User: MuxNodes (**M**) For each cluster mode multiplexed nodes shall be statically assigned to particular TDMA rounds.

There is thus no conflict about the point in time when a multiplexed node can send a frame.

Figure 5.1 on this page shows an example of a cluster cycle consisting of four TDMA rounds. The last slot is shared by the multiplexed nodes 3, 4 and 5, with node 3 sending in the TDMA rounds 0 and 2, node 4 sending in round 1 and node 5 in round 3. Node 3 has half the transmission frequency of a non-multiplexed node having a sending slot in each TDMA round. Node 4 and node 5 have a quarter of the transmission frequency of a non-multiplexed node because they both send only once a cluster cycle while e.g. node 0 sends four times.

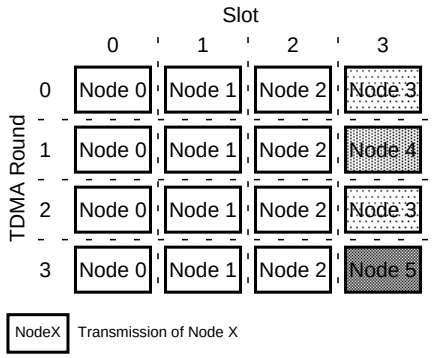

Figure 5.1: Multiplexed Slot Assignment

User: PassiveNode (**M**) Multiplexed nodes, permanently passive nodes, and nodes that transmit frames with implicit *C-State* even in startup mode, shall not be allowed to send a cold start frame or to answer to cold start frames.

The host of a permanently passive node can read all frame data from the CNI, but can never send a frame, neither during cluster startup nor during synchronized operation.

User: IdleTime (**M**) If a slot duration and the length of the TP are given in the schedule, the idle phase shall begin at

$$Idle_{start} = AT + \Delta_{TP} + \Delta_{PRP_{max}} \tag{5.1}$$

and has a duration of

$$\Delta_{Idle} = \Delta_{slot} - (\Delta_{TP} + \Delta_{PRP_{max}} + \Delta_{PSP_{max}}) \tag{5.2}$$

$\Delta_{PRP_{max}}$ and $\Delta_{PSP_{max}}$ are the worst-case durations of the post-receive phase and the pre-send phase, respectively.

User: LimitedColdstarts (**M, S**) In architectures without independent bus guardian the number of cold start attempts of a node shall be limited, because a TTP/C controller with incoming link fault may prevent the cluster from a successful startup.

User: ValidTXAddress (**M**) The value ”ignore” shall only be used for frames to receive but not for frames to be sent.

User: MedlId (**M**) The *Cluster Schedule Identification* field shall contain identical values for all controllers in the cluster. This is achieved by deriving the personalized MEDLs of all controllers from a single cluster design.

User: MinimumConfiguration1 (**M**) For fault-tolerant re-integration, there shall be at least two nodes which transmit frames with explicit *C-State* in each cluster cycle.

User: FastStartup (**M**) In startup mode, as many nodes as possible shall send frames with explicit *C-State*; the only reason for transmission of implicit *C-State*s in startup mode is to reduce the slot length (see calculation of slot duration below).

User: MinimumConfiguration2 (**M**) A minimum of four nodes per TDMA round shall be defined in order to provide fault-tolerant protocol operation.

User: IntegrationCount (**M**) The *Minimum Integration Count (MIC)* field shall be set at least to 2 to prevent fault propagation through integrating nodes.

Note that in general one will like to have a value of exactly 2 for this field. A value of 2 is sufficient to prevent fault propagation as long as the single fault assumption holds. If a larger value were chosen, then integration of nodes into a cluster with only a few nodes being synchronized would take longer than necessary. In case a single node only integrated on a cold start frame an integrating node will perceive only two correct slots per TDMA round. If *Minimum Integration Count (MIC)* were set to 4 in this case, an integrating node would need one extra TDMA round to join the cluster.

User: SlotDuration (**M**) The duration of the TDMA slots shall be at least the time required to transmit

- the longest frame transmitted by any node in this slot (regarding jitter and propagation delays) in any cluster mode
- plus the longest computation time (PRP+PSP) of any controller in the cluster (i.e., the maximum IFG of the slowest controller in the cluster),
- plus the duration of one precision interval (Π),

rounded up to full macrotick length.

If a slot is shorter than necessary to transmit a frame with explicit *C-State*, nodes sending in this slot have to send frames with an implicit one even in startup mode.

User: ResyncInterval (**M**) The *Clock Synchronization (ClkSyn)* flag shall be set so that in any resynchronization interval (which is determined by the slots with *Clock Synchronization (ClkSyn)* flag set) at least four slots with the *Synchronization Frame (SYF)* flag set are present.

User: SyncSlots (**M**) If a slot is intentionally left empty for future expansion or is intended for a node that is not present all the time, the *Synchronization Frame (SYF)* flag shall not be set for this slot.

The *Clock Synchronization (ClkSyn)* flag should be set at least every eight slots having the *Synchronization Frame (SYF)* flag set, or once per TDMA round if there are less than eight slots having the *Synchronization Frame (SYF)* flag set in a TDMA round.

User: ModeChangePermission (**M**) The *Mode Change Permissions (MCP)* for a slot shall be set so that a mode change request to an undefined cluster mode is prohibited.

User: SingleSlotPerRound (**M**) A node shall have the *Sending Slot (SS)* flag set at most once a TDMA round.

User: MinimumConfiguration3 (**M**) There shall be at least two nodes that are capable and allowed (by the MEDL) to cold start in order to start up cluster communication.

It is recommended to plan the cold start scenario in a way that other nodes (without cold start permission) are already waiting and can synchronize on the cold starting node immediately.

User: RAMExecutionOnly D1 (**A**) The *Startup Command* field shall be initialized by the host with the request of execution from the instruction RAM (command 0xBA95) or the invalid command (command 0xFFFF), all other values shall not be used.

Guidance: Other TASM binary code located in the ROM that is not part of this certification, could be activated by other startup command values and must not be executed.

6 Hardware Constraints Resulting from Problem Reports

This chapter lists the AS8202NF Constraints related to the Hardware Open Problem. The Hardware Open Problem Reports are described in greater detail in TTP/C Controller AS8202NF Hardware Accomplishment Summary ([TTC14]).

C2NFSUCC: Bug in detecting invalid frame length AN120 (Rup:20711) AN120 V1.0, dated 2003-02-11, reports an issue of the AS8202NF with detecting an invalid frame length upon reception.

See repository :pserver:user@cvs.vie.at.tttech.ttt:/ttt/ttchip/vc

The application note is located at `/as8202/vhdl/doku/bug_reports/public/AN120/AN120_AS8202NF_rx001-bug.pdf-r1.2`

The bug has been resolved in the CVS version of the AS8202NF source code as of `/as8202/vhdl/vhdl/a_mfm_receiver.vhd.diff-r1.3.2.1`, `themanufacturedAS8202NF` devices don't include this patch.

Impact of this bug:

Since the fault happens when checking invalid frame lengths reported as valid, it has the same failure mode as

(a) a faulty channel cutting off or stretching the transmitted frames, (b) a faulty sending node doing the same.

Taking care of these two cases is explicitly required for a time-triggered architecture. As a consequence, this unresolved bug does not add an additional failure mode but fits into these covered failure modes.

Leaving this as an open issue for certification of the unchanged AS8202NF is OK.

C2NFSUCC: Resolve bug report AN121 (Rup:5441) After the receivers of the AS8202NF are activated they are able to synchronize on a received frame. The chip is designed to ignore all receive patterns until a valid pattern is received and the SOF (start of frame) is detected during the start window. Due to a design bug this mechanism doesn't work if Manchester encoding is selected. In this case any invalid traffic (noise, etc.) in the time between activating the receivers and the end of the start window will leave the receiver in a state where it will wrongly detect a valid frame as having an SOF (start of frame) error.

TASM 2.04 and above provide work-around with MEDL parameters selected according to application note AN136.

C2NFSUCC: Manchester reception with noise in synchronous mode leads to SOF error (Rup:5983) The AS8202NF's implementation of a receiver supporting a Manchester-encoded data stream contains a circuit that detects the reception of a valid preamble followed by a SOF (start of frame). The decoder is designed to correctly detect a frame that contains garbage, followed by zero or more preamble-di-bits, followed by an SOF symbol. Due to the bug, this detection works only correctly if the receiver is reset during a period of time when there is silence on the bus. If the receiver is reset when there is traffic on the bus, this preamble-detecting circuit is not reset correctly. After such a hazard, the preamble detector can only detect a valid preamble-SOF sequence if there is at least one preamble-di-bit instead of the specified zero count.

TASM 2.04 and above provide work-around with MEDL parameters selected according to application note AN134 (see Rup:4885).

C2NF timer interrupt (Rup:10011) From VHDL simulation it appears that TTP timer interrupts are raised oneMACROtick later than one would expect. i.e., setting the timer field within the CNI's Control Area to a value x will result in an interrupt (provided timer interrupts are enabled) to be raised once global time becomes x+1. it is quite likely that users would expect the interrupt to be raised once the global time becomes x in this case.

The effect has to be taken into consideration on application level (e.g. TTP-OS). It represents an additional constraint for the selection of the interrupt latency. See application note AN156.

C2NFSUCC: MFM operation does not work when RS485 bit is set (Rup:10018) When the RS485Bit is set during MFM operation the integration of nodes does not work, because silence detection, which is used by TASM software 1.02 and later, does not work correctly (it detects silence in frames and aborts reception).

System manufacturer has to take this setting into account (see application note AN157).

Channel switching in CRC unit wrong on unit level (Rup:15470) If channel select is toggled right after a CRC shift request in 24 bit mode, the CRC will be calculated wrong. Precisely: A write access to the shift register is issued at clock cycle n, channel select is toggled at clock cycle n+1. This is an implementation bug.

Assigning signals in the way stated for the stand-alone CRC unit is not possible within the AS8202NF.

Synchronous READYB generated for 0/2 clocks (Rup:16906) Synchronous READYB should be aligned to host clock (with pulse duration of one host clock cycle) to fulfil the required host timing constraints for input setup and input hold time to/after host clock rising edge.Internally generated asynchronous READYB should be sampled twice by host clock to avoid metastability. Due to a bug in VHDL code, the sampling is done only once which can result in metastability state with following impacts: the synchronous

READYB is than generated for 2 host clock cycles or not at all. This functionality must not be used for safety-relevant applications.

AS8202NF data sheet V1.6 and above as well as AS8202B data sheet V1.0 and above clearly state that this functionality must not be used in safety critical systems.

Data bus instability by read access to the last word in page (Rup:16907) Due to a bug in Read Ahead state machine, subsequent host read access to ”second last word in page” and ”last word in page” can result in data bus instability by the ’last word in page’ read access

Impact on the application. Proposed workarounds:

1. The last word of each page has to be spared from the schedule (MEDL) so that the host never reads data from these CNI addresses OR
2. Write access to any RAM location or to page ’Nirvana’ (no impact) after the host read access to ’second last word in page’ OR
3. In the application to program the host to introduce break between ’second last word in page’ and ’last word in page’ read accesses longer than 32 * Tc (32 * 25 ns = 800 ns). See application note AN158.

AS8202NF PLL lock detection circuitry indicates unjustified PLL-unlock signal (Rup:43613) According to the datasheet rev. 2.1 and earlier, the AS8202NF Communication Controller supports two main clock operation modes: 10MHz (crystal or oscillator) and 40MHz oscillator. In some cases of operation with enabled PLL, the TTP controller can switch into FREEZE STATE. This affects all applications that use the internal AS8202NF PLL circuitry with the PLLOFF pin connected to Vss. Applications that a 40MHz main oscillator and disable the PLL by connecting the PLLOFF pin to Vdd are not affected.

A 40MHz main oscillator shall be used and the PLL shall be disabled by connecting the PLLOFF pin to Vdd. Then this problem will not have any impact. If a 10MHz clock and the PLL is used, the impact has to be analyzed by the system integrator. See application note D-151-AN-05-002.

C2NF is shut down but displays protocol state ACTIVE (Rup:55500) An incorrect protocol state might be indicated in the Protocol State register when the AS8202NF TTP Controller is turned off by the host. When turning the AS8202NF TTP Controller off by a host access (writing 0x0000 to the Controller On Flag located at 0x06 word address) a race condition between the TASM Protocol Firmware and the host access can take effect. Instead of indicating a protocol state of FREEZE (0x0000 read at word address 0x0A) which would be the expected value, the content of this register remains in some cases on the last valid protocol state before the shutdown (unequal to 0x0000). All other cases in which the AS8202NF TTP Controller during protocol execution determines to shut down are not affected by this issue. If the AS8202NF TTP Controller shuts down by a BIST or

Protocol Error (Interrupt Status bit 15 or 14 set at word address 0x01), the protocol state register will always indicate FREEZE (0x0000) afterwards.

If the host deactivates the AS8202NF TTP controller by writing 0x0000 to the controller on flag, it shall not rely on checking only the protocol state register to determine if the TTP controller is operational. Instead it shall include the controller on flag in the check. In this case the problem will not result in a failure. See application note D-CHIP-AN-10-002.

C2NF receiver interface: Delay between receiver reset and stop of FIFO filling (Rup:38071) After the reset of the receiver (move $zero, $recbytes) the receiver does not stop immediately with putting phantom bytes into the FIFO if $recbytes was >0 before the reset. Using 20 MHz MII clock at least one inserted phantom byte was monitored.

In the implementation of Loading Library TASM 3.04 Client/Master and TTP TASM 2.04 there is only one instruction between the receiver reset and the FIFO reset and received phantom bytes have been observed after the FIFO reset.

Impact: The additional phantom byte invalidates the next reception (LLTASM client & master and TTP TASM 2.04) and transmission (LLTASM client) of a frame.

This means that it is never guaranteed (especially in noise scenarios) that

1. A TTP node will integrate into a running TTP cluster (TTP TASM 2.04)
2. A TTP node will integrate to a cold start frame (TTP TASM 2.04)
3. Download communication will be established (LLTASM 3.04)

See application note D-CHIP-AN-10-001.

The issue has been fixed in TASM version 2.05. See application note D-001-AN-05-002.

7 Software Constraints Resulting from Problem Reports

This chapter lists the AS8202NF constraints related to the software open problems. The software open problem reports are described in greater detail in TTP/C Controller AS8202NF Software Accomplishment Summary ([TTC13]).

Integration on coldstart frames (Rup:15738) The issue addresses a problem with coldstart frames carrying an invalid mode change request in its header. The controllers would adopt this request and - in case the request refers to a cluster mode that is not defined in the MEDL - would perceive a BIST error at the start of the next cluster cycle. Consequences of this problem can be prevented by having all successor modes of the startup mode defined in the MEDL (they may define the startup mode itself as a successor mode).

Correctness of MEDLs with respect to this issue is checked by TTP-Verify versions 1.5.1 and above (cf. also Rup: 17725 and 15785).

PRD: Big Bang (Rup:15748) The issue addresses the invalid specification of the big bang algorithm. The algorithm is intended to avoid initial cliques in case of a collision of cold start frames at startup. Depending on the properties of the physical layer receiving nodes may perceive a correct frame (one or the other of the frames being part of the collision) or a collision. In this case startup cliques may evolve if the controllers would use either frame for integration. The big bang algorithm is intended to prohibit integration on collided frames but is not correctly specified. In clusters containing more than four nodes cliques may evolve in situations specified in detail by AN155 unless respective workarounds or configuration constraints are applied on the cluster.

Please refer to AN155 for a detailed description and possible workarounds.

Implementation errors: implicit acknowledgment (Rup:19746) This issue is raised against the TASM software. The TASM software does not correctly implement the implicit acknowledgment algorithm: if a controller is not acknowledged by its first successor, it is supposed to clear the membership flag of the respective controller (as required by Time-Triggered Protocol TTP/C Requirements Document requirements). However, the TASM software does not clear the flag of the first successor until it either receives faulty frames from some potential second successor or confirmation from the second successor.

Please refer to application note AN154 for a detailed description of the consequences for the application software.

clock correction check in muT is only 8 bit wide (Rup:17037) The problem report (this problem is addressed by internal issue17037) addresses a range issue of the Clock Correction Check parameter of the Schedule and Protocol Table of the MEDL. If the parameter contains a value larger than 255, clock correction may fail as the controller hardware processes only 8 bits of macrotick correction (and there is no software workaround). The issue needs to be addressed by the MEDL tool. There is no problem for MEDLs specifying a parameter in the supported range.

This is a documentation issue. Correctness of MEDLs with respect to this issue is checked by TTP-Verify versions 0.9.13 and above.

No Manchester preamble cut-off during startup-timeout (Rup:9253) The problem report asks for adding the preamble cut-off mechanism implemented in the listen state also to the startup timeout phase in the cold start state and refers to TTP/C Controller AS8202NF Software Design Document.

This is a minor finding, integration may be delayed by one frame in clusters using Manchester bus encoding (performance issue). The issue does not have a safety impact.

8 Appendix

The AS8202NF has a set of fixed registers, described in TTP/C Controller AS8202NF Conceptual Design Document that can be accessed by their symbolic names, which are more convenient to use when implementing TASM Firmware. The register symbolic names, which are defined in TASM, are depicted in TASM Manual [TTC04]. The following register names used for communication setup are TASM register symbolic names.

8.1 Communication Settings Parameters

- $oversamp - groups the general communication settings
- $corr - time correction for transmission and receive start.
- $fifodata - fifo data transfer register
- $fifostat - fifo status bits
- $transstat - transmission status bits
- $recstat - reception status bits
- $recstartw - time window width for expected frame start on reception
- $recbytes - expected frame size in bytes
- $transbytes - transmitted frame size in bytes

8.2 Receiving Frames in AS8202NF

The frame receive process in AS8202NF is performed per channel and per frame. After programming the communication main parameters the receive process is triggered by writing the $recbytes, which means how many bytes to expect[1]. The value written to $recbytes must not be 1 (header only frames) in the case of MII traffic on the configured channel (see paragraph 4 on page 7).

8.3 Transmitting Frames in AS8202NF

The frame transmit process in AS8202NF is performed per channel and per frame. After programming the communication main parameters the transmit process is triggered by

[1] the actual value written into $recbytes must be incremented by 1 to allow frame header reception.

writing the $transbytes, which means how many bytes to transmit from the data fifo[2]. Paragraph 4 on page 7 specifies that no transmission should be performed with MII mode set.

8.4 Host Paged Access in AS8202NF

The read/write accesses by the host to AS8202NF CNI memory is paged[3]. This means address targets a location in a 2k words page and a previous write access to **HOST_MEM_PAGE** register must be performed by the host to select the appropriate page. The physical address is calculated as resulting form the formula:

PhAdds = **HOST_MEM_PAGE** * 2K + **HOST_ADDR**

Where:
PhAdds is the resulting address in CNI memory address space
HOST_ADDR is the address from the particular host access inside a page.

Paragraph 4 on page 7 specifies that **HOST_ADDR** value of 0xfff should not be used for read or write accesses by the host.

[2] the actual value written into $transbytes must be incremented by 1 to include frame header transmission.
[3] There are 32 pages, each having 2k locations covering the entire AS8202NF memory space

8.5 List of AS8202NF Application and Technical Notes

The following table 8.1 gives an overview of all AS8202NF application and technical notes with status explanation. Application notes not covered by this table do not exist or refer to other designs and are therefore not relevant for the user of AS8202NF.

Document Name	Num.	Ver.	Date	Author	Status
C2NF Startup Procedure	AN115	1.0	9/24/02	H.Angelow	**OBSOLETE** Booting from ROM not allowed. The complete set of startup requirements is included in SRD, SDD
Waveform and Time Difference Capturing with C2NF's TTP Manchester Encoding	AN116	1.0	26/09/02	M. Wächter	public version of the Manchester Difference Capturing. The complete set of requirements is included in HRD, CDD (bus unit)
C-state Unit buffer becomes inconsistent	AN117	1.0	05/02/03	H.Angelow	**OBSOLETE** when using FW higher or equal to 1.01
Appnote Phys Layer for TTP/C	AN118	1.0	08/01/03	W. Dittrich, I. Rajkovic	MFM Physical Layer for TTP/C Appnote: Calculating Time Skew Requirements
TXPADSOFF (TTEST) Pin Overrides Bus Guardian in AS8202NF	AN119	1.0	12/02/03	M. Wächter	**OBSOLETE** when TXPADSOFF (TTEST) connected to VDD
Receiver Bug 001 in AS8202NF	AN120	1.0	11/02/03	M. Wächter	Since the fault happens when checking invalid frame lengths reported as valid, it has the same failure mode as (a) a faulty channel cutting off or stretching the transmitted frames, (b) a faulty sending node doing the same. Taking care of these two cases is explicitly required for a time-triggered architecture. As a consequence, this unresolved bug does not add an additional failure mode but fits into these covered failure modes.
Receiver Bug 002 in AS8202NF (Reduced Noise Tolerance for Manchester)	AN121	1.0	06/05/03	M. Wächter	**OBSOLETE**, FW 2.04 provides work-around (application note AN136)
False READYB Generation during Host Read Accesses in AS8202NF	AN122	1.2	16/09/03	R. Hindak / M. Wächter	**OBSOLETE**, the correct timing setup described in datasheets higher V0.5
Host Read Accesses Speedup in AS8202NF	AN123	1.1	11/09/03	M. Wächter	This document is intended to help designing glueless and high-speed connection between the host and the AS8202NF by explaining in which situations an inactivity time of as small as 5 ns can be used between successive read operations and how to avoid the remaining situations when the default timing is required.

Maximal Data-Rates of TTTech Systems	AN124	1.1	14/07/03	A. Bergner	Communication speed for TTP using AS8202 or AS8202NF controllers with MFM coding is up to 5 Mbit/s. Not only the throughput of the controller chips (transmitter and receiver), but also the signal transmission in the physical layer limits the data rate.
Maximal Data-Rates of the TTTech Controller Portfolio	AN125	1.0	16/04/03	A. Bergner	**NOT RELEVANT**, Overview - maximal data rates of the TTTech Controller Portfolio, outdated
MFM - Manchester Converter	AN126	1.0	22/05/03	W. Ettlmayr	**NOT RELEVANT**, Use of old C2 monitoring node with C2NF cluster
C2NF Conversion Proposal	AN127	1.0	07/07/03	R. Hindak	**NOT RELEVANT**, it is an implementation guideline for asic floorplaner
AS8202NF Manchester Coding Specification Bug	AN128	1.1	16/09/03	M. Wächter	**OBSOLETE** when using FW higher or equal to 1.02
AS8202NF Manchester Preamble Decoding Bug	AN129	1.1	16/09/03	M. Wächter	**OBSOLETE** when using FW higher or equal to 1.02
AS8202NF Manchester Decoding Bug	AN130	1.1	16/09/03	M. Wächter	**OBSOLETE** when using FW higher or equal to 1.02
AS8202/AS8202NF MFM/MII Async Reception Bug	AN131	1.1	16/09/03	M. Wächter	**OBSOLETE** when using FW higher or equal to 1.02, internal version
AS8202/AS8202NF MFM/MII Async Reception Bug	AN132	1.1	16/09/03	M. Wächter	**OBSOLETE** when using FW higher or equal to 1.02, public version
TTP/C Protocol Binary Release 1.02 for the AS8202NF controller	AN133	1.0	07/08/03	H.Angelow	**OBSOLETE**, release note for V1.02
Reception Scheme changed for Ignoring IFG Traffic / Transformer Noise during Synchronized Operation	AN134	1.5	25/07/07	H.Angelow	Describes MEDL parameter selection for different noise scenarios, protocol V2.00 and higher
Shadow Nodes in TTP	AN135	1.0	02/04/03	H.Angelow	**OBSOLETE**, when using FW higher or equal to 1.02
Fix for tolerating transformer noise in Manchester mode in AS8202NF	AN136	1.1	16/09/03	M. Wächter	Describes MEDL parameter selection for different noise scenarios, protocol V2.00 and higher
AS8202NF (TTP/C-C2NF controller) Connected to MPC555 Microcontroller	AN137	1.0	5/11/07	M. Waechter	**OBSOLETE**, connecting an MPC555 to the AS8202NF is covered by datasheet v1.7 or higher.
Poison Node Specification / Host Interface	AN138	1.0	11/09/03	H.Angelow	**NOT RELEVANT**, implementation proposal requirements for poisonos node
TTP/C Protocol Binary Release 2.02 for the AS8202NF controller	AN139	1.0	23/10/03	H.Angelow	**OBSOLETE**, release note for V2.02
TTP/C Protocol Binary Release 2.03 for the AS8202NF controller	AN140	1.0	05/11/03	H.Angelow	**OBSOLETE**, release note for V2.03

TTP/C Protocol Binary Release 2.04 for the AS8202NF controller	AN145	1.1	31/01/08	H.Angelow	relevant for FW 2.04
2nd Bang Hold-Off Implementation Approach	AN146	1.0	15/06/04	H.Angelow	Impact only on systems with central bus guardian
AS8202NF / C2NF - CRC Calculation	AN147	1.0	21/01/05	M. Wächter	The AS8202NF device uses CRC for error detection in the TTP messages. The implemented CRC fulfills the requirement ”Hamming distance of 6” for messages of up to 201 bit total message length. Beyond this value, a Hamming distance of 4 is assured by the implementation
Comments on Dead/Deactivated Code in TASM Software V2.04 of the AS8202NF	AN148	1.0	11/01/05	M. Wächter	The TASM Software V2.04, which is loaded into the AS8202NF protocol instruction RAM by the host at power-up, is certified software and does not contain any dead or deactivated code
AS8202NF TASM Software V2.04 MFM RS485 Bug	AN149	1.0	21/02/05	M. Wächter	**OBSOLETE** as an extra application note, same content as AN150
AS8202NF TASM Software V2.04 MFM RS485 Bug	AN150	1.0	21/02/05	M. Wächter	When operated with the TASM Software V2.04, the AS8202NF cannot handle MFM encoding in RS485 media tolerance mode correctly. MFM encoding with RS485 cannot be used with this TASM Software release, public version
AS8202NF (TTP/C-C2NF controller) Connected to MII Transceiver	AN151	1.0	28/02/05	R. Hindak	Application Note how to connect MII Transceiver to the TTP controller.
Data bus instability by Read Access to the last word in page in AS8202NF	AN152	1.0	21/07/05	R. Hindak	**NOT RELEVANT** when using software provided by TTTEch
TTP/C Controller AS8202NF User Constraints Document	AN153	1.0.12	05/07/06	W.Hofmann	This application note.
AS8202NF Host View of Membership during Controller Acknowledgement Phase	AN154	1.0	22/05/06	H.Angelow	**no impact** on the protocol functionality, because the controller operates internally with the correct membership vector as specified in SRD V1.1.2
AS8202NF Big Bang Configuration Constraints	AN155	1.0	29/05/06	G.Bauer	Big Bang algorithm - avoiding cold start cliques
Application Constraints using AS8202NF Timer Interrupt	AN156	1.0	22/05/06	H.Angelow	A host application or task scheduler must consider the delay of one macro tick and must set the value of the timer to n-1 if an interrupt at global time n should be raised
Constraints using MFM Encoding on AS8202NF	AN157	1.0	17/05/06	R. Hindak / M.Wächter	Hardware Bug Related to Protocol Version 2.04 of TASM Software; **no impact when using Manchester encoding**
Constraints read access of last word in a memory page of the AS8202NF	AN158	1.0	18/05/06	R. Hindak	**OBSOLETE** because addendum to the obsolete application note AN122

Constraints on the use of the internal PLL of AS8202NF	D-151-AN-05-002	1.1	17/07/12	G. Gaderer	AS8202NF PLL lock detection circuitry indicates unjustified PLL-unlock signal and sets AS8202NF into FREEZE STATE.
TASM Receiver and FIFO Reset Timing Constraints	D-CHIP-AN-10-001	0.4	23/12/10	H. Angelow	Impact of Technical Note H-151-TN-10-001 on TTP Protocol version 2.04 Firmware (TASM 2.04 Software).
Protocol binary update to version 2.05	D-001-AN-05-002	1.1	08/03/12	G. Gaderer	Release of TASM 2.05 to fix D-CHIP-AN-10-001.
TTP Controller Deactivation Constraints	D-CHIP-AN-10-002	1.1	12/08/13	M. Artner	An incorrect Protocol State might be indicated in the Protocol State register when the AS8202NF TTP Controller is turned off by the host application SW.
Impact Analysis of D-CHIP-AN-10-002 on TTP Middleware implementations	D-151-AN-01-001	1.2	04/03/14	B. Hirschler	Only TTP-Driver Middleware is affected.
List of Transceivers for TTP/C use as of March 2002	TN118	1.0	22/04/02	L. Gagea	**NOT RELEVANT**, recommendations for transceiver selection
BusGuardian Layout on AS8202NF Controller	TN119	1.0	15/05/03	M. Wächter	**NOT RELEVANT**, only information on routing (inside the chip) of bus guardian
AS8202NF synthesis Equivalence of the RTL sign-off baseline and AS8202NF device	TN121	1.1.1	05/07/06	V. Moleavin	This technical note presents the historical considerations and methodology for ensuring the equivalence of the RTL model used for the verification (in the simulation) and the implemented silicon
AS8202NF Write to Read Access Gap Enhancement	TN122	1.0	14/07/05	M. Wächter	**OBSOLETE** covered by datasheet v1.4 or higher
Report CVS to SVN Migration	TN159	1.0.3	19/06/06	V. Lucian	This technical note depicts the migration from CVS to SVN as well as the proof of equivalence.
AS8202NF Receiver and FIFO Reset Timing	H-151-TN-10-001	0.1	26/11/10	M. Wächter	Proper Timing Between Receiver and FIFO Reset Commands.

553 Table 8.1: List of AS8202NF Application and Technical Notes

[AMS09] AMS. *AS8202NF TTP-C2NF Communication Controller Data Sheet v2.1*, 2009.

[AMS13] AMS. *AS8202B TTP-C2NF Communication Controller Data Sheet v1.0*, 2013.

[TTC03] TTChip. *Functional Description of the AS8202NF*. D-032-S-10-047, TTChip Entwicklungsges.m.b.H., 2003.

[TTC04] TTChip. *TTP/C Controller C2NF Assembler Manual (TASM C2NF)*. D-032-S-10-043, TTChip Entwicklungsges.m.b.H., 2004.

[TTC05a] TTChip. Time-Triggered Protocol TTP/C Requirements Document. D-121-S-10-106, TTChip Entwicklungsges.m.b.H., 2005.

[TTC05b] TTChip. TTP/C Controller AS8202NF Conceptual Design Document. D-121-D-10-106, TTChip Entwicklungsges.m.b.H., 2005.

[TTC05c] TTChip. TTP/C Controller AS8202NF Hardware Requirements Document. D-121-S-10-105, TTChip Entwicklungsges.m.b.H., 2005.

[TTC05d] TTChip. TTP/C Controller AS8202NF Software Design Document. D-121-D-10-107, TTChip Entwicklungsges.m.b.H., 2005.

[TTC05e] TTChip. TTP/C Controller AS8202NF Software Requirements Document. D-121-S-10-107, TTChip Entwicklungsges.m.b.H., 2005.

[TTC13] TTChip. *TTP/C Controller AS8202NF Software Accomplishment Summary*. D-121-E-10-012, TTChip Entwicklungsges.m.b.H., 2013.

[TTC14] TTChip. *TTP/C Controller AS8202NF Hardware Accomplishment Summary*. D-115-AC-10-003, TTChip Entwicklungsges.m.b.H., 2014.

