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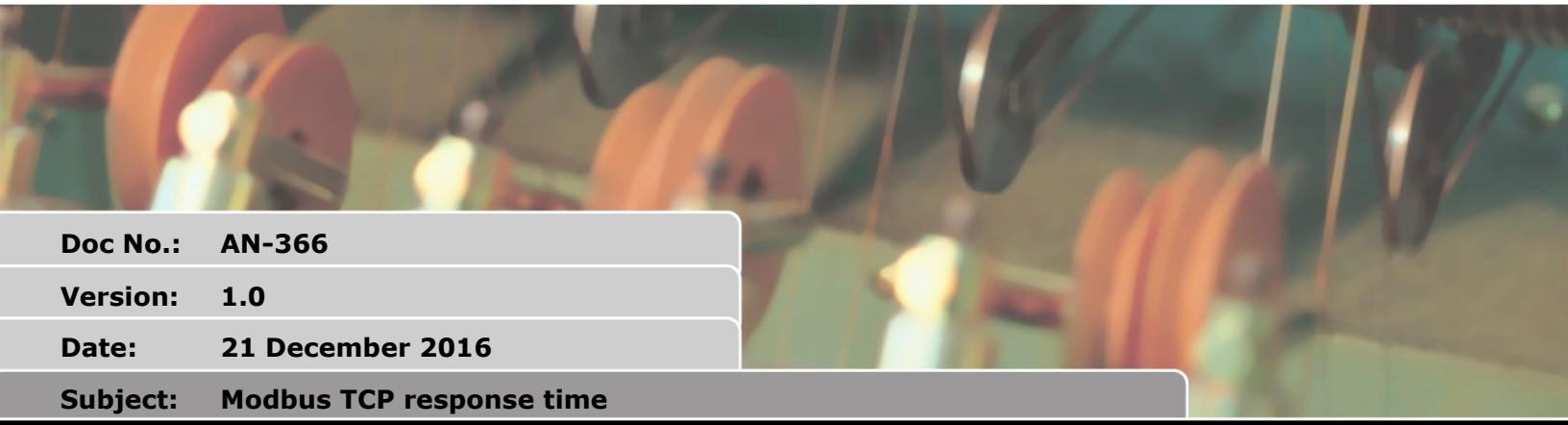

Doc No.: AN-366

Version: 1.0

Date: 21 December 2016

Subject: Modbus TCP response time

APPLICATION NOTE

1. Introduction

When planning a network and the communication links between devices, the available response time is often needed to allow the system designer to work out how much data can be transferred. System critical data may need to be written or read in a known time, either in a cyclic or non-cyclic way.

This document lists the results of some timing tests on MC4/5/6 range Motion Coordinators with Ethernet ports supporting the Modbus TCP protocol.

2. Test conditions

To be as representative as possible, the target Motion Coordinator (server) needs to be set up as if running a real set of programs and motion. To achieve this, the Motion Coordinator (server) will run 3 programs in the multi-tasking, one program on a normal process and 2 programs on fast processes. Motion will be run so as to put the SYSTEM_LOAD at 40%.

The tests were run using firmware version 2.0278.

The Modbus client used for the tests is a Trio MC4N-ECAT Motion Coordinator running a program that transfers 50 Floating Point values to the server using Modbus function 16 and then reads back 50 Floating Point values from the server using Modbus function 3.

A local unmanaged Ethernet Switch was used for connection between the 2 Motion Coordinators and the single PC that runs Motion Perfect V4. This was to prevent other Ethernet traffic from disturbing the Modbus messages.

** In the real world, other Ethernet traffic may cause message collisions so that occasionally the Modbus request and response takes many times the average value. TCP/IP IS NOT DETERMINISTIC.

3. Comparing Motion Coordinators

3.1. MC405 Server

To send and receive 50 FP values via Modbus TCP:

```
SYSTEM_LOAD: 38.1
SYSTEM_LOAD_MAX: 42.0
```

Response time results:

Minimum = 21 msecs
Maximum = 64 msecs
Average = 32 msecs

3.2. MC4N-ECAT server

```
SYSTEM_LOAD: 38.6401
SYSTEM_LOAD_MAX: 46.0632
```

Minimum = 20 msecs
Maximum = 60 msecs
Average = 31 msecs

3.3. MC508 server

Note: Was not possible to create 40% SYSTEM_LOAD with the MC508 running all axes.

```
SYSTEM_LOAD: 19.5349
SYSTEM_LOAD_MAX: 23.2818
```

Minimum = 7 msecs
Maximum = 24 msecs
Average = 12 msecs

3.4. MC664 (P861) server

```
SYSTEM_LOAD: 38.4897
SYSTEM_LOAD_MAX: 41.6455
```

Minimum = 12 msecs
Maximum = 31 msecs
Average = 21 msecs

3.5. MC664X (P862) server

```
SYSTEM_LOAD: 39.3245
SYSTEM_LOAD_MAX: 44.0561
```

Minimum = 6 msecs
Maximum = 16 msecs
Average = 9 msecs

3.6. Results table

Test	MC405	MC4N-E	MC508	MC664	MC664X
Min time (ms)	21	20	7	12	6
Max time (ms)	64	60	24	31	16
Average time (ms)	32	31	12	21	9

4. Program load effects

The time taken to process the Modbus request and respond to it depends on what other things are running on the Modbus Server.

In section 3, all the tests were done with the conditions shown in section 4.5, with axes set up to make a 40% SYSTEM_LOAD if possible. In this section (section 4) the controller starts with a very light load and then SYSTEM_LOAD is increased and running programs are brought in to play. The results can be seen below.

4.1. MC405 after reset with no programs running and no Motion Perfect connection

```
SYSTEM_LOAD_MAX: 20
```

Response time results:

Minimum = 6 msecs
Maximum = 18 msecs
Average = 10 msecs

4.2. MC405 with Motion Perfect (sync connection)

```
SYSTEM_LOAD_MAX: 21
```

Response time results:

Minimum = 6 msecs
Maximum = 19 msecs
Average = 10 msecs

4.3. MC405 with 1 Normal Process running

```
SYSTEM_LOAD_MAX: 21
```

Response time results:

Minimum = 15 msecs
Maximum = 41 msecs
Average = 22 msecs

4.4. MC405 with 1 normal and 2 fast Processes

```
SYSTEM_LOAD_MAX: 21
```

Response time results:

Minimum = 14 msecs
Maximum = 49 msecs
Average = 23 msecs

4.5. MC405 with 1 normal, 2 fast processes and 16 axes moving (11 virtuals)

```
SYSTEM_LOAD: 38.1
SYSTEM_LOAD_MAX: 43.4
```

Response time results:

Minimum = 20 msecs
Maximum = 61 msecs
Average = 33 msecs

4.6. Results table

Test	4.1 No load	4.2 MPv4 in sync	4.3 1 process	4.4 3 processes	4.5 3 processes and 38% SL
Min time (ms)	6	6	15	14	20
Max time (ms)	18	19	41	49	61
Average time (ms)	10	10	22	23	33