

IMT901 I²C Controller Manual

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1. General discription

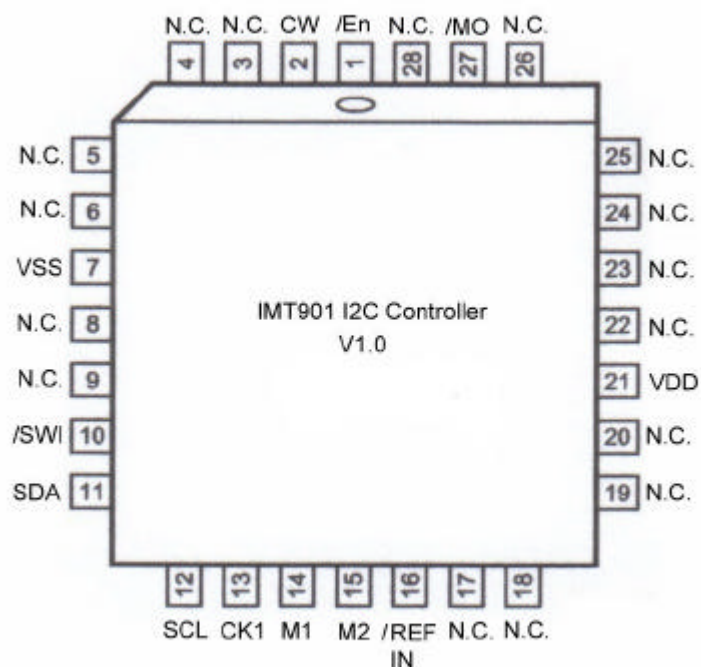
The IMT901 I²C Controller enables easy interfacing a IMT901 circuit to an I²C-Bus (two wire serial interface). The IMT901 is microstep stepper motor driver. Communication between a host and the IMT901 I²C Controller takes places via the two wire bi-directional serial interface. It is possible to connect up to 64 devices on the same bus. Slave addresses are programmable via controller EEPROM.

Features:

- 2.4 V to 3.6 V V_{DD} operating range. I/O pins are 5 V tolerant (may be pulled up or driven to 5.5 V).
- Max. 18 mA I_{DD} (Power supply current), operating
- Low-level input voltage (SCL,SDA only): min. $-0.5V$ - max. $0.3V_{DD}$
- High-level input voltage (SCL,SDA only): min. $0.7 V_{DD}$ - max. $5.5V$
- 100 kHz byte-wide I²C-bus communication port.

For further information, see the datasheet for the microcontroller "P89LPC932" from Philips. For further information about the IMT901 please visit the following site: http://www.nanotec.de/page_steuerungen_imt901_de.html

2. Pinning Information

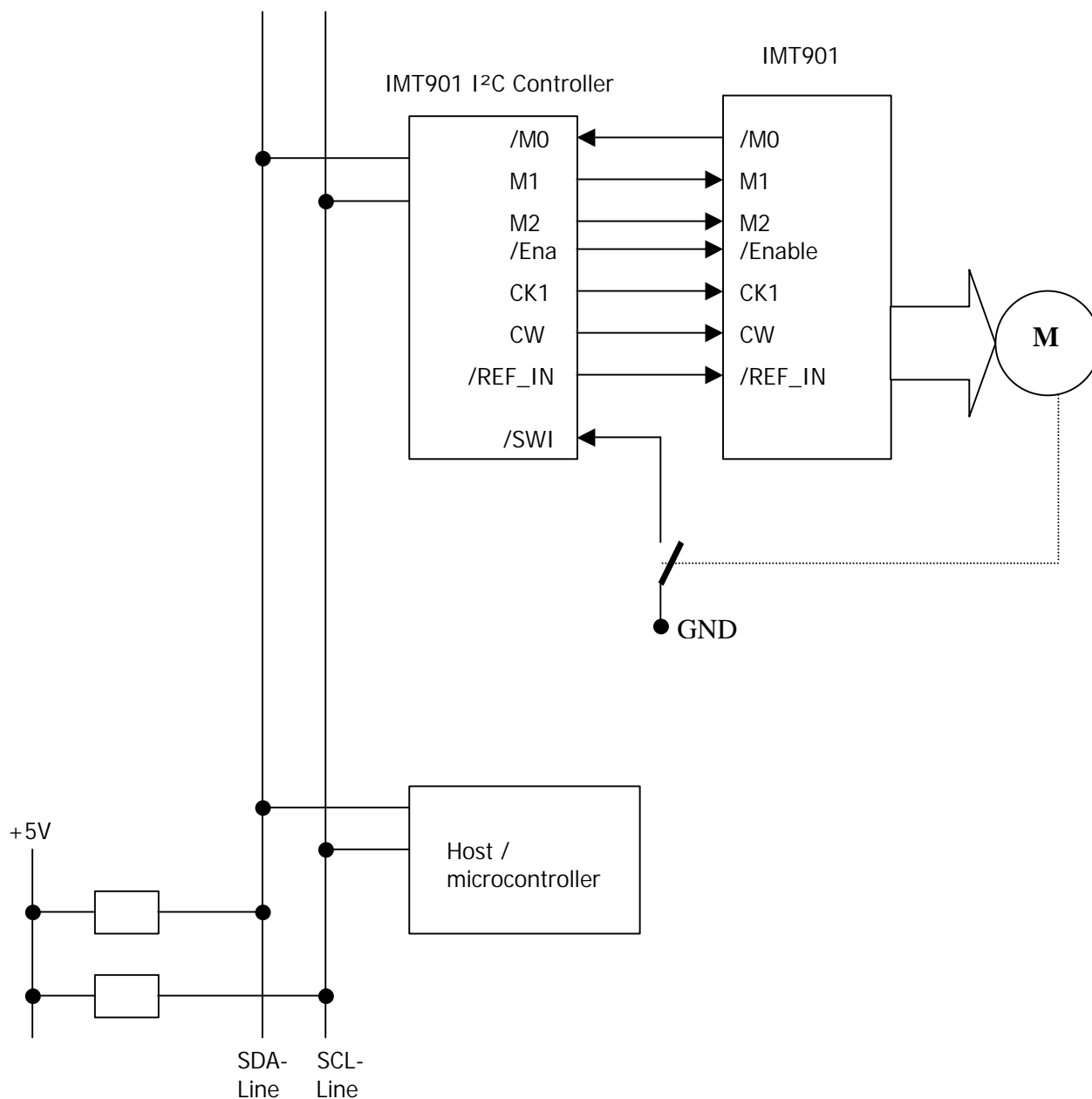


Pin		Discription
3,4,5,6,8,9,17,18,19, 20,22,23,24,25,26,28	N.C.	Not Connected
1	/Enable	Enable (IMT901)
2	CW	Direction (IMT901)
7	V _{SS}	V _{SS}
10	/SWI	Position Switch
11	SDA Line	serial Data line
12	SCL Line	serial clock line
13	CK1	Clock 1 (IMT901)
14	M1	Mode 1 (IMT901)
15	M2	Mode 2 (IMT901)
16	/REF_IN	/REF_IN (IMT901)
21	V _{DD}	3.3V
27	/MO	(IMT901)

3. Communication via I²C-Bus

3.1 I²C-Bus configuration

I²C-Bus uses two wires (SDA and SCL) to transfer information between devices connected to the bus. Each device connected to the bus is software addressable by a unique address and simple master/slave relationship exists at all times.



Example of an I²C-bus configuration

3.2 Address of the circuit

This circuit operates in slave mode. Each circuit must be provided with a physical address on order to discern this circuit from other ones on the I²C-bus. This address is coded on 7 bits and one bit is hardwired to '1', so that it is possible to connect 64 different circuits on the same bus. The address is always 0xFE at delivery.

3.3 The I²C Bus specification

3.3.1 Start and Stop conditions

Within the procedure of the I²C bus, unique situations arise which are defined as START (S) and STOP (P) conditions.

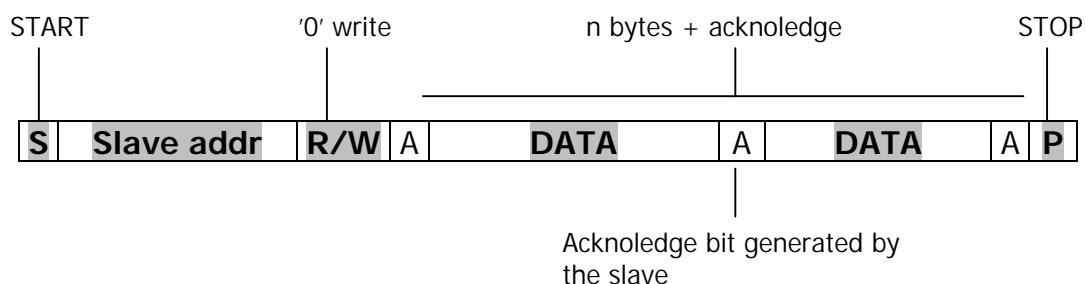
- A HIGH to LOW transtion on the SDA line while SCL is HIGH defines a Start condition.
- A LOW to HIGH transtion on the SDA line while SCL is HIGH defines a Stop condition.

Start and Stop conditions are always generated by the master. The bus is considered to be busy after a START condition. The bus is considered to be free again a certain time after a STOP condition.

3.3.1 Write data To I²C Device

Writing data to a device on the I²C-Bus is agreed as follow:

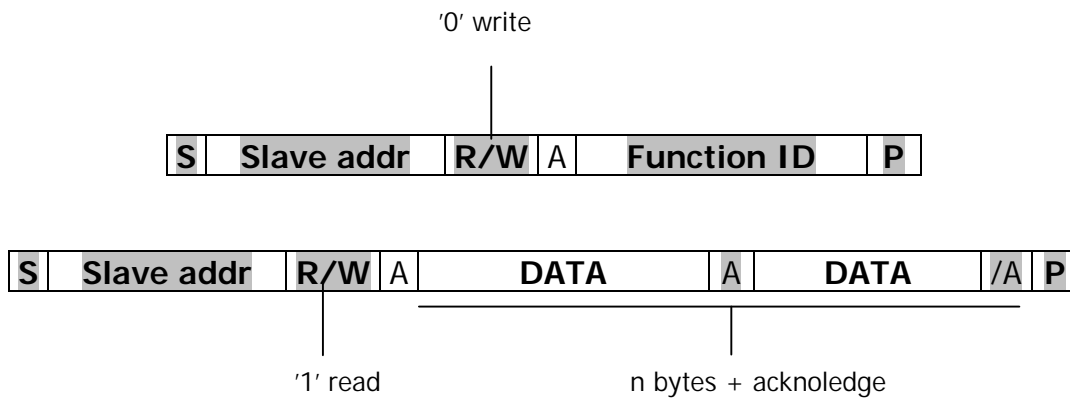
After the START condition, a slave address is sent. This address is 7 bits long followed by an eight bit which is a data direction bit ('0'=write, '1'=read) and an acknoledge bit. Any further data byte is followed by an acknoledge bit. A data transfer is always terminated by a STOP condition.



3.3.1 Read data from I²C Device

Reading data from a device on the I²C-Bus is agreed as follow and it consists of two sequences:

1. The first sequence consists of two bytes of data. The first byte is the slave address and write bit. The second consists of an internal register address which reads and stores in an internal register of the I²C Controller.
2. The second sequence consists of the slave address and the read bit. Then the master can read the data. After each byte of data the master has to acknowledge correct data reception. The last byte is not to acknowledge by the master and therefore the slave knows the end of transmission.



For further information about the I²C-Bus specification please visit philips semiconductors on the internet at <http://www.semiconductors.philips.com> and download the datasheet.

4. Commands description

4.1 Command Overview

Command	Function	Command Byte
MotorON	Enables Motor	0x61
MotorOFF	Disables Motor	0x62
SoftStop	Immediate deceleration followed by a stop	0x63
HardStop	A stop without deceleration	0x64
GoRight	Moves motor right without target position	0x65
GoLeft	Moves motor left without target position	0x66
Current65	Current reduction down to 65%	0x67
Current100	No current reduction (100%)	0x68
ModeDown	Stepping mode down (1/1 -> ...-> 1/8)	0x6B
ModeUp	Stepping mode up (1/8 -> ...-> 1/1)	0x6C
IntStopON	On SWI: issue a HardStop	0x6D
IntStopOFF	On SWI: issue a SoftStop	0x6E
GoBackOFF	On SWI: do not move	0x6F
GoBackON	On SWI: go a predefined steps back	0x70
SetHomeOFF	On SWI: do not change actual position	0x71
SetHomeON	On SWI: set actual position to zero	0x72
SaveParamASpeed	Save parameter bits and speed parameter	0x80
SaveActPos	Save actual position	0x81
SaveGoBackPos	Save GoBack Position	0x82
SetSpeedParam	Set Vmin, Vmax and Acc	0x90
SetParamBits	Set Current,Mode,IntStop,GoBack,SetHome	0x91
SetActPos	Set actual position	0x92
SetTagPos	Set target position	0x93
SetGoBackPos	Set GoBack position	0x94
ReadActPos	Read actual poistion	0xA0
ReadSpeedParam	Read Vmin, Vmax and Acc	0xA1
ReadParamBits	Read Current,Mode,IntStop,GoBack,SetHome	0xA2
ReadStatusBits	Read MotorON, InProcess, Shaft, SWI, CW	0xA3
ReadGoBackPos	Read GoBack position	0xA4
SetSlvAdr	Set slave address	0xF0

4.2 Command Description

4.2.1 MotorON

This command is provided to the circuit to turn the motor ON.

MotorON command (0x61)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	MotorON	0	1	1	0	0	0	0	1

4.2.2 MotorOFF

This command is provided to the circuit to turn the motor OFF.

MotorOFF command (0x62)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	MotorOFF	0	1	1	0	0	0	1	0

4.2.3 SoftStop

This command provokes an immediate deceleration to Vmin followed by a stop.

SoftStop command (0x63)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SoftStop	0	1	1	0	0	0	1	1

4.2.4 HardStop

This command provokes an immediate stop without deceleration.

HardStop command (0x64)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	HardStop	0	1	1	0	0	1	0	0

4.2.5 GoRight

Motor goes right without a target position.

GoRight command (0x65)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	GoRight	0	1	1	0	0	1	0	1

4.2.6 GoLeft

Motor goes left without a target position.

GoLeft command (0x66)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	GoLeft	0	1	1	0	0	1	1	0

4.2.7 Current65

Sets coil hold current down to 65%.

Current65 command (0x67)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	Current65	0	1	1	0	0	1	1	1

4.2.8 Current100

Sets coil hold current to 100%.

Current100 command (0x68)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	Current100	0	1	1	0	1	0	0	0

The following commands sets/clears Bits of the Byte 'ParamBits'

content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ParamBits	X	X	Current65	SetHome	GoBack	IntStop	M2	M1

4.2.9 ModeDown (M1 , M2)

This command is provided to the circuit to set the stepping mode one level down.
(1/8 → 1/4 → 1/2 → 1/1)

ModeDown command (0x6B)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	ModeDown	0	1	1	0	1	0	1	1

4.2.10 ModeUp (M1, M2)

This command is provided to the circuit to set the stepping mode one level up.
(1/1 → 1/2 → 1/4 → 1/8)

ModeUp command (0x6C)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	ModeUp	0	1	1	0	1	1	0	0

4.2.11 IntStopON

This command is provided to the circuit to issue a Hardstop command when position switch is closed.

IntStopON command (0x6D)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	IntStopON	0	1	1	0	1	1	0	1

4.2.12 IntStopOFF

This command is provided to the circuit to issue a Softstop command when position switch is closed.

IntStopOFF command (0x6E)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	IntStopOFF	0	1	1	0	1	1	1	0

4.2.13 GoBackOFF

No motion occurs, when position switch is closed.

GoBackOFF command (0x6F)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	GoBackOFF	0	1	1	0	1	1	1	1

4.2.14 GoBackON

This command is provided to the circuit to issue a GoBack command when position switch is closed. When a GoBack command is issued the motor goes a predefined steps in the reverse direction. To set the count of steps use the command 'SetGoBackPos'.

GoBackON command (0x70)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	GoBackON	0	1	1	1	0	0	0	0

4.2.15 SetHomeOFF

The actual position is not set to zero, if the position switch closes.

SetHomeOFF command (0x71)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SetHomeOFF	0	1	1	1	0	0	0	1

4.2.16 SetHomeON

This command is provided to the circuit to issue a SetHome command when position switch is closed. When a SetHome command is issued the actual position is set to zero.

SetHomeON command (0x72)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SetHomeON	0	1	1	1	0	0	1	0

4.2.17 SaveParamASpeed

The actual parameters like coil hold current, mode, etc..., and motion parameters like Vmin, Vmax and Acc will be saved.

SaveParamASpeed command (0x80)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SaveParamASpeed	1	0	0	0	0	0	0	0

4.2.18 SaveActPos

This command is provided to the circuit to save the actual position.

SaveActPos command (0x81)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SaveActPos	1	0	0	0	0	0	0	1

4.2.19 SaveGoBackPos

This command is provided to the circuit to save the GoBack position.

SaveGoBackPos command (0x82)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SaveGoBackPos	1	0	0	0	0	0	1	0

4.2.20 SetSpeedParam

This command is provided to the circuit to set the following motion parameters:

- Vmin = 0 .. 58 *
- Vmax = 0 .. 58 *
- Acc = 0 .. 4

SetSpeedParam command (0x90)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SetSpeedParam	1	0	0	1	0	0	0	0
2	Vmin	0	0	Vmin (5:0)					
3	Vmax	0	0	Vmax (5:0)					
4	Acc	0	0	Vacc (5:0)					

*s. appendix

4.2.21 SetParamBits

This command is provided to the circuit to set the following parameters:

SetParamBits command (0x91)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SetParamBits	1	0	0	1	0	0	0	1
2	ParamBits	X	SetHome	GoBack	IntStop	X	REFIN	M2	M1

	M1	M2	Stepping mode
0	0	0	1/1
1	0	1	1/2
2	1	0	1/4
3	1	1	1/8

REFIN	1	s. command Current100
	0	s. command Current65
IntStop	1	s. command IntStopON (SoftStop)
	0	s. command IntStopOFF (HardStop)
GoBack	1	s. command GoBackON
	0	s. command GoBackOFF
SetHome	1	s. command SetHomeON
	0	s. command SetHomeOFF

4.2.22 SetActPos

This command is provided to the circuit to set the actual position:

SetActPos command (0x92)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	SetActPos	1	0	0	1	0	0	1	0
2	ActPos 1	ActPos (31:24)							
3	ActPos 2	ActPos (23:16)							
4	ActPos 3	ActPos (15:8)							
5	ActPos 4	ActPos (7:0)							

4.2.23 SetTagPos

This command is provided to the circuit to set the target position. The target position is a relative position to the zero position:

SetTagPos command (0x93)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	SetTagPos	1	0	0	1	0	0	1	1
2	TagPos 1	TagPos (31:24)							
3	TagPos 2	TagPos (23:16)							
4	TagPos 3	TagPos (15:8)							
5	TagPos 4	TagPos (7:0)							

4.2.24 SetGoBackPos

This command is provided to the circuit to set the GoBack position. If Bit GoBack (Bit5 in ParamBits) is set, and the position switch closes while a motor in a motion, then a Hardstop command is issued and a motion in the reverse direction occurs. The count of steps of this reverse motion is defined in GoBackPos:

SetGoBackPos command (0x94)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	SetGoBackPos	1	0	0	1	0	1	0	0
2	GoBackPos 1	GoBackPos (31:24)							
3	GoBackPos 2	GoBackPos (23:16)							
4	GoBackPos 3	GoBackPos (15:8)							
5	GoBackPos 4	GoBackPos (7:0)							

4.2.25 ReadActPos

This function returns five bytes: 1. the slave address of the selected device and other 4 bytes, the actual position. The actual position is a signed 32 bits

ReadActPos command (0xA0)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	ReadActPos	1	0	1	0	0	0	0	0

ReadActPos Response									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address (W)	M7	M6	M5	M4	M3	M2	1	1
1	Slave address	Slave address of the selected device							
2	ActPos 1	ActPos (31:24)							
3	ActPos 2	ActPos (23:16)							
4	ActPos 3	ActPos (15:8)							
5	ActPos 4	ActPos (7:0)							

4.2.26 ReadSpeedParam

This function returns two bytes: 1. the slave address of the selected device and 3 other bytes: Vmin, Vmax and Acc.

ReadSpeedParam command (0xA1)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	ReadSpeedParam	1	0	1	0	0	0	0	1

ReadSpeedParam Response									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address (W)	M7	M6	M5	M4	M3	M2	1	1
1	Slave address	Slave address of the selected device							
2	Vmin	X	X	Vmin (5:0)					
3	Vmax	X	X	Vmax (5:0)					
4	Acc	X	X	Acc (5:0)					

4.2.27 ReadParamBits

This function returns two bytes: 1. the slave address of the selected device and 2. byte, ParamBits.

ReadParamBits command (0xA2)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	ReadParamBits	1	0	1	0	0	0	1	0

ReadParamBits Response									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave address	M7	M6	M5	M4	M3	M2	1	1
1	Slave address	Slave address of the selected device							
2	ParamBits	X	SetHome	GoBack	IntStop	X	REFIN	M2	M1

4.2.28 ReadStatusBits

This function returns two bytes: 1. the slave address of the selected device and 2. byte, StatusBits

ReadStatusBits command (0xA3)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	ReadStatusBits	1	0	1	0	0	0	1	1

ReadStatusBits Response									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave address	M7	M6	M5	M4	M3	M2	1	1
1	Slave address	Slave address of the selected device							
2	StatusBits	X	X	X	/MO	Shaft	/SWI	InProcess	/MotorON

/MotorON	1	IMT901 is disabled
	0	IMT901 is enabled
InProgress	1	Motion
	0	No motion
/SWI	1	Position switch is open
	0	Position switch is closed
Shaft	1	Direction (e.g. left)
	0	Direction (e.g. right)
/MO	1	Rotor position
	0	Rotor position - Home position

4.2.29 ReadGoBackPos

This function returns five bytes: 1. the slave address of the selected device and other 4 bytes, the GoBack position. The actual position is a signed 32 bits

ReadGoBackPos command (0xA4)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	M7	M6	M5	M4	M3	M2	1	0
1	ReadGoBackPos	1	0	1	0	0	1	0	0

ReadGoBackPos Response									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address (W)	M7	M6	M5	M4	M3	M2	1	1
1	Slave address	Slave address of the selected device							
2	GoBackPos 1	GoBackPos (31:24)							
3	GoBackPos 2	GoBackPos (23:16)							
4	GoBackPos 3	GoBackPos (15:8)							
5	GoBackPos 4	GoBackPos (7:0)							

4.2.30 SetSlvASdr

In order to change the slave address issue the following command:

SetSlvAdr command (0xF0)									
Byte	content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slave Address	A7	A6	A5	A4	A3	A2	1	0
1	SetSlvAdr	1	1	1	1	0	0	0	0
2	Slave address	SlvAdr(7:2)						X	X

5. Appendix

5.1 Vmax & Vmin Parameters

Dec	Hex	Steps/s	Dec	Hex	Steps/s	Dec	Hex	Steps/s
0	0x00	100	20	0x14	1200	40	0x28	3200
1	0x01	150	21	0x15	1300	41	0x29	3300
2	0x02	200	22	0x16	1400	42	0x2A	3400
3	0x03	250	23	0x17	1500	43	0x2B	3500
4	0x04	300	24	0x18	1600	44	0x2C	3600
5	0x05	350	25	0x19	1700	45	0x2D	3700
6	0x06	400	26	0x1A	1800	46	0x2E	3800
7	0x07	450	27	0x1B	1900	47	0x2F	3900
8	0x08	500	28	0x1C	2000	48	0x30	4000
9	0x09	550	29	0x1D	2100	49	0x31	4200
10	0x0A	600	30	0x1E	2200	50	0x32	4400
11	0x0B	650	31	0x1F	2300	51	0x33	4600
12	0x0C	700	32	0x20	2400	52	0x34	4800
13	0x0D	750	33	0x21	2500	53	0x35	5000
14	0x0E	800	34	0x22	2600	54	0x36	5200
15	0x0F	850	35	0x23	2700	55	0x37	5400
16	0x10	900	36	0x24	2800	56	0x38	5600
17	0x11	950	37	0x25	2900	57	0x39	5800
18	0x12	1000	38	0x26	3000	58	0x3A	6000
19	0x13	1100	39	0x27	3100	---	---	---