

# I<sup>2</sup>C GLCD Adapter for T6963C Manual (1.1)

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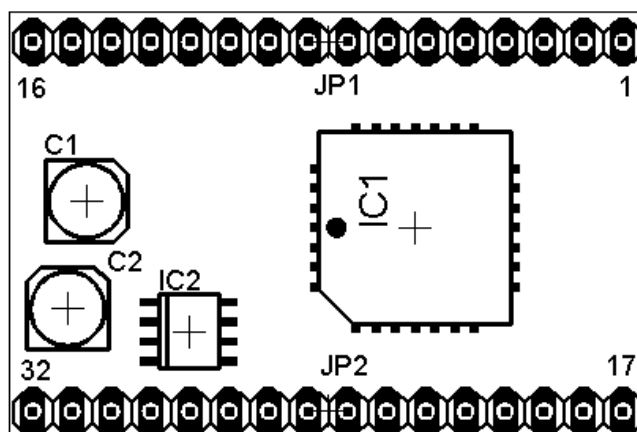
## 1. General discription

The I<sup>2</sup>C LC-Display Adapter enables easy interfacing a graphic LC-Display (T6963C) to an I<sup>2</sup>C-Bus (two wire serial interface). Communication between a host and the I<sup>2</sup>C GLCD takes places via the two wire bi-directional serial interface. It is possible to connect up to 128 devices (theoretical) on the same bus. Slave addresses are programmable via controller EEPROM.

Features:

- 5 V supply voltage
- 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
- 400 kHz byte-wide I2C-bus communication port

## 2. Pinning Information



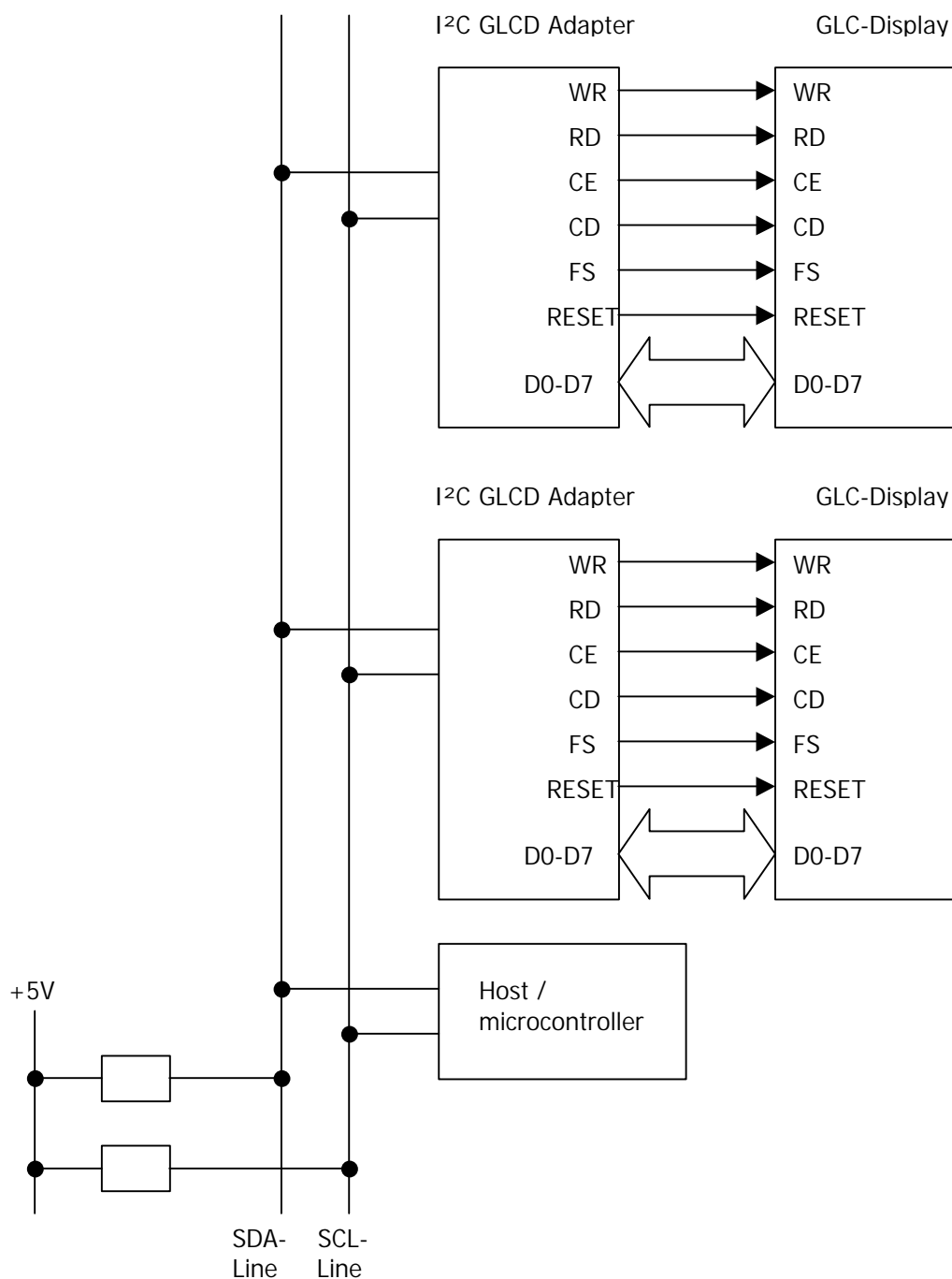
Pin	Description
1	RST RESET
2	N.C. Not connected
3	FS Font select
4	N.C. Not connected
5	CD Instruction/Data
6	CE Chip enable signal
7	RD Read signal
8	WR Write signal
9	DB7 Data Bit 7
10	DB6 Data Bit 6
11	DB5 Data Bit 5
12	DB4 Data Bit 4
13	DB3 Data Bit 3
14	DB2 Data Bit 2
15	DB1 Data Bit 1
16	DB0 Data Bit 0

Pin	Description
17	N.C. Not connected
18	N.C. Not connected
19	SCL serial clock line
20	SDA serial data line
21	N.C. Not connected
22	N.C. Not connected
23	IO1 In/Out-pin 1
24	IO2 In/Out-pin 2
25	N.C. Not connected
26	N.C. Not connected
27	GND 0V Ground
28	N.C. Not connected
29	GND 0V Ground
30	GND 0V Ground
31	GND 0V Ground
32	V <sub>DD</sub> 5V Supply voltage

## 3. Communication via I<sup>2</sup>C-Bus

### 3.1 I<sup>2</sup>C-Bus configuration

I<sup>2</sup>C-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 I<sup>2</sup>C-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 I<sup>2</sup>C-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 I<sup>2</sup>C Bus specification

### 3.3.1 Start and Stop conditions

Within the procedure of the I<sup>2</sup>C bus, unique situations arise which are defined as START (S) and STOP (P) conditions.

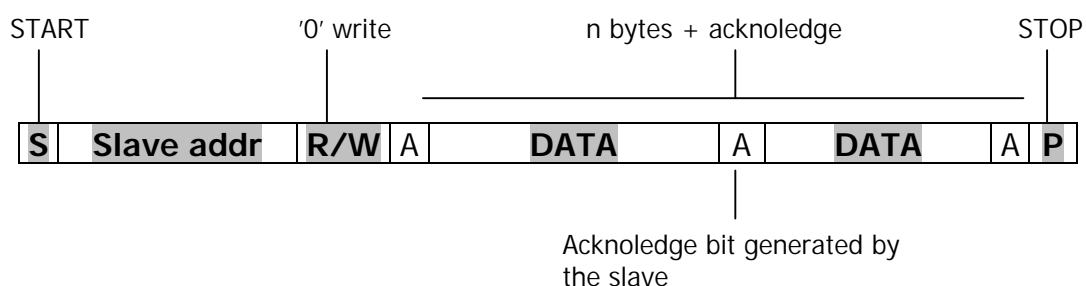
- A HIGH to LOW transtion on the SDA line while SCL is HIGH defines a Start condition.
- A LOW to HIGH transtion on the SDA line while SCL is HIGH defines a Stop condition.

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 I<sup>2</sup>C GLCD Controller

Writing data to a device on the I<sup>2</sup>C-Bus is agreed as follow:

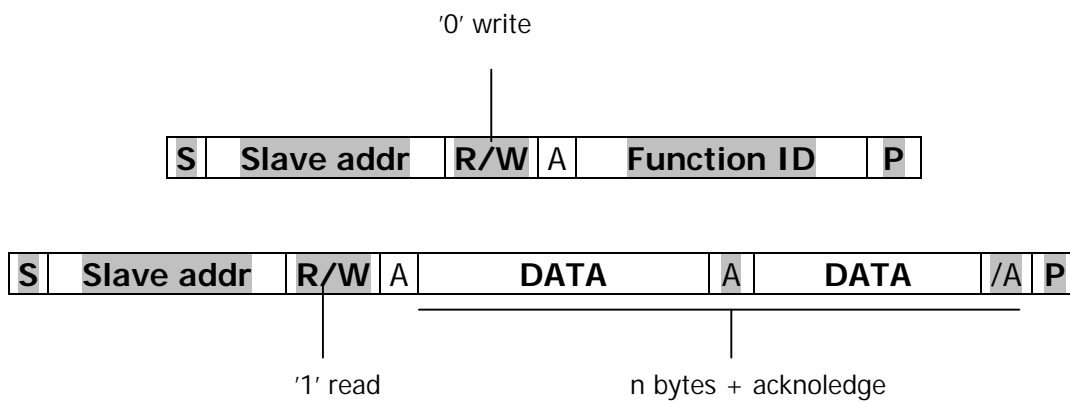
After the START condition, a slave address is sent. This address is 7 bits long followed by an eight bit which is a data direction bit ('0'=write, '1'=read) and an acknowledge bit. Any further data byte is followed by an acknowledge bit. A data transfer is always terminated by a STOP condition.



### 3.3.1 Read data from I<sup>2</sup>C GLCD Controller

Reading data from a device on the I<sup>2</sup>C-Bus is agreed as follow and it consists of two sequences:

1. The first sequence consists of four bytes of data. The first byte is the slave address and write bit. The second consists of the function ID (or more) which reads the data from the RAM of the GLCD and stores them in an internal register of the I<sup>2</sup>C GLCD 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 I<sup>2</sup>C-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
SetCursorPtr	Set Cursor Pointer	0x21
SetOffSetReg	Set Offset register	0x22
SetAddrPtr	Set address pointer	0x24
SetTxtPos	Set Text Position (Column,Row)	0x25
SetGPCPos	Set Graphic Position (Column, Row)	0x26
SetTxtHomeAddr	Set Text Home Address	0x40
SetTxtArea	Set Text Area	0x41
SetGPCHomeAddr	Set Graphic Home Address	0x42
SetGPCArea	Set Graphic Area	0x43
SetDispWidth	Set Display Width	0x44
SetDispHeight	Set Display Height	0x45
SetMode	Set Mode	0x80
SetDispMode	Set Display Mode	0x90
SetCursorPat	Set Cursor Pattern	0xA0
AutoWrite	Data Auto Write	0xB0
AutoRead	Data Auto Read	0xB1
WriteInc	1 Byte Data Write and Increment ADP	0xC0
ReadInc	Data Read and Increment ADP	0xC1
WriteDec	1 Byte Data Write and Decrement ADP	0xC2
ReadDec	Data Read and Increment ADP	0xC3
Write	1 Byte Data Write and Nonvariable ADP	0xC4
Read	1 Byte Data Read and Nonvariable ADP	0xC5
WriteDataInc	Data Write and Increment ADP (up to 254 Byte)	0xC6
WriteDataDec	Data Write and Decrement ADP (up to 254 Byte)	0xC7
ReSetPixel	Reset or Set a Pixel	0xC8
ClearTxt	Clear Text Area	0xCA
ClearGPC	Clear Graphic Area	0xCB
SetFont	Set Font (6x8 or 8x8)	0xCD
ReSetIO1	Reset or Set IO-Pin 1	0xCE
ReSetIO2	Reset or Set IO-Pin 2	0xCF
HLine	Draws a horizontal line	0xD0
VLine	Draws a vertical line	0xD1
FillRect	Draws a solid rectangle	0xD2
Rectangle	Draws a rectangle	0xD3
RoundRectangle	Draws a round rectangle	0xD4
Circle	Draws a circle	0xD5
ReadTxtHomeAddr	Read Text Home Address	0xE1
ReadGPCHomeAddr	Read Graphic Home Address	0xE2
ReadTxtArea	Read Text Area	0xE3
ReadGPCArea	Read Graphic Area	0xE4
ReadMode	Read Mode	0xE5

ReadDispMode	Read Display Mode	0xE6
ReadCurPat	Read Cursor Pattern	0xE7
ReadDispWidth	Read Display Width	0xE9
ReadDispHeigh	Read Display Heigh	0xEA
ReadFont	Read selected Font	0xEB
ReadIOs	Reads the state of IO-Pins 1 and 2	0xEC
ReadStatus	Reads the status of the GLCD	0xEF
SaveIni	Save parameter	0x70
LCDIni	Reset and initialize LCD	0x71
SetSlvAdr	Change slave address	0x73

## 4.2 Command Description

### 4.2.1 SetCursorPtr

The cursor position can only be moved by this command.

SetCursorPtr command (0x21)									
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	M1	0
1	SetCursorPtr	0	0	1	0	0	0	0	1
2	Column (X ADRS)	0 – 0x27 / 0x4F (depends on GLCD)							
3	Row (Y ADRS)	0 – 0x07 / 0x0F (depends on GLCD)							

### 4.2.2 SetOffsetReg

The offset register is used to determine the external character generator RAM area.

SetOffsetReg command (0x22)									
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	M1	0
1	SetOffsetReg	0	0	1	0	0	0	1	0
2	Data 1	D1 – Low Byte Data							

### 4.2.3 SetAddrPtr

The Set Address Pointer command is used to indicate the start address for writing to (or reading from) external RAM.

SetAddrPtr command (0x24)									
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	M1	0
1	SetAddrPtr	0	0	1	0	0	1	0	0
2	Data 1	D1 – Low address							
3	Data 2	D2 – High address							

#### 4.2.4 SetTxtPos

In order to set the address pointer to column X and row Y (cursor) in the text area issue the following command.

<b>SetTxtPos command (0x25)</b>									
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	M1	0
1	SetTxtPos	0	0	1	0	0	1	0	1
2	Column	X ADRS							
3	Row	Y ADRS							

#### 4.2.5 SetGPCPos

In order to set the address pointer to column X and row Y (as pixel) in the graphic area issue the following command.

<b>SetGPCPos command (0x26)</b>									
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	M1	0
1	SetGPCPos	0	1	0	0	0	1	1	0
2	Column	X ADRS							
3	Row	Y ADRS							

#### 4.2.6 SetTxtHomeAddr

The starting address in the external display RAM for text display is defined by this command. The text home address indicates the leftmost and uppermost position.

<b>SetTxtHomeAddr command (0x40)</b>									
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	M1	0
1	SetTxtHomeaddr	0	1	0	0	0	0	0	0
2	Data 1	D1 – Low address							
3	Data 2	D2 – High address							

#### 4.2.7 SetTxtArea

This command can be used to adjust the columns of the display (text area):

<b>SetTxtArea command (0x41)</b>									
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	M1	0
1	SetTxtArea	0	1	0	0	0	0	0	1
2	Columns	number of columns							

#### 4.2.8 SetGPCHomeAddr

The starting address of the external display RAM used for graphic is defined by this command. The graphic home address indicates the leftmost and uppermost position.

<b>SetGPCHomeAddr command (0x42)</b>									
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	M1	0
1	SetGPCHomeAddr	0	1	0	0	0	0	1	0
2	Data 1	D1 – Low address							
3	Data 2	D2 – High address							

#### 4.2.9 SetGPCArea

This command can be used to adjust the columns of the display (graphic area):

<b>SetGPCArea command (0x43)</b>									
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	M1	0
1	SetGPCArea	0	1	0	0	0	0	1	1
2	Columns	number of columns							

#### 4.2.10 SetDispWidth

This command is provided by the master to set the width of a Display (e.g. 240 pixels).

<b>SetDispWidth command (0x44)</b>									
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	M1	0
1	SetDispWidth	0	1	0	0	0	1	0	0
2	Data 1	Low Byte							
3	Data 2	High Byte							

#### 4.2.11 SetDispHeight

This command is provided by the master to set the height of a Display (e.g. 64 pixels).

<b>SetDispHeight command (0x45)</b>									
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	M1	0
1	SetDispHeight	0	1	0	0	0	1	0	1
2	Data 1	Low Byte							
3	Data 2	High Byte							

#### 4.2.12 SetMode

The display mode is defined by this command. The display mode does not change until the next command is sent. The logical OR, EXOR, AND of text or graphic display can be displayed.

SetMode command (0x80)									
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	M1	0
1	SetMode	1	0	0	0	0	0	0	0
2	Data byte	x	x	x	x	<b>CG</b>	<b>L2</b>	<b>L1</b>	<b>L0</b>

L2	L1	L0	Function
0	0	0	OR MODE
0	0	1	EXOR MODE
0	1	1	AND MODE
1	0	0	TEXT ATTRIBUTE MODE

CG	Function
0	Internal Character Generator Mode
1	External Character Generator Mode

x	Do not care
---	-------------

#### Attribute function:

The attribute operations are Reverse display, Character blink and Inhibit. The attribute data is written into area which was defined by the Set Control Word command. Only text display is possible in Attribute Function mode; graphic display is automatically disabled. However the Display Mode command must be used to turn both Text and Graphic on in order for the Attribute function to be available. The attribute data for each character in the text area is written to the same address in the graphic area. The Attribute function is defined as follows.

**Attribute RAM 1byte**    x   x   x   x   d3   d2   d1   d0

d3	d2	d1	d0	Function
0	0	0	0	Normal display
0	1	0	1	Reverse display
0	0	1	1	Inhibit display
1	0	0	0	Blink of normal display
1	1	0	1	Blick of reverse display
1	0	1	1	Blink of inhibit display

### 4.2.13 SetDispMode

The following command is provided by the master to the display mode.

SetDispMode command (0x90)									
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	M1	0
1	SetDispMode	1	0	0	1	0	0	0	0
2	data	x	x	x	x	<b>d3</b>	<b>d2</b>	<b>d1</b>	<b>d0</b>

d3	d2	d1	d0	Function
0	0	0	0	Display off
-	-	0	1	Cursor on, blink off
-	-	1	1	Cursor on, blink on
1	0	-	-	Text on, graphic off
1	1	-	-	Text off, graphic on
1	0	-	-	Text on, graphic

### 4.2.14 SetCursorPat

When cursor display is ON, this command selects the cursor pattern in the range 1 line to 8 lines.

SetCursorPat 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	M1	0
1	SetCursorPat	1	0	1	0	0	0	0	0
2	Lines	x	x	x	x	x	(3:0) Lines		

### 4.2.15 AutoWrite

Issue this command to write an array of bytes starting at position X,Y. The **AR** bit selects text or graphic area.

AutoWrite command (0xB0)									
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	M1	0
1	AutoWrite	1	0	1	1	0	0	0	0
2	Column	X ADRS							
3	Row	Y ADRS							
4	Area	x	x	x	x	x	x	x	<b>AR</b>
5	Data 1	1. data byte							
...	...	2. to n-1 byte							
n+5	Data n	n data byte (up to 252 data bytes)							

AR	Function
0	Text area is selected
1	Graphic area is selected

#### 4.2.16 AutoRead

The following command is provided by the master to read up to 128 bytes from the text or graphic display area.

<b>AutoRead command (0xB1)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	AutoRead	1	0	1	1	0	0	0	1
2	Column	X ADRS							
3	Row	Y ADRS							
4	Length	Number of byte to read							
5	Area	x	x	x	x	x	x	x	<b>AR</b>

<b>AutoRead Response</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	1
1	Slave address	Slave address of the selected device							
2	Byte 1	1. Byte							
...	...	...							
n+1	Byte n	n Bytes (up to 128 bytes; n = Length)							

#### 4.2.17 WriteInc

This command is used for writing data to external display RAM. The address pointer will be automatically incremented.

<b>WriteInc command (0xC0)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	WriteInc	1	1	0	0	0	0	0	0
2	Data byte	1 Data byte							

#### 4.2.18 ReadInc

This command is used for reading data from external display RAM. The address pointer will be automatically incremented.

ReadInc command (0xC1)									
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	M1	0
1	ReadInc	1	1	0	0	0	0	0	1
2	Length	0	Number of Bytes to read (up to 128 bytes)						

ReadInc 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	M1	1
1	Slave address	Slave address of the selected device							
2	Byte 1	1. Byte							
...	...	...							
n+1	Byte n	n Bytes (up to 128 bytes; n = Length)							

#### 4.2.19 WriteDec

This command is used for reading data from external display RAM. The address pointer will be automatically decremented.

WriteDec command (0xC2)									
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	M1	0
1	WriteDec	1	1	0	0	0	0	1	0
2	Data byte	1 Data byte							

#### 4.2.20 ReadDec

This command is used for reading data from external display RAM. The address pointer will be automatically decremented.

ReadDec command (0xC3)									
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	M1	0
1	ReadDec	1	1	0	0	0	0	1	1
2	Length	0	Number of Bytes to read (up to 128 bytes)						

ReadDec 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	M1	1
1	Slave address	Slave address of the selected device							
2	Byte 1	1. Byte							
...	...	...							
n+1	Byte n	n Bytes (up to 128 bytes; n = Length)							

#### 4.2.21 Write

This command is used for reading data from external display RAM. The address pointer is nonvariable.

Write command (0xC4)									
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	M1	0
1	Write	1	1	0	0	0	1	0	0
2	Data byte	1 Data byte							

#### 4.2.22 Read

This command is used for reading 1 byte from external display RAM. The address pointer is nonvariable.

Read command (0xC5)									
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	M1	0
1	Read	1	1	0	0	0	1	0	1

Read 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data byte	Data byte							

#### 4.2.23 WriteDataInc

In order to write an array of data bytes issue the following command. The address pointer will be automatically incremented.

WriteDataInc command (0xC6)									
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	M1	0
1	WriteDataInc	1	1	0	0	0	1	1	0
2	Data 1	1. data byte							
...	...	2. to n-1 byte							
n+1	Data n	n data byte (up to 255 data bytes)							

#### 4.2.24 WriteDataDec

In order to write an array of data bytes issue the following command. The address pointer will be automatically decremented.

WriteDataDec command (0xC7)									
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	M1	0
1	WriteDataDec	1	1	0	0	0	1	1	1
2	Data 1	1. data byte							
...	...	2. to n-1 byte							
n+1	Data n	n data byte (up to 255 data bytes)							

#### 4.2.25 ReSetPixel

This command use to set or reset a bit at X,Y – Coordinate. Only one bit can be set / reset at a time.

ReSetPixel command (0xC8)									
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	M1	0
1	ReSetPixel	1	1	0	0	1	0	0	0
2	X - Coordiante	X ADRS							
3	Y - Coordiante	Y ADRS							
4	Re/Set	x	x	x	x	x	x	x	<b>ST</b>

ST	Function
0	Set Pixel
1	Reset Pixel

#### 4.2.26 ClearTxt

This command is issued in order to clear text area.

ClearTxt command (0xCA)									
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	M1	0
1	ClearTxt	1	1	0	0	1	0	1	0

#### 4.2.27 ClearGPC

This command is issued in order to clear graphic area.

ClearGPC command (0xCB)									
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	M1	0
1	ClearGPC	1	1	0	0	1	0	1	1

#### 4.2.28 SetFont

In order to Pin FS (Font select) HIGH or LOW use this command.

SetFont command (0xCD)									
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	M1	0
1	SetFont	1	1	0	0	1	1	0	1
2	Font	x	x	x	x	x	x	x	<b>FS</b>

FS	Font
0	8x8
1	6x8

#### 4.2.29 ReSetIO1

Issue the following command to set or reset GPIO 1.

ReSetIO1 command (0xCE)									
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	M1	0
1	ReSetIO1	1	1	0	0	1	1	1	0
2	State	x	x	x	x	x	x	x	<b>ST</b>

#### 4.2.30 ReSetIO2

Issue the following command to set or reset GPIO 2.

ReSetIO2 command (0xCF)									
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	M1	0
1	ReSetIO2	1	1	0	0	1	1	1	1
2	State	x	x	x	x	x	x	x	<b>ST</b>

ST	comment
0	IO Low
1	IO High

x	Do not care
---	-------------

### 4.2.31 HLine

Issue this command to draw a horizontal line starting at position X,Y.

HLine command (0xD0)									
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	M1	0
1	HLine	1	1	0	1	0	0	0	0
2	X - Coordinate	0x00 - (depends on GLCD)							
3	Y - Coordinate	0x00 - (depends on GLCD)							
4	Length	0x00 < X < (depends on GLCD)							
5	Color	x	x	x	x	x	X	x	<b>ST</b>

### 4.2.32 VLine

Issue this command to draw a vertical line starting at position X,Y.

HLine command (0xD1)									
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	M1	0
1	HLine	1	1	0	1	0	0	0	1
2	X - Coordinate	0x00 - (depends on GLCD)							
3	Y - Coordinate	0x00 - (depends on GLCD)							
4	Length	0x00 < X < (depends on GLCD)							
5	Color	x	x	x	x	x	x	x	<b>ST</b>

### 4.2.33 FillRect

The following command is provided by the master to draw a solid rectangle on GLCD. Position X,Y is the upper left corner of a rectangle.

FillRect command (0xD2)									
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	M1	0
1	FillRect	1	1	0	1	0	0	1	0
2	Coordinate X	0x00 - (depends on GLCD)							
3	Coordinate Y	0x00 - (depends on GLCD)							
4	Height	0x00 < X < (depends on GLCD)							
5	Width	0x00 < X < (depends on GLCD)							
6	Color	x	x	x	x	x	x	x	<b>ST</b>

ST	comment
0	White (Clears pixels)
1	Black (Sets pixels)

#### 4.2.34 Rectangle

The following command is provided by the master to draw a rectangle on GLCD. Position X,Y is the upper left corner of a rectangle.

Rectangle command (0xD3)									
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	M1	0
1	Rectangle	1	1	0	1	0	0	1	1
2	Coordinate X	0x00 - (depends on GLCD)							
3	Coordinate Y	0x00 - (depends on GLCD)							
4	Height	0x00 < X < (depends on GLCD)							
5	Width	0x00 < X < (depends on GLCD)							
6	Color	x	x	x	x	x	x	x	<b>ST</b>

#### 4.2.35 RoundRectangle

The following command is provided by the master to draw a round rectangle on GLCD. Position X,Y is the upper left corner of a rectangle.

RoundRectangle command (0xD4)									
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	M1	0
1	RoundRectangle	1	1	0	1	0	1	0	0
2	Coordinate X	0x00 - (depends on GLCD)							
3	Coordinate Y	0x00 - (depends on GLCD)							
4	Height	0x00 < X < (depends on GLCD)							
5	Width	0x00 < X < (depends on GLCD)							
6	Radius	0x00 - (depends on GLCD)							
7	Color	x	x	x	x	x	x	x	<b>ST</b>

#### 4.2.36 Circle

Issue this command to draw a circle with a center at position X,Y.

Circle command (0xD5)									
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	M1	0
1	Circle	1	1	0	1	0	1	0	1
2	Coordinate X	0x00 - (depends on GLCD)							
3	Coordinate Y	0x00 - (depends on GLCD)							
4	Radius	0x00 < X < (depends on GLCD)							
5	Color	x	x	x	x	x	x	x	<b>ST</b>

#### 4.2.37 ReadTxtHomeAddr

This function returns three bytes: 1. the slave address of the selected device. The 2. and 3. data bytes are the Text Home address (16 bit).

<b>ReadTxtHomeAddr command (0xE1)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	ReadTxtHomeAddr	1	1	1	0	0	0	0	1

<b>ReadTxtHomeAddr Response</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Text Home Address – High address							
3	Data 2	Text Home Address – Low address							

#### 4.2.38 ReadGPCHomeAddr

This function returns three bytes: 1. the slave address of the selected device. The 2. and 3. data bytes are the Graphic Home address (16 bit).

<b>ReadGPCHomeAddr command (0xE2)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	ReadGPCHomeAddr	1	1	1	0	0	0	1	0

<b>ReadGPCHomeAddr Response</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Graphic Home Address – High address							
3	Data 2	Graphic Home Address – Low address							

#### 4.2.39 ReadTxtArea

This function returns two bytes: 1. the slave address of the selected device. The 2. data byte is the number of columns of the display (Text Area).

ReadTxtArea command (0xE3)									
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	M1	0
1	ReadTxtArea	1	1	1	0	0	0	1	1

ReadTxtArea 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Number of columns (Text Area)							

#### 4.2.40 ReadGPCArea

This function returns two bytes: 1. the slave address of the selected device. The 2. data byte is the number of columns of the display (Graphic Area).

ReadGPCArea command (0xE4)									
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	M1	0
1	ReadGPCArea	1	1	1	0	0	1	0	0

ReadTxtArea 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Number of columns (Graphic Area)							

#### 4.2.41 ReadMode

This function returns two bytes: 1. the slave address of the selected device. The 2. data byte is the mode of the display (s. SetMode).

ReadMode command (0xE5)									
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	M1	0
1	ReadMode	1	1	1	0	0	1	0	1

ReadTxtArea 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Mode							

#### 4.2.42 ReadDispMode

This function returns two bytes: 1. the slave address of the selected device. The 2. data byte is the display mode.

ReadDispMode command (0xE6)									
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	M1	0
1	ReadDispMode	1	1	1	0	0	1	1	0

ReadTxtArea 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Display Mode							

#### 4.2.43 ReadCurPat

This function returns two bytes: 1. the slave address of the selected device. The 2. data byte is the number of lines (1-8) of cursor pattern.

ReadCurPat command (0xE7)									
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	M1	0
1	ReadCurPat	1	1	1	0	0	1	1	1

ReadTxtArea 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Cursor Pattern (number of lines)							

#### 4.2.44 ReadDispWidth

This function returns three bytes: 1. the slave address of the selected device. The 2. and 3. data bytes are the width of a display (16 bit). (s. SetDispWidth)

ReadDispWidth command (0xE9)									
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	M1	0
1	ReadDispWidth	1	1	1	0	1	0	0	1

ReadGPCHomeAddr 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Display width – High Width							
3	Data 2	Display width – Low Width							

#### 4.2.45 ReadDispHeight

This function returns three bytes: 1. the slave address of the selected device. The 2. and 3. data bytes are the height of a display (16 bit). (s. SetDispHeight)

ReadDispHeight command (0xEA)									
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	M1	0
1	ReadDispHeight	1	1	1	0	1	0	1	0

ReadDispHeight 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	M1	1
1	Slave address	Slave address of the selected device							
2	Data 1	Display width – High Height							
3	Data 2	Display width – Low Height							

#### 4.2.46 ReadFont

This function returns two bytes: 1. the slave address of the selected device and 2. a data byte from the position (column,row) of the GLCD.

ReadFont command (0xEB)									
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	M1	0
1	ReadIOs	1	1	1	0	1	0	1	1

ReadFont 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	M1	1
1	Slave address	Slave address of the selected device							
2	Font	x	x	x	x	x	x	x	FS

FS	comment
0	8x8 characters
1	6x8 characters

#### 4.2.47 ReadIOs

This function returns two bytes: 1. the slave address of the selected device and 2. data byte is the state of IO-pins.

ReadIOs command (0xEC)									
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	M1	0
1	ReadIOs	1	1	1	0	1	1	0	0

ReadIOs 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	M1	1
1	Slave address	Slave address of the selected device							
2	State	x	x	x	x	x	x	ST2	ST1

IO	comment
ST1	0 IO Low
	1 IO High
ST2	0 IO Low
	1 IO High

#### 4.2.48 ReadStatus

This function returns two bytes: 1. the slave address of the selected device and 2. data byte is the status byte of the GLCD.

ReadStatus command (0xEF)									
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	M1	0
1	ReadStatus	1	1	1	0	1	1	1	1

ReadStatus 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	M1	1
1	Slave address	Slave address of the selected device							
2	State	STA7	STA6	STA5	STA4	STA3	STA2	STA1	STA0

The T6963C status word format is as follow:

STA0	Check command execution capability	0: Disable 1: Enable
STA1	Check data read / write capability	0: Disable 1: Enable
STA2	Check Auto mode data read capability	0: Disable 1: Enable
STA3	Check Auto mode data wite capability	0: Disable 1: Enable
STA4	Not used	
STA5	Check controller operation capability	0: Disable 1: Enable
STA6	Error flag. Used for screen Peek and screen copy commands	0: No error 1: Error
STA7	Check the blink condition	0: Disable 1: Normal display

#### 4.2.48 SaveIni

This command is issued in order to save display's parameter. These parameter are: Text Home Address, Graphic Home Address, Text Area, Graphic Area, Display Width, Display Height, Mode, Display Mode, Cursor Pattern and Font Size.

<b>SaveIni command (0x70)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	SaveIni	0	1	1	1	0	0	0	0

#### 4.2.49 LCDIni

In order to reset and initialize the GLCD issue this command. The GLCD will be initialised with parameters, which was saved with SaveIni. On power up the controller executes this function to initialise the GLCD.

<b>LCDIni command (0x71)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	LCDIni	0	1	1	1	0	0	0	1

#### 4.2.50 SetSlvAdr

In order to change the slave address issue this command and then send the new slave address. Bit 1 is hardwired.

<b>SlvAdr command (0x73)</b>									
<b>Byte</b>	<b>content</b>	<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
0	Slave Address	M7	M6	M5	M4	M3	M2	M1	0
1	WriteSlvAdr	0	1	1	1	0	0	1	1
2	Slave Address	upper 6 bits of Slave address (7:2)						x	x

x	Do not care
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