

Code Generator for HD Barcode

This manual explains operation of the Code Generator for HD Barcode. This device is used to create HD Barcodes suitable for printing or for displaying on a screen.

Understanding the Key Card (SD card)

Each Code Generator requires a Key Card to function. Some of the information stored on the Key Card includes:

- Company name
- Authorization key for this company and specific Code Generator
- Expiration date
- Lifetime maximum number of codes allowed on this Code Generator

Note: Each Code Generator has its own matching Key Card. A Key Card from another unit will not work!

How to connect the Code Generator

Make sure the matching Key Card is inserted.

Connect an Ethernet cable from your network to the unit. A wired connection is required – the Code Generator does **NOT** support a wireless connection. Your network must support DHCP.

Note: Although it is possible to connect a Code Generator directly to a computer with an available Ethernet port, this configuration is not recommended. It is usually quite difficult to properly “bridge” the networks in order for this to work correctly. To avoid confusion, connect the Code Generator directly to a network router or a network switch, but not directly not a computer.

Connect the power cable. Since the Code Generator is actually a computer running an operating system, it should be powered down “smoothly” by pushing the power button. If possible, use an uninterruptible power supply (UPS) to provide continuous power.

You must also connect a display via the HDMI port. Do NOT connect a keyboard or a mouse since the USB ports do not function.

Note: The Code Generator contains a Key Card with an expiration date. Warnings will appear on the screen during the last month before the expiration date is reached. You must send a picture of the screen to renewal@hdbarcode.com in order to extend the expiration date or to increase the number of available codes.

How to power up the Code Generator

Make sure the Key Card is inserted firmly in the SD card slot:

Note: The Code Generator will not function unless the matching Key Card is installed.

Push the large power button on the front right side of the unit. The white power indicator will illuminate immediately. It takes the unit about 2 minutes to be ready to process requests to generate HD Barcodes. Some displays show progress, but others may show a blank screen for more than a minute. Please be patient.

How to power down the Code Generator

Since the Code Generator is actually a computer running an operating system, it should be powered down “smoothly”. Push the power button. After about 5 seconds, the power light will go out and the unit will be powered down. Do not remove power or the power cable while the white power light is illuminated.

Network Information

The Code Generator identifies itself on the network with the name “HDBARCODE”.

Note: Do not connect more than one Code Generator to the same network!

If you have purchased more than one Code Generator, the intent is for each to be connected to its own separate isolated network. Code Generators are not designed to improve throughput by sharing the load. Since all Code Generators use the same name, you can only connect at most one to a network.

The Code Generator uses port 8877. Make sure that any network or computer firewalls allow this port to be used.

Upgrading Software

In the event that the software in your Code Generator needs to be updated, you will receive a new SD card. The upgrade procedure is:

1. Turn off the unit
2. Remove the old SD card
3. Insert the new SD card
4. Turn on the unit
5. Recycle the old SD card

Demo Software

Two programs are provided which demonstrate how to interface with the Code Generator.

CreateHDBarcode is a graphical Windows program which allows you to manually create HD Barcodes.

SerialDemo is a Microsoft Visual C++ program which automatically generates a series of HD Barcodes.

Source code is included for both programs.

The latest versions can be found here:

<http://www.hdbarcodesdk.com/Code%20Generator/>

Serial Demo

This program creates:

- 100 serialized public HD barcodes (readable by anyone with the reader app)
- 100 serialized company private HD Barcodes (can't read without authorization)
- 1 temporary universal authorization HD Barcode

Each barcode created is a monochrome BMP file.

The 100 public HD Barcodes are encoded with "ABCDE00001" through "ABCDE00100". They are stored in a folder named Public.

The 100 private HD Barcode are encoded with "XYZZY00001" through "XYZZY00100". They are stored in a folder named Private.

The single universal authorization HD Barcode is stored in a folder named Authorization.

Please refer to the source code for more information.

This program is written in Microsoft Visual Studio 2015, but is easily adaptable to other operating systems such as Linux or OS X. Before running SerialDemo.exe, you may need to install the Visual C 2015 Runtime package which is included.

*Note: This software was intended to be a very clear illustration of how to interface with the Code Generator. It is **NOT** intended to be a model of good programming practices. All unexpected errors are fatal and the program exits without cleaning up properly.*

CreateHDBarcode

This is a graphical Windows program which is used to generate HD Barcodes.

To install this program, download and run the following on a computer running Windows 7 or later”

<http://www.hdbarcodesdk.com/Code%20Generator/CreateHDBarcode/InstallCreateHDBarcode.exe>

Note: CreateHDBarcode is written in Visual Basic 6.0 which was obsoleted many years ago. The source code is provided mostly for illustration. However, if you wish to recompile this software yourself, it is still possible to purchase Visual Basic 6.0 on either Amazon.com or eBay.com.

Code Generator API (Application Program Interface)

The Code Generator software is a server which operates on port 8877. It accepts and then responds to binary packets.

Make sure that any network or computer firewalls allow port 8877 to be used.

Code Generator Locator via UDP

The Code Generator is a security device. As such, we have made every reasonable attempt to “lock it down”. The device's internal firewall blocks all ports with the single exception of port 8877.

This means that even though the Code Generator has a device name of “HDBARCODE”, it is usually not possible to find it on the network using normal means, because the ports used by NETBIOS and other techniques are blocked.

In order to find a Code Generator on the network, it is necessary to broadcast a UDP packet. This packet consists of the 10-character string “HDBARCODE?”. If a Code Generator sees this UDP packet, it will response with a string of the form “HDBARCODE=CompanyName” where the company name is filled in. This enables the sender to identify both the company name and the IP address of the Code Generator.

Both demo programs implement this technique in order to find a Code Generator.

TCP Packet Protocol Layer

Because TCP is a “stream” protocol and not a “packet” protocol, a simple protocol layer is needed around packets to allow them to be received in pieces but then reassembled into a single packet. There are two special bytes used for this:

0xAA	is the EndPacketByte
0xAB	is the EscPacketByte

Every packet must end with a 0xAA byte. If the packet data itself includes 0xAA and/or 0xAB bytes, then each of these must be replaced with the EscPacketByte (0xAB) followed by the inverse of the desired character. In other words:

0xAA →	0xAB followed by 0x55
0xAB →	0xAB followed by 0x54

The source code for the included SerialDemo program can be consulted as a reference.

Code Generator Command Codes

The first byte of the packet is the command code. The following command codes are implemented:

- 0x11: Set Geometry
- 0x21: Set Text
- 0x22: Append Text
- 0x31: Set Binary
- 0x32: Append Binary
- 0x41: Set Secret Phrase
- 0x42: Set Identification Tag
- 0x51: Generate Public HD Barcode
- 0x52: Generate Company Private HD Barcode
- 0x53: Generate Permanent Authorization HD Barcode
- 0x54: Generate Temporary Authorization HD Barcode
- 0x61: Retrieve First Line of BMP
- 0x62: Retrieve Next Line of BMP

The response always consists of two or more bytes.

The first byte of the response duplicates the command code.

The second byte of the response is the error code. A 0x00 means no error.

Bytes beyond the second byte only occur where there is no error. For the 0x5x series, there are three bytes after the first byte which contain the actual number of rows, columns, and error correction used. For the 0x6x series, the bytes after the first two contain binary data which is used to build a bitmap of the HD Barcode.

0x11: Set Geometry

This command code is followed by 6 byte values.

Value #1 is the number of rows. This must be an even number between 2 and 254. 0 is also allowed, which means the Code Generator can automatically select a value. 1 is also allowed, but only if the number of columns is one of the following values: 4, 8, 12, or 16.

Value #2 is the number of columns. This must be an even number between 2 and 254. 0 is also allowed, which means the Code Generator can automatically select a value. 1 is also allowed, but only if the number of rows is one of the following values: 4, 8, 12, or 16.

Value #3 is the amount of error correction. This must be a number between 2 and 17. This is the number of errors that can be corrected in each group of 48 bytes. 0 is also allowed, which means the Code Generator can automatically select a value.

Value #4 is the grid size, which is the number of pixels between adjacent parallel lines or dots. This must be a number between 3 and 32. 0 is not allowed – the grid size must be specified.

Value #5 is the style. Use 1 for lines, or use 2 for dots. No other values including 0 are allowed.

Value #6 is the line thickness or dot size. It must be a number between 1 and 8. 0 is not allowed – the thickness must be specified. The thickness should be no more than half of the grid size.

0x21: Set Text

This command is used to define the text portion to encode in the HD Barcode. Any previously set text is overwritten with this information.

This command may be sent as a single byte without any text information following the command code. In this case, the text data is removed from the next HD Barcode created.

0x22: Append Text

This command is identical to the 0x21 command, except it adds to any existing text data.

Multiple 0x22 commands may be used to generate exceptionally long text strings, but it is usually more efficient to embed a ZIP file containing an HTML representation of the text.

0x31: Set Binary

This command sets the binary portion of the HD Barcode. Only 3 formats are supported:

JPEG	(first two bytes are 0xFF and 0xD8)
PNG	(first two bytes are 0x89 and 0x50)
ZIP	(first two bytes are 0x50 and 0x4B)

If the first two bytes are not one of these three combinations, a 0x31: File Type Not Valid error will result.

This command may be sent as a single byte without any binary information. In this case, the binary data is completely removed from the next HD Barcode created.

0x32: Append Binary

This command adds to the binary portion of the HD Barcode. A previous 0x31 command must have been issued. Otherwise, a 0x31: File Type Not Valid error will result.

0x41: Set Secret Phrase

The secret phrase is used to implement encryption. Company private HD Barcodes are encrypted using the secret phrase. Authorization HD Barcodes embed the secret phrase, and are used to communicate the encryption key.

The secret phrase is just that – secret. Without knowing the secret phrase, it is not possible to read the HD Barcode. Even we here at HD Barcode, LLC cannot read the code!

Each company may have multiple secret phrases, and control who is authorized to read HD Barcodes created with each phrase. To help keep track of which readers are authorized, there is also something called an identification tag. The identification tag is paired with a secret phrase. The identification tag appears on the screens of authorized readers, but it has no value when it comes to decrypting codes – only the secret phrase matters. The secret phrase does not appear on the screen of authorized readers.

In theory, you could reuse the same identification tag for more than one secret phrase, but then this makes it next to impossible to know who is authorized and who is not.

0x42: Set Identification Tag

The identification tag is used in authorization HD Barcodes to identify the codes it will authorize. It is NOT part of the encryption process.

0x51: Generate Public HD Barcode

This command generates a public HD Barcode using previously sent information. Public means that everyone is capable of reading the code.

The command consists of a single byte. No additional bytes are allowed. If there is no error, the response consists of 5 bytes:

0x51	Duplicates the command code
0x00	Indicates no error
xx	Indicates the actual number of rows used
yy	Indicates the actual number of columns used
zz	Indicates the actual error correction used

0x52: Generate Company Private HD Barcode

This command is exactly like the 0x51 command, except that it generates a company private HD Barcode using previously sent information. A company private HD Barcode can only be read by authorized readers. This authorization comes from a different HD Barcode called an authorization HD Barcode.

0x53: Generate Permanent Authorization HD Barcode

This command is exactly like the 0x51 command, except that it generates an authorization HD Barcode. Such a code contains a secret phrase, an identification tag, and an expiration date. The expiration date is the same as the one in the Code Generator – you cannot alter it.

Permanent means once a reader learns this authorization, it keeps it as long as the app is installed.

If the command code is the only byte in the packet, then this creates a “Universal” authorization HD barcode, which means anyone can read it and become authorized.

If there is a text string after the command code, and if that string is in the form #####-#####-#####, then this creates a “Unique” authorization HD Barcode. It is only readable by an app whose reader serial number matches the number provided.

If there is a text string after the command code which is not a reader serial number, then this creates a “Cascaded” Authorization HD Barcode. A cascaded code uses two secret phrases. In order to read the code generated, the reader must have been previously authorized for the secret phrase sent in this 0x53 command. If they are capable of reading the code, then they will become authorized for the new secret phrase and identification tags which were sent in earlier 0x41 and 0x42 commands.

0x54: Generate Temporary Authorization HD Barcode

This command is exactly like the 0x53 command, except that the code generated is temporary and not permanent. This means that it is forgotten every time the user exits the reader app. In order to re-authorize reading of private codes, this code must be scanned again.

0x61: Retrieve Start of BMP

This retrieves the BMP file header. The header is always 62 bytes long and uses the following format:

File identifier	2 bytes	'B' 'M'	
Size of BMP file	4 bytes	s3 s2 s1 s0	
Reserved	4 bytes	00 00 00 00	
Offset to pixel data	4 bytes	3E 00 00 00	
Header size	4 bytes	28 00 00 00	
Image width in pixels	4 bytes	w3 w2 w1 w0	
Image height in pixels	4 bytes	h3 h2 h1 h0	
Number of planes	2 bytes	01 00	
Bits per pixel	2 bytes	01 00	
Compression	4 bytes	00 00 00 00	
Image size	4 bytes	i3 i2 i1 i0	
XPelsPerMeter	4 bytes	46 5C 00 00	(600 DPI)
YPelsPerMeter	4 bytes	45 5C 00 00	(600 DPI)
Color map entries used	4 bytes	02 00 00 00	
Important colors	4 bytes	00 00 00 00	
'0' pixel color	4 bytes	FF FF FF 00	(white)
'1' pixel color	4 bytes	00 00 00 00	(black)

If there is no error, the response is actually 64 bytes long, because the first byte is the command code (0x61) and the next byte is 0x00 indicating no error.

0x62: Retrieve Next Line of BMP

This retrieves the next line of the BMP file. The number of bytes will be equal to the image width in pixels divided by 8 rounded up to the next multiple of 4. A 1 bit indicates black, while a 0 bit indicates white.

Since every HD Barcode has a top and bottom border, the first few lines and the last few lines will be all 0's to indicate a completely white line. Since there is also a left and right border, the first few bits and the last few bits of every line will also be 0's to indicate a white edge.

If there are no more lines to send, the error code 0x62: No More Lines is sent.

Text Strings

The following commands accept text data after the command code:

- 0x21: Set Text
- 0x22: Append Text
- 0x41: Set Secret Phrase
- 0x42: Set Identification Tag
- 0x53: Generate Authorization HD Barcode

For these commands, the text which appears after the command code may not contain embedded null (0x00) characters. If UTF-8 is being used, then it must use one of the following three formats:

U+0000 to U+007F	0xxxxxxx
U+0080 to U+07FF	110xxxxx 10xxxxxx
U+0800 to U+FFFF	1110xxxx 10xxxxxx 10xxxxxx

Code Generator Error Codes

0x00: No Error

0x01: Command Code Not Valid

The command code (first byte) is either invalid, or not yet implemented.

0x02: Too Little Packet Data

The packet was too short for the command code. Some required data was missing.

0x03: Too Much Packet Data

The packet was too long for the command code. Extra data was not understood.

0x04: Invalid Text String

The text string contained embedded null characters (0x00), or characters outside of the supported UTF-8 range (0xF0 to 0xFF).

0x05: Out Of Memory

The computer was unable to obtain memory to process the packet.

0x06: Key Card Has Expired

The keycard has expired. Please contact www.hdbarcode.com to purchase a new one.

0x11: Rows Not Valid

The value for rows must be an even number between 2 and 254. 0 is also allowed, which means the Code Generator can automatically select a value. 1 is also allowed, but only if the number of columns is one of the following values: 4, 8, 12, or 16.

0x12: Columns Not Valid

The value for columns must be an even number between 2 and 254. 0 is also allowed, which means the Code Generator can automatically select a value. 1 is also allowed, but only if the number of rows is one of the following values: 4, 8, 12, or 16.

0x13: Error Correction Not Valid

The value for error correction must be a number between 2 and 17. 0 is also allowed, which means the Code Generator can automatically select a value.

0x14: Grid Size Not Valid

The value for grid size must be a number between 3 and 128. 0 is not allowed.

0x15: Style Not Valid

The value for style must be 1 for lines, or 2 for dots.

0x16: Thickness Not Valid

The value for thickness must be a number between 1 and 8. Thickness is not allowed to be more than half the grid size.

0x31: File Type Not Valid

The first two bytes of the binary file determine its type, which must be JPEG, PNG, or ZIP.

0x51: Geometry Not Set

A valid 0x11 command is needed before an HD Barcode can be generated.

0x52: Data To Encode Not Set

Either text data, or binary data, or both must be set prior to creating an HD Barcode.

0x53: Secret Phrase Not Set

Company private HD Barcodes require a secret phrase to be set.

0x54: Too Much Data For Geometry

There is too much text and/or binary data to fit in the requested geometry.

0x61: Bitmap Not Set

The BMP file cannot be retrieve until an HD Barcode is generated.

0x62: No More Lines

All of the lines in the BMP have been transmitted.