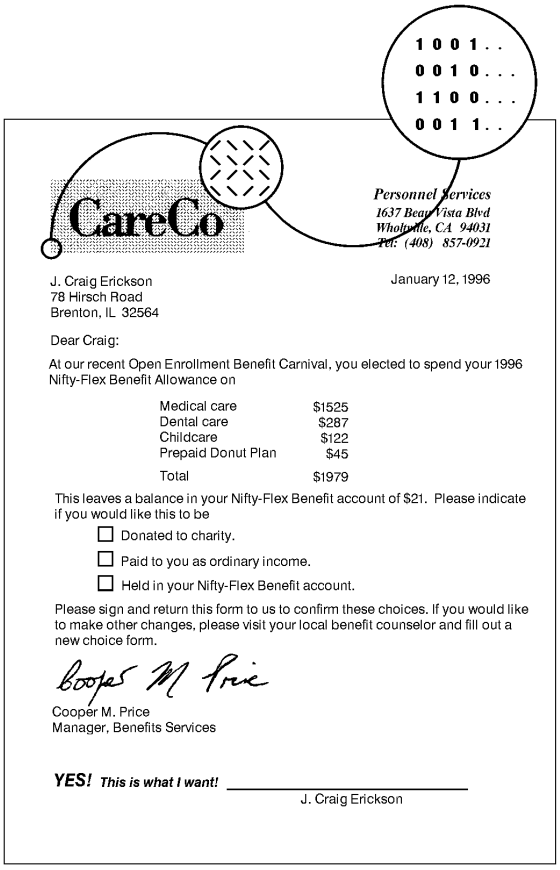
What is Xerox DataGlyph Technology?

DataGlyph technology is a new paper-electronics (papertronics) communication channel and interface paradigm. It provides supporting technology for reliable exchange and transportation of data and controls. The emphasis is on a paper communication channel to meet human and business needs in conjunction with existing and projected electronic document systems.

DataGlyph codes represent a new way for people, documents, and machines to communicate. They allow a document to carry thousands of bytes of digital ***information*** in unobtrusive gray patterns that can appear as backgrounds, shade patterns, or conventional graphic design elements. These patterns can contain digitally encoded information that can be used for finishing instructions, authenticity verification, print verification, and many other applications.

DataGlyph codes can be incorporated into the design of forms and documents and printed as gray shadings, thus eliminating the need for unsightly barcodes. ***Quality*** documents retain visual impact.

Any binary data can be contained in a DataGlyph code. DataGlyph codes can carry text information such as name, address and telephone number: as well as other digital data such as audio data, image data, and proprietary data formats. In fact, the entire contents and format of the document itself can be encoded in the DataGlyph pattern. For example, data can be compressed and/or encrypted prior to encoding. In this way, documents carrying DataGlyph codes can be used as high density, protected "paper floppy disk".



1001..
0010...
1100...
0011..

CareCo

Personnel Services
1637 Beau Vista Blvd
Wholtville, CA 94031
Tel: (408) 857-0921

J. Craig Erickson
78 Hirsch Road
Brenton, IL 32564

January 12, 1996

Dear Craig:

At our recent Open Enrollment Benefit Carnival, you elected to spend your 1996 Nifty-Flex Benefit Allowance on

Medical care	$1525
Dental care	$287
Childcare	$122
Prepaid Donut Plan	$45
Total	$1979

This leaves a balance in your Nifty-Flex Benefit account of $21. Please indicate if you would like this to be

- ☐ Donated to charity.
- ☐ Paid to you as ordinary income.
- ☐ Held in your Nifty-Flex Benefit account.

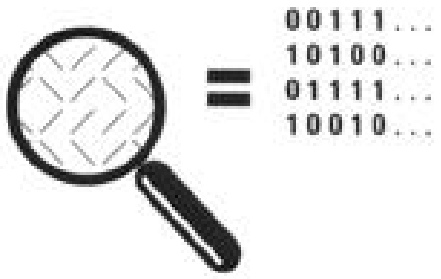
Please sign and return this form to us to confirm these choices. If you would like to make other changes, please visit your local benefit counselor and fill out a new choice form.

Cooper M. Price
Manager, Benefits Services

YES! *This is what I want!* _____
J. Craig Erickson

What is Xerox DataGlyph Code:

A Xerox DataGlyph is a new two-dimensional symbology for encoding machine readable data onto paper documents or other physical media utilizing a phase modulation technique. They encode information into thousands of tiny, individual glyph elements. Each glyph or symbol comprises a DataGlyph code. These symbols (a forward and backward slash , each at 45 degrees) represent the numbers zero and one, respectively



These symbols are referred to as Embedded Data Characters, or EDCs. Binary data can be embedded in paper documents by printing patterns of EDCs.

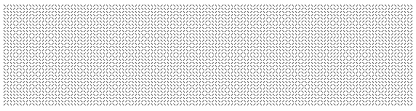
The EDC pattern is rendered using a bitmap or font and printed. On a 300 dpi printer using 5 by 5 pixel EDCs, 60 EDCs per inch can be printed, corresponding to a density of 3600 EDCs per square inch. The final DataGlyph code has the appearance of a gray shaded area with a gray density of approximately 12.0%.

Additional graphic annotation, such as logos, time stamps, and page numbers, can be added. DataGlyph codes can blend easily into the design of a document. Though the size of a DataGlyph depends upon the amount of data encoded and the degree of error correction required, the dimensions of a DataGlyph code can be adjusted to fit a particular area of a page. This makes it possible to produce DataGlyph code whose size and appearance are fully integrated into the overall look of the document. They can be placed anywhere within a document, and are easily incorporated into existing documents. The individual glyphs are grouped together on the page, where they form unobtrusive, evenly textured gray areas, like half-toned pictures. One of the reasons for using diagonal glyph elements is because research has shown that the patterns that they form when massed together are not visually distracting.

DataGlyph technology allows ordinary business documents to carry thousands of characters of information hidden in these unobtrusive gray patterns that can appear as backgrounds, shading patterns or conventional graphic design elements. Often, their presence will go completely unnoticed. (The entire Gettysburg

Address will fit in a DataGlyph about the size of a US postage stamp.)

DataGlyph areas can be printed on a document as part of its normal printing process. The information to be put in the DataGlyphs is encoded as a sequence of individual glyphs, and these can be printed either directly by the encoding software (for instance, by computer laser printer) or via a conventional printing process, such as offset.



Actual glyph – 320 characters

(Three quotes by Bertrand Russell)

The glyphs are laid down on a finely spaced rectangular grid so that the area is evenly textured. In addition, each glyph area contains an embedded synchronization lattice or "skeleton" -- a repeating, fixed pattern of glyphs which marks the boundaries of the glyph area and serves as a clocking track to improve the reliability of reading.

Before data is placed into the synchronization frame, it's grouped into blocks of a few dozen bytes and error correcting code is added to each block. The amount of error correction to be used is chosen by the application, depending on the expected quality of the print-scan cycle. Higher levels of error correction increase the size of the glyph area needed for a given amount of data, but improve the reliability with which the data can be read back. This can be very important in environments where there's a high level of image noise (for example, fax) or where the documents are subjected to rough handling.

As a final step, the bytes of data are randomly dispersed across the glyph area, so that if any part of the glyph area on the paper is severely damaged, the damage to any individual block of data will be slight, and thus easy for the error correcting code to recover. Together, error correction and randomization provide very high levels of reliability, even when the glyph area is impaired by ink marks, staples and other kinds of image damage.

DataGlyph codes can also be adjusted to accommodate the wide variety of office and commercial equipment that is used to print and scan paper documents. Documents containing Xerox DataGlyph code can be printed on dot matrix printers, desktop laser printers, and high-speed centralized printers. They can also be printed by traditional offset printing methods. DataGlyph images may be acquired for decoding using any industry-standard scanner capable of 300 dpi grayscale or binary scanning as well as by video acquisition card and standard video cameras.

The capture device generates an image and an attached processor running DataGlyph SDK-enabled software decomposes (decodes) the image into its logical components resulting in a collection of digital information. The raw recovered digital information is then passed through error correction algorithms to render the error-corrected digital data originally embedded on the printed page. The reconstructed data may then be used in applications such as controlling finishing equipment, print verification, and document return processing

.

How Can I Access DataGlyph Technology?

Xerox has approved the release of the patented DataGlyph technology through licensed third party Value Added Resellers (VARs), direct licensing to customers wishing to do their own development, and built into specially engineered DocuPrint production printing systems.

Licensing for both customers and VARs is through the DataGlyph Software Developers Kit (SDK) described in the following charts:

DataGlyph Software Developers ToolKit (SDK):

Multi-platform toolkit with a single API

Consists of 5 libraries for broad application usage

General Encode Decode Supplement SDK

Development Language is generic "C" from single source tree

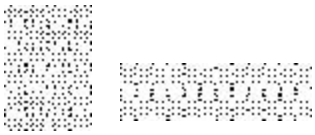
Support platforms:

PC	Sun	Main Frame
32 bit Windows/ NT	Solaris I, Solaris II	MVS
		SASS-C / IBM-C

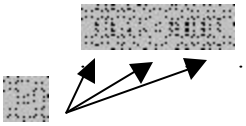
DataGlyph Toolkit Version 2.00 Functionality:

Feature	Range/Value/Comment
DataGlyph Types	Rectangular, Tiled and Occlusions
Special Processing Data	Yes(14 User defined bits)
DataGlyph Minimum Size	16 glyphs X 16 glyphs – ¼" X ¼" - 17 bytes of user data
DataGlyph Maximum Size	769 glyphs X 769 glyphs – 63,750 bytes of user data
Glyph Symbol Type	Bitmap (single/double stroke)
Glyph Symbol Size	5x5, 6x6, 10x10
Error Correction Codeword	26,64,128,255
Error Correction Parity	0,2,4, ... codeword size
Dynamic Sizing	Yes (right, bottom, both)
Output Type	Binary or Bitmap or Hex
Output Format	Binary or Font
User Data	0 to DataGlyph capacity
Decode Image Format	8-bit gray and 1-bit binary
Extensible Architecture	Yes

Rectangular



Tiled



Occlusions