DECADE ENGINEERING

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XBOB-E Application Guide ~ Firmware v2.00 ~ September 2, 2005

(*Please check our website for the latest version of this document.*)

Cautions:

ESD (electro-static discharge) safety precautions must be followed at all times when handling XBOB-E boards. Use a grounded wrist strap and grounded work surface. XBOB-E boards must be stored and shipped in static-shield (metallic, not pink poly) packaging.

Specifications:

Physical	PCB nominal length and width is 4.825 x 3.950 inches, exclusive of controls and connectors. Overall height is less than 0.75 inches. Weight is about 3.74 ounces (106g). Ambient operating temperature range is 0~50 degrees C. For XBOB-EC, the cabinet measures 5.25 (L) x 5.35 (W) x 2.00 (H) inches, exclusive of feet, controls and connectors. Total weight is about 11.3 ounces (320g).
Power Supply	Nominal supply voltage range is 8~15VDC at 90~100mA, not including power supplied to the distance encoder. Decade Engineering recommends the use of power supplies with substantially higher current ratings, e.g. 500mA, for better voltage regulation. Use a standard coaxial DC power plug with 2.1mm ID and 5.5mm OD, and wire the center pin positive. *RadioShack.com* part number 910-0902 is a suitable DC power input plug. Note that unregulated "9VDC" power supplies typically deliver about 12VDC with a light load, and "12VDC" supplies often exceed 15VDC output!
Data I/O	The data path is RS-232 asynchronous serial with crystal-controlled rates of 2400, 4800, 9600, 19.2K or 38.4K bits per second, using 8 data bits, no parity, and one stop bit (8N1). Default bit rate is 9600. Other rates are selectable with an internal DIP switch. The data I/O port is a 9-pin D series subminiature female type, intended for direct connection to a PC COM port using a straight-through (modem) male/female cable. The PC hardware handshake signals are looped back.
Video I/O	XBOB-E's video environment is RS-170A (NTSC) composite baseband, 1Vpp 75 ohms unbalanced. BNC jacks are provided for video I/O. PAL-B video compatibility is available as an ordering option. The video input accommodates up to +2.5VDC bias mixed with incoming video. The video output contains a small DC bias (+1V), which is common to many video sources and is well tolerated at the inputs to most video equipment. An internal color video background signal is automatically generated if video input is not supplied, but application programs may enforce genlock or local video modes.
Encoder Interface	XBOB-E accepts 5V incremental quadrature distance encoders. Open-collector as well as "totem-pole" encoder outputs are acceptable. The encoder connector provides regulated (±5%) 5VDC power at up to 100mA, which adds directly to XBOB-E power supply input current. The encoder updates a 24-bit count register. The count register rolls under to -00000001 and continues negative if decremented below zero. Positive or negative maximum count (16,777,215) rolls over to zero. The maximum count rate for no missing counts is 200KHz. The contents of the count register may be queried and preset by the host computer. Count data is not preserved through a power outage.

Character Format	Up to 680 characters may be displayed on screen, in 40 columns and 17 rows (16 when scrolling is active). 320 character patterns are provided as 12x13 pixel bitmaps, including upper & lower case, italics, European language support, and a set of graphics characters useful for lines, bar graphs, etc. Non-ASCII characters are accessible through a simple command protocol. 63 of the standard character patterns are stored in font RAM and may be replaced by user-defined bitmaps, to support character-based graphics displays or alternate languages.
Display Features	Only monochrome text is available in genlock/overlay mode. Characters from ROM are displayed by default in white with a thin black outline. Halftone (reduced video intensity) and black character backgrounds are optional. Characters from font RAM have less display flexibility. This includes European language support, which is part of the default RAM character set. Color display features, including character background control, are supported in local video generation mode. In local mode, blue matte background is supplied by default. Other background colors are available by command. Blinking may be selected for any character or group in either video mode. Manual adjustment of transparency as well as character and background brightness (gray scale) is optional, with external circuits. Vertical scrolling may be configured for any contiguous group of display rows. The entire text display may be toggled on or off without affecting the contents of display RAM. Writes to display RAM are permitted while the display is off. A non-volatile boot script memory stores up to 256 characters that may be used to configure XBOB-E and/or automatically generate a display at power-up time.

Note: Product specifications, policies and prices are subject to change without notice. Contact Decade Engineering to confirm current status if any specified parameter is critical to your application.

Front Panel Controls:

XBOB-E provides a power switch and power indicator LED, as well as an LED to indicate missing video at the video input connector.

Two screwdriver adjustments are provided for setting character foreground brightness (FOR) and background brightness (BAK). These settings are factory-calibrated for video levels near white and black, respectively, in the genlock/overlay mode. It is normal to see some character level variation when switching to local mode (blue screen), but it's usually best to leave the factory settings as-is unless you plan to use local mode exclusively. Use an oscilloscope or video waveform monitor to achieve accurate control settings.

A third screwdriver adjustment is provided for setting overlay transparency (MIX). The factory setting is full clockwise, resulting in maximum overlay contrast. The full CCW setting makes characters almost disappear. This control may be freely adjusted for best results in each application. Mid-range settings allow background video to show through superimposed characters, and also reduce the crawling effect sometimes seen around character edges when they're placed over intensely colored regions of the image. In local video mode (blue screen), the MIX pot must be set full clockwise.

Baud Rate Configuration:

A three-position DIP switch is provided to configure the communication bit rate. This switch is marked "CONFIG" (SW1) on the PCB. Set the three numbered switch sliders to obtain communication rates as listed in the following table:

1	2	3	Baud Rate
On	On	Off	2400
Off	On	Off	4800
Off	Off	Off	9600
On	Off	Off	19,200
Off	Off	On	38,400

Note that undefined switch setting combinations default to 9600bps. XBOB-E is shipped from the factory configured for 9600bps.

System Hookup:

For connection to a PC COM port, XBOB-E requires a 9-pin D-subminiature male/female cable assembly with all pins wired straight through. This is commonly referred to as a DCE or modem style cable. Do not use a null-modem style hookup cable.

The video output jack must be wired to the video input of a TV or video monitor, using 75 ohm coaxial cable with a BNC style plug at XBOB-E. TV inputs marked “Cable” or “RF” are not suitable. It’s not necessary to connect XBOB-E’s video input jack for a quick operating test, because XBOB-E will generate video. If you want to overlay text on video, connect the composite video output of a camera, or equivalent video source, to XBOB-E’s video input jack. This connection also requires 75 ohm coaxial cable terminated with a BNC plug.

See Power Supply specification, above, for guidance on a compatible power supply.

Distance encoders connect differently to the board and cabinet versions of XBOB. For the board version, use a Molex 22-01-2047 or equivalent crimp terminal housing, and connect a 5VDC incremental quadrature encoder directly to J3 using the following pin assignments:

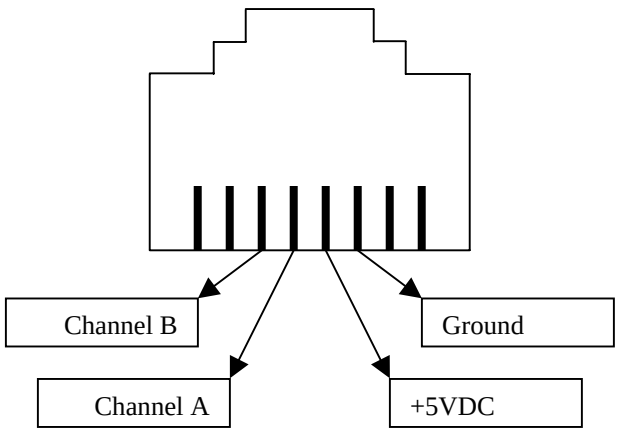
Pin Number	Encoder Conection
1	+5V auxiliary power to encoder (100mA max.)
2	Channel A signal
3	Channel B signal
4	Ground

Note that crimp contacts are often sold separately for this style of connector, and must be installed in the connector housing subsequent to wire attachment. IDC or “punch-down” style connectors are also widely available. These require a punch-down tool instead of a crimper, and are more critical with regard to wire size.

For the cabinet version of XBOB-E, a female RJ-45 style encoder connector is provided on the rear panel. Only the four center contacts are used. If telephone-style 8-conductor flat cable is installed with the blue wire on the left when looking at the face of the plug with latch side up, then wire colors at the encoder will be as follows:

Wire Color	Encoder Connection
Red	+5V auxiliary power to encoder (100mA max.)
Green	Channel A signal
Yellow	Channel B signal
Black	Ground

If another type of plug and/or cable is used, please refer to this drawing for pin assignments as viewed looking into the rear-panel encoder connector:



Video Modes:

It's important to understand the video operating modes offered by XBOB-E. The basic modes are "Local" and "Genlock". Genlock mode may also be called *overlay* mode, because video generator synchronization (genlock) must be achieved in order to superimpose characters on the image. A third video operating mode, "Automatic," derives from XBOB-E's ability to switch between the basic modes by detecting video supplied to the input jack.

XBOB-E powers up in Automatic. If there's no video input, it selects local mode. In this case, XBOB-E generates the complete video signal, and characters appear on a blue (by default) matte background. If video input is present, XBOB-E switches to genlock mode so that characters are superimposed on the externally generated video signal. XBOB-E continues to monitor incoming video and switch between the basic modes as required to maintain a video signal at the output.

Application programmers can force XBOB-E to stay in local or genlock modes if desired. Be aware, however, that video crosstalk artifacts can result from forcing local mode while video input is applied. Undesired mode switching (to local mode) due to incoming video signal dropouts or glitches can be avoided by forcing genlock mode.

Control Protocol:

Serial communication parameters are: **8N1** (8 data bits, no parity, 1 stop bit). Bit rates are configured with a DIP switch in XBOB-E. See *Baud Rate Configuration* above.

Your application program must manage the software handshake correctly if you transmit data to XBOB-E continuously at a high rate. XBOB-E transmits the **<XOFF>** character (hex 13, ctrl-S) if the receive data buffer (256 bytes) reaches 75% full, and transmits **<XON>** (hex 11, ctrl-Q) when it drops below 25% full. This is an industry-standard flow control technique that is fully compatible with common PC terminal emulation programs such as HyperTerminal[tm].

After a brief start-up delay (<300mS), XBOB-E transmits **{HR<CR>** (hardware reset) and **<XON>**, to inform the host controller that it's on-line. XBOB-E may send a garbage character or two during initialization. XBOB-E always monitors incoming video. If video status changes, XBOB-E transmits **{Vv<CR>** where "v" is T or F, indicating presence or absence of incoming video.

Any received character not preceded by the command prefix (**{**) is interpreted as ASCII text and written to the screen at the current 'cursor' (print position) location. The cursor automatically advances to the next available character cell and wraps to the next line, or back up to the first line as required. Display rows (lines) are numbered from the top down starting with zero. Display columns are numbered from left to right starting with zero. ROM characters are presented with white foreground and thin black outline by default.

Non-ASCII characters and unsupported ASCII characters are ignored in character translation modes other than 3 and 4. In those modes, transmit literal byte values (see character set illustrations) to specify each printable character. Do not send data containing the command prefix character (hex 7B) while in translation modes 3 or 4 unless you intend to send a command. Supported ASCII characters are:

A~Z a~z 0~9 ' ' , : • . ; " ( ) ? ! + - * / = % < > CR (carriage return) **SP** (space)

ASCII **<CR>** (carriage return) immediately moves the print position to the left end of the next available line.

Commands sent to XBOB-E must be prefixed by the left curly brace character: **{** All commands except **{N** and **{VW** employ a fixed-length format, and do not require a command suffix. Command salvos require a **{** prefix to each command in the string. Command letters are not case-sensitive.

Command	Description
{Ayy	Clears a single row of characters if “yy”=00~16. Clears the entire screen and sets the ‘cursor’ to top left home position if “yy”=17. Clears the scroll buffer if “yy”=18.
{BE & {BD	Display enable/disable. Enabled by default. Display RAM contents are not affected, and characters may be written to display RAM in either mode.
{Cxxyy	Moves print position (cursor). “xx” is the two-digit decimal ASCII column number (00~39) and “yy” is the row number (00~16). “yy” is ignored in scroll mode, but must be present.
{Dn	Character cell background color (local mode). “n” = 0~7. Defaults to blue.
{En	Character color for subsequent characters (local mode). “n” = 0~7. Defaults to white
{Fn	Screen color (local mode). “n” = 0~7. Defaults to blue.
{GE & {GD	Blink enable/disable. Subsequent characters flash or don’t flash in the display. Does not affect characters from RAM font.
{GCn	Blink duty cycle. “n” = 0~3. 0: Off, 1: 25%, 2: 50%, 3: 75%. Defaults to 50%
{GMn	Blink mode. “n” = 0~1. 0: Default on/off flash, 1: Pixel data reversal
{GTn	Blink rate. “n” = 0~1. 0: Default slow (1S), 1: Fast (0.5S)
{HN & {HX	Not valid in XBOB-E. Video level controls are always active.
{HHphh	Horizontal display position offset with single-pixel resolution. “p” is a polarity sign (+ or -). “hh” is a two-digit hex value in the range of 00~FF. Numeric letters may be either case. Range is limited internally, but limits vary with product version. For NTSC, the limits are –100 and +255.
{HVphh	Vertical display position offset with single-pixel resolution. “p” is a polarity sign (+ or -). “hh” is a two-digit hex value in the range of 00~FF. Numeric letters may be either case. Range is limited internally, but limits vary with product version. For NTSC, the limits are –9 and +226.
{Iyyn	Character background mode by row. “yy” = 00~16 (row number), “n” = 0~3. 0: no outline, 1: black outline, 2: cell color with char outline, 3: cell halftone (dark video) with char outline. Defaults to mode 1 in every row. RAM characters do not follow these rules, but mode 2 is useful.
{JE & {JD	Vertical scroll enable/disable. Defaults to disabled. While scrolling is enabled, received data goes into a 40-character line buffer. Buffer content scrolls into display when **<CR>** is received or buffer is filled. Only 16 lines may be displayed in scroll mode.
{JU & {JO	Scroll up/down. Defaults to scroll up.
{JSxx	Scroll block starting line. “xx”=00~14. Defaults to 14.
{JNxx	Scroll block ending line +1. “xx”=02~17. Minimum setting is starting line +2. Defaults to 17.
{JAn	Scroll buffer autoerase. “n”=0~1. 0: off, 1: on. On is the default setting.
{JT	Scroll status query. XBOB-E returns: **{SS <E/D> S=hh E=hh D=<U/D> L=hh<CR>** where E/D indicates scrolling enabled/disabled, S parameter is the starting row, E parameter is the ending row, U/D indicates up/down scroll direction, and L parameter is the buffer line number. Numeric parameters are in hex.
{Lyyhv	Sets character size by row. “yy” = 00~16 (row number), “h” = 0~1 (horizontal size), “v” = 0~1 (vertical size). Size value 1 doubles the character size in either or both directions. Defaults to minimum character size in every row.
{MF	Video mode locked to Local Generation.
{ML	Video mode locked to Genlock/Overlay.
{MM	Video automatic mode select (default). Allow time for lockup if external video is applied.
{N<data>|	Writes a boot script into non-volatile memory. Send a zero-length string to disable (default). When the termination character (vertical bar symbol) is received, XBOB-E sends **<XOFF>**, then sends **<XON>** and **{OK<CR>** upon completion of the write operation (up to 3S later). All command and printable characters count toward the maximum script length of 256 characters. **Do not include an {R command!** The script is always executed at power-up time, without a host controller, but BOB-3 also operates normally if a host is connected. Note: The termination character was **<CR>** in firmware versions previous to v2.00.
{ODh	Not valid for XBOB-E
{OPh	Not valid for XBOB-E
{P<data>	Writes user-definable character memory (font RAM). This command must be followed by exactly 1638 bytes of data, which loads all 63 user-definable characters. The data is structured as follows: Each character is 12 pixels wide by 13 tall. Data bits set to 1 (true) indicate active foreground pixels in the display. 2 data bytes represent each pixel row, starting with MSB at left end of each row. The last 4 bits of the second byte for each row of pixels are always zero. Pixel rows are sampled top-to-bottom within each character, and characters are sampled sequentially

	from character number 00 to 3E (3F is a 'transparent' space char). Notes: [1] This command could overflow the receive buffer if transmitted at high speed without pacing or flow control. [2] See default RAM character set illustration. [3] The BOB-3/XBOB-E Font Editor utility program is available without charge from Decade Engineering. See <www.decadenet.com>
{QT	If Q is true, **{U** controls RAM character background color (globally), and **{E** controls RAM character foreground color (globally) in local mode. In genlock mode, send **{U0** for black backgrounds. Other settings yield white backgrounds, so RAM characters can be made visible only be sending **{E0**.
{QF	If Q is false, RAM character background is defeated and the **{U** command controls character foreground color instead.
{QA	Engages automatic Q control mode (default). Sets Q false in genlock video mode, true in local video mode. To achieve the appearance of transparent character backgrounds in both video modes, RAM character backgrounds are set to the screen color in local mode.
{R	Forces XBOB-E system re-initialization. Restores all defaults and clears display RAM. Not allowed in a boot script.
{S	System status query. XBOB-E returns: **{ST Vv Mm Dd<CR>** where "v" is **T** or **F** (input video present or not), "m" is 0~3 (video mode; 0: auto/local, 1: auto/genlock, 2: local, 3: genlock), "d" is **E** or **D** (display enabled or disabled).
{Tn	Character translation mode. "n" = 0~4. 0: standard ASCII (default), 1: italic ASCII, 2: spatially offset ASCII, 3: non-ASCII ROM characters, 4: user-definable RAM characters. See character set illustrations for ROM characters (modes 0~3) and default RAM characters.
{Un	Background color for RAM characters (local mode). "n" = 0~7. Defaults to 4 (blue). See **{Q** commands for important details!
{V	Not valid for XBOB-E
{Wpnnnnnnnn	Preset the count register. "p" = + or -. "n" = 0~9, but magnitude cannot exceed 16,777,215. The command processor does not check for a valid argument, but it substitutes zeros for characters that are not valid ASCII numbers. Attempts to preset the count to values outside the acceptable range yield nonsensical results.
{W0	Clear the count register.
{X	Query the count register. XBOB-E responds with **{pnnnnnnnn<CR>**. The polarity symbol is always + or -.

Notes:

- If the command prefix is followed by an unknown command, XBOB-E responds with **{?<CR**>. If a command argument is out of range, XBOB-E responds with **{OR=0<CR>** and, in most cases, offending arguments are interpreted as zero. **{HH** and **{HV** parameters will be set to minimum. For **{JN** argument <2 it will be set to 2; if >17 it will be set to 17; if <= start value +1, it will be set to start +2. For **{JS** argument => end value –1, it will be set to end –2.

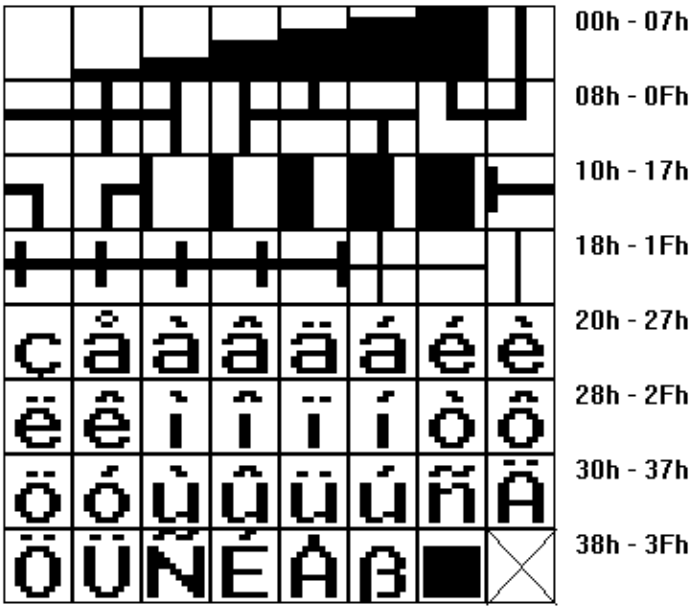
- In genlock/overlay mode, any color specification other than black causes a white display. The color controls operate normally only in local video generation mode. Command color parameters are as follows:

"n"	Color
0	Black
1	Red
2	Green
3	Yellow
4	Blue
5	Magenta
6	Cyan
7	White

- RAM characters are not treated the same as ROM characters in the display. Outlines are not available. See **{I**, **{Q** and **{U** commands for additional discussion. Include a space character in custom character sets, to avoid frequent **{T** mode switching. The space character at 3F in RAM behaves like the space character at FF in ROM. They both show screen color instead of character cell background color.

ROM Character Set:

Default RAM Character Set:



Application Programming:

Here's a simple QuickBASIC[tm] programming example:

```
' BOB-3 Test Program   ....Provides a very brief exercise....
OPEN "com1: 9600,n,8,1,cs0,ds0,cd0,op1000,rs" FOR OUTPUT AS #1
PRINT #1, "{A17"; 'Clear the screen, in case we've been playing
PRINT #1, "{C1101"; 'Print title in center of 2nd line...
PRINT #1, "BOB-3 Test Program"
PRINT #1,
PRINT #1, "Time: "; TIME$
PRINT #1, "Date: "; DATE$
PRINT #1, "{U0{D0" 'Set background attribute for RAM & ROM chars
PRINT #1, "RAM characters are next... ";
PRINT #1, "{T4"; 'Prepare to print a few RAM characters
PRINT #1, CHR$(0); CHR$(1); CHR$(2); CHR$(3); CHR$(4); CHR$(5); CHR$(6);
PRINT #1, CHR$(33); CHR$(34); CHR$(35); CHR$(36); CHR$(37); CHR$(38);
PRINT #1, "{T0"  'Return to normal ASCII translation mode
CLOSE #1
END
```

Note that RAM character codes were entered as decimal values in this example, but hex values are given as labels in the Default RAM Character Set illustration above.

The following example shows a basic method of retrieving and displaying distance information:

```
'open com port for i/o
OPEN "com1:9600,n,8,1,CS0,DS0,RS" FOR RANDOM AS #1
'clear the screen
PRINT #1, "{a17";
c = 0
'send query
PRINT #1, "{X";
'get return value
DO UNTIL (c = 13)
     value$ = INPUT$(1, #1)
     c = ASC(value$)
     'print to screen
```

```
     'disallow beginning character '{' because BOB interprets as command prefix
     IF (c <> 123) THEN PRINT #1, value$;
LOOP
CLOSE #1
```

If the overlay doesn't fit your monitor screen:

XBOB-E displays up to 17 lines of characters in both NTSC and PAL versions. The NTSC version, however, leaves little guard space at screen top and bottom, which could cause portions of these lines to be masked by video monitors that overscan excessively. If this happens to you, consider two possible solutions: [1] Don't write anything to line 0 or line 16. [2] Shift the overlay position downward with the **{HV** command and don't use line 16.

The PAL version could exhibit the opposite problem, in that excessive guard space appears above the top line and below the bottom line of displayed text. The best that can be done in this case is to move the overlay position up or down, allowing text to come closer to screen top or bottom but not both.

If the text overlay isn't stable:

Overlay jitters can be caused by weak and/or noisy input video. Typically, the video signal has been attenuated by passage through a long cable (or double termination). The best cure for long cable woes is a robust cable drive amplifier with pre-equalization for cable loss characteristics. Decade Engineering offers a Camera Adapter Board (CAB) with broad adjustment ranges and high drive capability for this purpose. A Cable Compensator or Video Processor at the receiving end may also be suitable. Bear in mind that long cables are subject to noise injection from a variety of sources, including ground loops, so the cable receiving circuit may have to deal with several kinds of signal defect simultaneously. Coaxial cable losses in the baseband video spectrum are notoriously nonlinear as a function of frequency, making long cable compensation a distinctly non-trivial exercise.

Note: XBOB-E was not designed to work with tape *playback* signals from VCRs. In many cases it will work as desired, especially with high-performance machines, but overlay stability can be unacceptable with some VCRs. It's generally worse in special effects modes (e.g. freeze frame).

If the encoder counting sense is incorrect:

Swap the encoder signal (channel A/B) wires. It's not unreasonable to install a DPDT switch, wired to allow effortless reversal of these two signals, if system operational convenience benefits from it. Your host computer could, of course, accomplish the same thing in software if desired.

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