

XBOB-4S Preliminary PCB Application Guide ~ Firmware V1.05 19 September 2008 ~ Please check our website for the latest version of this document.



Introduction

XBOB-4S provides a simple distance data overlay function for remote video inspection systems. The PCB assembly is nearly identical to XBOB-4E, but XBOB-4S does **not** communicate with a host computer during normal operation. It operates in stand-alone mode only, with four outboard keyswitches providing the operator control interface. Distance data may be displayed in one of five possible screen locations, or defeated. XBOB-4S works directly with industry-standard 5V incremental quadrature distance encoders. XBOB-4S automatically switches to internal video if the external video source is missing, which insures a stable display of distance information even if the camera fails or becomes disconnected.

XBOB-4S offers several functional improvements relative to Decade's earlier model XBOB-S (XBOB-NS), including precise distance calibration for any reasonable encoder installation. Default calibration and configuration settings may be changed by transmitting commands through a temporary RS-232 serial port connection to a PC (not the DB9 connector at the rear edge of the board). A data terminal emulation program such as Bray's Terminal or HyperTerminal provides the installer's interface.

Caution

ESD (electro-static discharge) safety precautions must be followed at all times when handling XBOB-4S boards. Use a grounded wrist strap and grounded work surface. XBOB-4S boards must be stored and shipped in static-shield (black or metallic, but not pink poly) packaging.

Specifications:

Physical	PCB nominal length and width is 4.825 x 3.944 inches (122.6 x 100.2 mm), exclusive of controls and connectors. Overall height is less than 1.50 inches (38mm). See Appendix A for detailed dimensional information. Weight is about 4.0 ounces (114g). Ambient operating temperature range is 0~50 degrees C.
Power Supply	Input voltage range is 8~15VDC at 140mA (typical), not including current supplied to the distance encoder via J8.
Data I/O	The main RS-232 interface circuit and DB9 female connector may be installed, but are not active in this version of XBOB-4. An encoder interface configuration port is provided at J7. This port requires an outboard RS-232 hardware interface circuit for connection to a PC.
Video I/O	The video environment is RS-170A NTSC or PAL-B composite baseband, 1Vpp ($\pm 10\%$), 75 ohms unbalanced. BNC jacks are provided for video I/O. 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 video background signal (black screen) is automatically generated if video input is not supplied.
Distance Encoder	XBOB-4S requires a 5V quadrature incremental distance encoder. Encoder index outputs are not used. Encoder resolution is arbitrary, but the default distance calibration is correct for 10 cycle-per-foot encoder installations, regardless of data display mode (English or metric). Open-collector as well as standard logic or "totem-pole" encoder outputs are acceptable. Internal pullups of 3.9K to +5V are provided. The encoder connector provides regulated ($\pm 5\%$) 5VDC power at up to 200mA, which adds directly to XBOB-4S power supply input current. The maximum input rate for no missing counts is greater than 200,000 phase transitions or 50,000 complete quadrature cycles per second.
Display Format	By default, distance data is displayed with a leading polarity symbol ("+" or "-") followed by four most-significant digits, a decimal point, a single least-significant digit, and a measurement units symbol ("F" or "M"). The data display may be defeated or shown in one of five possible locations: the four corners of the screen, or center. Characters are printed in white with a thin black outline, yielding good legibility regardless of video background scene content. Displayed units of distance may be English (F) or Metric (M), and may be changed freely during operation. Displayed distance may skip some values in the least significant digit, in order to display the closest calculated result.

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-4S provides a power switch and green power indicator LED, as well as a red LED to indicate missing video at the video input connector.

Two screwdriver adjustments are provided for setting character foreground brightness (FORG) and outline brightness (BAK). These settings are factory calibrated for video levels near white and black, respectively, in the genlock/overlay mode.

A third screwdriver adjustment is provided for setting overlay transparency (MIX). The factory setting is full clockwise, resulting in maximum overlay contrast. The full counterclockwise setting makes characters 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 an image.

Video Hookup

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-4S. TV inputs marked "Cable" or "RF" are not suitable. It's not necessary to connect the video input jack for a quick operating test, because XBOB-4S will generate video. If you want to overlay text on video, connect the composite video output of a camera, or equivalent video source, to the video input jack. This connection also requires 75 ohm coaxial cable terminated with a BNC plug.

Power Supply Hookup

XBOB-4S power supply input voltage range is 8~15VDC at 140mA, not including current normally supplied to the distance encoder at J8. Decade Engineering recommends the use of power supplies with substantially higher current ratings, e.g. 500mA, for better voltage regulation and long life. 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!

Encoder Hookup

Use a Molex 22-01-2047 or equivalent crimp terminal housing, and connect a 5V incremental quadrature encoder directly to **J8** using pin assignments in the table below:

J8 Pin	Encoder Connection
1	+5VDC power to encoder; 200mA maximum; adds directly to XBOB-4S power supply current. Note that removal of JP1 shunt 13~14 inserts 180R in series to this pin.
2	Channel A signal (3.9K internal pullup to +5V)
3	Channel B signal (3.9K internal pullup to +5V)
4	Ground

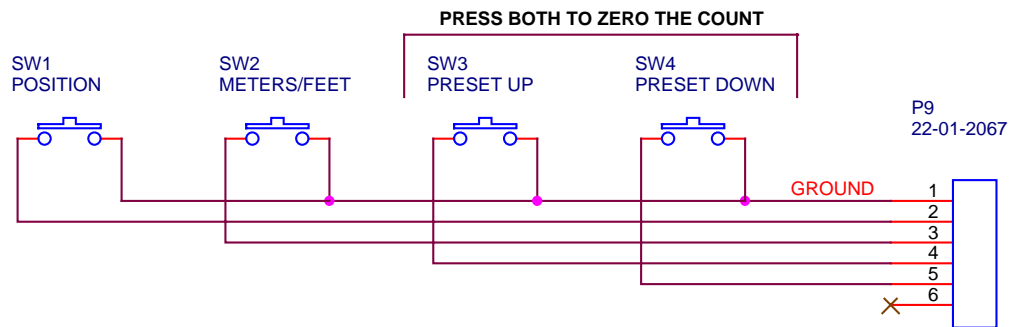
Note that crimp contacts are often sold separately for this style of connector, and must be installed in the connector housing subsequent to wire attachment. Compatible insulation-displacement (IDC) or "punch-down" style connectors are also widely available. These require a punch-down tool instead of a crimper, and are more critical with regard to wire size, but they eliminate tedious wire stripping and crimping operations.

The XBOB-4S power supply regulator can supply 200mA maximum to external devices on pin 1 of J8, which is sufficient for most distance encoders. Contact Decade Engineering if you must use an encoder that draws higher current.

Two LEDs are provided on the XBOB-4S board (D4 & D5) to confirm encoder and interface functionality. These LEDs track encoder A/B signal status visually: ON = logic high. OFF = logic low.

Operator Control Hookup

Four operator control switches must be connected to J9. These switches must be Normally Open (NO) momentary type, providing contact closure to ground (J9 pin 1) when activated. Short stroke “tactile” (snap-action) switches are preferred for this application. Use a Molex 22-01-2067 or equivalent crimp terminal housing with contacts chosen to match hookup wire size.



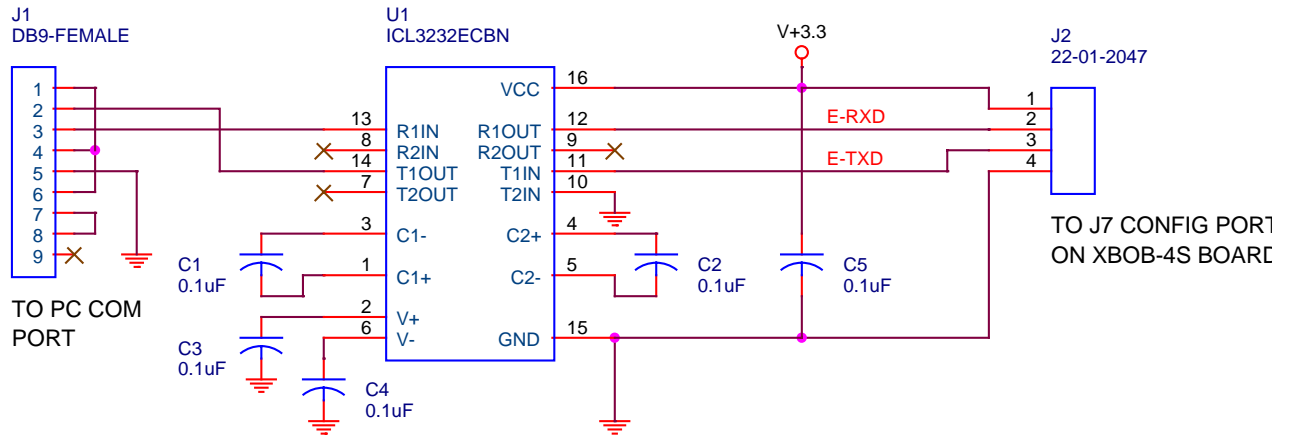
J9 Pin	Operator Control Connection
1	Ground (switch common)
2	Display Position switch
3	Metric/English switch
4	Count-Up distance preset switch
5	Count-Down distance preset switch
6	Do not connect (+3.3V output)

Caution

Be aware of ESD (electrostatic discharge) hazards! Sparks happen! Add protective networks if your switches don't guarantee that ESD strikes are shunted to ground.

Configuration Port Hookup

J7 provides PC access for XBOB-4S configuration and distance display calibration. This port operates at 9600bps, with eight data bits, no parity, and one stop bit (8N1). The required RS-232 interface hardware may be built into an adapter cable for hookup to the serial COM port of a PC. Here's an RS-232 interface circuit example:



In this example, the PC's hardware handshake signals are looped back so you don't have to deal with PC handshake setup issues. The DB9 pin connections are for a standard male/female 9-pin modem cable with all pins wired straight through. This hookup will not work with null-modem cables. Analog Devices' ADM3202 and Texas Instruments' MAX3232 are good alternates for the Intersil chip shown. The ADM3202 is available in a conventional plastic DIP-16 package.

Operation

The *Display Position* switch cycles through five possible data display positions (corners of the screen and center), and display OFF. When powered up, XBOB-S retrieves the last saved contents of the count register from non-volatile memory and displays distance at the position last selected by the Display Position switch.

The *Count Up* and *Count Down* switches allow distance register presetting and clearing. If either switch is held down for more than 10 counts, the count rate increases. Press both switches simultaneously to clear the count. Note: These functions are active even if the count is not currently displayed.

The *Metric/English* switch may be used at any time during normal operation, and causes the displayed units symbol ("m" or "f") as well as the displayed data value to be modified immediately. The current selection is saved in non-volatile memory, and will be used again at power-up time.

Note: If the distance display is decremented (by the encoder) below +000.0, it rolls under to -000.1 and counts negative from there. If incremented above +999.9, it rolls over to +000.0 and continues upward. The internal count register does not actually overflow until the raw count exceeds $\pm 2^{32}-1$, so displayed rollovers are not forgotten. The display behaves like the least-significant digits of a much larger counter. The current contents of the count register are preserved in non-volatile memory through a power-down interval and recalled to the display at power-up time.

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.

Power supply note

If the incoming power supply voltage falls below 9.0VDC, however briefly, XBOB-4S initiates an orderly shutdown sequence that would result in complete cessation of microprocessor activity if not for the watchdog timer causing a system reset about one second later. Bear this in mind when testing the non-volatile data memory function, or if erratic operation occurs.

If the data 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-4S 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).

Configuration Commands

The command prefix **<CSI>** is a two-character escape sequence consisting of two special code bytes: **<ESC>** (0x1B, Ctrl-[), and **“[“** (0x5B); otherwise known as the **<CSI>** (Control Sequence Introducer). PC terminal programs normally generate **<CSI>** with just two keystrokes: “Esc” followed by “[“.

c <CSI>n;m Distance calibration

If **n=0**, the raw count is multiplied by **m** to get feet display. **m** is a positive floating point number with a maximum of 15 digits to the right of the decimal point. If **n=1**, then **m** is the desired display value at the current count (the actual calibration multiplier is calculated internally). For metric display, the result is further multiplied by 0.3048. The default calibration multiplier is 0.1000, which is appropriate for a 10 cycle per foot distance encoder installation.

d <CSI>n Set number of digits to the right of the decimal point

n = 0~4. Display width is not changed. Default = 1.

f <CSI>n Set font

For **n=0** (default), use 12x13 pixel font. For **n=1**, use larger 13x32 font.

p <CSI>n;x;y Set starting print position (row & column) for each of five display locations on screen

n = data display location, **x** = column position, **y** = row position. See table for default values:

Display Location	Column (x)	Row (y)	Comment
0	0	0	Upper left
1	26	0	Upper right
2	14	7	Center
3	0	15	Lower left
4	26	15	Lower right
5	N/A	N/A	Display OFF

Note that locations listed in the Comment column are based on the 12x13 default font and default data field width.

r <CSI>r Restore default configuration values

s <CSI>s Transmit status report

u <CSI>n;m Set units label

If **n=0**, label is for English units (feet). If **n=1**, label is for metric display. **m** is decimal ASCII code value of character desired for label. If **m=32**, (ASCII **<SP>**; the space code), no label is displayed. Defaults are “F” and “M”. ASCII tables are widely published on the web. Here’s one: <http://www.asciitable.com/>

v <CSI>nv Set video standard

For **n=0** (default), use NTSC. For **n=1**, use PAL.

w <CSI>nw Number of characters in the data display

n = width of the numeric display *including the sign character but not the units label*. Default is seven characters. With a single place to the right of the decimal (default), the distance data display consists of a sign character, four digits left of the decimal point, a decimal point, and one digit to the right of the decimal point. Also see **d** command.

Obligatory Boilerplate

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