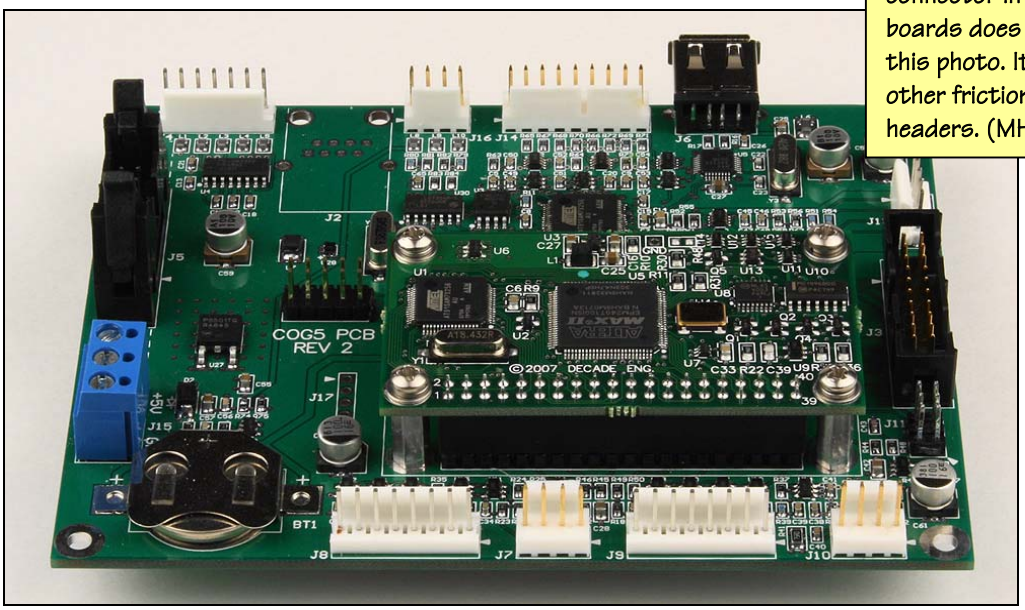
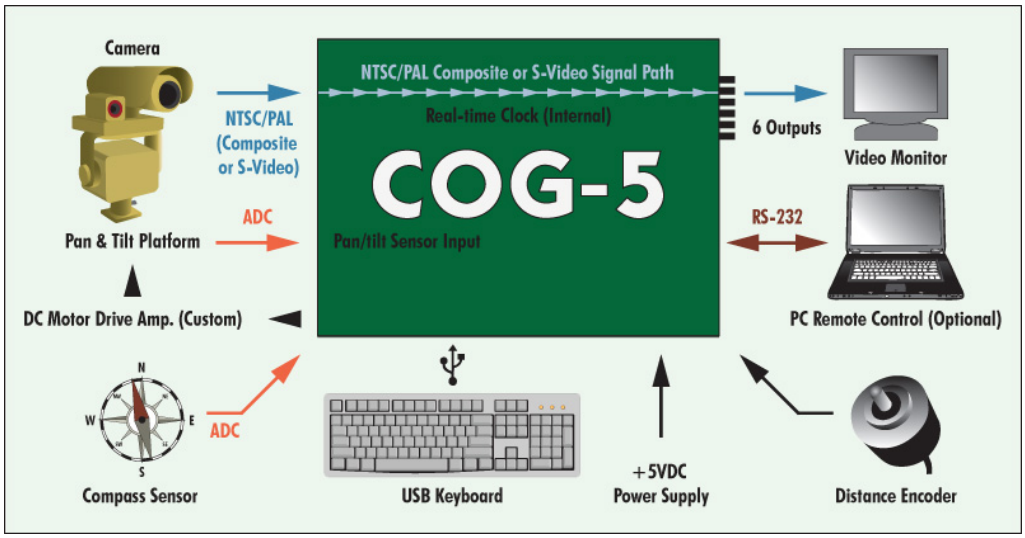
COG-5 Preliminary Application Guide (Firmware V5.3.2)

15 July 2010

Note: The USB keyboard connector in production boards does not match this photo. It's like the other friction-latch pin headers. (MH)





Introduction

COG-5 is an intelligent video character overlay generator with input/output interfaces to complement the requirements of commercial and industrial video remote inspection systems. It superimposes text over video from composite or Y/C (S-Video) sources and distributes output video to as many as six destinations. Overlay data comes from an on-board clock, distance encoder, camera pan/tilt angle sensors, compass sensor, keyboard, and other peripheral devices. COG-5 can also control camera pan/tilt platforms through analog voltage output channels. COG-5 may be operated in stand-alone mode, directly from a PC-compatible USB keyboard, or through an RS-232 serial link to a host computer. An Ethernet remote control interface is planned for later introduction.

Specifications

Physical	Board outline dimensions are 4.00 x 5.00 inches. Overall height, exclusive of (optional) ejector handles on J5, is 0.86 inches, with 0.70 inches of this above the surface of the board, which is 0.06 inches in thickness. Weight is 0.226 pounds (102g) including Lithium coin cell and BOB-4H video module. COG-5 is currently specified for the commercial operating temperature range: 0~50°C.
Power Supply	COG-5 requires high-quality 5VDC ±5% regulated power at J15 and consumes about 260mA with a typical USB keyboard attached, no distance encoder or other peripheral devices, and a single video output in service. The Ethernet LAN option increases load current by up to 300mA, if populated. Decade Engineering recommends a power supply rated at 1A, to insure ample margin under all operating conditions. Installers must include over-current protection in COG-5 power supply arrangements. A BR2032 (Panasonic) or equivalent 3V Lithium coin cell is required for timekeeping. This item is normally pre-installed at the factory. A raw power failure detector (PFD) for 12VDC upstream sources is provided on a separate pin of J15. If connected and configured, the PFD input can trigger storage of distance data to flash memory when system power drops below +9.0V. This is not a main power supply input option! The main +5VDC power supply input must hold up for at least 35mS subsequent to the PFD event.
Async Serial I/O	J4 and J5 both provide access to the processor's UART0 RXD and TXD lines, interfaced to RS-232 specs through an industry-standard IC. The pinout at J5 accommodates hookup to a 9-pin PC COM port with ribbon cable and IDC connectors. J4 also carries the processor's debug UART RXD and TXD lines, with RS-232 hardware interfacing and additional pins to facilitate factory board testing.
Keyboard Interface	COG-5 uses a standard PC USB keyboard connected at J6. Keyboard power supply current adds directly to COG-5 power supply input requirement.
Distance Encoder Interface	Incremental quadrature distance encoders operating on 5VDC power may be connected at J16. Encoder power supply current adds directly to COG-5 power supply input requirement. Maximum encoder count rate is 900KHz in early production boards.
Analog Input	Four analog voltage (ADC) inputs are provided at J13. Basic measurement resolution is 10 bits (0.1%). All ADC inputs are low-pass filtered to 5Hz and scaled with 1% resistors to yield a 5V input range with 1.34 megohms load resistance. Standard COG-5 firmware uses the analog inputs to measure camera pan/tilt angles and compass heading (with a Dinsmore R1655 sine/cosine magnetic sensor).
Analog Output	Three analog voltage outputs with zero to +5V range are provided at J14. These are low-pass filtered (5Hz) and buffered PWM outputs from COG-5's microcontroller chip. Two outputs include 511R series resistors. The third is direct from its OPA2348 buffer chip, and requires at least 470R in series if capacitive load is significant. Standard COG-5 firmware uses these outputs to control motor-driven camera pan/tilt platforms. Additional circuitry provides analog inputs at J14 for optional joystick or equivalent manual pan/tilt controls.
Misc. I/O	System Expansion Port (J3): I^2C bus pins have internal 4.7K pullups to +5V. Eight additional digital I/O pins conform to 3.3V CMOS logic specs. Inputs are 5V-tolerant, except that hard 5V drive is not allowed during system reset. Resistance in series to input pins must not exceed 500 ohms. Maximum logic output current is 2~8mA depending on the pin. Two of the digital I/O pins may also serve as ADC inputs. See J3 pin assignment table for details. Standard COG-5 firmware does not currently use this port. An optional JTAG TAP (debug port) for the system processor is provided at J1 (not factory-installed). An optional BOB-4 debug serial port is provided at J17 (not factory-installed). This port is hard-coded to run at 115.2kbps, 8N1, without handshake, and requires an external 3.3V RS-232 hardware interface adapter if used. See BOB-4 Application Guide for additional information.

Ethernet LAN	Not currently implemented (J2).
Video I/O	COG-5's video environment is RS-170A (NTSC) or PAL-B composite baseband, 1Vpp 75 ohms unbalanced. Video AGC (automatic gain control) with ±6dB range is provided in the composite/luma input channel only. Y/C video (S-Video) is directly accommodated. The video inputs tolerate up to 2.5VDC bias mixed with incoming video. Four independent composite or Y/C video outputs are provided, as well as two independent composite video outputs derived by mixing Y/C video. All video outputs contain a small DC bias (about +1V when properly terminated), which is common to many video sources and is well tolerated at the inputs to most video equipment. A 'local' video signal (black background) is generated by default if video input is not present.
OSD Character Format	On-screen data display capabilities are provided by Decade's BOB-4H module. Please refer to the BOB-4 Application Guide for a full description, but note that only a small subset of these functions will be implemented in COG-5 unless additional customer requirements are identified. Superimposed characters are monochrome only: white with a thin black outline. Text is displayed within a grid of 52 character columns and 16 (NTSC) or 19 (PAL) rows.
System Processor	The compute engine in COG-5 is Atmel's 32-bit AT91SAM7S256 with ARM7 TDMI core operating at 48MHz. This processor carries 64KB of SRAM and 256KB of flash memory on board.
Data Memory	COG-5 includes supplemental non-volatile data memory; currently a 512KB Atmel DataFlash® chip with SPI serial interface.

Major COG-5 Features

Text display functions

A seven-character ID field may be displayed in addition to Distance, Time, Date, Pan Angle, Tilt Angle, and Compass Heading Angle fields in a compact 'data stack' that moves *en masse* to any screen position. Gaps left in the stack from unused data fields are closed automatically.

- A 'TV typewriter' function allows free-form comments to be typed at any screen position.
- A persistent one-line title bar may be configured to appear on any screen line.
- Up to 26 one-line observation codes can appear briefly on any screen line.
- Up to five title screens can appear individually or in a timed 'slide-show' sequence.

Video pointer

A single flashing triangular arrow character can be moved to any position on screen.

Distance encoder

COG-5 accepts industry-standard 5V quadrature incremental encoders for distance measurement. Distance information may be displayed conveniently in two alternate formats, such feet and meters, and precise distance display calibration for any reasonable combination of encoder and measuring wheel can be achieved by following on-screen instructions.

Time of day

The on-board real-time clock circuit is powered by a Lithium coin cell with design lifetime in excess of five years. Date and time setup is performed through on-screen prompting. System operators may enable date and time display fields individually.

Camera pan & tilt

A pair of analog voltage inputs is provided for pan and tilt position sensors with outputs in the zero to +5VDC range. A calibration procedure compensates for individual sensor variation to allow precise display of pan/tilt angles.

DC voltage outputs are provided to operate camera pan/tilt platforms through external motor drive amplifiers (not supplied by Decade Engineering). These outputs may be controlled through the keyboard, with high, medium, and low preset speeds configured via on-screen setup, and with external switches and speed control pots. Compatible motor drive amplifiers must have differential inputs with zero to +5VDC minimum common-mode input range.

Up to 12 camera platform positions may be stored in non-volatile memory and recalled to automatically drive the platform back to stored positions.

Compass heading

A pair of analog voltage inputs is provided for the sine and cosine outputs of a low-cost compass sensor, such as Dinsmore's R1655. Sine and cosine voltage input ranges are zero to +5VDC. A simple compass calibration procedure automatically compensates for normal sensor production tolerances. Display resolution is one degree. The compass heading display may be enabled or disabled independently of other data display fields.

RS-232 remote control

Remote computers can assume full control of COG-5 through the RS-232 serial port, using it as a peripheral device to collect measurement data from local sensors and output control signals. COG-5 configuration memory may be uploaded (to a PC) and downloaded, including all segments of text memory. This feature allows multiple COG-5s to be configured identically with minimum installer effort. Decade Engineering encourages all customers to upload and save configuration data in case it becomes necessary to repair or replace individual COG-5 boards.

Field firmware upgrade

Customers can replace the firmware program that controls COG-5 (in flash memory), by using a Windows PC utility program from Decade Engineering and a simple RS-232 adaptor cable. See upgrade procedure in this document.

Differences Relative To COG-4

Hardware

COG-5 is designed in the same 'form-factor' as COG-4, so there's no change in basic mounting arrangements, but it needs a bit more vertical clearance (see specs). A BOB-4H module is mounted piggyback on COG-5, hence the added height. COG-5 boards are delivered with the BOB-4H module installed and tested, as a single purchasing line item. Lithium coin cell mounting arrangements differ, but frequent access isn't necessary.

COG-5 requires a USB keyboard (at J6), which is probably the only installation change that affects all customers. The auxiliary RS-232 port is now J4, and its pinout has been modified to facilitate factory testing. The remaining connector locations and reference designators have shifted relative to COG-4, which could alter mating cable length requirements, but **pin assignments within those connectors are unchanged**.

The video standard is configured automatically to match incoming video (NTSC or PAL). The video gain trimmer in COG-4 was deleted because COG-5 has video AGC (automatic gain control). The power fail detector (PFD) voltage threshold trimmer has also been deleted, in favor of a fixed threshold intended for 12VDC raw power supply systems. **Please do not misinterpret this comment — COG-5 requires 5VDC power, just like COG-4**. The PFD input is an optional connection **upstream** of the customer's 5V power supply regulator.

Firmware

COG-5 operation will seem almost unchanged from COG-4. Displayed character size is slightly smaller, yielding increased on-screen information density. Operators may notice additional information in the Help and configuration screens.

Most customers don't have application software for COG-4 because they operate it in stand-alone mode. If you are using the RS-232 remote control port on COG-4, then be aware that Decade Engineering has changed the control protocol in COG-5 for conformance with other current products (BOB-4 and XBOB-4).

Operating Instructions

Press F1 to view the 'Help' and system configuration screens. Decade Engineering has attempted to make all of these items self-explanatory with improved on-screen prompting, but a separate COG-5 Operator's Guide may be offered as well. When available, this item will be published at www.decadenet.com.

Cautions!

Do not allow the board to rest on bare metal or other conductive surfaces prior to installation! COG-5 is supplied with a Lithium coin cell installed, which means that some circuits on the board are always live.

ESD (electro-static discharge) safety precautions MUST be followed at all times when handling COG-5 boards. Use a grounded wrist strap and grounded static-dissipative work surface. COG-5 boards must be stored and shipped in static-shield (metallic, not pink poly) packaging with buried metal or outside metal layers.

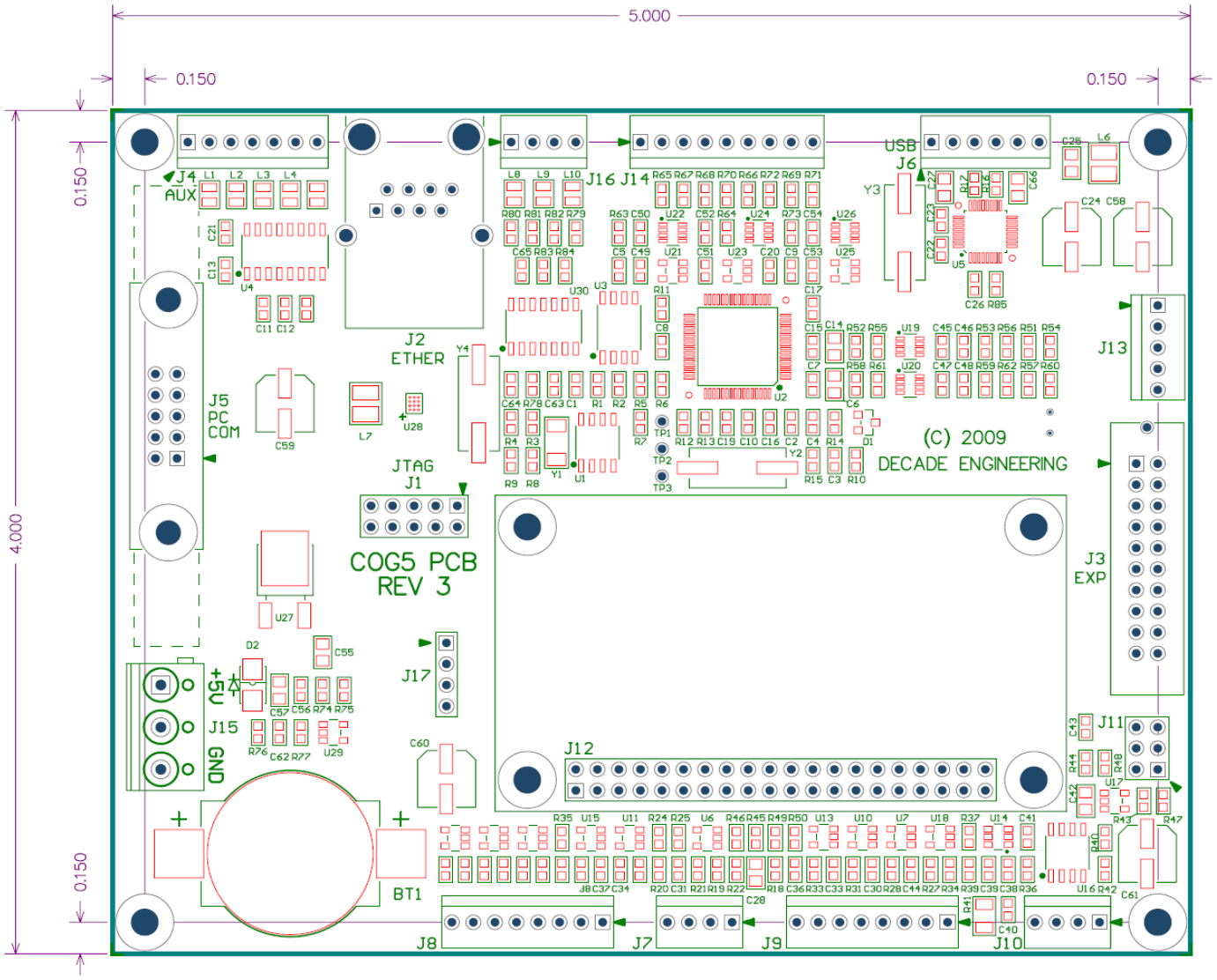
COG-5 is not designed to tolerate power supply shortcomings. Be certain that you have a stable 5VDC power supply, regulated to ±5% or better, BEFORE proceeding with COG-5 application development. Applied voltage must never exceed +5.500V under any circumstances, however briefly. Higher voltages or poor regulation can cause flash memory corruption as well as permanent hardware damage, and such damage is not covered by the warranty. Power supply voltage overshoots must not occur at turn-on or turn-off time, or when power supply load conditions change.

Decade Engineering has confirmed that Elenco model XP-660 and XP-760 benchtop power supplies can generate severe output voltage transients at turn-off time, apparently due to arcing at power switch contacts and lack of inter-winding shields in the transformer. These transients can sometimes blast through downstream voltage regulator chips and destroy modern digital ICs such as those in COG-5. IC damage may be slight at first, but it's cumulative, and total failure soon develops. It's almost certain that other low-cost power supply units exhibit similar defects. An arc suppression network added across AC line switch contacts might solve the problem, but full confirmation is required. Don't attempt power supply modifications of this nature without a complete understanding of the safety issues.

External circuitry connected to COG-5 must prevent ESD strikes (electrostatic discharge) from reaching any connector. It's best to treat all pins with the same ESD preventive measures as industry-standard CMOS logic chips. Consult with Decade Engineering on countermeasures and exceptions if necessary.

Use the correct mating connectors. Soldering directly to COG-5 voids the warranty.

Mounting Hole & Connector Locations



Dimensions are given in inches. The four corner mounting holes are 0.128” ID, to clear #4 size machine hardware.

Connector Pinout & Hookup Notes

The pin #1 location is marked with a triangular symbol on the PCB at all COG-5 connectors. Any connectors not called out in this document are reserved for product development or manufacturing use.

Most of the COG-5 user connectors (except J3, J5, and J15) are Molex KK series .100" friction-lock square-post headers. They mate with Molex 'crimp & poke' female connector housings or with Amp MTA-series .100" IDC female plugs. We like the IDC plugs, but a compatible punch-down tool is required, and they're restricted to a single wire size within each plug. Crimp & poke housings allow different wire sizes to be mixed in the same plug. Note that contacts are usually sold separately for the Molex connector housings. Digi-Key stocks a lot of the Molex stuff. Amp's CST-100 series is a similar product.

J15: Power supply input connector

Pin	Function
1	**+5VDC input, regulated to ±5%. DO NOT CONNECT 12-VOLT POWER HERE. DAMAGE WILL RESULT.**
2	Power fail detector (PFD) input; +9.0V threshold
3	Ground

It is critically important to avoid connecting 12V power to J15 pin 1. COG-5 (without Ethernet option) requires up to 300mA plus additional power supply current for all peripheral loads (keyboard, encoder, etc.). A power supply current rating of 1A is suggested. Customer must provide over-current protection.

COG-5 may be configured to preserve the most recent distance data through power failures. This feature depends on detecting power supply voltage decay prior to complete dropout. If power failure detection is required, connect the raw +12VDC supply voltage upstream of your 5V regulator to J15 pin 2. The +5VDC input must hold up for 35mS subsequent to PFD going below +9.0VDC, which allows time for writing distance data to flash memory. This would normally be achieved by using a large energy-storage capacitor on the raw power supply input to the customer's 5V regulator subsystem. It's usually wise to add a series diode as well, so that upstream loads cannot drain the capacitor prematurely.

J6: USB keyboard

Pin	Function	Pigtail Color
1	Ground (shield)	Gray
2	Ground (signal and power)	Black
3	D+ (differential data plus)	Green
4	D– (differential data minus)	White
5	+5VDC power output for keyboard	Red
6	Power detect input option (do not connect)	N/A

Keyboard power adds to COG-5 main power supply current requirement.

Color callouts above refer to Molex connector part numbers 84729-0001 (28ga) and 84729-0002 (20ga). These are chassis-mounting industrial USB jacks with pigtail wires that may be convenient for customer installation with COG-5. Don't increase pigtail length — use six inches or less for reliable USB keyboard communication — and twist the D+/D– pair to maintain differential signal balance.

J16: Encoder

Pin	Function
1	+5VDC power output for encoder
2	Channel A signal input (with 1K pullup to +5V)
3	Channel B signal input (with 1K pullup to +5V)
4	Ground

Uses standard 5VDC quadrature encoder. Encoder index output, if present, is not connected. Encoder load current adds to COG-5 main power supply current drain.

J10: Composite video input or Y/C (S-Video) input

Pin	Function
1	Chroma (C) input for Y/C video, 0.3Vpp into 75 ohms (leave open unless using S-Video)
2	Ground
3	Composite video input, or luma (Y) input for Y/C video, 1Vpp into 75 ohms
4	Ground

The composite video input on J10 pin 3 has internal AGC that corrects video input level errors within a ±6dB range. In addition, a shunt may be added across J11 pins 1~2 to enable high-frequency boost that offsets excessive high-frequency video losses in a long cable. These features do not eliminate the need for cable pre-compensation in the camera head, but they can help some remote viewing systems work better under difficult conditions.

J8: Chroma (C) outputs for Y/C video

Pin	Function
1	Ground
2	Chroma output A
3	Ground
4	Chroma output B
5	Ground
6	Chroma output C
7	Ground
8	Chroma output D

J8 is not used in standard composite video applications. For best performance, use pin 2 if only one output is needed. All outputs deliver 0.3Vpp into 75-ohm loads.

J9: Composite video outputs or luma (Y) outputs for Y/C video

Pin	Function
1	Ground
2	CV/Luma output A
3	Ground
4	CV/Luma output B
5	Ground
6	CV/Luma output C
7	Ground
8	CV/Luma output D

J9 is the primary video output port for standard composite video applications. For best performance, use pin 2 if only one output is needed. All outputs deliver 1Vpp into 75 ohms.

J7: Composite video outputs for Y/C video

Pin	Function
1	Ground
2	CV output A
3	Ground
4	CV output B

J7 provides two composite video outputs derived by mixing the Y/C inputs in S-Video applications. J7 also provides two additional CV outputs in composite video applications. For best performance, use pin 2 if only one output is needed. Both outputs deliver 1Vpp into 75 ohms.

J5: Primary RS-232 serial data port

Function	Pin		Function
1, 2, and 7 are linked	1	2	1, 2, and 7 are linked
TXD0 - transmit data 0	3	4	4 and 6 are linked
RXD0 - receive data 0	5	6	4 and 6 are linked
1, 2, and 7 are linked	7	8	N/C
Ground	9	10	N/C

J5 is designed for connection to a 9-pin PC COM port or equivalent, using ribbon cable and IDC connectors at both ends with pin 1 routed to pin 1. The linked pins in J5 are loop-back connections for PC hardware handshake signals, which can simplify PC application programming. TXD0 and RXD0 are duplicated at J4.

3M part number D89110-0131HK (with polarizing bump) is one of numerous possible female plug connectors to mate with J5. The matching cable strain relief option is 3M part number D3448-89110. Use a DB9 style female plug at the opposite end of this cable, to mate with PC COM ports. Trim the tenth conductor away, to make the cable fit into this connector. Amp part number 1658614-4 is one example among many possibilities for the DB9 connector.

Decade Engineering plans to install 3M part number N3793-6002RB (without ejectors) for the box header receptacle at J5, leaving customers the option of adding short or long ejector handles if desired. The short handles, which accommodate plugs **without** cable strain relief, are 3M part number N3505-30B. Long handles, for plugs **with** strain relief, are 3M part number N3505-31B. Both items are stocked by Digi-Key at this writing. Note that connectors other than the planned 3M type may appear in early production COG-5 boards.

J4: Auxiliary RS-232 serial data port

Pin	Function
1	+3.3VDC power output
2	Test (do not connect)
3	RXD0 - receive data 0
4	TXD0 - transmit data 0
5	DRXD - debug receive data
6	DTXD - debug transmit data
7	Ground

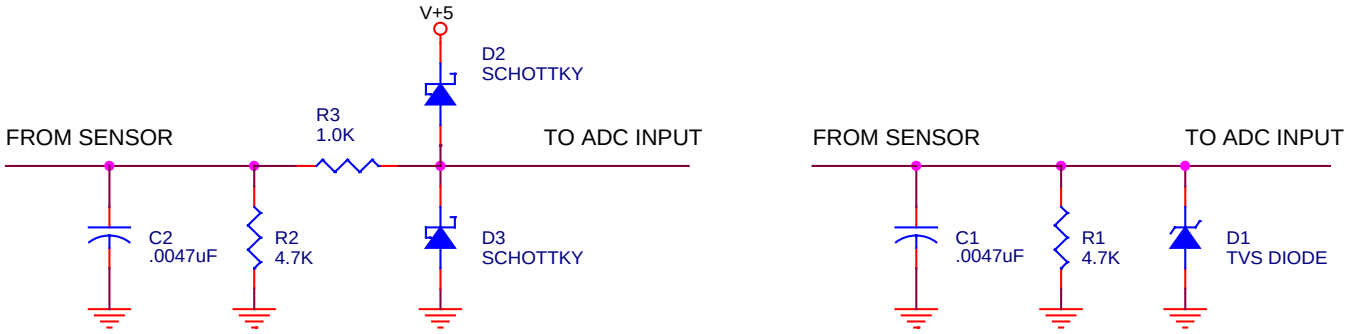
The primary RS-232 port (J5) TXD0 and RXD0 signals are duplicated here. Debug port DRXD and DTXD are not reserved for debugging purposes only. They may be used for firmware upgrades and to support future peripheral device communications.

J13: Analog voltage inputs

Pin	Function
1	ADC7 input; zero to +5V range (curve 2 sensor)
2	ADC6 input; zero to +5V range (curve 1 sensor)
3	ADC5 input; zero to +5V range (pan angle sensor)
4	ADC4 input; zero to +5V range (tilt angle sensor)
5	Analog ground

References to “curve 1” and “curve 2” above apply to the Dinsmore R1655 compass sensor documentation supplied by The Robson Company, dated 14 October 2003. The sensor must be oriented with leads down for correct operation of the COG-5 compass heading display feature. Compass sensor power may be taken from the +5VDC output available on several other COG-5 connectors, or directly from the customer’s main +5VDC power supply. Any sensor supply voltage change subsequent to calibration, e.g. from altered cable length, can degrade heading measurement accuracy. The Hall ICs in the Dinsmore sensor require a 10nF (0.01uF) power supply bypass capacitors installed local to the sensor, and the manufacturer recommends 4.7nF (0.0047uF) capacitors across the ground and sensor signal output pins to protect against EMC hazards. Ceramic capacitors rated at 50V or greater should be used in this application.

If the sensor will be installed remotely, Decade Engineering recommends supplementary ESD protection networks at the ADC inputs to COG-5. These networks could take the form of a series resistor followed by reverse-biased schottky diodes (e.g. BAT42 or BAT43) to V+5 and ground, or a single unidirectional TVS (zener) diode connected to ground. Be aware that TVS reverse leakage current is significant in this application. Suitable axial-lead TVS diodes include part numbers P6KE8.2 and P6KE8.2A from Diodes Inc., and On Semiconductor’s SA7.0A, SA7.5A, SA8.0A, and SA8.5A. All ADC inputs have series resistors to limit fault current due to brief input voltage overloads. Here are example input networks, including the capacitor and pulldown resistor recommended by the Hall device manufacturer:



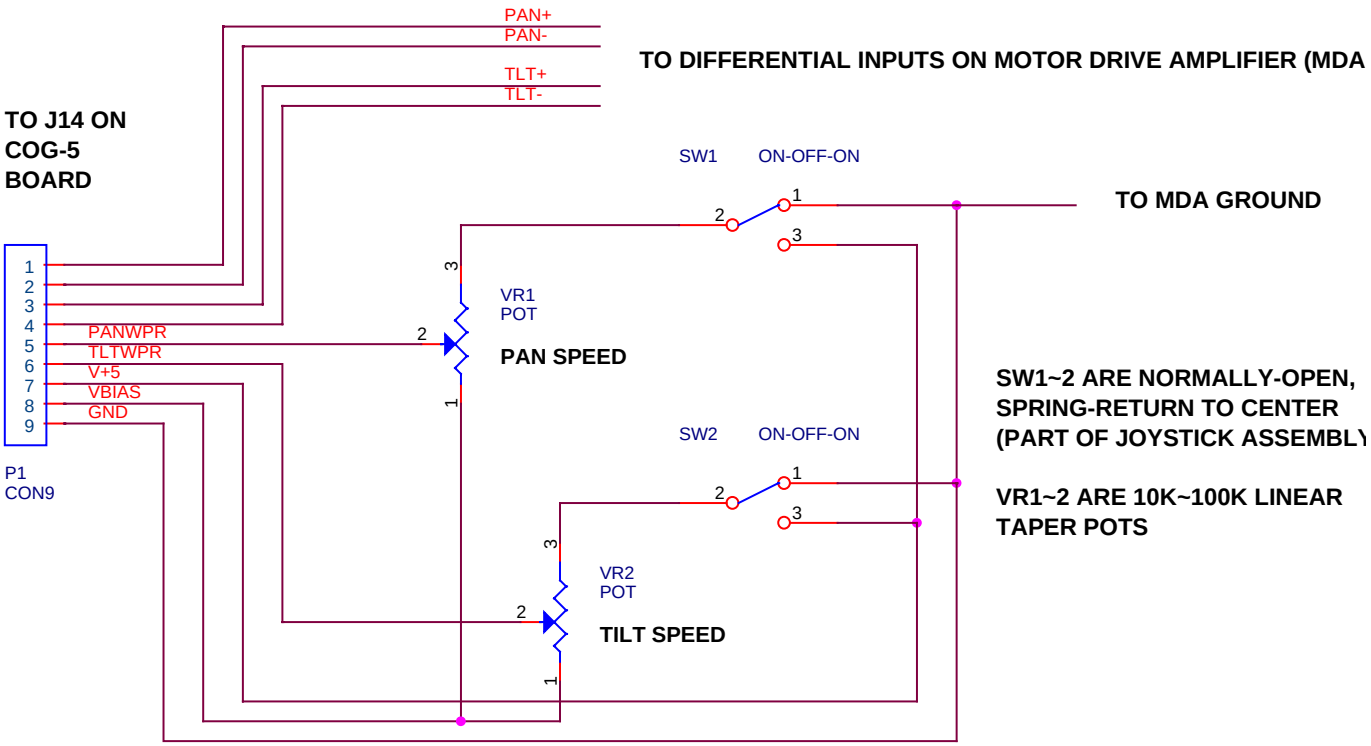
COG-5 pan/tilt angle measurement firmware relies on averaging to improve resolution and stability of the reading, as well as calibration to remove measurement error. The passive input filters offer substantial ESD protection, so that supplementary outboard networks are unnecessary except in the most hostile application environments.

J14: PWM DAC outputs or pan/tilt platform control

Pin	Basic Function	Pan/Tilt Control Function
1	PWM0 output	Pan + drive output
2	Reserved	Pan – drive output
3	PWM1 output	Tilt + drive output
4	Reserved	Tilt – drive output
5	Reserved	Pan speed control input
6	Reserved	Tilt speed control input
7	+5VDC power output	+5VDC power output
8	PWM2 output	Bias output for manual controls (+2.5V reference)
9	Ground	Ground

PWM output 2 requires capacitive load isolation of 470 ohms or more in series.

The following is an external hookup schematic for the standard pan/tilt control application. The external manual controls are optional. Add 470R in series at P1 pin 8 if a long cable is used.



J3: System Expansion Port

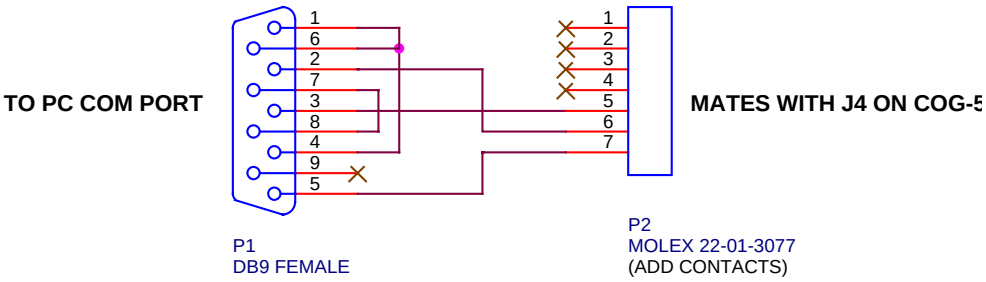
Function	Pin		Function
I^2C bus SDA	1	2	+5VDC power output
I^2C bus SCL	3	4	+3.3VDC power output
Processor GPIO port PA28	5	6	Ground
Processor GPIO port PA7	7	8	Ground
Processor GPIO port PA8	9	10	Ground
Processor GPIO port PA26	11	12	Ground
Processor GPIO port PA15	13	14	Ground
Processor GPIO port PA16	15	16	Ground
Processor GPIO/ADC port PA18	17	18	Ground
Processor GPIO/ADC port PA17	19*	20*	Ground

Pin 17 and pin 19 are limited to 2mA maximum output current. These pins can also serve as ADC inputs with zero to +3.000V range, and they enjoy maximum voltage measurement accuracy from this hardware. Remaining GPIO pins are good for 8mA in output mode. See Atmel's AT91SAM7S256 technical literature for details on alternate applications of all GPIO pins. No application for J3 is currently supported in standard COG-5 firmware.

* Note: A shunt may be installed on pins 19~20 in COG-5 boards with early release firmware. If present, it must be left in place until firmware is upgraded.

Firmware Upgrade Procedure

COG-5 firmware upgrades require the use of a Windows (XP) PC equipped with an RS-232 serial COM port or USB/serial adapter device. The field service technician must install the free BOB-4 Conscriptor program from Decade Engineering's website on his PC, and connect to COG-5's debug serial port using a customer-supplied serial data cable assembly. Here's a hookup diagram for the required cable:



1. **Connect the COG-5 debug serial port (pins 5~7 of J4) to a PC serial COM port.**
2. **Launch BOB-4 Conscriptor, set the serial data rate to 115,200bps, and select the connected serial port.**
3. **Select 'Terminal' from the Serial menu, and click the Connect button. (Any terminal emulation program may be used for steps 3~5. just be sure the port is disconnected prior to step 6!)**
4. **Type "reset d" in the Transmit window, and hit the Enter key. This action should be echoed in the Receive window and followed by the message: "---- COG5 boot loader (xs: 5.1.2)"**
5. **Click the Disconnect button, then the Quit button.**
6. **From the Serial menu, select: 'Download/Firmware (repair).'**
7. **In the Open File dialog, navigate to and select the desired *.enc COG-5 firmware file (supplied by Decade Engineering).**
8. **A dialog window should pop up showing progress of the flash memory write operation.**
9. **When the 'Download Complete' message box appears, click the OK button.**

Configuration File Transfers

COG-5 allows the contents of its configuration memory to be stored on a PC for safekeeping and for duplicating the configuration in multiple COG-5 installations. These operations require the use of a PC terminal emulation program that supports XModem CRC file transfer protocol. Hyperterminal is acceptable. In the command sequences given below, note that <ESC> represents the Escape key and <CR> is the Enter key.

To export current configuration from COG-5 to file:

1. **Connect PC serial COM port to primary or debug serial port on COG-5**
2. **Set terminal baud rate to 115,200**
3. **Send command '<ESC>[1@' to primary port, or 'config 1<CR>' to debug port**
4. **Initiate XModem file receive in terminal program**
5. **Press Enter key on COG-5 keyboard**

To import configuration to COG-5 from file:

1. **Connect PC serial COM port to primary or debug serial port on COG-5**
2. **Set terminal baud rate to 115,200**
3. **Send command '<ESC>[2@' to primary port, or 'config 2<CR>' to debug port**
4. **Initiate XModem file transmit in terminal program**
5. **Press Enter key on COG-5 keyboard**
6. **COG-5 resets and uses the new configuration automatically after the transfer**

To export observation codes only to file (for printing a 'cheat sheet'):

1. **Connect PC serial COM port to primary or debug serial port on COG-5**
2. **Set terminal baud rate to 115,200**
3. **Send command '<ESC>[3@' to primary port, or 'config 3<CR>' to debug port**
4. **Set terminal program to capture input as text file**
5. **Press Enter key on COG-5 keyboard**

RS-232 Remote Control Interface

The local COG-5 keyboard is disabled and its Scroll Lock LED is lit when remote control is enabled. RS-232 remote control is possible through COG-5's primary serial port only. The communication bit rate for this port is fixed at 115,200 bps, with eight data bits, no parity, and one stop bit (8N1). Data flow control is not implemented.

COG-5 commands begin with an 'escape sequence' of two special code bytes: <ESC> (0x1B, Ctrl-[ ), and "[" (0x5B); otherwise known as <CSI> (Control Sequence Introducer). PC terminal programs normally generate <CSI> with just two keystrokes: "Esc" followed by "[". In this document, "<CSI>" is used interchangeably with "<ESC>[".

COG-5 command syntax is **postfix**, meaning that parameters precede the operator. Numeric arguments are transmitted in an intuitive variable-length ASCII decimal format, separated by semicolons. If a parameter is omitted, then a zero/null argument is normally assumed for that parameter. Some commands elicit response strings, which are always terminated with <CR><LF> (carriage return & line feed).

Character cells (character row/column locations) are numbered from the top left corner, where row=0 and column=0. In the vertical axis, row values increase downward. In the horizontal axis, column values increase rightward.

COG-5 Remote Command Set

@	Configuration	Syntax: <CSI>n@ (for debug port: config n <CR>)
n=1	Transmit binary COG-5 configuration data to remote computer using XModem protocol	
n=2	Receive and store binary COG-5 configuration data using XModem protocol	
n=3	Transmit observation codes only, as a formatted text file for printing	

a	ADC Read	Syntax: <CSI>na
n=1	Read analog input channel 4; return format: **ADC4 0000<CR><LF>** (data range is 0000~03FF)?????	
n=2	Read analog input channel 5; return format: **ADC5 0000<CR><LF>**	
n=4	Read analog input channel 6; return format: **ADC6 0000<CR><LF>**	
n=8	Read analog input channel 7; return format: **ADC7 0000<CR><LF>**	

This command supports multiple ADC readings. Just sum the '**n**' numbers listed above, to specify the desired combination of ADC channels to read in a single command. The return string includes a sequence of labels and data formatted as above, with one space between each field and one final <CR><LF>. For example, <CSI>3a yields the following return string: ADC4 0000 ADC5 0000<CR><LF>

c	Camera Pan/Tilt	Syntax: <CSI>n;<parameter1>;<parameter2>c
n=0	Stop camera movement; syntax: **<CSI>0c**	
n=1	Read pan/tilt angles in degrees; format: **pan:047 tilt:342<CR><LF>**	
n=2	Drive camera to specified position; syntax: **<CSI>2;<pan>;<tilt>c** with pan/tilt values in degrees	
n=5	Store camera position; syntax is **<CSI>5<index>c** with index of 1~12 corresponding to F-keys	
n=6	Drive camera to stored position; syntax: **<CSI>6;<index>c** with F-key index of 1~12 as above	
n=7	Tilt up; syntax is **<CSI>7;<speed>c** with speed of 1 (slow), 2 (medium), or 3 (fast)	
n=8	Tilt down; syntax is **<CSI>8;<speed>c** with speed options as above	
n=9	Pan left; syntax is **<CSI>9;<speed>c** with speed options as above	
n=10	Pan right; syntax is **<CSI>10;<speed>c** with speed options as above	

The **c** command allows simultaneously driving the camera platform on both axes.

e	Encoder	Syntax: <CSI>n;<count>e
n=1	Returns contents of encoder count register; format: **[0/-]000000000<CR><LF>** (The leading zero is replaced by a minus sign if reading is negative.)	
n=2	Load count register with specified value; syntax: **<CSI>2;<count>e** (use "<" to specify negative count)	
n=3	Clear count register to zero	
n=4	Load count register with the value manually stored by operator in distance-preset memory	

m	Remote Mode	Syntax: <CSI>n;m
n=0	Disables remote control and returns control to local COG-5 keyboard	
n=1	Enables remote control; local COG-5 keyboard is disabled and Scroll Lock LED is lit	

p	PWM Direct	Syntax: <CSI>n;<channel>;<value>p
n=1	Read PWM generator settings; syntax: **<CSI>1;<channel>p** with channel of 0~7 (see note); return format length depends on command; max length as follows: **PWM1 000 PWM2 000 PWM3 000<CR><LF>**	
n=2	Load PWM generator; syntax: **<CSI>2;<channel>;<value>p** with channel of 1~3; value of 1~210 with inverse relationship to final output of zero to +5.00V. Value argument of 105 yields +2.50V output, and this is the default setting.	

The PWM (pulse width modulator) command supports multiple channel reading, but not multiple channel writing. The read channel argument is derived by summing bit values for the three possible channels, with bit-0 for PWM1, bit-1 for PWM2, and bit-2 for PWM3. Thus an argument of 7 (binary 111) commands a read of all three channels, while an argument of 4 (binary 100) reads only PWM3. This is an alternate method of controlling the same COG-5 outputs used by the **c** command.

r	Real-Time Clock	Syntax: <CSI>n;<min>;<hour>;<day>;<month>;<year>r
n=1	Read clock; syntax: **<CSI>1r** Returns time & date; format: **03:30PM 10 Sep 09<CR><LF>**	
n=2	Set clock; argument ranges: min; 0~59, hour; 1~24, day; 1~31, month; 1~12, year; 0~99	

t	Text Print	Syntax: <CSI>n;<column>;<row>t
n=1	Enable printing & set print position to specified row and column numbers. Column range is 0~51. Row range is 0~15 for NTSC, 0~18 for PAL. Defaults are both zero (upper left corner position).	
n=2	Print; syntax: **<CSI>2t** Subsequent printable ASCII character codes appear on TV screen; also handles the following control codes: <CR> (carriage return) and <BS> (backspace)	
n=3	Clear text overlay and disable printing; syntax: **<CSI>3t**	

Text does not scroll automatically, but wraps to the upper left corner position. Words break.

Firmware Revision History

V5.2.0 [18 January 2010] Revised USB keyboard interface to remedy keyboard compatibility problems.

V5.1.0 [14 September 2009] Added RS-232 serial remote control interface. Activated watchdog timer. Added option to preserve distance data upon power failure. Fixed keyboard LED operation. Added Num-Lock and Caps-Lock keyboard functions.

V5.0.0 [01 September 2009] Early production release.

Decade Engineering Contact Information

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