DECADE ENGINEERING

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COG-4 Application Guide (Firmware V24)

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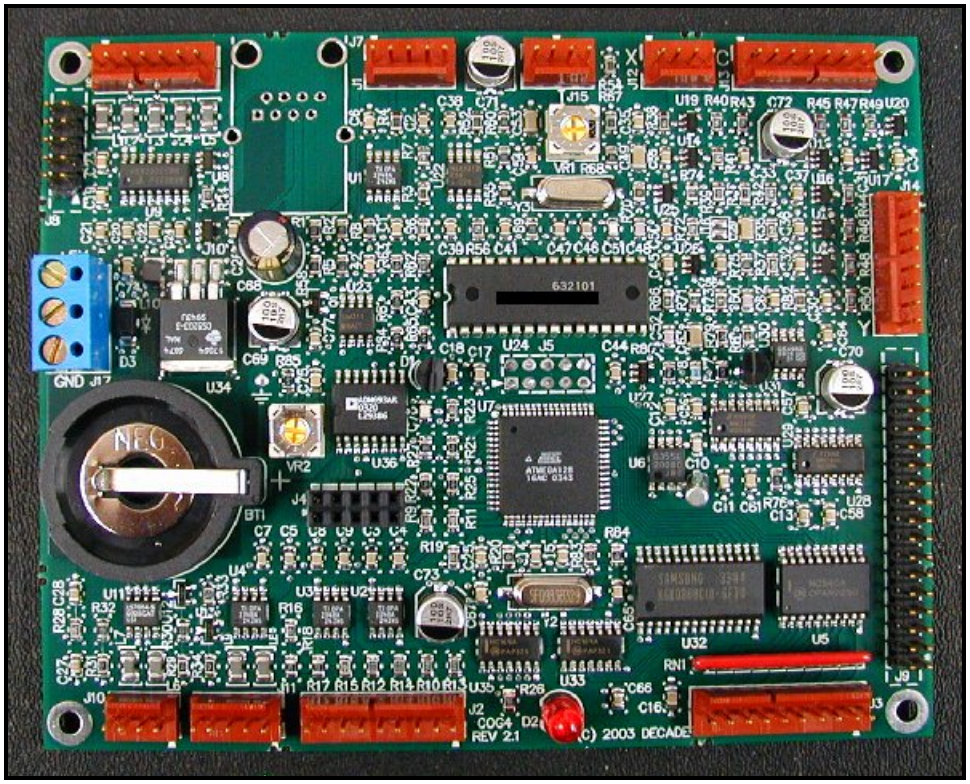


Introduction:

COG-4 is a video character overlay generator board with numerous interfaces intended to complement the requirements of commercial and industrial video systems. It can superimpose text over video from composite or Y/C (S-Video) sources and distribute the output video to as many as six destinations. Data for the overlay can come from an on-board clock, distance encoder, pan/tilt angle sensors, compass sensor, keyboard, GPS receiver (soon), and other peripheral devices. COG-4 is also capable of controlling camera pan/tilt platforms through analog output channels. COG-4 can be controlled directly from a PC-compatible keyboard, or through an RS-232 serial link to a host computer. An Ethernet remote control interface is planned for later introduction.

Many of the feature descriptions in this document reflect current firmware status, but COG-4 hardware permits the development of many other functions not described. For the benefit of customers contemplating special applications, the hardware feature set of a fully populated COG-4 board is listed here:

- Atmel ATmega128 processor: 10MIPS, 128KB flash, 4KB SRAM, 4KB EEPROM*
- 32K bytes of non-volatile SRAM external to processor chip (serial interface)
- Real-Time Clock with Lithium primary power cell
- PC keyboard interface, for standard AT/PS2 style keyboards (J11)
- Quadrature distance encoder interface with 5VDC power output (J10)
- Flexible video character overlay (OSD) subsystem
- Composite or Y/C (S-Video) input (J15)
- Four composite video or S-Video outputs (J13, J14)
- Two composite video outputs derived from S-Video input (J12)
- Two RS-232 serial data I/O ports (J6, J8)
- Ethernet LAN port (J7) (this option deletes one RS-232 serial port)
- Eight general-purpose digital inputs with pullup (J3)
- Four ADC inputs with 10-bit (0.1%) basic resolution (J1)**
- Three filtered and buffered PWM DAC outputs with 0~+5V range (J2)
- Raw power supply failure detector (allows for critical data backup when power fails)
- 34-pin Expansion Port including V+5, SPI, I^2C, ADC, two interrupts, and GPIO pins (J9)

* See www.atmel.com for a full description of the processor's feature set.

** The ADC reference voltage is +4.096V, but two of the four ADC inputs are scaled with 1% resistors to yield 5V input ranges.

Dimensions:

Board outline dimensions are 4.00 x 5.00 inches. Overall height is 0.70 inches, with 0.50 inches of this above the surface of the board, which is .062 inches in thickness. Weight is 0.174 pounds (79 grams), not including the Lithium coin cell required for operation (supplied).

Power supply:

COG-4 requires 5VDC ±5% regulated power at 200~300mA, depending on video loads and excluding peripheral devices. We don't plan to populate the Ethernet port in early production, because software for it will not be ready in time, but this item is expected to double the power supply current.

A BR2330 (Panasonic) or equivalent 3V Lithium coin cell is required for timekeeping and data memory backup. This item is normally supplied installed in new boards.

Video I/O:

The standard version of COG-4 is NTSC compatible. PAL video compatibility is optional, through hardware assembly options and minor firmware changes. A single composite or Y/C (S-Video) input connector is provided. Four composite or Y/C video outputs may be used simultaneously. In addition, two composite video outputs derived by mixing the Y/C channels are available if Y/C video input is supplied.

Video character overlay capabilities are similar to those of Decade's XBOB board, including crawl and scroll, but excluding the manual video controls. Please refer to the *XBOB Application Guide* at www.decadenet.com for a full description, but note that only a subset of these functions will be implemented until customer requirements indicate otherwise. Superimposed characters in genlock/overlay mode can be black/white only, and are white with a thin black outline by default. Black background video is generated automatically (local mode) if external video is not supplied. For the main composite video outputs only, in local mode, six background and character colors are available.

Data I/O:

Two RS-232 serial data ports are provided. One of these is intended for remote control through a PC or other host computer, and it's not available when the Ethernet option is implemented. The other is intended for use with a GPS receiver, but it could be reassigned to meet customer requirements. Commands to a digital video camera (e.g. Sony VISCA protocol) could be transmitted through this port, for instance.

A general-purpose 8-bit digital input port (J3) is provided, as well as a very flexible system expansion port (J9). See the connector pinout table for details. Neither of these ports is in service at this writing (20 July 2004).

Distance encoder:

COG-4 accepts industry-standard 5V quadrature incremental encoders for distance measurement. Cycle rates up to 100kHz are supported. Distance information may be displayed conveniently in two alternate formats, such feet or meters, and precise distance display calibration can be achieved by following on-screen instructions.

Time of day:

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

Camera pan & tilt:

A pair of analog voltage inputs is provided for pan and tilt position sensors with outputs in the 0~+5VDC range. A calibration procedure compensates for individual sensor variations to allow precise display of pan/tilt angles. Operators may enable or disable the pan and tilt display fields as a pair only.

DC voltage outputs are provided to operate camera pan/tilt platforms through external motor drive amplifiers (not currently supplied by Decade Engineering). These outputs may be controlled through the keyboard, with high and low preset speeds configured via on-screen setup, or with external switches and speed control pots. Compatible motor drive amplifiers must have differential inputs with 0~+5VDC minimum input ranges.

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

Compass heading:

A pair of analog voltage inputs is provided for the sine and cosine outputs of a compass sensor, such as Dinsmore's R1655. The sine and cosine voltage input ranges are zero to +4.096VDC maximum. 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.

Text display functions:

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

- A "TV typewriter" function allows free-form comments to be typed in 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 sequence.

Video pointer:

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

RS-232 remote control:

Development is not complete at this writing.

The RS-232 remote control interface uses a robust communication protocol (SNAP) to insure data integrity. It allows the host computer to print characters into the video overlay, retrieve data from sensors attached to COG-4, and drive a camera pan/tilt platform. It can also be used to preload the text display memories. The "primary" RS-232 port at J8 is allocated for remote control and firmware upgrades. See *RS-232 Remote Control Protocol* section for current implementation details.

Field firmware upgrade:

Customers can replace the firmware program that controls COG-4 (in flash memory), by using a Windows PC utility program from Decade Engineering and a simple RS-232 adaptor cable. The "primary" RS-232 port at J8 is allocated for remote control and firmware upgrades. See upgrade procedure in this document.

Future developments:

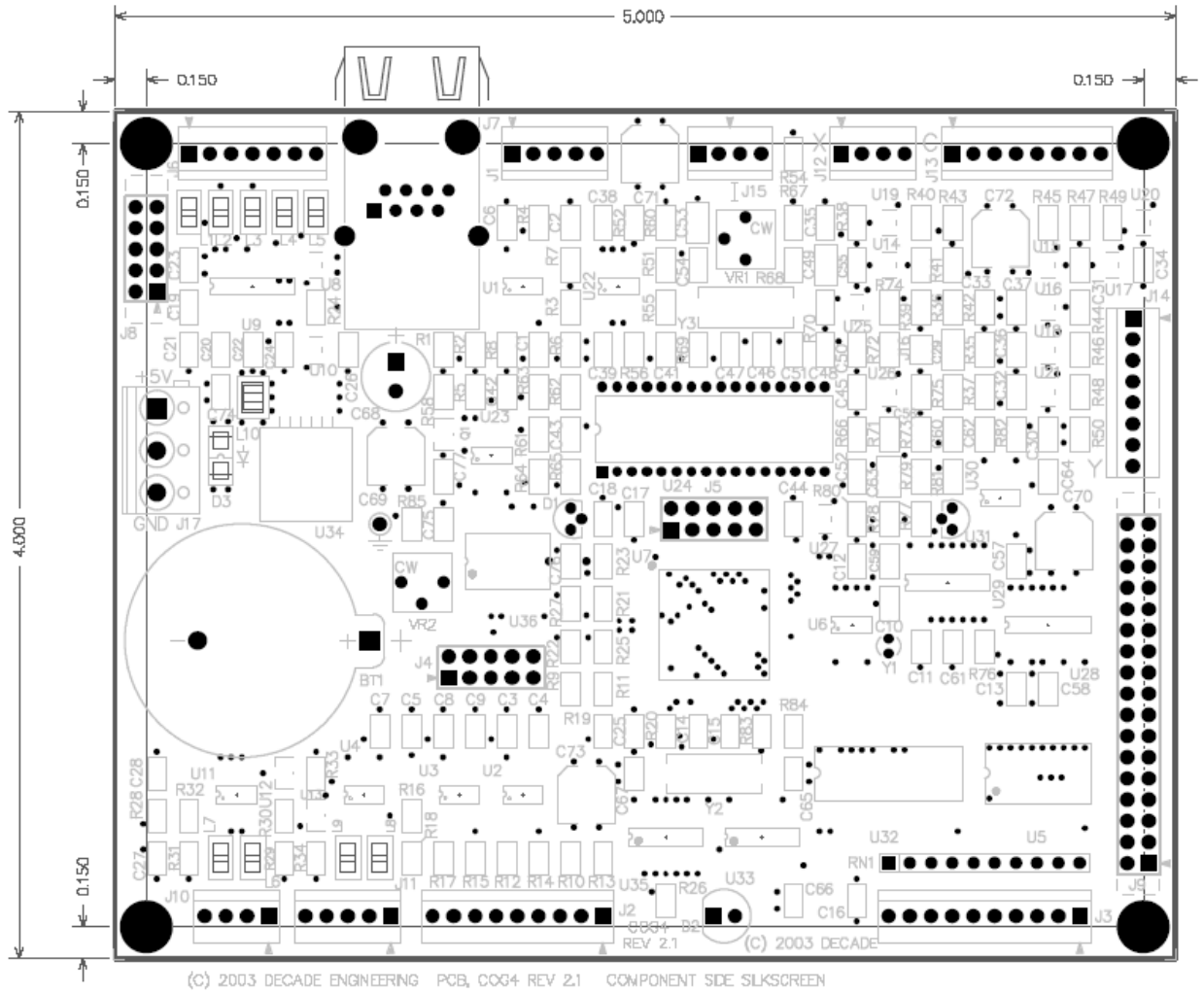
No guarantees, of course, but here's the stuff on our short list:

- GPS data display
- Memory card interface to make reports and/or setup information portable
- Sony VISCA remote video camera control
- General-purpose "video voltmeter" implementation
- Ethernet remote control
- PC demo application programs

Operating Instructions

Press F1 to view the "help" and system configuration screens. We have attempted to make all of these items self-explanatory, with on-screen hints, but a separate COG-4 Operator's Guide may be available as well.

Mounting Hole & Connector Locations



Note: The four corner mounting holes are 0.128” ID, for #4 size hardware.

Connector Pinout & Hookup Notes

The pin #1 location is marked with a triangular symbol on the PCB at all COG-4 connectors. Those connectors not called out in this document are reserved for manufacturing use.

Most of the COG-4 connectors (except J8, J9, and J17) are Molex KK series .100" friction-lock square post headers. They mate with Molex crimp & poke female connector housings or with Amp MTA .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.

J17: Power supply input connector

Pin	Function
1	+5VDC input, regulated to ±5%
2	V+ raw upstream voltage
3	Ground

Notes: **Link J17 pin 2 to pin 1 unless new firmware requires use of the power failure detector!** Connect pin 2 to the raw DC supply voltage upstream of the 5V regulator if power fail detection is required, and calibrate VR2 as instructed. COG-4 (without Ethernet) requires up to 300mA plus additional power supply current consumed by all peripheral loads (keyboard, encoder, etc.). A power supply current rating of at least 1A is suggested.

J11: PC Keyboard (Uses standard PC AT or PS2 type keyboards)

Pin	Function
1	Keyboard clock
2	Keyboard data
3	N/C
4	Ground
5	+5VDC keyboard power

Note: Keyboard power adds to COG-4 main power supply current drain. The corresponding pinout for 6-pin mini-DIN connectors used on industry-standard PS2 style keyboards is reproduced below, for convenience. Mouser stocks mini-DIN receptacles with wire pigtails pre-attached (i.e. 161-2106). This drawing shows the pin arrangement seen looking into the keyboard's male plug or the back (wiring side) of the mating female socket:

Pin	Function
1	Data
2	N/C
3	Ground
4	+5VDC keyboard power
5	Clock
6	N/C

Also note that the shield (shell) of this connector should be linked to chassis ground.

J10: Encoder (Uses standard 5VDC quadrature encoder)

Pin	Function
1	+5VDC encoder power
2	Channel A input
3	Channel B input
4	Ground

Notes:

Encoder load current adds to COG-4 main power supply current drain.

Channel A/B inputs must be driven below 0.6V for logic low, above 3.3V for logic high. 4.7K internal pullup resistors are provided.

J15: Composite video or Y/C (S-Video) inputs

Pin	Function
1	Chroma (C) input for Y/C video, 0.3Vpp into 75 ohms
2	Ground
3	Composite video input, or luma (Y) input for Y/C video, 1Vpp into 75 ohms
4	Ground

Notes:

Leave pin 1 open in composite video applications.

The composite video input on J15 pin 3 has an internal gain adjustment, VR1, that may be used to correct insufficient video input level due to long camera cables, etc. Use a scope on the video output line (e.g. J14 pin 2) to confirm the gain setting. Sync amplitude should be 0.286V from sync tip to blanking level (back porch) if the output is loaded, or 0.572V if unloaded. The pair of solder pads labeled J16 may be shunted with solder to enable a composite video high-frequency boost that offsets excessive HF losses in a long cable. These options 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.

J13: Chroma 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

Note: This connector is not used in composite video applications. Outputs are 0.3Vpp into 75 ohm loads.

J14: Composite video outputs or luma 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

Note: J14 is the video output port for composite video applications. Outputs are 1Vpp into 75 ohms.

J12: Composite video outputs for Y/C video

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

Note: This connector provides two composite video outputs derived by mixing the Y/C inputs. This connector is unused in composite-input video applications.

J6: Auxiliary RS-232 data port

Pin	Function
1	+5VDC power output
2	Ground
3	Receive data B
4	Transmit data B
5	Receive data A
6	Transmit data A
7	Ground

Note: TX/RX channel B signals are duplicated at J8.

J8: Primary RS-232 data port

Pin	Function
1	1, 2, and 7 are linked
2	1, 2, and 7 are linked
3	Transmit data B
4	4 and 6 are linked
5	Receive data B
6	4 and 6 are linked
7	1, 2, and 7 are linked
8	N/C
9	Ground
10	N/C

Note: J8 connects to a PC COM port by use of a ribbon cable and IDC connectors with pin 1 routed to pin 1. The linked pins are loop-back connections for the PC hardware handshake signals. TX/RX channel B signals are duplicated at J6. J8 may not be used if the Ethernet port (J7) is installed.

J7: Ethernet LAN port (not currently implemented)

Note: J8 (primary RS-232 port) may not be used if J7 is placed in service.

J3: General-purpose digital inputs

Pin	Function
1	Ground
2	GP input 7
3	GP input 6
4	GP input 5
5	GP input 4
6	GP input 3
7	GP input 2
8	GP input 1
9	GP input 0
10	+5VDC power output

Note: 4.7K pull-ups to +5V are provided on these inputs.

J1: Analog voltage inputs

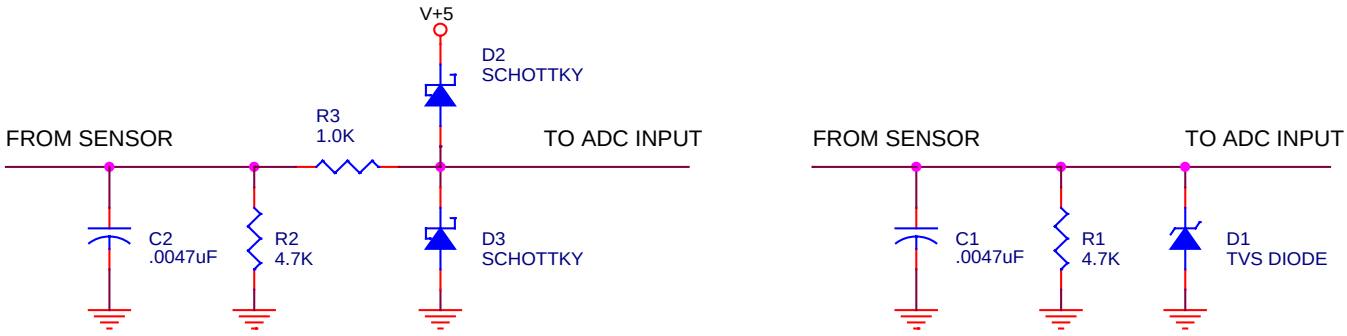
Pin	Function
1	ADC input 3, 0~4.096V range (curve 2 sensor)
2	ADC input 2, 0~4.096V range (curve 1 sensor)
3	ADC input 1, 0~5V range (pan sensor)
4	ADC input 0, 0~5V range (tilt sensor)
5	Analog ground

Notes:

ADC inputs 2~3 have input resistance of about 100 megohms and accuracy specifications determined by the ATmega128 chip (see Atmel's current data sheet), as well as the 4.096V analog reference device used in COG-4. The voltage reference used here is National's LM4040AIZ-4.1, which offers worst-case error of ±0.1% at 25°C. ADC input 3 is duplicated at the expansion port (J9).

The references to "curve 1" and "curve 2" above relate 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-4 compass heading display feature. Compass sensor power may be taken from the +5VDC output available on several other COG-4 connectors, such as J2, J3, J6, or directly from the main +5VDC power supply. Any sensor supply voltage change subsequent to calibration, e.g. cable length change, will degrade heading measurement accuracy. The Hall ICs used in the Dinsmore sensor require a 10nF (0.01uF) power supply bypass capacitor 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-4. 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. ADC inputs 2~3 have internal 470 ohm 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:



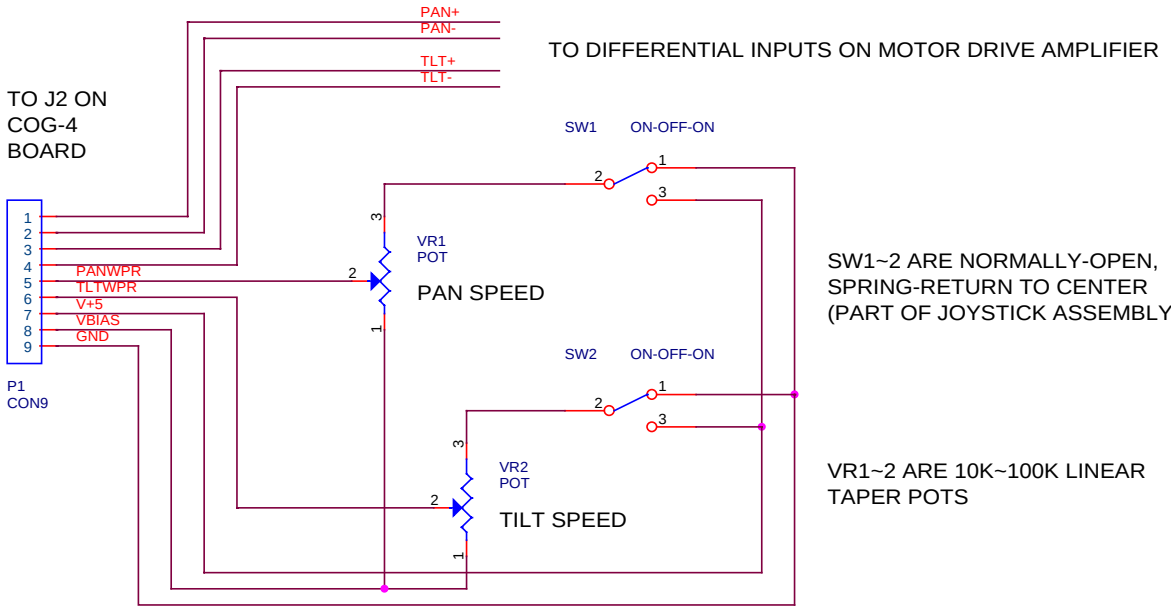
ADC inputs 0~1 have input resistance of 2.2 megohms and accuracy degraded (relative to ADC inputs2~3) by the 1% tolerance divider resistors used to achieve 5V input ranges. In addition, these inputs are low-pass filtered by simple RC networks with a 5Hz cutoff frequency. The pan/tilt angle measurement 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.

J2: PWM DAC outputs or pan/tilt platform control

Pin	Basic Function	Pan/Tilt Control Function
1	PWM output 0	Pan + drive
2	Reserved	Pan – drive
3	PWM output 1	Tilt + drive
4	Reserved	Tilt – drive
5	Reserved	Pan speed control
6	Reserved	Tilt speed control
7	+5VDC power output	+5VDC power output
8	PWM output 2	Speed control bias (+2.5V reference)
9	Ground	Ground

Note: PWM output 2 requires 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. Be aware that a common ground connection must exist between the motor drive amplifier and COG-4, but it's not shown in this drawing:



J9: Expansion port

Pin	Function	Pin	Function
1	+5VDC power output	2	+5VDC power output
3	+5VDC power output	4	+5VDC power output
5	GPIO Port A0	6	GPIO Port A1
7	GPIO Port A2	8	GPIO Port A3
9	GPIO Port A4	10	GPIO Port A5
11	GPIO Port A6	12	GPIO Port A7
13	Port B0 or SPI SS\	14	Port B1 or SPI SCK
15	Port B2 or SPI MOSI	16	Port B3 or SPI MISO
17	Port B4 or Timer OC0	18	Port D0 or INT0 or I^2C SCL
19	Port D1 or INT1 or I^2C SDA	20	GPIO Port D4
21	GPIO Port D5	22	GPIO Port D6
23	GPIO Port D7	24	Ground
25	Ground	26	Ground
27	Ground	28	Ground
29	Ground	30	Ground
31	Analog ground	32	Analog ground
33	ADC input 3, 0~4.096V range	34	Analog ground

Note: ADC input 3 is duplicated at J1.

Firmware Upgrade Procedure

1. Remove power from COG-4 board
2. Place shunt across pins 1,2 of J3.
3. Connect PC serial port to J8* on COG-4, using cable described in hookup section of this document
4. Apply power to COG-4
5. Run *update.exe* utility program on PC
6. Select PC COM port in utility program window
7. Click *update* button
8. Select update firmware file (.enc suffix) in file select dialog
9. The status bar in utility program window indicates file upload progress
10. When update is completed, remove shunt from J3 and cycle power on COG4

*Note: COG-4 boards with firmware versions prior to 20 require connection to the auxiliary serial port at J6 instead of J8. Assuming a 9-pin PC COM port, wire the adapter cable as follows:

J6 Pin	COG-4 Function	PC COM Port Pin	PC Function
5	RX data A input	3	TX data output
6	TX data A output	2	RX data input
7	Ground	5	Ground

RS-232 Remote Control Protocol

COG-4 communicates over the serial port at J8 using the SNAP protocol (SNAP documentation is available at www.hth.com). The SNAP DLL makes this protocol easy to implement in Visual Basic. Please request a copy of the COG-4 RS-232 Remote Control Protocol document from Decade Engineering if you plan to use this feature.