

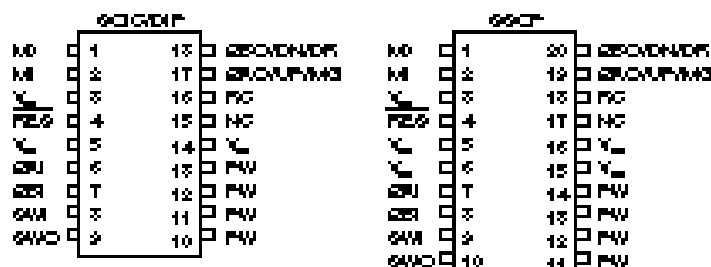


Series 65: GH65C11-X

Features

- Interfaces With All Grayhill And Most Standard Quadrature Optical Encoders.
- Power Management Feature Manages Encoder Power Consumption for Battery Powered Systems (Typically Saves 75% to 90%).
- 1 Of 3 User Selectable Output Modes Simplify μ C Interface:
 - Standard
 - Up/Down
 - Magnitude/Direction
- Debounces Pushbutton.

Pinout



Options

GH65C11-X-YY

Temperature:

C = Commercial (0° C to 70° C)
N = Industrial (-40° C to 85° C)

Packaging:

PD = 18 lead 300 mil wide Plastic DIP
SO = 18 lead 300 mil wide gull wing SOIC
SS = 20 lead SSOP

Available Combinations:

GH65C11-C-PD GH65C11-C-SO GH65C11-C-SS GH65C11-N-PD GH65C11-N-SO

Operation

The GH65C11-X is designed to receive input from a standard quadrature optical encoder. $\emptyset A$ and $\emptyset B$ outputs from the encoder connect to the $\emptyset AI$ and $\emptyset BI$ pins respectively. The power management feature can be used by connecting the encoder power supply to the PW outputs. When connected in this manner, power is applied to the encoder only during sampling periods, thus conserving power for battery powered systems. Sample rate is a nominal 4K per second allowing high speed quadrature input. The GH65C11-X operates in 1 of 3 user selectable output modes. The mode selection pins, M0, M1 are sampled on power up and the mode is selected according to the truth table. The 3 modes are outlined below:

- **Mode 0 - $\emptyset A$, $\emptyset B$**

This mode delivers standard quadrature on the output pins $\emptyset AO$ and $\emptyset BO$. These outputs follow the state of the $\emptyset AI$, $\emptyset BI$ inputs.

- **Mode 1 - UP, DOWN**

This mode monitors the incoming quadrature and pulses the UP output pin when an up count is detected and pulses the DN output pin when a down count is detected (4X decoding). The pulses are positive going and 20uS nominal in duration.

- **Mode 2 - MAGNITUDE, DIRECTION**

This mode pulses the MG pin when any valid change is detected in the incoming quadrature inputs (4X decoding). Direction can be determined by the DR output pin which will be high for positive quadrature directions (phase A leads phase B) and low for negative.

If the encoder contains an integral switch, it can be debounced by connecting one end of the switch to the SWI input pin and the other end to the desired active state. Debounce is satisfied by 16.4 mS nominal stable input condition. Because all inputs are floating, pull-up (or pull-down) resistors are required on all inputs.

Pin Descriptions

Name	Type	Description
M0,M1	I	Mode selection input pins.
V_{DD}	P	+5VDC nominal power source.
RES*	I	Reset pin, normally connected to V_{DD} .
V_{SS}	P	GND, 0v nominal power return.
$\emptyset AI$, $\emptyset BI$	I	Phase A and B quadrature input pins.
SWI	I	Switch input pin.
SWO	O	Debounced switch output pin.
NC	O	No connect, This pin must be left unconnected.
PW	O	Power source for encoder power management.
RC	I/O	RC oscillator pin.
$\emptyset BO/DN/DR$	O	Phase B, down, direction, mode conditional output pin.
$\emptyset AO/UP/MG$	O	Phase A, up, magnitude, mode conditional output pin.

Pin Types: I = Input, O = Output, P = Power. * indicates signal is active low

Mode Select Pins

The M0 and M1 mode select pins select the output mode of the GH65C11-X on power-up according to the following truth table:

M1	M0	Mode
0	0	Standard A,B Quadrature
0	1	Up, Down
1	0	Magnitude, Direction
1	1	Test Mode, Standard A,B Quadrature, Power Management Disabled

Reset Pin

The RES* pin is an active low reset pin that can usually be connected directly to V_{DD} for most power supplies. The built in reset function holds the device in reset about 18mS after voltage at this pin reaches logic high. For slow rising power supplies in sensitive applications hold this pin low externally until power has stabilized.

A_I, A_{BI} Input Pins

These pins receive the incoming quadrature from the encoder. Because the inputs are floating, open collector type encoders will require pull-ups on these pins in order to create a logic high. These pins are sampled at a nominal rate of about 4K (depends on RC timing accuracy), providing best case maximum input speeds for various resolution encoders according to the following table:

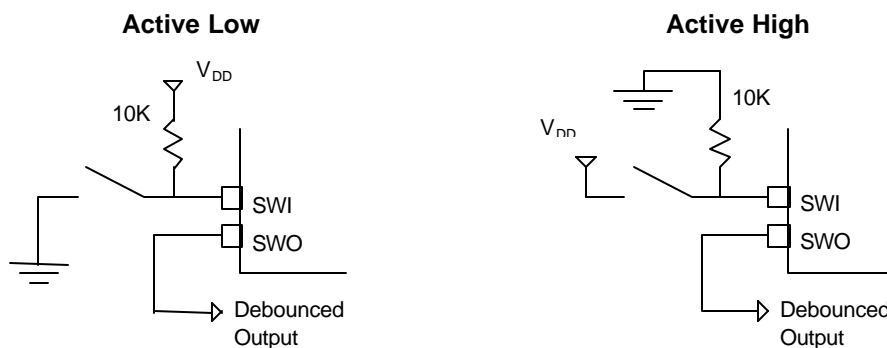
Pulses per channel per revolution	Number of quadrature state changes per revolution	Maximum allowable speed of encoder (rev. per sec.)
4	16	244
8	32	122
16	64	61.0
32	128	30.5
64	256	15.3
128	512	7.63

Note: table assumes exact duty quadrature and recommended RC oscillation frequency.

SWI, SWO Pins

The SWI and SWO pins provide debounce for a switch input. The SWI input pin accepts active low or active high input signals and provides a debounced output on the SWO pin. Debounce is satisfied when the input is stable over a nominal time period of 16.4mS. Note that RC timing affects the total time for debounce. If the debounce feature is not used, the SWI pin should be connected to V_{SS} or V_{DD} .

Typical Circuits for Debounce



PW Power Management

These pins source power to the optical encoder only during sampling periods to conserve power. It is recommended that these pins be tied together. Maximum total current that can be sourced from these pins is 40mA. Current is sunk by the PW pins when the power is in the off state. Power is applied to these pins roughly 6uS before and after sampling at 256uS intervals. This results in approximately a 5% duty cycle. This timing is compatible with all Grayhill optical encoders but may not be compatible with others. Check with the manufacturer of the encoder to ensure compatibility. It is important to sufficiently bypass this device when used with power management due to the large transient current drawn by a typical optical encoder when it is switched on and off. A 10uF tantalum or electrolytic capacitor is recommended when the power supply is located away from the device. A typical .1uF ceramic bypass capacitor should always be used. To conserve maximum power, the pull-up resistors for the ØAI, ØBI and SWO inputs should also be connected to the PW pins. Total average current consumption when connected in this manner can be estimated from the formula:

$$I_{Tave} = I_{DD} + .05 * (I_{EN} + I_{PU})$$

where:

I_{Tave} is the total average current consumption.

I_{DD} is the current used by the GH65C11.

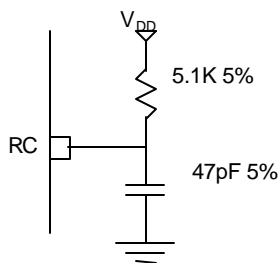
I_{EN} is the steady state current used by the encoder.

I_{PU} is the current used in the pull-ups.

RC Oscillator

An RC oscillator provides low cost device timing. The recommended RC circuit and RC values are shown below. Locate these parts as close as possible to the RC pin. Timing parameters listed in this data sheet are for recommended RC part values which result in an operating frequency of 2 MHz +/- 30%. RC timing variations can be due to part variations, environmental conditions, and supply voltages.

Recommended RC Circuit



ÆAO/UP/MG, ÆBO/DN/DR Output Pins

These pins output data from the chip according to the condition of the mode select pins at power up.

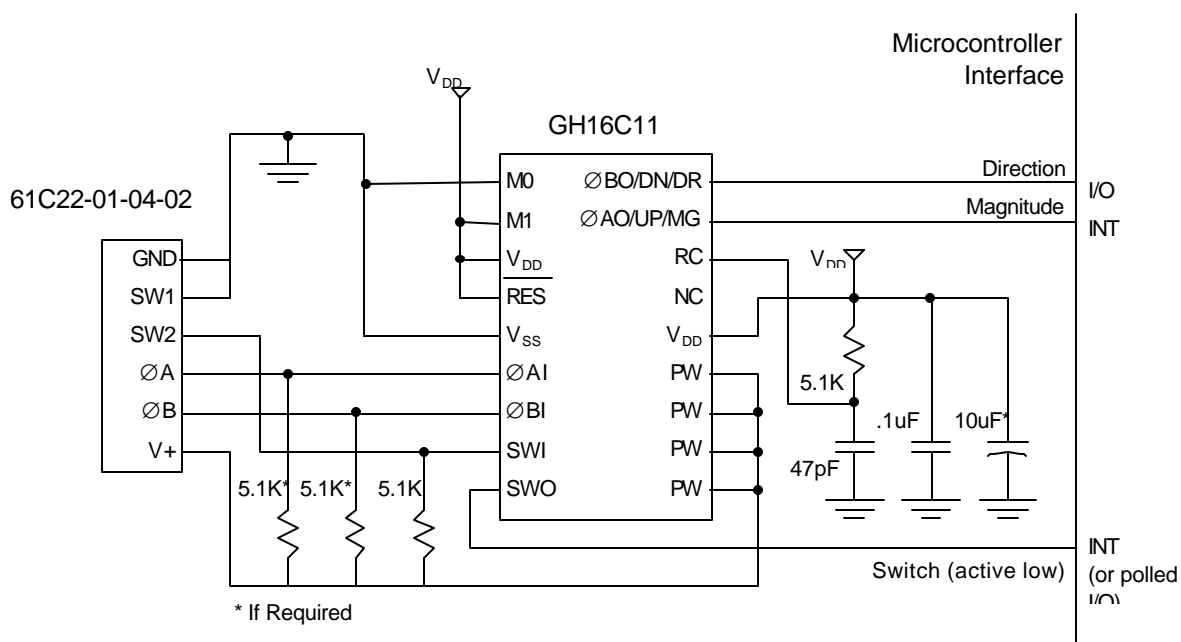
In mode 0, standard quadrature outputs are generated which follow the inputs. This mode can be used to retrofit designs which require quadrature inputs but would improve with the use of the power management feature. In order to interface quadrature code directly to a microcontroller at 4X decoding (1 resolution unit for every quadrature *state change*); a polling routine is usually necessary. Consecutive samples are then compared to determine if the count should be incremented or decremented. At 1X decoding (1 resolution unit for every quadrature *cycle*) this task becomes simpler because for every state change on either of the phases the other can be used to determine direction. For example, ØA0 can be connected to an edge triggered interrupt to generate a change while the ØB0 output can be monitored by the service routine through an I/O pin to determine direction.

Mode 1: UP, DOWN; pulses the UP output when an up count is detected and the down output when a down count is detected (positive going, 20uS nominal duration). This allows a simpler interface method for encoders requiring 4X decoding. If two hardware

interrupts are available, the two outputs in this mode can be connected directly to these interrupts. One service routine increments the count while the other decrements the count. This results in very fast service routines with very low system software requirements.

Mode 2: MAGNITUDE, DIRECTION; pulses the MG output pin when any change is detected in the incoming quadrature. The DR output pin indicates direction. This mode can be used when 4X decoding is required and only one interrupt is available. Connect the MG output pin to this interrupt and read the direction through an I/O port bit connected to the DR output pin. This method results in an efficient use of system software, time, and hardware resources.

Typical Circuit





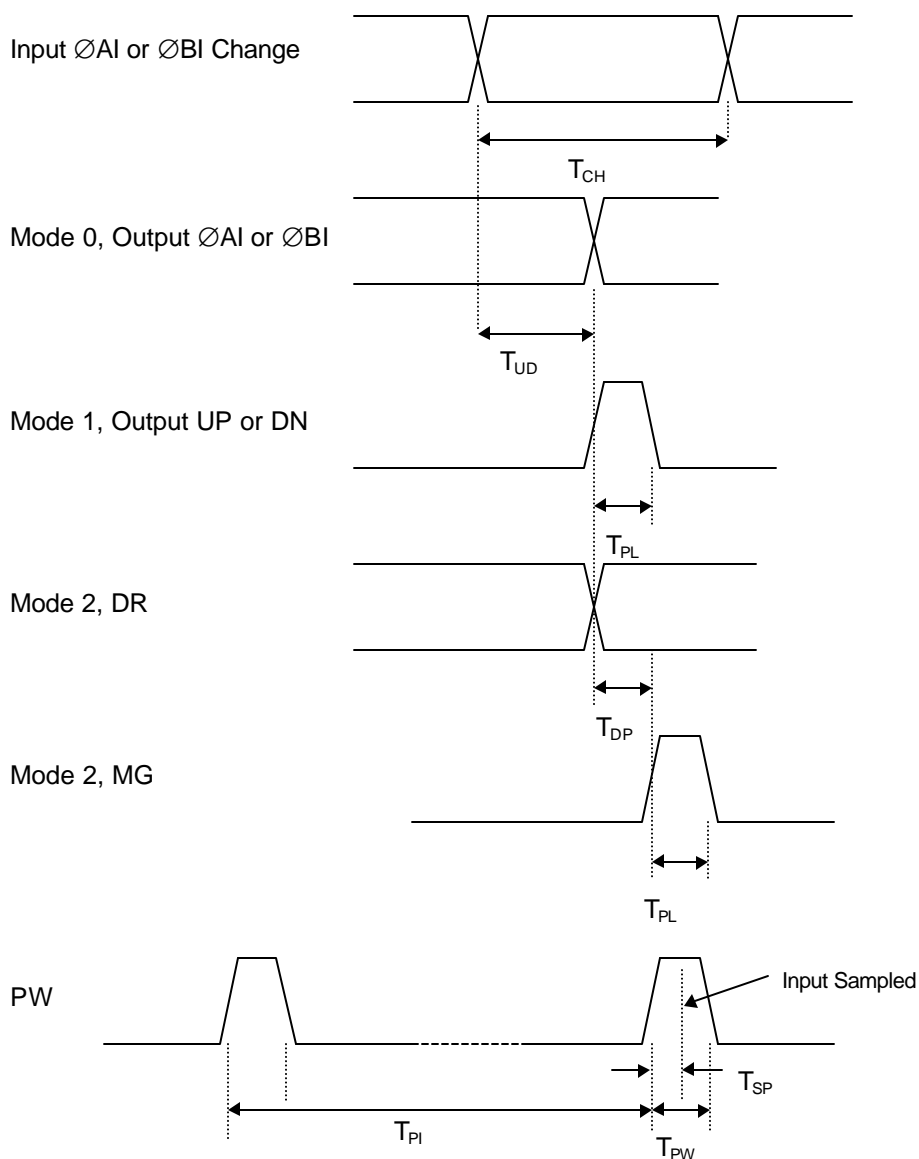
Maximum Ratings

Rating	Absolute Maximum
Storage Temperature	-65 °C to +150 °C
Temperature Under Bias	-55 °C to +125 °C
Voltage on any Input Pin	-0.6V to $V_{DD} + 0.6V$
Current Sourced by any Output Pin	20 mA
Current Sunk by any Output Pin	25 mA
PW Total Output Current	40 mA

Operating Characteristics

Characteristic	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Voltage	V_{DD}	3.0		6.25	V	
Supply Current	I_{DD}		1.0	2.0	mA	
Output Low Voltage	V_{OL}			0.6	V	$I_{OL} = 8.7mA$ $V_{DD} = 4.5V$
Output High Voltage	V_{OH}	$V_{DD} - .7$			V	$I_{OH} = -5.4mA$ $V_{DD} = 4.5V$
Input Low Voltage	V_{IL}	V_{SS}		.2 V_{DD}	V	
Input High Voltage	V_{IH}	.45 V_{DD}		V_{DD}	V	
Input Bias Current	I_B	-1	.5	+1	uA	$V_{SS} \leq V_{IN} \leq V_{DD}$
Industrial Operating Temperature		-40		+85	°C	
Commercial Operating Temperature		0		+70	°C	

Timing Diagrams



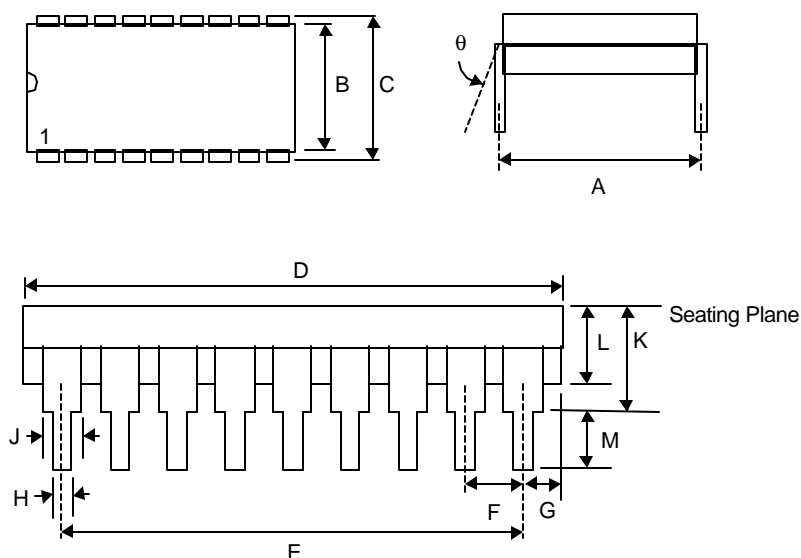
Parameter	Min.*	Typ.	Max.*	Units
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T_{CH}	333			μS
T_{UD}	14		390	μS
T_{PL}	14	20		μS
T_{DP}	14	20		μS
T_{PW}		12		μS
T_{PI}		256		μS
T_{SP}	4.2	6		μS

*Assumes +/- 30% timing accuracy of RC oscillator circuit

Packaging Information

-PD 18 lead 300 mil wide Plastic DIP



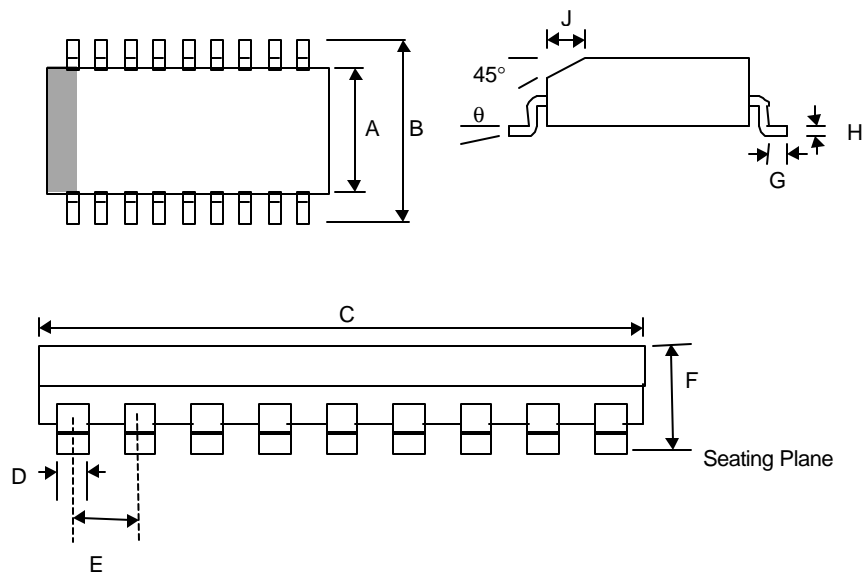
Symbol	Min. mm/in	Typ. mm/in	Max. mm/in
A		7.620/0.300	
B	6.096/0.240		7.112/0.280
C	7.620/0.300		8.255/0.325
θ	0°		10°
D	22.479/0.885		23.495/0.925
E		20.320/0.800	
F	2.489/0.098		2.591/0.102
G	0.889/0.035		
H	0.355/0.014		0.559/0.022
J		1.524/0.060	
K			4.064/0.160



OPTICAL ENCODER INTERFACE: Series 65
GH65C11-X

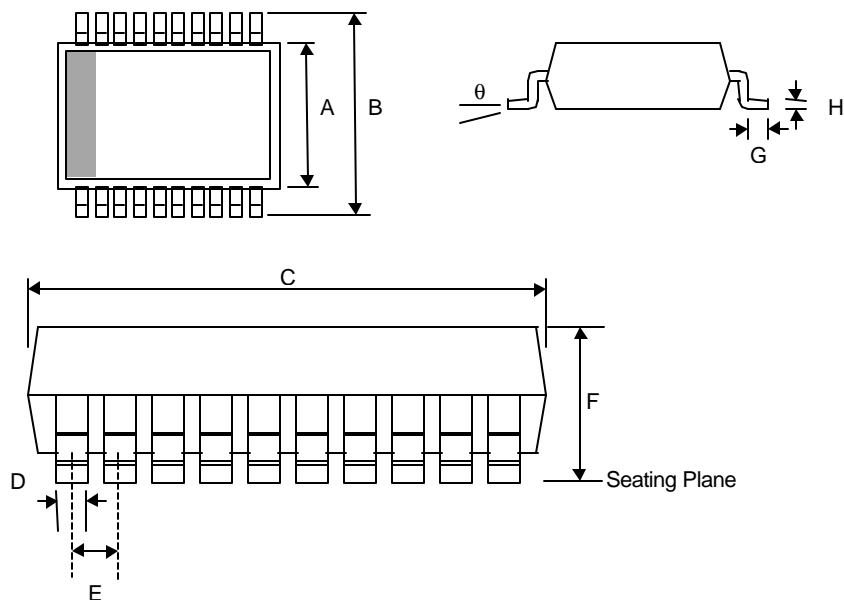
L	3.048/0.120		3.810/0.150
M	3.048/0.120		3.556/0.140

- SO = 18 lead 300 mil wide gull wing SOIC



Symbol	Min. mm/in	Typ. mm/in	Max. mm/in
A	7.417/0.292		7.595/0.299
B	10.008/0.394		10.643/0.419
C	11.354/0.447		11.735/0.462
D	0.356/0.014		0.483/0.019
E		1.270/.050	
F	2.362/0.093		2.642/0.104
G	0.406/0.016		1.143/0.045
H	0.241/0.0095		0.318/0.0125
J	0.381/0.015		0.762/0.030
θ	0°		8°

- SS = 20 lead SSOP



Symbol	Min. mm/in	Typ. mm/in	Max. mm/in
A	5.200/0.205		5.380/0.212
B	7.650/0.301		7.900/0.311
C	7.070/0.278		7.330/0.289
D	0.250/0.010		0.380/0.015
E		0.650/0.026	
F	1.730/0.068		1.990/0.078
G	0.550/0.022		0.950/0.037
H	0.130/0.005		0.220/0.009
θ	0°		8°