Pin	Signal	Description
1	GND	Ground
2	TX	Transmit
3	RXA	RS-232 (single ended) receive input or RS-485 (differential) positive side of differential receiver
4	/RXA	RS-485 – inverted side of differential receiver
5	TXA	RS-485 – positive side of differential transmiter
6	/TXA	RS-485 – inverted side of differential transmitter

Table 5, *RS232 RS485 Communications Port (P1) Description*

3.6.4 Controller Port (P2)

The DB25 connector at P2 is designed to connect an external controller to the G Series servodrive. The signals present on this connector should provide all that is needed to permit an external controller to control the operation of the power output section of the servodrive. Additional detail can be found in appendix B.

Pin	Signal	Description
1	**Velocity/Torque Analog Command Signal Input (+)**	This input is the positive input of the analog command signal for velocity or torque.
		Note: In order for the G Series servodrive to control motor motion through this analog signal, the servodrive must be operating in ANALOG mode, not SERIAL mode. ANALOG is the default startup mode for the servodrive when it first powers up. Please refer to the software commands later in this manual.
		Differential Input: For differential input, the analog command signal is applied between P2 pin 1 (positive input) and P2 pin 2 (negative input).
		Single-ended Non-inverted Input: For single-ended non-inverted input, the signal is applied to P2 pin 1 with respect to common, which is analog ground, pin 4. To achieve single-ended input, P2 pin 2 must be jumpered to pin 3.
2	**Velocity/Torque Analog Command Signal Inverted Input (–)**	When using differential inputs, this input is the negative input of the analog command signal for velocity or torque.
		When using single-ended non-inverted input mode, pin 2 must be jumpered to pin 3.
		When using single-ended inverted input mode, pin 1 must be jumpered to pin 3, and the command signal is applied to this pin (pin 2). See pin 1 above.
3	**Analog Ground**	Single-ended jumper reference. This ground is provided to facilitate operation with single-ended input.
4	**Analog Ground**	Shield for differential input, or single-ended common.
5	**+ 5 volts**	For external use (10 ma max.)
6	**Encoder Reference Output Z –**	Index or marker channel compliment reference
7	**Encoder Reference Output Z +**	Index or marker channel reference

Table 6, Controller Port (P2) Description (continued on next page)

| Pin	Signal	Description
8	**Encoder Reference Output B +**	Encoder data channel B reference. See Section 4.5, Commutation Feedback.
9	**Encoder Reference Output B –**	Encoder data channel B compliment reference
10	**Encoder Reference Output A +**	Encoder data channel A reference. See Section 4.5, Commutation Feedback
11	**Encoder Reference Output A –**	Encoder data channel A compliment reference
12*	**Dedicated Fault Output Common**	This pin provides a common for **Fault Output** (pin 13). This is an isolated output.
13*	**Dedicated Fault Output**	This output will normally be closed if no fault condition exists. If a fault condition occurs, this output will be opened until the fault condition causing it is cleared. Cycling P2 pin 24 will not clear this fault output by itself. The fault can only be cleared by first correcting the condition causing the fault, and then by performing a Fault reset using pin 24 or sending the FAULT 0 command via the RS232 port or completely resetting or repowering the servodrive.
14*	**Digital Input 1 (INP1)**	This input provides a convenient means for sending an input signal from the controller to a user selectable input. This isolated input is identical to **INP1** on P3. See 3.6.4.1, Shared Digital Inputs & Outputs.
15*	**Digital Input 2 (INP2)**	This input provides a convenient means for sending a second input signal from the controller to a user selectable input. This isolated input is identical to **INP2** on P3. See 3.6.4.1, Shared Digital Inputs & Outputs.
16*	**Digital Input Common**	This pin provides a common for both of the digital input connections. These are all isolated inputs.
17*	**Digital Output 1 (OUT1)**	This output provides a convenient means for sending an output signal from the servodrive back to the controller. This isolated output is identical to **OUT1** on P3. See 3.6.4.1, Shared Digital Inputs & Outputs.
18*	**Digital Output 2 (OUT2)**	This output provides a convenient means for sending a second output signal from the servodrive back to the controller. This isolated output is identical to **OUT2** on P3. See 3.6.4.1, Shared Digital Inputs & Outputs.
* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 10, Making Digital I/O Connections**, later in this chapter.		

Table 6, *Controller Port (P2) Description (continued on next page)*

Pin	Signal	Description
19*	**Digital Output 3 (OUT3)**	This output provides a convenient means for sending a third output signal from the servodrive back to the controller. This isolated output is identical to **OUT3** on P3. See 3.6.4.1, Shared Digital Inputs & Outputs, below.
20	**Digital Output Common**	This pin provides a common for all three of the digital output connections. These are all isolated outputs.
21	**Reserved**	Do not connect to this terminal.
22	**Reserved**	Do not connect to this terminal.
23*	**Dedicated Drive Enable Input**	By default, this input must be pulled high in order to enable the servodrive. If this input is held open, output to the motor will be disabled. This default setting can be reversed by changing the INPFN98 setting in the command mode, or by changing the drive enable input setting in UltraTools.
24*	**Dedicated Fault Reset Input**	In the event that a servodrive fault occurs, it can be cleared and reset by closing this input for a minimum of 4 milliseconds and then reopening it. This default setting can be reversed by changing the INPFN99 setting in the command mode, or by changing the drive reset input setting in UltraTools.
25*	**Dedicated Drive Enable / Fault Reset Common**	This pin provides a common for the Drive Enable and Fault Reset Inputs. These are both isolated outputs.
* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 10, Making Digital I/O Connections**, later in this chapter.		

Table 6, *Controller Port (P2) Description (continued from previous page)*

3.6.4.1 Shared Digital Inputs & Outputs

Please note that the two digital inputs (**INP1** & **INP2**) and three digital outputs (**OUT1** – **OUT3**) brought out by this P2 connector to the controller are <u>identical</u> to the I/O of the same name on the P3 connector. They are included on P2 for convenience in connecting with the controller. The digital outputs can be monitored at both P2 and P3 without confusion or harmful results. However, the digital inputs must be controlled at only one location, either P2 or P3. If the inputs (**INP1** & **INP2**) are actually controlled at P2, then no connection should be made to these inputs on the P3 connector. If the inputs are controlled at P3, then no connection should be made to them at the P2 connector. See **Figure 9**. Additional detail can be found in appendix B.

G Series Drive

INP1
INP2

OUT1
OUT2
OUT3

P2 Connector

INP3
INP4

OUT4

P3 Connector
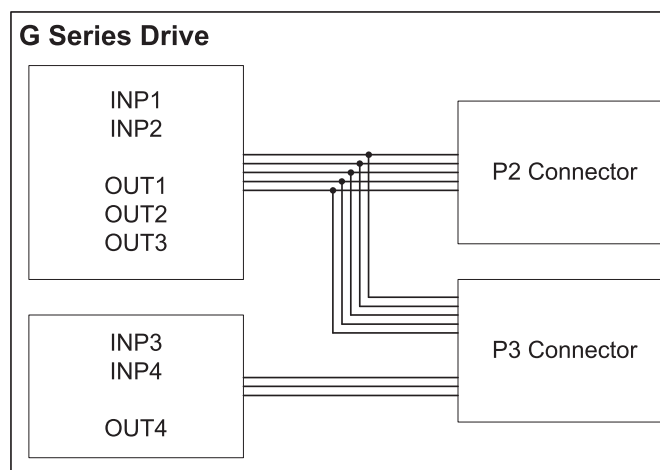
Figure 9, *Shared Digital Inputs & Outputs*
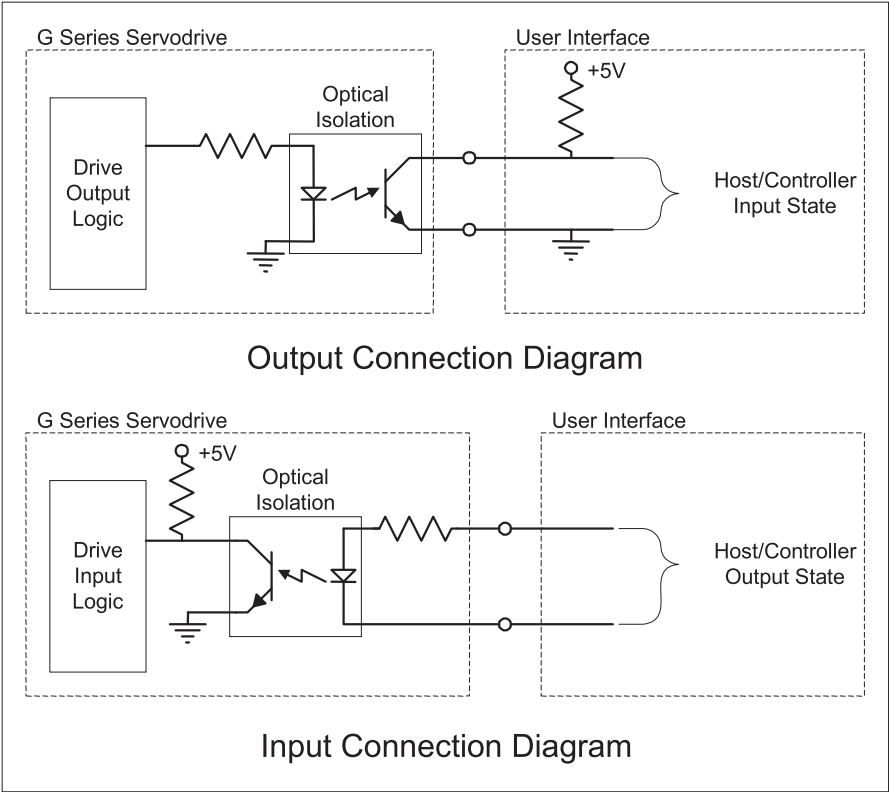
3.6.5 Supplemental Input Port (P3)

This quick-disconnecting Phoenix style header provides connections for the digital I/O, the DACs, and the motor temperature input. The digital inputs and outputs are user definable as to function and provide flexibility in handling such things as servodrive faults, etc. The two DAC outputs can help monitor signal levels and other items of interest. The motor temperature condition tracked on this connector provides protection against damaging the motor. Please note that the motor temperature wiring hookup must agree with the MOTMODE software command of the servodrive. That is, if 'Overtemp:' in the motor setup in UltraTools indicates to IGNORE the motor temperature sensor (MOTMODE 0), then no connection should be made to the TMP terminals on P3, or an 'F4' motor temperature error will occur. Likewise, if the choice is to indicate a fault (MOTMODE 1 and 2), then a valid motor temperature connection MUST be made, or an 'F4' motor temperature error will occur.

Pin	Signal	Description
1*	**Digital Input 1 (INP1)**	Fully isolated digital input. See 3.6.4.1, Shared Digital Inputs & Outputs.
2*	**Digital Input 2 (INP2)**	Fully isolated digital input. See 3.6.4.1, Shared Digital Inputs & Outputs.
3*	**Digital Input 3 (INP3)**	Fully isolated digital input.
4*	**Digital Input 4 (INP4)**	Fully isolated digital input.
* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 10, Making Digital I/O Connections**, later in this chapter.		

Table 7, *Supplemental I/O Port (P3) Description(continued from previous page)*

Pin	Signal	Description
5*	**Digital Input Common**	This pin provides a common for all of the digital input connections. These are all isolated inputs.
6*	**Digital Output 1 (OUT1)**	Fully isolated, user definable digital output. See 3.6.4.1, Shared Digital Inputs & Outputs.
7*	**Digital Output 2 (OUT2)**	Fully isolated, user definable digital output. See 3.6.4.1, Shared Digital Inputs & Outputs.
8*	**Digital Output 3 (OUT3)**	Fully isolated, user definable digital output. See 3.6.4.1, Shared Digital Inputs & Outputs.
9*	**Digital Output 4 (OUT4)**	Fully isolated, user definable digital output.
10*	**Digital Output Common**	This pin provides a common ground for all of the digital output connections. These are all isolated outputs.
11	**Digital – to - Analog Output 1 (DAC1)**	Torque Monitor ±10 VDC analog signal. 3 VDC = rated torque.
12	**Digital – to - Analog Output 2 (DAC2)**	Velocity Monitor ±10 VDC analog signal. The scaling depends on the maximum speed of the motor: Max speed 5000 rpm or higher: 1 VDC = 1000 rpm. Max speed between 2000-4999 rpm: 2 VDC = 1000 rpm. Max speed 1999 rpm or lower: 5 VDC = 1000 rpm. The maximum speed normally defaults to the maximum speed printed on the side of the motor, but for G-Series motors rated for 460 VAC (MAC-Gxxxx**4**), but operated at 230 VAC, it is limited to <u>half</u> of the maximum speed printed on the side of the motor.
13	**DAC Signal Common**	This pin provides a common for the two digital to analog outputs.
14*	**Motor Temperature Input**	This is the input pin for the normally closed motor thermal switch. These motor temperature pins are located close to the feedback connector, the normal source for the motor temperature input wires. The MOTMODE command defines how the drive will react to this input. **Note**: Failure to monitor the motor temperature outputs could result in damage to the motor and could void your warranty.
15*	**Motor Temperature Common**	This pin provides a common for the Motor Temperature Input.

* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 10, Making Digital I/O Connections**, later in this chapter.

Table 7, *Supplemental I/O Port (P3) Description(continued from previous page)*

Figure 10, *Making Digital I/O Connections*

Additional detail can be found in appendix B.

3.6.6 Feedback Port (P4)

The DB15 connector at P4 provides a simple and effective method for connecting the servomotor feedback to the G Series servodrive. This supplies the necessary encoder and Hall or resolver information to the DSP which allow it to track velocity and also provide commutation control to the servomotor.

Note, the quadrature and resolver feedback versions use different connector genders to prevent accidentally connecting the wrong feedback type.

Feedback Type	Connector on Drive	Connector on cable
Quadrature	Female DB15	Male DB15
Resolver	Male DB15	Female DB15

Refer to the Servodrive Connector Part Numbers section (page 81) of the Specifications chapter for further information. Additional detail can be found in appendix B.

Pin	Signal	Description
1	ENC PWR	+5 VDC power supply output for the motor encoder (450 mA max). This power is derived from the input control power at pins **r,t**.
2	DGND	Common for the +5 VDC supply (ENC PWR).
3 4	ENCZ' ENCZ	Differential input, "once per revolution" marker signal from the motor encoder.
5 6	ENCB' ENCB	Differential input, quadrature feedback channel B from the motor encoder.
7 8	ENCA' ENCA	Differential input, quadrature feedback channel A from the motor encoder.
9	SHIELD	Motor encoder shield termination point
10 11 12 13 14 15	W' W V' V U' U	Differential or single-ended input, commutation feedback channels U, V and W from the motor encoder. The U, V and W (pins 15, 13 & 11) inputs are intended for use with single ended commutation feedback. If the feedback signals are open collector outputs, external biasing hardware may be required. The U', V' and W' (pins 14, 12 & 10) inputs are internally biased and no connection or external circuitry is required for use with single ended feedback.

Table 8, *Feedback Port (P4) Connections – Quadrature interface*

Pin	Signal	Description
1 2	Ref + Ref -	Differential analog reference output from the drive to the resolver.
3 4	Sin - Sin +	Differential analog input from the resolver. Note that the names Sin and Cos as labeled on the resolver may not always provide the phasing as required by the drive. It may be necessary to reverse the Sin and Cos pairs to get proper control. The drive expects feedback position to increase with counter clockwise rotation of the motor shaft as viewed from the shaft end of the motor.
5 6	Cos + Cos -	Differential analog input from the resolver.
7	DGND	Common for the +5 VDC supply (+5 V).
8	+5 V	+5 VDC power supply output (450 mA max). This power is derived from the input control power at pins **r,t**.
9	SHIELD	Motor resolver shield termination point. It is recommended that the cable to the resolver use separate shields around the 3 signal pairs (Ref, Sin, Cos) and that each shield be terminated in one of the shield pins.
10	Motor Temp input	Duplicate of the P3 pin 14 Motor Temperature Input.
11	SHIELD	Motor resolver shield termination point.
12	N/C	Do not connect any wire to this terminal.
13	SHIELD	Motor resolver shield termination point.
14	N/C	Do not connect any wire to this terminal.
15	SHIELD	Motor resolver shield termination point.

Table 9, *Feedback Port (P4) Connections – Resolver interface*

3.6.7 External Regen Resistor Wiring (RG)

Regenerative (regen) shunt circuitry, for use with external regen resistors, is provided on Servodrive models G210, G217, G220, G225, G235, G260, and G4xx only. Regen resistors are connected between the **Bus** + and **REGEN** terminals on TB1 (refer to **Figure 11**).

The following methods are recommended for proper installation of regen resistors:

1. **Regen resistors can become very hot as part of normal operation and should be mounted in a ventilated, "touch safe" enclosure.** ORMEC SAC-SWRR/0700, SAC-SWRR/0845, SAC-SWRR/0846, and SAC-SWRR/1700 regen resistors are supplied with enclosures. Mounting enclosures for the SAC-SWRR/0055 and SAC-SWRR/0095 regen resistors are not included and must be supplied by the user.

2. Regen resistor wiring should have heat resistant, non-combustible insulation.