Huntsman Technologies

Analog / Digital Combo Card.

Instruction Manual.

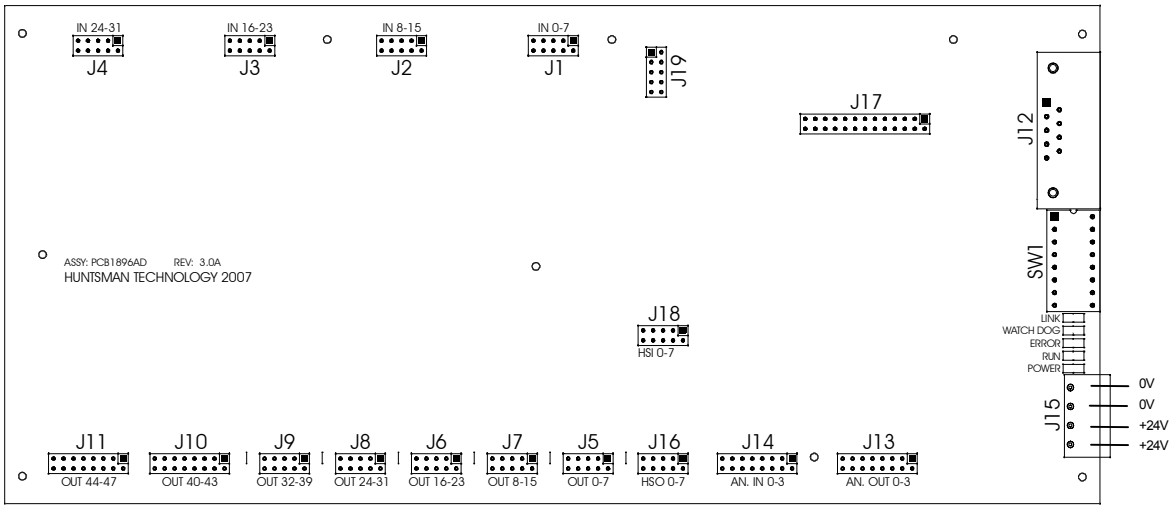
Chapter

1

Combo Board Connectors.

Detailed description of each connector on the combo board.

Connector Locations



• Figure 1. PCB Layout

General Purpose Inputs (J1 to J4)

Description.

The general purpose inputs enter the board via 4 x 10 way connectors. Each connector provides 8 inputs thus providing a total of 32 inputs. Inputs are grouped into blocks of 4, each block can be set to be driven by sinking or sourcing outputs. Each block is fully isolated and independent from the other blocks.

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	INPUT 0	INPUT 1	2
3	INPUT 2	INPUT 3	4
5	COMMON 0 – 3	COMMON 4 – 7	6
7	INPUT 4	INPUT 5	8
9	INPUT 6	INPUT 7	10

• Table1. Inputs 0 to 7 (J1).

1	INPUT 8	INPUT 9	2
3	INPUT 10	INPUT 11	4
5	COMMON 8 – 11	COMMON 12 – 15	6
7	INPUT 12	INPUT 13	8
9	INPUT 14	INPUT 15	10

• Table2. Inputs 8 to 15 (J2).

1	INPUT 16	INPUT 17	2
3	INPUT 18	INPUT 19	4
5	COMMON 16 – 19	COMMON 20 – 23	6
7	INPUT 20	INPUT 21	8
9	INPUT 22	INPUT 23	10

• Table3. Inputs 16 to 23 (J3).

1	INPUT 24	INPUT 25	2
3	INPUT 26	INPUT 27	4
5	COMMON 24 – 27	COMMON 28 – 31	6
7	INPUT 28	INPUT 29	8
9	INPUT 30	INPUT 31	10

• Table4. Inputs 24 to 31 (J4).

Input Specifications.

Symbol	Description	Min	Typ	Max	Units
$V_{IN(ON)}$	Input voltage range	18	24	30	V
I_{IN}	Input current	5	7	11	mA

• Table5. Input Specifications.

General Purpose Outputs (J5 to J9)

Description.

The general purpose outputs leave the board via 5 x 10 way connectors. Each connector provides 8 outputs thus providing a total of 40 outputs. Outputs are grouped into blocks of 8. All outputs are sourcing only.

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	OUTPUT 0	OUTPUT 1	2
3	OUTPUT 2	OUTPUT 3	4
5	OUTPUT 4	OUTPUT 5	6
7	OUTPUT 6	OUTPUT 7	8
9	0V	0V	10

• Table6. Outputs 0 to 7 (J5).

1	OUTPUT 8	OUTPUT 9	2
3	OUTPUT 10	OUTPUT 11	4
5	OUTPUT 12	OUTPUT 13	6
7	OUTPUT 14	OUTPUT 15	8
9	0V	0V	10

• Table7. Outputs 8 to 15 (J7).

1	OUTPUT 16	OUTPUT 17	2
3	OUTPUT 18	OUTPUT 19	4
5	OUTPUT 20	OUTPUT 21	6
7	OUTPUT 22	OUTPUT 23	8
9	0V	0V	10

• Table8. Outputs 16 to 23 (J6).

1	OUTPUT 24	OUTPUT 25	2
3	OUTPUT 26	OUTPUT 27	4
5	OUTPUT 28	OUTPUT 29	6
7	OUTPUT 30	OUTPUT 31	8
9	0V	0V	10

• Table9. Outputs 24 to 31 (J8).

1	OUTPUT 32	OUTPUT 33	2
3	OUTPUT 34	OUTPUT 35	4
5	OUTPUT 36	OUTPUT 37	6
7	OUTPUT 38	OUTPUT 39	8
9	0V	0V	10

• Table10. Outputs 32 to 39 (J9).

Output Specifications.

Symbol	Description	Max	Units
I_{OUT}	Maximum output current	500	mA
I_{BLK}	Maximum total current per block	500	mA

• Table11. Output Specifications.

General Purpose High Current Outputs (J10 and J11)

Description.

The general purpose high current outputs leave the board via 2 x 16 way connectors. Each connector provides 4 outputs thus providing a total of 8 high current outputs. The high current outputs require a 24V supply to be provided to each connector. An external fuse should also be provided for the 24V supply.

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	+24V	+24V	2
3	+24V	+24V	4
5	OUTPUT 40	OUTPUT 40	6
7	OUTPUT 41	OUTPUT 41	8
9	OUTPUT 42	OUTPUT 42	10
11	OUTPUT 43	OUTPUT 43	12
13	0V	0V	14
15	0V	0V	16

• Table12. Outputs 40 to 43 (J10).

1	+24V	+24V	2
3	+24V	+24V	4
5	OUTPUT 44	OUTPUT 44	6
7	OUTPUT 45	OUTPUT 45	8
9	OUTPUT 46	OUTPUT 46	10
11	OUTPUT 47	OUTPUT 47	12
13	0V	0V	14
15	0V	0V	16

• Table12. Outputs 44 to 47 (J11).

Output Specifications.

Symbol	Description	Max	Units
V_{SUPPLY}	Maximum supply voltage	30	V
I_{OUT}	Maximum output current	2.0	A
I_{PK}	Peak output current (20uS)	10.0	A

• Table13. Output Specifications.

Analog Outputs (J13)

Description.

A single 16 way connector provides 4 analog outputs. Each output is available as either a voltage output or a current output. Current outputs are sourcing and have a range of 0 to 20mA. Voltage outputs have a range of 0 to 10V.

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	VOUT0	0V	2
3	IOUT0	0V	4
5	VOUT1	0V	6
7	IOUT1	0V	8
9	VOUT2	0V	10
11	IOUT2	0V	12
13	VOUT3	0V	14
15	IOUT3	0V	16

• Table14. Analog Outputs 0 to 3 (J13).

Analog Output Specifications.

Symbol	Description	Min	Max	Units
$V_{(VOUT)}$	Voltage output range	0.0	10.0	V
$I_{(VOUT)}$	Maximum voltage output current		5.0	mA
$V_{(IOUT)}$	Maximum current output voltage		10.0	V
$I_{(IOUT)}$	Current output range	0.0	20.0	mA

• Table15. Analog Output Specifications.

Analog Inputs (J14)

Description.

A single 16 way connector provides 4 analog inputs. Each input is available as either a voltage input or a current input. All inputs are differential.

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	VIN0+	VIN0-	2
3	IIN0+	IIN0-	4
5	VIN1+	VIN1-	6
7	IIN1+	IIN1-	8
9	VIN2+	VIN2-	10
11	IIN2+	IIN2-	12
13	VIN3+	VIN3-	14
15	IIN3+	IIN3-	16

• Table16. Analog Inputs 0 to 3 (J14).

Analog Input Specifications.

Symbol	Description	Min	Max	Units
$V_{CM(VIN)}$	Common mode voltage range	0.0	30.0	V
$V_{DIFF(VIN)}$	Differential mode voltage range	0.0	10.0	V
$Z_{DIFF(VIN)}$	Differential input impedance		80.0	kΩ
$V_{CM(IIN)}$	Common mode voltage range	0.0	15.0	V
I_{IN}	Current range	0.0	20.0	mA
$Z_{(IIN)}$	Input impedance		125	Ω

• Table17. Analog Output Specifications.

Power Connector (J15)

Description.

A single 4 way connector provides power to the combo board. Circuitry has been provided to protect against over voltage and reverse polarity however should any of these conditions be applied, the on-board fuse will blow.

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB, Pin 1 is closest to the corner of the PCB.

4	0V
3	0V
2	+24V
1	+24V

• Table18. Power Connector (J15).

Power Supply Specifications.

Symbol	Description	Min	Typ	Max	Units
V_{IN}	Supply voltage range	18.0	24.0	30.0	V
I_{IN}	Supply current (No Load)	100	130	200	mA
I_{FUSE}	Fuse Rating		3.0		A

• Table19. Power Supply Specifications.

High Speed Digital Outputs (J16)

Description.

A single 10 way connector provides 8 high speed digital outputs. These outputs are 5 Volt CMOS and requires external buffers to drive at different voltage levels (See applications section).

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	HS OUTPUT 0	HS OUTPUT 1	2
3	HS OUTPUT 2	HS OUTPUT 3	4
5	HS OUTPUT 4	HS OUTPUT 5	6
7	HS OUTPUT 6	HS OUTPUT 7	8
9	0V	0V	10

• Table20. High Speed Outputs 0 to 7 (J16).

Output Specifications.

Symbol	Description	Min	Max	Units
V_{OH}	High output voltage	3.9	5.1	V
V_{OL}	Low output voltage	0.0	0.4	V
I_{OUT}	Maximum output current		5.0	mA

• Table21. High Speed Output Specifications.

High Speed Digital Inputs (J18)

Description.

A single 10 way connector provides 8 high speed digital inputs. These inputs are 5 Volt CMOS with TTL compatible voltage levels. External circuitry may be required to translate incoming signals to levels that are compatible with these inputs (See applications section).

Connector Layouts.

The following tables describes each pin and it's function.

Note: Viewed from component side of PCB.

1	HS INPUT 0	HS INPUT 1	2
3	HS INPUT 2	HS INPUT 3	4
5	HS INPUT 4	HS INPUT 5	6
7	HS INPUT 6	HS INPUT 7	8
9	0V	0V	10

• Table22. High Speed Inputs 0 to 7 (J18).

Output Specifications.

Symbol	Description	Min	Max	Units
V_{IH}	High input voltage	2.0	5.0	V
V_{IL}	Low input voltage	0.0	0.8	V

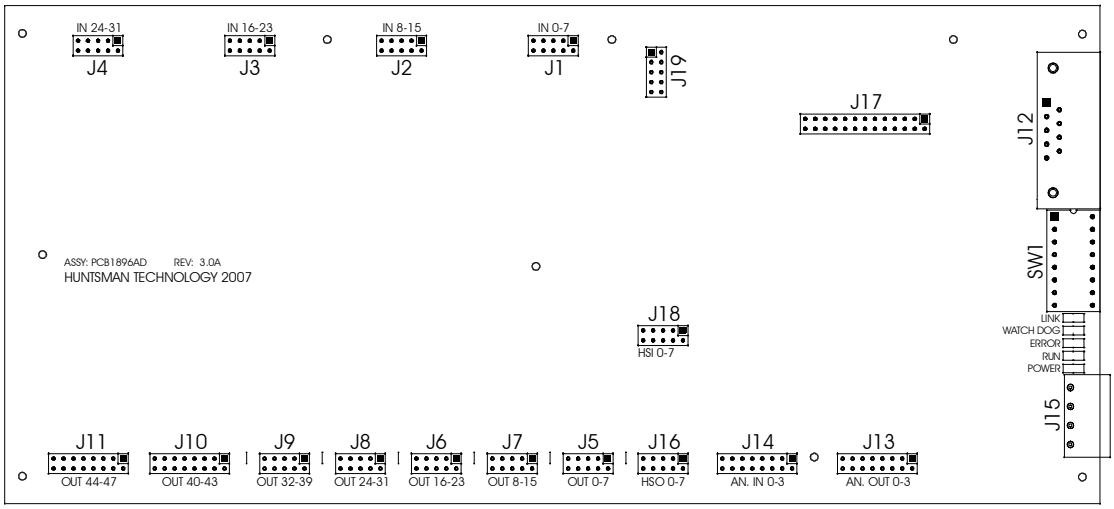
• Table23. High Speed Input Specifications.

Chapter
2

Combo Board DIP Switch and LEDs.

Detailed description of DIP switch settings and status LEDs.

DIP Switch and LED Locations



• Figure 2. PCB Layout

DIP Switch (SW1)

Description.

DIP switch SW1 has a total of 8 switches, 1 of these switches is used to reset the combo board, the 7 remaining switches are used to set the ProfiBUS address.

Switch 1.

Switch 1 is used to reset the combo board. The combo board will operate normally when this switch is in the off position. To reset the board, switch 1 needs to be put into the on position then taken back to the off position.

Note: When in the reset is active, Switch 1 is on, the outputs of the card may be in an undefined state.

Switches 2 to 8.

Switches 2 to 8 set the ProfiBUS address. The Address is set by setting the DIP switches to the binary value of the desired address (See table below). Any changes to the address will not take place until the board has been reset or had the power cycled. Setting the address to 0 (switches 2 to 8 off) will set the combo board into “Enhanced mode” (Default). Setting the address to 127 (switches 2 to 8 on) will set the combo board into “Legacy mode” which maintains compatibility with previous hardware.

Switch	Binary Value
2	1
3	2
4	4
5	8
6	16
7	32
8	64

• Table24. Binary coding of DIP switches.

The following table will show some examples of switches settings for various addresses.

Address	DIP Switch						
	2	3	4	5	6	7	8
17	ON	OFF	OFF	OFF	ON	OFF	OFF
11	ON	ON	OFF	ON	OFF	OFF	OFF
89	ON	OFF	OFF	ON	ON	OFF	ON
35	ON	ON	OFF	OFF	OFF	ON	OFF

• Table25. DIP switch examples.

Status LEDs

Description.

A total of 5 LEDs located between the DIP switches and the power connector indicate the overall status of the combo board.

Power LED.

This LED simply indicates that the on-board logic is powered.

Run LED.

This LED will light up when the combo board is running and has passed the system diagnostics. This LED will flash when in “Legacy mode” instead of remaining in a steady state.

Error LED.

This LED will flash when a fatal system fault occurs. In this state the board is unable to link to the ProfiBUS and will not recover unless the board is reset or power cycled. If this LED is lit constantly then an error has occurred on the ProfiBUS but will recover when the cause of the fault has been remedied.

Watchdog LED.

This LED will flash constantly to indicate that the on-board CPU is running.

Link LED.

This LED will light up when the combo board enters the data exchange mode on the ProfiBUS.

Chapter

3

Combo Board Basic Modules.

Detailed description of each basic module.

Digital Inputs 0 - 31

Description.

This module provides 32 general purpose inputs. This module may be placed in any slot however no more than 1 instance can be present. This module is used to read the inputs on connectors J1 to J4.

I/O Usage.

This module uses 4 input bytes.

Parameters.

None.

Digital Outputs 0 - 7

Description.

This module provides 8 general purpose outputs. This module may be placed in any slot however no more than 1 instance can be present. This module controls the outputs on connector J5.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Digital Outputs 8 - 15

Description.

This module provides 8 general purpose outputs. This module may be placed in any slot however no more than 1 instance can be present. This module controls the outputs on connector J6.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Digital Outputs 16 - 23

Description.

This module provides 8 general purpose outputs. This module may be placed in any slot however no more than 1 instance can be present. This module controls the outputs on connector J7.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Digital Outputs 24 - 31

Description.

This module provides 8 general purpose outputs. This module may be placed in any slot however no more than 1 instance can be present. This module controls the outputs on connector J8.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Digital Outputs 32 - 39

Description.

This module provides 8 general purpose outputs. This module may be placed in any slot however no more than 1 instance can be present. This module controls the outputs on connector J9.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Digital Outputs 40 – 47 (High current)

Description.

This module provides 8 general purpose high current outputs. This module may be placed in any slot however no more than 1 instance can be present. This module controls the outputs on connectors J10 and J11.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Analog Input 0

Description.

This module provides a means to read analog input 0 on connector J14. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Input 1

Description.

This module provides a means to read analog input 1 on connector J14. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Input 2

Description.

This module provides a means to read analog input 2 on connector J14. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Input 3

Description.

This module provides a means to read analog input 3 on connector J14. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Output 0

Description.

This module provides a means to control analog output 0 on connector J13. This module may be placed in any slot however no more than 1 instance can be present and cannot be present if another module is using analog output 0.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Output 1

Description.

This module provides a means to control analog output 1 on connector J13. This module may be placed in any slot however no more than 1 instance can be present and cannot be present if another module is using analog output 1.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Output 2

Description.

This module provides a means to control analog output 2 on connector J13. This module may be placed in any slot however no more than 1 instance can be present and cannot be present if another module is using analog output 2.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Analog Output 3

Description.

This module provides a means to control analog output 3 on connector J13. This module may be placed in any slot however no more than 1 instance can be present and cannot be present if another module is using analog output 3.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Chapter
4

Combo Board Advanced Modules.

Detailed description of each advanced module.

Frequency Counter 0

Description.

This module is used to measure in Hertz, the frequency of the selected high speed input on connector J18. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input word (2 bytes).

Parameters.

Input Source – Which input bit to measure.

Requires.

None.

Frequency Counter 1

Description.

This module is used to measure in Hertz, the frequency of the selected high speed input on connector J18. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input word (2 bytes).

Parameters.

Input Source – Which input bit to measure.

Requires.

None.

Position Encoder 0

Description.

This module is used to read the position provided by an incremental encoder attached to the selected high speed inputs on connector J18. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input double word (4 bytes).

Parameters.

Ch A Input Source – Which input bit to use as channel A.

Ch B Input Source – Which input bit to use as channel B.

Reset Input Source – Which input bit to use as a counter reset.

Reset Input Enable – Controls whether the reset input is used.

Reset Input Polarity – Controls whether the reset input is active high or low.

Reset Input Gated – Controls whether the reset input is gated with Channels A and B.

Count Direction – Controls whether the counter counts normally or in the reverse direction.

Requires.

None.

Position Encoder 1

Description.

This module is used to read the position provided by an incremental encoder attached to the selected high speed inputs on connector J18. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 input double word (4 bytes).

Parameters.

Ch A Input Source – Which input bit to use as channel A.

Ch B Input Source – Which input bit to use as channel B.

Reset Input Source – Which input bit to use as a counter reset.

Reset Input Enable – Controls whether the reset input is used.

Reset Input Polarity – Controls whether the reset input is active high or low.

Reset Input Gated – Controls whether the reset input is gated with Channels A and B.

Count Direction – Controls whether the counter counts normally or in the reverse direction.

Requires.

None.

PWM Output 0

Description.

This module is used to set the duty cycle of channel 0 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 0 on connector J16 via the HSO module as well as being an input term for logic unit 0. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 1

Description.

This module is used to set the duty cycle of channel 1 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 1 on connector J16 via the HSO module as well as being an input term for logic unit 0. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 2

Description.

This module is used to set the duty cycle of channel 2 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 2 on connector J16 via the HSO module as well as being an input term for logic unit 0. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 3

Description.

This module is used to set the duty cycle of channel 3 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 3 on connector J16 via the HSO module as well as being an input term for logic unit 0. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 4

Description.

This module is used to set the duty cycle of channel 4 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 4 on connector J16 via the HSO module as well as being an input term for logic unit 1. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 5

Description.

This module is used to set the duty cycle of channel 5 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 5 on connector J16 via the HSO module as well as being an input term for logic unit 1. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 6

Description.

This module is used to set the duty cycle of channel 6 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 6 on connector J16 via the HSO module as well as being an input term for logic unit 1. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

PWM Output 7

Description.

This module is used to set the duty cycle of channel 7 of the 8 channel PWM block. The High Speed Output module is required if this module is used. The PWM output may be routed to high speed output 7 on connector J16 via the HSO module as well as being an input term for logic unit 1. This module may be placed in any slot however no more than 1 instance can be present.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out.

Pulse Frequency 0

Description.

This module is used to set the frequency in Hertz, maximum of 10kHz, of pulser 0. The High Speed Output module is required if this module is used. The output may be routed to any of the high speed outputs 0 to 3 on connector J16 via the HSO module as well as being an input term for logic units 0 and 1. This module may be placed in any slot however no more than 1 instance can be present. A second module is also required to set the duty cycle.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

High Speed Digital Out and either Pulse Duty 0 or Set Ramp Duty 0.

Pulse Frequency 1

Description.

This module is used to set the frequency in Hertz, maximum of 10kHz, of pulser 1. The High Speed Output module is required if this module is used. The output may be routed to any of the high speed outputs 4 to 7 on connector J16 via the HSO module as well as being an input term for logic units 0 and 1. This module may be placed in any slot however no more than 1 instance can be present. A second module is also required to set the duty cycle.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

High Speed Digital Out and either Pulse Duty 1 or Set Ramp Duty 1.

Pulse Duty 0

Description.

This module is used with the Pulse Frequency 0 module to set the duty cycle of pulser 0. This module cannot be used with the Set Ramp Duty 0 module. The output can be set from 0 to 100% duty cycle.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out and Pulse Frequency 0.

Conflicts With.

Set Ramp Duty 0.

Pulse Duty 1

Description.

This module is used with the Pulse Frequency 1 module to set the duty cycle of pulser 1. This module cannot be used with the Set Ramp Duty 1 module. The output can be set from 0 to 100% duty cycle.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

High Speed Digital Out and Pulse Frequency 1.

Conflicts With.

Set Ramp Duty 1.

Feed Rate Ratio 0

Description.

This module is used as 1 of 3 methods for setting the current feed rate ratio for ramp unit 0. The module will accept data in the range of 0 to 10000 where 10000 = 100%. This module cannot be used with any other module that sets the feed rate for ramp unit 0. This module also requires the duty ramping and/or the power ramping modules for ramp unit 0. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

Set Duty Ramp Function 0 and/or Set Power 0.

Conflicts With.

Feedrate Analog 0 and Actual Feedrate 0 and Set Feedrate 0.

Feed Rate Ratio 1

Description.

This module is used as 1 of 3 methods for setting the current feed rate ratio for ramp unit 1. The module will accept data in the range of 0 to 10000 where 10000 = 100%. This module cannot be used with any other module that sets the feed rate for ramp unit 1. This module also requires the duty ramping and/or the power ramping modules for ramp unit 1. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

Set Duty Ramp Function 1 and/or Set Power 1.

Conflicts With.

Feedrate Analog 1 and Actual Feedrate 1 and Set Feedrate 1.

Feed Rate Analog 0

Description.

This module is used as 1 of 3 methods for setting the current feed rate ratio for ramp unit 0. The module accepts no data however it gets the current feed rate from an analog input on connector J14. This module cannot be used with any other module that sets the feed rate for ramp unit 0. This module also requires the duty ramping and/or the power ramping modules for ramp unit 0. See chapter 6 for more details.

I/O Usage.

None.

Parameters.

Feedrate Input Source – Select which analog input to use.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Requires.

Set Duty Ramp Function 0 and/or Set Power 0.

Conflicts With.

Feedrate Ratio 0 and Actual Feedrate 0 and Set Feedrate 0.

Feed Rate Analog 1

Description.

This module is used as 1 of 3 methods for setting the current feed rate ratio for ramp unit 1. The module accepts no data however it gets the current feed rate from an analog input on connector J14. This module cannot be used with any other module that sets the feed rate for ramp unit 0. This module also requires the duty ramping and/or the power ramping modules for ramp unit 1. See chapter 6 for more details.

I/O Usage.

None.

Parameters.

Feedrate Input Source – Select which analog input to use.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Requires.

Set Duty Ramp Function 1 and/or Set Power 1.

Conflicts With.

Feedrate Ratio 1 and Actual Feedrate 1 and Set Feedrate 1.

Actual Feed Rate 0

Description.

This module is used as 1 of 3 methods for setting the current feed rate ratio for ramp unit 0. The module will accept 32 bit data and calculate the ratio based on the set feed rate. This module cannot be used with any other module that sets the feed rate for ramp unit 0 however the set feed rate 0 module is required. This module also requires the duty ramping and/or the power ramping modules for ramp unit 0. See chapter 6 for more details.

I/O Usage.

This module uses 1 output double word (4 bytes).

Parameters.

None.

Requires.

Set Duty Ramp Function 0 and/or Set Power 0.

Set Feedrate 0.

Conflicts With.

Feedrate Ratio 0 and Feedrate Analog 0.

Actual Feed Rate 1

Description.

This module is used as 1 of 3 methods for setting the current feed rate ratio for ramp unit 1. The module will accept 32 bit data and calculate the ratio based on the set feed rate. This module cannot be used with any other module that sets the feed rate for ramp unit 1 however the set feed rate 1 module is required. This module also requires the duty ramping and/or the power ramping modules for ramp unit 1. See chapter 6 for more details.

I/O Usage.

This module uses 1 output double word (4 bytes).

Parameters.

None.

Requires.

Set Duty Ramp Function 1 and/or Set Power 1.

Set Feedrate 1.

Conflicts With.

Feedrate Ratio 1 and Feedrate Analog 1.

Set Feed Rate 0

Description.

This module is used as 1 of 3 methods in conjunction with the Actual Feedrate 0 module. This module also requires the duty ramping and/or the power ramping modules for ramp unit 0. See chapter 6 for more details.

I/O Usage.

This module uses 1 output double word (4 bytes).

Parameters.

None.

Requires.

Set Duty Ramp Function 0 and/or Set Power 0.

Actual Feedrate 0.

Set Feed Rate 1

Description.

This module is used as 1 of 3 methods in conjunction with the Actual Feedrate 1 module. This module also requires the duty ramping and/or the power ramping modules for ramp unit 1. See chapter 6 for more details.

I/O Usage.

This module uses 1 output double word (4 bytes).

Parameters.

None.

Requires.

Set Duty Ramp Function 1 and/or Set Power 1.

Actual Feedrate 1.

Set Duty Ramp Function 0

Description.

This module is used to set the duty cycle of Pulser 0 based on a ramping function. This module requires the Duty Ramp Min % 0 module as well as a feed rate input module. This

module cannot be used with the Pulse Duty 0 module. The Pulse Frequency 0 and High Speed Digital Out modules are also required. See chapter 6 for more details.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

Pulse Frequency 0.

Duty Ramp Min % 0.

High Speed Digital Out.

Actual Feed Rate 0 / Set Feed Rate 0, Feed Rate Analog 0 or Feed Rate Ratio 0.

Conflicts With.

Pulse Duty 0.

Set Duty Ramp Function 1

Description.

This module is used to set the duty cycle of Pulser 1 based on a ramping function. This module requires the Duty Ramp Min % 1 module as well as a feed rate input module. This module cannot be used with the Pulse Duty 1 module. The Pulse Frequency 1 and High Speed Digital Out modules are also required. See chapter 6 for more details.

I/O Usage.

This module uses 1 output byte.

Parameters.

None.

Requires.

Pulse Frequency 1.

Duty Ramp Min % 1.

High Speed Digital Out.

Actual Feed Rate 1 / Set Feed Rate 1, Feed Rate Analog 1 or Feed Rate Ratio 1.

Conflicts With.

Pulse Duty 1.

Duty Ramp % 0

Description.

This module is used to set the minimum duty cycle of Pulser 0 based on a ramping function. This module requires the Set Duty Ramp Function 0 module as well as a feed rate input module. This module cannot be used with the Pulse Duty 0 module. The Pulse Frequency 0 and High Speed Digital Out modules are also required. Input is a percentage where 10000 is equal to 100.00%. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

Pulse Frequency 0.

Set Duty Ramp Function 0.

High Speed Digital Out.

Actual Feed Rate 0 / Set Feed Rate 0, Feed Rate Analog 0 or Feed Rate Ratio 0.

Conflicts With.

Pulse Duty 0.

Duty Ramp % 1

Description.

This module is used to set the minimum duty cycle of Pulser 1 based on a ramping function. This module requires the Set Duty Ramp Function 1 module as well as a feed rate input module. This module cannot be used with the Pulse Duty 1 module. The Pulse Frequency 1 and High Speed Digital Out modules are also required. Input is a percentage where 10000 is equal to 100.00%. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

Pulse Frequency 1.

Set Duty Ramp Function 1.

High Speed Digital Out.

Actual Feed Rate 1 / Set Feed Rate 1, Feed Rate Analog 1 or Feed Rate Ratio 1.

Conflicts With.

Pulse Duty 1.

Set Power 0

Description.

This module is used to set an analog output based on a ramping function. This module requires the Power Ramp Min % 0 module as well as a feed rate input module. This module cannot be used with any other module that uses the same analog output. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

Analog Output – Which analog output to use.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Requires.

Power Ramp Min % 0.

Actual Feed Rate 0 / Set Feed Rate 0, Feed Rate Analog 0 or Feed Rate Ratio 0.

Conflicts With.

Any module that uses the same analog output.

Set Power 1

Description.

This module is used to set an analog output based on a ramping function. This module requires the Power Ramp Min % 1 module as well as a feed rate input module. This module cannot be used with any other module that uses the same analog output. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

Analog Output – Which analog output to use.

Gain (Unsigned16) and Offset (Signed16). See chapter 5 for gain and offset calculations.

Requires.

Power Ramp Min % 1.

Actual Feed Rate 1 / Set Feed Rate 1, Feed Rate Analog 1 or Feed Rate Ratio 1.

Conflicts With.

Any module that uses the same analog output.

Power Ramp % 0

Description.

This module is used to set the minimum analog output based on a ramping function. This module requires the Set Power 0 module as well as a feed rate input module. Input is a percentage where 10000 is equal to 100.00%. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

Set Power 0.

Actual Feed Rate 0 / Set Feed Rate 0, Feed Rate Analog 0 or Feed Rate Ratio 0.

Power Ramp % 1

Description.

This module is used to set the minimum analog output based on a ramping function. This module requires the Set Power 1 module as well as a feed rate input module. Input is a percentage where 10000 is equal to 100.00%. See chapter 6 for more details.

I/O Usage.

This module uses 1 output word (2 bytes).

Parameters.

None.

Requires.

Set Power 1.

Actual Feed Rate 1 / Set Feed Rate 1, Feed Rate Analog 1 or Feed Rate Ratio 1.

High Speed Digital In

Description.

This module is used to read the high speed inputs directly.

I/O Usage.

This module uses 1 input byte.

Parameters.

None.

High Speed Digital Out

Description.

This module is used to set the high speed outputs directly or to be used as inputs to the logic blocks. Each of the 8 outputs can be set to direct output, PWM output, pulser output or logic unit output. Outputs 0 to 3 can use Pulser 0 or Logic Unit 0 while outputs 4 to 7 can use Pulser 1 or Logic Unit 1. When an output is set PWM, the PWM channel that is the same as the output number is used. Additionally each output can be inverted.

I/O Usage.

This module uses 1 output byte.

Parameters.

Polarity Control – used to set each output to true or inverted logic.

Output Source – used to set each bit to Direct Out , PWM Out, Pulser Out or Logic Out.

Logic Unit 0

Description.

This module is used to define logic unit 0. This module allows the user to define high speed combinatorial logic based on High Speed Inputs 0 to 3, PWM outputs 0 to 3, High Speed Outputs 0 to 3 (Profibus bits not actual outputs) and the outputs of both pulsers. See Chapter 7 for implementation details.

I/O Usage.

None.

Parameters.

See Chapter 7.

Requires.

High Speed Digital Out.

Logic Unit 1

Description.

This module is used to define logic unit 1. This module allows the user to define high speed combinatorial logic based on High Speed Inputs 4 to 7, PWM outputs 4 to 7, High Speed Outputs 4 to 7 (Profibus bits not actual outputs) and the outputs of both pulsers. See Chapter 7 for implementation details.

I/O Usage.

None.

Parameters.

See Chapter 7.

Requires.

High Speed Digital Out.

Command Unit

Description.

This module is used execute commands that perform various functions. See chapter 8 for details.

I/O Usage.

The module uses the following:

1 output word – Command Word

1 output word – Command Data

1 input word – Last Command

1 input word – Command Result.

Parameters.

None.

Chapter

5

Combo Board Gain and Offset Calculation.

Analog gain and offset calculations.

Analog Inputs (Voltage Mode)

Variables.

VMAX – Maximum input voltage in mV.

DMAX – Desired result at VMAX.

VMIN – Minimum input voltage in mV.

DMIN – Desired result at VMIN.

Gain – Calculated gain value.

Offset – Calculated offset value.

Gain calculation.

$$Gain = \left(\frac{D_{MAX} - D_{MIN}}{V_{MAX} - V_{MIN}} \right) \times 5000$$

Offset calculation.

$$Offset = D_{MIN} - \left(\frac{V_{MIN} \times Gain}{5000} \right)$$

Analog Inputs (Current Mode)

Variables.

IMAX – Maximum input current in μA.

DMAX – Desired result at IMAX.

IMIN – Minimum input current in μA.

DMIN – Desired result at IMIN.

Gain – Calculated gain value.

Offset – Calculated offset value.

Gain calculation.

$$Gain = \left(\frac{D_{MAX} - D_{MIN}}{I_{MAX} - I_{MIN}} \right) \times 10000$$

Offset calculation.

$$Offset = D_{MIN} - \left(\frac{I_{MIN} \times Gain}{10000} \right)$$

Analog Outputs (Voltage Mode)

Variables.

VMAX – Maximum output voltage in mV.

DMAX – Desired input to set VMAX.

VMIN – Minimum output voltage in mV.

DMIN – Desired input to set VMIN.

Gain – Calculated gain value.

Offset – Calculated offset value.

Gain calculation.

$$Gain = \left(\frac{V_{MAX} - V_{MIN}}{D_{MAX} - D_{MIN}} \right) \times 13421.7728$$

Offset calculation.

$$Offset = V_{MIN} \times 0.4096 - \left(\frac{D_{MIN} \times Gain}{32768} \right)$$

Analog Outputs (Current Mode)

Variables.

IMAX – Maximum output current in μA.

DMAX – Desired input to set IMAX.

IMIN – Minimum output current in μA.

DMIN – Desired input to set IMIN.

Gain – Calculated gain value.

Offset – Calculated offset value.

Gain calculation.

$$Gain = \left(\frac{I_{MAX} - I_{MIN}}{D_{MAX} - D_{MIN}} \right) \times 6710.8864$$

Offset calculation.

$$Offset = I_{MIN} \times 0.2048 - \left(\frac{D_{MIN} \times Gain}{32768} \right)$$

Chapter
6

Combo Board Ramping Functions.

Detailed description of the ramping functions.

General

Description.

The Combo Board provides 2 separate ramping units. Each ramping unit consists of a single input block (Feed rate) and either 1 or 2 output blocks. There are 3 different kinds of input blocks and 2 different output blocks. The input unit provides a percentage or ratio of between 0 and 100%. This value is used by the output blocks to provide a ramp between a minimum and maximum value, this is a linear transfer function. An output block uses a set value as the maximum and a set percentage of the maximum as the minimum. Setting the minimum percentage to 100% (10000), the ramping function is disabled and the set maximum becomes the output irrespective of the input ratio.

Input Blocks.

For each ramping unit used, 1 input block must be used. The input block's function is to calculate a feed rate ratio. This ratio is used by the output block(s) to calculate the output. There are 3 different input blocks:

Feed Rate Ratio

A single module that provides the ratio as a percentage directly. The input range is 0 to 10000 where 10000 = 100%.

Feed Rate Ratio Analog

A single module that uses no I/O but uses an analog input to provide the feed rate ratio.

Set Feed Rate and Actual Feed Rate

A combination of 2 modules that provide the set Feed Rate and the current Feed Rate and calculates the ratio of the 2 values.

$$FeedRateRatio = \frac{ActualFeedRate}{SetFeedRate}$$

Output Blocks.

For each ramping unit used, one or both output blocks must be used. The output block uses the Feed Rate Ratio provided by the input block to calculate the final output. Each type of output block consists of 2 modules. The first module sets the actual maximum value whilst the other module sets the minimum value as a percentage of the maximum value. The percentage value has the range of 0 to 10000 where 10000 = 100%.

Power Ramp Output

This block controls an analog output to set a ramped power level.

Duty Ramp Output

This block controls the duty cycle of a pulse generator.

Output Transfer Function

The following formulas describe the actual transfer function that is performed by the output blocks:

$$Value_{Max} = SetValue$$
$$Value_{Min} = Value_{Max} \times MinMaxRatio$$
$$Output = Value_{Min} + (Value_{Max} - Value_{Min}) \times FeedRateRatio$$
$$where$$
$$0 \le MinMaxRatio \le 1$$
$$0 \le FeedRateRatio \le 1$$

Chapter
7

Combo Board Logic Units.

Detailed description of the logic units.

General

Description.

The Combo Board provides 2 separate logic units. Each logic unit provides a programmable logic block that performs a sum of products (SOP). Each logic unit consists of a 4 input OR gate where each input is connected to a multi input AND gate. Each AND gate has a global enable and each input can be programmed via parameters as “must be high”, “must be low” or not used (“Don’t care”). If an AND gate is unused then the global enable for that AND gate must be disabled.

Logic Unit 0

Description.

Logic Unit 0 can be routed to any of high speed outputs 0 to 3 via the High Speed Out module. The inputs to the logic array are as follows:

High Speed In 0.
High Speed In 1.
High Speed In 2.
High Speed In 3.
High Speed Out 0 (Profibus side).
High Speed Out 1 (Profibus side).
High Speed Out 2 (Profibus side).
High Speed Out 3 (Profibus side).
PWM Out 0.
PWM Out 1.
PWM Out 2.
PWM Out 3.
Pulser Out 0.
Pulser Out 1.

Logic Unit 1

Description.

Logic Unit 1 can be routed to any of high speed outputs 4 to 7 via the High Speed Out module. The inputs to the logic array are as follows:

High Speed In 4.
High Speed In 5.
High Speed In 6.
High Speed In 7.
High Speed Out 4 (Profibus side).

High Speed Out 5 (Profibus side).
High Speed Out 6 (Profibus side).
High Speed Out 7 (Profibus side).
PWM Out 4.
PWM Out 5.
PWM Out 6.
PWM Out 7.
Pulser Out 0.
Pulser Out 1.

Application Example

Problem.

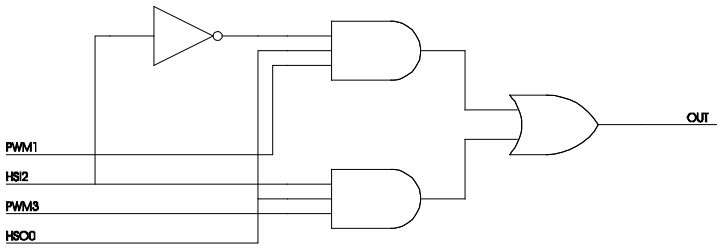
Create a logic block that performs the following functions:

1. HSI2 used to select between PWM1 and PWM3.

2. HSO0 used as output enable.

Solution.

Equivalent Circuit (SOP format)



• Figure 3. Example equivalent circuit

Resulting Boolean Equation

$$Out = HSO0 \bullet \overline{HSI2} \bullet PWM1 + HSO0 \bullet HSI2 \bullet PWM3$$

Implementation

AND 1 GLOBAL ENABLE = ENABLED
AND 1 TERM HSO0 = MUST BE HIGH
AND 1 TERM HSI2 = MUST BE LOW
AND 1 TERM PWM1 = MUST BE HIGH
AND 2 GLOBAL ENABLE = ENABLED
AND 2 TERM HSO0 = MUST BE HIGH
AND 2 TERM HSI2 = MUST BE HIGH
AND 2 TERM PWM3 = MUST BE HIGH
AND 3 GLOBAL ENABLE = DISABLED
AND 4 GLOBAL ENABLE = DISABLED
All other terms are set to “Don’t Care”

Chapter

8

Combo Board Command Unit.

Detailed description of the command unit.

General

Description.

The Combo Board provides a single command unit. 2 output words control the command unit. The first word is the command and the second word is an optional parameter. 2 input words are used for reading back the results of a command. The first word indicates the last command executed and the second word is used for returning a result if the command returns one.

Commands

Description.

Currently there are no commands implemented. Commands will be added to this section as they are implemented.

Chapter
9

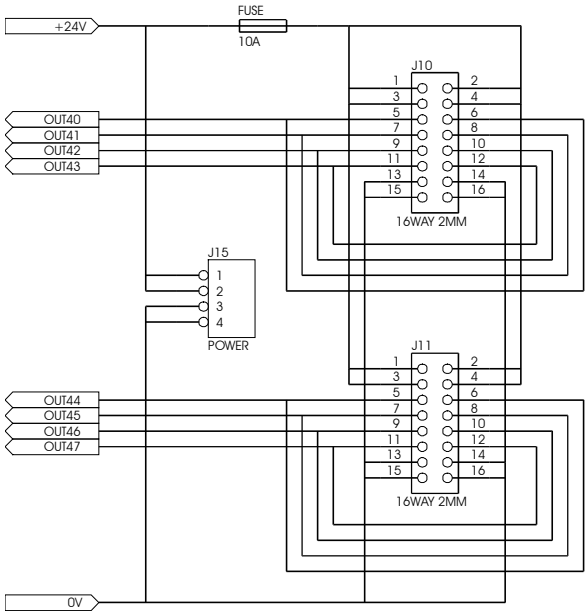
Combo Board Application Notes.

Application Notes.

High Current Output Connections

Description.

The following circuit demonstrates how to connect the high current outputs and apply power to the combo board.

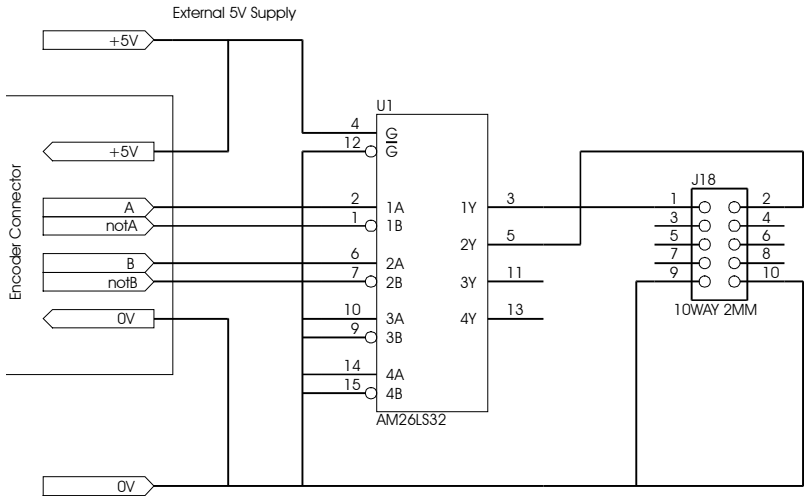


• Figure 4. Example high current output circuit.

Incremental Encoder Interface

Description.

The following circuit demonstrates how to connect an incremental encoder to the high speed inputs on the combo board. **Note:** input protection and power supply circuitry not shown.

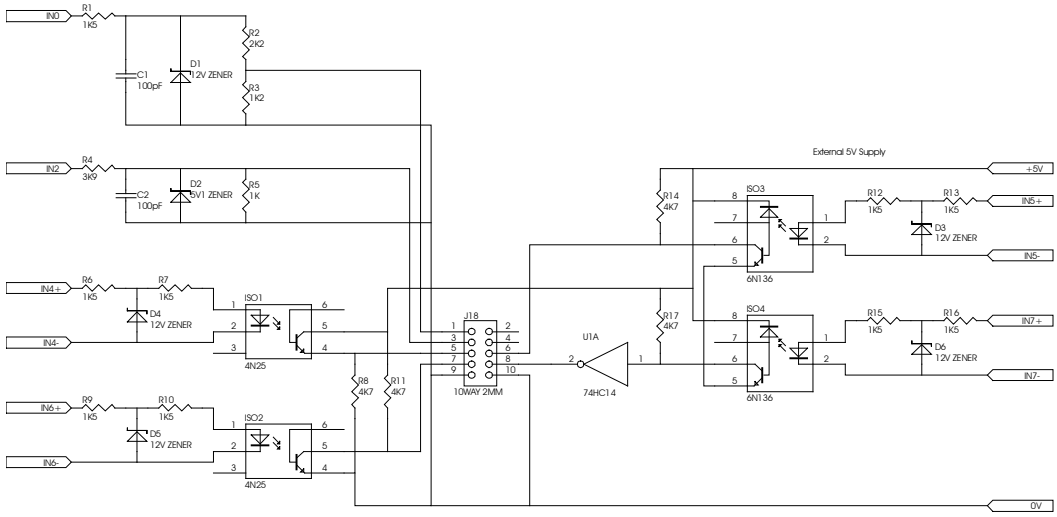


• Figure 5. Example encoder interface.

Interfacing High Speed Inputs To 24V Signals

Description.

The following circuit demonstrates various methods on how to interface 24V signals to the high speed inputs. **Note:** inputs 5 and 6 are inverted.

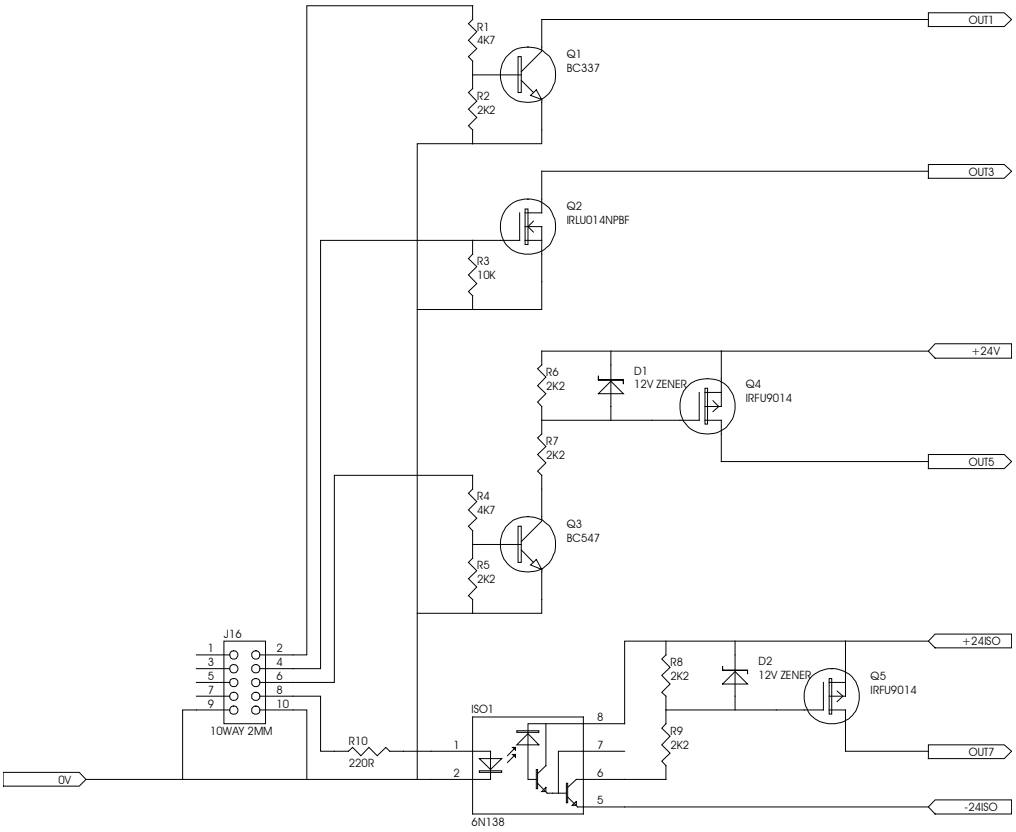


• Figure 6. Example input interface circuit.

Interfacing High Speed Outputs To 24V Signals

Description.

The following circuit demonstrates various methods on how to drive 24V signals from the high speed outputs. **Note:** outputs 1 and 3 are sinking, output 5 is sourcing and output 7 is an isolated sourcing output.



• Figure 7. Example output interface circuit.