KOLLMORGEN ®

Because Motion Matters™

MA840

PC840 Hardware & Software Reference Manual

Brushless Servo Drive with SERCOS Interface

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1 Overview of the PC840

Introduction   This chapter introduces the PC840 SERCOS drive. Topics covered are:

- PC840 Overview

- PC840 Connection Diagram

- Setting Intensity and Baud Rate using SW4

- Setting up Serial Address Using Rotary Switches SW5 and SW6

- List of Supported IDNs

PC840 overview   The PC840 SERCOS contains all the hardware and firmware necessary to connect to a SERCOS network.

This chapter explains how to wire a PC840 system, defines switch settings, and lists the SERCOS IDNs the PC840 supports.

1.1 Interfaces and Connections

Introduction   The diagrams on the following pages show the connections for inputs and outputs for the PC840.

- Power Board 13-Position Terminal Strip

- RS-232 Serial Port 9-pin female D-connector

- Command I/O 44-pin female D-connector

- Fiber Optic Transmit and Receive connectors

PC840
connection
diagram

FROM OTHER ELECTRONICS

240/120 VAC
47 - 63 Hz

BRUSHLESS MOTOR

MOTOR

RESOLVER

PTC

12.5 Ω EXTERNAL

S1 / HALL 1
S3 / HALL 2
S2 / HALL 3
S4
R1 EXCIT
R2 EXCIT RTN
PTC
PTC RTN
+ 5VDC
I/O RTN
ENCODER INPUT CHANNEL A (+)
ENCODER INPUT CHANNEL A (-)
ENCODER INPUT CHANNEL B (+)
ENCODER INPUT CHANNEL B (-)

L1 CTRL VAC
L2 CTRL VAC
PE
L1 240 VAC
L2 240/120 VAC
L3 240/120 VAC
+ BUS
REGEN R
- BUS
CHASSIS GND
PHASE U
PHASE V
PHASE W

TB1
AC POWER
REGEN
MOTOR POWER

1
2
3
4
5
6
7
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9
10
11
12
13

J3
FEEDBACK
1
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4
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14
15

PE CHASSIS GROUND POINT

PC840

SERCOS OUT
SERCOS IN

RX TX

J2

RS-232/485 SERIAL PORT

J1
1 2 3 4 5 6 7 8 9

RS-485 RXD -
RS-485 RXD +
RS-485 TXD -
RS-485 TXD +
I/O RTN/+5 VDC RTN
+5 VDC
RS-232 RXD
RS-232 TXD
SHIELD/+5 VDC RTN

TO HOST SET UP OR CONTROL COMPUTER

COMMAND I/O

1
2
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44

ANALOG CMD +
ANALOG CMD -
I/O RTN
ANALOG OUTPUT1 (DACMONITOR1)
ANALOG OUTPUT2 (DACMONITOR2)
ANALOG CURRENT LIMIT
I/O RTN
ENCODER OUTPUT CHANNEL A
ENCODER OUTPUT CHANNEL A
ENCODER OUTPUT CHANNEL B
ENCODER OUTPUT CHANNEL B
ENCODER OUTPUT CHANNEL Z
ENCODER OUTPUT CHANNEL Z
+5 VDC (OUTPUT, 250 mA)
I/O RTN / +5 VDC RTN
I/O RTN
ENCODER INPUT CH A (STEP)
ENCODER INPUT CH A (STEP)
ENCODER INPUT CH B (DIR)
ENCODER INPUT CH B (DIR)
NO CONNECT
NO CONNECT
NO CONNECT
RELAY OUTPUT (+) (OUT4)
RELAY OUTPUT (-) (OUT4)
NO CONNECT
NO CONNECT
ANALOG INPUT 2
ANALOG INPUT 3
I/O RTN
INPUT 1 (FAULT RESET)
INPUT 2 (CWINH)
INPUT 3 (CCWINH)
INPUT 4 (REG1)
INPUT 5 (REG2)
INPUT 6
ENABLE INPUT
INPUT RTN
+24 VDC OUTPUT RTN
+24 VDC (OUTPUT, 80mA)
OUT1, 2, 3 SUPPLY (INPUT)
OUT1 (FAULT)
OUT2 (BRAKE)
OUT3

SYSTEM STATUS
MONITORING
INCREMENTAL SHAFT POSITION OUTPUT
INCREMENTAL POSITION COMMAND

LIMIT SWITCH EXAMPLE

+24 VDC USER SUPPLY

1 - 2

MA840 - Rev B

1.2 Setting up Intensity and Baud Rate Using SW4

Definition   Switch SW4 is used to select the SERCOS baud rate and the fiber optic light intensity (power level).

Switch SW4   The following diagram shows the location of switch S4.
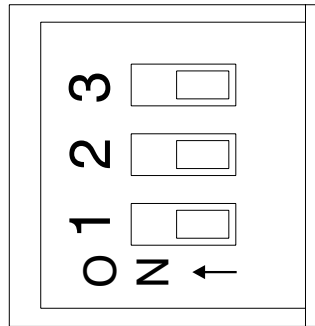
Intensity Level

SW4-1	Fiber Optic Light Intensity Level
ON	High power transmission
OFF	Low power transmission (default)

Baud Rate

Baud Rate	SW4-2	SW4-3
2 Mbaud (default)	OFF	OFF
4 MBaud	OFF	ON
8 MBaud	ON	OFF
16 MBaud	ON	ON

1.3 Setting up Serial Addresses Using Switches SW5 and SW6

Definition   The two hexademical rotary switches SW5 and SW6 are used to set the axis address for each PC840 on the SERCOS ring.

Procedure   The following diagram shows the location of switch SW5 and SW6. The view shows the location of the switches looking at the front of the PC840.

Note: *Each PC840 must have a unique serial address.*

Switch SW5 and SW6   The diagram below shows the SW5 and SW6 switch settings.

The 8-bit address consists of two hexadecimal digits. The low and high digits are determined by the position of SW5 and SW6.
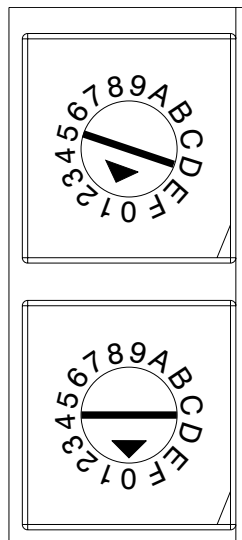
Note: *The axis address is set to 1 by default at the factory.*

Procedure
1. Remove power from the PC840 servocontroller.

2. Refer to the table below to set the PC840 to the appropriate address.

Address table

Address	SW6	SW5	Address	SW6	SW5
0*	0	0	18	1	2
1	0	1	19	1	3
2	0	2	20	1	4
3	0	3	21	1	5
4	0	4	22	1	6
5	0	5	23	1	7
6	0	6	24	1	8
7	0	7	25	1	9
8	0	8	26	1	A
9	0	9	27	1	B
10	0	A	28	1	C
11	0	B	29	1	D
12	0	C	30	1	E
13	0	D	31	1	F
14	0	E	32	2	0
15	0	F	…	…	…
16	1	0	…	…	…
17	1	1	255**	F	F

*Repeater Application Only
**Not Allowed for SERCOS Applications

3. Re-connect power to the PC840.

4. Repeat steps 1 through 4 for other units on the ring. Make sure to give the other units unique addresses.

1.4 Identification Numbers (IDNs)

Introduction   This is the list of SERCOS IDNs which are supported by the PC840. For additional information on each IDN please consult a SERCOS specification or Chapter 6.

List of supported IDNs

1   Control Unit Cycle Time (TNcvc)

2   Communication Cycle Time (Tscvc)

3   Shortest AT Transmission Starting Time (T1min)

4   Transmit/Receive Transition Time (TATMT)

5   Minimum Feedback Processing Time (T4min)

6   AT Transmission Starting Time (T1)

7   Feedback Acquisition Capture Point (T4)

8   Command Value Valid Time (T3)

9   Position of Data Record in MDT

10   Length of Master Data Telegram

11   Class 1 Diagnostic

14   Interface Status

15   Telegram Type Parameter

16   Configuration List of AT

17   IDN List of all Operation Data

18   IDN List of Operation Data for CP2

19   IDN List of Operation Data for CP3

21   IDN List of Invalid Operation Data for CP2

22   IDN List of Invalid Operation Data for CP3

24   Configuration List of the MDT

25   IDN List of all Procedure Commands

28   MST Error Counter

IDNs (Cont'd)

29	MDT Error Counter	
30	Manufacturer Version	
32	Primary Operation Mode	
36	Velocity Command Value	
40	Velocity Feedback Value	
41	Homing Velocity	
42	Homing Acceleration	
43	Velocity Polarity Parameter	
44	Velocity Data Scaling Type	
45	Velocity Data Scaling Factor	
46	Velocity Data Scaling Exponent	
47	Position Command Value	
51	Position Feedback Value 1 (Motor Feedback)	
52	Reference Distance 1	
55	Position Polarity Parameter	
76	Position Data Scaling Type	
77	Linear Position Data Scaling Factor	
78	Linear Position Data Scaling Exponent	
79	Rotational Position Resolution	
80	Torque Command Value	
82	Positive Torque Limit Value	
83	Negative Torque Limit Value	
84	Torque Feedback Value	
85	Torque Polarity Parameter	
88	Receive to Receive Recovery Time (TMTSY)	
89	MDT Transmission Starting Time (T2)	

IDNs (Cont'd)

90	Command Value Proceeding Time (TMTSG)	
95	Diagnostic Message	
96	Slave Arrangement	
99	Reset Class 1 Diagnostic	
100	Velocity Loop Proportional Gain (kvp)	
101	Velocity Loop Integral Action Time (kvi)	
103	Modulo Value	
104	Position Loop Kv Factor (kpp)	
106	Current Loop Proportional Gain 1 (kip)	
107	Current Loop Integral Action Time 1 (kii)	
110	Amplifier Peak Current	
127	Communications Phase 3 Transition Check	
128	Communications Phase 4 Transition Check	
129	Manufacturer Class 1 Diagnostic	
130	Probe Value 1 Positive Edge	
131	Probe Value 1 Negative Edge	
132	Probe Value 2 Positive Edge	
133	Probe Value 2 Negative Edge	
140	Controller Type	
142	Application Type	
143	SYSTEM Interface Version	
147	Homing Parameter	
148	Drive-Controlled Homing Procedure Command	
159	Monitoring Window	
160	Acceleration Data Scaling Type	
161	Acceleration Data Scaling Factor	

IDNs (Cont'd)	162	Acceleration Data Scaling Exponent
	169	Probe Control Parameter
	170	Probing Cycle Procedure Command
	185	Length of the Configurable Data Record in the AT
	186	Length of the Configurable Data Record in the MDT
	187	IDN List of Configurable data in the AT
	188	IDN List of Configurable data in the MDT
	189	Following Distance (PosErrorMax)
	192	IDN List of Backup Operation Data
	263	Load Working Memory Procedure Command
	264	Backup Working Memory Procedure Command
	301	Allocation of Real-Time Control Bit 1
	303	Allocation of Real-Time Control Bit 2
	305	Allocation of Real-Time Status Bit 1
	307	Allocation of Real-Time Status Bit 2
	400	Home Switch
	401	Probe 1
	402	Probe 2
	403	Position Feedback Value Status
	405	Probe 1 Enable
	406	Probe 2 Enable
	409	Probe 1 Positive Latched
	410	Probe 1 Negative Latched
	411	Probe 2 Positive Latched
	412	Probe 2 Negative Latched

IDNs (Cont'd)	32800	DSP Debug Address
	32801	DSP Debug Word
	32802	DSP Debug Dword
	32803-32806	ARM Debug Variables
	32807	Pole Count
	32809	Filter Value for ADF0
	32810	DM1F0
	32811	DM2F0
	32812	DM1Gain
	32813	DM2Gain
	32814	DM1Map - Mux Select
	32815	DM2Map - Mux Select
	32816	EncOut (Encoder Output)
	32817	InpMap1
	32818	InpMap2
	32819	InpMap3
	32820	InpMap4
	32821	InpMap5
	32822	InpMap6
	32823	EncInFilt
	32824	RemoteFB
	32826	CommOff
	32828	EncIn (Encoder Input)
	32829	ITThresh
	32830	StopTime
	32831	VBusThresh

IDNs (cont'd)   32832 VelLmtHi

32833 VelLmtLo

32835 CoastTime

32836 CommEnbl

32837 Motor 1 Name

32838 Motor 2 Name

32840 Kvff

32841 ARZ0

32842 ARZ1

32843 ARF0

32844 ARF1

32845 Firmware version

32846 Encoder Data Scaling Method

32847 Encoder Modulo Value

32853 CommSrc (Commutation Source)

32857 ResPos (Resolver Position)

32858 Last Fault

32859 Last ExtFault

32860 OutMap1

32861 OutMap2

32862 OutMap3

32863 OutMap4

32866 Analog Input Voltage Offset (ADOffset)

32870 I^2*t Motor Protection Threshold Value (I^2*tFilt)

32871 I^2*t Motor Protection Low Pass Filter Value (I^2tF0)

32872 I^2*t Motor Current Value

IDNs (cont'd)	32875	State of Hall Sensors (HallState)
	32876	Offset Angle for Hall Sensors (HallOffset)
	32878	Digital Command Counts (DigitalCmd)
	32879	Digital Command Frequency (DigitalCmdFreq)
	32880	AnalogOut1
	32881	AnalogOut2
	32882	Analog Current Limit Value (AnalogILmt)
	32883	Analog Current Limit Gain (AnalogILmtGain)
	32884	Analog Current Limit Filter (AnalogILmtFilt)
	32885	Analog Current Limit Offset (AnalogILmtOffset)
	32886	Actual Positive Current Limit (ActualILmtPlus)
	32887	Actual Negative Current Limit (ActualILmtMinus)
	34817	PC840 Input Bit #1
	34818	PC840 Input Bit #2
	34819	PC840 Input Bit #3
	34820	PC840 Input Bit #4
	34821	PC840 Input Bit #5
	34822	PC840 Input Bit #6
	34824	PC840 Input Port (Inputs)
	34825	AnalogIn
	34826	EncPos (Encoder Position)
	34833	PC840 Output Bit #1
	34834	PC840 Output Bit #2
	34835	PC840 Output Bit #3
	34836	PC840 Output Bit #4
	34840	PC840 Output Port (Outputs)

2 Interfaces and Connections

Introduction   This chapter describes all of the connections to the PC840 and provides the information required to interface to it.

In the list below an overbar on a signal <u>name</u> means that the signal is active low logic. For example, "Fault" indicates the drive is faulted when it is pulled low.

Earth Ground   Chassis Ground, M4 x 12 screw with flat and lock washer.

2.1 PC840 Power Board Connector

TB1   13 Position Terminal Strip

Pin	Label	Description
TB1-1	L1	240/120 VAC Control Power
TB1-2	L2	240/120 VAC Control Power
TB1-3	PE	Chassis Ground
TB1-4	L1	240/120 VAC (Input)
TB1-5	L2	240/120 VAC (Input)
TB1-6	L3	240/120 VAC (Input)
TB1-7	+B	+ Bus
TB1-8	R	Regen Transistor
TB1-9	-B	- Bus
TB1-10	PE	Chassis Ground
TB1-11	U	Motor Phase U
TB1-12	V	Motor Phase V
TB1-13	W	Motor Phase W

AC Power

L1, L2 (TB1-1, 2)
240 VAC
/ 120 VAC
Control Power

These terminals connect the 240/120 VAC power provided by the user to the drive's control voltage power supply.

If a single supply is used for bus power and control power, externally connect control L1, L2 (TB1-1, 2) to bus power L1, L2 (TB1-4, 5). **Control power L1, L2 are NOT connected internally to bus power L1, L2.**

Note: *The control voltage for the PC840 controllers is input to a switching power supply. This input will accept voltages ranging from 85 to 265 Vac.*

Chassis Ground

PE (TB1-3)

Convenience connector point for the user to connect the drive's control power and bus power to protective earth ground. This pin is directly connected to the chassis and thus to the Chassis Ground Stud. Local electrical code may require using the Earth Ground Chassis stud for this function.

AC Power

L1, L2, L3
(TB1-4, 5, 6)
240 VAC
/ 120 VAC

These terminals connect the 240/120 VAC power provided by the user to the drive's power output stage bus to drive the motor. For single phase operation use any two of these terminals and leave the third terminal open.

Regeneration Interface

+B, R, -B
(TB1-7, 8, 9)
+Bus, Regen
Resistor, - Bus

These terminals provide the connection points for an external resistor to absorb regenerated energy from the motor. An external regeneration resistor goes from + B to R. **-Bus (-B) on TB1-9 is usually left open.**

Caution! High Voltage!

During normal operation +B, R, and -B operate at the bus power voltages. A 240 Vac system operates at $\cong$ 400 Vdc. These are dangerous voltages.

External Regen Resistor

The table below lists the recommended values for an external regen resistor. To order from Kollmorgen use part number PRK-200.

Note: *Regen Resistance MUST be in the range of 11.25 Ω to 13.75 Ω.*

Model	Resistance
PC8x2/3/4	12.5 Ω (±10%), 200 W, 1,500 V Isolation

For safety it is recommended that the resistor be mounted on a grounded panel or use a grounding wire connected to a mounting screw. The terminals of the resistor must not be grounded.

Warning!

Wait 10 minutes after Bus Power is removed for the bus cap voltage to decay to a safe level before touching regen resistor or wiring. The voltage on the bus caps can be monitored with a voltmeter from +BUS (TB1-7) to -BUS (TB1-9).

Motor Power

PE (TB1-10) Motor Case Ground

This termination provides a convenient point for the motor ground connection and motor power wire shield. Local electrical code may require using the Earth Ground Chassis stud for this function.

U, V, W (TB1-11, 12, 13) Motor Phase

These three terminations provide the 3-phase power output to the brushless motor. Observe motor polarity on these connections. For example, connect U on the drive to U on the motor.

2.2 Serial Port

J1   The serial port (J1), utilizes the 9 contact female D
                         subminiature style connector shown below. A brief description
                         of each signal is included in the J1 I/O table on following page.
                         For additional information, please refer to the Serial
                         Communications Transceiver Schematic at the end of this
                         section.

J1 Diagram   The figure below illustrates the pin-out for the 9 pin
                         connector. It shows the front view looking at the PC840.
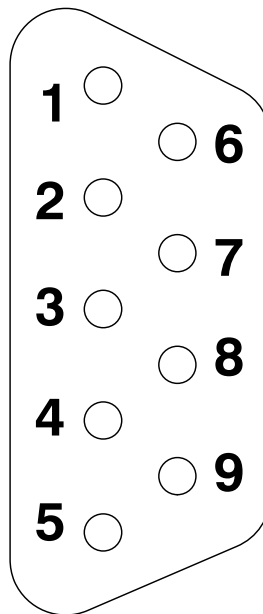
I/O Table

Pin Number	Input/Output	Explanation
J1-1	Shield	Common/shield - serial port interface
J1-2	RS-232 TXD	RS-232 transmitter output (from PC840)
J1-3	RS-232 RXD	RS-232 receiver input (to PC840)
J1-4	Not Used	
J1-5	I/O RTN/+5 VDC RTN	Common serial port interface
J1-6	Not Used	
J1-7	Not Used	
J1-8	Not Used	
J1-9	Not Used	

The information provided in this section should be used to connect the PC840 to your computer for firmware upgrades.

2.2.1 RS-232 Connections

RS-232 Connections

RS-232 connections on J1 are shown below. Cable wiring required for connecting to either 9 or 25 pin serial ports of most computers are also shown.

Note: *Pinouts vary among computer manufacturers. Check the hardware reference manual for your machine before wiring.*

Cabling diagram

A 6 foot (1.8 m) RS-232 Cable with 9 pin connectors and a 9 pin to 25 pin adapter is available from Kollmorgen. The Kollmorgen order number is RS-232-5600.

Note: *Shielded wiring is recommended for the serial communications cable to minimize potential errors from electrical noise.*

I/O RTN

RS-232 RXD

RS-232 TXD
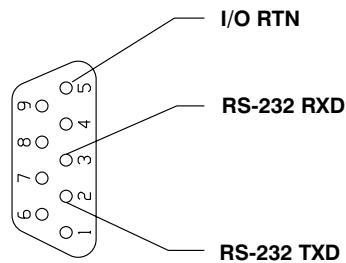
9 CONTACT FEMALE D SUBMINIATURE CONNECTOR

TYPICAL CABLES

9 PIN FEMALE   9 PIN MALE

TO PC   2   2
(9 PIN)   3   3   TO PC830 J1
               5   5

25 PIN FEMALE   9 PIN MALE

TO PC   3   2
(25 PIN)   2   3   TO PC830 J1
               7   5
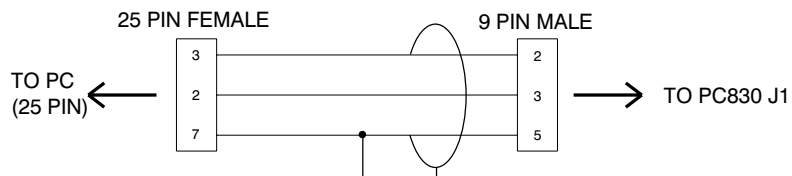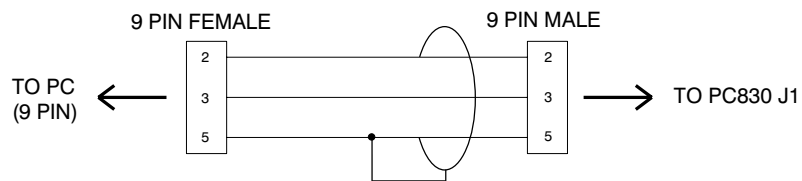
**PC840 Serial
Communications
Transceiver
Schematic**
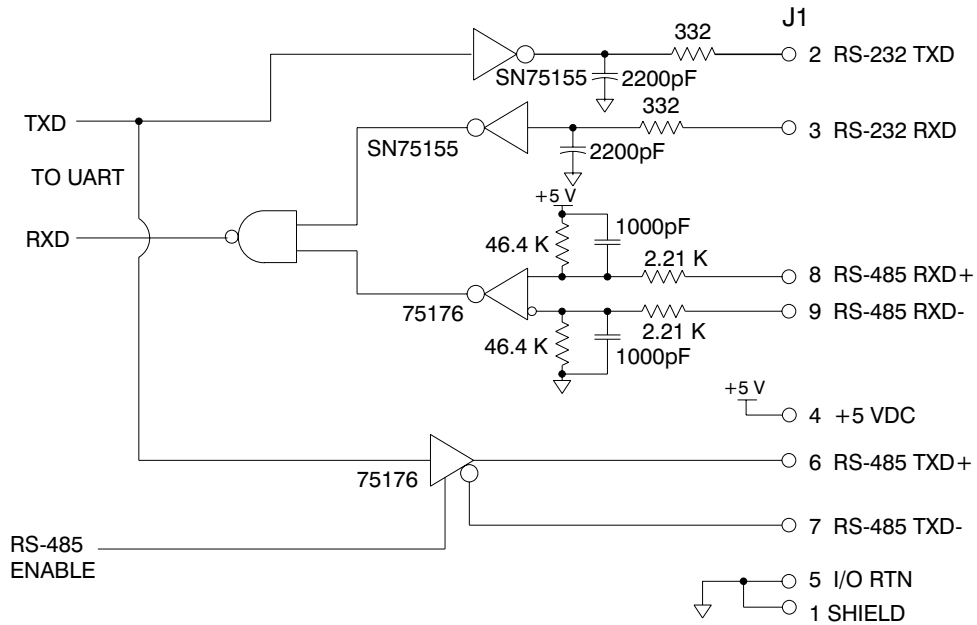
2.3 Command I/O

J2   44 Position D subminiature female

Pin	Description	Pin	Description
J2-1	Analog Command Input (+)	J2-23	No Connect
J2-2	Analog Command Input (-)	J2-24	Relay Output (+) (Out4)
J2-3	I/O RTN	J2-25	Relay Output (-) (Out4)
J2-4	Analog Output1 (DacMonitor1)	J2-26	No Connect
J2-5	Analog Output2 (DacMonitor2)	J2-27	No Connect
J2-6	Analog Current Limit Input	J2-28	Analog Input 2
J2-7	I/O RTN	J2-29	Analog Input 3
J2-8	Encoder Output Channel A	J2-30	I/O RTN
J2-9	Encoder Output Channel $\overline{A}$	J2-31	Input 1 (Fault Reset)
J2-10	Encoder Output Channel B	J2-32	Input 2 (CwInh)
J2-11	Encoder Output Channel $\overline{B}$	J2-33	Input 3 (CcwInh)
J2-12	Encoder Output Channel Z	J2-34	Input 4 (Reg1)
J2-13	Encoder Output Channel $\overline{Z}$	J2-35	Input 5 (Reg2)
J2-14	+5 VDC (Output)	J2-36	Input 6
J2-15	I/O RTN/ +5 VDC RTN	J2-37	Enable Input
J2-16	I/O RTN	J2-38	Input RTN
J2-17	Command Encoder Input Channel A (Step)	J2-39	+24 VDC Output RTN
J2-18	Command Encoder Input Channel $\overline{A}$ (Step)	J2-40	+24 VDC (Output)
J2-19	Command Encoder Input Channel B (Dir)	J2-41	Out1, 2, 3 Supply (Input)
J2-20	Command Encoder Input Channel $\overline{B}$ (Dir)	J2-42	Out1 ($\overline{\text{Fault}}$)
J2-21	No Connect	J2-43	Out2 ($\overline{\text{Brake}}$)
J2-22	No Connect	J2-44	Out3

J2 Diagram   The figure below illustrates the pin-out for the 44 pin connector. It shows the front view looking at the PC840.
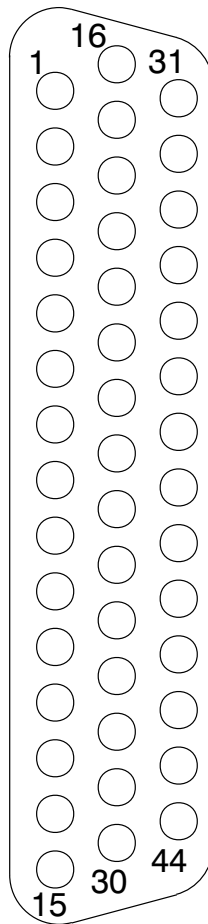
Command I/O

Analog CMD
(+), (-) Inputs
J2-1, 2

These inputs accept the analog command from the user. This is a differential input to an A/D. It has a maximum single ended input range with respect to I/O RTN on either input of ± 21V and an input impedance of 50kΩ. The full scale differential command input range is ± 13.5 V. The offset and single pole low pass bandwidth of this signal is adjustable via a software setup parameter. When used as a motion command the gain from this input is also adjustable via a software setup parameter.

1200 Hz FILTER
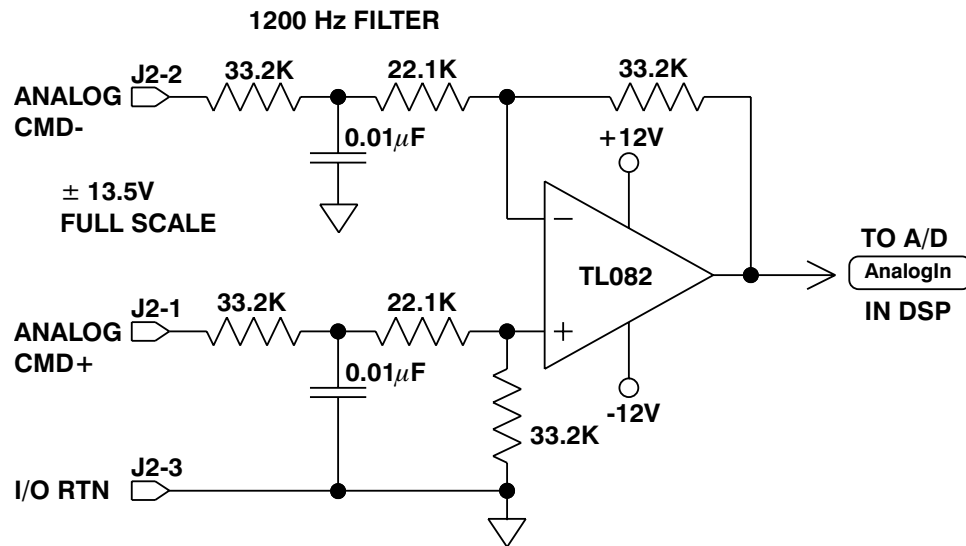
Note: *Always connect I/O RTN (J2-3) to the signal ground of the source. Failure to do so may result in erratic operation.*

I/O RTN
J2-3, 7, 15, 16

This terminal is signal common for the analog and non-optically isolated digital inputs and outputs. These pins are internally connected in the drive.

For protection against line surges, one of the I/O RTN pins must be connected to Earth ground. Kollmorgen recommends making this connection at an earth ground point in the cabinet reserved for single point grounding of all I/O Returns (drives and supplies).

Command I/O Continued

DAC Monitor
1, 2 Outputs
J2-4, 5

These analog outputs are general purpose monitor points.
The output range is ± 5.5 V with a resolution of 11V/65536 =
0.168 mV. The source impedance is 1 kΩ, which yields a
maximum short circuit to I/O RTN current of ± 5 mA. These
outputs are updated every 250 μS. There is a 2.5 kHz, 4.8 kHz
and a 9.6 kHz analog Low Pass Filter on these outputs.

Each DAC MONITOR can be mapped by software to be one
of a number of internal variables. The scale factor and the
frequency of a single low pass filter pole are software
adjustable on each output by the DM1Gain, DM1F0 and
DM2Gain, DM2F0 software parameters for DAC Monitor 1
and 2 respectively. Variables marked with a "∗" are not range
clamped and are allowed to wrap around when the signal
exceeds the output dac's voltage range. The other variables
will clamp at maximum when they exceed the analog voltage
range. The table on the following page lists the defined signal
mappings.

DacMon
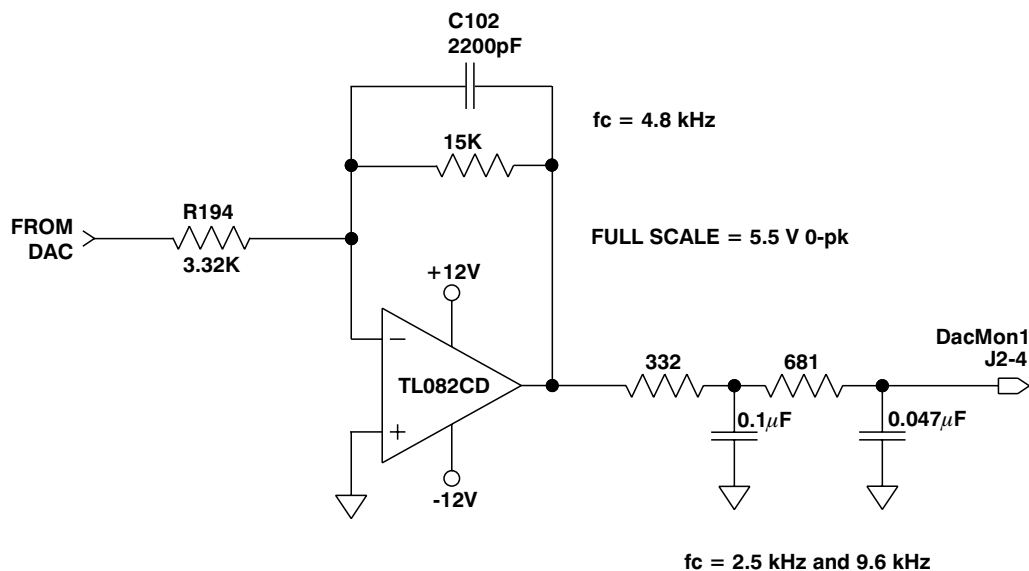
Dac Monitor List Table

DMxMap	Variable	Description	DAC Out Units (DMxGain = 1)
0	AnalogOutx	Actual Analog Output Command	V/V
1	VelFB	Measured Velocity (DM2 Default)	1 V/kRPM
2	VelCmdA	Actual Velocity Command (VelCmdA)	1 V/kRPM
3	VelErr	Velocity Error	1 V/kRPM
4	FVelErr	Compensated Velocity Error	1 V/kRPM
5	Position	Measured Position*	1 V/Rev
6	PosError	Position Error*	1 V/Rev
7	PosCommand	Commanded Position*	1 V/Rev
8	Icmd	Commanded Torque Current	1 V/A
9	IFB	Measured Torque Current (DM1 Default)	1 V/A
10	AnalogIn	Filtered A/D Input	1 V/V
11	EncFreq	Encoder Frequency	1 V/Hz
12	EncPos	Encoder Position*	10 V/4096 Cnts
13	ItFilt	Filtered Output Current Amplitude	1 V/100%
14	HSTemp	Measured Heat Sink Temperature	1 V/°C
15		Commutation Electrical Angle*	1 V/Cycle
16	IU	Motor Phase U Output Current	1 V/A
17	IV	Motor Phase V Output Current	1 V/A
18	IW	Motor Phase W Output Current	1 V/A
19		Motor Phase U Voltage Duty Cycle	1 V/100%
20		Motor Phase V Voltage Duty Cycle	1 V/100%
21		Motor Phase W Voltage Duty Cycle	1 V/100%
22	VBus	Drive Bus Voltage	1 V/V
23	ResPos	Resolver Absolute Position*	1 V/Rev
24		Commanded non-torque current	1 V/A
25		Measured non-torque current	1 V/A
26		Torque Voltage Duty Cycle	1 V/100%
27		Non-torque Voltage Duty Cycle	1 V/100%
28	VelCmd	Velocity Command (VelCmd)	1 V/kRPM
29	DigitalCmdFreq	Digital Command Frequency	1 V/Hz
30	I^2*t	I^2*t Filtered Current	1 V/%Ipeak^2

*These variables are allowed to wrap around when the signal exceeds the output voltage range.

J2 Command I/O Continued

Analog Current
Limit J2-6

This input limits the current flow to the motor when a voltage is applied with respect to I/O RTN.

CH A OUT
CH A OUT,
CH B Out,
CH B Out
Outputs
J2-8, 9, 10, 11

These two output pairs are differential TTL incremental position signals generated by the Resolver feedback electronics. These outputs are quadrature encoded to emulate an optical encoder. The resolution of these signals, i.e. the emulated line count, is set by the EncOut parameter. These outputs are buffered by 26LS31 type RS-422 compatible line drivers. Maximum recommended load current is ± 20 mA, which corresponds to a minimum line-to-line load resistance of 100 Ω. This drive capacity corresponds to ten RS-422 compatible inputs such as the PC830 encoder inputs. These outputs are indefinitely short circuit proof to I/O RTN.

CH Z OUT
CH Z OUT
Outputs
J2-12, 13

These two terminals function as a differential, TTL marker pulse. The output pulse occurs once per motor shaft revolution starting at resolver position = 0 and its width is approximately one quadrature encoder width. This output comes from an 26LS31 type RS-422 compatible line driver. Maximum recommended load current is ± 20 mA, which corresponds to a minimum line-to-line load resistance of 100 Ω. This drive capacity corresponds to ten RS-422 compatible inputs such as the PC830 encoder inputs. This output is indefinitely short circuit proof to I/O RTN.

+5 VDC,
I/O RTN/+5 VDC
RTN Output
J2-14, J2-15

These two connections provide an auxiliary power supply for the user. This output is 5 Vdc ± 5% and is short circuit protected at 1 A nominal. The maximum load limit for all connections to this supply is 250 mA. The +5 VDC RTN (J2-15) is connected to I/O RTN (J2-3, J2-7, J2-16, J2-30).

J2 Command I/O Continued

Encoder Inputs   CH A IN, CH $\overline{\text{A}}$ IN, CH B IN, CH $\overline{\text{B}}$ IN,
Step +, Step -, Dir +, Dir -,
Step Up +, Step Up -, Step Dn +, Step Dn -

J2-17, 18, 19, 20   These inputs are used as a quadrature encoder, step and
direction, or up and down count format incremental signal
source. The decoding mode is set by the EncMode parameter.
The scale factor of this incremental position command input is
fully adjustable with software parameters. Full decoding speed
or more noise immune slow speed decoding is software
selectable.

These two input pairs are differential and are detected by
26LS32 type RS-422 compatible line receivers. As differential
inputs, the recommended common mode range is $< \pm$ 7 V with
respect to I/O RTN and the guaranteed differential voltage
logic thresholds are $> \pm$ 0.2 V. Recommended drivers should
be able to source and sink $>$ 3 mA to/from these inputs. Each
of these inputs have internal bias networks to allow easy
connection to single ended sources. When an input is open
circuited it will bias itself to between 2.2 and 2.5 V, thus the
remaining input pair terminal will have a single ended
guaranteed logic low for inputs $<$ 2.0 V and a guaranteed logic
high for inputs $>$ 2.7V. These levels are compatible with a
TTL driver combined with a pull up resistor. Pull up resistor
should be $<$ 470Ω.

J2 Command I/O Continued

Relay Outputs   These relay outputs are normally open. They are rated for 1
J2-24, 25   Amp at 30 VDC. These relays may be opened/closed by
                     Out4. When the drive has no control power the relay is open.

J2-24

Normally
Open

J2-25
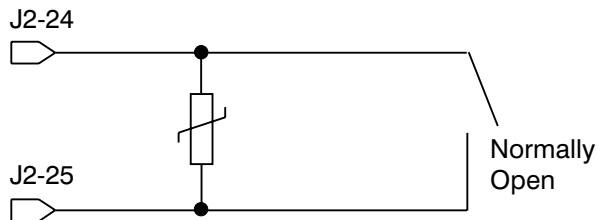
$\overline{\text{Brake}}$ Output   This output is low when the control power is off, or when
                     control voltage is on and the drive is disabled (Enabled = 0).
                     This output is pulled high otherwise. This output is intended
                     to drive a normally open relay that in turn powers a
                     mechanical brake on the motor shaft for applications that
                     require a positive shaft lock when the servo drive is off.

J2 Encoder I/O Interface Schematics Diagram

ENCODER INPUTS

+5V

CH A IN J2-17
CH A IN J2-18
2.2 TO 2.5V OPEN CIRCUIT

15K 15K 15K 15K

1K
1K
220pF

AM26LS32
ENCIN A

TO DECODE & COUNT

220pF

CH B IN J2-19
CH B IN J2-20

1K
1K
220pF

ENCIN B
AM26LS32

220pF

15K 15K 15K 15K

I/O RTN J2-16

OPTION CARD USER +5 VDC

+5 VDC J2-14
+5V REG 250 mA MAX
+8V UNREG

EMULATED ENCODER OUTPUTS

CH A OUT J2-8 AM26LS31
CH A OUT J2-9 EMU A

CH B OUT J2-10 AM26LS31
CH B OUT J2-11 EMU B

CH Z OUT J2-12 AM26LS31
CH Z OUT J2-13 EMU Z

RESOLVER POSITION TO EMULATED QUADRATURE

PPR= EncOut

EncOut = 0 PASSES ENCIN A, B TO EMU A.B

CW ROTATION I/O RTN J2-16

PC840 BASE UNIT ENCODER I/O

**Using TTL
differential line
drivers**

ENCODER   PC840

+5V SUPPLY   J2   +5

+5V SUPPLY ←   CONNECT ONLY IF J2   14 | +5 VDC @ 250 mA
                  SOURCES ENCODER POWER

CH A ▷   17 | CH A
                              TWISTED
                              PAIR   18 | $\overline{\text{CH A}}$

CH B ▷   19 | CH B
                              TWISTED
                              PAIR   20 | $\overline{\text{CH B}}$

                                         16 | I/O RTN

+5V SUPPLY RETURN
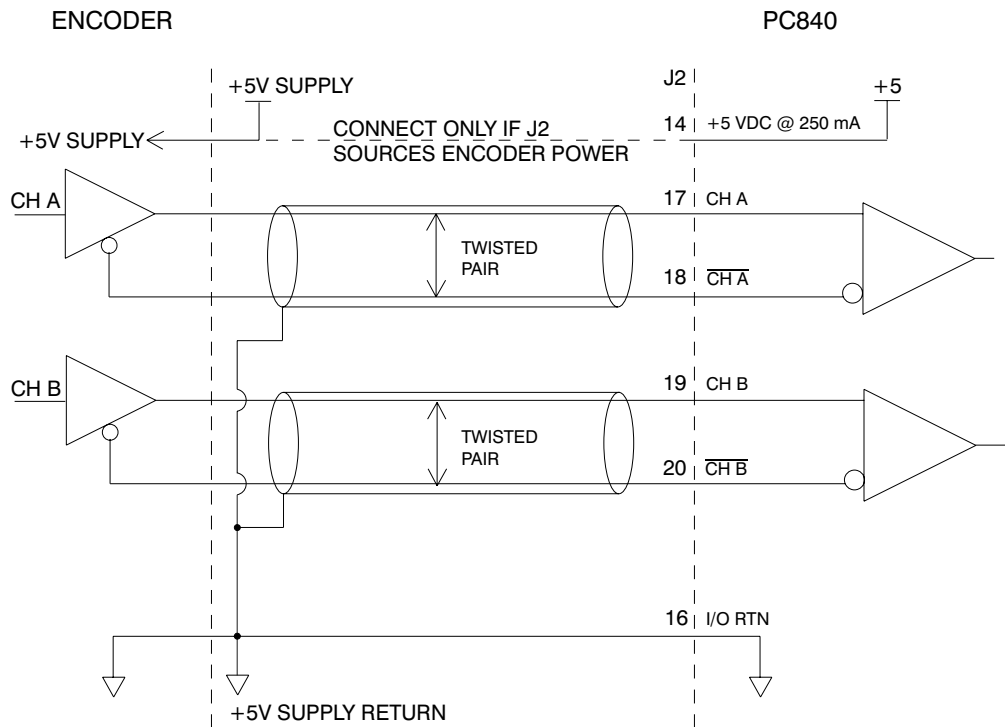
Using TTL single-ended drivers

ENCODER   PC840

+5V SUPPLY

+5V SUPPLY ←   CONNECT ONLY IF J2
                     SOURCES ENCODER POWER

J2

14   +5 VDC @ 250 mA   +5

CH A   17   CH A
                        TWISTED
                        PAIR
                                              18   $\overline{CH\ A}$

CH B   19   CH B
                        TWISTED
                        PAIR
                                              20   $\overline{CH\ B}$

                                              16   I/O RTN

+5V SUPPLY RETURN
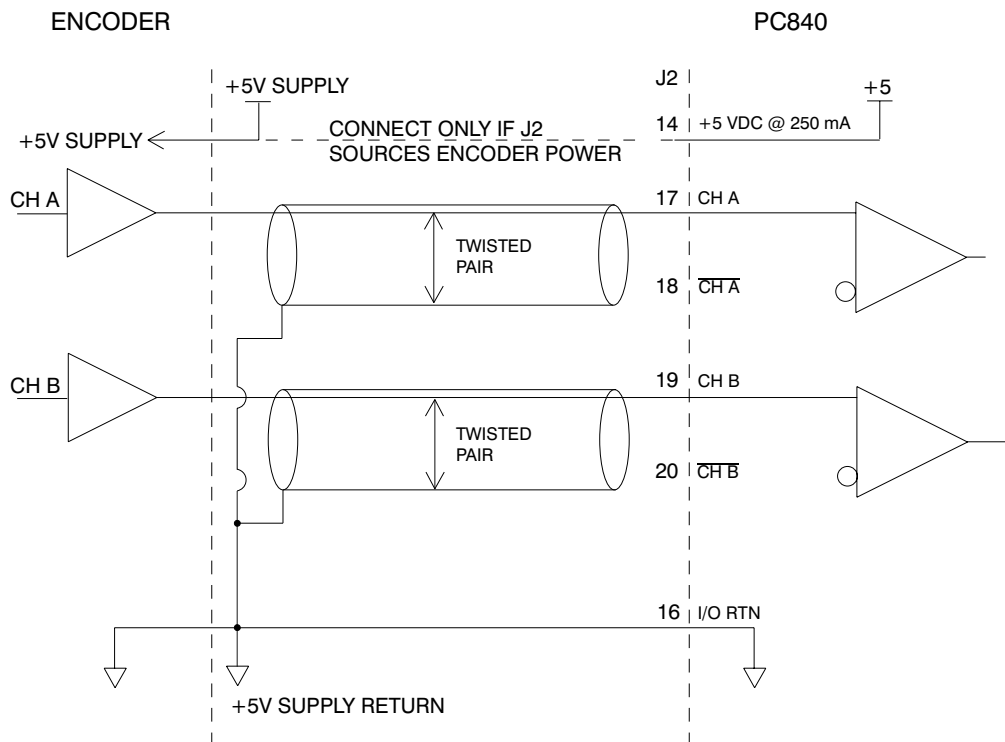
J2 Command I/O   Continued

Auxiliary Analog   Not Used.
Inputs J2-28, 29

Inputs 1-6 J2-31,   These six optically isolated I/O connections are user
32, 33, 34, 35, 36   programmable discrete 24 V inputs.   These inputs share a
                       floating return (J2-38) with the Enable Input (J2-37). A
                       minimum drive capability of 4 mA is required to fully power
                       the opto. The user must supply 10 - 30 V to these inputs.

                       Note: *5 V inputs CAN NOT be used.*

                       Each of the inputs is set and read by software every 2 mSec.
                       Each one can be configured to be any of the available
                       functions and the configuration can be changed on the fly via
                       digital communications. The user's default configuration is
                       stored in the non-volatile memory. The present state of each
                       of these lines can be read via digital communications. The
                       logic polarity of these signals is also software programmable.
                       That is, an input can be defined to be active low or active
                       high. For edge triggered functions the active edge is
                       programmable.
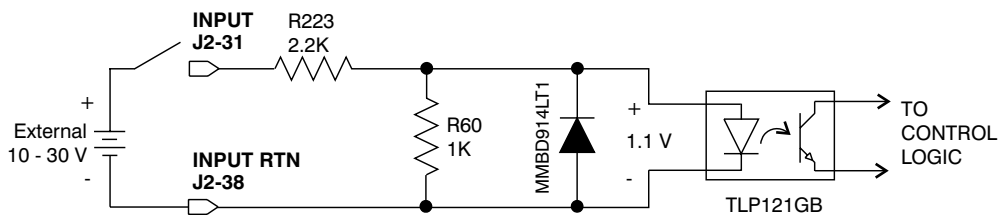
Logic State	InpX with respect to Input RTN
Low	0 to +2 V
Undefined	+2 V to + 10 V
High	+10 V to + 30 V

J2 Command I/O Continued

The list below describes the subset of the available functions and the mappings used as the factory defaults for each of the inputs.

Fault Reset
Input

Input 1: This input is used to reset the amplifier following a fault. This input is programmed active high so that an open circuited input does not activate the function. During Fault Reset active the output stage is disabled and the reset condition will be held in hardware for approximately 0.1 sec after Fault Reset is returned inactive.

CwInh Input

Input 2: This input prevents further motion in the clockwise shaft motion direction. This input is programmed active high so that an open circuited input does not activate the function. If the shaft is already moving in the clockwise direction, then the motor will decelerate to zero velocity with the maximum torque allowed by the user set output current limits. This input will have no effect on motion in the counterclockwise direction. This input is useful for a clockwise over travel limit switch.

CcwInh Input

Input 3: Analogous to the CwInh input, except that this input prevents counterclockwise motion.

Reg1 Input

Input 4: This high speed input latches motor position within 50 μsec after a transition.

Reg2 Input

Input 5: Analogous to Reg1 input.

Input Mapped
Off

Input 6: Input Mapped Off

**Reg1 Input
J2-34**

Note: Probe inputs have a 50 μsec latch time.
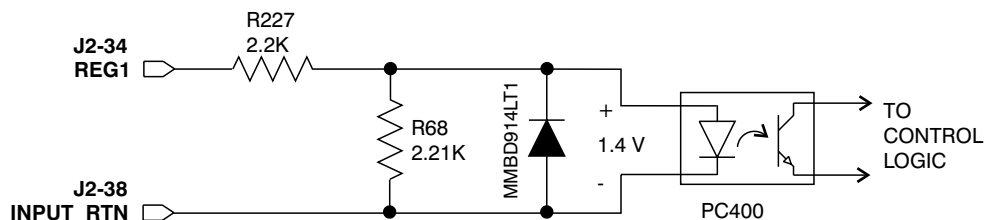
J2 Command I/O   Continued

Enable Input
J2-37

This optically isolated input is used to enable the drive and is active high. The output stage is disabled when this input is inactive. A minimum drive capability of 4 mA is required. The user must supply 10 V - 30 V to drive this input. This input is filtered with a 1 mSec time constant low pass filter to prevent false triggering from noise. The Enable input shares a floating return (J2-38) with Inputs 1 - 6.

Note: *5 V input CAN NOT be used.*
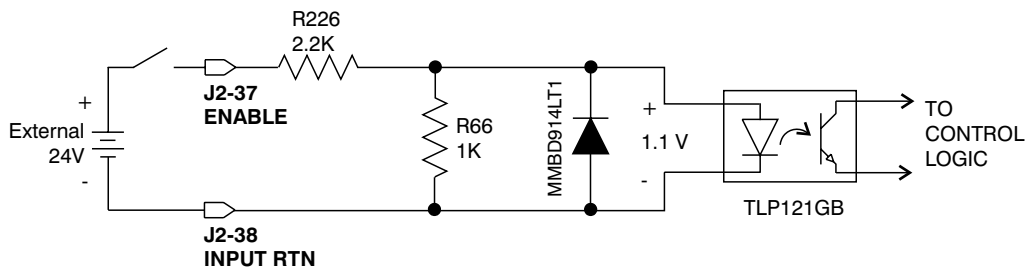
Note: *If the drive's 24 V supply is being used, connect as shown below.*
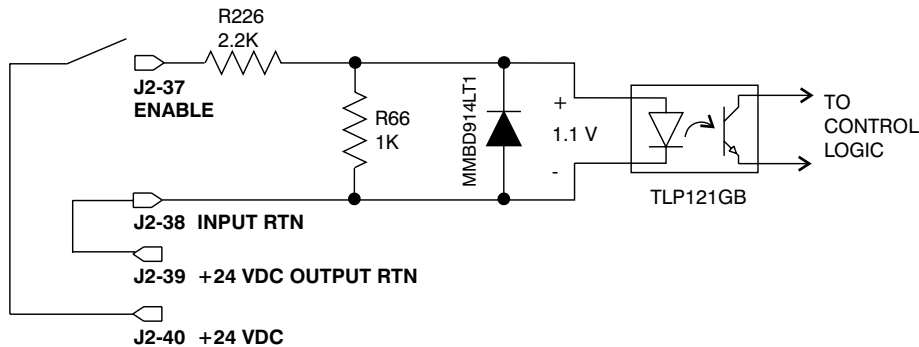
J2 Command I/O Continued

Input RTN
J2-38

This terminal is the floating common return for the six optically isolated digital inputs and the optically isolated Enable input.

+24 VDC RTN,
+24 VDC (Output)
J2-39, J2-40

These two connections provide an auxiliary floating power supply for the user. This output is 24 Vdc ± 10 % and is short circuit protected at 100 mA nominal. The maximum load limit for all connections to this supply is 80 mA. + 24 VDC RTN is not connected to Input RTN.

Out1, 2, 3
Supply (Input)
J2-41

The PC840 requires an external 12 - 24 VDC power source for the outputs. This power source must be capable of supplying at least 150 mA.

Outputs
J2-42, 43, 44

These optically isolated outputs are current sourcing at 0 to 50 mA maximum. External output supply should be limited to 30 V. These outputs are short circuit protected. Current folds back to about 25 mA during a short circuit. The external output supply (J2-41) is shared by the three outputs.

V_{ON}	1.9 V @ 25 mA 2.25 V @ 50 mA
I_{OFF}	5 μa
Response time	1 msec
Clamp voltage	40 V (nominal)

Each of the outputs is set and written to by software every 2 mSec. Each one can be configured to be any of the available functions and the configuration can be changed on the fly via digital communications. The user's default configuration is stored in the non-volatile memory. The present state of commanded outputs can be read via digital communications. The logic polarity of these signals is also software programmable. That is, an output can be defined to be active low or active high. For edge triggered functions the active edge is programmable.

J2 Command I/O Continued

The list below describes the subset of the available functions and the mappings used as the factory defaults for each of the outputs.

$\overline{\text{Fault}}$ Output   **Output 1:** This output is low when the drive is faulted or has no control power. This line can be used to indicate a problem with the drive.

Output Mapped   **Output 2:** Output Mapped Off
Off

Output Mapped   **Output 3:** Output Mapped Off
Off

Outputs

ON State

V_{ON} = 1.9 V @ 25 mA
          2.25V @ 50 mA

I_{ON} = 0 to 50 mA*
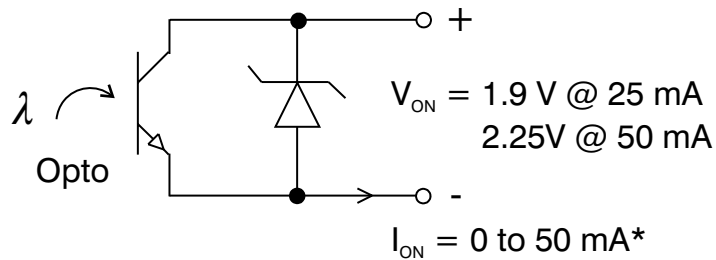
*During short circuit folds back to 25 mA

OFF State

V_{OFF} = 0 to 30V

I_{OFF} = 5μa (max)
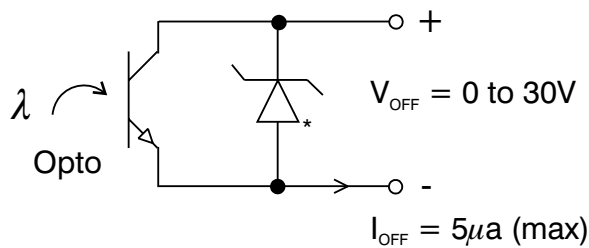
*36V Transient Surge Protector clamps @ 40 V nominal

Outputs Driving
Typical Loads
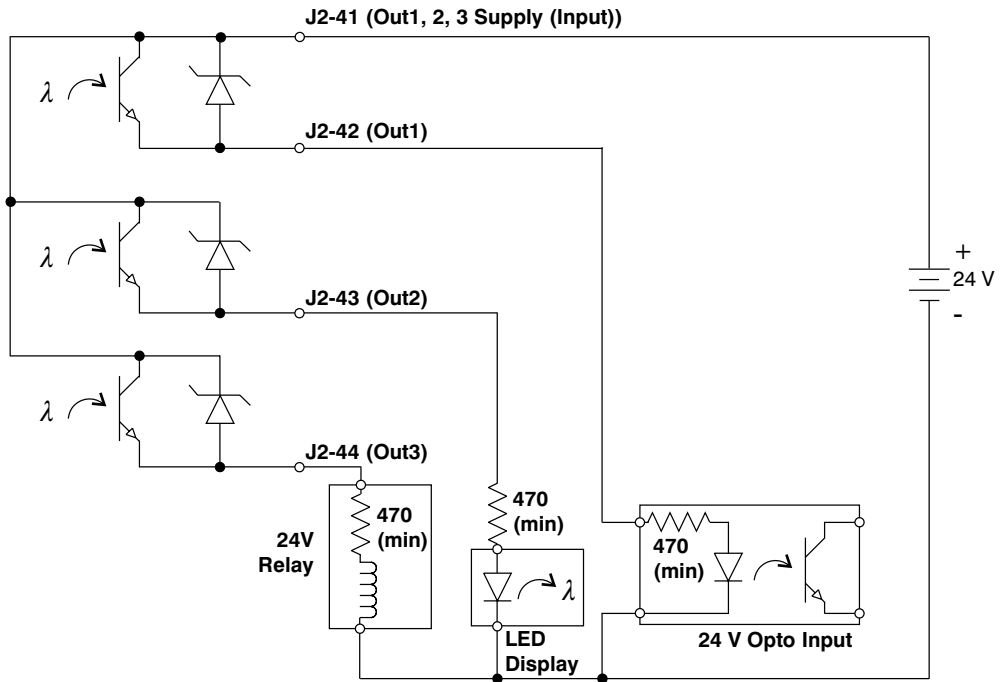
Output
Schematic
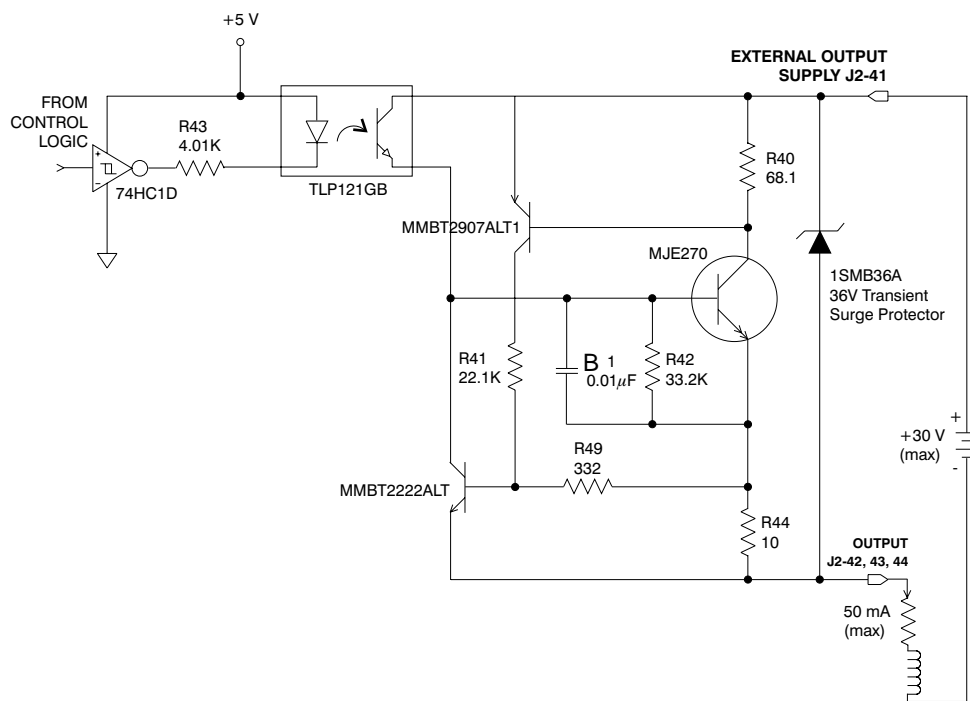
2.4 Feedback

J3   FEEDBACK 15 Position D subminiature female

Pin	Description
1	RESOLVER S1 SIN + (Input) / Hall 1
2	RESOLVER S3 SIN - (Input) / Hall 2
3	RESOLVER S2 COS + (Input) / Hall 3
4	RESOLVER S4 COS - (Input)
5	SHIELD (I/O RTN)
6	RESOLVER R1 EXCITATION (Output)
7	RESOLVER R2 EXCITATION RTN (Output)
8	MOTOR PTC (Input)
9	MOTOR PTC RTN (Input)
10	+5 VDC
11	I/O RTN
12	FEEDBACK ENCODER CHANNEL A (+)
13	FEEDBACK ENCODER CHANNEL A (-)
14	FEEDBACK ENCODER CHANNEL B (+)
15	FEEDBACK ENCODER CHANNEL B (-)

Feedback

Resolver S1, S2, S3, S4 Inputs
J3-1, 2, 3, 4

These connections provide the inputs for the resolver's sine/cosine outputs. Differential inputs with 75 Vμsec common mode impulse range and 25 kΩ input impedance.

Note: *This only applies if a Resolver feedback device is being used.*

Hall1, Hall2, Hall3
J3-1, 2, 3

These three single-ended hall channel sensor inputs are detected by +5 Vdc CMOS compatible commutation signals with 60° spacing. These inputs are each internally pulled-up to +5 Vdc via a 10 kΩ resistor. These input signals are low pass filtered in hardware at 10 kHz.

Note: *This only applies if a Hall feedback sensor is being used.*

Resolver R1 Excitation, R2 Excitation RTN Outputs
J3-6, 7

These connections provide the resolver excitation output. 9.2 V rms at 6510.42 Hz 75 mA rms maximum load. These outputs are fully short circuit protected to I/O COMMON or to each other at room temperature (25°C), but at ambient temperatures above 50°C, shorts longer than 5 minutes may cause damage.

Motor PTC, PTC RTN Inputs
J3-8, 9

These two inputs are intended to connect to a positive temperature coefficient thermistor or normally closed thermostatic switch imbedded in the motor windings. When the resistance between these terminals becomes greater than 6.2 kΩ the drive will fault and indicate a Motor Over Temperature fault. This circuit directly interfaces with Kollmorgen's standard motor PTC.

Note: *PTC RTN is connected to I/O RTN.*

Feedback   Continued

Encoder Inputs   CH A, $\overline{\text{CH A}}$, CH B, $\overline{\text{CH B}}$,
J3-12, 13, 14, 15

These differential inputs expect quadrature encoder feedback
signals. These two input pairs are differential and are detected
by 26LS32 type RS-422 compatible line receivers. As
differential inputs, the recommended common mode range is
7 V with respect to I/O RTN and the guaranteed differential
voltage logic thresholds are ± 0.2 V. Recommended drivers
should be able to source and sink > 3 mA to/from these
inputs.
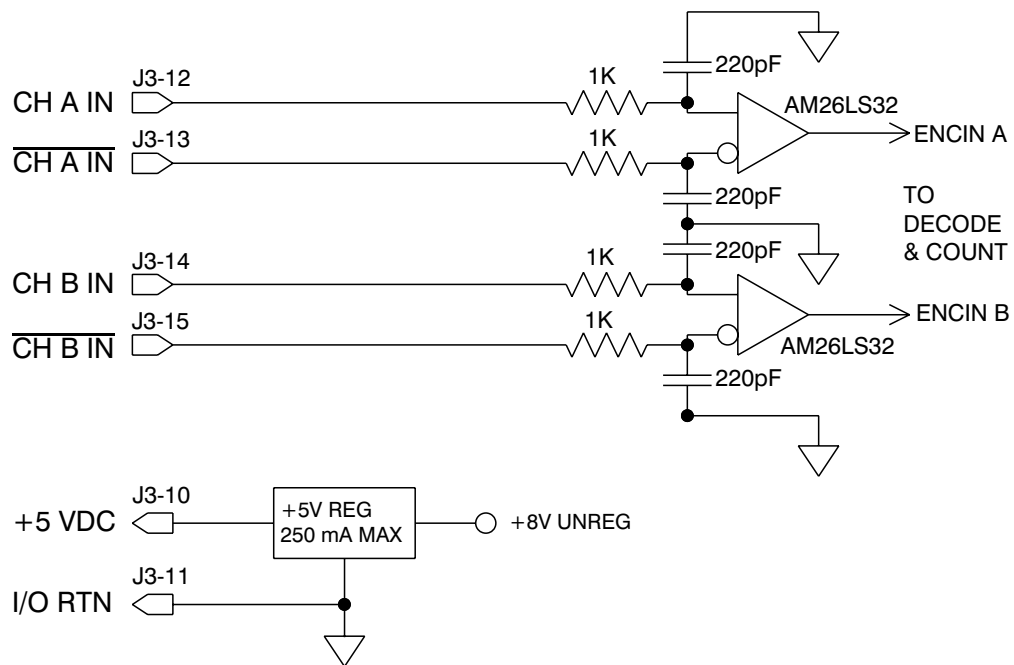
Note: *An adapter can be powered from the serial port +5 Vdc
output on J1-4 as long as the load current on J1-4, J2-14, and
J3-10 total less than 250 mA.*

Using TTL differential line drivers

ENCODER   PC840

```
                    +5V SUPPLY                          J3
                                                         10   +5 VDC @ 250 mA        +5
  +5V SUPPLY ←          CONNECT ONLY IF J3
                        SOURCES ENCODER POWER

  CH A                                               12   CH A
                            TWISTED
                            PAIR                     13   CH A

  CH B                                               14   CH B
                            TWISTED
                            PAIR                     15   CH B

                                                     11   I/O RTN

              +5V SUPPLY RETURN
```
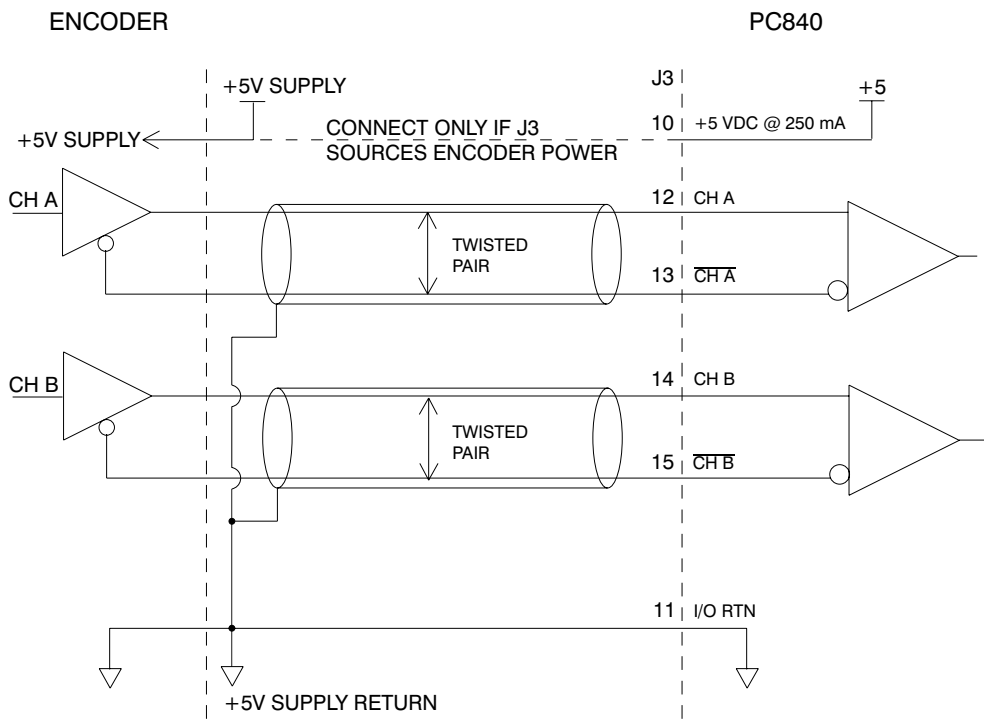
Drive Wiring Diagram
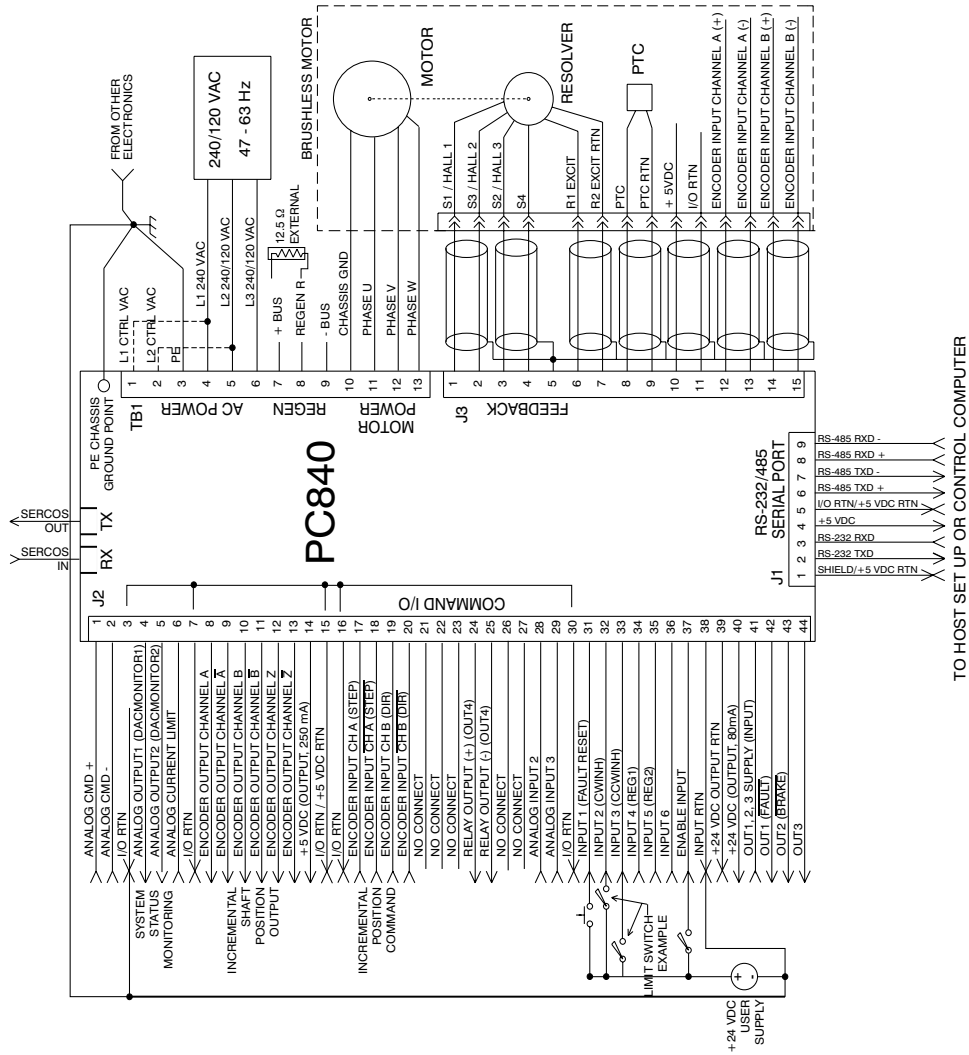
3 Inputs/Outputs

Introduction The PC840 has six digital user mappable inputs (J2-31 to J2-36), three digital user mappable outputs (J2-42 to J2-44), and one mappable relay output (J2-24, 25) which are available for users to interface to external devices; proximity switch, PLC, LED.

In addition, the PC840 has one analog input (J2-1, 2) and two analog outputs (J2-4, 5) that can be set to various output functions.

3.1 General Purpose Inputs/Outputs

The PC840 Input and Output pins are optically isolated from the rest of the PC840 and each other.

Below is a table of the applicable IDNs for the PC840 General Purpose I/O:

IDN(s)	Description	Function
34817-34822	PC840 Input Bits (1-6)	Read Input Bit (1-6)
34824	PC840 Input Port	Read Entire Input Port
34833-34836	PC840 Output Bits (1-4)	Read/Write Output Bits (1-4)
34840	PC840 Output Port	Read/Write Entire Output Port

Service Channel All of the above IDNs can be read through the SERCOS Service Channel. Reading an input bit would return the value of the bit located in the input port. Reading IDN 34824 would return the value of all the input bits as a single word. Reading an output bit would return the value the PC840 is attempting to drive on the output pin. Reading IDN 34840 would return the value the PC840 is attempting to drive on all the output pins.

Example

The PC840 has 00010101 on its input pins.

The PC840 is attempting to drive 00001010 on its output pins.

Reading IDN 34824 would return 0x15.

Reading IDN 34817 would return 1 (bit zero - input byte).

Reading IDN 34818 would return 0 (bit one - input byte).

Reading IDN 34821 would return 1 (bit four - input byte).

Reading IDN 34840 would return 0x0A

Reading IDN 34833 would return 0 (bit zero - output byte).

Reading IDN 34834 would return 1 (bit one - output byte).

Reading IDN 34836 would return 0 (bit four - output byte).

Cyclic Channel

The only two PC840 I/O IDNs which can be placed in the cyclic channel are IDN 34824 (Input Port) and IDN 34840 (Output Port). IDN 34824 (Input Port) can be placed in the AT and returns 2 bytes of data. The AT data would have the input port in the low byte of the return AT data and a zero in the high byte. IDN 34840 (Output Port) can be placed in the MDT and allows the user to write to the output pins once every MST cycle. The low byte of the written data would be placed into the output port, the high byte is ignored.

Real Time Control/Status

All of the input bit IDNs (34817 - 34822) and output bit IDNs (34833 - 34836) can be used through the use of real time control/status bits.

Use Control Bit IDNs (301 or 303) to update up to two output points within the cyclic channel update time. Writing an output bit IDN into either of the two allocation of control bit IDNs will cause the value of the real time control bit in the MDT to be placed into that output bit. Example, write one of the output bit IDNs (34833 - 34836) into IDN 301 or IDN 303. Then use the output bit IDN (Ex. 34833) to set the state of the output point. It will be updated within the cyclic channel update time.

Use Status Bit IDNs (305 or 307) to update up to two input points within the cyclic channel update time. Writing an input bit IDN into either of the two allocation of status bit IDNs will cause the value of the input bit to appear in the real time status bit returned in the AT. Example, write one of the input bit IDNs (34817 - 34822) into IDN 305 or IDN 307. Then use the input bit IDN (Ex. 34817) to read the state of the input point. It will be updated within the cyclic channel update time.

Example

Writing 34817 (PC840 Input Bit #1) to IDN 305 (Allocation of Real Time Status Bit 1) will cause the value of Input Bit #1 to appear as Status Bit 1 in the cyclic AT status word.

Writing 34822 (PC840 Input Bit #6) to IDN 307 (Allocation of Real Time Status Bit 2) will cause the value of Input Bit #6 to appear as Status Bit 2 in the cyclic AT status word.

Writing 34834 (PC840 Output Bit #2) to IDN 303 (Allocation of Real Time Control Bit 2) will cause the value of Control Bit 2 in the cyclic MDT to be written to Output Bit #2.

Writing 34836 (PC840 Output Bit #4) to IDN 301 (Allocation of Real Time Control Bit 1) will cause the value of Control Bit 1 in the cyclic MDT to be written to Output Bit #4.

Inputs Table (InpMapX)

The following table lists the mappable input functions available for the Digital Inputs.

Mappable Input Function	Function Number	Description
Analog Input Null	7	Nulls the analog input by setting ADOffset to old ADOffset minus AnalogIn
Counterclockwise Inhibit (default)	6	Inhibits motor motion in the counter-clockwise direction when asserted
Clockwise Inhibit (default)	5	Inhibits motor motion in the clockwise direction when asserted
Command Gain Select	9	Switches the analog input scale factor between CmdGain and CmdGain2
Enable 2	3	Second enable function
Fault Reset (default)	1	Resets drive faults
Home Switch Input	15	Home switch input for a homing move
No Function	0	Turns off mappable input functionality
Position Mode Select	8	Switches the active mode of operation to position mode
Run Stop	2	Selects between normal operation and setting the velocity command to zero
Velocity Command Source	4	Selects between VelCmd and VelCmd2

Outputs Table (OutMapX)

The following table lists the mappable output functions available for the Digital and Relay Outputs.

Mappable Output Function	Function Number	Description
Brake (default)	3	Indicates when the motor is not powered and a mechanical brake is needed to hold the motor
Electrical Revs	5	Square wave whose frequency is equal to the motor electrical frequency
Enabled	2	Indicates whether power can flow to the motor
Excess Position Error	7	Asserted when there is excess following error for an extended period of time (following error limit is defined by PosErrorMax)
Fault (default)	1	Indicates whether the drive has faulted and is disabled
Mechanical Revs	4	Square wave whose frequency is equal to the resolver's electrical frequency which is typically equal to the mechanical Rev/sec
No Function	0	Turns off mappable output functionality
Zero Speed	6	Activated when the motor's speed goes below the speed threshold set by the parameter ZeroSpeedThresh

Active hi/lo

Each of the digital inputs and outputs can be defined as either active high or active low. If the mappable output function (bit) is configured as active HIGH (LOW) then when the function (bit) is asserted, the output will be HIGH (LOW).

IDNs
32817 - 32822

InpMapX IDNs set the logical functions of the inputs on J2-31 to J2-36. Bits must be set to determine the polarity and the function. The default settings for InpMap1 (IDN 32817) - InpMap6 (IDN 32822) are shown in the following table:

InpMapX	Default State	Default Polarity	Default Value
InpMap1 (IDN 32817)	General Purpose I/O	Active Low	0x0
InpMap2 (IDN 32818)	General Purpose I/O	Active Low	0x0
InpMap3 (IDN 32819)	General Purpose I/O	Active Low	0x0
InpMap4 (IDN 32820)	General Purpose I/O	Active Low	0x0
InpMap5 (IDN 32821)	General Purpose I/O	Active Low	0x0
InpMap6 (IDN 32822)	General Purpose I/O	Active Low	0x0

IDNs 32860 -
32863

OutMapX IDNs set the logical functions of the outputs on J2-41 to J2-43. Bits must be set to determine the polarity and the function. The default settings for OutMap1 (IDN 32860) - OutMap4 (IDN 32863) are shown in the following table:

OutMapX	Default State	Default Polarity	Default Value
OutMap1 (IDN 32860)	General Purpose I/O	Active Low	0x0
OutMap2 (IDN 32861)	General Purpose I/O	Active Low	0x0
OutMap3 (IDN 32862)	General Purpose I/O	Active Low	0x0
OutMap4 (IDN 32863)	General Purpose I/O	Active Low	0x0

Bit settings   To change the default settings follow the bit settings listed below.

Note: *For general purpose I/O, the function number must be set to zero, with bit 15 also set to zero.*

Bit #	Description
15	Polarity 0 = Active Low 1 = Active High
4-14	Must be 0
0-3	Determine the function of the input or output. Refer to the Input and Output function tables.

Reading/writing I/O   In order to set a pin as a general purpose input the InpMap IDN must be set to zero. Reading a Input pin would return the value of the input pin. Reading IDN 34824 would return the value of all the input pins as a single word.

Reading an Output pin would return the appropriate bit value located in the Output port. Reading IDN 34840 would return the value of the Output port.

Writing a 0 or 1 to IDNs 34833-34836 (Output Pins) will set Output Pins to that value, or writing a value between 0 and 15 to IDN 34863 (Output Port) will set the Output port to that value.

| **Example** | To change the mapping of InpMap1 from General Purpose Input (default) to the Home Switch, perform the following: |

1. Write 0xC0000008 to InpMap1 (IDN 32817).

2. Read the first bit of the Input Port (IDN 34824) or read Input 1 (IDN 34817) to monitor the state of the input.

Note: *IDN 34817 can only be read using the service channel. IDN 34824 can be read using the service channel or the cyclic channel.*

3.2 Probe/Registration Functionality

| **Introduction** | In a typical application, probes are used to define the position of a part or the depth of a hole or cut. When the probe touches the surface, the switch closes and the position data is latched. |

Position registration uses the closure of a proximity switch, photo eye, or similar device to signal the latching of position data.

On the PC840, during probing and registration, position latching is perfomed by the drive.

| **Guidelines** | The PROBE 1 function must reside on Inp4 (J2-34) when probe/registration is in use. |

The PROBE 2 function must reside on Inp5 (J2-35) when probe/registration is in use.

The two probe functions work identically, but require additional setup prior to use when compared to other Input functions.

Note: *When RemoteFB = 1 or 2 (IDN 32824), Probe 2 cannot be used to latch position. Probe 2 is used only as the marker pulse input for homing. Probe 1 can be used to latch position (encoder position). When RemoteFB = 0, Probe 1 and Probe 2 can be used to latch position (resolver position).*

Probe table   Below is a list of IDNs related to the Probe functionality:

IDN	Description	Function
130	Probe 1 Positive Edge	Returns Probe 1 Positive Edge Data
131	Probe 1 Negative Edge	Returns Probe 1 Negative Edge Data
132	Probe 2 Positive Edge	Returns Probe 2 Positive Edge Data
133	Probe 2 Negative Edge	Returns Probe 2 Negative Edge Data
169	Probe Control	Specifies which probe edges are active
170	Probe Cycle Command	Allows the beginning of a probe cycle
401	Probe 1	Returns the current state of Probe 1 pin.
402	Probe 2	Returns the current state of Probe 2 pin.
405	Probe 1 Enable	Enables the latching of data upon a Probe 1 edge.
406	Probe 2 Enable	Enables the latching of data upon a Probe 2 edge.
409	Probe 1 Positive Latched	Returns a '1' when Probe 1 Positive Edge data has been latched.
410	Probe 1 Negative Latched	Returns a '1' when Probe 1 Negative Edge data has been latched.
411	Probe 2 Positive Latched	Returns a '1' when Probe 2 Positive Edge data has been latched.
412	Probe 2 Negative Latched	Returns a '1' when Probe 2 Negative Edge data has been latched.

Service channel operation   All of the above IDNs can be accessed through the Service Channel. For the probe function to take place, several of the IDNs must be set up prior to an event.

IDN 169

Probe Control Parameter:

Bit Number	Setting
0 - Probe 1 Positive Edge	0 = Positive edge inactive 1 = Positive edge active
1 - Probe 1 Negative Edge	0 = Negative edge inactive 1 = Negative edge active
2 - Probe 2 Positive Edge	0 = Positive edge inactive 1 = Positive edge active
3 - Probe 2 Negative Edge	0 = Negative edge inactive 1 = Negative edge active

IDN 170

Probing Cyclic Procedure Command: A probing cycle procedure must be active in order for a probe event to be captured. This is done by writing a 3 to IDN 170. To cancel probing control write a 0 to IDN 170.

IDN 405

Probe 1 Enable: Probe 1 must be enabled in order to capture a probe 1 event.

Bit Number	Bit Setting
0	0 = Probe 1 Not Enabled 1 = Probe 1 Enabled

IDN 406

Probe 2 Enable: Probe 2 must be enabled in order to capture a probe 2 event.

Bit Number	Bit Setting
0	0 = Probe 2 Not Enabled 1 = Probe 2 Enabled

Note: *The above three items MUST be done to capture a probe event. They may be done in ANY order.*

Once the above items have been set, and the correct edge has occurred on the probe line, probe data will be latched.

Once the probe data are latched and ready to be sent to the Master, the correct Probe Latched bit (IDNs 409 - 412) will return a 1 when read.

- The latched position data can be read through IDNs 130 - 133.

- The initial default data is 0. Data are updated only after a probe event has occurred.

- The probe event can be reset by clearing any of the four control IDNs (IDNs 169, 170, 405/406) and then re-enabling them.

Example   Writing 1 to IDN 169 (Probe Control Parameter) will cause Probe 1 Positive Edge events to be recorded. IDNs 405 and 170 must still be configured.

Writing 1 to IDN 405 (Probe 1 Enable) will enable probe 1.

Writing 3 to IDN 170 (Probe Command) will initiate probing on probe 1 (INP4) and probe 2 (INP5). At this point, if probe 1 (INP4) did not transition (low to high), reading IDN 409 (Probe 1 Positive Latch) will return a 0 indicating a probe did not take place. Reading IDN 130 (Probe 1 Positive Edge Data) will return 0.

After a positive transition on probe 1 (INP4), reading IDN 409 (Probe 1 Positive Latch) will return a 1 indicating a probe had occurred. Reading IDN 130 (Probe 1 Positive Edge Data) will return the latched position. To latch position on probe 1 again, reset IDN 405 by writing a 0 and then a 1 to it.

Since probe 2 was not enabled using IDNs 169 and 406, reading probe 2 related IDNs will return 0.

Cyclic Channel

Of all the Probe Input IDNs, only IDNs 130 - 133 (IDNs which return latched position data) can be inserted into the AT. The data returned will either be 0 (no data has been latched) or the last latched data for that probe edge.

Real Time Control/Status Bits

All of the Probe Data Latched IDNs (IDNs 409 - 412) and Probe Enable IDNs (IDNs 405 and 406) can be used through the use of real time control/status bits. Writing the IDN of a Probe Data Latched into either of the two Allocation of Status Bit IDNs (IDN 305 or IDN 307) will cause the value of that IDN to appear in the real time status bit returned in the AT. Writing the IDN of the Enable Probe into either of the two Allocation of Control Bit IDNs (IDN 301 or IDN 303) will cause the value of the real time control bit in the MDT to be placed into that Probe Enable function.

Example

Writing 409 (Probe 1 Positive Data Latched) to IDN 305 (Allocation of Real Time Status Bit 1) will cause the value of Probe 1 Positive Data Latched to appear as Status Bit 1 in the cyclic AT status word.

Writing 412 (Probe 2 Negative Data Latched) to IDN 307 (Allocation of Real Time Status Bit 2) will cause the value of Probe 2 Negative Data Latched to appear as Status Bit 2 in the cyclic AT status word.

Writing 406 (Probe 2 enable) to IDN 303 (Allocation of Real Time Control Bit 2) will cause the value of Control Bit 2 in the cyclic MDT to be written to Probe 2 Enable.

Writing 405 (Probe 1 Enable) to IDN 301 (Allocation of Real Time Control Bit 1) will cause the value of Control Bit 1 in the cyclic MDT to be written to Probe 1 Enable.

Use of the Real Time Control/Status bit IDNs (IDNs 405, 406, 409 - 412) along with the cyclic channel IDNs (130 - 133) results in registration events recorded and acted upon in real time.

3.3 Analog Input

This IDN can be read through either the Service or the Cyclic channel.

IDN 34825   Allows the master to read the Analog Input on the base unit. The value of this IDN is:

AnalogIn (V) = value read/$(954.3 * 2^{16})$

IDN 32809   First-order low-pass filter corner frequency for the analog input channel on J2-1,2 (ADF0). This IDN should be set so that:

IDN 32809 (ADF0) = Break Frequency of Analog Input
Filter in Hz

3.4 Analog Outputs

The analog outputs can be set to various output functions, including a user specified voltage.

The Analog Output function is selected using the DACMAP IDNs (IDNs 32814 and 32815). The DACMAP functions must be 'OFF' (IDNs 32814 or 32815 = zero) for user controlled AnalogOut. AnalogOut1 can be written to using IDN 34841. AnalogOut2 can be written to using IDN 34842. The break frequencies for the Analog Outputs' low-pass filter are IDNs DM1F0 (IDN 32810) and DM2F0 (IDN 32811).

IDN 32810   DM1F0 sets the frequency in Hz of a single pole low-pass filter on the DAC Monitor 1 output (J2-4). This IDN should be set so that:

IDN 32810 = Break Frequency (Hz)

IDN 32811   DM2F0 sets the frequency in Hz of a single pole low-pass filter on the DAC Monitor 2 output (J2-5). This IDN should be set so that:

IDN 32811 = Break Frequency (Hz)

Analog I/O IDNs   Below is a list of the Analog Input and Output IDNs:

IDN	Description	**Function**
32809	ADF0	Break Frequency for AnalogIn in Hz.
34825	AnalogIn	Analog Voltage Input
32810	DM1F0	Break Frequency for AnalogOut 1 in Hz.
32811	DM2F0	Break Frequency for AnalogOut 2 in Hz.
32812	DM1GAIN	Gain for AnalogOut1 - Scaling varies according to function
32813	DM2GAIN	Gain for AnalogOut2 - Scaling varies according to function.
32814	DM1MAP	Selects Variable to be mapped to AnalogOut1
32815	DM2MAP	Selects Variable to be mapped to AnalogOut2.
34841	AnalogOut1	Writes AnalogOut1 (If IDN 32814 = 0)
34842	AnalogOut2	Writes AnalogOut2 (If IDN 32815 = 0)

Example   User reads IDN 32809 (AnalogIn) to be 8000000.

Voltage on AnalogIn pin is:

$$8000000/(954.3*2^{16}) = 0.13 \text{ volts}$$

User reads IDN 32809 (AnalogIn) to be 200,000,000

Voltage on AnalogIn pin:

$$200,000,000/(954.3*2^{16}) = 3.2 \text{ volts}$$

Note: *The analog input is a differential input to an A/D. The full scale differential command input range is ±13V.*

3.5 DACMap Parameters

IDN 32814   DM1Map selects the signal sent to the DAC Monitor 1 output on J2-4. This IDN should be set so that:

IDN 32814 = Monitor # from the table on the following page.

IDN 32815   DM2Map selects the signal sent to the DAC Monitor 2 output on J2-5. This IDN should be set so that:

IDN 32815 = Monitor # from the table on the following page.

Note: *Set the value of the DM1Map and DM2Map (IDNs 32814 and 32815) before setting the values of DM1Gain and DM2Gain (IDNs 32812 and 32813).*

IDN 32812   DM1Gain sets the multiplicative scale factor applied to the DM1Map selected signal before outputting on DAC Monitor 1 (J2-4) (DM1Gain). This IDN should be set so that:

IDN 32812 = DM1Gain

IDN 32813   DM2Gain sets the multiplicative scale factor applied to the DM1Map selected signal before outputting on DAC Monitor 2 (J2-5) (DM2Gain). This IDN should be set so that:

IDN 32813 = DM2Gain

DAC Out units   The table below lists the units when DMxGain = 1.

Monitor #	Variable	Description	DAC Out Units
0	AnalogOutX		0.001 V/V
1	VelFB	Measured Velocity (DM2 Default)	0.001 V/kRPM
2	VelCmdA	Actual Velocity Command (VelCmdA)	0.001 V/kRPM
3	VelErr	Velocity Error	0.001 V/kRPM
4	FVelErr	Compensated Velocity Error	0.001 V/kRPM
5	Position	Measured Position*	0.001 V/Rev
6	PosError	Position Error*	0.001 V/Rev
7	PosCommand	Commanded Position*	0.001 V/Rev
8	ICmd	Commanded Torque Current	0.001 V/A
9	IFB	Measured Torque Current (DM1 Default)	0.001 V/A
10	AnalogIn	Filtered A/D Input	0.001 V/V
11	EncFreq	Encoder Frequency	0.001 V/Hz
12	EncPos	Encoder Position*	0.010 V/4096 counts
13	ItFilt	Filtered Output Current Amplitude	0.001 V/100%
14	HSTemp	Measured Heat Sink Temperature	0.001 V/C
15		Commutation Electrical Angle*	0.001V/Cycle
16	IR	Motor Phase R Output Current	0.001 V/A
17	IS	Motor Phase S Output Current	0.001 V/A
18	IT	Motor Phase T Output Current	0.001 V/A
19		Motor Phase R Voltage Duty Cycle	0.001V/100%
20		Motor Phase S Voltage Duty Cycle	0.001V/100%

Table (cont'd)

Monitor #	Variable	Description	DAC Out Units
21		Motor Phase T Voltage Duty Cycle	0.001V/100%
22	VBus	Drive Bus Voltage	0.001 V/V
23	ResPos	Resolver Absolute Position*	0.001 V/Rev
24		Commanded non-torque current	0.001 V/A
25		Measured non-torque current	0.001 V/A
26		Torque Voltage Duty Cycle	0.001 V/100%
27		Non-Torque Voltage Duty Cycle	0.001 V/100%
28		Velocity Command (VelCmd)	0.001 V/kRPM
65536	No change to variable, turn range clamp off		
65537	No change to variable, turn range clamp on		

* - These variables are allowed to wrap around when the signal exceeds the output voltage range.

Note: *Dac monitor outputs have a range of ±5V with a resolution of 10V/256 = 0.039 V.*

Example   To view the velocity feedback (VelFB) signal on an oscilloscope (to measure overshoot, rise-time, or other motion performance parameters) do the following:

1. Command a 4 KRPM move. VelFB is the default setting for DM2Map (IDN 32815 = 1), therefore use DAC Monitor 2 (J2-5 with respect to pin 5).

2. To filter out noise, set DM2F0 (IDN 32811) to 1000 Hz. DAC Monitor 2 will display an analog signal representing VelFB.

3. Set DM2Gain (IDN 32813). The range of the DAC Monitors is ± 5 volts. Set DM2Gain so that the signal is not clamped and a high resolution signal is maintained.

   For example, set DM2Gain so that 5 KRPM will correspond to 5 volts:
   5 KRPM * 0.001 Volt/KRPM * DM2Gain = 5 Volts.
   This implies that DM2Gain = 1000.

4. Connect the scope probe to DAC Monitor 2 and command a move. The velocity feedback signal should be visible on the scope.

DACMap diagram

The diagram shows a DAC MONITOR CH x SELECTION AND UNITS CONVERSION block with inputs:

- 0 ANALOG.OUT
- 1 VelFb
- 2 VelCmdA
- 3 VelErr
- 4 FVelErr
- 5 Position
- 6 PosError
- 7 PosCommand
- 8 ICmd
- 9 IFB
- 10 AnalogIN
- 11 EncFreq
- 12 EncPos
- 13 ItFilt
- 14 HsTemp
- 28 VelCmd

Controlled by DMxMap. Output goes to LOW PASS FILTER (DMxF0), then DMxGAIN (with DMxOut output), then CLAMP (CLAMP ON), then 8 BIT DAC (+/- 5 V) to DAC MONITOR x OUTPUT.

4 Servo Loop Parameters

Introduction
This chapter describes setting parameters associated with the current, velocity and position loops. In some cases the user must adjust control loop parameters due to large mismatches between motor and load inertia, mechanical resonance, backlash, etc. This chapter provides guidance for handling these situations.

Note: *The two anti-resonant zeroes (`ARZ0` and `ARZ1`) are assumed to both be off (set to zero) for this discussion.*

4.1 Current Loop

IDN 106
Current Loop Proportional Gain (Kip). This IDN should be set so that:

Kip V/Amp = L_{1-l} (in henries) * 2 * π * 1000

IDN 106 = Kip (Volts/Amp) * I_{Peak} * 405.6685e-3

IDN 107
Current Loop Integral Gain (Kii). This IDN should be set so that:

Kii = 50 Hz

IDN 107 = Kii (Hz) * 12.868

4.2 Velocity Loop

Velocity loop bandwidth is the key indicator of system performance. Systems with fast settling time must have high velocity loop bandwidth. Conversely, if the velocity loop bandwidth is low, attempting to achieve fast settling time by increasing the position loop bandwidth, `KPP`, leads to overshoot and ringing.
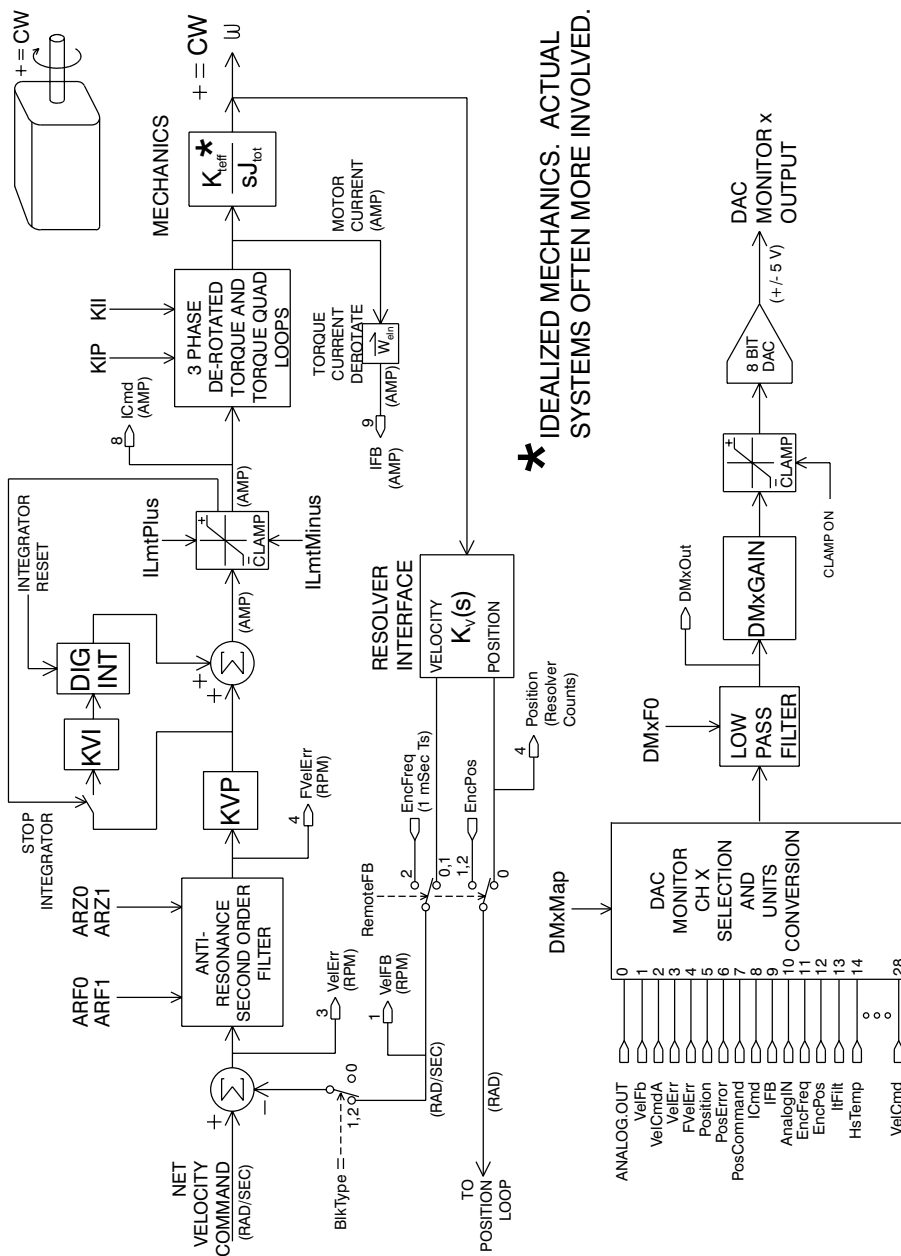
Velocity loop bandwidth

The velocity loop bandwidth (f_{vc}) is given by the equation:

$$f_{vc}(Hz) = \frac{KVP * K_T \, {}^{\sqrt{3}}\!/_{2}}{2p * J_{TOT}} \approx 0.138 * KVP * \frac{K_T}{J_{TOT}}$$

where:

KVP is the velocity loop proportional gain in amps/(rad/sec)

K_T is the 0-peak line-line motor torque constant in lb-in/amp

J_{TOT} is the total inertia (motor total + load total) in lb-in-sec^2.

(Any consistent set of units for K_T, J_{TOT}, such as MKS, that yields K_T/J_{TOT} in rad/sec^2/amp will work)

The motor torque constant is the value of K_T peak published in the HighPerformance Servo Motors catalog.

Note: *f_{vc} is the unity gain open-loop crossover frequency of the idealized rigid single mass system. See hardware specifications for maximum f_{vc} value.*

Load inertia

From the formula for bandwidth, it is seen that bandwidth changes inversely with total inertia. If the load inertia equals the motor plus resolver inertia, the velocity loop bandwidth will be half the values shown. If the load inertia is ten times the motor plus resolver inertia, the bandwidths will be one eleventh these values. Clearly KVP must be increased to compensate for increased load inertia if bandwidth is to be maintained. Typically, load inertia up to 3(motor + resolver) give acceptable performance without further optimization.

The most common servo setup problem is adding large load inertia without a corresponding increase in KVP.

KVP

The value of KVP to achieve a desired bandwidth can easily be calculated as follows:

$$KVP = \frac{2p * f_{vc} * J_{TOT}}{K_{TRMS}} \bigg/ \frac{\sqrt{3}}{2\sqrt{2}} \approx 10.26 * f_{vc} * \frac{J_{TOT}}{K_{TRMS}}$$

Example calculation

For example, to achieve 75 Hz bandwidth with a PMA22 motor having 20 to 1 load inertia = 0.011 lb-in-sec^2:

J_{TOT}[1] $= 0.00039 + 0.011 = 0.01139$ lb-in-sec^2

K_T[2] $= 4.31$ lb-in/amp

$$KVP = 10.26 * 75 * \frac{0.01139}{4.31} = 2.03$$

There is no specific answer to the general question "What should the bandwidth be?" In general, the higher the velocity loop bandwidth, the faster the settling time will be and the better the rejection of torque disturbances (increased stiffness). Typically, velocity loop bandwidths range from 30 to 100 Hz. However, too high a bandwidth can lower the damping of resonance in mechanical linkages, causing excessive ringing and/or wear in coupled mechanics. Remember, it is the resulting motion at the end of any mechanical linkages that typically matters, not the response at the motor shaft.

1   Motor plus resolver inertia (0.00039 lb-in-sec^2) for the PMA22 motor can be found in the catalog.

2   K_T can be found in the catalog as $K_{T\,RMS}$ (4.31 lb-in/amp) or by using the Back EMF Constant, K_E (31.2 Volts/kRPM) in the following formula:
$K_{T\,RMS} = K_{E\,RMS} * 1.06 \big/ \sqrt{3}$ (volts/krpm).

$K_{T\,0\text{-}PK} = K_{T\,RMS} * 0.707$

IDN 100	Velocity Loop Proportional Gain (Kvp). This IDN should be set so that:

Kvp (Amps/rad/sec) = $2\pi * f_{vc}$ (Hz) $* J_{total}/K_{teff}$ (rad/sec^2/amp)

IDN 100 = Kvp (Amps/rad/sec) / ($I_{Peak} * 193.38e{-}6$)

where:

J_{total} = Load inertia reflected to the motor shaft + motor inertia (lb-in-s^2)

fvc = velocity loop bandwidth (Hz)

K_{teff} = torque constant (effective)

Problems with high load inertia

It would seem that setting KVP is simply a matter of increasing its value to compensate for load inertia. Unfortunately, the following problems often interfere, particularly when the load inertia is large compared with the motor's inertia:

1. Mechanical resonance between motor and load cause high frequency oscillation.

2. Backlash between motor and load effectively unload the motor over a small angle. Within this small angle the increased bandwidth results in oscillation.

3. Ripple in the velocity feedback signal results in large motor ripple current if KVP is large.

As a general rule, any system with KVP set higher than 5 times the medium bandwidth setting will require adjustment to the default ARF0 and ARF1 settings.

Resonance   Mechanical resonance is caused by springiness between motor inertia and load inertia. This may result from belts, flexible couplings, or the torsional stiffness of shafts. **In general, the stiffer the couplings, the higher the resonance frequency and the easier it is to tune the system for good performance.**

If the velocity loop breaks into an oscillation at a frequency well above the calculated velocity loop bandwidth, a resonance problem may well exist. A second symptom is that the frequency of oscillation is relatively constant in the presence of changes to ARF0 and ARF1.

Anti-resonance Filters

Two digital anti-resonance filters, ARF0 (IDN 32843) and ARF1 (IDN 32844) are included in the velocity loop. These filters attenuate the velocity loop gain at the mechanical resonant frequency.

Recommended values are shown below:

f_{vc} (Hz)	25	75	200
ARF0 (Hz)	100	150	1500
ARF1 (Hz)	200	750	1×10^5

ARZ0 (IDN 32841) and ARZ1 (IDN 32842) are generally not needed and should be set to zero, which eliminates them entirely. However, for advanced compensation, ARZ0 or ARZ1 can be used to add lead compensation or used together to add a notch filter.

ARZ0 positive sets the zero frequency in Hz. If ARZ0 is less than zero, ARZ0 sets the under damped zero pair frequency in Hz and ARZ1 sets the under damped pair Q.

IDN 32841   First velocity loop compensation zero. This IDN should typically be set to ARZ0 (Hz/100) = 0.

The units of ARZ0 are 0.01 Hz.

IDN 32842   Second velocity loop compensation zero. This IDN should typically be set to ARZ1 (Hz/100) = 0.

The units of ARZ1 are 0.01 Hz.

IDN 32843   First velocity loop compensation anti-resonance low-pass filter corner frequency. This IDN should be set so that:

IDN 32843 = ARF0 (Hz) * 100

= 10000 for Gentle Response,
= 15000 for Medium Response,
and = 150000 for Stiff Response

IDN 32844   Second velocity loop compensation anti-resonance low-pass filter corner frequency. This IDN should be set so that:

IDN 32844 = ARF1 (Hz) * 100

= 20000 for Gentle Response,
= 75000 for Medium Response,
and = 10000000 for Stiff Response

Procedure   If the velocity loop bandwidth cannot be raised to an acceptable value without encountering a resonant oscillation, the following procedure is recommended.

1. Set both `ARF0` and `ARF1` to 400 Hz and set `KVP` low enough to prevent oscillation.

2. Increase `KVP` slowly until oscillation at the resonant frequency just begins. Then, reduce `KVP` slightly until the oscillation just stops. Compute the velocity loop bandwidth using the formula given at the beginning of this section. If the velocity loop bandwidth is less than .25 times the value of `ARF0` and `ARF1`, then proceed to Step 3. Otherwise, go to Step 4.

3. Decrease both `ARF0` and `ARF1` by 20% and go back to Step 2.

4. The velocity loop bandwidth should now be approximately one quarter the value of `ARF0` and `ARF1`. For margin, reduce `KVP`, `ARF0`, and `ARF1` by 20%.

Backlash   Some backlash may be unavoidable, especially when gear reduction is used. If backlash is present, the inertia match must be good (load inertia should be roughly equal to motor inertia) for good servo performance. Gearing reduces the inertia reflected to the motor by the square of the gear reduction from motor to load. Therefore, select a gear ratio to give the required match.

| Current ripple | The velocity feedback signal in standard PC840 drives operating with the standard 20 arcmin resolver can have up to 3% p-p ripple. The resulting motor torque current ripple, with no `ARF0/ARF1` filtering, can be calculated using the following formula: |

$$\text{Current ripple (amps p-p)} = \frac{3}{100} * \text{Speed (RPM)} * \frac{2p}{60} * KVP$$

$$\approx 0.003 * \text{Speed (RPM)} * KVP$$

There can be cause for concern when this p-p number exceeds 40% of the drive's or motor's current rating. The motor current should be monitored using Dac Monitors on J2-4 to insure actual ripple current, with `ARF0/ARF1` filtering, is not excessive.

Motor current ripple can often be reduced by lowering the `ARF0`, `ARF1` low-pass filter break frequencies. This benefit is limited by velocity loop bandwidth and stability constraints. Velocity feedback ripple, and hence motor current ripple, can also be reduced by specifying a higher accuracy resolver.

| KVI | The parameter `KVI` sets the so called "lag-break" frequency of the velocity loop. `KVI` is equal to the frequency in Hz where the velocity loop compensation transitions from predominantly integral characteristics to predominantly proportional characteristics. Drive rejection of torque disturbances increase as `KVI` increases. Default values for `KVI` are shown below: |

f_{vc} **(Hz)**	**25**	**75**	**200**
KVI (Velocity Loop Lag-Break Freq. (Hz))	1.7	5.0	13.3

IDN 101

Velocity Loop Integral Gain (Kvi). This IDN should be set so that:

Kvi = f_{vc} (Hz) / 15

IDN 101 = Kvi (Hz) * 51.4719

If the drive is to be used within a position loop (either with `BlkType = 2` or when using an external position drive and `BlkType = 1`), `KVI` should be equal to or less than 0.1 times the velocity loop bandwidth. If no position loop is used, `KVI` can be set to 0.25 times the velocity loop bandwidth (or higher if some ringing can be tolerated). In general, the response to a velocity command step (or truncated ramp) will have velocity overshoot for non-zero values of `KVI`.

4.3 Position Loop

When `BlkType` is set equal to 2, a position loop is configured outside the velocity loop. **The velocity loop must be set up and evaluated in terms of bandwidth before attempting to setup the position loop.**

KPP

The position loop proportional gain, `KPP`, determines the settling time of the position loop. `KPP` is the bandwidth of the position loop, in Hz, assuming an ideal velocity loop. Recommended values for `KPP` are shown below:

f_{vc} (Hz)	25	75	200
KPP (Position Loop Bandwidth (Hz))	5	15 (default)	50

In general, the higher the value of `KPP`, the faster the settling time. However, **trying to set `KPP` to a high value with inadequate velocity loop bandwidth results in overshoot and ringing.** A good trade off is to set `KPP` to 0.2 times the velocity loop bandwidth. Slightly higher values can be used if overshoot can be tolerated.

Position Loop
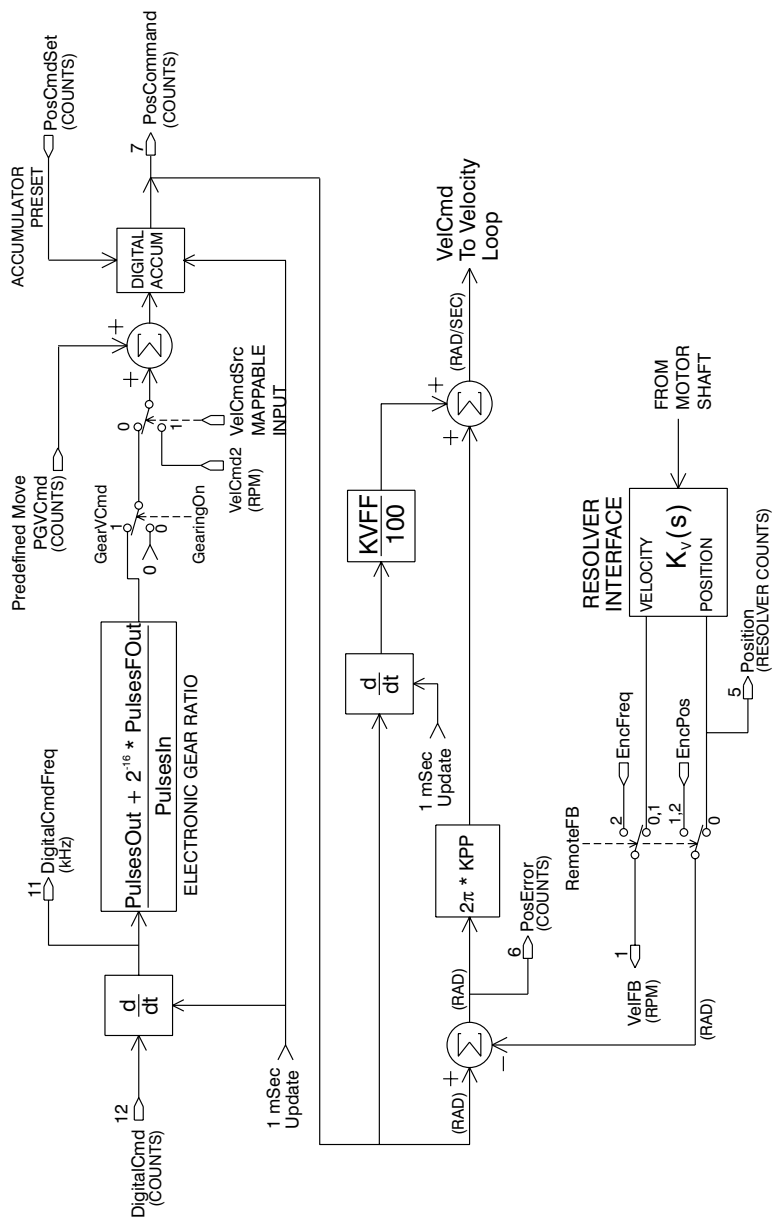
IDN 104

Position Loop Proportional Gain (Kpp). This IDN should be set according to table below. Gain settings are determined by the response type: Gentle, Medium, or Stiff.

Response	f_{vc}	IDN 101 (Kvi)	IDN 32843 (ARF0)	IDN 32844 (ARF1)	IDN 104 (Kpp)
Gentle	25	172	10000	20000	2056
Medium	75	515	15000	75000	6167
Stiff	250	1716	150000	10,000,000	20556

IDN 104 = Kpp (Hz) / 2.4324e-3
(for Resolver Feedback - IDN 32824 = 0)

IDN 104 = 4 * Kpp (Hz) / 2.4324e-3
(for Encoder Feedback - IDN 32824 = 1 or 2)

Note: *Kpp sets the position loop bandwidth for all values of RemoteFB (IDN 32824).*

KVFF	KVFF is the velocity feed forward gain. In the absence of velocity feed forward (KVFF = 0), the commanded velocity is proportional to the position (following) error. This means that the actual position will lag the commanded position by a value proportional to the speed. The error will be smaller for larger values of KPP.

The following table gives a feel for the following error magnitude.

Speed (RPM)	KPP (Hz)	Following Error (revolutions)
1000	10	0.27
2000	10	0.53
5000	10	1.33
1000	20	0.13
2000	20	0.27
5000	20	0.66

Note: *The following error can easily exceed one complete motor revolution. In many electronic gearing applications, such following errors are not acceptable (real gears don't have following errors!) Also, stepper systems don't have such errors.*

Feed forward takes advantage of the fact that the PC840 DSP knows the frequency of the encoder or step inputs and hence knows how fast the motor should be going at a given instant. All or part of this velocity can be added to the velocity command to reduce following error. If KVFF is set to 100 (%), then the steady state following error reduces to zero.

IDN 32840

This IDN should be set so that:

IDN 32840 = Kvff (%) * 10

Note: Increasing Kvff reduces steady state following error (position loop null error proportional to speed) and gives faster response time. However, if Kvff is too large, it will provide overshoot. Typically Kvff should not be set larger than 80 for smooth dynamics and acceptable overshoot, but should be set to 100 for minimum following error, which may be necessary in some applications.

Overshoot

Setting KVFF equal to 100% can result in position overshoot. Somewhat lower values may be required if this is a problem. KVFF set to 70%-80% typically achieves the fastest step response with no overshoot. However, setting KVFF to less than 100% will give steady state following error when running at constant speed.

4.4 Advanced Velocity Loop Tuning

Continuous time transfer function approximation

The transfer function for the velocity loop compensation block is given below:

$$\frac{FVelErr}{VelErr}(s) = \frac{\left(\dfrac{s}{w_z}\right)^2 + \dfrac{1}{Q_z}\dfrac{s}{\mathrm{w}_z} + 1}{\left(\dfrac{s}{\mathrm{w}_f}\right)^2 + \dfrac{1}{Q_f}\dfrac{s}{\mathrm{w}_f} + 1}$$

$$\frac{ICmd}{VelErr}(s) = \frac{\left(\dfrac{s}{\mathrm{w}_z}\right)^2 + \dfrac{1}{Q_f}\dfrac{s}{\mathrm{w}_z} + 1}{\left(\dfrac{s}{\mathrm{w}_f}\right)^2 + \dfrac{1}{Q_f}\dfrac{s}{\mathrm{w}_f} + 1}$$

For ARx0 > 0 both roots are real and:

$$\mathrm{w}_x = 2\pi\sqrt{(ARx0)(ARx1)}$$

$$Q_x = \frac{\sqrt{(ARx0)(ARx1)}}{Arx0 + ARx1}$$

For ARx0 < 0 roots are a complex pair and:

$$\mathrm{w}_x = -2\pi ARx0$$

$$Q_x = ARx1$$

Note: *When* `ARZ0` *and* `ARZ1` *are both zero, the numerator of* $\dfrac{FvelErr}{VelErr}(s)$ *reduces to 1. If* `ARZ0` *or* `ARZ1` *is individually 0 the numerator reduces to* $\dfrac{s}{2\pi ARZx} + 1.$

**Discrete time
transfer function**

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$$s \rightarrow \frac{1}{T_s}\left(1 - z^{-1}\right)$$

where $T_s = 250\,\mu$sec.

Mode Selection and Command processing
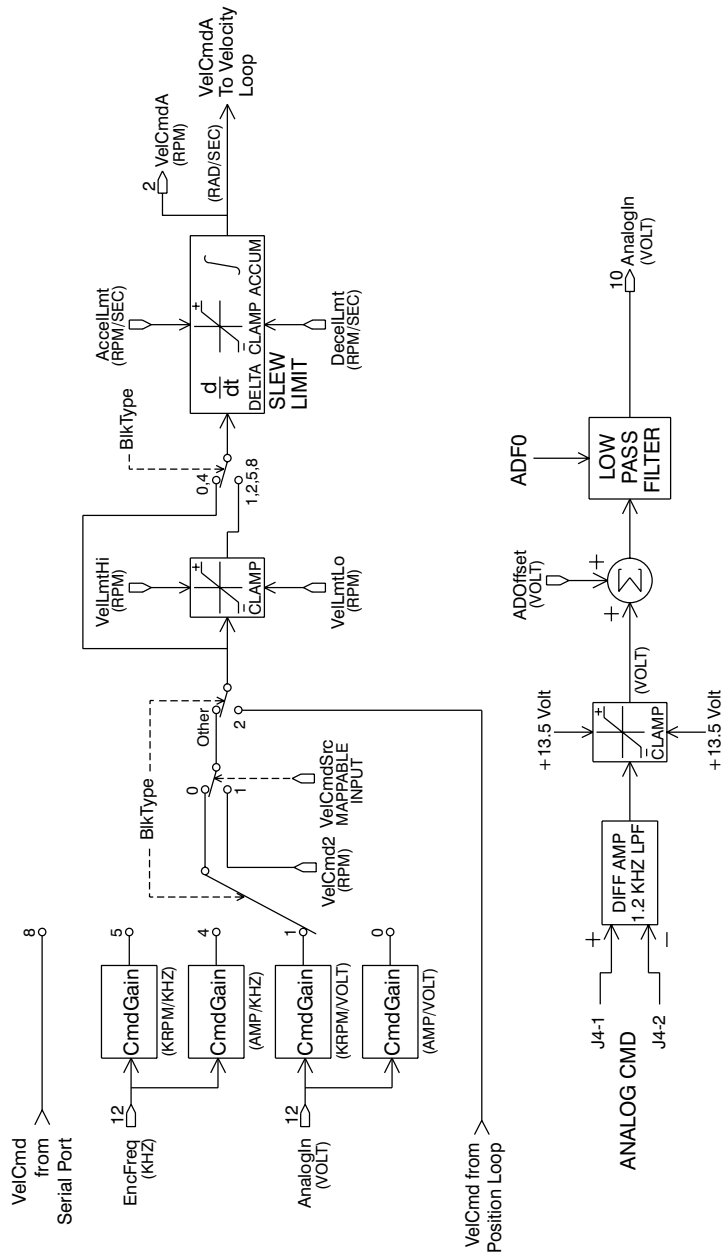
5 IDN Attributes

Introduction   This section contains a list of Identification Numbers (IDNs) in numerical order.

5.1 SERCOS Specific Parameters

IDN 1: Control unit cycle time   Parameter Data IDN

                                                                Unsigned Decimal Number

Sercos Cycle Rate. This is the update rate for AT and MDT IDNs. This value must be at least 1000 (1 mSec) for Velocity mode, and 2000 (2 mSec) for Position mode operation. The maximum value is 64000 (64 mSec).

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	01000
Maximum Value:	64000
Master Read (Phase 2):	Always reads 0xFA00 - 64 mSec - Current value.
Master Read (Phase 3 or 4):	Value written to this drive while in Phase 2.
Master Write:	This IDN can only be written in Phase 2.

IDN 2: Communication cycle time   Parameter Data IDN

                                                         Unsigned Decimal Number

This value must be the same as IDN 1 - Control unit cycle time.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Units: μs

Minimum Value: 01000

Maximum Value: 64000

Access State: Read/Write in Phase 2.
                                   Read Only in Phase 3 and 4.

IDN 3: Shortest AT Transmission starting time   Parameter Data IDN

                                                         Unsigned Decimal Number

Time required by the PC840 after the MST before it is able to send the AT.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Units: μs

Minimum Value: 20

Maximum Value: 20

Access State: Read Only by the Master.

IDN 4: Transmit/receive transition time   Parameter Data IDN

                                                        Unsigned Decimal Number

Time required by the PC840 after the end of transmitting the AT before it is ready
to receive the MDT from the master.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	20
Maximum Value:	20
Access State:	Read Only by the Master.

IDN 5: Minimum feedback processing time   Parameter Data IDN

                                                        Unsigned Decimal Number

Time required by the PC840 to acquire and compile the AT data prior to the
MST.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	300
Maximum Value:	300
Access State:	Read Only by the Master.

IDN 6: AT transmission starting time Parameter Data IDN

Unsigned Decimal Number

The time the PC840 sends the AT after the end of the MST, as measured in μSec. This value is calculated and written by the Master during Phase 2. The value read back is always the current value.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	20
Maximum Value:	64000
Access State:	Read/Write in Phase 2. Read Only in Phase 3 and 4.

IDN 7: Feedback acquisition capture point Parameter Data IDN

Unsigned Decimal Number

The PC840 shall acquire the AT data at this time. This value is calculated and written by the master during phase 2. The value read back is always the current value.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	0
Maximum Value:	63700
Access State:	Read/Write in Phase 2. Read Only in Phase 3 and 4.

IDN 8: Command value valid time Parameter Data IDN

Unsigned Decimal Number

At this moment of time, the PC840 shall begin using the data received from the master in the MDT. This value is calculated and written by the master during phase 2.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	0
Maximum Value:	64000
Access State:	Read/Write in Phase 2. Read Only in Phase 3 and 4.

IDN 9: Position of data record in MDT Parameter Data IDN

Unsigned Decimal Number

Position within the MDT that the drive's data begins. This value is in bytes and must be an odd value. This value is calculated and written by the master during phase 2.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65531
Access State:	Read/Write in Phase 2. Read Only in Phase 3 and 4.

IDN 10: Length of MDT   Parameter Data IDN

Unsigned Decimal Number

The length of the MDT in bytes. This includes data records for all drives. This value is calculated and written by the master during phase 2.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	4
Maximum Value:	65534
Access State:	Read/Write in Phase 2. Read Only in Phase 3 and 4.

IDN 11: Class 1 diagnostic   Parameter Data IDN

Binary Data

This IDN reports back the status of the motor/drive. The fault reported in this IDN causes the PC840 to disable the drive. Clearing the fault is required before the motor can be enabled. The PC840 supports the following bits in this IDN:

Bit Number	Description
Bit 15	Manufacturer Specific Fault See IDN 129 for additional information

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	0x8000
Access State:	Read Only by the Master.

IDN 14: Interface status   Parameter Data IDN

                                                              Binary Data

This IDN reports back the Communication Interface Status.   The PC840 supports
the following bits in this IDN:

Bit Number	Description
Bits 0-2	Phase - Indicates current phase.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0x0007

Access State: Read Only by the Master.

IDN 15: Telegram type parameter   Parameter Data IDN

                                                              Binary Data

This IDN indicates which set of IDNs are to be supported in the AT and MDT.

The PC840 supports the following parameter configurations (0 - 7 inclusive):

Configuration 0 : No AT or MDT IDNs.

Configuration 4 : IDN 47 (Position Command) in the MDT
                       IDN 51 (Position Feedback) in the AT.

Configuration 7 : User defined AT and MDT. Refer to IDNs 16 and 24.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 7

Access State: Read/Write in Phase 2.
                                      Read Only in Phase 3 and 4.

IDN 16: Configuration list of AT   Parameter Data IDN

                                                        IDN ID Number List

List of IDNs which are to be included in a User Defined AT. The data contained
in this list is governed by the following restrictions:

Each IDN must be included in the list of Valid AT IDNs (Refer to IDN 187).

Total number of AT IDNs must be 8 or less.

Total number of bytes transferred must be 20 or less.

This IDN must be written when IDN 15 = 7. (Custom Telegram)

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read/Write in Phase 2.
                                      Read Only in Phase 3 and 4.

IDN 17: IDN list of all operation data   Parameter Data IDN

                                                        IDN ID Number List

The Master receives a list of valid IDNs when this IDN is read.

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 18: IDN list of operation data for CP2   Parameter Data IDN

                                                        IDN ID Number List

List of required operational data which must be received by the PC840 before a
change to phase 3 can proceed.

Note: *A valid waveshape must exist prior to phase 3. The PC840 has a default value
which allows access into phase 3. Partially overwriting the waveshape will prevent
access into CP3.*

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 19: IDN list of operation data for CP3   Parameter Data IDN

                                                        IDN ID Number List

List of required operational data which must be received by the PC840 before a
change to phase 4 can proceed.

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 21: IDN list of invalid operation data for CP2 Parameter Data IDN

                                                        IDN ID Number List

List of required operational data which has not been received by the PC840 before
a change in phase to phase 3 can proceed.

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 22: IDN list of invalid operation data for CP3   Parameter Data IDN

IDN ID Number List

List of required operational data which has not been received by the PC840 before
a change in phase to phase 4 can proceed.

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 24: Configuration list of MDT   Parameter Data IDN

IDN ID Number List

List of IDNs which are to be included in a User Defined MDT. The data
contained in this list is governed by the following restrictions:

Each IDN must be included in the list of Valid MDT IDNs (Refer to IDN 188).

Total number of MDT IDNs must be 8 or less.

Total number of bytes transferred must be 20 or less.

This IDN must be written when IDN 15 = 7. (Custom Telegram)

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read/Write in Phase 2.
Read Only in Phase 3 and 4.

IDN 25: IDN list of all procedure commands   Parameter Data IDN

IDN ID Number List

List of all COMMAND IDNs (Reset Fault, Home, etc.) supported by the PC840.

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 28: MST Error Counter Parameter Data IDN

<div style="text-align:right">Unsigned Decimal Number</div>

Counts all invalid MSTs in communication phases 3 and 4.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65535
Access State:	Read by the Master. Write only 0.

IDN 29: MDT Error Counter Parameter Data IDN

<div style="text-align:right">Unsigned Decimal Number</div>

Counts all invalid MDTs in communication phase 4.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65535
Access State:	Read by the Master. Write only 0.

IDN 30: Manufacturer Version Parameter Data IDN

<div style="text-align:right">Text Data String</div>

The operation data of the manufacturer version contains the constant string "Pacific Scientific."

Conversion Scaling Factor:	1
Data Length:	1 Byte data - Variable length
Access State:	Read Only by the Master.

IDN 32: Primary operation mode   Parameter Data IDN

Unsigned Decimal Data

The mode of operation is sent by the Master to the PC840 during Phase 2 with this IDN. Valid modes of operation are velocity, position and torque mode.

Mode 1: Torque Mode - Allows the use of IDN 80 (Torque Command) over the Service Channel to control torque of drive.

Mode 2 : Velocity Mode - Allows use of IDN 36 (Velocity Command) over the Service Channel to control speed of drive.

Mode 3 : Position Mode - Allows use of IDN 47 (Position Command) over the Cyclic and Service Channel to control position of drive.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	1
Maximum Value:	3
Access State:	Read/Write in Phase 2. Read Only in Phase 3 and 4.

IDN 36: Velocity command value   Parameter Data IDN

Signed Decimal Number

Gives access to the instantaneous Velocity Command value of the PC840.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units	Motor velocity (RPM) / [(IDN 45)*10$^\wedge$(IDN 46)]
Minimum Value:	-2,147,483,647
Maximum Value:	2,147,483,647
Master Read:	Reads the instantaneous Velocity Command from the PC840.

IDN 36 continued

Master Write:	**Position Mode:** Always overwritten by new Velocity Command generated from the Position Command. **Velocity Mode:** Sets the Velocity Command of the PC840.
Access State:	Read/Write in phases 2-4.

IDN 40: Velocity feedback value   Parameter Data IDN

Signed Decimal Number

Gives access to the instantaneous Velocity Feedback value of the PC840.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units	Motor velocity (RPM) / [(IDN 45)*10 $\wedge$ (IDN 46)]
Minimum Value:	-2,147,483,647
Maximum Value:	2,147,483,647
Master Read:	Reads the instantaneous Velocity Feedback from the PC840.

IDN 41: Homing velocity   Parameter Data IDN

Signed Decimal Number

Sets the velocity a home command is processed at. For example, if IDN 45 = 1, IDN 46 = -3, then LSB weight of IDN 41 = 0.001 RPM.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units	Motor velocity (RPM) / [(IDN 45)*10 $\wedge$ (IDN 46)]
Minimum Value:	-2,147,483,647
Maximum Value:	2,147,483,647
Access State:	Read/Write in phases 2-4.

IDN 42: Homing acceleration   Parameter Data IDN

Unsigned Decimal Number

Sets the acceleration a home command is processed at. For example, if IDN 161 = 1 and IDN 162 = -3 then LSB weight of IDN 42 = 0.001 RPM/Sec.

Conversion Scaling Factor :   1

Data Length: 4 bytes

Units: Motor acceleration (RPM/Sec)/
                                      $[(\text{IDN }161*10^{(\text{IDN }162)}]$

Minimum Value: 1

Maximum Value: 4,294,967,295

Access State: Read/Write in phases 2-4.

IDN 43: Velocity polarity parameter   Parameter Data IDN

Binary Data

Defines the polarity of the velocity data (IDNs 36 and 40).

Bit Number	Bit Setting (1 = Inverted, 0 = Non-Inverted)
Bit 0	Controls Velocity Command Data
Bit 1	Must be zero
Bit 2	Controls Velocity Feedback Data
Bits 3 - 15	Reserved and must be zero.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0x0

Maximum Value: 0x0005

Access State: Read/Write in phases 2-4.

IDN 44: Velocity data scaling type Parameter Data IDN

Defines the scaling type for the PC840. For the PC840, IDN 44 = 0xA.

Bit Number	Bit Setting
Bits 0-2	010 : Rotational Scaling
Bit 3	1 : Parameter Scaling
Bit 4	0 : Revolutions
Bit 5	0 : Minutes
Bit 6	0 : At the Motor Shaft

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0xA

Maximum Value: 0xA

Access State: Read Only by the Master.

IDN 45: Velocity data scaling factor Parameter Data IDN

Unsigned Decimal Number

All velocity data (IDNs 36, 40 and 41) are scaled by the following formula:
(IDN 45)*10$^{\wedge}$(IDN 46).

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 1

Maximum Value: 65535

Access State: Read/Write by the Master.

IDN 46: Velocity data scaling exponent   Parameter Data IDN

Signed Decimal Number

All velocity data (IDNs 36, 40 and 41) are scaled using the following formula:
(IDN 45)*10 $\wedge$ (IDN 46).

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	-32768
Maximum Value:	32767
Access State:	Read/Write by the Master.

IDN 47: Position command value   Parameter Data IDN

Signed Decimal Number

Allows the Master to have access to the instantaneous Position Command value of
the PC840 drive. The value is scaled by IDN 79.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	resolver or encoder counts * (65536 / (IDN 79)) (depending on feedback device used)
Minimum Value:	-2,147,483,647
Maximum Value:	2,147,483,647
Master Read:	Reads the instantaneous Position Command Value.
Master Write:	Sets the instantaneous Position Command Value. This value will be overwritten by the Position Feedback Data when the drive is not enabled. This value sent over the Service Channel will be overwritten by any applicable cyclic channel data.
Access State:	Read/Write in phases 2-4.

IDN 51: Position feedback value 1   Parameter Data IDN

                                                             Signed Decimal Number

Allows the Master to have access to the instantaneous Position Feedback value of
the PC840 drive. The value is scaled by IDN 79.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	resolver or encoder counts * ((IDN 79) / 65536) (depending on feedback device used)
Minimum Value:	-2,147,483,647
Maximum Value:	2,147,483,647
Master Read:	Reads the instantaneous Position Command Value.

IDN 52: Reference distance 1   Parameter Data IDN

                                                             Signed Decimal Number

Programmable Position offset used during Home Commands. The value is scaled
by IDN 79.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	resolver or encoder counts * (65536 / (IDN 79)) (depending on feedback device used)
Minimum Value:	-2,147,483,647
Maximum Value:	2,147,483,647
Access State:	Read/Write in phases 2-4.

IDN 55: Position polarity parameter   Parameter Data IDN

Binary Data

Defines the Position Polarity Parameters.

Bit Number	Bit Setting (1 = Inverted, 0 = Non-Inverted)
Bit 0	Position Command Data (IDN 47).
Bit 1	Must be zero.
Bit 2	Position Feedback Data (IDN 51).
Bit 3	Must be zero.
Bit 4	Must be zero.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 5

Access State: Read in phases 2-4.
Write in phase 2.

IDN 76: Position data scaling type   Parameter Data IDN

Binary Data

Defines the position scaling type for the PC840.

Bit Number	Bit Setting
Bits 0-2	010 : Rotational Scaling.
Bit 3	1 : Parameter Scaling.
Bit 4	0 : Degrees.
Bit 5	0 : Reserved.
Bit 6	0 : At the Motor Shaft.
Bit 7	0/1 : 0 => Absolute Format. 1 => Modulo Format (IDN 103).

Note: *Only Bit 7 may be changed by the Master while in phase 2. All other bits are Read Only, trying to change them results in a Service Channel error.*

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0x0A

Maximum Value: 0x8A

Access State: Read/Write in phase 2
Read Only in phase 4.

IDN 77: Linear position data scaling factor Parameter Data IDN

<div style="text-align:right">Unsigned Decimal Number</div>

All position data IDNs (IDNs 47, 51, 52, 103, 130, 131, 132, 133, 159, and 189) are scaled according to the formula (IDN 77)*10$^\wedge$(IDN 78).

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 1

Maximum Value: 65535

Access State: Read Only by the Master.

IDN 78: Linear position data scaling exponent Parameter Data IDN

<div style="text-align:right">Signed Decimal Number</div>

All position data IDNs (IDNs 47, 51, 52, 103, 130, 131, 132, 133, 159 and 189) are scaled according to the formula (IDN 77)*10$^\wedge$(IDN 78).

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: -32,768

Maximum Value: 32,767

Access State: Read Only by the Master.

IDN 79: Rotational position resolution   Parameter Data IDN

                                                    Unsigned Decimal Number

All position data is scaled using IDN 79. Command IDNs (IDNs 47, 52, 103) are scaled by (65536 / (IDN 79)). Feedback IDNs (IDNs 51, 130, 131, 132, 133, 189) are scaled by ((IDN 79 / 65536). If IDN 79 = 32768 counts per revolution, the position data is scaled by 65536 / 32768 = 2 or 32768 / 65536 = ½. If IDN 47 = 1000 units * 2 = 2000 units. If IDN 51 = 3000 units *1/2 = 1500 units.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: percent

Minimum Value: 0

Maximum Value: 2,147,483,647

Access State: Read/Write in phases 2-4.

IDN 80: Torque command value   Parameter Data IDN

                                                    Signed Decimal Number

Gives access to the instantaneous torque value of the PC840.

Conversion Scaling Factor: 0.009 Amps (1000 = 9 Amps)

Data Length: 2 bytes

Minimum Value: -32768

Maximum Value: 32767

Master Read: Reads the instantaneous current command of the PC840.

Master Write: **Position and Velocity Mode:**
                                    Always overwritten by new current command generated by the velocity loop.

                                    Torque Mode:
                                    Sets the current command of the PC840.

Access State: Read/Write in phases 2-4.

IDN 82: Positive torque limit value   Parameter Data IDN

                                                  Unsigned Decimal Number

Value of IlmtPlus corresponds to the clockwise direction of the motor and is set in % increments.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	percent of peak current rating of the drive
Minimum Value:	0
Maximum Value:	100
Access State:	Read/Write by the Master in phases 2-4.

IDN 83: Negative torque limit value   Parameter Data IDN

                                                  Unsigned Decimal Number

Value of IlmtMinus corresponds to the counter-clockwise direction of the motor is % increments.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	percent of peak current rating of drive
Minimum Value:	0
Maximum Value:	100
Access State:	Read/Write by the Master in phases 2-4.

IDN 84: Torque feedback value   Parameter Data IDN

                                                            Signed Decimal Number

Gives access to the instantaneous Torque Feedback Value of the PC840.

Conversion Scaling Factor: 0.009 Amps (1000 = 9 Amps)

Data Length: 2 bytes

Minimum Value: -32768

Maximum Value: 32767

Access State: Read Only by the Master.

IDN 85: Torque polarity parameter   Parameter Data IDN

                                                                    Binary Data

Defines the Torque Polarity Parameters.

Bit Number	Bit Setting (1 = Inverted, 0 = Non-Inverted)
Bit 0	Torque command value
Bit 1	Additive Torque command value - Must be zero
Bit 2	Torque feedback value
Bits 3-15	Reserved and must be zero

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 5

Access State: Read/Write in phase 2.
                                      Read Only by the Master in Phases 3-4.

IDN 88: Receive to receive recovery time   Parameter Data IDN

                                                                Unsigned Decimal Number

Required time for the PC840 between the end of the MDT and the beginning of
the next MST.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	350
Maximum Value:	350
Access State:	Read Only by the Master.

IDN 89: MDT transmission starting time   Parameter Data IDN

                                                                Unsigned Decimal Number

Value sent by the Master to indicate the starting time in uSec of the MDT. This
value is calculated and written by the master during phase 2.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	1
Maximum Value:	64000
Access State:	Read/Write by the Master in Phase 2.

IDN 90: Command value proceeding time　　　　　　　Parameter Data IDN

Unsigned Decimal Number

Value read by the Master indicating how soon after the MDT the PC840 can make the received data available for usage.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	μs
Minimum Value:	1
Maximum Value:	64000
Access State:	Read Only by the Master.

IDN 95: Diagnostic message　　　　　　　Parameter Data IDN

Text Data String

The diagnostic messages are generated by the drive as text and stored in the operation data of this IDN. If IDN 129 = 0x0314 (Faultcode = 20 and ExtFault = 3) the diagnostic message will be "Initialization Fault. Calibration data corrupted. Fatal Fault."

Conversion Scaling Factor:	1
Data Length:	1 Byte data - Variable Length
Access State:	Read Only by the Master.

IDN 96: Slave Arrangement 0   Parameter Data IDN

                                                         Binary Data

The PC840 returns its axis address in both the low and high byte of this IDN. The
PC840 is not capable of supporting multiple motors on a single drive. Valid axis
addresses range from 0x01 to 0xFE (1 - 254 decimal).

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0x0101

Maximum Value: 0xFEFE

Access State: Read Only by the Master.

IDN 99: Reset class 1 diagnostic   Command Data IDN

                                              Unsigned Decimal Number

Command Procedure IDN : Used to clear recorded faults in the PC840. Faults
which cause the PC840 to cycle back to phase 0 are recorded and saved for
transmission in phase 2. The PC840 will automatically notify the Master upon
completion of this Command IDN. While this Command IDN is being performed,
other service channel IDNs may be processed. Write 3 to IDN 99 to initiate Reset
Class 1 Diagnostics (this will reset the fault and disable the drive). Write 0 to IDN
99 to de-activate the fault reset command. The drive cannot be enabled while fault
reset is asserted.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 3

Access State: Read/Write by the Master in phases 2-4.

IDN 100: Velocity loop proportional gain   Parameter Data IDN

                                                    Unsigned Decimal Number

Allows the master to set the value of kvp (Amp/rad/sec).
IDN 100 = kvp / (Ipeak * 193.38e-6).

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 65534

Access State: Read/Write by the Master in phases 2-4.

IDN 101: Velocity loop integral gain   Parameter Data IDN

                                                    Unsigned Decimal Number

Allows the master to set the value of kvi (Hz). IDN 101 = kvi * 51.4719.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 1

Maximum Value: 65535

Access State: Read/Write by the Master in phases 2-4.

IDN 103: Modulo value Parameter Data IDN

<div style="text-align:right">Unsigned Decimal Number</div>

If bit 7 of IDN 76 is set to modulo format, the modulo value defines the range that the drive and control must implement. This IDN is scaled by IDN 79.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	Modulo value * (65536 / (IDN 79))
Minimum Value:	10
Maximum Value:	2,147,483,647
Access State:	Read/Write in phase 2. Read Only in phases 3 and 4.

IDN 104: Position loop Kp-factor Parameter Data IDN

<div style="text-align:right">Unsigned Decimal Number</div>

Allows the master to set the value of kpp (Hz).
IDN 104 = kpp / 2.4324e-3 (for resolver feedback).
IDN 104 = 4 * kpp / 2.4324e-3 (for encoder feedback).

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65534
Access State:	Read/Write by the Master in phases 2-4.

IDN 106: Current Loop Proportional Gain 1 Parameter Data IDN

Unsigned Decimal Number

Allows the master to set the value of kip (Volts/Ampere).
IDN 106 = kip * Ipeak * 405.6685e-3.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	62000
Access State:	Read/Write by the Master in phases 2-4.

IDN 107: Current Loop Integral Action Time 1 Parameter Data IDN

Unsigned Decimal Number

Allows the master to set the value of kii (Hz). IDN 107 = kii * 12.868.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65535
Access State:	Read/Write by the Master in phases 2-4.

IDN 110: Amplifier peak current Parameter Data IDN

Unsigned Decimal Number

Contains the amplifier peak current. Set to 30,000 mA as default.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	mA
Minimum Value:	0
Maximum Value:	4,294,967,295
Access State:	Read Only by the Master.

IDN 127: Command Data IDN

Communication phase 3 transition check Binary Data

Command Procedure IDN used to check whether the PC840 is ready to proceed into phase 3. This IDN must be performed and successfully completed prior to going into phase 3. If all IDNs identified in IDN 18 have not been completed, or if the waveshape is incomplete, or if this IDN is not performed and the Master goes to phase 3, the PC840 will declare a fault and go to phase 0.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	3
Access State:	Read/Write by the Master in phase 2.

IDN 128: Command Data IDN

Communication phase 4 transition check Binary Data

Command Procedure IDN used to check whether the PC840 is ready to proceed into phase 4. This IDN must be performed and successfully completed prior to going into phase 4. If not all IDNs identified in IDN 19 have not been completed or if this IDN is not performed and the Master goes to phase 4, the PC840 will declare a fault and go to phase 0.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	3
Access State:	Read/Write by the Master in phase 3.

IDN 129: Manufacturer Class 1 Diagnostic   Parameter Data IDN

<div align="right">Binary Data</div>

The data in this IDN contains the current manufacturer specific fault code. If no fault is present in the PC840, this value will be zero.

The low byte of the data is the Fault Code that is displayed on the PC840 drive.

The high byte of the data is the Extended Fault Code. If the fault code has an associated extended fault code, it will be displayed here. Most fault codes do not have extended fault codes.

FaultCode	Fault Description
1	Velocity feedback (VelFB) over speed*
2	Motor over temperature
3	User +5V low
4	Continuous current fault
5	Drive over current (instantaneous)
6	Control ±12 V under voltage
7	Not Assigned
9	Bus over voltage detected by DSP, External Regen Fault
10	Not Assigned
11	Bus under voltage* (Only if VBus < VBusThresh)
12	Ambient temperature too low
13	Encoder alignment failed*
14	Software and non-volatile memory versions not compatible
15	Hardware not compatible with software version
16	UnConfigured drive fault
17	Two AInNull events too close together
18	Position following error fault
19	Parameter memory error*
20	Initialization fault*
21	Drive over temperature
22	Resolver Fault

*To further identify this fault see software ExtFault table.

IDN 129 continued

ExtFault   The following table lists the values for ExtFault.

ExtFault	ExtFault Description
1	Absolute Resolver Overspeed. |VelFB| > 21038 RPM
2	Variable Resolver Overspeed. |VelFB| > max(VelLmtxx)*1.5
3	Calibration data corrupted*
4	Excessive dc offset in current feedback sensor*
5	DSP incompletely reset by line power dip*
8	Excessive dc offset in Analog Command A/D*
9	Not Assigned
10	DSP stack overflow*
12	Software and control card ASIC incompatible*
13	Actual Model not same as stored in NV memory*
14	Unable to determine power stage*
15	Drive non-volatile parameters corrupt*
16	RAM failure*
17	Calibration RAM failure*
18	Encoder alignment: no motion fault
19	Encoder alignment: excessive motion fault
20	Encoder alignment: motor not settled
21	Encoder alignment: test failed
22	Encoder alignment: motion overflow fault
23	Hall Commutation: invalid configuration
24	Hall Commutation: overspeed
25	Hall Commutation: invalid hall state
26	Hall Commutation: invalid hall transition
27	I*t Drive
28	I^2*t Motor

IDN 129 continued

Ext Fault continued

ExtFault	ExtFault Description
29	DP RAM Test A *
30	DP RAM Test 5 *
31	DP RAM Test Run 1*
32	DP RAM Test Run 0 *
33	DP RAM Test C *
65	Data Read Only
66	Data Bounds Error
67	Execute no such command
68	RT not Implemented
69	FC not Implemented

*These fault states CANNOT be reset with the Fault Reset function and require the line control power to be turned OFF and ON again.

IDN 130: Probe value 1 positive edge   Parameter Data IDN

                                                            Signed Decimal Number

Returns the position value latched by the PC840 drive when a rising edge of the Probe 1 signal has occurred. The position is either in resolver or encoder counts depending on the feedback device used to close the position loop. This value is scaled using IDN 79.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Probe Value *((IDN 79) / 65536)

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read Only by the Master.

IDN 131: Probe value 1 negative edge   Parameter Data IDN

                                                            Signed Decimal Number

Returns the position value latched by the PC840 drive when a falling edge of the
Probe 1 signal has occurred. The position is either in resolver or encoder counts
depending on the feedback device used to close the position loop. This value is
scaled using IDN 79.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: **Probe Value *((IDN 79) / 65536)**

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read Only by the Master.

IDN 132: Probe value 2 positive edge   Parameter Data IDN

                                                            Signed Decimal Number

Returns the position value latched by the PC840 drive when a rising edge of the
Probe 2 signal has occurred. The position is either in resolver or encoder counts
depending on the feedback device used to close the position loop. This value is
scaled using IDN 79.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: **Probe Value *((IDN 79) / 65536)**

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read Only by the Master.

IDN 133: Probe value 2 negative edge   Parameter Data IDN

Signed Decimal Number

Returns the position value latched by the PC840 drive when a falling edge of the Probe 2 signal has occurred. The position is either in resolver or encoder counts depending on the feedback device used to close the position loop. This value is scaled using IDN 79.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	**Probe Value *((IDN 79) / 65536)**
Minimum Value:	2,147,483,647
Maximum Value:	2,147,483,647
Access State:	Read Only by the Master.

IDN 134: Master Control Word   Parameter Data IDN

Unsigned Decimal Number

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65536
Access State:	Read Only by Master.

IDN 135: Drive Status Word   Parameter Data IDN

                                                                   Unsigned Decimal Number

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 65536

Access State: Read Only by Master.

IDN 140: Controller Type   Parameter Data IDN

                                                                   Text Data String

Allows the Master to read a TEXT description of the drive model number (PC843).

Conversion Scaling Factor: 1

Data Length: 1 Byte data - Variable length

IDN 142: Application Type   Parameter Data IDN

                                                                   Text Data String

Allows the Master to read a TEXT description of the Application (Kollmorgen Drive).

Conversion Scaling Factor: 1

Data Length: 1 Byte data - Variable length

IDN 143: SYSTEM Interface Version   Parameter Data IDN

                                                                   Text Data String

Allows the Master to read a TEXT description of the SERCOS specification which the PC840 was designed to : V01.02

Conversion Scaling Factor: 1

Data Length: 1 Byte data - Variable length

IDN 147: Homing parameter   Parameter Data IDN

Binary Data

Defines the HOME parameters used by the PC840.

Bit Number	Bit Setting
Bit 0: Home Direction	0 => Positive/Clockwise Direction 1 => Negative/Counter Clockwise Direction
Bit 1: Position Feedback Marker Pulse	0 => First Marker Pulse after Positive Edge of Home Switch 1 => First Marker Pulse after Negative Edge of Home Switch
Bit 2: Home Switch : Connected to Drive	Must be 1.
Bit 3: Homing : Using Motor Feedback	Must be 0.
Bit 4: Interpretation in the drive : Homing Enable Only	Must be 1.
Bit 5: Evaluation of Home Switch	0 => Home Switch evaluated 1 => Home Switch not evaluated.
Bit 6: Evaluation of Position Feedback Marker Pulse	0 => Marker Pulse evaluated 1 => Marker Pulse not evaluated.

Note: *Only Bits 0, 1, 5 and 6 may be changed by the Master while in phases 2-4. All other bits are Read Only, trying to change them results in a Service Channel error.*

Note: *Writing 0x77 to IDN 147 makes the current motor position the home (zero) position.*

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0x0014

Maximum Value: 0x0077

Access State: Read/Write by Master in phases 2-4.

IDN 148: Drive controlled homing procedure   Command Data IDN

Binary Data

Command Procedure IDN used to initiate a Home event on the PC840. During the Home event, all velocity and position data received from the Master is ignored with the exception of Home Velocity (IDN 41) and Home Acceleration (IDN 42). Once the drive has finished the HOME event, the Position Feedback Value Status will be set (IDN 403). The Master must read the new position at this time and begin sending updated Position Commands prior to finishing this Command IDN to avoid Excessive Position Error Faults.

Note: *To execute homing more than once, reset IDN 148 by writing 0 and then 3.*

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0 (deactivate drive controlled homing)
Maximum Value:	3 (activate drive controlled homing)
Access State:	Read/Write by the Master in phases 2-4.

IDN 159: Monitoring Window   Parameter Data IDN

Unsigned Decimal Number

Sets the Maximum Position Deviation allowed by the PC840.

Conversion Scaling Factor:	16
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65535
Access State:	Read/Write by Master in phases 2-4.

IDN 160: Acceleration data scaling type   Parameter Data IDN

Binary Data

Defines the scaling type for the PC840.

Bit Number	Bit Setting
Bits 0-2	010 : Rotational Scaling
Bit 3	1 : Parameter Scaling
Bit 4	0 : Radian
Bit 5	0 : Seconds
Bit 6	0 : At the motor shaft.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0x0A

Maximum Value: 0x0A

Access State: Read Only by the Master.

IDN 161: Acceleration data scaling factor   Parameter Data IDN

Unsigned Decimal Number

All acceleration data is scaled by the following formula:

(IDN 161)*10^(IDN 162)

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 1

Maximum Value: 65535

Access State: Read/Write by the Master in phases 2-4

IDN 162: Acceleration data scaling exponent   Parameter Data IDN

Signed Decimal Number

All acceleration data is scaled by the following formula:

(IDN 161)*10$^{\wedge}$(IDN 162)

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: -32766

Maximum Value: 32765

Access State: Read/Write by the Master in phases 2-4.

IDN 169: Probe control parameter   Parameter Data IDN

Binary Data

Defines the PROBE parameters used by the PC840.

Bit Number	Bit Setting
Bit 0: Probe 1 Positive Edge	0 => Positive edge is not active. 1 => Positive edge is active.
Bit 1: Probe 1 Negative Edge	0 => Negative edge is not active. 1 => Negative edge is active.
Bit 2: Probe 2 Positive Edge	0 => Positive edge is not active. 1 => Positive edge is active.
Bit 3: Probe 2 Negative Edge	0 => Negative edge is not active. 1 => Negative edge is active.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0x0F

Access State: Read/Write by Master in phases 2-4.

IDN 170: Probing cycle procedure command   Command Data IDN

                                                                        Binary Data

Command Procedure IDN used to initiate PROBE events on the PC840. While this IDN is active, all probe events described in IDN 169, and enabled by IDN 405 and 406 are allowed to be recorded. This command must be activated in order for PROBE events to occur. Please refer to Chapter 3 for additional information.

Note: *To activate probing, write 3 to IDN 170.*

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	3
Access State:	Read/Write by the Master in phases 2-4.

IDN 185:   Parameter Data IDN

Length of the configurable data record in the AT   Unsigned Decimal Number

Maximum number of bytes allowed in the AT as configurable data is 20 bytes.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65535
Access State:	Read Only by the Master.

IDN 186:   Parameter Data IDN

Length of the configurable data record in the MDT   Unsigned Decimal Number

Maximum number of bytes allowed in the MDT as configurable data is 20 bytes.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 65535

Access State: Read Only by the Master.

IDN 187:   Parameter Data IDN

IDN list of the configurable data in the AT   IDN ID Number List

List of IDNs available for entry into the AT configuration list.

IDN	IDN Description
40	Velocity Feedback
51	Position Feedback
84	Torque Feedback
130	Probe Value 1 Positive Edge
131	Probe Value 1 Negative Edge
132	Probe Value 2 Positive Edge
133	Probe Value 2 Negative Edge
189	Following Distance
400	Home Switch
32857	Resolver Position
32878	Digital Command Counts
32879	Digital Command Frequency
34824	Input Port
34825	Analog Input
34826	Encoder Position

IDN 187 continued

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read/Write by Master in phases 2-4.

IDN 188: Parameter Data IDN

IDN list of the configurable data record in the MDT IDN ID Number List

List of IDNs available for entry into the MDT configuration list.

IDN	IDN Description
36	Velocity Command
47	Position Command
80	Torque Command
32880	Analog Output 1
32881	Analog Output 2
34840	Output Port

Conversion Scaling Factor: 1

Data Length: 2 Bytes data - Variable Length

Access State: Read Only by the Master.

IDN 189: Following Distance   Parameter Data IDN

Allows the Master to read the current instantaneous Position Error. This value is scaled by IDN 79.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Following Distance * ((IDN 79) / 65536)

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read Only by the Master.

IDN 192: IDN list of backup operation data   Parameter Data IDN

IDN ID Number List

List of IDNs stored to and from non-volatile memory.

IDN	IDN Description
15	Telegram Type Parameter
32	Primary Operation Mode
41	Homing Velocity
42	Homing Acceleration
55	Position Polarity Parameter
76	Position Data Scaling Type
82	Positive Torque Limit Value
83	Negative Torque Limit Value
100	Velocity Loop Proportional Gain
101	Velocity Loop Integral Action Time
103	Modulo Value
104	Position Loop Kv Factor
106	Current Loop Proportional Gain 1
107	Current Loop Integral Action Time 1

IDN 192 continued List of IDNs stored to and from non-volatile memory.

140	Controller Type
147	Homing Parameter
159	Monitoring Window
32807	Pole Count
32809	Filter Value for ADF0
32810	DM1F0
32811	DM2F0
32812	DM1Gain
32813	DM2Gain
32814	DM1Map - Mux Select
32815	DM2Map - Mux Select
32816	Encoder Output (EncOut)
32817	InpMap1
32818	InpMap2
32819	InpMap3
32820	InpMap4
32821	InpMap5
32822	InpMap6
32823	EncInFilt
32824	RemoteFB
32826	CommOff
32828	Encoder Input (EncIn)
32829	ITThresh
32830	StopTime
32831	VBusThresh

IDN 192 continued List of IDNs stored to and from non-volatile memory.

32832	VelLmtHi
32833	VelLmtLo
32835	CoastTime
32837	Motor 1 Name
32838	Motor 2 Name
32840	Kvff
32841	ARZ0
32842	ARZ1
32843	ARF0
32844	ARF1
32846	Encoder Data Scaling Method
32847	Encoder Modulo Value
32853	CommSrc (Commutation Source)
32866	ADOffset

Conversion Scaling Factor: 1

Data Length: 2 Bytes data

Access State: Read Only by the Master.

IDN 194: Acceleration Command   Parameter Data IDN

Unsigned Decimal Number

Sets the acceleration rate a velocity command is processed at. Acceleration = Deceleration.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	Motor acceleration(RPM/sec) / $[(IDN\ 161)*10\char`\^(IDN\ 162)]$
Minimum Value:	1
Maximum Value:	4,294,967,295
Access State:	Read/Write in phases 2-4.

IDN 263: NVLoad   Command Data IDN

Unsigned Decimal Number

Commmand Procedure IDN used to load saved IDNs from Non-Volatile (NV) memory to the drive's active memory, whenever the drive is powered on or is in phase 0. The master need not write to these IDNs as part of the drive initialization thereby substantially reducing the time required to bring the SERCOS ring to Phase 4.

This function will only be executed if NVSave was executed.

Note: *Writing 0 to NVSave (IDN 263) DISABLES NVLoad.*

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	3
Access State:	Read/Write by the Master in phases 2-4.

IDN 264: NVSave   Command Data IDN

Unsigned Decimal Number

Command Procedure IDN used to copy IDNs to Non-Volatile (NV) memory as defined by IDN 192.

NVSave	Description
0	NVSave function is NOT performed. NVLoad (IDN 263) is DISABLED.
3	Performs NVSave function. NVLoad (IDN 263) is ENABLED.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 3

Access State: Read/Write by the Master in phases 2-4.

IDN 301: Allocation of real-time control bit 1   Parameter Data IDN

Unsigned Decimal Number

The Master sends the number of an IDN whose data is a BIT variable. This BIT variable is then sent in the MDT cyclic Real Time Control Bit 1 data. Please refer to Chapter 3 for additional information.

The IDNs which can be used for Real Time Control bits are:

IDN	IDN Description
405	Probe 1 Enable
406	Probe 2 Enable
34833	Output Bit #1
34834	Output Bit #2
34835	Output Bit #3
34836	Output Bit #4

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0 (Off)

Maximum Value: 34836

Access State: Read/Write by Master in phases 2-4.

IDN 303: Allocation of real-time control bit 2   Parameter Data IDN

Unsigned Decimal Number

The Master sends the number of an IDN whose data is a BIT variable. This BIT variable is then sent in the MDT cyclic Real Time Control Bit 2 data. Please refer to Chapter 3 for additional information.

The IDNs which can be used for Real Time Control bits are:

IDN	IDN Description
405	Probe 1 Enable
406	Probe 2 Enable
34833	Output Bit #1
34834	Output Bit #2
34835	Output Bit #3
34836	Output Bit #4

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0 (Off)

Maximum Value: 34836

Access State: Read/Write by Master in phases 2-4.

IDN 305: Allocation of real-time status bit 1   Parameter Data IDN

Unsigned Decimal Number

The Master sends the number of an IDN whose data is a BIT variable. This BIT variable is then sent in the AT cyclic Real Time Status Bit 1 data. Please refer to Chapter 3 for additional information.

The IDNs which can be used for Real Time Status bits are:

IDN	IDN Description	IDN	IDN Description
400	Home Switch	34817	Input Bit #1
401	Probe 1	34818	Input Bit #2
402	Probe 2	34819	Input Bit #3
403	Position Feedback Value Status	34820	Input Bit #4
409	Probe 1 Positive Latched	34821	Input Bit #5
410	Probe 1 Negative Latched	34822	Input Bit #6
411	Probe 2 Positive Latched		
412	Probe 2 Negative Latched		

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0 (Off)

Maximum Value: 34822

Access State: Read/Write by Master in phases 2-4.

IDN 307: Allocation of real-time status bit 2 Parameter Data IDN

Unsigned Decimal Number

The Master sends the number of an IDN whose data is a BIT variable. This BIT variable is then sent in the AT cyclic Real Time Status Bit 2 data. Please refer to Chapter 3 for additional information.

The IDNs which can be used for Real Time Status bits are:

IDN	IDN Description	IDN	IDN Description
400	Home Switch	34817	Input Bit #1
401	Probe 1	34818	Input Bit #2
402	Probe 2	34819	Input Bit #3
403	Position Feedback Value Status	34820	Input Bit #4
409	Probe 1 Positive Latched	34821	Input Bit #5
410	Probe 1 Negative Latched	34822	Input Bit #6
411	Probe 2 Positive Latched		
412	Probe 2 Negative Latched		

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0 (Off)

Maximum Value: 34822

Access State: Read/Write by Master in phases 2-4.

IDN 400: Home Switch   Parameter Data IDN

                                                            Binary Data

Allows the Master to read the current state of the Home Switch. If more than one input is defined to be the Home Switch, the highest Input (1-6) is the value returned.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 401: Probe 1   Parameter Data IDN

                                                            Binary Data

Allows the Master to read the current state of the Probe 1 switch. The only Input pin which can be defined as Probe 1 is Input 4.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 402: Probe 2 Parameter Data IDN

Binary Data

Allows the Master to read the current state of the Probe 2 switch. The only input pin which can be defined as Probe 2 is Input 5.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 403: Position feedback value status Parameter Data IDN

Binary Data

This bit is set by the PC840 whenever a Home has been successfully completed.

This bit starts off CLEARED upon initialization.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 405: Probe 1 enable Parameter Data IDN

<div style="text-align:right">Binary Data</div>

This bit must be set by the Master (either by Cyclic or Service Channel) in order for Probe 1 Data to be latched. IDN 169 must specify the valid Probe edges to latch and IDN 170 must also be active for Probe 1 data to be latched. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read/Write by Master.

IDN 406: Probe 2 enable Parameter Data IDN

<div style="text-align:right">Binary Data</div>

This bit must be set by the Master (either by Cyclic or Service Channel) in order for Probe 2 Data to be latched. IDN 169 must specify the valid Probe edges to latch and IDN 170 must also be active for Probe 2 data to be latched. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read/Write by Master.

IDN 409: Probe 1 positive latched   Parameter Data IDN

Binary Data

This bit is used to indicate that Probe 1 Positive Edge data has been latched by the PC840. Reading IDN 130 will return the Probe data for this event. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 410: Probe 1 negative latched   Parameter Data IDN

Binary Data

This bit is used to indicate that Probe 1 Negative Edge data has been latched by the PC840. Reading IDN 131 will return the Probe data for this event. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 411: Probe 2 positive latched   Parameter Data IDN

Binary Data

This bit is used to indicate that Probe 2 Positive Edge data has been latched by
the PC840. Reading IDN 132 will return the Probe data for this event. Please
refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 412: Probe 2 negative latched   Parameter Data IDN

Binary Data

This bit is used to indicate that Probe 2 Positive Edge data has been latched by the
PC840. Reading IDN 133 will return the Probe data for this event. Please refer to
Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

5.2 Manufacturer Specific Parameters

IDN 32800: DSP Debug Address   Parameter Data IDN

Binary Data

Used for Manufacturer Investigations. Master would write an address to access into this IDN.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	0xFFFF
Access State:	Read/Write by the Master.

IDN 32801: DSP Debug Word   Parameter Data IDN

Binary Data

Used for Manufacturer Investigations. Reading this IDN causes the WORD data located in the address specified in IDN 32800 to be read.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	0xFFFF
Access State:	Read Only by the Master.

IDN 32802: DSP Debug DWord Parameter Data IDN

<div style="text-align:right">Binary Data</div>

Used for Manufacturer Investigations. Reading the IDN causes the DWORD data located in the address specified in IDN 32800 to be read.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Minimum Value: 0

Maximum Value: 0x0FFFFFFF

Access State: Read Only by the Master.

IDN 32803 - 32806: ARM Debug Variables Parameter Data IDN

<div style="text-align:right">Binary Data</div>

Used for Manufacturer Investigations. **DO NOT USE**.

IDN 32807: Pole Count Parameter Data IDN

<div style="text-align:right">Unsigned Decimal Number</div>

Number of motor poles used for motor commutation. For encoder based commutation:

$$\text{Polecount} = \frac{\text{Encoder counts / rev}}{\left(\text{motor poles / 2}\right)}$$

Note: *IDN 32853 (CommSrc) must be set BEFORE IDN 32807. Please refer to Chapter 6 for additional information.*

Conversion Scaling Factor: 1

Data Length: 2 bytes

Units: motor poles

Minimum Value: 2

Maximum Value: 32766

Access State: Read/Write by the Master in phase 2.
Read/Write in phases 3 and 4.

IDN 32809: Filter Value for ADF0   Parameter Data IDN

                                                    Unsigned Decimal Number

Sets the filter break frequency for the Analog Input. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Units: Hz

Minimum Value: 1

Maximum Value: 4.17e9

Access State: Read/Write by the Master.

IDN 32810: DM1F0   Parameter Data IDN

                                                    Unsigned Decimal Number

Sets the filter break frequency for DacMonitor 1. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Units: Hz

Minimum Value: 1

Maximum Value: 4.17e9

Access State: Read/Write by the Master.

IDN 32811: DM2F0   Parameter Data IDN

                                            Unsigned Decimal Number

Sets the filter break frequency for DacMonitor 2. Please refer to Chapter 3 for
additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Units: Hz

Minimum Value: 1

Maximum Value: 4,294,967,295

Access State: Read/Write by the Master.

IDN 32812: DM1Gain   Parameter Data IDN

                                            Signed Decimal Number

Sets the analog output gain for DacMap 1. Scale factor depends on the setting of
DacMap 1. Refer to Dac Monitor Map and Gain Units List. Please refer to
Chapter 3 for additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read/Write by the Master.

IDN 32813: DM2Gain   Parameter Data IDN

                                                          Signed Decimal Number

Sets the analog output gain for DacMap 2. Scale factor depends on the setting of
DacMap 2. Refer to Dac Monitor Map and Gain Units List. Please refer to
Chapter 3 for additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read/Write by the Master.

IDN 32814: DM1Map -Mux Select   Parameter Data IDN

                                                          Unsigned Decimal Number

Refer to Dac Monitor Map and Gain Units List. Use the DMxMAP column for
the desired function. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 75

Access State: Read/Write by the Master.

IDN 32815: DM2Map -Mux Select   Parameter Data IDN

Unsigned Decimal Number

Refer to Dac Monitor Map and Gain Units List. Use the DMxMAP column for the desired function. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	75
Access State:	Read/Write by the Master.

IDN 32816: EncOut   Parameter Data IDN

Unsigned Decimal Number

Sets the line count of the emulated encoder. Writing 0 to this IDN internally connects the EncIn input pins to the EncOut output buffers.

125, 250, 500, 1000, 2000, 4000, 8000, 16000 lines/rev

128, 256, 512, 1024, 2048, 4096, 8192, 16384 lines/rev

Note: *The number of encoder counts per revolution is equal to 4 * encoder line count.*

Conversion Scaling Factor:	1
Data Length:	4 bytes
Units:	Emulated encoder count
Minimum Value:	0
Maximum Value:	16384
Access State:	Read/Write by the Master.

IDN 32817: InpMap1   Parameter Data IDN

                                                        Binary Data

Refer to Input Map List, Function Number Column for the desired function.

Set High/Low Polarity bits as required. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0xFFFF

Access State: Read/Write by the Master.

IDN 32818: InpMap2   Parameter Data IDN

                                                        Binary Data

Refer to Input Map List, Function Number Column for the desired function.

Set High/Low Polarity bits as required. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0xFFFF

Access State: Read/Write by the Master.

IDN 32819: InpMap3   Parameter Data IDN

Binary Data

Refer to Input Map List, Function Number Column for the desired function.

Set High/Low Polarity bits as required. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0xFFFF

Access State: Read/Write by the Master.

IDN 32820: InpMap4   Parameter Data IDN

Binary Data

Refer to Input Map List, Function Number Column for the desired function.

Set High/Low Polarity bits as required. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0xFFFF

Access State: Read/Write by the Master.

IDN 32821: InpMap5   Parameter Data IDN

Binary Data

Refer to Input Map List, Function Number Column for the desired function.

Set High/Low Polarity bits as required. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0xFFFF

Access State: Read/Write by the Master.

IDN 32822: InpMap6   Parameter Data IDN

Binary Data

Refer to Input Map List, Function Number Column for the desired function.

Set High/Low Polarity bits as required. Please refer to Chapter 3 for additional information.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0xFFFF

Access State: Read/Write by the Master.

IDN 32823: EncInFilt Parameter Data IDN

Unsigned Decimal Number

Sets the break frequency of the input filters on the Encoder Input pins.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Hz

Minimum Value: 50,000

Maximum Value: 16,000,000

Access State: Read/Write by Master.

EncMode	Scaling	Encoder Input Filter Setting			
		High	**Medium**	**Low**	**Lowest**
(0) Quadrature	Max Quadrature Freq.	1600000	800000	400000	200000
(1) StepDir	Max Step Freq	800000	200000	100000	50000
(2) Up/Down	Max Step Freq	800000	200000	100000	50000
(3) Hold Count	N/A	N/A	N/A	N/A	N/A

IDN 32824: RemoteFB　　　　　　　　　　　　　　　Parameter Data IDN

Unsigned Decimal Number

Determines the source of Velocity and Position Feedback.

Conversion Scaling Factor:　　　1

Data Length:　　　4 bytes

Minimum Value:　　　0

Maximum Value:　　　2

Access State:　　　Read/Write by Master in Phase 2.

RemoteFB	Velocity Feedback	Position Feedback
0	Resolver	Resolver
1	Resolver	Encoder
2	Encoder	Encoder

IDN 32826: CommOff　　　　　　　　　　　　　　　Parameter Data IDN

Signed Decimal Number

Allows the commutation offset to be set. For Kollmorgen motors this should be zero. For custom motors, this should be set for proper commutation.

Note: *Negative numbers will be returned as the positive equivalent angle (modulo 360).*

Conversion Scaling Factor:　　　0.001

Data Length:　　　4 bytes

Units:　　　Electrical degrees

Minimum Value:　　　-360,000

Maximum Value:　　　360,000

Access State:　　　Read/Write by Master.

IDN 32828: EncIn   Parameter Data IDN

Unsigned Decimal Number

Allows the line count of input encoder to be defined. Must be set when RemoteFB (IDN 32824) = 1 or 2.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Encoder line count

Minimum Value: 1

Maximum Value: 65535

Access State: Read/Write in phase 2
                                    Read Only in phases 3 and 4.

IDN 32829: ITThresh   Parameter Data IDN

Unsigned Decimal Number

Allows the fault threshold for the IT Fault to be adjusted.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: percent

Minimum Value: 0

Maximum Value: 100

Access State: Read/Write by Master.

Kollmorgen Model Family	**Minimum Value**	**Maximum Value**
84X	0	60

IDN 32830: StopTime   Parameter Data IDN

                                                  Unsigned Decimal Number

The StopTime variable is associated with the RunStop I/O Function. It determines
the maximum time after RunStop transitions to Stop that it will take the drive to
disable. This IDN corresponds to an obsolete function. Do not use.

Conversion Scaling Factor: 0.001

Data Length: 2 bytes

Units: seconds

Minimum Value: 2

Maximum Value: 32,000

Access State: Read/Write by Master.

IDN 32831: VBusThresh   Parameter Data IDN

                                                  Signed Decimal Number

Allows the Bus Undervoltage threshold to be set. If set to a negative number, turns
off the bus undervoltage fault.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Units: Volts

Minimum Value: -1

Maximum Value: 1,000

Access State: Read/Write by Master.

IDN 32832: VelLmtHi   Parameter Data IDN

                                                    Signed Decimal Number

Minimum value allowed for the velocity command into the velocity block. Also
sets the overspeed fault threshold if $|VelLmtHi|\rangle|VelLmtLo|$.

Overspeed fault set at $1.5 * \left(\max of \left(|VelLmtHi|, |VelLmtLo|\right)\right)$

Conversion Scaling Factor: 0.001

Data Length: 4 bytes

Units: RPM

Minimum Value: -21,039,000

Maximum Value: 21,039,000

Access State: Read/Write by Master.

IDN 32833: VelLmtLo   Parameter Data IDN

                                                    Signed Decimal Number

Minimum value allowed for the velocity command into the velocity block. Also
sets the overspeed fault threshold if $|VelLmtHi|\rangle|VelLmtLo|$.

Overspeed fault set at $1.5 * \left(\max of \left(|VelLmtHi|, |VelLmtLo|\right)\right)$.

Conversion Scaling Factor: 0.001

Data Length: 4 bytes

Units: RPM

Minimum Value: -21,039,000

Maximum Value: 21,039,000

Access State: Read/Write by Master.

IDN 32835: CoastTime   Parameter Data IDN

                                                    Unsigned Decimal Number

Allows the amount of time the drive will coast for after the bus voltage drops below
VBusThresh before generating undervoltage fault.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	seconds
Minimum Value:	0
Maximum Value:	32
Access State:	Read/Write by Master.

IDN 32836: CommEnbl   Parameter Data IDN

                                                    Unsigned Decimal Number

Enables commutation of the motor current based on rotor position. When the
drive powers up CommEnbl is set to 1. When CommEnbl is set to 0, the
commutation angle of the current flowing in the motor windings is determined by
the value of CommOff. When CommEnbl is set to 1, the commutation angle is
determined by the sum of CommSrc feedback device electrical angle and the
CommOff variable.

Conversion Scaling Factor:	1
Data Length:	4 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read/Write by Master.

IDN 32837: Motor 1 Name   Parameter Data IDN

                                                     Binary Data

The Motor variable is a 32-bit long unsigned long integer which is used to identify the waveshape downloaded to the PC840 controller. By convention the 4 ASCII character abbreviation of the motor name is converted to an integer and downloaded along with the waveshape. For example, if this variable is 0x53494E45 = 'S' (0x53) : 'I' (0x49) : 'N' (0x4E) : 'E' (0x45).

Used to assign a label to Wave Shape Generation Table created

Conversion Scaling Factor: 1

Data Length: 4 bytes

Minimum Value: 0

Maximum Value: 0xFFFFFFFF

Access State: Read/Write in Phase 2.
                                   Read Only in Phase 3 and 4.

IDN 32838: Motor 2 Name   Parameter Data IDN

                                                     Binary Data

The Motor variable is a 32-bit long unsigned long integer which is used to identify the waveshape downloaded to the PC840 controller. By convention the 4 ASCII character abbreviation of the motor name is converted to an integer and downloaded along with the waveshape.

Used to assign a label to Wave Shape Generation Table created

Conversion Scaling Factor: 1

Data Length: 4 bytes

Minimum Value: 0

Maximum Value: 0xFFFFFFFF

Access State: Read/Write in Phase 2.
                                   Read Only in Phase 3 and 4.

IDN 32840: Kvff   Parameter Data IDN

Unsigned Decimal Number

Allows following error to be reduced when running at a constant speed. When the drive is commanded to run at a constant speed, kvff = 1000 will reduce the steady state following error to zero, but will cause overshoot. A value of 700 is typically used.

Conversion Scaling Factor: 0.1

Data Length: 2 bytes

Units: percent

Minimum Value: 0

Maximum Value: 1,999

Access State: Read/Write by the Master.

IDN 32841: ARZ0   Parameter Data IDN

Unsigned Decimal Number

ARZ0 is the first velocity loop compensation zero. Please refer to Chapter 4 for additional information.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Hz

Minimum Value: 20

Maximum Value: 100,000

Access State: Read/Write by the Master.

IDN 32842: ARZ1   Parameter Data IDN

Unsigned Decimal Number

ARZ0 is the second velocity loop compensation zero. Please refer to Chapter 4 for additional information.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Hz

Minimum Value: 20

Maximum Value: 1,000,000

Access State: Read/Write by the Master.

IDN 32843: ARF0   Parameter Data IDN

Signed Decimal Number

ARF0 is the first velocity loop compensation anti-resonance low-pass filter corner frequency. Please refer to Chapter 4 for additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Units: Hz

Minimum Value: -10,000,000

Maximum Value: 10,000,000

Access State: Read/Write by the Master.

IDN 32844: ARF1   Parameter Data IDN

                                                  Signed Decimal Number

ARF1 is the second velocity loop compensation anti-resonance low-pass filter corner frequency. Please refer to Chapter 4 for additional information.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Units: Hz

Minimum Value: -10,000,000

Maximum Value: 10,000,000

Access State: Read/Write by the Master.

IDN 32845: Firmware Version   Parameter Data IDN

                                                                  Text

Allows the Master to read a TEXT description of the current versions fo the ARM and the DSP firmware: DSP Version 1.20, ARM version 6.0.

Note: *DSP and ARM versions continue to change with each build.*

Conversion Scaling Factor: 1

Data Length: Byte list

Access State: Read Only by the Master.

IDN 32846: Encoder Data Scaling Method   Parameter Data IDN

                                                              Binary Data

Sets the working parameters for the Encoder Position.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0x0A

Maximum Value: 0x18A

Access State: Read/Write in phase 2.
                                    Read Only in Phases 3 and 4.

Bit Number	Bit Setting (1 = Inverted, 0 = Non-Inverted)
Bits 0-2	010 : Rotational Scaling.
Bit 3	1 : Parameter Scaling
Bit 4	0 : Degrees
Bit 5	0 : Reserved
Bit 6	0 : At the Motor Shaft
Bit 7	0 : Absolute format 1 : Modulo format (IDN 32847)
Bit 8	0 : Non-Inverted Encoder Data 1 : Inverted Encoder Data

IDN 32847: Encoder Modulo Value   Parameter Data IDN

                                                       Unsigned Decimal Number

Allows the master to set the Encoder Modulo value (IDN 32846).

Conversion Scaling Factor: 1

Data Length: 4 bytes

Minimum Value: 10

Maximum Value: 2,147,483,647

Access State: Read/Write in phase 2.
                                  Read Only in Phases 3 and 4.

IDN 32853 : CommSrc   Parameter Data IDN

                                                       Unsigned Decimal

Selects between resolver, incremental encoder, or hall encoder feedback for motor commutation.

Note: *CommSrc (IDN 32853) must be set BEFORE PoleCount (IDN 32807).*

Conversion Scaling Factor: 1

Data Length: 4 Bytes

Minimum Value: 0

Maximum Value: 2

Access State: Read/Write in all phases.

CommSrc	Feedback Device
0	Resolver
1	Encoder
2	Hall Encoder

IDN 32857: Resolver Position   Parameter Data IDN

                                        Unsigned Decimal Number

ResPos returns the absolute resolver position within one revolution. The PC840 has 65536 resolver counts per revolution. This IDN will, therefore, return a value between 0 and 65535. This IDN is NOT affected by Position Modulo (IDN 103).

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	65535
Access State:	Read/Write by the Master in phases 2-4.

IDN 32858: Last Fault   Parameter Data IDN

                                        Signed Decimal Number

Returns the last fault occurred in the drive. The value of this IDN is NOT cleared by a fault reset command. A user can clear Last Fault by explicity writing 0 to this IDN. See IDN 129 for description of faultcodes.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	22
Access State:	Read Only by the Master in phases 2-4.

IDN 32859: Last ExtFault   Parameter Data IDN

                                                                Signed Decimal Number

Returns the last extended fault occurred in the drive. The value of this IDN is
NOT cleared by a fault reset command. A user can clear Last ExtFault by explicity
writing 0 to this IDN. See IDN 129 for description of extended faultcodes.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 69

Access State: Read Only by the Master in phases 2-4.

IDN 32866: ADOffset   Parameter Data IDN

                                                                Signed Decimal Number

Adjusts the steady-state value of the analog command input.

Conversion Scaling Factor: 10,00

Data Length: 4 bytes

Units: volts

Minimum Value: -150,000

Maximum Value: 150,000

Access State: Read/Write by Master.

IDN 32870: I2tThresh   Parameter Data IDN

Unsigned Decimal Number

Allows I^2*t motor protection threshold value. If I2tFilt exceeds I2tThresh, the
drive will fault.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Units: % of Ipeak^2

Minimum Value: 0

Maximum Value: 100

Access State: Read/Write by Master.

IDN 32871: I2tF0   Parameter Data IDN

Unsigned Decimal Number

I2tF0 sets the low pass filter break frequency for the filter used to implement the
I^2*t motor drive thermal protection.

I2tF0 and I2tThresh set the thermal protection for the motor. See IDN 32872
(I2tFilt). If I2tFilt exceeds I2tThresh, the drive will fault.

Conversion Scaling Factor: 0.001

Data Length: 2 bytes

Units: Hertz

Minimum Value: 1

Maximum Value: 1,000

Access State: Read/Write by Master.

IDN 32872: I2tFilt   Parameter Data IDN

                                                    Unsigned Decimal Number

I2tFilt is the filtered value of the square of the currents flowing in the motor:

I2tFilt = $[(IU^2 + IV^2 + IW^2)* 100/Ipeak^2]$ low pass filtered by I2tF0 (IDN 32871).

When I2tFilt exceeds the threshold value specified by I2tThresh, the drive will fault.

Conversion Scaling Factor:	0.001
Data Length:	4 bytes
Units:	% of $Ipeak^2$
Minimum Value:	0
Maximum Value:	100,000
Access State:	Read Only by Master.

IDN 32875: HallState   Parameter Data IDN

                                                    Unsigned Decimal Number

HallState indicates the value of the hall sensors.
HallState = (4*Hall 3) + (2*Hall 2) + (1*Hall 1)

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	7
Access State:	Read Only by Master.

IDN 32876: Offset Angle for Hall Sensors

Parameter Data IDN

Unsigned Decimal Number

HallOffset sets the offset angle for the hall sensors. Hall signals are to be wired as shown in the Kollmorgen High Performance Servo Drives Catalog. By default it's value is set to 0 degrees.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	electrical degrees
Minimum Value:	0
Maximum Value:	360
Access State:	Read/Write by Master.

IDN 32878: Digital Command Counts

Parameter Data IDN

Signed Decimal Number

DigitalCmd indicates the position of the external command encoder (J2-17 through J2-20) or the accumulation of step inputs if step-and-direction input format is used. By default it's value is set = 0.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Units:	Encoder counts
Minimum Value:	-65536
Maximum Value:	65535
Access State:	Read by Master in all phases.

IDN 32879: Digital Command Frequency   Parameter Data IDN

                                                            Signed Decimal Number

DigitalCmdFreq indicates the frequency of the digital command signal. Is is
calculated from delta DigitalCmd at position loop update rate. Although the values
returned do not have fractional parts this variable is communicated as a floating
point quantity. By default it's value is set = 0.

Conversion Scaling Factor: 0.01

Data Length: 4 bytes

Units: Hz

Minimum Value: -300,000,000

Maximum Value: 300,000,000

Access State: Read by Master in all phases.

IDN 32880: AnalogOut1   Parameter Data IDN

                                                            Signed Decimal Number

Allows the Master to set the voltage on Analog Output 1 when DacMap 1 equals
zero. The scaling for this IDN is 5/128 Volts per least significant bit (lsb).

Conversion Scaling Factor: 0.001

Data Length: 2 bytes

Units: Volts

Minimum Value: -5,000

Maximum Value: 4,961

Access State: Read/Write by the Master.

IDN 32881: AnalogOut2   Parameter Data IDN

                                                    Signed Decimal Number

Allows the Master to set the voltage on Analog Output 2 when DacMap 2 equals
zero. The scaling for this IDN is 5/128 Volts per least significant bit (lsb).

Conversion Scaling Factor:	0.001
Data Length:	2 bytes
Units:	Volts
Minimum Value:	-5,000
Maximum Value:	4,961
Access State:	Read/Write by the Master.

IDN 32882: Analog Current Limit   Parameter Data IDN

                                                    Unsigned Decimal Number

Allows the Master the current limit set (float value) by the Analog Current Limit
input (J2-6)

Conversion Scaling Factor:	0.01
Data Length:	2 bytes
Units:	% of Ipeak
Min:	0
Max:	10,000
Access State:	Read only by the Master

IDN 32883: Analog Current Limit Gain   Parameter Data IDN

Unsigned Decimal Number

AnalogILmtGain allows the Master to set the scale factor (float value) for the
Analog Current Limit Input (J2-6).

Conversion Scaling Factor:	0.001
Data Length:	4 bytes
Units:	% of Ipeak/Volt
Min:	0
Max:	5,000,000
Access State:	Read/Write by the Master

IDN 32884: Analog Current Limit Filter   Parameter Data IDN

Unsigned Decimal Number

AnalogILmtFilt allows the Master to set the low-pass filter break frequency (float
value) on the Analog Current Limit Input (J2-6).

Conversion Scaling Factor:	0.01
Data Length:	4 bytes
Units:	Hertz
Min:	0
Max:	100,000,000
Access State:	Read/Write by the Master

IDN 32885: Current Limit Offset Voltage   Parameter Data IDN

Signed Decimal Number

AnalogILmtOffset allows the Master to set the offset (in volts) that is added to the
Analog Current Limit Input (J2-6).

Conversion Scaling Factor:	0.001
Data Length:	2 bytes
Units:	Volts
Min:	-10,000
Max:	+10,000
Access State:	Read/Write by the Master

IDN 32886: Actual Positive Current Limit   Parameter Data IDN

Unsigned Decimal Number

AnalogILmtPlus allows the Master to display the actual positive current limit float
value used by the drive.

Conversion Scaling Factor:	0.01
Data Length:	2 bytes
Units:	% of peak current rating of drive
Min:	0
Max:	10,000
Access State:	Read only by the Master

IDN 32887: Actual Negative Current Limit   Parameter Data IDN

Unsigned Decimal Number

AnalogILmtMinus allows the Master to display the actual negative current limit
(float value) used by the drive.

Conversion Scaling Factor:	0.01
Data Length:	2 bytes
Units:	% of peak current rating of drive
Min:	0
Max:	10,000
Access State:	Read only by the Master

IDN 34817: Input Bit #1   Parameter Data IDN

Binary Data

Allows the Master to read the value of the Input Bit 1 located on J2-31
Note: *User must supply Input Power to have Input Circuitry to operate*.

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read Only by the Master.

IDN 34818: Input Bit #2   Parameter Data IDN

Binary Data

Allows the Master to read the value of the Input Bit 2 located on J2-32.
Note: *User must supply Input Power to have Input Circuitry to operate*.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 34819: Input Bit #3   Parameter Data IDN

Binary Data

Allows the Master to read the value of the Input Bit 3 located on J2-33 .
Note: *User must supply Input Power to have Input Circuitry to operate*.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 34820: Input Bit #4   Parameter Data IDN

Binary Data

Allows the Master to read the value of the Input Bit 4 located on J2-34.
Note: *User must supply Input Power to have Input Circuitry to operate*.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 34821: Input Bit #5   Parameter Data IDN

Binary Data

Allows the Master to read the value of the Input Bit 5 located on J2-35.
Note: *User must supply Input Power to have Input Circuitry to operate*.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 34822: Input Bit #6   Parameter Data IDN

Binary Data

Allows the Master to read the value of the Input Bit 6 located on J2-36.
Note: *User must supply Input Power to have Input Circuitry to operate*.

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read Only by the Master.

IDN 34824: Input Port

Allows the Master to read the entire Input Port. The data returned is in the following format:

Bit Number	Description	Bit Number	Description
Bit 0	Input Bit 1	Bit 4	Input Bit 5
Bit 1	Input Bit 2	Bit 5	Input Bit 6
Bit 2	Input Bit 3	Bits 8-15	undefined
Bit 3	Input Bit 4		

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0x003F

Access State: Read Only by the Master.

IDN 34825: AnalogIn   Parameter Data IDN

Signed Decimal Number

Allows the master to read the Analog Input on the base unit. Refer to the scaling factor document for the correct Analog Input Scaling.

Conversion Scaling Factor: 0.001

Data Length: 4 bytes

Units: Volts

Minimum Value: -13,500

Maximum Value: 13,500

Access State: Read Only by the Master.

IDN 34826: EncPos   Parameter Data IDN

                                                 Signed Decimal Number

Accumulated Encoder Position.

Conversion Scaling Factor: 1

Data Length: 4 bytes

Units: Encoder counts

Minimum Value: -2,147,483,647

Maximum Value: 2,147,483,647

Access State: Read Only by the Master.

IDN 34833: Output Bit #1   Parameter Data IDN

                                                          Binary Data

Allows the Master to write the value to Output Bit 1 located on J2-42.
Note: *User must supply Output Power to have Output Circuitry to operate.*

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 1

Access State: Read/Write by the Master.

IDN 34834: Output Bit #2   Parameter Data IDN

Binary Data

Allows the Master to write the value to Output Bit 2 located on J2-43.
Note: *User must supply Output Power to have Output Circuitry to operate.*

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read/Write by the Master.

IDN 34835: Output Bit #3   Parameter Data IDN

Binary Data

Allows the Master to write the value to Output Bit 3 located on J2-44.
Note: *User must supply Output Power to have Output Circuitry to operate.*

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read/Write by the Master.

IDN 34836: Output Bit #4   Parameter Data IDN

Binary Data

Allows the Master to write the value to Output Bit 4 located on J2-25.
Note: *User may use Out4 for relay signal. See Section 2 for additonal information.*

Conversion Scaling Factor:	1
Data Length:	2 bytes
Minimum Value:	0
Maximum Value:	1
Access State:	Read/Write by the Master.

IDN 34840: PC840 Output Byte   Parameter Data IDN

Binary Data

Allows the Master to read/write the entire Output Port. The data is in the following format:

Bit Number	Description
Bit 0	Output Bit 1
Bit 1	Output Bit 2
Bit 2	Output Bit 3
Bit 3	Output Bit 4
Bits 4 - 15	undefined

Conversion Scaling Factor: 1

Data Length: 2 bytes

Minimum Value: 0

Maximum Value: 0x000F

Access State: Read/Write by the Master.

6 Diagnostics and Protection Circuits

Introduction   The drive is fully protected against "normal" abuse and has a seven segment LED on the front panel to indicate SERCOS ring or drive status. The servo drive has the following specific protections:

- Output motor short circuit protection line-to-line and line-to-neutral.

- Interface to Kollmorgen's standard motor PTC or a normally closed thermostat to sense motor over temperature.

- Internal monitoring of the power stage heat sink temperature for drive over temperature.

- Bus over voltage detection.

- Bus under voltage fault with adjustable threshold.

- Incorporating the measured heat sink temperature there is an excessive current I*t fault. This fault limits the peak current time and intelligently changes the continuous current fault trip dependent on the measured heat sink temperature to limit the continuous output current.

- Control voltage under voltage detection.

- The user +5V output is short circuit to I/O RTN protected.

- The user +24V output is short circuit protected.

- All control outputs are short circuit to I/O RTN protected.

- When a drive is powered up without valid parameters the power stage cannot be enabled and no damage occurs to the drive.

Fault generation   The following sequence will occur when the protection circuits generate a fault. The fault source is latched, the output stage is disabled, the Fault mappable output function is activated, and the LED indicates the appropriate fault code. Faults are cleared by activating the Fault Reset input or by turning the AC power OFF and then ON again.

FaultCode List   The following table lists the PC840 fault codes.

FaultCode	Fault Description
1	Velocity feedback (VelFB) over speed*
2	Motor over temperature
3	User +5V low
4	Continuous current fault
5	Drive over current (instantaneous)
6	Control ±12 V under voltage
7	Not Assigned
9	Bus over voltage detected by DSP, External Regen Fault
10	Not Assigned
11	Bus under voltage* (Only if VBus < VBusThresh)
12	Ambient temperature too low
13	Encoder alignment failed*
14	Software and non-volatile memory versions not compatible
15	Hardware not compatible with software version
16	UnConfigured drive fault
17	Two AInNull events too close together
18	Position following error fault
19	Parameter memory error*
20	Initialization fault*
21	Drive over temperature
22	Resolver Fault

*To further identify this fault see software variable ExtFault.

ExtFault   The following table lists the values for ExtFault.

ExtFault	ExtFault Description
1	Absolute Resolver Overspeed. $\|VelFB\| > 21038$ RPM
2	Variable Resolver Overspeed. $\|VelFB\| > \max(VelLmtxx)*1.5$
3	Calibration data corrupted*
4	Excessive dc offset in current feedback sensor*
5	DSP incompletely reset by line power dip*
8	Excessive dc offset in Analog Command A/D*
9	Not Assigned
10	DSP stack overflow*
12	Software and control card ASIC incompatible*
13	Actual Model not same as stored in NV memory*
14	Unable to determine power stage*
15	Drive non-volatile parameters corrupt*
16	RAM failure*
17	Calibration RAM failure*
18	Encoder alignment: no motion fault
19	Encoder alignment: excessive motion fault
20	Encoder alignment: motor not settled
21	Encoder alignment: test failed
22	Encoder alignment: motion overflow fault
23	Hall Commutation: invalid configuration
24	Hall Commutation: overspeed
25	Hall Commutation: invalid hall state
26	Hall Commutation: invalid hall transition
27	I*t Drive
28	I^2*t Motor

ExtFault (cont')d

ExtFault	ExtFault Description
29	DP RAM Test A *
30	DP RAM Test 5 *
31	DP RAM Test Run 1*
32	DP RAM Test Run 0 *
33	DP RAM Test C *
65	Data Read Only
66	Data Bounds Error
67	Execute no such command
68	RT not Implemented
69	FC not Implemented

*These fault states CANNOT be reset with the Fault Reset function and require the line control power to be turned OFF and ON again.

6.1 Troubleshooting

Introduction   A table of faults and their possible causes is listed below.

FaultCode	Possible Cause
1	Loose or open circuit wiring to the resolver feedback connector J3.
	Actual motor speed exceeded 1.5 * (Max Of |VelLmtLo| or |VelLmtHi|) or 21,038 RPM which is the over speed trip level.
	For Encoder velocity feedback (RemoteFB = 2) check that EncIn is set properly.
2	Loose or open circuit wiring to motor PTC thermal sensor (J3-8, J3-9).
	High ambient temperature at motor.
	Insufficient motor heat sinking from motor mounting.
	Operating above the motor's continuous current rating.
3	Short circuited wiring on the output (J2-25).
4	Mechanically jammed motor.
	Motion profile accelerations too high.
	Machine load on the motor increased by a friction.
	Problem with wiring between drive and motor yielding improper motion.
	Drive and/or motor under sized for application.
	Note: *See HSTemp, ItFilt, and ItF0 for information on measuring thermal margin in an application.*

Fault Codes

FaultCode	Possible Cause
5	Motor power wiring (TB1-4, 5, or 6) short circuit line-to-ground/neutral.
	Motor power cable length is enough longer than the data sheet specification to cause excessive motor line to earth ground/neutral capacitance.
	Internal motor winding short circuit.
	Insufficient motor inductance causing output over current faults.
	KIP or KII improperly set causing excessive output current overshoots.
6	Insufficient control AC voltage on TB1-1 to TB1-2.
	External short on signal connector.
	Internal drive failure.
7	Not Assigned.
9	Disconnected external regeneration resistor on TB1.
	External regeneration resistor ohmage too large yielding Bus OverVoltage fault.
	External regeneration resistor short circuit.
	Motor AC power input voltage too high.
10	Not Assigned.
11	Check the measured bus voltage VBus and the fault threshold VBusThresh to make sure they are consistent.
12	Ambient temperature is below drive specification. Drive's internal temperature sensor has a wiring problem.
13	Encoder Alignment failure. See ExtFault for additional information.
14	Not Assigned.

Fault Codes

FaultCode	Possible Cause
15	Attempt to upgrade the drive's software will not work. Contact factory for upgrade details.
	Resolver wiring error. Remove J2 and J3 connectors. Turn AC power OFF and then ON again. If FaultCode = 2, then correct resolver excitation wiring.
	Internal failure. Return to factory for repair.
16	Unconfigured drive (Red and Green LEDs blinking after power up) was fully configured with the drive motor power enable active. This fault can be reset or the control AC power turned OFF and then ON again to get the drive-motor operating.
17	The AInNull function was re-activated too soon after going inactive. This can be caused by switch bounce on the input pin mapped to activate AInNull.
18	The motor is either stalled or partially jammed.
	The value for PosErrorMax is set too sensitive for the loop tuning and commanded motion profiles.
19	Glitch while last saving the NV parameters. Corrupted NV memory contents. Hardware problem with the NV memory. Re-Download parameters to restore drive operation.
20	Initialization Failure. See ExtFault for additional information.
21	High drive ambient temperature. Restriction of cooling air due to insufficient space around unit.
	Operating above the drive's continuous current rating.
	Note: *See HSTemp, ItFilt, and ItF0 for information on measuring thermal margin in an application.*
22	Resolver signal is lost or intermittent. Check resolver cable.

6.2 Motor Commutation

IDN 32807   Number of motor magnetic poles (Polecount), which is the same as twice the number of motor electrical cycles per mechanical revolution. This IDN should be set so that:

For resolver based commutation (IDN 32853 = 0):

IDN 32807 (PoleCount) = Number of motor poles

For encoder based commutation (IDN 32853 = 1):

IDN 32807 (PoleCount) = Number of encoder counts / electrical cycle.

IDN 32807 = 4 * IDN 32828 / (Motor poles / 2)

Note: *For encoder based commutation, it is required to do an encoder alignment using IDN 32854.*

Example   If the application uses resolver based commutation with an R-Series motor, set IDN 32807 = 4 (R-Series motors have 4 poles).

If the application uses resolver based commutation with an S-Series motor, set IDN 32807 = 6 (S-Series motors have 6 poles).

If the application uses encoder based commutation with an R-Series motor and an 1024 line count encoder, set IDN 32807 = 4 * 1024 / (4/2) = 2048.

Note: *CommSrc (IDN 32853) must be set before PoleCount (IDN 32807).*

IDN 32826   CommOff sets the origin for the electrical commutation angle. This IDN should be set so that for Kollmorgen motors:

IDN 32826 (CommmOff) = 0

6.3 System protection

Current Limits   To protect the motor and drive, set the ILmts to:

IDN 82   Clockwise Current Limit (IlmtPlus). This IDN should be set so that:

$$IlmtPlus = min(100\%, 100\% * 5 * I_{CS}/I_{Peak})$$

where I_{CS} is the motor's rms terminal current rating

IDN 82 = % of Ipeak * 10
(i.e. for a 9x3 IlmtPlus of 50% or 7.5A set IDN 82 to 500)

IDN 83   Counter-Clockwise Current Limit (IlmtMinus). This IDN should be set so that:

$$IlmtMinus = min(100\%, 100\% * 5 * I_{CS}/I_{Peak})$$

where I_{CS} is the motor's rms terminal current rating

IDN 83 = % of I_{Peak} * 10
(i.e. for a 9x3 IlmtMinus of 50% or 7.5A set IDN 83 to 500)

Note: *Application requirements may constrain the ILmts even further.*

IDN 32829

ItThresh sets the maximum continuous output current, as a percentage of Ipeak, before the I*T thermal protection faults the drive. This IDN should be set so that:

IDN 32829 (ItThresh) = $\min(60\%, 100\% * 3 * I_{MTRcontinuous}/I_{PR})$

IPeak

The following tables list the peak current rating for each of the drives in the PC800 family.

Kollmorgen **Model**	**Ipeak (Amps)**
8X2	7.5
8X3	15.0
8X4	30.0

Appendix A Specifications

A.1   Output Power Specifications

	PC8x2	PC8x3	PC8x4
Peak Output Current (RMS)[1]			
5 seconds, (0 to 40°C) Ambient	$5.3A_{RMS}$	$10.6A_{RMS}$	$21.2A_{RMS}$
Continuous Output Current (RMS)[2]			
Convection (0 to 40°C) Ambient	$2.7A_{RMS}$	$3.6A_{RMS}$	$7.1A_{RMS}$
Forced Air (0 to 40°C) Ambient[3]	N/A	$5.3A_{RMS}$	$10.6A_{RMS}$
Peak Output Power			
Idealized Electrical Max (rectangular torque vs. speed)	2.25kW	4.5kW	9.0kW
Drive & Motor System Output Power			
240 VAC three phase[4] (5 seconds)	1.35 to 1.58kW	2.7 to 3.15kW	5.4 to 6.3kW
240 VAC single phase (1 second)	1.25 kW	2.5 kW	5.0 kW
120 VAC single phase (1 second)	.63 kW	1.25 kW	2.5 kW

1   To convert A_{RMS} to A (0-pk) multiply A_{RMS} * 1.41.
     Peak current (5 sec):   PC843 = 15A (0-pk), PC844 = 30A (0-pk)

2   Above 40°C ambient, linearly derate so that 50°C rating = 0.67*40°C rating.

3   Forced air requires 3.6" x 1" fan mounted 2" below the drive.

4   Varies with the motor. Maximum peak output power with most motors is between 60% to 70% of Idealized Electrical Max.

A.1   Output Power Specifications (Cont'd)

	PC8x2	PC8x3	PC8x4
Continuous Output Power Drive & Motor System @ Convection Ambient			
240 VAC three phase	1.1kW	1.5kW	3.0kW
240 VAC single phase	1.1kW	1.5kW	2.0kW*
120 VAC single phase	550W	750W	1.0kW*
RMS Line Current @ Continuous Output Power Convection Ambient			
240 VAC three phase	4.5 A	6 A	12 A
240 VAC single phase	9 A	12 A	16 A*
120 VAC single phase	9 A	12 A	16 A*

*Single phase operation of the PC8x4 requires derating of continuous output power to avoid excessive line and front end currents.

	PC8x2	PC8x3	PC8x4
Power Stage Efficiency @ P_{cont}	98%	98%	98%
Shunt Regulator Power			
Peak Power (500 mSec)	12.8kW	12.8kW	12.8kW
Continuous Power**	800W	800W	800W
Maximum External Regen Duty Cycle	6%	6%	6%
Bus Capacitance Energy Absorption			
From 320V Nominal Bus	20J	30J	40J

**See Appendix E, *Using External Regen* for additional information.

A.1   Output Power Specifications (Cont'd)

	PC8x2	PC8x3	PC8x4
Output Current Ripple Freq f$_s$	20 kHz	20 kHz	16 kHz
Minimum Motor Inductance l-l	4.0mH	2.0mH	1.25mH
Maximum Motor Inductance l-l	4H	2H	1H
Maximum Motor Power Cable Length	-------------50 m/164ft------------		

A.2   Input Power Specifications

The drive is capable of direct line operation. All units are fully isolated and do not require external isolation transformers. Also, the inrush current on the connection to the line is internally limited to a safe level for the drive. There are no voltage selection or ranging switches required to operate within the specified voltage input ranges. It is the responsibility of the user to supply appropriate fuses or circuit breakers in the TB1 AC Power motor power lines to comply with local electrical codes.

The control input power required should be between 15 and 25 Watt. The AC input motor power depends on output power and the losses in the power stage. The control power input has a single UL/CSA rated fuse in line with one of the AC line inputs.

PC800 Control Power Supply

Input Voltage Range

85 to 265 VAC,
47 - 440 Hz single phase or 130 to 370 Vdc

Ride Through Time
For AC Line Drop

90 VAC 50 Hz	>0.7 50 Hz cycle
120 VAC 60 Hz	>2.1 60 Hz cycles
240 VAC 60 Hz	>13.3 60 Hz cycles

PC830 Motor AC Power Supply

Model Number	Voltage Range	Phases	Transformer Suggested kVA	Maximum AC Line* kVA
PC8x2	90-265 Vac	1 or 3	1.5 to 3 kVA	100 kVA
PC8x3	90-265 Vac	1 or 3	2 to 4 kVA	100 kVA
PC8x4	180-265 Vac	3	3 to 6 kVA	250 kVA

*Maximum AC Line is specified to limit the line surges coupled to the drive.

Bus Voltage (nominal, standard drive)

240 VAC Three Phase Input . . . . 320 VDC

120 VAC Single Phase Input . . . 155 VDC

PC840 Inrush Current & Fusing

Model Number	Inrush Peak Current	Inrush Pulse Width	Fuse Type	Manufacturer, Part Number
PC8x2	300 A 0-p	1.0 msec	10 A 250 V Time Delay	Bussmann, MDA-10
PC8x3	300 A 0-p	1.5 msec	20 A 250 V Time Delay	Bussmann, MDA-20
PC8x4	300 A 0-p	2.0 msec	30 A 250 V Slo-Blo	Littlefuse, FLM 30

A.3 Performance Characteristics

Note: *Unless otherwise specified, the below specifications are worst case limits and apply over the specified operating ambient temperature and over the specified operating line voltage.*

Motor Current Control

Motor Phase Current Waveform	Back EMF Matched Pseudo Sine
Motor Shaft Torque (Ignoring motor magnetic saturation)	
Peak (hot)[5]	K_t (Nm/A$_{RMS}$)*Drive Ipeak (A$_{RMS}$)
Instantaneous	K_t (Nm/A$_{RMS}$)*IFB$/\sqrt{2}$
Bandwidth	
Maximum Bandwidth	1.5 kHz
Recommended Bandwidth	1.0 kHz
Bandwidth Variation For Fixed Motor L	$\pm$ 10%
Bandwidth Variation For $\pm$ 25%	
AC Line Variation	$\pm$ 2%
Update Period	62.5 μsec
Recommended Motor Electrical Frequency	< 400 Hz

[5]   Multiply by 1.06 for cold K_T (PMA motors).

Analog Command

Maximum Differential Range	±13.5 Volts
Maximum Single Ended Range	±21 Volts
Full Scale Tolerance	±5% (worst case)
	±1% (typical)
Linearity	0.1% Full Scale
Monotonic to	$< 2^{-16}$ Full Scale
S/N Ratio Referred to Full Scale	
Full A/D Bandwidth	14 bits
150 Hz A/D Bandwidth	16 bits
10 Hz A/D Bandwidth	18 bits
Offset	Adjustable to 0
Maximum Unadjusted Offset	50 mV
Offset Drift	250 μV/°C typ.
CMRR	> 30 dB @ 60 Hz

Digital Position Commands

Modes	Quadrature Encoder, Step & Direction, or Up & Dn Count
Maximum Input Rate For Fast Decode	
Quadrature Decode Max Line Frequency	800 kHz
Step/Dir Decode Max Step Frequency	800 kHz
Up/Dn Count Max Frequency	800 kHz
Minimum Fast Decode Pulse Width	0.6 μSec
Fast Decode Direction Setup Time	0.6 μSec
Fast Decode Direction Hold Time	0.6 μSec
Relative Timing For Filtered Decode	4, 8, or 16 to 1 e.g. Max Step Freq 800, 200, 100, or 50 kHz

Velocity Loop

Maximum Stable Bandwidth	> 400 Hz
Update Period	250μSec
Range	0 to 21,000 RPM
Command Resolution	< 0.001 RPM
Velocity Loop Compensation Parameters	
KVP Range (Depends on Ipeak)	0 to 12.6 (I_{peak})(1/rad/sec)
KVP Resolution	16 bit
KVI Range	0 to > 200 Hz
KVI Resolution	16 bit
ARF0* Range	0.01 to $> 1e5$ Hz
ARF1* Range	0.01 to $> 1e5$ Hz
ARZ0* Range	0 to $> 1e5$ Hz or off
ARZ1* Range	20 to $> 1e5$ Hz or off
CMDGAIN Range	0 to $\pm 15,000$ RPM/V
	0 to $\pm 10(I_{peak})$ V^{-1}
CMDGAIN Resolution	≥ 16 bit mantissa

*ARx0 set to a negative number allows complex poles/zeros. In this case, ARx1 becomes the Q and the corresponding |ARx0| is the frequency in Hz.

Position Loop

Maximum Stable Bandwidth	> 100 Hz
Update Period	1 mSec
Position Range	0 to $\pm$ 32768 Rev
Position Error Range	0 to $\pm$ 4500 Rev
Command Resolution	2^{-16} Rev $= 0.33$ arc min
Position Loop Compensation Parameters	
KPP Range	0 Hz to > 150 Hz
KPP Resolution	16 bit
KVFF Range	0 to 199.9%
KVFF Resolution	16 bit

General

Max Delay AC Line To Control Supply On	1.0 Sec
Max Delay AC Line To Fully Operational	2.0 Sec

Environmental

Storage Temperature	-40°C to 70°C
Humidity, non-condensing	10% to 90%
Altitude	1500 m (5000 feet)

A.4 Resolver Feedback Specifications

Note: *Unless otherwise specified, the below specifications are worst case limits and apply over the specified operating ambient temperature and over the specified operating line voltage.*

Resolver Position Signal

Resolution/Rev	24 bits = 0.0013 arc min
Repeatability	$< \pm 2^{-18}$ Rev = ± 0.08 arc min rms
Noise	
No Filtering	$< 2^{-16}$ Rev rms = 0.3 arc min rms
150 Hz Single Pole Filtered	$< 2^{-17}$ Rev rms = 0.16 arc min rms
10 Hz Single Pole Filtered	$< 2^{-19}$ Rev rms = 0.04 arc min rms
dc Offset Temperature Drift	$< 2^{-18}$ Rev/°C = 0.08 arc min/°C
Absolute Accuracy	
Drive only	$\pm 2^{-12}$ Rev = ± 5.3 arc min
Drive with 20 arc min resolver	$\pm 2^{-9.75}$ Rev = ± 25 arc min
Software Update Time	1 mSec

Resolver Velocity Signal

|	
Resolution	< 0.001 RPM
Quanta	= 0.0143 RPM
Noise	
No Filtering	< 3 RPM rms
150 Hz Single Pole Filtered	< 0.6 RPM rms
10 Hz Single Pole Filtered	< 0.06 RPM rms
DC Accuracy	
Typical @ 25°C	±0.01%
Worst case	±0.05%
Ripple	
Drive only	0.75% p-p at 1000 RPM
Drive with 20 arc min resolver	3% p-p at 1000 RPM
Offset	< 0.0001 RPM
Software Update Time	250 μSec

Emulated Encoder Output Signals

Available Resolutions (PPR)	
Binary	128, 256, 512, 1024, 2048, 4096, 8192, 16384
Decimal	125, 250, 500, 1000, 2000, 4000, 8000, 16000
Maximum Output Line Frequency	833 kHz
Max Recommended Speed @ 16384 PPR	2900 RPM
Max Recommended Speed @ 4096 PPR	11600 RPM
Marker Pulse Width	$\approx$ 1 Quadrature Pulse

General

-3 dB Bandwidth	> 1500 Hz
-45° Phase Lag	> 400 Hz
Resolver Excitation Frequency	6510.42 Hz
Max Tracking Rate	> 48600 RPM
Max Recommended Rate	25 kRPM
Max Tracking Acceleration	> 16×10^6 RPM/Sec
Maximum Feedback Cable Length	50 m/164 ft

Nominal Frequency Response
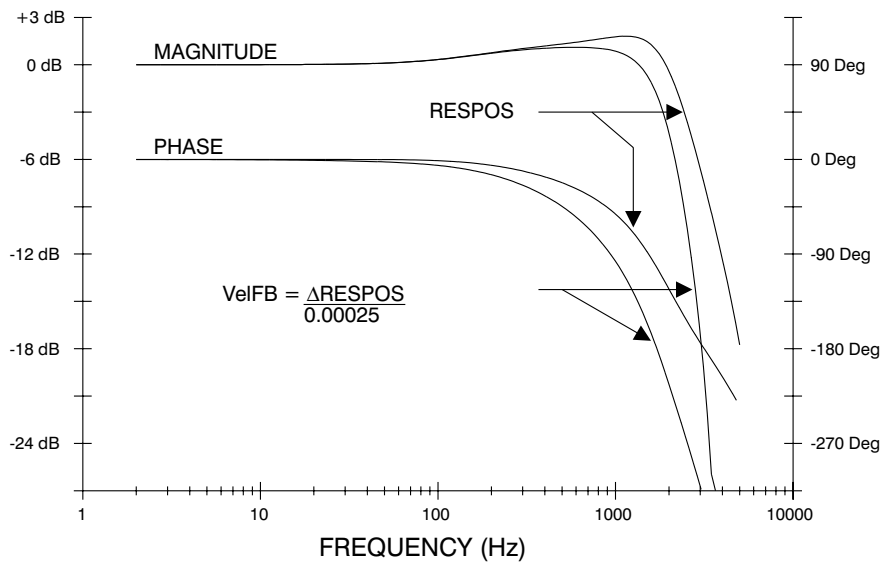
The PC830 packaging is totally enclosed single axis panel mount. The figure on the next page gives the key dimensions for use in physically mounting the product. When mounting multiple units on one panel there should be at least 20 mm (0.75") of air space on the sides and 40 mm (1.5") or air space above and below the unit.

When mounting multiple drives in a row some customers have found the stiffness of the drive and their mounting panel to be too low. To increase the mounted mechanical integrity, connect to the threaded insert on the top front edge.

The overall drive panel dimensions and the mounted depth not including mating connectors is listed in the below chart. The extra depth for mating connectors is 1.0" or less.
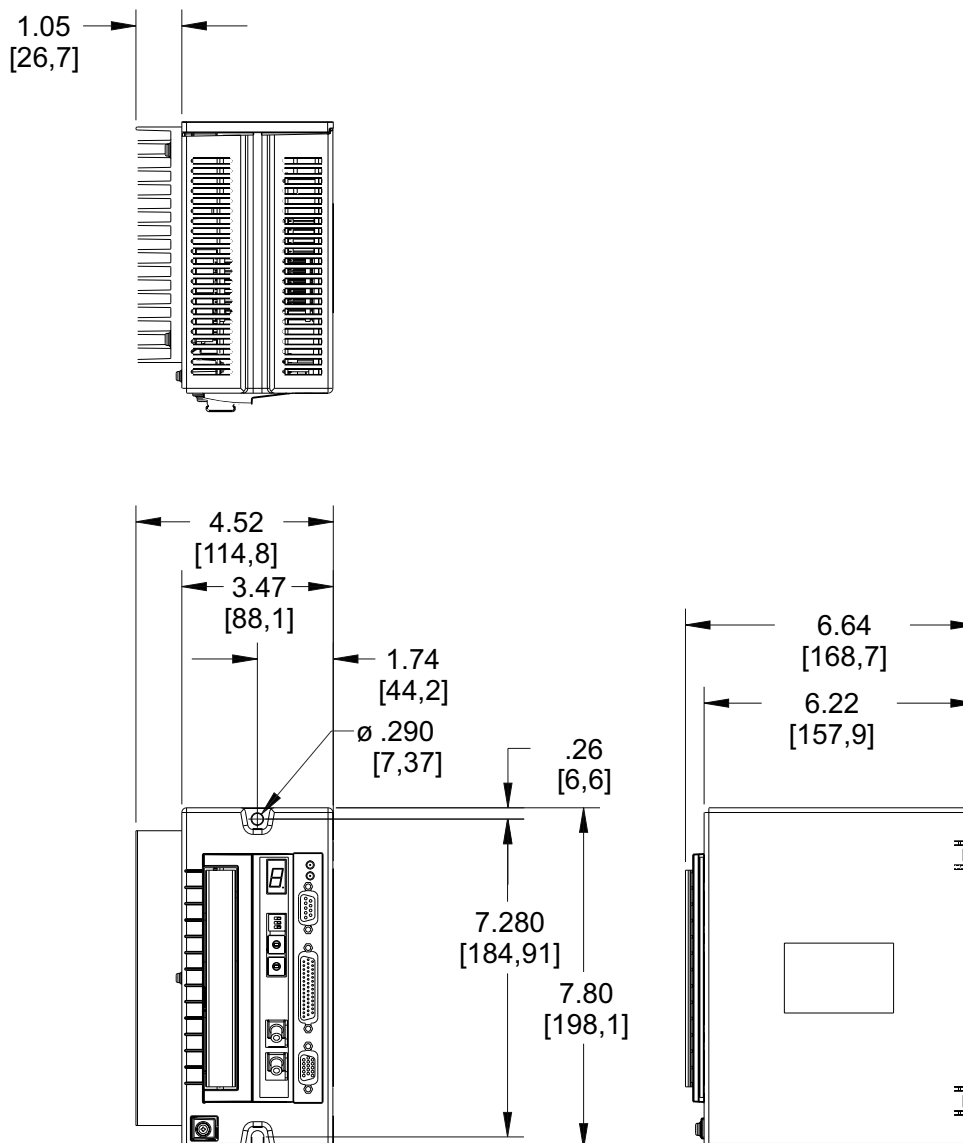
Dimensions

Model	Height	Width	Depth
PC8x2	198.1 mm/7.8"	88.1 mm/3.47"	158 mm/6.22"
PC8x3	198.1 mm/7.8"	88.1 mm/3.47"	158 mm/6.22"
PC8x4	198.1 mm/7.8"	114 mm/4.49"	158 mm/6.22"

Weight

Model	Weight
PC8x2	1.9 kg/4 lb
PC8x3	2 kg/4.3 lb
PC8x4	2.6 kg/5.7 lb

Drive Mechanical Outline

PC8X2/3/4

1.05
[26,7]

4.52
[114,8]

3.47
[88,1]

1.74
[44,2]

ø .290
[7,37]

.26
[6,6]

7.280
[184,91]

7.80
[198,1]

6.64
[168,7]

6.22
[157,9]

PC830 Terminal Block Adapter

4.65
[118,1]

1.15
[29,2]

2.253
[57,23]

.15
[3,8]

.33
[8,3]

.675
[17,15]

1.85
[47]

15

5

22

1

8

1

44

23

16

9

2 x 22 PIN CONNECTOR WECO P/N: 934-22
2 x 8 PIN CONNECTOR WECO P/N: 934-08

.062
[1,57]

3.230
[82,04]

.994
[25,24]

.725
[18,42]

1.250
[31,75]

Fan Option Kit

4.00
[101,6]

.31
[7,9]

3.38
[85,7]

ø .172
[4,37]

MOUNTING FOR M4 OR #8-32
TYP 2 PL.

5.09
[129,4]

.38
[9,5]

2.00
[50,8]

2.22
[56,3]
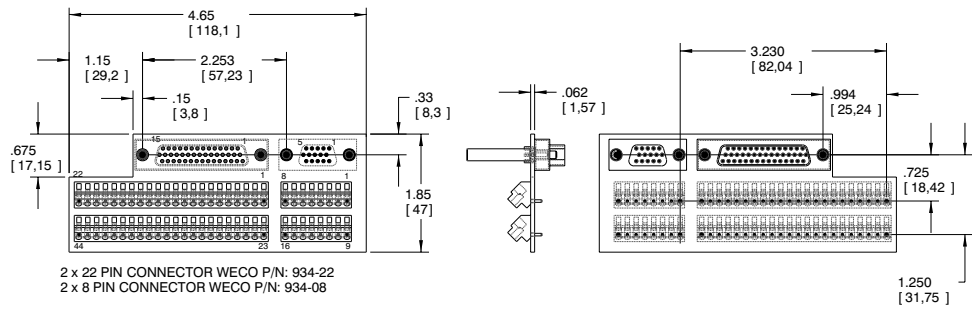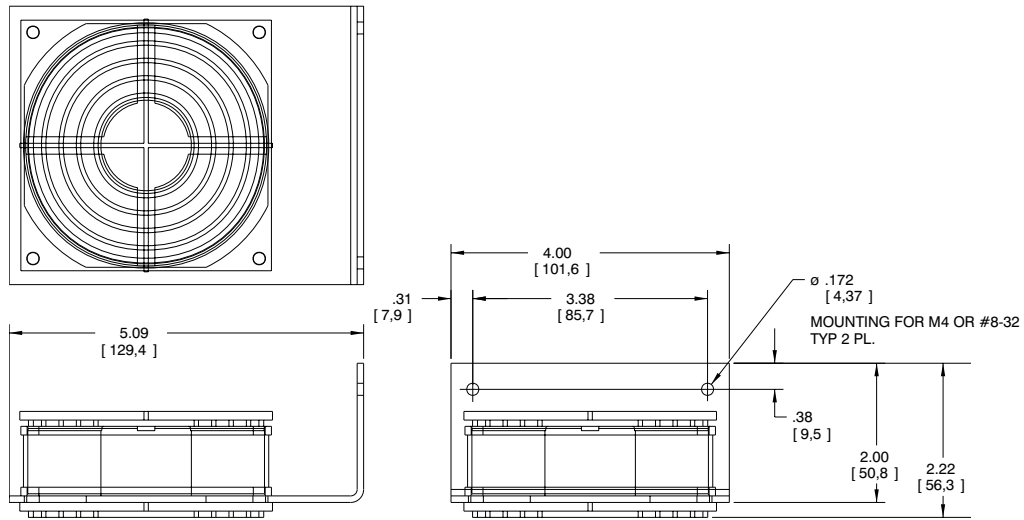
Appendix B Model Identification

B.1 Servo Drive Package Order Numbering System

P C 8 X X - 0 0 1 - X

PC8 = Servo Drive Family Designation

4 = Command Interface Designation
4 = SERCOS Network

3 = Power Level
2 = 2.7 A_{RMS} cont. @ 25 °C, 5.3 A_{RMS} pk.
3 = 3.6 A_{RMS} cont. @ 25 °C, 10.6 A_{RMS} pk.
4 = 7.1 A_{RMS} cont. @ 25 °C, 21.2 A_{RMS} pk.

- 001 = Customization Code
001 = Standard Unit
XYZ = Factory Assigned Hardware Customization

X = Accessories
N = No accessories
A = Basic connector kit
T = TB adapter connector kit

Example Order Numbers

Order #	Model #	Description
PC843-001-T	PC843-001-T	10.6 A_{RMS} peak standard servo drive
	CA800-TB	TB adapter PC803 connector kit
	MA840	*PC840 User Manual*
PC844-001-A	PC844-001-A	21.2 A_{RMS} peak standard servo drive
	CA800	Basic PC804 connector kit
	MA840	*PC840 User Manual*
PC844-001-N	PC844-001-N	21.2 A_{RMS} peak standard servo drive
	MA840	*PC840 User Manual*

B.2 PC800 Accessories

Connector Mate Kits

CA800   15-pin and 44-pin d-subminiature mates for the PC80x servo drive.

CA800-TB   15-pin and 44-pin d-subminiature terminal block adapter mates for the PC80x servo drive.

Manual and Documentation Kits

MA840   *PC840 User Manual*

Regen Resistors

PRK-200   External regen resisitor kit

Fan Kits

PFK-120   120 VAC Fan

PFK-240   240 VAC Fan