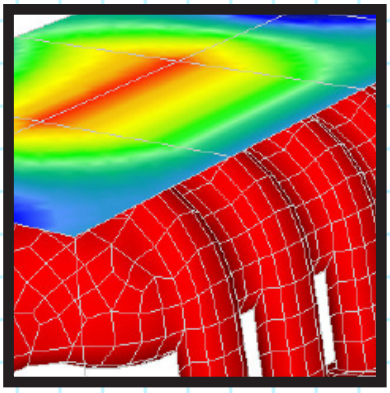
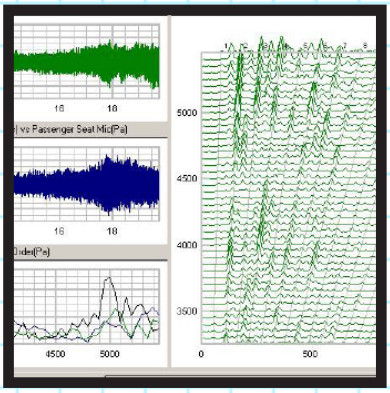
NOISE & VIBRATION MEASUREMENT HANDBOOK





PROSIG Data Acquisition & Analysis Tools

Third Edition

P8004 - Ultra Portable 4-Channel system

- **Small, light, ultra portable**
- **24-bit precision**
- **Sample at up to 400k samples/second/channel**
- **4 analog channels plus tacho input**
- **105dB dynamic range**
- **-120dB noise floor**
- **USB 2.0**

The Prosig P8004 is an ultra portable, high quality, 24-bit data acquisition system. It has 4 analog inputs plus a dedicated tacho input. Input connection is via industry standard BNC connectors. Each input can be configured for AC/DC or IEPE with programmable gain and anti-alias filter.

System	
Analog inputs	**4 channels plus tacho input**
Maximum sampling rate	**100k samples/sec per channel (24 bit)** **400k samples/sec per channel (16 bit)**
Tacho input and external trigger	**Programmable ±28V**
Programmability	**All features under software control**
Resolution	**24 bit**
Overall accuracy	**± 0.10% full scale**
Non-linearity	**Less than 1LSB**
Input voltage range	**±10mV to ±10V**
Input impedance	**1Mohm**
Analog over voltage protection	**± 24V**
Communications	**USB 2.0**
Signal Conditioning	
Signal inputs	**Direct voltage** **IEPE with TEDS**
Anti-alias protection	**>100dB**
Autozero	**Signal autozero and amplifier autozero**
DC offset control	**±50% full scale range in 32768 steps**
Dynamic range	**105dB**
Noise floor	**-120dB**
Environmental	
Shock and vibration	**Suitable for mobile use (10g rms)**
Operating temperature	**0°C to +40°C (32°F to +104°F)**
Humidity	**80% RH, non-condensing**
Weight	**1 kg (2.2 lbs)**
General	
Power usage	**<6W**
Supply voltage	**Choice of 10-17V DC (e.g. vehicle battery) or AC mains (adapter supplied)**
Connectors	**BNC**
Dimensions† (H x W x D)	**50mm x 120mm x 240mm** **(2" x 4.7" x 9.4")**

† Dimensions are measured exclusive of any handles or other attachments

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P8012 & P8020 - Portable 24-bit Data Acquisition

P8020

P8012

System

Analog inputs	**Up to 40 channels plus tachos**
Expansion	**Flexible packaging options**
Split rate sampling	**Multiple sampling rates can run concurrently on separate cards**
Programmability	**All features under software control**
Communications	**USB 2.0**

Environmental

Shock and vibration	**Suitable for mobile use (7g rms)**
Operating temperature	**0°C to +40°C (32°F to +104°F)**
Humidity	**80% RH, non-condensing**
Weight	**Dependent on configuration, channel count & chassis**

General

Supply voltage	**Choice of 10-17V DC (e.g. vehicle battery) or AC mains (adapter supplied)**
Dimensions† (H x W x D) P8012	**50mm x 290mm x 270mm (2.0" x 11.4" x 9.4")**
P8020	**50mm x 380mm x 330mm (2.0" x 15.0" x 13.0")**

† Dimensions are measured exclusive of any handles or other attachments

- **P8012 - 3 card chassis**
- **P8020 - 5 card chassis**
- **Configurable channel options**
- **24-bit precision**
- **Up to 100k samples/sec/channel (24bit)**
- **Up to 400k samples/sec/channel (16bit)**
- **Up to 40 analog channels plus tacho**

The P8012 supports 24 analog inputs plus two dedicated tacho inputs. The P8020 supports up to 40 analog inputs plus two tachos. Units can be stacked to expand the system up to 160 channels. Various input options are available. These include analog, thermocouple, strain gauge, high speed tacho, charge, CAN and GPS. Each option is complete with programmable signal conditioning, that is controlled by the DATS™ software. Each input card can be programmed to sample at its own rate.

Available cards are:

4ch ADC + Tacho, IEPE, Direct (03-33-8402)
4ch ADC + Tacho, IEPE, Direct, Bridge (03-33-8404)
8ch ADC + Tacho, IEPE, Direct (03-33-8412)
8ch ADC + Tacho, Direct, Bridge (03-33-8414)
8ch Thermocouple (03-33-8408)
4ch Advanced Tacho (03-33-8420)
2ch/4ch DAC, Digital I/O (03-33-8424)
4ch ADC + Tacho, Charge Input (03-33-8405)
CAN, GPS (03-33-8440)

P8048 - High Channel Count System

- **High channel count**
- **12 card chassis**
- **Standalone or rack mount**
- **24-bit precision**
- **Up to 100k samples/sec/channel (24bit)**
- **Up to 400k samples/sec/channel (16bit)**
- **Up to 1024 channels**
- **Configurable channel options**

System	
Analog inputs	**48 to 1024 channels plus tachos**
Expansion	**Flexible packaging options**
Split rate sampling	**Multiple sampling rates can run concurrently in separate cards**
Programmability	**All features under software control**
Communications	**USB 2.0**
Environmental	
Shock and vibration	**Suitable for mobile use (5g rms)**
Operating temperature	**0°C to +40°C (32°F to +104°F)**
Humidity	**80% RH, non-condensing**
Weight	**Dependent on configuration, channel count & chassis**
General	
Supply voltage	**Choice of 10-17V DC (e.g. vehicle battery) or AC mains (adapter supplied)**
Dimensions† (H x W x D)	**185mm x 450mm x 400mm (7.3" x 17.7" x 15.7")**

† Dimensions are measured exclusive of any handles or other attachments

The P8048 is the high channel count version of the Prosig P8000 24-bit data acquisition system. It has all the same signal conditioning as the P8012/P8020. It can also be configured with all the same cards as follows;

Available cards are:

4ch ADC + Tacho, IEPE, Direct (03-33-8502)
4ch ADC + Tacho, IEPE, Direct, Bridge (03-33-8504)
8ch ADC + Tacho, IEPE, Direct (03-33-8512)
8ch ADC + Tacho, Direct, Bridge (03-33-8514)
8ch Thermocouple (03-33-8508)
4ch Advanced Tacho (03-33-8520)
2ch/4ch DAC, Digital I/O (03-33-8524)
4ch ADC + Tacho, Charge Input (03-33-8505)
CAN, GPS (03-33-8540)

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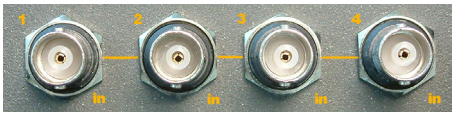
P8000 Cards

All of the cards in this section are available in the P8012, P8020 and P8048 systems. The P8012 can be configured with a maximum of three cards. The P8020 can have a maximum of five cards. The P8048 can hold up to twelve cards. The P8004 is only available with a single 4ch ADC + Tacho, IEPE, Direct card (8402).

8402

AC/DC · IEPE · TEDS · Tacho input

4ch ADC + Tacho, IEPE, Direct



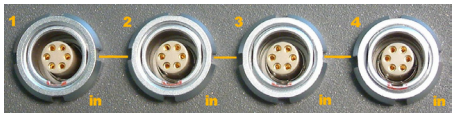
- 4 analog channels and 1 tacho input
- DC, AC and IEPE† inputs
- 400k samples/second/channel
- Tacho input sampled at up to 800k samples/second/channel
- TEDS with connection detection

The 8402 is a flexible general purpose acquisition card, with built-in signal conditioning for almost any type of transducer. It has the capability of high sample rates and synchronous parallel sampling with an additional tachometer input. It also offers a choice of AC or DC coupling to direct voltage inputs and support for IEPE† transducers, including those with TEDS. Importantly has a large number of analogue amplifier steps to maximize resolution. Additionally, the 8402 card has a dedicated tachometer channel. This card offers the flexibility of capturing data in 24-bit resolution or in 16-bit resolution. When working in the frequency domain or the order domain this card is the natural choice.

8404

AC/DC · IEPE · TEDS · Tacho input · Bridge

4ch ADC + Tacho, IEPE, Direct, Bridge



- 4 analog channels and 1 tacho input
- DC, AC and IEPE† inputs
- 400k samples/second/channel
- Tacho input sampled at up to 800k samples/second/channel
- TEDS with connection detection
- Programmable excitation
- Programmable ¼, ½, full bridge input
- Input nulling & excitation sensing

The 8404 is an ultra-flexible general purpose acquisition card. It encapsulates Prosig's 30-years of test and measurement experience and is the only card you'll ever need! The 8404 has all the functionally and full specification of the 8402 card. But additionally each channel includes bridge completion configurations of ¼, ½ and full bridge, internal calibration shunt resistors and selectable bridge resistance configurations of 120, 350 or 1000Ω. Further each channel provides program selectable supply voltage for transducer excitation.

8412

AC/DC · IEPE · TEDS · Tacho input

8ch ADC + Tacho, IEPE, Direct

- 8 analog channels and 1 tacho input
- DC, AC and IEPE† inputs
- 100k samples/second/channel (24 bits)
- Tacho input sampled at up to 800k samples/second/channel
- TEDS with connection detection

This card is ideal for situations where higher sampling rates are not required, but high quality, repeatable, high resolution data captures are desired. Although the 8412 has a slightly lower specification than the 8402 it provides twice the channel density. This allows for example a P8020 chassis to support a total of 40 analog channels with two tacho channels. This card is used primarily in situations where high channel counts are required, the flexible, mutlipole connector makes the complex wiring tasks associated with high channel counts systems both manageable and tidy.

03-33-8402

Description	4ch ADC + Tacho, IEPE, Direct
Input channels	4
Output channels	n/a
16-bit sample rate *	400k
24-bit sample rate *	100k
Effective bandwidth	0.4 x sample rate
Anti-aliasing attenuation	> 100dB
AC coupling high pass filter	20dB/dec -3dB at 0.3 or 1Hz
DC Input	✓
AC Input	✓
IEPE Input	✓
Charge Input	×
Programmable excitation	×
24-bit Dynamic range	105dB at 10Ks/s
24-bit Noise floor	-120dB at 10Ks/s
16-bit Dynamic range	92dB at 10Ks/s
16-bit Noise floor	-110dB at 10Ks/s
Non-linearity	< 1 bit
Accuracy	±0.1% FSD
DC Offset control	±50% FS in 32768 steps
Tacho channels	1
Tacho input range	±28V
Supports TEDS	✓
Autozero	✓
Input range	±10mV to ±10V
Output range	n/a
Gain Steps	13
Input common mode range	±10V
Absolute max input range	±24V
Prog. bridge completion	×
Connector	BNC
Power usage (worst case)	6W

03-33-8404

Description	4ch ADC + Tacho, IEPE, Direct, Bridge
Input channels	4
Output channels	n/a
16-bit sample rate *	400k
24-bit sample rate *	100k
Effective bandwidth	0.4 x sample rate
Anti-aliasing attenuation	> 100dB
AC coupling high pass filter	20dB/dec -3dB at 0.3 or 1Hz
DC Input	✓
AC Input	✓
IEPE Input	✓
Charge Input	×
Programmable excitation	✓
24-bit Dynamic range	105dB at 10Ks/s
24-bit Noise floor	-120dB at 10Ks/s
16-bit Dynamic range	92dB at 10Ks/s
16-bit Noise floor	-110dB at 10Ks/s
Non-linearity	< 1 bit
Accuracy	±0.1% FSD
DC Offset control	±50% FS in 32768 steps
Tacho channels	1
Tacho input range	±28V
Supports TEDS	✓
Autozero	✓
Input range	±10mV to ±10V
Output range	n/a
Gain Steps	13
Input common mode range	±10V
Absolute max input range	±24V
Prog. bridge completion	✓
Connector	Lemo
Power usage (worst case)	8W

03-33-8412

Description	8ch ADC + Tacho, IEPE, Direct
Input channels	8
Output channels	n/a
16-bit sample rate *	n/a
24-bit sample rate *	100k
Effective bandwidth	0.4 x sample rate
Anti-aliasing attenuation	> 100dB
AC coupling high pass filter	20dB/dec -3dB at 0.3 or 1Hz
DC Input	✓
AC Input	✓
IEPE Input	✓
Charge Input	×
Programmable excitation	×
24-bit Dynamic range	102dB at 10Ks/s
24-bit Noise floor	-120dB at 10Ks/s
16-bit Dynamic range	n/a
16-bit Noise floor	n/a
Non-linearity	< 1 bit
Accuracy	±0.1% FSD
DC Offset control	±50% FS in 32768 steps
Tacho channels	1
Tacho input range	±28V
Supports TEDS	✓
Autozero	✓
Input range	±80mV to ±10V
Output range	n/a
Input common mode range	±10V
Absolute max input range	±24V
Prog. bridge completion	×
Connector	Multipin **
Power usage (worst case)	6W

† IEPE (Integral Electronic PiezoElectric) type transducers are often known by trade names such as Piezotron®, Isotron®, DeltaTron®, LIVM™, ICP®, CCLD, ACOtron™ and others.
* All sample rates are specified in number of samples per second per channel
** Cables are available to provide BNC or bare end inputs (see 03-33-955 and 03-33-956 on p20)
NOTE: The specification of the 03-33-85xx cards used by the P8048 is identical to the 03-33-84xx cards used by the P8012/P8020 as described above.

P8000 Cards

All of the cards in this section are available in the P8012, P8020 and P8048 systems. The P8012 can be configured with a maximum of three cards. The P8020 can have a maximum of five cards. The P8048 can hold up to twelve cards. The P8004 is only available with single 4ch ADC + Tacho, IEPE, Direct card (8402).

8414

AC/DC · Bridge · Tacho input

8ch ADC + Tacho, Direct, Bridge

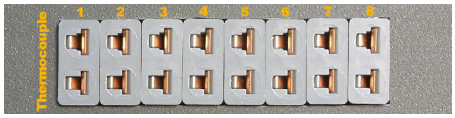
- 8 analog channels and 1 tacho input
- DC, AC inputs
- 100k samples/second/channel (24 bits)
- Tacho input sampled at up to 800k samples/second/channel
- Programmable excitation
- Programmable ¼, ½, full bridge input
- Input nulling & excitation sensing

This card has the main features of the 8412 and includes bridge completion and transducer excitation. Each channel provides bridge completion configurations of ¼, ½ and full bridge, internal calibration shunt resistors and selectable bridge resistance of 120, 350 or 1000Ω. The 8414 has a slightly lower specification than the 8404, but provides twice the channel density. This allows a P8020 chassis to support up to 40 analog channels and two tacho channels. The flexible mutlipole connector gives these systems manageable wiring and offers the option of fast connection external boxes if desired.

8408

°C/°F

8ch Thermocouple



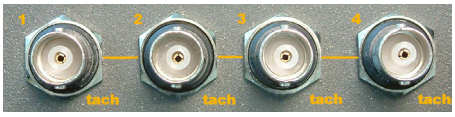
- Eight channels of single ended thermocouple inputs
- Universal input connector supports all popular thermocouple types
- Smallest step change 0.075 degrees (assuming 1 degree = 40µV)
- Integral cold junction reference
- Typical accuracy : 0.5°C

This is the universal thermocouple card suitable for use with industry standard connector types, but also supporting universal input connectors. The 8408 provides up to eight thermocouple inputs and supports all popular thermocouple types. This card gives the option for temperature data to be integrated and synchronised with noise and vibration data.

8420

Tacho input

4ch Advanced Tacho



- Programmable signal conditioning to de-bounce inputs
- 60MHz resolution
- Pulse counting
- Noise Offset' & 'Hold Off' setting
- Programmable threshold & slope
- Pulse time stamping

The 8420 card is intended as a solution for situations with rotating machines where positional information and time relative to position information are required. This would classically be a very high speed shaft encoder with a fine resolution. This card is used in applications where there is a requirement to accurately measure rotational speed at several points in a drivetrain. The high speed and resolution of this card mean it is suitable for in depth rotational machine analysis such as torsional and angular vibration. The 8420 card measures the time between pulses with a 16ns resolution.

03-33-8414

Description	8ch ADC + Tacho, Direct, Bridge
Input channels	8
Output channels	n/a
16-bit sample rate *	n/a
24-bit sample rate *	100k
Effective bandwidth	0.4 x sample rate
Anti-aliasing attenuation	> 100dB
AC coupling high pass filter	20dB/dec -3dB at 0.3 or 1Hz
DC Input	✓
AC Input	✓
IEPE Input	×
Charge Input	×
Programmable excitation	✓
24-bit Dynamic range	102dB at 10Ks/s
24-bit Noise floor	-120dB at 10Ks/s
16-bit Dynamic range	n/a
16-bit Noise floor	n/a
Non-linearity	< 1 bit
Accuracy	±0.1% FSD
DC Offset control	±50% FS in 32768 steps
Tacho channels	1
Tacho input range	±28V
Supports TEDS	✓
Autozero	✓
Input range	±80mV to ±10V
Output range	n/a
Input common mode range	±10V
Absolute max input range	±24V
Prog. bridge completion	✓
Connector	Multipin **
Power usage (worse case)	12W

03-33-8408

Description	8ch Thermocouple
Input channels	8
Output channels	n/a
16-bit sample rate *	n/a
24-bit sample rate *	500
Effective bandwidth	n/a
Anti-aliasing attenuation	n/a
DC Input	✓
AC Input	×
IEPE Input	×
Charge Input	×
Programmable excitation	×
Non-linearity	< 1 bit
Accuracy	±0.1% FSD
Tacho channels	n/a
Tacho input range	n/a
Supports TEDS	×
Autozero	×
Input range	Thermocouple
Output range	n/a
Gain Steps	4
Input common mode range	n/a
Absolute max input range	n/a
Prog. bridge completion	×
Connector	IsoThermal Block
Power usage (worst case)	6.2W

03-33-8420

Description	Advanced Tacho
Tacho input channels	4
Tacho input range	±28V
Absolute max input range	±50V
Slope selection	+ve, -ve
Dynamic noise rejection	✓
Resolution	16.6ns
Connector	BNC
Power usage (worst case)	1.3W

* All sample rates are specified in number of samples per second per channel
** Cables are available to provide BNC or bare end inputs (see 03-33-955 and 03-33-956 on p20)
NOTE: The specification of the 03-33-85xx cards used by the P8048 is identical to the 03-33-84xx cards used by the P8012/P8020 as described above.

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P8000 Cards

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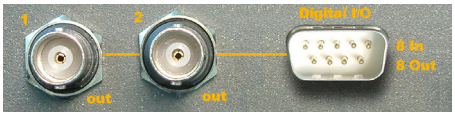
DAC 8424

2ch/4ch DAC, Digital I/O



- Four analog output channels - DAC
- 288k samples/second/channel maximum output
- Digital interpolating filter
- Optional integral digital I/O with 8 inputs & 8 outputs

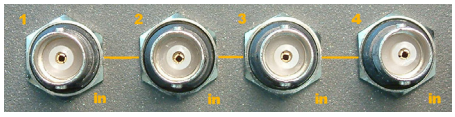
The 8424 DAC card, often known as an analog output card, is ideal for situations where analog replay of signals is required. Traditionally, it is used in applications such as modal analysis or general noise and vibration analysis. Analogue output is most often used where driving a multi-post shaker is required. Captured or various generated signals can be replayed as analog voltages at optimal sample rates.

A selection of optional front panel configuration offers either four DAC outputs, two DAC outputs combined with digital I/O or digital I/O only. These options offer greater flexibility and integration with other systems.

03-33-8424	
Description	2ch/4ch DAC, Digital I/O
Option 1 - 4ch DAC	
Analogue output channels	4
Digital input channels	0
Digital output channels	0
24-bit sample rate *	288k
Analog output range	±4V
Digital output range	n/a
Connector	4 x BNC
Power usage (worst case)	1.8W
Option 2 - 2ch DAC, Digital I/O	
Analogue output channels	2
Digital input channels	4
Digital output channels	4
24-bit sample rate *	288k
Analog output range	±4V
Digital output range	TTL compatible
Connector	2 x BNC + 9-way D-type
Power usage (worst case)	1.8W
Option 3 - Digital I/O only	
Analogue output channels	0
Digital input channels	8
Digital output channels	8
24-bit sample rate *	n/a
Digital output range	TTL compatible
Connector	2 x 9-way D-type
Power usage (worst case)	1.8W

Charge input / Tacho input 8405

4ch ADC + Tacho, Charge Input



- Four analog 24-bit charge inputs
- BNC connectors
- Tacho input sampled at up to 800k samples/second/channel

The 8405 provides 4 inputs for charge mode transducers. These are normally high temperature accelerometers. Charge mode transducers are normally used in automotive and aerospace applications where heat and low frequency response are important. The 8405 offers an impressive input range of ±68pC to ±68000pC Full Scale Deflection with, importantly, a large number of analogue amplifier steps to maintain and maximize signal resolution.

03-33-8405	
Description	4ch ADC + Tacho, Charge Input
Input channels	4
Output channels	n/a
16-bit sample rate *	400k
24-bit sample rate *	100k
Effective bandwidth	0.4 x sample rate
Anti-aliasing attenuation	> 100dB
AC coupling high pass filter	40dB/dec -3dB at 0.5Hz
DC Input	×
AC Input	×
IEPE Input	×
Charge Input	✓
Programmable excitation	×
24-bit Dynamic range	105dB at 10Ks/s
24-bit Noise floor	-120dB at 10Ks/s
16-bit Dynamic range	92dB at 10Ks/s
16-bit Noise floor	-110dB at 10Ks/s
Non-linearity	< 1 bit
Accuracy	±0.1% FSD
DC Offset control	±50% FS in 32768 steps
Tacho channels	1
Tacho input range	±28V
Supports TEDS	×
Autozero	✓
Input range	±68pC to ±68000pC
Output range	n/a
Gain Steps	13
Input common mode range	n/a
Absolute max input range	n/a
Prog. bridge completion	×
Connector	BNC
Power usage (worst case)	6W

CAN bus / GPS 8440

CAN, GPS

- CAN-bus input
- Passive and active CAN modes
- Time stamping: time or sample number
- GPS Data

The 8440 card supports both simple monitoring, where messages are read and logged from the bus, and PID mode, where automatic PIDs can be requested under user control. CAN Bus gives the flexibility of access to the tens or hundreds of parameters that are already present on an automotive vehicle or even modern aircraft communication bus.

The 8440 card supports two separate independent CAN Bus inputs for dual system monitoring and capture.

A GPS option is available so that position, velocity or accurate wall clock time can be recorded with the data. Further there are GPS options that have different specification depending on the customer's requirements.

03-33-8440	
Description	CAN
Link interface	ISO11898
Bus rates	250kHz, 500kHz, 1MHz
Operating modes	Passive, Log all traffic Active, request PID etc
Power usage (worst case)	1.3W
CAN Bus inputs	2
GPS Option 1	
Receiver type	50 channels, GPS L1
Update rate	4Hz
Velocity accuracy	0.1 m/sec
Position accuracy	2.5m
Time accuracy	30ns RMS
GPS Option 2	
Receiver type	GPS L1
Update rate	20Hz
Velocity accuracy	0.03m/s
Position accuracy	1.8m
Time accuracy	20ns RMS

* All sample rates are specified in number of samples per second per channel
** Cables are available to provide BNC or bare end inputs (see 03-33-955 and 03-33-956 on p20)
NOTE: The specification of the 03-33-85xx cards used by the P8048 is identical to the 03-33-84xx cards used by the P8012/P8020 as described above.

P8004 systems

03-33-8004 P8004 4-channel system. Includes
- 4 analog channels with tacho module & BNC connectors
- PC to P8004 USB 2.0 communications cable (02-33-852)
- Mains power supply for P8004 (02-33-853)
- In-vehicle power cable for P8004 (02-33-846)

P8012 / P8020 systems

03-33-8012 12-channel (3 card) chassis. Includes
- P8012 chassis (capable of holding a maximum of 3 cards)
- PC to P8012 USB 2.0 communications cable (02-33-852)
- Mains power supply for P8012 (02-33-883)
- In-vehicle power cable for P8012 (02-33-884)

03-33-8020 20-channel (5 card) chassis. Includes
- P8020 chassis (capable of holding a maximum of 5 cards)
- PC to P8020 USB 2.0 communications cable (02-33-852)
- Mains power supply for P8020 (02-33-854)
- In-vehicle power cable for P8020 (02-33-885)

Select any combination of the following cards up to a maximum of 3 cards (P8012) or 5 cards (P8020)

03-33-8402	4ch ADC + Tacho, IEPE, Direct (BNC connectors) *
03-33-8404	4ch ADC + Tacho, IEPE, Direct, Bridge (6-pin Lemo connectors) *
03-33-8405	4ch ADC + Tacho, Charge Input
03-33-8408	8ch Thermocouple
03-33-8412	8ch ADC + Tacho, IEPE, Direct
03-33-8414	8ch ADC + Tacho, Direct, Bridge
03-33-8420	4ch Advanced Tacho
03-33-8424	2ch/4ch DAC, Digital I/O
03-33-8440	CAN, GPS

* The P8012/P8020 chassis has two tacho inputs (T1 & T2). To have a tacho input available on T1 either an 8402, 8404, 8412 or 8414 card needs to be fitted in slot 1. Similarly, to have a tacho input available on T2 either an 8402, 8404, 8412 or 8414 card needs to be fitted in slot 2.

P8048 systems

03-33-8048 48-channel (12 card) chassis. Includes
- Rack mount chassis (capable of holding a maximum of 12 cards. Racks can be linked for higher channel counts)
- PC to P8048 USB 2.0 communications cable (02-33-852)
- Mains power supply for P8048 (02-33-867)
- In-vehicle power cable for P8048 (02-33-866)

Select any combination of the following cards up to a maximum of 12 cards

03-33-8502	4ch ADC + Tacho, IEPE, Direct (BNC connectors) *
03-33-8504	4ch ADC + Tacho, IEPE, Direct, Bridge (6-pin Lemo connectors) *
03-33-8505	4ch ADC + Tacho, Charge Input
03-33-8508	8ch Thermocouple
03-33-8512	8ch ADC + Tacho, IEPE, Direct
03-33-8514	8ch ADC + Tacho, Direct, Bridge
03-33-8520	4ch Advanced Tacho
03-33-8524	2ch/4ch DAC, Digital I/O
03-33-8540	CAN, GPS

* The P8048 chassis has two tacho inputs (T1 & T2). To have a tacho input available on T1 either an 8502, 8504, 8512 or 8514 card needs to be fitted in slot 1. Similarly, to have a tacho input available on T2 either an 8502, 8504, 8512 or 8514 card needs to be fitted in slot 2.

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