

Option Modules

Resolver Option

HA503540U001 Issue 1
Technical Manual

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

ENGINEERING YOUR SUCCESS

AC30 Resolver Feedback

Technical Manual
HA503540U001 Issue 1

Compatible with Firmware versions 2.13 & 3.13 (or later)

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Safety Information

Requirements

IMPORTANT: *Please read this information BEFORE installing the equipment.*

Intended Users

This manual is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, EMC considerations, and to enable the user to obtain maximum benefit from the equipment.

Complete the following table for future reference detailing how the unit is to be installed and used.

INSTALLATION DETAILS	
Model Number *(see product label)*	
Where installed *(for your own information)*	

Application Area

The equipment described is intended for industrial motor speed control utilising AC induction or AC synchronous machines

Personnel

Installation, operation and maintenance of the equipment should be carried out by competent personnel. A competent person is someone who is technically qualified and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

Product Warnings

DANGER Risk of electric shock	**WARNING** Hot surfaces	**Caution** Refer to documentation	**Earth/Ground** Protective Conductor Terminal

CAUTION!

APPLICATION RISK

- The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to the user's specific application. We cannot guarantee the suitability of the equipment described in this Manual for individual applications.

RISK ASSESSMENT

Under fault conditions, power loss or unintended operating conditions, the drive may not operate as intended. In particular:

- Stored energy might not discharge to safe levels as quickly as suggested, and can still be present even though the drive appears to be switched off
- The motor's direction of rotation might not be controlled
- The motor speed might not be controlled
- The motor might be energised

A drive is a component within a drive system that may influence its operation or effects under a fault condition. Consideration must be given to:

- Stored energy
- Supply disconnects
- Sequencing logic
- Unintended operation

Safety Information



DANGER! - Ignoring the following may result in injury

1. This equipment can endanger life by exposure to rotating machinery and high voltages.
2. The equipment must be permanently earthed due to the high earth leakage current, and the drive motor must be connected to an appropriate safety earth.
3. Ensure all incoming supplies are isolated before working on the equipment. Be aware that there may be more than one supply connection to the drive.
4. There may still be dangerous voltages present at power terminals (motor output, supply input phases, DC bus and the brake, where fitted) when the motor is at standstill or is stopped.
5. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range.
   CAT I and CAT II meters must not be used on this product.
6. Allow at least 5 minutes for the drive's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and between power terminals and earth.
7. Unless otherwise stated, this product must NOT be dismantled. In the event of a fault the drive must be returned. Refer to "Routine Maintenance and Repair".

WARNING! - Ignoring the following may result in injury or damage to equipment

SAFETY

Where there is conflict between EMC and Safety requirements, personnel safety shall always take precedence.

- Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.
- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.
- When replacing a drive in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all external wiring is rated for the highest system voltage.
- Thermal sensors contained within the motor must have at least basic insulation.
- All exposed metalwork in the Inverter is protected by basic insulation and bonded to a safety earth.
- RCDs are not recommended for use with this product but, where their use is mandatory, only Type B RCDs should be used.

EMC

- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.
- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
- This is a product of the restricted sales distribution class according to IEC 61800-3. It is designated as "professional equipment" as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

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AC30 RESOLVER FEEDBACK

Introduction

The Resolver Feedback Option is compatible with the AC30 range of drives, with firmware versions 2.13 and 3.13 (or later). It offers compatibility with a wide range of resolvers from many manufacturers.

Using this module enables the AC30P or AC30D to operate in closed-loop speed control with resolvers fitted to PMAC or induction motors. Alternatively the resolver input may be used as a speed setpoint, with the drive operating in an open-loop (volts / Hz or sensorless) control mode.

Understanding the Product Code

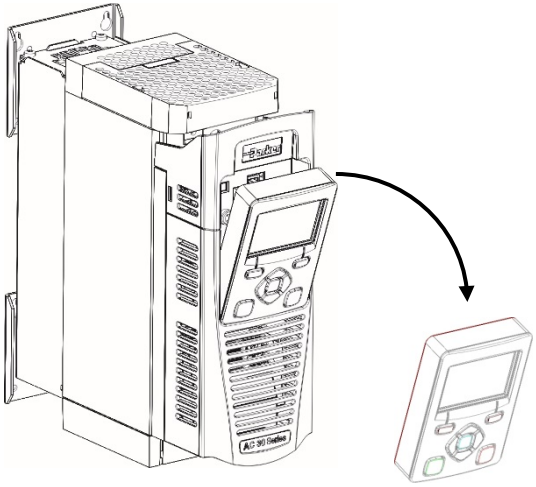
The Speed Feedback Option product code is of the form 7004-XX-YY.

Product Code	Features available
7004-05-00	1 x Incremental Resolver Feedback 1 x Motor Thermistor Input
7004-05-00	Standard optimized minimal conformal coating

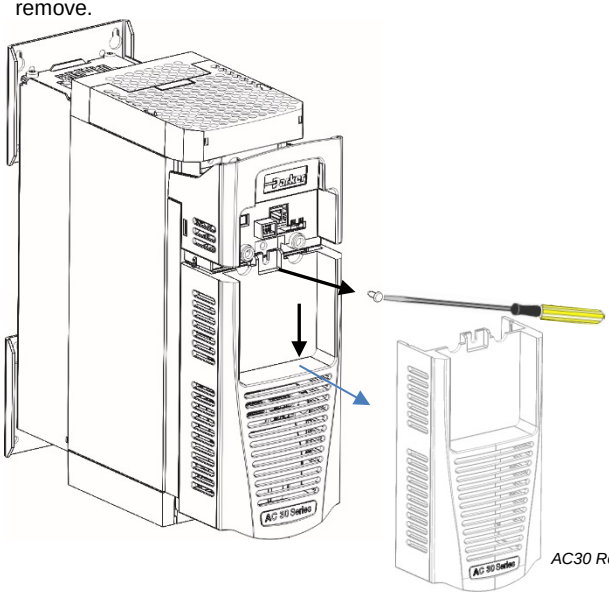
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Installation

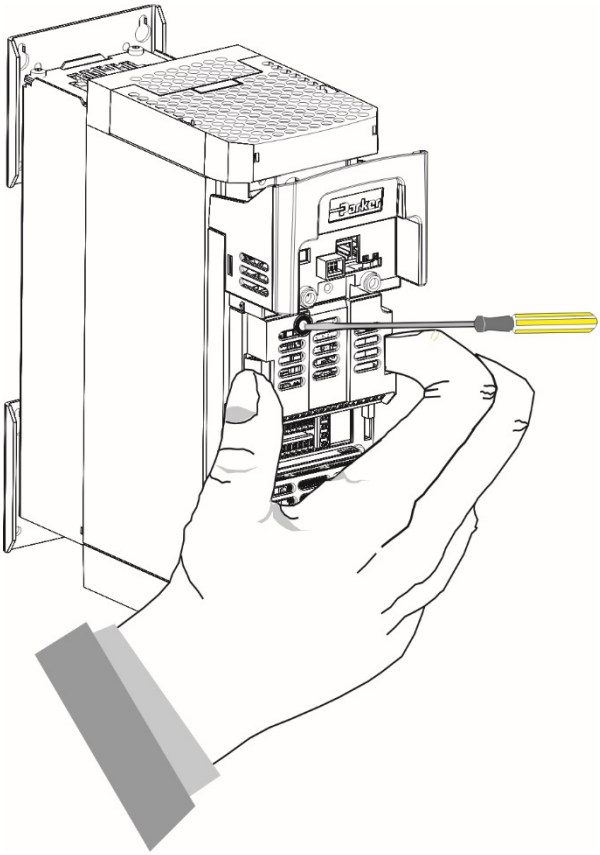
1. This equipment contains electrostatic discharged (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
2. Refer to the AC30 product manual Chapter 1: Safety before installing or removing a resolver feedback option.
3. Ensure all power is removed from the drive.
4. Remove the GKP by pulling from the top down, and remove.



5. After removing the screw, slide the VCM lower cover down slightly and then remove.



6. Click the Option into place and tighten the retaining screw, as shown.

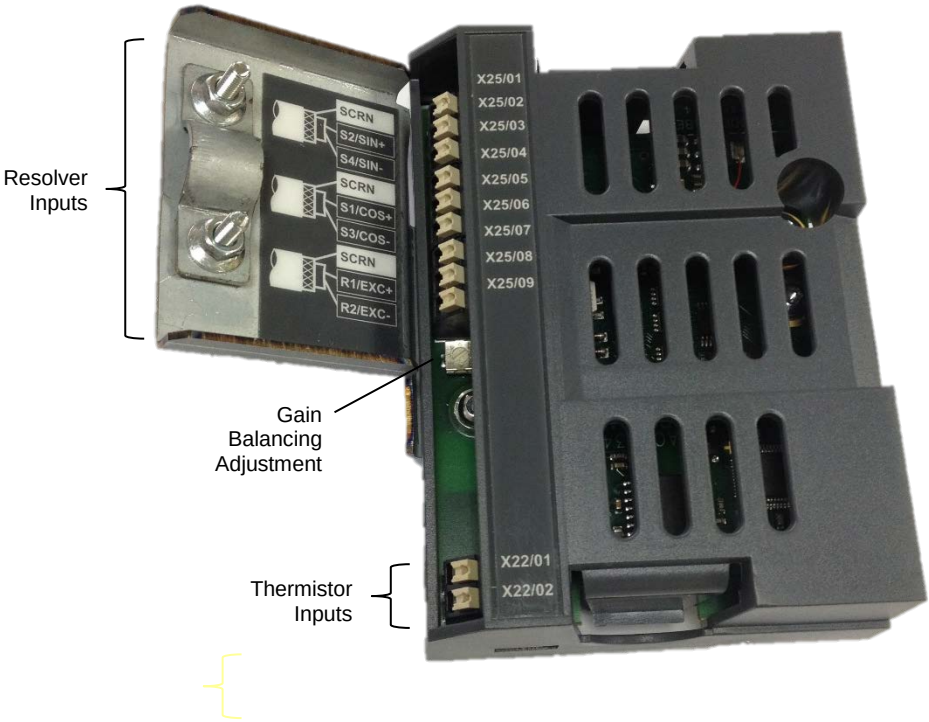


7. Slide and click back the VCM lower cover, tighten the retaining screw and slot back the GKP.

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User Terminals

The Resolver Feedback Option contains blocks of user terminals, as shown below.



User Wiring

Terminal Cable Specification

Solid minimum H05(07)V-U 0.2sqmm.

Solid maximum H05(07)V-U 1.5 sqmm.

Flexible minimum H05(07)V-K 0.2 sqmm.

Flexible maximum H05(07)V-K 1.5 sqmm.

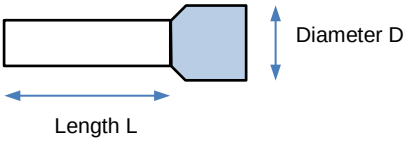
W.wire end Ferrule DIN46228 Pt 1 minimum 0.25 sqmm.

W.wire end Ferrule DIN46228 Pt 1 maximum 1.5 sqmm.

W.plastic collar Ferrule DIN46228 Pt4 0. 25 sqmm,
length L = 8mm or 10mm nominal, diameter D < 2.6mm

W.plastic collar Ferrule DIN46228 Pt4 0. 50 sqmm,
length L = 10mm nominal, diameter D < 3.8mm

W.plastic collar Ferrule DIN46228 Pt4 0. 75 sqmm,
length L = 10mm nominal, diameter D < 3.8mm



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Motor Thermistor

The motor thermistor input provides a means of monitoring motor temperature in order to protect the motor from a potentially damaging high temperature.

By default the drive will trip if the motor exceeds a user-defined temperature threshold thereby preventing the motor temperature from rising further.

Once tripped, the user can attempt to reset the trip at any time. However if the motor temperature is still above the trip threshold, the trip cannot be reset.

Refer to the Chapter 10 in the AC30 product manual (HA501718U002) for information on trips, possible causes, and how to reset them. A motor thermistor fault is identified in that manual as ID13 (Motor Overtemp).

Terminals

Terminal		Name	Range	Description
X22	01	TH1	0Ω to 4500Ω	Connect motor thermistor between these two terminals. If a thermistor is not required, connect these two terminals together, and ensure PTC thermistor is selected in parameter 1184.
	02	TH2		

Programming

Parameter Name (PNO)	Write / Read	Value Range	Description	
Thermistor Type (1184)	Write or Read	NTC PTC KTY	Thermistor type. Default = PTC	
Thermistor Resistance (1185)	Read only	0 to 5000Ω	Measured thermistor resistance.	
			0Ω	The thermistor measurement is invalid. Probably caused by a faulty encoder board.
			1Ω to 4500Ω	The thermistor measurement is valid. Note - A short circuit thermistor reports a small non-zero value.
			5000Ω	The thermistor is open-circuit or the measurement is invalid.
Thermistor Trip Level (1004)	Write or Read	0 to 4500Ω	Thermistor trip level. Default = 1000Ω	
			NTC	The drive trips if the thermistor resistance is less than this trip level.
			PTC or KTY	The drive trips if the thermistor resistance exceeds this trip level.
Thermistor Warn Delta	Write or Read	0 to 4500Ω	Thermistor warning level, expressed relative to the trip level (PNO 1004). Default = 100Ω	
			NTC	The drive warns if the thermistor resistance is less than the trip level plus this delta.
			PTC or KTY	The drive warns if the thermistor resistance exceeds the trip level less this delta.

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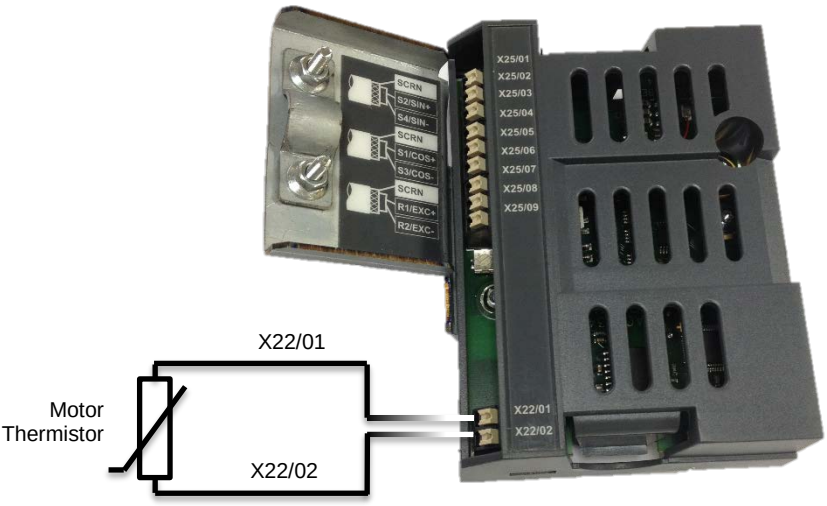
Specification

Thermistor resistance measurement range	0 to 4500Ω
Resistance measurement accuracy	±5% ±20Ω
Thermistor compatibility	NTC, PTC, KTY Default = PTC
Measurement supply voltage	1.3V @ 1kΩ
Motor temperature trip threshold	Resistance threshold set by user. Default = 1000Ω.
Update rate	1 second
Insulation	Reinforced insulation between thermistor terminals and drive electronics.

Important safety information:

Insulation and routing of wiring to the thermistor terminals must be appropriately rated to ensure the correct degree of insulation to other user wiring.

Example Application

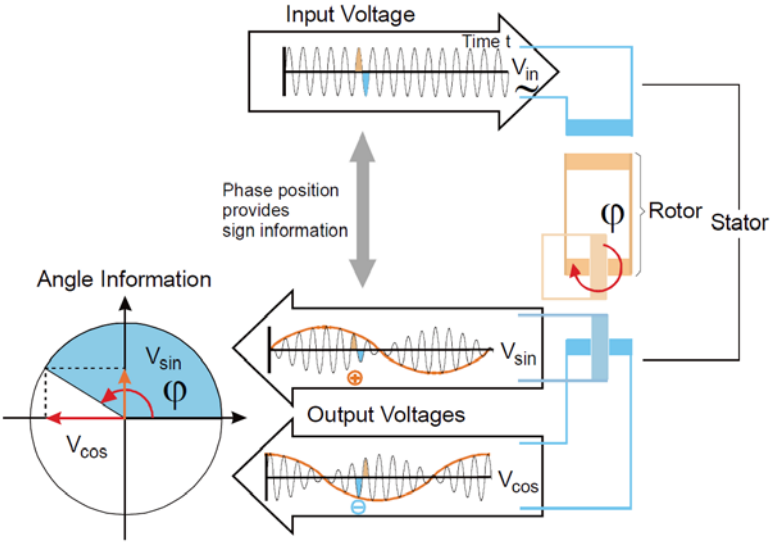


Resolver Feedback

The Resolver Feedback Option enables closed-loop speed control in the AC30P and AC30D drive products, with PMAC or induction motors.

A resolver provides absolute shaft angle feedback to the drive.
It is constructed as a rotary transformer with two secondaries positioned at 90° to each other. A sinusoidal 'excitation' voltage is applied to the resolver and two outputs are generated, one scaled by the sine of the shaft angle, the other scaled by the cosine.

The Resolver Feedback Option measures the relative sizes of the sine and cosine outputs from the resolver and converts this into shaft position and shaft speed data.



SINE Input: Vsin = Vexcitation x TR x sinθ

COSINE Input: Vcos = Vexcitation x TR x cosθ

where 'TR' is the transfer ratio of the resolver.

Resolvers are available in many forms, both mechanically and electrically.

Some have more than 2 poles and resultantly have more than one cycle of the sine / cosine output amplitudes for each mechanical rotation of the shaft.

Some have 'multi-turn' gearing, and resultantly require more than one mechanical rotation of the shaft for each cycle of the sine / cosine output amplitudes

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Terminals

Terminal		Name	Range	Description
X25	01	Sin Screen[1]	Selectable 2Vrms to 12Vrms	Sine feedback input, from resolver.
	02	Sin +		
	03	Sin -		
	04	Cos Screen[1]	Selectable 2Vrms to 12Vrms	Cosine feedback input, from resolver.
	05	Cos +		
	06	Cos -		
	07	Excitation Screen[1]	Selectable 4Vrms to 12Vrms	Excitation output, to resolver.
	08	Exc +		
	09	Exc -		

[1] All three screen inputs are connected directly to 0V inside the Resolver Feedback Option.

Programming

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Voltage (1790)	Write or Read	0V 4V 5V 6V 7V 8V 9V 10V 11V 12V	7V	The r.m.s. amplitude of the sinusoidal excitation voltage output. This is set to the resolver's requirement. Setting 0V will disable the excitation output.
Resolver Frequency (1791)	Write or Read	2kHz to 20kHz	8kHz	The frequency of the sinusoidal excitation voltage output. This is set to the resolver's requirement.
Resolver Ratio (1792)	Write or Read	0.15 to 3.00	0.50	The ratio of the amplitudes of the sine / cosine feedbacks to the excitation voltage output. This is set to the resolver's characteristic.
Resolver Max Speed (1825)	Write or Read	0 to 120000 rpm	20000 RPM	The maximum operating resolver shaft speed required. This is set to the application requirements, which must be no greater than the resolver rating. If the resolver is not the active feedback, this is used to auto-select the best possible speed / position resolution.
Resolver Poles (1793)	Write or Read	2 to 20	2	The number of poles in the resolver. This is set to the resolver's characteristic A 2-pole resolver has one sine / cosine amplitude cycle for each mechanical rotation of the shaft.

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Built-In Gear (1822)	Write or Read	0.1 to 1000.0	1.0	The mechanical gearing of the resolver, reflecting resolver shaft turns per resolver coil turn. This is set to the resolver's characteristic. For example, a multi-turn 2-pole resolver, that requires 10 resolver shaft rotations for each sine / cosine amplitude cycle, would use value 10.0.
Resolver Invert (1810)	Write or Read	TRUE or FALSE	FALSE	Used to set the direction of rotation which results in the position increasing positively, and the speed reporting as positive.
Resolver Position (1824)	Read Only	-32768 to 32767	-	(ENGINEER view level only.) Actual resolver coil position, expressed as a count value, where one complete amplitude cycle is 65536 counts.
Resolver Turns (1811)	Read Only	-(2^31) to +(2^31 -1)	-	The integer number of completed resolver shaft mechanical turns.
Resolver Fraction Turns (1812)	Read Only	-(2^31) to +(2^31 -1)	-	The fractional part of the number of resolver shaft mechanical turns.

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Speed Filter (1815)	Write or Read	10% to 10000%	1000%	The corner frequency of the speed-tracking, single-order filter applied to the raw resolver speed, before it is reported in the Resolver Speed parameters or used as speed feedback. Expressed in terms of the ratio of filter corner frequency to raw resolver cycle frequency. Used to remove speed ripple caused by the resolver measurement, particularly when the option is used as a reference speed input.
Resolver Min Filter (1851)	Write or Read	10Hz to 1000Hz	100Hz	Limit applied as the minimum corner frequency of the speed-tracking, single-order filter applied to the raw resolver speed. Used to prevent the speed-tracking filter from causing control instabilities at low speed.
Resolver Actual Filter (1826)	Read-Only	Units of Hz	-	The actual corner frequency being used for the speed-tracking, single-order filter applied to the raw resolver speed. The actual filter corner frequency is limited to 8000Hz maximum.
Resolver Speed RPM (1813)	Read-Only	Units of RPM	-	Resolver mechanical speed diagnostic / output.

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Speed % (1814)	Read-Only	Units of % (scaled by PNO 464)	-	Resolver mechanical speed diagnostic / output.
Resolver Speed Hz (1821)	Read-Only	Units of Hz	-	Resolver mechanical speed diagnostic / output.
Resolver Speed Ripple (1823)	Read-Only	Units of X % (scaled by PNO 464)	-	The peak-to-peak ripple in resolver speed samples. Used to assist the trimming process which gain matches the sine to cosine inputs. Calculated from max. speed – min. speed over last 128 samples on a 1ms sampling interval.
Resolver Resolution (1816)	Write or Read	AUTO 12 BITS 14 BITS 16 BITS	AUTO	The target resolution setting for the speed / position feedback. See 'Specifications' for limitations, prior to changing this parameter. The 'AUTO' setting is used to automatically select the best, allowable resolution, given other parameter settings. The resolution setting affects the dynamic performance of the feedback. In 'AUTO' mode, the actual resolution in use may be different from the target resolution, depending on other parameter settings Only change this parameter when motor is stopped / torque is off.

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Active Resol (1827)	Read-Only	12 BITS 14 BITS 16 BITS	-	The actual resolution setting for the speed / position feedback. The resolution setting affects the dynamic performance of the feedback. In 'AUTO' mode, the actual resolution in use may be different from the target resolution, depending on other parameter settings (see section 'Specifications').
Resolver State (1817)	Read-Only	ACTIVE TRIPPED	-	The state of the Resolver Feedback Option. ACTIVE = Operating TRIPPED = Not-Operating due to a detected fault (see parameter Resolver Trip Type). [1]A fault detected when the option is being used as the active feedback will cause a drive trip, stopping the motor.
Resolver Turns Reset (1818)	Write or Read	TRUE FALSE	FALSE	Used to reset both the Resolver Turns and Fraction Turns to zero, and Resolver Trip Type. The turns count parameters are held at zero whilst this parameter is held TRUE. The state of this parameter does not affect the operation of the resolver as a speed / position feedback, it only affects the turn count diagnostics.

[1] Note that a fault detected when the option is **not** being used as the active feedback will **not** cause a drive trip, and the appropriate trip response should be arranged by the user in the application.

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Reset Power On (1819)	Write or Read	TRUE FALSE	FALSE	When TRUE the Resolver Turns and Resolver Fraction Turns parameters are reset to zero on drive power-on. When FALSE the Resolver Turns and Resolver Fraction Turns parameters will persist through power cycling. The absolute shaft position with be retained, provided that no more than 180° of resolver coil rotation has occurred during the power-off state.

Parameter Name (PNO)	Write / Read	Value Range	Default Value	Parameter Description
Resolver Trip Type (1820)	Read-Only	NONE PARITY PHASE ERROR MAX VELOCITY TRACKING ERROR SIN COS MISMATCH SIN COS OVERRANGE SIN COS BELOW LOS SIN COS CLIPPED	-	Diagnostic that indicates the current (or most recent) trip type on the resolver option. May be reset to NONE by using parameter 'Resolver Turns Reset'. Value meanings: PARITY = Parity error in the configuration register of the option. Contact Parker for assistance. PHASE ERROR = Phase lag from excitation output to sin / cos inputs exceeds operating limit. Check resolver specification. MAX VELOCITY = Velocity exceeds maximum tracking rate. Select resolver with built-in gearing to reduce resolver velocity. TRACKING ERROR = Position tracking phase locked loop has exceeded its maximum error limit. Use a lower acceleration rate or select a lower target resolution. SIN COS MISMATCH = The amplitudes of the sine and cosine inputs differ excessively. Check input connections, and gain matching potentiometer setting. SIN COS OVERRANGE = One or both of the sine / cosine input signals is overrange. Check that the Resolver Ratio parameter is set correctly, and that the input signals do not exceed 12.5Vrms. SIN COS BELOW LOS = One or both of the sine / cosine input signals is underrange. Check that the Resolver Ratio parameter is set correctly, and that the input signals are at least 1.6Vrms. SIN COS CLIPPED = One or both of the sine / cosine input signals is overrange and being clipped. Check that the Resolver Ratio parameter is set correctly, and that the input signals do not exceed 12.5Vrms.

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Specification

Excitation Output	
Nominal Excitation Voltage	Software adjustable in steps: Min. 4V rms Max. 12V rms Resolution 1V rms steps
Excitation Voltage Accuracy	± 14%
Excitation Disable	Yes – set excitation voltage to 0V
Nominal Excitation Frequency	Software adjustable: Min. 2.00kHz Max. 20.00kHz
Excitation Frequency Accuracy	± 200Hz
Output Drive capability	Max. 70mA rms
Output protection	Short-circuit protected (Resettable internal fuse at approx. 180mA output rms.)
Output Voltage Cross-Over Distortion at Current Direction Change	Approx. 1uVs pk (compared to half period between 90uVs and 2700uVs for 4V @ 20kHz and 12V @ 2kHz respectively)
Isolation	**Not** isolated from drive control circuitry.

Sine / Cosine Inputs	
Input Type	Differential
Nominal Input Scaling	Configured by 'Resolver Ratio' parameter): Min. 2V rms Max. 12V rms
Diff. Input Z	Approx. 2.4kΩ + 1nF (series)
Absolute Maximum Input Voltage	± 24V pk differential, or with respect to drive control 0V.
Isolation	Inputs **not** isolated from drive control circuitry, nor from each other.

Resolver to Digital Conversion	
Resolution[1]	Software Selectable: - **12-bits** (5.3 arc min / 36 rpm) only use for excitation between 6kHz and 20kHz. - **14-bits** (1.3 arc min / 4.4 rpm) only use for excitation between 3kHz and 12kHz, and *max. speed parameter* set < 30000rpm. - **16-bits** (0.3 arc min / 0.29 rpm) only use for excitation between 2kHz and 10kHz, and *max. speed parameter* set < 7500rpm. *where max. speed parameter = PNO 464 if the option is the active feedback, else PNO 1825.*
Angular Accuracy (excluding resolution effects)	< ± 10 arc min
Steady-State Speed Output Variation Over One Coil Cycle	Trim to < 0.2% typical at 50Hz resolver coil speed.
Maximum External Phase Shift Allowed	± 25° (excitation output to inputs) of excitation frequency
Absolute Maximum Resolver Coil Speed Measured	70,000 rpm @ 12-bits 35,000 rpm @ 14-bits 9,000 rpm @ 16-bits
Maximum Resolver Coil Acceleration	90000 rps^2 @ 12-bits 48000 rps^2 @ 14-bits 2400 rps^2 @ 16-bits
Typical Measurement Dynamic Performance - Bandwidth	2000Hz @ 12-bits 1000Hz @ 14-bits 200Hz @ 16-bits

[1] Note that the Resolver Speed Filter can be used to effectively increase resolution on the speed outputs, when using the lower resolution settings.

Resolver Cable

The ideal cable should have:

- Three twisted pairs
  (one pair each for excitation output, sine input and cosine input)
- Each pair individually screened
- Overall shield
- Maximum cable length of 50m

Cable Screen Connections

At the resolver option end of the cable:

Terminals X25/01, X25/04 and X25/07 are for terminating the individual screens from each of the twisted-pairs. Do **not** take these inners screens to the resolver option cabling bracket.
The outer cable screen should be exposed and trapped under the cable clamp on the resolver option cabling bracket.

At the resolver end of the cable:

All screens should be left unconnected, but isolated from each other.

Resolver Alignment to PMAC Motor

When used with PMAC motors, in closed-loop speed / position control, the drive must be setup to allow for the alignment of the physical angle of the resolver with regard to the motor windings.

Please refer to the AC30 user manual HA501718U001 for information on how to manually or automatically correct for this physical alignment.

Sine / Cosine Input Gain Matching

The signal levels in the sine and cosine feedbacks from the resolver must be well matched in amplitude in order to prevent speed ripple appearing in the measurement at twice the resolver coil frequency.



Important safety information:

Remove and appropriately insulate the motor thermistor wiring during this adjustment, to avoid accidental contact with it. This may require temporarily masking the motor thermistor trip.



An adjustment point is provided on the option to allow for relative adjustment of the sine and cosine signal amplifications.

With the resolver running at typical application speed, parameter ‘Resolver Speed Ripple’ (PNO 1823) should be observed and the adjustment varied (by fine flat screwdriver) to minimize the speed ripple.

Closed-Loop Operation

Please refer to the AC30 user manual HA501718U001 for information on setting up and running the drive in closed loop operation using resolver feedback.

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Accessories

Resolver Cable for use with Parker PMAC Motors

A resolver cable accessory is available for use with certain PMAC motors from Parker.

Part Number	Motor Ranges For Use With
CS7UA1F1R00xx where xx = cable length in meters, max. 50m.	NX, MGV, EY, NV
CS7UA1D1R00xx where xx = cable length in meters max. 50m.	EX

The cable has a 12-pin circular connector at the resolver end, and is wire-ended at the AC30 feedback option end.

The wire colourings for connection to the option's terminals are detailed.

Wire Colour (from pair)	Function	Option Terminal
Screen (black/blue pair)	Screen	25/01
Black (black/blue pair)	SIN +	25/02
Blue	SIN -	25/03
Screen (black/white pair)	Screen	25/04
Black (black/white pair)	COS +	25/05
White	COS -	25/06
Screen (black/red pair)	Screen	25/07
Red	EXC +	25/08
Black (black/red pair)	EXC -	25/09
Green	Thermistor	22/01
Black (black/green pair)	Thermistor	22/02

Environmental

Restriction, Evaluation, Authorisation and Restriction of Chemicals (REACH)

The Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) entered into force on June 1, 2007. Parker agrees with the purpose of REACH which is to ensure a high level of protection of human health and the environment. Parker is compliant with all applicable requirements of REACH.

The registration requirements do not apply to Parker since it is neither a manufacturer nor an importer of preparations into Europe.

However, product (article) manufacturers or importers into Europe are obligated under Article 33 of REACH to inform recipients of any articles that contain chemicals on the Substances of Very High Concern (SVHC) candidate list above a 0.1% concentration (by weight per article). As of 19th December 2011 VSD products manufactured and marketed by Parker do not contain substances on the REACH SVHC candidate list in concentrations greater than 0.1% by weight per article. Parker will continue to monitor the developments of the REACH legislation and will communicate with our customers according to the requirement above.

Restriction of Hazardous Substances (RoHS)

This product is in full compliance with RoHS Directive 2011/65/EU, with respect to the following substances:

1) Lead (Pb),
2) Mercury (Hg),
3) Cadmium (Cd),
4) Hexavalent chromium (Cr (VI)),
5) Polybrominated biphenyls (PBB),
6) Polybrominated diphenyl ethers (PBDE).

Waste Electrical and Electronic Equipment (WEEE)



Waste Electrical and Electronic Equipment - must not be disposed of with domestic waste.

It must be separately collected according to local legislation and applicable laws.

Parker Hannifin Company, together with local distributors and in accordance with EU directive 2002/96/EC, undertakes to withdraw and dispose of its products, fully respecting environmental considerations.

For more information about how to recycle your Parker supplied waste equipment, please contact your local Parker Service Centre.

Packaging

During transport our products are protected by suitable packaging. This is entirely environmentally compatible and should be taken for central disposal as secondary raw material.

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