Rotary Position Transducers

Single-Turn, Geared Single-Turn, and Dual (Multi-Turn) RESOLVERS

Instruction & Operation Manual

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Instruction Manual

Resolvers

Rugged and Reliable

The resolver is a highly accurate and highly dependable device for absolute position shaft encoding. Resolvers have a reliable track record of applications in aerospace, military, and industry, where they have been used for decades for position sensing. Some of the common applications are radar antenna position sensing, missile guidance systems, NC machine position feedback, automotive stamping presses, 2 piece can-manufacturing presses and packaging machines. The resolver is designed to operate reliable under extremely hostile environments, such as; continuous mechanical shock, vibration, extreme temperature and humidity changes, oil mist, coolants and solvents.

The resolver is a passive transducer. It is a brushless rotary transformer with one rotor and two stator windings. The stator windings are electrically 0 degrees out of phase with each other. As the shaft rotates, the relative position of the rotor and the stator windings change. Either the rotor or the two stator windings together can be used as the primary of the rotary transformer and the secondary will then produces an analog voltage corresponding to the shaft position.

RL100 Resolver — The Workhorse of the Industry

Autotech's Model RL100 resolver is the most rugged resolver in the industry today. Autotech has over 25,000 of these resolvers operating with extreme reliability in highly demanding applications in automotive, can-manufacturing and packing industries. Rugged industrial housing, heavy duty double row ball bearings, and an internal flexible coupling lend to an extremely reliable design.

Built-in Gear Train for Multi-turn Application

Various resolver models from Autotech are available with a built-in precision gear train. The resolver makes 1 turn for many turns (see *How to Order* for gear ratios available) of the input shaft.

Explosion Proof, FM Approved

Autotech's series E8R resolver has FM approved explosion proof housing and meets the requirements as per Class 1, Division 1, Groups B, C, and D.

Submersible, Stainless Steel Resolver

Autotech's RL101-RM11 resolver is NEMA 6P compliant for operation in submersible depths of up to 100 feet. It is chemically resistant to a wide variety of solvents, hydrocarbons, water, and sea water. The housing and all fasteners are 316 stainless steel.

Dual Resolvers for Multi-Turn Application

A multi-turn resolver consists of two resolvers coupled to each other through a gear train. One of the resolvers, called the fine resolver, is coupled to the machine shaft in such a way that it turns at the same RPM as the machine, while the other resolver, called the coarse resolver, is geared down by the gear ratio used. As the shaft of the multi-turn resolver turns with the machine movement, the coarse resolver keeps track of the number of revolutions and the fine resolver keeps track of the shaft position in each revolution. Thus the combination of the two resolver signals gives the absolute machine position. The gear train uses an anti-backlash gear to eliminate backlash errors.

Specifications

ELECTRICAL

Frequency: 2250 Hz
Input voltage: 1.88 V
Input current: 6 mA
Input power: 6.5 mW watts

Rotor impedence with stator
Open circuit Z_{ro}: 180+ j256 ohms
DC resistance (Rotor): 18.3 ohms
Output voltage (Stator): 2.63 V ± 5%
Transformation ratio: 1.400

MECHANICAL					
Resolver	**SAC-RL100 SAC-RL210**	**E8R-RL101 E8R-RL210-xxxMC**	**E6R-RL101 E7R-RL101**	**SAC-RL101**	**SAS-RL101-RM11**
Housing Size	Size 40 (4.0″ dia.)	Size 40 , Explosion Proof (4.0″ dia.)	Size 25 (2.5″ dia.)	Size 11 (1.1″ dia.)	Size 40, Submersible (4.0″ dia.) (316 SS)
Max. Starting Torque @ 25° C (oz-in):	8	8	5	0.07	8
Moment of Inertia (gm/cm^2)	45	45	45	3.3	45
Max. Slew Speed (RPM):	5000	5000	5000	3600	100
Shaft Size:	5/8″	5/8″	3/8″	0.120″	5/8″ (316 SS)
Max. Shaft Loading: Axial (lbs): Radial (lbs):	 50 100	 50 100	 40 6(E6R), 36 (E7R)	 0.3 0.7	 50 100
Bearing life at Max. Mfr. Spec. (Rev.)	$2x10^9$	$2x10^9$	$2x10^8$	$2x10^9$	$2x10^9$
Approx. Weight (lbs):	6	8	1	0.25	11
ENVIRONMENTAL					
Shock:	200g for 11 mSec.			50g for 11 mSec	200g for 11 mSec
Vibration:	20g to 2000Hz			15g to 2000 Hz	20g to 2000 Hz
Operating Temperature:	-67 to 248° F				29 to 100° F
Storage Temperature:	-85 to 302° F				-20 to 180° F
Enclosure:	NEMA 13	NEMA 4X Class I, Div I, Groups B, C, D	NEMA 13	NEMA 1	NEMA 6P
Special Features:					Submerged Working Depth = 100 Ft. Chemically resistant to wide variety of solvents, hydrocarbons, water, and sea water.

How to Order

Single-turn and Geared Single-turn Rotary Position Transducers

Size 40 NEMA 13/NEMA 4/Intrinsically Safe/Submersible

SAC-RL100-010 Brushless resolver, single-turn, NEMA 13, 5/8" shaft dia, with wiring terminal block.

SAC-RL100-M11 Above resolver with MS connector

SAC-RL100-M11T Above with built-in transformer and the following specification changes 1. Rotor Input Volts: 4 Vrms, 2. Stator Output Voltage: 2 Vrms ± 10%, 3. Transformation Ratio: 0.5 @ 5000 Hz

SAC-RL100-GXXX ***** Brushless resolver with XXX : 1 built-in gear train

where XXX = 002, 003, 004, 008, 012, 016, 020, 024, 032, 036, 040, 048, 060, 064, 080 or 100

***** *Terminal connections standard; Add suffix* **M** *for MS Connector*

Substitute "C" in SAC-XXXXX-XXX with "4" for NEMA 4 rating

SAS-RL101-RM11 Stainless steel, submersible resolver NEMA 6P

Size 40, Explosion Proof

E8R-RL101-XXX **MC** Explosion proof brushless resolver, single-turn, Class I, Div I, Groups B, C, and D, FM approved, terminal connections, 5/8" shaft dia., with built-in XXX : 1 gear train,

Where XXX = 000 (**No gears**)
002, 003, 004, 008, 012, 016, 020, 024, 032, 036, 040, 048, 060, 064, 080 or 100

Size 25 NEMA 13/NEMA 4

EX**R-RL101-000** X X Brushless resolver, single-turn, NEMA 13, 3/8" shaft dia.

Connector Position:
E: Back-end **S**: Side

Mounting
F: Flange Mount **S:** Servo Mount

Mechanical characteristics
1: Engineered plastic housing, corrosion resistant, light duty NEMA 13. Light duty bearing, 6 lbs radial load (Must use external flexible coupling)
7: Metal housing, medium duty bearing, 36 lbs radial load, NEMA 13. For NEMA 4, substitute "000" in E7-RL101-000XX by "NE4"
9: Engineered plastic housing, corrosion resistant, medium duty bearing, 36 lbs radial load, NEMA 4X

Size 11

SAC-RL101-010 Brushless resolver, single turn, size 11

Dual (Multi-turn) Resolvers

Size 40

SAC-RL210-G XXX *****

Dual Brushless resolver, multi-turn, NEMA 13, 5/8" shaft dia.
with XXX: 1 built-in gear train between the two resolvers,
where XXX = 064 or 128
***** *Terminal connection standard; Add suffix* **M** *for MS Connector*

Size 40, Explosion Proof

E8R-RL210- XXX **MC**

Explosion proof, Dual Brushless resolver, conduit fitting, multi-turn, Class I, Div I, Groups B, C, and D, FM approved, terminal connections, 5/8" shaft dia. with built-in XXX : 1 gear train between the two resolvers,
where XXX = 064 or 128

Accessories

Please NOTE: See page 10 for how- to- order information for the cable and connector used with the RL101-RM11 Submersible Resolver.

CABLES

CBL-10T22-X XXX

22 AWG, 10 conductor (5 twisted pairs) overall foil shielded cable

Length in feet

Standard lengths are 010, 020, 050 feet and increments of 50 ft (e.g.: 100,150, 200, etc.)

Connector

C: Without connector
M: With 10 pin MS connector (ECM-10REC-ITT) on one end

CBL-RL210-MXXX

22 AWG, 10 conductor (5 twisted pairs) overall foil shielded cable, with 19 pin MS connector (ECM-19REC-ITT) on one end

Length in feet

Standard lengths are 010, 020, 050 feet and increments of 50 ft (e.g.: 100, 150, 200, etc.)

COUPLINGS

CPL-001/4-1/4	1/4" to 1/4" flexible coupling
CPL-003/8-3/8	3/8" to 3/8" flexible coupling
CPL-005/8-5/8	5/8" to 5/8" flexible coupling

MATING CONNECTOR

ECM-10REC-ITT	10 pin Mating MS connector for single turn resolvers with MS connector (MS 3116F-12-10S)
ECM-19REC-ITT	19 pin Mating MS connector for multi-turn resolvers with MS connector (MS 3116F-14-19S)

MOUNTING BRACKET

MMB-EN359-010	Mounting bracket for **size 25 & 40** resolvers

Mounting

Autotech resolvers are designed to operate reliably under extremely hostile environments, such as; continuous mechanical shock, vibration, extreme temperature and humidity changes, oil mist, coolant and solvents. Still ordinary precautions to prevent damage to bearings of any rotation device should be followed to prolong their life.

1. It is recommended that the Autotech encoder mounting bracket (MMB-EN359-010) be used, wherever possible, for size 40 resolvers.

   The servo-mount resolvers may be mounted either with traditional servo-clamps or through the four threaded mounting holes on the face of the resolver.

   The flange-mount resolvers are mounted using four mounting holes in the square flange.

2. If the resolver is to be axially shaft driven, be sure that the shafts are aligned. Misaligned shafts can destroy resolver bearings.

3. If a pulley, coupling, or sprocket is mounted to the resolver shaft, DO NOT hammer or press on the shaft. DO NOT force fit anything on to or off of the resolver shaft.

CAUTION

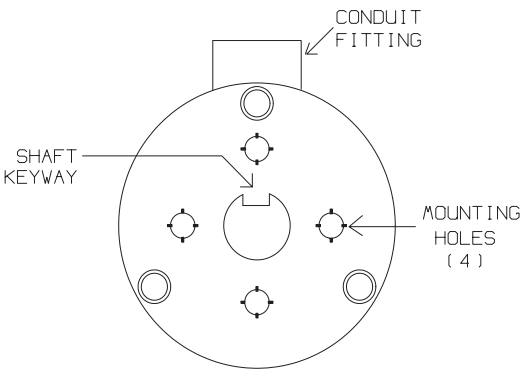
E6R and RL101 (size 11) resolvers must be coupled to an external shaft using a flexible coupling. See "How to Order" page.

4. If the resolver is belt-driven or chain-driven, DO NOT OVERTIGHTEN the drive belt or chain. Too much side loading (radial) can destroy the resolver bearings. Side loading is not allowed for E6R and RL101 (size 11) resolvers.

5. To maintain the NEMA 13 rating of the resolver, the following precautions must be taken: a) sealing compound must be used when fitting the conduit pipe; b) the bearing seal must be checked once every six months and replaced if necessary. Lubricating the bearing seal periodically prolongs its life.

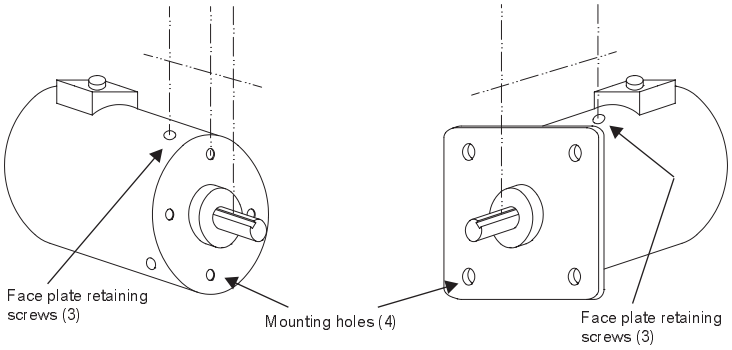
6. Zero Reference: For most resolver types, the approximately zero reference may be located by aligning the shafts as shown in the figures below.

Zero Reference-Size 40 resolvers (SAC-RL100, E8R and SAC-RL210)



Size 40 resolvers are at approximately zero when the shaft key way is aligned with mounting hole and conduit fitting.

Zero Reference-Size 25 resolvers (E6R and E7R)



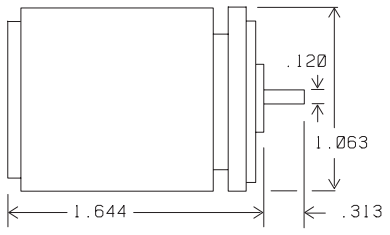
Servo mount resolvers: *Align shaft keyway with the face plate retaining screw which is in line with a mounting hole.*

Flange mount resolver: *Align shaft keyway with the face plate retaining screw that lies midway between two mounting holes.*

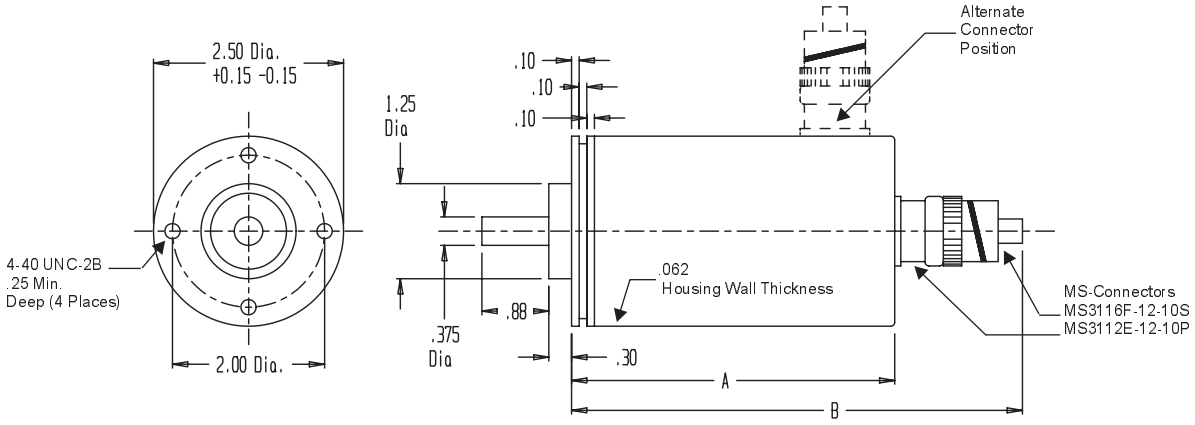
Outline Dimensions

The outline dimensions of the resolvers are shown in the following diagrams.

Size 11, SAC-RL101-010 Resolver

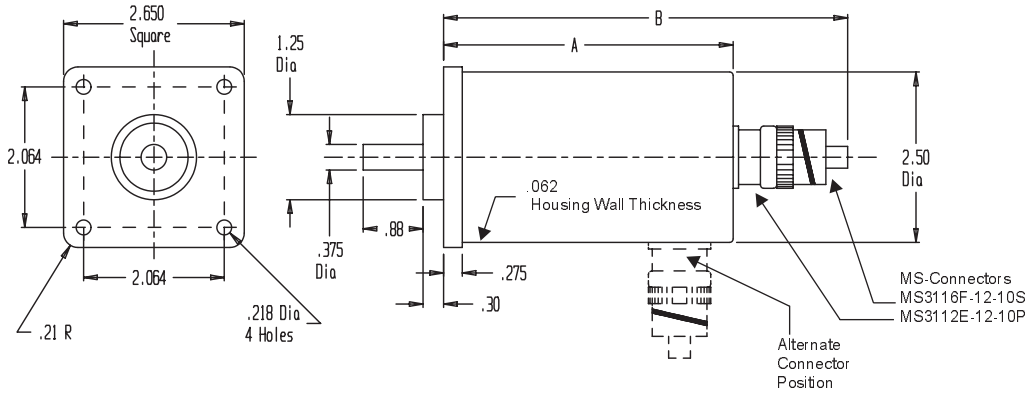


Size 25, *Resolvers* E6R-RL101, E7R-RL101 with Servo-mount



Dimension	*E6R*	*E7R*
A	3.27"	3.87"
B	5.375”	5.975”

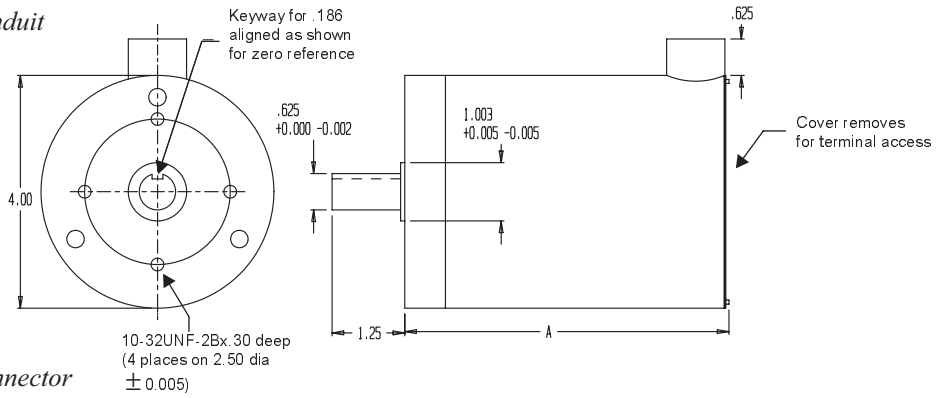
Size 25, *Resolvers* E6R-RL101, E7R-RL101 with Flange-mount



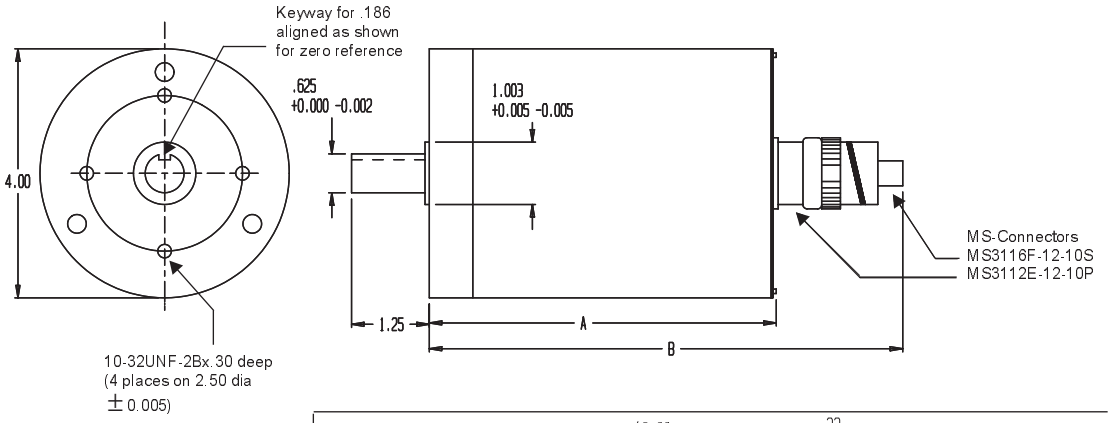
Dimension	*E6R*	*E7R*
A	3.27"	3.87"
B	5.375”	5.975”

Size 40 *Resolvers* SAC-RL100 and SAC-RL210

Resolver with conduit

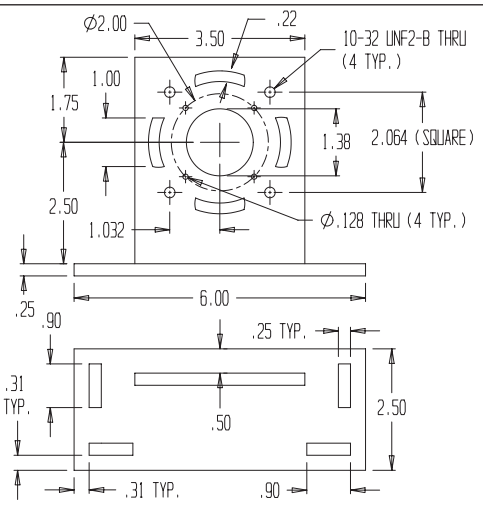


Resolver with end connector

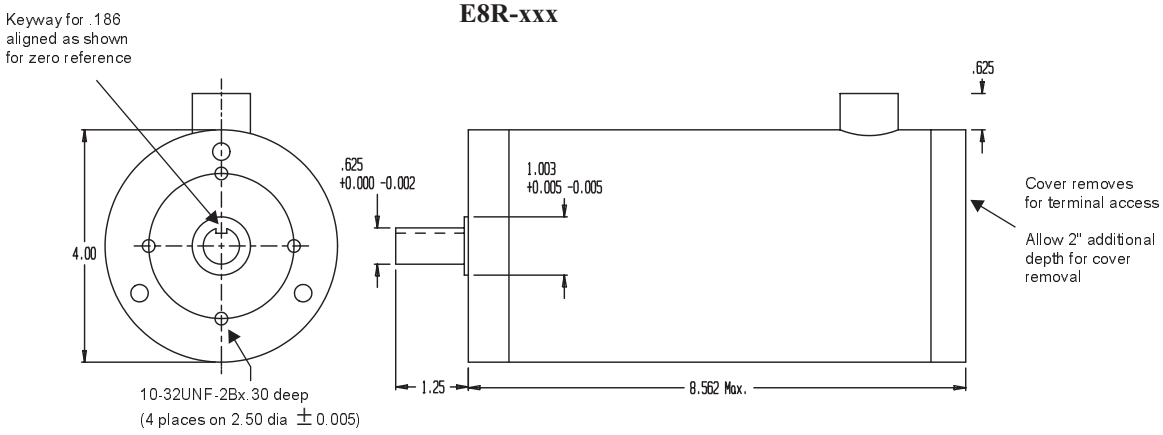


Dimension	*RL100*	*RL210*
A	5.50"	6.50"
B	7.60"	8.60"

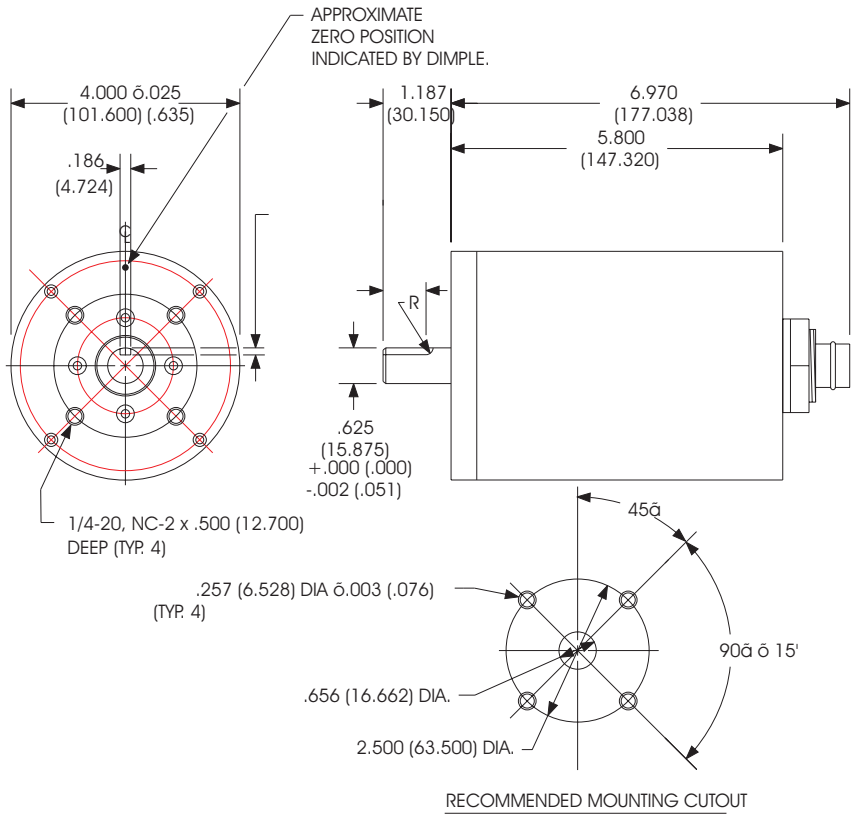
Mounting bracket for size 25 and 40 Resolvers



E8R-xxx



SAS-RL101-RM11 Submersible Stainless Steel Resolver
Overall and Mounting Dimensions/Zero Reference



Wiring

Wiring Table
SAC-RL101-010 resolver
(The unit comes with 12-inch pigtails)

Wire color	Function
Red	S1 Stator
Black	S3 Stator
Yellow	S2 Stator
Blue	S4 Stator
Red/White	R1 Rotor
Yellow/White	R2 Rotor

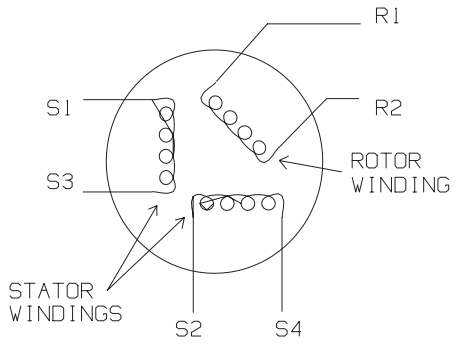
Note:
It is strongly recommended that this unit be connected using twisted pairs of wires. The pairs must be formed as follows:

Wiring Table for Single-turn Resolvers
E6R-RL101, E7R-RL101, SAC-RL100, E8R-RL101

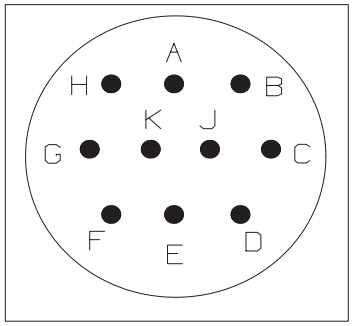
CBL-10T22-xxxx Wire Color		Signal / Function	Resolvers with terminals		Resolvers with MS Connectors Pin #
			SAC-RL100-010	SAC-RL100-Gxxx	
Black/Green	Twisted pair	Rotor R1	R1 (RL)	1	F
Green		Rotor R2	R2 (RH)	2	E
Black/Yellow	Twisted pair	S1 Stator	S1	3	D
Yellow		S3 Stator	S3	5	C
Black/Blue	Twisted pair	S2 Stator	S2	4	B
Blue		S4 Stator	S4	6	A
Shield		Case Ground	GND (Green Screw)	GND (Green Screw)	G

Notes:
1. Black/Green indicates a black wire with green stripes.
2. An overall foil shielded cable with twisted pairs (such as Autotech's cable CBL-10T22-xxxx) must be used or wiring the unit. The pairs must be formed as follows: S1 and S3, S2 and S4, R1 and R2
3. MS connector: MS3112E-12-10P; Mating connector: MS3116F-12-10S (Autotech P/N ECM-10REC-ITT).
4. MS connector is not available with E8R series.

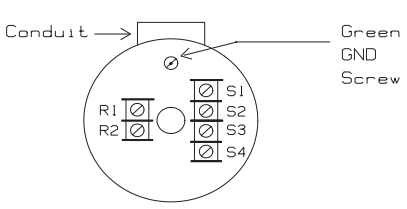
Resolver Windings



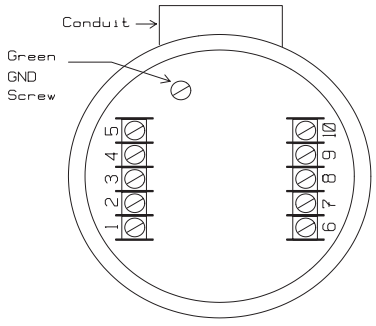
MS Connector on a Single-Turn Resolver



Terminal Block on a Single-Turn Resolver



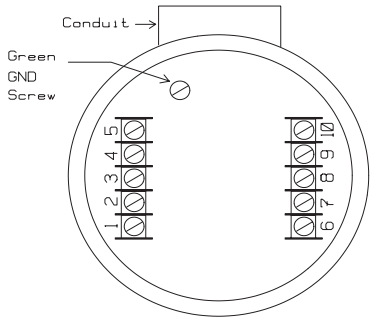
Terminal Block on a Geared Single-Turn Resolver



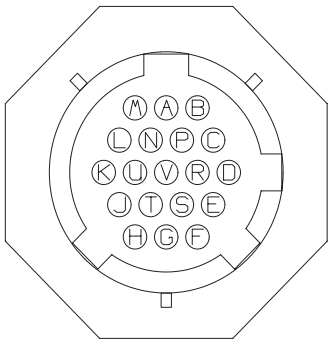
Wiring Table for Dual (Multi-turn) Resolvers SAC-RL210, E8R-RL210			
CBL-RL210-Mxxx Wire Color	Signal / Function	Resolver Terminal	MS Connector Pin #
Black/Green (Twisted pair)	Rotor R1	1	A
Green	Rotor R2	2	B
Black/Yellow (Twisted pair)	Coarse Stator CS1	3	C
Yellow	Coarse Stator CS3	5	E
Black/White (Twisted pair)	Coarse Stator CS2	4	D
White	Coarse Stator CS4	6	F
Black/Red (Twisted pair)	Fine Stator FS1	7	H
Red	Fine Stator FS3	9	L
Black/Blue (Twisted pair)	Fine Stator FS2	8	K
Blue	Fine Stator FS4	10	M
Shield	Case Ground	GND Green Screw	S

Notes:
1. Black/Green indicates a black wire with green stripes.
2. MS connector: MS3112E-14-19P; Mating connector: MS3116F-14-19S (Autotech P/N ECM-19REC-ITT).
3. MS connector is not available with E8R series.

Terminal Block on a Dual (Multi-Turn) Resolver



MS Connector on a Dual (Multi-Turn) Resolver



Grounding and Shielding

1. Resolver wiring must be done using twisted pairs in cable with an overall foil shield. The twisted paris must be wired as per wiring instructions. See "How to Order" section for suitable cable offered by Autotech.

2. It is recommended that the shielded resolver cable be routed in its own conduit or cable tray.

3. All shielded resolver cable must be kept at a minimum distance of 2 inches from all high voltage or inductive wiring.

4. All shielded resolver cable must be kept at a minimum distance of 12 inches from all motor wiring controlled by AC or DC drives.

5. All ground planes (chassis grounds) in the total system must be held to the same RF potential, by good metallic connections to building frames, conduit or wiring trays.

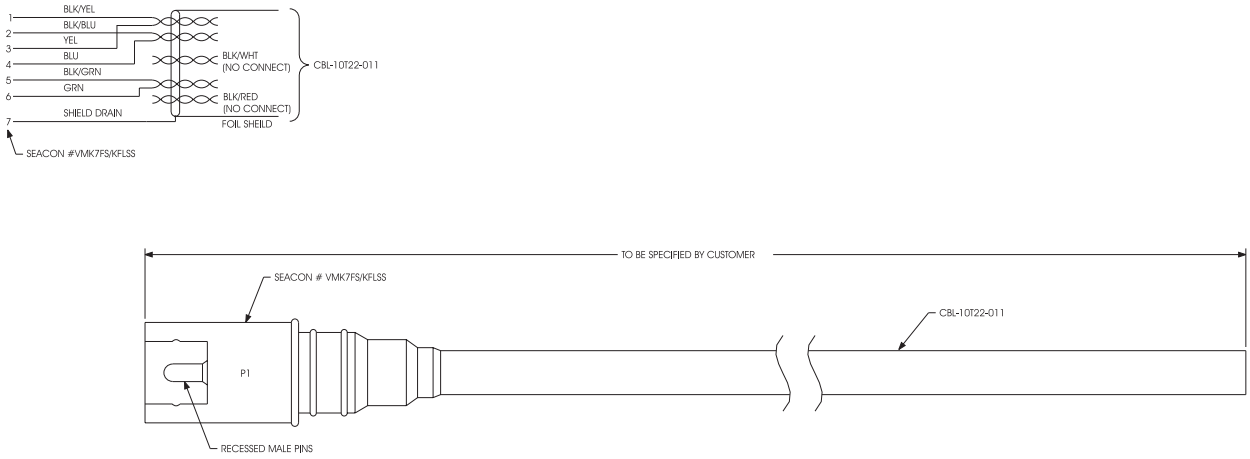
6. The shield drain wires may be terminated in one of two ways.

a) Connect to chassis ground at each end and not connected to signal reference at any pont in the system.
b) Connect to signal reference at the decoder only. The shield drain should remain unconnected at the resolver end and the shield should not touch earth ground at any point in its run.

NOTE: Resolver with MS connectors have shield drain wire pre-terminted for method a).

Method a) is recommended for all Autotech products. In certain circumstances, in unusual EMI conditons, method b) may be necessary after consulting factory.

Mating Cable and Connector for Submersible Resolver



Wiring Table for Submersible Resolver SAS-RL101-RM11

Resolver Connector #VMK7FS/KFLSS	Wire Color	CBL-10T22-011 Termination
P1-1	Black/Yellow Twisted Pair	None
P1-2	Yellow	None
P1-3	Black/Blue Twisted Pair	None
P1-4	Blue	None
P1-5	Black/Green Twisted Pair	None
P1-6	Green	None
P1-7	Shield Drain	Shield Drain
N/C	Black/White Twisted Pair	None
N/C	Black/Red Twisted Pair	None

Mating Cable and Connector for the Submersible Resolver SAS-RL101-RM11

This resolver is equipped with a seven pin female bulkhead connector. The manufacturer's part number is Seacon #VSK-7-BCL. The recommended cable to be used with this resolver is AVG #CBL-10T22-011.

The Mating Connector (Seacon #VMK-7-FS/KFLSS) for the resolver is available from: Seacon/Brantner and Associates, Inc., 1240 Vernon Way, El Cajon, CA 92020 (Phone: 619-562-7071, FAX: 619-562-9706). This connector is molded onto the customer supplied cable as follows:

1. Telephone Seacon /Brantner and request a "CF" number (CF stands for "Customer Furnished").
2. Send cable with the "CF" number and purchase order along with a copy of the drawing (above) from this document.
3. Request termination of cable (per this drawing) to Seacon "VMK-7-FS/KFLSS and mold.

WARRANTY

Autotech Corntrols warrant their products to be free from defects in materials or workmanship for a period of one year from the date of shipment, provided the products have been installed and used under proper conditions. The defective products must be returned to the factory freight prepaid and must be accompanied by a Return Material Authorization (RMA) number. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Autotech Controls harmless from, defend, and indemnify Autotech Controls against damages, claims, and expenses arising out of subsequent sales of Autotech Controls' products or products containing components manufactured by Autotech Controls and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or subcontractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (p.l. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The customer acknowledges the disclaimers and limitations contained and relies on no other warranties or affirmations.

CAUTION

Autotech Controls' products are carefully engineered and rigorously tested to provide many years of reliable operation. However any solid-state device may fail or malfunction sometime.The user must ensure that his system design has built-in redundancies if Autotech Controls' product is being used in applications where a failure or malfunction of the unit may directly threaten life or cause human injury. The system should be so designed that a single failure or malfunction does not create an unsafe condition. Regularly scheduled inspections, at least once a week, should be made to verify that the redundant circuits are fully functional. All faults should be immediately corrected by repair or replacement of the faulty unit. In addition, the user may have to comply with OSHA, ANSI, state or local standards of safety. The user of Autotech Controls' products assumes all risks of such use and indemnifies Autotech Controls against any damages.

The information in this book has been carefully checked and is believed to be accurate; however, no responsiblility is assumed for inaccuracies. Autotech Controls reserves the right to make changes without further notice to any products herein to improve reliablility, function or design. Autotech Controls does not assume any liability arising out of application or use of any product described herein.

Autotech Controls does not recommend the use of its products in applications wherein a failure or malfunction of the unit may directly threaten life or cause human injury. The user of Autotech Controls' products assumes all risks of such use and indemnifies Autotech Controls against all damages.