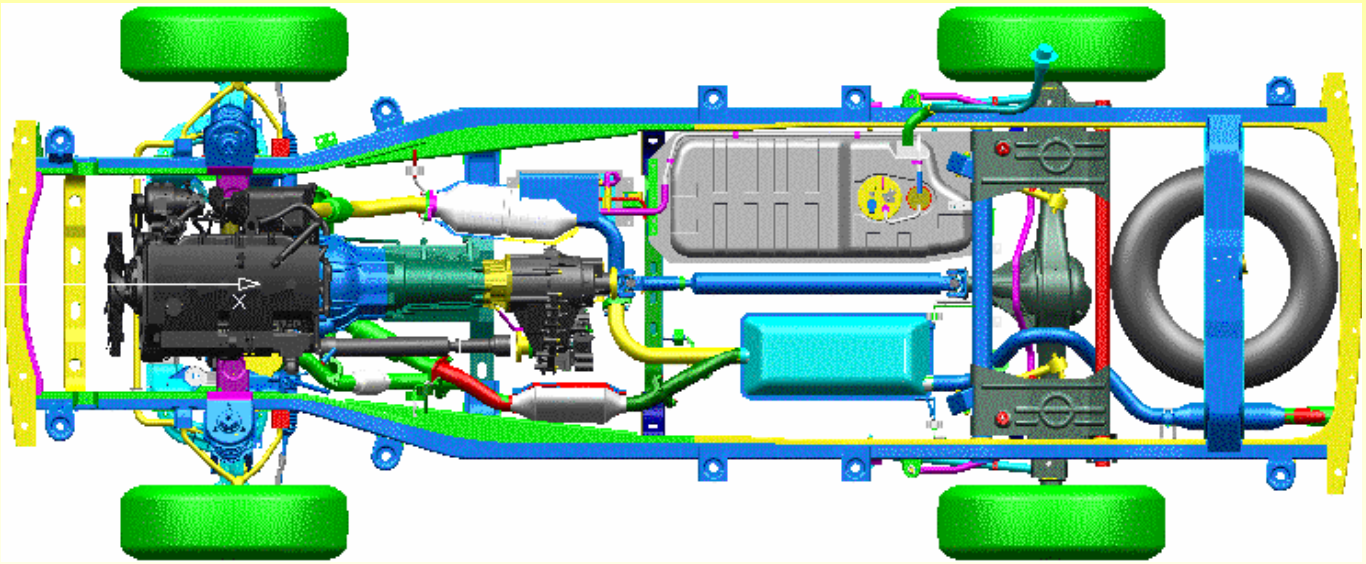
SISTEMA 4X4



- EST (Transfer con cambio eléctrico)
- ATT (Transferrencia de par activa)

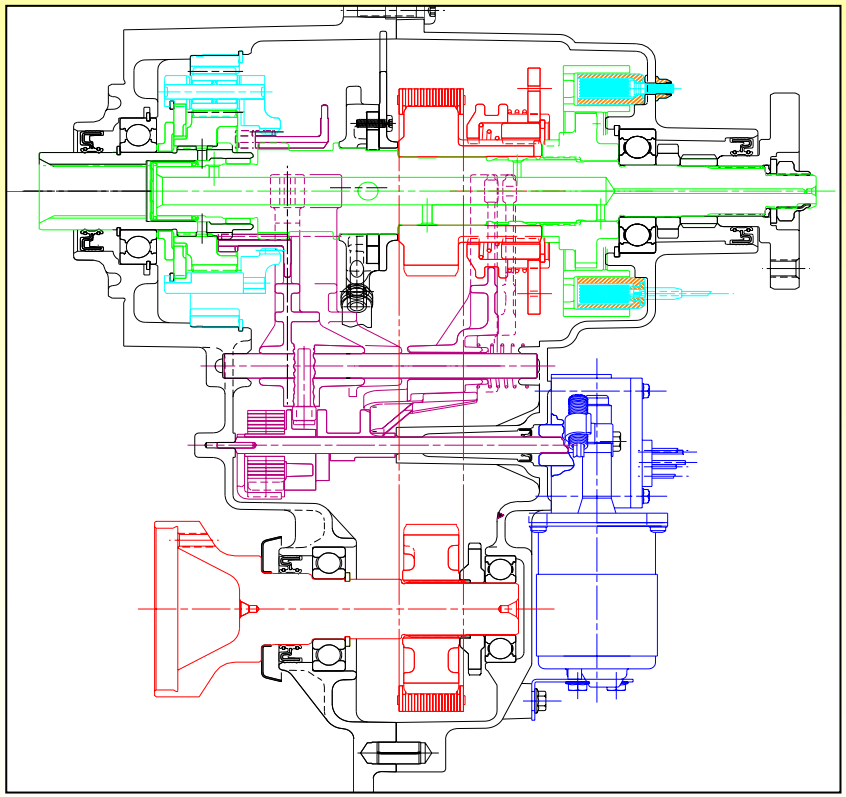
SISTEMA 4X4

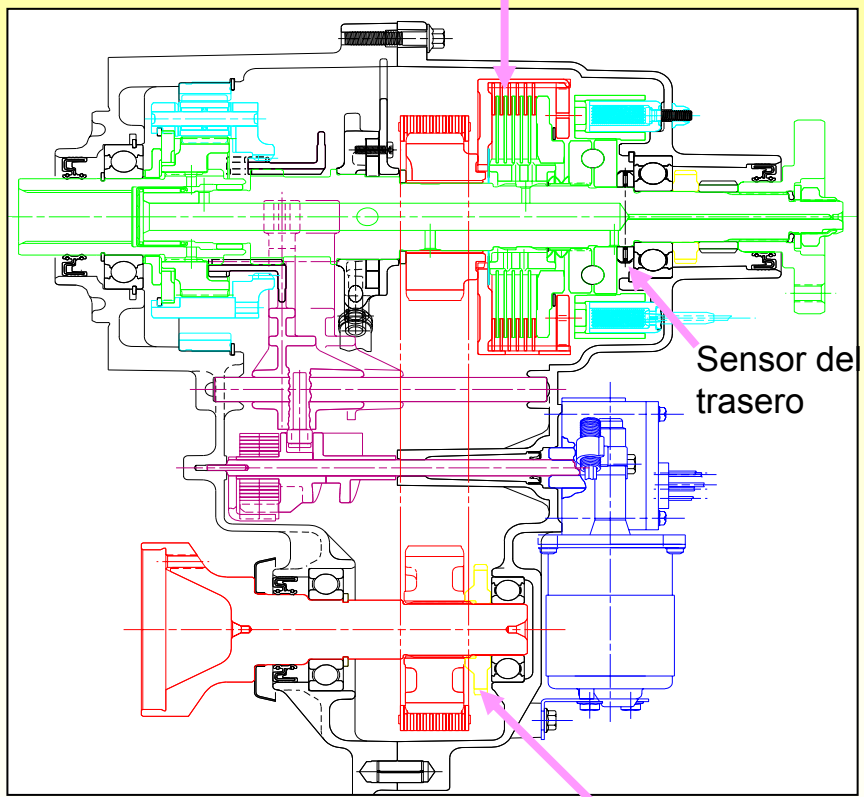
¿Qué es EST y ATT?

- **EST:** En el cambio controlado eléctricamente para el sistema de 4X4, donde el cliente puede efectuar el cambio de 4X2 a 4X4 hasta una velocidad de 80 Km/h..
- **ATT:** Transferencia de par activo, es decir, el cliente no tiene que preocuparse de activar o desactivar el sistema de 4X4, sino que este cambio es realizado electrónicamente, transfiriendo el par precisado desde el eje trasero al delantero.

SISTEMA 4X4

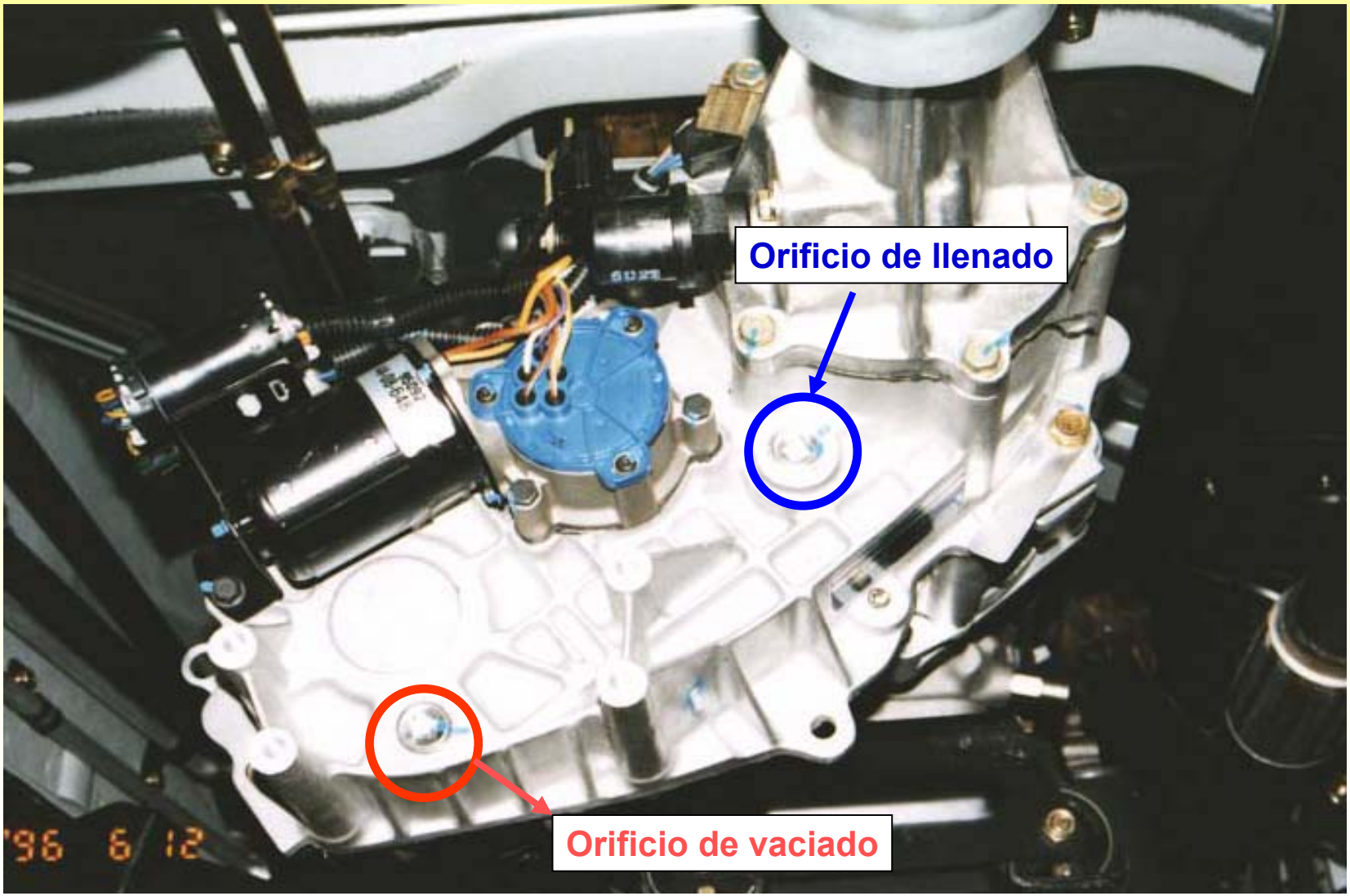
EST & ATT



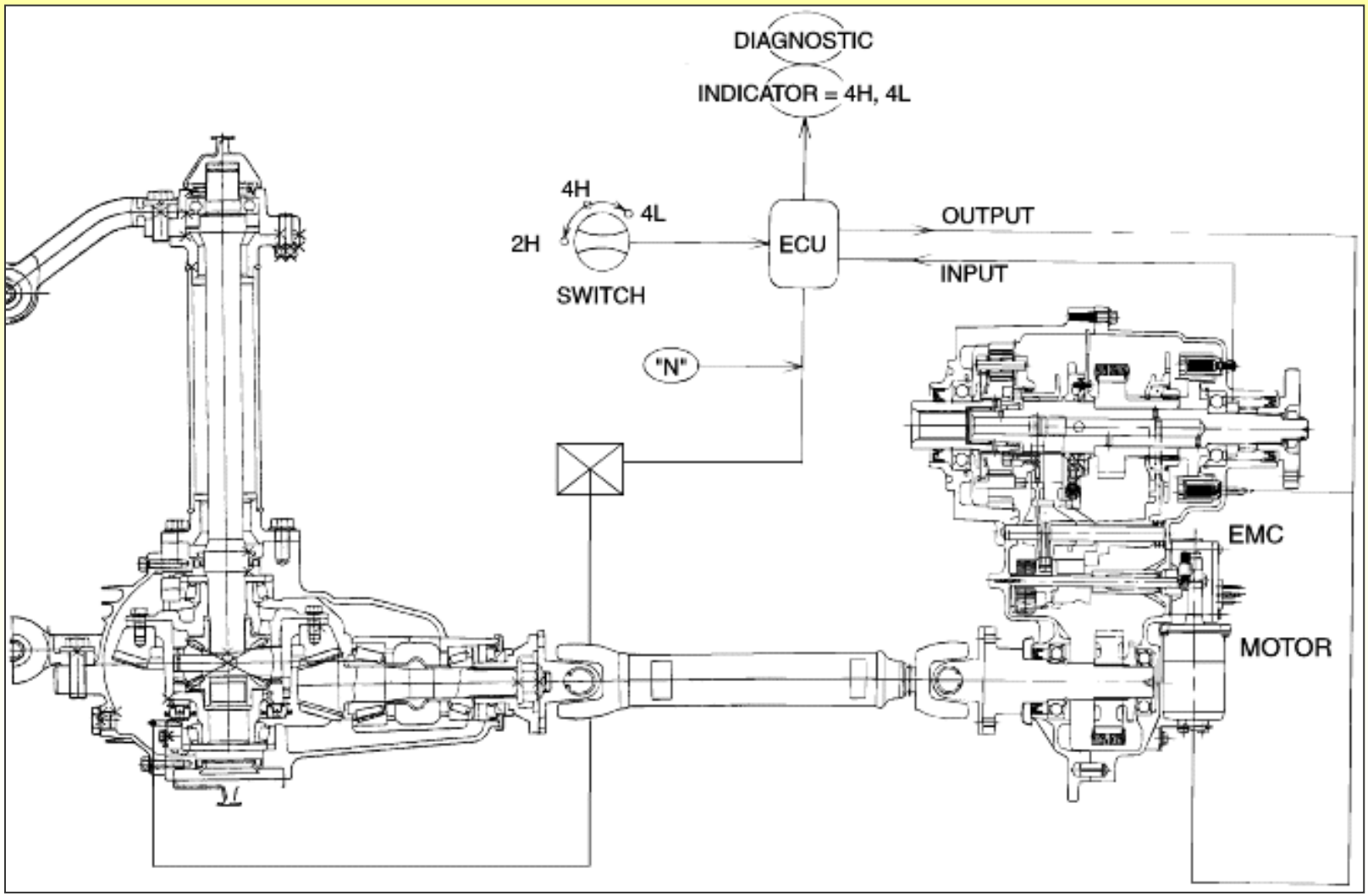


SISTEMA 4X4

Drive type	Drive item	Drive mode	Drive status	Useful condition
Electric Shift Transfer (EST type)	Drive mode	2H	2WD, Rear wheel drive	Use on the roadway.
		4H	4WD HIGH	* Use on the off-road or snowy and rainy road having slippery road surface. * When turning on the roadway at low speed, vibration and noise happens by tight corner braking.
		4L	4WD LOW	Use in the condition which driving force is required like escaping from rough way and towing.
	Transfer	2H ↔ 4H	2WD ↔ 4WD	Possible to transfer 2WD into 4WD and vice versa at 80kph or below during driving.
		4H ↔ 4WD(L)	4WD(H) ↔ 4WD(L)	* Necessary to stop the vehicle for transfer - M/T vehicle : Transfer after pressing the clutch pedal. - A/T vehicle: Transfer after positioning the A/T lever to “N”. * All vehicles with 4L mode should stop the vehicle for transfer.
Active Torque Transfer (ATT type)	Drive mode	AUTO	2WD ↔ 4WD	* Use on the various road surfaces including roadway, off-road, or snowy and rainy road surface. * Using multiple clutch, control the revolution difference between front and rear wheels electronically. So this mode can correspond to the various road surfaces by controlling the ATT unit automatically.
		LOW	4WD LOW	Refer to 4L of part time.
	Transfer	AUTO ↔ LOW	4WD(H) ↔ 4WD(L)	* Necessary to stop the vehicle for transfer M/T vehicle: Transfer after pressing the clutch pedal. A/T vehicle: Transfer after positioning the A/T lever to “N”. * All vehicles with 4L mode should stop the vehicle for transfer.


Orificio de llenado
Orificio de vaciado
'96 6 12

FRRD (Free Running Differential)



FRRD (Free Running Differential)

EST

Reduction of friction loss

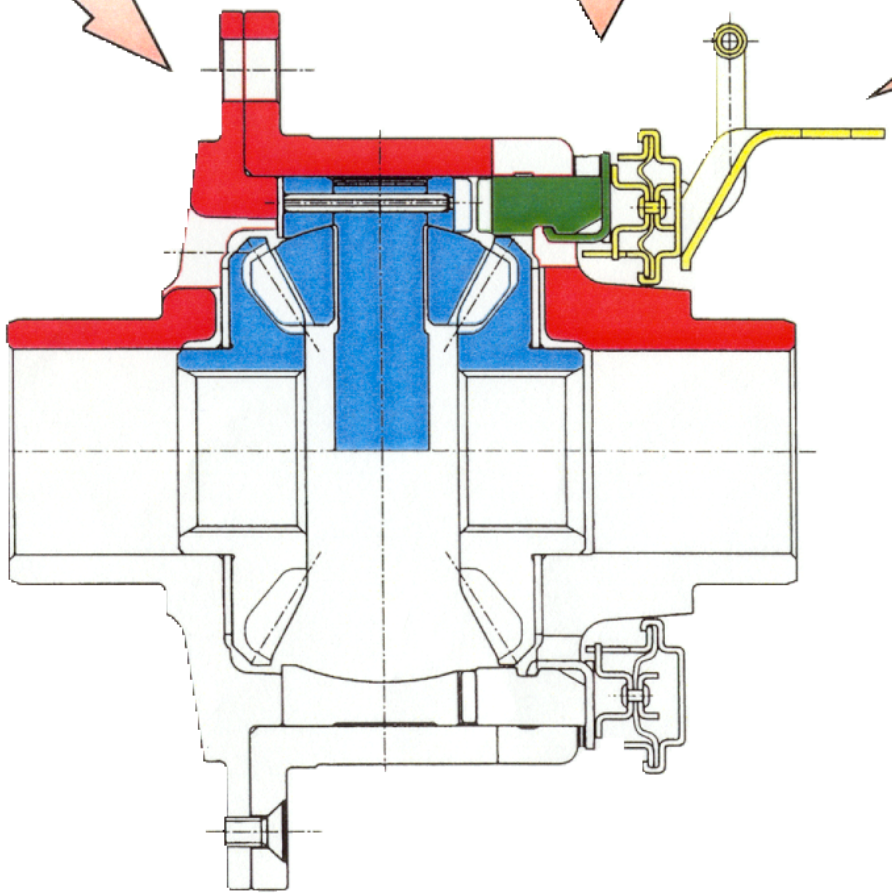
To improve fuel consumption

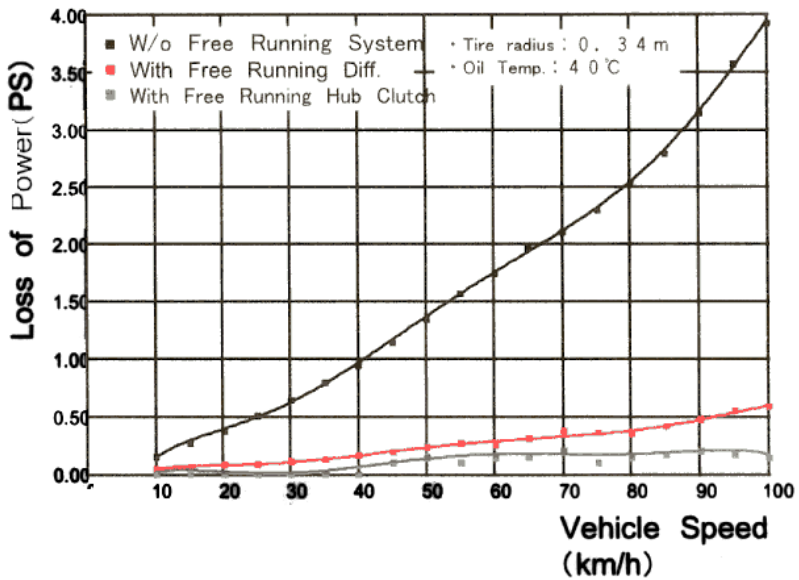
Combination of Hub-lock and Diff.

Lightening, cost reduction

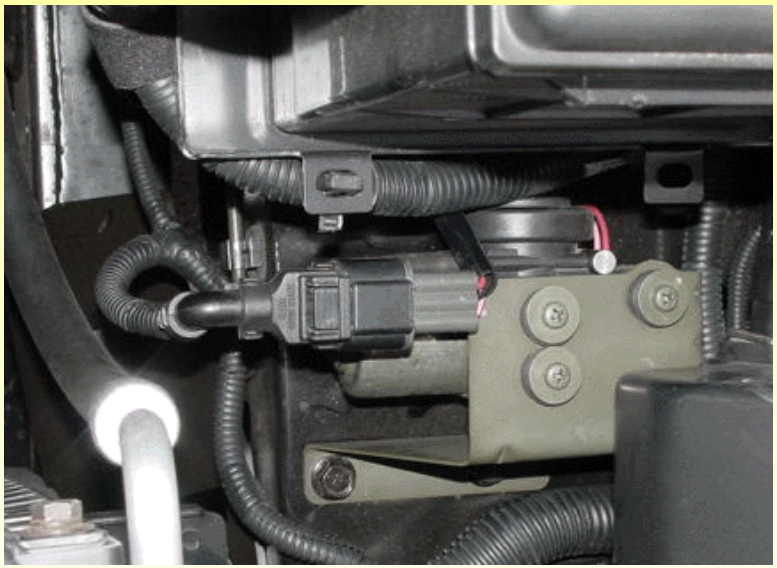
Space of FRRD.

FRRD can be assembled in normal final differential units

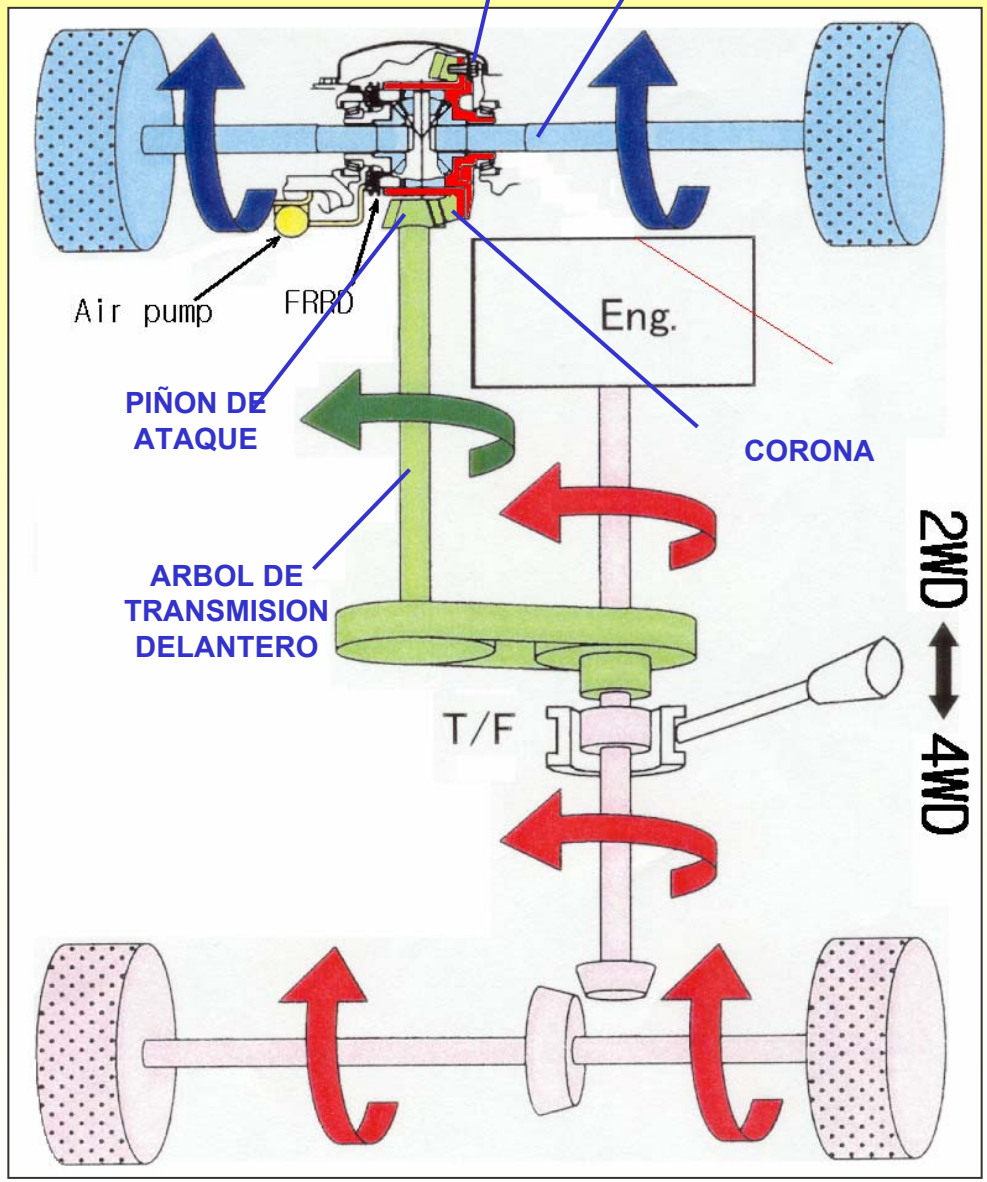




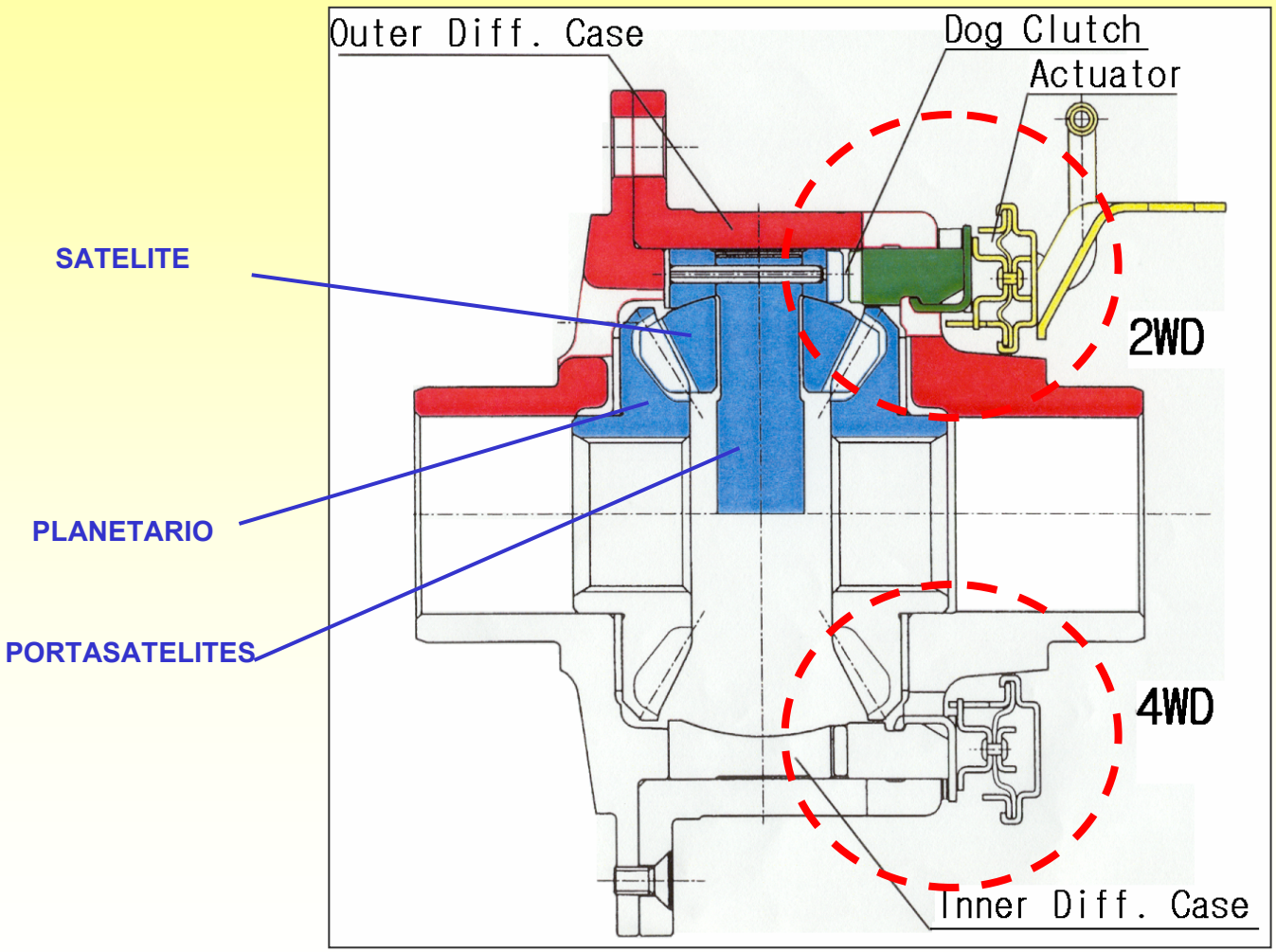
FRRD (Free Running Differential)



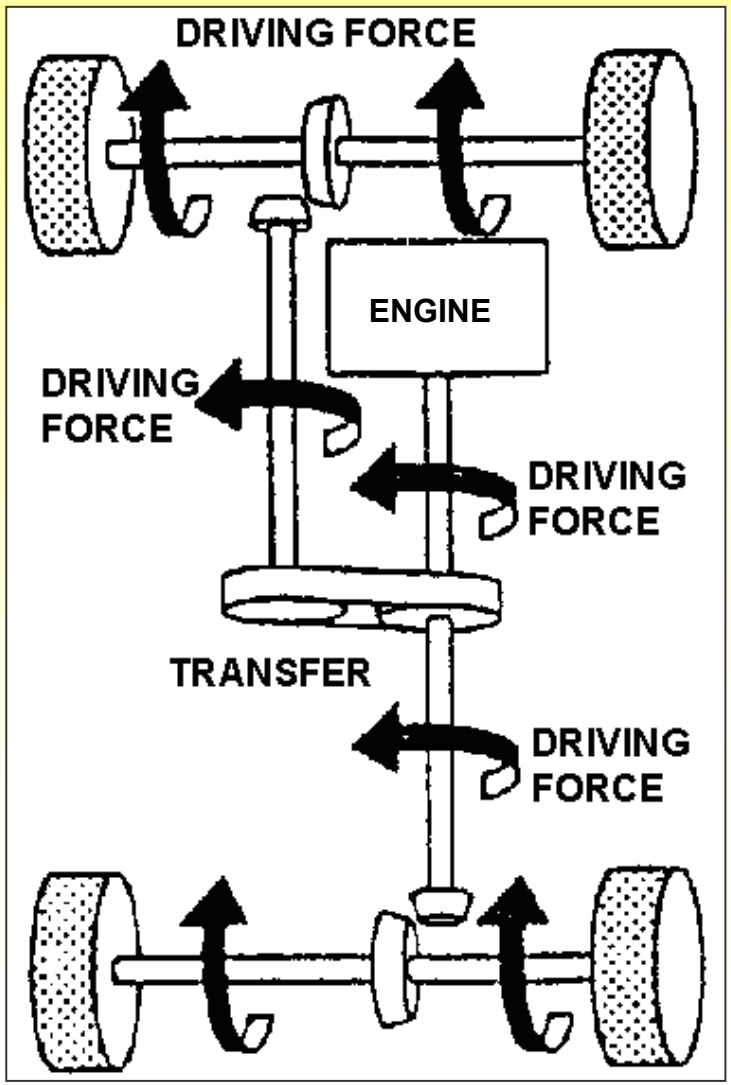
Bomba de aire

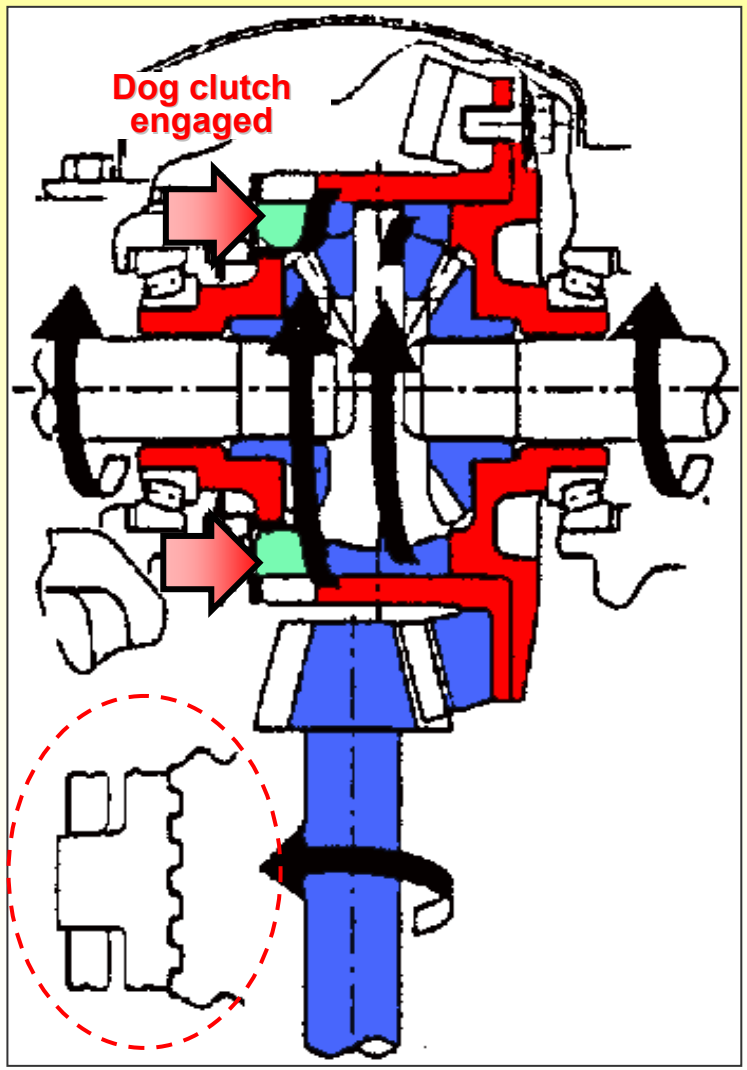


FRRD (Free Running Differential)

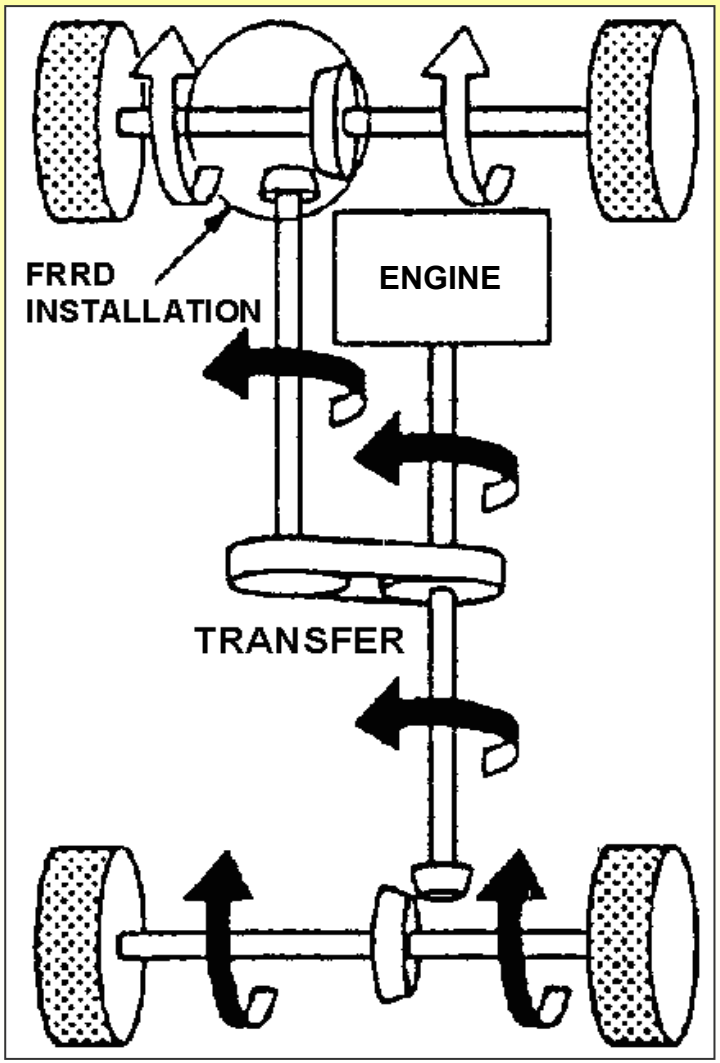


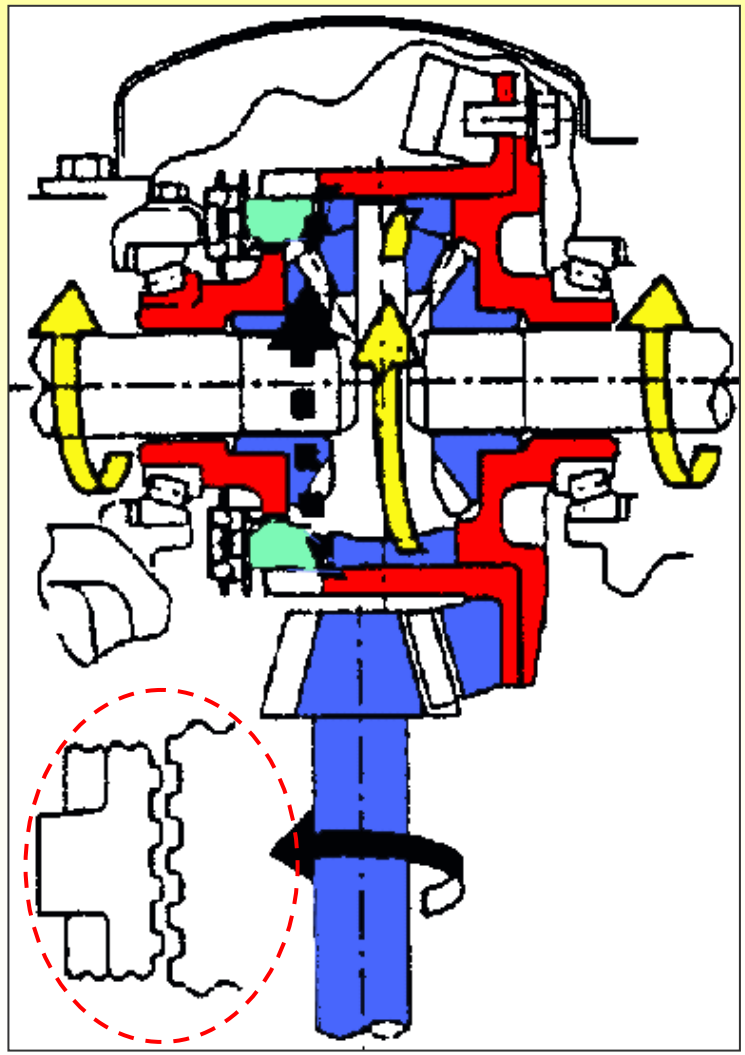
FRRD funcionamiento (4WD)



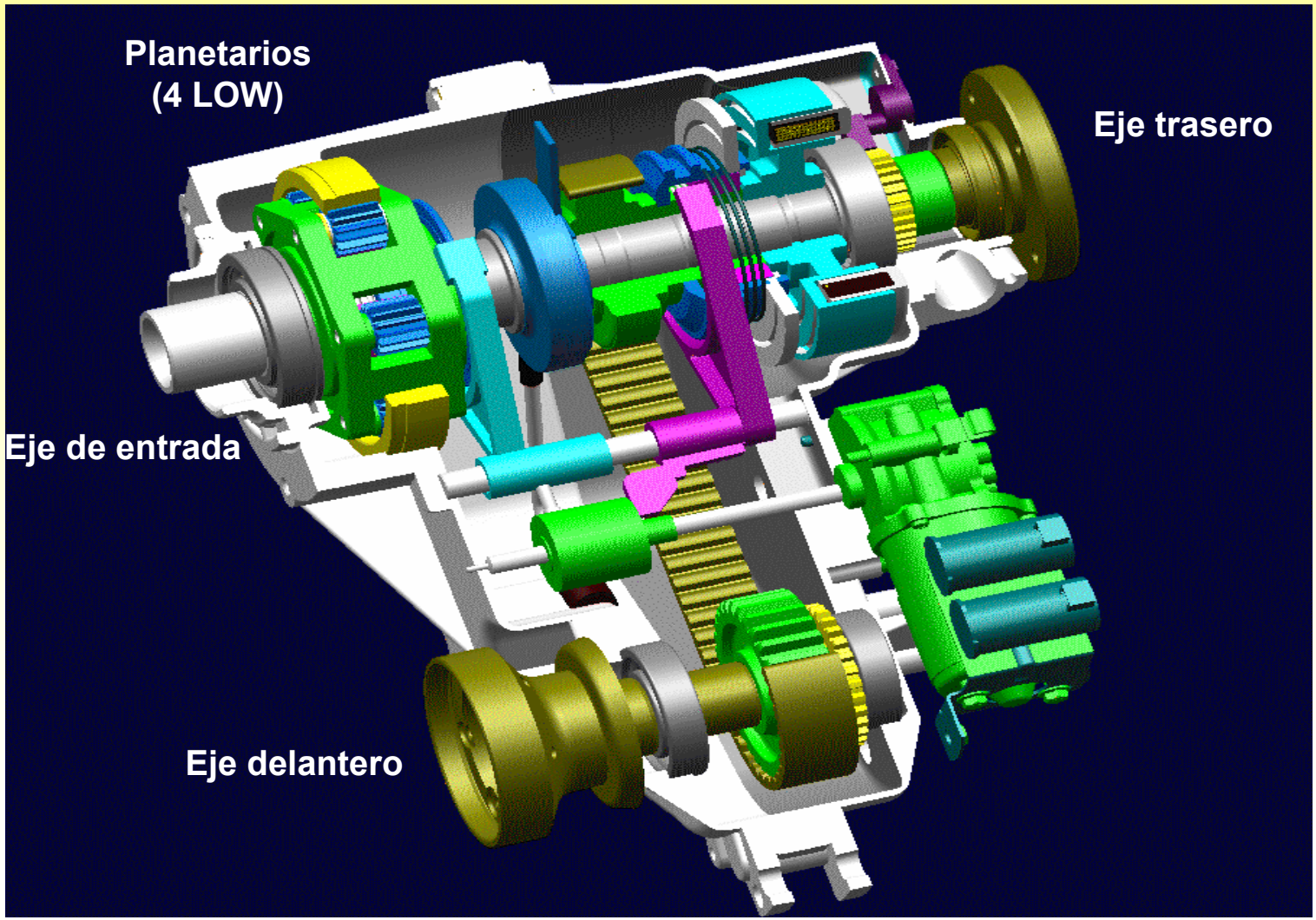


FRRD funcionamiento (2WD)

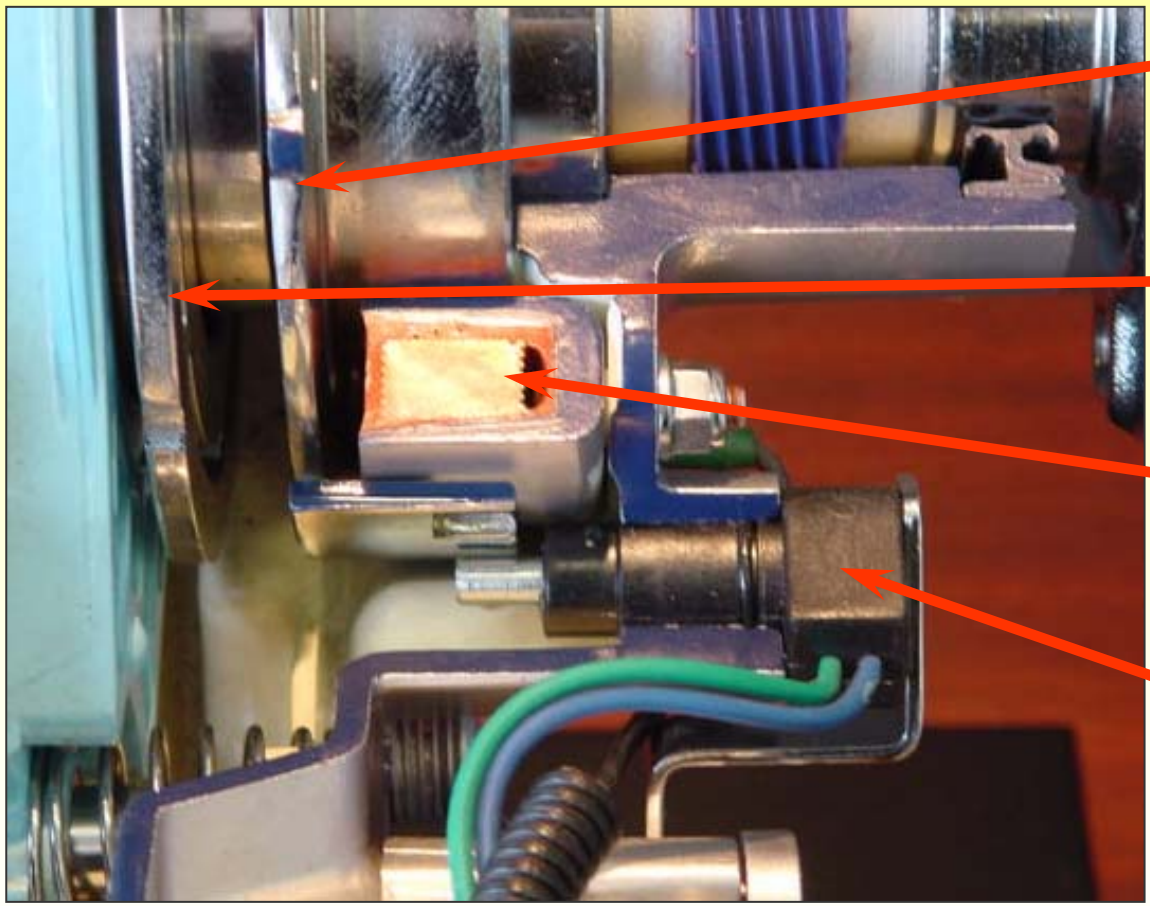




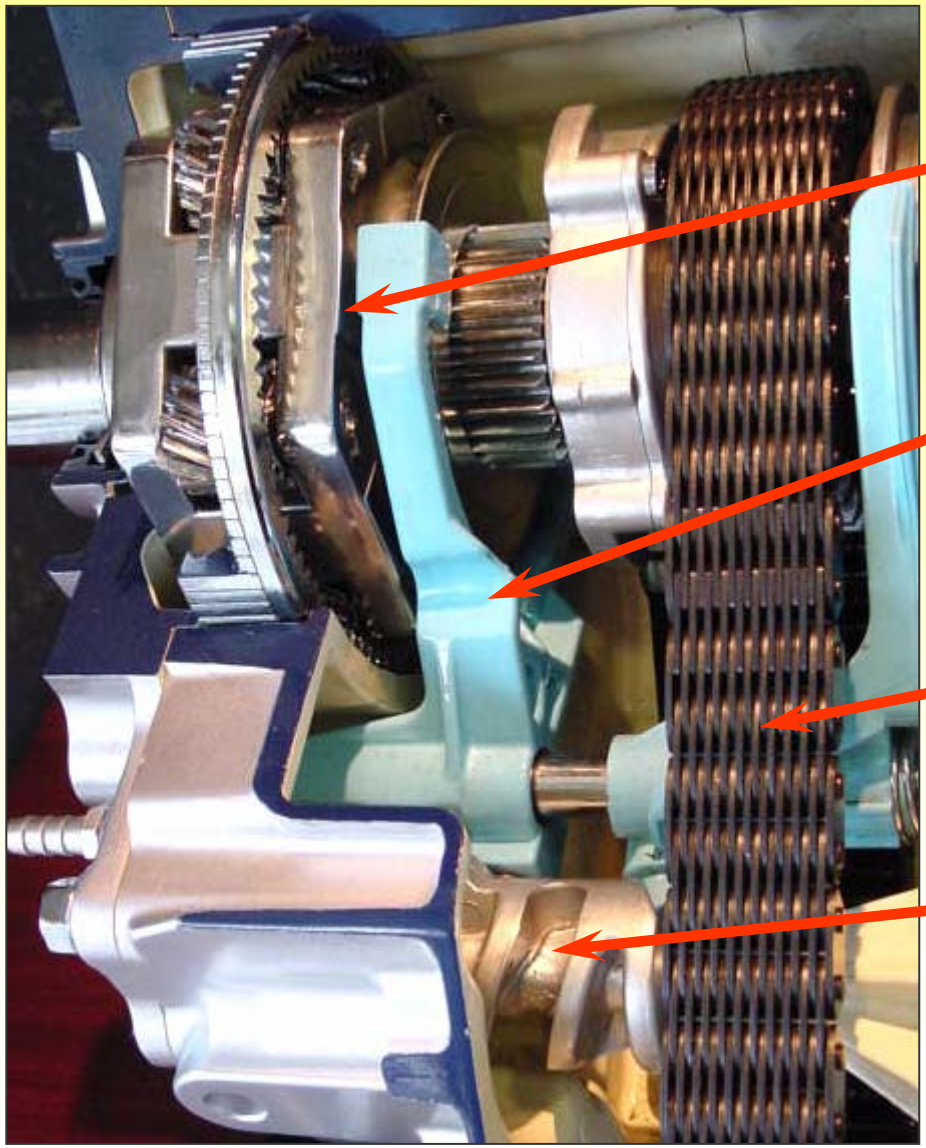
Componentes



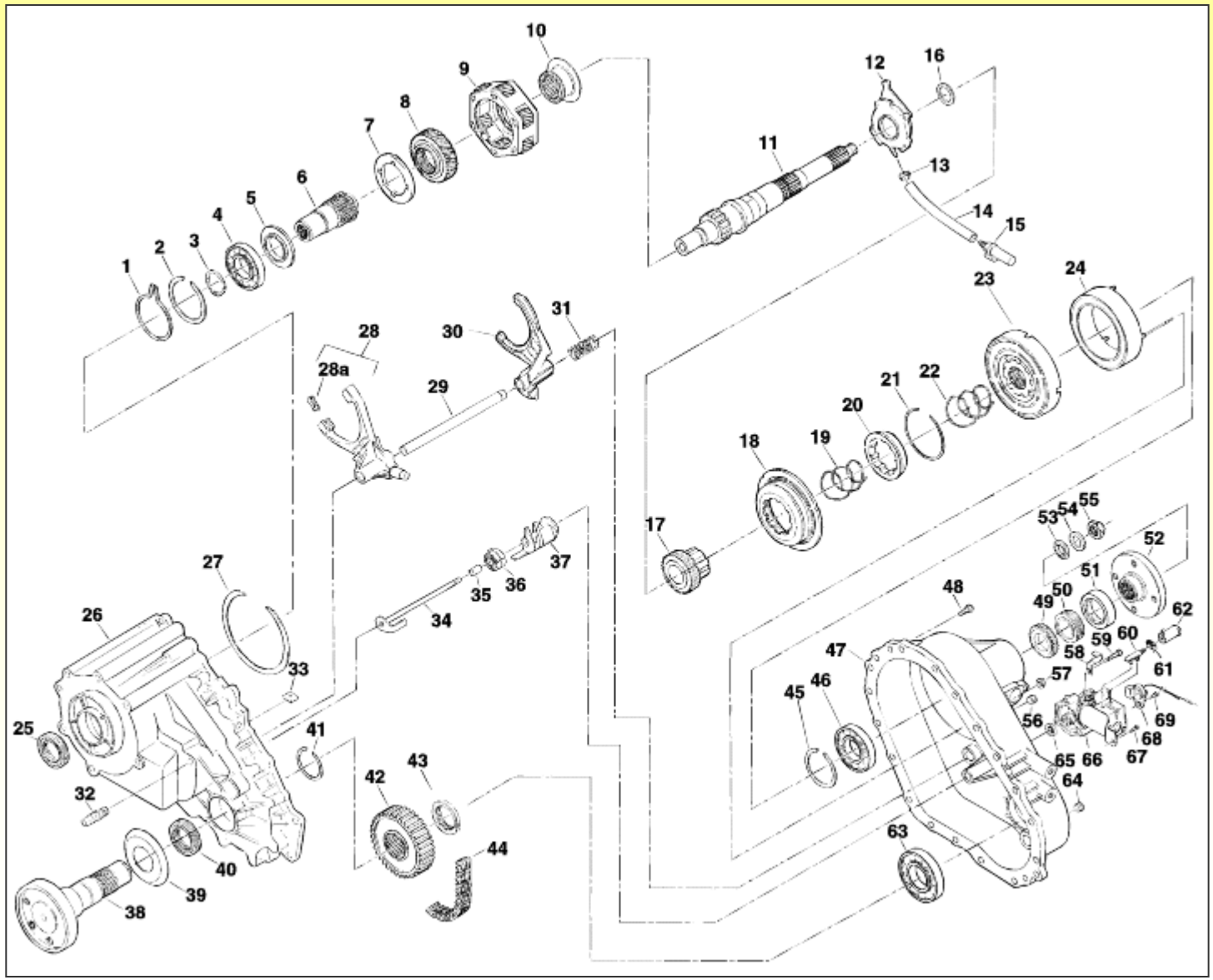
Componentes



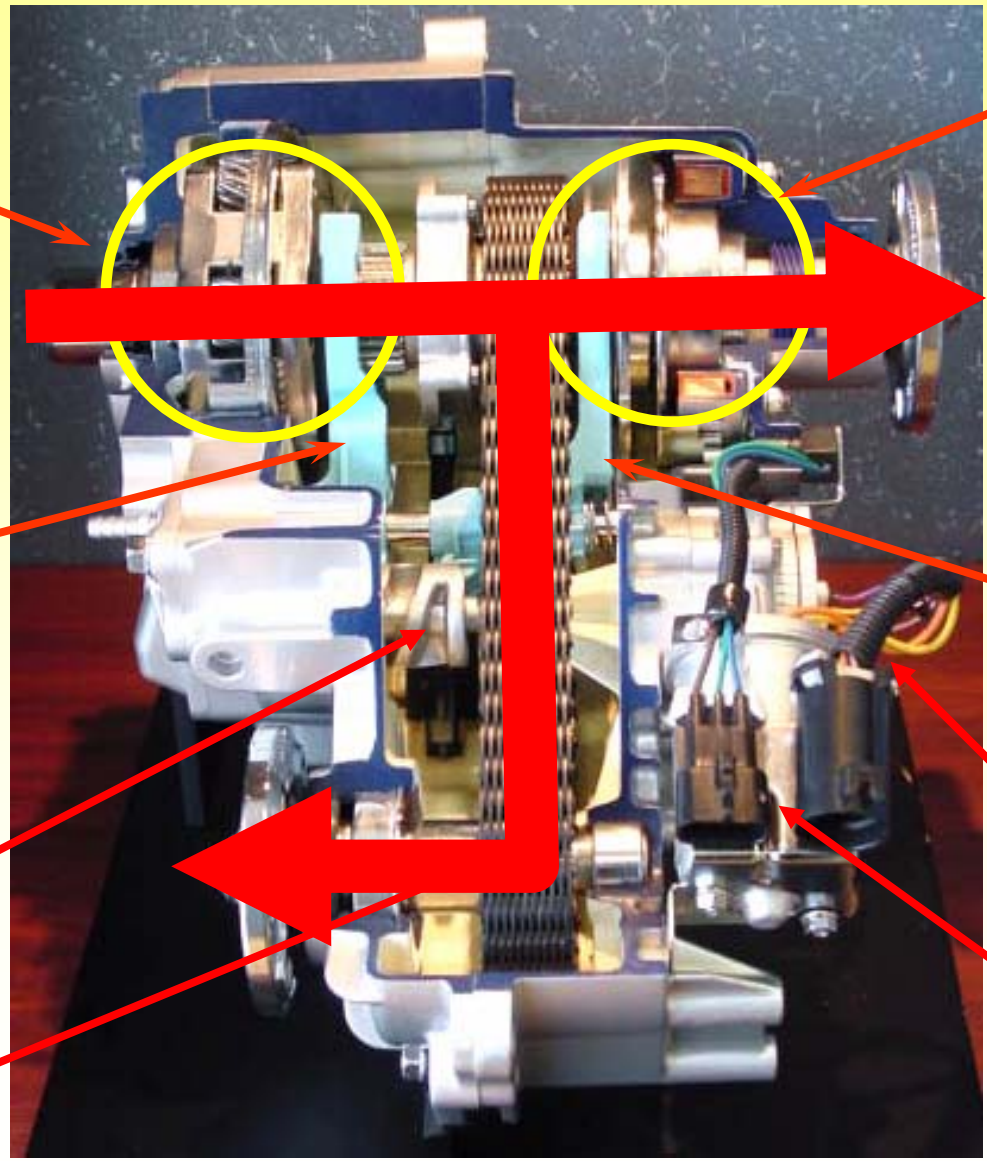
Componentes



Componentes



Distribución de fuerzas



Distribución de fuerzas 2H

2H Mode
(Rear Wheel Drive)

Transmission output shaft

↓

Input shaft → Output shaft
(Transfer direct connection)

↓

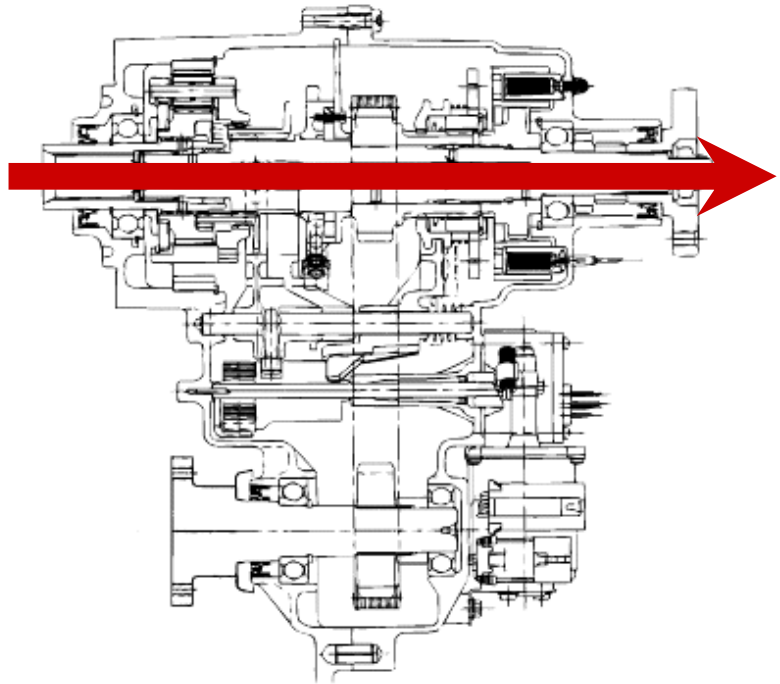
Rear propeller shaft

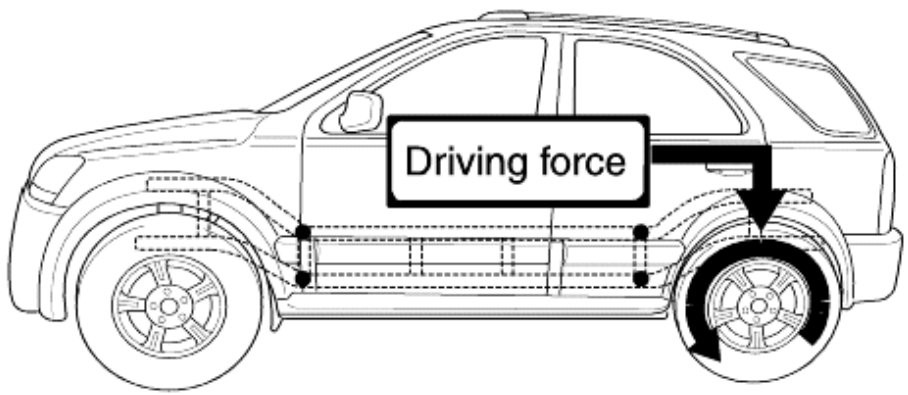
↓

Rear axle

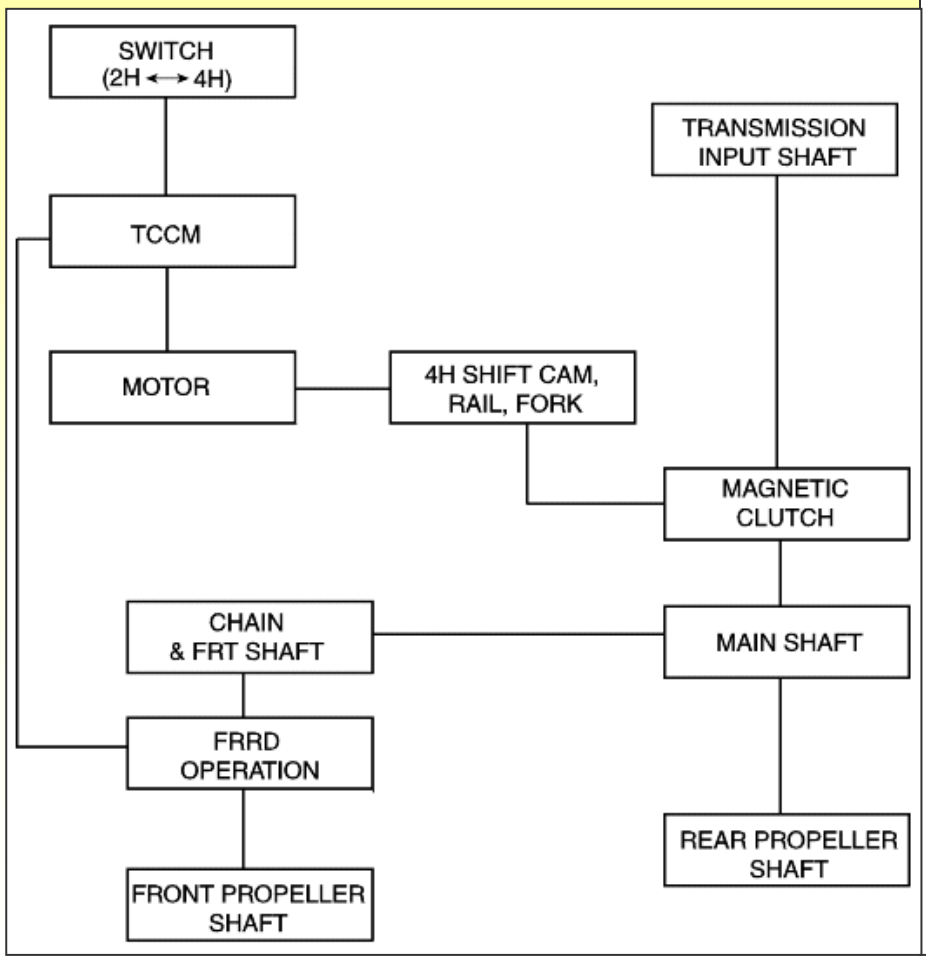
↓

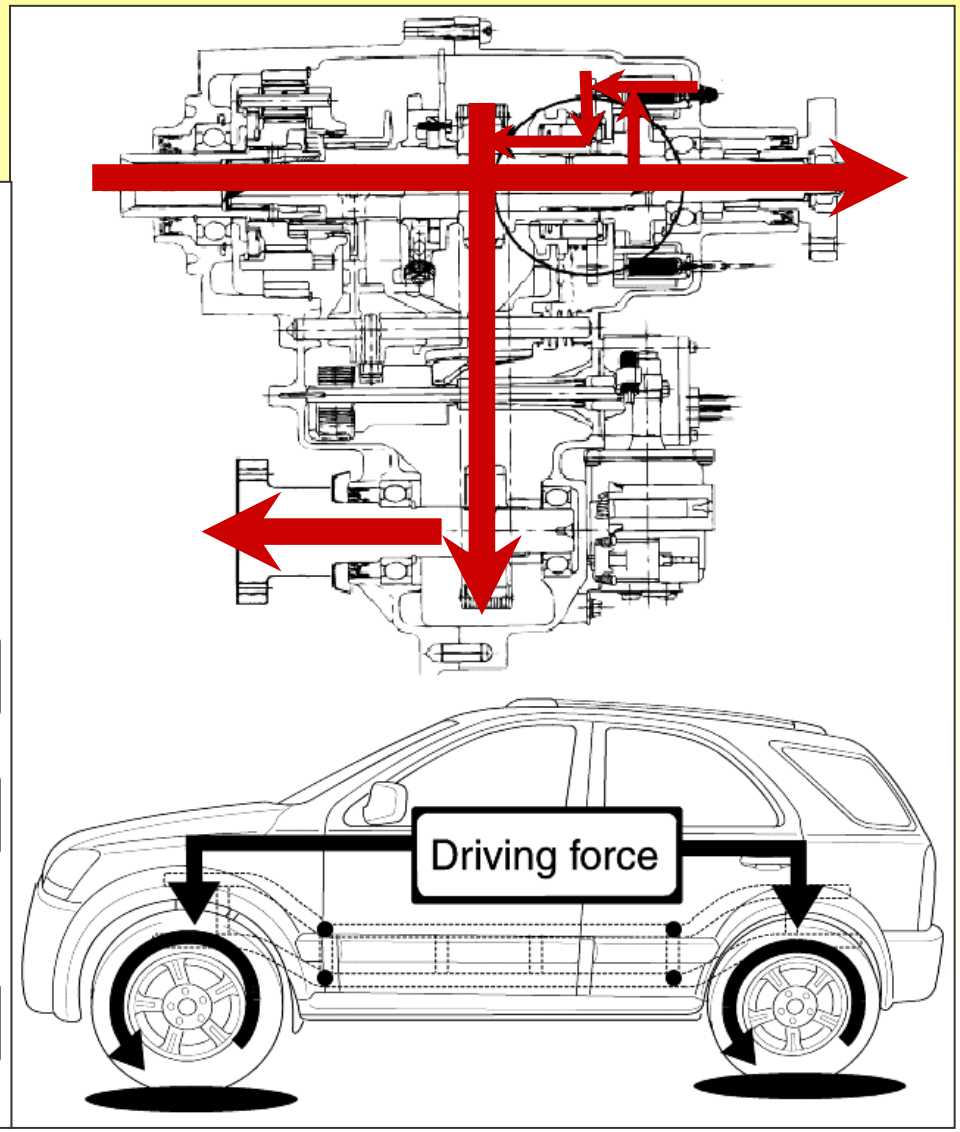
Rear wheel



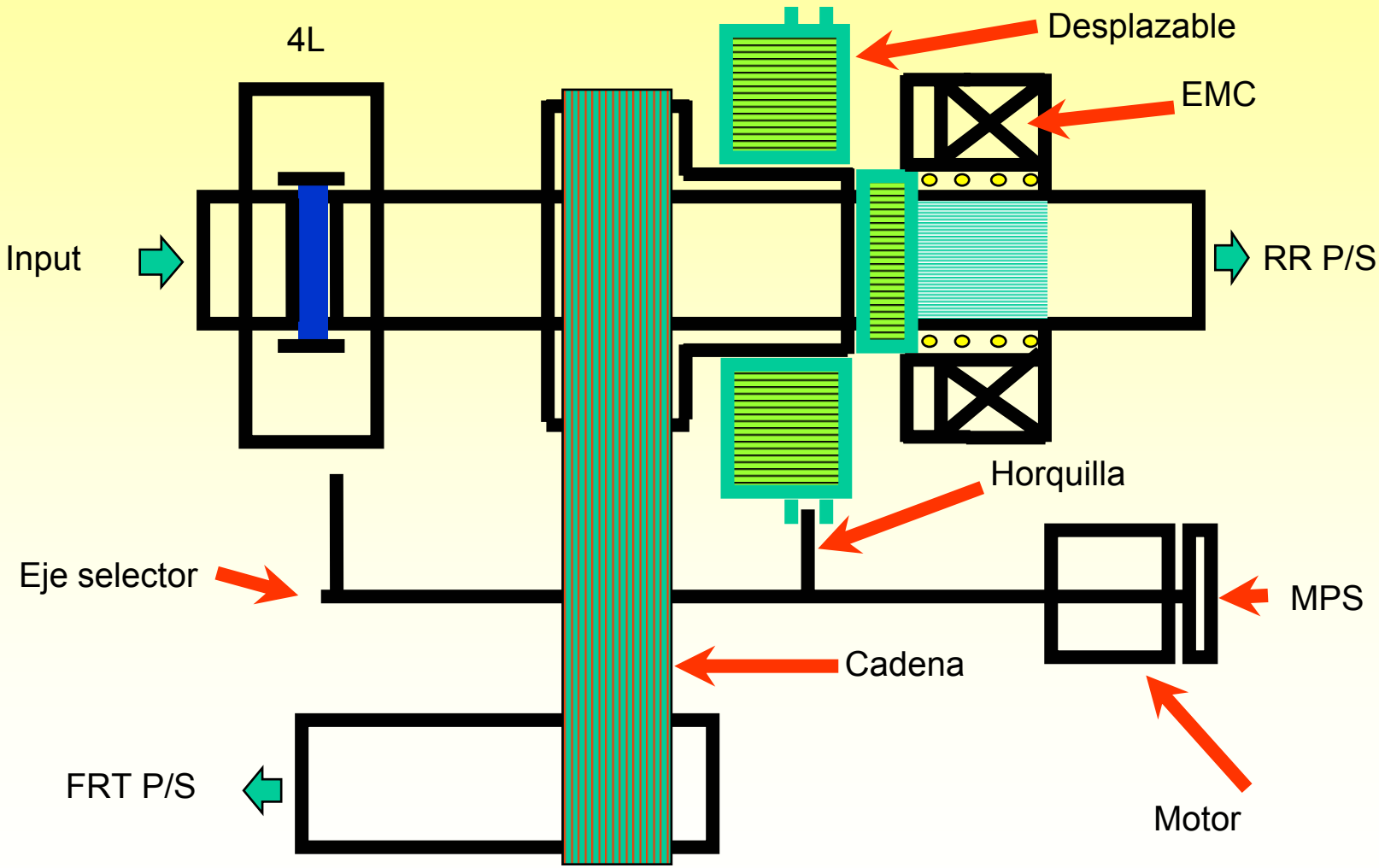


Distribución de fuerzas 4H



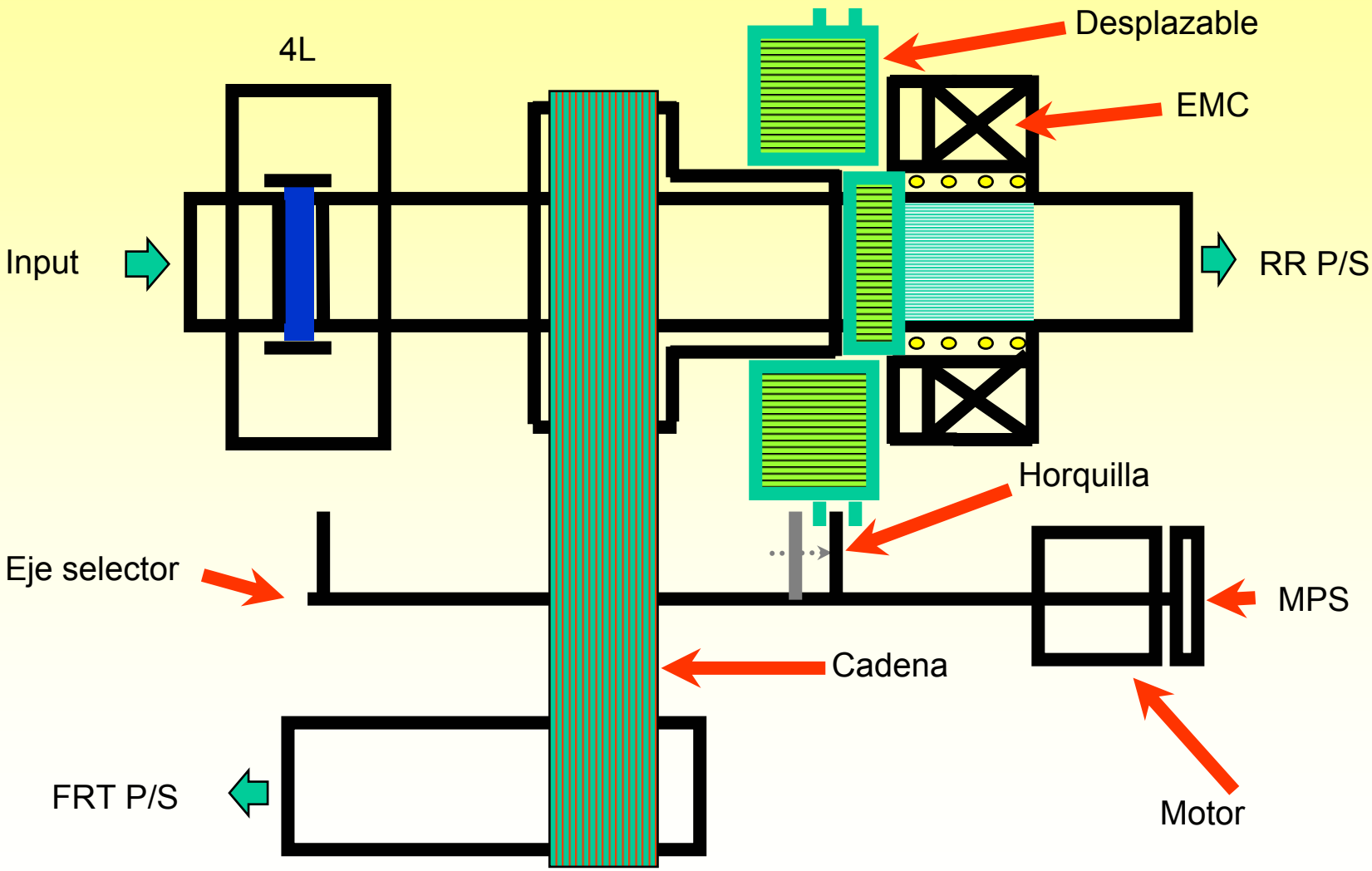


2WD

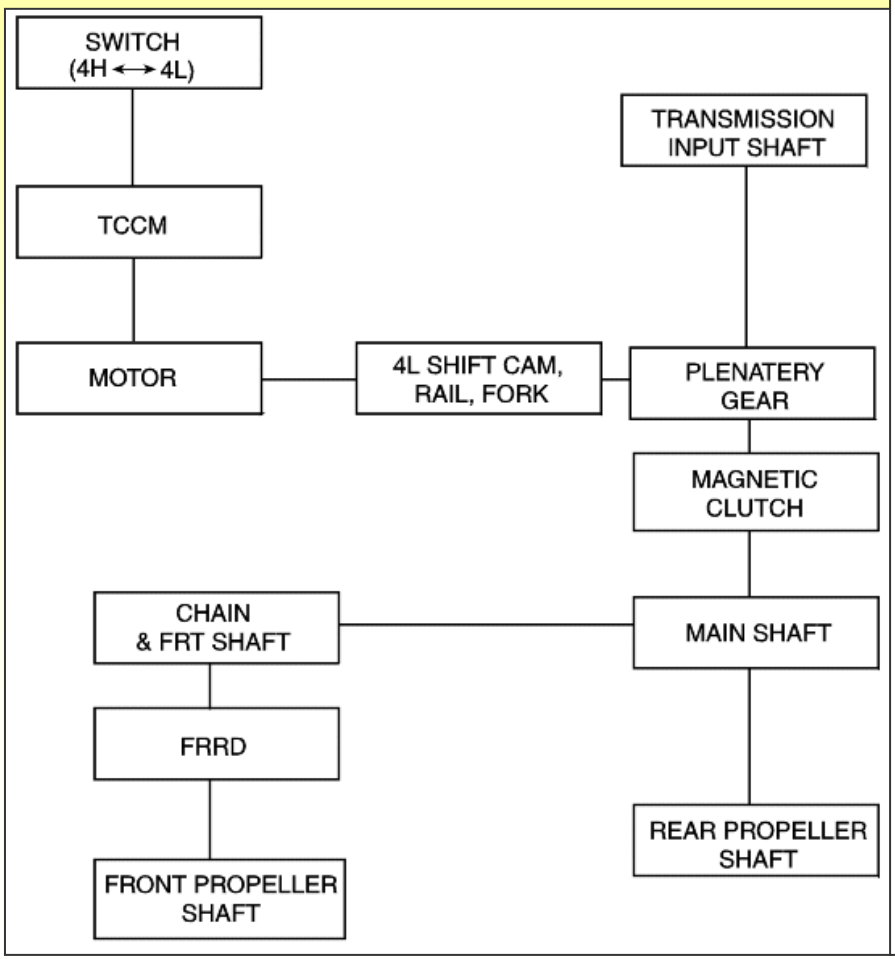

4L
Desplazable
EMC
Input
RR P/S
Horquilla
Eje selector
MPS
Cadena
FRT P/S
Motor

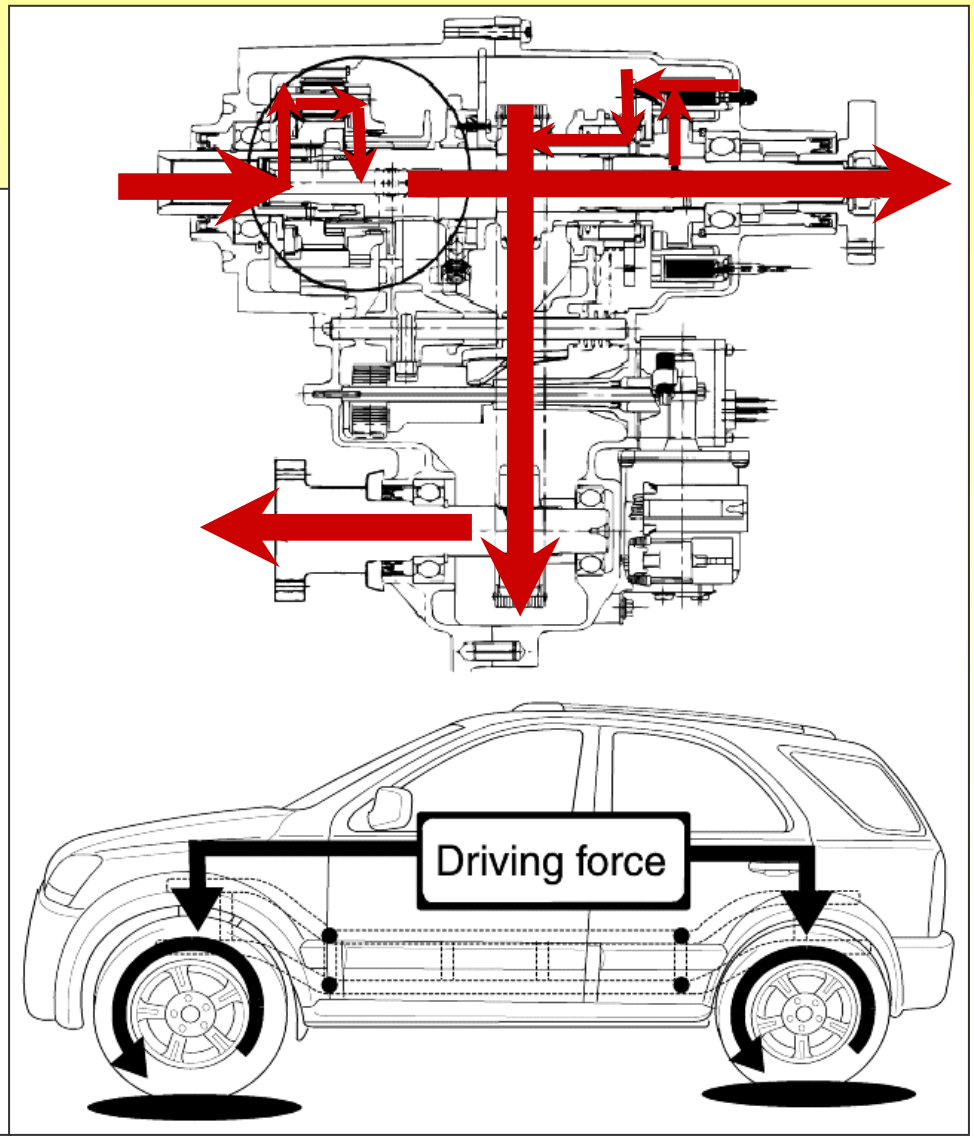
EST

4WD

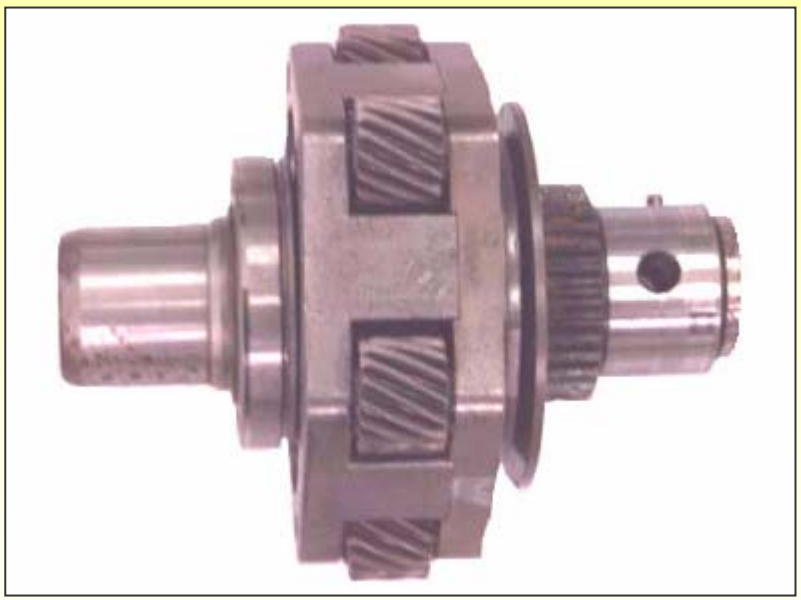

4L
Desplazable
EMC
Input
RR P/S
Horquilla
Eje selector
MPS
Cadena
FRT P/S
Motor

Distribución de fuerzas 4L

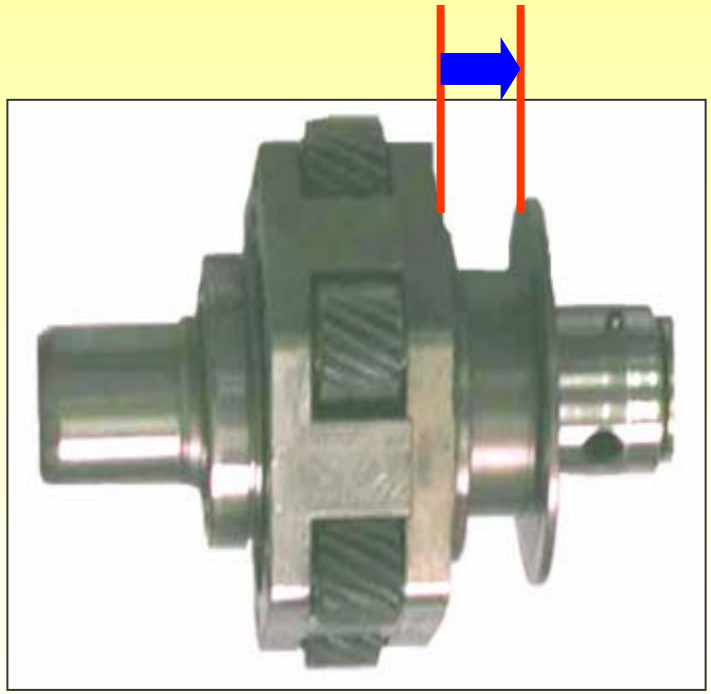




(2H, 4H) conexión 1:1

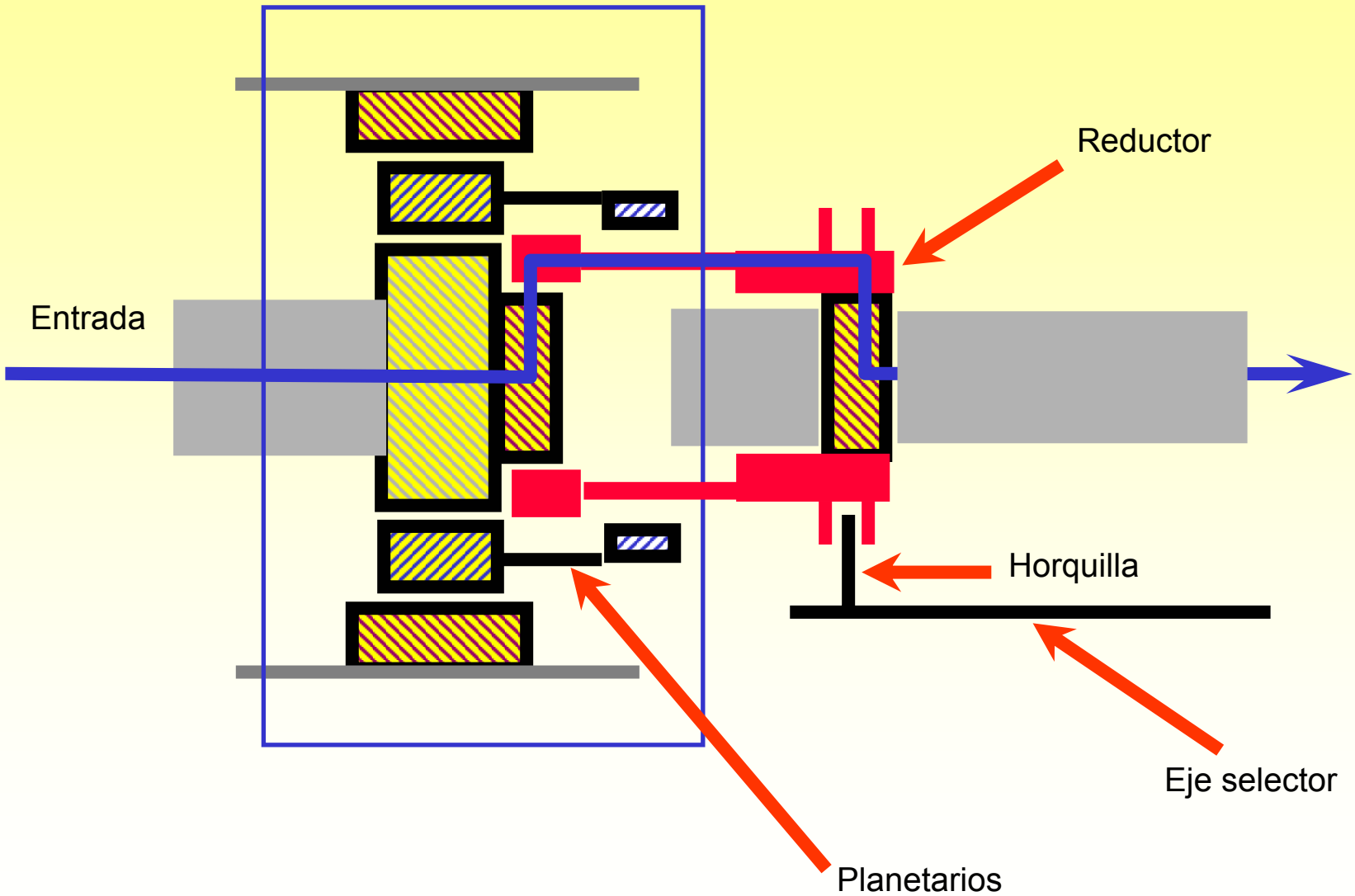


2H, 4H conexión 1:1

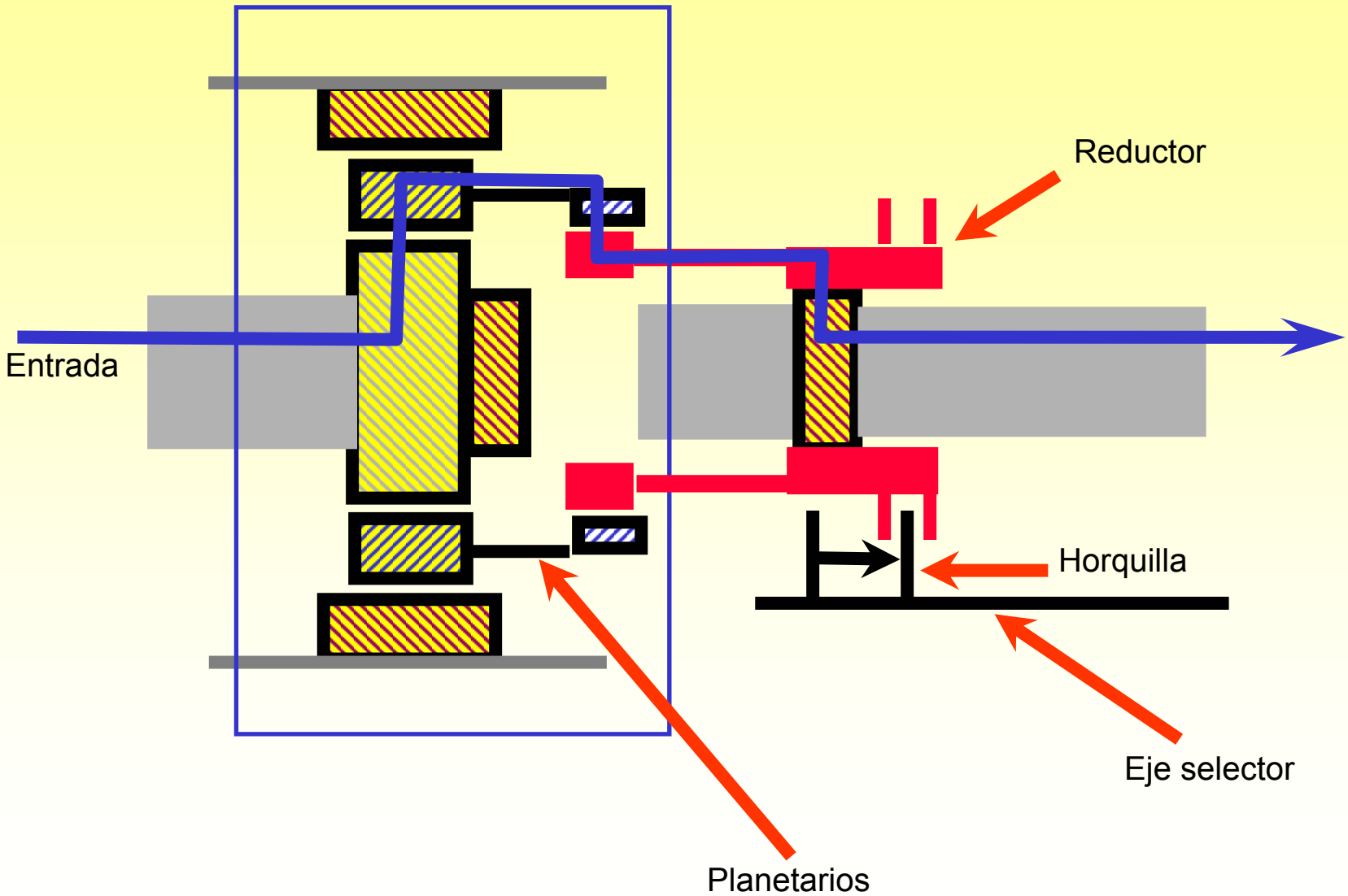


4L conexión 2,48:1

(2H, 4H) conexión 1:1



4L conexión 2,48:1



Componentes – selector 2H/4H/4L

1) 2H: Sólo ruedas traseras

2) 4H:

Se puede conectar mientras no se sobrepase 80 Km/h. Cuando se ha realizado el cambio, se ilumina la luz del cuadro.

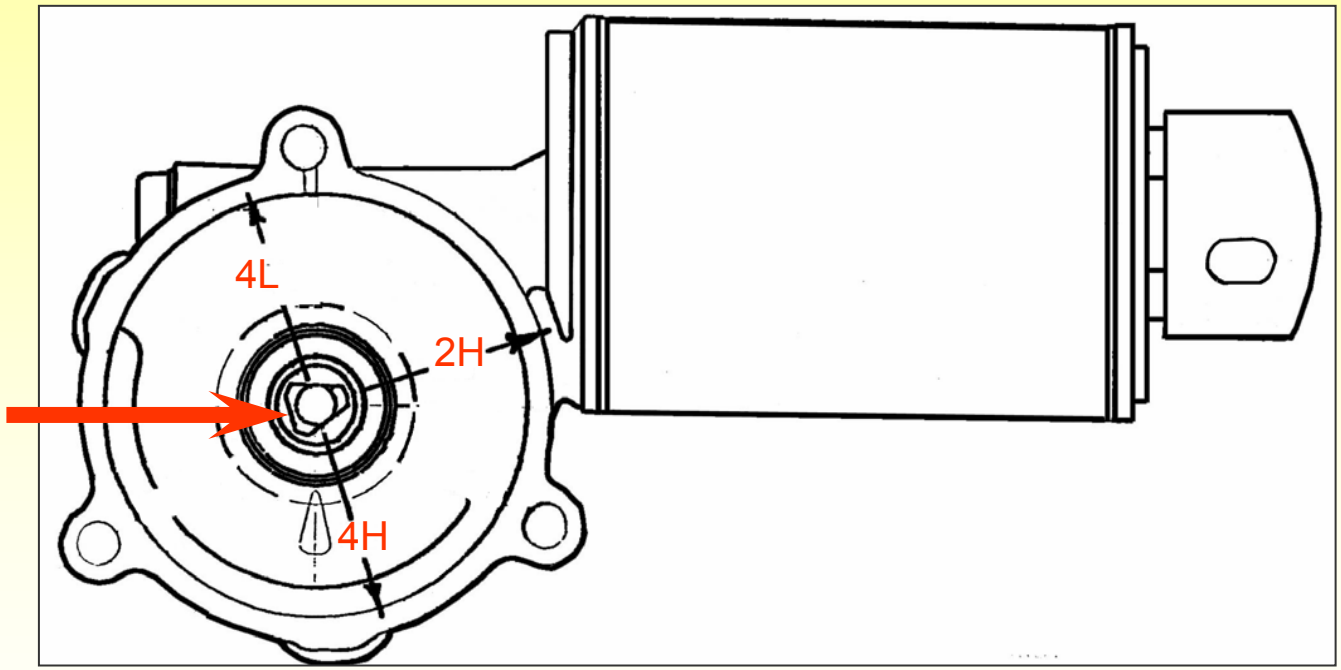
3) 4L:

El vehículo debe de estar parado o a menos de 3 Km/h. Se debe pisar el ambrague para el cambio manual o poner la palanca selectora en Neutro para el cambio automático. Cuando se realiza el cambio se enciende la luz del cuadro.

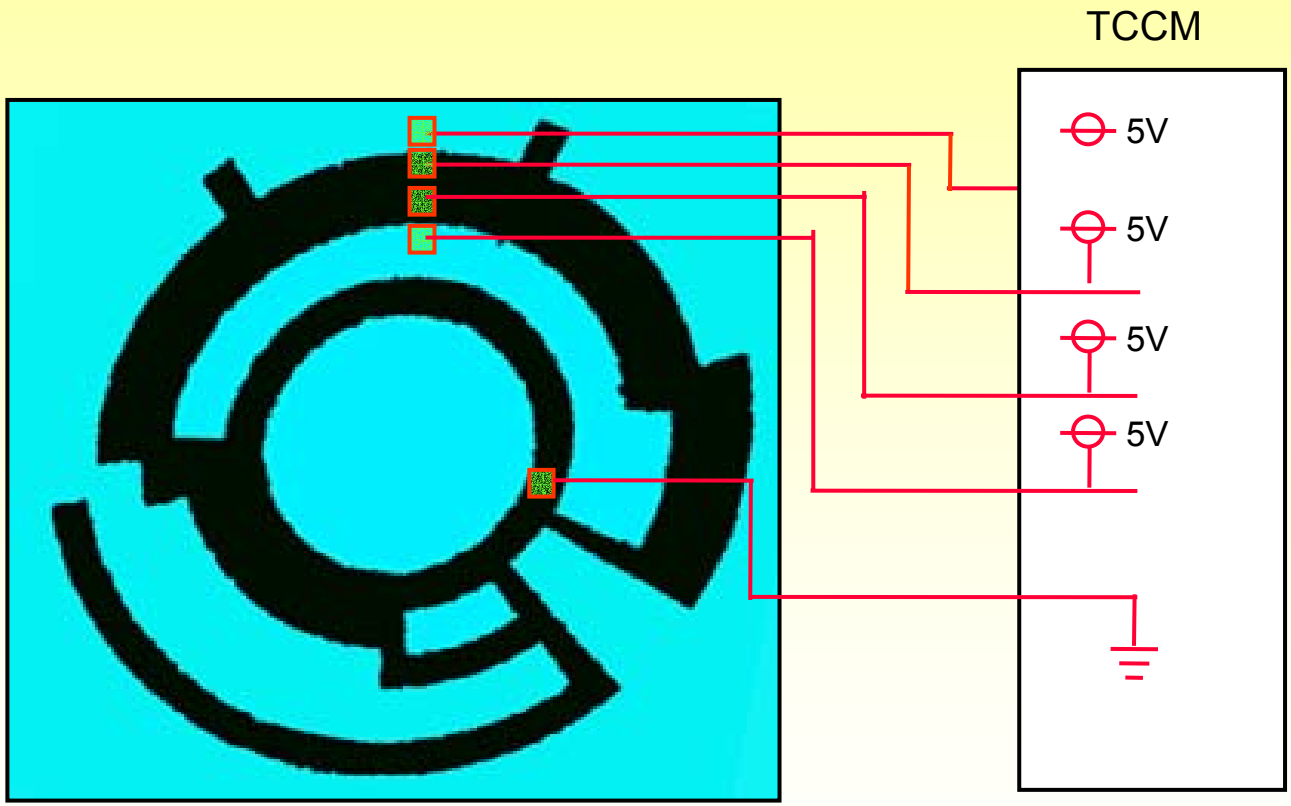
MOTOR

MOTOR

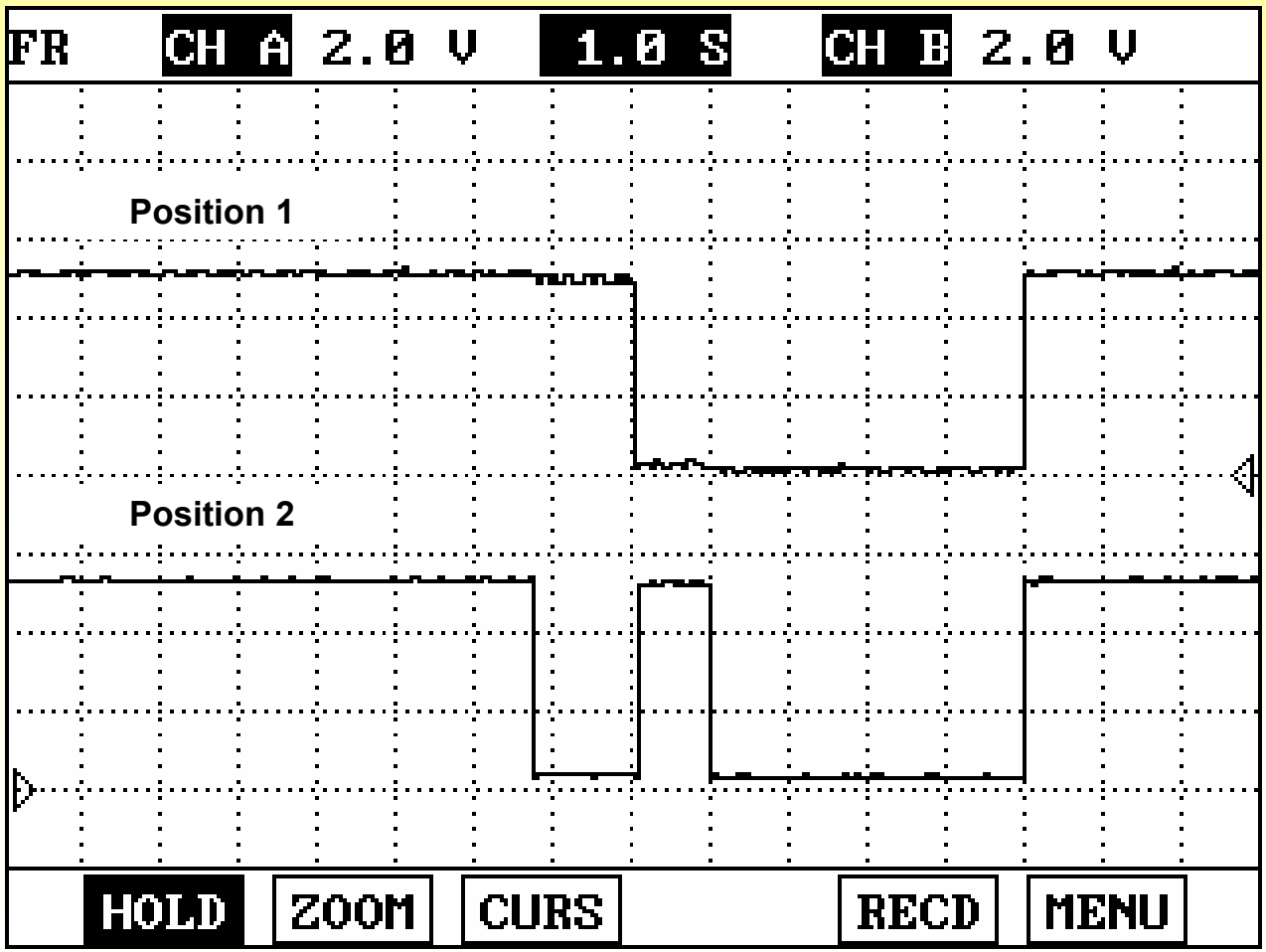
Posición



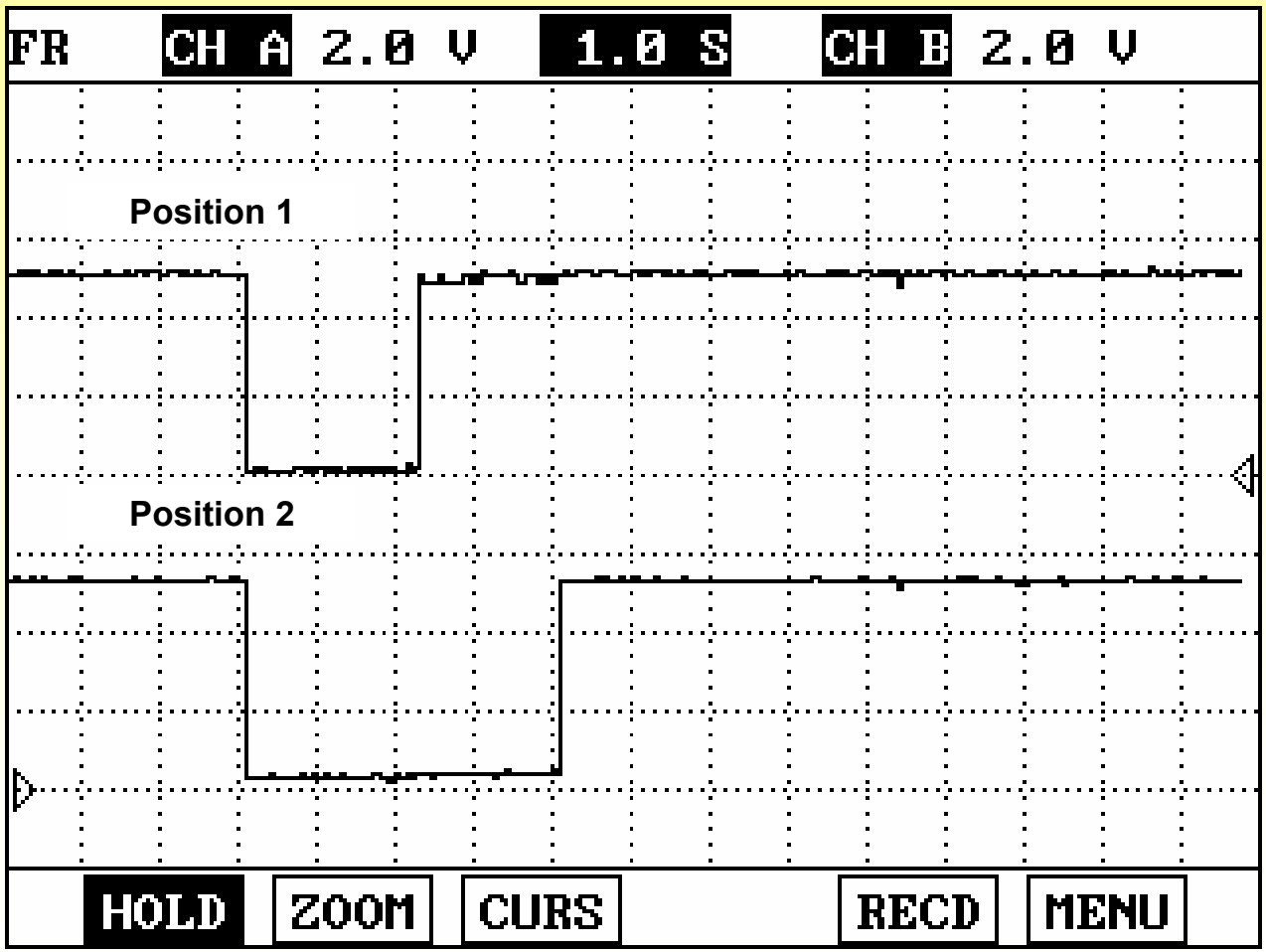
MPS



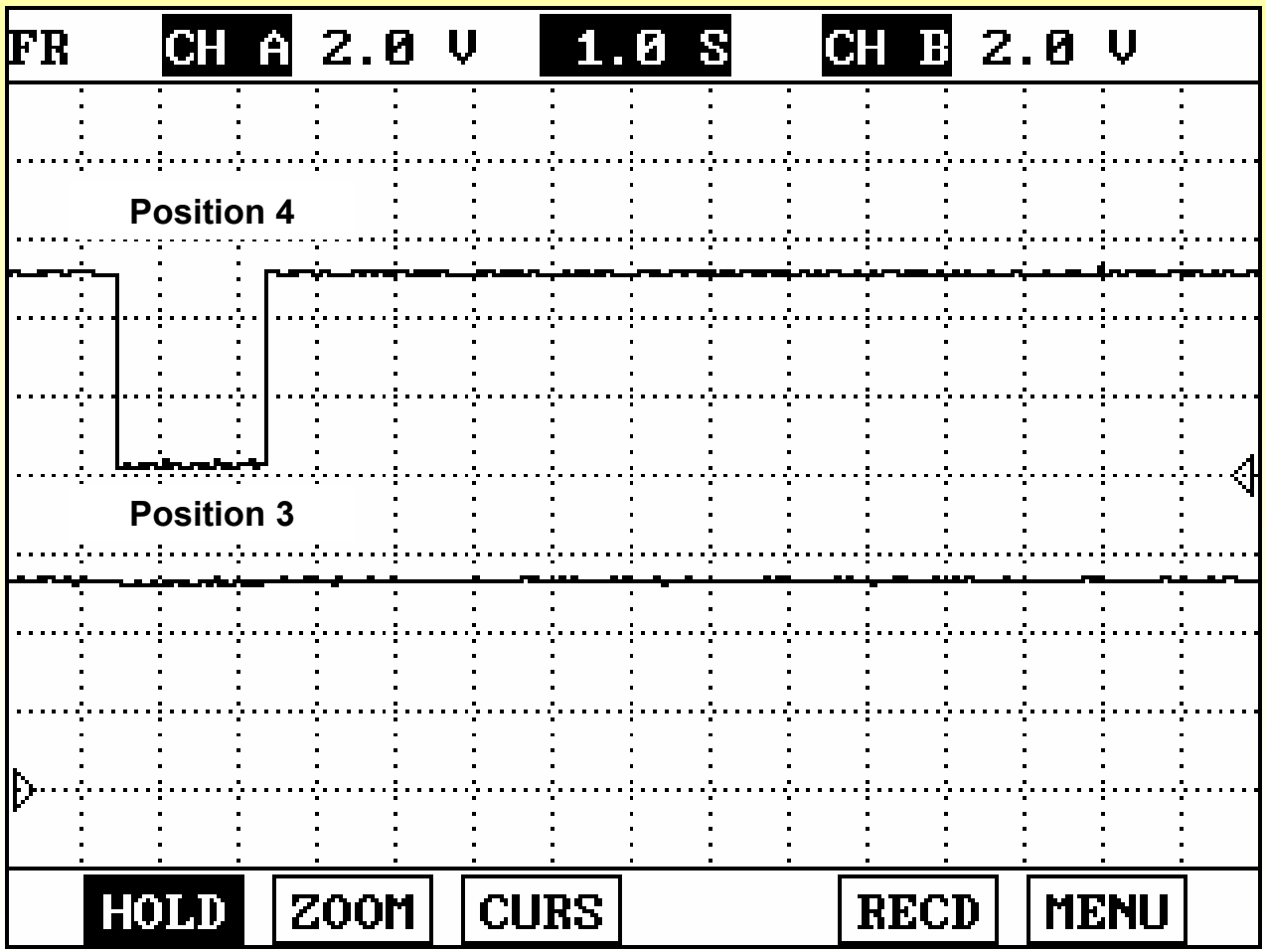
MPS señales (2H → 4H)



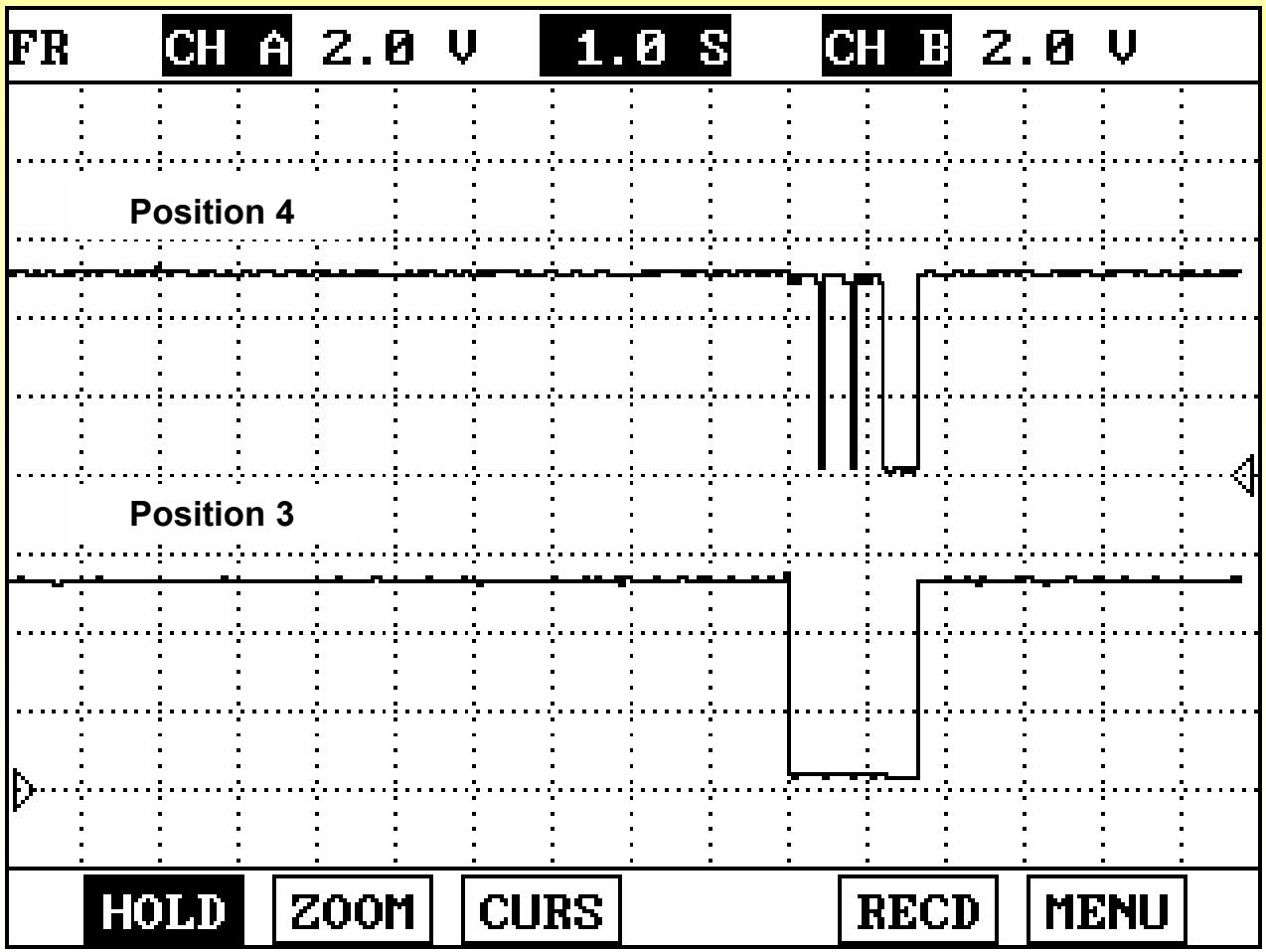
MPS señales (4H → 4L)



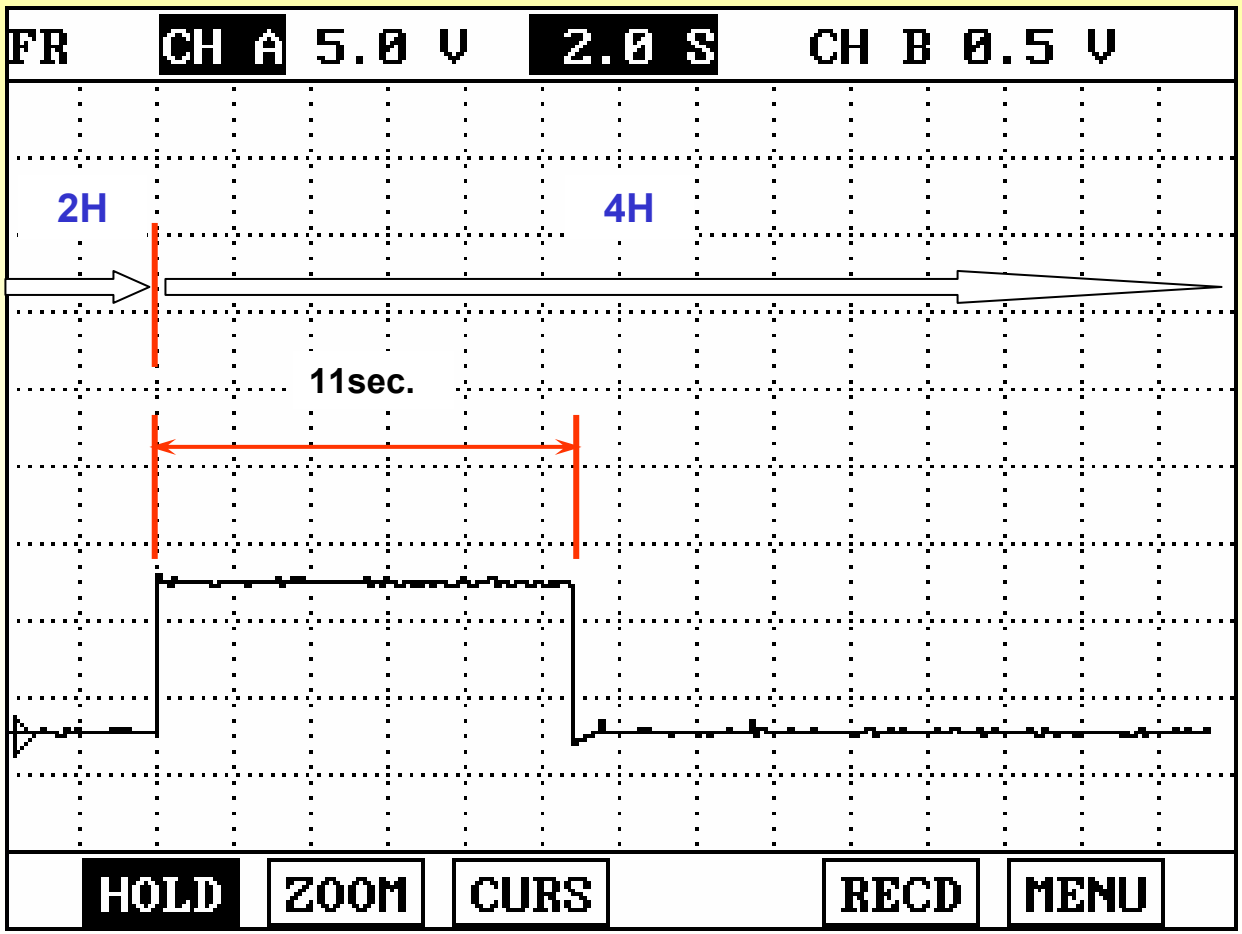
MPS señales (2H → 4H)



MPS señales (4H → 4L)

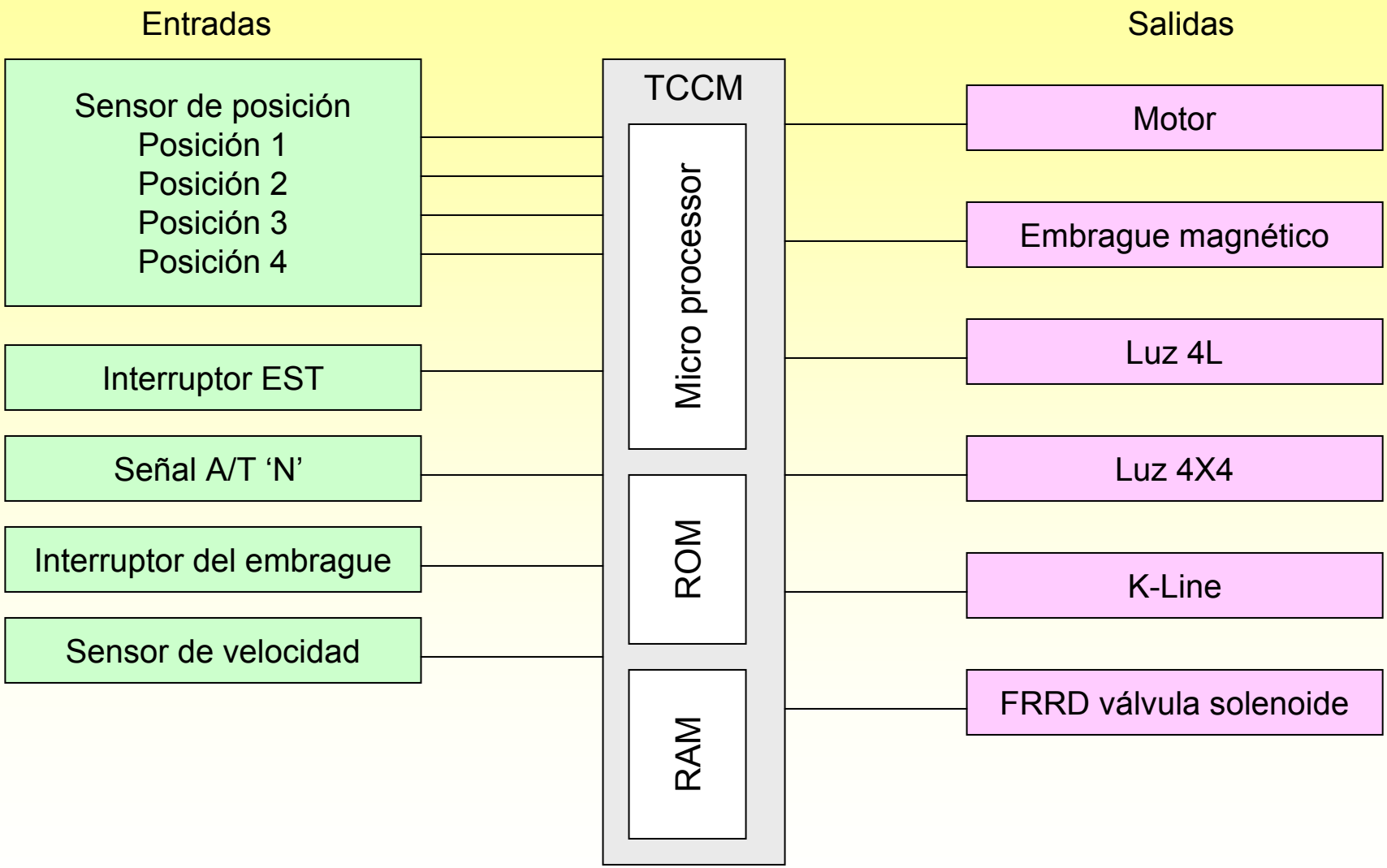


Embrague magnético (2H → 4H)



EST

Diagrama de bloques



TCCM

Conector de diagnosis

Códigos de avería

Los códigos se leen por destellos de la luz del cuadro

Decimal	Binary	Fault
1	001	TCCM (Transfer case control module)
2	010	Shift motor
3	011	EMC (Electro magnetic clutch)
4	100	Speed sensor
5	101	FRRD air pump motor
6	110	2H-4H-4L switch
7	111	MPS (Motor position sensor)

Lista de datos nominales

No		Items	Condition	Signal		Remarks
				Type	Level	
1	A1	MOTOR OUTPUT (2H-4H-4L)	IDLE("N")	DC	Vbatt	* Current : INRUSH(+) : 4.64A INRUSH(-) : 4.4A Operation : 0.6A
				↑	0V	
2	A2	MOTOR OUTPUT (2H-4H-4L)	IDLE("N")	DC	Vbatt	
				↑	0V	
3	A3	GND				
4	A4	CLUTCH COIL	IDLE (2H →4H →4L)	DC	Vbatt	* Current : 4.28A
				↑	0V	
5	A5	POSITION 1 MTR	IDLE (P/R/N/D/2/L)	2H	CODE : 1010	* MTR POS. CODE : 1/2/3/4 = XXXX (1 = 5V dc) (0 ≤ 0.5V dc)
				2H →4H	CODE : 0011	
				4H →4L	CODE : 1100	
					LOGIC HI(1) : 5V	
					LOGIC LO(0) : 0.5V or less	

Lista de datos nominales

No		Items	Condition	Signal		Remarks
				Type	Level	
6	A6	SPEED SNSR	IDLE	PULSE	 135Hz at 60KPH	* VSS of 60KPH : HI : 16.4V LO : -6.4V
7	A7	2H SW	SW OFF	DC	4.5 ~ 5.5V	
			SW ON	↑	0.5V or less	
8	A8	4H DISPLAY	SW OFF	DC	Vbatt	
			SW ON	↑	0.5V or less	
9	A9	BATT	IGN OFF	DC	Vbatt	
			IGN ON	↑	Vbatt	
10	A10	BATT	IGN OFF	DC	Vbatt	
			IGN ON	↑	Vbatt	
11	A11	GND				

Lista de datos nominales

No		Items	Condition	Signal		Remarks
				Type	Level	
12	A12	POSITION 2 MTR	IDLE (P/R/N/D/2/L)	2H 2H →4H 4H →4L	CODE : 1010 CODE : 0011 CODE : 1100 LOGIC HI(1) : 5V LOGIC LO(0) : 0.5V or less	* MTR POS. CODE : 1/2/3/4 = XXXX (1 = 5V dc) (0 ≤ 0.5V dc)
13	A13	4L SW	SW OFF	DC	4.5 ~ 5.5V	
			SW ON	↑	0.5V or less	
14	A14	INHIBITOR SW(AT) CLUTCH INTERLOC SW(MT)	N P/R/D/2/L	DC ↑	0V Vbatt	
15	A15	4L DISPLAY	IDLE("N")	DC	Vbatt	
				↑	0V	
16	A16	MOTOR OUTPUT (4L-4H-2H)	IDLE("N")	DC	Vbatt	
				↑	0V	

Lista de datos nominales

No		Items	Condition	Signal		Remarks
				Type	Level	
17	A17	MOTOR OUTPUT (4L-4H-2H)	IDLE("N")	DC	Vbatt	
				↑	0V	
18	A18	COMMON RETURN	IGN OFF	DC	0.9V or less	
			IGN ON	↑	4.75 ~ 5.25V	
19	A19	IGN 1	IGN OFF	DC	0V	
			IGN ON	↑	Vbatt	
20	A20	POSITION 4 MTR	IDLE (P/R/N/D/2/L)	2H 2H →4H 4H →4L	CODE : 1010 CODE : 0011 CODE : 1100 LOGIC HI(1) : 5V LOGIC LO(0) : 0.5V or less	* MTR POS. CODE : 1/2/3/4 = XXXX (1 = 5V dc) (0 ≤ 0.5V dc)

Lista de datos nominales

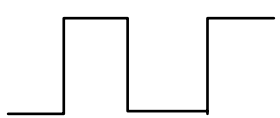
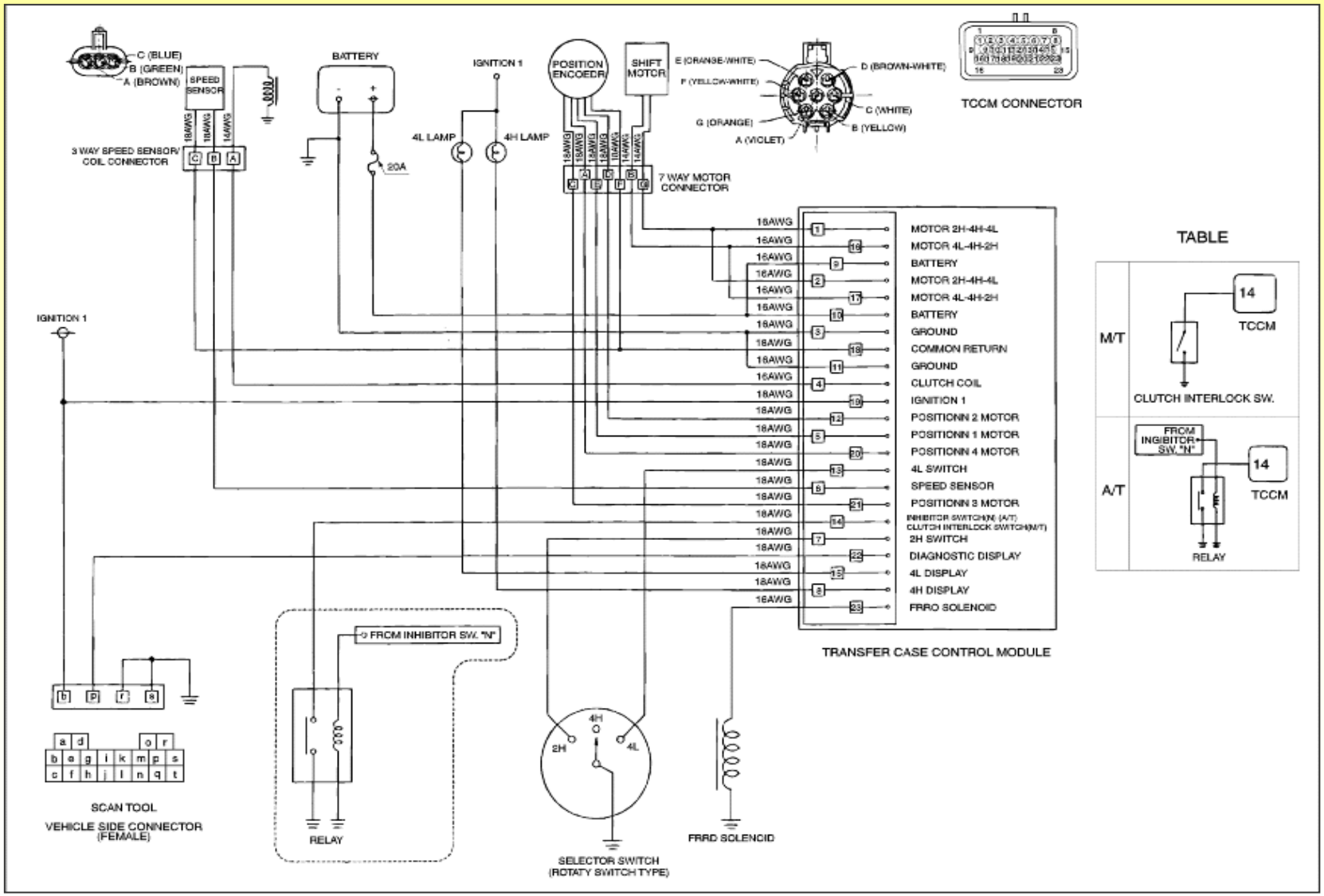
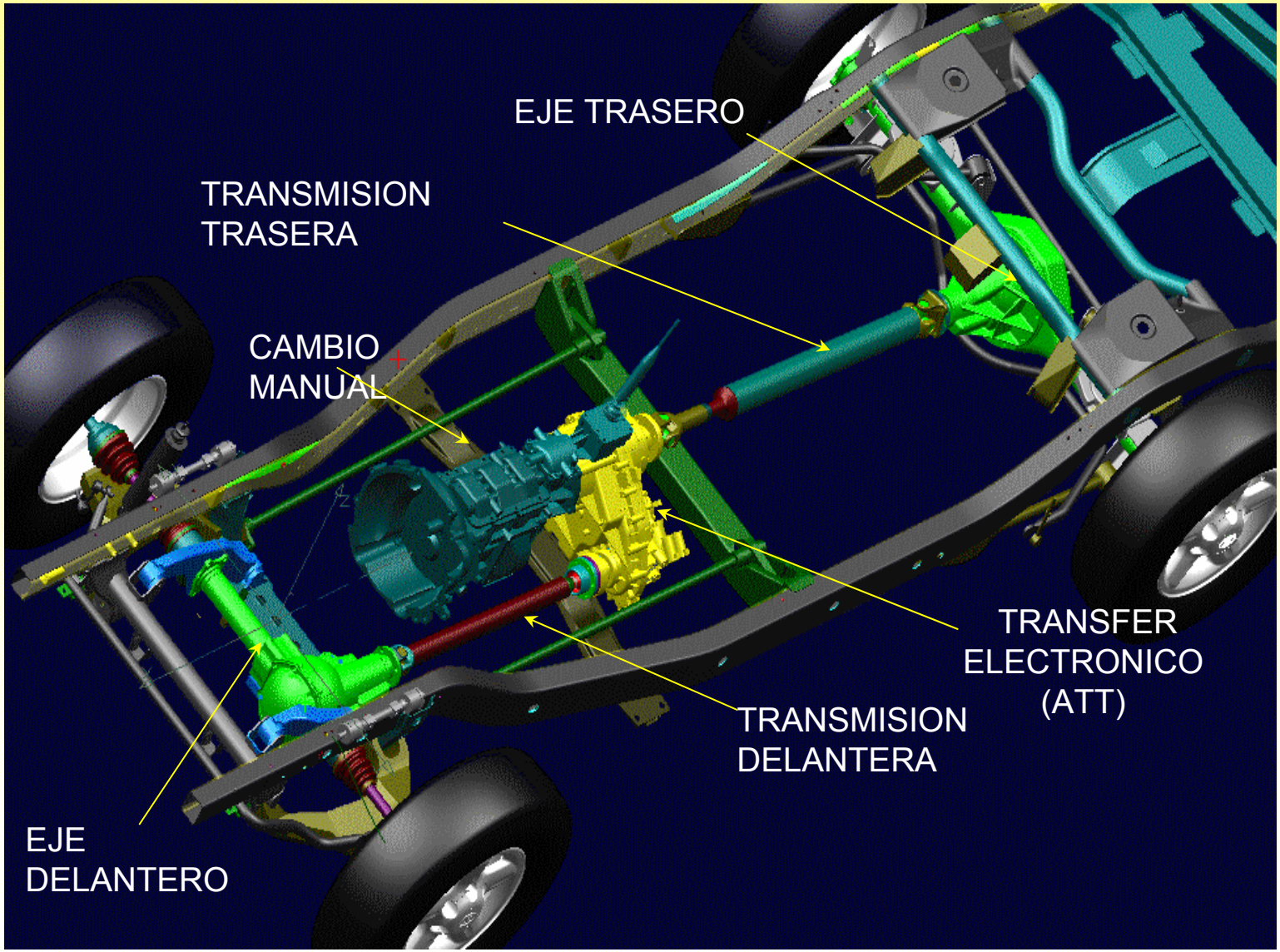
No		Items	Condition	Signal		Remarks
				Type	Level	
21	A21	POSITION 3 MTR	IDLE (P/R/N/D/2/L)	2H 2H →4H 4H →4L	CODE : 1010 CODE : 0011 CODE : 1100 LOGIC HI(1) : 5V LOGIC LO(0) : 0.5V or less	* MTR POS. CODE : 1/2/3/4 = XXXX (1 = 5V dc) (0 ≤ 0.5V dc)
22	A22	DIA. DISPLAY	In comm.	PULSE	 4V or more 0 ~ 0.9V	
23	A23	C FRRD SOLENOID	IDLE (2H →4H)	OFF		
				ON	′ or less	

Diagrama eléctrico



ATT

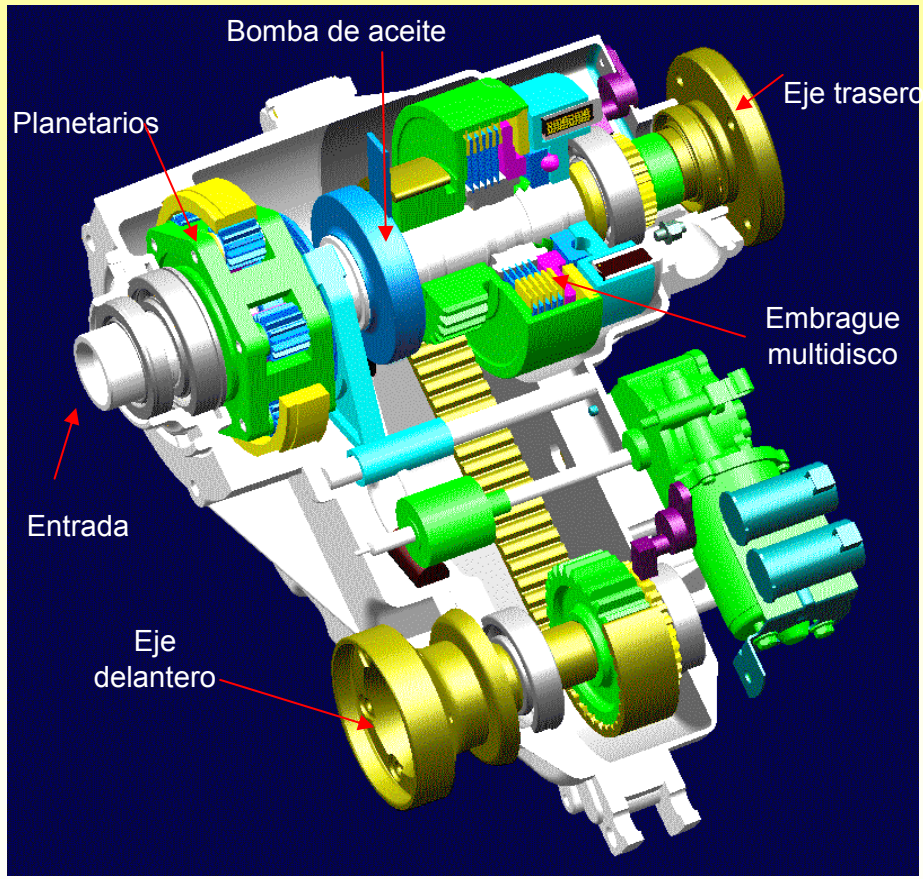

EJE TRASERO
TRANSMISION TRASERA
CAMBIO MANUAL
TRANSFER ELECTRONICO (ATT)
TRANSMISION DELANTERA
EJE DELANTERO

ATT

Introducción

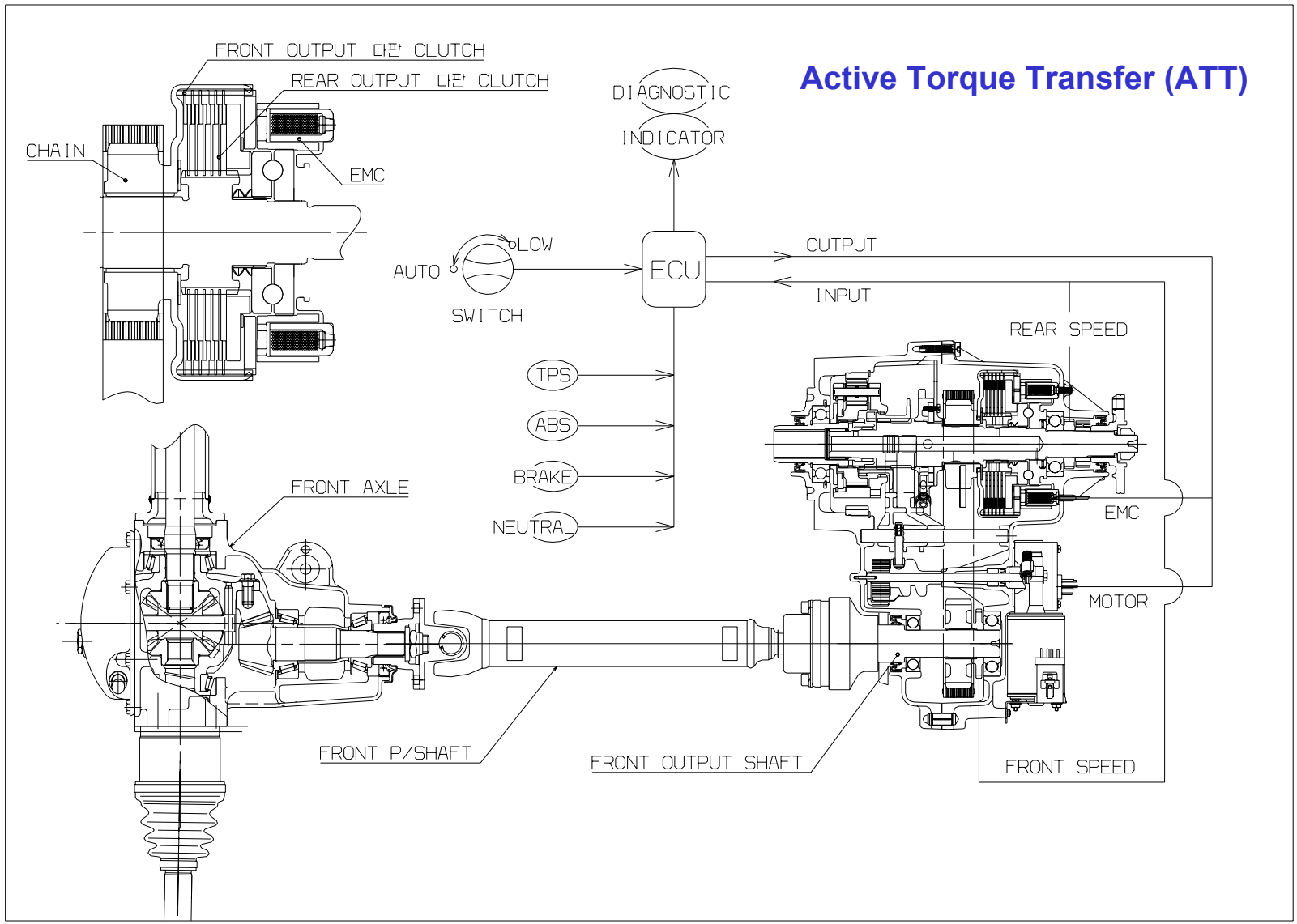
Dependiendo de la diferencia de velocidad de las ruedas delanteras y de las traseras, se transmite el par de las ruedas traseras a las delanteras de forma automática.

Si no hay diferencia de velocidad, el par es llevado a las ruedas traseras en un 100%, a medida que las ruedas delanteras giren más despacio que las ruedas traseras, se va repartiendo el par hasta un máximo de 50% a los dos ejes.



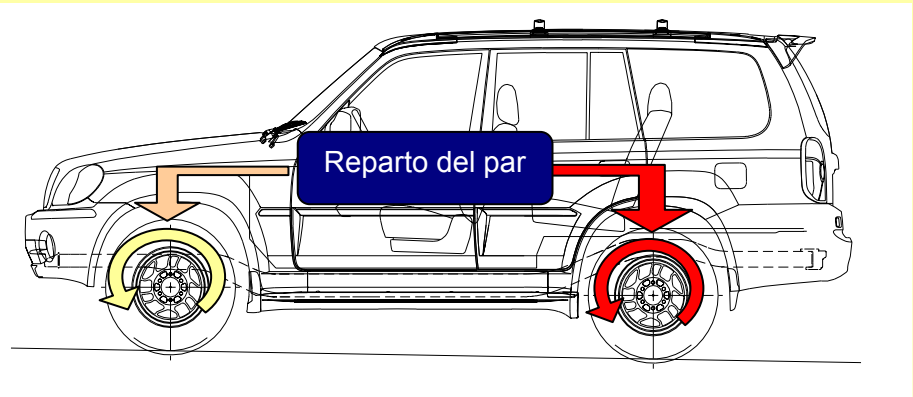
ATT (Active torque transfer)

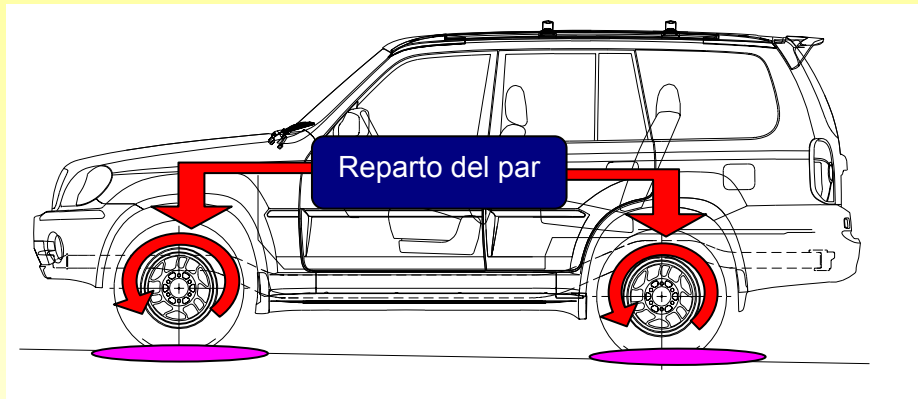
ATT

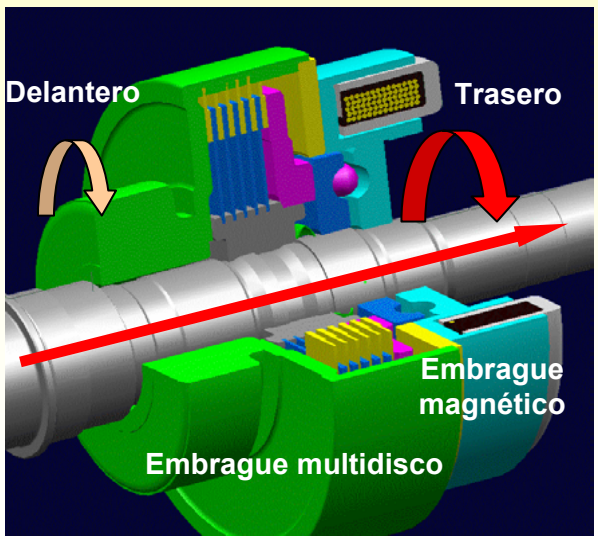

Active Torque Transfer (ATT)
FRONT OUTPUT 다판 CLUTCH
REAR OUTPUT 다판 CLUTCH
CHAIN
EMC
DIAGNOSTIC
INDICATOR
AUTO
LOW
SWITCH
ECU
OUTPUT
INPUT
REAR SPEED
TPS
ABS
BRAKE
NEUTRAL
FRONT AXLE
EMC
MOTOR
FRONT P/SHAFT
FRONT OUTPUT SHAFT
FRONT SPEED

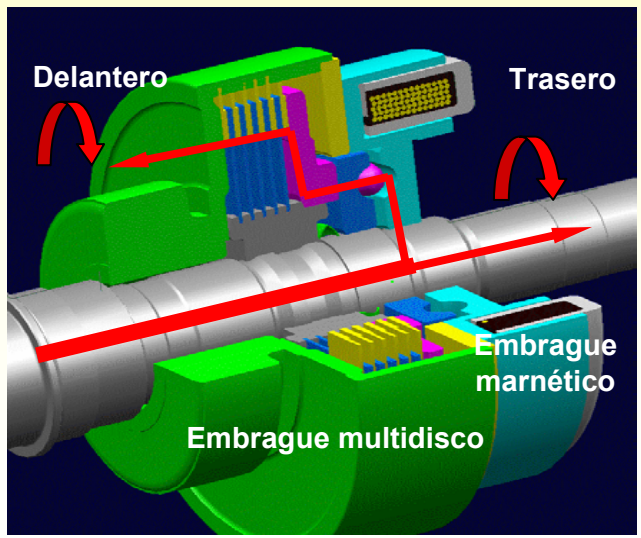
ATT

Selección



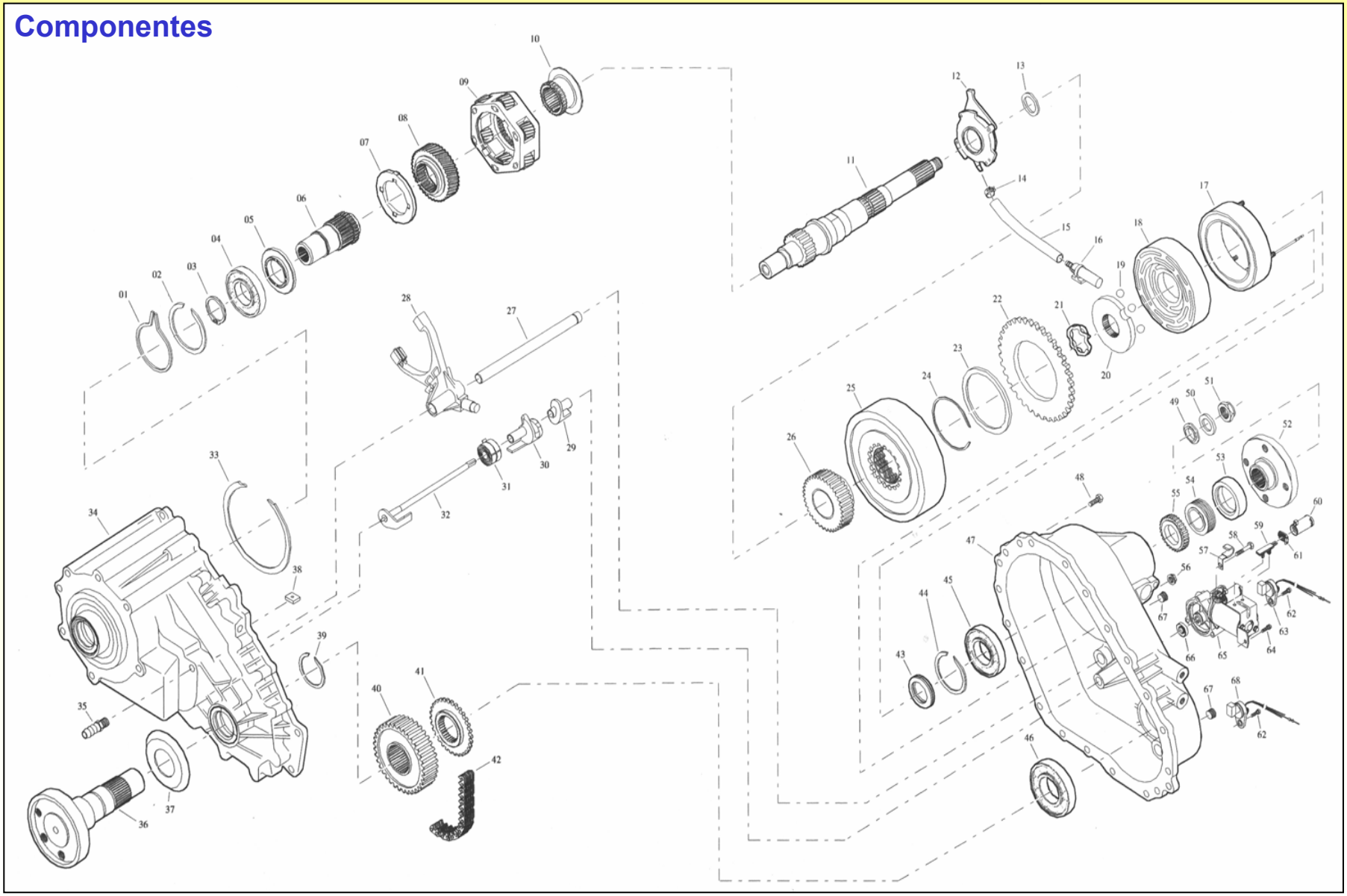






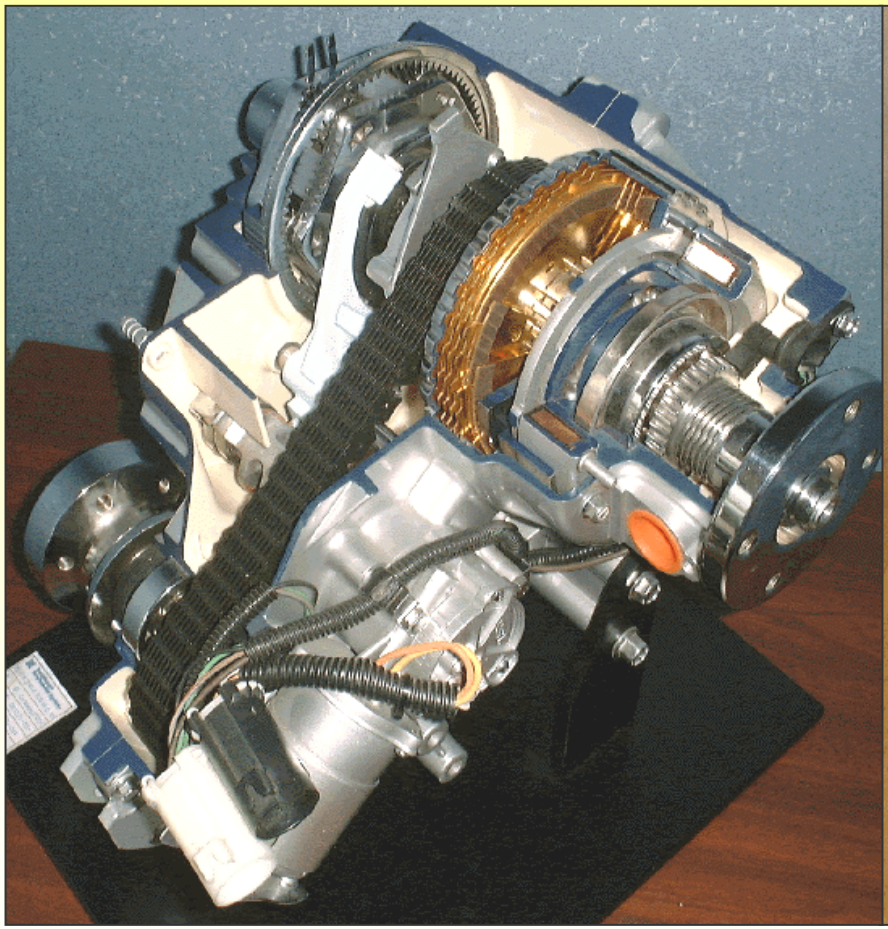
ATT

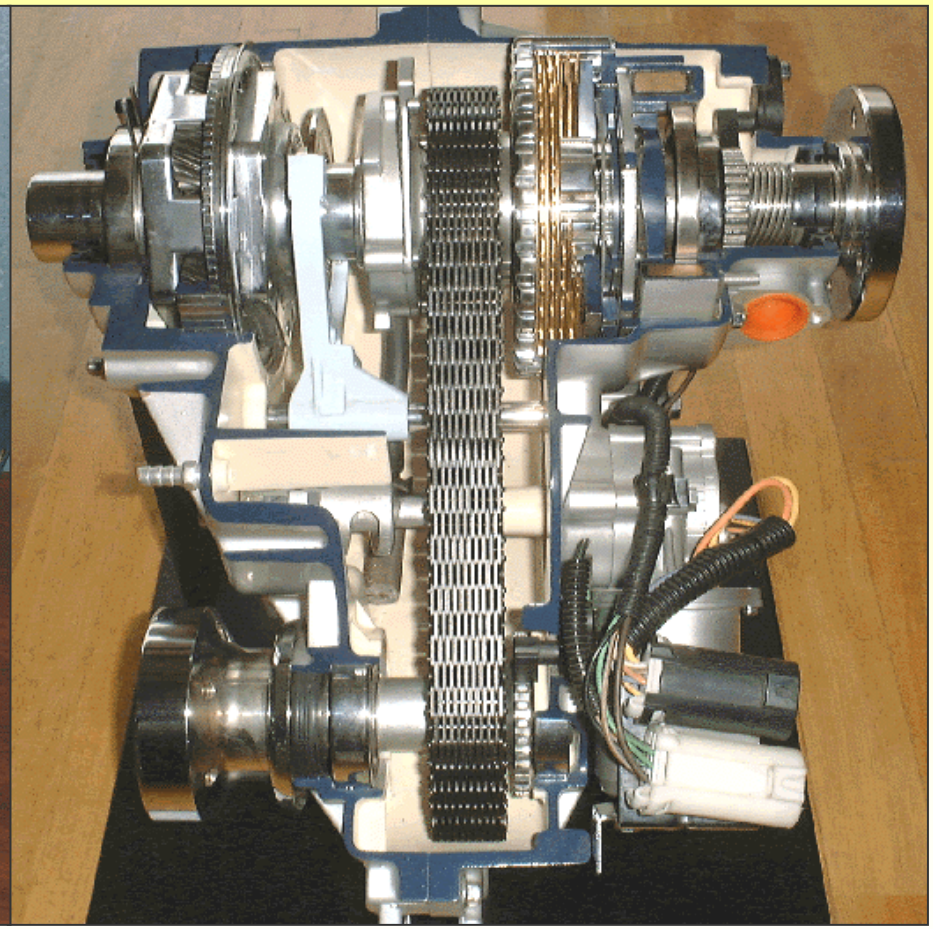
Componentes



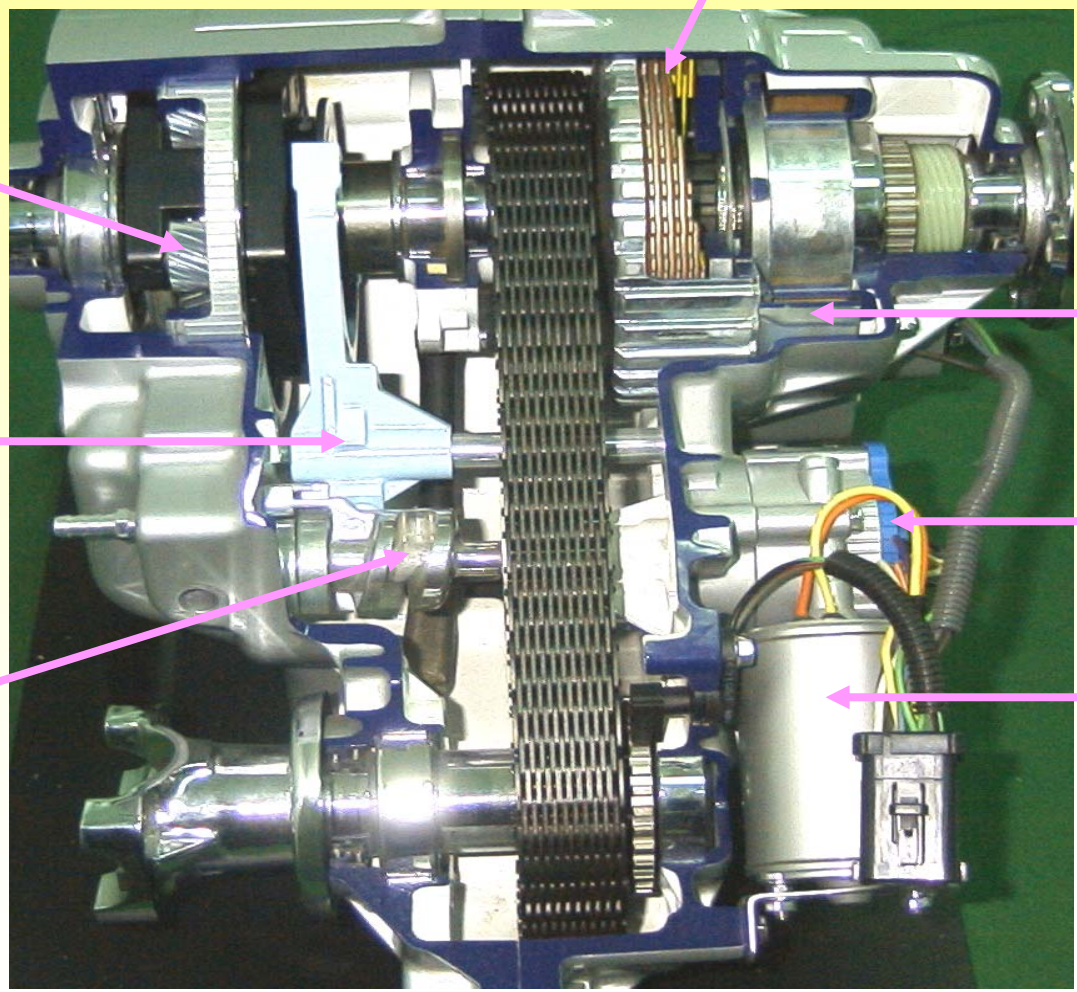
ATT

Vistas

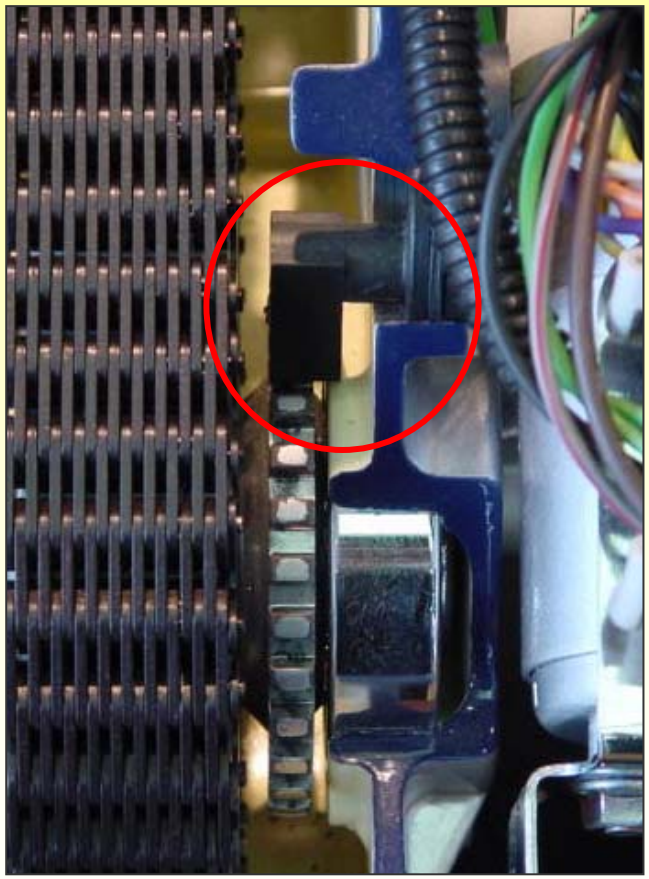




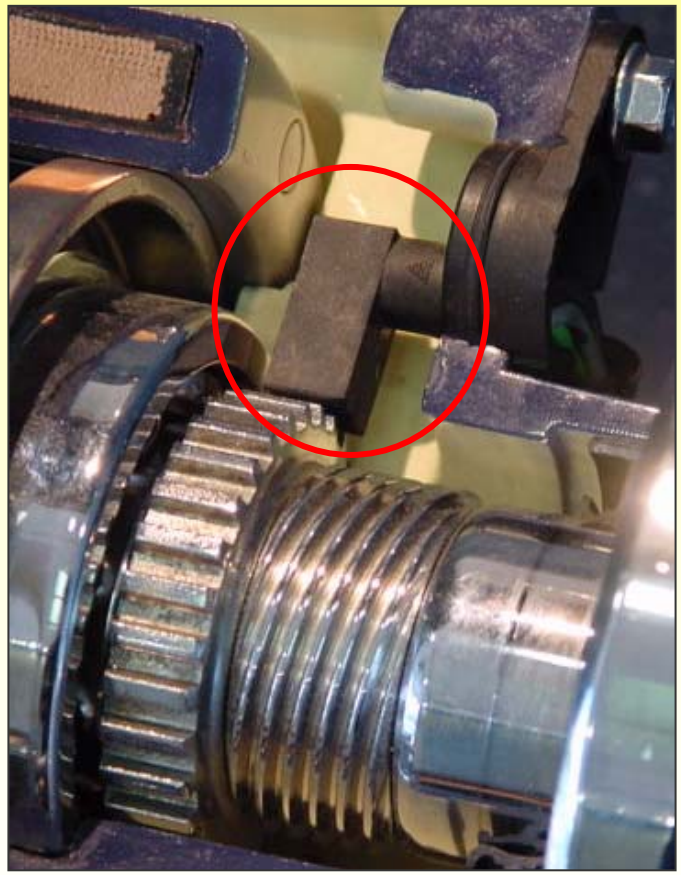
Vistas


Embrague múltiple
Planetarios
Embrague magnético
Horquilla
Sensor de posición del motor
Eje selector
Motor

Sensores de velocidad

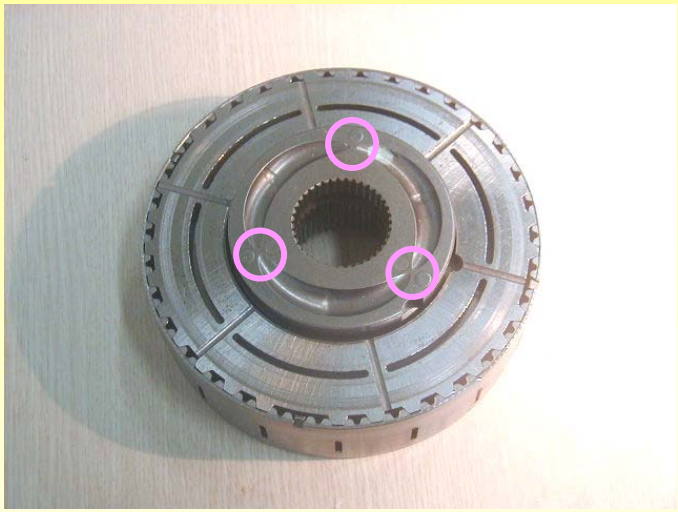


Sensor de velocidad del eje delantero



Sensor de velocidad del eje trasero

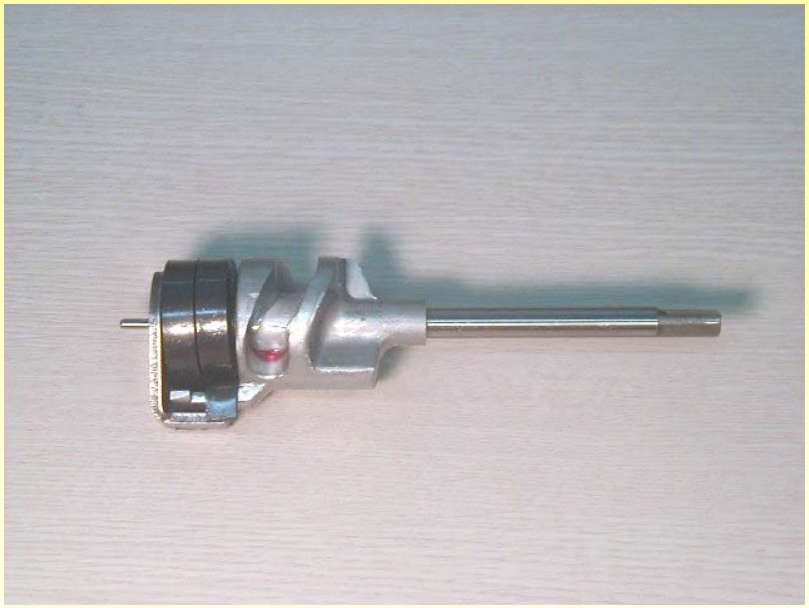
Componentes – Embrague multidisco

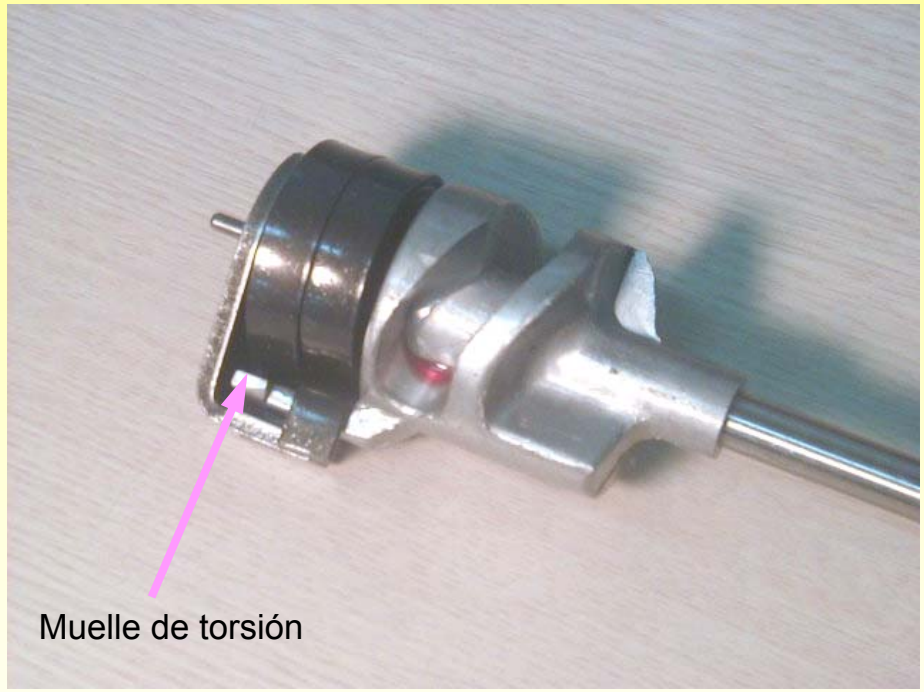


Lleva el sistema tres bolas de acero con tres rampas para que se comprima el embragur sea cual sea el sentido de giro.

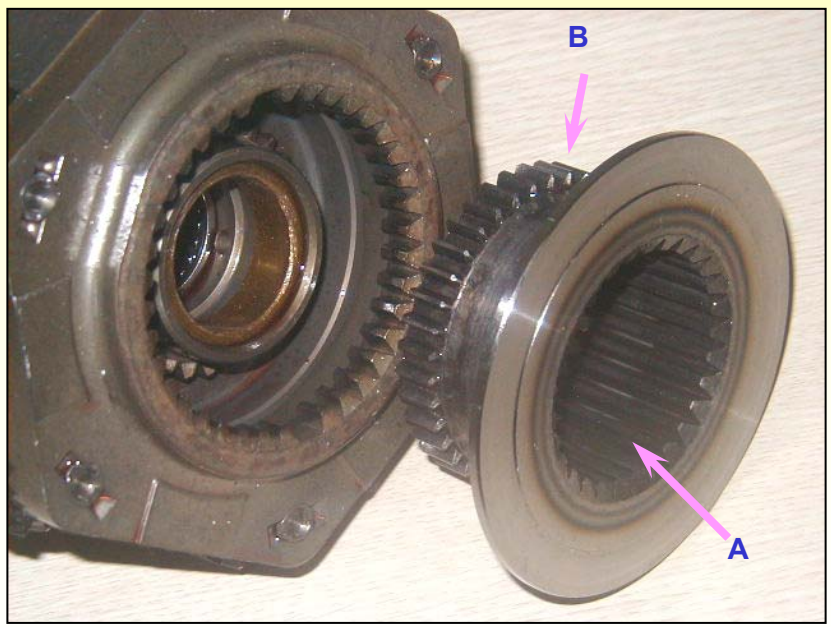
El sistema lleva 11 discos.

Componentes – Eje selector





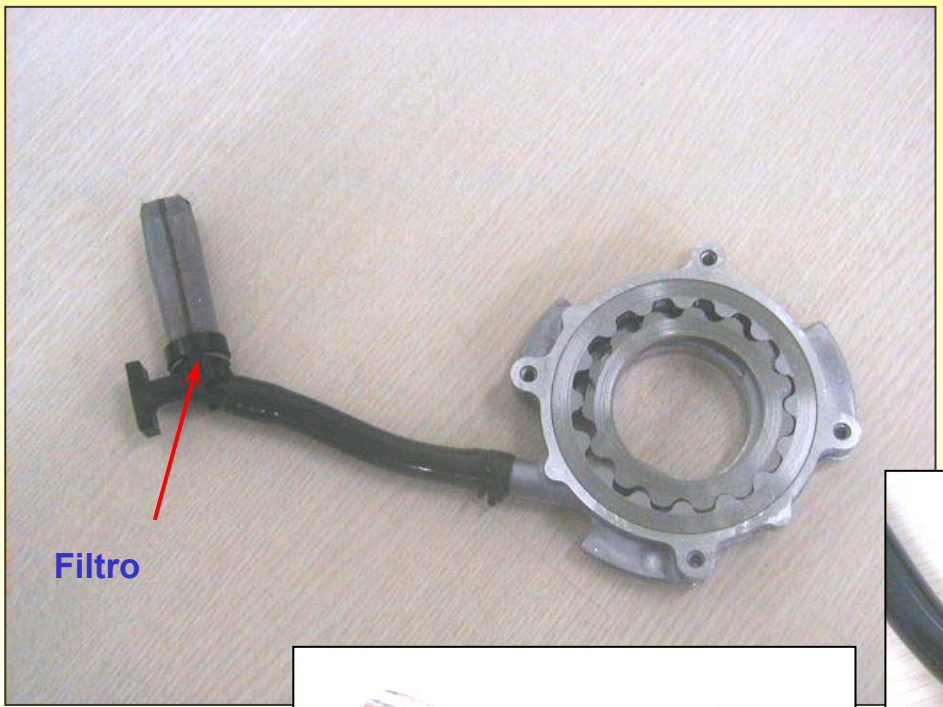
Componentes – Planetarios



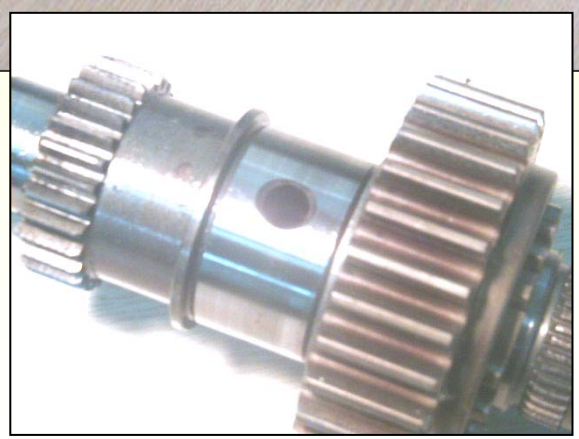
En caso de conexión por el dentado A :
La relación es de 1:1

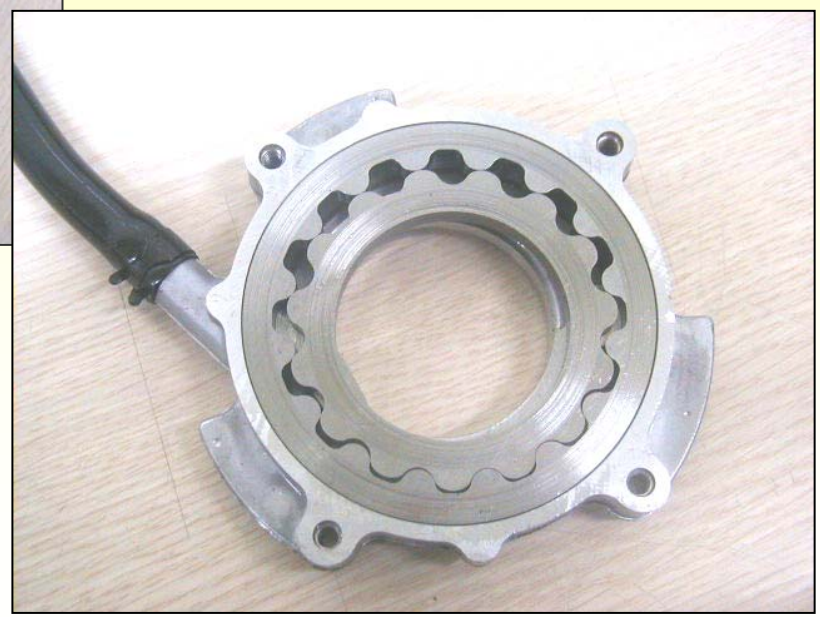
En caso de conexión del dentado B :
La relación es de 2,48:1 (4L)

Componentes – bomba de aceite

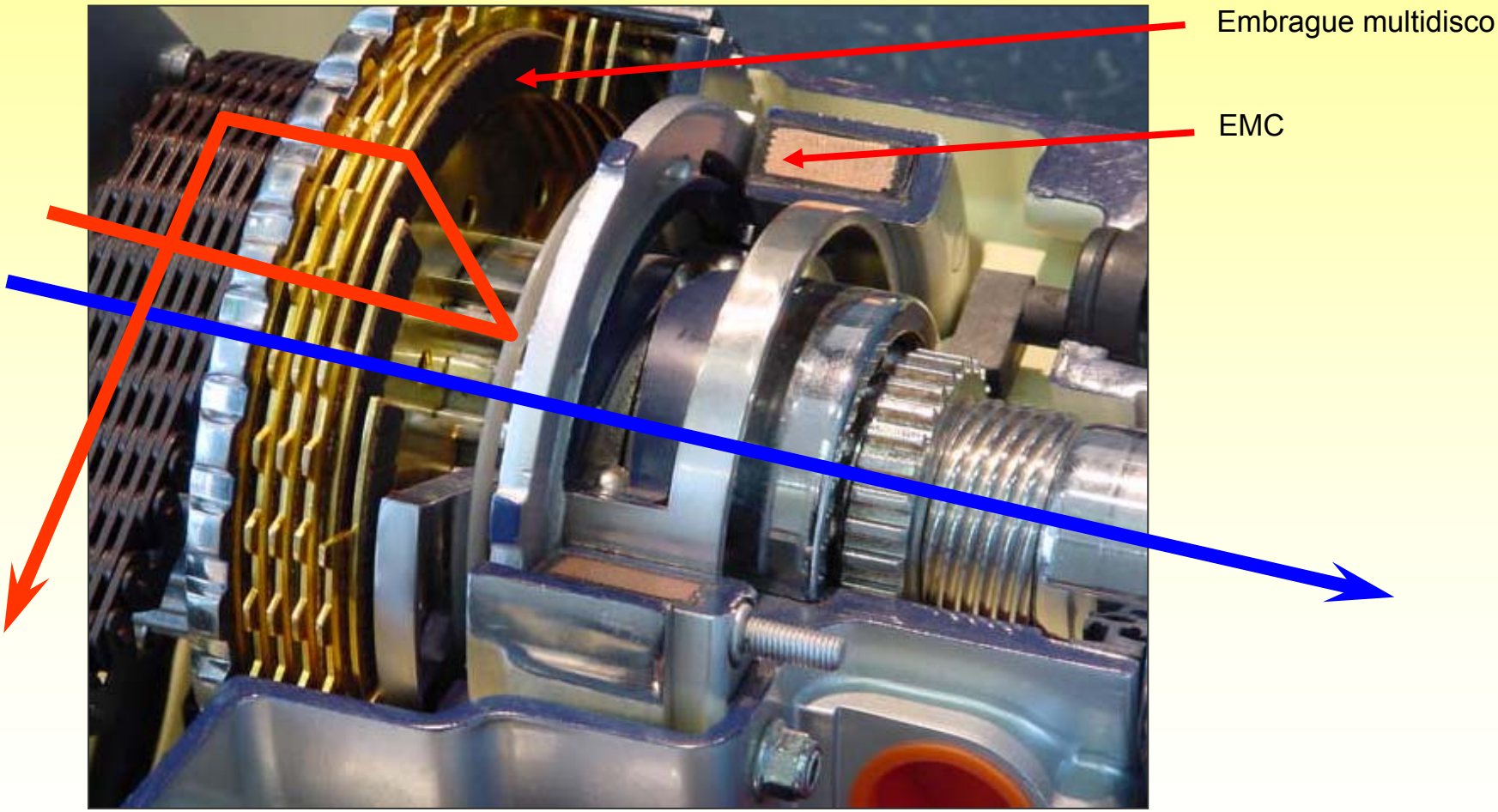


La bomba está instalada para lubricar todas las piezas del transfer.



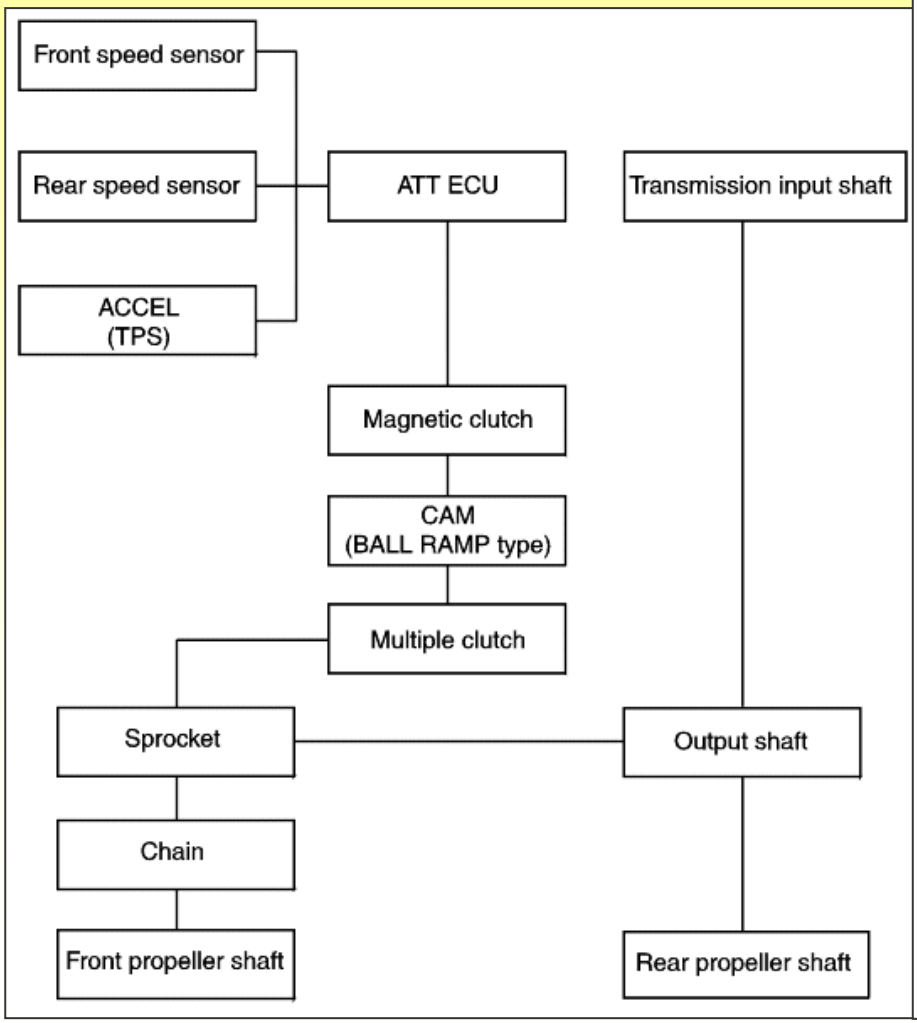


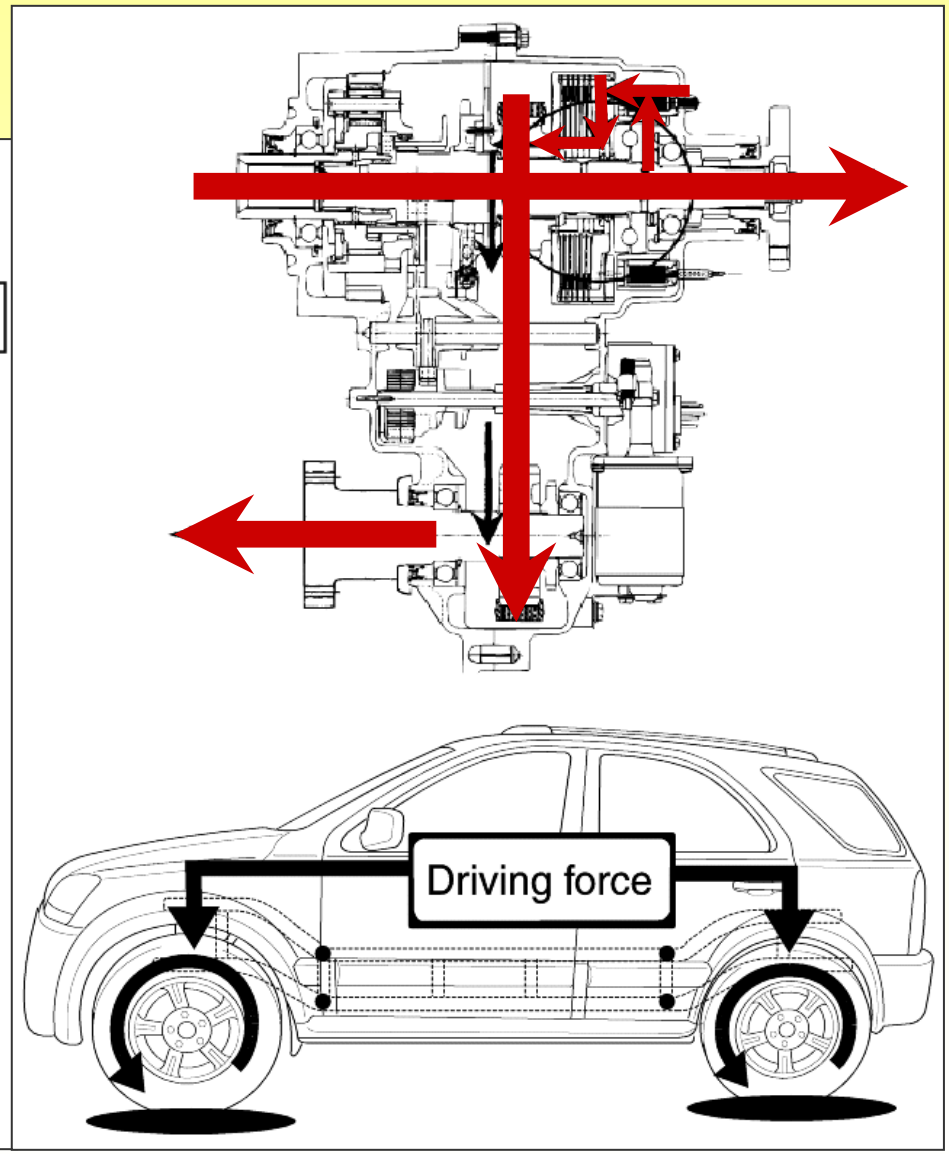
Transmisión de fuerzas



ATT

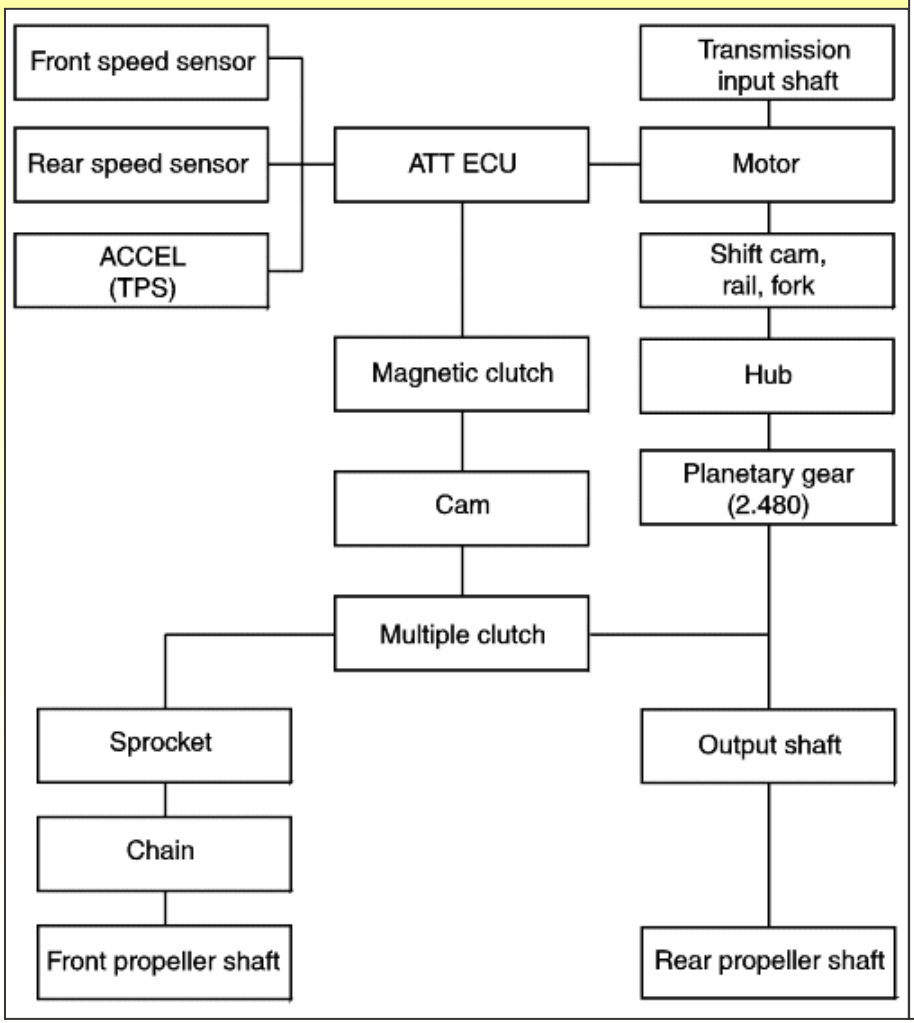
Transmisión de fuerzas





ATT

Distribución de fuerzas



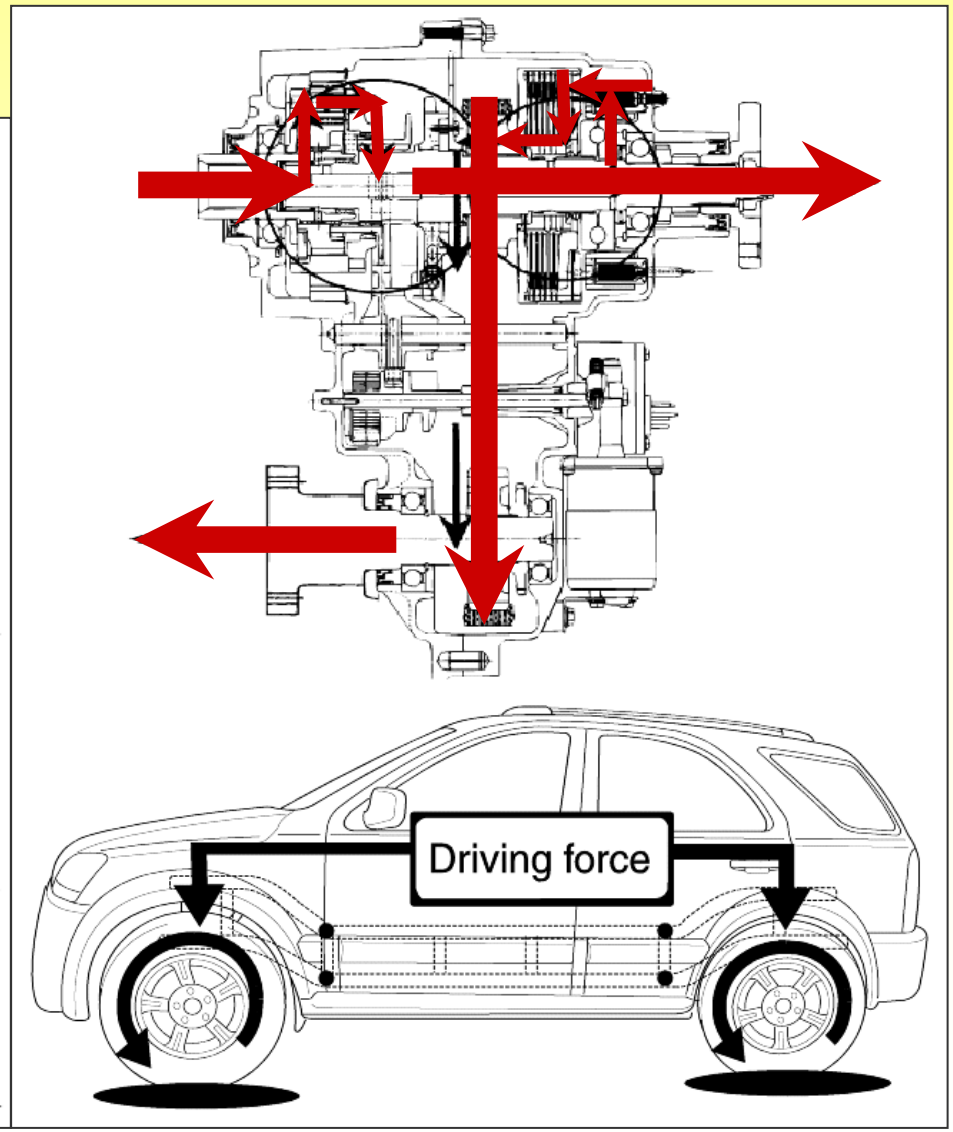
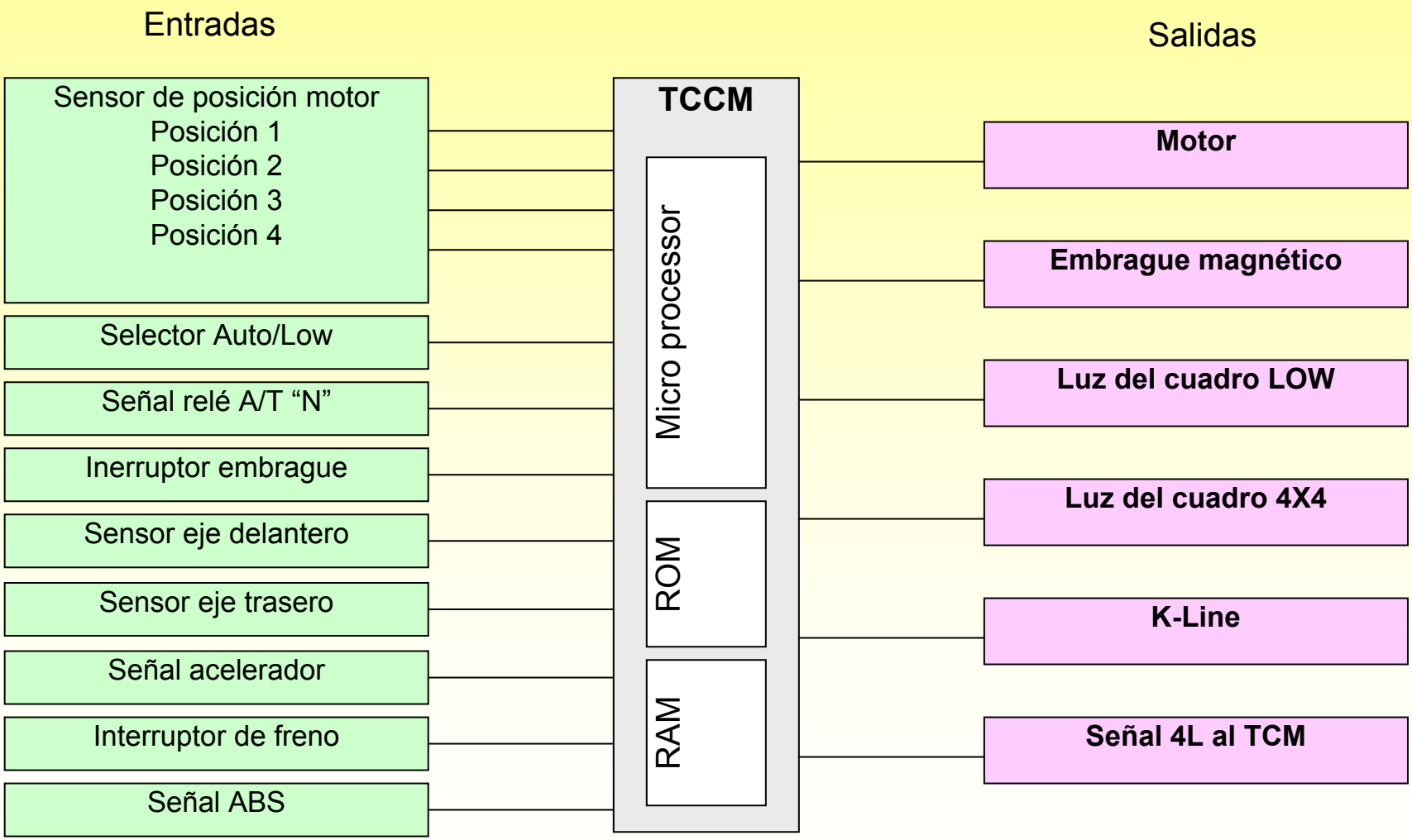
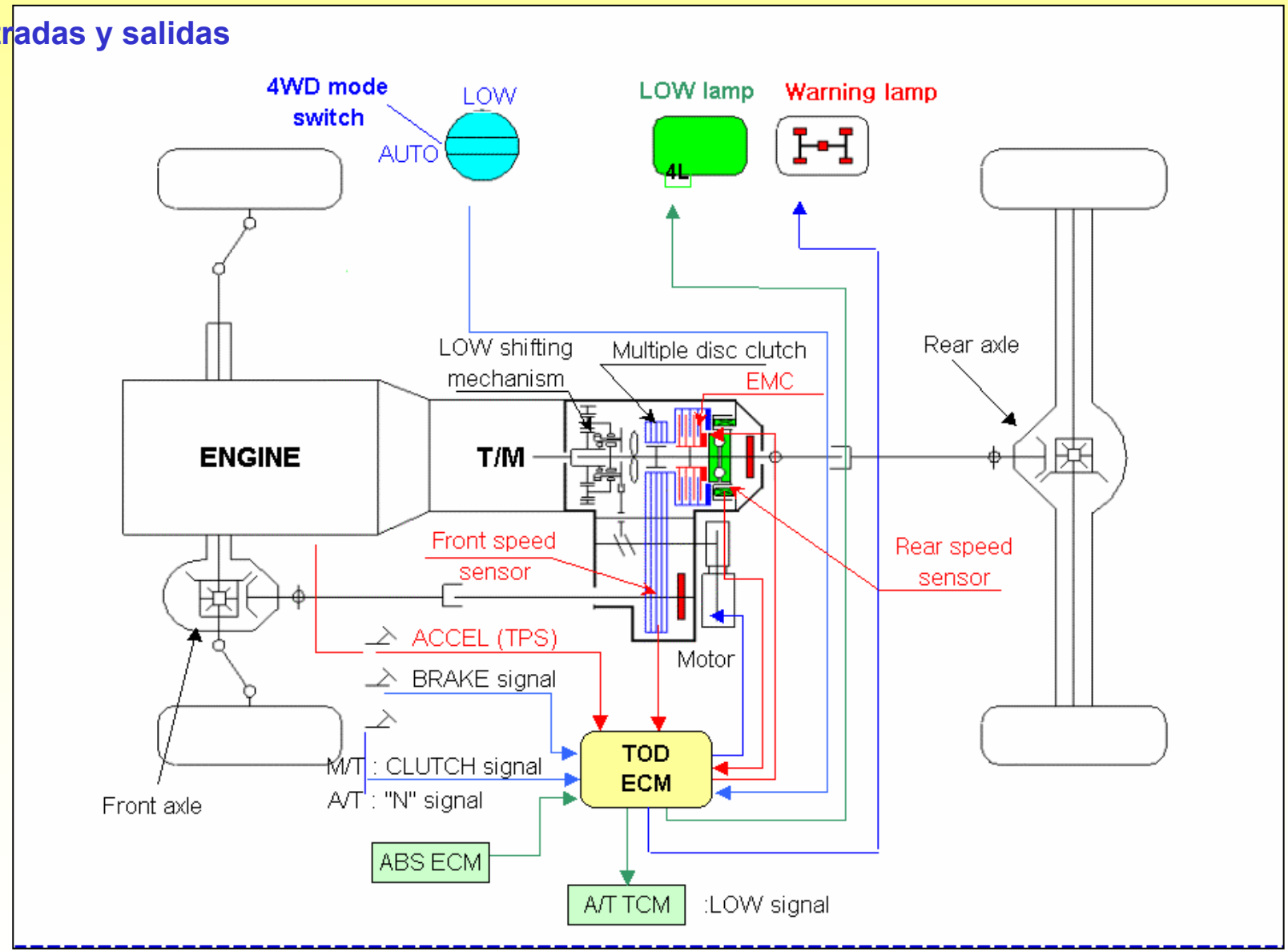


Diagrama de bloques



ATT

Entradas y salidas



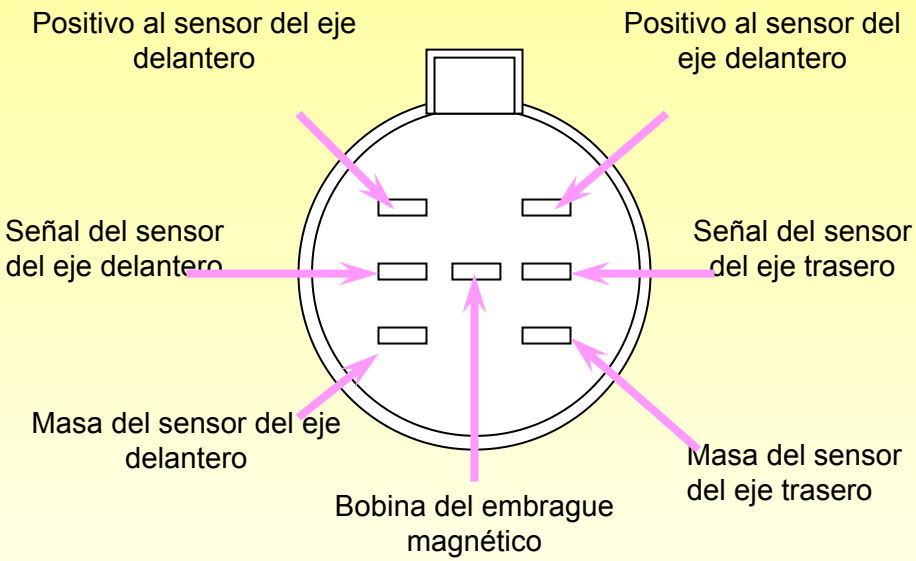
Componentes – Embrague magnético EMC

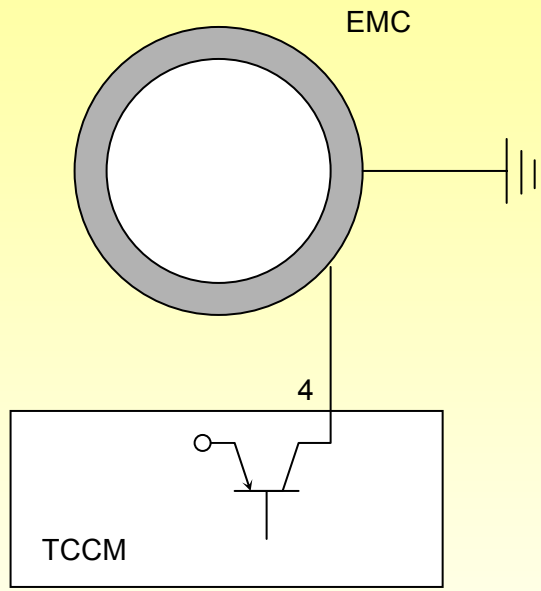
EMC

Embrague multidisco

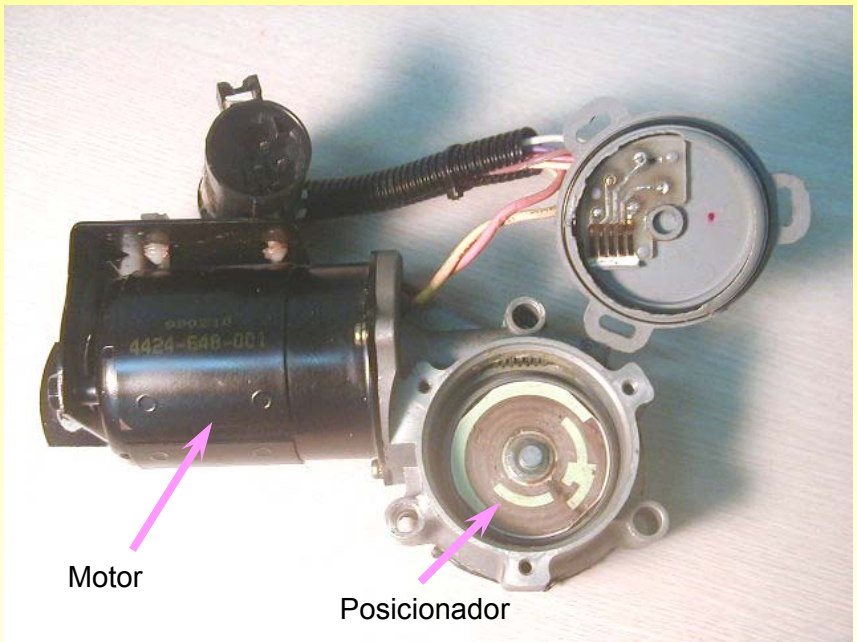
Cuando se aplica corriente al EMC, se presiona el embrague multidisco, de esta manera, se transmite par al eje delantero.

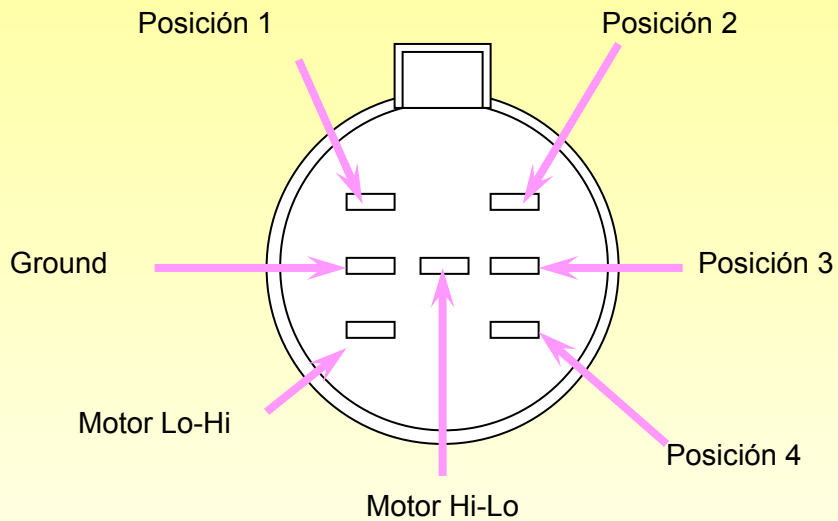
Componentes – Conector





Componentes – Motor y sensor de posición MPS





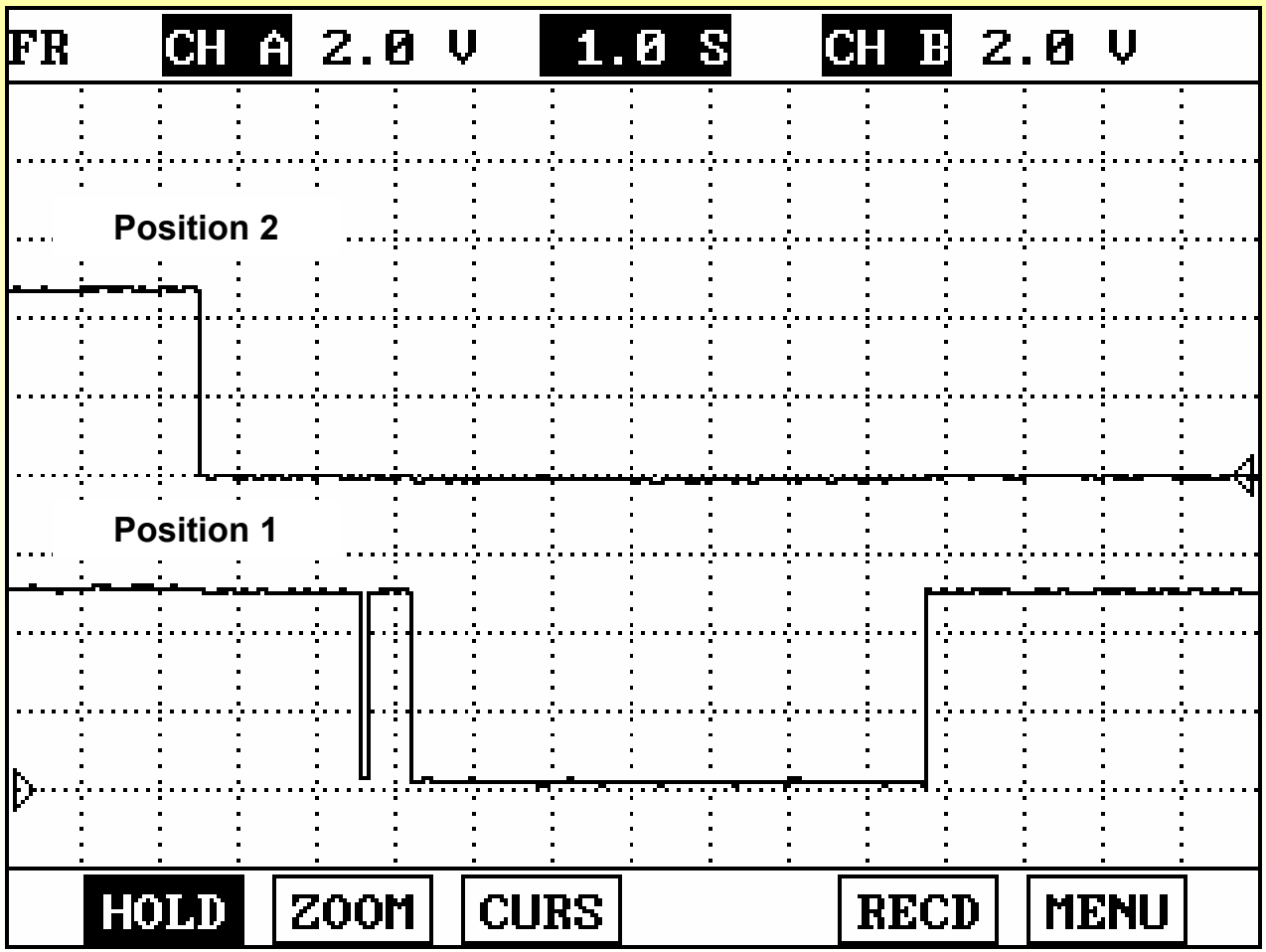
Es un motor de corriente continua controlado por la TCCM. Su misión es pasar de H a L y viceversa.

Resistencia de la bobina : 0.78 ± 0.078Ω

* El motor del ATT y del EST no son intercambiables.

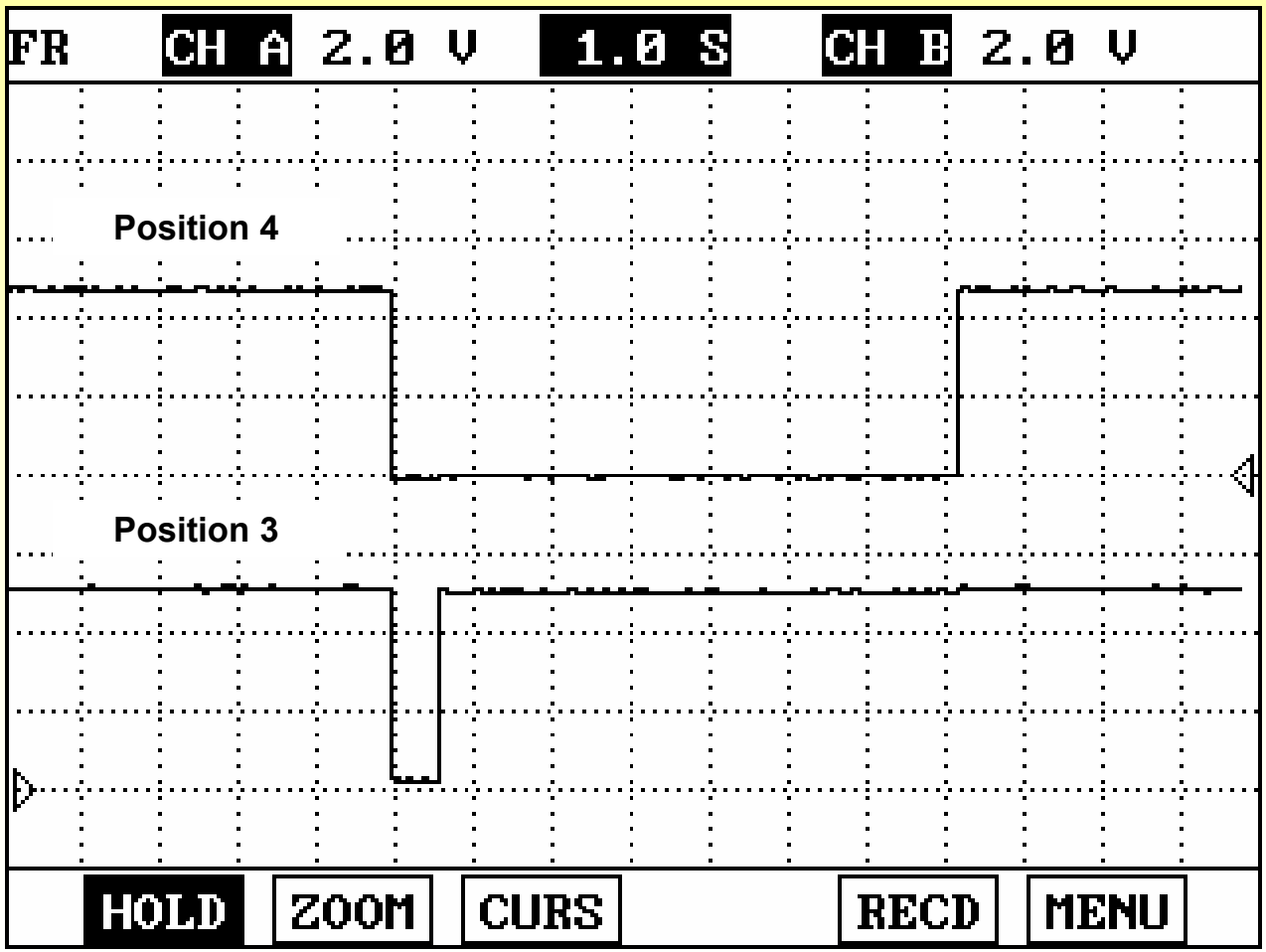
ATT

Señales del MPS (AUTO → LOW)



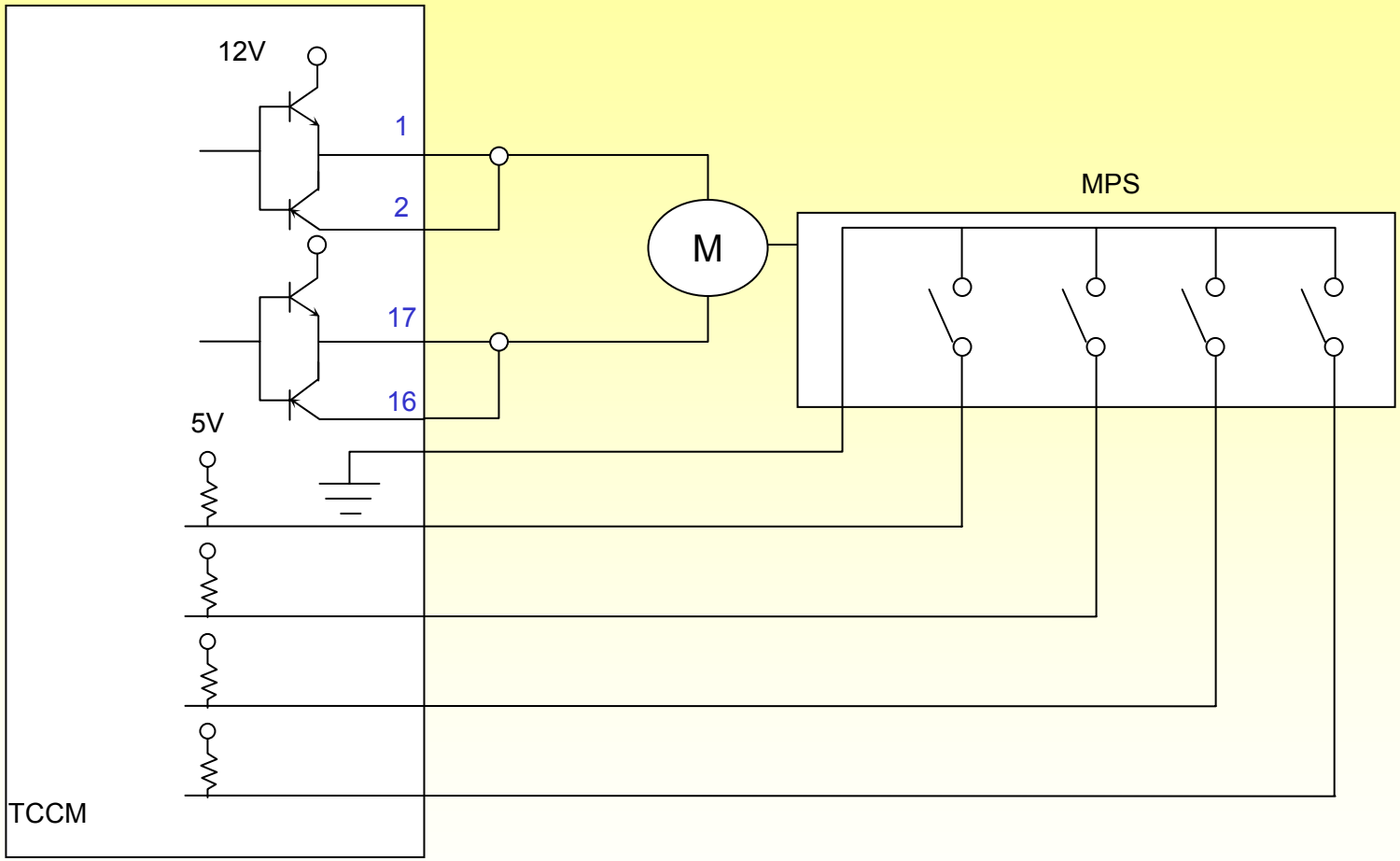
3.5 GSL with TOD

Señales del MPS (AUTO → LOW)



3.5 GSL with TOD

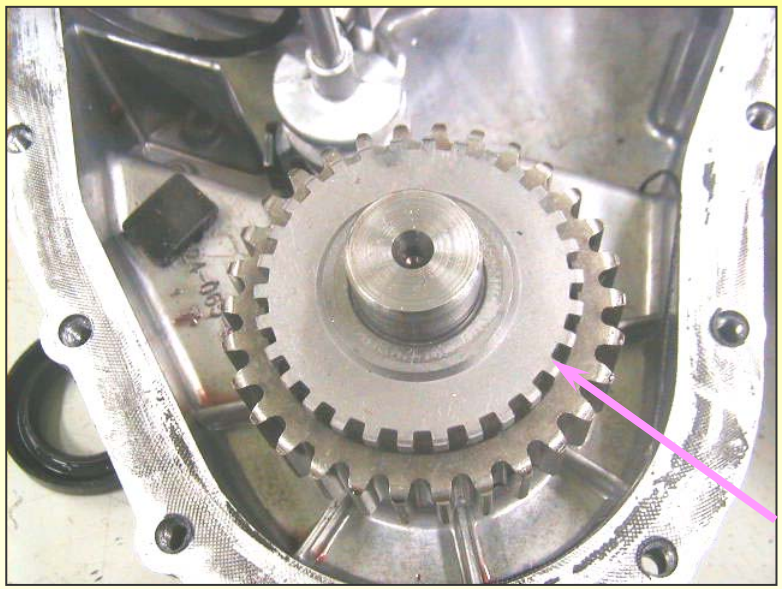
Componentes – Motor y sensor de posición



Giro a derechas (Hi →Lo) : Terminales 1,2 son B+ (12V), terminales 16,17 son masa.

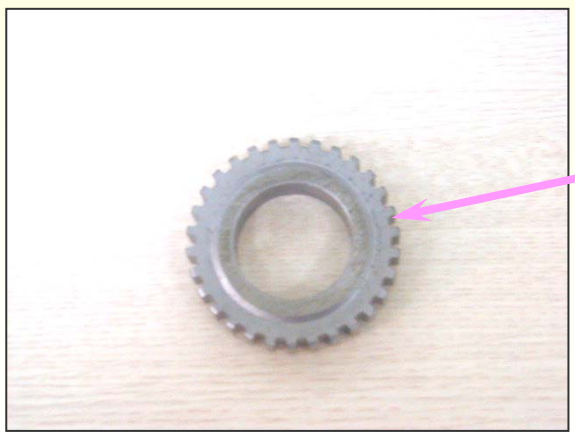
Giro a izquierdas (Lo →Hi) : Terminales 1,2 son masa, terminales 16,17 son B+ (12V).

Componentes – Sensores de los ejes delantero y trasero



Rueda dentada del sensor delantero (30 dientes)

Sensor Hall



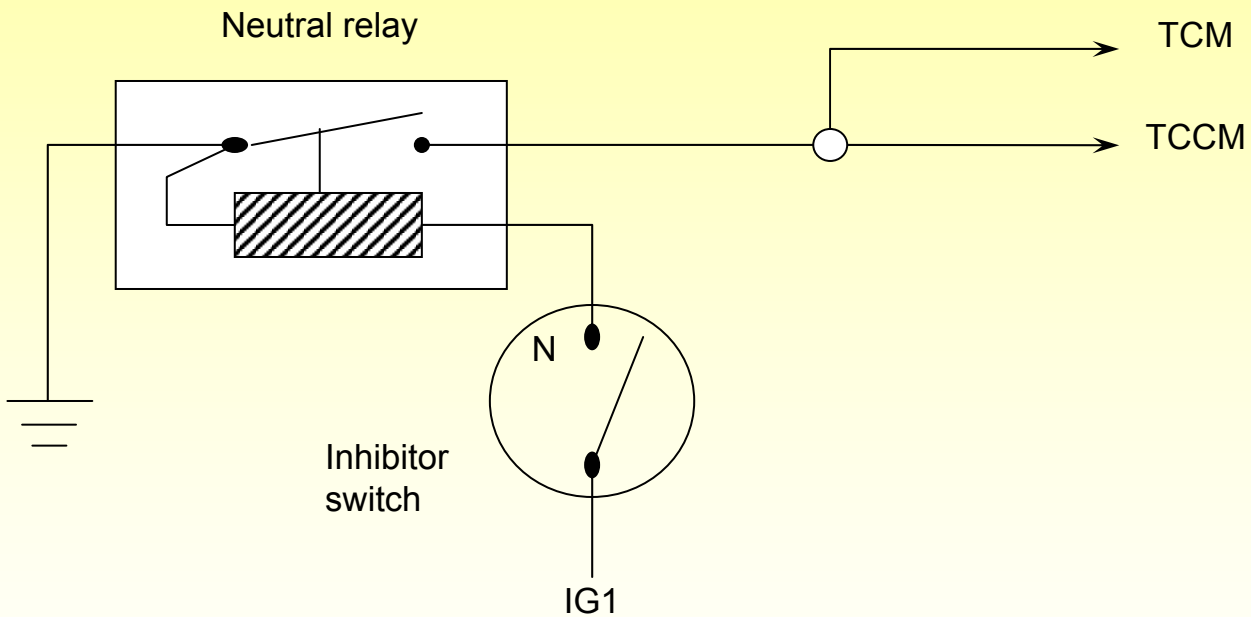
Rueda dentada del sensor trasero (30 dientes)

TOD

Components - Indicator

Condition	A/T LEVER	TOD SW mode	INDICATOR		Description
			4LOW	W/Lamp	
IGN ON or IDLE	P/R/D/2/1	AUTO	ON (3sec)	ON (3sec)	ON (3sec) --> OFF at IG. ON
		AUTO→ 4LOW	Blinking	OFF	'AUTO mode' holding
		4LOW→ AUTO	OFF	OFF	'AUTO mode' holding
	N	AUTO	ON (3sec)	ON (3sec)	ON (3sec) --> OFF at IG. ON
		AUTO→ 4LOW	7 times blinking --> ON	OFF	4LOW indicator : 6 times blinking --> Shift motor ON --> 1 time blinking --> ON
		4LOW→ AUTO	7 times blinking --> OFF	OFF	4LOW indicator : 6 times blinking --> Shift motor ON --> 1 time blinking --> OFF

Componentes – Relé del A/T posición “N” (EST / ATT)

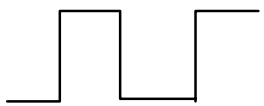


Códifos de avería

DTC	Content
P1725	TOD CONTROL MODULE(CHECKSUM) ERROR
P1726	THROTTLE POSITION INPUT - LOSS OF SIGNAL
P1727	THROTTLE POSITION INPUT - OUT OF RANGE
P1728	EMC - OPEN/SHORT TO BATTERY
P1729	EMC - SHORT TO GROUND
P1730	FRONT SPEED SENSOR - LOW INPUT
P1731	FRONT SPEED SENSOR - HIGH INPUT
P1732	REAR SPEED SPEED SENSOR - LOW INPUT
P1733	REAR SPEED SPEED SENSOR - HIGH INPUT
P1734	SPEED SENSOR REFERENCE - LOW INPUT
P1735	SPEED SENSOR REFERENCE - HIGH INPUT
P1736	SHIFT MOTOR - OPEN
P1737	SHIFT MOTOR - OPEN/SHORT TO GROUND
P1738	SHIFT SYSTEM TIMEOUT
P1739	GENERAL POSITION ENCODER FAULT
P1740	POSITION 1 - SHORT TO GROUND
P1741	POSITION 2 - SHORT TO GROUND
P1742	POSITION 3 - SHORT TO GROUND
P1743	POSITION 4 - SHORT TO GROUND

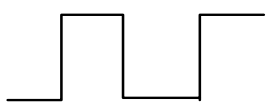
ATT

Valores nominales de entradas y salidas en el TCCM (2.5 TCI – ATT)

No		Items	Condition	Signal		Remarks
				Type	Level	
1	A1	MOTOR OUTPUT (HI-LOW)	IDLE("N"단)	DC	Vbatt	
				↑	0V	
2	A2	MOTOR OUTPUT (LOW-HI)	IDLE("N"단)	DC	Vbatt	
				↑	0V	
3	A3	EMC	Vehicle driving	PULSE (PWM)	 Vbatt 0V FREQ. : 50Hz DUTY(-) : 0 ~ 88%	* 4LOW DUTY(-): 88.72%
4	A4	BATT	IGN OFF	DC	Vbatt	
			IGN ON	↑	Vbatt	
5	A5	IGN 1	IGN OFF	DC	0V	
			IGN ON	↑	Vbatt	
6	B1	ENCODER GND				
7	B2	DIAGNOSTIC DISPLAY	LAMP OFF	DC	Vbatt	
			LAMP ON	↑	0.5V or less	

ATT

Valores nominales de entradas y salidas en el TCCM (2.5 TCI – ATT)

No		Items	Condition	Signal		Remarks
				Type	Level	
8	B3	TPS(PWM)	ACCEL C.T & W.O.T	PWM	HI : 4V MIN LO : 0.9V MAX FREQ. : 100Hz DUTY(-) : C.T - 10% W.O.T - 83%	
9	B4	AUTO/LOW SW	IDLE (A/T LEVER "N")	AUTO LOW	4V or more 0.9V or less (AUTO mode : 4V or more)	
10	B5	SHIFT MOTOR POSITION 2	IDLE (A/T LEVER "N")	→AUTO →LOW	CODE : 0010 →0000 CODE : 0101 →0000 LOGIC HI(1) : 4.5V or more LOGIC LO(0) : 0.5V or less	* MTR POS. CODE: 1/2/3/4 = XXXX
11	B6	FRT SPEED SNSR	Vehicle driving	PULSE	 4V or more 0～0.9V 30PULSE/PROPSHAFT REV. DUTY(-) : 50%	* VSS 60KPH : 985Hz

ATT

Valores nominales de entradas y salidas en el TCCM (2.5 TCI – ATT)

No		Items	Condition	Signal		Remarks
				Type	Level	
12	B7	N.A				
13	B8	SPEED SNSR GND				
14	A6	MOTOR OUTPUT (HI-LOW)	IDLE("N")	DC	Vbatt	
				↑	0V	
15	A7	MOTOR OUTPUT (LOW-HI)	IDLE("N")	DC	Vbatt	
				↑	0V	
16	A8	SPEED REFERENCE	IGN OFF	DC	0.9V or less	
			IGN ON	↑	4.75 ~ 5.25V	
17	A9	GND FOR ECU				
18	A10	GND FOR ECU				
19	A11	BATT	IGN OFF	DC	Vbatt	
			IGN ON	↑	Vbatt	
20	A12	K-LINE	In comm (10.4Kbps)	PULSE	LOGIC "0" : Vbatt 20% or less LOGIC "1" : Vbatt 80% or more	

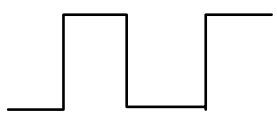
ATT

Valores nominales de entradas y salidas en el TCCM (2.5 TCI – ATT)

No		Items	Condition	Signal		Remarks
				Type	Level	
21	B9	4LOW DISPLAY	SW OFF	DC	Vbatt	* IGN ON :
			SW ON	↑	0.5V or less	Turned on for 3sec.
22	B10	N.A				
23	B11	N.A				
24	B12	TRANS. NEUTRAL	N	DC	0.9V or less	
			P/R/D/2/L	↑	4.5 ~ 5.5V	
25	B13	ABS INPUT	ABS OFF	DC	4.5 ~ 5.5V	
			ABS ON	↑	0.9V or less	
26	B14	BRAKE SW	SW OFF	DC	0.9V or less	
			SW ON	↑	Vbatt	
27	B15	SHIFT MOTOR POSITION 1	IDLE (A/T LEVER "N")	→AUTO →LOW	CODE : 0010 →0000 CODE : 0101 →0000 LOGIC HI(1) : 4.5V or more LOGIC LO(0) : 0.5V or less	* MTR POS. CODE: 1/2/3/4 = XXXX

ATT

Valores nominales de entradas y salidas en el TCCM (2.5 TCI – ATT)

No		Items	Condition	Signal		Remarks
				Type	Level	
28	B16	SHIFT MOTOR POSITION 3	IDLE (A/T LEVER "N")	→AUTO →LOW	CODE : 0010 →0000 CODE : 0101 →0000 LOGIC HI(1) : 4.5V or more LOGIC LO(0) : 0.5V or less	* MTR POS. CODE: 1/2/3/4 = XXXX
29	B17	RR SPEED SNSR	Vehicle driving	PULSE	 4V or more 0～0.9V 30PULSE/PROPSHAFT REV. DUTY(-) : 50%	* VSS 60KPH : 966Hz
30	B18	SHIFT MOTOR POSITION 3	IDLE (A/T LEVER "N")	→AUTO →LOW	CODE : 0010 →0000 CODE : 0101 →0000 LOGIC HI(1) : 4.5V or more LOGIC LO(0) : 0.5V or less	* MTR POS. CODE: 1/2/3/4 = XXXX

ATT

Diagrama eléctrico