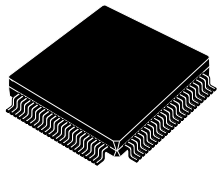
L9390

Twelve channel valve driver

Data Brief

Features

- Four low side switched output drivers with 0.1Ω $R_{ds,ON}$ at 25°C
  Possibly configurable as PWM controlled adding external freewheeling diodes
- Two low side PWM controlled output drivers with 0.1Ω $R_{ds,ON}$ at 25°C and integrated active freewheeling diodes
- Six low side current controlled output drivers with 0.16Ω $R_{ds,ON}$ at 25°C and integrated active freewheeling diodes
  Current accuracy:
  – 10% (I_{load} < 800mA)
  – 6% (I_{load} > 800mA)
- All outputs with integrated 35V zener clamp
- Five pin SPI port (four standard pins plus additional SPI enable input pin)
- Six serial high speed input for output control
- High level diagnostic, including Silent Valve Driver Test
- Direct disable of outputs with an external pin
- Programmable jitter frequency of PWM and current controlled outputs
- TQFP100 exposed pad package



TQFP100
(Exposed pad down)

Description

The L9390 is a twelve output low side valve driver designed for use in an ABS/ESP vehicle system. All outputs are PWM configurable, while six out of twelve are current regulated. Each of the twelve outputs is open drain configured and has a built-in 35V clamp. Eight of the twelve have integrated active freewheeling diodes for active rectification of the PWM controlled load.

In order to minimize electromagnetic emissions during load actuation, the possibility to control output slopes is provided.

Two separate communication interfaces are present: the SPI port is primarily designated to provide diagnostics and secondary control. The serial High End Timer Interface (HET) provides the primary output control functions from on/off switching to current level control commands.

Diagnostic includes over current protection, under current detection, open load detection, loss of ground detection, loss of freewheeling diode, and over temperature detection, output integrity check, SVDT, leakage current test, PWM integrity and functionality check, valve resistance sense check, loss of freewheeling diode detection and more.

Power supply monitoring is also included.

Table 1. Device summary

Part number	Package	Packing
L9390	TQFP100 14x14x1.0mm (exposed pad down)	Tray

1 Pin description

Figure 1. Pin connection (top view)

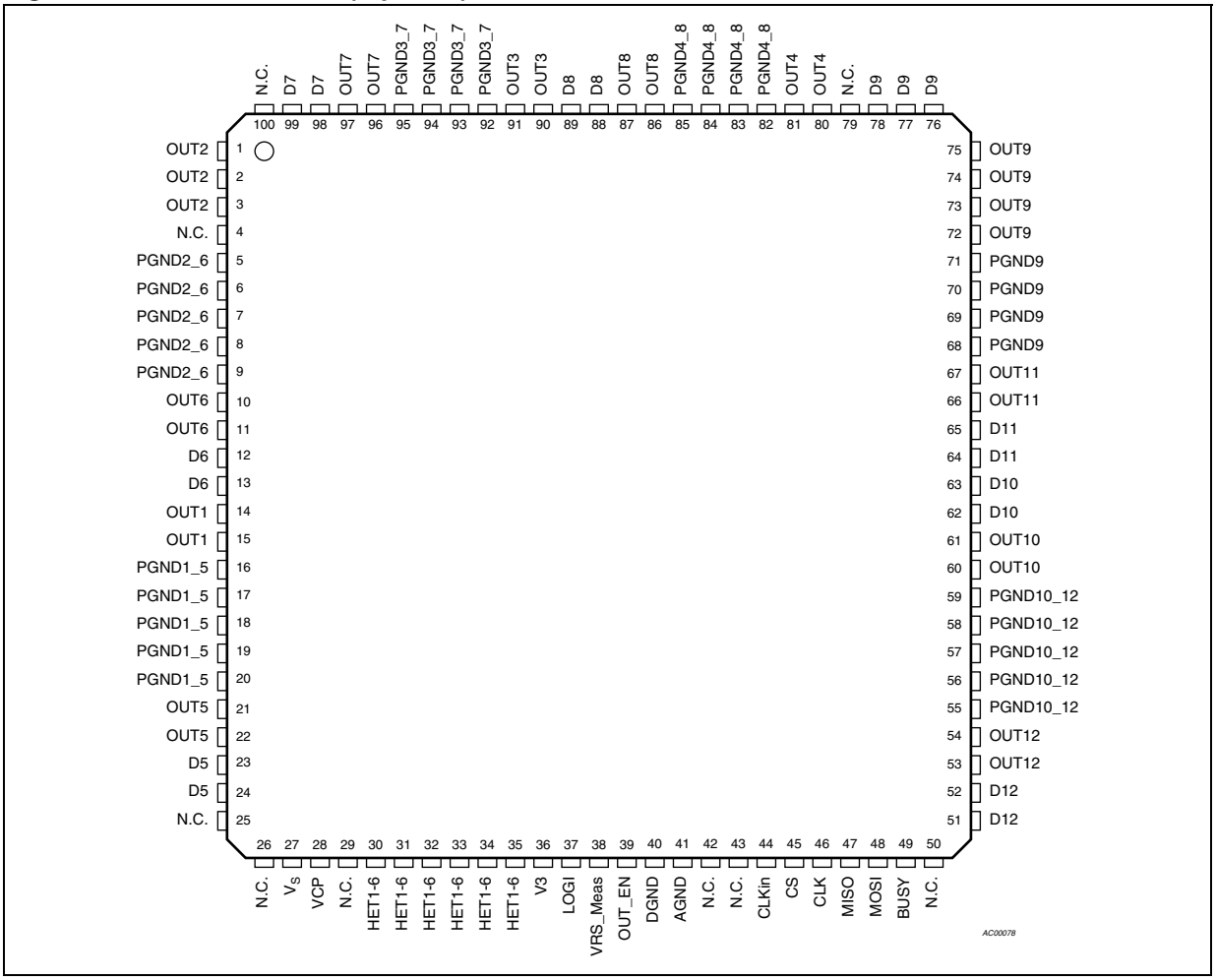


Table 2. Pins description

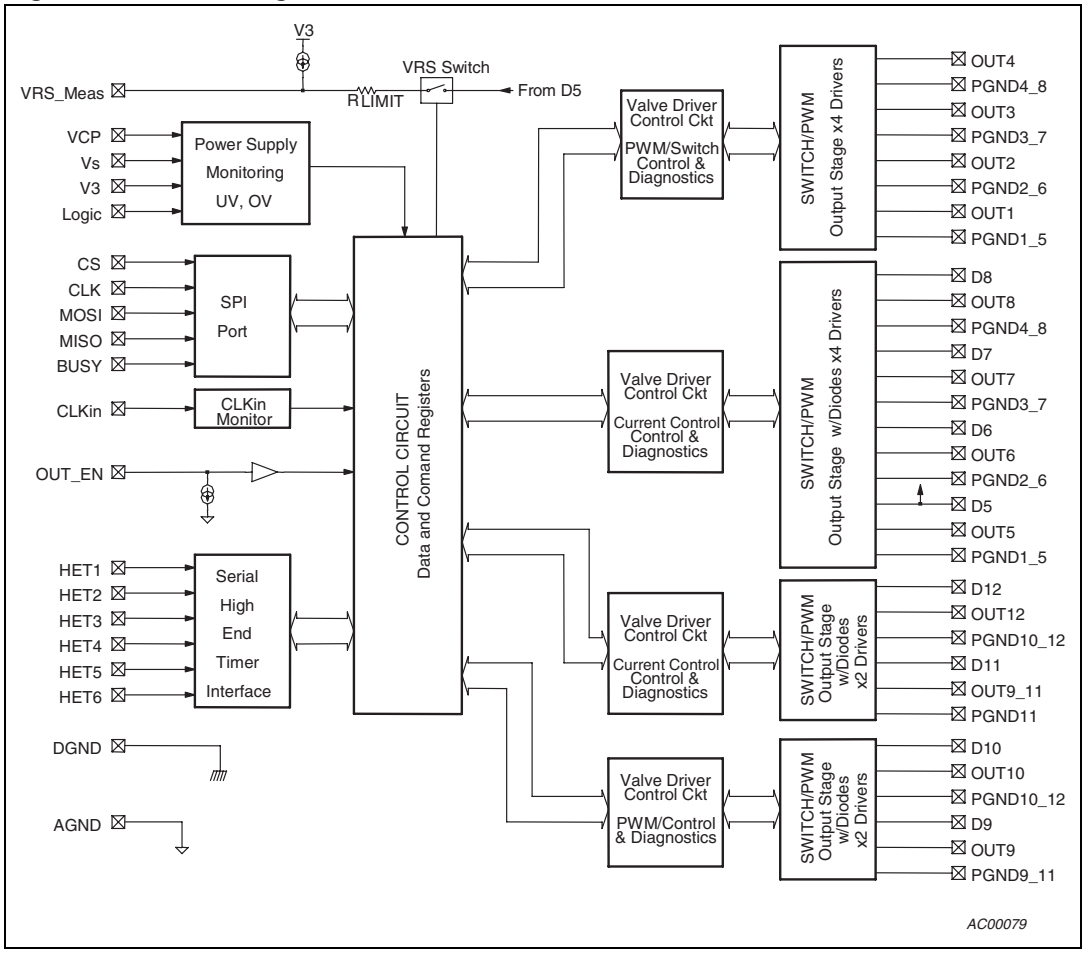
Pin #	Name	Description
1-3	OUT2	Valve Low Side Driver output, Switched or PWMmed
4	N.C.	Not Connected
5-9	PGND2_6	Dedicated Output Power Ground
10-11	OUT6	Valve Low Side Driver output, PWMmed or Current Regulated
12-13	D6	Freewheeling Diode Cathode
14-15	OUT1	Valve Low Side Driver output, Switched or PWMmed
16-20	PGND1_5	Dedicated Output Power Ground
21-22	OUT5	Valve Low Side Driver output, PWMmed or Current Regulated
23-24	D5	Freewheeling Diode Cathode
25-26	N.C.	Not Connected
27	Vs	Battery level Supply input voltage

Table 2. Pins description (continued)

Pin #	Name	Description
28	VCP	Charge Pump voltage input
29	N.C.	Not Connected
30-35	HET1-6	Serial High End Timer inputs
36	V3	3.3V supply input
37	LOGI	Logic Supply Input, must be tied to V3
38	VRS_Meas	Switch connection to pin D5 for the purpose of diagnosing specific load resistances.
39	OUT_EN	Enables/ disables all outputs asynchronous to any other commands
40	DGND	Circuit ground
41	AGND	Signal Ground
42-43	N.C.	Not Connected
44	CLKin	Clock input for IC
45	CS	SPI Chip Select input
46	CLK	SPI Clock input
47	MISO	SPI Master in Slave out
48	MOSI	SPI Master out Slave in
49	BUSY	SPI Enable input
50	N.C.	Not Connected
51-52	D12	Freewheeling Diode Cathode
53-54	OUT12	Valve Low Side Driver output, Current Regulated
55-59	PGND10_12	Dedicated Output Power Ground
60-61	OUT10	Valve Low Side Driver output, Current Regulated
62-63	D10	Freewheeling Diode Cathode
64-65	D11	Freewheeling Diode Cathode
66-67	OUT11	Valve Low Side Driver output, PWMmed
68-71	PGND9	Dedicated Output Power Ground
72-75	OUT9	Valve Low Side Driver output, PWMmed
76-78	D9	Freewheeling Diode Cathode
79	N.C.	Not Connected
80-81	OUT4	Valve Low Side Driver output, Switched or PWMmed
82-85	PGND4_8	Dedicated Output Power Ground
86-87	OUT8	Valve Low Side Driver output, PWMmed or Current Regulated
88-89	D8	Freewheeling Diode Cathode
90-91	OUT3	Valve Low Side Driver output, Switched or PWMmed
92-95	PGND3_7	Dedicated Output Power Ground
96-97	OUT7	Valve Low Side Driver output, PWMmed or Current Regulated
98-99	D7	Freewheeling Diode Cathode
100	N.C.	Not Connected

2 Block diagram

Figure 2. Block diagram



3 Electrical specifications

3.1 Absolute maximum ratings

Warning: The absolute maximum ratings are the values at which if exceeded the device may become damaged.

Table 3. Absolute maximum ratings

PIN/Parameter Name	Parameter	Value		Unit
		Min	Max	
V_S	Supply Voltage (Continuous)	-0.3	+20	V
	Supply Voltage (t < 5 min)		+27	V
V_S, VCP	Supply Voltage τ < 400ms		+35	V
V3, VLOGIC	Maximum Voltage		+3.6	V
CS, CLK, MOSI, MISO, EN, CLKin, HETx	Maximum Voltage	-0.3	+3.6	V
OUT_EN	Maximum Voltage	-0.3	+3.6	V
VRS_Meas	Maximum Voltage	-0.3	+3.6	V
OUTx, Dx	Maximum Voltage	-0.3	+35	V
$T_{J(Operating)}$	Junction Temperature	-40	(1)	°C
$T_{J(Operating)}$	Junction Temperature (1h over life-time)		+190(2)	°C
$T_{J(Storage)}$	Storage Temperature	-65	+150	°C

1. Internally limited
2. Allowed only during switch-off

3.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Value		Unit
		Min	Max	
$T_{J(Operating)}$	Junction Temperature	-40	+150	°C
$T_{A(Operating)}$	Ambient Temperature	-40	+105	°C
$R_{th(j-a)}$	Thermal resistance Junction to Ambient(3)		20	°C/W
$R_{th(j-c)}$	Thermal resistance Junction to case		2	°C/W
$E_{OUT(MAX)}$	Maximum OUTx clamping energy, Single Pulse		50	mJ

4 Package information

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark.

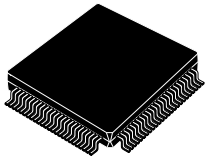
ECOPACK specifications are available at: www.st.com.

Figure 3. TQFP100 mechanical data & package dimensions

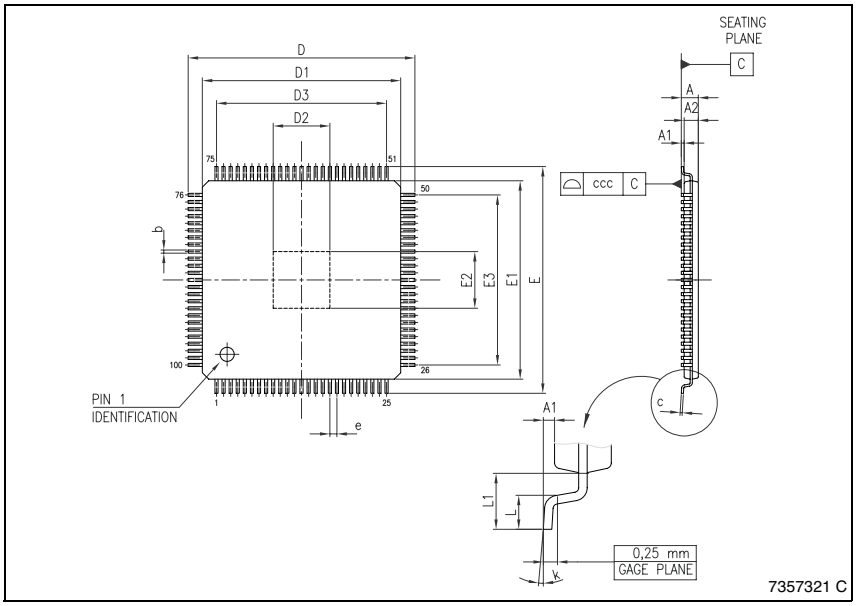
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.200			0.0472
A1	0.050		0.150	0.0020		0.0059
A2	0.950	1.000	1.050	0.0374	0.0394	0.0413
b	0.170	0.220	0.270	0.0067	0.0087	0.0106
c	0.090		0.200	0.0035		0.0079
D	15.800	16.000	16.200	0.6220	0.6299	0.6378
D1	13.800	14.000	14.200	0.5433	0.5512	0.5591
D2(1)	2.000			0.0787		
D3		12.000			0.4724	
E	15.800	16.000	16.200	0.6220	0.6299	0.6378
E1	13.800	14.000	14.200	0.5433	0.5512	0.5591
E2(1)	2.000			0.0787		
E3		12.000			0.4724	
e		0.500			0.0197	
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1		1.000			0.0394	
k		3.500	7.000		0.1378	0.2756
ccc			0.080			0.0031

(1) The size of exposed pad is variable depending of leadframe design pad size. End user should verify “D2” and “E2” dimensions for each device application.

OUTLINE AND MECHANICAL DATA



TQFP100 (14x14x1.40mm)
Exposed pad down



5 Revision history

Table 5. Document revision history

Date	Revision	Changes
22-Mar-2007	1	Initial release.

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