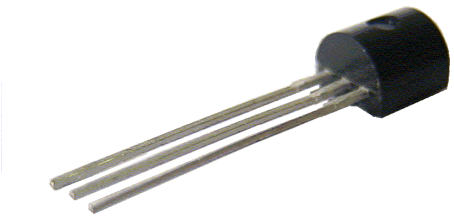
MLX90721

Auto Shut Off Timer

Features and Benefits

Low cost – minimal external components
Small package (to92 for the 3 pins version, pdip8, psop8 or cob for the 4 pins version)
On chip calibrated timer
Drives different relay types, including low cost 12V relays and most custom made relays.
Low power consumption (low dissipation)



Applications

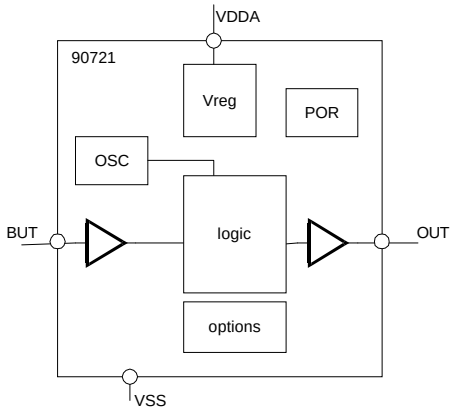
Household appliances
Heater
Hand-dryer

Ordering Information

Part No.	Temperature Suffix	Package	option	Temperature Range
MLX90721	S	TA	-x	0C to 85C
MLX90721	S	A	-x	0C to 85C
MLX90721	S	L	-x	0C to 85C

The customer specific option code is indicated with 1 character at the end of the ordering number.
For cob assembly, please contact Melexis directly.

Functional Diagram



Description

The chip is intended to be used for switching on and off a mains powered device, with the added feature of automatic switch off after a well-defined amount of time. Such device can replace conventional switches in all appliances that might be left on inadvertently. Besides saving energy, the main goal is to prevent all hazards due to appliances left on unattended.
The chip can be used in its 3-pin version, where applying the supply to the chip does switching on.
In the 4-pin version switching on and off is done with a single push-button.
As an alternative the fourth pin can also be used as a reset pin, where the auto-shut-off time counter is reset when pushing this button.
The auto-shut-off time is mask programmable and can be almost anything between 2.5 minutes and 32 hours. The duty cycle of the relay driver can also be adjusted by mask to adapt to almost any kind of relay construction.

General Description

The chip is intended to be used for switching on and off a mains powered device, with the added feature of automatic switch off after a fixed amount of time. Such device can replace conventional switches in all appliances that might be left on inadvertently.
Besides saving energy, the main goal is to prevent all hazards due to appliances left on unattended.
The chip is offered in a 3-pin version, where applying the supply is switching the chip on. In its 4-pin version, switching on and off is done with a single push-button.
As an alternative the fourth pin can also be used as a reset pin, where the auto-shut-off time counter is reset when pushing this button.
The chip application version (3 or 4 pins) and auto-shut-off time are mask programmable. The auto-shut-off time can be almost any value between 2.5 minutes and 32 hours. The duty cycle of the relay driver can also be adjusted by the same mask to adapt to all types of relay construction.

Power-On-Reset.

The Power-On-Reset of the ASIC is a combination of a digital power-on-reset with hysteresis DPOR, and an analog APOR.
DPOR is used to initialize the logic on the chip.
The APOR is characterized by a low level – APL signal and a high level – APH signal, which are debounced as follows:

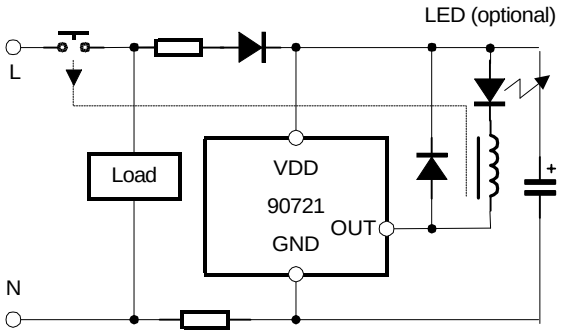
low level debouncing – approx. 25mS
high level debouncing – approx. 3.5mS

The digital signal APOR is a logic combination of the debounced signals APLd and APHd. APOR is set to High when APHd = high and APOR is reset to Low when APLd = low.
A transition to the active state is indicated by the digital signal **APOR=1** in case of application 1 and 2, or **APOR=1** and **START=1** in case of application 3. The result is that the transistor at the pin OUT is activated after a delay time ***Td*** , and starts switching ON and OFF with the specified frequency ***F1*** and duty cycle ***DC1***.
The digital signal **APOR=0** immediately brings the logic back to the INACTIVE state, i.e. the output is disabled and the state of the digital output signal from the start-stop/reset button (if present in the particular application) is initialized to non-pressed (released) state.

Button Input.

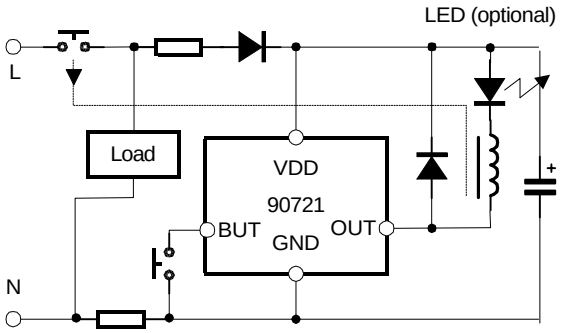
The Button Input can have three different functions, which determine the three different applications: APPL.1, APPL.2 and APPL.3. The function of the input is defined by the options mask.

APPL.1-*No Function*. The BUT input is not used and therefore not connected externally. BUT is an internally pulled up digital input. In this case, the transitions INACTIVE > ACTIVE state and vice versa are defined only by the APOR signal.



Appl.1 ASO without button

APPL.2-*Auto Shut-OFF Time Reset*. The input BUT can be connected to GND via an external button. The input is an internally pulled up, active Low, inverting digital input. In this case, the transitions INACTIVE state > ACTIVE state and vice versa are again defined only by the APOR signal. Each time the button is pressed a Reset signal is generated and the countdown for the Auto Shut-Off Time starts from 0 again.
The state of this input (pressed or not) is checked each 3.5mS. The high level (button pressed) at the digital output is debounced for approx. 3.5mS.



Appl.1 ASO with time reset button

APPL.3-*Start/Stop Toggle Function*. The input BUT is now an active High, zero cross input with internal pull down. The input is connected via a button and external resistor to the mains. Each time this button is pressed, the internal START signal toggles and in combination with the APOR signal it defines the logic transitions in the following way:

APOR=1 and START=1 –> transition to ACTIVE state

APOR=1 and START=0 –> transition to INACTIVE state

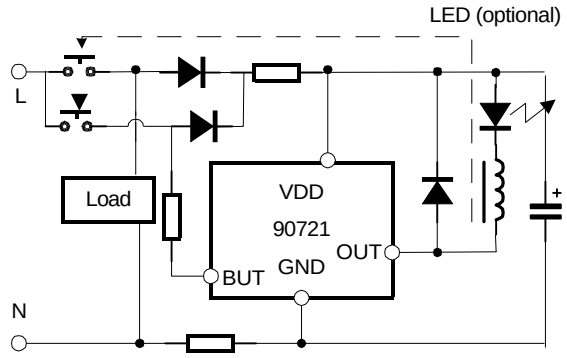
APOR=0 – defines the INACTIVE state and initialization of a start signal START= 0

The digital output of the BUT input is debounced as follows:

High level debouncing (button pressed) – approx. 3.5mS

Low level debouncing (button released) – approx. 100mS

The first time the button is pressed after initialization sets START=1. Once the logic has found that the button is pressed, it has to detect a released button in order to interpret correctly consecutive activations of the button. Each next pressing toggles the START signal.



Appl.1 ASO with start/stop button

Auto Shut-OFF Function.

When the ASIC is in the ACTIVE state and when the delay period ***Td*** has elapsed, the output is activated (with a well defined duty cycle) for a predefined Auto Shut-OFF Time ***Ta***. At the end of that period ***Ta***, the output is switched OFF, the ASIC is brought to the INACTIVE state and the state of the digital output signal from the start-stop/reset button (if present) is initialized.

Doubled Duty cycle

Mechanical relays normally need a higher magnetic field (and thus a higher coil current) to move the contact away from his normal position, then to keep the contact in that position. Therefore it is possible to increase the current supplied to the coil during the first 6 msec. After activation of the output driver. This is done by doubling the duty cycle which has been selected by mask option.

With a proper dimensioning of the external components the power consumption of the module can be optimized in this way.

Test Mode

The test mode aims full verification of the above specified logic functions and electrical characteristics, both on wafer and packaged device.

The test mode is defined under the following conditions:

V(OUT) = 0V for approx. 5msec. The ASIC enters test mode when on pin **OUT** is detected a short-circuit to GND. This detection is done after a digital debouncing for a period of ~ 5mS, and the result is latched and saved in a test status flip-flop.

When in test mode, pin **OUT** is used as an input for the test clock sequence, as well as an output for the IC reaction. This is achieved by appropriate definition of input/output signal levels.

V(OUT) < 9V. This restriction aims to make a clear distinction between normal mode operation, when ***V(OUT)***=VDDA, and test mode. This feature also ensures that if by mistake test mode is activated during Normal Mode operation, and at the same time on pin **OUT** is found a potential higher than 9V, follows immediate reset of test mode, and the IC is brought back to normal mode.

Disclaimer

MLX90721 Electrical Specifications

DC Operating Parameters T_A = 0ºC to 85ºC

Operating Ranges

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Max. junction temperature	Tjm				125	°C
Ambient temperature	Ta		0		85	°C

Supply Current

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply current at VDDA=48V	Idd1	VDDA=48V, OUT open BUT not active	170	270	370	µA
Supply current at VDDA=55V	Idd2	VDDA=55V, OUT open BUT not active	200	300	400	µA

Integrated Zener

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Zener voltage at VDDA	Vzen		62	66	70	V
Maximum sink current	Izm				10	mA

Power On Reset

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
DPOR high level	Vdh			2.8		V
DPOR hysteresis	Vdhys			0.9		V
APOR high level	VAPH		32		42	V
APOR hysteresis	VHYS		7		12	V

Relay Driver Output

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Maximum current in ON state	Ion				50	mA
Output voltage in ON state	Von	Iout = 50mA	0.4		3	V
Leakage current in OFF state	Ioff	V(OUT)=Vzen	1		50	mA
Over voltage protection	Vprot			90		V
Rise / fall times	Trf	Iout = 25mA	0.7	1.0	1.3	µs
Frequency of the relay driver	F1			21.8		kHz
Duty cycle of the relay driver	DC1	See options		Var.		%

Internal Oscillator

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Nominal frequency	Fosc	VDDA = 60V, Tamb		437		kHz
Frequency tolerance	Df	20V < VDDA < 70V	-6		6	%
Temp. coefficient of oscillator frequency	TCf	T=0°-100°C		1000		ppm

Integrated Zener

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Zener voltage at VDDA	Vzen		62	66	70	V
Maximum sink current	Izm				10	mA

Button Input

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Threshold voltage	Vtr	Valid for APPL.1 and APL.2		2.5		V
Threshold current	Itr	Valid for APPL.3		+12		mA
Max. source current	Im1				-350	mA
Max. sink current	Im2				350	mA
Clamp voltage 1	Vc1	APPL.3; Ibut = +4mA			5	V
Clamp voltage 2	Vc2	APPL.3; Ibut = -4mA	0			V

Timings

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Switch ON delay time	Td			47		mS
Auto Shut-OFF time	Ta	See options				
Increased Duty Cycle period	Tdub	In case this option is enabled		6		mS

Duty Cycle and Auto Shut-OFF Options

The function of input BUT as well as the doubled duty cycle function can be define by mask option.
Also following options can be defined by mask option:

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Relay Frequency Duty Cycle	DC	In steps of 2.5%	5		37.5	%

Interval	AUTO SHUT-OFF TIMES							
0 – 1 H	2.5	5	7.5	10	12.5	15	17.5	20
	22.5	25	30	35	37.5	40	45	50
								52.5 min
1 – 2 H	1h	1h10m	1h15m	1h20m	1h30m	1h40m	1h45m	
2 – 3 H	2h	2h20m	2h30m	2h40m				
3 – 4 H	3h	3h20m	3h30m					
4 – 5 H	4h	4h40m						
5 – 6 H	5h	5h20m						
6 – 7 H	6h	6h40m						
7 – 9 H	7h	8h						
9 – 10 H	9h	9h20m						
10 – 11 H	10h	10h40						
12 – 32 H	12h	14h	16h	20h	24h	28h	32h	

ESD Precautions

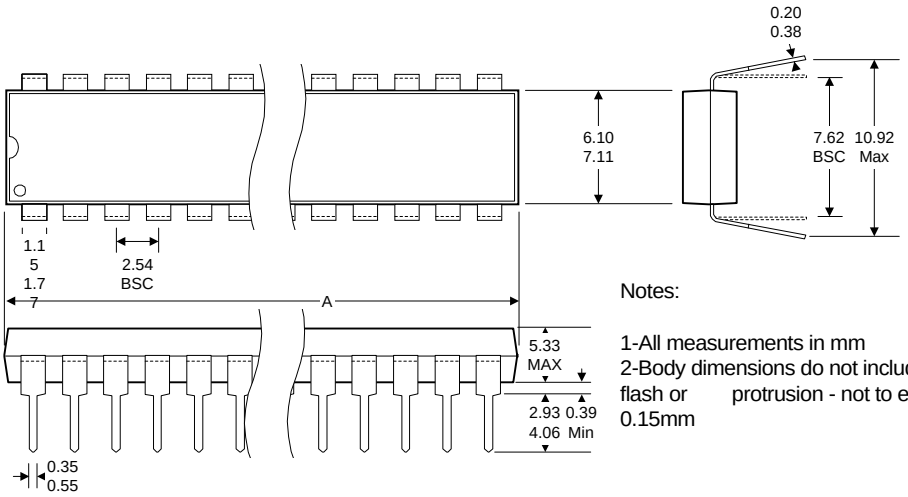
Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).
Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

Pinout

Standard package for the 3 pins version is a 3-pin TO 92 package, and PDIP8 or PSOP8 for the 4 pins version.

Pin	Name	Type	Description
1	VDDA	Input	supply
2	GND	Input	ground
3	OUT	output	relay driver output
4 (opt.)	BUT	input	Button input

"A" Package Dimensions

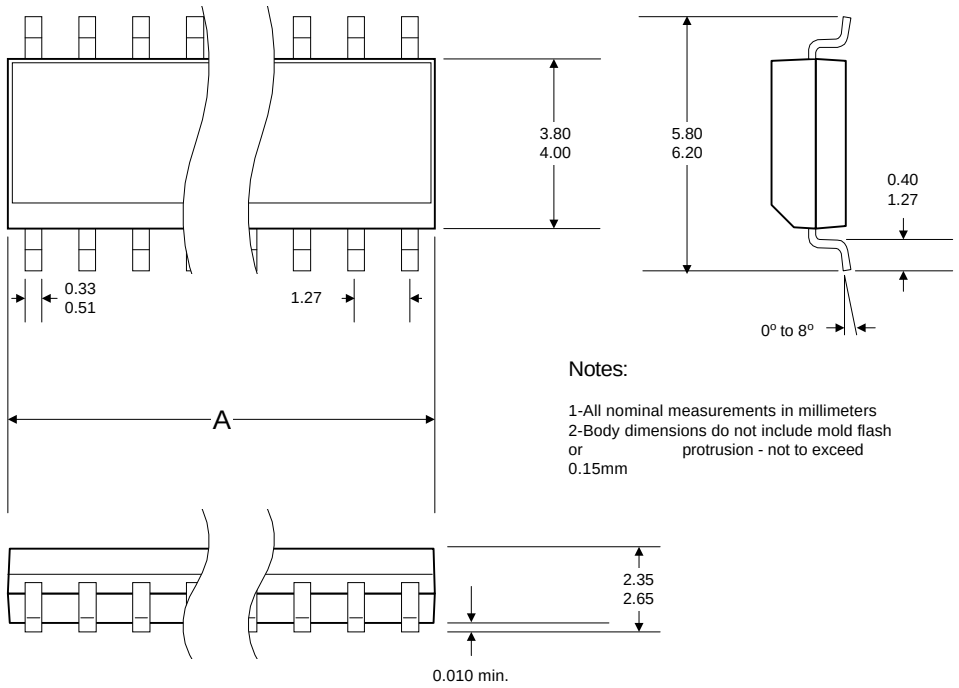


Notes:

1-All measurements in mm
2-Body dimensions do not include mold flash or protrusion - not to exceed 0.15mm

Dimension		8 Leads	14 Leads	16 Leads	18 Leads	20 Leads	24 Leads
A	Min	9.02	18.67	18.67	22.35	24.89	31.24
	Max	10.16	19.68	19.68	23.67	26.92	32.51

"L" Package Dimensions

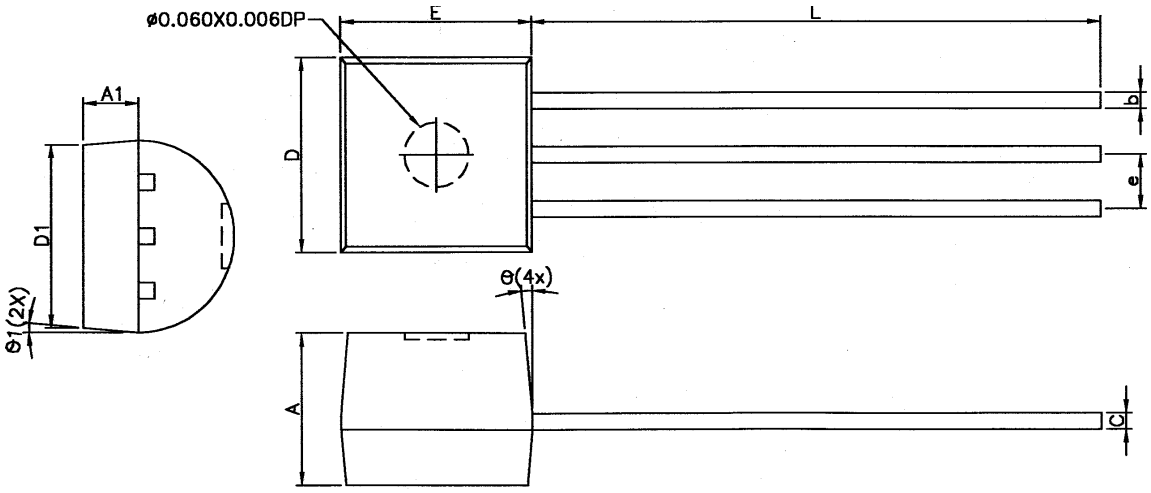


Notes:

1-All nominal measurements in millimeters
2-Body dimensions do not include mold flash or protrusion - not to exceed 0.15mm

Dimension		8 Leads	14 Leads	16 Leads
A	Min	4.80	8.55	9.80
	Max	5.00	8.75	10.00

"TA" Package Dimensions



Note: All dimensions in inches.

symbols	Dimensions in millimeters			Dimensions in inches		
	MIN	NOM	MAX	MIN	NOM	MAX
A	3.45	3.56	3.66	0.136	0.140	0.144
A1	1.22	1.30	1.37	0.048	0.051	0.054
b	-	0.38	-	-	0.015	-
C	-	0.38	-	-	0.015	-
D	4.27	4.52	4.78	0.168	0.178	0.188
D1	4.14	4.29	4.45	0.163	0.169	0.175
E	4.32	4.57	4.83	0.170	0.180	0.190
L	12.98	13.49	14.00	0.511	0.531	0.551
e	-	1.27	-	-	0.050	-
q	-	5º	-	-	5º	-
q	-	5º	-	-	5º	-

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