

Quad low-side intelligent power switch

Datasheet - production data



- Per channel thermal shutdown diagnostic
- Designed to meet IEC 61131-2
- Miniaturized HTSSOP20 package

Applications

- Programmable logic control
- Industrial PC peripheral input/output
- Numerical control machines
- General low-side switch applications

Features

| R _{DS(on)} (typ.) | I _{OUT} | | V _{CC} AMR |
|----------------------------|------------------|-------|---------------------|
| | 4 ch | 1 ch | |
| 0.26 Ω | 0.5 A | 2.0 A | 55 V |
| | | | |

- 8 V to 50 V operating voltage range
- Four independent protected channels
- V_{CC} undervoltage lock-out
- High speed operation (t_r, t_f < 1 μs)
- Programmable load current limitation level by external resistor
- Typical operating load current: 0.5 A (per channel) / 2 A (one channel)
- Thermally independent junction overtemperature protections
- Programmable non-dissipative short-circuit protection (cut-off) by external resistor
- Open load (off-state) and short-to-ground common diagnostic activated by external pull-down resistors
- Fast demagnetization of inductive loads with integrated catch diodes clamping turn-off transients
- Ground and V_{CC} wire break protection
- V_{CC} overvoltage protection
- Common open load diagnostic
- Common thermal shutdown and overload diagnostic

Description

The IPS4260L is a monolithic high speed (F_{SW} = 100 kHz) device, which can drive four independent capacitive, resistive or inductive loads with one side connected to supply voltage.

Four integrated inductive catch diodes clamp the turn-off transients generated by inductive loads combined with proper external TVS allowing fast decay even with huge inductance. Each channel is protected by the overload protection limiting the output current in case of overload. The IC allows the overload current limitation level (I_{COLIM}) to be set by an external resistor on I_{LIM} pin.

Built-in thermal shutdown protects the chip against overtemperature even in case of short-circuit. If enabled, the integrated cut-off protection features a non-dissipative protection in case of overload; it limits both the output average current value and, consequently, the device overheating. Cut-off delay/restart can be programmed by external resistors on CoD pin; it can be disabled by shorting CoD to GND.

Two common diagnostic open drains pins (OL, for open load and FLT for overload and thermal shutdown) together with the four open drain on each IN_x pin (overload and thermal shutdown) feature an extensive diagnostic of the chip.

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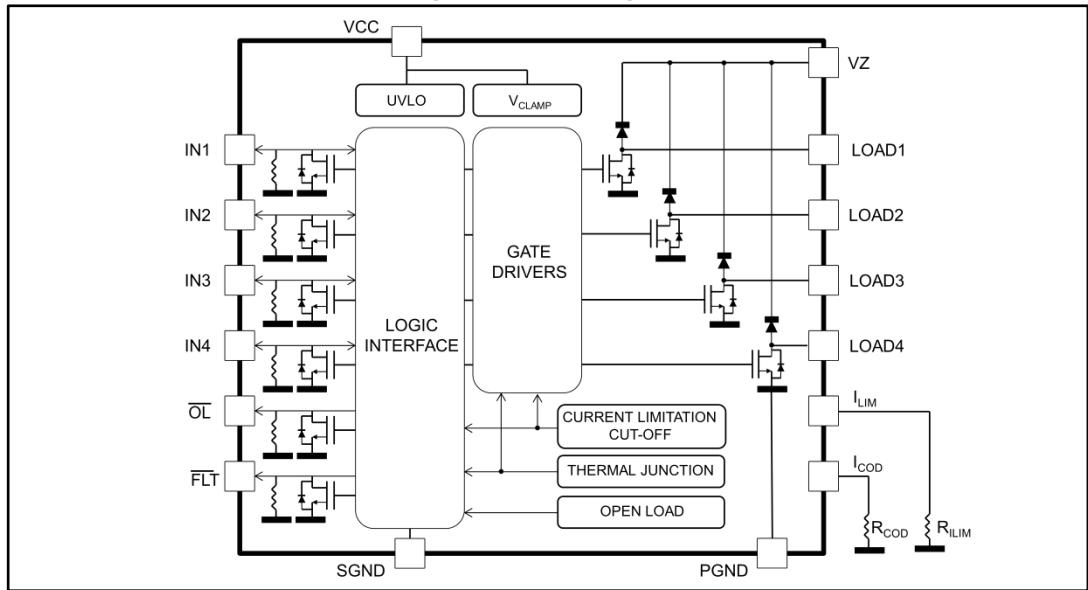
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1 Block diagram

Figure 1: Block diagram



2 Pin description

Figure 2: Pin connection (top view)

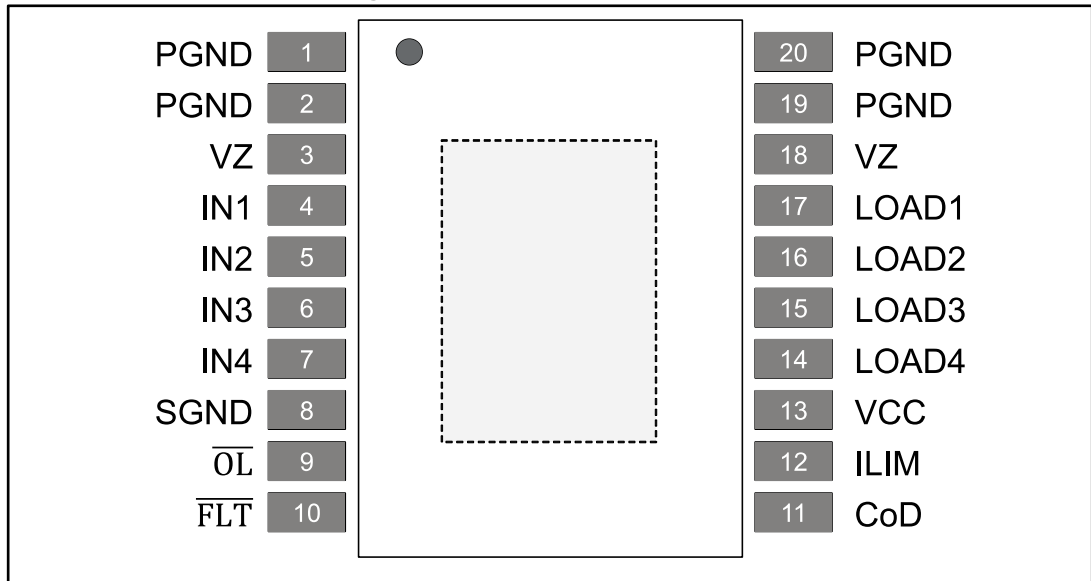


Table 1: Pin configuration

| Number | Name | Function | Type |
|----------------|------------------|---|-------------------------|
| 1, 2, 19, 20 | PGND | Integrated power switch ground | Supply |
| 3, 18 | VZ | Load clamp voltage pins. Pins 3 and 18 must be shorted on the application board and then connected directly to the supply rail, or by an external Zener or TVS diode to the supply rail or to PGND (see Section 2.3: "VZ") | Output |
| 4 | IN1 | Channel 1 input / cut-off and thermal shutdown diagnostic | Input/output open drain |
| 5 | IN2 | Channel 2 input / cut-off and thermal shutdown diagnostic | Input/output open drain |
| 6 | IN3 | Channel 3 input / cut-off and thermal shutdown diagnostic | Input/output open drain |
| 7 | IN4 | Channel 4 input / cut-off and thermal shutdown diagnostic | Input/output open drain |
| 8, exposed pad | SGND | Logic interface block ground | Supply |
| 9 | \overline{OL} | Cumulative power stage open load or short ground common diagnostic | Output open drain |
| 10 | \overline{FLT} | Cut-off and thermal shutdown pin. Common diagnostic pin both for thermal shutdown and cut-off | Output open drain |

| Number | Name | Function | Type |
|--------|-------|--|--------|
| 11 | CoD | Programmable cut-off intervention delay during overcurrent operation. It cannot be left floating: connect to PCB SGND ground plane to disable the cut-off function or connect a resistor between CoD and PCB ground plane to set the delay | Input |
| 12 | ILIM | Limitation current adjustment. It cannot be left floating: connect a resistor between ILIM and SGND to set the current limit threshold | Input |
| 13 | VCC | Supply voltage. Connect to the supply rail | Supply |
| 14 | LOAD4 | Power stage, channel 4 | Input |
| 15 | LOAD3 | Power stage, channel 3 | Input |
| 16 | LOAD2 | Power stage, channel 2 | Input |
| 17 | LOAD1 | Power stage, channel 1 | Input |

2.1 VCC

IC supply voltage. This pin has to be connected to the supply rail of the application.

2.2 PGND, SGND

PGND stands for power ground and it is internally connected to the source pins of the integrated switches. SGND stands for signal ground and it is the reference level for the logic interface. SGND and PGND pins must be shorted on the application board. In order to reduce as much as possible the switching noises from PGND to SGND, the application board has to be designed with two different ground planes for SGND and PGND. The two ground planes have to be shorted by a dedicated net.

2.3 VZ

These pins supply the integrated clamp diodes and must be shorted together on the application board and then connected directly to supply rail or, alternatively, connected by a Zener or TVS diode to supply rail or PGND. Connecting VZ pins directly to the supply rail implies that the inductive loads are demagnetized without fast decay option: in fact the V_{LOADx} (voltage on LOADx pin) is forced to the forward voltage of the integrated clamp diodes. The connection by a Zener or TVS diode to supply rail or PGND allows the LOADx pin voltage to exceed the main supply voltage; this approach is useful for loads requiring fast current decay (fast demagnetization). For the proper selection of the external Zener or TVS, please refer to [Section 7: "Active clamp"](#).



Leaving VZ pins floating, the integrated output voltage clamp is activated and the fast current decay capability is limited by the heatsink capability of the IC. See E_{AS} in [Table 2: "Absolute maximum ratings"](#).

2.4 IN1, IN2, IN3, IN4

These pins drive the power stage on pins LOAD1, LOAD2, LOAD3 and LOAD4. Besides an internal weak pull-down resistor (see IIN in [Table 7](#)), each INx pins is internally wired to

an open drain transistor, used for diagnostic purposes, and must be driven through a series resistor. The open drain transistor is turned-on in case of thermal shutdown or cut-off protection of the relative channel (see [Section 6.2: "Overtemperature"](#) and [Section 6.3: "Current limitation and cut-off"](#)).

2.5 LOAD1, LOAD2, LOAD3, LOAD4

Power stage load connection pins: integrated power transistor are in low-side configuration, so the load has to be connected between LOADx pin and VCC. The power stage channels can be paralleled.

2.6 Open load in off-state

$\overline{\text{OL}}$ pin is used for diagnostic purpose and it is internally wired to an open drain transistor. The open drain transistor is turned on in case of open load or short-to-ground of LOADx pins, while the channel is in OFF condition.

2.7 FLT

This pin is used for diagnostic purpose and it is internally wired to an open drain transistor. The open drain transistor is turned on in case of junction thermal shutdown or during the cut-off protection.

2.8 ILIM

This pin cannot be left floating and can be used to program the limitation current value through an external resistor (R_{ILIM}) see [Table 8: "Protection and diagnostic"](#). The resistor R_{ILIM} has to be connected between ILIM and SGND pins. When the IPS4260L ICs are used in the same application, their ILIM pins cannot be wired together: each IC must be connected to its own resistor.

2.9 CoD

This pin cannot be left floating and can be used to program the cut-off delay time t_{coff} (see [Table 8: "Protection and diagnostic"](#)) through an external resistor (R_{CoD}). The resistor R_{CoDM} has to be connected between CoD and SGND pins. The cut-off function can be completely disabled by shorting CoD pin to SGND: in this condition the power stage channel remains ON in limitation condition, supplying the current to the load until the input is forced LOW or the thermal shutdown threshold is triggered.

3 Absolute maximum ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------------------------------|--|----------------------------|------|
| V _{CC} | Supply voltage | -0.3 to 55 | V |
| V _Z | Internal clamp diode supply | -0.3 to 55 | V |
| V _{LOADx} | Power stage (LOADx channel) voltage | -0.3 to V _{DEMAG} | V |
| V _{INx} | INx pin voltage | -0.3 to 5.5 | V |
| I _{INx} | INx pin current | -10 to +10 | mA |
| V _{CoD} , V _{ILIM} | CoD and ILIM pin voltage | 5.5 | V |
| I _{CoD} , I _{ILIM} | CoD and ILIM pin current | -1/+5 | mA |
| V _{OD} | Open drain fault pins (FLT and OL) voltage | -0.3 to 5.5 | V |
| I _{OD} | Open drain fault pins (FLT and OL) current | -10/10 | mA |
| I _{CC} | Maximum DC reverse current (from GND to V _{CC}) | -250 | mA |
| I _{LOADHx} | Power stage (LOADx channel) current | Internally limited | A |
| -I _{LOADHx} | Reverse current on LOADx channel | 5 | A |
| E _{AS} | Single pulse avalanche energy per channel not simultaneously @ T _{AMB} = 125 °C, I _{LOAD} = 500 mA, V _Z pins floating | 0.9 | J |
| P _{TOT} | Power dissipation at T _C = 25 °C | Internally limited | W |
| T _{STG} | Storage temperature range | -55 to 150 | °C |
| T _J | Junction temperature | -40 to 150 | °C |



Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. All voltages are referenced to GND.

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|------------------------------------|--|-------|------|
| R _{th(JC)} ⁽¹⁾ | Thermal resistance junction-case | 20 | °C/W |
| R _{th(JA)} ⁽²⁾ | Thermal resistance junction-ambient, 2s board natural convection | 87 | |

Notes:

⁽¹⁾Thermal resistance between the die and the top case surface as per Jedec best practice guidelines (JESD51) .

⁽²⁾JESD51-3.

4 Electrical characteristics

(8 V < V_{CC} < 50 V; -40 °C < T_J < 125 °C, unless otherwise specified)

Table 4: Supply

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------------|-----------------------------|---|-------------------|------|------|------|
| V _{CC} | Operating voltage range | | V _{UVON} | | 50 | V |
| V _{UVON} | Undervoltage on threshold | V _{CC} increasing | 7 | | 8 | V |
| V _{UVOFF} | Undervoltage off threshold | V _{CC} decreasing | 6.5 | | 7.5 | |
| V _{UVH} | Undervoltage hysteresis | | 0.2 | 0.5 | | V |
| I _s | Supply current in off-state | V _{CC} = 24 V (all IN _x OFF) | | 1 | | μA |
| | | V _{CC} = 50 V (all IN _x OFF) | | 1.2 | 1.6 | |
| | Supply current in on-state | V _{CC} = 24 V all IN _x ON, LOAD _x open load [x = 1..4] | | 2 | | mA |
| | | V _{CC} = 50 V all IN _x ON, LOAD _x open load [x = 1..4] | | 2.4 | 3 | |

Table 5: Output stage

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|-------------------------------|--|--------------------|------|------|------|
| R _{DS(on)} | On-state resistance | R _{LOAD} = 48 Ω, V _{CC} = 24 V @ T _J = 25 °C | | 280 | | mΩ |
| | | R _{LOAD} = 48 Ω, V _{CC} = 24 V @ T _J = 125 °C | | | 560 | |
| V _{OUT(OFF)} | Off-state power stage voltage | V _{IN} = 0 V and I _{LOAD} = 0 A | V _{CC} -2 | | | V |
| I _{OUT(OFF)} | Off-state power stage current | V _{IN} = 0 V, V _{LOAD} = V _{CC} = 24 V | | 0.5 | | μA |
| | | V _{IN} = 0 V, V _{LOAD} = V _{CC} = 50 V | | | 10 | |

Table 6: Switching (V_{CC} = 24 V; R_{LOAD} = 24 Ω, input rise time < 0.1 μs)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|-----------------|------|------|------|------|
| t _r | Rise time | | | 450 | | ns |
| t _f | Fall time | | | 500 | | |
| t _{PD(H-L)} | Propagation delay time IN _x to LOAD _x , low to high | | | 500 | | |
| t _{PD(L-H)} | Propagation delay time IN _x to LOAD _x , high to low | | | 400 | | |

Figure 3: trise and tfall

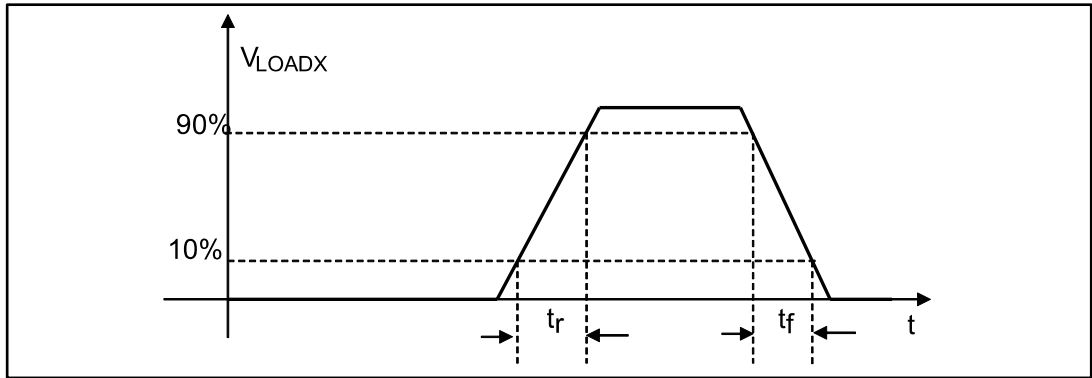


Figure 4: tPD(L-H) and tPD(H-L)

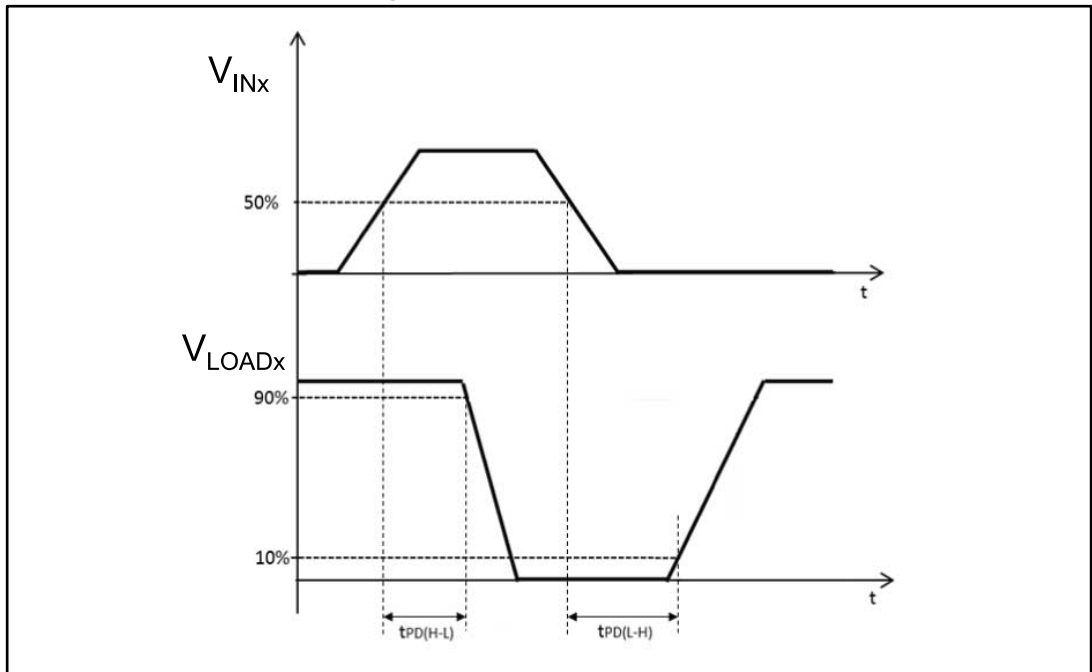


Table 7: Logic inputs

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|------|------|------|
| V_{IL} | Input low level voltage | V_{IN} decreasing | | | 0.8 | V |
| V_{IH} | Input high level voltage | V_{IN} increasing | 2.0 | | | |
| $V_{I(HYST)}$ | Input hysteresis voltage | | | 0.4 | | |
| V_{OL} | Voltage drop on OL pin | $I_{OL} = 5\text{ mA}$, $V_{INx} = 0\text{ V}$, $OUTx = \text{open load}$, R_{PD} between $OUTx$ and GND | | | 0.1 | |
| V_{FAULT} | Voltage drop on FAULT pin or INx pin | $I_{FLT} = 5\text{ mA}$, $V_{INx} = 0\text{ V}$, ($T_{JX} > T_{JSD}$ or cut-off event) | | | 0.1 | |
| I_{INX} | All digital input/output pin current | $V_{IN} = 5\text{ V}$ | | | 70 | |

Table 8: Protection and diagnostic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------------|--|---|--|---------|---------|--------------------|
| V_{clamp} | VCC clamp voltage | $I_{\text{CC}} \leq 10 \text{ mA}$ | 55 | 58 | 60 | V |
| V_{demag} | Demagnetization voltage | $I_{\text{OUT}} = 0.5 \text{ A}$; load $\geq 10 \text{ mH}$ | 55 | 58 | 60 | |
| I_{LIM} | Current limitation | $30 \text{ k}\Omega \leq R_{\text{ILIM}} < 120 \text{ k}\Omega$ | $60/R_{\text{ILIM}}[\text{k}\Omega] \pm 30\%$ | | | A |
| | | $0 < R_{\text{ILIM}} < 30 \text{ k}\Omega$ | $3 \pm 30\%$ | | | |
| t_{coff} | Cut-off current delay time | Programmable by external resistor on "cut-off" pin (valid in the range $30 \text{ k}\Omega \leq R_{\text{CoD}} < 120 \text{ k}\Omega$) | $R_{\text{CoD}}[\text{k}\Omega]/120 \pm 15\%$ | | | ms |
| | | $R_{\text{CoD}} = 0 \Omega$ cut-off disabled | Output ON in current limitation (chip protected by thermal shutdown) | | | |
| t_{res} | Power stage restart delay time | | $31 * t_{\text{coff}} \pm 15\%$ | | | ms |
| t_{BKT} | Open load blanking time | | 12.0 | 16.5 | 21 | μs |
| I_{VD} | VCC disconnection power stage current | $V_{\text{INx}} = V_{\text{CC}} = 0 \text{ V}$; $V_{\text{LOADx}} = 24 \text{ V}$, V_{z} floating | | | 50 | μA |
| T_{JSD} | Junction temperature shutdown | | | 160 | | $^{\circ}\text{C}$ |
| T_{JHYST} | Junction temperature thermal hysteresis | | | 20 | | $^{\circ}\text{C}$ |
| V_{OLoff} | Open load (off-state) or short-to-ground detection threshold | | Vcc-4.5 | Vcc-3.5 | Vcc-2.5 | V |

5 Power stage logic

Table 9: Power stage (LOADx pin) truth table

| Operation | MCU_OUTx | INx | LOADx | $\overline{\text{FLT}}$ | $\overline{\text{OL}}$ |
|------------------------|----------|-----|-------|-------------------------|------------------------|
| Normal | L | L | H | H | H |
| | H | H | L | H | H |
| Cut-off | L | L | H | L | H |
| | H | L | H | L | H |
| UVLO | L | L | H | X | X |
| | H | H | H | X | X |
| Open load/short-to-GND | L | L | L | H | L |
| | H | H | L | H | H |
| Overtemperature | L | L | H | L | H |
| | H | L | H | L | H |

Figure 5: Application circuit (fast decay enabled by TVS between VZ and supply rail)

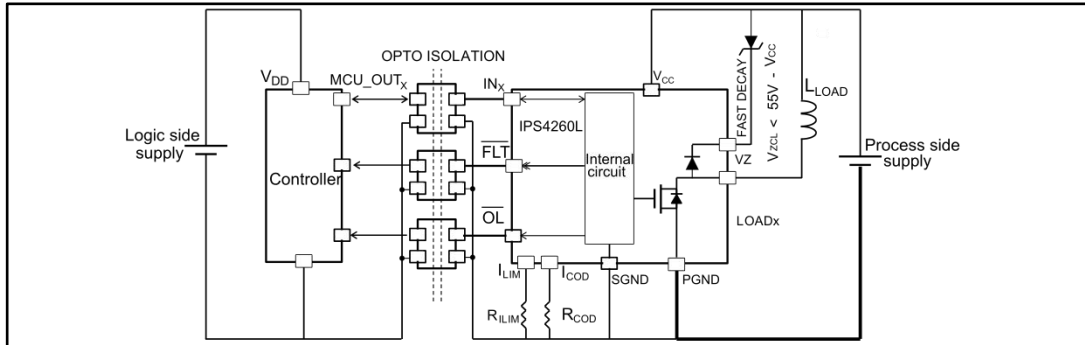


Figure 6: Application circuit (fast decay enabled by TVS between VZ and PGND)

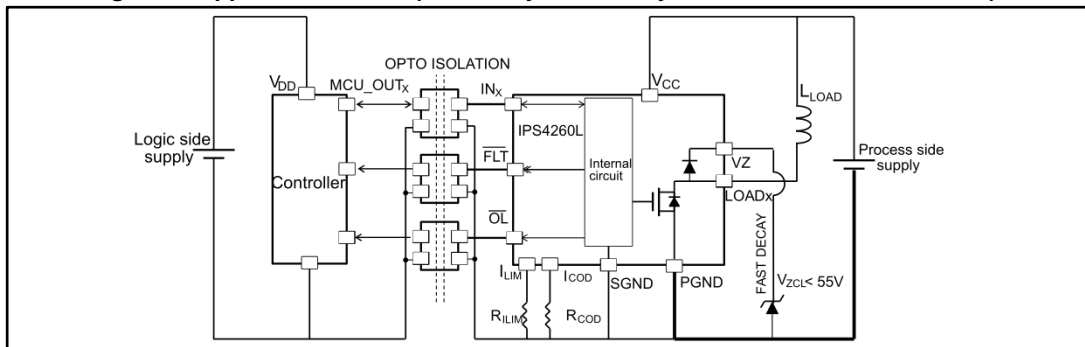
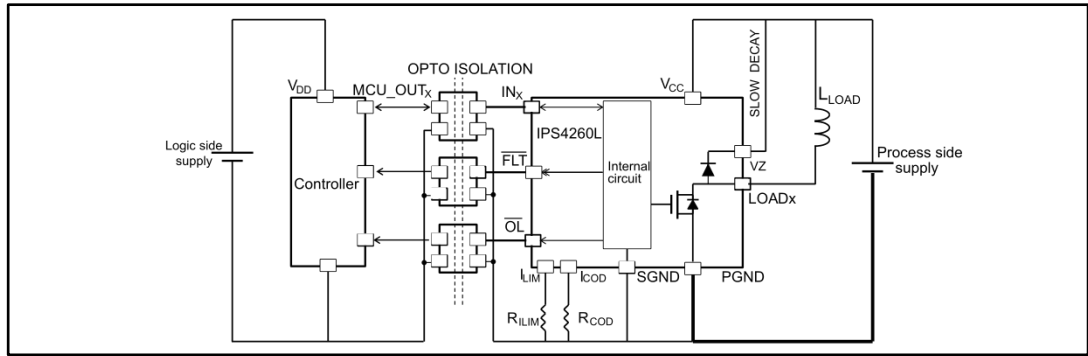


Figure 7: Application circuit (fast decay disabled by TVS between VZ and supply rail)



6 Protection and diagnostic

The IC integrates several protections to ease the design of a robust application.

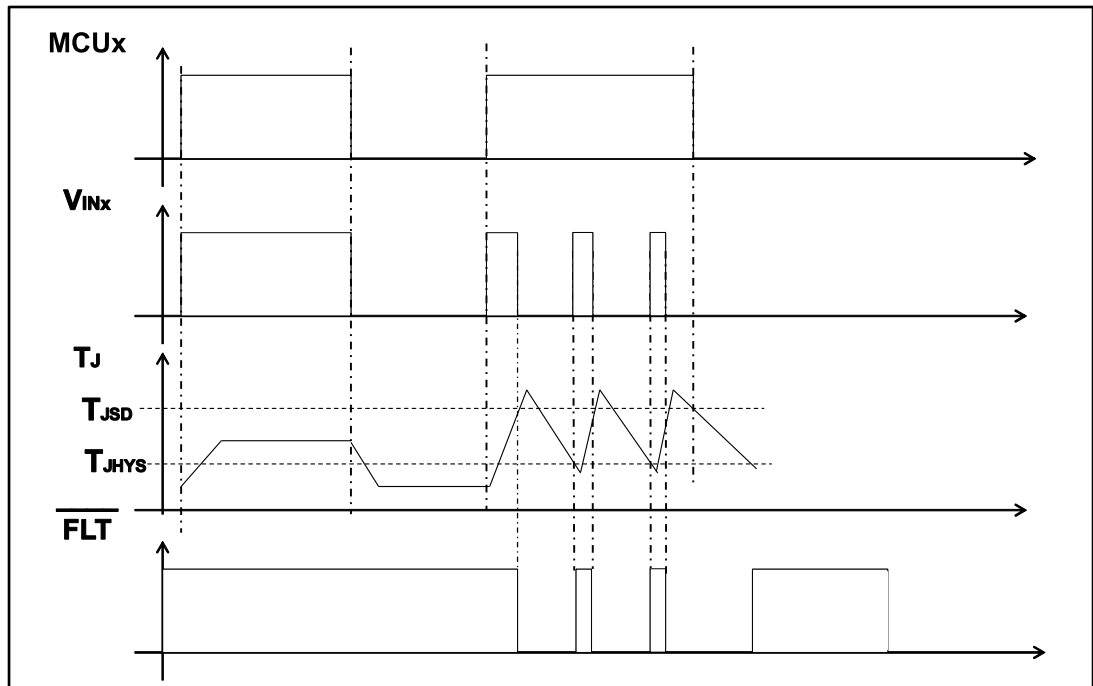
6.1 Undervoltage lock-out

The device turns off if the supply voltage falls below the turn-off threshold ($V_{UV(off)}$). Normal operation restarts after V_{CC} exceeds the turn-on threshold ($V_{UV(on)}$). Turn-on and turn-off thresholds are defined in [Table 4: "Supply"](#).

6.2 Overtemperature

The power stage of each channel is turned off as its internal junction temperature (T_J) exceeds the shutdown threshold (T_{JSD}). Normal operation restarts when T_J comes back below the reset threshold (see [Table 8: "Protection and diagnostic"](#)). The internal fault signal is set when the channel is OFF due to thermal protection. This information is reported both on the digital side to the input pin (INx) corresponding to the power stage channel in fault, through an integrated open drain transistor, and on the common diagnostic \overline{FLT} pin. The status of the \overline{FLT} is independent of the INx pin status, and is low during the whole time any of the channel temperature has exceeded the shutdown threshold and has not come back below the reset threshold. The same behavior has to be respected on fault signals on input pins.

Figure 8: Thermal protection signalization behavior on FLT



6.3 Current limitation and cut-off

The load current flows through the integrated power stage and it is internally limited by the specific I_{LIM} threshold that can be set by an external resistor (R_{ILIM}) placed between I_{LIM} and SGND ground plane. The design rule for the R_{ILIM} resistor is:

Equation 1:

$$I_{LIM} = 60/R_{ILIM}[k\Omega]$$

The above design rule is valid in the range $30\text{ k}\Omega \leq R_{ILIM} \leq 120\text{ k}\Omega$. For $0 \leq R_{ILIM} < 30\text{ k}\Omega$, the current is internally limited up to 3 A (typical). For $R_{ILIM} > 120\text{ k}\Omega$ the current is anyway limited but the linearity is not guaranteed.

The IPS4260L implements the cut-off feature which limits the duration of the current limitation condition. The duration of the current limitation condition (T_{coff}) can be set by a resistor (R_{CoD}) placed between CoD and SGND ground plane. The design rule for R_{CoD} is:

Equation 2:

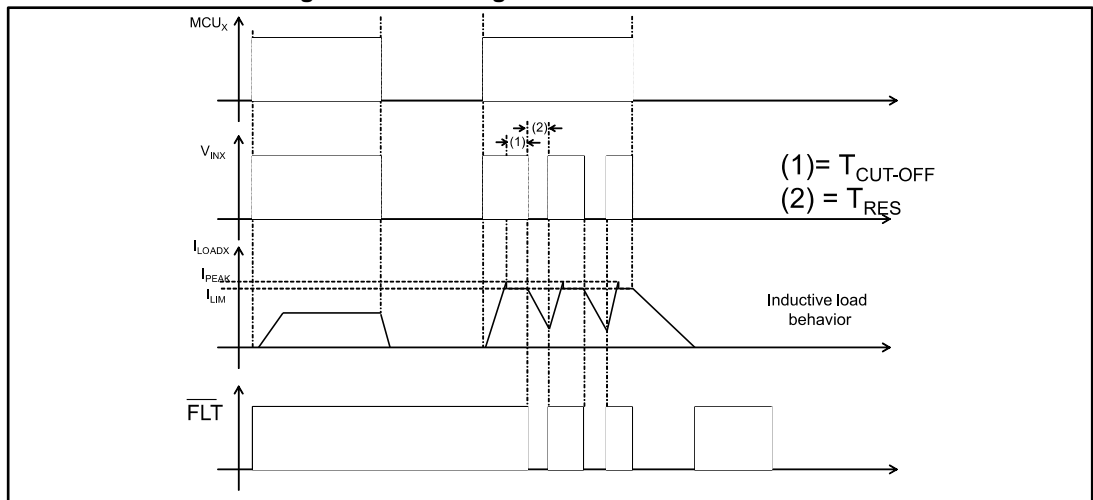
$$T_{coff} = R_{CoD}[k\Omega]/120$$

The above design rule is valid in the range $60\text{ k}\Omega \leq R_{CoD} \leq 240\text{ k}\Omega$. As $0 < R_{CoD} < 60\text{ k}\Omega$, T_{coff} anyway decreases but the linearity of the above design rule is not guaranteed. As $R_{CoD} = 0\text{ }\Omega$ (short-to-ground plane) the cut-off feature is disabled, by means the IC is protected by thermal shutdown only. Concerning $R_{CoD} > 240\text{ k}\Omega$, T_{coff} increases but linearity of equation 2 is not guaranteed.

In case I_{LIM} threshold is triggered, the power stage remains in the current limitation condition ($I_{LOADx} = I_{LIM}$) at least for t_{coff} . If t_{coff} elapses, the power stage is turned off and restarted after the t_{res} restart time. The fault condition is reported both on \overline{FLT} pin and on the input pin (INx) corresponding to the channel in fault. The internal cut-off flag signal is latched at power stage switch-off and released after the time t_{res} . The same behavior is reported on \overline{FLT} pin and on the INx pins related to the LOADx in fault. If one of the four channels is in overload protection, the other channels (in operating conditions) work properly. The status of \overline{FLT} is independent of the INx pin status, and is low during the whole cut-off time (t_{res}). The same behavior has to be respected on fault signals on input pins.

If CoD pin is shorted to SGND ground plane (cut-off feature disabled) then the output channel remains ON, in current limitation condition, until the related input becomes LOW or the thermal protection threshold is triggered.

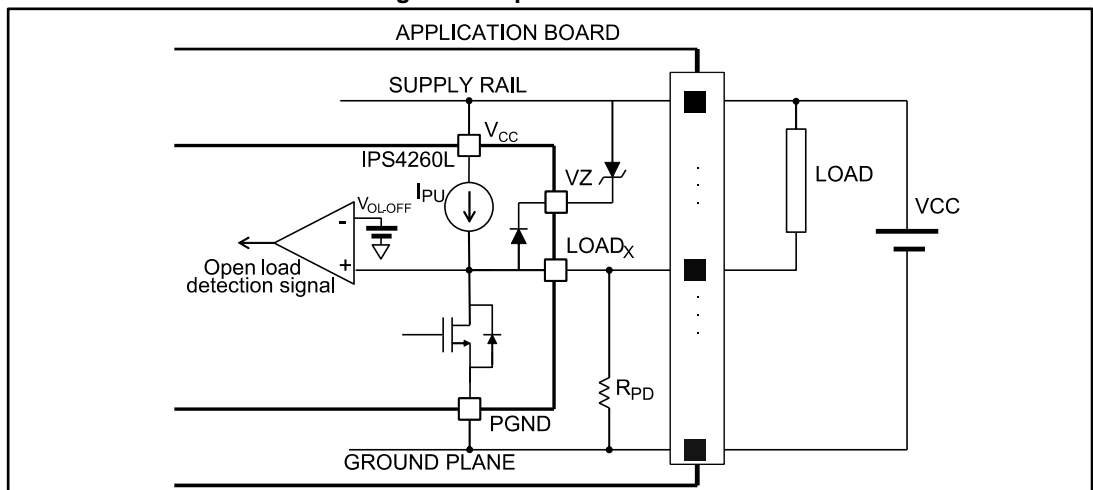
Figure 9: Cut-off signalization behavior on FLT



6.4 Open load in off-state

The IPS4260L provides the open load detection feature, which detects if the load is disconnected (wire break) from the $LOAD_x$ pin when in OFF-state ($IN_x = LOW$). This feature can be activated by placing a proper resistor (R_{PD}) between $LOAD_x$ and PGND ground plane.

Figure 10: Open load off-state



The voltage on $LOAD_x$ pin (V_{LOAD_x}) is internally compared with the V_{OLOFF} threshold: if the related IN_x pin is LOW and the V_{LOAD_x} goes lower than V_{OLOFF} then the open load condition is triggered. The fault condition is reported on the \overline{OL} pin and the fault reset occurs when load is reconnected. If the channel is switched ON by the related IN_x pin, the fault condition is no longer detected.

In OFF state, the IPS4260L achieves the open load detection feature by forcing the internally generated current I_{PU} ($= 20 \mu A$) on the external pull-down resistor R_{PD} . The following design rule has to be followed in order to set the proper value of R_{PD} :

Equation 4:

$$R_{PD} < \frac{V_{OLOFF(min)}}{I_{PU}} = \frac{V_{cc(min)} - 4}{I_{PU}}$$

Note that in normal conditions (by means, the load is connected) V_{LOADx} must be lower than V_{OLOFF} . So, the selection of R_{PD} may limit the R_{LOAD} for which the open load detection feature can work. In fact, to avoid any false triggering in OFF-state of the V_{OLOFF} threshold it must result:

Equation 5:

$$V_{LOAD} - V_{CC} * \left(\frac{R_{PD}}{R_{PD} + R_{LOAD}} \right) > V_{OLOFF(MAX)}$$

Therefore:

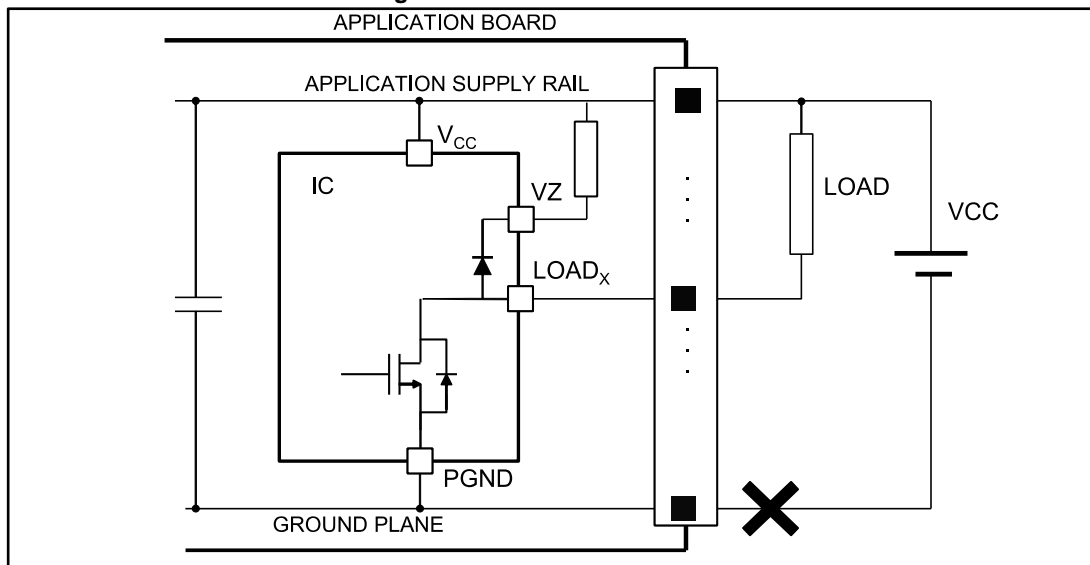
Equation 6:

$$R_{LOAD} < R_{PD} * \left(\frac{V_{CC}}{V_{OLOFF(MAX)}} - 1 \right) = R_{PD} * \left(\frac{V_{CC}}{V_{CC} - 2} - 1 \right)$$

6.5 GND disconnection protection

GND disconnection is intended as the disconnection event of the SGND and PGND pins from the ground of the supply system. When this event happens, all power stages are turned off independently of the input status. In case of inductive load, if the ground disconnection event happens while one or more channels are active, the current flows through the integrated power switch, which is activated by active clamp as if the input had been deactivated.

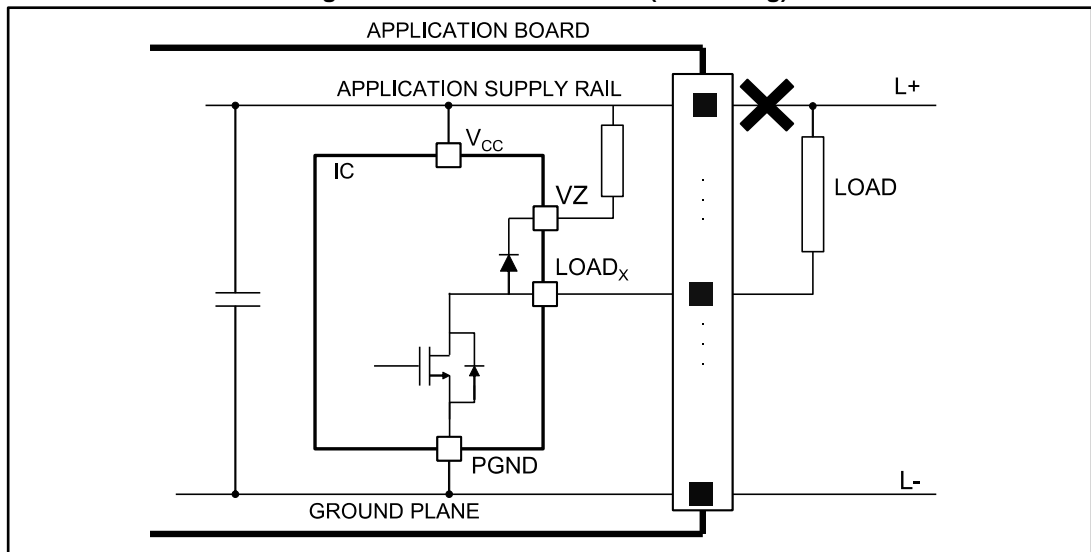
Figure 11: GND disconnection



6.6 VCC disconnection protection

VCC disconnection is intended as the disconnection (wire break) of the application board from rail supply. When this condition is detected, all power stage channels are turned off independently of the input status. The maximum steady-state current measured through a channel in short to the supply voltage is not greater than I_{VD} (see [Table 8](#)). The same behavior is guaranteed when all channels are simultaneously in short to the supply voltage. In case of inductive load, if the V_{CC} is disconnected while one or more channels are active, the current flows through the power, which is activated by the active clamp as if the input had been deactivated.

Figure 12: VCC disconnection (VZ floating)



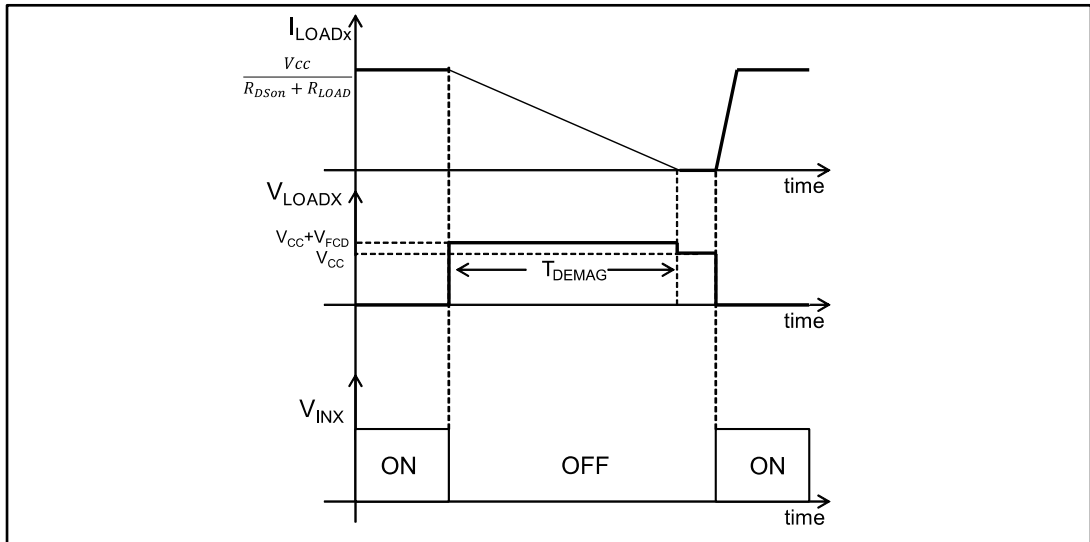
VCC disconnection protection is guaranteed when VZ floats or when VZ is connected to GND by a proper TVS, while it cannot be guaranteed when VZ is shorted to V_{CC}.

If VZ is connected to V_{CC} by a TVS (with clamping voltage = V_{CL}), then V_{CC} disconnection protection is limited by the following design rule: $V_{CL} > V_{L+} - (V_{LOAD} + V_D + V_{UVLO})$.

7 Active clamp

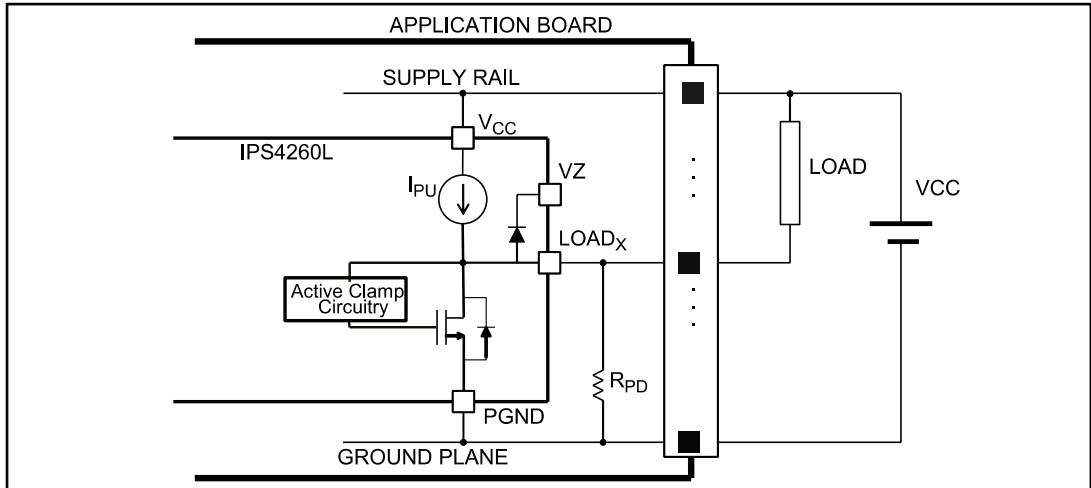
Active clamp is also known as fast demagnetization of inductive loads or fast current decay. When a low-side driver turns off an inductance, an overvoltage on load is detected. If VZ pins are directly shorted to the supply rail then the fast current decay is disabled: the inductive load is demagnetized slowly and according to the forward voltage of the integrated clamp diodes (V_{FCD}). The figure below shows the typical waveforms of the load voltage and current in case of slow demagnetization.

Figure 13: V_{LOAD} and I_{LOAD} in case of slow demagnetization



If VZ pins are left floating or connected by a Zener or TVS diode to supply rail or PGND then the fast decay is activated. When VZ pins are left floating the integrated clamping circuit protects the IC despite overvoltages: the conduction state of the integrated switches is modulated in order to keep the LOADx pin voltage $< V_{demag}$ until the energy in the load has been dissipated. The demagnetization energy is dissipated in the IC and it is limited by the internal heatsink capability, see E_{AS} in [Table 2: "Absolute maximum ratings"](#).

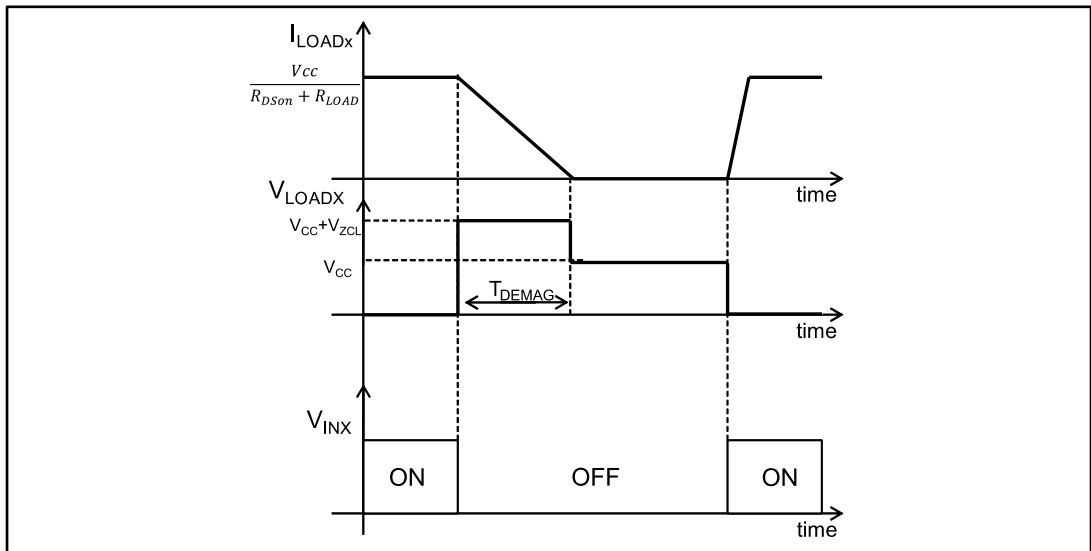
Figure 14: Active clamp equivalent principle schematic



7.1 Fast current decay with TVS between VZ and supply rail

Being V_{CLZ} the clamping voltage of the external TVS, when the inductive load is turned off the $LOADx$ pin is pulled up to $V_{CC} + V_{CLZ}$. In order to avoid any damage to the IPS4260L, the external diode must be selected such that $V_{CLZ} < (V_{DEMAG(MIN)} - V_{CC})$. Furthermore, the external diode must be selected such that it is able to dissipate the power due to the demagnetization currents flowing from the active channels.

Figure 15: V_{LOAD} and I_{LOAD} in case of fast demagnetization (fast decay)



7.2 Fast current decay with TVS between VZ and PGND

Being V_{CLZ} the clamping voltage of the external TVS, when the inductive load is turned off the LOADx pin is clamped by the lower voltage between V_{CLZ} and $V_{DEMAG(MIN)}$. In order to avoid any damage on the external TVS it has to be selected such that its V_{BR} results $> V_{CC}$, while in order to avoid any damage to the IPS4260L the V_{CLZ} of the external TVS must be selected such that $V_{CLZ} < V_{DEMAG(MIN)}$. Further, the external diode must be selected such that it is able to dissipate the power due to the demagnetization currents flowing from the active channels.

8 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

8.1 HTSSOP20 package information

Figure 16: HTSSOP20 package outline

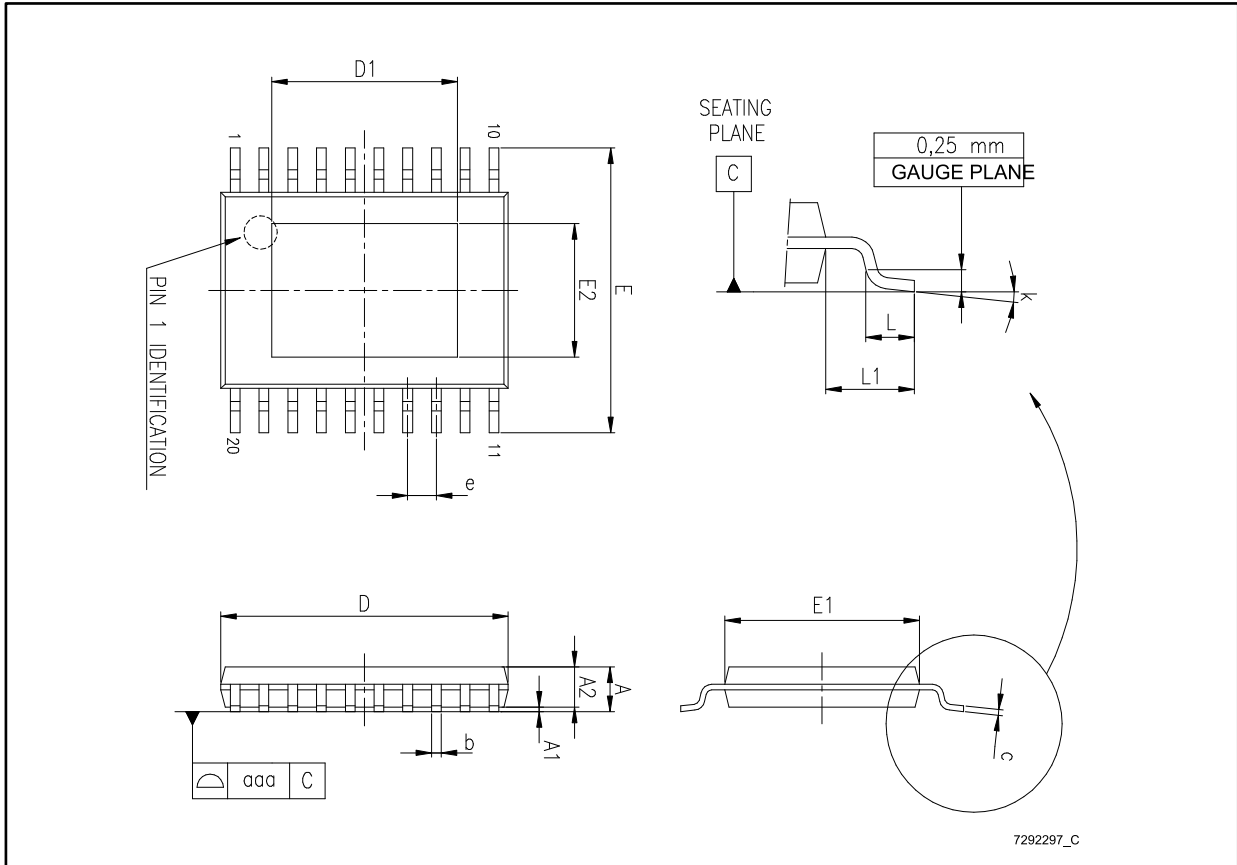


Table 10: HTSSOP20 mechanical data

| Dim. | mm | | | inch | | |
|------|------|------|------|-------|--------|--------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.2 | | | 0.047 |
| A1 | | | 0.15 | | 0.004 | 0.006 |
| A2 | 0.8 | 1 | 1.05 | 0.031 | 0.039 | 0.041 |
| b | 0.19 | | 0.30 | 0.007 | | 0.012 |
| c | 0.09 | | 0.20 | 0.004 | | 0.0089 |
| D | 6.4 | 6.5 | 6.6 | 0.252 | 0.256 | 0.260 |
| D1 | 4.1 | 4.2 | 4.3 | 0.161 | 0.165 | 0.169 |
| E | 6.2 | 6.4 | 6.6 | 0.244 | 0.252 | 0.260 |
| E1 | 4.3 | 4.4 | 4.5 | 0.169 | 0.173 | 0.177 |
| E2 | 2.9 | 3.0 | 3.1 | 0.114 | 0.118 | 0.122 |
| e | | 0.65 | | | 0.0256 | |
| K | 0° | | 8° | 0° | | 8° |
| L | 0.45 | 0.60 | 0.75 | 0.018 | 0.024 | 0.030 |

9 Ordering information

Table 11: Ordering information

| Order code | Package | Packing |
|------------|----------|---------------|
| IPS4260L | HTSSOP20 | Tube |
| IPS4260LTR | | Tape and reel |

10 Revision history

Table 12: Document revision history

| Date | Revision | Changes |
|-------------|----------|------------------|
| 02-Oct-2017 | 1 | Initial release. |

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