ISO808, ISO808-1

Datasheet

Galvanic isolated octal high-side power solid state relay for high inductive loads



IPS

Product status link
ISO808
ISO808-1

Product label
SUSTAINABLE TECHNOLOGY

Features

- $V_{CC(AMR)}$ = 45 V
- Wide process side op. range V_{CC} = 9.2 to 36 V
- R_{DS}(on) = 0.125 Ω per channel (TYP)
- Fast demagnetization of inductive loads $V_{DEMAG(TYP)} = V_{CC}$ - 54 V
- Per channel process side op. current
  - ISO808/ISO808Q I_{OUT} < 0.7 A
  - ISO808-1/ISO808Q-1 I_{OUT} < 1 A
- Low process and logic sides supply current
- Under-voltage shut down with auto restart and hysteresis
- Logic side 5 V and 3.3 V TTL/CMOS and MCU compatible I/Os
- Common output enable/disable pin
- Reset function for IC outputs disable
- High common mode transient immunity
- Short circuit protection on output channels
  - ISO808/ISO808Q $I_{LIM(MIN)}$ = 0.7 A
  - ISO808-1/ISO808Q-1 $I_{LIM(MIN)}$ = 1 A
- Per-channel over-temperature protection with thermal independence of separate channels
- Case over-temperature protection
- Over-voltage protection (V_{CC} clamping)
- Loss of GND and V_{CC} protections
- Common fault open drain diagnostic
- Designed to meet IEC 61000-4-2, IEC 61000- 4-4, IEC 61000-4-5 and IEC 61000-4-8
- UL1577 and UL508 certified
- Safety limits according to IEC 60747-17 (former VDE 0884-11)
- PowerSO-36 and TFQFPN32 Package

Applications

- Programmable logic control
- Industrial PC peripheral input/output
- Numerical control machines
- Drivers for all type of loads (resistive, capacitive, inductive)

Description

The ISO808, ISO808-1 (PowerSO-36) and ISO808Q, ISO808Q-1 (TFQFPN32) are galvanic isolated 8-channel drivers featuring a low supply current. Each driver contains 2 independent galvanic isolated voltage domains (V_{CC} and V_{DD} for the Process and Control Logic stages, respectively). The ICs are intended for driving any kind of load with one side connected to ground.

Active channel current limitation (OVL) combined with thermal shutdown (OVT), independent for each channel, protects the device against overload.

Built-in thermal shutdown protects each channel from overtemperature and overload: each overheated channel automatically turns OFF after its junction temperature triggers the protection threshold (T_{JSD}). The channel turns back ON if its junction temperature decreases lower than restart threshold (T_{JR}).

An additional case temperature sensor protects the whole chip against overtemperature (OVC event): if the case temperature triggers the T_{CSD} threshold then overloaded channels are turned OFF and restart only when case temperature decreased down to the reset threshold (T_{CR}). Non overloaded channels continue to operate normally.

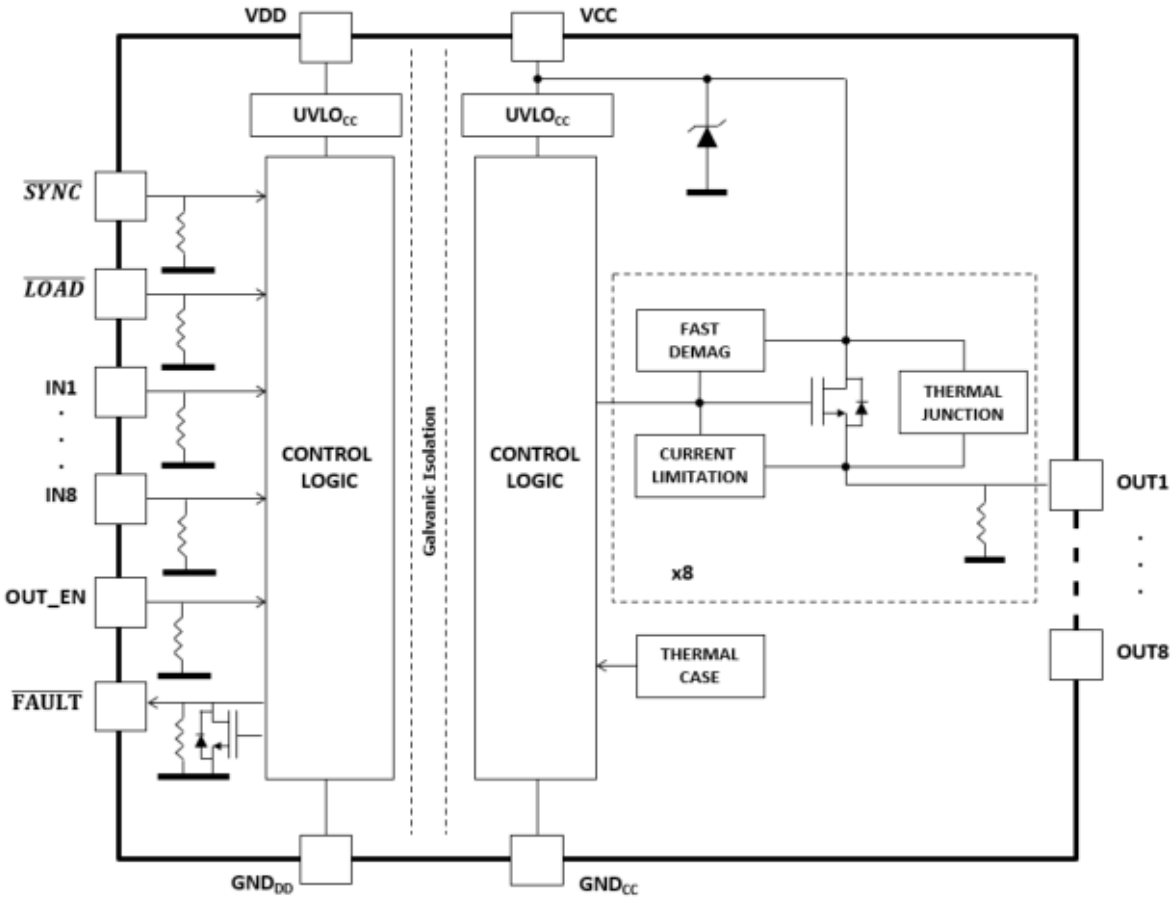
Other embedded functions are loss of ground protection, V_{CC} and V_{DD} UVLOs (with hysteresis), and watchdog.

An internal circuit provides an OR-wired not latched OVT that is reported on the common $\overline{\text{FAULT}}$ indicator pin. $\overline{\text{FAULT}}$ is an open drain, active low, fault indication pin.

The Synchronous Control Mode (by driving $\overline{\text{SYNC}}$ and $\overline{\text{LOAD}}$ pins independently) is used to reduce the jittering of the outputs and to drive at the same time the outputs of different devices.

1 Block Diagram

Figure 1. **Block diagram**



2 Pin Connection

Figure 2. **Pin connection PowerSO-36 (top through view)**

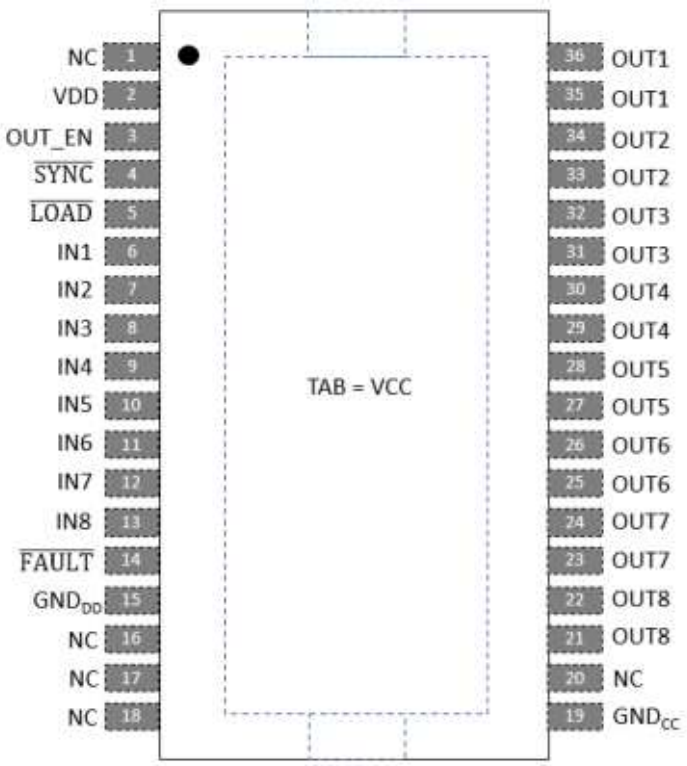


Figure 3. **Pin connection TFQFPN32 (top through view)**

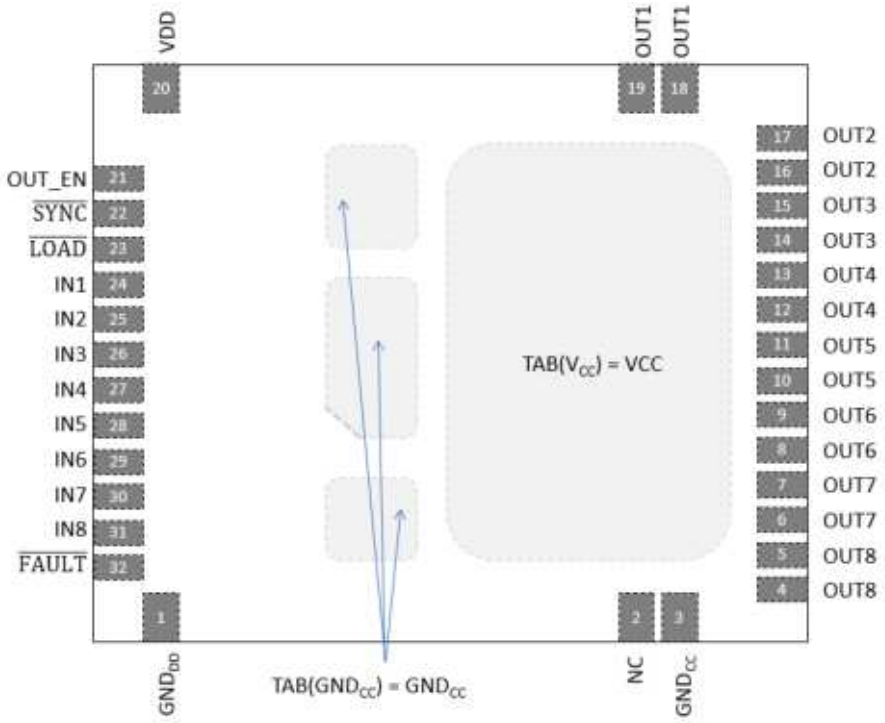


Table 1. Pin description

Pin		Name	Description
PowerSO-36	TFQFPN32		
1	-	N.C.	Not connected
2	20	V_{DD}	Positive Control Logic Stage supply
3	21	OUT_EN	Output enable
4	22	$\overline{SYNC}$	Input to output synchronization signal, active low
5	23	$\overline{LOAD}$	Load input data signal, active low
6	24	IN1	Channel 1 input
7	25	IN2	Channel 2 input
8	26	IN3	Channel 3 input
9	27	IN4	Channel 4 input
10	28	IN5	Channel 5 input
11	29	IN6	Channel 6 input
12	30	IN7	Channel 7 input
13	31	IN8	Channel 8 input
14	32	$\overline{FAULT}$	Common fault (OVT and Internal Communication Error) pin - active low
15	1	GND_{DD}	Input logic ground, negative logic supply
16	-	NC	Not connected
17	-	NC	Not connected
18	2	NC	Not connected
19	3	GND_{CC}	Output (process side) power ground
-	TAB(GND_{CC})	TAB(GND_{CC})	Connect to GND_{CC} on the application board
20	-	NC	Not connected
21	4	OUT8	Channel 8 power output(1)
22	5		
23	6	OUT7	Channel 7 power output(1)
24	7		
25	8	OUT6	Channel 6 power output(1)
26	9		
27	10	OUT5	Channel 5 power output(1)
28	11		
29	12	OUT4	Channel 4 power output(1)
30	13		
31	14	OUT3	Channel 3 power output(1)
32	15		
33	16	OUT2	Channel 2 power output(1)
34	17		
35	18	OUT1	Channel 1 power output(1)
36	19		
TAB	TAB(V_{CC})	V_{CC}	Exposed tab internally connected to V_{CC} positive Process Stage supply voltage

1. *Connect the two pins on the same net of the application board*

3 Absolute Maximum Ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Process Stage supply voltage	-0.3	+45	V
V_{DD}	Control Logic Stage supply voltage	-0.3	+6	V
V_{IN}	DC Input pins (IN_X, $\overline{LOAD}$, $\overline{SYNC}$ and OUT_EN) current	-0.3	V_{DD}	V
V_{FAULT}	$\overline{FAULT}$ pin voltage	-0.3	+6.0	V
$I_{GND_{DD}}$	DC digital ground Reverse Current		-25	mA
I_{OUT}	Channel Output Current (continuous)		Internally limited	A
$I_{GND_{CC}}$	DC Power Ground Reverse Current		-250	mA
I_{RX}	Reverse Output Current (from OUTx pins to V_{CC})		-6(1)	A
I_{IN}	DC Input pins current (IN_X, $\overline{LOAD}$, $\overline{SYNC}$ and OUT_EN)	-10	+10	mA
I_{FAULT}	$\overline{FAULT}$ pin current	-10	+10	mA
V_{ESD}	Electrostatic discharge with Human Body Model (R = 1.5 KΩ; C = 100 pF)		2000	V
V_{IO}	Isolation DC voltage applied between GND_{DD} and GND_{CC} pins for PowerSO-36		180	V
	Isolation DC voltage applied between GND_{DD} and GND_{CC} pins for TFQFPN32		75	
EAS	Single pulse avalanche energy per channel, all channels driven simultaneously @T_{AMB}= 125 °C, I_{OUT} = 0.6 A (PowerSO-36)		2.11	J
	Single pulse avalanche energy per channel, all channels driven simultaneously @T_{AMB}= 125 °C, I_{OUT} = 0.6 A (TFQFPN32)		0.48	
P_{TOT}	Power dissipation		Internally limited (2)	W
T_J	Junction operating temperature		Internally limited(2)	°C
T_{STG}	Storage temperature		-40 to 150	°C

1. *this value is intended with each couple of OUTx pins shorted on the application board*
2. *Protection functions are intended to avoid IC damage in fault conditions and are not intended for continuous operation. Continuous or repetitive operation of protection functions may reduce the IC lifetime.*

4 Thermal Data

Table 3. Thermal data

Symbol	Parameter	Max. value		Unit
		PowerSO-36	TFQFPN32	
$R_{th\ j\text{-}case}$	Thermal resistance, junction-to-case (1)	0.8	1	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance, junction-to-ambient (2)	16.9(3)	25(4)	

1. *Rth between the die and the bottom case surface measured by cold plate as per JESD51-12.*
2. *JESD51-7.*
3. *Maximum power dissipation = 3.8W (@T_{amb} = 85°C, T_J < 150°C)*
4. *Maximum power dissipation = 2.6W (@T_{amb} = 85°C, T_J < 150°C)*

5 Electrical characteristics

9.2 V ≤ V_{CC} ≤ 36 V; 2.75 V ≤ V_{DD} ≤ 5.5 V; -40 °C < T_J < 125 °C, unless otherwise specified.

Table 4. Power section

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{CC}	Operating voltage range		9.2		36	V
$V_{CC(THON)}$	V_{CC} undervoltage turn-on threshold	V_{DD} = 3.3 V, V_{CC} increasing		8.4	9.2	V
$V_{CC(THOFF)}$	V_{CC} undervoltage turn-off threshold	V_{DD}= 3.3 V, V_{CC} decreasing	7.7	8.1		V
$V_{CC(HYS)}$	V_{CC} undervoltage hysteresis			0.15		V
$V_{CCclamp}$	Clamp on VCC pin	I_{clamp} = 20 mA	47	52	57	V
$R_{DS(ON)}$	ON-state resistance (see Figure 4)	I_{OUT} = 0.5 A, T_J = 25 °C		0.125	0.16	Ω
		I_{OUT} = 0.5 A, T_J = 125 °C			0.26	
I_{CC}	Power supply current	All channels in OFF-state, V_{CC} = 36 V		5.5		mA
		All channels in ON-state, V_{CC} = 36 V		16		
I_{LGND}	Ground disconnection output current	V_{CC} = V_{GND} = 0 V, V_{OUT} = -24 V			500	µA
$V_{OUT(OFF)}$	OFF-state output voltage	Channel OFF and I_{OUT} = 0 A			3	V
$I_{OUT(OFF)}$	OFF-state output current	Channel OFF and V_{OUT} = 0 V			5	µA

Table 5. Digital supply voltage

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{DD}	Operating voltage range		2.75		5.5	V
$V_{DD(THON)}$	V_{DD} undervoltage turn-on threshold	V_{CC} = 24 V, V_{DD} increasing	2.55		2.75	V
$V_{DD(THOFF)}$	V_{DD} undervoltage turn-off threshold	V_{CC} = 24V, V_{DD} decreasing	2.45		2.65	V
$V_{DD(HYS)}$	V_{DD} undervoltage hysteresis		0.04	0.1		V
I_{DD}	V_{DD} supply current	V_{DD} = 5 V and input channel with a steady logic level		4.5	6	mA
		V_{DD} = 3.3 V and input channel with a steady logic level		4.4	5.9	mA

Table 6. Diagnostic pin and output protection function

Symbol	Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_{FAULT}	$\overline{FAULT}$ pin open drain voltage output low		I_{FAULT} = 5 mA			0.4	V
I_{LFAULT}	$\overline{FAULT}$ output leakage current		V_{FAULT} = 5 V			1	µA
I_{PEAK}	Maximum DC output current before limitation		V_{CC} = 24 V; R_{LOAD} = 0 Ω			2.7	A
I_{LIM}	Short-circuit current limitation	ISO808, ISO808Q		0.7		1.9	A
		ISO808-1, ISO808Q-1		1			
Hyst	I_{LIM} tracking limits				0.3		A
T_{JSD}	Junction shutdown temperature			150	175	200	°C
T_{JR}	Junction reset temperature				160		°C
T_{JHYST}	Junction thermal hysteresis				15		°C
T_{CSD}	Case shutdown temperature			125	130	135	°C
T_{CR}	Case reset temperature				115		°C
T_{CHYST}	Case thermal hysteresis				15		°C
V_{DEMAG}	Output voltage at turn-off		I_{OUT} = 0.5 A; I_{LOAD} >= 1 mH	V_{CC}-50	V_{CC}-54	V_{CC}-58	V

Table 7. Power switching characteristics (V_{CC} = 24 V; R_{LOAD} = 48 Ω; -40 °C < T_J < 125 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
dV/dt(ON)	Turn-on voltage slope	(see Figure 5)		0.7		V/µs
tr	Rise time			19	32	µs
dV/dt(OFF)	Turn-off voltage slope			1.5		V/µs
tf	Fall time			7	23	µs
td(ON)	Turn-ON delay time	(see Figure 6, Figure 7)		15	24	µs
td(OFF)	Turn-OFF delay time			43	80	µs
$t_{w(OUT_EN)}$	OUT_EN pulse width	(see Figure 9, Figure 10)	150			ns
$t_{p(OUT_EN)}$	OUT_EN propagation delay			40	80	µs

Figure 4. $R_{DS(on)}$ measurement

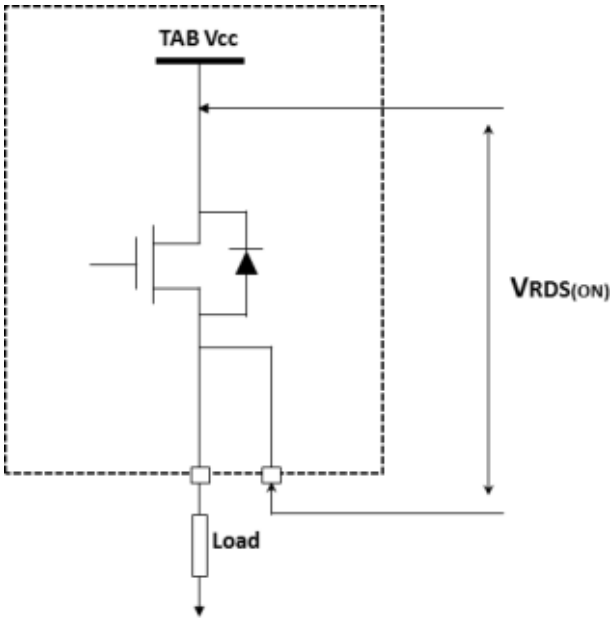


Figure 5. dV/dT definition

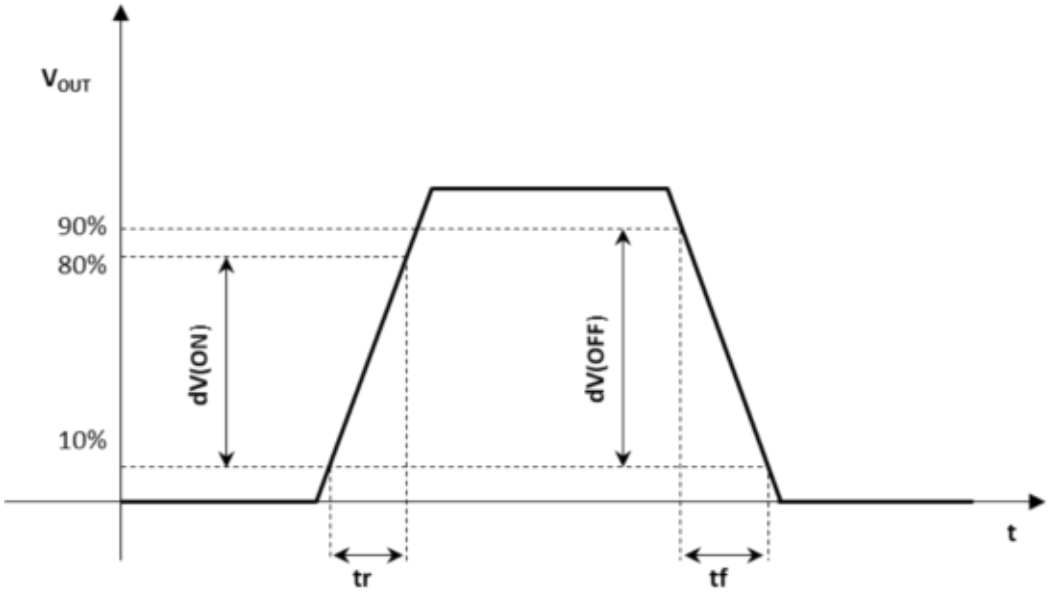


Figure 6. td(ON)-td(OFF) Synchronous Control Mode (SCM)

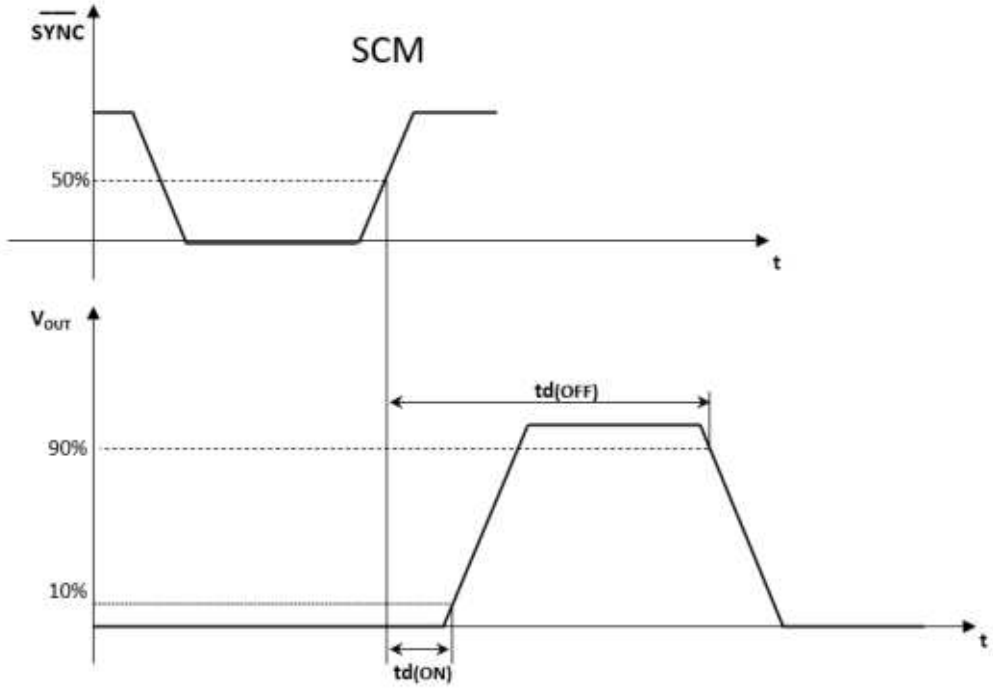


Figure 7. td(ON)-td(OFF) Direct Control Mode (DCM)

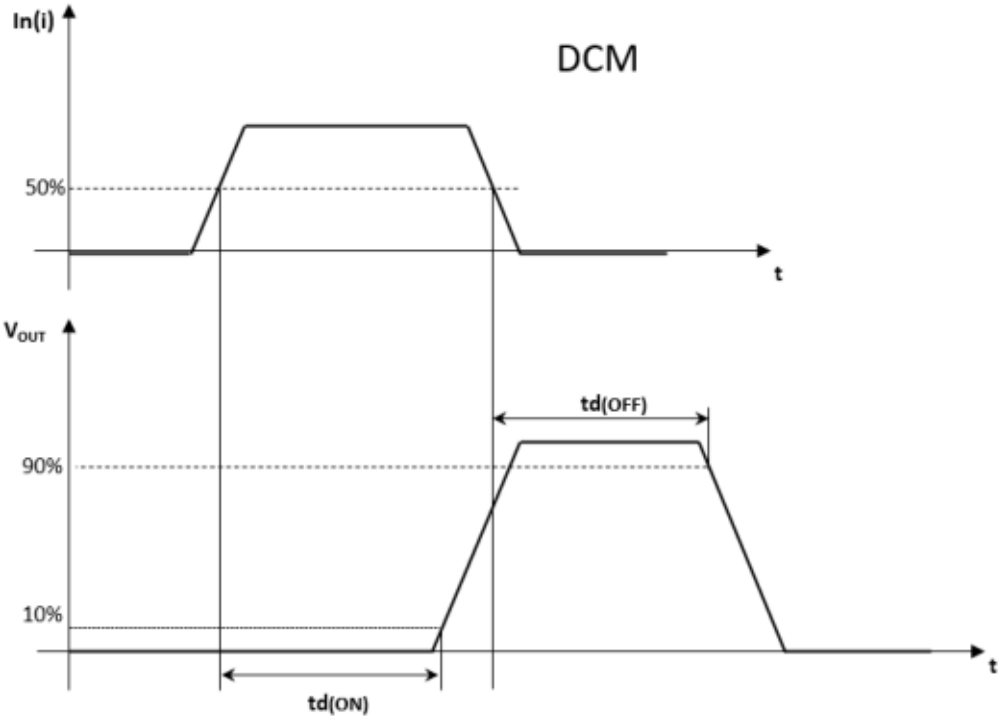


Table 8. Logic inputs and output

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IL}	$\overline{LOAD}$, $\overline{SYNC}$, IN_X and OUT_EN low level voltage		-0.3		0.3 x V_{DD}	V
V_{IH}	$\overline{LOAD}$, $\overline{SYNC}$, IN_X and OUT_EN high level voltage		0.7 x V_{DD}		V_{DD} +0.3	V
$V_{I(HYST)}$	$\overline{LOAD}$, $\overline{SYNC}$, IN_X and OUT_EN hysteresis voltage	V_{DD} = 5 V		100		mV
I_{IN}	$\overline{LOAD}$, $\overline{SYNC}$, IN_X and OUT_EN current	V_{IN} = 5 V	10	55	90	µA

Table 9. Parallel interface timings (V_{DD} = 5 V; V_{CC} = 24 V; -40 °C < T_J < 125 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{dis(SYNC)}$	$\overline{SYNC}$ disable time	Sync. control mode	10			µs
$t_{dis(DCM)}$	$\overline{SYNC}$, $\overline{LOAD}$ disable time	Direct control mode	80			ns
$t_{w(SYNC)}$	$\overline{SYNC}$ negative pulse width	Sync. control mode	20		195	µs
$t_{su(LOAD)}$	$\overline{LOAD}$ setup time	Sync. control mode	80			ns
$t_{h(LOAD)}$	$\overline{LOAD}$ hold time	Sync. control mode	400			ns
$t_{w(LOAD)}$	$\overline{LOAD}$ pulse width	Sync. control mode	240			ns
$t_{su(IN)}$	Input setup time		80			ns
$t_{h(IN)}$	Input hold time		10			ns
$t_{w(IN)}$	Input pulse width	Sync. control mode	160			ns
		Direct control mode	20			µs
t_{INLD}	IN to $\overline{LOAD}$ time	Direct control mode from IN variation to $\overline{LOAD}$ falling edge	80			ns
t_{LDIN}	$\overline{LOAD}$ to IN time	Direct control mode from $\overline{LOAD}$ falling edge to IN variation	400			ns
$t_{jitter(SCM)}$	Jitter on single channel	Sync. control mode			6	µs
$t_{jitter(DCM)}$		Direct control mode			20	

Table 10. Internal communication timings (V_{DD} = 5 V; V_{CC} = 24 V; -40 °C < T_J < 125 °C)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$f_{refresh}$	Refresh delay			15		kHz
t_{WD}	Watchdog time		272	320	400	µs

Table 11. Insulation and safety-related specifications

Symbol	Parameter	Test conditions	Value		Unit
			PowerSO 36	TFQFPN32	
CLR(1)	Clearance (minimum external air gap)	Measured from input terminals to output terminals, shortest distance through air	2.6	3.3	mm
CPG (1)	Creepage (minimum external tracking)	Measured from input terminals to output terminals, shortest distance path along body	2.6	3.3	mm
CTI(2)	Comparative tracking index (tracking resistance)		≥400	≥600	V
	Isolation group	Material group	II	I	-

1. *Creepage and clearance requirements should be applied according to the specific equipment isolation standard of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the PCB do not reduce this distance.*
2. *When high voltage is applied across the isolator, electric discharges on or close to the surface of the package, can cause localized deterioration in the mold compound, resulting in a partially conducting path from one side of the isolator to the other. This phenomenon is called tracking. The ability of a material to withstand tracking is quantified by a comparative tracking index (CTI). Using a mold compound with a higher CTI allows the use of smaller packages and saves board space.*

Table 12. Insulation characteristics

Symbol	Parameter	Test condition	Value		Unit
			PowerSO 36	TFQFPN32	
In accordance with IEC 60747-17					
V_{PR}	Input-to-output test voltage	Method a, type test, tm = 10 s partial discharge < 5 pC	1500	1500	V_{PEAK}
		Method b, 100% production test, tm = 1 s partial discharge < 5 pC	1758	1758	V_{PEAK}
V_{IOTM}	Transient overvoltage	Type test; t_{ini} = 60 s	3537	4245	V_{PEAK}
V_{IOSM}	Maximum surge insulation voltage	Type test	3537	4245	V_{PEAK}
R_{IO}	Insulation resistance	Type test V_{IO} = 500 V, T_{STG} = 60 s	$>10^9$	$>10^9$	Ω
UL1577					
V_{ISO}	Insulation withstand voltage	1 min. type test	2000/2830	2500/3536	V_{RMS}/V_{PEAK}
V_{ISO} test	Insulation withstand test	1 s 100% production	2500/3537	3000/4245	V_{RMS}/V_{PEAK}
Common Mode Transient Immunity					
dV_{ISO}/dt	CMTI	Type test at V_{CM} = 500 V	±25	±25	V/ns

Table 13. Safety limits

Symbol	Parameter	Test conditions	Value	Unit
Input safety, Logic side				
T_{SI}	Safety temperature of Logic side	-	150	°C
P_{SI}	Safety power of Logic side(1)	$V_{DD} \leq 6.0$ V, $V_{LOGIC(x)} \leq 6.0$ V, $I_{LOGIC(x)} \leq 10$ mA, $T_J \leq T_{SI}$	0.9	W
Output safety, Process side				
T_{SO}	Safety temperature of Process side	-	150	°C
P_{SO}	Safety power of Process side(1)	$V_{CC} \leq 36$ V, $I_{OUT(x)} \leq 1.5$ A, $T_J \leq T_{SO}$	5	W

1. *The above limits are measured according to IEC 60747-17. Respecting the above limits prevents potential damage to the isolation barrier upon failure on logic or process side circuitry. The user should apply these values to protect the IC and ensure the safety of the embedded isolation barrier. LOGIC(x) stands for any pin on the logic side; OUT(x) stands for any of the 8 output pins on the process side.*

6 Functional description

6.1 Parallel interface

The integrated smart parallel interface offers three interfacing signals easily managed by a micro-controller. The $\overline{LOAD}$ signal enables the input buffer storing the value of the channel inputs. The $\overline{SYNC}$ signal copies the input buffer value into the transmission buffer and manages the synchronization between low voltage side and the channel outputs on the isolated side.

The OUT_EN signal enables the channel outputs. An internal refresh signal updates the configuration of the channel outputs with a $f_{refresh}$ frequency. This signal can be disabled forcing low the $\overline{SYNC}$ input when $\overline{LOAD}$ is high. $\overline{SYNC}$ and $\overline{LOAD}$ pins can be in direct control mode (DCM) or synchronous mode (SCM).

6.1.1 Input signals (IN1 to IN8)

Inputs from IN1 to IN8 are the driving signals of the corresponding OUT1 to OUT8 outputs. Data are directly loaded on related outputs if $\overline{SYNC}$ and $\overline{LOAD}$ inputs are low (DCM operation) or stored into input buffer when $\overline{LOAD}$ is low, and $\overline{SYNC}$ is high.

6.1.2 Load input data

The input is active low; it stores the data from IN1 to IN8 into the input buffer

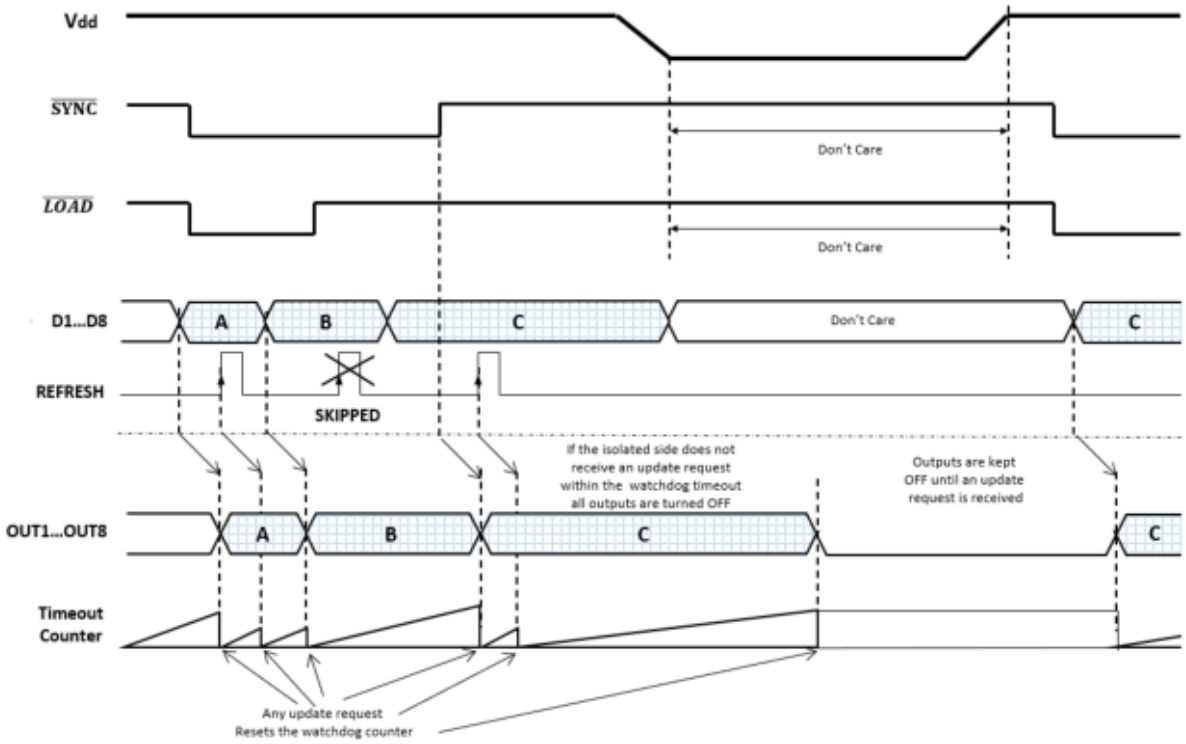
6.1.3 Output synchronization

The input is active low; it enables the integrated transmission buffer loading input buffer data and manages the transmission between the two isolated sides of the device.

6.1.4 Watchdog

The IC is composed by two chips (Logic Stage and Process Stage) supplied by two independent and galvanic isolated sources (V_{DD}/GND_{DD} and V_{CC}/GND_{CC} pins, respectively). The IC provides a watchdog function in order to guarantee a safe condition for the Process Stage when V_{DD} (or GND_{DD}) supply voltage is missing. If the Logic Stage does not update the output status within t_{WD}, all the outputs of the Process Stage are disabled until a new update request is received. The Logic Stage chip periodically sends a refresh signal to the Process Stage chip. The refresh signal is also considered a valid update signal to reset the timeout counter on the Process Stage, so the isolated side watchdog does not protect the system from a failure of the host controller (e.g., MCU freezing).

Figure 8. Watchdog behavior



6.1.5 Output enable (OUT_EN)

This pin provides a fast way to disable all the outputs simultaneously. When the OUT_EN pin is driven low for at least $t_{W(OUT_EN)}$, all eight outputs are disabled. This timing execution is compatible with an external reset push from the operator, safety requirements, and permits, in a PLC system, a micro-controller polling for obtain all internal information during a reset procedure.

Figure 9. OUT_EN without effect on output

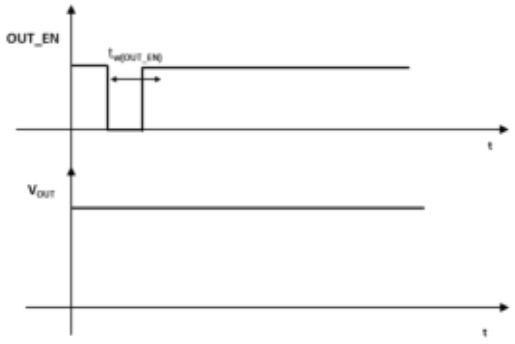
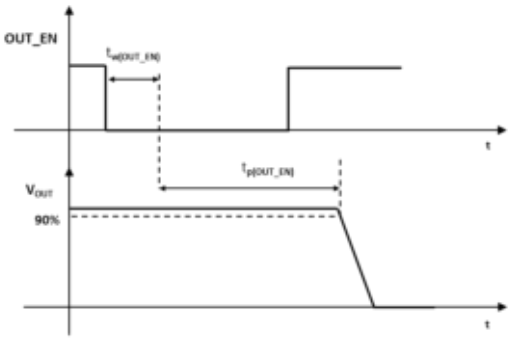


Figure 10. OUT_EN effective on output channel



6.2 Direct Control Mode (DCM)

When $\overline{\text{SYNC}}$ and $\overline{\text{LOAD}}$ inputs are driven by the same signal, the device operates in direct control mode (DCM). In DCM the $\overline{\text{SYNC}}$ / $\overline{\text{LOAD}}$ signal operates as an active low input enable:

- When the signal is high, the current output configuration is kept regardless the input values
- When the signal is low, each channel input directly drives the respective output

This operation mode can also be set shorting both signals to the digital ground; in this case the channel outputs are always directly driven by the inputs except when OUT_EN is low (outputs disabled).

Table 14. Interface signal operation in DCM

$\overline{\text{SYNC}}$ / $\overline{\text{LOAD}}$	OUT_EN	Device behavior
Don't care	Low(1)	The outputs are disabled (turned off)
High	High	The outputs are left unchanged
Low	High	The channel inputs drive the outputs

1. *The outputs are turned off on OUT_EN falling edge and they are kept disabled as long as it is low*

Figure 11. Direct Control Mode, IC configurations

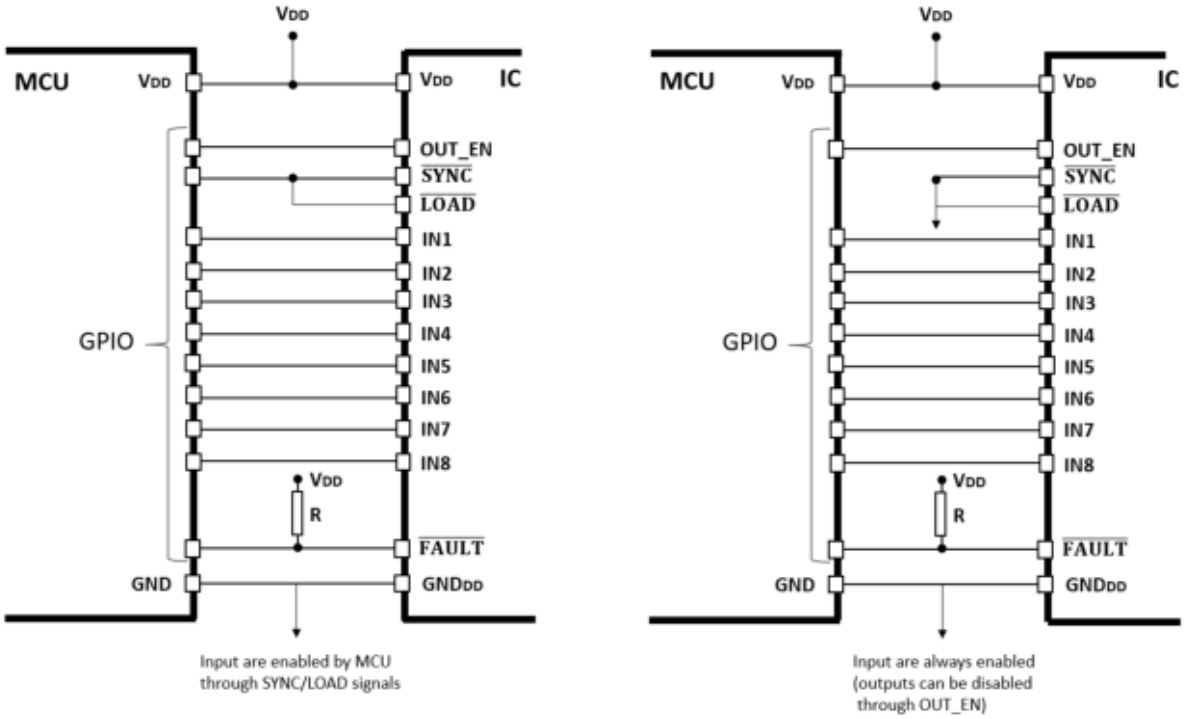
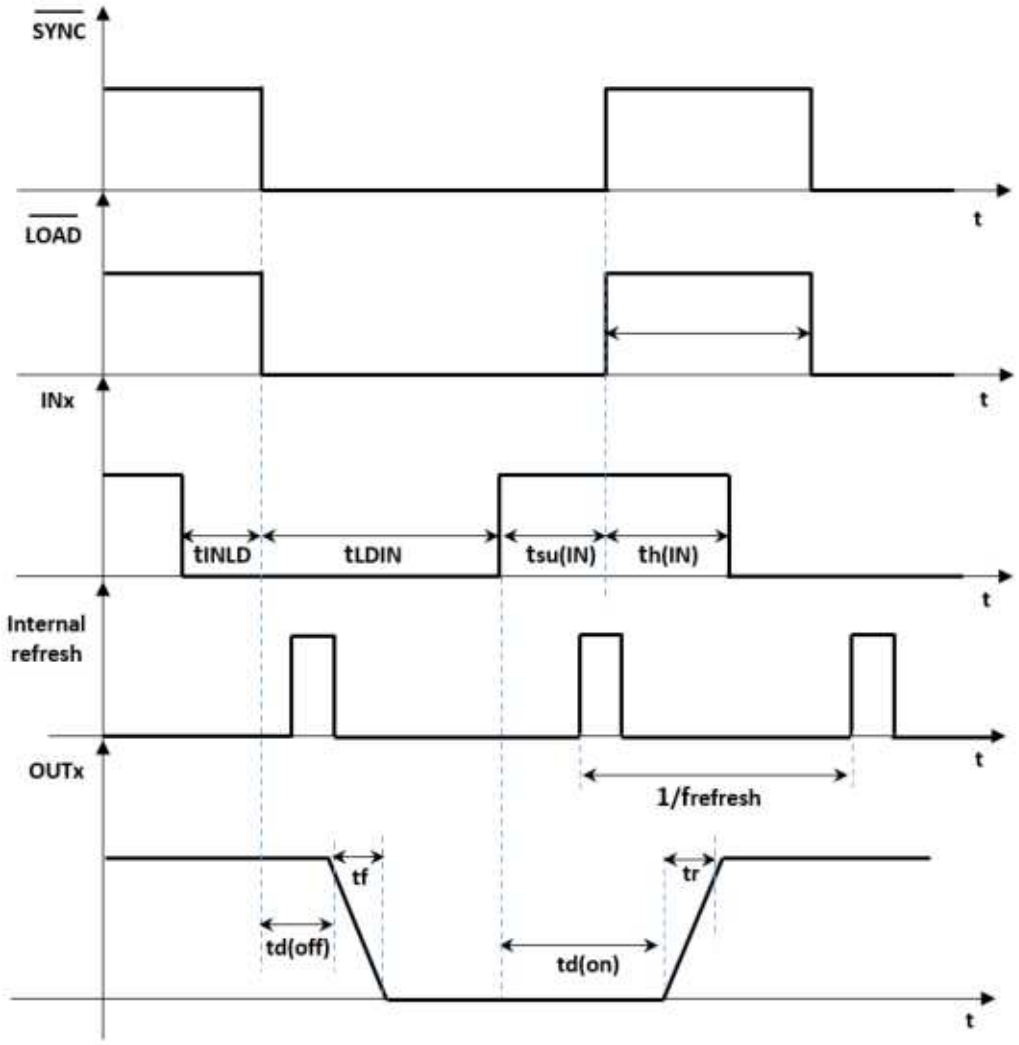


Figure 12. **Direct Control Mode, time diagram**



6.3 Synchronous control mode (SCM)

When $\overline{SYNC}$ and $\overline{LOAD}$ inputs are independently driven, the device can operate in synchronous control mode (SCM). The SCM is used to reduce the jittering of the outputs and to drive all outputs of different devices at the same time. In SCM the $\overline{LOAD}$ signal is forced low to update the input buffer while the $\overline{SYNC}$ signal is high. The $\overline{LOAD}$ signal is raised and the $\overline{SYNC}$ one is forced low for at least $t_{SYNC(SCM)}$. During this period, the internal refresh is disabled and any pending transmission between the low voltage and the isolated side is completed. When the $\overline{SYNC}$ signal is raised the channel output configuration is changed according to the one stored in the input. If the $t_{SYNC(SCM)}$ limit is met, the maximum jitter of the channel outputs is $t_{jitter(SCM)}$. If more devices share the same $\overline{SYNC}$ signal, all device outputs change simultaneously with a maximum jitter related to maximum delay and maximum jitter for single device.

Table 15. Interface signal operation in synchronous mode

$\overline{\text{LOAD}}$	$\overline{\text{SYNC}}$	OUT_EN	Device behavior
Don't care	Don't care	Low(1)	The outputs are disabled (turned off)
High	High	High	The outputs are left unchanged
Low	High	High	The input buffer is enabled, the outputs are left unchanged
High	Low	High	The internal refresh signal is disabled, the transmission buffer is updated and the outputs are left unchanged
Low	Low	High	Should be avoided (DCM operation only)

1. *The outputs are turned off on OUT_EN falling edge and they are kept disabled as long as it is low.*

Figure 13. Synchronous control mode, IC configuration

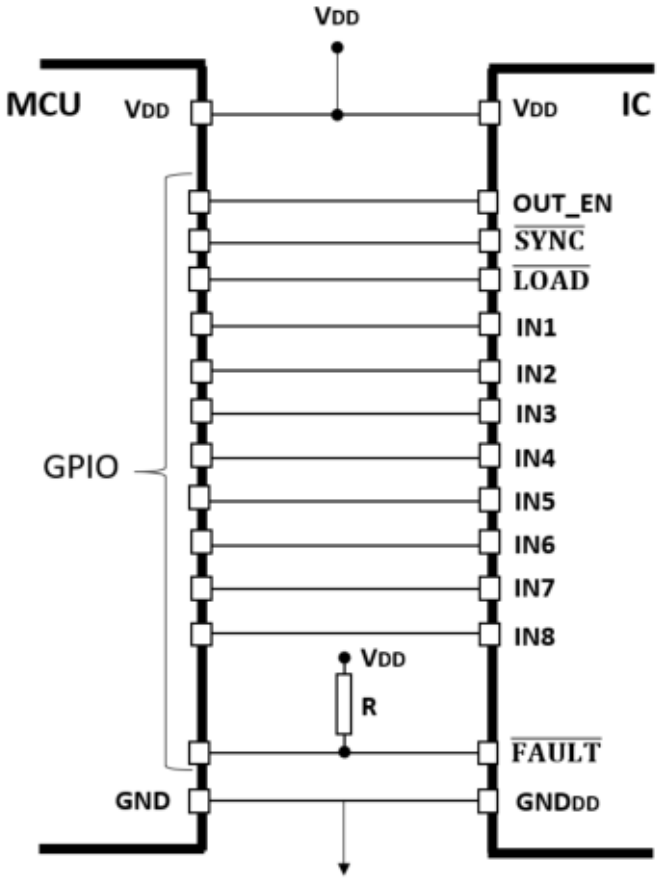


Figure 14. **Synchronous Control Mode, time diagram**

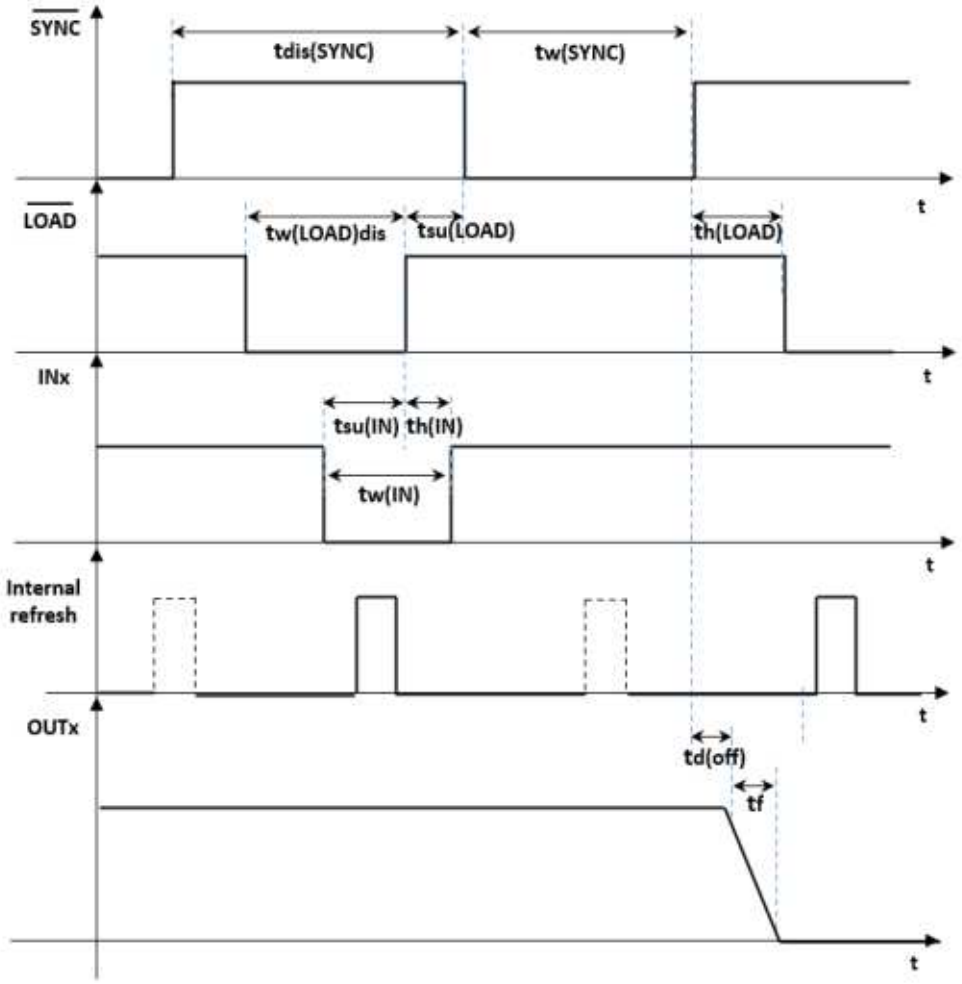
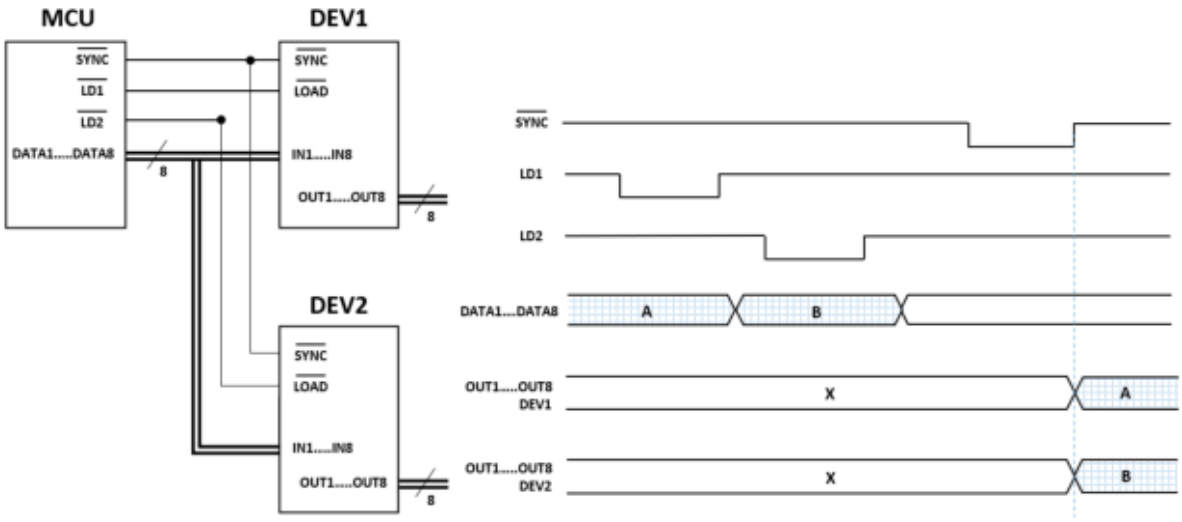


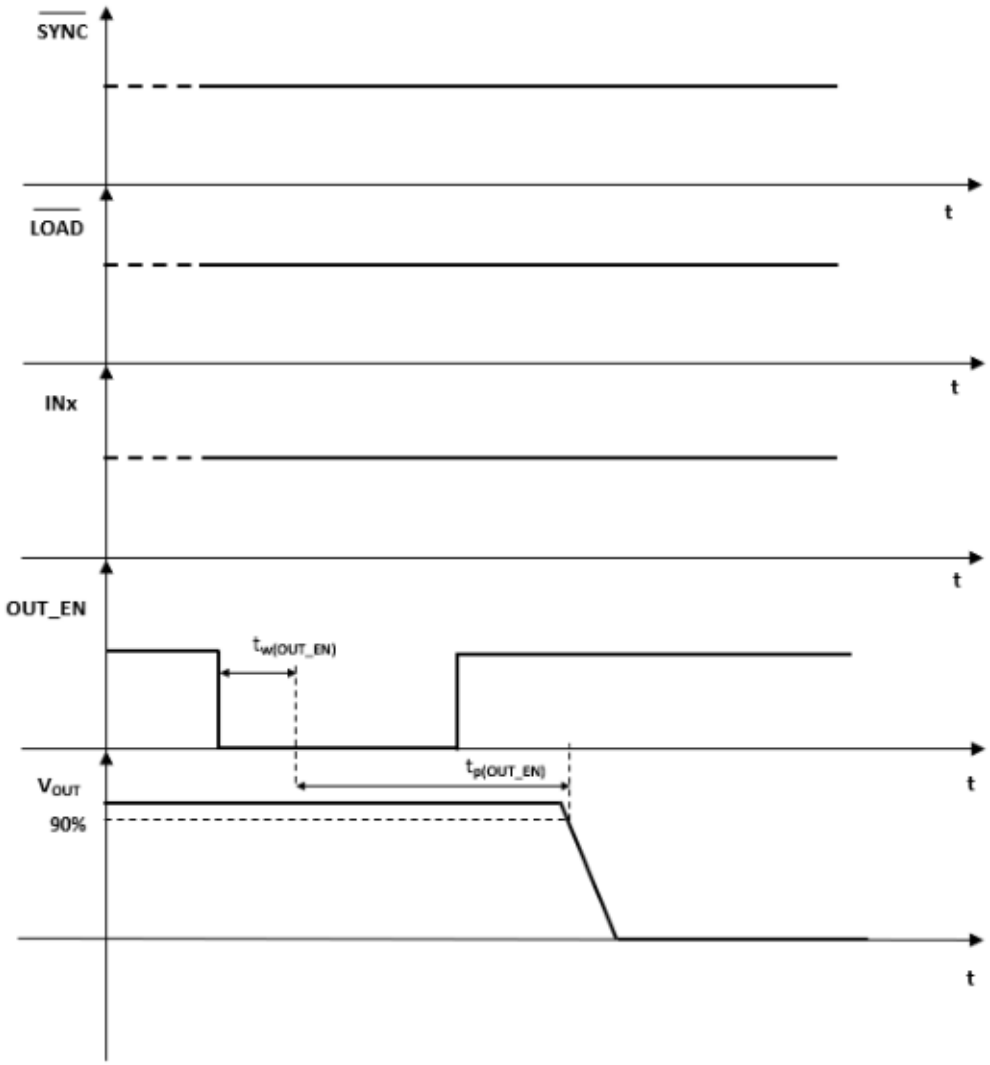
Figure 15. **Multiple device Synchronous Control Mode**



6.3.1 OUT_EN behavior in Synchronous Control Mode

In SCM the OUT_EN signal acts as a reset for the internal data register driving the output switches. When the OUT_EN pin is driven low for at least $t_{w(OUT_EN)}$ (see Figure 16), all the eight outputs are disabled. OUTx remains low even if OUT_EN is raised with INx already high: a new transition of $\overline{LOAD}$ and $\overline{SYNC}$ is required (see Figure 14).

Figure 16. OUT_EN behavior in Synchronous Control Mode, time diagram



6.4 FAULT indication

The $\overline{FAULT}$ pin is an active low open drain output indicating fault conditions. This pin is activated when at least one of the following conditions occurs:

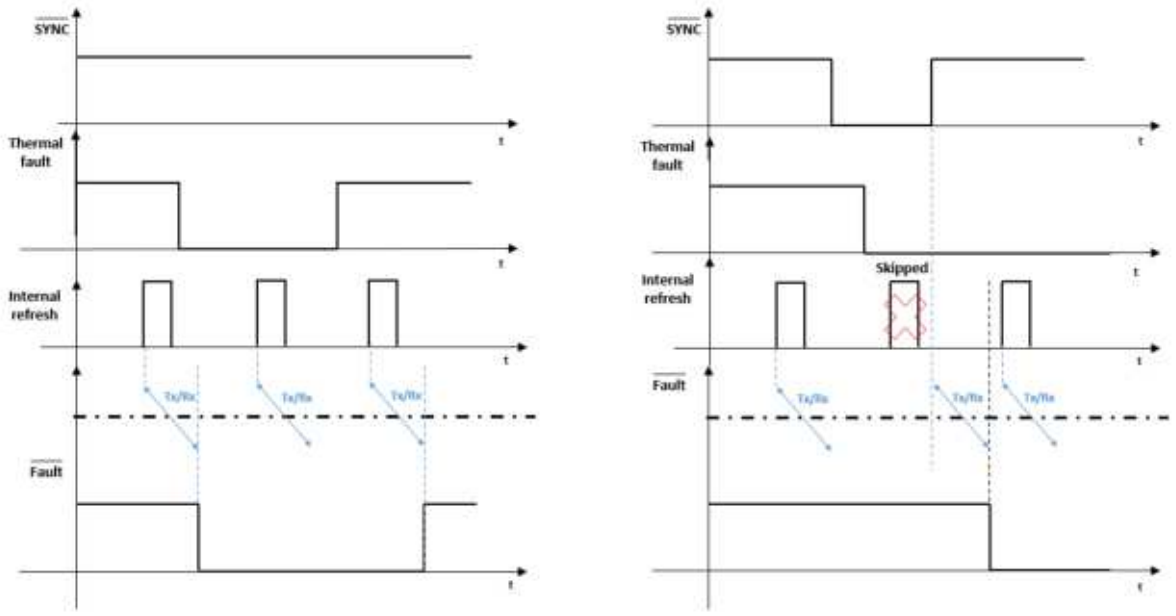
- Junction over-temperature ($T_{JX} > T_{JSD}$) of one or more channels of the Process Stage or case shut-down protection ($T_C > T_{CSD}$) is active
- Internal communication error.

The communication error is intended as an internal data corruption event in the data transfer through isolation. In case of communication error, the outputs are initially kept in the previous status and then reset (turned off) at the first communication error during data transfer of the refresh signal

6.4.1 Junction over-temperature

The thermal status of the device is updated during each transmission sequence between the two isolated stages. In SCM operation, when LOAD signal is high and SYNC one is low, the communication between the two stages is disabled. In this case the thermal status of the device cannot be updated, and the FAULT indication could be different to the actual status. In any case, the thermal protections of the channel outputs in the Process Stage are always operative.

Figure 17. Thermal status update



6.5 Truth table

Table 16. Truth table

x = maintain the previous condition.

Condition	Input IN_x	OUT_x	FAULT
Normal operation	H	ON	H (not active)
	L	OFF	
Thermal Junction ($T_{JX} > T_{JSD}$)	H	OFF	L (active)
	L	OFF	H (not active)
Thermal Case $T_C > T_{CSD}$	See Figure 24		H (not active)(1)
V_{CC} UVLO FAULT	L	OFF	X
	H		
V_{DD} UVLO (Watchdog)	X	OFF	H (not active)
Internal communication error	X	X	L (active)

1. *Usually, the thermal case is consequence of thermal junction event latching the FAULT pin low until the thermal junction event resets. If the thermal case is triggered without any thermal junction event (for example in case of very high ambient temperature) then the FAULT pin is not activated*

7 Power section

7.1 Current limitation

The current limitation process is activated when the current sense connected on the output stage measures a current value higher than a fixed threshold. When this condition is verified, the gate voltage is modulated to avoid output current increasing over the limitation value.

The following figures show typical output current waveforms with different load conditions.

Figure 18. Switching on resistive load

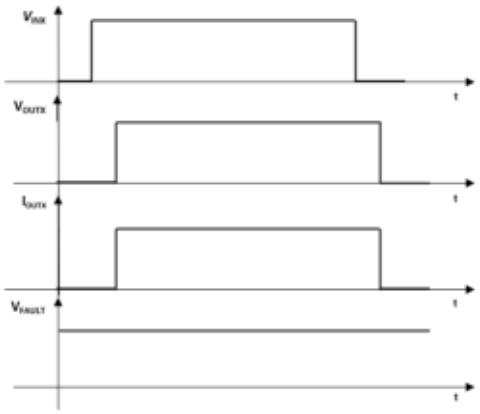


Figure 19. Switching on bulb lamp

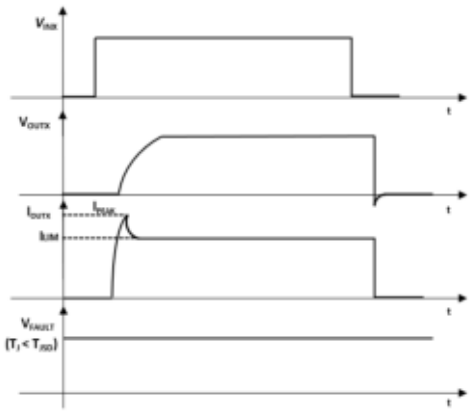


Figure 20. Switching on light inductive load

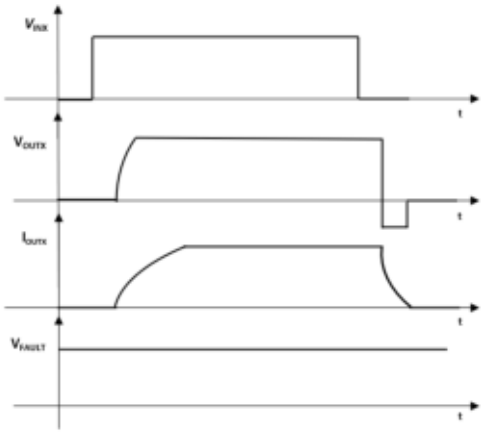


Figure 21. Switching on heavy inductive load

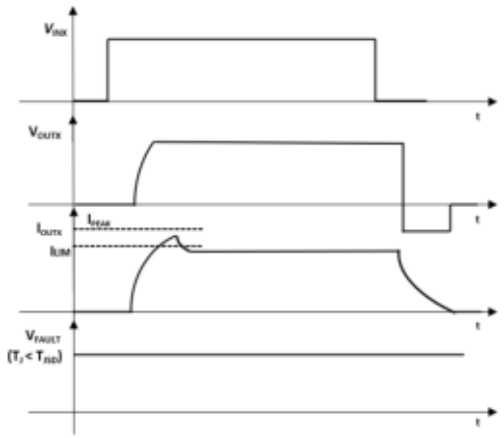


Figure 22. **Short-circuit (with OVT) during ON-state**

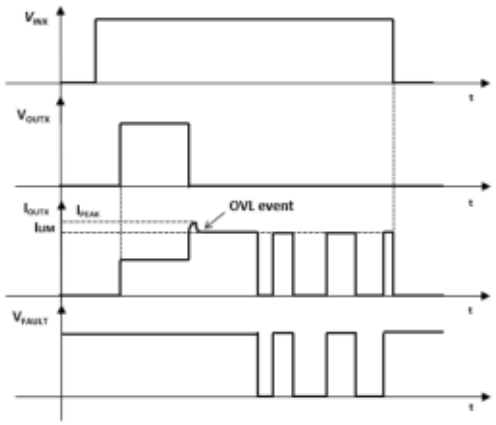
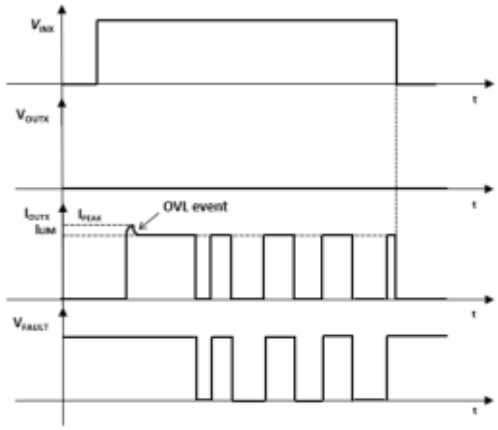


Figure 23. **Switching on short-circuit (with OVT)**



7.2 Thermal protection

The device is protected against overheating due to overload conditions. During driving period, if the output is overloaded, the device suffers two different thermal stresses, the first one related to the junction, and the second related to the case.

The two faults have different trigger thresholds: the junction protection threshold (T_{JSD}) is higher than that of the case protection (T_{CSD}). Generally, the first protection that is activated in thermal stress conditions is the junction thermal shutdown. The output is turned off when the temperature is higher than the related threshold and turned back on when it falls below the reset threshold (T_{JR}). This behavior continues while the fault on the output is present.

If the thermal protection is active and the temperature of the package increases over the fixed case protection threshold, the case protection is activated, and the output is switched off and back on when the junction temperature of each channel in fault and case temperature are below the respective reset thresholds.

Figure 24. **Thermal protection flowchart**

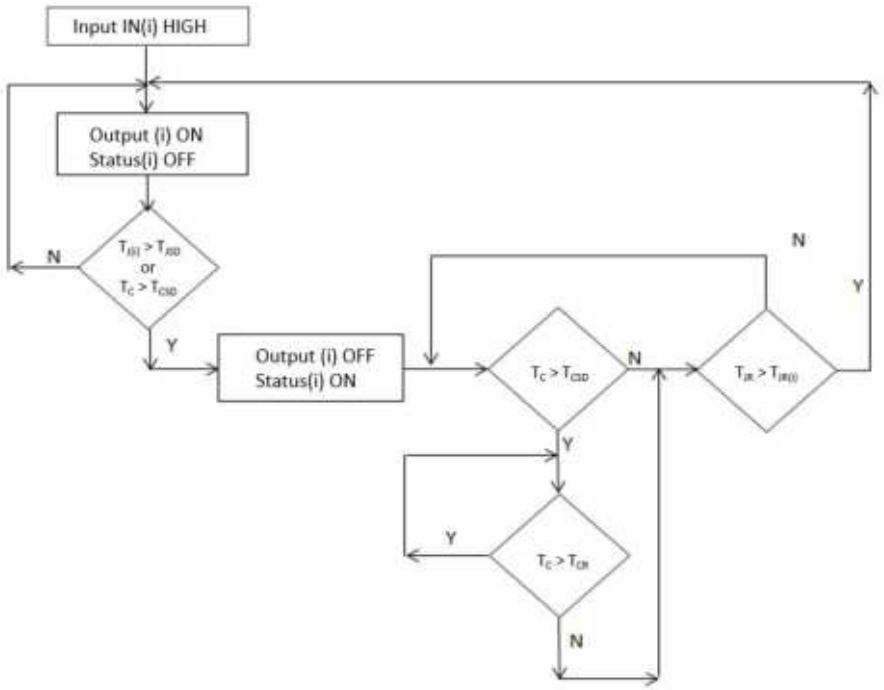


Figure 25. Thermal protection and fault behavior (T_{JSD} triggered before T_{CSD})

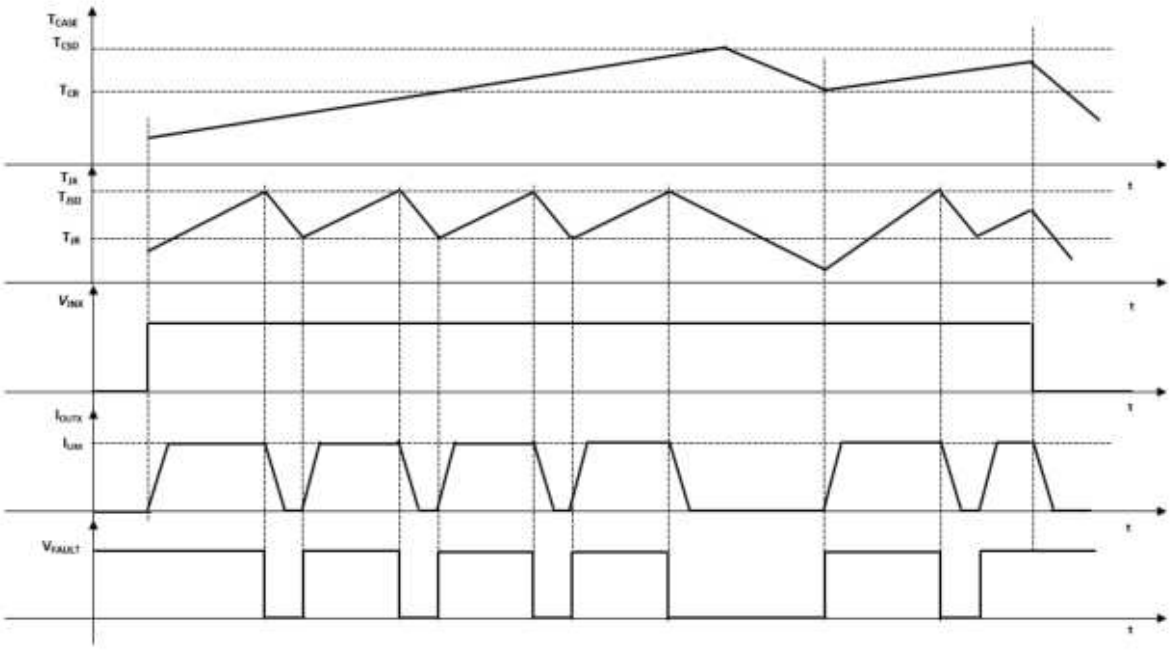
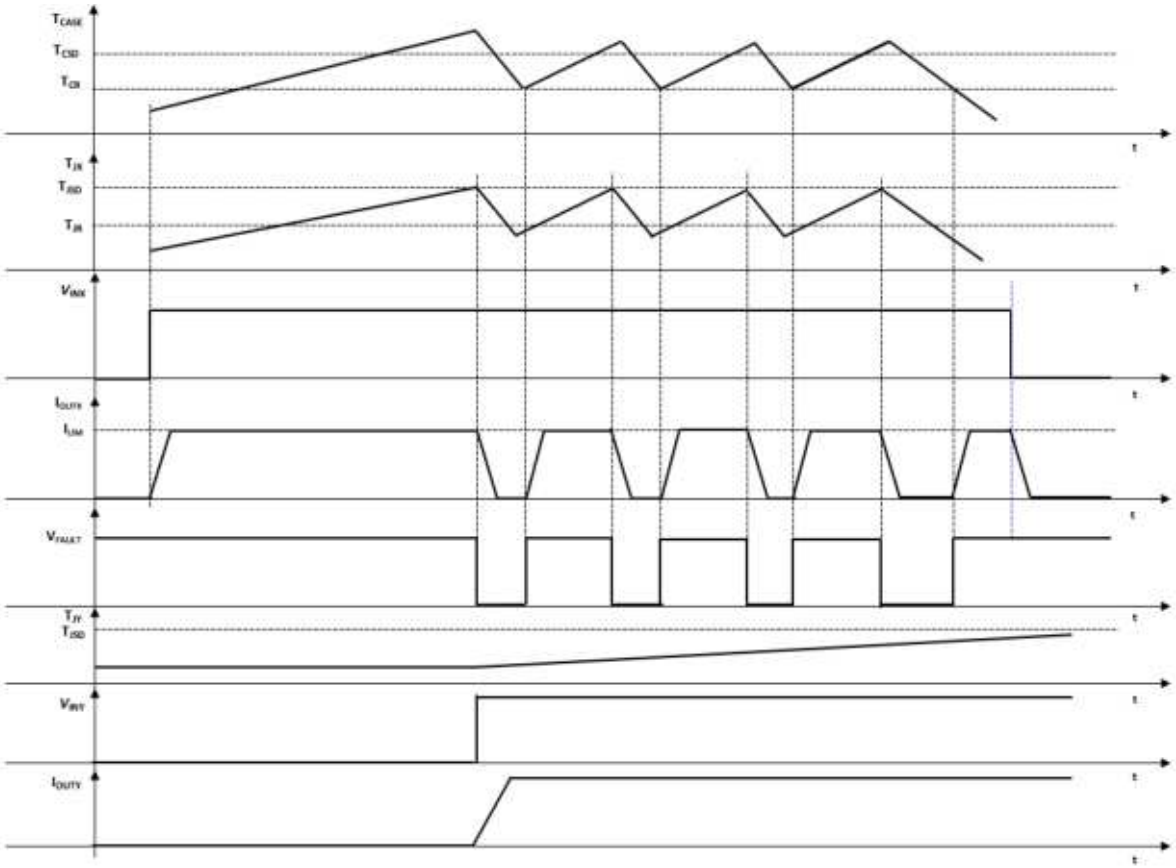


Figure 26. Thermal protection and fault behavior (T_{CSD} triggered before T_{JSD})



8 Reverse polarity protection

Reverse polarity protection can be implemented on the board using two different solutions (or both, which is recommended):

1. Placing a resistor (R_{GND}) between IC GND pin and load GND
2. Placing a diode in parallel to a resistor between IC GND pin and load GND

If option 1 is selected, the minimum resistance value must be selected according to the following equation:

$$R_{GND} \geq \frac{V_{CC}}{I_{GND_{CC}}} \quad (1)$$

where $I_{GND_{CC}}$ is the DC reverse ground pin current and can be found in Table 2.

The power dissipated by R_{GND} during reverse polarity is:

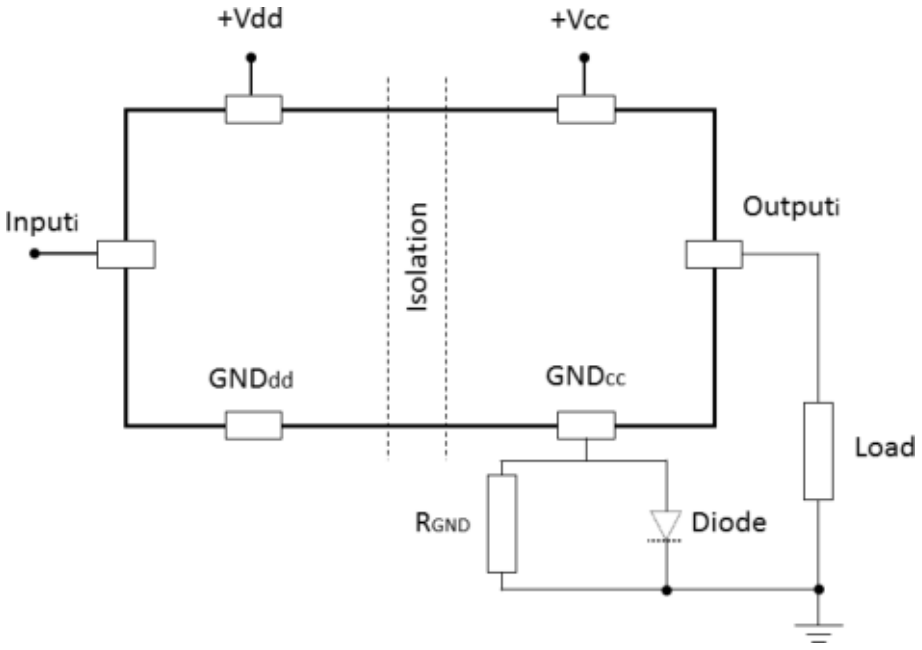
$$P_D = \frac{(V_{CC})^2}{R_{GND}} \quad (2)$$

If option 2 is selected, the diode has to be chosen by taking into account $V_{RRM} > |V_{CC}|$ and its power dissipation capability:

$$P_D \geq I_S \times V_F \quad (3)$$

*Note: In normal operation (no reverse polarity), there is a voltage drop (ΔV) between GND of the device and GND of the system. Using option 1, ΔV = Rgnd * Icc. Using option 2, ΔV = VF@(IF).*

Figure 27. Reverse polarity protection



Note: Input(i) is intended as any input pin on logic side.

This schematic can be used with any type of load.

9 Reverse polarity on VDD

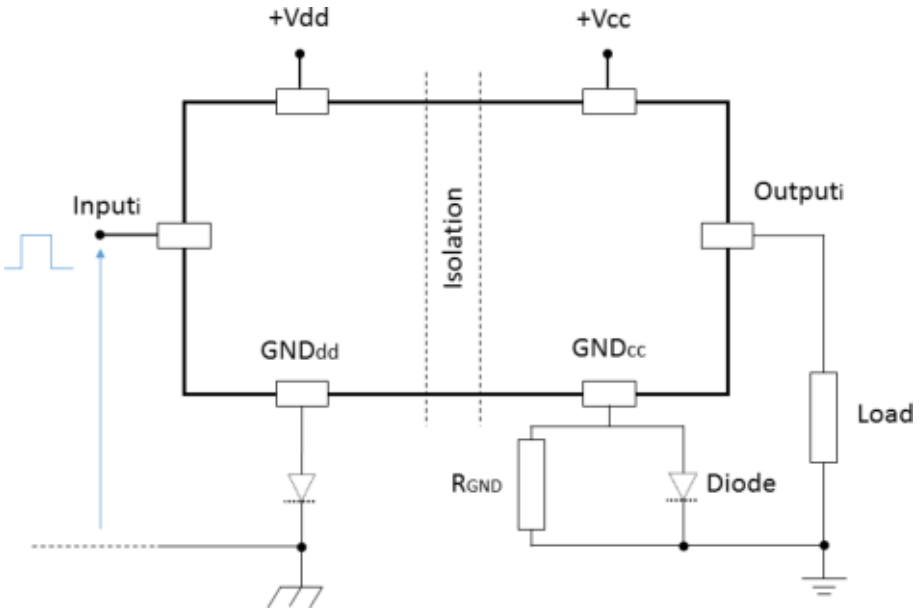
The reverse polarity on V_{DD} can be implemented on the board by placing a diode between the GND_{DD} pin and GND digital ground.

The diode must be chosen by taking into account $V_{RRM} > |V_{DD}|$ and its power dissipation capability:

$$P_D \geq I_{DD} \times V_F \quad (4)$$

Note: In normal operation (no reverse polarity), due to the diode, there is a voltage drop (ΔV = VF@(Idd)) between GND_{DD} of the device and digital ground of the system. In order to guarantee proper triggering of the input signal, ΔV(max.) must result lower than $V_{IH(MIN)}$.

Figure 28. V_{DD} reverse polarity protection



Note: Input(i) is intended as any input pin on logic side.

10 Demagnetization energy

Figure 29. **Single pulse demagnetization energy vs. load current (Typical values at T_{AMB} = 125 °C)**

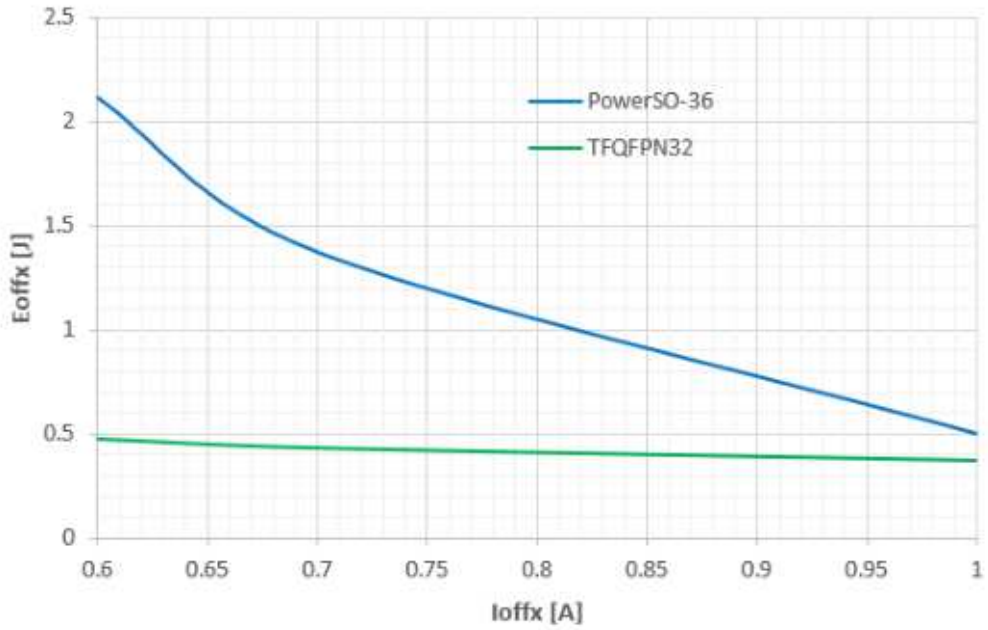


Figure 29 shows the single pulse (not repetitive) demagnetization capability per channel, all channels switched simultaneously

Figure 30. **Single pulse inductive load capability vs. load current (T_{AMB} = 125 °C)**

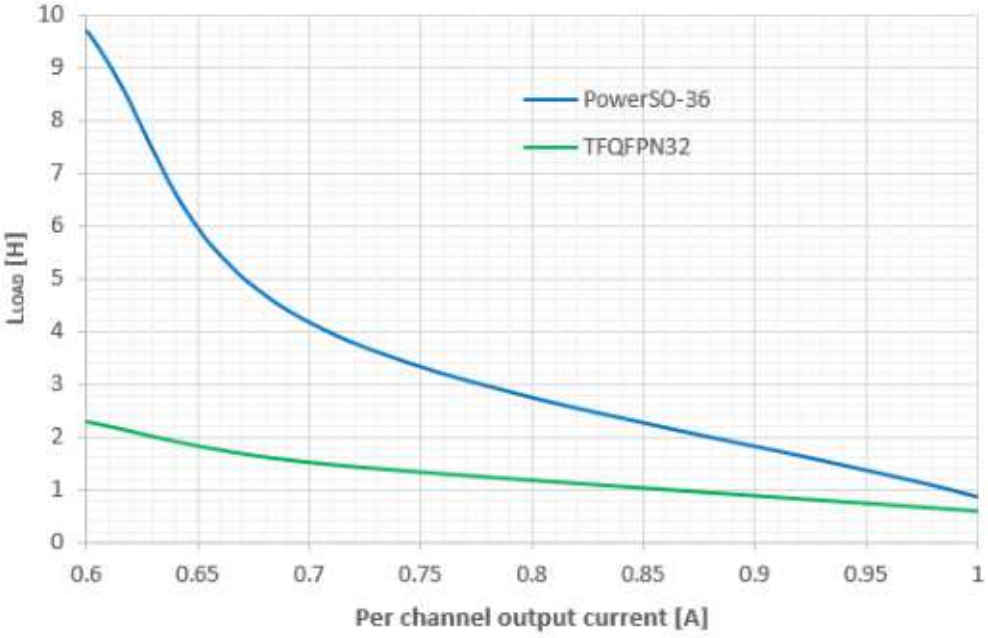
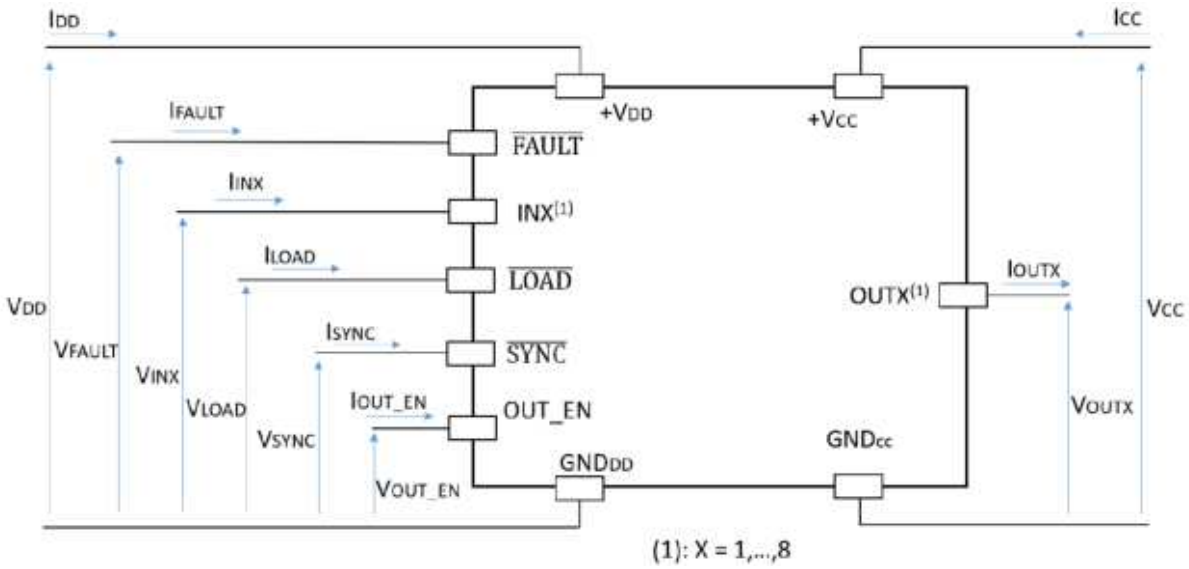


Figure 30 shows the single pulse (not repetitive) inductive load capability per channel, all channels switched simultaneously

11 Conventions

11.1 Supply voltage and power output conventions

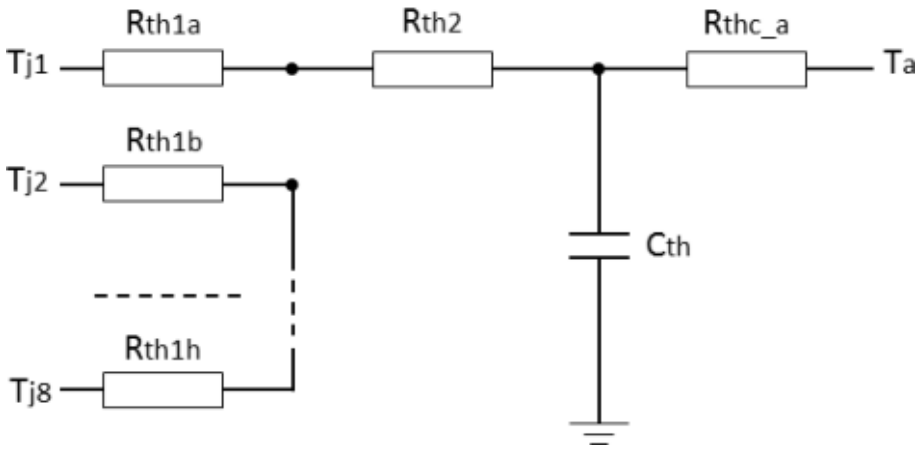
Figure 31. **Supply voltage and power output conventions**



12 Thermal information

12.1 Thermal impedance

Figure 32. **Simplified thermal model of the process stage**



13 Package information

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.

13.1 PowerSO-36 package information

Figure 33. PowerSO-36 package outline

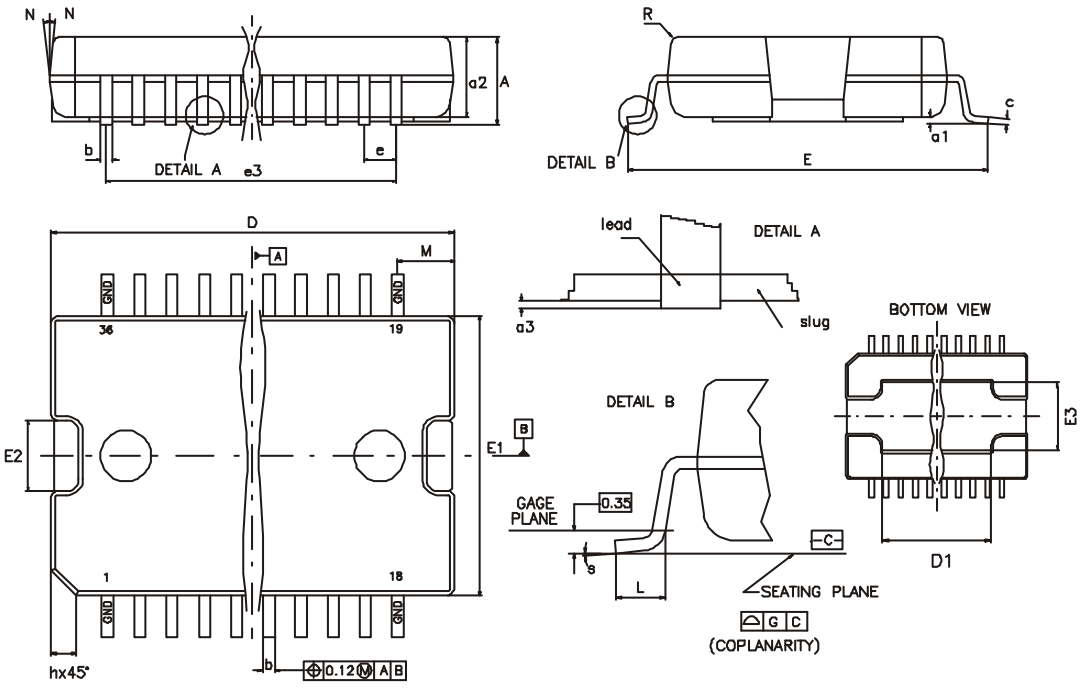


Table 17. **PowerSO-36 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A			3.6
a1	0.10		0.30
a2			3.30
b	0.22		0.38
c	0.23		0.32
D(1)	15.80		16.00
D1	9.40		9.80
E	13.90		14.50
E1(1)	10.90		11.10
E2			2.90
E3	5.80		6.20
e		0.65	
e3		11.05	
G	0		0.10
H	15.50		15.90
h			1.10
L	0.80		1.10
N			10°
S	0°		8°

1. *"D" and "E1" do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (0.006"). Critical dimensions are "a3", "E" and "G"*

Figure 34. **PowerSO-36 suggested footprint**

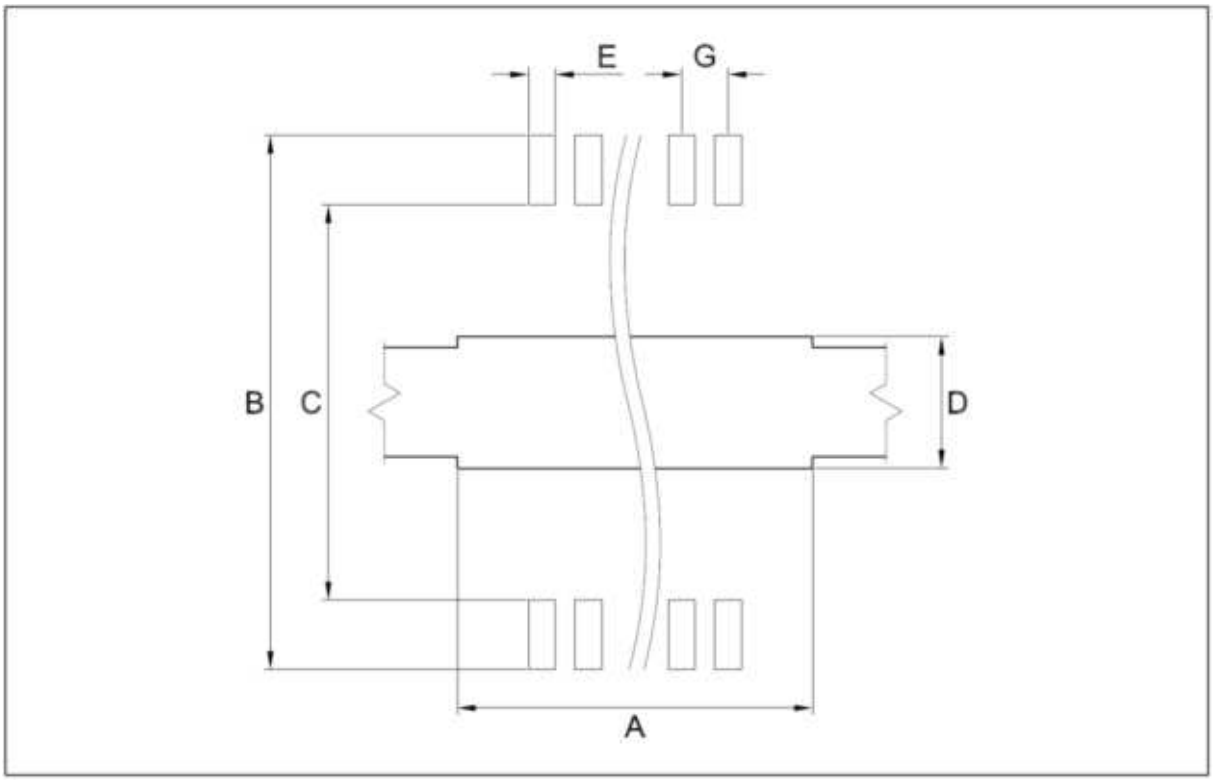


Table 18. **PowerSO-36 footprint data**

Dim	mm
A	9.5
B	14.7-15.0
C	12.5-12.7
D	6.3
E	0.42
G	0.65

13.2 TFQFPN32 package information

Figure 35. **TFQFPN32 package outline**

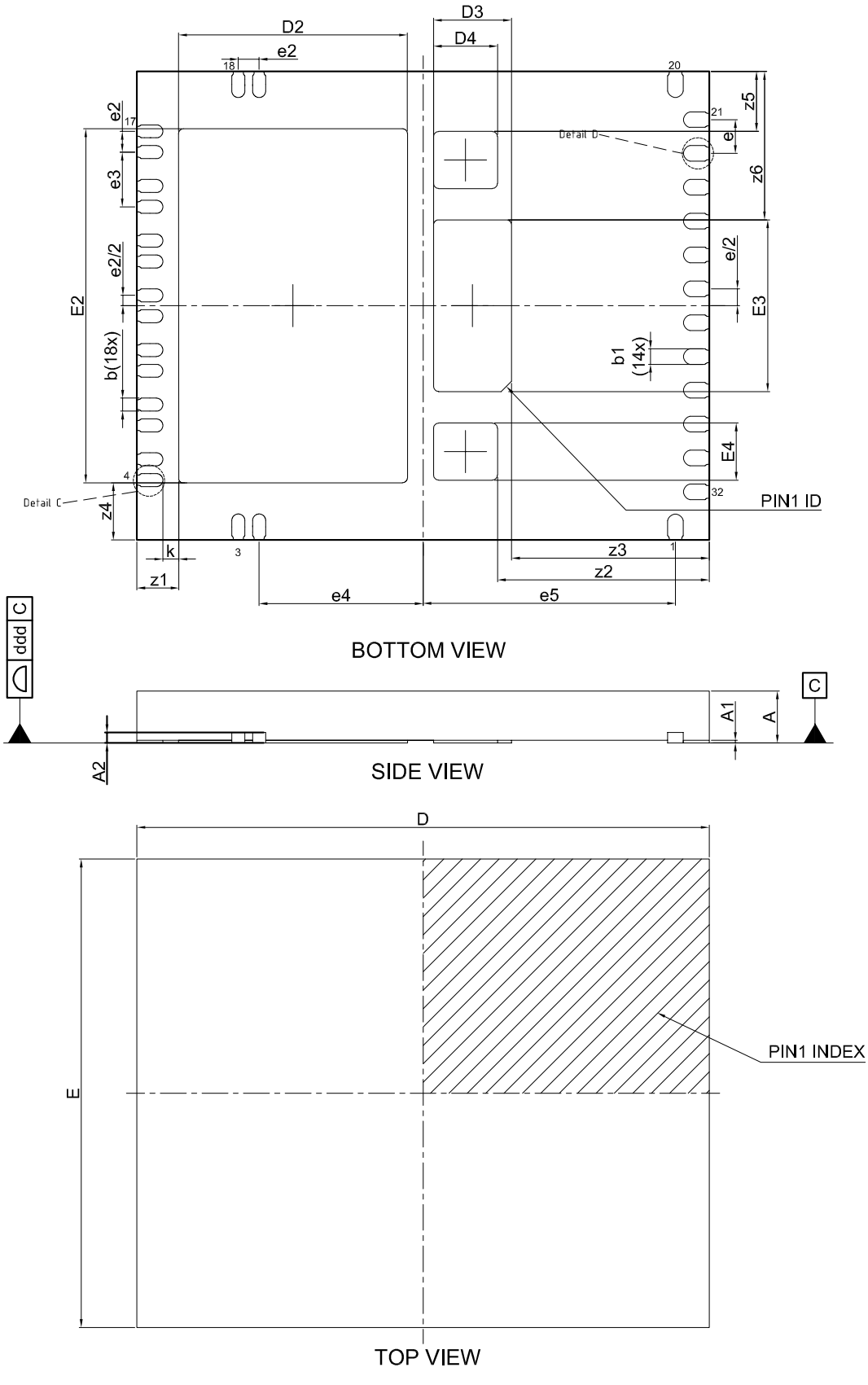


Figure 36. **TFQFPN32 package detail outline**

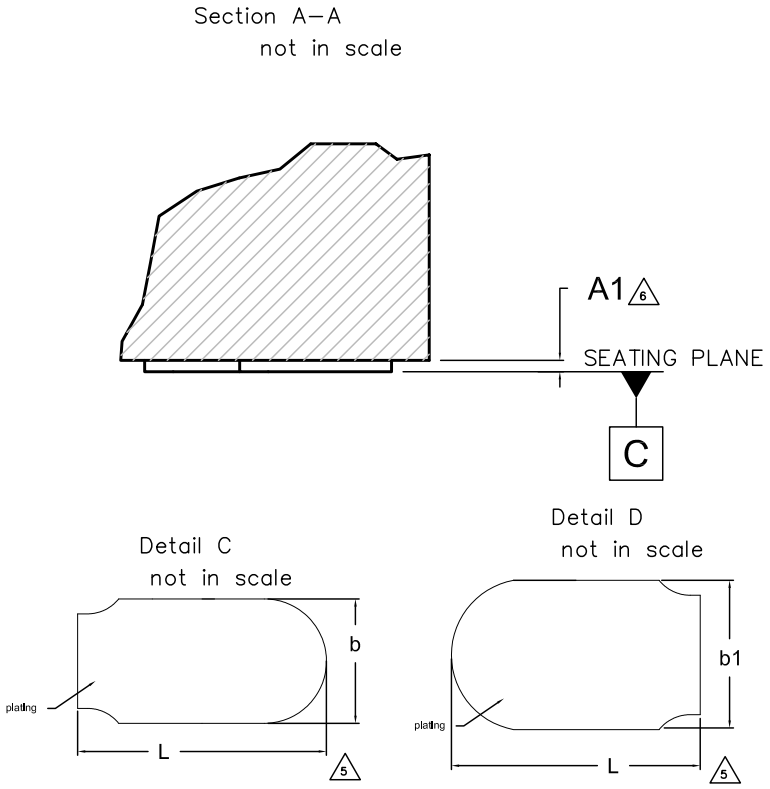


Figure 37. **TFQFPN32 suggested footprint (measured in mm)**

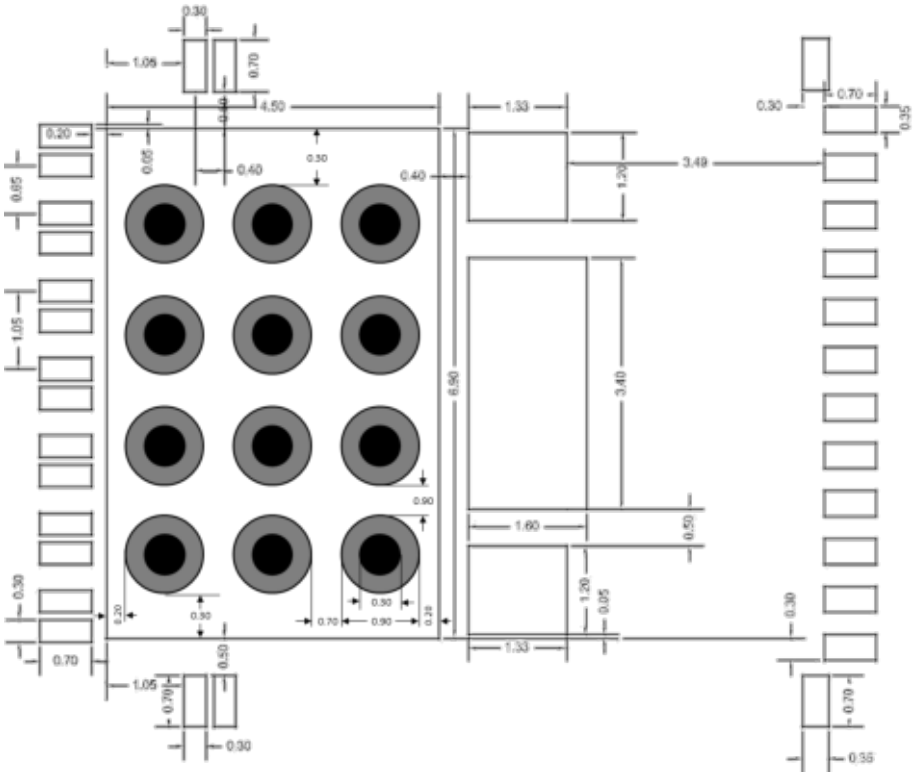


Table 19. TFQFPN32 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.95	1.00	1.05
A1	0	-	0.05
A2	-	0.20 REF	-
b (1)	0.20	0.25	0.30
b1(1)	0.25	0.30	0.35
D	10.90	11.0	11.10
E(1)	8.90	9.00	9.10
D2	4.30	4.40	4.50
E2	6.70	6.80	6.90
D3	1.40	1.50	1.60
E3	3.20	3.30	3.40
D4	1.13	1.23	1.33
E4	1.00	1.10	1.20
e	-	0.65	-
e2	-	0.40	-
e3	-	1.05	-
e4	-	3.15	-
e5	-	4.85	-
k	0	0.30	-
z1	-	0.80	-
z2	-	4.07	-
z3	-	3.80	-
z4	-	1.10	-
z5	-	1.15	-
z6	-	2.85	-
L(1)	0.45	0.50	0.55

1. *Dimensions “b” and “L” are measured on terminal plating surface.*

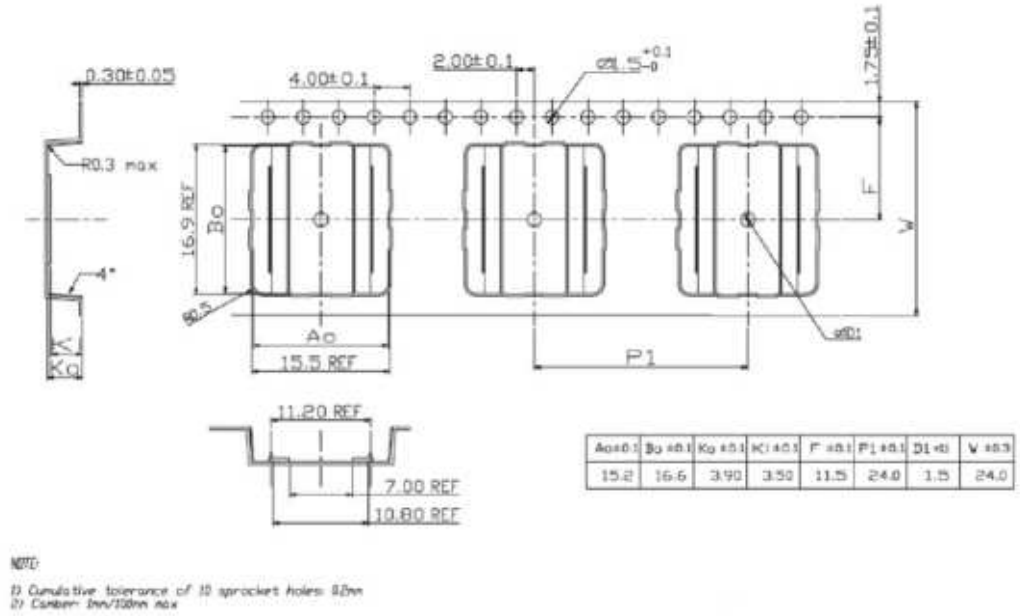
Table 20. Tolerance of form and position

Symbol	Tolerance of form and position	Definition	Notes
Aaa	0.15	The bilateral profile tolerance that controls the position of the plastic body sides. The centers of the profile zones are defined by the basic dimensions D and E.	-
Bbb	0.10	The tolerance that controls the position of the entire terminal pattern with respect to datums A and B. The center of the tolerance zone for each terminal is defined by the basic dimension "e" as related to datum's A and B.	-
Ccc	0.10	The tolerance located parallel to the seating plane in which the top surface of the package must be located.	-
ddd	0.08	The tolerance that controls the position of the terminals to each other. The centers of the profile zones are defined by basic dimension "e".	This tolerance is normally compounded with tolerance zone defined by bbb.
eee	0.08	The unilateral tolerance located above the seating plane where in the bottom surface of all terminals must be located.	This tolerance is commonly known as the "coplanarity" of the package terminals.
fff	0.10	The tolerance that controls the position of the exposed metal heat feature. The center of the tolerance zone will be datum's defined by the centerlines of the package body.	-
REF	-	-	No tolerance for A2

14 Packing information

14.1 PowerSO-36 packing information

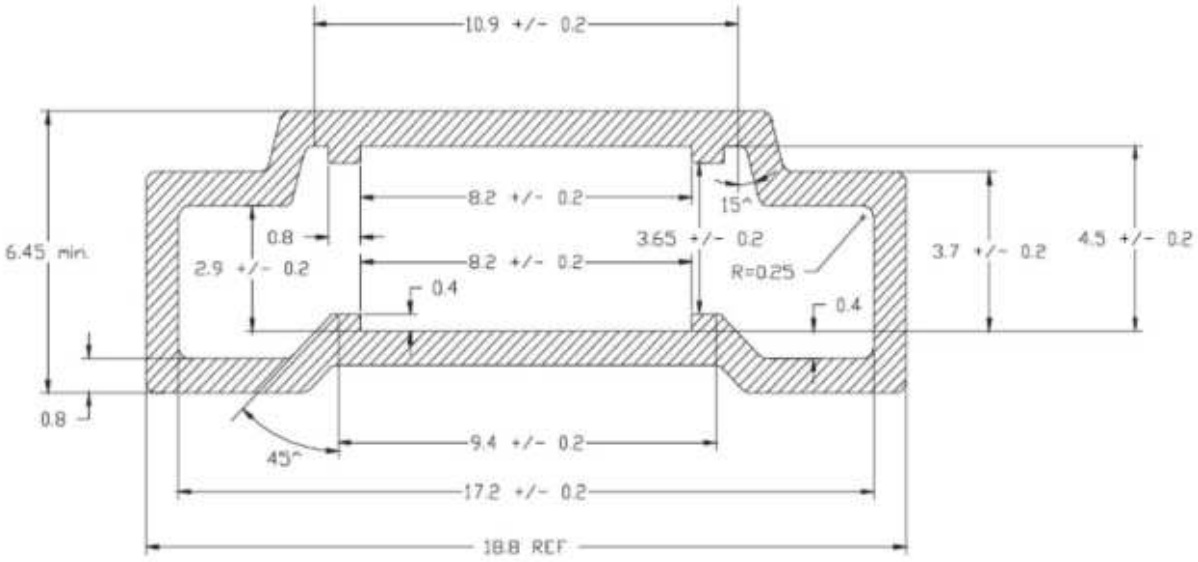
Figure 38. **PowerSO-36 carrier tape**



Ao±0.1	Bo ±0.1	Ko ±0.1	Ki ±0.1	F ±0.1	P1 ±0.1	Di ±0	W ±0.3
15.2	16.6	3.90	3.50	11.5	24.0	1.5	24.0

NOTE:
1) Cumulative tolerance of 10 sprocket holes: ±2mm
2) Camber: 1mm/100mm max

Figure 39. **PowerSO-36 shipping tube**



14.2 TFQFPN32 packing information

Figure 40. **Tape and reel packing method concept**

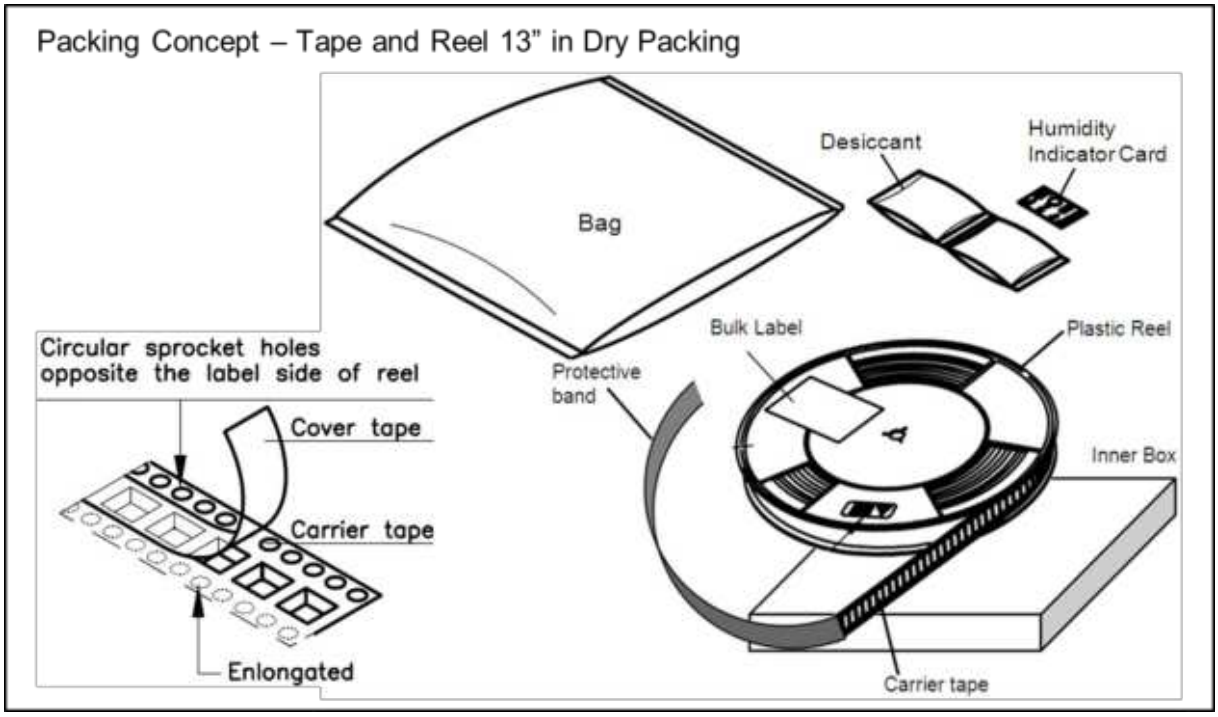


Figure 41. **Winding direction**

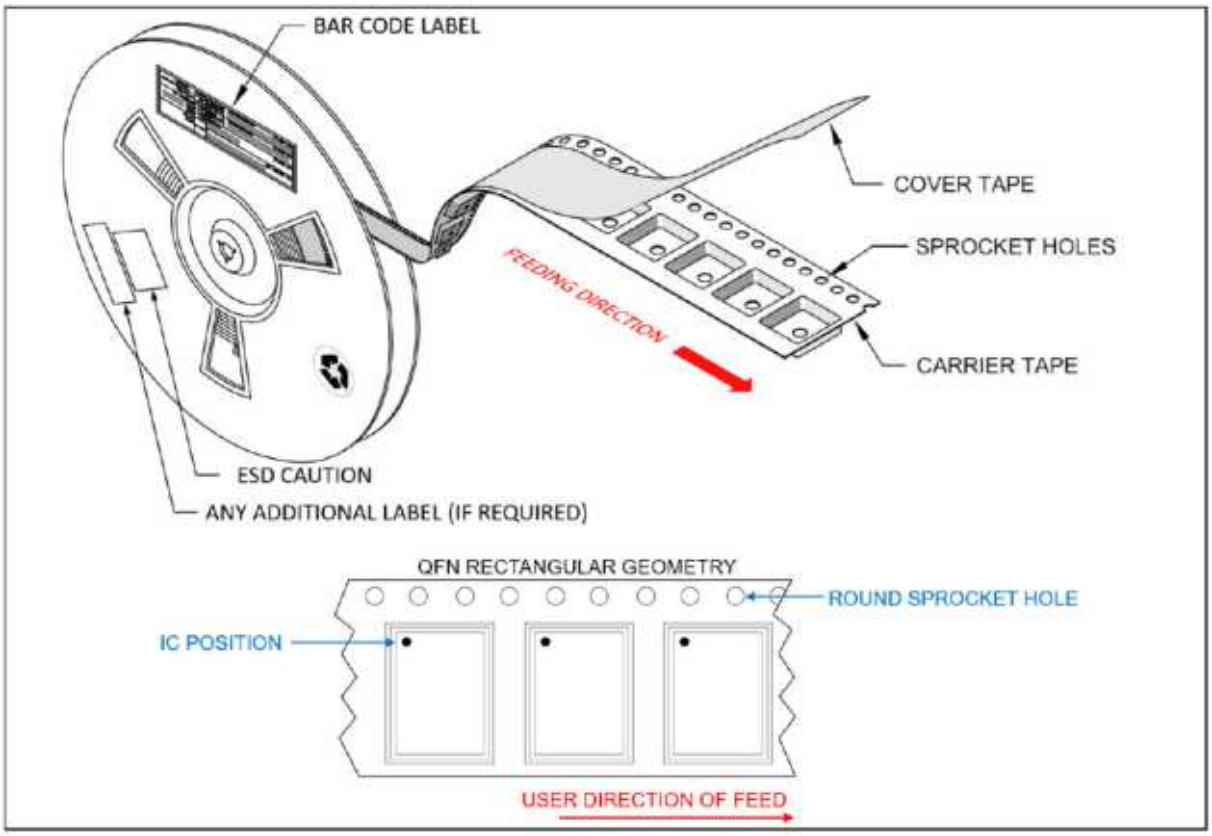
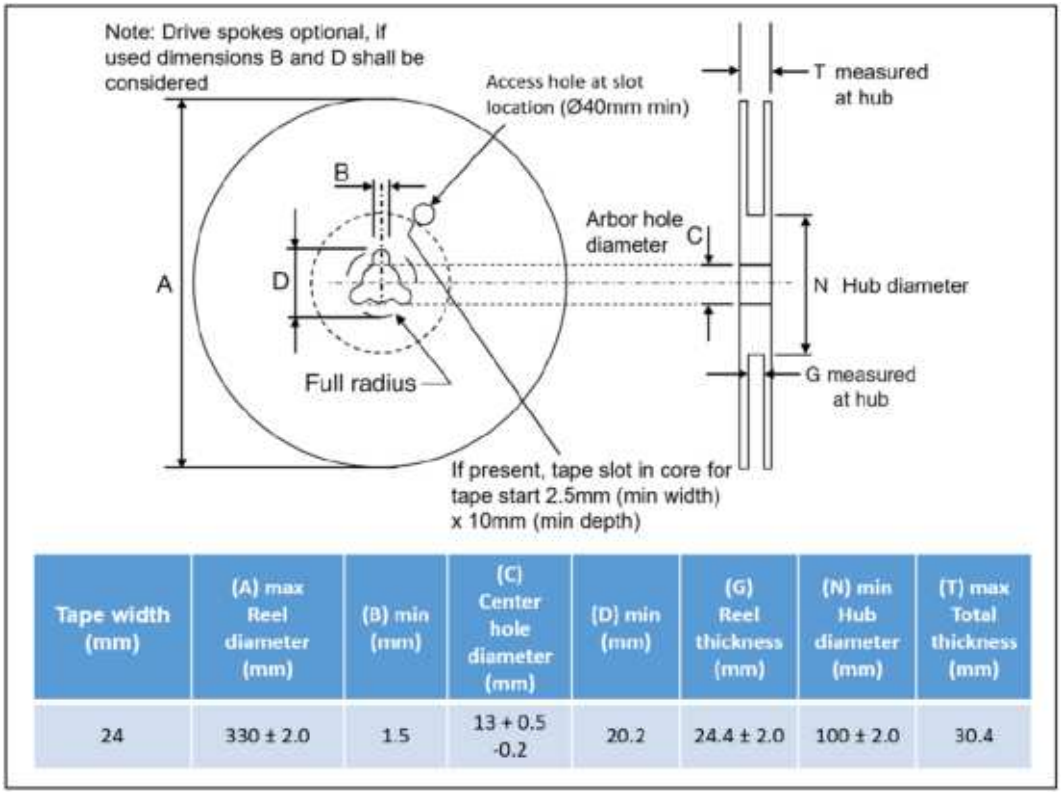
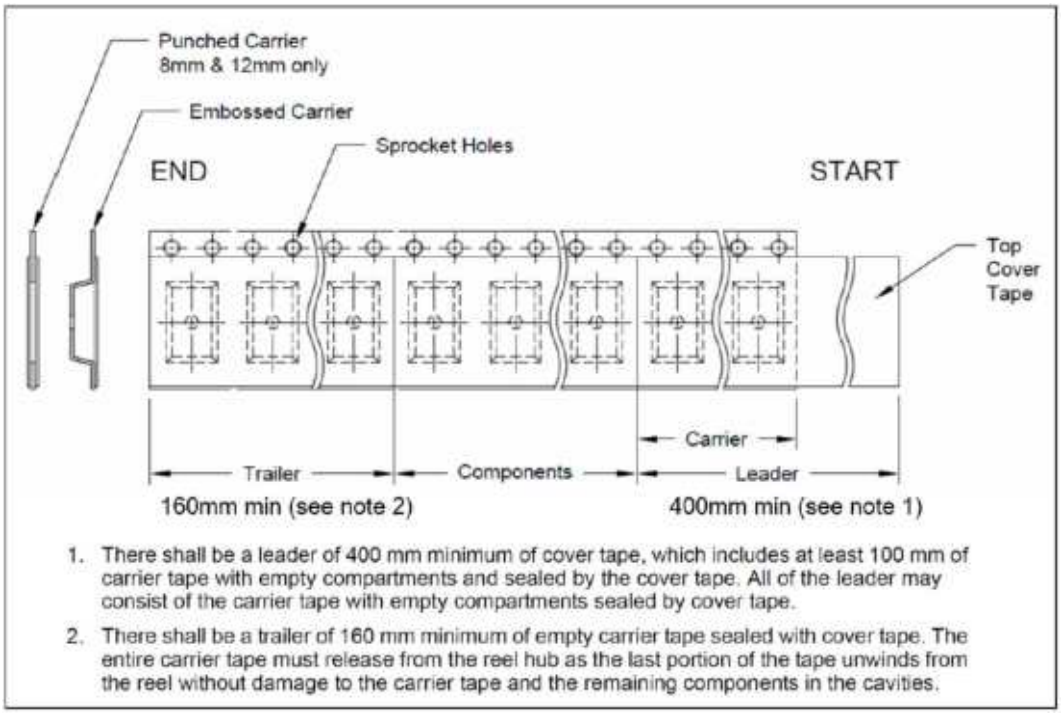


Figure 42. **Reel dimensions (as per EIA-481 specification)**



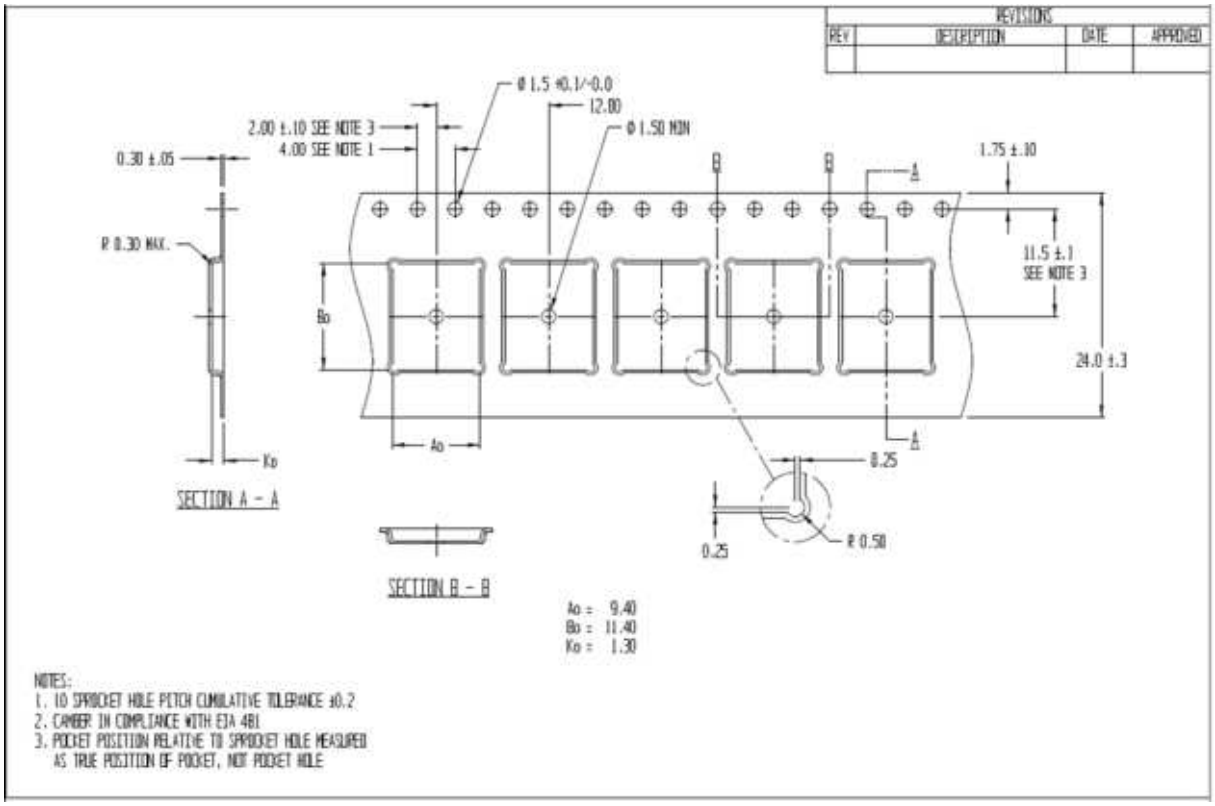
Tape width (mm)	(A) max Reel diameter (mm)	(B) min (mm)	(C) Center hole diameter (mm)	(D) min (mm)	(G) Reel thickness (mm)	(N) min Hub diameter (mm)	(T) max Total thickness (mm)
24	330 ± 2.0	1.5	13 + 0.5 -0.2	20.2	24.4 ± 2.0	100 ± 2.0	30.4

Figure 43. **Leader and Trailer dimensions (as per EIA-481 specification)**



1. There shall be a leader of 400 mm minimum of cover tape, which includes at least 100 mm of carrier tape with empty compartments and sealed by the cover tape. All of the leader may consist of the carrier tape with empty compartments sealed by cover tape.
2. There shall be a trailer of 160 mm minimum of empty carrier tape sealed with cover tape. The entire carrier tape must release from the reel hub as the last portion of the tape unwinds from the reel without damage to the carrier tape and the remaining components in the cavities.

Figure 44. **TFQFPN32 carrier tape**



15 Ordering information

Table 21. **Ordering information**

Part number	Package	Packaging
ISO808	PowerSO-36	Tube
ISO808-1	PowerSO-36	Tube
ISO808TR	PowerSO-36	Tape and reel
ISO808TR-1	PowerSO-36	Tape and reel
ISO808QTR	TFQFPN32	Tape and reel
ISO808QTR-1	TFQFPN32	Tape and reel

Revision history

Table 22. **Document revision history**

Date	Revision	Changes
21-Dec-2022	1	Initial release.
12- Sep-2023	2	Throughout the document added reference to TFQFPN32 package : changed Section Cover image; updated table in Section Product status link / summary; updated Section Features with ISO808Q/ISO808Q-1; updated first row in Description; added Figure 3; updated Table 1; updated Table 2; updated Table 3; updated Table 6, Table 11 and Table 12; deleted Table 14 in Section 6.1; added Section 6.3.1 and Section 6.5; updated Figure 18, Figure 19, Figure 20, Figure 21, Figure 22, Figure 23, Figure 25, Figure 26, Figure 29; added Figure 30; added Section 13.2, Section 14.2; updated Table 21.
22-Dec-2023	3	Added reference to safety limits certification according to IEC 60747-17 in front page and Table 13. Replaced Figure 3 and added a new row in Table 1. In Table 3 added a footnote regarding the maximum power dissipation based on the package version.
18-Mar-2024	4	Fixed typo on VDE number in the front page
04-Sep-2024	5	Fixed value of T_{JR} parameter in Table 6
24-Jul-2025	6	Changed Ipeak value in Table 6

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