TN1243
Technical note

Notes about Over Current Recovery mode in L99DZ100G/P

Introduction

All the embedded outputs of the L99DZ100G(P), from OUT1 to OUT15 and OUT_HS, come with the Over Current protection (latch); this feature is enabled by default. For the 9 outputs from OUT1 to OUT8 and OUT_HS, besides the Over Current protection feature, a mode called Over Current Recovery (OCR) or Auto Recovery is implemented.

Scope of this Technical Note is to give an overview of the Over Current Recovery mode, detailing the timing parameters involved in this mechanism in order to provide detailed information about that Protection mechanism (see *Section Appendix A: References*).

Contents

List of tables

List of figures

1 The Over Current Recovery mode

The Over Current Recovery allows to automatically switch ON the Outputs that have been switched OFF after an Over Current detection; this method is needed when loads with start-up currents higher than the Over Current limits need to be driven.

If the outputs are not configured in Over Current Recovery mode, once the load current reaches the Over Current threshold, after the time interval T_{FOC}[a], the status bit OUTx_OC (SR 3) is latched and the driver is switched OFF too; in this case the microcontroller has to Read & Clear the according status bits in order to reactivate the corresponding output driver.

If the outputs (from OUT1 to OUT8 and OUT_HS) are configured in Over Current Recovery mode, once the Over Current condition is detected (i.e. the load current reaches the Over Current threshold), the corresponding driver is switched OFF and hence automatically switched ON after a certain time interval.

The Over Current Recovery mode can be individually enabled for a given output, i.e. for each of the Half Bridges (OUT_1, .. , OUT6) and for each of the High Side drivers (OUT7, OUT8 and OUT_HS) by setting the corresponding OUTx_OCR (CR7) bit.

The Activation sequence of a specific Output driver (switch OFF / switch ON) can be seen as composed by the following 3 timings (see *Figure 1* and *Figure 2*):

- $T_{blanking}$
- T_{ocr}
- T_{off}

The $T_{blanking}$ time,has been designed to be 40 µs (typ).

The T_{ocr} time is the filter time, i.e. current needs to be above the OC threshold for $t>T_{ocr}$ to detect an OC condition.

The T_{off} is the time interval in which the output driver is switched OFF.

The following two situations may occur:

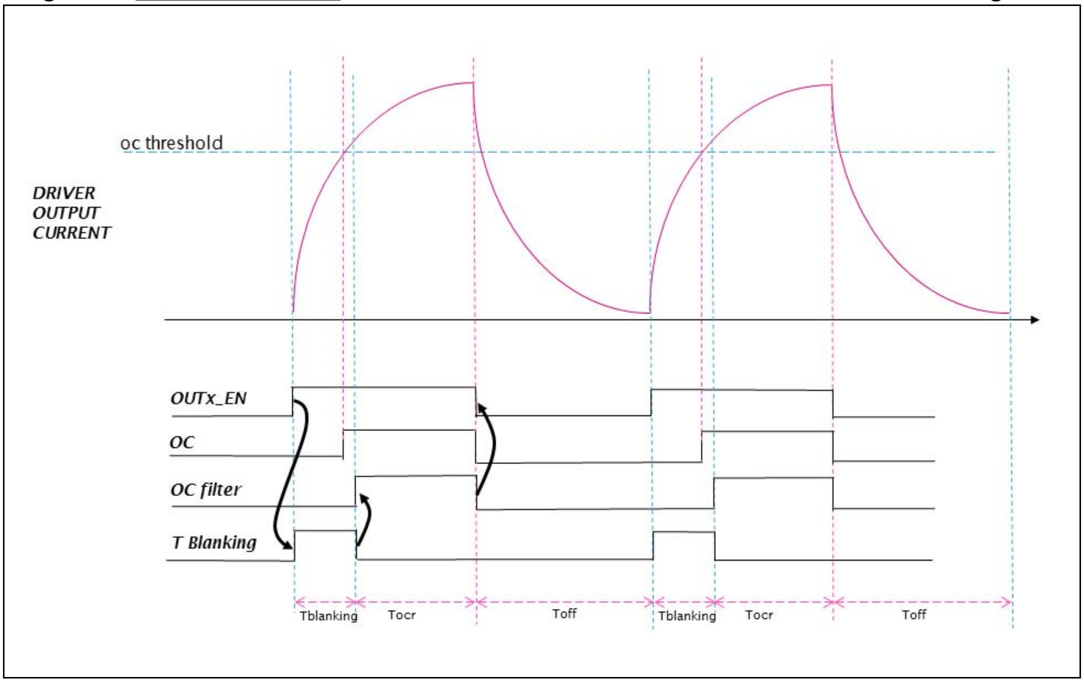
- Hard Short case: the OC threshold is reached before the end of the blanking time (*Figure 1*)
- Overload case: the OC threshold is reached after the end of the blanking time (*Figure 2*).

1.1 The Hard Short case

The Hard Short case refers to the situation in which the driver output current reaches the OC threshold before of the fixed by design $T_{blanking}$ time, as reported in *Figure 1*.

a. T_{FOC} parameter reported in Section 3.4.12 of the L99DZ100G(P) datasheet is represented in *Table 1* by the T_{ocr_hb} parameter and in *Table 2* by the T_{ocr_hs} parameter.

Figure 1. Hard Short case, the OC threshold is reached before end of blanking time



In this case:

$$T_{on} = T_{blanking} + T_{ocr} \qquad (1)$$

Being $T_{blanking}$ and T_{ocr} values guaranteed by design, both Ton and Toff are hence guaranteed by design.

The accuracy of the values reported in *Table 1* and *Table 2* depends on the accuracy of the frequency generated by the internal oscillator OSC1.

1.2 The Overload case

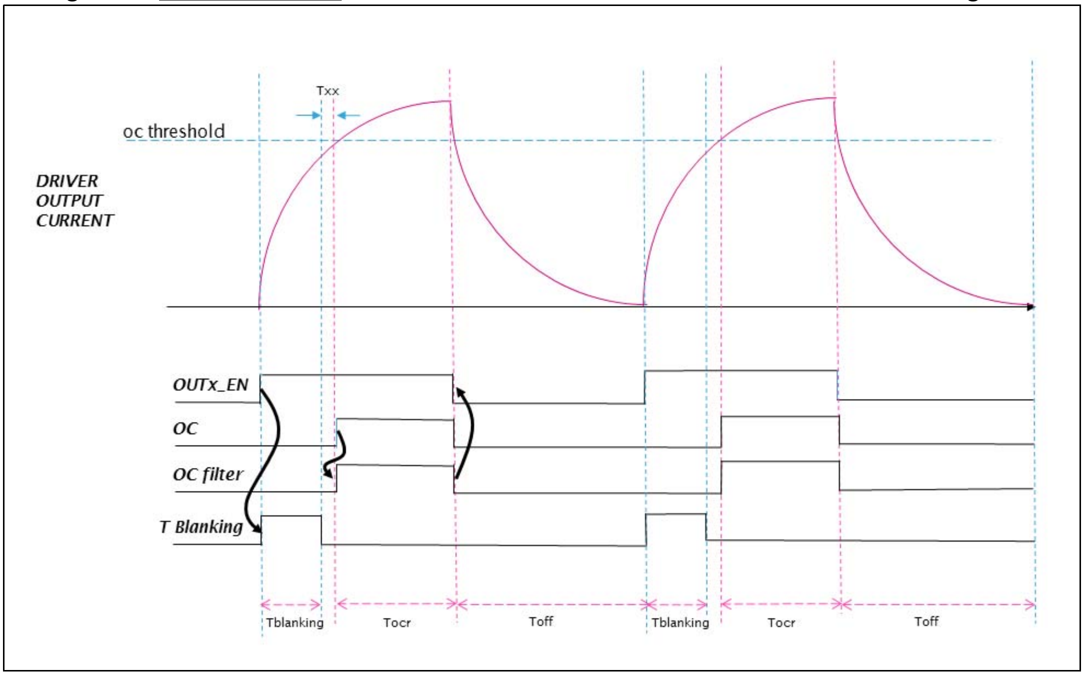
In the Overload case the time interval in which the OUTx driver is ON, T_{on} is not only composed by the $T_{blanking}$ and the T_{ocr} time intervals, but also from the time interval comprised between the end of the $T_{blanking}$ interval and the time in which the OC threshold is reached by the driver output current.

So, in the Overload case

$T_{on} = T_{blanking} + T_{ocr} + T_{xx}$ (2)

where T_{xx} is in the range [0, xx] sec (strictly depending on the overload characteristics)

Figure 2. Overload case, the OC threshold is reached after end of blanking time



That means a minimum value of the T_{on} can be guaranteed by design (the case T_{xx} = 0 and the Hard Short and Overload case are equivalent) meanwhile the maximum value of T_{on} depends on the load connected to the OUTx and cannot be guaranteed by design.

2 The Over Current Recovery settings

In the following tables the minimum, typical and maximum values for the $T_{blanking}$, T_{ocr} and T_{off} timing parameters are reported; *Table 1* reports the parameters for the Half Bridges and *Table 2* for the High Sides depending on the values assigned to the (HB_TON_1, HB_TON_0) and (HS_TON_1, HS_TON_0) pairs and to the OCR_FREQ bit.

Table 1. Half Bridges (OUT1, ... , OUT6) Over Current Recovery settings

Symbol	Parameter		Test Condition	Min.	Typ.	Max.	Unit
$T_{blanking}$			Guaranteed by Design	33	40	47	µs
T_{ocr_hb}	Over Current Filter Time for Half Bridges	HB_TON = 00	Guaranteed by Design	53	64	75	µs
		HB_TON = 01		40	48	56	µs
		HB_TON = 10		33	40	47	µs
		HB_TON = 11		26	32	38	µs
T_{off_hb}	OFF Time for Half Bridges	HB_TON = 00 & OCR_FREQ = 0	Guaranteed by Design	398	480	562	µs
		HB_TON = 00 & OCR_FREQ = 1		192	232	272	µs
		HB_TON = 01 & OCR_FREQ = 0		305	368	431	µs
		HB_TON = 01 & OCR_FREQ = 1		146	176	206	µs
		HB_TON = 10 & OCR_FREQ = 0		252	304	356	µs
		HB_TON = 10 & OCR_FREQ = 1		120	144	168	µs
		HB_TON = 11 & OCR_FREQ = 0		218	264	310	µs
		HB_TON = 11 & OCR_FREQ = 1		106	128	150	µs

Table 2. High Sides (OUT7, OUT8 and OUT_HS) Over Current Recovery settings

Symbol	Parameter		Test Condition	Min.	Typ.	Max.	Unit
$T_{blanking}$			Guaranteed by Design	33	40	47	µs
T_{ocr_hs}	Over Current Filter Time for High Sides	HS_TON = 00	Guaranteed by Design	53	64	75	µs
		HS_TON = 01		40	48	56	µs
		HS_TON = 10		33	40	47	µs
		HS_TON = 11		26	32	38	µs
T_{off_hs}	OFF Time for High Sides	HS_TON = 00 & OCR_FREQ = 0	Guaranteed by Design	398	480	562	µs
		HS_TON = 00 & OCR_FREQ = 1		192	232	272	µs
		HS_TON = 01 & OCR_FREQ = 0		305	368	431	µs
		HS_TON = 01 & OCR_FREQ = 1		146	176	206	µs
		HS_TON = 10 & OCR_FREQ = 0		252	304	356	µs
		HS_TON = 10 & OCR_FREQ = 1		120	144	168	µs
		HS_TON = 11 & OCR_FREQ = 0		218	264	310	µs
		HS_TON = 11 & OCR_FREQ = 1		106	128	150	µs

Basing on the values reported in *Table 1* and *Table 2* the Activation sequence, involved in the switch OFF / switch ON of a certain OUT, can be computed.

3 Conclusion

The Technical Note describes the Over Current Recovery mode by which the L99DZ100G(P) device can drive loads with start-up current higher than the overcurrent limits, highlighting the time intervals involved in this mechanism; how the activation / deactivation of the Output driver works has been here detailed.

Appendix A References

L99DZ100G/P datasheet rev4 (DocID029077 Rev 4)

Revision history

Table 3. Document revision history

Date	Revision	Changes
13-Jan-2017	1	Initial release.