Self powered digital input current limiter
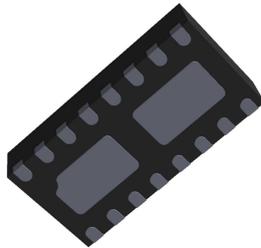
QFN 2X4-16L
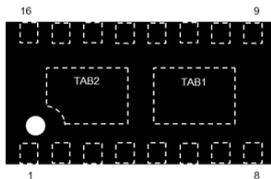
Features

- 2 isolated channels device
- No power supply needed
- Digital input current limitation
- Glitch filter for EMC robustness
- High side/ Low side compatible
- Input are reverse plugin compatible
- Direct opto-coupler or 3.3 V LVTTL output
- Operating temperature range from – 30 °C to 125 °C
- QFN 2 x 4 – 16L - 500 µm pitch
- Exceeds IEC 61000-4-2 level 4 standard:
    – ±4 kV (air discharge)
    – ±2 kV (contact discharge)
- IEC61131-2 type 3
- IEC 61508

Applications

Where current limitation is required in factory automation application:

- Programmable logic controller
- Remote input module

Description

The CLT03-2Q3 is a digital input current limiter which does not require external power supply and is powered through inputs. The product is housed in a QFN 2 x 4 -16L and is high side, low side compatible and as well as reverse plugin compatible.

The CLT03-2Q3 can drive either opto-coupler or 3.3V LVTTL circuit.

Product status link
CLT03-2Q3

Product summary	
Order code	CLT03-2Q3
Package	QFN 2X4-16L
Packing	Tape and reel

DS12302 - **Rev 2** - **December 2018**
For further information contact your local STMicroelectronics sales office.

www.st.com

1 Circuit block diagram

Figure 1. One line diagram

1.1 I/O pin description

Table 1. Pins name, type and description

Name	Pin #	Type	Description
INA1 / INA2	7 / 3	Signal input	Logic input with current limitation
INATTL1 / INATTL2	6 / 2	Signal input	Logic input with current limitation for non-isolated configuration
INB1 / INB2	8 / 4	Signal input	Logic input with current limitation
TP1 / TP2	9 / 14	Test input	Test pulse input for capacitor
VBUF1 / VBUF2	10 / 15	Power output	Buffer capacitor
OUTN1	5 / TAB1	Ground	Logic output ground (channel 1 output ground)
OUTN2	13 / TAB2	Ground	Logic output ground (channel 2 output ground)
OUTP1 / OUTP2	11 / 16	Signal output	Data output
PD1/PD2	12 / 1	Ground	Logic output ground with pull down resistor (non-isolated mode)

Figure 2. QFN 2x4-16L pinout (top view)
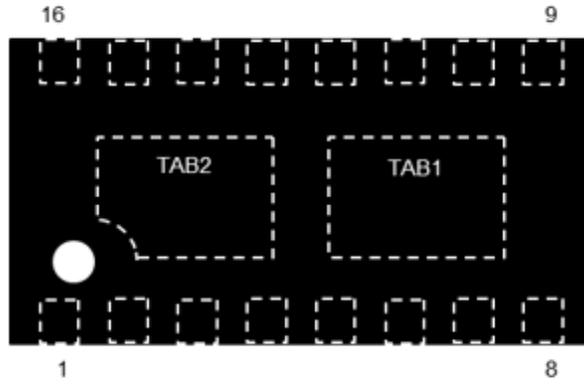
2   Characteristics

Table 2. Absolute maximum ratings

Symbol	Parameter name		Value	Unit
V_{PP}	Peak pulse voltage	HBM	2	kV
V_{PP} [1][2]	Peak pulse voltage (pins INA, INATTL & INB), IEC 61000-4-2 (contact)		2	kV
V_{IN}	Maximum input voltage for 1 minute		-60 to 60	V
V_{ISO}	Isolation between channel 1 and 2		230	V_{AC}
T_j	Maximum operating ambient temperature		175	°C
T_{STG}	Storage temperature range		-55 to + 150	°C

1. See application schematic
2. Performance level depends on layout and environment

Table 3. Electrical characteristics (-30 °C < T_j < +125 °C, unless otherwise specified) (values)

Symbol	Description	Name	Min.	Typ.	Max.	Unit
		Input				
I_{LIM}	Input current – On state		2.5		4	mA
V_{TLH}	High to Low state input voltage			9.4	11	V
V_{THL}	Low to High state input voltage		5	7.5		V
V_{HYST}	Input triggering voltage hysteresis		1.2		2.6	V
V_{FAULT}	Fault mode threshold voltage		30	40		V
I_{FAULT}	Input current in fault region $V_{IN} > V_{FAULT}$		1		3	mA
t_{FAULT}	Fault mode triggering latency after $V_{IN} > V_{FAULT}$			25		μs
		Timing parameters				
f_{IN}	Input frequency				35	kHz
t_{PLH}	Input to output low to high propagation time[1]		2		5	μs
t_{PHL}	Input to output high to low propagation time [1]		2		5	μs
		Ouput				
I_{OUT}	On state	Isolated mode	2		4	mA
		Non-isolated mode			1	mA
	Off state	Isolated and non-isolated mode	-10		10	μA
V_{OUT}	On state	Isolated and non-isolated mode	3		3.6	V
	Off state	Isolated and non-isolated mode	-3		-0.4	V
R_{OUT}	OUTP to OUTN internal equivalent output resistance ($V_{INA} - V_{INB} = 0$)			24		kΩ
R_{PD}	OUTN to PD internal pull down resistor		2.85		4.25	kΩ

1. See rise/fall time measurement section

3 U-I operation description

Figure 3. **Input U-I operation**
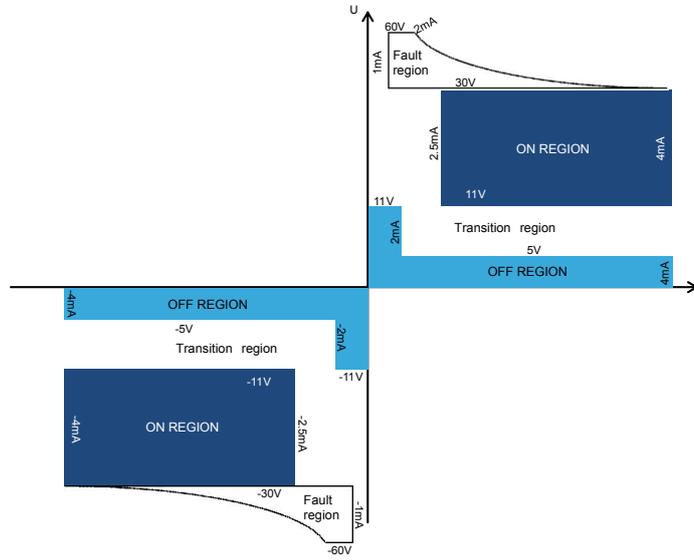
Figure 4. **Output U-I operation**
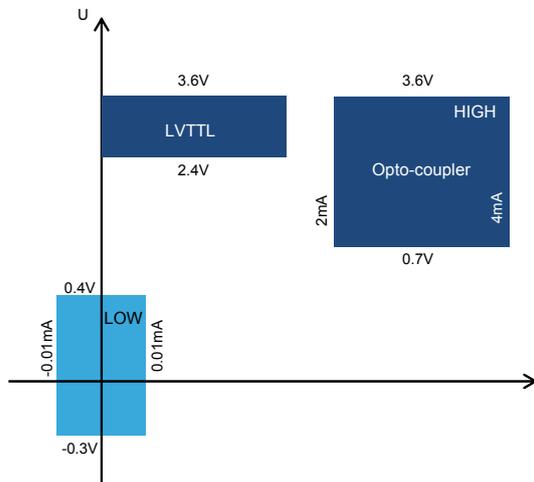
4 Fault mode description

Fault mode is a working mode of CLT03-2Q3 occuring when input voltage is higher than 30 V minimum (V_{FAULT}). In normal conditions, the system is not meant to operate in this area. However, the IEC 61508 requires that systems should survive up to 1 minute with voltages up to 60 V.

When $V_{IN} > V_{FAULT}$, the impacted channel enters into fault mode after a certain time defined as t_{FAULT}. When fault mode is activated, the input current limitation is reduced down to I_{FAULT}. In this mode, the channel output is not functional anymore.

CLT03-2Q3 guarantees fault mode conditions up to 1 minute according to IEC 61508 standard.

5   Test pulse feature description

The built-in test pulse feature complies with the latest safety standards. Thus, it is possible to know on a regular basis that CLT03-2Q3 is still working properly.

In order, to enable the Test Pulse feature a capacitor should be connected between TP and OUTN pins. When such a capacitor is connected, the OUTP value will be forced to low state every TP period (P_{TP}) for a define test pulse width (t_{TP}). TP period is equal to 256 times t_{TP}.

The frequency of the "Test Pulse low state" is managed through the capacitor value. In order to disable this feature, TP should be shorted to OUTN.

Table 4. Test pulse parameters

| Symbol	Description	Min.	Typ.	Max.	Unit
f_{TP}	PTest pulse frequency	4.1		219	kHz
C_{TP}	External capacitor range	100		4700	pF
t_{TP}	Test pulse width		$1/f_{TP}$		ms
P_{TP}	Test pulse period		$256 \times t_{TP}$		
Δf_{TP}	Test pulse frequency variation (out of capacitance variation)	-60		+60	%

Figure 5. Test Pulse parameters description
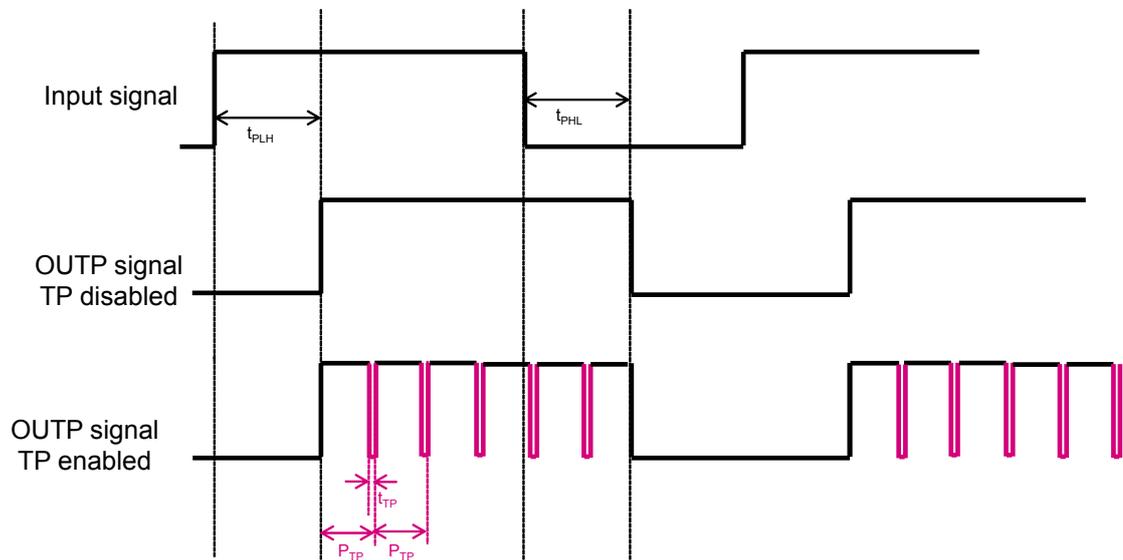
Figure 6. f$_{TP}$ versus C$_{TP}$ value
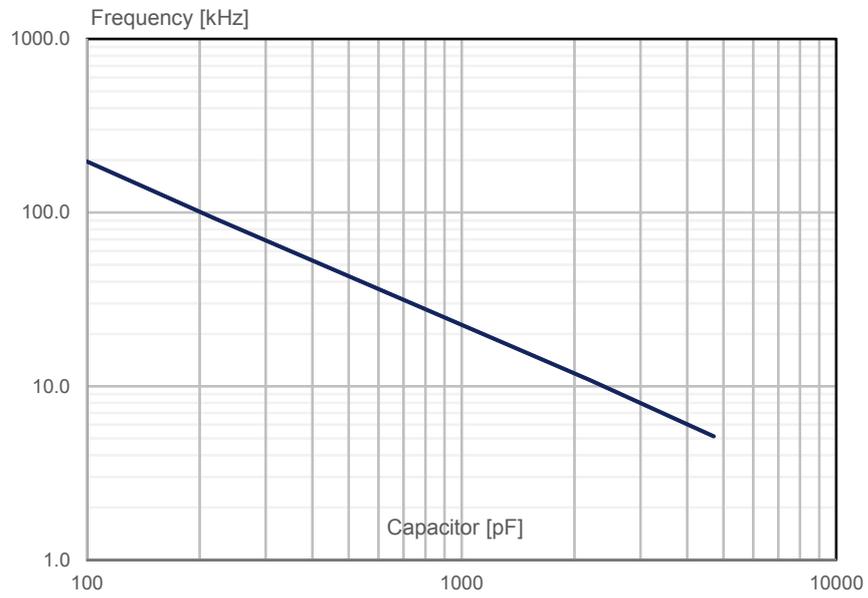
# 6   Propagation time measurement description

Figure 7. t_{PLH} and t_{PHL} test condition
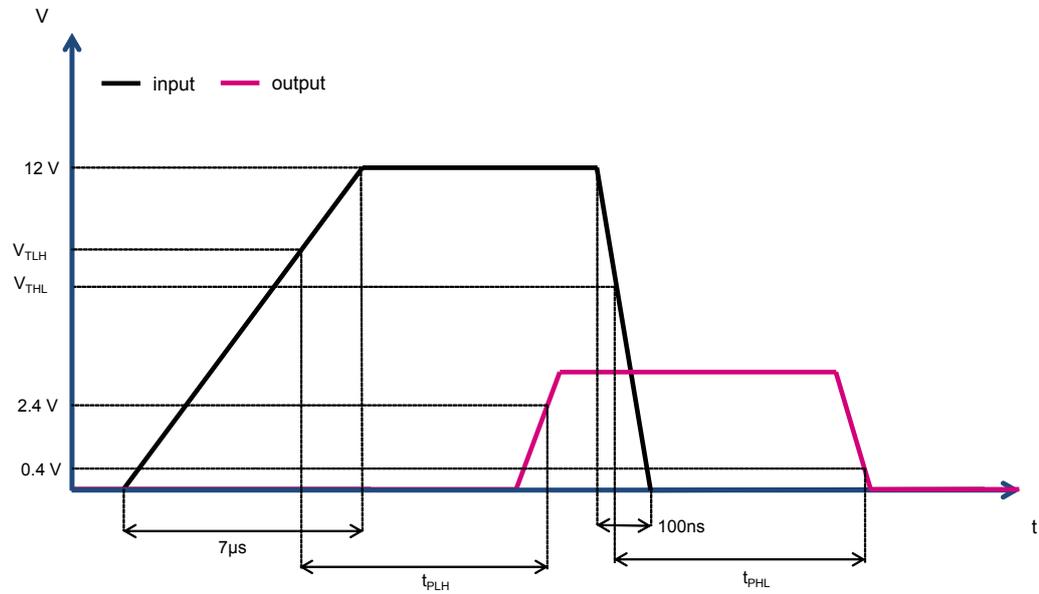
Note: *for t_{PLH} and t_{PHL} measurement, V_{TLH} and V_{THL} should be determined for each sample. Timing measurement should be done with these sample specific V_{TLH} and V_{THL} thresholds.*

7 Simplified application schematic

Table 5. Configuration compatibility of CLT03-2Q3

Symbol	High Side	Low Side
Isolated	OK	OK
Non-isolated	OK	KO

Each circuit given in this section is given for 1 line only.

Figure 8. High side – isolated configuration
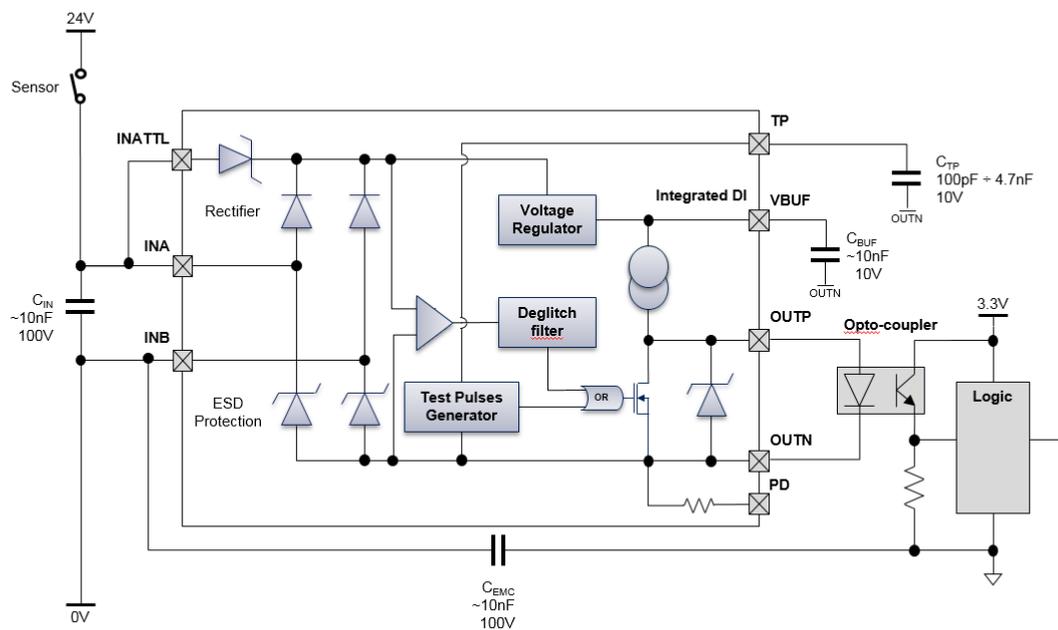
Figure 9. Low side – isolated configuration
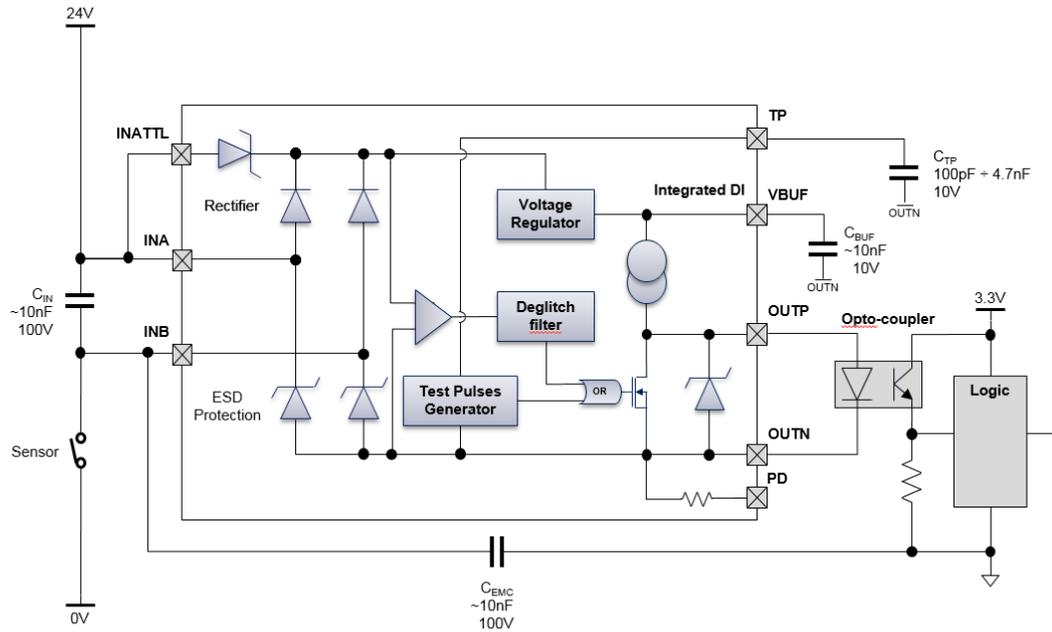
Figure 10. High side – non-isolated configuration
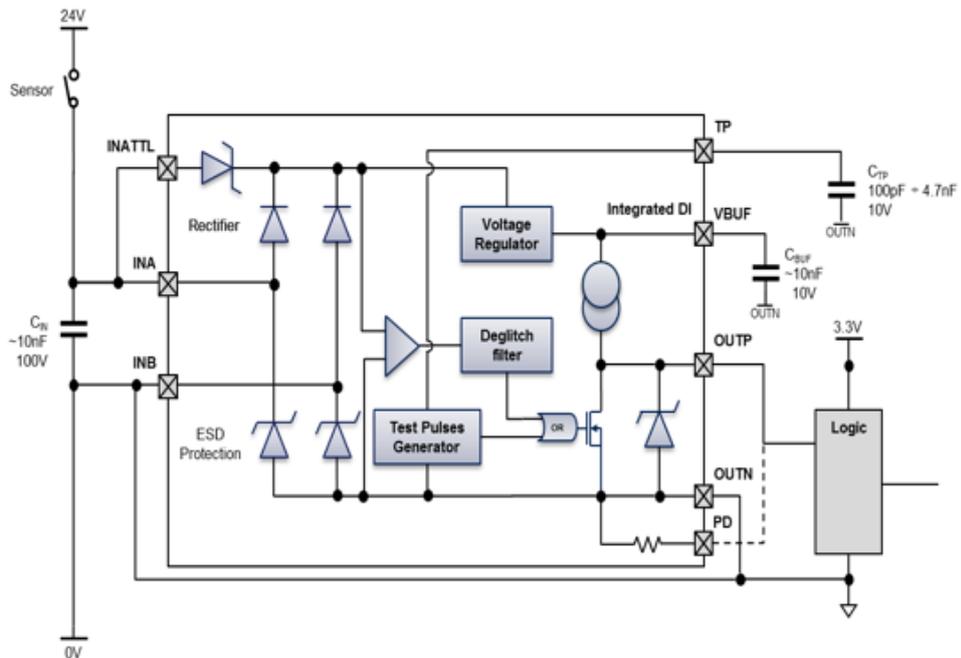
*Note:* *OUTP to PD connection is optional.*

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 QFN 2X4 -16 package information

Figure 11. QFN 2X4-16L package outline
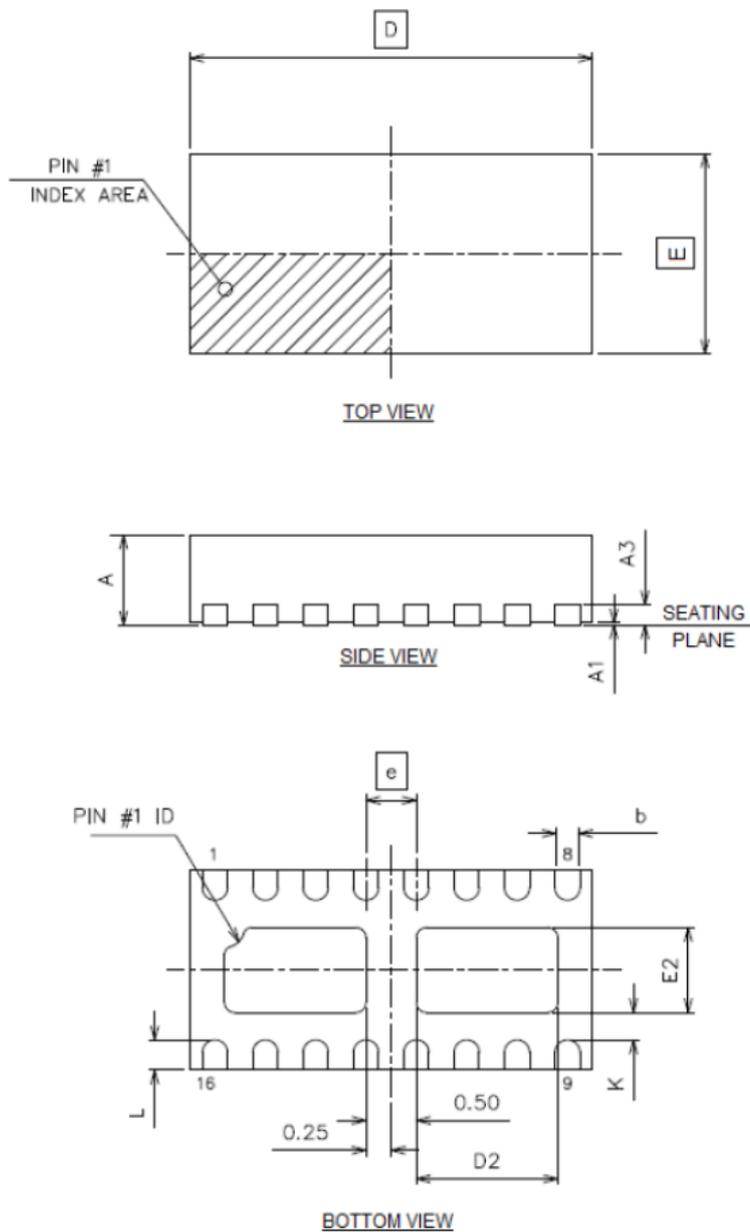
Table 6. **QFN 2X4-16L package mechanical data**

| Ref.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.80	0.90	1.00	0.0315	0.0354	0.0394
A1		0.02	0.05		0.0008	0.0020
A3		0.20			0.008	
B	0.18	0.25	0.30	0.0071	0.0100	0.0118
D	3.95	4.00	4.05	0.1555	0.1574	0.1594
E	1.95	2.00	2.05	0.0768	0.0787	0.0807
D2	1.25	1.40	1.51	0.0492	0.0551	0.0594
E2	0.70	0.85	0.95	0.0276	0.0334	0.0374
e		0.50			0.0197	
K	0.15			0.0059		
L	0.20	0.30	0.40	0.0079	0.0118	0.0157

1. Values in inches are converted from mm and rounded to 4 decimal digits.

Figure 12. **Footprint recommendations**

Figure 13. **Marking**
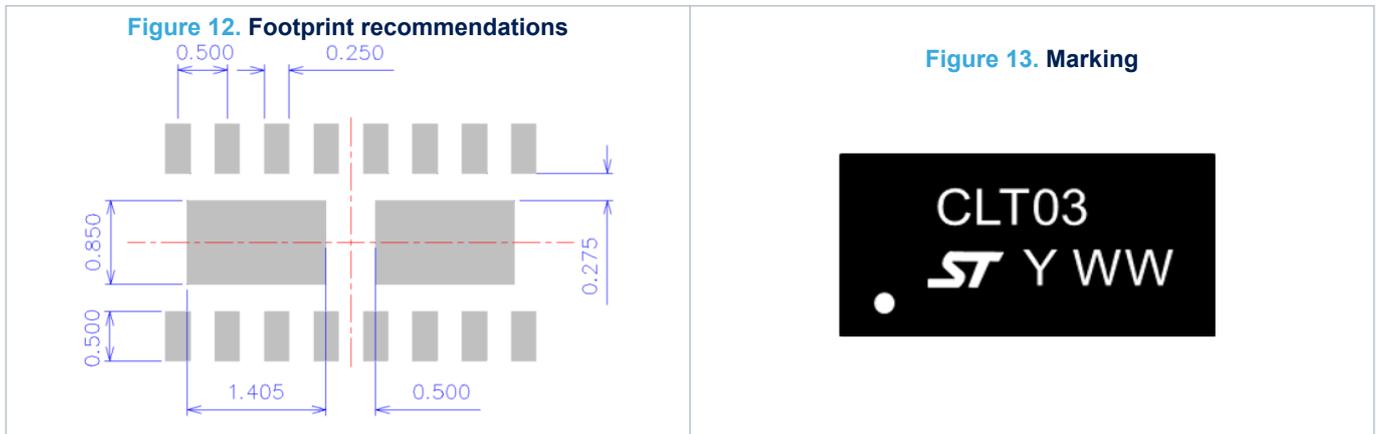
Figure 14. Tape and reel outline
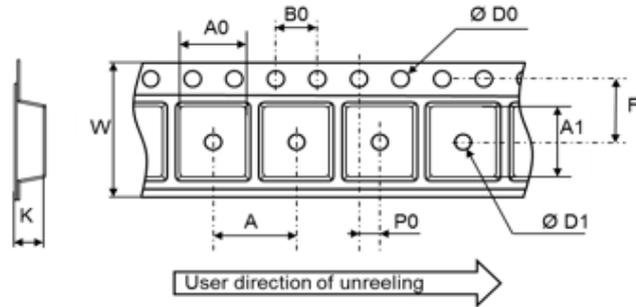
Note: Pocket dimensions are not on scale
         Pocket shape may vary depending on package
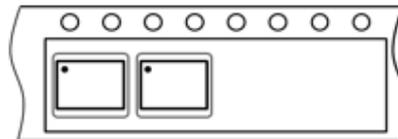
Table 7. Tape and reel mechanical data

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
A	3.9	4	4.1
A0	2.2	2.25	2.3
A1	4.2	4.25	4.3
B0	3.9	4	4.1
ØD0	1.5		1.6
ØD1	1		
F	1.65	1.75	1.85
K	1.10	1.15	1.20
P0	1.95	2	2.05
W	11.9	12	12.3

9 Reflow profile

Figure 15. ST ECOPACK® recommended soldering reflow profile for PCB mounting
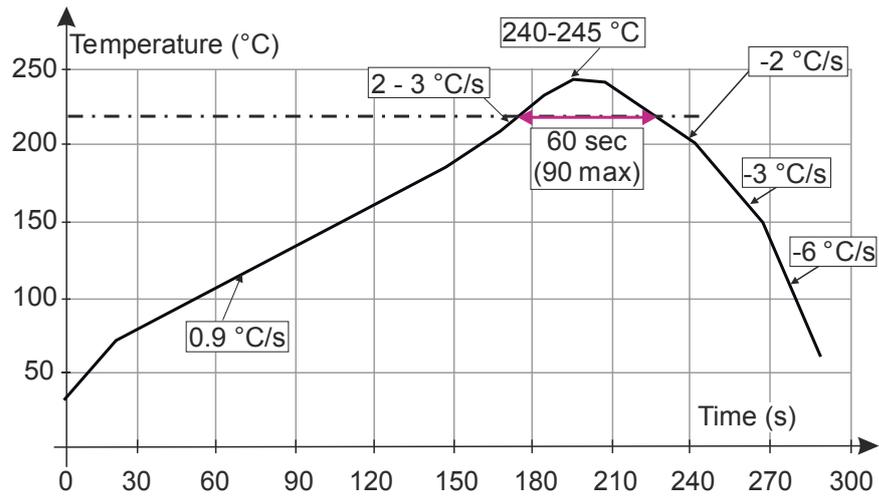
*Note:*   *Minimize air convection currents in the reflow oven to avoid component movement.*

Note: *Maximum soldering profile corresponds to the latest IPC/JEDEC J-ST-020.*

10   Ordering information

Figure 16. Ordering information scheme

CLT   03   –   2   Q   3

Current limiter

03 : Version

2 : 2 channels

Q : QFN

3 : 3 mA current limitation typ.
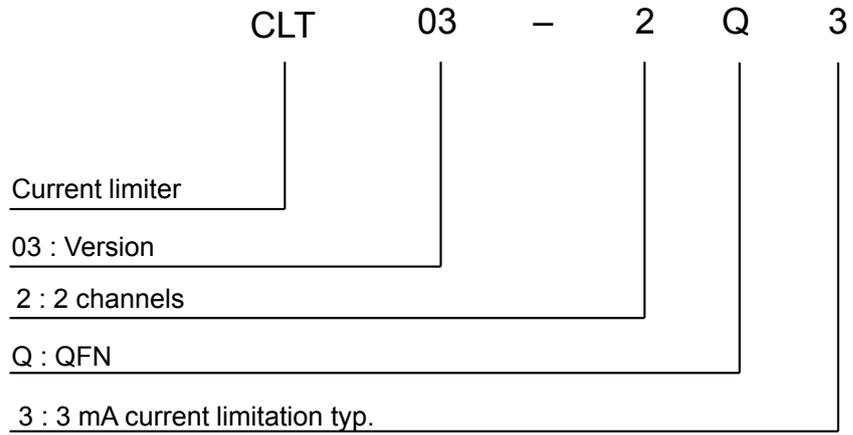
Table 8. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
CLT03-2Q3	CLT03	QFN 2 x 4 – 16L	20 mg	3000	Tape and reel

Revision history

Table 9. Document revision history

Date	Revision	Changes
18-Dec-2017	1	Initial release.
11-Dec-2018	2	Minor text change to improve readability.

IMPORTANT NOTICE – PLEASE READ CAREFULLY