

## Proximity Switch

**TCA 305  
TCA 355**

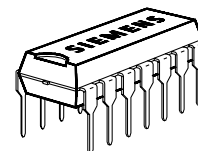
**Bipolar IC**

### Features

- Lower open-loop current consumption;  $I_s < 1 \text{ mA}$
- Lower output saturation voltage
- The temperature dependence of the switching distance is lower and compensation of the resonant circuit  $TC$  (temperature coefficient) is easier
- The sensitivity is higher, so that larger switching distances are possible and coils of a lower quality can be used
- The switching hysteresis remains constant as regards temperature, supply voltage and switching distance
- The TCA 305 even functions without external integrating capacitor. With an external capacitor (or with RC combination) good noise immunity can be achieved
- The outputs are temporarily short-circuit proof (approx. 10 s to 1 min depending on package)
- The outputs are disabled when  $V_s < \text{approx. } 4.5 \text{ V}$  and are enabled when the oscillator stabilizes (from  $V_{s \text{ min}} = 5 \text{ V}$ )
- Higher switching frequencies can be obtained
- Pb-free lead plating; RoHS compliant



**PG-DSO-8-1**



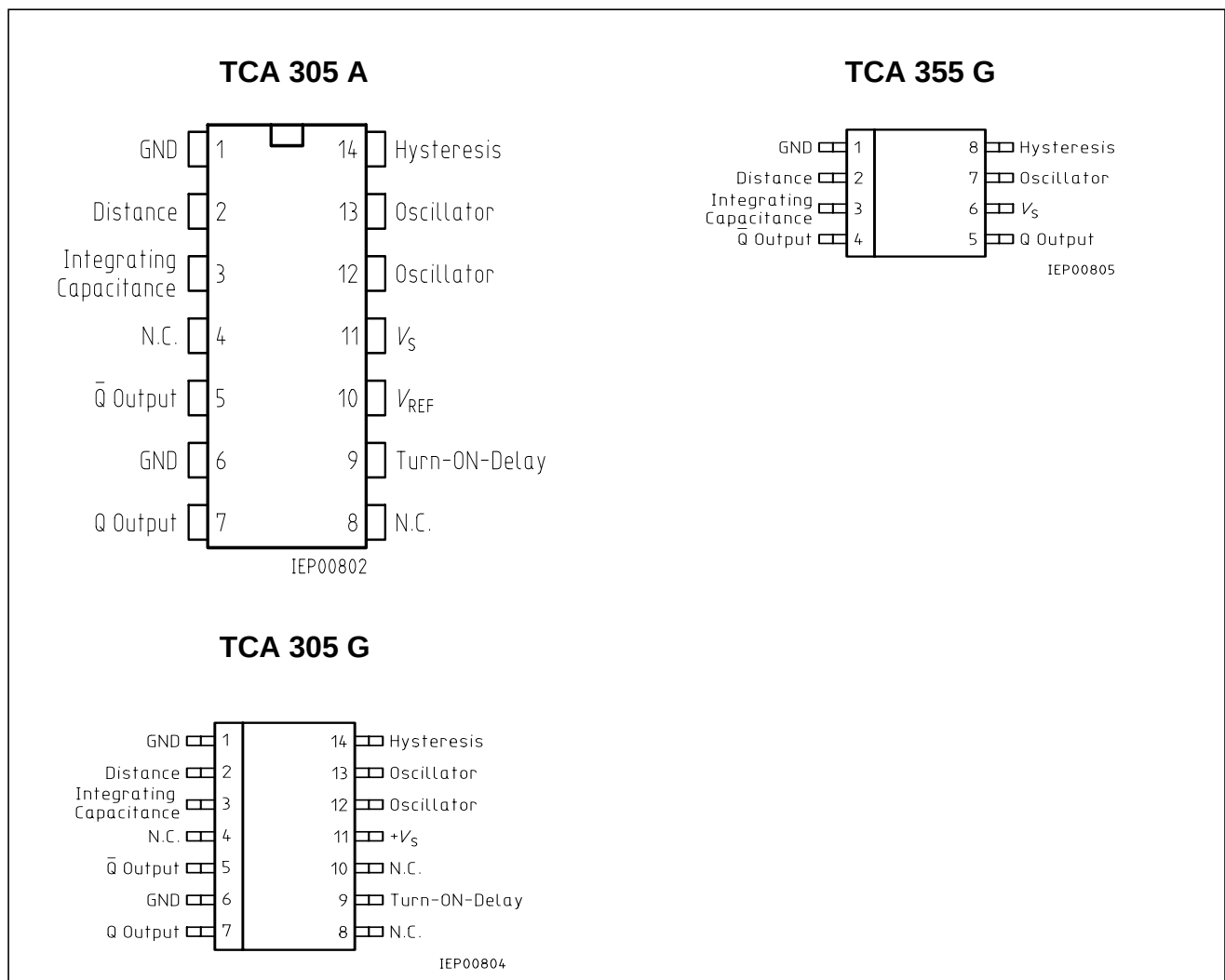
**PG-DIP-14-1**



**PG-DSO-14-1**

| Type        | Ordering Code | Package           |
|-------------|---------------|-------------------|
| ■ TCA 305 A | Q67000-A2291  | PG-DIP-14-1       |
| TCA 305 G   | Q67000-A2305  | PG-DSO-14-1 (SMD) |
| TCA 355 G   | Q67000-A2444  | PG-DSO-8-1 (SMD)  |

■ Not for new design



## Pin Configurations (top view)

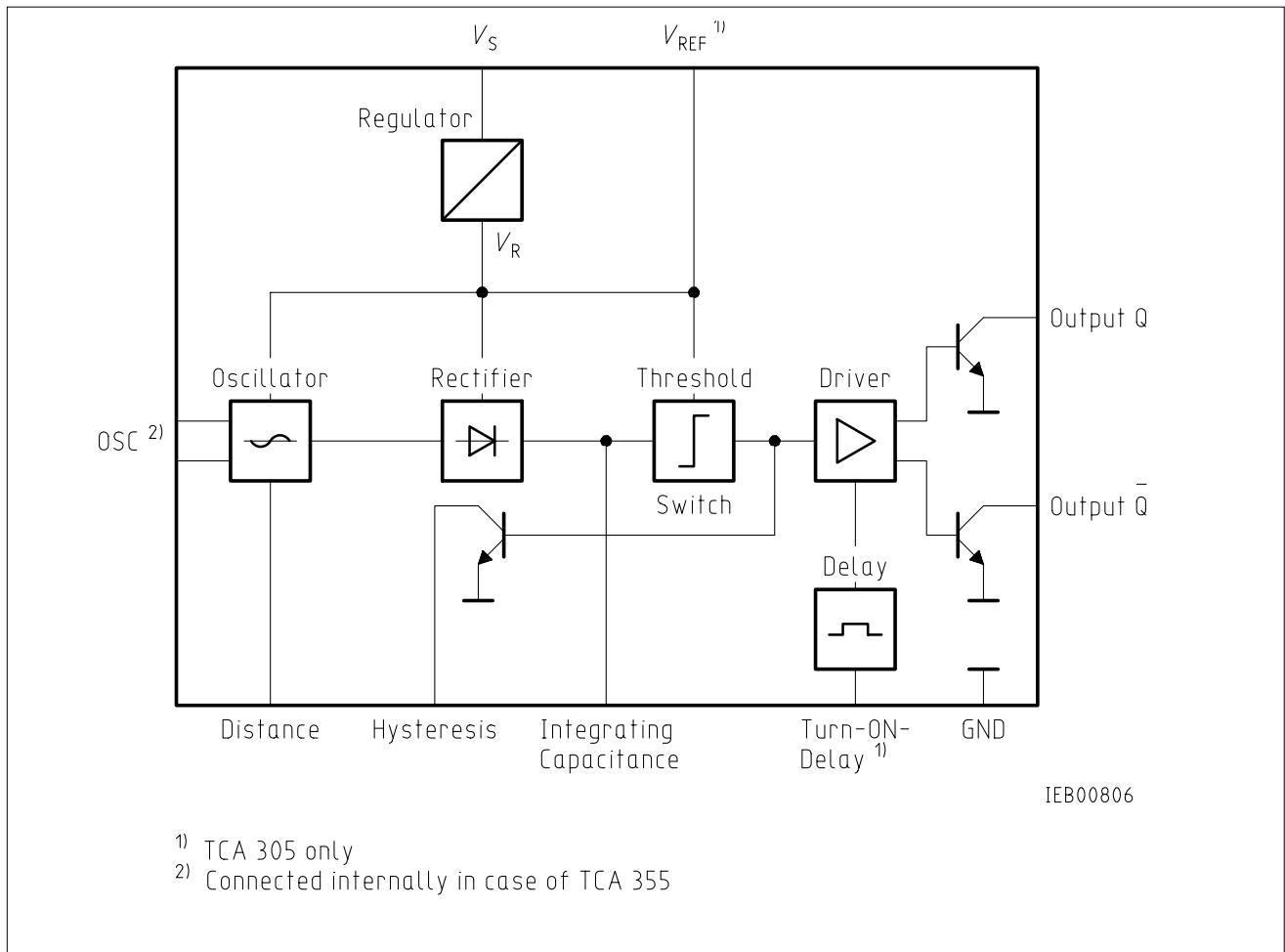
The devices TCA 305 and TCA 355 contain all the functions necessary to design inductive proximity switches. By approaching a standard metal plate to the coil, the resonant circuit is damped and the outputs are switched.

## Operation Schematic: see TCA 205

The types TCA 305 and TCA 355 have been developed from the type TCA 205 and are outstanding for the following characteristics:

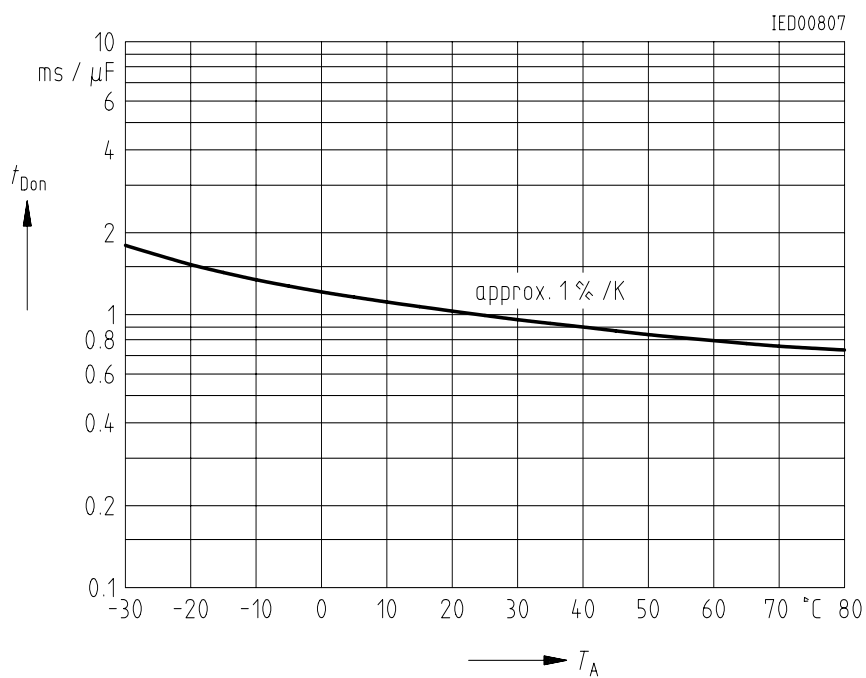
## Logic Functions

| Oscillator | Outputs |   |
|------------|---------|---|
|            | Q       |   |
| not damped | H       | L |
| damped     | L       | H |



## Block Diagram

### Standard Turn-ON Delay Referred to $T_A = 25^\circ\text{C}$



## Absolute Maximum Ratings

| Parameter                       | Symbol           | Limit Values            | Unit        |
|---------------------------------|------------------|-------------------------|-------------|
| Supply voltage                  | $V_S$            | 35                      | V           |
| Output voltage                  | $V_Q$            | 35                      | V           |
| Output current                  | $I_Q$            | 50                      | mA          |
| Distance, hysteresis resistance | $R_{Di}, R_{Hy}$ | 0                       | $\Omega$    |
| Capacitances                    | $C_i, C_D$       | 5                       | $\mu F$     |
| Junction temperature            | $T_j$            | 150                     | $^{\circ}C$ |
| Storage temperature range       | $T_{stg}$        | – 55 to 125             | $^{\circ}C$ |
| Thermal resistance              |                  |                         |             |
| system - air TCA 305 A          | $R_{th SA}$      | 85 (135) <sup>2)</sup>  | K/W         |
| TCA 305 G                       | $R_{th SA}$      | 140 (200) <sup>2)</sup> | K/W         |

## Operating Range

|                      |           |                       |             |
|----------------------|-----------|-----------------------|-------------|
| Supply voltage       | $V_S$     | 5 to 30 <sup>3)</sup> | V           |
| Oscillator frequency | $f_{osc}$ | 0.015 to 1.5          | MHz         |
| Ambient temperature  | $T_A$     | – 25 to 85            | $^{\circ}C$ |

## Characteristics

$V_S = 12 V$ ,  $T_A = -25$  to  $85^{\circ}C$

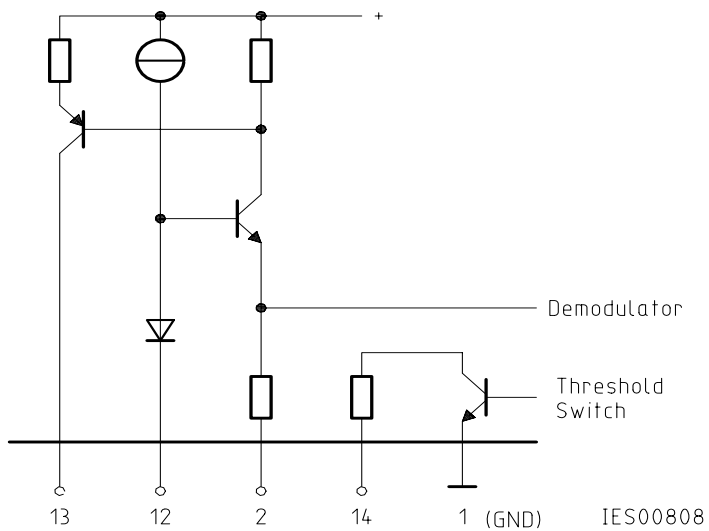
| Parameter                       | Symbol     | Limit Values |      |                         | Unit        | Test Condition       |
|---------------------------------|------------|--------------|------|-------------------------|-------------|----------------------|
|                                 |            | min.         | typ. | max.                    |             |                      |
| Open-loop current consumption   | $I_S$      |              | 0.6  | 0.9 (1.0) <sup>2)</sup> | mA          | outputs open         |
| Reference voltage <sup>1)</sup> | $V_{REF}$  |              | 3.2  |                         | V           | $I_{REF} < 10 \mu A$ |
| L-output voltage                | $V_{Q L}$  |              | 0.04 | 0.15                    | V           | $I_{Q L} = 5 mA$     |
| per output                      | $V_{Q L}$  |              | 0.10 | 0.35                    | V           | $I_{Q L} = 25 mA$    |
|                                 | $V_{Q L}$  |              | 0.22 | 0.75                    | V           | $I_{Q L} = 50 mA$    |
| H-output current per output     | $I_{Q H}$  |              |      | 10                      | $\mu A$     | $V_{Q H} = 30 V$     |
| Threshold at 3                  | $V_{S 3}$  |              | 2.1  |                         | V           |                      |
| Hysteresis at 3                 | $V_{Hy}$   | 0.4          | 0.5  | 0.6                     | V           |                      |
| Turn-ON delay <sup>1)</sup>     | $t_{D ON}$ | – 25 %       | 600  | – 25 %                  | ms/ $\mu F$ | $T_A = 25^{\circ}C$  |
| Switching frequency w/o $C_i$   | $f_s$      |              |      | 5                       | kHz         |                      |

<sup>1)</sup> TCA 305 only

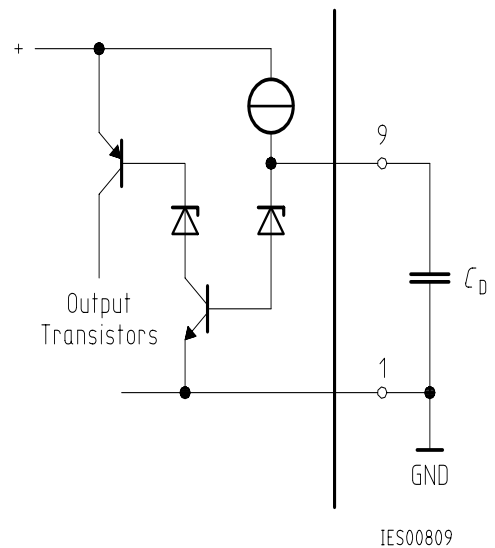
<sup>2)</sup> Values in parenthesis apply to TCA 355 only

<sup>3)</sup> Operation at voltages less than 5 V (between approx. 2.5 and 5 V) is possible, if  $V_{REF}$  is connected to  $V_S$ . In this case  $V_{REF}$  is no longer internally stabilized. Additionally, the pin "turn-on delay" is to be applied as follows: If no turn-on delay is needed, this pin has to be connected to  $V_S$ . If, however, a turn-on delay is required, the charge current for  $D_D$  has to be adjusted with an external resistor between this pin and  $V_S$  (recommended value  $390 k\Omega$ ).

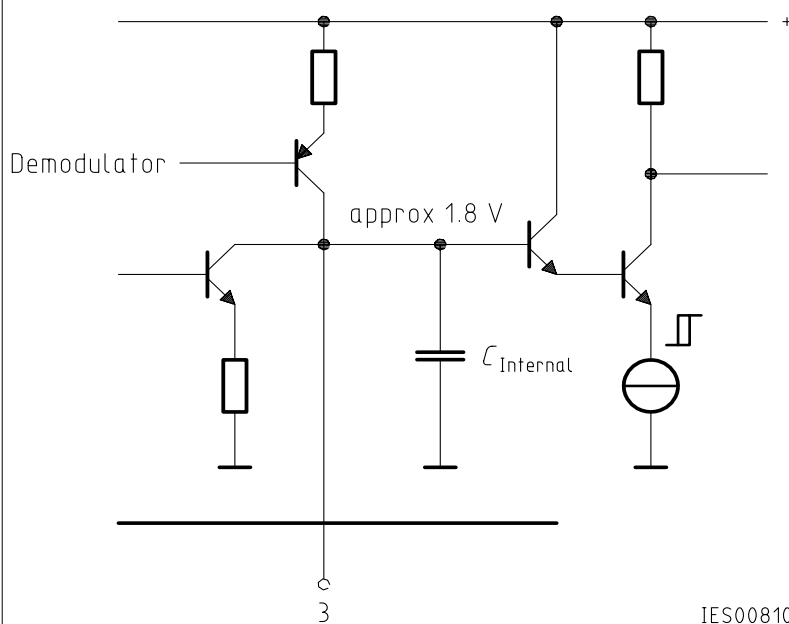
### Oscillator



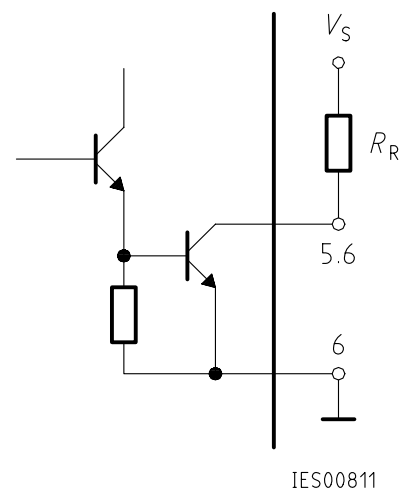
### Turn-ON Delay for TCA 305 A; G



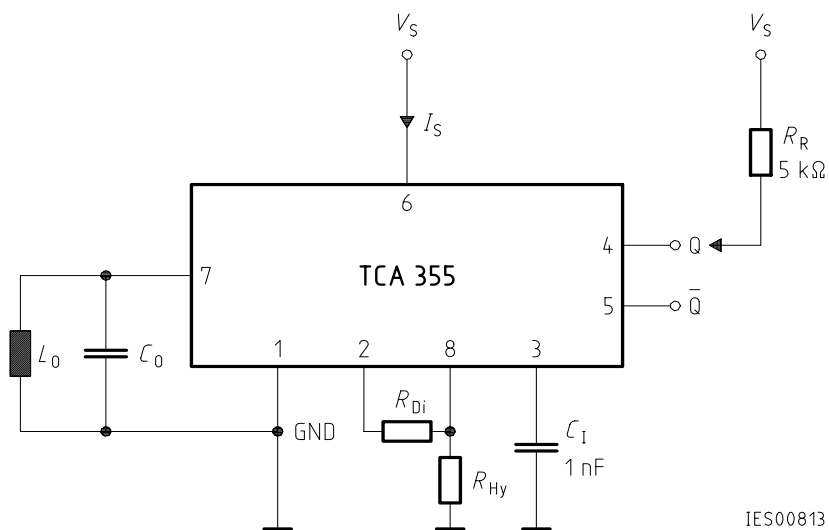
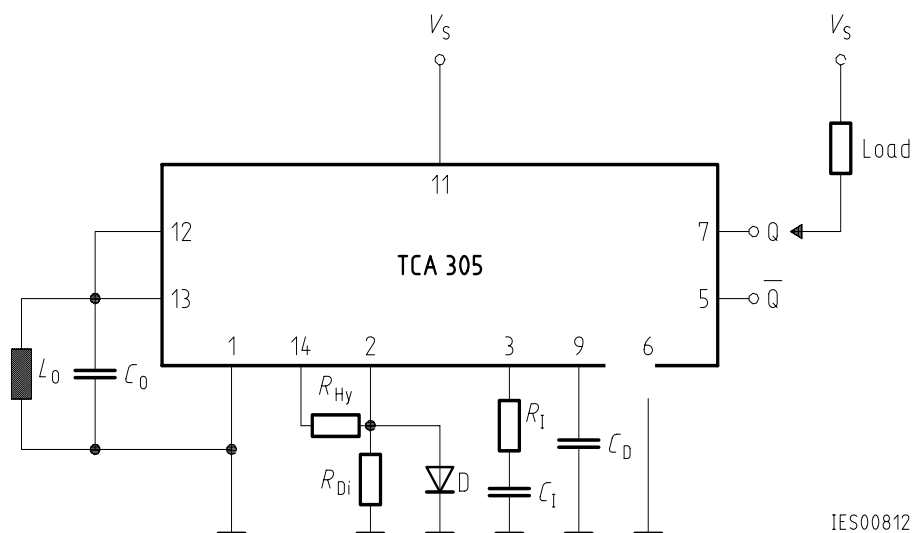
### Integrating Capacitor



### Outputs



## Schematic Circuit Diagram



## Application Circuit

|            |                                                                                                                                                                                                                                                   |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $L_0, C_0$ | Resonant circuit                                                                                                                                                                                                                                  |
| $R_{Hy}$   | Hysteresis adjustment                                                                                                                                                                                                                             |
| $R_{Di}$   | Distance adjustment                                                                                                                                                                                                                               |
| $D$        | Temperature compensation of the resonant circuit; possibly with series resistance for the purpose of adjustment. The diode is not absolutely necessary. Whether it is used or not depends on the temperature coefficient of the resonant circuit. |
| $R_i, C_i$ | Integration element. At pin 3 (integrating capacitance) we recommend a capacitor of typ. 1 nF. To increase noise immunity this capacitor can be substituted by an RC circuit with, e.g., $R_i = 1\text{ M}\Omega$ and $C_i = 10\text{ nF}$ .      |
| $C_D$      | Delay capacitor                                                                                                                                                                                                                                   |

## Dimensioning Examples in Accordance with CENELEC Standard (flush)

|                       | M 12                          | M 18                 | M 30                           |
|-----------------------|-------------------------------|----------------------|--------------------------------|
| Ferrite pot core      | M 33 (7.35 × 3.6) mm          | N 22 (14.4 × 7.5) mm | N 22 (25 × 8.9) mm             |
| Number of turns       | 100                           | 80                   | 100                            |
| Cross section of wire | 0.1 CuL                       | 20 × 0.05            | 10 × 0.1                       |
| $L_0$                 | 206 $\mu\text{H}$             | 268 $\mu\text{H}$    | 585 $\mu\text{H}$              |
| $C_0$ (STYROFLEX®)    | 1000 pF                       | 1.2 nF               | 3.3 nF                         |
| $f_{sc}$              | appr. 350 kHz                 | appr. 280 kHz        | appr. 115 kHz                  |
| Sn                    | 4 mm                          | 8 mm                 | 15 mm                          |
| $R_A$ (Metal)         | 8.2 k $\Omega$ + 330 $\Omega$ | 33 k $\Omega$        | 22 k $\Omega$ + 2.7 k $\Omega$ |
| $C_D$                 | 100 nF                        | 100 nF               | 100 nF                         |