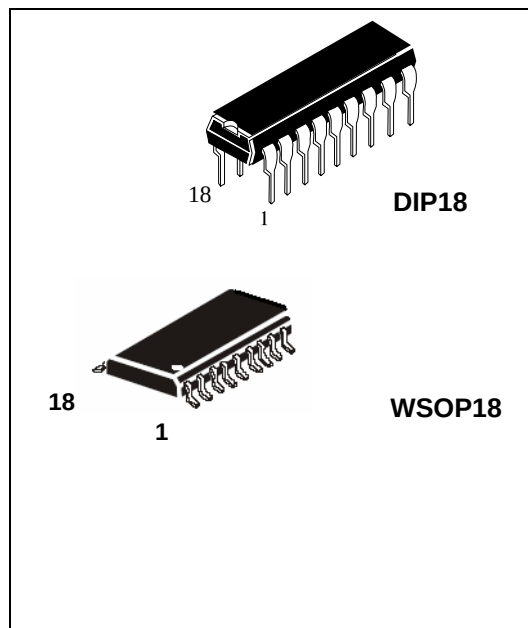


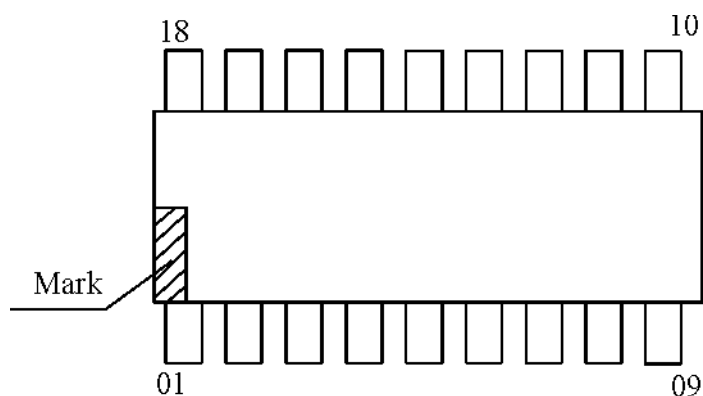
## ***Dual Tone Multi Frequency (DTMF)***

Microcircuit is purposed for receiving and decoding of tone pairs from tone-pulse dialers in frequency dialing mode. Microcircuit can be used in telecom systems, consumer electronic devices.

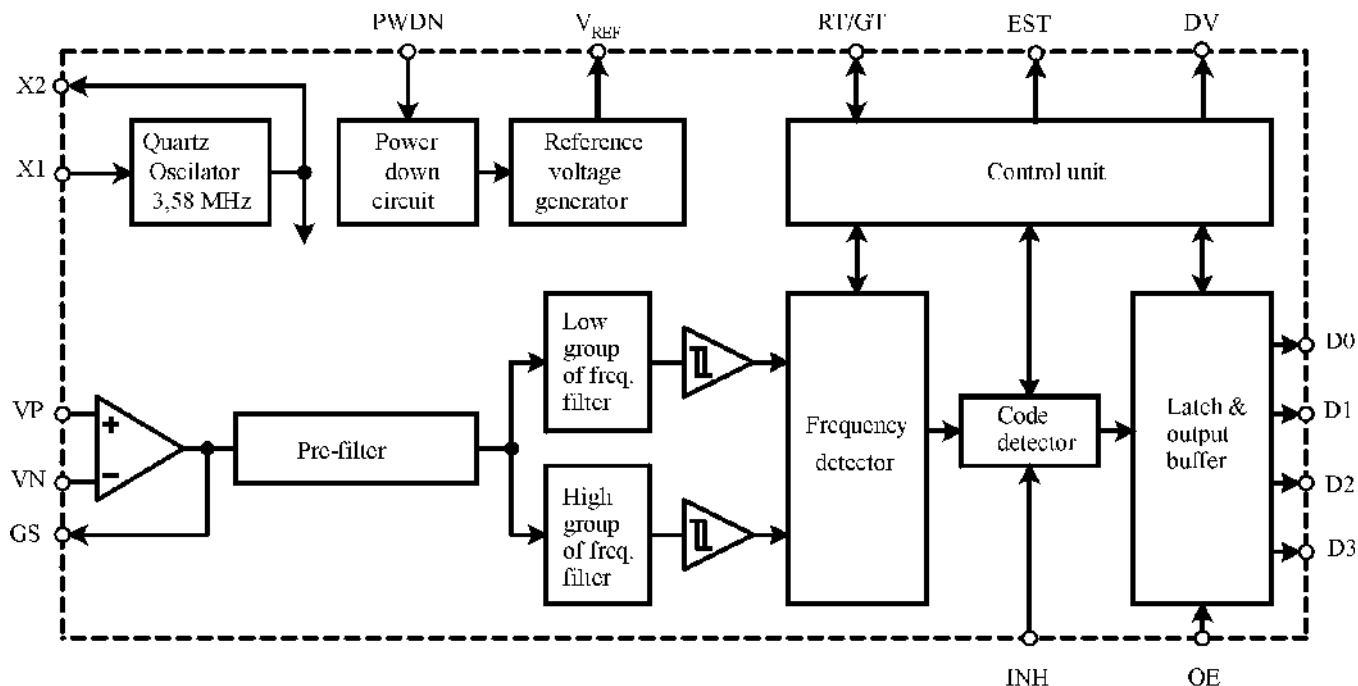
Main features:

- Supply voltage  $U_{CC} = (2,5 - 5,5) V$
- No external filter is required
- Low-cost 3,58 MHz resonator is used
- 1633 Hz signal detection inhibit
- 3 state data output
- Power down mode
- Temperature range  $-20 \dots +75\text{ }^{\circ}\text{C}$
- Permissible electrostatic discharge potential 500V





| Pin number | Symbol    | Description                               |
|------------|-----------|-------------------------------------------|
| 01         | $V_P$     | Operational amplifier non-inverting input |
| 02         | $V_N$     | Operational amplifier inverting input     |
| 03         | GS        | Operational amplifier output terminal     |
| 04         | $V_{REF}$ | Reference voltage output terminal         |
| 05         | INH       | “1633 Hz signal detection disable” input  |
| 06         | PWDN      | Power down mode input                     |
| 07         | X1        | Clock oscillator input                    |
| 08         | X2        | Clock oscillator output                   |
| 09         | $V_{SS}$  | Common                                    |
| 10         | OE        | “Output enable” input                     |
| 11         | DO        | Three-state data output                   |
| 12         | D1        | Three-state data output                   |
| 13         | D2        | Three-state data output                   |
| 14         | D3        | Three-state data output                   |
| 15         | DV        | Delay control output                      |
| 16         | EST       | Early steering output                     |
| 17         | RT/GT     | Protection time control input/output      |
| 18         | $V_{CC}$  | Supply voltage input                      |



| Symbol   | Parameter      | Value |                          | Unit |
|----------|----------------|-------|--------------------------|------|
|          |                | Min.  | Max.                     |      |
| $U_{CC}$ | Supply voltage | - 0,3 | 6,0                      | V    |
| $U_I$    | Input voltage  | - 0,3 | $U_{CC} + 0,3 \text{ V}$ | V    |

Table 3 – Recommended operation conditions

| Symbol   | Parameter                   | Value |      | Unit |
|----------|-----------------------------|-------|------|------|
|          |                             | Min.  | Max. |      |
| $U_{CC}$ | Supply voltage              | 2,5   | 5,5  | V    |
| $I_{CC}$ | Consumption current         | -     | 7,0  | mA   |
| $T_A$    | Operating temperature range | - 20  | 75   | °C   |

| Symbol           | Parameter                            | Mode of measurements                                     | Value |      | T <sub>A</sub> , °C | Unit |
|------------------|--------------------------------------|----------------------------------------------------------|-------|------|---------------------|------|
|                  |                                      |                                                          | Min.  | Max. |                     |      |
| I <sub>CC</sub>  | Consumption current                  | U <sub>CC</sub> = 5,0 V                                  | –     | 7,0  | -20; 75             | mA   |
| I <sub>STB</sub> | Stand-by mode consumption current    | U <sub>CC</sub> = 5,0 V<br>U <sub>IH</sub> = 5,0 V       | –     | 25   |                     | μA   |
| U <sub>IL</sub>  | Low level input voltage              | U <sub>CC</sub> = 5,0 V                                  | –     | 1,0  |                     | V    |
| U <sub>IH</sub>  | High level input voltage             | U <sub>CC</sub> = 5,0 V                                  | 4,0   | –    |                     | V    |
| I <sub>IL</sub>  | Low level input current              | U <sub>CC</sub> = 5,0 V<br>U <sub>IL</sub> = 0 V         | –     | 0,1  |                     | μA   |
| I <sub>IH</sub>  | High level input current             | U <sub>CC</sub> = 5,0 V<br>U <sub>IH</sub> = 5,0 V       | –     | 0,1  |                     | μA   |
| R <sub>OE</sub>  | Pull-high resistance                 | U <sub>CC</sub> = 5,0 V<br>U <sub>IH</sub> = 5,0 V       | 60    | 150  |                     | kΩ   |
| I <sub>OL</sub>  | Low level output current             | U <sub>CC</sub> = 5,0 V<br>U <sub>O</sub> = 0,5 V        | 1,0   | –    |                     | μA   |
| I <sub>OH</sub>  | High level output current            | U <sub>CC</sub> = 5,0 V<br>U <sub>O</sub> = 4,5 V        | - 0,4 | –    |                     | μA   |
| U <sub>IN</sub>  | Level of input voltage               | U <sub>CC</sub> = 3,0 V<br>f <sub>OSC</sub> = 3,5795 MHz | - 36  | - 6  |                     | dBm  |
|                  |                                      | U <sub>CC</sub> = 5,0 V<br>f <sub>OSC</sub> = 3,5795 MHz | - 29  | 1,0  |                     |      |
| T <sub>PUT</sub> | Active operation mode enable time    | U <sub>CC</sub> = 5,0 V<br>f <sub>OSC</sub> = 3,5795 MHz | –     | 60   |                     | ms   |
| T <sub>DP</sub>  | Tone present detection time          | U <sub>CC</sub> = 5,0 V                                  | 5,0   | 22   |                     | ms   |
| T <sub>DA</sub>  | Tone absent detection time           | U <sub>CC</sub> = 5,0 V                                  | –     | 8,5  |                     | ms   |
| T <sub>ACC</sub> | Acceptable Tone Duration             | U <sub>CC</sub> = 5,0 V                                  | –     | 42   |                     | ms   |
| T <sub>REJ</sub> | Rejected tone duration               | U <sub>CC</sub> = 5,0 V                                  | 20    | –    |                     | ms   |
| T <sub>IA</sub>  | Accepted inter-digit pause           | U <sub>CC</sub> = 5,0 V                                  | –     | 42   |                     | ms   |
| T <sub>IR</sub>  | Rejected inter-digit pause           | U <sub>CC</sub> = 5,0 V                                  | 20    | –    |                     | ms   |
| T <sub>PDO</sub> | Propagation delay time (RT/GT to DO) | U <sub>CC</sub> = 5,0 V                                  | -     | 11   |                     | μs   |
| T <sub>PDV</sub> | Propagation delay time (RT/GT to DV) | U <sub>CC</sub> = 5,0 V                                  | -     | 20   |                     | μs   |
| T <sub>DOV</sub> | Output data setup time (DO to DV)    | U <sub>CC</sub> = 5,0 V                                  | 4,5   | -    |                     | μs   |

| Symbol                         | Parameter                                         | Value     |           | Unit             |
|--------------------------------|---------------------------------------------------|-----------|-----------|------------------|
|                                |                                                   | Min.      | Max.      |                  |
| $f_{OSC}$                      | Clock frequency                                   | 3,5759    | 3,5831    | MHz              |
| $R_{IN}$                       | Input impedance                                   | 5,0       | –         | M $\Omega$       |
| AC parameters of DTMF signal   |                                                   |           |           |                  |
| $\pm\Delta U_I$                | Input DTMF signal tone level deviation            | –         | 10        | dBm              |
| $K_{DT}$                       | Dial tone tolerance                               | –         | 18        | dB               |
| $K_N$                          | Noise tolerance                                   | –         | -12       | dB               |
| $K_{TT}$                       | Third tone tolerance                              | –         | -16       | dB               |
| $\Delta f_A$                   | Deviation of frequency of input signal acceptance | –         | $\pm 1,5$ | %                |
| $\Delta f_R$                   | Deviation of frequency of input signal rejection  | $\pm 3,5$ | –         | %                |
| Operation amplifier parameters |                                                   |           |           |                  |
| $R_I$                          | Input resistance                                  | 5,0       | -         | M $\Omega$       |
| $I_{IN}$                       | Input leakage current                             | -         | 1,0       | $\mu A$          |
| $U_{OS}$                       | Offset voltage                                    | -         | $\pm 45$  | mV               |
| PSRR                           | Power supply rejection                            | 50        | -         | dB               |
| CMRR                           | Common mode rejection                             | 50        | -         | dB               |
| $A_{VO}$                       | Open loop gain                                    | 50        | -         | dB               |
| $f_T$                          | Gain bandwidth                                    | 1,0       | -         | MHz              |
| $U_{OUT}$                      | Output voltage swing                              | 4,3       | -         | V (peak to peak) |
| $R_L$                          | Load resistance (GS)                              | 50        | -         | k $\Omega$       |
| $C_L$                          | Load capacitance (GS)                             | -         | 100       | pF               |
| $U_{CM}$                       | Common mode voltage swing                         | -         | 3,0       | V (peak to peak) |
| Dynamic behavior               |                                                   |           |           |                  |
| $T_{EDO}$                      | Propagation delay time (OE to DO)                 | -         | 60        | ns               |
| $T_{DDO}$                      | Propagation delay time (OE to DO)                 | -         | 400       | ns               |

### **Operation description**

The IC detects all sixteen standard DTMF signals and converts them into corresponding digital code.

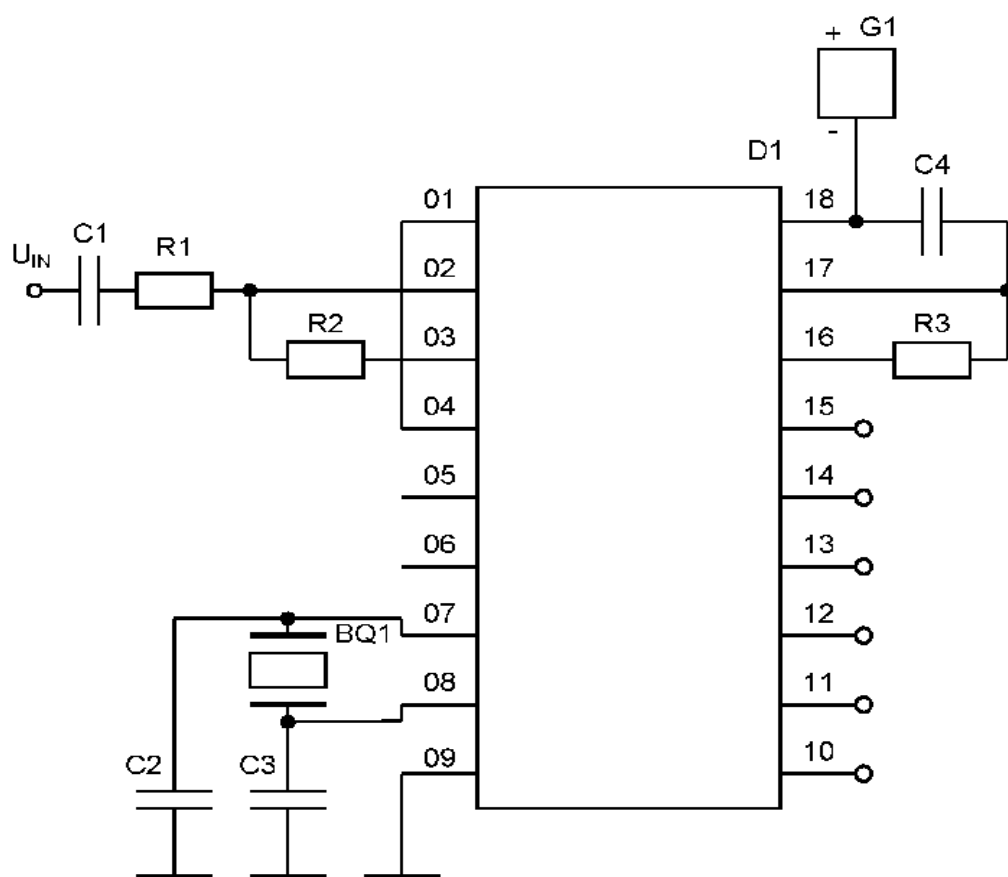
Input of the IC is composed of input operational amplifier and three filters - pre-filter, filter of low-frequency group, filter of high-frequency group.

The signal received at the input of IC, is supplied to inverting input of operational amplifier  $V_N$ , which gain ratio is set by external components (at typical application gain equals 1). From the operational amplifier output signal is supplied to pre-filter. Preliminary filter is a band rejection filter and is designed to suppress frequencies to 440 Hz. After filtering DTMF signal is simultaneously supplied to filter high and low groups. Filter low-frequency group - band filter that passes only the low tone group. Filter high-frequency group - band-pass filter which passes only the high-tone group. Allocated signals are amplified and passed through to the frequency detector. Frequency detector determines the frequency of signals received from each filter, code detector converts this information in to 4-bit code, which goes to the latch output. Output latches are designed for the reception, transmission and storage of 4-bit code. When a high-level signal at the output DV, the tone code can be read from D0 - D3 pins.

Control unit allows controlling intertone pause duration and the duration of the input DTMF signal for the given values of R3 and C4 (Fig. 4).

Figure 4 provides application diagram. Operation timing diagram of IC is presented in Figure 5.

| DTMF signal             |                          | Button | INH | OE | Output code                                               |    |    |    |
|-------------------------|--------------------------|--------|-----|----|-----------------------------------------------------------|----|----|----|
| Low group frequency, Hz | High group frequency, Hz |        |     |    | D3                                                        | D2 | D1 | D0 |
| 697                     | 1209                     | 1      | L   | H  | 0                                                         | 0  | 0  | 1  |
| 697                     | 1336                     | 2      | L   | H  | 0                                                         | 0  | 1  | 0  |
| 697                     | 1477                     | 3      | L   | H  | 0                                                         | 0  | 1  | 1  |
| 770                     | 1209                     | 4      | L   | H  | 0                                                         | 1  | 0  | 0  |
| 770                     | 1336                     | 5      | L   | H  | 0                                                         | 1  | 0  | 1  |
| 770                     | 1477                     | 6      | L   | H  | 0                                                         | 1  | 1  | 0  |
| 852                     | 1209                     | 7      | L   | H  | 0                                                         | 1  | 1  | 1  |
| 852                     | 1336                     | 8      | L   | H  | 1                                                         | 0  | 0  | 0  |
| 852                     | 1477                     | 9      | L   | H  | 1                                                         | 0  | 0  | 1  |
| 941                     | 1209                     | 0      | L   | H  | 1                                                         | 0  | 1  | 0  |
| 941                     | 1336                     | *      | L   | H  | 1                                                         | 0  | 1  | 1  |
| 941                     | 1477                     | #      | L   | H  | 1                                                         | 1  | 0  | 0  |
| 697                     | 1633                     | A      | L   | H  | 1                                                         | 1  | 0  | 1  |
| 770                     | 1633                     | B      | L   | H  | 1                                                         | 1  | 1  | 0  |
| 852                     | 1633                     | C      | L   | H  | 1                                                         | 1  | 1  | 1  |
| 941                     | 1633                     | D      | L   | H  | 0                                                         | 0  | 0  | 0  |
| -                       | -                        | Any    |     | L  | Z                                                         | Z  | Z  | Z  |
| 697                     | 1209                     | 1      | H   | H  | 0                                                         | 0  | 0  | 1  |
| 697                     | 1336                     | 2      | H   | H  | 0                                                         | 0  | 1  | 0  |
| 697                     | 1477                     | 3      | H   | H  | 0                                                         | 0  | 1  | 1  |
| 770                     | 1209                     | 4      | H   | H  | 0                                                         | 1  | 0  | 0  |
| 770                     | 1336                     | 5      | H   | H  | 0                                                         | 1  | 0  | 1  |
| 770                     | 1477                     | 6      | H   | H  | 0                                                         | 1  | 1  | 0  |
| 852                     | 1209                     | 7      | H   | H  | 0                                                         | 1  | 1  | 1  |
| 852                     | 1336                     | 8      | H   | H  | 1                                                         | 0  | 0  | 0  |
| 852                     | 1477                     | 9      | H   | H  | 1                                                         | 0  | 0  | 1  |
| 941                     | 1209                     | 0      | H   | H  | 1                                                         | 0  | 1  | 0  |
| 941                     | 1336                     | *      | H   | H  | 1                                                         | 0  | 1  | 1  |
| 941                     | 1477                     | #      | H   | H  | 1                                                         | 1  | 0  | 0  |
| 697                     | 1633                     | A      | H   | H  | No detecting. D0 – D3<br>keep state of previous detecting |    |    |    |
| 770                     | 1633                     | B      | H   | H  |                                                           |    |    |    |
| 852                     | 1633                     | C      | H   | H  |                                                           |    |    |    |
| 941                     | 1633                     | D      | H   | H  |                                                           |    |    |    |
| -                       | -                        | Any    |     | L  | Z                                                         | Z  | Z  | Z  |



BQ1 – quartz resonator with frequency 3,579545 MHz

C1, C4 – capacitors  $0,1 \mu\text{F} \pm 10 \%$

C2, C3 - capacitors  $20 \text{ pF} \pm 5 \%$

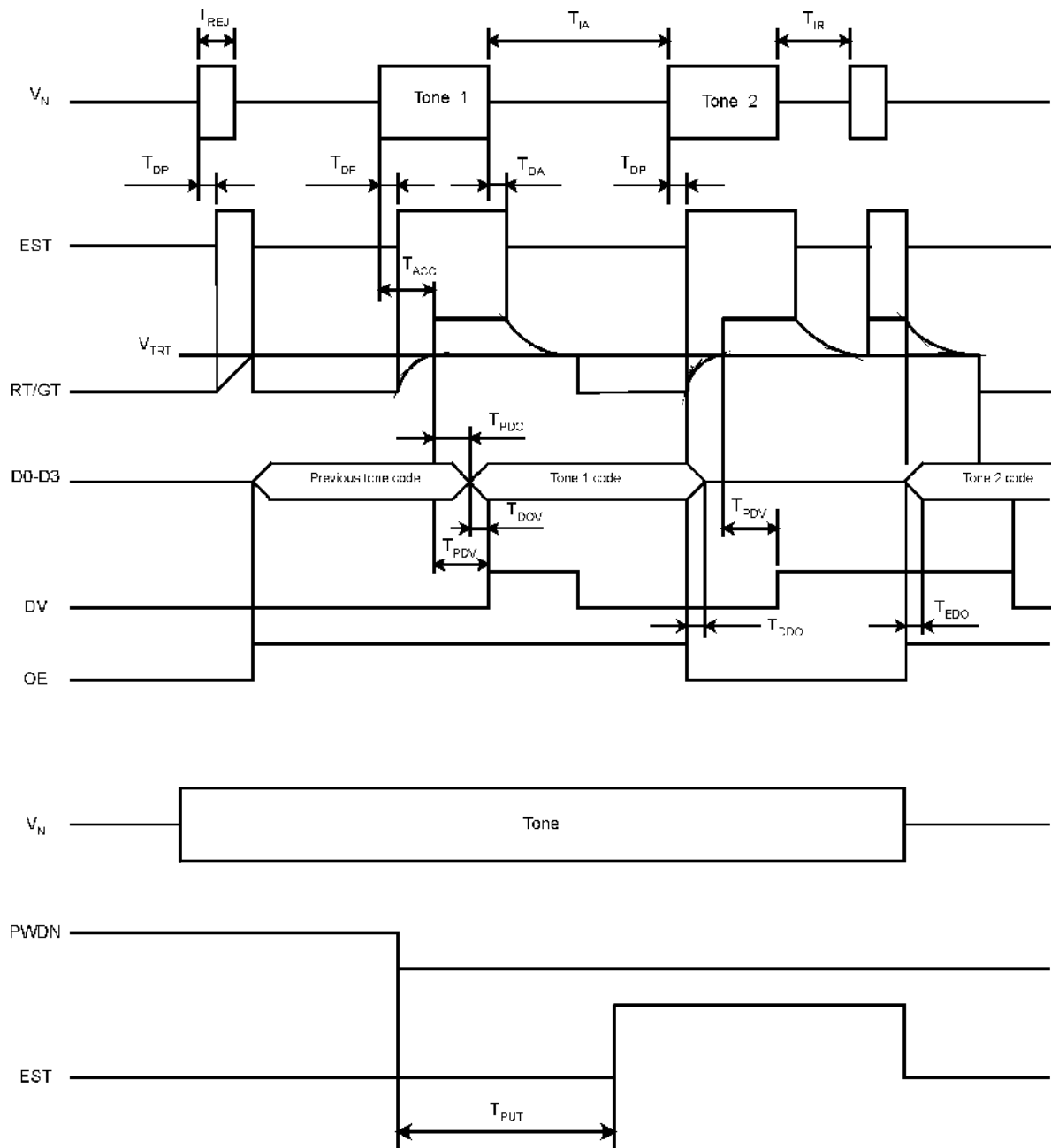
D1 – microcircuit

G1 – supply voltage source  $5,0 \text{ V} \pm 5 \%$

R1, R2 – resistors  $100 \text{ k}\Omega \pm 5\%$

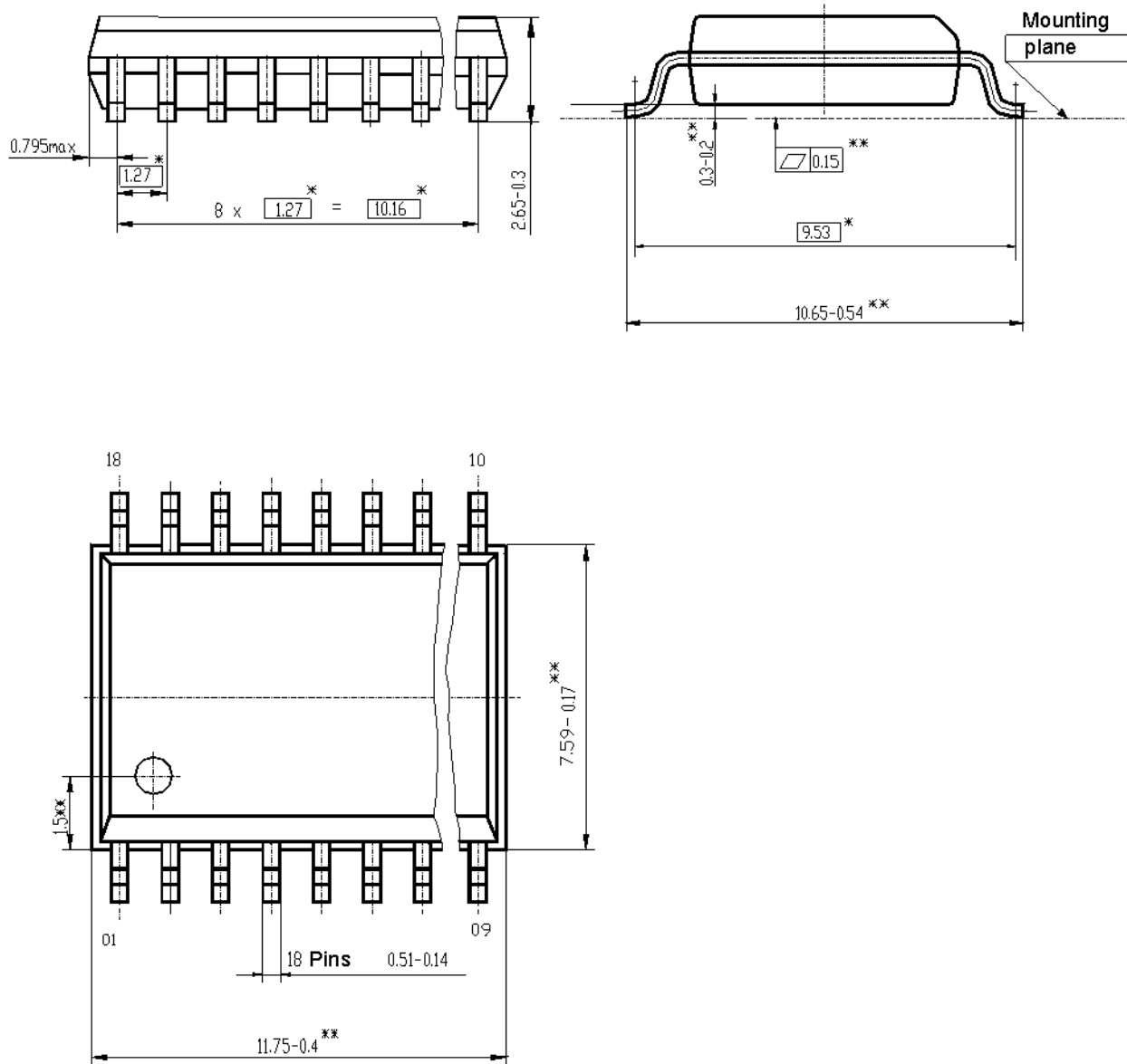
R3 – resistor  $300 \text{ k}\Omega \pm 5\%$





## Package dimensions

### WSOP18



## DIP18

