

TONE DECODER IC

The IL567CN, IL567CD are general purpose tone decoders .

ICs are purposed to receive and decode sine signal of wide bandwidth in telecom systems.

IC can be applied for tone (voice-frequency) decoding, frequency control, broadband FSK demodulations, ultrasonic frequency control, in precision generator, search decoders.

Main features

- Bandwidth, BW, %
(relatively to central frequency f_c)
min.....10;
max.....18;
- Bandwidth central frequency, f_c , kHz
min.....100;
(at $U_{CC} = 5\text{ V}$, $R = 2, 8\text{ k}\Omega$, $C = 3300\text{ pF}$)
max.....500;
(at $U_{CC} = 5\text{ V}$, $R = 2, 8\text{ k}\Omega$, $C = 800\text{ pF}$)
Center frequency adjustable from 0,01Hz to 500 kHz.
- Quiescent consumption current, I_{CC} , mA
(at $U_{CC} = 5\text{ V}$, $R_L = 20\text{ k}\Omega$),
not more8;
- Operating temperature range 0 to +70°C;
- Immunity to ESD potential 200 V. Limiting value of the potential of static electricity 350 V;
- Logic compatible output with 100mA current sinking capability;
- High rejection of outband signals and noise;
- Thermal resistance «junction-ambient»
for IL567CN not more 110 °C/W;
for IL567CD not more 160 °C/W.

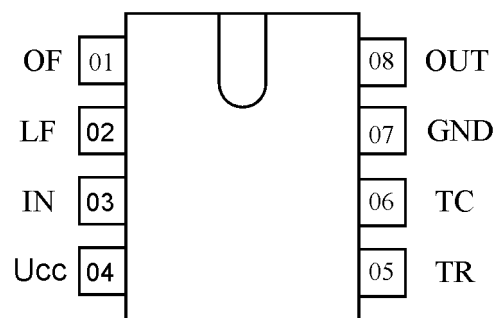
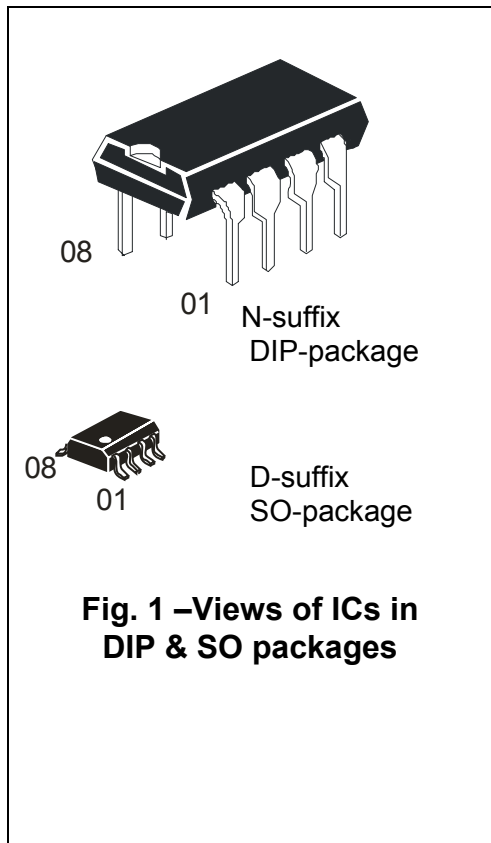


Fig. 2 – Pinout diagramm

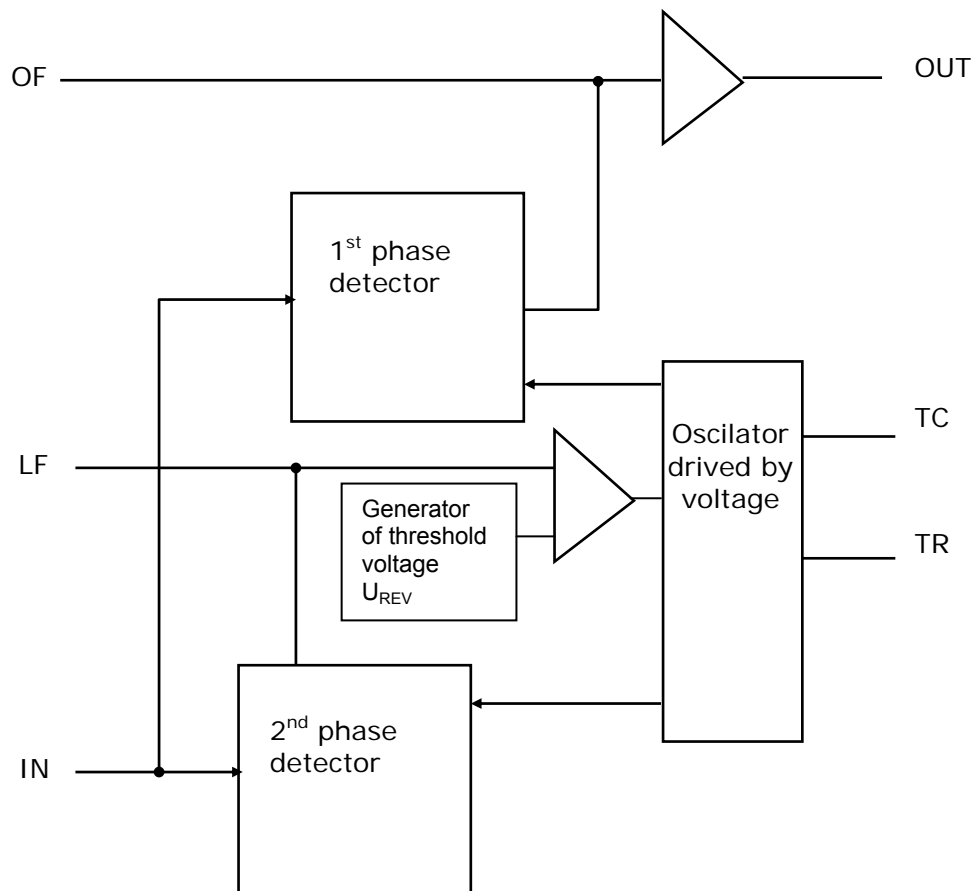


Fig. 3 – Block diagram of IC

Table 1 – Pin description

Pin number	Symbol	Description
01	OF	Filter output
02	LF	Loop filter (Low frequency filter of the synchronous demodulator)
03	IN	Detected frequency input
04	U_{CC}	Supply voltage pin
05	TR	Timing resistor connection pin
06	TC	Timing capacitor connection pin
07	GND	Common pin (Ground)
08	OUT	Output

Table 2 – Absolute maximum ratings

Symbol	Parameter	Norm		Unit
		Min	Max	
U _{CC}	Supply voltage	-	9,5	V
U ₀₃	Input voltage (pin 03)	-10	U _{CC} +0,5	V
P _{tot} ¹⁾	Total power dissipation	-	1100 ²⁾	mW
T _a	Storage temperature	-50	125	°C

¹⁾At IC operation junction temperature has not to exceed 115 °C taking into account thermal resistance "junction-ambient". For IL567CN thermal resistance "junction-ambient" - 110 °C/W. For IL567CD thermal resistance "junction-ambient" - 160 °C/W.
Maximum power P_{tot},W, dissipated by IC for T_A , is calculated by formula

$$P_{tot} = (115 - T_A) / R_{TJA} , \quad (1)$$

115 – maximum permissible operating junction temperature, °C;
T_A – ambient temperature, °C;
R_{TJA} – thermal resistance «junction-ambient» , °C/W.

²⁾ Duration of influence of extreme mode has to be not more than 20 ms

Table 3 – Recommended operation modes

Symbol	Parameter	Norm		Unit
		Min	Max	
U _{CC}	Supply voltage	4,75	9	V
U ₀₈	Voltage applied to closed output, V (pin 08)	-	15	V
T _a	Operating ambient temperature	0	70	°C

Table 4 – Electric parameters

Parameter, unit, mode of measurement	Symbol	Norm		Ambient temperature, °C
		Min	Max	
Quiescent consumption current, mA at $U_{CC} = 5\text{ V}$, $R_L = 20\text{ k}\Omega$	I_{CC}	-	$\frac{8}{9}$	$\frac{25 \pm 10}{0; 70}$
Dynamic consumption current, mA at $U_{CC} = 5\text{ V}$, $R_L = 20\text{ k}\Omega$	I_{OCC}	-	$\frac{13}{14}$	
Input resistance, $\text{k}\Omega$ at $U_{CC} = 5\text{ V}$	R_I	$\frac{15}{14}$	-	
Smallest detectable input voltage, mV (RMS) at $U_{CC} = 5\text{ V}$, $I_L = 100\text{ mA}$, $f_i = f_C$	U_{Imin}	-	$\frac{25}{30}$	
Largest detectable input voltage (at signal absence), mV (RMS) at $U_{CC} = 5\text{ V}$, $I_L = 100\text{ mA}$, $f_i = f_C$	U_{Imax}	$\frac{10}{9}$	-	
Bandwidth, % (relatively to central frequency f_C)	BW	$\frac{10}{9}$	$\frac{18}{19}$	
Bandwidth relative deviation, % (relatively to central frequency f_C) at $U_{CC} = 5\text{ V}$	ΔBW_{REL}	-	$\frac{3,0}{3,5}$	
Coefficient of bandwidth variation with supply voltage, % / V at $U_{CC} = (4,75 - 6,75)\text{ V}$	K_{BW}	-	$\frac{\pm 5}{\pm 5,5}$	
Highest center frequency, kHz at $U_{CC} = 5\text{ V}$, $R = 2,8\text{ k}\Omega$, $C = 3300\text{ pF}$	f_C	$\frac{100}{110}$	-	
at $U_{CC} = 5\text{ V}$, $R = 2,8\text{ k}\Omega$, $C = 800\text{ pF}$		-	$\frac{500}{400}$	
Center frequency variation with supply voltage, %/V at $U_{CC} = (4,75 - 6,75)\text{ V}$ at $U_{CC} = (4,75 - 9,0)\text{ V}$	δ_{fC}	-	$\frac{2,0}{2,5}$	
High level output leakage current, μA at $U_{CC} = 5\text{ V}$, $U_{O8} = 15\text{ V}$	I_{OLH}	-	$\frac{25}{40}$	
Output saturation voltage, V at $U_{CC} = 5; 9\text{ V}$, $I_{O8}^{1)} = 30\text{ mA}$, $U_{O3} = 25\text{ mV}$	U_{OSAT}	-	$\frac{0,4}{0,6}$	
at $U_{CC} = 5; 9\text{ V}$, $I_{O8} = 100\text{ mA}$, $U_{O3} = 25\text{ mV}$		-	$\frac{1,0}{1,5}$	
<p>1) I_{O8} – 08 pin current</p>				

Table 5 – Reference parameters

Parameter, unit, mode of measurement	Symbol	Norm		Ambient temperature, °C
		Min	Max	
Largest Simultaneous Outband Signal to Inband Signal Ratio, dB	N_S	$\frac{1,5}{1,0}$	$\frac{9}{8}$	25 ± 10 0; 70
Minimum Input Signal to Wideband Noise Ratio, dB at $U_{CC} = 5\text{ V}$, $B_n = 140\text{ kHz}$	N_n	$\frac{-1,5}{-1,0}$	$\frac{-9}{-8}$	
Cycle repeating frequency, kHz at $U_{CC} = 5\text{ V}$	f_{CYC}	-	$\frac{f_C/20}{f_C/25}$	
Output fall time, ns at $U_{CC} = 5\text{ V}$	t_f	-	$\frac{60}{80}$	
Output rise time, ns at $U_{CC} = 5\text{ V}$	t_r	-	$\frac{300}{350}$	
Coefficient of bandwidth variation with temperature, % / °C at $U_{CC} = 5\text{ V}$	α_{BW}	-	$\pm 0,2$	0; 70
Coefficient of central frequency variation with temperature, ppm/°C at $U_{CC} = (4,75 - 5,75)\text{ B}$	α_{fC}	-100	100	0; 70

Functionality of the microcircuit

Tone signals decoder IC is purposed for decoding of frequencies in bandwidth BW (relatively the central frequency), %, determined by expression

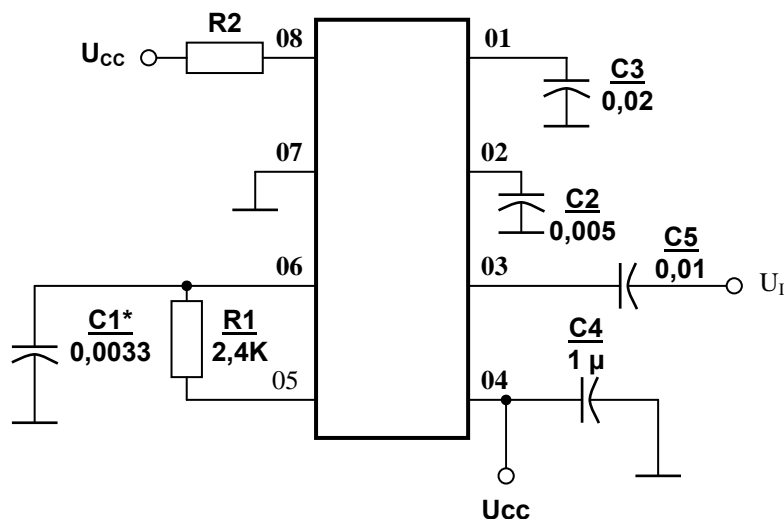
$$BW = 1070 \sqrt{\frac{U_i}{f_c C_2}}, \quad (2)$$

U_i - input voltage (RMS) $U_i \leq 200$ mV;

f_c – bandwidth central frequency of decoder, kHz, is determined by formula

$$f_c \cong \frac{1}{1.1R_1C_1}, \quad (3)$$

R_1, C_1, C_2 - external passive components.



R2 – load resistor

* for frequency $f_c = 100$ kHz only.

Capacitor C1 used to correct oscillator central frequency.

Capacitor C2 used to determine decoder bandwidth.

Fig. 4 – Recommended application diagram

Reference diagramm

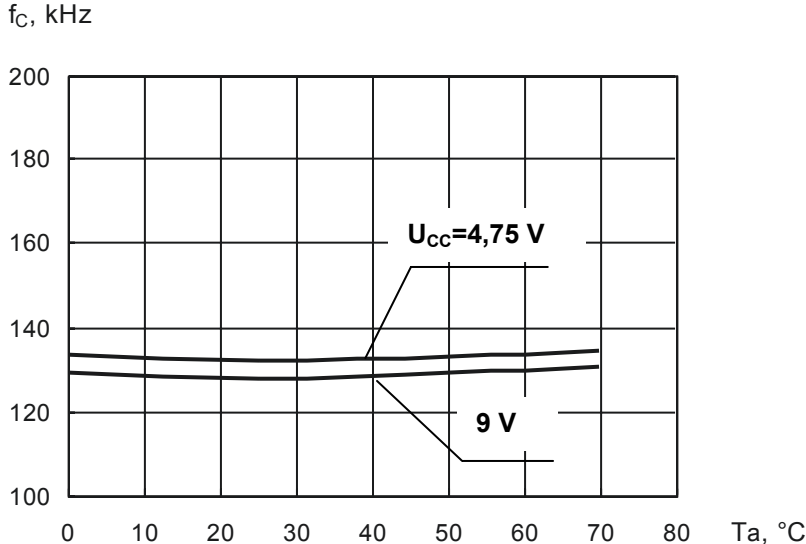


Fig. 5 – Bandwidth central frequency average values versus ambient temperature

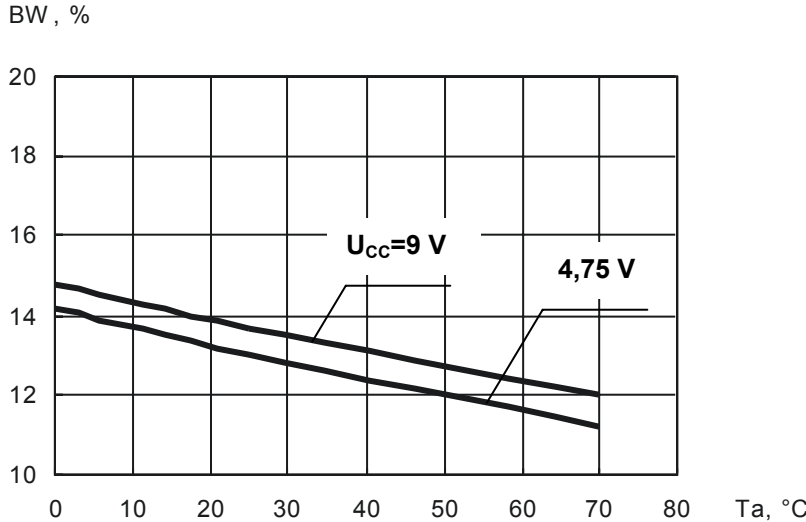


Fig. 6 – Bandwidth average values versus ambient temperature

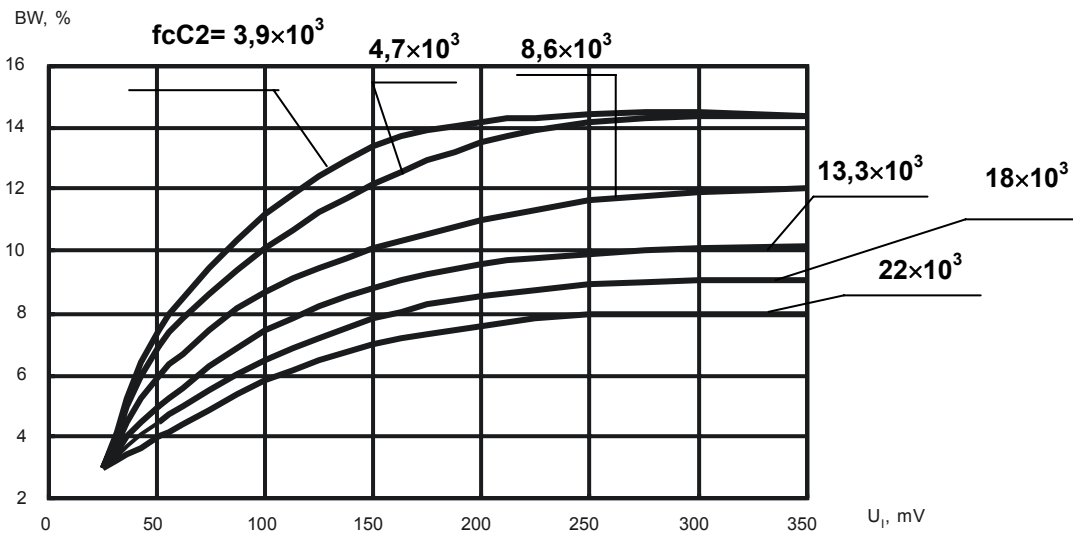


Fig. 7 Bandwidth average values versus input voltage at U_{CC}= 5 V, Ta = (25±10) °C

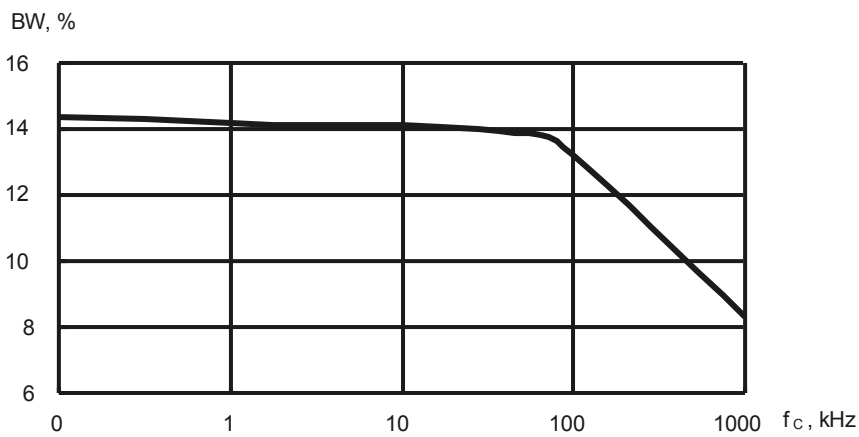


Fig. 8 Bandwidth average values versus central frequency at U_{CC}= 5 V, Ta = (25±10)°C

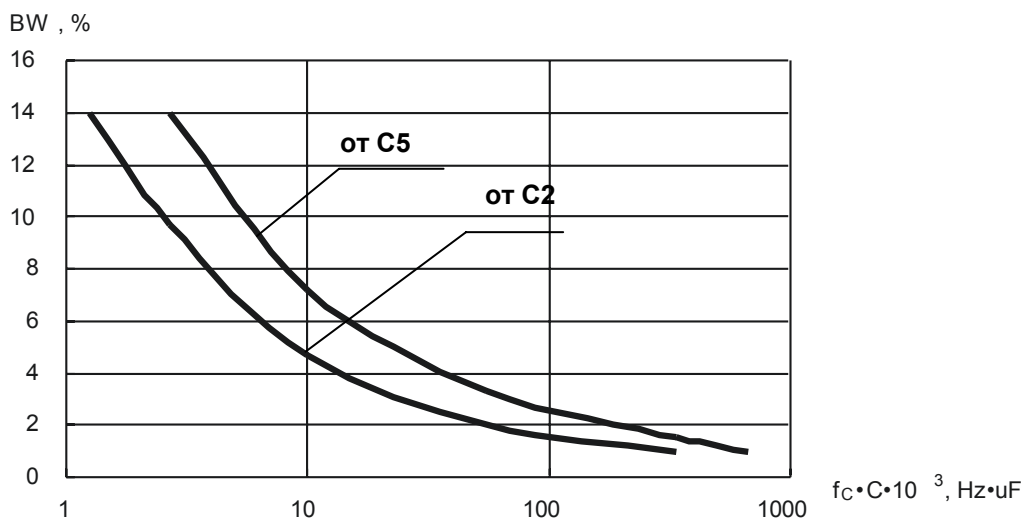


Fig. 9 – Bandwidth average values versus capacity at U_{CC}= 5 V, Ta = (25±10) °C

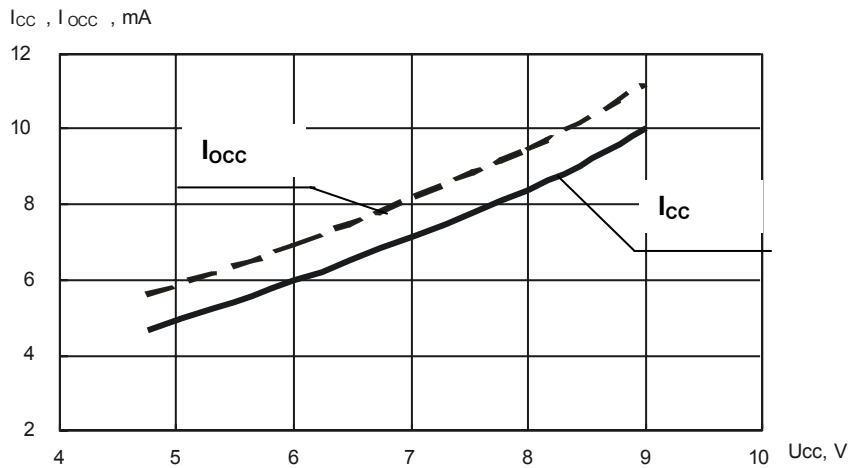


Fig.10 – Quiescent consumption current and dynamic consumption current average values versus supply voltage $T_a = (25 \pm 10) ^\circ C$

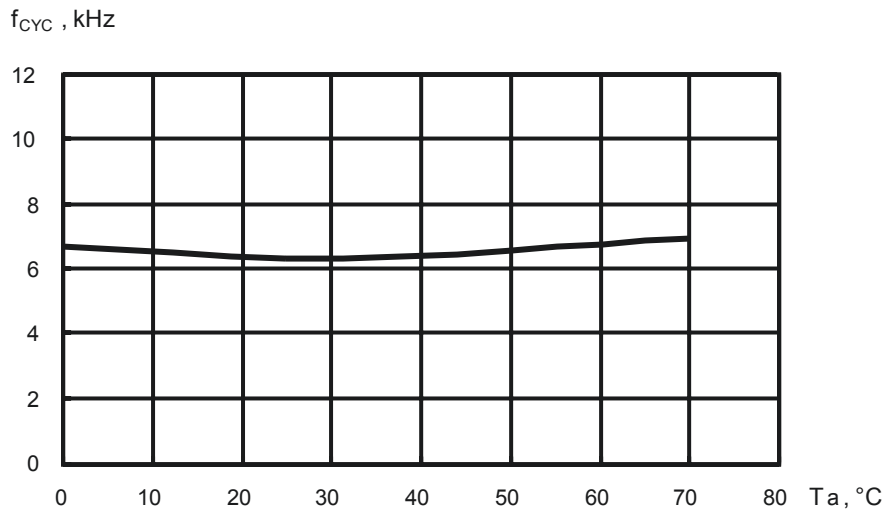


Fig. 11 – Cycle repeating frequency average values versus ambient temperature at $U_{CC}= 5 V$

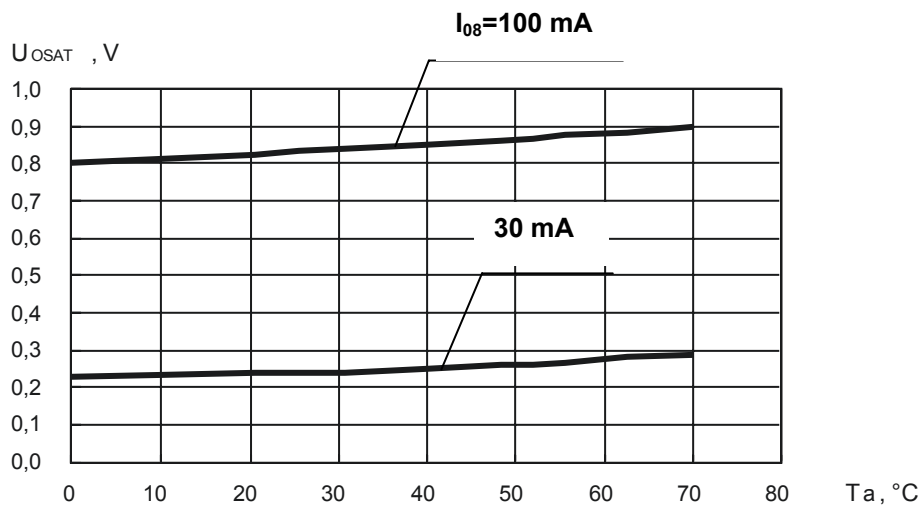


Fig. 12 – Output saturation voltage average values versus ambient temperature at $U_{CC}= 5 V$

Typical applications diagrams

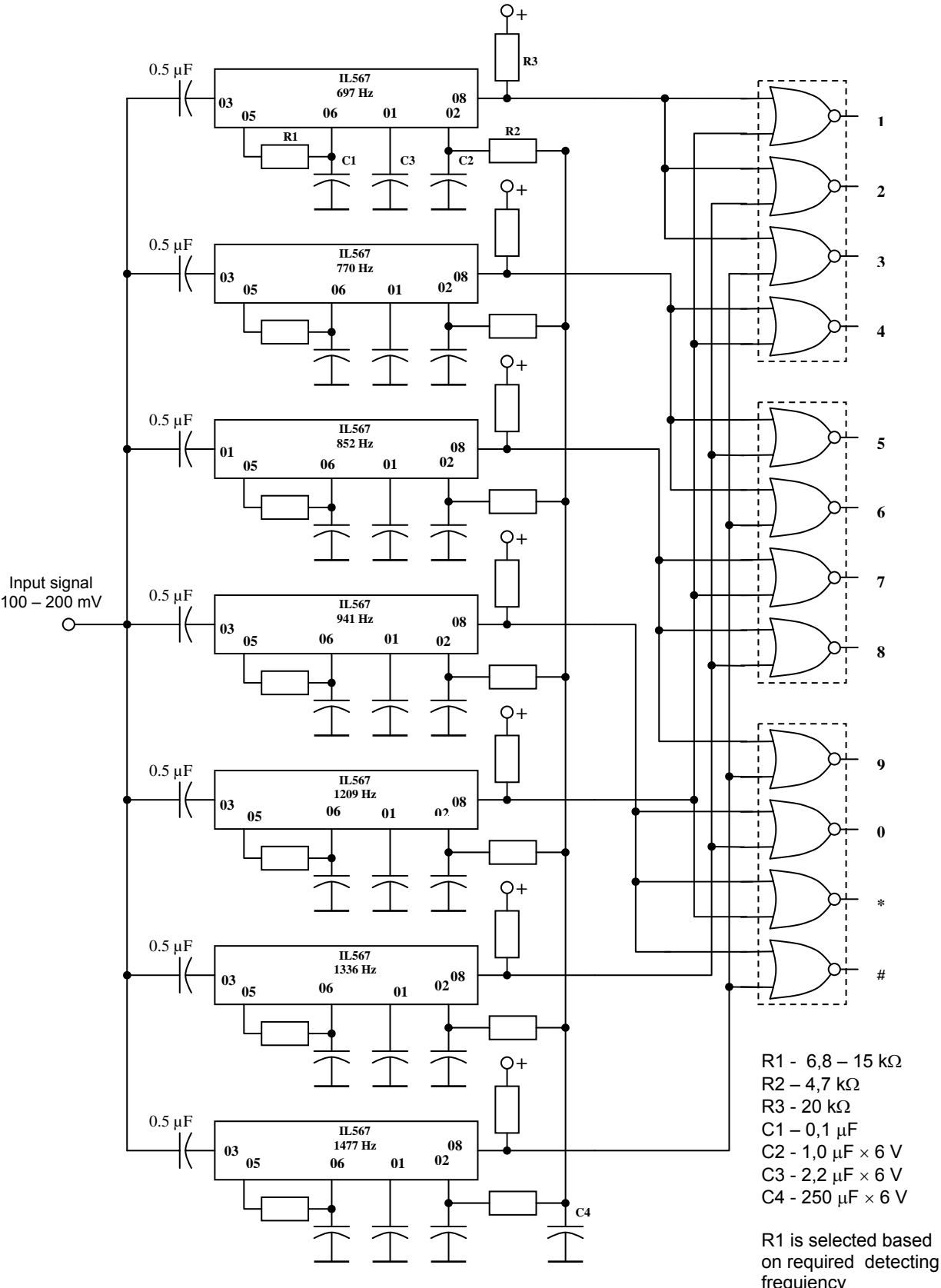
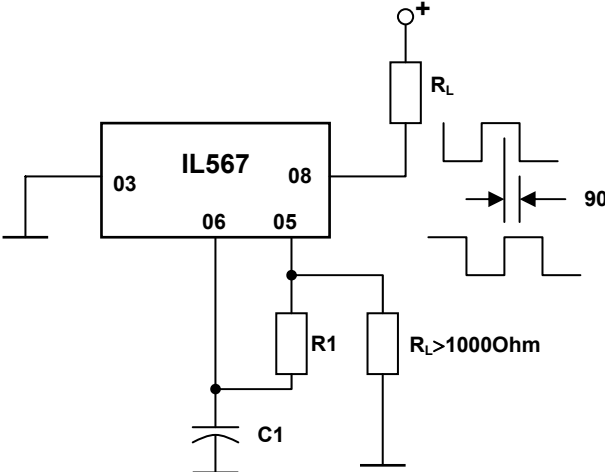


Fig.13 - Push-button phone decoder



Output signal is inverted at 2,8V voltage applied to pin 03 .

Fig. 14 - Oscillator with Quadrature Output

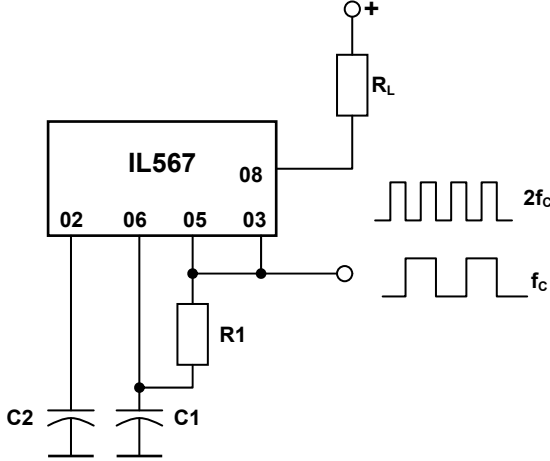


Fig. 15 - Oscillator with Double Frequency Output

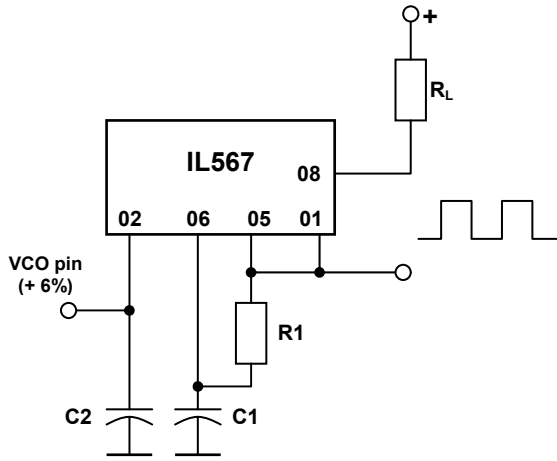
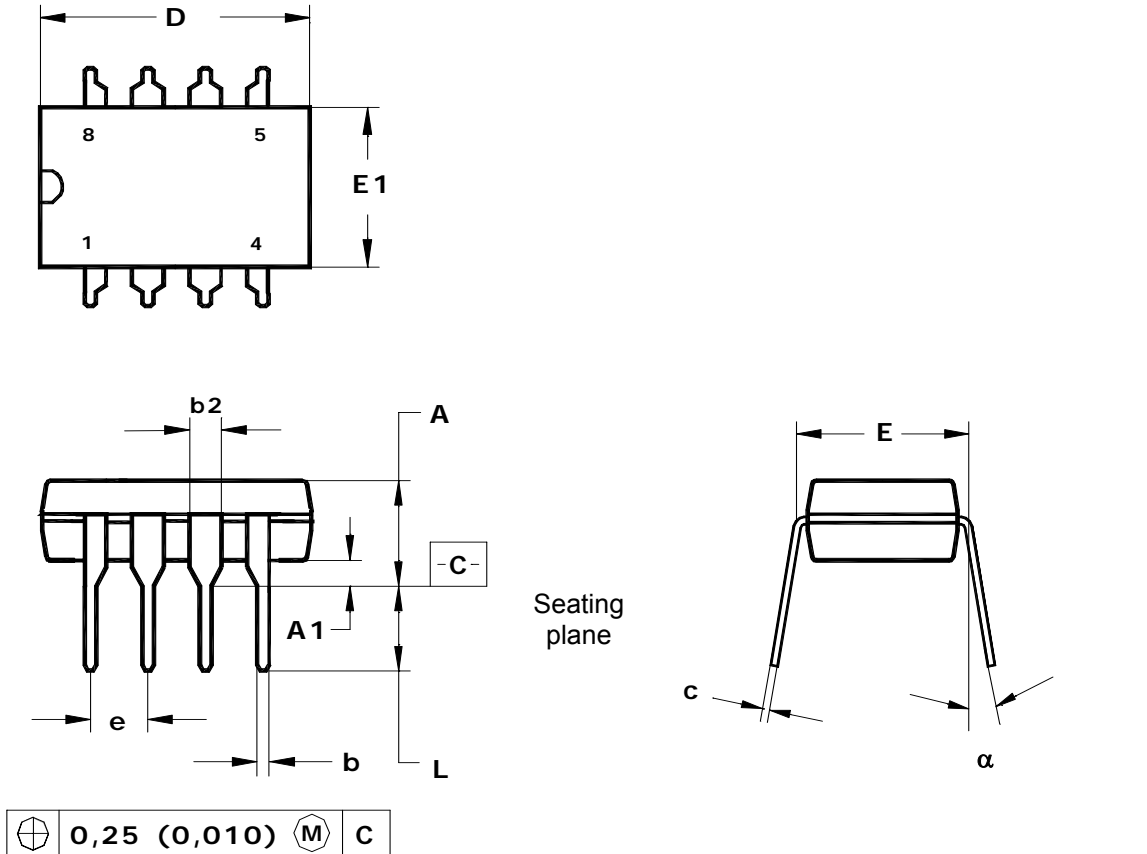


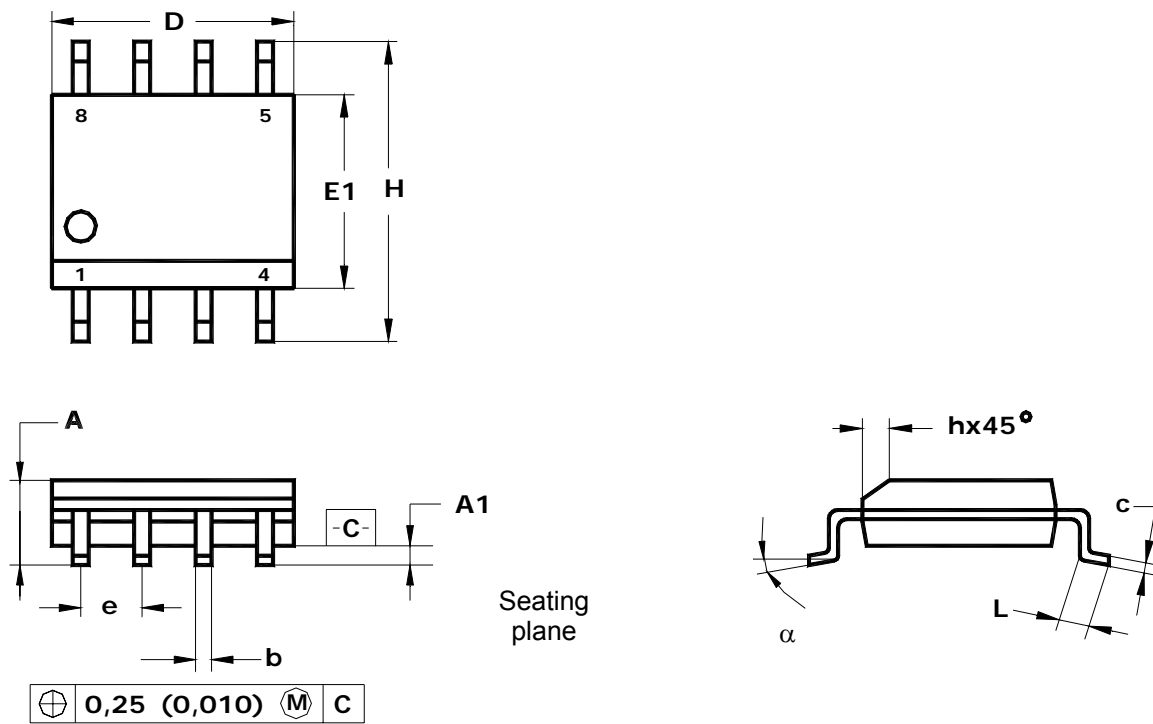
Fig. 16 - Precision oscillator-driver with 100 mA load



Note – The sizes D, E1 do not include size of the spew which should not be more 0,25 (0,010) on the side.

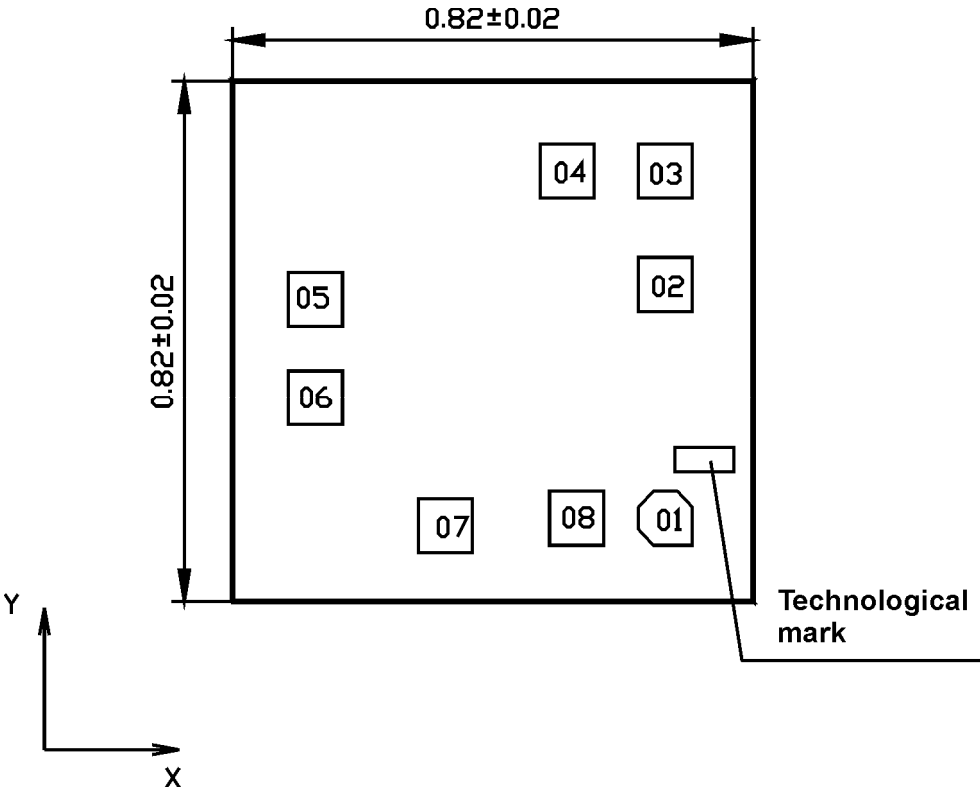
	D	E1	A	b	b2	e	α	L	E	c	A1
mm											
min	9.02	6.07	—	0.36	1.14		0°	2.93	7.62	0.20	0.38
max	10.16	7.11	5.33	0.56	1.78	2.54	15°	3.81	8.26	0.36	—
inches											
min	0.355	0.240	—	0.014	0.045		0°	0.115	0.300	0.008	0.015
max	0.400	0.280	0.210	0.022	0.070	0.1	15°	0.150	0.325	0.014	—

Fig. 17 – DIP-packade (MS-001BA) dimensions



	D	E1	H	b	e	α	A	A1	c	L	h
mm											
min	4.80	3.80	5.80	0.33		0°	1.35	0.10	0.19	0.41	0.25
max	5.00	4.00	6.20	0.51	1.27	8°	1.75	0.25	0.25	1.27	0.50
inches											
min	0.1890	0.1497	0.2284	0.013		0°	0.0532	0.0040	0.0075	0.016	0.0099
max	0.1968	0.1574	0.2440	0.020	0.100	8°	0.0688	0.0090	0.0098	0.050	0.0196

Fig. 18 – SO- package (MS-012AA) dimensions



Technological mark coordinates IL567CN (mm): left bottom corner x = 0,6971, y = 0,2044.
 Chip thickness 0,35 ± 0,02 mm.

Contact pad number	Coordinates(left bottom corner), mm	
	X	Y
01	0,6397	0,0885
02	0,6397	0,4577
03	0,6397	0,6362
04	0,4847	0,6362
05	0,0885	0,4341
06	0,0885	0,2791
07	0,2931	0,0765
08	0,4996	0,0885

Note - Contact pad dimensions 0.085 x 0.085 mm and coordinates are indicated under "Passivation" layer

Fig. 19 – Contact pad layout and coordinates