

## 4-line IPAD™ EMI filter and ESD protection for headset

### Features

- lead-free package
- high attenuation: -30 dB at 900 MHz
- low cut-off frequencies: 60 MHz for speaker lines
- high current capability: 50 mA per line
- very low PCB space consumption: 1.5 mm x 1.7 mm
- very thin package: 0.6 mm maximum
- high efficiency in ESD suppression IEC6 1000-4-2 level 4
- high reliability offered by monolithic integration

### Complies with following standards:

- IEC 61000-4-2 level 4 all pins:
  - 15 kV (air discharge)
  - 8 kV (contact discharge)

### Application

- mobile phones

### Description

The EMIF04-EAR02M8 chip is a highly integrated device designed to suppress EMI/RFI noise for mobile phone headsets. The new LC architecture on the speaker lines provides a high attenuation value maintaining a very low serial resistance.

The  $\mu$ QFN-8L package offers the possibility to integrate the whole function in a very small PCB space.

Additionally, this filter includes ESD protection circuitry, which prevents damage to the protected device when subjected to ESD surges up to 30 kV.

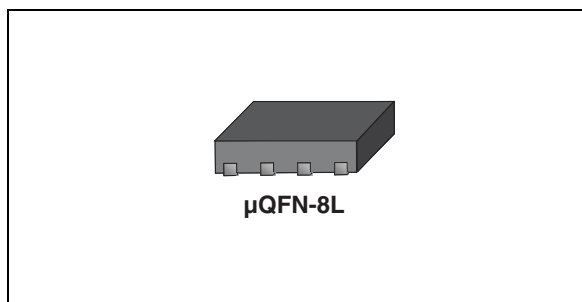


Figure 1. Pin configuration (bottom side)

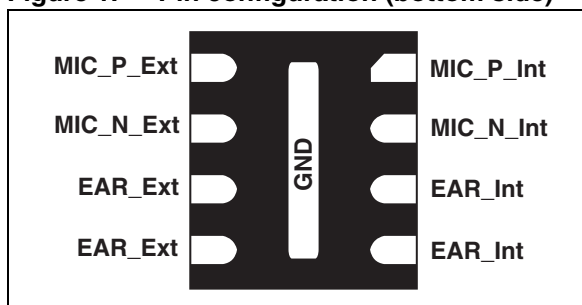
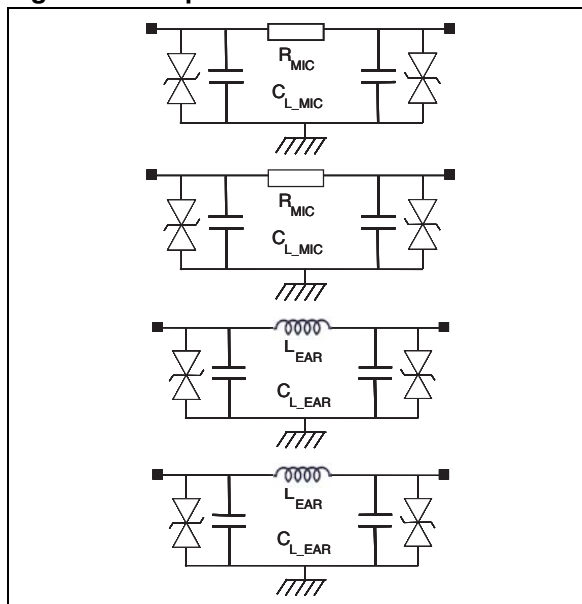


Figure 2. Equivalent circuit



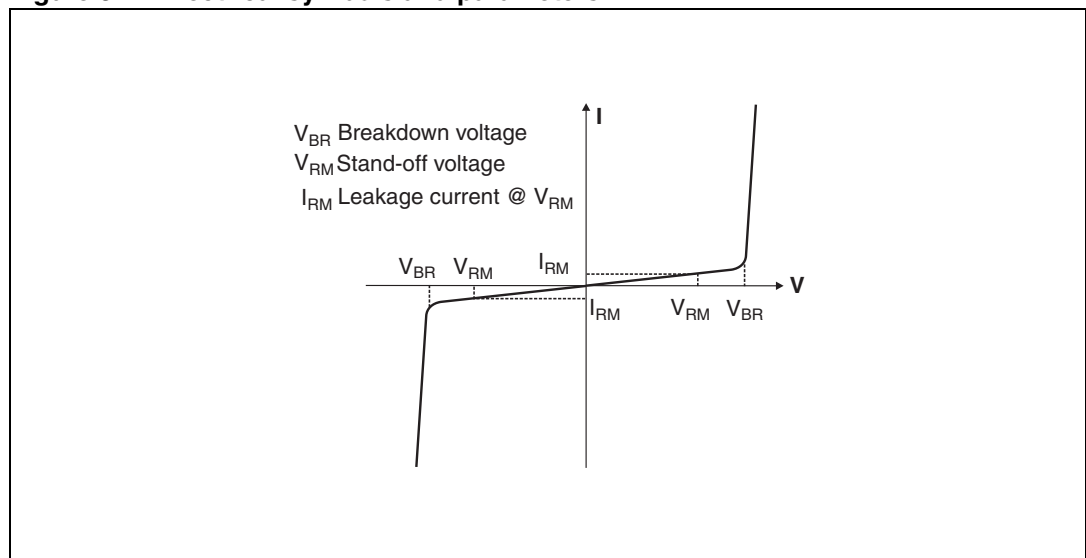
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# 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ °C}$ )**

Symbol	Parameter	Value	Unit
$V_{PP}$	ESD IEC 61000-4-2 air discharge	30	kV
	contact discharge	30	
$I_{EAR}$	Maximum rms current per channel	50	mA
$T_j$	Operating junction temperature	-30 to 125	°C
$T_{stg}$	Storage temperature range	-55 to +150	°C

**Figure 3. Electrical symbols and parameters**



**Table 2. Electrical characteristics ( $T_{amb} = 25\text{ °C}$ )**

Symbol	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR}$	$I_R = 1\text{ mA}$	7			V
$I_{RM}$	$V_{RM} = 3\text{ V}$			100	nA
$L_{EAR}$			1.5		nH
$R_L$	Parasitic resistance of inductor $L_{EAR}$		0.30	0.6	$\Omega$
$R_{MIC}$		54	68	82	$\Omega$
$C_{L\_EAR}$	$V_R = 0\text{ V DC}$ , 1 MHz	84	105	126	pF
$C_{L\_MIC}$	$V_R = 0\text{ V DC}$ , 1 MHz	60	76	92	pF
$F_{c\_EAR}$	Cut-off frequency earphone line: $Z_{SOURCE} = Z_{LOAD} = 50\ \Omega$		60		MHz
$F_{c\_MIC}$	Cut-off frequency microphone line: $Z_{SOURCE} = Z_{LOAD} = 50\ \Omega$		70		MHz

Figure 4. S21 attenuation measurement

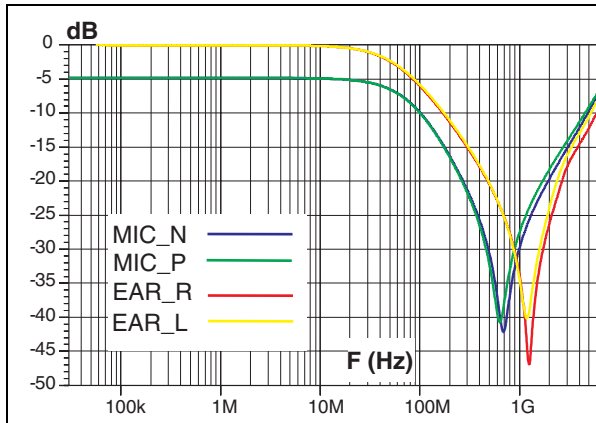


Figure 5. Analog cross talk measurements

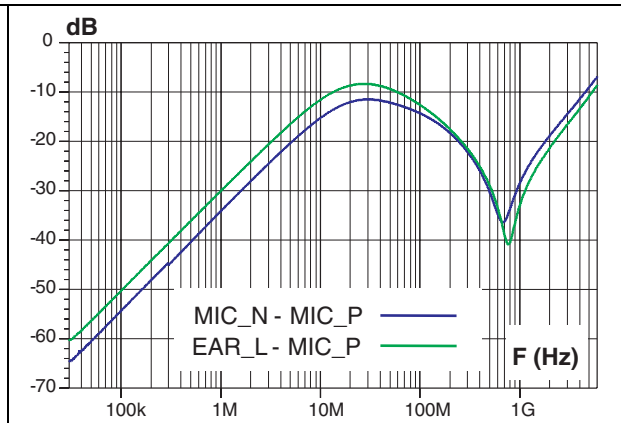


Figure 6. ESD response to IEC 61000-4-2 (+15 kV air discharge) on one MIC input ( $V_{in}$ ) and on one MIC output

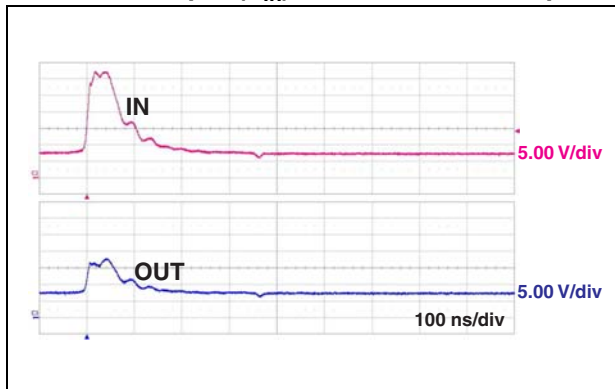


Figure 7. ESD response to IEC 61000-4-2 (-15 kV air discharge) on one MIC input ( $V_{in}$ ) and on one MIC output

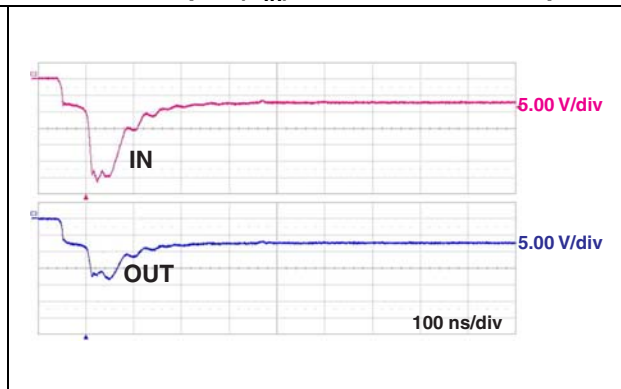


Figure 8. ESD response to IEC 61000-4-2 (+15 kV air discharge) on one EAR input ( $V_{in}$ ) and on one EAR output

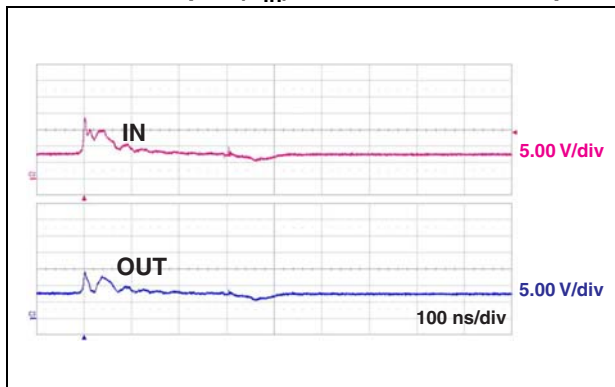


Figure 9. ESD response to IEC 61000-4-2 (-15 kV air discharge) on one EAR input ( $V_{in}$ ) and on one EAR output

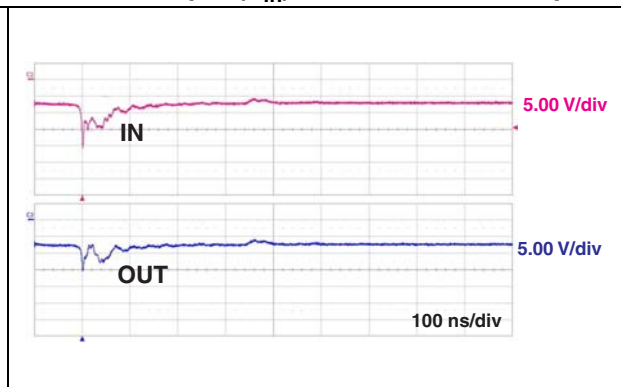


Figure 10. Relative line capacitance variation versus applied voltage

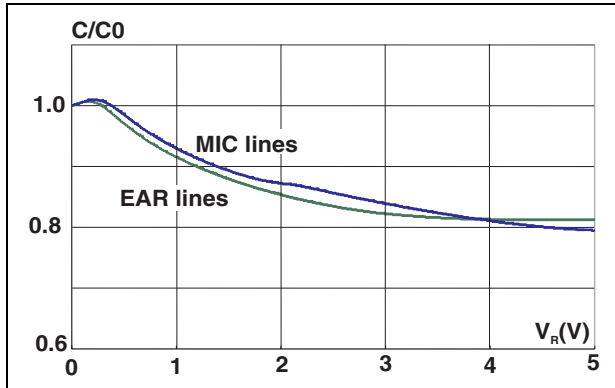


Figure 11. Total harmonic distortion with noise: MIC lines, R = 10 kΩ

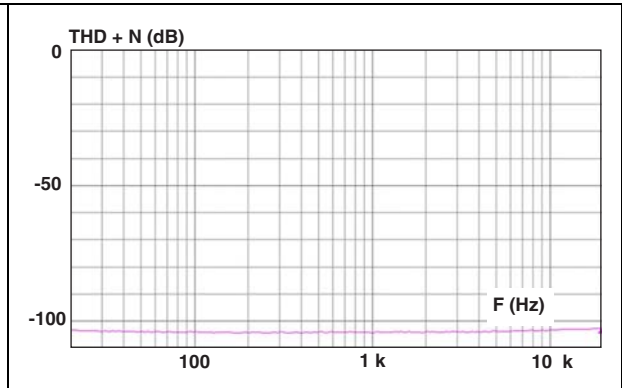


Figure 12. Total harmonic distortion with noise: MIC lines, R = 32 Ω

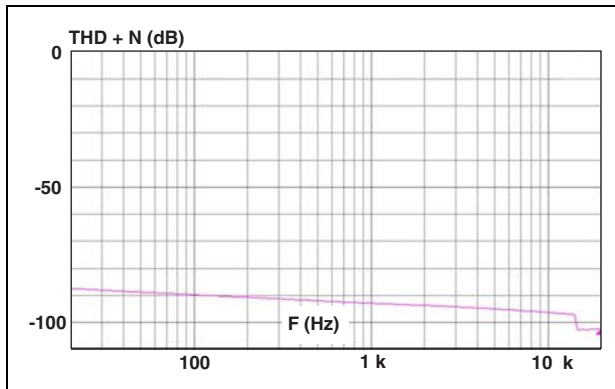


Figure 13. Total harmonic distortion with noise: EAR lines, R = 32 Ω

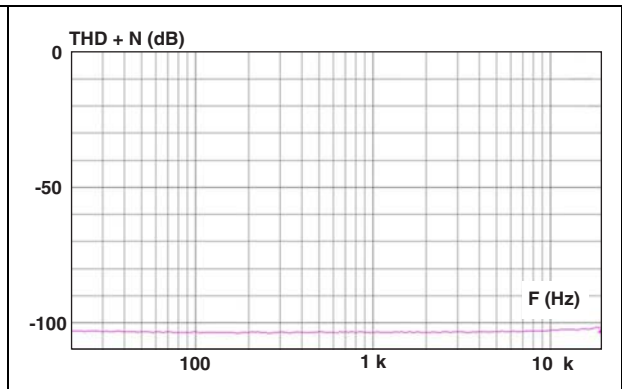
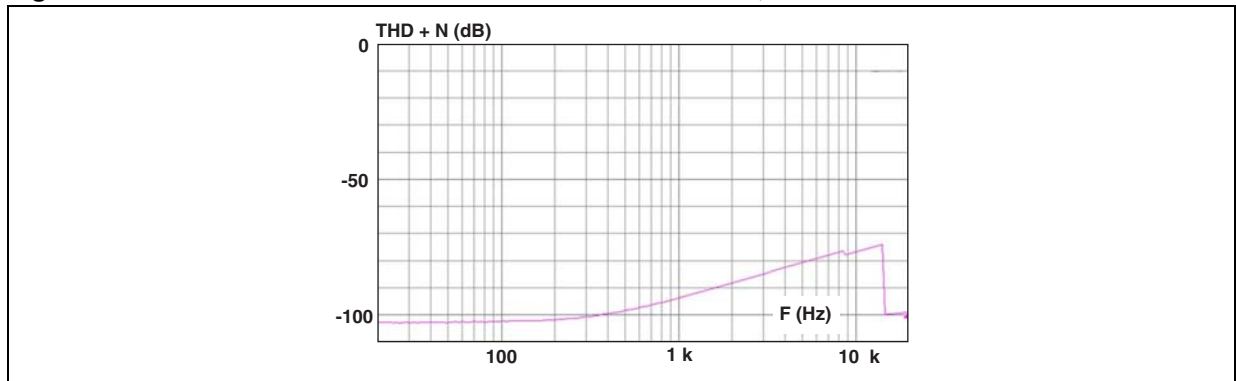
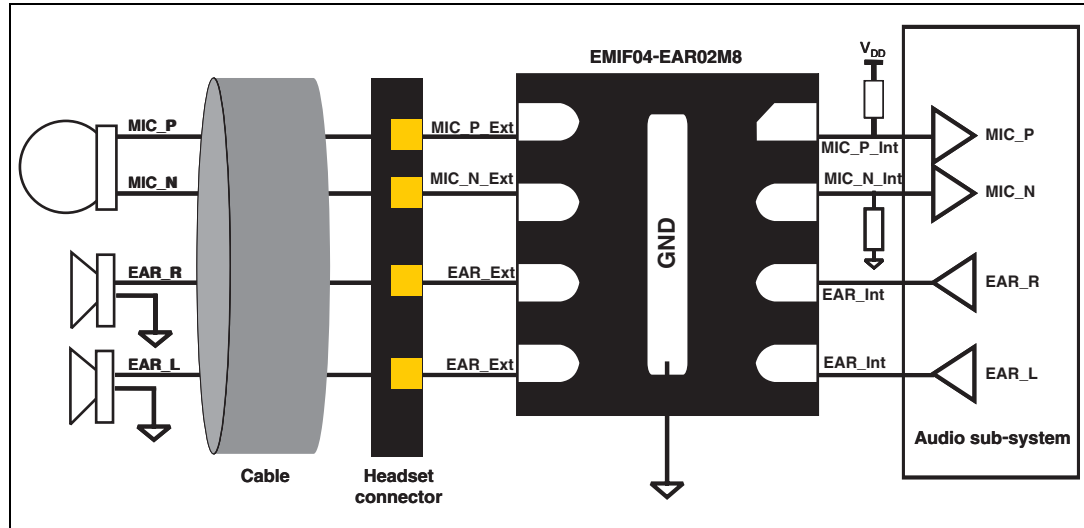


Figure 14. Total harmonic distortion with noise: EAR lines, R = 8 Ω



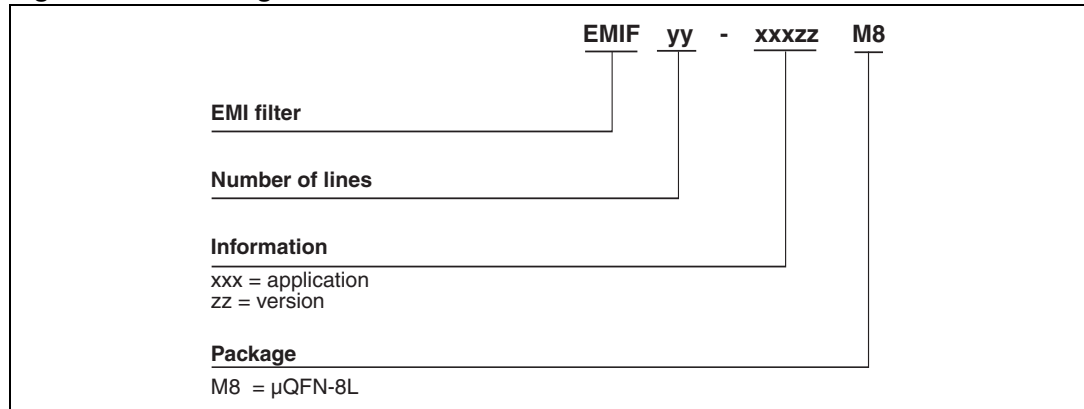
## 2 Application information

Figure 15. Example of application scheme using EMIF04-EAR02M8



## 3 Ordering information scheme

Figure 16. Ordering information scheme



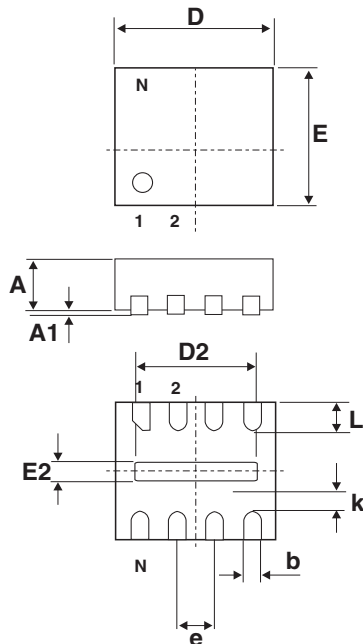
## 4 Package information

- Epoxy meets UL94, V0
- Lead-free package

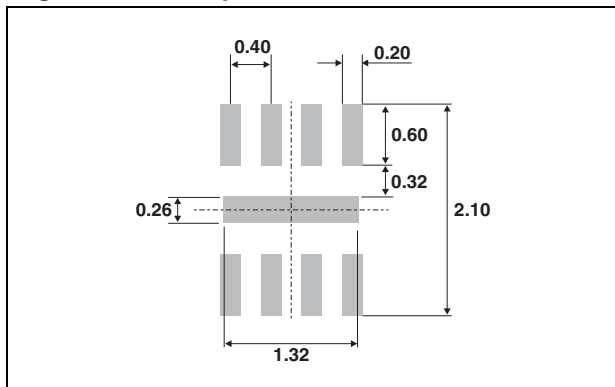
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

**Table 3. μQFN-8L dimensions**

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.50	0.55	0.60	0.020	0.022	0.024
A1	0.00	0.02	0.05	0.000	0.001	0.002
b	0.15	0.18	0.25	0.006	0.007	0.001
D	1.65	1.70	1.75		0.067	
D2	1.15	1.3	1.4	0.045	0.051	0.055
E	1.45	1.50	1.55		0.059	
E2	0.05	0.20	0.30	0.002	0.008	0.012
e		0.40			0.016	
k	0.20			0.008		
L	0.25	0.30	0.35	0.010	0.012	0.014



**Figure 17. Footprint**



**Figure 18. Marking**

Dot: Pin1 identification  
XX = Marking

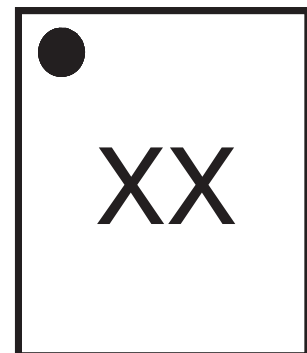
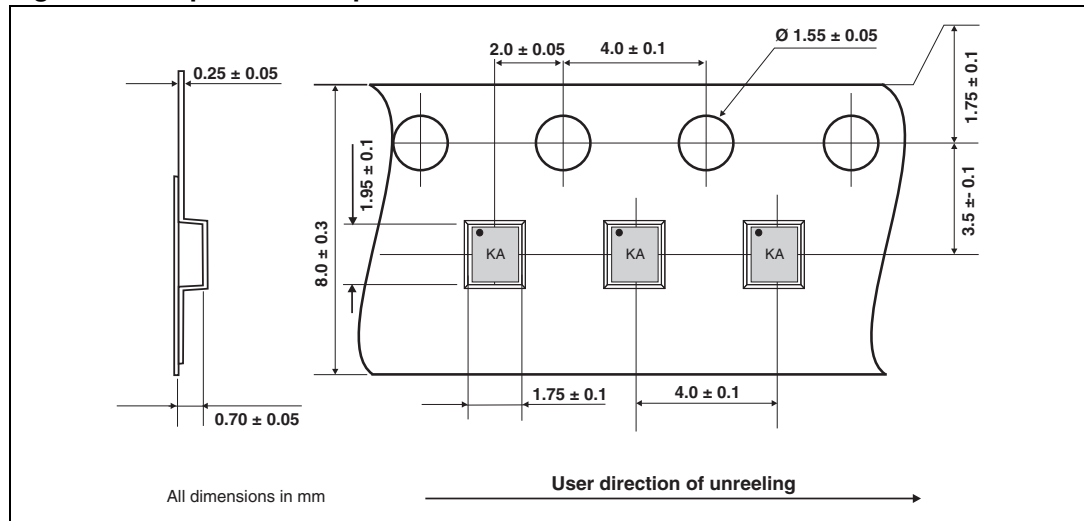


Figure 19. Tape and reel specification



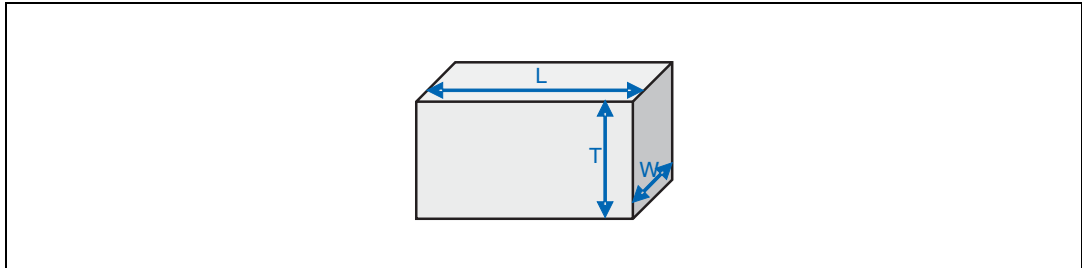
**Note:** *Product marking may be rotated by multiples of 90° for assembly plant differentiation. In no case should this product marking be used to orient the component for its placement on a PCB. Only pin 1 mark is to be used for this purpose.*

## 5 Recommendation on PCB assembly

### 5.1 Stencil opening design

1. General recommendation on stencil opening design
  - a) Stencil opening dimensions: L (Length), W (Width), T (Thickness).

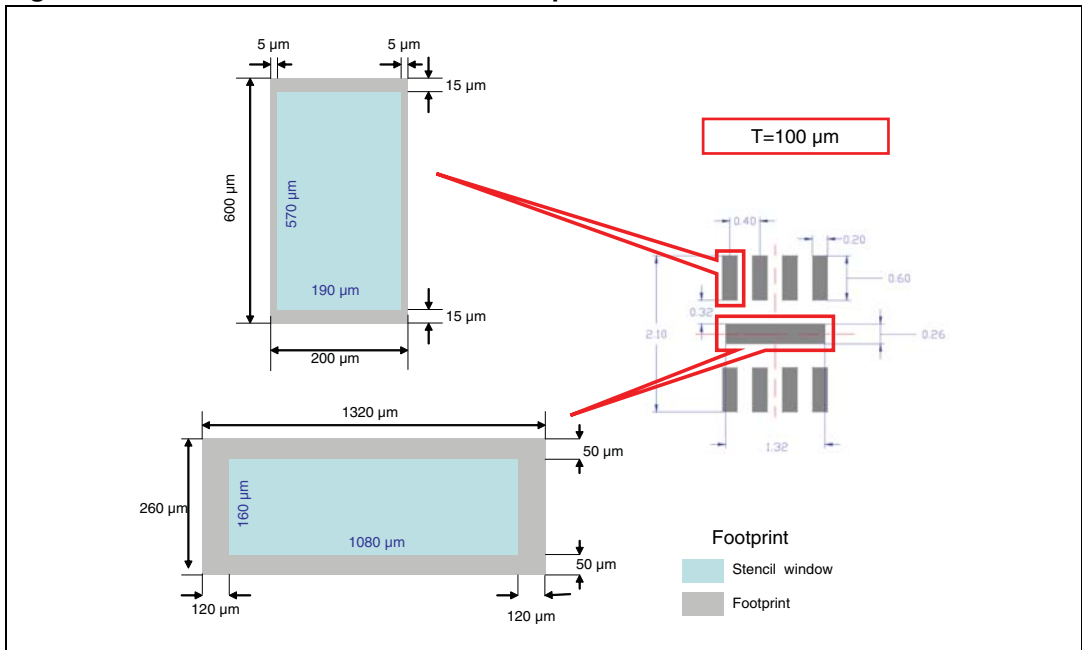
**Figure 20. Stencil opening dimensions**



- b) General design rule
  - Stencil thickness (T) = 75 ~ 125 μm
  - Aspect Ratio =  $\frac{W}{T} \geq 1.5$
  - Aspect Area =  $\frac{L \times W}{2T(L + W)} \geq 0.66$

2. Reference design
  - a) Stencil opening thickness: 100 μm
  - b) Stencil opening for central exposed pad: Opening to footprint ratio is 50%.
  - c) Stencil opening for leads: Opening to footprint ratio is 90%.

**Figure 21. Recommended stencil window position**





## 5.2 Solder paste

1. Halide-free flux qualification ROL0 according to ANSI/J-STD-004.
2. “No clean” solder paste is recommended.
3. Offers a high tack force to resist component movement during high speed
4. Solder paste with fine particles: powder particle size is 20-45  $\mu\text{m}$ .

## 5.3 Placement

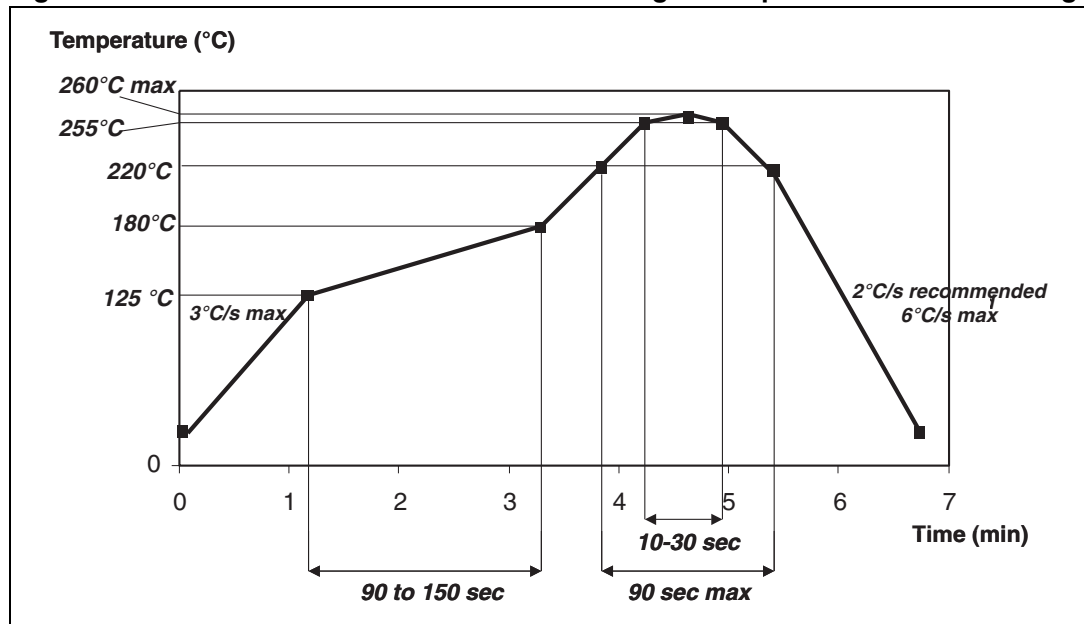
1. Manual positioning is not recommended.
2. It is recommended to use the lead recognition capabilities of the placement system, not the outline centering
3. Standard tolerance of  $\pm 0.05$  mm is recommended.
4. 3.5 N placement force is recommended. Too much placement force can lead to squeezed out solder paste and cause solder joints to short. Too low placement force can lead to insufficient contact between package and solder paste that could cause open solder joints or badly centered packages.
5. To improve the package placement accuracy, a bottom side optical control should be performed with a high resolution tool.
6. For assembly, a perfect supporting of the PCB (all the more on flexible PCB) is recommended during solder paste printing, pick and place and reflow soldering by using optimized tools.

## 5.4 PCB design preference

1. To control the solder paste amount, the closed via is recommended instead of open vias.
2. The position of tracks and open vias in the solder area should be well balanced. The symmetrical layout is recommended, in case any tilt phenomena caused by asymmetrical solder paste amount due to the solder flow away.

### 5.5 Reflow profile

Figure 22. ST ECOPACK® recommended soldering reflow profile for PCB mounting



Note: Minimize air convection currents in the reflow oven to avoid component movement.

## 6 Ordering information

**Table 4. Ordering information**

Order code	Marking	Package	Weight	Base qty	Delivery mode
EMIF04-EAR02M8	KA <sup>(1)</sup>	μQFN-8L	3.8 mg	3000	Tape and reel

1. The marking can be rotated by multiples of 90° to differentiate assembly location.

For the latest information on available order codes see the product pages on [www.st.com](http://www.st.com).

## 7 Revision history

**Table 5. Document revision history**

Date	Revision	Changes
24-Mar-2009	1	Initial release
02-Sep-2010	2	Changed "input pins" to "all pins" in standards compliance section. Updated <a href="#">Figure 16</a> . Added paragraph in <a href="#">Section 6: Ordering information</a> .

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