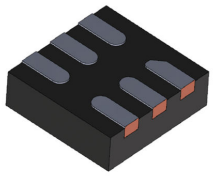
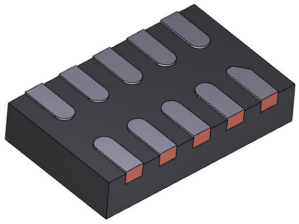
ECMF2-40A100N6, ECMF4-40A100N10

Datasheet

Common mode filter with ESD protection for high speed serial interface



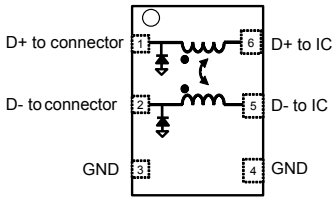
µQFN-6L (Bottom view)
1.35 mm x 1.4 mm x 0.5mm



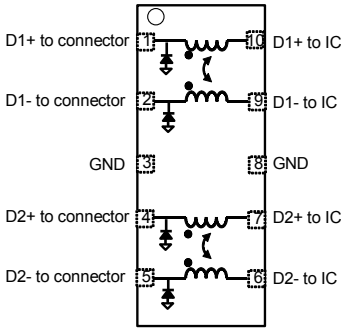
µQFN-10L (Bottom view)
1.35 mm x 2.2 mm x 0.5mm

Functional schematic

ECMF2-40A100N6



ECMF4-40A100N10



Features

- 10.7 GHz differential bandwidth to comply with HDMI 2.1, HDMI 2.0, HDMI 1.4, USB4, USB 3.2 Gen2, USB 2.0, MIPI, Display port 2.0, etc.
- High common mode attenuation on WLAN frequencies:
  - -15 dB at 2.4 GHz
  - -21 dB at 5.0 GHz
  - -17 dB at 6.0 GHz
- Low serial resistance: 3.0 Ω
- Very low PCB space consumption
- Thin package: 0.5 mm max.
- High reduction of parasitic elements through integration
- Lead free and RoHS package
- Exceeds IEC 61000-4-2 level 4 standard:
  - Contact discharge:
    - ±9 kV (contact discharge, ECMF2-40A100N6)
    - ±10 kV (contact discharge, ECMF4-40A100N10)
  - Air discharge:
    - ±20 kV (air discharge, ECMF2-40A100N6)
    - ±25 kV (air discharge, ECMF4-40A100N10)

Applications

- Notebook, laptop
- Streaming box, HDMI stick
- Game console, Set top box
- Tablet
- Portable devices

Description

The ECMF2-40A100N6 and ECMF4-40A100N10 are highly integrated common mode filters designed to suppress EMI/RFI common mode noise on high speed differential serial buses like HDMI 2.1, HDMI 2.0, HDMI1.4, USB4, USB 3.2 Gen 2, USB 2.0, ethernet, MIPI, Display Port and other high speed serial interfaces.

They have a very large differential bandwidth to comply with these standards and can also protect and filter one or two differential lanes.

Product status	
Part number	**Package**
ECMF2-40A100N6	µQFN-6L
ECMF4-40A100N10	µQFN-10L

1 Characteristics

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

Symbol	Parameter		Value	Unit
V_{PP}	Peak pulse voltage	IEC 61000-4-2 contact discharge: ECMF2-40A100N6 ECMF4-40A100N10	 ±9 ±10	kV
		IEC 61000-4-2 air discharge: ECMF2-40A100N6 ECMF4-40A100N10	 ±20 ±25	kV
I_{RMS}	Maximum RMS current		100	mA
T_{op}	Maximum operating temperature range		-55 to +125	°C
T_{stg}	Storage temperature range		-55 to +150	
T_L	Maximum temperature for soldering during 10 s		260	

Figure 1. Electrical characteristics (definitions)

V_{RM} Maximum stand-off voltage
V_{CL} Clamping voltage at peak pulse current I_{PP}
I_{RM} Leakage current at V_{RM}
I_{PP} Peak pulse current
V_{BR} Breakdown voltage
C_{DIODE} ESD diode capacitance
R_{DC} DC serial resistance
f_C Differential cut off frequency

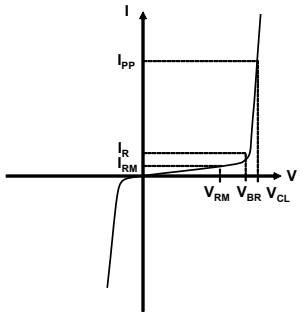


Table 2. Electrical characteristics (T_{amb} = 25 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{BR}	Breakdown voltage	I_R = 1 mA	5.3	5.8		V
I_{RM}	Leakage current	V_{RM} = 3.6 V per line		< 1	50	nA
		V_{RM} = 5 V per line		3	70	
V_{RM}	Reverse working voltage				5	V
R_{DC}	DC serial resistance, I_{DC} = 20 mA			3.0		Ω
f_c	Differential mode cut-off frequency(1)			10.7		GHz
V_{CL}	Reverse clamping voltage	TLP measurement (pulse duration 100 ns), 16 A I_{PP}		20.5		V
		8 kV contact discharge after 30 ns, IEC 61000-4-2		18		
C_{DIODE}	Capacitance	V_{BIAS} = 0 V, F = 2.5 GHz to 9 GHz, V_{OSC} = 30 mV		0.25	0.40	pF
R_D	Dynamic resistance, TLP measurement (pulse duration 100 ns)			0.8		Ω

1. *Attenuation at 10 MHz as reference.*

Figure 2. Functional schematic (ECMF2-40A100N6)

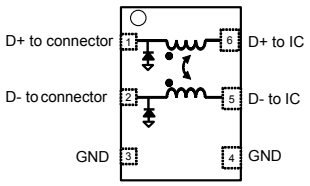


Table 3. ECMF2-40A100N6 pin discription

Pin number	Description	Pin number	Description
1	D+ to connector	6	D+ to IC
2	D- to connector	5	D- to IC
3	GND	4	GND

Figure 3. Functional schematic (ECMF4-40A100N10)

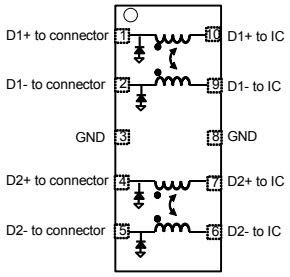


Table 4. ECMF4-40A100N10 pin description

Pin number	Description	Pin number	Description
1	D1+ to connector	10	D1+ to IC
2	D1- to connector	9	D1- to IC
3	GND	8	GND
4	D2+ to connector	7	D2+ to IC
5	D2- to connector	6	D2- to IC

1.1 Characteristics (curves)

Figure 4. Differential attenuation versus frequency ($Z_{0\ DIFF}$ = 100 Ω)

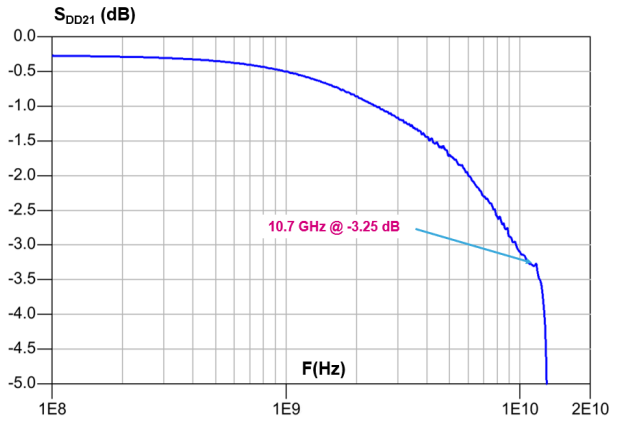


Figure 5. Common mode attenuation versus frequency ($Z_{0\ COM}$ = 50 Ω)

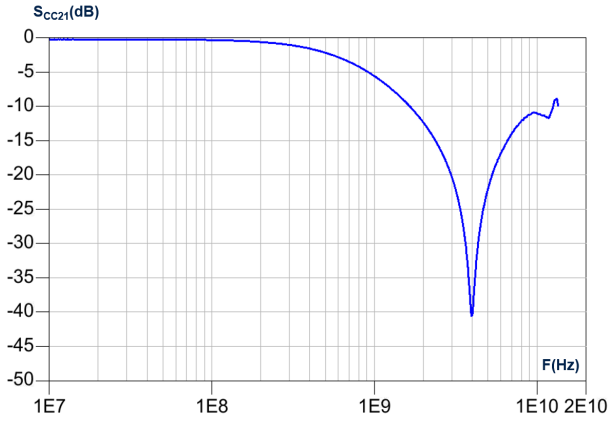


Figure 6. HDMI2.1 12 Gbps eye diagram without ECMFx-40A100Nx (with worst cable model (WCM3), EQ with 8 dB CTLE and One-tap DFE)

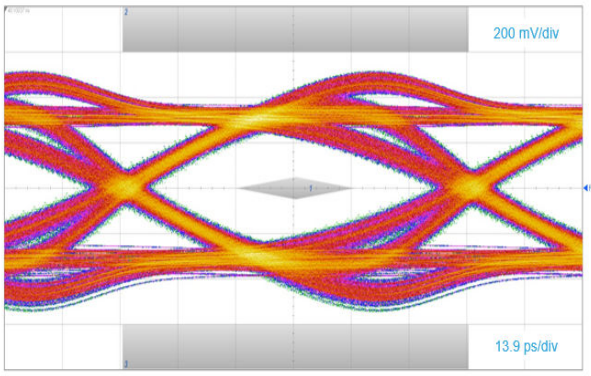


Figure 7. HDMI2.1 12 Gbps eye diagram with ECMFx-40A100Nx (with worst cable model (WCM3), EQ with 8 dB CTLE and One-tap DFE)

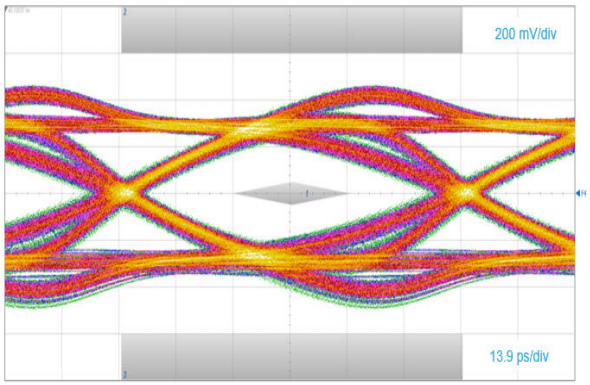


Figure 8. HDMI2.0 5.94 Gbps eye diagram without ECMFx-40A100Nx (with worst cable model and equalizer)

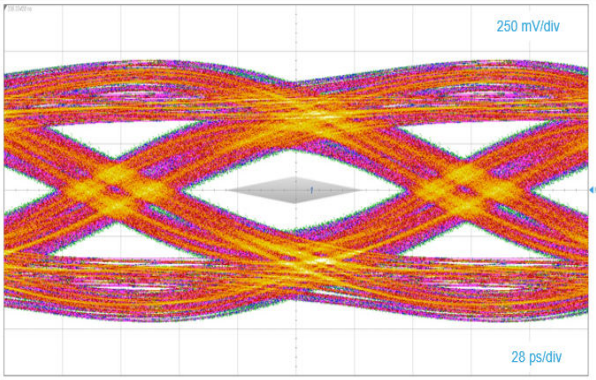


Figure 9. HDMI2.0 5.94 Gbps eye diagram with ECMFx-40A100Nx (with worst cable model and equalizer)

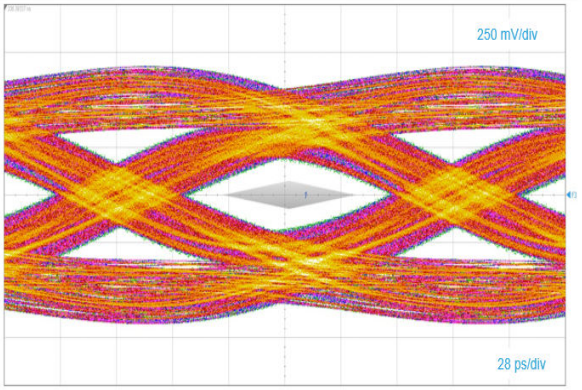


Figure 10. USB4 20.0 Gbps eye diagram without ECMFx-40A100Nx (with Preset 0, reference cable 0.8m, equalizer with ADC = 0dB and DFE)

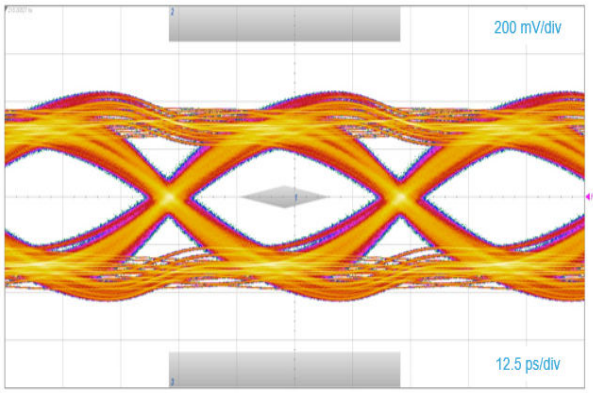


Figure 11. USB4 20.0 Gbps eye diagram with ECMFx-40A100Nx (with Preset 0, reference cable 0.8m, equalizer with ADC = 0dB and DFE)

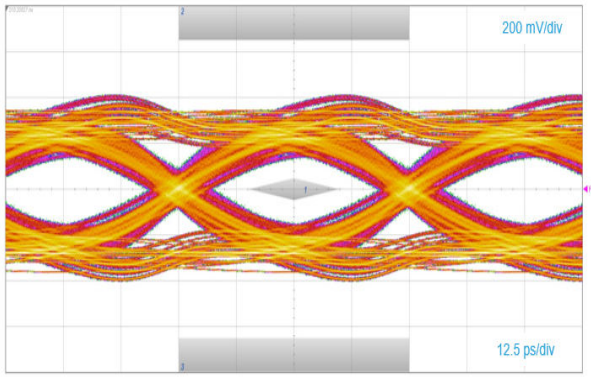


Figure 12. USB3.2 Gen 2 10.0 Gbps eye diagram without ECMFx-40A100Nx (with type C connector, reference cable, equalizer with ADC = 5 dB and DFE)

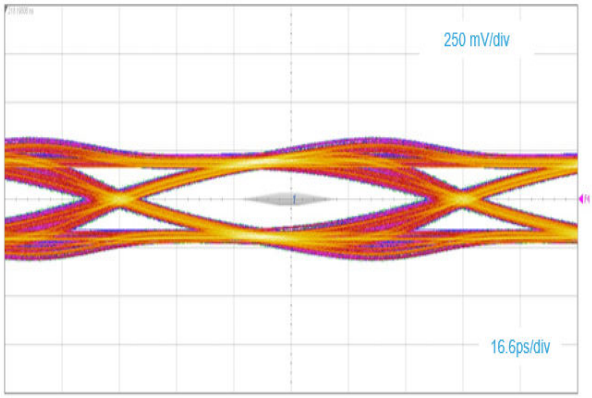


Figure 13. USB3.2 Gen 2 10.0 Gbps eye diagram with ECMFx-40A100Nx (with type C connector, reference cable, equalizer with ADC = 5 dB and DFE)

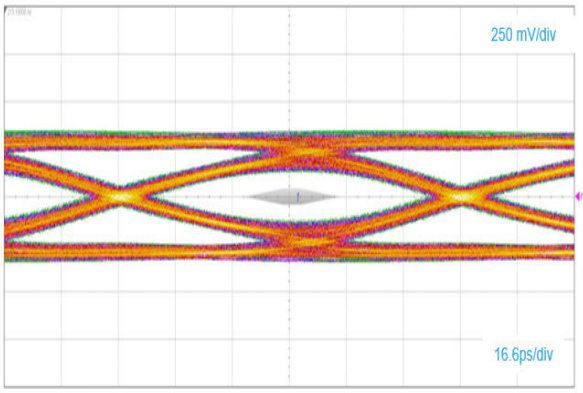


Figure 14. USB3.2 Gen 1 5.0 Gbps eye diagram without ECMFx-40A100Nx (with type C connector, reference cable and equalizer)

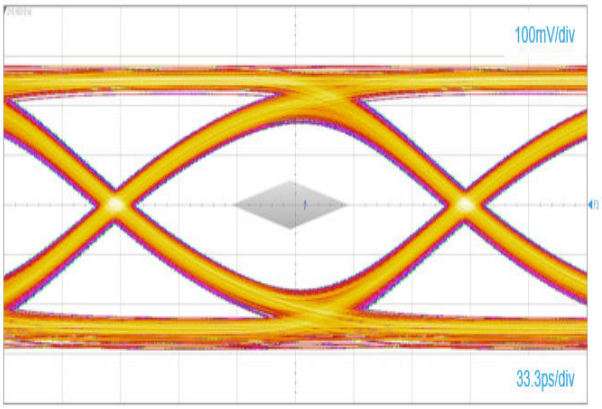


Figure 15. USB3.2 Gen 1 5.0 Gbps eye diagram with ECMFx-40A100Nx (with type C connector, reference cable and equalizer)

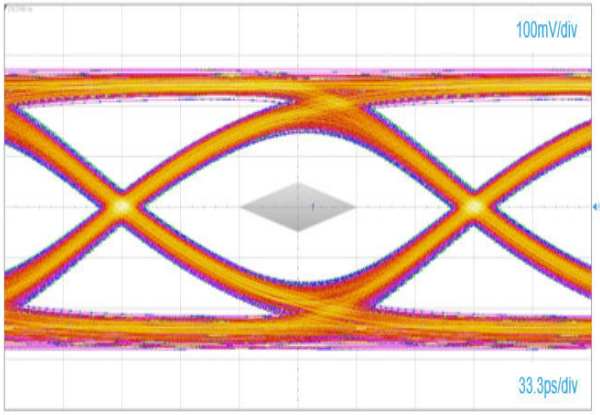


Figure 16. USB 2.0 High Speed 480 Mbps eye diagram, Template 1, without ECMFx-40A100Nx

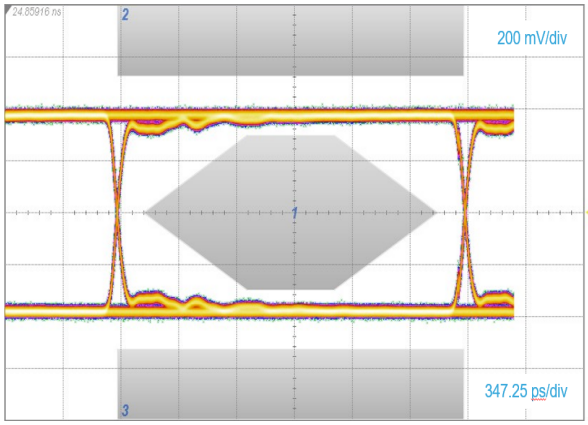


Figure 17. USB 2.0 High Speed 480 Mbps eye diagram, Template 1, with ECMFx-40A100Nx

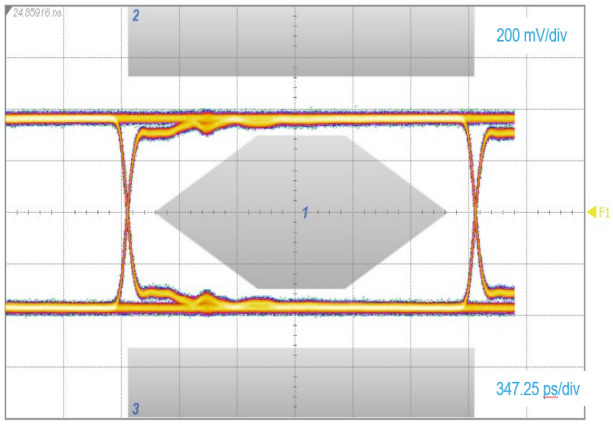


Figure 18. MIPI M-PHY – Gear 3 at 5.83 Gbps eye diagram without ECMFx-40A100Nx

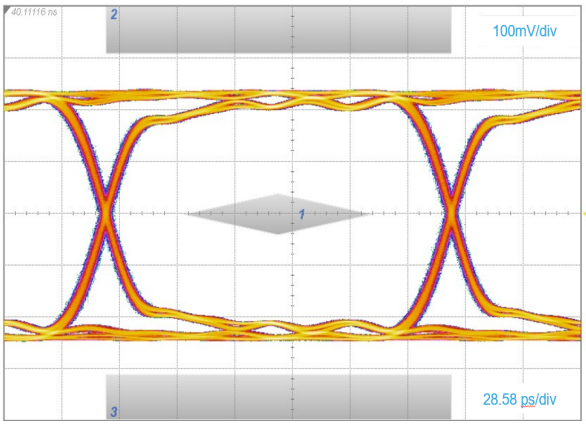


Figure 19. MIPI M-PHY – Gear 3 at 5.83 Gbps eye diagram with ECMFx-40A100Nx

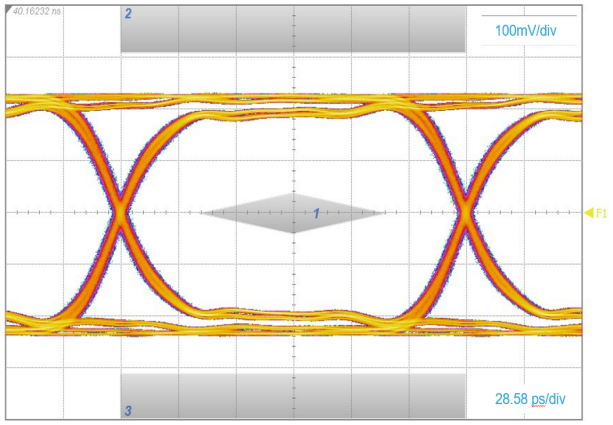


Figure 20. MIPI M-PHY – Gear 4 at 11.66 Gbps eye diagram without ECMFx-40A100Nx

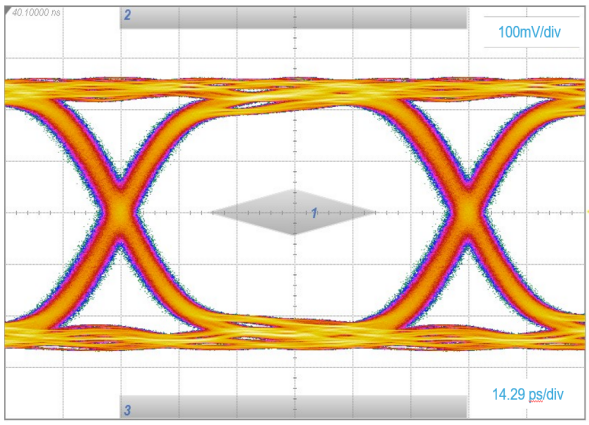


Figure 21. MIPI M-PHY – Gear 4 at 11.66 Gbps eye diagram with ECMFx-40A100Nx

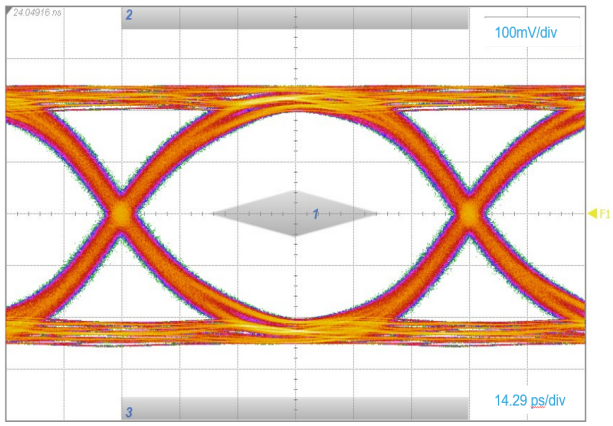


Figure 22. ESD response to IEC61000-4-2 (+8 kV contact discharge)

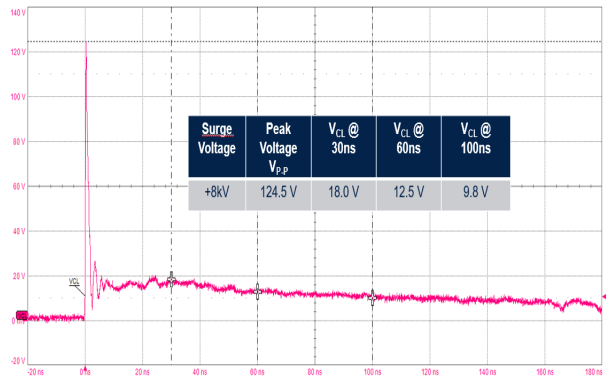


Figure 23. ESD response to IEC61000-4-2 (-8 kV contact discharge)

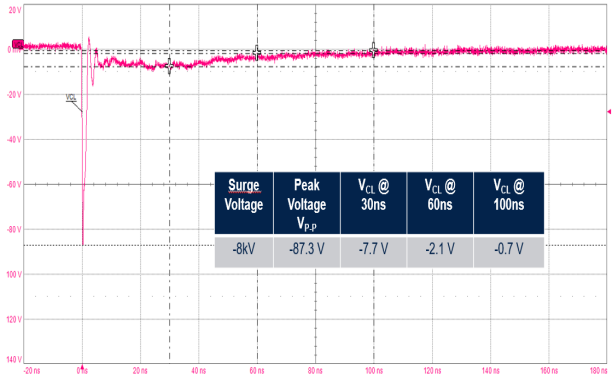
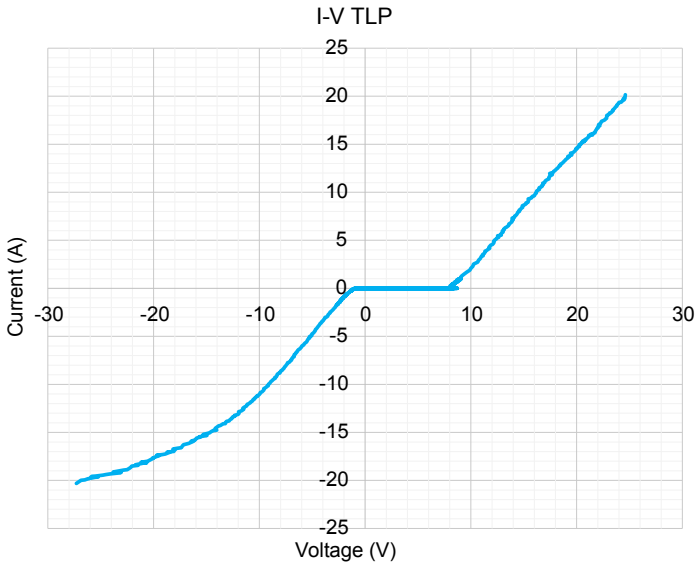


Figure 24. TLP characteristic



2 Package information

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.

2.1 µQFN6L package information

Figure 25. µQFN6L package outline

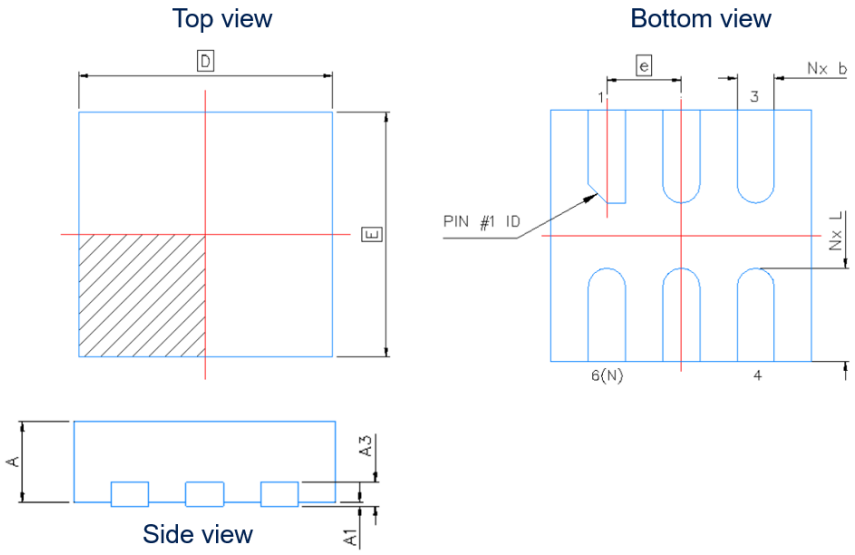


Table 5. µQFN6L package mechanical data

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
A	0.41	0.45	0.50
A1	0.00	0.02	0.05
A3		0.127	
b	0.15	0.20	0.25
D	1.35	1.40	1.45
E	1.30	1.35	1.40
e		0.40	
L	0.40	0.50	0.60
N		6	

2.2 µQFN10L package information

Figure 26. **µQFN10L package outline**

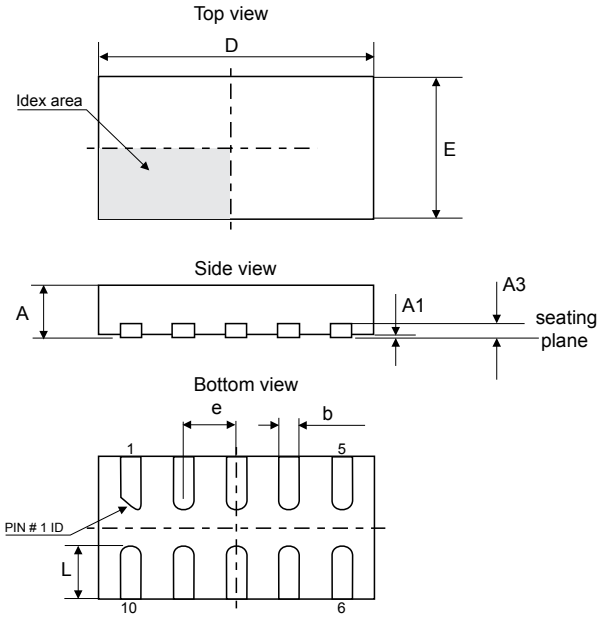


Table 6. **µQFN10L package mechanical data**

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
A	0.41	0.45	0.50
A1	0.00	0.02	0.05
A3		0.127	
b	0.15	0.20	0.25
D	2.15	2.20	2.25
E	1.30	1.35	1.40
e		0.40	
L	0.40	0.50	0.60

2.3 Packing information

Figure 27. **ECMF2-40A100N6 marking**

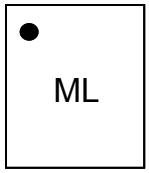
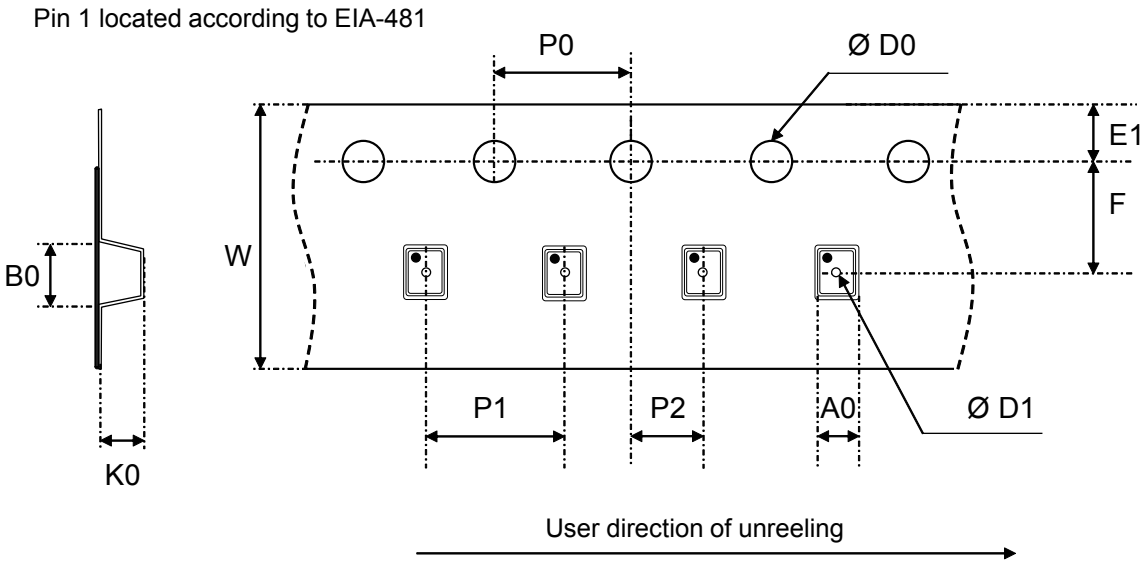


Figure 28. **ECMF4-40A100N10 marking**

Note: The marking codes can be rotated by 90 ° or 180° to differentiate assembly location. 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.

Figure 29. **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

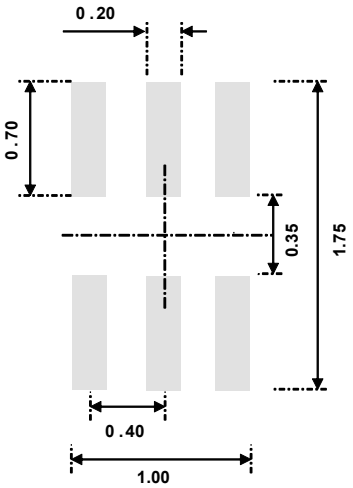
Ref.	Dimensions (millimeters)		
	Min.	Typ.	Max.
P1	3.90	4.00	4.10
P0	3.90	4.00	4.10
Ø D0	1.40	1.50	1.60
Ø D1 (ECMF2-40A100N6)	0.45	0.50	0.55
Ø D1 (ECMF4-40A100N10)	0.8		
F	3.45	3.50	3.55
E1	1.65	1.75	1.85
K0 (ECMF2-40A100N6)	0.70	0.75	0.80
K0 (ECMF4-40A100N10)	0.60	0.65	0.70
P2	1.95	2.00	2.05
W	7.90	8.00	8.10
A0 (ECMF2-40A100N6)	1.43	1.48	1.53
A0 (ECMF4-40A100N10)	1.50	1.55	1.60
B0 (ECMF2-40A100N6)	1.75	1.80	1.85
B0 (ECMF4-40A100N10)	2.35	2.40	2.45

3 Recommendation on PCB assembly

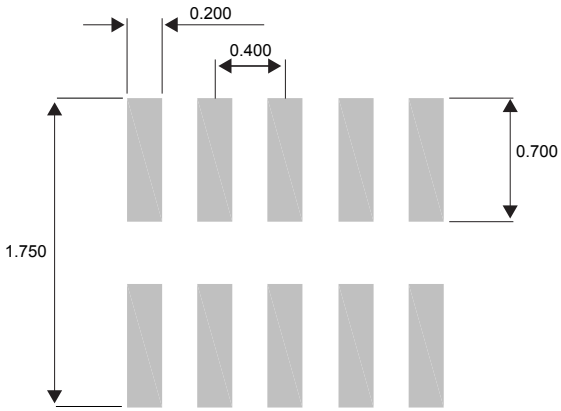
3.1 Footprint

Figure 30. **ECMF2-40A100N6 footprint in mm**

Figure 31.



ECMF4-40A100N10 footprint in mm



SMD footprint design is recommended.

3.2 Stencil opening design

Recommended design reference: stencil opening thickness: 100 µm

Figure 32. ECMF2-40A100N6 stencil opening recommendations

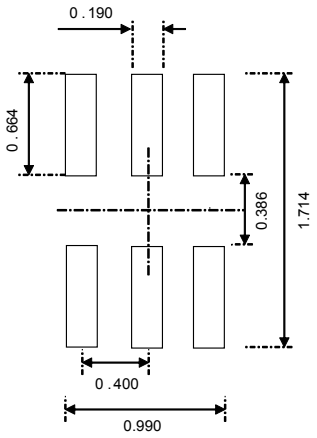
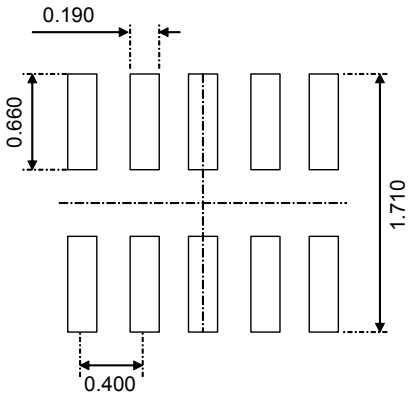


Figure 33. ECMF4-40A100N10 stencil opening recommendations



3.3 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 PCB movement.
4. Solder paste with fine particles: powder particle size is 20-38 µm.

3.4 Placement

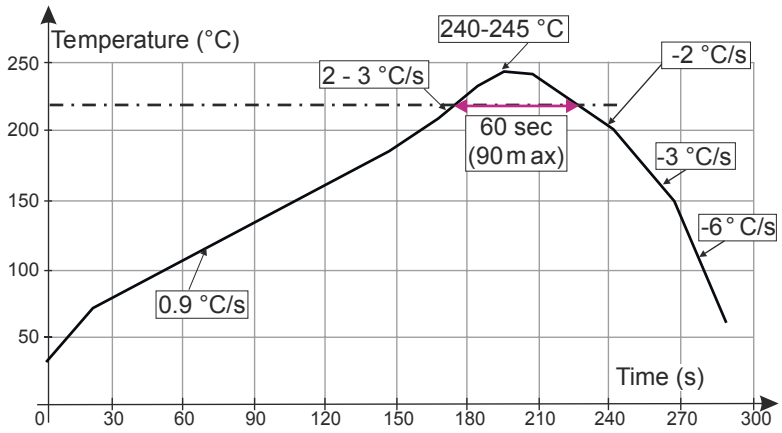
1. Manual positioning is not recommended.
2. It is recommended to use the lead recognition capabilities of the placement system, not the outline centering
3. Standard tolerance of ±0.05 mm is recommended.
4. 3.5 N placement force is recommended. Too much placement force can lead to squeezed out solder 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.

3.5 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. A symmetrical layout is recommended, to avoid any tilt phenomena caused by asymmetrical solder paste due to solder flow away.

3.6 Reflow profile

Figure 34. ST ECOPACK® recommended soldering reflow profile for PCB mounting



Note: Minimize air convection currents in the reflow oven to avoid component movement. Maximum soldering profile corresponds to the latest IPC/JEDEC J-STD-020.

4 Ordering information

Figure 35. Ordering information scheme

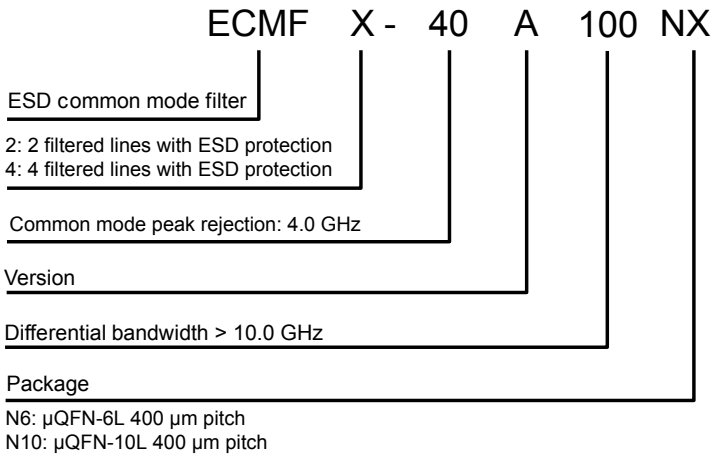


Table 8. Ordering information

Order code	Marking[1]	Package	Weight	Base qty.	Delivery mode
ECMF2-40A100N6	ML	µQFN-6L	2.4 mg	3000	Tape and reel
ECMF4-40A100N10	MK	µQFN-10L	3.9 mg	3000	Tape and reel

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

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
14-Feb-2022	1	Initial release.
19-May-2022	2	Added from *Figure 15* to *Figure 20*.
27-Sep-2022	3	Updated *Figure 3*.
30-Jan-2025	4	Updated Section Cover image, Section Pin configuration, Figure 2, Table 3, Figure 3, and Table 4.