AC Line EMI Suppression and RC Networks

P278 Series Metallized Impregnated Paper, Class X1, 480 VAC

Overview

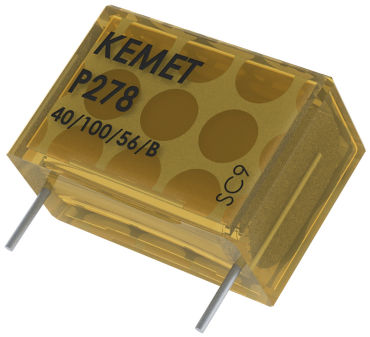
The P278 Series is constructed of multilayer metallized paper encapsulated and impregnated in self-extinguishing material meeting the requirements of UL 94 V–0.

Applications

Typical applications include worldwide use as an electromagnetic interference suppressor in all X1 and across-the-line applications.

Benefits

- Approvals: ENEC, UL, cUL
- Rated voltage: 480 VAC 50/60 Hz
- Capacitance range: 0.001 – 0.15 µF
- Lead spacing: 10.2 – 25.4 mm
- Capacitance tolerance: ±20%
- Climatic category: 40/110/56, IEC 60068–1
- Tape and reel in accordance with IEC 60286–2
- RoHS Compliant and lead-free terminations
- Operating temperature range of -40˚C to +110˚C
- 100% screening factory test at 2,700 VDC
- Highest possible safety regarding active and passive flammability
- Excellent self-healing properties which ensure long life even when subjected to frequent over voltages
- Good resistance to ionization due to impregnated paper dielectric
- Impregnated paper ensures excellent stability and reliability properties, particularly in applications with continuous operation



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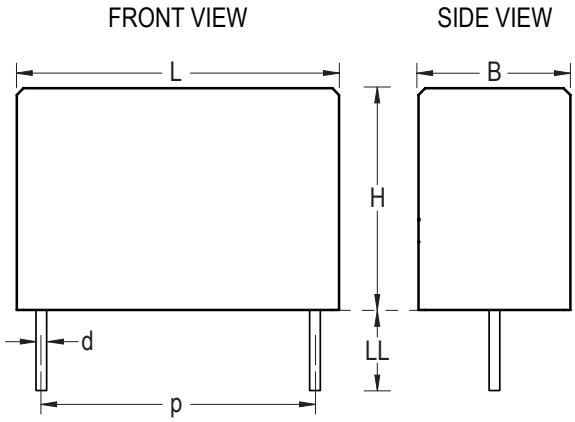
Part Number System

P	278	H	E	102	M	480	A
Capacitor Class	Series	Lead Spacing (mm)	Size Code	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VAC)	Lead and Packaging Code
P = Paper	X1, Metallized Paper	H = 10.2 Q = 15.2 C = 20.3 S = 22.5 E = 25.4	See Dimension Table	First two digits indicate the two most significant digits of the capacitance value in picofarads. The third digit is the number of following zeros.	M = ±20%	480 = 480	See Ordering Options Table

Ordering Options Table

Lead Spacing Nominal (mm)	Type of Leads and Packaging	Lead Length (mm)	Part Number (Insert at 14th character)
10.2	**Standard Lead and Packaging Options**		
	Bulk – Short Leads	6 +0/-1	C
	Bulk – Maximum Length Leads	30 +5/-0	A
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L
	Other Lead and Packaging Options		
	Ammo Pack	H_0= 18.5 +/-0.5	XLAF1
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P
15.2	**Standard Lead and Packaging Options**		
	Bulk – Short Leads	6 +0/-1	C
	Bulk – Maximum Length Leads	30 +5/-0	A
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L
	Other Lead and Packaging Options		
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P
20.3	**Standard Lead and Packaging Options**		
	Tray – Short Leads	6 +0/-1	C
	Bulk – Maximum Length Leads	30 +5/-0	A
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L
	Other Lead and Packaging Options		
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P
22.5	**Standard Lead and Packaging Options**		
	Tray – Short Leads	6 +0/-1	C
	Bulk – Maximum Length Leads	30 +5/-0	A
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L
	Other Lead and Packaging Options		
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P
25.4	**Standard Lead and Packaging Options**		
	Tray – Short Leads	6 +0/-1	C
	Bulk – Maximum Length Leads	30 +5/-0	A

Dimensions – Millimeters



Size Code	p		B		H		L		d	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
HE	10.2	+/-0.4	3.9	Maximum	7.5	Maximum	13.5	Maximum	0.6	+/-0.05
HH	10.2	+/-0.4	4.1	Maximum	8.2	Maximum	13.5	Maximum	0.6	+/-0.05
HL	10.2	+/-0.4	5.1	Maximum	10.5	Maximum	13.5	Maximum	0.6	+/-0.05
QE	15.2	+/-0.4	5.2	Maximum	10.5	Maximum	18.5	Maximum	0.8	+/-0.05
QJ	15.2	+/-0.4	5.5	Maximum	11.1	Maximum	18.5	Maximum	0.8	+/-0.05
QS	15.2	+/-0.4	8.5	Maximum	14.3	Maximum	18.5	Maximum	0.8	+/-0.05
CE	20.3	+/-0.4	7.6	Maximum	14.0	Maximum	24.0	Maximum	0.8	+/-0.05
CJ	20.3	+/-0.4	9.0	Maximum	15.0	Maximum	24.0	Maximum	0.8	+/-0.05
CP	20.3	+/-0.4	11.3	Maximum	16.5	Maximum	24.0	Maximum	0.8	+/-0.05
SJ	22.5	+/-0.4	8.0	Maximum	17.0	Maximum	27.0	Maximum	0.8	+/-0.05
SP	22.5	+/-0.4	10.0	Maximum	19.0	Maximum	27.0	Maximum	0.8	+/-0.05
SU	22.5	+/-0.4	12.0	Maximum	22.0	Maximum	27.0	Maximum	0.8	+/-0.05
EJ	25.4	+/-0.4	12.1	Maximum	19.0	Maximum	30.5	Maximum	1.0	+/-0.05
EL	25.4	+/-0.4	15.3	Maximum	22.0	Maximum	30.5	Maximum	1.0	+/-0.05

Note: See Ordering Options Table for lead length (LL) options.

Performance Characteristics

Rated Voltage	480 VAC 50/60 Hz	
Capacitance Range	0.001 – 0.15 µF	
Capacitance Tolerance	±20%	
Temperature Range	-40°C to +110°C	
Climatic Category	40/110/56/B	
Approvals	ENEC, UL, cUL	
Dissipation Factor	Maximum Values at +23°C	
	1 kHz	1.3%
Test Voltage Between Terminals	The 100% screening factory test is carried out at 2,700 VDC. The voltage level is selected to meet the requirements in applicable equipment standards. All electrical characteristics are checked after the test. It is not permitted to repeat this test as there is a risk to damage the capacitor. KEMET is not liable in such case for any failures.	
Insulation Resistance	Minimum Value Between Terminals	
	≥ 12,000 MΩ	
In DC Applications	Recommended voltage ≤ 1,000 VDC	

Environmental Test Data

Test	IEC Publication	Procedure
Vibration	IEC 60068–2–6 Test Fc	3 directions at 2 hours each 10 – 500 Hz at 0.75 mm or 98 m/s^2
Bump	IEC 60068–2–29 Test Eb	4,000 bumps at 390 m/s^2
Change of Temperature	IEC 60068–2–14 Test Na	Upper and lower rated temperature 5 cycles
Active Flammability	IEC 60384–14	V_R + 20 surge pulses at 4.0 kV (pulse every 5 seconds)
Passive Flammability	IEC 60384–14	IEC 60384–1, IEC 60695–11–5 Needle-flame test
Damp Heat Steady State	IEC 60068–2–78 Test Cab	+40°C and 93% RH, 56 days

Approvals

Certification Body	Mark	Specification	File Number
Intertek Semko AB		EN/IEC 60384-14	SE/0140–35
UL		UL 60384-14 CAN/ CSA-E60384-14-09	E73869

Environmental Compliance

All KEMET EMI capacitors are RoHS Compliant.

RoHS Compliant

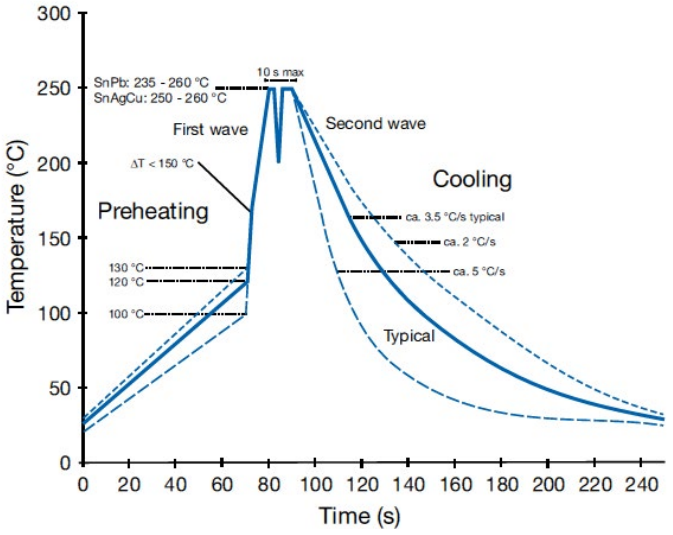
Table 1 – Ratings & Part Number Reference

Capacitance Value (µF)	Maximum Dimensions in mm			Lead Spacing (p)	f_o (MHz)	dV/dt (V/µs)	KEMET Part Number
	B	H	L				
0.001	3.9	7.5	13.5	10.2	53	2000	P278HE102M480(1)
0.0015	3.9	7.5	13.5	10.2	44	2000	P278HE152M480(1)
0.0022	3.9	7.5	13.5	10.2	37	2000	P278HE222M480(1)
0.0033	4.1	8.2	13.5	10.2	30	2000	P278HH332M480(1)
0.0047	5.1	10.5	13.5	10.2	24	2000	P278HL472M480(1)
0.0068	5.2	10.5	18.5	15.2	18.5	1400	P278QE682M480(1)
0.010	5.2	10.5	18.5	15.2	15.5	1400	P278QE103M480(1)
0.015	5.5	11.1	18.5	15.2	13	1400	P278QJ153M480(1)
0.022	8.5	14.3	18.5	15.2	9.6	1400	P278QS223M480(1)
0.033	7.6	14.0	24.0	20.3	9.6	1000	P278CE333M480(1)
0.047	9.0	15.0	24.0	20.3	7.5	1000	P278CJ473M480(1)
0.068	11.3	16.5	24.0	20.3	6.2	1000	P278CP683M480(1)
0.033	8.0	17.0	27.0	22.5	7.2	1000	P278SJ333M480(1)
0.047	8.0	17.0	27.0	22.5	6	1000	P278SJ473M480(1)
0.068	10.0	19.0	27.0	22.5	4.8	1000	P278SP683M480(1)
0.1	12.0	22.0	27.0	22.5	3.6	600	P278SU104M480(1)
0.1	12.1	19.0	30.5	25.4	3.9	600	P278EJ104M480(1)
0.15	15.3	22.0	30.5	25.4	3.2	600	P278EL154M480(1)
Capacitance Value (µF)	**B (mm)**	**H (mm)**	**L (mm)**	**Lead Spacing (p)**	**f_o (MHz)**	**dV/dt (V/µs)**	**KEMET Part Number**

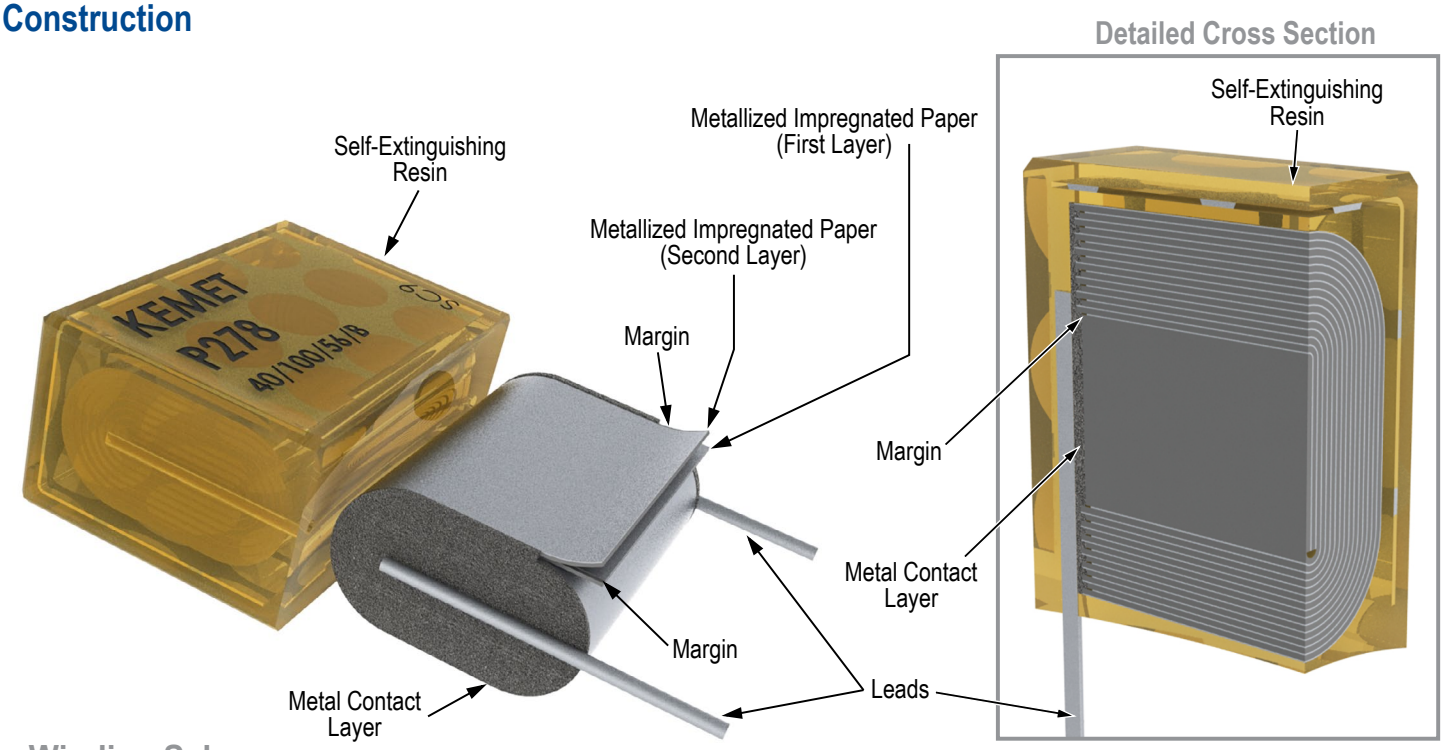
(1) Insert ordering code for lead type and packaging. See Ordering Options Table for available options.

Soldering Process

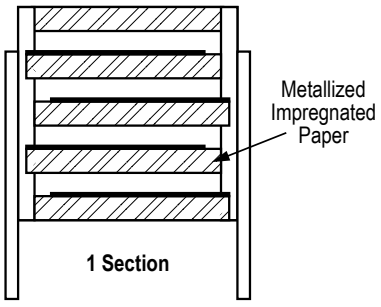
The implementation of the RoHS Directive has required the use of SnAgCu (SAC) or SnCu alloys as primary solder. These alloys require a higher liquidus temperature (217ºC – 221ºC) as compared to SnPb eutectic alloy (183ºC). Due to the higher pre-heat and wave temperatures, the heat stress to components has increased considerably. Polypropylene capacitors are especially sensitive to soldering temperature due to the relatively low melting point of polypropylene material (160ºC – 170ºC). As a result, wave soldering can be destructive, especially to mechanically small polypropylene capacitors with lead spacings of 5 – 10 mm. For more information, please refer to KEMET's Recommended Soldering Profiles or contact a KEMET representative. IEC Publication 61760–1 Edition 2 may also be consulted for general guidelines.



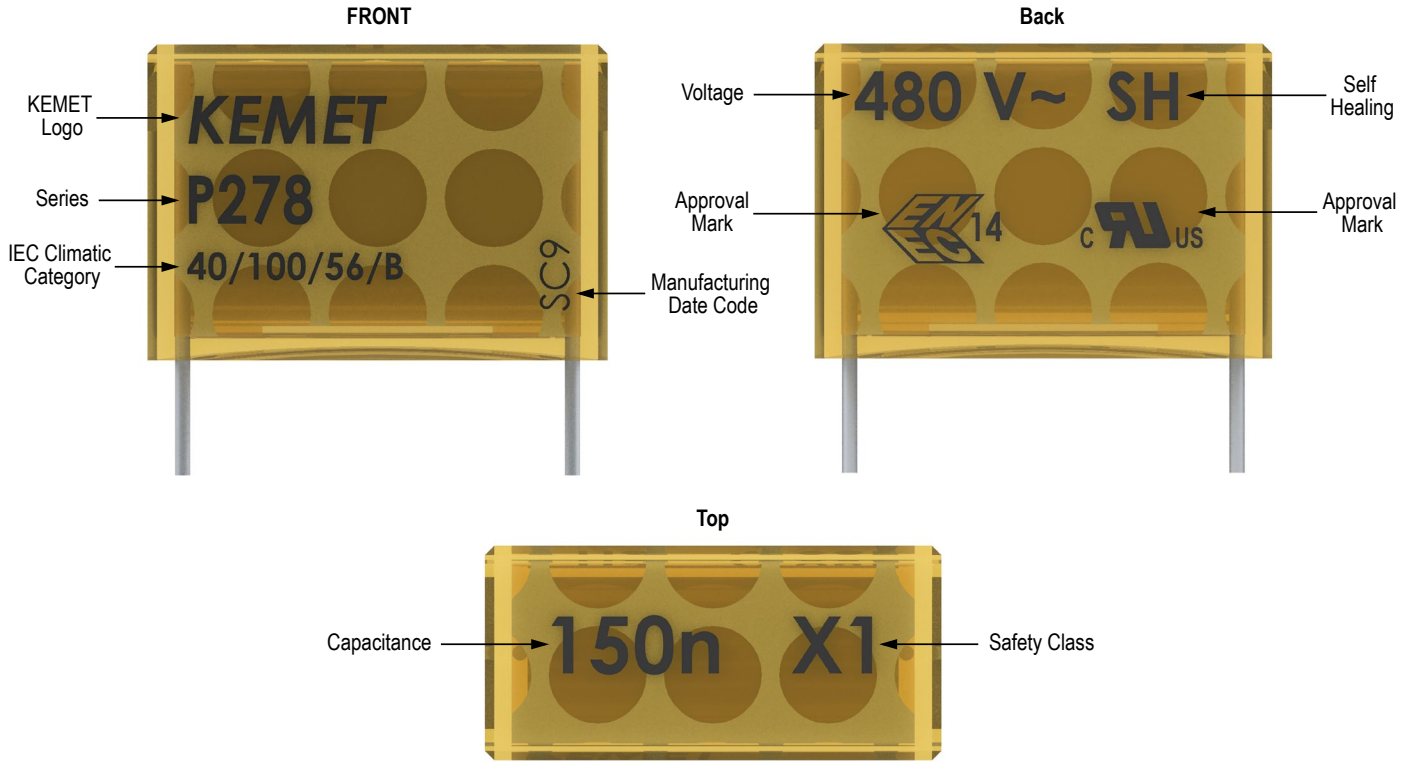
Construction



Winding Scheme



Marking

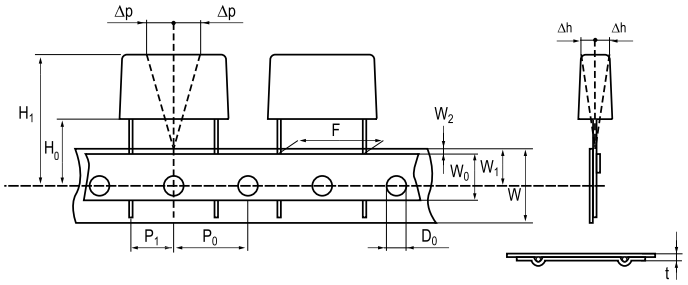

FRONT
KEMET Logo
KEMET
Series
P278
IEC Climatic Category
40/100/56/B
SC9
Manufacturing Date Code
Back
Voltage
480 V~ SH
Self Healing
Approval Mark
14
C US
Approval Mark
Top
Capacitance
150n X1
Safety Class

Packaging Quantities

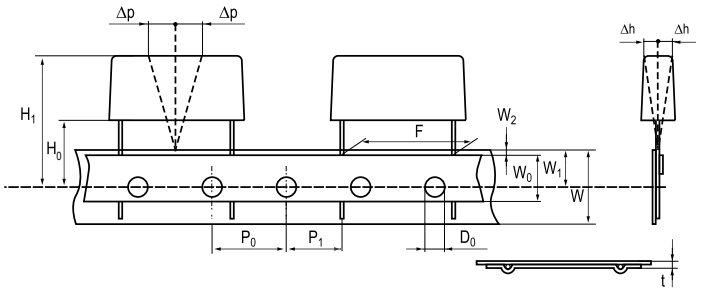
Lead Spacing (mm)	Thickness (mm)	Height (mm)	Length (mm)	Bulk Short Leads	Bulk Long Leads	Standard Reel ø 360 mm	Large Reel ø 500 mm	Ammo Formed
10.2	3.9	7.5	13.5	2000	1000	700	1400	800
	4.1	8.2	13.5	2000	1000	600		780
	5.1	10.5	13.5	1600	800	600	1200	630
15.2	5.5	12.5	18.0	1000	500	600		
	6.5	12.5	18.0	600	400	400		
	7.5	14.5	18.0	600	400	400		
	8.5	16.0	18.0	400	250	400		
	5.2	10.5	18.5	1000	500	600		
	5.5	11.1	18.5	1000	500	500		
	6.0	12.5	18.5	600	400	400		
	7.3	13.0	18.5	600	400	400	800	
	7.8	13.5	18.5	600	400	400		
	8.5	14.3	18.5	500	300	350		
20.3	7.6	14.0	24.0	1500	250	250	500	
	8.4	14.0	24.0	1200	200	250	500	
	9.0	15.0	24.0	1500	200	250		
	11.3	16.5	24.0	1000	150	180	400	
22.5	8.0	17.0	27.0	1200	200			
	10.0	19.0	27.0	1000	150	200		
	12.0	22.0	27.0	800	100	180	350	
25.4	10.6	16.1	30.5	1000	150			
	10.5	17.3	30.5	1000	100			
	12.1	19.0	30.5	800	100			
	15.3	22.0	30.5	600	75			

Lead Taping & Packaging (IEC 60286–2)

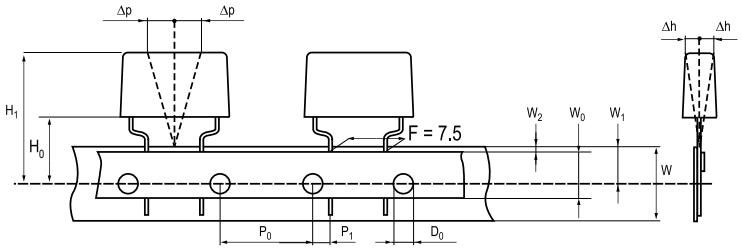
Lead Spacing 10.2 – 15.2 mm



Lead Spacing 20.3 – 22.5 mm



Formed Leads from 10.2 to 7.5 mm



Taping Specification

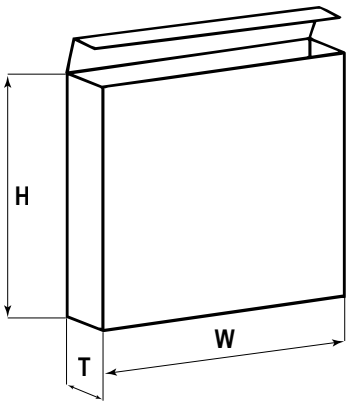
Dimensions in mm								Standard IEC 60286–2
Lead spacing	+6/-0.1	F	Formed 7.5	10.2	15.2	20.3	22.5	F
Carrier tape width	+/-0.5	W	18	18	18	18	18	$18^{+1/-0.5}$
Hold-down tape width	+/-0.3	W_0	9	12	12	12	12	
Position of sprocket hole	+/-0.5	W_1	9	9	9	9	9	$9^{+0.75/-0.5}$
Distance between tapes	Maximum	W_2	3	3	3	3	3	3
Sprocket hole diameter	+/-0.2	D_0	4	4	4	4	4	4
Feed hole lead spacing	+/-0.3	P_0 (1)	12.7(4)	12.7	12.7	12.7	12.7	12.7
Distance lead – feed hole	+/-0.7	P_1	3.75	7.6	5.1	8.9	5.3	P1
Deviation tape – plane	Maximum	Δp	1.3	1.3	1.3	1.3	1.3	1.3
Lateral deviation	Maximum	Δh	2	2	2	2	2	2
Total thickness	+/-0.2	t	0.7	0.7	0.7	0.7	0.9^{MAX}	0.9^{MAX}
Sprocket hole/cap body	Nominal	H_0 (2)	$18^{+2/-0}$	$18^{+2/-0}$	$18^{+2/-0}$	$18^{+2/-0}$	$18.5^{+/-0.5}$	$18^{+2/-0}$
Sprocket hole/top of cap body	Maximum	H_1 (3)	35	35	35	35	58	58^{MAX}

(1) Maximum cumulative feed hole error, 1 mm per 20 parts.
(2) 16.5 mm available on request.
(3) Depending on case size.
(4) 15 mm available on request.

Lead Taping & Packaging (IEC 60286–2) cont'd

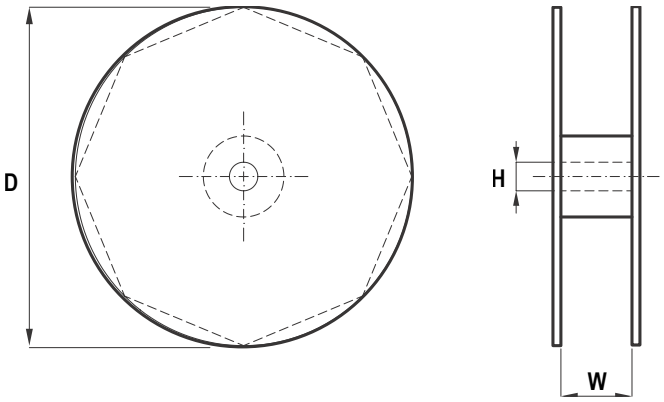
Ammo Specifications

Series	Dimensions (mm)		
	H	W	T
P278	330	330	50



Reel Specifications

Series	Dimensions (mm)		
	D	H	W
P278	360 500	30	46 (Max)



Manufacturing Date Code (IEC–60062)

Y = Year, Z = Month			
Year	Code	Month	Code
2000	M	January	1
2001	N	February	2
2002	P	March	3
2003	R	April	4
2004	S	May	5
2005	T	June	6
2006	U	July	7
2007	V	August	8
2008	W	September	9
2009	X	October	O
2010	A	November	N
2011	B	December	D
2012	C		
2013	D		
2014	E		
2015	F		
2016	H		
2017	J		
2018	K		
2019	L		
2020	M		

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