AC Line EMI Suppression and RC Networks

P409 Series Metallized Impregnated Paper Class X2, 275 VAC

Overview

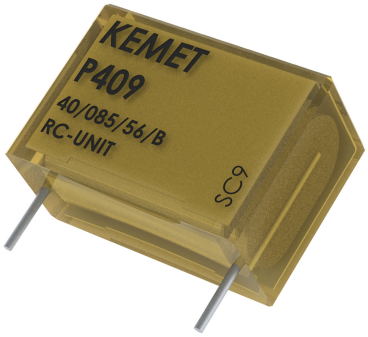
The P409 Series is constructed of multilayer metallized paper encapsulated and impregnated in self-extinguishing material meeting the requirements of UL 94 V–0.

Applications

Typical applications include worldwide use in contact protection, contact interference suppression and transient suppression.

Benefits

- Approvals: ENEC, UL, cUL
- Rated voltage: 275 VAC 50/60 Hz
- Capacitance range: 0.047 – 0.47 µF
- Capacitance tolerance: ±20%
- Resistance range: 22 – 470 Ω
- Resistance tolerance: ±30%
- Lead spacing: 15.2 – 25.4 mm
- Climatic category: 40/085/56/B, IEC 60068–1
- Tape and reel packaging in accordance with IEC 60286–2
- RoHS Compliant and lead-free terminations
- Operating temperature range of -40˚C to +85˚C
- Excellent self-healing properties which ensure long life even when subjected to frequent over voltages
- Good resistance to ionization due to impregnated paper dielectric
- High dV/dt capability
- Impregnated paper ensures excellent stability and reliability properties, particularly in applications with continuous operation



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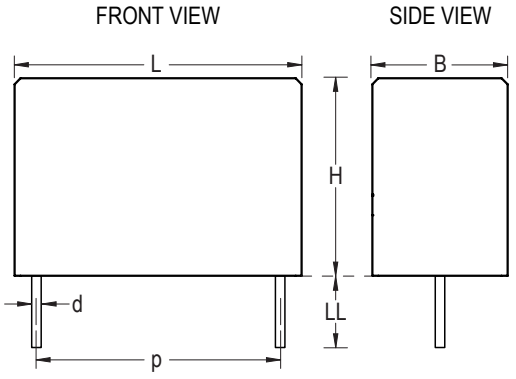
Part Number System

P	409	Q	M	473	M	275	A	H470
Capacitor Class	Series	Lead Spacing (mm)	Size Code	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VAC)	Lead and Packaging Code	Resistance (Ω)
P= Metallized Paper	RC Snubber	Q = 15.2 C = 20.3 E = 25.4	See Dimension Table	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20%	275 = 275	See Ordering Options Table	H + first two digits representing significant figures. Third digit specifies number of zeros.

Ordering Options Table

Lead Spacing Nominal (mm)	Type of Leads and Packaging	Lead Length (mm)	Part Number (Insert at 14th character)
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
25.4	**Standard Lead and Packaging Options**		
	Bulk – Short Leads	6 +0/-1	C
	Bulk – Maximum Length Leads	30 +5/-0	A

Dimensions – Millimeters

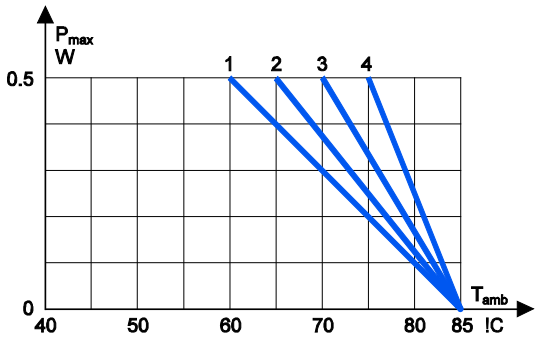


Size Code	p		B		H		L		d	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
QM	15.2	+/-0.4	7.3	Maximum	13.0	Maximum	18.5	Maximum	0.8	+/-0.05
CE	20.3	+/-0.4	7.6	Maximum	14.0	Maximum	24.0	Maximum	0.8	+/-0.05
CP	20.3	+/-0.4	11.3	Maximum	16.5	Maximum	24.0	Maximum	0.8	+/-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	275 VAC 50/60 Hz	
Capacitance Range	0.047 – 0.47 µF	
Capacitance Tolerance	±20%	
Resistance Range	22 – 470 Ω	
Resistance Tolerance	±30%	
Temperature Range	-40°C to +85°C	
Climatic Category	40/085/56/B	
Approvals	ENEC, UL, cUL	
Peak Pulse Voltage	1,000 V	
Series Resistance	The series resistance is defined at 1 kHz for RC ≥ 50 µs and at 100 kHz for RC < 50 µs	
Insulation Resistance	Minimum Values Between Terminals	
	C ≤ 0.33 µF	≥ 3,000 MΩ
	C > 0.33 µF	≥ 1,000 MΩ • µF
Pulse Current	Maximum 12 A repetitive. Maximum 20 A peak for occasional transients.	
Test Voltage Between Terminals	The 100% screening factory test is carried out at 1,800 VDC. The voltage level is selected to meet the requirements in applicable equipment standards. All electrical characteristics are checked after the test.	
In DC Applications	Recommended voltage ≤ 630 VDC	
Power Ratings	The average losses may reach 0.5 W provided the surface temperature does not exceed + 85°C. For maximum permitted power dissipation vs. temperature, see Derating Curves.	
Derating Curves	Maximum Allowable Power Dissipation vs. Ambient Temperature and Case Sizes.	



Curve	Dimension B (mm)
1	7.3
2	7.6
3	11.3
4	15.3

Environmental Test Data

Test	IEC Publication	Procedure
Endurance	IEC 60384-14	1.25 x V_R Vac 50Hz, once every hour increase to 1,000 Vac for 0.1 second, 1,000 hours at upper rated temperature.
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 temperature 5 cycles
Active Flammability	IEC 60384–14	V_R + 20 surge pulses at 2.5 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/0140–33
UL		UL 60384-14 CAN/CSA-E60384-14-09	E73869

Environmental Compliance

All KEMET EMI capacitors are RoHS Compliant.

RoHS Compliant

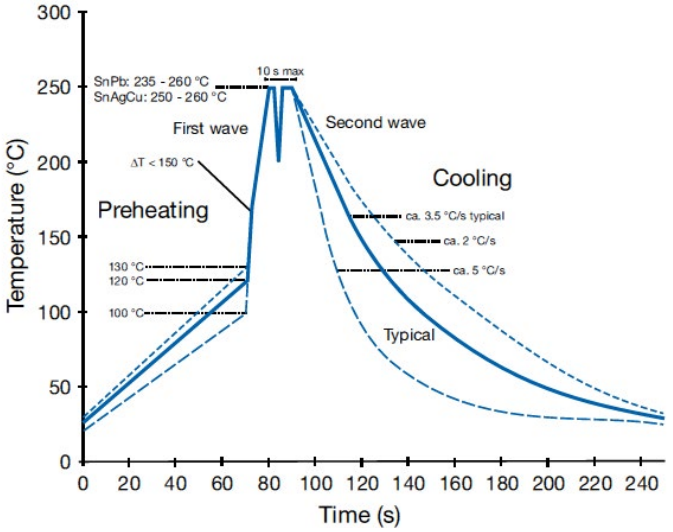
Table 1 – Ratings & Part Number Reference

Lead Spacing (p)	Capacitance Value (µF)	Resistance (Ω)	Maximum Dimensions in mm			KEMET Part Number
			B	H	L	
15.2	47	47	7.3	13.0	18.5	P409QM473M275(1)H470
15.2	47	100	7.3	13.0	18.5	P409QM473M275(1)H101
20.3	0.1	22	7.6	14.0	24.0	P409CE104M275(1)H220
20.3	0.1	33	7.6	14.0	24.0	P409CE104M275(1)H330
20.3	0.1	47	7.6	14.0	24.0	P409CE104M275(1)H470
20.3	0.1	68	7.6	14.0	24.0	P409CE104M275(1)H680
20.3	0.1	100	7.6	14.0	24.0	P409CE104M275(1)H101
20.3	0.1	150	11.3	16.5	24.0	P409CP104M275(1)H151
20.3	0.1	220	11.3	16.5	24.0	P409CP104M275(1)H221
20.3	0.1	330	11.3	16.5	24.0	P409CP104M275(1)H331
20.3	0.1	470	11.3	16.5	24.0	P409CP104M275(1)H471
20.3	0.22	22	11.3	16.5	24.0	P409CP224M275(1)H220
20.3	0.22	33	11.3	16.5	24.0	P409CP224M275(1)H330
20.3	0.22	47	11.3	16.5	24.0	P409CP224M275(1)H470
20.3	0.22	68	11.3	16.5	24.0	P409CP224M275(1)H680
20.3	0.22	100	11.3	16.5	24.0	P409CP224M275(1)H101
20.3	0.22	150	11.3	16.5	24.0	P409CP224M275(1)H151
20.3	0.22	220	11.3	16.5	24.0	P409CP224M275(1)H221
25.4	0.22	330	12.1	19.0	30.5	P409EJ224M275(1)H331
25.4	0.22	470	15.3	22.0	30.5	P409EL224M275(1)H471
25.4	0.47	33	15.3	22.0	30.5	P409EL474M275(1)H330
25.4	0.47	47	15.3	22.0	30.5	P409EL474M275(1)H470
25.4	0.47	68	15.3	22.0	30.5	P409EL474M275(1)H680
25.4	0.47	100	15.3	22.0	30.5	P409EL474M275(1)H101
25.4	0.47	150	15.3	22.0	30.5	P409EL474M275(1)H151
25.4	0.47	220	15.3	22.0	30.5	P409EL474M275(1)H221
Lead Spacing (p)	**Capacitance Value (µF)**	**Resistance Ω**	**B (mm)**	**H (mm)**	**L (mm)**	**KEMET Part Number**

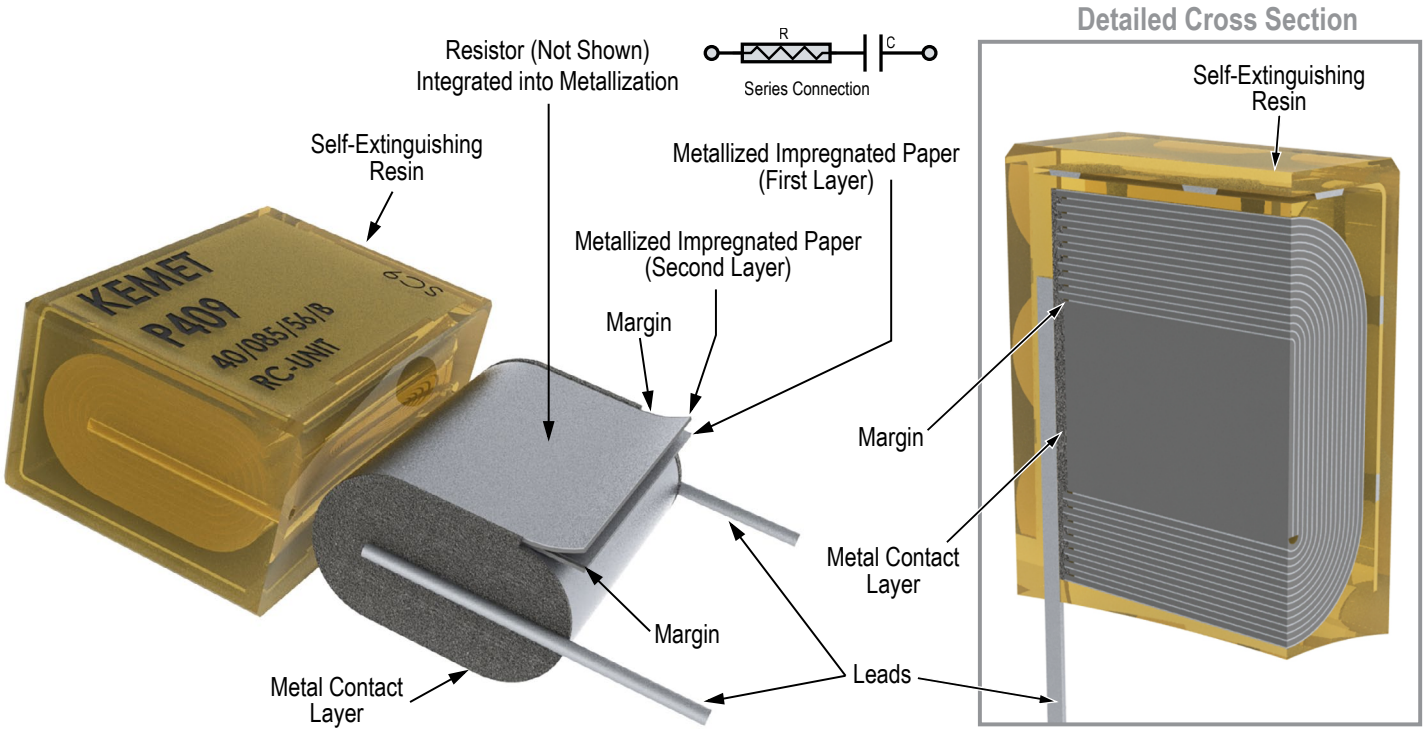
(1) Insert lead and packaging code. See Ordering Options Table for available options.

Soldering Process

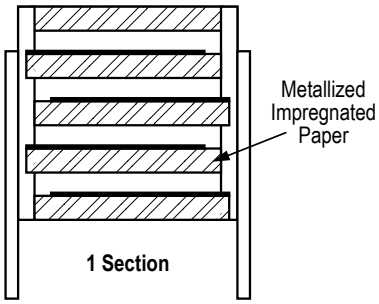
The implementation of the RoHS Directive has required the use of SnAgCu (SAC) or SnCu alloys as primary solder. These alloys require a higher liquidus temperature (217ºC – 221ºC) as compared to SnPb eutectic alloy (183ºC). Due to the higher pre-heat and wave temperatures, the heat stress to components 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



Mounting

RC units are mounted in parallel with the contacts to be protected or in parallel with the inductive load (Fig. 1 and Fig. 2). RC units are generally mounted in parallel with the contacts to suppress radio interferences (Fig. 1).

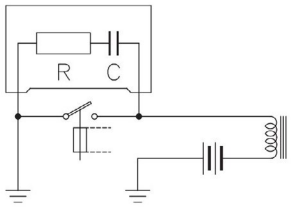


Fig. 1

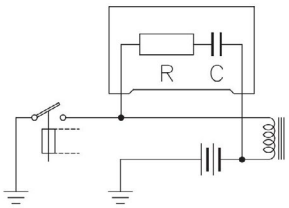
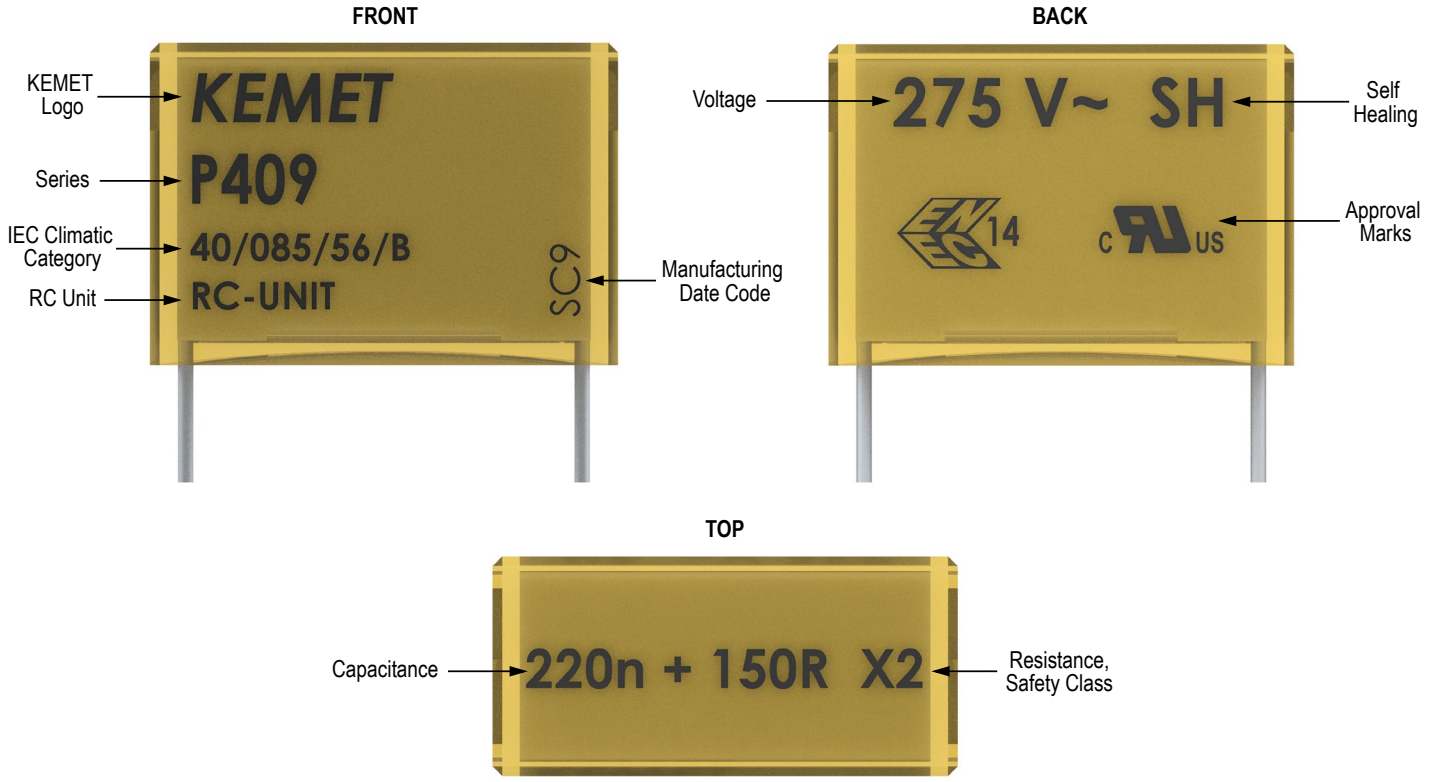


Fig. 2

Marking

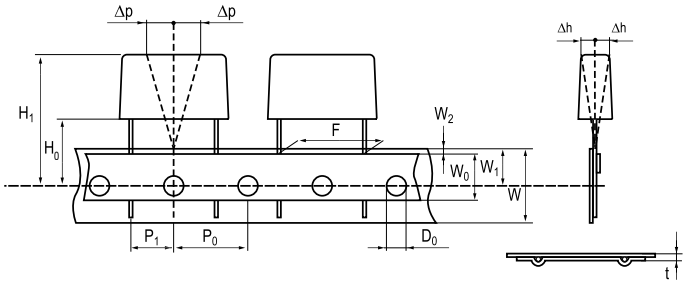


Packaging Quantities

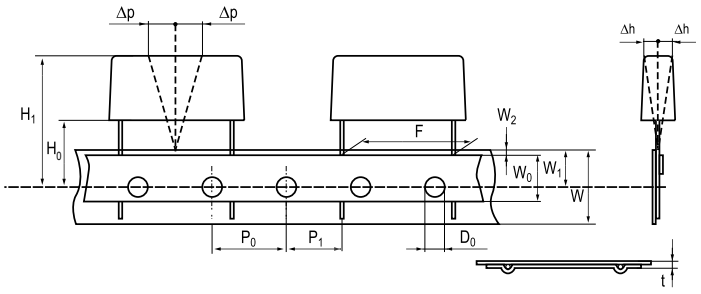
Lead Spacing (mm)	Thickness (mm)	Height (mm)	Length (mm)	Bulk Short Leads	Bulk Long Leads	Standard Reel ø 360 mm
15.2	7.3	13.0	18.5	500	100	600
20.3	7.6	14.0	24.0	250	1500	250
	11.3	16.5	24.0	150	1000	180
25.4	12.1	19.0	30.5	100	800	
	15.3	22.0	30.5	75	600	

Lead Taping & Packaging (IEC 60286–2)

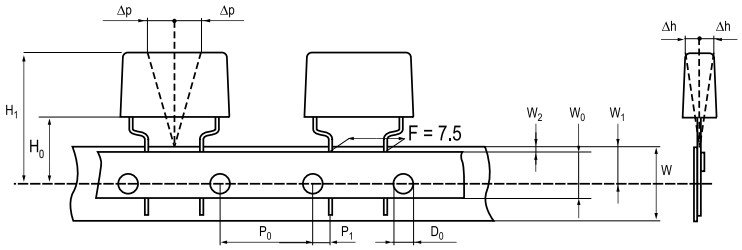
Lead Spacing 10.2 – 15.2 mm



Lead Spacing 20.3 – 22.5 mm



Formed Leads from 10.2 to 7.5 mm



Taping Specification

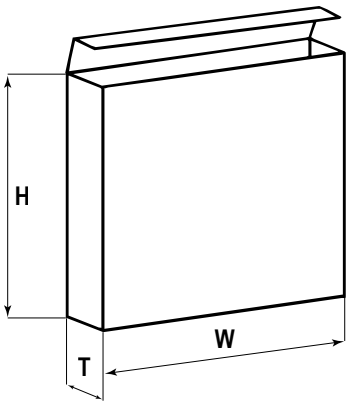
Dimensions in mm								Standard IEC 60286–2
Lead spacing	+6/-0.1	F	Formed 7.5	10.2	15.2	20.3	22.5	F
Carrier tape width	+/-0.5	W	18	18	18	18	18	$18^{+1/-0.5}$
Hold-down tape width	+/-0.3	W_0	9	12	12	12	12	
Position of sprocket hole	+/-0.5	W_1	9	9	9	9	9	$9^{+0.75/-0.5}$
Distance between tapes	Maximum	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	P^1
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

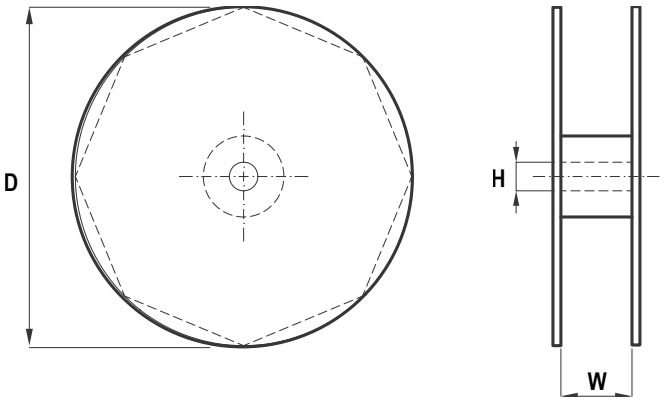
Ammo Specifications

Series	Dimensions (mm)		
	H	W	T
P409	330	330	50



Reel Specifications

Series	Dimensions (mm)		
	D	H	W
P409	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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