



## ESTABLISHED RELIABILITY MILITARY TO-5 RELAYS SPDT



SERIES	RELAY TYPE
411	SPDT basic relay
411D	SPDT relay with internal diode for coil transient suppression
411DD	SPDT relay with polarity reversal protection and coil transient suppression diode
411T	SPDT relay with internal transistor driver and coil transient suppression diode

### DESCRIPTION

The TO-5 relay, originally conceived and developed by Teledyne, has become one of the industry standards for low-level switching from dry circuit to 1 ampere. Designed specifically for high-density PC board mounting, its small size and low coil power dissipation make the 411 relay one of the most versatile ultraminiature relays available.

The following unique construction features and manufacturing techniques provide excellent resistance to environmental extremes and overall high reliability.

#### The 411 feature:

- All welded construction.
- Unique uni-frame design, providing high magnetic efficiency and mechanical rigidity.
- High force/mass ratios for resistance to shock and vibration.
- Advanced cleaning techniques provide maximum assurance of internal cleanliness.

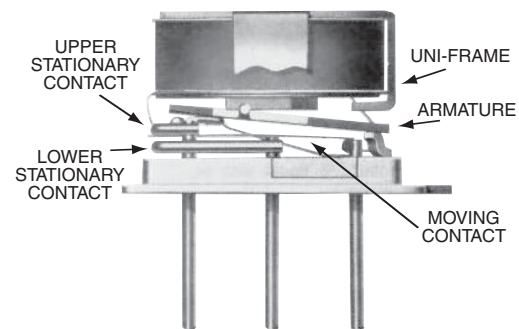
- Precious metal alloy contact material with gold plating assures excellent high current and dry circuit switching capabilities.

The Series 411D and 411DD relays have internal discrete silicon diodes for coil suppression and polarity reversal protection. The hybrid 411T relay features an internal silicon suppression diode and transistor driver. This hybrid package reduces required PC board floor space by reducing the number of external components needed to drive the relay.

By virtue of its inherently low intercontact capacitance and contact circuit losses, the 411 relay has proven to be an excellent ultraminiature RF switch for frequency ranges well into the UHF spectrum. A typical RF application for the TO-5 relay is in handheld radio transceivers, wherein the combined features of good RF performance, small size, low coil power dissipation and high reliability make it a preferred method of T-R switching (see Figure 1).

ENVIRONMENTAL AND PHYSICAL SPECIFICATIONS	
<b>Temperature</b> (Ambient)	-65°C to +125°C
<b>Vibration</b> (General Note I)	30 g's to 500 Hz
<b>Shock</b> (General Note I)	75 g's, 6ms half sine
<b>Acceleration</b>	50 g's
<b>Enclosure</b>	Hermetically sealed
<b>Weight</b>	0.09 oz. (2.55g) max.

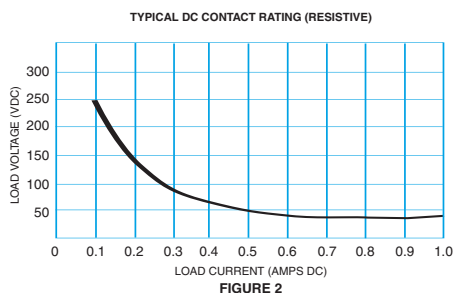
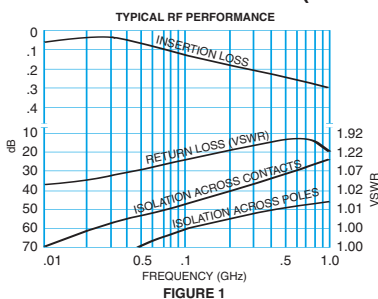
### INTERNAL CONSTRUCTION



**SERIES 411**  
**GENERAL ELECTRICAL SPECIFICATIONS (@25°C)**

<b>Contact Arrangement</b>	1 Form C (SPDT)	
<b>Rated Duty</b>	Continuous	
<b>Contact Resistance</b>	0.1 Ω max.; 0.2 Ω max. afterlife at A / 28 Vdc	
<b>Contact Load Rating (DC)</b>	Resistive: 1 A / 28 Vdc Inductive: 200 mA / 28 Vdc (320mH) Lamp: 100 mA / 28 Vdc (320mH) Low level: 10 to 50 μA @ 10 to 50 mV	
<b>Contact Load Rating (AC)</b>	Resistive: 250 mA / 115Vac, 60 and 400 Hz (Case not grounded) 100 mA / 115 Vac, 60 and 400 Hz (Case grounded)	
<b>Contact Life Ratings</b>	10,000,000 cycles (typical) at low level 1,000,000 cycles (typical) at 0.5 A / 28 Vdc resistive 100,000 cycles min. at all other loads specified above	
<b>Contact Overload Rating</b>	2 A / 28 Vdc Resistive (100 cycles min.)	
<b>Coil Operating Power</b>	300 mW typical at nominal rated voltage	
<b>Contact Carry Rating</b>	Contact Factory	
<b>Operate Time</b>	2.0 msec max. at nominal rated coil voltage	
<b>Release Time</b>	<b>411</b>	1.5 ms max.
	<b>411D</b>	4.0 ms max.
	<b>411DD</b>	
	<b>411T</b>	
<b>Contact Bounce</b>	1.5 ms max.	
<b>Intercontact Capacitance</b>	0.4 pf typical	
<b>Insulation Resistance</b>	10,000 MΩ min. between mutually isolated terminals	
<b>Dielectric Strength (Vrms/60 Hz)</b>	Atmospheric pressure : 500	70,000 ft : 125
<b>Negative Coil Transient (Vdc)</b>	<b>411D</b> <b>411DD</b> <b>411T</b>	1.0 max.
<b>Diode P.I.V (Vdc)</b>	<b>411D</b> <b>411DD</b> <b>411T</b>	100 min.
<b>411 Transistor Characteristics</b>	Base Turn Off Voltage (Vdc)	0.3 min
	Emitter-Base breakdown Voltage ( $BV_{EBO}$ ) (Vdc)	6.0 min
	Collector-Base breakdown Voltage ( $BV_{CBO}$ ) (Vdc) ( $I_c = 100\mu A$ )	75 min

**PERFORMANCE CURVES (Note 2)**



**GENERAL NOTES**

1. Relay contacts will exhibit no chatter in excess of 10 μsec or transfer in excess of 1 μsec.
2. "Typical" characteristics are based on available data and are best estimates. No on-going verification tests are performed.
3. Unless otherwise specified, parameters are initial values.
4. Relays can be supplied with a spacer pad. See appendix.

**SERIES 411**  
**DETAILED ELECTRICAL SPECIFICATIONS (@25°C)**

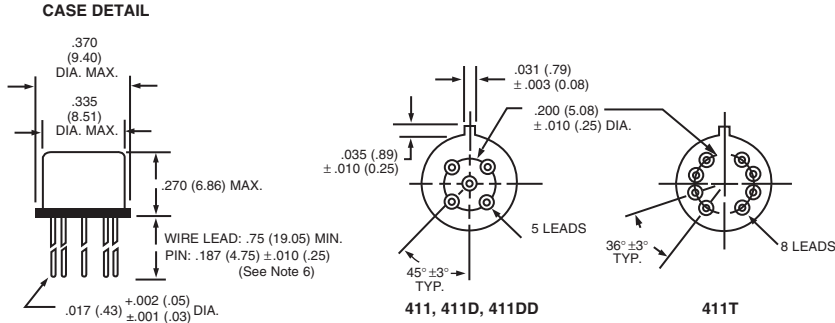
BASE PART NUMBERS (411, 411D, 411DD)		411-5	411-6	411-9	411-12	411-18	411-26	
		411D-5 411D-5	411D-6 411D-6	411D-9 411D-9	411D-12 411D-12	411D-18 411D-18	411D-26 411D-26	
Coil Voltage	Nom.	5.0	6.0	9.0	12.0	18.0	26.5	
	Max.	7.5	10.0	15.0	20.0	30.0	40.0	
Coil Resistance (Ohms ±10%)	411 411D	63	125	280	500	1130	2000	
	411DD	50	98	280	500	1130	2000	
Coil Current	411DD	Min	72.7	46.3	25.9	20.0	13.6	11.5
		Max	100	62.4	33.7	25.6	17.2	14.4
Pick-Up Voltage (Vdc, max.)	411 411D	3.7	4.5	6.8	9.0	13.5	18.0	
	411DD	4.5	5.5	7.8	10.0	14.5	19.0	
Drop-Out Voltage	Min.	0.15	0.18	0.35	0.4	0.58	0.89	
	Max.	2.4	2.8	4.2	5.6	8.4	10.4	

BASE PART NUMBERS (411T)		411T-5	411T-6	411T-9	411T-12	411T-18	411T-26
Coil Voltage	Nom.	5.0	6.0	9.0	12.0	18.0	26.5
	Max.	7.5	10.0	15.0	20.0	30.0	40.0
Coil Resistance (Ohms ±10%)		63	125	280	500	1130	2000
Coil Current	Min	66.6	42.0	28.0	20.9	13.8	11.5
	Max	89.6	55.5	38.1	28.1	18.8	15.5
Pick-Up Voltage (Vdc, max.)		3.9	5.2	7.8	10.0	14.5	19.0
Turn On Base Current (mAdc, Max.)		2.38	1.6	1.07	0.8	0.53	0.40
Drop-Out Voltage (Note8)	Min.	0.15	0.18	0.35	0.4	0.58	0.89
	Max.	2.4	2.8	4.2	5.6	8.4	10.4

**NOTES:**

1. Relay contacts will exhibit no chatter in excess of 10 µsec or transfer in excess of 1 µsec.
2. "Typical" characteristics are based on available data and are best estimates. No on-going verification tests are performed.
3. Unless otherwise specified, parameters are initial values.
4. For reference only. Coil resistance not directly measurable at relay terminals due to internal series semiconductor, 411DD and 411T only.
5. Unless otherwise specified, relays will be supplied with either gold-plated or solder-coated leads.
6. The slash and characters appearing after the slash are not marked on the relay.
7. Limit Base Emitter current to 15 mAdc.
8. Applicable to all coil voltages. See Base current to turn on.
9. Screened HI-REL versions available. Contact factory.

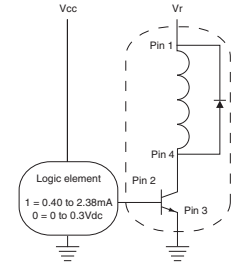
**SERIES 411  
OUTLINE DIMENSIONS**



Dimensions: in. (mm)

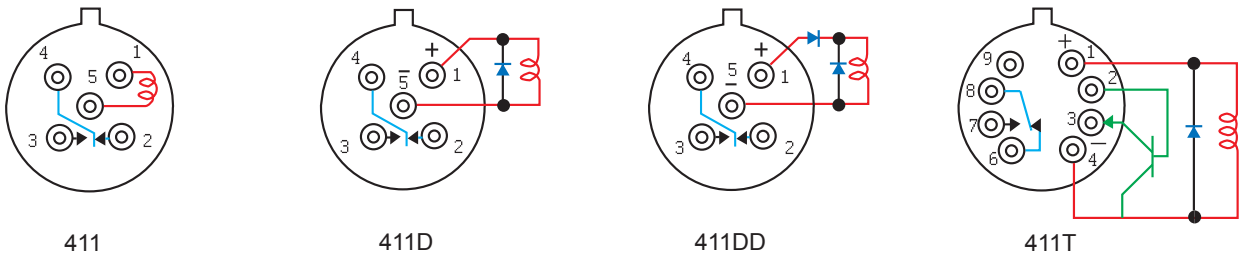
(Viewed From Terminals)

**TYPICAL LOGIC INTERFACE**  
(See Note 8)

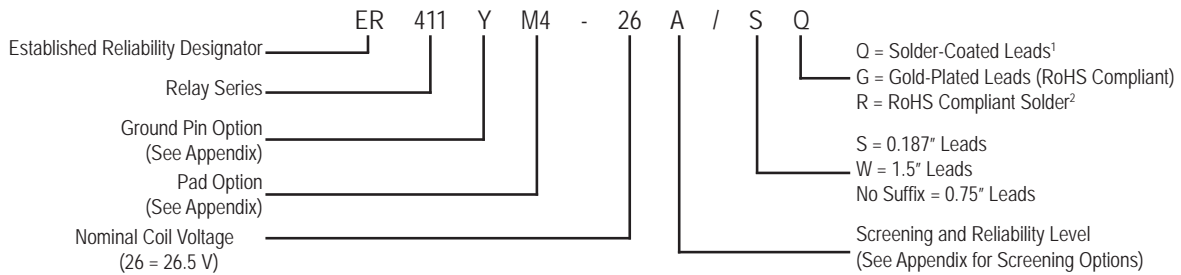


Notes:  
Logic 1 activates the relay.  
Logic 0 de-activates the relay.  
Vcc = logic bias power.  
Vr = coil energization voltage.

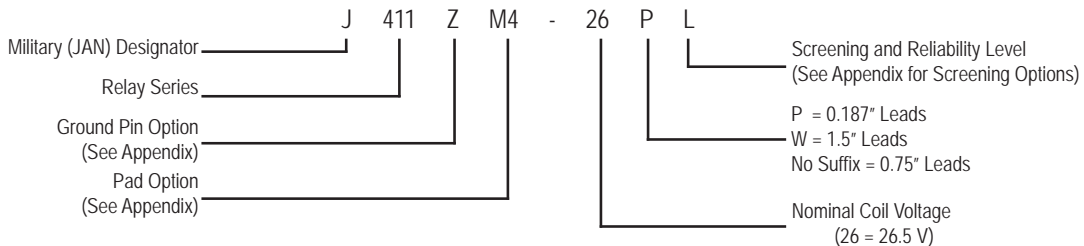
**SCHEMATIC DIAGRAMS**



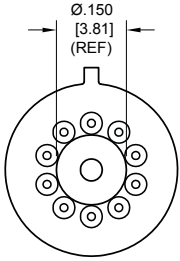
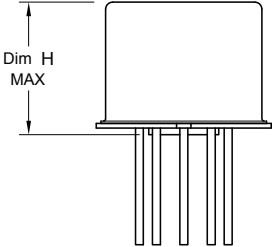
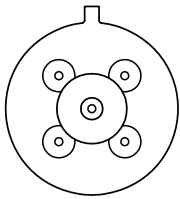
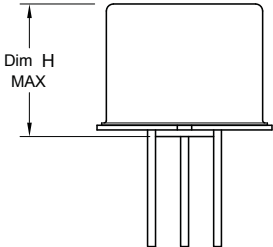
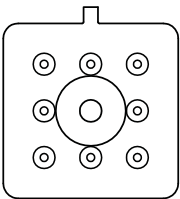
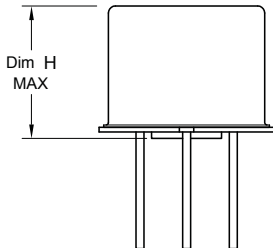
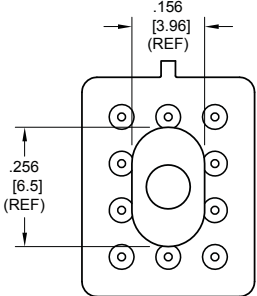
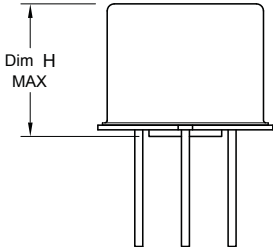
**T<sup>2</sup>R Established Reliability Relays**



**Military Qualified (JAN) Relays**



## APPENDIX: Spacer Pads

Pad designation and bottom view dimensions	Height	For use with the following:	Dim. H Max.
 <p style="text-align: center;">“M4” Pad for TO-5</p>		ER412, ER412D, ER412DD	.295 (7.49)
		712, 712D, 712TN, RF300, RF310, RF320 RF700, RF703	.300 (7.62)
		ER420, ER420D, ER420DD, 421, ER421D, ER421DD, ER422, ER422D, ER422DD, 722, 722D, RF341	.305 (7.75)
		ER431T, ER432T, ER432, ER432D, ER432DD	.400 (10.16)
		732, 732D, 732TN, RF303, RF313, RF323	.410 (10.41)
		RF312, RF332 SI800, SI803	.350 (8.89)
 <p style="text-align: center;">“M4” Pad for TO-5</p>		ER411, ER411D, ER411DD, ER411T	.295 (7.49)
		ER431, ER431D, ER431DD	.400 (10.16)
		RF311	.300 (7.62)
		RF331	.410 (10.41)
 <p style="text-align: center;">“M4” Pad for Centigrid®</p>		172, 172D	.305 (7.75)
		ER114, ER114D, ER114DD, J114, J114D, J114DD	.300 (7.62)
		ER134, ER134D, ER134DD, J134, J134D, J134DD	.400 (10.16)
		RF100	.315 (8.00)
		RF103	.420 (10.67)
 <p style="text-align: center;">“M9” Pad for Centigrid®</p>		122C, A152	.320 (8.13)
		ER116C, J116C	.300 (7.62)
		ER136C, J136C	.400 (10.16)
		RF180	.325 (8.25)
		A150	.305 (7.75)

**Notes:**

1. Spacer pad material: Polyester film.
2. To specify an “M4” or “M9” spacer pad, refer to the mounting variants portion of the part numbering example in the applicable datasheet.
3. Dimensions are in inches (mm).
4. Unless otherwise specified, tolerance is  $\pm .010$ " (.25 mm).
5. Add 10 m $\Omega$  to the contact resistance shown in the datasheet.
6. Add 0.01 oz. (0.25 g) to the weight of the relay assembly shown in the datasheet.

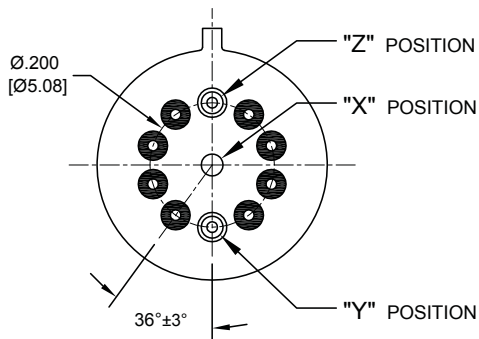
## APPENDIX: Spreader Pads

Pad designation and bottom view dimensions	Height	For use with the following:	Dim. H Max.
<p style="text-align: center;"><b>"M" Pad <u>5/</u> <u>6/</u></b></p>		ER411T, J411T, ER412, ER412D ER412DD, J412, J412D, J412DD ER412T, J412T	.388 (9.86)
		712, 712D, 712TN	.393 (9.99)
		ER431T, J431T, ER432, ER432D ER432DD, J432, J432D, J432DD ER432T, J432T	.493 (12.52)
		732, 732D, 732TN	.503 (12.78)
		ER420, J420, ER420D, J420D ER420DD, J420DD, ER421, J421 ER421D, J421D, ER421DD J422D, ER422DD, J422DD, 722	.398 (10.11)
<p style="text-align: center;"><b>"M2" Pad <u>7/</u> <u>8/</u></b></p>		ER411T ER412, ER412D, ER412DD J412, J412D, J412DD	.441 (11.20)
		712, 712D	.451 (11.46)
		ER421, ER421D, ER421DD 722, 732D	.451 (11.46)
		ER431T ER432, ER432D, ER432DD	.546 (13.87)
		732, 732D	.556 (14.12)
<p style="text-align: center;"><b>"M3" Pad <u>5/</u> <u>6/</u> <u>9/</u></b></p>		ER411, ER411D, ER411DD, ER411TX ER412X, ER412DX, ER412DDX ER412TX	.388 (9.86)
		712X, 712DX, 712TNX	.393 (9.99)
		ER420X, ER420DX, ER420DDX ER421X, ER421DX, ER421DDX ER422X, ER422DX ER422DDX, 722X, 722DDX	.398 (10.11)
		ER431, ER431D, ER431DD ER431TX ER432X, ER432DX, ER432DDX ER432TX	.493 (12.52)
		732X, 732DX, 732TNX	.503 (12.78)

**Notes:**

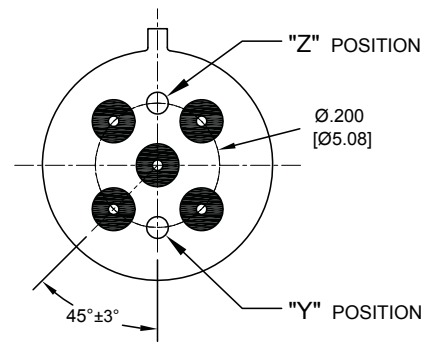
1. Spreader pad material: Diallyl Phthalate.
2. To specify an "M", "M2" or "M3" spreader pad, refer to the mounting variants portion of the part number example in the applicable datasheet.
3. Dimensions are in inches (mm).
4. Unless otherwise specified, tolerance is  $\pm .010$ " (0.25 mm).
- 5/. Add 25 m $\Omega$  to the contact resistance shown in the datasheet.
- 6/. Add .01 oz. (0.25 g) to the weight of the relay assembly shown in the datasheet.
- 7/. Add 50 m $\Omega$  to the contact resistance shown in the datasheet.
- 8/. Add 0.025 oz (0.71 g) to the weight of the relay assembly shown in the datasheet.
- 9/. M3 pad to be used only when the relay has a center pin (e.g. ER411M3-12A, 722XM3-26.)

# APPENDIX: Ground Pin Positions



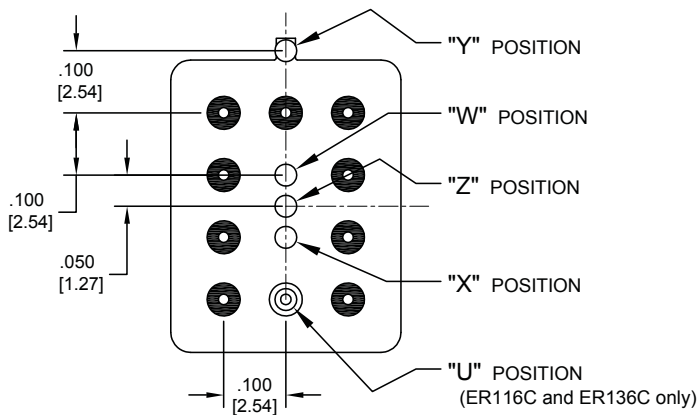
### TO-5 Relays:

ER411T, ER412, ER412T, ER420, ER421, ER422, ER431T, ER432, ER432T, 712, 712TN, 400H, 400K, 400V, RF300, RF303, RF341, RF312, RF332, RF310, RF313, RF320, RF323, SI800, SI803, RF700, RF703



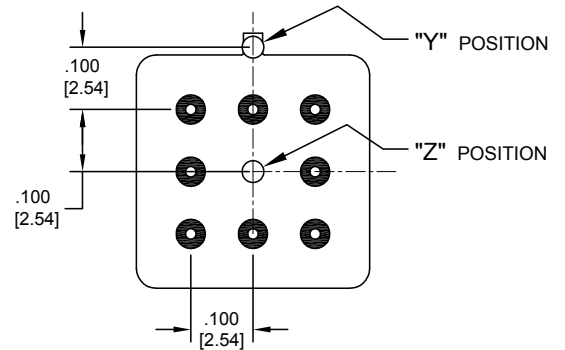
### TO-5 Relays:

ER411, ER431, RF311, RF331



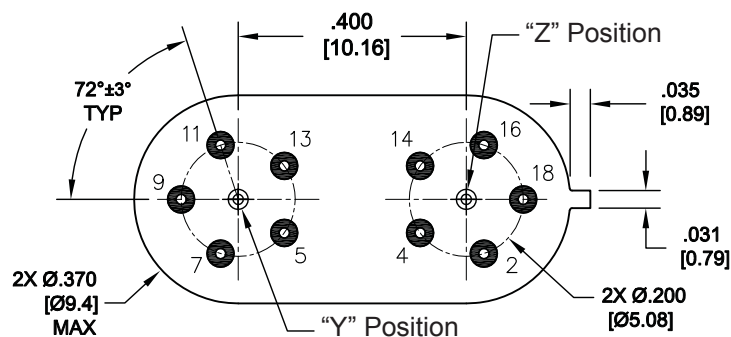
### Centigrad® Relays:

RF180, ER116C, 122C, ER136C



### Centigrad® Relays:

RF100, RF103, ER114, ER134, 172



### Loopback Relays:

LB363

- Indicates ground pin position
- Indicates glass insulated lead position
- ⊙ Indicates ground pin or lead position depending on relay type

### NOTES

1. Terminal views shown
2. Dimensions are in inches (mm)
3. Tolerances:  $\pm .010$  ( $\pm .25$ ) unless otherwise specified
4. Ground pin positions are within .015 (0.38) dia. of true position
5. Ground pin head dia., 0.035 (0.89) ref: height 0.010 (0.25) ref.
6. Lead dia. 0.017 (0.43) nom.

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