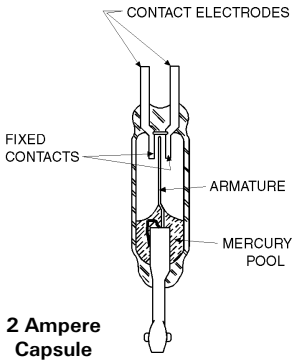
159/160 series

Mercury-Wetted Reed Relays

Users should thoroughly review the technical data before selecting a product part number. It is recommended that users also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.



2 Ampere Capsule

General Information

The mercury-wetted contact relay represents one of the more sophisticated types of relays made today. The early pioneer work in mercury-wetted contact switching dates back to the 1950's, as telephone laboratory scientists sought out the "perfect contact". Mercury-wetted contacts represent the nearest thing to the perfect contact yet developed, being characterized by such parameters as: bounce-free operation; very low and stable contact resistance; hermetic protection; fast operating speeds; Form C or Form D contact, action contact life measured in billions of operations. The only major weakness of a mercury-wetted contact relay is the necessity to mount the relay within 30° of a vertical position, due to its position sensitivity.

While there are several variations of the mercury-wetted contact relay on the market, the basic contact element has essential concepts in common. The mercury-wetted contact element consists of a glass-encapsulated nickel-iron reed with its base immersed in a pool of mercury. The free reed cantilever projects upward between sets of stationary contact electrodes, which have been glass-sealed in proper juxtaposition at the top of the glass chamber. The mercury is induced to flow up the cantilever by capillary action, wetting mercury on both the cantilever contact tip as well as the stationary contacts. Thus a mercury-to-mercury contact is maintained on both the normally-closed and normally-open contacts, and the system is self-replenishing. The 2-ampere mercury-wetted capsule is shown far left.

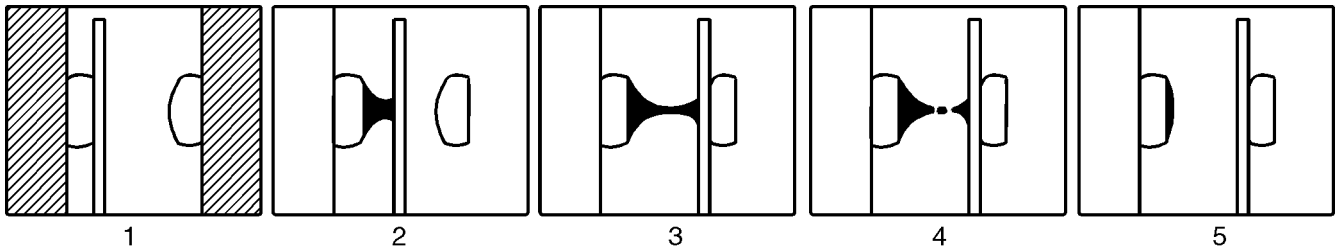
Along with the inherent fast actuation of the capsule and excellent load-handling capacity, the mercury-wetted contacts exhibit extremely long life, as the mercury films re-establish at each closure and contact erosion is eliminated. Contact interface resistance is very low and stable, and as the mercury films are elastic, contact bounce is eliminated. A dynamic sequence of the mercury-wetted contact action is shown below.

While the below sequence portrays a Form D (make-before-break) contact action, a true Form C (break-before-make) contact can be provided by proper control of the mercury film dynamics and the contact electrode spacing.

The mercury-wetted contact capsules generally are mounted within a coil assembly, and with appropriately mounted bias magnets, mounting base and magnetic shielded enclosures. The more popular assemblies contain one or two capsules in a convenient printed circuit mounting module.

Mercury-wetted relays can be adjusted to operate with very low levels of input power, in the order of 10-20 milliwatts. Thus, power gain switching of as great as 10,000 can be realized. For all but very light contact loads, contact protection is required to limit the current or voltage rise time across the contacts.

Form D Mercury-Wetted Contact Action As Seen In High-Speed Sequence



(1) Mercury (shown in black) covers armature and contact points; (2) and (3) as armature moves from open to closed position, mercury filament joins both contacts momentarily; (4) ruptured mercury surfaces accelerate away from each other, providing rapid breaking action; (5) as contact surfaces join, mercury wetting dampens rebound, eliminates electrical chatter, and provides contact reliability.

SPDT (Form C or Form D) Contact Specifications

Material	Rating (Switched Load)	(Carry Load)	Bridging and Transfer Time	Contact Resistance	Life Expectancy
Mercury-wetted platinum contacts hermetically sealed in an inert atmosphere	2 amperes maximum 500 volts maximum 100 VA maximum	5 amperes maximum Not switched	When operated by a single DC pulse, the bridging or transfer time will be greater than 50 microseconds, but less than 500 microseconds.	14 milliohms typical; 20 milliohms maximum Stable within ±2 milliohms throughout life.	1 billion operations minimum at rated load

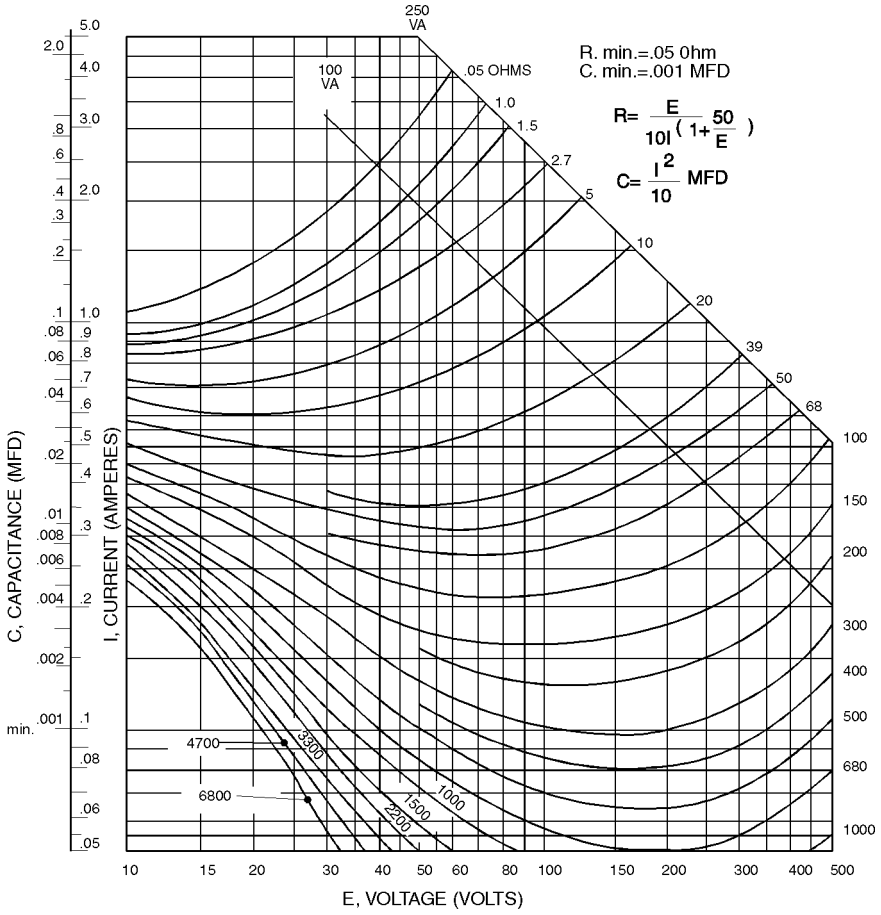
Dimensions are shown for reference purposes only.
Dimensions are in inches over (millimeters) unless otherwise specified.
Specifications and availability subject to change.

Mercury-Wetted Relays Contact Protection

The essentially infinite life of mercury-wetted contact relays may only be realized if the requirements for suitable contact protection are observed.

In that the goal is control of the rate of rise of voltage across the contacts when the circuit is opened (rather than peak transient limiting), the only suitable protection recognized is an RC network.

Values of R and C may be calculated using the formula shown, or may be obtained from the direct reading nomograph.



Nomograph Explanation

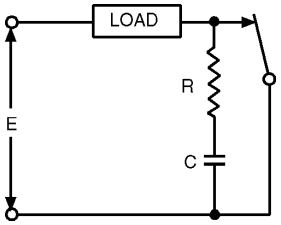
I=Steady state current at time of circuit opening
E=Open circuit voltage
Find I on the ordinate scale. Read C on the scale adjacent to I. R is found at the intersection of I and E.

To reduce voltage transient amplitudes, C may be increased up to 10 times calculated values. (R must be calculated value.)

For I=0.5 amps or less
and
E=50 volts or less
R may be omitted
C must be calculated value

Resistor Tolerances

E	R
Less than 70V	R up to 2R
70V to 100V	±50%
100V to 150V	±10%
Greater than 150V	±5%



Specifications

Parameter	159 Series	160 Series
Coils		
Single Wound–max. ohms	8,600	9,000
Double Wound–max. ohms	4,275	4,500
Rating–Watts Continous	2.0	1.75
Temp. Rise–°C per watt	30°	35°
Dielectric Breakdown–RMS, 60Hz	1,000	1,000
Insulation Resistance–Megohms–500 VDC	1,000	1,000
Capacitance–Armature to Coi pf, Typical	9.0	9.0
Electrostatic Shielding–Optional	yes	yes
Typical Operate Times–mS, 2X Must Operate	1-3	1-3
Typical Release Times–mS, 2X	2.5	2.5
Contact Form Available	Form C, D	Form C, D
Adjustments Available		
Single-side-stable	yes	yes
Bi-stable	yes	yes
Polar 1% Balance	yes	yes
Temperature Range Operating °C	All types – 38.8°C to + 85°C	
Storage °C	All types – 65°C to + 100°C	
Weight–ounces	2.0	0.5
Encapsulant	Polyurethane	Polyurethane
Mounting Method	PCB	PCB

159 series

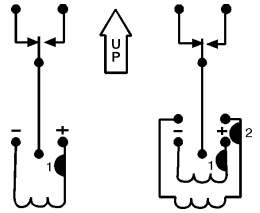
Mercury-Wetted Reed Relays

Features

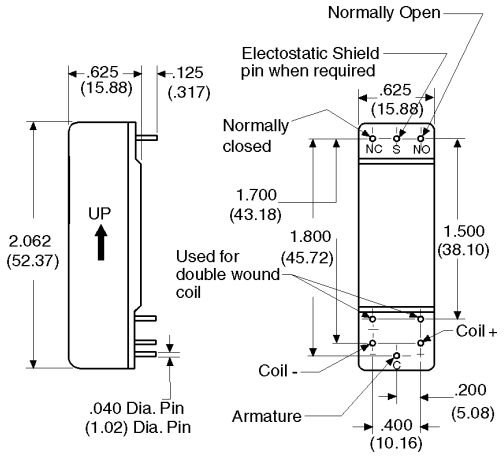
159 series relays are available in a Form C or Form D 2 amp contact arrangement, single or dual coil and printed circuit board terminals.
Weight: 1.0 ounce

Positive potential applied to the start of the winding indicated by the symbol ◠ will close the contacts shown open on the electrical schematics. For reset of bistable relays, reversed polarity must be applied.

Wiring Diagrams



Outline Dimensions



Note: Relay must be mounted within 30° of vertical and suitable contact protection must be used.

Part Numbering System

Relay Series	Enclosure And Terminals	Contacts And Adjustment	Coils	Standard Or Special
160	1–.625 Ht., .125 Lg. 2–.625 Ht., .156 Lg. 3–.625 Ht., .187 Lg. 4–.625 Ht., .250 Lg. 0–Special	1–1D Single-Side-Stable 2–1D Bistable 5–1C Single-Side-Stable 6–1C Bistable 7–1C Dynamic (1%) Balanced Bistable 0–Special	1A-1Z–Single Coil 2K-2V–Double Coil 7A-7T–Single Coil 8A-8Z–Bifilar Coil 9A-9Z–Double Coil (Concentric) 1S and 2S–Special	00–Standard A1-Z9–Special Customer Requirement

Example: 159-151N00 is a 159 series relay, enclosure height of .625 in., pin length of .125 in., Form C contact, single-side-stable adjustment, single coil 1N, of completely standard construction.

Coil Characteristics and Part Numbers

One Winding Single-Side-Stable 40 Milliwatts

Coils	Coil Resistance (Ohms)	Must Operate Current (MA-DC)	Must Operate Voltage (VDC)	Must Release Voltage (VDC)	Maximum Voltage (VDC)	Part Number	
						Form C	Form D
1A	2.2	116	.28	.06	2.1	159-151A00	159-111A00
1B	3.9	86	.37	.07	2.8	159-151B00	159-111B00
1C	6.4	67	.47	.09	3.6	159-151C00	159-111C00
1D	9.0	60	.60	.12	4.3	159-151D00	159-111D00
1E	14	47	.72	.15	5.3	159-151E00	159-111E00
1F	24	35	.93	.19	6.9	159-151F00	159-111F00
1G	34	32	1.2	.24	8.2	159-151G00	159-111G00
1H	56	24	1.5	.30	11	159-151H00	159-111H00
1J	86	20	1.9	.39	13	159-151J00	159-111J00
1K	140	15	2.3	.46	17	159-151K00	159-111K00
1L	225	12	2.9	.59	21	159-151L00	159-111L00
1M	385	9.0	3.8	.73	28	159-151M00	159-111M00
1N	620	7.0	4.8	.95	35	159-151N00	159-111N00
1P	940	5.8	6.0	1.2	43	159-151P00	159-111P00
1Q	1,450	4.8	7.7	1.6	54	159-151Q00	159-111Q00
1R	2,430	3.6	9.7	2.0	70	159-151R00	159-111R00
1T	3,620	2.9	12	2.3	85	159-151T00	159-111T00
1U	5,500	2.5	15	3.0	105	159-151U00	159-111U00
1V	8,600	2.0	19	3.8	130	159-151V00	159-111V00

Dimensions are shown for reference purposes only.
Dimensions are in inches over (millimeters) unless otherwise specified.
Specifications and availability subject to change.
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Technical support:
Refer to inside back cover.

159 Series (continued) – Coil Characteristics and Part Numbers

Coils	Coil Resistance (Ohms)	Must Operate Current (MA-DC) (Either Winding)	Must Operate Voltage (VDC) (Either Winding)	Must Release Voltage (VDC) (Either Winding)	Maximum Voltage (VDC) (Either Winding)	Dielectric Stand Off Between Coils (VDC)	Part Number	
							Form C	Form D
Two Windings Single-Side-Stable 80 Milliwatts Per Winding								
2K	70/70	30	2.3	.47	12	500	159-152K00	159-112K00
2L	115/115	23	3.0	.60	15	500	159-152L00	159-112L00
2M	190/190	18	3.8	.79	19	400	159-152M00	159-112M00
2N	325/325	14	5.0	1.0	26	400	159-152N00	159-112N00
2P	490/490	12	6.2	1.3	31	400	159-152P00	159-112P00
2Q	730/730	9.6	7.7	1.6	38	400	159-152Q00	159-112Q00
2R	1250/1250	7.2	10	2.0	50	400	159-152R00	159-112R00
2T	1860/1860	5.8	12	2.5	61	200	159-152T00	159-112T00
2U	2760/2760	5.0	15	3.0	74	200	159-152U00	159-112U00
2V	4275/4275	3.9	18	3.8	92	200	159-152V00	159-112V00
Two Windings Single-Side-Stable 40 Milliwatts Per Winding								
2K	70/70	15	.30	1.2	12	500	159-162K00	159-122K00
2L	115/115	12	.37	1.5	15	500	159-162L00	159-122L00
2M	190/190	9.0	.47	1.9	19	400	159-162M00	159-122M00
2N	325/325	7.0	.62	2.5	26	400	159-162N00	159-122N00
2P	490/490	5.8	.77	3.1	31	400	159-162P00	159-122P00
2Q	730/730	4.8	.97	3.9	38	400	159-162Q00	159-122Q00
2R	1250/1250	3.6	1.2	5.0	50	400	159-162R00	159-122R00
2T	1860/1860	3.0	1.5	6.0	61	200	159-162T00	159-122T00
2U	2760/2760	2.5	1.8	7.5	74	200	159-162U00	159-122U00
2V	4275/4275	2.0	2.3	9.2	92	200	159-162V00	159-122V00
Two Windings Bifilar Windings Bistable 40 Milliwatts Per Winding								
8A	135/135	16	.48	2.4	16.4	500	159-168A00	159-128A00
8B	170/170	15.5	.58	2.9	18.5	400	159-168B00	159-128B00
8C	200/200	13.3	.58	2.9	20.0	400	159-168C00	159-128C00
8D	310/310	11.9	.82	4.1	24.9	400	159-168D00	159-128D00
8E	460/460	7.8	.80	4.0	30.3	400	159-168E00	159-128E00
8F	675/675	6.5	.96	4.8	36.7	400	159-168F00	159-128F00
8G	810/810	6.85	1.2	6.1	40.2	400	159-168G00	159-128G00
8H	1000/1000	6.75	1.5	7.4	44.7	400	159-168H00	159-128H00
8J	1240/1240	5.6	1.4	7.0	49.8	400	159-168J00	159-128J00
8K	2300/2300	3.82	1.9	9.7	67.8	200	159-168K00	159-128K00

Note: All values at 25°C. Resistances specified are ±10%. Maximum voltages based on 2 watts continuous dissipation.

Nominal Resistance (Ohms)	Single-Side-Stable						Bistable				
	Must Operate Current (MA-DC)	Must Operate Voltage (VDC)	Must Release Voltage (VDC)	Maximum Voltage (VDC)	Part Number		Must Operate Current (MA-DC)	Must Operate Voltage (VDC)	Must Release Voltage (VDC)	Part Number	
					Form C	Form D				Form C	Form D
One Winding Single-Side-Stable 115 Milliwatts And Bistable 25 Milliwatts											
18	66.6	1.3	.18	6.0	159-157A00	159-117A00	31.2	.12	.62	159-167A00	159-127A00
65	37.4	2.7	.36	11.4	159-157B00	159-117B00	17.8	.26	1.3	159-167B00	159-127B00
85	33.3	3.1	.42	13.0	159-157C00	159-117C00	15.6	.30	1.5	159-167C00	159-127C00
90	37.7	3.8	.51	13.4	159-157D00	159-117D00	17.6	.36	1.8	159-167D00	159-127D00
115	30.0	3.8	.51	15.1	159-157E00	159-117E00	14.0	.36	1.8	159-167E00	159-127E00
275	17.0	5.2	.77	23.4	159-157F00	159-117F00	8.0	.50	2.5	159-167F00	159-127F00
450	12.9	6.4	.85	30.0	159-157G00	159-117G00	6.0	.60	3.0	159-167G00	159-127G00
675	11.6	8.6	1.1	36.7	159-157H00	159-117H00	5.4	.80	4.0	159-167H00	159-127H00
940	10.1	10.5	1.4	43.3	159-157J00	159-117J00	4.7	.98	4.9	159-167J00	159-127J00
950	12.1	12.7	1.7	43.6	159-157K00	159-117K00	5.7	1.2	6.0	159-167K00	159-127K00
1250	9.4	12.9	1.8	50.0	159-157L00	159-117L00	4.4	1.2	6.1	159-167L00	159-127L00
1425	8.3	13	1.8	53.4	159-157M00	159-117M00	3.9	1.2	6.2	159-167M00	159-127M00
1800	9.4	18.6	2.6	60.0	159-157N00	159-117N00	4.4	1.7	8.8	159-167N00	159-127N00
1950	7.5	17.6	2.1	62.4	159-157P00	159-117P00	3.5	1.5	7.5	159-167P00	159-127P00
2400	7.35	20.6	2.6	69.2	159-157Q00	159-117Q00	3.4	1.8	9.0	159-167Q00	159-127Q00
4000	5.55	24.4	3.3	89.5	159-157R00	159-117R00	2.6	2.3		159-167R00	159-127R00
4000		17.6	2.4	89.5	159-157T00	159-117T00	1.9	1.6	8.3	159-167T00	159-127T00

160 series

Mercury-Wetted Reed Relays

Features

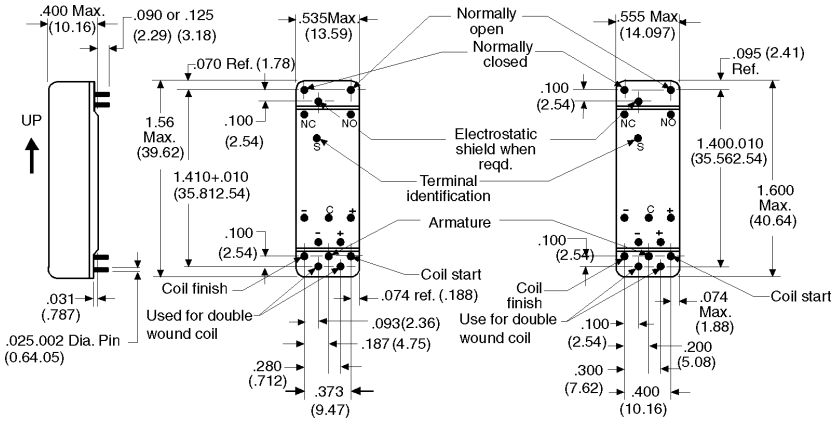
160 series relays are available in a single Form C or Form D two ampere contact arrangement, single or dual coil and printed circuit board terminals.

The part numbers shown on the adjacent page are for relays with 0.093" terminal spacing. The part number designator for the 0.100" grid is a 160-3XXXXX for a pin of 0.09" length, and 160-4XXXXX for a pin of 0.125" length.

Positive potential applied to the start of the winding indicated by the symbol ◠ will close the contacts shown open on the electrical schematics. For reset of bistable relays, reversed polarity must be applied. Weight 0.5 ounces. UL File E55708

Note: Relay must be mounted within 30° of vertical and suitable contact protection must be used.

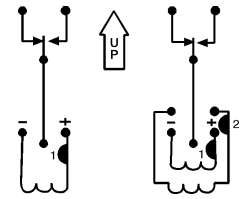
Outline Dimensions



Grid 0.093
(160-1)
(160-2)

Grid 0.100
(160-3)
(160-4)

Wiring Diagrams



Single Coil Double Coil

Part Numbering System

Relay Series	Enclosures And Terminals	Contacts and Adjustments	Coil	Standard or Special
160	1–.090 Lg., .093 Grid 2–.125 Lg., .093 Grid 3–.090 Lg., .100 Grid 4–.125 Lg., .100 Grid 0–Special	1–1D Single-Side-Stable 2–1D Bistable 5–1C Single-Side-Stable 6–1C Bistable 7–1C Dynamic (1%) Balanced Bistable 0–Special	1A-1Z–Single Coil 2A-2Z–Double Coil 1S–Special Single Coil 2S–Special Double Coil	00–Standard A1-Z9–Special Customer Requirement

Example: 160-151K00 is a 160 series relay, enclosure height of .400 in., pin length of .090 in., Form C contact, single-side-stable adjustment, single coil 1K, of completely standard construction.

Coil Characteristics and Part Numbers

Two Windings Bistable 20 Milliwatts Per Winding

Coil	Coil Resistance (Ohms)	Must Operate Current (MA-DC) (Either Winding)	Must Not Operate Voltage (VDC) (Either Winding)	Must Operate Voltage (VDC) (Either Winding)	Maximum Voltage (VDC) (One Winding Only)	Dielectric Standoff Between Coils (VDC)	Part Number	
							Form C	Form D
2K	60/60	17	.29	1.1	10	500	160-162K00	160-122K00
2L	90/90	15	.38	1.5	13	400	160-162L00	160-122L00
2M	155/155	11	.49	1.9	16	400	160-162M00	160-122M00
2N	205/205	10	.61	2.3	19	400	160-162N00	160-122N00
2P	340/340	7.5	.73	2.8	24	400	160-162P00	160-122P00
2Q	560/560	6.0	.98	3.6	31	400	160-162Q00	160-122Q00
2R	870/870	4.7	1.2	4.5	39	200	160-162R00	160-122R00
2T	1320/1320	3.8	1.4	5.5	48	200	160-162T00	160-122T00
2U	1980/1980	3.2	1.8	7.0	59	200	160-162U00	160-122U00
2V	3000/3000	2.7	2.3	9.0	73	200	160-162V00	160-122V00
2W	4500/4500	2.1	2.8	11.0	89	200	160-162W00	160-122W00

Note: All values at 25°C. Resistances specified are ±10%. Maximum voltages based on 1.75 watts continuous dissipation.

Dimensions are shown for reference purposes only.
Dimensions are in inches over (millimeters) unless otherwise specified.
Specifications and availability subject to change.
www.tycoelectronics.com
Technical support:
Refer to inside back cover.

160 Series (continued) – Coil Characteristics and Part Numbers

One Winding Single-Side-Stable 40 Milliwatts

Coil Resistance (Ohms)	Must Operate Current (MA-DC)	Must Operate Voltage (VDC)	Must Release Voltage (VDC)	Maximum Voltage (VDC)	Part Number	
					Form C	Form D
2.2	113	.27	.05	2.0	160-151A00	160-111A00
3.1	103	.35	.07	2.3	160-151B00	160-111B00
4.4	90	.43	.08	2.8	160-151C00	160-111C00
5.9	80	.52	.10	3.2	160-151D00	160-111D00
13.0	49	.71	.14	4.8	160-151E00	160-111E00
18.7	43	.87	.18	5.7	160-151F00	160-111F00
27.7	36	1.1	.22	7.0	160-151G00	160-111G00
50	25	1.4	.28	9.4	160-151H00	160-111H00
70	23	1.8	.35	11	160-151J00	160-111J00
125	16	2.3	.46	15	160-151K00	160-111K00
185	14	2.9	.60	18	160-151L00	160-111L00
325	11	3.8	.77	24	160-151M00	160-111M00
435	10	4.6	.94	28	160-151N00	160-111N00
680	7.5	5.7	1.1	35	160-151P00	160-111P00
1,120	5.9	7.2	1.4	44	160-151Q00	160-111Q00
1,750	4.6	8.8	1.7	55	160-151R00	160-111R00
2,650	3.8	11	2.2	68	160-151T00	160-111T00
3,900	3.2	14	2.7	83	160-151U00	160-111U00
6,100	2.6	17	3.5	103	160-151V00	160-111V00
9,000	2.1	21	4.2	125	160-151W00	160-111W00

Two Windings Single-Side-Stable 80 Milliwatts Per Winding

Coil Resistance (Ohms)	Must Operate Current (MA-DC) (Either Winding)	Must Not Operate Voltage (VDC) (Either Winding)	Must Operate Voltage (VDC) (Either Winding)	Maximum Voltage (VDC) (One Winding Only)	Dielectric Standoff Between Coils (VDC)	Part Number	
						Form C	Form D
60/60	33	2.2	.44	10	500	160-152K00	160-112K00
90/90	29	2.9	.58	13	400	160-152L00	160-112L00
155/155	22	3.7	.74	16	400	160-152M00	160-112M00
205/205	20	4.5	.92	19	400	160-152N00	160-112N00
340/340	15	5.6	1.1	24	400	160-152P00	160-112P00
560/560	10.8	7.9	1.3	31	400	160-152Q00	160-112Q00
870/870	9.3	9.0	1.8	39	200	160-152R00	160-112R00
1,320/1,320	7.5	11.0	2.2	48	200	160-152T00	160-112T00
1,980/1,980	6.4	14.0	2.8	59	200	160-152U00	160-112U00
3,000/3,000	5.3	18.0	3.5	73	200	160-152V00	160-112V00
4,500/4,500	4.2	21.0	4.2	89	200	160-152W00	160-112W00