NASA-STD-8739.11 Tutorial
Section R1: Relays

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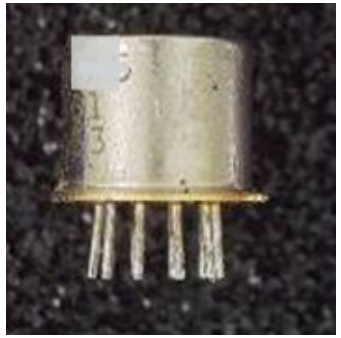
Acronyms

AEC	Automotive Electronics Council
COTS	Commercial-Off-The-Shelf
Cpk	Process Capability Index
CM	Common Mode (Choke)
DLA	Defense Logistics Agency
DoD	Department of Defense
DPPM	Defective Parts Per Million
EEEE	Electrical, Electronic, Electromechanical, Electro-Optical
EOL	End-Of-Line
ETW	Electronics Technology Workshop
FIT	Failure-In-Time
FMEA	Failure Mode and Effects Analysis
GSFC	Goddard Space Flight Center
IL	In-Line
JEDEC	Joint Electron Device Engineering Council
LED	Light Emitting Diode

MIL-SPEC	Military Specification
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
NASA	National Aeronautics and Space Administration
NEPP	NASA Electronic Parts & Packaging (Program)
NESC	NASA Engineering & Safety Center
PCB	Printed Circuit Board
PDA	Photodiode Array
PSW	Part Submission Warrant
QML	Qualified Manufacturers List
QPL	Qualified Product List
RF	Radio Frequency
SMA	Safety and Mission Assurance
SMD	Standard Microcircuit Drawing
SME	Subject Matter Expert
SPC	Statistical Process Control
SSR	Solid State Relay

Covered Part Types

- Relays for space are hermetic, and include small, large, high & low current, latching & non-latching. MIL-PRF-28776 has long been used at NASA, but only recently included in the NASA standard.



MIL-PRF-28776

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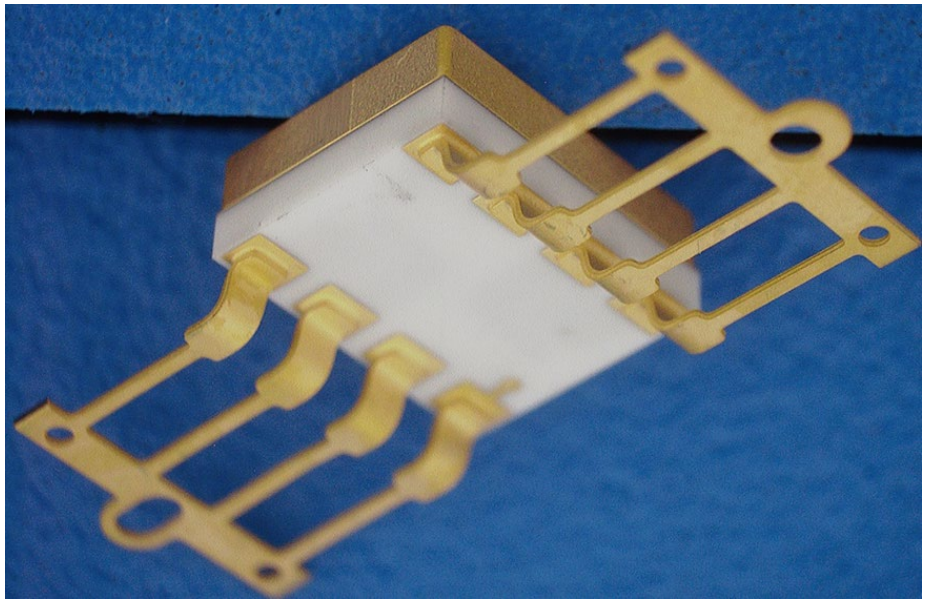
Not Covered in this Spec: Solid State Relays (SSRs)



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This Section R1 only covers fully mechanical Relays

Key Considerations

Key considerations to be made in the selection of a relay for a given application:

- Type of load to be switched (resistive, inductive, capacitive)
- Inrush current
- Switching time
- Contact voltage rating
- Contact load current rating
- Coil voltage rating
- On-off cycle and frequency of operation

Major Changes from EEE-INST-002

New Overview page, instead of some of the Notes

R1.1.1 This section covers the guidelines and recommendations for the selection, test, lot acceptance, and application of the electromechanical relays based on the requirements set for the use in space applications in accordance with government and industry standards.

R1.1.2 An electromagnetic relay is an electrical switch controlled by an electromagnet consisting of one or more wire coils wrapped around iron cores. Electromagnetic relays are used in aerospace applications to switch dry circuits (low voltage), signals, or powered loads.

R1.1.3 Energizing a coil causes an armature to pivot, operating one or more sets of contacts. When the coil of a non-latching relay is de-energized, the contacts return to their original open or closed positions. Latching relays are designed with extra magnets and coils to retain contact positions after switching. Relays may contain diodes across coils to suppress electromagnetic interference (EMI) voltages.

R1.1.4 Electromechanical relays intended for use in spaceflight hardware shall be selected for the applicable project parts assurance level in accordance with Table 1. Table 1 also lists screening and LATs required for the different assurance levels.

R1.1.5 A variety of different metals and alloys are used in relay contacts, depending on the load to be switched. These include gold plating over silver or other base alloys, silver nickel, silver copper nickel, and gold silver nickel alloys, palladium and even tungsten. Some high current silver alloy contacts may contain the prohibited material cadmium – this is acceptable in hermetically sealed relays.

R1.1.6 Relays are typically designed to switch 100,000 DC electrical loads minimum and 1,000,000 mechanical cycles when used to specification.

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Major Changes from EEE-INST-002

- Inclusion of MIL-PRF-28776 hybrid relays (small cans)
- Like other sections for this new 8739.11, each Level's section (1,2, & 3) shows all the Use As Is relay types for that Level

Assurance Level	Fuse Style and Type	Specification	Use as Is	Screening FRL	LAT	DPA
Level 1	Relays, Electromagnetic, Latching and Nonlatching, Low Level to 25 Amperes	GSFC S-311-P-754	X			X
	All Relays	SCD		X	X	X
Level 2	Relays, Electromagnetic, Latching and Nonlatching, Low Level to 25 Amperes	GSFC S-311-P-754	X			
	Relays, Electromagnetic, Latching and Nonlatching, 25 Amperes and Up (Includes Some Lower Contact Ratings)	MIL-PRF-6106		X		X
	Relays, Electromagnetic, Established Reliability, Latching and Nonlatching, Low Level to 5 Amperes	MIL-PRF-39016		(P, R)		X
	Relays, Electromagnetic, Established Reliability, Latching and Nonlatching, Low Level to 25 Amperes	MIL-PRF-83536		(P, R)		X
	Relays, Hybrid, Established Reliability	MIL-PRF-28776		(P, R)		X

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Additional Notes

- Cadmium is specifically mentioned, as acceptable within the contact surfaces. This does not OK cadmium-plating.
- Pure tin as a forbidden material is not mentioned – it's considered covered by the base specs and best practices. Relays have been observed with accidental pure tin plating somewhat recently. XRF 'em!
- Electrical testing and relay derating are not substantially changed from EEE-INST-002.

Send email to address below for questions

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