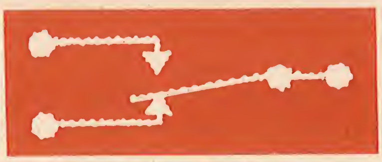


Standardized relay terminology simplifies selection and aids usage

Plagued by the lack of uniformity in relay nomenclature? Then use these performance-oriented standards. They facilitate understanding and may even optimize design.†

AT FIRST GLANCE, no device seems basically simpler than a relay. One would expect, therefore, that standardization of terminology would be easy. But prior to relatively recent publications by NARM and ASA*—and similar groups and trade associations—little or no progress was made in developing a common language.

One reason for this is that the many and varied industries that rely on relays use different technical language. Each has over the years, by usage and practice peculiar to its own operation, established relay designations differing from those in other industries.

In comparing relays, engineers may become frustrated by the lack of uniform terminology. One catalog or specification sheet may describe a relay's attributes with such terms as pull-in, release, pickup time, and so on. Another will feature pickup, dropout and operate time as the corresponding equivalents.

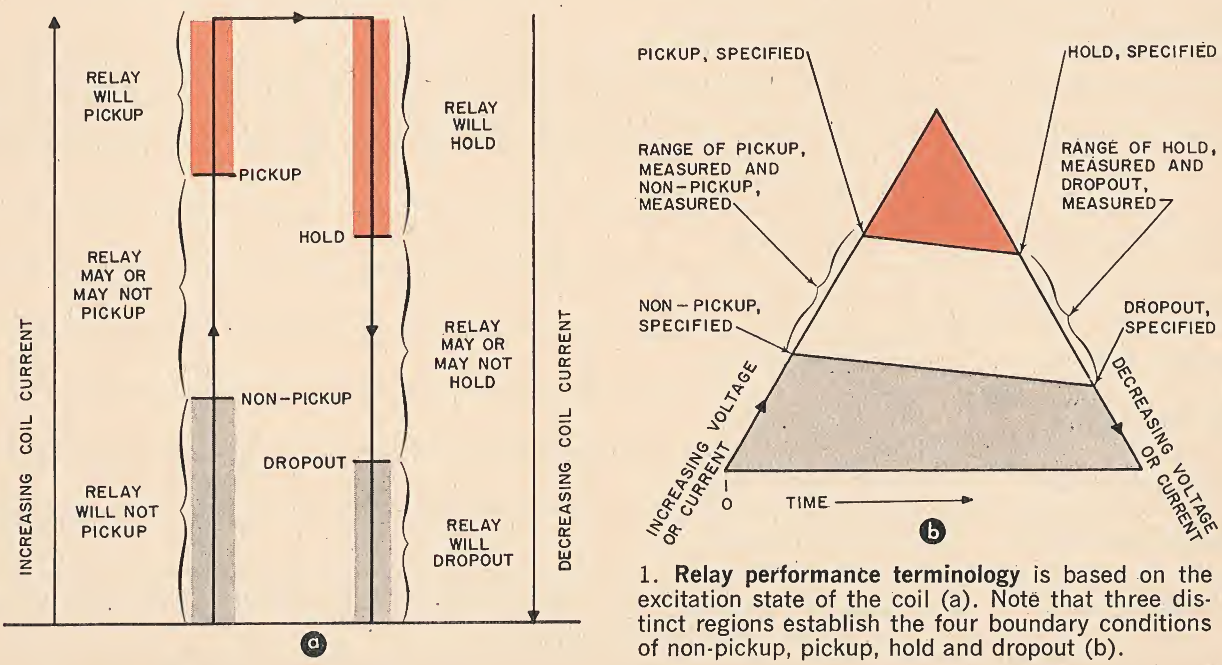
To alleviate this problem, a broad-based set of standards is being established by NARM.

From these standards, let's consider the ones that are most important for design engineers (see Table 1). Nomenclature on the physical makeup of the relay, materials, etc., has been omitted. Similarly, let's look at the preferred terminology as it applies to applications (Table 2).

The next step is to see how the preferred terminology is used in practice. The function

* The National Association of Relay Manufacturers (NARM) in a joint effort with the American Standards Association (ASA).

†This article is a condensed version of material extracted from Sect. II of the forthcoming NARM Engineers Relay Handbook.



1. **Relay performance terminology** is based on the excitation state of the coil (a). Note that three distinct regions establish the four boundary conditions of non-pickup, pickup, hold and dropout (b).

Table 1. Definitions of relay terminology

Bridging	The normal make-before-break action of a make-break contact combination. A momentary coming-together of adjacent contacts (in stepping switches). Also, "Abnormal Bridging": The undesired closing of open contacts caused by a metallic bridge or protrusion developed by arcing.
Chatter	The undesirable vibration of the relay armature and/or contacts caused by uncompensated or inadequate ac performance, or external shock and vibration.
Contact bounce	The intermittent, internally induced opening of closed contacts or closing of open contacts caused by the vibration of parts during relay operation or release. Also may be the result of external vibration or shock.
Dropout, measured	The maximum current or voltage at which the relay restores to its unoperated position.
Dropout, specified	The specified maximum current or voltage at which the relay must restore to its unoperated position.
Functioning time	The time between energization and pickup or between de-energization and dropout.
Hold, measured	The minimum current or voltage at which the armature does not move perceptibly from its fully operated position after having been energized electrically.
Hold, specified	The current or voltage at or above which the armature is required not to move perceptibly from its fully operated position, after having been energized electrically.
Lock-up relay	A relay that is capable of remaining in the fully operated position after the energizing pulse has been terminated.
Maximum dropout	(see Hold, specified)
Maximum pickup	(see Pickup, specified)
Minimum dropout	(see Dropout, specified)
Minimum pickup	(see Non-pickup, specified)
Non-dropout, measured	(see Hold, measured)
Non-dropout, specified	(see Hold, specified)
Non-operate, measured	(see Non-pickup, measured)
Non-pickup, measured	The maximum current or voltage at which a relay does not operate any contacts or only specified contacts.
Non-pickup, specified	The current or voltage at or below which a relay is required to not operate any contacts or only certain specified contacts.
Non-release, measured	(see Hold, measured)
Non-release, specified	(see Hold, specified)
Operate, measured	(see Pickup, measured)
Operate, specified	(see Pickup, specified)
Operate value, just	(see Pickup, measured)
Operate value, must	(see Pickup, specified)
Pickup, measured	The current or voltage at or below which the armature is seated against the coil core by assuming its fully operated position or a specified position.

Pickup, specified	The specified current or voltage at which the armature must assume its fully operated position or a specified position.
Pull-in value, measured	(see Pickup, measured)
Pull-in value, specified	(see Pickup, specified)
Pull-on value, measured	(see Pickup, measured)
Pull-on value, specified	(see Pickup, specified)
Rating, short-time	The highest value of current or voltage that the relay can stand without injury for specified short intervals. For ac circuits, the rms total value, including the dc component.
Release, measured	(see Dropout, measured)
Release, specified	(see Dropout, specified)
Time, actuation	The time at which a specified contact functions.
Time, actuation, effective	The sum of the initial actuation time and the contact-bounce intervals following such actuation.
Time, actuation, initial	The time of the first closing of a previously open contact or the first opening of a previously closed contact.
Time, bunching	The time during which all three contacts of a bridging contact combination are electrically connected during the armature stroke.
Time, contact bounce	The interval from initial actuation of a contact to the end of the bounce.
Time, drop-away	(see Time, release)
Time, dropout	(see Time, release)
Time, operate	The interval from coil energization to the functioning time of the last contact to function. It does not include contact bounce time.
Time, pickup	(see Time, operate)
Time, pull-in	(see Time, operate)
Time, release	The interval from coil de-energization to the functioning time of the last contact to function. It does not include contact bounce.
Time, stagger	The interval between the actuation of any two contact sets.
Time, transfer	The interval between opening the closed contact and closing the open contact of a break-make contact set.

of the coil and the reaction of the contacts is presented in Fig. 1. Standard terms describe the correct amount of coil power to achieve the relay action.

Figs. 2 and 3 show the actions of the relay and the proper terms to use in describing its actions (functioning).

In designs where operating times are most critical, the traces on Figs. 2 and 3 can be used to establish timing requirements. Note that the portions devoted to transient effects (contact bounce, chatter)—consume 10-20% of the over-all functioning time. This is not typical, however. The transient portion may even consume as much time as the functioning period in some common relay types. The drawings themselves are simulated (near-ideal), rather than actual. This was done to facilitate the understanding of the switching action.

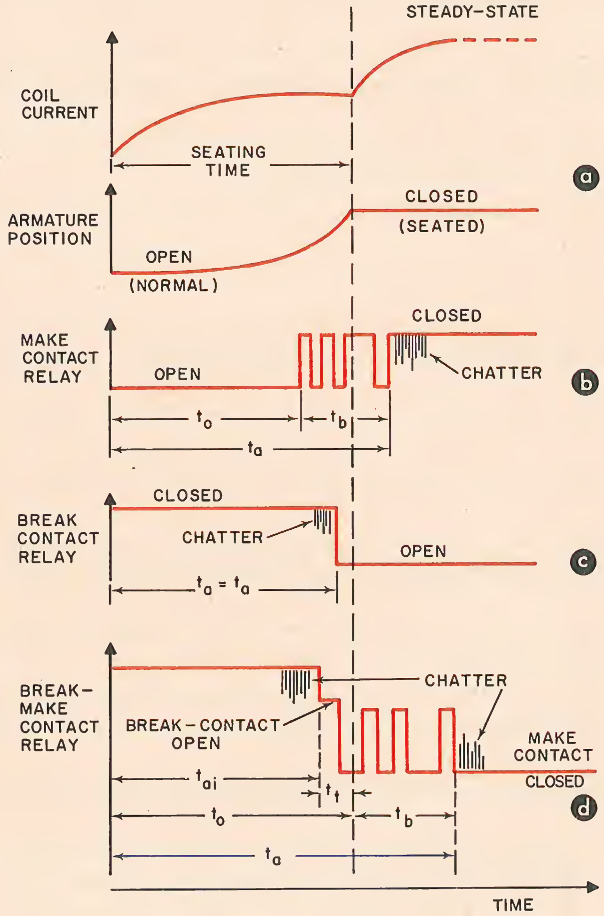
(Note also that in Fig. 2a, on energization, the coil current varies as a function of

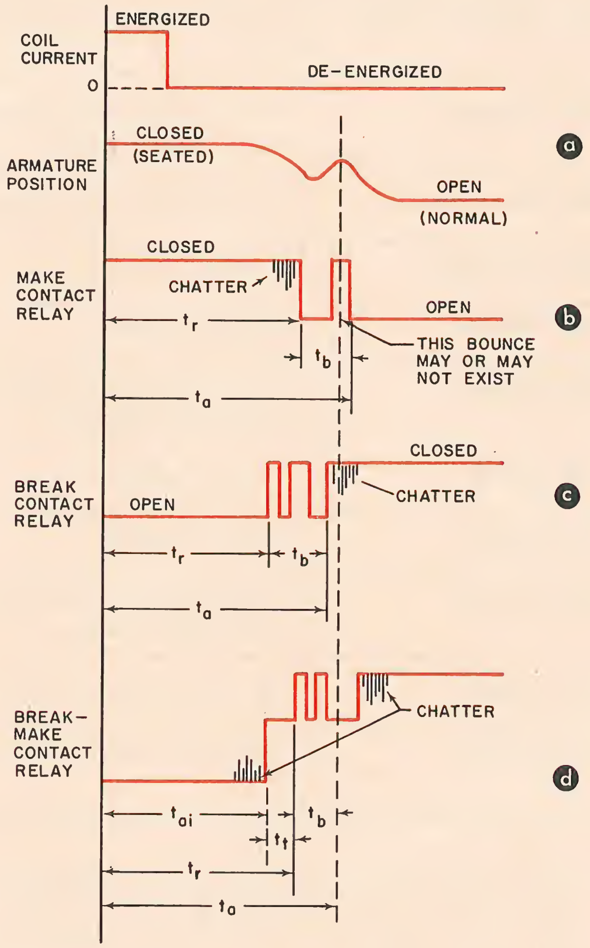
(text copntinued on p 50)

Table 2. Relay performance terminology

Preferred	Not preferred
Dropout, measured	Release, measured
Dropout, specified	Release, specified Minimum dropout
Hold, measured	Non-dropout, measured Non-release, measured
Hold, specified	Maximum dropout Non-dropout, specified Non-release, specified
Non-pickup, measured	Non-operate, measured

Preferred	Not preferred
Non-pickup, specified	Minimum pickup
Pickup, measured	Operate, measured Pull-In (or Pull-On) value, measured Operate value, just
Pickup, specified	Operate, specified Pull-In (or Pull-On) value, specified Operate value, must Maximum pickup
Time, operate	Time, pickup (or pull-in)
Time, release	Time, dropout (or drop away)

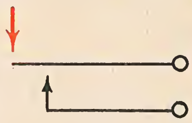
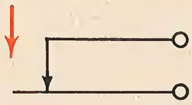
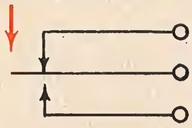
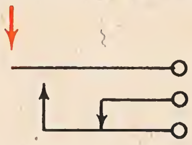
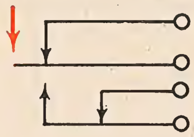
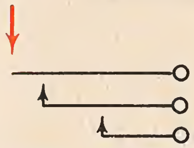
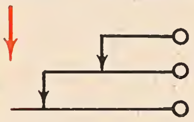
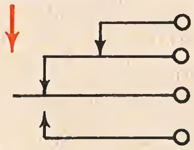
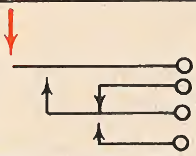
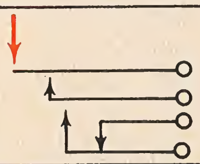
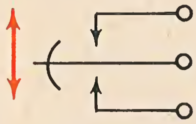


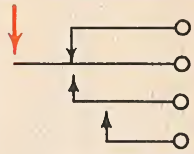
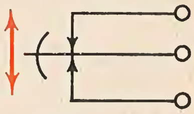
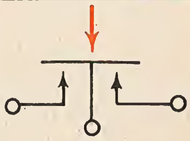
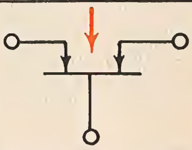
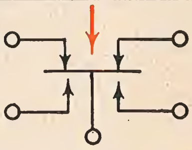
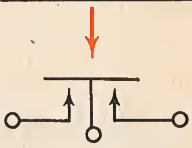
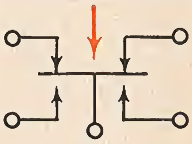


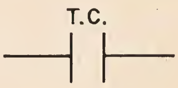
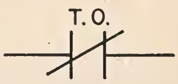
NOTE: 1. t_a = ACTUATION TIME
2. t_b = BOUNCE TIME
3. t_o = OPERATE TIME
4. t_r = RELEASE TIME
5. t_t = TRANSFER TIME
6. t_{ai} = INITIAL ACTUATION TIME
7. CHATTER ALSO KNOWN AS "GRASS" & "DYNAMIC RESISTANCE"

2. **Relay pickup function displayed with time as a base.** Contact change is shown as a function of coil current and armature position (a). Note that armature position as well as coil impedance determines current. Transient phenomena for MAKE (b) and BREAK (c) contacts and combination MAKE and BREAK contacts in one relay (d) are depicted.

3. **Time traces of the relay dropout function.** Coil current and armature position (a), MAKE contact (b), BREAK contact (c) and combined MAKE and BREAK contacts (d) are plotted as a function of elapsed time after the coil current has dropped to zero. Note that contact current flows as long as contacts are not open, independent of coil state.

Form	Description	Symbol
A	MAKE or SPSTNO	
B	Break or SPSTNC	
C	Break, Make, or SPDT (B-M), or transfer	
D	Make, Break or Make-Before-Break, or SPDT (M-B), or "Continuity transfer"	
E	Break, Make, Break, or Break-Make-Before-Break, or SPDT (B-M-B)	
F	Make, Make SPST (M-M)	
G	Break, Break or SPST (B-B)	
H	Break, Break, Make, or SPST (B-B-M)	
I	Make, Break, Make, or SPST (M-B-M)	
J	Make, Make, Break, or SPST (M-M-B)	
K	Single pole, Double throw Center off, or SPDTNO	

Form	Description	Symbol
L	Break, Make, Make, or SPST (B-M-M)	
M	Single pole, Double throw, Closed Neutral, (This is peculiar to Spec. MIL-R-5757)	
U	Double make, Contact on Arm. SP ST NO DM	
V	Double break, Contact on Arm. SP ST NC DB	
W	Double break, Double make, Contact on Arm. ST DT NC-NO (DB-DM)	
X	Double make or SP ST NO DM	
Y	Double break or SP ST NC DB	
Z	Double break, Double make SP DT NC-NO (DB-DM)	

Special A	Timed close	
Special B	Timed open	

4. **Contact nomenclature and symbols** for the various primary relay types. Heavy, colored arrow indicates direction of operation.

(continued from p 47)
both circuit impedances and the armature position and speed. The current for each contact case is based upon non-inductive loads.

In the case of de-energization (Fig. 3a) the coil current is affected by arcing and external circuit transients, as well as by circuit impedances. Here, too, the performance of three distinct types of contacts and their respective transient phenomena are demonstrated.

The contact-spring combinations available on a relay are defined in standard terms of the number of poles, number of throws, normal position (open or closed contacts) and the sequence of make and break. To simplify their designation, letter symbols have been applied in Fig. 4 to the most common types of sets. These representations are useful in relay selection and design. Engineers are likely to come across them in catalogs, specification sheets, technical articles, schematic diagrams and, occasionally, on the relay can itself.

Any treatment dealing with the standardization of relay terminology would be incomplete, unless some mention were made of classification. The proper identification of a relay may hinge on this. Moreover, a widely-embraced set of classification standards helps engineers to select the best relay for the job.

Relays may be classified by the electrical input they require. Thus dc and ac types would constitute the main areas. Dc types should be sub-classified according to whether the relay is neutral (non-polarized) or polarized. The ac specification should also include a mention of the frequency range in question.

The contact requirements (the load) may also establish a set of classification standards. The most prevalent and useful terms here would be dc, ac (including frequency range), power (heavy duty), radio-frequency and coaxial.

The categorizing of relays by duty is also desirable. With this means of classification, a statement containing quantitative information about contact capability, the number of contacts, their rating and the number of operations in their useful life will be useful. These items are preferable to such descriptions as light, medium and heavy duty. As an adjunct to this mode of classification, such terms as commercial, industrial, military. etc., may be used to further delineate the relay's purpose.

Relays may also be classified by performance and/or industrial application. The article on page 57 of this report covers this aspect in detail. ■ ■