Data sheet terminology guide

1. **Coil parameter** – Running a voltage (V) through a coil of wire that is wrapped around an iron core creates a magnetic field. In a relay, the magnetic field moves an armature and a contact. Thus, the coil actuates the relay. When the voltage is removed, the relay returns to its original state. Relays functioning like this are called monostable relays. Latching relays, also called bistable relays, are relays which switch the same as monostable relays, but once actuated, a magnet holds the armature and contact in place. These are advantageous in that the coil need not be powered to maintain the relay function. The disadvantage operationally is that if the relay (or application) fails, the relay will not switch back to its original state. For example, if power is flowing through the relay contacts and the application suffers damage for any reason, it is likely that the relay will continue to carry power.

   The coil parameter table shows coil power options available for the relay series. Coil power is sometimes called sensitivity. Latching relays can have one coil which toggles the contacts between the two relay states (by reversing the voltage flow through the coil), or they can have two separate coils to accomplish this goal. The sensitivity, in either case, will be shown here.

2. **Coil data** – These tables will show the coil current (measured in milliamps – mA) and resistance for each available coil voltage (measured in volts – VAC or VDC depending if the circuit is alternating current or direct current). The higher the coil resistance (measured in Ohms - Ω), the lower the power requirement to actuate the relay. Most manufacturers standardize coil resistance, but in some cases, differences exist. Churod has a few series which have "super-sensitive" coils. These lead the industry in low power consumption. Typically, the larger the relay and the higher the amperage of the contacts, the higher the coil power will be. The table also shows the operate voltage (must operate voltage) and the release voltage (must release voltage). The operate voltage is the voltage by which the relay is guaranteed to operate or move to its actuated position. The release voltage is the voltage by which the relay must drop out or stop holding the relay in its actuated position. Sometimes the table will list the absolute maximum voltage allowable on the coil before damage can occur. In the case of latching relays, the data sheet may also list the amount of time coil voltage is required to actuate the relay.

3. **Contact Arrangement** – This tells what form the relay contacts take. A single pole, single throw relay (SPST) has two contacts which the relay will actuate to open or close. SPST-NO (normally open) means that the relay contacts default to being open, and so electricity cannot pass between them. When the relay actuates, the contacts close allowing current to flow. This relay is also called a 1 form A. SPST-NC (normally closed) means that the relay contacts default to being closed. Actuating the relay opens the contacts to prevent current from flowing. This relay is also called a 1 form B. SPDT (single pole, double throw) relays have both normally open and normally closed contacts. Functionally, these are two separate circuits. Actuating the relay will change from one state to another (one circuit opens while the other closes). This relay is called a 1 form C. If a relay has more than one set of contacts, the nomenclature remains the same with the exception of changing to the number of contact sets (two pole, single throw is 2PST or DPST for double pole, single throw; 3 poles would be 3PST, etc.).

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4. **Contact material** – Contacts are metal discs which pass the electric current. Contacts will almost always have a high degree of silver (Ag) since it passes current very well with little heating due to internal resistance. Many times, the contact will not be entirely silver. Frequently there is a silver layer on top of a copper core. Other metals can be mixed, too. Cadmium (Cd) is very good for long life applications. Tin (Sn) is good for high inrush applications. Indium (In) can be added to silver tin for very high inrush applications. If long life is required and loads will be very low, gold (Au) can be layered on top of silver alloy. Gold has very low internal resistance, so it is good for passing low energy loads like telecom signals.

5. **Initial contact resistance** – Relay contacts will naturally have some amount of internal resistance. This resistance depends on what metal or metals are used. Contact resistance also changes as the contacts become hot due to passing an electric load. The lower the initial contact resistance, the lower the losses will be due to heating when the contacts increase in temperature. In the case of high amperage relays for electric meters or industrial applications, this becomes critical. These relays have the potential to grow extremely hot if the contact resistance is too high.

6. **Max. switching voltage** – This is the highest voltage the relay has been tested to switch. There will usually be an AC voltage and a DC voltage listed. This does not mean that the relay is not able to switch higher voltages. It means that the factory has no test data above this level.

7. **Max. switching current** – This is the highest current (in Amps – A) the relay has been tested to switch. The value may not tell if the load is an AC or DC load. The rating does not mean that the relay cannot switch higher currents, only that the factory has no test data above this level.

8. **Max. switching power** – This is a mathematical formula, simply amps times volts. If the voltage is DC, the switching power will be in Watts (W). If the voltage is AC, the switching power will be in VoltAmps (VA). Typically, the max switching power will be the highest current rating times the highest voltage rating, but this is not always true. Sometimes the highest current rating will be at a lower voltage and vice versa.

9. **Contact rating** – This is a list of approved regulatory ratings the relay holds from agencies like UL (), TUV (), VDE (), and CQC (). The file issued by a regulatory agency will outline the specific test conditions of each rating the relay holds. File numbers will be shown at the top right of the data sheet. The test conditions will include: current; voltage; nature of the load (resistive, inductive, capacitive, etc.); ambient temperature during the test; number of cycles; which contact was tested; and any other special conditions of the test (e.g. relay was vented as opposed to sealed, or Class F insulated version only). The list of ratings will not usually include all parameters of the load, because space on the data sheet is at a premium. Complete regulatory information is available through Churod Americas.

10. **Mechanical endurance** – This measure shows the minimum number of switching cycles the relay is guaranteed to perform if no load is passed through the contacts.

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11. **Electrical endurance** – This measure shows the minimum number of switching cycles the relay will perform at a given electrical load. This is a benchmark number only, as switching cycles can vary greatly depending upon load conditions. Conditions of the test will often be listed.

12. **Minimum load** – The minimum load shows the lowest load that the relay can pass without losses in the integrity of the load. One reason for this measurement is that relays can form a film on the contact faces from the oxidation of contact material. A minimum load is required to burn this film from the contacts. If the load is too small and the film remains, the load will not pass effectively (or sometimes at all) when the contacts close.

13. **Operate voltage** – As mentioned in the coil data section, the operate voltage (or must operate voltage) is the highest voltage required to actuate the relay. The coil data section shows this spec nominally in VDC or VAC. Operate voltage on its own lists the operate voltage as a percentage of nominal coil voltage. For example, if a coil has a nominal voltage rating of 12VDC and a must operate voltage of 75%, the relay is guaranteed to actuate at 9VDC or lower.

14. **Release voltage** - As mentioned in the coil data section, the release voltage (or must release voltage) is the voltage by which the relay is guaranteed to stop actuation. The coil data section shows this spec nominally in VDC or VAC. Release voltage on its own lists the release voltage as a percentage of nominal coil voltage. For example, if a coil has a nominal voltage rating of 12VDC and a must release voltage of 5%, the relay is guaranteed to open at 0.6VDC or higher.

15. **Min. holding voltage** – This spec is not on many data sheets, but it is becoming more present as companies become more vigilant in saving energy in their applications. A relay requires more energy to close the contacts than it requires to keep them closed. This is due to the inertia of the armature. The minimum holding voltage shows the lowest voltage that is guaranteed to keep the relay actuated after the initial actuation. It is important to note whether the application in which the relay will be used will employ PWM, or pulse width modulation. This is a method of driving the coil using a square wave supply voltage, or a high frequency on/off cycle. PWM reduces the amount of power needed to drive the coil by the amount of time the square wave is off. For example, a common duty cycle for this type of wave would be 50% on: 50% off. This type of wave would reduce the total coil power by 50%. A common frequency for PWM applications is 20kHz (20,000 cycles per minute). If the frequency is too low (1kHz or below), there is a danger that the mechanical operation of the relay will be affected (ie the frequency is slow enough that the relay can partially deactuate and reactuate with each cycle).

16. **Operate time** – The operate time is the maximum time the relay will take to actuate after the coil voltage is applied to the relay. If a relay has multiple coil sensitivity options, this spec may change based on the sensitivity of the coil. The operate time is also affected by the amount of voltage applied to the relay. If the relay is overdriven (more than nominal coil voltage supplied), the relay will actuate faster.

17. **Release time** – The release time is the maximum time the relay will take to stop actuating when voltage is removed from the coil.

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18. **Insulation resistance** – This specifies the minimum resistance between isolated sections of the relay. This can mean between open contacts or between the coil and contacts, but it is not limited to these points.

19. **Dielectric strength** – The dielectric strength is a measurement of the relay's ability to prevent an arc between two points for a sustained period of time. The most common reference points are between coil and contacts and between open contacts. The benchmark test time is 1 minute.

20. **Surge voltage** – This is a measurement of the relay's ability to prevent an arc between the coil and contacts in a very high voltage and short duration event. The benchmark test time is 50µs.

21. **Shock resistance** – This measurement gives a minimum level of shock that when applied to the relay will not cause damage. There are usually two measurements, functional and destructive. As the name implies, functional shock resistance is the shock the relay will withstand without inhibiting function of the relay. Typically, this means that contacts which are closed will not open at the specified level of shock. Destructive shock resistance is the level of shock the relay will withstand without changing its operating characteristics.

22. **Ambient temperature** – This range outlines the highest and lowest temperatures in which the relay is guaranteed to operate. The relay's operating characteristics may differ across this range, but it will continue to function. One example of this is that coil resistance changes with temperature, so across a wide range of operating temperatures, the pull in and drop out voltages may differ.

23. **Ambient humidity** – This range outlines the highest and lowest levels of humidity in which the relay is guaranteed to operate.

24. **Terminal** – Relays can have many types of terminations from PCB pins to quick connect terminals to screw clamps and more.

25. **Enclosure –** UL 94V-0 is an industry benchmark outlining the ability of plastics used in the product to self-extinguish during thermal events. Vented relays have one or more openings to outside air. Vented relays are not recommended to be used in high humidity and dust environments or when the relay is assembled onto a PC board which will go through a wash process. Sealed relays are enclosed with epoxy to the degree that they are highly water-resistant. Note that they should not be considered to be waterproof, as certain conditions (namely high temperature and pressure wash processes) can lead to water ingress. This spec may reference an RT rating which is a degree of sealing per IEC61810 standard.

26. **Weight** – The weight refers to the relay's mass in grams independent of anything else including packaging or external connections.

27. **Insulation class** – The insulation class refers to the relay's ability to function at specific temperature levels without physical degradation. Most Churod relays are designed with a Class F insulation system which guarantees the relay will not physically degrade in applications up to 155^0C. Note that there is a difference between Class F construction (typically the coil only) and a Class F insulation system. A Class F constructed coil will withstand temperatures up to 155^0C, but the rest of the relay may not. A Class F system is a system which is recognized by UL. All plastics and systems are tested together and recognized to withstand a 155^0C operating temperature (ambient temperature + load heating + heating from operation).