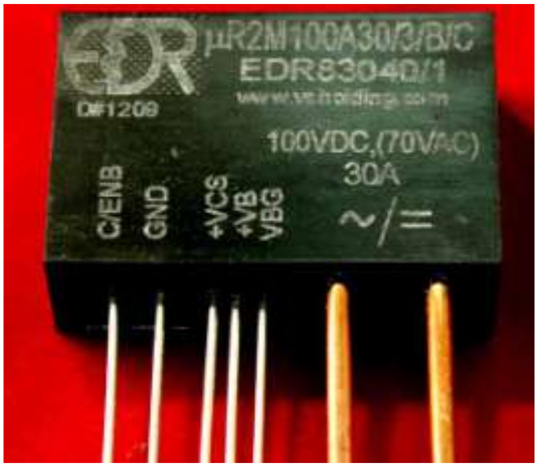
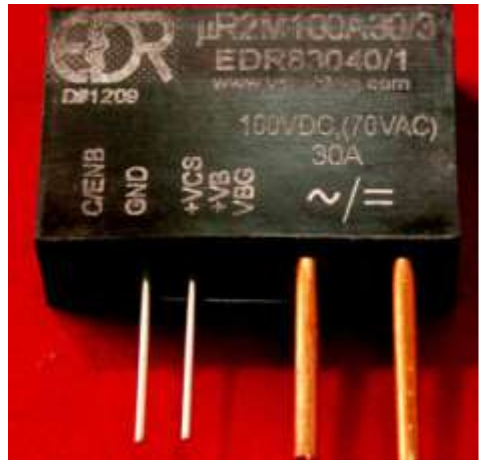
Normally Closed, Micro-Power Consumption SPST-NC (1 Form B) Solid-State Relays





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***Electronic Design & Research** is a pioneer in developing and manufacturing high-speed, high-power relays/switches. Since 1998, we have produced vast varieties of solid-state modules and devices. Our products have been used in thousands Defense related and industrial applications.*

Piezo Drivers
Video Switches
½ Bridge drivers
Cardio Stimulator
Q-type high-pass filters
Precision F-to-V converter
Super-High Resolution EKG
Soft-Landing Solenoid Drivers
50Hz/60Hz Comb Notch filters
H-bridge or Full-bridge Drivers
Super-high Power, Fast Switches
High-power, high-speed Switches
Universal Analog Building Module
Signal Switching Separating Network
Sockets for relays, switches, and drivers
Charge-Pump Wide-Band FM detectors
Low-noise, High-Voltage DC/DC converters
DC-3phase AC resonance mode driver for EV
DC-12phase AC resonance mode driver for EV
Perpetual Pulse-width Discriminator, US Patent
½ and H Fuzzy Logic sockets for various relays
Fuzzy-Logic SPDT Relays, Switches, and ½ Drivers
Fully protected, Solid-State DPST Brake, US Patent
μ-Power SPST-NC and SPDT-NO Solid-State Relays
Single Pole, Single Throw Relays, and Switches (SPST)
Neutral-cell Multichannel signal processor, US Patent
Power-distributing module for Motorcycles, US Patent
Single Pole, Double Throw Relays, and Switches (SPDT)
Double Pole, Single Throw Relays and Switches (DPST)
1-Form B, SPST-NC (normally closed) Solid State Relays
Charge-and-Add, Up/Down DC/DC Converters, US patent
μ-Power Controller for Magnetic Latching Valves, US Patent
High Voltage, Nana-Seconds Rise/Fall time, Push-Pull Drivers
1-Form B and 1-Form A and DPST-NC/NO Solid State Relays
Super-low noise preamplifiers for low and high-impedance sources
μ-control, High-Power SPST-NC, normally closed relays, US Patent

We are working hard to bring new devices to the market to meet your requests. Above is an incomplete list of the family of devices we have developed and are manufacturing. Most of them are covered by propriety technologies, and some of them are so unique and protected by US patents. We keep a small number of popular devices in stock and are ready to ship them on demand. Our production capacities exceed 10,000 devices per month when two production robots are programmed and working at full speed.

For your unique application that requires a different voltage, current, or speed, ordering instructions (on the last page) could be helpful in creating a new part and summarizing what you need. Do not hesitate to send us an email at info@vsholding.com (or v_shvartsman@vsholding.com) asking for additional information, delivery schedules, and prices.

Families of μSPST-NC and μSPST-NO relays with ultra-low input power consumption.

For years, electromechanical relays have been used in a wide variety of power control electrical applications. Though these mechanical devices, which are built of a coil and contacts, have demonstrated considerable reliability, they suffer from the problems associated with having moving parts. Material fatigue shortens the life span of mechanical relays, and reliability suffers due to shock and vibration. A mechanical relay is subject to arkes and sparks, contacts bouncing. In applications where it is required to switch a high DC voltage, the cost of a mechanical relay snowballs. The coil switching leads to voltage spikes or fly-back voltage. A coil-operating device requires plenty of power to operate correctly. It is not suitable for high power and high switching frequency. Some relays require much more power to energize their coil. Such a high waste of power has prohibited using many electromechanical relays in modern electronic devices where only a few milliwatts of power are available. Since semiconductor devices started flourishing and their cost decreased, solid-state relays became a valuable alternative to electromechanical devices. Only electromechanical relays with normally closed terminals continue to be king because a solid-state relay with customarily closed (SSR-NC) terminals suffers from production costs. While it was possible to build an SSR-NC with comparable ratings (high current and voltage) using a large number of depletion mode MOSFETs (D-MOSFET) or J-FET, the exceptionally high cost and large size of such components made it generally impractical.

In 2010, Patent No. US 7,755,414 granted titled by "Very Low Power Consumption Sold State Relay." It describes the techniques for making solid-state relays with normally closed and normally open terminals that need only a few milliwatts to operate. Thousands of devices have been built since that time, and they are operating successfully in portable devices around the world. A solid-state relay with a normally closed terminal (SPST-NC) rated at 100VDC (72VAC) & 30A assembled in 1.75" H x 1.80" L x 0.6" W required only five mA at 3.6 V (18-mW) for switching 3-kW.

That was impressive for a while until we were confronted with demanding requirements for lowering power consumption, needs for higher switching frequency, and increasing device longevity. A newly designed μSSR has met those challenges. An μSSR rated at 100VDC & 30A or 3-kW required only 0.4mA at 2.4V or just 0.96 milliwatt for its regular operation. That is almost 20 times more improvements than the previous technology. Currently, we offer meager power consumption relays such as μSSR-NO (normally open) and μSSR-NC (customarily closed) relays. Both are a valuable addition to modern portable and handheld devices.

That family of devices is designed to accommodate the most available MOSFETs on the market. That means you can ask for a device to meet your rating requirements, even if we have not listed it yet. There is no additional fee for accommodating your specific requirements in any of our already developed and manufactured devices unless some modifications are required.

The μSSR's combined unique design and functionalities undoubtedly contributed to delivering outstanding performances, which have all encouraged us to file a patent application.

Thank you,

Vladimir A. Shvartsman, Ph.D.
V_Shvartsman@vsholding.com

1 Form B, SPST-NC, µ-Power SSR

30A Normally Closed Relay, 0.5mA control current at 2.6V

Electronic Design & Research
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Technology for people's ideas

FEATURES:

Utilizes only 1.5 sq. in. of PCB area and only 1.15" tall
Sealed Construction for Automatic Soldering and Cleaning
High sensitivity, only 400 µA is required for controlling
Very high surge current tolerance
Very low on-state resistance, less than .003 Ohm

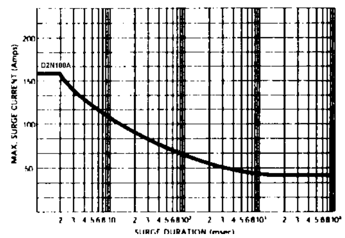
Input Specifications: p/n EDR83040/1

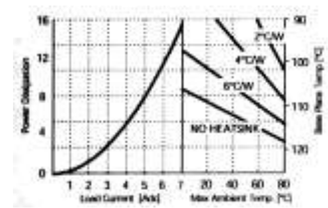
Vcs voltage	3V	4V	5V
I cs current	0.8mA	1.3mA	1.5mA

Typical Output Specifications (µR2M100A30)

Operating DC voltage range	100VDC (70AVC)
Maximum continuous current	30A rms
Maximum surge current (IDM) -1mS	400 A
Continues current (ID), 100mS	100 A
Maximum on-state resistance	3.0 mOhm
Rising time	2.3µS
Delay-on time	44 µS
Falling time	2.1µS
Delay-off time	1.5 µS
Maximum switching frequency at Vcs=5V	3.4 KHz
Leakage at the maximum rating, 25^{o}C	40 nA

Test performed at the input current equal to 1.40 mA





General Specifications:

Ambient operating temperature ranges	from -40^{0} C to 85^{0} C
Ambient storage temperature ranges	from -55^{0} C
Dialectic Strength input-to-output	2,500 V rms (MIN)

Mechanical Specifications:

Weight (oz)	.08
Encapsulation ResTech	10207/053
Dimensions for #2 package	1.15" H x 1.75" L x 0.595" W
Inputs terminals/pins	.030" diameter
Output terminals pin .100 "diameter	

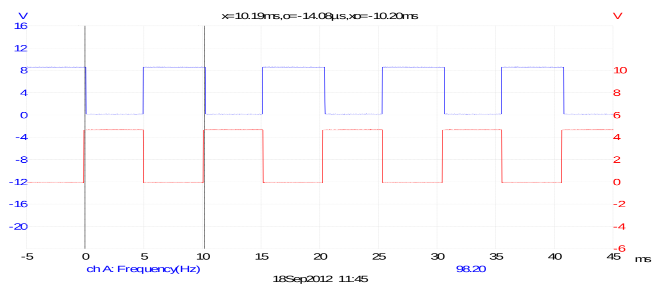
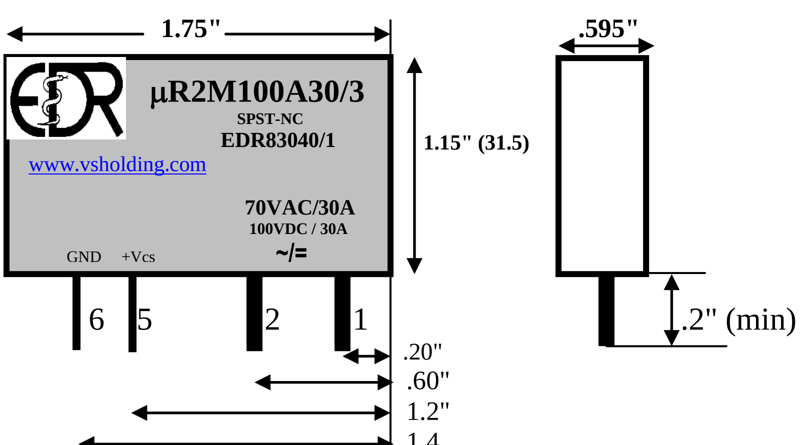
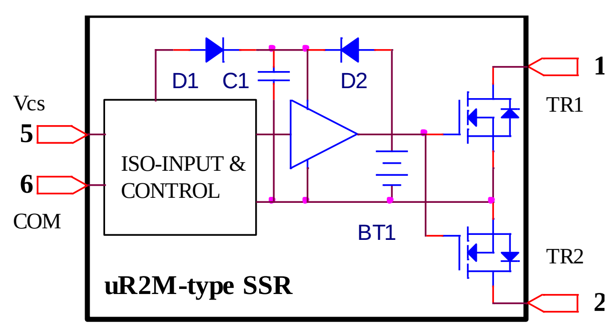


Figure 1
A relay chops at 20 Amp at about 100 Hz.

Information and pins-out for a SIP package

PIN #1: LOAD or ~/= Power
PIN #2: LOAD or ~/= Power
PIN #5: +Vcs (control signal)
PIN #6: GND (Vcs return)





NOTE: Order **µRPM100A30/3 for a panel-mounted package**

Simplified diagram of the micro-power SSR

Transient Protection: All loads are inductive, even ones that are not so obvious or labeled. An inductive load produces a harmful transient voltage, which is much higher than the applied voltage when it is turned off. An SSR built with a MOSFET output acts as an ideal switch and can produce a seemingly "non-inductive" load, which can cause damage if not suppressed. A transient voltage suppressor, which is bi-directional for an AC-applied voltage and unidirectional for a DC-applied voltage, should be used to clamp excessive spikes.

The Vcs input characteristics						
PARAMETERS	CONDITION	SYMBOL	MIN	TYP	MAX	UNIT
Input control current	F = DC to 50Hz	Ics	.230	1.1	3.1	mA
Input control voltage	F = DC to 50HZ	Vcs	2.4	3	5	V
Input control current	I cs vs. F, Vcs=3.0VDC	Ics	.500	1.7	2.7	mA
Switching frequency		F	50	500	800	
Isolated voltage				3,000		Vrms
Operating temperature			-40		+85	°C

Table 5

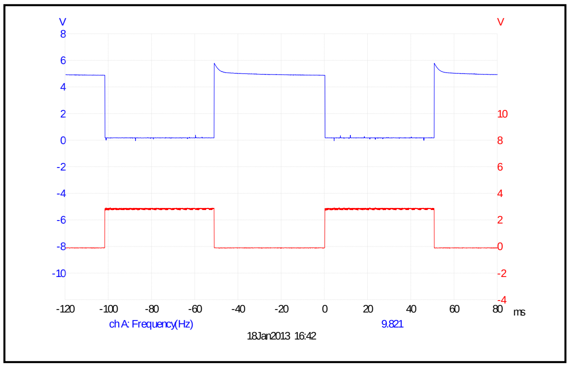
NOTE: The Ics is switching-frequency dependent.

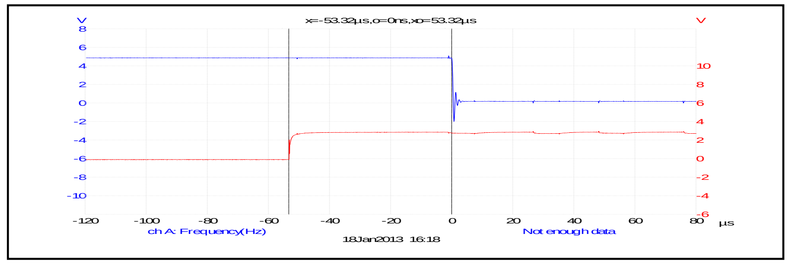
Application reminders:

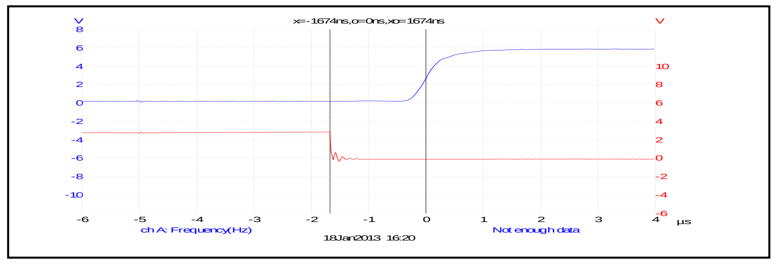
Providing a dual control via the Vcs and C/EBN, the µSSR delivers valuable flexibility to a designer's desire to have specific and unique application solutions. Here are just a few obvious points.

1. Via the Vcs is the simplest and most efficient way to control a relay. A meager power consumption of less than 800 µW has made the µSSR an essential device that works with portable and remote equipment.
2. Suppose an increased current consumption by the Vcs during a high frequency switching might overload a source of a control signal. In that case, the C/ENB input can be used for controlling the µSSR instead. The C/ENB requires less than 150 µA and is irrelevant to a switching frequency, thus giving the µSSR the ability to interface with any equipment easily.
3. The C/ENB can be used as the Vcs disabling control.
4. The C/ENB can be used for pulse-width modulation (PWM).
5. The C/ENB can be used to charge the internal bank of energy.

VCS = 3VDC

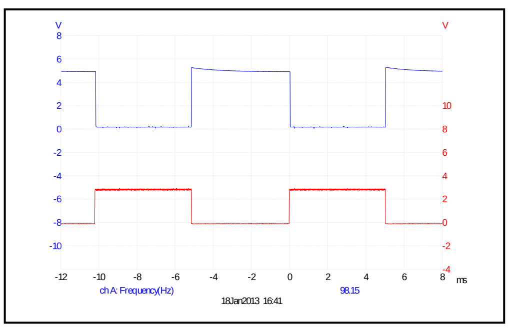


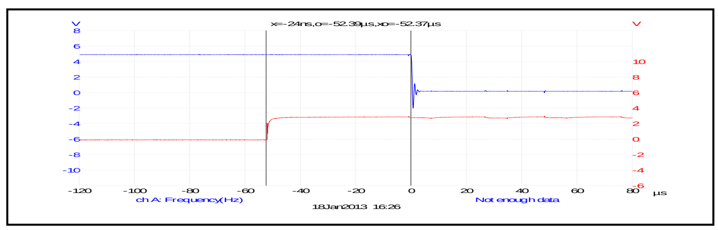


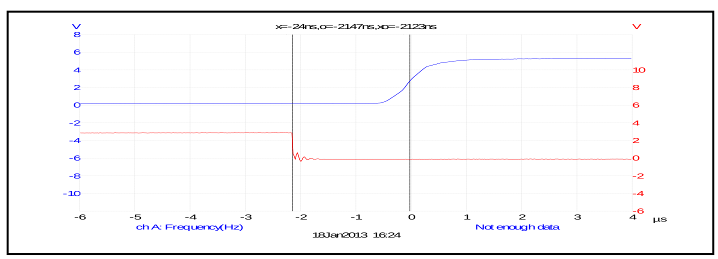


FREQUENCY = 10HZ, TURN-ON DELAY = 53US

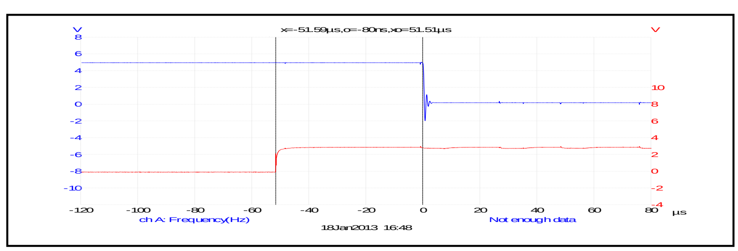
TURN-OFF DELAY = 1.67US

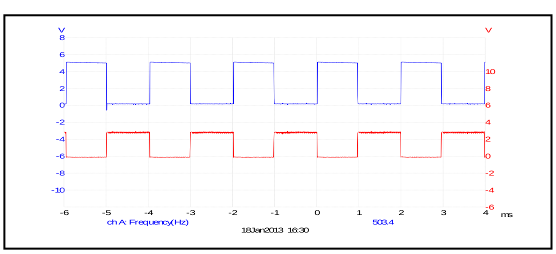


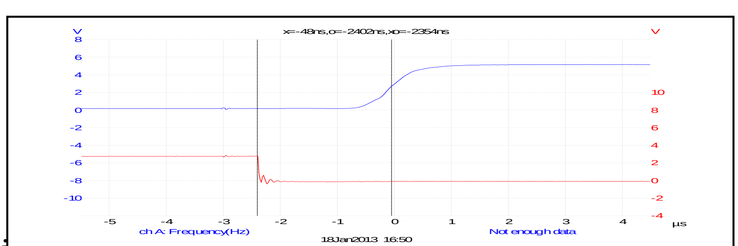




FREQUENCY = 100HZ, TURN-ON DELAY = 52.37
TURN-OFF DELAY = 2.193US

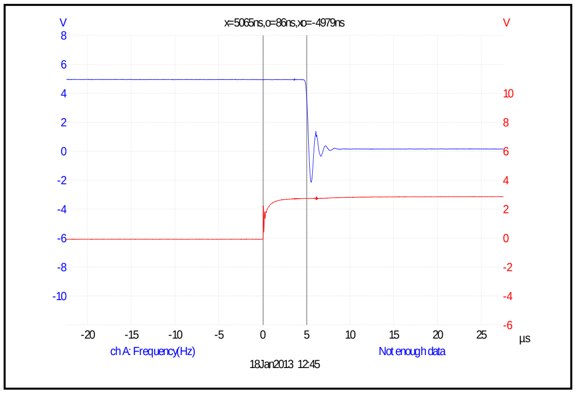






FREQUENCY = 500HZ

Switching time test – Load – 25 Ohm & 20A, a single 100 mS pulse width



LOAD

CONTROL

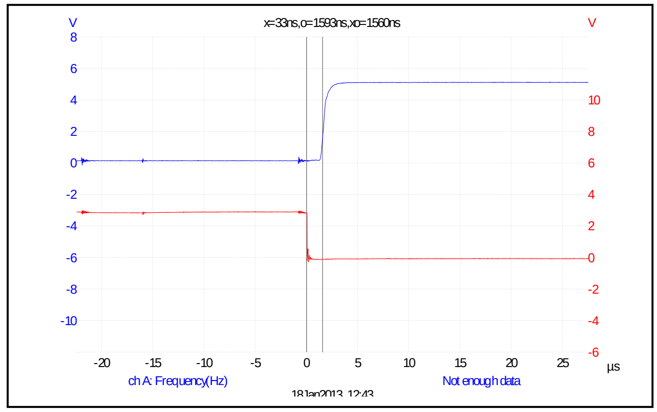
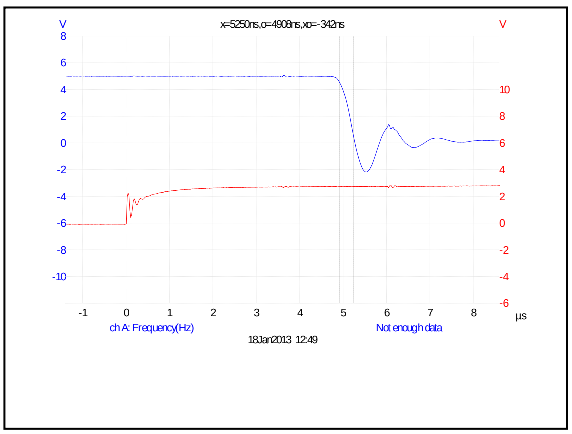


FIG.8 Turn-on delay is 4.97µS

FIG.9 Turn-off delay is 1.6µS



LOAD

CONTROL

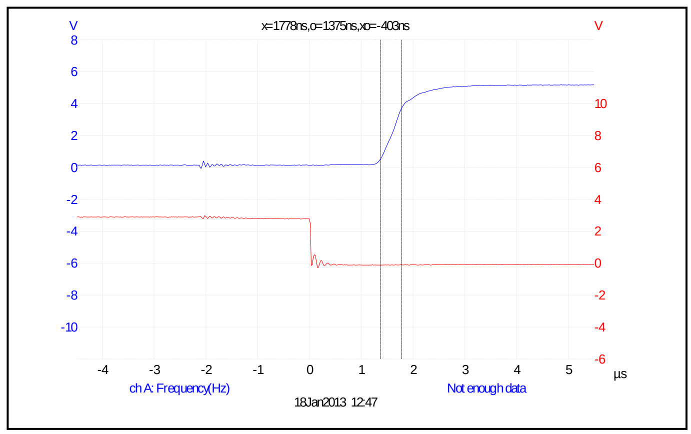


FIG.10 Rising Time is 342nS

FIG.11 Fall Time is 403nS

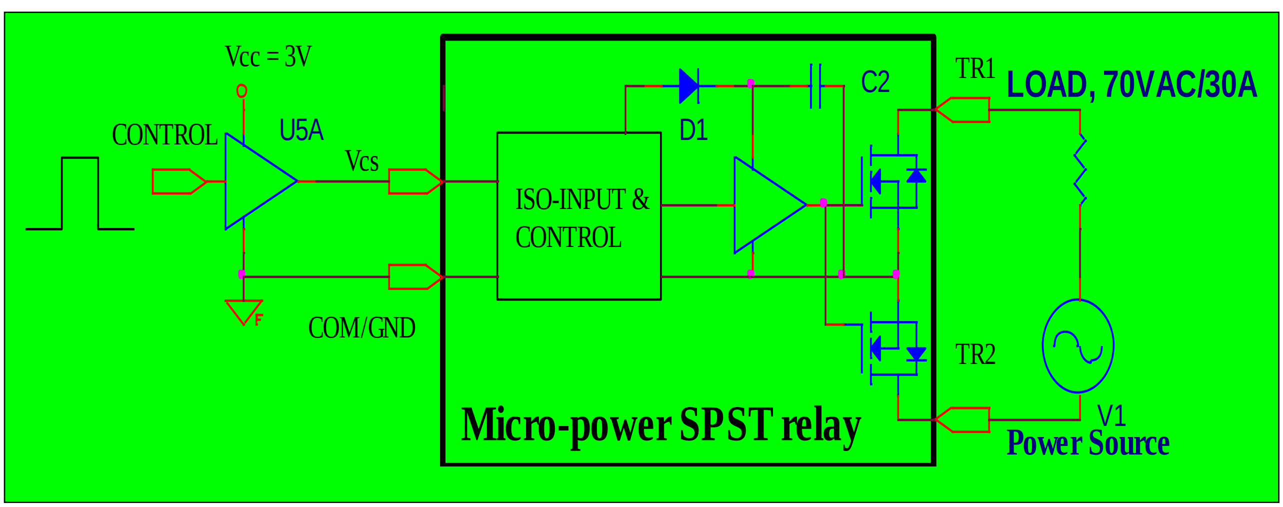


FIG.12
Switching Time Test Circuit

Operation & Applications (page #1)

The µSPST (both types, SPST-NC and SPST-NC) allows the implementation of one of several modes of operation. The simplest of them is what we call a "direct-controlling mode of operation or a direct mode," as FIG.2 shows. This direct mode is similar to hooking up a regular electromechanical or solid-state SPST relay. The Vcs acts as a control input and a power provider. Two output terminals (TR1 and TR2) are for connecting a load and a power. It is a highly efficient mode of control that requires less than one milliwatt for a low switching rate.

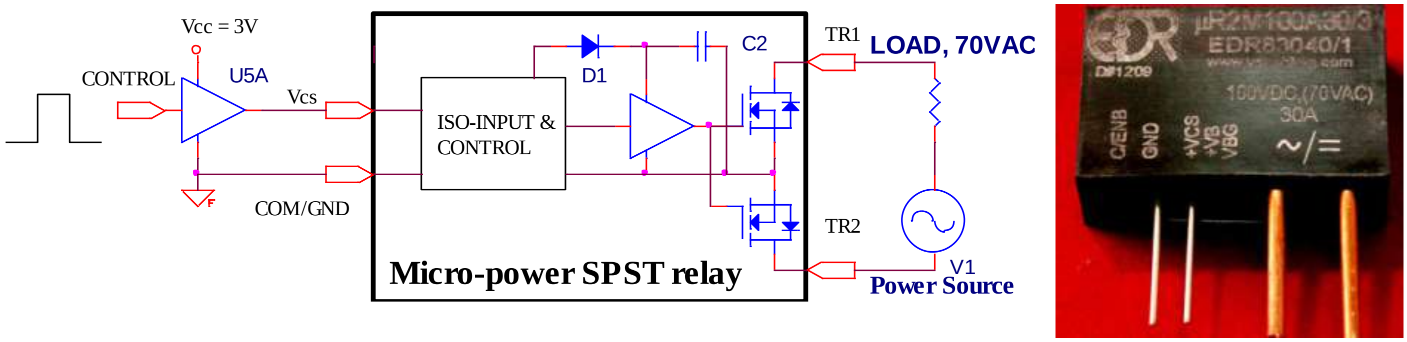


FIG.2. Most efficient µSPST' hook-up

(An µSSR can be ordered with just four pins, two input terminals and two output terminals)

The basic hook-up of the µSPST, allowing the most efficient control, is shown in FIG.2. An input current consumption via the Vcs is minimal and depends on switching frequency and, of course, the output power rating. A high-power MOSFET requires a measurable amount of energy for its driving. Suppose a chopping (switching) frequency does not exceed a few times per second. In that case, the current consumption is about 0.4 mA and increases to 6 mA at 1000 Hz chopping frequency. There are some limitations related to PWM applications, specifically to the shortest possible pulse width. A pulse should be longer than 1.0 mS, which is how much time is required to charge capacitor C3 fully at the frequency of 100 Hz, and 1.0 mS is 10%. Increasing the Vcc to 5V will somewhat extend the frequency range and allow for the application of shorter pulses. Further reduction of power consumption is possible by reducing Vcc to 2.4VDC and installing a resistor in series to the Vcs.

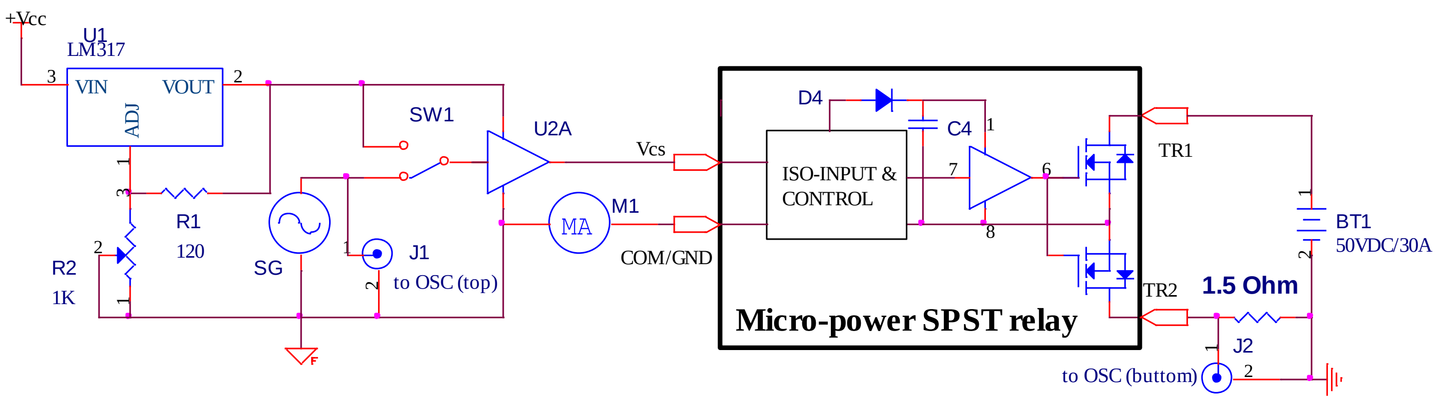
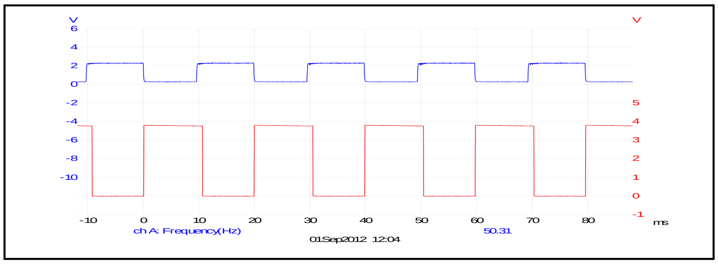


FIG.3. Hook-up diagram used for taking current consumption measurements

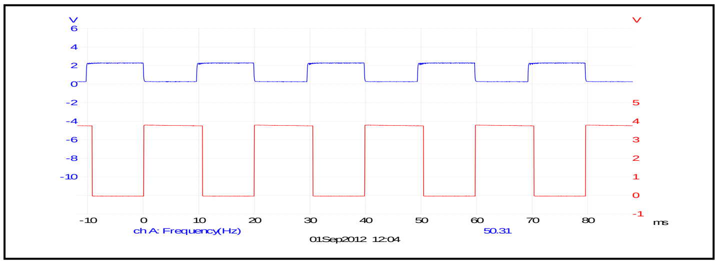
Application notes (continue, page #2): tests were performed with an µR2M100A30/2 relay

An µSPST consumes a meager amount of power for its regular operation, allowing a wide range of voltages to apply, from 2.0VDC to 5.0VDC, a maximum efficiency can be achieved. For a low switching frequency (less than ten switches per second), at Vcs = 2.0VDC, the current is only 240-µA (rms). That makes an µSPST relay power consumption of only 480-µW. Customers can select the optimum (maximum) efficiency depending on their particular application requirements.

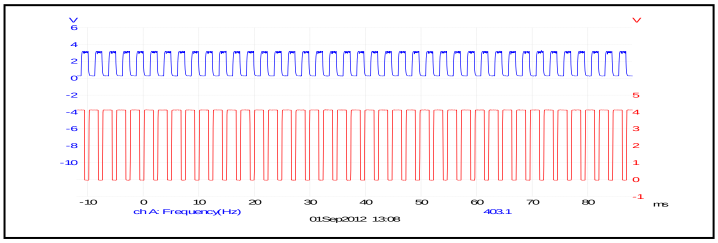
Vcs	=	2VDC
Ib	=	240-µA at 1.0-Hz
Fmr	=	50-Hz (maximum)
Ics	=	280-µA
P	=	560-µW at 50-Hz



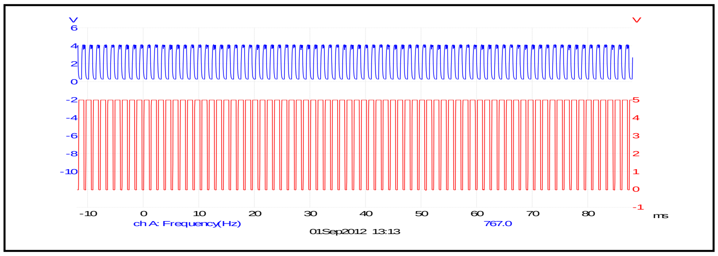
Vcs	=	2.7VDC
Ib	=	780-µA at 1.0-Hz
Fmr	=	200-Hz (maximum)
Ics	=	900-µA (rms)
Pw	=	2.43-mW at 200-Hz



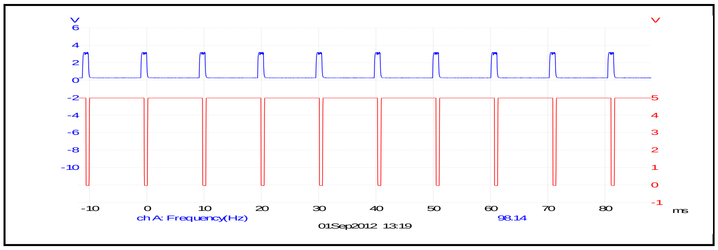
Vcs	=	3.0VDC
Ib	=	1.00-mA at 1.0-Hz
Fmr	=	400-Hz (maximum)
Ics	=	1.17-mA (rms)
Pw	=	3.51-mW at 400-Hz



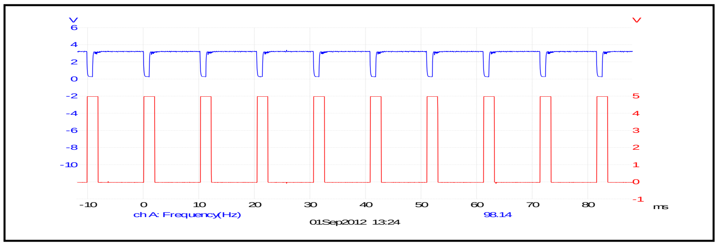
Vcs	=	4.0VDC
Ib	=	2.13-mA at 1.0-Hz
Fmr	=	760-Hz (maximum)
Ics	=	2.41-mA (rms)
Pw	=	9.64-mW at 760-Hz



Vcs	=	3.0VDC
Fpwm	=	100-Hz (main frequency)
P	=	9.0-mS or 90%
Ics	=	290-µA (rms)
Pw	=	870-µW



Vcs	=	3.0VDC
Fpwm	=	100-Hz (main frequency)
P	=	1.0-mS or 10%
Ics	=	1.39-mA (rms)
Pw	=	4.17-mW (rms)



μPower Solid-State Relay (μSSR) with the ENB/PWM input option (/E)

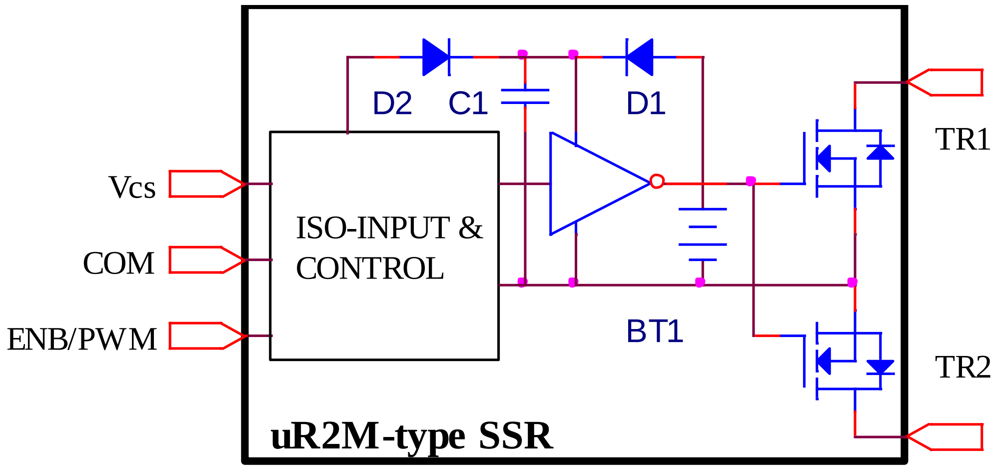


FIG.1. Simplified diagram of the micro-power Solid-State Relay, μSSR

DESCRIPTION

FIG.1 shows a block diagram utilized for assembling SPST-NO (normally open) and SPST-NC (customarily closed) solid-state relays (SSR). Uniquely designed circuitry makes it possible to manufacture devices consuming low power, thus creating a new family of micro-power consumption solid-state relays (μSSR). The μSSR is a robust, low-power device ideally suited for portable and remote industrial and defense-related applications. Its dual-control versatility will meet requirements in many new designs and is best for replacing power-hungry electromechanical relays. Both an SPST-NO normally open relay (1 Form A) and an SPST-NC normally closed relay (1 Form B) are manufactured with differences only in the output MOSFET's driving circuitry. It is a hybrid design. A PC Board that was made for accommodating control components and the most popular power MOSFETs allows the manufacturing of hundreds of various relays. The μSSR comprises a transformer coupled with a 3,000 V isolation DC/DC converter for delivering a control signal and energy for driving output MOSFETs. Non-tapped primary drives are in a push-pull fashion by pulses from a pulse-frequency modulated (PFM) generator and derivatives of an input signal control its frequency. It is relatively high from the beginning of the input pulse and, about a half millisecond later, decreases and stays steady until the pulse has ended. The DC/DC converter delivers, highly efficiently, about 13 VDC from 3.0 V/300 μA for driving high-power MOSFETs at about 60 mS chopping rate. More current is required for a higher switching frequency. In addition, it employs current-limiting circuitry, which meets lightning surge testing as per ANSI/TIA-968-B. Other regulatory voltage surge requirements and overvoltage protection are provided.

Table 1. Lead (terminals) Definitions

In/Out	Symbol	Description
INPUT	**Vcs**	Control signal or high side of power supply (Vcc + Vs)
INPUT	**COM**	Control signal return or low side of power supply
INPUT	**ENB/PWM**	ISO control signal, high side
OUTPUT	**TR1**	Load or Vss (VDC or VAC)
OUTPUT	**TR2**	Load or Vss (VDC or VAC)

TERMINALS FUNCTION

The μSSR has two controls: the Vcs and the ENB/PWM. It was designed with various applications and design flexibilities in mind. The primary control the Vcs devised for carrying two functions. It can be used (1) as dual functions, as a power input (Vcc) and as an input control signal (Vs), or (2) just as a power input. The ENB/PWM input terminal is used only to control. The selection of one option over another is based on the need for a switching frequency and allowing power to be wasted. At a low switching frequency, less than ten times per second, an μSSR can operate with less than 150μW and still be able to switch 3-kW.

The most popular and simplest hook-up is using the Vcs input for a control input signal and a power supply. The current consumption is less than 400μA at 2.4VDC at about 100Hz, and it automatically adjusts when more energy is needed to switch at a higher frequency. Current consumption increases almost linearly to 2.5mA at about 1,000 Hz.

The low power of the ENB/PWM input is usable for various applications. It can be used for emergencies, disabling the VCS. Suppose a relay is manufactured as a normally open (SPST-NO). In that case, the output stops conducting once a control voltage is applied to the ENB/PWM, regardless of whether a control voltage is present on the Vcs or not. It can be used to control the output if the Vcs are engaged as a power source. Suppose a relay is assembled as a normally closed (SPST-NC). The output starts conducting once a control is applied to the ENB/PWM, regardless of whether the Vcs are activated or not. The ENB/PWM input is used to assist the Vcs recharging of an energy-storing capacitor C1 and an internal battery.

Output terminals (TR1 and TR2) are made of 0.1" diameter pure copper for a high current flow, and all input pins are made of 0.05" diameter copper. A SIP-5 package is designed for mounting on a PC Board.

Both SPST-NO and SPST-NC relays are essentially the same, with a few minor differences. The SPST-NC contains an internal battery and a MOSFET driver that is designed slightly differently. Most of the energy for driving MOSFETs and maintaining their states comes from the capacitor C1. During the driving of MOSFETs, a significant amount of energy is wasted that is restored (recharged) during the first half of a millisecond while an input control signal lasts. The internal battery isn't required for a routine operation. It is installed to maintain the output state for years-long idling.

Reliability and life expectancy of the μSPST device are incredibly high. A single vulnerable place could be considered the output or powerful transistors. If good protection is installed, the μSPST should function forever.

Both SPST-NO and SPST-NC are encapsulated in small 1.75" H x 1.80" L x 0.6" W plastic boxes as a SIP-5 for a PC Board mounting. Other packages are also available.

<u>ORDERING INSTRUCTION</u>

For a μSSR SPST-NO	μ**D2M vvv**	**X**	**cc**
For a μSSR SPST-NC	μ**R2M vvv**	**X**	**cc**

"vvv" must be replaced with a number representing a maximum output voltage,

"X" must be replaced with "A" for AC/DC voltages applications, or
must be replaced with "D" for DC voltage applications and

"cc" must be replaced with a number representing a maximum output current for continuous (rms) operation.

For example, μ**R2M100A30** is an SPST-NC (normally closed) relay, rated at 100VDC (72VAC) & 30 A.

$_{\mu}$SSR SPST-NO (normally open) and SPST-NC (normally closed) relays

The $_{\mu}$SSR is uniquely designed, having an input circuitry that is identical to SPST-NO and SPST-NC relays. That advantage can be realized during the development and production of new applications. An R&D engineer would only need to learn once how to use both devices the best way. The schematic and ratings for the input circuitry are the same for both devices.

Table2. ABSOLUTE MINIMUM/MAXIMUM RATINGS (T amb = 25°C, unless otherwise specified)

		Minimum	**Maximum**	**Unit**
+Vcs	Control signal (voltage)	2	6.0	V
+Vcs	Control signal (current)	0.230	8	mA
ENB/PWM	Input voltage	2.5	20	V
ENB/PWM	Input current	0.02	.2	mA

Note: Applying the absolute maximum ratings can cause permanent damage to the device. Exposure to absolute maximum ratings for an extended time would adversely affect reliability.

Table 3. TYPICAL MINIMUM/MAXIMUM RATINGS (T amb = 25°C, unless otherwise specified)

		Minimum	**Maximum**	**Unit**
+Vcs	Control signal (voltage)	2.2	5	V
+Vcs	Control signal (current)	0.230	5	mA
ENB/PWM	Input voltage	2.5	12	V
ENB/PWM	Input current	0.02	.12	mA

Note: Typical values and characteristics of the device result from engineering evaluations. Typical values are for informational purposes only and are not part of the testing requirements.

There are some differences between SPST-NC and SPST-NO. It is primarily related to a MOSFET's gate driver. Both types of relays are available with the same output voltage and current ratings.

Components of both devices operate at meager power consumption and, as a result, life expectancy is exceptionally long. Of course, reasonable care should be taken to protect output MOSFETs.

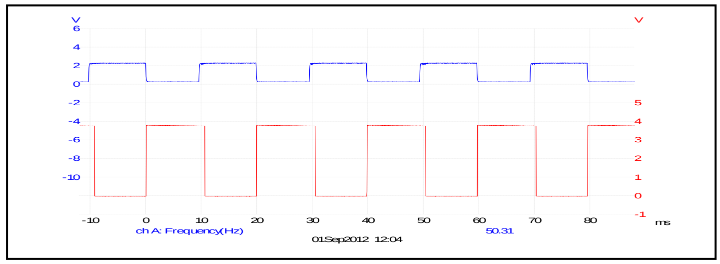
There is no shelf-life limit for SPST-NO (normally open) relays.

There is at least a five-year guaranteed shelf life for SPST-NC (normally closed) relays. There is no limit to the life expectancy if the power is applied to the Vcs at least once for 1.0 mS for 15 days.

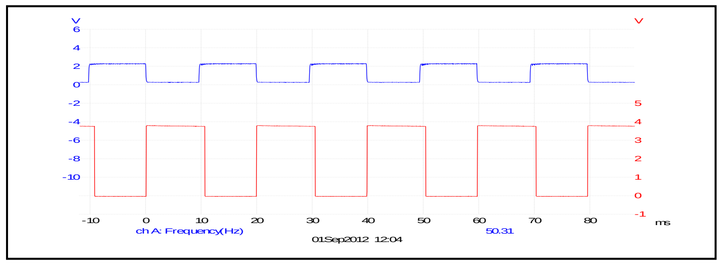
Application notes (continue, page #2): tests were performed with an µR2M100A30/2 relay

An µSPST consumes a meager amount of power for its regular operation that allows a wide range of voltages to apply, from 2.0VDC to 5.0VDC, a maximum efficiency can be achieved. For a low switching frequency (less than ten switches per second), at Vcs = 2.0VDC, the current is only 240-µA (rms). That makes an µSPST relay power consumption of only 480-µW. Customers can select the optimum (maximum) efficiency depending on their particular application requirements.

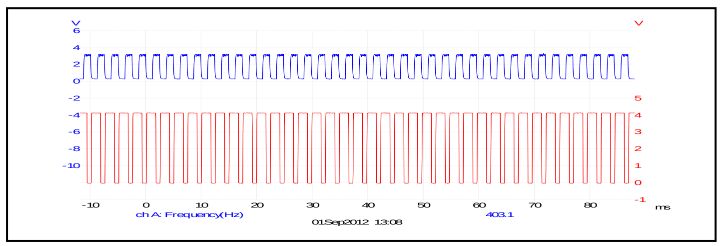
Vcs	=	2VDC
Ib	=	240-µA at 1.0-Hz
Fmr	=	50-Hz (maximum)
Ics	=	280-µA
P	=	560-µW at 50-Hz



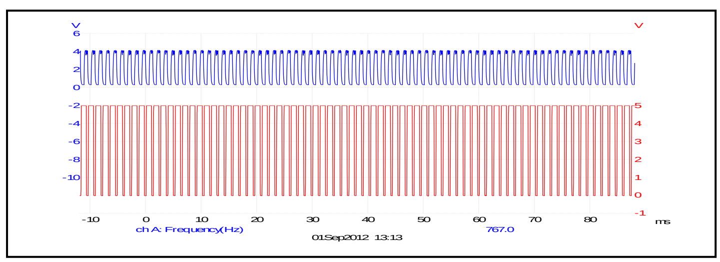
Vcs	=	2.7VDC
Ib	=	780-µA at 1.0-Hz
Fmr	=	200-Hz (maximum)
Ics	=	900-µA (rms)
Pw	=	2.43-mW at 200-Hz



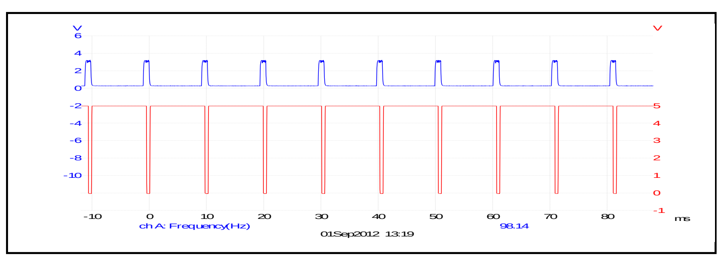
Vcs	=	3.0VDC
Ib	=	1.00-mA at 1.0-Hz
Fmr	=	400-Hz (maximum)
Ics	=	1.17-mA (rms)
Pw	=	3.51-mW at 400-Hz



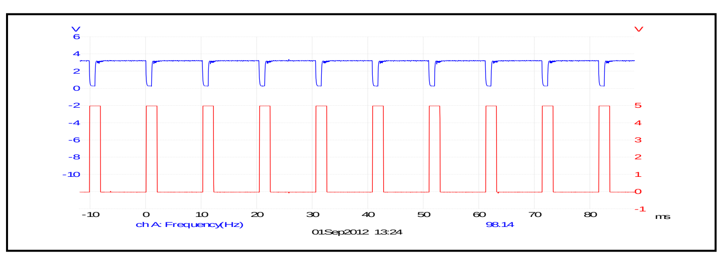
Vcs	=	4.0VDC
Ib	=	2.13-mA at 1.0-Hz
Fmr	=	760-Hz (maximum)
Ics	=	2.41-mA (rms)
Pw	=	9.64-mW at 760-Hz



Vcs	=	3.0VDC
Fpwm	=	100-Hz (main frequency)
P	=	9.0-mS or 90%
Ics	=	290-µA (rms)
Pw	=	870-µW



Vcs	=	3.0VDC
Fpwm	=	100-Hz (main frequency)
P	=	1.0-mS or 10%
Ics	=	1.39-mA (rms)
Pw	=	4.17-mW (rms)



Application notes (continue, page #3)

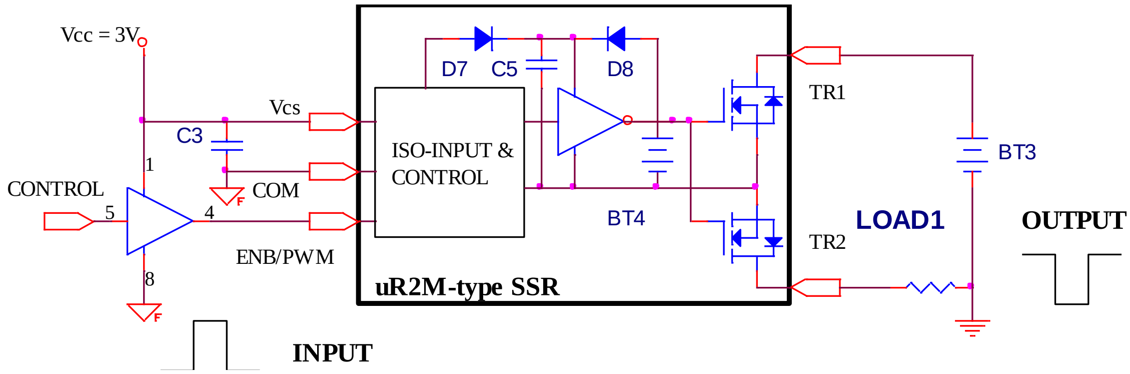


FIG.5. A hook-up for higher frequency applications

In cases when a higher switching (chopping) frequency is required. More energy is available, and the □SPST meets that challenge by applying a control signal via the ENB/PWM input, as it shown on FIG.5. It should be understood that the □SPST is a low-power consumption device. It wasn't designed for high-frequency applications. EDR Inc/VSholding LLC manufactures a wide variety of devices, including switches for megawatts of power in nanoseconds. As it is shown in FIG.5, the Vcs inputs are dual-purpose terminals. They can control the relay's output, and in cooperation with the ENB/PWM input, the Vcs can be used to provide power to the relay.

Attention must be paid to the fact that if the ENB/PWM is used as a control, an output signal is presented in the opposite phase.

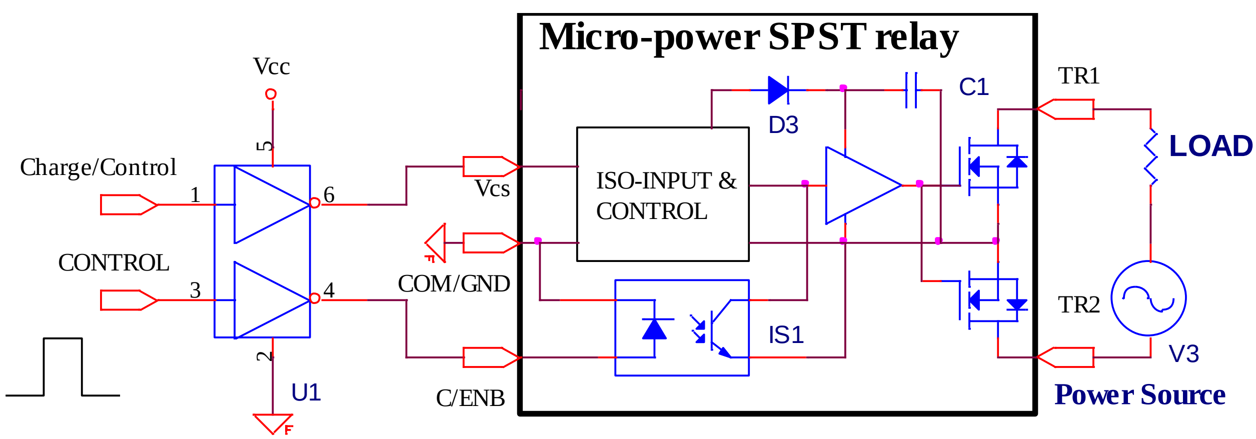


FIG.7. Typical multi-optional controls

A triple controls operation is presented in FIG.7. The CONTROL/LP input can be used for a low current (0.3mA) supplier at a low switching frequency (80 Hz for a 30A relay). The Charge/Control input can be used for higher switching frequencies (800 Hz) and in conjunction with the CONTROL input for even higher switching frequencies (2 KHz). The CONTROL is handy in PWM applications when both inputs can charge an internal bank of energy without disturbing the relay's output.

CONTROL VIA THE C/ENB = 3V, VCS = 3VDC, ICS = 1.51MA

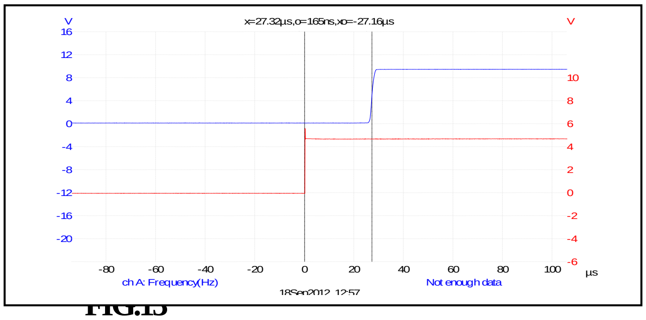


FIG.13

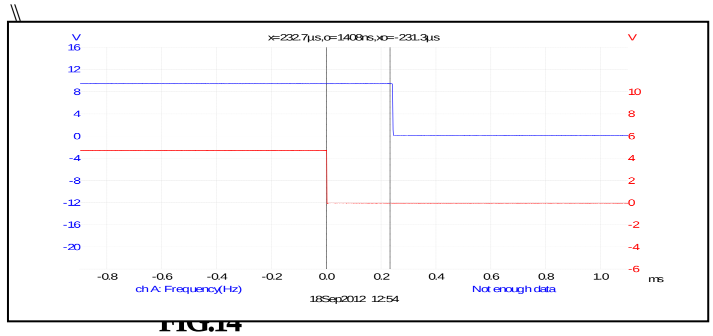


FIG.14

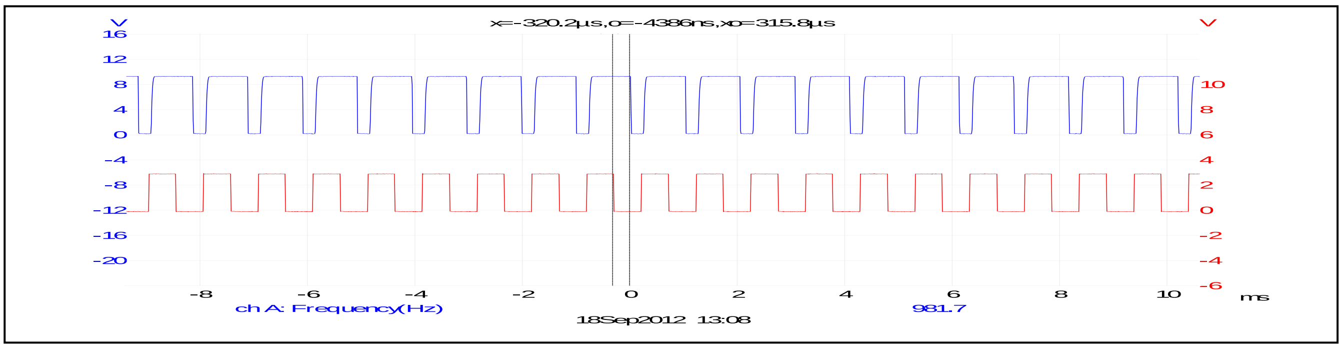


FIG.15

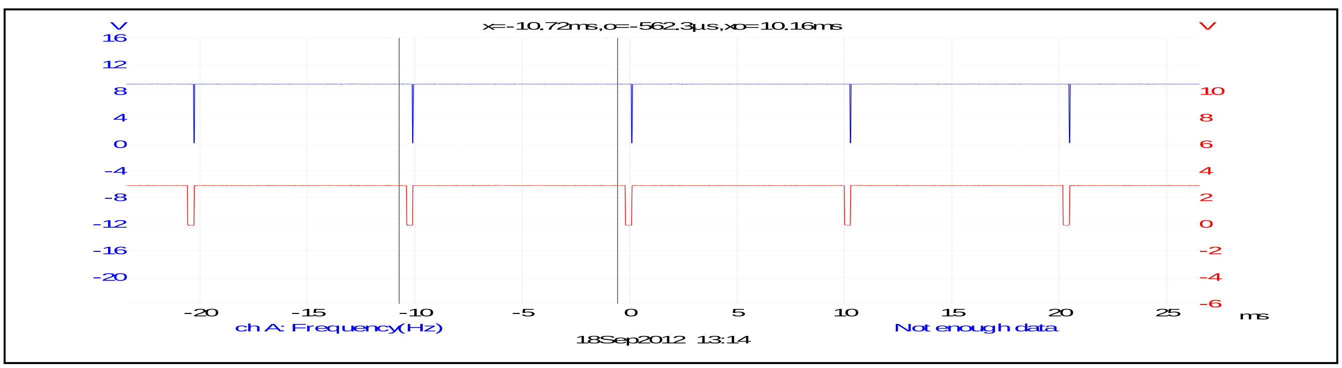


FIG.16

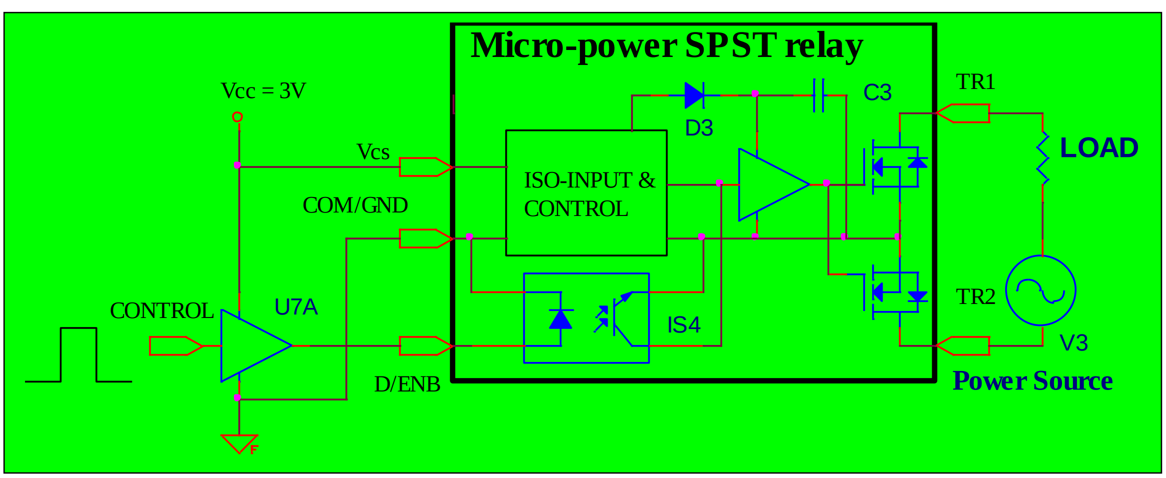


FIG.17

The Vcs=4V, Ics= 2.68mA

1 Form B, SPST-NC Solid State Relays to replace electromechanical relays

OUTPUT SPECIFICATIONS (We rated our SSRs for the maximum current without a heat sink)

Model	V max	Vcc	Id	Idm	p/n
µR2M24D22	0 to 24VDC	24VDC	22	200	EDR83051
µR2M24A20	+/-24VDC	24VDC (16VAC)	20	190	EDR83052
µR2M24D40	0 to 24VDC	24VDC	40	410	EDR83053
µR2M24A40	+/-24VDC	24VDC (16AVC)	40	400	EDR83054
µR2M30D15	0 to 30VDC	30VDC	15	160	EDR83055
µR2M30A14	+/-30VDC	30VDC (21VAC)	14	140	EDR83056
µR2M30D20	0 to 30VDC	30VDC	28	260	EDR83057
µR2M30A20	+/-30VDC	30VDC (21VAC)	26	250	EDR83058
µR2M60D20	0 to 40VDC	40VDC	40	400	EDR83059
µR2M60D20	+/-40VDC	40VDC (28VAC)	39	460	EDR83060
µR2M60D20	0 to 55VDC	55VDC	38	370	EDR83061
µR2M60D20	+/-55VDC	55VDC (38VAC)	37	190	EDR83062
µR2M60D20	0 to 60VDC	60VDC	20	190	EDR83063
µR2M60A18	+/- 60VDC	60VDC (42VAC)	18	160	EDR83064
µR2M60D40	0 to 60VDC	60VDC	40	380	EDR83065
µR2M60A38	+/- 60VDC	60VDC (42VAC)	38	380	EDR83066
µR2M75D16	0 to 75VDC	75VDC	16	150	EDR83067
µR2M75A15	+/- 75VDC	75VDC (52VAC)	15	140	EDR83068
µR2M75D30	0 to 75VDC	75VDC	30	280	EDR83069
µR2M75A28	+/-75VDC	75VDC (52VAC)	28	240	EDR83070
µR2M100D20	0 to 100VDC	100VDC	20	190	EDR83071
µR2M100A20	+/-100VDC	100VDC (70AVC)	20	190	EDR83072
µR2M100D35	0 to 100VDC	100VDC	35	360	EDR83073
µR2M100A30	+/-100VDC	100VDC (70VAC)	30	300	EDR83040
µR2M150D12	0 to 150VDC	150VDC	12	160	EDR83074
µR2M150A12	+/-150VDC	150VDC (115VAC)	12	150	EDR83075
µR2M150A21	0 to 150VDC	150VDC	21	200	EDR83076
µR2M150A20	+/-150VDC	150VDC (115VAC	20	190	EDR83077
µR2M250D5	0 to 250VDC	250VDC	5	50	EDR83078
µR2M250A5	+/-250VDC	250VDC (170VAC)	5	50	EDR83079

Any listed above relay can be encapsulated in a panel-mounting box. In this case, the third symbol should be replaced with a "P" to take part as µRPM100A30/1 and P/N EDR83040/1/P.

All input ratings, specifications, and other properties of **µR2M**-type relays very much resembled the p/n EDR83040 (PAGE #11). There are some differences for various relays related to switching frequency, turn-on delay, slope, etc. These are somewhat dependent on the output rating. Please request a specific data sheet if that is important for your application.

We charge no production set-up fee for an order of 400 and above for any type (input and output specifications) of Solid State Relay/Switch and Solid State Breaker.

ELECTRONIC DESIGN & RESEARCH INC. ** 7331 INTERMODAL DR. ** LOUISVILLE ** KY 40258

TEL: 502-933-8660; FAX: 502-933-3422; SALES: 800-336-1337; E-MAIL: VSHOLDING@VSHOLDING.COM

1 Form A, SPST-NO Solid State Relays to replace electromechanical relays

OUTPUT SPECIFICATIONS (We rated our SSRs for the maximum current without a heat sink)

Model	V max	Vcc	Id	Idm	p/n
µD2M24D22	0 to 24VDC	24VDC	22	200	EDR83080
µD2M24A20	+/-24VDC	24VDC (16VAC)	20	190	EDR83081
µD2M24D40	0 to 24VDC	24VDC	40	410	EDR83082
µD2M24A40	+/-24VDC	24VDC (16AVC)	40	400	EDR83083
µD2M30D15	0 to 30VDC	30VDC	15	160	EDR83084
µD2M30A14	+/-30VDC	30VDC (21VAC)	14	140	EDR83085
µD2M30D20	0 to 30VDC	30VDC	28	260	EDR83086
µD2M30A20	+/-30VDC	30VDC (21VAC)	26	250	EDR83087
µD2M60D20	0 to 40VDC	40VDC	40	400	EDR83088
µD2M60D20	+/-40VDC	40VDC (28VAC)	39	460	EDR83089
µD2M60D20	0 to 55VDC	55VDC	38	370	EDR83090
µD2M60D20	+/-55VDC	55VDC (38VAC)	37	190	EDR83091
µD2M60D20	0 to 60VDC	60VDC	20	190	EDR83092
µD2M60A18	+/- 60VDC	60VDC (42VAC)	18	160	EDR83093
µD2M60D40	0 to 60VDC	60VDC	40	380	EDR83094
µD2M60A38	+/- 60VDC	60VDC (42VAC)	38	380	EDR83095
µD2M75D16	0 to 75VDC	75VDC	16	150	EDR83096
µD2M75A15	+/- 75VDC	75VDC (52VAC)	15	140	EDR83097
µD2M75D30	0 to 75VDC	75VDC	30	280	EDR83098
µD2M75A28	+/-75VDC	75VDC (52VAC)	28	240	EDR83099
µD2M100D20	0 to 100VDC	100VDC	20	190	EDR83100
µD2M100A20	+/-100VDC	100VDC (70AVC)	20	190	EDR83101
µD2M100D35	0 to 100VDC	100VDC	35	360	EDR83102
µD2M100A30	+/-100VDC	100VDC (70VAC)	30	300	EDR83103
µD2M150D12	0 to 150VDC	150VDC	12	160	EDR83104
µD2M150A12	+/-150VDC	150VDC (115VAC)	12	150	EDR83105
µD2M150A21	0 to 150VDC	150VDC	21	200	EDR83106
µD2M150A20	+/-150VDC	150VDC (115VAC	20	190	EDR83107
µD2M250D5	0 to 250VDC	250VDC	5	50	EDR83108
µD2M250A5	+/-250VDC	250VDC (170VAC)	5	50	EDR83109

Any listed above relay can be encapsulated in a panel-mounting box. In this case, the third symbol should be replaced with a "P" to take part as µDPM250A5/1 and P/N EDR83109/1/P.

All input ratings, specifications, and other properties of **µD2M**-type relays very much resembled the p/n EDR83040 (PAGE #11). There are some differences for various relays related to switching frequency, turn-on delay, slope, etc. These are somewhat dependent on the output rating. Please request a specific data sheet if that is important for your application.

We charge no production set-up fee for an order of 400 and above for any type (input and output specifications) of Solid State Relay/Switch and Solid State Breaker.

ELECTRONIC DESIGN & RESEARCH INC. ** 7331 INTERMODAL DR. ** LOUISVILLE ** KY 40258

TEL: 502-933-8660; FAX: 502-933-3422; SALES: 800-336-1337; E-MAIL: VSHOLDING@VSHOLDING.COM

1 Form C, SPST-NC Solid-State Relays to replace electromechanical relays

OUTPUT SPECIFICATIONS (We rated our SSRs for the maximum current without a heat sink)

Model	V max	Vcc	Id	Idm	p/n
µR2M24D22	0 to 24VDC	24VDC	22	200	EDR83080
µR2M24A20	+/-24VDC	24VDC (16VAC)	20	190	EDR83081
µR2M24D40	0 to 24VDC	24VDC	40	410	EDR83082
µR2M24A40	+/-24VDC	24VDC (16AVC)	40	400	EDR83083
µR2M30D15	0 to 30VDC	30VDC	15	160	EDR83084
µR2M30A14	+/-30VDC	30VDC (21VAC)	14	140	EDR83085
µR2M30D20	0 to 30VDC	30VDC	28	260	EDR83086
µR2M30A20	+/-30VDC	30VDC (21VAC)	26	250	EDR83087
µR2M60D20	0 to 40VDC	40VDC	40	400	EDR83088
µR2M60D20	+/-40VDC	40VDC (28VAC)	39	460	EDR83089
µR2M60D20	0 to 55VDC	55VDC	38	370	EDR83090
µR2M60D20	+/-55VDC	55VDC (38VAC)	37	190	EDR83091
µR2M60D20	0 to 60VDC	60VDC	20	190	EDR83092
µR2M60A18	+/- 60VDC	60VDC (42VAC)	18	160	EDR83093
µR2M60D40	0 to 60VDC	60VDC	40	380	EDR83094
µR2M60A38	+/- 60VDC	60VDC (42VAC)	38	380	EDR83095
µR2M75D16	0 to 75VDC	75VDC	16	150	EDR83096
µR2M75A15	+/- 75VDC	75VDC (52VAC)	15	140	EDR83097
µR2M75D30	0 to 75VDC	75VDC	30	280	EDR83098
µR2M75A28	+/-75VDC	75VDC (52VAC)	28	240	EDR83099
µR2M100A18	+/-100VDC	100VDC (70AVC)	18	180	EDR83041
µR2M100D35	0 to 100VDC	100VDC	35	360	EDR83042
µR2M100A30	+/-100VDC	100VDC (70VAC)	30	300	EDR83040
µR2M100D70	0 to 100VDC	100VDC	70	490	EDR83043
µR2M150D13	0 to 150VDC	150VDC	13	160	EDR83044
µR2M150A12	+/-150VDC	150VDC (115VAC)	12	150	EDR83045
µR2M150D21	0 to 150VDC	150VDC	21	200	EDR83046
µR2M150A20	+/-150VDC	150VDC (115VAC	20	190	EDR83047
µR2M250D5	0 to 250VDC	250VDC	5	50	EDR83108
µR2M250A5	+/-250VDC	250VDC (170VAC)	5	50	EDR83109

Any listed above relay can be encapsulated in a panel-mounting box. In this case, the third symbol should be replaced with a "P" to take part as µDPM250A5/1 and P/N EDR83109/1/P.

Selection and Ordering Instruction for EDRs made Solid State Modules such as Relays, Switches, Breakers, ½ and Full-bridge Drivers, etc.

Notes: During the past ten years, the rapid development of new and additional [products gave us no choice but to expand, modify, and unify part descriptions. Below is the third modification. Our module description will be marked according to the specifications below, but p/n EDR11111 will stay the same for items already in circulation (already sold).

Part description:	**µ**	**H**	**3**	**L**	**200**	**D**	**10**	**/5**	**/12**
Micro-Power	**X**	**A**	**B**	**C**	**F**	**H**	**/E**	**/I**	
	H-Driver	size =	Speed "L" = low	Voltage = 200V	Current = DC	Current = 10A	CS=5V	Vcc=12V	

"X" module type

- D — Solid-State Relay or Switch with output terminals: SPST-NO (normally open)
- R — Solid-State Relay or Switch with normally closed output terminals, such as an SPST-NC or 1 Form C
- W — Solid-State Relay or Switch with output terminals: DPST
- T — Drivers, such as ½-bridge or an SPDT relay, which can work as a ½ driver
- M — Driver, such as a switch with a built-in PWM controller
- H — Full-bridge (H-bridge) Driver
- C — Relay with built-in de-bouncing or a turn-on/off delay
- B — Solid State Breaker and brake control modules

"A" package dimensions

- 1 — 0.615"H x 1.48"L x 0.290"W
- 2 — 1.75"H x 1.80"L x 0.595"W
- 3 — 1.125"H x 1.75"L x 0.8"W
- 4 — 1.15"H x 2.0"L x 0.92"W
- 5 — 1.15"H x 2.8"L x 1.15"W
- 6 — DIP24, 0.375"H x 0.925"L x 0.53"W
- 7 — panel mount, .82"H x 3.95"L x 1.96"W
- 8 — .575"H x 1.1"L x .2"W
- 9 — panel mount 3"H x 10"L x 8"W
- 0 — DIN type enclosure, 2.36"H x 2.36"L x 1.5"W, for 35mm DIN Rail
- P — panel mount, .8"H x 2.275" L x 1.75"W
- R — panel mount, 1.82"H x 6.0"L x 3.3"W

"B" Speed - A device's ability to turn ON/OFF output terminal(s) times per second

- L — a low-speed relay/switch, rated DC – 500 Hz, direct driving control
- M — a low switching frequency, rated DC – 2,000 Hz
- A — low-speed relay/switch, AC input relays
- N — a medium speed relay/switch, rated DC - 25 KHz, direct driving control
- G — a medium speed relay/switch, rated DC - 25 KHz, low current control and power
- F — a fast relay/switch, rated up to DC - 350 KHz, low current control and power
- S — a super-fast relay/switch, rated DC - 1.4 MHz, low current control and power
- U — a super-fast relay/switch, rated DC – 1.2 MHz, direct driving control
- V — Fast, High Voltage Solid-State Switches with Nanoseconds rise time

"C" Output Voltage - A maximum allowed voltage between output terminals, up to 100kV

It must be replaced with the required voltage, and we offer the closest and highest value available.
Note: In an "AC" -relay, a voltage specified a peak-to-peak maximum voltage, and the maximum VAC could be calculated by multiplying a maximum allowed voltage by a factor of 0.7

"F" A relay can be used to control either AC, DC, or AC/DC power

- A — - a relay/switch designed to switch/chop an AC/DC power
- D — - a relay/switch designed to switch/chop a DC power
- "none" — - relay with a SCR or TRIAC on the output to control only AC power

"H" A maximum allowed RMS CURRENT (Ampere) without a heat sink

We can manufacture a device for any required current.

"I" Some of our products use an internal DC/DC converter to provide power to the internal electronics.

Varieties voltages are available: 5VDC+/-5%, 12VDC+/-5%, 24VDC+/-5% and 48VDC+/-5%. For a wider input power voltage swing, please add "W" after the voltage. For an example, 24W is for 24V +/-12V.

"E" We offer several standard control voltages 5VDC, 12VDC, 24VDC, 48VDC, 3-20VDC and 18-38VDC

Please specify the input control voltage, for example, D1L30D12/xx. Replace xx with a 3, 5, 12, 24, 48, 3-20 and 18-38 that is for 3VDC, 5VDC, 12VDC, 24VDC, 48VDC, 3-20VDC and 18-38VDC. Respectful control voltage is represented at the end of the part number in the following way, for example, EDR82653/1 and EDR82653/8. Both relays are almost the same, and the difference is only an applied control voltage, "1" is for 3VDC, and "8" is for 18-38VDC;

Control Voltage	#	Control Voltage	#	Control Voltage	#
3VDC	1	5VDC	2	12VDC	3
24VDC	4	48VDC	5	26VDC	6
3-20VDC	7	18-38VDC	8	90-120VAC	9
74VDC	10				

"Z" A relay/switch built with the following standard isolations

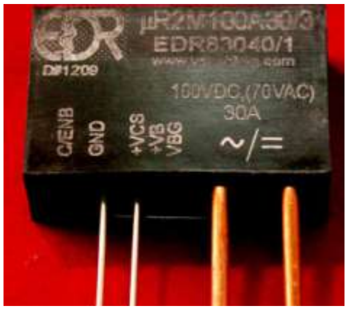
- "L" or "none" — type relay is 2500 V
- "N" — type relay is 3000V, 4000VDC ("H4"), and 5200 ("H5") VDC.

"T" Turn-on delays; "S" for seconds, "M" for milliseconds, "U" for microseconds, M102 – 100 mS turn-off delay, 102M mS – turn-on delay

News Release

EDR/VSholding Announces New µR2M (1 Form B) and µD2M (1 Form A) Relay Series

Micro-power Solid-State Relays Output to 3.5kW of VAC or VDC with control of only 0.6mW



Louisville, KY, September 2012: Electronic Design & Research Inc. has introduced the µR2M and µD2M series to their industrial solid-state relays product line. These relays are ideal for interfacing portable and remote equipment to high current applications. The features are an innovative isolated driver that ensures ultra-low input power consumption of only 300µA at 2.4V, fast rising and falling slopes allowing the use of high-power MOSFETs, ultra-low output leakage current, dual control, low Rds, and low cost.

Both SPST-NO and SPST-NC relays are offered for AC and DC output voltages. They were encapsulated in SIP-4, SIP5, and SIP7 box relays measuring 1.15" H x 1.75" L x 0.595" W and in an industrial standard panel mounting box (suffix "P" added). Cost varies on devices and quantities. For example, µD2M150A20, SPST-NO relay rated at 150 VDC (115 VAC) & 20A rms costs $74.50 ea/100. Click for a data sheet

For more information, visit www.vsholding.com or send email to info@vsholding.com

Electronic Design & Research Inc., a Unit of VS Holding LLC, has been the world's innovative leader in manufacturing solid-state switching products for nearly 15 years. The company's comprehensive product line of SSR, SPDT drivers, H-Drivers, Super-High Power Switching Systems, Security Modules, Fog-Bulb relays, Super-Fast High-Voltage Switches, and many more meets a wide range of requirements for industrial, commercial, military, and aerospace uses worldwide.