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VCR2N/4N/7N
Vishay Siliconix

JFET Voltage-Controlled Resistors

PRODUCT SUMMARY			
Part Number	$V_{GS(off)}$ Max (V)	$V_{(BR)GSS}$ Min (V)	$r_{DS(on)}$ Max (Ω)
VCR2N	-7	-25	60
VCR4N	-7	-25	600
VCR7N	-5	-25	8000

FEATURES

- Continuous Voltage-Controlled Resistance
- High Off-Isolation
- High Input Impedance

BENEFITS

- Gain Ranging Capability/Wide Range Signal Attenuation
- No Circuit Interaction
- Simplified Drive

APPLICATIONS

- Variable Gain Amplifiers
- Voltage Controlled Oscillator
- AGC

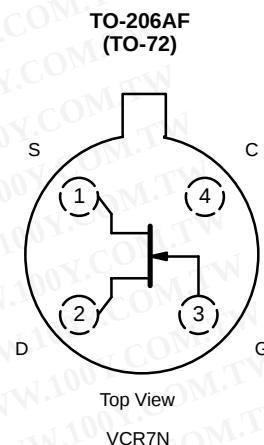
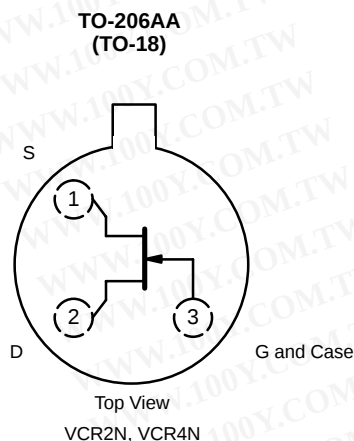
DESCRIPTION

The VCR2N/4N/7N JFET voltage controlled resistors have an ac drain-source resistance that is controlled by a dc bias voltage (V_{GS}) applied to their high impedance gate terminal. Minimum r_{DS} occurs when $V_{GS} = 0$ V. As V_{GS} approaches the pinch-off voltage, r_{DS} rapidly increases. This series of junction FETs is intended for applications where the drain-source voltage is a low-level ac signal with no dc component.

Key to device performance is the predictable r_{DS} change versus V_{GS} bias where:

$$r_{DS(bias)} \approx \frac{r_{DS(@V_{GS}=0)}}{1 - \left| \frac{V_{GS}}{V_{GS(off)}} \right|}$$

These n-channel devices feature $r_{DS(on)}$ ranging from 20 to 8000 Ω . All packages are hermetically sealed and may be processed per MIL-S-19500 (see Military Information).



For applications information see AN105.

ABSOLUTE MAXIMUM RATINGS^a

Gate-Source, Gate-Drain Voltage	−25 V
Gate Current	10 mA
Power Dissipation ^b	300 mW
Operating Junction Temperature Range	−55 to 175°C
Storage Temperature	−65 to 200°C

Lead Temperature ($1/16$ " from case for 10 sec.) 300°C

Notes:

- a. $T_A = 25^\circ\text{C}$ unless otherwise noted.
 b. Derate 2 mW/°C above 25°C.

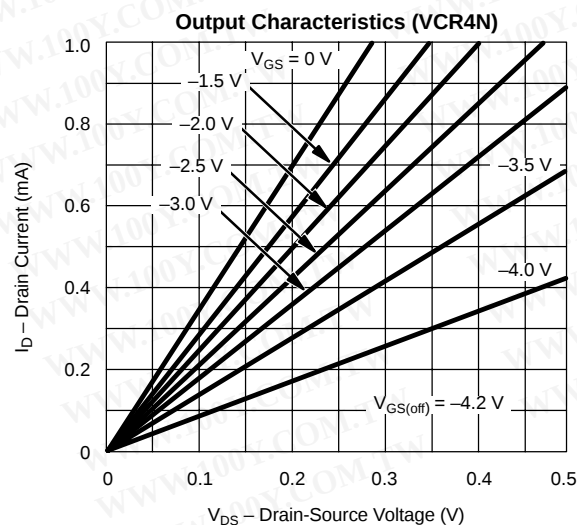
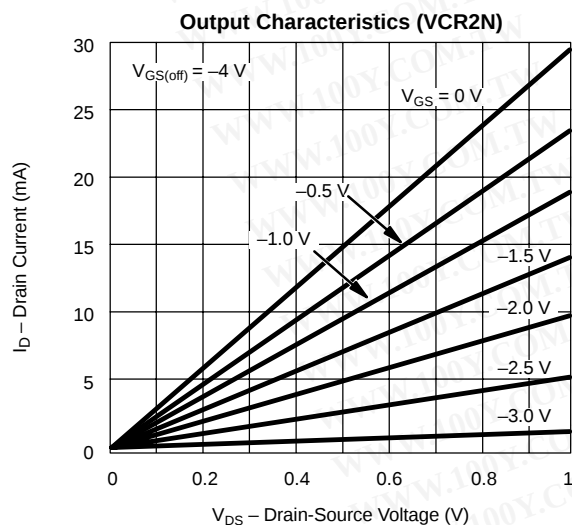
SPECIFICATIONS ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

Parameter	Symbol	Test Conditions	Typ ^a	Limits						Unit
				VCR2N		VCR4N		VCR7N		
				Min	Max	Min	Max	Min	Max	
Static										
Gate-Source Breakdown Voltage	V _{(BR)GSS}	I _G = −1 μA, V _{DS} = 0 V	−55	−25		−25		−25		V
Gate-Source Cutoff Voltage	V _{GS(off)}	V _{DS} = 10 V, I _D = 1 μA		−3.5	−7	−3.5	−7	−2.5	−5	
Gate Reverse Current	I _{GSS}	V _{GS} = −15 V, V _{DS} = 0 V			−5		−0.2		−0.1	nA
Drain-Source On-Resistance	r _{DS(on)}	V _{GS} = 0 V, I _D = 10 mA		20	60					Ω
		V _{GS} = 0 V, I _D = 1 mA				200	600			
		V _{GS} = 0 V, I _D = 0.1 mA						4000	8000	
Gate-Source Forward Voltage	V _{GS(F)}	V _{DS} = 0 V, I _G = 1 mA	0.7							V
Dynamic										
Drain-Source On-Resistance	r _{ds(on)}	V _{GS} = 0 V, I _D = 0 mA f = 1 kHz		20	60	200	600	4000	8000	Ω
Drain-Gate Capacitance	C _{dg}	V _{GD} = −10 V, I _S = 0 mA f = 1 MHz			7.5		3		1.5	pF
Source-Gate Capacitance	C _{sg}	V _{GS} = −10 V, I _D = 0 mA f = 1 kHz			7.5		3		1.5	

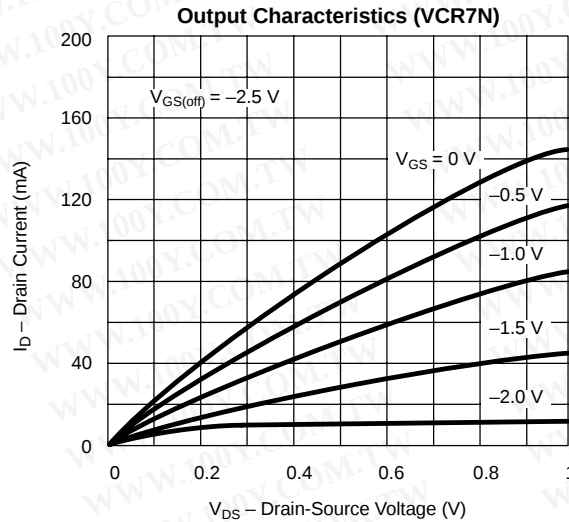
Notes:

- a. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

NCB/NPA/NT

TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

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APPLICATIONS

A simple application of a FET VCR is shown in Figure 1, the circuit for a voltage divider attenuator.

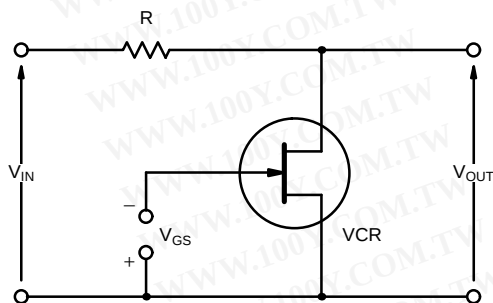


FIGURE 1. Simple Attenuator Circuit

The output voltage is:

$$V_{OUT} = \frac{V_{IN} r_{DS}}{R + r_{DS}}$$

It is assumed that the output voltage is not so large as to push the VCR out of the linear resistance region, and that the r_{DS} is not shunted by the load.

The lowest value which V_{OUT} can assume is:

$$V_{OUT(min)} = \frac{V_{IN} r_{DS(on)}}{R + r_{DS(on)}}$$

Since r_{DS} can be extremely large, the highest value is:

$$V_{OUT(max)} = V_{IN}$$

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