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

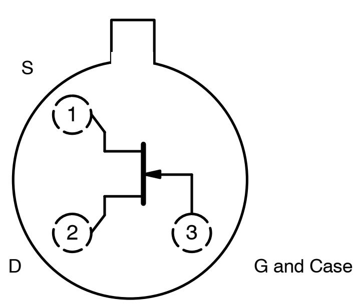
The VCR2N/4N/7N JFET voltage controlled resistors have an ac drain-source resistance that is controlled by a dc bias voltage (V_{GS}) applied to their high impedance gate terminal. Minimum r_{DS} occurs when V_{GS} = 0 V. As V_{GS} approaches the pinch-off voltage, r_{DS} rapidly increases. This series 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:

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

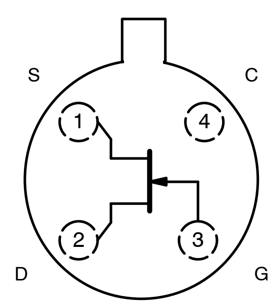
These n-channel devices feature $r_{DS(on)}$ ranging from 20 to 8000 Ω. All packages are hermetically sealed and may be processed per MIL-S-19500 (see Military Information).

TO-206AA
(TO-18)



Top View
VCR2N, VCR4N

TO-206AF
(TO-72)



Top View
VCR7N

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°C unless otherwise noted.
b. Derate 2 mW/°C above 25°C.

SPECIFICATIONS (T_A = 25°C UNLESS OTHERWISE NOTED)

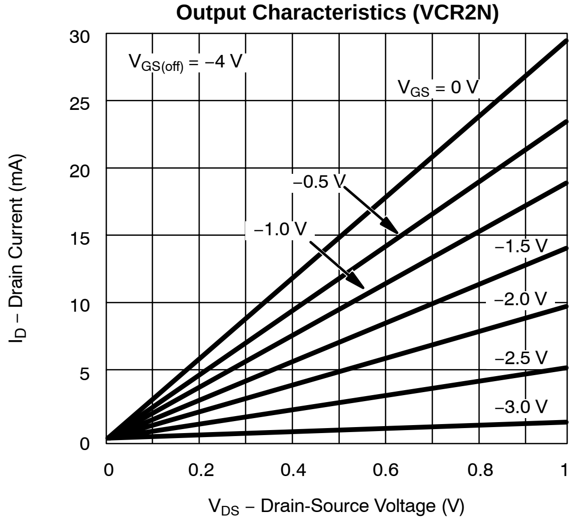
Parameter	Symbol	Test Conditions	Typ[a]	Limits VCR2N Min	VCR2N Max	VCR4N Min	VCR4N Max	VCR7N Min	VCR7N Max	Unit
Static										
Gate-Source Breakdown Voltage	$V_{(BR)GSS}$	I_G = −1 µA, V_{DS} = 0 V	−55	−25		−25		−25		V
Gate-Source Cutoff Voltage	$V_{GS(off)}$	V_{DS} = 10 V, I_D = 1 µA		−3.5	−7	−3.5	−7	−2.5	−5	V
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			Ω
		V_{GS} = 0 V, I_D = 0.1 mA						4000	8000	Ω
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	pF

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

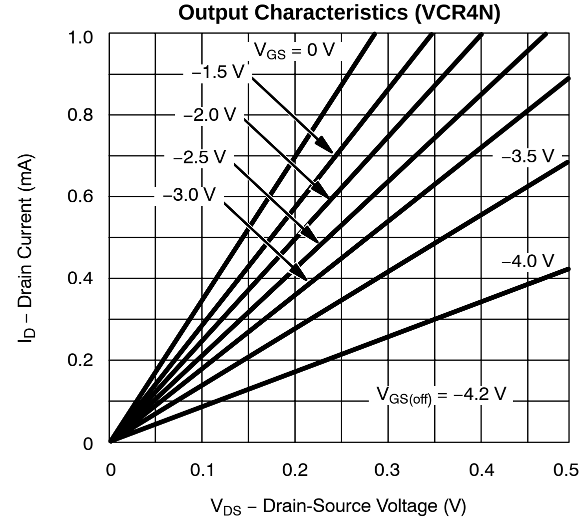
NCB/NPA/NT

TYPICAL CHARACTERISTICS (T_A = 25°C UNLESS OTHERWISE NOTED)

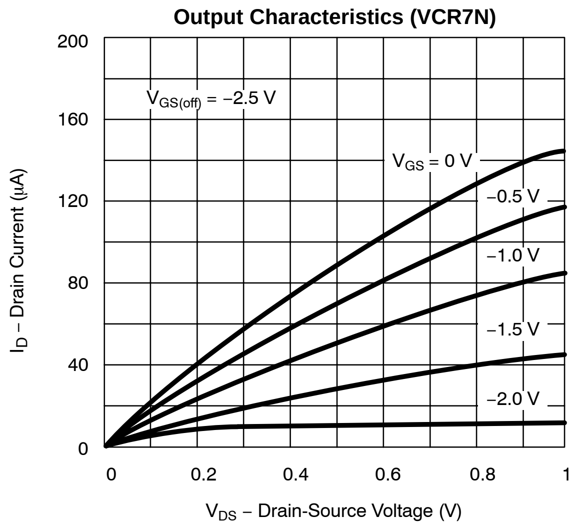
Output Characteristics (VCR2N)



Output Characteristics (VCR4N)



TYPICAL CHARACTERISTICS (T_A = 25°C UNLESS OTHERWISE NOTED)



APPLICATIONS

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

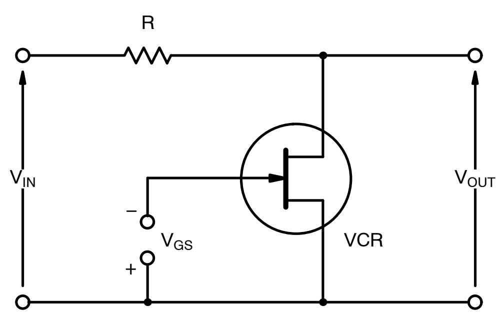


FIGURE 1. Simple Attenuator Circuit

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:

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

Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.