

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

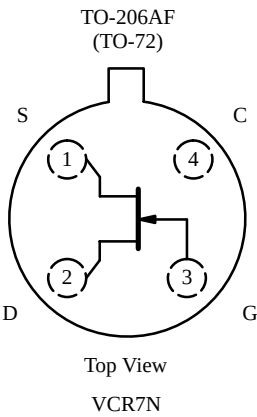
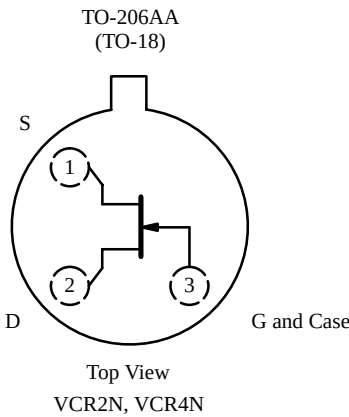
Description

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).



Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70293. Applications information may also be obtained via FaxBack, request document #70598.

VCR2N/4N/7N

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^a

Parameter	Symbol	Test Conditions	Typ ^b	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:

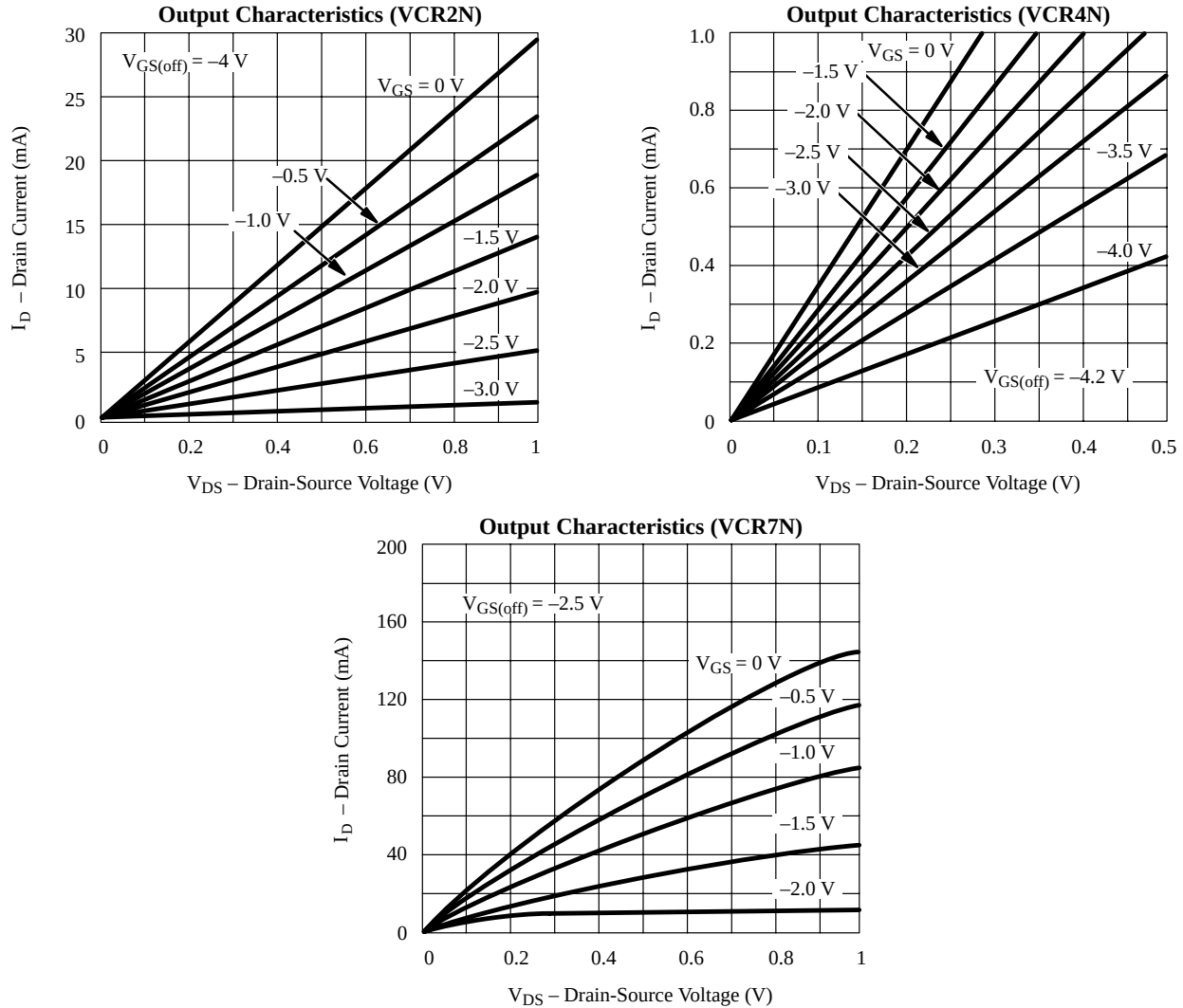
- a. $T_A = 25^\circ\text{C}$ unless otherwise noted.
 b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

NCB

NPA

NT

Typical Characteristics



Applications

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

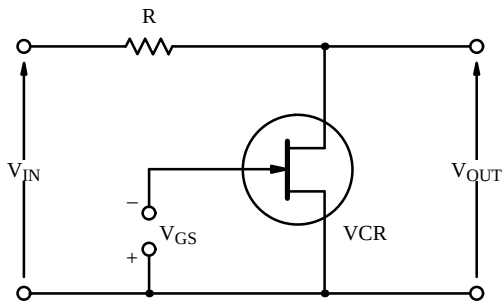


Figure 1. Simple Attenuator Circuit

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:

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