

## High-Speed Drivers with SPDT JFET Switches

### Features

- Constant On-Resistance Over Entire Analog Range
- Low Leakage
- Low Crosstalk
- Rad Hardness

### Benefits

- Low Distortion
- Eliminates Large Signal Errors
- High Precision
- High Bandwidth Capability
- Fault Protection

### Applications

- Audio Switching
- Video Switching
- Sample/Hold
- Guidance and Control Systems
- Telemetry

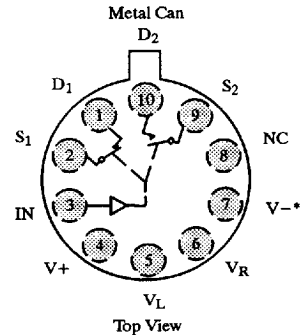
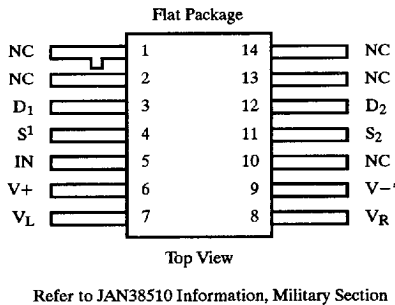
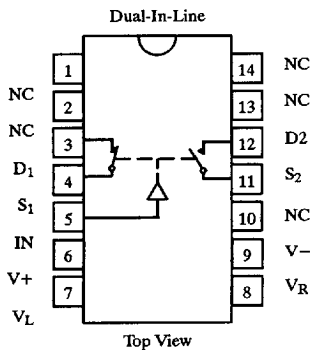
### Description

The DG186/187/188 are precision single-pole, double-throw (SPDT) analog switches designed to provide accurate switching of video and audio signals. This series is ideally suited for applications requiring a constant on-resistance over the entire analog range.

The major difference in the devices is the on-resistance (DG186—10 Ω, DG187—30 Ω, DG188—75 Ω). Reduced errors are achieved through low leakage current ( $I_{D(on)}$  < 2 nA). Applications which benefit from the flat JFET on-resistance include audio switching, video switching, and data acquisition.

To achieve fast and accurate switch performance, each device comprises two n-channel JFET transistors and a TTL compatible bipolar driver. The driver is designed to achieve break-before-make switching action, eliminating the inadvertent shorting between channels and the crosstalk which would result. In the on state, each switch conducts current equally well in either direction. In the off condition, the switches will block up to 20 V peak-to-peak, with feedthrough of less than -60 dB at 10 MHz.

### Functional Block Diagram and Pin Configuration



#### Ordering Information – DG186/187/188

Temp Range	Package	Part Number
-25 to 85°C	10-Pin Metal Can	DG186BA
		DG187BA
		DG188BA
	14-Pin Sidebraze	DG186BP
		DG187BP
		DG188BP
-55 to 125°C	10-Pin Metal Can	DG186AA/883
		DG187AA/883, JM38510/11105BIA
		DG188AA/883, JM38510/11106BIA
	14-Pin Sidebraze	DG186AP/883
		DG187AP/883, JM38510/11105BCA
		DG188AP/883, JM38510/11106BCA
14-Pin Flat Pack	JM38510/11105BXA	
	JM38510/11106BXA	

#### Truth Table

Logic	SW <sub>1</sub>	SW <sub>2</sub>
0	OFF	ON
1	ON	OFF

Logic "0" ≤ 0.8 V  
Logic "1" ≥ 2.0 V

Switches Shown for Logic "1" Input

**Absolute Maximum Ratings**

V+ to V-	36 V
V+ to V <sub>D</sub>	33 V
V <sub>D</sub> to V-	33 V
V <sub>D</sub> to V <sub>D</sub>	±22 V
V <sub>L</sub> to V-	36 V
V <sub>L</sub> to V <sub>IN</sub>	8 V
V <sub>L</sub> to V <sub>R</sub>	8 V
V <sub>IN</sub> to V <sub>R</sub>	8 V
V <sub>R</sub> to V-	27 V
V <sub>R</sub> to V <sub>IN</sub>	2 V
Current (S or D) DG186	200 mA

Current (S or D) DG187, DG188	30 mA
Current (All Other Pins)	30 mA
Storage Temperature	-65 to 150°C
Power Dissipation <sup>a</sup>	
10-Pin Metal Can <sup>b</sup>	450 mW
14-Pin Sidebraze <sup>c</sup>	825 mW
14-Pin Flat Pack <sup>d</sup>	900 mW

Notes:

- a. All leads welded or soldered to PC Board.
- b. Derate 6 mW/°C above 75°C
- c. Derate 11 mW/°C above 75°C
- d. Derate 10 mW/°C above 75°C

**Specifications<sup>a</sup> for DG186**

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V- = -15 V, V <sub>L</sub> = 5 V V <sub>R</sub> = 0 V, V <sub>IN</sub> = 0.8 or 2 V <sup>f</sup>	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		B Suffix -25 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full		-7.5	15	-7.5	15	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	I <sub>S</sub> = -10 mA, V <sub>D</sub> = -7.5 V	Room Full	7.5		10 20		15 25	Ω
Source Off Leakage Current	I <sub>S(off)</sub>	V <sub>S</sub> = ±10 V, V <sub>D</sub> = ∓10 V V+ = 10 V, V- = -20 V	Room Hot	0.05		10 1000		15 300	nA
		V <sub>S</sub> = ±7.5 V, V <sub>D</sub> = ∓7.5 V	Room Hot	0.05		10 1000		15 300	
Drain Off Leakage Current	I <sub>D(off)</sub>	V <sub>S</sub> = ±10 V, V <sub>D</sub> = ∓10 V V+ = 10 V, V- = -20 V	Room Hot	0.04		10 1000		15 300	nA
		V <sub>S</sub> = ±7.5 V, V <sub>D</sub> = ∓7.5 V	Room Hot	0.03		10 1000		15 300	
Channel On Leakage Current	I <sub>D(on)</sub>	V <sub>D</sub> = V <sub>S</sub> = ±7.5 V	Room Hot	-0.1	-2 -200		-10 -200		
Saturation Drain Current	I <sub>DSS</sub>	2 ms Pulse Duration	Room	300					mA
<b>Digital Input</b>									
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>IN</sub> = 5 V	Room Hot	<0.01		10 20		10 20	μA
Input Current with Input Voltage Low	I <sub>INL</sub>	V <sub>IN</sub> = 0 V	Full	-30	-250		-250		
<b>Dynamic Characteristics</b>									
Turn-On Time	t <sub>on</sub>	See Switching Time Test Circuit	Room	240		400		425	ns
Turn-Off Time	t <sub>off</sub>		Room	140		200		225	
Source-Off Capacitance	C <sub>S(off)</sub>	f = 1 MHz	Room	21					pF
Drain-Off Capacitance	C <sub>D(off)</sub>		V <sub>S</sub> = -5 V, I <sub>D</sub> = 0	Room	17				
Channel-On Capacitance	C <sub>D(on)</sub>		V <sub>D</sub> = -5 V, I <sub>S</sub> = 0	Room	17				
Off Isolation	OIRR	f = 1 MHz, R <sub>L</sub> = 75 Ω	Room	>55					dB
<b>Power Supplies</b>									
Positive Supply Current	I+	V <sub>IN</sub> = 0 V, or 5 V	Room			0.8		0.8	mA
Negative Supply Current	I-		Room		-3		-3		
Logic Supply Current	I <sub>L</sub>		Room			3.2		3.2	
Reference Supply Current	I <sub>R</sub>		Room		-2		-2		



## Specifications<sup>a</sup> for DG187

Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}, V_L = 5\text{ V}$ $V_R = 0\text{ V}, V_{IN} = 0.8\text{ or }2\text{ V}^f$	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		B Suffix -25 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full		-7.5	15	-7.5	15	V
Drain-Source On-Resistance	$r_{DS(on)}$	$I_S = -10\text{ mA}, V_D = -7.5\text{ V}$	Room Full	22		30 60		50 75	$\Omega$
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$	Room Hot	0.06		1 100		5 100	nA
		$V_S = \pm 7.5\text{ V}, V_D = \mp 7.5\text{ V}$	Room Hot	0.13		1 100		5 100	
Drain Off Leakage Current	$I_{D(off)}$	$V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$	Room Hot	0.04		1 100		5 100	
		$V_S = \pm 7.5\text{ V}, V_D = \mp 7.5\text{ V}$	Room Hot	0.03		1 100		5 100	
Channel On Leakage Current	$I_{D(on)}$	$V_D = V_S = \pm 7.5\text{ V}$	Room Hot	-0.02	-2 -200		-10 -200		
<b>Digital Input</b>									
Input Current with Input Voltage High	$I_{INH}$	$V_{IN} = 5\text{ V}$	Room Hot	<0.01		10 20		10 20	$\mu\text{A}$
Input Current with Input Voltage Low	$I_{INL}$	$V_{IN} = 0\text{ V}$	Full	-30	-250		-250		
<b>Dynamic Characteristics</b>									
Turn-On Time	$t_{on}$	See Switching Time Test Circuit	Room	85		150		180	ns
Turn-Off Time	$t_{off}$		Room	95		130		150	
Source-Off Capacitance	$C_{S(off)}$	$f = 1\text{ MHz}$	Room	9					pF
Drain-Off Capacitance	$C_{D(off)}$		$V_D = -5\text{ V}, I_S = 0$	Room	6				
Channel-On Capacitance	$C_{D(on)}$		$V_D = V_S = 0\text{ V}$	Room	14				
Off Isolation	OIRR	$f = 1\text{ MHz}, R_L = 75\ \Omega$	Room	>50					dB
<b>Power Supplies</b>									
Positive Supply Current	$I_+$	$V_{IN} = 0\text{ V}, \text{ or } 5\text{ V}$	Room			0.8		0.8	mA
Negative Supply Current	$I_-$		Room		-3		-3		
Logic Supply Current	$I_L$		Room			3.2		3.2	
Reference Supply Current	$I_R$		Room		-2		-2		

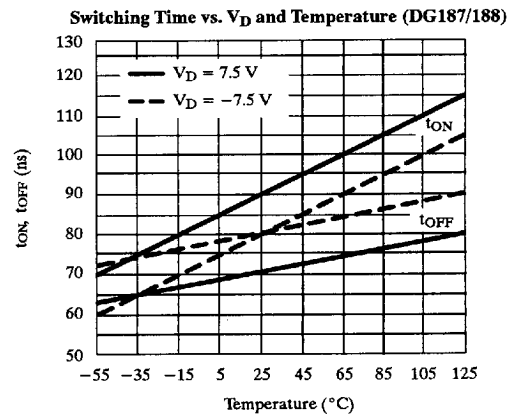
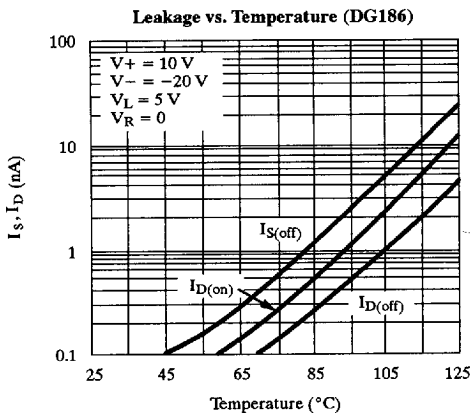
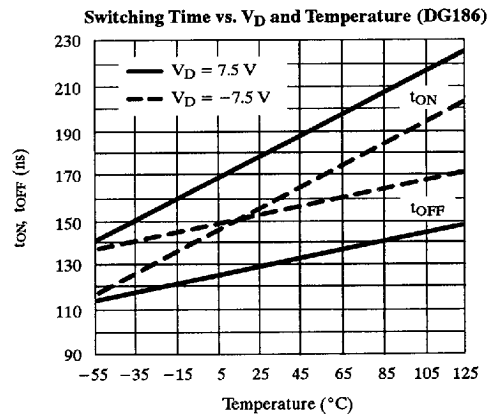
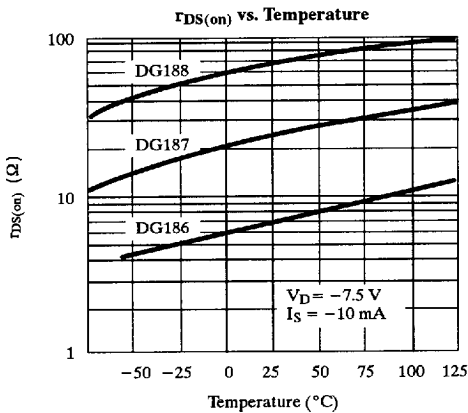
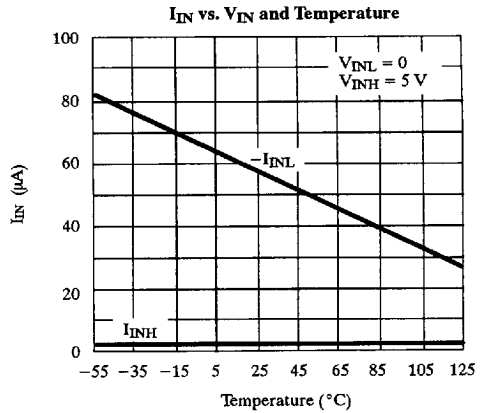
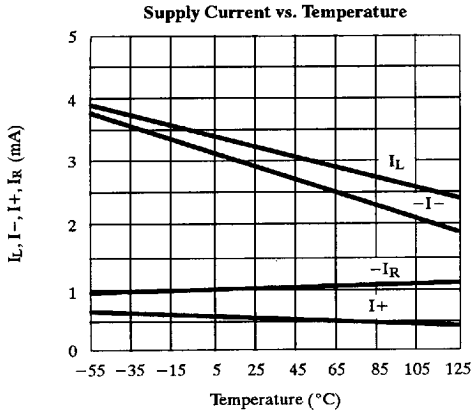
**Specifications<sup>a</sup> for DG188**

Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}, V_L = 5\text{ V}$ $V_R = 0\text{ V}, V_{IN} = 0.8\text{ or }2\text{ V}^f$		Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		B Suffix -25 to 85°C		Unit
						Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>										
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full			-10	15	-10	15	V
Drain-Source On-Resistance	$r_{DS(on)}$	$I_S = -10\text{ mA}, V_D = -7.5\text{ V}$	Room Full	35			75 150		100 150	$\Omega$
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$	Room Hot	0.05			1 100		5 100	$\mu\text{A}$
		$V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$	Room Hot	0.07			1 100		5 100	
Drain Off Leakage Current	$I_{D(off)}$	$V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$	Room Hot	0.04			1 100		5 100	$\mu\text{A}$
		$V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$	Room Hot	0.50			1 100		5 100	
Channel On Leakage Current	$I_{D(on)}$	$V_D = V_S = \pm 10\text{ V}$	Room Hot	-0.03		-2 -200		-10 -200		
<b>Digital Input</b>										
Input Current with Input Voltage High	$I_{INH}$	$V_{IN} = 5\text{ V}$	Room Hot	<0.01			10 20		10 20	$\mu\text{A}$
Input Current with Input Voltage Low	$I_{INL}$	$V_{IN} = 0\text{ V}$	Full	-30	-250			-250		
<b>Dynamic Characteristics</b>										
Turn-On Time	$t_{on}$	See Switching Time Test Circuit		Room	120		250		300	ns
Turn-Off Time	$t_{off}$			Room	100		130		150	
Source-Off Capacitance	$C_{S(off)}$	$f = 1\text{ MHz}$	$V_S = -5\text{ V}, I_D = 0$	Room	9					pF
Drain-Off Capacitance	$C_{D(off)}$		$V_D = -5\text{ V}, I_S = 0$	Room	6					
Channel-On Capacitance	$C_{D(on)}$		$V_D = V_S = 0\text{ V}$	Room	14					
Off Isolation	OIRR	$f = 1\text{ MHz}, R_L = 75\ \Omega$	Room	>50						dB
<b>Power Supplies</b>										
Positive Supply Current	$I_+$	$V_{IN} = 0\text{ V}, \text{ or }5\text{ V}$		Room			0.8		0.8	mA
Negative Supply Current	$I_-$			Room		-3		-3		
Logic Supply Current	$I_L$			Room			3.2		3.2	
Reference Supply Current	$I_R$			Room		-2		-2		

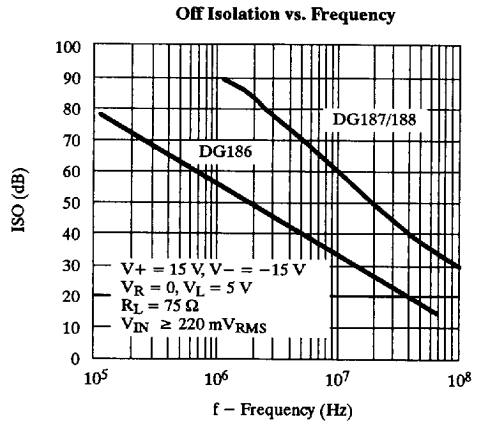
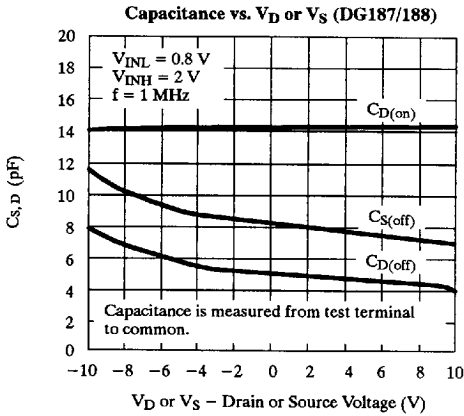
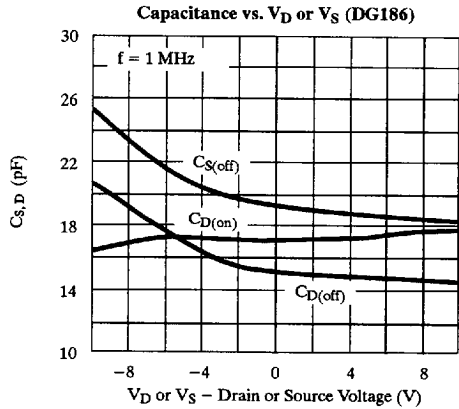
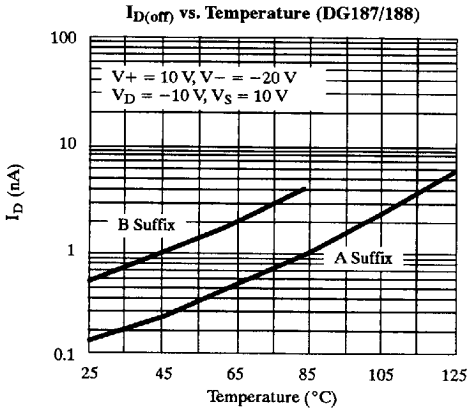
**Notes:**

- a. Refer to PROCESS OPTION FLOWCHART (Section 5 of the 1994 Data Book or FaxBack number 7103).
- b. Room = 25°C, Full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- e. Guaranteed by design, not subject to production test.
- f.  $V_{IN}$  = input voltage to perform proper function.

## Typical Characteristics



**Typical Characteristics (Cont'd)**



**Schematic Diagram (Typical Channel)**

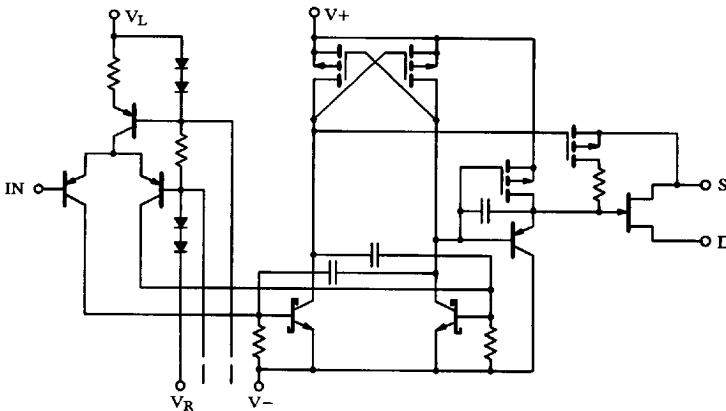
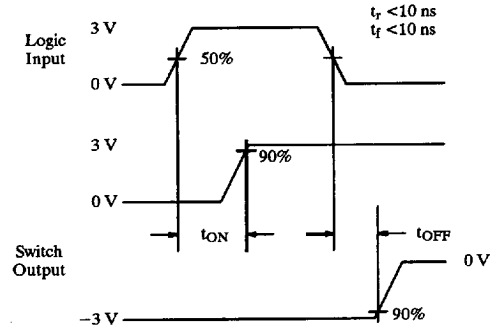
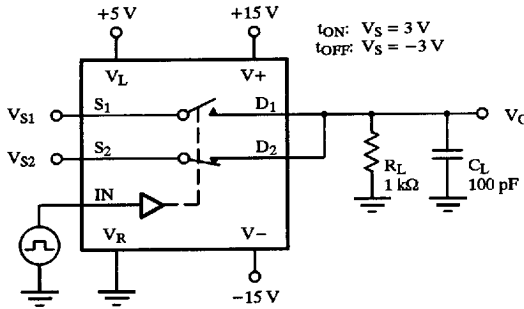


Figure 1.

## Test Circuits

Feedthrough due to charge injection may result in spikes at the leading and trailing edge of the output waveform.



$C_L$  (includes fixture and stray capacitance)

$$V_{OUT} = V_S \times \frac{R_L}{R_L + r_{DS(on)}}$$

Figure 2. Switching Time

## Application Hints<sup>a</sup>

Switch	V+ Positive Supply Voltage (V)	V- Negative Supply Voltage (V)	VL Logic Supply Voltage (V)	VR Reference Supply Voltage (V)	VIN Logic Input Voltage VINI(min)/ VINI(max) (V)	VS Analog Voltage Range (V)
DG186	15 <sup>b</sup>	-15	5	GND	2.0/0.8	-7.5 to 15
DG187	10	-20	5	GND	2.0/0.8	-12.5 to 10
	12	-12	5	GND	2.0/0.8	-4.5 to 12
DG188	15 <sup>b</sup>	-15	5	GND	2.0/0.8	-10 to 15
	10	-20	5	GND	2.0/0.8	-15 to 10
	12	-12	5	GND	2.0/0.8	-7 to 12

**Notes:**

- a. Application Hints are for DESIGN AID ONLY, not guaranteed and not subject to production testing.
- b. Electrical Parameter Chart based on V+ = 15 V, VL = 5 V, VR = GND