

# Hi-Reliability Optically Coupled Isolator

4N22, 4N23, 4N24 [A] (TX, TXV)

4N47, 4N48, 4N49 [A] (TX, TXV)



## Features:

- TO-78 hermetically sealed package
- High current transfer ratio
- 1 kV electrical isolation
- Base contact provided for conventional transistor biasing
- TX and TXV devices processed to MIL-PRF-19500

## Description:

Each isolator in this series consists of an infrared emitting diode and a NPN silicon phototransistor, which are mounted in a hermetically sealed TO-78 package. Devices are designed for military and/or harsh environments. The suffix letter "A" denotes the collector is electrically isolated from the case.

The 4N22, 4N22A, 4N23, 4N23A, 4N24, and 4N24A (TX, TXV) devices are processed to MIL-PRF-19500/486.

The 4N47, 4N47A, 4N48, 4N48A, 4N49, and 4N49A (TX, TXV) devices are processed to MIL-PRF-19500/548.

Please contact your local representative or OPTEK for more information.

## Applications:

- High-voltage isolation between input and output
- Electrical isolation in dirty environments
- Industrial equipment
- Medical equipment
- Office equipment

ORDERING INFORMATION						
Part Number	Isolation Voltage (kV)	CTR % Min / Max	I <sub>F</sub> (mA) Typ / Max	V <sub>CE</sub> (Volts) Max	Processing MIL-PRF-195000	
4N22 or 4N22A	1	25 / NA	10 / 40	35	486	
4N22TX or 4N22ATX						
4N22TXV or 4N22ATXV						
4N23 or 4N23A						
4N23TX or 4N23ATX						
4N23TXV or 4N23ATXV						
4N24 or 4N24A						
4N24TX or 4N24ATX						
4N24TXV or 4N24ATXV						
4N47 or 4N47A		50 / NA	1 / 40	40	548 548	
4N47TX or 4N47ATX						
4N47TXV or 4N47ATXV						
4N48 or 4N48A		100 / 500				
4N48TX or 4N48ATX						
4N48TXV or 4N48ATXV						
4N49 or 4N49A		200 / 1,000				
4N49TX or 4N49ATX						
4N49TXV or 4N49ATXV						

## General Note

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4N47, 4N48, 4N49 [A] (TX, TXV)



<b>Absolute Maximum Ratings</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)	
Storage Temperature Range 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A (TX, TXV) 4N47, 4N47A, 4N48, 4N48A, 4N49, 4N49A (TX, TXV)	-65° C to +125° C
Operating Temperature Range 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A (TX, TXV) 4N47, 4N47A, 4N48, 4N48A, 4N49, 4N49A (TX, TXV)	-55° C to +125° C
Input-to-Output Isolation Voltage	$\pm 1.00\text{ kVDC}^{(1)}$
Lead Soldering Temperature [1/16 inch (1.6 mm) from case for 5 seconds with soldering iron]	260° C <sup>(2)</sup>
<b>Input Diode</b>	
Forward DC Current (65° C or below)	40 mA
Reverse Voltage	2 V
Peak Forward Current (1 $\mu\text{s}$ pulse width, 300 pps) 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A (TX, TXV)	1 A
Power Dissipation	60 mW <sup>(3)</sup>
<b>Output Phototransistor (4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A )</b>	
Continuous Collector Current	50 mA
Collector-Emitter Voltage	35 V
Collector-Base Voltage	35 V
Emitter-Base Voltage	4 V
Power Dissipation	300 mW <sup>(4)</sup>
<b>Output Phototransistor (4N47, 4N47A, 4N48, 4N48A, 4N49, 4N49A )</b>	
Continuous Collector Current	50 mA
Collector-Emitter Voltage	40 V
Collector-Base Voltage	45 V
Emitter-Base Voltage	7.0 V
Power Dissipation	300 mW <sup>(4)</sup>

**Notes:**

1. Measured with input leads shorted together and output leads shorted together.
2. RMA flux is recommended. Duration can be extended to 10 seconds maximum when flow soldering.
3. Derate linearly 1.0 mW/° C above 65° C.
4. Derate linearly 3.0 mW/° C above 25° C.

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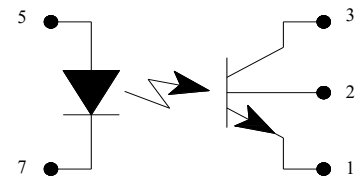
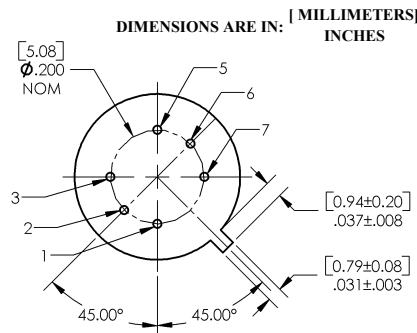
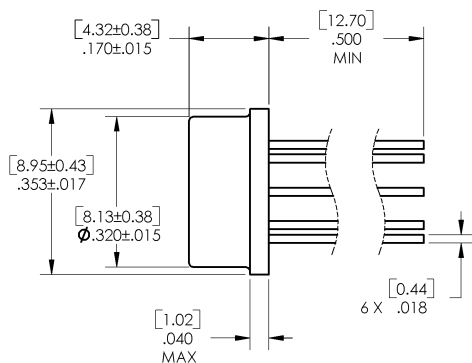
## Performance

Electrical Characteristics (T <sub>A</sub> = 25°C unless otherwise noted)						
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
<b>Input Diode</b>						
V <sub>F</sub>	Forward Voltage					
	4N22, 4N23, 4N24 [A] (TX, TXV)	0.80	-	1.30	V	I <sub>F</sub> = 10.0 mA
	4N22, 4N23, 4N24 [A] (TX, TXV)	1.00	-	1.50		I <sub>F</sub> = 10.0 mA, T <sub>A</sub> = -55° C <sup>(1)</sup>
	4N22, 4N23, 4N24 [A] (TX, TXV)	0.70	-	1.20		I <sub>F</sub> = 10.0 mA, T <sub>A</sub> = -100° C <sup>(1)</sup>
	4N47, 4N48, 4N49 [A] (TX, TXV)	0.80	-	1.50		I <sub>F</sub> = 10.0 mA
4N47, 4N48, 4N49 [A] (TX, TXV)	1.00	-	1.70	I <sub>F</sub> = 10.0 mA, T <sub>A</sub> = -55° C <sup>(1)</sup>		
	4N47, 4N48, 4N49 [A] (TX, TXV)	0.70	-	1.30		I <sub>F</sub> = 10.0 mA, T <sub>A</sub> = -100° C <sup>(1)</sup>
I <sub>R</sub>	Reverse Current	-	-	100	μA	V <sub>R</sub> = 2.0 V
<b>Output Phototransistor</b>						
V <sub>(BR)CEO</sub>	Collector-Emitter Breakdown Voltage	35	-	-	V	I <sub>C</sub> = 1.0 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	40	-	-		I <sub>C</sub> = 1.0 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 0
V <sub>(BR)CBO</sub>	Collector-Base Breakdown Voltage	35	-	-	V	I <sub>C</sub> = 100 μA, I <sub>B</sub> = 0, I <sub>F</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	45	-	-		I <sub>C</sub> = 100 μA, I <sub>B</sub> = 0, I <sub>F</sub> = 0
V <sub>(BR)EBO</sub>	Emitter-Base Breakdown Voltage	4	-	-	V	I <sub>E</sub> = 100 μA, I <sub>C</sub> = 0, I <sub>F</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	7	-	-		I <sub>E</sub> = 100 μA, I <sub>C</sub> = 0, I <sub>F</sub> = 0
I <sub>CEO</sub>	Collector-Emitter Dark Current	-	-	100	nA	V <sub>CE</sub> = 20 V, I <sub>B</sub> = 0, I <sub>F</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	-	-	100		μA
I <sub>C(OFF)</sub>	Collector-Emitter Dark Current	-	-	100	nA	V <sub>CE</sub> = 20 V, I <sub>B</sub> = 0, I <sub>F</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	-	-	100		μA
I <sub>CB(OFF)</sub>	Collector-Base Dark Current	-	-	10	nA	V <sub>CB</sub> = 20 V, I <sub>E</sub> = 0, I <sub>F</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	-	-	10		

**Notes:**

1. Guaranteed but not tested.

2. Sample tested, LTPD = 10.



Pin #	Function	Pin #	Function
1	Emitter	5	Anode
2	Base	6	Open
3	Collector	7	Cathode

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4N47, 4N48, 4N49 [A] (TX, TXV)



## Electrical Characteristics (T<sub>A</sub> = 25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
<b>Coupled</b>						
I <sub>C(ON)</sub>	On-State Collector Current 4N22, 4N22A (TX, TXV)	0.15	-	-	mA	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N22, 4N22A (TX, TXV)	2.50	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N22, 4N22A (TX, TXV)	1.00	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, T <sub>A</sub> = -55° C <sup>(1)</sup>
	4N22, 4N22A (TX, TXV)	1.00	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, T <sub>A</sub> = 100° C <sup>(1)</sup>
	4N23, 4N23A (TX, TXV)	0.20	-	-		I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N23, 4N23A (TX, TXV)	6.00	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N23, 4N23A (TX, TXV)	2.50	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, T <sub>A</sub> = -55° C <sup>(1)</sup>
I <sub>C(ON)</sub>	4N23, 4N23A (TX, TXV)	2.50	-	-	I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, T <sub>A</sub> = 100° C <sup>(1)</sup>	
	4N24, 4N24A (TX, TXV)	0.40	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0	
I <sub>C(ON)</sub>	4N24, 4N24A (TX, TXV)	10.0	-	-	I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0	
	4N24, 4N24A (TX, TXV)	4.00	-	-	I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, T <sub>A</sub> = -55° C <sup>(1)</sup>	
I <sub>C(ON)</sub>	4N24, 4N24A (TX, TXV)	4.00	-	-	I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, T <sub>A</sub> = 100° C <sup>(1)</sup>	
	4N47, 4N47A (TX, TXV)	0.50	-	-	I <sub>F</sub> = 1.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0	
I <sub>C(ON)</sub>	4N47, 4N47A (TX, TXV)	0.70	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0, T <sub>A</sub> = -55° C <sup>(1)</sup>	
	4N47, 4N47A (TX, TXV)	0.50	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0, T <sub>A</sub> = 100° C <sup>(1)</sup>	
I <sub>C(ON)</sub>	4N48, 4N48A (TX, TXV)	1.00	-	5	I <sub>F</sub> = 1.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0	
	4N48, 4N48A (TX, TXV)	1.40	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0, T <sub>A</sub> = -55° C <sup>(1)</sup>	
I <sub>C(ON)</sub>	4N48, 4N48A (TX, TXV)	1.00	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0, T <sub>A</sub> = 100° C <sup>(1)</sup>	
	4N49, 4N49A (TX, TXV)	2.00	-	10	I <sub>F</sub> = 1.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0	
I <sub>C(ON)</sub>	4N49, 4N49A (TX, TXV)	2.80	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0, T <sub>A</sub> = -55° C <sup>(1)</sup>	
	4N49, 4N49A (TX, TXV)	2.00	-	-	I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0, T <sub>A</sub> = 100° C <sup>(1)</sup>	
I <sub>CB(ON)</sub>	On-State Collector Base 4N47, 4N48, 4N49 [A] (TX, TXV)	30	-	-	μA	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0, I <sub>F</sub> = 10 mA
V <sub>CE(SAT)</sub>	Collector-Emitter Saturation Voltage 4N22, 4N23, 4N24 [A] (TX, TXV)	-	-	0.30	V	I <sub>F</sub> = 20 mA, I <sub>C</sub> = 2.5 mA, I <sub>B</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	-	-	0.30		I <sub>F</sub> = 20 mA, I <sub>C</sub> = 5.0 mA, I <sub>B</sub> = 0
	4N22, 4N23, 4N24 [A] (TX, TXV)	-	-	0.30		I <sub>F</sub> = 20 mA, I <sub>C</sub> = 10.0 mA, I <sub>B</sub> = 0
	4N47, 4N47A (TX, TXV)	-	-	0.30		I <sub>F</sub> = 2.0 mA, I <sub>C</sub> = 0.5 mA, I <sub>B</sub> = 0
	4N48, 4N48A (TX, TXV)	-	-	0.30		I <sub>F</sub> = 2.0 mA, I <sub>C</sub> = 1.0 mA, I <sub>B</sub> = 0
	4N49, 4N49A (TX, TXV)	-	-	0.30		I <sub>F</sub> = 2.0 mA, I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0
H <sub>FE</sub>	DC Current Gain 4N22, 4N22A (TX, TXV)	>300	-	-	V	V <sub>CE</sub> = 5.0 V, I <sub>C</sub> = 10.0 mA, I <sub>F</sub> = 0 mA
	4N23, 4N23A (TX, TXV)		-	-		
	4N24, 4N24A (TX, TXV)		-	-		
	4N47, 4N48, 4N49 [A] (TX, TXV)		-	-		
R <sub>IO</sub>	Resistance (Input-to-Output) 4N22, 4N23, 4N24 [A] (TX, TXV)	10 <sup>11</sup>	-	-	Ω	V <sub>I-O</sub> = ± 1000 VDC <sup>(3)</sup>
	4N47, 4N48, 4N49 [A] (TX, TXV)	10 <sup>11</sup>	-	-		V <sub>I-O</sub> = ± 1000 VDC <sup>(3)</sup>
C <sub>IO</sub>	Capacitance (Input-to-Output)	-	-	5	pF	V <sub>I-O</sub> = 0 V, f = 1.0 MHz <sup>(3)</sup>

**Notes:**

1. Guaranteed but not tested.

2. Sample tested, LTPD = 10.

3. Measured with input leads shorted together and output leads shorted together.

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4N22, 4N23, 4N24 [A] (TX, TXV)

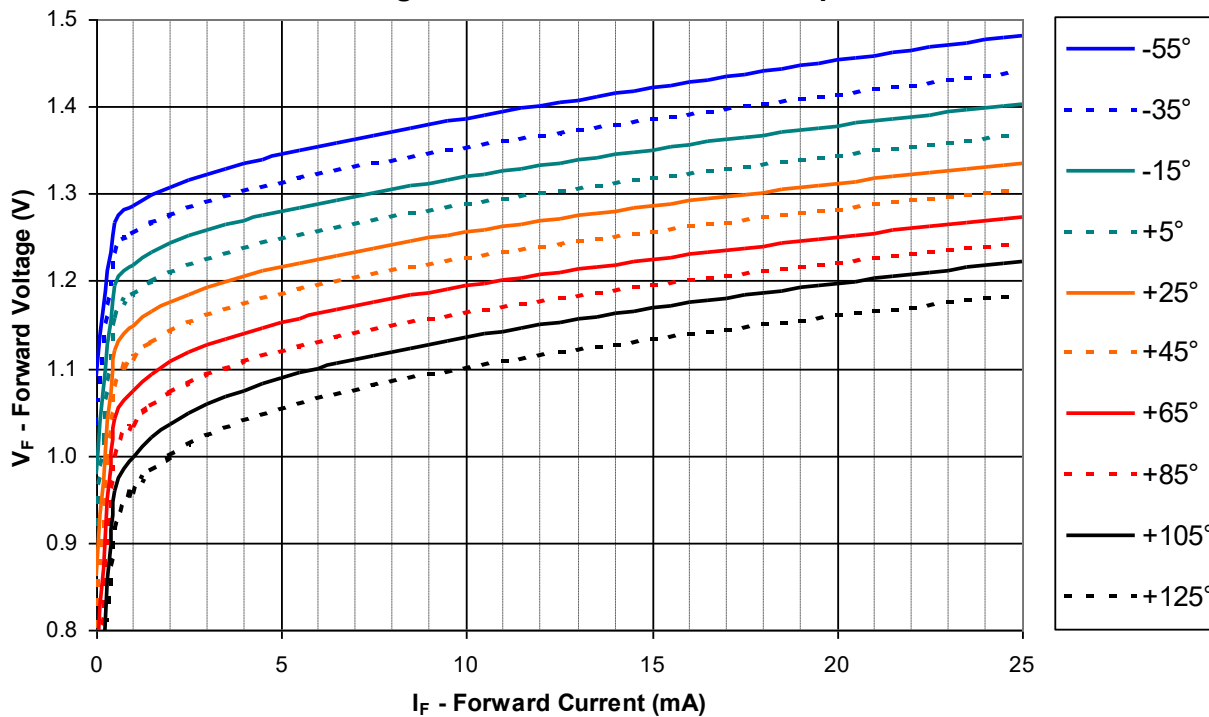
4N47, 4N48, 4N49 [A] (TX, TXV)



Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise noted)						
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
<b>Coupled</b>						
$T_R$	Output Rise Time	-	-	15	$\mu\text{s}$	$V_{CC} = 10.0\text{ V}$ , $I_f = 10.0\text{ mA}$ , $R_L = 100\text{ mA}$
	4N22A (TX, TXV)	-	-	15		$V_{CC} = 10.0\text{ V}$ , $I_f = 10.0\text{ mA}$ , $R_L = 100\text{ mA}$
	4N23A (TX, TXV)	-	-	20		$V_{CC} = 10.0\text{ V}$ , $I_f = 10.0\text{ mA}$ , $R_L = 100\text{ mA}$
	4N24A (TX, TXV)	-	-	20		$V_{CC} = 10.0\text{ V}$ , $I_f = 5.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N47 (TX, TXV)	-	-	20		$V_{CC} = 10.0\text{ V}$ , $I_f = 5.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N48 (TX, TXV)	-	-	25		$V_{CC} = 10.0\text{ V}$ , $I_f = 5.0\text{ mA}$ , $R_L = 100\ \Omega$
$T_F$	Output Fall Time	-	-	15	$\mu\text{s}$	$V_{CC} = 10.0\text{ V}$ , $I_f = 10.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N22A (TX, TXV)	-	-	15		$V_{CC} = 10.0\text{ V}$ , $I_f = 10.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N23A (TX, TXV)	-	-	20		$V_{CC} = 10.0\text{ V}$ , $I_f = 10.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N24A (TX, TXV)	-	-	20		$V_{CC} = 10.0\text{ V}$ , $I_f = 5.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N47 (TX, TXV)	-	-	20		$V_{CC} = 10.0\text{ V}$ , $I_f = 5.0\text{ mA}$ , $R_L = 100\ \Omega$
	4N48 (TX, TXV)	-	-	25		$V_{CC} = 10.0\text{ V}$ , $I_f = 5.0\text{ mA}$ , $R_L = 100\ \Omega$

## Typical Performance Curves

Forward Voltage vs Forward Current vs Temperature



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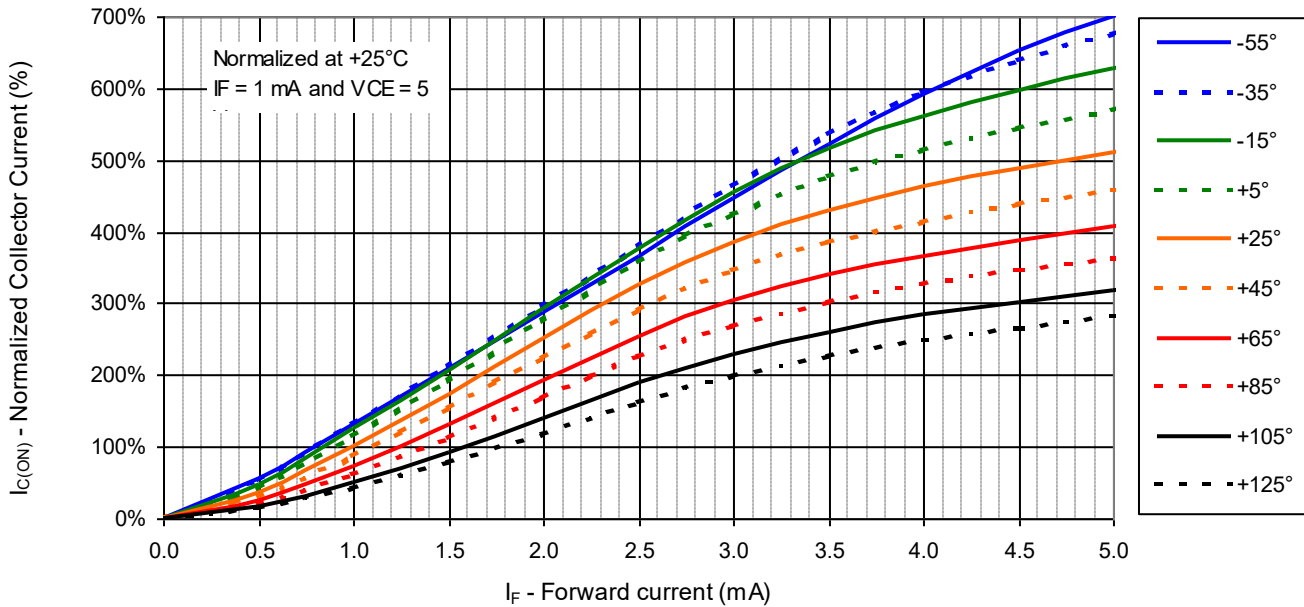
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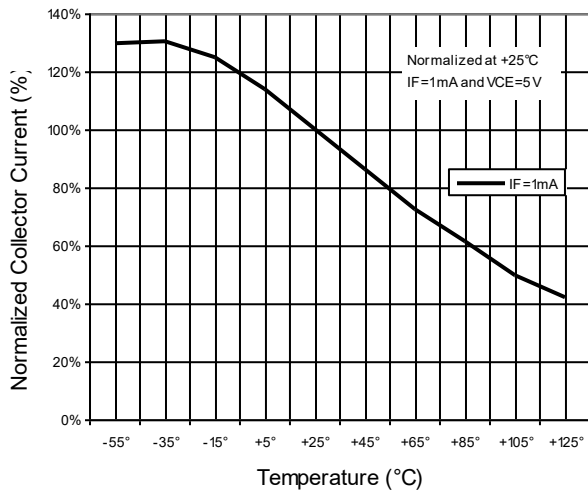
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## Typical Performance Curves

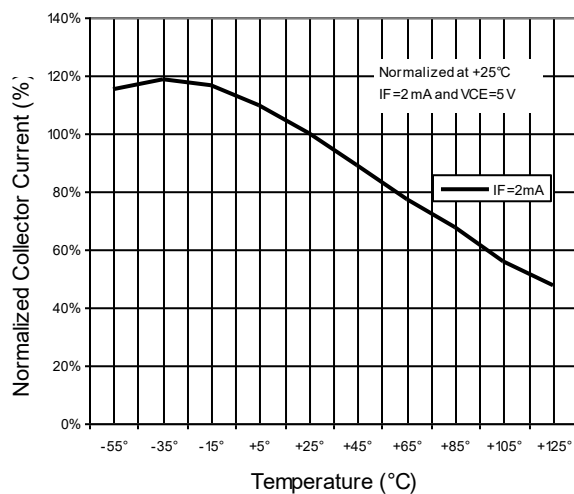
Collector Current vs Forward Current vs Temperature



Normalized Collector Current Vs Temperature



Normalized Collector Current Vs Temperature



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