

# Hi-Reliability Optically Coupled Isolator

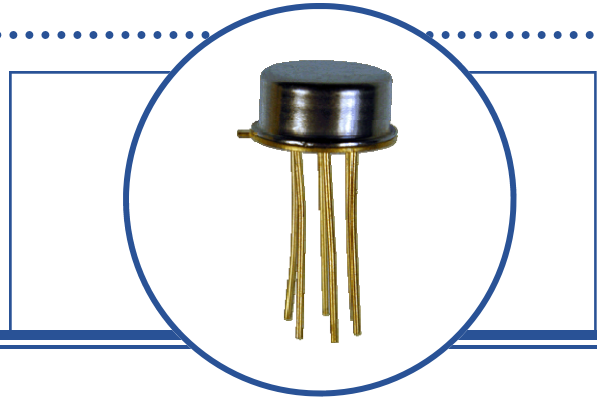
4N22, 4N23, 4N24 [A] (COTS, TX, TXV)

4N47, 4N48, 4N49 [A] (COTS, 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
- Patent No. 4124860



## Description:

Each isolator in this series has a 890 nm (for the 4N2\_ series) and 935nm (for the 4N4\_ series) wavelength 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. Burn-in condition is  $V_{CE} = 10V$ ,  $I_F = 40mA$ ,  $P_D = 275 mW$ ,  $T_A = 25^\circ C$ . 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	LED Peak Wavelength	Sensor	Isolation Voltage (kV)	CTR % Min / Max	$I_F$ (mA) Typ / Max	$V_{CE}$ (Volts) Max	Processing MIL-PRF-195000
4N22 or 4N22A	935 nm	Transistor	1	25 / NA	10 / 40	35	COTS
4N22TX or 4N22ATX							486
4N22TXV or 4N22ATXV							COTS
4N23 or 4N23A				486			
4N23TX or 4N23ATX				COTS			
4N23TXV or 4N23ATXV				486			
4N24 or 4N24A				486			
4N24TX or 4N24ATX				COTS			
4N24TXV or 4N24ATXV				486			
4N47 or 4N47A				486			
4N47TX or 4N47ATX				548			
4N47TXV or 4N47ATXV				COTS			
4N48 or 4N48A				548			
4N48TX or 4N48ATX				COTS			
4N48TXV or 4N48ATXV				548			
4N49 or 4N49A				548			
4N49TX or 4N49ATX				COTS			
4N49TXV or 4N49ATXV				548			

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

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



## Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Storage Temperature Range 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A (COTS, TX, TXV) 4N47, 4N47A, 4N48, 4N48A, 4N49, 4N49A (COTS, TX, TXV)	-65° C to +125° C -55° C to +150° C
Operating Temperature Range 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A (COTS, TX, TXV) 4N47, 4N47A, 4N48, 4N48A, 4N49, 4N49A (COTS, TX, TXV)	-65° C to +125° C -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>

## Input Diode

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 (COTS, TX, TXV)	1 A
Power Dissipation	60 mW <sup>(3)</sup>

## Output Sensor (4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A )

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>

## Output Phototransistor (4N47, 4N47A, 4N48, 4N48A, 4N49, 4N49A )

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

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



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

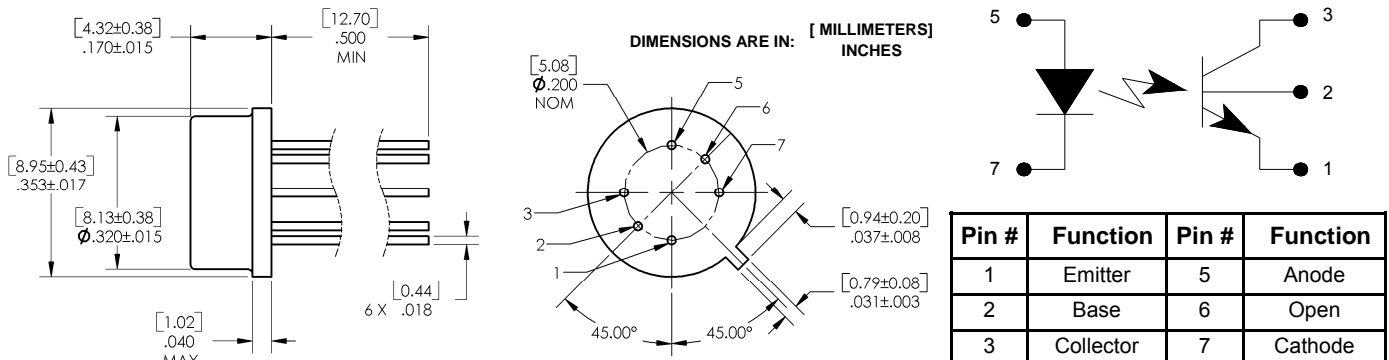
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
<b>Input Diode</b>						
V <sub>F</sub>	Forward Voltage					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	0.80	-	1.30		I <sub>F</sub> = 10.0 mA
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	1.00	-	1.50		I <sub>F</sub> = 10.0 mA, T <sub>A</sub> = -55° C <sup>(1)</sup>
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	0.70	-	1.20	V	I <sub>F</sub> = 10.0 mA, T <sub>A</sub> = -100° C <sup>(1)</sup>
	4N47, 4N48, 4N49 [A] (COTS, TX, TXV)	0.80	-	1.50		I <sub>F</sub> = 10.0 mA
I <sub>R</sub>	Reverse Current	-	-	100	μA	V <sub>R</sub> = 2.0 V

### Output Phototransistor

V <sub>(BR)CEO</sub>	Collector-Emitter Breakdown Voltage					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	35	-	-	V	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					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	35	-	-	V	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					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	4	-	-	V	I <sub>E</sub> = 100 μA, I <sub>C</sub> = 0, I <sub>F</sub> = 0
I <sub>CEO</sub>	Collector-Emitter Dark Current					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	-	-	100	nA	V <sub>CE</sub> = 20 V, I <sub>B</sub> = 0, I <sub>F</sub> = 0
I <sub>C(OFF)</sub>	Collector-Emitter Dark Current					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	-	-	100	nA	V <sub>CE</sub> = 20 V, I <sub>B</sub> = 0, I <sub>F</sub> = 0
I <sub>CB(OFF)</sub>	Collector-Base Dark Current					
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	-	-	10	nA	V <sub>CB</sub> = 20 V, I <sub>E</sub> = 0, I <sub>F</sub> = 0

#### Notes:

1. Guaranteed but not tested.
2. Sample tested, LTPD = 10.



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# Hi-Reliability Optically Coupled Isolator

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

4N47, 4N48, 4N49 [A] (COTS, 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 (COTS, 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 (COTS, TX, TXV)	2.50	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N22, 4N22A (COTS, 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 (COTS, 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 (COTS, TX, TXV)	0.20	-	-		I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N23, 4N23A (COTS, TX, TXV)	6.00	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N23, 4N23A (COTS, 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>
	4N23, 4N23A (COTS, 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 (COTS, TX, TXV)	0.40	-	-		I <sub>F</sub> = 2.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N24, 4N24A (COTS, TX, TXV)	10.0	-	-		I <sub>F</sub> = 10.0 mA, V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0
	4N24, 4N24A (COTS, 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>
	4N24, 4N24A (COTS, 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 (COTS, TX, TXV)	0.50	-	-		I <sub>F</sub> = 1.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0
4N47, 4N47A (COTS, 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 (COTS, 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>		
4N48, 4N48A (COTS, 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 (COTS, 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>		
4N48, 4N48A (COTS, 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 (COTS, TX, TXV)	2.00	-	10	I <sub>F</sub> = 1.0 mA, V <sub>CE</sub> = 5.0 V, I <sub>B</sub> = 0		
4N49, 4N49A (COTS, 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 (COTS, 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] (COTS, 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				V	
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	-	-	0.30		I <sub>F</sub> = 20 mA, I <sub>C</sub> = 2.5 mA, I <sub>B</sub> = 0
	4N22, 4N23, 4N24 [A] (COTS, 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] (COTS, TX, TXV)	-	-	0.30		I <sub>F</sub> = 20 mA, I <sub>C</sub> = 10.0 mA, I <sub>B</sub> = 0
	4N47, 4N47A (COTS, 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 (COTS, 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 (COTS, 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				V	
	4N22, 4N22A (COTS, TX, TXV)	200	-	-		V <sub>CE</sub> = 5.0 V, I <sub>C</sub> = 10.0 mA, I <sub>F</sub> = 0 mA
	4N23, 4N23A (COTS, TX, TXV)	300	-	-		V <sub>CE</sub> = 5.0 V, I <sub>C</sub> = 10.0 mA, I <sub>F</sub> = 0 mA
	4N24, 4N24A (COTS, TX, TXV)	400	-	-		V <sub>CE</sub> = 5.0 V, I <sub>C</sub> = 10.0 mA, I <sub>F</sub> = 0 mA
	4N47, 4N48, 4N49 [A] (COTS, TX, TXV)	100	-	-		V <sub>CE</sub> = 5.0 V, I <sub>C</sub> = 10.0 mA, I <sub>F</sub> = 0 mA
R <sub>IO</sub>	Resistance (Input-to-Output)				Ω	
	4N22, 4N23, 4N24 [A] (COTS, TX, TXV)	10 <sup>11</sup>	-	-		V <sub>I-O</sub> = ± 1.0 VDC <sup>(3)</sup>
4N47, 4N48, 4N49 [A] (COTS, 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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4N47, 4N48, 4N49 [A] (COTS, TX, TXV)

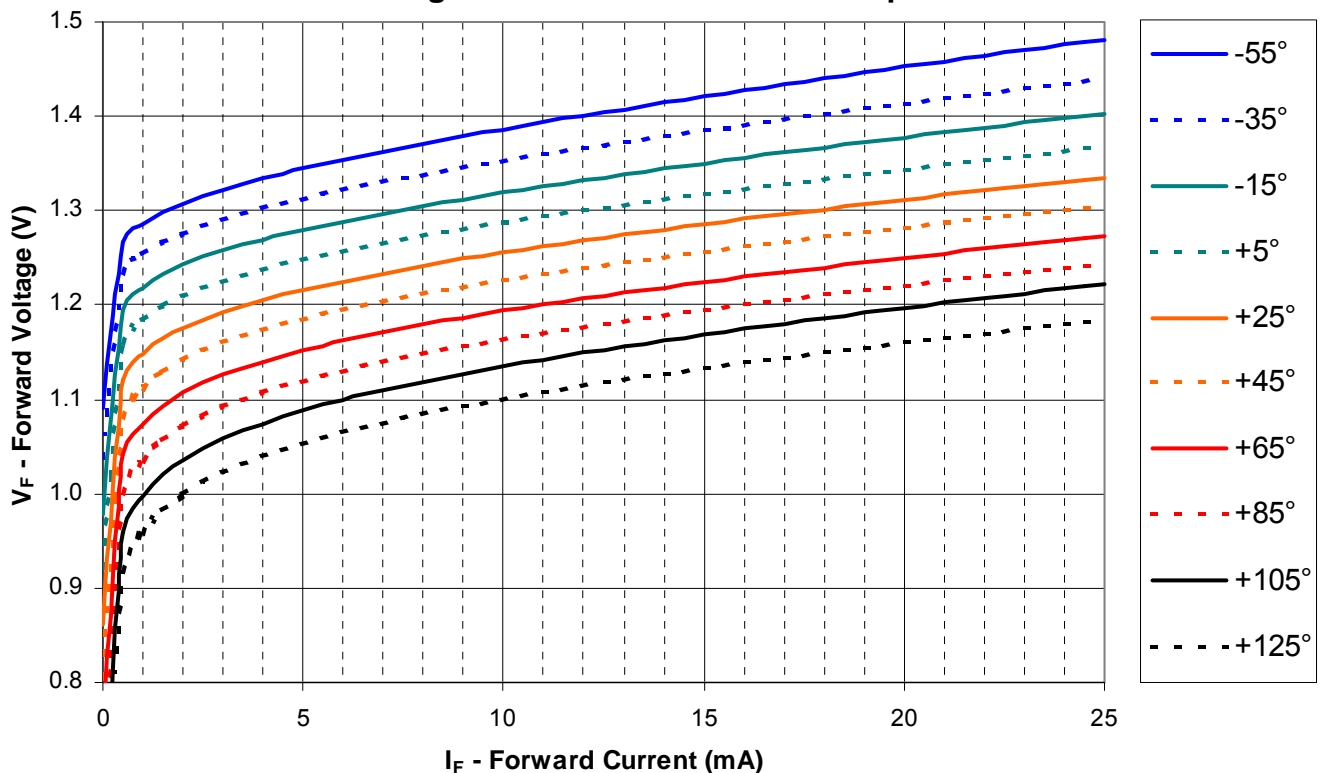


## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

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

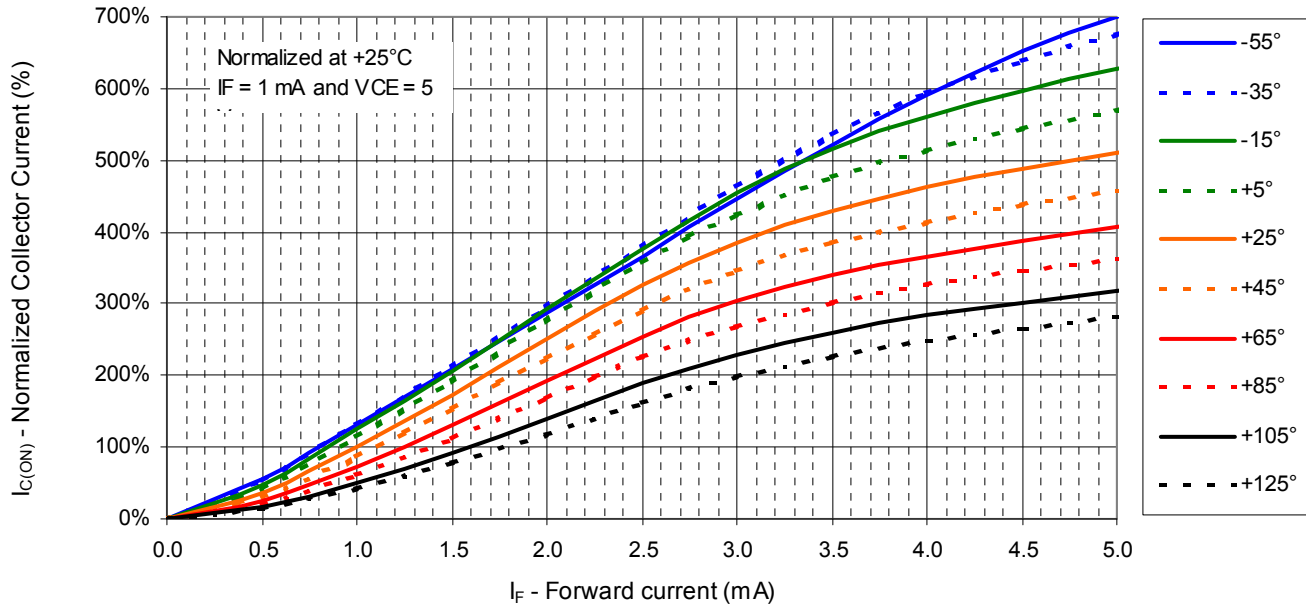
Forward Voltage vs Forward Current vs Temperature



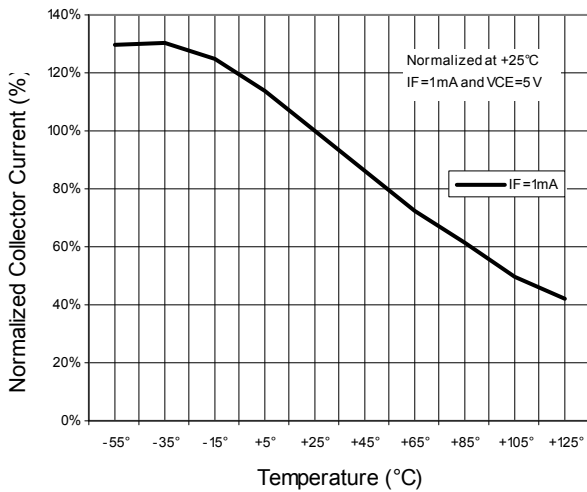
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Typical Performance Curves

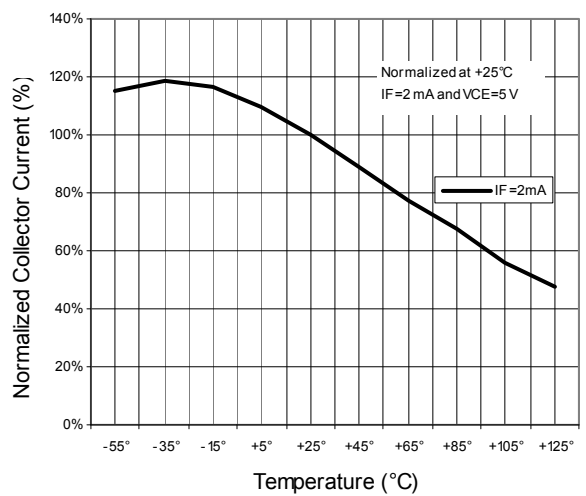
Collector Current vs Forward Current vs Temperature



Normalized Collector Current Vs Temperature



Normalized Collector Current Vs Temperature



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