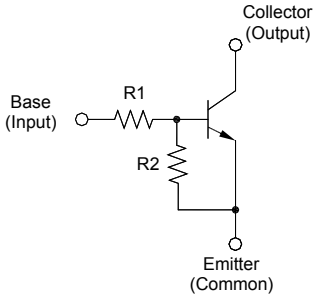
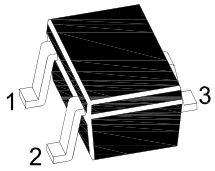
# MMBTRC416E…MMBTRC422E

## NPN Silicon Epitaxial Planar Transistor

for switching, interface circuit and drive circuit applications




1.Base 2.Emitter 3.Collector
SOT-523 Plastic Package

**Features**

- With built-in bias resistors
- Simplify circuit design
- Reduce a quantity of parts and manufacturing process

**Resistor Values**

| Type | R1 (KΩ) | R2 (KΩ) |
|---|---|---|
| MMBTRC416E | 1 | 10 |
| MMBTRC417E | 2.2 | 2.2 |
| MMBTRC418E | 2.2 | 10 |
| MMBTRC419E | 4.7 | 10 |
| MMBTRC420E | 10 | 4.7 |
| MMBTRC421E | 47 | 10 |
| MMBTRC422E | 100 | 100 |

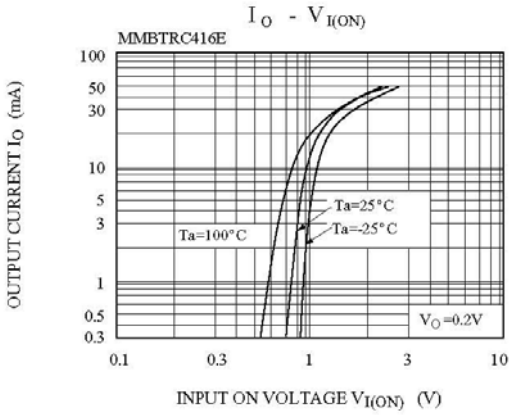
**Absolute Maximum Ratings ($T_a$ = 25 °C)**

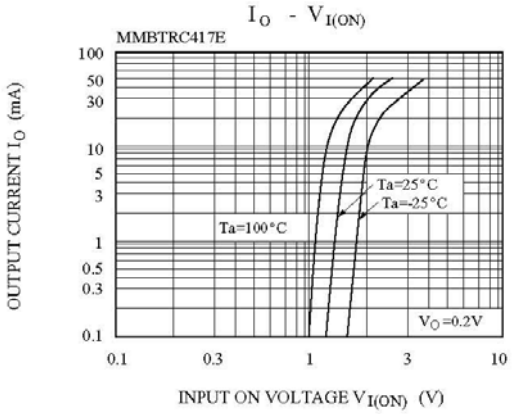
| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Output Voltage | | $V_O$ | 50 | V |
| Input Voltage | MMBTRC416E | $V_I$ | 10, - 5 | V |
| | MMBTRC417E | | 12, - 10 | |
| | MMBTRC418E | | 12, - 5 | |
| | MMBTRC419E | | 20, - 7 | |
| | MMBTRC420E | | 30, - 10 | |
| | MMBTRC421E | | 40, - 15 | |
| | MMBTRC422E | | 40, - 10 | |
| Output Current | | $I_O$ | 100 | mA |
| Total Power Dissipation | | $P_{tot}$ | 100 | mW |
| Junction Temperature | | $T_j$ | 150 | °C |
| Storage Temperature Range | | $T_{stg}$ | - 55 to + 150 | °C |

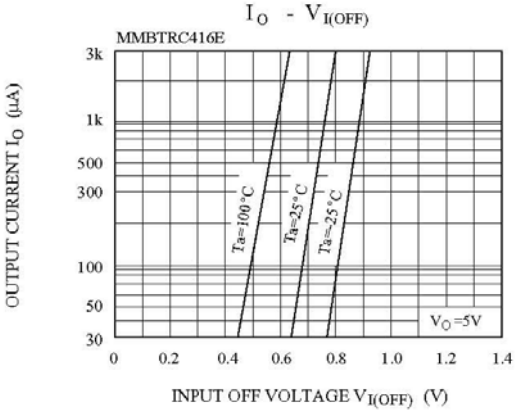
**Characteristics at $T_a$ = 25 °C**

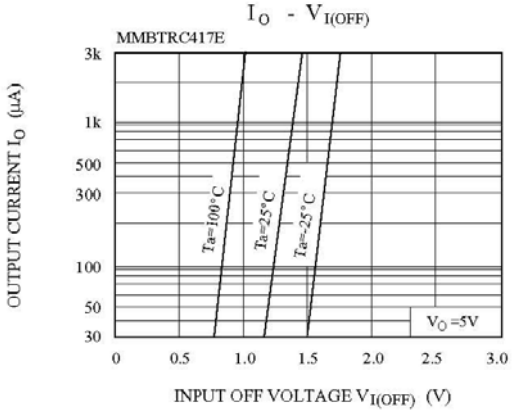
| Parameter | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| DC Current Gain | | | | | | |
| at $V_O$ = 5 V, $I_O$ = 5 mA | MMBTRC416E | | 33 | - | - | - |
| at $V_O$ = 5 V, $I_O$ = 20 mA | MMBTRC417E | | 20 | - | - | - |
| at $V_O$ = 5 V, $I_O$ = 10 mA | MMBTRC418E | $G_I$ | 33 | - | - | - |
| at $V_O$ = 5 V, $I_O$ = 10 mA | MMBTRC419E | | 30 | - | - | - |
| at $V_O$ = 5 V, $I_O$ = 10 mA | MMBTRC420E | | 24 | - | - | - |
| at $V_O$ = 5 V, $I_O$ = 5 mA | MMBTRC421E | | 33 | - | - | - |
| at $V_O$ = 5 V, $I_O$ = 5 mA | MMBTRC422E | | 62 | - | - | - |
| Output Cutoff Current | | | | | | |
| at $V_O$ = 50 V | | $I_{O(OFF)}$ | - | - | 500 | nA |
| Input Current | | | | | | |
| at $V_I$ = 5 V | MMBTRC416E | | - | - | 7.2 | |
| | MMBTRC417E | | - | - | 3.8 | |
| | MMBTRC418E | | - | - | 3.8 | |
| | MMBTRC419E | $I_I$ | - | - | 1.8 | mA |
| | MMBTRC420E | | - | - | 0.88 | |
| | MMBTRC421E | | - | - | 0.16 | |
| | MMBTRC422E | | - | - | 0.15 | |
| Output Voltage | | | | | | |
| at $I_O$ = 10 mA, $I_I$ = 0.5 mA | MMBTRC416E | | - | - | 0.3 | |
| at $I_O$ = 10 mA, $I_I$ = 0.5 mA | MMBTRC417E | | - | - | 0.3 | |
| at $I_O$ = 10 mA, $I_I$ = 0.5 mA | MMBTRC418E | | - | - | 0.3 | |
| at $I_O$ = 10 mA, $I_I$ = 0.5 mA | MMBTRC419E | $V_{O(ON)}$ | - | - | 0.3 | V |
| at $I_O$ = 10 mA, $I_I$ = 0.5 mA | MMBTRC420E | | - | - | 0.3 | |
| at $I_O$ = 10 mA, $I_I$ = 0.5 mA | MMBTRC421E | | - | - | 0.3 | |
| at $I_O$ = 5 mA, $I_I$ = 0.25 mA | MMBTRC422E | | - | - | 0.3 | |
| Input Voltage (ON) | | | | | | |
| at $V_O$ = 0.3 V, $I_O$ = 20 mA | MMBTRC416E | | - | - | 3 | |
| at $V_O$ = 0.3 V, $I_O$ = 20 mA | MMBTRC417E | | - | - | 3 | |
| at $V_O$ = 0.3 V, $I_O$ = 20 mA | MMBTRC418E | | - | - | 3 | |
| at $V_O$ = 0.3 V, $I_O$ = 20 mA | MMBTRC419E | $V_{I(ON)}$ | - | - | 2.5 | V |
| at $V_O$ = 0.3 V, $I_O$ = 2 mA | MMBTRC420E | | - | - | 3 | |
| at $V_O$ = 0.3 V, $I_O$ = 2 mA | MMBTRC421E | | - | - | 5 | |
| at $V_O$ = 0.3 V, $I_O$ = 1 mA | MMBTRC422E | | - | - | 3 | |
| Input Voltage (OFF) | | | | | | |
| at $V_{CC}$ = 5 V, $I_O$ = 100 µA | MMBTRC416E | | 0.3 | - | - | |
| | MMBTRC417E | | 0.5 | - | - | |
| | MMBTRC418E | | 0.3 | - | - | |
| | MMBTRC419E | $V_{I(OFF)}$ | 0.3 | - | - | V |
| | MMBTRC420E | | 0.8 | - | - | |
| | MMBTRC421E | | 1 | - | - | |
| | MMBTRC422E | | 0.5 | - | - | |
| Transition Frequency | | | | | | |
| at $V_O$ = 10 V, $I_O$ = 5 mA | | $f_T$ [1)] | - | 250 | - | MHz |

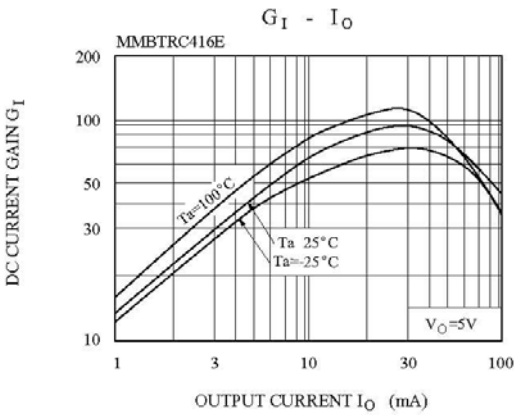
[1)] Characteristic of transistor only.

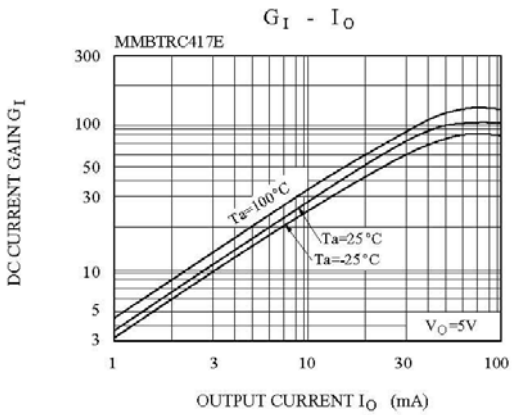

$I_O$ - $V_{I(ON)}$
MMBTRC416E
OUTPUT CURRENT $I_O$ (mA)
100
50
30
10
5
3
1
0.5
0.3
Ta=25°C
Ta=-25°C
Ta=100°C
$V_O$=0.2V
0.1
0.3
1
3
10
INPUT ON VOLTAGE $V_{I(ON)}$ (V)

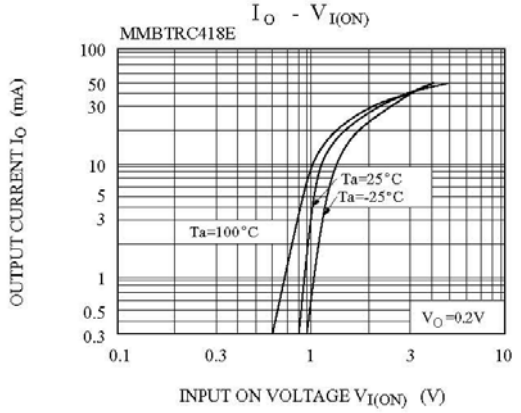

$I_O$ - $V_{I(ON)}$
MMBTRC417E
OUTPUT CURRENT $I_O$ (mA)
100
50
30
10
5
3
1
0.5
0.3
0.1
Ta=25°C
Ta=-25°C
Ta=100°C
$V_O$=0.2V
0.1
0.3
1
3
10
INPUT ON VOLTAGE $V_{I(ON)}$ (V)

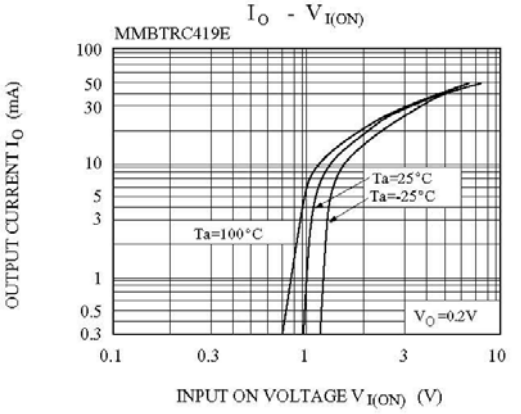

$I_O$ - $V_{I(OFF)}$
MMBTRC416E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)

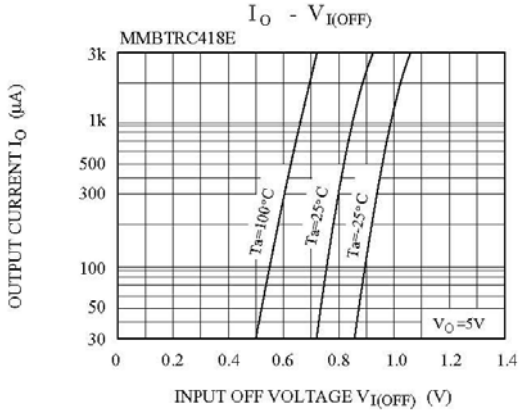

$I_O$ - $V_{I(OFF)}$
MMBTRC417E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
0
0.5
1.0
1.5
2.0
2.5
3.0
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)

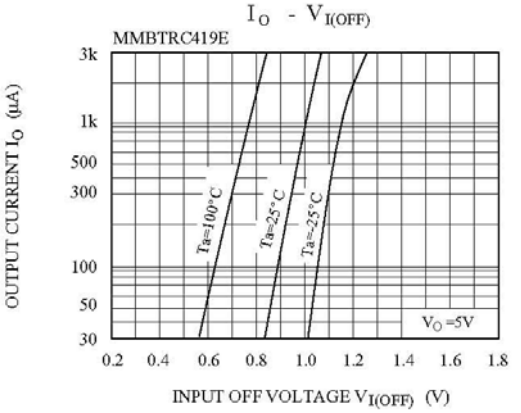

$G_I$ - $I_O$
MMBTRC416E
DC CURRENT GAIN $G_I$
200
100
50
30
10
Ta=100°C
Ta 25°C
Ta=-25°C
$V_O$=5V
1
3
10
30
100
OUTPUT CURRENT $I_O$ (mA)

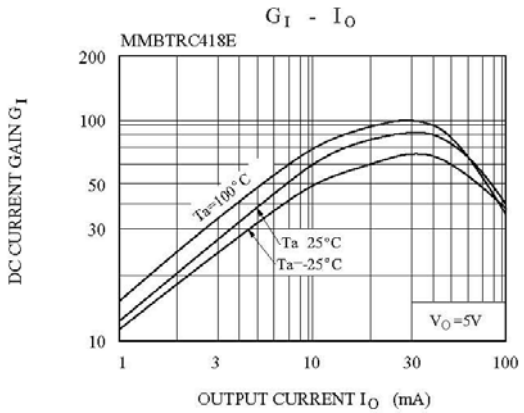

$G_I$ - $I_O$
MMBTRC417E
DC CURRENT GAIN $G_I$
300
100
50
30
10
5
3
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
1
3
10
30
100
OUTPUT CURRENT $I_O$ (mA)

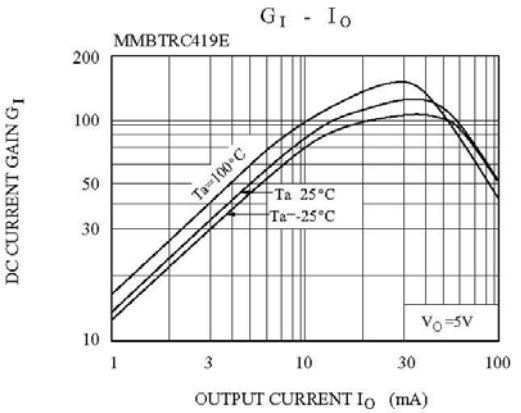

$I_O$ - $V_{I(ON)}$
MMBTRC418E
OUTPUT CURRENT $I_O$ (mA)
100
50
30
10
5
3
1
0.5
0.3
Ta=25°C
Ta=-25°C
Ta=100°C
$V_O$=0.2V
0.1
0.3
1
3
10
INPUT ON VOLTAGE $V_{I(ON)}$ (V)

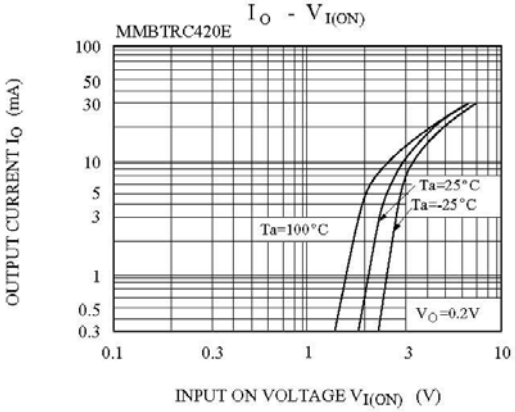

$I_O$ - $V_{I(ON)}$
MMBTRC419E
OUTPUT CURRENT $I_O$ (mA)
100
50
30
10
5
3
1
0.5
0.3
Ta=25°C
Ta=-25°C
Ta=100°C
$V_O$=0.2V
0.1
0.3
1
3
10
INPUT ON VOLTAGE $V_{I(ON)}$ (V)

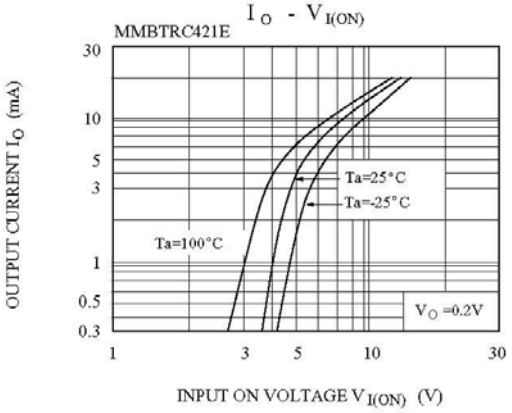

$I_O$ - $V_{I(OFF)}$
MMBTRC418E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)

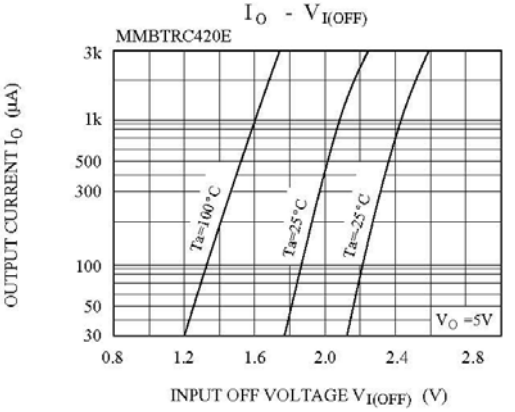

$I_O$ - $V_{I(OFF)}$
MMBTRC419E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)

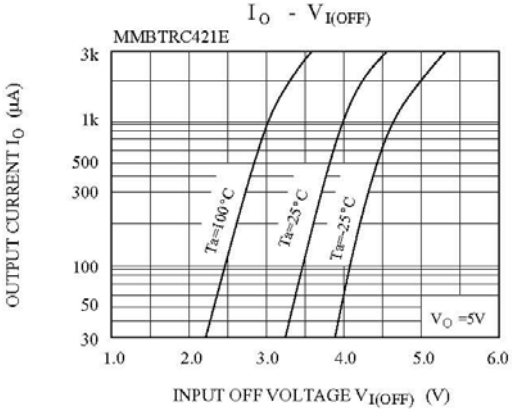

$G_I$ - $I_O$
MMBTRC418E
DC CURRENT GAIN $G_I$
200
100
50
30
10
Ta=100°C
Ta 25°C
Ta=-25°C
$V_O$=5V
1
3
10
30
100
OUTPUT CURRENT $I_O$ (mA)

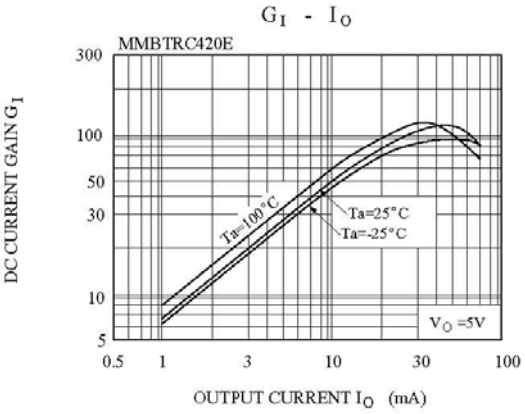

$G_I$ - $I_O$
MMBTRC419E
DC CURRENT GAIN $G_I$
200
100
50
30
10
Ta=100°C
Ta 25°C
Ta=-25°C
$V_O$=5V
1
3
10
30
100
OUTPUT CURRENT $I_O$ (mA)

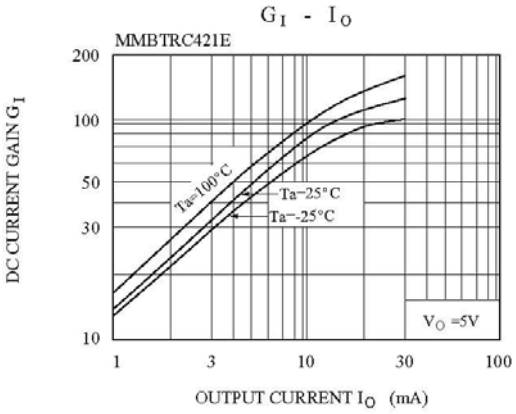

$I_O$ - $V_{I(ON)}$
MMBTRC420E
OUTPUT CURRENT $I_O$ (mA)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.3
1
3
10
Ta=25°C
Ta=-25°C
Ta=100°C
$V_O$=0.2V
INPUT ON VOLTAGE $V_{I(ON)}$ (V)

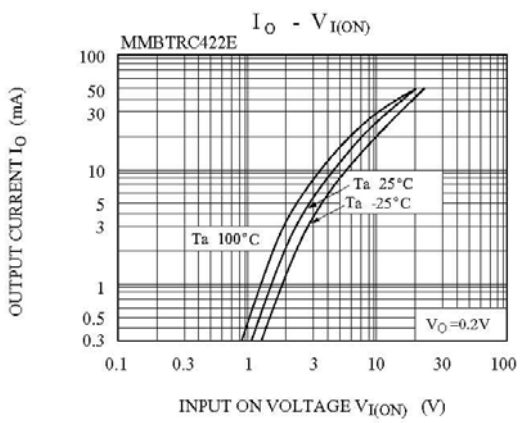

$I_O$ - $V_{I(ON)}$
MMBTRC421E
OUTPUT CURRENT $I_O$ (mA)
30
10
5
3
1
0.5
0.3
1
3
5
10
30
Ta=25°C
Ta=-25°C
Ta=100°C
$V_O$=0.2V
INPUT ON VOLTAGE $V_{I(ON)}$ (V)

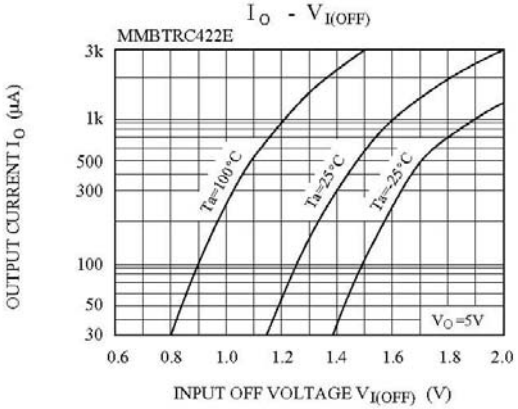

$I_O$ - $V_{I(OFF)}$
MMBTRC420E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
0.8
1.2
1.6
2.0
2.4
2.8
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$ =5V
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)

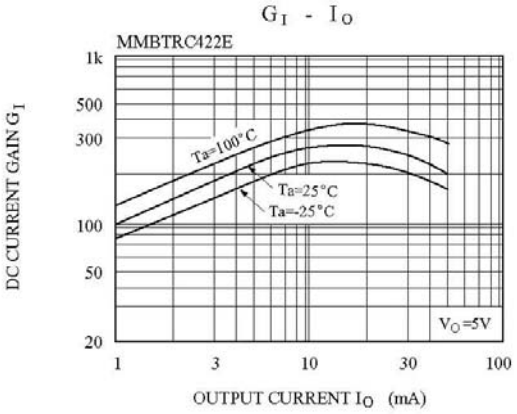

$I_O$ - $V_{I(OFF)}$
MMBTRC421E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
1.0
2.0
3.0
4.0
5.0
6.0
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$ =5V
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)


$G_I$ - $I_O$
MMBTRC420E
DC CURRENT GAIN $G_I$
300
100
50
30
10
5
0.5
1
3
10
30
100
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$ =5V
OUTPUT CURRENT $I_O$ (mA)


$G_I$ - $I_O$
MMBTRC421E
DC CURRENT GAIN $G_I$
200
100
50
30
10
1
3
10
30
100
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$ =5V
OUTPUT CURRENT $I_O$ (mA)


$I_O$ - $V_{I(ON)}$
MMBTRC422E
OUTPUT CURRENT $I_O$ (mA)
100
50
30
10
5
3
1
0.5
0.3
Ta 25°C
Ta -25°C
Ta 100°C
$V_O$=0.2V
0.1
0.3
1
3
10
30
100
INPUT ON VOLTAGE $V_{I(ON)}$ (V)


$I_O$ - $V_{I(OFF)}$
MMBTRC422E
OUTPUT CURRENT $I_O$ (μA)
3k
1k
500
300
100
50
30
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
INPUT OFF VOLTAGE $V_{I(OFF)}$ (V)


$G_I$ - $I_O$
MMBTRC422E
DC CURRENT GAIN $G_I$
1k
500
300
100
50
20
Ta=100°C
Ta=25°C
Ta=-25°C
$V_O$=5V
1
3
10
30
100
OUTPUT CURRENT $I_O$ (mA)