

# Device Modeling Report

COMPONENTS: Digital transistors (built-in resistors)  
PART NUMBER: DTC143ZKA  
MANUFACTURER: ROHM

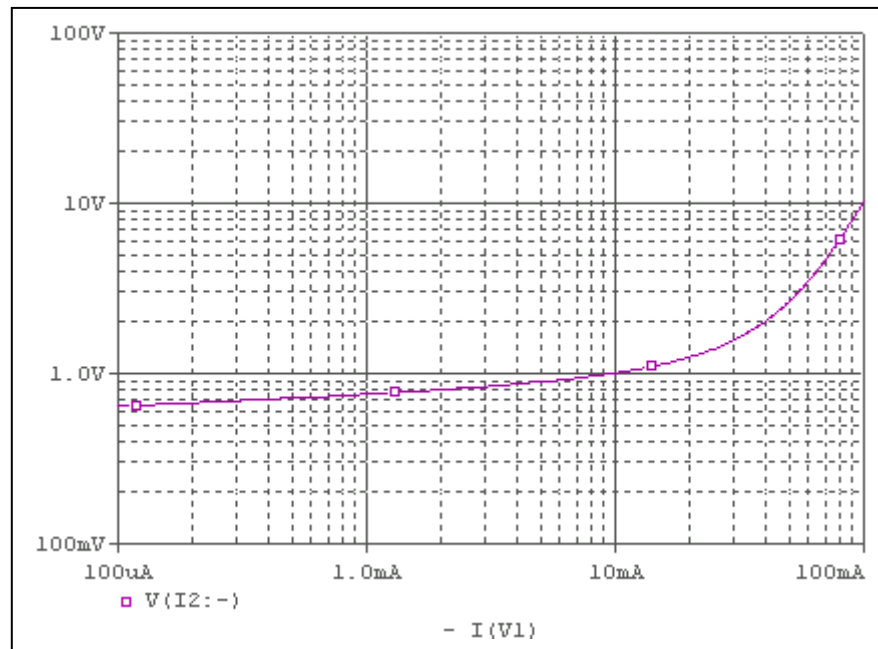


**Bee Technologies Inc.**

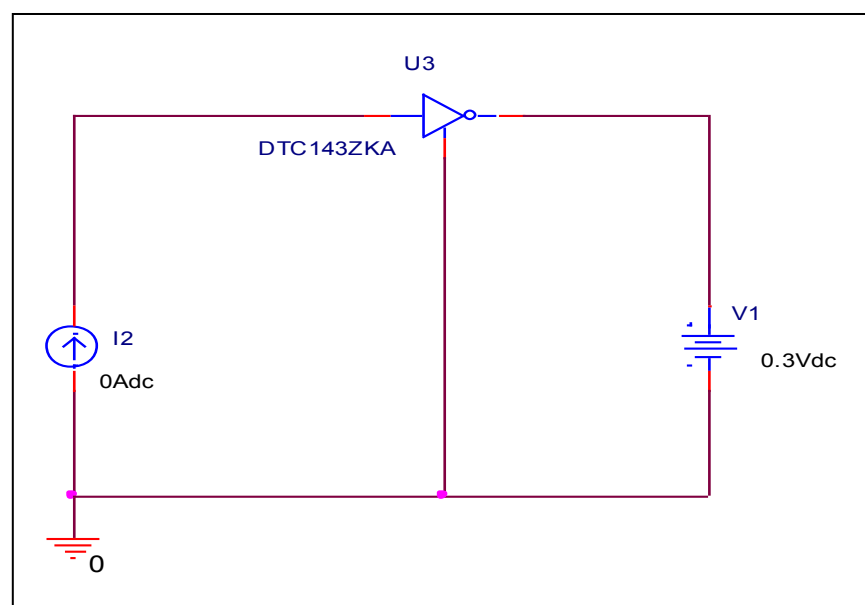
| PSpice model parameter | Model description                                           |
|------------------------|-------------------------------------------------------------|
| IS                     | Saturation Current                                          |
| BF                     | Ideal Maximum Forward Beta                                  |
| NF                     | Forward Current Emission Coefficient                        |
| VAF                    | Forward Early Voltage                                       |
| IKF                    | Forward Beta Roll-off Knee Current                          |
| ISE                    | Non-ideal Base-Emitter Diode Saturation Current             |
| NE                     | Non-ideal Base-Emitter Diode Emission Coefficient           |
| BR                     | Ideal Maximum Reverse Beta                                  |
| NR                     | Reverse Emission Coefficient                                |
| VAR                    | Reverse Early Voltage                                       |
| IKR                    | Reverse Beta Roll-off Knee Current                          |
| ISC                    | Non-ideal Base-Collector Diode Saturation Current           |
| NC                     | Non-ideal Base-Collector Diode Emission Coefficient         |
| NK                     | Forward Beta Roll-off Slope Exponent                        |
| RE                     | Emitter Resistance                                          |
| RB                     | Base Resistance                                             |
| RC                     | Series Collector Resistance                                 |
| CJE                    | Zero-bias Emitter-Base Junction Capacitance                 |
| VJE                    | Emitter-Base Junction Potential                             |
| MJE                    | Emitter-Base Junction Grading Coefficient                   |
| CJC                    | Zero-bias Collector-Base Junction Capacitance               |
| VJC                    | Collector-base Junction Potential                           |
| MJC                    | Collector-base Junction Grading Coefficient                 |
| FC                     | Coefficient for Onset of Forward-bias Depletion Capacitance |
| TF                     | Forward Transit Time                                        |
| XTF                    | Coefficient for TF Dependency on Vce                        |
| VTF                    | Voltage for TF Dependency on Vce                            |
| ITF                    | Current for TF Dependency on Ic                             |
| PTF                    | Excess Phase at $f=1/2\pi \cdot TF$                         |
| TR                     | Reverse Transit Time                                        |
| EG                     | Activation Energy                                           |
| XTB                    | Forward Beta Temperature Coefficient                        |
| XTI                    | Temperature Coefficient for IS                              |

## Input voltage vs. output current (ON characteristics)

### Circuit simulation result

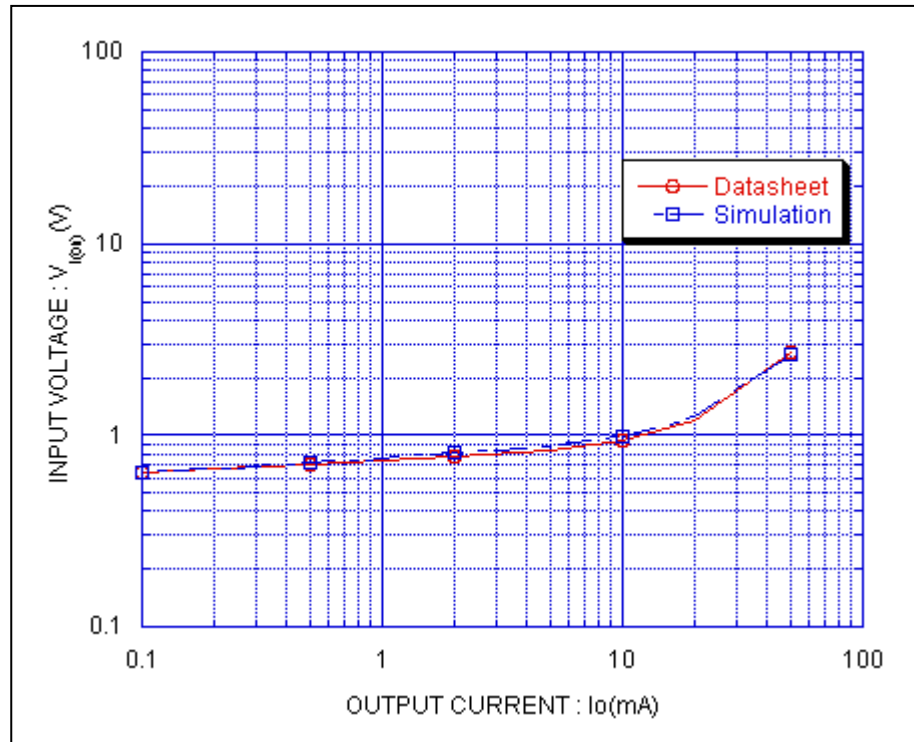


### Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



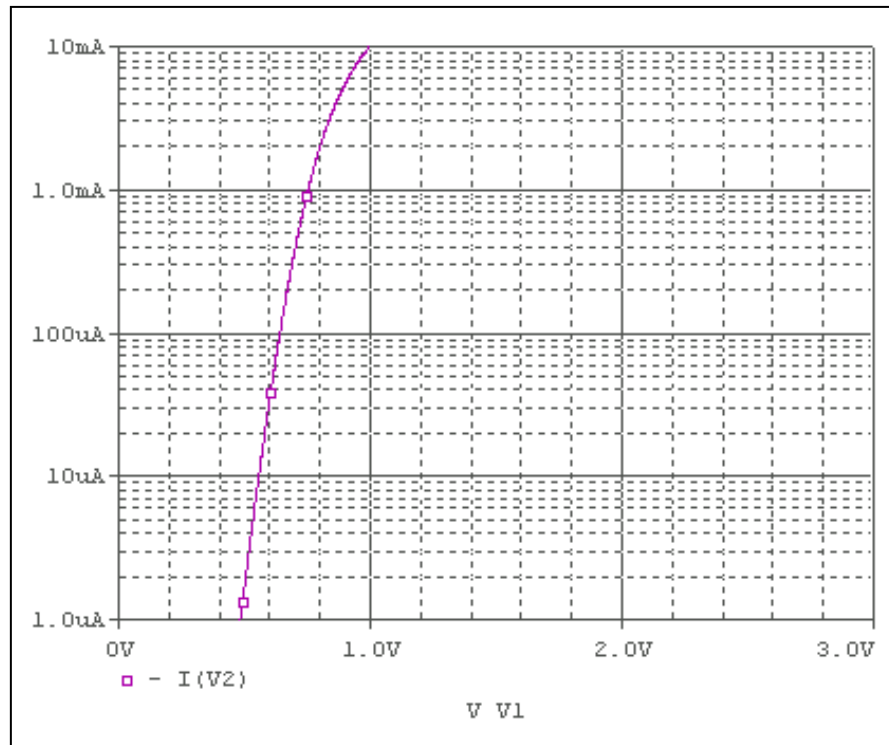
### Simulation Result

Condition @  $V_O = 0.3$  V

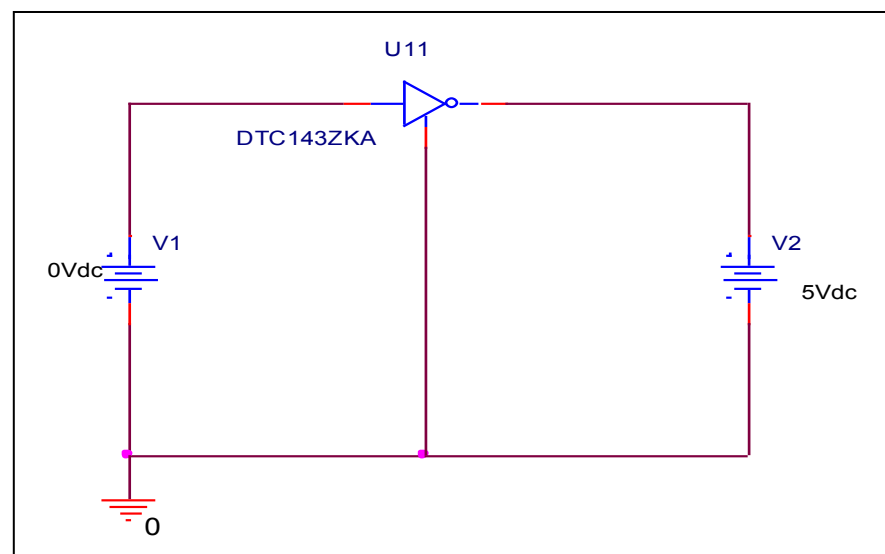
| $I_O$ (A) | $V_{I(ON)}$ (V) |            | Error (%) |
|-----------|-----------------|------------|-----------|
|           | Datasheet       | Simulation |           |
| 100u      | 0.64            | 0.646      | 0.937     |
| 200u      | 0.67            | 0.672      | 0.298     |
| 500u      | 0.71            | 0.716      | 0.845     |
| 1m        | 0.74            | 0.755      | 2.027     |
| 2m        | 0.77            | 0.804      | 4.415     |
| 5m        | 0.83            | 0.87       | 4.819     |
| 10m       | 0.94            | 0.98       | 4.255     |
| 20m       | 1.2             | 1.25       | 4.166     |
| 50m       | 2.7             | 2.64       | -2.222    |

## Output current vs. input voltage (OFF characteristics)

Circuit simulation result

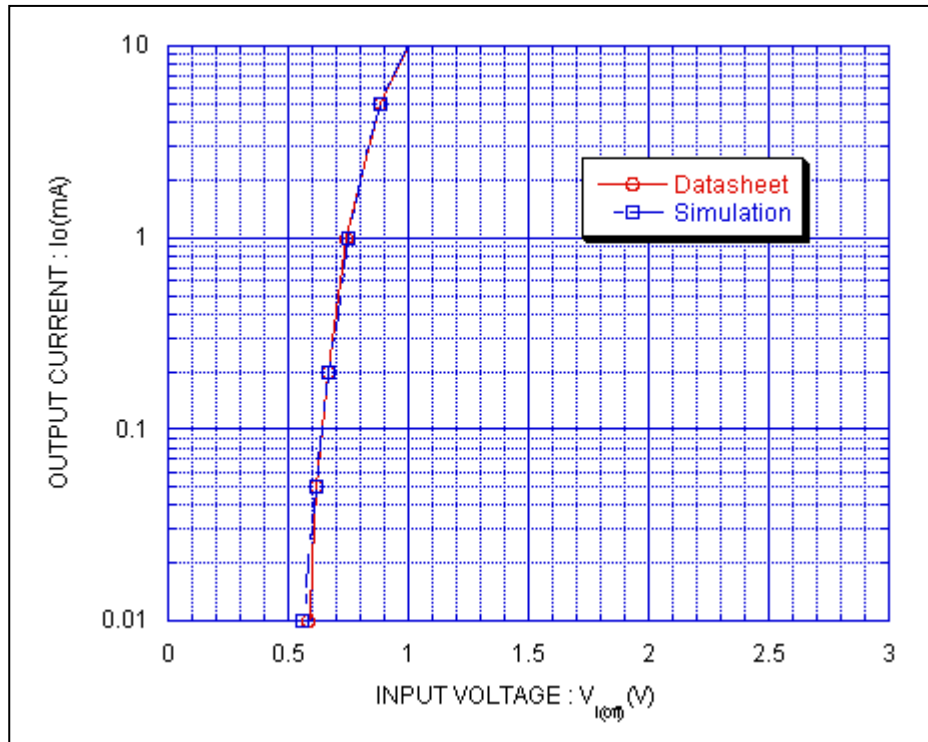


Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



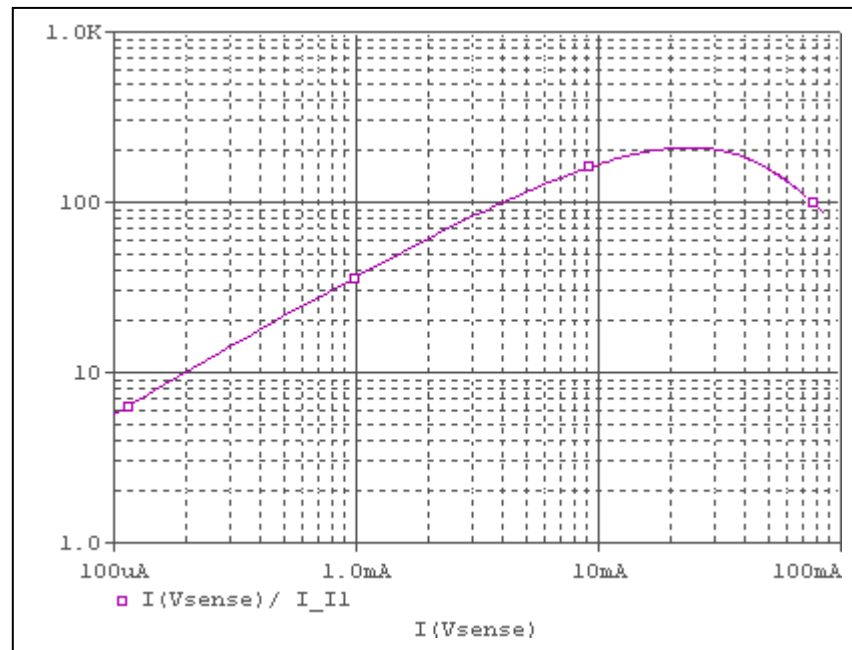
### Simulation Result

Condition @  $V_{CC} = 5\text{ V}$

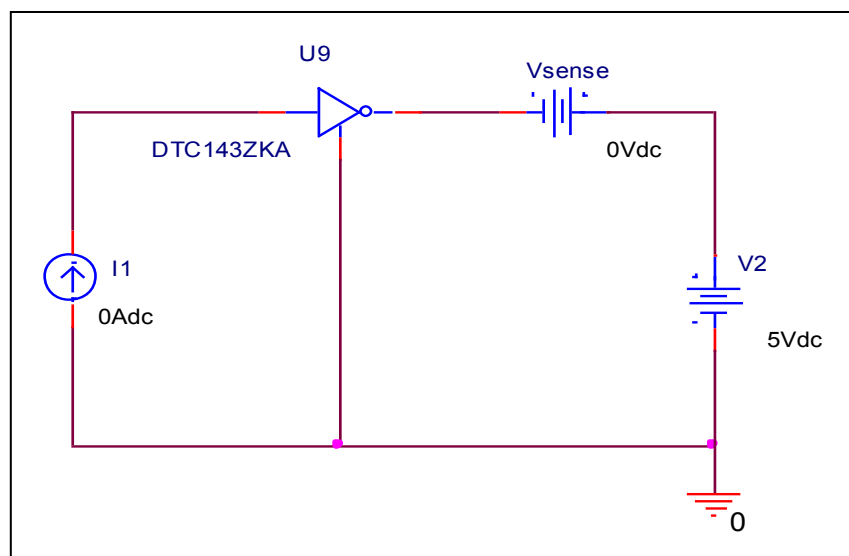
| $I_o(\text{A})$ | $V_{l(off)} (\text{V})$ |            | Error (%) |
|-----------------|-------------------------|------------|-----------|
|                 | Datasheet               | Simulation |           |
| 10u             | 0.58                    | 0.556      | -4.137    |
| 20u             | 0.6                     | 0.582      | -3        |
| 50u             | 0.62                    | 0.614      | -0.967    |
| 100u            | 0.64                    | 0.64       | 0         |
| 200u            | 0.67                    | 0.67       | 0         |
| 500u            | 0.71                    | 0.713      | 0.422     |
| 1m              | 0.74                    | 0.752      | 1.621     |
| 2m              | 0.8                     | 0.8        | 0         |
| 5m              | 0.88                    | 0.886      | 0.681     |
| 10m             | 1                       | 0.998      | -0.2      |

## DC current gain vs. output current

Circuit simulation result

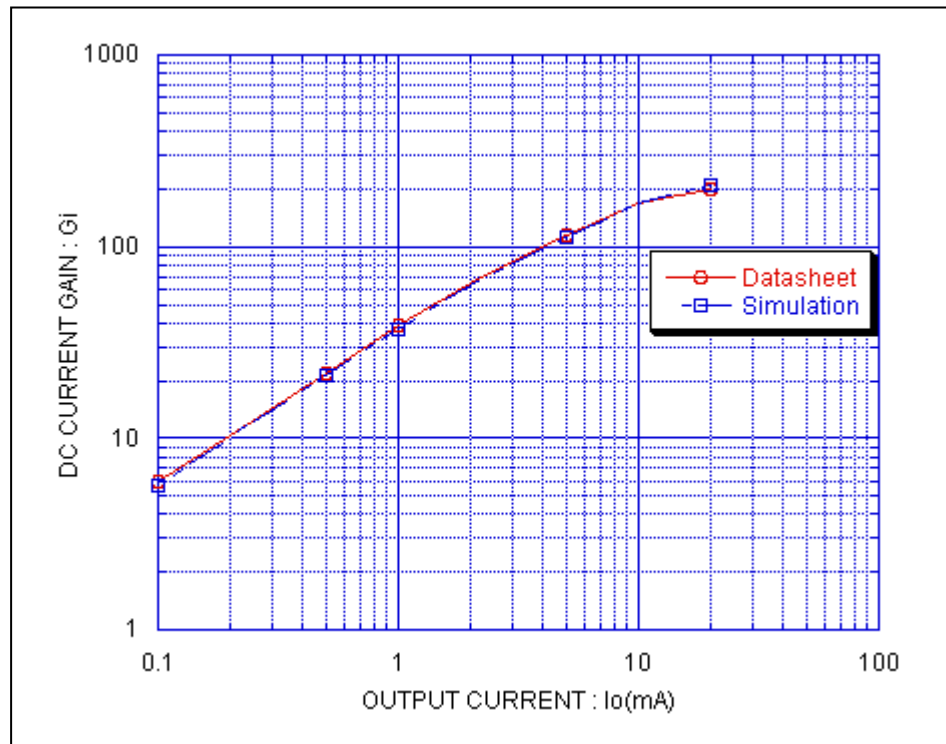


Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



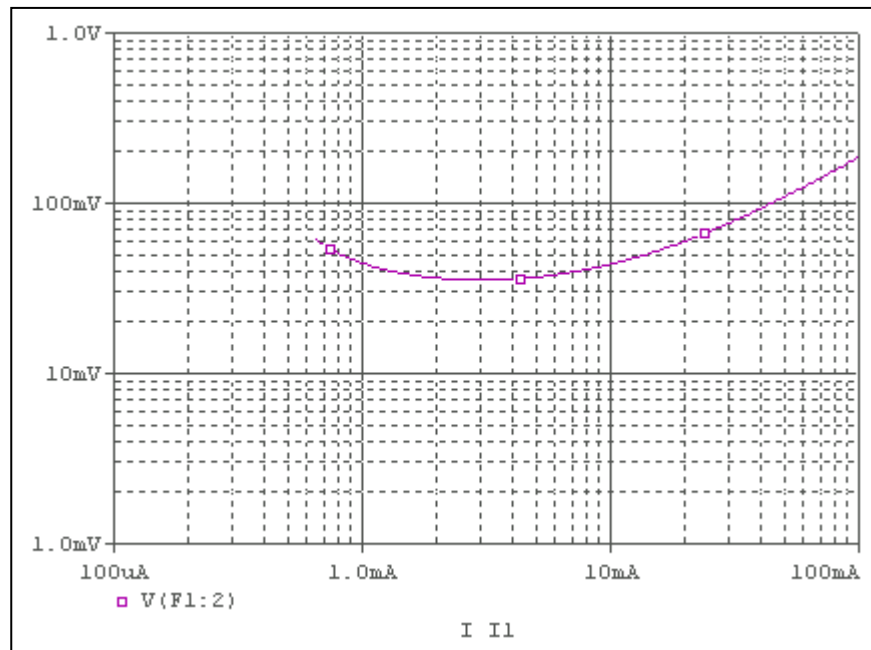
### Simulation Result

Condition @  $V_{CC} = 5V$

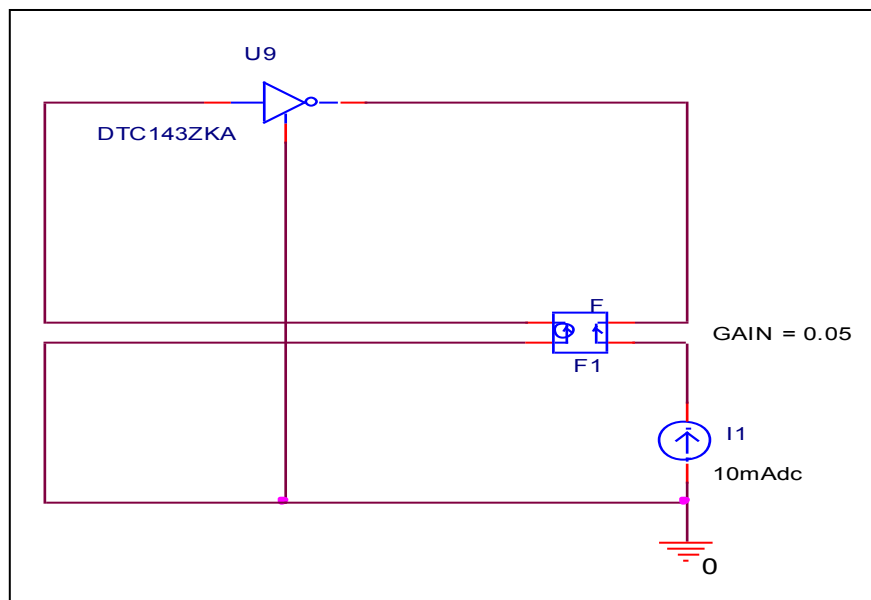
| $I_o(A)$ | $V_{I(Off)} (V)$ |            | Error (%) |
|----------|------------------|------------|-----------|
|          | Datasheet        | Simulation |           |
| 100u     | 5.9              | 5.65       | -4.237    |
| 200u     | 10.4             | 10.14      | -2.5      |
| 500u     | 22               | 21.3       | -3.181    |
| 1m       | 38.5             | 36.6       | -4.935    |
| 2m       | 65               | 62.62      | -3.661    |
| 5m       | 115              | 113        | -1.739    |
| 10m      | 170              | 167        | -1.764    |
| 20m      | 200              | 207        | 3.5       |

## Output voltage VS. output current

Circuit simulation result

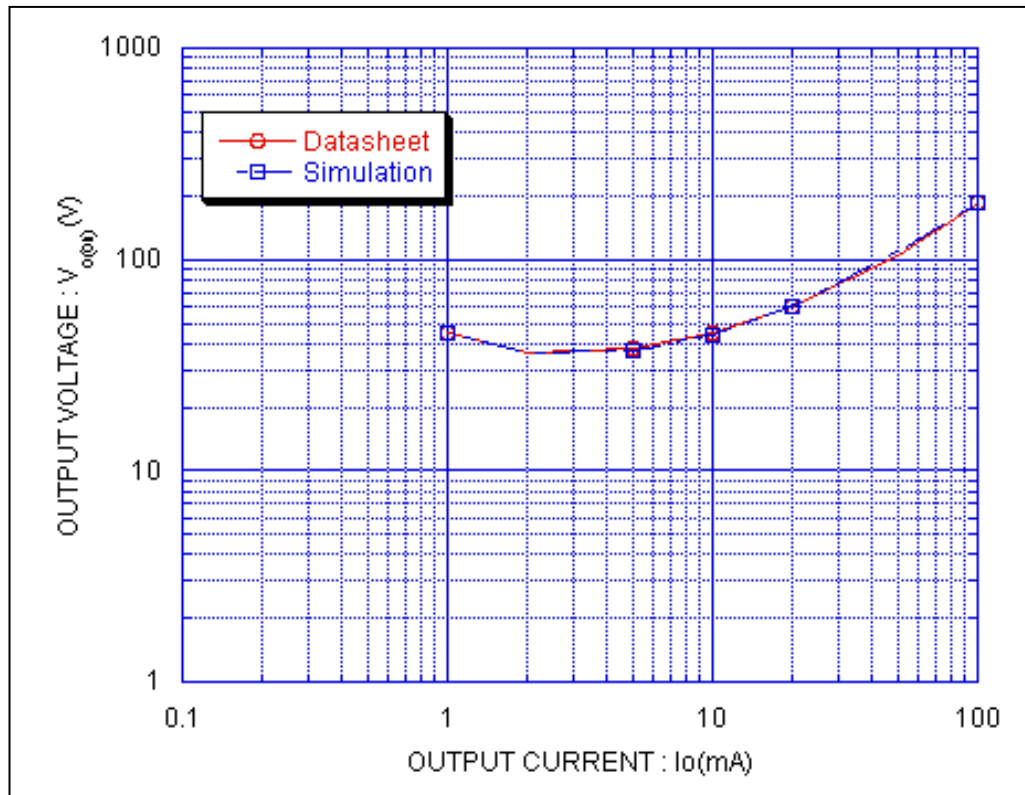


Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



### Simulation Result

Condition @  $I_o/I_I = 20$

| $I_o$ (A) | $V_{I(off)}$ (mV) |            | Error (%) |
|-----------|-------------------|------------|-----------|
|           | Datasheet         | Simulation |           |
| 1m        | 45                | 44.42      | -1.288    |
| 2m        | 36                | 36.37      | 1.027     |
| 5m        | 38                | 36.8       | -3.157    |
| 10m       | 45                | 43.81      | -2.644    |
| 20m       | 60                | 60         | 0         |
| 50m       | 105               | 109        | 3.809     |
| 100m      | 185               | 186        | 0.54      |