

# Device Modeling Report

COMPONENTS: Digital transistors (built-in resistors)  
PART NUMBER: DTC124XKA  
MANUFACTURER: ROHM

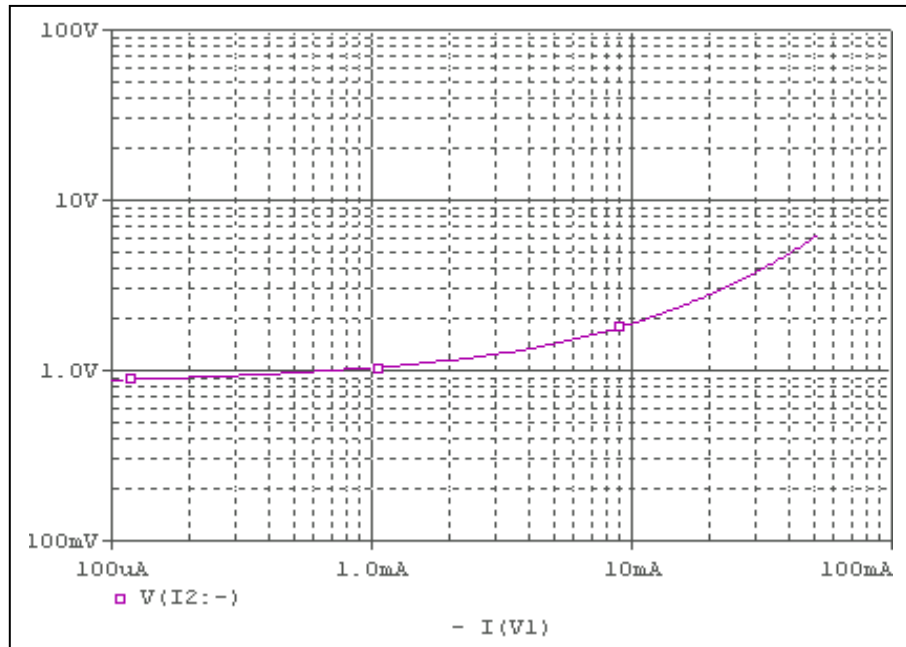


**Bee Technologies Inc.**

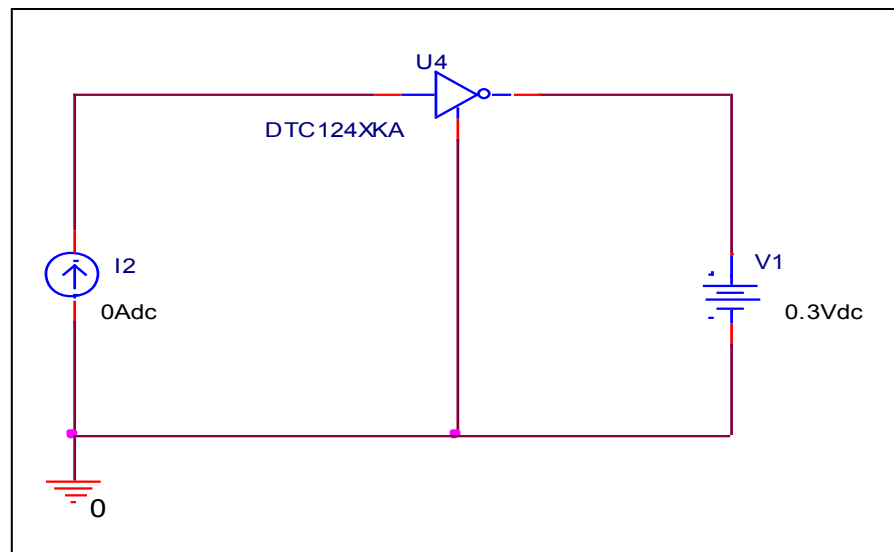
| PSpice model parameter | Model description   |
|------------------------|---|
| IS                     | Saturation Current  |
| BF                     | Ideal Maximum Forward Beta                                  |
| NF                     | Forward Current Emission Coefficient                        |
| 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 $f=1/2\pi*TF$                               |
| 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

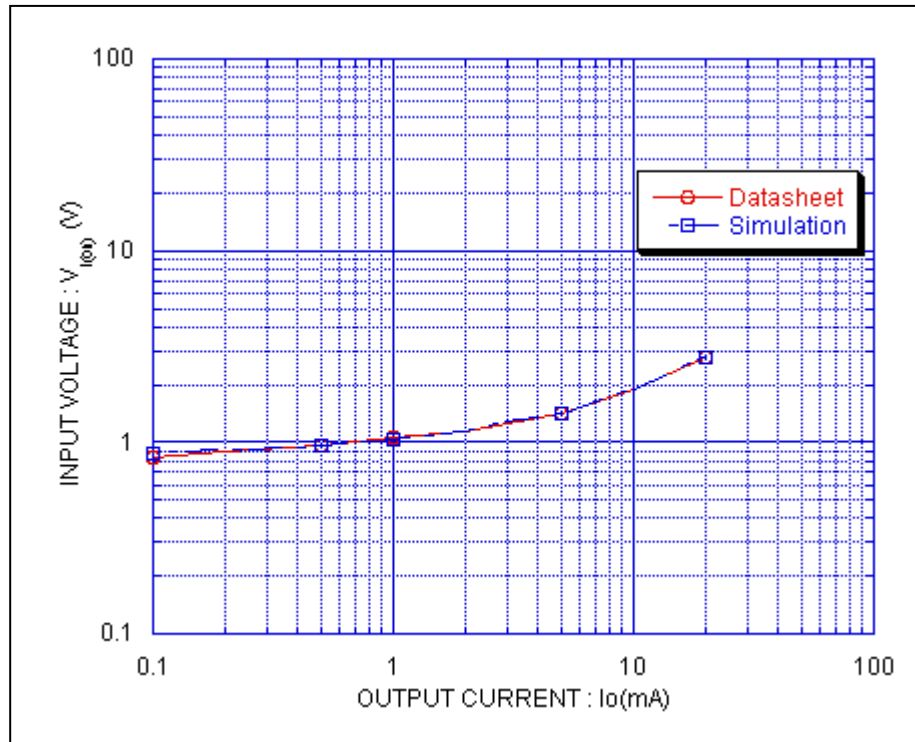


### Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



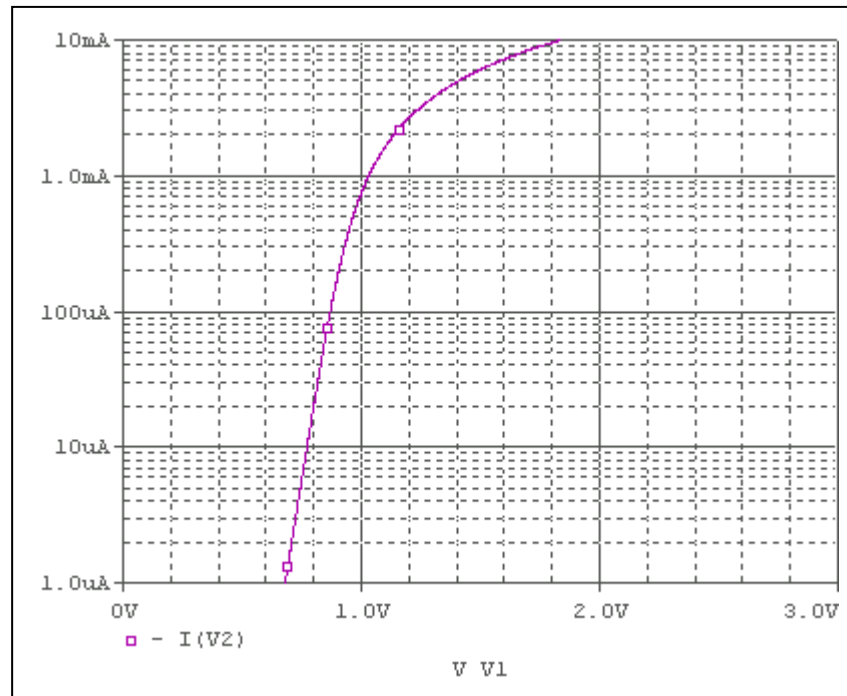
### Simulation Result

Condition @  $V_o = 0.3$  V

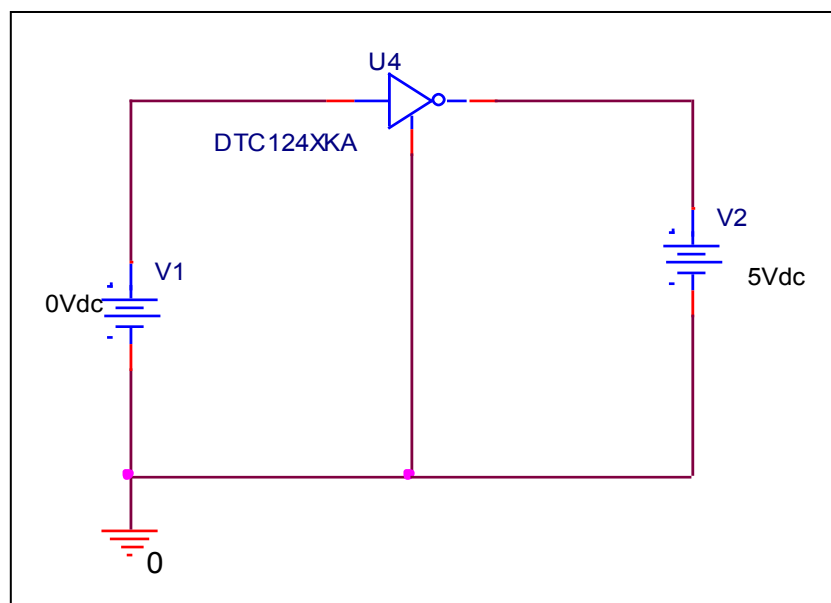
| $I_o$ (A) | $V_{I(ON)}$ (V) |            | Error (%) |
|-----------|-----------------|------------|-----------|
|           | Datasheet       | Simulation |           |
| 100u      | 0.84            | 0.872      | 3.809     |
| 200u      | 0.89            | 0.907      | 1.91      |
| 500u      | 0.96            | 0.969      | 0.937     |
| 1m        | 1.05            | 1.03       | -1.904    |
| 2m        | 1.15            | 1.14       | -0.869    |
| 5m        | 1.4             | 1.43       | 2.142     |
| 10m       | 1.9             | 1.88       | -1.052    |
| 20m       | 2.8             | 2.8        | 0         |

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

### Circuit simulation result

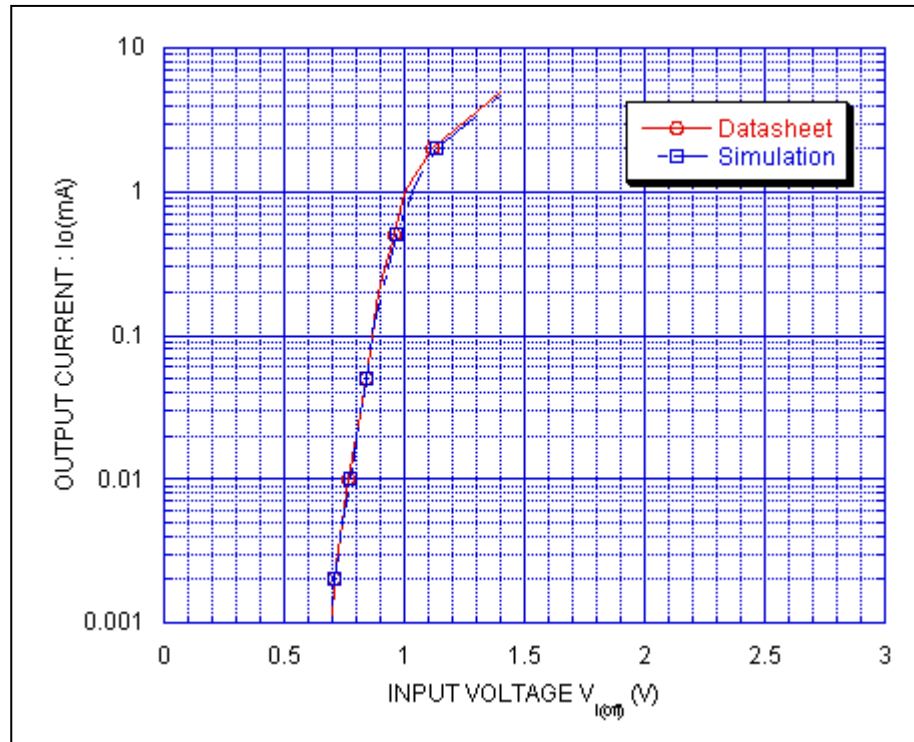


### Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



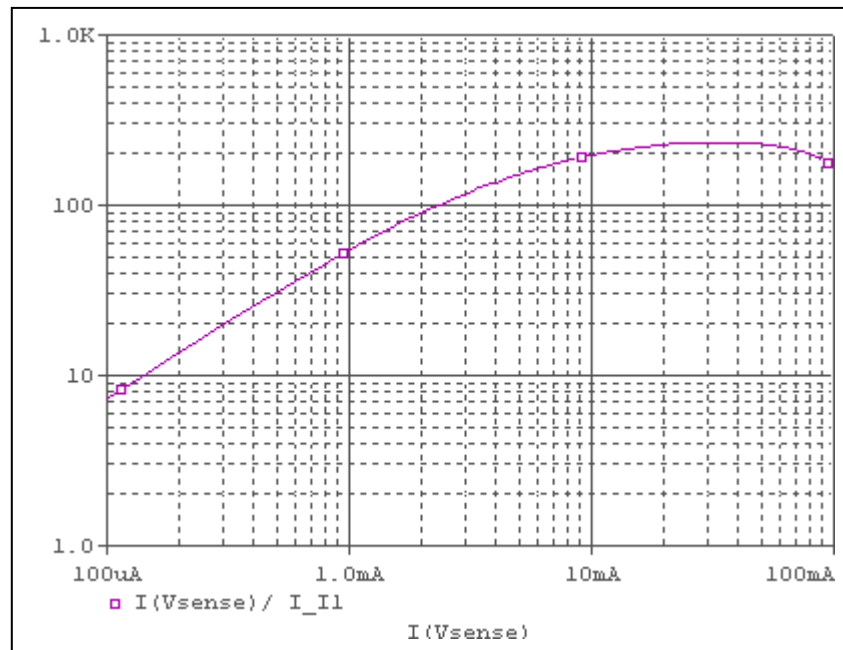
### Simulation Result

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

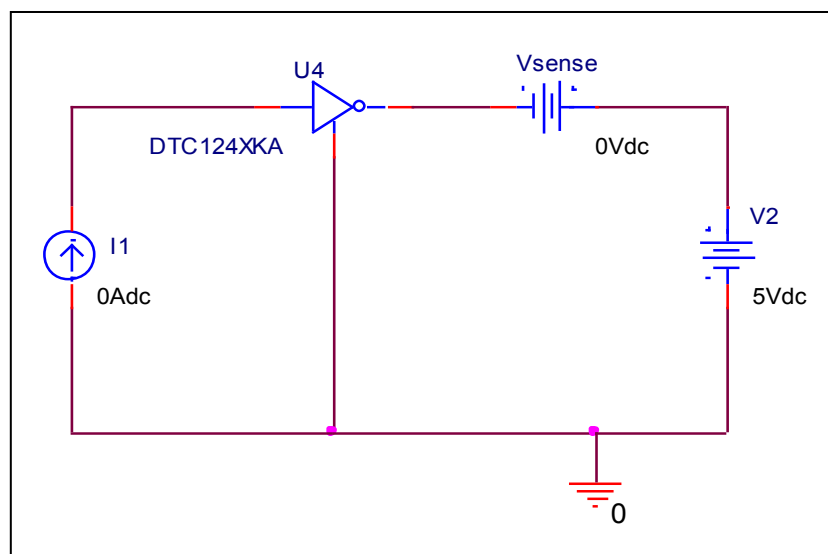
| $I_o$ (A) | $V_{I(off)}$ (V) |            | Error (%) |
|-----------|------------------|------------|-----------|
|           | Datasheet        | Simulation |           |
| 1u        | 0.69             | 0.68       | -1.449    |
| 2u        | 0.71             | 0.707      | -0.422    |
| 5u        | 0.74             | 0.743      | 0.405     |
| 10u       | 0.77             | 0.772      | 0.259     |
| 20u       | 0.8              | 0.8        | 0         |
| 50u       | 0.84             | 0.839      | -0.119    |
| 100u      | 0.87             | 0.869      | -0.114    |
| 200u      | 0.89             | 0.907      | 1.91      |
| 500u      | 0.96             | 0.964      | 0.416     |
| 1m        | 1                | 1.03       | 3         |
| 2m        | 1.12             | 1.13       | 0.892     |
| 5m        | 1.4              | 1.414      | 1         |

## DC current gain vs. output current

### Circuit simulation result

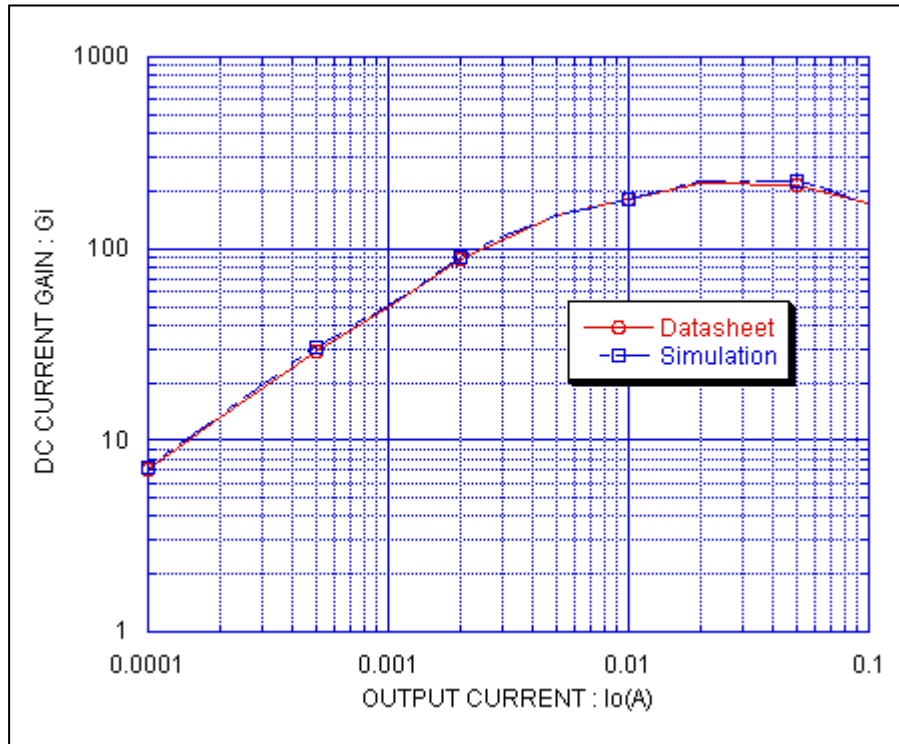


### Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



### Simulation Result

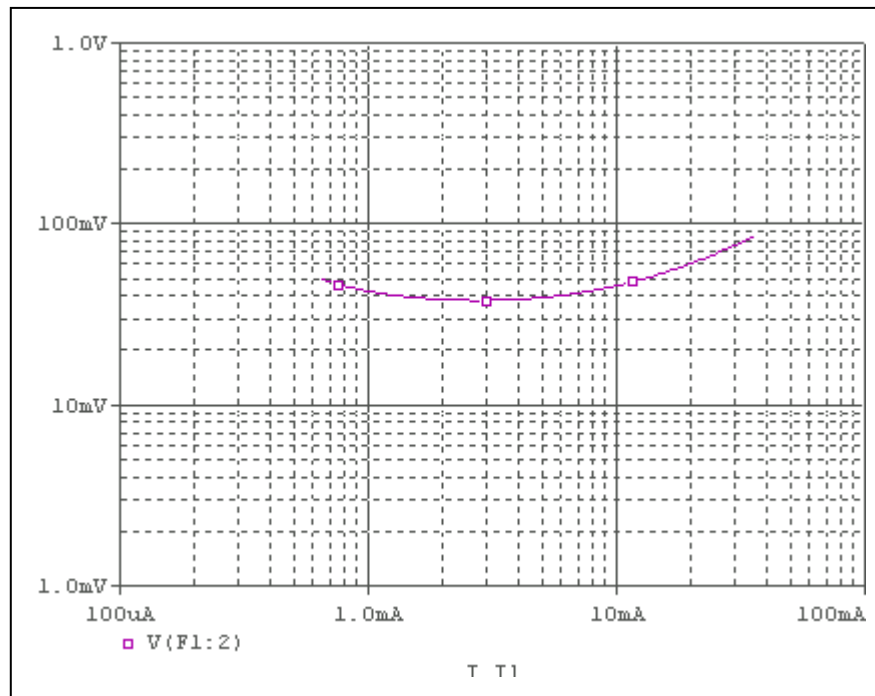
Condition @  $V_{CC} = 5V$

| Io(A) | $V_{I(Off)}$ (V) |            | Error (%) |
|-------|------------------|------------|-----------|
|       | Datasheet        | Simulation |           |
| 100u  | 7                | 7.25       | 3.571     |
| 200u  | 13               | 13.41      | 3.153     |
| 500u  | 29               | 30.22      | 4.206     |
| 1m    | 49               | 50.61      | 3.285     |
| 2m    | 87               | 90.51      | 4.034     |
| 5m    | 150              | 151.12     | 0.746     |
| 10m   | 170              | 169.19     | -0.476    |
| 20m   | 220              | 226.88     | 3.127     |
| 50m   | 215              | 223.48     | 3.944     |
| 100m  | 170              | 167.43     | -1.511    |

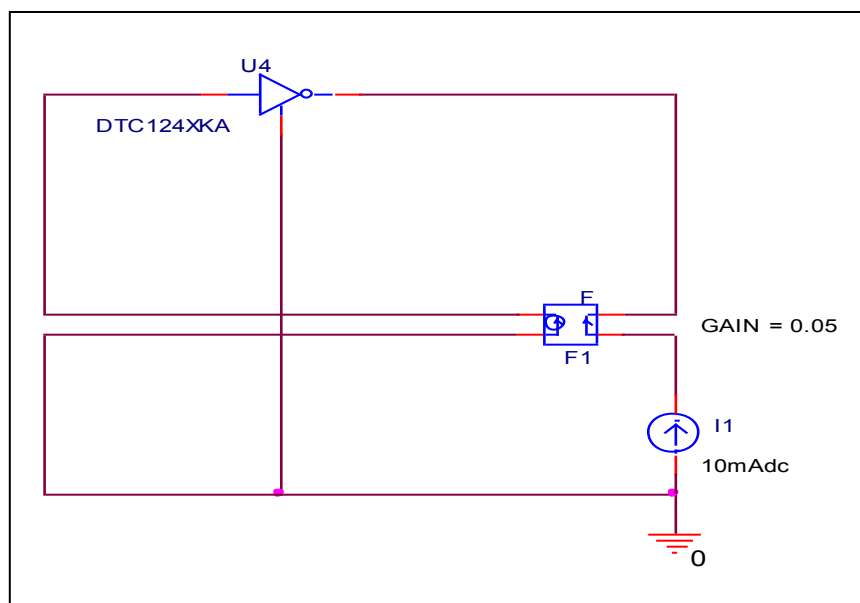


## Output voltage VS. output current

### Circuit simulation result

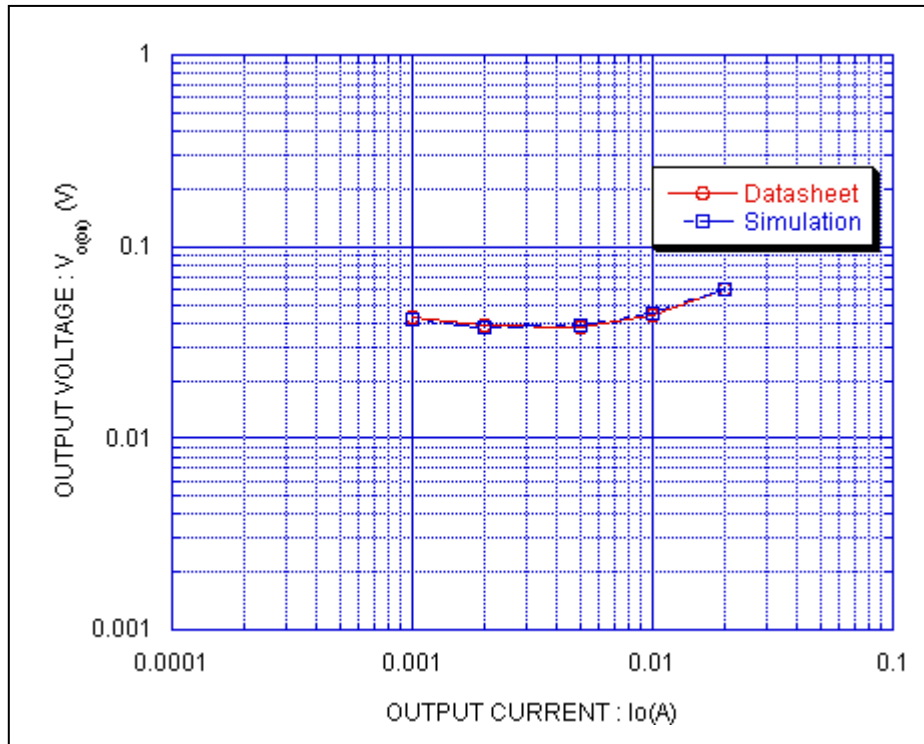


### Evaluation circuit



## Comparison Graph

### Circuit Simulation Result



### Simulation Result

Condition @  $I_o/I_i = 20$

| $I_o$ (A) | $V_{I(off)}$ (mV) |            | Error (%) |
|-----------|-------------------|------------|-----------|
|           | Datasheet         | Simulation |           |
| 1m        | 0.043             | 0.042      | -2.325    |
| 2m        | 0.039             | 0.038      | -2.564    |
| 5m        | 0.038             | 0.039      | 2.631     |
| 10m       | 0.044             | 0.045      | 2.272     |
| 20m       | 0.06              | 0.06       | 0         |