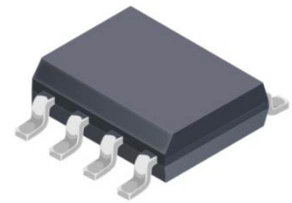
The MCS108K series of current sensors is suitable for all markets, including automotive, industrial, commercial, and communication system applications, and the current sensing of AC and DC provides a smaller, more cost-effective solution with multiple output modes.

Features and Benefits

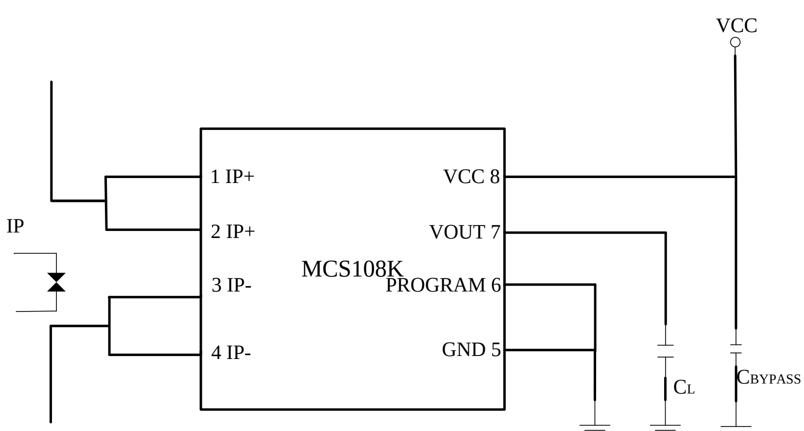


- Open-loop current sensor using Hall effect IC
- Single 3.3V supply
- Support unidirectional, bidirectional output,
- Analog signal output
- Current detection range: ±10A - ±50A
- Operating temperature range：-40℃ to +125℃
- QVO (Zero current output)：
  -xR：QVO ratiometric to supply voltage V_{CC}，Fixed Gain $V_{QVO}=V_{CC}/2$ or $V_{CC}/10$
- Differential Hall sensor, good accuracy, linearity and temperature drift
- Low internal resistance, can effectively control the heat dissipation and power consumption

Application

- EV/HEV motor controller
- frequency converters
- DC/DC

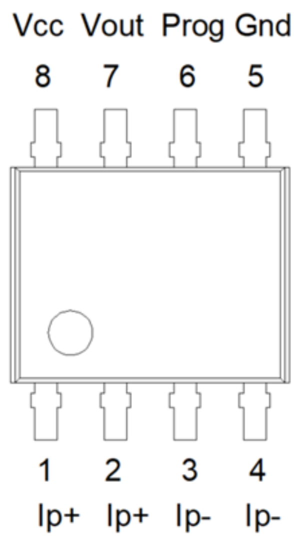
Typical Application Circuit



**Vcc BYPASS capacitor must be close to device Vcc pin*

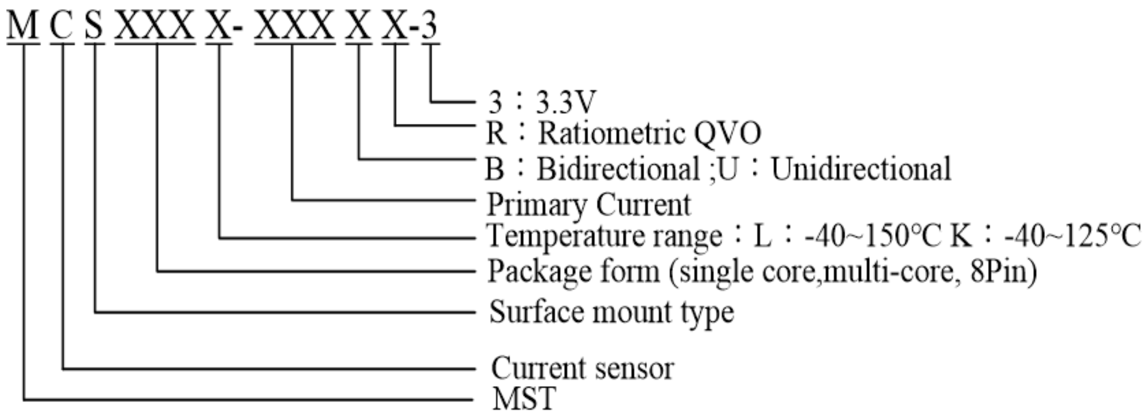
**Vout BYPASS capacitor must be close to device Vout pin*

Pin diagram



Pin number	name	description
1,2	IP+	Positive terminals for current being sensed(enter)
3,4	IP-	Negative terminals for current being sensed(out)
5	GND	Ground terminal
6	PROGRAM	Factory calibrated feet (grounded recommended)
7	VOUT	Analog output
8	VCC	Power supply terminal

Ordering Information



Part Number	QVO $V_{OUT(Q)}$ (V)	Primary Current I_P (A)	Sensitivity $Sens_{(Typ.)}$ (mV/A)	TA (℃)	MPQ (PCS)
MCS108K-010BR-3	$V_{CC}/2$	±10	132	-40~125	1000
MCS108K-020BR-3	$V_{CC}/2$	±20	66	-40~125	1000
MCS108K-020UR-3	$V_{CC}/10$	20	132	-40~125	1000
MCS108K-030BR-3	$V_{CC}/2$	±30	44	-40~125	1000
MCS108K-030UR-3	$V_{CC}/10$	30	88	-40~125	1000
MCS108K-050BR-3	$V_{CC}/2$	±50	26.4	-40~125	1000
MCS108K-050UR-3	$V_{CC}/10$	50	52.8	-40~125	1000

**Please contact factory for currents other than standard current specifications*

Absolute Maximum Ratings

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{CC}	-0.3 to 4.6	V
Supply Current	I_{CC}	20	mA
Output Voltage/ Reference voltage	V_{OUT}	0.15 to V_{CC}-0.15	V
Output Current	I_{OUT}	±40	mA
Operating Temperature	T_A	-40 to 125	℃
Max Junction Temperature	T_J	165	℃
Storage Temperature	T_S	-55 to 150	℃

Electrical Specifications

Dc operating parameters at VCC = 3.3V (unless otherwise stated), TA within the specified temperature range.

<table>
<tr><th>Parameter</th><th>Symbol</th><th colspan="2">Condition</th><th>Min</th><th>Typ.</th><th>Max</th><th>Unit</th></tr>
<tr><td>Supply Voltage</td><td>V_{CC}</td><td colspan="2"></td><td>3.0</td><td>3.3</td><td>3.6</td><td>V</td></tr>
<tr><td>Supply Current</td><td>I_{CC}</td><td colspan="2">$R_L \geq 10K\Omega$</td><td></td><td>16</td><td></td><td>mA</td></tr>
<tr><td>Power on Delay</td><td>T_{PO}</td><td colspan="2">T_A=25℃</td><td></td><td></td><td>1000</td><td>μs</td></tr>
<tr><td>QVO Ratiometric Error (-R)</td><td>E_r</td><td colspan="2"></td><td>-0.3</td><td></td><td>0.3</td><td>%</td></tr>
<tr><td rowspan="2">Zero Current Output Voltage</td><td rowspan="2">V_{QVO}</td><td>MCS108K-xxxBR-3</td><td rowspan="4">T_A = 25℃</td><td colspan="3">$V_{CC}/2$</td><td rowspan="4">V</td></tr>
<tr><td>MCS108K-xxxUR-3</td><td colspan="3">$V_{CC}/10$</td></tr>
<tr><td rowspan="2">Output voltage Range @I_P</td><td rowspan="2">V_{OUT}-V_{QVO}</td><td>MCS108K-xxxBR-3</td><td colspan="3">±1.32</td></tr>
<tr><td>MCS108K-xxxUR-3</td><td colspan="3">2.64</td></tr>
<tr><td>Output Load Resistance</td><td>R_L</td><td colspan="2">V_{OUT} to V_{CC} or GND</td><td>5</td><td></td><td></td><td>KΩ</td></tr>
<tr><td>Output Load Capacitance</td><td>C_L</td><td colspan="2">V_{OUT} TO GND</td><td></td><td></td><td>10</td><td>nF</td></tr>
<tr><td>Response Time</td><td>$t_{RESPONSE}$</td><td colspan="2">T_A=25℃, C_L=1nF, I_P step=50% of I_{P+}, 90% input to 90% output</td><td></td><td>1</td><td></td><td>μs</td></tr>
<tr><td>Internal Bandwidth</td><td>BW</td><td colspan="2">Small signal –3dB, C_L=1nF, T_A=25℃</td><td></td><td>0.7</td><td>1</td><td>MHz</td></tr>
<tr><td>DC Output Impedance</td><td>R_{OUT}</td><td colspan="2">T_A = 25℃</td><td></td><td></td><td>20</td><td>KΩ</td></tr>
</table>

Isolation Characteristics

<table>
<tr><th>Characteristic</th><th>Symbol</th><th>Notes</th><th>Rating</th><th>Unit</th></tr>
<tr><td>Dielectric Strength Test Voltage</td><td>V_{ISO}</td><td>Agency type-tested for 60 seconds per UL standard 60950-1, 2nd Edition</td><td>2400</td><td>VAC</td></tr>
<tr><td rowspan="2">Working Voltage for Basic Isolation</td><td rowspan="2">V_{WFSI}</td><td rowspan="2">According to UL Standard 60950-1 2nd Edition, Basic (Single) Isolation</td><td>420</td><td>VDC or V_{pk}</td></tr>
<tr><td>297</td><td>V_{rms}</td></tr>
<tr><td>Electrical distance</td><td>D_{CL}</td><td>Minimum distance from IP pin to signal pin (air)</td><td>4.2</td><td>mm</td></tr>
<tr><td>Creepage distance</td><td>D_{CR}</td><td>Minimum distance from IP pin to signal pin (plastic body)</td><td>4.2</td><td>mm</td></tr>
</table>

**1 ：60-second test is only for UL test; Tested in production against UL60950-1 2nd Edition*

MCS108K-010BR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃, unless other wise specified

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		-10		10	A
Sensitivity	$Sens_{TA}$	@V_{CC}=3.3V		132		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/2		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A， T_A=25℃	-10	±5	10	mV
		I_P=0A， T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=–40℃~25℃		±3		%

MCS108K-020BR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃, unless other wise specified

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		-20		20	A
Sensitivity	$Sens_{TA}$	@V_{CC}=3.3V		66		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/2		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A， T_A=25℃	-10	±5	10	mV
		I_P=0A， T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=–40℃~25℃		±3		%

MCS108K-020UR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃, unless other wise specified

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		0		20	A
Sensitivity	$Sens_{TA}$	@V_{CC}=3.3V		132		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/10		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A，T_A=25℃	-10	±5	10	mV
		I_P=0A，T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=–40℃~25℃		±3		%

MCS108K-030BR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃,unless otherwise specified

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		-30		30	A
Sensitivity	$Sens_{TA}$	@V_{CC}=3.3V		44		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/2		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A，T_A=25℃	-10	±5	10	mV
		I_P=0A，T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=-40°C~25°C		±3		%

MCS108K-030UR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃,unless otherwise specified

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		0		30	A
Sensitivity	$Sens_{TA}$	@V_{CC}=3.3V		88		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/10		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A，T_A=25℃	-10	±5	10	mV
		I_P=0A，T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=–40℃~25℃		±3		%

MCS108K-050BR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃,unless otherwise specified

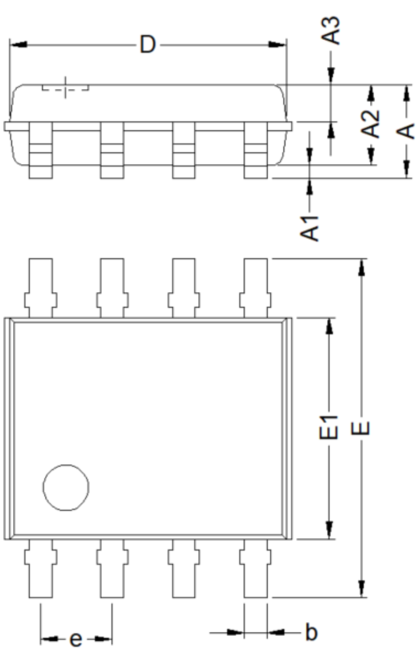
Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		-50		50	A
Sensitivity	$Sens_{TA}$	@V_{CC}=5.0V		26.4		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/2		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A，T_A=25℃	-10	±5	10	mV
		I_P=0A，T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=–40℃~25℃		±3		%

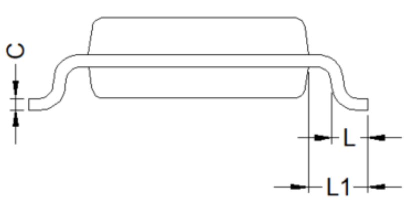
MCS108K-050UR-3 Performance Characteristics

Dc operating parameters at VCC = 3.3V ，TA=-40℃ ~125℃,unless otherwise specified

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal parameters						
Current Sensing Range	I_P		0		50	A
Sensitivity	$Sens_{TA}$	@V_{CC}=3.3V		52.8		mV/A
Zero-current output voltage	V_{QVO}	Ip=0A		Vcc/10		V
Accuracy Performance						
Sensitivity Error	E_{Sens}	@T_A=25℃;V_{CC}=3.3V	-1		1	%
Electrical Offset Error	V_{OE}	I_P=0A，T_A=25℃	-10	±5	10	mV
		I_P=0A，T_A=-40℃ ~125℃	-30	±15	30	mV
Linearity Error	Lin_{ERR}	Of full rang	-1	0.5	1	%
Total Output Error	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~125℃	-2		2	%
	$E_{TOT(HT)}$	Full scale of I_P, T_A=25℃~85℃	-1.5		1.5	%
	$E_{TOT(LT)}$	Full scale of I_P, T_A=–40℃~25℃		±3		%

Package Information





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.65
A1	0.10	--	0.25
A2	1.40	1.42	1.50
A3	0.60	0.65	0.70
b	0.33	--	0.47
c	0.20	--	0.24
D	4.80	4.90	5.00
E	5.90	6.00	6.20
E1	3.85	3.90	4.00
e	1.27 (BSC)		
L	0.50	0.60	0.70
L1	1.05 (BSC)		

Performances Parameters Definitions

- **Quiescent Voltage Output (QVO):**

In the quiescent state (no significant magnetic field, B=0G), Current Sensor Output Voltage **V_{QVO}**

-xR: V_{QVO} has a constant ratio to the supplyvoltage;

$V_{QVO}=V_{CC}/2$ or $V_{QVO}=Vcc/10$

- **Sensitivity(Sens):**

Sens is the slope of the reference output line ; $V_{OUT} = V_{QVO} + 1.32 \times I_P/I_{P\_MAX}$
which refers to the following,the change of current, the change of output,its relationship with current is : **Sens** $= 1.32/I_{P\_MAX}$

- **Offset with Temperature:**

Due to internal component tolerances and thermal considerations, the Quiescent Voltage Output (QVO) may drift from its nominal value through the operating ambient temperature (TA).

- **Sensitivity with temperature:**

Due to the influence of internal temperature compensation coefficient, the sensitivity will change through the whole working temperature, and be different from the expected value at room temperature.

- **Offset voltage:**

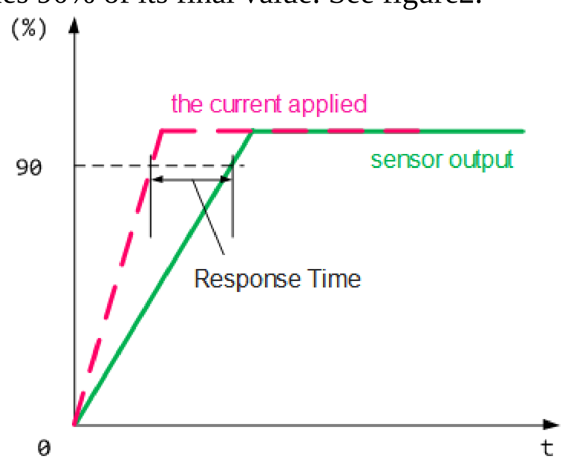
The zero offset voltage is the output voltage when the primary current is zero, with ideal value:**$V_{QVO}=Vcc/2$**(or **$Vcc/10$**)。 The difference between V_{QVO} and ideal value is named Total offset voltage error. This offset error can be attributed to the zero-point offset voltage (due to the ASIC internal QVO adjusted resolution), magnetic offset, temperature drift, and hysteresis.

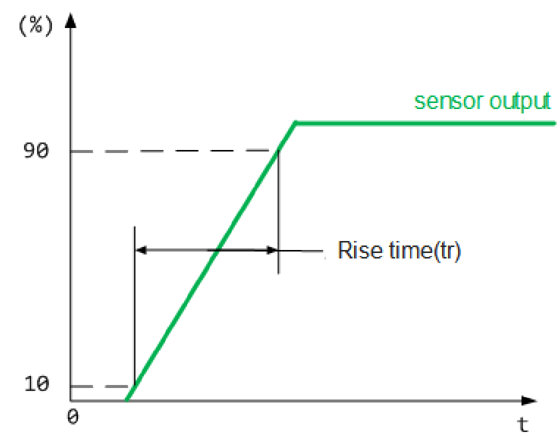
- **Response Time:**

The time between the primary current signals (IPN) reaches 90% of its final value and when the sensor output signal reaches 90%. See figure1.

- **Rise time:**

The time between when the sensor output reaches 10% of its final value, and when it reaches 90% of its final value. See figure2.





- **QVO Ratiometricity error：**

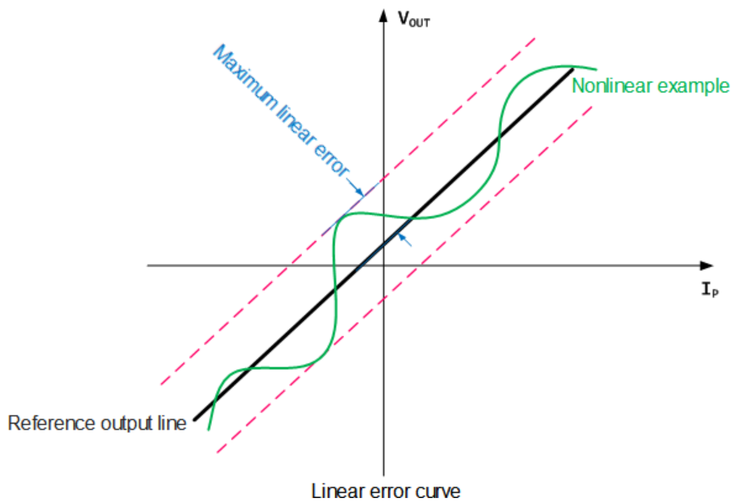
When the supply voltage V_{CC} changes from 3.3V to 3.15<V_{CC1}<3.45V ,the deviation between the sensor zero output and the theoretical value, the formula is defined as follows:

$$\mathrm{Er} = \frac{(V_{QVO(VCC1)}}{V_{QVO(3.3V)-}{}^{VCC1}/_{3.3V}} \times 100\%$$

- **Linearity：**

The maximum Positive and Negative error comparing with ideal output line

(-BR mode：$V_{OUT}=V_{CC}/2+1.32\times I_P/I_{P(MAX)}$)



- **Total Output Error ETOT:**

Error between the device measurement current and Applied current (I_P), which is defined as the difference between the ideal output voltage and the actual output voltage divided by the ideal sensitivity:

$$E_{TOT(I_P)} = \frac{V_{I_{OUT(I_P)}} - V_{I_{OUT(ideal)(I_P)}}}{Sens_{(ideal)} \times I_P}$$

$$V_{I_{OUT(ideal)(I_P)}} = V_{I_{OUT(Q)}} + (Sens_{(ideal)} \times I_P)$$

At relatively high currents, E_{TOT} is mainly due to sensitivity errors; while at relatively low currents, E_{TOT} is mainly due to offset voltage errors (V_{OE}).

Actually, when the I_P approaches zero, the E_{TOT} approaches infinity due to offset voltage error.

Important notes：

1. Wrong wiring may cause sensor damage. After the sensor is connected to the 3.3V power supply, the measured current passes through the direction of the sensor current terminal, and the corresponding voltage value can be measured at the output end.
2. -BR： V_{OUT} is proportional to V_{CC}， $\boldsymbol{V_{OUT}} = \boldsymbol{V_{CC}}/\boldsymbol{2} + 1.32 \times \boldsymbol{I_P}/\boldsymbol{I_{P(MAX)}}$

   Supply voltage change will cause V_{OUT} change by ratio.

   For example： V_{CC}range 3.15V~3.45V； V_{QVO} output range at 1.575V~1.725V 。

   $V_{OUT(IPMAX)}$ output range at 2.895V~3.045V.