

#### ■ 概要

R3111x シリーズは、CMOS プロセス技術を用いて開発した、低電圧動作仕様の高精度、超低消費電流の電圧検出器です。システムリセット等に用いられる IC で、内部回路は基準電圧源、コンパレータ、検出電圧用抵抗網、ヒステリシス回路及び出力ドライブトランジスタから構成されています。又、検出電圧は高精度に IC 内で固定されている完全無調整型となっています。

出力形態は、Nch オープンドレイン、CMOS の 2 タイプがあります。

電気的特性につきましては弊社従来製品である Rx5VL シリーズより低電圧動作を狙い電池一本駆動を可能にしました。

パッケージは TO-92 , SOT-89 , SOT-23-3 , SOT-23-5 , SC-82AB の 5 種類があります。

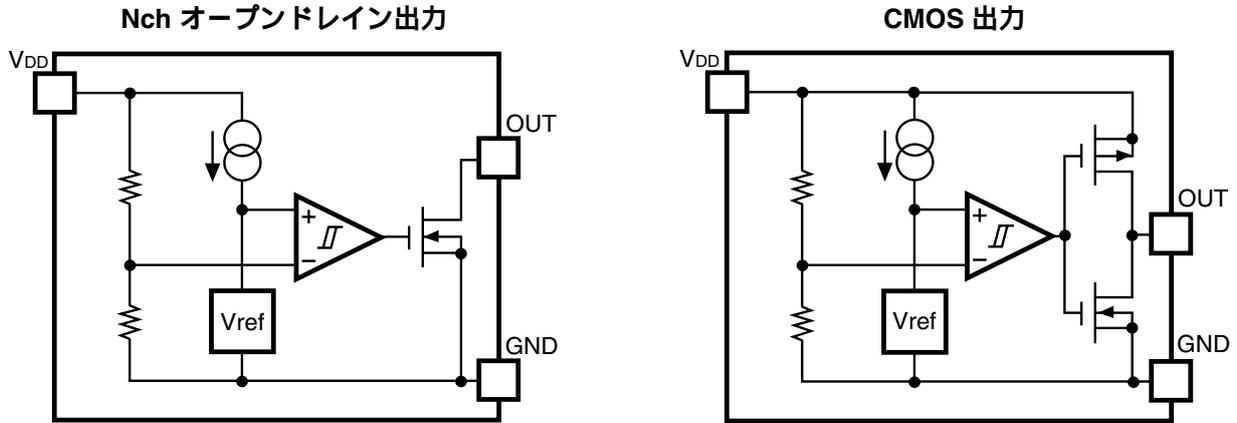
#### ■ 特長

- 超低消費電流..... TYP. 0.8 $\mu$ A ( $V_{DD}=1.5V$ )
- 動作電圧範囲が広い..... 0.7V ~ 10.0V ( $T_{opt}=25^{\circ}C$ )
- 検出電圧は 0.9V ~ 6.0V 間を 0.1V ステップで設定可能
- 検出電圧精度が高い.....  $\pm 2.0\%$
- 検出電圧の温度特性..... TYP.  $\pm 100ppm/^{\circ}C$
- 出力形態..... Nch オープンドレイン、CMOS の 2 種
- 4 種類のパッケージ..... TO-92 , SOT-89 , SOT-23-3 , SOT-23-5 , SC-82AB

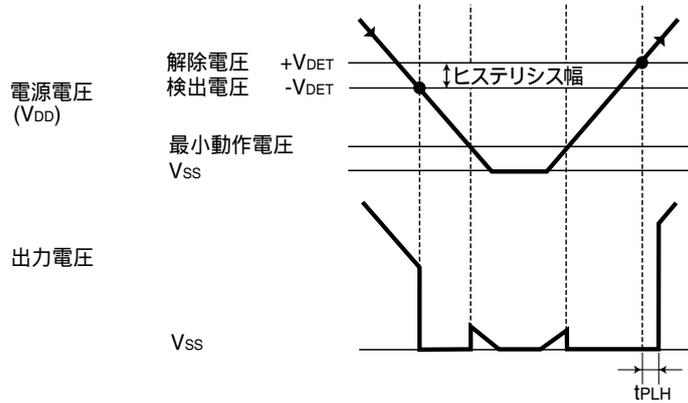
#### ■ アプリケーション

- マイコン、ロジック回路のリセット
- バッテリーチェッカー
- レベル弁別装置
- 波形整流回路
- バックアップ電源の切り替え回路
- 停電検出

■ ブロック図



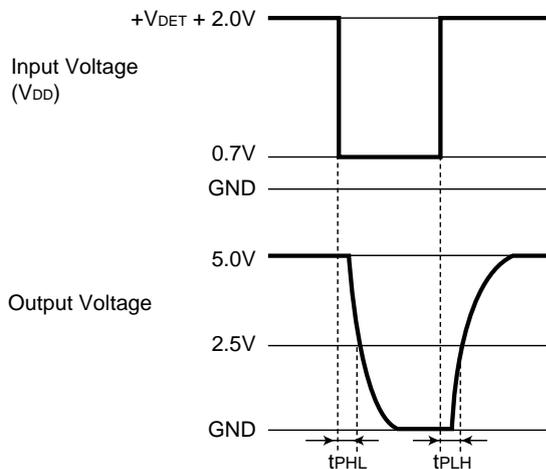
■ タイムチャート



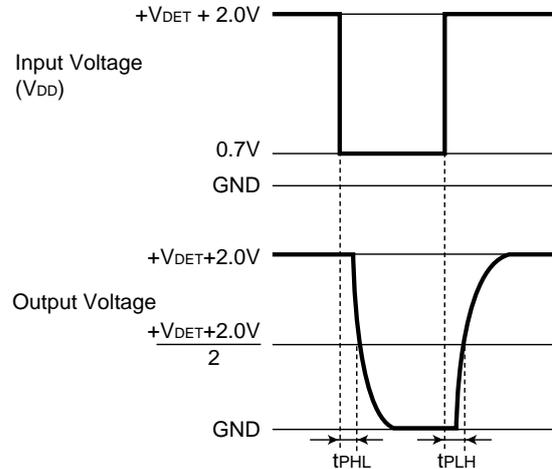
■ 伝達遅延 tPLH の説明

伝達遅延 tPLH は以下の条件で規定します。

1. Nch オープンドレイン出力の場合  
出力端子 (OUT) を抵抗 470kΩ で 5V にプルアップし、V<sub>DD</sub> に 0.7V (+V<sub>DET</sub>)+2.0V のパルス電圧を印加した時点から出力電圧が 2.5V に達するまでの時間。
2. CMOS 出力の場合  
V<sub>DD</sub> に 0.7V (+V<sub>DET</sub>)+2.0V のパルス電圧を印加した時点から出力電圧が V<sub>DD</sub>/2 に達するまでの時間。



Nch オープンドレイン出力

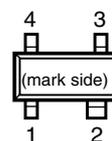
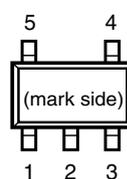
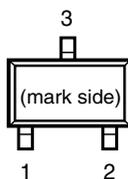
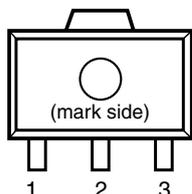
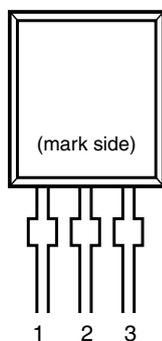


CMOS 出力



## ■ 端子接続図

- TO-92
- SOT-89
- SOT-23-3
- SOT-23-5
- SC-82AB



## ■ 端子説明

### ● TO-92

| 端子番号 | 端子名             |
|------|-----------------|
| 1    | V <sub>DD</sub> |
| 2    | GND             |
| 3    | OUT             |

### ● SOT-89

| 端子番号 | 端子名             |
|------|-----------------|
| 1    | OUT             |
| 2    | V <sub>DD</sub> |
| 3    | GND             |

### ● SOT-23-3

| 端子番号 | 端子名             |
|------|-----------------|
| 1    | OUT             |
| 2    | GND             |
| 3    | V <sub>DD</sub> |

### ● SOT-23-5

| 端子番号 | 端子名             |
|------|-----------------|
| 1    | OUT             |
| 2    | V <sub>DD</sub> |
| 3    | GND             |
| 4    | NC              |
| 5    | NC              |

### ● SC-82AB

| 端子番号 | 端子名             |
|------|-----------------|
| 1    | OUT             |
| 2    | V <sub>DD</sub> |
| 3    | NC              |
| 4    | GND             |

## ■ 絶対最大定格

| 記号                  | 項目          | 定格  | 単位 |
|---------------------|-------------|---|----|
| V <sub>DD</sub>     | 電源電圧        | 12  | V  |
| V <sub>OUT1</sub>   | 出力電圧 (CMOS) | V <sub>SS</sub> -0.3~V <sub>DD</sub> +0.3 | V  |
| V <sub>OUT2</sub>   | 出力電圧 (Nch)  | V <sub>SS</sub> -0.3~12                   | V  |
| I <sub>OUT</sub>    | 出力電流        | 70  | mA |
| P <sub>D</sub>      | 許容損失 1 *1   | 300                                       | mW |
| P <sub>D</sub>      | 許容損失 2 *2   | 150                                       | mW |
| T <sub>opt</sub>    | 動作周囲温度      | -40~85                                    | °C |
| T <sub>stg</sub>    | 保存周囲温度      | -55~125                                   | °C |
| T <sub>solder</sub> | ハンダ付け条件     | 260°C 10 秒間                               |    |

\*1) 許容損失 1 は SOT-89 , TO-92 に適用

\*2) 許容損失 2 は SOT-23-3 , SOT-23-5 , SC-82AB に適用

## ■ 電気的特性

### ● R3111x09xA/C

T<sub>opt</sub>=25°C

| 記号                     | 項目                 | 条件  | MIN.  | TYP.       | MAX.       | 単位     |
|------------------------|--------------------|---|-------|------------|------------|--------|
| -V <sub>DET</sub>      | 検出電圧               |   | 0.882 | 0.900      | 0.918      | V      |
| V <sub>HYS</sub>       | ヒステリシス幅            |   | 0.027 | 0.045      | 0.063      | V      |
| I <sub>SS</sub>        | 消費電流               | V <sub>DD</sub> =0.80V<br>2.90V                       |       | 0.8<br>0.9 | 2.4<br>2.7 | μA     |
| V <sub>DDH</sub>       | 最大動作電圧             |   |       |            | 10         | V      |
| V <sub>DDL</sub>       | 最小動作電圧<br>*注1      | T <sub>opt</sub> =25°C                                |       | 0.55       | 0.70       | V      |
|                        |                    | -40°C T <sub>opt</sub> 85°C                           |       | 0.65       | 0.80       |        |
| I <sub>OUT</sub>       | 出力電流<br>(ドライバ出力端子) | Nch<br>V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.70V | 0.01  | 0.05       |            | mA     |
|                        |                    | V <sub>DS</sub> =0.50V, V <sub>DD</sub> =0.85V        | 0.05  | 0.50       |            |        |
|                        |                    | Pch<br>V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V  | 1.0   | 2.0        |            | mA     |
| t <sub>PLH</sub>       | 伝達遅延時間 *注2         |   |       |            | 100        | μs     |
| Δ-V <sub>DET</sub> /ΔT | 検出電圧温度係数           | -40°C T <sub>opt</sub> 85°C                           |       | ±100       |            | ppm/°C |

### ● R3111x18xA/C

T<sub>opt</sub>=25°C

| 記号                     | 項目                 | 条件  | MIN.  | TYP.       | MAX.       | 単位     |
|------------------------|--------------------|---|-------|------------|------------|--------|
| -V <sub>DET</sub>      | 検出電圧               |   | 1.764 | 1.800      | 1.836      | V      |
| V <sub>HYS</sub>       | ヒステリシス幅            |   | 0.054 | 0.090      | 0.126      | V      |
| I <sub>SS</sub>        | 消費電流               | V <sub>DD</sub> =1.70V<br>3.80V                       |       | 0.8<br>1.0 | 2.4<br>3.0 | μA     |
| V <sub>DDH</sub>       | 最大動作電圧             |   |       |            | 10         | V      |
| V <sub>DDL</sub>       | 最小動作電圧<br>*注1      | T <sub>opt</sub> =25°C                                |       | 0.55       | 0.70       | V      |
|                        |                    | -40°C T <sub>opt</sub> 85°C                           |       | 0.65       | 0.80       |        |
| I <sub>OUT</sub>       | 出力電流<br>(ドライバ出力端子) | Nch<br>V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.70V | 0.01  | 0.05       |            | mA     |
|                        |                    | V <sub>DS</sub> =0.50V, V <sub>DD</sub> =0.85V        | 1.00  | 2.00       |            |        |
|                        |                    | Pch<br>V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V  | 1.0   | 2.0        |            | mA     |
| t <sub>PLH</sub>       | 伝達遅延時間 *注2         |   |       |            | 100        | μs     |
| Δ-V <sub>DET</sub> /ΔT | 検出電圧温度係数           | -40°C T <sub>opt</sub> 85°C                           |       | ±100       |            | ppm/°C |

## R3111xxxxA/C

### ● R3111x27xA/C

Topt=25°C

| 記号                     | 項目                 | 条件  | MIN.         | TYP.         | MAX.       | 単位     |
|------------------------|--------------------|---|--------------|--------------|------------|--------|
| -V <sub>DET</sub>      | 検出電圧               |   | 2.646        | 2.700        | 2.754      | V      |
| V <sub>HYS</sub>       | ヒステリシス幅            |   | 0.081        | 0.135        | 0.189      | V      |
| I <sub>SS</sub>        | 消費電流               | V <sub>DD</sub> =2.60V<br>4.70V   |              | 0.9<br>1.1   | 2.7<br>3.3 | μA     |
| V <sub>DDH</sub>       | 最大動作電圧             |   |              |              | 10         | V      |
| V <sub>DDL</sub>       | 最小動作電圧<br>*注1      | Topt=25°C   |              | 0.55         | 0.70       | V      |
|                        |                    | -40°C Topt 85°C   |              | 0.65         | 0.80       |        |
| I <sub>OUT</sub>       | 出力電流<br>(ドライバ出力端子) | Nch<br>V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.70V<br>V <sub>DS</sub> =0.50V, V <sub>DD</sub> =1.50V | 0.01<br>1.00 | 0.05<br>2.00 |            | mA     |
|                        |                    | Pch<br>V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V  | 1.0          | 2.0          |            | mA     |
| t <sub>PLH</sub>       | 伝達遅延時間 *注2         |   |              |              | 100        | μs     |
| Δ-V <sub>DET</sub> /ΔT | 検出電圧温度係数           | -40°C Topt 85°C   |              | ±100         |            | ppm/°C |

### ● R3111x36xA/C

Topt=25°C

| 記号                     | 項目                 | 条件  | MIN.         | TYP.         | MAX.       | 単位     |
|------------------------|--------------------|---|--------------|--------------|------------|--------|
| -V <sub>DET</sub>      | 検出電圧               |   | 3.528        | 3.600        | 3.672      | V      |
| V <sub>HYS</sub>       | ヒステリシス幅            |   | 0.108        | 0.180        | 0.252      | V      |
| I <sub>SS</sub>        | 消費電流               | V <sub>DD</sub> =3.47V<br>5.60V   |              | 1.0<br>1.2   | 3.0<br>3.6 | μA     |
| V <sub>DDH</sub>       | 最大動作電圧             |   |              |              | 10         | V      |
| V <sub>DDL</sub>       | 最小動作電圧<br>*注1      | Topt=25°C   |              | 0.55         | 0.70       | V      |
|                        |                    | -40°C Topt 85°C   |              | 0.65         | 0.80       |        |
| I <sub>OUT</sub>       | 出力電流<br>(ドライバ出力端子) | Nch<br>V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.70V<br>V <sub>DS</sub> =0.50V, V <sub>DD</sub> =1.50V | 0.01<br>1.00 | 0.05<br>2.00 |            | mA     |
|                        |                    | Pch<br>V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V  | 1.0          | 2.0          |            | mA     |
| t <sub>PLH</sub>       | 伝達遅延時間 *注2         |   |              |              | 100        | μs     |
| Δ-V <sub>DET</sub> /ΔT | 検出電圧温度係数           | -40°C Topt 85°C   |              | ±100         |            | ppm/°C |

## ● R3111x45xA/C

Topt=25°C

| 記号                     | 項目                 | 条件  | MIN.         | TYP.         | MAX.       | 単位     |
|------------------------|--------------------|---|--------------|--------------|------------|--------|
| -V <sub>DET</sub>      | 検出電圧               |   | 4.410        | 4.500        | 4.590      | V      |
| V <sub>HYS</sub>       | ヒステリシス幅            |   | 0.135        | 0.225        | 0.315      | V      |
| I <sub>SS</sub>        | 消費電流               | V <sub>DD</sub> =4.34V<br>6.50V   |              | 1.1<br>1.3   | 3.3<br>3.9 | μA     |
| V <sub>DDH</sub>       | 最大動作電圧             |   |              |              | 10         | V      |
| V <sub>DDL</sub>       | 最小動作電圧<br>*注1      | Topt=25°C   |              | 0.55         | 0.70       | V      |
|                        |                    | -40°C Topt 85°C   |              | 0.65         | 0.80       |        |
| I <sub>OUT</sub>       | 出力電流<br>(ドライバ出力端子) | Nch<br>V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.70V<br>V <sub>DS</sub> =0.50V, V <sub>DD</sub> =1.50V | 0.01<br>1.00 | 0.05<br>2.00 |            | mA     |
|                        |                    | Pch<br>V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =8.0V  | 1.5          | 3.0          |            | mA     |
| t <sub>PLH</sub>       | 伝達遅延時間 *注2         |   |              |              | 100        | μs     |
| Δ-V <sub>DET</sub> /ΔT | 検出電圧温度係数           | -40°C Topt 85°C   |              | ±100         |            | ppm/°C |

## ● R3111x54xA/C

Topt=25°C

| 記号                     | 項目                 | 条件  | MIN.         | TYP.         | MAX.       | 単位     |
|------------------------|--------------------|---|--------------|--------------|------------|--------|
| -V <sub>DET</sub>      | 検出電圧               |   | 5.292        | 5.400        | 5.508      | V      |
| V <sub>HYS</sub>       | ヒステリシス幅            |   | 0.162        | 0.270        | 0.378      | V      |
| I <sub>SS</sub>        | 消費電流               | V <sub>DD</sub> =5.20V<br>7.40V   |              | 1.2<br>1.4   | 3.6<br>4.2 | μA     |
| V <sub>DDH</sub>       | 最大動作電圧             |   |              |              | 10         | V      |
| V <sub>DDL</sub>       | 最小動作電圧<br>*注1      | Topt=25°C   |              | 0.55         | 0.70       | V      |
|                        |                    | -40°C Topt 85°C   |              | 0.65         | 0.80       |        |
| I <sub>OUT</sub>       | 出力電流<br>(ドライバ出力端子) | Nch<br>V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.70V<br>V <sub>DS</sub> =0.50V, V <sub>DD</sub> =1.50V | 0.01<br>1.00 | 0.05<br>2.00 |            | mA     |
|                        |                    | Pch<br>V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =8.0V  | 1.5          | 3.0          |            | mA     |
| t <sub>PLH</sub>       | 伝達遅延時間 *注2         |   |              |              | 100        | μs     |
| Δ-V <sub>DET</sub> /ΔT | 検出電圧温度係数           | -40°C Topt 85°C   |              | ±100         |            | ppm/°C |

\*注1： 出力電圧が 0.1V 以下になる電源電圧の値。(Nch オープンドレイン品の場合、プルアップ抵抗 470kΩ、プルアップ電圧 5.0V とします。)

\*注2： (CMOS 品の場合) V<sub>DD</sub> に 0.7V→(+V<sub>DET</sub>)+2.0V のパルス電圧を印加した時点から、出力電圧が V<sub>DD</sub>/2 の電位に達するまでの時間。(Nch オープンドレイン品の場合)プルアップ抵抗 470kΩ、プルアップ電圧 5.0V の条件で、V<sub>DD</sub> に 0.7V→(+V<sub>DET</sub>)+2.0V のパルス電圧を印加した時点から、出力電圧が 2.5V に達するまでの時間。

■ 検出電圧別電気的特性

● R3111x09x ~ R3111x60x

| 製品名        | 検出電圧                  |       |       | ヒステリシス幅              |       |       | 消費電流 1  |      |      | 消費電流 2                |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
|------------|-----------------------|-------|-------|----------------------|-------|-------|---|------|------|-----------------------|---|------|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|-----|-----|-----|-----|---|
|            | -V <sub>DET</sub> [V] |       |       | V <sub>HYS</sub> [V] |       |       | I <sub>SS1</sub> [μA]                               |      |      | I <sub>SS2</sub> [μA] |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
|            | MIN.                  | TYP.  | MAX.  | MIN.                 | TYP.  | MAX.  | 条件  | TYP. | MAX. | 条件                    | TYP.  | MAX. |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x09xx | 0.882                 | 0.900 | 0.918 | 0.027                | 0.045 | 0.063 | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.10V | 0.8  | 2.4  | 1.0                   | 0.9   | 2.7  |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x10xx | 0.980                 | 1.000 | 1.020 | 0.030                | 0.050 | 0.070 |   |      |      |                       | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.13V | 1.0  | 3.0 | 1.1 | 3.3 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x11xx | 1.078                 | 1.100 | 1.122 | 0.033                | 0.055 | 0.077 |   |      |      |                       |   |      |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.16V | 1.1 | 3.3 | 1.2 | 3.6 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x12xx | 1.176                 | 1.200 | 1.224 | 0.036                | 0.060 | 0.084 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.16V | 1.1 | 3.3 | 1.3 | 3.9 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x13xx | 1.274                 | 1.300 | 1.326 | 0.039                | 0.065 | 0.091 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x14xx | 1.372                 | 1.400 | 1.428 | 0.042                | 0.070 | 0.098 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x15xx | 1.470                 | 1.500 | 1.530 | 0.045                | 0.075 | 0.105 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x16xx | 1.568                 | 1.600 | 1.632 | 0.048                | 0.080 | 0.112 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x17xx | 1.666                 | 1.700 | 1.734 | 0.051                | 0.085 | 0.119 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x18xx | 1.764                 | 1.800 | 1.836 | 0.054                | 0.090 | 0.126 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x19xx | 1.862                 | 1.900 | 1.938 | 0.057                | 0.095 | 0.133 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x20xx | 1.960                 | 2.000 | 2.040 | 0.060                | 0.100 | 0.140 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x21xx | 2.058                 | 2.100 | 2.142 | 0.063                | 0.105 | 0.147 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x22xx | 2.156                 | 2.200 | 2.244 | 0.066                | 0.110 | 0.154 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x23xx | 2.254                 | 2.300 | 2.346 | 0.069                | 0.115 | 0.161 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x24xx | 2.352                 | 2.400 | 2.448 | 0.072                | 0.120 | 0.168 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x25xx | 2.450                 | 2.500 | 2.550 | 0.075                | 0.125 | 0.175 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |
| R3111x26xx | 2.548                 | 2.600 | 2.652 | 0.078                | 0.130 | 0.182 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |
| R3111x27xx | 2.646                 | 2.700 | 2.754 | 0.081                | 0.135 | 0.189 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |
| R3111x28xx | 2.744                 | 2.800 | 2.856 | 0.084                | 0.140 | 0.196 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V |
| R3111x29xx | 2.842                 | 2.900 | 2.958 | 0.087                | 0.145 | 0.203 | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2  | 3.6  | 1.4                   |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x30xx | 2.940                 | 3.000 | 3.060 | 0.090                | 0.150 | 0.210 |   |      |      |                       | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2  | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x31xx | 3.038                 | 3.100 | 3.162 | 0.093                | 0.155 | 0.217 |   |      |      |                       |   |      |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x32xx | 3.136                 | 3.200 | 3.264 | 0.096                | 0.160 | 0.224 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x33xx | 3.234                 | 3.300 | 3.366 | 0.099                | 0.165 | 0.231 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x34xx | 3.332                 | 3.400 | 3.468 | 0.102                | 0.170 | 0.238 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x35xx | 3.430                 | 3.500 | 3.570 | 0.105                | 0.175 | 0.245 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x36xx | 3.528                 | 3.600 | 3.672 | 0.108                | 0.180 | 0.252 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x37xx | 3.626                 | 3.700 | 3.774 | 0.111                | 0.185 | 0.259 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x38xx | 3.724                 | 3.800 | 3.876 | 0.114                | 0.190 | 0.266 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x39xx | 3.822                 | 3.900 | 3.978 | 0.117                | 0.195 | 0.273 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x40xx | 3.920                 | 4.000 | 4.080 | 0.120                | 0.200 | 0.280 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x41xx | 4.018                 | 4.100 | 4.182 | 0.123                | 0.205 | 0.287 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x42xx | 4.116                 | 4.200 | 4.284 | 0.126                | 0.210 | 0.294 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x43xx | 4.214                 | 4.300 | 4.386 | 0.129                | 0.215 | 0.301 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x44xx | 4.312                 | 4.400 | 4.488 | 0.132                | 0.220 | 0.308 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x45xx | 4.410                 | 4.500 | 4.590 | 0.135                | 0.225 | 0.315 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |
| R3111x46xx | 4.508                 | 4.600 | 4.692 | 0.138                | 0.230 | 0.322 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |
| R3111x47xx | 4.606                 | 4.700 | 4.794 | 0.141                | 0.235 | 0.329 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |
| R3111x48xx | 4.704                 | 4.800 | 4.896 | 0.144                | 0.240 | 0.336 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V |
| R3111x49xx | 4.802                 | 4.900 | 4.998 | 0.147                | 0.245 | 0.343 | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2  | 3.6  | 1.4                   |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x50xx | 4.900                 | 5.000 | 5.100 | 0.150                | 0.250 | 0.350 |   |      |      |                       | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2  | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x51xx | 4.998                 | 5.100 | 5.202 | 0.153                | 0.255 | 0.357 |   |      |      |                       |   |      |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x52xx | 5.096                 | 5.200 | 5.304 | 0.156                | 0.260 | 0.364 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x53xx | 5.194                 | 5.300 | 5.406 | 0.159                | 0.265 | 0.371 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x54xx | 5.292                 | 5.400 | 5.508 | 0.162                | 0.270 | 0.378 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x55xx | 5.390                 | 5.500 | 5.610 | 0.165                | 0.275 | 0.385 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x56xx | 5.488                 | 5.600 | 5.712 | 0.168                | 0.280 | 0.392 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x57xx | 5.586                 | 5.700 | 5.814 | 0.171                | 0.285 | 0.399 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x58xx | 5.684                 | 5.800 | 5.916 | 0.174                | 0.290 | 0.406 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x59xx | 5.782                 | 5.900 | 6.018 | 0.177                | 0.295 | 0.413 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |
| R3111x60xx | 5.880                 | 6.000 | 6.120 | 0.180                | 0.300 | 0.420 |   |      |      |                       |   |      |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     | V <sub>DD</sub> =<br>(-V <sub>DET</sub> )<br>-0.20V | 1.2 | 3.6 | 1.4 | 4.2 |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |     |     |     |     |   |

注 1 : CMOS 出力の場合 : V<sub>DD</sub> に 0.7V → (+V<sub>DET</sub>)+2.0V のパルス電圧を印加した時点から、出力電圧が 50%の電位に達するまでの時間。  
Nch オープンドレイン出力の場合 : 出力端子を抵抗 470kΩで 5V にプルアップし、V<sub>DD</sub> に 0.7V → (+V<sub>DET</sub>)+2.0V のパルス電圧を印加した時点から、出力電圧が 50%の電位に達するまでの時間。

注 2 : 出力電圧が 0.1V 以下になる電源電圧の値。Nch オープンドレイン品の場合は抵抗 470kΩで 5V にプルアップ。

条 件 1 : Topt=25°C  
条件 2 : -40°C Topt 85°C

| 出力電流 1   |      |      | 出力電流 2                           |                            |      | 伝達遅延時間                | 最小動作電圧               |              | 検出電圧温度係数                        |                                   |      |
|--|------|------|----------------------------------|----------------------------|------|-----------------------|----------------------|--------------|---------------------------------|-----------------------------------|------|
| I <sub>OUT1</sub> [mA]                                 |      |      | I <sub>OUT2</sub> [mA]           |                            |      | t <sub>PLH</sub> [μs] | V <sub>DDL</sub> [V] |              | - V <sub>DET</sub> / T [ppm/°C] |                                   |      |
| 条件   | MIN. | TYP. | 条件                               | MIN.                       | TYP. | MAX.                  | TYP.                 | MAX.         | 条件                              | TYP.                              |      |
| Nch<br>V <sub>DS</sub> =0.05V<br>V <sub>DD</sub> =0.7V | 0.01 | 0.05 | Nch<br>V <sub>DS</sub> =<br>0.5V | V <sub>DD</sub> =<br>0.85V | 0.05 | 0.5                   | 注 1<br>100           | 注 2          | 注 2                             | -40°C<br>T <sub>opt</sub><br>85°C | ±100 |
|  |      |      |                                  | V <sub>DD</sub> =<br>1.0V  | 0.2  | 1.0                   |                      |              |                                 |                                   |      |
|  |      |      |                                  | V <sub>DD</sub> =<br>1.5V  | 1.0  | 2.0                   |                      |              |                                 |                                   |      |
|  |      |      |                                  |                            |      |                       | 条件 2<br>0.65         | 条件 2<br>0.80 |                                 |                                   |      |

■ 動作説明

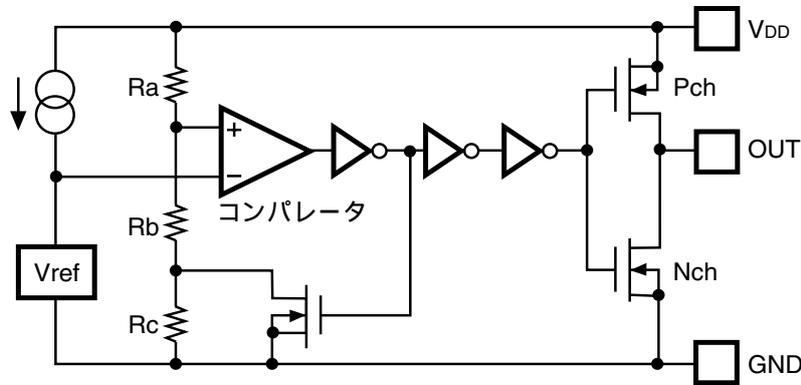
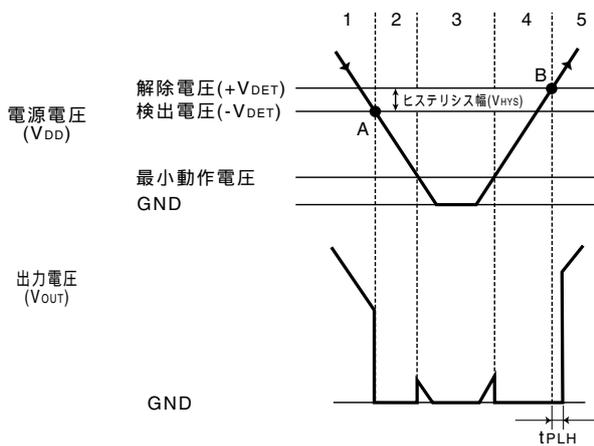


図-1 ブロック図



| 動作状態             | 1   | 2   | 3   | 4  | 5   |
|------------------|-----|-----|-----|----|-----|
| コンパレータ (+)端子入力電圧 | I   | II  | III | IV | V   |
| コンパレータ出力         | H   | L   | 不定  | L  | H   |
| Tr.1             | OFF | ON  | 不定  | ON | OFF |
| 出力 Tr.           | Pch | ON  | OFF | 不定 | OFF |
|                  | Nch | OFF | ON  | 不定 | ON  |

$$I. \frac{Rb + Rc}{Ra + Rb + Rc} \cdot V_{DD}$$

$$II. \frac{Rb}{Ra + Rb} \cdot V_{DD}$$

図-2 動作状態説明図

動作状態の説明

出力電圧は電源電圧(V<sub>DD</sub>)と等しくなります。

A 点で  $V_{ref} = V_{DD} \times (Rb + Rc) / (Ra + Rb + Rc)$  となりコンパレータの出力が反転し、出力電圧は GND となります。A 点が検出電圧(-V<sub>DET</sub>)です。

電源電圧が最小動作電圧より小さいときには出力トランジスタの動作は不定となり、出力がプルアップされている場合には V<sub>DD</sub> が出力されます。

出力電圧は GND と等しくなります。

B 点で  $V_{ref} = V_{DD} \times Rb / (Ra + Rb)$  となりコンパレータの出力が反転し、出力電圧は電源電圧(V<sub>DD</sub>)と等しくなります。B 点が解除電圧(+V<sub>DET</sub>)です。

解除電圧と検出電圧の差がヒステリシス幅になります。

## ■ 測定回路

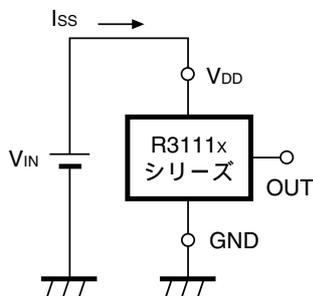
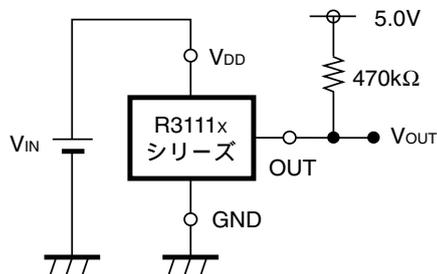


図-3 消費電流測定回路



\* CMOS 品はプルアップ不要

図-4 検出電圧測定回路

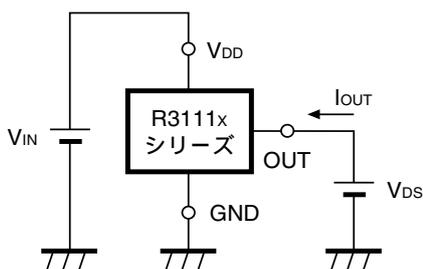
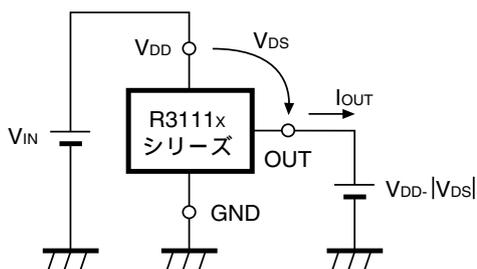


図-5 Nch ドライバ出力電流測定回路



\* CMOS 品のみ

図-6 Pch ドライバ出力電流測定回路

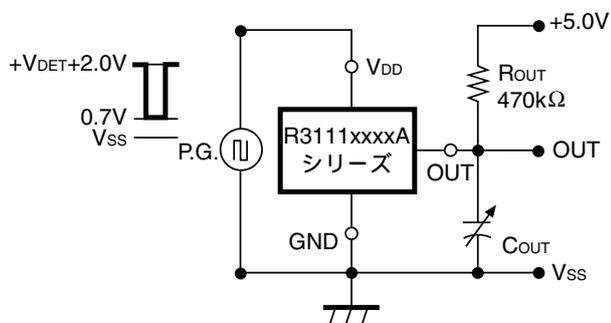


図-7 伝達遅延測定回路(1)

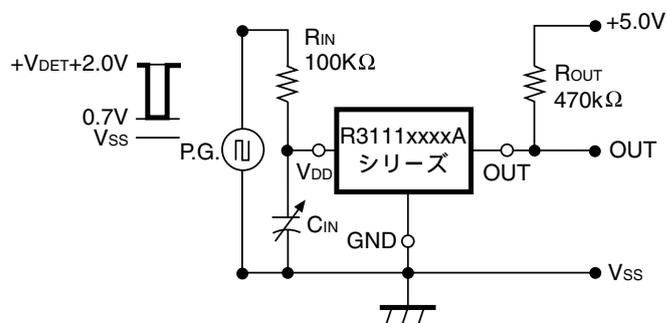
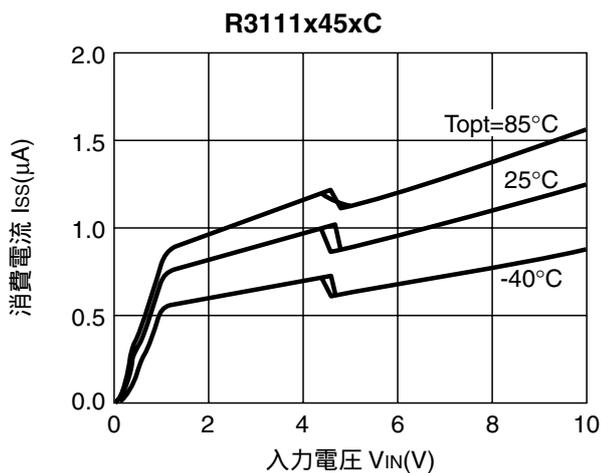
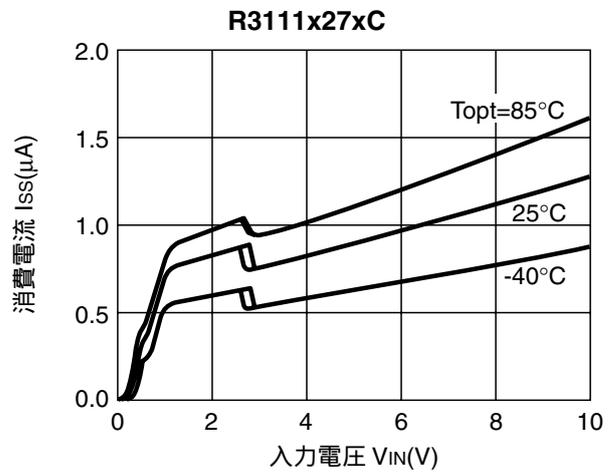
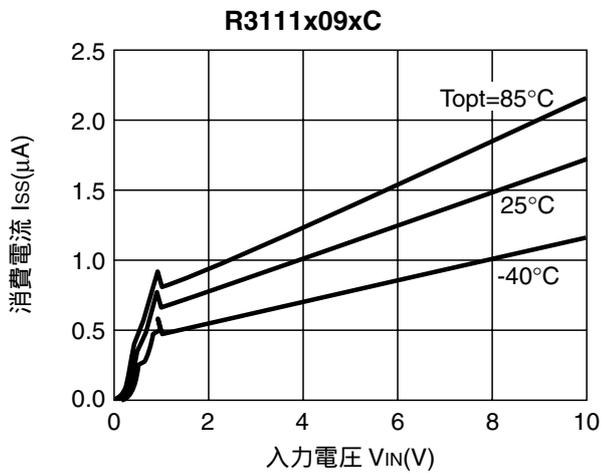


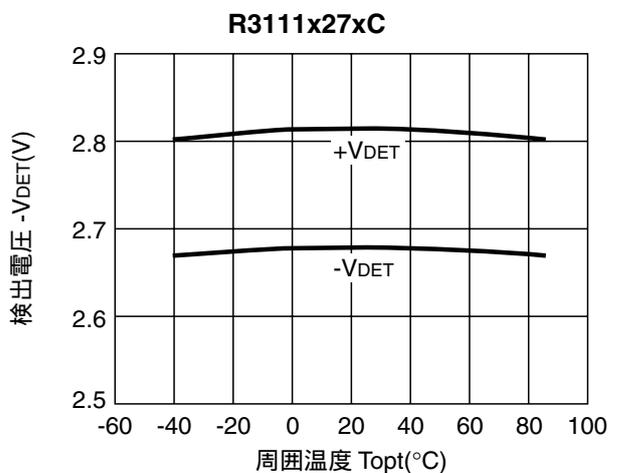
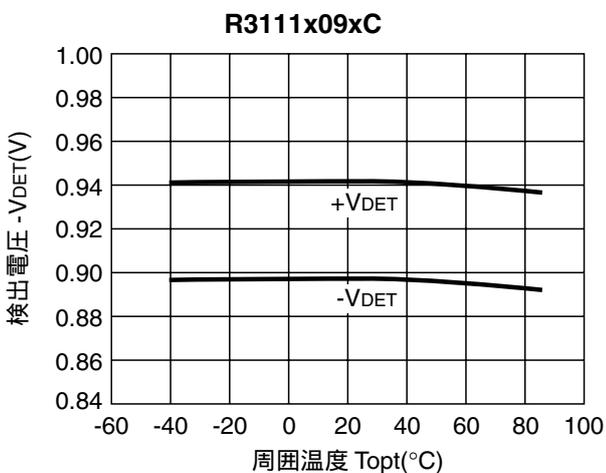
図-8 伝達遅延時間測定回路(2)

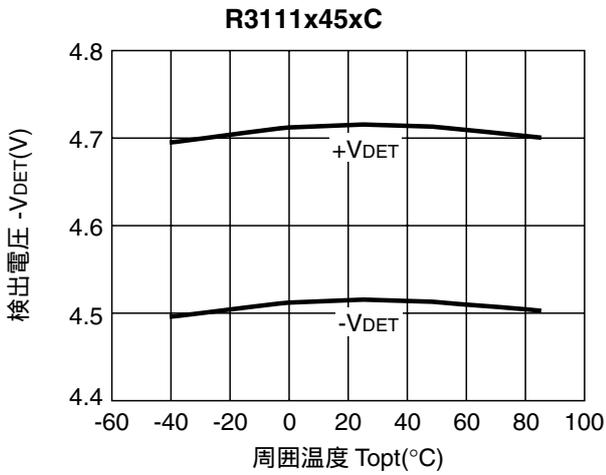
■ 特性例

1) 消費電流対入力電圧特性例

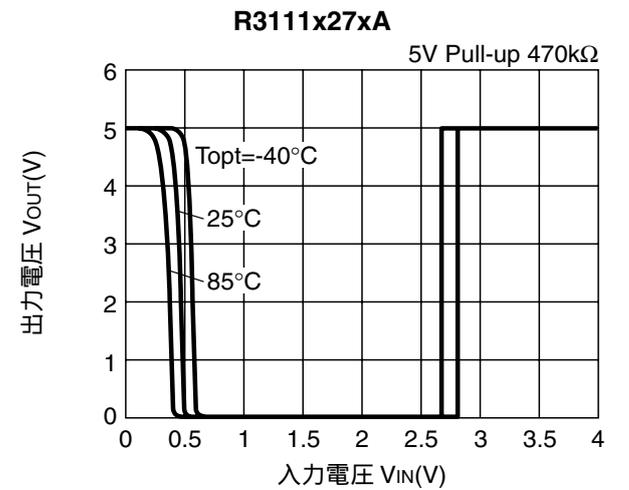
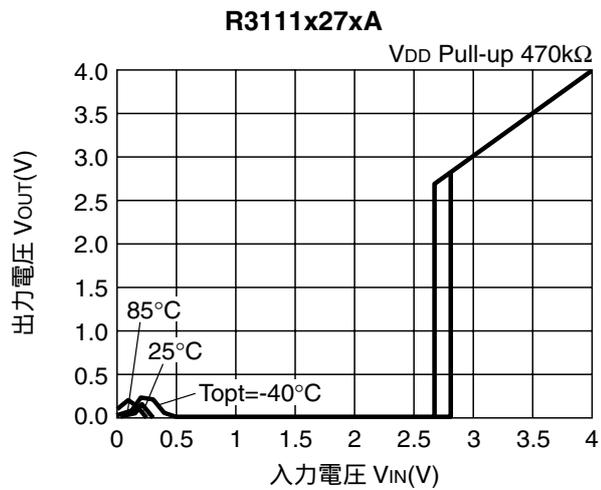
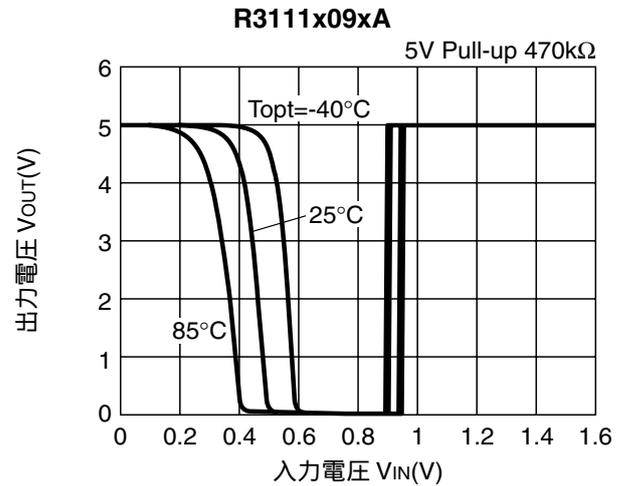
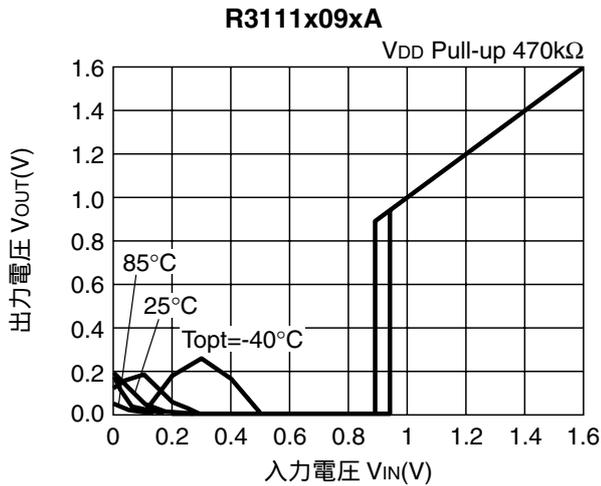


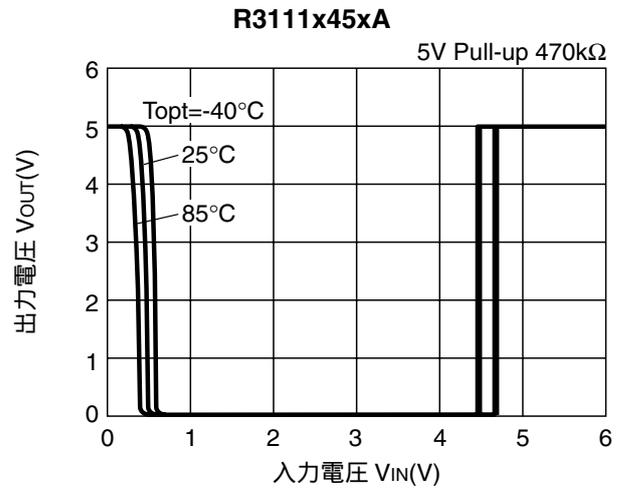
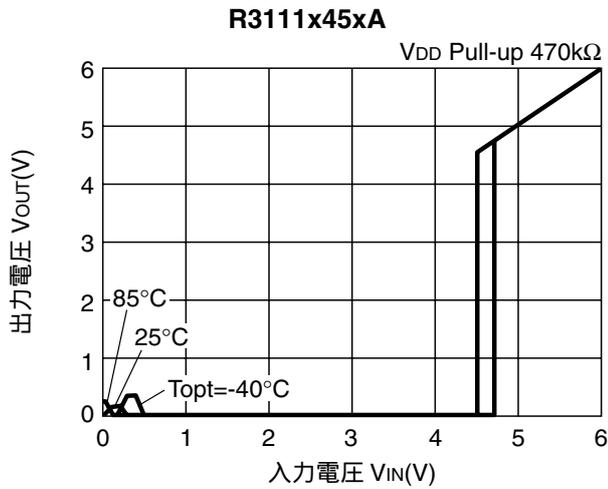
2) 検出電圧対周囲温度特性例



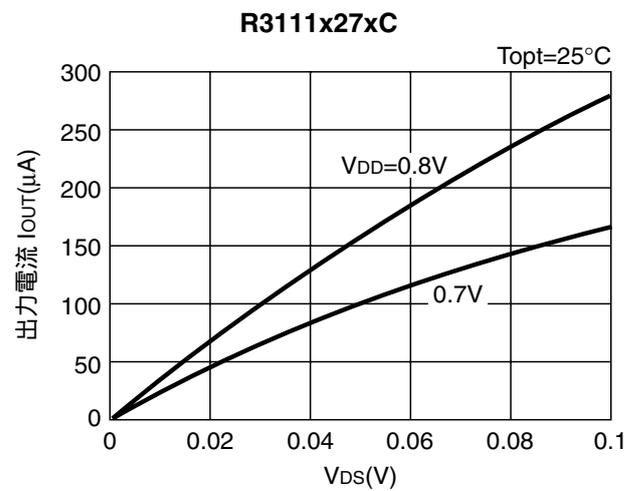
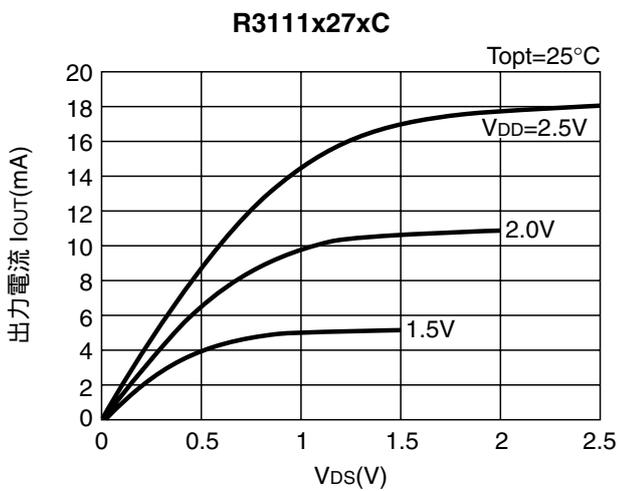
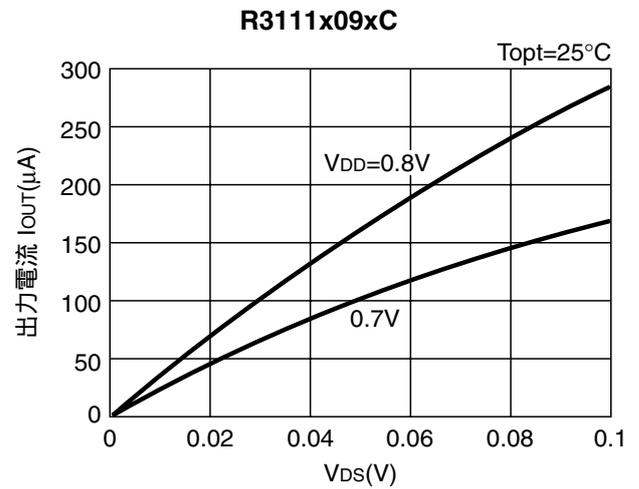
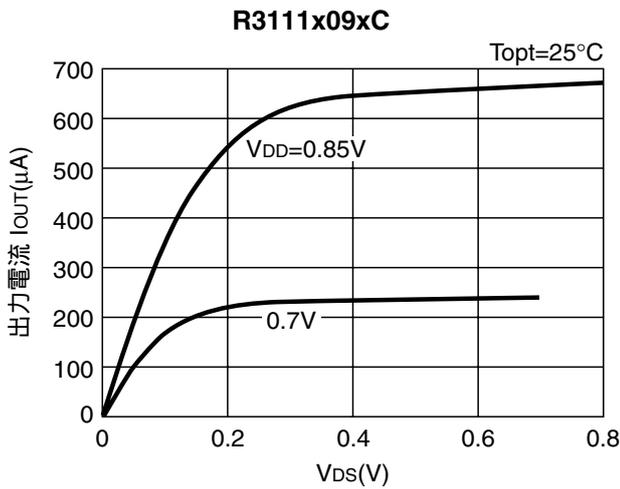


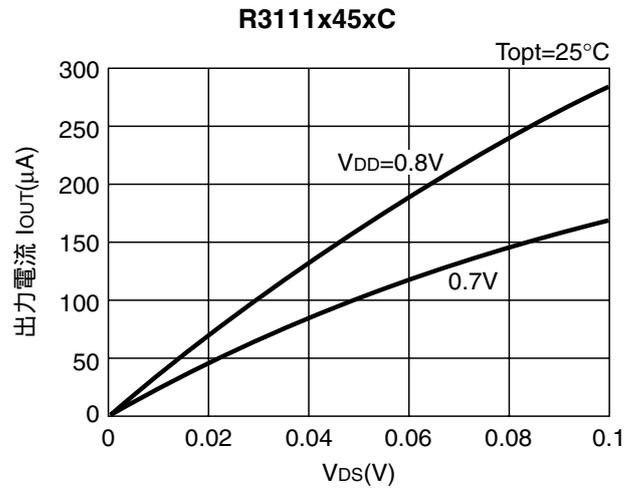
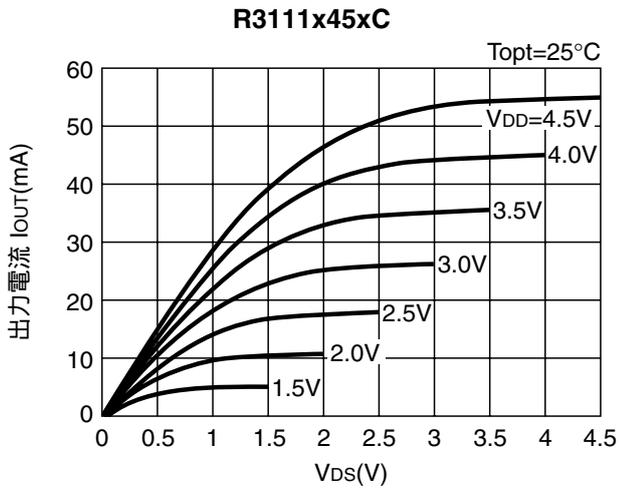
3) 出力電圧対入力電圧特性例



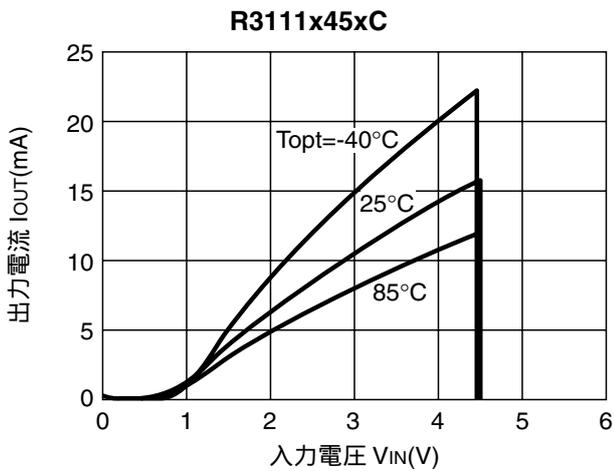
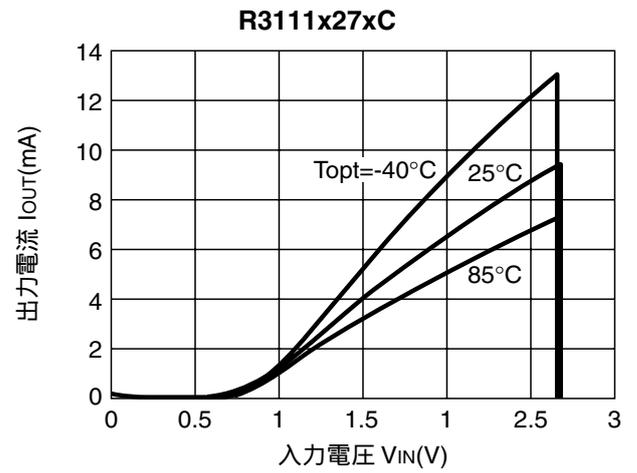
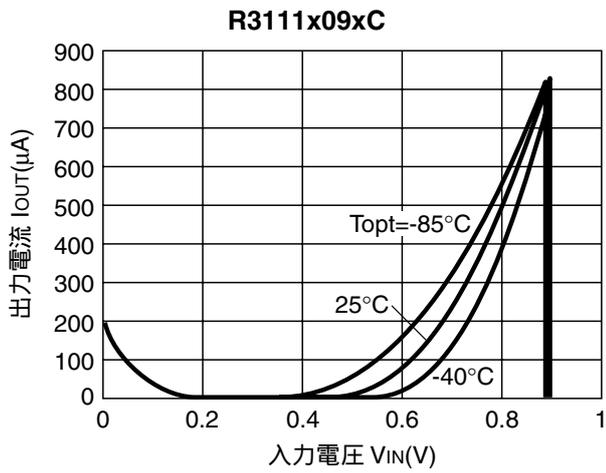


4) Nch ドライバ出力電流対 V<sub>DS</sub> 特性例



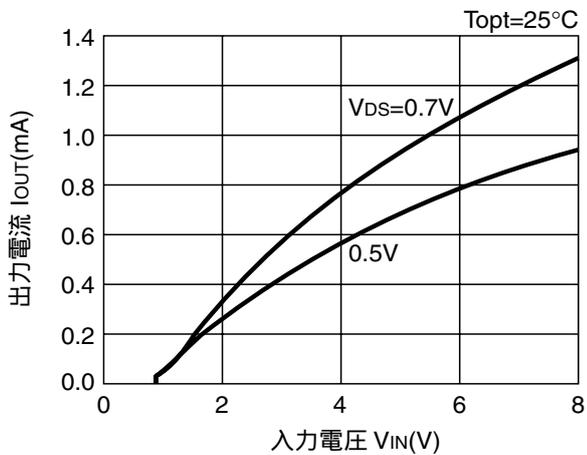


5) Nch ドライバ出力電流対入力電圧特性例

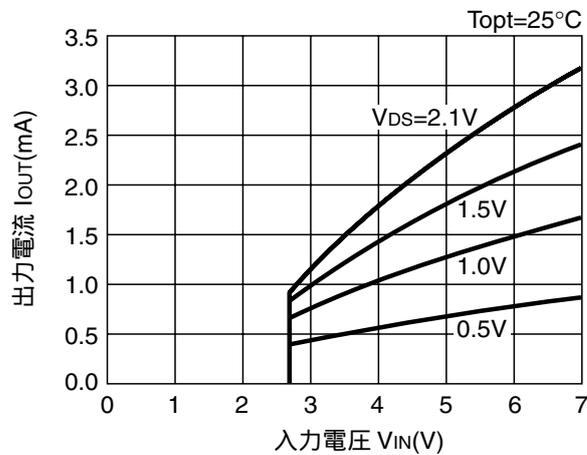


6) Pch ドライバ出力電流対入力電圧特性例

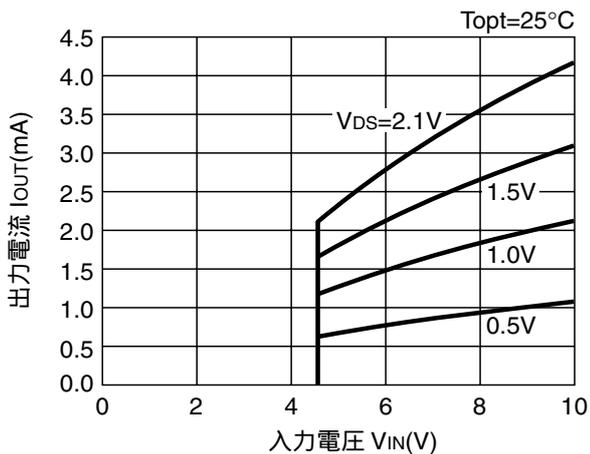
R3111x09xC



R3111x27xC

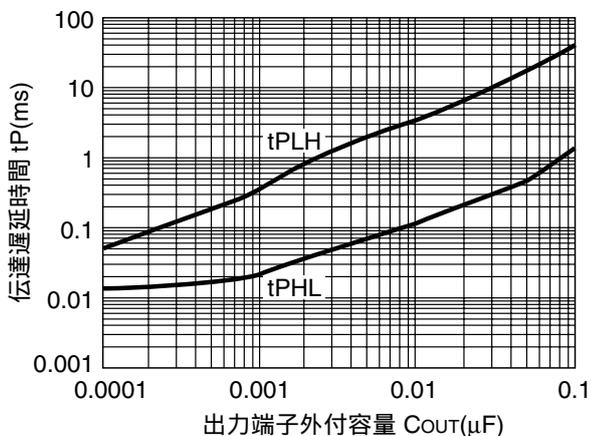


R3111x45xC

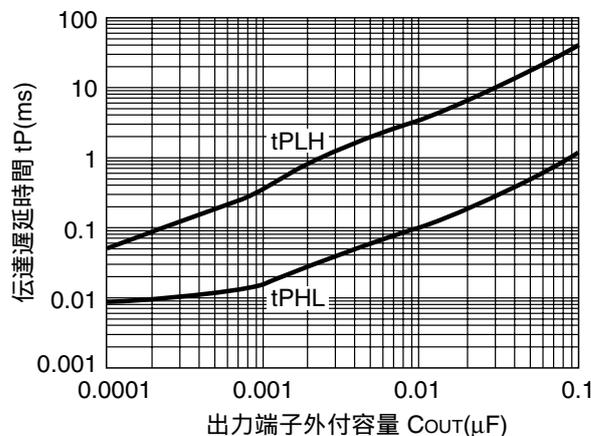


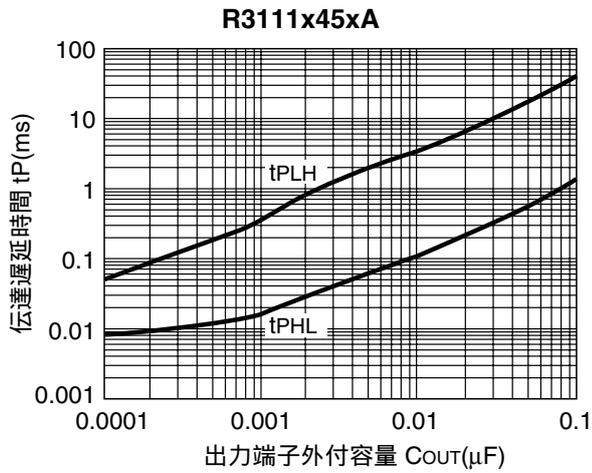
7) 伝達遅延時間対出力端子外付容量特性例

R3111x09xA

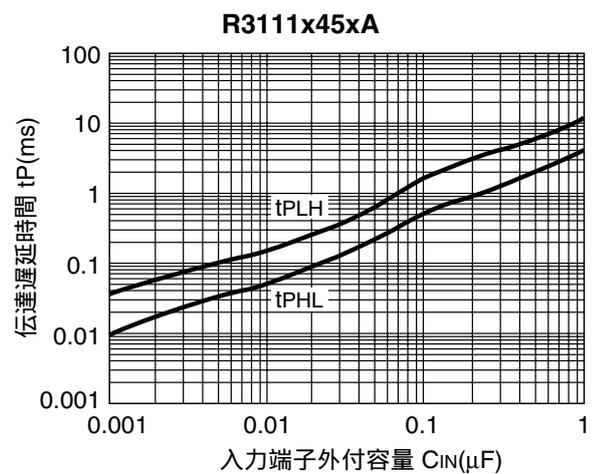
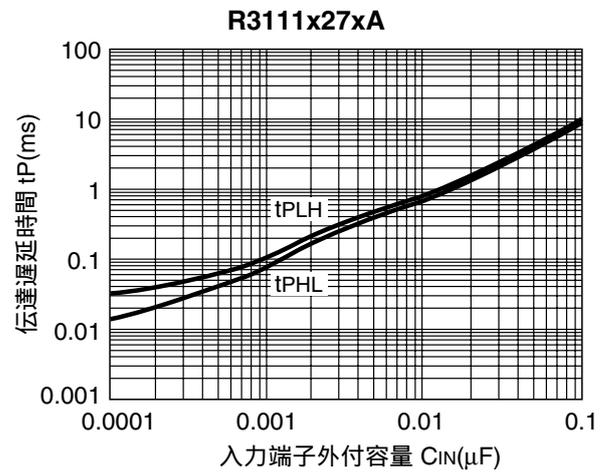
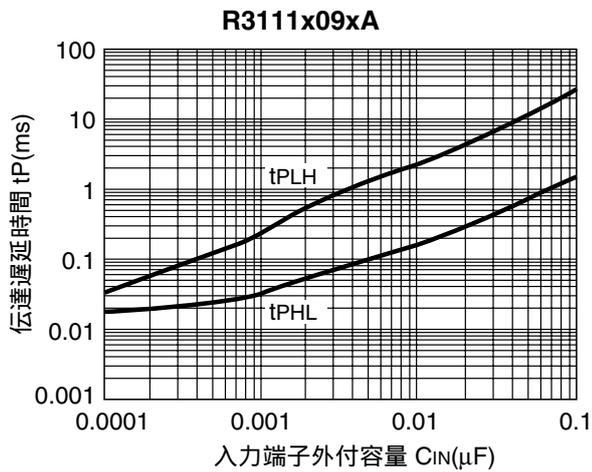


R3111x27xA





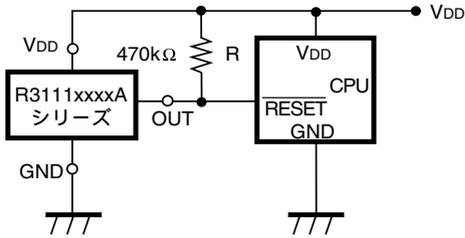
### 8) 伝達遅延時間対入力端子外付容量特性例



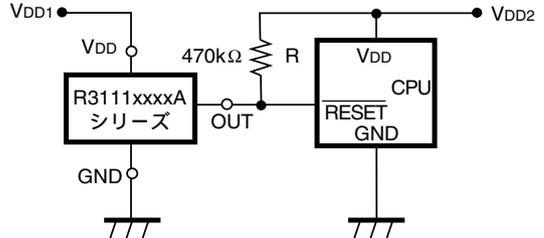
■ 基本回路例

● R3111xxx1A CPU リセット回路 (Nch オープンドレイン出力)

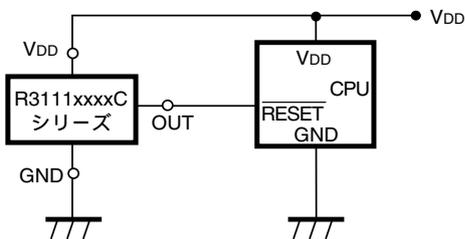
(1) R3111xxxxA の入力電圧と CPU の入力電圧が等しい場合



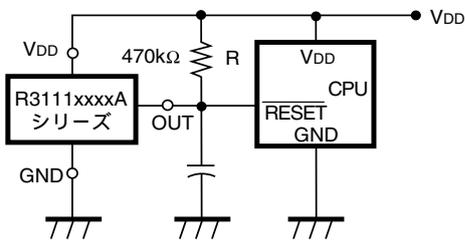
(2) R3111xxxxA の入力電圧と CPU の入力電圧が異なる場合



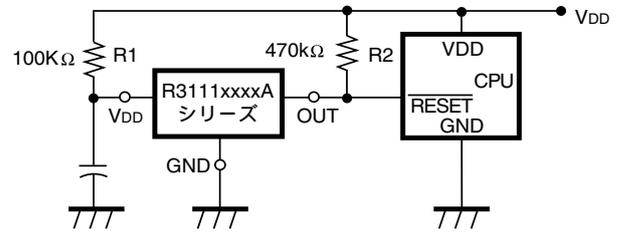
● R3111xxxxA CPU リセット回路 (CMOS 出力)



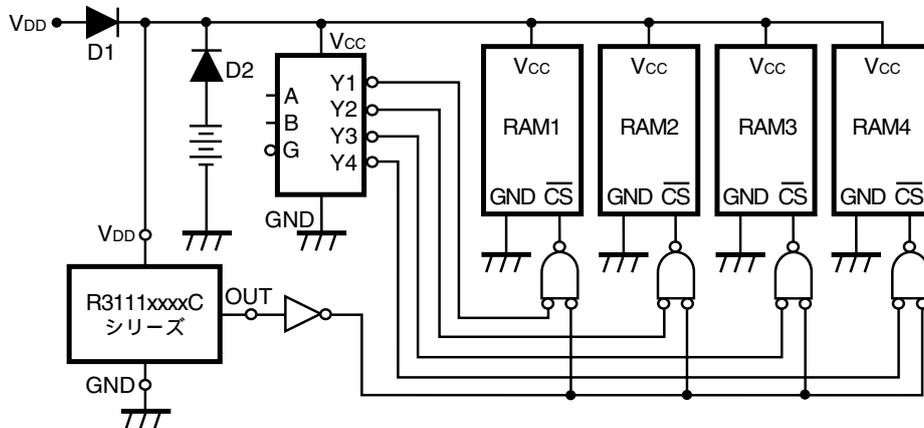
● R3111xxxxA 伝達遅延回路 1 (Nch オープンドレイン)



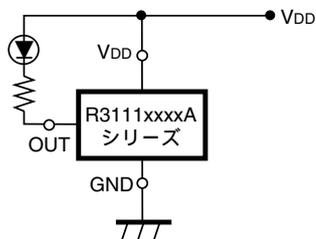
● R3111xxxxA 伝達遅延回路 2 (Nch オープンドレイン)



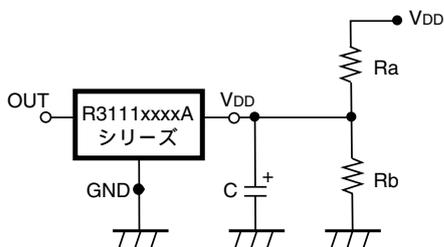
● メモリ・バックアップ回路



- 電圧レベルインジケータ回路（電圧低下時点灯タイプ）  
（Nch オープンドレイン出力）



- 任意電源電圧検出回路  
（Nch オープンドレイン出力）

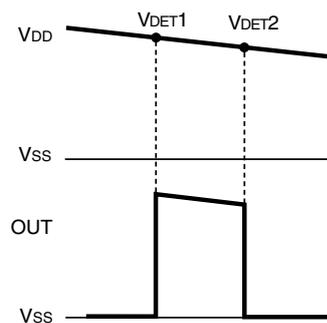
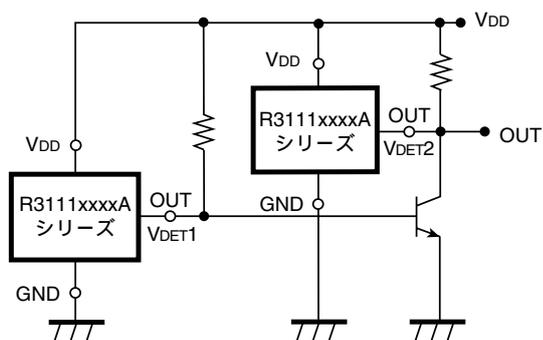


$$\text{希望検出電圧} = (-V_{\text{DET}}) * (R_a + R_b) / R_b$$

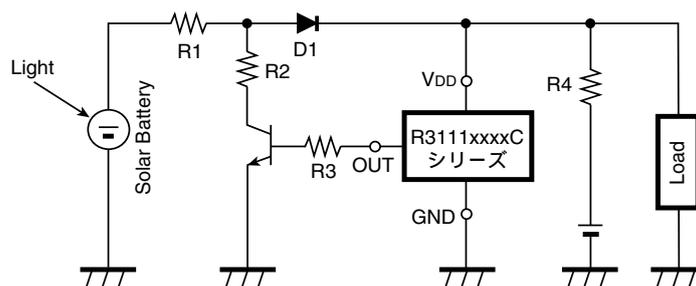
$$\text{ヒステリシス電圧} = (V_{\text{HYS}}) * (R_a + R_b) / R_b$$

\*)  $R_a$  の値が大きくなると、IC 自体の消費電流による  $R_a$  での電圧降下のため検出電圧が計算式と異なってきますので注意してください。

- ウィンドウコンパレータ回路  
（Nch オープンドレイン）



- 過充電防止回路



## 注意事項

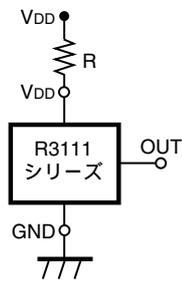


図-9

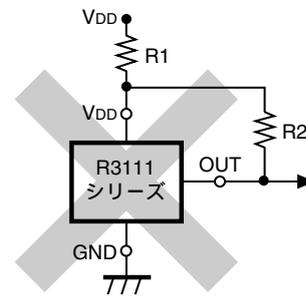


図-10

1. 図-9 において R3111xxxxC を使用する場合、電源端子  $V_{DD}$  と R3111xxxxC シリーズの  $V_{DD}$  端子間にインピーダンスを接続すると検出時の貫通電流により発振することがありますのでご注意ください。R3111xxxxA を使用する場合には、R が大きくなると IC 自体の消費電流の電圧降下で検出電圧が変動してしまいますのでご注意ください。
2. 図-10 のような接続は全ての出力タイプとも発振の原因になりますのでご注意ください。