**Analogue Semiconductor IC**

**VRH Series**

High speed, Low dropout, ±1% High output accuracy
CMOS Voltage Regulator with On/Off circuit

(IMPORTANT: Please check the last page for Genuine Product Labeling)

Rev. E13-01

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........... Future of the analog world
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**GENERAL DESCRIPTIONS**

The VRH series are positive voltage regulators with high speed, low voltage dropout and high accuracy output achieved by low current consumption. The output voltage is guaranteed within ±1% within the given temperature range by Vref controlling the temperature characteristic. It corresponds to the low ESR capacitor as an output stabilization capacitor. The charged ESR capacitor can be discharged with an internal switch by making the EN=Vss, as a result the VOUT quickly returns to the Vss level. To make the current capacity of the output transistor not exceeded, the over-current protection circuit is built in.

**FEATURES**

- Output voltage range: 0.9V~5.0V (selectable with a step of 0.05V)
- Operating voltage range: 1.6V~6.0V
- High accuracy output voltage: ±1% (VOUT=1.95V ~ 5.0V) / ±20mV (VOUT=0.9V ~ 1.9V)
- Maximum output current: 250mA
- Dropout voltage: Typ. 90mV (output=3.0V, IOUT=100mA)
- Low current consumption: Typ. 25μA
- High ripple rejection: Typ. 75dB at 1KHz
- Low ESR capacitor: 1.0 μF ceramic capacitor
- Operating temperature range: −40°C ~ +85°C
- Built-in over-current protector: Limit current: 300mA
- CL high-speed auto-discharge
- Built-in On/Off circuit
- Small package: SOT-25 (2.9×2.8×1.1mm), LLP-4 (1.2×1.6×0.6mm), SDFN-4 (1.0×1.0×0.4mm)

**APPLICATIONS**

- Battery powered devices
- Cellular phone
- Digital / Video cameras
- Portable games
- Handheld instruments
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**PRODUCTS NUMBERING GUIDE**

**VRH**

- **Discharge function**: X : Auto discharge
- **Package form**: T : SOT-25  
  L : LLP-4  
  V : SDFN-4
- **Function specification**: L : VOUT=0.9V~1.9V  
  N : VOUT=1.95V~5.0V
- **Accuracy rate**: 1 : ±1%  
  2 : ±20mV
- **Output voltage**: 090 ~ 500 : Selectable with a step of 0.05V in the range of 0.9V ~ 5.0V  
  e.g.) 090 : 0.90V,  285 : 2.85V

**PIN CONFIGURATION / MARKING SPECIFICATION (SOT-25)**

- **Pin Configuration**

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbol</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VIN</td>
<td>Voltage input</td>
</tr>
<tr>
<td>2</td>
<td>VSS</td>
<td>Power ground</td>
</tr>
<tr>
<td>3</td>
<td>EN</td>
<td>Chip enable</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>Non connection (open)</td>
</tr>
<tr>
<td>5</td>
<td>VOUT</td>
<td>Output</td>
</tr>
</tbody>
</table>

- **Marking Specification**

<table>
<thead>
<tr>
<th>Code</th>
<th>Mark</th>
<th>Contents</th>
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<tbody>
<tr>
<td>A</td>
<td>H</td>
<td>Products series name</td>
</tr>
<tr>
<td>BCD</td>
<td>090~500</td>
<td>Output voltage</td>
</tr>
<tr>
<td>E</td>
<td>X</td>
<td>Discharge function</td>
</tr>
<tr>
<td>F</td>
<td>Internal rule</td>
<td>Lot number</td>
</tr>
</tbody>
</table>
High speed, Low dropout, \(\pm 1\%\) High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**PIN CONFIGURATION / MARKING SPECIFICATION (LLP-4)**

**Pin Configuration**

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbol</th>
<th>Descriptions</th>
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<tr>
<td>1</td>
<td>VOUT</td>
<td>Output</td>
</tr>
<tr>
<td>2</td>
<td>VSS</td>
<td>Power ground</td>
</tr>
<tr>
<td>3</td>
<td>EN</td>
<td>Chip enable</td>
</tr>
<tr>
<td>4</td>
<td>VIN</td>
<td>Voltage input</td>
</tr>
<tr>
<td>5</td>
<td>VSS</td>
<td>Power ground</td>
</tr>
</tbody>
</table>

**Marking Specification**

<table>
<thead>
<tr>
<th>Code</th>
<th>Mark</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
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<td>H</td>
<td>Products series name</td>
</tr>
<tr>
<td>B</td>
<td>X</td>
<td>Discharge function</td>
</tr>
<tr>
<td>CDE</td>
<td>090~500</td>
<td>Output voltage</td>
</tr>
<tr>
<td>F</td>
<td>Internal rule</td>
<td>Lot number</td>
</tr>
</tbody>
</table>

**PIN CONFIGURATION / MARKING SPECIFICATION (SDFN-4)**

**Pin Configuration**

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbol</th>
<th>Descriptions</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>VOUT</td>
<td>Output</td>
</tr>
<tr>
<td>2</td>
<td>VSS</td>
<td>Power ground</td>
</tr>
<tr>
<td>3</td>
<td>EN</td>
<td>Chip enable</td>
</tr>
<tr>
<td>4</td>
<td>VIN</td>
<td>Voltage input</td>
</tr>
<tr>
<td>5</td>
<td>VSS</td>
<td>Power ground</td>
</tr>
</tbody>
</table>

**Marking Specification**

<table>
<thead>
<tr>
<th>Code</th>
<th>Mark</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>09~50</td>
<td>Output voltage</td>
</tr>
<tr>
<td>CD</td>
<td>Internal rule</td>
<td>Lot number</td>
</tr>
</tbody>
</table>
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

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**BLOCK DIAGRAM**

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**ABSOLUTE MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range</td>
<td>VIN</td>
<td>–0.3 ~ +7.0</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>IOUT</td>
<td>500</td>
<td>mA</td>
</tr>
<tr>
<td>Output voltage range</td>
<td>VOUT</td>
<td>VSS –0.3 ~ VIN +0.3</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation ※1</td>
<td>PD</td>
<td>600</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>LLP-4</td>
<td>1000</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>SDFN-4</td>
<td>550</td>
<td>mW</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>TOPR</td>
<td>–40 ~ +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>TSTG</td>
<td>–55 ~ +125</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note:
※1) Power dissipation depends on conditions of mounting on boards.
Pcb dimension is 50mm×50mm×1.6mm.

---

**TYPICAL APPLICATION CIRCUITS**

---


ELECTRICAL CHARACTERISTICS

(Ta=25°C unless otherwise specified)

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Test circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage</td>
<td>VOUT</td>
<td>VOUT+1.0V ≤ V IN ≤ 6.0V</td>
<td>VOUT ≥ 1.95V</td>
<td>VOUT × 0.99</td>
<td>VOUT</td>
<td>VOUT × 1.01</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IOUT=30mA Ta=−40°C ~ +85°C</td>
<td>VOUT ≤ 1.90V</td>
<td>-20</td>
<td>-</td>
<td>+20</td>
<td>mV</td>
</tr>
<tr>
<td>Output current</td>
<td>IOUT</td>
<td>VIN ≥ VOUT+1.0V</td>
<td>1.2V ≤ VOUT ≤ 1.65V</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.7V ≤ VOUT ≤ 2.25V</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.3V ≤ VOUT ≤ 2.85V</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.9V ≤ VOUT ≤ 3.45V</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.5V ≤ VOUT ≤ 4.05V</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.0V ≤ VOUT ≤ 5.00V</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Dropout voltage</td>
<td>VDROP</td>
<td>IOUT=100mA</td>
<td>1.2V ≤ VOUT ≤ 1.65V</td>
<td>-</td>
<td>210</td>
<td>340</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.7V ≤ VOUT ≤ 2.25V</td>
<td>-</td>
<td>130</td>
<td>205</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.3V ≤ VOUT ≤ 2.85V</td>
<td>-</td>
<td>100</td>
<td>150</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.9V ≤ VOUT ≤ 3.45V</td>
<td>-</td>
<td>90</td>
<td>137</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.5V ≤ VOUT ≤ 4.05V</td>
<td>-</td>
<td>85</td>
<td>125</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.1V ≤ VOUT ≤ 5.00V</td>
<td>-</td>
<td>80</td>
<td>115</td>
<td>mV</td>
</tr>
</tbody>
</table>
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

ELECTRICAL CHARACTERISTICS (continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Test circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>IDD</td>
<td>$V_{IN}=V_{OUT}+1.0V, V_{OUT}=0mA, I_{OUT}=0mA$</td>
<td>-</td>
<td>25</td>
<td>40</td>
<td>µA</td>
<td>2</td>
</tr>
<tr>
<td>Standby current</td>
<td>ISTB</td>
<td>$EN=V_{SS}$</td>
<td>-</td>
<td>0.01</td>
<td>0.1</td>
<td>µA</td>
<td>2</td>
</tr>
<tr>
<td>Input voltage</td>
<td>$V_{IN}$</td>
<td>1.6 - 6.0</td>
<td>V</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load regulation</td>
<td>$\Delta V_{OUT}$</td>
<td>$V_{IN}=V_{OUT}+1.0V, I_{OUT}=0.1mA - 100mA$</td>
<td>-</td>
<td>10</td>
<td>40</td>
<td>mV</td>
<td>1</td>
</tr>
<tr>
<td>Line regulation</td>
<td>$\Delta V_{Vi} / \Delta V_{In}$</td>
<td>$V_{OUT}+1.0V \leq V_{IN} \leq 6.0V, I_{OUT}=30mA$</td>
<td>-</td>
<td>0.01</td>
<td>0.1</td>
<td>%/V</td>
<td>1</td>
</tr>
<tr>
<td>Ripple rejection</td>
<td>Rr</td>
<td>$V_{IN}=V_{OUT}+1.0V, f=1KHz, \Delta V_{RIP}=0.5VP-P, I_{OUT}=30mA$</td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>dB</td>
<td>3</td>
</tr>
<tr>
<td>Limit current</td>
<td>ILIMIT</td>
<td>$EN=V_{IN}$</td>
<td>300</td>
<td>-</td>
<td>-</td>
<td>mA</td>
<td>1</td>
</tr>
<tr>
<td>Short circuit current</td>
<td>ISHORT</td>
<td>$V_{IN}=V_{OUT}+1.0V, V_{OUT}=0V$</td>
<td>-</td>
<td>40</td>
<td>-</td>
<td>mA</td>
<td>1</td>
</tr>
<tr>
<td>Output voltage temperature coefficient</td>
<td>$\Delta V_{OUT} / \Delta T_a$</td>
<td>$V_{EN}=V_{IN}, I_{OUT}=300mA$ $T_a=-40^\circ C \sim +85^\circ C$</td>
<td>-20</td>
<td>ppm</td>
<td>°C</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>EN high level voltage</td>
<td>VENH</td>
<td></td>
<td>1.2</td>
<td>-</td>
<td>6.0</td>
<td>V</td>
<td>4</td>
</tr>
<tr>
<td>EN low level voltage</td>
<td>VENL</td>
<td></td>
<td>-</td>
<td>-</td>
<td>0.3</td>
<td>V</td>
<td>4</td>
</tr>
<tr>
<td>EN high level current</td>
<td>IENH</td>
<td>$V_{EN}=V_{IN}=5V$</td>
<td>0.25</td>
<td>-</td>
<td>5.0</td>
<td>µA</td>
<td>4</td>
</tr>
<tr>
<td>EN low level current</td>
<td>IENL</td>
<td>$V_{EN}=V_{SS}$</td>
<td>-0.1</td>
<td>-</td>
<td>0.1</td>
<td>µA</td>
<td>4</td>
</tr>
<tr>
<td>Cl auto-discharge resistance</td>
<td>RDIS</td>
<td>$V_{IN}=6.0V, V_{OUT}=4.0V, V_{EN}=V_{SS}$</td>
<td>-</td>
<td>160</td>
<td>-</td>
<td>Ω</td>
<td>1</td>
</tr>
</tbody>
</table>
TEST CIRCUITS

- **Circuit (1)** - Output voltage, Output current, Dropout voltage, Input voltage, Load regulation, Line regulation, Limit current, Short circuit current, Output voltage temperature coefficient, CL auto-discharge resistance

- **Circuit (2)** - Current consumption, Standby current

- **Circuit (3)** - Ripple rejection

- **Circuit (4)** - EN high level voltage, EN low level voltage, EN high level current, EN low level current
DESCRIPTION OF OPERATION

- **General operation**
  
  In reference to following block diagram of the VRH series:

  ![Block Diagram](image)

  By the error amplifier, the reference voltage ($V_{REF}$) is compared with $V_{FEEDBACK}$ which is divided by feedback resistors $R_1$ and $R_2$. It supplies the output transistor (see note *1) to keep a stabilized output voltage against any fluctuation of input voltage by negative feedback system.

  **Note *1)**

  The VRH series has P-channel MOSFET which is connected to the $V_{OUT}$ terminal as the output transistor. To prevent the VRH series from being damaged due to inverse current from $V_{OUT}$ terminal to $V_{IN}$ terminal through a parasitic diode, $V_{OUT}$ should not be exceeded $V_{IN} + 0.3V$.

- **EN terminal (shutdown function) & CL auto-discharge**
  
  The VRH series can be shutdown through EN terminal. The P-channel MOSFET is turned off and operation of all internal circuits stops to reduce the current consumption when the signal of EN terminal is set to the shutdown level. In shutdown mode, the VRH series enables the electric charge at the $C_L$ to be discharged via the auto-discharge resistance ($R_{DIS}$; 160Ω), and the $V_{OUT}$ terminal can be rapidly returned to the $V_{SS}$ level as a result.

- **Output capacitor (CL)**
  
  For phase compensation, an output capacitor ($C_L$) is required to connected between $V_{OUT}$ terminal and $V_{SS}$ terminal as close as possible. A ceramic capacitor with capacitance value of at least 1.0µF is recommended. Of course, the suitable capacitance value should be different by the condition of each application. In addition, an input capacitor ($C_{IN}$) with capacitance value of at least 1.0µF is also recommended between $V_{IN}$ terminal and $V_{SS}$ terminal for stable input power.

- **Over current protection and short circuit protection**
  
  Built-in over current protection circuit performs circuit protection from over current as a current limiter. When the load current reaches the limit level, the output voltage drops and output current also decreases accordingly. A current of typ. 40mA will flow when output terminal is shorted.
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

TYPICAL CHARACTERISTICS – Output Voltage vs. Output Current

- **VRH1202xxx (Vout=1.2V)**

![VRH1202xxx (Vout=1.2V) Graph](image)

- **VRH1802xxx (Vout=1.8V)**

![VRH1802xxx (Vout=1.8V) Graph](image)

- **VRH2801xxx (Vout=2.8V)**

![VRH2801xxx (Vout=2.8V) Graph](image)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TYPICAL CHARACTERISTICS** – Output Voltage vs. Output Current (continued)

- **VRH3001xxx (Vout=3.0V)**

- **VRH3301xxx (Vout=3.3V)**

- **VRH3001xxx (Vout=3.0V)**

- **VRH3301xxx (Vout=3.3V)**
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

TYPICAL CHARACTERISTICS – Output Voltage vs. Input Voltage

- **VRH1202xxx (V_{OUT}=1.2V)**

  ![Graph of VRH1202xxx (V_{OUT}=1.2V)]

- **VRH1802xxx (V_{OUT}=1.8V)**

  ![Graph of VRH1802xxx (V_{OUT}=1.8V)]

- **VRH2801xxx (V_{OUT}=2.8V)**

  ![Graph of VRH2801xxx (V_{OUT}=2.8V)]

- **VRH1202xxx (V_{OUT}=1.2V)**

  ![Graph of VRH1202xxx (V_{OUT}=1.2V)]

- **VRH1802xxx (V_{OUT}=1.8V)**

  ![Graph of VRH1802xxx (V_{OUT}=1.8V)]

- **VRH2801xxx (V_{OUT}=2.8V)**

  ![Graph of VRH2801xxx (V_{OUT}=2.8V)]
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TYPICAL CHARACTERISTICS** – Output Voltage vs. Input Voltage (continued)

- **VRH3001xxx (Vout=3.0V)**

- **VRH3301xxx (Vout=3.3V)**

- **VRH3001xxx (Vout=3.0V)**

- **VRH3301xxx (Vout=3.3V)**
TYPICAL CHARACTERISTICS – Dropout Voltage vs. Output Current

- **VRH1202xxx (Vout=1.2V)**
  
  - Dropout Voltage : $V_{DROP}$ (V)
  - Output Current : $I_{OUT}$ (mA)

- **VRH1802xxx (Vout=1.8V)**
  
  - Dropout Voltage : $V_{DROP}$ (V)
  - Output Current : $I_{OUT}$ (mA)

- **VRH2801xxx (Vout=2.8V)**
  
  - Dropout Voltage : $V_{DROP}$ (V)
  - Output Current : $I_{OUT}$ (mA)

- **VRH3001xxx (Vout=3.0V)**
  
  - Dropout Voltage : $V_{DROP}$ (V)
  - Output Current : $I_{OUT}$ (mA)

- **VRH3301xxx (Vout=3.3V)**
  
  - Dropout Voltage : $V_{DROP}$ (V)
  - Output Current : $I_{OUT}$ (mA)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TYPICAL CHARACTERISTICS – Output Voltage vs. Ambient Temperature**

- **VRH1202xxx (V_{OUT}=1.2V)**
  ![Graph showing output voltage vs. ambient temperature for VRH1202xxx](image)

- **VRH1802xxx (V_{OUT}=1.8V)**
  ![Graph showing output voltage vs. ambient temperature for VRH1802xxx](image)

- **VRH2801xxx (V_{OUT}=2.8V)**
  ![Graph showing output voltage vs. ambient temperature for VRH2801xxx](image)

- **VRH3001xxx (V_{OUT}=3.0V)**
  ![Graph showing output voltage vs. ambient temperature for VRH3001xxx](image)

- **VRH3301xxx (V_{OUT}=3.3V)**
  ![Graph showing output voltage vs. ambient temperature for VRH3301xxx](image)

- **VRH3802xxx (V_{OUT}=3.8V)**
  ![Graph showing output voltage vs. ambient temperature for VRH3802xxx](image)

**TYPICAL CHARACTERISTICS – CL-Discharge Resistance vs. Ambient Temperature**

- **VRH1202xxx (V_{OUT}=1.2V)**
  ![Graph showing CL-discharge resistance vs. ambient temperature for VRH1202xxx](image)

- **VRH1802xxx (V_{OUT}=1.8V)**
  ![Graph showing CL-discharge resistance vs. ambient temperature for VRH1802xxx](image)

- **VRH2801xxx (V_{OUT}=2.8V)**
  ![Graph showing CL-discharge resistance vs. ambient temperature for VRH2801xxx](image)

- **VRH3001xxx (V_{OUT}=3.0V)**
  ![Graph showing CL-discharge resistance vs. ambient temperature for VRH3001xxx](image)

- **VRH3301xxx (V_{OUT}=3.3V)**
  ![Graph showing CL-discharge resistance vs. ambient temperature for VRH3301xxx](image)

- **VRH3802xxx (V_{OUT}=3.8V)**
  ![Graph showing CL-discharge resistance vs. ambient temperature for VRH3802xxx](image)
TYPICAL CHARACTERISTICS – Supply Current vs. Input Voltage

- **VRH1202xxx (V_{OUT}=1.2V)**
  - EN=V_{IN}, C_{IN}=C_{L}=1.0µF
  - Supply Current : I_{DD} (µA)
  - Input Voltage : V_{IN} (V)
  - Ta=+25°C
  - Ta=–40°C
  - Ta=+85°C

- **VRH1802xxx (V_{OUT}=1.8V)**
  - EN=V_{IN}, C_{IN}=C_{L}=1.0µF
  - Supply Current : I_{DD} (µA)
  - Input Voltage : V_{IN} (V)
  - Ta=+25°C
  - Ta=–40°C
  - Ta=+85°C

- **VRH2801xxx (V_{OUT}=2.8V)**
  - EN=V_{IN}, C_{IN}=C_{L}=1.0µF
  - Supply Current : I_{DD} (µA)
  - Input Voltage : V_{IN} (V)
  - Ta=+25°C
  - Ta=–40°C
  - Ta=+85°C

- **VRH3001xxx (V_{OUT}=3.0V)**
  - EN=V_{IN}, C_{IN}=C_{L}=1.0µF
  - Supply Current : I_{DD} (µA)
  - Input Voltage : V_{IN} (V)
  - Ta=+25°C
  - Ta=–40°C
  - Ta=+85°C

- **VRH3301xxx (V_{OUT}=3.3V)**
  - EN=V_{IN}, C_{IN}=C_{L}=1.0µF
  - Supply Current : I_{DD} (µA)
  - Input Voltage : V_{IN} (V)
  - Ta=+25°C
  - Ta=–40°C
  - Ta=+85°C
TYPICAL CHARACTERISTICS – Load Transient Response

- **VRH1202xxx (Vout=1.2V)**
  
- **VRH1802xxx (Vout=1.8V)**

- **VRH2801xxx (Vout=2.8V)**

- **VRH3001xxx (Vout=3.0V)**

- **VRH3301xxx (Vout=3.3V)**
TYPICAL CHARACTERISTICS – Input Transient Response (I_{OUT}=1mA)

- **VRH1202xxx (V_{OUT}=1.2V)**
  
  ![Input Transient Response (VRH1202xxx)](image)

- **VRH1802xxx (V_{OUT}=1.8V)**
  
  ![Input Transient Response (VRH1802xxx)](image)

- **VRH2801xxx (V_{OUT}=2.8V)**
  
  ![Input Transient Response (VRH2801xxx)](image)

- **VRH3001xxx (V_{OUT}=3.0V)**
  
  ![Input Transient Response (VRH3001xxx)](image)

- **VRH3301xxx (V_{OUT}=3.3V)**
  
  ![Input Transient Response (VRH3301xxx)](image)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TYPICAL CHARACTERISTICS** – Input Transient Response (I\textsubscript{OUT}=30mA)

- **VRH1202xxx (V\textsubscript{OUT}=1.2V)**
- **VRH1802xxx (V\textsubscript{OUT}=1.8V)**
- **VRH2801xxx (V\textsubscript{OUT}=2.8V)**
- **VRH3001xxx (V\textsubscript{OUT}=3.0V)**
- **VRH3301xxx (V\textsubscript{OUT}=3.3V)**

![Input Transient Response Diagrams](image-url)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TYPICAL CHARACTERISTICS** – Input Transient Response (I\textsubscript{OUT}=100mA)

- **VRH1202xxx (V\textsubscript{OUT}=1.2V)**

- **VRH1802xxx (V\textsubscript{OUT}=1.8V)**

- **VRH2801xxx (V\textsubscript{OUT}=2.8V)**

- **VRH3001xxx (V\textsubscript{OUT}=3.0V)**

- **VRH3301xxx (V\textsubscript{OUT}=3.3V)**

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TYPICAL CHARACTERISTICS – Input Rise Time (I_{OUT}=1mA)

- VRH1202xxx (V_{OUT}=1.2V)
- VRH1802xxx (V_{OUT}=1.8V)
- VRH2801xxx (V_{OUT}=2.8V)
- VRH3001xxx (V_{OUT}=3.0V)
- VRH3301xxx (V_{OUT}=3.3V)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

TYPICAL CHARACTERISTICS – Input Rise Time (I\text{OUT}=30mA)

- **VRH1202xxx (V\text{OUT}=1.2V)**
  ![VRH1202xxx Graph](https://via.placeholder.com/150)

- **VRH1802xxx (V\text{OUT}=1.8V)**
  ![VRH1802xxx Graph](https://via.placeholder.com/150)

- **VRH2801xxx (V\text{OUT}=2.8V)**
  ![VRH2801xxx Graph](https://via.placeholder.com/150)

- **VRH3001xxx (V\text{OUT}=3.0V)**
  ![VRH3001xxx Graph](https://via.placeholder.com/150)

- **VRH3301xxx (V\text{OUT}=3.3V)**
  ![VRH3301xxx Graph](https://via.placeholder.com/150)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

VRH Series

TYPICAL CHARACTERISTICS – Input Rise Time (I_{OUT}=100mA)

- **VRH1202xxx (V_{OUT}=1.2V)**
- **VRH1802xxx (V_{OUT}=1.8V)**
- **VRH2801xxx (V_{OUT}=2.8V)**
- **VRH3001xxx (V_{OUT}=3.0V)**
- **VRH3301xxx (V_{OUT}=3.3V)**
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TYPICAL CHARACTERISTICS** – EN Rise Time (I\(_{\text{OUT}}\)=1mA)

- **VRH1202xxx (V\(_{\text{OUT}}\)=1.2V)**
  
  ![Graph](image)

- **VRH1802xxx (V\(_{\text{OUT}}\)=1.8V)**
  
  ![Graph](image)

- **VRH2801xxx (V\(_{\text{OUT}}\)=2.8V)**
  
  ![Graph](image)

- **VRH3001xxx (V\(_{\text{OUT}}\)=3.0V)**
  
  ![Graph](image)

- **VRH3301xxx (V\(_{\text{OUT}}\)=3.3V)**
  
  ![Graph](image)

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Rev. E13-01

VRH Series

TYPICAL CHARACTERISTICS – EN Rise Time (I\text{OUT}=30\text{mA})

- **VRH1202xxx (V\text{OUT}=1.2V)**
  \[
  \text{EN Input Voltage : } V_{\text{EN}} (\text{V})
  \]
  \[
  4 \quad 3 \quad -1 \quad -3 
  \]
  \[
  2 \quad 1 
  \]
  \[
  \text{Time (40\mu s/div)}
  \]
  \[
  \text{Output Voltage : } V_{\text{OUT}} (\text{V})
  \]
  \[
  0 \quad 5 \quad 7 \quad 6 \quad 2 \quad 0 \quad 1 \quad 5 \quad 4 \quad 3 \quad 8 
  \]

- **VRH1802xxx (V\text{OUT}=1.8V)**
  \[
  \text{EN Input Voltage : } V_{\text{EN}} (\text{V})
  \]
  \[
  4 \quad 3 \quad -1 \quad -3 
  \]
  \[
  2 \quad 1 
  \]
  \[
  \text{Time (40\mu s/div)}
  \]
  \[
  \text{Output Voltage : } V_{\text{OUT}} (\text{V})
  \]
  \[
  0 \quad 5 \quad 7 \quad 6 \quad 2 \quad 0 \quad 1 \quad 5 \quad 4 \quad 3 \quad 8 
  \]

- **VRH2801xxx (V\text{OUT}=2.8V)**
  \[
  \text{EN Input Voltage : } V_{\text{EN}} (\text{V})
  \]
  \[
  4 \quad 3 \quad -1 \quad -3 
  \]
  \[
  2 \quad 1 
  \]
  \[
  \text{Time (40\mu s/div)}
  \]
  \[
  \text{Output Voltage : } V_{\text{OUT}} (\text{V})
  \]
  \[
  0 \quad 5 \quad 7 \quad 6 \quad 2 \quad 0 \quad 1 \quad 5 \quad 4 \quad 3 \quad 8 
  \]

- **VRH3001xxx (V\text{OUT}=3.0V)**
  \[
  \text{EN Input Voltage : } V_{\text{EN}} (\text{V})
  \]
  \[
  4 \quad 3 \quad -1 \quad -3 
  \]
  \[
  2 \quad 1 
  \]
  \[
  \text{Time (40\mu s/div)}
  \]
  \[
  \text{Output Voltage : } V_{\text{OUT}} (\text{V})
  \]
  \[
  0 \quad 5 \quad 7 \quad 6 \quad 2 \quad 0 \quad 1 \quad 5 \quad 4 \quad 3 \quad 8 
  \]

- **VRH3301xxx (V\text{OUT}=3.3V)**
  \[
  \text{EN Input Voltage : } V_{\text{EN}} (\text{V})
  \]
  \[
  4 \quad 3 \quad -1 \quad -3 
  \]
  \[
  2 \quad 1 
  \]
  \[
  \text{Time (40\mu s/div)}
  \]
  \[
  \text{Output Voltage : } V_{\text{OUT}} (\text{V})
  \]
  \[
  0 \quad 5 \quad 7 \quad 6 \quad 2 \quad 0 \quad 1 \quad 5 \quad 4 \quad 3 \quad 8 
  \]

\[
\text{VIN=VOUT+1.0V} \quad \text{Tr=5\mu s, Ta=25°C, CIN=CL=1.0\mu F} \\
\text{VIN=VOUT+1.0V} \quad \text{Tr=5\mu s, Ta=25°C, CIN=CL=1.0\mu F} \\
\text{VIN=VOUT+1.0V} \quad \text{Tr=5\mu s, Ta=25°C, CIN=CL=1.0\mu F} \\
\text{VIN=VOUT+1.0V} \quad \text{Tr=5\mu s, Ta=25°C, CIN=CL=1.0\mu F}
\]
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

TYPICAL CHARACTERISTICS – EN Rise Time (I_OUT=100mA)

○ VRH1202xxx (V_OUT=1.2V)

○ VRH1802xxx (V_OUT=1.8V)

○ VRH2801xxx (V_OUT=2.8V)

○ VRH3001xxx (V_OUT=3.0V)

○ VRH3301xxx (V_OUT=3.3V)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

VRH Series

**TYPICAL CHARACTERISTICS** – Ripple Rejection Rate

- **VRH1202xxx (Vout=1.2V)**
  - Ripple Rejection Rate : RR (dB)
  - Ripple Frequency : f (KHz)
  - \( V_{IN} \) = \( EN \) = (Vout + 1.0) \( V_{DC} \) + 0.5Vp-pac
  - \( I_{OUT} \) = 30mA, \( Ta = 25°C \), \( C_{IN} = C_{L} = 1.0\mu F \)

- **VRH1802xxx (Vout=1.8V)**
  - Ripple Rejection Rate : RR (dB)
  - Ripple Frequency : f (KHz)
  - \( V_{IN} \) = \( EN \) = (Vout + 1.0) \( V_{DC} \) + 0.5Vp-pac
  - \( I_{OUT} \) = 30mA, \( Ta = 25°C \), \( C_{IN} = C_{L} = 1.0\mu F \)

- **VRH2801xxx (Vout=2.8V)**
  - Ripple Rejection Rate : RR (dB)
  - Ripple Frequency : f (KHz)
  - \( V_{IN} \) = \( EN \) = (Vout + 1.0) \( V_{DC} \) + 0.5Vp-pac
  - \( I_{OUT} \) = 30mA, \( Ta = 25°C \), \( C_{IN} = C_{L} = 1.0\mu F \)

- **VRH3001xxx (Vout=3.0V)**
  - Ripple Rejection Rate : RR (dB)
  - Ripple Frequency : f (KHz)
  - \( V_{IN} \) = \( EN \) = (Vout + 1.0) \( V_{DC} \) + 0.5Vp-pac
  - \( I_{OUT} \) = 30mA, \( Ta = 25°C \), \( C_{IN} = C_{L} = 1.0\mu F \)

- **VRH3301xxx (Vout=3.3V)**
  - Ripple Rejection Rate : RR (dB)
  - Ripple Frequency : f (KHz)
  - \( V_{IN} \) = \( EN \) = (Vout + 1.0) \( V_{DC} \) + 0.5Vp-pac
  - \( I_{OUT} \) = 30mA, \( Ta = 25°C \), \( C_{IN} = C_{L} = 1.0\mu F \)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

VRH Series

PACKAGE DIMENSIONS (SOT-25)

(Unit : mm)

---

a = 0.32 \pm 0.10

Flat length = 0.2 min.
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

VRH Series

TAPING AND LOADING SPECIFICATIONS (SOT-25)

(Unit : mm)

REEL DIMENSIONS (SOT-25)

(Unit : mm)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

PACKAGE DIMENSIONS (LLP-4)

(Unit : mm)

Recommended land pattern
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

VRH Series

TAPING AND LOADING SPECIFICATIONS (LLP-4)

(Unit : mm)

REEL DIMENSIONS (LLP-4)

(Unit : mm)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

VRH Series

PACKAGE DIMENSIONS (SDFN-4)

(Unit : mm)

Recommended land pattern

(C0.12)

(Marked Side)
High speed, Low dropout, ±1% High output accuracy with On/Off circuit CMOS Voltage Regulator

**VRH Series**

**TAPPING AND LOADING SPECIFICATIONS (SDFN-4)**

(Unit : mm)

![Taping and Loading Specifications Diagram]

**REEL DIMENSIONS (SDFN-4)**

(Unit : mm)

![Reel Dimensions Diagram]
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