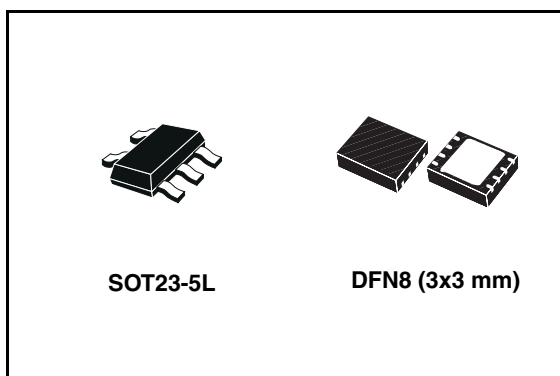


## High input voltage - 85 mA LDO linear regulator

### Features

- 2.5 V to 24 V input voltage
- Low dropout voltage (500 mV typ. at 85 mA)
- Very low quiescent current (3.8  $\mu$ A typ. at full load)
- 85 mA guaranteed output current
- Output voltage: fixed or adjustable
- Compatible with ceramic output capacitors from 0.47  $\mu$ F to 10  $\mu$ F
- Internal current limit
- Package DFN8 (3x3 mm), SOT23-5L
- Temperature range: -40 °C to 125 °C



similar battery powered systems. The wide input voltage range makes the ST715xx an ideal solution for low power industrial applications also.

The ST715xx is available in the DFN8 (3x3 mm) 8 leads or the SOT23-5.

### Description

The ST715xx is a high voltage, ultra low quiescent low drop linear regulator capable of providing an output current in excess of 85 mA. The device operates over an input voltage range spanning from 2.5 V to 24 V, and is also stable with output ceramic capacitors. Fault condition protection includes short-circuit current limitation. The ultra low quiescent current of 3.8  $\mu$ A at full load makes it highly suitable for low power applications and battery powered systems. Typical applications are mobile phones, personal digital assistant (PDAs), cordless phones and

**Table 1. Device summary**

| Order codes              |         |                           |         | Output Voltage |
|--------------------------|---------|---------------------------|---------|----------------|
| SOT23-5L                 | Marking | DFN8 (3x3 mm)             | Marking |                |
| ST715MR                  | 71AD    | ST715PUR                  | 715AD   | ADJ            |
| ST715M15R <sup>(1)</sup> | 7115    | ST715PU15R <sup>(1)</sup> | 71515   | 1.5 V          |
| ST715M18R <sup>(1)</sup> | 7118    | ST715PU18R <sup>(1)</sup> | 71518   | 1.8 V          |
| ST715M25R                | 7125    | ST715PU25R <sup>(1)</sup> | 71525   | 2.5 V          |
| ST715M28R <sup>(1)</sup> | 7128    | ST715PU28R <sup>(1)</sup> | 71528   | 2.8 V          |
| ST715M33R <sup>(1)</sup> | 7133    | ST715PU33R                | 71533   | 3.3 V          |

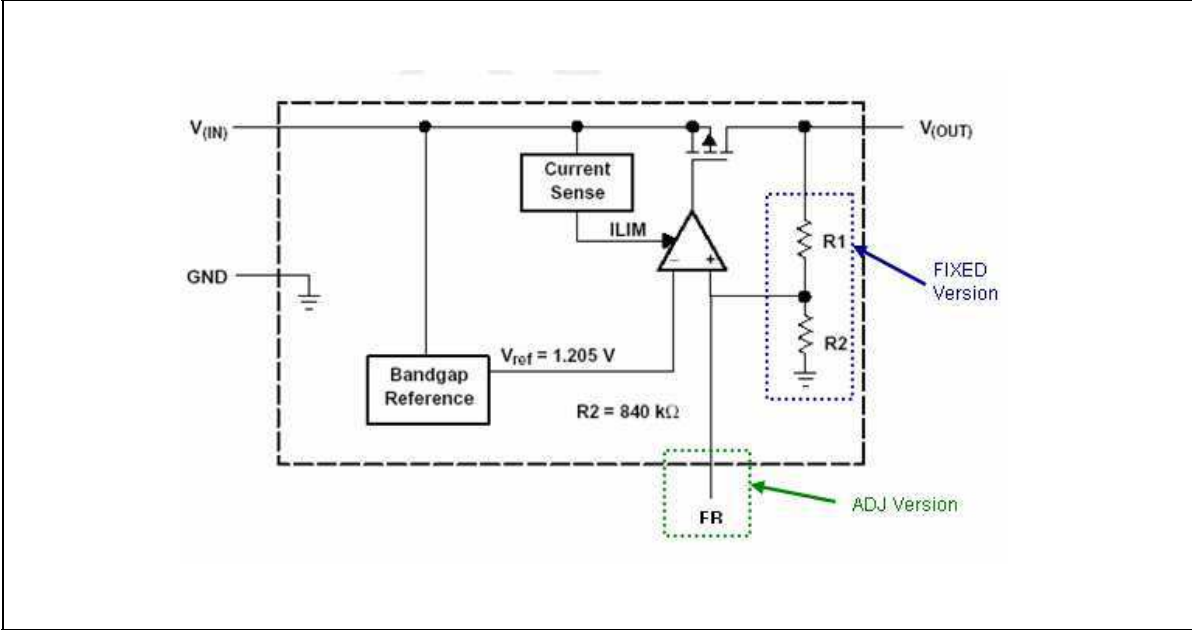
1. Available on request.

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# 1 Diagram

Figure 1. Block diagram



## 2 Pin configuration

Figure 2. Pin connections (top view)

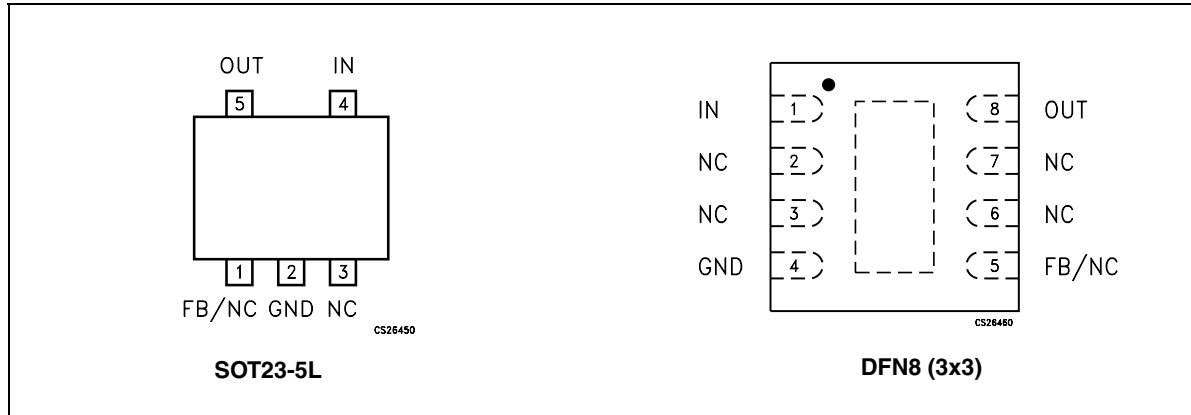


Table 2. Pin description (DFN8 3x3 mm)

| Symbol | Pin for fixed        | Pin for adjustable   | Name and function        |
|--------|----------------------|----------------------|--------------------------|
| IN     | 1                    | 1                    | Input voltage of the LDO |
| NC     | 2, 3, 5, 7, Exp. pad | 2, 3, 6, 7, Exp. pad | Not internally connected |
| GND    | 4                    | 4                    | Common ground            |
| FB     | -                    | 5                    | Feedback pin             |
| OUT    | 8                    | 8                    | Output voltage           |

Table 3. Pin description (SOT23-5L)

| Symbol | Pin for fixed | Pin for adjustable | Name and function        |
|--------|---------------|--------------------|--------------------------|
| IN     | 4             | 4                  | Input voltage of the LDO |
| NC     | 3             | 1, 3               | Not internally connected |
| GND    | 2             | 2                  | Common ground            |
| FB     | 1             |                    | Feedback pin             |
| OUT    | 5             | 5                  | Output voltage           |

### 3 Maximum ratings

**Table 4. Absolute maximum ratings**

| Symbol    | Parameter                                 | Value                                  | Unit |
|-----------|---|--|------|
| $V_{IN}$  | DC input voltage                          | from -0.3 to 26                        | V    |
| $V_{OUT}$ | DC output voltage                         | From -0.3 to $V_{IN}+0.3$              | V    |
| $I_{OUT}$ | Continuous output current DFN package     | According to package power dissipation | A    |
|           | Continuous output current SOT23-5 package | According to package power dissipation |      |
| $V_{ESD}$ | ESD ratings                               | $\pm 2$                                | kV   |
| $P_D$     | Power dissipation DFN package             | = 5                                    | W    |
|           | Power dissipation SOT23-5 package         | = 1                                    |      |
| $T_{STG}$ | Storage temperature range                 | -65 to 150                             | °C   |
| $T_{OP}$  | Operating junction temperature range      | -40 to 125                             | °C   |

*Note: Absolute maximum ratings are the values beyond which damage to the device may occur. Functional operation under these conditions is not implied.*

**Table 5. Thermal data**

| Symbol     | Parameter                           | SOT23-5L | DFN8 | Unit |
|------------|-------------------------------------|----------|------|------|
| $R_{thJA}$ | Thermal resistance junction-ambient | 255      | 52   | °C/W |

## 4 Electrical characteristics

**Table 6. Electrical characteristics - adjustable version**

( $T_J = 25\text{ }^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 1\text{ V}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 1\text{ }\mu\text{F}$ ,  $I_{OUT} = 1\text{ mA}$ , unless otherwise specified) (*Note 1*)

| Symbol           | Parameter                              | Test conditions   | Min.                 | Typ.  | Max.  | Unit                |
|------------------|--|---|----------------------|-------|-------|---------------------|
| $V_{IN}$         | Operating input voltage                | $I_{OUT} = 85\text{ mA}$  | 2.5                  |       | 24    | V                   |
| $V_{OUT}$        | Output voltage range                   |   | 1.2                  |       |       | V                   |
| $I_{OUT}$        | Output current                         | $V_{IN} = 2.5\text{ to }6\text{ V}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$  |                      |       | 85    | mA                  |
| $V_{FB}$         | Feedback voltage                       |   |                      | 1.2   |       | V                   |
|                  | $V_{FB}$ accuracy ( <i>Note 1</i> )    | $V_{IN} = V_{OUT} + 1\text{ to }24\text{ V}$ , $I_{OUT} = 1\text{ mA to }85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$                   | -4.0                 |       | 4.0   | %                   |
| $\Delta V_{OUT}$ | Line regulation                        | $V_{IN} = V_{OUT} + 1\text{ to }24\text{ V}$ , $I_{OUT} = 1\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$                                   |                      | 0.001 | 0.004 | %/V                 |
| $\Delta V_{OUT}$ | Load regulation                        | $I_{OUT} = 1\text{ mA to }85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$  |                      | 0.002 | 0.004 | %/mA                |
| $e_N$            | Output noise voltage ( <i>Note 4</i> ) | 200Hz to 100kHz, $I_{OUT} = 50\text{ mA}$ , $C_{OUT} = 10\text{ }\mu\text{F}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$ , $V_{OUT} = 1.2\text{ V}$ |                      |       | 95    | $\mu\text{V}_{RMS}$ |
| SVR              | Supply voltage rejection               | $V_{IN} = V_{OUT(NOM)} + 1\text{ V} \pm V_{RIPPLE}$ , $V_{RIPPLE} = 0.2\text{ V}$ , $I_{OUT} = 1\text{ mA}$ , $C_{OUT} = 10\text{ }\mu\text{F}$                           |                      | 45    |       | dB                  |
|                  |  | $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$  | $f = 100\text{ kHz}$ | 62    |       |                     |
| $I_Q$            | Quiescent current                      | $I_{OUT} = 0\text{ mA to }85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$  |                      |       | 4.5   | $\mu\text{A}$       |
|                  |  | $I_{OUT} = 0\text{ mA to }85\text{ mA}$ , $V_{IN} = 24\text{ V}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$   |                      |       | 5.5   |                     |
| $I_{SC}$         | Short circuit current                  | $V_{OUT} = 0$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$ , $V_{IN} = 3.8\text{ V}$  | 120                  |       |       | mA                  |
| $T_{ON}$         | Turn on time ( <i>Note 3</i> )         | $V_{IN} = 4.2\text{ V}$ , $C_{OUT} = 10\text{ }\mu\text{F}$ , $I_{OUT} = 60\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C to }125\text{ }^\circ\text{C}$                   |                      | 0.7   |       | ms                  |
| $C_{OUT}$        | Output capacitor                       | Capacitance $f = 100\text{ kHz}$  | 0.47                 |       |       | $\mu\text{F}$       |

Note: 1 For  $V_{OUT(NOM)} < 2\text{ V}$ ,  $V_{IN} = 2.5\text{ V}$ .

2 Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification does not apply for output voltages below 2 V.

3 Turn-on time is time measured between the input just exceeding 90% of its final value and the output voltage just reaching 95 % of its nominal value.

4 Guaranteed by design.

**Table 7. Electrical characteristics - fixed version**

( $T_J = 25\text{ }^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 1\text{ V}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 1\text{ }\mu\text{F}$ ,  $I_{OUT} = 1\text{ mA}$ ,  $V_{OUT} = 3.3\text{ V}$  unless otherwise specified) (*Note 1*)

| Symbol           | Parameter                                  | Test conditions   | Min.                    | Typ.  | Max.  | Unit                |               |
|------------------|--|---|-------------------------|-------|-------|---------------------|---------------|
| $V_{IN}$         | Operating input voltage                    | $I_{OUT} = 85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$   | $V_{OUT} + V_{DROPTYP}$ |       | 24    | V                   |               |
| $I_{OUT}$        | Output current                             | $V_{IN} = 4.3$ to $24\text{ V}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$  | 0                       |       | 85    | mA                  |               |
| $V_{OUT}$        | $V_{OUT}$ total accuracy ( <i>Note 1</i> ) | $V_{IN} = V_{OUT} + 1$ to $24\text{ V}$ , $I_{OUT} = 0$ to $85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$              | -5                      |       | +5    | %                   |               |
| $\Delta V_{OUT}$ | Line regulation                            | $V_{IN} = 4.3$ to $24\text{ V}$ , $I_{OUT} = 1\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$                              |                         | 0.001 | 0.004 | %/V                 |               |
| $\Delta V_{OUT}$ | Load regulation                            | $I_{OUT} = 100\text{ }\mu\text{A}$ to $85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$                                   |                         | 0.002 | 0.003 | %/mA                |               |
| $V_{DROPTYP}$    | Drop output voltage ( <i>Note 2</i> )      | $I_{OUT} = 85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$   |                         | 500   | 1000  | mV                  |               |
| $e_N$            | Output noise voltage ( <i>Note 4</i> )     | 200Hz to 100kHz, $I_{OUT} = 50\text{ mA}$ , $C_{OUT} = 10\text{ }\mu\text{F}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$          |                         |       | 210   | $\mu\text{V}_{RMS}$ |               |
| SVR              | Supply voltage rejection                   | $V_{IN} = V_{OUT(NOM)} + 1\text{ V} + V_{RIPPLE}$ , $V_{RIPPLE} = 0.2\text{ V}$ , $I_{OUT} = 1\text{ mA}$ , $C_{OUT} = 10\text{ }\mu\text{F}$             | $f = 1\text{ kHz}$      |       | 38    | dB                  |               |
|                  |  | $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$  | $f = 100\text{ kHz}$    |       | 57    |                     |               |
| $I_Q$            | Quiescent current                          | $I_{OUT} = 0\text{ mA}$ to $85\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$  |                         |       | 3.75  | 4.5                 | $\mu\text{A}$ |
|                  |  |   | $V_{IN} = 24\text{ V}$  |       | 4.15  | 5.5                 |               |
| $I_{SC}$         | Short circuit current                      | $V_{OUT} = 0$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$ , $V_{IN} = 3.8\text{ V}$  | 120                     |       |       | mA                  |               |
| $T_{ON}$         | Turn on time ( <i>Note 3</i> )             | $V_{IN} = 4.2\text{ V}$ , $C_{OUT} = 10\text{ }\mu\text{F}$ , $I_{OUT} = 60\text{ mA}$ , $T_J = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$ |                         | 0.7   |       | ms                  |               |
| $C_{OUT}$        | Output capacitor                           | Capacitance $f = 100\text{ kHz}$  | 0.47                    |       |       | $\mu\text{F}$       |               |

*Note:* 1 For  $V_{OUT(NOM)} < 2\text{ V}$ ,  $V_{IN} = 2.5\text{ V}$ .

2 Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification does not apply for output voltages below 2 V.

3 Turn-on time is time measured between the input just exceeding 90 % of its final value and the output voltage just reaching 95% of its nominal value.

4 Guaranteed by design.





## 6 Typical application

Figure 3. Application circuit for fixed version

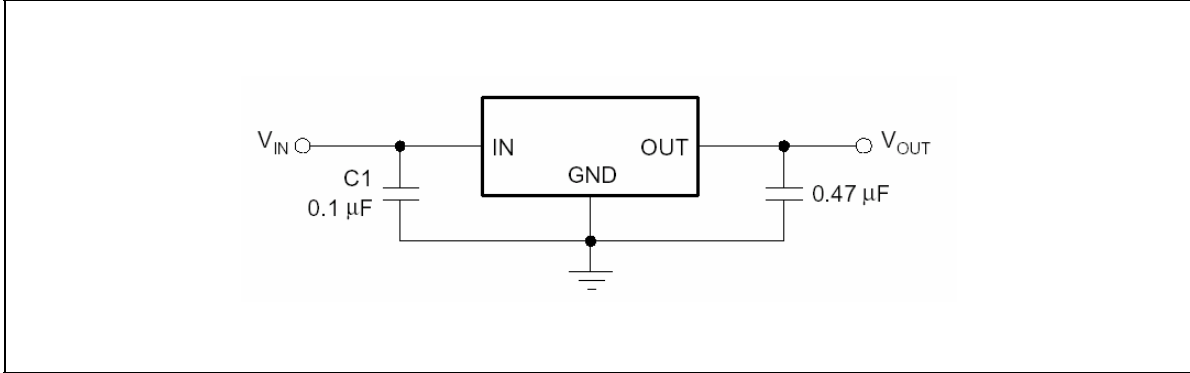
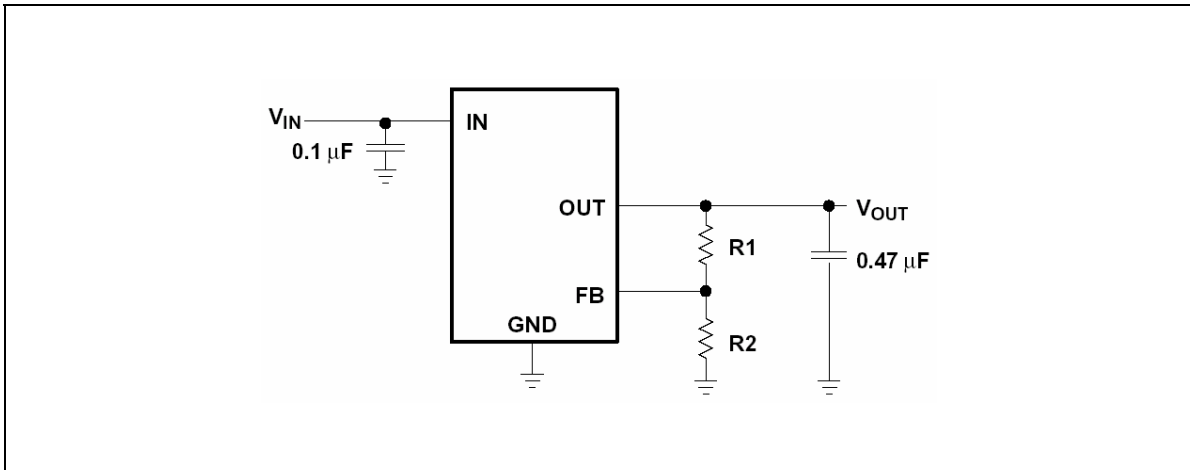


Figure 4. Application circuit for adjustable version



## 7 Typical performance characteristics

Figure 5. Output voltage vs temperature

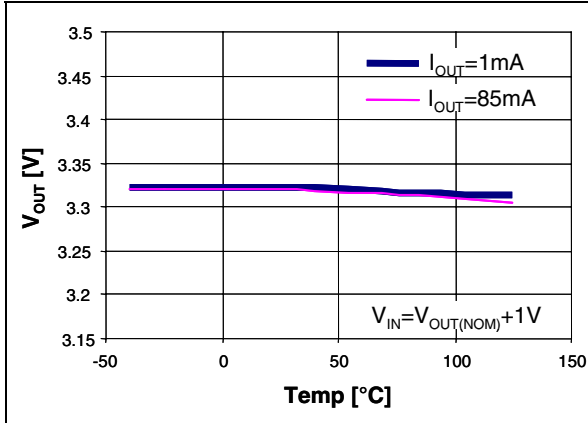


Figure 6. Output voltage vs input voltage

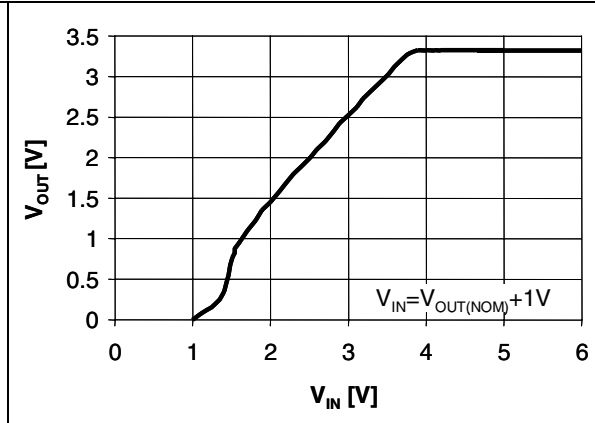


Figure 7. Dropout voltage vs output current

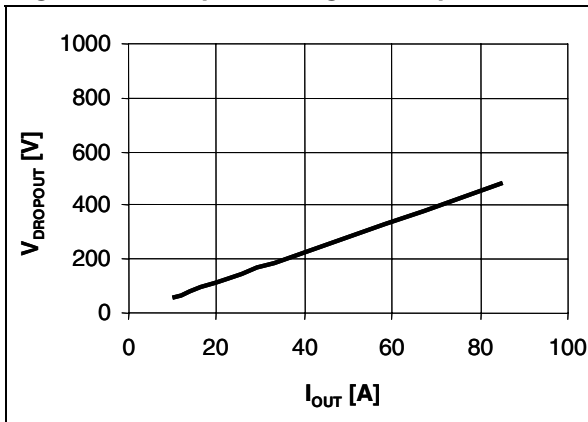


Figure 8. C\_OUT stability region

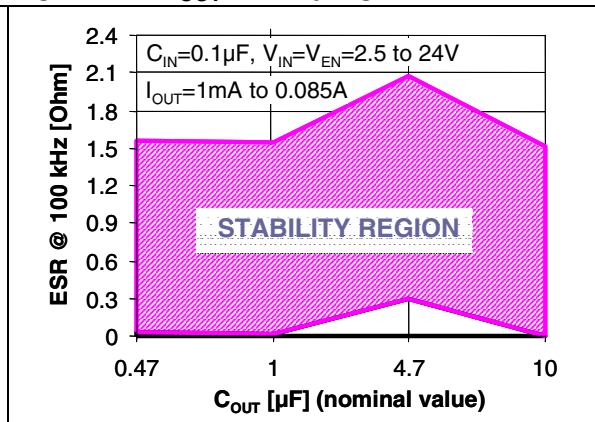


Figure 9. Supply voltage rejection vs frequency

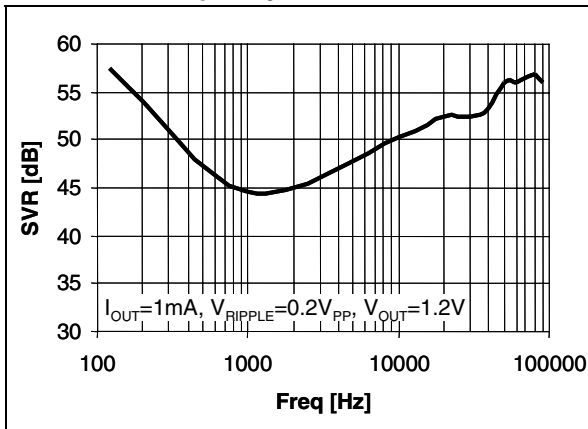


Figure 10. Output noise voltage vs frequency

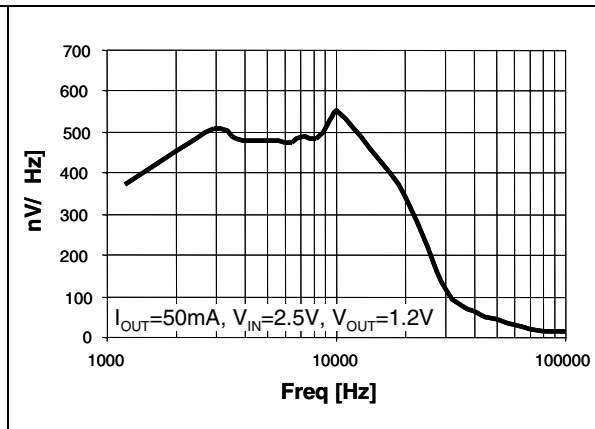


Figure 11. Quiescent current vs input voltage

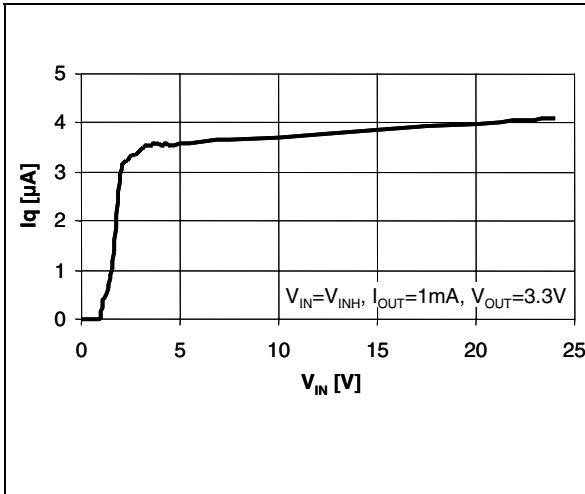


Figure 12. Load transient

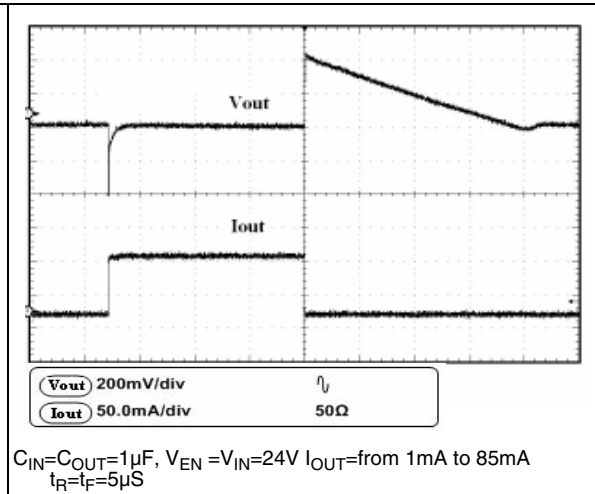


Figure 13. Line transient

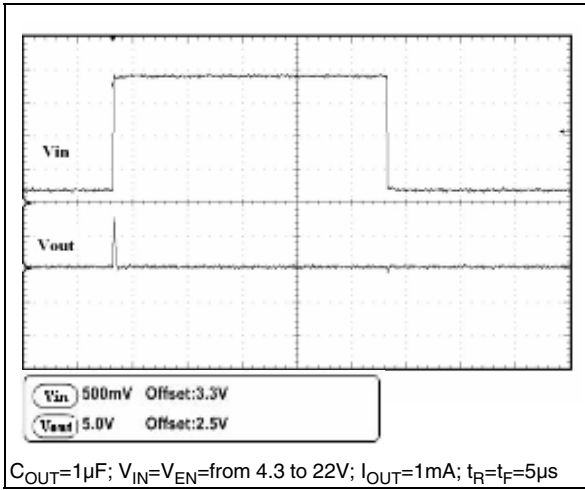
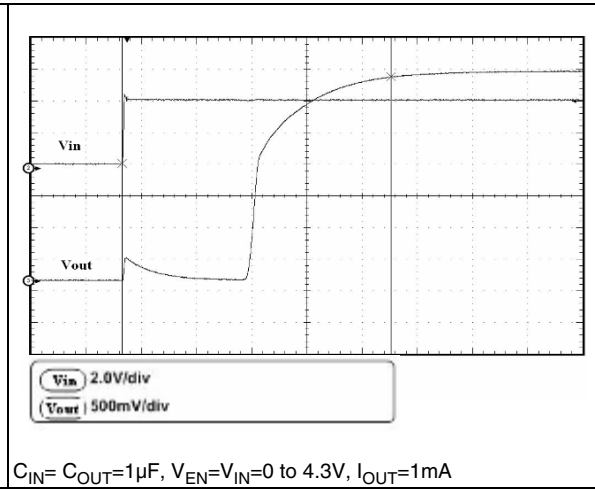


Figure 14. Enable transient

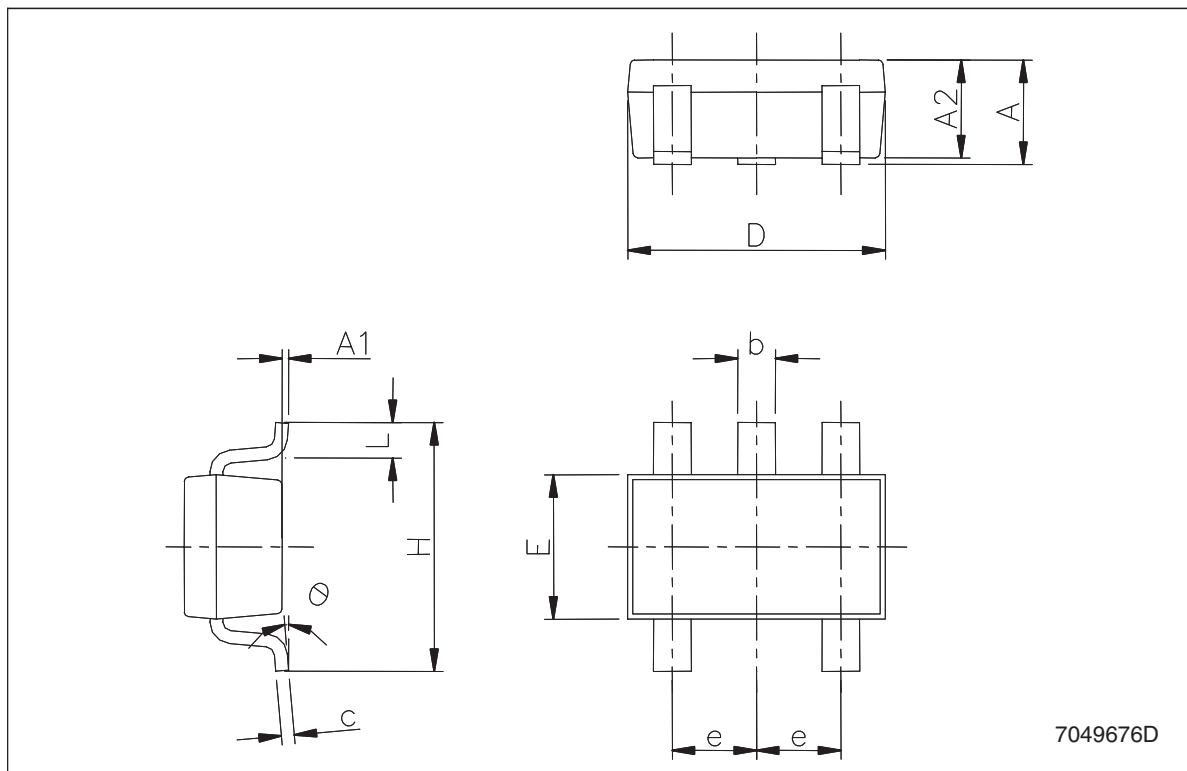


## 8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> packages. These packages have a lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

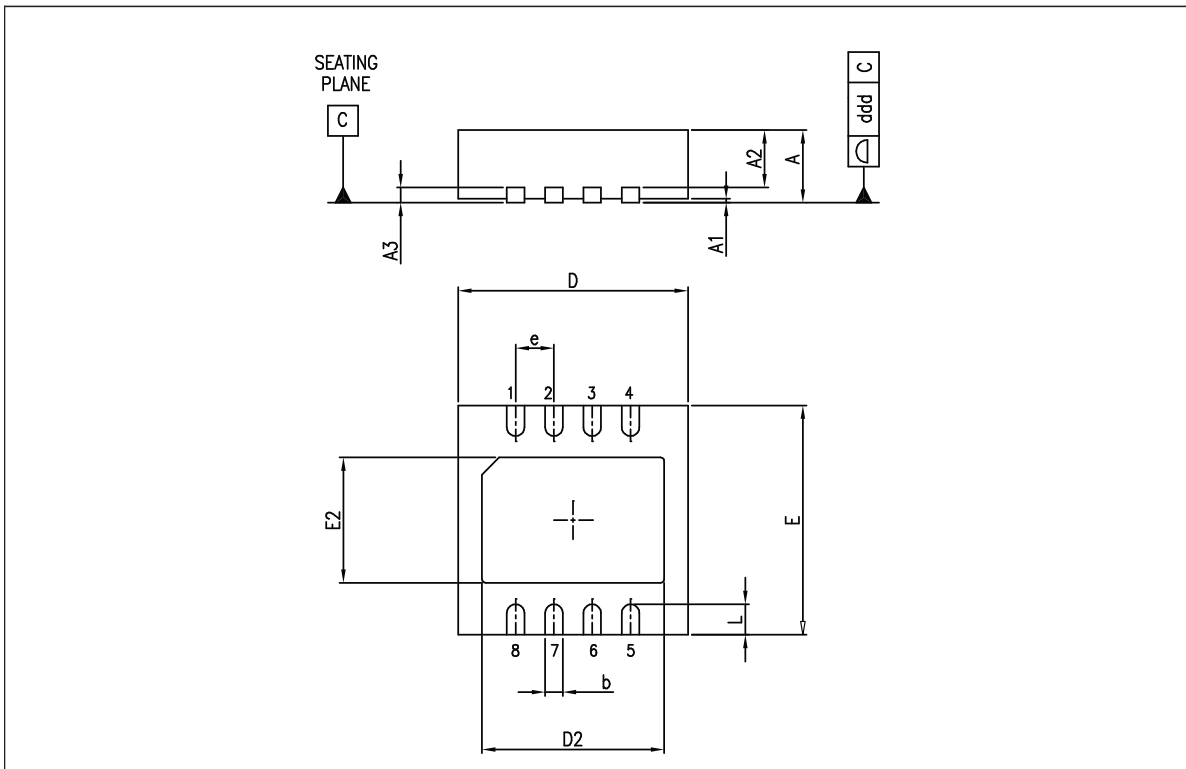
## SOT23-5L mechanical data

| Dim. | mm.  |      |      | mils. |      |       |
|------|------|------|------|-------|------|-------|
|      | Min. | Typ. | Max. | Min.  | Typ. | Max.  |
| A    | 0.90 |      | 1.45 | 35.4  |      | 57.1  |
| A1   | 0.00 |      | 0.10 | 0.0   |      | 3.9   |
| A2   | 0.90 |      | 1.30 | 35.4  |      | 51.2  |
| b    | 0.35 |      | 0.50 | 13.7  |      | 19.7  |
| C    | 0.09 |      | 0.20 | 3.5   |      | 7.8   |
| D    | 2.80 |      | 3.00 | 110.2 |      | 118.1 |
| E    | 1.50 |      | 1.75 | 59.0  |      | 68.8  |
| e    |      | 0.95 |      |       | 37.4 |       |
| H    | 2.60 |      | 3.00 | 102.3 |      | 118.1 |
| L    | 0.10 |      | 0.60 | 3.9   |      | 23.6  |



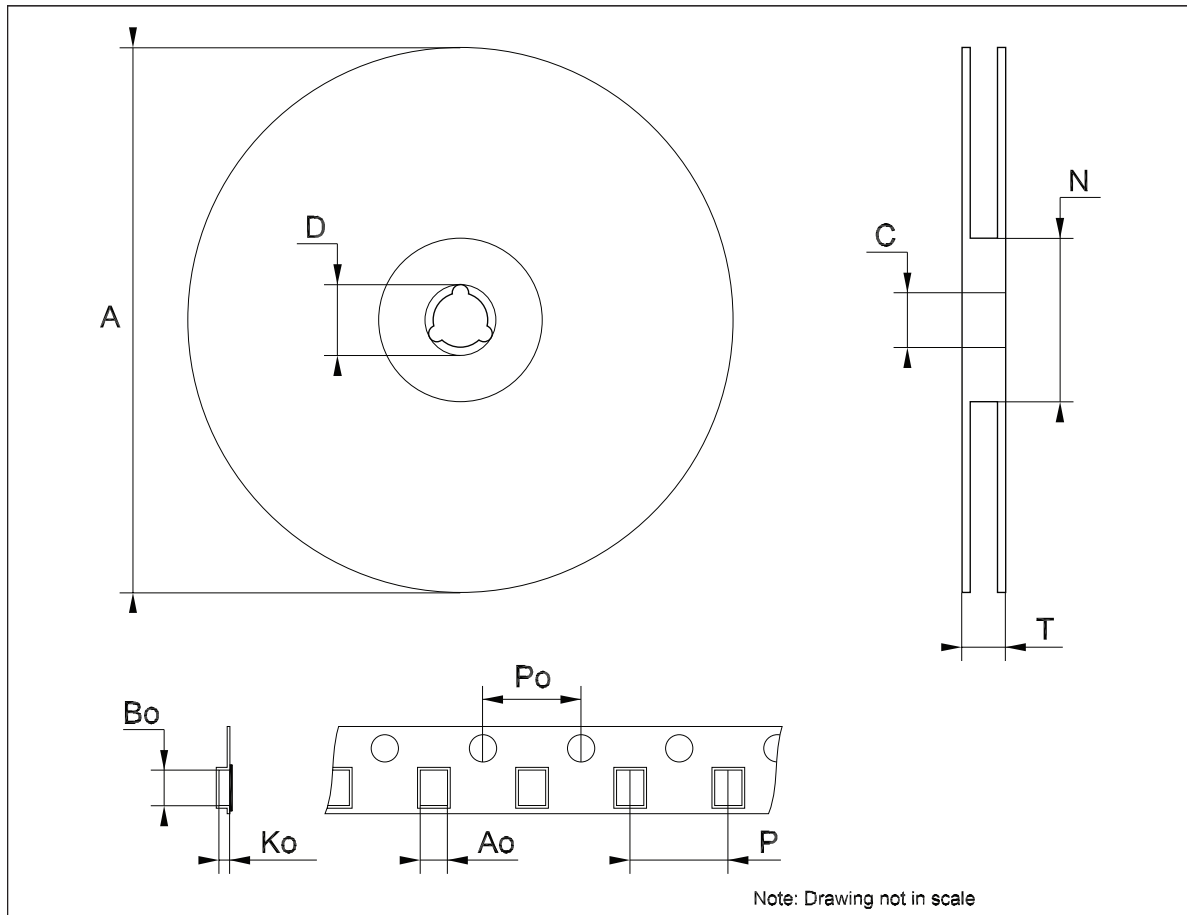
**DFN8 (3x3 mm) mechanical data**

| Dim. | mm.  |      |      | mils. |       |      |
|------|------|------|------|-------|-------|------|
|      | Min. | Typ. | Max. | Min.  | Typ.  | Max. |
| A    | 0.80 | 0.90 | 1.00 | 31.5  | 35.4  | 39.4 |
| A1   |      | 0.02 | 0.05 |       | 0.8   | 2.0  |
| A2   |      | 0.70 |      |       | 27.6  |      |
| A3   |      | 0.20 |      |       | 7.9   |      |
| b    | 0.18 | 0.23 | 0.30 | 7.1   | 9.1   | 11.8 |
| D    |      | 3.00 |      |       | 118.1 |      |
| D2   | 2.23 | 2.38 | 2.48 | 87.8  | 93.7  | 97.7 |
| E    |      | 3.00 |      |       | 118.1 |      |
| E2   | 1.49 | 1.64 | 1.74 | 58.7  | 64.6  | 68.5 |
| e    |      | 0.50 |      |       | 19.7  |      |
| L    | 0.30 | 0.40 | 0.50 | 11.8  | 15.7  | 19.7 |



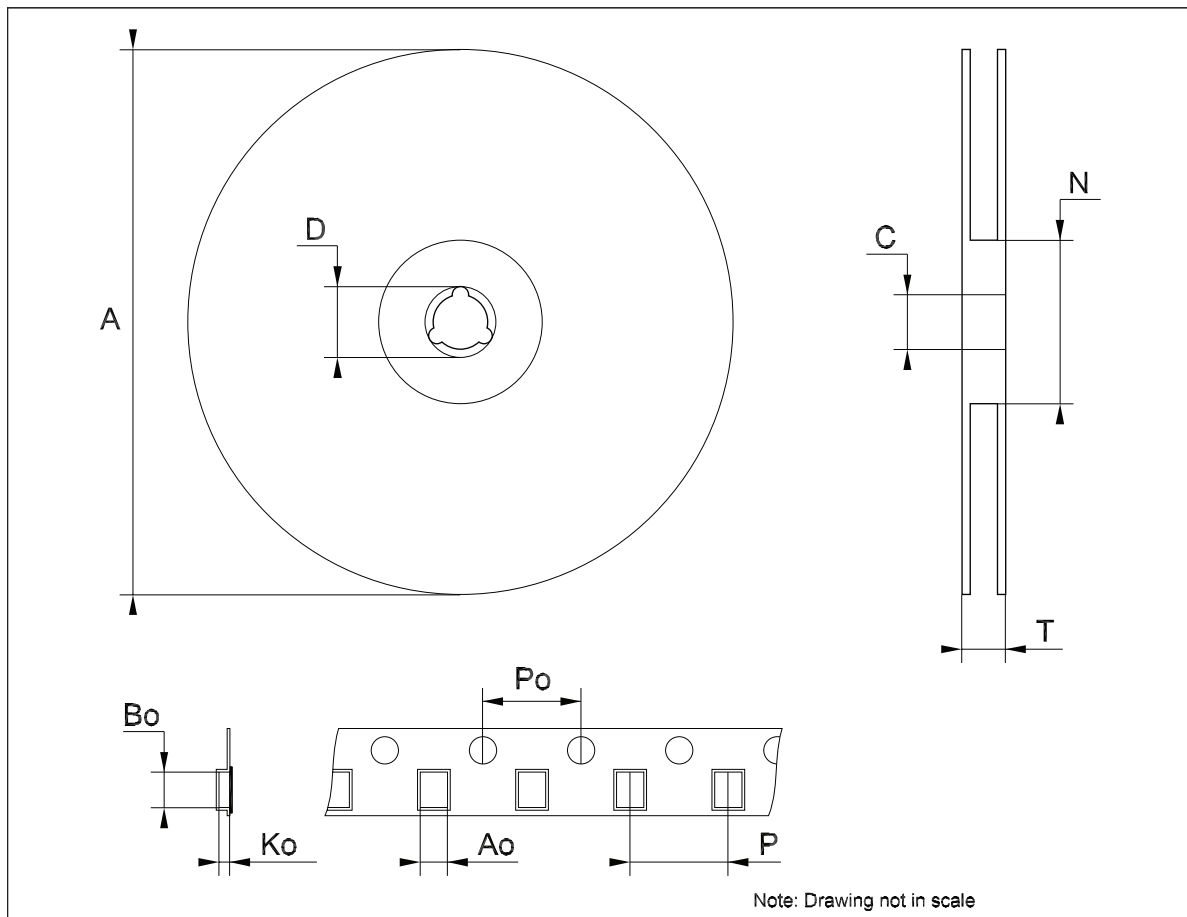
## Tape &amp; reel SOT23-xL mechanical data

| Dim. | mm.  |      |      | inch. |       |       |
|------|------|------|------|-------|-------|-------|
|      | Min. | Typ. | Max. | Min.  | Typ.  | Max.  |
| A    |      |      | 180  |       |       | 7.086 |
| C    | 12.8 | 13.0 | 13.2 | 0.504 | 0.512 | 0.519 |
| D    | 20.2 |      |      | 0.795 |       |       |
| N    | 60   |      |      | 2.362 |       |       |
| T    |      |      | 14.4 |       |       | 0.567 |
| Ao   | 3.13 | 3.23 | 3.33 | 0.123 | 0.127 | 0.131 |
| Bo   | 3.07 | 3.17 | 3.27 | 0.120 | 0.124 | 0.128 |
| Ko   | 1.27 | 1.37 | 1.47 | 0.050 | 0.054 | 0.058 |
| Po   | 3.9  | 4.0  | 4.1  | 0.153 | 0.157 | 0.161 |
| P    | 3.9  | 4.0  | 4.1  | 0.153 | 0.157 | 0.161 |



**Tape & reel QFNxx/DFNxx (3x3) mechanical data**

| Dim. | mm.  |      |      | inch. |       |       |
|------|------|------|------|-------|-------|-------|
|      | Min. | Typ. | Max. | Min.  | Typ.  | Max.  |
| A    |      |      | 180  |       |       | 7.087 |
| C    | 12.8 |      | 13.2 | 0.504 |       | 0.519 |
| D    | 20.2 |      |      | 0.795 |       |       |
| N    | 60   |      |      | 2.362 |       |       |
| T    |      |      | 14.4 |       |       | 0.567 |
| Ao   |      | 3.3  |      |       | 0.130 |       |
| Bo   |      | 3.3  |      |       | 0.130 |       |
| Ko   |      | 1.1  |      |       | 0.043 |       |
| Po   |      | 4    |      |       | 0.157 |       |
| P    |      | 8    |      |       | 0.315 |       |





## 9 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes                              |
|-------------|----------|--------------------------------------|
| 08-Feb-2008 | 1        | Initial release.                     |
| 19-Feb-2008 | 2        | Modified: <i>Features on page 1.</i> |

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