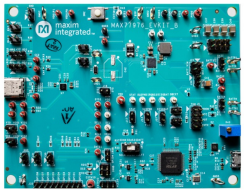
ANALOG DEVICES MAX77975 High Performance Fast Charger



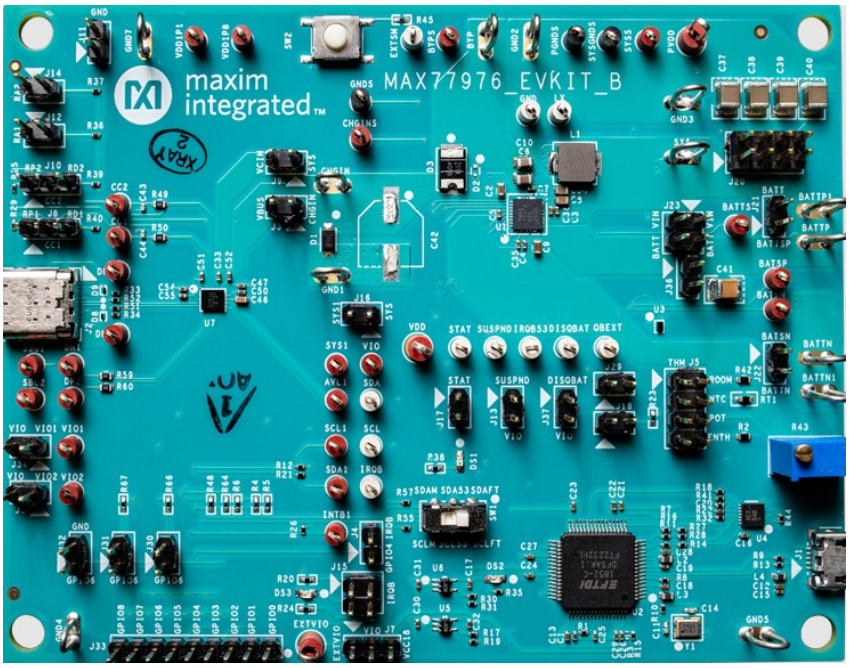
# ANALOG DEVICES MAX77975 High Performance Fast Charger Instructions



Contents



## ANALOG DEVICES MAX77975 High Performance Fast Charger




## Product Information

### Specifications

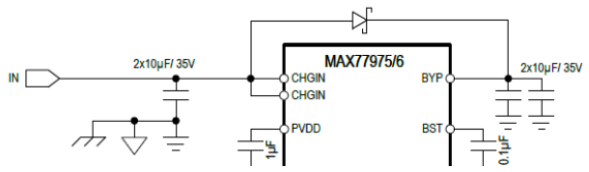
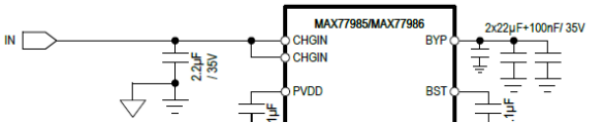
- Product Name: MAX77985/MAX77986
- Input Voltage: High-input 3.5/5.5A
- Fast Charger: Yes
- Smart Power Selector: Yes, trademark of Maxim Integrated Products, Inc.
- Supports: Li-ion, Li-Polymer, LiFePO4 battery chemistry
- Buck Inductor Current Limit: IHSILIM for MAX77986 is 11.1A (typ), IHSILIM for MAX77985 is 8.3A (typ)
- CHGIN Input Current Limit Setting Range: IINLIMIT for MAX77986 = 0.1A to 5.5A, IINLIMIT for MAX77985 = 0.1A to 3.5A

## Product Usage Instructions

1. Ensure the input voltage is within the specified range of 3.5/5.5A.
2. If using Li-ion, or Li-Polymer batteries, set the Charge Termination Voltage within the recommended range.
3. Utilize QBEXT/PGOOD Pin 30 as needed for External Battery FET Control Output or unplug detection.
4. Take advantage of Spread Spectrum Modulation to reduce EMI by configuring SS_ENV [Bit7:6] in the register CHG_CNFG_00.
5. Be mindful of the Buck Inductor Current Limit and CHGIN Input Current Limit settings based on the specific model.

## General Description

The MAX77985/MAX77986 is a high-performance high-input 3.5/5.5A fast charger with a Smart Power Selector™. The MAX77985/MAX77986 is the next generation of the MAX77975/MAX77976. Hence, we encourage customers to migrate the solution from MAX77975 to MAX77985 and from MAX77976 to MAX77986.

<table>
<tr><th>No.</th><th>MAX77975/MAX77976</th><th>MAX77985/MAX77986</th></tr>
<tr><td>1.</td><td>MAX77975/MAX77976 needs an external protection to support a 15V hot plug.<br> 
</td><td>MAX77985/MAX77986 supports a 15V hot plug without an external protection.<br> 
</td></tr>
<tr><td>2.</td><td>The B2SOVRC feature is not available.<br>CHG_CNFG_05 (0x1B)<br>Charger configuration 5
<table>
<tr><th>BIT</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>Field</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>RECYCLE_EN</td><td colspan="4">Reserved[3:0]</td></tr>
<tr><td>Reset</td><td>0b0</td><td>0b0</td><td>0b0</td><td>0b0</td><td colspan="4">0x6</td></tr>
<tr><td>Access Type</td><td>Write, Read</td><td>Write, Read</td><td>Write, Read</td><td>Write, Read</td><td colspan="4">Write, Read</td></tr>
</table>
<table>
<tr><th>BITFIELD</th><th>BITS</th><th>DESCRIPTION</th><th>DECODE</th></tr>
<tr><td>Reserved</td><td>7</td><td>Reserved</td><td>Reserved</td></tr>
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<tr><td>Reserved</td><td>5</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>RECYCLE_EN</td><td>4</td><td>DISIBS Event Recycle Option</td><td>0b0: In case of DISIBS events, buck is disabled (OFF) and $Q_{BATT}$ FET is opened. System recycles after 150ms (min) only in case a valid charger is present.<br>0b1: In case of DISIBS events, buck is disabled (OFF) and $Q_{BATT}$ FET is opened. System recycles after 150ms (min).</td></tr>
<tr><td>Reserved</td><td>3:0</td><td>Reserved</td><td>0x0: Recommended<br>0x6: Default (Not recommended)</td></tr>
</table></td><td>The B2SOVRC feature is available.<br>CHG_CNFG_05 (0x1B)<br>Charger configuration 5
<table>
<tr><th>BIT</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>Field</td><td>B2SOVRC_DTC</td><td>B2SOVRC_ALARM_ONLY</td><td>B2SOVRC_CTRL</td><td>RECYCLE_EN</td><td colspan="4">B2SOVRC[3:0]</td></tr>
<tr><td>Reset</td><td>0b0</td><td>0b0</td><td>0b0</td><td>0b0</td><td colspan="4">0x6</td></tr>
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</table>
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<tr><th>BITFIELD</th><th>BITS</th><th>DESCRIPTION</th><th>DECODE</th></tr>
<tr><td>B2SOVRC_DTC</td><td>7</td><td>BATT to SYS Overcurrent Debounce to $Q_{BATT}$ Clear Control</td><td>0x0: 105µs<br>0x1: 10ms</td></tr>
<tr><td>B2SOVRC_ALARM_ONLY</td><td>6</td><td>B2SOVRC Alarm Only Control</td><td>0x0: Alarm only is disabled: when tripping B2SOVRC, I/T is triggered and $Q_{BATT}$ opens after $T_{OCP}$.<br>0x1: Alarm only is enabled: when tripping B2SOVRC, I/T is triggered but $Q_{BATT}$ remains closed even after $T_{OCP}$.</td></tr>
<tr><td>B2SOVRC_CTRL</td><td>5</td><td>Battery Mode B2SOVRC Monitoring Control</td><td>0x0: Automatic mode<br>0x1: Continuous mode</td></tr>
<tr><td>RECYCLE_EN</td><td>4</td><td>B2S OCP or DISIBS Event Recycle Option</td><td>0b0: In the case of B2S OCP or DISIBS events, the buck is disabled (OFF) and $Q_{BATT}$ FET is opened. System recycles after 150ms (min) only if a valid charger is present.<br>0b1: In the case of B2S OCP or DISIBS events, buck is disabled (OFF) and $Q_{BATT}$ FET is opened. System recycles after 150ms (min).</td></tr>
<tr><td>B2SOVRC</td><td>3:0</td><td>BATT to SYS Overcurrent Threshold (A)</td><td>0x0: Disabled<br>0x1: 3.0<br>0x2: 3.5<br>0x3: 4.0<br>0x4: 4.5<br>0x5: 5.0<br>0x6: 5.5<br>0x7: 6.0<br>0x8: 6.5<br>0x9: 7.0<br>0xA: 7.5<br>0xB: 8.0<br>0xC: 8.5<br>0xD: 9.0<br>0xE: 9.5<br>0xF: 10.0</td></tr>
</table></td></tr>
</table>

| No. | MAX77975/MAX77976 | MAX77985/MAX77986 |
|---|---|---|
| 3. | MINSYS = 3.60V (fixed). | **MAX77985A/MAX77986A** MINSYS is 3.4V, 3.5V, 3.6V, and 3.7V.<br>**MAX77985B/MAX77986B** MINSYS is 3.0V, 3.1V, 3.5V, and 3.6V. |
| 4. | CHG_CV_PRM (Charge Termination Voltage) is 4.15V to 4.46V (default 4.2V with 10mV steps).<br>**Battery Chemistry = Li-ion, Li-Polymer** | **MAX77985A/MAX77986A** CHG_CV_PRM (Charge Termination Voltage) is 4.15V to 4.5375V (default 4.2V with 12.5mV steps).<br>**Battery Chemistry = Li-ion, Li-Polymer**<br><br>**MAX77985B/MAX77986B** CHG_CV_PRM (Charge Termination Voltage) is 3.50V to 4.275V (default 3.60V with 25mV steps).<br>**Battery Chemistry = $LiFePO_4$** |
| 5. | QBEXT (Pin 30)—External Battery FET Control Output. | QBEXT/PGOOD (Pin 30)—Configurable as External Battery FET Control Output or PGOOD as unplug detection of 9V and 15V sources. |
| 6. | N/A | Spread Spectrum Modulation to reduce EMI.<br>SS_ENV [Bit7:6] in the register CHG_CNFG_00. |
| 7. | Buck Inductor Current Limit, $I_{HSILIM}$.<br>$I_{HSILIM}$ for **MAX77976** is 9.5A (typ)<br>$I_{HSILIM}$ for **MAX77975** is 7A (typ) | Buck Inductor Current Limit, $I_{HSILIM}$.<br>$I_{HSILIM}$ for **MAX77986** is 11.1A (typ)<br>$I_{HSILIM}$ for **MAX77985** is 8.3A (typ) |
| 8. | CHGIN Input Current Limit Setting Range, $I_{INLIMIT}$.<br>$I_{INLIMIT}$ = 0.1A to 3.2A. | CHGIN Input Current Limit Setting Range, $I_{INLIMIT}$.<br>$I_{INLIMIT}$ for **MAX77986** = 0.1A to 5.5A<br>$I_{INLIMIT}$ for **MAX77985** = 0.1A to 3.5A |
| 9. | N/A | Higher $V_{SYS}$ buck mode (Mode 0x6) |
| 10. | Unplug TA during charging when $V_{BATT} > V_{TERM}$ is not detected. | The bug is fixed. |
| 11. | SYSUVLO/OVLO/TDIE may turn off permanently after the LPM register is cleared. | The bug is fixed. |

12. $I_{CHGIN}$, $V_{CHGIN\_UVLO\_ACC}$, and $V_{CHGIN2SYS\_TH}$.

**Electrical Characteristics**

($V_{SYS}$ = 3.8V, $V_{BATT}$ = 3.8V, $V_{VIO}$ = 1.8V, $V_{CHGIN}$ = 5V, unless otherwise specified. Limits are production tested at $T_A$ = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| GENERAL ELECTRICAL CHARACTERISTICS | | | | | | |
| CHGIN Quiescent Current | $I_{CHGIN}$ | $V_{CHGIN}$ = 5.0V, SUSPEND pin digital high or MODE = 0, DEEP_SUSP_DIS = 1 | | 0.19 | 0.38 | mA |
| | | $V_{CHGIN}$ = 5.0V, SUSPEND pin digital high or MODE = 0, DEEP_SUSP_DIS = 0 | | 85 | | µA |
| | | $V_{CHGIN}$ = 5.0V, $V_{BATT}$ = 4.2V, MODE = 5, DONE state ($V_{SYS}$ = 4.35V), $I_{SYS}$ = 0A | | 2.35 | | mA |
| CHGIN Undervoltage Threshold Accuracy | $V_{CHGIN\_UVLO\_ACC}$ | $V_{CHGIN}$ rising, 4.7V setting | 4.6 | 4.7 | 4.8 | V |
| CHGIN to SYS Undervoltage Threshold Rising | $V_{CHGIN2SYS\_TH}$ | $V_{CHGIN}$ - $V_{SYS}$, rising | 0.12 | 0.20 | 0.28 | V |

Tight tolerance of $I_{CHGIN}$, $V_{CHGIN\_UVLO\_ACC}$, and $V_{CHGIN2SYS\_TH}$.

**Electrical Characteristics**

($V_{SYS}$ = 3.8V, $V_{BATT}$ = 3.8V, $V_{VIO}$ = 1.8V, $V_{CHGIN}$ = 5V, unless otherwise specified. Limits are production tested at $T_A$ = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| GENERAL ELECTRICAL CHARACTERISTICS | | | | | | |
| CHGIN Quiescent Current | $I_{CHGIN}$ | $V_{CHGIN}$ = 5.0V, SUSPEND pin digital high or MODE = 0, DEEP_SUSP_DIS = 1 | | 0.19 | 0.32 | mA |
| | | $V_{CHGIN}$ = 5.0V, SUSPEND pin digital high or MODE = 0, DEEP_SUSP_DIS = 0 | | 85 | | µA |
| | | $V_{CHGIN}$ = 5.0V, $V_{BATT}$ = 4.2V, MODE = 5, DONE state ($V_{SYS}$ = 4.35V), $I_{SYS}$ = 0A | | 2.35 | | mA |
| CHGIN Undervoltage Threshold Accuracy | $V_{CHGIN\_UVLO\_ACC}$ | $V_{CHGIN}$ rising, 4.7V setting | 4.625 | 4.7 | 4.775 | V |
| CHGIN to SYS Undervoltage Threshold Rising | $V_{CHGIN2SYS\_TH}$ | $V_{CHGIN}$ - $V_{SYS}$, rising | 0.15 | 0.20 | 0.25 | V |

13. CHGIN Input Current Limit Accuracy [Min = -12%, Max = 0%]

| | | | | | | |
|---|---|---|---|---|---|---|
| CHGIN Input Current Limit Accuracy | $I_{INLIMIT}$ | Charger enabled, 500mA input current limit setting | 440 | 470 | 500 | mA |
| | | Charger enabled, 1000mA input current limit setting | 880 | 940 | 1000 | |
| | | Charger enabled, 1800mA input current limit setting | 1584 | 1692 | 1800 | |
| | | Charger enabled, 3200mA input current limit setting | 2816 | 3008 | 3200 | |

CHGIN Input Current Limit Accuracy [Min = -10%, Max = 0~+10%]

| | | | | | |
|---|---|---|---|---|---|
| CHGIN Input Current Limit Accuracy | $I_{INLIMIT}$ | Charger enabled, CHGIN = 5V ±5%, input current limit setting ≤ 2.7A, $T_A$ = -5°C to +85°C | -10 | 0 | % |
| | | Charger enabled, CHGIN = 5V ±5%, input current limit setting > 2.7A, $T_A$ = -5°C to +85°C | -10 | +5 | |
| | | Charger enabled, CHGIN = 9V ±5%, input current limit setting ≤ 1.5A, $T_A$ = -5°C to +85°C | -10 | 0 | |
| | | Charger enabled, CHGIN = 9V ±5%, input current limit setting > 1.5A, $T_A$ = -5°C to +85°C | -10 | +5 | |
| | | Charger enabled, CHGIN = 12V ±5%, input current limit setting ≤ 1A, $T_A$ = -5°C to +85°C | -10 | +5 | |
| | | Charger enabled, CHGIN = 12V ±5%, input current limit setting > 1A, $T_A$ = -5°C to +85°C | -10 | +10 | |
| | | Charger enabled, CHGIN = 15V ±5%, input current limit setting ≤ 0.5A, $T_A$ = -5°C to +85°C | -10 | +5 | |
| | | Charger enabled, CHGIN = 15V ±5%, input current limit setting > 0.5A, $T_A$ = -5°C to +85°C | -10 | +10 | |

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 6/23 | Initial release | — |



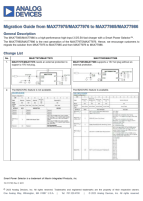
## FAQ

**Q: Can I use MAX77985B/MAX77986B with LiFePO4 batteries?**
A: Yes, MAX77985B/MAX77986B supports LiFePO4 battery chemistry with specific Charge Termination Voltage settings.

**Q: What is the default MINSYS for MAX77985A/MAX77986A?**
A: The default MINSYS for MAX77985A/MAX77986A is in the range of 3.4V to 3.7V.

**Q: What are the improvements in MAX77985/MAX77986 compared to MAX77975/MAX77976?**
A: The improvements include support for a 15V hotplug without external protection, availability of the B2SOVRC feature, and tighter tolerance for various inputs.

## Documents / Resources

| | |
|---|---|
|  | ANALOG DEVICES MAX77975 High Performance Fast Charger [pdf] Instructions<br>MAX77985, MAX77986, MAX77975 High Performance Fast Charger, High Performance Fast Charger, Performance Fast Charger, Fast Charger, Charger |

## References

- User Manual