

### 3 Amp & 5 Amp ULDO REGULATORS

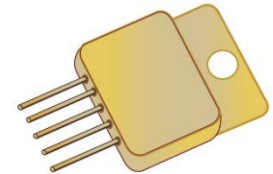
#### MHL8601 / MHL8605 Series

(Formerly SAT8601 / SAT8605 Series)  
 (Consult Table 4 for Part Number Designations)

Levels Available  
**COTS**  
**MILITARY**  
**SPACE**

#### DESCRIPTION

The MHL Series are space qualified, ultra low dropout linear regulators designed for military and space flight applications. Assembled in a hermetic MO-078 package, this series provides an ultra low drop out voltage of 400mV @ 3A, or 500mV at 5A. They are optimized for operation at a +5V input or a +3.3V input. All components are derated per internal requirements.



**MO-078 PACKAGE**

**Important:** For the latest information, visit our website <http://www.microsemi.com>.

#### FEATURES

- Rad-Tolerant to 300K rad TID (Note 9)
- Ultra Low Dropout Voltage – 400mV @ 3.0A
- Space-Level screening available
- Shutdown pin for output control
- Thermal Shutdown @ 150°C
- Optimized for operation at an input voltage of 3.3V or 5V
- Available in fixed or adjustable output versions

#### APPLICATIONS / BENEFITS

- Ultra low dropout voltages lead to lower losses.
- Some models run from a 3.3V input.

**Table 1 – ABSOLUTE MAXIMUM RATINGS ( $T_c = +25^\circ\text{C}$  unless otherwise note)**  
*(Exceeding maximum ratings may damage the device)*

Parameters / Test Conditions	Symbol	Value		Unit
		(3A Version)	(5A Version)	
DC input Voltage $V_{in}$ - $V_{ground}$	$V_{in}$	10.0	10.0	V
Output Current	$I_o$	3.3	5.5	A
Power Dissipation $T_{case} = 25^\circ\text{C}$	$P_d$	25	25	W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	3.0	$^\circ\text{C/W}$
Storage Temperature	$T_{stg}$	-65 to +150	-65 to +150	$^\circ\text{C}$
Operating Temperature Range	$T_j$	-55 to +125	-55 to +125	$^\circ\text{C}$
Maximum Soldering Temperature, 10 sec.	$T_{solder}$	300	300	$^\circ\text{C}$

#### MECHANICAL and PACKAGING

- See Figure 5 for packaging information

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**Table 2 – ELECTRICAL CHARACTERISTICS**  
*( $T_A = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  unless otherwise noted) (Nominal reference voltage is 1.265V @  $25^{\circ}\text{C}$ )*

Parameters / Test Conditions	Symbol	(3A Version)			(5A Version)			Unit
		Min.	Typ	Max.	Min.	Typ	Max.	
Output Voltage Accuracy, Adjustable Units $V_{in} = 3.3\text{V}$ or $5\text{V}$ as appropriate (Note 4) $V_o = V_{ref}$ , $I_o = 1\text{A}$	$V_{out}$	1.24	1.265	1.29	1.24	1.265	1.29	V
Output Voltage Accuracy, Fixed Voltage Units (Note 4) $I_o = 1\text{A}$	$V_{out}$	-3		+3	-3		+3	%
Input Voltage Range: +3.3V Versions (Note 4) $I_{out} = 2\text{A}$ or $4\text{A}$ as appropriate, $\Delta V_o \leq 2\%$	$V_{in}$ (+3.3)	2.9		3.6	3.0		3.6	V
Input Voltage Range: +5.0V Versions (Note 4) $I_{out} = 2\text{A}$ or $4\text{A}$ as appropriate, $\Delta V_o \leq 2\%$	$V_{in}$ (+5.0)	4.5		5.5	4.5		5.5	V
Dropout Voltage (Note 2) $I_{out} = 3.0\text{A}$ , $V_{out} \geq +2.5\text{V}$	$V_{drop}$			0.40	N/A			V
Dropout Voltage (Note 2) $I_{out} = 5.0\text{A}$ , $V_{out} \geq +2.5\text{V}$	$V_{drop}$	N/A					0.5	V
Current Limit $T_C = 25^{\circ}\text{C}$ $V_{out} = 2.5\text{V}$ or $V_{fixed}$ as appropriate $V_{in} = 3.3\text{V}$ or $5\text{V}$ as appropriate	$I_{latch}$	3.3			5.5			A
Ripple Rejection $V_{in} = 3.3\text{V}$ or $5\text{V}$ as appropriate (Note 6) $V_r = 500\text{mV}_{pp}$ ; $1\text{KHz} < f < 10\text{kHz}$ , $I_{out} = 100\text{mA}$	PSRR			-20			-20	dB
Shutdown Input threshold (Note 1) $V_{out} < 0.5\text{V}$ , $V_{in} = 3.3$ or $5\text{V}$ as appropriate	$V_{shdn}$	1.0		1.6	1.0		1.6	V

**Table 3 – POST-RADIATION (Notes 3, 9)  $T_A = 25^\circ\text{C}$** 

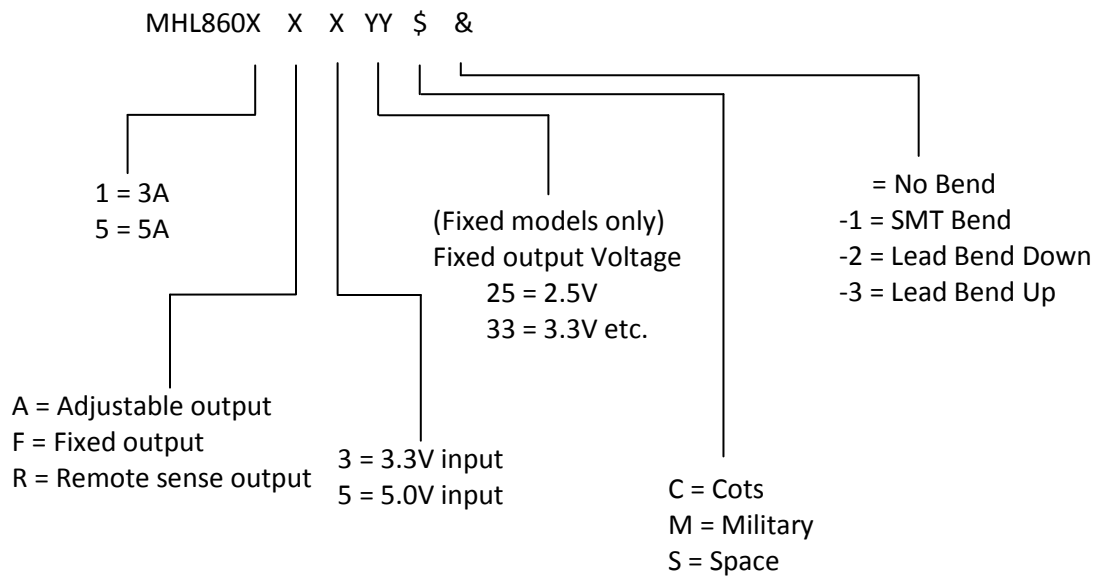
Parameters / Test Conditions	Symbol	(3A Version)			(5A Version)			Unit
		Min.	Typ	Max.	Min.	Typ	Max.	
Output Voltage Accuracy (Note 4, 5) $V_{in} = 3.3\text{V}$ or $5\text{V}$ as appropriate $V_o = V_{ref}$ , $I_o = 1\text{A}$	$V_{out}$	-100	$\pm 25$	+100	-100	$\pm 25$	+100	mV
Output Voltage Accuracy, Fixed Voltage Versions $I_o = 1\text{A}$ (Note 4, 5)	$V_{out}$	-8.0	$\pm 6.6$	+8.0	-8.0	$\pm 6.6$	+8.0	%
Input Voltage Range: +3.3V Versions (Note 4) $I_{out} = 2\text{A}$ or $4\text{A}$ as appropriate, $\Delta V_o \leq 2\%$	$V_{in}$ (+3.3)	2.9		3.6	3.0		3.6	V
Input Voltage Range: +5.0V Versions (Note 4) $I_{out} = 2\text{A}$ or $4\text{A}$ as appropriate, $\Delta V_o \leq 2\%$	$V_{in}$ (+5.0)	4.5		5.5	4.5		5.5	V
Dropout Voltage (Note 2) $I_{out} = 3.0\text{A}$ , $V_{out} \geq +2.5\text{V}$	$V_{drop}$			0.40	N/A			V
Dropout Voltage (Note 2) $I_{out} = 5.0\text{A}$ , $V_{out} \geq +2.5\text{V}$	$V_{drop}$	N/A					0.50	V
Current Limit $T_C = 25^\circ\text{C}$ $V_{out} = 2.5\text{V}$ or $V_{fixed}$ as appropriate $V_{in} = 3.3\text{V}$ or $5\text{V}$ as appropriate	$I_{latch}$	3.3			5.5			A
Shutdown Input threshold (Note 1) $V_{out} < 0.5\text{V}$ , $V_{in} = 3.3\text{V}$ or $5\text{V}$ as appropriate	$V_{shdn}$	1.0		1.6	1.0		1.6	V

**Table 4 – PART NUMBER FUNCTIONAL CHART**

ADJUSTABLE OUTPUT VOLTAGE PART NUMBERS	Input Voltage	Iout Range	Vout Range
MHL8601A3\$&	3.3V	0 – 3A	1.265 – 2.5V
MHL8605A3\$&	3.3V	0 – 5A	1.265 – 2.5V
MHL8601A5\$&	5V	0 – 3A	1.265 – 4.0V
MHL8605A5\$&	5V	0 – 5A	1.265 – 4.0V

Examples of Part Numbers with Fixed Output Voltages *	Input Voltage	Iout Range	Vout
MHL8601F325\$&	3.3 V	0 – 3 A	2.5 V
MHL8605F320\$&	3.3 V	0 – 5 A	2.0 V
MHL8601F530\$&	5.0 V	0 – 3 A	3.0 V
MHL8605F533\$&	5.0 V	0 – 5 A	3.3 V

\* Replace the “F” with an “R” for remote sense versions.



**Table 5 – SCREENING OPTIONS**

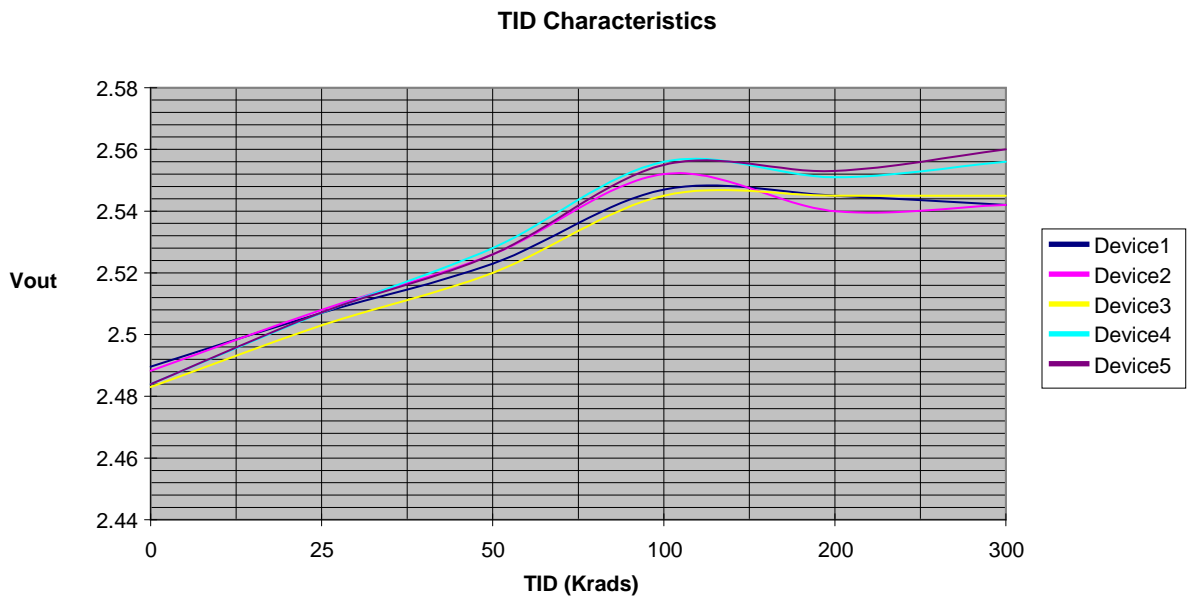
TESTS	SCREENING LEVELS			MIL-STD-883 METHOD
	Commercial	MILITARY	SPACE	
	COTS	MIL-PRF-38534 Certified		
Element Evaluation	N/A			Note 7
Non-Destruct Wirebond Pull	N/A	Sample	100%	2023
Pre-Cap Visual	N/A	100%	100%	2017
Temperature Cycle	N/A	100%	100%	1010
Constant Acceleration	N/A	100%	100%	2001
PIND	N/A	N/A	100%	2020
Pre-Burn-In Electrical	N/A	100%	100%	
Burn-In	N/A	100% (160 hours)	100% (320 hours)	1015
Final Electrical Tests	100% (25°C)	100%	100%	Note 7
Hermeticity (Fine & Gross Leak)	100%	100%	100%	1014
X-Ray (Note 8)	N/A	N/A	YES	2012
External Visual	Sample	100%	100%	2009
Certified	N/A	YES	YES	

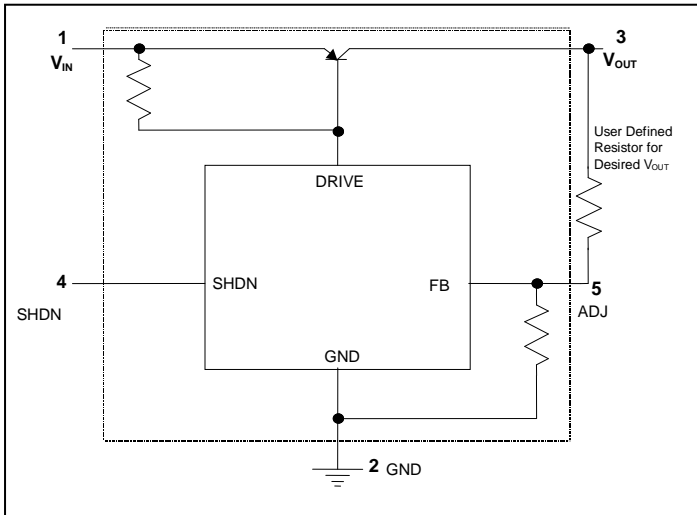
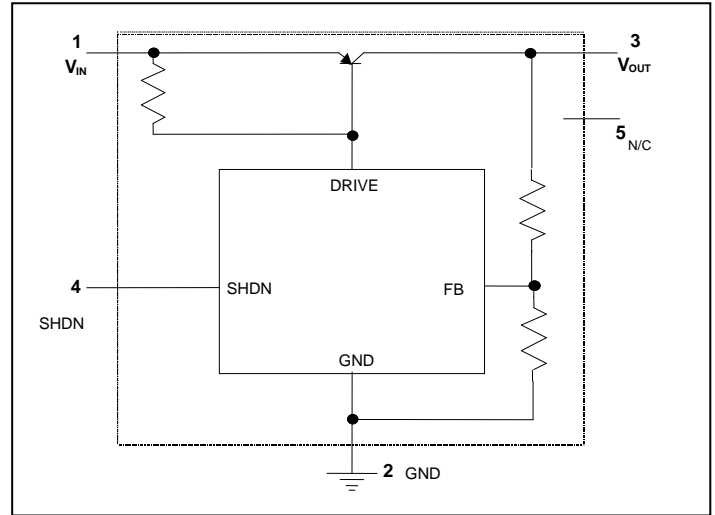
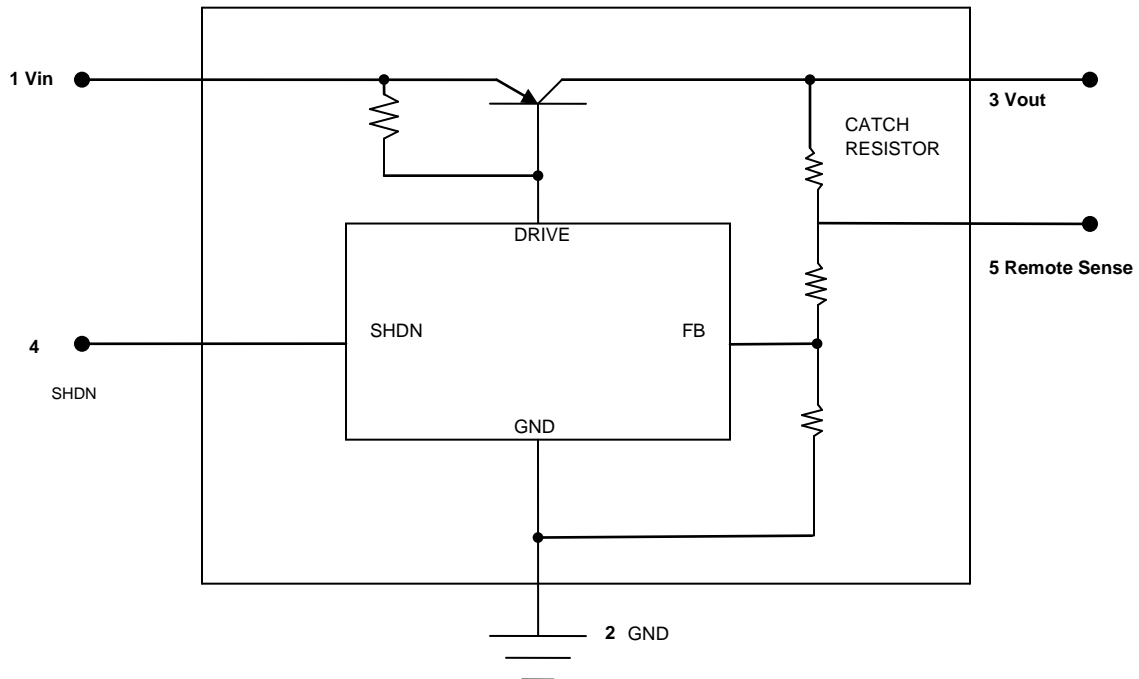
**NOTES:**

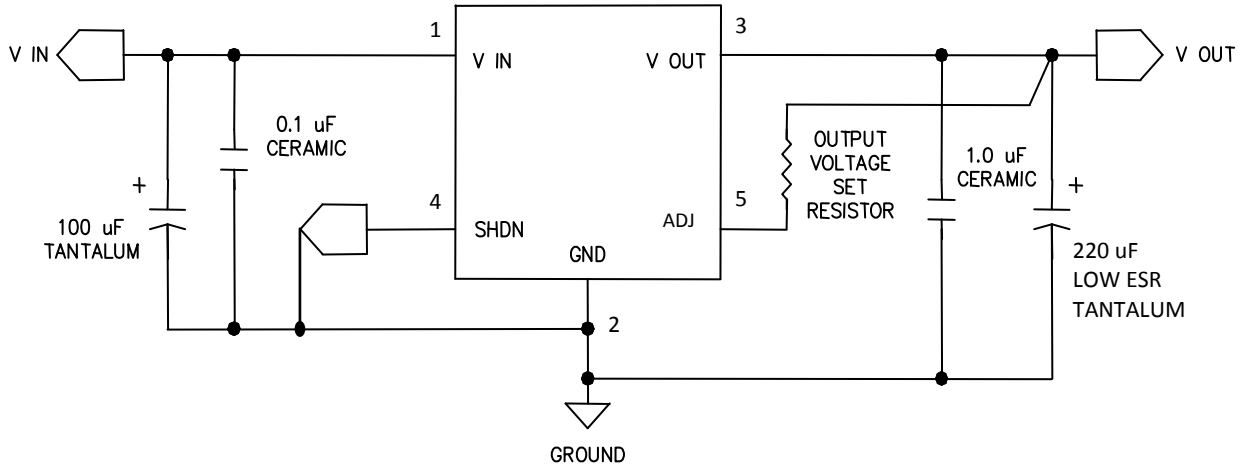
1. Shutdown pin voltage must be > 2.0V to initiate output inhibit. Pin should be grounded if not used. Pin input voltage can exceed supply voltage, but not greater than 10V above GND pin.
2. Actual voltage dropout is affected by device operating point. Minimum operating input voltage is 2.9V. As a result, the dropout specification applies to output voltage of 2.5V and higher, and the model numbers specifically designed to operate at these output voltage levels, 3.3V input voltage product only.
3. Radiation testing is per MIL-STD-883, Method 1019.
4. These regulators are optimized for specific Input Voltage ranges. The 860xx3 will have peak performance at +3.0V to +3.6V. The 860xx5 will have peak performance at +4.5V to +5.5V. Input voltages outside of this range can affect short-circuit current, load current capability and create electrical overstress to internal components.
5. Typical post 100K Rad ELDRS radiation performance in the powered mode is < +/-5%. Typical unpowered performance is ±6.6%.
6. Guaranteed by design.
7. Per MIL-PRF-38534.
8. Performed at a DLA approved facility.
9. Certified to Appendix G of MIL-PRF-38534 for Radiation Hardness Assurance (RHA) requirements for Hybrid Microcircuits and Multichip Modules effective June 27, 2013. (See [RHA Test Laboratory Suitability](#))

**RADIATION CHANGES**

**Figure 1 – Typical Radiation Characteristics – Vout**



**BLOCK DIAGRAMS**
**Figure 2 - External connections for the various versions.**
**Adjustable Version**

**Fixed Output Version**

**Remote Sense Version**


**APPLICATIONS**
**Figure 3 – Application Circuit, Adjustable Output Circuit**


$$V_{out} = V_{ref} \times (1 + R_{adj}/1000), \text{ with } V_{ref} \sim 1.265 \text{ Volts}$$

**Figure 4 – Fixed Output 3/5 Amp Regulator**
