POWER MANAGEMENT

60mA/110mA/160mA Super Low Dropout CMOS Regulators with Battery Life Extending Shutdown Mode and ERROR Output

The IMP2054, IMP2055 and IMP2186 high performance CMOS low dropout voltage regulators offer superior dropout voltage performance and load regulation characteristics as compared to the pin compatible TC1054/1055/1186 devices offered by TelCom Semiconductor. Dropout voltage performance has been improved by up to 40%.

Load regulation and power supply PSRR have been optimized. Load regulation is typically 0.32% and PSRR is 53dB at 1kHz.

A logic input controlled shutdown mode extends system battery life by reducing quiescent current to 0.2µA maximum. The shutdown mode can be initiated by a system microcontroller.

The regulators were designed with ease of use and stability in mind. Stability is guaranteed for 0.47µF and greater load capacitors with an ESR up to 5Ω. Ceramic or tantalum capacitors can be used.

Three devices with different guaranteed output current specifications are available: IMP2054 (60mA), IMP2055 (110mA) and IMP2186 (160mA). Each device has output voltage options of 2.5V, 2.7V, 2.85V, 3.0V, 3.3V, 3.6V and 4.0V.
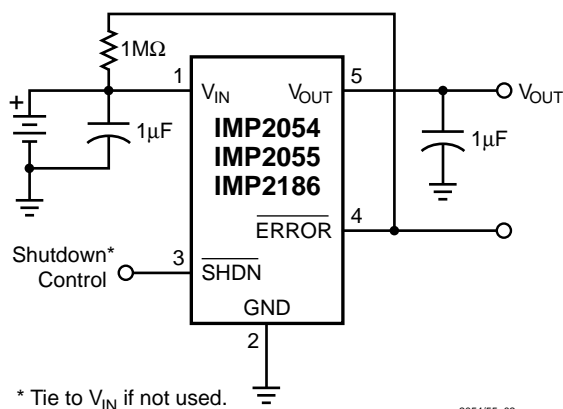
Key Features

◆ Pin Compatible with TelCom TC1054/1055/1186
◆ Lower Dropout Voltage for Long Battery Life
  – IMP2054: 70mV vs. TelCom TC1054 120mV
  – IMP2055: 160mV vs. TelCom TC1055 250mV
  – IMP2186: 250mV vs. TelCom TC1186 400mV
◆ Power Saving Shutdown Mode
  – 0.2µA shutdown current
◆ ERROR Output
  – Low battery detection
  – Processor reset
◆ Superior Load Regulation
  – 0.32%
◆ Long Battery Life
  – 33µA no load ground current
◆ Accurate Output Voltage
  – ± 2.5% over temperature
◆ Low Drift Output: 40ppm/°C
◆ Guaranteed Minimum Output Current
  – IMP2054: 60mA
  – IMP2055: 110mA
  – IMP2186: 160mA
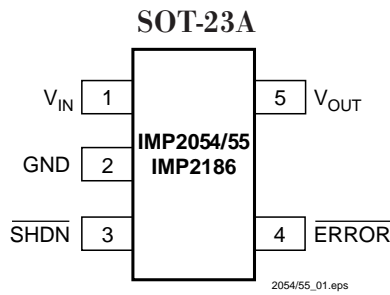◆ Over-Current and Over-Temperature Protection
◆ Compact SOT-23A-5 Package

Applications

◆ Pagers
◆ Cellular/GSM/PHS Phones
◆ Instrumentation
◆ Wireless Terminals
◆ Battery Powered Systems
◆ Medical Instruments
◆ Linear Post-Regulators

Typical Application

IMP2054
IMP2055
IMP2186

* Tie to V_IN if not used.

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Pin Configuration

SOT-23A

V$_{IN}$	1	5	V$_{OUT}$
GND	2		
$\overline{SHDN}$	3	4	$\overline{ERROR}$

IMP2054/55
IMP2186

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Pin Descriptions

Pin Number	Name	Function
1	V$_{IN}$	Unregulated supply input.
2	GND	Ground terminal.
3	$\overline{SHDN}$	Shutdown control input. A shutdown mode is entered when $\overline{SHDN}$ is a logic LOW. During shutdown the output voltage falls to 0V and quiescent current drops to 2.0μA.
4	$\overline{ERROR}$	Out-of-Regulation Flag output. An open drain output that goes LOW when the output is out-of-tolerance by approximately 5%.
5	V$_{OUT}$	Output voltage

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Ordering Information

Part Number*	Package	Output Voltage (V)	Output Current (mA)	Shutdown Pin	Adjust Pin	ERROR Flag Output	Reference Bypass Pin	Package Marking			
								A	B	C	D
IMP2054-2.5JUK/T	SOT23A-5	2.5	60	●		●		R	A	x	x
IMP2054-2.7JUK/T	SOT23A-5	2.7	60	●		●		R	B	x	x
IMP2054-2.85JUK/T	SOT23A-5	2.85	60	●		●		R	C	x	x
IMP2054-3.0JUK/T	SOT23A-5	3.0	60	●		●		R	D	x	x
IMP2054-3.3JUK/T	SOT23A-5	3.3	60	●		●		R	E	x	x
IMP2054-3.6JUK/T	SOT23A-5	3.6	60	●		●		R	F	x	x
IMP2054-4.0JUK/T	SOT23A-5	4.0	60	●		●		R	G	x	x
IMP2055-2.5JUK/T	SOT23A-5	2.5	110	●		●		T	A	x	x
IMP2055-2.7JUK/T	SOT23A-5	2.7	110	●		●		T	B	x	x
IMP2055-2.85JUK/T	SOT23A-5	2.85	110	●		●		T	C	x	x
IMP2055-3.0JUK/T	SOT23A-5	3.0	110	●		●		T	D	x	x
IMP2055-3.3JUK/T	SOT23A-5	3.3	110	●		●		T	E	x	x
IMP2055-3.6JUK/T	SOT23A-5	3.6	110	●		●		T	F	x	x
IMP2055-4.0JUK/T	SOT23A-5	4.0	110	●		●		T	G	x	x
IMP2186-2.5JUK/T	SOT23A-5	2.5	160	●		●		Y	A	x	x
IMP2186-2.7JUK/T	SOT23A-5	2.7	160	●		●		Y	B	x	x
IMP2186-2.85JUK/T	SOT23A-5	2.85	160	●		●		Y	C	x	x
IMP2186-3.0JUK/T	SOT23A-5	3.0	160	●		●		Y	D	x	x
IMP2186-3.3JUK/T	SOT23A-5	3.3	160	●		●		Y	E	x	x
IMP2186-3.6JUK/T	SOT23A-5	3.6	160	●		●		Y	F	x	x
IMP2186-4.0JUK/T	SOT23A-5	4.0	160	●		●		Y	G	x	x

xx = Date Code   * /T indicates Tape and Reel

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Absolute Maximum Ratings

Input Voltage 7V
Output Voltage . . . . $-0.3V$ to $V_{IN} + 0.3V$
Maximum Voltage on Any Pin . . . . $-0.3V$ to $(V_{IN} + 0.3V)$
Shutdown Voltage ($\overline{SHDN}$) . . . . $\overline{SHDN} \le V_{IN} + 0.3V$

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

Operating Junction Temperature Range . . . $-40°C < T_J < 125°C$
Storage Temperature . . . . $-65°C$ to $150°C$
Power Dissipation . . . . Internally limited

Note: T_J = Junction Temperature, T_A = Ambient Temperature

Electrical Characteristics

$V_{IN} = V_{OUT} + 1V$, $I_L = 100\mu A$, $C_L = 1\mu F$, $\overline{SHDN} > V_{IH}$, $T_A = 25°C$, unless otherwise noted. **Bold/blue** specifications apply for junction temperature range $-40°C < T_J < 125°C$.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}	$0°C < T_J < 125°C$			**6.50**	V
		$-40°C < T_J < 125°C$			**6.50**	
Maximum Output Current	I_{OMAX}	IMP2054	**60**			mA
		IMP2055	**110**			
		IMP2186	**160**			
Fixed Output Voltage	V_{OUT}	Note 1	**$V_R - 2.5\%$**	$V_R \pm 0.5\%$	**$V_R + 2.5\%$**	V
Dropout Voltage (Note 2)	$V_{IN} - V_O$	$I_L = 100\mu A$		1		mV
		$I_L = 20mA$		17	**23**	
		$I_L = 50mA$		60	**70**	
		$I_L = 100mA$ (IMP2054, IMP2186)		90	**160**	
		$I_L = 150mA$ (IMP2186)		143	**250**	
Quiescent Current (Ground Current)		No load		33	**50**	μA
Shutdown Supply Current	I_{INSD}	$\overline{SHDN} = 0V$ $T_J \le 25°C$		0.2	2	μA
Output Temperature Coefficient				40		ppm/°C
Thermal Regulation				0.04		%/W
Line Regulation		$V_R + 1V \le V_{IN} \le 6V$		0.0375	**0.35**	%

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Notes: 1. V_R is the regulated output voltage: 2.5V, 2.7V, 2.85V, 3.0V, 3.3V, 3.6V or 4.0V.

    2. Dropout Voltage is defined as the difference between IN and OUT when V_R drops 2% below its nominal value.

    3. Specifications which would otherwise be affected by self-heating of the die are tested at a constant die temperature by using low duty cycle pulse testing.

    3. PSRR guaranteed by design.

Electrical Characteristics

V_{IN} = V_{OUT} +1V, I_L = 100µA, C_L = 1µF, $\overline{SHDN}$ > V_{IH}, T_A = 25°C, unless otherwise noted. **Bold/blue** specifications apply for junction temperature range of −40°C < T_J < 125°C.

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Load Regulation: IMP2054		I_L = 100µA to 50mA			0.32	**2.0**	%
IMP2055		I_L = 100µA to 100mA			0.32	**2.0**	
IMP2186		I_L = 100µA to 150mA			0.32	**3.0**	
Thermal Shutdown Die Temperature					150		°C
Thermal Shutdown Hysteresis					12		°C
Ripple Rejection	PSRR	V_{IN} ≥ (V_O + 1V) ± 0.25V C_O = 3.3µF ceramic	Freq. = 1kHz		58		dB
			Freq. = 10kHz		45		
			Freq. = 1MHz		34		
Output Noise		300Hz to 50kHz I_L = 50mA (IMP2054) I_L = 100mA			280		µV$_{RMS}$
$\overline{SHDN}$ Input HIGH Threshold		2.5V ≤ V_{IN} ≤ 6.5V		**45**			% of V_{IN}
$\overline{SHDN}$ Input LOW Threshold		2.5V ≤ V_{IN} ≤ 6.5V				**15**	% of V_{IN}
$\overline{ERROR}$ Flag Minimum Supply Voltage				1.5			V
$\overline{ERROR}$ Flag Threshold Voltage		V_{TH}			0.95V_R		V
$\overline{ERROR}$ Flag Hysteresis		V_{HYS}			50		mV
$\overline{ERROR}$ Flag Output Low Voltage		$I_{\overline{ERROR}}$ = 1mA			75	**400**	mV
Reverse Current into V_{OUT}		$V_{(IN)}$ < $V_{(OUT)}$ $\overline{SHDN}$ = HIGH = V_{IN}			2.0		mA
		$V_{(IN)}$ < $V_{(OUT)}$ $\overline{SHDN}$ = LOW			2.7		µA
Output Current Limit					350	**600**	mA

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Notes: 1. V_R is the regulated output voltage: 2.5V, 2.7V, 2.85V, 3.0V, 3.3V, 3.6V or 4.0V.

2. Dropout Voltage is defined as the difference between IN and OUT when V_R drops 2% below its nominal value.

3. Specifications which would otherwise be affected by self-heating of the die are tested at a constant die temperature by using low duty cycle pulse testing.

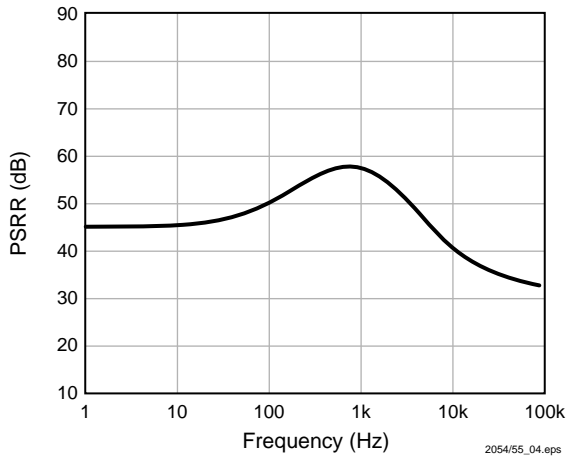4. PSRR guaranteed by design.

Typical Characteristics

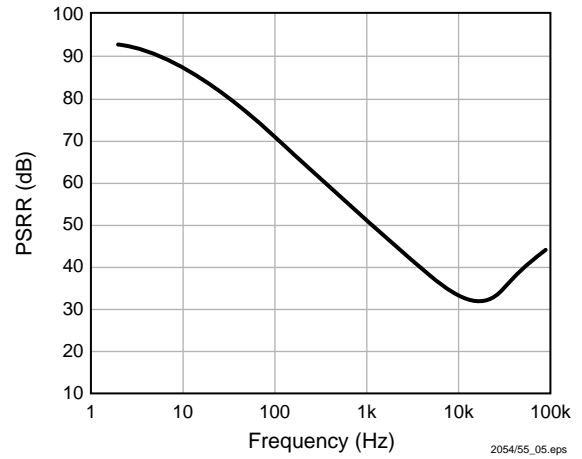
Figure 1. IMP2055 PSRR at I$_{LOAD}$ = 100mA

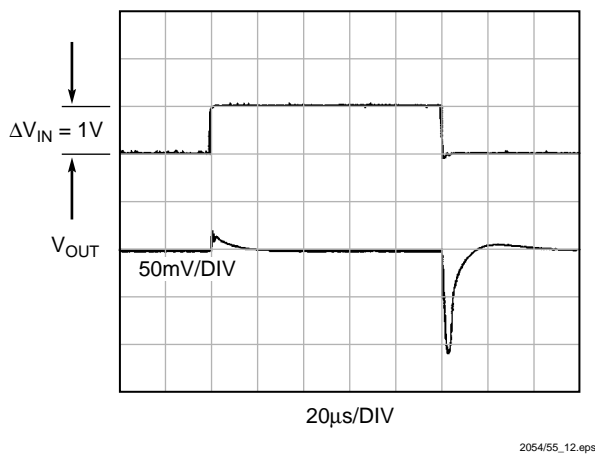*Figure 2. IMP2055 PSRR at I$_{LOAD}$ = 1mA*
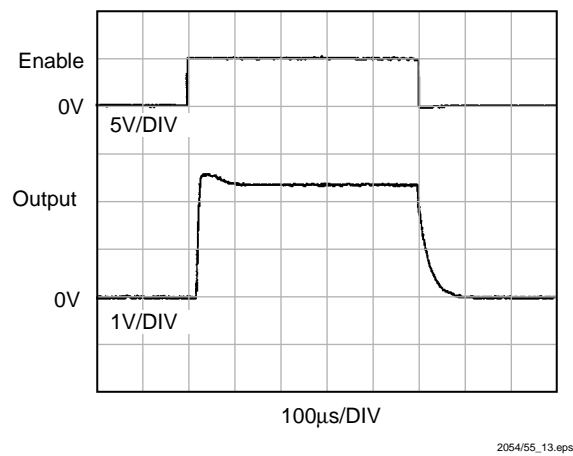

Figure 3. Line Transient Response

Figure 4. Enable Input Response

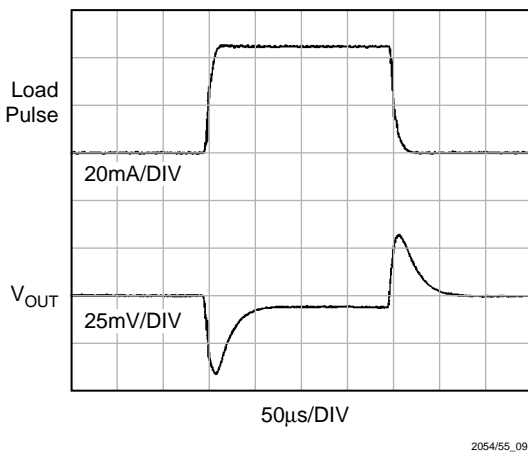*Figure 5. Load Transient Response (50mA Step)*
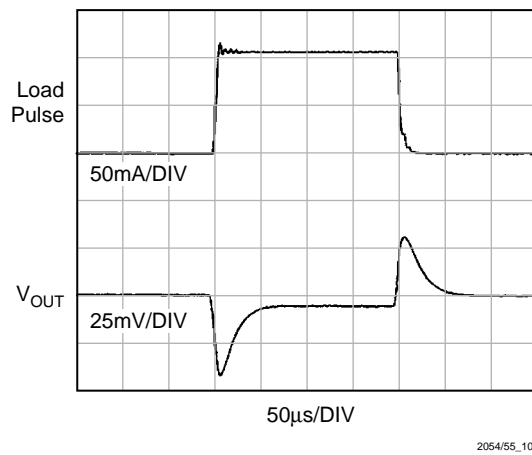
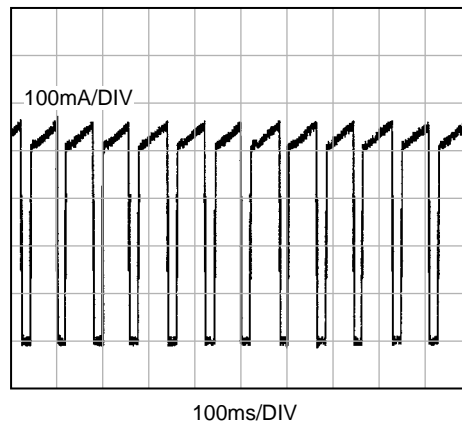*Figure 6. Load Transient Response (100mA Step)*

Typical Characteristics

100mA/DIV

100ms/DIV

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Figure 7. Output Short Circuit Response

Application Information

The IMP2054, IMP2055 and IMP2186 have been designed to offer exceptionally low dropout voltage, superior load regulation and minimum quiescent power.

Shutdown Mode

A battery-life-extending mode is available. Through the active LOW shutdown pin, $\overline{SHDN}$, the regulator can be enabled or turned off. The regulator is shutdown (turned off) when $\overline{SHDN}$ is LOW and enabled (turned on) when $\overline{SHDN}$ is HIGH.

The shutdown signal can be supplied from a CMOS gate or from an I/O port of a microcontroller.

During shutdown, the output voltage falls to 0V and the supply current is typically only 200nA.

If the shutdown mode is not needed, $\overline{SHDN}$ should be connected directly to the regulator input voltage pin.

$\overline{ERROR}$ Open Drain Output

$\overline{ERROR}$ is driven low whenever V_{OUT} falls out of regulation by more than 5 percent typically. This condition may be caused by low input voltage, output current limiting, or thermal limiting. The $\overline{ERROR}$ threshold is 5% below rated V_{OUT} regardless of the programmed output voltage value (e.g. $\overline{ERROR}$ = V_{OL} at 4.7V (typical) for a 5.0V regulator and 2.85V (typical) for a 3.0V regulator). $\overline{ERROR}$ output operation is shown in *Figure 8*.

Note that $\overline{ERROR}$ is active when V_{OUT} falls to V_{TH}, and inactive when V_{OUT} rises above V_{TH} by V_{HYS}.

As shown in *Figure 9*, $\overline{ERROR}$ can be used as a battery low flag, or as a microcontroller $\overline{RESET}$ signal (with the addition of timing capacitor C2). R1 x C2 should be chosen to maintain $\overline{ERROR}$ below V_{IH} of the processor $\overline{RESET}$ input for at least 200ms to allow time for the system to stabilize.

Output Capacitor

The IMP2054, IMP2055 and IMP2186 were designed for stable operation with a wide range of capacitor values and type. The output capacitor should be above 0.47µF. A 1µF value is recommended. Ceramic or tantalum capacitors are suitable with an ESR up to 5Ω.

Thermal Shutdown

An on-chip thermal protection circuit shuts the LDO regulator off when the die temperature exceeds 150°C. There is a built in 12°C hysteresis. The regulator will remain off until the die temperature drops to approximately to 138°C.

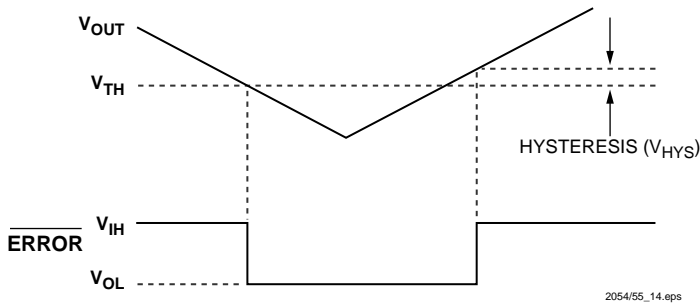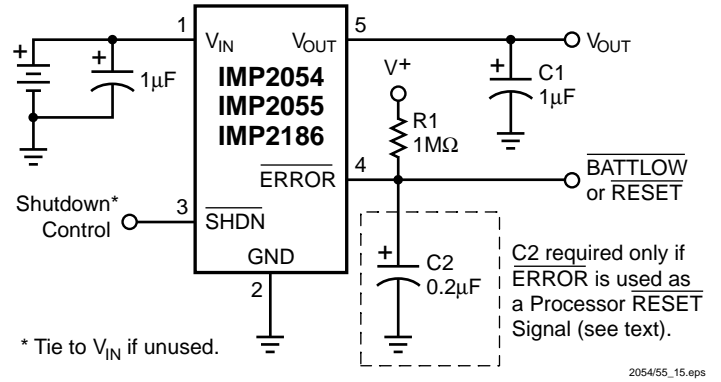*Figure 8. $\overline{ERROR}$ Output Operation*

Figure 9. Typical Application Circuit

ISO 9001 Registered

Notes

Project

ISO 9001 Registered

IMP2054/55, IMP2186