Open Source, 3.3 V to 1.8 V, 100 mA Full Regulator

1 Features

- 100mA Output Current Capability.
- Standard Fixed Output Voltage of 1.8 V.
- Low Dropout Voltage: 650 mV at 100 mA
- Stable with Output Capacitor[a] of 47 µF.
- Low Supply Current of 115 µA (No Load).
- Low Temperature Coefficient 125 ppm/°C.
- 0.016 V/V Line Regulation at 100 mA.
- 0.0083 mV/mA Load Regulation at 3.3 V.
- Power Supply Ripple Rejection of 38.9 dB.
- Startup time of 450 µs at rising time of 100 µs.

2 Applications

- 3.3V to 1.8V Logic Power Supply

3 Description

The EF_LDOR01 is a positive low dropout regulator for output of 1.8 V. It is capable of supplying 100 mA of output current with a dropout voltage of 650 mV. Low operating quiescent current of 115 µA is consumed at no load current. Moreover, it provides a standard fixed output voltage of 1.8V which is a good choice for logic power supply. The EF_LDOR01 requires an output capacitance of 47 µF with a wide range of ESR (0.1 Ω to 0.5 Ω) for stability. Output capacitors of this size are typically included in most regulator designs.

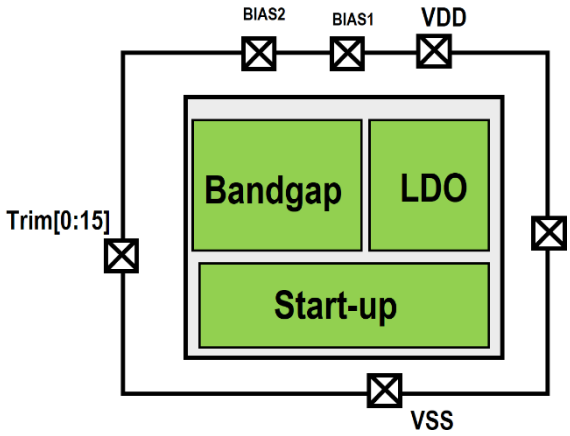


Figure 1. Functional Block Diagram

[a]: CAP ALUM 47UF 20% 35V SMD

Pin Configuration and Functions

Pin's Name	I/O	Description
VDD	Supply	Positive power supply voltage, 3.3 V.
VSS	Supply	Ground.
VOLDO	Analog Output	The output of the LDO at 1.8 V.
BIAS1	Analog Input	It is connected to a resistor to VDD for 1st internal OTA
BIAS2	Analog Input	It is connected to a resistor to VDD for 2nd internal OTA
Trim [0:15]	Digital input (3.3 V)	Trimming port

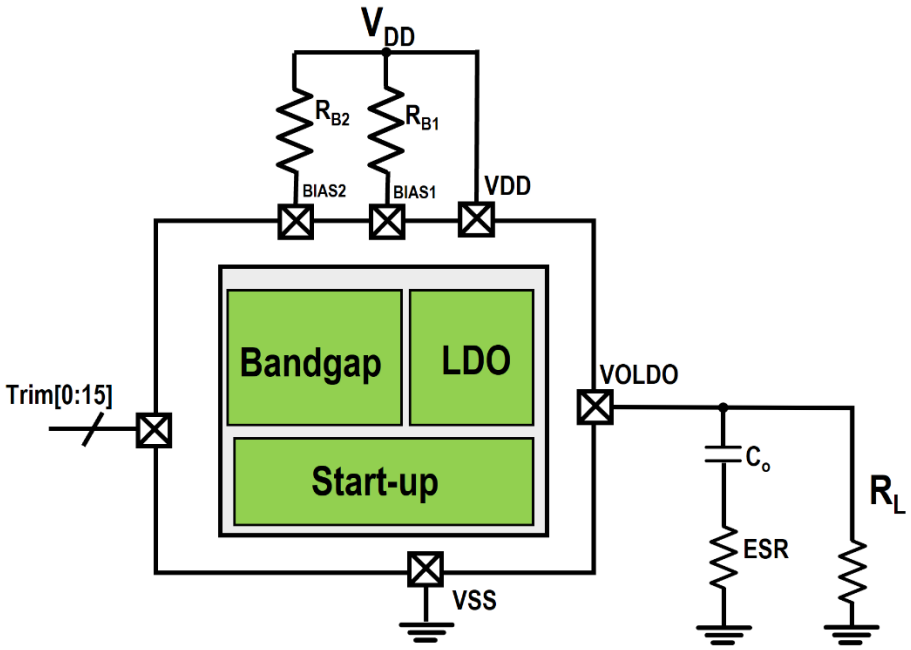


Figure 2. Typical Application
NOTE: Co is CAP ALUM 47UF 20% 35V SMD, ESR could be in range 0.1 Ω to 0.5 Ω.
R_{B1}=450 KΩ, R_{B2}=300 KΩ.

4 Electrical Characteristics

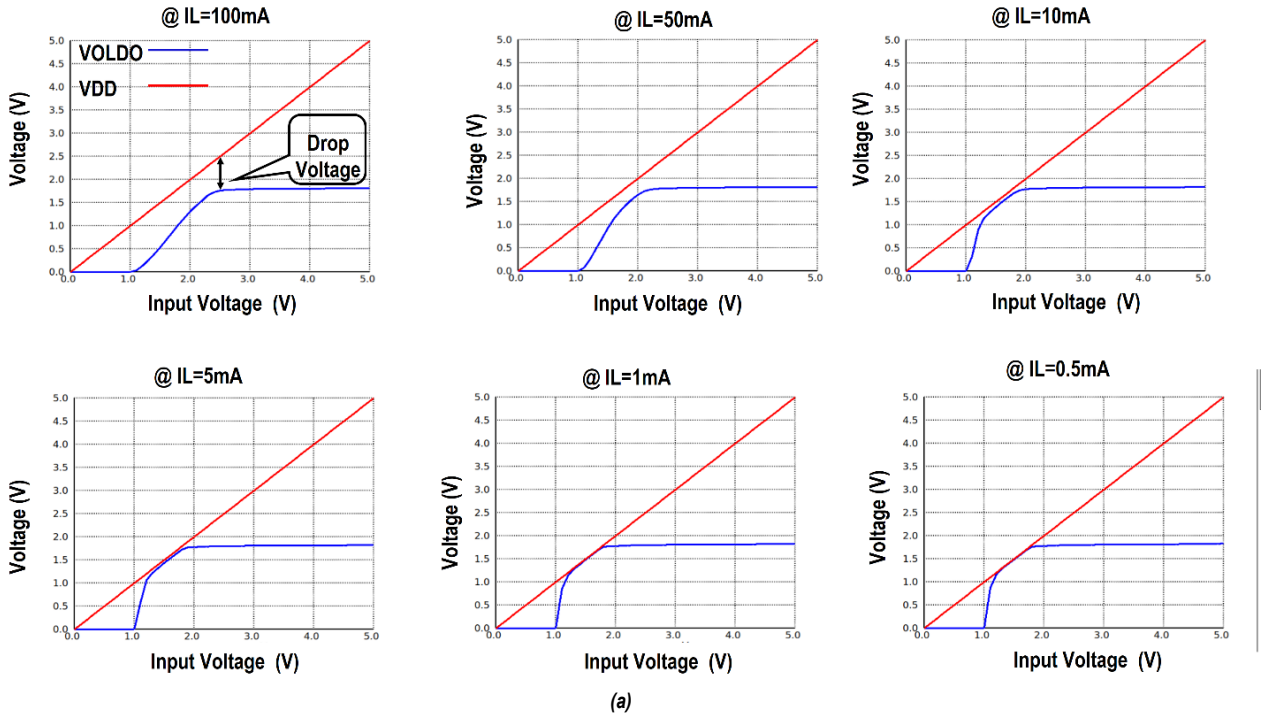
The listed parameters are reported at room temperature (27°C), Co=47µF, ESR=0.1Ω, R_{B1}=450 KΩ, R_{B2}=300 KΩ, Only Trim[6]=3.3 V.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
VDD	Power Supply			3.3		V
VOLDO	LDO's output			1.8		V
IL	Current Load				100	mA
IQ	Quiescent Current	IL=0		0.115		mA
	Line Regulation	IL=100 mA, VDD ranges from 1.1 VDD to 0.9 VDD		0.016		V/V
		IL=0.5mA, VDD ranges from 1.1 VDD to 0.9 VDD		0.0083		
	Load Regulation	VDD=3.3 V, IL range from 0.1 mA to 100mA		0.0489		mV/mA
	Voltage Dropout	IL=0.5 mA		9		mV
		IL=100 mA		650		
	[a]Temperature Range		0		70	°
TC	Temperature Coefficient	IL=1 mA		115		ppm/°C
		IL=100 mA		125		
	Startup-time	Rising time (tr)=1 µs, IL= 100 mA		335		µs
		Rising time (tr)=10 µs, IL= 100 mA		355		
		Rising time (tr)=50 µs, IL= 100 mA		400		
		Rising time (tr)=100 µs, IL= 100 mA		450		
PSRR	Power Supply Ripple Rejection	f_{ripple} = 120 Hz, (V_{in} – V_O) = 1.5 V, V_{ripple} = 0.5 V_{P-P}, IL= 100 mA		38.9		dB
		f_{ripple} = 120 Hz, (V_{in} – V_O) = 1.5 V, V_{ripple} = 1 V_{P-P}, IL= 100 mA		34		
	Output Deviation at Load Transient	IL transits from 1 mA to 100 mA, tr=tf=10 µs, VDD=3.3 V.		11.7		mV
	Output Deviation at Line Transient	VDD transits from 2.97 V to 3.63 V, tr=tf=10 µs, IL=100 mA.		52		mV
	Output noise spectral density	IL=100 mA ,f=120 Hz		32		$\mu V/\sqrt{Hz}$
	Core Silicon area	SKYWATER 130nm		315x118		μm^2

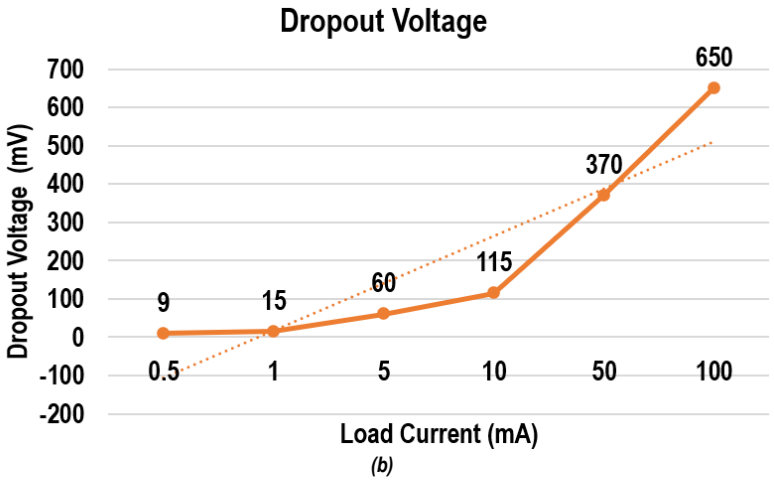
[a] : Commercial Temperature Range.

5 Typical Performance Curves

5.1 Drop output Voltage



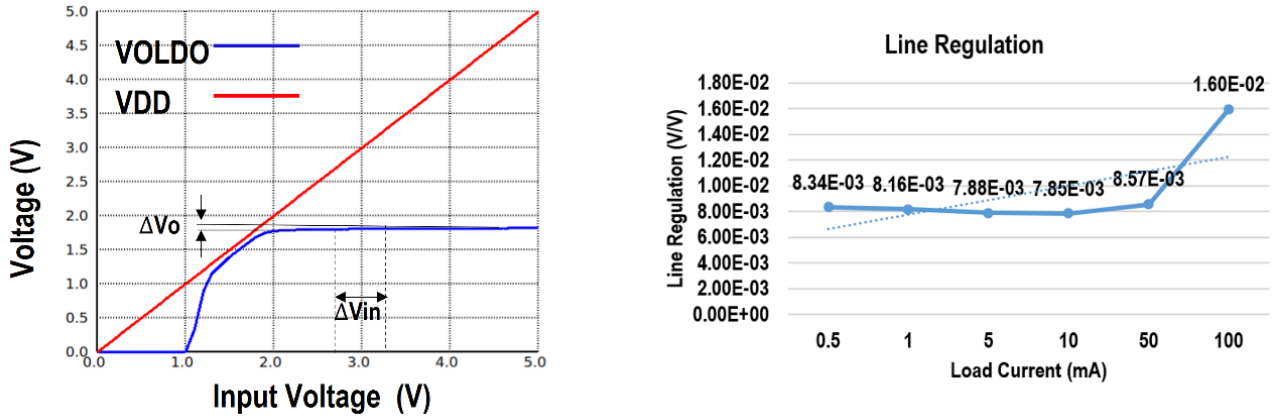
(a)



(b)

Figure 3. (a) Output Voltage vs Input Voltage, (b) Dropout Voltage vs Load Current.

5.2 Linear Regulation



(a) *(b)*

Figure 4. (a) Output Voltage vs Input Voltage, (b) Line Regulation vs Load Current.

5.3 Load Regulation

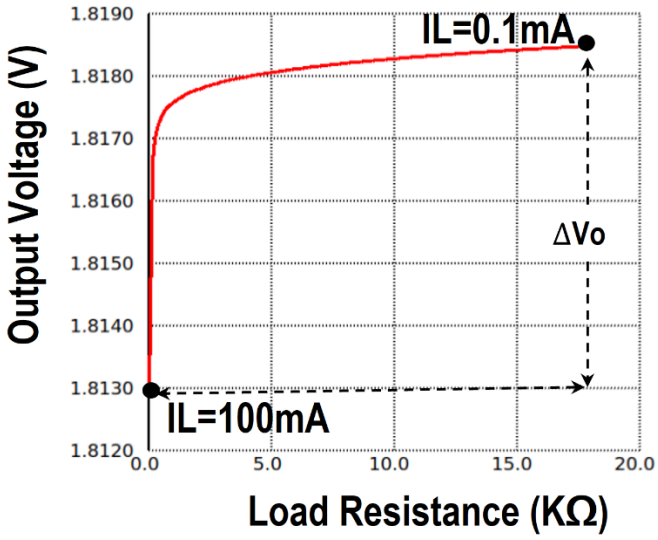


Figure 5. Output Voltage vs Load Resistance at VDD=3.3V

5.4 Startup time

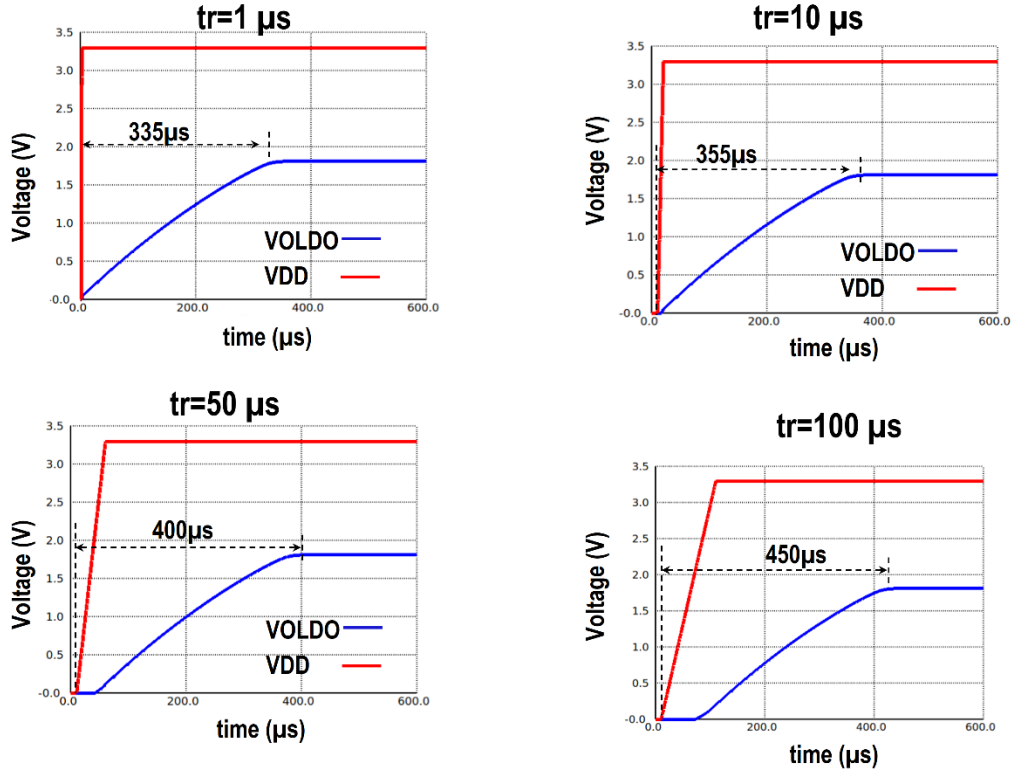
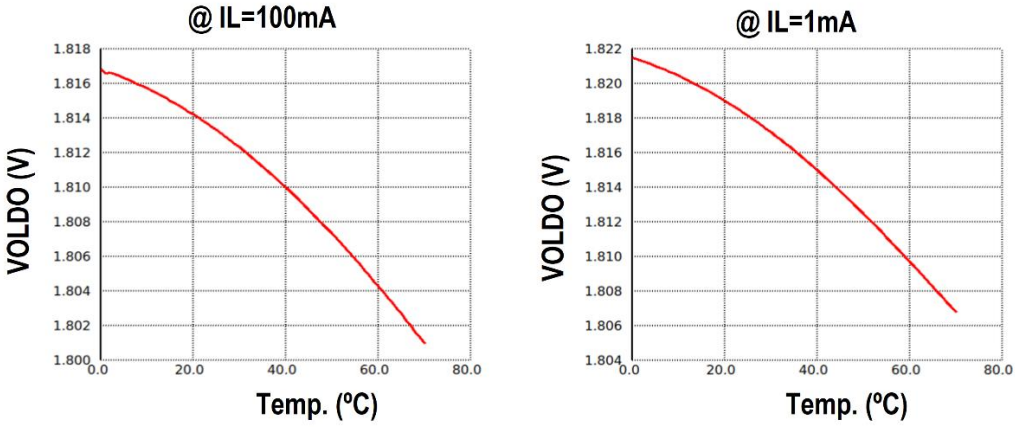


Figure 6. Startup time at different rising time of input voltage Il=100 mA.

5.5 Temperature Coefficient



(a) *(b)*

Figure 7. Temperature Coefficient of the output voltage at (a) IL=100 mA, and (b) IL=1 mA

5.6 Power Supply Rejection (PSR)

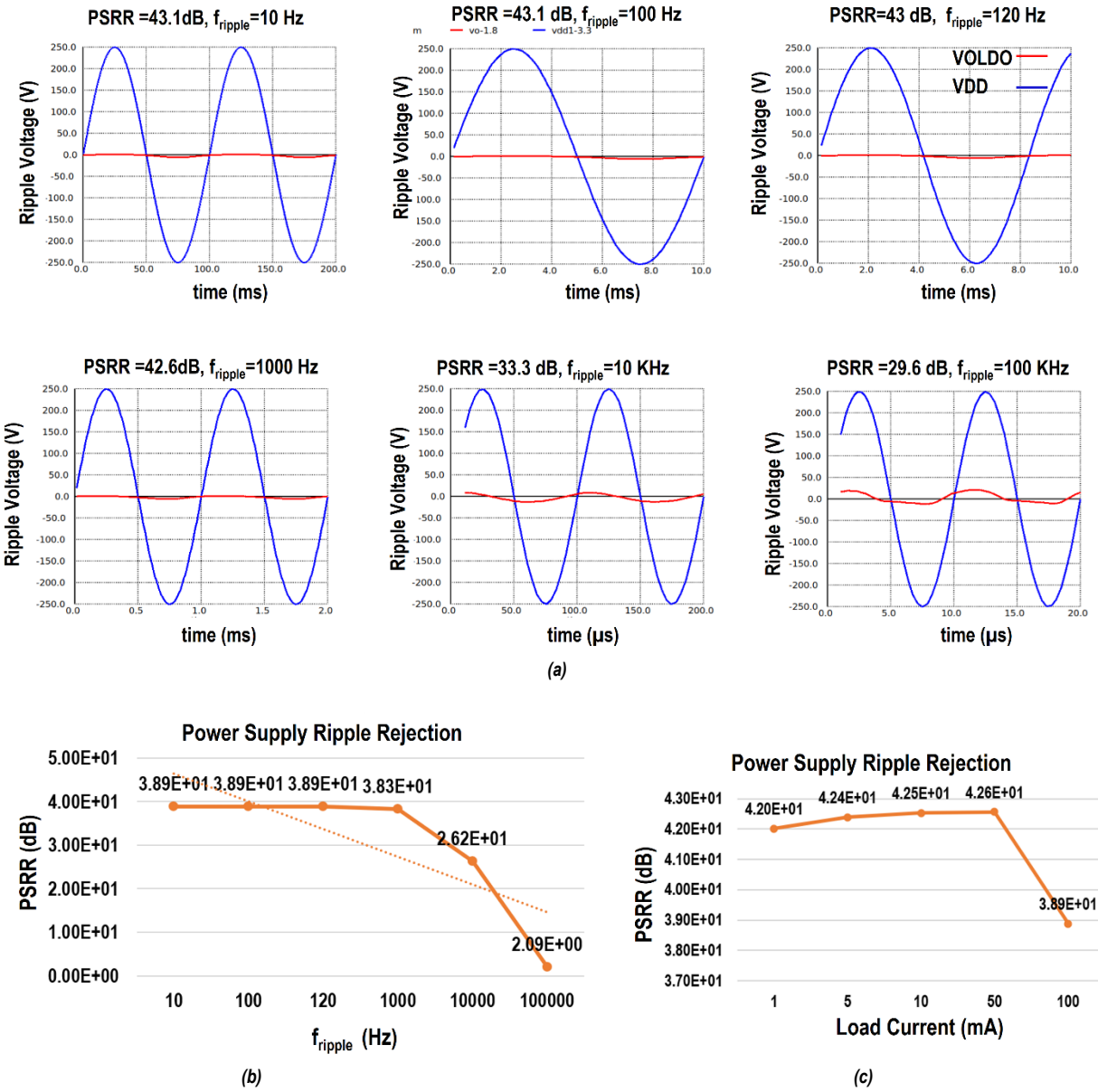


Figure 8. (a) Ripple Voltage at Vp-p=0.5 V , (b) PSRR vs Frequency at IL=100 mA, (c) PSRR Vs Load current at f_{ripple}=120 Hz and V_{p-p}=0.5 V

5.7 Load Transient

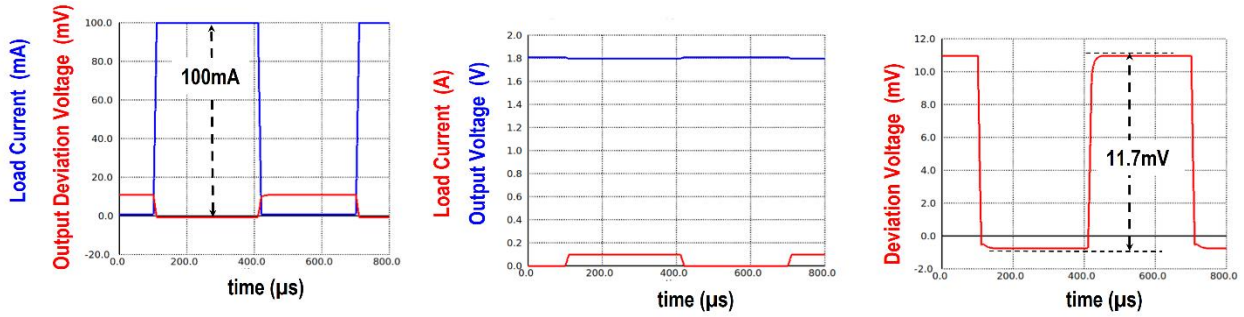


Figure 9. Load Transient Response at VDD of 3.3 V (tr=tf=10µs).

5.8 Line Transient

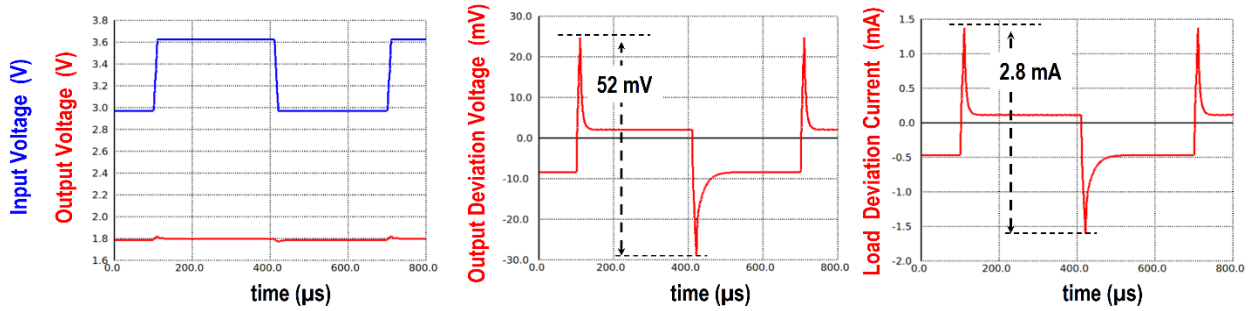


Figure 10. Line Transient Response at IL of 100 mA and VDD transits from 2.97 V to 3.63 V.

5.9 Noise Analysis

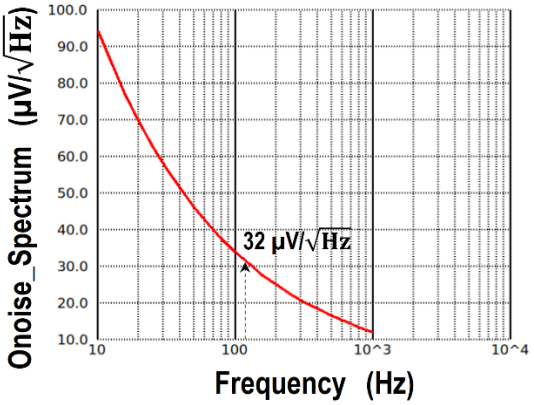


Figure 11. Output Noise Spectrum

5.10 Core Silicon area

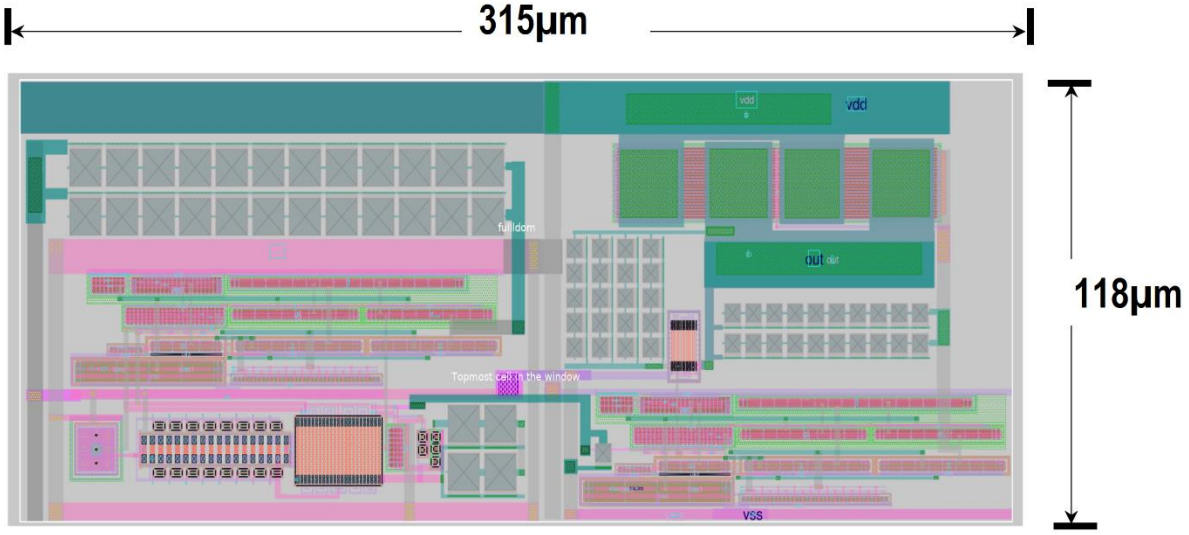


Figure 12. Full Regulator Layout