

# TPS780/781 LDOs designed for the MSP430

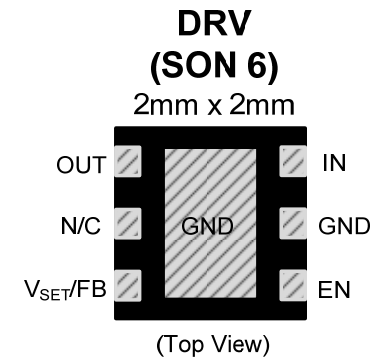
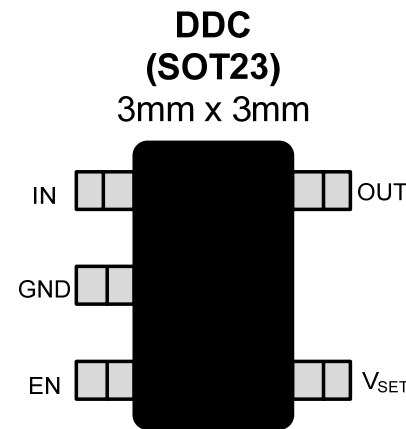
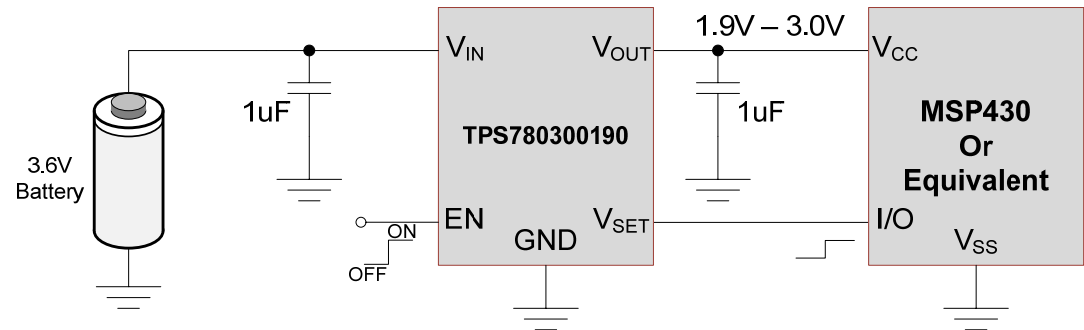
December 2008

# TPS780xx/781xx

## Low IQ LDO with Dual-Level Outputs

### Benefits

- **Ultra-Low  $I_Q$ :**
  - 500nA typ (TPS780xx)
  - 1uA typ (TPS781xx)
- **Drop out Voltage: 130mV @ 150mA**
- **Output Voltages: Fixed (1.5 to 4.2V) and Adjustable (1.22 to 5.25V)**
- **$V_{SET}$  Pin allows  $V_{OUT}$  to Toggle Between Two Factory EEPROM Preset Values**
- **Stable with 1 $\mu$ F Ceramic Output Capacitor**
- **TSOT23-5, 2X2mm SON Packages**



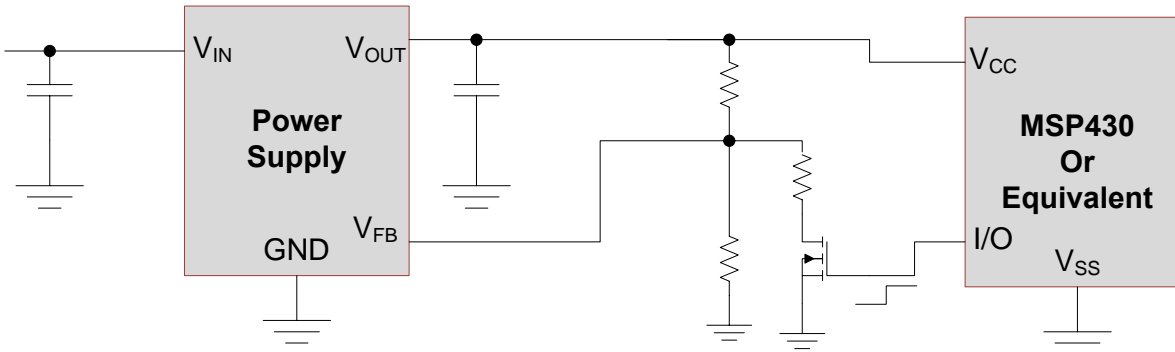
### Applications

- Power Management - LDO
- TI MSP430 Attach Applications
- Wireless Handsets
- Portable Media Players
- Battery Operated Devices w/ extended sleep times

Device	$V_{IN}$ (V)	$I_{OUT}$ (mA)	$V_{OUT}$ (V)	$I_Q$ ( $\mu$ A)	$V_{DO}$ (mV)
TPS780	2.2 – 5.5	150	1.5 – 4.2	0.5	130
TPS781	2.2 - 5.5	150	1.5 – 4.2	1	130

# Dynamic Voltage Scaling (DVS)

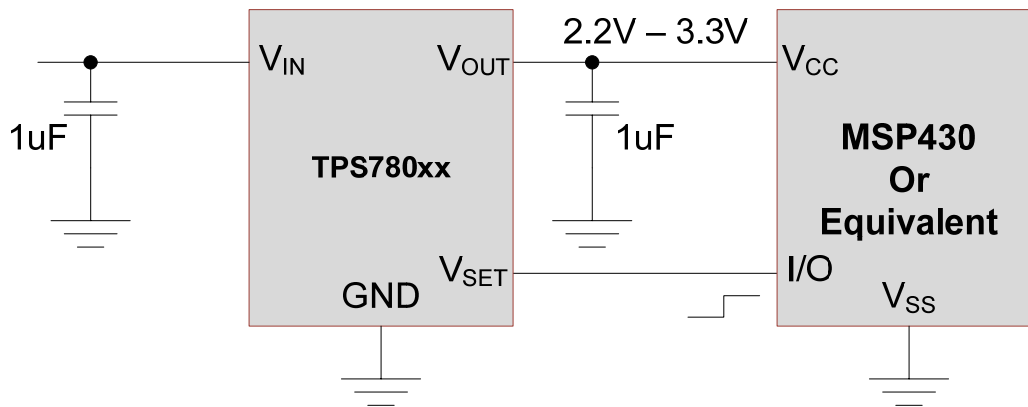
## Discrete DVS implementation



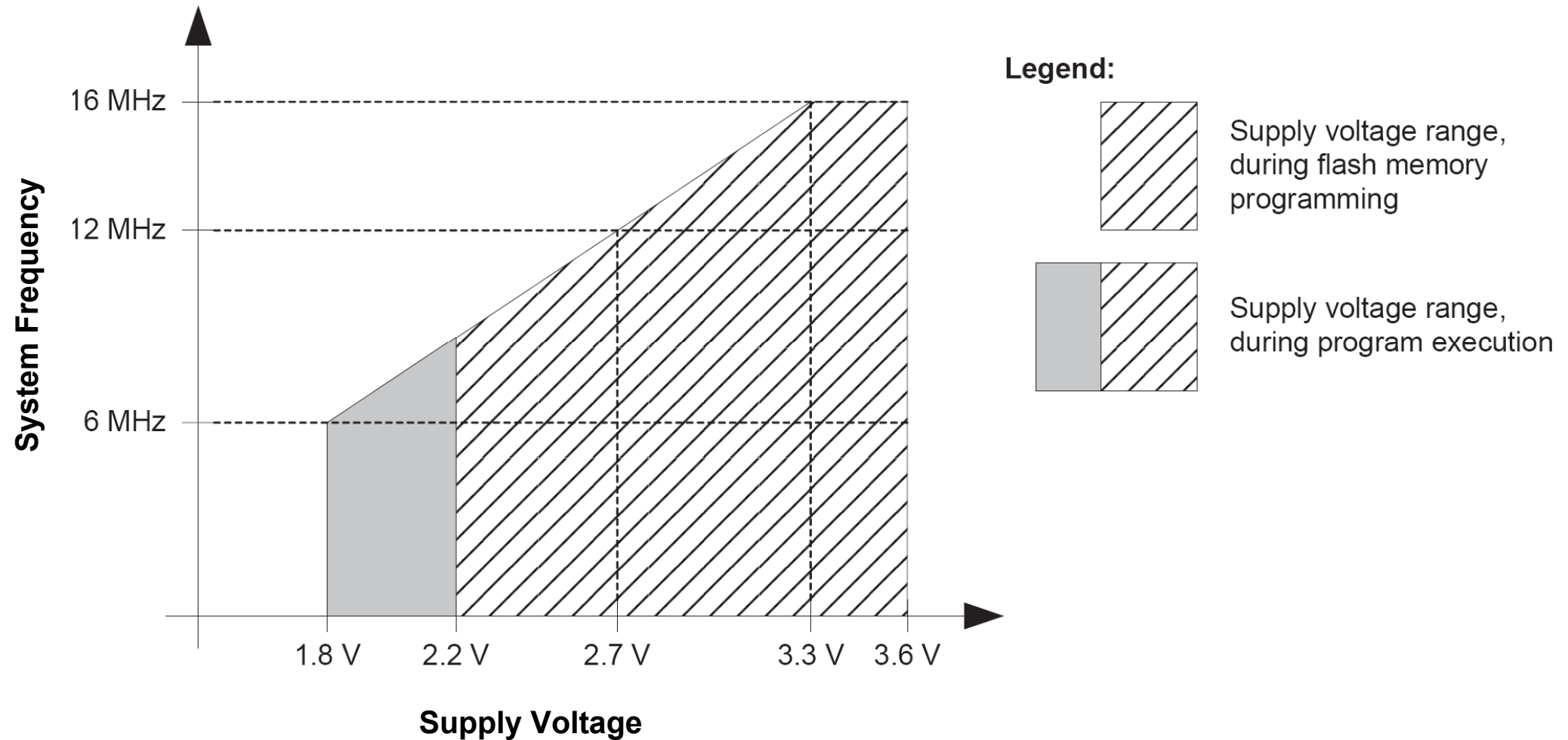
## Benefits of DVS

- Dynamically switch  $V_{OUT}$  between 2 preset levels
- Lower  $V_{CC}$  results in lower  $I_Q$  thus prolonging battery life
- Integrated DVS eliminates power lost in the discrete components

## DVS implementation with TPS780xx



# Minimum Operating Voltage MSP430F21X1



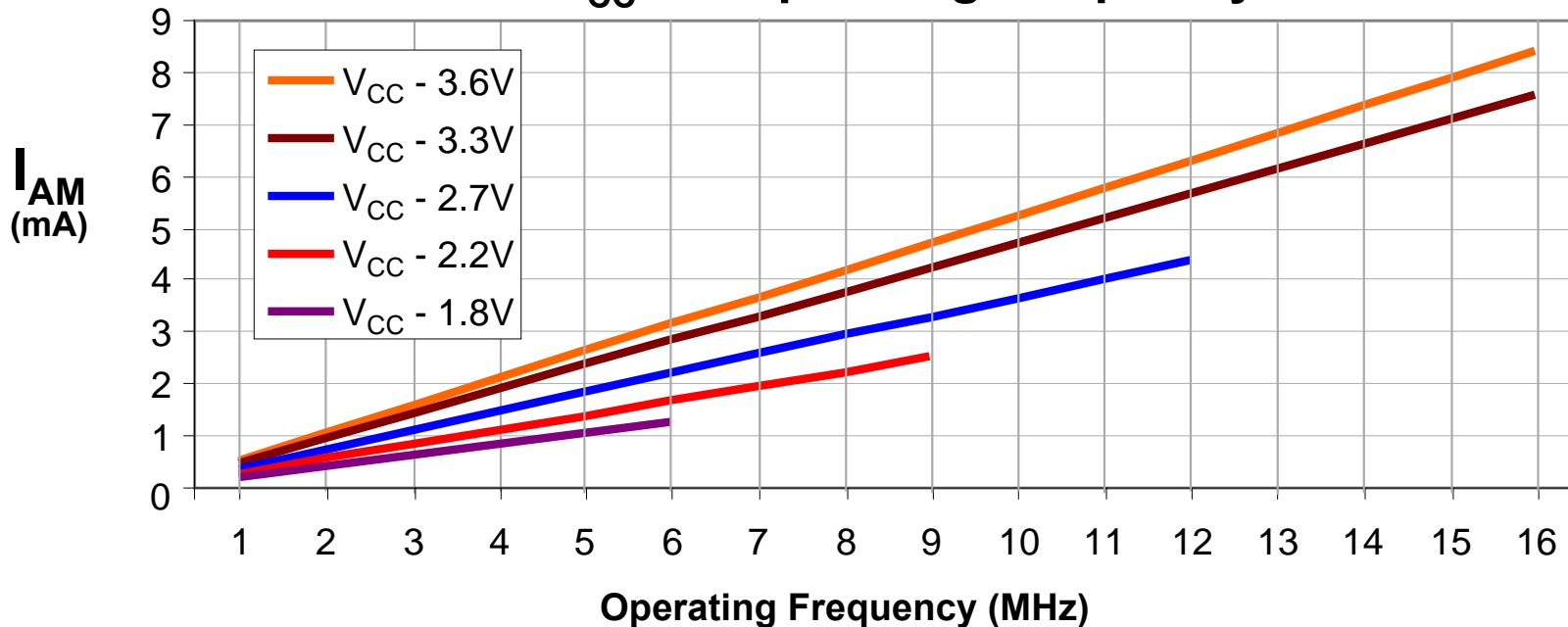
# MSP430 Active Current (F Version)

- Across  $V_{CC}$  and Frequency

- Current consumption of Active Mode vs. System Frequency (F-Version)

- $I_{AM} = (I_{AM})[1\text{MHz}] \times f(\text{System})[\text{MHz}] \longrightarrow I_{AM} \equiv \left( 175 \cdot \frac{\mu\text{A}}{\text{V}} \cdot V_{CC} - 105\mu\text{A} \right) \cdot \text{Freq}$

**MSP430 “F Version” Active Mode Current ( $I_{AM}$ )  
 $V_{CC}$  vs. Operating Frequency**



# Runtime Calculations

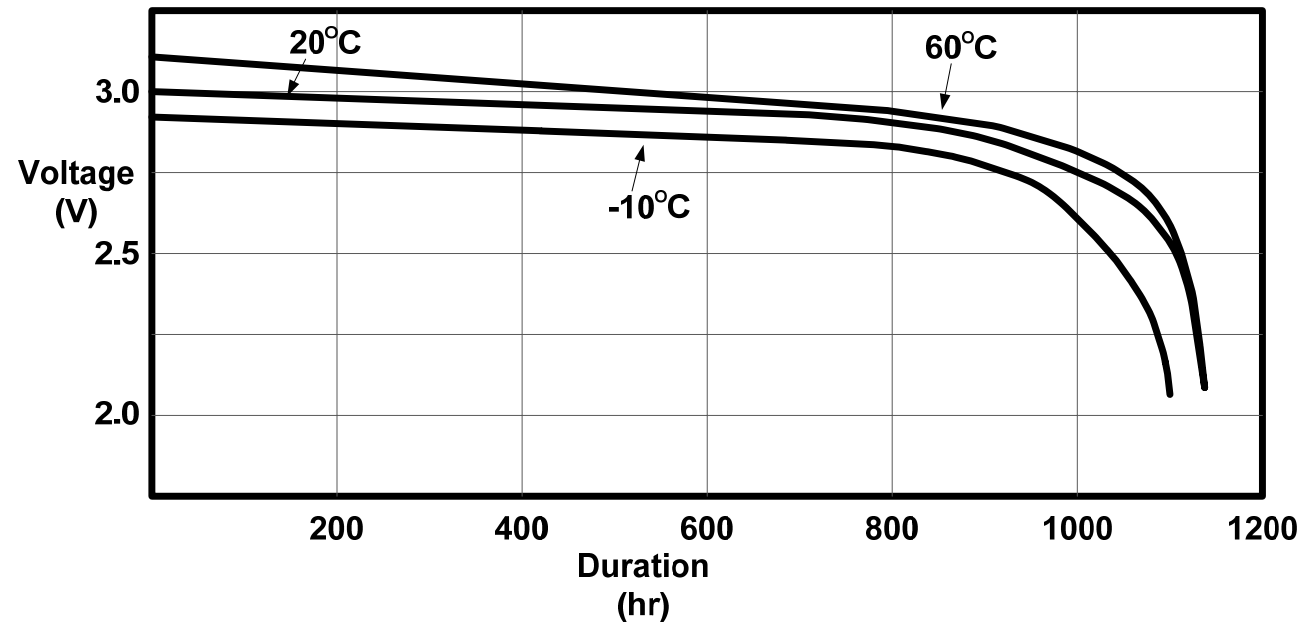
- **Input Power**
  - CR2032 Lithium Coin Cell
- **MSP430**
  - Clock 6MHz
  - $V_{CC} > 2V$  for 6MHz clock

## Specifications for CR2032

Nominal Voltage (V)	3
Nominal Capacity (mAh)	220
Continuous Drain (mA)	0.2
Operating Temp (°C)	-30 ~ +60

Temperature Characteristics

Load: 15k $\Omega$ (190uA)

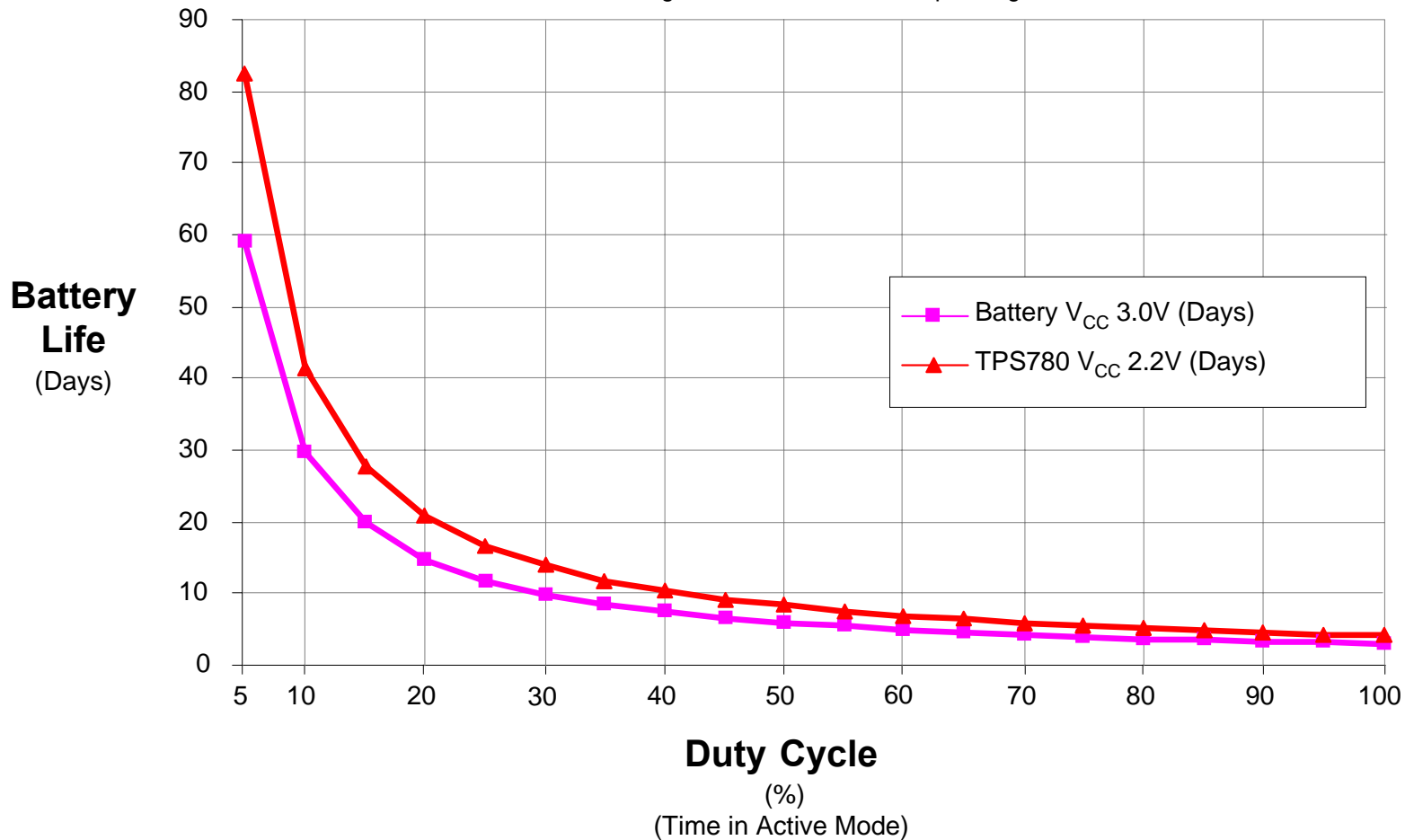


# Comparison of Battery Life

TPS780 vs. CR2032 Coin Cell

## Battery Life Comparison

Calculated assuming a MSP430 "F" Version operating @ 6Mhz.



# Battery Life Comparison for MSP430F2619 TPS780 vs. Battery, 1uA LDO and 20uA LDO

	TPS780 (Days)	Battery (Days)	1uA LDO (Days)	20uA LDO (Days)
Efficiency with $V_{BAT}=3.0$ $V_{CC}=2.2V$	73%	100%	73%	73%
LDO Quiescence Current ( $I_Q$ )	0.5uA	0	1uA	20uA
MSP430 Active current	2.19mA	3.09mA	2.19mA	2.19mA
MSP430 Low Power current	0.5uA	0.6uA	0.5uA	0.5uA
Active Mode 1 sec/hour	5742	6286	4373	434
Active Mode 10 sec/hour	1320	998	1085	346
Active Mode 100 sec/hour	151	106	148	114
Active Mode 1000 sec/hour	15.4	10.7	15.4	14.9
Active Mode all the time	4.2	3.0	4.2	4.2

# DVS Offerings

Device	V <sub>IN</sub> (V)	I <sub>OUT</sub> (mA)	V <sub>OUT</sub> (V)	I <sub>Q</sub> ( $\mu$ A)	V <sub>DO</sub> (mV)	Package
TPS780330220	2.2 - 5.5	150	3.3 / 2.2	0.5	130	TSOT-23/SON 6
TPS780230300	2.2 - 5.5	150	2.3 / 3.0	0.5	130	SON 6
TPS780300250	2.2 - 5.5	150	3.0 / 2.5	0.5	130	SON 6
TPS780270200	2.2 - 5.5	150	2.7 / 2.0	0.5	130	TSOT-23
TPS78001	2.2 - 5.5	150	1.22 - 5.25V	1.7	130	TSOT-23/SON 6
TPS781330220	2.2 - 5.5	150	3.3 / 2.2	1	130	TSOT-23/SON 6
TPS78101	2.2 - 5.5	150	1.22 - 5.25V	2.7	130	TSOT-23/SON 6
TPS728185315	2.7 - 6.5	200	1.85 / 3.15	45	230	SON 6/WCSP