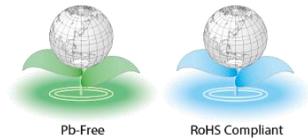


### Features

- Any frequency between 80.000001 and 220 MHz accurate to 6 decimal places of accuracy
- 100% pin-to-pin drop-in replacement to quartz-based VCXO
- Frequency stability as low as  $\pm 10$  ppm
- Widest pull range options from  $\pm 25$  ppm to  $\pm 1600$  ppm
- Industrial or extended commercial temperature range
- Superior pull range linearity of  $\leq 1\%$ , 10 times better than quartz
- LVC MOS/LVTTL compatible output
- Four industry-standard packages:  
2.7 x 2.4 mm (4-pin) (compatible with 2.5 x 2.0 mm footprint),  
3.2 x 2.5mm (4-pin), 5.0 x 3.2 mm (6-pin), 7.0 x 5.0 mm (6-pin)
- Instant samples with Time Machine II and fieldprogrammable oscillators
- RoHS and REACH compliant, Pb-free, Halogen-free and Antimony-free

### Applications

- Telecom clock synchronization, instrumentation
- Low bandwidth analog PLL, jitter cleaner, clock recovery, audio
- Video, 3G/HD-SDI, FPGA, broadband and networking



### Electrical Specifications

**Table 1. Electrical Characteristics<sup>[1,2,3]</sup>**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Frequency Range</b>						
Output Frequency Range	f	80.000001	–	220	MHz	
<b>Frequency Stability and Aging</b>						
Frequency Stability	F_stab	-10	–	+10	PPM	Inclusive of Initial tolerance <sup>[4]</sup> at +25 °C, and variations over operating temperature, rated power supply voltage and load
		-25	–	+25	PPM	
		-50	–	+50	PPM	
Aging	F_aging	-5	–	+5	PPM	10 years, +25°C
Operating Temperature Range	T_use	-20	–	+70	°C	Extended Commercial
		-40	–	+85	°C	Industrial
<b>Supply Voltage and Current Consumption</b>						
Supply Voltage	Vdd	+1.71	+1.8	+1.89	V	Supply voltages between +2.5V and +3.3V can be supported. Contact KDS for additional information.
		+2.25	+2.5	+2.75	V	
		+2.52	+2.8	+3.08	V	
		+2.97	+3.3	+3.63	V	
Current Consumption	Idd	–	+34	+36	mA	No load condition, f = 100 MHz, Vdd = +2.5V, +2.8V or +3.3V
		–	+30	+33	mA	No load condition, f = 100 MHz, Vdd = +1.8V
Standby Current	I_std	–	–	+70	μA	Vdd = +2.5V, +2.8V or +3.3V, $\overline{ST}$ = GND, output is Weakly Pulled Down
		–	–	+10	μA	Vdd = +1.8 V. $\overline{ST}$ = GND, output is Weakly Pulled Down
<b>VCMO Characteristics</b>						
Pull Range <sup>[5,6]</sup>	PR	$\pm 25, \pm 50, \pm 100, \pm 150, \pm 200, \pm 400, \pm 800, \pm 1600,$			ppm	See the Absolute Pull Range and APR table on page 10
Upper Control Voltage	VC_U	+1.7	–	–	V	Vdd = +1.8V, Voltage at which maximum deviation is guaranteed.
		+2.4	–	–	V	Vdd = +2.5V, Voltage at which maximum deviation is guaranteed.
		+2.7	–	–	V	Vdd = +2.8V, Voltage at which maximum deviation is guaranteed.
		+3.2	–	–	V	Vdd = +3.3V, Voltage at which maximum deviation is guaranteed.
Lower Control Voltage	VC_L	–	–	+0.1	V	Voltage at which minimum deviation is guaranteed.
Control Voltage Input Impedance	Z_in	100	–	–	kΩ	
Control Voltage Input Capacitance	C_in	–	5	–	pF	
Linearity	Lin	–	0.1	1	%	
Frequency Change Polarity	–	Positive Slope			–	
Control Voltage Bandwidth (-3dB)	V_BW	–	8	–	kHz	Contact KDS for 16 kHz and other high bandwidth options

**Electrical Specifications (continued)**

**Table 1. Electrical Characteristics<sup>[1,2,3]</sup>**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>LVC MOS Output Characteristics</b>						
Duty Cycle	DC	45	–	55	%	f ≤ 165MHz, All Vdds. Refer to Note 11 for definition of Duty Cycle
		40	–	60	%	f > 165MHz, All Vdds. Refer to Note 11 for definition of Duty Cycle
Rise/Fall Time	Tr,Tf	–	1.5	2.0	ns	Vdd = +1.8V, +2.5V, +2.8V or +3.3V, 10% - 90% Vdd level
Output High Voltage	VOH	90%	–	–	Vdd	IOH = -7 mA (Vdd = +3.0V or +3.3V) IOH = -4 mA (Vdd = +2.8V or +2.5V) IOH = -2 mA (Vdd = +1.8V)
Output Low Voltage	VOL	–	–	10%	Vdd	IOH = +7 mA (Vdd = +3.0V or +3.3V) IOH = +4 mA (Vdd = +2.8V or +2.5V) IOH = +2 mA (Vdd = +1.8V)
<b>Input Characteristics</b>						
Input Pull-up Impedance	Z_in	–	100	250	kΩ	For the OE/ST pin for 6-pin devices
Input Capacitance	C_in	–	5	–	pF	For the OE/ST pin for 6-pin devices
<b>Startup and Resume Timing</b>						
Startup Time	T_start	–	–	10	ms	See Figure 7 for startup resume timing diagram
OE Enable/Disable Time	T_oe	–	–	115	ns	f = 80.000001 MHz, all Vdds. For other freq, T_oe = 100 ns + 3 clock periods
Resume Time	T_resume	–	7	10	ms	See Figure 8 for resume timing diagram
<b>Jitter</b>						
RMS Period Jitter	T_jitt	–	1.5	2.0	ps	f = 156.25 MHz, Vdd = +2.5V, +2.8V or +3.3V
		–	2.0	3.0	ps	f = 156.25 MHz, Vdd = +1.8V
RMS Phase Jitter (random)	T_phj	–	0.5	1.0	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz

**Note:**

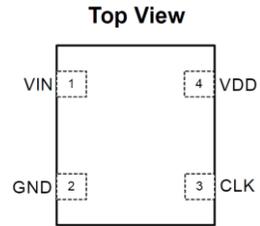
1. All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
2. The typical value of any parameter in the Electrical Characteristics table is specified for the nominal value of the highest voltage option for that parameter and at +25°C temperature
3. All max and min specifications are guaranteed across rated voltage variations and operating temperature ranges, unless specified otherwise
4. Initial tolerance is measured at Vin = Vdd/2
5. Absolute Pull Range (APR) is defined as the guaranteed pull range over temperature and voltage.
6. APR = pull range (PR) - frequency stability (F\_stab) - Aging (F\_aging)

**Table 2. Pin Description. 4-Pin Configuration**  
(For 2.7 x 2.0 mm and 3.2 x 2.5 mm Packages)

Pin	Symbol		Functionality
1	VIN	Input	0-Vdd: produces voltage dependent frequency change
2	GND	Power	Electrical ground
3	CLK	Output	Oscillator output
4	VDD	Power	Power supply voltage <sup>[7]</sup>

**Notes:**

7. A capacitor value of 0.1  $\mu$ F between VDD and GND is recommended.



**Figure 1.**

**Table 3. Pin Description. 6-Pin Configuration**  
(For 5.0 x 3.2 mm and 7.0 x 5.0 mm Packages)

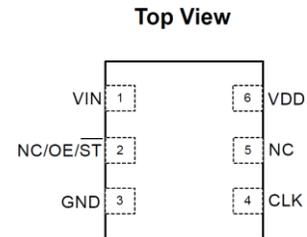
Pin	Symbol		Functionality
1	VIN	Input	0-Vdd: produces voltage dependent frequency change
2	NC/OE/ST	No Connect	H or L or Open: No effect on output frequency or other device function
		Output Enable	H or Open <sup>[9]</sup> : specified frequency output L: output is high
		Standby	H or Open <sup>[9]</sup> : specified frequency output L: output is low (weak pull down) <sup>[9]</sup> . Oscillation stops
3	GND	Power	Electrical ground
4	CLK	Output	Oscillator output
5	NC	No Connect	H or L or Open: No effect on output frequency or other device functions
6	VDD	Power	Power supply voltage <sup>[10]</sup>

**Notes:**

8. In OE or ST mode, a pull-up resistor of 10 k $\Omega$  or less is recommended if pin 2 in the 6-pin package is not externally driven. If pin 2 needs to be left floating, use the NC option.

9. Typical value of the weak pull-down impedance is 5 m $\Omega$

10. A capacitor value of 0.1  $\mu$ F between VDD and GND is recommended.



**Figure 2.**

**Table 4. Absolute Maximum Limits**

Attempted operation outside the absolute maximum ratings may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

Parameter	Min.	Max.	Unit
Storage Temperature	-65	+150	$^{\circ}$ C
VDD	-0.5	+4.0	V
Electrostatic Discharge	-	+2000	V
Soldering Temperature (follow standard Pb free soldering guidelines)	-	+260	$^{\circ}$ C

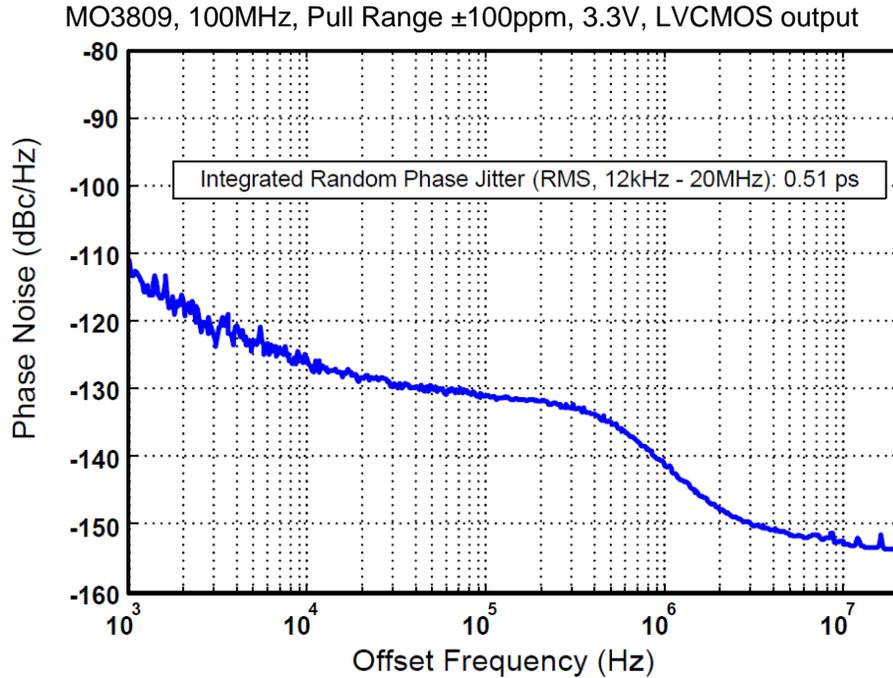
**Table 5. Thermal Consideration**

Package	$\theta$ JA, 4 Layer Board ( $^{\circ}$ C/W)	$\theta$ JA, 2 Layer Board ( $^{\circ}$ C/W)	$\theta$ JC, Bottom ( $^{\circ}$ C/W)
7050	191	263	30
5032	97	199	24
3225	109	212	27
2724	117	222	26

**Table 6. Environmental Compliance**

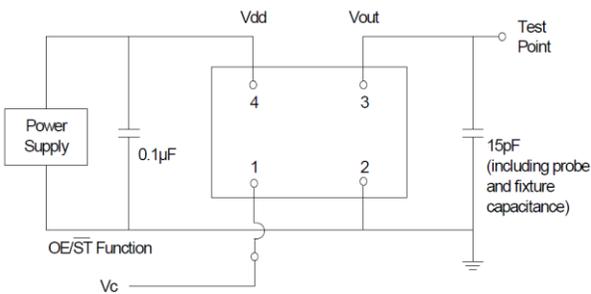
Parameter	Condition/Test Method
Mechanical Shock	MIL-STD-883F, Method 2002
Mechanical Vibration	MIL-STD-883F, Method 2007
Temperature Cycle	JESD22, Method A104
Solderability	MIL-STD-883F, Method 2003
Moisture Sensitivity Level	MSL1 @ 260 $^{\circ}$ C

**Phase Noise Plot**

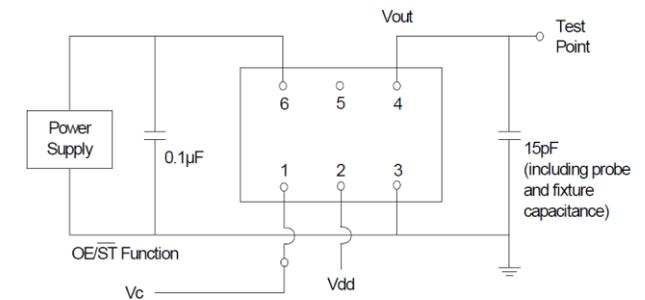


**Figure 3. Phase Noise**

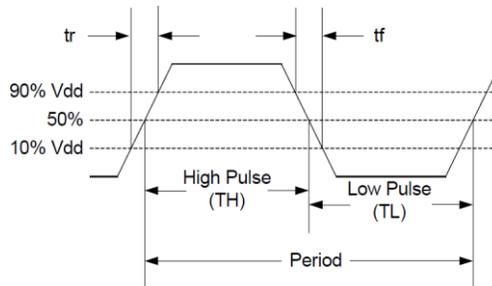
**Test Circuit and Waveform**



**Figure 4. Test Circuit (4-Pin Device)**



**Figure 5. Test Circuit (6-Pin Device)**

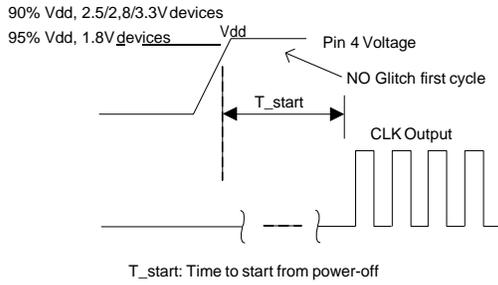


**Figure 6. Waveform**

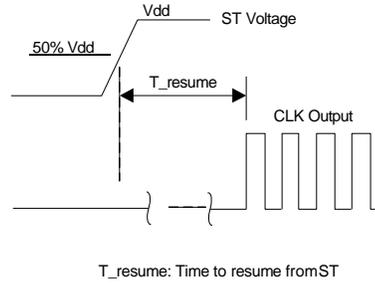
**Notes:**

11. Duty Cycle is computed as Duty Cycle = TH/Period.
12. MO3809 supports the configurable duty cycle feature. For custom duty cycle at any given frequency, contact KDS.

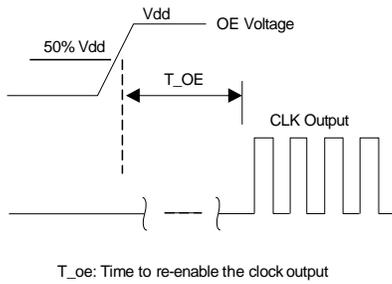
**Timing Diagram**



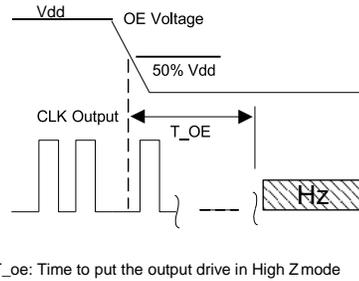
**Figure 7. Startup Timing (OE/ST Mode)**



**Figure 8. Standby Resume Timing (ST Mode Only)**



**Figure 9. OE Enable Timing (OE Mode Only)**



**Figure 10. OE Disable Timing (OE Mode Only)**

**Notes:**

- 13. MO3809 supports “no runt” pulses and “no glitch” output during startup or resume.
- 14. MO3809 supports gated output which is accurate within rated frequency stability from the first cycle.
- Typical Tr/f time = 1.66 ns (rise/fall time part number code =G)

Part number for the above example:

MO3808ID4-**CG**H-33NP-0049152000



Drive strength code is here.

### Instant Samples with Time Machine and Field Programmable Oscillators

KDS supports a field programmable version of the MO3809 VCMO for fast prototyping and real time customization of features. The field programmable devices (FP devices) are available for all four standard MO3809 package sizes and can be configured to one's exact specification using the Time Machine II, an USB powered MEMS oscillator programmer.

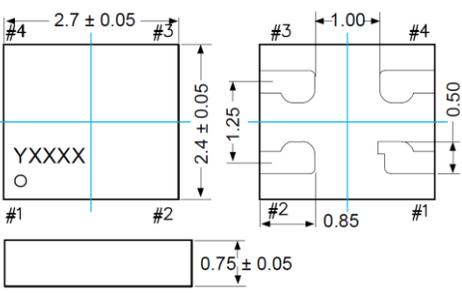
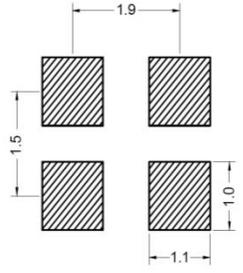
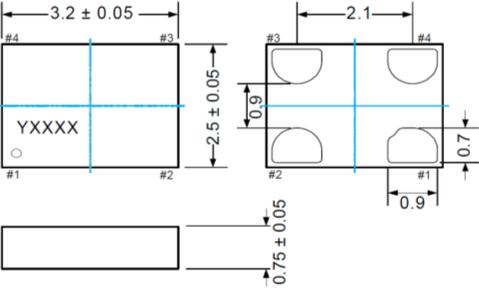
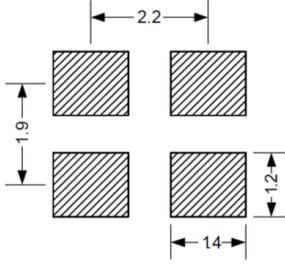
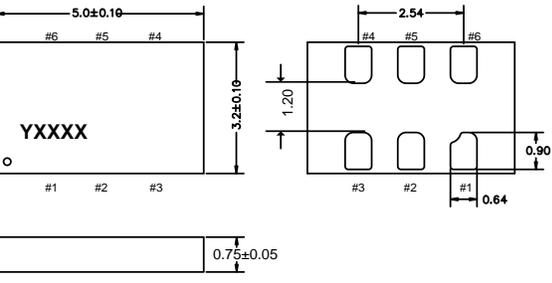
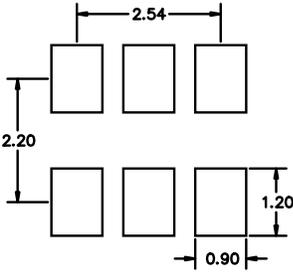
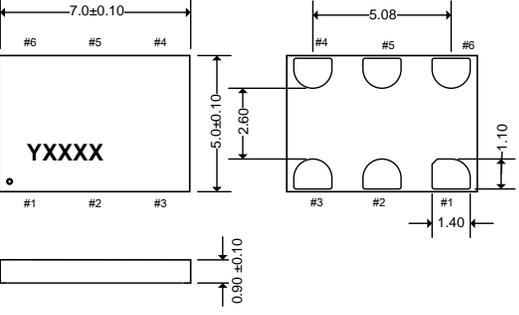
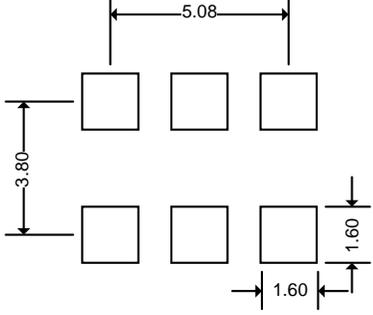
#### Customizable Features of the MO3809 FP Devices Include

- Any frequency between 80.000001 – 220 MHz
- Three frequency stability options,  $\pm 10$  ppm,  $\pm 25$  ppm,  $\pm 50$  ppm
- Two operating temperatures,  $-20$  to  $+70^{\circ}\text{C}$  or  $-40$  to  $+85^{\circ}\text{C}$
- Four supply voltage options,  $+1.8\text{V}$ ,  $+2.5\text{V}$ ,  $+2.8\text{V}$ ,  $+3.3\text{V}$
- Eight pull range options:  $\pm 25$  ppm,  $\pm 50$  ppm,  $\pm 100$  ppm,  $\pm 150$  ppm,  $\pm 200$  ppm,  $\pm 400$  ppm,  $\pm 800$  ppm,  $\pm 1600$  ppm

For more information regarding KDS's field programmable solutions, contact KDS.

MO3809 is typically factory-programmed per customer ordering codes for volume delivery.

**Dimensions and Patterns**

Package Size – Dimensions (Unit: mm) <sup>[15]</sup>	Recommended Land Pattern (Unit: mm)
<p><b>2.7 x 2.4 x 0.75 mm (100% compatible with 2.5 x 2.0 mm footprint)</b></p> 	
<p><b>3.2 x 2.5 x 0.75 mm</b></p> 	
<p><b>5.0 x 3.2 x 0.75 mm</b></p> 	
<p><b>7.0 x 5.0 x 0.90 mm</b></p> 	

**Notes:**

15. Top marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.

**Ordering Information**

**M O 3 8 0 9 D D 4 - C 0 H - 3 3 N P - 0 1 2 5 1 2 3 4 5 6 Y**

**Part Family**  
"MO3809"

**Temperature Range**  
"D" Extended Commercial -20°C to +70°C  
"I" Industrial -40°C to +85°C

**Package Size**  
"F4" 2.7 x 2.4 mm  
(compatible with 2.5 x 2.0 mm footprint)  
"D4" 4-pin 3.2 x 2.5 mm  
"B6" 6-pin 5.0 x 3.2 mm  
"A6" 6-pin 7.0 x 5.0 mm

**Signaling Type**  
"C" LVCMOS

**Output Drive Strength<sup>[16]</sup>**  
"0": Default below the line

**Frequency Stability**  
"F" ±10ppm  
"H" ±25ppm  
"K" ±50ppm

**Packing**  
"Y" 12mm Tape & Reel, 1ku reel  
"D" 8mm Tape & Reel, 3ku reel  
"E" 8mm Tape & Reel, 1ku reel

**Frequency**  
80.000001 to 220.000000MHz  
cf.) 80.000001MHz -> "0080000001"  
220.000000MHz -> "0220000000"

**Pull Range Options**  
"F" ±25 ppm  
"H" ±50 ppm  
"L" ±100 ppm  
"N" ±150 ppm  
"P" ±200 ppm  
"R" ±400 ppm  
"S" ±800 ppm  
"T" ±1600 ppm

**Feature Pin (#1 pin)**  
"E" Output Enable (6-pin only)  
"S" Standby (6-pin only)  
"N" No Connect in 6-pin devices  
Default value in 4-pin devices

**Supply Voltage**  
"18" +1.8V ±5%  
"25" +2.5V ±10%  
"28" +2.8V ±10%  
"33" +3.3V ±10%

**Table 7. APR Table**

Absolute pull range (APR) = Nominal pull range (PR) – frequency stability (F\_stab) – Aging (F\_aging)

Nominal Pull Range	Frequency Stability		
	±10	±25	±50
	APR (ppm)		
±25	±10	-	-
±50	±35	±20	-
±100	±85	±70	±45
±150	±135	±120	±95
±200	±185	±170	±145
±400	±385	±370	±345
±800	±785	±770	±745
±1600	±1585	±1570	±1545

**Table 8. Ordering Codes for Supported Tape & Reel Packing Method<sup>[16]</sup>**

Device Size	12 mm T&R (3ku)	12 mm T&R (1ku)	8 mm T&R (3ku)	8 mm T&R (1ku)
2.7 x 2.4 mm	-	-	D	E
3.2 x 2.5 mm	-	-	D	E
5.0 x 3.2 mm	-	Y	-	-
7.0 x 5.0 mm	-	Y	-	-

Notes:  
16. "-" indicates "not available."

## Revision History

**Table 9. Datasheet Version and Change Log**

Version	Release Date	Change Summary
0.6	1/24/13	Preliminary
1.0	3/18/14	<ul style="list-style-type: none"><li>· Preliminary removed from title</li><li>· Updated features and application</li><li>· Updated electrical specifications table</li><li>· Updated figure 4,</li><li>· Added new 6-pin device for figure 5</li><li>· Updated timing diagrams</li><li>· Updated ordering information drawing</li><li>· Updated APR table</li><li>· Updated ordering codes for tape and reel table</li><li>· Reformatted additional information table columns</li></ul>
1.01	1/8/15	<ul style="list-style-type: none"><li>· Corrected CLK and VDD functionality description in Table 2</li><li>· Revised VIN functionality description in Table 3</li></ul>