



LMC7215 - Micro-Power, Rail-to-Rail CMOS Comparators with Open-Drain/Push-Pull Outputs and TinyPak Package from the PowerWise® Family

Features

(Typical unless otherwise noted)

- Ultra low power consumption 0.7 μ A
- Wide range of supply voltages 2V to 8V
- Input common-mode range beyond V^+ and V^-
- Open collector and push-pull output
- High output current drive: (@ $V_S = 5V$) 45 mA
- Propagation delay (@ $V_S = 5V$, 10 mV overdrive) 25 μ s
- Tiny 5-Pin SOT23 package
- Latch-up resistance >300 mA

Applications

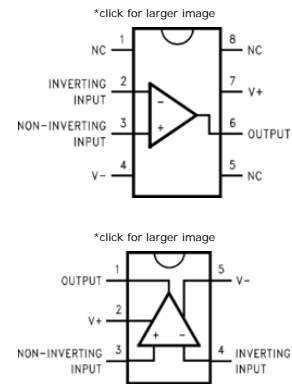
- Laptop computers
- Mobile phones
- Metering systems
- Hand-held electronics
- RC timers
- Alarm and monitoring circuits
- Window comparators, multivibrators

Typical Application

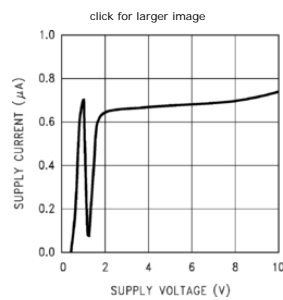
Parametric Table


Response Time	24 μ s
Output Bus	Push Pull
Supply Min	2 Volt
Supply Max	8 Volt
Channels	1 Channels
Offset Voltage max, 25C	6 mV
Output Current	30 mA
Input Range	R-R Input
Supply Current Per Channel	0.0007 mA
PowerWise Rating 3	17 μ A x μ s
Max Input Bias Current	1 nA
Special Features	Undefined
Temperature Min	-40 deg C
Temperature Max	85 deg C
Function	Comparator
Automotive Selection Guide	Yes
PowerWise	Yes

Connection Diagram



Typical Performance



 RoHS Compliance Information
LMC7215/LMC7225 Micro-Power, Rail-to-Rail CMOS Comparators with Push-Pull/Open-Drain Outputs and TinyPak™ Package
LMC7215/LMC7225 Micro-Power, Rail-to-Rail CMOS Comparators with Push-Pull/Open-Drain Outputs and TinyPak™ Package (Japanese)

Package Availability, Models

Part Number	Package							Factory Lead Time		Models	Std Pack Size	Package Marking Format
	Type	Pins	Spec.	MSL Rating	Peak Reflow	RoHS Report	CAD Symbols	Weeks	Qty			
LMC7215IM	SOIC NARROW	8	NOPB	1	260	RoHS	Download	Full production		LMC7215.MOD	rail of 95	NSZXTT LMC7215IM
								6 weeks	2000			
LMC7215IMX	SOIC NARROW	8	NOPB	1	260	RoHS	Download	Full production		LMC7215.MOD	reel of 2500	NSZXTT LMC7215IM
								6 weeks	15000			
LMC7215IM5	SOT-23	5	STD	1	260	RoHS	Download	Full production		LMC7215.MOD	reel of 1000	C02B XTT
			NOPB	1	260			6 weeks	7500			
LMC7215IM5X	SOT-23	5	STD	1	260	RoHS	Download	Full production		LMC7215.MOD	reel of 3000	C02B XTT
			NOPB	1	260			6 weeks	25000			

General Description

The LMC7215/LMC7225 are ultra low power comparators with a maximum of 1 μ A power supply current. They are designed to operate over a wide range of supply voltages, from 2V to 8V.

The LMC7215/LMC7225 have a greater than rail-to-rail common mode voltage range. This is a real advantage in single supply applications.

The LMC7215 features a push-pull output stage. This feature allows operation with absolute minimum amount of power consumption when driving any load.

The LMC7225 features an open drain output. By connecting an external resistor, the output of the comparator can be used as a level shifter to any desired voltage to as high as 15V.

The LMC7215/LMC7225 are designed for systems where low power consumption is the critical parameter.

Guaranteed operation over the full supply voltage range of 2.7V to 5V and rail-to-rail performance makes this comparator ideal for battery-powered applications.

Reliability Metrics

Part Number	Process	EFR Reject	EFR Sample Size	PPM *	LTA Rejects	LTA Device Hours	FITS	MTTF (Hours)
LMC7215IM	P2CMOS	0	48295	0	1	4172500	2	536440139
LMC7215IM5	P2CMOS	0	48295	0	1	4172500	2	536440139
LMC7215IM5X	P2CMOS	0	48295	0	1	4172500	2	536440139
LMC7215IMX	P2CMOS	0	48295	0	1	4172500	2	536440139

Note: The Early Failure Rates were calculated as point estimates. The Long Term Failure Rates were calculated at 60% confidence using the Arrhenius equation at 0.7eV activation energy and derating the assumed stress temperature of 150°C to an application temperature of 55°C.



LMC7215/LMC7225

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Features

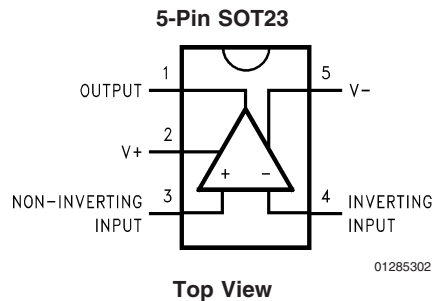
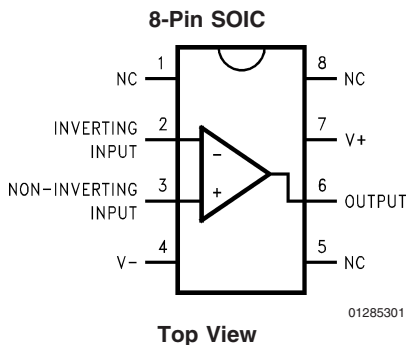
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Connection Diagrams



TinyPak™ is a trademark of National Semiconductor Corporation.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

ESD Tolerance (Note 2)	2 kV
Differential Input Voltage	$V^+ +0.3V, V^- -0.3V$
Voltage at Input/Output Pin	$V^+ +0.3V, V^- -0.3V$
Supply Voltage ($V^+ - V^-$)	10V
Current at Input Pin	± 5 mA
Current at Output Pin (Note 3)	± 30 mA
Current at Power Supply Pin	40 mA

Lead Temperature (soldering, 10 sec)	260°C
Storage Temperature Range	-65°C to +150°C
Junction Temperature (Note 4)	150°C

Operating Ratings(Note 1)

Supply Voltage	$2V \leq V_{CC} \leq 8V$
Temperature Range(Note 4) LMC7215IM, LMC7225IM	-40°C to +85°C
Package Thermal Resistance (θ_{JA})	
8-Pin SOIC	165°C/W
5-Pin SOT23	325°C/W

2.7V to 5V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = 2.7V$ to $5V$, $V^- = 0V$, $V_{CM} = V_O = V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ (Note 5)	LMC7215 Limit (Note 6)	LMC7225 Limit (Note 6)	Units
V_{OS}	Input Offset Voltage		1	6 8	6 8	mV max
TCV_{OS}	Input Offset Voltage Average Drift		2			$\mu\text{V}/^\circ\text{C}$
I_B	Input Current		5			fA
I_{OS}	Input Offset Current		1			fA
CMRR	Common Mode Rejection Ratio	(Note 7)	80	60	60	dB min
PSRR	Power Supply Rejection Ratio	$V^+ = 2.2V$ to $8V$	90	60	60	dB min
A_V	Voltage Gain		140			dB
CMVR	Input Common-Mode Voltage Range	$V^+ = 2.7V$ CMRR > 50 dB	3.0	2.9 2.7	2.9 2.7	V min
		$V^+ = 2.7V$ CMRR > 50 dB	-0.2	0.0 0.2	0.0 0.2	V max
		$V^+ = 5.0V$ CMRR > 50 dB	5.3	5.2 5.0	5.2 5.0	V min
		$V^+ = 5.0V$ CMRR > 50 dB	-0.3	-0.2 0.0	-0.2 0.0	V max
V_{OH}	Output Voltage High	$V^+ = 2.2V$ $I_{OH} = 1.5$ mA	2.05	1.8 1.7	NA	V min
		$V^+ = 2.7V$ $I_{OH} = 2.0$ mA	2.05	2.3 2.2	NA	V min
		$V^+ = 5.0V$ $I_{OH} = 4.0$ mA	4.8	4.6 4.5	NA	V min
V_{OL}	Output Voltage Low	$V^+ = 2.2V$ $I_{OH} = 1.5$ mA	0.17	0.4 0.5	0.4 0.5	V max
		$V^+ = 2.7V$ $I_{OH} = 2.0$ mA	0.17	0.4 0.5	0.4 0.5	V max
		$V^+ = 5.0V$ $I_{OH} = 4.0$ mA	0.2	0.4 0.5	0.4 0.5	V max
I_{SC+}	Output Short Circuit	$V^+ = 2.7V$, Sourcing	15		NA	mA

2.7V to 5V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = 2.7\text{V}$ to 5V , $V^- = 0\text{V}$, $V_{CM} = V_O = V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ (Note 5)	LMC7215 Limit (Note 6)	LMC7225 Limit (Note 6)	Units
	Current (Note 10)	$V^+ = 5.0\text{V}$, Sourcing	50		NA	mA
I_{SC-}	Output Short Circuit	$V^+ = 2.7\text{V}$, Sinking	12			mA
	Current (Note 10)	$V^+ = 5.0\text{V}$, Sinking	30			mA
$I_{Leakage}$	Output Leakage Current	$V^+ = 2.2\text{V}$ $V_{IN^+} = 0.1\text{V}$, $V_{IN^-} = 0\text{V}$, $V_{OUT} = 15\text{V}$	0.01	NA	500	nA max
I_S	Supply Current	$V^+ = 5.0\text{V}$	0.7	1	1	μA
		$V_{IN^+} = 5\text{V}$, $V_{IN^-} = 0\text{V}$		1.2	1.2	max

AC Electrical Characteristics

Unless otherwise specified, $T_J = 25^\circ\text{C}$, $V^+ = 5\text{V}$, $V^- = 0\text{V}$, $V_{CM} = V^+/2$

Symbol	Parameter	Conditions	LMC7215 Typ (Note 5)	LMC7225 Typ (Notes 5, 8)	Units	
t_{rise}	Rise Time	Overdrive = 10 mV (Note 8)	1	12.2	μs	
t_{fall}	Fall Time	Overdrive = 10 mV (Note 8)	0.4	0.35	μs	
t_{PHL}	Propagation Delay (High to Low)	(Notes 8, 9)	Overdrive = 10 mV	24	24	μs
			Overdrive = 100 mV	12	12	
		$V^+ = 2.7\text{V}$ (Notes 8, 9)	Overdrive = 10 mV	17	17	μs
			Overdrive = 100 mV	11	11	
t_{PLH}	Propagation Delay (Low to High)	(Notes 8, 9)	Overdrive = 10 mV	24	29	μs
			Overdrive = 100 mV	12	17	
		$V^+ = 2.7\text{V}$ (Notes 8, 9)	Overdrive = 10 mV	17	22	μs
			Overdrive = 100 mV	11	16	

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: Human Body Model, applicable std. MIL-STD-883, Method 3015.7. Machine Model, applicable std. JESD22-A115-A (ESD MM std. of JEDEC). Field-Induced Charge-Device Model, applicable std. JESD22-C101-C (ESD FICDM std. of JEDEC).

Note 3: Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C .

Note 4: The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA} , and T_A . The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/\theta_{JA}$. All numbers apply for packages soldered directly into a PC board.

Note 5: Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.

Note 6: All limits are guaranteed by testing or statistical analysis.

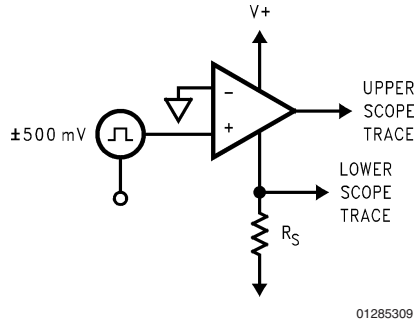
Note 7: CMRR measured at $V_{CM} = 0\text{V}$ to 2.5V and 2.5V to 5V when $V_S = 5\text{V}$, $V_{CM} = 0.2\text{V}$ to 1.35V and 1.35V to 2.7V when $V_S = 2.7\text{V}$. This eliminates units that have large V_{OS} at the V_{CM} extremes and low or opposite V_{OS} at $V_{CM} = V_S/2$.

Note 8: All measurements made at 10 kHz . A $100\text{ k}\Omega$ pull-up resistor was used when measuring the LMC7225. $C_{LOAD} = 50\text{ pF}$ including the test jig and scope probe. The rise times of the LMC7225 are a function of the R-C time constant.

Note 9: Input step voltage for the propagation measurements is 100 mV .

Note 10: Do not short the output of the LMC7225 to voltages greater than 10V or damage may occur.

Application Information (Continued)



01285309

FIGURE 6.

LATCH-UP

In the past, most CMOS IC's were susceptible to a damaging phenomena known as latch-up. This occurred when an ESD current spike or other large signal was applied to any of the pins of an IC. The LMC7215 and LMC7225 both are designed to make them highly resistant to this type of damage. They have passed qualification tests with input currents on any lead up to 300 mA at temperatures up to 125°C.

SPICE MODELS

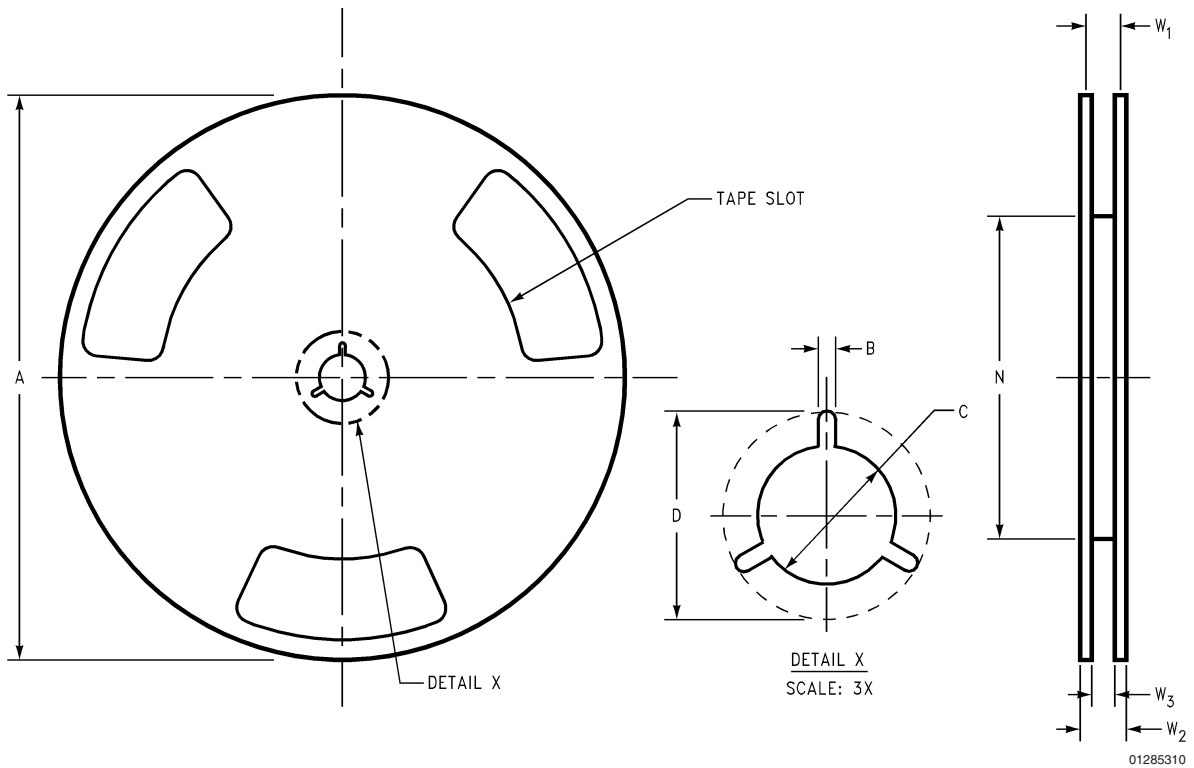
For a SPICE model of the LMC7215, LMC7225 and many other op amps and comparators, contact the NSC Customer Response Center at 800-272-9959 or on the World Wide Web at <http://www.national.com/models/index.html>.

Ordering Information

Package	Part Number	Package Marking	Transport Media	NSC Drawing
8-Pin SOIC	LMC7215IM	LMC7215IM	95 Units/Rail	M08A
	LMC7215IMX		2.5k Units Tape and Reel	
5-Pin SOT23	LMC7215IM5	C02B	1k Units Tape and Reel	MF05A
	LMC7215IM5X		3k Units Tape and Reel	
	LMC7225IM5	C03B	1k Units Tape and Reel	
	LMC7225IM5X		3k Units Tape and Reel	

SOT-23-5 Tape and Reel Specification

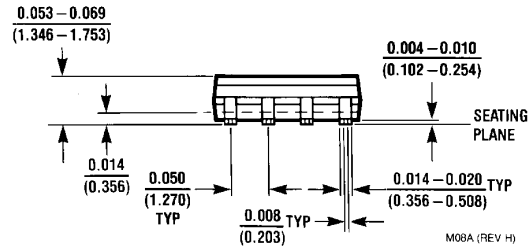
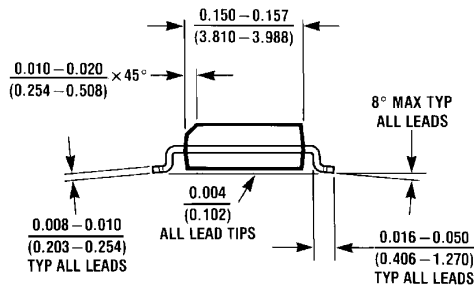
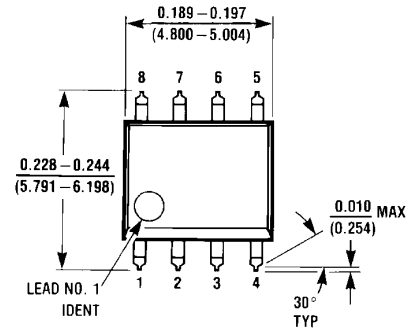
REEL DIMENSIONS



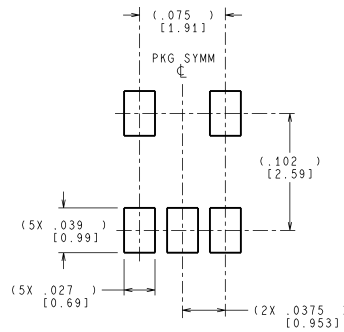
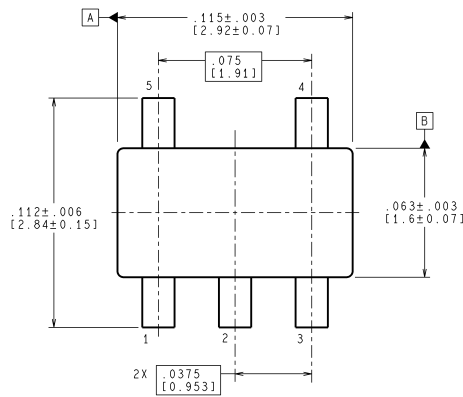
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8 mm	7.00	0.059	0.512	0.795	2.165	0.331 + 0.059/-0.000	0.567	W1 + 0.078/-0.039
	330.00	1.50	13.00	20.20	55.00	8.40 + 1.50/-0.00	14.40	W1 + 2.00/-1.00
Tape Size	A	B	C	D	N	W1	W2	W3

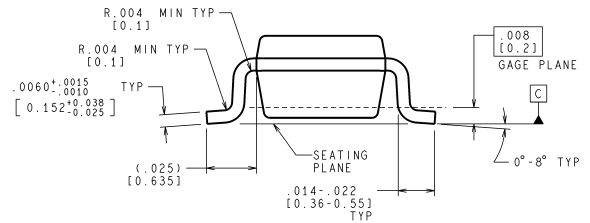
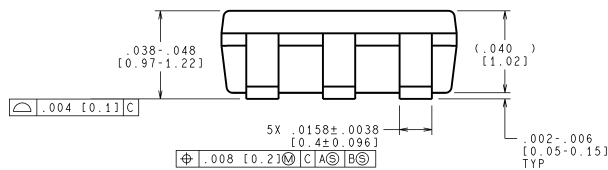
Physical Dimensions inches (millimeters) unless otherwise noted



**8-Pin SOIC
NS Package Number M08A**



LAND PATTERN RECOMMENDATION



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS
DIMENSIONS IN () FOR REFERENCE ONLY

MF05A (Rev C)

**5-Pin SOT23
NS Package Number MF05A**