APPENDIX H

DATA SHEETS

27. Electrical Characteristics

27.1 Absolute Maximum Ratings*

Operating Temperature	-55°C to +125°C
Storage Temperature	-65°C to +150°C
Voltage on any Pin except $\overline{\text{RESET}}$ with respect to Ground	-0.5V to V_{CC}+0.5V
Voltage on $\overline{\text{RESET}}$ with respect to Ground	-0.5V to +13.0V
Maximum Operating Voltage	6.0V
DC Current per I/O Pin	40.0 mA
DC Current V_{CC} and GND Pins	200.0 mA and 400.0 mA TQFP/MLF

*NOTICE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

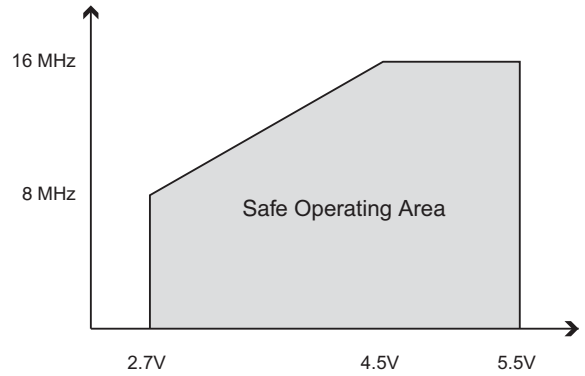
27.2 DC Characteristics

T_A = -40°C to 85°C, V_{CC} = 2.7V to 5.5V (Unless Otherwise Noted)

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{IL}	Input Low Voltage except XTAL1 and $\overline{\text{RESET}}$ pins	V_{CC}=2.7 - 5.5 V_{CC}=4.5 - 5.5	-0.5		0.2 V_{CC}[1]	V
V_{IH}	Input High Voltage except XTAL1 and $\overline{\text{RESET}}$ pins	V_{CC}=2.7 - 5.5 V_{CC}=4.5 - 5.5	0.6 V_{CC}[2]		V_{CC} + 0.5	V
V_{IL1}	Input Low Voltage XTAL1 pin	V_{CC}=2.7 - 5.5	-0.5		0.1 V_{CC}[1]	V
V_{IH1}	Input High Voltage XTAL1 pin	V_{CC}=2.7 - 5.5 V_{CC}=4.5 - 5.5	0.7 V_{CC}[2]		V_{CC} + 0.5	V
V_{IL2}	Input Low Voltage $\overline{\text{RESET}}$ pin	V_{CC}=2.7 - 5.5	-0.5		0.2 V_{CC}	V
V_{IH2}	Input High Voltage $\overline{\text{RESET}}$ pin	V_{CC}=2.7 - 5.5	0.9 V_{CC}[2]		V_{CC} + 0.5	V
V_{OL}	Output Low Voltage[3] (Ports A,B,C,D)	I_{OL} = 20 mA, V_{CC} = 5V I_{OL} = 10 mA, V_{CC} = 3V			0.7 0.5	V V
V_{OH}	Output High Voltage[4] (Ports A,B,C,D)	I_{OH} = -20 mA, V_{CC} = 5V I_{OH} = -10 mA, V_{CC} = 3V	4.2 2.2			V V
I_{IL}	Input Leakage Current I/O Pin	V_{CC} = 5.5V, pin low (absolute value)			1	µA
I_{IH}	Input Leakage Current I/O Pin	V_{CC} = 5.5V, pin high (absolute value)			1	µA
R_{RST}	Reset Pull-up Resistor		30	60	85	kΩ
R_{pu}	I/O Pin Pull-up Resistor		20		50	kΩ

27.3 Speed Grades

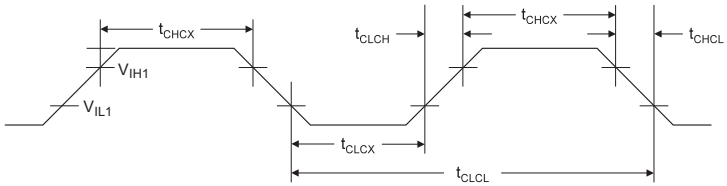
Figure 27-1. Maximum Frequency vs. V_{CC}.



27.4 Clock Characteristics

27.4.1 External Clock Drive Waveforms

Figure 27-2. External Clock Drive Waveforms



27.4.2 External Clock Drive

Figure 27-3. External Clock Drive

Symbol	Parameter	V_{CC} = 2.7V to 5.5V		V_{CC} = 4.5V to 5.5V		Units
		Min	Max	Min	Max	
$1/t_{CLCL}$	Oscillator Frequency	0	8	0	16	MHz
t_{CLCL}	Clock Period	125		62.5		ns
t_{CHCX}	High Time	50		25		ns
t_{CLCX}	Low Time	50		25		ns

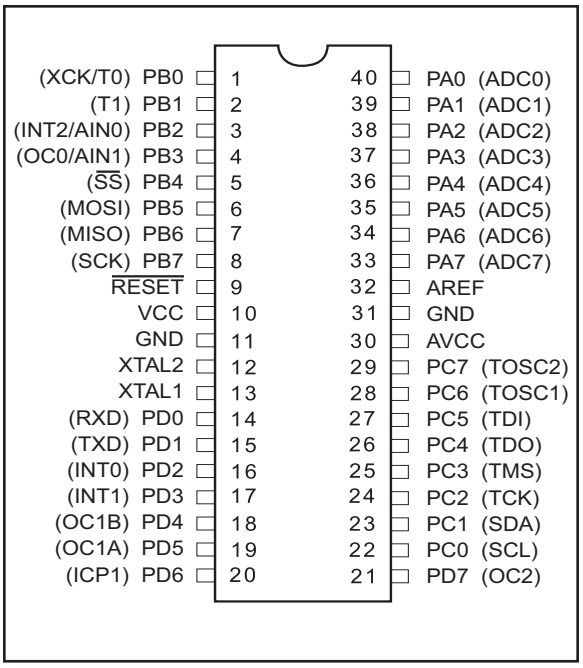


Figure H-1. ATmega16/32 DIP

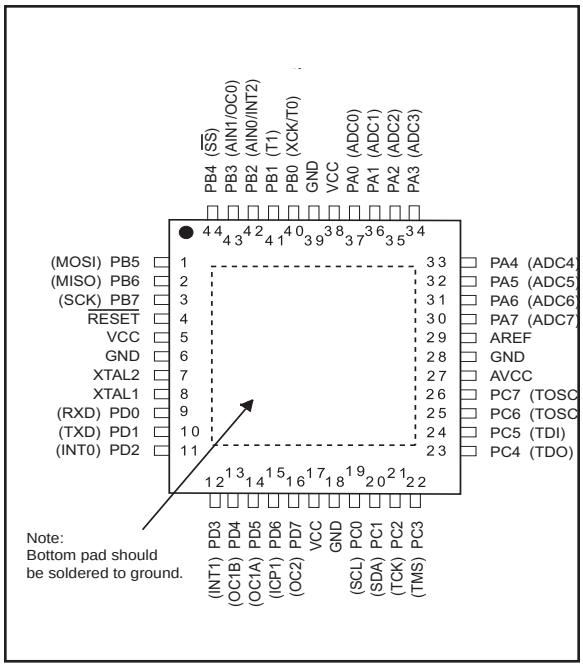


Figure H-2. ATmega16/32 TQFP

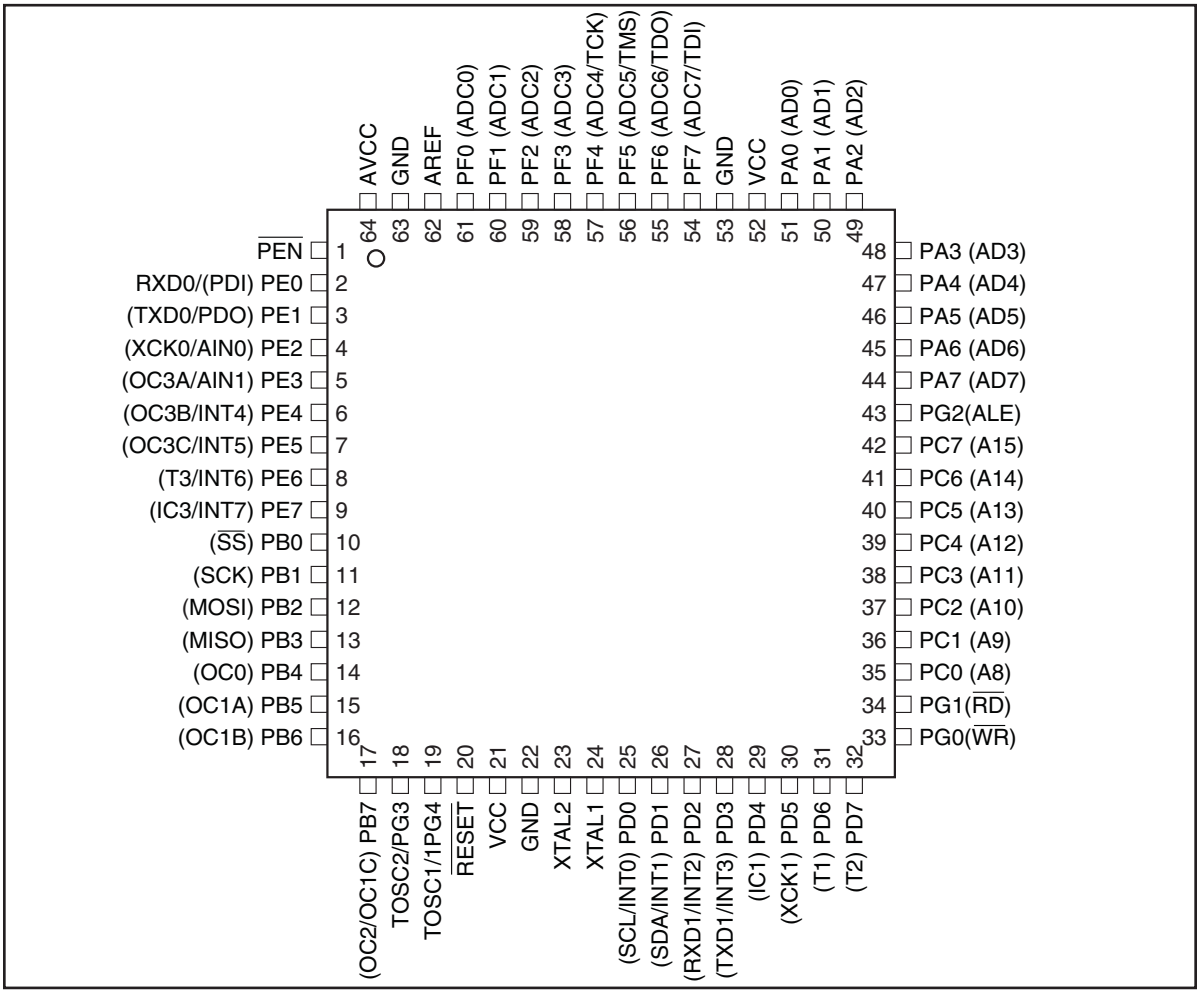


Figure H-3. ATmega 64/128 TQFP

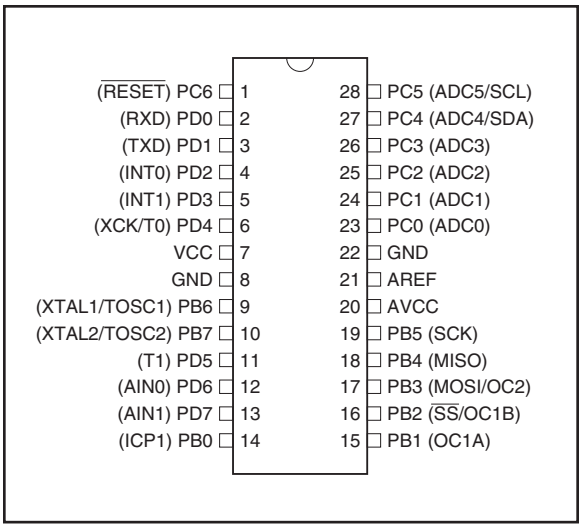


Figure H-4. ATmega8 DIP

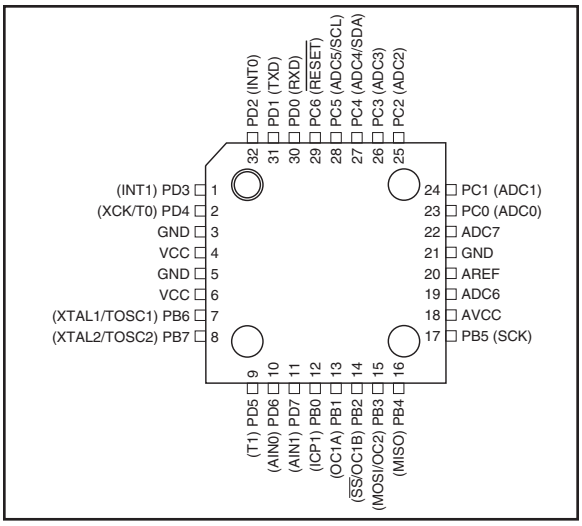


Figure H-5. ATmega8 TQFP

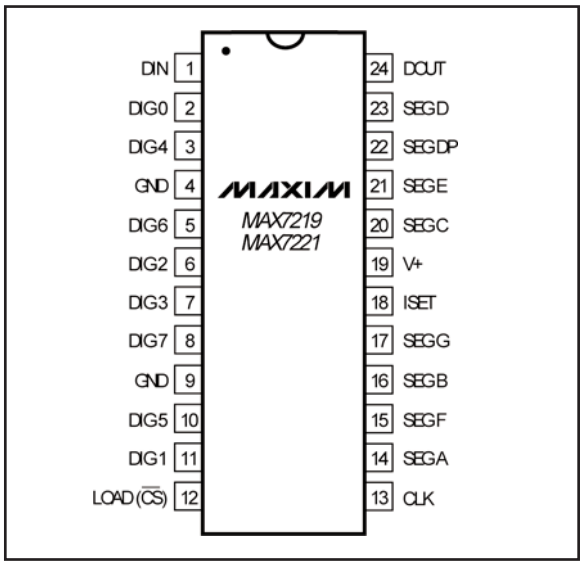


Figure H-6. MAX7221

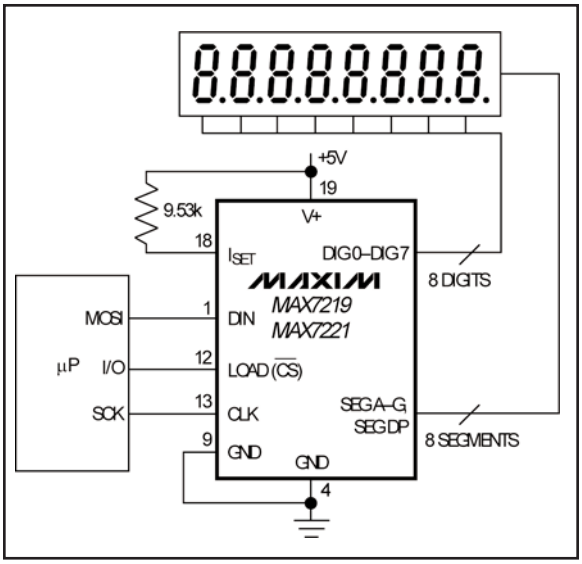


Figure H-7. MAX7221 Connections

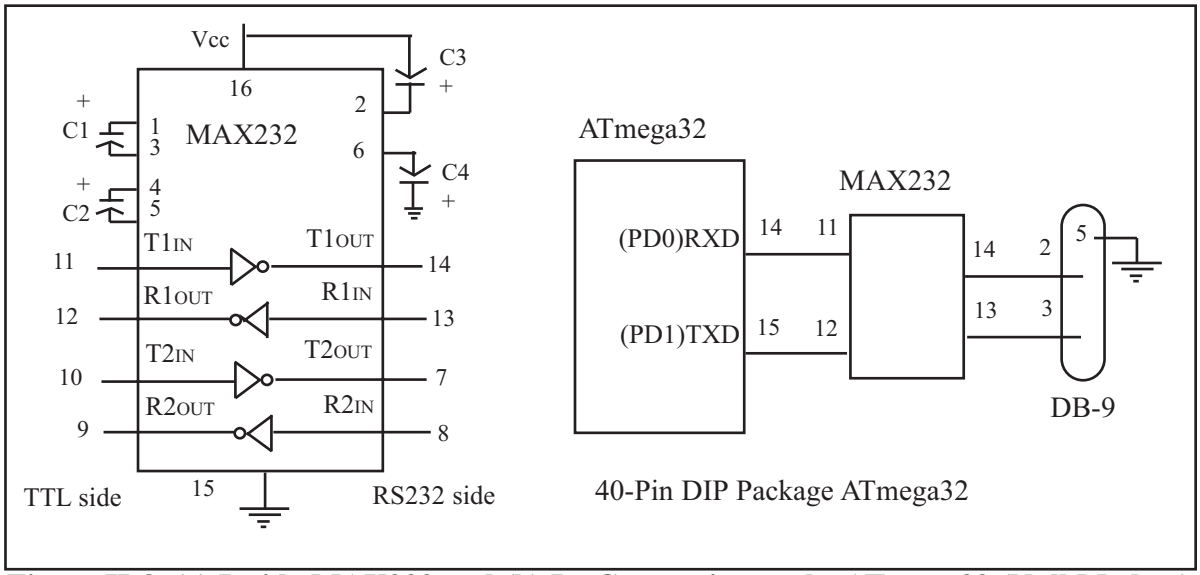


Figure H-8. (a) Inside MAX232 and (b) Its Connection to the ATmega32 (Null Modem)

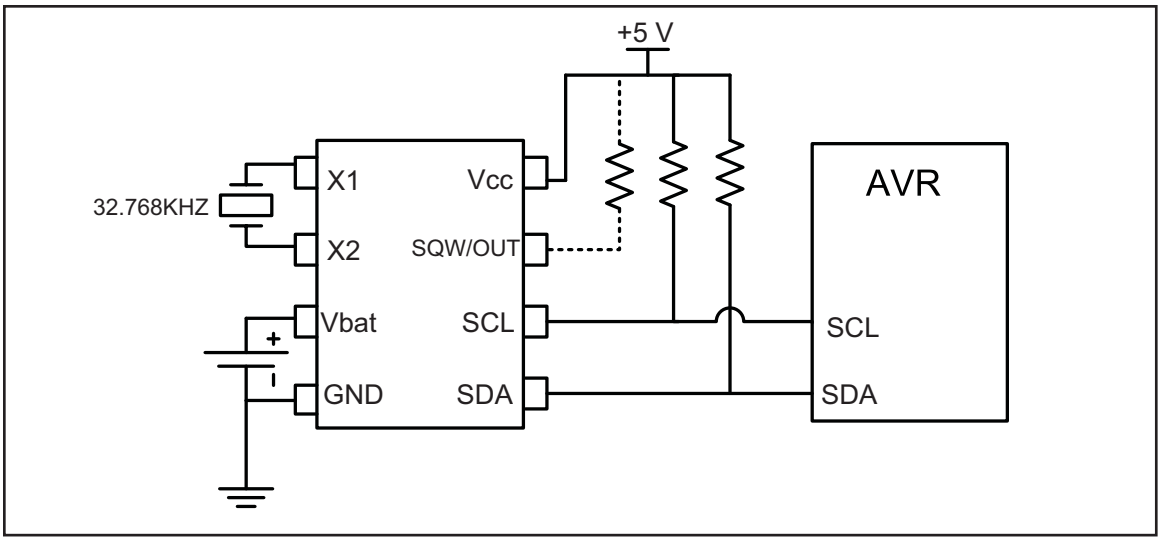


Figure H-9. DS1307 Power Connection Options (Maxim/Dallas Semiconductor)

LCD Pin	Symbol
1	Ground
2	V_{CC}
3	V_{EE}
4	RS
5	R/W
6	E
7	DB0
...	...
14	DB7

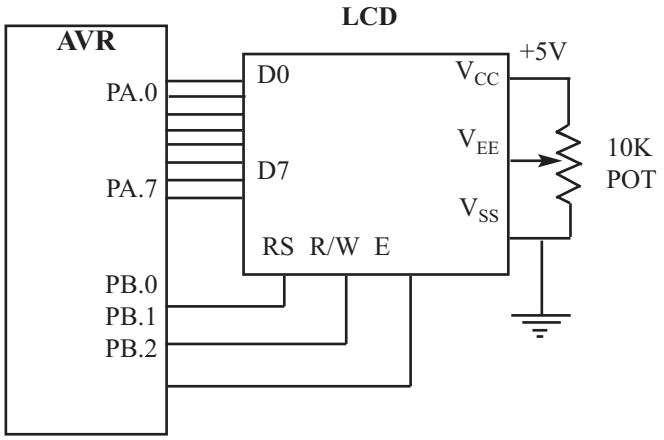


Figure H-10. LCD Connections for 8-bit Data

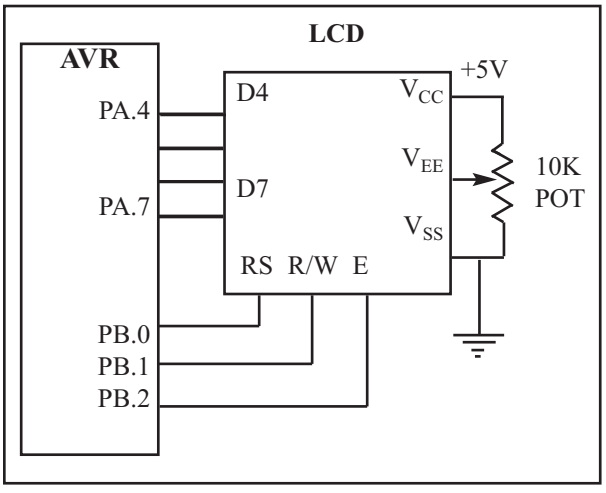


Figure H-11. LCD Connections Using 4-bit Data

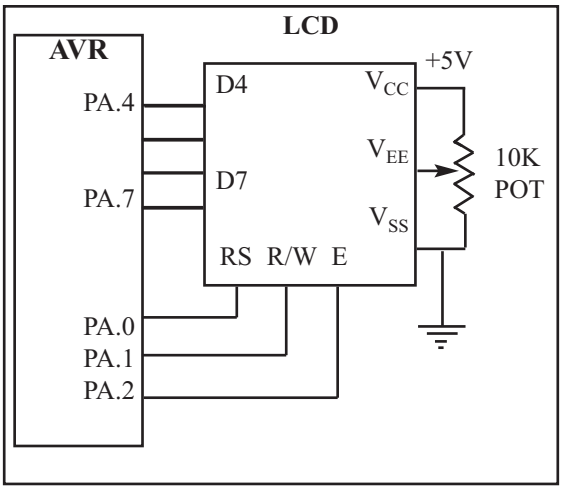


Figure H-12. LCD Connections Using a Single Port