



MILITARY DATA SHEET

MN54AC169-X REV 1A0

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4 - Stage Synchronous Bidirectional Counter

General Description

The AC169 is a fully synchronous 4-stage up/down counter. The AC169 is a modulo-16 binary counter. It features a preset capability for programmable operation, carry lookahead for easy cascading and a U/D input to control the direction of counting. All state changes, whether in counting or parallel loading, are initiated by the LOW-to-HIGH transition of the Clock.

Industry Part Number

54AC169

Prime Die

Z169

NS Part Numbers

54AC169DMQB
54AC169FMQB
54AC169LMQB

Processing

MIL-STD-883, Method 5004

Quality Conformance Inspection

MIL-STD-883, Method 5005

| Subgrp | Description | Temp (°C) |
|--------|---------------------|------------|
| 1 | Static tests at | +25 |
| 2 | Static tests at | +125 |
| 3 | Static tests at | -55 |
| 4 | Dynamic tests at | +25 |
| 5 | Dynamic tests at | +125 |
| 6 | Dynamic tests at | -55 |
| 7 | Functional tests at | +25 |
| 8A | Functional tests at | +125 |
| 8B | Functional tests at | -55 |
| 9 | Switching tests at | +25 |
| 10 | Switching tests at | +125 |
| 11 | Switching tests at | -55 |

Features

- Icc reduced by 50%
- Synchronous counting and loading
- Built-In lookahead carry capability
- Presetable for programmable operation
- Outputs source/sink 24 mA
- Standard Military Drawing (SMD)
- AC169: 5962-91603

(Absolute Maximum Ratings)

(Note 1)

| | |
|---|--------------------|
| Supply Voltage (Vcc) | -0.5V to +7.0V |
| DC Input Voltage (Vi) | -0.5V to Vcc +0.5V |
| DC Output Diode Current (Iok) | |
| Vo = -0.5V | -20 mA |
| Vo = Vcc +0.5V | +20 mA |
| DC Output Source or Sink Current (Io) | ±50 mA |
| DC Vcc or Ground Current per Output Pin (Icc or Ignd) | ±50 mA |
| Storage Temperature (Tstg) | -65 C to +150 C |
| Junction Temperature (Tj) | 175 C |
| DC Input Diode Current (Iik) | |
| Vi = -0.5V | -20 mA |
| Vi = Vcc +0.5V | +20 mA |
| DC Output Voltage (Vo) | -0.5V to Vcc +0.5V |

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specification should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT™ circuits outside databook specifications.

Recommended Operating Conditions

| | |
|---|-----------------|
| Supply Voltage (Vcc) | 2.0V to 6.0V |
| Input Voltage (Vi) | 0V to Vcc |
| Output Voltage (Vo) | 0V to Vcc |
| Operating Temperature (Ta) | -55 C to +125 C |
| Minimum Input Edge Rate (Delta V/Delta t) | |
| AC Devices | |
| Vin from 30% to 70% of Vcc | |
| Vcc @ 3.0V, 4.5V, 5.5V | 125 mV/ns |

Electrical Characteristics

DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)

DC: VCC 3.0V to 5.5V, Temperature Range: -55C to 125C. NOTE: -55C TEMPERATURE, SUBGROUP 3 IS GUARANTEED BUT NOT TESTED.

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|--|-----------------------------|---|---------|----------|---------|---------|------|------------|
| IIH | High Level Input Current | VCC=5.5V, VM=5.5V | 1, 2 | INPUT | | 0.1 | uA | 1 |
| | | | 1, 2 | INPUT | | 1.0 | uA | 2, 3 |
| IIL | Input Leakage Current | VCC=5.5V, VM=0.0V | 1, 2 | INPUT | | -0.1 | uA | 1 |
| | | | 1, 2 | INPUT | | -1.0 | uA | 2, 3 |
| VOL | Low level output voltage | VCC=3.0V, VIL=0.9V, VIH=2.1V, IOL=12.0mA | 1, 2 | OUTPUT | | .36 | V | 1 |
| | | | 1, 2 | OUTPUT | | .50 | V | 2, 3 |
| | | VCC=3.0V, VIL=0.9V, VIH=2.1V, IOL=50.0uA | 1, 2 | OUTPUT | | .10 | V | 1, 2, 3 |
| | | | 1, 2 | OUTPUT | | .36 | V | 1 |
| | | VCC=4.5V, VIL=1.35V, VIH=3.15V, IOL=24.0mA | 1, 2 | OUTPUT | | .10 | V | 1, 2, 3 |
| | | | 1, 2 | OUTPUT | | .50 | V | 2, 3 |
| | | VCC=4.5V, VIL=1.35V, VIH=3.15V, IOL=50.0uA | 1, 2 | OUTPUT | | .36 | V | 1 |
| | | | 1, 2 | OUTPUT | | .50 | V | 2, 3 |
| VCC=5.5V, VIL=1.65V, VIH=3.85V, IOL=24.0mA | 1, 2 | OUTPUT | | .10 | V | 1, 2, 3 | | |
| | 1, 2 | OUTPUT | | .36 | V | 1 | | |
| VCC=5.5V, VIL=1.65V, VIH=3.85V, IOL=50.0uA | 1, 2 | OUTPUT | | .50 | V | 2, 3 | | |
| | 1, 2 | OUTPUT | | .10 | V | 1, 2, 3 | | |
| VIOL | Dynamic Output Current LOW | VCC=5.5V, VIL=1.65V, VIH=3.85V, IOL=50.0uA | 1, 2, 5 | OUTPUT | | 1.65 | V | 1, 2, 3 |
| VOH | High level output voltage | VCC=3.0V, VIL=0.9V, VIH=2.1V, IOL=-12.0mA | 1, 2 | OUTPUT | 2.56 | | V | 1 |
| | | | 1, 2 | OUTPUT | 2.40 | | V | 2, 3 |
| | | VCC=3.0V, VIL=0.9V, VIH=2.1V, IOL=-50.0uA | 1, 2 | OUTPUT | 2.90 | | V | 1, 2, 3 |
| | | | 1, 2 | OUTPUT | 3.86 | | V | 1 |
| | | VCC=4.5V, VIL=1.35V, VIH=3.15V, IOL=-24.0mA | 1, 2 | OUTPUT | 3.70 | | V | 2, 3 |
| | | | 1, 2 | OUTPUT | 4.40 | | V | 1, 2, 3 |
| | | VCC=4.5V, VIL=1.35V, VIH=3.15V, IOL=-50.0uA | 1, 2 | OUTPUT | 4.86 | | V | 1 |
| | | | 1, 2 | OUTPUT | 4.70 | | V | 2, 3 |
| 1, 2 | OUTPUT | 5.40 | | V | 1, 2, 3 | | | |
| VIQH | Dynamic Output Current HIGH | VCC=5.5V, VIL=1.65V, VIH=3.85V, IOH=-50.0mA | 1, 2, 5 | OUTPUT | 3.85 | | V | 1, 2, 3 |
| ICCH | Supply Current | VCC=5.5V | 1, 2 | VCC | | 4 | uA | 1 |
| | | | 1, 2 | VCC | | 80 | uA | 2, 3 |

Electrical Characteristics

DC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)

DC: VCC 3.0V to 5.5V, Temperature Range: -55C to 125C. NOTE: -55C TEMPERATURE, SUBGROUP 3 IS GUARANTEED BUT NOT TESTED.

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|--------|----------------|------------|-------|----------|-----|-----|------|------------|
| ICCL | Supply Current | VCC=5.5V | 1, 2 | VCC | | 4 | uA | 1 |
| | | | 1, 2 | VCC | | 80 | uA | 2, 3 |

AC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)

AC: CL=50pF, RL=500 OHMS, TR=3.0ns, TF=3.0ns, Temp Range: -55C to +125C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

| | | | | | | | | |
|---------|-------------------|----------|---------|-----------|-----|------|----|--------|
| tpLH(1) | Propagation Delay | VCC=4.5V | 3, 4, 7 | CP to Qn | 1.5 | 10.0 | ns | 9 |
| | | | 3, 4, 7 | CP to Qn | 1.0 | 12.0 | ns | 10, 11 |
| tpHL(1) | Propagation Delay | VCC=4.5V | 3, 4, 7 | CP to Qn | 1.5 | 11.0 | ns | 9 |
| | | | 3, 4, 7 | CP to Qn | 1.5 | 13.0 | ns | 10, 11 |
| tpLH(2) | Propagation Delay | VCC=4.5V | 3, 4, 7 | CP to TC | 3.0 | 13.0 | ns | 9 |
| | | | 3, 4, 7 | CP to TC | 3.0 | 16.0 | ns | 10, 11 |
| tpHL(2) | Propagation Delay | VCC=4.5V | 3, 4, 7 | CP to TC | 3.0 | 13.0 | ns | 9 |
| | | | 3, 4, 7 | CP to TC | 3.0 | 16.0 | ns | 10, 11 |
| tpLH(3) | Propagation Delay | VCC=4.5V | 3, 4, 7 | CET to TC | 1.5 | 10.5 | ns | 9 |
| | | | 3, 4, 7 | CET to TC | 1.5 | 13.0 | ns | 10, 11 |
| tpHL(3) | Propagation Delay | VCC=4.5V | 3, 4, 7 | CET to TC | 1.5 | 9.0 | ns | 9 |
| | | | 3, 4, 7 | CET to TC | 1.5 | 11.0 | ns | 10, 11 |
| tpLH(4) | Propagation Delay | VCC=4.5V | 3, 4, 7 | U/D to TC | 1.5 | 10.5 | ns | 9 |
| | | | 3, 4, 7 | U/D to TC | 1.5 | 13.0 | ns | 10, 11 |
| tpHL(4) | Propagation Delay | VCC=4.5V | 3, 4, 7 | U/D to TC | 1.5 | 10.0 | ns | 9 |
| | | | 3, 4, 7 | U/D to TC | 1.5 | 12.0 | ns | 10, 11 |

Electrical Characteristics

AC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
 AC: $CL=50\text{pF}$, $RL=500\ \text{OHMS}$, $TR=3.0\text{ns}$, $TF=3.0\text{ns}$, Temp Range: -55C to $+125\text{C}$. NOTE: -55C TEMPERATURE, SUBGROUP
 11 IS GUARANTEED BUT NOT TESTED.

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|------------|-------------------------|------------|-------|---|-----|------|------|------------|
| ts(H/L)(1) | Setup Time, HIGH or LOW | VCC=4.5V | 6 | Pn to CP | 3.5 | | ns | 9 |
| | | | 6 | Pn to CP | 4.5 | | ns | 10, 11 |
| th(H/L)(1) | Hold Time, HIGH or LOW | VCC=4.5V | 6 | Pn to CP | 2.5 | | ns | 9, 10, 11 |
| ts(H/L)(2) | Setup Time HIGH or LOW | VCC=4.5V | 6 | \overline{PE} to CP | 5.0 | | ns | 9 |
| | | | 6 | \overline{PE} to CP | 6.5 | | ns | 10, 11 |
| th(H/L)(2) | Hold Time HIGH or LOW | VCC=4.5V | 6 | \overline{PE} to CP | 1.5 | | ns | 9 |
| | | | 6 | \overline{PE} to CP | 2.0 | | ns | 10, 11 |
| ts(H/L)(3) | Setup Time HIGH or LOW | VCC=4.5V | 6 | \overline{CE} Por \overline{CE} T to CP | 7.5 | | ns | 9 |
| | | | 6 | \overline{CE} Por \overline{CE} T to CP | 9.0 | | ns | 10, 11 |
| th(H/L)(3) | Hold Time HIGH or LOW | VCC=4.5V | 6 | \overline{CE} Por \overline{CE} T to CP | 1.5 | | ns | 9 |
| | | | 6 | \overline{CE} Por \overline{CE} T to CP | 2.5 | | ns | 10, 11 |
| ts(H/L)(4) | Set Up Time HIGH or LOW | VCC=4.5V | 6 | U/\overline{D} to CP | 7.5 | | ns | 9 |
| | | | 6 | U/\overline{D} to CP | 9.0 | | ns | 10, 11 |
| th(H/L)(4) | Hold Time HIGH or LOW | VCC=4.5V | 6 | U/\overline{D} to CP | 1.5 | | ns | 9 |
| | | | 6 | U/\overline{D} to CP | 2.0 | | ns | 10, 11 |
| tw(H/L)(1) | CP Pulse Width | VCC=4.5V | 6 | CP | 5.0 | | ns | 9, 10, 11 |
| fmax(1) | Maximum Clock Frequency | VCC=4.5V | 6 | CP | 95 | | MHz | 9 |
| | | | 6 | CP | 75 | | MHz | 10, 11 |
| tpLH(5) | Propagation Delay | VCC=3.0V | 3, 4 | CP to Qn | 1.0 | 13.0 | ns | 9 |
| | | | 3, 4 | CP to Qn | 1.0 | 15.0 | ns | 10, 11 |

Electrical Characteristics

AC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
 AC: CL=50pf, RL=500 OHMS, TR=3.0ns, TF=3.0ns, Temp Range: -55C to +125C. NOTE: -55C TEMPERATURE, SUBGROUP
 11 IS GUARANTEED BUT NOT TESTED.

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|------------|------------------------|------------|-------|-------------------------------|-----|------|------|------------|
| tpHL(5) | Propagation Delay | VCC=3.0V | 3, 4 | CP to Qn | 1.0 | 14.5 | ns | 9 |
| | | | 3, 4 | CP to Qn | 1.0 | 16.5 | ns | 10, 11 |
| tpLH(6) | Propagation Delay | VCC=3.0V | 3, 4 | CP to TC | 3.0 | 18.0 | ns | 9 |
| | | | 3, 4 | CP to TC | 3.0 | 22.0 | ns | 10, 11 |
| tpHL(6) | Propagation Delay | VCC=3.0V | 3, 4 | CP to TC | 3.0 | 18.0 | ns | 9 |
| | | | 3, 4 | CP to TC | 3.0 | 22.0 | ns | 10, 11 |
| tpLH(7) | Propagation Delay | VCC=3.0V | 3, 4 | $\overline{\text{CET}}$ to TC | 1.0 | 15.0 | ns | 9 |
| | | | 3, 4 | $\overline{\text{CET}}$ to TC | 1.0 | 18.5 | ns | 10, 11 |
| tpHL(7) | Propagation Delay | VCC=3.0V | 3, 4 | $\overline{\text{CET}}$ to TC | 1.0 | 12.5 | ns | 9 |
| | | | 3, 4 | $\overline{\text{CET}}$ to TC | 1.0 | 16.0 | ns | 10, 11 |
| tpLH(8) | Propagation Delay | VCC=3.0V | 3, 4 | U/D to TC | 1.0 | 15.0 | ns | 9 |
| | | | 3, 4 | U/D to TC | 1.0 | 18.5 | ns | 10, 11 |
| tpHL(8) | Propagation Delay | VCC=3.0V | 3, 4 | U/D to TC | 1.0 | 13.5 | ns | 9 |
| | | | 3, 4 | U/D to TC | 1.0 | 16.5 | ns | 10, 11 |
| ts(H/L)(5) | Setup Time HIGH or LOW | VCC=3.0V | 6 | Pn to CP | 6.0 | | ns | 9 |
| | | | 6 | Pn to CP | 7.0 | | ns | 10, 11 |
| th(H/L)(5) | Hold Time HIGH or LOW | VCC=3.0V | 6 | Pn to CP | 1.0 | | ns | 9 |
| | | | 6 | Pn to CP | 2.0 | | ns | 10, 11 |
| ts(H/L)(6) | Setup Time HIGH or LOW | VCC=3.0V | 6 | $\overline{\text{PE}}$ to CP | 7.0 | | ns | 9 |
| | | | 6 | $\overline{\text{PE}}$ to CP | 8.5 | | ns | 10, 11 |

Electrical Characteristics

AC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
 AC: CL=50pf, RL=500 OHMS, TR=3.0ns, TF=3.0ns, Temp Range: -55C to +125C. NOTE: -55C TEMPERATURE, SUBGROUP
 11 IS GUARANTEED BUT NOT TESTED.

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|------------|-------------------------|------------|-------|------------------------------|------|-----|------|------------|
| th(H/L)(6) | Hold Time HIGH or LOW | VCC=3.0V | 6 | \overline{PE} to CP | 0.0 | | ns | 9 |
| | | | 6 | \overline{PE} to CP | 0.5 | | ns | 10, 11 |
| ts(H/L)(7) | Setup Time HIGH or LOW | VCC=3.0V | 6 | $\overline{CEPorCE}$ T to CP | 10.5 | | ns | 9 |
| | | | 6 | $\overline{CEPorCE}$ T to CP | 13.5 | | ns | 10, 11 |
| th(H/L)(7) | Hold Time HIGH or LOW | VCC=3.0V | 6 | $\overline{CEPorCE}$ T to CP | 0.0 | | ns | 9 |
| | | | 6 | $\overline{CEPorCE}$ T to CP | 0.5 | | ns | 10, 11 |
| ts(H/L)(8) | Setup Time HIGH or LOW | VCC=3.0V | 6 | U/ \overline{D} to CP | 10.0 | | ns | 9 |
| | | | 6 | U/ \overline{D} to CP | 13.0 | | ns | 10, 11 |
| th(H/L)(8) | Hold Time HIGH or LOW | VCC=3.0V | 6 | U/ \overline{D} to CP | 0.0 | | ns | 9 |
| | | | 6 | U/ \overline{D} to CP | 0.5 | | ns | 10, 11 |
| tw(H/L)(2) | CP Pulse Width | VCC=3.0V | 6 | CP | 5.0 | | ns | 9, 10, 11 |
| fMAX(2) | Maximum Clock Frequency | VCC=3.0V | 6 | CP | 75 | | MHz | 9 |
| | | | 6 | CP | 55 | | MHz | 10, 11 |

Note 1: SCREEN TESTED 100% ON EACH DEVICE AT +25C & +125C TEMPERATURE, SUBGROUPS A1, 2, 7 & 8.

Note 2: SAMPLE TESTED (METHOD 5005, TABLE 1) ON EACH MFG. LOT AT +25C & +125C TEMPERATURE, SUBGROUPS A1, 2, 7 & 8.

Note 3: SCREEN TESTED 100% ON EACH DEVICE AT ROOM TEMPERATURE ONLY, SUBGROUP A9.

Note 4: SAMPLE TESTED (METHOD 5005, TABLE 1) ON EACH MFG. LOT AT +25 C & +125 C TEMPERATURE, SUBGROUPS A9 & 10.

Note 5: TRANSMISSION LINE DRIVING TEST, GUARDBANDS LIMITS SET FOR +25 C, 2MSEC DURATION MAX.

Note 6: GUARANTEED BUT NOT TESTED. (DESIGN CHARACTERIZATION DATA).

Note 7: +25C & +125C MIN LIMITS GUARANTEED FOR 5.5V BY GUARDBANDING 4.5V MIN. LIMITS.