

**OBSOLETE PRODUCT
POSSIBLE SUBSTITUTE PRODUCT
DG409, DG509A, HI-0509(A)**

April 1999

8-Channel CMOS Analog Multiplexer

Features

- Ultra Low Leakage - $I_{D(OFF)} \leq 100\mu A$ (Typ)
- $r_{DS(ON)} < 400\Omega$ Over Full Signal and Temperature Range
- Power Supply Quiescent Current Less Than $100\mu A$
- $\pm 14V$ Analog Signal Range
- No SCR Latchup
- Break-Before-Make Switching
- Binary Address Control (2 Address Inputs Control 2 Out of 8 Channels)
- TTL and CMOS Compatible Address Control
- Pin Compatible with DG509A, HI-509 and ADG509A
- Internal Diode in Series with $V+$ for Fault Protection

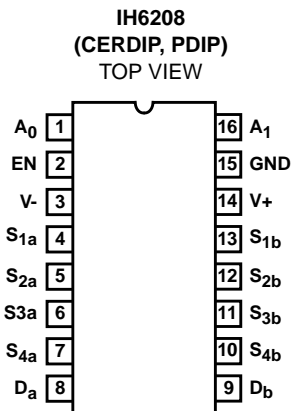
Description

The IH6208 is a CMOS 2 of 8 multiplexer. The part is a plug-in replacement for the DG509A. Two-line binary decoding is used so that the 8 channels can be controlled in pairs by the binary inputs; additionally a third input is provided for use as a system enable. When the ENABLE input is high (5V), the channels are sequenced by the 2 line binary inputs, and when low (0V) all channels are off. The 2 Address inputs are controlled by TTL logic or CMOS logic elements with a "0" corresponding to any voltage less than 0.8V and a "1" corresponding to any voltage greater than 2.4V. Note that the ENABLE input must be taken to 5V to enable the system, and less than 0.8V to disable the system.

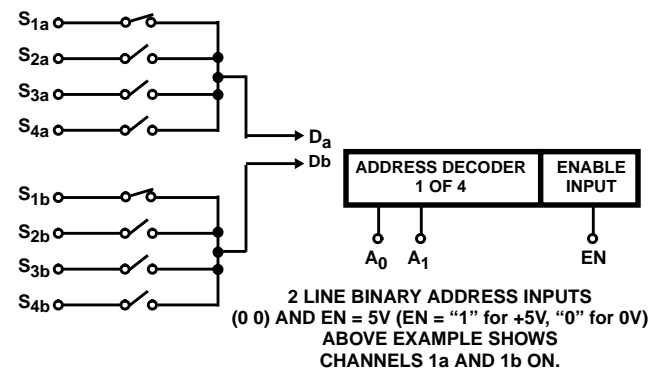
Part Number Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE | PKG. NO. |
|----------------|------------------|-----------------|----------|
| IH6208MJE | -55 to 125 | 16 Ld CERDIP | F16.3 |
| IH6208MJE/883B | -55 to 125 | 16 Ld CERDIP | F16.3 |
| IH6208MFE/883B | -55 to 125 | 16 Ld Flat Pack | K16.A |
| IH6208CJE | 0 to 70 | 16 Ld CERDIP | F16.3 |
| IH6208CPE | 0 to 70 | 16 Ld PDIP | E16.3 |

Pinout



Functional Diagram



TRUTH TABLE

| A ₁ | A ₀ | EN | ON SWITCH PAIR |
|----------------|----------------|----|----------------|
| x | x | 0 | None |
| 0 | 0 | 1 | 1a, 1b |
| 0 | 1 | 1 | 2a, 2b |
| 1 | 0 | 1 | 3a, 3b |
| 1 | 1 | 1 | 4a, 4b |

NOTE: A₀, A₁
Logic "1" = $V_{AH} \geq 2.4V$, $V_{ENH} \geq 4.5V$
Logic "0" = $V_{AL} \leq 0.8V$.

IH6208

Absolute Maximum Ratings

| | |
|----------------------------------|-------------|
| V_{IN} (A, EN) to Ground | -15V to 15V |
| V_S or V_D to V_+ | 0V, -36V |
| V_S to V_D to V_- | 0V, 36V |
| V_+ to Ground | 18V |
| V_- to Ground | -18V |
| Current (Any Terminal) | 30mA |
| Current (Analog Source or Drain) | 20mA |

Thermal Information

| | | |
|---|----------------------|----------------------|
| Thermal Resistance (Typical, Note 1) | θ_{JA} (°C/W) | θ_{JC} (°C/W) |
| CERDIP Package | 80 | 22 |
| Ceramic Flatpack Package | 85 | 25 |
| PDIP Package | 100 | N/A |
| Maximum Junction Temperature (Hermetic Package) | 175°C | |
| Maximum Junction Temperature (Plastic Package) | 150°C | |
| Maximum Storage Temperature Range | -65°C to 150°C | |
| Maximum Lead Temperature (Soldering 10s) | 300°C | |

Operating Conditions

Temperature Range

| | |
|----------|----------------|
| C Suffix | 0°C to 70°C |
| M Suffix | -55°C to 125°C |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications $V_+ = 15V$, $V_- = -15V$, $V_{EN} = +5V$, Ground = 0V, Unless Otherwise Specified, (Note 4)

| PARAMETER | MEASURED TERMINAL | NO TESTS PER TEMP | TYP 25°C | TEST CONDITIONS | M SUFFIX (°C) | | | C SUFFIX (°C) | | | UNITS |
|---------------------|---------------------------------|-------------------|----------|---|---------------|-----------|----------|---------------|---------|-----------|----------|
| | | | | | -55 | 25 | 125 | 0 | 25 | 70 | |
| SWITCH | | | | | | | | | | | |
| $r_{DS(ON)}$ | S to D | 8 | 180 | $V_D = +10V$, $I_S = -1.0mA$ Sequence Each Switch On $V_{AL} = 0.8V$, $V_{AH} = 2.4V$ | 300 | 300 | 400 | 350 | 350 | 450 | Ω |
| | | 8 | 150 | $V_D = -10V$, $I_S = -1.0mA$ Sequence Each Switch On $V_{AL} = 0.8V$, $V_{AH} = 2.4V$ | 300 | 300 | 400 | 350 | 350 | 450 | Ω |
| $\Delta r_{DS(ON)}$ | | | 20 | $\Delta r_{DS(ON)} = \frac{r_{DS(ON)MAX} - r_{DS(ON)MIN}}{r_{DS(ON)AVG}}$ $V_S = \pm 10V$ | - | - | - | - | - | - | % |
| $I_{S(OFF)}$ | S | 8 | 0.002 | $V_S = 10V$, $V_D = -10V$ | - | ± 0.5 | ± 50 | - | ± 1 | ± 50 | nA |
| | | 8 | 0.002 | $V_S = -10V$, $V_D = 10V$, $V_{EN} = 0.8V$ | - | ± 0.5 | ± 50 | - | ± 1 | ± 50 | nA |
| $I_{D(OFF)}$ | D | 2 | 0.03 | $V_D = 10V$, $V_S = -10V$, $V_{EN} = 0.8V$ | - | ± 2 | ± 50 | - | ± 5 | ± 100 | nA |
| | | 2 | 0.03 | $V_D = -10V$, $V_S = 10V$, $V_{EN} = 0.8V$ | - | ± 2 | ± 50 | - | ± 5 | ± 100 | nA |
| $I_{D(ON)}$ | D | 8 | 0.1 | $V_{S(ALL)} = V_D = 10V$, Sequence Each Switch On $V_{AL} = 0.8V$, $V_{AH} = 2.4V$ | - | ± 2 | ± 50 | - | ± 5 | ± 100 | nA |
| | | 8 | 0.1 | $V_{S(ALL)} = -10V$, Sequence Each Switch On $V_{AL} = 0.8V$, $V_{AH} = 2.4V$ | - | ± 2 | ± 50 | - | ± 5 | ± 100 | nA |
| INPUT | | | | | | | | | | | |
| $I_{AN(ON)}$ | A ₀ , A ₁ | 2 | 0.01 | $V_A = 0V$ | - | -10 | -30 | - | -10 | -30 | μA |
| $I_{AN(OFF)}$ | | 2 | 0.01 | $V_A = 14V$ | - | 10 | 30 | - | 10 | 30 | μA |
| I_A | A ₀ , A ₁ | 2 | 0.01 | $V_{EN} = 5V$, All $V_A = 0V$ (Address Pins) | - | -10 | -30 | - | -10 | -30 | μA |
| | EN | 1 | 0.01 | $V_{EN} = 0V$, All $V_A = 0V$ (Address Pins) | - | -10 | -30 | - | -10 | -30 | μA |

Electrical Specifications $V_+ = 15V$, $V_- = -15V$, $V_{EN} = +5V$, Ground = 0V, Unless Otherwise Specified, (Note 4) (Continued)

| PARAMETER | MEASURED TERMINAL | NO TESTS PER TEMP | TYP 25°C | TEST CONDITIONS | M SUFFIX (°C) | | | C SUFFIX (°C) | | | UNITS |
|--------------------------|-------------------|-------------------|----------|---|---------------|-----|-----|---------------|----|------|---------|
| | | | | | -55 | 25 | 125 | 0 | 25 | 70 | |
| DYNAMIC | | | | | | | | | | | |
| $t_{TRANSITION}$ | D | | 0.3 | See Figure 1 | - | 1 | - | - | - | - | μs |
| t_{OPEN} | D | | 0.2 | See Figure 2 | - | - | - | - | - | - | μs |
| $t_{EN(ON)}$ | D | | 0.6 | See Figure 3 | - | 1.5 | - | - | - | - | μs |
| $t_{EN(OFF)}$ | D | | 0.4 | See Figure 3 | - | 1 | - | - | - | - | μs |
| "OFF" Isolation | D | | 60 | $V_{EN} = 0V$, $R_L = 200\Omega$, $C_L = 3pF$, $V_S = 3V_{RMS}$, $f = 500kHz$ | - | - | - | - | - | - | dB |
| $C_{S(OFF)}$ | S | | 5 | $V_S = 0V$, $V_{EN} = 0V$, $f = 140kHz$ to 1MHz | - | - | - | - | - | - | pF |
| $C_{D(OFF)}$ | D | | 12 | $V_D = 0V$, $V_{EN} = 0V$, $f = 140kHz$ to 1MHz | - | - | - | - | - | - | pF |
| $C_{DS(OFF)}$ | D to S | | 1 | $V_S = 0V$, $V_D = 0V$, $V_{EN} = 0V$, $f = 140kHz$ to 1MHz | - | - | - | - | - | - | pF |
| SUPPLY | | | | | | | | | | | |
| Positive Supply Current | V_+ | 1 | 40 | $V_{EN} = 5V$, All $V_A = 0V$ or 5V | - | - | 200 | - | - | 1000 | μA |
| Negative Supply Current | V_- | 1 | 2 | $V_{EN} = 5V$, All $V_A = 0V$ or 5V | - | - | 100 | - | - | 1000 | μA |
| Positive Standby Current | V_+ | 1 | 1 | $V_{EN} = 0V$, All $V_A = 0V$ or 5V | - | - | 100 | - | - | 1000 | μA |
| Negative Standby Current | V_- | 1 | 1 | $V_{EN} = 0V$, All $V_A = 0V$ or 5V | - | - | 100 | - | - | 1000 | μA |

NOTE:

- See "Enable Input Strobing Levels" in Application Section.

Switching Information

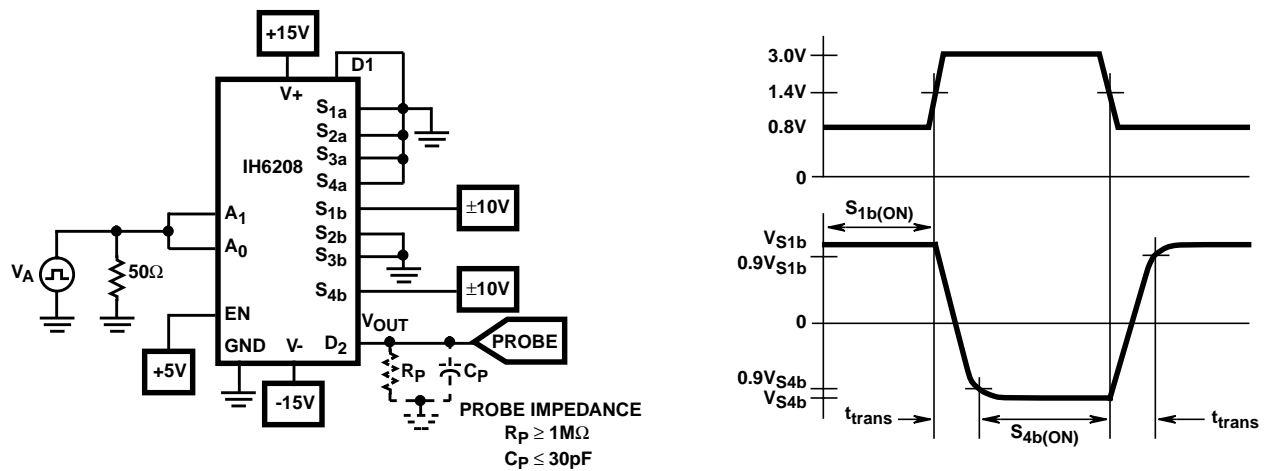


FIGURE 1. $t_{TRANSITION}$ SWITCHING TEST CIRCUIT AND WAVEFORMS

Switching Information (Continued)

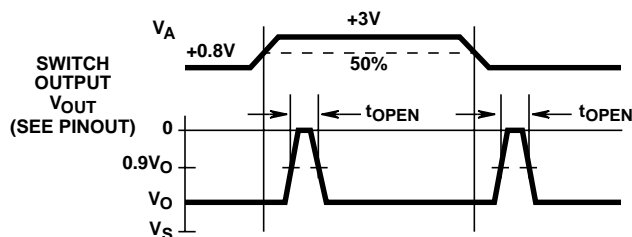
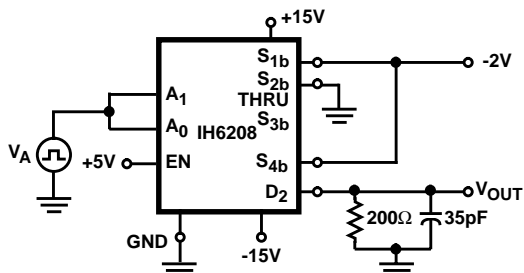


FIGURE 2. t_{OPEN} (BREAK-BEFORE-MAKE) SWITCHING TEST CIRCUIT AND WAVEFORMS

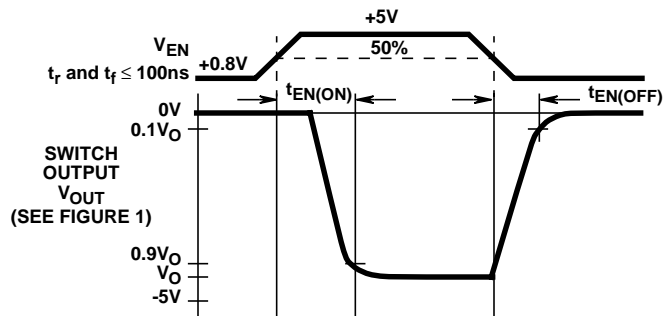
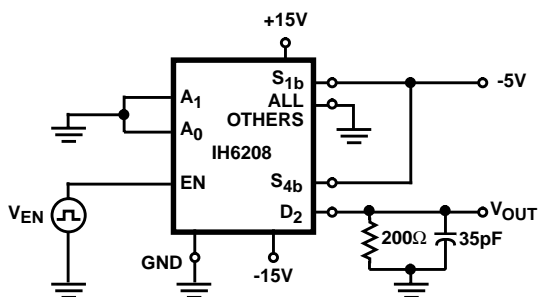


FIGURE 3. t_{ON} AND t_{OFF} SWITCHING TEST CIRCUIT AND WAVEFORMS

IH6208 Application Information

ENABLE Input Strobing Levels

The ENABLE input on the IH6208 requires a minimum of +4.5V to trigger to the "1" state and a maximum of +0.8V to trigger to the "0" state. If the ENABLE input is being driven from TTL logic, a pull-up resistor of 1kΩ to 3kΩ is required from the gate output to +5V supply. (See Figure 4)

When the EN input is driven from CMOS logic, no pullup is necessary, see Figure 5.

The supply voltage of the CD4009 affects the switching speed of the IH6208; the same is true for TTL supply voltage levels. The following chart shows the effect, on t_{trans} for a supply varying from +4.5V to +5.5V.

| CMOS OR TTL SUPPLY VOLTAGE | TYPICAL T_{TRANS} AT 25°C |
|----------------------------|-----------------------------|
| +4.5V | 400ns |
| +4.75V | 300ns |
| +5.00V | 250ns |
| +5.25V | 200ns |
| +5.50V | 175ns |

The throughput rate can therefore be maximized by using a +5V to +5.5V supply for the ENABLE Strobe Logic.

The examples shown in Figure 4 and 5 deal with ENABLE strobing when expansion to more than eight channels is required. In these cases the EN terminal acts as a fourth address input. If eight channels or less are being multiplexed, the EN terminal can be directly connected to +5V logic supply to enable the IH6208 at all times.

Using the IH6208 with Supplies Other Than ±15V

The IH6208 can be used with power supplies ranging from ±6V to ±16V. The switch $r_{DS(ON)}$ will increase as the supply voltages decrease, however, the multiplexer error term (the product of leakage times $r_{DS(ON)}$) will remain approximately constant since leakage decreases as the supply voltages are reduced.

Caution must be taken to ensure that the enable (EN) voltage is at least 0.7V below V_+ at all times. If this is not done, the Address input strobing levels will not function properly. This may be achieved quite simply by connecting EN (pin 2) to V_+ (pin 14) via a silicon diode as shown in Figure 6. When using this type of configuration, a further requirement must be met: the strobe levels of A0 and A1 must be within 2.5V of the EN voltage in order to define a binary "1" state. For the case shown in Figure 6 the EN voltage is 11.3V which means that logic high at A0 and A1 is +8.8V (logic low continues to be 0.8V). In this configuration the IH6208 cannot be driven by TTL (+5V) or CMOS (+5V) logic. It can be driven by TTL open collector logic or CMOS logic with +12V supplies.

If the logic and the IH6208 have common supplies, the EN pin should again be connected to the supply through a silicon diode. In this case, tying EN to the logic supply directly will not work since it violates the 0.7V differential voltage required between V_+ and EN, (See Figure 7). A 1μF capacitor can be placed across the diode to minimize switching glitches.

Switching Information

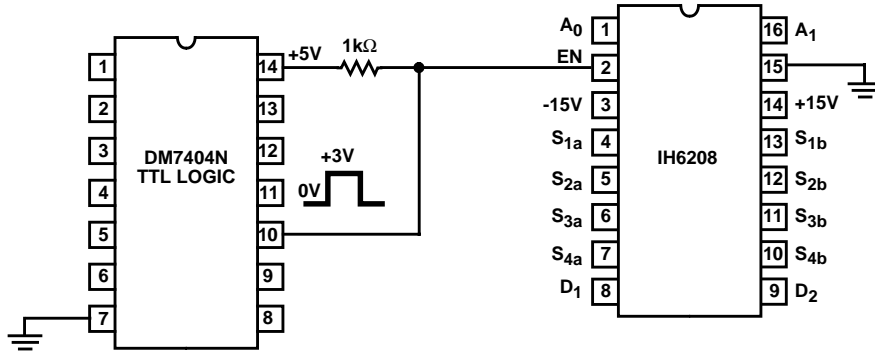


FIGURE 4. ENABLE INPUT STROBING FROM TTL LOGIC

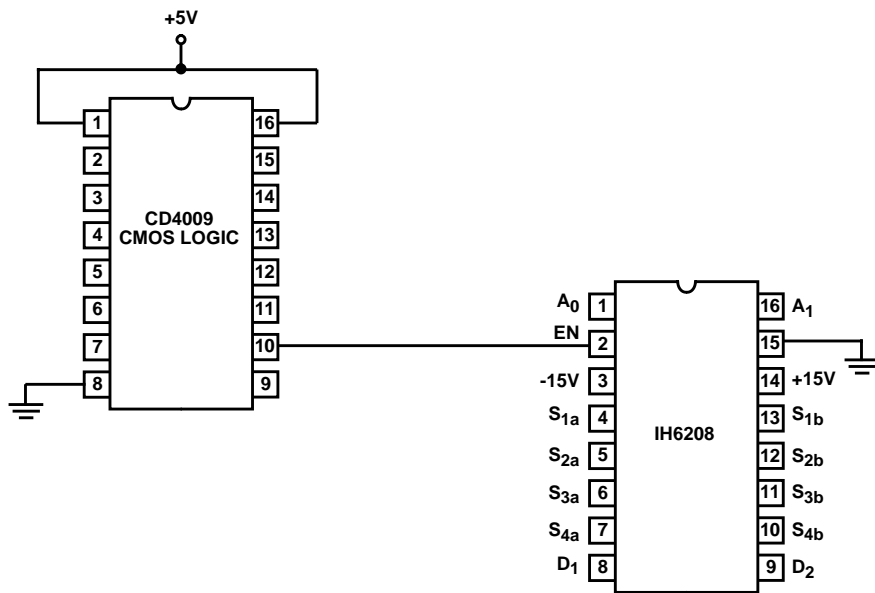


FIGURE 5. CMOS LOGIC DRIVING ENABLE PIN

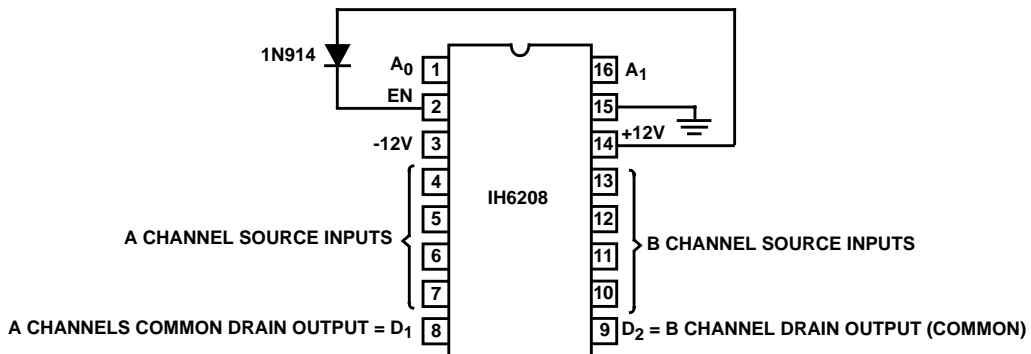


FIGURE 6. IH6208 CONNECTION DIAGRAM FOR LESS THAN ±15V SUPPLY OPERATION

Switching Information (Continued)

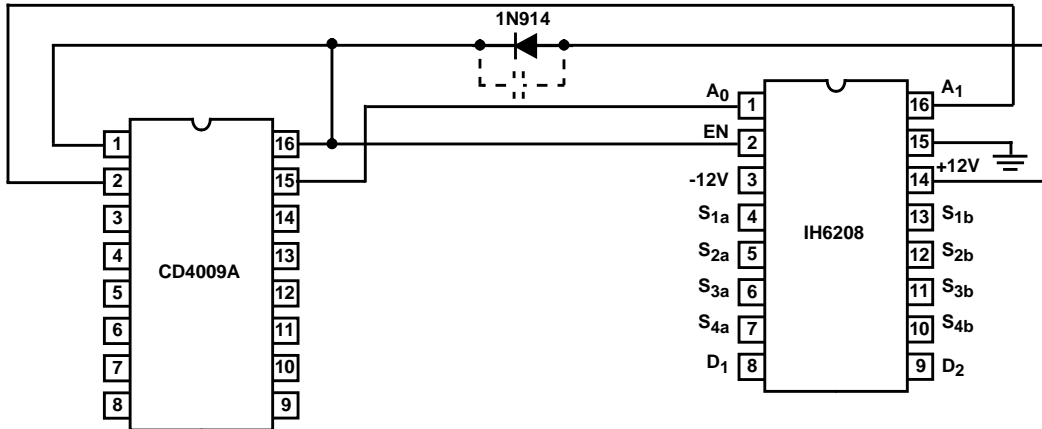


FIGURE 7. IH6208 CONNECTION DIAGRAM WITH ENABLE INPUT STROBING FOR LESS THAN ±15V SUPPLY OPERATION

Peak-to-Peak Signal Handling Capability

The IH6208 can handle input signals up to ±14V (actually -15V to +14.3V because of the input protection diode) when using the ±15V supplies.

The electrical specifications of the IH6208 are guaranteed for ±10V signals, but the specifications have very minor changes for ±14V signals. The notable changes are slightly lower $r_{DS(ON)}$ and slightly higher leakages.

Schematic Diagram

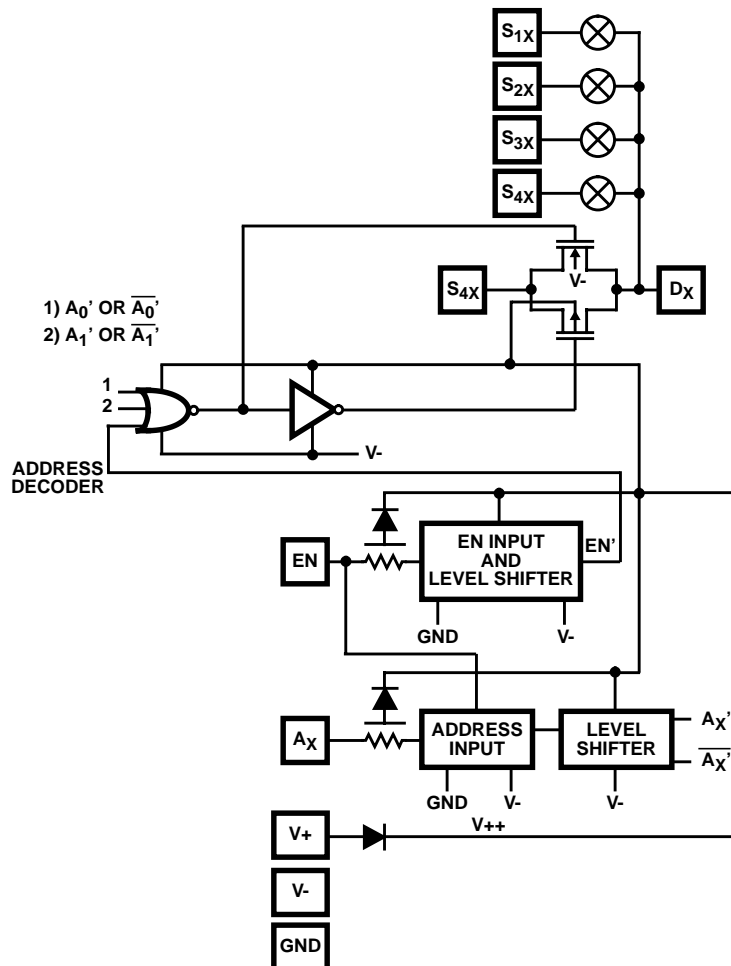


FIGURE 8. 1/2 IH6208 SCHEMATIC DIAGRAM

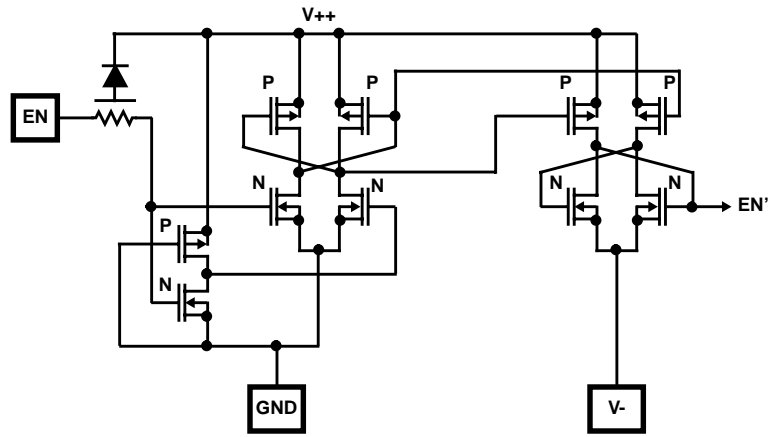


FIGURE 9. ENABLE INPUT AND LEVEL SHIFTER

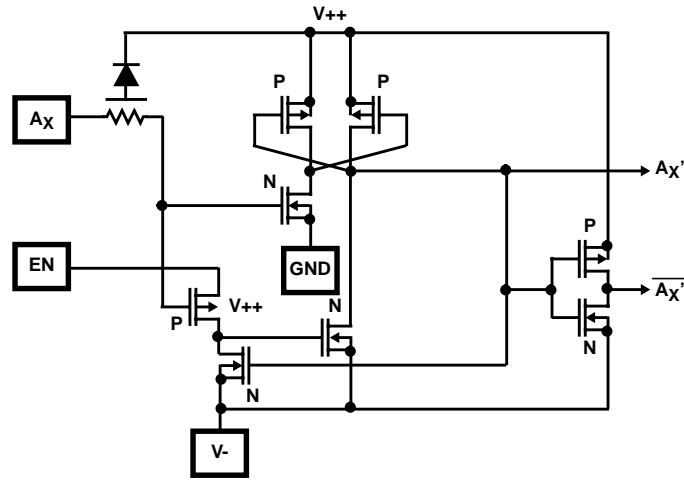


FIGURE 10. ADDRESS INPUT AND LEVEL SHIFTER