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## NTE2056 Integrated Circuit 8–Bit Multiplying Digital–to–Analog Converter

**Description:**

The NTE2056 is an 8–bit multiplying D–to–A converter in a 16–Lead DIP type package designed for use where the output current is a linear product of an eight–bit digital word and an analog input voltage.

**Features:**

- Fast Setting Time: 300ns Typ
- Non–Inverting Digital Inputs are MTTL and CMOS Compatible
- Output Voltage Swing: +0.4V to –5.0V
- High–Speed Multiplying Input: Slew Rate 4.0mA/μs
- Standard Supply Voltages: +5.0V and –5.0V to –15V

**Applications:**

- |  |                                    |
|--|------------------------------------|
| ● Tracking A–to–D Converters                 | ● Audio Digitizing and Decoding    |
| ● Successive Approximation A–to–D Converters | ● Programmable Power Supplies      |
| ● 2 1/2 Digit Panel Meters and DVM’s         | ● Analog–Digital Multiplication    |
| ● Waveform Synthesis                         | ● Digital–Digital Multiplication   |
| ● Sample and Hold                            | ● Analog–Digital Division          |
| ● Peak Detector                              | ● Digital Addition and Subtraction |
| ● Programmable Gain and Attenuation          | ● Speech Compression and Expansion |
| ● CRT Character Generation                   | ● Stepping Motor Drive             |

**Absolute Maximum Ratings:** ( $T_A = +25^{\circ}C$  unless otherwise specified)

Power Supply Voltage	
$V_{CC}$ .....	+5.5V
$V_{EE}$ .....	–16.5V
Digital Input Voltage, $V_5$ thru $V_{12}$ .....	0 to +5.5V
Applied Output Voltage, $V_O$ .....	+0.5V, –5.2V
Reference Current, $I_{14}$ .....	5mA
Reference Amplifier Inputs	
$V_{14}$ .....	$V_{CC}$
$V_{15}$ .....	$V_{EE}$
Operating Temperature Range, $T_A$ .....	0° to +75°C
Storage Temperature Range, $T_{stg}$ .....	–65° to +150°C

**Electrical Characteristics:** ( $T_A = 0^\circ$  to  $+75^\circ\text{C}$ ,  $V_{CC} = +5\text{V}$ ,  $V_{EE} = -15\text{V}$ ,  $V_{ref}/R14 = 2\text{mA}$ , All digital inputs at high logic level, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Relative Accuracy (Error relative to full scale $I_O$ )	$E_r$	Note 1	–	–	$\pm 0.78$	%
Setting Time to within $\pm 1/2$ LSB (Includes $t_{PLH}$ )	$t_S$	$T_A = +25^\circ\text{C}$ , Note 2	–	300	–	ns
Propagation Delay Time	$t_{PLH}$ , $t_{PHL}$	$T_A = +25^\circ\text{C}$	–	30	100	ns
Output Full Scale Current Drift	$TCI_O$		–	–20	–	PPM/ $^\circ\text{C}$
Digital Input Logic Levels (MSB) High Level, Logic “1”	$V_{IH}$		2.0	–	–	V
Low Level, Logic “0”	$V_{IL}$		–	–	0.8	V
Digital Input Current (MSB) High Level	$I_{IH}$	$V_{IH} = 5\text{V}$	–	0	0.04	mA
Low Level	$I_{IL}$	$V_{IL} = 0.8\text{V}$	–	–0.4	–0.8	mA
Reference Input Bias Current (Pin15)	$I_{15}$		–	–1.0	–5.0	$\mu\text{A}$
Output Current Range	$I_{OR}$	$V_{EE} = -5\text{V}$	0	2.0	2.1	mA
		$V_{EE} = -15\text{V}$ , $T_A = +25^\circ\text{C}$	0	2.0	4.2	mA
Output Current	$I_O$	$V_{ref} = 2.000\text{V}$ , $R14 = 1000\Omega$	1.9	1.99	2.1	mA
	$I_{O (min)}$	All bits low	–	0	4.0	$\mu\text{A}$
Output Voltage Compliance	$V_O$	$E_r \leq 0.19\%$ , $T_A = +25^\circ\text{C}$ Pin1 Grounded	–	–	–0.55, +0.4	V
		Pin1 Open, $V_{EE}$ below $-10\text{V}$	–	–	–5.0, +0.4	V
Reference Current Slew Rate	$SR I_{ref}$		–	4.0	–	mA/ $\mu\text{s}$
Output Current Power Supply Sensitivity	PSRR(–)		–	0.5	2.7	$\mu\text{A}/\text{V}$
Power Supply Current	$I_{CC}$	All bits low	–	+13.5	+22.0	mA
	$I_{EE}$		–	–7.5	–13.0	mA
Power Supply Voltage Range	$V_{CCR}$	$T_A = +25^\circ\text{C}$	+4.5	+5.0	+5.5	V
	$V_{EER}$		–4.5	–15.0	–16.5	V
Power Dissipation All bits low	$P_D$	$V_{EE} = -5\text{V}$	–	105	170	mW
		$V_{EE} = -15\text{V}$	–	190	305	mW
		$V_{EE} = -5\text{V}$	–	90	–	mW
		$V_{EE} = -15\text{V}$	–	160	–	mW
All bits high						

Note 1. All current switches are tested to guarantee at least 50% of rated output current.

Note 2. All bits switched.

### Pin Connection Diagram

