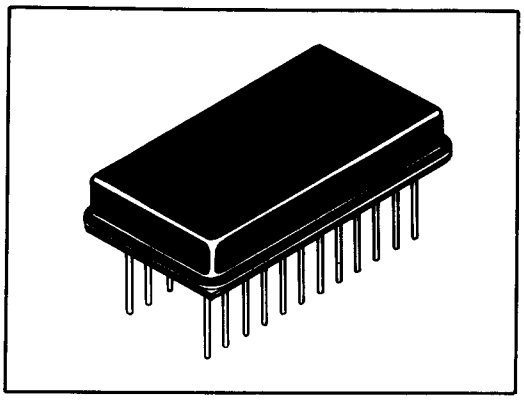
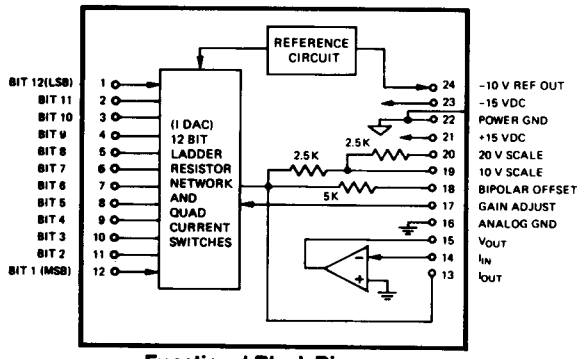
4058

Fast, 12 Bit High Reliability D/A Converter



The 4058 is a true 12 bit digital to analog converter with TTL compatible inputs. It has user programmable output voltage ranges of 0 to -5V, 0 to -10V, ±2.5V, and ±10V and output current ranges of 0 to +4mA and ±2mA. It is one of the fastest settling D/As available, guaranteeing output settling to ±½LSB in 2.5μsec for a 20V step to 200nsec for a 4mA step. The standard 4058 is fully specified for 0°C to +70°C operation. The 4058-83 is specified over the -55°C to +125°C temperature range and meets the high reliability requirements of MIL-STD-883C, Class "B". This product may also be ordered screened to Class "S".

The 4058 is packaged in an industry-standard, hermetically sealed, metal dual-in-line package. Active laser trimming results in integral and differential linearity errors guaranteed not to exceed ±½LSB. For the most critical applications, external gain and offset adjustments are user optional. The 4058 operates from ±15V supplies with no need for a +5V logic supply. Power consumption, at 645mW maximum, is extremely low for a device of this speed.



Functional Block Diagram

Analog ground and power ground must be externally connected with each other. Power ground is connected to case. All units are supplied with a mylar insulator for isolation between the case and pc board.

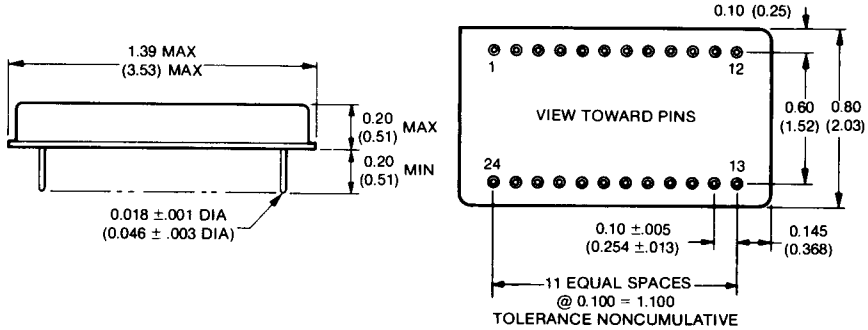
FEATURES

- ±Fast Settling to ±0.01% 2.5μsec Max. 20V Step 200nsec Max. 4mA Step
- ±½LSB Max. Integral and Differential Nonlinearities
- Monotonicity Guaranteed Over Temperature
- Power Consumption 645mW Max.
- −55°C to +125°C Operation

APPLICATIONS

- Military Environments
- High Reliability Industrial Equipment
- Data Distribution Systems
- Precision Displays
- Portable Instrumentation

PACKAGE DIMENSIONS Dimensions are in inches. Those in parentheses are expressed in centimeters.



PIN DESIGNATION	
1. BIT 12 (LSB)	24. −10V REF. OUT
2. BIT 11	23. −15V SUPPLY
3. BIT 10	22. POWER GROUND
4. BIT 9	21. +15V SUPPLY
5. BIT 8	20. 20V SCALE
6. BIT 7	19. 10V SCALE
7. BIT 6	18. BIPOLAR OFFSET
8. BIT 5	17. GAIN ADJUST
9. BIT 4	16. ANALOG GROUND
10. BIT 3	15. V_{OUT}
11. BIT 2	14. I_{IN}
12. BIT 1 (MSG)	13. I_{OUT}

ABSOLUTE MAXIMUM RATINGS

+15V Supply (+V_{CC}, Pin 21)	+18V
−15V Supply (+V_{CC}, Pin 23)	−18V
Digital Input Voltage (Pins 1-12)	0 to +7V
Output Short Circuit Duration (1)	Continuous to Ground
Operating Temperature Range	−55°C to +125°C
Specified Temperature Range	
4058	0°C to +70°C
4058-83 (2)	−55°C to +125°C
Storage Temperature Range	−65°C to +150°C

SPECIFICATIONS (T_A = +25°C, ±V_{CC} = ±15V unless otherwise indicated.)

PARAMETER	MIN.	TYP.	MAX.	UNITS
DIGITAL INPUTS				
Logic Levels: Logic "1"	+2.0	—	+5.5	V
Logic "0"	0	—	+0.8	V
Loading (3)	—	—	1	TTL Load
Logic Coding (4): Voltage Output	—	CBIN, COB	—	
Current Output	—	BIN, OBIN	—	
ANALOG OUTPUT				
Voltage: Ranges Unipolar	—	0 to −5, 0 to −10	—	V
Ranges Bipolar	—	±2.5, ±5, ±10	—	V
Output Current	±5	±20	—	mA
Output Resistance	—	0.05	—	Ω
Short Circuit Current (1)	—	±25	—	mA
Max. Capacitive Load	—	50	—	pF
Current: Range Unipolar	—	0 to +4	—	mA
Range Bipolar	—	±2	—	mA
Output Resistance Unipolar	—	1.5	—	kΩ
Output Resistance Bipolar	—	1.2	—	kΩ
Compliance Voltage	±0.6	—	—	V
TRANSFER CHARACTERISTICS				
Integral Linearity Error: +25°C	—	±¼	±½	LSB
0°C to 70°C (4058)	—	±½	—	LSB
−55°C to +125°C (4058-83)	—	±½	—	LSB
Differential Linearity Error	—	±¼	±½	LSB
Guaranteed Monotonicity: 4058	0	—	+70	°C
4058-83	−55	—	+125	°C
Zero Offset Error: (5)				
Voltage Output: Unipolar (000...000)	—	±1	±4	LSB
Bipolar (100...000)	—	±1	±4	LSB
Current Output: Unipolar (000...000)	—	±¼	±½	LSB
Bipolar (100...000)	—	±¼	±½	LSB
Gain Error (5) (6): Voltage Output	—	±0.05	±0.2	%
Current Output	—	±0.1	±1	%
STABILITY				
Zero Offset Drift				
Voltage Output: Unipolar	—	±3	±15	ppm of FSR/°C
Bipolar	—	±10	±25	ppm of FSR/°C
Current Output: Unipolar	—	±0.5	±1	ppm of FSR/°C
Bipolar	—	±5	±10	ppm of FSR/°C
Gain Drift: Voltage Output	—	±10	±20	ppm/°C
Current Output (7)	—	±7	±20	ppm/°C
Reference Drift	—	±5	±15	ppm/°C
Power Supply Rejection Ratio	—	±0.001	±0.0024	%FSR/%V_s
Warm Up Time to Within ±1LSB	—	30	—	Seconds
DYNAMIC CHARACTERISTICS				
Settling Time to ±½LSB				
Voltage Output: 5V Step	—	1.2	2	μsec
10V Step	—	1.2	2	μsec
20V Step	—	1.9	2.5	μsec
Current Output: 4mA Step	—	150	200	nsec
Slew Rate	—	16	—	V/μsec
REFERENCE				
Voltage	—	−10.0	—	V
Accuracy	—	±1	—	%
External Load	—	—	2	mA

PARAMETER	MIN.	TYP.	MAX.	UNITS
POWER SUPPLIES				
Range	---	±2	---	%
Current Drain: +15V Supply	---	+20	+25	mA
−15V Supply	---	−13	−18	mA
Power Consumption	---	495	645	mW

NOTES

1. The 4058's current and voltage outputs can withstand continous shorts to ground. The reference output (pin 24) can withstand a short for approx. 2 seconds.
2. The 4058-HR is fully specified for −55 to +125°C operation.
3. A TTL load is defined as sinking 40μA with a logic "1" applied and sourcing 1.6mA with a logic "0" applied.
4. CBIN = Complementary Binary. COB = Complemetary Offset Binary, BIN = Binary (straight binary). OBIN = Offset Binary. See Digital Coding Table.
5. Adjustable to zero with optional external trim potentiometer.
6. Gain error is defined as the error in the slope of the converter transfer function. It is expressed as a percentage and is equivalent to the deviation (divided by the ideal value) between the actual and the ideal value for the full output voltage/current span from the 0000 0000 0000 output to the 1111 1111 1111 output.
7. Gain drift is measured using the internal feedback resistors. Using an external resistor, the gain drift is typically 35ppm/° C.

APPLICATIONS INFORMATION

Grounding and Bypassing

High speed systems require added care in power distribution for maximum accuracy and speed. Although power supply inputs on the 4058 are internally bypassed with 0.01μF ceramic capacitors, it is recommended that an additional 1μF tantalum capacitor be added externally between each supply input and analog ground for optimum performance. It is important to realize that power ground (pin 22) is internally connected to the case and must be connected to system analog ground to minimize ground loop errors. It is preferable to have the 4058's analog and power ground pins soldered directly to a large analog ground plane beneath the 4058.

Optimizing Settling Time

To optimize settling time of the 4058 and to make the settling time independent of the characteristics of the digital driver, 2.2kΩ 1/8Watt pull-down resistors are recommended at all logic inputs.

Logic Inputs

Logic inputs are standard TTL/DTL compatible. If any bits are not used, it is recommended they be grounded since an "open" bit input line is equivalent to a logic "1". Opening the bit lines should not, however, be used as a means of generating a logic "1" due to the possibilities of noise pickup. The table in right column shows the binary input code used by the 4058. If desired, virtually any other binary code can be used with the addition of the necessary external logic.

ANALOG OUTPUT		DIGITAL INPUT	
Voltage	Current	Unipolar Binary	Bipolar Offset Binary
+F.S.	−F.S.	---	000...000
+½F.S.	−½F.S.	---	010...000
+1LSB	−1LSB	---	011...111
0	0	000...000	100...000
−1LSB	+1LSB	000...001	100...001
−½F.S.	+½F.S.	100...000	110...000
−F.S. +1LSB	+F.S. −1LSB	111...111	111...111

Trim Procedures

Initial zero and gain errors may be trimmed to zero using external potentiometers. Adjustments should be made following warm-up, and to avoid interaction, zero should be adjusted before gain. Fixed resistors can be ±20% carbon composition or better. Multiturn potentiometers with TCRs of 100ppm/°C or less are recommended to minimize drift with temperature.

Zero Adjustment — For voltage output operation, set the digital input code to 000...000, and adjust the offset trim potentiometer for zero output voltage (unipolar) or plus full scale output voltage (bipolar). For current output operation, set the digital input code to 000...000, and adjust the offset trim potentiometer for zero output current (unipolar) or minus full scale output current (bipolar).

Gain Adjustment — For voltage output operation, set the digital input code to 111...111, and adjust the gain trim potentiometer for minus full scale plus 1LSB output voltage. For current output operation, set the digital input code to 111...111, and adjust the gain trim potentiometer for plus full scale minus 1LSB output current.

OUTPUT			PIN PROGRAMMING		
Output Range	Output Pin	Jumper Pin 14 to	Jumper Pin 18 to	Jumper Pin 19 to	Jumper Pin 20 to
0 to −5V	Pin 15	Pin 13	Pin 16 (ground)	Pin 15	Pin 13
0 to −10V	Pin 15	Pin 13	Pin 16 (ground)	Pin 15	---
±2.5V	Pin 15	Pin 13	Pin 24	Pin 15	Pin 13
±5V	Pin 15	Pin 13	Pin 24	Pin 15	---
±10V	Pin 15	Pin 13	Pin 24	---	Pin 15
0 to +4mA	Pin 13	Pin 15 (1)	---	---	---
±2mA	Pin 13	Pin 15 (1)	Pin 24	---	---

NOTE 1. If oscillations or ringing occur, connect a 100kΩ resistor between pins 14 and 15.