TMC1185

10-Bit, 40 Msps Sampling Analog-to-Digital Converter

Features

- 10-bit resolution
- 40 Msps
- Low power: 380 mW
- High signal-to-noise ratio: 58dB
- Internal track-and-hold
- Built-in reference
- Single +5Volt power supply

Applications

- Video Digitizing
- CCD imaging
- Scanners and cameras
- Set-top boxes
- Medical imaging
- Cable modems
- Test instrumentation

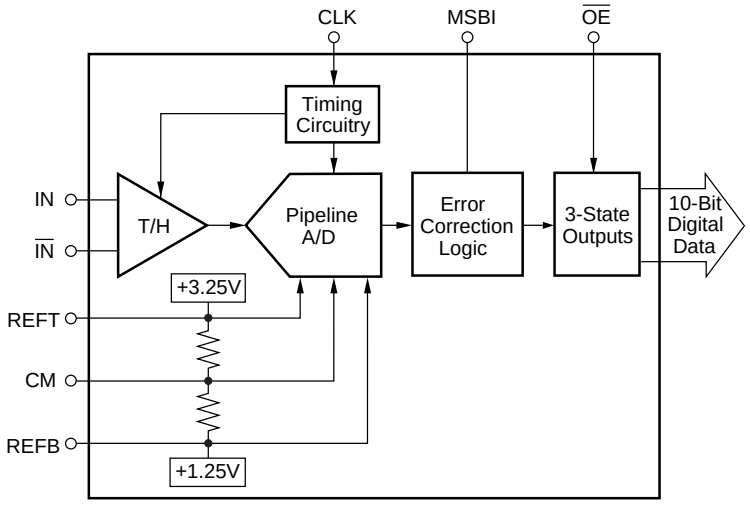
Description

The TMC1185 is a high performance, low power, 10-bit 40 Msps analog-to-digital converter. The monolithic converter includes a 10 bit quantizer with internal track-and-hold, reference, and power down mode. Inputs can be configured to accept either differential or single-ended inputs. It is fabricated in low power submicron CMOS and operates from a single +5 Volt power supply, dissipating only 380mW.

The TMC1185 is designed with digital error correction, to provide excellent Nyquist differential linearity performance for demanding imaging applications. Low distortion, high SNR and high oversampling capability gives the TMC1185 the margin needed for video and telecommunication applications.

This A/D convertor supports sampling rates up to 40 Msps. It is available in a 28-pin SOIC package.

Block Diagram



Functional Description

The TMC1185 is a high speed sampling analog-to-digital converter with pipelining. It uses a fully differential architecture and digital error correction to guarantee 10-bit resolution. The differential track/hold circuit is shown in Figure 1. The switches are controlled by an internal clock which has a non-overlapping two phase signal, $\phi1$ and $\phi2$. At the sampling time, the input signal is sampled on the bottom plates of the input capacitors. In the next clock phase, $\phi2$, the bottom plates of the input capacitors are connected together and the feedback capacitors are switched to the op amp output. At this time the charge redistributes from C_I to C_H, completing one track/hold cycle. The differential output is a held DC representation of the analog input at the sample time. The track/hold circuit can also convert a single-ended input signal into a fully differential signal for the quantizer.

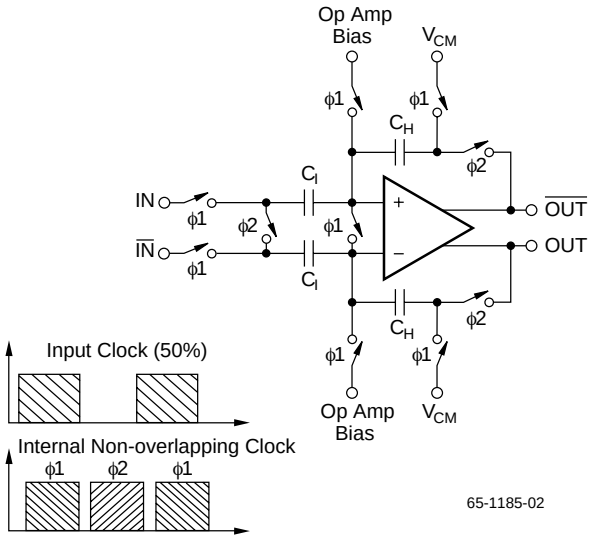


Figure 1. Input Track/Hold Configuration with Timing Signals

The pipelined quantizer architecture has 9 stages with each stage containing a two-bit quantizer and a two bit digital-to-analog converter, as shown in Figure 2. Each two-bit quantizer stage converts on the edge of the sub-clock, which is twice the frequency of the externally applied clock. The output of each quantizer is fed into its own delay line to

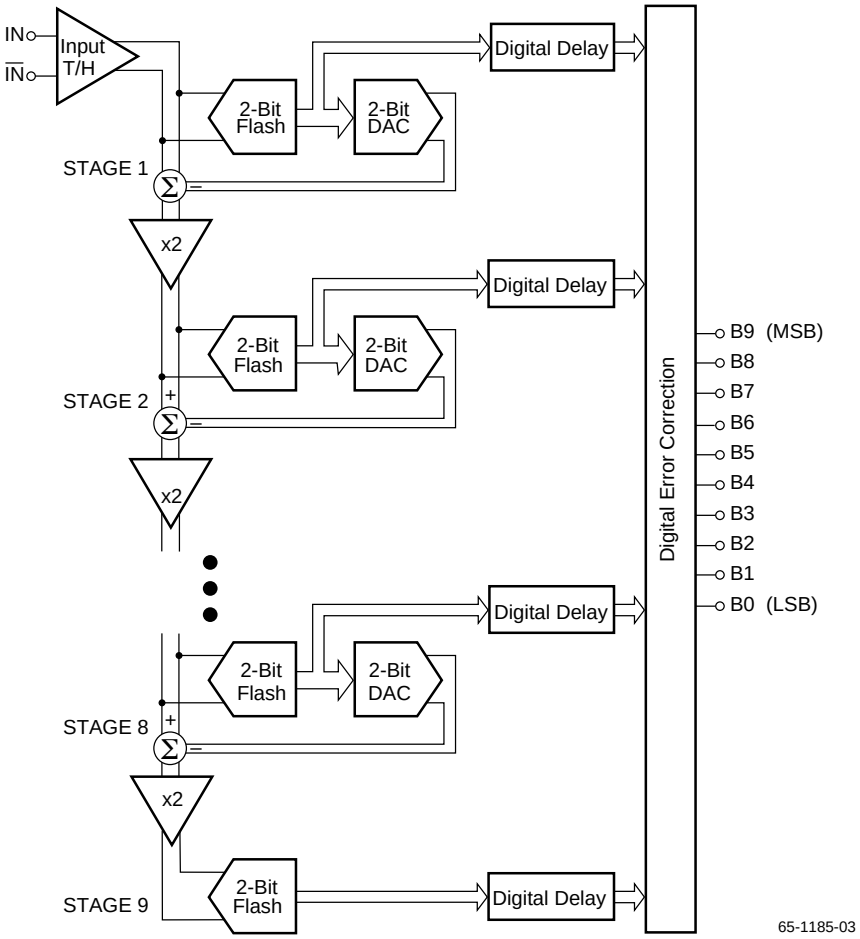


Figure 2. Pipeline A/D Architecture

time-align it with the data created from the following quantizer stages. This aligned data is fed into a digital error correction circuit which can adjust the output data based on the information found on the redundant bits. This technique gives the TMC1185 excellent differential linearity and guarantees no missing codes at the 10-bit level.

The output data is available in Straight Offset Binary (SOB) or Binary Two's Complement (BTC) format.

The Analog Input and Internal Reference

The analog input of the TMC1185 can be configured in various ways and driven with different circuits, depending on the nature of the signal and the level of performance desired. The TMC1185 has an internal reference that sets the full scale input range of the A/D. The differential input range has each input centered around the common-mode of +2.25V, with each of the two inputs having a full scale range of +1.25V to +3.25V. Since each input is 2V peak-to-peak and 180° out of phase with the other, a 4V differential input signal to the quantizer results. As shown in Figure 3, the positive full scale reference (REFT) and the negative full scale reference (REFB) are brought out for external bypassing. In addition, the common-mode voltage (CM) may be used as a reference to provide the appropriate offset for the driving circuitry. However, care must be taken not to appreciably load this reference node. For more information regarding external references, single-ended inputs, and input drive circuits, refer to the applications section.

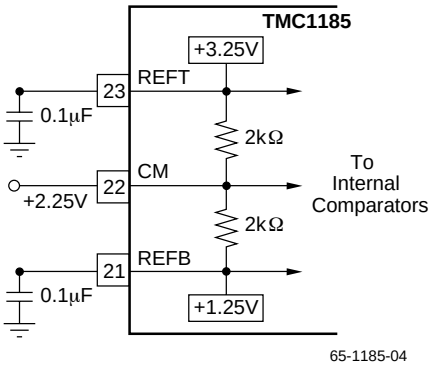


Figure 3. Internal Reference Structure

Clock Requirements

The CLK pin accepts a CMOS level clock input. Both the rising and falling edges of the externally applied clock control the various interstage conversions in the pipeline. Therefore, the clock signal's jitter, rise/fall times and duty cycle can affect conversion performance.

- Low clock **jitter** is critical to SNR performance in frequency-domain signal environments.
- Clock **rise and fall times** should be as short as possible (<2ns for best performance).
- For most applications, the clock duty should be set to 50%. However, for applications requiring no missing codes, a slight skew in the duty cycle will improve DNL performance for conversion rates >35MHz and input frequencies <2MHz (see Timing Diagram). A possible method for skewing the 50% duty cycle source is shown in Figure 4.

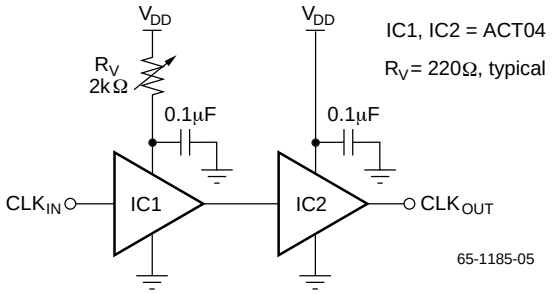


Figure 4. Clock Skew Circuit

Digital Output Data

The 10-bit output data is provided at CMOS logic levels. There is a 6.5 clock cycle data latency from the start convert signal to the valid output data. The standard output coding is Straight Offset Binary where a full scale input signal corresponds to all "1's" at the output. This condition is met with pin 19 "LO" or Floating due to an internal pull-down resistor. By applying a high voltage to this pin, a Binary Two's Complement output will be provided where the most significant bit is inverted. The digital outputs of the TMC1185 can be set to a high impedance state by driving $\overline{OE}$ (pin 18) with a logic "HI". Normal operation is achieved with pin 18 "LO" or Floating due to an internal pull-down resistor. This function is provided for testability purposes and is not meant to drive digital buses directly or be dynamically changed during the conversion process.

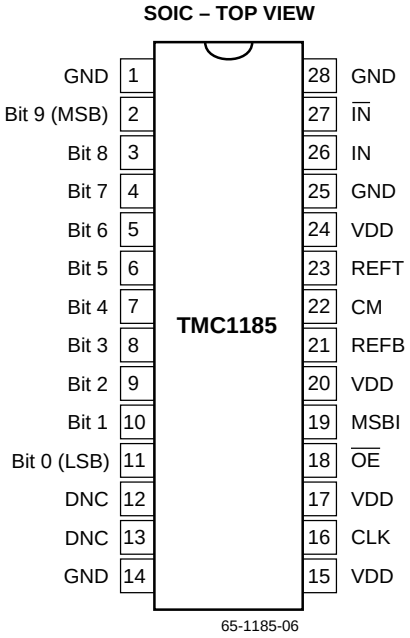
Table 1. Coding Table for the TMC1185

Differential Input[1]	Output Code	
	SOB (Pin 19 Floating or LO)	BTC (Pin 19 Hi)
+FS (IN = +3.25V, $\overline{IN}$ = +1.25V)	1111111111	0111111111
+FS -1LSB	1111111111	0111111111
+FS -2LSB	1111111110	0111111110
+3/4 Full Scale	1110000000	0110000000
+1/2 Full Scale	1100000000	0100000000
+1/4 Full Scale	1010000000	0010000000
+1LSB	1000000001	0000000001
Bipolar Zero (IN = $\overline{IN}$ = +2.25V)	1000000000	0000000000
-1LSB	0111111111	1111111111
-1/4 Full Scale	0110000000	1110000000
-1/2 Full Scale	0100000000	1100000000
-3/4 Full Scale	0010000000	1010000000
-FS +1 LSB	0000000001	1000000001
-FS (IN = +1.25V, $\overline{IN}$ = +3.25V)	0000000000	1000000000

Note:

1. In the single-ended input mode, +FS = +4.25V and -FS = +0.25V.

Pin Assignments



Pin Descriptions

Pin Name	Pin Number	Pin Function Description
B9	2	Bit 9, Most Significant Bit
B8	3	Bit 8
B7	4	Bit 7
B6	5	Bit 6
B5	6	Bit 5
B4	7	Bit 4
B3	8	Bit 3
B2	9	Bit 2
B1	10	Bit 1
B0	11	Bit 0, Least Significant Bit
CLK	16	Convert Clock Input, 50% Duty Cycle
CM	22	Common-Mode Voltage. It is derived by (REFT + REFB)/2.
GND	1, 14, 25, 28	Ground
IN	26	Input
$\overline{IN}$	27	Complementary Input
MSBI	19	Most Significant Bit Inversion, HI: MSB inverted for complementary output. LO or Floating: Straight output. Internal pull-down resistor.
DNC	12, 13	Do not connect.

Pin Descriptions (continued)

Pin Name	Pin Number	Pin Function Description
$\overline{OE}$	18	HI: High Impedance State. LO or Floating: Normal Operation. Internal pull-down resistor.
REFB	21	Bottom Reference Bypass. For external bypassing of internal +1.25V reference.
REFT	23	Top Reference Bypass. For external bypassing of internal +3.25V reference.
VDD	15, 17, 20, 24	+5V Power Supply

Absolute Maximum Ratings

Parameter	Min	Max	Unit
VDD		+6	V
Analog Input	0V	VDD + 300mV	V
Logic Input	0V	VDD + 300mV	V
Case Temperature		+100	°C
Junction Temperature		+150	°C
Storage Temperature		+125	°C
External Top Reference Voltage (REFT)		+3.4	V
External Bottom Reference Voltage (REFB)	+1.1		V

Note:
1. Stresses above these ratings may permanently damage the device.

Electrostatic Discharge Sensitivity

This integrated circuit can be damaged by ESD. Electrostatic discharge can cause damage ranging from performance degradation to complete device failure. Fairchild recommends that all integrated circuits be handled, stored and installed using appropriate ESD protection methods.

Electrical Specifications

at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.

Parameter	Conditions	Temp	Min	Typ	Max	Unit
Resolution					10	Bits
Specified Temperature Range	$T_{AMBIENT}$		–40		+85	°C
Analog Input						
Differential Full Scale Input Range			+1.25		+3.25	V
Common-Mode Voltage				2.25		V
Analog Input Bandwidth (–3dB)						
Small Signal	-20dBFS(1) Input	+25°C		120		MHz
Full Power	0dB Input	+25°C		65		MHz
Input Impedance				1.25 || 4		MΩ || pF
Digital Input						
Logic Family			TTL/HCT Compatible CMOS			
Convert Command	Start Conversion		Falling Edge			

Electrical Specifications (continued)

at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.

Parameter	Conditions	Temp	Min	Typ	Max	Unit
Accuracy(2)						
Gain Error		+25°C		±0.6	±1.5	%
		Full		±1.1	±2.5	%
Gain Tempco				±85		ppm/°C
Power Supply Rejection of Gain	Delta +VDD = ±5%	+25°C		0.01	0.15	%FSR/%
Input Offset Error		Full		±2.1	±3.5	%
Power Supply Rejection of Offset	Delta +VDD = ±5%	+25°C		0.02	0.15	%FSR/%
Conversion Characteristics						
Sample Rate			10k		40M	Sample/s
Data Latency				6.5		Convert Cyde
Dynamic Characteristics						
Differential Linearity Error	t_H = 13ns(3)					
f = 500kHz		+25°C		±0.5	±1.0	LSB
		0°C to +70°C		±0.6	±1.0	LSB
f = 12MHz		+25°C		±0.5	±1.0	LSB
		0°C to +70°C		±0.6	±1.0	LSB
No Missing Codes		0°C to +70°C		Guaran-teed		
Integral Linearity Error at f = 500kHz		0°C to +70°C		±0.5	±2.0	LSB
Spurious-Free Dynamic Range (SFDR)						
f = 500kHz (–1dBFS input)		+25°C	60	70		dBFS
		Full	54	67		dBFS
f = 12MHz (–1dBFS input)		+25°C	58	63		dBFS
		Full	54	62		dBFS
Two-Tone Intermodulation Distortion (IMD)(4)						
f = 4.4MHz and 4.5MHz (referred to –1dBFS envelope)		+25°C		-61		dB
		Full		-60		dB
Signal-to-Noise Ratio (SNR)						
f = 500kHz (–1dBFS input)		+25°C	57	59		dB
		Full	55	59		dB
f = 12MHz (–1dBFS input)		+25°C	56	58		dB
		Full	54	58		dB
Signal-to-(Noise + Distortion) (SINAD)						
f = 500kHz (–1dBFS input)		+25°C	56	58.5		dB
		Full	55	58		dB
f = 12MHz (–1dBFS input)		+25°C	53	57		dB
		Full	50	56		dB
Differential Gain Error	NTSC or PAL	+25°C		0.5		%
Differential Phase Error	NTSC or PAL	+25°C		0.1		degrees
Effective Bits(5)	f_{IN} = 3.58MHz	+25°C		9.3		Bits
Aperture Delay Time		+25°C		2		ns
Aperture Jitter		+25°C		7		ps rms
Overvoltage Recovery Time(6)	1.5x Full Scale Input	+25°C		2		ns

Electrical Specifications (continued)

at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.

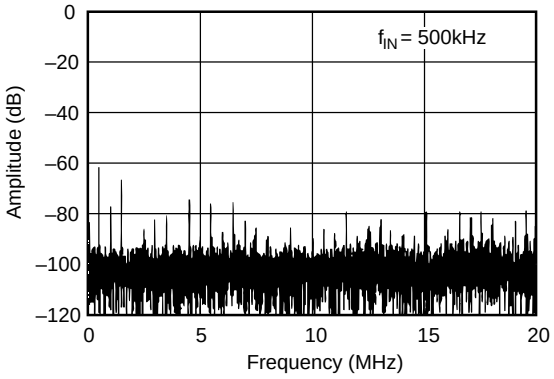
Parameter	Conditions	Temp	Min	Typ	Max	Unit
Outputs						
Logic Family		TTL/HCT Compatible CMOS				
Logic Coding	Logic Selectable	SOB or BTC				
Logic Levels	Logic “LO”, C_L = 15pF	Full	0		0.4	V
	Logic “HI”, C_L = 15pF	Full	2.5		VDD	V
3-State Enable Time				20	40	ns
3-State Disable Time		Full		2	10	ns
Power Supply Requirements						
Supply Voltage: VDD	Operating	Full	+4.75	+5	+5.25	V
Supply Current: IDD	Operating	+25°C		76	88	mA
	Operating	Full		78	90	mA
Power Consumption	Operating	+25°C		380	460	mW
	Operating	Full		390	470	mW
Thermal Resistance, θ_{JA}						
28-Pin SOIC				75		°C/W

Notes:

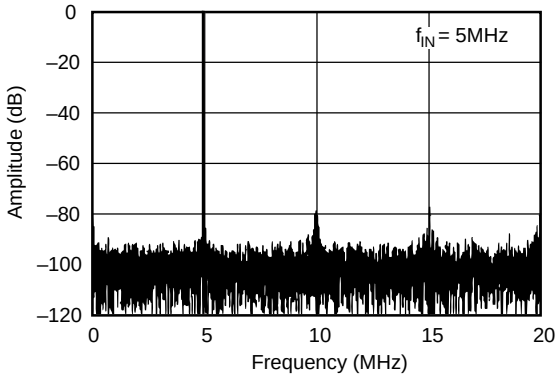
1. dBFS refers to dB below Full Scale.
2. Percentage accuracies are referred to the internal A/D Full Scale Range of 4Vp-p.
3. Refer to Timing Diagram footnotes for the f_{IN} = 500kHz differential linearity error performance condition.
4. IMD is referred to the larger of the two input signals. If referred to the peak envelope signal (=0dB), the intermodulation products will be 7dB better.
5. Based on (SINAD -1.76)/6.02.
6. No “rollover” of bits.

Typical Performance Curves

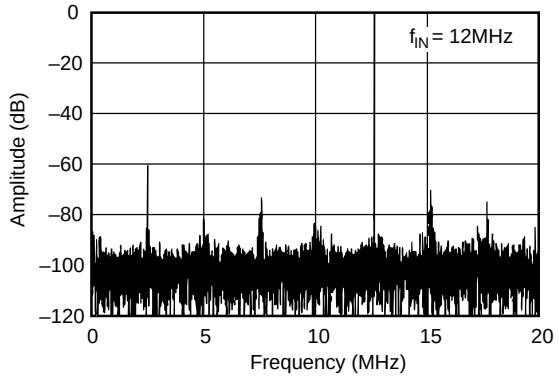
at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.



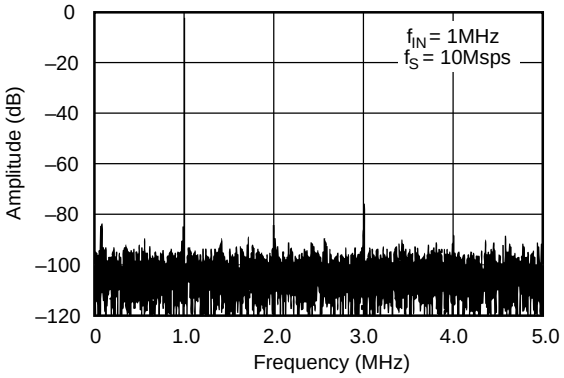
SPECTRAL PERFORMANCE



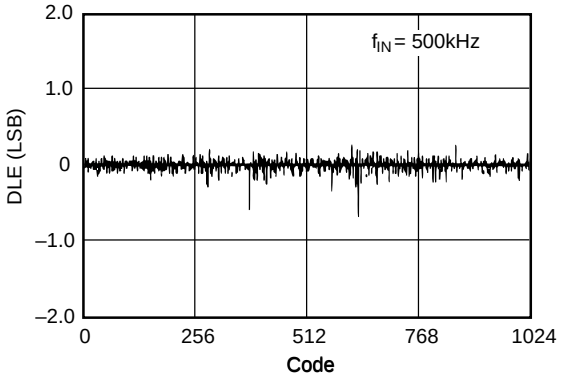
SPECTRAL PERFORMANCE



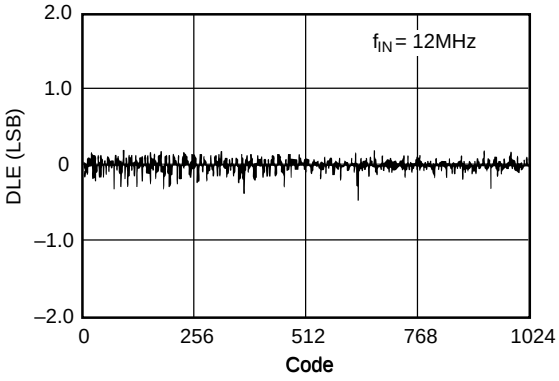
SPECTRAL PERFORMANCE



SPECTRAL PERFORMANCE



DIFFERENTIAL LINEARITY ERROR

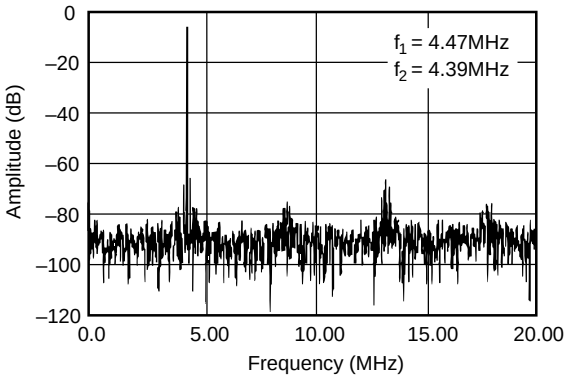


DIFFERENTIAL LINEARITY ERROR

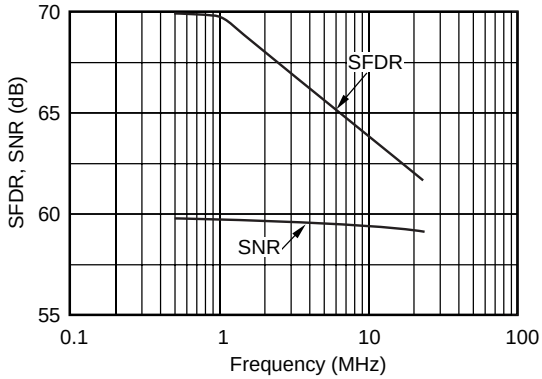
65-1185-07

Typical Performance Curves (continued)

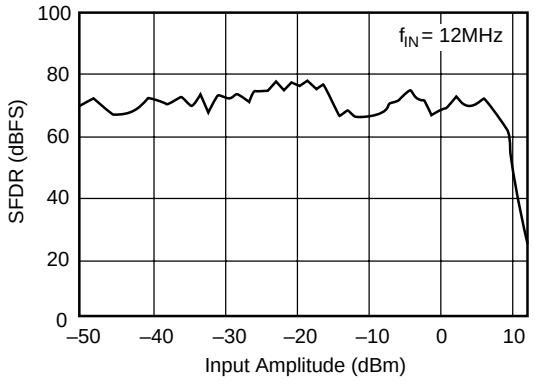
at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.



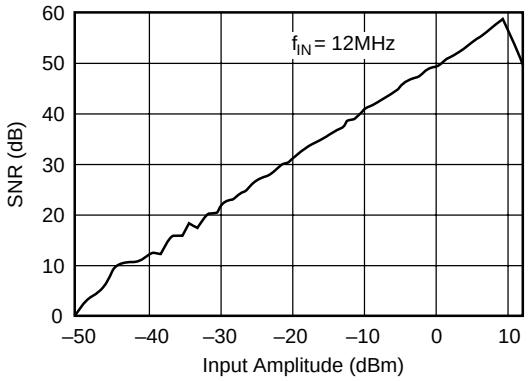
TWO-TONE INTERMODULATION



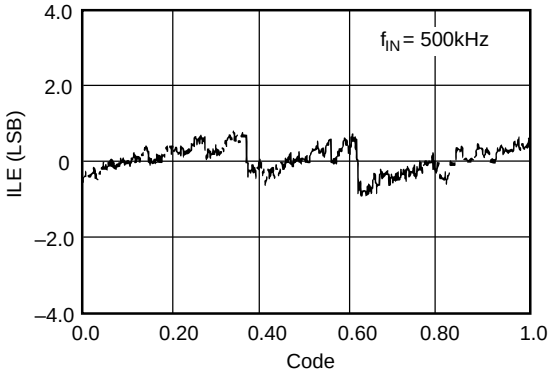
DYNAMIC PERFORMANCE vs INPUT FREQUENCY



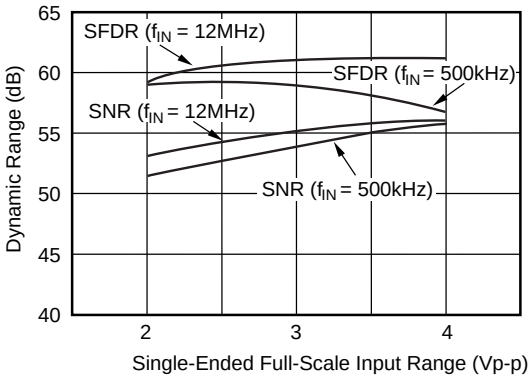
SWEPT POWER SFDR



SWEPT POWER SNR



INTEGRAL LINEARITY ERROR



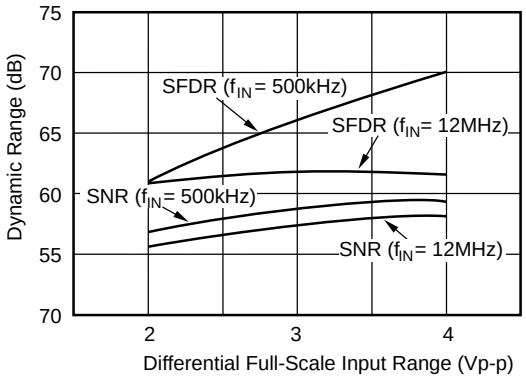
NOTE: REFTEXT varied, REFB is fixed at the internal value of +1.25V.

DYNAMIC PERFORMANCE vs SINGLE-ENDED FULL-SCALE INPUT RANGE

65-1185-08

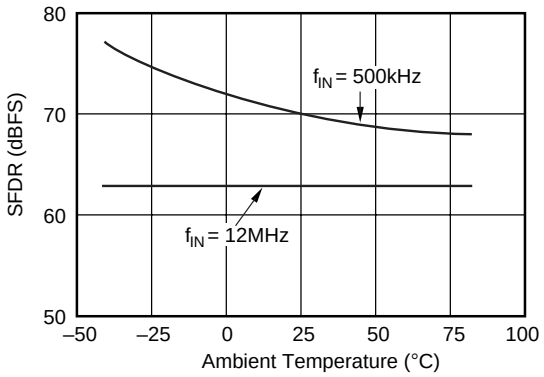
Typical Performance Curves (continued)

at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.

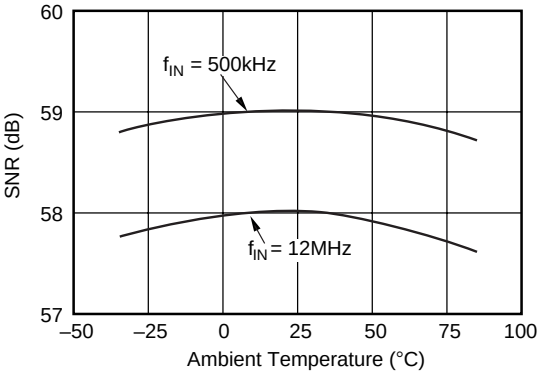


NOTE: $REFT_{EXT}$ varied, REFB is fixed at internal value of +1.25V.

DYNAMIC PERFORMANCE vs DIFFERENTIAL FULL-SCALE INPUT RANGE

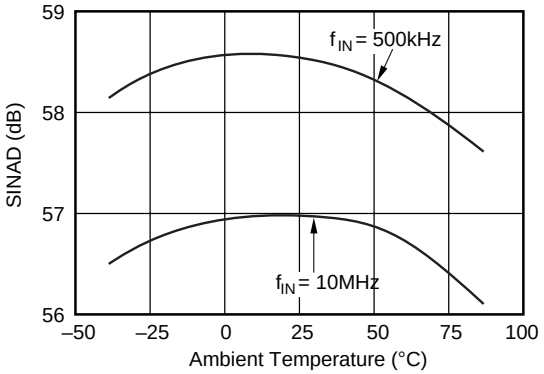


SPURIOUS FREE DYNAMIC RANGE vs TEMPERATURE

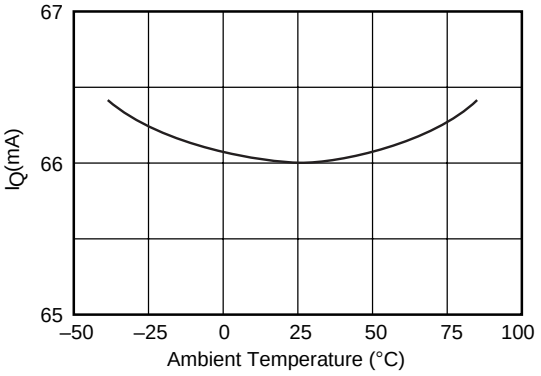


SIGNAL-TO-NOISE RATIO vs TEMPERATURE

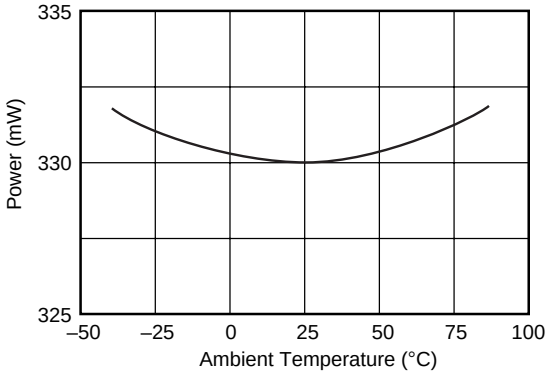
vs TEMPERATURE



SIGNAL-TO-(NOISE + DISTORTION)



SUPPLY CURRENT vs TEMPERATURE

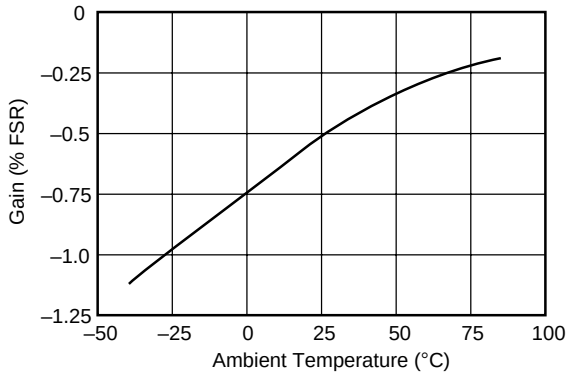


POWER DISSIPATION vs TEMPERATURE

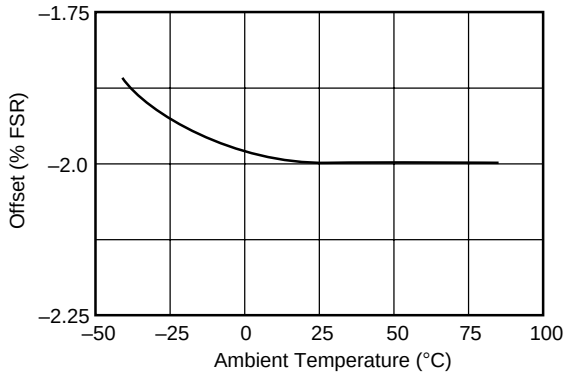
65-1185-09

Typical Performance Curves (continued)

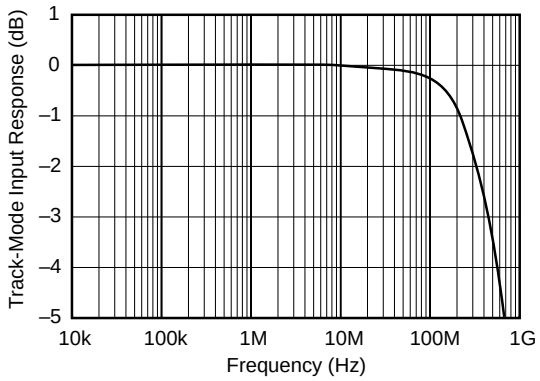
at T_A = +25°C, VDD = +5V, Sampling Rate = 40 Msps, with a 50% duty cycle clock having a 2ns rise/fall time, unless otherwise noted.



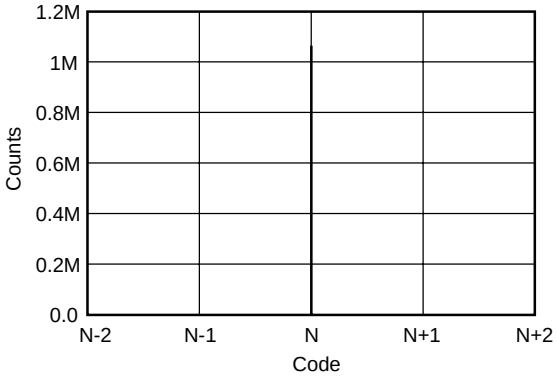
GAIN ERROR vs TEMPERATURE



OFFSET ERROR vs TEMPERATURE



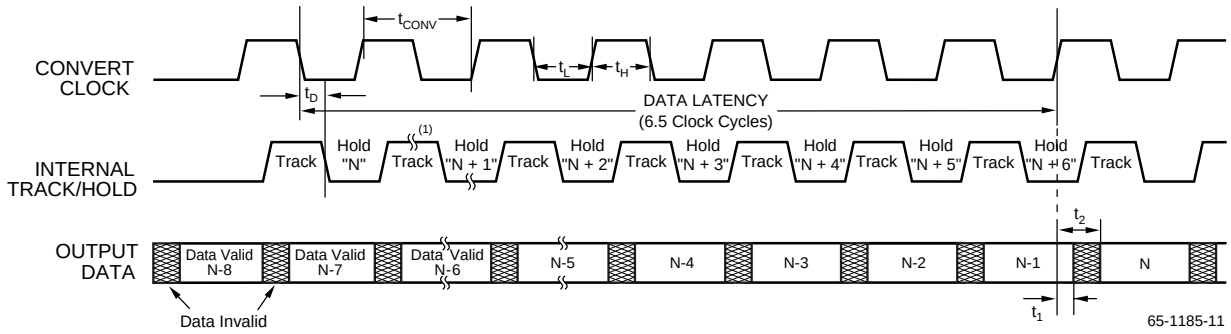
TRACK-MODE SMALL-SIGNAL INPUT BANDWIDTH



OUTPUT NOISE HISTOGRAM (NO SIGNAL)

65-1185-10

Timing Diagram



Symbol	Description	Min	Typ	Max	Units
t_{CONV}	Convert Clock Period	25		100µs	ns
t_L	Clock Pulse Low	12	12.5		ns
t_H	Clock Pulse High	12(2)	12.5		ns
t_D	Aperture Delay		2		ns
t_1	Data Hold Time, C_L = 0pF	3.9			ns
t_2	New Data Delay Time, C_L = 15pF max			12.5	ns

Notes:

1. "≬" indicates the portion of the waveform that will stretch out at slower sample rates.
2. t_H must be 13ns minimum if no missing codes is desired only for the conditions of $t_{CONV} \leq 28ns$ and $f_{IN} < 2MHz$. Refer to the Clock Requirements for a possible clock skew circuit for this condition.

Applications Discussion

Driving the TMC1185

The TMC1185 has a differential input with a common-mode of +2.25V. For AC-coupled applications, the simplest way to create this differential input is to drive the primary winding of a transformer with a single-ended input. A differential output is created on the secondary if the center tap is tied to the common-mode voltage (CM) of +2.25V per Figure 5. This transformer-coupled input arrangement provides good high frequency AC performance. It is important to select a transformer that gives low distortion and does not exhibit core saturation at full scale voltage levels. Since the transformer does not appreciably load the ladder, there is no need to buffer the common-mode (CM) output in this instance. In general, it is advisable to keep the current draw from the CM output pin below 0.5µA to avoid nonlinearity in the internal reference ladder. A FET input operational amplifier such as the OPA130 can provide a buffered reference for driving external circuitry. The analog IN and $\overline{IN}$ inputs should be bypassed with 22pF capacitors to minimize track/hold glitches and to improve high input frequency performance.

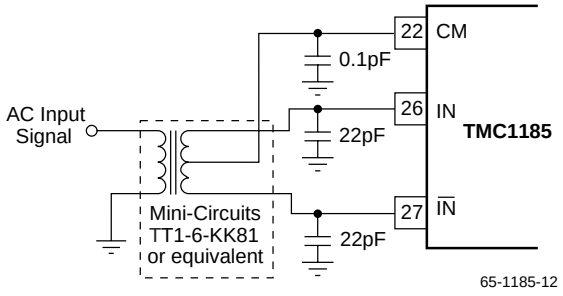


Figure 5. AC-Coupled Single-Ended to Differential Drive Circuit Using a Transformer

Figure 6 illustrates another possible low cost interface circuit which utilizes resistors and capacitors in place of a transformer. Depending on the signal bandwidth, the component values should be carefully selected in order to maintain the performance outlined in the data sheet. The input capacitors, C_{IN}, and the input resistors, R_{IN}, create a high-pass filter with the lower corner frequency at $f_C = 1/(2\pi R_{IN} C_{IN})$.

The corner frequency can be reduced by either increasing the value of R_{IN} or C_{IN}. If the circuit operates with a 50Ω or 75Ω impedance level, the resistors are fixed and only the value of the capacitor can be increased. Usually AC-coupling capacitors are electrolytic or tantalum capacitors with values of 1µF or higher. It should be noted that these large capacitors become inductive with increased input frequency, which could lead to signal amplitude errors or oscillation. To maintain a low AC-coupling impedance throughout the signal band, a small value (e.g. 1µF) ceramic capacitor could be added in parallel with the polarized capacitor.

Capacitors C_{SH1} and C_{SH2} are used to minimize current glitches resulting from the switching in the input track-and-hold stage and to improve signal-to-noise performance.

These capacitors can also be used to establish a low-pass filter and effectively reduce the noise bandwidth. In order to create a real pole, resistors R_{SER1} and R_{SER2} were added in series with each input. The cut-off frequency of the filter is determined by $f_C = 1/(2\pi R_{SER} \bullet (C_{SH} + C_{ADC}))$ where R_{SER} is the resistor in series with the input, C_{SH} is the external capacitor from the input to ground, and C_{ADC} is the internal input capacitance of the A/D converter (typically 4pF).

Resistors R_1 and R_2 are used to derive the necessary common mode voltage from the buffered top and bottom references. The total load of the resistor string should be selected so that the current does not exceed 1mA. Although the circuit in Figure 6 uses two resistors of equal value so that the common mode voltage is centered between the top

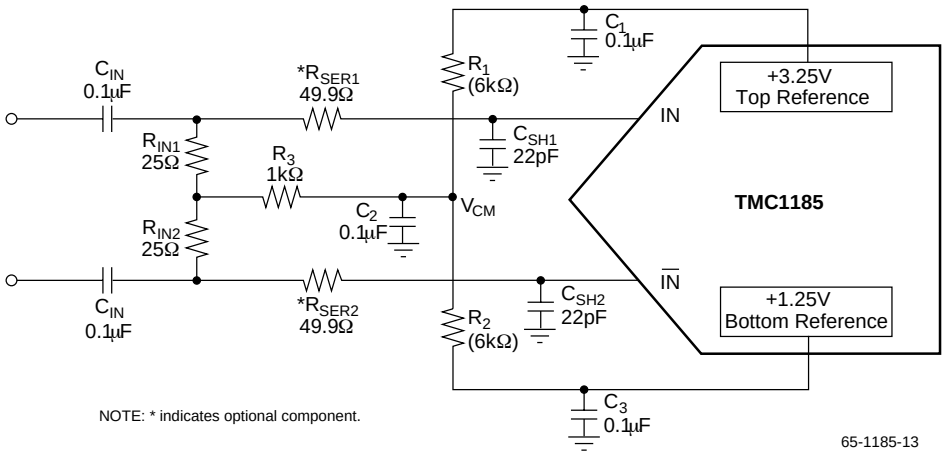


Figure 6. AC-Coupled Differential Input Circuit

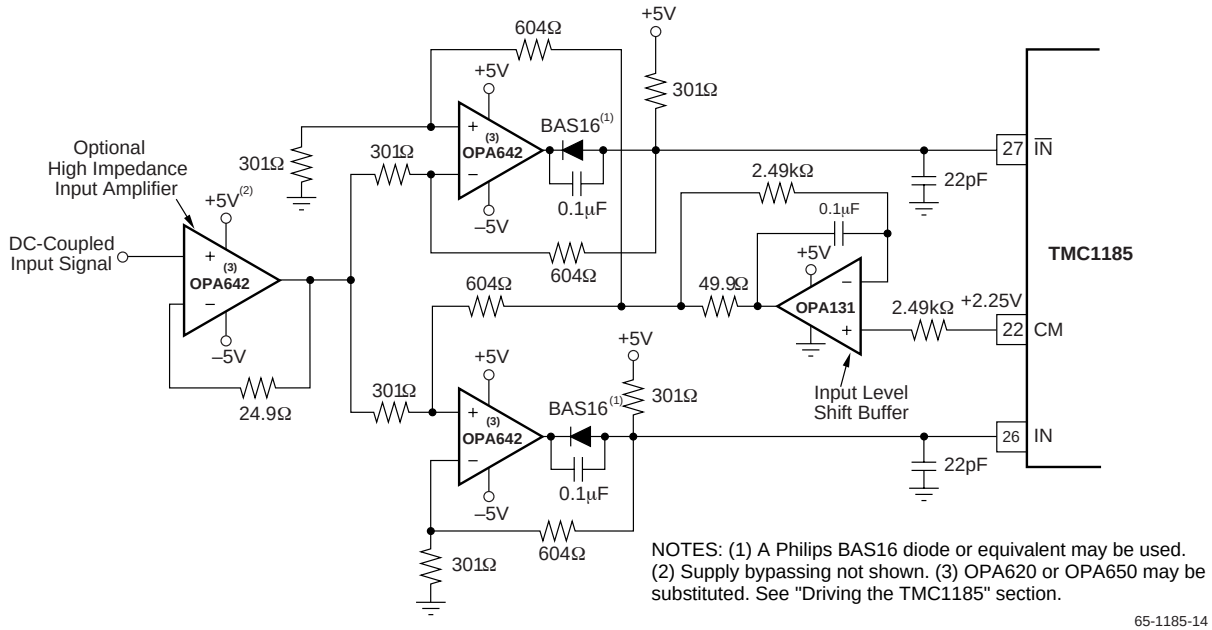
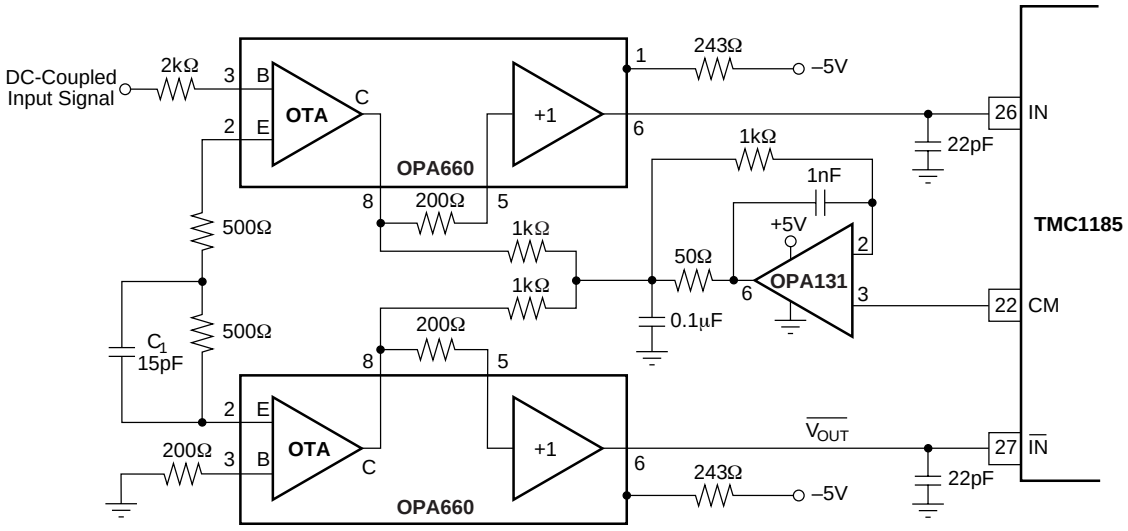


Figure 7. A Low Distortion DC-Coupled, Single-Ended to Differential Input Driver Circuit



NOTE: Power supplies and bypassing not shown. The measured SNR performance with 12.5MHz input signal is 57dB with this driver circuit.

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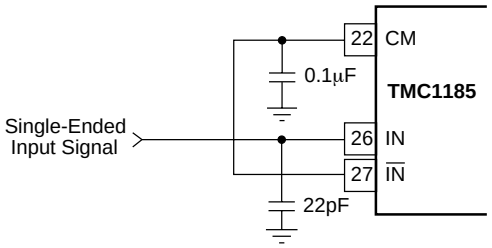
Figure 8. A Wideband DC-Coupled, Single-Ended to Differential Input Driver Circuit

and bottom reference (+2.25V), it is not necessary to do so. In all cases the center point, V_{CM} , should be bypassed to ground in order to provide a low impedance AC ground.

If the signal needs to be DC coupled to the input of the TMC1185, an operational amplifier input circuit is required. In the differential input mode, any single-ended signal must be modified to create a differential signal. This can be accomplished by using two operational amplifiers, one in the noninverting mode for the input and the other amplifier in the inverting mode for the complementary input. The low distortion circuit in Figure 7 will provide the necessary input shifting required for signals centered around ground. It also employs a diode for output level shifting to guarantee a low distortion +3.25V output swing. Another DC-coupled circuit is shown in Figure 8. Other amplifiers can be used in place of the OPA642s if the lowest distortion is not necessary. If output level shifting circuits are not used, care must be taken to select operational amplifiers that give the necessary performance when swinging to +3.25V with a ±5V supply operational amplifier. The OPA620 and OPA621, or the lower power OPA650 or OPA651 can be used in place of the OPA642s in Figure 7. In that configuration, the OPA650 and OPA651 will typically swing to within 100mV of positive full scale. If the OPA621 or OPA651 is used, the input buffer must be configured in a gain of 2.

The TMC1185 can also be configured with a single-ended input full scale range of +0.25V to +4.25V by tying the complementary input to the common-mode reference voltage as shown in Figure 9. This configuration will result in increased even-order harmonics, especially at higher input frequencies. However, this tradeoff may be quite acceptable for time-domain applications. The driving amplifier must give adequate performance with a +0.25V to +4.25V output swing in this case.



Full Scale = +0.25V to +4.25V with internal references.

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Figure 9. Single-Ended Input Connection

External References and Adjustment of Fullscale Range

The internal reference buffers are limited to approximately 1mA of output current. As a result, these internal +1.25V and +3.25V references may be overridden by external references that have at least 25mA of output drive capability. In this instance, the common-mode voltage will be set halfway between the two references. This feature can be used to adjust the gain error, improve gain drift, or to change the full scale input range of the TMC1185. Changing the full scale range to a lower value has the benefit of easing the swing requirements of external input amplifiers. The external references can vary as long as the value of the external top reference ($REFT_{EXT}$) is less than or equal to +3.4V and the value of the external bottom reference ($REFB_{EXT}$) is greater than or equal to +1.1V and the difference between the external references are greater than or equal to 800mV.

For the differential configuration, the full scale input range will be set to the external reference values that are selected. For the single-ended mode, the input range is 2 • ($REFT_{EXT}$ – $REFB_{EXT}$), with the common-mode being centered at ($REFT_{EXT}$ + $REFB_{EXT}$)/2. Refer to the typical performance curves for expected performance vs. full scale input range.

The circuit in Figure 10 works completely on a single +5V supply. As a reference element, it uses the micro-power reference REF1004-2.5, which is set to a quiescent current of 0.1mA. Amplifier A_2 is configured as a follower to buffer the +1.25V generated from the resistor divider. To provide the necessary current drive, a pull-down resistor, R_P is added.

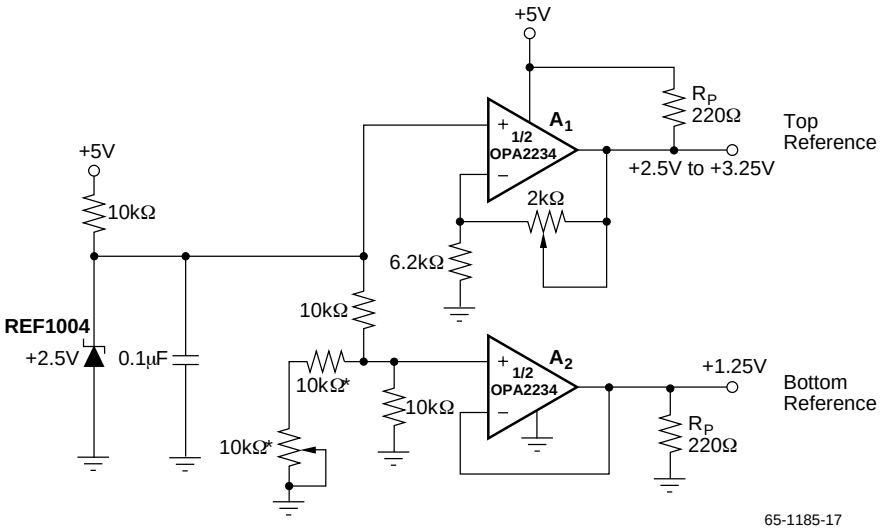
Amplifier A_1 is configured as an adjustable gain stage, with a range of approximately 1 to 1.32. The pull-up resistor again relieves the op amp from providing the full current drive. The value of the pull-up/down resistors is not critical and can be varied to optimize power consumption. The need for pull-up/down resistors depends only on the drive capability of the selected drive amplifier and thus can be omitted.

PC Board Layout and Bypassing

A well-designed, clean PC board layout will assure proper operation and clean spectral response. Proper grounding and bypassing, short lead lengths, and the use of ground planes are particularly important for high frequency circuits. Multilayer PC boards are recommended for best performance but if carefully designed, a two-sided PC board with large, heavy ground planes can give excellent results. It is recommended that the analog and digital ground pins of the TMC1185 be connected directly to the analog ground plane. In our experience, this gives the most consistent results. The A/D power supply commons should be tied together at the analog ground plane. Power supplies should be bypassed with 0.1 μF ceramic capacitors as close to the pin as possible.

Dynamic Performance Testing

The TMC1185 is a high performance converter and careful attention to test techniques is necessary to achieve accurate results. Highly accurate phase-locked signal sources allow high resolution FFT measurements to be made without using data windowing functions. A low jitter signal generator such as the HP8644A for the test signal, phase-locked with a low jitter HP8022A pulse generator for the A/D clock, gives excellent results. Low pass filtering (or bandpass filtering) of test signals is absolutely necessary to test the low distortion of the TMC1185. Using a signal amplitude slightly lower than full scale will allow a small amount of “headroom” so that noise or DC offset voltage will not overrange the A/D and cause clipping on signal peaks.



NOTE: (*) Use parts alternatively for adjustment capability.

Figure 10. Optional External Reference to Set the Full-Scale Range Utilizing a Dual, Single-Supply Op Amp

Dynamic Performance Definitions

1. Signal-to-Noise-and-Distortion Ratio (SINAD):

$$10\log\frac{\text{Sinewave Signal Power}}{\text{Noise + Harmonic Power (first 15 harmonics)}}$$

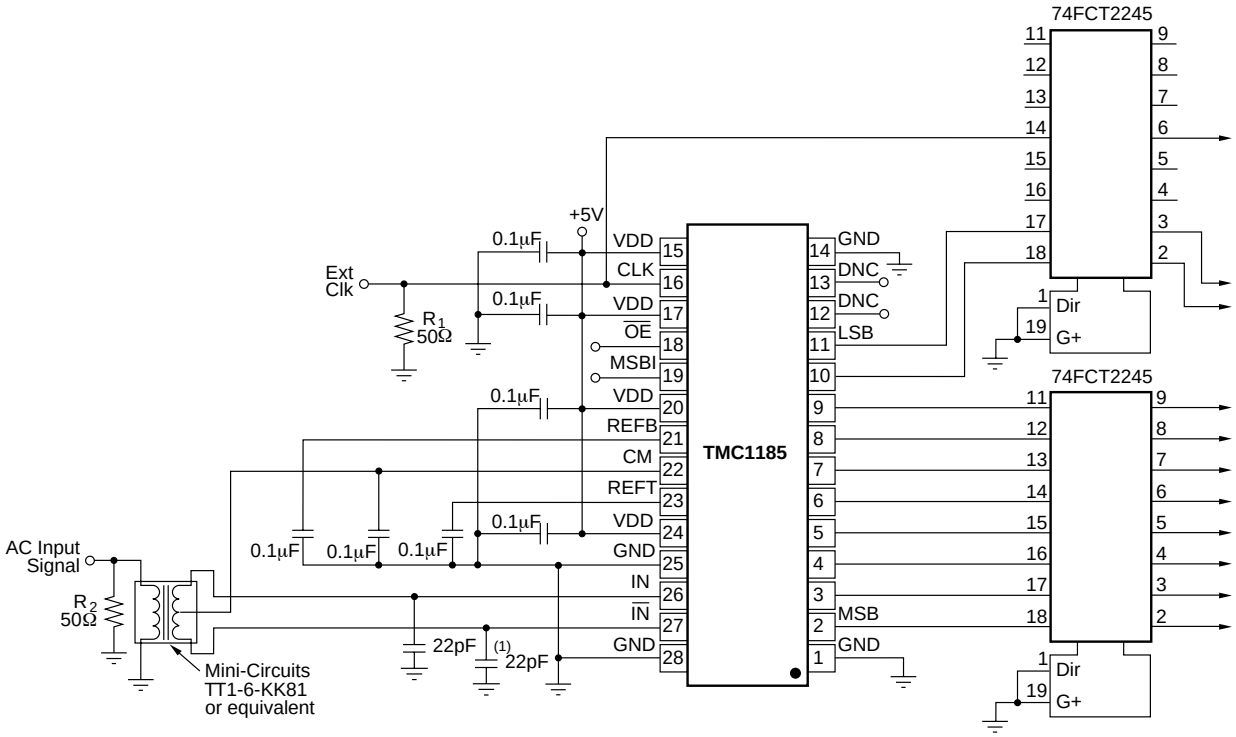
2. Signal-to-Noise Ratio (SNR):

$$10\log\frac{\text{Sinewave Signal Power}}{\text{NoisePower}}$$

3. Intermodulation Distortion (IMD):

$$10\log\frac{\text{Highest IMD Product Power (to 5th-order)}}{\text{Sinewave Signal Power}}$$

IMD is referenced to the larger of the test signals f_1 or f_2. Five "bins" either side of peak are used for calculation of fundamental and harmonic power. The "0" frequency bin (DC) is not included in these calculations as it is of little importance in dynamic signal processing applications.



NOTE: (1) All capacitors should be located as close to the pins as the manufacturing process will allow. Ceramic X7R surface-mount capacitors or equivalent are recommended.

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Figure 11. TMC1185 Interface Schematic with AC-Coupling and External Buffers

Video Capture

The TMC1185 should be used for digitizing video data in high quality, professional video designs prior to feeding data into Fairchild's digital mixers (TMC2080, TMC2081) or TMC22x5y decoder family. Fairchild offers an analog video front end design, both schematics and artwork, to assist designers in designing a high performance video system. For more information contact your Fairchild sales representative or e-mail applications@lj.sd.ray.com.

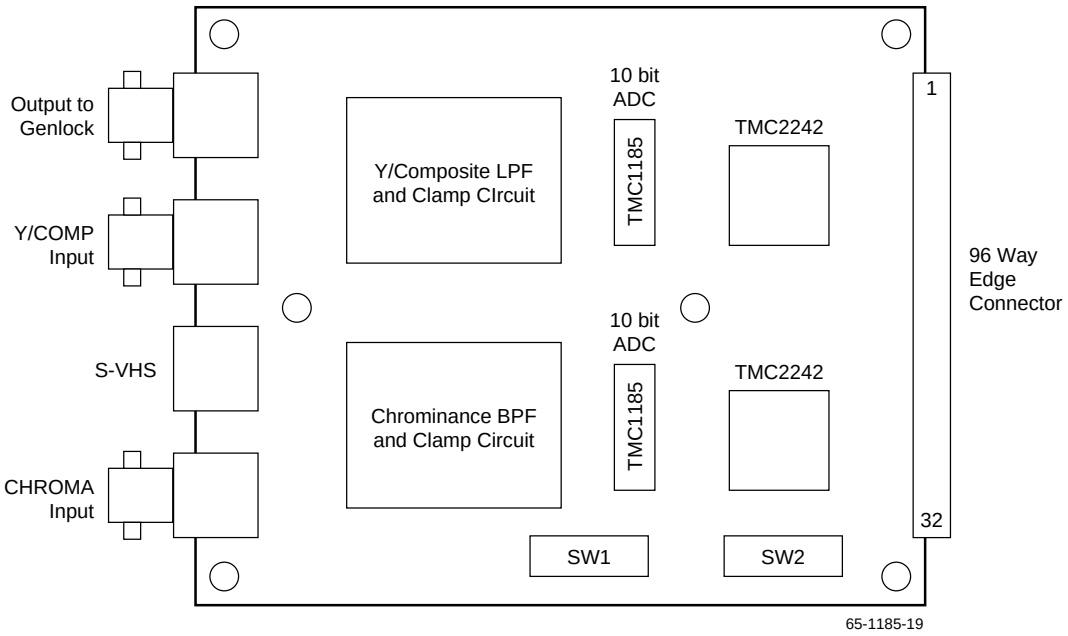


Figure 12. 10-Bit Video Capture Reference Design

Notes:

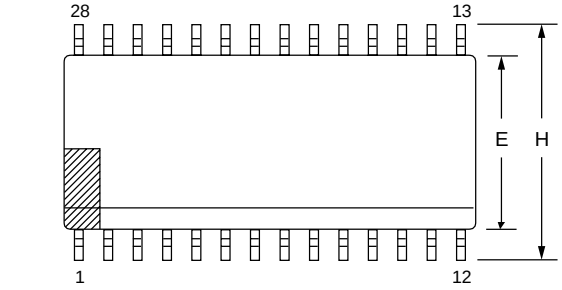
Mechanical Dimensions

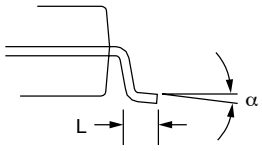
28 Lead SOIC Package

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.0926	.1043	2.35	2.65	
A1	.004	.0118	0.10	0.30	
B	.013	.020	0.33	0.51	7
C	.0091	.0125	0.23	0.32	
D	.6969	.7125	17.70	18.10	2
E	.2914	.2992	7.40	7.60	3
e	.050 BSC		1.27 BSC		
H	.398	.419	10.11	10.65	
h	.010	.0295	0.25	0.75	4
L	.020	.040	0.508	1.02	5
N	28		28		6
α	0°	8°	0°	8°	

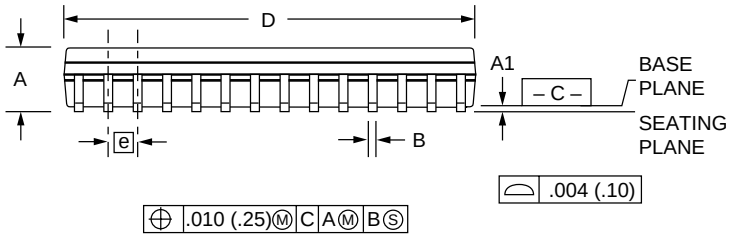
Notes:

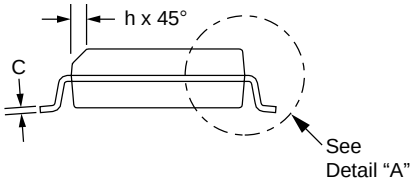
1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions and gate burrs shall not exceed .006 in. (0.15mm) per side.
3. Dimension E does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed .010 in. (0.25mm) per side.
4. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
5. L is the length of terminal for soldering to a substrate.
6. N is the number of terminal positions.
7. The lead width B, as measured .014 in. (0.36 mm) or greater above the seating plane, shall not exceed a maximum value of 0.24 in. (0.61 mm).
8. Lead to lead coplanarity shall be less than .004 in. (0.10 mm) from seating plane.





Detail “A”





Ordering Information

Product Number	Package
TMC1185NDC40	28 pin SOIC