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12-Bit Quad Voltage Output DIGITAL-TO-ANALOG CONVERTER

FEATURES

- LOW POWER: 250mW max
- SINGLE SUPPLY OUTPUT RANGE: +10V
- DUAL SUPPLY OUTPUT RANGE: $\pm 10V$
- SETTLING TIME: 10 μ s to 0.012%
- 12-BIT LINEARITY AND MONOTONICITY: -40°C to +85°C
- RESET TO MID-SCALE (DAC7724) OR ZERO-SCALE (DAC7725)
- DATA READBACK
- DOUBLE-BUFFERED DATA INPUTS

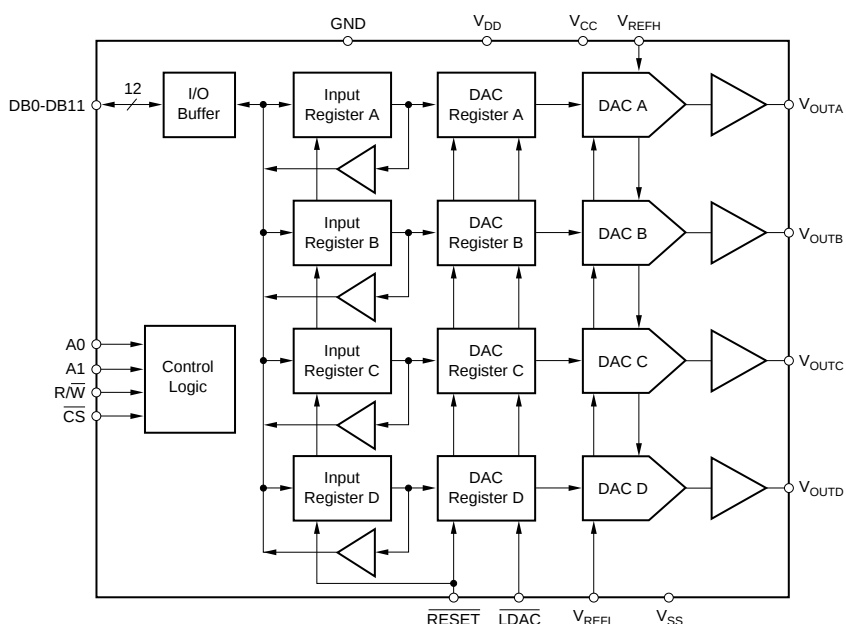
APPLICATIONS

- PROCESS CONTROL
- CLOSED-LOOP SERVO-CONTROL
- MOTOR CONTROL
- DATA ACQUISITION SYSTEMS

DESCRIPTION

The DAC7724 and DAC7725 are 12-bit quad voltage output digital-to-analog converters with guaranteed 12-bit monotonic performance over the specified temperature range. They accept 12-bit parallel input data, have double-buffered DAC input logic (allowing simultaneous update of all DACs), and provide a readback mode of the internal input registers. An asynchronous reset clears all registers to a mid-scale code of 800_H (DAC7724) or to a zero-scale of 000_H (DAC7725). The DAC7724 and DAC7725 can operate from a single +15V supply, or from +15V and -15V supplies.

Low power and small size per DAC make the DAC7724 and DAC7725 ideal for automatic test equipment, DAC-per-pin programmers, data acquisition systems, and closed-loop servo-control. The DAC7724 and DAC7725 are available in a PLCC-28 or a SO-28 package, and offer guaranteed specifications over the -40°C to $+85^{\circ}\text{C}$ temperature range.



International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111
Twx: 910-952-1111 • Internet: <http://www.burr-brown.com/> • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

SPECIFICATION (DUAL SUPPLY)

At $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = +15\text{V}$, $V_{DD} = +5\text{V}$, $V_{SS} = -15\text{V}$, $V_{REFH} = +10\text{V}$, $V_{REFL} = -10\text{V}$, unless otherwise noted.

PARAMETER	CONDITIONS	DAC7724N, U DAC7725N, U			DAC7724NB, UB DAC7725NB, UB			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
ACCURACY								
Linearity Error	T_{MIN} to T_{MAX} Code = 000 _H	12	1	± 2	*	*	± 1	LSB ⁽¹⁾
Linearity Matching ⁽²⁾				± 2			± 1	LSB
Differential Linearity Error				± 1			± 1	LSB
Monotonicity								Bits
Zero-Scale Error	Code = FFF _H			± 2		*	*	LSB
Zero-Scale Drift								ppm/ $^{\circ}\text{C}$
Zero-Scale Matching ⁽²⁾				± 2			± 1	LSB
Full-Scale Error	At Full Scale		10	± 2		*	*	LSB
Full-Scale Matching ⁽²⁾				± 2			± 1	LSB
Power Supply Sensitivity								ppm/V
ANALOG OUTPUT								
Voltage Output ⁽³⁾	No Oscillation	V_{REFL} ± 5	500 ± 20 Indefinite	V_{REFH}	*		*	V
Output Current					*		*	mA
Load Capacitance						*		pF
Short-Circuit Current						*		mA
Short-Circuit Duration	To V_{SS} , V_{CC} , or GND					*		
REFERENCE INPUT								
V_{REFH} Input Range		$V_{\text{REFL}} + 1.25$ -10 -0.5 -3.5		+10	*		*	V
V_{REFL} Input Range				$V_{\text{REFH}} - 1.25$	*		*	V
Ref High Input Current				3.0	*		*	mA
Ref Low Input Current				0	*		*	mA
DYNAMIC PERFORMANCE								
Settling Time	To $\pm 0.012\%$, 20V Output Step		8	10		*	*	μs
Channel-to-Channel Crosstalk			0.25			*		LSB
Digital Feedthrough	$f = 10\text{kHz}$		2				*	nV-s
Output Noise Voltage			65			*		nV/ $\sqrt{\text{Hz}}$
DIGITAL INPUT/OUTPUT								
Logic Family	$I_{\text{IH}} \leq \pm 10\mu\text{A}$ $I_{\text{IL}} \leq \pm 10\mu\text{A}$ $I_{\text{OH}} = -0.8\text{mA}$ $I_{\text{OL}} = 1.6\text{mA}$	TTL-Compatible CMOS			*			
Logic Levels								
V_{IH}		2.4		$V_{\text{DD}} + 0.3$	*		*	V
V_{IL}		-0.3		0.8	*		*	V
V_{OH}		3.6		V_{DD}	*		*	V
V_{OL}		0.0		0.4	*		*	V
Data Format		Straight Binary				*		
POWER SUPPLY REQUIREMENTS								
V_{DD}		+4.75	50 6 -8 180	+5.25	*		*	V
V_{CC}		+14.25		+15.75	*		*	V
V_{SS}		-14.25		-15.75	*		*	V
I_{DD}						*	*	μA
I_{CC}				8.5		*	*	mA
I_{SS}					*	*	*	mA
Power Dissipation				250		*	*	mW
TEMPERATURE RANGE								
Specified Performance		-40		+85	*		*	$^{\circ}\text{C}$

NOTES: (1) LSB means Least Significant Bit, when V_{REFH} equals +10V and V_{REFL} equals -10V, then one LSB equals 4.88mV. (2) All DAC outputs will match within the specified error band. (3) Ideal output voltage, does not take into account zero or full-scale error.

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SPECIFICATION (SINGLE SUPPLY)

At $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = +15\text{V}$, $V_{DD} = +5\text{V}$, $V_{SS} = \text{GND}$, $V_{REFH} = +10\text{V}$, $V_{REFL} = 0\text{V}$, unless otherwise noted.

PARAMETER	CONDITIONS	DAC7724N, U DAC7725N, U			DAC7724NB, UB DAC7725NB, UB			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
ACCURACY								
Linearity Error ⁽¹⁾	T_{MIN} to T_{MAX} Code = 004 _H	12	2	± 2	*	*	± 1	LSB ⁽²⁾
Linearity Matching ⁽³⁾				± 2			± 1	LSB
Differential Linearity Error				± 1			± 1	LSB
Monotonicity								Bits
Zero-Scale Error				± 4			*	LSB
Zero-Scale Drift	Code = FFF _H			± 4		*	± 2	ppm/ $^{\circ}\text{C}$
Zero-Scale Matching ⁽³⁾				± 4			*	LSB
Full-Scale Error				± 4			*	LSB
Full-Scale Matching ⁽³⁾	At Full Scale		20	± 4		*	± 2	LSB
Power Supply Sensitivity								ppm/V
ANALOG OUTPUT								
Voltage Output ⁽⁴⁾	No Oscillation	V_{REFL} ± 5	500 ± 20 Indefinite	V_{REFH}	*		*	V
Output Current					*			mA
Load Capacitance						*		pF
Short-Circuit Current						*		mA
Short-Circuit Duration						*		
REFERENCE INPUT								
V_{REFH} Input Range		$V_{\text{REFL}} + 1.25$ 0 -0.3 -2.0		+10	*		*	V
V_{REFL} Input Range				$V_{\text{REFH}} - 1.25$	*		*	V
Ref High Input Current				1.5	*		*	mA
Ref Low Input Current				0	*		*	mA
DYNAMIC PERFORMANCE								
Settling Time ⁽⁵⁾	To $\pm 0.012\%$, 10V Output Step		8 0.25 2 65	10		*	*	μs
Channel-to-Channel Crosstalk								LSB
Digital Feedthrough								nV-s
Output Noise Voltage								nV/ $\sqrt{\text{Hz}}$
DIGITAL INPUT/OUTPUT								
Logic Family	$I_{\text{IH}} \leq \pm 10\mu\text{A}$ $I_{\text{IL}} \leq \pm 10\mu\text{A}$ $I_{\text{OH}} = -0.8\text{mA}$ $I_{\text{OL}} = 1.6\text{mA}$	TTL-Compatible CMOS			*			
Logic Levels								
V_{IH}		2.4		$V_{\text{DD}} + 0.3$	*		*	V
V_{IL}		-0.3		0.8	*		*	V
V_{OH}		3.6		V_{DD}	*		*	V
V_{OL}		0.0		0.4	*		*	V
Data Format		Straight Binary				*		
POWER SUPPLY REQUIREMENTS								
V_{DD}		+4.75 14.25	50 3.0 45	+5.25	*		*	V
V_{CC}				15.75	*		*	V
I_{DD}						*	*	μA
I_{CC}						*	*	mA
Power Dissipation						*	*	mW
TEMPERATURE RANGE								
Specified Performance		-40		+85	*		*	$^{\circ}\text{C}$

NOTES: (1) If $V_{\text{SS}} = 0\text{V}$, specification applies at code 004_H and above. (2) LSB means Least Significant Bit, when V_{REFH} equals +10V and V_{REFL} equals 0V, then one LSB equals 2.44mV. (3) All DAC outputs will match within the specified error band. (4) Ideal output voltage, does not take into account zero or full-scale error. (5) Full-scale positive 10V step and negative step from code FFF_H to 004_H.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

V_{CC} to V_{SS}	-0.3V to +32V
V_{CC} to GND	-0.3V to +16V
V_{SS} to GND	+0.3V to -16V
V_{DD} to GND	-0.3V to 6V
V_{REFH} to GND	-9V to +11V
V_{REFL} to GND ($V_{SS} = -15V$)	-11V to +9V
V_{REFL} to GND ($V_{SS} = 0V$)	-0.3V to +9V
V_{REFH} to V_{REFL}	-1V to +22V
Digital Input Voltage to GND	-0.3V to $V_{DD} + 0.3V$
Digital Output Voltage to GND	-0.3V to $V_{DD} + 0.3V$
Maximum Junction Temperature	+150°C
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10s)	+300°C

NOTE: (1) Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to absolute maximum conditions for extended periods may affect device reliability.



ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

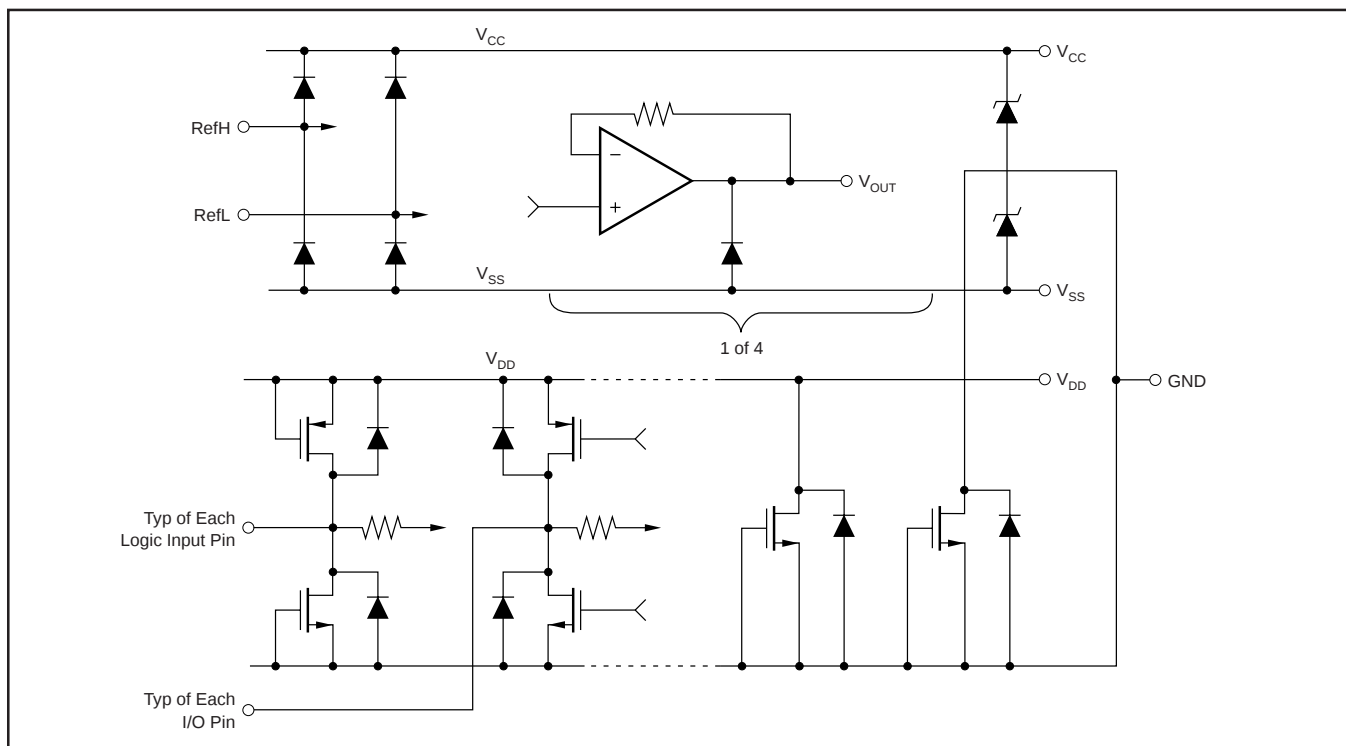
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

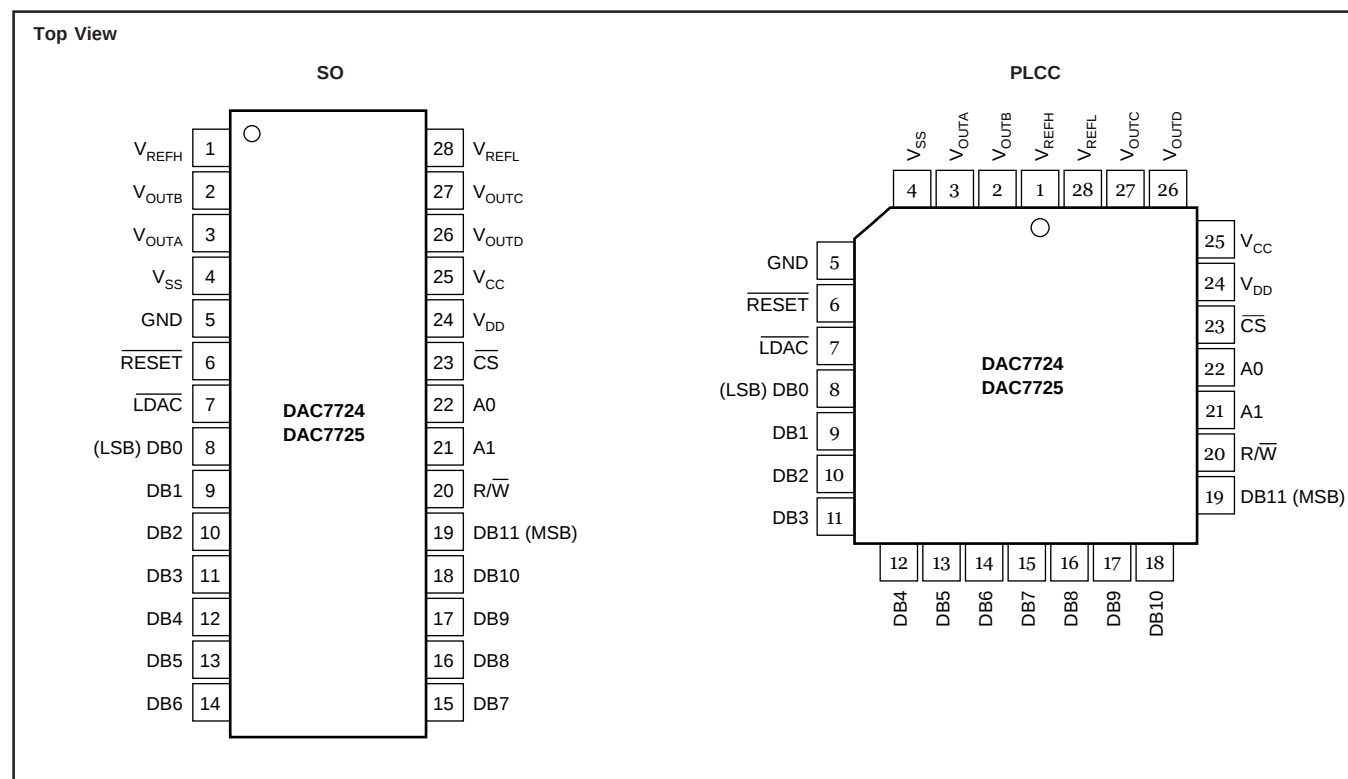
PRODUCT	MAXIMUM LINEARITY ERROR (LSB)	MAXIMUM DIFFERENTIAL NONLINEARITY ERROR (LSB)	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFICATION TEMPERATURE RANGE	ORDERING NUMBER ⁽¹⁾	TRANSPORT MEDIA
DAC7724N	±2	±1	PLCC-28	251	-40°C to +85°C	DAC7724N	Rails
"	"	"	"	"	"	DAC7724N/750	Tape and Reel
DAC7724NB	±1	±1	PLCC-28	251	-40°C to +85°C	DAC7724NB	Rails
"	"	"	"	"	"	DAC7724NB/750	Tape and Reel
DAC7724U	±2	±1	SO-28	217	-40°C to +85°C	DAC7724U	Rails
"	"	"	"	"	"	DAC7724U/1K	Tape and Reel
DAC7724UB	±1	±1	SO-28	217	-40°C to +85°C	DAC7724UB	Rails
"	"	"	"	"	"	DAC7724UB/1K	Tape and Reel
DAC7725N	±2	±1	PLCC-28	251	-40°C to +85°C	DAC7725N	Rails
"	"	"	"	"	"	DAC7725N/750	Tape and Reel
DAC7725NB	±1	±1	PLCC-28	251	-40°C to +85°C	DAC7725NB	Rails
"	"	"	"	"	"	DAC7725NB/750	Tape and Reel
DAC7725U	±2	±1	SO-28	217	-40°C to +85°C	DAC7725U	Rails
"	"	"	"	"	"	DAC7725U/1K	Tape and Reel
DAC7725UB	±1	±1	SO-28	217	-40°C to +85°C	DAC7725UB	Rails
"	"	"	"	"	"	DAC7725UB/1K	Tape and Reel

NOTE: (1) Models with a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /750 indicates 750 devices per reel). Ordering 750 pieces of "DAC7724/750" will get a single 750-piece Tape and Reel.

ESD PROTECTION CIRCUITS



PIN CONFIGURATIONS



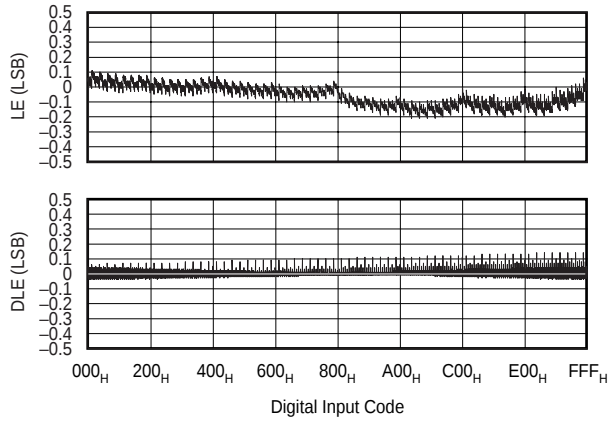
PIN DESCRIPTIONS

PIN	NAME	DESCRIPTION
1	V_{REFH}	Reference Input Voltage High. Sets maximum output voltage for all DACs.
2	V_{OUTB}	DAC B Voltage Output.
3	V_{OUTA}	DAC A Voltage Output.
4	V_{SS}	Negative Analog Supply Voltage, 0V or -15V.
5	GND	Ground.
6	$\overline{RESET}$	Asynchronous Reset Input. Sets DAC and input registers to either mid-scale (800 _H , DAC7724) or zero-scale (000 _H , DAC7725) when LOW.
7	$\overline{LDAC}$	Load DAC Input. All DAC Registers are transparent when LOW.
8	DB0	Data Bit 0. Least significant bit of 12-bit word.
9	DB1	Data Bit 1
10	DB2	Data Bit 2
11	DB3	Data Bit 3
12	DB4	Data Bit 4
13	DB5	Data Bit 5
14	DB6	Data Bit 6
15	DB7	Data Bit 7
16	DB8	Data Bit 8
17	DB9	Data Bit 9
18	DB10	Data Bit 10
19	DB11	Data Bit 11. Most significant bit of 12-bit word.
20	$R/\overline{W}$	Read/Write Control Input (read = HIGH, write = LOW).
21	A1	Register/DAC Select (C or D = HIGH, A or B = LOW).
22	A0	Register/DAC Select (B or D = HIGH, A or C = LOW).
23	$\overline{CS}$	Chip Select Input.
24	V_{DD}	Positive Digital Supply, +5V.
25	V_{CC}	Positive Analog Supply Voltage, +15V nominal.
26	V_{OUTD}	DAC D Voltage Output.
27	V_{OUTC}	DAC C Voltage Output.
28	V_{REFL}	Reference Input Voltage Low. Sets minimum output voltage for all DACs.

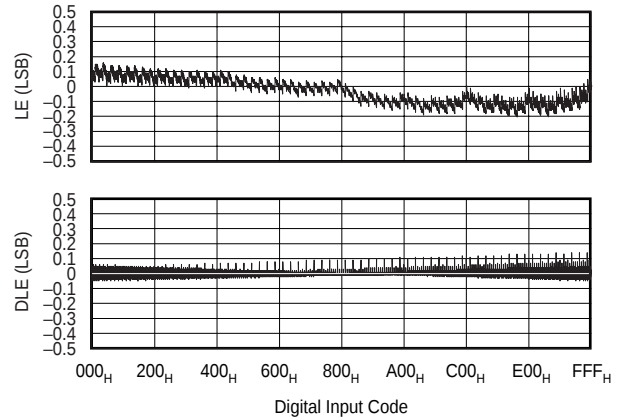
TYPICAL PERFORMANCE CURVES: $V_{SS} = 0V$

At $T_A = +25^\circ C$, $V_{CC} = +15V$, $V_{DD} = +5V$, $V_{SS} = 0V$, $V_{REFH} = +10V$, $V_{REFL} = 0V$, representative unit, unless otherwise specified.

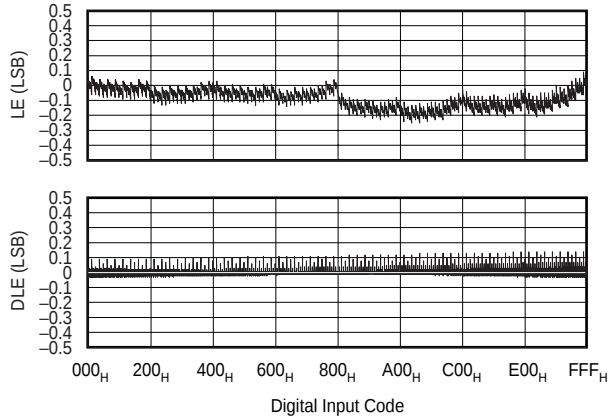
LINEARITY ERROR AND
DIFFERENTIAL LINEARITY ERROR vs CODE
Single Channel 25°C
(Typical of Each Output Channel)



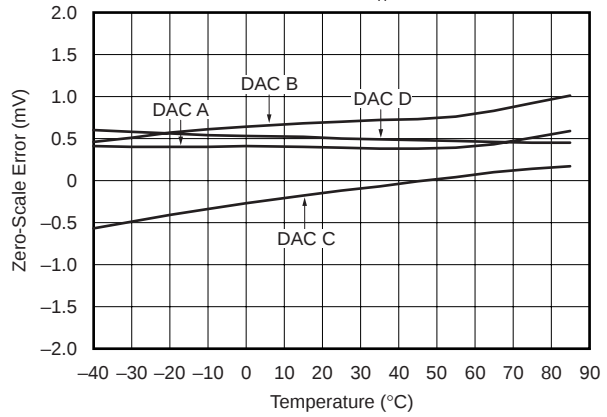
LINEARITY ERROR AND
DIFFERENTIAL LINEARITY ERROR vs CODE
Single Channel 85°C
(Typical of Each Output Channel)



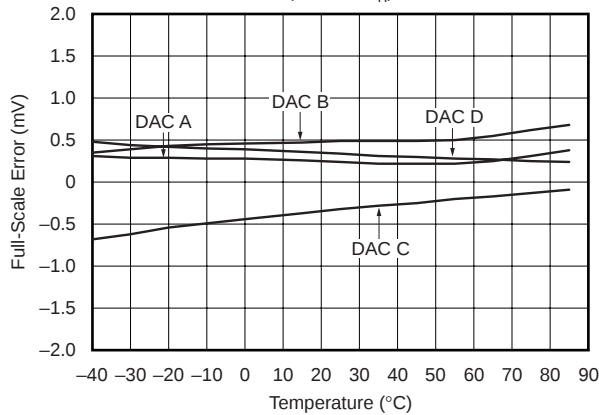
LINEARITY ERROR AND
DIFFERENTIAL LINEARITY ERROR vs CODE
Single Channel -40°C
(Typical of Each Output Channel)



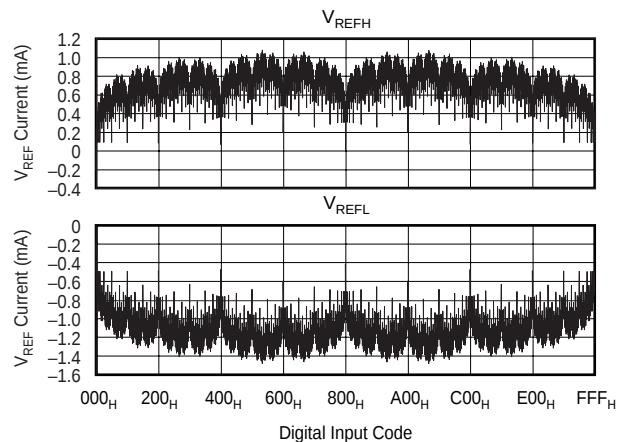
ZERO-SCALE ERROR vs TEMPERATURE
(Code 004_H)



FULL-SCALE ERROR vs TEMPERATURE
(Code FFF_H)

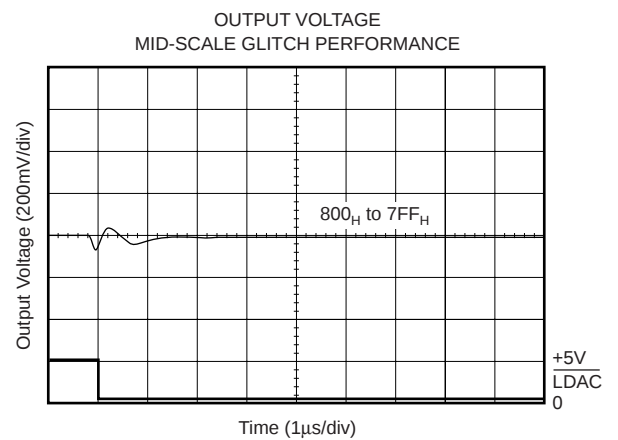
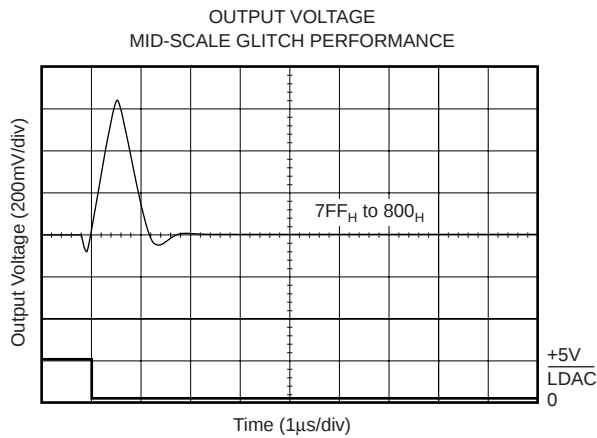
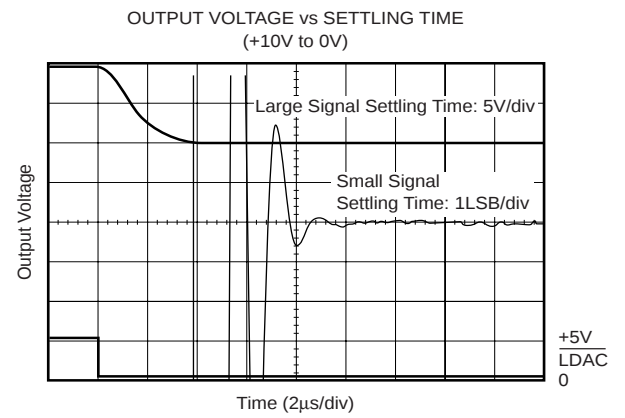
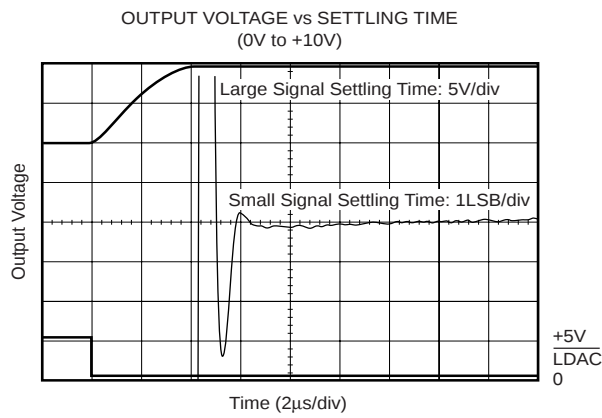
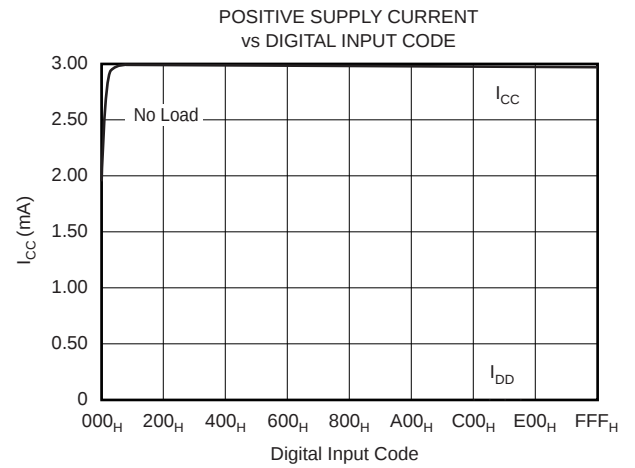
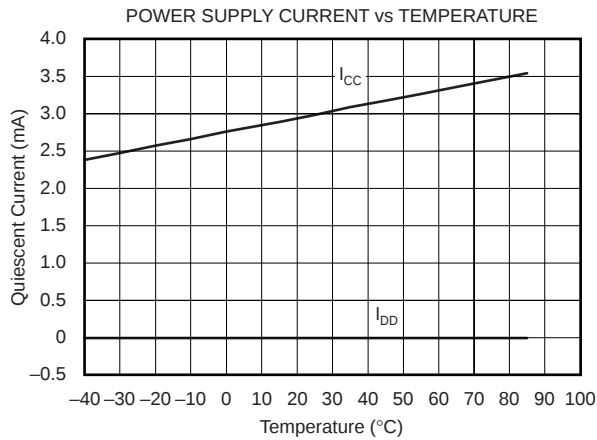


CURRENT vs CODE
All DACs Sent to Indicated Code



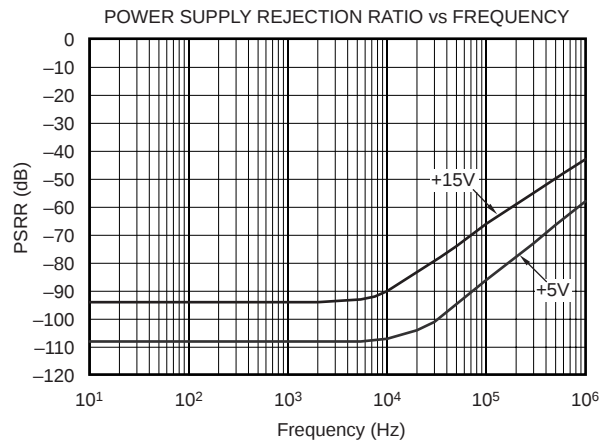
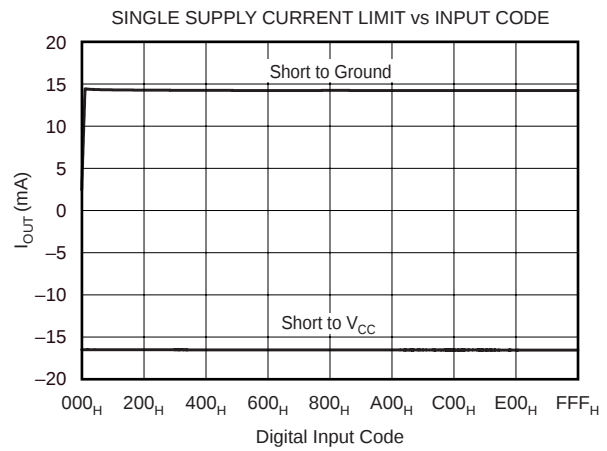
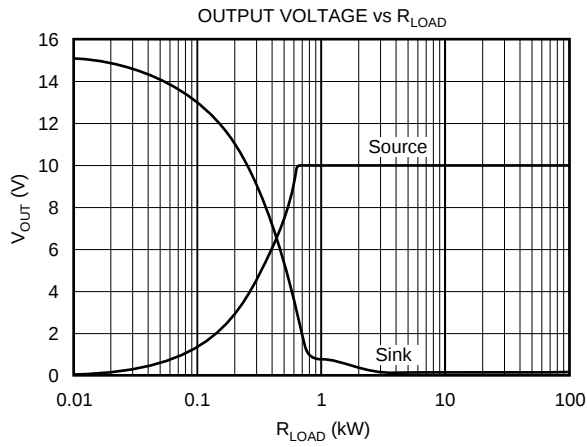
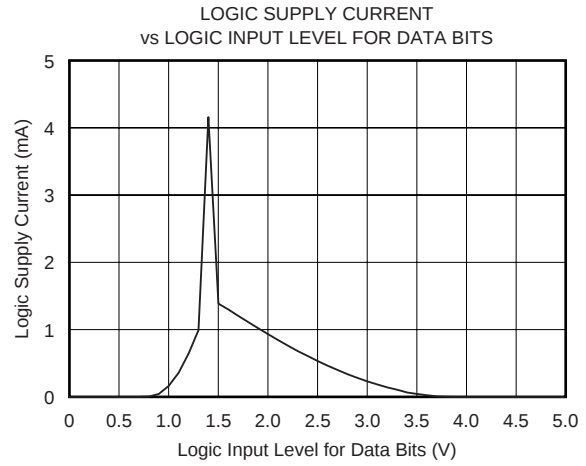
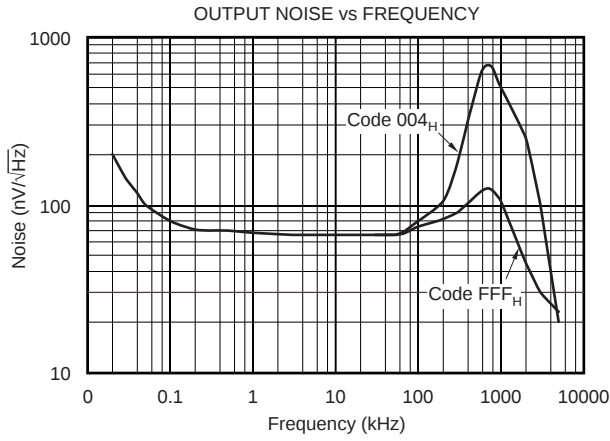
TYPICAL PERFORMANCE CURVES: $V_{SS} = 0V$ (Cont.)

At $T_A = +25^\circ C$, $V_{CC} = +15V$, $V_{DD} = +5V$, $V_{SS} = 0V$, $V_{REFH} = +10V$, $V_{REFL} = 0V$, representative unit, unless otherwise specified.



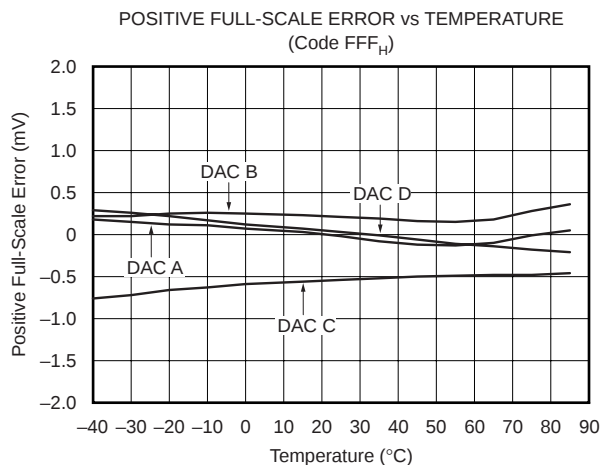
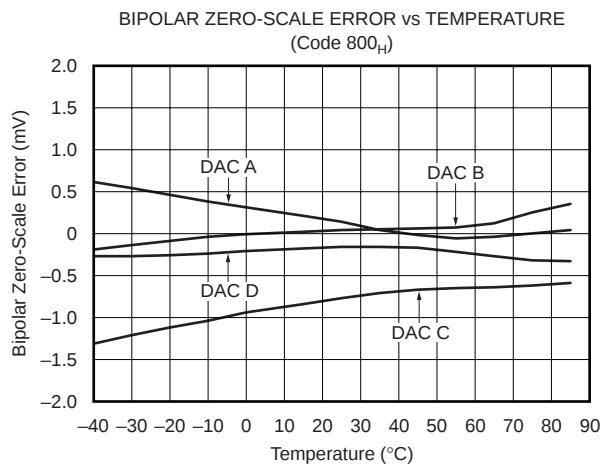
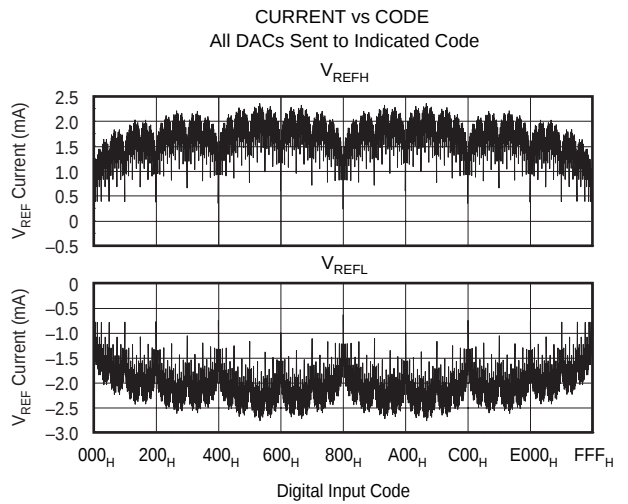
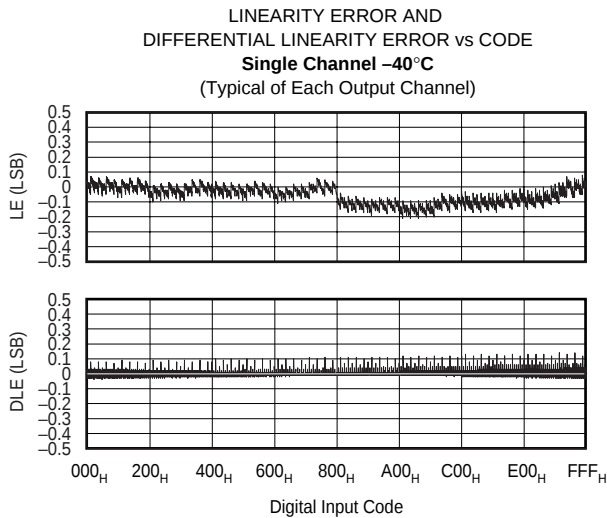
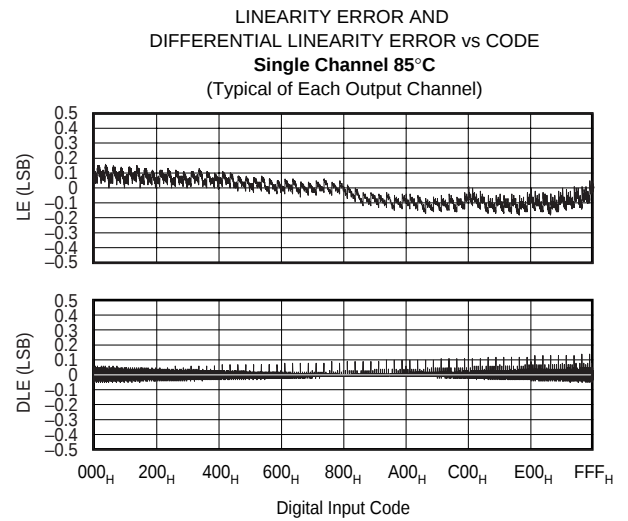
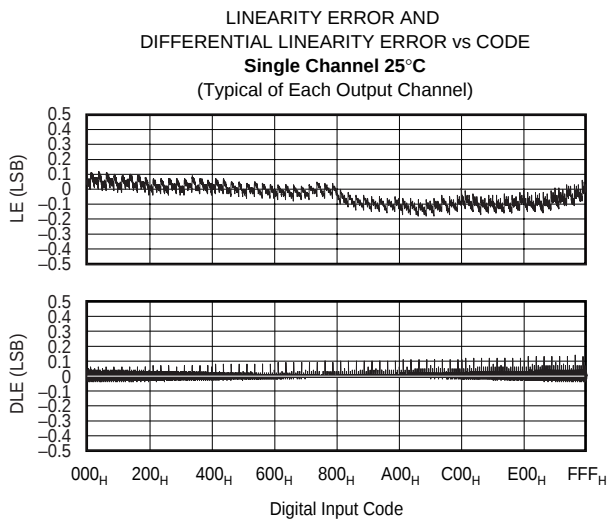
TYPICAL PERFORMANCE CURVES: $V_{SS} = 0V$ (Cont.)

At $T_A = +25^\circ C$, $V_{CC} = +15V$, $V_{DD} = +5V$, $V_{SS} = 0V$, $V_{REFH} = +10V$, $V_{REFL} = 0V$, representative unit, unless otherwise specified.



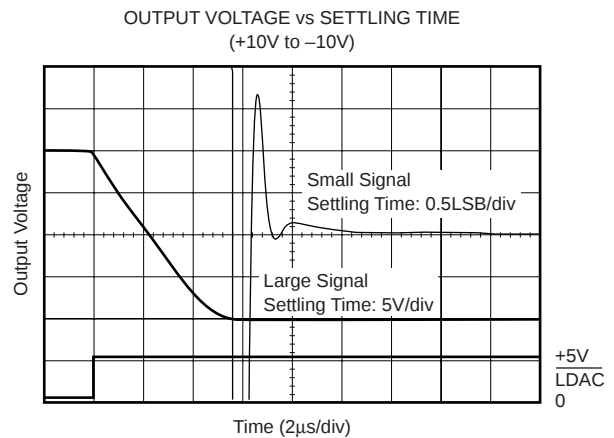
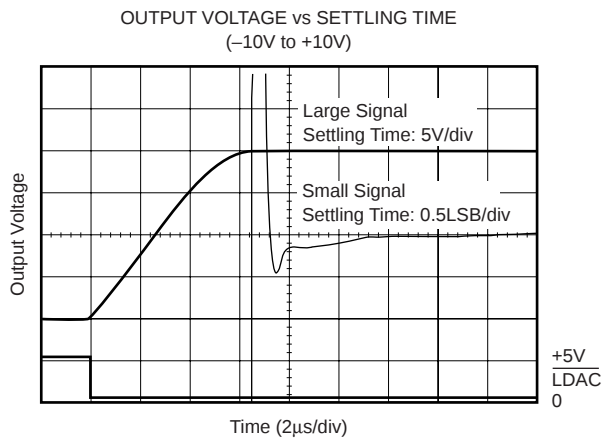
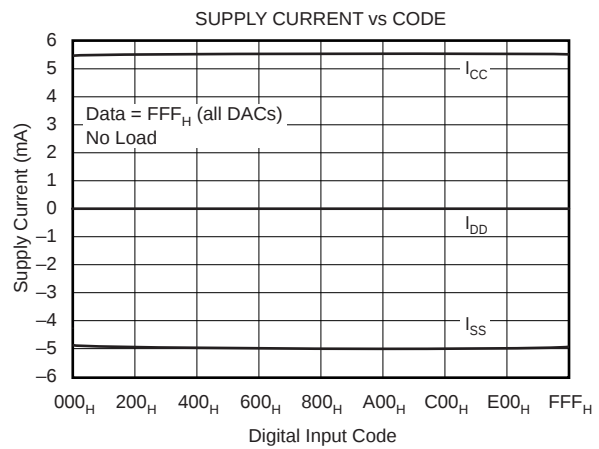
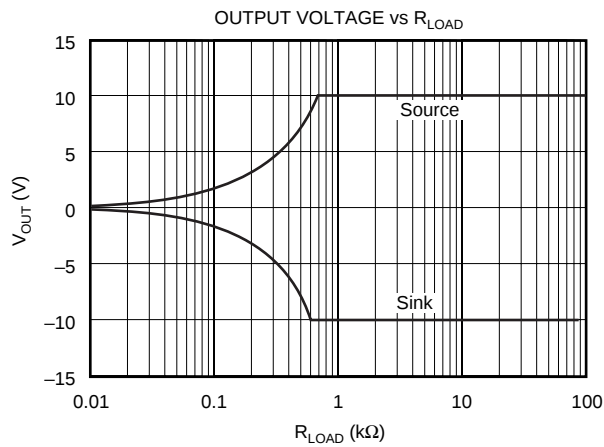
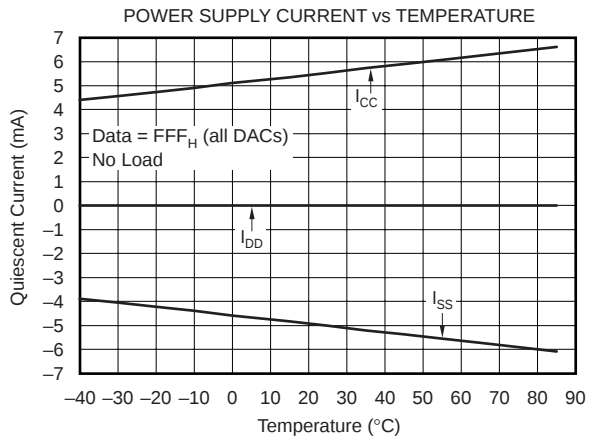
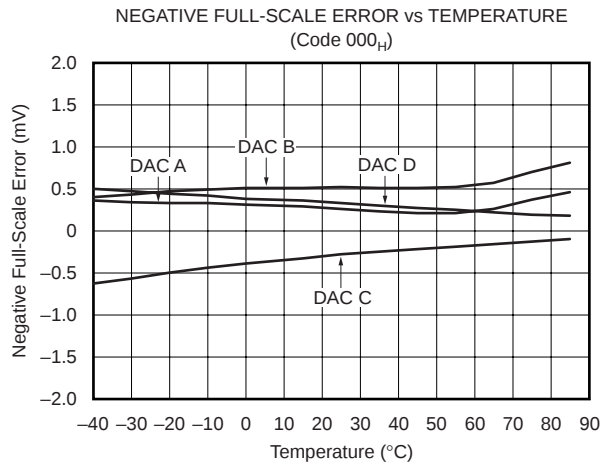
TYPICAL PERFORMANCE CURVES: $V_{SS} = -15V$

At $T_A = +25^\circ C$, $V_{CC} = +15V$, $V_{DD} = +5V$, $V_{SS} = -15V$, $V_{REFH} = +10V$, $V_{REFL} = -10V$, representative unit, unless otherwise specified.



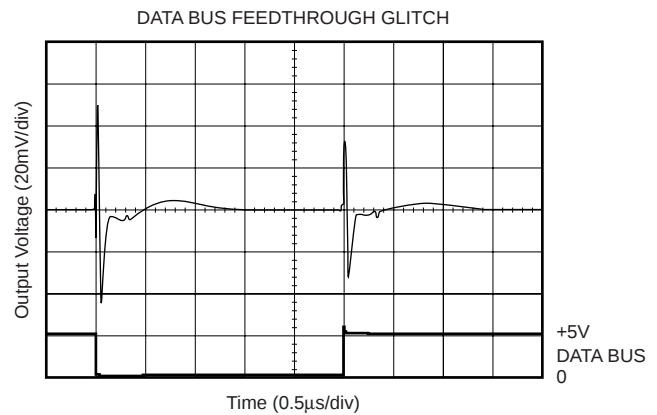
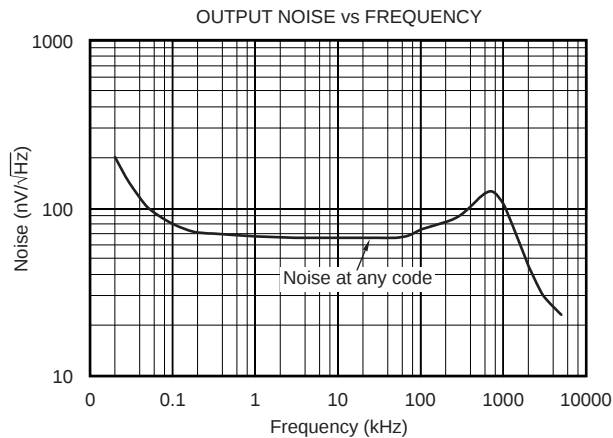
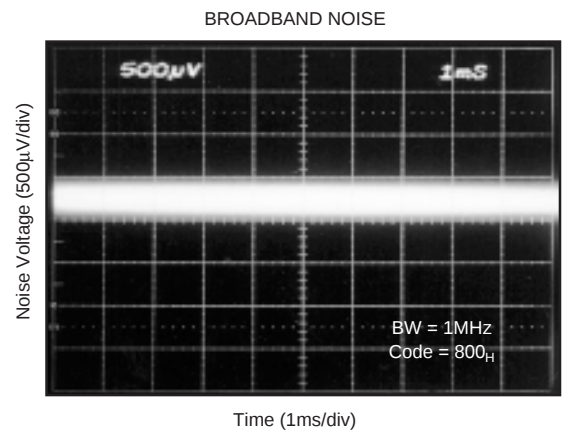
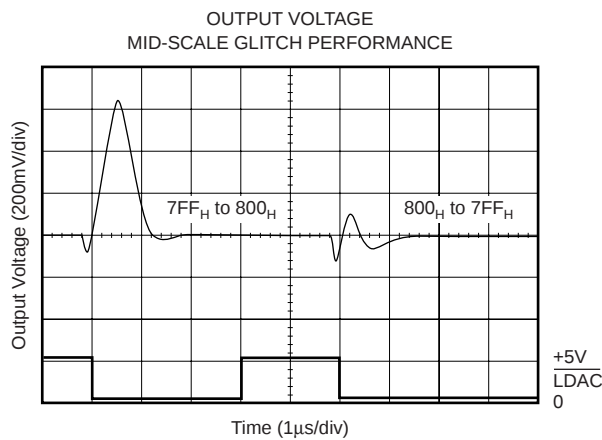
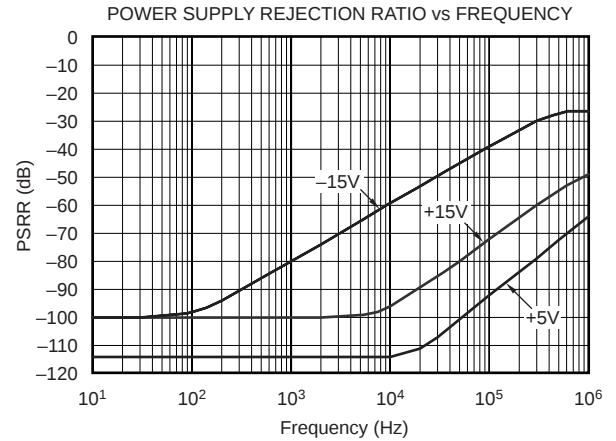
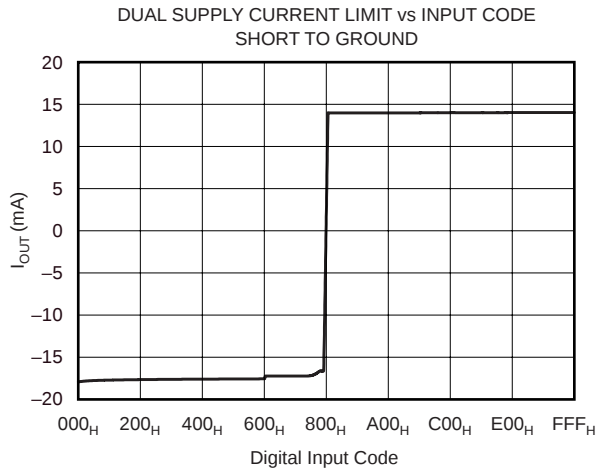
TYPICAL PERFORMANCE CURVES: $V_{SS} = -15V$ (Cont.)

At $T_A = +25^\circ C$, $V_{CC} = +15V$, $V_{DD} = +5V$, $V_{SS} = -15V$, $V_{REFH} = +10V$, $V_{REFL} = -10V$, representative unit, unless otherwise specified.



TYPICAL PERFORMANCE CURVES: $V_{SS} = -15V$ (Cont.)

At $T_A = +25^\circ C$, $V_{CC} = +15V$, $V_{DD} = +5V$, $V_{SS} = -15V$, $V_{REFH} = +10V$, $V_{REFL} = -10V$, representative unit, unless otherwise specified.



THEORY OF OPERATION

The DAC7724 and DAC7725 are quad voltage output, 12-bit digital-to-analog converters (DACs). The architecture is a classic R-2R ladder configuration followed by an operational amplifier that serves as a buffer, as shown in Figure 1. Each DAC has its own R-2R ladder network and output op-amp, but all share the reference voltage inputs. The minimum voltage output (“zero-scale”) and maximum voltage

output (“full-scale”) are set by the external voltage references (V_{REFL} and V_{REFH} , respectively). The digital input is a 12-bit parallel word and the DAC input registers offer a readback capability. The converters can be powered from a single +15V supply or a dual $\pm 15V$ supply. Each device offers a reset function which immediately sets all DAC registers and DAC output voltages to mid-scale (DAC7724, code 800_H) or to zero-scale (DAC7725, code 000_H). See Figures 2 and 3 for the basic operation of the DAC7724/25.

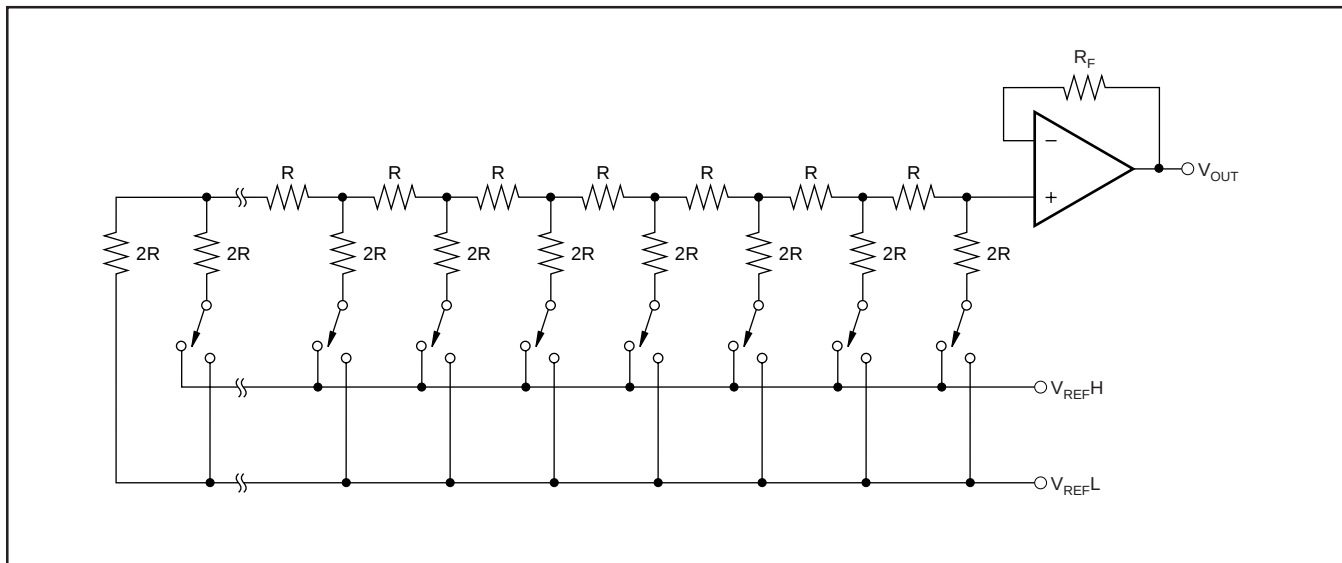


FIGURE 1. DAC7724/25 Architecture.

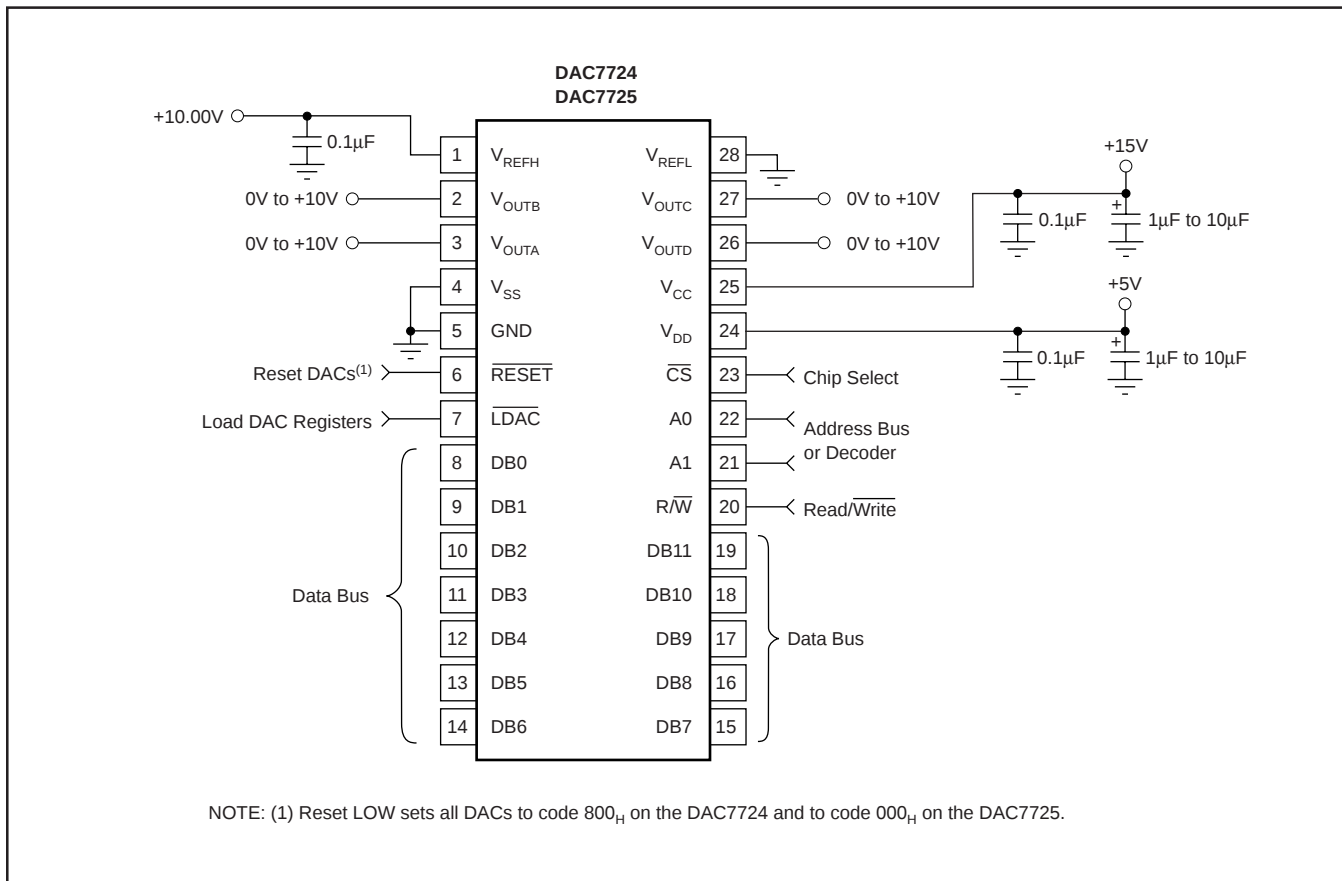


FIGURE 2. Basic Single-Supply Operation of the DAC7724/25.

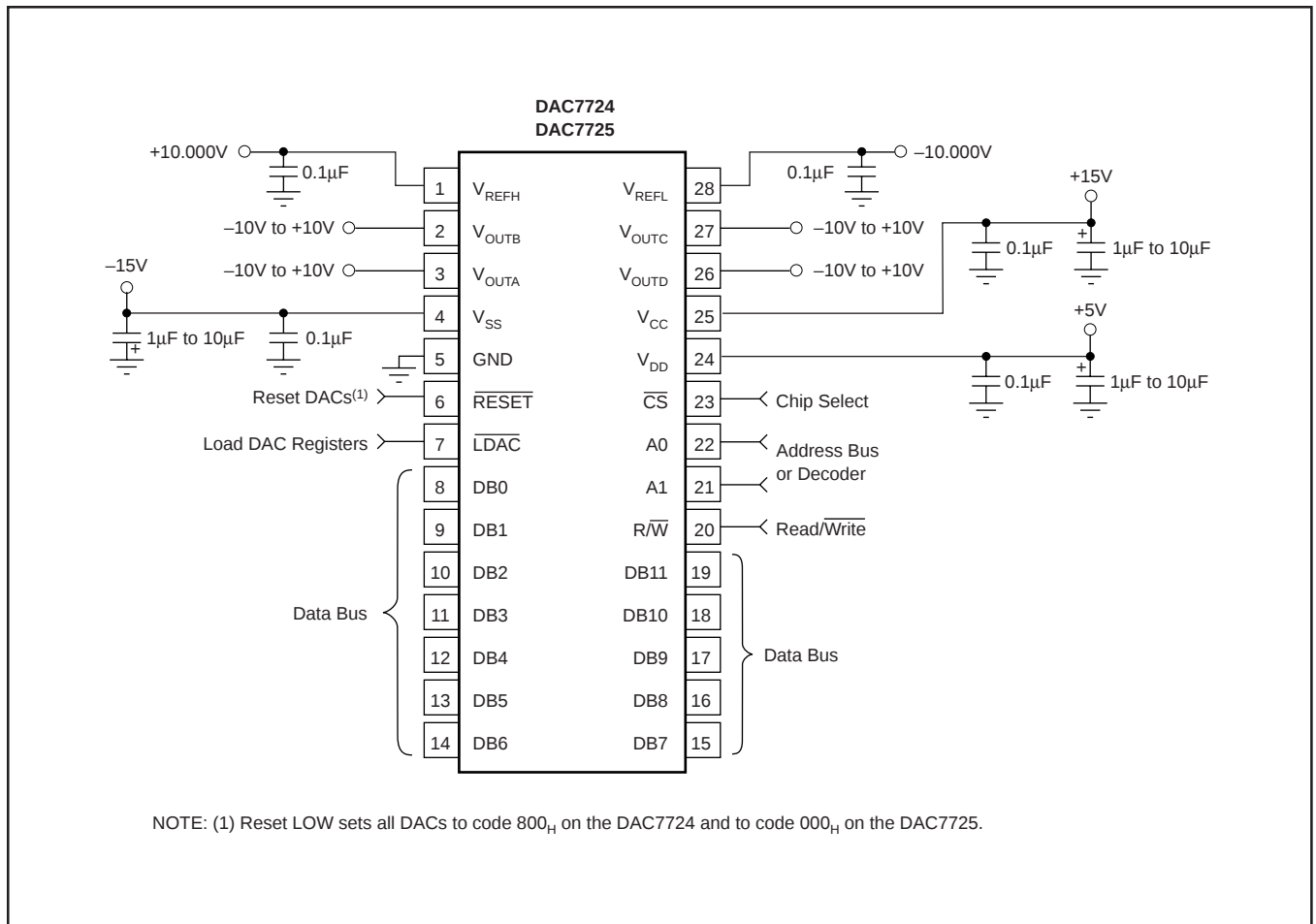


FIGURE 3. Basic Dual-Supply Operation of the DAC7724/25.

ANALOG OUTPUTS

When $V_{SS} = -15V$ (dual supply operation), the output amplifier can swing to within 4V of the supply rails, guaranteed over the $-40^{\circ}C$ to $+85^{\circ}C$ temperature range. With $V_{SS} = 0V$ (single-supply operation) and R_{LOAD} connected to ground, the output can swing to ground. Note that the settling time of the output op-amp will be longer with voltages very near ground. Additionally, care must be taken when measuring the zero-scale error when $V_{SS} = 0V$. Since the output voltage cannot swing below ground, the output voltage may not change for the first few digital input codes (000_H, 001_H, 002_H, etc.) if the output amplifier has a negative offset. At the negative offset limit of -4 LSB ($-9.76mV$), for the single-supply case, the first specified output starts at code 004_H.

REFERENCE INPUTS

For dual-supply operation, the reference inputs, V_{REFL} and V_{REFH} , can be any voltage between $V_{SS} + 4V$ and $V_{CC} - 4V$ provided that V_{REFH} is at least 1.25V greater than V_{REFL} . For single-supply operation ($V_{SS} = 0V$), V_{REFL} value can be above 0V, with the same provision that V_{REFH} is at least 1.25V greater than V_{REFL} . The minimum output of each DAC is equal to V_{REFL} plus a small offset voltage (essen-

tially, the offset of the output op-amp). The maximum output is equal to V_{REFH} plus a similar offset voltage. Note that V_{SS} (the negative power supply) must either be connected to ground or must be in the range of $-14.25V$ to $-15.75V$. The voltage on V_{SS} sets several bias points within the converter, if V_{SS} is not in one of these two configurations, the bias values may be in error and proper operation of the device is not guaranteed.

The current into the V_{REFH} input and out of V_{REFL} depends on the DAC output voltages and can vary from a few microamps to approximately 0.3mA. The reference input appears as a varying load to the reference. If the reference can sink or source the required current, a reference buffer is not required. See "Reference Current vs Code" in the Typical Performance Curves.

The analog supplies (or the analog supplies and the reference power supplies) have to come up first. If the power supplies for the references come up first, then the V_{CC} and V_{SS} supplies will be "powered from the reference via the ESD protection diodes" (see page 4).

Bypassing the reference voltage or voltages with at least a 0.1µF capacitor placed as close to the DAC7724/25 package is strongly recommended.

DIGITAL INTERFACE

Table I shows the basic control logic for the DAC7724/25. Note that each internal register is level triggered and not edge triggered. When the appropriate signal is LOW, the register becomes transparent. When this signal is returned HIGH, the digital word currently in the register is latched. The first set of registers (the Input Registers) are triggered via the A0, A1, $\overline{R/\overline{W}}$, and $\overline{CS}$ inputs. Only one of these registers is transparent at any given time. The second set of registers (the DAC Registers) are all transparent when $\overline{LDAC}$ input is pulled LOW.

Each DAC can be updated independently by writing to the appropriate Input Register and then updating the DAC Register. Alternatively, the entire DAC Register set can be configured as always transparent by keeping $\overline{LDAC}$ LOW—the DAC update will occur when the Input Register is written.

The double buffered architecture is mainly designed so that each DAC Input Register can be written at any time and then all DAC output voltages updated simultaneously by pulling $\overline{LDAC}$ LOW. It also allows a DAC Input Register to be written to at any point and the DAC voltage to be synchronously changed via a trigger signal connected to $\overline{LDAC}$.

DIGITAL TIMING

Figure 4 and Table II provide detailed timing for the digital interface of the DAC7724 and DAC7725.

DIGITAL INPUT CODING

The DAC7724 and DAC7725 input data is in straight binary format. The output voltage is given by the following equation:

$$V_{OUT} = V_{REFL} + \frac{(V_{REFH} - V_{REFL}) \cdot N}{4096}$$

where N is the digital input code. This equation does not include the effects of offset (zero-scale) errors.

A1	A0	$\overline{R/\overline{W}}$	$\overline{CS}$	$\overline{RESET}$	$\overline{LDAC}$	SELECTED INPUT REGISTER	STATE OF SELECTED INPUT REGISTER	STATE OF ALL DAC REGISTERS
L ⁽¹⁾	L	L	L	H ⁽²⁾	L	A	Transparent	Transparent
L	H	L	L	H	L	B	Transparent	Transparent
H	L	L	L	H	L	C	Transparent	Transparent
H	H	L	L	H	L	D	Transparent	Transparent
L	L	L	L	H	H	A	Transparent	Latched
L	H	L	L	H	H	B	Transparent	Latched
H	L	L	L	H	H	C	Transparent	Latched
H	H	L	L	H	H	D	Transparent	Latched
L	L	H	L	H	H	A	Readback	Latched
L	H	H	L	H	H	B	Readback	Latched
H	L	H	L	H	H	C	Readback	Latched
H	H	H	L	H	H	D	Readback	Latched
X ⁽³⁾	X	X	H	H	L	NONE	(All Latched)	Transparent
X	X	X	H	H	H	NONE	(All Latched)	Latched
X	X	X	X	L	X	ALL	Reset ⁽⁴⁾	Reset ⁽⁴⁾

NOTES: (1) L = Logic LOW. (2) H= Logic HIGH. (3) X = Don't Care. (4) DAC7724 resets to 800_H, DAC7725 resets to 000_H. When $\overline{RESET}$ rises, all registers that are in their latched state retain the reset value.

TABLE I. DAC7724 and DAC7725 Control Logic Truth Table.

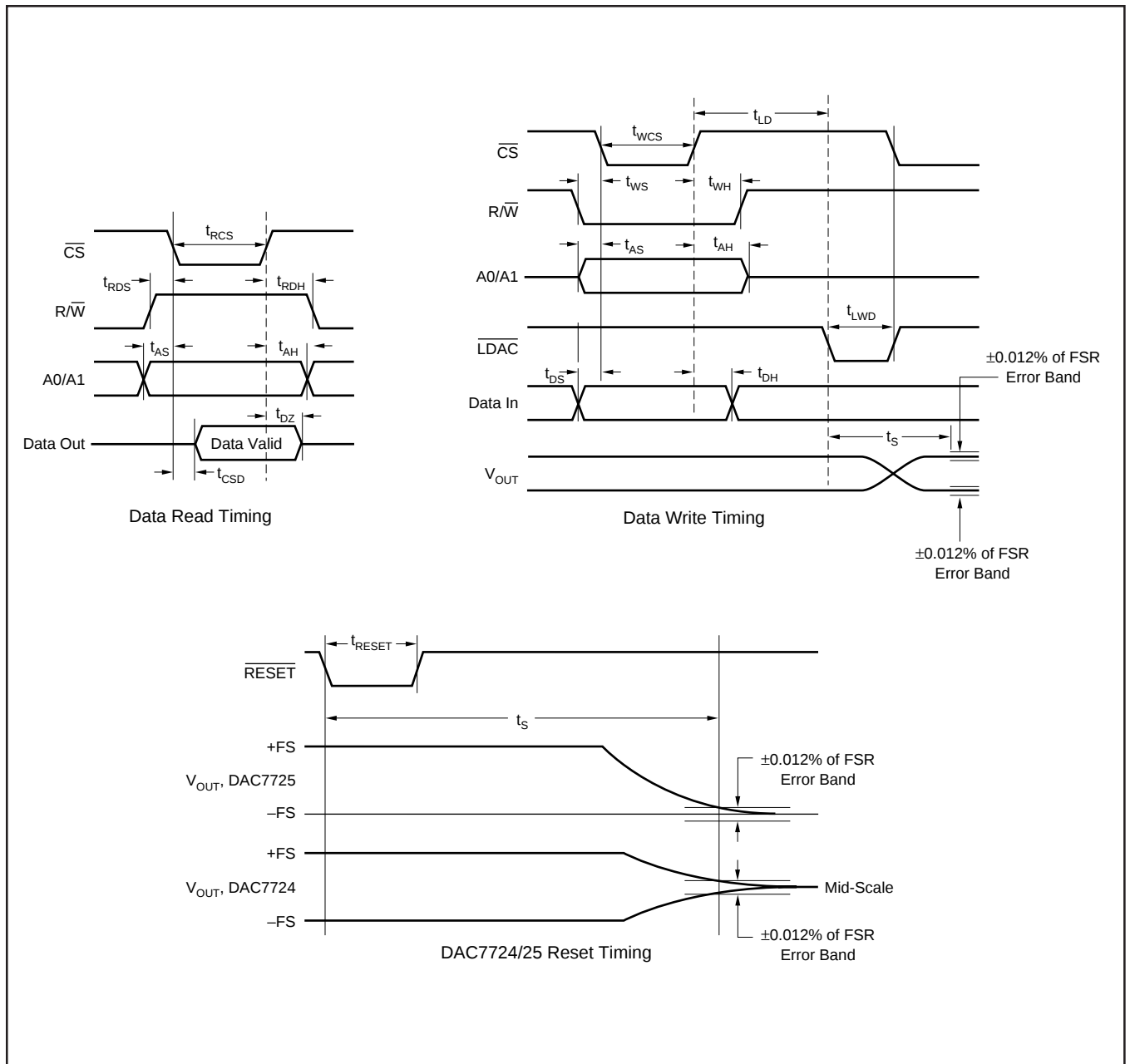


FIGURE 4. Digital Input and Output Timing.

SYMBOL	DESCRIPTION	MIN	TYP	MAX	UNITS
t_{RCS}	$\overline{CS}$ LOW for Read	200			ns
t_{RDS}	$R/\overline{W}$ HIGH to $\overline{CS}$ LOW	10			ns
t_{RDH}	$R/\overline{W}$ HIGH after $\overline{CS}$ HIGH	10			ns
t_{DZ}	$\overline{CS}$ HIGH to Data Bus in High Impedance		100		ns
t_{CSD}	$\overline{CS}$ LOW to Data Bus Valid		100	160	ns
t_{WCS}	$\overline{CS}$ LOW for Write	50			ns
t_{WS}	$R/\overline{W}$ LOW to $\overline{CS}$ LOW	0			ns
t_{WH}	$R/\overline{W}$ LOW after $\overline{CS}$ HIGH	0			ns
t_{AS}	Address Valid to $\overline{CS}$ LOW	0			ns
t_{AH}	Address Valid after $\overline{CS}$ HIGH	0			ns
t_{LD}	LDAC Delay from $\overline{CS}$ HIGH	10			ns
t_{DS}	Data Valid to $\overline{CS}$ LOW	0			ns
t_{DH}	Data Valid after $\overline{CS}$ HIGH	0			ns
t_{LWD}	LDAC LOW	50			ns
t_{RESET}	RESET LOW Time	50			ns
t_S	Settling Time			10	μ s

TABLE II. Timing Specifications ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$).

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DAC7724N	Obsolete	Production	PLCC (FN) 28	-	-	Call TI	Call TI	-40 to 85	DAC7724N
DAC7724NB	Obsolete	Production	PLCC (FN) 28	-	-	Call TI	Call TI	-40 to 85	DAC7724N B
DAC7724NB/750	Obsolete	Production	PLCC (FN) 28	-	-	Call TI	Call TI	-40 to 85	DAC7724N B
DAC7724U	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724U.A	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724U/1K	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724U/1K.A	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724UB	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724UB.A	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724UB/1K	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7724UB/1K.A	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7724U B
DAC7725NB	Obsolete	Production	PLCC (FN) 28	-	-	Call TI	Call TI	-40 to 85	DAC7725N B
DAC7725NB/750	Obsolete	Production	PLCC (FN) 28	-	-	Call TI	Call TI	-40 to 85	DAC7725N B
DAC7725U	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B
DAC7725U.A	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B
DAC7725UB	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B
DAC7725UB.A	Active	Production	SOIC (DW) 28	20 TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DAC7725UB/1K	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B
DAC7725UB/1K.A	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B
DAC7725UB/1KG4	Active	Production	SOIC (DW) 28	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	DAC7725U B

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(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

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(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DAC7724U/1K	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
DAC7724UB/1K	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
DAC7725UB/1K	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DAC7724U/1K	SOIC	DW	28	1000	350.0	350.0	66.0
DAC7724UB/1K	SOIC	DW	28	1000	350.0	350.0	66.0
DAC7725UB/1K	SOIC	DW	28	1000	350.0	350.0	66.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
DAC7724U	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7724U.A	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7724UB	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7724UB.A	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7725U	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7725U.A	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7725UB	DW	SOIC	28	20	506.98	12.7	4826	6.6
DAC7725UB.A	DW	SOIC	28	20	506.98	12.7	4826	6.6

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