

Table 7: AC Parameters (Packaged Parts)

Symbol	Characteristic	Min ⁽²⁾	Typ ⁽¹⁾	Max ⁽²⁾	Units	Conditions	
T _{REC}	Record Duration	ISD33120	114.9		124.5	sec	Commercial ⁽⁶⁾
		ISD33120D	114.9		125.7	sec	Extended ⁽⁶⁾
		ISD33120I	111.8		129.6	sec	Industrial ⁽⁶⁾
		ISD33150	143.7		155.6	sec	Commercial ⁽⁶⁾
		ISD33150D	143.7		157.1	sec	Extended ⁽⁶⁾
		ISD33150I	139.8		162.0	sec	Industrial ⁽⁶⁾
		ISD33180	172.4		186.7	sec	Commercial ⁽⁶⁾
		ISD33180D	172.4		188.5	sec	Extended ⁽⁶⁾
		ISD33180I	167.8		194.5	sec	Industrial ⁽⁶⁾
		ISD33240	229.9		248.9	sec	Commercial ⁽⁶⁾
		ISD33240D	229.9		251.3	sec	Extended ⁽⁶⁾
ISD33240I	223.7		259.3	sec	Industrial ⁽⁶⁾		
T _{PLAY}	Playback Duration	ISD33120	114.9		124.5	sec	Commercial ⁽⁶⁾
		ISD33120D	114.9		125.7	sec	Extended ⁽⁶⁾
		ISD33120I	111.8		129.6	sec	Industrial ⁽⁶⁾
		ISD33150	143.7		155.6	sec	Commercial ⁽⁶⁾
		ISD33150D	143.7		157.1	sec	Extended ⁽⁶⁾
		ISD33150I	139.8		162.0	sec	Industrial ⁽⁶⁾
		ISD33180	172.4		186.7	sec	Commercial ⁽⁶⁾
		ISD33180D	172.4		188.5	sec	Extended ⁽⁶⁾
		ISD33180I	167.8		194.5	sec	Industrial ⁽⁶⁾
		ISD33240	229.9		248.9	sec	Commercial ⁽⁶⁾
		ISD33240D	229.9		251.3	sec	Extended ⁽⁶⁾
ISD33240I	223.7		259.3	sec	Industrial ⁽⁶⁾		
T _{PUD}	Power-Up Delay	ISD33120	23.9		26.0	msec	Commercial
		ISD33120D	23.9		26.2	msec	Extended
		ISD33120I	23.3		27.0	msec	Industrial
		ISD33150	29.9		32.4	msec	Commercial
		ISD33150D	29.9		32.7	msec	Extended
		ISD33150I	29.1		33.8	msec	Industrial
		ISD33180	35.9		38.9	msec	Commercial
		ISD33180D	35.9		39.3	msec	Extended
		ISD33180I	34.9		40.5	msec	Industrial
		ISD33240	47.9		51.9	msec	Commercial
		ISD33240D	47.9		52.4	msec	Extended
ISD33240I	46.6		54.0	msec	Industrial		
T _{STOP} OR T _{PAUSE}	Stop or Pause in Record or Play	ISD33120		25.0		msec	
		ISD33150		31.25		msec	
		ISD33180		37.5		msec	
		ISD33240		50.0		msec	

Table 7: AC Parameters (Packaged Parts)

Symbol	Characteristic	Min ⁽²⁾	Typ ⁽¹⁾	Max ⁽²⁾	Units	Conditions	
T _{RAC}	RAC Clock Period	ISD33120	143.7		155.6	msec	Commercial ⁽¹⁰⁾
		ISD33120D	143.7		157.1	msec	Extended ⁽¹⁰⁾
		ISD33120I	139.8		162.0	msec	Industrial ⁽¹⁰⁾
		ISD33150	179.6		194.5	msec	Commercial ⁽¹⁰⁾
		ISD33150D	179.6		196.3	msec	Extended ⁽¹⁰⁾
		ISD33150I	174.7		202.6	msec	Industrial ⁽¹⁰⁾
		ISD33180	215.5		233.3	msec	Commercial ⁽¹⁰⁾
		ISD33180D	215.5		235.6	msec	Extended ⁽¹⁰⁾
		ISD33180I	209.7		243.1	msec	Industrial ⁽¹⁰⁾
		ISD33240	287.3		311.1	msec	Commercial ⁽¹⁰⁾
		ISD33240D	287.3		314.1	msec	Extended ⁽¹⁰⁾
		ISD33240I	279.6		324.1	msec	Industrial ⁽¹⁰⁾
T _{RACLO}	RAC Clock Low Time	ISD33120	11.9		13.0	msec	Commercial
		ISD33120D	11.9		13.1	msec	Extended
		ISD33120I	11.6		13.5	msec	Industrial
		ISD33150	14.9		16.2	msec	Commercial
		ISD33150D	14.9		16.4	msec	Extended
		ISD33150I	14.5		16.9	msec	Industrial
		ISD33180	17.9		19.5	msec	Commercial
		ISD33180D	17.9		19.7	msec	Extended
		ISD33180I	17.4		20.3	msec	Industrial
		ISD33240	23.9		26.0	msec	Commercial
		ISD33240D	23.9		26.2	msec	Extended
		ISD33240I	23.3		27.0	msec	Industrial
T _{RACM}	RAC Clock Period in Message Cueing Mode	ISD33120		187.50		μsec	
		ISD33150		234.40		μsec	
		ISD33180		281.25		μsec	
		ISD33240		375.00		μsec	
T _{RACML}	RAC Clock Low Time in Message Cueing Mode	ISD33120		15.62		μsec	
		ISD33150		19.56		μsec	
		ISD33180		23.42		μsec	
		ISD33240		31.34		μsec	
THD	Total Harmonic Distortion		1	2	%	@ 1 KHz	
V _{IN}	ANA IN Input Voltage			32	mV	Peak-to-Peak ^{(4) (8) (9)}	

1. Typical values @ T_A = 25°C and 3.0 V.
2. All min/max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3. Low-frequency cut off depends upon the value of external capacitors (see Pin Descriptions).
4. Single-ended input mode. In the differential input mode, V_{IN} max. for ANA IN+ and ANA IN- is 16 mV peak-to-peak.
5. For greater stability, an external clock can be utilized (see Pin Descriptions).
6. Minimum and maximum limits are guaranteed by ISD via 100 percent electrical testing or characterization to meet or exceed a Cpk of 1.33.
7. Filter specification applies to the antialiasing filter and to the smoothing filter.
8. The typical output voltage will be approximately 570 mV peak-to-peak with V_{IN} at 32 mV peak-to-peak.
9. For optimal signal quality, this maximum limit is recommended.
10. When a record command is sent, T_{RAC} = T_{RAC} + T_{RACLO} on the first row addressed.

Table 8: Absolute Maximum Ratings (Die)⁽¹⁾

Condition	Value
Junction temperature	150°C
Storage temperature range	-65°C to +150°C
Voltage applied to any pad	(V _{SS} - 0.3 V) to (V _{CC} + 0. V)
Voltage applied to any pad (Input current limited to ±20 mA)	(V _{SS} - 1.0 V) to (V _{CC} + 1.0 V)
Voltage applied to MOSI, SLK, and SS pins (Input current limited to ±20 mA)	(V _{SS} - 1.0 V) to 5.5 V
V _{CC} - V _{SS}	-0.3 V to +7.0 V

1. Stresses above those listed may cause permanent damage to the device. Exposure to the absolute maximum ratings may affect device reliability. Functional operation is not implied at these conditions.

Table 9: Operating Conditions (Die)

Condition	Value
Commercial operating temperature range	0°C to +50°C
Supply voltage (V _{CC}) ⁽¹⁾	+2.7 V to +3.3 V
Ground voltage (V _{SS}) ⁽²⁾	0 V

- 1. V_{CC} = V_{CCA} = V_{CCD}
- 2. V_{SS} = V_{SSA} = V_{SSD}.

Table 10: DC Parameters (Die)

Symbol	Parameters	Min ⁽²⁾	Typ ⁽¹⁾	Max ⁽²⁾	Units	Conditions
V _{IL}	Input Low Voltage			V _{CC} x 0.2	V	
V _{IH}	Input High Voltage	V _{CC} x 0.8		3.3 ⁽³⁾	V	
V _{OL}	Output Low Voltage			0.4	V	I _{OL} = 10 μA
V _{OL1}	RAC, INT Output Low Voltage			0.4	V	I _{OL} = 1 mA
V _{OH}	Output High Voltage	V _{CC} - 0.4			V	I _{OH} = -10 μA
I _{CC}	V _{CC} Current Operating) — Playback — Record		25 30	30 40	mA mA	R _{EXT} = ∞ ⁽⁴⁾ R _{EXT} = ∞ ⁽⁴⁾
I _{SB}	V _{CC} Current (Standby)		1	10	μA	(4) (5)
I _{IL}	Input Leakage Current			±1	μA	
I _{HZ}	MISO Tristate Current		1	10	μA	
R _{EXT}	Output Load Impedance	5			KΩ	
R _{ANA IN+}	ANA IN+ Input Resistance	2.2	3.0	3.8	KΩ	

Table 10: DC Parameters (Die)

Symbol	Parameters	Min ⁽²⁾	Typ ⁽¹⁾	Max ⁽²⁾	Units	Conditions
R _{ANA IN-}	ANA IN- Input Resistance	40	56	71	KΩ	
A _{ARP}	ANA IN+ or ANA IN- to AUD OUT Gain		25		dB	⁽⁶⁾

1. Typical values @ T_A = 25°C and 3.0 V.
2. All min/max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3. When driven by a 5-volt microcontroller, the maximum V_{IH} for the MOSI, SCLK, and \overline{SS} pins is 5.5 volts.
4. V_{CCA} and V_{CCD} connected together.
5. $\overline{SS} = V_{CCA} = V_{CCD}$, XCLK = MOSI = V_{SSA} = V_{SSD} and all other pins floating.
6. Measured with AutoMute feature disabled.

Table 11: AC Parameters (Die)

Symbol	Characteristic	Min ⁽²⁾	Typ ⁽¹⁾	Max ⁽²⁾	Units	Conditions
F _S	Sampling Frequency	ISD33120	8.0		KHz	⁽⁵⁾
		ISD33150	6.4		KHz	⁽⁵⁾
		ISD33180	5.3		KHz	⁽⁵⁾
		ISD33240	4.0		KHz	⁽⁵⁾
F _{CF}	Filter Pass Band	ISD33120	3.4		KHz	3dB Roll-Off Point ⁽³⁾⁽⁷⁾
		ISD33150	2.7		KHz	3dB Roll-Off Point ⁽³⁾⁽⁷⁾
		ISD33180	2.3		KHz	3dB Roll-Off Point ⁽³⁾⁽⁷⁾
		ISD33240	1.7		KHz	3dB Roll-Off Point ⁽³⁾⁽⁷⁾
T _{REC}	Record Duration	ISD33120	115.1	124.4	sec	⁽⁵⁾⁽⁶⁾
		ISD33150	143.8	155.5	sec	⁽⁵⁾⁽⁶⁾
		ISD33180	172.6	186.6	sec	⁽⁵⁾⁽⁶⁾
		ISD33240	229.3	249.9	sec	⁽⁵⁾⁽⁶⁾
T _{PLAY}	Playback Duration	ISD33120	115.1	124.4	sec	⁽⁵⁾⁽⁶⁾
		ISD33150	143.8	155.5	sec	⁽⁵⁾⁽⁶⁾
		ISD33180	172.6	186.6	sec	⁽⁵⁾⁽⁶⁾
		ISD33240	229.3	249.9	sec	⁽⁵⁾⁽⁶⁾
T _{PUD}	Power-Up Delay	ISD33120	23.9	26.0	msec	⁽⁶⁾
		ISD33150	29.9	32.4	msec	⁽⁶⁾
		ISD33180	35.9	38.9	msec	⁽⁶⁾
		ISD33240	47.7	52.1	msec	⁽⁶⁾
T _{STOP} OR T _{PAUSE}	Stop or Pause in Record or Play	ISD33120	25.0		msec	
		ISD33150	31.25		msec	
		ISD33180	37.5		msec	
		ISD33240	50.0		msec	
T _{RAC}	RAC Clock Period	ISD33120	143.8	155.5	msec	⁽⁶⁾⁽¹⁰⁾
		ISD33150	179.7	194.4	msec	⁽⁶⁾⁽¹⁰⁾
		ISD33180	215.6	233.2	msec	⁽⁶⁾⁽¹⁰⁾
		ISD33240	286.6	312.3	msec	⁽⁶⁾⁽¹⁰⁾

Table 11: AC Parameters (Die)

Symbol	Characteristic	Min ⁽²⁾	Typ ⁽¹⁾	Max ⁽²⁾	Units	Conditions
T _{RACLO}	RAC Clock Low Time	ISD33120	12.50		msec	(6)
		ISD33150	15.63		msec	(6)
		ISD33180	18.75		msec	(6)
		ISD33240	25.0		msec	(6)
T _{RACM}	RAC Clock Period in	ISD33120	187.5		μsec	
	Message Cueing	ISD33150	234.4		μsec	
	Mode	ISD33180	281.3		μsec	
		ISD33240	375.0		μsec	
T _{RACML}	RAC Clock Low Time	ISD33120	15.6		μsec	
	in Message Cueing	ISD33150	19.5		μsec	
	Mode	ISD33180	23.4		μsec	
		ISD33240	31.3		μsec	
THD	Total Harmonic Distortion		1	2	%	@ 1 KHz
V _{IN}	ANA IN Input Voltage			32	mV	Peak-to-Peak ^{(4) (8) (9)}

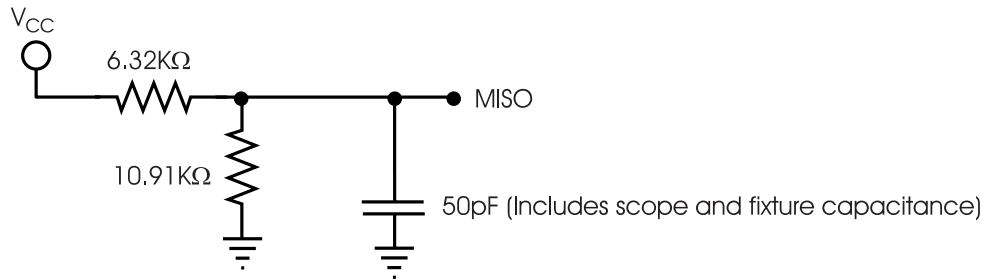
1. Typical values @ $T_A = 25^\circ\text{C}$ and 3.0 V.
2. All min/max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3. Low-frequency cut off depends upon the value of external capacitors (see Pin Descriptions).
4. Single-ended input mode. In the differential input mode, V_{IN} maximum for ANA IN+ and ANA IN- is 16 mV peak-to-peak.
5. For greater stability, an external clock can be utilized. See "PIN DESCRIPTIONS" on page 2.
6. Minimum and maximum limits are guaranteed by ISD via 100 percent electrical testing or characterization to meet or exceed a Cpk of 1.33.
7. Filter specification applies to the antialiasing filter and to the smoothing filter.
8. The typical output voltage will be approximately 570 mV peak-to-peak with V_{IN} at 32 mV peak-to-peak.
9. For optimal signal quality, this maximum limit is recommended.
10. When a record command is sent, $T_{RAC} = T_{RAC} + T_{RACLO}$ on the first row addressed.

Table 12: SPI AC Parameters⁽¹⁾

Symbol	Characteristics	Min	Max	Units	Conditions
T _{SSS}	SS Setup Time	500		nsec	
T _{SSH}	SS Hold Time	500		nsec	
T _{DIS}	Data In Setup Time	200		nsec	
T _{DIH}	Data In Hold Time	200		nsec	
T _{PD}	Output Delay		500	nsec	
T _{DF} ⁽²⁾	Output Delay to hiZ		500	nsec	
T _{SSmin}	SS HIGH	1		μsec	
T _{SCKhi}	SCLK High Time	400		nsec	
T _{SCKlow}	SCLK Low Time	400		nsec	
F ₀	CLK Frequency		1,000	KHz	

1. Typical values @ T_A = 25°C and 3.0 V. Timing measured at 50 percent of the V_{CC} level.

2. Tristate test condition.



TIMING DIAGRAMS

Figure 5: Timing Diagram

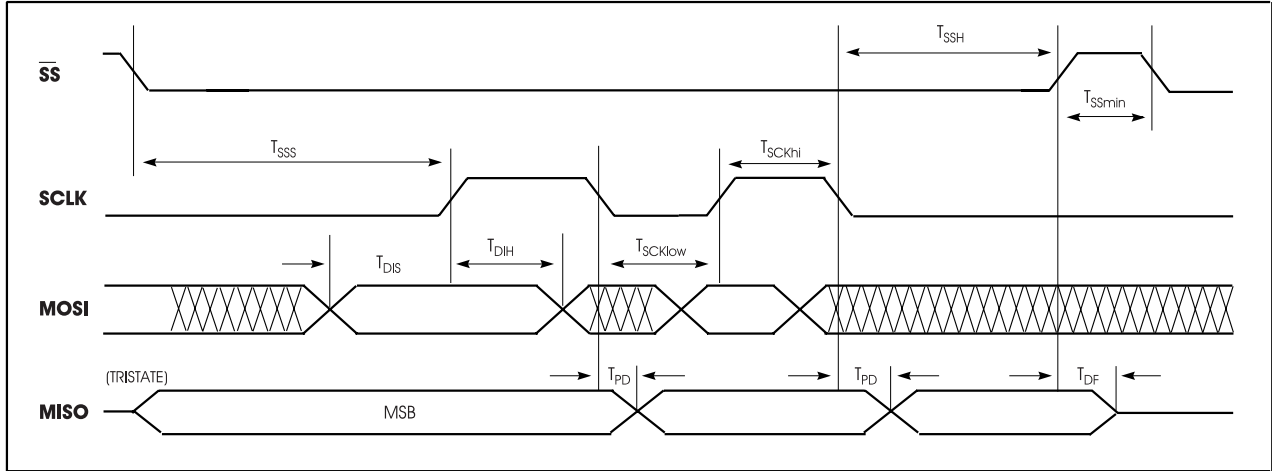


Figure 6: 8-Bit Command Format

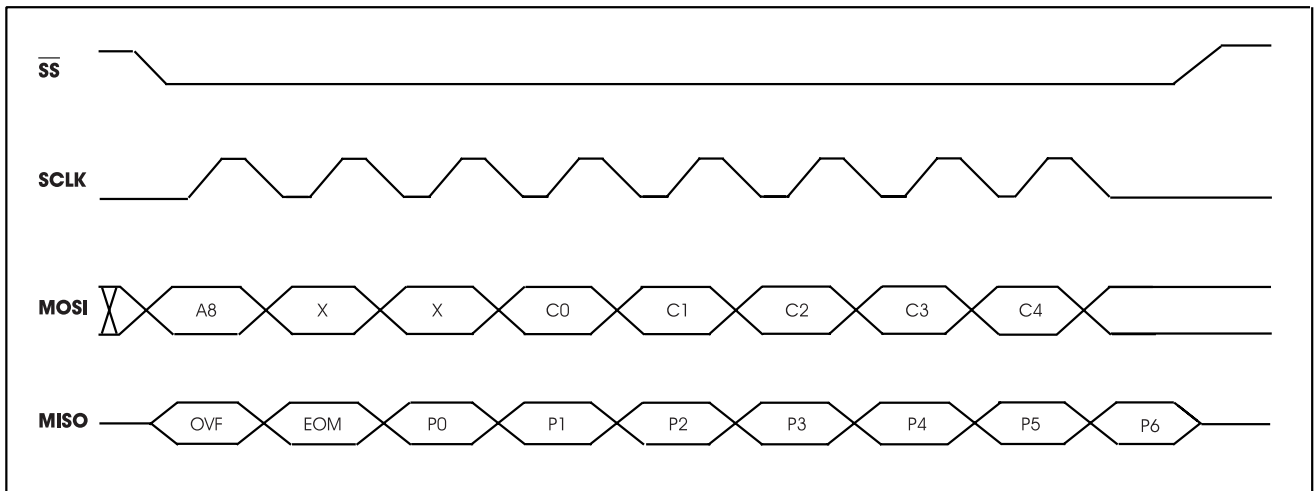


Figure 7: 16-Bit Command Format

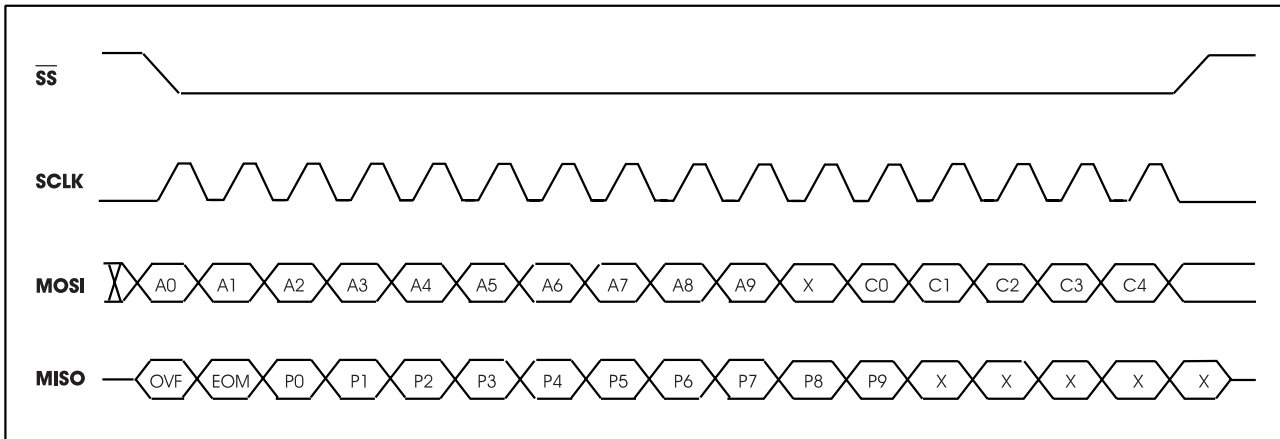


Figure 8: Playback/Record and Stop Cycle

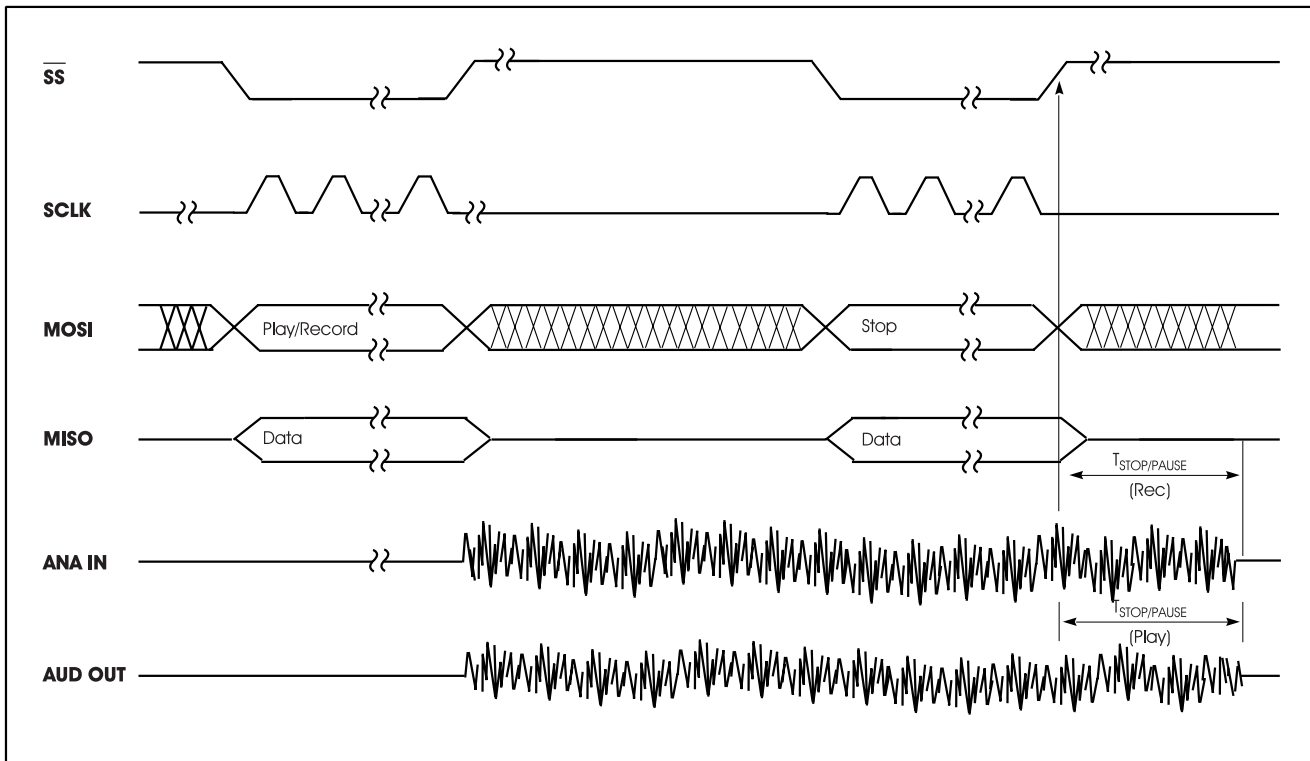
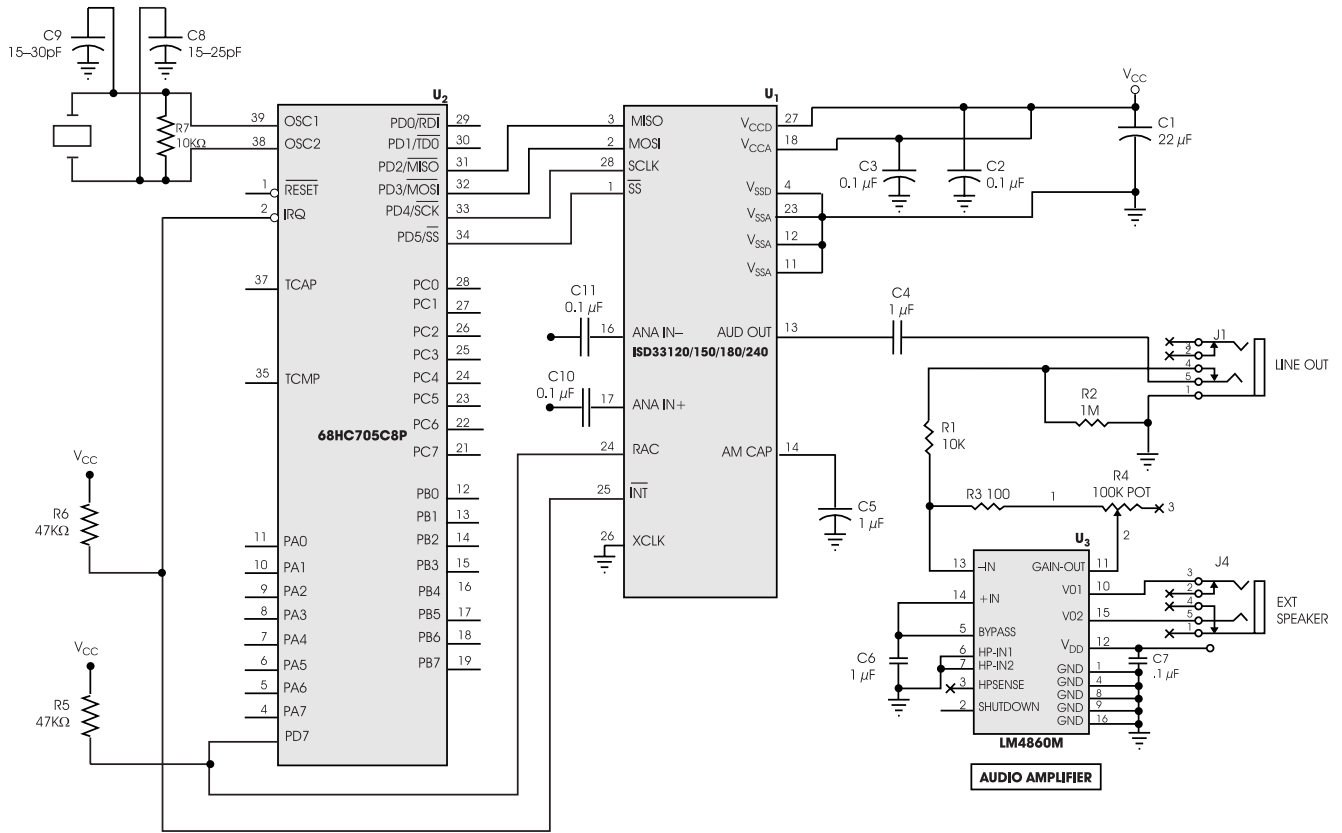
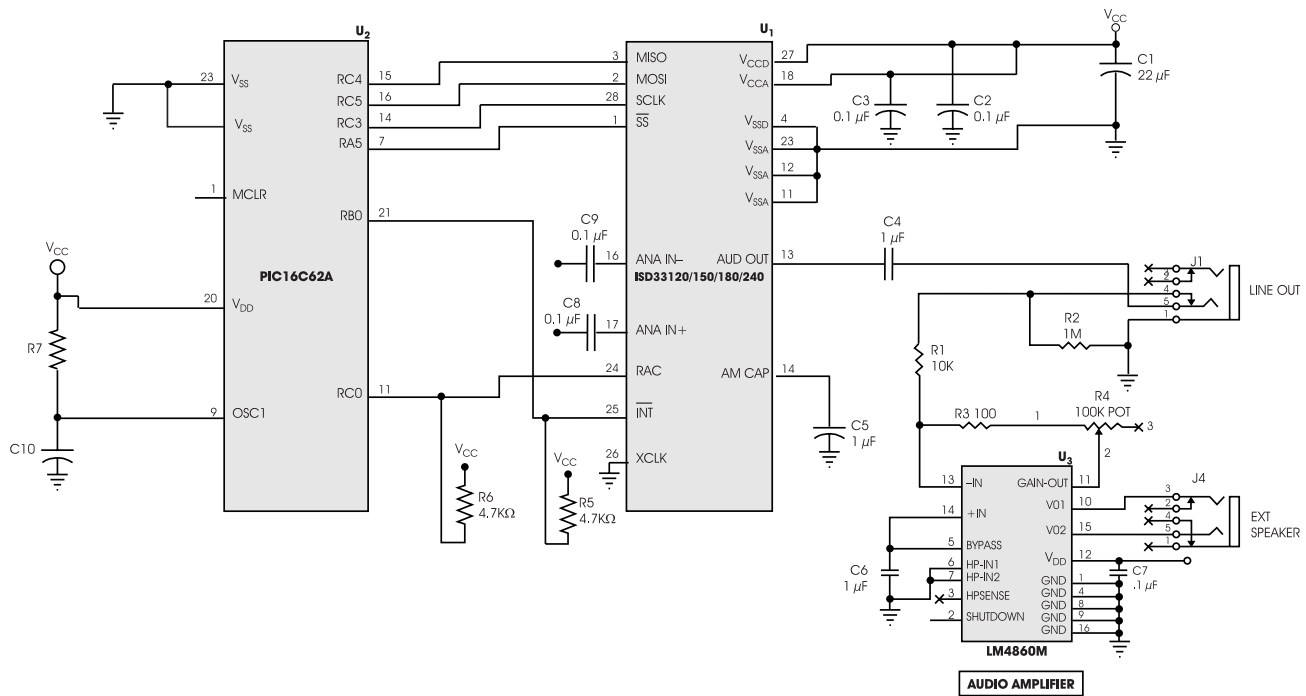


Figure 9: Application Example Using SPI



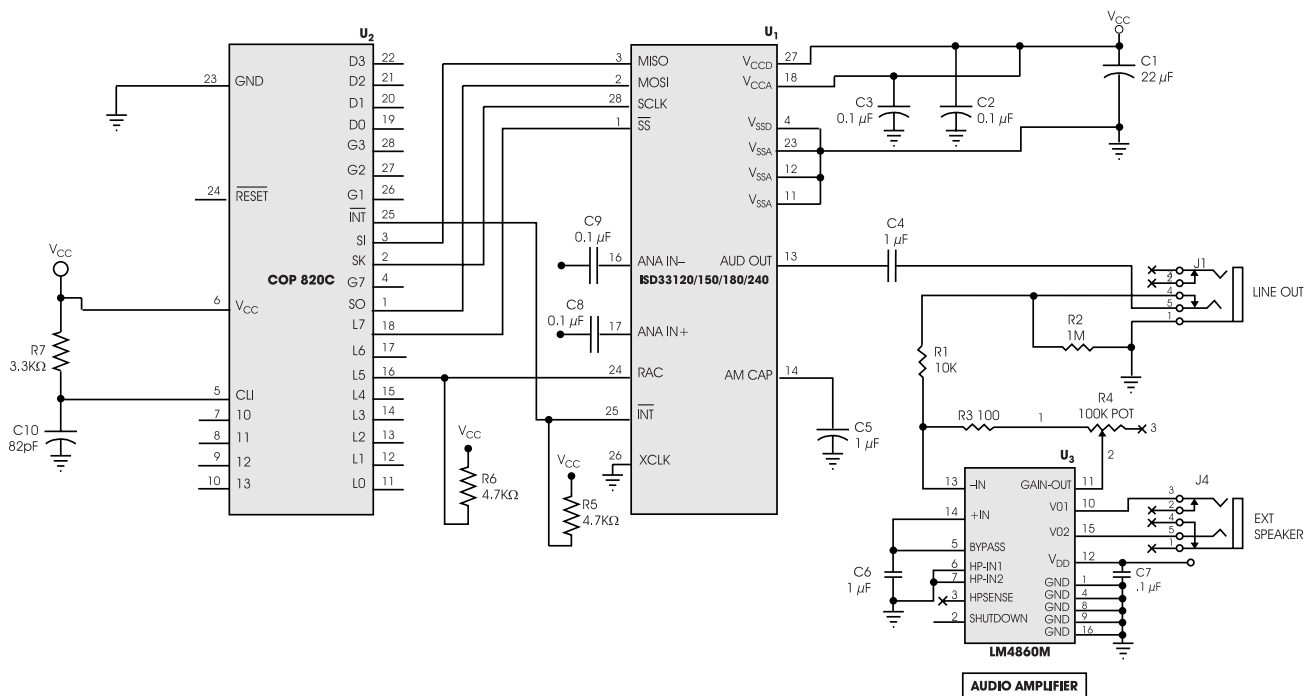
NOTE: This application example is for illustration purposes only. ISD makes no representation or warranty that such application will be suitable for production.

Figure 10: Application Example Using Microwire



1. This application example is for illustration purposes only. ISD makes no representation or warranty that such application will be suitable for production.

Figure 11: Application Example Using SPI Port on Microcontroller



NOTE: This application example is for illustration purposes only. ISD makes no representation or warranty that such application will be suitable for production.