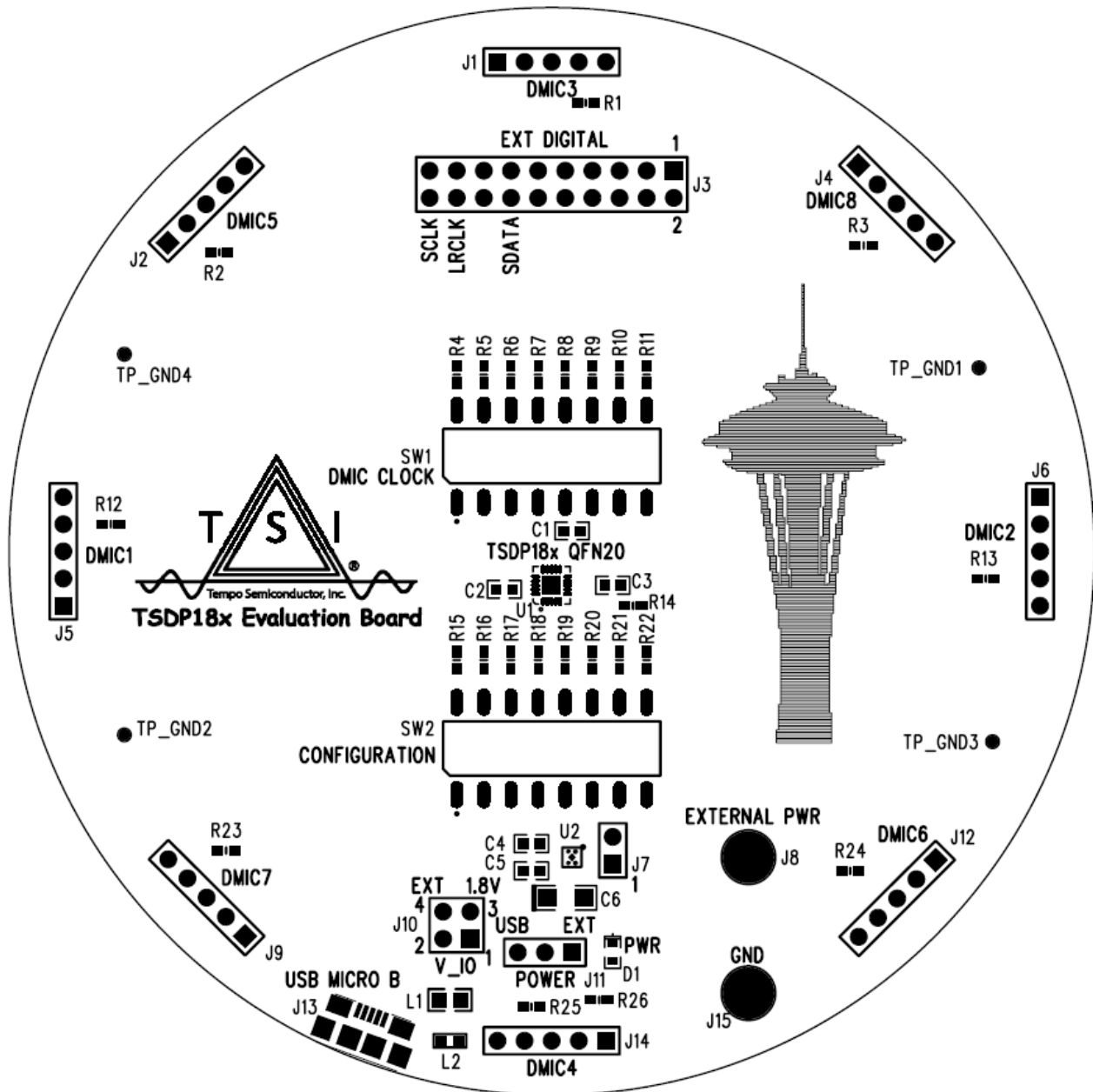


*Tempo Semiconductor, Inc.*

*TSDP18x Evaluation Board User Guide*

*Rev 0.2 (June 28, 2019)*



## TSDP18x Supported Modes

Valid PCM Word Slots in TDM Mode SCLK to LRCLK Ratio									
Word Length	512	384	256	192	128	96	64	48	32
32	8	8	8	6	4	3	2	N/A	N/A
24	8	8	8	8	5*	4	2*	2	N/A
16	8	8	8	8	8	6	4	3	2

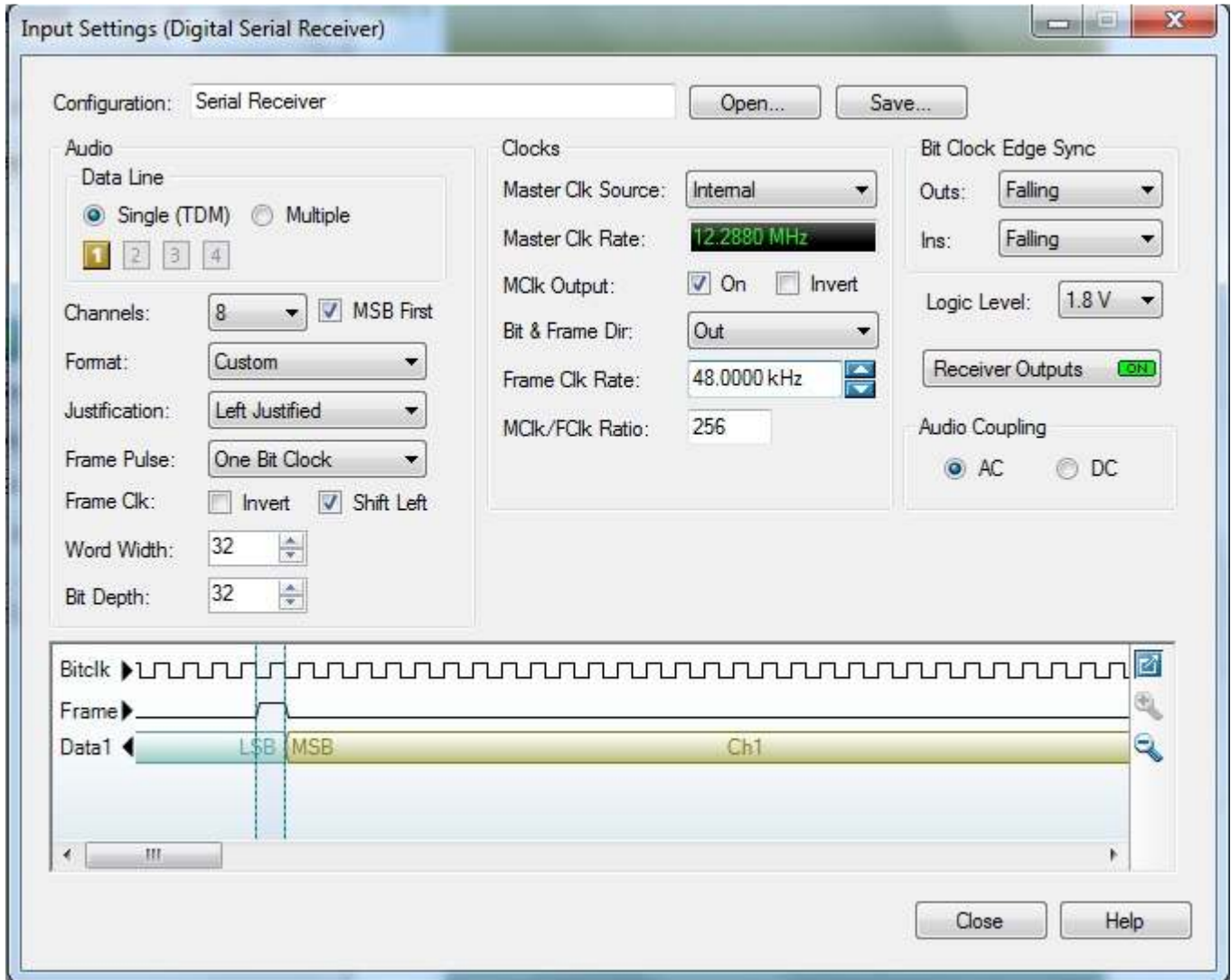
TDM Mode PCM Word Slot Availability based on SCLK to LRCLK Ratio and Word Length

## I2S Configuration

The screenshot displays the 'Input Settings (Digital Serial Receiver)' configuration window. The configuration is set to 'Serial Receiver'. The 'Audio' section is configured for 'Single (TDM)' mode with 2 channels, 'I2S' format, 'Left Justified' justification, 'One Subframe' frame pulse, and 'Word Width' and 'Bit Depth' both set to 32. The 'Clocks' section shows 'Master Clk Source' as 'Internal' at '3.07200 MHz', 'MClk Output' checked 'On', 'Bit & Frame Dir' set to 'Out', 'Frame Clk Rate' at '48.0000 kHz', and 'MClk/FClk Ratio' at '64'. The 'Bit Clock Edge Sync' section shows 'Outs' and 'Ins' both set to 'Rising' edge sync, 'Logic Level' at '1.8 V', and 'Receiver Outputs' checked 'ON'. The 'Audio Coupling' is set to 'AC'. A timing diagram at the bottom shows 'Bitclk' as a square wave, 'Frame' as a pulse, and 'Data1' as a signal with 'LSB' and 'MSB' markers. The 'Close' and 'Help' buttons are visible at the bottom right.

This figure shows an example of a typical timing configuration required to support I2S modes. Please note the SCLK and LRCLK relationship, and edge directions.

## TDM Configuration



This figure shows an example of a typical timing configuration required to support TDM modes. Please note the SCLK and LRCLK relationship, and edge directions.

## **Power Connections**

The TSDP18x evaluation board can be powered externally in several ways. The part itself needs two voltages, 1.8V for its main supply, and V\_IO which must match the signaling voltage and the configuration input signals, and can be either 1.8V or 3.3V.

There is a 1.8V LDO regulator (U2) on the board that can provide 1.8V and it is supplied from either the USB Micro B connector or the External Pwr connection. The jumper at J11 determines which of these inputs provide the source voltage to the LDO. A green LED will indicate that power is being supplied to the LDO. The jumper at J7 must be installed to provide the 1.8V output from the LDO to the TSDP18x itself.

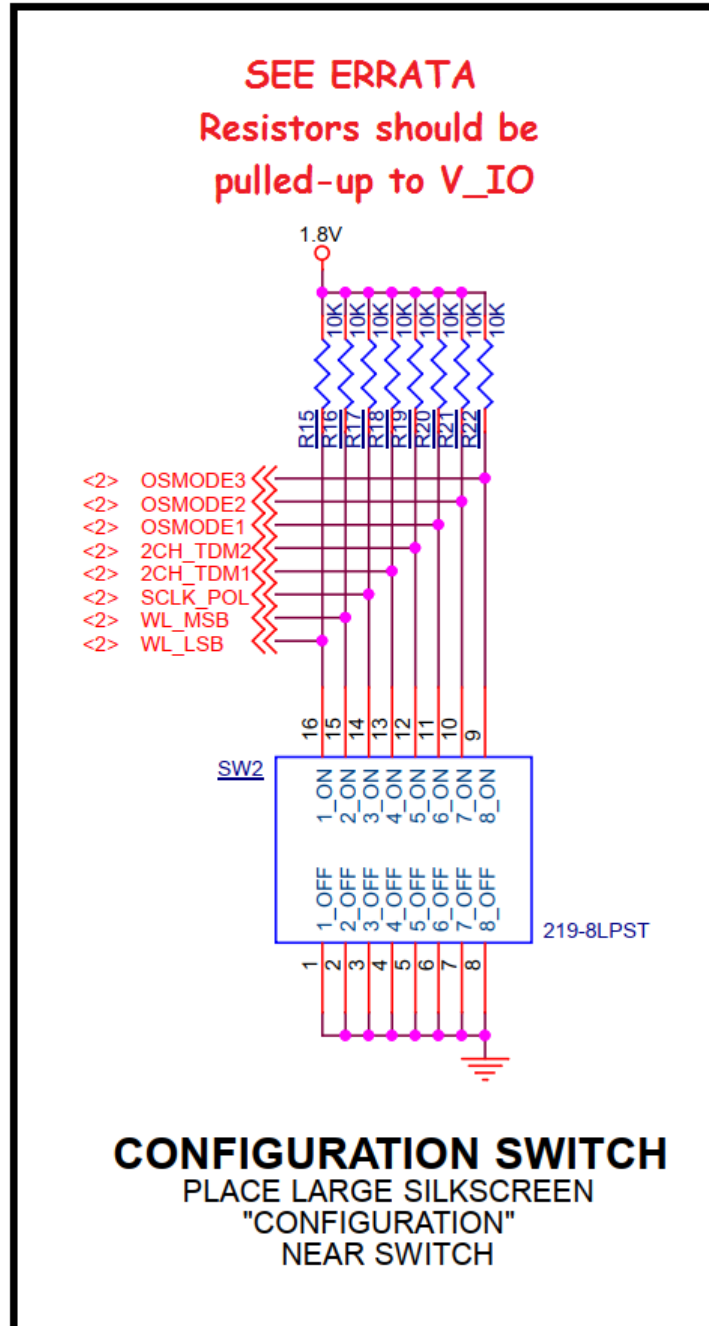
External power can be provided from either the bench supply connectors, J8 and J15, or from the External Digital header, pins 1 and 3. They should be between 2.5V and 5V.

V\_IO can be provided from the 1.8V regulator or from an external source. Jumpering 1/3 on connector J10 will use the 1.8V LDO and 2/4 will use an external I/O voltage supplied from the External Digital header, J3 pins 7 and 9.

There are 4 GND test points located at the edges of the board.

## SW2 - Configuration Switch

When "ON" this switch will provide a logical low ("0") or GND to the input signal. When "OFF" it will provide a logical high ("1") or V<sub>IO</sub> pull-up voltage to the input signal.



	2CH_TDM1	2CH_TDM2
I2S Mode 0, 1 Channel Output Mode, Double-Edged Clocking on PDM Sources	0	0
I2S Mode 1, 2 Channel Output Mode, Single-Edged Clocking on PDM Sources	0	1
Left-Justified, 2 Channel Output Mode, Double-Edged Clocking on PDM Source	1	0
TDM, up to 8 Channel Output Mode, Double-Edged Clocking on PDM Source	1	1

**Configuring the PCM Output Format using the 2CH\_TDM1 and 2CH\_TDM2 Pins**

	WL_MSB	WL_LSB
PCM Word Length = 32-bits	0	0
PCM Word Length = 24-bits	0	1
Reserved	1	0
PCM Word Length = 16-bits	1	1

**PCM Word Length Configuration using WL\_MSB and WL\_LSB Pins**

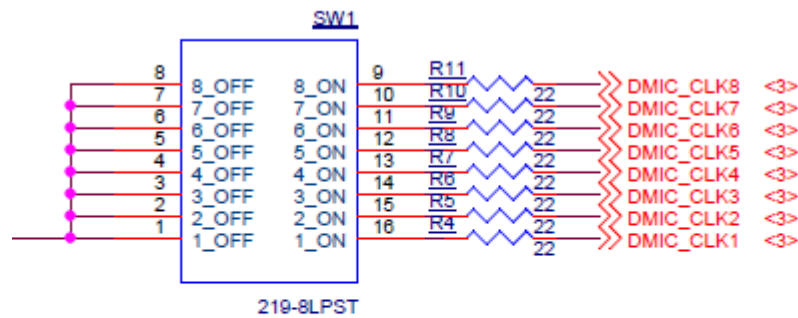
OS_MODE3	OS_MODE2	OS_MODE1	Oversample Rate	Bandwidth at -1dB (Normalized)	Typical Fs Range (kHz)	Valid SCLK / LRCLK Ratios for Corresponding OS_MODE Pin Selection
0	0	0	N/A	N/A	N/A	Reserved
0	0	1	N/A	N/A	N/A	Reserved
0	1	0	8	0.1189	256 to 384	32, 48, 64, 96, 128
0	1	1	16	0.2268	128 to 192	32, 48, 64, 96, 128, 192, 256
1	0	0	32	0.4536	64 to 96	32, 64, 96, 128, 192, 256, 384, 512
1	0	1	48	0.4536	48 to 64	48, 96
1	0	1	64	0.4536	32 to 48	64, 128, 192, 256, 384, 512
1	1	0	96	0.4536	24 to 32	96, 192
1	1	0	128	0.4536	16 to 24	128, 256, 384, 512
1	1	1	192	0.4536	8 to 16	192, 384
1	1	1	256	0.4536	8 to 12	256, 512

**Configuring the Oversampling Mode using OS\_MODE3, OS\_MODE2, OS\_MODE1 Pins**

## SW1 - DMIC Clock Switch

This switch connects the single PDM clock output from the part to each of the eight DMIC connectors. When the switch is set to "ON" the connection is made from pin U1.14 to each of the DMIC connector clock pins, Jx.pin2.

Note: due to the different microphone array options, this node has the potential of variable loading and signal reflections that may produce non-monotonic clock edges or violate timing requirements at the DMIC connectors. For any testing or DMIC connections, the signal integrity must be validated at all destinations. This may involve replacing the series termination resistors, or modifying the connections to the DMIC connectors themselves to make sure that the PDM clock output arrives with the correct setup and hold timings for testing or for the microphone array being evaluated.



**DMIC CLOCK SWITCH**  
PLACE LARGE SILKSCREEN  
"DMIC CLOCK"  
NEAR SWITCH



### J3 - External Digital Header

This header provides the digital interface to the TSDP18x. There are connections for the signals as well as power.

Pin 20 - input for SCLK

Pin 18 - input for LRCLK (frame clock)

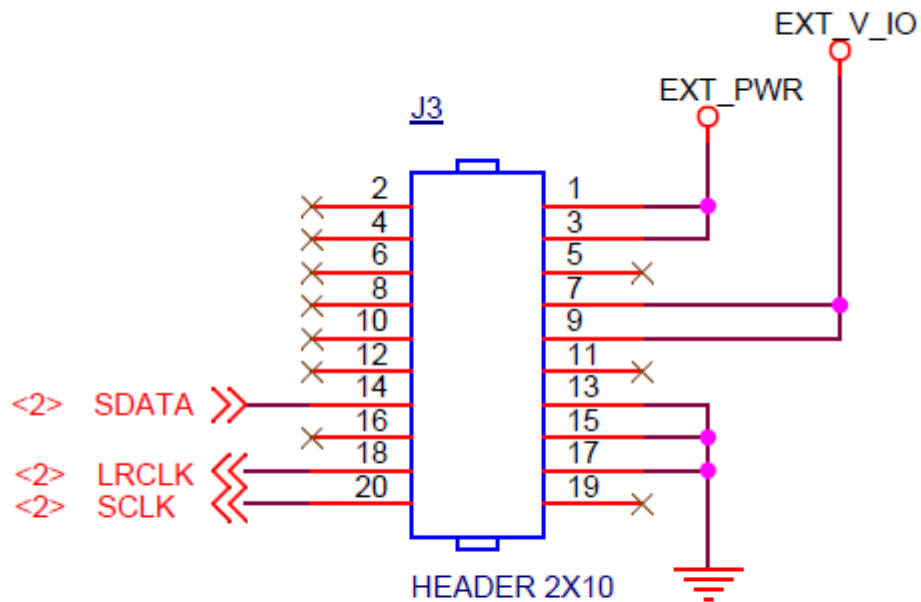
Pin 14 - output of SDATA

Pins 1/3 - external power supply connection

Pins 7/9 - external V<sub>IO</sub> supply connection

Pins 13/15/17 - GND

Other pins - unused



PLACE LARGE SILKSCREEN  
"EXTERNAL DIGITAL"  
NEAR HEADER

## **DMIC Connectors – (J5/J6 )/ (J1/J14) / (J2/J12) / (J9/J4)**

There are 8 DMIC connectors available for connecting the various array options. They are paired, and pin 3 on each of the connectors will be strapped either to V\_IO or GND to select the rising/falling PDM clock edge.

DMIC1/DMIC2 – Use the base pair for I2S, other stereo, and all other array configurations.

DMIC3/DMIC4 – Add pair for quad array configurations.

DMIC5/DMIC6 – Add pair for hex array configurations.

DMIC7/DMIC8 – Add pair for octal array configurations.

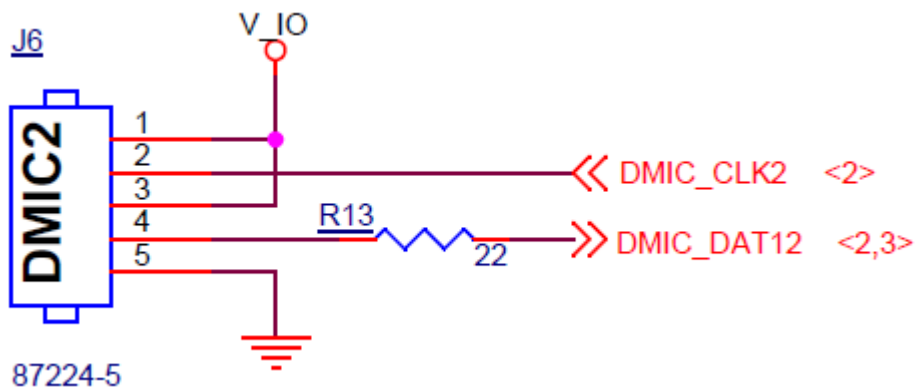
Pin 1 – V\_IO power

Pin 2 – PDM Clock

Pin 3 – Select PCM clock edge for data

Pin 4 – PDM Data (paired with other channel DMIC connector)

Pin 5 - GND



Example DMIC Connector Signal Connections

## **Errata (28Jun19):**

- The DMIC5 connector had its clock and data connections incorrectly swapped in the schematic. A rework is required to swap the connections between pins 2 and 4, to match the orientation of the other DMIC connectors.
- The configuration switch resistors are pulled-up to the wrong voltage supply. They should have been pulled-up to V\_IO instead of 1.8V. As the 1.8V supply is still above  $V_{IO} / 2$  even when 3.3V is used for the V\_IO voltage, no board rework is required, and all testing to date indicates that the configuration will be set correctly even when using 1.8V as the pull-up voltage with 3.3V V\_IO. Customers using the evaluation board as a reference for their own designs should make note of this, especially if they choose to use 3.3V for the V\_IO voltage.



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