

# LOW POWER SPREAD SPECTRUM OSCILLATOR

## SERIES „LPSSO“ WITH SPREAD-OFF FUNCTION 1.0—110.0 MHz

### FEATURES

- + 100% pin-to-pin drop-in replacement to quartz and MEMS based XO
- + Low Power Spread Spectrum Oscillator for Low Cost
- + Spread-off function on Pin1 up to 50 MHz
- + Excellent long time reliability - outperforms quartz-based XO
- + LVCMOS/LVTTL compatible output
- + Standby current as low as 0.4  $\mu$ A
- + Fast resume time of 3 ms (typ)
- + <30 ps cycle-to-cycle jitter
- + Spread options (contact Petermann-Technik for other spread options)
  - Center spread:  $\pm 0.50\%$ ,  $\pm 0.25\%$  (standard)
  - Down spread:  $-1\%$ ,  $-0.5\%$  (standard)
- + Outstanding mechanical robustness for portable applications
- + Express samples within 1 day ex works
- + Pb-free, RoHS and REACH compliant / MSL1@260°C

### APPLICATIONS

- + Printers
- + Flat panel drivers
- + PCI
- + MCU
- + USB 3.0
- + PCI or PCI Express
- + Low Power MCU
- + Industrial
- + Telecom
- + Commercial
- + Medical

### GENERAL DATA

PARAMETER AND CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITION
<b>FREQUENCY RANGE</b>						
Output Frequency Range	f	1	-	110	MHz	
<b>FREQUENCY STABILITY AND AGING</b>						
Frequency Tolerance	F_tol	-50	-	+50	PPM	Inclusive of: Initial stability, operating temperature, rated power, supply voltage change, load change, shock & vibration
		-100	-	+100	PPM	Spread Off
Aging	Ag	-1	-	1	PPM	1st year at 25°C
<b>OPERATING TEMPERATURE RANGE</b>						
Operating Temperature Range	T_use	-20	-	+70	°C	Extended Commercial
		-40	-	+85	°C	Industrial
Storage Temperature Range	T_stor	-55	-	+125	°C	Storage
<b>SUPPLY VOLTAGE AND CURRENT CONSUMPTION</b>						
Supply Voltage	VDD	1.71	1.8	1.89	V	
		2.25	2.5	2.75	V	
		2.52	2.8	3.08	V	
		2.97	3.3	3.63	V	
Current Consumption	IDD	-	3.7	4.1	mA	No load condition, f = 20 MHz, VDD = 2.5V, 2.8V, or 3.3V
		-	3.2	3.5	mA	No load condition, f = 20 MHz, VDD = 1.8V
Standby Current	I_std	-	2.4	4.3	$\mu$ A	ST = GND, VDD = 3.3V, output is pulled down
		-	1.2	2.2	$\mu$ A	ST = GND, VDD = 2.5V or 2.8V, output is pulled down
		-	0.4	0.8	$\mu$ A	ST = GND, VDD = 1.8V, output is pulled down
<b>LVCMOS OUTPUT CHARACTERISTICS</b>						
Duty Cycle	DC	45	-	55	%	All VDDs. f $\leq$ 70 MHz
		40	-	60	%	All VDDs. f > 70 MHz
Rise/Fall Time	Tr, Tf	-	1	2	ns	20% - 80% VDD = 2.5V, 2.8V or 3.3V, 15 pf load
		-	1.3	2.5	ns	20% - 80% VDD = 1.8V, 15 pf load

## GENERAL DATA (continued)

PARAMETER AND CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITION
<b>LVC MOS OUTPUT CHARACTERISTICS</b>						
Output High Voltage	VOH	90%	-	-	VDD	IOH = -4 mA (VDD = 3.3V) IOH = -3 mA (VDD = 2.8V and VDD = 2.5V) IOH = -2 mA (VDD = 1.8V)
Output Low Voltage	VOL	-	-	10%	VDD	IOL = -4 mA (VDD = 3.3V) IOL = -3 mA (VDD = 2.8V and VDD = 2.5V) IOL = -2 mA (VDD = 1.8V)
Output Load	Ld	-	-	15	pF	At maximum frequency and supply voltage. Contact Petermann-Technik for higher output load option.
<b>INPUT CHARACTERISTICS</b>						
Input High Voltage	VIH	70%	-	-	VDD	Pin 1, OE or ST or SD
Input Low Voltage	VIL	-	-	30%	VDD	Pin 1, OE or ST or SD
<b>STARTUP AND RESUME TIMING</b>						
Startup Time	T_start	-	-	10	ms	Measured from the time VDD reaches its rated minimum value
Resume Time	T_resume	-	3.0	3.8	ms	Measured from the time ST pin crosses 50% threshold
<b>JITTER</b>						
Cycle-to-Cycle Jitter	T_cyc	-	-	26	ps	f = 50 MHz, Spread = ON
		-	-	26	ps	f = 50 MHz, Spread = OFF
<b>EXCELLENT RELIABILITY DATA</b>						
MTBF						500 million hours
Shock Resistance						10.000 g
Vibration Resistance						70 g

## SPREAD SPECTRUM MODES<sup>[1]</sup>

CODE	CENTER SPREAD		DOWN SPREAD	
	A	B	C	D
PERCENTAGE	±0.25%	±0.50% <sup>[2]</sup>	-0.5%	-1.0% <sup>[3]</sup>

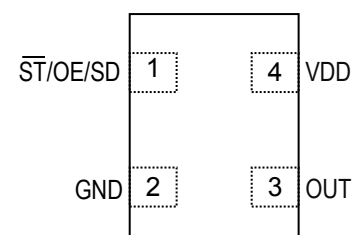
Note: 1. In both center spread and down spread modes, triangle modulation is employed with a frequency of ~32 kHz.

2. ±0.5% and -1.0% are available ONLY for <75 MHz in extended commercial temperature range.

## PIN DESCRIPTION

PIN	SYMBOL	FUNCTIONALITY
1	Standby (ST)	H or Open <sup>[4]</sup> ; specified frequency output. L: output is low (weak pull down). Oscillator stops.
	$\overline{ST/OE/SD}$ Output Enable (OE)	H or Open <sup>[4]</sup> ; specified frequency output. L: output is high impedance.
	Spread Disable (SD)	H or Open: Spread=ON (DOWN SPREAD ONLY) L: Spread=OFF
2	GND	Ground Connect to ground
3	OUT	Output Clock output
4	VDD	Power Supply

## TOP VIEW



Note: 3. In 1.8 V mode, a resistor of <10 kΩ between OE pin and VDD is recommended.

## TIMING DIAGRAMS

FIGURE 1. STARTUP TIMING (OE/ $\overline{ST}$  MODE)

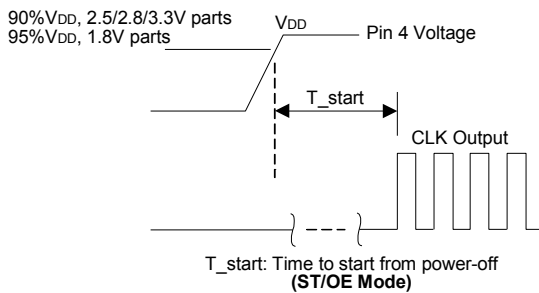
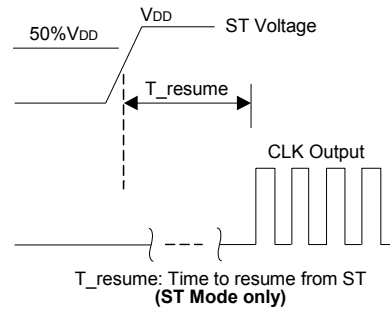


FIGURE 2. STANDBY RESUME TIMING ( $\overline{ST}$  MODE ONLY)



## PROGRAMMABLE DRIVE STRENGTH

The LPSS0 includes a programmable drive strength feature named SoftLevel to provide a simple, flexible tool to optimize the clock rise/fall time for specific applications. Benefits from the programmable drive strength feature are:

- + Improves system radiated electromagnetic interference (EMI) by slowing down the clock rise/fall time
- + Improves the downstream clock receiver's (RX) jitter by decreasing (speeding up) the clock rise/fall time.
- + Ability to drive large capacitive loads while maintaining full swing with sharp edge rates.

For more detailed information about rise/fall time control and drive strength selection, see the Petermann-Technik Applications Note section: <http://www.petermann-technik.com>

### EMI REDUCTION BY SLOWING RISE/FALL TIME (SoftLevel FUNCTION)

FIGURE 3. HARMONIC EMI REDUCTION AS A FUNCTION OF SLOWER RISE/FALL TIME (SoftLevel FUNCTION)

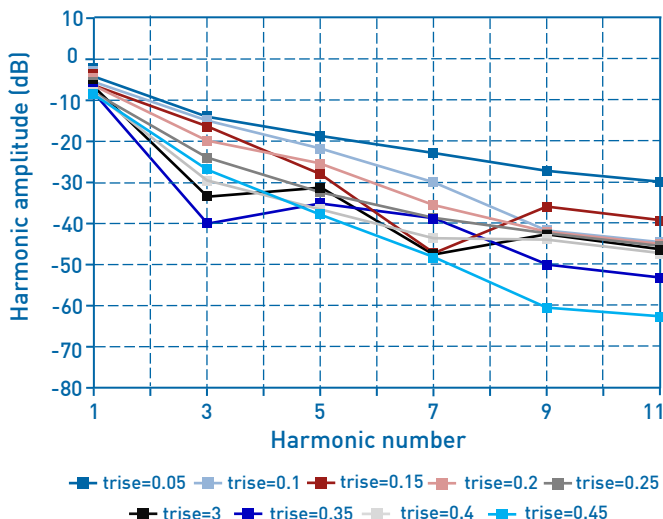


Figure 3 shows the harmonic power reduction as the rise/fall times are increased (slowed down). The rise/fall times are expressed as a ratio of the clock period. For the ratio of 0.05, the signal is very close to a square wave. For the ratio of 0.45, the rise/fall times are very close to near-triangular waveform. These results, for example, show that the 11th clock harmonic can be reduced by 35 dB if the rise/fall edge is increased from 5% of the period to 45% of the period.

### HIGH OUTPUT LOAD CAPABILITY

The rise/fall time of the input clock varies as a function of the actual capacitive load the clock drives. At any given drive strength, the rise/fall time becomes slower as the output load increases. As an example, for a 3.3V LPSS0 device with default drive strength setting, the typical rise/fall time is 1ns for 15 pF output load. The typical rise/fall time slows down to 2.6ns when the output load increases to 45 pF. One can choose to speed up the rise/fall time to 1.68ns by then increasing the drive strength setting on the LPSS0.

The LPSS0 can support up to 60 pF or higher in maximum capacitive loads with up to 3 additional drive strength settings. Refer to the Rise/Fall Time Tables to determine the proper drive strength for the desired combination of output load vs. rise/fall time.

### LPSS0 DRIVE STRENGTH SELECTION

Tables 1 through 4 define the rise/fall time for a given capacitive load and supply voltage.

1. Select the table that matches the LPSS0 nominal supply voltage (1.8V, 2.5V, 2.8V, 3.3V).
2. Select the capacitive load column that matches the application requirement (15 pF to 60 pF)
3. Under the capacitive load column, select the desired rise/fall times.
4. The left-most column represents the part number code for the corresponding drive strength.
5. Add the drive strength code to the part number for

## PROGRAMMABLE DRIVE STRENGTH (continued)

### CALCULATING MAXIMUM FREQUENCY

Based on the rise and fall time data given in Tables 1 through 4, the maximum frequency the oscillator can operate with guaranteed full swing of the output voltage over temperature as follows:

#### EXAMPLE 1

$$\text{Max. frequency} = \frac{1}{5 \times \text{Trf}_{20/80}}$$

Calculate  $f_{\text{MAX}}$  for the following condition:

- + VDD = 3.3V (Table 1)
- + Capacitive Load: 30pF
- + Desired Tr/f time = 1.6ns (rise/fall time part number code=**Z**)

Part number for the above example:

LPSS033-2520-E-50-M-25.000MHZ-T-S-A



Drive strength code is inserted here. Standard setting is "S"

## RISE/FALL TIME (20% TO 80%) vs $C_{\text{LOAD}}$ <sup>[4]</sup>

TABLE 1. RISE/FALL TIMES, VDD = 1.8V ±5%, T = 40°C TO 85°C

DRIVE STRENGTH		UNIT	LOAD (pF)			
			15	30	45	60
U	Max.	ns	4.2	6.8	9.4	12.1
	Typ.	ns	3.1	5.1	7.3	9.2
X	Max.	ns	3.2	4.9	6.9	8.7
	Typ.	ns	2.3	3.7	5.3	6.5
Z	Max.	ns	2.7	3.9	5.5	6.7
	Typ.	ns	1.7	2.9	4.2	5.2
S = standard	Max.	ns	2.5	3.3	4.6	5.7
	Typ.	ns	1.4	2.4	3.4	4.3

TABLE 2. RISE/FALL TIMES, VDD = 2.5V ±10%, T = 40°C TO 85°C

DRIVE STRENGTH		UNIT	LOAD (pF)			
			15	30	45	60
U	Max.	ns	2.8	4.6	6.8	8.3
	Typ.	ns	2.1	3.6	5.2	6.4
X	Max.	ns	2.3	3.3	5.0	5.9
	Typ.	ns	1.4	2.5	3.7	4.7
S = standard	Max.	ns	2.0	2.6	3.4	4.8
	Typ.	ns	1.1	1.9	2.8	3.6
H	Max.	ns	1.3	2.2	3.3	4.0
	Typ.	ns	0.9	1.6	2.3	2.9

TABLE 3. RISE/FALL TIMES, VDD = 2.8V ±10%, T = 40°C TO 85°C

DRIVE STRENGTH		UNIT	LOAD (pF)			
			15	30	45	60
U	Max.	ns	2.5	4.1	6.0	7.3
	Typ.	ns	2.0	3.2	4.8	5.9
X	Max.	ns	2.2	3.0	4.5	5.4
	Typ.	ns	1.3	2.2	3.3	4.3
S = standard	Max.	ns	2.0	2.4	3.5	4.3
	Typ.	ns	1.0	1.7	2.5	3.2
H	Max.	ns	1.2	1.9	2.9	3.6
	Typ.	ns	0.7	1.5	2.0	2.6

TABLE 4. RISE/FALL TIMES, VDD = 3.3V ±10%, T = 40°C TO 85°C

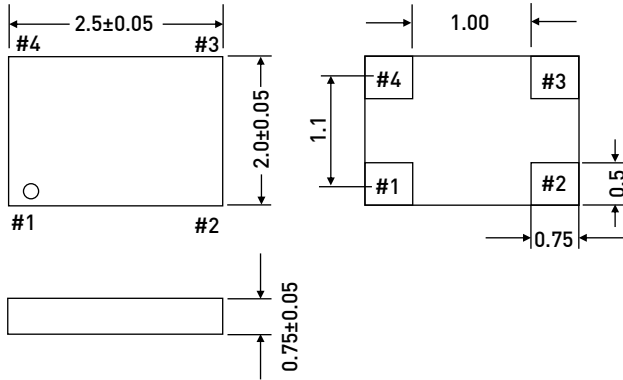
DRIVE STRENGTH		UNIT	LOAD (pF)			
			15	30	45	60
U	Max.	ns	2.4	3.5	5.5	6.4
	Typ.	ns	1.7	2.8	4.3	5.4
S = standard	Max.	ns	2.0	2.5	3.9	4.8
	Typ.	ns	1.1	2.0	2.9	3.8
Z	Max.	ns	1.2	2.0	3.0	3.7
	Typ.	ns	0.8	1.6	2.2	2.9
H	Max.	ns	0.9	1.7	2.5	3.0
	Typ.	ns	0.6	1.3	1.9	2.3

Note: 4. All rise/fall times are measured for the thresholds of 20% to 80% of VDD.

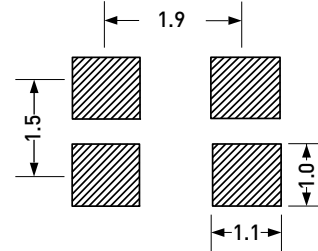
## DIMENSIONS AND PATTERNS

### PACKAGE SIZE - DIMENSIONS (UNIT:MM)

2.5 X 2.0 X 0.75 MM

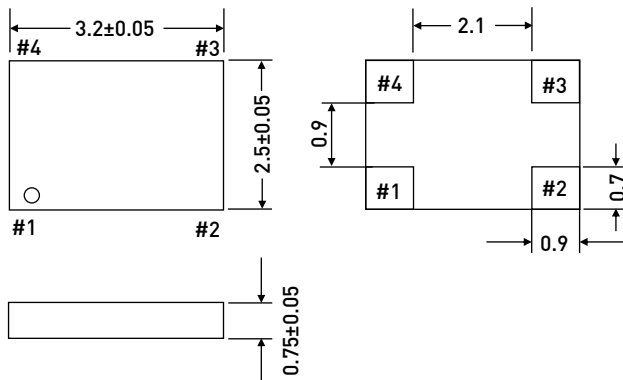


### RECOMMENDED LAND PATTERN (UNIT:MM)<sup>[5]</sup>

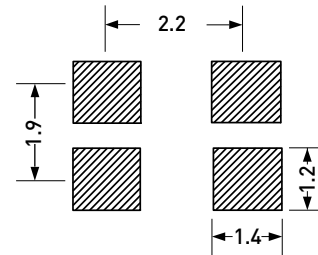


### PACKAGE SIZE - DIMENSIONS (UNIT:MM)

3.2 X 2.5 X 0.75 MM

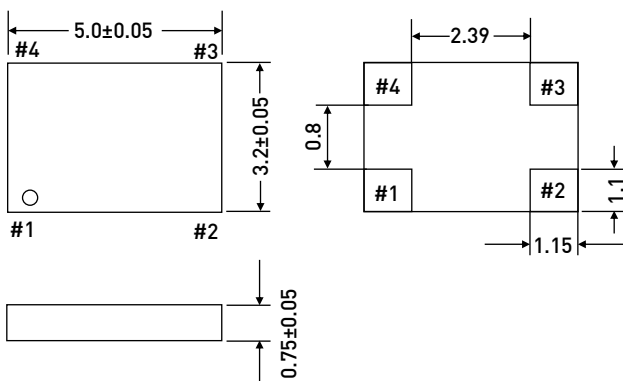


### RECOMMENDED LAND PATTERN (UNIT:MM)

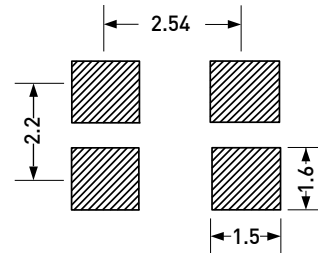


### PACKAGE SIZE - DIMENSIONS (UNIT:MM)

5.0 X 3.2 X 0.75 MM



### RECOMMENDED LAND PATTERN (UNIT:MM)

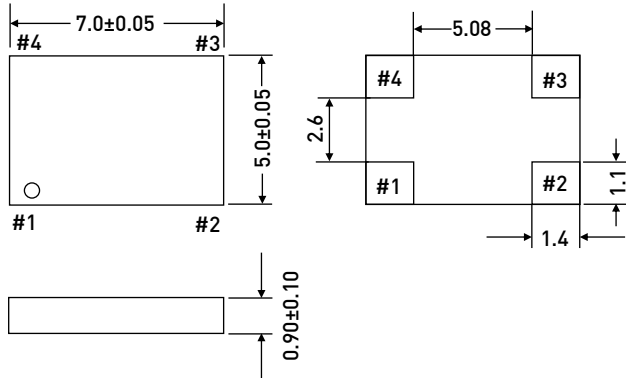


Note: 5. A capacitor value of 0.1 µF between VDD and GND is recommended.

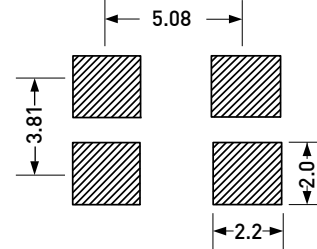
## DIMENSIONS AND PATTERNS

### PACKAGE SIZE - DIMENSIONS (UNIT:MM)

7.0 X 5.0 X 0.90 MM

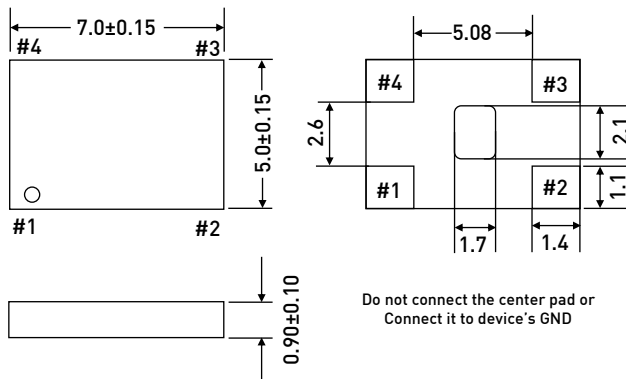


### RECOMMENDED LAND PATTERN (UNIT:MM)

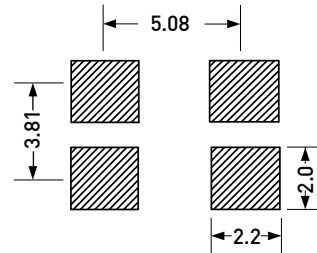


### PACKAGE SIZE - DIMENSIONS (UNIT:MM)

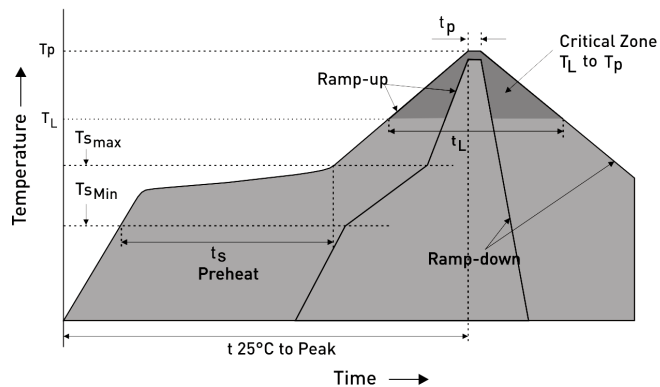
7.0 X 5.0 X 0.90 MM WITH CENTER-PAD



### RECOMMENDED LAND PATTERN (UNIT:MM)

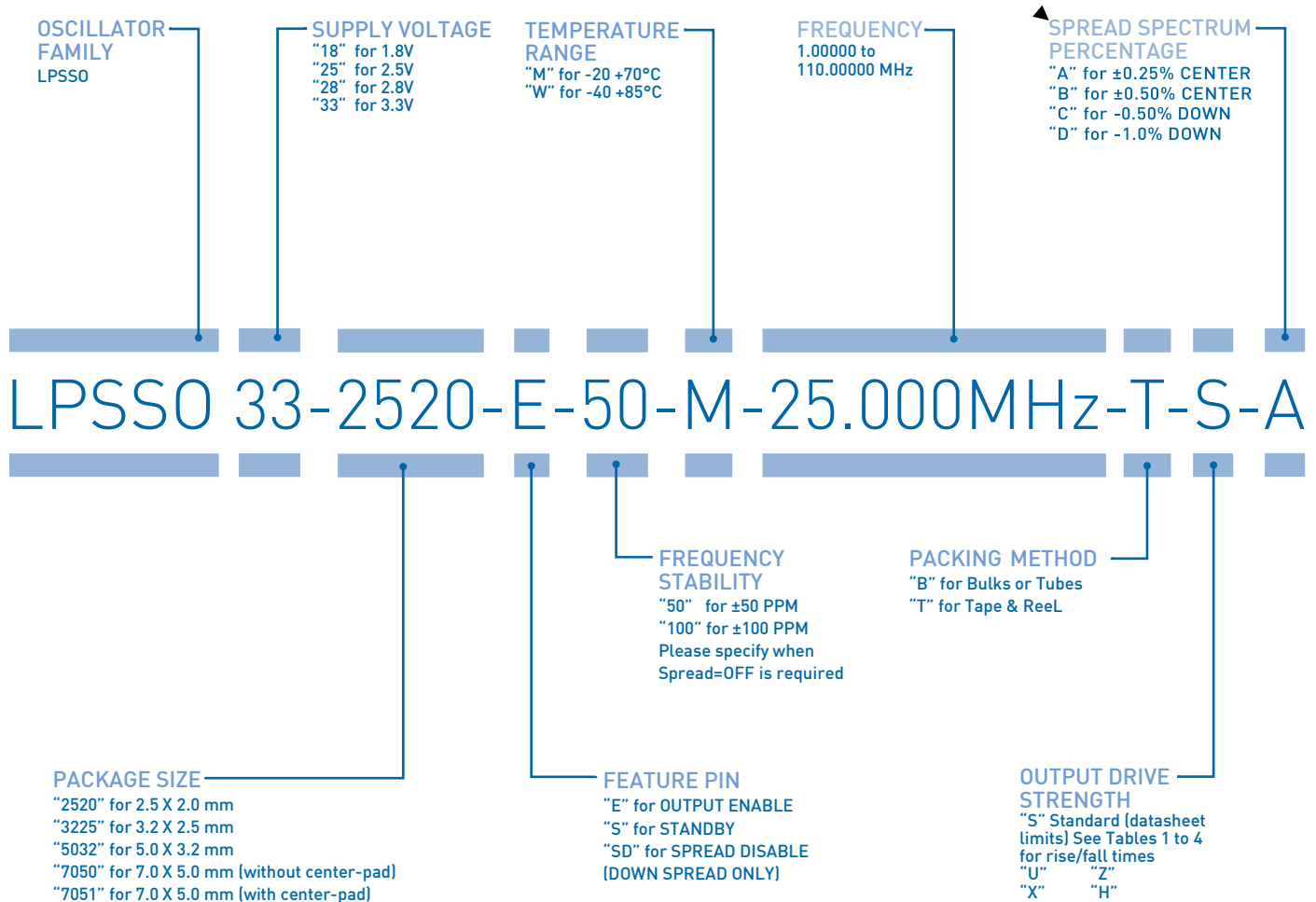


### REFLOW SOLDER PROFILE



IPC/JEDEC Standard	IPC/JEDEC J-STD-020
Moisture Sensitivity Level	Level 1
TS MAX to TL (Ramp-up Rate)	3°C/second Maximum
Preheat	
- Temperature Minimum (TS MIN)	150°C
- Temperature Typical (TS TYP)	175°C
- Temperature Typical (TS MAX)	200°C
- Time (ts)	60 - 180 Seconds
Ramp-up Rate (TL to TP)	3°C/second Maximum
Time Maintained Above:	
- Temperature (TL)	217°C
- Time (TL)	60 - 150 Seconds
Peak Temperature (TP)	260°C Maximum
Target Peak Temperature (TP Target)	255°C
Time within 5°C of actual peak (tP)	20 - 40 Seconds
Max. Number of Reflow Cycles	3
Ramp-down Rate	6°C/second Maximum
Time 25°C to Peak Temperature (t)	8 minutes Maximum

## ORDERING INFORMATION



EXAMPLE: LPSS033-2520-E-50-M-25.000MHZ-T-S-A  
[PLEASE CLICK HERE TO CREATE YOUR OWN ORDERING CODE](#)

**EXPRESS SAMPLES ARE DELIVERABLE ON THE SAME DAY  
IF ORDERED UNTIL 02:00 PM!**



## PREMIUM QUALITY BY PETERMANN-TECHNIK



OUR COMPANY IS CERTIFIED ACCORDING TO ISO 9001:2008 IN OCTOBER 2013 BY THE DMSZ CERTIFIKATION GMBH.

THIS IS FOR YOU TO ENSURE THAT THE PRINCIPLES OF QUALITY MANAGEMENT ARE FULLY IMPLEMENTED IN OUR QUALITY MANAGEMENT SYSTEM AND QUALITY CONTROL METHODS ALSO DOMINATE OUR QUALITY STANDARDS.