Marking

Because of the limited space available for part marking on some SMT packages, abbreviated marking codes are used to identify the device. These codes, if used, are identified in the individual SMT package data sheets.

Lead Finish and Solderability

Standard lead finish is electroplated 100% matte tin. LTC also offers electroplated PbSn (15% Pb/85% Sn) lead finish upon request. Both are electroplated with < 0.05% carbon content. Solderability meets the requirements of MIL-STD-883C, Method 2003. Recommended minimum solder pad dimensions are given with each package. (Note: Consideration should be given to your process and power requirements.)

Wave and Reflow Soldering for Lead Frame Packages (QFN, DFN, CLCC, SOIC, SSOP, TSSOP, MSOP, PDIP, TO-220/DD-Pak, TSOT, SOT, SC70 and LQFP)

Following are the recommended procedures for soldering surface mount packages to PC boards.

1. Wave Soldering

- Use solder plating boards.
- Dispense adhesive to hold components on board.
- Place components on board.
- Cure adhesive per adhesive manufacturer's specification.
- Preheat package temperature shall be between 100°C and 130°C.
- Foam flux using RMA (Rosin Mildly Activating) flux.
- Wave solder using a dual wave soldering system, see Figure 3 (Guideline for Dual-Wave Solder Profile), for details.
- Clean board.
- **Wave soldering is not recommended for SOT-223, QFN and DFN packages.**

2. Reflow Soldering Temperature Profile for SnPb and Matte Sn Lead Finishes

Linear Technology offers products with either SnPb or matte Sn finishes for lead frame packages (QFN, DFN, CLCC, SOIC, SSOP, TSSOP, MSOP, PDIP, TO-220/DD-PAK, TSOT, SOT, SC70, and LQFP) which are compatible with eutectic SnPb and SnAgCu/ SAC solder pastes for PCB assemblies. SMT reflow conditions per IPC/JEDEC J-STD-020 are recommended for SnPb finish and matte Sn finish products (see Figure 1 and Figure 2). It is recommended not to exceed a maximum three cycles of SMT reflow under the appropriate conditions.

Table 1. SnPb Eutectic Process–Classification Temperatures (T_P)

PACKAGE THICKNESS	VOLUME mm^3 <350	VOLUME mm^3 ≥350
<2.5mm	235°C	220°C
≥ 2.5mm	220°C	220°C

Table 2. Pb-free Process–Classification Temperatures (T_P)

PACKAGE THICKNESS	VOLUME mm^3 <350	VOLUME mm^3 350 to 2000	VOLUME mm^3 >2000
<1.6mm	260°C	260°C	260°C
1.6mm to 2.5 mm	260°C	250°C	245°C
> 2.5 mm	250 °C	245 °C	245 °C

Table 3. Classification of Reflow Profiles

PROFILE FEATURE	Sn-Pb EUTECTIC ASSEMBLY	Pb-FREE ASSEMBLY
Preheat and Soak Temperature Min (T_{SMIN}) Temperature Max (T_{SMAX}) Time (T_{SMIN} to T_{SMAX}) (t_S)	 100°C 150°C 60 to 120 Seconds	 150°C 200°C 60 to 120 Seconds
Average Ramp-Up Rate (T_{SMAX} to T_P)	3°C/Second Max	3°C/Second Max
Liquidous Temperature (T_L) Time at Liquidous (t_L)	183°C 60 to 150 seconds	217°C 60 to 150 seconds
Peak Package Body Temperature (T_P)	See Table 1	See Table 2
Time (t_P) Within 5°C of the Specified Classification Temperature (T_P)	20 Seconds Max	30 Seconds Max
Average Ramp-Down Rate (T_P to T_{SMAX})	6°C/Second Max	6°C/Second Max
Time 25°C to Peak Temperature	6 Minutes Max	8 Minutes Max

Note: Reflow profiles in this document are for classification/preconditioning and are not meant to specify board assembly profiles. Actual board assembly profiles should be developed based on specific process needs and board designs and should not exceed the parameters in Table 3.

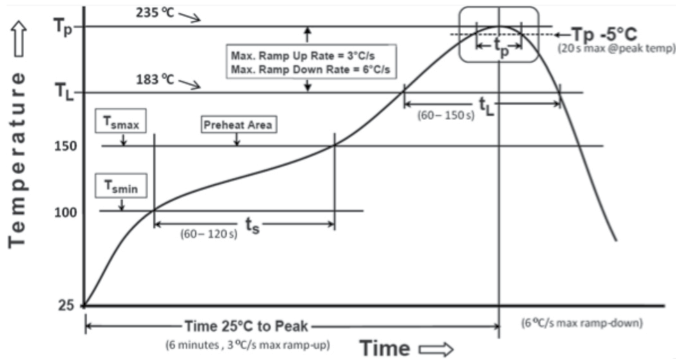


Figure 1. SnPb Eutectic Process–Reflow Profile (J-STD-020D)

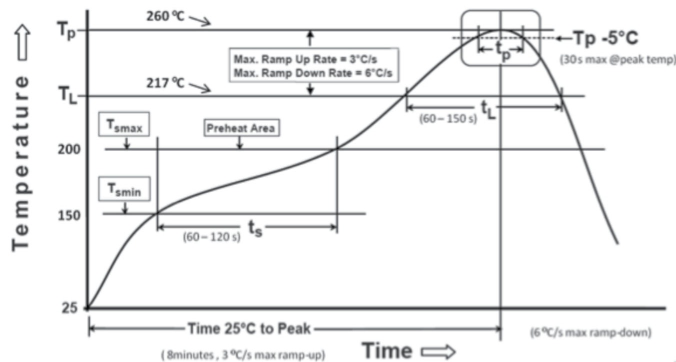


Figure 2. Pb Free Process–Reflow Profile (J-STD-020D)

3. Backward Compatibility

Lead frame package finishes are backward compatible, meaning that the component can be soldered with SnPb solder using SnPb soldering process. Lead frame packages that use a matte Sn plating on the leads which is compatible with both Pb-free soldering alloys and SnPb soldering alloy.

4. Hand Soldering

- **Hand soldering of packages is not recommended for QFN, DFN, CLCC leadless packages.**

5. Wave Solder Profile

Non-surface mount pin through-hole IC packages, the recommendation is to follow **IPC-7530-Guideline for Temperature Profiling for Massive Soldering Processes (See Figure 3) and IPC-9502-PWB Assembly Soldering Process Guideline for Electronic Components.** The ramp up, thermal spike, dwell time and maximum topside

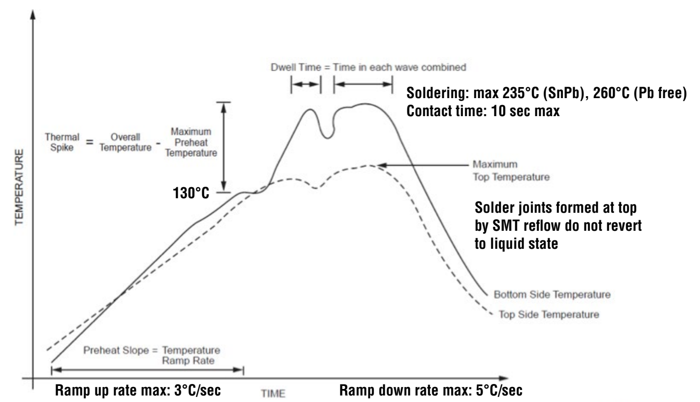


Figure 3. Guideline for Dual-Wave Solder Profile

temperature shall be carefully considered and simulated to ensure no damages to the components, PC boards and to achieve a good quality of solder joints.

Dry Pack in Moisture Barrier Bags

In the event of a requirement for Dry Pack, LTC employs as a guideline the methods of IPC-SM-786A, Procedures for Characterization of Moisture/Reflow Sensitive ICs.

Thermal Information

Table 4 shows the range of junction-to-ambient thermal resistance of SO devices mounted on a PCB of FR4 material with copper traces, in still air at 25°C. θ_{JA} with a ceramic substrate is about 70% of the FR4 value. Maximum power dissipation may be calculated by the following formula:

$$P_{DMAX}(T_A) = \frac{T_{JMAX} - T_A}{\theta_{JA}}$$

where,

T_{JMAX} = Maximum operating junction temperature.
T_A = Desired ambient operating temperature.
θ_{JA} = Junction-to-ambient thermal resistance.

Table 4. Typical Thermal Resistance Values

SO-8	150°C/W to 200°C/W	SO-18	70°C/W to 100°C/W
SO-14	100°C/W to 140°C/W	SO-20	70°C/W to 90°C/W
SO-16 (0.150)	90°C/W to 130°C/W	SO-24	60°C/W to 80°C/W
SO-16 (0.300)	85°C/W to 100°C/W	SO-28	55°C/W to 75°C/W

Conditions: PCB mount on FR4 material, still air at 25°C, copper trace.

Thermal resistance for power packages (DD and SOT-223) depends greatly on the individual device type. Please consult the device data sheets for thermal information.

More current data, by device type, may be obtained by contacting LTC, Marketing Department.

Tape and Reel Packing (See Tape and Reel Section)

Plastic Tube Packing

LTC's Surface Mount products are packed in "antistatic" plastic tubes with the tube dimensions indicated in Figure 2. Unit quantities packaged per tube are listed below in Table 5.

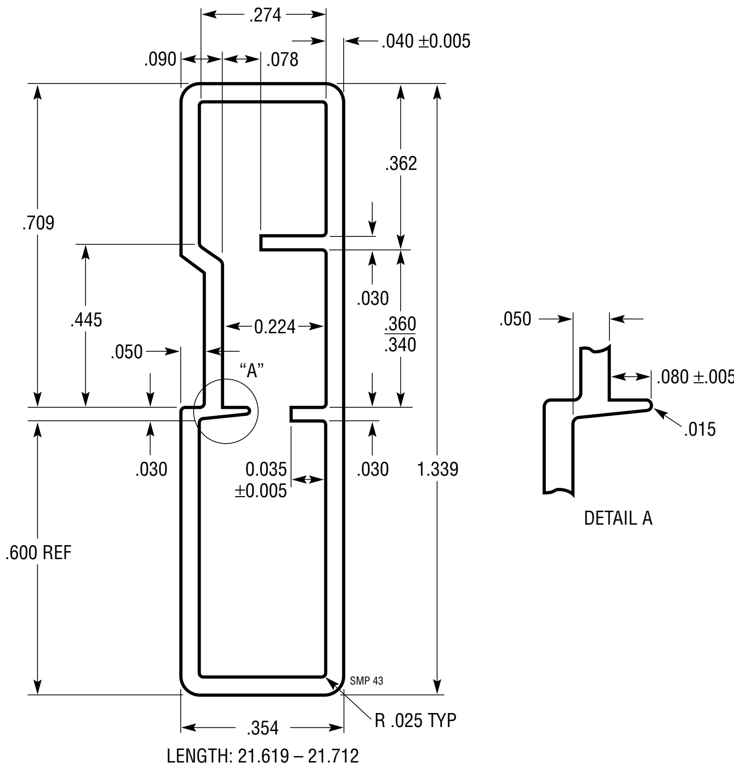
Table 5. Devices Per Tube

LTC Package Code Designator	LTC Package Type	Actual Lead Count	Number of Units
DC	DFN (2mm × 2mm)	3, 4, 6, 8	142
DCB	DFN (2mm × 3mm)	6, 8	95
DD	DFN (3mm × 3mm)	8, 10, 12	121
DDB	DFN (3mm × 2mm)	5, 8, 10, 12	95
DE, UE	DFN (4mm × 3mm)	12, 14, 16	91
DF	DFN (4mm × 4mm)	12	91
DH	DFN (5mm × 5mm)	16	73
DHC	DFN (5mm × 3mm)	16	73
DHD	DFN (5mm × 4mm)	16	73
DJC	DFN (6mm × 3mm)	22	61
DKD	DFN (7mm × 4mm)	24, 32	52
F, FE	TSSOP (4.4mm)	20	74
F, FE	TSSOP (4.4mm)	14, 16	95
FE	TSSOP (4.4mm)	24	62
FE	TSSOP (4.4mm)	28, 38	50
FW	TSSOP (6.1mm)	48	39
FW	TSSOP (6.1mm)	56	35
G	SSOP (5.3mm)	16	77
G	SSOP (5.3mm)	20	66
G	SSOP (5.3mm)	24	59
G	SSOP (5.3mm)	28	47
G	SSOP (5.3mm)	36, 44, 48	37
GN	SSOP (0.150)	16	100
GN	SSOP (0.150)	20, 24	55
GN	SSOP (0.150)	28	49
GW	SSOP (7.62mm)	36	32
GW	SSOP (7.62mm)	44	27
MS8, MS8E	MSOP (0.118)	8	50
MS, MSE	MSOP (0.118)	10	50
MS, MSE	MSOP (0.118)	12, 16	37
M, Q, R	DD	3, 5, 7	50

LTC Package Code Designator	LTC Package Type	Actual Lead Count	Number of Units
S8, S8E	SO (0.150)	8	100
S	SO (0.150)	14	55
S	SO (0.150)	16	50
ST	SOT-223	3	78
SW	SO (0.300)	16	47
SW	SO (0.300)	18	40
SW	SO (0.300)	20	38
SW	SO (0.300)	24	32
SW	SO (0.300)	28	27
UDB	QFN (3mm × 2mm)	10	95
UD	QFN (3mm × 3mm)	12,16, 20	121
UDC	QFN (3mm × 4mm)	20, 24	91
UDD	QFN (3mm × 5mm)	24	73
UDE	QFN (3mm × 6mm)	28	61
UF	QFN (4mm × 4mm)	16, 20, 24, 28	91
UFD	QFN (4mm × 5mm)	20, 24, 28	73
UFE	QFN (4mm × 6mm)	26, 38	61
UFF	QFN (4mm × 7mm)	36, 34, 44	52
UFH	QFN (4mm × 9mm)	44	40
UH	QFN (5mm × 5mm)	20, 32, 40, 24	73
UHE	QFN (5mm × 6mm)	28, 36, 42	61
UHF	QFN (5mm × 7mm)	38	52
UHG	QFN (5mm × 8mm)	39, 52	45
UHH	QFN (5mm × 9mm)	48, 56	40
UJ	QFN (6mm × 6mm)	40	61
UK	QFN (7mm × 7mm)	44, 48	52
UKG, WKG	QFN (7mm × 8mm)	52	45
UKH, WKH	QFN (7mm × 9mm)	64	40
UKJ	QFN (7mm × 11mm)	64	33
UKK	QFN (7mm × 12mm)	64	30
UP, WP	QFN (9mm × 9mm)	64	40

PLASTIC TUBE SPECIFICATIONS

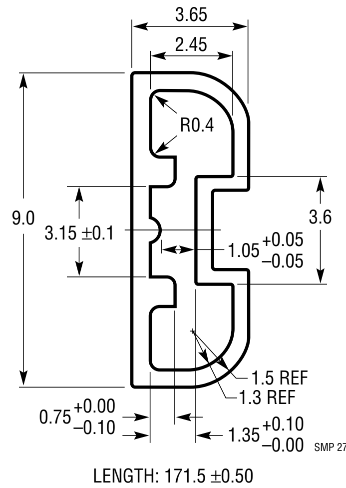
DD Pak
M, Q, R Package Shipping Tube



LENGTH: 21.619 – 21.712

NOTE: ALL DIMENSIONS ARE IN INCHES, ±.010
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

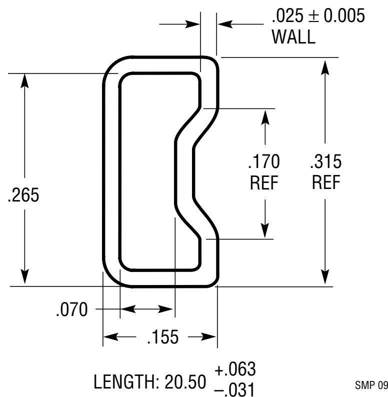
MSOP
MS8 Package Shipping Tube



LENGTH: 171.5 ±0.50

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS, ±0.15
UNLESS OTHERWISE STATED.
MATERIAL: POLYCARBONATE, ANTISTATIC TREATED

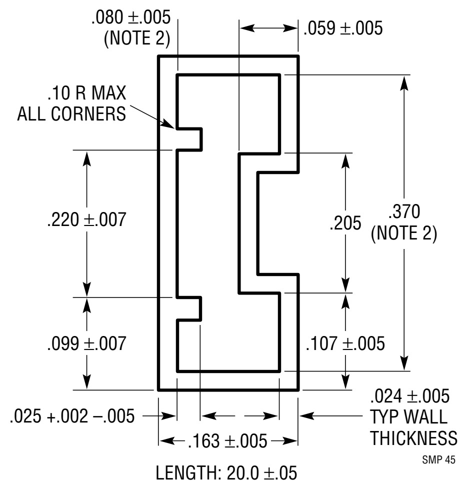
S (0.150)
SO Package Shipping Tube



LENGTH: 20.50 $^{+.063}_{-.031}$

NOTE: ALL DIMENSIONS ARE IN INCHES, ±.010
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

SSOP
G Package Shipping Tube

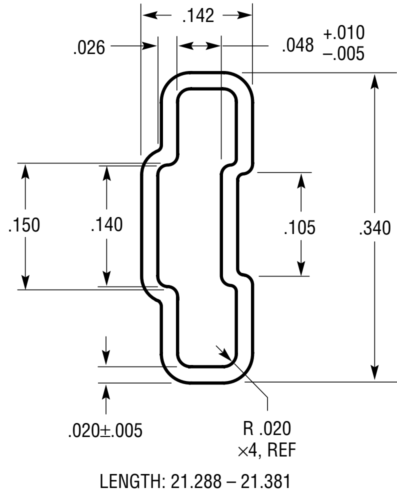


LENGTH: 20.0 ±.05

NOTE: ALL DIMENSIONS ARE IN INCHES, ±.010
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

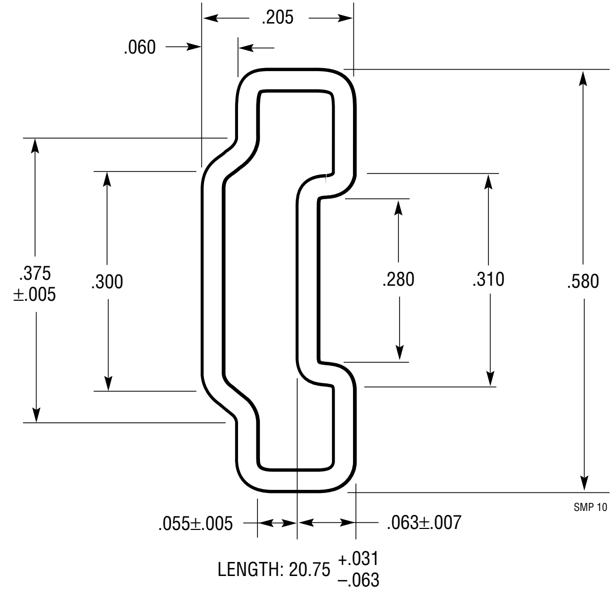
PLASTIC TUBE SPECIFICATIONS

ST
SOT-223 Package Shipping Tube



NOTE: ALL DIMENSIONS ARE IN INCHES, ±.010
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

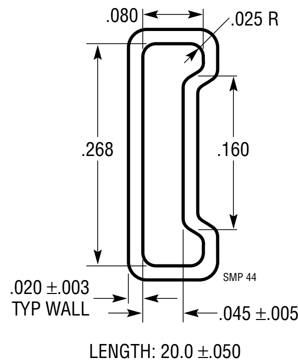
SW (0.300)
SO Package Shipping Tube



LENGTH: 20.75 +.031 –.063

NOTE: ALL DIMENSIONS ARE IN INCHES, ±.010
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

TSSOP
F, FE Package Shipping Tube

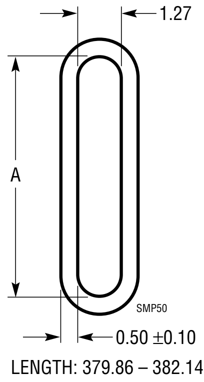


LENGTH: 20.0 ±.050

NOTE: ALL DIMENSIONS ARE IN INCHES, ±.010
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

PLASTIC TUBE SPECIFICATIONS

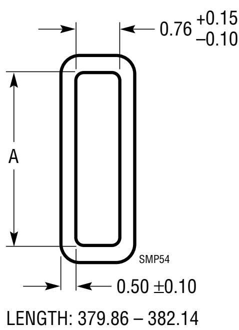
DFN/QFN
0.80mm Thick Package Shipping Tube



NOTE: ALL DIMENSIONS ARE IN MILLIMETERS, ±0.25
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

MINIMUM PACKAGE WIDTH	A DIMENSION
3mm	3.50 ±0.20
4mm	4.50 ±0.20
5mm	5.50 ±0.20
6mm	6.50 ±0.20
7mm	7.50 ±0.20
9mm	9.50 ±0.20

UTDFN/UTQFN
0.60mm Thick Package Shipping Tube



NOTE: ALL DIMENSIONS ARE IN MILLIMETERS, ±0.25
UNLESS OTHERWISE STATED.
MATERIAL: PVC, ANTISTATIC TREATED

MINIMUM PACKAGE WIDTH	A DIMENSION
3mm	3.50 ±0.20
4mm	4.50 ±0.20
5mm	5.50 ±0.20
7mm	7.50 ±0.20