ALPHA & OMEGA SEMICONDUCTOR, INC.

March 2002

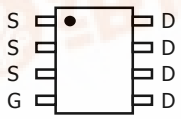
AO4406
N-Channel Enhancement Mode Field Effect Transistor

General Description

The AO4406 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 2.5V. This device makes an excellent high side switch for notebook CPU core DC-DC conversion.

Features

V_{DS} (V) = 30V
I_D = 11.5A
$R_{DS(ON)}$ < 14mΩ (V_{GS} = 10V)
$R_{DS(ON)}$ < 16.5mΩ (V_{GS} = 4.5V)
$R_{DS(ON)}$ < 26mΩ (V_{GS} = 2.5V)



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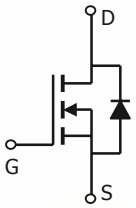

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	30	V
Gate-Source Voltage		V_{GS}	±12	V
Continuous Drain Current [A]	T_A=25°C	I_D	11.5	A
	T_A=70°C		9.6	
Pulsed Drain Current [B]		I_{DM}	80	
Avalanche Current [B,E]		I_{AV}	25	A
Repetitive Avalanche Energy [B,E] L=0.1mH		E_{AV}	78	mJ
Power Dissipation	T_A=25°C	P_D	3	W
	T_A=70°C		2.1	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics

Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	23	40	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		48	65	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	12	16	°C/W

Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=250µA, V_{GS}=0V	30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=24V, V_{GS}=0V			1	µA
		T_J=55°C			5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}= ±12V			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=250µA	0.8	1	1.5	V
$I_{D(ON)}$	On state drain current	V_{GS}=4.5V, V_{DS}=5V	60			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=12A		11.5	14	mΩ
		T_J=125°C		16	19.2	
		V_{GS}=4.5V, I_D=10A		13.5	16.5	mΩ
		V_{GS}=2.5V, I_D=8A		19.5	26	mΩ
g_{FS}	Forward Transconductance	V_{DS}=5V, I_D=10A	25	38		S
V_{SD}	Diode Forward Voltage	I_S=10A,V_{GS}=0V		0.83	1	V
I_S	Maximum Body-Diode Continuous Current				4.5	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=15V, f=1MHz		1630		pF
C_{oss}	Output Capacitance			201		pF
C_{rss}	Reverse Transfer Capacitance			142		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		0.8		Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=4.5V, V_{DS}=15V, I_D=11.5A		18		nC
Q_{gs}	Gate Source Charge			2.5		nC
Q_{gd}	Gate Drain Charge			5.5		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=15V, R_L=1.2Ω, R_{GEN}=3Ω		4		ns
t_r	Turn-On Rise Time			5		ns
$t_{D(off)}$	Turn-Off DelayTime			32		ns
t_f	Turn-Off Fall Time			5		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=10A, dI/dt=100A/µs		18,7		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=10A, dI/dt=100A/µs		19.8		nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The value in any a given application depends on the user's specific board design. The current rating is based on the t ≤ 10s thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.

D. The static characteristics in Figures 1 to 6 are obtained using 80µs pulses, duty cycle 0.5% max.

E. These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The SOA curve provides a single pulse rating.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

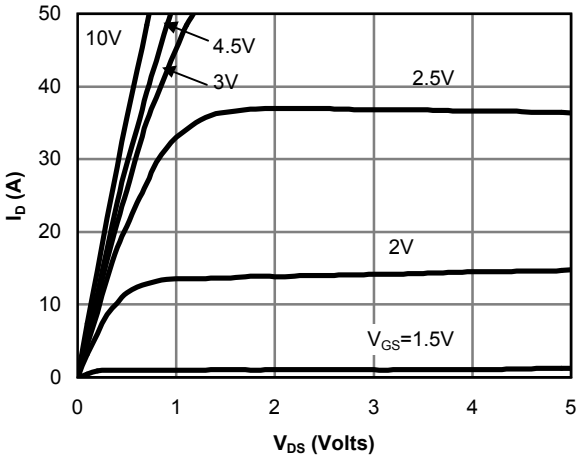

Fig 1: On-Region Characteristics

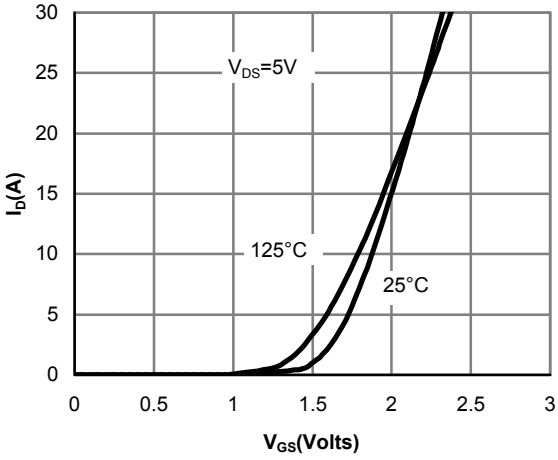

Figure 2: Transfer Characteristics

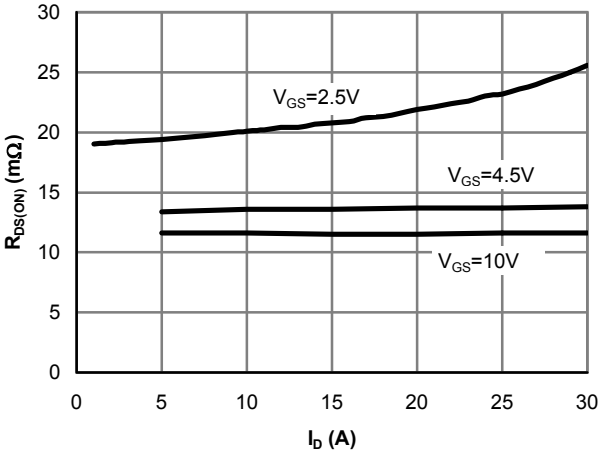

Figure 3: On-Resistance vs. Drain Current and Gate Voltage

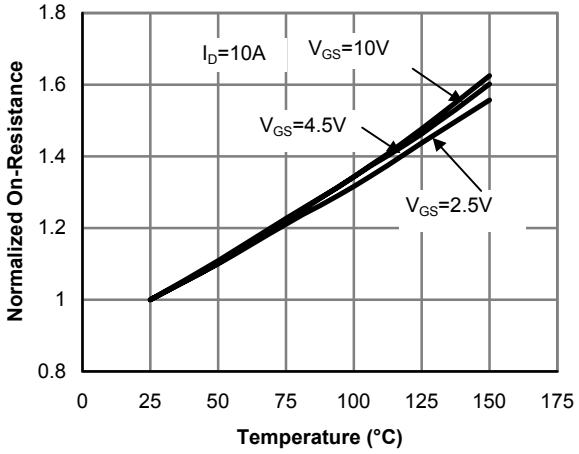

Figure 4: On-Resistance vs. Junction Temperature

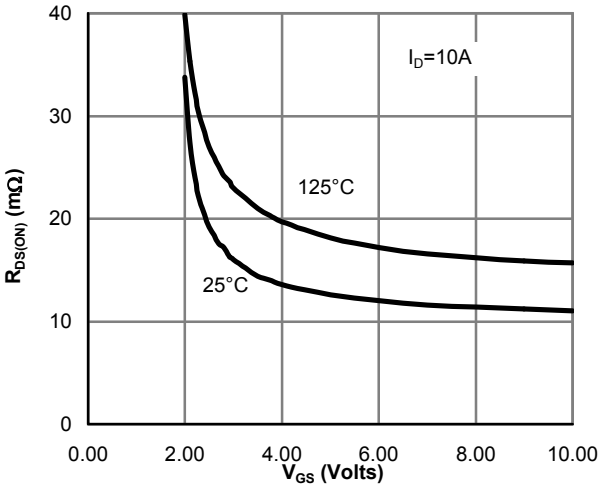

Figure 5: On-Resistance vs. Gate-Source Voltage

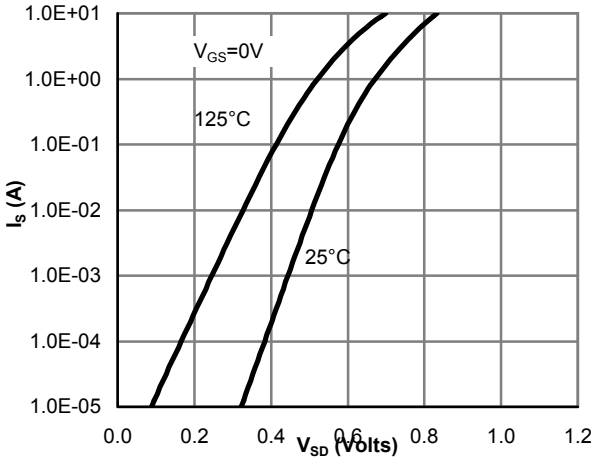

Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

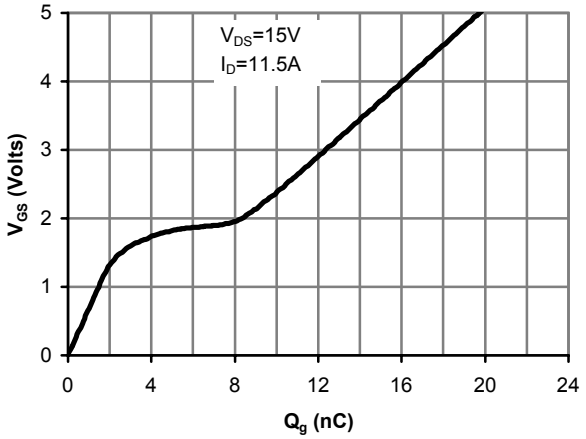

Figure 7: Gate-Charge Characteristics

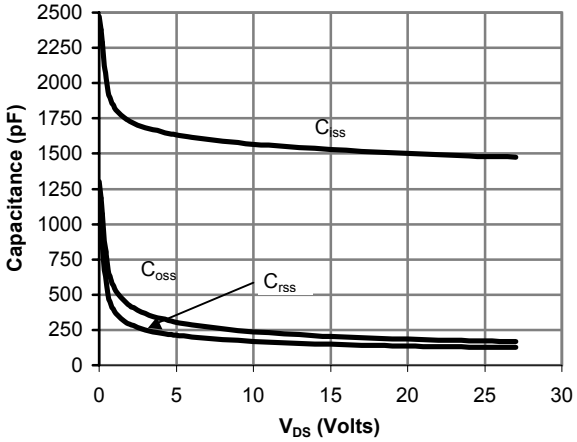

Figure 8: Capacitance Characteristics

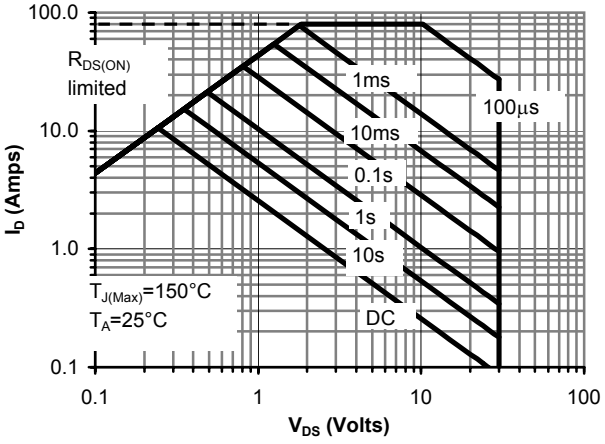

Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

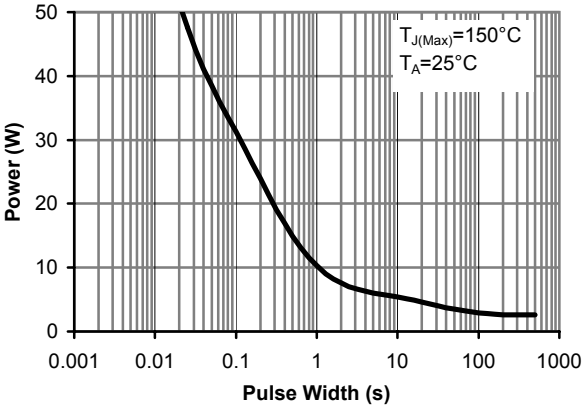

Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

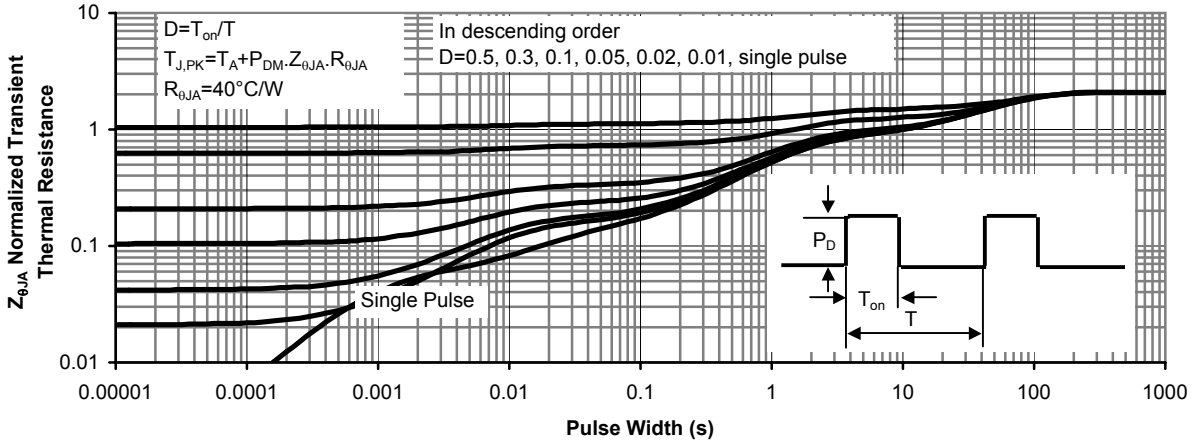

Figure 11: Normalized Maximum Transient Thermal Impedance

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

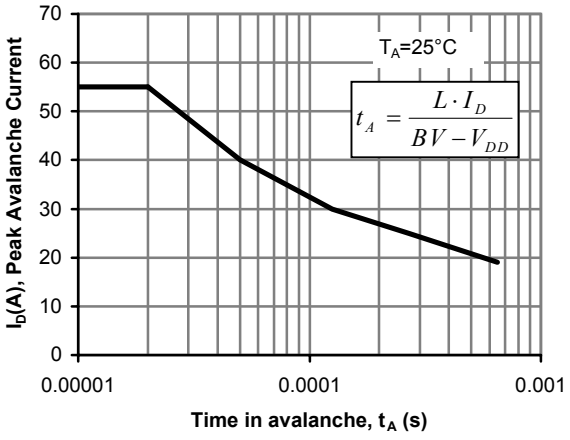

Figure 12: Avalanche capability

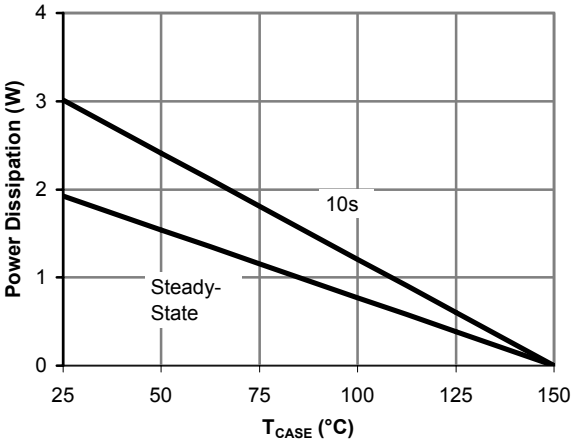

Figure 13: Power De-rating (Note A)

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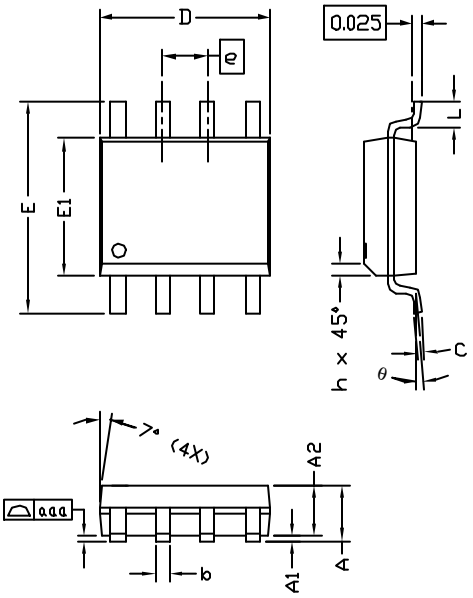
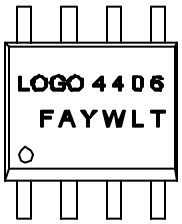
SO-8 Package Data



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.45	1.50	1.55	0.057	0.059	0.061
A1	0.00	——	0.10	0.000	——	0.004
A2	——	1.45	——	——	0.057	——
b	0.33	——	0.51	0.013	——	0.020
c	0.19	——	0.25	0.007	——	0.010
D	4.80	——	5.00	0.189	——	0.197
E1	3.80	——	4.00	0.150	——	0.157
e	1.27 BSC			0.050 BSC		
E	5.80	——	6.20	0.228	——	0.244
h	0.25	——	0.50	0.010	——	0.020
L	0.40	——	1.27	0.016	——	0.050
aaa	——	——	0.10	——	——	0.004
θ	0°	——	8°	0°	——	8°

NOTE:
1. LEAD FINISH: 150 MICROINCHES (3.8 um) MIN. THICKNESS OF Tin/Lead (SOLDER) PLATED ON LEAD
2. TOLERANCE ±0.10 mm (4 mil) UNLESS OTHERWISE SPECIFIED
3. COPLANARITY : 0.10 mm
4. DIMENSION L IS MEASURED IN GAGE PLANE

PACKAGE MARKING DESCRIPTION

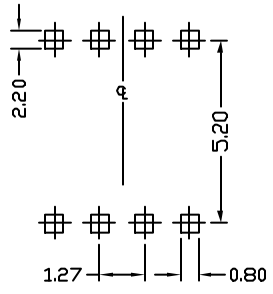


NOTE:
LOGO - AOS LOGO
4406 - PART NUMBER CODE.
F - FAB LOCATION
A - ASSEMBLY LOCATION
Y - YEAR CODE
W - WEEK CODE.
L N - ASSEMBLY LOT CODE

SO-8 PART NO. CODE

PART NO.	CODE
AO4406	4406

RECOMMENDED LAND PATTERN



UNIT: mm

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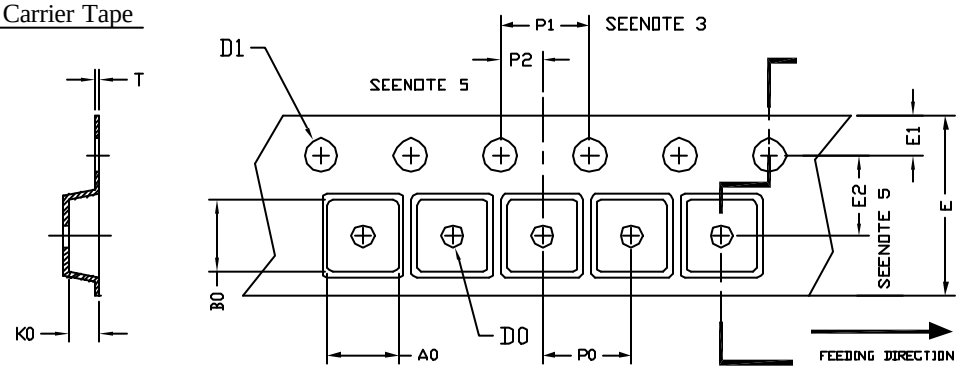
SO-8 Tape and Reel Data

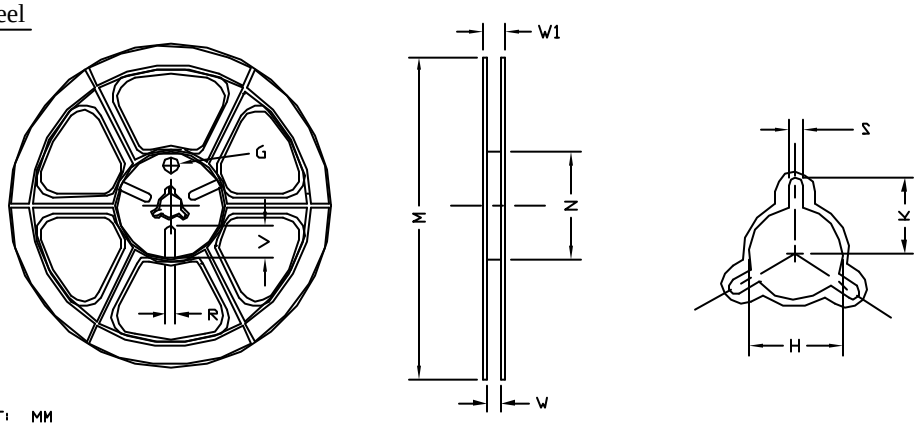
SO-8 Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
SO-8 (12 mm)	6.40 ±0.10	5.20 ±0.10	2.10 ±0.10	1.60 ±0.10	1.50 +0.10	12.00 ±0.30	1.75 ±0.10	5.50 ±0.05	8.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.25 ±0.05

SO-8 Reel



UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	W1	H	K	S	G	R	V
12 mm	ø330	ø330.00 ±0.50	ø97.00 ±0.10	13.00 ±0.30	17.40 ±1.00	ø13.00 +0.50 -0.20	10.60	2.00 ±0.50	---	---	---

SO-8 Tape

Leader / Trailer & Orientation