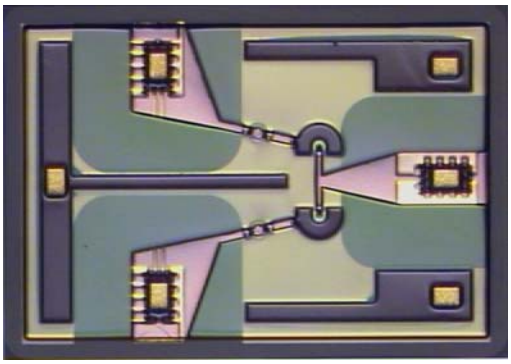
MASW-002103-1363

HMIC™ Silicon PIN Diode SPDT Switch
50 MHz - 20 GHz

Rev. V7

Features

- Specified from 50 MHz to 20 GHz
- Usable up to 26 GHz
- Low Insertion Loss
- High Isolation
- Low Parasitic Capacitance and Inductance
- RoHS Compliant Surmount™ Package
- Rugged, Fully Monolithic
- Glass Encapsulated Construction
- Up to +38 dBm C.W. Power Handling[1] @ +25°C
- Silicon Nitride Passivation
- Polymer Scratch Protection



Description

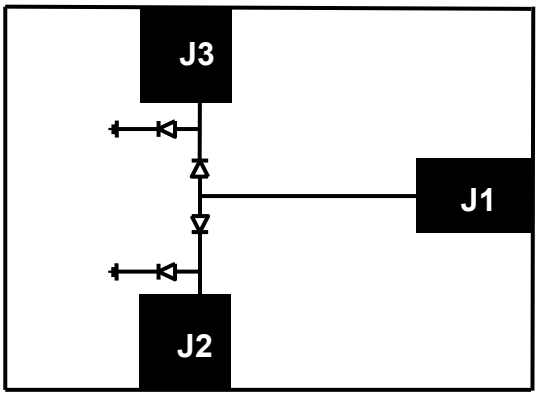
The MASW-002103-1363 is a Surmount™ broadband monolithic SPDT switch using series and shunt connected silicon PIN diodes. This part is designed for use as a moderate signal, high performance switch in applications up to 20 GHz. This Surface Mount chipscale configuration is optimized for broadband performance with minimal associated parasitics usually associated with hybrid MMIC designs incorporating beam lead and PIN diodes that require chip and wire assembly.

The MASW-002103-1363 is fabricated using M/A-COM Tech's patented HMIC™ (Heterolithic Microwave Integrated Circuit) process, US Patent 5,268,310. This process allows the incorporation of silicon pedestals that form series and shunt diodes or vias by imbedding them in low loss, low dispersion glass. By using small spacing between elements, this combination of silicon and glass gives HMIC devices low loss and high isolation performance through low millimeter frequencies.

Selective backside metalization is applied producing a surface mount device. The topside is fully encapsulated with silicon nitride and has an additional polymer layer for scratch and impact protection. These protective coatings prevent damage to the junction and the anode airbridge during handling and assembly.

1. Power Handling Testing performed @ 2GHz

Functional Schematic



Pin Configuration [2]

Pin	Function
J1	RFC
J2	RF1
J3	RF2

2. The exposed pad centered on the chip bottom must be connected to RF and DC ground.

Ordering Information

Part Number	Package
MASW-002103-13630G	50 piece gel pack
MASW-002103-13635P	500 piece reel
MASW-002103-13630P	3000 piece reel
MASW-002103-001SMB	Sample Test Board

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Electrical Specifications: T_A = 25°C, P_{IN} = 0 dBm, Z_0 = 50 Ω, 20mA/-10V

Parameter	Frequency	Units	Min.	Typ.	Max.
Insertion Loss	6 GHz 13 GHz 20 GHz	dB	— — —	0.55 0.80 1.05	0.63 0.93 1.25
Input to Output Isolation	6 GHz 13 GHz 20 GHz	dB	45 33 23	52 38 27	— — —
Return Loss	6 GHz 13 GHz 20 GHz	dB	20 17.3 16.5	25 23 23	— — —
Input 0.1dB Compression Point	2 GHz	dBm	—	36	—
IIP3	0.05 GHz, 5 MHz Spacing, +10dBm 0.5 GHz, 5 MHz Spacing ,+20dBm 1 GHz, 10 MHz Spacing, +20dBm 2 GHz, 10 MHz Spacing, +20dBm	dBm	— — — —	45 59 63 66	— — — —
Switching Speed [3]	—	ns	—	20	—
Voltage Rating [4]	—	V	—	—	80

3. Typical Switching Speed measured fro 10% to 90 % of detected RF signal driven by TTL compatible drivers.
4. Maximum reverse leakage current in either the shunt or series PIN diodes shall be 0.5 uA maximum @ -80 volts.

Absolute Maximum Ratings [5,6]

Parameter	Absolute Maximum
Operating Temperature	-65 °C to +125 °C
Storage Temperature	-65 °C to +150 °C
Junction Temperature	+175 °C
Applied Reverse Voltage	|-80 V|
RF CW Incident Power	38dBm CW @ 2GHz,+25ºC 33dBm CW @ 20GHz,+25ºC
Bias Current +25°C	± 50 mA

Max Operating Conditions for combination RF Pwr, DC Bias, & Temp: 33dBm CW @ 20mA per Diode @ +85ºC @ 2GHz

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. M/A-COM Tech does not recommend sustained operation near these survivability limits.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These devices are rated at Class 1A Human Body Model. Proper ESD control techniques should be used when handling these devices.

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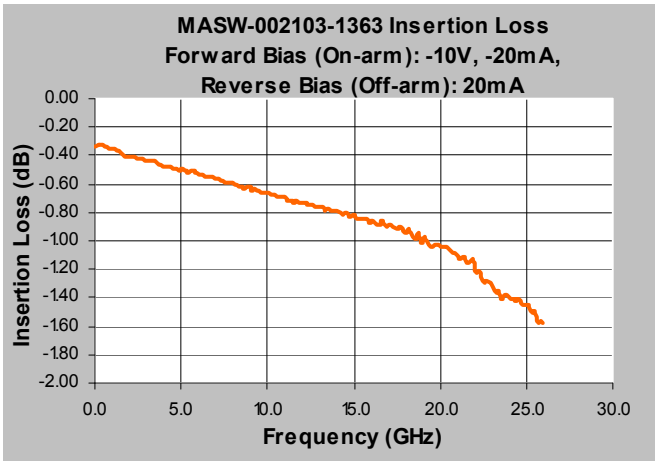
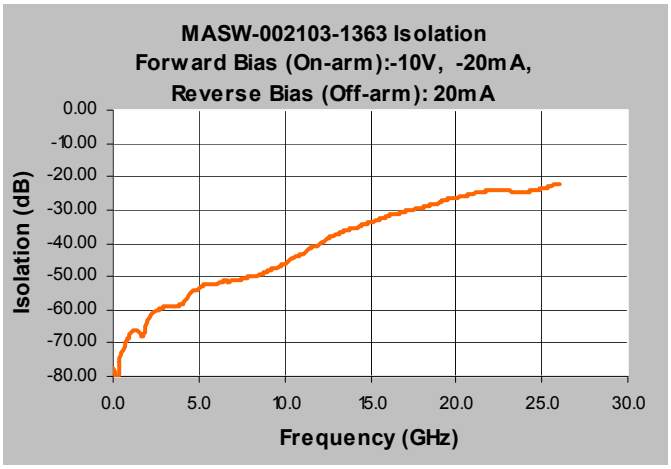
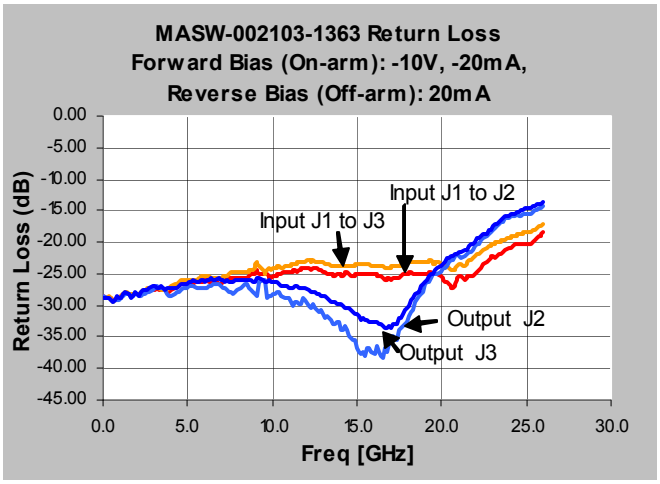
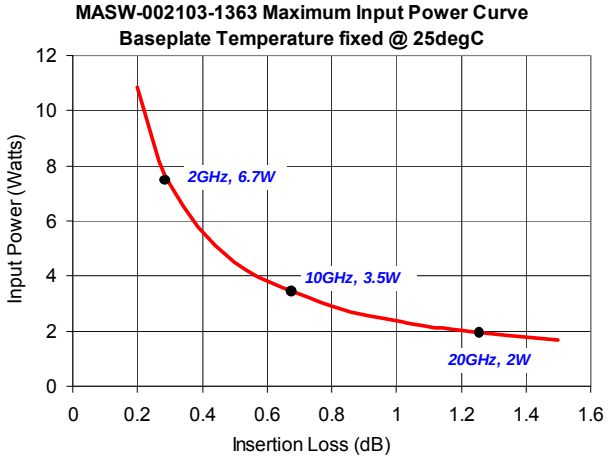
Typical Small Signal Performance at +25°C (On-Wafer RF Test)









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Bias Control

Optimal operation of the MASW-002103-1363 is achieved by simultaneous application of negative DC voltage and current to the low loss switching arm and positive DC voltage and current to the remaining switching arm as shown in the applications circuit below. DC return is achieved via R2 on the RFC path.

In the low loss state, the series diode must be forward biased with current and the shunt diode reverse biased with voltage. In the isolated arm, the shunt diode is forward biased with current and the series diode is reverse biased with voltage.

Driver Connections

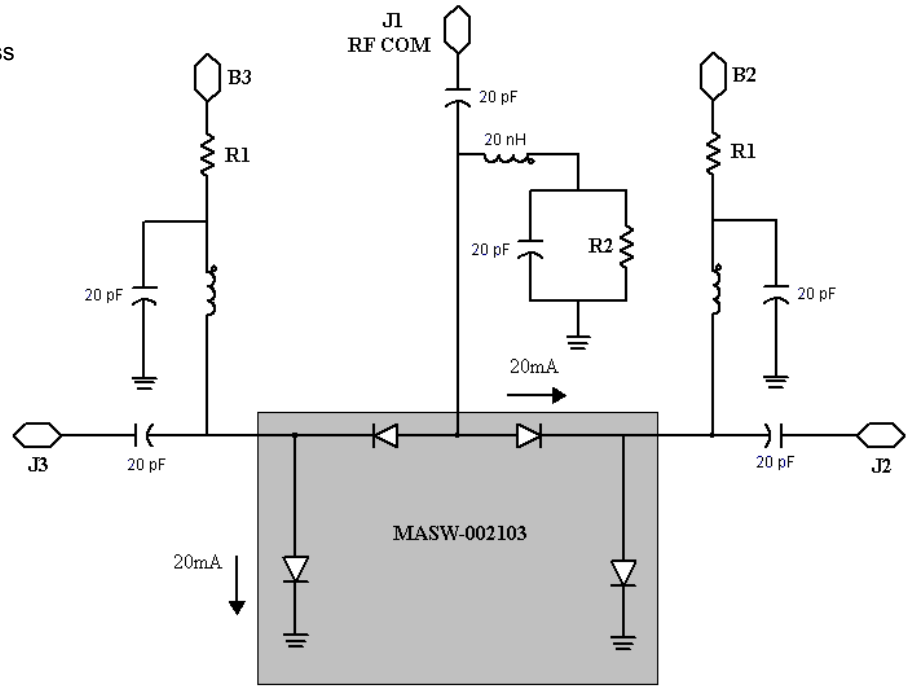
Control Level (DC Currents and Voltages)		Condition of RF Output	Condition of RF Output
B2	B3	J1-J2	J1-J3
-15V at -20mA [7]	6V at +20mA	Low Loss	Isolation
6V at + 20mA	-15V at -20mA[7]	Isolation	Low Loss

7. As long as 20mA is applied through the on diodes, the voltage can vary.

Application Circuit [8,9,10,11,12]

Example:

J1 to J2→ Low Loss
R1 = 250Ω
R2 = 450Ω
B2 = -15V
B3 = 6V



Notes:

8. Assume Vf ~ 1V at 20mA
9. R1 = 5V / 0.02A = 250Ω; R2 = 9V / 0.02A = 450Ω
10. P_{R1} = 0.02A x 0.02A x 250 = 0.1 W
11. P_{R2} = 0.02A x 0.02A x 450 = 0.18 W
12. Inductors are bias RF chokes. The operating band width of a broad-band PIN diode switch is often dependent on the bias components, particularly the RF bias chokes. It is suggested that the frequency response be checked with all the bias components attached before installing the PIN diode.

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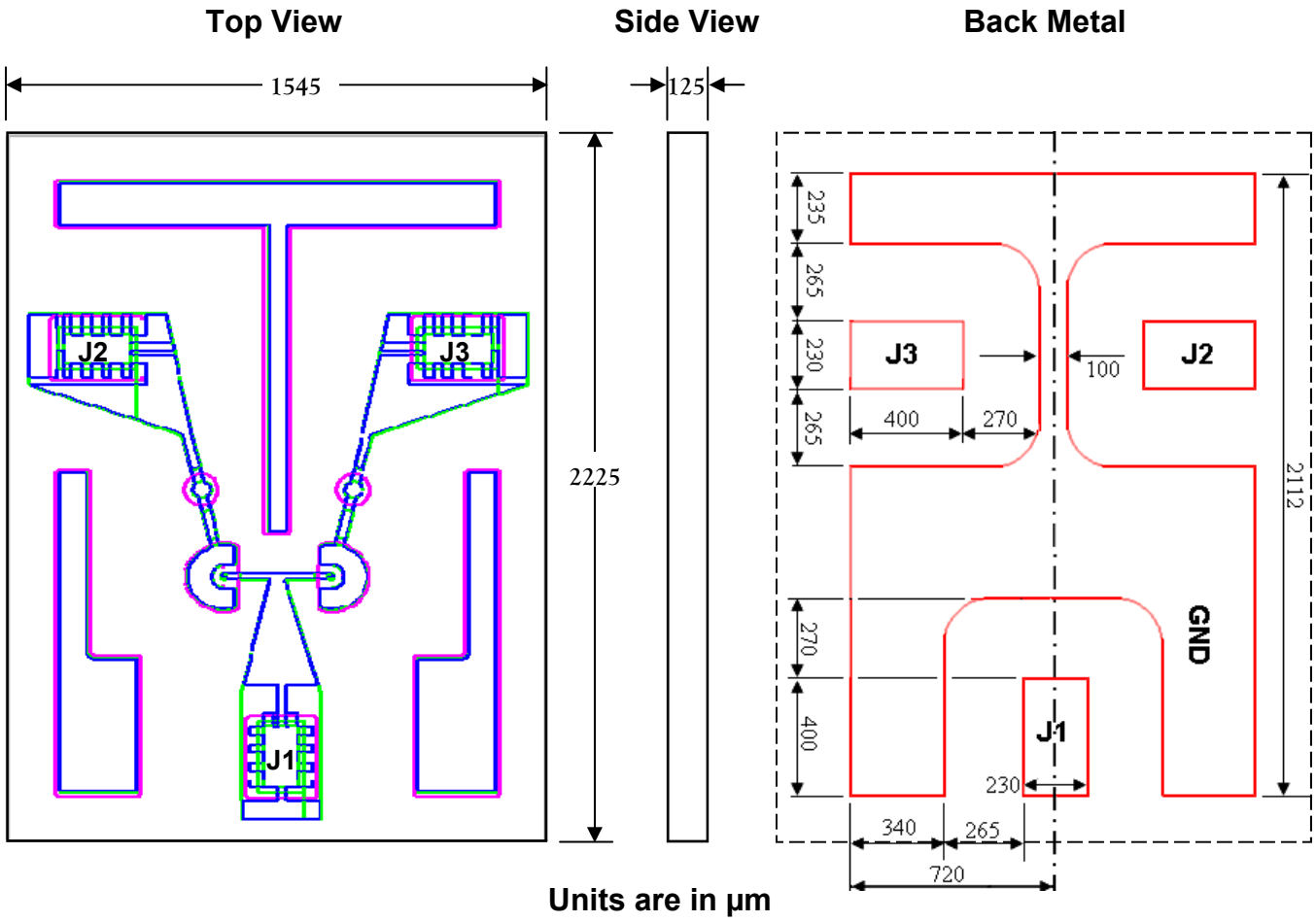
MASW-002103-1363 Outline Drawing



Units are in µm

MASW- 002103-1363				
DIM	Inches		mm	
	MIN	MAX	MIN	MAX
Width	0.060	0.062	1.52	1.57
Length	0.087	0.089	2.20	2.25
Thickness	0.004	0.006	0.10	0.15

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Handling Procedures

Attachment to a circuit board is made simple through the use of standard surface mount technology. Mounting pads are conveniently located on the bottom surface of these devices and are removed from the active junction locations. These devices are well suited for solder attachment onto hard and soft substrates. The use of 80Au/20Sn, or RoHS compliant solders is recommended. For applications where the average power is ≤ 1W, conductive silver epoxy may also be used. Cure per manufacturers recommended time and temperature. Typically 1 hour at 150°C.

When soldering these devices to a hard substrate, a solder re-flow method is preferred. A vacuum tip pick-up tool and a force of 60 to100 grams applied to the top surface of the device while placing the chip is recommended. When soldering to soft substrates, such as Duroid, it is recommended to use a soft solder at the circuit board to mounting pad interface to minimize stress due to any TCE mismatches that may exist. Position the die so that its mounting pads are aligned with the circuit board mounting pads. Solder reflow should not be performed by causing heat to flow through the top surface of the die to the back. Since the HMIC glass is transparent, the edges of the mounting pads can be visually inspected through the die after attachment is completed.

Typical re-flow profiles for Sn60/Pb40 and RoHS compliant solders is provided in Application Note M538 , “Surface Mounting Instructions“ and can viewed on the MA-COM Technology Solutions website @ www.macomtech.com

Sample Board

Samples test boards are available upon request

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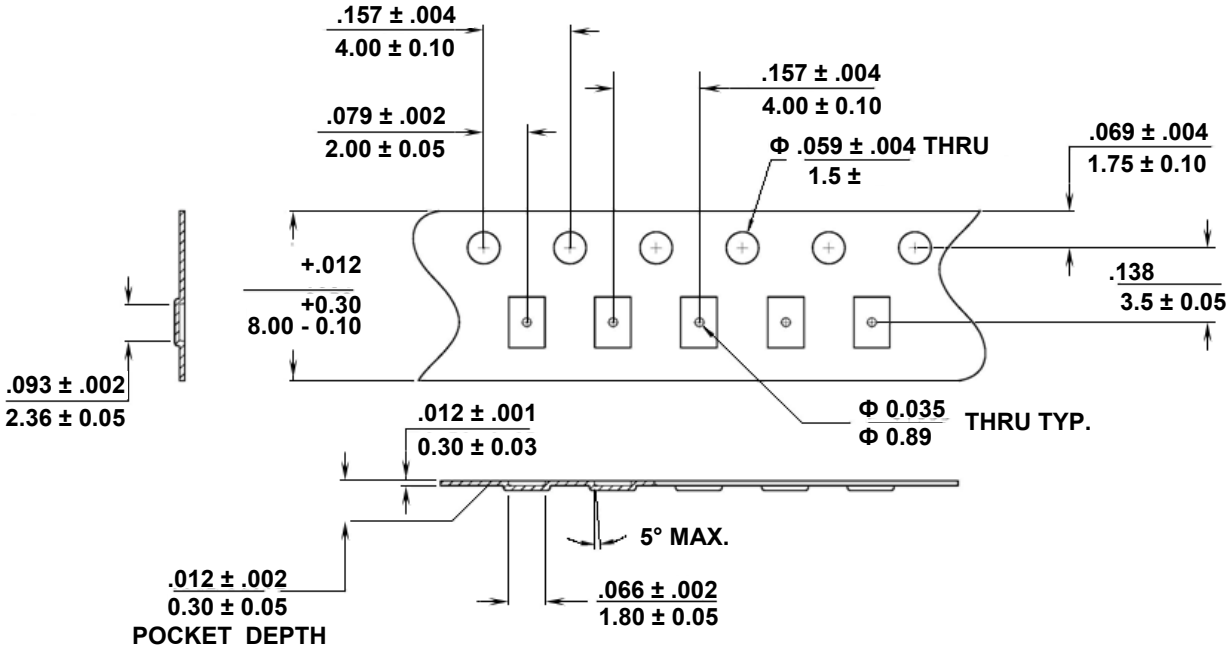
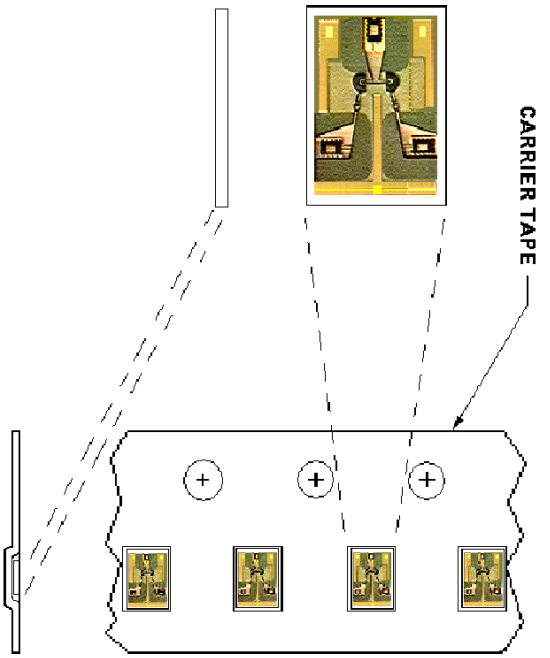
Pocket Tape Dimensions



Chip Orientation in Pocket



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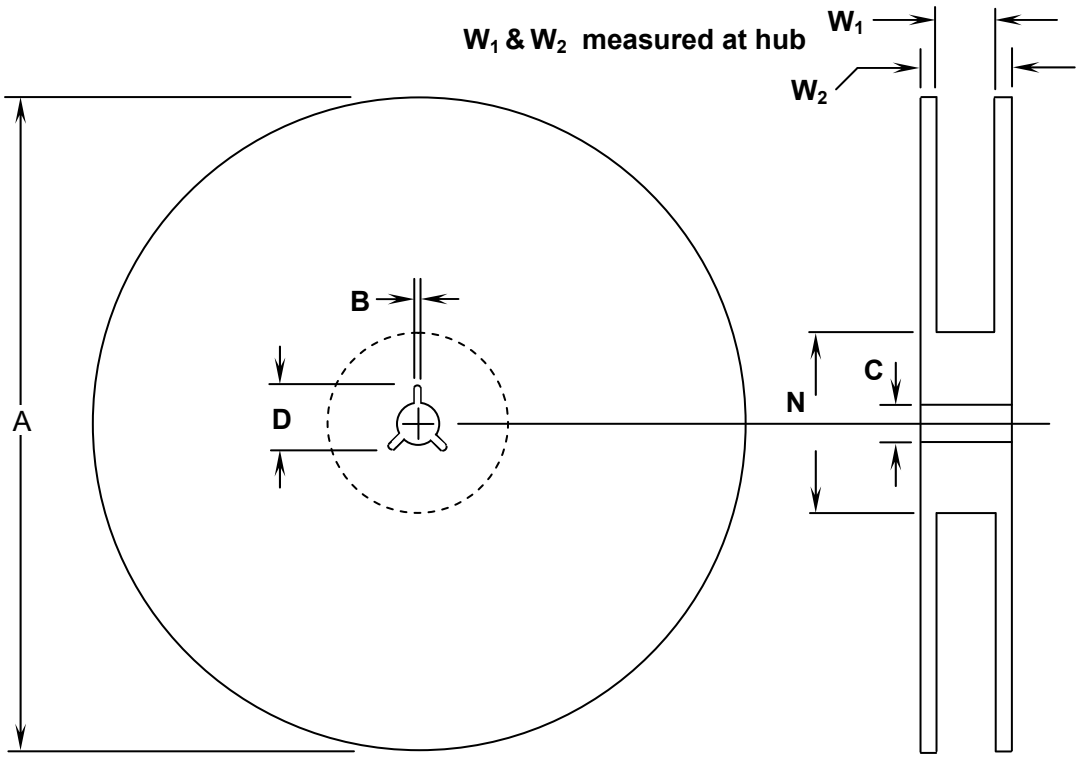
Reel Information



DIM	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
A	6.98	7.02	177.3	178.3
B	.059	.098	1.5	2.5
C	.504	.520	12.8	13.2
D	.795	.815	20.2	20.7
N	2.14	2.19	54.5	55.5
W_1	.331	.337	8.4	8.55
W_2	—	.567	—	14.4

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