

GaAs DPDT Diversity Switch
0.5 - 3.0 GHz

MASWSS0040
V3

Features

- Low Insertion Loss 0.7 dB at 2.4 GHz
- Low Cost 3 mm 12-Lead PQFN Package
- Ideal for WLAN IEEE 802.11b
- 0.5 micron GaAs PHEMT Process

Description

M/A-COM's MASWSS0040 is a GaAs PHEMT MMIC DPDT diversity switch in a low cost miniature 3 mm 12-lead PQFN Package. The MASWSS0040 is ideally suited for applications where very small size and low cost are required.

Typical applications are for WLAN IEEE 802.11b/g systems that employ two antennas for transmit and receive diversity. This part is designed for low insertion loss and allows for independent control and selection of each switch path. This part can be used in all systems operating up to 3.0 GHz requiring moderate power and diversity switching.

The MASWSS0040 is fabricated using a 0.5 micron gate length GaAs pHEMT process. The process features full passivation for performance and reliability.

Ordering Information ¹

| Part Number | Package |
|-------------------|---|
| MASWSS0040 | Bulk Packaging |
| MASWSS0040TR | 1000 piece reel |
| MASWSS0040TR-3000 | 3000 piece reel |
| MASWSS0040SMB | Sample Test Board (Includes 5 Samples) |

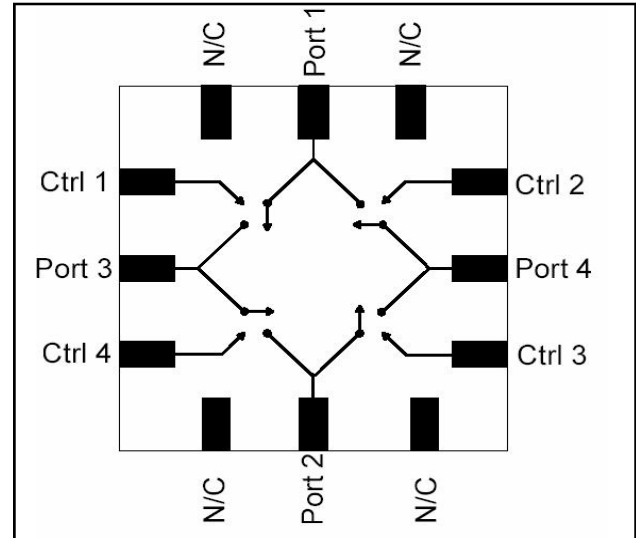
1. Reference Application Note M513 for reel size information.

Absolute Maximum Ratings ^{2,3}

| Parameter | Absolute Maximum |
|------------------------|------------------|
| Input Power 3V Control | +32 dBm |
| Input Power 5V Control | +34 dBm |
| Operating Voltage | +8.5 volts |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -65°C to +150°C |

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

Functional Schematic



Pin Configuration

| Pin No. | Pin Name | Description |
|---------|----------|---------------|
| 1 | Ctrl 1 | Control 1 |
| 2 | Port 3 | RF Port 3 |
| 3 | Ctrl 4 | Control 4 |
| 4 | N/C | No Connection |
| 5 | Port 2 | RF Port 2 |
| 6 | N/C | No Connection |
| 7 | Ctrl 3 | Control 3 |
| 8 | Port 4 | RF Port 4 |
| 9 | Ctrl 2 | Control 2 |
| 10 | N/C | No Connection |
| 11 | Port 1 | RF Port 1 |
| 12 | N/C | No Connection |

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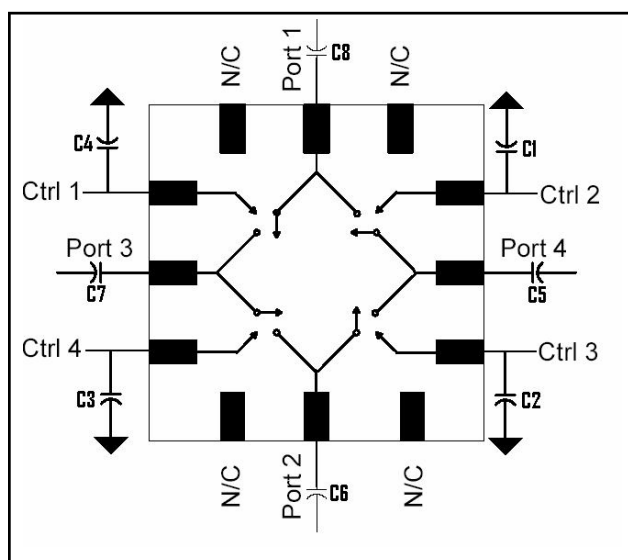
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Electrical Specifications: $T_A = 25^\circ\text{C}$, $Z_0 = 50 \Omega$

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|-----------------------------|--|---------------|------|-------|------|
| Insertion Loss ⁴ | 0.5 - 1.0 GHz | dB | — | 0.5 | 1.2 |
| | 1.0 - 2.0 GHz | dB | — | 0.6 | 1.2 |
| | 2.0 - 2.5 GHz | dB | — | 0.7 | 1.2 |
| | 2.5 - 3.0 GHz | dB | — | 0.8 | 1.2 |
| Isolation ⁵ | 0.5 - 1.0 GHz | dB | 17.0 | 28.0 | — |
| | 1.0 - 2.0 GHz | dB | 17.0 | 21.0 | — |
| | 2.0 - 2.5 GHz | dB | 17.0 | 19.0 | — |
| | 2.5 - 3.0 GHz | dB | 17.0 | 18.0 | — |
| Return Loss | 0.5 - 3.0 GHz | dB | — | 20 | — |
| IP3 | Two Tone +5 dBm, 5 MHz Spacing, > 50 MHz | dBm | — | 47 | — |
| | $V_C = 0.2 \text{ V} / 2.3 \text{ V}$ $V_C = 0.2 \text{ V} / 3.0 \text{ V}$ | dBm | — | 52 | — |
| P1dB | $V_C = 0.2 \text{ V} / 2.3 \text{ V}$ | dBm | — | 26 | — |
| | $V_C = 0.2 \text{ V} / 3.0 \text{ V}$ | dBm | — | 31 | — |
| 2 nd Harmonic | 2.4 GHz, $P_{IN} = 20 \text{ dBm}$, $V_C = 0.2 \text{ V} / 2.5 \text{ V}$ | dBc | — | 70 | — |
| 3 rd Harmonic | 2.4 GHz, $P_{IN} = 20 \text{ dBm}$, $V_C = 0.2 \text{ V} / 2.5 \text{ V}$ | dBc | — | 60 | — |
| Trise, Tfall | 10% to 90% RF and 90% to 10% RF | nS | — | 12/20 | — |
| Ton, Toff | 50% Control to 90% RF | nS | — | 35 | — |
| | 50% Control to 10% RF | nS | — | 40 | — |
| Gate Leakage | $ V_C = 5 \text{ V}$ | μA | — | 5 | 50 |

4. Insertion Loss can be optimized by varying the DC Blocking Capacitor value, i.e. 1000 pF for 100 MHz - 1.0 GHz, 27 pF for 0.5 - 3.0 GHz.
5. Isolation of two paths on either side of the selected path.

Circuit Block Diagram



Parts List

| Part | Description |
|-----------|-----------------------------|
| C1 – C4 | 27 pF Decoupling Capacitor |
| C5 – C8 | 27 pF DC Blocking Capacitor |
| RF1 – RF4 | RF connector |
| Item 3 | 10-pin solder connector |

Handling Procedures

Please observe the following precautions to avoid damage:

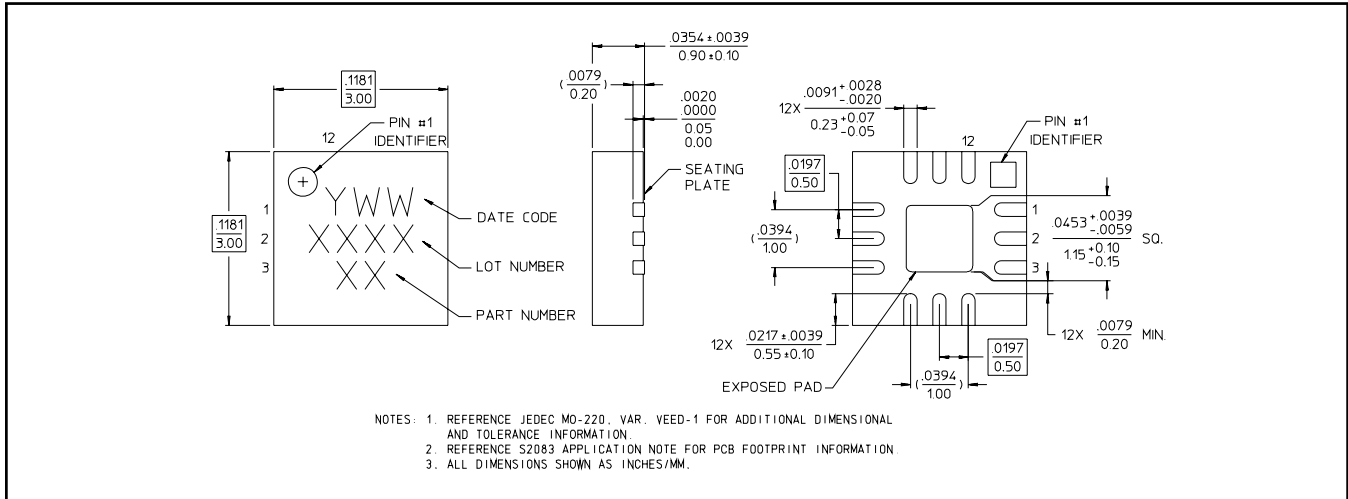
Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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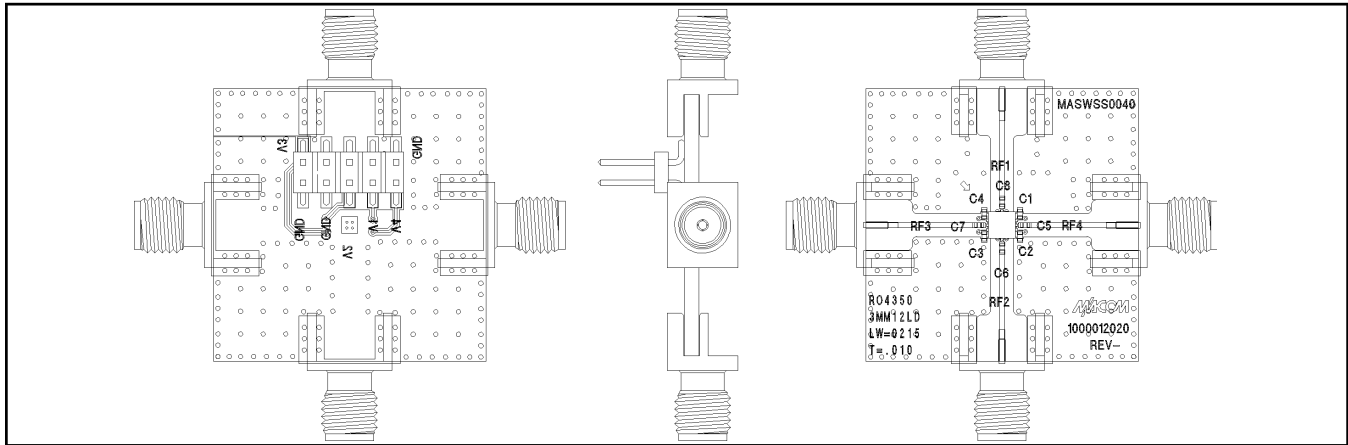
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3 mm 12-Lead PQFN†



† Meets JEDEC moisture sensitivity level 1 requirements

Evaluation Board MASWSS0040



Truth Table 6,7

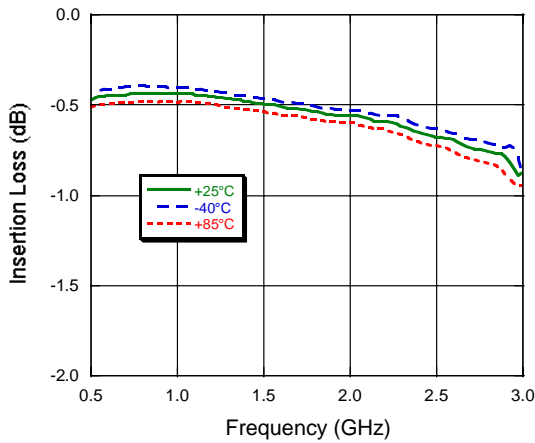
| Control V1 | Control V2 | Control V3 | Control V4 | Port 1 - Port 3 | Port 1 - Port 4 | Port 2 - Port 4 | Port 2 - Port 3 |
|------------|------------|------------|------------|-----------------|-----------------|-----------------|-----------------|
| 1 | 0 | 0 | 0 | On | Off | Off | Off |
| 0 | 1 | 0 | 0 | Off | On | Off | Off |
| 0 | 0 | 1 | 0 | Off | Off | On | Off |
| 0 | 0 | 0 | 1 | Off | Off | Off | On |
| 1 | 0 | 1 | 0 | On | Off | On | Off |
| 0 | 1 | 0 | 1 | Off | On | Off | On |

6. External DC blocking capacitors are required on all RF ports.

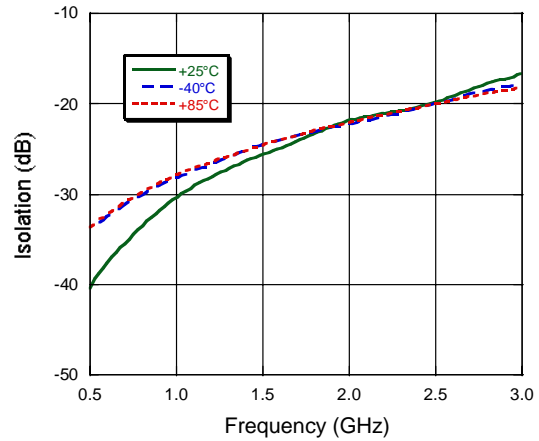
7. 0 = 0 V ± 0.2 V, 1 = +2.3 V to 5.0 V

Typical Performance Curves

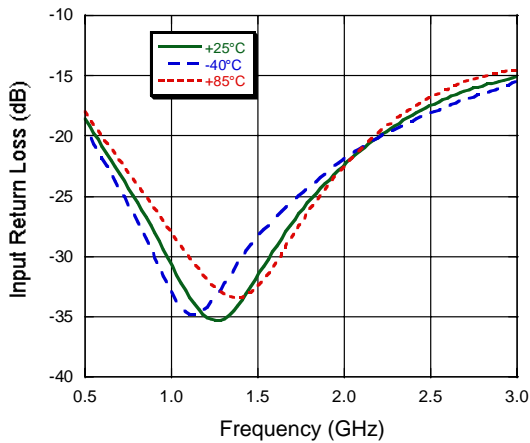
Insertion Loss, 27 pF



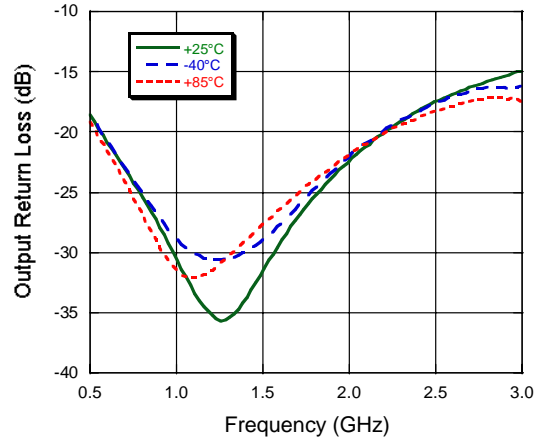
Isolation, 27 pF



Input Return Loss



Output Return Loss



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S-Parameters - Insertion Loss State, RF Port 1 to RF Port 3

| Temp: Freq GHz) | +25 C S11 (dB) | +25 C S21 (dB) | +25 C S22 (dB) | -40 C S11 (dB) | -40 C S21 (dB) | -40 C S22 (dB) | +85 C S11 (dB) | +85 C S21 (dB) | +85 C S22 (dB) |
|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 0.50 | -18.6027 | -0.4654 | -18.5213 | -19.3613 | -0.4339 | -19.1541 | -18.0085 | -0.5123 | -17.9488 |
| 0.60 | -20.8494 | -0.4416 | -20.8067 | -21.8376 | -0.4069 | -21.5515 | -20.0388 | -0.4891 | -20.0041 |
| 0.70 | -23.0914 | -0.4450 | -23.0463 | -24.2872 | -0.4045 | -24.1074 | -22.0202 | -0.4913 | -21.9549 |
| 0.80 | -25.3732 | -0.4330 | -25.2263 | -26.9306 | -0.3923 | -26.9988 | -23.9682 | -0.4790 | -23.7412 |
| 0.90 | -27.7353 | -0.4377 | -27.2666 | -29.6162 | -0.3995 | -29.9640 | -25.8897 | -0.4831 | -25.3424 |
| 1.00 | -30.7638 | -0.4448 | -29.0320 | -33.5275 | -0.4100 | -32.0794 | -28.1240 | -0.4859 | -26.7539 |
| 1.10 | -33.5635 | -0.2980 | -30.1795 | -36.4314 | -0.3327 | -32.5867 | -30.0768 | -0.4240 | -27.8247 |
| 1.20 | -35.9160 | -0.4558 | -31.1605 | -34.9625 | -0.4284 | -31.9804 | -31.9773 | -0.4995 | -29.1024 |
| 1.30 | -36.3211 | -0.4731 | -30.9829 | -32.4300 | -0.4460 | -30.5651 | -33.5190 | -0.5198 | -29.6264 |
| 1.40 | -34.0465 | -0.4786 | -29.9664 | -29.9757 | -0.4476 | -28.7205 | -34.2573 | -0.5231 | -29.5132 |
| 1.50 | -31.5467 | -0.4934 | -28.9178 | -28.1694 | -0.4627 | -27.4684 | -32.9181 | -0.5374 | -28.8812 |
| 1.60 | -29.3299 | -0.5189 | -27.8802 | -26.8191 | -0.4860 | -26.5125 | -30.9659 | -0.5619 | -28.0103 |
| 1.70 | -26.8650 | -0.5167 | -26.0353 | -25.2041 | -0.4891 | -24.9500 | -27.9354 | -0.5552 | -26.2555 |
| 1.80 | -25.2959 | -0.5396 | -24.6714 | -24.1522 | -0.5116 | -23.9778 | -26.0420 | -0.5827 | -24.7702 |
| 1.90 | -23.7871 | -0.5606 | -23.4366 | -23.0146 | -0.5222 | -22.9759 | -24.1191 | -0.6016 | -23.4124 |
| 2.00 | -22.2287 | -0.5534 | -21.7257 | -21.7321 | -0.5317 | -21.6541 | -22.3026 | -0.5787 | -21.5110 |
| 2.10 | -21.2390 | -0.5763 | -20.8956 | -21.0057 | -0.5310 | -21.0528 | -21.0415 | -0.6227 | -20.5431 |
| 2.20 | -19.8473 | -0.5803 | -19.6707 | -19.8795 | -0.5582 | -19.9287 | -19.4731 | -0.6076 | -19.2367 |
| 2.30 | -19.1325 | -0.6175 | -18.9507 | -19.4372 | -0.5703 | -19.3577 | -18.5966 | -0.6715 | -18.4240 |
| 2.40 | -18.1417 | -0.6681 | -18.2421 | -18.6325 | -0.6282 | -18.7855 | -17.5284 | -0.7171 | -17.6214 |
| 2.50 | -17.3713 | -0.6695 | -17.3284 | -17.9975 | -0.6322 | -17.9655 | -16.6874 | -0.7170 | -16.6287 |
| 2.60 | -16.8832 | -0.6625 | -17.1056 | -17.6555 | -0.6529 | -17.9103 | -16.1114 | -0.7607 | -16.2958 |
| 2.70 | -16.0634 | -0.7731 | -16.4745 | -16.7757 | -0.7208 | -17.3043 | -15.3337 | -0.8210 | -15.6184 |
| 2.80 | -15.8346 | -0.7433 | -16.1385 | -16.5488 | -0.7080 | -17.0290 | -15.0872 | -0.8058 | -15.3366 |
| 2.90 | -15.4466 | -0.7294 | -16.4468 | -16.0958 | -0.7457 | -17.2754 | -14.6606 | -0.9072 | -15.6625 |
| 3.00 | -15.0199 | -0.8677 | -16.1135 | -15.3471 | -0.8900 | -17.6242 | -14.5580 | -0.9451 | -15.5308 |

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S-Parameters - Isolation State, RF Port 1 to RF Port 3

| Temp: | +25 C | +25 C | +25 C | -40 C | -40 C | -40 C | +85 C | +85 C | +85 C |
|------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Freq (GHz) | S11 (dB) | S21 (dB) | S22 (dB) | S11 (dB) | S21 (dB) | S22 (dB) | S11 (dB) | S21 (dB) | S22 (dB) |
| 0.50 | -0.2387 | -40.3798 | -17.7871 | -0.2152 | -34.1017 | -18.3789 | -0.2663 | -33.6911 | -16.9063 |
| 0.55 | -0.2800 | -38.6075 | -20.2236 | -0.2315 | -33.2663 | -21.2041 | -0.2990 | -32.9165 | -19.4707 |
| 0.60 | -0.3033 | -37.8366 | -20.0361 | -0.2530 | -32.3662 | -20.8447 | -0.3329 | -32.1037 | -18.4824 |
| 0.65 | -0.3288 | -36.1271 | -21.9219 | -0.2765 | -31.8787 | -23.1748 | -0.3570 | -31.6315 | -22.2236 |
| 0.70 | -0.3458 | -35.5570 | -22.7520 | -0.3015 | -30.9632 | -23.9482 | -0.3958 | -30.7441 | -20.9590 |
| 0.75 | -0.3699 | -34.1188 | -23.3535 | -0.3129 | -30.7054 | -24.8857 | -0.4027 | -30.4427 | -24.1357 |
| 0.80 | -0.3992 | -33.6711 | -24.9219 | -0.3473 | -29.9284 | -26.4863 | -0.4397 | -29.5393 | -22.1973 |
| 0.85 | -0.4242 | -32.4027 | -24.4404 | -0.3683 | -29.5035 | -25.9434 | -0.4669 | -29.3653 | -24.7471 |
| 0.90 | -0.4424 | -31.8488 | -28.3438 | -0.3849 | -28.9525 | -30.0996 | -0.4931 | -28.6355 | -25.8428 |
| 0.95 | -0.4709 | -30.9988 | -25.7813 | -0.4060 | -28.5103 | -27.2520 | -0.5034 | -28.3662 | -26.2412 |
| 1.00 | -0.5064 | -30.2467 | -32.0176 | -0.4289 | -28.2122 | -36.0078 | -0.5291 | -27.8092 | -28.5147 |
| 1.10 | -0.5387 | -29.0098 | -41.0254 | -0.4724 | -27.3494 | -46.4727 | -0.5826 | -26.9278 | -32.7441 |
| 1.20 | -0.5820 | -28.0480 | -36.3633 | -0.5003 | -26.7386 | -48.4902 | -0.6150 | -26.4994 | -38.3535 |
| 1.30 | -0.5913 | -27.1969 | -39.8516 | -0.5073 | -25.8648 | -36.0879 | -0.6279 | -25.8930 | -39.4004 |
| 1.40 | -0.6143 | -26.2585 | -33.0508 | -0.5439 | -25.0932 | -31.3506 | -0.6680 | -25.1077 | -33.9746 |
| 1.50 | -0.6225 | -25.5753 | -28.3721 | -0.5428 | -24.4977 | -26.8906 | -0.6723 | -24.6341 | -34.2148 |
| 1.60 | -0.6517 | -24.9628 | -27.1650 | -0.5815 | -23.8834 | -26.3447 | -0.7105 | -23.9054 | -29.3721 |
| 1.70 | -0.6097 | -24.1436 | -25.7988 | -0.5652 | -23.4561 | -24.8975 | -0.6976 | -23.4766 | -27.4951 |
| 1.80 | -0.6376 | -23.2844 | -25.0801 | -0.5806 | -23.1137 | -24.3320 | -0.6954 | -22.8071 | -24.2686 |
| 1.90 | -0.6901 | -22.3777 | -23.5430 | -0.5976 | -22.5081 | -23.2480 | -0.7298 | -22.5175 | -22.2676 |
| 2.00 | -0.6900 | -21.6555 | -23.0645 | -0.6031 | -22.2552 | -22.6582 | -0.7099 | -21.9908 | -19.6436 |
| 2.10 | -0.7131 | -21.4391 | -20.4551 | -0.6269 | -21.8977 | -19.9346 | -0.7445 | -21.7545 | -18.6436 |
| 2.20 | -0.7304 | -20.9731 | -18.9287 | -0.6598 | -21.2974 | -18.6641 | -0.7727 | -21.1197 | -18.1172 |
| 2.30 | -0.7379 | -20.9154 | -17.3799 | -0.6549 | -21.0886 | -17.2998 | -0.7723 | -20.8756 | -17.5635 |
| 2.40 | -0.7639 | -20.3135 | -16.7227 | -0.7179 | -20.3845 | -16.7998 | -0.8387 | -20.4132 | -17.7207 |
| 2.50 | -0.8042 | -19.8248 | -16.7979 | -0.7549 | -19.9612 | -17.1514 | -0.8884 | -19.9776 | -16.8115 |
| 2.60 | -0.8694 | -19.2154 | -16.6455 | -0.8163 | -19.5861 | -17.3291 | -0.9644 | -19.5877 | -16.4570 |
| 2.70 | -0.9435 | -18.3638 | -15.5996 | -0.8816 | -18.8297 | -16.5332 | -1.0624 | -19.2242 | -15.0513 |
| 2.80 | -1.0205 | -17.6340 | -15.2612 | -0.9363 | -18.4579 | -16.1777 | -1.1379 | -18.6811 | -15.0679 |
| 2.90 | -1.1882 | -17.3241 | -14.5591 | -1.0298 | -18.0998 | -15.2344 | -1.2657 | -18.6548 | -14.0005 |
| 3.00 | -1.3138 | -16.4654 | -14.1133 | -1.1093 | -17.9439 | -14.6489 | -1.3771 | -17.8609 | -13.6182 |