

Precision

# Digital Step Attenuator

# TOAT-51020+

50Ω TTL Control, Pin Diode 10 to 1000 MHz



Generic photo used for illustration purposes only

CASE STYLE: QQ96

**+RoHS Compliant**

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

## Maximum Ratings

Operating Temperature	-55°C to 100°C
Storage Temperature	-55°C to 125°C
Input Power	15 dBm
DC Voltage	5.5 V
TTL	5.5V

Permanent damage may occur if any of these limits are exceeded.

## Pin Connections

RF IN	4
RF OUT	11
TTL CONTROL #1	2
TTL CONTROL #2	3
TTL CONTROL #3	1
+5V DC	12
CASE GROUND	5,6,7,8,9,10

## Features

- wideband, 10 to 1000 MHz
- excellent step accuracy, 0.2 dB typ.
- excellent VSWR 1.3 typ.
- low DC current, 6 mA typ.
- hermetic, metal, TO-8 case

## Applications

- base stations
- cellular
- test-sets
- military, hi-rel applications

## Digital Step Attenuator Electrical Specifications

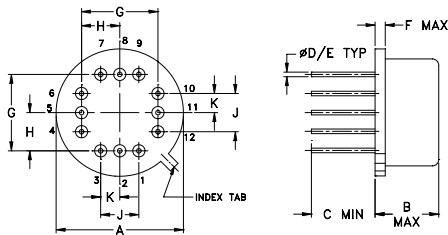
MODEL NO.	FREQUENCY (MHz)		PRIMARY ATTENUATION STEPS (dB)			ATTENUATION (dB)		VSWR (:1)		
	$f_l$	$f_u$	#1	#2	#3	(1,1,1)** Nom.	(0,0,0) Max.	L	M	U
TOAT-51020+	10	1000	5±0.4	10±0.4	20±0.5	35.0	4.0	1.6	1.4	1.5

L=10 to 100 MHz      M=100 to 500 MHz      U=500 to 1000 MHz

\*\* Total attenuation above thru-loss.

1. Step accuracy is specified for basic steps. For combination of steps accuracy is additive.
2. Thru-loss is minimum insertion loss with all attenuation elements bypassed (All TTL controls state are Low)
3. For optimum operation of TOAT models, ensure the device case is properly connected to the ground plane (of PC board)

## Outline Drawing



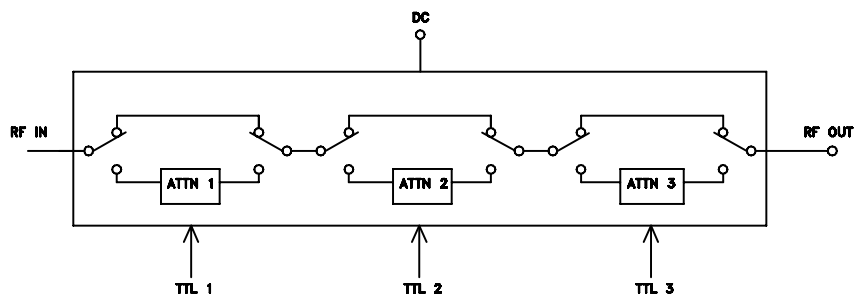
## Outline Dimensions (inch/mm)

A	B	C	D	E	F
.600	.250	.25	.016	.020	.04
15.24	6.35	6.35	0.41	0.51	1.02
G	H	J	K		wt
.400	.200	.200	.100		grams
10.16	5.08	5.08	2.54		4.0

## Additional Specifications

DC Voltage	+5V
DC Current	12mA max.
Switching Time (50% TTL to within specified accuracy of the next-selected attenuation step, and to within 0.1 dB of steady-state Thru-Loss)	10µs typ., 15µs max.,
TTL Input High Threshold	2V min
TTL Input Low Threshold	0.8V max.
TTL Toggle Rate	50 kHz typ.
1dB Compression	0 dBm (10-100 MHz) +10 dBm (100-1000MHz)

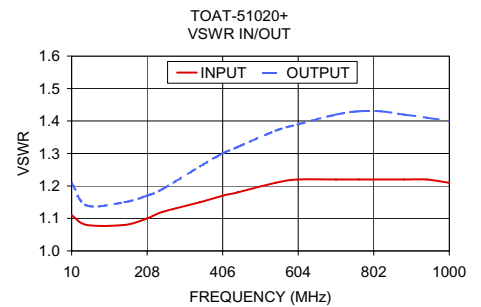
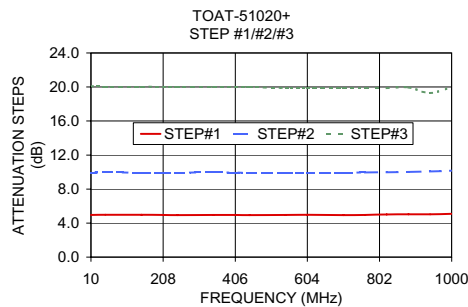
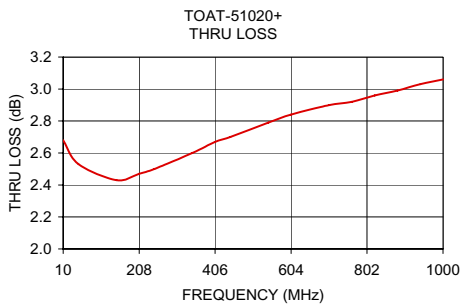
## Electrical Schematic



## Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
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### Step Attenuation\* at TTL Control State

FREQ.	000	001	010	011	100	101	110	111
(MHz)	THRU LOSS (dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
10.00	2.68	4.96	9.93	14.90	20.10	24.96	29.77	34.53
49.60	2.53	4.98	9.95	14.90	20.05	24.95	29.92	34.69
148.60	2.43	4.98	9.94	14.93	20.04	25.05	29.90	34.88
208.00	2.47	4.96	9.93	14.89	20.00	24.91	29.92	34.86
247.60	2.50	4.94	9.94	14.88	19.95	24.83	29.91	34.76
346.60	2.60	4.96	9.96	14.87	19.96	24.96	29.92	34.42
406.00	2.67	4.96	9.94	14.82	19.97	24.91	29.80	34.60
445.60	2.70	4.94	9.92	14.80	19.96	24.96	29.84	34.47
544.60	2.79	4.95	9.91	14.81	19.88	24.85	29.76	34.43
604.00	2.84	4.97	9.94	14.84	19.88	24.90	29.83	34.54
703.00	2.90	4.94	9.94	14.82	19.88	24.90	29.72	34.86
762.40	2.92	4.96	9.96	14.81	19.83	24.85	29.80	35.22
821.80	2.96	5.01	9.98	14.88	19.87	24.92	29.99	35.21
881.20	2.99	5.03	10.01	14.96	19.94	24.92	30.10	35.13
940.60	3.03	5.04	10.07	14.98	19.30	24.98	30.03	35.08
1000.00	3.06	5.09	10.16	15.08	20.00	25.28	29.95	35.55

### INPUT VSWR

FREQ.	001	010	011	100	101	110	111
(MHz)							
10.00	1.11	1.15	1.09	1.20	1.10	1.14	1.09
49.60	1.08	1.10	1.06	1.13	1.07	1.10	1.06
148.60	1.08	1.10	1.06	1.12	1.07	1.10	1.06
208.00	1.10	1.12	1.08	1.15	1.09	1.12	1.08
247.60	1.12	1.14	1.09	1.17	1.10	1.13	1.09
346.60	1.15	1.18	1.12	1.21	1.13	1.18	1.12
406.00	1.17	1.21	1.14	1.24	1.16	1.20	1.14
445.60	1.18	1.22	1.16	1.26	1.17	1.22	1.16
544.60	1.21	1.26	1.19	1.30	1.20	1.25	1.19
604.00	1.22	1.28	1.21	1.32	1.22	1.27	1.21
703.00	1.22	1.30	1.23	1.35	1.24	1.30	1.21
762.40	1.22	1.31	1.25	1.36	1.25	1.31	1.25
821.80	1.22	1.32	1.26	1.36	1.26	1.32	1.27
881.20	1.22	1.32	1.27	1.37	1.27	1.33	1.28
940.60	1.22	1.32	1.28	1.36	1.27	1.33	1.29
1000.00	1.21	1.32	1.29	1.36	1.28	1.33	1.30

### OUTPUT VSWR

FREQ.	001	010	011	100	101	110	111
(MHz)							
10.00	1.21	1.15	1.15	1.07	1.08	1.08	1.08
49.60	1.14	1.11	1.10	1.05	1.05	1.05	1.05
148.60	1.15	1.10	1.10	1.05	1.05	1.05	1.05
208.00	1.17	1.13	1.12	1.06	1.06	1.06	1.16
247.60	1.19	1.14	1.14	1.07	1.07	1.06	1.07
346.60	1.26	1.19	1.19	1.10	1.10	1.10	1.09
406.00	1.30	1.22	1.22	1.12	1.11	1.11	1.12
445.60	1.32	1.24	1.24	1.13	1.13	1.13	1.12
544.60	1.37	1.28	1.28	1.15	1.15	1.15	1.15
604.00	1.39	1.30	1.30	1.16	1.16	1.16	1.17
703.00	1.42	1.35	1.34	1.20	1.20	1.20	1.20
762.40	1.43	1.37	1.37	1.22	1.20	1.20	1.22
821.80	1.43	1.37	1.38	1.23	1.23	1.23	1.23
881.20	1.42	1.38	1.39	1.24	1.25	1.25	1.25
940.60	1.41	1.39	1.41	1.26	1.27	1.27	1.27
1000.00	1.40	1.40	1.42	1.27	1.27	1.28	1.28

\* Step attenuation above thru-loss (TTL logic 000)

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# Digital Step Attenuator

# TOAT-51020+

## Typical Performance Data

FREQUENCY (MHz)	STEP ATTENUATION* AT TTL CONTROL STATE (dB)							
	000 THRU LOSS	001 5 dB	010 10 dB	011 15 dB	100 20 dB	101 25 dB	110 30 dB	111 35 dB
10.0	2.68	4.96	9.93	14.90	20.10	24.96	29.77	34.53
49.6	2.53	4.98	9.95	14.90	20.05	24.95	29.92	34.69
148.6	2.43	4.98	9.94	14.93	20.04	25.05	29.90	34.88
208.0	2.47	4.96	9.93	14.89	20.00	24.91	29.92	34.86
247.6	2.50	4.94	9.94	14.88	19.95	24.83	29.91	34.76
346.6	2.60	4.96	9.96	14.87	19.96	24.96	29.92	34.42
406.0	2.67	4.96	9.94	14.82	19.97	24.91	29.80	34.60
445.6	2.70	4.94	9.92	14.80	19.96	24.96	29.84	34.47
544.6	2.79	4.95	9.91	14.81	19.88	24.85	29.76	34.43
604.0	2.84	4.97	9.94	14.84	19.88	24.90	29.83	34.54
703.0	2.90	4.94	9.94	14.82	19.88	24.90	29.72	34.86
762.4	2.92	4.96	9.96	14.81	19.83	24.85	29.80	35.22
821.8	2.96	5.01	9.98	14.88	19.87	24.92	29.99	35.21
881.2	2.99	5.03	10.01	14.96	19.94	24.92	30.10	35.13
940.6	3.03	5.04	10.07	14.98	19.30	24.98	30.03	35.08
1000.0	3.06	5.09	10.16	15.08	20.00	25.28	29.95	35.55

\* Step Attenuation above Thru Loss (TTL Logic 000).

FREQUENCY (MHz)	INPUT VSWR AT TTL CONTROL STATE (:1)						
	001 5 dB	010 10 dB	011 15 dB	100 20 dB	101 25 dB	110 30 dB	111 35 dB
10.0	1.11	1.15	1.09	1.20	1.10	1.14	1.09
49.6	1.08	1.10	1.06	1.13	1.07	1.10	1.06
148.6	1.08	1.10	1.06	1.12	1.07	1.10	1.06
208.0	1.10	1.12	1.08	1.15	1.09	1.12	1.08
247.6	1.12	1.14	1.09	1.17	1.10	1.13	1.09
346.6	1.15	1.18	1.12	1.21	1.13	1.18	1.12
406.0	1.17	1.21	1.14	1.24	1.16	1.20	1.14
445.6	1.18	1.22	1.16	1.26	1.17	1.22	1.16
544.6	1.21	1.26	1.19	1.30	1.20	1.25	1.19
604.0	1.22	1.28	1.21	1.32	1.22	1.27	1.21
703.0	1.22	1.30	1.23	1.35	1.24	1.30	1.21
762.4	1.22	1.31	1.25	1.36	1.25	1.31	1.25
821.8	1.22	1.32	1.26	1.36	1.26	1.32	1.27
881.2	1.22	1.32	1.27	1.37	1.27	1.33	1.28
940.6	1.22	1.32	1.28	1.36	1.27	1.33	1.29
1000.0	1.21	1.32	1.29	1.36	1.28	1.33	1.30

FREQUENCY (MHz)	OUTPUT VSWR AT TTL CONTROL STATE (:1)						
	001 5 dB	010 10 dB	011 15 dB	100 20 dB	101 25 dB	110 30 dB	111 35 dB
10.0	1.21	1.15	1.15	1.07	1.08	1.08	1.08
49.6	1.14	1.11	1.10	1.05	1.05	1.05	1.05
148.6	1.15	1.10	1.10	1.05	1.05	1.05	1.05
208.0	1.17	1.13	1.12	1.06	1.06	1.06	1.06
247.6	1.19	1.14	1.14	1.07	1.07	1.06	1.07
346.6	1.26	1.19	1.19	1.10	1.10	1.10	1.09
406.0	1.30	1.22	1.22	1.12	1.11	1.12	1.11
445.6	1.32	1.24	1.24	1.13	1.13	1.13	1.12
544.6	1.37	1.28	1.28	1.15	1.15	1.15	1.15
604.0	1.39	1.30	1.30	1.16	1.16	1.16	1.17
703.0	1.42	1.35	1.34	1.20	1.20	1.20	1.20
762.4	1.43	1.37	1.37	1.22	1.20	1.22	1.22
821.8	1.43	1.37	1.38	1.23	1.23	1.23	1.23
881.2	1.42	1.38	1.39	1.24	1.25	1.25	1.25
940.6	1.41	1.39	1.41	1.26	1.27	1.27	1.27
1000.0	1.40	1.40	1.42	1.27	1.27	1.28	1.28

REV. X1  
TOAT-51020+  
061207  
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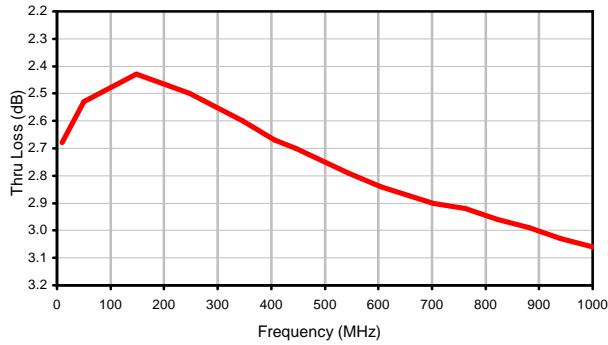


# Digital Step Attenuator

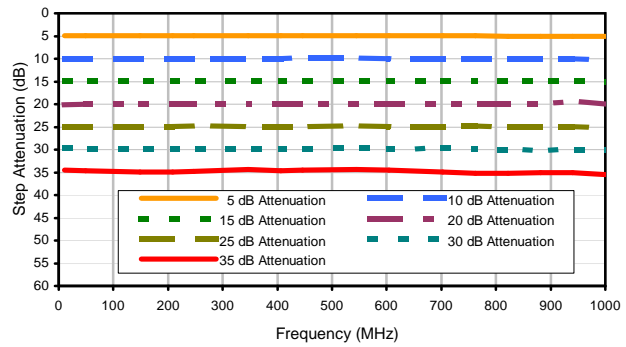
## Typical Performance Curves

TOAT-51020+

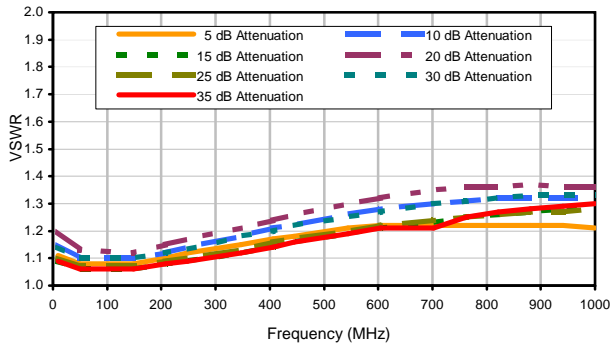
Thru Loss



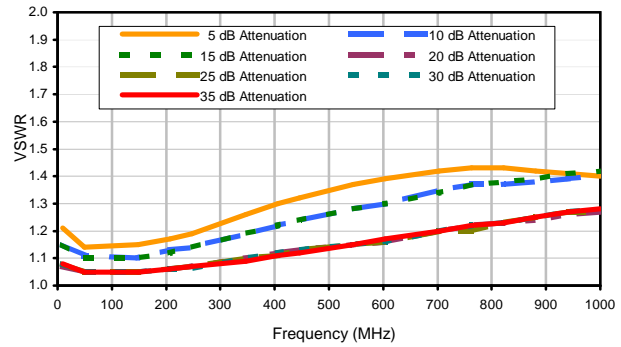
Step Attenuation



Input VSWR



Output VSWR



REV. X1  
TOAT-51020+  
061207  
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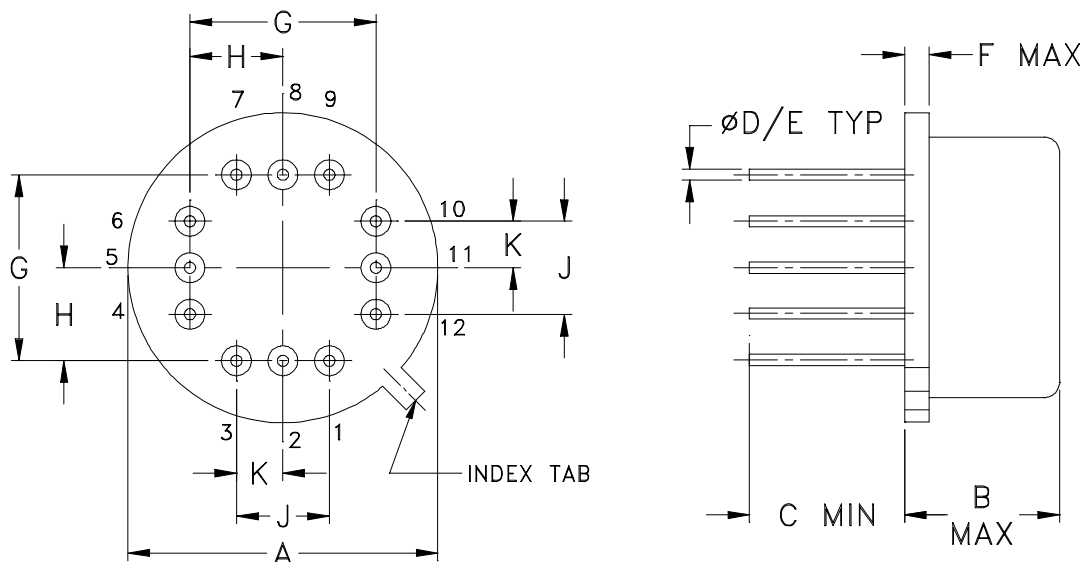


# Case Style

# QQ

QQ95  
QQ96

## Outline Dimensions



CASE#	A	B	C	D	E	F	G	H	J	K	WT. GRAM
QQ95	.500 (12.70)	.250 (6.35)	.25 (6.35)	.016 (.41)	.020 (.51)	.04 (1.02)	.300 (7.62)	.150 (3.81)	.150 (3.81)	.075 (1.91)	3.5
QQ96	.600 (15.24)	.250 (6.35)	.25 (6.35)	.016 (.41)	.020 (.51)	.04 (1.02)	.400 (10.16)	.200 (5.08)	.200 (5.08)	.100 (2.54)	4.0

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .03$ ; 3 Pl.  $\pm .015$

### Notes:

- Header material: Kovar.  
Pin material: Kovar.  
Cover material: Nickel.
- Pin finish: Gold plate 25  $\mu$  inches (.64 microns) min.
- For pin designations see specification data sheet.
- Pin numbers do not appear on unit, for reference only.

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Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Thermal Shock	-55° to 100°C, 10 cycles	MIL-STD-202, Method 107, Condition A, except +100°C & 10 cycles
Constant Acceleration	5000g, Y1 axis	MIL-STD-883, Method 2001, Condition A, except Y1 axis only
Solderability	10X Magnification	J-STD-002, 95% Coverage
Resistance to Solder Heat	260°C for 10 seconds	MIL-STD-202, Method 210, Condition B
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215
Gross Leak	125°C Bubble Test	MIL-STD-202, Method 112, Condition D