

The N20160B is a broadband booster helix travelling wave tube. It is capable of providing 160 W output power and operates over the frequency band 4.5 – 18 GHz. Saturation gain is typically 30 dB.

The TWT incorporates a dual stage collector, providing high overall efficiency. The design also includes convergent electron gun incorporating a focus electrode grid switch that enables the TWT to be operated in either pulsed or CW mode, PPM focusing and conduction cooling.

The N20160B is small and lightweight. It has been designed to meet the most demanding environmental requirements.

This TWT is one out of a range of mini and midi-types that have been designed by e2v technologies using the latest CAD methods to achieve optimised reliability and performance, whilst operating in the most demanding of environments.

Other devices in the range include: Multi-octave bandwidth, 3-stage and single stage collectors, with options of gain and/or phase matching.

### ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typical	Max	Units
<b>Heater</b>					
Voltage	$V_f$	-6.0	-6.3	-6.6	V
Current	$I_f$			1.00	A
Warm-up time		90			s
Surge current limit				1.5	A
<b>Helix</b>					
Voltage	$V_{hx}$	4.50	4.55	4.60	kV
Current	$I_{hx}$	0	6	20	mA
<b>Collector</b>					
Collector 1 voltage	$V_{c1}$	2.40	2.45	2.50	kV
Collector 2 voltage	$V_{c2}$	1.53	1.58	1.63	kV
Collector 1 current	$I_{c1}$	2		140	mA
Collector 2 current	$I_{c2}$	20	195	215	mA
<b>Focus Electrode</b>					
Beam-on voltage	$V_{fe}$	-12	0	0	V
Beam-off voltage	$V_{feo}$	-1.0	-1.1	-1.2	kV
Capacitance				20	pF
<b>Prime Power</b>			450	480	W

**Note:** All electrode voltages are referenced to cathode potential. The TWT is to be operated with the helix grounded and the collectors depressed.

### RF PERFORMANCE

#### Frequency Range

The electrical and RF performance specified herein shall apply over the frequency range from 4.5 GHz to 18 GHz.

#### Small Signal Gain

Small signal gain performance shall be as specified in the following table with straight-line approximations between frequency points.

Frequency (GHz)	Minimum Gain (dB)	Maximum Gain (dB)
4.5	26	33
5	30	37
6	35.5	42.5
7	38.5	45.5
8	40.5	47.5
9	44	51
10	45	52
11	45.5	52.5
12	44	51
13	42.5	49.5
14	40.5	47.5
15	38.5	45.5
16	36.5	43.5
17	32.5	39.5
18	29.5	36.5

#### RF Output Power

The RF output power shall meet the minimum and maximum values specified as a straight line approximation between the frequency points defined in the following table.

Frequency (GHz)	Minimum RF Output Power (W)
4.5	50
5	80
6	140
7	140
8	140
9	140
10	140
11	140
12	140
13	140
14	130
15	120
16	120
17	115
18	100

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## Maximum Drive for Rated Output Power

Frequency (GHz)	Maximum RF Input Power (dBm)
4.5	27.0
5	26.0
6	23.0
7	21.0
8	18.0
9	15.0
10	14.0
11	13.0
12	14.0
13	15.0
14	18.0
15	20.0
16	22.0
17	25.0
18	28.0

## Voltage Standing Wave Ratio (VSWR)

Input..... 2.5:1 max  
Output..... 2.5:1 max

## Harmonics

When operated at saturated output power and with the TWT terminated into a matched load, the second harmonics shall be less than specified in the following table.

Frequency (GHz)	Second Harmonic Level (dBc)
4.5	+2.0
5	-2.0
6	-9.0
7	-12.0
8	-12.0
9	-14.0

## Spurious Outputs

Spurious outputs from the TWT other than harmonic power and phase noise sidebands shall be no more than -30 dBc relative to saturated fundamental level.

## Noise Power Output

The Noise output power, with the input terminated in 50Ω and the tube operating into a matched load, shall not exceed the values specified in the following table.

Frequency (GHz)	Maximum RF Noise Power Output (dBm/MHz)
4.5	-48
5	-47
6	-43
7	-40
8	-37
9	-35
10	-35
11	-35
12	-35
13	-35
14	-36
15	-38
16	-41
17	-44
18	-46

## MECHANICAL

### RF Connectors

Input..... SMA male  
Output..... TNC male

### Wiring

Element	Colour	Wire Type
Heater	Brown	18 kV rated, silicone coated FEP
Cathode	Yellow	18 kV rated, silicone coated FEP
Anode	Blue	18 kV rated, silicone coated FEP
Focus Electrode	Green	18 kV rated, silicone coated FEP
Collector 1	Red	15 kV rated, lossy, FEP
Collector 2	White	15 kV rated, lossy, FEP

### Weight

Total weight of TWT shall not exceed 320 g

## ENVIRONMENTAL CONDITIONS

The unit shall satisfy the specified performance requirements within the conditions or combination of the environments defined in the applicable documents.

### Temperature Range

#### Operating

The TWT shall meet the RF Performance requirements specified above when the temperature of the TWT collector is within the range between -54 °C and 140 °C.

#### Non-Operating

The TWT shall not be damaged after being subjected to a non-operational temperature range of between -54 °C and +100 °C.

### Altitude

The TWT shall operate in the range between sea level and 21,336 m (70,000 feet).

## HEALTH AND SAFETY HAZARDS

e2v technologies electronic devices are safe to handle and operate provided that the relevant precautions stated herein are observed. e2v technologies does not accept responsibility for damage or injury resulting from the use of electronic devices it produces. Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipment incorporating e2v technologies devices and in operating manuals.

### High Voltage

Equipment must be designed so that operators cannot come into contact with high voltage circuits. Tube enclosures should have fail-safe interlocked switches to disconnect the primary power supply and discharge all high voltage capacitors before allowing access.

### RF Radiation

Personnel must not be exposed to excessive RF radiation. All RF connectors must be correctly fitted before operation, so that no leakage of RF energy can occur, and the RF output must be correctly terminated.

## X-Ray Radiation

The operating voltage of this device results in the emission of X-rays. The maximum penetrating ability of the X-rays may correspond to a voltage approximately twice the applied voltage. Shielding is required.

### Beryllium Oxide Ceramics

This tube contains beryllium oxide ceramic parts, which are not accessible unless the metal casing of the tube is damaged or removed. *Beryllium oxide dust or fumes are highly toxic if inhaled, or if particles enter a cut or abrasion.* Consult e2v technologies regarding the disposal of damaged or life-expired tubes.

## OUTLINE

(All dimensions nominal and in millimetres)

