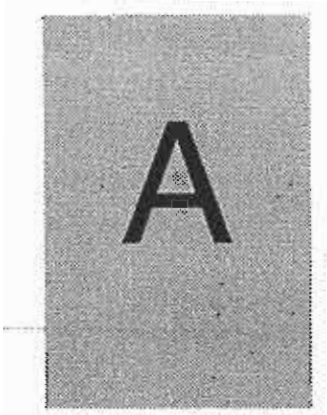


Technical Specifications

All specifications are nominal and subject to change without notice. A specification referred to as "typical" is within ± 20% of a stated value at room temperature (25° C/77° F) and a nominal input power voltage.

Performance Characteristics

General

Output configuration: isolated output

Cooling: natural convection; side and rear panel vents; fan

Display: eight digital seven-segment displays: 0.75 in. (1.9 cm) each

Mounting: Valleylab cart (E8006 or E8008), CUSA System 200 (using CUSA System 200 optional mounting brackets), Force GSU Unit, or any stable flat surface

Dimensions and Weight

Width: 14 in. (35.6 cm)

Depth: 18 in. (45.7 cm)

Height: $4\frac{3}{8}$ in. (11.1 cm)

Weight: < 18 lbs. (< 8.1 kg)

Performance Characteristics

Operating Parameters

Ambient temperature range: 50° to 104° F (10° to 40° C)

Relative humidity: 30% to 75%, noncondensing

Warm-up time: If transported or stored at temperatures outside the operating temperature range, allow one hour for the generator to reach room temperature before use.

Transport and Storage

Ambient temperature range: – 40° to 158° F (– 40° to 70° C)

Relative humidity: 10% to 100%, condensing

Atmospheric pressure: 500 to 1060 millibars

Duration of storage: If stored longer than one year, the battery must be replaced and a full checkout, including calibration, must be completed before use. For instructions, refer to the **Force FX Service Manual.**

Duty Cycle

Under maximum power settings and rated load conditions (***Pure*** cut, 300 watt setting, 300 ohm load) the Force FX is suitable for activation times of 10 seconds on, 30 seconds off for one hour.

If the internal temperature of the Force FX is too high, an alarm tone sounds and a number (451) flashes in the ***Cut*** display alternately with the power settings. You can activate the generator and change the power settings while this condition exists.

Performance Characteristics

Internal Memory

Nonvolatile, battery-backed RAM

Battery type: 3 V lithium button cell

Battery life: 5 years

Storage capacity:

- one configuration, including three power settings and three mode settings
- the last twenty error codes detected by the generator
- the number of times and length of activation for each mode
- the average power setting used for each mode
- the total time the generator is on
- other service related information

Audio Volume

The audio levels stated below are for activation tones (bipolar, cut, and coag) and alarm tones (REM and system alarms) at a distance of one meter.

Activation Tone

Volume (adjustable): 45 to ≥ 65 dB

Frequency:

Bipolar: 940 Hz

Cut: 660 Hz

Coag: 940 Hz

Alarm Tone

Volume (not adjustable): ≥ 65 dB

Frequency: 660 Hz

Performance Characteristics

REM Contact Quality Monitor

REM current is measured according to IEC 601-1, Ed. 1988, Figure 15.

Measurement frequency: 80 kHz ± 10 kHz

Measurement current: < 10 µA

Acceptable Resistance Range

REM patient return electrode: 5 to 135 ohms or up to a 40% increase in the initial measured contact resistance (whichever is less)

Patient return electrode without the REM safety feature (single section electrode): 0 to 20 ohms

If the measured resistance is outside the acceptable range(s) noted above, a REM fault condition occurs.

REM Alarm Activation

REM patient return electrode: When the measured resistance exceeds the standard range of safe resistance (below 5 ohms or above 135 ohms) or when the initial measured contact resistance increases by 40% (whichever is less), the ***REM Alarm*** indicator flashes red, a tone sounds twice, and RF output is disabled. The indicator remains illuminated red until you correct the condition causing the alarm. Then, the indicator illuminates green and RF output is enabled.

Patient return electrode without the REM safety feature: When the measured resistance between the patient return electrode pins exceeds 20 ohms, the ***REM Alarm*** indicator flashes red, a tone sounds twice, and RF output is disabled. The indicator remains illuminated red until you correct the condition causing the alarm. Then, the red indicator light is extinguished and RF output is enabled.

Serial Port

RS-232 compatible; 9600 baud, 8 data bits, 1 stop bit, no parity

9-pin connector supports the following signals:

- pin 2 – isolated transmit (serial data output transmit line)
- pin 3 – isolated receive (serial data input receive line)
- pin 5 – isolated ground (reference for transmit and receive)

Performance Characteristics

RF Activation Port

The RF activation port is a subminiature telephone jack attached to the contacts of a small relay. The contacts are closed when the output is energized and open at all other times. This port provides a means to tell other equipment that RF current is being generated. This may be useful when making EEG or ECG measurements.

Expansion Port

15-pin connector; supports the following signals:

- pin 2 – isolated transmit (serial data output transmit line)
- pin 3 – isolated receive (serial data input receive line)
- pin 5 – isolated ground (reference for transmit and receive)
- pin 9 – RF disable: input signal which, when activated by an external device, disables active RF output
- pin 10 – RF current: output signal proportional to active RF current
- pin 11 – RF voltage: output signal proportional to active RF voltage

Expansion power (from the low voltage power supply):

+5 V (pin 6), – 12 V (pin 14), + 12 V (pin 15), and ground (pins 12 & 13)

Low Frequency (50-60 Hz) Leakage Current

Enclosure source current, ground open: < 300 µA

Source current, patient leads, all outputs:

Normal polarity, intact ground: < 10 µA

Normal polarity, ground open: < 50 µA

Reverse polarity, ground open: < 50 µA

Sink current at high line, all inputs: < 50 µA

High Frequency (RF) Leakage Current

Bipolar RF leakage current: < 59.2 mA rms

Monopolar RF leakage current (additional tolerance): < 150 mA rms

CEM output modes: < 150 mA at ≤ 50 W

Performance Characteristics

Input Power

120 Volt	240 Volt
Maximum VA at nominal line voltage: Idle: 52 VA Bipolar: 450 VA Cut: 924 VA Coag: 530 VA	Maximum VA at nominal line voltage: Idle: 52 VA Bipolar: 450 VA Cut: 924 VA Coag: 530 VA
Input mains voltage, full regulation range: 104-132 Vac	Input mains voltage, full regulation range: 208-264 Vac
Input mains voltage, operating range: 85-132 Vac	Input mains voltage, operating range: 170-264 Vac
Mains current (maximum): Idle: 0.4 A Bipolar: 2.0 A Cut: 7.0 A Coag: 4.0 A	Mains current (maximum): Idle: 0.2 A Bipolar: 1.0 A Cut: 3.5 A Coag: 2.0 A
Mains line frequency range (nominal): 50 to 60 Hz	Mains line frequency range (nominal): 50 to 60 Hz
Fuses (2): 8 A	Fusing: 4 A
Power cord: 3-prong hospital grade connector	Power cord: 3-prong hospital grade connector

Standards and IEC Classifications

ATTENTION
Consult accompanying documents.

The generator output is floating (isolated) with respect to ground.

Danger
Explosion risk if used with flammable anesthetics.

Caution

To reduce the risk of electric shock, do not remove the cover. Refer servicing to qualified service personnel.

Class I Equipment (IEC 601-1)

Accessible conductive parts cannot become live in the event of a basic insulation failure because of the way in which they are connected to the protective earth conductor.

Type CF Equipment (IEC 601-1)

The Force FX provides a high degree of protection against electric shock, particularly regarding allowable leakage currents. It is type CF isolated (floating) output and may be used for procedures involving the heart.

Drip Proof (IEC 601-2-2)

The Force FX enclosure is constructed so that liquid spillage in normal use does not wet electrical insulation or other components which, when wetted, are likely to affect adversely the safety of the generator.

Standards and IEC Classifications

Electromagnetic Interference

When placed on or beneath an activated Valleylab electrosurgical generator, the Force FX operates without interference. The generator minimizes electromagnetic interference to video equipment used in the operating room.

Caution

Do not stack equipment on top of the Force FX or place the generator on top of electrical equipment (except the Valleylab Force GSU Unit and the Valleylab Electroshield Monitor). These configurations are unstable and/or do not allow for adequate cooling.

Electromagnetic Compatibility (IEC 601-1-2)

The Force FX complies with the appropriate IEC 601-1-2 specifications regarding electromagnetic compatibility.

Voltage Transients (Emergency Generator Mains Transfer)

The Force FX operates in a safe manner when the transfer is made between line AC and an emergency generator voltage source.

Defibrillator Proof

The Force FX complies with the ANSI/AAMI HF18 specifications for "defibrillator proof" designation.

Output Characteristics

Maximum Output for Bipolar and Monopolar Modes

Power readouts agree with actual power into rated load to within 15% or 5 watts, whichever is greater.

Mode	Open Circuit P–P Voltage (max)	Rated Load (max)	Power (max)	Crest Factor *
Bipolar				
Low (Precise)	450 V	100 Ω	70 W	1.5
Med (Standard)	320 V	100 Ω	70 W	1.5
Macro	750 V	100 Ω	70 W	1.5
Monopolar Cut				
Low	1350 V	300 Ω	300 W	1.5
Pure	2300 V	300 Ω	300 W	1.5
Blend	3300 V	300 Ω	200 W	2.5
Monopolar Coag				
Low (Desiccate)	3500 V	500 Ω	120 W	5
Med (Fulgurate)	6900 V	500 Ω	120 W	5.5
High (Spray)	9000 V	500 Ω	120 W	8

* Crest factor is an indication of a waveform's ability to coagulate bleeders without a cutting effect.

Maximum Output for Ultrasonic Electrosurgery (CEM)

Low cut and *Low (Desiccate)* coag are the only monopolar modes available to a connected CEM handpiece.

Mode	Open Circuit P–P Voltage (max)	Rated Load (max)	Power (max)	Crest Factor
Monopolar Cut				
Low	1000 V	300 Ω	100 W	1.5
Monopolar Coag				
Low (Desiccate)	3500 V	500 Ω	70 W	5

Output Characteristics

Available Power Settings in Watts

Bipolar and Macrobipolar

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
45	50	55	60	65	70				

Monopolar Cut: *Low* and *Pure*

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
45	50	55	60	65	70	75	80	85	90
95	100	110	120	130	140	150	160	170	180
190	200	210	220	230	240	250	260	270	280
290	300								

Monopolar Cut: *Blend*

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
45	50	55	60	65	70	75	80	85	90
95	100	110	120	130	140	150	160	170	180
190	200								

Monopolar Coag

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
45	50	55	60	65	70	75	80	85	90
95	100	110	120						

CEM Cut

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
45	50	55	60	65	70	75	80	85	90
95	100								

Output Characteristics

CEM Coag

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
45	50	55	60	65	70				

Output Waveforms`

Effect mode, an automatic adjustment, is applied to all bipolar modes and all cut modes. It is not applied to the coag modes because of their fulguration capabilities. As tissue resistance increases from zero, the generator outputs constant current followed by constant power followed by constant voltage. The maximum output voltage is controlled to reduce capacitive coupling and video interference and to minimize sparking.

Bipolar

Low (Precise)	470 kHz sinusoid
Med (Standard)	470 kHz sinusoid
Macro	470 kHz sinusoid

Monopolar Cut

Low	390 kHz sinusoid. Similar to the *Pure* cut mode except the maximum voltage is limited to a lower value.
Pure	390 kHz sinusoid
Blend	390 kHz bursts of sinusoid, recurring at 27 kHz intervals. 50% duty cycle envelope.

Monopolar Coag

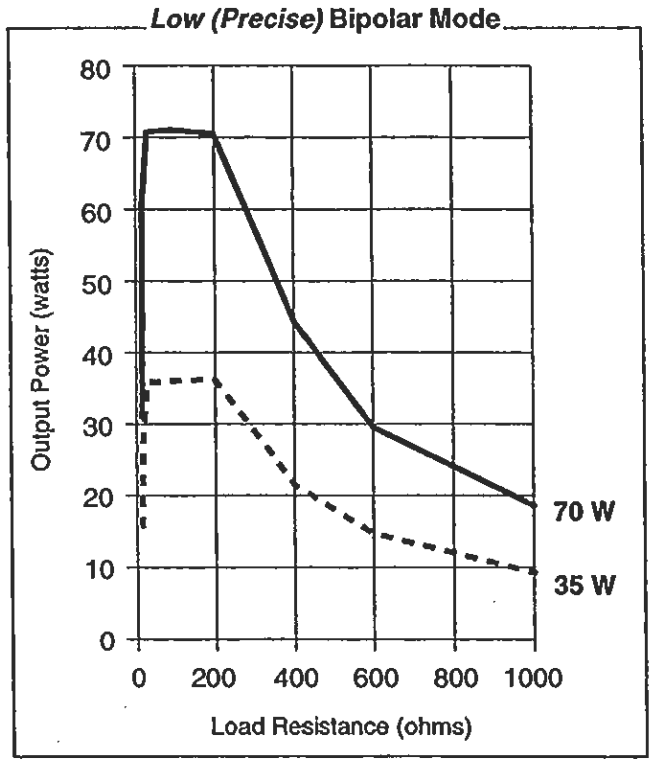
Low (Desiccate)	240 kHz sinusoid repeated at 39 kHz. 8% duty cycle.
Med (Fulgurate)	390 kHz damped sinusoidal bursts with a repetition frequency of 57 kHz into 300 ohms.
High (Spray)	390 kHz damped sinusoidal bursts with a randomized repetition centered at 28 kHz. Frequencies include 21 kHz < f < 35 kHz. Output is further modulated by a random 250 Hz envelope with a variable duty cycle.

Output Power vs. Resistance Graphs

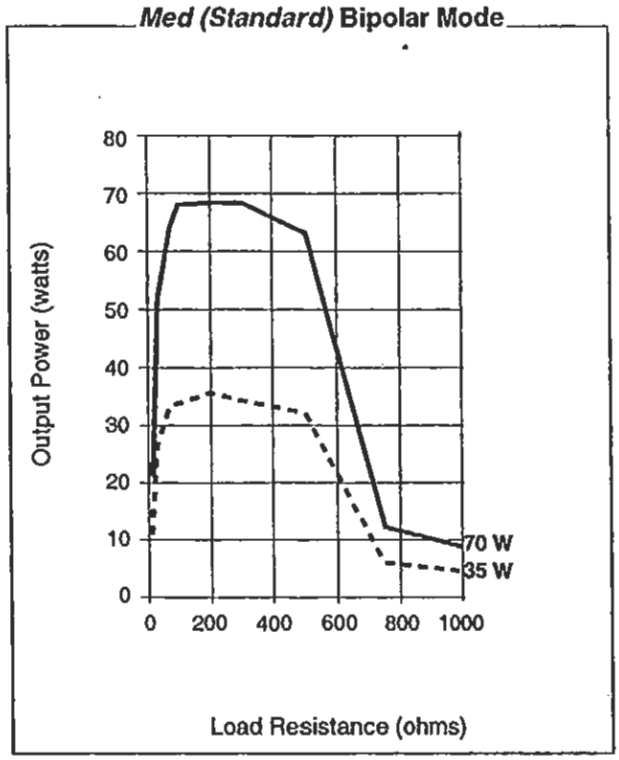
The graphs that follow depict the changes for each mode at specific power settings.

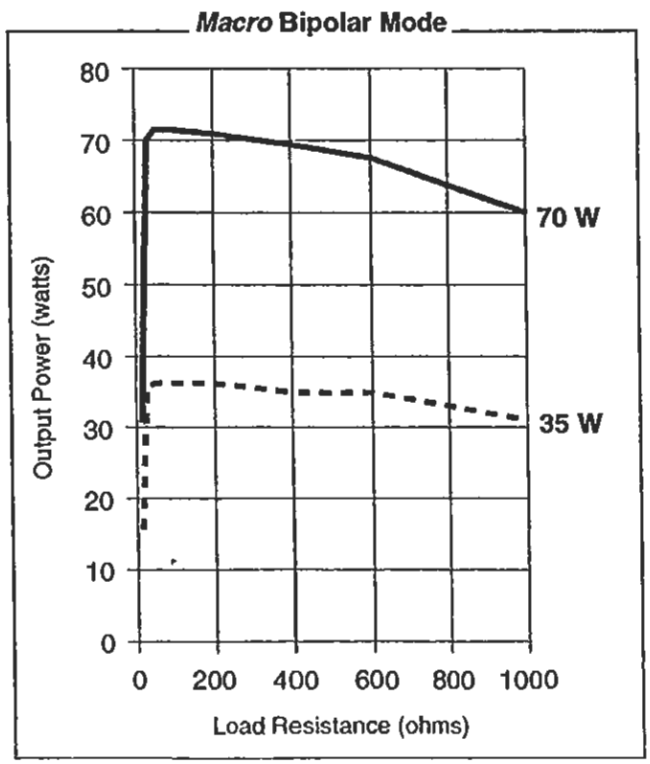
Bipolar Graphs

The insulating surface described in IEC 601-2-2 was used to obtain the bipolar output measurements.



Output Power vs. Resistance Graphs

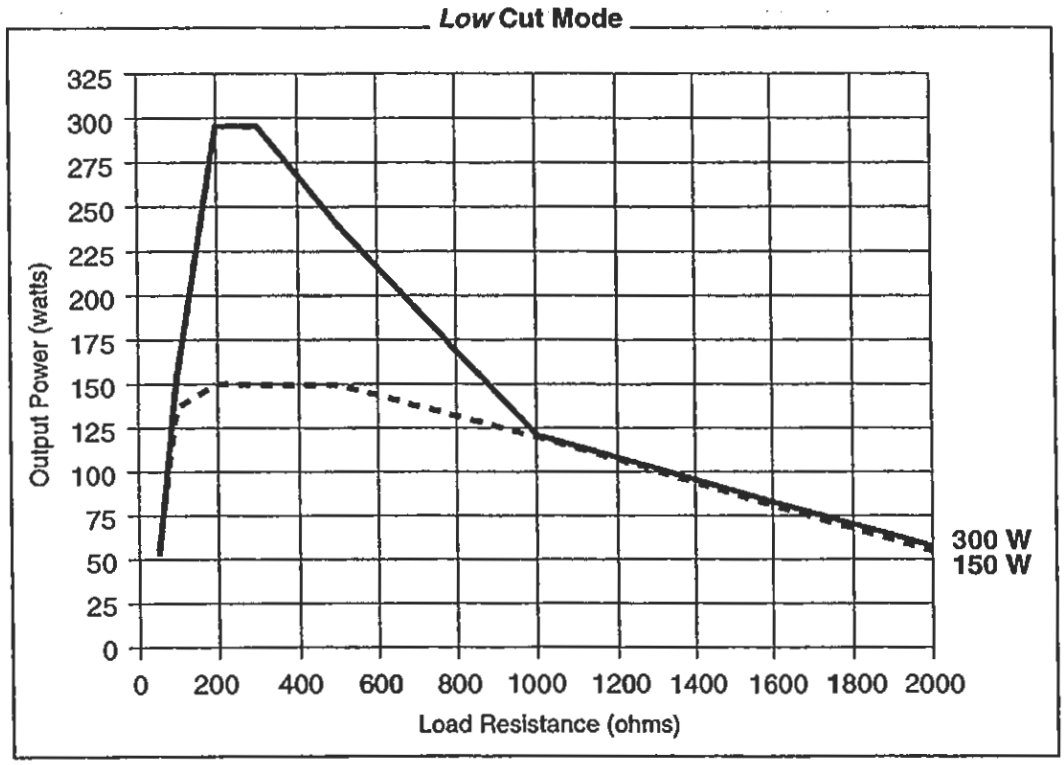




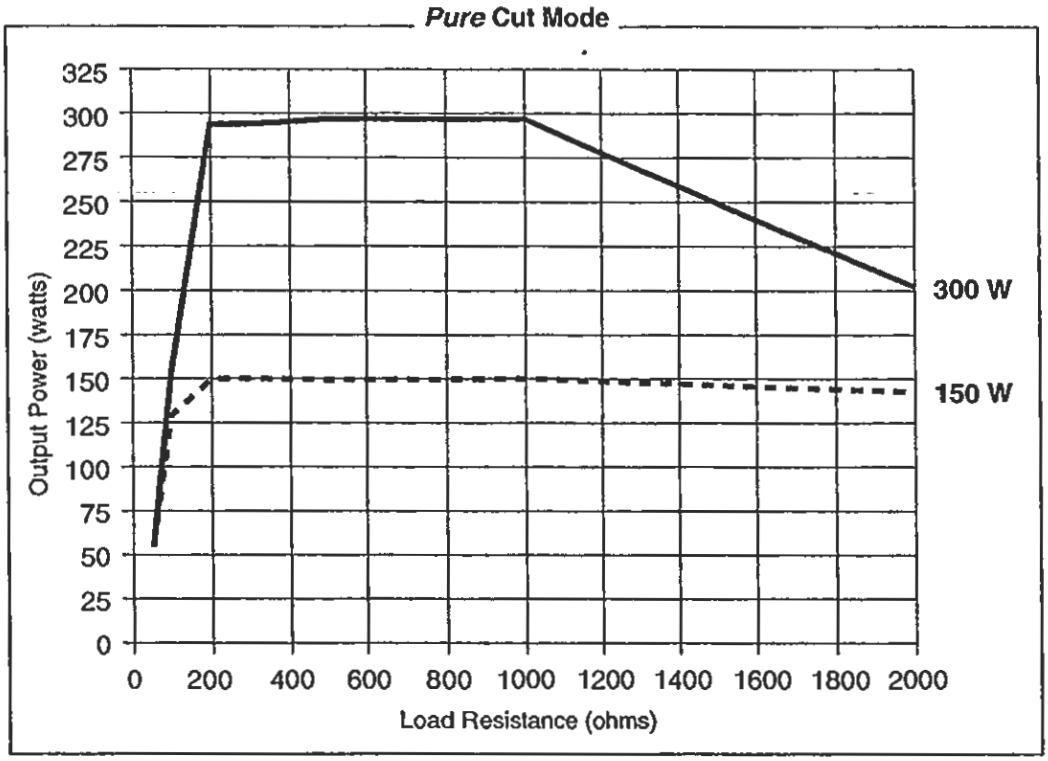
Output Power vs. Resistance Graphs

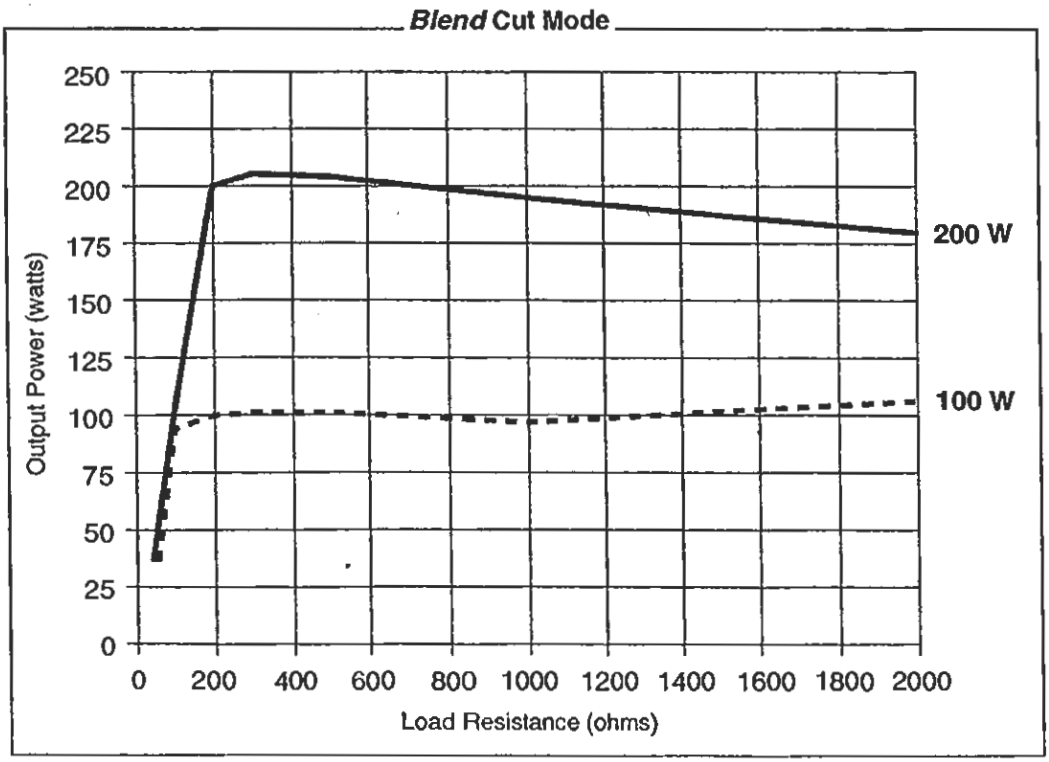
Monopolar Cut Graphs

These measurements were taken using short (< 0.5 meter) leads.



Output Power vs. Resistance Graphs

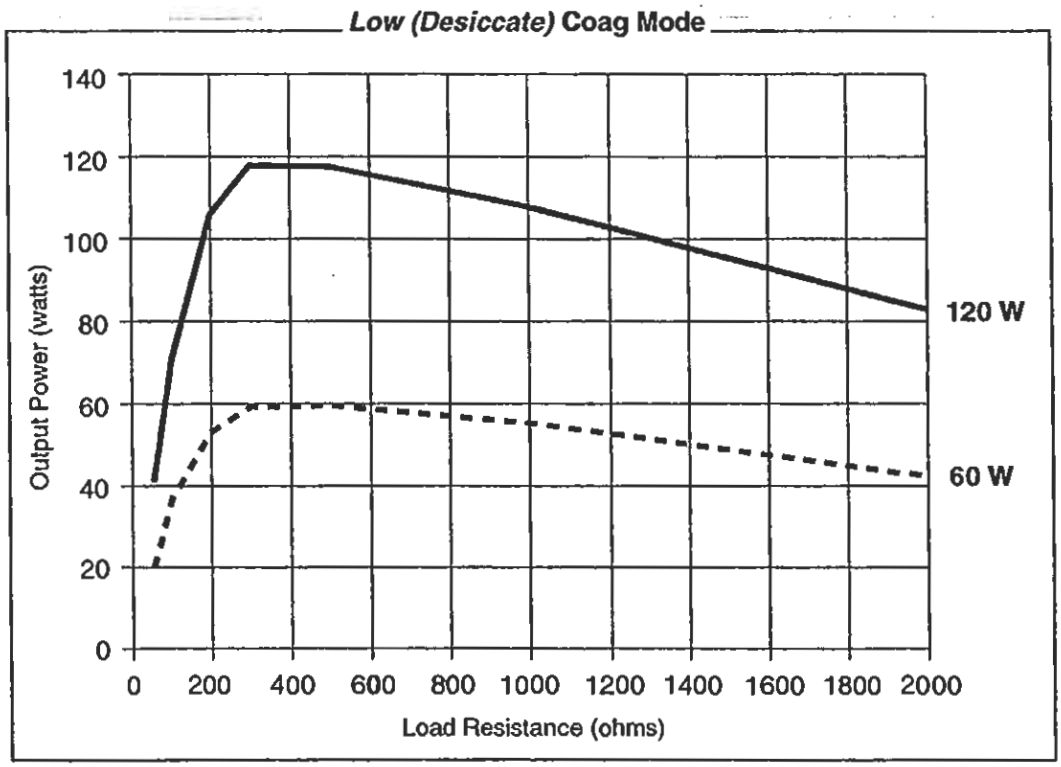




Output Power vs. Resistance Graphs

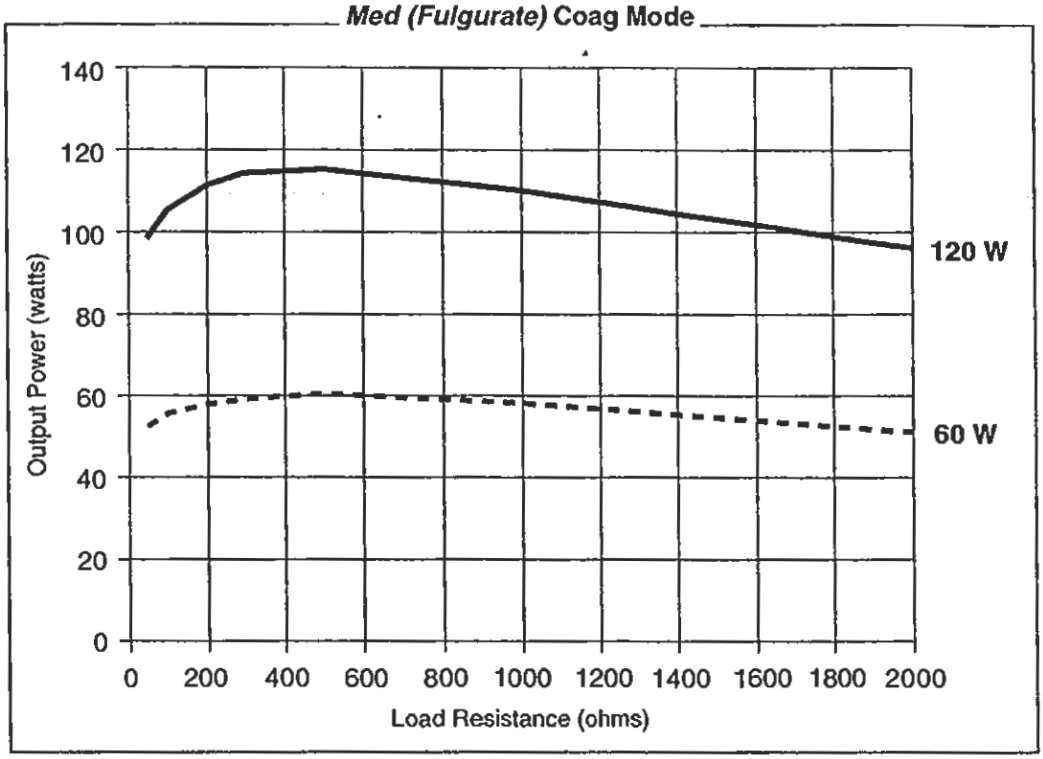
Monopolar Coag Graphs

These measurements were taken using short (< 0.5 meter) leads.



Output Power vs. Resistance Graphs

***Med (Fulgurate)* Coag Mode**



***High (Spray)* Coag Mode**