

# Microwave 6810A Series

Microwave Generators



Low Phase Noise Synthesized Source with 1 Hz resolution

## Features

- Models covering frequencies:
  - 10 MHz to 20 GHz
  - 10 MHz to 40 GHz
  - 10 MHz to 46 GHz
- Optional step attenuators
- CW, CW List and swept frequency and power modes of operation
- Optional trigger board
- Modular design for rapid service
- Built-in user level calibration
- Modulation: external FM standard, option generation of internal FM and pulse modulations

## Synthesized Generator

The synthesized generator has low phase noise and 1 Hz frequency resolution.

VCOs are used for frequencies above 3 GHz and an integrated RF synthesizer for the 10 MHz to 3 GHz range. Internal filtering results in excellent harmonic performance of <-50 dBc (70 MHz to 24 GHz).

Optional step attenuators are available to set low output powers for amplifier or receiver testing.

In CW mode the generator can be used for local oscillator substitution. A power sweep is provided for amplifier gain compression testing.

When used with a scalar analyzer the generator provides a swept synthesized output for frequency characterization of components and systems.

## Modulation

External FM can be applied by connecting an AF source to the rear panel modulation input. With the internal modulation generator option, a modulation generator provides frequency modulation of the source or generates pulse trains that can be applied to a pulse modulator to pulse modulate the source. Pulse trains can be generated as repeating single pulses or as complex multi-pulse patterns. An option for an internal pulse modulator is available, the pulse modulator can be driven with either the optional internal generator or from an external pulse generator connected to the rear panel input connector.

## List Mode

Frequency list mode provides up to 1024 frequencies that can be entered into a list and output on receipt of a trigger command. The trigger modes comprise: internal continuous, internal single step, RS-232 control lines and external. The trigger sources can be from either: menu softkey, GPIB or RS-232 command (GET or \*TRG) or a TTL trigger if the optional trigger board is fitted.

List mode can be enabled in either forward or reverse direction through the frequency list.

Several lists can be stored as instrument settings to internal memory or USB Flash Memory.

By using a 6230A or L series detector it is possible to perform a re-calibration of the source output level.

# SPECIFICATION

## SOURCE

### Functionality

Synthesized CW                      Synthesized sweeper  
Frequency List mode              CW Power sweep

External FM Modulation

Internal FM + Pulse Driver (Option 23)

Internal Pulse Modulator (Option 25)

### Frequency Range

6813A 10 MHz to 20 GHz  
6815A 10 MHz to 46 GHz  
6815AR 10 MHz to 40 GHz

### Resolution (Settable)

6813A 1 Hz to 20 GHz  
6815A 1 Hz to 46 GHz

### CW Accuracy

(Frequency Standard error x Frequency)  $\pm 10$  Hz

### Swept Accuracy (Typical)

300 $\mu$ s Step Time	Frequency Settled Within
10 MHz to 3 GHz	<20 kHz
3 GHz to 46 GHz	<200 kHz
1 ms Step Time	Frequency Settled Within
10 MHz to 3 GHz	<1 kHz
3 GHz to 46 GHz	<10 kHz
10 ms Step Time	Frequency Settled Within
10 MHz to 3 GHz	<100 Hz
3 GHz to 46 GHz	<1 kHz

### List Mode Step Time

<500  $\mu$ s minimum step time per point  
10 MHz to 3 GHz              <4 kHz  
3 GHz to 46 GHz              <40 kHz

### Levelled Power Range

6813A 10 MHz to 20 GHz	-10 to +10 dBm	
6815A 10 MHz to 8 GHz	-10 to +8 dBm	+10 dBm typ
8 GHz to 20 GHz	-10 to +5 dBm	+7 dBm typ
6815AR 20 GHz to 24 GHz	-10 to +4 dBm	+6 dBm typ
24 GHz to 40 GHz	-10 to 0 dBm	+3 dBm typ
40 GHz to 46 GHz	-10 to 0 dBm typ*	

\* Excluding the effect of connector moding

6813A + Option 011 (70 dB Step Attenuator)  
10 MHz to 3 GHz              -80 to +8 dBm  
3 GHz to 20 GHz              -80 to +7 dBm

6813A + Option 012 (90 dB Step Attenuator)  
10 MHz to 3 GHz              -100 to +8 dBm  
3 GHz to 20 GHz              -100 to +7 dBm

6815A/6815AR + Option 013 (70 dB Step Attenuator)  
10 MHz to 8 GHz              -80 to +6 dBm              +8 dBm typ  
8 GHz to 20 GHz              -80 to +2 dBm              +4 dBm typ  
20 GHz to 24 GHz              -80 to +1 dBm              +3 dBm typ  
24 GHz to 40 GHz              -80 to -3 dBm              0 dBm typ

Note: 1) For option 002 (Field Replaceable connectors) guaranteed levelled output is reduced by 0.5 dB.

2) For option 025, (Internal Pulse Modulation) the guaranteed levelled output is reduced as detailed under the option specification

### Settable Power Range\*

-110 dBm to +20 dBm \*dependant on attenuator option

### Settable Power Resolution

0.01 dB

### Power Sweep Range (from Maximum Levelled Power) Without Attenuator

>20 dB

### Internal Levelling Accuracy at 0 dBm (no options fitted)

10 MHz to 3 GHz,  $\pm 0.7$  dB  
3 GHz to 24 GHz,  $\pm 1.0$  dB  
24 GHz to 40 GHz,  $\pm 1.5$  dB

### Levelled Power Accuracy With Options 011, 012 and 013

10 MHz to 3 GHz < $\pm 1$  dB  
( $\pm 0.3$  dB or  $\pm 2\%$  of attenuator setting in dB whichever is greater)  
3 GHz to 24 GHz < $\pm 1$  dB  
( $\pm 1$  dB or  $\pm 4\%$  of attenuator setting in dB whichever is the greater)  
24 GHz to 40 GHz < $\pm 1.5$  dB  
( $\pm 1$  dB or  $\pm 4\%$  of attenuator setting in dB whichever is the greater)

### Linearity (No Options Fitted) Over Levelled Power Range Relative to 0 dBm

10 MHz to 40 GHz              < $\pm 0.5$  dB

### Power Stability With Temperature (Typical)

10 MHz to 40 GHz              <0.1 dB/ $^{\circ}$ C

### Harmonics and Sub-Harmonics Over Levelled Power Range

#### Harmonics

<70 MHz,              <-25 dBc  
70 MHz to 3 GHz,    <-55 dBc  
3 GHz to 24 GHz,    <-50 dBc  
24 GHz to 40 GHz,   <-20 dBc

#### Sub-Harmonics

10 MHz to 3 GHz, <-60 dBc  
3 GHz to 20 GHz, none  
24 GHz to 40 GHz, <-40 dBc

### Spurious Signals (Typical)

For carrier frequencies <375 MHz

Offset:

30 kHz to 150 kHz,              <-50 dBc  
>150 kHz                          <-55 dBc

For carrier frequencies >375 MHz

Offset:

30 kHz to 150 kHz,              <-50 dBc  
>150 kHz                          <-60 dBc

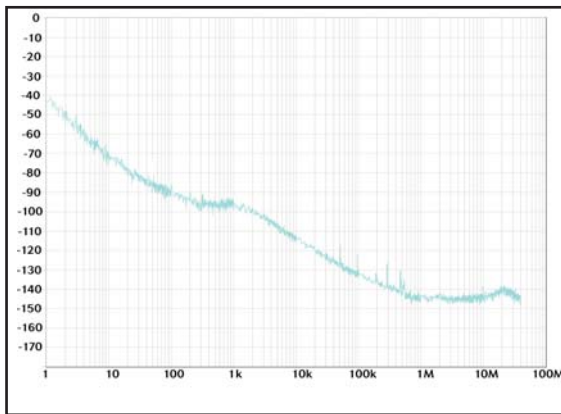
### Phase Noise <dBc/Hz in CW Mode

#### Phase Noise <dBc/Hz in CW mode - guaranteed

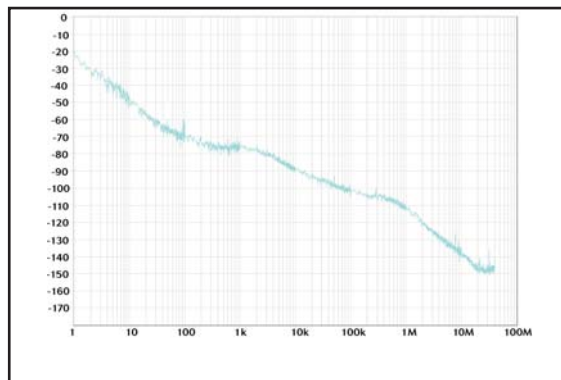
CW Freq	Frequency Offset		
	1 kHz	10 kHz	100 kHz
0.25 GHz	-86	-95	-108
0.5 GHz	-98	-112	-134
1 GHz	-92	-106	-128
2 GHz	-86	-100	-122
4 GHz	-80	-92	-100
10 GHz	-72	-84	-90
20 GHz	-66	-78	-822
40 GHz	-63	-75	-79

#### Typical Phase Noise <dBc/Hz in CW mode

CW Freq	Frequency Offset				
	(GHz)	100 Hz	1 kHz	10 kHz	100 kHz 1 MHz
0.3	-88	-90	-101	-110	-135
0.6	-90	-99	-114	-130	-140
1	-87	-92	-109	-129	-140
3	-76	-86	-100	-120	-138
4	-75	-82	-97	-111	-120
6	-71	-80	-94	-101	-110
10	-68	-73	-87	-100	-110
20	-60	-74	-84	-93	-105
24	-58	-64	-76	-80	-103
40	-55	-63	-75	-79	-100



Measured Phase Noise at 1 GHz



Measured Phase Noise at 10 GHz

#### Source Match (Typical)

- 1 MHz to 3 GHz, <-15 dB
- 3 GHz to 20 GHz, <-10 dB
- 20 GHz to 40 GHz, <-8 dB

#### Output Connector

- 6813A Precision N type, female (standard) or Precision 3.5 mm, female (option)
- 6815A Precision 2.92 mm female or Field replaceable connectors (option)

## MODULATION

#### External Frequency Modulation

Peak deviation (1 V peak input)

- |                   |                    |
|-------------------|--------------------|
| 10 MHz - 375 MHz  | 1 kHz to 5 MHz     |
| 375 MHz - 750 MHz | 250 Hz to 1.25 MHz |
| 750 MHz - 1.5 GHz | 500 Hz to 2.5 MHz  |
| 1.5 GHz - 3 GHz   | 1 kHz to 5 MHz     |
| 3 GHz - 46 GHz    | 20 kHz to 1 MHz    |

Accuracy (1 kHz modulating frequency) 20-400 kHz deviation  
±3 % of indication ±1 Hz excluding residual FM

-3 dB bandwidth, AC coupled mode

- |                |                             |
|----------------|-----------------------------|
| 10 MHz - 3 GHz | <100 Hz to >1 MHz typical   |
| 3 GHz - 46 GHz | <100 Hz to >500 kHz typical |

-3 dB bandwidth, DC coupled mode

- |                |                        |
|----------------|------------------------|
| 10 MHz - 3 GHz | DC to >1 MHz typical   |
| 3 GHz - 46 GHz | DC to >500 kHz typical |

#### Option 023 Internal Modulation Generator

##### FM Source

Modulation signal: sinewave, 0.1 Hz to 500 kHz, resolution 0.1 Hz  
Other specifications as for External Frequency Modulation except:  
Accuracy (1 kHz modulating frequency) 20 - 400 kHz deviation ±5 %  
of indication ±1 Hz excluding residual FM

##### Pulse Generator Source (Output enabled with option 025 fitted)

##### Modes

Single Pulse

##### Pulse Pattern

Pulse patterns comprising up to 256 pulse width/PRI pairs can be set up, stored and recalled.

##### Trigger Modes

External, Internal continuous

##### Pulse Widths (PW)

120 ns to >1 second

##### Resolution

120 ns

##### Pulse Period (PRI)

240 ns to 7 seconds (PRF <1 Hz to 4.16 MHz)

##### Resolution

120 ns

##### Pulse Delay

Zero to 100 ms where zero is <120 ns referred to trigger or sync pulse falling edge

##### Resolution

120 ns

##### Sync Output

120 ns pulse referred to trigger. Available at trigger socket

##### Inputs/Outputs

##### Trigger in/out

Rear panel BNC connector provides either trigger input or sync output dependant upon trigger mode. TTL level

#### Options 025a & 025b Internal Pulse Modulator

##### Option 25a (6813A)

##### Frequency Range

50 MHz to 18 GHz

Usable to 20 GHz

##### RF Output Range

The levelled power range is reduced by:

<3.5 dB up to 6 GHz

<4.5 dB up to 14 GHz

<5.0 dB up to 18 GHz

when pulse modulation is selected

##### RF Level Accuracy

Adds ± 0.3 dB to the levelled power accuracy specification when pulse modulation is enabled and for powers of <-1 dBm

##### Source Harmonics (with Pulse Modulation enabled)

50 MHz - 2 GHz

<-35 dBc

2 GHz - 20 GHz

<-50 dBc

##### On/Off Ratio

50 MHz - 1 GHz

>55 dB

1 GHz - 9 GHz

>60 dB

9 GHz - 17 GHz

>70 dB

17 GHz - 18 GHz

>80 dB

18 GHz - 20 GHz

>80 dB (typical)

##### Rise/Fall Times

(measured at 10% and 90% of edge)

##### Rise Time

<8 ns (Typically <5 ns)

##### Fall Time

<12 ns (Typically <9 ns)

##### Option 25b (6815A and 6815AR)

##### Frequency Range

50 MHz to 40 GHz (46 GHz for 6815A)

##### RF Output Range

The levelled power range is reduced by:

<5 dB up to 20 GHz

<8 dB up to 30 GHz

<9 dB up to 40 GHz

when pulse modulation is selected

##### RF Level Accuracy

Adds ±0.3 dB to the levelled power accuracy specification when pulse modulation is enabled and for output powers of <-3 dBm

### Source Harmonics (with Pulse Modulation enabled)

50 MHz - 375 MHz	<-35 dBc
375 MHz - 24 GHz	<-50 dBc
24 GHz - 40 GHz	<-20 dBc

### On/Off Ratio

50 MHz - 10 GHz	>60 dB
10 GHz - 26.5 GHz	>60 dB (typically >70 dB)
26.5 GHz - 40 GHz	>60 dB (typically >80 dB)

### Rise/Fall Times (measured at 10% and 90% of edge)

Rise Time	<7 ns (Typically <6 ns)
Fall Time	<11 ns (Typically <10 ns)

### Pulse Modulation Control

#### Modes

Pulse, Pulse CW

External (via rear panel BNC connector)  
Internal (if Opt 23 fitted)

#### Control

Control of pulse modulation is:

Internal via soft key menu when the modulation generator option (Opt 023) is fitted or

External via the rear panel BNC Mod in/out socket.

Level is TTL, High = On, Low = Off.

When pulse mod Off is selected the output is the selected CW output level.

**Pulse CW** In both internal or external modes, allows setting of output level in the 'On' condition for reference or calibration.

## FREQUENCY STANDARD

### Internal 10 MHz OCXO

#### Drift

$\pm 5$  in  $10^8$  over 0 to 55°C

#### Ageing

$\pm 2$  in  $10^7$  per year (OCXO)

### External Frequency Standard

1 MHz or 10 MHz, Connector: BNC

## REAR PANEL CONNECTORS

### RS-232

9 way D-type connector, male, Baud rate 300 to 9600

### GPIB Interface

GPIB is IEEE 488.1 and 488.2 compatible

### Frequency Standard In/Out BNC

1 MHz or 10 MHz input and 10 MHz output selectable from front panel

### Mod In/Out BNC

Mod in/out

Rear panel BNC connector, TTL level. Impedance approx 100  $\Omega$

### External Monitor

Standard VGA, 640 by 480 color output, 15 way high density D-type female connector

### Voltage Output

Auxiliary 9-pin connector. Settable for 0 to 10 V ramp, fixed voltage

### External Levelling Input

Input voltage range: 0 to +1 V, Connector: BNC (f)

## TRIGGER BOARD OPTION 24

### External Trigger Input

Connector: BNC (f)

TTL input to trigger sweep in frequency list mode, Connector: BNC (f)

### Lock Output

Connector: BNC (f)

TTL output indicating source locked

## GENERAL FEATURES

### Display

Color active matrix TFT liquid crystal display with 16.5 cm (6.5") visible diagonal

### Data Storage and Firmware Upgrade

USB Flash Memory

### Weight – Model and Option Dependent

16 kg (35 lb)

Size (Not including front handles)

230 mm H x 430 mm W x 570 mm D (9" H x 17" W x 22" D)

### Power Supply

Auto-sensing 90 V to 265 V, 45 Hz to 65 Hz AC. Plus 90 V to 110 V, 400 Hz AC. Consumption 150 W

### Rated Range of Use

Temperature	6813	0 to +50°C
	6815	+5°C to +45°C
Humidity	Up to 93% RH at +40°C	

### Conditions of Storage and Transportation

Temperature	-40 to +71°C
Humidity	Up to 93% RH at +40°C
Altitude	Up to 4570 m (15,000 ft)

## ELECTROMAGNETIC COMPATIBILITY

Conforms to the protection requirements of EEC Council directive 2004/108/EC.

Conforms to the limits specified in the following standards:

IEC/EN61326-1

RF Emission Class A, Immunity table 3

The instrument is intended for the use in industrial environments. It may not be possible to ensure electromagnetic compatibility in other environments because of conducted or radiated disturbances.

## SAFETY

Conforms with the requirements of EEC Council Directive 2006/95/EC (as amended) and product standard IEC/EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.

## VERSIONS AND OPTIONS

When ordering please quote the full ordering number information.

### Ordering Numbers

### Versions

6813A	10 MHz to 20 GHz Generator
6815A	10 MHz to 46 GHz Generator
6815AR	10 MHz to 40 GHz Generator

### Supplied Accessories

46886/067	CD-ROM containing:
46892/920	6820A/6840A Series Operating Manual
46892/922	6810A 6820A/6840A Series Getting Started Guide
46892/921	6820A/6840A Series Remote Operating Manual
46892/931	6810A Series Operating/Remote Programming Manual

43123/076	AC Supply Lead
37591/755	Front Panel Cover

### Options

002	Field Replaceable Precision N (f) or 3.5 mm (f) RF Connectors (6813A), 2.92 mm (f) 6815A, 6815AR
011	20 GHz 70 dB Step Attenuator (only available for 6813A)
012	26.5 GHz 90 dB Step Attenuator (only available for 6813A)
013	40 GHz 70 dB Step Attenuator (only available for 6815A)
023	Internal Modulation
024	Trigger Board
025	Internal Pulse Modulator (Opt 25a 6813A), (Opt 25b 6815AR)

Note : All specifications quoted are for operation at calibration temperature  $\pm 3^{\circ}\text{C}$ .

Specifications involving Type N connectors above 18 GHz are not traceable to national standards as these do not exist at present.

Specifications involving 2.92 mm connectors above 40 GHz are not traceable to national standards as these do not exist at present.

Typical specifications are non-warranted.

## ACCESSORIES

### 6230A/L SCALAR DETECTORS

#### Accessories for level calibration

6230A Series      Standard Detectors (-65 dBm to +20 dBm) typical

### ACCESSORIES

#### Miscellaneous Electrical Cables

43129/189	GPIB Cable
43139/042	BNC (m) to BNC (m) 1.5 m

#### Standard Microwave Cables

54351/022	0.5 m, 18 GHz, N (m) to N (m)
54351/025	0.5 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)
54351/027	0.5 m, 40 GHz, 2.92 mm (m) to 2.92 mm (m)

#### Attenuators

56534/901	Precision Fixed Coaxial Attenuator 3 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/902	Precision Fixed Coaxial Attenuator 6 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/903	Precision Fixed Coaxial Attenuator 10 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/904	Precision Fixed Coaxial Attenuator 20 dB DC to 18 GHz 5 W, N(m) to N(f)

### MISCELLANEOUS

46885/038	Rack Mount Kit for 6800/6800A Series
46880/122	Service Manual (consists of Maintenance Manual (printed) + Operating Manual (CD-ROM))
46882/931	6810A Series Operating/Remote Programming Manual (printed)
46882/922	6810A and 6820A/6840A Series Getting Started Guide (printed)
84501	Soft Carrying Case
46662/695	Flight Case
54152/001	3.5 mm Torque Wrench
54211/008	Compact Keyboard





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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.