Data Sheet

Plasma Control Technologies

COMET cito

Air cooled RF Generator

cito 276, 2710, 406, 4010

COMET

Technology with Passion

Product overview

Scope

This data sheet describes Comet's cito generators. cito is designed for use in plasma processing applications. The generators are air cooled and operate from single phase, 230 VAC, 50 to 60 Hz AC source.

Safety note

WARNING! - IMPROPER USE OF THIS PRODUCT CAN RESULT IN SERIOUS INJURY OR DEATH. READ AND UNDERSTAND THE OPERATOR'S MANUAL PRIOR TO OPERATING THIS PRODUCT.

Code compliance

Reference Number	Description
2014/35/EU Low voltage directive	Safety regulations for electrical measuring, controlling, and regulating equipment and for laboratory equipment
EN 61010-1	Electrical Equipment for Measurement, Control, and Laboratory use; Part 1: General Requirements
2014/30/EU EMC directive	Electromagnetic Compatibility (generic immunity standard – industrial)
EN 55011	Suppression of Radio disturbances caused by electrical appliances and systems; Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment (Class A, Group2)
EN 61000-6-2	Generic standards – Immunity for industrial environments
2011/65/EC RoHS directive	RoHS Directive (update)
SEMI F47-0706	Voltage Sag Immunity

Product overview

Features

Frequency operation	27.12/40.68 MHz
Maximum forward power	600/1000 W
Phase synchronization	CEX Input
Serial interface	RS-232
Analog control	Sub-D connector on the rear panel, the number of pins depends on the analog/digital interface option: 9-pin, 25-pin, or 37-pin
RF output connector	N-type
RF output cable	Interlocked
Front panel	Active
Front panel control	Front panel is active with front mains switch, keys and jogwheel for control, and 256x132 LCD, black and white.
Load mismatch protection	Unit will operate into any impedance mismatch condition without damage or malfunction.
RF output power connector interlock	A fail safe, hard wired interlock disables the RF output power of the unit upon removal of the coaxial cable.
Interlock	A fail safe, hard wired interlock disables the RF output power of the unit upon opening of a loop via dedicated pins of the analog/digital interface.
Overtemperature fault	The unit protects itself against high internal temperature.
Reflected power limit	Yes
RF power limit	Yes
Humidity	No
DC current limit	No
DC overload	No

Product overview

Product key

The product key contains all basic product information.

cito 27 10-ACNA-N37A-FF

Frequency	RF Power
27: 27.12 MHz	6: 600 W
40: 40.68 MHz	**10**: 1000 W
→page 6	→page 6

cito 2710-ACNA-N37A-FF

Cooling	Display	Output connector	Input voltage	Fieldbus	Analog / Digital interface	Match interface	Fixed/ Variable freq.
A: Air	**C**: Active (Comet)	**N**: N-type	**A**: 230 VAC	**N**: None	9-pin	**A**: AGS	**FF**: Fixed frequency
-	-	-	-	-	25-pin	C: COMET	-
-	-	-	-	-	**37**-pin	-	-
→ page 7	→ page 4	→ page 9	→ page 6	→ page 9	→ page 9	→ page 9	

Product specifications

Electrical specifications

AC input voltage	230 VAC
Input voltage range	Single phase 187 VAC to 265 VAC
AC line frequency	50/60 Hz nominal
AC input current	4.0 A (27.12 MHz, 600 W RF Power) 4.1 A (40.68 MHz, 600 W RF Power) 6.4 A (27.12/40.68 MHz, 1000 W RF Power)
Ground leakage current	< 5 mA
Inrush current	< 35 A
Power factor	> 0.95 typical
Overcurrent protection	User must provide 10 A circuit breaker with 'C' characteristic due to inrush current.
Efficiency (line to load)	> 0.69 typical at full-rated power, nominal line, into a 50 ohm load

Output power characteristics

Power control method	Forward or load power or process control
Output power range	1 W to 600 W 1 W to 1000 W
Output load	50 ohm non-reactive nominal
Reflected power limit	120 W (600 W RF Power) 200 W (1000 W RF Power)
Forward power accuracy[1]	± 1.5 % (± 2 %)[2] of setpoint or ± 0.15 % (± 0.2 %)[2] of full rated output power, whichever is greater, into a 50 ohm non-reactive load
Unit-to-unit repeatability of forward power	± 3 % of setpoint or ± 0.3 % of full rated output power, whichever is greater, into a 50 ohm non-reactive load
Rise time	< 30 ms after RF ON command
Fall time	< 1 ms after RF OFF command
Overshoot	≤ 10 % of power level requested as measured on forward power signal
RF output frequency with tolerance	27.12 MHz ± 0.01 % 40.68 MHz ± 0.01 %
Output filtering	
Harmonic signals	≤ - 40 dBc
Spurious signals	≤ - 50 dBc

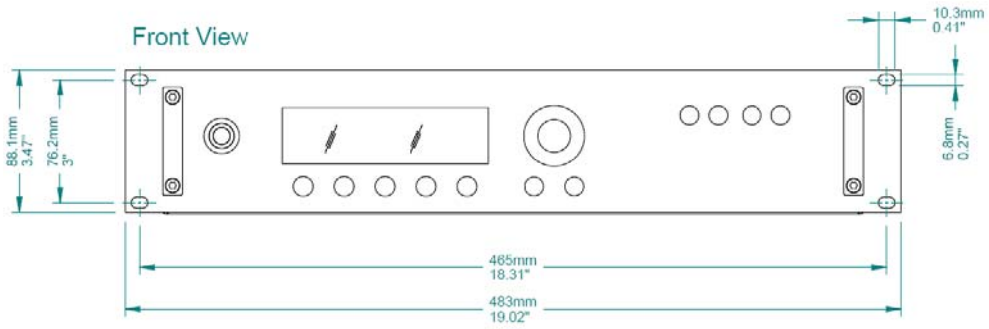
[1] valid within a calibration interval of 6 months

[2] cito 2710-ACNA-N37A-FF

Product specifications

Mechanical specifications

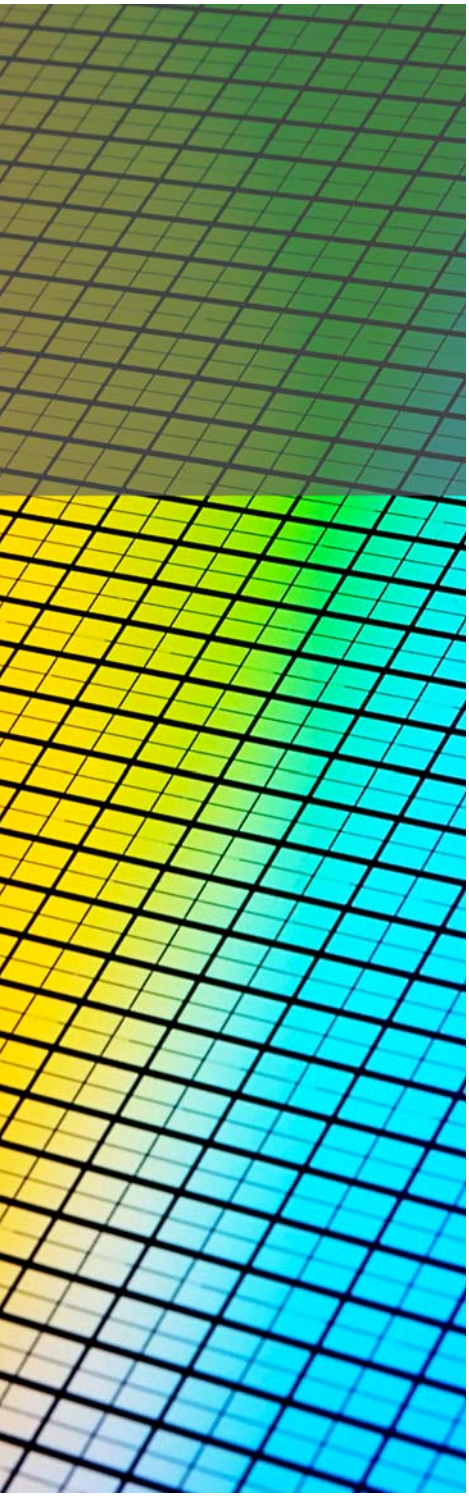
Size	441 mm (width) x 500 mm (depth) x 88 mm (height)
Weight	< 15 kg
Mounting	19″ EIA rack mounting
Clearance	80 mm at each side for cooling 100 mm for rear panel connections
Handles for positioning	Unit has 2 handles on front panel
Cooling medium	Air



Environmental conditions

Ambient temperature	Operating: + 5 °C to + 35 °C Non-operating: - 30 °C to + 60 °C
Relative humidity	Operating: 30 % to 80 % non-condensing environment Non-operating: > 80 %
Altitude	Operating: - 50 ft to + 7000 ft Non-operating: - 50 ft to + 45000 ft

Appendix



Connections and interfaces

RS-232 and Profibus pin descriptions

Analog/Digital interface factory defaults:

9-pin

15-pin

25-pin

37-pin

Document Information

Connections and interfaces

AC input cable	IEC 320
Chassis ground	One M5 tapped hole located on the rear panel 'Ground Symbol' marking located visibly next to the hole.
RF output power connector	N-type (female) receptacle
Matching network	AGS/COMET
Matching network communication port	9-pin D-sub (male)
Ethernet user port	RJ-45
Analog/Digital interface	Number of pins depends on the product key: → **page 5** Factory default signals: 9-pin → **page 11** 25-pin → **page 14** 37-pin → **page 17**
RS-232 user port	9-pin D-sub (female) receptacle (pin descriptions → **page 10**)
SyncBus interface	IEEE 1394 Connector
Fieldbus	None
Water connections	None
CEX input/output	BNC (F) @ 50 ohm Input: + 0 dBm (27.12/40.68 MHz) Output (supports up to three units): + 5 dBm (40.68 MHz) + 6 dBm (27.12 MHz)
CEX phase shift (degrees)	- 180 degrees to + 180 degrees in 1 degree steps
Pulsing	Signal pin on analog/digital interface
Frequency	0.017 Hz to 30 kHz
Pulse period resolution	0.1 µs
Duty cycle	0.01 % to 99.99 %
Minimum pulse on time	16 µs
Timing	
RF rise time	< 10 µs
RF fall time	< 1 µs

RS-232 and Profibus pin descriptions

RS-232

Pin #	Name	Description
1	n.c	-
2	TxD	Transmit data
3	RxD	Receive data
4	n.c	-
5	GND	Data common
6	n.c	-
7	n.c	-
8	n.c	-
9	n.c	-

Profibus

Pin #	Name	Description
1	Unassigned	-
2	Unassigned	-
3	B Line	Positive RxD/TxD, RS485 level
4	RTS	Request to send
5	GND bus	Isolation ground
6	+5 V Bus output	Isolated +5V termination power
7	Unassigned	-
8	A	Negative RxD/TxD, RS485 level
9	Unassigned	-

9-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Level	Description
1	3	Interlock Input (+)	Input (floating)	5 V to 24 V	Contact closure to pin 2 via an external interlock loop. User may also provide a 5 VDC to 24 VDC signal referenced to pin 3 to satisfy the interlock.
2	3	Interlock Output	Output (floating)	15 V	Contact closure to pin 1 via the user's external interlock loop. The voltage output is floating and has no reference to ground.
3	1 or 2	Interlock Return (-)	floating	0 V	Return pin for an external interlock signal. This pin must be used as the return for the external interlock voltage, because the interlock input (pin 1) is floating and has no reference to ground.
4					Connect to the shield of the external interlock cable
5					No Connection
6					No Connection
7					No Connection
8					No Connection
9					No Connection

15-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
1	8	Operating Mode A	DI	Connecting pin 1 and pin 2 to a high or low level allows you to set the regulation mode. A high level switches to remote control.
2	8	Operating Mode B	DI	Connecting pin 1 and pin 2 to a high or low level allows you to set the regulation mode. A high level switches to remote control.
3	8	Ready Status	DO	When the cito is Ready to make RF power, a low impedance (opto-coupler output, 8 mA maximum) is created between this pin and pin 8.
4	8	Error	DO	When the cito is in an error state, a low impedance (opto-coupler output, 8 mA maximum) is created between this pin and pin 8.
5	8	Maximum RF Power Level Reached	DO	When the cito is incapable of producing requested power, a low impedance (opto-coupler output, 8 mA maximum) is created between this pin and pin 8. This error message may occur in the following situations: • In Process Control mode, the RF power necessary for the desired process control level may be higher than the cito is able to deliver • In Load Power Control mode, the forward power necessary may be higher than the generator is able to deliver. • The external pulsing frequency exceeds the limits.
6	8	RF Enable	DO	When the cito RF is ON, a low impedance (opto-coupler output, 8 mA maximum) is created between this pin and pin 8.

15-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
7	8	Interface Voltage	DI	If no voltage is applied to pin 7, 5 VDC is the standard level for the digital inputs and outputs. If you want any other level, an external voltage must be applied to pin 7 and will be used as supply voltage for pins 3, 4, 5 and 6. The voltage range is 5 VDC to 24 VDC, with a maximum current of 300 mA, depending on the load of the outputs.
8		Ground		Reference pin.
9	8	Blanking/Pulse Mode	DI	An external 5V TTL pulse signal can be applied to pulse the RF output power Pin 8 MUST be grounded on host or client side.
10	8	RF Power On	DI	The signal enables or disables RF output power. A positive voltage of 4 V to 24 V will enable RF output. A voltage of 1.5 V or less will disable RF output.
11	8	Process Control Setpoint	AI	0 to +10 VDC = 0 to 1000 V linear (this can be adjusted via front panel or Stolberg Commander). Make certain the scaling on the system probe (example: DC Bias) and cito match.
12	8	RF Power Setpoint	AI	0 to +10 VDC = 0 to 1000 W, Linear (see Serial Tag for actual rating); Pin 8 MUST be grounded on host or client side.
13	8	Forward Power Monitor	AO	0 to +10 VDC = 0 to 1000 W, Linear (see Serial Tag for actual rating); Pin 8 MUST be grounded on host or client side.
14	8	Reflect Power Monitor	AO	0 to +10 VDC = 0 to 1000 W, Linear (typically 20% of rated power); Pin 8 MUST be grounded on host or client side.
15	8	Process Feedback Monitor	AO	This 0 V to 10 V signal closes the control loop around external components in the RF path. Pin 8 MUST be grounded on host or client side.

25-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
1	12 14	Setpoint Status Return/CEX Locked Return	Return	See pin 14
2	15	Reflected Power Monitor	AO	Provides a linearly scaled readback of the RF reflected power. Default range 0 V to 5 V. 0 V to 5 V correlates to 0 W to 1000W.
3	16	RF Power Monitor	AO	Provides a linearly scaled readback of the RF power. The source of the signal depends on the power control mode. In forward power control mode it provides the forward power, in load power control mode the load power. Default range 0 V to 5 V. 0 V to 5 V correlates to 0 W to 1000 W.
4	17	RF Power On	DI	Enables or disables RF output power. A transition from low to high state will enable RF output power; a transition from high to low state will disable RF output power.
5	18	RF Power/ Process Control Setpoint	AI	Represents a linearly scaled setting for the RF power setpoint. The function of the signal provided to this analog input depends on the power control mode. In forward power control mode it sets the requested forward power; in load power control mode the requested load power. Voltage range 0 V to 5 V. 0 V to 5 V correlates to 0 W to 1000 W.
6	19	Process Control	DI	Selects forward power or process control regulation mode. A transition from low to high state will enable process control regulation mode, a transition from high to low state will enable forward power regulation mode. See also pin 8.

25-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
7	20	Process Control Feedback	AI	Used as process control feedback input, where the process control set-point is given by pin 5. The scaling for Process Control Setpoint (pin 5) and Process Control Feedback (pin 7) must be identical. This signal closes the control loop around external components in the RF path. Typically, matching networks provide a scaled DC bias or RF peak voltage monitor signal which is applied to this pin. When set to process control mode, the generator compares the value for process control setpoint with process control feedback and adjusts the RF output power to maintain both values at the same level. To enable this function, the process feedback source must be set to analog (see user manual for more details).
8	21	Load Power Control	DI	Selects forward power or load power regulation mode. A transition from low to high state will enable load power regulation mode. A transition from high to low state will enable forward power regulation mode. See also pin 29.
9	22	Over-temperature Error Return	Return	See pin 22
10	23	Interlock	DI	To satisfy the interlock, an external loop with a resistance of less than 15 ohms must be closed between pin 10 and pin 23. Pin 23 supplies this loop through a current limiting circuit (maximum 120 mA). Also a voltage between 5 V and 24 V referenced to ground (pin 19 or 21) can be applied to pin 10 to close the interlock.

25-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
11	24	Interlock Satisfied Return	Return	See pin 24
12	1	CEX Locked	DO	When the generator has recognized a valid CEX signal on the CEX input and has locked on it, a low impedance is created between this pin and pin 1.
13	Shield of 25-pin D-Sub connec-tor	12 V DC Supply Voltage	Supply	Supply voltage of 12 V (maximum current 100 mA).
14	1	Setpoint Warning	DO	When the generator is out of setpoint, a low impedance is created between this pin and pin 1.
15	2	Reflected Power Monitor Return	Return	See pin 2
16	3	RF Power Monitor Return	Return	See pin 3
17	4	RF Power On Return	Return	See pin 4
18	5	RF Power/ Process Control Setpoint Return	Return	See pin 5
19	N/A	GND	GND	DC ground connection common to chassis ground.
20	7	Process Control Feedback Return	Return	See pin 7
21	N/A	GND	GND	DC ground connection common to chassis ground.
22	9	Over-temperature Error	DO	When the generator detects an over-temperature condition and issues an error, a low impedance is created between this pin and pin 9.
23	10	Interlock	Supply	Supply for the interlock string ending at pin 10.
24	11	Interlock Satisfied	DO	When the interlock is satisfied, a low impedance is created between this pin and pin 11.
25	19	Blanking/Pulsing	Pulse Input	An external square wave signal can be applied to this digital input to exter-nally pulse the RF output power.

37-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
1	2 3 20 21 22	Analog Input Return	Return	Common return pin for analog inputs. This pin must be grounded either on host or client side.
2	1	Process Control Setpoint	AI	Represents a linearly scaled setting for the process control setpoint. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 to maximum process control value (4000 V default maximum value). For example a voltage of 2.5 V correlates to a process control setpoint of 1000 V (with default settings).
3	1	Match Position Load Setpoint	AI	Represents a linearly scaled setting for the position of the CLoad capacitor. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 % to 100 % of the capacitor's range. For example a voltage of 5 V correlates to a capacitor position of 50 %.
4	8	RF Power Monitor	AO	Provides a linearly scaled readback of the RF power. The source of the signal depends on the power control mode. In forward power control mode it provides the forward power, in load power control mode the load power. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 W to nominal RF power. For example 5 V correlates to 50 % of the nominal RF power.

37-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
5	8	Process Control Monitor	AO	Provides a linearly scaled readback of the process control value. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 to maximum process control value (4000 V default maximum value). For example a voltage of 5 V correlates to 50 % of the maximum process control value.
6	8	Match Position Load Monitor	AO	Provides a linearly scaled readback of the position of the CLoad capacitor. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 % to 100 % of the capacitor range. For example a voltage of 5 V correlates to a capacitor position of 50 %.
7	8	Not Used	AO	This pin is not used by default.
8	4 5 6 7 23 24 25 26	Analog Output Return	Return	Common return pin for analog outputs. This pin must be grounded either on host or client side.
9	27	Remote	DI	Sets the remote control source of the generator. A transition from low to high state will switch setpoint source and matching source to Analog Port. A transition from high to low state will switch back to the previously selected settings.
10	27	Load Power Control	DI	Selects forward power or load power regulation mode. A transition from low to high state will enable load power regulation mode. A transition from high to low state will enable forward power regulation mode. See also pin 29.

37-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
11	27	Error Reset	DI	Used to clear error messages. A transition from low to high state will clear all revoked errors. Pending or persistent errors however cannot be cleared. In this case the reason for the error must be cleared first.
12	27	Not Used	DI	This pin is not used by default.
13	16	Over-temperature Error	DO	When the generator detects an over-temperature condition and issues an error, a low impedance is created between this pin and pin 16.
14	16	Setpoint Warning	DO	When the generator is out of setpoint, a low impedance is created between this pin and pin 16.
15	16	Interlock Satisfied	DO	When the interlock is satisfied, a low impedance is created between this pin and pin 16.
16	13 14 15 31 32 33 34	Digital Output Return	Return	Common return pin for digital outputs. This pin must be grounded either on host or client side.
17	35	Blanking/ Pulsing Return	Return	This pin must be grounded either on host or client side. See pin 35.
18	36	Interlock Return	Return	Return/reference pin for an external interlock signal. For a description of the interlock circuit see pin 36.
19	N/A	GND	GND	DC ground connection common to chassis ground.

37-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
20	1	RF Power Setpoint	AI	Represents a linearly scaled setting for the RF power setpoint. The function of the signal provided to this analog input depends on the power control mode. In forward power control mode it sets the requested forward power, in load power control mode the requested load power. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 W to nominal RF power. For example a voltage of 5 V correlates to 50 % of the nominal RF power.
21	1	Match Position Tune Setpoint	AI	Represents a linearly scaled setting for the position of the CTune capacitor. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 % to 100 % of the capacitor's range. For example a voltage of 5 V correlates to a capacitor position of 50 %.
22	1	Process Control Feedback	AI	Used as process control feedback input, where the process control setpoint is given by pin 2. The scaling for Process Control Setpoint (pin 2) and Process Control Feedback (pin 22) must be identical. This signal closes the control loop around external components in the RF path. Typically, matching networks provide a scaled DC bias or RF peak voltage monitor signal which is applied to this pin. When set to process control mode, the generator compares the value for process control setpoint with process control feedback and adjusts the RF output power to maintain both values at the same level. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 to maximum process control value (4000 V default maximum value). Please note that this input does only accept positive values. For negative DC bias voltages the scaled absolute value must be provided to this pin.

37-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
23	8	Reflected Power Monitor	AO	Provides a linearly scaled readback of the RF reflected power. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 W to nominal RF power. For example a voltage 1 V correlates to 10 % of the nominal RF power.
24	8	Match Position Tune	AO	Provides a linearly scaled readback of the position of the CTune capacitor. Default voltage range 0 V to 10 V. 0 V to 10 V correlates to 0 % to 100 % of the capacitor range. For example a voltage of 5 V correlates to a capacitor position of 50 %.
25	8	Not Used	AO	This pin is not used by default.
26	8	Not Used	AO	This pin is not used by default.
27	9 10 11 12 28 29 30	Digital Input Return	Return	Common return pin for digital inputs. This pin must be grounded either on host or client side.
28	27	RF Power On	DI	Enables or disables RF output power. A transition from low to high state will enable RF output power, a transition from high to low state will disable RF output power.
29	27	Process Control	DI	Selects forward power or process control regulation mode. A transition from low to high state will enable process control regulation mode, a transition from high to low state will enable forward power regulation mode. See also pin 10.
30	27	Set Match Capacitor	DI	Used to apply certain capacitor positions. A transition from low to high state will cause the generator to move the capacitors in an attached matching network to the positions provided by the signals on pin 21 and pin 24.

37-pin Analog/Digital interface factory defaults

Signal Pin	Related Pin	Signal Name	Signal Type	Description
31	16	Matching Active	DO	When the generator detects that the capacitors in an attached matching network are moving, a low impedance is created between this pin and pin 16.
32	16	Error	DO	When the generator is in an error state, a low impedance is created between this pin and pin 16.
33	16	CEX Locked	DO	When the generator has recognized a valid CEX signal on the CEX input and has locked on it, a low impedance is created between this pin and pin 16.
34	16	Ready Status	DO	When the generator is ready to deliver RF power, a low impedance is created between this pin and pin 16.
35	17	Blanking/Pulsing	Pulse Input	An external square wave signal can be applied to this digital input to externally pulse the RF output power.
36	18	Interlock	DI	To satisfy the interlock and to allow the RF output to be enabled, a voltage of 5 V to 24 V, referenced to pin 18, must be applied to this input. The voltage can be obtained from pin 37 (13.8 V DC) through an external loop. In this configuration pin 18 must be grounded. Alternatively an external voltage of 5 V to 24 V (minimum current 10 mA) referenced to pin 18 can be applied to this input to satisfy the interlock.
37	19	13.8 V DC Supply Voltage	Supply	Supply voltage of 13.8 V (maximum current 100 mA).

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