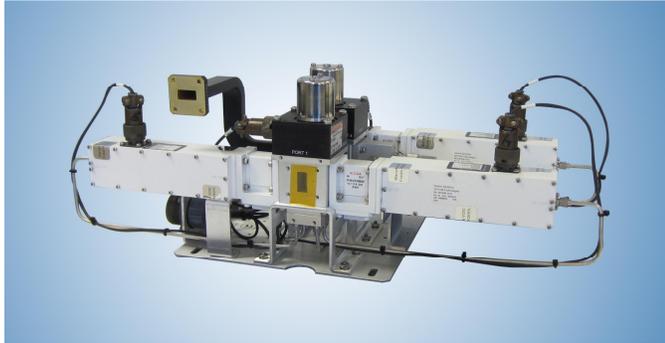


Ku-Band Redundant LNA Systems

LRK-1000 Series



Typical Ku-Band 1:2 LNA Plate Assembly

Plate Assembly Features

- LK-12000 Series Ku-band Low Noise Amplifiers (LNAs)
- High quality dual waveguide/coaxial switches
- Manual override
- Waveguide input flanges
- Output coaxial isolators standard
- Transmit reject filter(s), input crossguide coupler(s), output coax couplers, and offline I/O options available

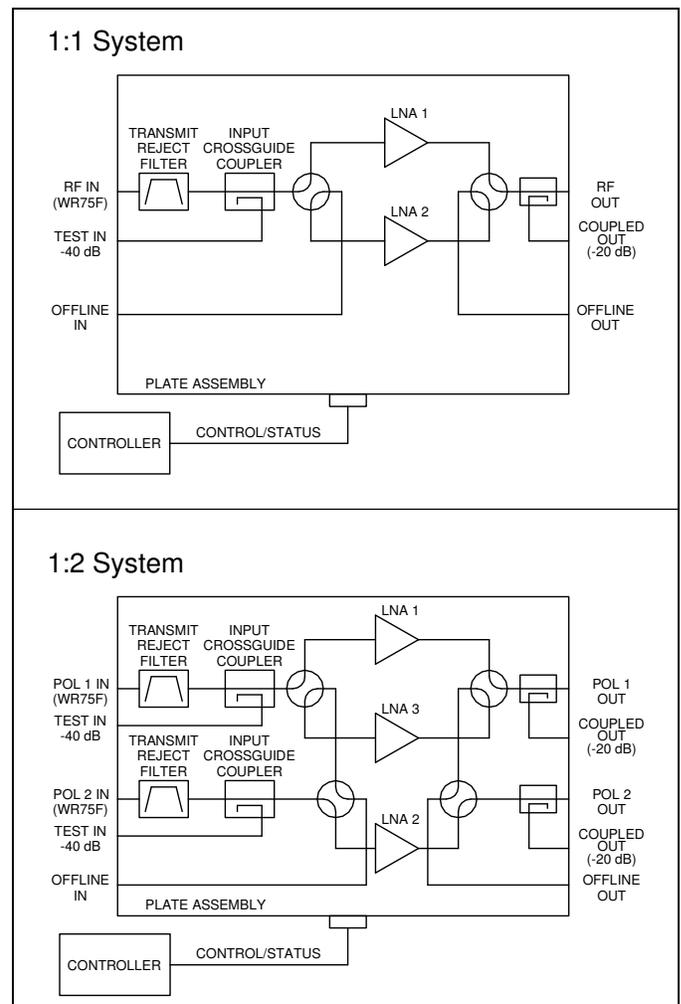
Redundancy Controller Features

- 10/100 Base T Ethernet network interface
- Supports SNMP v1, v2c, and v3
- Rack-mount chassis, 19" wide, 1¾" (1 RU) high
- Dual, redundant power supplies
- Manual or automatic operation
- Monitors unit currents, external alarms, or both
- Automatically switches RF path to standby unit when unit failure occurs
- User-selectable RS-232/-422/-485 serial I/O M&C interface
- Parallel I/O M&C interface
- Menu-driven user configuration of all options
- Front panel graphically depicts switch positions and unit status
- Worldwide universal AC input capability standard; consult factory for DC prime power
- Audible alarm
- CE certified and RoHS compliant; EAR 99

Introduction

Redundant LNA systems minimize system downtime due to LNA failure by providing a spare LNA and an automatic means of switching to the spare upon failure of a primary LNA. A 1:1 system provides one spare LNA for one primary LNA. A 1:2 system provides a spare LNA for either of two primary LNAs. The systems consist of an outdoor plate assembly which mounts at the antenna hub, an indoor control panel and interconnecting control cable.

System Block Diagrams



System Specifications *

| Parameter | Notes | Min. | Nom./Typ. † | Max. | Units |
|---|---|-------|--|-------|---------------------|
| Frequency Range | Band "E" | 10.95 | | 12.75 | GHz |
| | Band "R" | 10.70 | | 12.75 | GHz |
| Noise Temperature, System | At +23 °C Versus temperature | | See Table 1 See Table 2 | | |
| Gain | Standard LNA | 60 | 63 | | dB |
| | LNA with Option 1 | 50 | 53 | | dB |
| Gain Match | Between LNAs | | | 1 | dB |
| Gain Flatness | Full band | | | ±0.5 | dB |
| | Per 40 MHz | | | ±0.2 | dB |
| Gain Stability | Per day, constant temp | | | ±0.2 | dB |
| | Versus temperature | | -0.04 | | dB/°C |
| VSWR | Input, standard | | 1.20 | 1.25 | :1 |
| | Input, with system option B, Tx filter | | 1.25 | 1.30 | :1 |
| | Output | | 1.20 | 1.25 | :1 |
| Power Output at 1 dB Compression (P _{1 dB}) | Standard LNA | +10 | +13 | | dBm |
| | LNA with Option 2 | +18 | +20 | | dBm |
| | LNA with Option 2 & system option D, output couplers | +17 | +19 | | dBm |
| Third Order Output Intercept Point (OIP ₃) | Standard LNA | +20 | +23 | | dBm |
| | LNA with Option 2 | +28 | +30 | | dBm |
| | LNA with Option 2 & system option D, output couplers | +27 | +29 | | dBm |
| AM/PM Conversion | At -5 dBm out | | | 0.05 | %/dB |
| Group Delay per 40 MHz | Linear | | | 0.02 | ns/MHz |
| | Parabolic | | | 0.002 | ns/MHz ² |
| | Ripple | | | 0.2 | ns p-p |
| Maximum Input Power | Without damage | | | 0 | dBm |
| Desensitization Threshold for 13.75–14.50 GHz in | Standard system | | | -20 | dBm |
| | With system option B, Tx filter | | | +30 | dBm |
| Connectors | RF Input RF Output Offline In/Out, Coupler In/Out | | WR75F Waveguide Flange Type N Female ^A Type N Female ^A | | |
| Temperature Range | Switch Plate Assy | -40 | | +60 | °C |

* System specifications depend on choice of LNA and various options. Specifications shown are for a typical system using LK-12000 series LNAs (Specification 5908).

† When there is only one value on a line, the Nom./Typ. column is a nominal value; otherwise it is a typical value. Typical values are intended to illustrate typical performance, but are not guaranteed.

^A SMA Female connectors available on request (custom option).

Part Number/Ordering Information

| Ku-Band LNA Systems ^(a) | | L | R | K | | | | | | | | | | | | | | | | |
|------------------------------------|---------------------------------|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| System Type: | 1:1 | 1 | | | | | | | | | | | | | | | | | | |
| | 1:2 | 2 | | | | | | | | | | | | | | | | | | |
| LNA Frequency: | 10.95-12.75 GHz | E | | | | | | | | | | | | | | | | | | |
| | 10.70-12.75 GHz | R | | | | | | | | | | | | | | | | | | |
| LNA Noise Temp.: | 65 K ^(b) | 6 | 5 | | | | | | | | | | | | | | | | | |
| | 70 K | 7 | 0 | | | | | | | | | | | | | | | | | |
| | 80 K | 8 | 0 | | | | | | | | | | | | | | | | | |
| | 90 K | 9 | 0 | | | | | | | | | | | | | | | | | |
| LNA Options: | 60 dB gain (standard) . . . | X | | | | | | | | | | | | | | | | | | |
| | 50 dB gain (option) | 1 | | | | | | | | | | | | | | | | | | |
| | +12 dBm output (standard) . | X | | | | | | | | | | | | | | | | | | |
| | +20 dBm output (option) . . | 2 | | | | | | | | | | | | | | | | | | |
| System Options: | No filter | X | | | | | | | | | | | | | | | | | | |
| | Tx reject filter, -60 dB . . . | B | | | | | | | | | | | | | | | | | | |
| | • 13.75-14.50 GHz reject band | | | | | | | | | | | | | | | | | | | |
| | No input coupler(s) | X | | | | | | | | | | | | | | | | | | |
| | Input CG coupler(s), -40 dB . | C | | | | | | | | | | | | | | | | | | |
| | No output coupler (s) | X | | | | | | | | | | | | | | | | | | |
| | Output coaxial coupler(s), -20 | D | | | | | | | | | | | | | | | | | | |
| | dB | | | | | | | | | | | | | | | | | | | |
| | No offline I/O | X | | | | | | | | | | | | | | | | | | |
| | Offline I/O, terminated, with | E | | | | | | | | | | | | | | | | | | |
| | isolator | | | | | | | | | | | | | | | | | | | |
| Control Cable: | No cable | X | | | | | | | | | | | | | | | | | | |
| (Standard service) | 100 ft. (30 m) | 1 | | | | | | | | | | | | | | | | | | |
| | 150 ft. (45 m) | 2 | | | | | | | | | | | | | | | | | | |
| | 200 ft. (60 m) | 3 | | | | | | | | | | | | | | | | | | |
| | 250 ft. (75 m) | 4 | | | | | | | | | | | | | | | | | | |

Examples:

1:1 system with 10.95-12.75 GHz, 80 K LNAs, no LNA options, no system options, and 100 ft. cable:

Order Number L R K 1 E 8 0 - X X X X X X 1

1:1 system with 10.70-12.75 GHz, 65 K LNAs^(b), no LNA options, Tx Reject filter, CG coupler, and 200 ft. cable:

Order Number L R K 1 R 6 5 - X X B C X X 3

1:2 system with 10.95-12.75 GHz, 90 K LNAs with low gain option, input CG coupler, output coax coupler, offline I/O, and 150 ft. cable:

Order Number L R K 2 E 9 0 - 1 X X C D E 2

1:2 system with 10.70-12.75 GHz, 70 K LNAs with high power output and low gain options, Tx filter, input and output couplers, offline I/O, and 250 ft. cable:

Order Number L R K 2 R 7 0 - 1 2 B C D E 4

Notes:

(a) Consult factory for custom configurations.

(b) Consult factory for delivery of 65 K LNAs.

Table 1 — Typical System Noise Temperature with Various Options (Add to T_{LNA})

| System Configuration: | 1:1 | | 1:2 | | |
|---|------|------|--------|--------|---------|
| | | | Pol. 1 | Pol. 2 | Standby |
| Standard Configuration (Add to T _{LNA}) | 5 K | 5 K | 9 K | 14 K | 14 K |
| With 40 dB Crossguide Coupler(s) | 7 K | 7 K | 11 K | 16 K | 16 K |
| With Transmit Reject Filter(s) | 18 K | 18 K | 22 K | 27 K | 27 K |
| With Tx Filter(s) and Coupler(s) | 20 K | 20 K | 24 K | 29 K | 29 K |

Table 2 — Noise Temperature vs. Ambient Temperature

Noise temperature vs. ambient temperature can be found from the equation,

$$NT_2/NT_1 = (T_2/T_1)^n$$

where:

- NT₂ = Noise Temperature at T₂
- NT₁ = Noise Temperature at T₁
- T₂ = Temperature 2 in K
- T₁ = Temperature 1 in K
- n = 1.8 for the LNAs or = 1.0 for passive losses

For the case where T₁ = 296 K (+23 °C), the ratio NT₂/NT₁ is shown in the table below for both LNAs (n = 1.8) and for passive losses (n = 1.0):

| Ambient Temperature T ₂ (°C) | n = 1.8 NT ₂ /NT ₁ | n = 1.0 NT ₂ /NT ₁ |
|--|---|---|
| 0 | 0.86 | 0.92 |
| +23 | 1.00 | 1.00 |
| +40 | 1.11 | 1.06 |
| +50 | 1.17 | 1.09 |
| +60 | 1.24 | 1.13 |

Example: For a 1:1 system with Tx filter, crossguide coupler and 80 K LNAs, T_{LNA} = 80 K at +23 °C and passive losses = 20 K at +23 °C; thus, T_{sys} = 100 K at +23 °C. What is T_{sys} at +50 °C?

From the table, NT₂/NT₁ at 50 °C = 1.17 for the LNAs and 1.09 for the passive losses:

$$NT_2 = 1.17 \times (80 \text{ K}) + 1.09 \times (20 \text{ K}) = 94 \text{ K} + 22 \text{ K} = 116 \text{ K at } +50 \text{ °C.}$$

Redundant System Controller



1:2 Redundant System Controller, Model RSC12V1-AC

The RSC series redundant system controllers for 1:1 and 1:2 systems directly power the LNAs and monitor the output voltages and currents to detect faults. The RSC

can also monitor external alarm signals or a combination of output currents and external alarm inputs. Upon detecting a fault, the RSC drives an RF transfer switch to activate the spare unit.

The RSC offers monitoring and control of auxiliary RF hardware; remote monitor and control via network, serial interface, or parallel I/O; flexible configuration of system behavior; remote disable of local controls for security; and the ability to detect and report certain failures within the controller itself.

A second RSC can be linked to a primary RSC to provide full system control from an alternate control site. When set up this way, the secondary RSC is referred to as a remote control panel, or RCP. The configuration and settings of the primary RSC are transferred to the RCP, which then mimics its controls and interfaces. This permits system operation from a location that is up to 4000 ft (1200 m) distant from the primary controller.

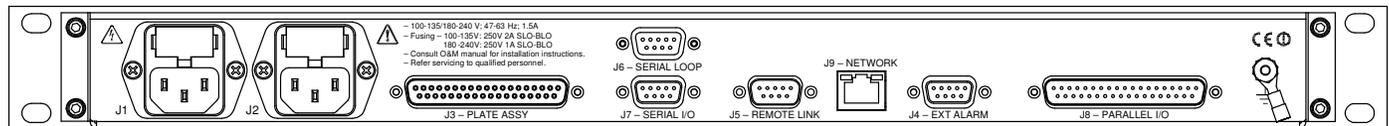
Controller Specifications

| | |
|-----------------------------|--|
| Unit Status Monitor Methods | Controller monitors unit bias current; alarm is generated if current goes outside of allowed tolerance window (LNA or LNB systems). Controller also monitors external alarm inputs (SSPA and other systems) or combinations of both internal unit current and external alarm inputs. |
| Unit Current Window Width | ±5% to ±25% of nominal; user selectable in 5% steps (applies to all monitored unit currents) |
| Switchover Time | 100 ms maximum |
| Unit Power Outputs | +14.3 to +15.0 Vdc, 700 mA maximum |
| Switch Drive Outputs | -22 to -28 Vdc, 2 A maximum |
| External Alarm Inputs | Optionally up to one per unit; require sinking 5 mA at 5 Vdc to negate alarm |
| Serial I/O Interface | RS-232/RS-422/RS-485 2- or 4-wire; user selection |
| Parallel I/O Interface | Control inputs: Contact closures to ground; require sinking 20 mA at 15 Vdc Status outputs: Form 'C' dry contacts; 100 Vdc, 0.5 A, 3 W max (resistive load) |
| Controller Dimensions | 19" (483 mm) W x 1.72" (43.7 mm) H x 17.5" (445 mm) D; 7.6 lb (3.4 kg) |
| Chassis Slides | Standard. Radio relay rack-mount brackets available on request. |
| Cable Length to Plate Assy | Order cable separately. 100 ft (30 m) to 250 ft (75 m) lengths in 50 ft (15 m) increments are standard; other lengths (up to 500 ft or 150 m) are available by special order. |
| AC Input (standard) | 90-264 Vac, 47–63 Hz, 100 W; Dual AC inputs and dual redundant power supplies. |
| DC Input (option) | Requires DC-AC inverter. Consult factory. |
| Temperature Range | Operating: 0 to +50 °C (indoor equipment environment) Storage: -40 to +70 °C |
| Relative Humidity | Operating: 5% to 95% non-condensing |
| Altitude | Up to 10,000 ft (3000 m) above mean sea level |
| Reliability | MTBF: 48,200 hours; MTTR: less than 30 minutes with spares and proper technical person. |

Controller Front Panel Controls and Indicators

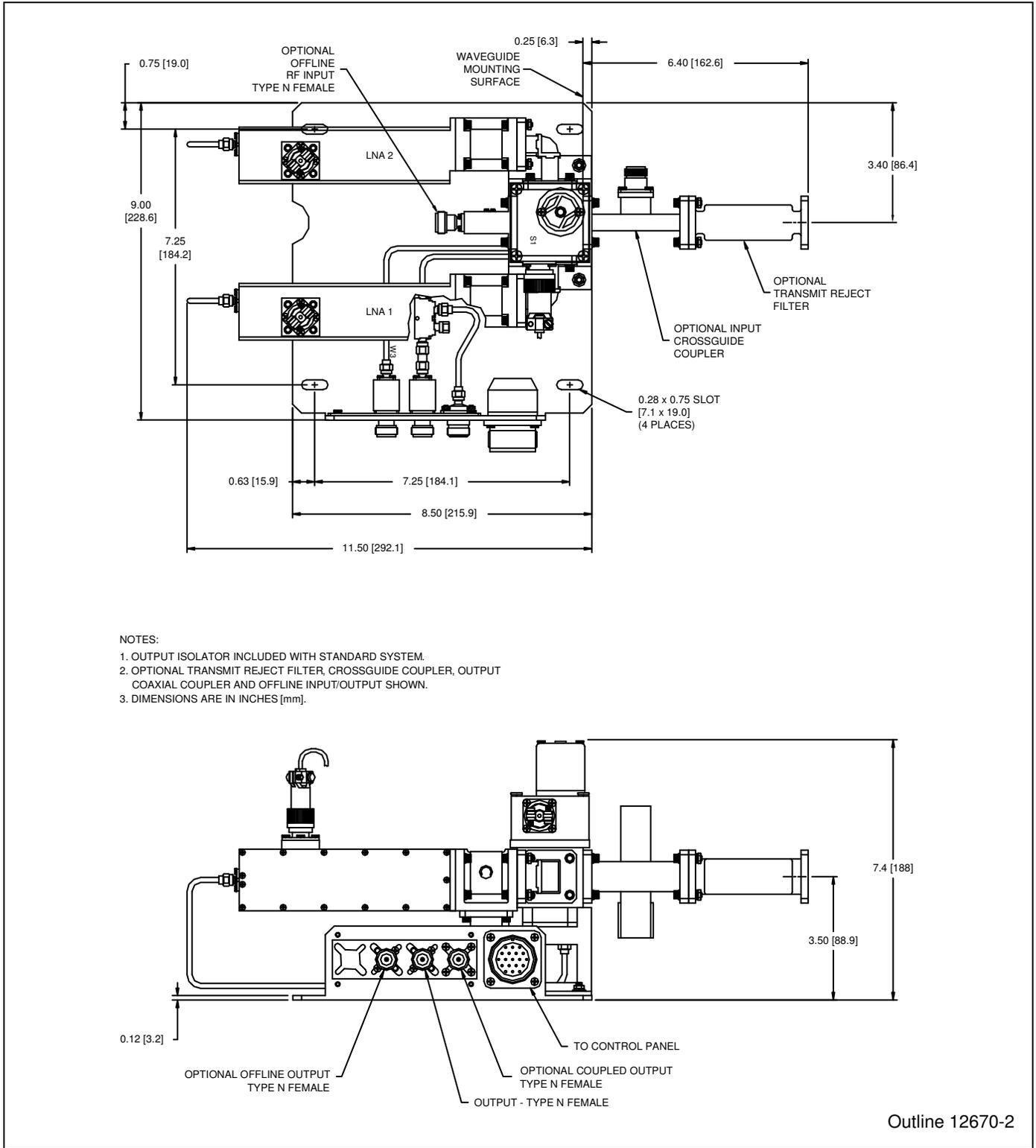
| | |
|--------------------------------------|--|
| Unit Status Alarms | LED Indicators glow green when OK, red when a fault is detected. |
| PS Indicator | Glow red to show fault with either dual redundant power supply. |
| Panel Test | Pushbutton lights all indicators & tests audible alarm. |
| RF Switch Pushbuttons and Indicators | <p>Pushbuttons are used to manually switch units. Front panel indicators show which units are on-line. Unit indicators light red to show faulted units.</p> <p>In a typical 1:1 system, Unit 1 is the primary unit and Unit 2 is on standby. In a 1:2 system, Unit 1 is the primary unit for Pol 1 and Unit 2 is the primary unit for Pol 2. Unit 3 is on standby and can be selected for either Pol. In a dual 1:1 system, Unit 1 is the primary unit and Unit 2 is on standby for Pol 1; Unit 3 is the primary and Unit 4 is on standby for Pol 2.</p> |
| Auto/Manual Switch and Indicators | In Auto mode, a unit failure initiates automatic switchover to the standby unit. In manual mode, the on-line unit can be selected from the front panel or by serial I/O, parallel I/O or network command. |
| Remote/Local Switch and Indicators | <p>Selects local (front panel) control, or remote control from serial I/O, parallel I/O, or network.</p> <p>An optional second RSC, configured as a Remote Control Panel, provides the means to operate the system from a physically distant, alternate location.</p> |

Controller Rear Panel Interfaces



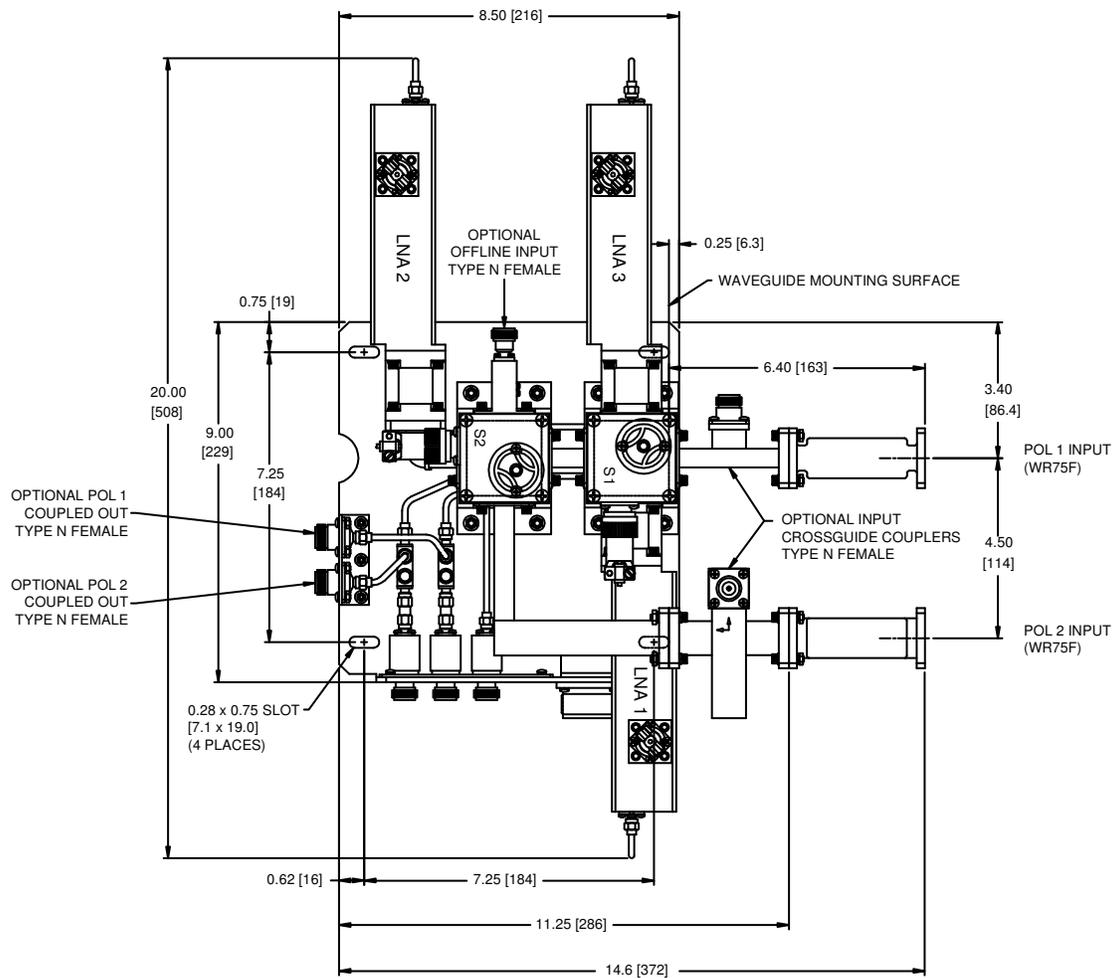
| | |
|---|---|
| J1, J2 – LINE 1, LINE 2 (IEC 320-C14) | Dual power entry modules contain the AC line input connectors. System can be powered from separate AC lines if desired. Either or both power supplies are capable of operating the system. |
| J3 – PLATE ASSY (37-pos D, Female) | Cable to plate assembly carries unit power (for line drivers, LNAs or LNBs) and switch drive signals. Order cable separately. Standard lengths are 100' (30 m) to 250' (75 m) in 50' (15 m) increments; other lengths are special order. An adapter cable mates the controller to legacy system cables. |
| J6 – SERIAL I/O and J7 – SERIAL LOOP (9-pos D Female) | RS-232/RS-422/RS-485 connector for user M&C System. Commands provide monitoring, controlling, and configuration. Interconnect cable lengths to 4000 ft (1200 m) with RS-422 or RS-485. A serial loop connector provides a convenient connection for daisy-chained systems. |
| J5 – REMOTE LINK (9-pos D Male) | For connection via a proprietary RS-422 link (up to 4000 ft/1200 m) to an optional, second RSC, which duplicates Local control functions at a secondary site. |
| J9 – NETWORK (RJ-45) | 10/100 Base T Ethernet connection port via standard RJ-45 connector. Supports SNMP v1, v2c and v3. |
| J4 – EXT ALARM (9-pos D Female) | External Alarm inputs. Substitute for or combine with internal unit current monitor alarms. Allows an external signal to indicate unit failure. Unused inputs can be used as status inputs to M&C system. |
| J8 – PARALLEL I/O (37-pos D Male) | <p>Parallel I/O (discrete logic) connection for limited control and monitoring of the system.</p> <p>Form 'C' relay contact outputs (1:2 system example; others are similar):</p> <ul style="list-style-type: none"> • Unit 1 status • Unit 2 status • Unit 3 status • PS 1 status • PS 2 status • Local/Remote mode • Pol 1: Unit 1 or Unit 3 • Pol 2: Unit 2 or Unit 3 • Auto/Manual mode <p>Control inputs—contact closure to ground (1:2 system example; others are similar):</p> <ul style="list-style-type: none"> • Pol 1 Unit 1 select • Pol 1 Unit 3 select • Pol 2 Unit 2 select • Pol 2 Unit 3 select • Auto/Manual select |

1:1 Plate Assembly Outline Drawing, with Various Options Installed



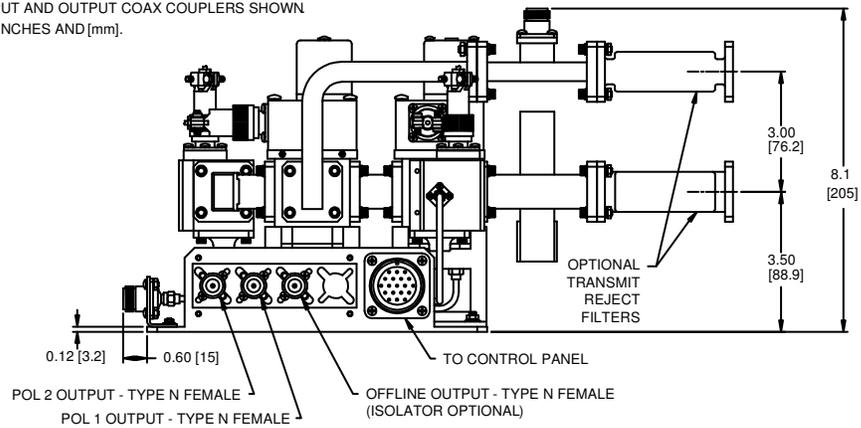
Outline 12670-2

1:2 Plate Assembly Outline Drawing, with Various Options Installed



NOTES:

1. OUTPUT ISOLATORS INCLUDED WITH STANDARD SYSTEM
2. OPTIONAL INPUT CROSSGUIDE COUPLERS, TRANSMIT REJECT FILTERS, OFFLINE INPUT/OUTPUT AND OUTPUT COAX COUPLERS SHOWN.
3. DIMENSIONS ARE IN INCHES AND [mm].



Outline 12671-3



Other Products

- Solid-State Power Amplifiers and SSPA Systems
- Solid-State Power BUCs and SSPB Systems
- Low Noise Amplifiers and LNA Systems
- Low Noise Block Converters and LNB Systems
- Block Up and Block Down Converters
- Synthesized Converters
- Line Drive Amplifiers
- Power Supply Monitors
- Redundant Control Panels for SSPAs, SSPBs, and LNAs

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