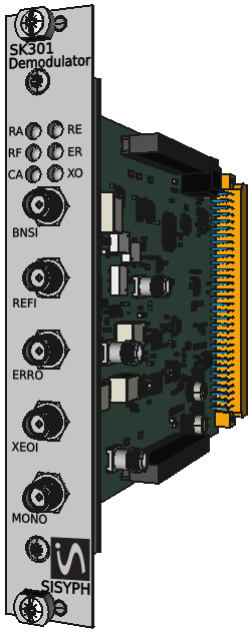
Datasheet

SK301 *Vidourle* RF Demodulator

SK-Series Modules

Features

- RF Phase sensitive detection
- Operation from 5 MHz to 150 MHz
- Analog design – Free of digital noise
- Remote interface
- Platform and stand-alone operation



Applications

- Laser frequency stabilization
- Pound-Drever-Hall laser locking
- Quantum physics and engineering
- Time & Frequency instrumentation

General Description

Overview

The SK301 *RF Demodulator* was primary designed for use in laser frequency stabilization applications where the frequency offset between the laser source and the optical reference requires tight and fast control. Indeed, when used in a Pound-Drever-Hall locking scheme, the SK301 provides a voltage related to the frequency offset under control. This error signal is further processed by an external compensator in order to drive the laser frequency actuator. The SK301 actually performs a phase sensitive detection of a photodetector output signal to translate its spectrum from the RF domain to a base-band error signal. In complement with this basic frequency mixer operation, the SK301 provides the user with several useful functionalities in this specific context.

Like all modular instruments of the SK-Series, the SK301 *RF Demodulator* can be operated stand-alone or within a platform where several modules can be assembled to configure a specific control or measurement system. The SK301 can be thus coupled to the SK433 *PI2D Compensator* for high-performance, closed-loop laser frequency control.

Functional Block Diagram

Refer to the *Functional Block Diagram* available online for a synthetic presentation of the SK301.

User's Guide

The last version of the SK301 *User's Guide* is available online at the product page.

Programming Guide

The online *Programming Guide* provides a detailed description of the SK301's remote commands.

Remote Interface

SK301's settings are changed through the remote interface. All instrument settings can also be queried *via* the remote interface. The module generates a status signal to report a specific event to the host computer. The SK301 can be operated either inside or outside the dedicated SPK-Series platform.

Front-Panel Display

The front panel of the SK301 provides the user with minimal information about the status of the instrument.

RF Signals

The SK301 performs a phase-sensitive detection between the Beat-Note and Reference input signals. These signals are typically provided by an RF photodetector (Beat-Note) and a function generator (Reference). Because the RF inputs are routed to an RF double-balanced mixer, their power levels are continuously measured in order to detect abnormal excessive levels at the mixer's input ports.

Error Signal

The SK301's Error output signal is obtained from the mixer's IF output port after several filter and amplifier configurable stages. The Error signal is also measured and its peak voltages are available for remote monitoring.

Monitoring

The SK301 provides the user with monitoring several useful signals : the Error signal, its filtered versions and the RF power detectors outputs can be routed to the Monitoring output connector. These signals are also available for remote monitoring through specific commands.

Error Offset

It is possible to offset the Error mean value using the voltage provided by the internal DAC. This feature is useful to compensate offsets and drifts caused by the circuitry. In order to allow fast control of the Error's offset voltage, an External Offset input is also provided. It can be useful for injecting a test or compensating signal during closed-loop operation. Error Offset control features can be also used to slightly modify the servo loop's setpoint.

Specifications

Unless otherwise noted, BUFG = 0 dB, all configurable filters disabled.

RF Inputs and Output

Both Inputs (BNSI & REFI)

Freq. Range	from 5 MHz to 150 MHz.
Impedance	50 Ω termination, AC-coupled, 1:1 isolation transformer.
Protection	internal limiter, +15 dBm.
Interface	front-panel SMA connector.

Beat-Note Input (BNSI)

Max. Level	+4 dBm, before compression.
Input Filter	low-pass filter, 3rd order, Butterworth, 200 MHz.
$2f_{\mathrm{mod}}$ Filter	band-reject filter, non-reflexive,
Center Freq.	60 MHz ±1 MHz.
Attenuation	≥ 20 dB, $f = 30$ MHz.
Add. Loss	≤ 1 dB, $f = 30$ MHz.
Transmission to ERRO, Δf frequency offset	
$\Delta f = 0$	(−2 dB, 0°).
$\Delta f = 1$ MHz	(−2 dB, −1°).
$\Delta f = 10$ MHz	(−3 dB, −30°).
Noise, RTI	≤ −140 dBm/Hz, $\Delta f \geq 1$ kHz.

Reference Input (REFI)

Op. Level	+10 dBm, sine-wave.

Beat-Note Output (BNSO)

Impedance	50 Ω.
Transmission from mixer RF-input	
Coupling	−22.5 dB.

Baseband Inputs and Outputs

Error Output (ERRO)

Impedance	50 Ω series.
Interface	front-panel SMA connector.
Offset Voltage	±2 mV max, RTO.
Noise Voltage	≤ 10 nV/$\sqrt{\mathrm{Hz}}$, $f \geq 1$ kHz, RTO.
$1f_{\mathrm{mod}}$ Filter	band-reject filter, non-reflexive,
Center Freq.	30 MHz ±0.5 MHz.
Attenuation	≥ 20 dB, $f = 30$ MHz.
Loss/Phase	≤ 0.1 dB/3°, $f = 1$ MHz.
	≤ 1 dB/30°, $f = 10$ MHz.
$2f_{\mathrm{mod}}$ Filter	band-reject filter, non-reflexive.
Center Freq.	60 MHz ±1 MHz.
Attenuation	≥ 12 dB, $f = 60$ MHz.

Error Offset DAC (OFSS)

Range	−12 mV to +12 mV, ref. to ERRO.
Resolution	12 bit.
Stability	±25 ppm/K.

Both Inputs (CALI & XEOI)

Impedance	50 Ω termination.
Interface	front-panel SMA connector.
Max. Level	200 $\mathrm{mV_{rms}}$.

External Error Offset (XEOI)

Transmission to ERRO	
$f = 0$	(−20 dB, 0°).
$f = 1$ kHz	(−20 dB, −1°).
$f = 1$ MHz	(−20 dB, −3°).

Calibration (CALI)

Interface	SMA connector on PCB.
Transmission to ERRO	
$f = 0$	(+5.5 dB, 0°).
$f = 1$ kHz	(+5.5 dB, −1°).
$f = 1$ MHz	(+6 dB, −30°).

General Characteristics

This module is designed to be operated in laboratory environment.

Operating Temperature

Range	+15 °C to +40 °C, non-condensing.

Host PC Communications

UART format	9600 baud, 8-bit data, 1 stop-bit, no flow control.
Interface	DIN41612 backplane connector.

Connectors

Backplane	DIN41612 96C male.
Expansion/Test	
AIO	40-pin PC/104 header.
DIO	40-pin PC/104 header.
BNSI	SMA front-panel.
REFI	SMA front-panel.
XEOI	SMA front-panel.
ERRO	SMA front-panel.
MONO	SMA front-panel.
CALI	SMA printed-circuit board.

Front Panel Indicators

Remote Cntr.	Error, Activity.
Alarms	RF levels, Error voltage.
Inputs	CALI enabled, XEOI enabled.

Power Supply Inputs

Analog	+15 V × 70 mA
Analog	−15 V × 50 mA
Digital	+5 V × 30 mA.

Printed Circuit Board

Form factor	Eurocard.
Dimensions	100 × 160 × 1.6 mm.
Technology	4-layer, improved FR-4.

Physical Properties

Height	128.4 mm (3U).
Width	Single-wide, 20 mm (4HP).
Depth	174.5 mm.
Weight	≈ 200 g.
Front-Panel	Anodized aluminium with rear conductive.

Warranty

One (1) year parts and labor on defects.

Ordering Information

SK301 Module

The SK301 module can be ordered with different options.

Ordering Code	Front-Panel Options
SK301-FP	Shielded 3U-4HP front-panel (standard).
SK301-NP	No front-panel.

Accessories

Accessories and optional parts described in this section are not included in the SK301's package and must be therefore ordered separately if required.

Module Adapters

While the SK301 module was designed to operate within an SPK-Series Platform, it is also possible to use it stand-alone. In such case, the user has to externally wire all required signals and power supplies through the DIN41612 connector. To help the user in this operation, *Signals and Systems for Physics* provides several module adapters. Thus, the SKN10 features several terminal blocks to wire the power supplies without any soldering. An isolated USB bridge is also available to directly connect the module to the host PC without introducing common-mode noise. On the other hand, the SKN11 module adapter just provides the user with a small break-out board where the user has to solder the mating connector's pads.

Ordering Code	Description
SKN10	SK-Series module adapter with USB interface and terminal blocks.
SKN11	SK-Series module adapter.

Document Identifier

This document is identified by SK301-SU03-P24A.

Document Revision History

P24A (2024-04-03)
Initial version.

Important Notice

Information in this document is subject to change without notice.

Signals and Systems for Physics
BP90406
16 place saint-Georges
F31000 Toulouse France
Phone (+33) 781 547 391
www.sisyph.com