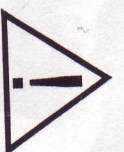


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CAUTION

WARNING - Maximum input voltage is 12VDC. Automotive voltages may exceed 12V causing damage to internal circuitry. Damage resulting from excessive input voltage is readily apparent and will not be covered under warranty. Units returned for warranty service that have damage resulting from excessive supply voltages will incur service charges.

WARNING - Maximum antenna input signal is +15dBm (50mW). Under no circumstances should the APS105 be directly connected to an RF transmitter or be used in close proximity to a radio transmitter of more than 5 watts. Damage to the input amplifier circuitry is readily apparent and will not be covered under warranty. Units returned for warranty service that have damage to the input circuitry will incur service charges.

Introduction

The APS105 Active Preslector is a narrow bandpass filter that can be manually, automatically, or remotely tuned between 10MHz and 1GHz. The APS105 incorporates a narrow 4MHz bandpass filter that can be coupled with a variety of radio receivers or nearfield devices.

Frequency counters or nearfield receivers typically need to see a signal that is at least 10 to 15 dB stronger than the background RF. The APS105 narrows the bandwidth from 2-3GHz down to 4MHz. The reduction in RF background signal level allows the signal of interest to be more easily detected. The APS105 can be used in conjunction with a variety of communications receivers and scanners to prevent strong signal overload and non-linear operation. The filter edge can be placed between two different signals to reduce interference.

Theory of Operation

The 4MHz wide band pass filter is fixed in frequency and heterodyning techniques are used to mix the incoming RF with a Local Oscillator. The resulting sum is passed through the filter (1300MHz nominal center frequency), and then mixed back down by the same LO. The Local Oscillator is synthesized and controlled by a microcontroller. The effect is as if the filter had been tuned to the frequency of interest. It is difficult to mechanically tune a filter, and the adjustment range is much more limited. By using this technique a wide tuning range can be achieved electronically.

Introduction

APS105 Design

The heart of the APS105 is the fixed 4MHz wide bandpass filter centered at 1300MHz. It is custom manufactured to exact tolerances and each filter is individually calibrated. The filter is machined from copper waveguide material. It has four elements that must be hand soldered to the copper braid and then correctly tuned before any signal passes through the filter. The degree of difficulty in producing the filter is the major cost driver in the APS105.

Additional RF Elements include wide band MMIC amplifiers, VCO, Mixers, and a Synthesizer. Line techniques are used throughout the design. The Digital portion of the circuit includes a monolithic 8 Bit Flash Microcontroller. It is socketed to permit future firmware upgrades. A Chip-On-Glass 16 character LCD display has superior contrast and viewing angle. The display is integrated into a switch panel that connects to the main APS105 board through a high-density surface mount connector. An Electro Luminescent Back Light is used for low light and room light readability. In addition to the push button switches, there is a rotary control with a push button function for selecting and tuning.

A Universal Input AC adapter with regulated 12V output uses switchmode power supply technology and is cool running even under maximum load. The APS105 is supplied with a 12" high quality cable with Male BNC connectors at each end for connecting the APS105 to the input of a Near Instrument or Radio Receiver.

Operating Modes

Operating Modes

The APS105 has three operating modes for tuning the center frequency:

Manual Mode

The operator adjusts the center frequency using the shaft encoder knob on top. Press the knob once, twice, or three times to select the increment in which to tune and then turn the knob.

Automatic Sweep Mode

The filter can automatically sweep between two preset frequencies.

Remote Mode

Permits the APS105 to be computer controlled through the serial data port. Custom software for remote mode will be required for operation.

Manual Mode

Use shaft encoder knob to adjust center frequency
30 detente per complete revolution of the knob
Push in to select between 1, 10, and 50MHz per detente

Automatic Sweep Mode

Use Sweep Button to start and stop
Sweep Rate: 1, 10, 50 MHz per Second
Minimum Full Range Sweep Period: 20 Seconds
Maximum Full Range Sweep Period: 17 Minutes
Center Frequency Accuracy: $\pm 0.5\text{MHz}$

Remote Mode

Serial interface commands are used to tune or sweep the APS105. The complete listing of available commands is included on page 13. Custom software will be required.

Front / Top Panel Controls and Indicators

Power

Press the POWER button once quickly and firmly to turn on the APS105. Upon power up the display will default to the Center Frequency display. For example:

CtrFreq 400 Mhz

Locked

Turn the unit off in the same manner. Automatic sweeping must first be stopped in order to turn the unit off. Press and hold the POWER button for two seconds to activate the EL backlight.

Mode Button

Press the MODE button to select between the five menus: Pgm CENTER FREQ, Pgm SWEEP START, Pgm SWEEP STOP, and Pgm SWEEP TIME. Note: After 5 seconds of inactivity the display will default back to the CtrFreq menu.

Setup Button

Press the SETUP button to enter each menu and change values. Note: After 5 seconds of inactivity the display will default back to the CtrFreq menu.

Sweep Button

Press the SWEEP button to start or stop automatic sweeping.

Push / Tune Knob

Press and turn the KNOB to change values for manual or automatic sweeping.

Panel Controls/Indicators

Panel Controls/Indicators

BNC In

Antenna input. Use 50 Ohm antenna with BNC connector to detect incoming signals.

BNC Out

Signal output to connected device. Use BNC to BNC coaxial cable (supplied) between the BNC out of the APS105 and the BNC input of the connecting device.

Data 2.5mm jack

Used for remote tuning from computer. Note: Software required. No software available at current time. Serial interface specification is supplied on page 17 for software development.

Lock LED

The LOCK LED indicator monitors the synthesizer lock condition and should always be lit.

Charge LED

ON- When the AC adapter is plugged in the LED will stay lit and the batteries will be charged.

12VDC

Input for the supplied 12 volt adapter.

Operation

Understanding how the APS105 operates is very important in determining what type of sweep to use. Please consult the following in helping you determine which sweep is right for your application.

Manual Tune

Manual tune is achieved by manually moving the top knob into the desired center frequency range. Because the filter is 4MHz wide, the APS105 can actually see frequencies 2MHz on either side of the center frequency. For example, if the center frequency display read 450MHz the APS105 could pass a signal from 448MHz to 452MHz. Each time the knob was moved up or down the 4MHz filter would follow that center frequency. The APS105 may be manually tuned in 1, 10, 50MHz steps. It is recommended when first using the APS105 to tune to a known transmitting frequency using manual tune. This will allow you to become familiar in how to use the manual tune mode. Tuning too fast may not allow the device being used with the APS105 enough time to determine whether there was an actual signal present.

Automatic Sweep

Automatic Sweep is achieved by programming a start frequency and a stop frequency, selecting a sweep rate of 1, 10, or 50MHz per second. Automatic sweep is useful for sweeping desired range to quickly determine the activity of that range.

Sweeping in 50MHz per second will allow the APS105 to sweep its entire frequency range in just a few seconds. This may be useful in finding consistently strong signals quickly. However, it is not recommended to use this sweep rate when looking for weaker and inconsistent signals, or when sweeping a narrow frequency range.

Operation

Sweeping in 10MHz per second allows the APS105 to sweep its entire range in under two minutes.

This is better for sweeping broad frequency ranges. Sweeping in 1MHz per second allows the APS105 to sweep its entire range in about 17 minutes. This is good for sweeping narrow frequency ranges.

It is recommended to experiment with this form of sweeping first. For example, try to tune a known transmitting frequency using the three different sweep rates. Also, try altering the programmed frequency range from narrow to broad while using different sweep rates. Using the fastest sweep rate in a narrow programmed frequency range is not recommended for optimum results. It is recommended that the sweep time be more relative to the programmed frequency range. For example, sweeping at a rate of 50MHz per second in a programmed frequency range of 50MHz or less may be too fast for the connected device to detect a signal even though a signal has passed through the filter. Sweeping at a rate of 50MHz per second may be better if tuning across a broad frequency range of 200MHz or more. Also, sweeping at a rate of 1MHz per second over a frequency range of 100MHz or more may be too slow to lock onto a signal that is transmitting at different intervals. Sweeping at a rate of 1MHz per second may be better if tuning across a narrow frequency range of 50MHz or less.

Sweeping is excellent for unattended operation where near field signals present over an extended time are recorded. In Sweep mode with a Scout for instance, all near field signals can be recorded for hours on end if both devices are supplied with external power.

Pgm CENTER FREQ

Use this mode when performing a Manual Tune. Press the MODE button once. The current Center Frequency selected will be displayed. Example: CtrFreq 400 Mhz. Press the SETUP button once to enter the change CENTER FREQ menu. Change the frequency using the top knob. Press the knob down to move the cursor below the value to be changed, selecting between 1, 10 or 100MHz. Rotate

the knob to change frequency. The select mode will automatically exit 5 seconds after making the last change.

Manual Sweep

To start a manual sweep press down on the top knob. Continue pressing the knob until the cursor moved under the value to be changed. First program in the desired center frequency then place cursor under the value to move for sweeping. For example, program the center frequency to 400MHz. Now place the cursor under the 400 to tune in 1MHz steps. To tune in 10MHz steps place the cursor under the 400. To tune in 100MHz steps place the cursor under the 400.

Pgm SWEEP START

Use this mode when performing an Automatic Sweep. Upon entering this mode the current sweep start frequency will be displayed at the top of the display. Press the MODE button twice. Press the SETUP button once to enter the change SWEEP START menu. Change the frequency using the knob. Press the knob down to move the cursor below the value to be changed, selecting between 10 or 50MHz. Rotate the knob to change frequency. After 5 seconds of inactivity the display will default back to the CtrFreq menu.

Pgm SWEEP STOP

Upon entering this mode the current sweep stop frequency will be displayed at the top of the display. Press the MODE button three times. Press the SETUP button once to enter the change SWEEP menu. Change the frequency using the top knob. Press the knob down to move the cursor below the value to be changed, selecting between 1, 10 or 50MHz. Rotate the knob to change frequency. 5 seconds of inactivity the display will default back to the CtrFreq menu.

Operation

Operation

Pgm SWEEP TIME

Upon entering this mode the current sweep time will be displayed at the top of the display. Press the MODE button four times. Press the SETUP button once to enter the change SWEEP TIME menu. Press the MODE button to select between 1, 10, and 50MHz per second. After you have selected the desired Sweep Time, lock it in by pressing the SETUP button once. To indicate that the sweep time has been locked in, an * will appear before and after the sweep time. For example: * 1 Mhz/Sec * After 5 seconds of inactivity the display will default back to the CtrFreq menu.

Automatic Sweep

To start an automatic sweep press the SWEEP button. The APS105 will display the start and stop frequencies as well the flashing word SWEEPING.

For example:

100 --> 400
** SWEEPING **

To stop an automatic sweep press the SWEEP button.

BATTERY CHARGE

Plug the supplied 12v adapter into the APS105 to begin charging.

BACKLIGHT

To activate the backlight press and hold the POWER button for two seconds. The backlight will remain on until turned off. To turn the backlight off press and hold the POWER button for two seconds.

Specifications

Specifications

Frequency Range:

Input Impedance:

Filter Bandwidth:

Ultimate Rejection:

Insertion Loss:

10MHz - 1000MHz

50 Ohm

4MHz at -3dB typical, constant with tune frequency

30-60dB typical

10MHz - 800MHz 0dB

800MHz - 900MHz 20dB - 10dB

900MHz - 1000MHz 0dB - 35dB

0.7dB max.

AC

1.26V (+15dBm, 32mW)

Ripple in Passband:

Coupling:

Maximum Input signal:

Specifications

Power

Battery Pack: 6 cell, 7.2V, Ni-MH 1500mAh
External Power: 12V DC 350mA, 600mA during battery charging
Battery Charge Time: 15 Hours
Battery Discharge Time: Approximately 4 hours
Adapter: UVAC13 100-240VAC 47-63Hz Input, 12VDC +/- 5% 1.25A Output

Physical

Size: 6"H x 3.85"W x 1.4"D
Weight: 1 Lb.

RF Connector Type: Female BNC
Supplied with 12" Coax cable with male BNC connectors, TAI00S telescoping whip antenna, and UVAC13 universal input 12V adapter.

Typical Applications

The following applications are a representative sampling to show the possibilities for employing APS105. These applications employ the APS105 with some other Optoelectronics products. There are undoubtedly many more applications involving many diverse types of receivers and detectors.

Although one of the most commonly asked questions is "What pick up distance can I expect when using the APS105?", it can not be precisely answered. The way in which the APS105 works is to reduce the background RF and it is only a secondary function to provide any gain. The improvement in pick up distance will depend upon the effect of reducing the other signals that compete with the desired signal. As a rule of thumb, when using the APS105 with a nearfield device such as a Scout, a 10X improvement in pick up distance may be observed. This is can not be guaranteed because it depends upon a number of factors that may change from location to location. The examples below are typical of APS105 applications but are by no means comprehensive.

APS105 & Scout

Place the TAI00S antenna on the input BNC of the APS105. (Other antennas can be used for specific frequencies of interest. See the Optoelectronics Catalog for available antenna options.) Use the BNC-BNC cable supplied to connect the APS105 output to the Scout antenna input. Place the Scout into FILTER and CAPTURE mode by placing both slide switches in the UP position. Because the Scout takes very rapid measurements of a signal before displaying that frequency, it is recommended that when using the Scout with the APS105 that manual tune or a very slow automatic tune be used. Using a fast manual or automatic sweep can be too fast for the Scout to capture even if there is a signal present.

Applications

Applications

Configured this way, the APS105 and Scout combination will record all frequencies in the nearfield (strong RF carriers that are 15-20 dB greater in amplitude than the background RF floor). The Scout will record the frequencies and number of hits on each. In addition, the Scout can Reaction Tune a CI-5 or AR8000/8200 communications receiver for monitoring the frequencies that are captured.

APS105 & Xplorer / R11

The hookup is similar to the above example where the APS105 is connected to the Antenna. The Xplorer can be operated in sweep mode with or without blocks. The effective pick up range of this combination should prove to be greater than with the Scout. Signals can be listened to and locked out. Use the Hold button on Xplorer to lock it to any signal of interest. The APS105 can be taken out of automatic sweep mode and manually tuned to the signal of interest. In automatic sweep mode both the Xplorer and the APS105 would be sweeping at the same time. However, it is virtually impossible to have both units synchronized in their respective sweep times and ranges. For that reason it is recommended that manual tune be used for best results with the Xplorer and R11.

APS105 & Optocom

The APS105 can be used in conjunction with the Optocom Communications Receiver to reduce interference and to lock into distant or weak signals. The improvement in weak signal performance is dramatic. The APS105 can be connected to outside antennas but it has no internal protection against lightning so it should be removed when not in use. In the same way, the APS105 can be connected to any communications receiver or scanner.

Applications

Using the APS105 With Radio Receivers

Additional broadband gain will almost never prove useful when applied to an adequate radio receiver. The APS105 may prove useful under certain circumstances where the effect of the filter can prove useful. It should not be thought of simply as an amplifier.

Note, that the APS105 will be of little or no benefit to a receiver with superior characteristics. With the APS105 will provide dramatic results when used with Near Field devices, the application of the APS105 with a conventional radio receiver requires specific circumstances to be beneficial. In general, those circumstances are where multiple signals are mixing together or where RF conditions such that the effects of external filtering are beneficial. Even in those conditions, the weakness of the APS105 mixers and front end components will be tested in the same way that the those in the receiver were when by itself.

Calibration

Calibration

This is the factory calibration procedure presented here for reference only. It requires the use of a calibrated spectrum analyzer and tracking generator.

In order to compensate for the fact that build tolerances in the fabrication/alignment of the APS105, 1.3GHz (nominal) center frequency waveguide filter will be several MHz off frequency, a built in calibration feature has been added to the control software for the APS105 Active Presetector. Due to the method used for setting the PLL synthesizer, the CALIBRATION mode MUST be used when aligning the waveguide filter. This is necessary to insure that the synthesizer is set to the proper frequency for filter alignment. Once the alignment is complete, a 'calibration factor' is set to compensate for the tolerances discussed above.

The following describes the steps necessary in using the calibration routine contained in the embedded software for the Model APS-105:

- 1) Power on unit. Annunciator should be in the Manual Frequency entry mode.
- 2) Using the shaft encoder control set the center frequency (as indicated on the LCD display) to 500 MHz. Make sure that the digit pointer is at the x1 position upon completion. Allow the unit to time out. LOCKED should be indicating on the LCD display.
The unit must be set to this frequency only to enter the calibration routine.
- 3) While holding down the SETUP button, press the shaft encoder push button.
CAL ENABLED should be indicated on the LCD display.
- 4) At this point, the technician may align the filter if desired. It is important that the center freq. is aligned within ± 4 MHz of 1.3 GHz, otherwise calibration will not be possible.

Calibration

Once alignment is complete (if an alignment was actually needed), the shaft encoder is set ± 4 MHz to center the filter response as viewed on the network analyzer, etc. Even though it is possible to move the filter response more than ± 4 MHz, only these limits will be allowed.

Press the shaft encoder push button once more to complete the operation. CAL COMPLETE should be indicated on the LCD display at this point. The display will also reset to 500 MHz and the calibration factor information will be stored in NVRAM. This calibration information will be used each time the unit is powered up.

Inspect the display center frequency and compare with the network analyzer response to insure agreement between display and filter center frequency.

Note: Optoelectronics is not responsible for any misalignment resulting from this procedure. If the APS105 requires realignment it will be done at the current labor rates of the Optoelectronics service department.

Filter alignment

It is not possible to adjust the filter with the power supply board and battery pack in place. It is not considered likely that filter re-alignment will ever be necessary. The four screws in the side of the filter should not be turned because it is very easy to de-tune the filter. If any issues develop concerning filter alignment, contact Optoelectronics first.

Serial Interface Specification

Serial Interface Specification

Communication parameters:

DATA RATE: 9600 BPS
START BITS: 1
DATA BITS: 8
PARITY: NONE
STOP BITS: 1
MODE: Half Duplex - TTL

CL-V Address:

Unit will internally set for an interface address of 98 hex.

Command Set:

20h	-	Initiate Sweep	
21h	-	Abort Sweep	
22h	-	Pause Sweep	
23h	-	Resume Sweep	
24h	-	Set Manual Freq.	
25h	-	Set Start Freq.	
26h	-	Set Stop Freq.	
27h	-	Set Sweep Rate	
28h	-	Request SW Rev	
29h	-	Enable Battery Charger	FUTURE
30h	-	Disable Battery Charger	FUTURE

Serial Interface Specification

Command Set Details:

INITIATE SWEEP- Enables Sweep Process starting from the start freq.

Structure: FE FE ra ta 20 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

ABORT SWEEP- Aborts Sweep Process and returns unit to the Manual Entry Mode.

Structure: FE FE ra ta 21 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

PAUSE SWEEP - Temporarily PAUSES Sweep Process.

Structure: FE FE ra ta 22 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

RESUME SWEEP- Resumes Sweep Process from last Frequency.

Structure: FE FE ra ta 23 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

SET MANUAL FREQ- Program the Center Frequency.

Structure: FE FE ra ta 24 bcd3 bcd2 bcd1 bcd0 FD

Serial Interface Specification

SET MANUAL FREQ- Program the Center Frequency.

Structure: FE FE ra ta 24 bcd3 bcd2 bcd1 bcd0 FD

BCD3 - BCD0 REPRESENTS THE FREQUENCY IN MHZ

PROGRAM - 550 MHz

FE FE ra ta 24 00 05 05 00 FD

PROGRAM - 1000 MHz

FE FE ra ta 24 01 00 00 00 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

SET START FREQ Program the Sweep Start Frequency

Structure: FE FE ra ta 25 bcd3 bcd2 bcd1 bcd0 FD

BCD3 - BCD0 REPRESENT THE START FREQUENCY IN MHZ

PROGRAM - 10 Mhz

FE FE ra ta 25 00 00 01 00 FD

PROGRAM - 50 Mhz

FE FE ra ta 25 00 01 00 00 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

Serial Interface Specification

SET STOP FREQ Program the Sweep Stop Frequency

Structure: FE FE ra ta 26 bcd3 bcd2 bcd1 bcd0 FD

BCD3 - BCD0 REPRESENT THE STOP FREQUENCY IN MHZ

PROGRAM - 900 MHz

FE FE ra ta 26 00 09 00 00 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

SET SWEEP SPEED Program the Sweep Speed

Structure: FE FE ra ta 27 bcd0 FD

Where bcd0 represents:

00 1 MHz/Sec

01 10 Mhz/Sec

02 100 Mhz/Sec

PROGRAM - 10 MHz/Sec

FE FE ra ta 27 01 FD

Response:

OK: FE FE ra ta FB FD

ERR: FE FE ra ta FA FD

Antenna Recommendations

Following is a list of antennas available through Optoelectronics. The APS105 comes supplied with the TA100S telescoping whip antenna. The frequency range of the TA100S is 100-600MHz.

RD27 26-150MHz	1,2,3
RD50 40-60MHz	3
RD150 144-165MHz	2,3
RD440 440-480MHz	2,3
RD800 500MHz-1GHz	1,2,3
DB32 100MHz-1GHz	3

These antennas may be purchased separately or in different combination packs referred to as Antenna Pak1, Antenna Pak2 and Antenna Pak3. The TA100S is included in all Antenna Packs.

Factory Service

PRODUCT WARRANTY

Optoelectronics, Inc. warrants all products and accessories for one (1) year against defects in materials and workmanship to the original purchaser. Products returned for warranty service will be repaired or replaced at Optoelectronics' option.

Specifically excluded are any products returned under this warranty that upon examination, have been modified, had unauthorized repairs attempted, have suffered damage to the input circuitry from the application of an excessive input signal, have suffered damage to the charging circuitry or internal batteries from the application of excessive voltage, or show other evidence of misuse or abuse. Optoelectronics reserves sole right to make this determination.

No other warranties are expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Optoelectronics, Inc. is not liable for consequential damages.

WARRANTY

Products under warranty must be returned, transportation prepaid, to Optoelectronics' service center. All parts replaced and labor performed under warranty are at no charge to the customer.

NON-WARRANTY

Products not under warranty must be returned, transportation prepaid, to Optoelectronics' service center. Factory service will be performed on a time and materials basis at the service rate in effect at the time of repair. A repair estimate prior to commencement of service may be requested. Return shipping will be added to the service invoice and is to be paid by the customer.

Factory Service

RETURN POLICY

The Optoelectronics Service Department will provide rapid turnaround of your repair. No return authorization is required. Enclose complete information as follows:

1. Copy of sales receipt if under warranty.
2. Detailed description of problem(s).
3. Complete return address and phone number (UPS street address for USA).
4. Proper packaging (insurance recommended). Note: Carriers will not pay for damage if items are improperly packaged.
5. Proper remittance including return shipping, if applicable (Visa/MasterCard number with expiration date, Money order, Company PO, etc.). Note: Personal checks are held for a minimum of two weeks before shipment.

Address all items to:

Optoelectronics, Inc.
Service Department
5821 NE 14th Avenue
Fort Lauderdale, FL 33334

If in question, contact the factory for assistance. Service Department: (954) 771-2050.
Monday - Friday 8:30 AM to 5:00 PM Eastern Time.

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