

# TECHNICAL SPECIFICATION

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## LCR/SMR-2000 LF-HF DSP RECEIVER



The LCR/SMR-2000 is a multi-mode digital signal processing (DSP) receiver with a frequency range from 10 kHz to 30 MHz. Control is via a remote serial interface bus. By selecting various parameters, the receivers can detect a wide variety of signals. These include: amplitude modulation (AM), on/off keyed (CW), upper sideband (USB), lower sideband (LSB), independent sideband (ISB), phase modulation (PM), and frequency modulation (FM). Frequency shift keyed (FSK) signals can be demodulated as single sideband suppressed carrier signals or as true FM signals.

A “PHONES” jack on the front panel provides for connection of an external speaker or headphones. The audio level is controlled by the front panel power/volume control. Either an internal or external reference frequency may be used; the external frequency is automatically sensed and used when connected to the rear panel.

### FEATURES

- 10 kHz to 30 MHz tuning range
- 1 Hz tuning step size
- 3 ms typical synthesizer tuning speed
- 51 standard bandwidths
- ISB, LSB, USB, CW, AM, FM, PM & FSK detection modes
- 19” Rack-mount, 1-3/4” (1RU)
- Rugged construction using surface mount technology
- Low synthesizer phase noise
- Third order intercept point: +30 dBm
- Continuous self-test, BITE and BIT

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than 2:1, 400 Hz and above)  
Inband Ripple: 1 dB maximum  
Stop Band: >90 dB

## INTERFERENCE IMMUNITY

IF Rejection: 100 dB  
Image Rejection: 100 dB  
Cross Modulation: Unmodulated desired signal of -60 dBm together with a modulated (30% AM at 1 kHz) undesired signal of -10 dBm, spaced 100 kHz apart, will produce less than 10% cross modulation of the desired signal  
Blocking: Attenuation of a desired RF signal of -60 dBm caused by an unmodulated signal of +10 dBm spaced 100 kHz away is less than 3 dB  
Synthesizer Phase Noise: -110 dBc/Hz @ 1 kHz spacing, nominal  
Oscillator Reradiation (up to 100 MHz): -110 dBm; -95 dBm (100 - 1000 MHz)  
Spurious Responses: -120 dBm equivalent or less for -50 dBm input signals  
Generated Spurious: None >-100 dBm  
Intermodulation Distortion:  
Second order input intercept point: +60 dBm typical  
Third order input intercept point: +30 dBm typical  
Third order in-band IMD: -50 dBc below two -25 dBm signals

## OUTPUTS

Video: Demodulated FM, 2V peak-to-peak into 75 ohm (deviation equal to 30% of selected bandwidth)  
Audio Line Output (Normal, USB when ISB is selected):  
600 ohms balanced center-tapped pair, short circuit protected, less than 3% distortion at rated output  
AM (90%), CW, LSB, USB, PM (1 radian): 0 dBm,  $\pm 3$  dB  
FM: 0.5 V/kHz AC coupled (4V peak-to-peak maximum)  
Audio Line Output (Alternate, LSB when ISB is selected):  
600 ohms balanced center-tapped pair, short circuit protected, less than 3% distortion at rated output. 0 dBm  $\pm 3$  dB

Frequency Response:  
100 Hz to 5 kHz (-3 dB)  
BFO (in DSP):  $\pm 6$  kHz in 1 Hz increments  
FSK: RS-232 compatible output  
Headphones: 0 to 5V peak-to-peak, 8 ohm load impedance to front panel phone jack. Short circuit protected  
NBIF: 455 kHz with BW equal to selected receiver BW. Level -10 dBm  $\pm 3$  dB over AGC dynamic range  
IF Shift: DSP function for use in CW mode.  $\pm 6$  kHz in 1 Hz increments  
WBIF: 456 kHz, 20 kHz min. BW  
Digital IF (I&Q):  
Protocol: Serial (C31) pre-demodulation in all demodulation modes  
Terminations: Back terminated with resistors  
C.O.R.: Normal Carrier Operated Relay Signal

## INPUTS

Synthesizer Reference: Automatic lock-on to externally applied 10 MHz signal. 50 ohm impedance, VSWR <1.2:1, level 0 dBm  
Antenna: 50 ohm (VSWR <3:1)  
Mute: Control signal to mute audio  
**REMOTE CONTROL**  
RS-232 and RS-422  
DSP software is programmable into internal flash memory via the remote control interface  
Selectable baud rates between 75 baud and 125 kbaud

## BITE

Probability of Detection: 90%  
Entire chain is tested. In addition, fault detectors continuously monitor voltage levels and phase lock.  
Performed at power on or on demand over remote bus

## RELIABILITY

MTBF: 9,000 hours. Calculation based on "Naval Sheltered" (NS) as defined in MIL-HDBK-217F  
All inputs/outputs are short circuit protected

## POWER REQUIREMENTS

90 - 260 VAC, 47 - 440 Hz, 50 watts, universal

20 - 32 VDC @ 4A max. (optional)

## ENVIRONMENTAL DATA

(Designed to meet)  
Operating High Temperature: MIL-STD-810E, Method 501.3, Procedure II, Table 501.3-I (ambient air conditions), maximum test temperature 50°C, one cycle  
Operating Low Temperature: MIL-STD-810E, Method 502.3, Procedure II, Temperature 0°C  
Storage High Temperature: MIL-STD-810E, Method 501.3, Procedure I, 85°C, one cycle  
Storage Low Temperature: MIL-STD-810E, Method 502.3, Procedure I, -40°C for 12 hours  
Humidity: MIL-STD-810E, Method 507.3, Procedure I-Natural, Table 507.3.I, five cycles total  
Shock: MIL-STD-810E, Method 514.4, Procedure I, Category 9, Figure 514.4-15

## EMI/EMC

Equipment designed to intent of the applicable requirements of MIL-STD-461/462 as a guide

## DESIGN AND CONSTRUCTION

Workmanship: MIL-E-16400, Paragraph 3.17 as a guideline

## DIMENSIONS AND WEIGHT

Standard Rack-mount:  
19 inches (48.3 cm) wide  
1.72 inches (4.44 cm) high  
21.46 inches (54.5 cm) deep  
Weight: 9 lbs (4 kg)

## FINISH

Front Panel: Black anodize  
Chassis: Corrosion protected following guidelines established in paragraph 3.4 of MIL-E-16400  
Silkscreen Markings: White

## OPTIONS

Rack-Mount Slides: Install into 19" rack  
Speaker: Front Panel Mounted  
DC Power: 20-32 VDC @ 4A max.  
3<sup>rd</sup> IF (digital): I&Q outputs from DSP  
Internal Ref Freq Oscillator: Substitute TCXO with a high performance OCXO ( $\pm 0.1$  ppm of tune frequency).

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## FREQUENCY

Tuning Range: 10 kHz to 30 MHz  
 Tuning Step Size: 1 Hz to 10 MHz  
 Synthesizer Tuning Speed:  
 From receipt of last command byte until within 1 kHz of the final frequency): All modulation modes  
 $\Delta f < 100 \text{ kHz} < 1.0 \text{ msec}$ , typical  
 $\Delta f < 1 \text{ MHz} < 1.5 \text{ msec}$ , typical  
 $\Delta f < 10 \text{ MHz} < 2.0 \text{ msec}$ , typical  
 Receiver Tuning Time: 10 ms max.  
 Command Processing: 2 ms  
 Synthesizer Tuning Time: 2 ms  
 IF Settling Time: 4 ms  
 AGC Attack Time (fast): 2 ms  
 Applicable in all modes with IF bandwidth of 2 kHz or greater  
 Tuning Accuracy:  
 Internal Standard TCXO:  $\pm 1 \text{ ppm}$  of tuned frequency (Optional OCXO,  $\pm 0.1 \text{ ppm}$  of tuned frequency)  
 External Standard: Equal to accuracy of external standard in ppm  
 Internal/External Frequency Standard: 10 MHz

## DETECTION MODES

AM, FM, PM: All bandwidths  
 USB, LSB, CW, FSK: Bandwidths  $\pm 6 \text{ kHz}$   
 ISB: 2.8 kHz bandwidth per sideband

Demod. Mode	Normal Audio	Alternate Audio	Max. IF BW (kHz)
AM	AM	AM	16
FM	FM	AM	16
PM	PM	AM	16
LSB	LSB	AM	6
USB	USB	AM	6
ISB	USB	LSB	2.8
CW (FSK)	CW (FSK)	AM	6

## SCAN AND SWEEP

Channels: 250 programmable channels  
 Scan: Up to 250 channels  
 Sweep:  $f_1$  to  $f_2$  at selected steps. Up to 125 sweep bands  
 Sweep and Scan Rate: 1 to 100 per second  
 Adjustable Threshold: -112 to 0 dBm

in 0.5 dB increments

## RF SECTION

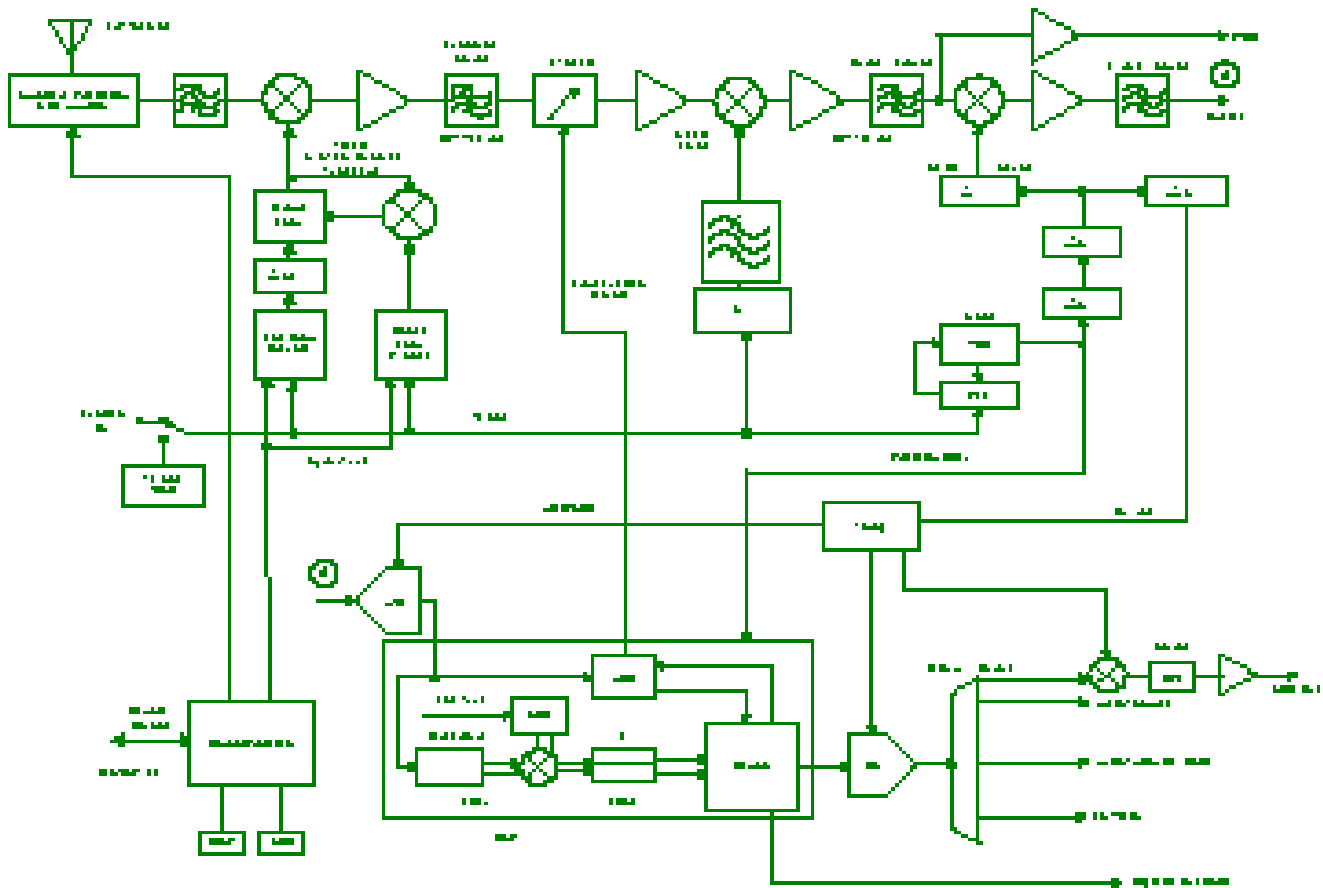
Input Impedance: 50 ohms nominal  
 Input VSWR: Less than 3:1  
 Sensitivity for 10 dB SINAD, above 1.6 MHz  
 AM (6 kHz BW): -105 dBm, 50% modulation  
 CW (500 Hz BW): -122 dBm  
 SSB (3 kHz BW): -113 dBm  
 FM (16 kHz BW): -98 dBm input, 5 kHz deviation, 400 Hz modulation: 20 dB SINAD  
 PM (6 kHz BW): -110 dBm input, 1 radian, 10 dB SINAD  
 Noise Figure: 14 dB typical  
 RF Protection: 50 dB reflective attenuation. Activates at signal levels between +10 dBm and +20 dBm. Protects from input signals of levels up to 10 watts  
 RF Filters: Eight one-half octave ( $\leq 40\% \text{ BW}$ ) bandpass preselector filters used from 1.6 to 30 MHz. Frequencies below 1.6 MHz are selected by LPF. Filter selection is automatic with tuned frequency selection  
 Squelch: User controllable (112 dB range)  
 AGC (fast attack selectable decay):  
 Attack Time (SSB and CW modes):  
 Fast:  $< 2 \text{ msec}$  for 50 dB change (sweep and scan only)  
 Normal:  $< 10 \text{ msec} \pm 25\%$  for 50 dB change  
 Decay Times: Selectable 20 ms to 4 sec nominal for 50 dB change  
 Dynamic Range: Output level held within  $\pm 1 \text{ dB}$  over a 110 dB range  
 Threshold: -112 dBm (Output level -3 dB with respect to a -60 dBm signal)  
 Dump: Bus-controllable, time  $< 2 \text{ ms}$   
 AM: Averaging attack and decay times 50 ms nominal for 50 dB change  
 MGC: Bus-controllable over 127 dB range in 0.5 dB nominal steps

## IF SECTION

First IF: 40.456 MHz  
 Second IF: 456 kHz  
 Third IF: 24 kHz  
 Fourth IF (up-loadable DSP):  
 51 standard bandwidths from 100 Hz to 16 kHz, bus selectable  
 Shape Factor: 3 dB to 60 dB (better

CONTROLS AND CONNECTORS	LCR/SMR-2000
<b>Front Panel:</b> Volume ON/OFF knob 1/4" phone jack for headset	yes yes
<b>Rear Panel:</b> Power connector Ref input Antenna input Audio Bus control  Ground stud Address/ baud switch NBIF out WBIF out Digital out	IEC320 BNC TNC Type 15 pin Sub D RS-232/RS-422, 25 pin Sub D 10/32 w/wing nut S1/S2 BNC BNC 15 pin Sub D

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The LCR/SMR-2000 LF-HF receiver is a triple-conversion superheterodyne design in which the final IF filtering and demodulation are accomplished with digital signal processing (DSP) for superior accuracy and flexibility. The three intermediate frequencies (IFs) are 40.456 MHz, 456 kHz, and 24 kHz. At the third IF, the signal is converted to digital form. A digital signal processor chip then provides fine tuning, IF filtering to the selected bandwidth, and AM, FM or product detection according to the operating mode. Fifty-one bandwidths are offered from 100 Hz to 16 kHz. The demodulated signals are converted back to analog form for output to the speaker, headphone or balanced line audio output.

## Ordering Information

Model	Part Number	Description
LCR/SMR-2000	2701-1000-3	1.72" (1RU), 19" Rack-mount, 10 kHz - 30 MHz
DC Power	2701-1000-2	Optional 20 - 32 VDC
RKSLD-KIT-01	222-024/222-036	Rack Slides Kit for 1.72" (1RU)
VIRTCONT-01	2800-1000-12	HF Virtual Control Software (order with unit)

Specifications subject to change without prior notice

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