DATA SHEET

Flex Max® RF Amplifiers

FM332

1.2 GHz Line Extender Amplifier

FEATURES

- Supports 1.2 GHz Downstream and 204 MHz Upstream bandpass for DOCSIS® 3.1 migration
- Increased gain to allow drop in upgrades for ≥ 750 MHz spacing
- Modular RF Electronics package with upgradable frequency split options
- Mechanically compatible with legacy E7/FM330/FM331 amplifier housings
- QAM and Analog ADU options for automatic level control and gain hold in the event of pilot loss

For cable operators looking to ensure scalability, maximum backward compatibility, and protect network investments, CommScope offers solutions that deliver new services with minimal CAPEX, enhance network efficiency, and increase subscriber satisfaction.

The new CommScope 1.2 GHz Flex Max® FM332 Line Extender Amplifier enables cable operators to take advantage of DOCSIS 3.1 efficiencies while maintaining backward compatibility with existing 750 MHz, 870 MHz, and 1 GHz systems.

Downstream

The FM332 is equipped with Gallium Nitride (GaN) hybrid technology and a single high-level driven RF output. New 1.2 GHz Forward Cable Equalizers (CE-120-*) and Cable Simulators (CS-120-*) are available to optimize system designs. These new plug-ins are in the JXP-style form factor and plug into a carrier board with a backward compatible footprint, so operators who want to use the new amplifiers in older 870 MHz or 1 GHz systems can re-use their legacy SEQ-* equalizers.

FM332 line extenders feature a new series of plug-in Automatic Level Control (ALC) boards that include standard 711 MHz and 609 MHz QAM as well an option for legacy 499.25 MHz analog pilot frequencies. The amplifier utilizes a gain hold feature in the event of pilot loss for added system reliability. If Manual Level Control (MLC) option is chosen, there is an Automatic/Manual mode jumper that can be set to enable the amplifier to operate in Thermal Gain Control mode. There is an LED indicator to provide visual confirmation of the selected mode and pilot presence.

The FM332 utilizes pluggable filters, which provides operators with the flexibility to change band splits in the future. The following frequency splits are available:

- 5 to 42 MHz/54 to 1218 MHz (042 split)
- 5 to 85 MHz/102 to 1218 MHz (085 split)
- 5 to 204 MHz/258 to 1218 MHz (204 split)

Upstream

The FM332 features 27 dB of gain in the upstream to accommodate a wide variety of network designs including high split. The upstream circuitry includes a single attenuator location prior to the output test point that allows operators to set levels. The return equalizer maintains the MEQ-**-* form factor from the FM331, and operators can select MEQ return path equalizers based on the diplex split and values required in their network design. Previous generation MEQT return path equalizers are no longer required because of the FM332's on-board thermal compensation feature, which helps maintain levels over temperature.

Backward Compatibility

The FM332 RF Module is backward compatible with the previous versions of FM330 and FM331 amplifier housings. Earlier E5 and E7 housings require a baseplate kit and performance > 1 GHz is not guaranteed.

COMPATIBILITY

Platform	FlexNet E5	FlexNet E7	Flex Max 330	Flex Max 331
Upgrade to FM332	Yes*	Yes*	Yes	Yes

* Requires Baseplate Upgrade Kit part number 1500855-001 - Performance > 1 GHz not guaranteed

SPECIFICATIONS

Downstream Parameter		Specification
Frequency Split, MHz[1]	042 Split 085 Split 204 Split	54–1218 102–1218 258–1218
Flatness, dB[2]		± 0.75
Operational Gain, dB[3]		38 min
Internal Slope, dB[4]	042 Split 085 Split 204 Split	11.9 11.1 9.0
Noise Figure, dB[5]		7.5 max @ 54 MHz 9.0 @ 1218 MHz
Test Point, dB		20 ± 1.0
Return Loss, dB		16
Hum Modulation @ 15A, dBc[6]	F_{minfwd} to 870 MHz 871 to 1003 MHz 1004 to 1218 MHz	-60 -55 -50
Distortion: 1.2 GHz Analog/Digital, 30 Analog/160 Digital Channels[7]		
Reference Frequency, MHz		1218/258/54
Reference Input Level, dBmV		19/10.7/9.9 (virtual)
Reference Output Level (21 dB Slope), dBmV		57/39.7/36 (virtual)
Composite Triple Beat (CTB), dBc		-74
Composite Second Order (CSO), dBc		-78
Carrier to Composite Noise (CCN), dB		56
Distortion: 1.2 GHz All Digital, 190 Digital Channels		
Reference Frequency, MHz		1218/258/54
Reference Input Level, dBmV		13/4.7/3.9 (actual)
Reference Output Level (21 dB Slope), dBmV		51/33.7/30 (actual)
Carrier to Composite Noise (CCN), dB[8]		50
MER, dB[9]		48

NOTES:

1. Operating passband of station is determined by the diplex filters, forward correction board, and high pass filter installed in the amplifier.
2. Flatness is measured with respect to slope. Slope is calculated using least squares.
3. Specified at Ta = 25 ± 5°C and measured at 1218 MHz. Includes the gain control back-off of 5.0 ± 0.1 dB and forward equalizer loss of 1.0 dB.
4. Specified from 54 MHz to 1218 MHz, 5.0 dB Linear Slope plus 6.9 dB Cable Slope.
5. The noise figure is measured with a 1 dB attenuator installed in the forward equalizer location and is specified at Ta = 25 ± 5°C. The noise figure may degrade by up to 1 dB over the full operating temperature range. The applicable specification value for any test frequency between 54 MHz and 1218 MHz is determined by applying linear interpolation to the listed specification values.
6. Hum modulation is measured at 15 Arms AC current passing through the port under test.
7. 30 analog channels from 55.25 MHz to 253.25 MHz, 124 digital QAM channels from 261 MHz to 999 MHz, and a 192 MHz wide OFDM channel centered at 1122 MHz.
8. CCN is measured by turning off the QAM channel under test and inserting a CW test signal at the corresponding QAM RF level in its place.
9. MER is calculated from the measured CCN.

SPECIFICATIONS

Upstream Parameter		Specification
Frequency Split, MHz[1]	042 Split 085 Split 204 Split	5–42 5–85 5–204
Flatness, dB[2]		± 0.5
Operational Gain, dB[3]		27
Slope, dB		0 ± 0.75
Noise Figure, dB[4]		6.0
Test Points, dB		20 ± 1.0 dB
Return Loss, dB[5]		16
Response Over Temperature, dB[6]		± 0.5 max
Hum Modulation @ 15A, dBc[7]		-50, 5–10 MHz -55, 11–15 MHz -60, 16–$F_{maxreturn}$ MHz
Distortion: All Digital, 6 Digital Channels[8]		
Reference Frequency, MHz		42/5
Reference Input Level, dBmV		13/13
Reference Output Level, dBmV		40/40
NPR Dynamic Range, dB[9]		36
BER Dynamic Range, dB[10]		42
Distortion: All Digital, 13 Digital Channels[8]		
Reference Frequency, MHz		85/5
Reference Input Level, dBmV		9/9
Reference Output Level, dBmV		36/36
NPR Dynamic Range, dB[9]		33
BER Dynamic Range, dB[10]		39
Distortion: All Digital, 33 Digital Channels[8]		
Reference Frequency, MHz		204/5
Reference Input Level, dBmV		6/6
Reference Output Level, dBmV		33/33
NPR Dynamic Range, dB[9]		29
BER Dynamic Range, dB[10]		35

NOTES:
1. Upstream bandwidth is determined by the diplex filters, low pass filter (RPLPF), and upstream equalizer (MEQ * *) installed in the amplifier.
2. Flatness is measured with respect to slope; slope is linear and calculated using a least squares.
3. The operational gain is specified at F_{maxret} and Ta = 25 ± 5°C and includes gain control back-off of 3.0 ± 0.1 dB and a reverse equalizer loss of 1.0 dB.
4. Specified at Ta = 25 ± 5°C. Measured with an MEQ-0-0 installed in the reverse equalizer location and a 1 dB attenuator installed in the reverse output pad location. May degrade by up to 1 dB over the full operating temperature range.
5. The return loss from 5–15 MHz may degrade by up to 1 dB over the operating temperature range.
6. Specified relative to the response measured at Ta = 25 ± 5°C.
7. Hum modulation is measured at 15 Arms AC current passing through the port under test.
8. The QAM load is 256 QAM, J.83 Annex B, 5.360537 MS/s; 6 MHz/channel.
9. The NPR dynamic range is specified for an NPR greater than or equal to 40 dB.
10. The BER dynamic range is specified for an uncorrected (Pre-FEC) BER less than or equal to 1.0×10^{-6}.

SPECIFICATIONS

Powering	Specification
AC Input Current (Typical)	0.81 A/25 W @ 45 V 0.36 A/22.5 W @ 75 V 0.30 A/22.5 W @ 90 V
AC Input Voltage Range, VAC	45–90
AC Bypass Current, A	15
General	**Specification**
Operating Temperature Range	-40° to +60°C -40° to +140°F
Housing Dimensions, L x W x D	12.3 x 9.6 x 3.5 inches 312 x 243 x 89 mm
Weight	9 lbs 4 kg

1.2 GHz FM332 LINE EXTENDER ORDERING GUIDE

In the example below, part number FML12X085-SHMPR1N corresponds to the shaded rows in the Key Guide.

F	M	L	1	2	X	0	8	5	—	S	H	M	P	R	1	N

Key	Technology
FML12	1.2 GHz GaN Output w/38 dB Gain

Key	Reference Slope
X	11.9 dB (54–1218 MHz)

Key	Bandpass Split
042	42/54 MHz
085	85/102 MHz
204	204/258 MHz

Key	Level Control
X	Manual Level Control (MLC)
A	499.25 MHz ALC
Q	609.00 MHz QAM ALC
S	711.00 MHz QAM ALC

Key	Upstream Gain
H	27 dB

Key	Output Configuration
M	-20 dB Internal Test Points

Key	Powering
P	1.0 A, 60-90V, 50/60 Hz power supply

Key	Housing
A	None (RF Module Only)
R	2 Port FlexMax Internal Test Points

Key	Housing Finish
1	Standard

Key	Options
N	N/A

REQUIRED ACCESSORIES

Model Name	Description
CE-120-* CS-120-*	Forward 1.2 GHz Cable Equalizer 2 to 20 dB in 1 dB steps -or- Forward 1.2 GHz Cable Simulator 1 to 10 dB in 1 dB steps
MEQ-**-*	Return Equalizer, 5–42 MHz (042 Split), 5–85 MHz (085 Split), 5–204 MHz (204 Split)
NPB-* NPB-750	Plug-in attenuator/pad (values 0 to 26 dB in 1 dB steps) Plug-in terminator (75 ohm)

RELATED PRODUCTS

ADU/QADU	Optical Nodes
FM902 1.2 GHz Trunk/Bridger	Frequency Split Upgrade Kits
Forward Signal Correction Plug-in Accessories	Installation Services

Contact Technical Services for product support:

- United States: +1-888-944-4357
- International: +1-215-323-2345

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Note: Specifications are subject to change without notice.

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