Micro Linear

February 1997
PRELIMINARY

ML6424*/ML6425*

CCIR601 Video Lowpass Filter with Optional Sinx/x Correction

GENERAL DESCRIPTION

The ML6424 is a monolithic BiCMOS Video Lowpass Filter IC, incorporating a 5th order Elliptic (Cauer) lowpass filter, a third order allpass filter, and a 75Ω coax cable driver. The ML6425 additionally provides sinx/x amplitude correction. These active lowpass filters are available with a 2.75MHz (-2) or a 5.50MHz (-1) cutoff frequency.

The input signal can be either AC or DC coupled under the control of the MODE pin. In the DC coupled case, a control pin (RANGE) is provided to allow the inputs to swing down to ground. Internal self clamping is provided for AC coupled signals.

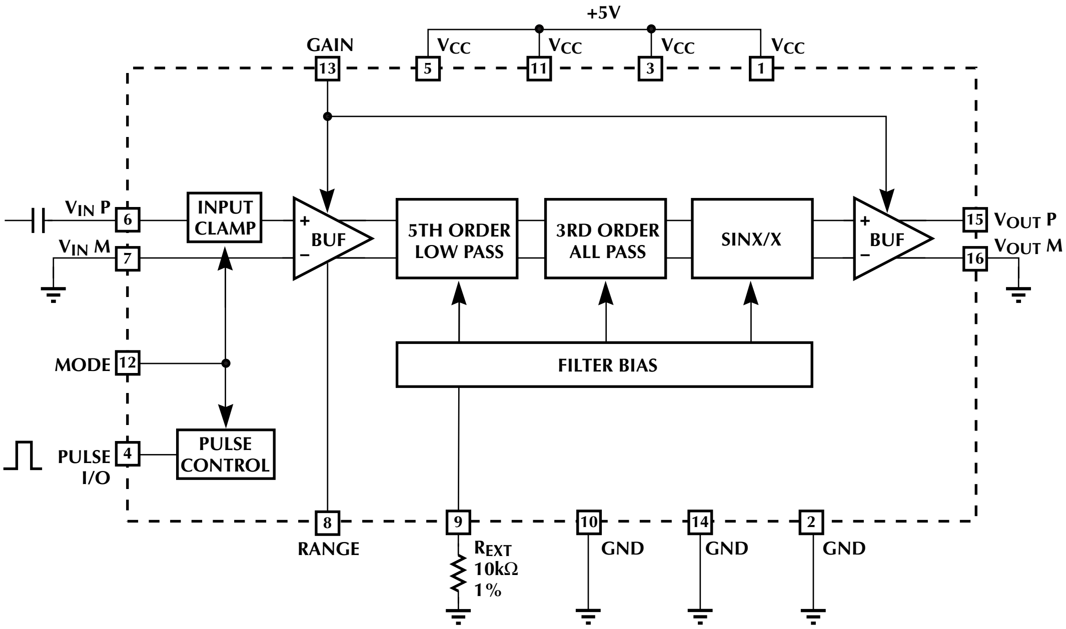
The ML6424 and ML6425 are powered by a single 5V supply, and can drive 1V_{PP} into 75Ω (0.5V to 1.5V), or 2V_{PP} into 150Ω (0.5 to 2.5V). The maximum output swing from 0.5V to 2.5V allows easy interface to the ML6400 family of A/D converters.

FEATURES

- External or internal input clamping with pulse output for synchronous clamping of multiple filters
- Frequency tunable with R_{EXT}: ±10%
- ±0.25dB ripple
- >40dB attenuation at f > 1.45 x f_C (w/o sinx/x)
- >35dB attenuation at f > 1.45 x f_C (with sinx/x)
- –12dB attenuation at f = 1.23 x f_C
- Group delay distortion: ±20ns up to 0.9 x f_C
- <1% peak overshoot and ringing on 2T test pulse
- 0.5% diff. gain and 0.5· diff. phase typical
- THD <1% at 3.58 or 4.43MHz
- Programmable input-output gain of 1x or 2x
- 5V ±5% operation

*Some packages Are Obsolete

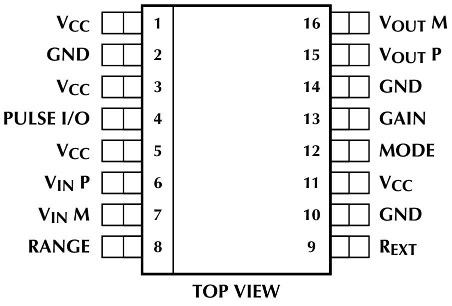
BLOCK DIAGRAM



	ML6424-1	ML6424-2	ML6425-1	ML6425-2
Bandwidth	5.50MHz	2.75MHz	5.50MHz	2.75MHz
Sinx/x	No	No	Yes	Yes

PIN CONFIGURATION

Package: S16W
16-Pin SOIC



PIN DESCRIPTION

Pin #	Name	Description
1,3, 5,11	V_{CC}	Positive supply voltages (4.75V to 5.25V).
2,10, 14	GND	Ground voltages.
4	PULSE I/O	U/V clamp switch control input/output pin. When MODE is low, U/V clamp control pulse can be applied to this input pin. When MODE is high, the internal circuit generates a U/V clamp control signal to produce an output pulse at this pin. When MODE is floating, do not apply any voltage to this pin since it is internally tied low in this case. (See table below)
6,7	V_{IN} P, V_{IN} M	Input to the filter. The input voltage for the filter is applied to V_{IN} P pin with respect to V_{IN} M pin which is grounded. (With no connection to MODE pin, input signal range should be from V_{IN} = 0.5V to 1.5V when RANGE = Low, V_{IN} = 0V to 1V when RANGE = High). There is a 100µA internal current source connected to each of these inputs.
8	RANGE	Input signal range control when MODE is floating. When RANGE is low, the input signal range is 0.5V to 1.5V, when RANGE is tied high the input signal range is 0V to 1V.
9	R_{EXT}	Precision resistor to ground that defines the cutoff frequency of the filter. (Typical value = 10kΩ) 10% change in R_{EXT} produces a 10% change in f_C (Fig. 28).
12	MODE	Input coupling mode control pin. When MODE is low, U/V signal can be applied through an external ac coupling capacitor to V_{IN} P. When MODE is high, Y signal can be applied through an external AC coupling capacitor to V_{IN} P. In this case, an internal circuitry clamps the sinc tip of the video input signal. When MODE is set to mid supply or left floating, input signal can be directly applied to the input without an AC coupling capacitor.
13	GAIN	Three state gain control pin. GAIN tied low sets the input amplifier gain to 3/4 (0.75) and the output amplifier gain to 4/3 (1.333). When GAIN is tied high, the input amplifier gain is 3/2 (1.5) and the output amplifier gain is 4/3. When GAIN is set to mid supply or left to float, the input amplifier gain is 3/4 and the output gain is 8/3 (2.666). (See table below)
15,16	V_{OUT} P, V_{OUT} M	The output from the filter is derived from the V_{OUT} P pin with respect to the V_{OUT} M pin which is grounded typically. It can drive $1V_{PP}/75\Omega$ (0.5V to 1.5V) or $2V_{PP}/150\Omega$ (0.5V to 2.5V). If the ouput common-mode level needs to be increased, it can be done by raising the potential of V_{OUT} M. In this case, the output is measured from V_{OUT} P with respect to GND.

MODE	INPUT COUPLING	PULSE
Low	AC for U/V	Input
Float	DC	Internally biased
High	AC for Y	Output

Pulse Mode Table

GAIN SELECT	INPUT	INPUT BUFFER GAIN	OUTPUT BUFFER GAIN	OUTPUT	OPTIMIZES
Low	$1V_{PP}$	0.75	1.333	$1V_{PP}$	—
Float	$1V_{PP}$	0.75	2.666	$2V_{PP}$	Differential Phase & Gain
High	$1V_{PP}$	1.50	1.333	$2V_{PP}$	Noise

Gain Table

ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

DC Supply Voltage ....–0.3V to 7V
Analog & Digital
Inputs/Outputs................................ –0.3V to V_{CC} + 0.3V
Input current per pin ....–25mA to 25mA
Storage Temperature ....–65°C to 150·C
Maximum Junction Temperature .... 150·C

OPERATING CONDITIONS

Operating temperature range ....0°C to 70·C
Operating supply range ....5V ±5%

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{CC} = 4.75 to 5.25V, T_A = Operating Temperature Range (Note 1).

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current			100	150	mA
Input Current (V_{IN} P, V_{IN} M)	Sourcing out of the device	80	100	120	µA
Input Current Matching	Between V_{IN} P and V_{IN} M (tied to GND)		3.0	5	%
Low Frequency Gain	V_{IN} = 100mV_{P-P} @ 100kHz	–0.2	0.0	0.2	dB
Passband Ripple	100Hz < f_{IN} < f_C	–0.25		0.25	dB
Differential Gain (RANGE = High)	V_{IN}: 1.0V ± 0.5V, @ 3.58 or 4.43MHz		0.5	1	%
Differential Phase (RANGE = High)	V_{IN}: 1.0V ± 0.5V, @ 3.58 or 4.43MHz		0.5	1	Degree
Dynamic Input Signal Range (MODE = Float)	RANGE = Low	0.5		1.5	V
	RANGE = High	0		1	V
Output Noise (GAIN = High)	Bw: 30MHz, ML6424-1		1.7	2.3	mV_{RMS}
	Bw: 30MHz, ML6424-2		1.3	1.9	mV_{RMS}
	Bw: 30MHz, ML6425-1		1.7	2.3	mV_{RMS}
	Bw: 30MHz, ML6425-2		1.3	1.9	mV_{RMS}
Corner Frequency (f_C) (±0.25dB)	ML6424-1 or ML6425-1	5.23	5.50	5.78	MHz
	ML6424-2 or ML6424-2	2.61	2.75	2.89	MHz
Stopband Loss (ML6424-1, -2)	f_{IN} > 1.45 x corner frequency	35	38		dB
Stopband Loss (ML6425-1, -2)	f_{IN} > 1.45 x corner frequency	30	33		dB
Peak Overshoot and Ringing	2T, 0.7V_{P-P} pulse			1	%
Composite Chroma/Luma Delay	T_D(subcarrier) – T_D(0); f_C = 5.5MHz			20	ns
Output Short Circuit Current	V_{OUT} P to GND while V_{OUT} M = GND		45		mA
Load Capacitance	V_{OUT} P to GND		35		pF
Logic Input Low (V_{IL})	RANGE			0.8	V
Logic Input High (V_{IH})	RANGE	V_{CC} – 0.8			V
Logic Input Low (I_{IL})	V_{IN} = GND	–1			µA
Logic Input High (I_{IL})	V_{IN} = V_{CC}			1	µA

Note 1: Limits are guaranteed by 100% testing, sampling, or correlation with worst case conditions.
Note 2: Digital Inputs: All inputs are high impedance 1µA leakage, with MAX input voltage levels of 0.8V from each supply

FUNCTIONAL DESCRIPTION

The ML6424 and ML6425 are monolithic CCIR601 continuous time video filters, designed for broadcast and professional luminance and chrominance antialias and reconstruction applications. They are fabricated using Micro Linear's 1.5µ, 4 GHz BiCMOS process. The filter incorporates an input amplifier, programmable gain of 1x or 2x set by the GAIN pin, a fifth order lowpass filter, a third order allpass filter, and an output amplifier capable of driving 75Ω to ground. The ML6425 provides sinx/x equalization.

The ML6424–1 is intended for application as luminance antialias processing, the ML6424–2 for chrominance antialias, the ML6425–1 for luma reconstruction, and the ML6425–2 for chroma reconstruction.

Input signals can be applied either through an AC coupling capacitor (MODE = High/Low) or directly to the input pin (MODE = float). With MODE = High, Y-Channel signal can be applied to the input and the PULSE I/O pin generates a clamping pulse for the U/V channel. When MODE = Low, U/V channel signal can be applied to the input. In this case, the PULSE I/O pin can take the pulse signal generated from the PULSE I/O pin of the other chip in the Y-channel. In the case of direct coupling, RANGE should be adjusted according to the input signal range. When RANGE is low, the input signal range is 0.5V to 1.5V. When the input signal goes down to 0V, RANGE should be tied high. In this case, an offset is added to the input so that the filter can process the 0V DC level.

The output amplifier is designed to drive up to 20mA peak into a 75Ω load, or 17mA peak into a 150Ω load. Load resistance less than 75Ω and/or output voltage above 1.5V into 75Ω (2.5V into 150Ω) may cause signal distortion.

Good high frequency decoupling is required between each power supply pin and ground, otherwise oscillations and/or excessive crosstalk may occur.

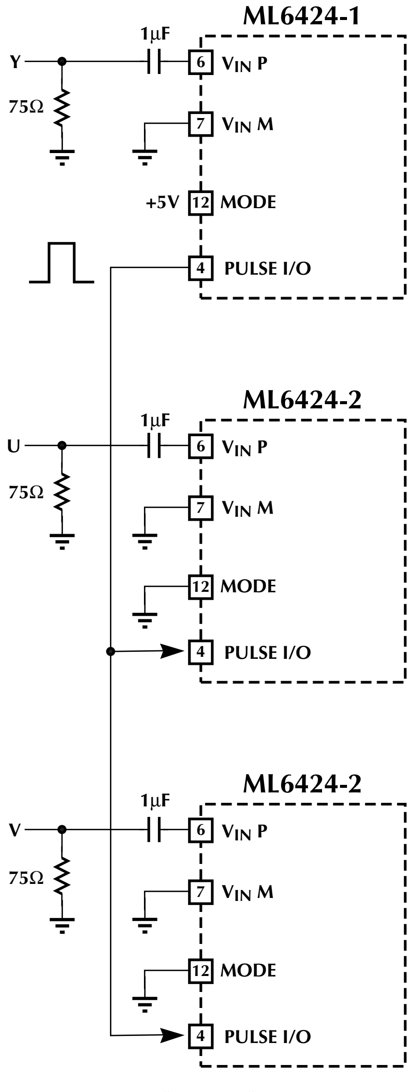


Figure 1. YUV Filter with Sync on Y Input and Auto Clamp On

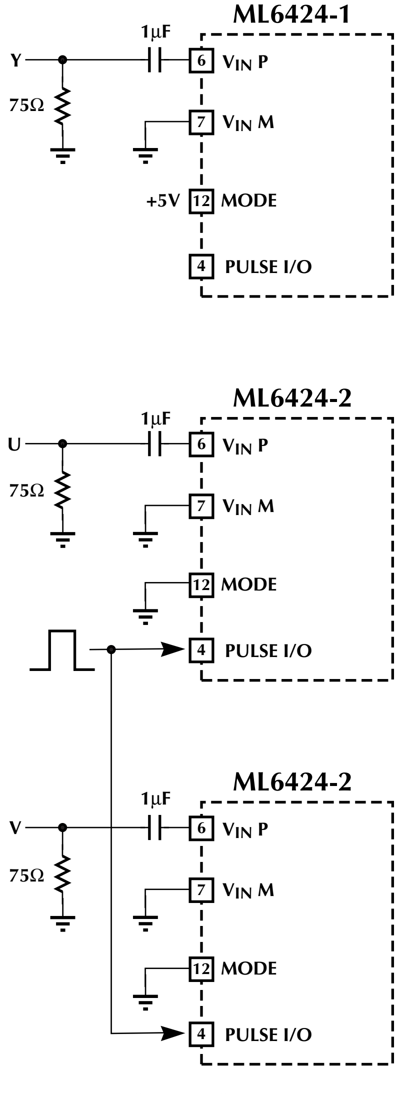


Figure 2. YUV Filter with External Sync for U/V

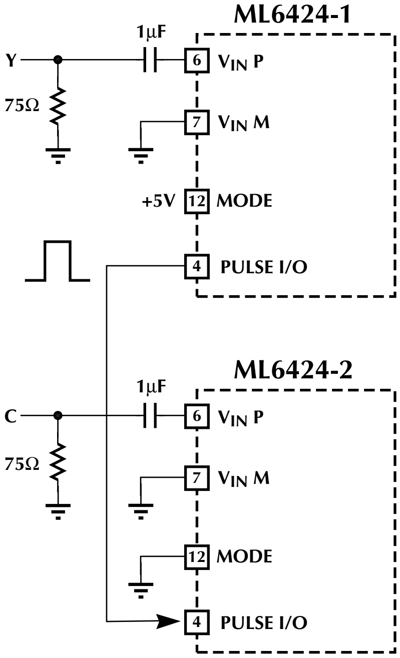


Figure 3. Y/C Filter

ML6424-1 RESPONSE CURVES

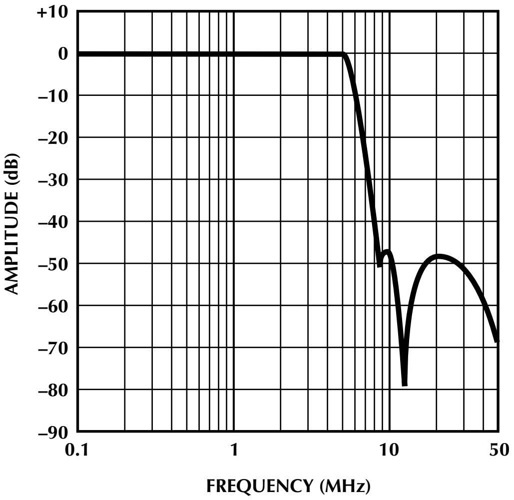


Figure 4. Amplitude vs Frequency

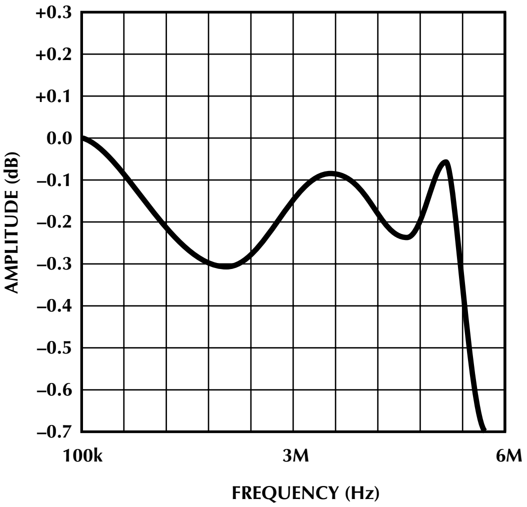


Figure 5. Amplitude vs Frequency

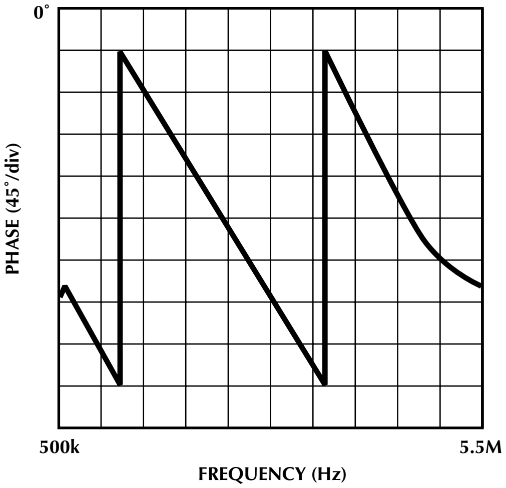


Figure 6. Phase vs Linear Frequency

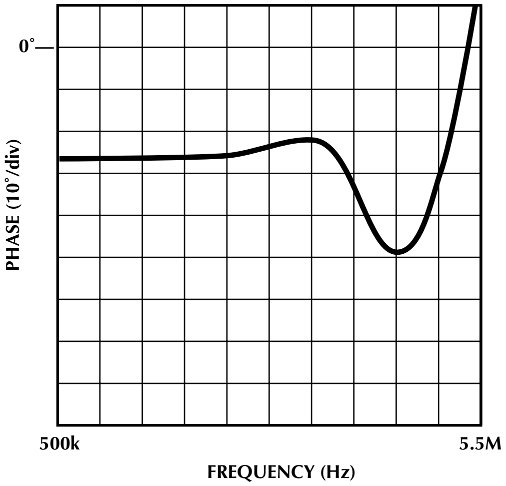


Figure 7. Deviation from Linear Phase

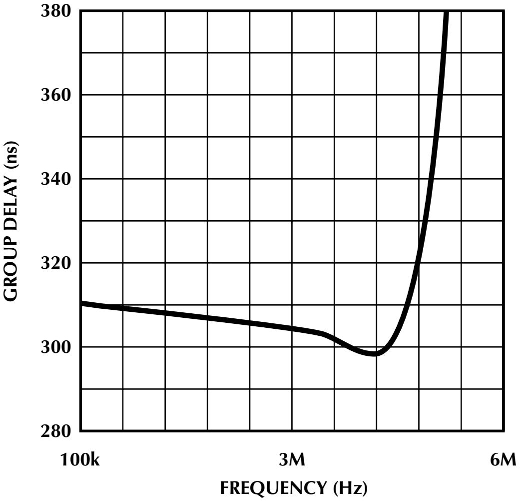


Figure 8. Group Delay vs Frequency

ML6424-2 RESPONSE CURVES

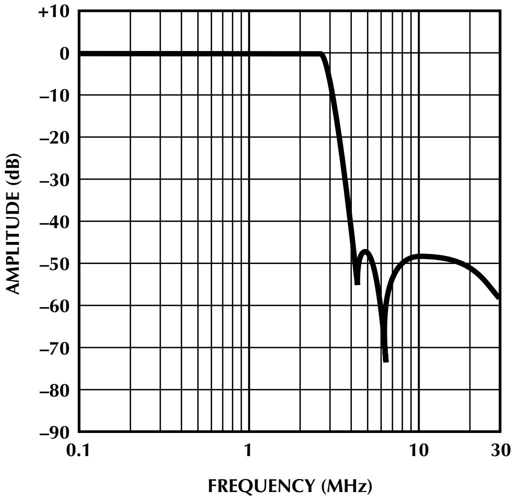


Figure 9. Amplitude vs Frequency

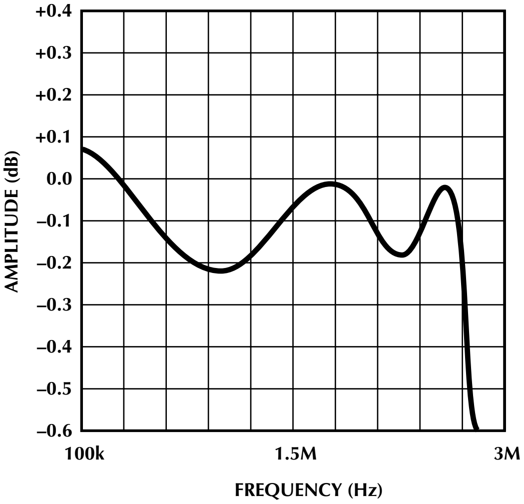


Figure 10. Amplitude vs Frequency

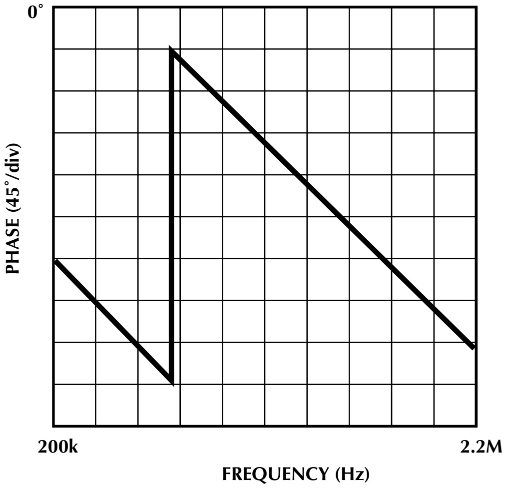


Figure 11. Phase vs Linear Frequency

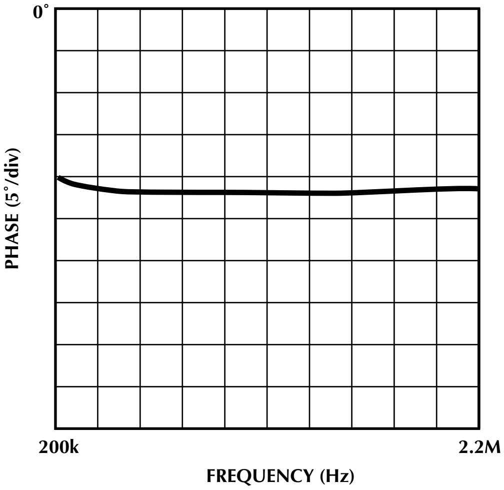


Figure 12. Deviation from Linear Phase

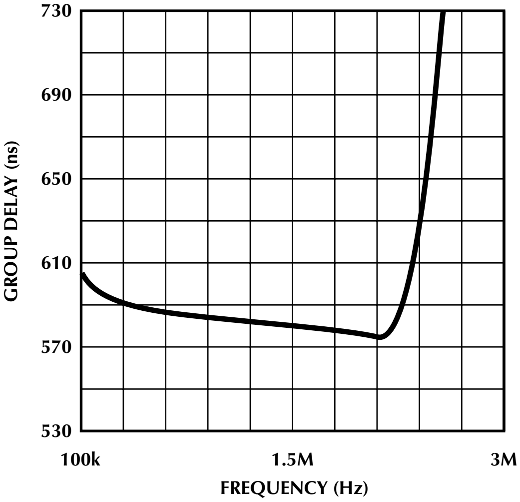


Figure 13. Group Delay vs Frequency

ML6425-1 RESPONSE CURVES

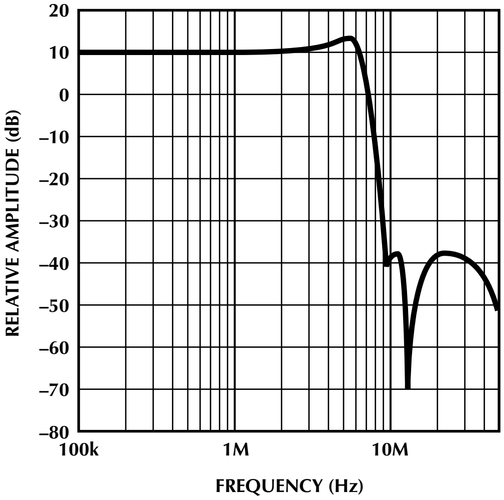


Figure 14. Amplitude vs Frequency

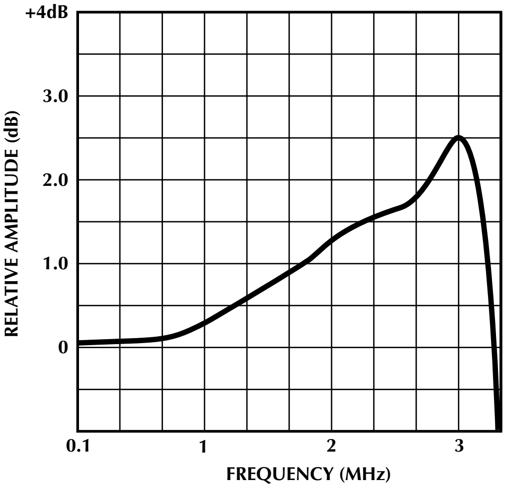


Figure 15. Amplitude vs Frequency

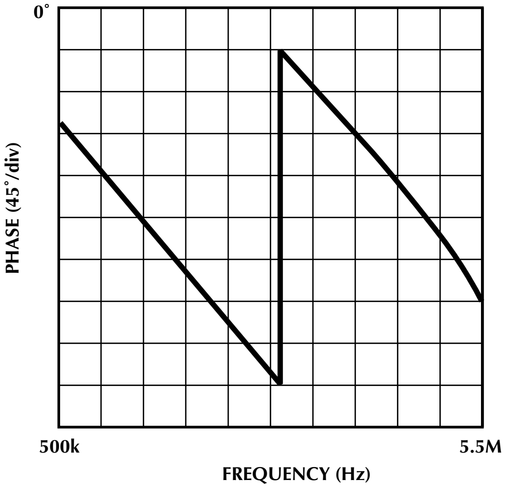


Figure 16. Phase vs Frequency

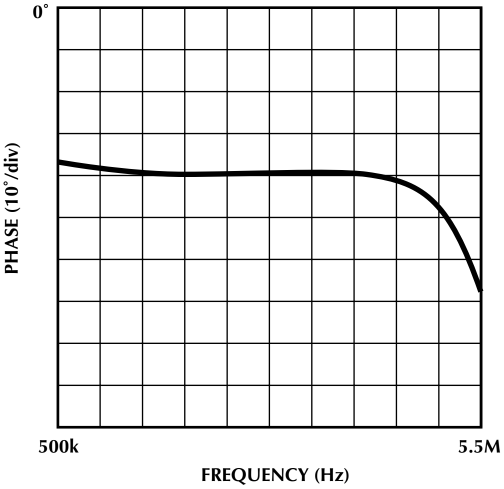


Figure 17. Deviation from Linear Phase

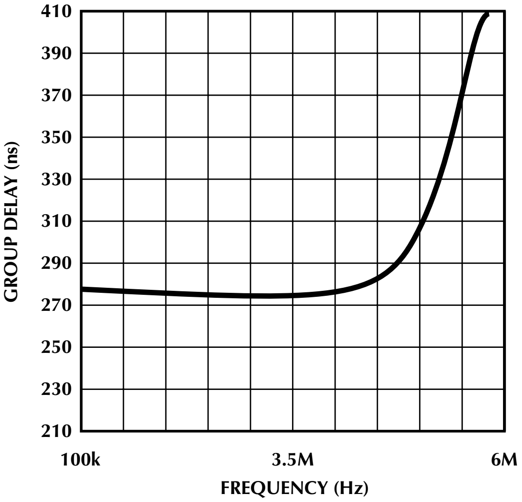


Figure 18. Group Delay vs Frequency

ML6425-2 RESPONSE CURVES

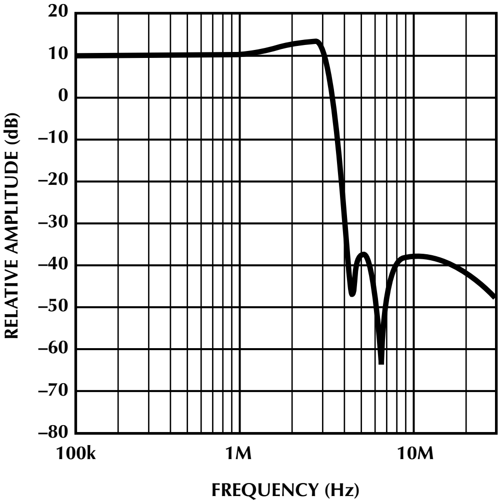


Figure 19. Amplitude vs Frequency

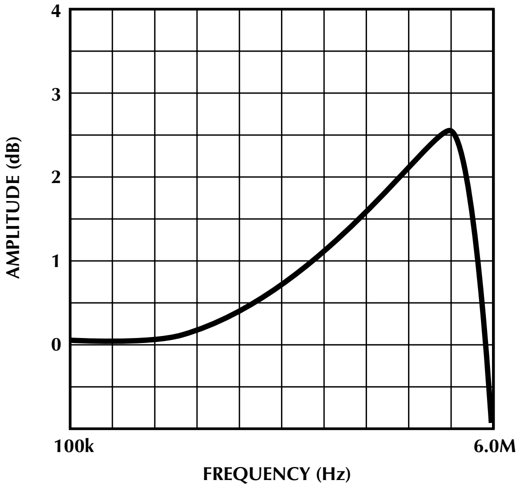


Figure 20. Amplitude vs Frequency

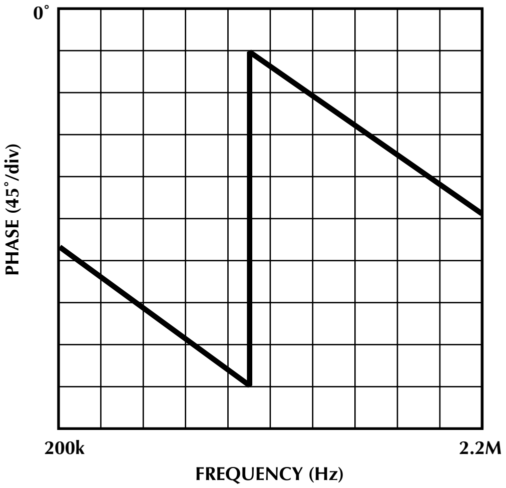


Figure 21. Phase vs Linear Frequency

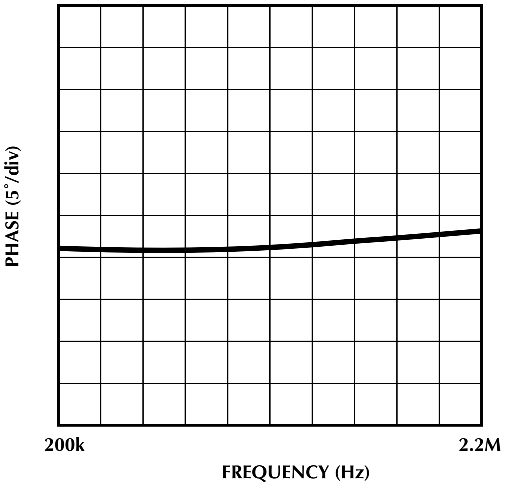


Figure 22. Deviation from Linear vs Phase

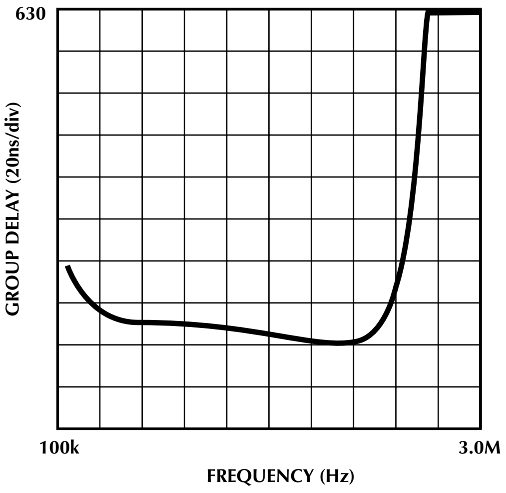


Figure 23. Group Delay vs Frequency

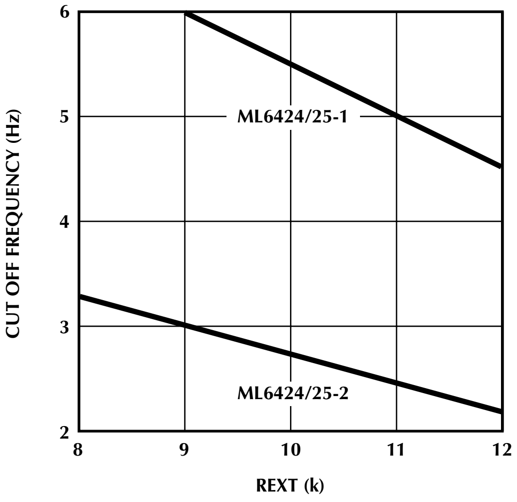


Figure 24. Frequency vs R_{EXT}

ML6425-2 RESPONSE CURVES

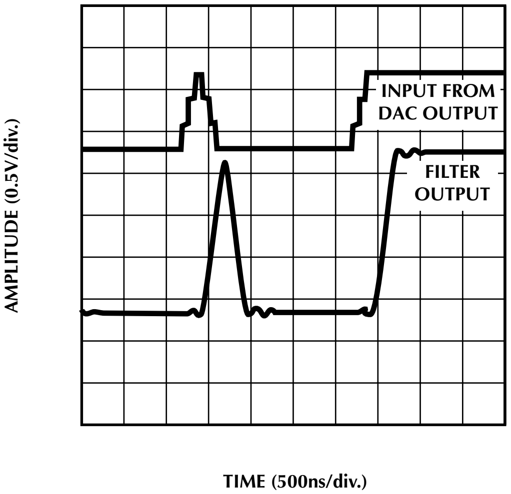
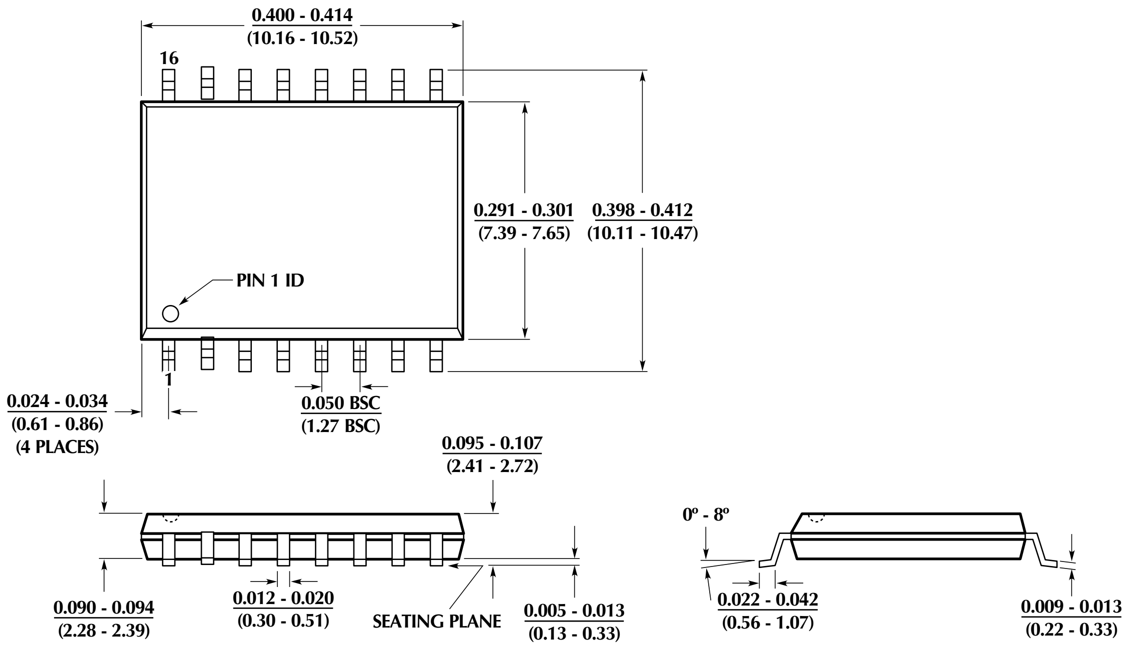


Figure 25. Transient Response

PHYSICAL DIMENSIONS inches (millimeters)

Package: S16W
16-Pin Wide SOIC



ORDERING INFORMATION

PART NUMBER	FREQ	SIN X/X	TEMPERATURE RANGE	PACKAGE
ML6424-1	5.5	NO	0·C to 70·C	16-Pin SOIC (S16W) (Obsolete)
ML6424-2	2.75	NO	0·C to 70·C	16-Pin SOIC (S16W)
ML6425-1	5.5	YES	0·C to 70·C	16-Pin SOIC (S16W) (Obsolete)
ML6425-2	2.75	YES	0·C to 70·C	16-Pin SOIC (S16W)

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