



# MC13022A

## Advance Information

# Advanced Medium Voltage AM Stereo Decoder

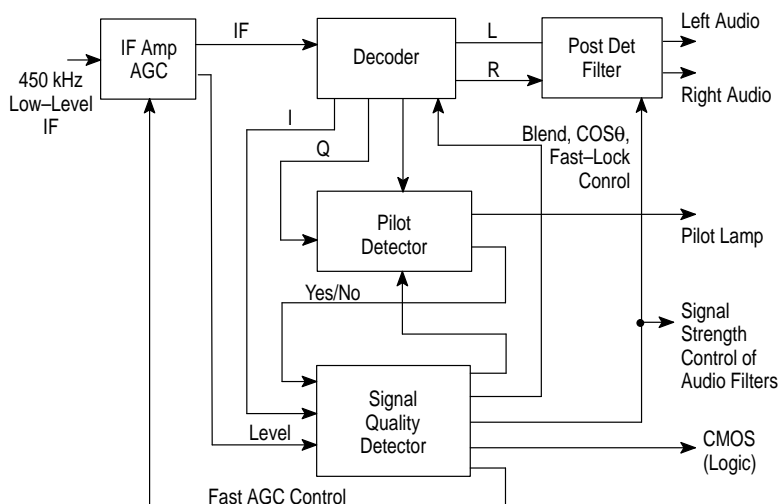
The MC13022A is designed for home and automotive AM stereo radio applications. The circuits and functions included in the design allow implementation of a full-featured C-QUAM® AM stereo radio with relatively few, inexpensive external parts. It is available in either 28-lead DIP or EIAJ compatible wide-bodied 28-lead SOIC. Functionally, the MC13022A and MC13022 are very similar. The MC13022A has 10 dB more audio output and a CMOS compatible logic level output (Pin 15) for stop sense. The stop sense/AGC function has been internally connected to the output notch filter control.

- Operation from 6.0 V to 10 V Supply with Current Drain of 20 mA Typ
- IF Amplifier with Two Speed AGC
- Post Detection Filters that Allow Automatic Adjustable Audio Bandwidth Control and Notch Filtering (9.0 or 10 kHz)
- Signal Quality Controlled Stereo Blend and Noise Reduction
- Noise and Co-Channel Discriminating Stop-On-Station
- Signal Strength Indicator Output for Stop Sense and/or Meter Drive
- Signal Strength Controlled IF and Audio Bandwidth
- Noise Immune Pilot Detector Needs no Precision Filter Components
- MC13025 Complementary Electronically Tuned Radio Front End
- CMOS Compatible Driver for Stop Sense

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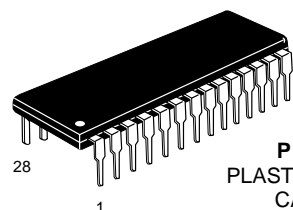
The purchase of the Motorola C-QUAM® AM Stereo Decoder does not carry with such purchase any license by implication, estoppel or otherwise, under any patent rights of Motorola or others covering any combination of this decoder with other elements including use in a radio receiver. Upon application by an interested party, licenses are available from Motorola on its patents applicable to AM Stereo radio receivers.

### Simplified Application

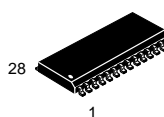


## C-QUAM ADVANCED MEDIUM VOLTAGE AM STEREO DECODER

### SEMICONDUCTOR TECHNICAL DATA



**P SUFFIX**  
PLASTIC PACKAGE  
CASE 710



**DW SUFFIX**  
PLASTIC PACKAGE  
CASE 751F  
(SO-28L)

### PIN CONNECTIONS

Env Det	1	28	I Det
Decoder Input	2	27	L-R Det
Ref	3	26	Q Out
AGC	4	25	VCC
IF Input	5	24	Loop Filter
SS	6	23	Blend
Filtered Left Out	7	22	GND
Left Notch In	8	21	Stereo Lamp
Feedback	9	20	Osc Feedback
Unfiltered L <sub>out</sub>	10	19	Osc In
Unfiltered R <sub>out</sub>	11	18	Pilot Det In
Feedback	12	17	I Pilot
Right Notch In	13	16	Q Pilot
Filtered Right Out	14	15	CMOS SS Out

(Top View)

### ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC13022AP	$T_A = -40^\circ \text{ to } +85^\circ \text{C}$	Plastic Power
MC13022ADW		SO-28L

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## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Input Voltage	$V_{CC}$	12	Vdc
Stereo Indicator Lamp Current (Pin 21)	–	30	mA <sub>dc</sub>
Operating Ambient Temperature	$T_A$	–40 to +85	°C
Storage Temperature Range	$T_{stg}$	–65 to +150	°C
Operating Junction Temperature	$T_{J(max)}$	150	°C
Power Dissipation Derate above 25°C	$P_D$	1.25 10	W mW/°C

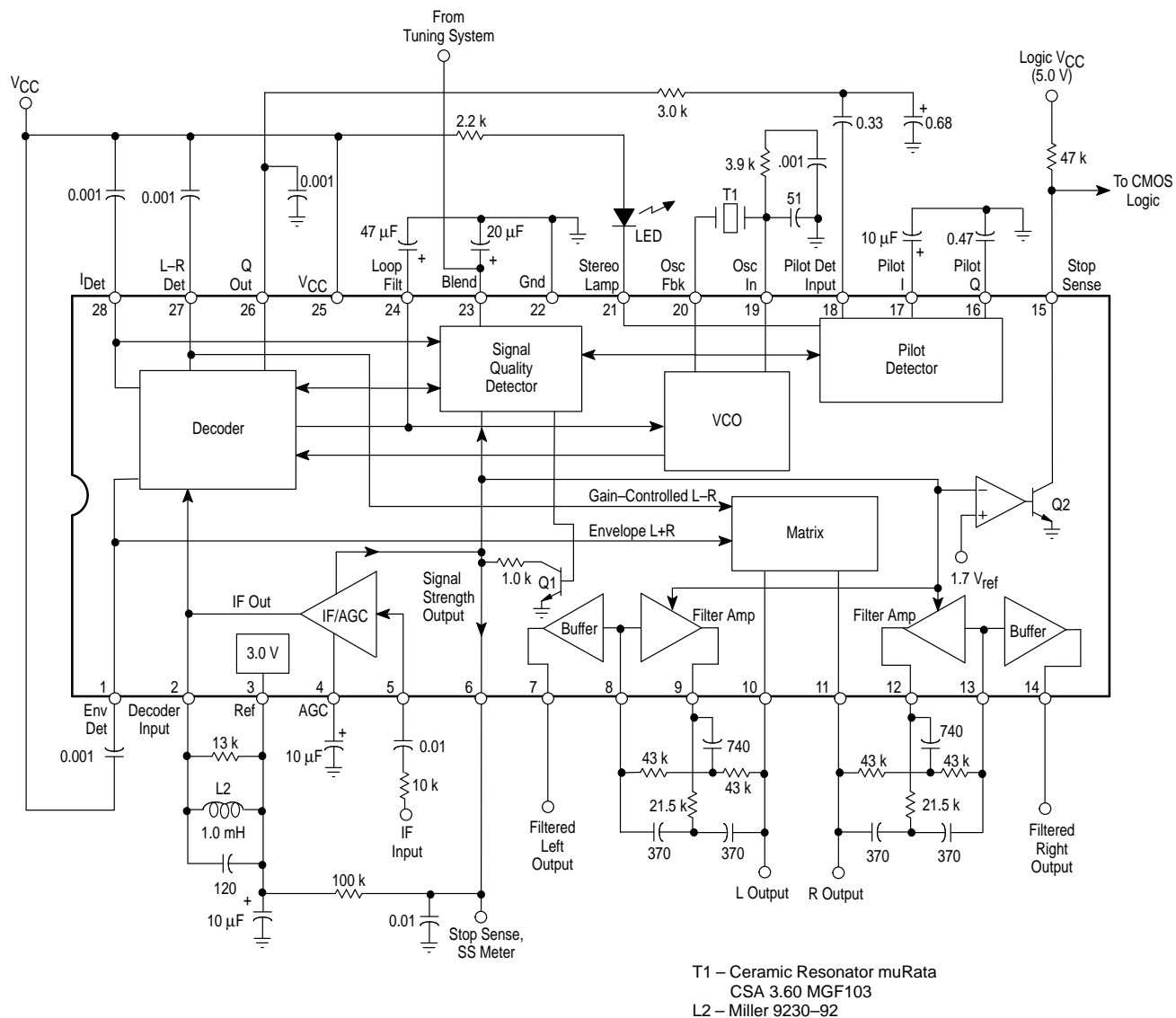
**NOTE:** ESD data available upon request.

## ELECTRICAL CHARACTERISTICS ( $V_{CC} = 8.0$ V, $T_A = 25^\circ\text{C}$ , Test Circuit of Figure 1, unless otherwise noted.)

Characteristic	Min	Typ	Max	Unit
Power Supply Operating Range	6.0	8.0	10	Vdc
Supply Line Current Drain (Pin 25)	10	20	25	mA <sub>dc</sub>
Minimum Input Signal Level, Unmodulated for Full Operation (Pin 5)	–	5.0	–	mV <sub>rms</sub>
Audio Output Level, 50% Modulation, L only or R only (Pins 10, 11) Stereo	290	400	530	mV <sub>rms</sub>
Audio Output Level, 50% Modulation (Pins 10, 11) Monaural	140	200	265	mV <sub>rms</sub>
Output THD, 50% Modulation Monaural	–	0.3	0.8	%
Stereo	–	0.5	1.6	%
Channel Separation, L only or R only, 50% Modulation Stereo	22	35	–	dB
Pilot Acquisition Time Following Blend Reset to 0.3 Vdc	–	–	600	ms
Audio Output Impedance at 1.0 kHz (Pins 7, 14)	–	300	–	$\Omega$
Stereo Indicator Lamp Pin Saturation Voltage at 3.0 mA Load Current ( $V_{sat}$ Pin 21)	–	–	200	mV <sub>dc</sub>
Stereo Indicator Lamp Pin Leakage Current (Pin 21)	–	–	1.0	$\mu\text{A}_{dc}$
Oscillator Capture Range	–	$\pm 3.0$	–	kHz

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Figure 1. Test Circuit



- NOTES:**
1. Q1 is switched on when the Blend Pin 23 is externally held low and the signal is weak or has 110% negative modulation. In this condition Q1 pulls Pin 6 low (0.25 to 1.3 V). At all other times, Pin 6 follows the curve in Figure 4.
  2. Q2 (Pin 15) is switched on when Pin 6 voltage is below 1.7 V. Q2 could then be used as a logic output to the tuning system, telling the tuning system to continue searching for a good signal.
  3. User is cautioned not to require more than 1.0 mA from Pin 6.

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### EXPLANATION OF FEATURES

#### Blend and Noise Reduction

Although AM stereo does not have the extreme difference in S/N between mono and stereo that FM does (typically less than 3.0 dB versus greater than 20 dB for FM), sudden switching between mono and stereo is quite apparent. Some forms of interference such as co-channel have a large L-R component that makes them more annoying than would ordinarily be expected for the measured level. The MC13022A measures the interference level and reduces L-R as interference increases, blending smoothly to monaural. The pilot indicator remains on as long as a pilot signal is detected, even when interference is severe, to minimize annoying pilot light flickering.

#### Signal Strength

A dc voltage proportional to the log of signal strength is provided at Pin 6. This can be used for signal strength indication, and it directly controls the post detection filter. Normal operation is above 2.2 V as shown in Figure 4.

#### Stop Sense

The signal strength information is multiplexed with the stop sense signal. The stop sense is activated when scanning by externally pulling the blend, Pin 23, below 0.3 V. This would typically be done from the mute line in a frequency synthesizer.

If at any time Pin 23 is low and there is either no signal in the IF or a noisy signal of a predetermined interference level, Pins 6 and 15 will go low. This low can be used to tell

the frequency synthesizer to immediately scan to the next channel. The interference detection prevents stopping on many unlistenable stations, a feature particularly useful at night when many frequencies may have strong signals from multiple co-channel stations. Pin 6 drives a comparator which has a 1.7 V reference. Therefore the comparator output, Pin 15, is low if Pin 6 is <1.7 V and high if Pin 6 is >1.7 V.

#### IF Bandwidth Control

IF AGC attenuates the signal by shunting the signal at the IF input. This widens the IF bandwidth by decreasing the loaded Q of the input coupling coil as signal strength increases.

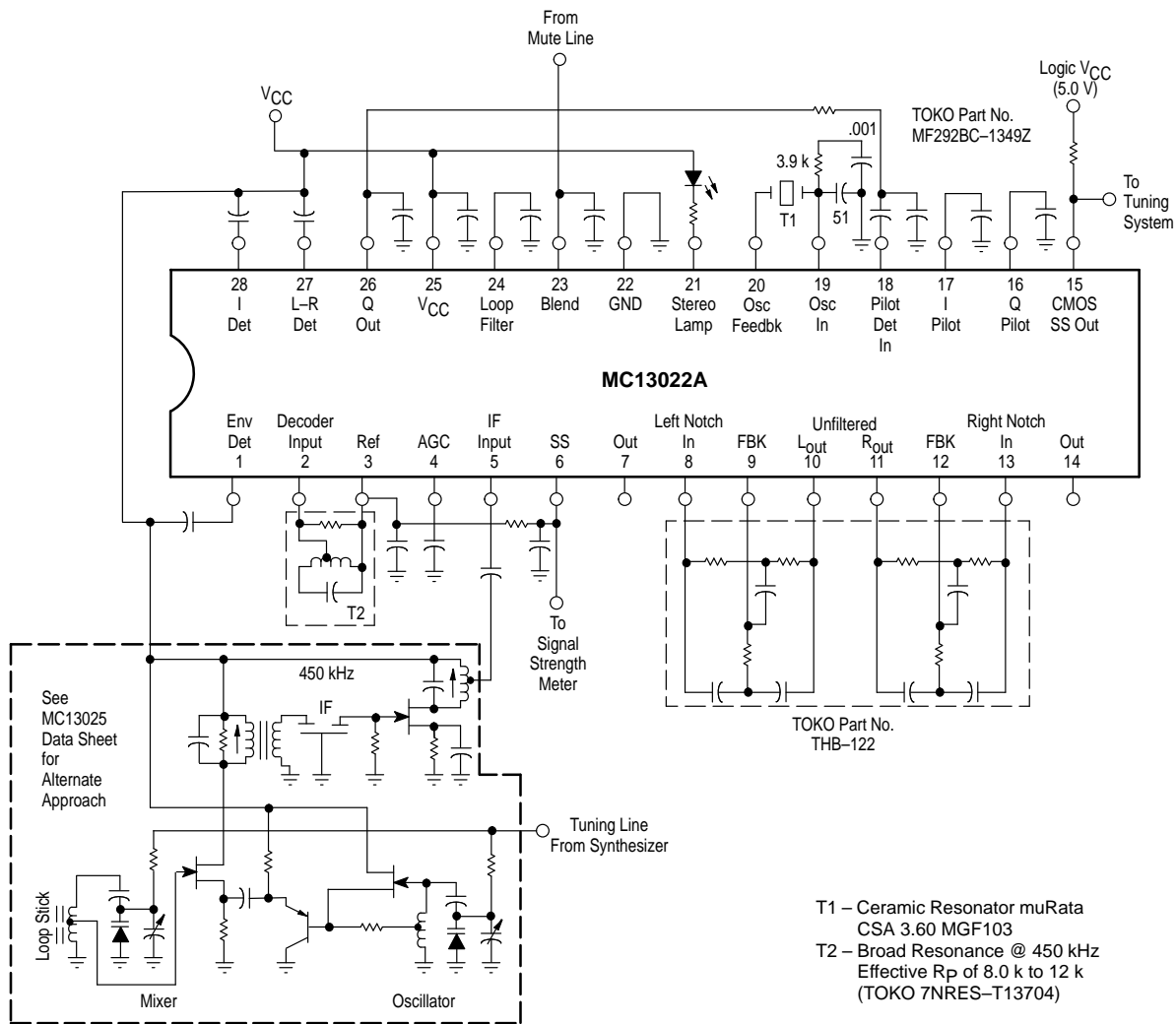
#### Post Detection Filtering

With weak, noisy signals, high frequency rolloff greatly improves the sound. Conventional tone controls do not attenuate the highs sufficiently to control noise without also significantly affecting the mid-range. Also, notch filters are necessary with any wide-band AM radio to eliminate the 10 kHz whistle from adjacent stations.

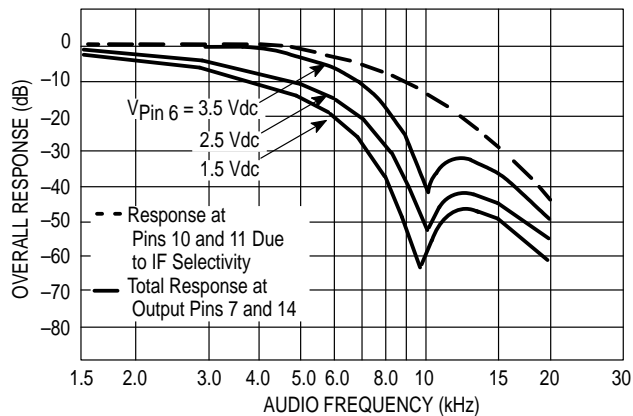
By using a twin-T filter with variable feedback to the normally grounded center leg, a variable Q notch filter is formed that provides both the 10 kHz notch and variable high frequency rolloff functions. Typical range of response is shown in Figure 3. Response is controlled by Pin 6 for automatic audio bandwidth control as a function of signal strength.

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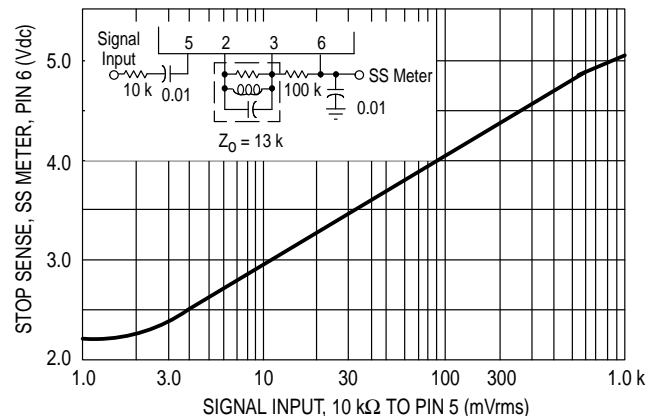
**Figure 2. High Performance Home Type AM Stereo Receiver**



**Figure 3. Overall Selectivity of a Typical Receiver versus Filter Control Voltage**



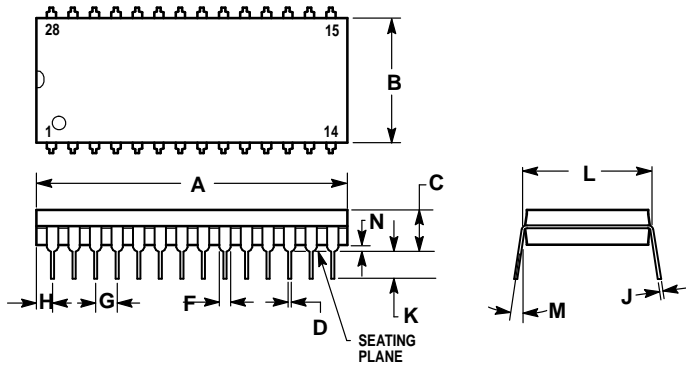
**Figure 4. Strength Output versus Input Signal**



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## OUTLINE DIMENSIONS

### P SUFFIX PLASTIC PACKAGE CASE 710-02 ISSUE B

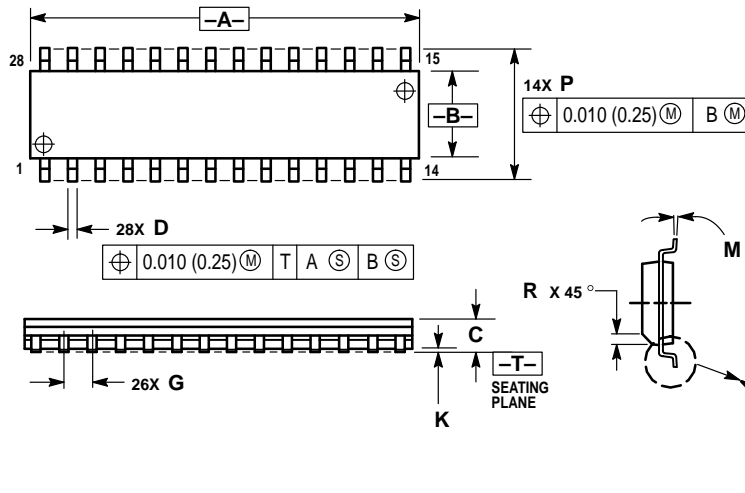


#### NOTES:

1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	36.45	37.21	1.435	1.465
B	13.72	14.22	0.540	0.560
C	3.94	5.08	0.155	0.200
D	0.36	0.56	0.014	0.022
F	1.02	1.52	0.040	0.060
G	2.54	BSC	0.100	BSC
H	1.65	2.16	0.065	0.085
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	15.24	BSC	0.600	BSC
M	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040


### DW SUFFIX PLASTIC PACKAGE CASE 751F-04 (SO-28L) ISSUE E



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	17.80	18.05	0.701	0.711
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27	BSC	0.050	BSC
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.01	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

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**MC13022A/D**

