

# 1.25Gbps Limiting Amplifier MC2046-2/C

Postamplifier/Quantiser for Gigabit Ethernet and Fiber Channel Applications

## Main Features:

- ❑ Low-cost IC, available as die or in QSOP16 and TSSOP20 packages. Fabricated in advanced sub-micron BiCMOS process.
- ❑ Very wide range of operation; suitable for up to 1.5Gbps. 4mV input sensitivity at 1.25Gbps.
- ❑ Pin-compatible, superior replacement for Motorola MC10SX1125
- ❑ Microcosm MC2044C/MC2045-2 Pin-Compatible.
- ❑ Programmable input-signal level detect. (On-chip default, saving external components)
- ❑ Fully differential
- ❑ 3.3 volt operation. (5v supported)
- ❑ CMOS and PECL Link-Status variants.

## Ordering Information

Part Number	Pin Package
MC2046CT20	TSSOP20
MC2046T20	TSSOP20
MC2046Q16	QSOP16
MC2046CQ16	QSOP16
MC2046DIEWP	Waffle Pack
MC2046WAFER	Expanded whole 8" on a 10" grip ring

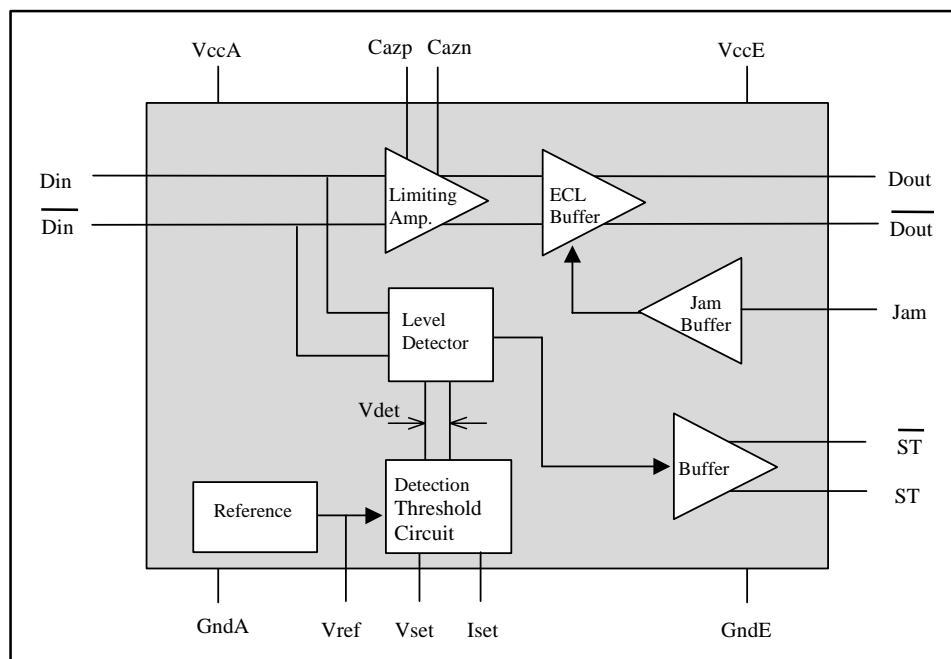
## General Description:

The MC2046-2/C is a 2<sup>nd</sup>-generation, integrated, high gain limiting amplifier intended for high speed fiberoptics based communications. Normally placed following the photodetector and transimpedance or pre-amplifier, the limiting amplifier provides the necessary gain to give PECL compatible logic outputs.

The MC2046-2/C also includes a programmable signal-level detector, allowing the user to set thresholds at which the logic outputs are enabled.

Capable of operating over a very wide frequency range, the MC2046-2 supports most fiberoptic industry standards, but it is especially suited to 1.06Gbps Fiber Channel and 1.25Gbps Ethernet. It is pin and functionally compatible with the Motorola MC10SX1125 and earlier Microcosm Post-amplifiers.

The MC2046-2 die has both PECL and CMOS Status outputs. Packaged, the MC2046-2 has PECL Status outputs and the MC2046-2C has CMOS Status outputs.



## Pin descriptions

TSSOP 20 Or Die Pin No.	QSOP16 Pin No.	Name	Function
1	1	Cazn	Auto-zero capacitor pin. Connect Caz between this pin and Pin2.
2	2	Cazp	See Pin 1
3	-	Iset	May be left unconnected or else may connect resistor for programming threshold detection level – See description of Detection Threshold Circuit.
4	3	GndA	Ground pin for analogue section. Connect to most negative supply. Must be at same potential as GndE.
5	4	Din	Differential Data Input.
6	5	Dinb	Inverse Differential Data Input
7	6	VccA	Supply pin for analogue section. Connect to most positive supply. Must be at the same potential as VccE
8	7	Vref	Test point for on-chip voltage reference. This pin may be left unconnected or else a capacitor may be connected between this pin and the positive supply.
11	8	Jam	ECL and CMOS compatible logic input. When HIGH, data outputs Dout and Doubt are disabled (Dout being held LOW and Doubt being held HIGH).
12	9	STb <sup>1</sup>	Signal detect status output. LOW when input signal level is above detection threshold. This output may be connected to the Jam input pin.
13	10	ST <sup>1</sup>	Signal detect status output. HIGH when input signal level is above detection threshold.
14,15	11	GndE	Ground pin for PECL output stage. Connect to the most negative supply. Must be at the same potential as GndA
16	12	Doubt	PECL compatible differential data output. In phase with input Dinb-Din.
17	13	Dout	PECL compatible differential data output. In phase with input Din-Dinb.
18,19	14	VccE	Supply pin for PECL output stage. Connect to the most positive supply. Must be at the same potential as VccA.
20	16	Vset	Input threshold-level setting circuit. Connect to Analogue Ground via a resistor. See Application diagram. Must be connected to ground even if function not required.

<sup>1</sup>MC2046-2 - ECL outputs are 100k compatible. MC2046-2C - CMOS output levels.

## Absolute maximum ratings

Symbol	Parameter	Rating	Units
Vcc	Power supply (Vcc-Gnd)	6	V
Ta	Operating ambient	-40 to +85	°C
Tstg	Storage temperature	-65 to +150	°C

These are the absolute maximum ratings at or beyond which the IC can be expected to fail or be damaged. Reliable operation at these extremes for any length of time is not implied.

## Recommended operating conditions

Symbol	Parameter	Rating	Units
V <sub>cc</sub>	Power supply (V <sub>cc</sub> -Gnd)	3.0 to 5.5	V
T <sub>a</sub>	Operating ambient	-40 to +85	°C

## DC Electrical Characteristics (over recommended operating conditions)

Symbol	Parameter	Min.	Typ.	Max.	Units	
V <sub>in</sub>	Minimum input signal	Single-ended	-	-	0.002	V <sub>p</sub>
		Differential	-	-	0.004	V <sub>p-p</sub>
	Maximum input signal	Single-ended	1	-	-	V <sub>p</sub>
		Differential	2	-	-	V <sub>p-p</sub>
V <sub>os</sub>	Input offset voltage	-	-	tba	μV	
V <sub>n</sub>	Input RMS noise	-	-	93	μV	
V <sub>th</sub>	Level detect programmability	min	-	-	2	mV <sub>p-p</sub>
		max	100	-	-	mV <sub>p-p</sub>
V <sub>hys</sub>	Level detect hysteresis (optical)	1.75	2.25	2.75	dB	
I <sub>inl</sub>	JAM input current (at 0V)	-10	-	10	μA	
V <sub>OH</sub>	Data output HIGH	-1.051	-	-0.879	V	
V <sub>OL</sub>	Data output LOW	-1.892	-	-1.548	V	
V <sub>OH</sub> -V <sub>OL</sub>	Differential Data output	0.627	-	0.879	V	
I <sub>cc</sub>	Supply current (no ECL loads)	-	-	40	mA	

## AC Electrical Characteristics (over recommended operating conditions)

Symbol	Parameter	Min.	Typ.	Max.	Units
BWL	Lower -3dB frequency	-	-	3	KHz
BWU	Upper -3dB frequency	1000	-	-	MHz
R <sub>in</sub>	Differential input resistance	2.8	-	9.7	kOhms
C <sub>in</sub>	Input capacitance	-	-	2	pF
T <sub>pwd</sub>	Pulse Width Distortion	-	-	30	pS
Tr,Tf	ECL out rise/fall times (20-80% points)	-	200	250	pS
R <sub>az</sub>	Auto-zero output resistance	-	25	-	kOhms
T <sub>ld</sub>	Level detect time constant	0.5	1	2.0	μS

## Microcosm MC2046-2/MC2046-2C/MC2044C compatibility

The MC2046-2/C and MC2044C are pin-compatible and functionally identical, except that the MC2044C has lower internal bandwidth to improve input sensitivity. In all cases, the C suffix indicates CMOS level Link-Status outputs, while the absence of the C indicates PECL levels.

## Signal Path Description

### ***Input biasing***

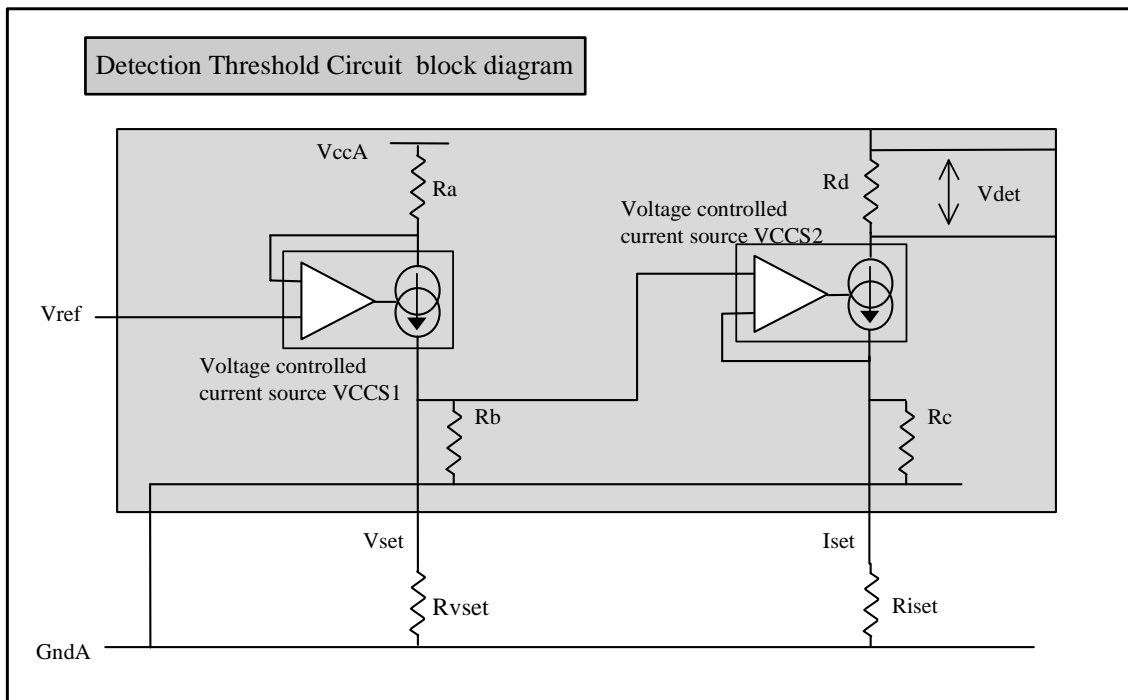
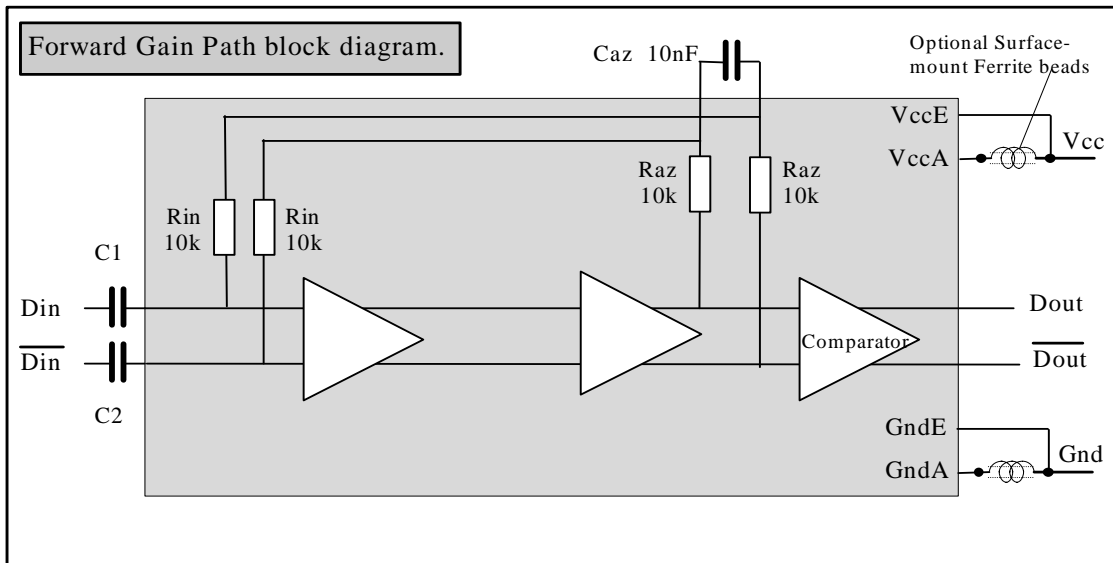
The Data Input pins are internally DC biased at approx.  $V_{ccA} - 1V$ , via the  $R_{in}$  resistors. Although the MC2046-2 can be DC coupled, normally it will be AC coupled, using capacitors C1 & C2. Note that  $R_{in}$  and C1,2 form a filter to low frequencies. The capacitors must therefore be large enough to pass the lowest input frequencies (consecutive '1's or '0's) of interest. For example, setting C1,2 to 10nF will give a typical -3dB point of approx. 10KHz.

### ***Autozero circuit***

The MC2046-2 includes an autozero circuit. In the absence of data, the feedback amplifier and summing circuit cancel the inherent offset voltage of the signal path, keeping the comparator at its toggle point. The time constant of this circuit is set by the combination of  $R_{az}$  and  $C_{az}$ , but is not critical.  $C_{az}$  is normally set to 100nF.

### ***Power supply decoupling & optimising sensitivity***

Generally, a 4-layer board is required to achieve maximum sensitivity. A good layout on a 4+ layer board should mean ferrite suppressors (as shown) are unnecessary. Contact Microcosm for further assistance in this area.



### Level detector

The MC2046-2 provides for programmable input-signal level detection, and this may be used to automatically force the Data Outputs to a known state if the input signal falls below threshold. This is normally used to allow data to propagate only when the signal is above the users' Bit-Error-Rate (BER) requirement. It therefore also stops the data outputs toggling due to noise when no signal is present.

Referring to the block diagram shown on the front page, the Detection Threshold Circuit produces a differential signal "Vdet". The Level Detector compares the input differential peak amplitude with this voltage. The Detection Threshold Circuit is shown here in detail.

$V_{ref}$  is 0.5V below  $V_{ccA}$ .  $R_{vset}$  and  $R_{iset}$  are optional and, if connected, appear in parallel with on-chip resistors  $R_b$  and  $R_c$ , respectively. For the following, let  $R_b'$  be the parallel combination of  $R_b$  and  $R_{vset}$ , and let  $R_c'$  be the parallel combination of  $R_c$  and  $R_{iset}$ .

Voltage controlled current source VCCS1 causes the current through  $R_a$  to be  $0.5V/R_a$ . The voltage at pin Vset is defined by this current and resistance  $R_b$ . This voltage is applied across resistance  $R_c$  by voltage controlled current source VCCS2. The current through  $R_d$  is thus defined and the voltage Vdet is given by:

$$V_{det} = 0.5V \frac{R_b \cdot R_d}{R_a \cdot R_c}$$

The nominal values of the on-chip resistors are

$R_a$	2.8K $\Omega$
$R_b$	5.6K $\Omega$
$R_c$	1.2K $\Omega$
$R_d$	60 $\Omega$

The absolute values of these resistors have uncertainty of +/-20%, however the ratios are well defined.

With neither  $R_{vset}$  nor  $R_{iset}$  connected:

$$\text{Detection Level} = V_{det} = 50\text{mV (i.e. } 50\text{mV diff peak or } 100\text{mV diff peak - peak)}$$

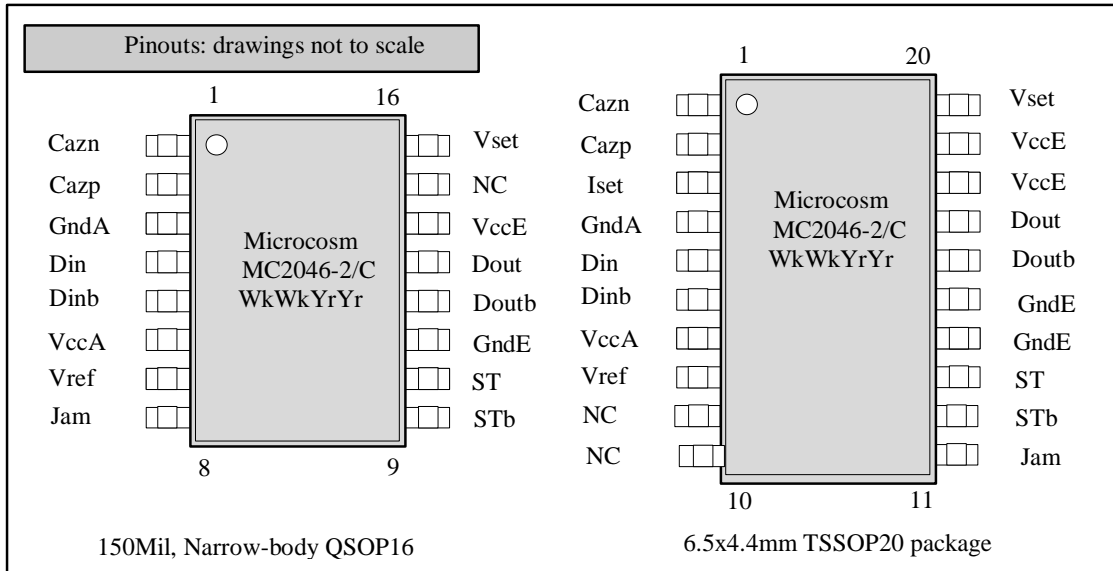
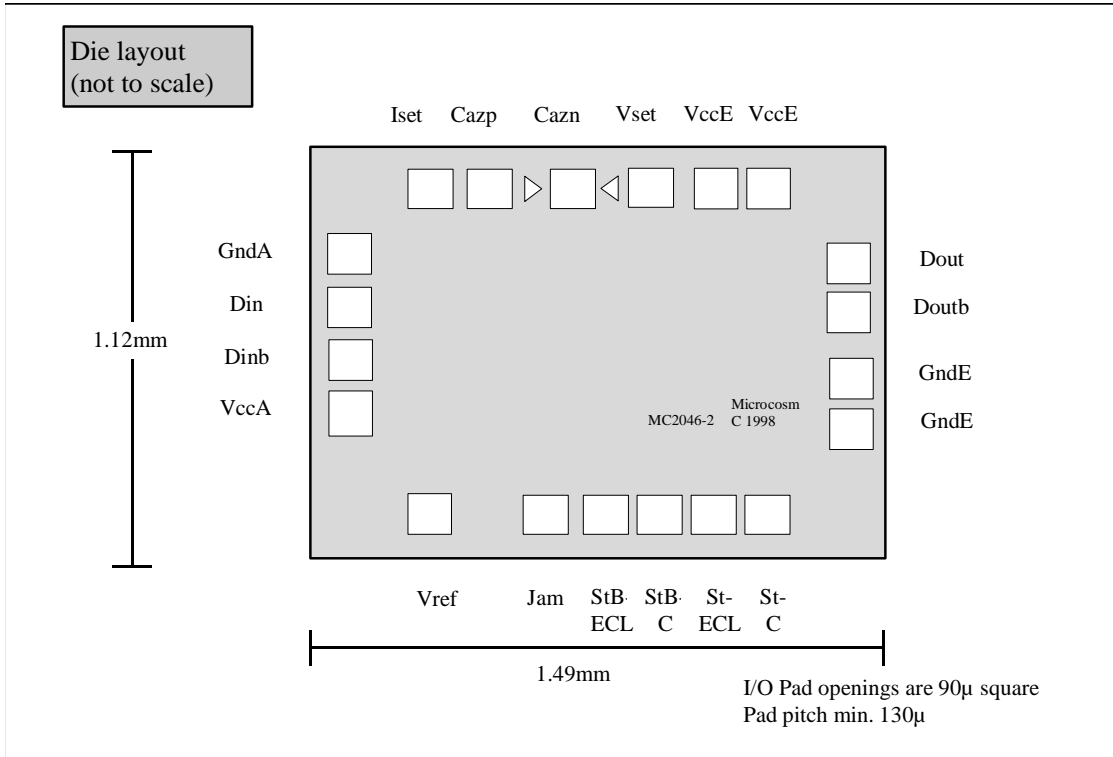
With  $R_{vset}$  resistor connected:

$$\text{Detection Level} = V_{det} = \frac{V(V_{set})}{20} = 0.025V \frac{(R_b // R_{vset})}{R_a} V_{diff \text{ peak}}$$

### ***Application Note on 50 $\Omega$ loads.***

When running PECL outputs into a capacitively coupled 50 $\Omega$  load, 180 $\Omega$  pull-down resistors are recommended.

If higher impedance lines are used to matched to a higher impedance load, then larger pull-down resistors may be used.



This specification is derived from simulation results and tests on engineering samples. These specifications may yet change prior to full product release.

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