

M02046-14/-24

Application Note: Using the M02046-14/-24 to Replace the MC2046-2C/-2 in an Existing 3.3V Design

Revision History

Revision	Date	Description
B	April 2005	Correction: changed Table 3 M0246-x4 VOH_PECL minimum value from $V_{CC}-1.042$ to $V_{CC}-1.115$.

This application note provides recommendations on how to modify the components in an existing design to replace the MC2046-2C or MC2046-2 with the M02046-14 or M02046-24 in the QSOP package.

The M02046-14/-24 limiting amplifier was specifically designed to provide an upgrade to existing MC2046 designs. It has better performance and requires lower supply current. Like the MC2046 the M02046-x4 comes in two versions: one with a CMOS status output and one with a PECL status output. Unlike the MC2046 the M02046-x4 comes with only a CMOS LOS output (which connects to a CMOS compatible Jam input if desired). [Table 1](#) provides the cross-reference information for the M02046-x4 versions.

Table 1. Cross Reference Information

Device	MC2046 Part Number	M02046 Part Number
3.3V Limiting Amplifier with a PECL Status Output (CMOS LOS Output) in QSOP16 Package	MC2046-2Q16	M02046-24
3.3 V Limiting Amplifier with a CMOS Status Output (CMOS LOS Output) in QSOP16 Package	MC2046-2CQ16	M02046-14

Some pin functions of the M02046-x4 differ from the MC2046. However, in an existing layout it should be possible to use the M02046-x4 in place of the MC2046 with only component changes as described in [Table 2](#).

Table 2. Pin Differences Between the MC2046 and the M02046-x4

QSOP Pin #	MC2046 Name	M02046-x4 Name	Replacement Strategy
1	CAZ-	ST _{SET}	Remove capacitor CAZ and connect a 1% resistor between this pin and Pin 2 (V _{CC}) to set loss of signal threshold. This pin does not need to connect to V _{CC} as long as both other V _{CC} pins (pin 7 and pin 14) are connected to V _{CC} .
2	CAZ+	V _{CC}	Remove capacitor CAZ and connect a 1% resistor between this pin and Pin 1 (ST _{SET}) to set loss of signal threshold.
3	GndA	GND	No Difference
4	D _{IN}	DINP	MC2046 Data Inputs are high impedance, M02046-x4 Data Inputs are internally terminated with 50Ω to V _{TT} . Ensure the TIA driving the M02046-x4 can drive 100Ω differential resistance (The MC2009, MC2010 and M02016 TIAs can drive 100Ω differential resistance). If using a filter between the TIA and the Limit Amp, ensure that it is appropriate when terminated in the 100Ω differential input resistance of the M02046-x4.
5	D _{IN}	DINN	
6	V _{CCA}	NC	There is no bond wire to this pin in the M02046-x4. It is acceptable to connect it to 3.3V V _{CC} or to leave floating.
7	V _{REF}	V _{CC}	In typical MC2046 designs, this pin is either resistively or capacitively connected to V _{CC} . For 3.3V M02046-x4 applications the resistor or capacitor must be replaced with a 0Ω resistor to the 3.3V supply.
8	JAM	JAM	No difference. Connect to LOS output to disable outputs with loss of signal. It is not necessary to have a pull-down resistor on the LOS output. Leave floating or tie low to not use this feature.
9	STb	LOS	LOS in the M02046-x4 is CMOS only. STb of the MC2046 may be CMOS(MC2046-2C) or PECL(MC2046-2). To connect LOS to the JAM input, no pull-down resistor is required (if there was a pull down resistor in the existing MC2046 board layout, it needs to be removed).
10	ST	ST	No difference, both parts offer a CMOS or PECL variant for this output. It is assumed the replacement part is a -24 when replacing an MC2046-2 which both have a PECL output so no change in the pull down component is necessary. When using a -14 to replace an MC2046-2C, it is assumed there is no pull down component in the current design, but if a pull down component does exist, it should be removed when using the -14.
11	GndE	GND	No Difference
12	D _{OUTb}	PECLN	No Difference
13	D _{OUT}	PECLP	No Difference
14	V _{CC} E	V _{CC}	No Difference. Power supply. Must be connected to +3.3V.
15	NC	NC	No Difference. No Connect. Leave Floating.
16	V _{SET}	I _{REF}	In typical MC2046 designs, this pin is resistively connected to ground to set the signal detect threshold. In M02046-x4 designs this pin must be connected to ground through a 12.1kΩ 1% resistor.

Figure 1 is the schematic with recommended component values for the M02046-x4. In bold are the component differences from the recommended MC2046 schematic.

Figure 1. M02046-x4 Schematic Emphasizing Component Changes from a MC2046 design

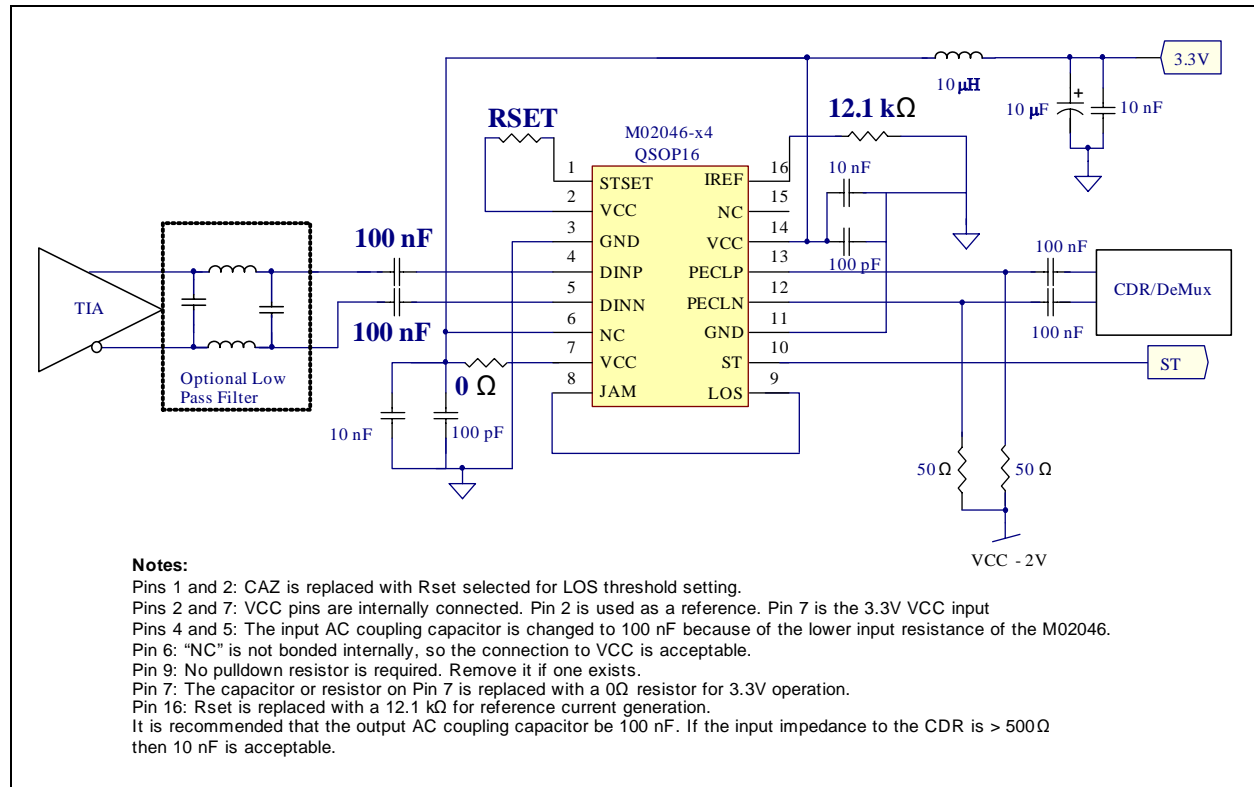


Figure 2. MC2046 Schematic for Comparison with the M02046-x4 Schematic

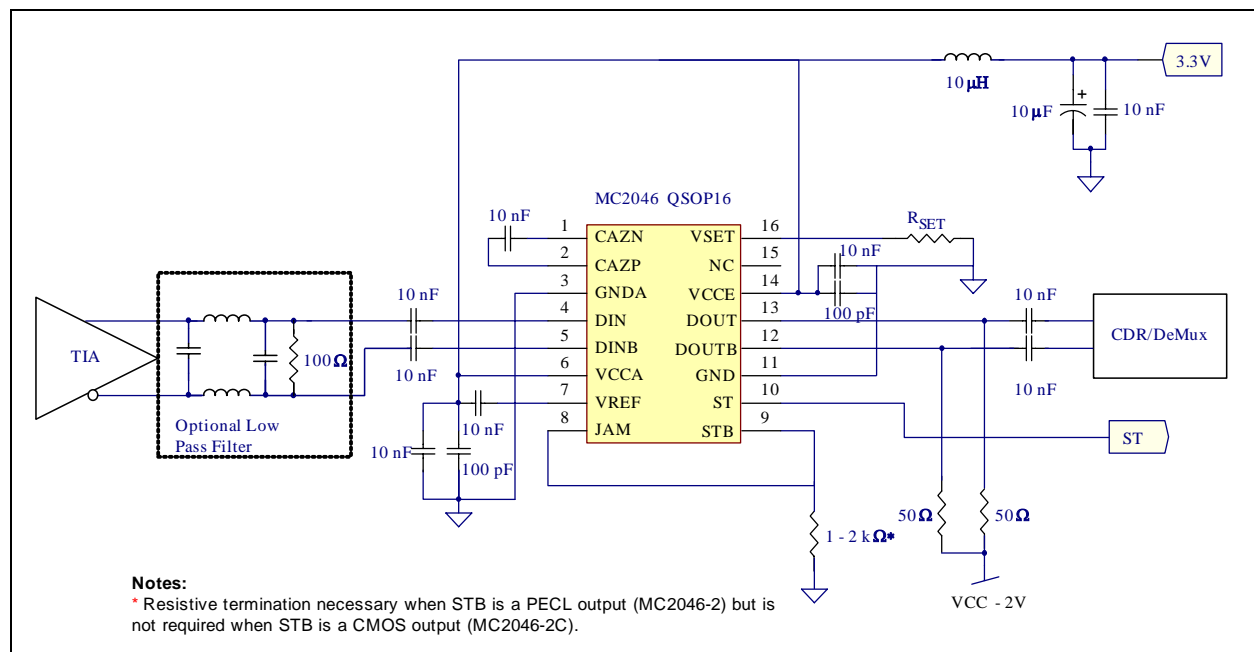


Table 3. Key Specifications of the MC2046 and the M02046-x4

NOTE: This table is for reference only; consult the current M02046 datasheet for confirmation of published M02046-x4 specifications.

Symbol	Parameter	Conditions	MC2046-2/-2C			M02046-x4			Units
			Min	Typ	Max	Min	Typ	Max	
I_{CC}	Supply Current	Includes PECL loads	–	70	–	–	52	TBD	mA
$V_{OUT_{PECL}}$	PECL Data Outputs Low Voltage	Single ended; 50 Ω load to $V_{CC} - 2V$	$V_{CC} - 1.89$	–	$V_{CC} - 1.55$	$V_{CC} - 1.81$	–	$V_{CC} - 1.62$	V
$V_{OUTH_{PECL}}$	PECL Data Outputs High Voltage	Single ended; 50 Ω load to $V_{CC} - 2V$	$V_{CC} - 1.05$	–	$V_{CC} - 0.88$	$V_{CC} - 1.025$	–	$V_{CC} - 0.88$	V
	Differential Input Resistance	Measured between DINP and DINN	2.8 k	–	9.7 k	90	115	135	Ω
V_{OH_PECL}	PECL ST Output Low Voltage ^(2, 3)	Single ended; 50 Ω load to $V_{CC} - 2V$	$V_{CC} - 1.05$	–	$V_{CC} - 0.88$	$V_{CC} - 1.115$	–	$V_{CC} - 0.97$	V
V_{OL_PECL}	PECL ST Output High Voltage ^(2, 3)	Single ended; 50 Ω load to $V_{CC} - 2V$	$V_{CC} - 1.89$	–	$V_{CC} - 1.55$	$V_{CC} - 1.88$	–	$V_{CC} - 1.69$	V
$V_{IN(MIN)}$	Differential Input Sensitivity	1.25 Gbps, BER < 10 ⁻¹²	–	–	4 ⁽¹⁾	–	2.8	5	mV
$V_{I(MAX)}$	Input Overload	differential input, 1.25 Gbps	2000	–	–	1200	–	–	mV
		single-ended input, 1.25 Gbps	1000	–	–	600	–	–	mV
V_{SD}	Signal Detect Programmable Range	Differential inputs ⁽⁴⁾	2	–	100	5	–	75	mV
HYS	Signal Detect Hysteresis	(electrical); across signal detect programmable range	3.5	4.5	5.5	2	3.5	5.5	dB
BW_{LF}	Small-Signal –3dB Low Frequency Cutoff	Excluding AC coupling capacitors	–	NA	–	–	25	–	kHz
DJ	Deterministic Jitter	K28.5 pattern at 1.25 Gbps	–	–	NA	–	–	70 ⁽⁵⁾	ps
RJ	Random Jitter	10 mV _{pp} input	–	NA	–	–	5	–	ps _{RMS}
t_r / t_f	Data Output Rise and Fall Times	20% to 80%; outputs terminated into 50 Ω to $V_{CC} - 2V$; 10 mV _{pp} input	–	200	250	–	150	230	ps
T_{LOS_ON}	Time from LOS state until LOS output is asserted	LOS assert time ⁽⁶⁾	–	–	NA	2.3	–	80	μ s

Table 3. Key Specifications of the MC2046 and the M02046-x4 (Continued)

NOTE: This table is for reference only; consult the current M02046 datasheet for confirmation of published M02046-x4 specifications.

Symbol	Parameter	Conditions	MC2046-2/-2C			M02046-x4			Units
			Min	Typ	Max	Min	Typ	Max	
T _{LOS_OFF}	Time from non-LOS state until LOS is deasserted	LOS deassert time ⁽⁷⁾	–	–	NA	2.3	–	80	μs

Notes:

1. MC2046-2/-2C uses BER < 10⁻¹⁰
2. MC2046 and M02046-24
3. When ST is terminated with a 510Ω resistor to ground, the ST output voltages are approximately the same as for V_{OUTHpecl} and V_{OUTLpecl}
4. M02046 specifies the LOS programmable range
5. Includes DCD
6. After 1 V_{pp} input signal is turned off; signal detect level set to 10 mV
7. After input crosses signal detect level; signal detect set to 10 mV with applied input signal of 20 mV_{pp}

Setting the Signal Detect Level

Using [Figure 3](#), the value for R_{ST} is chosen to set the LOS threshold at the desired value. The resulting hysteresis is also shown in [Figure 3](#).

From [Figure 3](#), it is apparent that small variations in R_{ST} cause significant variation in the LOS threshold level, particularly for low input signal levels. This is because of the logarithmic relationship between the RSSI voltage and the input signal level. It is recommended that a 1% resistor be used for R_{ST} and that allowance is provided for LOS variation, particularly when the LOS threshold is near the sensitivity limit of the M02046-x4.

Example R_{ST} resistor values are given in [Table 4](#).

Table 4. LOS Assert Levels for Various R_{ST} Resistor Values

VIN (mV pp) differential	R _{ST} (kΩ)
5.0	7.50
10.3	6.98
19.4	6.49
32.6	6.04
45.8	5.76

Figure 3. Loss of Signal Characteristic (Extended Range)

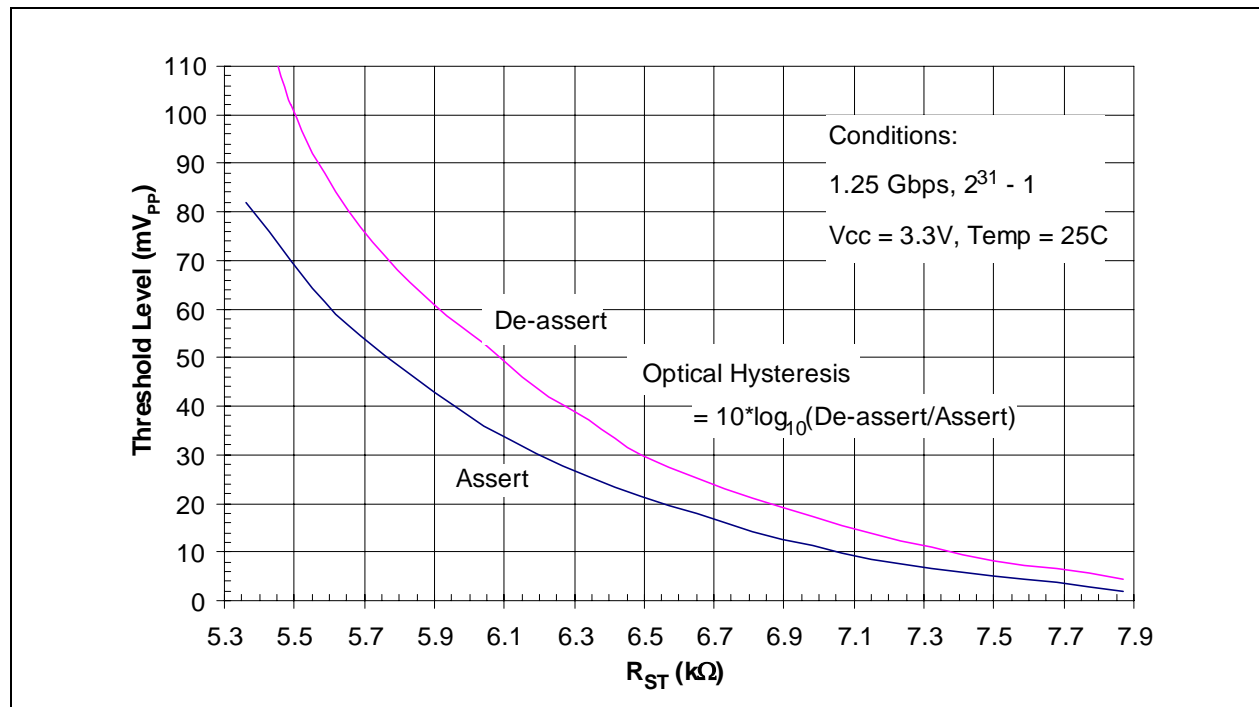


Figure 4. Loss of Signal Characteristic (Low Input Signal)

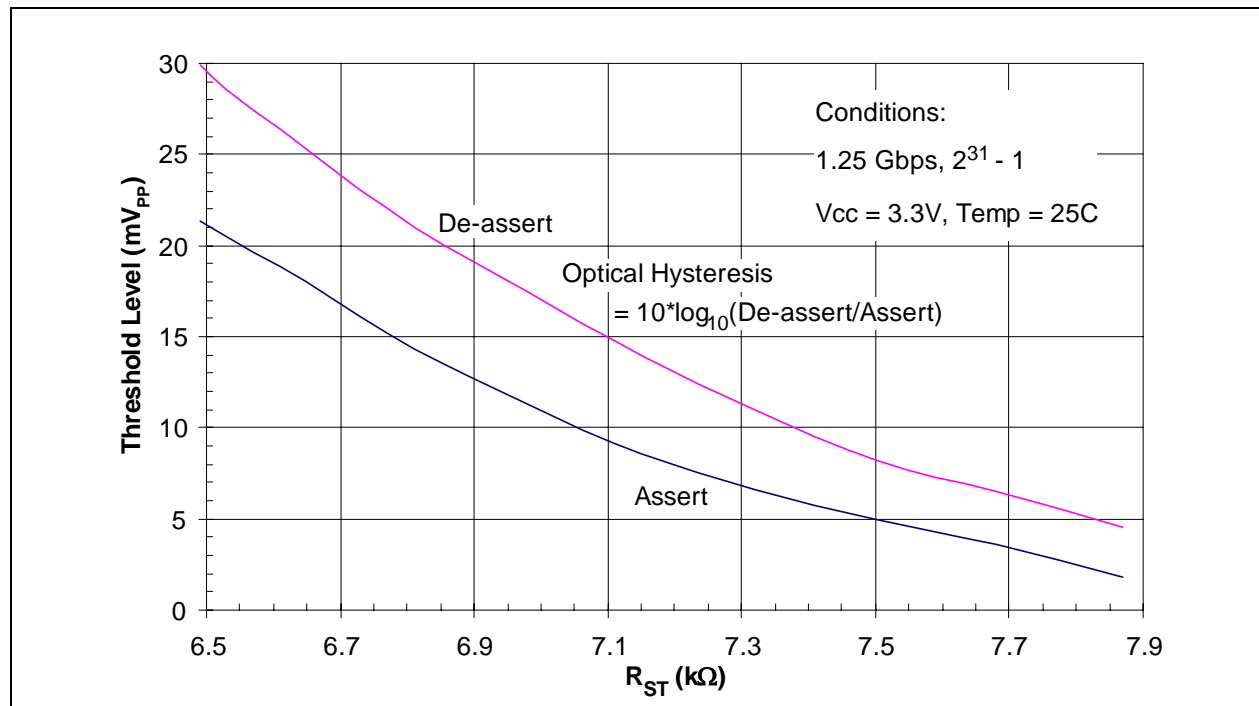


Figure 5. Loss of Signal Characteristic (High Input Level)

