MINDSPEED™

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# 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 |

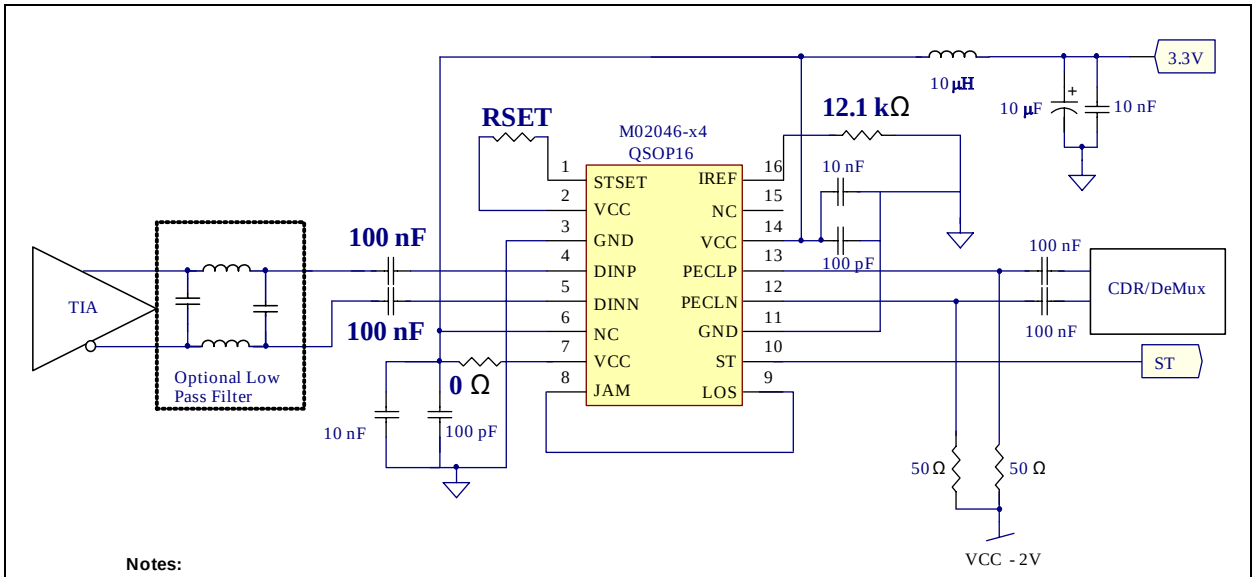
Some pin functions of the M02046-x4 differ from the MC2046. However, in an existing layout it should be possible to use the M02046-x4 in place of the MC2046 with only component changes as described in Table 2.

***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 | $V_{CC}A$ | 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 | $D_{OUT}b$ | 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. |

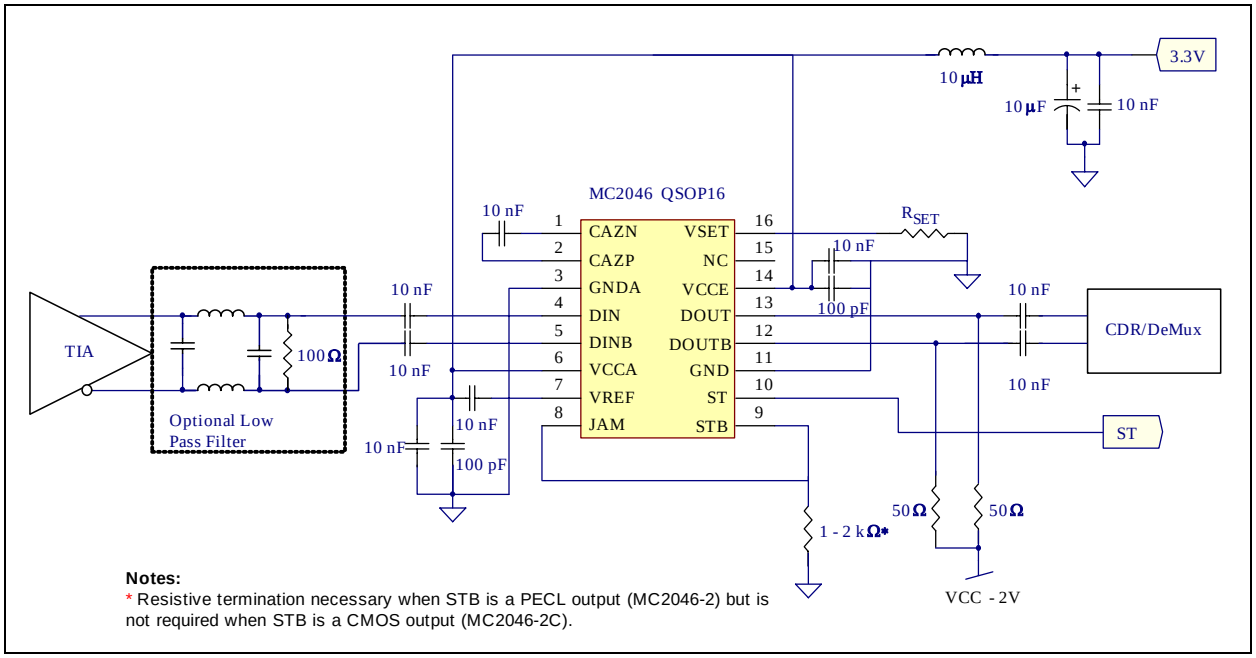
Figure 1 is the schematic with recommended component values for the M02046-x4. In bold are the component differences from the recommended MC2046 schematic.

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




**Notes:**
Pins 1 and 2: CAZ is replaced with Rset selected for LOS threshold setting.
Pins 2 and 7: VCC pins are internally connected. Pin 2 is used as a reference. Pin 7 is the 3.3V VCC input
Pins 4 and 5: The input AC coupling capacitor is changed to 100 nF because of the lower input resistance of the M02046.
Pin 6: "NC" is not bonded internally, so the connection to VCC is acceptable.
Pin 9: No pulldown resistor is required. Remove it if one exists.
Pin 7: The capacitor or resistor on Pin 7 is replaced with a 0Ω resistor for 3.3V operation.
Pin 16: Rset is replaced with a 12.1 kΩ for reference current generation.
It is recommended that the output AC coupling capacitor be 100 nF. If the input impedance to the CDR is > 500Ω then 10 nF is acceptable.

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




**Notes:**
* Resistive termination necessary when STB is a PECL output (MC2046-2) but is not required when STB is a CMOS output (MC2046-2C).

***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 |
| $V_{OUTLpecl}$ | PECL Data Outputs Low Voltage | Single ended; 50Ω load to $V_{CC}$ - 2V | $V_{CC}$- 1.89 | – | $V_{CC}$- 1.55 | $V_{CC}$- 1.81 | – | $V_{CC}$- 1.62 | V |
| $V_{OUTHpecl}$ | PECL Data Outputs High Voltage | Single ended; 50Ω 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; 50Ω 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; 50Ω 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 50Ω 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 | µs |

***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)***

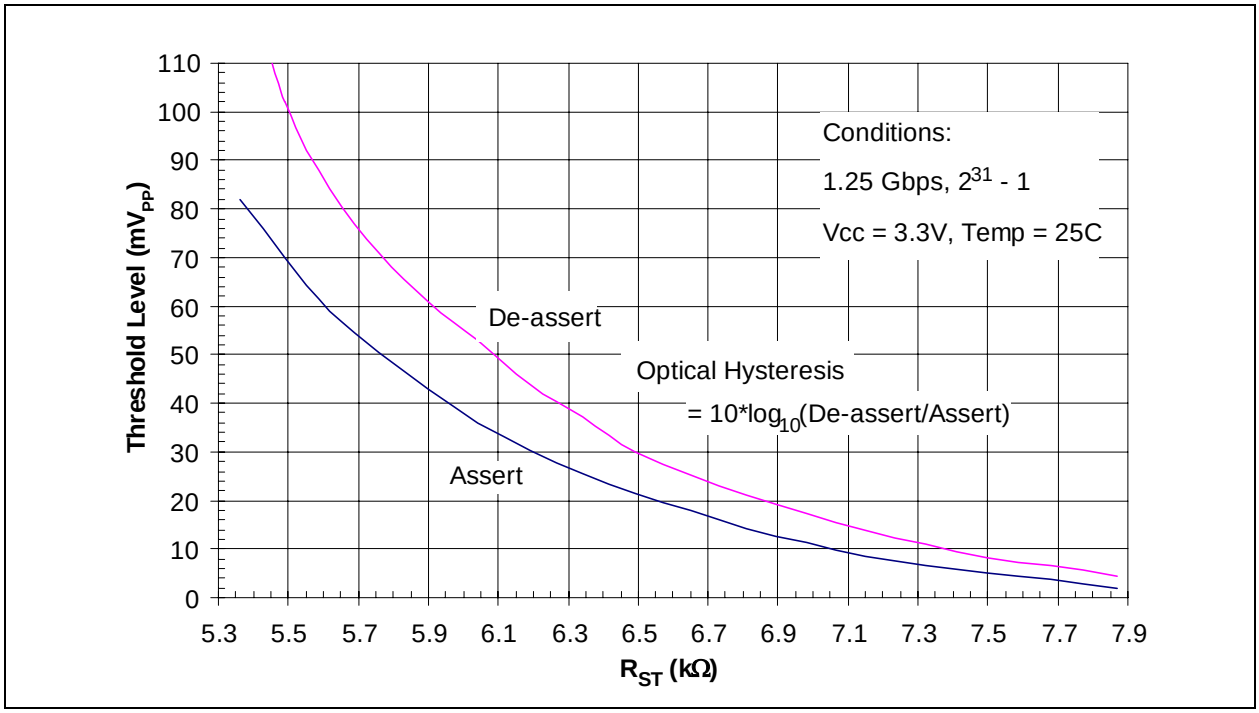



***Figure 4. Loss of Signal Characteristic (Low Input Signal)***

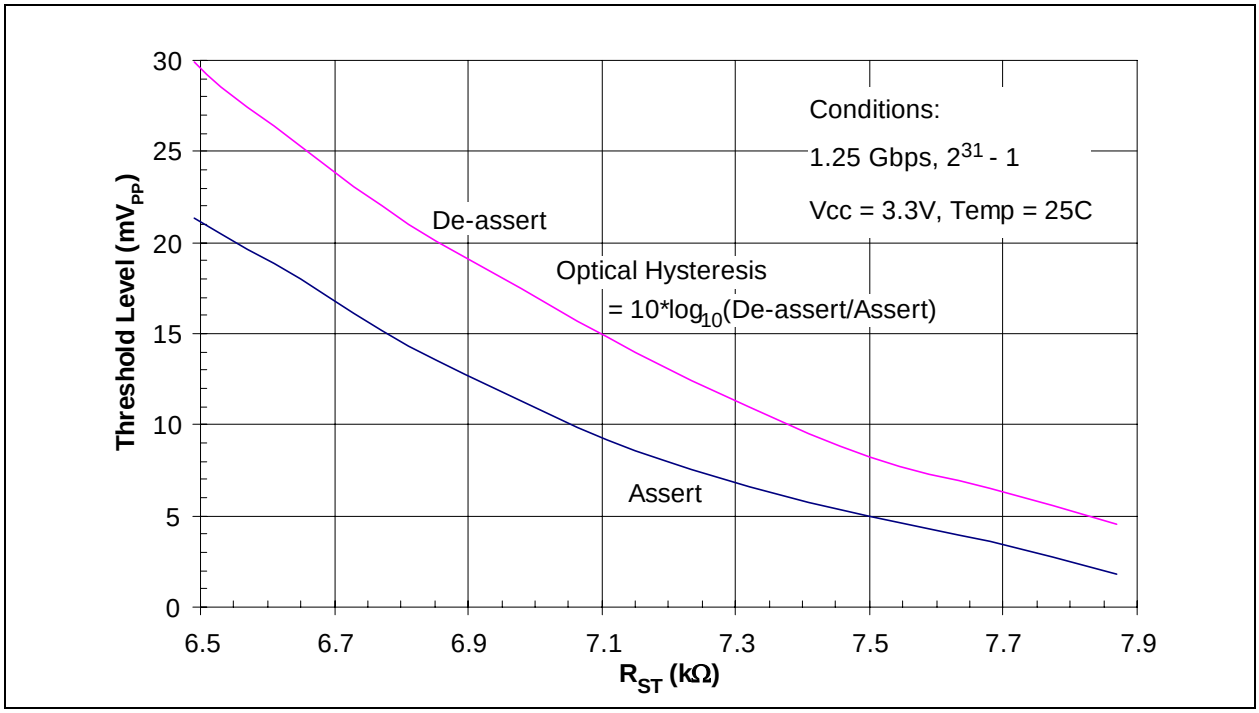


***Figure 5. Loss of Signal Characteristic (High Input Level)***