

---

## EQCO30R5.D 3G/HD-SDI Video Cable Equalizer

---

### Features

- Supports up to 140 Meters of Cable at 2.97 Gbps Using High-Quality Coax
- Supports up to 200 Meters of Cable at 1.485 Gbps Using High-Quality Coax
- Supports up to 450 Meters of Cable at 270 Mbps Using High-Quality Coax
- Compatible with all SMPTE3G SDI Data Rates:
  - SMPTE259M SDI, 143 to 360 Mbps
  - SMPTE344M, 540 Mbps
  - SMPTE292M HD-SDI, 1.485 Gbps
  - SMPTE372M Dual-Link HD-SDI, 2.97 Gbps
  - SMPTE424M Dual-Speed 3G-SDI, 2.97 Gbps
- Pin Compatible with Gennum and National Semiconductor Parts
- Also Operates with 8B/10B Coding
- Single 3.3V Supply.
- Low Power Consumption (181 mW)
- Better Robustness Due to Transmit Amplitude Independent Operation
- 16-Pin, 0.65 mm Pin Pitch, 4 mm QFN Package
- -40°C to +85°C Industrial Temperature Range
- Pb-Free and RoHS Compliant

### Applications

- High Definition, High Frame Rate Pro-Video HD-SDI Frame Store
- Surveillance, Industrial/Inspection, Medical Video Inputs
- HDcctv Applications

### Introduction

The EQCO30R5 is a video equalizer for 3G/HD/SD-SDI video, with speeds up to 2.97 Gbps. It is designed to be a direct replacement for competing video equalizers. In addition to downlink functionality from camera to frame grabber, it can also transmit a 5 Mbps uplink signal from the frame grabber to the camera. Additionally, power can be provided over the same cable using the same chip and a few external components. If 8b/10b encoding is used, the device can operate up to 3.125 Gbps.

**Note:** The EQCO30R5 video equalizer can be used in combination with the EQCO30T5 cable driver. This device is capable of receiving the uplink signal whilst other key parameters remain compliant to SMPTE specifications. Please refer to the Microchip website ([www.microchip.com](http://www.microchip.com)) for the EQCO30T5 data sheet.

# EQCO30R5.D

## Typical Link Performance

Table 1, Table 2, and Table 3 give an overview of video equalizer typical performance at room temperature without using the uplink and without providing power over the same coax. When providing power or using the uplink communication to the camera, a small length penalty may arise (in cable length, typically 10%) due to added parasitics and noise. The uplink operates to at least 400m at the 5 Mbps bit rate.

**TABLE 1: BELDEN TYPICAL EQUALIZATION PERFORMANCE**

|            | Name | Belden 7731A  | Belden 1694A      | Belden 1505A    | Belden 1505F | Belden 1855A   |
|------------|------|---------------|-------------------|-----------------|--------------|----------------|
|            | Type | Long Distance | Industry Standard | Compromise Coax | Flexible     | Thinnest Cable |
| Diameter   | (mm) | 10.3          | 6.99              | 5.94            | 6.15         | 4.03           |
| 270 Mbps   | (m)  | 718           | 469               | 384             | 302          | 270            |
| 1.485 Gbps | (m)  | 332           | 223               | 187             | 136          | 132            |
| 2.97 Gbps  | (m)  | 219           | 149               | 128             | 89           | 91             |

**TABLE 2: GEPKO TYPICAL EQUALIZATION PERFORMANCE**

|            | Name | Gepco VHD1100 | Gepco VSD2001     | Gepco VPM2000   | Gepco VHD2000M | Gepco VDM230   |
|------------|------|---------------|-------------------|-----------------|----------------|----------------|
|            | Type | Long Distance | Industry Standard | Compromise Coax | Flexible       | Thinnest Cable |
| Diameter   | (mm) | 10.3          | 6.91              | 6.15            | 6.15           | 4.16           |
| 270 Mbps   | (m)  | 772           | 502               | 387             | 305            | 273            |
| 1.485 Gbps | (m)  | 372           | 241               | 187             | 138            | 133            |
| 2.97 Gbps  | (m)  | 252           | 163               | 128             | 91             | 92             |

**TABLE 3: CANARE TYPICAL EQUALIZATION PERFORMANCE**

|            | Name | Canare L-7CFB | Canare L-5CFB     | Canare L-4CFB   | Canare L-3CFB | Canare L-2.5CFB |
|------------|------|---------------|-------------------|-----------------|---------------|-----------------|
|            | Type | Long Distance | Industry Standard | Compromise Coax | Thin Cable    | Thinnest Cable  |
| Diameter   | (mm) | 10.3          | 6.99              | 5.94            | 6.15          | 4.03            |
| 270 Mbps   | (m)  | 615           | 434               | 344             | 287           | 223             |
| 1.485 Gbps | (m)  | 281           | 201               | 161             | 135           | 109             |
| 2.97 Gbps  | (m)  | 182           | 132               | 107             | 90            | 73              |

Table of Contents

1.0 Device Overview ..... 4

2.0 Application Information ..... 8

3.0 Electrical Characteristics ..... 12

4.0 Packaging ..... 14

TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation possible to ensure successful use of your Microchip products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Communications Department via E-mail at [docerrors@microchip.com](mailto:docerrors@microchip.com) or fax the **Reader Response Form** in the back of this data sheet to (480) 792-4150. We welcome your feedback.

Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Worldwide Website at:

<http://www.microchip.com>

You can determine the version of a data sheet by examining its literature number found on the bottom outside corner of any page. The last character of the literature number is the version number, (e.g., DS30000A is version A of document DS30000).

Errata

An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

To determine if an errata sheet exists for a particular device, please check with one of the following:

- Microchip's Worldwide Website; <http://www.microchip.com>
- Your local Microchip sales office (see last page)

When contacting a sales office, please specify which device, revision of silicon and data sheet (include literature number) you are using.

Customer Notification System

Register on our website at [www.microchip.com](http://www.microchip.com) to receive the most current information on all of our products.

# EQCO30R5.D

## 1.0 DEVICE OVERVIEW

The EQCO30R5 is a multi-rate adaptive cable equalizer, designed to restore signals received over coaxial cable. The EQCO30R5 chip is optimized for SMPTE HD/SDI signals, but works equally well with 8B/10B coded signals. The device operates from a single 3.3V power supply.

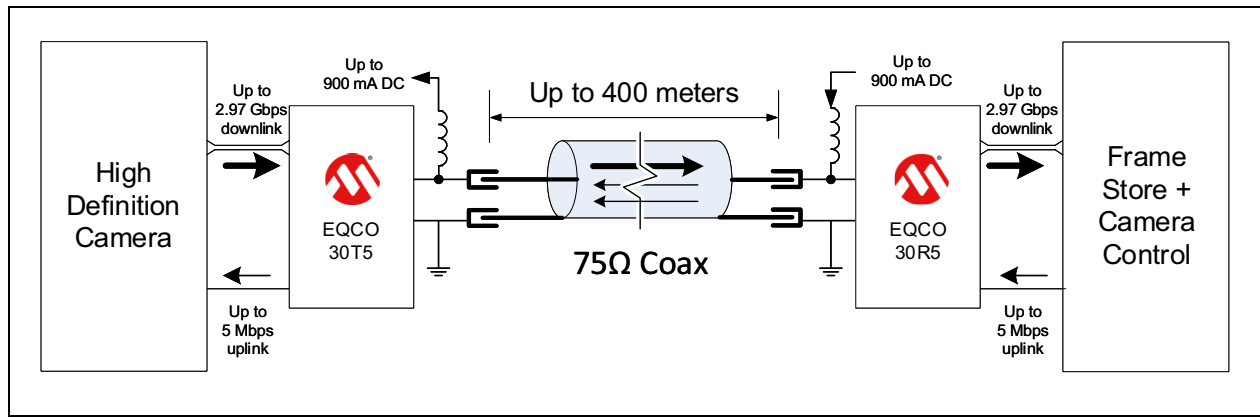
The EQCO30T5 is a cable driver that matches to the EQCO30R5, since it can receive the uplink signal. Implementing the uplink requires very few additional components on both sides of the link and complies with SMPTE specifications. The EQCO30T5 data sheet is available separately from Microchip.

The EQCO30R5 has a DC restore circuit to recover SMPTE pathological patterns in the data stream. The EQCO30R5 has a variable gain to compensate for low-frequency attenuation through the coax and variations in transmit amplitude.

Figure 1-1 shows a typical communication link using the EQCO30T5 and EQCO30R5 chips.

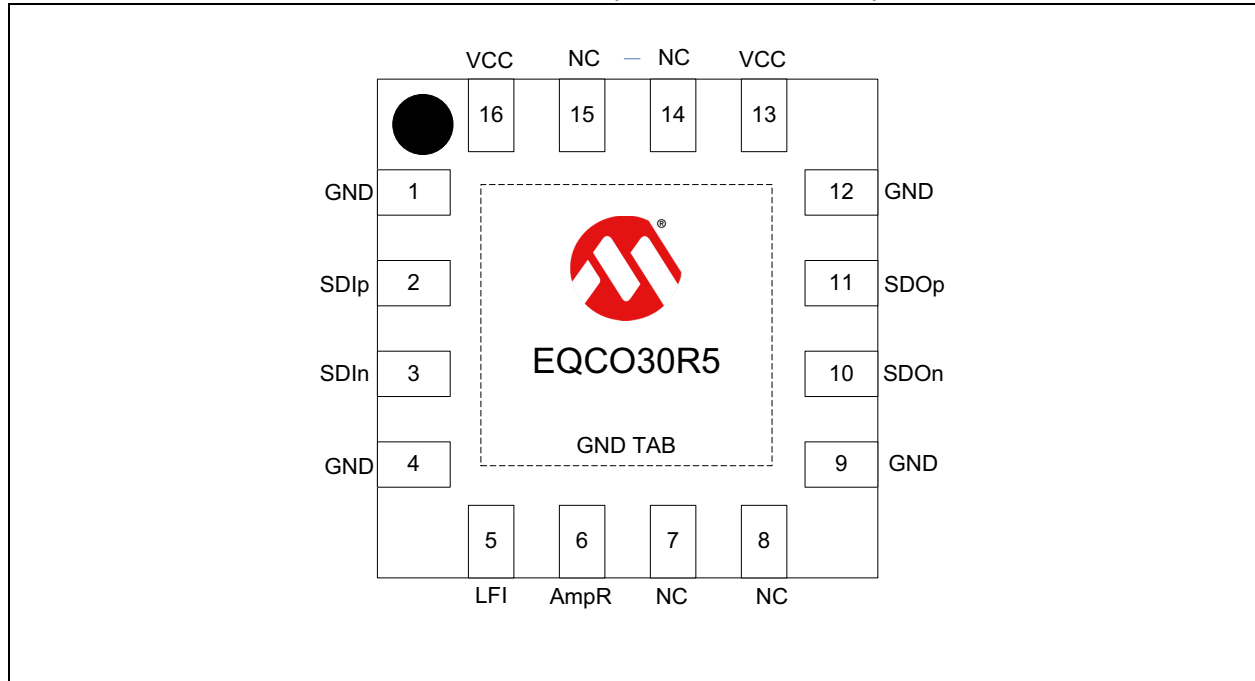
**Note:** Email address: eqcoproducts@microchip.com

**FIGURE 1-1: TYPICAL EQCO30R5 SETUP**



## 1.1 Pinout and Pin Description

**FIGURE 1-2: EQCO30R5.D PIN DIAGRAM (VIEWED FROM TOP)**



**TABLE 1-1: EQCO30R5.D PIN DESCRIPTIONS**

| Pin Number  | Pin Name   | Signal Type | Description                                                                                                                                                              |
|-------------|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (TAB)       | GND        | Power       | Use as single-point ground.                                                                                                                                              |
| 13, 16      | VCC        | Power       | +3.3V of power supply.                                                                                                                                                   |
| 1, 4, 9, 12 | GND        | Power       | Connect to ground of power supply.                                                                                                                                       |
| 2, 3        | SDIp, SDIn | CML Input   | Serial input positive/negative differential serial input. Connect SDIn to ground reference via termination network. External 75Ω resistors are required.                 |
| 11, 10      | SDOp/SDOn  | CML Output  | Serial output positive/negative differential serial output. Output has a swing of 2x370 mV and has 50Ω on-chip termination resistors to internal V <sub>DD</sub> (1.2V). |
| 5           | LFI        | Input       | Uplink signal. (Low = 0V, High = 1.2V). When driving from 3.3V, an external series resistance of 6.2 kΩ is required.                                                     |
| 6           | AmpR       | Input       | Connect to ground with a 1 kΩ resistor, defining the uplink amplitude to 150 mV.                                                                                         |
| 7           | NC         | Input       | Do not connect. Used for internal testing.                                                                                                                               |
| 8           | NC         | Input       | Do not connect. Used for internal testing.                                                                                                                               |
| 14          | NC         | Input       | Do not connect. Used for internal testing.                                                                                                                               |
| 15          | NC         | Input       | Do not connect. Used for internal testing.                                                                                                                               |

# EQCO30R5.D

## 1.1.1 SDIp/SDIn

SDIp/SDIn together form a differential input pair. The EQCO30R5 analyzes the differential voltage between these pins and adaptively equalizes for signal level and frequency response. The equalizer automatically detects and adapts to signals with different edge rates, different attenuation levels and different cable characteristics. Both SDIp and SDIn inputs need to be terminated by an external 75Ω resistor to GND.

## 1.1.2 SDOp/SDOn

SDOp/SDOn together form a differential CML pair outputting the reconstructed far-end transmit signal. SDOp/SDOn are terminated on-chip with two 50Ω resistors to 1.2V. These outputs should be AC coupled to the deserializer (unless a 800 mV-1V common-mode voltage is acceptable). For SMPTE signals, it is best to use 4.7 μF AC coupling capacitors.

## 1.1.3 LFI

LFI is the uplink input signal that will be transmitted on the SDIp/SDIn pair. LFI must be a 0-1.2V signal. The pin has an internal resistor of 3.6 kΩ. When driving with a 3.3V (2.5V) signal, an external resistor of 6.2 kΩ (3.9 kΩ) should be placed in series close to the EQCO30R5 chip. When not using uplink communications, leave this pin floating.

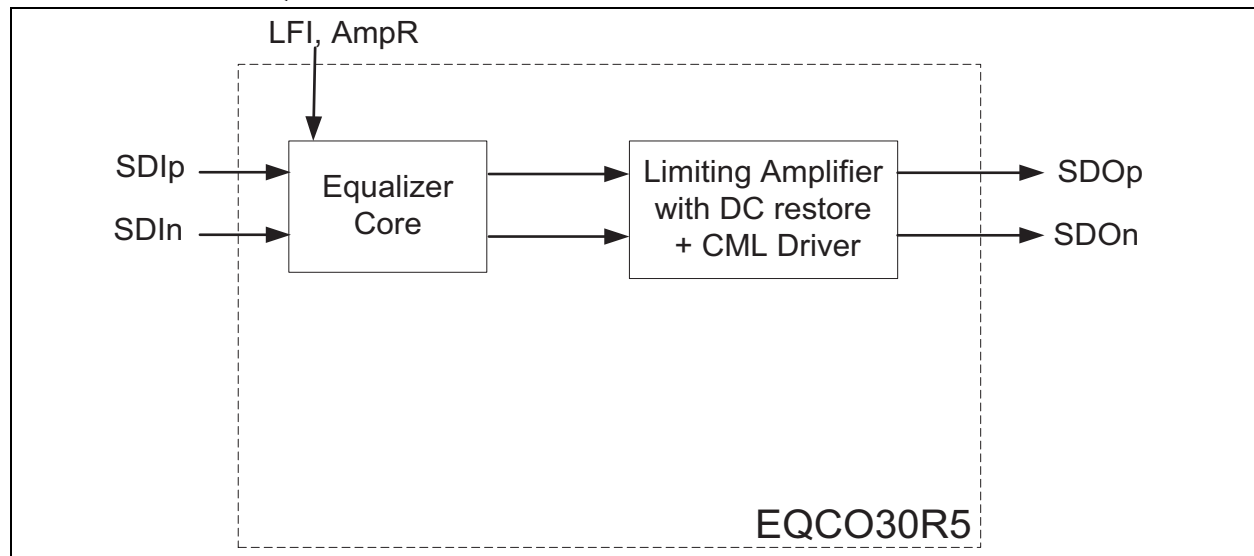
When the downlink signal is 8b/10b coded, the uplink signal can be 8b/10b at 5 Mbps. When the downlink signal is a SMPTE signal, the uplink signal cannot be 5 Mbps but needs to be a lower speed signal modulated to a 5 Mbps. See application note “AN1837 HD-SDI Repeater Reference Design” for more information on modulation. This application note is made available under NDA.

## 1.1.4 AmpR

AmpR is a VCC resistor that sets the transmit amplitude of the uplink output driver. The typical value is  $R_{amp} = 1\text{ k}\Omega$  for 150 mV transmit amplitude. When not using uplink communications, leave this pin floating.

## 1.2 Circuit Operation

**FIGURE 1-3: EQCO30R5.D BLOCK DIAGRAM SHOWING ELECTRICAL CONNECTIONS**



### 1.2.1 EQUALIZER CORE

The EQCO30R5 has an embedded equalizer in the receive path with the following characteristics:

- Auto-Adaptive

The equalizer controls a multiple-pole analog filter which compensates for attenuation of the cable, as illustrated in [Figure 1-4](#). The filter frequency response needed to restore the signal is automatically determined by the device using a time-continuous feedback loop that measures the frequency components in the signal. Upon the detection of a valid signal, the control loop converges within a few microseconds.

- Variable Gain

The EQCO30R5 equalizer has variable gain to compensate for low-frequency attenuation through the coax and variations in transmit amplitude; this makes the equalizer performance more robust, even at maximum cable lengths.

- Variable Coax

The equalizer can receive attenuated signals from other types of cables besides the Belden1694A.

- Multi-Speed

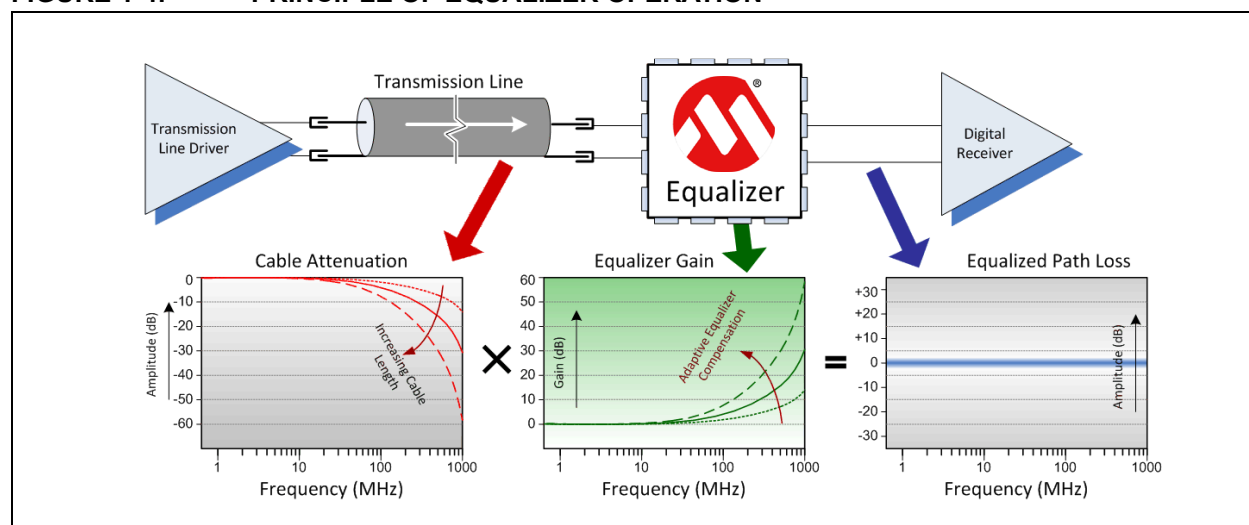
The EQCO30R5 works at data rates from 143 Mbps to 2.97 Gbps. With 8B/10B coding, the allowable bit rate is extended from 50 Mbps to 3.125 Gbps.

Example equalizer performance measurements can be found in [Appendix B: "Typical Equalizer Characteristics"](#).

## 1.2.2 RX OUTPUT DRIVER

The output driver converts the output of the equalizer core to an LVDS-like signal and sends it onto a 100Ω differential transmission line.

**FIGURE 1-4: PRINCIPLE OF EQUALIZER OPERATION**



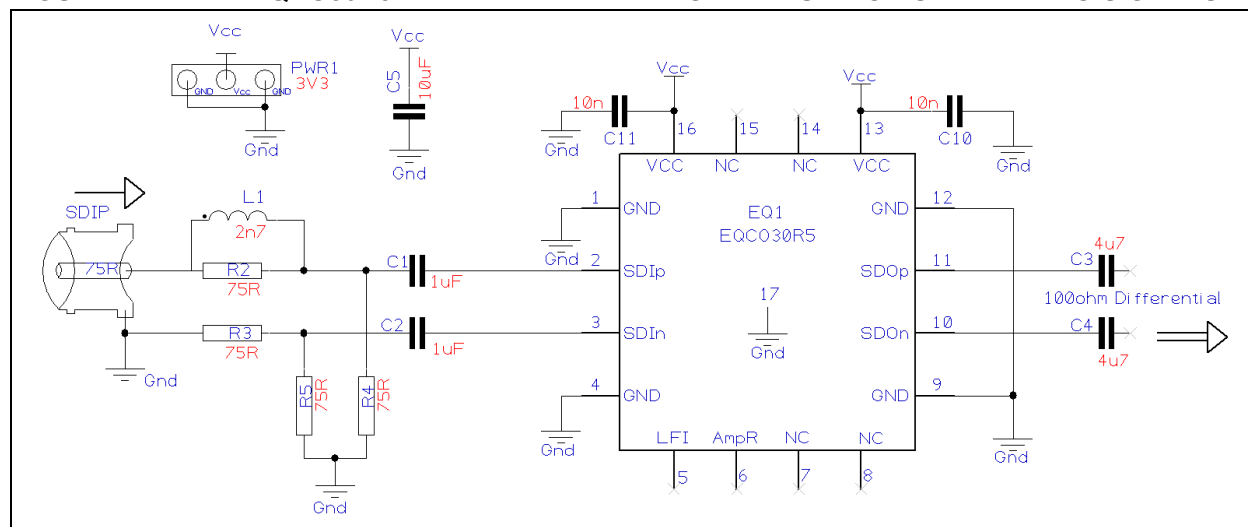
# EQCO30R5.D

## 2.0 APPLICATION INFORMATION

### 2.1 Typical Application Circuit for SMPTE Video Signals

Figure 2-1 illustrates a typical schematic implementation of the EQCO30R5 used as an equalizer for SMPTE video signals.

**FIGURE 2-1: EQCO30R5.D TYPICAL APPLICATION CIRCUIT FOR SMPTE VIDEO SIGNALS**



#### 2.1.1 RETURN-LOSS NETWORK

For optimal return-loss, an external return-loss network is needed. The value of R2 is 75Ω, and the value of L1 is 2.7 nH.

**TABLE 2-1: COMPONENT RECOMMENDATION FOR THE EQCO30R5.D BOARD LAYOUT FOR SMPTE VIDEO SIGNALS**

| Element        | Value   | Size | Recommended Component |
|----------------|---------|------|-----------------------|
| R2, R3, R4, R5 | 75Ω ±1% | 0402 |                       |
| L1             | 2.7 nH  | 0402 |                       |

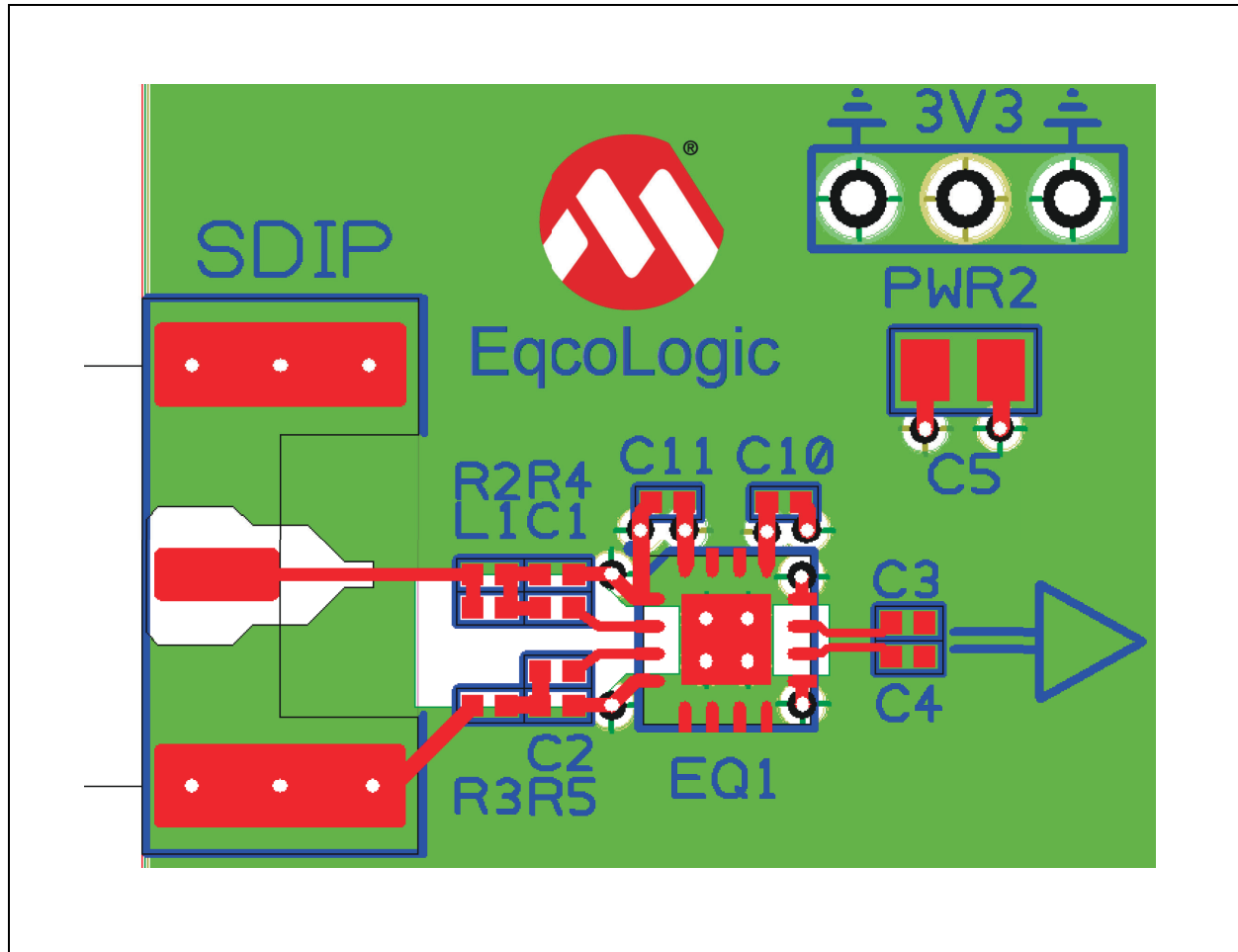
#### 2.1.2 GUIDELINES FOR PCB LAYOUT

All components in the high-speed signal path should be 0402 size for minimal parasitic effects.

The transmission line between the BNC connector and the return-loss network (L1, R2) shall be a 75Ω single-ended transmission line. Components R2, R4 and R5 are 75Ω resistors, and component L1 is a 2.7 nH inductor. Component R3 is the 75Ω termination resistor to GND. Components C1 and C2 are AC coupling capacitors connected to the input of the chip. Two decoupling capacitors (C10, C11) are placed between VCC and GND, close to the chip. The output of the chip is connected to the deserializer or FPGA with a 100Ω differential transmission line. To minimize unwanted parasitic effects, a cutout of the ground and power plane is made underneath capacitor C6 and underneath the input pins of the EQCO30R5 chip.

Figure 2-2 shows a recommended layout for the EQCO30R5 implementation.

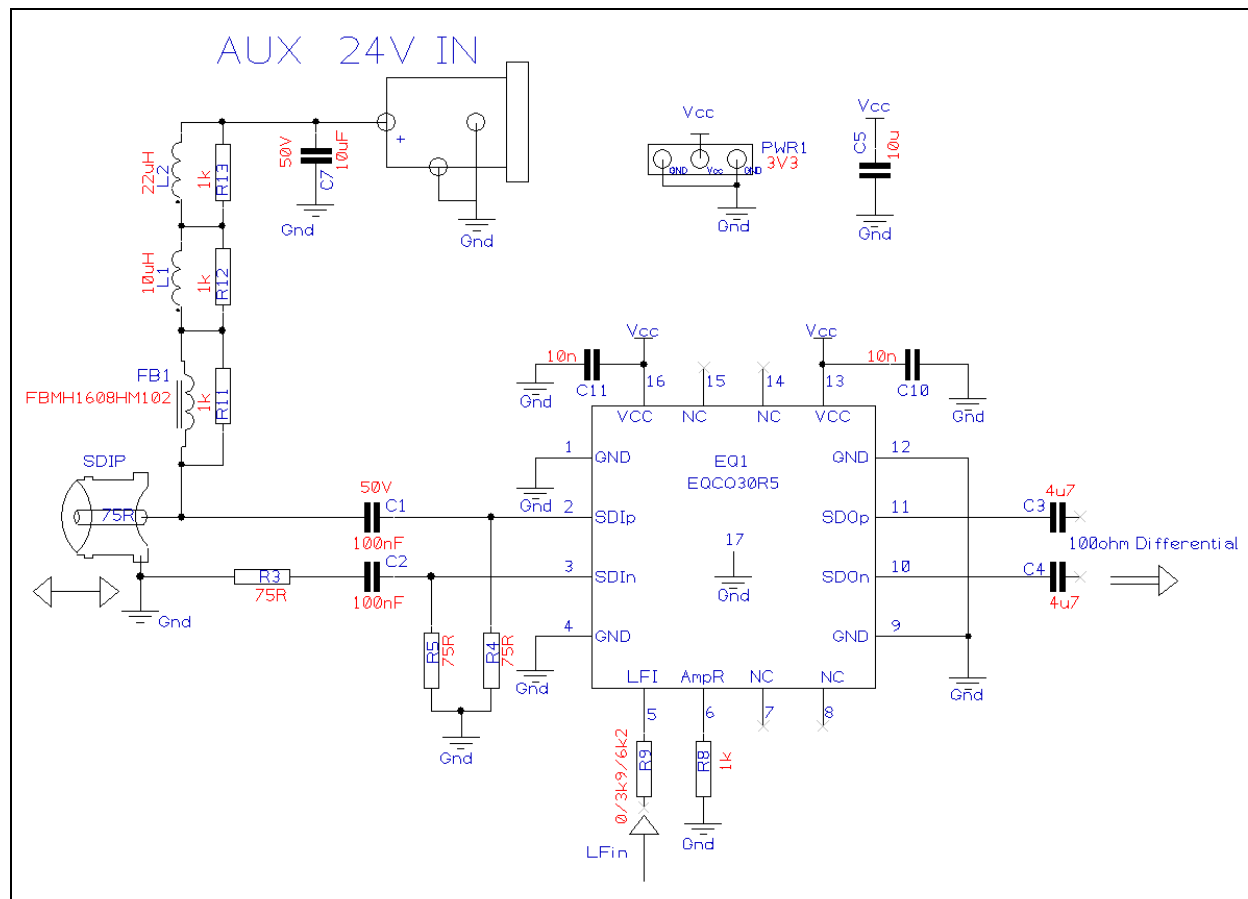
FIGURE 2-2: RECOMMENDED PCB LAYOUT FOR EQCO30R5



# EQCO30R5.D

## 2.2 Typical Application Circuit for Bidirectional Link with Power Over Coax

**FIGURE 2-3: EQCO30R5.D TYPICAL APPLICATION CIRCUIT FOR BIDIRECTIONAL LINK WITH POWER OVER COAX**



**TABLE 2-2: COMPONENT RECOMMENDATION FOR THE EQCO30R5.D BOARD LAYOUT**

| Element  | Value                       | Size | Recommended Component          |
|----------|-----------------------------|------|--------------------------------|
| Fb1, Fb2 | 1 kΩ @ 100 MHz Ferrite Bead | 0603 | FBMH1608HM102 from Taiyo Yuden |
| L1       | 10 μH                       | 1812 | 1812PS_103 from Coilcraft      |

### 2.2.1 BIDIRECTIONAL LINK IN SMPTE APPLICATIONS

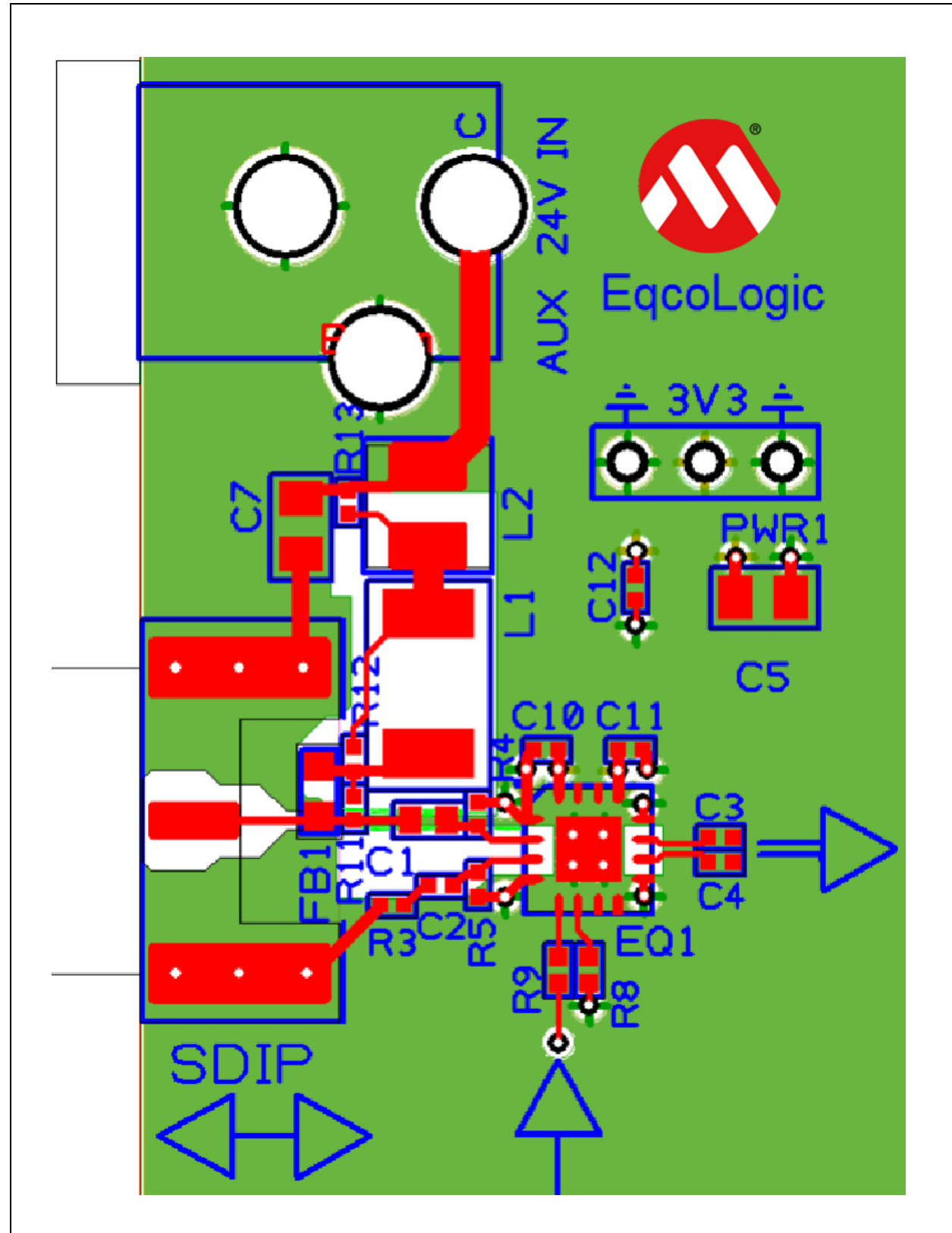
When using the bidirectional link with power supply transmission, the components (FB1, L1 and L2) and layout are very critical. Changes in the design or components may result in decreased performance.

### 2.2.2 PCB LAYOUT

All components in the high-speed signal path should be 0402 size for minimal parasitic effects.

Figure 2-4 shows a recommended layout for the EQCO30R5 with uplink and power over coax.

FIGURE 2-4: RECOMMENDED PCB LAYOUT FOR EQCO30R5 IN BIDIRECTIONAL LINK



## 3.0 ELECTRICAL CHARACTERISTICS

### 3.1 Absolute Maximum Ratings

Stresses beyond those listed under this section may cause permanent damage to the device. These are stress ratings only and are not tested. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**TABLE 3-1: ABSOLUTE MAXIMUM RATINGS**

| Parameter                | Conditions                                       | Min. | Typ. | Max. | Units |
|--------------------------|--------------------------------------------------|------|------|------|-------|
| Storage Temperature      | —                                                | -65  | —    | +150 | °C    |
| Ambient Temperature      | Power applied                                    | -55  | —    | +125 | °C    |
| Operating Temperature    | Normal operation<br>(V <sub>CC</sub> = 3.3V ±5%) | -40  | —    | +85  | °C    |
| Supply Voltage to Ground | —                                                | -0.8 | —    | +3.6 | V     |
| DC Input Voltage         | —                                                | -0.8 | —    | +3.6 | V     |
| DC Voltage to Outputs    | —                                                | -0.8 | —    | +3.6 | V     |
| Current into Outputs     | Outputs low                                      | —    | —    | 90   | mA    |

**TABLE 3-2: ELECTRICAL CHARACTERISTICS (OVER THE OPERATING V<sub>CC</sub> AND -40 TO +85°C RANGE)**

| Parameter                              | Description                                                              | Min.  | Typ.  | Max.  | Unit |
|----------------------------------------|--------------------------------------------------------------------------|-------|-------|-------|------|
| <b>Power Supply</b>                    |                                                                          |       |       |       |      |
| V <sub>CC</sub>                        | Supply voltage                                                           | 3.15  | 3.3   | 3.45  | V    |
| I <sub>S</sub>                         | Supply current, both transmitting and receiving                          | —     | 55    | —     | mA   |
| <b>Operational Bit Rate</b>            |                                                                          |       |       |       |      |
| BR <sub>smp</sub>                      | Bit rate using SMPTE data                                                | 0.143 | —     | 3.0   | Gbps |
| BR <sub>8B10B</sub>                    | Bit rate using 8B/10B coded data                                         | 0.05  | —     | 3.125 | Gbps |
| <b>SDIp Connection to Coax</b>         |                                                                          |       |       |       |      |
| Z <sub>coax</sub>                      | Coax cable characteristic impedance                                      | —     | 75    | —     | Ω    |
| R <sub>loss</sub>                      | Coax return-loss as seen on SDIp pin.<br>Frequency range = 1 MHz-1.5 GHz | —     | —     | -15   | dB   |
| R <sub>loss</sub>                      | Coax return-loss as seen on SDIp pin<br>Frequency range = 1.5 GHz-3 GHz  | —     | —     | -10   | dB   |
| ΔV <sub>TX</sub>                       | Transmit amplitude (at camera end into 75Ω)                              | 500   | 800   | 1200  | mV   |
| <b>SDOp/SDOn Outputs (CML to 1.2V)</b> |                                                                          |       |       |       |      |
| ΔV <sub>O</sub>                        | Output amplitude V <sub>SDOp,n</sub> (into 2x50Ω)                        | 2x300 | 2x370 | 2x450 | mV   |
| V <sub>cmout</sub>                     | Common-mode output voltage when AC coupled                               | —     | 0.83  | —     | V    |
| R <sub>output</sub>                    | Termination on SDOp/SDOn to V <sub>CC</sub>                              | —     | 50    | —     | Ω    |
| t <sub>rise_o</sub>                    | Rise/Fall time 20% to 80% of V <sub>SDOp,n</sub>                         | —     | 75    | —     | ps   |

**TABLE 3-2: ELECTRICAL CHARACTERISTICS (OVER THE OPERATING V<sub>CC</sub> AND -40 TO +85°C RANGE)**

| Uplink Parameters   |                                                                             |      |     |     |    |
|---------------------|-----------------------------------------------------------------------------|------|-----|-----|----|
| V <sub>LF</sub>     | Uplink transmit amplitude for R <sub>amp</sub> = 1 kΩ measured inside cable | 110  | 150 | 190 | mV |
| t <sub>rise_f</sub> | Rise/Fall time 20% to 80% of LF output on SDIp with R <sub>amp</sub> = 1 kΩ | 30   | 40  | 55  | ns |
| V <sub>ih</sub>     | LFI input high voltage                                                      | 0.8  | —   | 1.3 | V  |
| V <sub>il</sub>     | LFI input low voltage                                                       | -0.5 | —   | 0.4 | V  |
| R <sub>input</sub>  | Internal resistor to GND                                                    | —    | 3.6 | —   | kΩ |

**TABLE 3-3: JITTER NUMBERS<sup>(1)</sup>**

| Parameter                    | Conditions                                                                     | Min. | Typ. | Max. | Units |
|------------------------------|--------------------------------------------------------------------------------|------|------|------|-------|
| Jitter in Equalizer Output   | 2.97 Gbps from 0-120m <sup>(2)</sup>                                           | —    | —    | 0.25 | UI    |
| Jitter in Equalizer Output   | 2.97 Gbps from 120-140m <sup>(2)</sup>                                         | —    | 0.3  | —    | UI    |
| Jitter in Equalizer Output   | 1.485 Gbps from 0-160m <sup>(2)</sup>                                          | —    | —    | 0.25 | UI    |
| Jitter in Equalizer Output   | 1.485 Gbps from 160-200m <sup>(2)</sup>                                        | —    | 0.3  | —    | UI    |
| Jitter in Equalizer Output   | 270 Mbps from 0-400m <sup>(2)</sup>                                            | —    | —    | 0.2  | UI    |
| Additive Jitter on LF Output | 8B/10B coded signal at 5 Mbps over full V <sub>CC</sub> and temperature range. | —    | —    | 10   | ns    |
| DCD in LF Output             | 8B/10B coded signal at 5 Mbps over full V <sub>CC</sub> and temperature range. | —    | —    | 10   | ns    |

1: Jitter numbers (over operating V<sub>CC</sub> range at -40°C to +85°C and full  $\Delta V_{TX}$  range with pathological patterns)

2: Measured with Belden 1694A

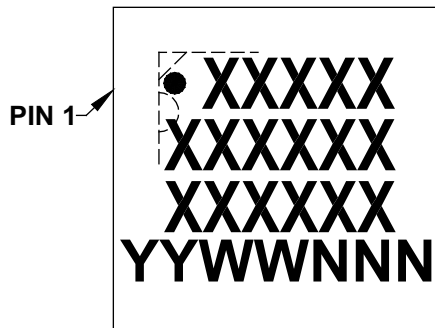
# EQCO30R5.D

## 4.0 PACKAGE INFORMATION

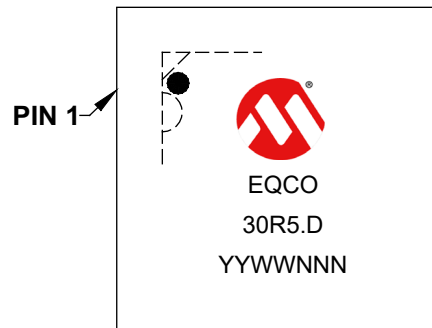
### 4.1 Package Marking Information

16-Lead Plastic Quad Flat, No Lead Package – 4x4x0.9 mm Body [QFN]

16-Lead QFN (4x4x0.9 mm)



Example

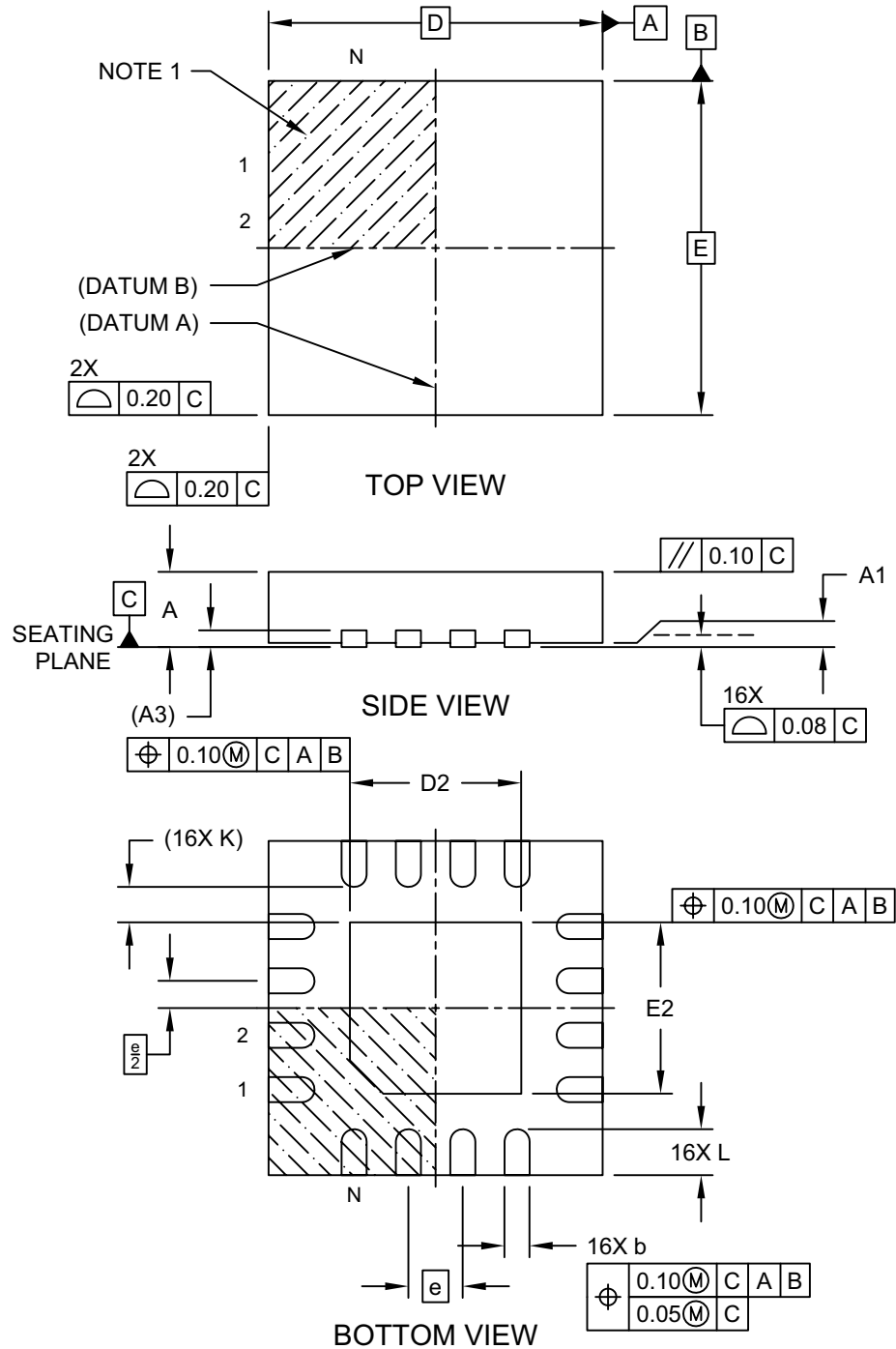


**Legend:** XX...X Customer-specific information  
Y Year code (last digit of calendar year)  
YY Year code (last 2 digits of calendar year)  
WW Week code (week of January 1 is week '01')  
NNN Alphanumeric traceability code  
(e3) Pb-free JEDEC® designator for Matte Tin (Sn)  
\* This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

## 16-Lead Plastic Quad Flat, No Lead Package (8E) - 4x4x0.9 mm Body [QFN]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

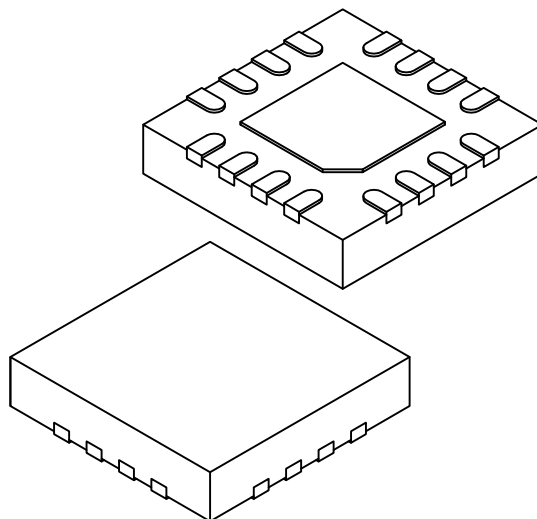


Microchip Technology Drawing C04-259B Sheet 1 of 2

# EQCO30R5.D

## 16-Lead Plastic Quad Flat, No Lead Package (8E) - 4x4x0.9 mm Body [QFN]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



|                         |    | Units | MILLIMETERS |      |      |
|-------------------------|----|-------|-------------|------|------|
| Dimension Limits        |    |       | MIN         | NOM  | MAX  |
| Number of Pins          | N  |       | 16          |      |      |
| Pitch                   | e  |       | 0.65 BSC    |      |      |
| Overall Height          | A  |       | 0.80        | 0.87 | 0.95 |
| Standoff                | A1 |       | 0.00        | 0.02 | 0.05 |
| Terminal Thickness      | A3 |       | 0.20 REF    |      |      |
| Overall Width           | E  |       | 4.00 BSC    |      |      |
| Exposed Pad Width       | E2 |       | 1.95        | 2.05 | 2.15 |
| Overall Length          | D  |       | 4.00 BSC    |      |      |
| Exposed Pad Length      | D2 |       | 1.95        | 2.05 | 2.15 |
| Terminal Width          | b  |       | 0.25        | 0.30 | 0.35 |
| Terminal Length         | L  |       | 0.45        | 0.55 | 0.65 |
| Terminal-to-Exposed-Pad | K  |       | 0.425 REF   |      |      |

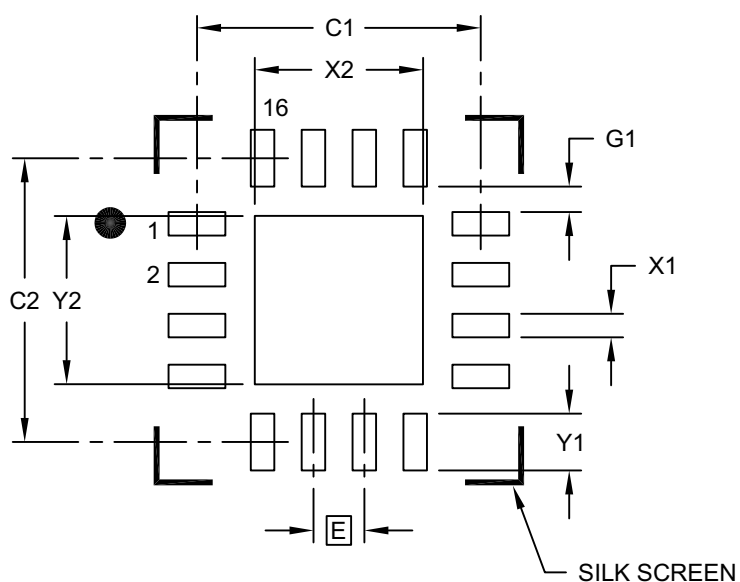
### Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.  
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-259B Sheet 2 of 2

## 16-Lead Plastic Quad Flat, No Lead Package (8E) - 4x4x0.9 mm Body [QFN]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



### RECOMMENDED LAND PATTERN

| Units                           |    | MILLIMETERS |       |       |
|---------------------------------|----|-------------|-------|-------|
| Dimension Limits                |    | MIN         | NOM   | MAX   |
| Contact Pitch                   | E  | 0.65 BSC    |       |       |
| Optional Center Pad Width       | X2 |             |       | 2.15  |
| Optional Center Pad Length      | Y2 |             |       | 2.15  |
| Contact Pad Spacing             | C1 |             | 3.625 |       |
| Contact Pad Spacing             | C2 |             | 3.625 |       |
| Contact Pad Width (X16)         | X1 |             |       | 0.30  |
| Contact Pad Length (X16)        | Y1 |             |       | 0.725 |
| Contact Pad to Center Pad (X16) | G1 | 0.20        |       |       |

#### Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2259A

# EQCO30R5.D

---

## APPENDIX A: REVISION HISTORY

### Revision D (December 2025)

- Updated document to remove mention of 1.2V part and other clarifications

### Revision C (November 2016)

- Revised Section 1.1.3 (LFI).

### Revision B (February 2016)

- Removed electrostatic discharge ratings from [Table 3-1](#).
- Minor typographical changes.

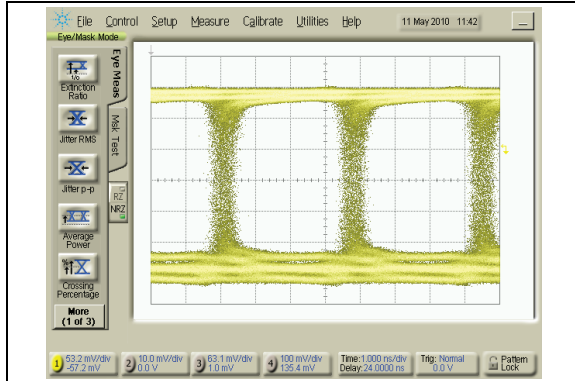
### Revision A (September 2014)

This is the initial release of the document in the Microchip format. This replaces EqcoLogic document version 1v0.

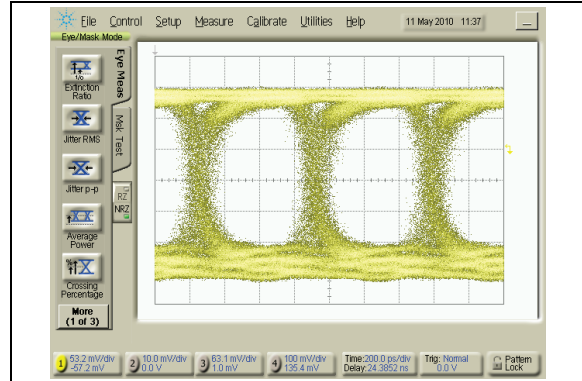
## APPENDIX B: TYPICAL EQUALIZER CHARACTERISTICS

All measurements at  $V_{CC} = 3.3V$ , Temp = +25°C, data pattern = prbs15 (including 20  $\mu s$  of each polarity of pathological pattern), measured with Belden 1694A cable.

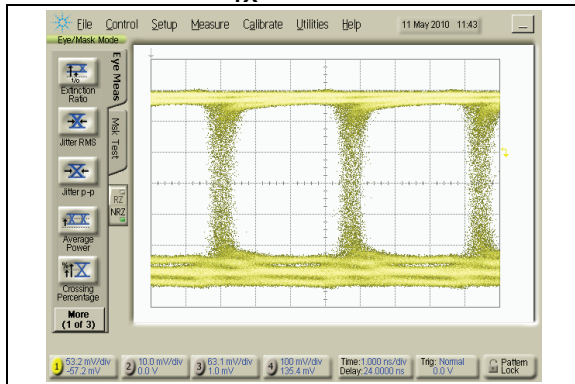
**FIGURE B-1: 270 Mbps, 410m,  
 $\Delta V_{TX} = 620$  mV**



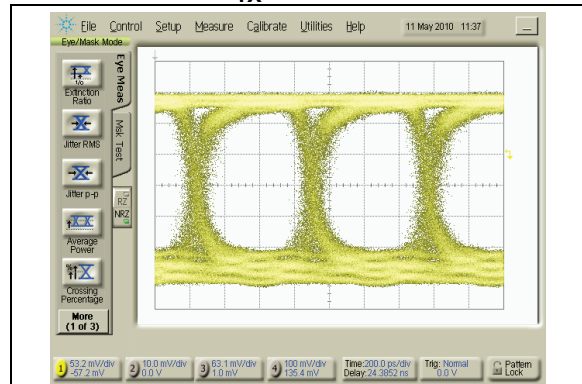
**FIGURE B-4: 1.485 Gbps, 200m,  
 $\Delta V_{TX} = 620$  mV**



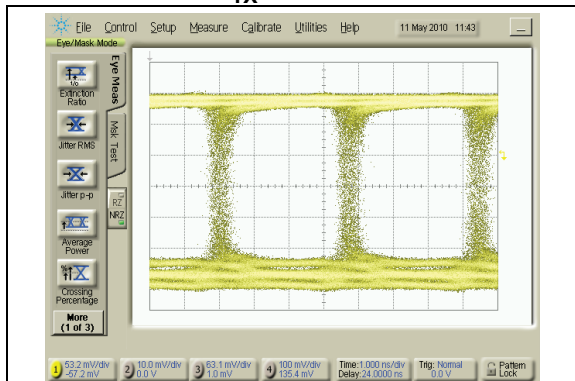
**FIGURE B-2: 270 Mbps, 410m,  
 $\Delta V_{TX} = 800$  mV**



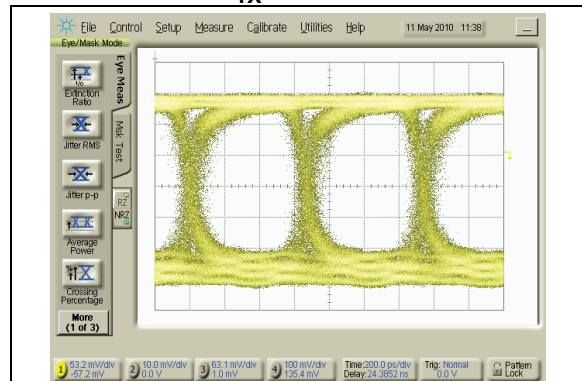
**FIGURE B-5: 1.485 Gbps, 200m,  
 $\Delta V_{TX} = 800$  mV**



**FIGURE B-3: 270 Mbps, 410m,  
 $\Delta V_{TX} = 980$  mV**

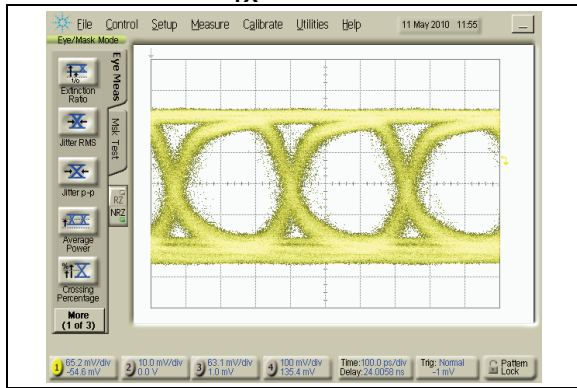


**FIGURE B-6: 1.485 Gbps, 200m,  
 $\Delta V_{TX} = 980$  mV**

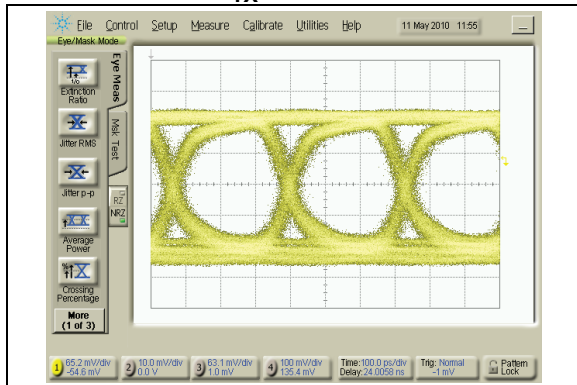


# EQCO30R5.D

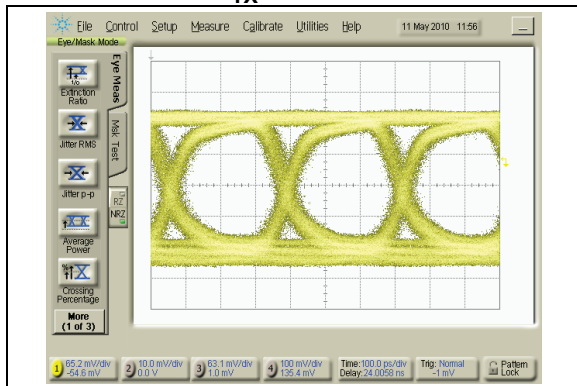
**FIGURE B-7: 2.97 Gbps, 140m,  
 $\Delta V_{TX} = 620 \text{ mV}$**



**FIGURE B-8: 2.97 Gbps, 140m,  
 $\Delta V_{TX} = 800 \text{ mV}$**



**FIGURE B-9: 2.97 Gbps, 140m,  
 $\Delta V_{TX} = 980 \text{ mV}$**



PRODUCT IDENTIFICATION SYSTEM

To order parts, including industrial, or obtain information, for e.g., on pricing or delivery, refer to the factory or the listed sales office.

|                                                                                                                                                          |                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Device:EQCO30R5.D</div> <div>Temperature Range: I = -40°C to +85°C (Industrial temperature)</div> <div>Package:TRAY = Tray<br/>(Blank) = Tube</div> | <div>Examples:</div> <div>a)EQCO30R5.D = Industrial temperature,<br/>16-Lead QFN<br/>Tube packaging</div> <div>b)EQCO30R5.D-TRAY = Industrial temperature,<br/>16-Lead QFN<br/>Tray packaging</div> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Microchip Information

### Trademarks

The “Microchip” name and logo, the “M” logo, and other names, logos, and brands are registered and unregistered trademarks of Microchip Technology Incorporated or its affiliates and/or subsidiaries in the United States and/or other countries (“Microchip Trademarks”). Information regarding Microchip Trademarks can be found at <https://www.microchip.com/en-us/about/legalinformation/microchip-trademarks>.

ISBN: 979-8-3371-2293-9

### Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at [www.microchip.com/en-us/support/design-help/client-support-services](http://www.microchip.com/en-us/support/design-help/client-support-services).

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

### Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.