EQCO30T5.2 3G/HD-SDI Video Cable Driver

Features

- 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
- Loss of Signal Detect at Input, Optional 3 dB Input Trace/Receive Equalization
- Also Operates with 8B/10B Coding
- Single 3.3V Supply.
- Low Power Consumption (150 mW, 3.3V supply)
- Output Driver Enable
- LF-Uplink Receiver Included, Receiving 5 Mbps in Full-Duplex Communication for Cable Lengths in 0-450m Range
- Up to 900 mA can be Received for Powering Camera Devices
- Selectable Slew Rate for SD and HD/3G
- 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

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

Introduction

The EQCO30T5 is a video cable driver for 3G/HD/SDI video, with speeds up to 4.0 Gbps. It is designed to be a direct replacement for competing cable drivers. In addition to downlink functionality from camera to frame grabber, it can also receive 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. The device operates with 8B/10B coded signals and with SMPTE signals up to 2.97 Gbps.

Typical Link Performance

Table 1, Table 2 and Table 3 give an overview of link performance (EQCO30T5 and EQCO30R5 combined) 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 LINK 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: GEPCO TYPICAL LINK 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 LINK 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

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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.

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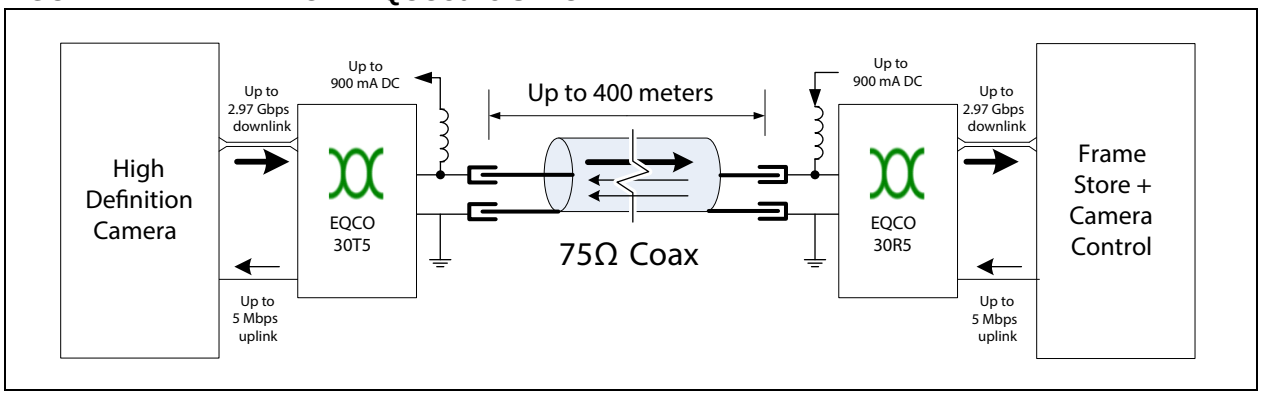
1.0 DEVICE OVERVIEW

The EQCO30T5 is a dual slew rate cable driver designed to drive digital signals over coaxial cable. The EQCO30T5 chip is optimized for driving SMPTE HD-SDI signals, but works equally well with 8B/10B coded signals.

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

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

FIGURE 1-1: TYPICAL EQCO30T5 SETUP



The EQCO30T5 includes an uplink receiver for receiving digital data coming from the frame store in full-duplex, giving 5 Mbps of bandwidth for:

- Triggering purposes, Auxiliary outputs
- Firmware upgrades,
- Audio channels
- Etc.

1.1 Pinout and Pin Description

FIGURE 1-2: EQCO30T5.2 PIN DIAGRAM (VIEWED FROM TOP)

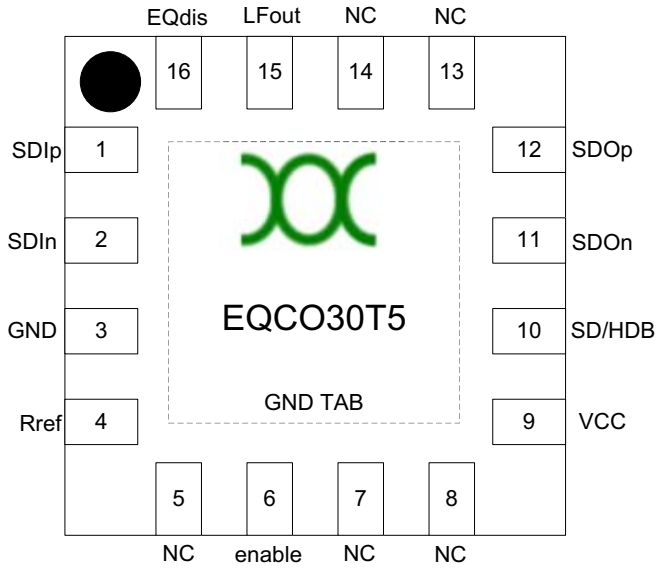


TABLE 1-1: EQCO30T5.2 PIN DESCRIPTIONS

Pin Number	Pin Name	Signal Type	Description
(TAB)	GND	Power	Use as single-point ground.
1, 2	SDIp, SDIn	Differential Input	Serial input positive/negative differential serial input.
3	GND	Power	Ground. Connect to GND TAB.
4	R_{ref}	Analog Input	Input determining output amplitude of cable driver.
9	VCC	Power	+3.3V of power supply.
6	Enable	Input	Enables the output driver pins.
5, 7, 8, 13, 14	NC	Input	Do not connect; leave floating. Used for internal testing.
10	SD/HDB	Input	Select edge rate.
11	SDOn	Driver Output	Serial negative cable driver output with 50Ω on-chip serial output resistance. Complement with 25Ω externally.
12	SDOp	Driver Output	Serial positive cable driver output with 50Ω on-chip serial output resistance. Complement with 25Ω externally.
15	LFout	Output	Digital output signal of the full-duplex uplink.
16	EQdis	Input	Disables input trace equalization.

1.1.1 SDIP/SDIN

SDIp/SDIn together form a differential input pair. Between SDIp and SDIn inputs, there is a termination resistor of 100Ω. The intention is to always use AC coupling. When AC-coupled, the common-mode gets biased to 600 mV.

1.1.2 RREF

A resistor is to be connected between VCC and the R_{ref} pin. A resistor of 750Ω gives an 800 mV launch amplitude in the 75Ω coaxial cables. A larger resistor gives a smaller amplitude.

1.1.3 ENABLE

When enable is floating or pulled high, the output driver is enabled. When enable is low, the output is disabled and power consumption drops significantly.

1.1.4 SD/HDB

With SD/HDB set to high, the output rise and fall times are set for SD operation. When left floating or pulled low, the rise and fall times are set for 3G/HD operation.

1.1.5 SDOn, SDOp

The output driver is not based on a CML output stage. Both outputs operate independently, so there is very little interference between the outputs and their termination condition. There is also no LR-output network needed for achieving good return-loss. A 25Ω resistor should be connected in series with the output to drive a 75Ω coax cable. The output amplitude is achieved behind this 25Ω resistor; refer to the application circuits at the end of the data sheet. The PCB doesn't require layout changes when migrating from competing cable drivers, however, fewer components are needed. One does not need to optimize the return-loss network, since it is omitted.

1.1.6 LFOUT

LFout provides the 5 Mbps received uplink signal (LVTTL voltage levels). It can easily drive a PCB trace of 20 pF at this speed. For longer distance communication from this pin to the next chip, using a buffer is recommended. The output impedance is about 300Ω.

1.1.7 EQdis

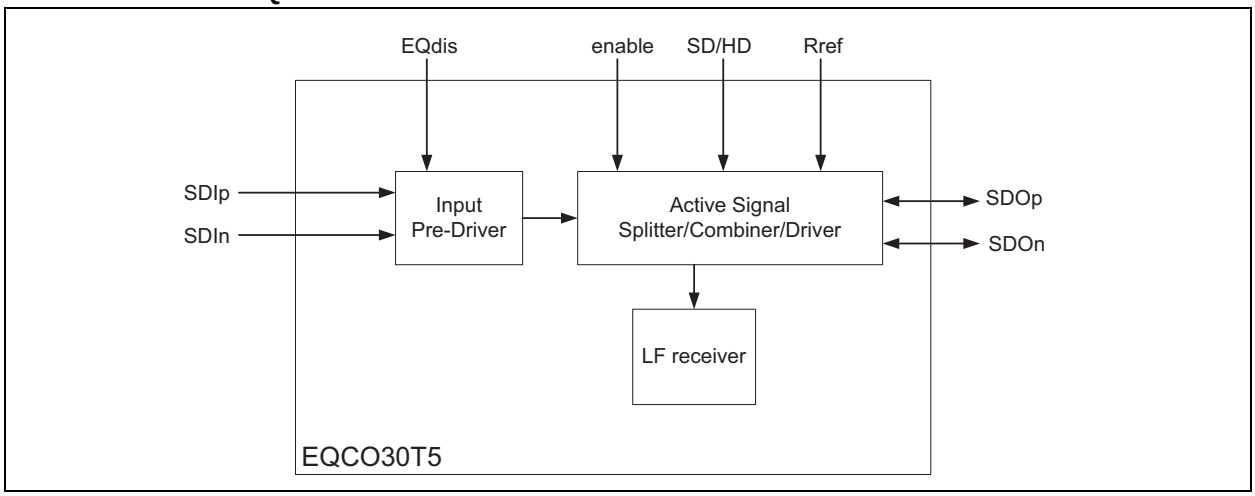
When EQdis is left floating or pulled low, the input trace equalization is turned on and invokes a typical 3 dB gain at 1.5 GHz.

This value is optimized for compensating the high-frequency losses of approximately 20 cm of 5-mil stripline in FR4. When pulled high, this equalization is turned off.

1.2 Circuit Operation

Figure 1-3 is a block diagram of the EQCO30T5, showing electrical connections. The input pre-driver brings the input signal to a digital signal, with or without the use of input trace equalization. The active splitter/combiner/driver launches the digital signal in the cable, with an amplitude determined by the external resistor connected to R_{ref} and with an edge rate for SD or 3G/HD-SDI depending on the SD/HDB signal. It also splits the incoming signal towards the LF receiver to provide the 5 Mbps LF_{out} signal.

FIGURE 1-3: EQCO30T5 BLOCK DIAGRAM SHOWING ELECTRICAL CONNECTIONS

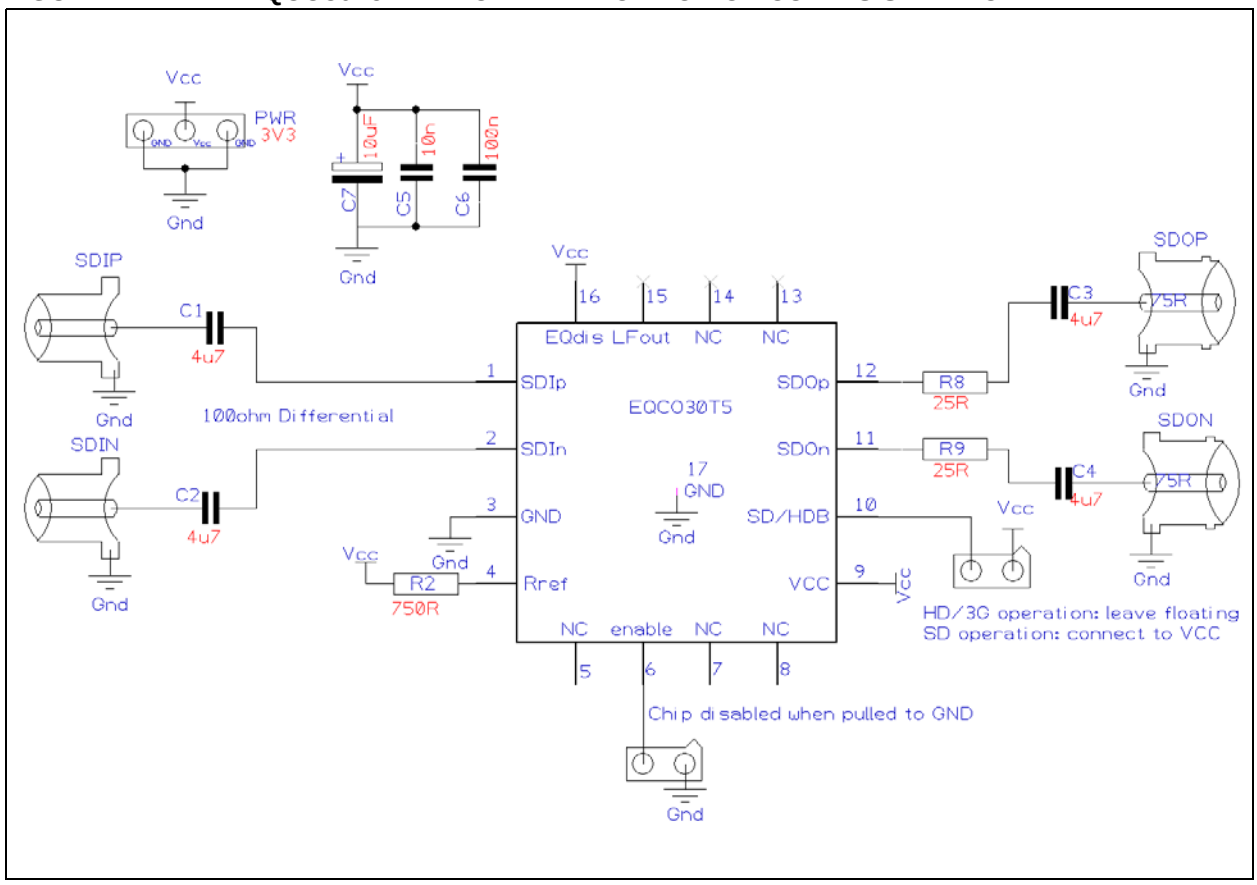


2.0 APPLICATION INFORMATION

2.1 Typical Application Circuit as SMPTE Cable Driver

Figure 2-1 illustrates a typical schematic implementation of the EQCO30T5 used as a cable driver for SMPTE video signals.

FIGURE 2-1: EQCO30T5.2 TYPICAL APPLICATION CIRCUIT AS SMPTE CABLE DRIVER



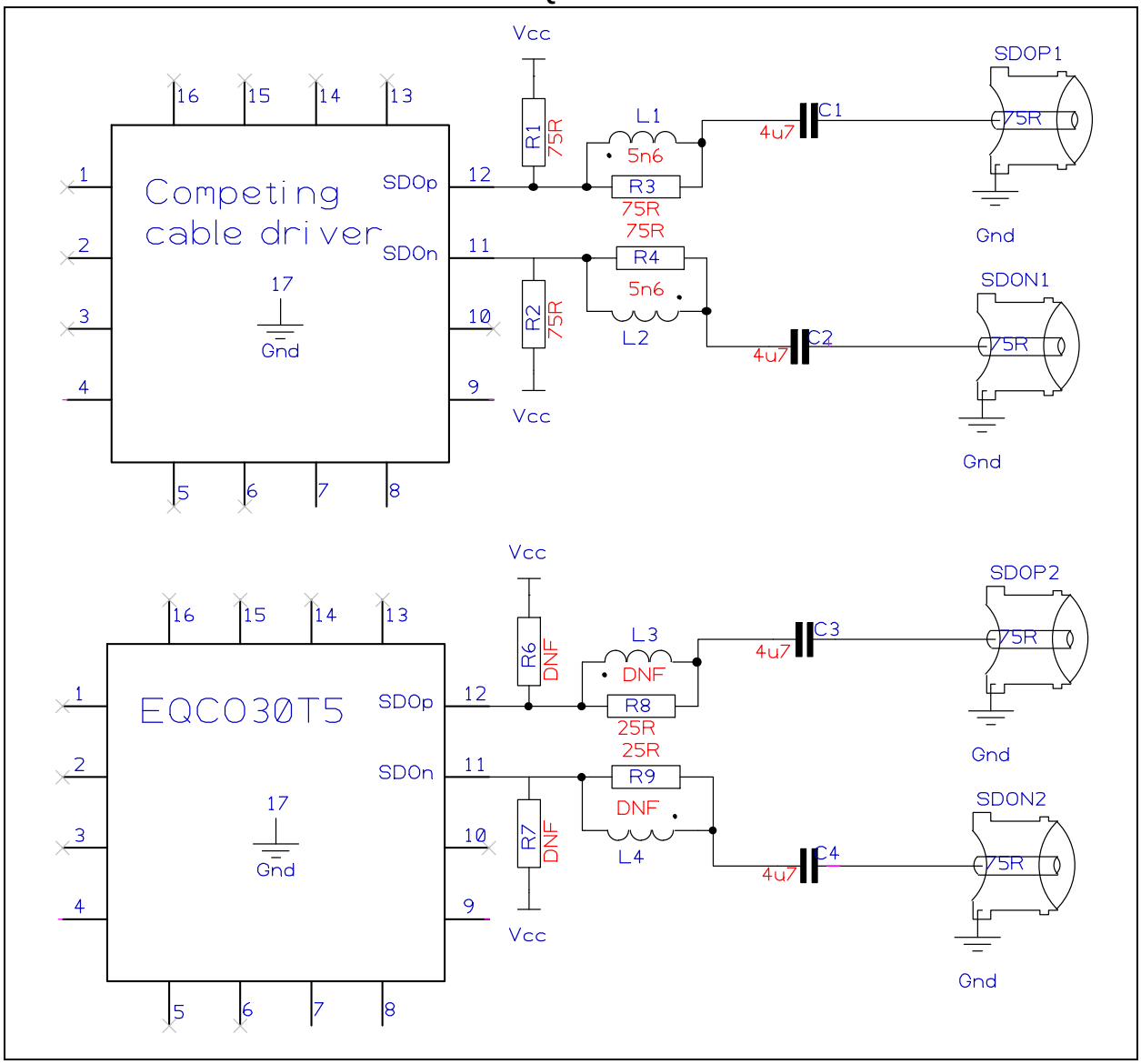
Resistors R8 and R9 are to be placed close to pins 12 and 11, respectively. From there onwards, the traces up to the coax connectors should be laid-out as 75Ω traces (including the C3 and C4 capacitors as AC-couplers).

2.1.1 RETURN-LOSS NETWORK

Competing cable drivers need external RL return-loss networks. The EQCO30T5 does not need these type of external networks. Figure 2-2 compares the output network of the EQCO30T5 with the network of competing cable drivers.

The EQCO30T5 is pin-compatible with other cable drivers, but with a different component population. No termination resistor to VCC is required (do not fit = DNF). The inductor of the return loss network must not be populated and the 75Ω resistor of this network should be replaced with a 25Ω resistor to achieve correct operation.

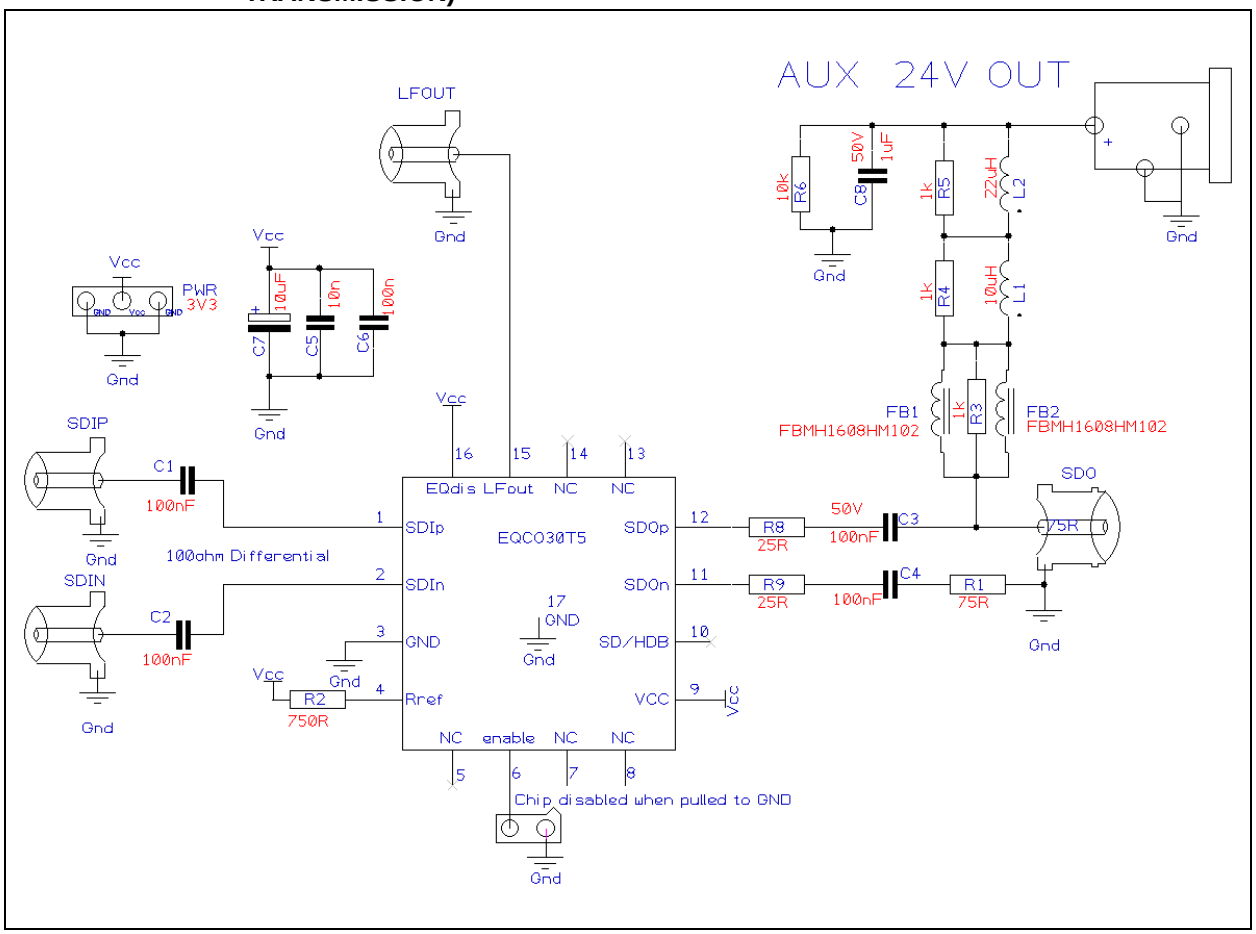
FIGURE 2-2: COMPARISON BETWEEN EQCO30T5 AND COMPETING SOLUTIONS



Note: Resistors marked DNF indicate “Do Not Fit”

2.2 EQCO30T5 in Bidirectional Link (Including Power Supply)

FIGURE 2-3: EQCO30T5 IN BIDIRECTIONAL LINK (INCLUDING POWER SUPPLY TRANSMISSION)



Resistors R8 and R9 are to be placed close to pins 12 and 11, respectively. From there onwards, the traces up to the coax connector SDIP1 should be laid out as 75Ω traces (including the C3 and C4 capacitors as AC couplers). Resistor R1 has to be placed very close to this coax connector with a very short, low-impedance connection between one of the shielding pins of the connector and the resistor. To achieve the return-loss illustrated in the appendix, the power and ground planes below components FB1, FB2, R3, R4, L1, R5, L2 should be removed (applying cut-outs).

2.2.1 COMPONENT RECOMMENDATION

When using the components below, a maximum current of 900 mA can be communicated to power-up the camera side. Different types of inductors may be suitable in order to allow a higher current level, however, the RF quality of the inductor should be checked.

Ferrite Beads Fb1, Fb2 = FBMH1608HM102 from Taiyo Yuden

Inductor L1= 1812PS_103 from Coilcraft

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 (VCC = 1.2V ±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 VCC AND -40 TO +85°C RANGE)

Parameter	Description	Min.	Typ.	Max.	Unit
Power Supply					
VCC	Supply voltage	3.15	3.3	3.45	V
I_S	Supply current, both transmitting and receiving	—	45	—	mA
Operational Bit Rate					
BR_{output}	Bit rate cable driver output	0.05	—	4	Gbps
BR_{uplink}	Bit rate uplink receiver	0.5	—	5	Mbps
SDIp/SDIn Input					
⌂Vi	Input amplitude $V_{SDIp,n}$	2x100	—	2x900	mV
V_{CMIN}	Input common-mode voltage	—	600	—	mV
R_{input}	Differential input termination	—	2x50	—	Ω

TABLE 3-2: ELECTRICAL CHARACTERISTICS (OVER THE OPERATING VCC AND -40 TO +85°C RANGE) (CONTINUED)

SDOp connection to Coax					
Z_{coax}	Coax cable characteristic impedance	—	75	—	Ω
R_{SDOp}, R_{SDOn}	Input impedance between SDOp and VCC/GND. To get to 75, add external 25Ω series resistor.	45	50	55	Ω
R_{loss}	Return-Loss as seen on SDOp pin having 25Ω series resistor. Frequency range = 5 MHz-1.5 GHz	—	—	-15	dB
R_{loss}	Return-Loss as seen on SDOp pin having 25Ω series resistor. Frequency range = 1.5 GHz-3.0 GHz	—	—	-10	dB
$\triangle V_{TX}$	Transmit amplitude with R_{ref} = 750Ω	720	800	880	mV
$t_{rise\_tx\_SD}$	Rise/Fall time 20% to 80% of $\triangle V_{TX}$ (SD/HDB = High)	400	—	800	ps
t_{rise_tx}	Rise/Fall time 20% to 80% of $\triangle V_{TX}$ (SD/HDB = Low)	—	—	65	ps
LFO Output (LVTTL-like)					
t_{rise_lLFO}	Rise/Fall time 20% to 80% of V_{CC} for 20 pF load	—	15	—	ns

TABLE 3-3: JITTER NUMBERS(1)

Parameter	Conditions	Min.	Typ.	Max.	Units
Additive peak to peak jitter on SDOp and SDOn	Downlink signal = 3.0 Gbps	—	10	—	ps
Peak to peak jitter on LFO	0-450m(2), @ low-speed signal = 5 Mbps, 8B/10B, and @ downlink signal = 270 Mbps, 8B/10B	—	50	—	ns

1: Jitter numbers (over operating VCC range at -40°C to +85°C and full $\triangle V_{TX}$ range with pathological patterns)

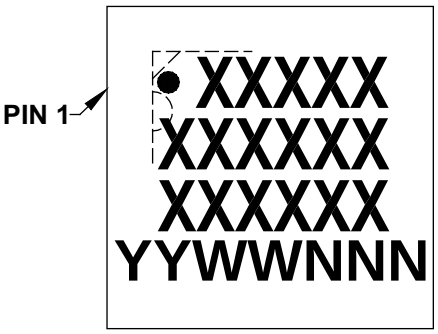
2: Measured with Belden 1694A coaxial cable

4.0 PACKAGING INFORMATION

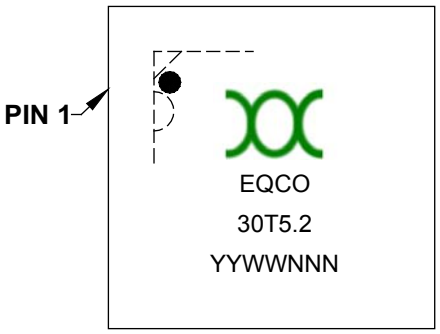
4.1 Package Marking Information

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

16-Lead QFN (4x4x0.9 mm)



Example

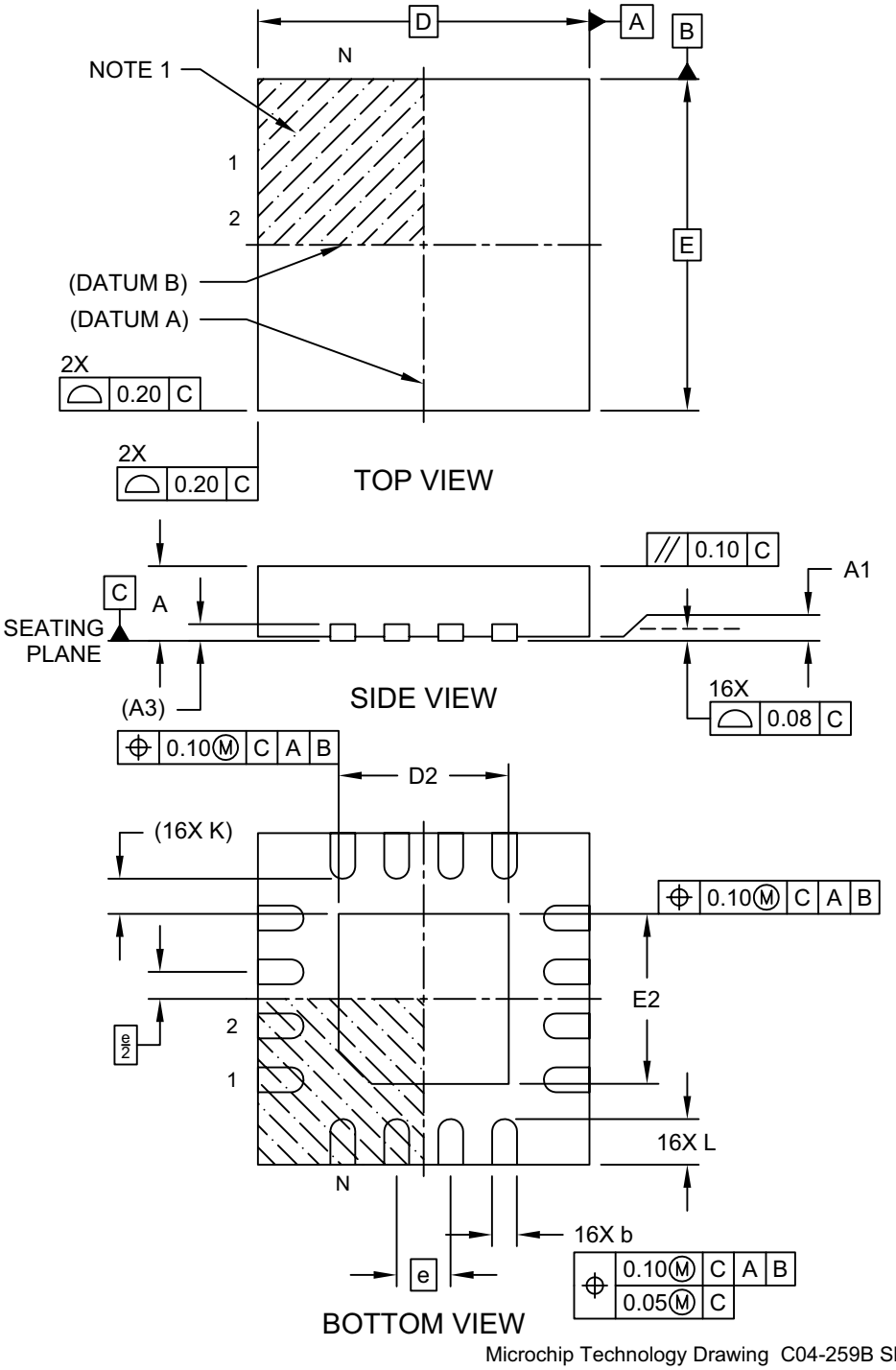


Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The 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]

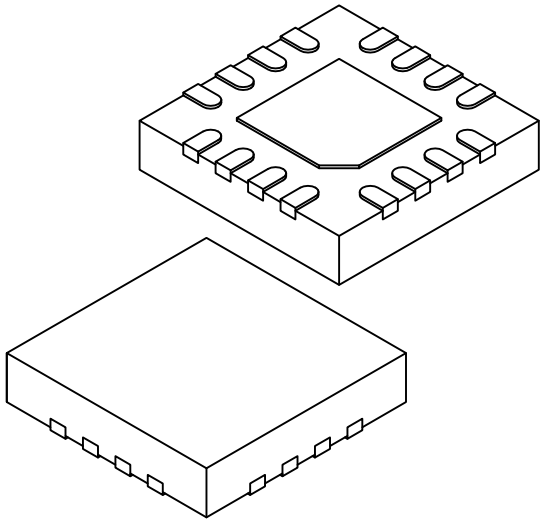
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-259B Sheet 1 of 2

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

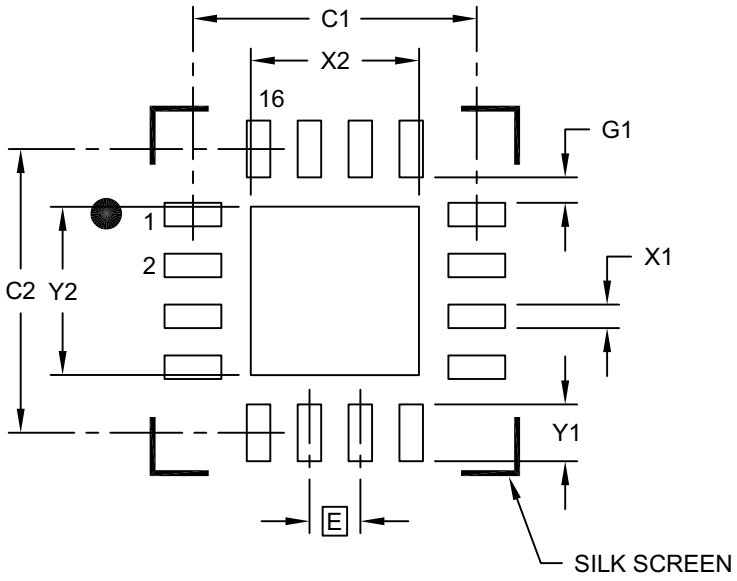
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   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

APPENDIX A: REVISION HISTORY

Revision C (February 2016)

- Removed electrostatic discharge ratings from Table 3-1.
- Minor typographical changes.

Revision B (February 2015)

- Updated the typical application circuit diagrams in Figures 2-1 and 2-3.

Revision A (September 2014)

This is the initial release of the document in the Microchip format. This replaces EqcoLogic document version 2v0.

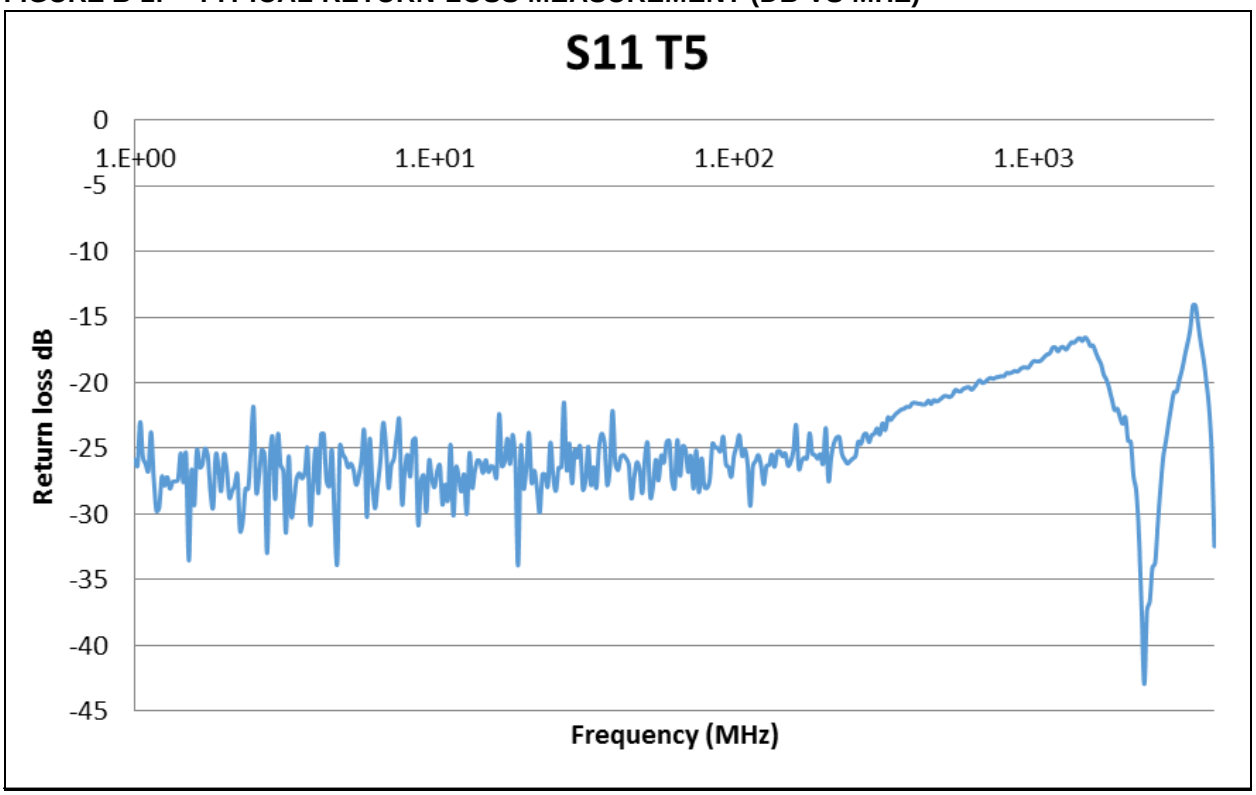
TABLE A-1: VERSION HISTORY

Version	Date	Author	Comments
2v0	1/27/14	A. Peeters	Revision
1v0	3/13/12	A. Peeters	Final document
0v2	1/17/12	M. Kuijk	Added Return-Loss measurement
0v1	1/6/12	B. Devuyst	New document

APPENDIX B: TYPICAL RETURN-LOSS MEASUREMENT

All measurements at VCC = 3.3V, Temp = +25ºC, data pattern = prbs15 (including 20 µs of each polarity of pathological pattern), measured with Belden 1694A cable.

FIGURE B-1: TYPICAL RETURN-LOSS MEASUREMENT (DB VS MHZ)



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PART NO.	I	RM	XXX
Device	Temp. Range	Radio Module	Firmware Revision Number

Device:	EQCO30T5.2	
Temperature Range:	I	= -40°C to +85°C (Industrial temperature)
Package:	TRAY	= Tray
	(Blank)	= Tube

Examples:

a) EQCO30T5.2 = Industrial temperature, 16-Lead QFN Tube packaging

b) EQCO30T5.2-TRAY = Industrial temperature, 16-Lead QFN Tray packaging

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- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
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- Microchip is willing to work with the customer who is concerned about the integrity of their code.
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ISBN: 978-1-5224-0256-5

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