

## 3.3V Single Supply Video Difference Amplifier

### DESCRIPTION

Demonstration circuit 815 is a Video Line-Driver & Receiver featuring the LT6552. The driver and receiver sections of the board are scored to be separable by the user so that evaluation with an intermediate cable-run is readily accomplished. Figure 1 shows the general layout of the board and the usual connections used to perform evaluations.


The intermediate cable link may be either 75Ω coaxial-cable (such as RG-6) or twisted-pair (CAT-5 Ethernet cable). BNC connectors are provided for the coaxial connections, including those for the source and destination video gear. The twisted-pair option for the intermediate link uses RJ-45 connections and transports over con-

tacts 7 & 8 (this pair is generally not used in Ethernet datacom applications and is always straight-through).

Jumpers are provided in the receive section that offer 4 levels of cable-loss equalization, sufficient for CAT-5 cable-runs up to 1000 feet (or 11dB max @ 4MHz).

The Performance Summary table below indicates the key electrical characteristics provided by this evaluation board.

**Design files for this circuit board are available. Call the LTC factory.**

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### PERFORMANCE SUMMARY

Specifications are at  $T_A = 25^\circ\text{C}$

| SYMBOL      | PARAMETER   | CONDITIONS  | MIN | TYP                     | MAX  | UNITS |
|-------------|---|---|-----|-------------------------|------|-------|
| $V_S$       | Power Supply Range                                      | No clipping of ac-coupled video   | 4.0 | 5.0                     | 12.6 | V     |
| $I_S$       | Power Supply Current                                    | 5V, video active, TX & RX total   |     | 40                      |      | mA    |
| $Z_{INTX}$  | Video Input Impedance                                   | $V_{IN} = 1.0V_{p-p}$   |     | 75                      |      | Ω     |
| $Z_{OUTRX}$ | Video Output Impedance                                  | $V_{OUT} = 1.0V_{p-p}$  |     | 75                      |      | Ω     |
| $Z_{OUTTX}$ | Line-driver Output Impedance                            | $V_{OUTTX} = 1.0V_{p-p}$ unbalanced coax<br>$V_{OUTTX} = 1.0V_{p-p}$ twisted-pair   |     | 75<br>110               |      | Ω     |
| $Z_{INRX}$  | Line-Receiver Input Impedance                           | RX Zin jumper set to 75 ohm<br>RX Zin jumper set to 110 ohm   |     | 75<br>110               |      | Ω     |
| $f_{CU}$    | Frequency Response, upper -3dB                          | any EQ setting  |     | 10                      |      | MHz   |
| $f_{CL}$    | Frequency Response, lower -3dB                          |   |     | 5.5                     |      | Hz    |
| EQ          | Line-Receiver Equalization,<br>Set by Jumpers EQ1 & EQ2 | EQ1=OFF, EQ2=OFF (none)<br>EQ1=ON, EQ2=OFF, f=3.58MHz (≈300')<br>EQ1=OFF, EQ2=ON, f=3.58MHz (≈800')<br>EQ1=ON, EQ2=ON, f=3.58MHz (≈1000') |     | 0<br>3.0<br>9.0<br>10.5 |      | dB    |

### OPERATING PRINCIPLES

The LT6552 in location U1 is used as a line-driver that accepts a differential input and generates a single-ended output in a gain-of-two configuration. The input provided is a 75Ω un-balanced connection that may contain sub-

stantial common-mode noise. The output is back-terminated to drive either a purely unbalanced 75Ω coaxial link, or a quasi-balanced 110Ω CAT-5 link. The simplified CAT-5 output as implemented here will produce a

video common-mode on the pair that may be undesirable in a productized realization, but helps demonstrate the capability of the receiver function of the DC815. U1 also demonstrates the compact DFN package.

The LT6552 in the U2 location (in the standard SO-8 package) is set up similarly, except that equalization networks are added to provide cable-loss correction. The input in this receiver circuit may be terminated in either 75 or 110 ohms, depending on the link media used. The output is an unbalanced 75Ω output, suitable for driving standard video equipment. The maximum equalization circuitry is optimized for 1000' (300m) CAT-5 cable, providing over 10dB of gain boost at the color sub-carrier frequency (i.e. 3.58MHz) as shown in Figure 2.

AC-coupling on the inputs and outputs allows the circuitry to operate from single supplies down to 4V (note that in dc-coupled video applications, the part is useful down to 3V). The supply and ground connections for the TX and RX sections are completely isolated so that common-mode ground-noise may be introduced during evaluation (up to 1.5V<sub>PP</sub> with 5.0V supplies). The supply current for each section is typically 20mA with active video present. Bringing the Shutdown connection(s) to ground will bring the LT6552(s) into a low-power idle condition.

The Bill-of-Materials is shown in Figure 3 and the schematic diagram of the circuitry in Figure 4.

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## QUICK START PROCEDURE

Demonstration circuit 815 is easy to set up to evaluate the performance of the LT6552. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

- Place jumpers in the following positions:
  - JP1** EQ2 "OFF" position
  - JP2** EQ1 "OFF" position
  - JP3** RX Zin "110 ohm" position
- With power off, connect the power supply to +5V TX and +5V RX, and the supply return to GND TX and GND RX.
- Connect a 75Ω video source to TX IN (J2), such as a camera or pattern generator, and assure that the signal source is powered and active.
- Connect a 75Ω video monitor or signal analyzer to RX OUT (J6), assuring that the device is powered and ready to accept video.
- Connect a CAT-5 patch cable from TX OUT (J1) to RX IN (J5).
- Turn on the demo circuit power supply.

Note. Make sure that the input voltage does not exceed 12V. All four board connections must be made to energize the entire circuitry.

- Check for the proper RX OUT output signal. The output video waveform should be a high fidelity copy of the original input (ac-coupled however).

Note. The output must be properly loaded with 75Ω, otherwise the signal will appear doubled in amplitude.

- If longer CAT-5 cables are available, such as a full 1000' (300m) carton with RJ-45 connectors fitted, the EQ1 and EQ2 jumpers may be repositioned for best video reproduction.
- Evaluation may also be performed with 75Ω coaxial-cable as the intermediate link instead of the CAT-5 twisted pair. To do this, remove the CAT-5 cable, move the JP3 jumper (RX Zin) to the "75 ohm" setting, and connect the coax link from TX OUT (J3) to RX IN (J4). Set the EQ1 and EQ2 jumpers for the best video reproduction.
- In some instances, it may be desirable to locate the TX and RX sub-circuits remote from one another to test an actual link, such as in an elevator car. The DC815 is scored to allow breaking the board into two standalone sections in order to place them separately. For short-term tests, a 9V battery may be used as a power source for each individual section, should powering be inconvenient otherwise.

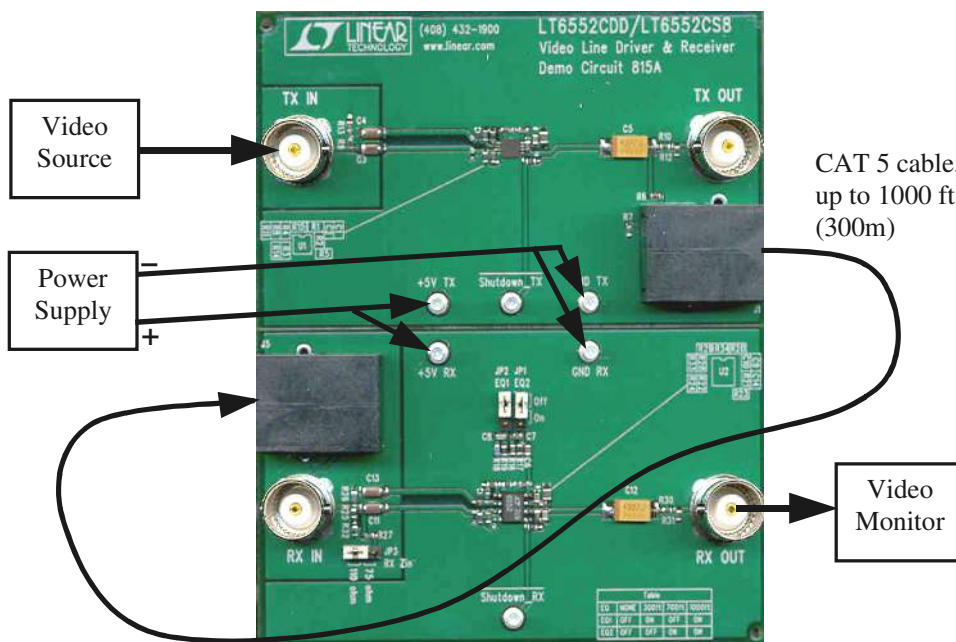


Figure 1. Proper Measurement Equipment Setup

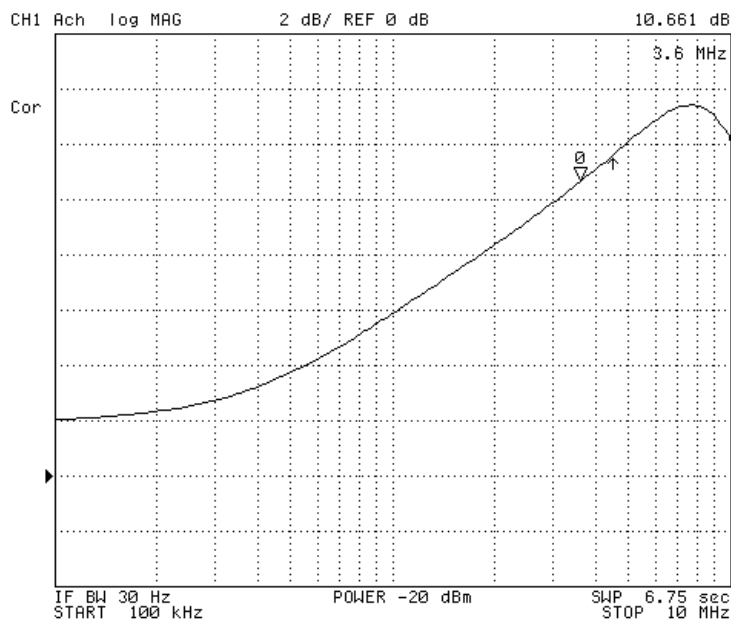


Figure 2. Receive Equalization Characteristic (max)

| Item | Qty. | Ref.                       | Part  | Mfr.                             |
|------|------|----------------------------|---|----------------------------------|
| 1    | 1    | C14                        | CAP., NPO 15pF 50V                                  | AVX, 06035A150JAT1A 0603         |
| 2    | 1    | C8                         | CAP., NPO 68pF 50V                                  | AVX, 06035A680JAT1A 0603         |
| 3    | 1    | C6                         | CAP., NPO 150pF 50V                                 | AVX, 06035A151JAT1A 0603         |
| 4    | 1    | C7                         | CAP., NPO 200pF 50V                                 | AVX, 06035A201JAT1A 0603         |
| 5    | 2    | C2,C10                     | CAP., X7R 0.01uF 50V                                | AVX, 06035C103MAT1A 0603         |
| 6    | 2    | C9,C1                      | CAP., X7R 4.7uF 10V                                 | TDK, C2012X7R1A475M 0805         |
| 7    | 4    | C3,C4,C11,C13              | CAP., X7R 10uF 16V                                  | TDK, C3216X7R1C106M 1206         |
| 8    | 2    | C12,C5                     | CAP., TANT 220uF 6.3V                               | AVX, TPSC227M006R0125 CASE C     |
| 9    | 6    | D1,D2,D3,D4,D5,D6          | DIODE, SCHOTTKY DIODE                               | DIODES INC. BAT54S-7 SOT-23      |
| 10   | 6    | E1,E2,E3,E4,E5,E6          | TESTPOINT, TURRET .094"                             | MILL-MAX 2501-2                  |
| 11   | 3    | JP1,JP2,JP3                | HEADER, 3PIN 1 ROW .079CC                           | COMM-CON 2802S-03-G1             |
| 12   | 3    | JP1,JP2,JP3                | SHUNT, .079" CENTER                                 | COMM-CON CCIJ2MM-138G            |
| 13   | 2    | J1,J5                      | CONN, RJ-45 RIGHT ANGLE                             | STEWART CONN. SYS.,SS-6488-NF-K1 |
| 14   | 4    | J2,J3,J4,J6                | CONN., VERT PC-MNT BNC 50-OHM                       | CONNEX 112404                    |
| 15   | 2    | R6,R7                      | RES., CHIP 54.9 1/16W 1%                            | AAC, CR16-54R9FM 0603            |
| 16   | 3    | R9,R10,R30                 | RES., CHIP 75 1/16W 5%                              | AAC, CR16-750JM 0603             |
| 17   | 1    | R26                        | RES., CHIP 110 1/16W 1%                             | AAC, CR16-1100FM 0603            |
| 18   | 1    | R27                        | RES., CHIP 243 1/16W 1%                             | AAC, CR16-2430FM 0603            |
| 19   | 2    | R15,R34                    | RES., CHIP 604 1/16W 1%                             | AAC, CR16-6040FM 0603            |
| 20   | 1    | R16                        | RES., CHIP 768 1/16W 1%                             | AAC, CR16-7680FM 0603            |
| 21   | 1    | R18                        | RES., CHIP 909 1/16W 1%                             | AAC, CR16-9090FM 0603            |
| 22   | 5    | R1,R2,R13,R20,R21          | RES., CHIP 1K 1/16W 5%                              | AAC, CR16-102JM 0603             |
| 23   | 2    | R4,R29                     | RES., CHIP 2.74K 1/16W 1%                           | AAC, CR16-2741FM 0603            |
| 24   | 7    | R5,R11,R14,R19,R23,R24,R33 | RES., CHIP 10K 1/16W 5%                             | AAC, CR16-103JM 0603             |
| 25   | 4    | R3,R8,R22,R28              | RES., CHIP 23.2K 1/16W 1%                           | AAC, CR16-2322FM 0603            |
| 26   | 2    | R12,R31                    | RES., CHIP 47K 1/16W 5%                             | AAC, CR16-473JM 0603             |
| 27   | 2    | R32,R25                    | RES., CHIP 100K 1/16W 5%                            | AAC, CR16-104JM 0603             |
| 28   | 1    | R17                        | RES., CHIP 2.32K 1/16W 1%                           | AAC, CR16-2321FM 0603            |
| 29   | 1    | U1                         | I.C., 3.3V Single Supply Video Difference Amplifier | Linear Tech. LT6552CDD DFN       |
| 30   | 1    | U2                         | I.C., 3.3V Single Supply Video Difference Amplifier | Linear Tech. LT6552CS8 SO8       |

FIGURE 3. DC815 Bill-of-Material

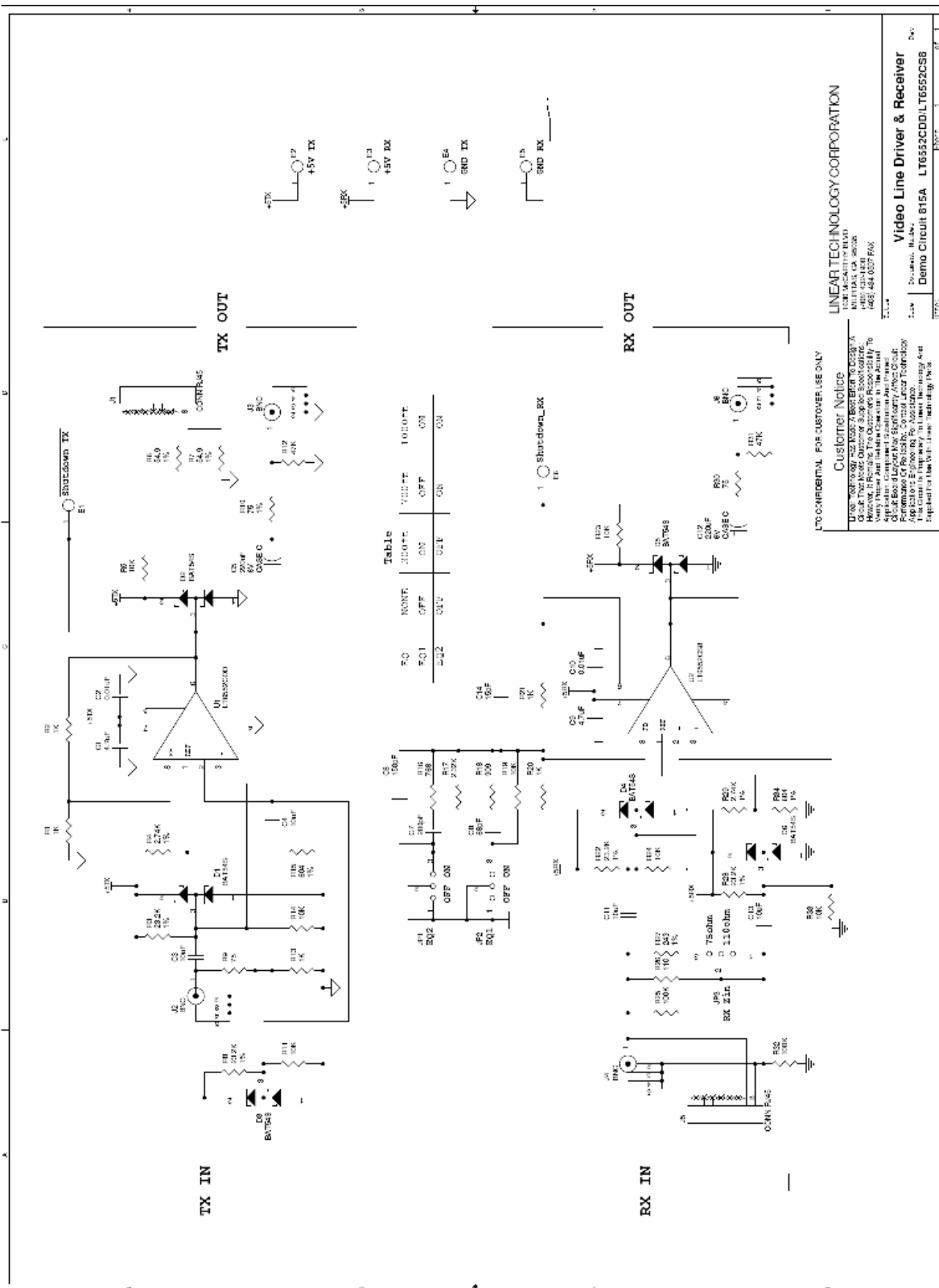


Figure 4. DC815 Electrical Schematic Diagram