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*MEMORANDUM*

DATE: December 24, 2018

TO: SQZ team
FROM: Daniel Sigg, Marc Pirello
SUBJECT: Modifications to the TTFSS V4 for locking the squeezer OPO
Refer to: LIGO-E1800283-v1

This document lists the modifications to the 4th generation TTFSS, based on PCB D1700346-v1 and on schematics D1700077, D1700076 and D1700078.

The modifications in E1700364-v2 need to be implemented first.

Since we lock a laser to an optical cavity, we need to use an IQ Demodulator, D0902745-v5, which implements the ultra-fast option, described in E1100044-v4.

**Board modifications**

Change 1 (Sign):

All TTFSS that use an IQ demodulation board need to implement jumper W1.

W1 → installed (solder jumper)

Change 2 (OPO pole):

The TTFSS transfer function is tailored to a reference cavity that has a pole around 77 kHz. For cavities with a higher pole an additional pole/zero pair has to be added. For the squeezer OPO the pole is around 2 MHz (Servo board, D1700077, top)

C18 → 100 pF (1%, NP0) + 1 kΩ
R14 → 20k

This yields a 76kHz/1.6MHz pole/zero pair after the additive offset path is summed in. This also adds an additional gain of 26 dB at DC.

Change 3 (Slew rate):

This will increase the slew rate limit in the PZT path by approximately 4 (HV board, D1700076, top & bottom).

U16 → AD829
U18 → AD829
C71 → 68 pF
C82 → 68 pF

Change 4 (Gain reallocation in PZT path):

Modify the 100 Hz pole at the PZT output to 100Hz/23kHz pole/zero pair (HV board, D1700076, bottom).

R138 → 15 Ω

Add a 23kHz pole to the fast only path (Servo board, D1700077, top).

C52 → 4.7 nF (1%, NP0)

Take out the 23kHz zero in the other fast path (Servo board, D1700077, top).

R56 → 0 Ω

This should reduce the upfront gain above 100kHz by 5 and more.

BOM (for 10 units, changes 1 through 4):

| Qty | Item | Distributor | Description |
|---|---|---|---|
| 10 | P20KDACT-ND | Digi-Key | R3; 20 kΩ |
| 10 | 80-C1206C101FBG | Mouser | C2; 100 pF |
| 10 | P1.0KDACT-ND | Digi-Key | C2; 1 kΩ |
| 20 | AD829ARZ-ND | Digi-Key | U16, 18; AD829 |
| 20 | 311-1109-1-ND | Digi-Key | C71,82; 68pF |
| 10 | CMF15.0HFCT-ND | Digi-Key | R138; 15 Ω |
| 10 | 80-C0805C472F5GACTU | Mouser | C52; 4.7 nF |
| 10 | P0.0ACT-ND | Digi-Key | R56; 0 Ω |