

## APPLICATIONS INFORMATION

### Bypass and Load Capacitors

The LTC6655 voltage references require a 0.1  $\mu\text{F}$  or larger input capacitor located close to the part to improve power supply rejection. An output capacitor with a value between 2.7  $\mu\text{F}$  and 100  $\mu\text{F}$  is also required.

The output capacitor has a direct effect on the stability, turn-on time and settling behavior. Choose a capacitor with low ESR to insure stability. Resistance in series with the output capacitor (ESR) introduces a zero in the output buffer transfer function and could cause instability. The 2.7  $\mu\text{F}$  to 100  $\mu\text{F}$  range includes several types of capacitors that are readily available as through-hole and surface mount components. It is recommended to keep ESR less than or equal to 0.1  $\Omega$ . Capacitance and ESR are both frequency dependent. At higher frequencies capacitance drops and ESR increases. To insure stable operation the output capacitor should have the required values at 100kHz.

In order to achieve the best performance, caution should be used when choosing a capacitor. X7R ceramic capacitors are small, come in appropriate values and are relatively stable over a wide temperature range. However, for a low noise application X7R capacitors may not be suitable since they may exhibit a piezoelectric effect. The mechanical vibrations cause a charge displacement in the ceramic dielectric and the resulting perturbation can look like noise. If X7R capacitors are necessary, a thorough bench evaluation should be completed to verify proper performance.

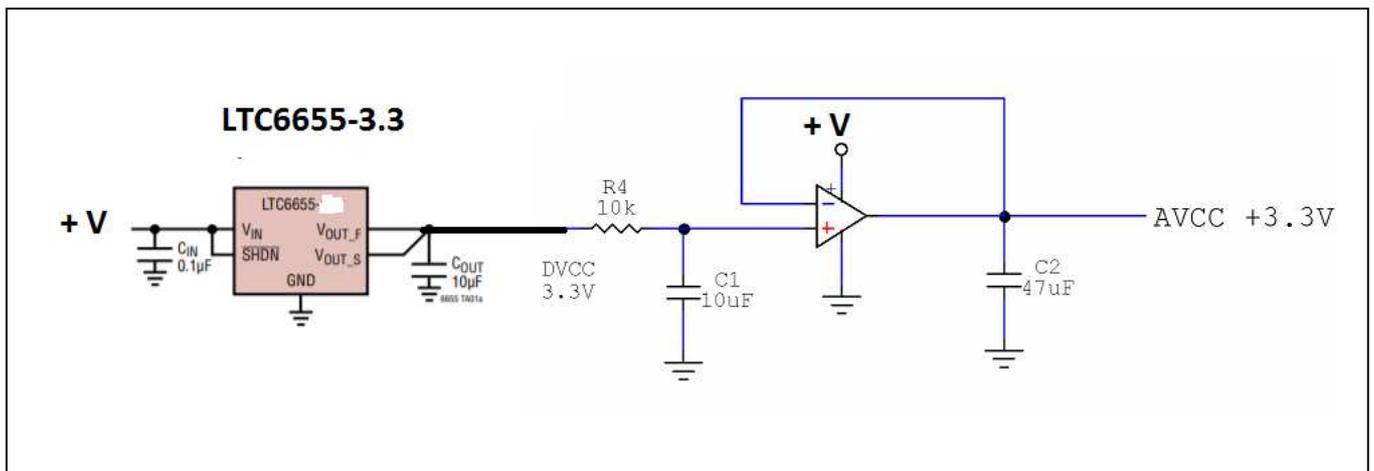
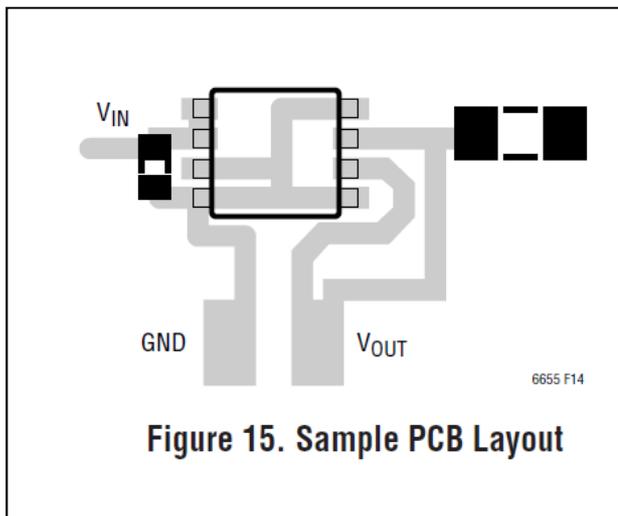
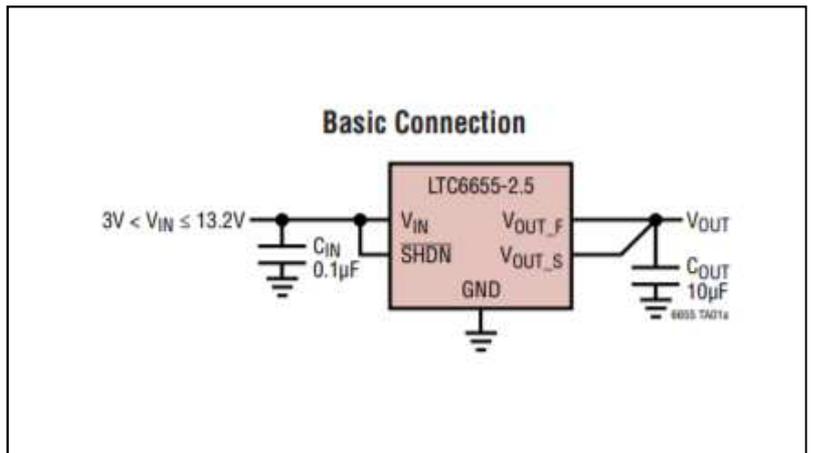
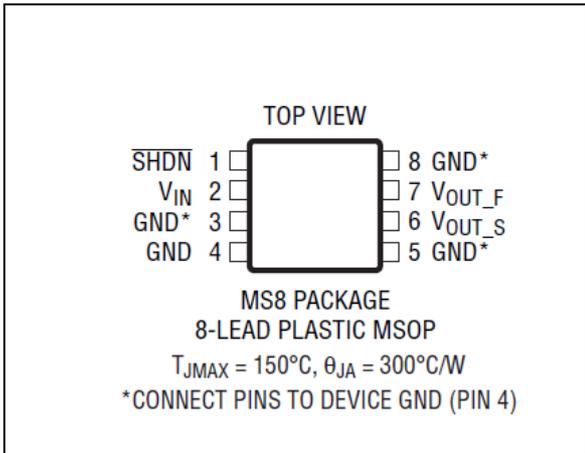
For very low noise applications where every nanovolt counts, film capacitors should be considered for their low noise and lack of piezoelectric effects. Film capacitors such as polyester, polystyrene, polycarbonate, and polypropylene have good temperature stability. Additional care must be taken as polystyrene and polypropylene have an upper temperature limit of 85°C to 105°C. Above these temperatures, the working voltages need to be derated according to manufacturer's specifications. Another type of film capacitor is polyphenylene sulfide (PPS). These devices work over a wide temperature range, are stable, and have large capacitance values beyond 1  $\mu\text{F}$ . In general, film capacitors are found in surface mount and leaded packages. Table 1 is a partial list of capacitor companies and some of their available products.

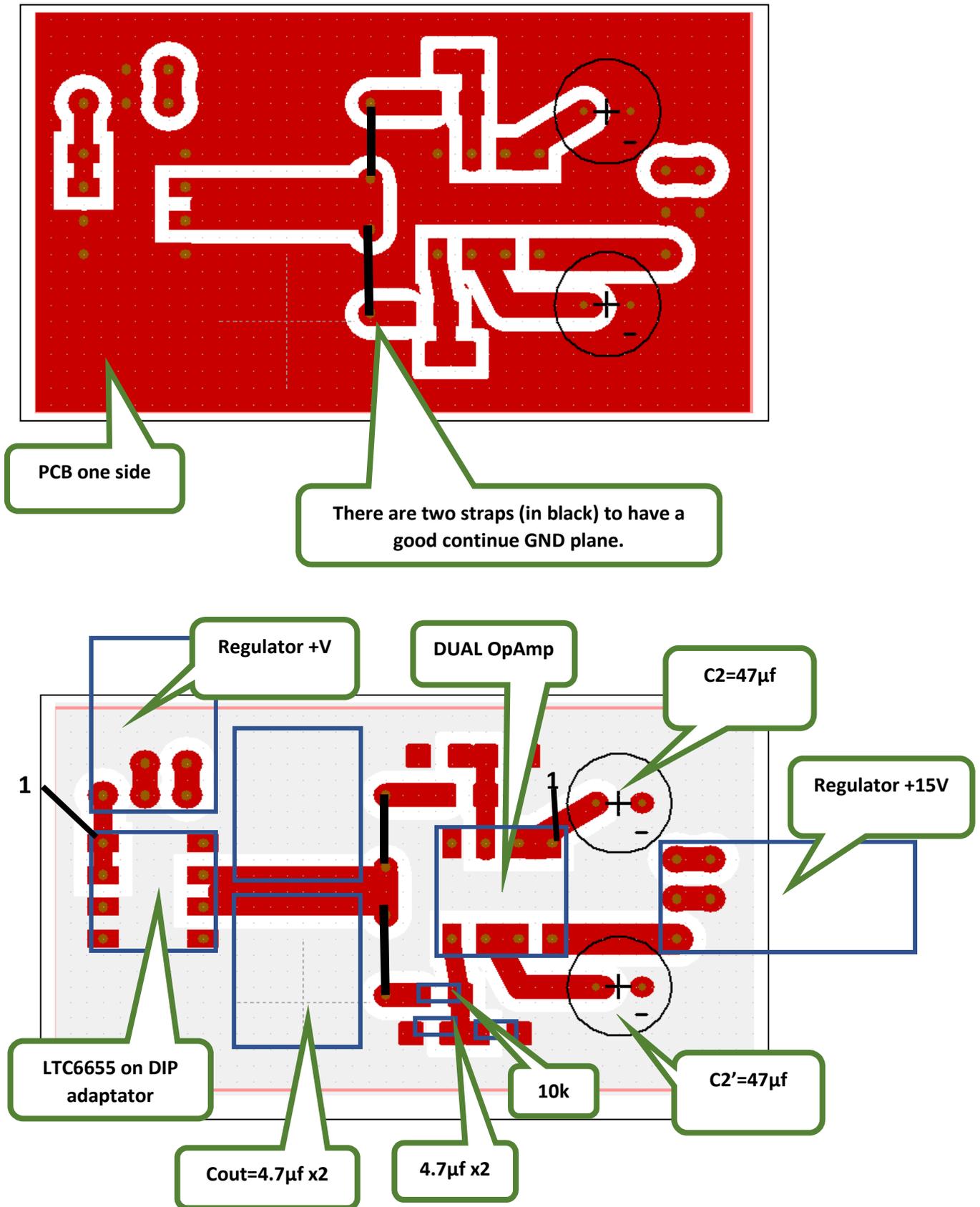
In voltage reference applications, film capacitor lifetime is affected by temperature and applied voltage. When polyester capacitors are operated beyond their rated temperatures (some capacitors are not rated for operation above 85°C) they need to be derated. Voltage derating is usually accomplished as a ratio of applied voltage to rated voltage limit. Contact specific film capacitor manufacturers to determine exact lifetime and derating information.

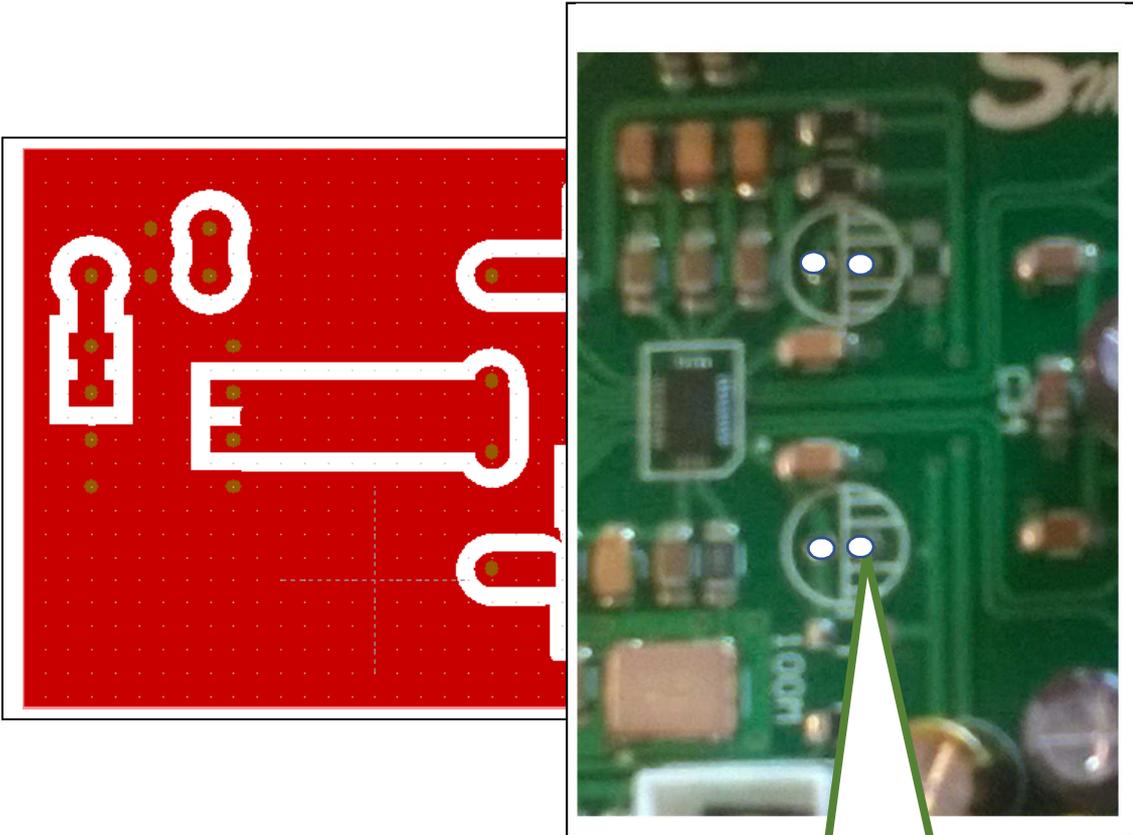
The lifetime of X7R capacitors is long, especially for reference applications. Capacitor lifetime is degraded by operating near or exceeding the rated voltage, at high temperature, with AC ripple or some combination of these. Most reference applications have AC ripple only during transient events.

**Table 1. Film Capacitor Companies**

COMPANY	DIELECTRIC	AVAILABLE CAPACITANCE	TEMPERATURE RANGE	TYPE
Cornell Dublier	Polyester	0.5 $\mu\text{F}$ to 10 $\mu\text{F}$	-55°C to 125°C	DME
Dearborn Electronics	Polyester	0.1 $\mu\text{F}$ to 12 $\mu\text{F}$	-55°C to 125°C	218P, 430P, 431P, 442P, and 410P
Tecate	Polyester	0.01 $\mu\text{F}$ to 18 $\mu\text{F}$	-40°C to 105°C	901, 914, and 914D
Wima	Polyester	10 $\mu\text{F}$ to 22 $\mu\text{F}$	-55°C to 100°C	MKS 4, MKS 2-XL
Vishay	Polyester	1000pF to 15 $\mu\text{F}$	-55°C to 125°C	MKT1820
Vishay	Polycarbonate	0.01 $\mu\text{F}$ to 10 $\mu\text{F}$	-55°C to 100°C	MKC1862, 632P
Dearborn Electronics	Polyphenylene Sulfide (PPS)	0.01 $\mu\text{F}$ to 15 $\mu\text{F}$	-55°C to 125°C	820P, 832P, 842P, 860P, and 880P
Wima	Polyphenylene Sulfide (PPS)	0.01 $\mu\text{F}$ to 6.8 $\mu\text{F}$	-55°C to 140°C	SMD-PPS







The PCB is under the DAC and the leads ( 47µf ) are soldered on the DAC

I have not yet test the circuit ...to be continued