OHMEDA PROBLEM - HOSPITALS CLAIM THAT VIAMED'S PROBES (P867RA) DIDNT WORK. OHMEDA'S METHOD OF BUIDLING WAFERS CAUSED PROBLEMS. WHEN THEY BUILD UP THE LAYERS OF SILICON TO PRODUCE A WAFER TO BE USED IN THE SENSOR IN THE PROBES, THEY PICK WAFERS AT RANDOM WHICH CAUSED THE PROBLEMS AND LED TO THE USE OF DIFFERENT RESISTORS. THE PROBLEM WITH VIAMED'S P867RA IS THAT THEY ARE TOO GOOD. VIAMED USED TO USE THE BEST LEAD FRAME & WAFERS AND THEY WERE VERY ACCURATE AND THEREFORE DID NOT SOMETIMES WORK ON OHMEDA MONITORS.
HISTORICALLY, THE OMEDA 3800 CAUSED A PROBLEM BECAUSE THERE WAS A SWITCH ON THE MONITOR, UP & DOWN,
A. PULSE - SPO2 READINGS OF 99-100
B. SAO2 - READINGS OF 97-98 (IT CANNT BE THIS AS SAO2 IS SUPPOSED TO BE MULTI)
GOLD STANDARD IN INDUSTRY
BUD GAS ANALYSIS - BLOOD SAMPLE
OR MULTIPLE WAVELENGTH OMITTERS
- (97% NORMAL ADULT)
VIAMED APPLY THE GOLD STANDARD, & THAT IS THE REASON WHY OUR OHMEDA PROBES WERENT WORKING PROPERLY.
- NOW WE CAN SOLVE THIS PROBLEM BY :
1. CHANGING THE CABLE LENGTH
2. ALTERING THE QUALITY OF OMITERS IN THE PROBE.
ONLY TELL CUSTOMERS:
1. WE HAVE RESPECIFIED/DESPECIFIED THE PROBE
2. WE HAVE DOWNGRADED VIAMED'S PROBE TO MATCH OHMEDA'S
3. WE HAVE WIDENED THE TOLERANCES OF THE VIAMED PROBE.
4. WE HAVE OPENED UP THE SPECIFICATIONS.

Positioning a finger in a probe
----------/----- Nellcor & Ohmeda
------/---------- Viameds
The disadvantage with top above positioning is a fat or thin person will not be able to get a reading.
The correct technique has been lost. Refer to the manual, ideally the alignment mark should be over the persons cuticle.

Underread of P867RA probes on Ohmeda 3800 pulse oximeter : 19-1-01 : SW.

Aristo range of probes evaluated on 3700 & 3800 pulse oximeters.
Recorded SpO2 as below.

Aristo Finger:	3700: 94% @ 97% (DL)	Human (SW): 100.
	3800: 94% @ 97% (DL)	Human (SW): 99.
Aristo Y probe:	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 95% @ 97% (DL)	Human (SW): 97.
Aristo Disposable : (Adult)	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 94% @ 97% (DL)	Human (SW): 99.
Aristo Disposable : (Neonatal)	3700: 97% @ 97% (DL)	Human (SW): 98.
	3800: 96% @ 97% (DL)	Human (SW): 97.
Aristo Disposable : (Pediatric)	3700: Can't test on DL	Human (SW): 99.
	3800: Can't test on DL	Human (SW): 99.
Aristo Ear Neonatal:	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 94% @ 97% (DL)	Human (SW): 99.
Aristo D.O.T : (Adult)	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 94% @ 97% (DL)	Human (SW): 98.
OSS Disposable:	3700: 97% @ 97% (DL)	Human (SW): 100.
	3800: 95% @ 97% (DL)	Human (SW): 98.

* Aristo disposable neonatal selected as most consistent SpO2 reading on simulator and human subject. Aristo disposable adult noted to have alternative detector, therefore selected also as a comparison. LED's & detectors from both probes removed and fitted into Viamed finger probes for further evaluation.

Prototype P867RA (Labelled A1, based upon Aristo disposable adult optics).

DL-3000 :	97	95	90	80	70	60
3700e :	95	93	89	80	71	62
DL-3000 :	97	95	90	80	70	60
3800 :	94	93	88	78	69	59

Human : 3700 : 98
3800 : 96

Prototype P867RA (Labelled A2, based upon Aristo disposable neonatal optics).

DL-3000 :	97	95	90	80	70	60
3700e :	97	95	90	80	70	61
DL-3000 :	97	95	90	80	70	60
3800 :	97	95	90	80	70	60

Human (SW) 3700 : 99
3800 : 99/98

Prototype P867RA (A1) shows inconsistant SpO2 readings, therefore rejected.
Prototype P867RA (A2) shows consistant SpO2 readings, therefore further evaluated.

Test of Prototype P867RA (A2) on human subjects.

Subject 1 (MS)	3700 : 99/98	3800 : 99
Subject 2 (SW)	3700 : 99	3800 : 99/98
Subject 3 (AB)	3700 : 99/98	3800 : 98
Subject 4 (MFG)	3700 : 98	3800 : 98
Subject 5 (DB)	3700 : 98	3800 : 98
Subject 6 (JB)	3700 : 98	3800 : 98
Subject 7 (RT)	3700 : 98	3800 : 98
Subject 8 (SV)	3700 : 98	3800 : 98
Subject 9 (LN)	3700 : 97	3800 : 98
Subject 10 (MS)	3700 : 100	3800 : 100
Subject 11 (RA)	3700 : 99	3800 : 98/97
Subject 12 (AH)	3700 : 97	3800 : 96
Subject 13 (ML)	3700 : 96	3800 : 97/96
Subject 14 (RM)	3700 : 99	3800 : 99

Prototype probe (A2) seems to reproduce SpO2 values consistantly (+/- 1%) on both 3700 & 3800 oximeters. Alignment problems minimised, as below, however recommend index marks to be introduced and optics moved forward more towards finger nail area.

A2 : Aligned	3700 : 100/99	3800 : 99
A2 : Misaligned	3700 : 98	3800 : 98

Test results of P867RA fitted with Ohmeda components : SW : 20-08-01.

2 probes built using Ohmeda original LEDs and MCI / PDI detectors. Both probes constructed as per stock supplied MCI P867RA's. Results as below :-

Ohmeda LED, PDI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	98	94	80	69	59

Human (SW) : 3700, Ohmeda original : 97 3700, Probe as above : 97
3800, Probe as above : 96 3800, Ohmeda original : 97

Ohmeda LED, MCI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	60
DL target	98	94	80	70	60
3800	98	94/93	80/79	69	59

Human (SW) : 3700, Ohmeda original : 98 3700, Probe as above : 97
3800, Probe as above : 98 3800, Ohmeda original : 97

Conclusion.

Only change in these probes to stock MCI P867RA's is change of LED package.

Based on current understanding of the DL-3000, LED package change should not have an effect on derived SpO2 values as the DL-3000 should continue to produce identical red to infrared ratios regardless of the change.

The only difference identified between the packages fitted above and MCI/PDI LED packages is the red wavelength : Ohmeda 650.5nm, MCI 658.0nm and PDI 658.0nm.(measured on Prema 9001).

Action : Build prototype using 650nm red emitter to eliminate this as source of underread. Samples requested to be sourced by SN from Dai Shin or alternative supplier at 650nm / 930nm respectively.

Test results of P867RA fitted with Ohmeda components : SW : 20-08-01.

2 probes built using Ohmeda original LEDs and MCI / PDI detectors. Both probes constructed as per stock supplied MCI P867RA's. Results as below :-

Ohmeda LED, PDI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	98	94	80	69	59

Human (SW) : 3700, Ohmeda original : 97 3700, Probe as above : 97
3800, Probe as above : 96 3800, Ohmeda original : 97

Ohmeda LED, MCI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	60
DL target	98	94	80	70	60
3800	98	94/93	80/79	69	59

Human (SW) : 3700, Ohmeda original : 98 3700, Probe as above : 97
3800, Probe as above : 98 3800, Ohmeda original : 97

Conclusion.

Only change in these probes to stock MCI P867RA's is change of LED package.

Based on current understanding of the DL-3000, LED package change should not have an effect on derived SpO2 values as the DL-3000 should continue to produce identical red to infrared ratios regardless of the change.

The only difference identified between the packages fitted above and MCI/PDI LED packages is the red wavelength : Ohmeda 650.5nm, MCI 658.0nm and PDI 658.0nm.(measured on Prema 9001).

Action : Build prototype using 650nm red emitter to eliminate this as source of underread. Samples requested to be sourced by SN from Dai Shin or alternative supplier at 650nm / 930nm respectively.

Report : Underread of P867RA on Ohmeda 3700e oximeter.

05-07-02.

Three probes tested: CF61092252, CF61092262, CF61092263.

CF61092252	Initially reads 93%. Increases to 95% in approx 5 seconds, then increases to stable 97% in approx 40 seconds.
CF61092262	Reads 95% for full duration of test.
CF61092263	Initially reads 93%, climbing to stable 97% in 5 seconds.

CF61092252	658.0	928.3	56.2
CF61092262	658.0	928.3	56.3
CF61092263	658.0	931.5	56.7

Spec: Red 660+/-3nm: All probes OK.
Infrared 940+/-10nm: All probes at very lowest wavelength to meet specs.

LED electrical characteristic: CF61092252 (probe alone).

1350	0.00	850	0.04
1400	0.00	900	0.07
1450	0.05	950	0.14
1500	0.11	1000	0.32
1550	0.27	1050	0.81
1600	0.81	1100	2.08
1650	2.48	1150	4.49
1700	5.79	1200	8.08
1750	10.36	---	---
1800	15.77	---	---

LED electrical characteristic: CF61092262 (probe alone).

1350	0.00	850	0.04
1400	0.00	900	0.08
1450	0.05	950	0.17
1500	0.08	1000	0.38
1550	0.20	1050	0.91
1600	0.66	1100	2.08
1650	2.25	1150	4.08
1700	5.54	1200	6.76

1750	10.30	---	---
1800	15.68	---	---

LED electrical characteristic: CF61092263 (probe alone).

1350	0.00	850	0.04
1400	0.00	900	0.07
1450	0.03	950	0.14
1500	0.07	1000	0.33
1550	0.19	1050	0.93
1600	0.51	1100	2.53
1650	1.96	1150	5.72
1700	4.99	1200	10.33
1750	9.32	---	---
1800	14.68	---	---

LED electrical characteristic: CF61092252 (probe with adapter fitted).

1350	0.00	850	2.45
1400	0.00	900	2.99
1450	0.05	950	3.58
1500	0.11	1000	4.30
1550	0.27	1050	5.33
1600	0.81	1100	7.16
1650	2.48	1150	10.12
1700	5.79	1200	14.28
1750	10.36	---	---
1800	15.77	---	---

LED electrical characteristic: CF61092262 (probe with adapter fitted).

1350	0.00	850	2.45
1400	0.00	900	3.00
1450	0.05	950	3.61
1500	0.08	1000	4.36
1550	0.20	1050	5.43
1600	0.66	1100	7.16
1650	2.25	1150	9.71
1700	5.54	1200	12.96
1750	10.30	---	---
1800	15.68	---	---

LED electrical characteristic: CF61092263 (probe with adapter fitted).

1350	0.00	850	2.45
1400	0.00	900	2.99
1450	0.03	950	3.58
1500	0.07	1000	4.31
1550	0.19	1050	5.45
1600	0.51	1100	7.61
1650	1.96	1150	11.35
1700	4.99	1200	16.53
1750	9.32	---	---
1800	14.68	---	---

Probes tested with adapter cable fitted:

CF61092252	96% for 3 seconds then stable 97%.
CF61092262	Reads 96% initially, increasing to 97/98% from then on.
CF61092263	Initially 96%, 97% in approx 1 second, then 98% from then on.

Conclusion:

Infrared emitters fitted in these probes do not conduct sufficiently high levels of current to be compatible with the Ohmeda 3700e, resulting in low readings of spO2.

Action req'd:

Alternatively:

1. Replace LED's with components capable of conducting higher levels of current for the infrared emitter.

2. Fit a series diode resistor combination in parallel to the infrared emitter to increase current with the driving 3700e thereby increasing displayed spO2.

Underread of P867RA probes on Ohmeda 3800 pulse oximeter : 19-1-01 : SW.

Aristo range of probes evaluated on 3700 & 3800 pulse oximeters.
Recorded SpO2 as below.

Aristo Finger:	3700: 94% @ 97% (DL)	Human (SW): 100.
	3800: 94% @ 97% (DL)	Human (SW): 99.
Aristo Y probe:	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 95% @ 97% (DL)	Human (SW): 97.
Aristo Disposable : (Adult)	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 94% @ 97% (DL)	Human (SW): 99.
Aristo Disposable : (Neonatal)	3700: 97% @ 97% (DL)	Human (SW): 98.
	3800: 96% @ 97% (DL)	Human (SW): 97.
Aristo Disposable : (Pediatric)	3700: Can't test on DL	Human (SW): 99.
	3800: Can't test on DL	Human (SW): 99.
Aristo Ear Neonatal:	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 94% @ 97% (DL)	Human (SW): 99.
Aristo D.O.T : (Adult)	3700: 95% @ 97% (DL)	Human (SW): 99.
	3800: 94% @ 97% (DL)	Human (SW): 98.
OSS Disposable:	3700: 97% @ 97% (DL)	Human (SW): 100.
	3800: 95% @ 97% (DL)	Human (SW): 98.

* Aristo disposable neonatal selected as most consistent SpO2 reading on simulator and human subject. Aristo disposable adult noted to have alternative detector, therefore selected also as a comparison. LED's & detectors from both probes removed and fitted into Viamed finger probes for further evaluation.

Prototype P867RA (Labelled A1, based upon Aristo disposable adult optics).

DL-3000 :	97	95	90	80	70	60
3700e :	95	93	89	80	71	62
DL-3000 :	97	95	90	80	70	60
3800 :	94	93	88	78	69	59

Human : 3700 : 98
3800 : 96

Prototype P867RA (Labelled A2, based upon Aristo disposable neonatal optics).

DL-3000 :	97	95	90	80	70	60
3700e :	97	95	90	80	70	61
DL-3000 :	97	95	90	80	70	60
3800 :	97	95	90	80	70	60

Human (SW) 3700 : 99
3800 : 99/98

Prototype P867RA (A1) shows inconsistant SpO2 readings, therefore rejected.
Prototype P867RA (A2) shows consistant SpO2 readings, therefore further evaluated.

Test of Prototype P867RA (A2) on human subjects.

Subject 1 (MS)	3700 : 99/98	3800 : 99
Subject 2 (SW)	3700 : 99	3800 : 99/98
Subject 3 (AB)	3700 : 99/98	3800 : 98
Subject 4 (MFG)	3700 : 98	3800 : 98
Subject 5 (DB)	3700 : 98	3800 : 98
Subject 6 (JB)	3700 : 98	3800 : 98
Subject 7 (RT)	3700 : 98	3800 : 98
Subject 8 (SV)	3700 : 98	3800 : 98
Subject 9 (LN)	3700 : 97	3800 : 98
Subject 10 (MS)	3700 : 100	3800 : 100
Subject 11 (RA)	3700 : 99	3800 : 98/97
Subject 12 (AH)	3700 : 97	3800 : 96
Subject 13 (ML)	3700 : 96	3800 : 97/96
Subject 14 (RM)	3700 : 99	3800 : 99

Prototype probe (A2) seems to reproduce SpO2 values consistantly (+/- 1%) on both 3700 & 3800 oximeters. Alignment problems minimised, as below, however recommend index marks to be introduced and optics moved forward more towards finger nail area.

A2 : Aligned	3700 : 100/99	3800 : 99
A2 : Misaligned	3700 : 98	3800 : 98

Underread of P867RA probes on Ohmeda 3800 pulse oximeter : 02-03-01 : SW.

2nd P867RA prototype based upon Aristo neonatal disposable optics built into Viamed clip - labelled Proto A5.

Both prototypes A2 & A5 evaluated by SW and independently by RT - results as follows :-

SW.

A2	3700	97	90	80	70	60	- Target DL3000.
		97	91	81	71	62	- Displayed SpO2.
	3800	97	90	80	70	60	- Target DL3000.
		97	90	80	70	59	- Displayed SpO2.
Finger	3700	100 (aligned)	98 (mis-aligned)				
	3800	99 (aligned)	98 (mis-aligned)				
A5	3700	97	90	80	70	60	- Target DL3000.
		97	90	81	71	61	- Displayed SpO2.
	3800	97	90	80	70	60	- Target DL3000.
		96	89	79	69	59	- Displayed SpO2.
Finger	3700	100 (aligned)	99 (mis-aligned)				
	3800	98 (aligned)	98 (mis-aligned)				

RT.

A2	3700	97	90	80	70	60	- Target DL3000.
		97	91	82	71	60	- Displayed SpO2.
	3800	97	90	80	70	60	- Target DL3000.
		97	90	81	70	60	- Displayed SpO2.
Finger	3700	97 (aligned)	98 (mis-aligned)				
	3800	98 (aligned)	97 (mis-aligned)				
A5	3700	97	90	80	70	60	- Target DL3000.
		97	90	80	70	61	- Displayed SpO2.
	3800	97	90	80	70	60	- Target DL3000.
		96	90	79	69	59	- Displayed SpO2.
Finger	3700	98 (aligned)	97 (mis-aligned)				
	3800	98 (aligned)	96 (mis-aligned)				

Test of 1st batch of Southmead spec probes : SW : 11-5-01.

1st batch of 25 probes tested on both 3700e & 3800 oximeters - details as per original document held in Southmead folder.

Test of MCI prototype P867RA's : SW : 25-6-01.

4 x prototype P867RA's received from MCI and tested against the Ohmeda 3800 oximeter on 14-6-01. Probes labelled 1,2,3 & 7 for reference.

Probes tested in comparison to known good simulator signals from DL-3000 SpO2 simulator and on a human subject.

Results as follows :-

Probe 1.

Human	Sim : 97%	Sim : 90%	Sim : 80%	Sim : 70%	Sim : 60%
98	94	87	77	68	57

Probe 2.

Human	Sim : 97%	Sim : 90%	Sim : 80%	Sim : 70%	Sim : 60%
98	94	88	79	68	58

Probe 4.

Human	Sim : 97%	Sim : 90%	Sim : 80%	Sim : 70%	Sim : 60%
97	94	88	77	67	57

Probe 7.

Human	Sim : 97%	Sim : 90%	Sim : 80%	Sim : 70%	Sim : 60%
98	94	87	77	67	57

Conclusion.

Probes read generally 2-3% low on this oximeter and are hence unsuitable.

P867 underead : Dai shin prototype : SW : 05-07-01.

P867RA prototype constructed using Dai Shin samples, results as follows :-

Probe tested on same hand to both oximeter models. 3800 reads 2% lower than 3700 independent of clip site, in comparison to Ohmeda original finger probe.

Conclusion : Unsuitable.

Exact part nos not known.

P867RA underread : Doklphin prototypes : SW : 02-07-01.

Optics taken from Dolphin Ohmeda compatible disposables and fitted (minus metal grid screens) into Viamed clips for evaluation. Results as follows :-

Serial no. 0016-1.

3700 oximeter.

DL3000 target :	98	94	80	70	60
Displayed :	98	94	80	71	62

3800 oximeter.

DL3000 target :	98	94	80	70	60
Displayed :	95	92	78	68	58

Serial no. 0103-2.

3700 oximeter.

DL3000 target :	98	94	80	70	60
Displayed :	98	94	80	71	61

3800 oximeter.

DL3000 target :	98	94	80	70	60
Displayed :	98	94	80	70	61

* Both probes tested on same hand to both oximeter models. 3800 reads 2% lower than 3700 independent of clip site, in comparison to Ohmeda original finger probe.

Conclusion : Both unsuitable.

P867RA underread : SW : 27-07-01.

Viamed optics fitted into Viamed shells / pad etc with O ring immediately infront of LED and Detector packages. Probe tested on DL-3000. Results as follows :-

3700 oximeter.

Target DL3000 Spo2 value	98	94	80	70	60
Displayed Spo2 value	Insufficient light on all values				

3800 oximeter.

Target DL3000 Spo2 value	98	94	80	70	60
Displayed Spo2 value	968	92	80	71	60

Test results of P867RA fitted with Ohmeda components : SW : 02-08-01.

3 probes built using Ohmeda original components / PDI components, results as below :-

PDI LED, PDI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	62
DL target	98	94	80	70	60
3800	96	92	79	69	59

PDI LED, Ohmeda sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	95	91	79	70	60

Ohmeda LED, Ohmeda sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	98	94	80	70	60

Ohmeda LED, PDI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	98	94	80	69	59

Conclusion - Change of LED package cures or compensates for cause of 2% underread.

Results of tests on Dai Shin prototype (2 x Infrared emitters) based P867RA : SW : 15-08-01.

As stock, 12 ft length, 68k resistor, no windows, labelled "Dai Shin proto 2 x IR's".

Shows "probe failure" when test attempted on DL-3000, 3800 (frac).

On Human (SW):-

3700	Original Ohmeda Lot 27299	98
3800	Dai shin prototype	95
3700	Dai shin prototype	95
3800	Original Ohmeda Lot 27299	98

Conclusion.

Unsuitable.

Results of test of MCI P867RA fitted with Ohmeda original cable : SW : 03-08-01.

P867RA constructed using MCI optics, our connector, shells, pads etc, using Ohmeda original cable. Fitted with a 23.2k resistor. 10ft length. Pin out as MCI.

Results as below :-

DL target	98	94	90	80	70	60
3700	98/97	94/93	90	80/79	70	60
DL target	98	94	90	80	70	60
3740	98	95/94	91	81	72	63
DL target	98	94	90	80	70	60
3800	98	94	90	81	72	63

Conclusion.

Change of resistor to value in the lower region of acceptable range gives extra 1% in displayed SpO2 for high 90's using the 3800. It doesnot adversely affect the lower SpO2 values.

Change of resistor causes change in the lower SpO2 values for the 3700 & 3740, values remaining within +/- 3%.

Probe component changes compensate or cure previous 2% underread.

Results of tests on MCI based P867RA (special) : SW : 15-08-01.

As stock except shortened to match comparson and resistor change.

Wavelength (red) : 654.7-658.0nm.
Wavelength (infrared) : 931.5-934.8nm.
resistor : 21.997kohm.
Length :
Forward diode voltage (red) : 1.5V.
Forward diode voltage (infrared) : 1.0V.
Forward diode voltage (detector) : 0.4V.
DL3000 module returns (attenuated setting) : Red, 17, Infrared, 16.
Reads 97% on 3800 against DL3000.
Human : SW : 97%.

Test of emitters and detector (voltages and currents measured at connector).
Detector test c/o sheilded from ambient light.

Red current at measured voltage .	Infrared current at measured voltage.	Detector voltage in response to red.	Detector voltage in response to infrared.
< 1µA.	700mV, 1µA.	< 5.2mV.	700mV, < 4.0mV.
< 1µA.	752mV, 2µA.	< 5.2mV.	752mV, 4.0mV.
< 1µA.	804mV, 7µA.	< 5.2mV.	803mV, 4.3mV.
< 1µA.	846mV, 16µA.	< 5.2mV.	854mV, 8.3mV.
< 1µA.	897mV, 43µA.	< 5.2mV.	906mV, 34.7mV.
< 1µA.	949mV, 116µA.	< 5.2mV.	947mV, 102.5mV.
< 1µA.	1000mV, 326µA.	< 5.2mV.	998mV, 171.6mV.
< 1µA.	1047mV, 896µA.	< 5.2mV.	1040mV, 214.2mV.
< 1µA.	1101mV, 2743µA.	< 5.2mV.	1099mV, 263.2mV.
< 1µA.	1143mV, 5482µA.	< 5.2mV.	1141mV, 288.6mV.
1200mV, 1µA.	1202mV, 11574µA.	< 5.2mV.	1200mV, 317.0mV.
1250mV, 1µA.		< 5.2mV.	
1302mV, 2µA.		< 5.2mV.	
1342mV, 4µA.		1346mV, 5.0mV.	
1392mV, 11µA.		1391mV, 6.7mV.	
1451mV, 32µA.		1450mV, 18.1mV.	
1501mV, 79µA.		1499mV, 76.0mV.	
1549mV, 199µA.		1548mV, 153.4mV.	
1601mV, 609µA.		1604mV, 215.7mV.	
1650mV, ----µA.		1657mV, 257.4mV.	
1696mV, 4594µA.		1704mV, 288.7mV.	
1754mV, 9949µA.		1752mV, 310.5mV.	
1802mV, 15370µA.		1800mV, 325.0mV.	

Results of tests on stock MCI P867RA's : SW : 08-08-01.

Stock MCI based P867RA taken from stock. Tested on 3800 / DL3000 - proven to read 2 to 3% low. 12ft long, 68k resistor.

Led removed and old style CSI Led fitted with 2 x infrared Leds on single ceramic -
unable to get probe to read on 3800 using DL3000.

Stock MCI based P867RA taken from stock. Tested on 3800 / DL3000 - proven to read 2 to 3% low. 12ft long, 68k resistor.

Sheilds shorted together at clip, both sheilds commoned to resistor at connector -
no change when tested.

Sheilds shorted together at clip, inner sheild connected to resistor at connector -
no change when tested.

Sheilds shorted together at clip, outer sheild connected to resistor at connector -
no change when tested.

Sheilds opened at clip, only inner sheild connected to resistor at connector -
no change when tested.

Sheilds opened at clip, only outer sheild connected to resistor at connector -
no change when tested.

Sheilds opened at clip, inner sheild connected to resistor at connector, outer to yellow (common anode) -
no change when tested.

Sheilds opened at clip, inner sheild connected to resistor at connector, outer to red (red cathode) -

no change when tested.

Sheilds opened at clip, inner sheild connected to resistor at connector, outer to orange (infrared cathode) -
no change when tested.

100k variable resistor connected across red led -
Occasionally reads 1% lower when tested, unable to show this happens at a given resistor setting.

100k variable resistor connected across infrared led -
no change when tested.

Jacket & outer sheild stripped and heatshrink tube used to simulate jacket, inner screen connected to resistor at connector -
reads 1% low when tested.

Ohmeda finger probe, lot 27299 : SW : 02-08-01.

6 core cable, red, brown, green, orange, black, white.

black / white form twisted pair enclosed in twisted inner sheild.

pin	1	orange	infrared cathode
	2	green	red cathode
	3	not used	
	4	brown/red	common anode
	5	resistor	51.14 kohm
	6	not used	
	7	sheild/resistor	common point
	8	black	detector anode
	9	white	detector cathode

emitters tested at 651.5nm (*) & 931.5nm respectfully.

(*) Not 660nm as previously thought.

Results of tests on Ohmeda original finger probe, Lot 27299 : SW : 15-08-01.

Wavelength (red) : 651.5nm. (*) Not 660nm as previously thought.
Wavelength (infrared) : 928.3-931.5nm.
resistor : 50.8kohm.
Length :
Forward diode voltage (red) : 1.5V.
Forward diode voltage (infrared) : 1.0V.
Forward diode voltage (detector) : 0.4V.
DL3000 module returns (attenuated setting) : Red, 19, Infrared, 50.
Reads 97% on 3800 against DL3000.
Human : SW : 97%.

Test of emitters and detector (voltages and currents measured at connector).

Red current at measured voltage .	Infrared current at measured voltage.	Detector voltage in response to red.	Detector voltage in response to infrared.
< 1µA.	700mV, 1µA.	< 17.6mV.	700mV, 16.0mV.
< 1µA.	754mV, 3µA.	< 17.6mV.	752mV, 16.3mV.
< 1µA.	803mV, 7µA.	< 17.6mV.	803mV, 18.1mV.
< 1µA.	854mV, 19µA.	< 17.6mV.	854mV, 30.9mV.
< 1µA.	897mV, 43µA.	< 17.6mV.	906mV, 100.7mV.
< 1µA.	957mV, 147µA.	< 17.6mV.	947mV, 169.8mV.
< 1µA.	9990mV, 341µA.	< 17.6mV.	998mV, 228.9mV.
< 1µA.	1059mV, 1234µA.	< 17.6mV.	1040mV, 269.2mV.
< 1µA.	1100mV, 2800µA.	< 17.6mV.	1099mV, 320.4mV.
< 1µA.	1142mV, 5927µA.	< 17.6mV.	1141mV, 348.0mV.
1200mV, 1µA.	1196mV, 11900µA.	< 17.6mV.	1200mV ,378.0mV.
1248mV, 2µA.		< 17.6mV.	
1298mV, 5µA.		1291mV, 17.6mV.	
1348mV, 12µA.		1351mV, 18.7mV.	
1396mV, 30µA.		1401mV, 27.0mV.	
1447mV, 76µA.		1450mV, 75.0mV.	
1496mV, 192µA.		1498mV, 158.7mV.	
1557mV, 602µA.		1558mV, 222.3mV.	
1610mV, 1193µA.		1607mV, 262.4mV.	
1645mV, 2399µA.		1647mV, 288.3mV.	
1703mV, 4696µA.		1704mV, 316.5mV.	
1751mV, 7132µA.		1752mV, 333.0mV.	
1802mV, 10076µA.		1801mV, 349.0mV.	

Results of test of PDI based P867RA fitted with Ohmeda original cable : SW : 06-08-01.

P867RA constructed using PDI optics, our connector, shells, pads etc, using Ohmeda original cable. Fitted with a 22k resistor. Approx. 10ft length. Pin out as Ohmeda original.

Results as below :-

DL target	98	94	90	80	70	60
3800	98	94	90	80	71	61
DL target	98	94	90	80	70	60
3740	98	94	90	80	71	61
DL target	98	94	90	80	70	60
3700	98	94	90	81	72	63

Conclusion.

Change of resistor to value in the lower region of acceptable range gives extra 1% in displayed SpO2 for high 90's using the 3800. It doesnot adversely affect the lower SpO2 values.

Change of resistor causes change in the lower SpO2 values for the 3700 & 3740, values remaining within +/- 3%.

Probe component changes compensate or cure previous 2% underread.

Results of tests on MCI based P867RA : SW : 15-08-01.

As stock except shortened to match comparison & resistor change.

Wavelength (red) : 654.7-658.0nm.
Wavelength (infrared) : 931.5nm.
Resistor : 21.889kohm.
Length :
Forward diode voltage (red) : 1.5V.
Forward diode voltage (infrared) : 1.0V.
Forward diode voltage (detector) : 0.4V.
DL3000 module returns (attenuated setting) : Red, 39, Infrared, 26.
Reads 96% on 3800 against DL3000.
Human : SW : 97%.

Test of emitters and detector (voltages and currents measured at connector).
Detector test c/o sheilded from ambient light.

Red current at measured voltage .	Infrared current at measured voltage.	Detector voltage in response to red.	Detector voltage in response to infrared.
< 1µA.	700mV, 1µA.	< 3.2mV.	700mV, < 4.0mV.
< 1µA.	742mV, 2µA.	< 3.2mV.	750mV, 4.0mV.
< 1µA.	805mV, 7µA.	< 3.2mV.	795mV, 4.3mV.
< 1µA.	856mV, 19µA.	< 3.2mV.	856mV, 8.3mV.
< 1µA.	907mV, 53µA.	< 3.2mV.	907mV, 34.7mV.
< 1µA.	948mV, 142µA.	< 3.2mV.	948mV, 102.5mV.
< 1µA.	999mV, 310µA.	< 3.2mV.	998mV, 171.6mV.
< 1µA.	1040mV, 684µA.	< 3.2mV.	1040mV, 214.2mV.
< 1µA.	1100mV, 2135µA.	< 3.2mV.	1099mV, 263.2mV.
< 1µA.	1140mV, 4.018µA.	< 3.2mV.	1141mV, 288.6mV.
1202mV, 0µA.	1200mV, 8751µA.	< 3.2mV.	1200mV, 317.0mV.
1253mV, 1µA.		< 3.2mV.	
1302mV, 2µA.		1300mV, 3.1mV.	
1342mV, 4µA.		1348mV, 4.5mV.	
1401mV, 11µA.		1399mV, 7.7mV.	
1451mV, 28µA.		1448mV, 33.6mV.	
1500mV, 67µA.		1497mV, 118.1mV.	
1549mV, 169µA.		1554mV, 193.7mV.	
1599mV, 493µA.		1604mV, 242.8mV.	
1656mV, 1883µA.		1652mV, 283.3mV.	
1705mV, 4585µA.		1701mV, 314.7mV.	
1753mV, 8452µA.		1749mV, 336.0mV.	
1802mV, 13094µA.		1798mV, 353.0mV.	

P867RA underead on 3800 : SW : 03-05-01.

4 Aristo lot no. / Part nos selected to be built up into Viamed clips - results as follows :-

Part no. 241-1, Lot no. 0038-1 (line 1 from table)

3700 oximeter.							
DL3000 target :	98	97	96	95	90	85	80
Displayed :	98	97	96	95	90	86/85	81/80
Human :	98/97 (SW)						
3800 oximeter.							
DL3000 target :	98	97	96	95	90	85	80
Displayed :	97	96	95	94	89	83	78
Human :	98 (SW)						

Conclusion : OK.

Part no. 241-1, lot no. 0031-2 (line 2 from table)

3700 oximeter.							
DL3000 target :	98	97	96	95	90	85	80
Displayed :	97/96	96	95	94	90	85	81
Human :	96 (SW)						
3800 oximeter.							
DL3000 target :	98	97	96	95	90	85	80
Displayed :	96	95	94	93	88	83	78
Human :	96 (SW)						

Conclusion : Unsuitable.

Part no. 241-1. lot no. 0027-3 (line 3 from table)

3700 oximeter.							
DL3000 target :	98	97	96	95	90	85	80
Displayed :	97	96	95	94	89	85	80
Human :	97(SW)						
3800 oximeter.							
DL3000 target :	98	97	96	95	90	85	80
Displayed :	96/95	95	94	93	88	83	78
Human :	96 (SW)						

Conclusion : Unsuitable.

Part no. 241-1, lot no. 0038-1 (line 15 from table)

3700 oximeter.

DL3000 target :	98	97	96	95	90	85	80
Displayed :	98	97	96	95	90	86	81
Human :	100 (SW)						

3800 oximeter.

DL3000 target :	98	97	96	95	90	85	80
Displayed :	98	97	96	95/94	89	84	79
Human :	99 (SW)						

Conclusion : OK.

Test results of P867RA fitted with Ohmeda components : SW : 20-08-01.

2 probes built using Ohmeda original LEDs and MCI / PDI detectors. Both probes constructed as per stock supplied MCI P867RA's. Results as below :-

Ohmeda LED, PDI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	98	94	80	69	59

Human (SW) : 3700, Ohmeda original : 97 3700, Probe as above : 97
3800, Probe as above : 96 3800, Ohmeda original : 97

Ohmeda LED, MCI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	60
DL target	98	94	80	70	60
3800	98	94/93	80/79	69	59

Human (SW) : 3700, Ohmeda original : 98 3700, Probe as above : 97
3800, Probe as above : 98 3800, Ohmeda original : 97

Conclusion.

Only change in these probes to stock MCI P867RA's is change of LED package.

Based on current understanding of the DL-3000, LED package change should not have an effect on derived SpO2 values as the DL-3000 should continue to produce identical red to infrared ratios regardless of the change.

The only difference identified between the packages fitted above and MCI/PDI LED packages is the red wavelength : Ohmeda 650.5nm, MCI 658.0nm and PDI 658.0nm.(measured on Prema 9001).

Action : Build prototype using 650nm red emitter to eliminate this as source of underread. Samples requested to be sourced by SN from Dai Shin or alternative supplier at 650nm / 930nm respectively.

Test results of P867RA fitted with Ohmeda components : SW : 20-08-01.

2 probes built using Ohmeda original LEDs and MCI / PDI detectors. Both probes constructed as per stock supplied MCI P867RA's. Results as below :-

Ohmeda LED, PDI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	61
DL target	98	94	80	70	60
3800	98	94	80	69	59

Human (SW) : 3700, Ohmeda original : 97 3700, Probe as above : 97
3800, Probe as above : 96 3800, Ohmeda original : 97

Ohmeda LED, MCI sensor.

DL target	98	94	80	70	60
3700	98	94	80	70	60
DL target	98	94	80	70	60
3800	98	94/93	80/79	69	59

Human (SW) : 3700, Ohmeda original : 98 3700, Probe as above : 97
3800, Probe as above : 98 3800, Ohmeda original : 97

Conclusion.

Only change in these probes to stock MCI P867RA's is change of LED package.

Based on current understanding of the DL-3000, LED package change should not have an effect on derived SpO2 values as the DL-3000 should continue to produce identical red to infrared ratios regardless of the change.

The only difference identified between the packages fitted above and MCI/PDI LED packages is the red wavelength : Ohmeda 650.5nm, MCI 658.0nm and PDI 658.0nm.(measured on Prema 9001).

Action : Build prototype using 650nm red emitter to eliminate this as source of underread. Samples requested to be sourced by SN from Dai Shin or alternative supplier at 650nm / 930nm respectively.

Test results of shortened MCI based P867RA's: SW : 03-09-01.

1 x MCI P867RA progressively shortened to a length where it was found to read correctly on the Ohmeda 3800 - 8 feet in length.

2 x further MCI P867RA's shortened to 8 ft - results for all 3 probes as below.

probes built using Ohmeda original LEDs and MCI / PDI detectors. Both probes constructed as per stock supplied MCI P867RA's. Results as below :-

#1B25730.

DL target	98	94	90	80	70	60	
3700	98	94	91	81	71	62	Human : 98.
3740	98	94	91	80	71	61	Human : 98.
3800	98	94	90	80	70	60	Human : 98.

#1B25733.

DL target	98	94	90	80	70	60	
3700	98	94	90	81	71	61	Human : 97.
3740	98	94	90	80	70	61	Human : 98.
3800	98	94	90	80	70	59	Human : 98.

#1B25748.

DL target	98	94	90	80	70	60	
3700	98	94	90	81	70	61	Human : 98.
3740	98	94	90	80	71	61	Human : 98.
3800	98	94	90	80	70	60	Human : 98.

Conclusion : Suitable modification to eliminate underread problem.

Test results of shortened MCI based P867RA's: SW : 03-09-01.

1 x MCI P867RA progressively shortened to a length where it was found to read correctly on the Ohmeda 3800 - 8 feet in length.

2 x further MCI P867RA's shortened to 8 ft - results for all 3 probes as below.

probes built using Ohmeda original LEDs and MCI / PDI detectors. Both probes constructed as per stock supplied MCI P867RA's. Results as below :-

#1B25730.

DL target	98	94	90	80	70	60	
3700	98	94	91	81	71	62	Human : 98.
3740	98	94	91	80	71	61	Human : 98.
3800	98	94	90	80	70	60	Human : 98.

#1B25733.

DL target	98	94	90	80	70	60	
3700	98	94	90	81	71	61	Human : 97.
3740	98	94	90	80	70	61	Human : 98.
3800	98	94	90	80	70	59	Human : 98.

#1B25748.

DL target	98	94	90	80	70	60	
3700	98	94	90	81	70	61	Human : 98.
3740	98	94	90	80	71	61	Human : 98.
3800	98	94	90	80	70	60	Human : 98.

Conclusion : Suitable modification to eliminate underread problem.

Summary of investigation into P867RA underread on 3800 oximeter.

Start of investigation into this problem Jan 02.

From this date the following prototypes have been constructed and tests carried out :-

Jan 2001	Aristo disposable range of probes evaluated on 3700 & 3800 pulse oximeters. Aristo Disposable (neonatal) gave best results and optics used from these probes until stocks exhausted.
May 2001	Other aristo disposable optics giving favourable results assembled into Viamed probes but prove to read low.
June 2001	4 x MCI supplied prototypes evaluated - all read low.
July 2001	P867RA assembled and tested using Dai Shin samples - reads low.
July 2001	P867RA's assembled using Dolphin disposable optics - all read low .
July 2001	P867RA assembled using O ring in front of the detector - reads low.
July 2001	P867RA's assembled using LED, detector or both from Ohmeda originals - conclude that change of LED to Ohmeda cures or compensates for underread. CSI LED with 2 x infrared emitters fitted - doesnot read on DL-3000.
Aug 2001	P867RA assembled using Dai Shin samples - LED with 2 x IR emitters on board - doesnot work on DL-3000, underreads on both 3700 & 3800 oximeters.
Aug 2001	P867RA assembled using MCI optics, Ohmeda original cable, 23k2 resistor and our remaining parts - component changes cure or compensate for the underread on the 3800.
Sept 2001	3 x MCI built P867RA's progressively shortened with regular testing - found that all three probes read correctly when reduced to 8 ft. - also found that the physical removal of cable outer screen cures the underread on probe at 12 ft length. Recommendation made that all P867RA's supplied as new or repaired as of this date are shortened to 8ft. Cable comparison made between ours and Ohmeda. Pin to pin checks carried out between good and bad probes for capacitance - unable to identify a difference between cable / probe types with only 12 ft lengths to examine. Cable samples provided to SN to be externally checked.

	- Results suggest change of cable to that with greater conductor cross sectional area. Cable ordered, one as above and standard cross sectional area sample without outer screen.
Oct 2001	P867RA assembled using high output infrared LED from Dai Shin - read on finger, doesnot work on DL-3000.
Jan 2002	2 x P867RA's assembled using new cables - both read accurately throughout the range. - prototype with inner screen only earmarked as modification to be embodied into further manufactured P867RA subject to satisfactory testing.
Jan 2002	Both prototypes further evaluated - Results good - both probe prototypes return the target Spo2 value in the range 100 - 80%. - Maximum error - +/- 1% below 80%. - Spo2 values displayed alter by -1% when correctly aligned compared to incorrectly aligned. Ohmeda original finger probe - displayed Spo2 doesnot alter. - Recommend optics are moved forward such that the probe cannot be placed on the finger incorrectly, fingertip against end stop, probe optics above and below finger nail.
Jan / Feb 2002	Prototype probes to be tested and tables generated comparing displayed Spo2 to probe resistor value for the three Ohmeda models available (3700, 3740 & 3800).

Investigation carried out by S Watmough, Technical Engineer, Viamed Ltd.

Report : Underread of P867RA on Ohmeda 3700e oximeter.

05-07-02.

Three probes tested: CF61092252, CF61092262, CF61092263.

Probe SN.	Test result against DL-3000 @ 97%.
CF61092252	Initially reads 93%. Increases to 95% in approx 5 seconds, then increases to stable 97% in approx 40 seconds.
CF61092262	Reads 95% for full duration of test.
CF61092263	Initially reads 93%, climbing to stable 97% in 5 seconds.

Probe SN.	λ (red) nm.	Λ (infrared) nm.	Ident resistor Kohms.
CF61092252	658.0	928.3	56.2
CF61092262	658.0	928.3	56.3
CF61092263	658.0	931.5	56.7

Spec: Red 660+/-3nm: All probes OK.
Infrared 940+/-10nm: All probes at very lowest wavelength to meet specs.

LED electrical characteristic: CF61092252 (probe alone).

Vf (red) mV	If (red) mA	Vf (infrared) mV	If (infrared) mA
1350	0.00	850	0.04
1400	0.00	900	0.07
1450	0.05	950	0.14
1500	0.11	1000	0.32
1550	0.27	1050	0.81
1600	0.81	1100	2.08
1650	2.48	1150	4.49
1700	5.79	1200	8.08
1750	10.36	---	---
1800	15.77	---	---

LED electrical characteristic: CF61092262 (probe alone).

Vf (red) mV	If (red) mA	Vf (infrared) mV	If (infrared) mA
1350	0.00	850	0.04
1400	0.00	900	0.08
1450	0.05	950	0.17
1500	0.08	1000	0.38
1550	0.20	1050	0.91
1600	0.66	1100	2.08
1650	2.25	1150	4.08
1700	5.54	1200	6.76
1750	10.30	---	---
1800	15.68	---	---

LED electrical characteristic: CF61092263 (probe alone).

Vf (red) mV	If (red) mA	Vf (infrared) mV	If (infrared) mA
1350	0.00	850	0.04
1400	0.00	900	0.07
1450	0.03	950	0.14
1500	0.07	1000	0.33
1550	0.19	1050	0.93
1600	0.51	1100	2.53
1650	1.96	1150	5.72
1700	4.99	1200	10.33
1750	9.32	---	---
1800	14.68	---	---

LED electrical characteristic: CF61092252 (probe with adapter fitted).

Vf (red) mV	If (red) mA	Vf (infrared) mV	If (infrared) mA
1350	0.00	850	2.45
1400	0.00	900	2.99
1450	0.05	950	3.58
1500	0.11	1000	4.30
1550	0.27	1050	5.33
1600	0.81	1100	7.16
1650	2.48	1150	10.12
1700	5.79	1200	14.28
1750	10.36	---	---
1800	15.77	---	---

LED electrical characteristic: CF61092262 (probe with adapter fitted).

Vf (red) mV	If (red) mA	Vf (infrared) mV	If (infrared) mA
1350	0.00	850	2.45
1400	0.00	900	3.00
1450	0.05	950	3.61
1500	0.08	1000	4.36
1550	0.20	1050	5.43
1600	0.66	1100	7.16
1650	2.25	1150	9.71
1700	5.54	1200	12.96
1750	10.30	---	---
1800	15.68	---	---

LED electrical characteristic: CF61092263 (probe with adapter fitted).

Vf (red) mV	If (red) mA	Vf (infrared) mV	If (infrared) mA
1350	0.00	850	2.45
1400	0.00	900	2.99
1450	0.03	950	3.58
1500	0.07	1000	4.31
1550	0.19	1050	5.45
1600	0.51	1100	7.61
1650	1.96	1150	11.35
1700	4.99	1200	16.53
1750	9.32	---	---
1800	14.68	---	---

Probes tested with adapter cable fitted:

Probe SN.	Test result against DL-3000 @ 97%.
CF61092252	96% for 3 seconds then stable 97%.
CF61092262	Reads 96% initially, increasing to 97/98% from then on.
CF61092263	Initially 96%, 97% in approx 1 second, then 98% from then on.

Conclusion:

Infrared emitters fitted in these probes do not conduct sufficiently high levels of current to be compatible with the Ohmeda 3700e, resulting in low readings of spO2.

Action req'd:

Alternatively:

1. Replace LED's with components capable of conducting higher levels of current for the infrared emitter.

2. Fit a series diode resistor combination in parallel to the infrared emitter to increase current with the driving 3700e thereby increasing displayed spO2.

Results of tests on MCI based P867RA (special) : SW : 17-08-01.

As stock except slightly shortened.

Wavelength (red) : 654.7-658.0nm.
Wavelength (infrared) : 931.5nm.
Resistor : 21.889kohm.
Length :
Forward diode voltage (red) : 1.5V.
Forward diode voltage (infrared) : 1.0V.
Forward diode voltage (detector) : 0.4V.
DL3000 module returns (attenuated setting) : Red, 39, Infrared, 26.
Reads 96% on 3800 against DL3000.
Human : SW : 97%.

Test of emitters and detector (voltages and currents measured at connector).
Detector test c/o sheilded from ambient light.

MCI LED removed.

Red current at measured voltage .	Infrared current at measured voltage.	Detector voltage in response to red.	Detector voltage in response to infrared.
	700mV,		700mV,
	750mV,		750mV,
	800mV,		800mV,
	850mV,		850mV,
	900mV,		900mV,
	950mV,		950mV,
	1000mV,		1000mV,
	1050mV,		1050mV,
	1100mV,		1100mV,
	1150mV,		1150mV,
1200mV,	1200mV,	1200mV,	1200mV,
1250mV,		1250mV,	
1300mV,		1300mV,	
1350mV,		1350mV,	
1400mV,		1400mV,	
1450mV,		1450mV,	
1500mV,		1500mV,	
1550mV,		1550mV,	
1600mV,		1600mV,	
1650mV,		1650mV,	
1700mV,		1700mV,	
1750mV,		1750mV,	
1800mV,		1800mV,	

As stock except Ohmeda LED fitted & slightly shortened.

Wavelength (red) : nm.
Wavelength (infrared) : nm.
Resistor : kohm.
Length :
Forward diode voltage (red) : V.
Forward diode voltage (infrared) : V.
Forward diode voltage (detector) : V.
DL3000 module returns (attenuated setting) : Red, , Infrared, .
Reads % on 3800 against DL3000.
Human : SW : %.

Ohmeda LED fitted.

Red current at measured voltage .	Infrared current at measured voltage.	Detector voltage in response to red.	Detector voltage in response to infrared.
	700mV,		700mV,
	750mV,		750mV,
	800mV,		800mV,
	850mV,		850mV,
	900mV,		900mV,
	950mV,		950mV,
	1000mV,		1000mV,
	1050mV,		1050mV,
	1100mV,		1100mV,
	1150mV,		1150mV,
1200mV,	1200mV,	1200mV,	1200mV,
1250mV,		1250mV,	
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